AGENDA

NFPA Technical Committee on Fire Service Training (FIY-AAA)
NFPA 1400/13E/1401/1405 First Draft Meeting (Custom ERRS Group 5)

February 6-9, 2024
8:00 a.m. – 5:00 p.m. (Eastern)

Wyndham Garden Lake Buena Vista
Disney Springs Resort Area
1850B Hotel Plaza Blvd., Lake Buena Vista, FL 32830

Web/Teleconference
To join the meeting, please contact Jenny Depew - jdepew@nfpa.org

1. **Call to order.** Ken Richards.
2. **Introductions.** See committee roster attached.
3. **Chair report.** Ken Richards.
4. **Staff liaison report.** Bob Fash.
5. **Previous meeting minutes.** FIY-AAA, Pre-First Draft Meeting February 14, 2023.(Attached)
6. **NFPA 1400, *Standard on Fire Service Training*, First Draft.**

   (Chair reserves the right to move agenda items)

   a. **Public Inputs.** See attached.

   b. **Task group report(s).**

      i. **1403 Task Group**. TG Chair – Dan Shaw.

      ii. **1404 Task Group**. TG Chair – Kevin Munson.

      iii. **1407 Task Group**. TG Chair - Douglas Mitchell.

      iv. **1408 Task Group**. TG Chair – Dan Madrzykowski.

      v. **1410 Task Group**. TG Chair – William Glover.

      vi. **1451 Task Group.** TG Chair - William Peterson.

   c. **Presentation(s).**

      i. **TBD**. [Topic]. [Time/Date?].

   d. **Committee Inputs.** TBD.

7. **NFPA 1401, *Recommended Practice for Fire Service Training Reports and Records*, First Draft.**

   a. **Task group report(s).**

i. **TG 1401**. TG Chair – Jeff Morrissette.

b. **Presentation(s).**

i. **TBD**. [Topic]. [Time/Date?].

c. **Committee Inputs.** TBD

8. NFPA 1405, *Guide for Land-Based Fire Departments that Respond to Marine Vessel Fires*, First Draft.

a. **Task group report(s).**

i. **TG 1401**. TG Chair – Corey Wilson.

b. **Presentation(s).**

i. **TBD**. [Topic]. [Time/Date?].

c. **Committee Inputs.** TBD

9. NFPA 13E, *Recommended Practice for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems*, First Draft.

a. **Public Inputs.** See attached.

b. **Task group report(s).**

i. **TG 13E**. TG Chair – Terin Hopkins.

c. **Presentation(s).**

i. **TBD**. [Topic]. [Time/Date?].

d. **Committee Inputs.** TBD

10. Other Business.

11. Future meetings.

12. Adjournment.

Address List

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Robert Fash 1/18/2019

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MINUTES

NFPA Technical Committee on Fire Service Training (FIY-AAA)
NFPA 1400/1401/1405/13E Pre-First Draft Meeting (Custom ERRS Group 5)

February 14, 2023
1:30 p.m. – 3:18 p.m. (Eastern)

Web/Teleconference

1. **Call to order.** Ken Richards, chair, called the meeting to order at 1:30 p.m. on February 14, 2023.
2. **Introductions.** Attendees introduced themselves and identified their affiliation. Attendance is recorded in Table 1.
3. **Chair report.** Ken Richards welcomed attendees and provided an overview of the meeting.
4. **Staff liaison report.** Bob Fash provided an overview of the regulations governing the standards development process, the document consolidation initiative of the documents overseen by the Emergency Responder and Responder Safety (ERRS) Division, and Task Group recommendation process. (Presentation Attached)
5. **Previous meeting minutes.** The minutes from FIY-AAA, Pre-First Draft Meeting February 17, 2022 were approved without revision.
6. **Discussion on Task Group assignments and review of current editions proposed in Group 5 of the ERRS Consolidation Project**
   a. **NFPA 1400**
      i. **NFPA 1402, (FAB-AAA) TC,** *Standard on Facilities for Fire Training and Associated Props*
      ii. **NFPA 1403,** *Standard on Live Fire Training Evolutions*
      iii. **NFPA 1404,** *Standard for Fire Service Respiratory Protection Training*
      iv. **NFPA 1407,** *Standard for Training Fire Service Rapid Intervention Crews*
      v. **NFPA 1408,** *Standard for Training Fire Service Personnel in the Operation, Care, Use, and Maintenance of Thermal Imagers*
      vi. **NFPA 1410,** *Standard on Training for Emergency Scene Operations*
      vii. **NFPA 1451,** *Standard for a Fire and Emergency Service Vehicle Operations Training* Program
   b. **NFPA 1401,** *Recommended Practice for Fire Service Training Reports and Records*
   c. **NFPA 13E,** *Recommended Practice for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems*
   d. **NFPA 1405,** *Guide for Land-Based Fire Departments that Respond to Marine Vessel*

Task group lists to be sent out and documents supplied to task groups as requested.

7. **No other business discussed**

8. **Future meetings.** The next committee meeting will be determined by the chair with consideration to the task group meetings.

9. **Adjournment.** The meeting was adjourned at 3:18 p.m. on February 14, 2023.

Table 1 Meeting Attendance.

	Name	Employer/Organization Represented	Interest Category	Feb 14
Chair	Kenneth W. Richards, Jr.	Old Mystic Fire Department	E	Y
Principals	Colin Samuel Aguilar	Jacksonville Fire & Rescue *Rep. International Association of Fire Fighters*	L	
	Wesley E. Barbour	CrossBar International LLC	SE	Y
	Brian Brush	Midwest City Fire Department	E	
	James R. Cannell	Columbus Ohio Division of Fire	L	Y
	Chris Ciccotelli	Eastern Florida State College	SE	Y
	Michael Clarke	Bath Iron Works	E	Y
	Bryan P. Duquin	Volunteer Fireman's Insurance Services, Inc. (VFIS) *Rep. Volunteer Fireman's Insurance Services, Inc.*	I	Y
	Rick Egelin	Fireblast Global	M	
	Ken Flower	Louisiana State University Fire and Emergency Training Institute	U	Y
	William E. Glover	High Temperature Linings (HTL)	M	Y
	Sean M. Gray	Cobb County Fire and Emergency Services	U	Y
	Eric Grootendorst	Vancouver Fire Rescue/JIBC	L	Y
	Casey Hall	Kentucky Fire Commission	SE	Y
	Forest Herndon, Jr.	Maritime Emergency Response Educators LLC	SE	
	Terin Hopkins	National Fire Sprinkler Association (NFSA) *Rep. National Fire Sprinkler Association*	M	Y
	Chris Hubbard	Hanover Fire EMS Department	U	
	John Johnson	American Fire Sprinkler Association (ASFA) *Rep. American Fire Sprinkler Association*	M	
	Thomas G. Keaney	Burlington Fire Department	U	
	James Keiken	Illinois Fire Service Institute	U	Y
	Manfred Kihn	E. D. Bullard Company	M	Y
	Roger M. LeBoeuf	Elliott, LeBoeuf & McElwain	SE	Y
	Karen E. Lehtonen	LION Group, Inc.	M	Y
	Gordon L. Lohmeyer	Texas A&M Engineering Extension Service	U	
	Daniel Madrzykowski	UL Firefighter Safety Research Institute	R/T	Y
	F. Patrick Marlatt	Maryland Fire and Rescue Institute	E	
	Douglas J. Mitchell, Jr.	Fire Department City of New York *Rep. Fire Department City of New York (FDNY)*	U	Y
	Jeffrey J. Morrissette	State of Connecticut - Connecticut Fire Academy *Rep. International Fire Service Training Association*	M	Y
	Kevin Munson, Jr.	East Hartford Fire Department	E	Y
	Brent Norwine	CAL-FIRE/Riverside County Fire Department	U	Y
	William E. Peterson	*Rep. International Fire Marshals Association*	SE	Y
	Robert E. Raheb	FAAC, Inc.	SE	Y
	Daniel N. Rossos	Oregon Department of Public Safety Standards & Training	E	
	Daniel D. Shaw	Fairfax County Fire and Rescue Department	U	Y
	Richard St. Denis	Whistler Fire Rescue Service	U	Y
	Thomas Scott Verrill	Blue Ridge Fiberboard	M	
	Brian A. Wade	North Carolina Office of the State Fire Marshal	E	Y
	Todd Wardwell	United States Coast Guard (USCG)	E	Y
	William J. Watters	Verisk Analytics/Insurance Services Office, Inc.	I	Y
	Steven H. Weinstein	Retired	SE	Y
	Steven J. Williamson	KFT Fire Trainer, LLC	M	Y

	Name	Employer/Organization Represented	Interest Category	Feb 14
	Corey Wilson	Portland Fire & Rescue	E	Y
Voting Alternate	Kevin Hall	American Fire Sprinkler Association *Rep. American Fire Sprinkler Association*	I/M	Y
	Heidi Sewchok	National Institute for Occupational Safety & Health (NIOSH) *Rep. National Institute for Occupational Safety & Health*	I	
Alternates	Ian Bennett *Alt. to Brian Brush*	Seattle Fire Department	E	Y
	Stephen Bird *Alt. to Manfred Kihn*	Bullard	M	
	Steve Brisebois *Alt. to William Peterson*	Flash Formation Rep. International Fire Marshals Association	SE	
	Timothy Michael Butler *Alt. to Terin Hopkins*	National Fire Sprinkler Association (NFSA) *Rep. National Fire Sprinkler Association*	M	Y
	Jonathan Carroll *Alt. to Colin Samuel Aguilar*	Cleveland Fire Department *Rep. International Association of Fire Fighters*	L	Y
	Robert Drake *Alt. to Chris Hubbard*	Hanover Fire EMS Department	U	Y
	Roland Fredrickson *Alt. to Brent Norwine*	City of Corona Fire Department	U	Y
	Gregory Hunter Alt. Daniel Shaw	Fairfax County Fire and Rescue Department *Rep. Fairfax County Fire and Rescue Department*	U	
	Salvatore J. Izzo *Alt. to William J. Watters*	Verisk Analystics/Insurance Services Office, Inc. (ISO)	I	Y
	Jeremy D. Jones *Alt. to Roger M. LeBoeuf*	Elliott, LeBoeuf & McElwain	SE	
	Roger Lunt *Alt. to James Keiken*	University of Illinois Fire Service Institute	U	
	Howard Meek *Alt. to Gordon L. Lohmeyer*	Texas A&M Engineering Extension Service	U	Y
	David Michaels *Alt. to Bryan Duquin*	Volunteer Firemen's Insurance Services, Inc. (VFIS) *Rep. Volunteer Firemen's Insurance Services, Inc. (VFIS)*		Y
	Alexander Perricone *Alt. to Patrick Marlatt*	*Rep. Maryland Fire and Rescue Institute*	E	
	Obed Rios *Alt. to Steven J. Williamson*	KFT Fire Trainer, LLC	M	
	Frank Rosciano *Alt. to Douglas Mitchell*	Fire Department City of New York (FDNY) *Rep. Fire Department City of New York*	U	
	Mark A. Rutherford *Alt. to Brian Wade*	North Carolina State Fire Marshal's Office	E	
	Keith Myers Stakes *Alt. to Daniel Madrzykowski*	UL Firefighter Safety Research Institute	R/T	
	Michael A. Wieder *Alt. to Jeffrey J. Morrissette*	Fire Protection Publications *Rep. International Fire Service Training Association*	M	
Staff Liaison	Robert Fash	National Fire Protection Association	-	Y
Guests	Pete Schecter	Chair – FAB-AAA (1402)	-	Y
	Michael Shahan	(CDC/NIOSH/NPPTL/CVSDB)	-	Y

Public Input No. 27-NFPA 1400-2023 [Chapter 1]

Chapter 1 Administration

GENERAL COMMENT: The scope and purpose statements written below, which are combinations from all of the previous 1400 series standards, are difficult to read. Recommend breaking them out so that they are not each a long, run-on sentence.

Recommend adding a statement indicating that merging the previous 1400 series standards into one 1400 Standard combines language that applies to facilities (from 1402) with language that applies to training operations (all of the other 1400 series standards), and that only Chapters 4 through 14 apply to facilities, with the remaining chapters applying to training operations.

1.1 Scope.

This standard addresses the minimum design, construction, and maintenance requirements for fire service training centers, fire training structures and props, gas-fueled and flammable liquid–fueled live fire training systems, mobile fire training props, and associated training props; the minimum requirements for training all fire suppression personnel engaged in firefighting operations under live fire conditions; minimum requirements for the training component of the respiratory protection programs; the basic training procedures for fire service personnel to conduct firefighter rapid intervention operations; minimum requirements for training fire service personnel to utilize fire service thermal imagers (TI); the context and minimum requirements for evaluating training for fire suppression and rescue procedures used by fire department personnel engaged in emergency scene operations; and the minimum requirements for a fire and emergency service organization (FESO) vehicle operations training programs.

1.2 Purpose.

The purpose of this standard is to establish consistent, minimum criteria for facilities, structures, and props that are used for conducting fire and rescue training classes and exercises; provide a process for conducting live fire training evolutions to ensure that training objectives are achieved and that exposure to health and safety hazards for the firefighters receiving the training is minimized; specify the minimum requirements for respiratory protection training for the emergency response organization, including safety procedures for those expected to be involved in fire suppression, rescue, and related activities in a toxic, contaminated, or oxygen-deficient atmosphere or environment; specify a training program that is designed to create a highly disciplined operational capability to rescue firefighter(s) who become lost, injured, trapped, incapacitated, or disoriented at an emergency scene or in the course of a training operation; specify a training program that is designed to create competency regarding the operation, application, use, and limitations of TI; provide the context and minimum requirements for evaluating training for fire suppression and rescue procedures used by fire department personnel engaged in emergency scene operations; establish a training standard designed to provide fire departments with an objective method of measuring performance for fire suppression and rescue procedures using available personnel and equipment; and specify the minimum requirements for a FESO vehicle operations training program, including procedures for those members that drive or occupy FESO vehicles, respond in private vehicles or unconventional means of transportation, and provide traffic control at the scene of an emergency.

1.3* Application.

This standard shall be applied as follows:

(1) Chapters 1 through 3; 4 through 14; and Annexes A, B, C, D and N constitute NFPA 1402.

(2) Chapters 1 through 3; 15 through 20; and Annexes A, E, F, G, and N constitute NFPA 1403.

(3) Chapters 1 through 3; 21 through 27; and Annexes A, H, I, and N constitute NFPA 1404.

(4) Chapters 1 through 3; 28 through 32; and Annexes A, J, and N constitute NFPA 1407.

(5) Chapters 1 through 3; 33 through 37; and Annexes A and N constitute NFPA 1408.

(6) Chapters 1 through 3; 38 through 46; and Annexes A, K, and N constitute NFPA 1410.

(7) Chapters 1 through 3; 47 through 53; and Annexes A, L, M and N constitute NFPA 1451.

Statement of Problem and Substantiation for Public Input

These revisions would add clarity and understanding to the 1400 Standard.

Submitter Information Verification

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Submittal Date: Wed Aug 23 00:08:02 EDT 2023
Committee: FIY-AAA

Public Input No. 87-NFPA 1400-2023 [Chapter 1]

Chapter 1 Administration

1.1 Scope.

This standard addresses the minimum design, construction, and maintenance requirements for fire service training centers, fire training structures and props, gas-fueled and flammable liquid–fueled live fire training systems, mobile fire training props, and associated training props; the minimum requirements for training all fire suppression personnel engaged in firefighting operations under live fire conditions; minimum requirements for the training component of the respiratory protection programs; the basic training procedures for fire service personnel to conduct firefighter rapid intervention operations; minimum requirements for training fire service personnel to utilize fire service thermal imagers (TI); the context and minimum requirements for evaluating training for fire suppression and rescue procedures used by fire department personnel engaged in emergency scene operations; and the minimum requirements for a fire and emergency service organization (FESO) vehicle operations training programs.

1.2 Purpose.

The purpose of this standard is to establish consistent, minimum criteria for facilities, structures, and props that are used for conducting fire and rescue training classes and exercises; provide a process for conducting live fire training evolutions to ensure that training objectives are achieved and that exposure to health and safety hazards for the firefighters receiving the training is minimized; specify the minimum requirements for respiratory protection training for the emergency response organization, including safety procedures for those expected to be involved in fire suppression, rescue, and related activities in a toxic, contaminated, or oxygen-deficient atmosphere or environment; specify a training program that is designed to create a highly disciplined operational capability to rescue firefighter(s) who become lost, injured, trapped, incapacitated, or disoriented at an emergency scene or in the course of a training operation; specify a training program that is designed to create competency regarding the operation, application, use, and limitations of TI; provide the context and minimum requirements for evaluating training for fire suppression and rescue procedures used by fire department personnel engaged in emergency scene operations; establish a training standard designed to provide fire departments with an objective method of measuring performance for fire suppression and rescue procedures using available personnel and equipment; and specify the minimum requirements for a FESO vehicle operations training program, including procedures for those members that drive or occupy FESO vehicles, respond in private vehicles or unconventional means of transportation, and provide traffic control at the scene of an emergency.

1.3* Application.

This standard shall be applied as follows:

(1) Chapters 1 through 3; 4 through 14; and Annexes A, B, C, D and N constitute NFPA 1402.

(2) Chapters 1 through 3; 15 through 20; and Annexes A, E, F, G, and N constitute NFPA 1403.

(3) Chapters 1 through 3; 21 through 27; and Annexes A, H, I, and N constitute NFPA 1404.

(4) Chapters 1 through 3; 28 through 32; and Annexes A, J, and N constitute NFPA 1407.

(5) Chapters 1 through 3; 33 through 37; and Annexes A and N constitute NFPA 1408.

(6) Chapters 1 through 3; 38 through 46; and Annexes A, K, and N constitute NFPA 1410.

(7) Chapters 1 through 3; 47 through 53; and Annexes A, L, M and N constitute NFPA 1451.

Additional Proposed Changes

File Name	Description	Approved
230830_NFPA_1402_preface.docx	Edit to 1402 Origin and Development of NFPA 1402	

Statement of Problem and Substantiation for Public Input

Explanatory material should be corrected to match Annex content

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Prefix: Origin and Development of NFPA 1402, page 1402-1

Last paragraph is incorrect in reference to two new annexes and the description. Revise to read “Three new annexes were added as well, proving guidance on the planning, design, construction and maintaining fire service training centers, administration and classroom buildings, and training and support buildings.”

Public Input No. 91-NFPA 1400-2023 [Section No. 2.2]

2.2 NFPA Publications.

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

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems,* 2019 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection,* 2022 edition.

NFPA 30, *Flammable and Combustible Liquids Code,* 2021 edition.

NFPA 54, *National Fuel Gas Code,* 2021 edition.

NFPA 58, *Liquefied Petroleum Gas Code,* 2020 edition.

NFPA 59, *Utility LP-Gas Plant Code,* 2021 edition.

NFPA 70®, *National Electrical Code®,* 2023 edition.

NFPA 86, *Standard for Ovens and Furnaces,* 2019 edition.

NFPA 414, *Standard for Aircraft Rescue and Fire-Fighting Vehicles,* 2020 edition.

NFPA 1001, *Standard for Fire Fighter Professional Qualifications,* 2019 edition.

NFPA 1002, *Standard for Fire Apparatus Driver/Operator Professional Qualifications,* 2017 edition.

NFPA 1003, *Standard for Airport Fire Fighter Professional Qualifications,* 2019 edition.

NFPA 1021, *Standard for Fire Officer Professional Qualifications,* 2020 edition.

NFPA 1041, *Standard for Fire and Emergency Services Instructor Professional Qualifications,* 2019 edition.

NFPA 1081, *Standard for Facility Fire Brigade Member Professional Qualifications,* 2018 edition.

NFPA 1142, *Standard on Water Supplies for Suburban and Rural Firefighting,* 2017 edition.

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

NFPA 1404, *Standard for Fire Service Respiratory Protection Training,* 2018 edition.

NFPA 1407, *Standard for Training Fire Service Rapid Intervention Crews,* 2020 edition.

NFPA 1500™, *Standard on Fire Department Occupational Safety, Health, and Wellness Program,* 2021 edition.

NFPA 1521, *Standard for Fire Department Safety Officer Professional Qualifications,* 2020 edition.

NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety,* 2020 edition.

NFPA 1582, *Standard on Comprehensive Occupational Medical Program for Fire Departments,* 2018 edition.

NFPA 1583, *Standard on Health-Related Fitness Programs for Fire Department Members,* 2015 edition.

NFPA 1584, *Standard on the Rehabilitation Process for Members During Emergency Operations and Training Exercises,* 2015 edition.

NFPA 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments,* 2020 edition.

NFPA 1720, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments,* 2020 edition.

NFPA 1801, *Standard on Thermal Imagers for the Fire Service,* 2021 edition.

NFPA 1851, *Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting,* 2020 edition.

NFPA 1852, *Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA),* 2019 edition.

NFPA 1901, *Standard for Automotive Fire Apparatus,* 2016 edition.

NFPA 1906, *Standard for Wildland Fire Apparatus,* 2016 edition.

NFPA 1911, *Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Emergency Vehicles,* 2017 edition.

NFPA 1917, *Standard for Automotive Ambulances,* 2019 edition.

NFPA 1964, *Standard for Spray Nozzles and Appliances,* 2018 edition.

NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting,* 2018 edition.

NFPA 1975, *Standard on Emergency Services Work Apparel,* 2019 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services,* 2019 edition.

NFPA 1982, *Standard on Personal Alert Safety Systems (PASS),* 2018 edition.

NFPA 1983, *Standard on Life Safety Rope and Equipment for Emergency Services,* 2017 edition.

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

Additional Proposed Changes

File Name	Description	Approved
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Statement of Problem and Substantiation for Public Input

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2.2 NFPA Standards: Revise references to date of current editions of referenced standards. Delete reference to NFPA 1403 , 1404, and 1407 as they are incorporated into new NFPA 1400.

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2.2 NFPA Publications.

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

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems,* 2019 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection,* 2022 edition.

NFPA 30, *Flammable and Combustible Liquids Code,* 2021 edition.

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NFPA 58, *Liquefied Petroleum Gas Code,* 2020 edition.

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NFPA 70®, *National Electrical Code®,* 2023 edition.

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NFPA 1001, *Standard for Fire Fighter Professional Qualifications,* 2019 edition.

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NFPA 1003, *Standard for Airport Fire Fighter Professional Qualifications,* 2019 edition.

NFPA 1021, *Standard for Fire Officer Professional Qualifications,* 2020 edition.

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

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NFPA 1407, *Standard for Training Fire Service Rapid Intervention Crews,* 2020 edition.

NFPA 1500™, *Standard on Fire Department Occupational Safety, Health, and Wellness Program,* 2021 edition.

NFPA 1521, *Standard for Fire Department Safety Officer Professional Qualifications,* 2020 edition.

NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety,* 2020 edition.

NFPA 1582, *Standard on Comprehensive Occupational Medical Program for Fire Departments,* 2018 edition.

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NFPA 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments,* 2020 edition.

NFPA 1720, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments,* 2020 edition.

NFPA 1801, *Standard on Thermal Imagers for the Fire Service,* 2021 edition.

NFPA 1851, *Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting,* 2020 edition.

NFPA 1852, *Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA),* 2019 edition.

NFPA 1901, *Standard for Automotive Fire Apparatus,* 2016 edition.

NFPA 1906, *Standard for Wildland Fire Apparatus,* 2016 edition.

NFPA 1911, *Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Emergency Vehicles,* 2017 edition.

NFPA 1917, *Standard for Automotive Ambulances,* 2019 edition.

NFPA 1964, *Standard for Spray Nozzles and Appliances,* 2018 edition.

NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting,* 2018 edition.

NFPA 1975, *Standard on Emergency Services Work Apparel,* 2019 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services,* 2019 edition.

NFPA 1982, *Standard on Personal Alert Safety Systems (PASS),* 2018 edition.

NFPA 1983, *Standard on Life Safety Rope and Equipment for Emergency Services,* 2017 edition.

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

Additional Proposed Changes

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230830_NFPA_1402_2.2.1.docx	2.2	

Statement of Problem and Substantiation for Public Input

I do not believe it was the Committee's intent to require compliance with NFPA 5000 and ICC IBC. This would create conflicts in attempting to comply with both model building codes. Under Live Fire Training Structures, 7.1.3.1 calls for structural requirements of the IBC or NFPA 5000 if the AHJ has not adopted a building code. Sections 2.2 and 2.3.4 should be revised to reflect a similar intent: If the AHJ has not adopted a building code, Facilities for Fire Training, including Training Towers, both Live Fire and Non-Live Fire shall be designed to meet the requirements of the current edition of the International Building Code. Compliance with the IBC provides a minimum level of construction standards, structural integrity, and life safety. Reference to NFPA 5000 is not included as it has no Use Group equal to IBC's U Utility and Miscellaneous Structures. All NFPA 5000 Use Groups have provisions that conflict with the construction of a practical and functional Fire Training Structure such as emergency egress lighting, exit signs, accessible door hardware that conflicts with hardware for Class A burn rooms, fire extinguishers, fire detection and alarm systems, and in some cases, full automatic fire surpression systems. Se also comments new section 4.1.2.4 and A.4.1.2.4.

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2.2 NFPA Publications and 2.3.4 ICC Publications: In listing both NFPA 5000 and ICC IBC documents, it could be interpreted that compliance with both documents is required. Delete reference to NFPA 5000 and/or move reference to NFPA 5000 to 2.4 References for Extracts in Mandatory Sections, as needed.

Public Input No. 92-NFPA 1400-2023 [Sections 2.3, 2.4]

Sections 2.3, 2.4

2.3 Other Publications.

2.3.1 ANSI Publications.

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

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

2.3.2 ASCE Publications.

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

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

2.3.3 FAMA Publications.

Fire Apparatus Manufacturers Association, P.O. Box 3065, Ocala, FL 34478

Fire Apparatus Safety Guide, 2017 edition.

2.3.4 ICC Publications.

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

International Building Code, 2015.

2.3.5 UL Publications.

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

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

2.3.6 US Government Publications.

US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

NIOSH Letters to all Respirator Manufacturers.

Title 42, Code of Federal Regulations, Part 84.

Title 49, Code of Federal Regulations, Part 383, “Commercial Motor Vehicle Safety Act,” 2003.

US General Service Administration KKK-A-1822-F, “Star of Life Ambulance Specifications,” August 2007.

2.3.7 Other Publications.

Merriam-Webster’s Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2020.

2.4 References for Extracts in Mandatory Sections.

NFPA 55, *Compressed Gases and Cryogenic Fluids Code,* 2016 edition.

NFPA 68, *Standard on Explosion Protection by Deflagration Venting,* 2013 edition.

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

NFPA 318, *Standard for the Protection of Semiconductor Fabrication Facilities,* 2018 edition.

NFPA 402, *Guide for Aircraft Rescue and Fire-Fighting Operations,* 2013 edition.

NFPA 472, *Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents,* 2018 edition.

NFPA 600, *Standard on Facility Fire Brigades,* 2015 edition.

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

NFPA 921, *Guide for Fire and Explosion Investigations,* 2017 edition.

NFPA 1001, *Standard for Fire Fighter Professional Qualifications,* 2013 edition.

NFPA 1002, *Standard for Fire Apparatus Driver/Operator Professional Qualifications,* 2017 edition.

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

NFPA 1201, *Standard for Providing Fire and Emergency Services to the Public,* 2015 edition.

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

NFPA 1500™, *Standard on Fire Department Occupational Safety, Health, and Wellness Program,* 2021 edition.

NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety,* 2020 edition.

NFPA 1670, *Standard on Operations and Training for Technical Search and Rescue Incidents,* 2014 edition.

NFPA 1670, *Standard on Operations and Training for Technical Search and Rescue Incidents,* 2017 edition.

NFPA 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments,* 2020 edition.

NFPA 1801, *Standard on Thermal Imagers for the Fire Service,* 2018 edition.

NFPA 1901, *Standard for Automotive Fire Apparatus,* 2016 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services,* 2013 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services,* 2019 edition.

NFPA 1982, *Standard on Personal Alert Safety Systems (PASS),* 2013 edition.

Additional Proposed Changes

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Administrative correction

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2.3 and 2.4 Revise references to date of current editions of referenced standards.

Public Input No. 55-NFPA 1400-2023 [Chapter 3]

Chapter 3 ~~Definitions~~ Definitions Consider revising and adding definitions to align with NFPA 1700 if NFPA 1700 is adopted.

3.1 General.

3.1.1

The definitions contained in this chapter shall apply to the terms used in this standard.

3.1.2

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.

3.1.3

Merriam-Webster's Collegiate Dictionary, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Authority Having Jurisdiction (AHJ).

An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.2 Labeled.

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

3.2.3* Listed.

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

3.2.4 Shall.

Indicates a mandatory requirement.

3.2.5 Should.

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

3.2.6 Standard.

An NFPA standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA manuals of style. When used in a generic sense, such as in the phrase "standards development process" or "standards development activities," the term "standards" includes all NFPA standards, including codes, standards, recommended practices, and guides.

3.3 General Definitions.

3.3.1 Acquired Prop.

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

3.3.2 Acquired Structure.

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

3.3.3 Air-Purifying Respirator (APR).

A respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

3.3.4 Apparatus.

3.3.4.1 *Aerial Fire Apparatus.*

A vehicle equipped with an aerial ladder, elevating platform, or water tower that is designed and equipped to support firefighting and rescue operations by positioning personnel, handling materials, providing continuous egress, or discharging water at positions elevated from the ground. [**1901,** 2016]

3.3.4.2 *Mobile Water Supply Apparatus (Tanker, Tender).*

A vehicle designed primarily for transporting (pickup, transporting, and delivering) water to fire emergency scenes to be applied by other vehicles or pumping equipment. [**1901,** 2016]

3.3.5 Appliance.

See 3.3.61, Gas-Fueled Training Appliance.

3.3.6 Backdraft.

A deflagration resulting from the sudden introduction of air into a confined space containing oxygen-deficient products of incomplete combustion.

3.3.7 Burn Room.

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

3.3.8 CBRN.

Acronym for Chemical, Biological, Radiological, and Nuclear. This refers specifically to a NIOSH certification on the protective capabilities of a respirator.

3.3.9 CBRNE.

Acronym for Chemical, Biological, Radiological, Nuclear, and Explosives. This term refers to the general types of terrorist attacks, or WMD events.

3.3.10 Closed-Circuit SCBA.

See 3.3.129, Self-Contained Breathing Apparatus (SCBA).

3.3.11 Combustible.

Capable of burning, generally in air under normal conditions of ambient temperature and pressure, unless otherwise specified. Combustion can occur in cases where an oxidizer other than oxygen in air is present (e.g., chlorine, fluorine, or chemicals containing oxygen in their structure).

3.3.12 Company.

The basic firefighting organizational unit staffed by various grades of firefighters under the supervision of an officer and assigned to one or more specific pieces of apparatus.

3.3.12.1 *Engine Company.*

A group of firefighters who work as a unit and are equipped with one or more pumping engines that have rated capacities of 750 gpm (2840 L/min) or more.

3.3.12.2 *Rescue Company.*

A group of firefighters who work as a unit and are equipped with one or more rescue vehicles.

3.3.12.3 *Truck Company.*

A group of firefighters who work as a unit and are equipped with one or more pieces of aerial fire apparatus.

3.3.13 Compliance/Compliant.

Meeting or exceeding all applicable requirements of this standard.

3.3.14 Component.

Any material, part, or subassembly used in the construction of the compliant product. [**1801,** 2018]

3.3.15 Conduction.

Heat transfer to another body or within a body by direct contact.

3.3.16* 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 or exit and is not designed for continuous human occupancy. [**1500,** 2018]

3.3.17 Containerized Training Structure.

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

3.3.18 Contaminant.

A harmful, irritating, or nuisance material foreign to the normal atmosphere. [**1500,** 2018]

3.3.19 Convection.

Heat transfer by circulation within a medium such as a gas or a liquid.

3.3.20 Corrective Lens.

A lens designed to fit the specifications of the wearer's individual corrective prescription.

3.3.21 Dead Loads.

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

3.3.22 Decay Stage.

The stage of fire development within a structure characterized by either a decrease in the fuel load or available oxygen to support combustion, resulting in lower temperatures and lower pressure in the fire area.

3.3.23 Deflagration.

Propagation of a combustion zone at a velocity that is less than the speed of sound in the unreacted medium.

3.3.24 Demonstration.

The act of showing a skill.

3.3.25* Designed Anchor Point.

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

3.3.26* Door Control.

The process of ensuring the entrance door providing access to the fire area is controlled and closed as much as possible after the search team enters without the protection of a hose line.

3.3.27 EBSS.

Abbreviation for emergency breathing safety system. [**1981,** 2018]

3.3.28 Effective Operation.

The accomplishment of or ability to accomplish the intended task.

3.3.29 Effective Stream.

A fire stream that has achieved and sustained the proper flow.

3.3.30 Emergency Breathing Safety System (EBSS).

A device on an SCBA that allows a user to share their available air supply in an emergency situation.

3.3.31 Emergency Escape Respirators (EER).

Units used by the general working population to afford effective respiratory protection in escaping from hazardous environments. These units can be either air-purifying or self-contained escape respirators.

3.3.32 Emergency Medical Services.

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

3.3.33 Emissivity.

The ratio of the radiation emitted by a surface to the radiation emitted by a blackbody at the same temperature. [**1801,** 2018]

3.3.34 End-of-Service-Time Indicator (EOSTI).

A warning device on an SCBA that alerts the user that the reserve air supply is being utilized. [**1981**, 2013]

3.3.35 Engine.

A fire department pumper that has a rated capacity of 750 gpm (2840 L/min) or more.

3.3.36 Evolution.

A set of prescribed actions that result in an effective fireground activity.

3.3.37 Exhalation Valve.

A device that allows exhaled air to leave a facepiece and prevents outside air from entering through the valve.

3.3.38* Facepiece.

Describes both full facepieces that cover the nose, mouth, and eyes and half facepieces that cover the nose and mouth.

3.3.39 Factored Load.

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

3.3.40 FESO Vehicle.

Any vehicle operated by an FESO.

3.3.41 Fire and Emergency Service Organization (FESO).

Any public, private, governmental, or military organization that provides emergency response, fire suppression, and related activities, whether for profit or government owned and operated. [**1201,** 2015]

3.3.42 Fire Apparatus.

A vehicle designed to be used under emergency conditions to transport personnel and equipment, and to support the suppression of fires and mitigation of other hazardous situations. [**1901,** 2016]

3.3.43 Fire Apparatus Driver/Operator.

A fire department member who is authorized by the authority having jurisdiction to drive, operate, or both drive and operate fire department vehicles.

3.3.44* Fire Department.

An organization providing rescue, fire suppression, emergency medical services, hazardous materials operations, special operations, and related activities.

3.3.44.1 Fire Department.

An organization providing rescue, fire suppression, and related activities, including any public, governmental, private, industrial, or military organization engaging in this type of activity. [**1002,** 2017]

3.3.45 Fire Growth Potential.

The potential size or intensity of a fire based on the available fuel load.

3.3.46 Fire Investigation Burn Cell (Burn Cell).

A smaller subdivision of either a fire investigation training structure or fire investigation training prop, designed or intended to contain the arrangement of fuels used in fire investigation training.

3.3.47 Fire Investigation Set (Set).

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

3.3.48 Fire Investigation Training Prop.

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

3.3.49 Fire Investigation Training Structure.

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

3.3.50 Fire Prop.

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

3.3.51 Fire Service.

Career or volunteer service groups that are organized and trained for the prevention and control of loss of life and property from any fire or disaster.

3.3.52* Flameover (Rollover).

The condition in which unburned fuel (pyrolysate) from the originating fire has accumulated in the ceiling layer to a sufficient concentration (i.e., at or above the lower flammable limit) that it ignites and burns. Flameover can occur without ignition of or prior to the ignition of other fuels separate from the origin.

3.3.53 Flashover.

A transition phase in the development of a compartment fire in which surfaces exposed to thermal radiation reach ignition temperature more or less simultaneously and fire spreads rapidly throughout the space, resulting in full room involvement or total involvement of the compartment or enclosed space.

3.3.54 Flow Path.

A path composed of at least one intake opening, one exhaust opening, and the connecting volume between the openings with the direction of the flow within the path determined by the difference in pressure where heat and smoke in a higher-pressure area will flow through openings toward areas of lower pressure, and cool, dense ambient air at atmospheric pressure will flow through openings into areas of lower pressure.

3.3.55 Flow Path Control.

The tactic of controlling or closing ventilation points to limit additional oxygen into the space thereby limiting fire development, heat release rate, and smoke production, and to control the movement of the heat and smoke conditions out of the fire area to the exterior and to other areas within the building.

3.3.56 Fuel-Limited Fire.

A fire in which the heat release rate and fire growth are controlled by the characteristics of the fuel because there is adequate oxygen available for combustion.

3.3.57 Fuel Load.

The total quantity of combustible contents of a building, space, or fire area, including interior finish and trim, expressed in heat units or the equivalent weight in wood.

3.3.57.1* Fuel Load.

The total quantity of combustible contents of a building, space, or fire area, including interior finish and trim, expressed in terms of heat release rate.

3.3.58* Fully Developed Stage.

The stage of fire development where heat release rate has reached its peak within a compartment.

3.3.59 Gas.

The state of matter characterized by complete molecular mobility and unlimited expansion; used synonymously with the term *vapor*. [**68,** 2013]

3.3.60* Gas-Fueled Live Fire Training System.

An engineered system comprised of the gas-fueled training appliance(s), the associated piping, and the fire prop(s).

3.3.61 Gas-Fueled Training Appliance.

An engineered product comprised of burner controls, safety systems, and ignition system used to operate the fire prop.

3.3.62 gpm.

Gallons per minute.

3.3.63 Growth Stage.

The stage of fire development where the heat release rate from an incipient fire has increased to the point where heat transferred from the fire and the combustion products are pyrolyzing adjacent fuel sources and the fire begins to spread across the ceiling of the fire compartment (rollover).

3.3.64* Hazard.

Any arrangement of materials that presents the potential for harm. [**921,** 2017]

3.3.65 Heads-Up Display (HUD).

Visual display of information and system condition status visible to the wearer. [**1981**, 2013]

3.3.66* Heat Release Rate.

The rate at which energy is generated by the burning of a fuel and oxygen mixture. As the heat release rate increases, the heat, smoke production, and pressure within the area will increase and spread along available flow paths toward low-pressure areas (such as open doors, windows, and roof openings).

3.3.67 Highline System.

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

3.3.68 High-Temperature Environment.

An environment with a temperature above 104°F (40°C).

3.3.69* Immediately Dangerous to Life or Health (IDLH).

Any condition that would pose an immediate or delayed threat to life, cause irreversible adverse health effects, or interfere with an individual's ability to escape unaided from a hazardous environment. [**1670,** 2014]

3.3.70 Incident Action Plan.

The objectives reflecting the overall incident strategy, tactics, risk management, and member safety that are developed by the incident commander. Incident action plans are updated throughout the incident. [**1500,** 2021]

3.3.71 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,** 2018]

3.3.72 Incident Management System (IMS).

A system that defines the roles and responsibilities to be assumed by responders and the standard operating procedures to be used in the management and direction of emergency incidents and other functions. [**1561,** 2020]

3.3.73 Incipient Stage.

The early stage of fire development where the fire’s progression is limited to a fuel source and the thermal hazard is localized to the area of the burning material.

3.3.74 Individual Air Management Program.

A program to develop an individual's awareness of his or her personal air consumption rate while wearing respiratory protection equipment in a work mode.

3.3.75 Industrial Fire Brigade.

An organized group of employees within an industrial occupancy who are knowledgeable, trained, and skilled in at least basic firefighting operations, and whose full-time occupation might or might not be the provision of fire suppression and related activities for their employer. [**600,** 2015]

3.3.76 Initial Safety Team (IST).

A dedicated crew of a minimum of two firefighters, located outside the IDLH, assigned to rescue injured or trapped firefighters prior to the assignment of a rapid intervention crew (RIC).

3.3.77 Instructor.

An individual qualified by the authority having jurisdiction to deliver firefighter training, who has the training and experience to supervise students during live fire training evolutions, and who has met the requirements of an Instructor I in accordance with NFPA 1041.

3.3.77.1 Instructor.

An individual deemed qualified by the authority having jurisdiction to deliver training in the operation of fire service vehicles.

3.3.78 Instructor-in-Charge.

An individual qualified as an instructor and designated by the authority having jurisdiction to be in charge of the live fire training evolution, and who has met the requirements of an Instructor II in accordance with NFPA 1041.

3.3.79 Intermittent Pilot.

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

3.3.80 Interrupted Pilot.

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

3.3.81 kPa.

Kilopascals.

3.3.82 Large-Diameter Hose.

A hose 3.5 in. (89 mm) or larger that is designed to move large volumes of water to supply master stream appliances, portable hydrants, manifolds, standpipe and sprinkler systems, and fire department pumpers from hydrants and in relay.

3.3.83 Line.

One or more lengths of connected fire hose.

3.3.83.1 *Attack Line.*

A hose line used primarily to apply water directly onto a fire and operated by a sufficient number of personnel so that it can be maneuvered effectively and safely.

3.3.83.2 *Backup Line.*

An additional hose line used to reinforce and protect personnel in the event the initial attack proves inadequate.

3.3.83.3 *Initial Attack Line.*

The first hose stream placed in service by a company at the scene of a fire in order to protect lives or to prevent further extension of fire while additional lines are laid and placed in position.

3.3.83.4* *Leader Line.*

A hose line supplying one or more smaller lines, as in a wyed line.

3.3.83.5 *Preconnected Line.*

A discharge hose line already attached to an engine outlet.

3.3.83.6 *Supply Line.*

One or more lengths of connected fire hose, also called a leader line, used to provide water to wyed lines or to the intake of a pump.

3.3.84 L/min.

Liters per minute.

3.3.85 Liquid-Fueled Live Fire Training System.

A training prop used for live fire training on a repetitive basis, fueled by gasoline, diesel, kerosene, reduced-emissions flammable liquid, or other flammable or combustible liquid.

3.3.86 Live Fire.

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

3.3.86.1 Live Fire.

Any unconfined open flame or device that can propagate fire to the building, structure, or other combustible materials.

3.3.87 Live Fire Training Prop.

A training prop utilized for conducting live fire training evolutions on a repetitive basis.

3.3.88* Live Fire Training Structure.

A structure utilized for conducting live fire training evolutions on a repetitive basis.

3.3.89 Live Loads.

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

3.3.90 Maintenance.

Work performed to ensure that equipment operates as directed by the manufacturer.

3.3.91 Manufacturer.

The entity that directs and controls any of the following: compliant product design, compliant product manufacturing, or compliant product quality assurance; also, the entity that assumes liability for the compliant product or provides the warranty for the compliant product. [**1801,** 2018]

3.3.92 Means of Egress.

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

3.3.93 Means of Escape.

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

3.3.94* Member.

A person involved in performing the duties and responsibilities of a fire department under the auspices of the organization. [**1500,** 2018]

3.3.95 Member Assistance Program (MAP).

A generic term used to describe the various methods used in the FESO for the control of alcohol and other substance abuse, stress, and personal problems that adversely affect member performance. [**1500,** 2018]

3.3.96 Mobile Training Prop.

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

3.3.97 Mock-Up.

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

3.3.98 NIOSH.

National Institute for Occupational Safety and Health of the US Department of Health and Human Services.

3.3.99* NIOSH Approved.

Tested and certified by the National Institute for Occupational Safety and Health (NIOSH) of the US Department of Health and Human Services.

3.3.100 Open-Circuit SCBA.

See 3.3.129, Self-Contained Breathing Apparatus (SCBA).

3.3.101 OSHA.

The Occupational Safety and Health Administration of the US Department of Labor. [**55,** 2016]

3.3.102 Overhaul.

The process of final extinguishment after the main body of a fire has been knocked down. All traces of fire must be extinguished at this time. [**402,** 2013]

3.3.103 Owner/Operator.

The organization with fiscal responsibility for the operation, maintenance, and profitability of the facility. [**654,** 2017]

3.3.104 Participant.

Any student, instructor, safety officer, visitor, or other person who is involved in the live fire training evolution within the operations area.

3.3.105 Personal Accountability Report (PAR).

A report requested by and communicated to the incident commander from fire crews operating at a scene as to their location and situation.

3.3.106 Personal Protective Clothing.

The full complement of garments firefighters are normally required to wear while on emergency scene, including turnout coat, protective trousers, firefighting boots, firefighting gloves, a protective hood, and a helmet with eye protection. [**1001,** 2013]

3.3.107 Personal Protective Equipment (PPE).

Consists of full personal protective clothing, plus a self-contained breathing apparatus (SCBA) and a personal alert safety system (PASS) device. [**1001,** 2013]

3.3.108 Portable Training Prop.

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

3.3.109 psi.

Pounds per square inch gauge.

3.3.110 Pyrolysate.

Product of decomposition through heat; a product of a chemical change caused by heating.

3.3.111* Pyrolysis.

The breakdown of fuels such as wood and foam plastics into their basic compound when subjected to heat.

3.3.112 Qualified Person.

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

3.3.113 Radiation.

Heat transfer by way of electromagnetic energy.

3.3.114* Rapid Intervention Crew/Company (RIC).

A dedicated crew of firefighters who are assigned for rapid deployment to rescue lost or trapped members.

3.3.115 Rapid Intervention Crew/Company Universal Air Connection (RIC/UAC).

A system that allows emergency replenishment of breathing air to the SCBA of disabled or entrapped fire or emergency services personnel.

3.3.116 Recruit.

An individual who has passed beyond the candidate level and who has actively commenced duties as a member of the organization.

3.3.117 Rescue.

Those activities directed at locating endangered persons at an emergency incident, removing those persons from danger, treating the injured, and providing for transport to an appropriate health care facility. [**1500,** 2021]

3.3.118 Rescue Vehicle.

A special vehicle, also known as a heavy rescue or squad, equipped with tools and equipment to perform one or more types of special rescue such as building collapse, confined space, high angle, vehicle extrication, and water rescue.

3.3.119 Residual Pressure.

The pressure that exists in the distribution system, measured at the residual hydrant at the time the flow readings are taken at the flow hydrants.

3.3.120 Respiratory Hazard.

Any exposure to products of combustion, superheated atmospheres, toxic gases, vapors, or dust, or potentially explosive or oxygen-deficient atmospheres, or any condition that creates a hazard to the respiratory system.

3.3.121* Respiratory Protection Equipment.

Devices that are designed to protect the respiratory system against exposure to gases, vapors, or particulates.

3.3.122 Respiratory Protection Program.

A systematic and comprehensive program of training in the use and maintenance of respiratory protection devices and related equipment.

3.3.123 Risk.

A measure of the probability and severity of adverse effects that result from exposure to a hazard.

3.3.124 Room Orientation.

The set of skills that allow an interior structural firefighter to move into and through interior rooms while remaining aware of their position in the room relative to their entry point, furnishings, alternate exit routes, and other connected rooms/areas.

3.3.125 Safety Officer.

An individual appointed by the authority having jurisdiction as qualified to maintain a safe working environment at all live fire training evolutions.

3.3.126 Sanitize.

The removal of dirt and the inhibiting of the action of agents that cause infection or disease.

3.3.127 SCBA.

Acronym for Self-Contained Breathing Apparatus. [**1982,** 2013]

3.3.128 Seismic Forces.

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

3.3.129 Self-Contained Breathing Apparatus (SCBA).

A respirator worn by the user that supplies a respirable atmosphere, that is either carried in or generated by the apparatus, and that is independent of the ambient environment.

3.3.129.1 *Closed-Circuit SCBA.*

A recirculation-type SCBA in which the exhaled gas is rebreathed by the wearer after the carbon dioxide has been removed from the exhalation and after the oxygen content within the system has been restored from sources such as compressed breathing gas, chemical oxygen, and liquid oxygen.

3.3.129.2 *Open-Circuit SCBA.*

An SCBA in which exhalation is vented to the atmosphere and not rebreathed. There are two types of open-circuit SCBA: negative pressure or demand type and positive pressure or demand type.

3.3.130* Situational Awareness.

The ongoing activity of assessing what is going on around you during the complex and dynamic environment of a fire incident.

3.3.131 Size-Up.

The process of gathering and analyzing information to help fire officers make decisions regarding the deployment of resources and the implementation of tactics.

3.3.132 Smoke.

The airborne solid and liquid particulates and gases evolved when a material undergoes pyrolysis or combustion, together with the quantity of air that is entrained or otherwise mixed into the mass. [**318,** 2018]

3.3.132.1* Smoke.

The combination of airborne solid particulates, liquid particulates, and gases emitted when a material undergoes pyrolysis or combustion.

3.3.133 Standard Operating Procedures (SOPs).

Written instructions that document and define the manner in which activities should be conducted.

3.3.134 Student.

Any person who is present at the live fire training evolution for the purpose of receiving training.

3.3.135 Supplied-Air Respirator (SAR) or Air-Line Respirator.

An atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

3.3.136 Technical Search and Rescue.

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

3.3.137* Training Prop.

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

3.3.138 Training Structure.

3.3.138.1 *Acquired Structure.*

A building or structure acquired by the authority having jurisdiction from a property owner for the purpose of conducting live fire training evolutions.

3.3.138.2* *Live Fire Training Structure.*

A structure specifically designed for conducting live fire training evolutions on a repetitive basis.

3.3.139 Training Tower.

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

3.3.140 Trial-for-Ignition Period (Flame-Establishing Period).

The interval of time during light-off that a combustion safeguard allows the fuel safety shutoff valve to remain open before the flame detector is required to supervise the flame.

3.3.141 Truck.

A common fire service term for aerial fire apparatus.

3.3.142 Unconventional Means of Transportation.

Can include, but are not limited to, bicycles, motorcycles, scooters, skateboards, and rollerblades.

3.3.143* Vent, Entry, Isolate, Search (VEIS).

The approved tactic for entering a structure through an opening (door or window) to locate possible victims.

3.3.144* Ventilation.

The controlled and coordinated removal of heat and smoke from a structure, replacing the escaping gases with fresh air.

3.3.144.1 *Horizontal Ventilation.*

The opening or removal of windows or doors on any floor of a fire building to create flow paths for fire conditions.

3.3.144.2 *Mechanical Ventilation.*

The use of mechanical fans to accelerate air flow or reverse air flow to assist in the movement of smoke throughout a structure.

3.3.144.3 *Vertical Ventilation.*

The vertical venting of structures involving the opening of bulkhead doors, skylights, scuttles, and roof cutting operations to release smoke and heat from inside the fire building.

3.3.145 Ventilation-Controlled Fire.

A fire in which the heat release rate or growth is controlled by the amount of air available to the fire.

3.3.146 Ventilation for Extinguishment.

The controlled and coordinated ventilation tactic that should coincide with the engine company extinguishment of the fire.

3.3.147 Ventilation for Search.

The controlled and coordinated ventilation tactic performed to facilitate the movement of a firefighter into an area to conduct a search for victims.

3.3.148* Ventilation-Induced Flashover.

A flashover initiated by the introduction of oxygen into a preheated, fuel-rich (smoke filled), oxygen-deficient area.

3.3.149 Ventilation-Limited Fire.

A fire in which the heat release rate and fire growth are regulated by the available oxygen within the space.

3.3.150 Ventilation Profile.

The appearance of the fire building's ventilation points showing the flow paths of heat and smoke out of the structure as well as any air movement into the structure.

3.3.151 Ventilation Tactics.

The coordinated and controlled opening of ventilation points in a structure to facilitate fire operations.

3.3.152 Weapons of Mass Destruction (WMD).

A WMD is any device, material, or substance used in a manner, in a quantity or type, or under circumstances evidencing an intent to cause death or serious injury to persons or significant damage to property. A weapon of mass destruction includes chemical, biological, radiological, nuclear, and explosive components.

3.3.153* Working Load.

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

Additional Proposed Changes

File Name	Description	Approved
1403_PI_No_22.pdf	NFPA 1403 Public Input No. 22	

Statement of Problem and Substantiation for Public Input

Continue to standardize terminology between training standards and NFPA 1700 Guide to Structural Firefighting.

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Public Input No. 22-NFPA 1403-2020 [Chapter 3]

Chapter 3 ~~Definitions~~ Definitions Consider revising and adding definitions to align with NFPA 1700 if NFPA 1700 is adopted.

3.1 General.

The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary,* 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Authority Having Jurisdiction (AHJ).

An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.2 Shall.

Indicates a mandatory requirement.

3.2.3 Should.

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

3.2.4 Standard.

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

3.3 General Definitions.

3.3.1 Acquired Prop.

A piece of equipment such as an automobile that was not designed for burning but is used for live fire training evolutions.

3.3.2 Backdraft.

A deflagration resulting from the sudden introduction of air into a confined space containing oxygen-deficient products of incomplete combustion.

3.3.3 Combustible.

Capable of burning, generally in air under normal conditions of ambient temperature and pressure, unless otherwise specified. Combustion can occur in cases where an oxidizer other than oxygen in air is present (e.g., chlorine, fluorine, or chemicals containing oxygen in their structure).

3.3.4 Conduction.

Heat transfer to another body or within a body by direct contact.

3.3.5 Convection.

Heat transfer by circulation within a medium such as a gas or a liquid.

3.3.6 Deflagration.

Propagation of a combustion zone at a velocity that is less than the speed of sound in the unreacted medium.

3.3.7 Demonstration.

The act of showing a skill.

3.3.8 Emergency Medical Services.

The provision of treatment, such as first aid, cardiopulmonary resuscitation, basic life support, advanced life support, and other pre-hospital procedures including ambulance transportation, to patients. [**1500,** 2013]

3.3.9 Evolution.

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

3.3.10 Flameover (Rollover).

The condition in which unburned fuel (pyrolysate) from the originating fire has accumulated in the ceiling layer to a sufficient concentration (i.e., at or above the lower flammable limit) that it ignites and burns. Flameover can occur without ignition of or prior to the ignition of other fuels separate from the origin.

3.3.11 Flashover.

A transition phase in the development of a compartment fire in which surfaces exposed to thermal radiation reach ignition temperature more or less simultaneously and fire spreads rapidly throughout the space, resulting in full room involvement or total involvement of the compartment or enclosed space.

3.3.12 Flow Path.

A path composed of at least one intake opening, one exhaust opening, and the connecting volume between the openings with the direction of the flow within the path determined by the difference in pressure where heat and smoke in a higher-pressure area will flow through openings toward areas of lower pressure, and cool, dense ambient air at atmospheric pressure will flow through openings into areas of lower pressure.

3.3.13 Fuel Load.

The total quantity of combustible contents of a building, space, or fire area, including interior finish and trim, expressed in heat units or the equivalent weight in wood.

3.3.14 High-Temperature Environment.

An environment with a temperature above 104°F (40°C).

3.3.15 Immediately Dangerous to Life or Health (IDLH).

Any condition that would pose an immediate or delayed threat to life, cause irreversible adverse health effects, or interfere with an individual's ability to escape unaided from a hazardous environment. [**1670,** 2014]

3.3.16 Instructor.

An individual qualified by the authority having jurisdiction to deliver fire-fighter training, who has the training and experience to supervise students during live fire training evolutions, and who has met the requirements of an Instructor I in accordance with NFPA 1041.

3.3.17 Instructor-in-Charge.

An individual qualified as an instructor and designated by the authority having jurisdiction to be in charge of the live fire training evolution, and who has met the requirements of an Instructor II in accordance with NFPA 1041.

3.3.18 Live Fire.

Any unconfined open flame or device that can propagate fire to the building, structure, or other combustible materials.

3.3.19 Participant.

Any student, instructor, safety officer, visitor, or other person who is involved in the live fire training evolution within the operations area.

3.3.20 Personal Accountability Report (PAR).

A report requested by and communicated to the incident commander from fire crews operating at a scene as to their location and situation.

3.3.21 Personal Protective Clothing.

The full complement of garments fire fighters are normally required to wear while on emergency scene, including turnout coat, protective trousers, fire-fighting boots, fire-fighting gloves, a protective hood, and a helmet with eye protection. [**1001,** 2013]

3.3.22 Personal Protective Equipment (PPE).

Consists of full personal protective clothing, plus a self-contained breathing apparatus (SCBA) and a personal alert safety system (PASS) device. [**1001,** 2013]

3.3.23 Pyrolysate.

Product of decomposition through heat; a product of a chemical change caused by heating.

3.3.24 Radiation.

Heat transfer by way of electromagnetic energy.

3.3.25 Safety Officer.

An individual appointed by the authority having jurisdiction as qualified to maintain a safe working environment at all live fire training evolutions.

3.3.26 Student.

Any person who is present at the live fire training evolution for the purpose of receiving training.

3.3.27 Training Structure.

3.3.27.1 Acquired Structure.

A building or structure acquired by the authority having jurisdiction from a property owner for the purpose of conducting live fire training evolutions.

3.3.27.2* Live Fire Training Structure.

A structure specifically designed for conducting live fire training evolutions on a repetitive basis.

3.3.28 Ventilation-Controlled Fire.

A fire in which the heat release rate or growth is controlled by the amount of air available to the fire.

Statement of Problem and Substantiation for Public Input

Continue to standardize terminology between training standards and NFPA 1700 Guide to Structural Firefighting.

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Public Input No. 50-NFPA 1400-2023 [Section No. 3.3.2]

3.3.2 Acquired Structure.

A building or structure acquired by the AHJ from a property owner for the purposes of conducting fire training evolutions, technical rescue training, hazardous materials training, or other fire rescue training whether including live fire training or not. This is to include abandon structures without owners that have claimed by AHJ and been inspected and deemed structually sound.

Additional Proposed Changes

File Name	Description	Approved
NFPA14_1.PDF	NFPA 1402 - Public Input No. 2	

Statement of Problem and Substantiation for Public Input

Many abandon structures with no property owner are claimed by the AHJ and demolished without any training taking place. These are prime opportunities for companies to train in real world scenarios.

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Public Input No. 2-NFPA 1402-2020 [Section No. 3.3.2]

3.3.2 Acquired Structure.

A building or structure acquired by the AHJ from a property owner for the purposes of conducting fire training evolutions, technical rescue training, hazardous materials training, or other fire rescue training whether including live fire training or not. This is to include abandon structures without owners that have claimed by AHJ and been inspected and deemed structually sound.

Statement of Problem and Substantiation for Public Input

Many abandon structures with no property owner are claimed by the AHJ and demolished without any training taking place. These are prime opportunities for companies to train in real world scenarios.

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Public Input No. 1-NFPA 1400-2023 [Section No. 3.3.24]

3.3.24 Demonstration.

~~The act of showing a skill~~ A practical exhibition and explanation of how something works or is performed .

Statement of Problem and Substantiation for Public Input

The current definition is not broad enough. Many demonstrations during live fire training do not involve skills development but instead are used to show or have the students experience different fire behavior or effects. For example, a flashover container is not used to show a skill but rather to show the stages leading up to flashover so that students can develop a visual "slide" so that they can recognize when these conditions are developing in a real fire.
The proposed definition is from the Oxford English dictionary.

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Public Input No. 2-NFPA 1400-2023 [Section No. 3.3.26]

3.3.26* Door Control.

The process of ~~ensuring the entrance door providing access to the fire area is controlled and closed~~ closing a door as much as possible ~~after the search team enters without the protection of a hose line~~ to limit the flow of smoke and fire gases into other spaces and/or air to the fire .

Statement of Problem and Substantiation for Public Input

The definition as written is to narrow as it does not capture many of the common uses of the term "door control."

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Public Input No. 18-NFPA 1400-2023 [Section No. 3.3.57.1]

3.3.57.1* Fuel Load.

The total quantity of combustible contents of a building, space, or fire area, including interior finish and trim~~, expressed in terms of heat release rate~~ .

Statement of Problem and Substantiation for Public Input

It is impractical to express the fuel load in terms of heat release rate. Individuals in the field do not have ready access to HRR values for a variety of products and even then they would not be accurate due to the wide variety of shapes, densities and types of fuels used in live fire training.

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Submittal Date: Mon Jun 19 19:41:15 EDT 2023
Committee: FIY-AAA

Public Input No. 5-NFPA 1400-2023 [Section No. 3.3.64]

3.3.64* Hazard.

~~Any arrangement of materials that presents the potential for harm.~~ [**~~921,~~** ~~2017~~] A source of danger.

Statement of Problem and Substantiation for Public Input

The previous definition is not the commonly understood definition of the word hazard. The proposed definition is from Merrian-Webster

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Public Input No. 6-NFPA 1400-2023 [New Section after 3.3.68]

Routine Thermal Conditions:

Where the surrounding temperature is between 68 degrees F and 158 degrees F. These conditions translate approximately to ambient conditions, not necessarily requiring any thermal protection.

Statement of Problem and Substantiation for Public Input

The Utech thermal conditions regularly referenced by UL are not referenced in the NFPA standard.

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Committee: FIY-AAA

Public Input No. 7-NFPA 1400-2023 [New Section after 3.3.68]

Ordinary Thermal Conditions

Temperatures between 158 degrees F and 392 degrees F and between 2 and 12 kW/m2. Firefighters should be able to function under ordinary operating conditions from 10-20 minutes at a time, or in other words for the working duration of an SCBA cylinder. Ordinary operating conditions are considered those that are typical of a house fire.

Statement of Problem and Substantiation for Public Input

The Utech thermal conditions regularly referenced by UL are not found in the NFPA standard.

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Public Input No. 8-NFPA 1400-2023 [New Section after 3.3.68]

Emergency Thermal Conditions

Thermal conditions exceeding 12 kW/m2 and 392◦F. s This zone as one in which a firefighter's PPE would only be able to withstand an exposure on the order of a few seconds.

Additional Proposed Changes

File Name	Description	Approved
Capture.PNG	Thermal ranges	

Statement of Problem and Substantiation for Public Input

The Utech thermal ranges regularly reference by UL are not contained in the NFPA standard.

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Committee: FIY-AAA

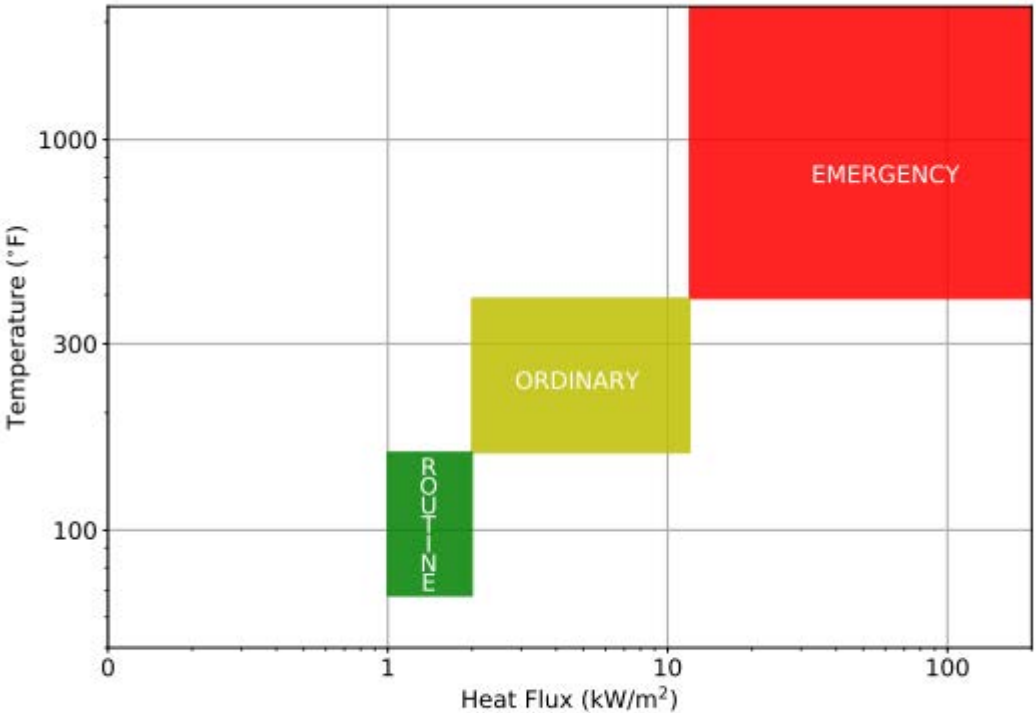


Figure 3.1: Utech's Thermal Exposure Conditions

Public Input No. 12-NFPA 1400-2023 [Section No. 3.3.68]

3.3.68 ~~High-Temperature Environment.~~

~~An environment with a temperature above 104°F~~

Dangerous Heat Index

A heat index above 103°F (40°C). H eat indices meeting or exceeding 103 ° F can lead to dangerous heat disorders with prolonged exposure and/or physical activity in the heat.

Statement of Problem and Substantiation for Public Input

The term "high-temperature environment" is misleading. Heat index is the accepted term when discussing environmental heat conditions that effect work capacity outside of a burning building or live fire training structure.

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Public Input No. 28-NFPA 1400-2023 [Section No. 3.3.86]

3.3.86 Live Fire.

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

~~**3.3.86.1** – Live Fire.~~

~~Any unconfined open flame or device that can propagate fire to the building, structure, or other combustible materials.~~

Statement of Problem and Substantiation for Public Input

This deletes the redundant definition and leaves only one definition of Live Fire. The definition being kept is from 1402 and the one being deleted is from 1403.

In 2018, when converting 1402 from a guide to a standard, the 1402 Committee wrote a new definition for Live Fire because the 1403 definition appeared to be intended for acquired structures and included a potential loophole for non-combustible live fire training structures. The 1402 Committee thought that if a live fire training structure is non-combustible, and if there are no other combustible materials in the live fire training structure, then the training fire could not propagate to those items and therefore, by 1403's definition, the training fire would not be a "live fire". That might allow instructors to disregard 1403 Chapters 4 through 8 (now Chapters 15 through 19) while burning in a non-combustible live fire training structure. The 1402 definition broadens what "live fire" includes and closes that loophole as well as requires the stricter design requirements found in Chapter 7 (live fire training structures) to be followed more often when designing and building live fire training structures.

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Public Input No. 84-NFPA 1400-2023 [Section No. 3.3.129.2]

3.3.129.2 *Open-Circuit SCBA.*

An SCBA in which exhalation is vented to the atmosphere and not rebreathed. There are two types of open-circuit SCBA: negative pressure or demand type and positive pressure or pressure- demand type.

Statement of Problem and Substantiation for Public Input

The definition was incorrect. The correct way to describe the SCBA is open circuit pressure-demand.

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Committee: FIY-AAA

Public Input No. 24-NFPA 1400-2023 [Section No. 3.3.138]

~~**3.3.138.2** * – *Live Fire Training Structure.*~~

~~A structure specifically designed for conducting live fire training evolutions on a repetitive basis.~~

3.3.138 Training Structure.

~~**3.3.138.1** – *Acquired Structure.*~~

~~A building or structure acquired by the authority having jurisdiction from a property owner for the purpose of conducting live fire training evolutions.~~

A structure utilized for conducting fire, rescue, hazmat, or related training evolutions on a repetitive basis, whether including live fire or not. This includes but is not limited to live fire training structures, training towers, and containerized training structures.

Statement of Problem and Substantiation for Public Input

These definitions for Acquired Structure and Live Fire Training Structure (which were from 1403) are redundant with the already-listed definitions (which were from 1402). The 1402 definitions are clearer than the 1403 definitions, so deleting the 1403 definitions and using the 1402 definitions will provide greater clarity and remove the redundancy.

In addition, moving the definitions for Acquired Structure and Live Fire Training Structure out from underneath the definition of Training Structure will make it easier to find the definitions because most readers would look under "A" and "L" instead of "T" to find those definitions.

The new definition of Training Structure is a modification of the current 1402 definition. The existing 1402 definition does not include all possible training structures, such as a one-story, non-live-fire, non-containerized training structure. This revised definition of what was in 1402, which is a new definition in 1400, adds clarity.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 67-NFPA 1400-2023 [Section No. A.3.3.138.2]	

Submitter Information Verification

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Submittal Date: Tue Aug 22 23:15:10 EDT 2023
Committee: FIY-AAA

Public Input No. 3-NFPA 1400-2023 [Section No. 3.3.143]

3.3.143* Vent, ~~Entry~~ Enter , Isolate, Search (VEIS).

The ~~approved~~ tactic ~~for~~ of entering a structure through ~~an opening (door or window) to locate possible victims.~~ a window to search a room. Also referred to as VES or window initiated search.

Statement of Problem and Substantiation for Public Input

The current definition states that entry through a door could be considered VEIS. This is not accurate. All industry publications and training materials refer to VEIS as an entry made through a window. This is what differentiates this method of entry from standard searches started by making entry through a door.

The terms VES and window initiated search should be added. VES is the historical term used instead of VEIS and is still in common usage. ULFSRI has begun using window initiated search in their technical publications.

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Public Input No. 4-NFPA 1400-2023 [New Section after 3.3.144]

Hydraulic Ventilation

Using the entrained air in the nozzle pattern to move the by-products of combustion out through a ventilation opening.

Statement of Problem and Substantiation for Public Input

Hydraulic ventilation is one of the most commonly used types of ventilation. Proper application of hydraulic ventilation is a common lesson during live fire training.

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Public Input No. 39-NFPA 1400-2023 [Chapter 15 [Title Only]]

Live Fire Training Evolutions - General (NFPA 1403)

Statement of Problem and Substantiation for Public Input

This adds clarity that this chapter is solely for live fire training evolutions, not for designing/building facilities and not for training on respiratory protection, thermal imagers, RIC, etc.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 40-NFPA 1400-2023 [Chapter 16 [Title Only]]	
Public Input No. 41-NFPA 1400-2023 [Chapter 17 [Title Only]]	
Public Input No. 42-NFPA 1400-2023 [Chapter 18 [Title Only]]	
Public Input No. 43-NFPA 1400-2023 [Chapter 19 [Title Only]]	
Public Input No. 44-NFPA 1400-2023 [Chapter 20 [Title Only]]	

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Submittal Date: Wed Aug 23 02:16:50 EDT 2023
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Public Input No. 16-NFPA 1400-2023 [Section No. 15.1.2.1]

15.1.2.1

The purpose of Chapters 15 through 20 shall be to provide a ~~process~~ framework for conducting live fire training evolutions ~~to ensure that~~ that manages and mitigates the risks associated with live fire training while ensuring that training objectives are achieved~~ and that exposure to health and safety hazards for the firefighters receiving the training is minimized~~ .

Statement of Problem and Substantiation for Public Input

This is more concise. Also, the standard is not designed to reduce hazard but manage risk. Hazards can be large while the risk of those hazards is effectively mitigated.

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Public Input No. 9-NFPA 1400-2023 [Section No. 15.4.1]

15.4.1* Required Minimum Training.

Prior to being permitted to participate in live fire training evolutions, the student shall have received training to meet the minimum job performance requirements for Firefighter I in NFPA 1001 related to the ~~following subjects:~~

(1) ~~Safety~~
(2) ~~Fire behavior~~
(3) ~~Portable extinguishers~~
(4) ~~Personal protective equipment (PPE)~~
(5) ~~Ladders~~
(6) ~~Fire hose, appliances, and streams~~
(7) ~~Overhaul~~
(8) ~~Water supply~~
(9) ~~Ventilation~~
(10) ~~Forcible entry~~
(11) ~~Building construction~~

tasks that they will be required to perform.

Statement of Problem and Substantiation for Public Input

AHJ's with access to live fire training facilities often wish to incorporate live fire exposure training early in a recruit firefighters training. By being less prescriptive in the requirements recruits who are competent at donning and working in their gear but had not yet received training on extinguishers or building construction, could be permitted to observe and experience live fire conditions without violating the standard.

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Public Input No. 10-NFPA 1400-2023 [Section No. 15.4.2 [Excluding any Sub-Sections]]

Prior to being permitted to participate in live fire training evolutions, all participants shall have received training to meet the requirements ~~in accordance with 15.4.2.1 through 15.4.2.5~~ . of firefighter 1.

Statement of Problem and Substantiation for Public Input

The information referenced in these subsections should be contained in the firefighter 1 standard not in the live fire training standard.

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Committee: FIY-AAA

Public Input No. 51-NFPA 1400-2023 [Section No. 15.4.2.2]

15.4.2.2 Health and Safety.

All participants shall have received training for the following:

(1) The components of their protective clothing and equipment required for use during operational evolutions

(2) The thermal and air supply capabilities and limitations of their protective clothing and equipment

Additional Proposed Changes

File Name	Description	Approved
1403_PI_No_16.pdf	NFPA 1403_Public Input No. 16	

Statement of Problem and Substantiation for Public Input

Specifying which capabilities and limitations need to be taught or addressed prior to participating in Live Fire Training.

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Submittal Date: Thu Aug 24 08:44:49 EDT 2023
Committee: FIY-AAA

Public Input No. 16-NFPA 1403-2020 [Section No. 4.3.2.2]

4.3.2.2 Health and Safety.

All participants shall have received training for the following:

(1) The components of their protective clothing and equipment required for use during operational evolutions

(2) The thermal and air supply capabilities and limitations of their protective clothing and equipment

Statement of Problem and Substantiation for Public Input

Specifying which capabilities and limitations need to be taught or addressed prior to participating in Live Fire Training.

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Submittal Date: Tue Jun 30 17:31:07 EDT 2020
Committee: FIY-AAA

Public Input No. 52-NFPA 1400-2023 [Section No. 15.4.2.4]

15.4.2.4 Fire Development in a Compartment.

All participants shall have received training for the following:

(1) The general development of a fire and extension beyond a single room or compartment, including heat transfer methods, pressurization within the space, stages of fire development, and transition from fuel-controlled to ventilation-controlled combustion

(2) Building factors influencing fire development

(3) The ~~stage~~ stages of fire growth for fuel-limited fire

(4) The stages of fire growth for a ventilation-limited fire

(5) The significance of the transition from a contents fire to a structural fire

(6) Terminology related to fire development, including plume, ceiling jet, hot gas layer, neutral plane, flow path, and gravity current

(7) The impact of the following factors on fire development in a compartment:

(8) Type of fuel

(9) Availability and locations of additional fuel

(10) Volume of the compartment

(11) Ceiling height and size, number, and arrangement of ventilation openings

(12) Thermal properties of the enclosure (i.e., insulation)

(13) The hazards presented by fire behavior that impact a singular or multiple compartment(s)

(14) How the following fire behavior phenomena occur:

(15) Flashover

(16) Backdraft

(17) Smoke explosion

(18) The influence of changes in ventilation in each of the following burning regimes:

(19) Fuel-controlled

(20) Ventilation-controlled

(21) Differences among ventilation, unplanned ventilation, and tactical ventilation

(22) The significance of fire behavior indicators in each of the following categories:

(23) Building

(24) Smoke

(25) Flow path

(26) Heat

(27) Flame

(28) Impact of wind

Additional Proposed Changes

File Name	Description	Approved
1403_PI_No_17.pdf	NFPA 1403_Public Input No. 17	

Statement of Problem and Substantiation for Public Input

editorial replaced Stage with Stages

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Public Input No. 17-NFPA 1403-2020 [Section No. 4.3.2.4]

4.3.2.4 Fire Development in a Compartment.

All participants shall have received training for the following:

(1) The general development of a fire and extension beyond a single room or compartment, including heat transfer methods, pressurization within the space, stages of fire development, and transition from fuel-controlled to ventilation-controlled combustion

(2) Building factors influencing fire development

(3) The ~~stage~~ stages of fire growth for fuel-limited fire

(4) The stages of fire growth for a ventilation-limited fire

(5) The significance of the transition from a contents fire to a structural fire

(6) Terminology related to fire development, including plume, ceiling jet, hot gas layer, neutral plane, flow path, and gravity current

(7) The impact of the following factors on fire development in a compartment:

(a) Type of fuel

(b) Availability and locations of additional fuel

(c) Volume of the compartment

(d) Ceiling height and size, number, and arrangement of ventilation openings

(e) Thermal properties of the enclosure (i.e., insulation)

(8) The hazards presented by fire behavior that impact a singular or multiple compartment(s)

(9) How the following fire behavior phenomena occur:

(a) Flashover

(b) Backdraft

(c) Smoke explosion

(10) The influence of changes in ventilation in each of the following burning regimes:

(11) Fuel-controlled

(12) Ventilation-controlled

(13) Differences among ventilation, unplanned ventilation, and tactical ventilation

(14) The significance of fire behavior indicators in each of the following categories:

(a) Building

(b) Smoke

(c) Flow path

(d) Heat

(e) Flame

(f) Impact of wind

Statement of Problem and Substantiation for Public Input

editorial replaced Stage with Stages

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Committee: FIY-AAA

Public Input No. 53-NFPA 1400-2023 [Section No. 15.4.2.5]

15.4.2.5 Nozzle Techniques and Door Control.

All participants shall have received training for the following:

(1) Factors influencing the effectiveness of extinguishment by cooling

(2) The application of ~~indirect attack and direct attack~~ a rotating solid stream or fog stream

(3) Key door entry size-up and risk assessment factors

(4) Integrated door control and fire gas cooling to reduce the risk of flashover during door entry

(5) Effective door entry and control procedures

Additional Proposed Changes

File Name	Description	Approved
1403_PI_No_18.pdf	NFPA 1403_Public Input No. 18	

Statement of Problem and Substantiation for Public Input

Added specifics to go beyond the traditional fire attack approaches. Adding types of hose stream uses to address water distribution, air entrainment, and pressure development.

References: https://ulfirefightersafety.org/research-projects/impact-of-fire-attack-on-firefighter-safety-andoccupant-survival.html

https://ulfirefightersafety.org/research-projects/coordinated-fire-attack-utilizing-acquired-structures.html

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Public Input No. 18-NFPA 1403-2020 [Section No. 4.3.2.5]

4.3.2.5 Nozzle Techniques and Door Control.

All participants shall have received training for the following:

(1) Factors influencing the effectiveness of extinguishment by cooling

(2) The application of ~~indirect attack and direct attack a solid stream or straight stream as a broken stream.~~

(3) The application of a rotating solid stream or fog stream.

(4) Key door entry size-up and risk assessment factors

(5) Integrated door control and fire gas cooling to reduce the risk of flashover during door entry

(6) Effective door entry and control procedures

Statement of Problem and Substantiation for Public Input

Added specifics to go beyond the traditional fire attack approaches. Adding types of hose stream uses to address water distribution, air entrainment, and pressure development.

References: https://ulfirefightersafety.org/research-projects/impact-of-fire-attack-on-firefighter-safety-and-occupant-survival.html

https://ulfirefightersafety.org/research-projects/coordinated-fire-attack-utilizing-acquired-structures.html

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Committee: FIY-AAA

Public Input No. 11-NFPA 1400-2023 [Section No. 15.4.3]

15.4.3* Documentation of Prescribed Minimum Training.

All participants in a live fire training evolution who have received the required minimum training from other than the AHJ shall not be permitted to participate in any live fire training evolution without first presenting ~~written evidence~~ documentation of having successfully completed the prescribed minimum training to the levels specified in 15.4.1.

Statement of Problem and Substantiation for Public Input

Most training records are stored, and can be accessed, digitally. Written documentation is cumbersome and no longer necessary.

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Committee: FIY-AAA

Public Input No. 20-NFPA 1400-2023 [Section No. 15.5.1]

15.5.1

Instructors and participants shall be rehabbed in accordance with the provisions of NFPA 1584, Chapter 6, and any necessary medical evaluation and treatment, food and fluid replenishment, and relief from climatic conditions . *(See Annex G.)*

Statement of Problem and Substantiation for Public Input

This section and 15.8.6 should be consolidated for brevity.

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Submittal Date: Mon Jun 19 19:51:51 EDT 2023
Committee: FIY-AAA

Public Input No. 13-NFPA 1400-2023 [Section No. 15.8.1]

15.8.1

The instructor shall meet the minimum job performance requirements for Live Fire ~~Instructor I in~~ Instructor in NFPA 1041.

Statement of Problem and Substantiation for Public Input

NFPA 1041 has a qualification for Live Fire Instructor. This is the standard that should be referenced not Instructor 1.

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Submittal Date: Mon Jun 19 13:21:38 EDT 2023
Committee: FIY-AAA

Public Input No. 14-NFPA 1400-2023 [Section No. 15.8.2]

15.8.2

The instructor-in-charge shall meet the minimum job performance requirements for Live Fire Instructor ~~II~~ in Charge in NFPA 1041.

Statement of Problem and Substantiation for Public Input

NFPA 1041 has a qualification for Live Fire Instructor in Charge. This is the standard that should be referenced.

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Public Input No. 60-NFPA 1400-2023 [Section No. 15.8.2]

15.8.2

The instructor-in-charge shall meet the minimum job performance requirements for Fire Instructor ~~II~~ I in NFPA 1041.

Additional Proposed Changes

File Name	Description	Approved
1403_PI_No_15.pdf	NFPA 1403 Public Input No. 15	

Statement of Problem and Substantiation for Public Input

The issue surrounding fire instructor 2 requirement, specifically in our area, is there re a very limited number of instructor 2's. We are in central Wisconsin and most of our departments are rural, volunteer. The requirements for obtaining and maintaining instructor 2 are not realistic for many, if not most, of the small volunteer/paid-on-call departments. Even in the smaller career departments, to be required to have instructor 2 in charge can be difficult; the need to send staff to school to become certified in Instructor 1 and the State requirements to become and maintain instructor 2 are cost prohibitive in a small union environment. It is very costly to send members to school to obtain and maintain these certifications. In this day and age of dwindling volunteers and greater expectations many have little desire or time to take on additional educational requirements. With the requirement of instructor 2 I know there are live fire training sessions happening where no instructor 2 is present because there simply are a limited number around. I don't agree with the training currently happening not in accordance with 1403 but I do understand it. The biggest difference I see between fire instructor 1 and 2 is an instructor 2 knows how to build a curriculum on a computer. Maybe instead of requiring a fire instructor 2 to be in charge, we change the curriculum and requirements for instructor 1 to include curriculum design. In summary, I am opposed to the fire instructor 2 requirement. I would prefer if it to revert to fire instructor 1. I think you would see better compliance.

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Submittal Date: Fri Aug 25 13:39:52 EDT 2023
Committee: FIY-AAA

Public Input No. 15-NFPA 1403-2020 [Section No. 4.7.2]

4.7.2

The instructor-in-charge shall meet the minimum job performance requirements for Fire Instructor ~~II~~ I in NFPA 1041.

Statement of Problem and Substantiation for Public Input

The issue surrounding fire instructor 2 requirement, specifically in our area, is there re a very limited number of instructor 2's. We are in central Wisconsin and most of our departments are rural, volunteer. The requirements for obtaining and maintaining instructor 2 are not realistic for many, if not most, of the small volunteer/paid-on-call departments. Even in the smaller career departments, to be required to have instructor 2 in charge can be difficult; the need to send staff to school to become certified in Instructor 1 and the State requirements to become and maintain instructor 2 are cost prohibitive in a small union environment. It is very costly to send members to school to obtain and maintain these certifications. In this day and age of dwindling volunteers and greater expectations many have little desire or time to take on additional educational requirements. With the requirement of instructor 2 I know there are live fire training sessions happening where no instructor 2 is present because there simply are a limited number around. I don't agree with the training currently happening not in accordance with 1403 but I do understand it. The biggest difference I see between fire instructor 1 and 2 is an instructor 2 knows how to build a curriculum on a computer. Maybe instead of requiring a fire instructor 2 to be in charge, we change the curriculum and requirements for instructor 1 to include curriculum design. In summary, I am opposed to the fire instructor 2 requirement. I would prefer if it to revert to fire instructor 1. I think you would see better compliance.

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Public Input No. 19-NFPA 1400-2023 [Section No. 15.8.6 [Excluding any Sub-Sections]]

~~The instructor-in-charge shall provide for rest and rehabilitation of participants operating at the scene, including any necessary medical evaluation and treatment, food and fluid replenishment, and relief from climatic conditions. *(See Annex G .)*~~

Statement of Problem and Substantiation for Public Input

This section should be combined with 15.5.1 for brevity. The IIC's responsibility to ensure proper rehab, etc. is implied by 15.8.3

Submitter Information Verification

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Submittal Date: Mon Jun 19 19:51:18 EDT 2023
Committee: FIY-AAA

Public Input No. 15-NFPA 1400-2023 [Section No. 15.8.6.1]

~~15.8.6.1~~ ~~*~~ –

~~Instructors shall be rotated through duty assignments. An instructor shall not serve as the ignition officer for more than one evolution in a row.~~

Statement of Problem and Substantiation for Public Input

Mandating the rotation of instructors, especially ignition officers, can lead to inexperienced instructors being placed in the ignition officer position. It also makes it difficult to provide the necessary instruction to newer instructors. Concerns about overheating of instructors, including ignition officers, should be dealt with through medical monitoring and providing adequate rest/rehab times. This should be left up to the direction of the AHJ and the instructors involved. This is already addressed in sections 15.8.6.2 and 15.8.8

Submitter Information Verification

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Submittal Date: Mon Jun 19 18:57:45 EDT 2023
Committee: FIY-AAA

Public Input No. 22-NFPA 1400-2023 [Section No. 15.8.7]

15.8.7

All instructors shall be qualified by the AHJ to deliver live fire training.

There should be a deference made between Rookie/Probationary firefighters and normal firefighters when in a paid full-time department.

Training associated with any number of recruit or probationary fighter, paid or volunteer, shall require all instructors be qualified by the AHJ to deliver live fire training.

Training associated with only paid, full-time, personnel who have completed their probationary time and packet, may substitute instructors for fire personnel tasked with incident command responsibilities during normal fireground operations.

Statement of Problem and Substantiation for Public Input

Smaller departments have a very difficult time putting on live fire training when so many live fire instructors are required. By limiting the experience firefighters may gain through live fire training we are making the more dangerous, real fire, incident, even more dangerous.

Submitter Information Verification

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Submittal Date: Fri Jul 07 09:47:51 EDT 2023
Committee: FIY-AAA

Public Input No. 17-NFPA 1400-2023 [Section No. 15.9]

15.9 ~~Fire Control Team~~ Ignition Team .

15.9.1

~~A fire control team~~ An ignition team shall consist of a minimum of two personnel, the Ignition Officer and Ignition Support .

15.9.1.1

~~One person who is not a student or safety~~ The ignition officer shall be ~~designated as~~ the ~~"ignition officer" to~~ one to ignite, maintain, and control the materials being burned.

15.9.1.1.1

The ignition ~~officer shall~~ officer shall not be a ~~member of the fire control team~~ student or the safety officer and shall meet the minimum job performance requirements for Live Fire Instructor in NFPA 1041 .

15.9.1.2*

~~One member of the fire control team~~ The ignition support shall be in the area to observe the ignition officer ignite and maintain the fire, and to recognize, report, and respond to any adverse conditions.

15.9.2

The decision to ignite the training fire shall be made by the instructor-in-charge in coordination with the safety officer.

15.9.3

~~The fire shall be ignited by the ignition officer.~~

~~15.9.4~~ ~~–~~

~~The fire control team shall wear full personal protective clothing, including SCBA, when performing this control function.~~

~~15.9.5~~ ~~–~~

A charged hose line shall be available when the fire control team is igniting or tending to any fire.

15.9.6 4

Fires shall not be ignited without an instructor visually confirming that the flame area is clear of personnel being trained.

Statement of Problem and Substantiation for Public Input

Ignition team is a much more widely recognized term for this functional group. The ignition officer should be trained at minimum to the Live Fire Instructor Level. The addition of a name for the other member of the team is for clarity. 15.9.3 is contained in 15.9.1.1 and so was deleted. 15.9.4 is implied in 15.8.9 and so was deleted.

Submitter Information Verification

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Public Input No. 68-NFPA 1400-2023 [Section No. 15.14]

15.14 Fuel Materials.

GENERAL COMMENT TO TASK GROUP: Clarify and reorganize Section 15. 14 to distinguish requirements for solid fuels, flammable liquid fuels, flammable gas fuels, liquified versions of flammable gas fuels, as well as maintain the general requirements that apply to all fuel types (such as 15. 14. 2, 15.14.4 and 15.14.6 through 15.14.10). 15.14 is a bit confusing and needs to be cleaned up.

15.14. 1*

The fuels that are utilized in live fire training evolutions shall only be wood products.

15.14.1.1

Fuel-fired buildings and props are permitted to use the appropriate fuels for the design of the building or prop.

15.14.2

Pressure-treated wood, rubber, plastic, polyurethane foam, tar paper, upholstered furniture, carpeting, and chemically treated or pesticide-treated straw or hay shall not be used as part of the fuel load.

15.14.3

Flammable or combustible liquids, as defined in NFPA 30, shall not be used in live fire training evolutions.

15.14.3.1

Combustible liquid with a flash point above 100°F (38°C) shall be permitted to be used in a live fire training structure or prop that has been specifically engineered to accommodate a defined quantity of the fuel.

15.14.4

Unidentified materials, such as debris found in or around the structure or prop that could burn in unanticipated ways, react violently, or create environmental or health hazards, shall not be used.

15.14.5

Propane lighters, butane lighters, fusees (safety flares), kitchen-type matches, and similar devices are permitted to be used to ignite training fires if the device is removed immediately after ignition of the training fire.

15.14.6*

Fuel materials shall be used only in the amounts necessary to create the desired fire size.

15.14.7*

The fuel load shall be limited to avoid conditions that could cause an uncontrolled flashover or backdraft. If a controlled flashover is designed to occur for training purposes, additional safety measures for providing a safe observation space for instructors and students shall be documented and followed.

15.14.8*

The instructor-in-charge and the safety officer shall assess the selected fire room environment for factors that can affect the growth, development, and spread of fire.

15.14.9*

The instructor-in-charge and the safety officer shall document fuel loading, including all of the following:

(1) Fuel material

(2) Wall and floor coverings and ceiling materials

(3) Type of construction of the structure, including type of roof and combustible void spaces

(4) Dimensions of the room

15.14.10*

The training exercise shall be stopped immediately when the instructor-in-charge or the safety officer determines through ongoing assessment that the combustible nature of the environment represents a potential hazard.

15.14.10.1

An exercise stopped as a result of an assessed hazard according to 15.14.10 shall continue only when actions have been taken to reduce the hazard.

15.14.11*

The use of flammable gas, such as propane and natural gas, shall be permitted only in live fire training structures specifically designed for their use.

15.14.11.1

Liquefied versions of the gases specified in 15.14.11 shall not be permitted inside the live fire training structure.

15.14.11.2*

All props that use pressure to move fuel to the fire shall be equipped with remote fuel shutoffs outside of the safety perimeter but within sight of the prop and the entire field of attack for the prop.

15.14.11.3

During the entire time the prop is in use, the remote shutoff shall be continuously attended by safety personnel who are trained in its operation and who have direct communications with the safety officer and instructors.

15.14.11.4

Liquefied petroleum gas props shall be equipped with all safety features as described in NFPA 58 and NFPA 59.

15.14.11.5

Where the evolution involves the failure of a safety feature, the failed part shall be located downstream from the correctly functioning safety feature.

15.14.11.6

Where flammable or combustible liquids are used, measures shall be taken to prevent runoff from contaminating the surrounding area.

15.14.11.6.1

There shall be oil separators for cleaning the runoff water.

15.14.11.7*

Vehicles used as props for live fire training shall have all fluid reservoirs, tanks, shock absorbers, drive shafts, and other gas-filled closed containers removed, vented, or drained prior to any ignition.

15.14.11.8

For flammable metal fires, there shall be a sufficient quantity of the proper extinguishing agent available so that all attack crews have the required supply as well as a 150 percent reserve for use by the backup crews.

15.14.11.9

All possible sources of ignition, other than those that are under the direct supervision of the ignition officer, shall be removed from the operations area.

Statement of Problem and Substantiation for Public Input

The following are examples of how 15.14 can be confusing as currently worded:

15.14.1 states that only wood products are allowed.

15.14.3.1 allows combustible liquids for live fire training evolutions and 15.14.11 allows flammable gas to fuel fires in live fire training structures and props specifically designed for such uses. All of that is reasonable but is a bit confusing given the current wording of 15.14.1, which allows only wood products. So, some revision is recommended.

A separate PI for editing 15.14.3.1 will also be submitted to clarify that language.

15.14.11 addresses the use of flammable gas but several subsections of 15.14.11 address flammable liquids / combustible liquids instead of flammable gas. The flammable liquids / combustible liquids language should be within their own subsection outside of 15.14.11.

15.14.11.7 addresses preparing vehicles for burns, which does not belong under 15.14 "Fuel Materials". Instead, the content of 15.14.11.7 should be moved to its own section in Chapter 15 (for example, "15.15 - Preparing Vehicles to be used as Live Fire Training Props").

15.14.3 should apply only to interior live fire training evolutions, and 15.14.3.1 should be clearly identified as an exception for interior live fire training evolutions. There should not be a ban on using flammable / combustible liquids in outdoor live fire training evolutions, such as fuel spill props. Parts of 15.14.11 already imply that flammable/combustible liquids are allowed in some circumstances, and Chapter 13 includes requirements for outdoor flammable/combustible liquids fire training props, which further implies that such fuels can be used for live fire training evolutions in certain types of props.

13.1.3 does not allow interior props that use flammable liquids but 15.14.3.1 does. This needs to be coordinated. There are some live fire training structures in the country that use flammable liquids for interior burns, so this needs to be considered carefully.

15.14.5 should be clarified to be only for wood fuels (interior and exterior fires) and flammable gas fuels when outdoors but not indoors (indoor manual ignition is prohibited by 17.1.4).

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Committee: FIY-AAA

Public Input No. 54-NFPA 1400-2023 [Section No. 15.14.1 [Excluding any Sub-Sections]]

The fuels that are utilized in live fire training evolutions shall ~~only be wood~~ include excelsior (wood fibers or shavings), wooden pallets, straw, hay, and other wood-based building products.

Additional Proposed Changes

File Name	Description	Approved
1403_PI_No_20.pdf	NFPA 1403_Public Input No. 20	

Statement of Problem and Substantiation for Public Input

Moved text from appendix in order to clarify the types of fuels that are acceptable for use in live fire training. Straw and hay are not wood but are acceptable. Also engineered lumber materials such as plywood, particle board, wood fiber board, and oriented strand board which are widely used in fire props, Class A burn building, and flash over simulators would technically not be allowed under the 2018 standard as the definition of "wood" is in the appendix note. Further excelsior is typically made from aspen as opposed to pine.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 56-NFPA 1400-2023 [Section No. A.15.14.1]	

Submitter Information Verification

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Submittal Date: Thu Aug 24 08:56:57 EDT 2023
Committee: FIY-AAA

Public Input No. 20-NFPA 1403-2020 [Section No. 4.13.1 [Excluding any Sub-Sections]]

The fuels that are utilized in live fire training evolutions shall ~~only be wood~~ include excelsior (wood fibers or shavings), wooden pallets, straw, hay, and other wood-based building products.

Statement of Problem and Substantiation for Public Input

Moved text from appendix in order to clarify the types of fuels that are acceptable for use in live fire training. Straw and hay are not wood but are acceptable. Also engineered lumber materials such as plywood, particle board, wood fiber board, and oriented strand board which are widely used in fire props, Class A burn building, and flash over simulators would technically not be allowed under the 2018 standard as the definition of "wood" is in the appendix note. Further excelsior is typically made from aspen as opposed to pine.

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Submittal Date: Tue Jun 30 18:02:49 EDT 2020
Committee: FIY-AAA

Public Input No. 69-NFPA 1400-2023 [Section No. 15.14.1.1]

15.14.1.1

~~Fuel-fired buildings and props are permitted to use the appropriate fuels for the design of the building or prop~~ See below for exceptions for flammable/combustible liquids and flammable gas .

Statement of Problem and Substantiation for Public Input

15.14.1.1 was intended to allow liquid and gas fuels to be used for live fire training structures and props that are designed for such use, but it reads "fuel-fired" instead of "liquid fuel-fired and gas fired". Because wood is a fuel, "fuel-fired" could cause confusion and make one believe that 15.14.1.1 only applies to wood fuels, not to liquid and gas fuels.

Furthermore, the exceptions for combustible liquids are written in 15.14.3.1 and the exceptions for flammable gas are written in 15.14.11. To delete redundancy and to eliminate a potential for conflicting wording between sections, it would be good to delete the current wording of 15.14.1.1 and to use that section to simply alert the reader that exceptions exist and are written later.

If this PI is rejected, the use of "building" in 15.14.1.1 needs to be revised to "live fire training structure" to be consistent with the rest of the document, and "fuel-fired" needs to be revised to "liquid fuel-fired and gas-fired" to more accurately reflect the intent.

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Committee: FIY-AAA

Public Input No. 59-NFPA 1400-2023 [Section No. 15.14.2]

15.14.2

Pressure-treated wood, oriented strand board containing Polymethylene Polyphenylisocyanate/ Polymeric Diphenylmethane Diisocyanate (PMDI), rubber, plastic, polyurethane foam, tar paper, upholstered furniture, carpeting, and chemically treated or pesticide-treated straw or hay shall not be used as part of the fuel load.

Additional Proposed Changes

File Name	Description	Approved
1403_PI_No_14.pdf	NFPA 1403 Public Input No. 14	
MSDS-8825471445461.1590940419219.pdf	BASF P-MDI SDS	
Weyerhaeuser_Oriented_Strand_Board_OSB_Products.1590940465276.pdf	SDS for OSB showing 1A carcinogen along with same CAS# 9016-87-9 same as the BASF P-MDI	
LP_SDS.1590940810150.pdf	LP OSB SDS showing same CAS # 9016-87-9 as BASF P-MDI	
SDS_Polyurethane-Foam-System-GUN-Can_US-English.1590943972246.pdf	Polyurethane Foam SDS CAS # 9016-87-9	
MSDS_Sheets_Polyurethane_Mixture_A_538_00.1590944023510.pdf	Polyurethane Foam SDS CAS # 9016-87-9	
OSB_Study.1590944097917.pdf	Firefighters and Instructors absorption of PAHs and benzene during training fires	
EPA_MDI_and_related_compunds_action_plan.1590944830097.pdf	EPA action plan for MDI/	

Polyurethane foam. This shows that P-MDI the binding agent in OSB is the same thing as Polyurethane foam. See page 3 section IV.

Statement of Problem and Substantiation for Public Input

Training fires along with continuing education are a major portion of firefighters' occupational exposures to smoke; however, the magnitude and composition of those exposures were not well understood and may vary by the type of training scenario and the fuel package used.
To understand how live fire training contributes to firefighters' and instructors' cancer-causing chemical exposures, a study was conducted and was then published in the International Journal of Hygiene and Environmental Health. The study titled “Firefighters' and instructors’ absorption of PAHs and benzene during training exercises” measured biomarkers and chemical concentrations based on level of exposure to the burning of pallet and straw, oriented strand board (OSB), and simulated smoke.
Urine samples were analyzed for metabolites of polycyclic aromatic hydrocarbons (PAHs) and breath samples were analyzed for volatile organic compounds (VOCs) including benzenes. Dermal absorption likely contributed to the biological levels as the respiratory route was well protected.
Median concentrations of nearly all PAH metabolites in urine increased from pre-to 3-hr post-training for each scenario and were highest for OSB, followed by pallet and straw, and then simulated smoke. For instructors who supervised three trainings per day, median concentrations increased with collections after each scenario. A single day of OSB exercises led to a 30-fold increase in 1-hydroxypyrene for instructors, culminating in a median end-of-shift concentration 3.5 times greater than median levels measured from firefighters in a previous controlled, residential fire study. Breath concentrations of benzene increased 2 to 7-times immediately after the training exercises except for simulated smoke training. Measured levels of PAHs and VOCs were highest in scenarios where fuel packages contained OSB and instructors’ levels were magnified with accumulated PAHs when taking part in repeated daily exercises.
Further analysis of the make-up of OSB has found that identical chemicals are used in the manufacturing of OSB and polyurethane foam, which has already been banned under 1403. Polymeric Diphenylmethane Diiocyanate (P-MDI) is noted on the Safety Data Sheet (SDS) for both OSB and the polyurethane foam as the chemical used in the manufacturing process. Both polyurethane foam, OSB, and PMDI have the same CAS number on their SDS sheet, CAS # 9016-87-9. The SDS documents were provided by Weyerhaeuser and Louisiana Pacific for OSB. The P-MDI SDS document was provided by BASF. Additionally, this information was cross checked for factuality utilizing the Environmental Protection Agencies Methylene Diphenyl Diisocyanate (MDI) and related compounds action plan April 2011. All supporting documents are being submitted as an attachment.
By adding OSB that contains P-MDI to the list of materials banned under 1403 4.13.2 this would help reduce the toxic exposure firefighter are receiving during training. It is our belief that OSB that contains P-MDI was unintentionally left out of previous drafts of NFPA 1403 due to the lack of supporting information relating to P-MDI as used in Polyurethane foam and OSB.

Submitter Information Verification

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Public Input No. 14-NFPA 1403-2020 [Section No. 4.13.2]

4.13.2 –

Pressure-treated wood,- ~~rubber,~~ oriented strand board containing Polymethylene Polyphenylisocyanate/ Polymeric Diphenylmethane Diisocyanate (PMDI) , rubber, plastic, polyurethane foam, tar paper, upholstered furniture, carpeting, and chemically treated or pesticide-treated straw or hay shall not be used as part of the fuel load.

Additional Proposed Changes

File Name	Description	Approved
MSDS-8825471445461.pdf	BASF P-MDI SDS	
Weyerhaeuser_Oriented_Strand_Board_OSB_Products.pdf	SDS for OSB showing 1A carcinogen along with same CAS# 9016-87-9 same as the BASF P-MDI	
LP_SDS.pdf	LP OSB SDS showing same CAS # 9016-87-9 as BASF P-MDI	
SDS_Polyurethane-Foam-System-GUN-Can_US-English.pdf	Polyurethane Foam SDS CAS # 9016-87-9	
MSDS_Sheets_Polyurethane_Mixture_A_538_00.pdf	Polyurethane Foam SDS CAS # 9016-87-9	
OSB_Study.pdf	Firefighters and Instructors absorption of PAHs and benzene during training fires	
EPA_MDI_and_related_compunds_action_plan.pdf	EPA action plan for MDI/ Polyurethane foam. This shows that P-MDI the binding agent in OSB is the same thing as Polyurethane foam. See page 3 section IV.	
APA_OSB_product_guid.pdf	Page 7 of the APA product guide for OSB states the intended uses of OSB sheeting. Per multiple conversations with the APA and a leading OSB manufacture burning OSB in firefighter training is not the intended use of this product.	

Statement of Problem and Substantiation for Public Input

Training fires along with continuing education are a major portion of firefighters' occupational exposures to

smoke; however, the magnitude and composition of those exposures were not well understood and may vary by the type of training scenario and the fuel package used.
To understand how live fire training contributes to firefighters' and instructors' cancer-causing chemical exposures, a study was conducted and was then published in the International Journal of Hygiene and Environmental Health. The study titled “Firefighters' and instructors’ absorption of PAHs and benzene during training exercises” measured biomarkers and chemical concentrations based on level of exposure to the burning of pallet and straw, oriented strand board (OSB), and simulated smoke.
Urine samples were analyzed for metabolites of polycyclic aromatic hydrocarbons (PAHs) and breath samples were analyzed for volatile organic compounds (VOCs) including benzenes. Dermal absorption likely contributed to the biological levels as the respiratory route was well protected.
Median concentrations of nearly all PAH metabolites in urine increased from pre-to 3-hr post-training for each scenario and were highest for OSB, followed by pallet and straw, and then simulated smoke. For instructors who supervised three trainings per day, median concentrations increased with collections after each scenario. A single day of OSB exercises led to a 30-fold increase in 1-hydroxypyrene for instructors, culminating in a median end-of-shift concentration 3.5 times greater than median levels measured from firefighters in a previous controlled, residential fire study. Breath concentrations of benzene increased 2 to 7-times immediately after the training exercises except for simulated smoke training. Measured levels of PAHs and VOCs were highest in scenarios where fuel packages contained OSB and instructors’ levels were magnified with accumulated PAHs when taking part in repeated daily exercises.
Further analysis of the make-up of OSB has found that identical chemicals are used in the manufacturing of OSB and polyurethane foam, which has already been banned under 1403. Polymeric Diphenylmethane Diiocyanate (P-MDI) is noted on the Safety Data Sheet (SDS) for both OSB and the polyurethane foam as the chemical used in the manufacturing process. Both polyurethane foam, OSB, and PMDI have the same CAS number on their SDS sheet, CAS # 9016-87-9. The SDS documents were provided by Weyerhaeuser and Louisiana Pacific for OSB. The P-MDI SDS document was provided by BASF. Additionally, this information was cross checked for factuality utilizing the Environmental Protection Agencies Methylene Diphenyl Diisocyanate (MDI) and related compounds action plan April 2011. All supporting documents are being submitted as an attachment.
By adding OSB that contains P-MDI to the list of materials banned under 1403 4.13.2 this would help reduce the toxic exposure firefighter are receiving during training. It is our belief that OSB that contains P-MDI was unintentionally left out of previous drafts of NFPA 1403 due to the lack of supporting information relating to P-MDI as used in Polyurethane foam and OSB.

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Submittal Date: Mon May 11 09:00:20 EDT 2020
Committee: FIY-AAA

Zip:
Submittal Date: Fri Aug 25 13:28:22 EDT 2023
Committee: FIY-AAA

We create chemistry

Safety Data Sheet
LUPRANATE® M70L ISOCYANATE

1. Identification

Product identifier used on the label

LUPRANATE® M70L ISOCYANATE

Recommended use of the chemical and restriction on use

Recommended use*: Chemical, Raw material
Recommended use*: polyurethane component; industrial chemicals
Suitable for use in industrial sector: Polymers industry; chemical industry

* The “Recommended use” identified for this product is provided solely to comply with a Federal requirement and is not part of the seller's published specification. The terms of this Safety Data Sheet (SDS) do not create or infer any warranty, express or implied, including by incorporation into or reference in the seller's sales agreement.

Details of the supplier of the safety data sheet

Company:
BASF CORPORATION
100 Park Avenue
Florham Park, NJ 07932, USA

Telephone: +1 973 245-6000

Emergency telephone number

CHEMTREC: 1-800-424-9300
BASF HOTLINE: 1-800-832-HELP (4357)

Other means of identification

Chemical family:	aromatic isocyanates
Synonyms:	POLYMETHYLENE POLYPHENYLISOCYANATE
	POLYMETHYLENE POLYPHENLISOCYANATE
	POLYMERIC MDI

2. Hazards Identification

According to Regulation 2012 OSHA Hazard Communication Standard; 29 CFR Part 1910.1200

Classification of the product

Acute Tox.	4 (Inhalation - mist)	Acute toxicity
Eye Dam./Irrit.	2B	Serious eye damage/eye irritation
Skin Corr./Irrit.	2	Skin corrosion/irritation

Skin Sens.	1B	Skin sensitization
Resp. Sens.	1	Respiratory sensitization
STOT SE	3 (irritating to respiratory system)	Specific target organ toxicity — single exposure
STOT RE	2 (by inhalation)	Specific target organ toxicity — repeated exposure

Label elements

Pictogram:



Signal Word:
Danger

Hazard Statement:

H320	Causes eye irritation.
H315	Causes skin irritation.
H332	Harmful if inhaled.
H334	May cause allergy or asthma symptoms or breathing difficulties if inhaled.
H317	May cause an allergic skin reaction.
H335	May cause respiratory irritation.
H373	May cause damage to organs (Olfactory organs) through prolonged or repeated exposure (inhalation).

Precautionary Statements (Prevention):

P280	Wear protective gloves.
P271	Use only outdoors or in a well-ventilated area.
P260	Do not breathe dust/gas/mist/vapours.
P261	Avoid breathing mist.
P284	In case of inadequate ventilation wear respiratory protection.
P272	Contaminated work clothing should not be allowed out of the workplace.
P264	Wash with plenty of water and soap thoroughly after handling.

Precautionary Statements (Response):

P312	Call a POISON CENTER or doctor/physician if you feel unwell.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P304 + P340	IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P314	Get medical advice/attention if you feel unwell.
P303 + P352	IF ON SKIN (or hair): Wash with plenty of soap and water.
P333 + P311	If skin irritation or rash occurs: Call a POISON CENTER or doctor/physician.
P332 + P313	If skin irritation occurs: Get medical advice/attention.
P362 + P364	Take off contaminated clothing and wash it before reuse.
P337 + P311	If eye irritation persists: Call a POISON CENTER or doctor/physician.

Precautionary Statements (Storage):

P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.

Precautionary Statements (Disposal):

P501	Dispose of contents/container in accordance with local regulations.

Hazards not otherwise classified

No specific dangers known, if the regulations/notes for storage and handling are considered.

Labeling of special preparations (GHS):
CONTAINS ISOCYANATES. INHALATION OF ISOCYANATE MISTS OR VAPORS MAY CAUSE RESPIRATORY IRRITATION, BREATHLESSNESS, CHEST DISCOMFORT AND REDUCED PULMONARY FUNCTION. OVEREXPOSURE WELL ABOVE THE PEL MAY RESULT IN BRONCHITIS, BRONCHIAL SPASMS AND PULMONARY EDEMA. LONG-TERM EXPOSURE TO ISOCYANATES HAS BEEN REPORTED TO CAUSE LUNG DAMAGE, INCLUDING REDUCED LUNG FUNCTION WHICH MAY BE PERMANENT. ACUTE OR CHRONIC OVEREXPOSURE TO ISOCYANATES MAY CAUSE SENSITIZATION IN SOME INDIVIDUALS, RESULTING IN ALLERGIC RESPIRATORY REACTIONS INCLUDING WHEEZING, SHORTNESS OF BREATH AND DIFFICULTY BREATHING. ANIMAL TESTS INDICATE THAT SKIN CONTACT MAY PLAY A ROLE IN CAUSING RESPIRATORY SENSITIZATION.

3. Composition / Information on Ingredients

According to Regulation 2012 OSHA Hazard Communication Standard; 29 CFR Part 1910.1200

CAS Number	Weight %	Chemical name
9016-87-9	>= 50.0 - < 75.0%	P-MDI
101-68-8	>= 25.0 - < 50.0%	Diphenylmethane-4,4'-diisocyanate (MDI)
17589-24-1	>= 1.0 - < 3.0%	1,3-Diazetidine-2,4-dione, 1,3-bis[4-[(4-isocyanatophenyl)methyl]phenyl]-
26447-40-5	>= 1.0 - < 3.0%	Methylenediphenyl diisocyanate
57636-09-6	>= 1.0 - < 3.0%	Isocyanic acid, polymethylenepolyphenylene ester, polymer with.alpha.-hydro-.omega.-hydroxypoly(oxy-1,2-ethanediyl)

4. First-Aid Measures

Description of first aid measures

General advice:
First aid personnel should pay attention to their own safety. If the patient is likely to become unconscious, place and transport in stable sideways position (recovery position). Immediately remove contaminated clothing.

If inhaled:
Keep patient calm, remove to fresh air, seek medical attention.

If on skin:
Immediately wash thoroughly with soap and water, seek medical attention.

If in eyes:
Wash affected eyes for at least 15 minutes under running water with eyelids held open, consult an eye specialist.

Wash affected eyes for at least 15 minutes under running water with eyelids held open.

If swallowed:
Immediately rinse mouth and then drink 200-300 ml of water, seek medical attention.

Rinse mouth immediately and then drink plenty of water, induce vomiting, seek medical attention.

Most important symptoms and effects, both acute and delayed

Symptoms: The most important known symptoms and effects are described in section 2 and/or in section 11., Eye irritation, skin irritation, allergic symptoms
Hazards: Symptoms can appear later.
Information on: Diphenylmethane-4,4'-diisocyanate (MDI)
Hazards: Respiratory sensitization may result in allergic (asthma-like) signs in the lower respiratory tract including wheezing, shortness of breath and difficulty breathing, the onset of which may be delayed. Repeated inhalation of high concentrations may cause lung damage, including reduced lung function, which may be permanent. Substances eliciting lower respiratory tract irritation may worsen the asthma-like reactions that may be produced by product exposures.

Indication of any immediate medical attention and special treatment needed

Note to physician

Antidote:	Specific antidotes or neutralizers to isocyanates do not exist.
Treatment:	Treatment should be supportive and based on the judgement of the physician in response to the reaction of the patient.

5. Fire-Fighting Measures

Extinguishing media

Suitable extinguishing media:
water spray, dry powder, carbon dioxide, foam

Special hazards arising from the substance or mixture

Hazards during fire-fighting:
nitrous gases, fumes/smoke, isocyanate, vapour

Advice for fire-fighters

Protective equipment for fire-fighting:
Firefighters should be equipped with self-contained breathing apparatus and turn-out gear.

Further information:
Keep containers cool by spraying with water if exposed to fire. Dispose of fire debris and contaminated extinguishing water in accordance with official regulations.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

Clear area. Ensure adequate ventilation. Wear suitable personal protective clothing and equipment.

Environmental precautions

Do not discharge into drains/surface waters/groundwater.

Methods and material for containment and cleaning up

For small amounts: Absorb isocyanate with suitable absorbent material (see § 40 CFR, sections 260, 264 and 265 for further information). Shovel into open container. Spill area can be decontaminated

with the following recommended decontamination solution: Mixture of 90 % water, 5-8 % household ammonia, 2-5 % detergent. Allow solution to stand for at least 10 minutes. Pick up with suitable absorbent material. Place into appropriately labeled waste containers. Do not make container pressure tight. Move container to a well-ventilated area (outside). Allow to stand for at least 48 hours to allow escape of evolved carbon dioxide. Dispose of absorbed material in accordance with regulations.
For large amounts: For spills, stop leaks and provide diking to contain the material. Prevent entry into sewage systems, ground and surface waters. If temporary control of isocyanate vapor is required, a blanket of protein foam or other suitable foam (available from most fire departments) may be placed over the spill. Transfer as much liquid as possible via pump or vacuum device into closed but not sealed containers for disposal.
For residues: The following measures should be taken for final cleanup: Spill area can be decontaminated with the following recommended decontamination solution: Mixture of 90 % water, 5-8 % household ammonia, 2-5 % detergent. Wash down spill area with decontamination solution. Allow solution to stand for at least 10 minutes. Pick up with suitable absorbent material. Place into appropriately labeled waste containers. Do not make container pressure tight. Move container to a well-ventilated area (outside). Allow to stand for at least 48 hours to allow escape of evolved carbon dioxide. Dispose of absorbed material in accordance with regulations.

7. Handling and Storage

Precautions for safe handling

Provide suitable exhaust ventilation at the processing machines. Ensure thorough ventilation of stores and work areas. Avoid aerosol formation. When handling heated product, vapours of the product should be ventilated, and respiratory protection used. Wear respiratory protection when spraying. Danger of bursting when sealed gastight. Protect against moisture. If bulging of drum occurs, transfer to well ventilated area, puncture to relieve pressure, open vent and let stand for 48 hours before resealing.

Protection against fire and explosion:
No special precautions necessary.

Conditions for safe storage, including any incompatibilities

Keep away from water. Segregate from foods and animal feeds. Segregate from acids and bases.

Suitable materials for containers: Carbon steel (Iron), High density polyethylene (HDPE), Low density polyethylene (LDPE), Stainless steel 1.4301 (V2)

Further information on storage conditions: Formation of CO2 and build up of pressure possible. Keep container tightly closed and in a well-ventilated place. Outage of containers should be filled with dry inert gas at atmospheric pressure to avoid reaction with moisture.

Storage stability:
Storage temperature: 60 - 80 °F
Protect against moisture.
The stated storage temperature is noted for health and safety in the workplace. With regard to Quality, please refer to the product specific Technical Bulletin.

8. Exposure Controls/Personal Protection

Components with occupational exposure limits

Diphenylmethane-4,4'-diisocyanate (MDI)	OSHA PEL	CLV 0.02 ppm 0.2 mg/m3 ; CLV 0.02 ppm 0.2 mg/m3 ;
	ACGIH TLV	TWA value 0.005 ppm ;

Advice on system design:
Provide local exhaust ventilation to maintain recommended P.E.L.

Personal protective equipment

Respiratory protection:
When workers are facing concentrations above the occupational exposure limits they must use appropriate certified respirators. When atmospheric levels may exceed the occupational exposure limit (PEL or TLV) NIOSH-certified air-purifying respirators equipped with an organic vapor sorbent and particulate filter can be used as long as appropriate precautions and change out schedules are in place. For emergency or non-routine, high exposure situations, including confined space entry, use a NIOSH-certified full facepiece pressure demand self-contained breathing apparatus (SCBA) or a full facepiece pressure demand supplied-air respirator (SAR) with escape provisions.

Hand protection:
Chemical resistant protective gloves should be worn to prevent all skin contact., Suitable materials may include, chloroprene rubber (Neoprene), nitrile rubber (Buna N), chlorinated polyethylene, polyvinylchloride (Pylox), butyl rubber, depending upon conditions of use.

Eye protection:
Tightly fitting safety goggles (chemical goggles). Wear face shield if splashing hazard exists.

Body protection:
Cover as much of the exposed skin as possible to prevent all skin contact., Suitable materials may include, saran-coated material, depending upon conditions of use.

General safety and hygiene measures:
Wear protective clothing as necessary to prevent contact. Eye wash fountains and safety showers must be easily accessible. Observe the appropriate PEL or TLV value. Wash soiled clothing immediately. Remove contaminated clothing immediately and clean before re-use or dispose it if necessary.

9. Physical and Chemical Properties

Form:	liquid	
Odour:	faintly aromatic	
Odour threshold:	not applicable	
Colour:	dark brown	
pH value:	not applicable	
Freezing point:	< -19 °C	
Boiling point:	200 °C (5 mmHg)	
Sublimation point:	No applicable information available.	
Flash point:	200 °C	(open cup)
Flammability:	not flammable	(derived from flash point)
Lower explosion limit:	For liquids not relevant for classification and labelling. The lower explosion point may be 5 - 15 °C below the flash point.	
Upper explosion limit:	For liquids not relevant for classification and labelling.	
Autoignition:	> 250 °C	
Vapour pressure:	0.00001 mmHg (20 °C)	

Density:	10.2 lb/USg (25 °C)
Relative density:	1.22 (25 °C)
Vapour density:	not applicable
Partitioning coefficient n-octanol/water (log Pow):	not applicable
Self-ignition temperature:	not self-igniting
Thermal decomposition:	No decomposition if stored and handled as prescribed/indicated.
Viscosity, dynamic:	not determined
Viscosity, kinematic:	675 mm2/s (25 °C)
Solubility in water:	Reacts with water.
Solubility (quantitative):	No applicable information available.
Solubility (qualitative):	No applicable information available.
Evaporation rate:	Value can be approximated from Henry's Law Constant or vapor pressure.
Other Information:	If necessary, information on other physical and chemical parameters is indicated in this section.

10. Stability and Reactivity

Reactivity

Corrosion to metals:
No corrosive effect on metal.

Oxidizing properties:
Based on its structural properties the product is not classified as oxidizing.

Chemical stability
The product is stable if stored and handled as prescribed/indicated.

Possibility of hazardous reactions
Reacts with water, with formation of carbon dioxide. Risk of bursting. Reacts with alcohols. Reacts with acids. Reacts with alkalies. Reacts with amines. Risk of exothermic reaction. Risk of polymerization. Contact with certain rubbers and plastics can cause brittleness of the substance/product with subsequent loss in strength.

Conditions to avoid
Avoid moisture.

Incompatible materials
acids, amines, alcohols, water, Alkalines, strong bases, Substances/products that react with isocyanates.

Hazardous decomposition products

Decomposition products:
Hazardous decomposition products: carbon monoxide, carbon dioxide, nitrogen oxide, hydrogen cyanide, nitrogen oxides, aromatic isocyanates, gases/vapours

Thermal decomposition:
No decomposition if stored and handled as prescribed/indicated.

11. Toxicological information

Primary routes of exposure

Routes of entry for solids and liquids are ingestion and inhalation, but may include eye or skin contact. Routes of entry for gases include inhalation and eye contact. Skin contact may be a route of entry for liquefied gases.

Acute Toxicity/Effects

Acute toxicity
Assessment of acute toxicity: Inhalation of vapours may cause irritation of the mucous membranes of the nose, throat or trachea, breathlessness, chest discomfort, difficult breathing and reduced pulmonary function. Inhalation exposure well above the PEL may result additionally in eye irritation, headache, chemical bronchitis, asthma-like findings or pulmonary edema. Isocyanates have also been reported to cause hypersensitivity pneumonitis, which is characterized by flu-like symptoms, the onset of which may be delayed.

Oral

Information on: Diphenylmethane-4,4'-diisocyanate (MDI)
Type of value: LD50
Species: rat (male/female)
Value: > 2,000 mg/kg (Directive 84/449/EEC, B.1)

Inhalation
Type of value: ATE
Species: rat
Value: 1.96 mg/l (OECD Guideline 403)
Exposure time: 4 h
An aerosol was tested.

Type of value: LC50
Species: rat
Value: > 2.24 mg/l (OECD Guideline 403)
Exposure time: 1 h
An aerosol was tested.

Dermal

Information on: Diphenylmethane-4,4'-diisocyanate (MDI)
Type of value: LD50
Species: rabbit (male/female)
Value: > 9,400 mg/kg

Assessment other acute effects
Assessment of STOT single:
Causes temporary irritation of the respiratory tract.

Irritation / corrosion
Assessment of irritating effects: Irritating to eyes, respiratory system and skin. Skin contact may result in dermatitis, either irritative or allergic.

Skin

Information on: Diphenylmethane-4,4'-diisocyanate (MDI)
Species: rabbit
Result: Irritating.
Method: Draize test

Eye

Information on: Diphenylmethane-4,4'-diisocyanate (MDI)
Species: rabbit
Result: Irritating.
Method: Draize test

Sensitization
Assessment of sensitization: Sensitization after skin contact possible. The substance may cause sensitization of the respiratory tract. As a result of previous repeated overexposures or a single large dose, certain individuals will develop isocyanate sensitization (chemical asthma) which will cause them to react to a later exposure to isocyanate at levels well below the PEL/TLV. These symptoms, which include chest tightness, wheezing, cough, shortness of breath, or asthmatic attack, could be immediate or delayed up to several hours after exposure. Similar to many non-specific asthmatic responses, there are reports that once sensitized an individual can experience these symptoms upon exposure to dust, cold air, or other irritants. This increased lung sensitivity can persist for weeks and in severe cases for several years. Chronic overexposure to isocyanates has also been reported to cause lung damage, including a decrease in lung function, which may be permanent. Prolonged contact can cause reddening, swelling, rash, scaling, or blistering. In those who have developed a skin sensitization, these symptoms can develop as a result of contact with very small amounts of liquid material, or even as a result of vapour-only exposure. Animal tests indicate that skin contact may play a role in causing respiratory sensitization.

Information on: Diphenylmethane-4,4'-diisocyanate (MDI)
Buehler test
Species: guinea pig
Result: sensitizing

Mouse Local Lymph Node Assay (LLNA)
Species: mouse
Result: sensitizing
Can cause skin sensitization

other
Species: guinea pig
Result: sensitizing
Studies in animals suggest that dermal exposure may lead to pulmonary sensitization. However, the relevance of this result for humans is unclear.

Aspiration Hazard
No aspiration hazard expected.

Chronic Toxicity/Effects

Repeated dose toxicity
Assessment of repeated dose toxicity: The substance may cause damage to the olfactory epithelium after repeated inhalation. The substance may cause damage to the lung after repeated inhalation. These effects are not relevant to humans at occupational levels of exposure.

Information on: Diphenylmethane-4,4'-diisocyanate (MDI)
Experimental/calculated data: rat (Wistar) (male/female) Inhalation 2 yrs, 6 hr/day 0, 0.2, 1, 6 mg/m3 , olfactory epithelium
NOAEL: 0.2 mg/m3
LOAEL: 1 mg/m3
The substance may cause damage to the olfactory epithelium after repeated inhalation. These effects are not relevant to humans at occupational levels of exposure. Repeated inhalative uptake of the substance did not cause damage to the reproductive organs.

Genetic toxicity
Assessment of mutagenicity: The substance was mutagenic in various bacterial test systems; however, these results could not be confirmed in tests with mammals.

Information on: Diphenylmethane-4,4'-diisocyanate (MDI)
Genetic toxicity in vitro: OECD Guideline 471 Ames-test Salmonella typhimurium:with and without metabolic activation ambiguous
---

Information on: Diphenylmethane-4,4'-diisocyanate (MDI)
Genetic toxicity in vivo: OECD Guideline 474 Micronucleus assay rat (male) Inhalation negative
No clastogenic effect reported.

Carcinogenicity
Assessment of carcinogenicity: A carcinogenic potential cannot be excluded after prolonged exposure to severely irritating concentrations. These effects are not relevant to humans at occupational levels of exposure. IARC Group 3 (not classifiable as to human carcinogenicity).

Information on: Diphenylmethane-4,4'-diisocyanate (MDI)
Assessment of carcinogenicity: A carcinogenic potential cannot be excluded after prolonged exposure to severely irritating concentrations. These effects are not relevant to humans at occupational levels of exposure. IARC Group 3 (not classifiable as to human carcinogenicity).

Information on: P-MDI

Information on: Methylenediphenyl diisocyanate
Assessment of carcinogenicity: A carcinogenic potential cannot be excluded after prolonged exposure to severely irritating concentrations. These effects are not relevant to humans at occupational levels of exposure. IARC Group 3 (not classifiable as to human carcinogenicity).

Information on: 1,3-Diazetidine-2,4-dione, 1,3-bis[4-[(4- isocyanatophenyl)methyl]phenyl]-
Assessment of carcinogenicity: The product has not been tested. The statement has been derived from substances/products of a similar structure or composition. A carcinogenic potential cannot be excluded after prolonged exposure to severely irritating concentrations. These effects are not relevant to humans at occupational levels of exposure.

Information on: Isocyanic acid, polymethylenepolyphenylene ester, polymer with.alpha.-hydro-.omega.-hydroxypoly(oxy-1,2-ethanediyl)

Experimental/calculated data: OECD Guideline 453 rat Inhalation 0, 0.2, 1, 6 mg/m3
Result: Lung tumors

Reproductive toxicity

Assessment of reproduction toxicity: Repeated inhalative uptake of the substance did not cause damage to the reproductive organs.

Teratogenicity
Assessment of teratogenicity: The substance did not cause malformations in animal studies; however, toxicity to development was observed at high doses that were toxic to the parental animals.

Development
OECD Guideline 414 rat Inhalation 0, 1, 4, 12 mg/m3
NOAEL Mat.: 4 mg/m3
NOAEL Teratog.: 4 mg/m3
The substance did not cause malformations in animal studies; however, toxicity to development was observed at high doses that were toxic to the parental animals.

Other Information
The product has not been tested. The statement has been derived from the properties of the individual components.

Symptoms of Exposure

The most important known symptoms and effects are described in section 2 and/or in section 11., Eye irritation, skin irritation, allergic symptoms

Medical conditions aggravated by overexposure
The isocyanate component is a respiratory sensitizer. It may cause allergic reaction leading to asthma-like spasms of the bronchial tubes and difficulty in breathing. Medical supervision of all employees who handle or come into contact with isocyanates is recommended. Contact may aggravate pulmonary disorders. Persons with history of respiratory disease or hypersensitivity should not be exposed to this product. Preemployment and periodic medical examinations with respiratory function tests (FEV, FVC as a minimum) are suggested. Persons with asthmatic conditions, chronic bronchitis, other chronic respiratory diseases, recurrent eczema or pulmonary sensitization should be excluded from working with isocyanates. Once a person is diagnosed as having pulmonary sensitization (allergic asthma) to isocyanates, further exposure is not recommended.

12. Ecological Information

Toxicity

Aquatic toxicity
Assessment of aquatic toxicity:
There is a high probability that the product is not acutely harmful to aquatic organisms. The inhibition of the degradation activity of activated sludge is not anticipated when introduced to biological treatment plants in appropriate low concentrations. Based on long-term (chronic) toxicity study data, the product is very likely not harmful to aquatic organisms.
The product may hydrolyse. The test result maybe partially due to degradation products. The product has not been tested. The statement has been derived from substances/products of a similar structure or composition.

Toxicity to fish
LC50 (24 h) > 500 mg/l, Brachydanio rerio (static)
Practically nontoxic.

Aquatic invertebrates
EC50 (24 h) > 500 mg/l, Daphnia magna
Practically nontoxic.

Aquatic plants
EC0 (72 h) 1,640 mg/l (growth rate), Scenedesmus subspicatus (OECD Guideline 201, static)

Microorganisms/Effect on activated sludge

Toxicity to microorganisms
OECD Guideline 209 aquatic
aerobic bacteria from a domestic water treatment plant/EC50 (3 h): > 100 mg/l

Persistence and degradability

Assessment biodegradation and elimination (H2O)
Poorly biodegradable. The product is unstable in water. The elimination data also refer to products of hydrolysis.

Elimination information

0 % BOD of the ThOD (28 d) (OECD Guideline 302 C) (aerobic, activated sludge) Poorly biodegradable.

Assessment of stability in water
In contact with water the substance will hydrolyse slowly.

Information on Stability in Water (Hydrolysis)
$t_{1/2}$ 20 h (25 °C)

Bioaccumulative potential

Assessment bioaccumulation potential
Significant accumulation in organisms is not to be expected.

Bioaccumulation potential
Bioconcentration factor: 200 (28 d), Cyprinus carpio (OECD Guideline 305 E)

Mobility in soil

Assessment transport between environmental compartments
The substance will not evaporate into the atmosphere from the water surface.
Adsorption to solid soil phase is not expected.

13. Disposal considerations

Waste disposal of substance:
Incinerate or dispose of in a licensed facility. Do not discharge substance/product into sewer system.

Container disposal:
DRUMS:
Steel drums must be emptied and can be sent to a licensed drum reconditioner for reuse, a scrap metal dealer or an approved landfill. Do not attempt to refill or clean containers since residue is difficult to remove. Under no circumstances should empty drums be burned or cut open with gas or electric torch as toxic decomposition products may be liberated. Do not reuse empty containers.

14. Transport Information

Land transport
USDOT

Not classified as a dangerous good under transport regulations

Sea transport
IMDG

Not classified as a dangerous good under transport regulations

Air transport
IATA/ICAO

Not classified as a dangerous good under transport regulations

Further information
DOT: This product is regulated if the amount in a single receptacle exceeds the Reportable Quantity (RQ). Please refer to Section 15 of this MSDS for the RQ for this product.

15. Regulatory Information

Federal Regulations

Registration status:
Chemical TSCA, US released / listed

EPCRA 311/312 (Hazard categories): Refer to SDS section 2 for GHS hazard classes applicable for this product.

EPCRA 313:

CAS Number	Chemical name
101-68-8	Diphenylmethane-4,4'-diisocyanate (MDI)
9016-87-9	P-MDI

CERCLA RQ	CAS Number	Chemical name
5000 LBS	101-68-8	Diphenylmethane-4,4'-diisocyanate (MDI)

State regulations

State RTK	CAS Number	Chemical name
PA	101-68-8	Diphenylmethane-4,4'-diisocyanate (MDI)
	9016-87-9	P-MDI
MA	101-68-8	Diphenylmethane-4,4'-diisocyanate (MDI)
	9016-87-9	P-MDI
NJ	26447-40-5	Methylenediphenyl diisocyanate
	9016-87-9	P-MDI
	101-68-8	Diphenylmethane-4,4'-diisocyanate (MDI)

NFPA Hazard codes:
Health: 2 Fire: 1 Reactivity: 1 Special:

HMIS III rating
Health: 2¤ Flammability: 1 Physical hazard: 1

16. Other Information

SDS Prepared by:
BASF NA Product Regulations

SDS Prepared on: 2019/05/09

We support worldwide Responsible Care® initiatives. We value the health and safety of our employees, customers, suppliers and neighbors, and the protection of the environment. Our commitment to Responsible Care is integral to conducting our business and operating our facilities in a safe and environmentally responsible fashion, supporting our customers and suppliers in ensuring the safe and environmentally sound handling of our products, and minimizing the impact of our operations on society and the environment during production, storage, transport, use and disposal of our products.

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END OF DATA SHEET

Safety Data Sheet (SDS)

Weyerhaeuser

Weyerhaeuser Oriented Strand Board (OSB) Products including: Sheathing, Edge™, Edge Gold™, RBS™ (Radiant Barrier Sheathing), Rim Board, SturdiStep™

1. Identification

TRADE NAME(S):	Weyerhaeuser Oriented Strand Board (OSB) products including: Sheathing, Edge, Edge Gold™, RBS™ (Radiant Barrier Sheathing), Rim Board, SturdiStep™
SYNONYMS and/or GRADES:	Radiant Barrier Sheathing (RBS™), Rim Board, Web stock, Sheathing, Roof Sheathing
PRODUCT USES:	Building Materials
CHEMICAL NAME/CLASS:	Wood Products
MANUFACTURER'S NAME:	Weyerhaeuser
ADDRESS:	220 Occidental Ave S., Seattle, WA 98104
EMERGENCY PHONE (DOT):	(844) 523-4081 (3E Company)
BUSINESS PHONE:	(206) 539-3910
INTERNET ACCESS:	See section 16
REVISED DATE:	August 27, 2018

2. Hazard(s) Identification

Signal Word: DANGER

NOTE: These products are not hazardous in the form in which they are shipped by the manufacturer but may become hazardous as the result of downstream activities (e.g. cutting, sanding) which creates small particles resulting in the potential hazards as described below.

Classification	Hazard Statement(s)	Pictogram(s)
HEALTH Carcinogen- Category 1A (H350) *	Wood dust may cause nasopharyngeal cancer and/or cancer of the nasal cavities and paranasal sinuses by inhalation	

2. Hazard(s) Identification (cont'd.)

Skin Irritation Category 2 (H315) Specific Target Organ Toxicity- Single Exposure (STOT) Category 3 (H335)	Causes skin irritation May cause respiratory irritation	
Eye Irritation Category 2B (H320)	Causes eye irritation	None
Combustible Dust (OSHA Defined Hazard)	If converted to small particles during further processing, handling, or by other means, may form combustible dust concentrations in air	None

*****Hazard codes (GHS)

HMIS Rating (Scale 0-4):	**Health =**	2*	**Fire =**	1	**Physical Hazard =**	0
NFPA Rating (Scale 0-4):	**Health =**	1	**Fire =**	1	**Reactivity =**	0

Precautionary Statement(s):

Prevention Statements**:**

P202: Do not handle until all safety precautions have been read and understood.
P210: Keep away from sparks, flame or other heat sources.
P243: Take precautionary measures against static discharge.
P261+284: Avoid breathing dust. In case of inadequate ventilation wear an approved respirator suitable for conditions of use.
P271: Use outdoors or in a well-ventilated area.
P280: Wear appropriate protective equipment for eye and skin exposure.

Response Statements:

P304+P340+P313: If inhaled and breathing becomes difficult, remove person to fresh air and keep comfortable for breathing. If symptoms persist, call a doctor or other qualified medical professional.
P333+P313: If skin irritation or rash occurs get medical advice/attention.
P352+P264: If on skin wash with plenty of soap and water.
P362+P364: Take off contaminated clothing and wash before reuse.
P305+P351+P338: If in eyes, rinse cautiously for several minutes. Remove contact lenses if present and easy to do so.

Disposal:

P501: Dispose of contents in accordance with federal, state and local regulations.

Ingredients of Unknown Acute Toxicity (>1%): NAP

3. Composition/Information on Ingredients

Ingredients	CAS#	Wt.%
Wood (wood dust, softwood or hardwood)	None	70-96
Resin Solids: Polymeric Phenol-Formaldehyde [1] (reacted)	9003-35-4	1-14
Polymeric Diphenylmethane Diisocyanate [2] $[C_6H_3(NCO)CH_2]n$ (reacted)	9016-87-9	1-14
Paraffin or Emulsified Wax[3]	8002-74-2	1-2
Polyethylene Coated and/or Laminated Paper Aluminum Foil (RBS Roof Sheathing only)	None	1-2

Common names: [1] Phenol-formaldehyde (PF) resin; [2] Polymeric MDI (pMDI); [3] Hydrocarbon waxes.

4. First Aid Measures

Inhalation: Remove to fresh air if respiratory symptoms are experienced. Seek medical help if persistent irritation, severe coughing, breathing difficulty or other serious symptoms occur.

Eye Contact: Treat dust in eye as a foreign object. Flush with water to remove dust particles. Remove contact lenses if present and easy to do so. Avoid touching or rubbing eyes to avoid further irritation or injury. Seek medical help if irritation persists.

Skin Contact: Wood dust may elicit contact dermatitis. Seek medical help if rash, irritation or dermatitis persists.

Skin Absorption: Not known to be absorbed through the skin.

Ingestion: Not applicable under normal use.

Symptoms or Effects:

Acute Symptoms/Effects – Dust may cause mechanical irritation of the eyes and respiratory system. Dust can cause physical obstructions in the nasal passages, resulting in dryness of nose, dry cough, and sneezing.

Delayed Symptoms/Effects – Unique delayed effects are not anticipated after exposure. See Section 11 for additional information on chronic effects.

5. Fire-fighting Measures

Extinguishing Media and Restrictions: Water, carbon dioxide and sand.

Specific Hazards, Anticipated Combustion Products: Thermal decomposition (i.e. smoldering, burning) products include carbon monoxide, oxides of nitrogen, hydrogen cyanide, carbon dioxide, aliphatic aldehydes, resin acids, terpenes, polycyclic aromatic hydrocarbons and aluminum oxides (RBS Roof Sheathing only).

Autoignition Temperature: Variable [typically 400°-500°F (204°-260°C)]

Special Firefighting Equipment/Procedures: No special equipment anticipated. Beware of potential combustible dust explosion hazard.

5. Fire-fighting Measures (cont'd.)

Unusual Fire and Explosion Hazards: Depending on moisture content, particle diameter and concentration, wood and resin dust may pose a flash fire or deflagration hazard. If suspended in air in an enclosure or container and ignited, an explosion may occur due to the development of internal pressure causing rupture. An airborne concentration of 40 grams (40,000 mg) of dust per cubic meter of air is often used as the Minimum Explosible Concentration (MEC) for wood dusts. Conduct regular housekeeping inspections and cleaning to prevent excessive dust accumulations. Design and maintain control equipment to minimize fugitive combustible dust emissions. Ensure that ventilation systems are operating properly to capture, transport and contain combustible dust while controlling ignition sources. Reference NFPA 652 "Standard on the Fundamentals of Combustible Dust".

6. Accidental Release Measures

Steps to be taken in case Material Is Released or Spilled: Sweep or vacuum up for recovery and disposal. Avoid creating dusty conditions whenever feasible. Maintain good housekeeping to avoid accumulation of wood and resin dust on exposed surfaces. Use approved filtering face piece respirator ("dust mask") or higher levels of respiratory protection as indicated and goggles where ventilation is not possible and exposure limits may be exceeded or for additional worker comfort.

7. Handling and Storage

Precautions to be taken in Handling and Storage: Product dust may pose a combustible dust hazard. Keep away from ignition sources. Avoid eye contact. Avoid prolonged or repeated contact with skin. Avoid prolonged or repeated breathing of dusts. Store in well-ventilated, cool, dry place away from open flame.

8. Exposure Control Measures/Personal Protection

Exposure Limits/Guidelines:

Ingredient(s)	Agency	Exposure Limit(s)	Comments
Wood (wood dust, softwood and hardwood)	OSHA	PEL-TWA 15 mg/m^3 (see footnote [A] below)	Total dust (PNOR)
	OSHA	PEL-TWA 5 mg/m^3 (see footnote [A] below)	Respirable dust fraction (PNOR)
	ACGIH	TLV-TWA 1 mg/m^3	Inhalable fraction
Resin Solids: Polymeric phenol-formaldehyde [B]	OSHA OSHA	PEL-TWA 0.75 ppm PEL-STEL 2 ppm	Free gaseous formaldehyde
	ACGIH ACGIH	TLV-TWA 0.1 ppm TLV-STEL 0.3 ppm	
Polymeric Diphenylmethane Diisocyanate [C]	OSHA ACGIH	None None	
Paraffin wax	OSHA ACGIH	PEL-TWA 2 mg/m^3 TLV-TWA 2 mg/m^3	Paraffin wax fume Paraffin wax fume

8. Exposure Control Measures/Personal Protection (cont'd.)

Polyethylene Coated and/or Laminated Paper Aluminum Foil (RBS Roof Sheathing only)	OSHA	PEL-TWA 15 mg/m^3	Aluminum (total dust fraction)
	OSHA	PEL-TWA 5 mg/m^3	Aluminum (respirable dust fraction)
	ACGIH	TLV-TWA 10 mg/m^3	Aluminum (total dust)

[A] In AFL-CIO v OSHA, 965 F. 2d 962 (11th Cir. 1992), the Court overturned OSHA's 1989 Air Contaminants Rule, including the specific PEL's for wood dust that OSHA had established at that time. The 1989 vacated PEL's were: 5 mg/m^3 PEL-TWA and 10 mg/m^3 STEL (15 min), all softwood and hardwood except Western Red Cedar. Wood dust is now regulated by OSHA as "Particulates Not Otherwise Regulated" (PNOR), which is also referred to as "nuisance dust". However, some states have regulated wood dust PEL's in their state plans. Additionally, OSHA indicated that it may cite employers under the OSH Act general duty clause in appropriate circumstances.
[B] These products may contain free formaldehyde (<0.1%, wt. %), which may be released depending on concentration and environmental conditions. These products contain no added urea-formaldehyde resins.
[C] This ingredient is the polymerized form of MDI resin.

Ventilation:

LOCAL EXHAUST – Provide local exhaust as needed so that exposure limits are met. Ventilation to control dust should be considered where potential explosive concentrations and ignition sources are present. The design and operation of any exhaust system should consider the possibility of explosive concentrations of wood and resin dust within the system. See "SPECIAL" section below. Use of tool mounted exhaust systems should also be considered, especially when working in enclosed areas.

MECHANICAL (GENERAL) – Provide general ventilation in processing and storage areas so that exposure limits are met.

SPECIAL – Ensure that exhaust ventilation and material transport systems involved in handling these products contain explosion relief vents or suppression systems designed and operated in accordance with applicable standards if the operating conditions justify their use.

OTHER ENGINEERING CONTROLS – Cutting and machining of these products should preferably be done outdoors or with adequate ventilation and containment.

Personal Protective Equipment:

RESPIRATORY PROTECTION – Use filtering face piece respirator ("dust mask") tested and approved under appropriate government standards such as NIOSH (US),CSA (Canada), CEN (EU), or JIS (Japan) where ventilation is not possible and exposure limits may be exceeded or for additional worker comfort or symptom relief. Use respiratory protection in accordance with jurisdictional regulatory requirements similar to the OSHA respiratory protection standard 29CFR 1910.134 following a determination of risk from potential exposures.

EYE PROTECTION – Approved goggles or tight fitting safety glasses are recommended when excessive exposures to dust may occur (e.g. during clean up) and when eye irritation may occur.

PROTECTIVE GLOVES – Cloth, canvas, or leather gloves are recommended to prevent direct contact and to minimize potential slivers and mechanical irritation from handling product.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT – Outer garments which cover the arms may be desirable in extremely dusty areas.

WORK/HYGIENE PRACTICES – Follow good hygienic and housekeeping practices. Clean up areas where wood and resin dust settles to avoid excessive accumulation of this combustible material. Minimize compressed air blowdown or other practices that generate high airborne-dust concentrations.

9. Physical/Chemical Properties

Appearance: Weyerhaeuser OSB products consist of a ligno cellulosic matrix of interlocking wood fibers having a slight characteristic odor. The wood component of these products may consist of aspen, southern pine, red pine, maple, black poplar or birch. OSB Sheathing has green with white paint on the edges. Edge™ flooring is painted green with white on the edges; Edge Gold™ flooring is painted gold on the edges. RBS™ has paper backed perforated aluminum foil adhered to one face of the board. Rim Board comes in variable length strips. SturdiStep™ is cut-to-order OSB.

Odor/Odor Threshold(s):	NAV
pH:	NAP
Melting/Freezing Point:	NAP
Boiling Point (@ 760 mm Hg) and Range:	NAP
Flash Point:	NAP
Evaporation Rate:	0
Flammability:	NAP
Lower/Upper Explosive Limits:	40,000 mg of dust per cubic meter of air is often used as the LEL for wood dusts.
Vapor Pressure (mm Hg):	NAP
Vapor Density (air = 1; 1 atm):	NAP
Relative Density:	NAP
Solubility:	<0.1
Partition Coefficient (n-octanol/water):	NAP
Autoignition Temperature:	Variable [typically 400°-500°F (204°-260°C)]
Decomposition Temperature:	NAV
Viscosity:	NAP
Other Properties:	NAP

10. Stability and Reactivity

Reactivity: NAP

Hazardous Polymerization: ☐ May occur ☒ Will not occur

Stability: ☐ Unstable ☒ Stable

Conditions to Avoid: Avoid open flame. Product may ignite at temperatures in excess of 400°F (204°C).

Incompatibility (Materials to Avoid): Avoid contact with oxidizing agents and drying oils.

Hazardous Decomposition or By-Products: Natural decomposition of organic materials such as wood may produce toxic gases and an oxygen deficient atmosphere in enclosed or poorly ventilated areas. Spontaneous and rapid hazardous decomposition will not occur.

Sensitivity to Static Discharge: Airborne wood and resin dust may be ignited by a static discharge depending on airborne concentrations, particle size and moisture content.

11. Toxicological Information

Likely Route(s) of Exposure:

- ☐ Ingestion:
- ☒ Skin: Dust
- ☒ Inhalation: Dust
- ☒ Eye: Dust

11. Toxicological Information (cont'd.)

Signs and Symptoms of Exposure:

Wood Dust - NTP: According to its Report on Carcinogens, Fourteenth Edition, NTP states, "Wood dust is known to be a human carcinogen based on sufficient evidence of carcinogenicity from studies in humans". An association between wood dust exposure and cancer of the nasal cavity has been observed in case reports, cohort studies, and case-control studies that specifically addressed nasal cancer. Associations with cancer of the nasal cavities and paranasal sinuses were observed both in studies of people whose occupations are associated with wood dust exposure and in studies that directly estimated wood dust exposure. This classification is based primarily on increased risk in the occurrence of adenocarcinomas of the nasal cavities and paranasal sinuses associated with exposure to wood dust. The evaluation did not find sufficient evidence to associate cancers of the oropharynx, hypopharynx, lung, lymphatic and hematopoietic systems, stomach, colon or rectum with exposure to wood dust. There is inadequate evidence for the carcinogenicity of wood dust from studies in experimental animals according to NTP.

Wood Dust: IARC – Group 1: Carcinogenic to humans; sufficient evidence of carcinogenicity. This classification is primarily based on studies showing an association between occupational exposure to wood dust and adenocarcinoma to the nasal cavities and paranasal sinuses. IARC did not find sufficient evidence of an association between occupational exposure to wood dust and cancers of the oropharynx, hypopharynx, lung, lymphatic and hematopoietic systems, stomach, colon or rectum.

Formaldehyde - NTP: According to its Report on Carcinogens, Fourteenth Edition, NTP states, Formaldehyde (gas) is known to be a human carcinogen based on sufficient evidence of carcinogenicity from studies in humans and sup porting data on mechanisms of carcinogenesis.

Formaldehyde: IARC – Group 1: Carcinogenic to humans, sufficient evidence of carcinogenicity. A working group of IARC has determined that there is sufficient evidence that formaldehyde causes nasopharyngeal cancer in humans, a rare cancer in developed countries and "strong but not sufficient evidence" for leukemia. However, numerous epidemiological studies have failed to demonstrate a relationship between formaldehyde exposure and nasal cancer or pulmonary diseases such as emphysema or lung cancer.

Carcinogenicity Listing:

☒	NTP:	Wood dust, Known Human Carcinogen. Formaldehyde, Known to be a Human Carcinogen.
☒	IARC Monographs:	Wood dust, Group 1 – carcinogenic to humans. Formaldehyde, Group 1-carcinogenic to humans.
☒	OSHA Regulated:	Formaldehyde Gas 29 CFR 1910.1048

Toxicity Data: No specific information available for product in purchased form. Individual component information is listed below.

Components:

Wood dust (softwood or hardwood)

Dusts generated from sawing, sanding or machining the product may cause respiratory irritation, nasal dryness and irritation, coughing and sinusitis. NTP and IARC (Group 1) classify wood dust as a human carcinogen. See Section 2 above.

Formaldehyde

Human inhalation TC_{Lo} of 17 mg/m^3 for 30 minutes produced eye and pulmonary results; human inhalation TC_{Lo} of 300 ug/m^3 produced nose and central nervous system results; LC_{50} (rat, inhalation) = 1,000 mg/m^3, 30 minutes; LC_{50} (mice, inhalation) = 400 mg/m^3, 2 hours. IARC and NTP classify formaldehyde as a human carcinogen (IARC Group 1). See Section 2 above.

Target Organs: Eyes, skin, and respiratory system.

Note: Weyerhaeuser evaluated the studies referenced in the ACGIH® TLV® Documentation for Wood Dust and others which included potential allergenic references for wood species which may cause skin or respiratory sensitization. There are a limited number of studies of highly variable consistency which reference sensitization from some species of wood. When the total weight of evidence is considered these products are determined to be an eye, skin and respiratory irritant and not a respiratory or skin sensitizer according to health hazard classification criteria.

12. Ecological Information

Ecotoxicity: NAV for finished product.
Formaldehyde component:

96 hr LC_{50} Fathead Minnow	24 mg/L
96 hr LC_{50} Bluegill	0.10 mg/L
5 min EC_{50} Photobacterium phosphoreum	9 mg/L
96 hr EC_{50} Water flea	20 mg/L

Biopersistance and Degradability: The wood portion of these products would be expected to be biodegradable.

Formaldehyde

Trace amounts of free formaldehyde may be released to the atmosphere and would be expected to be removed in the atmosphere by direct photolysis and oxidation by photochemically produced hydroxyl radicals (half-life of a few hours). In the aqueous phase formaldehyde biodegradation is expected to take place in a few days.

Polymeric MDI

The effects from a simulated accidental pollution event in a pond with polymeric MDI on different trophic levels of the aquatic ecosystem were investigated (Heimbach F. et.al., 1996). Neither monomeric MDI nor its potential reaction product MDA (4, 4′-diphenylmethanediamine) was detected in water or accumulated by fish. The MDI polymerized to inert polyurea on the sediment of the test ponds. This polymerization formed carbon dioxide, released as bubbles which floated to the water surface. There was no direct effect on the pelagic community (phytoplankton, zooplankton, fish, and macrophytes) of the test ponds.

Bioaccumulation: NAV
Soil Mobility: NAV
Other adverse effects: NAP

13. Disposal Considerations

Waste Disposal Method: Dry land disposal or incineration is acceptable in most areas. It is, however, the user's responsibility to determine at the time of disposal whether your waste meets any jurisdictional criteria. Note that wood and resin dust may pose a combustible dust hazard.

14. Transport Information

Mode: (air, land, water) Not regulated as a hazardous material by the U.S. Department of Transportation. Not listed as a hazardous material in Canadian Transportation of Dangerous Goods (TDG) regulations. Not regulated as a hazardous material by IMDG or IATA regulations concerning the transport of hazardous materials.

UN Proper Shipping Name:	NAP
UN/NA ID Number:	NAP
Hazard Class:	NAP
Packing Group:	NAP
Environmental Hazards (Marine Pollutant):	NAP
Special Precautions:	NAP

15. Regulatory Information

TSCA: Phenol-formaldehyde resin, polymeric diphenylmethane diisocyanate, titanium dioxide and paraffin wax are on the TSCA inventory.

CERCLA: Formaldehyde (100 lbs. RQ) is on the CERCLA chemical substance inventory.

DSL: Formaldehyde, titanium dioxide, polymeric diphenylmethane diisocyanate and paraffin wax are on the DSL.

OSHA: Wood products are not hazardous under the criteria of the federal OSHA Hazard Communication Standard 29 CFR 1910.1200. However, wood and resin dust generated by sawing, sanding or machining these products are considered hazardous. Workplace exposure to formaldehyde is specifically regulated under 29 CFR 1910.1048.

STATE RIGHT-TO-KNOW:

California Proposition 65 –

WARNING: This product can expose you to chemicals including wood dust which are known to the State of California to cause cancer, and methanol, which are known to the State of California to cause birth defects or other reproductive harm. Drilling, sawing, sanding or machining wood products can expose you to wood dust. Avoid inhaling wood dust or use a dust mask or other safeguards for personal protection. For more information go to www.P65Warnings.ca.gov and www.P65Warnings.ca.gov/wood.

This product also can release titanium dioxide (airborne, unbound particles of respirable size), a chemical known to the state of California to cause cancer, if the painted edges are cut or sanded.

These products contain formaldehyde, which depending on temperature and humidity may be emitted from the product. Formaldehyde is known to the State of California to cause cancer.

Pennsylvania – These products contain formaldehyde which, depending on temperature and humidity, may be emitted from the product. When cut or otherwise machined, these products may emit wood dust and titanium dioxide. These products may also contain paraffin wax. Formaldehyde, titanium dioxide, wood dust, and paraffin wax appear on Pennsylvania's Appendix A, Hazardous Substance Lists.

New Jersey – These products contain formaldehyde which, depending on temperature and humidity, may be emitted. When cut or otherwise machined, the products may emit wood dust and titanium dioxide. Formaldehyde, titanium dioxide and wood dust are on the New Jersey Environmental Hazardous Substance List.

SARA 313 Information: To the best of our knowledge, these products contain formaldehyde at de minimis concentrations (<0.1%) and is not subjected to the SARA Title III Section 313 supplier notification requirements.

SARA 311/312 Hazard Category: These products have been reviewed according the EPA "Hazard Categories: promulgated under SARA Title III, Sections 311 and 312 and is considered, under applicable definitions, to meet the following categories:

An immediate (acute) health hazard	Yes
A delayed (chronic) health hazard	Yes
A corrosive hazard	No
A fire hazard	No
A reactivity hazard	No
A sudden release hazard	No

FDA: Not intended for use as a food additive or indirect food contact item.

WHMIS Classification: Wood and products made from wood are exempt from WHMIS per the Hazardous Products Act (HPA). However, wood dust released during the use or modifications of wood products may be hazardous. See Section 2 for health and combustible dust hazard information.

16. Other Information

Date Prepared: 11/04/2010
Date Revised: 08/27/2018
Prepared By: Weyerhaeuser Company Health and Safety
Weyerhaeuser SDS available on:
http://www.wy.com/sustainability/environment/product-stewardship/safety-data-sheets/

User's Responsibility: The information contained in this Safety Data Sheet is based on the experience of occupational health and safety professionals and comes from sources believed to be accurate or otherwise technically correct. It is the user's responsibility to determine if the product is suitable for its proposed application(s) and to follow necessary safety precautions. The user has the responsibility to ensure that the most current SDS is used.

Definition of Common Terms:

ACGIH®	=	American Conference of Governmental Industrial Hygienists
C	=	Ceiling Limit
CAS#	=	Chemical Abstracts System Number
DOT	=	U. S. Department of Transportation
DSL	=	Domestic Substance List
EC#	=	Identifying Number Assigned to Chemicals Contained in the European Inventory of Existing Chemical Substances (EINECS)
EC_{50}	=	Effective Concentration That Inhibits the Endpoint to 50% of Control Population
EPA	=	U.S. Environmental Protection Agency
GHS	=	Globally Harmonized System of Classification and Labelling of Chemicals
HMIS	=	(Canada) Hazardous Materials Identification System
IARC	=	International Agency for Research on Cancer
IATA	=	International Air Transport Association
IMDG	=	International Maritime Dangerous Goods
LC_{50}	=	Concentration in Air Resulting in Death To 50% of Experimental Animals
LCLo	=	Lowest Concentration in Air Resulting in Death
LD_{50}	=	Administered Dose Resulting in Death to 50% of Experimental Animals
LDLo	=	Lowest Dose Resulting in Death
LEL	=	Lower Explosive Limit
LFL	=	Lower Flammable Limit
MSHA	=	Mine Safety and Health Administration
NAP	=	Not Applicable
NAV	=	Not Available
NIOSH	=	National Institute for Occupational Safety and Health
NFPA	=	National Fire Protection Association
NPRI	=	(Canada) National Pollution Release Inventory
NTP	=	National Toxicology Program
OSHA	=	Occupational Safety and Health Administration
PEL	=	Permissible Exposure Limit
PNOR	=	Particulate Not Otherwise Regulated
PNOS	=	Particulate Not Otherwise Specified
RCRA	=	Resource Conservation and Recovery Act
STEL	=	Short-Term Exposure Limit (15 minutes)
STP	=	Standard Temperature and Pressure
TCLo	=	Lowest Concentration in Air Resulting in a Toxic Effect
TDG	=	(Canada) Transportation of Dangerous Goods
TDLo	=	Lowest Dose Resulting In a Toxic Effect
TLV	=	Threshold Limit Value

16. Other Information (cont'd.)

TSCA	=	Toxic Substance Control Act
TWA	=	Time-Weighted Average (8 hours)
UFL	=	Upper Flammable Limit
WHMIS	=	(Canada) Workplace Hazardous Materials Information System

Material Safety Data Sheet

LP® OSB Sheathing
LP® TopNotch® OSB Sub-Flooring
LP® LongLength™ OSB Sheathing
LP® SuperStruct® Furniture Panels

1. PRODUCT AND COMPANY INFORMATION

Product Code: Not applicable

Product Name: Oriented Strand Board

Brand Names: LP® OSB Sheathing, LP® TopNotch® OSB Sub-Flooring, LP® LongLength™ OSB Sheathing, LP® SuperStruct® Furniture Panels

LP Corporation, 414 Union Street, Suite 2000, Nashville, TN 37219 Telephone: 800.450.6106

2. COMPOSITION AND INGREDIENT INFORMATION

Component(1)	CAS #	Exposure Limits	Cancer Designation
Wood Dust	NA	TLV-TWA = 1 mg/m3	MAK-1, NIOSH-Ca, TLV-A1, NTP-K
Phenol-Formaldehyde Resin — (solids) (less than 0.1% of 108-95-2 free formaldehyde)	9003-35-4	PEL-TWA = 0.75 ppm, PEL-STEL = 2 ppm, TLV-C = 0.3 ppm	MAK-3B, EPA-B1, IARC-1, NIOSH-Ca, NTP-R, OSHA-Ca, TLV-A2
Polymeric Diphenylmethane Diisocyanate	9016-87-9	PNOS2	MAK-3B
Wax Emulsion	NA	None Established	

(1) Small amounts of waterbase paint and oilbase black stamp ink may be used to identify the product and the nailing pattern and to inhibit moisture ingress along board edges.

(2) PNOS: PEL-TWA = 15 MG/M3, TOTAL DUST; PEL-TWA = 5 MG/M3, RESPIRABLE FRACTION; TLV-TWA = 10 MG/M3 INHALABLE PARTICULATE, 3 MG/M3 RESPIRABLE PARTICULATE

3. HAZARDS IDENTIFICATION

Emergency Overview

- Contact with strong oxidizers or exposure to temperatures greater than 400° F may cause a fire.
- Smoke may contain carbon monoxide, aldehydes, and other toxic materials.
- Airborne wood and resin dust may explode when combined with an ignition source.

Potential Health Effects (based on expected use of product)

- EYES: Dust may irritate the eyes.
- SKIN: Dust may cause skin irritation.
- INGESTION: Not known.
- INHALATION: Dust can cause irritation to mucous membranes and the upper respiratory tract. Wood dust and formaldehyde are considered carcinogens.

4. FIRST AID MEASURES

- EYES: For dust exposure, immediately flush eyes with plenty of water for at least 15 minutes.
- SKIN: Wash with soap and water. Get medical attention if irritation develops or persists.
- INGESTION: Consult a physician.
- INHALATION: Remove to fresh air, consult a physician.

Note to physicians: Exposure to dust may aggravate symptoms of persons with pre-existing respiratory tract conditions and may cause skin and gastrointestinal symptoms.

Material Safety Data Sheet

LP® OSB Sheathing
LP® TopNotch® OSB Sub-Flooring
LP® LongLength™ OSB Sheathing
LP® SuperStruct® Furniture Panels
(cont.)

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: (CONDITIONS TO AVOID) Stable.

INCOMPATIBILITY: Keep away from high temperatures and strong oxidizers, such as concentrated nitric acid, oxygen, hydrogen peroxide, and chlorine.

HAZARDOUS DECOMPOSITION PRODUCTS: Carbon monoxide, hydrogen cyanide, and other products of wood combustion.

HAZARDOUS POLYMERIZATION: Will not occur.

11. TOXICOLOGICAL INFORMATION FOR WOOD DUST, MDI AND FORMALDEHYDE

WOOD DUST

Wood dust is known to be a human carcinogen. An increased incidence of adenocarcinoma of the nasal cavities and paranasal sinuses was observed in studies of people whose occupations are associated with wood dust exposure. (10th Edition of the National Toxicology Program's Report on Carcinogens) Wood dust from some tree species may induce sensitization.

MDI RESIN and FORMALDEHYDE

CHRONIC (CANCER) INFORMATION: For typical products tested, MDI off-gassing is below the detection limit of 20 ppt. See Section 2 for carcinogenicity categories.

TERATOLOGY (BIRTH DEFECT) INFORMATION: NA

REPRODUCTION INFORMATION: Reproductive effects in animals have been reported in RTECS for formaldehyde.

SENSITIZER: Exposure to low doses of formaldehyde may cause sensitization.

12. ECOLOGICAL INFORMATION

These wood products are not expected to pose an ecological hazard as a result of their intended uses.

13. DISPOSAL CONSIDERATIONS

Dispose of waste according to local, state/provincial, and federal requirements.

14. TRANSPORTATION INFORMATION

Hazardous Materials Table 172.101

Shipping Name	NA	Packing Group	NA
Hazard Class	NA	Placards/Labels	NA
Identification No.	NA	Special Provisions	NA

15. REGULATORY INFORMATION

OSHA: Hazard Communication	CFR 1910.1200 (b)(6)(iv)	CERCLA RQ:	NA
EPCRA EHS RQ Section 302:	NA	EPA CAA Section 112(r):	NA
EPCRA SECTION 313:	NA	Uniform Fire Code:	NA

16. OTHER INFORMATION

This MSDS is intended solely for safety education and not for use as specifications or warranties. The information in this MSDS was obtained from usually reliable sources and is provided without any representation for warranties regarding the accuracy or correctness. Since the handling, use, and storage is beyond our control, LP assumes no responsibility and disclaims liability for any loss, damage, or expense arising therefrom.

Material Safety Data Sheet

LP® OSB Sheathing
LP® TopNotch® OSB Sub-Flooring
LP® LongLength™ OSB Sheathing
LP® SuperStruct® Furniture Panels
(cont.)

ABBREVIATIONS

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
C	Ceiling
CAA	Clean Air Act
CAS	Chemical Abstract Services (identifies specific chemical)
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFR	Code of Federal Regulations
Dust	A finely divided solid 0.017 in. or less in diameter that is capable of passing through a U.S. No. 40 standard sieve
EHS	Extremely Hazardous Substance
EPA-B1	Environmental Protection Agency-Limited evidence of carcinogenicity from epidemiological studies
EPCRA	Emergency Planning and Community Right-To-Know Act
IARC-2A	International Agency for Research on Cancer-Probably Carcinogenic to Humans
g/m3	Grams per cubic meter
mg/m3	Milligrams per cubic meter
lb/ft3	Pounds per cubic foot
MAK-1	Substances that cause cancer in man
MAK-3	Substances which cause concern that they could be carcinogenic for man
MAK-3B	Substances for which in vitro tests or animal studies have yielded evidence of carcinogenic effects
MSHA	Mine Safety Health Act
NA	Not applicable
NFPA	National Fire Protection Association
NIOSH-Ca	National Institute of Occupational Safety and Health-Potential occupational carcinogen, with no further categorization
NTP-K	National Toxicology Program-Known to be a carcinogen
NTP-R	National Toxicology Program-Reasonably anticipated to be a carcinogen
OSHA-Ca	Occupational Safety and Health Administration-Carcinogen defined with no further categorization
PNOS	Particle not otherwise specified
PEL	OSHA Permissible Exposure Limit
ppm	Parts per million
RTECS	Registry of Toxic Effects of Chemical Substances
RQ	Reportable Quantity
STEL	Short-Term Exposure Limit
TLV-A1	Threshold Limit Value-Confirmed Human Carcinogen
TLV-A2	Threshold Limit Value-Suspected Human Carcinogen
TWA	8-hour time-weighted average exposure

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Cal. Prop 65 Warning: Use of this product may result in exposure to wood dust, known to the State of California to cause cancer.

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Note: Louisiana-Pacific Corporation periodically updates and revises its product information. To verify this information, please call the number listed on page 1.

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Material Safety Data Sheet

LP® OSB Sheathing
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(cont.)

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES:

- Flash point: Not applicable.
- Combustible: Material may burn on contact with oxidizers or ignition sources.

FLAMMABLE LIMITS:

- Lower flammable limit: Not applicable.
- Upper flammable limit: Not applicable.

AUTO IGNITION TEMPERATURE: Typically 400-500° F.

EXPLOSION HAZARD: Airborne concentrations of combustible dust, when combined with an ignition source, can create an explosion hazard if the dust concentration exceeds 30–60 g/m3.

HAZARDOUS COMBUSTION PRODUCTS: Carbon dioxide, carbon monoxide, nitrogen oxides, aldehydes, cyanides, and other hazardous gases, vapors, and particles.

EXTINGUISHING MEDIA: Water, dry chemical and other agents rated for a wood fire (Type A fire). Use an extinguisher rated for a Type A fire.

FIRE FIGHTING INSTRUCTIONS: Evacuate the area and notify the fire department. If possible isolate the fire by moving other combustible materials. If the fire is small, use a hose-line or extinguisher rated for a Type A fire. If possible, dike and collect water used to fight fires. Fire fighters should wear normal protective equipment (full bunker gear) and positive-pressure self-contained breathing apparatus.

6. ACCIDENTAL RELEASE MEASURES

Does not apply.

7. HANDLING AND STORAGE

HANDLING: Provide ventilation or other measures so that dust levels are below the exposure limits listed in Section 2.

STORAGE: Keep dust away from ignition sources and store in a closed container. Consult NFPA 68 and 70 for additional information.

8. EXPOSURE CONTROL/PERSONAL PROTECTION

ENGINEERING CONTROLS: Control airborne dust concentrations below the exposure limits. Use only with adequate ventilation.

RESPIRATORY PROTECTION: When respiratory protection is required, or dust concentrations are unknown, use a NIOSH/MSHA approved air-purifying respirator for dusts.

SKIN PROTECTION: Wear work gloves to prevent skin irritation.

EYE PROTECTION: Wear ANSI approved eye protection.

9. PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT:	NA	DENSITY:	28 - 70 LB/FT3
MELTING POINT:	NA	pH:	NA
VAPOR PRESSURE:	NA	ODOR:	Slight to none
VAPOR DENSITY:	NA	APPEARANCE:	Oriented strand board with sealed edges
SOLUBILITY IN WATER:	NA		

SAFETY DATA SHEET
THE DOW CHEMICAL COMPANY

Product name: FROTH-PAK™ 1.75 ISO 12.0 Polyurethane Foam System GUN Can **Issue Date:** 10/06/2015

Print Date: 06/16/2016

THE DOW CHEMICAL COMPANY encourages and expects you to read and understand the entire (M)SDS, as there is important information throughout the document. We expect you to follow the precautions identified in this document unless your use conditions would necessitate other appropriate methods or actions.

1. IDENTIFICATION

Product name: FROTH-PAK™ 1.75 ISO 12.0 Polyurethane Foam System GUN Can

Recommended use of the chemical and restrictions on use
Identified uses: For industrial use. Component(s) for the manufacture of urethane polymers. We recommend that you use this product in a manner consistent with the listed use. If your intended use is not consistent with the stated use, please contact your sales or technical service representative.

COMPANY IDENTIFICATION
THE DOW CHEMICAL COMPANY
2030 WILLARD H DOW CENTER
MIDLAND MI 48674-0000
UNITED STATES

Customer Information Number: 800-258-2436
SDSQuestion@dow.com

EMERGENCY TELEPHONE NUMBER
24-Hour Emergency Contact: CHEMTREC +1 800-424-9300
Local Emergency Contact: 800-424-9300

2. HAZARDS IDENTIFICATION

Hazard classification
This material is hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29CFR 1910.1200.
Gases under pressure - Liquefied gas
Acute toxicity - Category 4 - Inhalation
Skin irritation - Category 2
Eye irritation - Category 2B
Respiratory sensitisation - Category 1
Skin sensitisation - Category 1
Specific target organ toxicity - single exposure - Category 3
Specific target organ toxicity - repeated exposure - Category 2 - Inhalation

Label elements
Hazard pictograms



Signal word: **DANGER!**

Hazards
Contains gas under pressure; may explode if heated.
Causes skin and eye irritation.
May cause an allergic skin reaction.
Harmful if inhaled.
May cause allergy or asthma symptoms or breathing difficulties if inhaled.
May cause respiratory irritation.
May cause damage to organs (Respiratory Tract) through prolonged or repeated exposure if inhaled.

Precautionary statements

Prevention
Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
Wash skin thoroughly after handling.
Use only outdoors or in a well-ventilated area.
Contaminated work clothing should not be allowed out of the workplace.
Wear protective gloves.
In case of inadequate ventilation wear respiratory protection.

Response
IF ON SKIN: Wash with plenty of soap and water.
IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
If skin irritation or rash occurs: Get medical advice/ attention.
If eye irritation persists: Get medical advice/ attention.
If experiencing respiratory symptoms: Call a POISON CENTER or doctor/ physician.
Take off contaminated clothing and wash before reuse.

Storage
Store in a well-ventilated place. Keep container tightly closed.
Store locked up.
Protect from sunlight. Store in a well-ventilated place.

Disposal
Dispose of contents/ container to an approved waste disposal plant.

Other hazards
No data available

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical nature: Polyurethane prepolymer
This product is a mixture.

Component	CASRN	Concentration
Diphenylmethane Diisocyanate, isomers and homologues	9016-87-9	>= 60.0 - <= 100.0 %
4,4' -Methylenediphenyl diisocyanate	101-68-8	>= 30.0 - <= 60.0 %
1,1,1,2-Tetrafluoroethane	811-97-2	>= 5.0 - <= 10.0 %

Note
Note: CAS 101-68-8 is an MDI isomer that is part of CAS 9016-87-9.

4. FIRST AID MEASURES

Description of first aid measures
General advice: First Aid responders should pay attention to self-protection and use the recommended protective clothing (chemical resistant gloves, splash protection). If potential for exposure exists refer to Section 8 for specific personal protective equipment.

Inhalation: Move person to fresh air. If not breathing, give artificial respiration; if by mouth to mouth use rescuer protection (pocket mask, etc). If breathing is difficult, oxygen should be administered by qualified personnel. Call a physician or transport to a medical facility.

Skin contact: Remove material from skin immediately by washing with soap and plenty of water. Remove contaminated clothing and shoes while washing. Seek medical attention if irritation persists. Wash clothing before reuse. An MDI skin decontamination study demonstrated that cleaning very soon after exposure is important, and that a polyglycol-based skin cleanser or corn oil may be more effective than soap and water. Discard items which cannot be decontaminated, including leather articles such as shoes, belts and watchbands. Suitable emergency safety shower facility should be available in work area.

Eye contact: Immediately flush eyes with water; remove contact lenses, if present, after the first 5 minutes, then continue flushing eyes for at least 15 minutes. Obtain medical attention without delay, preferably from an ophthalmologist. Suitable emergency eye wash facility should be immediately available.

Ingestion: If swallowed, seek medical attention. Do not induce vomiting unless directed to do so by medical personnel.

Most important symptoms and effects, both acute and delayed: Aside from the information found under Description of first aid measures (above) and Indication of immediate medical attention and special treatment needed (below), any additional important symptoms and effects are described in Section 11: Toxicology Information.

Indication of any immediate medical attention and special treatment needed
Notes to physician: Excessive exposure may aggravate preexisting asthma and other respiratory disorders (e.g. emphysema, bronchitis, reactive airways dysfunction syndrome). Maintain adequate

ventilation and oxygenation of the patient. May cause respiratory sensitization or asthma-like symptoms. Bronchodilators, expectorants and antitussives may be of help. Treat bronchospasm with inhaled beta2 agonist and oral or parenteral corticosteroids. Respiratory symptoms, including pulmonary edema, may be delayed. Persons receiving significant exposure should be observed 24-48 hours for signs of respiratory distress. If you are sensitized to diisocyanates, consult your physician regarding working with other respiratory irritants or sensitizers. Exposure may increase "myocardial irritability". Do not administer sympathomimetic drugs such as epinephrine unless absolutely necessary. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient.

5. FIREFIGHTING MEASURES

Suitable extinguishing media: Water fog or fine spray. Dry chemical fire extinguishers. Carbon dioxide fire extinguishers. Foam. Alcohol resistant foams (ATC type) are preferred. General purpose synthetic foams (including AFFF) or protein foams may function, but will be less effective.

Unsuitable extinguishing media: Do not use direct water stream. May spread fire.

Special hazards arising from the substance or mixture
Hazardous combustion products: During a fire, smoke may contain the original material in addition to combustion products of varying composition which may be toxic and/or irritating. Combustion products may include and are not limited to: Nitrogen oxides. Isocyanates. Hydrogen cyanide. Carbon monoxide. Carbon dioxide. Hydrogen halides. Halogenated hydrocarbons.

Unusual Fire and Explosion Hazards: Material reacts slowly with water, releasing carbon dioxide which can cause pressure buildup and rupture of closed containers. Elevated temperatures accelerate this reaction. Container may rupture from gas generation in a fire situation. Violent steam generation or eruption may occur upon application of direct water stream to hot liquids. Dense smoke is produced when product burns. Some components of this product will burn in a fire situation. Blowing agent vaporizes quickly at room temperature.

Advice for firefighters
Fire Fighting Procedures: Keep people away. Isolate fire and deny unnecessary entry. Stay upwind. Keep out of low areas where gases (fumes) can accumulate. Water is not recommended, but may be applied in large quantities as a fine spray when other extinguishing agents are not available. Do not use direct water stream. May spread fire. Fight fire from protected location or safe distance. Consider the use of unmanned hose holders or monitor nozzles. Immediately withdraw all personnel from the area in case of rising sound from venting safety device or discoloration of the container. Move container from fire area if this is possible without hazard. Use water spray to cool fire-exposed containers and fire-affected zone until fire is out. Contain fire water run-off if possible. Fire water run-off, if not contained, may cause environmental damage. Review the "Accidental Release Measures" and the "Ecological Information" sections of this (M)SDS.

Special protective equipment for firefighters: Wear positive-pressure self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, trousers, boots, and gloves). Avoid contact with this material during fire fighting operations. If contact is likely, change to full chemical resistant fire fighting clothing with self-contained breathing apparatus. If this is not available, wear full chemical resistant clothing with self-contained breathing apparatus and fight fire from a remote location. For protective equipment in post-fire or non-fire clean-up situations, refer to the relevant sections.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures: Isolate area. Keep unnecessary and unprotected personnel from entering the area. Refer to section 7, Handling, for additional precautionary measures. Keep personnel out of low areas. Keep upwind of spill. Spilled material may cause a slipping hazard. Ventilate area of leak or spill. If available, use foam to smother or suppress. See Section 10 for more specific information. Use appropriate safety equipment. For additional information, refer to Section 8, Exposure Controls and Personal Protection.

Environmental precautions: Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. See Section 12, Ecological Information.

Methods and materials for containment and cleaning up: Contain spilled material if possible. Absorb with materials such as: Dirt. Vermiculite. Sand. Clay. Do NOT use absorbent materials such as: Cement powder (Note: may generate heat). Collect in suitable and properly labeled open containers. Do not place in sealed containers. Suitable containers include: Metal drums. Plastic drums. Polylined fiber pacs. Wash the spill site with large quantities of water. Attempt to neutralize by adding suitable decontaminant solution: Formulation 1: sodium carbonate 5 - 10%; liquid detergent 0.2 - 2%; water to make up to 100%, OR Formulation 2: concentrated ammonia solution 3 - 8%; liquid detergent 0.2 - 2%; water to make up to 100%. If ammonia is used, use good ventilation to prevent vapor exposure. Contact your supplier for clean-up assistance. See Section 13, Disposal Considerations, for additional information.

7. HANDLING AND STORAGE

Precautions for safe handling: Avoid breathing vapor. Avoid contact with eyes, skin, and clothing. Avoid prolonged or repeated contact with skin. Use with adequate ventilation. Wash thoroughly after handling. Keep container tightly closed. Contents under pressure. Do not puncture or incinerate container. Containers, even those that have been emptied, can contain vapors. Do not cut, drill, grind, weld, or perform similar operations on or near empty containers. Do not enter confined spaces unless adequately ventilated. See Section 8, EXPOSURE CONTROLS AND PERSONAL PROTECTION.

Conditions for safe storage: Avoid prolonged exposure to heat and air. Elevated temperatures can cause pressure buildup in closed containers due to the release of blowing agents. Store under cover in a dry, clean, cool, well ventilated place away from sunlight. Do not store product contaminated with water to prevent potential hazardous reaction.

Storage stability

Storage temperature:	**Storage Period:**
24 °C (75 °F)	15 Month

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure limits are listed below, if they exist.

Component	Regulation	Type of listing	Value/Notation
4,4' -Methylenediphenyl diisocyanate	ACGIH	TWA	0.005 ppm
	OSHA Z-1	C	0.2 mg/m3 0.02 ppm
	NIOSH REL	TWA	0.05 mg/m3 0.005 ppm

	NIOSH REL	C	0.2 mg/m3	0.02 ppm
1,1,1,2-Tetrafluoroethane	US WEEL	TWA		1,000 ppm

Exposure controls

Engineering controls: Use only with adequate ventilation. Local exhaust ventilation may be necessary for some operations. Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines. Exhaust systems should be designed to move the air away from the source of vapor/aerosol generation and people working at this point. The odor and irritancy of this material are inadequate to warn of excessive exposure. Lethal concentrations may exist in areas with poor ventilation.

Individual protection measures

Eye/face protection: Use chemical goggles.

Skin protection

Hand protection: Use gloves chemically resistant to this material. Examples of preferred glove barrier materials include: Butyl rubber. Polyethylene. Chlorinated polyethylene. Ethyl vinyl alcohol laminate ("EVAL"). Examples of acceptable glove barrier materials include: Viton. Neoprene. Polyvinyl chloride ("PVC" or "vinyl"). Nitrile/butadiene rubber ("nitrile" or "NBR"). NOTICE: The selection of a specific glove for a particular application and duration of use in a workplace should also take into account all relevant workplace factors such as, but not limited to: Other chemicals which may be handled, physical requirements (cut/puncture protection, dexterity, thermal protection), potential body reactions to glove materials, as well as the instructions/specifications provided by the glove supplier.

Other protection: Use protective clothing chemically resistant to this material. Selection of specific items such as face shield, boots, apron, or full body suit will depend on the task.

Respiratory protection: Atmospheric levels should be maintained below the exposure guideline. When atmospheric levels may exceed the exposure guideline, use an approved air-purifying respirator equipped with an organic vapor sorbent and a particle filter. For situations where the atmospheric levels may exceed the level for which an air-purifying respirator is effective, use a positive-pressure air-supplying respirator (air line or self-contained breathing apparatus). For emergency response or for situations where the atmospheric level is unknown, use an approved positive-pressure self-contained breathing apparatus or positive-pressure air line with auxiliary self-contained air supply. In confined or poorly ventilated areas, use an approved self-contained breathing apparatus or positive pressure air line with auxiliary self-contained air supply.

The following should be effective types of air-purifying respirators: Organic vapor cartridge with a particulate pre-filter.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	
Physical state	Liquid.
Color	Brown
Odor	Musty
Odor Threshold	No test data available
pH	Not applicable
Melting point/range	No test data available
Freezing point	No test data available

Boiling point (760 mmHg)	No test data available
Flash point	**closed cup** Not applicable
Evaporation Rate (Butyl Acetate = 1)	No test data available
Flammability (solid, gas)	Not applicable to liquids
Lower explosion limit	No test data available
Upper explosion limit	No test data available
Vapor Pressure	240 lb/in2 at 23 °C (73 °F) *Estimated.*
Relative Vapor Density (air = 1)	No test data available
Relative Density (water = 1)	1.24 *Estimated.*
Water solubility	insoluble, reacts, evolution of CO2
Partition coefficient: n-octanol/water	No data available
Auto-ignition temperature	No test data available
Decomposition temperature	No test data available
Kinematic Viscosity	No test data available
Explosive properties	Not explosive
Oxidizing properties	No
Molecular weight	No data available

NOTE: The physical data presented above are typical values and should not be construed as a specification.

10. STABILITY AND REACTIVITY

Reactivity: No data available

Chemical stability: Stable under recommended storage conditions. See Storage, Section 7.

Possibility of hazardous reactions: Can occur. Exposure to elevated temperatures can cause product to decompose and generate gas. This can cause pressure build-up and/or rupturing of closed containers. Polymerization can be catalyzed by: Strong bases. Water.

Conditions to avoid: Exposure to elevated temperatures can cause product to decompose. Elevated temperatures can cause pressure buildup in closed containers due to the release of blowing agents. Generation of gas during decomposition can cause pressure in closed systems. Pressure build-up can be rapid. Avoid moisture. Material reacts slowly with water, releasing carbon dioxide which can cause pressure buildup and rupture of closed containers. Elevated temperatures accelerate this reaction.

Incompatible materials: Avoid contact with: Acids. Alcohols. Amines. Water. Ammonia. Bases. Metal compounds. Moist air. Strong oxidizers. Diisocyanates react with many materials and the rate of reaction increases with temperature as well as increased contact; these reactions can become violent. Contact is increased by stirring or if the other material mixes with the diisocyanate. Diisocyanates are not soluble in water and sink to the bottom, but react slowly at the interface. The reaction forms carbon dioxide gas and a layer of solid polyurea. Reaction with water will generate carbon dioxide and heat. Avoid contact with metals such as: Aluminum. Zinc. Brass. Tin. Copper.

Galvanized metals. Avoid contact with absorbent materials such as: Moist organic absorbents. Avoid unintended contact with polyols. The reaction of polyols and isocyanates generate heat.

Hazardous decomposition products: Decomposition products depend upon temperature, air supply and the presence of other materials. Gases are released during decomposition.

11. TOXICOLOGICAL INFORMATION

Toxicological information appears in this section when such data is available.

Acute toxicity

Acute oral toxicity

Low toxicity if swallowed. Small amounts swallowed incidentally as a result of normal handling operations are not likely to cause injury; however, swallowing larger amounts may cause injury. Observations in animals include: Gastrointestinal irritation.

As product: Single dose oral LD50 has not been determined.
LD50, Rat, > 2,000 mg/kg Estimated.

Acute dermal toxicity

Prolonged skin contact is unlikely to result in absorption of harmful amounts.

As product: The dermal LD50 has not been determined.
LD50, Rabbit, > 2,000 mg/kg Estimated.

Acute inhalation toxicity

In confined or poorly ventilated areas, vapor can easily accumulate and can cause unconsciousness and death due to displacement of oxygen. Excessive exposure may cause irritation to upper respiratory tract (nose and throat) and lungs. May cause pulmonary edema (fluid in the lungs.) Effects may be delayed. Decreased lung function has been associated with overexposure to isocyanates. Excessive exposure may increase sensitivity to epinephrine and increase myocardial irritability (irregular heartbeats). May cause central nervous system effects. Symptoms of excessive exposure may be anesthetic or narcotic effects; dizziness and drowsiness may be observed.
As product: The LC50 has not been determined.

Skin corrosion/irritation

Prolonged contact may cause skin irritation with local redness.
May stain skin.

Serious eye damage/eye irritation

May cause moderate eye irritation.
May cause slight temporary corneal injury.

Sensitization

Skin contact may cause an allergic skin reaction.
Animal studies have shown that skin contact with isocyanates may play a role in respiratory sensitization.

May cause allergic respiratory reaction.

MDI concentrations below the exposure guidelines may cause allergic respiratory reactions in individuals already sensitized.
Asthma-like symptoms may include coughing, difficult breathing and a feeling of tightness in the chest. Occasionally, breathing difficulties may be life threatening.

Specific Target Organ Systemic Toxicity (Single Exposure)
May cause respiratory irritation.
Route of Exposure: Inhalation

Specific Target Organ Systemic Toxicity (Repeated Exposure)
Tissue injury in the upper respiratory tract and lungs has been observed in laboratory animals after repeated excessive exposures to MDI/polymeric MDI aerosols.

Carcinogenicity
Lung tumors have been observed in laboratory animals exposed to respirable aerosol droplets of MDI/Polymeric MDI (6 mg/m3) for their lifetime. Tumors occurred concurrently with respiratory irritation and lung injury. Current exposure guidelines are expected to protect against these effects reported for MDI.

Teratogenicity
In laboratory animals, MDI/polymeric MDI did not cause birth defects; other fetal effects occurred only at high doses which were toxic to the mother. Contains component(s) which did not cause birth defects in animals; other fetal effects occurred only at doses toxic to the mother.

Reproductive toxicity
No relevant data found.

Mutagenicity
Genetic toxicity data on MDI are inconclusive. MDI was weakly positive in some in vitro studies; other in vitro studies were negative. Animal mutagenicity studies were predominantly negative.

Aspiration Hazard
Based on physical properties, not likely to be an aspiration hazard.

COMPONENTS INFLUENCING TOXICOLOGY:

Diphenylmethane Diisocyanate, isomers and homologues

Acute inhalation toxicity
LC50, Rat, 4 Hour, dust/mist, 0.49 mg/l

For similar material(s): 2,4'-Diphenylmethane diisocyanate (CAS 5873-54-1). LC50, Rat, 4 Hour, Aerosol, 0.31 mg/l

For similar material(s): 4,4'-Methylenediphenyl diisocyanate (CAS 101-68-8). LC50, Rat, 1 Hour, Aerosol, 2.24 mg/l

4,4' -Methylenediphenyl diisocyanate

Acute inhalation toxicity
LC50, Rat, 1 Hour, dust/mist, 2.24 mg/l

1,1,1,2-Tetrafluoroethane

Acute inhalation toxicity
LC50, Rat, 4 Hour, vapour, > 1,500 mg/l

12. ECOLOGICAL INFORMATION

Ecotoxicological information appears in this section when such data is available.

Toxicity

Diphenylmethane Diisocyanate, isomers and homologues

Acute toxicity to fish
The measured ecotoxicity is that of the hydrolyzed product, generally under conditions maximizing production of soluble species.
Material is practically non-toxic to aquatic organisms on an acute basis (LC50/EC50/EL50/LL50 >100 mg/L in the most sensitive species tested).
Based on information for a similar material:
LC50, Danio rerio (zebra fish), static test, 96 Hour, > 1,000 mg/l, OECD Test Guideline 203 or Equivalent

Acute toxicity to aquatic invertebrates
Based on information for a similar material:
EC50, Daphnia magna (Water flea), static test, 24 Hour, > 1,000 mg/l, OECD Test Guideline 202 or Equivalent

Acute toxicity to algae/aquatic plants
Based on information for a similar material:
NOEC, Desmodesmus subspicatus (green algae), static test, 72 Hour, Growth rate inhibition, 1,640 mg/l, OECD Test Guideline 201 or Equivalent

Toxicity to bacteria
Based on information for a similar material:
EC50, activated sludge, static test, 3 Hour, Respiration rates., > 100 mg/l

Toxicity to soil-dwelling organisms
EC50, Eisenia fetida (earthworms), Based on information for a similar material:, 14 d, > 1,000 mg/kg

Toxicity to terrestrial plants
EC50, Avena sativa (oats), Growth inhibition, 1,000 mg/l
EC50, Lactuca sativa (lettuce), Growth inhibition, 1,000 mg/l

4,4' -Methylenediphenyl diisocyanate

Acute toxicity to fish
The measured ecotoxicity is that of the hydrolyzed product, generally under conditions maximizing production of soluble species.
Material is practically non-toxic to aquatic organisms on an acute basis (LC50/EC50/EL50/LL50 >100 mg/L in the most sensitive species tested).
Based on information for a similar material:
LC50, Danio rerio (zebra fish), static test, 96 Hour, > 1,000 mg/l, OECD Test Guideline 203 or Equivalent

Acute toxicity to aquatic invertebrates
Based on information for a similar material:

EC50, Daphnia magna (Water flea), static test, 24 Hour, > 1,000 mg/l, OECD Test Guideline 202 or Equivalent

Acute toxicity to algae/aquatic plants
Based on information for a similar material:
NOEC, Desmodesmus subspicatus (green algae), static test, 72 Hour, Growth rate inhibition, 1,640 mg/l, OECD Test Guideline 201 or Equivalent

Toxicity to bacteria
Based on information for a similar material:
EC50, activated sludge, static test, 3 Hour, Respiration rates., > 100 mg/l

Toxicity to soil-dwelling organisms
EC50, Eisenia fetida (earthworms), Based on information for a similar material:, 14 d, > 1,000 mg/kg

Toxicity to terrestrial plants
EC50, Avena sativa (oats), Growth inhibition, 1,000 mg/l
EC50, Lactuca sativa (lettuce), Growth inhibition, 1,000 mg/l

1,1,1,2-Tetrafluoroethane

Acute toxicity to fish
Material is practically non-toxic to aquatic organisms on an acute basis (LC50/EC50/EL50/LL50 >100 mg/L in the most sensitive species tested).
LC50, Oncorhynchus mykiss (rainbow trout), semi-static test, 96 Hour, 450 mg/l

Acute toxicity to aquatic invertebrates
EC50, Daphnia magna (Water flea), 48 Hour, 980 mg/l

Toxicity to bacteria
EC50, Pseudomonas putida, static test, 6 Hour, Growth inhibition, > 730 mg/l

Persistence and degradability

Diphenylmethane Diisocyanate, isomers and homologues

Biodegradability: In the aquatic and terrestrial environment, material reacts with water forming predominantly insoluble polyureas which appear to be stable. In the atmospheric environment, material is expected to have a short tropospheric half-life, based on calculations and by analogy with related diisocyanates.
10-day Window: Not applicable
Biodegradation: 0 %
Exposure time: 28 d
Method: OECD Test Guideline 302C or Equivalent

4,4' -Methylenediphenyl diisocyanate

Biodegradability: In the aquatic and terrestrial environment, material reacts with water forming predominantly insoluble polyureas which appear to be stable. In the atmospheric environment, material is expected to have a short tropospheric half-life, based on calculations and by analogy with related diisocyanates.
10-day Window: Not applicable
Biodegradation: 0 %
Exposure time: 28 d
Method: OECD Test Guideline 302C or Equivalent

1,1,1,2-Tetrafluoroethane

Biodegradability: Material is expected to biodegrade very slowly (in the environment). Fails to pass OECD/EEC tests for ready biodegradability.
10-day Window: Fail
Biodegradation: 4 %
Exposure time: 28 d
Method: OECD Test Guideline 301D or Equivalent

Theoretical Oxygen Demand: 0.47 mg/mg

Photodegradation
Test Type: Half-life (indirect photolysis)
Sensitizer: OH radicals
Atmospheric half-life: 1,700 d
Method: Estimated.

Bioaccumulative potential

Diphenylmethane Diisocyanate, isomers and homologues

Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3). Reacts with water. In the aquatic and terrestrial environment, movement is expected to be limited by its reaction with water forming predominantly insoluble polyureas.
Bioconcentration factor (BCF): 92 Cyprinus carpio (Carp) 28 d

4,4' -Methylenediphenyl diisocyanate

Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3). Reacts with water. In the aquatic and terrestrial environment, movement is expected to be limited by its reaction with water forming predominantly insoluble polyureas.
Bioconcentration factor (BCF): 92 Cyprinus carpio (Carp) 28 d

1,1,1,2-Tetrafluoroethane

Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3).
Partition coefficient: n-octanol/water(log Pow): 1.68 Estimated.

Mobility in soil

Diphenylmethane Diisocyanate, isomers and homologues

In the aquatic and terrestrial environment, movement is expected to be limited by its reaction with water forming predominantly insoluble polyureas.

4,4' -Methylenediphenyl diisocyanate

In the aquatic and terrestrial environment, movement is expected to be limited by its reaction with water forming predominantly insoluble polyureas.

1,1,1,2-Tetrafluoroethane

Potential for mobility in soil is high (Koc between 50 and 150).
Partition coefficient(Koc): 97 Estimated.

13. DISPOSAL CONSIDERATIONS

Disposal methods: DO NOT DUMP INTO ANY SEWERS, ON THE GROUND, OR INTO ANY BODY OF WATER. All disposal practices must be in compliance with all Federal, State/Provincial and local laws and regulations. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the responsibility solely of the waste generator. AS YOUR SUPPLIER, WE HAVE NO CONTROL OVER THE MANAGEMENT PRACTICES OR MANUFACTURING PROCESSES OF PARTIES HANDLING OR USING THIS MATERIAL. THE INFORMATION PRESENTED HERE PERTAINS ONLY TO THE PRODUCT AS SHIPPED IN ITS INTENDED CONDITION AS DESCRIBED IN MSDS SECTION: Composition Information. FOR UNUSED & UNCONTAMINATED PRODUCT, the preferred options include sending to a licensed, permitted: Recycler. Reclaimer. Incinerator or other thermal destruction device. Landfill. For additional information, refer to: Handling & Storage Information, MSDS Section 7 Stability & Reactivity Information, MSDS Section10 Regulatory Information, MSDS Section 15

14. TRANSPORT INFORMATION

DOT

Proper shipping name	Aerosols
UN number	UN 1950
Class	2.2
Packing group	
Reportable Quantity	MDI

Classification for SEA transport (IMO-IMDG):

Proper shipping name	AEROSOLS
UN number	UN 1950
Class	2.2
Packing group	
Marine pollutant	No
Transport in bulk according to Annex I or II of MARPOL 73/78 and the IBC or IGC Code	Consult IMO regulations before transporting ocean bulk

Classification for AIR transport (IATA/ICAO):

Proper shipping name	Aerosols, non-flammable
UN number	UN 1950
Class	2.2
Packing group	

This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Transportation classifications may vary by container volume and may be influenced by regional or country variations in regulations. Additional transportation system information can be obtained through an authorized sales or customer service representative. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.

15. REGULATORY INFORMATION

OSHA Hazard Communication Standard
This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Sections 311 and 312
Acute Health Hazard
Chronic Health Hazard
Reactivity Hazard
Sudden Release of Pressure Hazard

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Section 313
This product contains the following substances which are subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and which are listed in 40 CFR 372.

Components	**CASRN**
4,4' -Methylenediphenyl diisocyanate	101-68-8
Diphenylmethane Diisocyanate, isomers and homologues	9016-87-9

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Section 103
This product contains the following substances which are subject to CERCLA Section 103 reporting requirements and which are listed in 40 CFR 302.4.

Components	**CASRN**	**RQ**
4,4' -Methylenediphenyl diisocyanate	101-68-8	5000 lbs RQ

Pennsylvania Worker and Community Right-To-Know Act:
To the best of our knowledge, this product does not contain chemicals at levels which require reporting under this statute.

California Proposition 65 (Safe Drinking Water and Toxic Enforcement Act of 1986)
This product contains no listed substances known to the State of California to cause cancer, birth defects or other reproductive harm, at levels which would require a warning under the statute.

United States TSCA Inventory (TSCA)
All components of this product are in compliance with the inventory listing requirements of the U.S. Toxic Substances Control Act (TSCA) Chemical Substance Inventory.

16. OTHER INFORMATION

Hazard Rating System
NFPA

Health	Fire	Reactivity

1	1	2

Revision

Identification Number: 101215564 / A001 / Issue Date: 10/06/2015 / Version: 6.0
Most recent revision(s) are noted by the bold, double bars in left-hand margin throughout this document.

Legend

ACGIH	USA. ACGIH Threshold Limit Values (TLV)
C	Ceiling
NIOSH REL	USA. NIOSH Recommended Exposure Limits
OSHA Z-1	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
TWA	8-hour, time-weighted average
US WEEL	USA. Workplace Environmental Exposure Levels (WEEL)

Information Source and References

This SDS is prepared by Product Regulatory Services and Hazard Communications Groups from information supplied by internal references within our company.

THE DOW CHEMICAL COMPANY urges each customer or recipient of this (M)SDS to study it carefully and consult appropriate expertise, as necessary or appropriate, to become aware of and understand the data contained in this (M)SDS and any hazards associated with the product. The information herein is provided in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ between various locations. It is the buyer's/user's responsibility to ensure that his activities comply with all federal, state, provincial or local laws. The information presented here pertains only to the product as shipped. Since conditions for use of the product are not under the control of the manufacturer, it is the buyer's/user's duty to determine the conditions necessary for the safe use of this product. Due to the proliferation of sources for information such as manufacturer-specific (M)SDSs, we are not and cannot be responsible for (M)SDSs obtained from any source other than ourselves. If you have obtained an (M)SDS from another source or if you are not sure that the (M)SDS you have is current, please contact us for the most current version.

Polyurethane Foam, Part A

MSDS # 538.00

Section 1: Product and Company Identification

Polyurethane Foam, Part A

Synonyms/General Names: N/A
Product Use: For educational use only
Manufacturer: Columbus Chemical Industries, Inc., Columbus, WI 53925.

24 Hour Emergency Information Telephone Numbers

CHEMTREC (USA): 800-424-9300 **CANUTEC (Canada): 613-424-6666**

ScholAR Chemistry; 5100 W. Henrietta Rd, Rochester, NY 14586; (866) 260-0501; www.Scholarchemistry.com

Section 2: Hazards Identification

Dark brown, viscous liquid, mild musty odor.

HMIS (0 to 4)

Health	1
Fire Hazard	1
Reactivity	1

WARNING! Slightly toxic by ingestion and body tissue irritant,
Target organs: None known.

This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Section 3: Composition / Information on Ingredients

Polymethane polyphenyl diisocyante (9016-87-9), 70-100%
4,4-Methylene bisphenylisocyanate (101-68-80, 0-30%

Section 4: First Aid Measures

Always seek professional medical attention after first aid measures are provided.

Eyes: Immediately flush eyes with excess water for 15 minutes, lifting lower and upper eyelids occasionally.
Skin: Immediately flush skin with excess water for 15 minutes while removing contaminated clothing.
Ingestion: Call Poison Control immediately. Rinse mouth with cold water. Give victim 1-2 cups of water or milk to drink. Induce vomiting immediately.
Inhalation: Remove to fresh air. If not breathing, give artificial respiration.

Section 5: Fire Fighting Measures

Combustible liquid. When heated to decomposition, emits acrid fumes.
Protective equipment and precautions for firefighters: Use foam or dry chemical to extinguish fire. Firefighters should wear full fire fighting turn-out gear and respiratory protection (SCBA). Cool container with water spray. Material is not sensitive to mechanical impact or static discharge.



Section 6: Accidental Release Measures

Use personal protection recommended in Section 8. Isolate the hazard area and deny entry to unnecessary and unprotected personnel. Contain spill with sand or absorbent material and place in sealed bag or container for disposal. Ventilate and wash spill area after pickup is complete. See Section 13 for disposal information.

Section 7: Handling and Storage Green

Handling: Use with adequate ventilation and do not breathe dust or vapor. Avoid contact with skin, eyes, or clothing. Wash hands thoroughly after handling.
Storage: Store in General Storage Area [Green Storage] with other items with no specific storage hazards. Store in a cool, dry, well-ventilated, locked store room away from incompatible materials.

Section 8: Exposure Controls / Personal Protection

Use ventilation to keep airborne concentrations below exposure limits. Have approved eyewash facility, safety shower, and fire extinguishers readily available. Wear chemical splash goggles and chemical resistant clothing such as gloves and aprons. Wash hands thoroughly after handling material and before eating or drinking. Use NIOSH-approved respirator with an acid/organic cartridge. Exposure guidelines: Polyurethane Foam, Part A: OSHA PEL: Not Available, ACGIH: TLV: Not Available, STEL: Not Available.

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Section 9: Physical and Chemical Properties

Molecular formula	Mixture.	**Appearance**	Brown liquid.
Molecular weight	N/A.	**Odor**	Musty odor.
Specific Gravity	1.24 g/mL @ 20°C.	**Odor Threshold**	N/A.
Vapor Density (air=1)	8.5.	**Solubility**	Insoluble.
Melting Point	N/A.	**Evaporation rate**	N/A. *(Butyl acetate = 1).*
Boiling Point/Range	210°C.	**Partition Coefficient**	N/A. *(log P_{OW}).*
Vapor Pressure (20°C)	N/A.	**pH**	N/A.
Flash Point:	>204°C (>400°F).	**LEL**	N/A.
Autoignition Temp.:	600°C (1100°F).	**UEL**	N/A.

N/A = Not available or applicable

Section 10: Stability and Reactivity

Avoid heat and moisture.
Stability: Stable under normal conditions of use and storage.
Incompatibility: Alkalis, amines, alcohols, water
Shelf life: Indefinite if stored properly.

Section 11: Toxicology Information

Acute Symptoms/Signs of exposure: ***Eyes***: Redness, tearing, itching, burning, conjunctivitis. ***Skin***: Redness, itching. ***Ingestion***: Irritation and burning sensations of mouth and throat, nausea, vomiting and abdominal pain. ***Inhalation***: Irritation of mucous membranes, coughing, wheezing, shortness of breath,
Chronic Effects: No information found.
Sensitization: Possible skin sensitizer
Polyurethane Foam, Part A: LD50 [oral, rat]; N/A; LC50 [rat]; N/A; LD50 Dermal [rabbit]; N/A
Material has not been found to be a carcinogen nor produce genetic, reproductive, or developmental effects.

Section 12: Ecological Information

Ecotoxicity (aquatic and terrestrial): Ecological impact has not been determined.

Section 13: Disposal Considerations

Check with all applicable local, regional, and national laws and regulations. Local regulations may be more stringent than regional or national regulations. Small amounts of this material may be suitable for sanitary sewer or trash disposal.

Section 14: Transport Information

DOT Shipping Name:	Not regulated by DOT.	**Canada TDG:**	Not regulated by TDG.
DOT Hazard Class:		**Hazard Class:**	
Identification Number:		**UN Number:**	

Section 15: Regulatory Information

EINECS: Not Listed
TSCA: All components are listed or are exempt
WHMIS Canada: Not WHMIS Controlled.
California Proposition 65: Not listed

The product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

Section 16: Other Information

Current Issue Date: January 23, 2009

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Firefighters' and instructors' absorption of PAHs and benzene during training exercises

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ABSTRACT

Introduction: Training fires may constitute a major portion of some firefighters' occupational exposures to smoke. However, the magnitude and composition of those exposures are not well understood and may vary by the type of training scenario and fuels.

Objectives: To understand how structure fire training contributes to firefighters' and instructors' select chemical exposures, we conducted biological monitoring during exercises involving combustion of pallet and straw and oriented strand board (OSB) or the use of simulated smoke.

Methods: Urine was analyzed for metabolites of polycyclic aromatic hydrocarbons (PAHs) and breath was analyzed for volatile organic compounds (VOCs) including benzene.

Results: Median concentrations of nearly all PAH metabolites in urine increased from pre-to 3-hr post-training for each scenario and were highest for OSB, followed by pallet and straw, and then simulated smoke. For instructors who supervised three trainings per day, median concentrations increased at each collection. A single day of OSB exercises led to a 30-fold increase in 1-hydroxypyrene for instructors, culminating in a median end-of-shift concentration 3.5-fold greater than median levels measured from firefighters in a previous controlled-residential fire study. Breath concentrations of benzene increased 2 to 7-fold immediately after the training exercises (with the exception of simulated smoke training). Exposures were highest for the OSB scenario and instructors accumulated PAHs with repeated daily exercises.

Conclusions: Dermal absorption likely contributed to the biological levels as the respiratory route was well protected. Training academies should consider exposure risks as well as instructional objectives when selecting training exercises.

1. Introduction

Studies suggest that firefighters have increased risk for numerous types of cancer (Daniels et al., 2014, 2015; Glass et al., 2014; Pukkala et al., 2009; Tsai et al., 2015) and the International Agency for Research on Cancer (IARC) classified occupational exposure as a firefighter to be possibly carcinogenic to humans (Group 2B) (IARC, 2010). Firefighters' exposure to chemical carcinogens during emergency fire responses may contribute to this increased risk (Daniels et al., 2015). Firefighters could also be exposed to chemical carcinogens during training fires. A recent study found a dose-response relationship between estimated exposures from training fires and cancer incidence at a fire training college in Australia (Glass et al., 2016). The high exposure group at the fire training college had increased risk of all cancers, testicular cancer, and

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melanoma compared to the general population.

Training fires may constitute a major portion of some firefighters' occupational exposures to smoke. Many fire departments require routine live-fire training for their firefighters to maintain and build proficiencies and certifications. Training institutes often utilize firefighters and officers from surrounding communities, or employ dedicated personnel, to serve as instructors. Instructors often oversee 3–5 live instructional fires per day over a combined period of several weeks or even months. This could add up to as many or more live-fire exposures (albeit in a controlled setting) than what firefighters in busy fire departments experience.

Fuels used for fire training vary, but typically follow recommendations from the National Fire Protection Association (NFPA) standard NFPA 1403 *Standard on Live Fire Training Evolutions* in an attempt to control the risk involved with this type of training (NFPA, 2018). Such training scenarios will often include Class A materials such as pallet and straw, which tend to produce light grey smoke for obscuring visibility, as well as elevated temperatures. In recent years, many training institutes have also begun to use engineered wood products, such as oriented strand board (OSB) in addition to the pallet and straw to generate products of combustion that more closely replicate those encountered in residential structure fires (e.g., flames "rolling" across the ceiling, darker smoke and higher temperatures) (Horn et al., 2011). Some fire training institutes have begun using simulation technologies to produce training environments with no live fire. These systems typically use theatrical smoke or pepper fog for visual obscuration; they may also incorporate propane burners or an electronic display of fire glow. While simulated smoke exercises are assumed to be less hazardous than live-fire training, chemical hazards like insoluble aerosols and formaldehyde have been measured at concentrations above or just below occupational exposure limits during these exercises (NIOSH, 2013). The relative risk of these varying approaches has not been studied in an integrated manner to allow direct comparison between fire training environments.

A relatively small number of studies have investigated firefighters' exposures during various types of live-fire training exercises, including those that used firewood, particle chipboard, plywood, OSB, diesel fuel, and heating oil as fuel sources (Feunekes et al., 1997; Kirk and Logan, 2015; Laitinen et al., 2010; Moen and Ovrebo, 1997; Stec et al., 2018). These studies generally show that firefighters can be exposed to single-ring and polycyclic aromatic hydrocarbons (PAHs) during training fires, leading to contamination of protective clothing and skin, as well as potential for biological uptake of benzene and pyrene. However, the accumulation of toxicants from repeated training exercises, especially among instructors, has not been fully characterized.

In a recent companion paper (Fent et al., In Press-a), we reported airborne contamination levels measured during firefighting exercises that used pallet and straw alone or in concert with OSB as fuel for the fires or used simulated smoke. Generally, the magnitude of contaminants measured in air were highest for the OSB exercises, followed by pallet and straw and then simulated smoke exercises. Although the participants wore self-contained breathing apparatus (SCBA) prior to entering the structure, as is typically the case for firefighters, some biological absorption could still take place via inhalation before donning respirators while outside of the structure. Dermal absorption may also be responsible for the biological absorption of toxicants. A number of firefighter exposure studies have documented absorption of toxicants despite the consistent use of SCBA, suggesting that the dermal route contributes substantially to the dose (Fent et al., 2014; Fent et al., In Press-b; Keir et al., 2017).

Building on our previous work evaluating airborne contamination (Fent et al., In Press-a), we assessed both firefighters' and instructors' exposures to PAHs and volatile organic compounds (VOCs) by collecting biological specimens over a five-day period of training exercises involving a) pallet and straw, b) OSB, and c) simulated smoke. This study design provides the opportunity to investigate the biological accumulation of hazardous substances in instructors over a typical workday involving routine training exercises with broad applicability in the U.S. fire service and abroad. By following the same methodology as in the previous controlled residential fires project (Fent et al., 2018; Fent et al., In Press-b), we are also able to compare findings between exercises involving training fuels and those involving furnishings typical of a residential home.

2. Methods

2.1. Participants

This study was approved by the Institutional Review Boards at the University of Illinois and the National Institute for Occupational Safety and Health (NIOSH). All participants were required to be active members of a fire department and/or fire training organization and have completed a medical evaluation consistent with National Fire Protection Association (NFPA) 1582 in the past 12 months. Firefighters with any known cardiovascular disease, who used tobacco, were younger than 18 or older than 55 years of age, had gastrointestinal complications, or pregnant were excluded from the study. All firefighters were fit tested for the SCBA mask which they used for this study within the past 12 months. Participants were also requested to avoid eating char-grilled or smoked foods 24-hr before and during each study day and were provided a standardized meal 1 h prior to reporting for pre-firefighting data collection. Twenty-four firefighters (22 male, 2 female) and ten fire instructors (9 male, 1 female) participated in the study.

2.2. Study design

Horn et al. (2019) provides a detailed description of the study design. Briefly, two sets of five instructors (designated alpha and bravo) worked alternating days (three study days in five calendar days each). On each study day, the instructors led three training exercises with a different crew of four firefighters involved in each daily exercise (Table 1). The training exercises took ~10 min to complete with ~3 h between each daily exercise. The firefighters had about 46 h between the previous training exercise and the following pre-firefighting data collection, while the instructors had about 40 h between the last training exercise of the day and the next pre-firefighting data collection.

For all three training scenarios, the firefighters had the same objective to suppress a two-room fire and to locate and rescue two simulated occupants of the structure. The three scenarios differed primarily by fuel package and type or orientation of the structure as described below:

- **Pallet and straw scenario** – Fires were ignited using three pine wood pallets and one bale of straw in two separate bedrooms in a single story concrete training structure. All pallets used in the study were new and had not been used for shipping or handling any materials that could potentially contaminate the wood. The structure was laid out similar to a mid-20th century single family dwelling (Supplemental Materials, Fig. S1). In all scenarios, flaming combustion was contained within the burners in the two bedrooms (did not spread to the structure or other rooms) and smoke filled the remaining rooms of the training structure, to the point of limiting visibility at crawling level. As is common in live-fire training, firefighters responded when smoke conditions reached limited visibility, which resulted in suppressing the fires when flaming combustion was still being supported by the pallets in each room. In each case, the pallets were not completely consumed prior to suppression.
- **OSB scenario** – Fires ignited in burners using two pallets and one bale of straw along with OSB in each of two separate bedrooms in a T-shaped metal shipping container based prop (Supplemental Materials, Fig. S2). Two different types of OSB were used, identified

Table 1
Training schedule and participant roles.

Participant	Description	Group	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Instructors	5 instructors, 2 assigned as stokers, and 3 assigned as officers, ~3-hr transpired between each daily exercise	Alpha	3 simulated smoke exercises	Day off	3 pallet and straw exercises	Day off	3 OSB exercises	Day off
		Bravo	Day off	3 OSB exercises	Day off	3 pallet and straw exercises	Day off	3 simulated smoke exercises
Firefighters	3 crews, 4 firefighters per crew, 2 firefighters assigned to attack and 2 firefighters assigned to search and rescue	Alpha	1 simulated smoke exercise per crew	Day off	1 pallet and straw exercise per crew	Day off	1 OSB exercise per crew	Day off
		Bravo	Day off	1 OSB exercise per crew	Day off	1 pallet and straw exercise per crew	Day off	1 simulated smoke exercise per crew

in the paper as alpha OSB (used for the alpha groups) and bravo OSB (used for the bravo groups). Each type of OSB contained the same Engineered Wood Association APA rating for 7/16″ thickness (panel grade 24/16, exposure 1). One and half sheet of the 7/16″ alpha OSB were placed along the ceiling to provide adequate fuel supply for the training fires. Because of supply limitations, we only had access to 1/4″ sheets of the bravo OSB sheathing. One sheet of this OSB was cut in half and stacked together and then two sheets were also stacked together and placed along the ceiling. This effectively produced one and half sheets of bravo OSB with a similar thickness and orientation to the alpha OSB fuel package. According to their safety data sheets (SDS), both OSB sheathing contained phenol formaldehyde adhesive and polymeric methylene bisphenyl diisocyanate (pMDI) adhesive, but the exact volume percentage of each is unknown. The primary difference between the SDSs for the two types of OSB was that bravo OSB reported < 0.01% of free formaldehyde, while alpha OSB reported < 0.1% of free formaldehyde. Flaming combustion was isolated to the burners in each fire room and the OSB sheets along the ceiling of the rooms, while smoke migrated to the other rooms of the training structure, again banking down to the floor. For each scenario, firefighters suppressed the fires while pallet and OSB materials were still undergoing combustion as is typical in live-fire training, so these materials were not completely consumed in any trial.

- **Simulated smoke scenario** – An electronic means of simulating a fire that also incorporated simulated smoke generation (Attack Digital Fire System, Bullex; Albany, NY) was utilized in a building constructed from metal shipping containers to have an identical layout to a mid-20th century single family dwelling (Supplemental Materials, Fig. S1). Smoke was allowed to collect throughout the structure and bank down to limit visibility, similar to the conditions common in live-fire scenarios.

The order in which the training fire environments were introduced was mirrored for the alpha and bravo groups (Table 1). Each crew was composed of two firefighters assigned to fire attack who advanced the fire hose from an engine and suppressed all active fires, and two firefighters assigned to search and rescue who performed forcible entry and then searched for and rescued two simulated victims (75 kg manikins). During each scenario, two instructors acted as stokers to light the fires and control ventilation for fire and smoke development, two instructors assigned as company officers supervised the attack teams, and the remaining instructor was the officer in charge of the search and rescue operations. The firefighters and instructors maintained these roles throughout the study.

Both the firefighters and instructors were required to wear SCBA while inside the structures during the firefighting simulation. Instructors assigned as stokers donned their SCBA masks prior to ignition, while instructors assigned as company officers and the firefighters generally donned their SCBA masks just before entry. A few donned their SCBA masks as soon as they exited the apparatus, although this was left up to the individual firefighter. Both the instructors and firefighters spent similar amounts of time inside the structures during smoky conditions (~10 min).

After each exercise, the firefighters and instructors doffed their turnout gear in a large open bay with ample ventilation and then promptly entered an adjacent climate-controlled transport container for specimen collection. Investigators performed surface sampling and wet-soap decontamination of the turnout gear as previously described (Fent et al., 2017). The firefighters' turnout gear was decontaminated after each exercise and the instructors' turnout gear was decontaminated at the end of each training day. Field decontamination was done because it is considered a best practice (if laundering cannot be done) and to reduce the potential for turnout gear to act as another source of exposure with subsequent use. The firefighters and instructors were also provided with cleansing wipes to use for decontaminating their skin,

which all firefighters and most instructors used during rehab (within the first 10 min following each training exercise).

2.3. Urine sampling and analysis

Firefighters provided spot urine samples pre-firefighting and 3-hr post-firefighting for all training exercises (n = 24 firefighters per scenario). Previous work has indicated that 3-hr post exposure may represent peak excretion of many PAH biomarkers (Fent et al., 2014; Fent et al., In Press-b). We collected urine from instructors before the first crew's training exercise (pre-firefighting), right after the second crew's training exercise (~3 h after first scenario), and 3-hr after the last crew's training exercise (~9 h after first scenario) (n = 10 instructors per scenario). The last sample collected from instructors each day represented the end-of-shift sample.

Urine samples (144 from firefighters and 90 from instructors) were shipped to the CDC National Center for Environmental Health to be analyzed for mono-hydroxylated PAH metabolites (OH-PAHs). Briefly, after enzymatic hydrolysis of conjugated OH-PAHs in urine (100 µL), the target OH-PAHs were quantified by online solid phase extraction coupled with high performance liquid chromatography-isotope dilution tandem mass spectrometry. Limits of detection (LODs) ranged from 8 to 90 ng/L, depending on the analyte (Wang et al., 2017).

Creatinine was measured using a Vitros Autoanalyzer (Johnson & Johnson, New Brunswick, NJ). Cotinine, a metabolite of nicotine, was measured using the Immulite® 2000 immunoassay system (Siemens Corp., Washington, DC). Cotinine concentrations were used to confirm current non-tobacco use status of the participants and to quantify possible exposure to environmental tobacco smoke (ETS), another source of PAH exposure (Suwan-ampai et al., 2009). The vast majority of urine samples (96%) had cotinine levels consistent with non-tobacco use status and no ETS exposure (< 10 ng/mL).

2.4. Exhaled breath sampling and analysis

Exhaled breath samples were collected from firefighters before and immediately after each scenario. Previous research has suggested that peak VOC breath concentrations occur right after firefighting (Fent et al., 2014; Fent et al., In Press-b). For instructors, breath samples were collected before the first crew's exercise and immediately after both the second and third crew's exercise. For the simulated smoke scenario, only two instructors and two firefighter per crew (n = 4 and 12, respectively) were sampled because we expected minimal VOC exposure during this scenario. All participating firefighters (n = 24 firefighters per scenario) and instructors (n = 10 instructors per scenario) were sampled for the other scenarios.

Breath samples were collected within 3–4 min after doffing SCBA. Participants were instructed to take a deep breath in and then forcefully exhale their entire breath into the Bio-VOC™ sampler (Markes International, Inc., Cincinnati, OH), which serves to collect the final 129- mL of breath. The collected air was pushed through Markes thermal desorption tubes (Carbograph 2TD/1TD dual bed tubes). The thermal desorption tubes were capped and stored at −20 °C until shipment to the U.S. Environmental Protection Agency analytical laboratory.

The method used to analyze the breath samples for benzene, toluene, ethylbenzene, and styrene is described in detail elsewhere (Geer Wallace et al., 2017). Method detection limits ranged from 0.14 ng/tube (styrene) to 1.1 ng/tube (ethylbenzene). The ng on tube was converted to ng/L by dividing by the total breath volume collected (129 mL) and results are reported as parts per billion by volume (ppbv).

2.5. Data analysis

We used instrumental readings for the OH-PAH metabolite results < LOD (3.7%). The OH-PAH concentrations were normalized by creatinine. To simplify the analyses, the individual OH-PAH concentrations of each parent compound were summed together to create the following variables: hydroxyphenanthrenes, hydroxynaphthalenes, and hydroxyfluorenes. In addition, some analyses were performed on the sum of all OH-PAH concentrations (ΣOH-PAHs).

Benzene, toluene, ethylbenzene, and styrene were non-detectable in 21, 8.1, 69, and 44% of the breath samples. We estimated breath concentrations < LOD using ordered imputations and Q-Q plots as described in Pleil et al. (Pleil, 2016a, b). This method relies on plotting the natural log of the compound concentrations (minus non-detects) versus the Z-scores to obtain a linear best fit equation. This equation is then used to impute values for the samples with concentrations < LOD by plugging the corresponding calculated Z-scores into the obtained equation.

All statistical analyses were performed in R version 3.4.3. Quartiles were used to summarize data. Since data were skewed, values were log-transformed for all statistical analyses. The Shapiro-Wilk test for normality was performed on the log-transformed data and it was determined that data did not violate the normality assumption. The difference between pre and post measurements were calculated and, since each individual participated in multiple scenarios, mixed linear models were used to control for repeated measures in testing whether the differences were different than 0 as well as to compare differences between groups.

3. Results

3.1. Urinary excretion of PAHs after training exercises

Figs. 1 and 2 provide a comparison of the hydroxyphenanthrenes and 1-hydroxypyrene results in urine over time between firefighters and instructors for the three types of scenarios, with further stratification between the two types of OSB. The Supplemental Materials provide the hydroxynaphthalenes and hydroxyfluorenes results (figs. S3–S4), as well as summary statistics for all the biomarkers that were measured (table S1). Firefighters had a significant increase in OH-PAH concentrations 3-hr after training for all scenarios ($p \leq 0.001$). Furthermore, instructors' OH-PAH concentrations increased steadily throughout each training day and by the end of the shift were significantly greater than the pre-training levels for all scenarios ($p \leq 0.001$). The relative magnitude of these increases generally followed the pattern: bravo OSB > alpha OSB > pallet and straw > simulated smoke. For firefighters undergoing the bravo OSB training scenarios, hydroxyphenanthrenes had the largest pre-to 3-hr post-training urine concentration increase on a percentage basis (median +1074%) while hydroxynaphthalenes had the largest increase on a unit basis (median +32.7 µg/g). For instructors in the bravo OSB training scenarios, 1-hydroxypyrene showed the largest pre-to end-of-shift percentage increase in concentrations (median +2860%) and hydroxynaphthalenes had the largest unit increase (median +34.3 µg/g).

We compared the pre-to 3-hr post training change in OH-PAHs for firefighters to the pre 1st exercise to post 2nd exercise change in OH-PAHs for instructors, as the timing of these biological samples were similar. Although instructors completed two training exercises between their urine collection sessions, exposures from their second training exercise was unlikely to contribute to their post 2nd exercise urine concentrations because of the timing of the collections (Fent et al., 2014). The change in urine concentrations did not differ significantly between firefighters and instructors (for all scenarios combined) except for 1-hydroxypyrene (firefighters +103%, instructors +46%, $p = 0.015$) and hydroxyphenanthrenes (firefighters +234%, instructors +188%, $p = 0.047$). Stratifying by type of scenario, only hydroxyphenanthrenes during the bravo OSB scenario differed significantly ($p = 0.026$) between firefighters (+1074%) and instructors (+316%). Importantly, we found no differences between firefighters

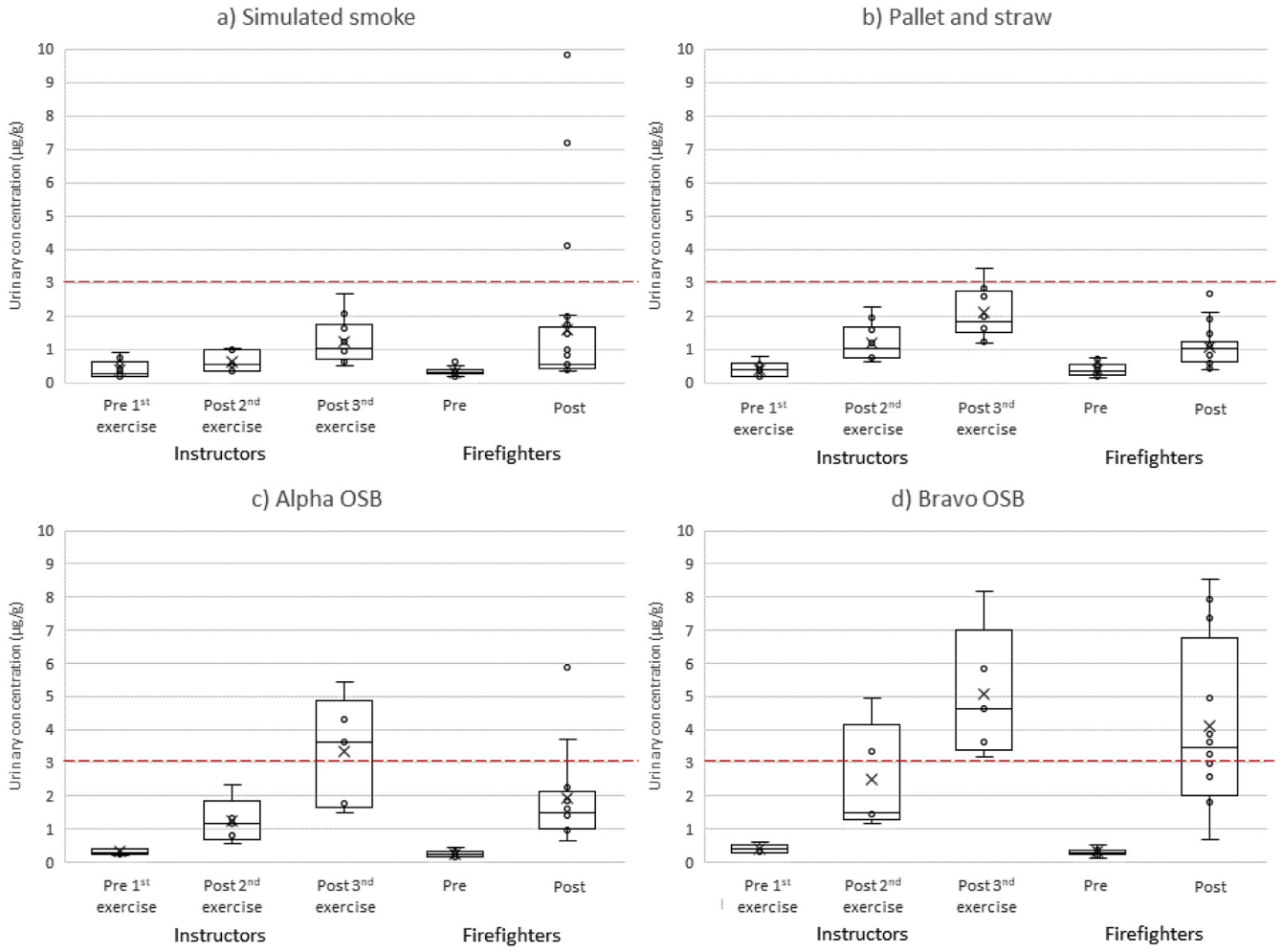


Fig. 1. Urinary concentrations of **hydroxyphenanthrenes** by participant type and collection period for training scenarios using a) simulated smoke, b) pallet and straw, c) alpha OSB, and d) bravo OSB. The lower quartile, median, and upper quartile are shown with the box and whiskers (excluding outliers 1.5 times greater or less than the upper and lower quartiles). The mean of the distribution is shown by X. A red dashed line representing the median 3-hr post-firefighting concentration (3.1 µg/g) measured from attack and search firefighters during our residential fire study (Fent et al., In Press-b) is provided for comparison. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

and instructors for the change in ΣOH-PAHs. In a related paper, we found that instructors had lower air concentrations of total PAHs than firefighters, but instructors had longer duration exposures, which could explain the similar magnitude of absorption in comparison to firefighters (Fent et al., In Press-a).

To further explore the impact of repeated exposures on OH-PAH concentrations, we compared instructors' pre-to end-of-shift change in concentrations (for all scenarios combined) to firefighters' pre-to 3-hr post-training change in concentrations (for all scenarios combined). Differences were statistically significant for 1-hydroxypyrene (firefighters +103%, instructors +397%, $p < 0.001$) and hydroxyphenanthrenes (firefighters +234%, instructors +480%, $p = 0.046$).These findings suggest cumulative exposures to PAHs in the instructors from overseeing multiple training exercises in a day.

The simulated smoke exercises are not expected to have produced PAHs because no combustion took place, which is supported by our previously published air sampling results (Fent et al., In Press-a). To further investigate why the participants experienced biological uptake of PAHs during these exercises, we compared the urinary concentrations of the alpha (started with simulated smoke) and bravo (ended with simulated smoke) participants to each other (Supplemental Materials, table S2) to determine whether the order of the scenarios had any effect. We found significantly greater ($p < 0.001$) pre-to 3-hr post-training increases in the ΣOH-PAHs during the simulated smoke scenario for the bravo firefighters (+538%) than the alpha firefighters (+48%). Similarly, the bravo instructors had significantly greater ($p = 0.023$) pre-to end-of-shift increases (+248%) in the ΣOH-PAHs than the alpha instructors (+89%). As is commonly the case, the hydroxynaphthalenes were the dominant species in the ΣOH-PAHs. These results suggest another source of PAHs was present during the simulated smoke training that was more abundant during the bravo exercises. However, it is unclear what the source of this contamination was and why this effect was more pronounced in firefighters than instructors.

We also explored the effect of job assignment by comparing the change in urine concentrations of OH-PAHs between the fire attack and search positions for the firefighters and between stoker and company officer positions for the instructors (data not shown). The changes in ΣOH-PAHs were similar between these comparison groups, with p-values > 0.4 for stoker vs. Officer instructors and p-values > 0.13 for attack vs. search firefighters.

Table 2 provides a comparison between the U.S. general non-smoking adult population urine concentrations of individual OH-PAHs to the firefighters' median 3-hr post-training concentrations and instructors' end-of-shift concentrations. These time points represent the peak excretion identified within the constraints of this study. It is important to note that the firefighters and instructors started each study day with many of the OH-PAH concentrations above (≤2-fold) general

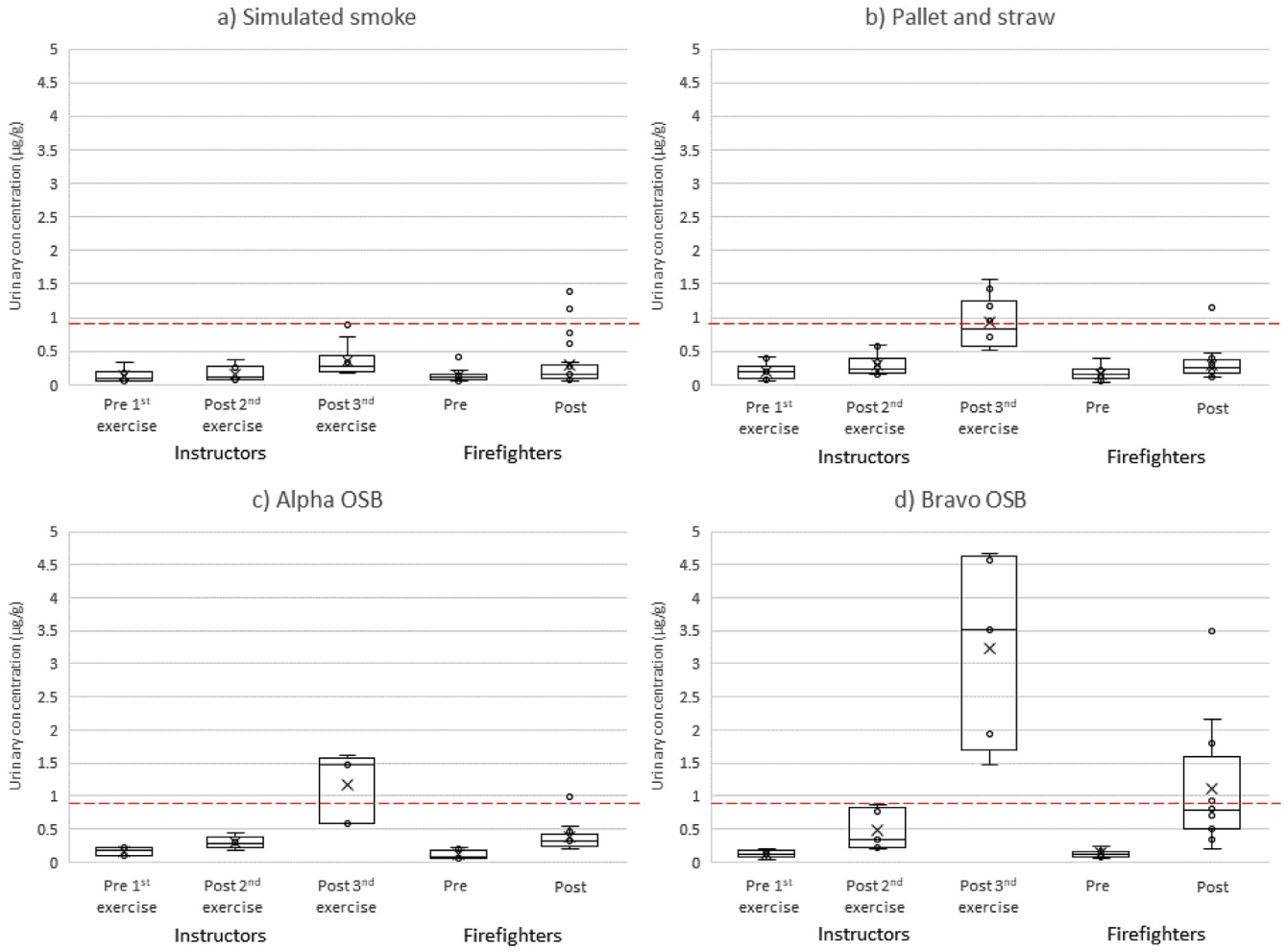


Fig. 2. Urinary concentrations of **1-hydroxypyrene** by participant type and collection period for training scenarios using a) simulated smoke, b) pallet and straw, c) alpha OSB, and d) bravo OSB. The lower quartile, median, and upper quartile are shown with the box and whiskers (excluding outliers 1.5 times greater or less than the upper and lower quartiles). The mean of the distribution is shown by X. A red dashed line representing the median 6-hr post-firefighting concentration (0.81 µg/g) measured from attack and search firefighters during our residential fire study (Fent et al., In Press-b) is provided for comparison. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

population medians. Regardless of the scenario, the firefighters' and instructors "peak" concentrations of individual OH-PAHs were significantly higher ($p < 0.05$) than their pre-training concentrations (with the exception of 1-hydroxynaphthalene measured during the simulated smoke scenario). In addition, many of the firefighters' and instructors' peak urine concentrations after live-fire scenarios (OSB and pallet and straw) were greater than the respective 95th percentiles of the general population.

3.2. Exhaled breath concentrations of VOCs after training

Table 3 provides the percent change in exhaled breath concentrations of VOCs for firefighters and instructors by training scenario, and Fig. 3 provides the specific results for benzene. In general, exhaled breath concentrations increased from the pre-training levels for all scenarios except the simulated smoke exercises, which had mixed results (although most VOC concentrations declined). For firefighters, the change in breath concentrations during bravo OSB training scenario was significantly greater than the alpha OSB training scenario for all analytes ($p < 0.05$). A similar pattern was found for instructors when comparing the change in breath concentrations of benzene (pre 1st exercise to post 2nd exercise) by the two types of OSB; however, the difference was not statistically significant ($p = 0.161$). The change in breath concentrations for instructors and firefighters generally did not differ (for all scenarios combined), with one exception for styrene (instructor pre 1st exercise to post 3rd exercise change +599% vs. Firefighter pre to post change +79%, $p < 0.001$). As with the OH-PAHs, job assignment for firefighters and instructors did not affect the change in exhaled breath concentrations ($p > 0.05$ for all VOCs and scenario combinations).

4. Discussion

This study improves our understanding of firefighters' and instructors' exposures during training exercises commonly performed at training institutes in the United States and many other countries around the world. The most important results of this study are: 1) firefighters and instructors are exposed to combustion byproducts even when wearing SCBA throughout the training exercise, and 2) firefighters and instructors undergoing training exercises involving OSB experienced higher exposures than pallet and straw (alone) as the fuel source. Furthermore, there is strong evidence of instructors' increasing cumulative exposure to PAHs with repeated training exercises. This is an important finding because instructors commonly oversee numerous live-fire training exercises during a single day and such activity may be repeated many days over the course of a year.

For the OSB training exercise, two types of OSB were used. It is not possible to be certain of the relative proportion of different adhesives in

Table 2
Comparison of urinary OH-PAH metabolite concentrations measured from ***firefighters*** 3 h after each training exercise and measured from ***instructors*** at the end of each shift to the non-smoking adult general population (μg/g creatinine).

OH-PAH biomarker	NHANES 2011–2012 data for 20–49 year old non-smokers[a]		Firefighters' median 3-hr post-firefighting concentrations by scenario				Instructors' median end-of-shift concentrations by scenario				
	Median	95th percentile	Simulated smoke (n = 24)	Pallet and straw (n = 24)	Alpha OSB (n = 12)	Bravo OSB (n = 12)	Simulated smoke (n = 10)	Pallet and straw (n = 10)	Alpha OSB (n = 5)	Bravo OSB (n = 5)
1-Hydroxynaphthalene	1.0	6.2	2.2	3.6	8.6	**21**	3.3	6.8	**17**	**22**
2-Hydroxynaphthalene	3.7	16.4	8.4	7.5	12	**20**	13	14	**18**	**17**
1-Hydroxyphenanthrene	0.12	0.47	0.23	0.38	0.49	**1.3**	0.32	0.72	**1.4**	**1.5**
2-Hydroxyphenanthrene and 3-hydroxyphenanthrene[b]	0.13	0.48	0.33	0.55	0.93	**2.3**	0.67	1.2	**2.2**	**3.0**
1-Hydroxypyrene	0.10	0.33	0.15	0.26	0.32	0.78	0.27	0.84	**1.5**	**3.5**
2-Hydroxyfluorene	0.18	0.64	0.45	0.55	0.96	**1.5**	0.88	1.3	**1.5**	**2.2**
3-Hydroxyfluorene	0.07	0.25	0.18	0.19	0.29	**0.45**	0.21	0.58	**0.68**	**0.92**

[a] Fourth National Report on Human Exposure to Environmental Chemicals, Updated Tables, March 2018, Volume Two (NCEH, 2018).

[b] 2-Hydroxyphenanthrene and 3-hydroxyphenanthrene were reported separately for 2011–2012 NHANES data. Thus, 2013–2014 NHANES summary statistics are provided for 2-hydroxyphenanthrene and 3-hydroxyphenanthrene (combined) for general population 20 years and older (which may include smokers). Values that are bolded were higher than the median concentrations measured from attack and search firefighters in our residential fire study (Fent et al., In Press-b).

the two OSB products as this is proprietary information. Median area air concentrations of methyl isocyanate, phenyl isocyanate, and MDI during the bravo OSB exercises were higher than the alpha OSB exercises, although the differences were not statistically significant (Fent et al., 2019a). This could suggest that the bravo OSB (with < 0.01% free formaldehyde) contained higher amounts of pMDI adhesives than the alpha OSB (with < 0.1% free formaldehyde). Differences in the types and amounts of adhesives used in the alpha and bravo OSB could have influenced the production of PAHs during combustion. PAH emissions could be further affected by the slightly different amounts of OSB used (i.e., 1.5 sheets of 7/16″ OSB for alpha vs. effectively 1.5 sheets of 1/2" OSB for bravo). However, the OSB sheathing was not fully consumed in the fires, so the exposure was not limited by the mass of fuel in any of the OSB scenarios. Other factors such as ventilation and temperature could also affect the production of combustion byproducts; although these factors were standardized to the extent possible among the different scenarios.

PAH and benzene exposures from the bravo OSB exercises (based on urine OH-PAH and breath VOC concentrations) were consistently higher than the alpha OSB exercises, which may be expected if the bravo OSB contained higher quantities of adhesives. Previously, we showed that the bravo OSB produced significantly ($p < 0.01$) higher personal air concentrations of total PAHs and benzene than the alpha OSB. If OSB is to be used for live fire training burns, OSB with the least amount of synthetic adhesives should be selected when possible. However, this information is not always readily available from the suppliers.

Prior to this study, we investigated firefighters' exposures during controlled residential fires involving household furnishings using the same methodology. We hypothesized that the firefighters and instructors would have lower PAH and benzene exposures from training fires than residential fires involving a variety of typical synthetic materials including foams, plastics, and textiles. On a per training fire basis, exposures were generally below what was measured from attack and search firefighters during the residential fire study (who conducted similar firefighting tasks and timeframes as in the current study) for all training scenarios other than the bravo OSB exercises. For example, firefighters and instructors had higher median urinary concentrations of hydroxynaphthalenes and hydroxyfluorenes ~3-hr after the bravo OSB exercises than reported during the same time period in the residential fire study (see Figs. S3 and S4 in Supplemental Materials).

It is important to consider the pre-to post-firefighting unit changes for breath results when comparing the training and residential fire studies because background levels on the breath tubes varied. For example, the 611% increase in exhaled breath concentrations of benzene for firefighters after the bravo OSB exercises is due to a unit increase of 18 ppbv, which is less than the median increase found for attack and search firefighters in the residential fire study (+24 ppbv). Interestingly, we found very little, if any, increase in breath concentrations of toluene, ethylbenzene, and styrene in the residential fire study (e.g., < 0.45 ppb increase for attack and search firefighters). However, for the present training fire study, we generally found marked increases in these VOCs in breath for all scenarios except for the simulated smoke exercises (Table 3). While median personal air concentrations of these VOCs were higher for the training fires (OSB and pallet and straw) than the residential fires (Fent et al., 2019a), the levels were at least an order of magnitude below applicable occupational exposure limits (ACGIH, 2018; NIOSH, 2010). Personal air concentrations of benzene for both the training fires (other than simulated smoke) and residential fires, on the other hand, were well above the NIOSH short-term exposure limit (1 ppm) (National Institute for Occupational Safety and Health, 2010), and may present a greater concern for toxicity, especially with repeated exposures.

Whereas the firefighters only participated in one training exercise per day, the instructors supervised three exercises per day. For both of the OSB scenarios, instructors' end-of-shift median urine concentrations

Table 3
Median change in exhaled breath concentrations during training scenarios.

Scenario	Participant	Comparison	n	Benzene		Toluene		Ethyl benzene		Styrene	
				ppbv	%	ppbv	%	ppbv	%	ppbv	%
Simulated smoke	Firefighters	Pre to post	12	−0.6	−15	−0.0	+0	+0.0	+172	−0.1	−28
	Instructors	Pre 1st to post 2nd exercise	4	−2.1	−38	−1.0	−45	−0.2	−44	−1.0	−65
		Pre 1st to post 3rd exercise	4	+1.4	+29	+1.3	+51	−0.1	−17	+2.9	+176
Pallet and straw	Firefighters	Pre to post	24	**+2.8**	**+99**	**+0.4**	**+55**	**+0.1**	**+553**	**+0.1**	**+99**
	Instructors	Pre 1st to post 2nd exercise	10	+0.9	+46	+0.2	+34	**+0.1**	**+773**	+0.2	+259
		Pre 1st to post 3rd exercise	10	+0.6	+20	+0.3	+40	**+0.2**	**+1134**	**+1.0**	**+1831**
Alpha OSB	Firefighters	Pre to post	12	**+6.6**	**+195**	**+1.2**	**+105**	+0.1	+63	−0.0	−1
	Instructors	Pre 1st to post 2nd exercise	5	+3.6	+149	+0.7	+73	+0.1	+25	+0.2	+25
		Pre 1st to post 3rd exercise	5	+3.0	+109	**+1.0**	**+63**	+0.0	+4	**+3.8**	**+572**
Bravo OSB	Firefighters	Pre to post	12	**+18.0**	**+611**	**+3.1**	**+292**	**+0.4**	**+669**	**+0.8**	**+460**
	Instructors	Pre 1st to post 2nd exercise	5	**+11.0**	**+327**	**+1.4**	**+162**	+0.2	+244	+0.2	+51
		Pre 1st to post 3rd exercise	5	+5.9	+165	**+1.2**	**+125**	**+0.2**	**+281**	**+1.9**	**+550**

Bolded values represent statistical significance at $p < 0.05$.

of all OH-PAHs were above the concentrations measured 3-hr after firefighting from attack and search firefighters in the residential fire study. In particular, 1-hydroxypyrene was 3.5-fold greater (Fig. 2), which is 35-times higher than the general population median. Of the PAH urine metabolites examined in this study, 1-hydroxypryene correlates most closely with the higher molecular weight PAHs (≥4 rings), many of which tend to be excreted in feces. Of these higher molecular weight PAHs, benzo[a]pyrene is a known human carcinogen widely considered the most toxic PAH (IARC, 2010). Our previous work shows that the composition of airborne PAHs were consistent across the OSB and pallet and straw scenarios, with benzo[a]pyrene constituting ~1% of the mixture. In contrast, naphthalene was the most abundant PAH measured in air, constituting 66–68% of the mixture (Fent et al., 2019a).

For all scenarios, firefighters' and instructors' OH-PAH urine concentrations (reported in Table 2) were greater than the medians for

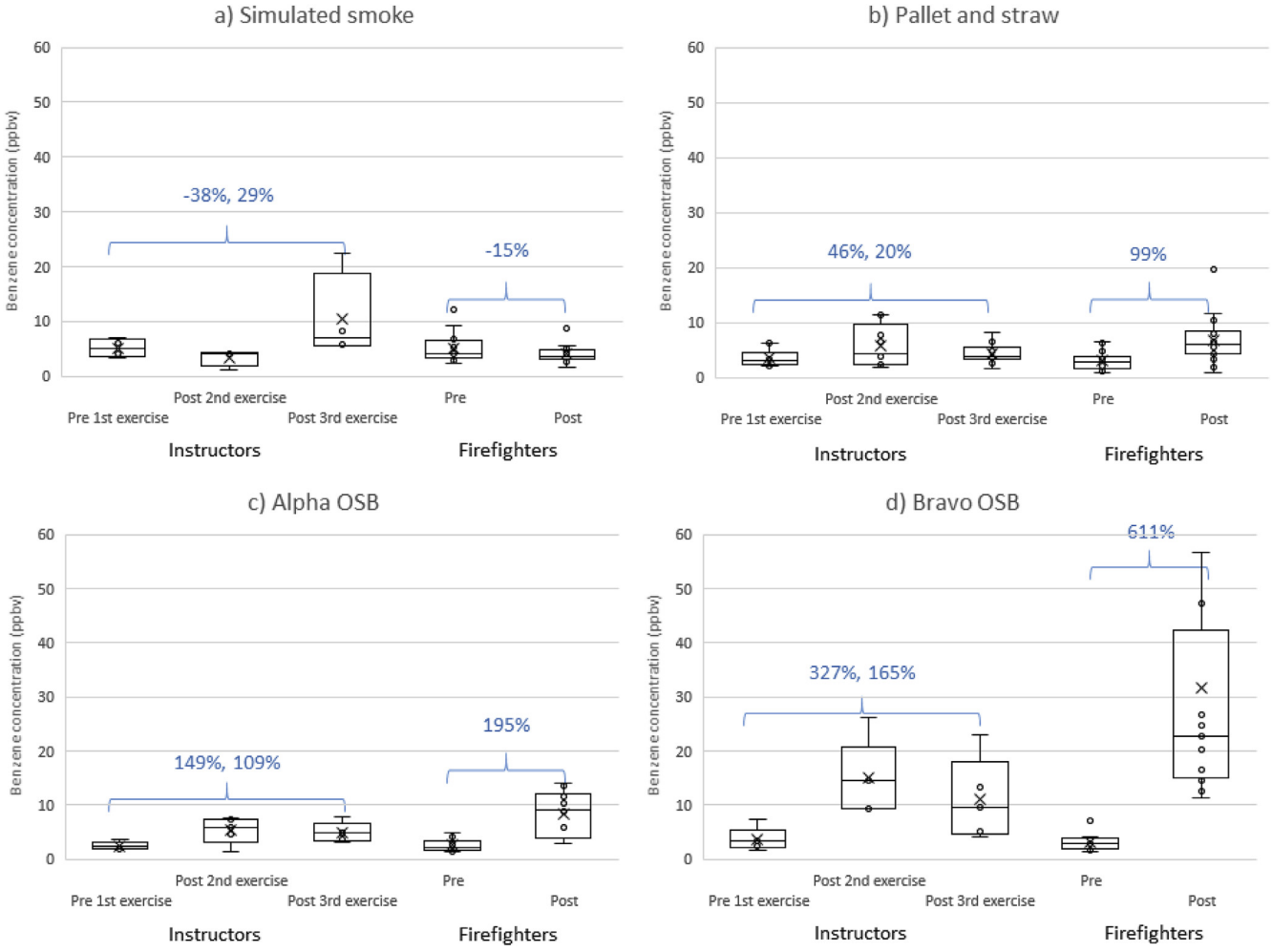


Fig. 3. Exhaled breath concentrations of **benzene** by participant type and collection period for training scenarios using a) simulated smoke, b) pallet and straw, c) alpha OSB, and d) bravo OSB. The percent change from pre-training levels are provided for instructors and firefighters.

non-smoking adults in the general population. Nearly all of the OH-PAHs measured after the OSB scenarios (and a few metabolites during the pallet and straw scenario) exceeded the 95th percentiles of the general population. The median end-of-shift concentration of 1-hydroxypryene measured from instructors after the bravo OSB scenario (3.5 μg/g) is within the range of average concentrations in gas workers (0.3–7.7 μg/g) and road pavers (1.2–3.5 μg/g), who are among the more exposed worker populations (Huang et al., 2004). Maximal urinary excretion of 1-hydroxypyrene following ingestion of PAHs has been estimated at 5.5 h (Li et al., 2012), and we previously found maximal excretion 6 h after firefighting (Fent et al., 2019b); thus, our study design may not have captured the peak urinary concentration of this metabolite. It is also important to note that PAHs and VOCs only represent a portion of the combustion products that are produced during fires, so caution should be exercised when interpreting the concentrations of only these compounds in firefighters relative to other populations. In addition, the firefighters and most of the instructors in this study used cleansing wipes post-training and all showered within an hour of completing their exercises each day. We have shown previously that commercial cleansing wipes can remove a median of 54% of PAH contamination from skin (Fent et al., 2017). Without these measures, we expect that exposures would have been even greater.

One unexpected finding from this study was the increase in ΣOH-PAHs during the simulated smoke exercises. Upon closer examination, we found statistically significant differences between the alpha and bravo groups ($p \leq 0.002$), where the bravo firefighters and instructors experienced higher post-training increases in urine OH-PAHs. Efforts were taken to minimize the firefighters' and instructors' exposures from peripheral sources at the training institute. For example, no live-fire training was permitted on the IFSI campus during the week other than the training required for the study. All turnout gear had been laundered before the start of the study, and field decontamination (using water, dish soap, and scrubbing) was used to clean the gear during the study. Although this type of decontamination has been shown to be effective (removing a median of 85% of PAHs on the outer shell) (Fent et al., 2017), some residual contamination will remain on the turnout gear. Moreover, field decontamination does little for contaminants on the inner liner of the gear that can directly contact firefighters' skin.

Because the alpha participants performed simulated smoke training first, any PAHs on their turnout gear (post-laundering) should have been low, although, laundering may not remove 100% of PAH contaminants (Mayer et al., 2018). The bravo participants, however, performed simulated smoke training last. As such, their gear would have received contamination from the OSB and pallet and straw scenarios performed 4 and 2 days prior, respectively. Thus, PAHs not removed via field decontamination could have been available for biological uptake upon subsequent use of the turnout gear as suggested by Stec et al. (2018). Any residual naphthalene could off-gas and be inhaled by the participants when not wearing SCBA. In addition to contaminated turnout gear, other sources of PAH exposure at the training institute (e.g., contaminants deposited in turnout gear storage area) cannot be ruled out. It is also important to note that the sample sizes (statistical power) were small, especially for the instructors (where $n = 5$ for each comparison group). Further research on how contaminated gear contributes to firefighters' exposure to PAHs is warranted.

5. Conclusions

Biological monitoring can be affected by a number of factors, such as physiological makeup and metabolism of workers, work-rate intensity and duration, and PPE use and maintenance. Thus, it is prudent to be cautious when comparing results between studies. Overall, this study suggests that live-fire training may expose firefighters and instructors to hazardous chemicals. Their dose will depend on the number of training fires and type of fuel package. Instructors' PAH exposures may be higher from repeated training fires than responding to a single emergency residential fire. Likewise, training fires will result in the uptake of benzene and other VOCs. Contamination on turnout gear may also contribute to the biological uptake of PAHs upon subsequent use. Exposures from training fires over time could increase firefighters' and instructors' risk of developing certain types of cancer. Efforts should be taken to reduce these exposures, including donning SCBA before approaching the structure, cleaning skin as quickly as possible (preferably immediately after exiting the structure), laundering turnout gear after live-fire training (or field decontamination if laundering cannot be done), showering as soon as possible following training, and selecting training fuels to provide realistic training while limiting unnecessary exposures for firefighters and instructors.

Declarations of interest

None.

Conflicts of interest

The authors declare that they have no competing financial interest in relation to the work described.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijheh.2019.06.006.

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Methylene Diphenyl Diisocyanate (MDI) And Related Compounds Action Plan [RIN 2070-ZA15]

I. Overview

This Action Plan addresses the use of methylene diphenyl diisocyanate (MDI) and related compounds (See Appendix 1) in products that may result in consumer and general population exposures, particularly in or around buildings, including homes and schools. Diisocyanates are well known dermal and inhalation sensitizers in the workplace and have been documented to cause asthma, lung damage, and in severe cases, fatal reactions. This Action Plan focuses on the potential health effects that may result from exposures to the consumer or self-employed worker while using products containing uncured (unreacted) diisocyanates (e.g., spray applied foam sealants, adhesives, and coatings) or incidental exposures to the general population while such products are used in or around buildings including homes or schools. In conducting this review of MDI compounds, EPA considered a number of potential actions, including regulatory actions under TSCA sections 4, 5, 6, and 8; cooperative actions with other federal agencies; and voluntary actions.

II. Introduction

As part of EPA's efforts to enhance the existing chemicals program under the Toxic Substances Control Act (TSCA)[1], the Agency identified an initial list of widely recognized chemicals, including MDI, for action plan development based on their presence in human blood; persistent, bioaccumulative, and toxic (PBT)[2] characteristics; use in consumer products; production volume; and other similar factors. This Action Plan is based on EPA's initial review of readily available use, exposure, and hazard information[3] on MDI. EPA considered which of the various authorities provided under TSCA and other statutes might be appropriate to address potential concerns with MDI in developing the Action Plan. The Action Plan is intended to describe the courses of action the Agency plans to pursue in the near term to address its concerns and does not constitute a final Agency determination or other final Agency action. Regulatory proceedings indicated by the Action Plan will include appropriate opportunities for public and stakeholder input, including through notice and comment rulemaking processes. In a concurrent action, a separate Action Plan is under development for Toluene Diisocyanate (TDI), a substance chemically related to MDI with similar hazard and exposure concerns.

[1] 15 U.S.C §2601 et seq.

[2] Information on PBT chemicals can be found on the EPA web site at http://www.epa.gov/pbt/.

[3] Sources initially consulted for basic background information for all the action plan chemicals, including MDI, include Inventory Update Report (IUR) submissions; Toxic Release Inventory (TRI) reporting; data submitted to the HPV Challenge Program; existing hazard and risk assessments performed by domestic and international authorities including but not limited to U.S. Federal government agencies, the Organization for Economic Cooperation and Development, the Stockholm Convention on Persistent Organic Pollutants, Health and Environment Canada, the European Union; and others. Details about the specific sources used for this Action Plan can be found in the reference list in Section XI. of this document.

III. Scope of Review

Diisocyanates (also commonly known as isocyanates) are highly reactive and versatile chemicals with widespread commercial and consumer use. Over 90% of the diisocyanates' market is dominated by two diisocyanates and their related polyisocyanates: MDI and toluene diisocyanate (TDI) (Allport *et al.*, 2003). They have unique properties and functional versatility, and contain free isocyanate functional groups (-N=C=O). When isocyanates are combined with other compounds that contain free hydroxyl functional groups (i.e. –OH) they react and begin to form polyurethane polymers. This chemical reaction is completed when all of the initially free –N=C=O groups are bound within the polymer network. This process is commonly referred to as "curing." Products that contain free –N=C=O groups are intended to react and undergo "curing" in the process of use. An example would be an adhesive, which is sold to be initially applied in an uncured form and as it cures (hardens), bonds two pieces of wood together. Other polyurethane products, such as mattresses, pillows, and bowling balls, are considered completely cured products before they are sold. Completely cured products are fully reacted and therefore are considered to be inert and non-toxic (Krone & Klinger, 2005). This Action Plan focuses on concerns for unreacted uncured products.

Because of their reactivity and the diversity of uses, MDI and its related polyisocyanates (see Appendix 1) are generally supplied by their manufacturers as raw materials to formulators who take advantage of the diisocyanates' chemistry to combine them with other chemicals to create different polyurethanes with a wide diversity of applications. This diversity of applications also means that exposures to diisocyanates can occur in a broad range of production facilities from small workshops to automated production lines. Diisocyanates are potent dermal and lung sensitizers and a major cause of work-related asthma worldwide (NIOSH, 2006). Diisocyanates are also commonly available in unreacted forms as part of product mixtures widely used in construction, automotive, and other similar applications that require an end-use reaction as part of the functional performance of these products. Such applications occurring beyond the confines of a controlled production facility could result in exposures unless there is careful observance of best practices and controls to prevent exposures, including the use of protective equipment, containment, ventilation, proper clean-up practices, and medical surveillance of anyone who may be exposed.

In the past, consumer exposures have not been a focus of concern with respect to diisocyanates, because it has been assumed that consumers were generally exposed to products containing cured polyurethanes, which have been generally considered to be inert and non-toxic (Krone & Klinger, 2005). However, an increase in the consumer availability of polyurethane products intended to further react and undergo "curing" has occurred in the marketplace (see additional discussion in section on *Consumer/General Population Exposure*). For example, installation of spray polyurethane foam insulation in homes, schools and other public buildings is a source of potential exposure to uncured isocyanates by building occupants, as well as in do-it-yourself (DIY) consumer projects. Readily available consumer products, such as adhesives (including glues) and sealants also contain diisocyanates that are not completely reacted when applied and can provide potential exposures (Krone, 2004; Bello *et al.*, 2007). In addition, certain workers (e.g., self-employed) are not subject to the applicable OSHA exposure limits, and are not legally required to receive health and safety training and chemical hazard

information, or wear personal protective equipment (PPE) or undergo medical surveillance and therefore could potentially be overexposed to uncured polyurethane products.

EPA is concerned about the presence of uncured MDI in products used by or around consumers, as well as other unprotected building occupants, and the lack of guidance or regulations to protect them, this action plan focuses on the potential health effects that may result from exposures to the consumer or self-employed worker while using products containing uncured MDI, or incidental exposures to the general population while such products are used in or around buildings, including homes or schools.

IV. Uses and Substitutes Summary

MDI and TDI are the largest volume aromatic diisocyanates, are high production volume chemicals, and are predominantly used in the production of polyurethanes. In 2008, the U.S. demand for pure MDI was 192.1 million pounds and for polymeric MDI was 1,418 million pounds (ACC, 2009). There are many types of polyurethane products in the marketplace, with foams representing the largest sector of the polyurethane industry. Non-foam polyurethane use sectors of MDI and polymeric MDI include coatings, adhesives, binders, and sealants. However, these products comprise a small amount of the total production volume. Polyurethane foams take two forms: flexible and rigid. Flexible foam is primarily used for cushioning, while rigid foam is used mainly for insulation. The majority of polyurethane products undergo curing prior to reaching the consumer. However, other polyurethane products such as spray foams, coatings, sealants and adhesives may be sold and used, most often in a mixture of formulated product, in an uncured form. Researchers looking at workplace exposures to diisocyanates have noted an increase in the number of isocyanate-containing products used by consumers. These researchers also noted that community exposures to isocyanates could potentially result from industrial exposures as well as the use of consumer products containing isocyanates (Redlich, et al, 2006).

The 2006 Inventory Update Reporting (IUR) database indicates that MDI chemicals are used in the following consumer/commercial categories: adhesives and sealants; paints and coatings; transportation products; rubber and plastic products; and lubricants, greases and fuel additives (EPA, 2010). The vast majority of these products contain forms of MDI as the diisocyanate components. To reduce vapor hazards, polyisocyanates and pre-polymer forms of isocyanates were developed; however, many products contain a mixture of MDI monomer and a MDI-based polyisocyanate.

The use of polyurethane foam for insulation is greatly expanding as many federal and state government programs create incentives for their use in increasing energy efficiency. In addition to their traditional uses by commercial applicators to insulate roofs and walls of buildings, pour-in-place foam, spray polyurethane foam (SPF) and one-component foam (OCF) have a variety of other uses. Pour-in-place, SPF, and OCF cans are all used in the arts arena for sculpture, mold making, and designing movie and theater sets. They are similarly used in theme parks, shopping malls, and parade floats (ACC, 2009). In addition, these types of foams are popularly used by arts and crafts hobbyists.

Other major types of non-foam polyurethane products sold for use in an uncured form include coatings and adhesives. The terms “coatings”, “sealants”, “binders”, and “adhesives” are

sometimes used interchangeably when referring to various polyurethane products and some industry sectors use some or all of those four types of products. In particular, the auto refinishing and repair, the marine leisure craft maintenance and repair (ACC, 2009), and the floor and deck maintenance and repair (Jarand *et al.*, 2002; ACC, 2009) sectors have all had a variety of uncured polyurethane products available to both the professional applicator as well as the DIY consumer. Additionally, the synthetic recreational surfacing industry uses a variety of polyurethane components in formulating its products for both indoor and outdoor surfaces (Advanced Polymer Technology Corporation, 2010). Polyurethane coatings are available for use by industry and consumers to seal concrete, waterproof walls and refinish floors. Polyurethane sealants have a variety of uses in the automotive sector, the largest being glass installation of windshields and side windows. Polyurethane adhesives are used in numerous industrial and consumer applications. Some of these products are specifically marketed to DIY consumers for general multi-purpose applications as well as for specialty uses in woodworking, bookbinding and other hobbies. Consumer use of adhesives and sealants is a growth sector as noted by an industry overview of this sector in late 2009. This growth reflects increasing numbers of DIY energy-conscious homeowners doing more of their own home renovation and repair work in order to save money, as well as from craftsmen and consumers generally continuing to use adhesives (Pianoforte, 2009). The spray foam industry, recognizing the growing use of these products by DIYers, recently developed a website on the use of spray foam with guidance directed specifically to DIYers, in addition to homeowners and professionals (ACC, 2010).

Replacement of diisocyanates in an environmentally and economically friendly manner presents a significant challenge. However, a new class of non-isocyanate polyurethanes that offers potentially safer alternatives to conventional polyurethanes has been reported by two research groups (Figovsky & Shapovalov, 2006; Javni *et al.*, 2008). Other reported technologies include an isocyanates-free expanding foam product (Soudal, 2010) and a faster curing "isocyanates-free" flexible food packaging adhesive that reportedly prevents potential migration of isocyanates into non-dry food. Of note, a soy-based adhesive intended to replace formaldehyde-urea adhesives received a Presidential Green Chemistry Award (EPA, 2009), but more research is needed to determine if soy-based adhesives would be an adequate substitute for polyurethane adhesives. While research and development of appropriate alternatives is underway with a goal of direct product substitutions, it is important to focus on the safe use of existing polyurethane products through hazard communication and educating product users.

V. Hazard Identification Summary

The toxicity studies discussed in this summary were carried out on MDI chemicals with unreacted (uncured) isocyanate functional groups.

Environmental and Ecological Hazards. Although there is a moderate acute ecotoxicity profile for MDI, the hazards associated with exposures to MDI chemicals have centered on human health effects not ecological effects. Experimental ecotoxicological data for MDI and its degradation products indicate moderate to low toxicity to aquatic organisms (Bayer, 1992; Bayer, 2000a; Bayer, 2000b; Bayer, 2000c; Bayer, 2009). Other toxicity data suggest low likelihood of effects to terrestrial biota such as plants and earthworms (Van der Hoeven *et al.*, 1992a; Van der Hoeven *et al.*, 1992b).

Toxicity in Humans. Most of the data on human health hazards resulting from diisocyanate exposures are based on occupational populations. These data indicate that exposure to diisocyanates can cause contact dermatitis, skin and respiratory tract irritation, immune sensitization, and asthma (NIOSH, 2006). It is well documented that isocyanate exposure is the leading cause of work-related asthma, and prevalence in the exposed workforce is estimated at 1-20% (Ott *et al.*, 2003; Bello *et al.*, 2004). Both inhalation and dermal exposures to diisocyanates are thought to contribute to the development of isocyanate asthma (Bello *et al.*, 2007; Liljelind *et al.*, 2010). Once a worker is sensitized to diisocyanates, subsequent exposures can trigger severe asthma attacks. Higher incidences of asthma are typically associated with processes that generate higher exposures, such as spray application or heated processes that generate airborne vapors and mists that can expose workers via respiratory and dermal routes. For example, the UK Health and Safety Executive reported that vehicle refinishers who spray coatings containing isocyanates have an 80 times higher risk of getting asthma compared with the UK working population. (HSE 2009) [http://www.hse.gov.uk/mvr/priorities/isocyanates.htm/].
Fewer cases of diisocyanate asthma have been reported in work settings with lower isocyanate airborne exposures, and most workers who developed diisocyanate asthma have experienced long periods of exposure (months or longer). However, the minimum exposure to isocyanates that can elicit sensitization responses or asthma is not known. In addition, immune response and subsequent disease in humans can be quite variable (Redlich *et al.*, 2006). Fatalities linked to diisocyanate exposures in sensitized persons have been reported (NIOSH, 1996; ACC, 2005).

There are very few reports of non-occupational exposures to diisocyanates available; however, some incidents have been reported where diisocyanates in products are suspected of causing asthma reactions in humans (Dietemann-Molard *et al.*, 1991; NIOSH, 1996; Jan *et al.*, 2008).

Toxicity in Laboratory Animals. MDI has low acute toxicity via the oral and dermal routes, but is considered toxic via the inhalation route in animals (Collins, 2002; ECB, 2005). Dermal absorption of MDI has been experimentally demonstrated, and MDI is uniformly distributed throughout the body, following inhalation exposure (Collins, 2002; ECB, 2005) (Gledhill *et al.*, 2005). MDI causes skin, eye, and lung irritation, progressive impairment of lung function with long-term inhalation exposure and is a respiratory sensitizer via both the dermal and inhalation routes of exposure in animals (Collins, 2002; ECB, 2005). Cross-sensitization has been observed between MDI, TDI, hexamethylene diisocyanate (HDI) and dicyclohexylmethane diisocyanate (HMDI) in mice, and between MDI, TDI and HDI in humans (O'Brien *et al.*, 1979). MDI is negative in gene mutation assays in vitro and in chromosomal aberration assays *in vitro* and *in vivo* (ECB, 2005). Animal data indicate that MDI may be carcinogenic; however, a consistent association has not been reported in epidemiologic studies (IARC, 1987b; IARC, 1987a; ECB, 2005).

VI. Fate Characterization Summary

Hydrolysis is the dominant process in determining the overall environmental fate, transport, and bioaccumulation potential of diisocyanates. Commercially, diisocyanates react at room temperature with other chemicals (i.e. polyols) to form various polymers. Data shows that water from humidity in air can hydrolyze MDI thus forming the amine, methylene diphenyl diamine/toluene diamine (MDA), which also has hazards associated with it. Although their rapid

hydrolysis in surface water will reduce persistence and bioaccumulation in the environment (Yakabe *et al.*, 1999), under conditions of low humidity, diisocyanates may be stable long enough to be transported some distances and inhaled. Data from the Toxics Release Inventory shows releases to all media (EPA, 2008b). Despite their apparent rapid reaction time, there is uncertainty regarding diisocyanate vapors and MDA in ambient air as a function of humidity (Dyson & Hermann, 1971). Air releases are of particular concern, because the hydrolysis products formed are irritants and there is a potential for inhalation exposure.

VII. Exposure Characterization Summary

Occupational Exposure. Approximately 280,000 U.S. workers were estimated to be potentially exposed to diisocyanates in 1996 (NIOSH, 1996) but given industry growth and new applications (Bello *et al.*, 2007), this estimate is expected to be higher today. OSHA regulates workplace exposures to MDI through its permissible exposure limits (PELs) (see Appendix 2). To reduce worker exposures when exposure levels exceed its PELs, OSHA requires use of PPE when engineering controls (e.g., ventilation) or administrative controls are infeasible or fail to reduce levels adequately.

Airborne MDI concentrations during manufacturing processes are influenced by whether the material is heated or sprayed, how the diisocyanate is reacted or cured, whether the process is conducted in an open or closed system, and the types of sampling methods used (Booth *et al.*, 2009). Exposures to MDI during SPF insulation and binder, coating, adhesive and sealant operations were found to be greater than MDI exposures from the production of other types of polyurethane products (e.g, mattresses) which reach consumers in a cured form (Booth *et al.*, 2009). Notably high MDI airborne exposures have been documented among workers during spray-on applications of truck bed liners and rigid foams for insulation (SPF) (Crespo & Galan, 1999; Lofgren *et al.*, 2003; Bonauto *et al.*, 2005; NIOSH, 2006; Lesage *et al.*, 2007). Certain NIOSH and OSHA evaluations have shown that worker exposures levels can be above OSHA PELs when spray applying MDI (NIOSH, 2004; Fairfax & Brooks, 2006) Airborne concentrations of MDI can also occur above established exposure limits in pour-in-place applications during process upsets (Booth *et al.*, 2009).

Occupational skin exposures in workers exposed to MDI are of concern because isocyanate sensitization and/or asthma has occurred in cases where the potential for skin exposure is substantial but measured airborne MDI monomer levels are below Occupational Exposure Levels (OELs) or below the limits of detection with the methods used, or where similar MDI levels would be expected but MDI air monitoring data is not available (Bernstein *et al.*, 1993; Ulvestad *et al.*, 1999; Petsonk *et al.*, 2000; Sommer *et al.*, 2000; Donnelly *et al.*, 2003). Skin exposure to MDI at work can occur even with use of personal protective equipment (Bello *et al.*, 2004).

In 132 OSHA inspections conducted between February 2004 and March 2005, approximately 46% of MDI samples collected during MDI-based spray-on urethane use in truck-bed lining exceeded OSHA's PEL (Fairfax & Brooks, 2006). The truck bed lining industry is primarily composed of small employers (six or fewer workers) with an estimated total of 10,000 workers (Lofgren *et al.*, 2003; Fairfax & Brooks, 2006). Since polyurethane coatings and sealants are marketed and used for truck trailers, house decks, walls, foundations and sports

flooring and these applications use the same or similar chemicals, spray techniques, and equipment as the spray-on truck bed lining process and SPF insulation, excessive exposure to MDI may occur during these related applications, resulting in risk to spray gun users and other nearby workers (NIOSH, 2006). However, non-OSHA covered self-employed workers and small firms, may not have access to or be aware of the hazard information and appropriate precautions to take when using uncured polyurethane products (Krone, 2004). Also, non-occupational exposures of workers, self-employed or otherwise, that have been sensitized to diisocyanates at work deserve special attention (ECB, 2005).

EPA is aware that there is uncertainty about curing time of various products under different situations and that additional data are needed to address certain concerns, such as re-entry time, which are important for improving communication to prevent exposure. Additionally, while OSHA and NIOSH have developed methods to estimate air concentrations within workplaces, current methods underestimate air concentrations and may warrant the use of a compensation factor and/or development of improved analytical methods. Methods for detection of dermal exposure are in the early stages of development and will be key to estimating dermal exposures. There are several data gaps associated with dermal exposure, sensitization, and the availability of uncured isocyanate groups (Streicher *et al.*, 1998; Bello *et al.*, 2007). In the U.S., only isocyanate monomers (e.g., TDI and MDI) are regulated, although similar polyisocyanates that are widely used in commercial and consumer products contain the same reactive isocyanates. EPA is concerned that there does not appear to be sufficient recognition that potential exposures of consumers and non-OSHA regulated workers to MDI and its related polyisocyanates may need to be addressed with similar recommendations for use of engineering controls, PPE, and hazard communication as those required for OSHA-regulated occupational settings.

Consumer/General Population Exposure. The higher exposure operations identified in occupational settings (Booth *et al.*, 2009) use polyurethane products which are most commonly used by consumers (e.g., spray foam, adhesives). Thus, consumers, bystanders, building occupants (including children), hobbyists and DIY applicators may be exposed to uncured MDI when using similar products. Unlike workers who are protected by workplace regulations and, in most cases, have access to hazard information and training for working with diisocyanates, most consumers are unaware of the potential hazards of consumer products containing uncured MDI. Consequently, incorrect use because of insufficient and inadequate hazard communication may lead to increased consumer exposure. Even if consumers are aware of the hazards, they may not take appropriate precautions. The European Union assumed that "the systematic use of PPE by the consumer will be unlikely." (ECB, 2005). Concerns for potential consumer exposure to MDI-containing products ultimately resulted in a regulation requiring the inclusion of appropriate gloves and precautionary statements in consumer products containing MDI (European Union, 2009).

Consumer use of uncured polyurethane products that contain MDI has increased rapidly as the market for consumer products has expanded (Krone, 2004; Redlich *et al.*, 2006). In 2004, the National Institutes of Health Household Products database, which represents a random sampling of brand name products, listed 16 products containing MDI (Krone, 2004). In 2010, a search of the same database resulted in 43 products containing MDI (NIH, 2010). In addition, there is a growing availability of products, both consumer products and those labeled as

"professional grade," that contain uncured MDI in retail and home improvement stores, as well as for purchase over the Internet that are available to the consumer (MPK Enterprises, 2010; NIH, 2010). Some professional art organizations have noted the common use of uncured polyurethane products by their members and warn their members of the potential hazards associated with these products in their safety library (United Scenic Artists, 2010). However, it is unclear whether amateur and school arts groups are similarly aware of the potential hazards resulting from the use of these same products.

Rigid foam products containing MDI are predominantly used to make spray foam insulation by a variety of systems. Exposures to consumers are not well characterized. The exposure potential varies with the method and quantity used, particle size distribution, and end-product curing time. With two-component high pressure spray polyurethane foam systems, chemical migration between floors was noted with certain conditions. Area samples show that occupants and bystanders, including sensitive populations, may be exposed at levels above the workplace exposure limits (Crespo & Galan, 1999; Lesage *et al.*, 2007; Bayer, 2009; IRSST, 2009). This is of special concern because exposure limits for the general population's exposure to hazardous chemicals are lower than workplace exposure limits, primarily because the general population also includes the sick, the disabled, sensitive and immuno-compromised individuals, and children (Redlich, *et al*, 2006). Several researchers have recommended establishing a work zone to minimize exposure of unprotected individuals during application. This is supported by data that show reduction of MDI (Lesage *et al.*, 2007) concentration with distance from the application site (Lesage *et al.*, 2007). Until polyurethane products fully cure, there may be the potential for inhalation and dermal exposure. However, limited information on the impact of such factors as product composition, temperature, humidity, and application technique on curing times affects determination of safe re-entry time after application.

Children exposed to the same airborne concentrations of MDI as adults may receive a larger dose because they breathe more per pound body weight and per unit respiratory surface area. Additionally, children may be more highly exposed to environmental toxicants through dermal routes than adults. For instance, children may crawl, roll or sit on surfaces treated with chemicals (i.e., carpets and floors) and play with objects such as toys where residues may settle. Similarly, children have a higher surface area relative to body weight, which would result in a greater dose relative to body weight for a child than for an adult with equivalent skin exposure (EPA, 2008a), and children are more likely to crawl, lay, or spend time on the floor. Children may have a greater potential for exposure if they use or are bystanders to the use of uncured MDI products, because they may not have fully developed judgment for following labeling instructions and safety precautions and may not cease activity even when they are experiencing symptoms of exposure. An accidental acute exposure of children to high levels of MDI in a polyurethane sealant used on a school athletic track was associated with asthma-like symptoms, including among children with no prior history of respiratory dysfunction (Jan *et al.*, 2008). This observation is consistent with MDI being a well known source of occupational asthma. Children with asthma are an especially vulnerable population for exposure; they are more susceptible to inflammatory narrowing of the airways, which results in a proportionally greater obstruction of their smaller respiratory system (NIH, 2011; Trasande & Thurston, 2005).

In contrast to the large amount of exposure data available for professional workers who work with diisocyanates, there is limited exposure data available characterizing the use and

exposure scenarios of consumer and commercial products containing uncured MDI. Additional data characterizing the concentration of MDI in the air is needed. It is unknown to what extent factors such as application techniques, product composition, and method of measurement influence the availability of uncured MDI. In addition, comparing concentrations to existing workplace exposure limits is not appropriate because the worker PEL is not sufficiently protective for the consumer (Redlich, *et al*, 2006).

IX. Risk Management Considerations

Similar quantities of uncured products are available for purchase by either professionals or consumers. Numerous authors have noted the versatility of polyurethane as well as its increasing uses. EPA is concerned that the potential exists for similar exposures in non-OSHA-regulated situations. Both primary users and bystanders should be made aware of the potential risks and appropriate precautions to take when uncured MDI is being used. In addition, personal and health care products, such as bandages and orthopedic casts could contain uncured MDI but are beyond the scope of this action plan. However, exposures from use of such products could contribute to cumulative diisocyanate exposures (Sommer *et al.*, 2000; Donnelly *et al.*, 2003). The factors described above suggest that a heightened concern for potential risks of diisocyanate exposure to children should be addressed during actions taken to manage these chemicals.

Current and Ongoing Regulatory and Related Activities

MDI and its related polyisocyanates are the subjects of a variety of regulatory and related activities, some of which are summarized below. Additional details, including numerical values, are provided in Appendix 2.

EPA Regulatory Activities. MDI is regulated under the Clean Air Act as a hazardous air pollutant and under RCRA and CERCLA as a hazardous waste. Diisocyanates as a category are subject to Toxics Release Inventory reporting. Under TSCA, EPA has previously used its authority under TSCA sections 8(a) and 8(d) to request information from industry (see 40 CFR parts 712 and 716). EPA has also received submissions regarding diisocyanates under TSCA section 8(c) and TSCA section 8(e). Diisocyanates are a TSCA New Chemicals Program Chemical Category and any new chemical substance falling in that category may be further regulated after a TSCA section 5 premanufacture notice has been submitted (EPA, 2002).

Spray Polyurethane Foam (SPF) Federal Partnership Promoting Stewardship & Research. In 2009, EPA convened a multi-agency partnership with OSHA, NIOSH, and the Consumer Product Safety Commission (CPSC) to evaluate and address potential exposures to isocyanates and other chemicals during installation of spray polyurethane foam (SPF) insulation and air sealants in homes and schools. Commercial and DIY applicators, as well as building occupants are often unaware of inhalation and dermal hazards. Applicators and others at the work site may not wear adequate PPE. Building occupants, who remain on the premises during the operations or re-enter the site before the product is fully cured may be at risk. The federal agencies are working with the polyurethanes industry to ensure accessible hazard communication, applicator training, and best workplace practices to prevent exposure to isocyanates and other SPF chemicals. In addition, the federal group has identified critical research needs to assess and measure exposures to total reactive isocyanate groups (TRIG)

during use and curing of SPF products. EPA will continue to work with its federal partners, the polyurethanes industry, and others to ensure improved labeling and product safety information for polyurethane products containing unreacted isocyanates, especially products targeted to consumers. EPA is also considering a green chemistry challenge to encourage the development of safer alternative chemicals.

European Union. Following publication of an MDI risk assessment which identified risks to human health for consumers, the European Union (EU) amended its REACH regulation to include restrictions on certain consumer uses of MDI. Effective December 27, 2010, all consumer products manufactured and imported into the EU containing concentrations of 0.1 percent or more MDI must include specific types of protective gloves and specific warnings and use instructions (European Union, 2009).

X. Next Steps

In conducting this review, EPA considered a number of potential actions, including regulatory actions under TSCA sections 4, 5, 6, and 8; cooperative actions with other federal agencies; and voluntary actions as described above. Based on EPA's screening level review of MDI and its related polyisocyanates (Appendix 1), EPA intends to:

1. Issue a data call-in for uncured MDI under TSCA section 8(c) to determine if there are allegations of significant adverse effects and initiate a TSCA section 8(d) rulemaking for one-time reporting of relevant unpublished health and safety studies for uncured MDI.

2. Consider initiating a TSCA section 4 test rule to require exposure monitoring studies on uncured MDI and its related polyisocyanates in consumer products and exposure monitoring studies in representative locations where commercial products with uncured MDI and its related polyisocyanates would be used.

3. Consider initiating rulemaking under TSCA section 6 for
   a. Consumer products containing uncured MDI, and
   b. Commercial uses of uncured MDI products in locations where the general population could be exposed.

4. Consider identifying additional diisocyanates and their related polyisocyanates that may be present in an uncured form in consumer products that should be evaluated for regulatory and/or voluntary action.

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Appendix 1

Tier 1: MDI monomers and related isomers and polymers

No	CASRN	CA Index Name	Acronym	Common Name
1	101-68-8	Benzene, 1,1'-methylenebis[4-isocyanato-	4,4'-MDI	4,4'-Methylenediphenyl diisocyante
2	5873-54-1	Benzene, 1-isocyanato-2-[(4-isocyanatophenyl)methyl]-	2,4'-MDI	2,4'-Methylenediphenyl diisocyante
3	2536-05-2	Benzene, 1,1'-methylenebis[2-isocyanato-	2,2'-MDI	2,2'-Methylenediphenyl diisocyante
4	26447-40-5	Benzene, 1,1'-methylenebis[isocyanato-	MDI	Methylenebis(phenyl isocyanate)
5	9016-87-9	Isocyanic acid, polymethylenepolyphenylene ester	Polymeric MDI	Poly(Methylenebis(phenyl isocyanate)

Tier 2: MDI dimers, trimers and polymers

No	CASRN	CA Index Name	Acronym	Common Name
6	17589-24-1	1,3-Diazetidine-2,4-dione, 1,3-bis[4-[(4-isocyanatophenyl) methyl]phenyl]-	4,4'-MDI dimer	4,4'-Methylenediphenyl diisocyante dimer
7	31107-36-5	1,3-Diazetidin-2-one, 1,3-bis[4-[(4-isocyanatophenyl)methyl]phenyl]-4-[[4-[(4-isocyanatophenyl)methyl] phenyl]imino]-	4,4'-MDI trimer	4,4'-Methylene diphenyl diisocyante trimer (or Uretonimine of 4,4'-MDI)
8	25686-28-6	Benzene, 1,1'-methylenebis[4-isocyanato-, homopolymer	4,4'-MDI homo-polymer	4,4'-Diphenyl methanediisocyanate homopolymer

Appendix 2 – Regulatory and Exposure Limits for MDI

EPA. The EPA's Integrated Risk Information System (IRIS) program has developed a reference concentration (RfC) for MDI of 6×10^{-4} mg/m^3 using histopathological changes in the upper respiratory system in animals as the critical effect (EPA, 1998).

OSHA. Diisocyanate hazards are addressed by OSHA in specific standards for the general industry, shipyard employment, and the construction industry, including PELs for workplace exposure.

OSHA's PEL for the MDI monomer is 0.2 mg/m^3 (0.02 ppm) as a ceiling limit (29 CFR § 1910.1000). OSHA also requires the use of PPE to reduce worker exposure to hazards when engineering and administrative controls are not feasible or effective in reducing exposure below its PELs.

NIOSH. In 1996 and 2006, NIOSH issued Alerts to prevent asthma and death from diisocyanate exposure to workers in certain situations (NIOSH, 1996; NIOSH, 2006). NIOSH considers SPF insulation application to present hazards similar to other spray polyurethane applications and recommends use of the same safety procedures and PPE.

NIOSH's Recommended Exposure Limit (REL) for the MDI monomer is a Time Weighted Average (TWA) of 0.05 mg/m^3 (0.005 ppm) for up to a 10-hour workday during a 40-hour workweek with a ceiling limit of 0.2 mg/m^3 (0.02 ppm) for any 10-minute period (NIOSH, 2005). The NIOSH REL is intended to prevent acute and chronic irritation and sensitization of workers but not to prevent health effects in workers who are already sensitized. Per NIOSH, available data do not indicate a concentration at which MDI fails to produce adverse reactions in sensitized persons (NIOSH, 2006).

ACGIH. American Conference of Governmental Industrial Hygienists. Threshold Limit Values (TLVs) for MDI address respiratory sensitivity but not dermal sensitivity. It has been suggested that there is now sufficient information to recommend the addition of a "skin notation" to the TLVs for MDI to bring attention to the potential for absorption of diisocyanates through the skin.

ACGIH has assigned the MDI monomer a TLV of 0.05 mg/m^3 (0.005 ppm) as a Time-Weighted Average (TWA) for a normal 8-hour workday and a 40-hour workweek. The ACGIH TLV for MDI is based, among other things, upon the potential for sensitization and meant to protect workers from induction of this effect (ACGIH, 2009).

California, OEHHA. In April 2010, California's Office of Environmental Health Hazard Assessment (OEHHA) released "for comment" draft documents describing proposed Reference Exposure Levels (RELs) for MDI which have been revised to include consideration of possible differential effects on the health of infants, children and other sensitive subpopulations (California EPA, 2010).

EU. Following publication of an MDI risk assessment which identified risks to human health for consumers, the EU amended its REACH regulation to include restrictions on certain consumer uses of MDI. Effective December 27, 2010, all consumer products manufactured and imported into the EU containing concentrations of 0.1 percent or more MDI must include specific types of protective gloves and specific warnings and use instructions (European Union, 2009).

Public Input No. 71-NFPA 1400-2023 [Section No. 15.14.6]

15.14.6*

Fuel materials shall be used only in the amounts necessary to create the desired fire size while maintaining a safe training environment for participants .

Statement of Problem and Substantiation for Public Input

The existing language allows a large fuel load that could endanger participants (students and instructors) if the "desired fire size" is a dangerously large fire in the burn room of the live fire training structure.

I have heard many anecdotal stories through the years, including in 2023, in which fuel loads were enlarged or fuel was added to an already burning fire for dramatic effect, to intimidate students, to expose students to the end-of-academy "hell day" or "hell burn", or to make large flames visible from the outside through the exterior window even though the interior was becoming too hot for the safety of inside participants. A strict interpretation of the existing language would allow for such dangerous conditions.

By adding the phrase about maintaining a safe training environment for the participants, the chances of dangerous, oversized training fires will be reduced. Hopefully this will also reduce the number of times we hear this statement from firefighters: "The hottest fire I've ever felt was in a burn building during training. If it gets that hot in the real world, we back out and take a defensive position outside."

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Public Input No. 70-NFPA 1400-2023 [Section No. 15.14.11 [Excluding any Sub-Sections]]

The use of flammable gas, such as propane and natural gas, shall be permitted only in live fire training structures and props specifically designed for their use.

Statement of Problem and Substantiation for Public Input

Without this revision, a strict interpretation would allow only wood fuels (per 15.14.1) to be used in automobile fire props, dumpster fire props, and aircraft fire props. In addition, this revision makes the wording of 15.14.11 consistent with 15.14.3.1, which also reads "live fire training structure or prop".

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Public Input No. 46-NFPA 1400-2023 [New Section after 15.18]

15.19 Fire Locations

15.19.1* Within live fire training structures, if there are adjoining burn rooms that share a door that serves as a mandatory exit for either room, live fires shall not be burned in both rooms simultaneously .

A.15.19.1 Live fires should not be burned simultaneously in adjoining rooms if they share an exit door that is one of the mandatory burn room exits defined by Chapter 7. The way out of an active burn room should not be into an adjoining room that also has a live fire burning. The intent is for the adjoining room to be less hazardous than the active burn room, to provide a higher level of safety should an emergency exist in the active burn room.

Statement of Problem and Substantiation for Public Input

In March 2018, the Technical Committee on Facilities for Fire Training and Associated Props (the 1402 Committee) had its second draft meeting in Austin and finalized the first edition of the new 1402 Standard. During that meeting, this item was identified as something that requires coordination with 1403 (now Chapters 15 through 20).

In the 2019 edition of 1402, new, stricter requirements for exits from burn rooms were added. The 1402 Committee didn't want the way out of an active burn room to be into another active burn room and wanted to add this language to 1402. The language could not go into 1402, however, because it was operational in nature and 1402 was a facilities document. It could go into 1403 (now Chapters 15 through 20), however, and is recommended to help ensure that the safety benefit gained by designing the burn rooms per 1402 (now Chapter 7) is sustained operationally while training in accordance with 1403.

Note this does not apply to acquired structures because Chapter 16 specifically states, "Only one fire at a time shall be permitted within an acquired structure." (16.1.12).

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Public Input No. 40-NFPA 1400-2023 [Chapter 16 [Title Only]]

Live Fire Training in Acquired Structures (NFPA 1403)

Statement of Problem and Substantiation for Public Input

This adds clarity that this chapter is solely for live fire training evolutions, not for designing/building facilities and not for training on respiratory protection, thermal imagers, RIC, etc.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 39-NFPA 1400-2023 [Chapter 15 [Title Only]]	Similar edit for similar reason.
Public Input No. 41-NFPA 1400-2023 [Chapter 17 [Title Only]]	
Public Input No. 42-NFPA 1400-2023 [Chapter 18 [Title Only]]	
Public Input No. 43-NFPA 1400-2023 [Chapter 19 [Title Only]]	
Public Input No. 44-NFPA 1400-2023 [Chapter 20 [Title Only]]	

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Public Input No. 47-NFPA 1400-2023 [Section No. 16.1.11]

~~16.1.11~~ –

~~No person(s) shall play the role of a victim inside the acquired structure.~~

Statement of Problem and Substantiation for Public Input

This section is redundant with 15.18.1. Because Chapter 15 applies to all subsequent chapters, the repeated language in Chapter 16 is the redundant language that should be deleted.

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Public Input No. 48-NFPA 1400-2023 [Chapter 17]

Chapter 17 Gas-Fired Live Fire Training Structures and Mobile Enclosed Live Fire Training Props (NFPA 1403)

17.1 Structures, Props, and Facilities.

17.1.1

This section pertains to all interior spaces where gas-fired live fire training exercises occur.

17.1.2

Live fire training structures and mobile enclosed live fire training props shall be left in a safe condition upon completion of live fire training evolutions.

17.1.3

Debris hindering the access or egress of firefighters shall be removed prior to the beginning of the training exercises.

17.1.4

Flammable gas fires shall not be ignited manually.

17.2 Inspection and Testing.

17.2.1*

Live fire training structures and mobile enclosed live fire training props shall be inspected visually for damage prior to live fire training evolutions.

17.2.1.1*

Damage shall be documented and the building/prop owner or AHJ shall be notified.

17.2.2

Where the ~~live fire training structure~~ damage is severe enough to affect the safety of the participants, training shall not be permitted.

17.2.3

All doors, windows and window shutters, railings, roof scuttles and automatic ventilators, mechanical equipment, lighting, manual or automatic sprinklers, and standpipes necessary for the live fire training evolution shall be checked and operated prior to any live fire training evolution to ensure they operate correctly.

17.2.4

All safety devices, ~~such as thermal~~ including but not limited to thermal sensors, combustible gas monitors, evacuation alarms, and emergency shutdown switches, shall be checked prior to any live fire training evolutions to ensure they operate correctly.

17.2.5

The instructors shall run the training system prior to exposing students to live flames in order to ensure the correct operation of devices ~~such as the~~ including but not limited to the gas valves, flame safeguard units, agent sensors, combustion fans, and ventilation fans.

17.2.6*

The structural integrity of the live fire training structure shall be evaluated and documented annually by the building owner or AHJ.

17.2.6.1

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

17.2.7*

The structural integrity of the live fire training structure shall be evaluated and documented by a licensed professional engineer with live fire training structure experience and expertise, or by another competent professional as determined by the AHJ, at least once every 10 years, or more frequently if determined to be required by the evaluator.

17.2.8*

All structures constructed with calcium aluminate refractory structural concrete shall be inspected by a structural engineer with expertise in live fire training structures every 3 years.

17.2.8.1

The structural inspection shall include removal of concrete core samples from the structure to check for delaminations within the concrete.

17.2.9*

Part of the live fire training structure evaluation shall include, at least once every 10 years, the removal and reinstallation of a representative area of thermal linings (if any) to inspect the hidden conditions behind the linings.

Statement of Problem and Substantiation for Public Input

These revisions were approved by the Training Committee at the October 2015 meeting. For some reason, presumably a mistake during final editing, the only approved revision that was incorporated into the final version of 1403 was the revision to the chapter title to include Mobile Enclosed Live Fire Training Props. The rest of the revisions to add mobile enclosed live fire training props to the chapter, however, were not incorporated. Those revisions are necessary to make Chapter 17 apply to mobile enclosed live fire training props in addition to live fire training structures.

Related Public Inputs for This Document

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Public Input No. 41-NFPA 1400-2023 [Chapter 17 [Title Only]]

Live Fire Training in Gas-Fired Live Fire Training Structures and Mobile Enclosed Live Fire Training Props (NFPA 1403)

Statement of Problem and Substantiation for Public Input

This adds clarity that this chapter is solely for live fire training evolutions, not for designing/building facilities and not for training on respiratory protection, thermal imagers, RIC, etc.

Related Public Inputs for This Document

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Public Input No. 39-NFPA 1400-2023 [Chapter 15 [Title Only]]	Similar edit for similar reason.
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Public Input No. 42-NFPA 1400-2023 [Chapter 18 [Title Only]]	
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Public Input No. 33-NFPA 1400-2023 [Section No. 17.2]

17.2 Inspection and Testing.

17.2.1*

Live fire training structures shall be inspected visually for damage prior to live fire training evolutions.

17.2.1.1*

Damage shall be documented and the building owner or AHJ shall be notified.

17.2.2

Where the live fire training structure damage is severe enough to affect the safety of the participants, training shall not be permitted.

17.2.3

All doors, windows and window shutters, railings, roof scuttles and automatic ventilators, mechanical equipment, lighting, manual or automatic sprinklers, and standpipes necessary for the live fire training evolution shall be checked and operated prior to any live fire training evolution to ensure they operate correctly.

17.2.4

All safety devices, such as thermal sensors, combustible gas monitors, evacuation alarms, and emergency shutdown switches, shall be checked prior to any live fire training evolutions to ensure they operate correctly.

17.2.5

The instructors shall run the training system prior to exposing students to live flames in order to ensure the correct operation of devices such as the gas valves, flame safeguard units, agent sensors, combustion fans, and ventilation fans.

~~**17.2.6** * –~~

~~The structural integrity of the live fire training structure shall be evaluated and documented annually by the building owner or AHJ.~~

~~**17.2.6.1** –~~

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

~~**17.2.7** * –~~

~~The structural integrity of the live fire training structure shall be evaluated and documented by a licensed professional engineer with live fire training structure experience and expertise, or by another competent professional as determined by the AHJ, at least once every 10 years, or more frequently if determined to be required by the evaluator.~~

~~**17.2.8** * –~~

~~All structures constructed with calcium aluminate refractory structural concrete shall be inspected by a structural engineer with expertise in live fire training structures every 3 years.~~

~~**17.2.8.1** –~~

~~The structural inspection shall include removal of concrete core samples from the structure to check for delaminations within the concrete.~~

~~**17.2.9** * –~~

~~Part of the live fire training structure evaluation shall include, at least once every 10 years, the removal and reinstallation of a representative area of thermal linings (if any) to inspect the hidden conditions behind the linings.~~

Statement of Problem and Substantiation for Public Input

Since its 2002 edition, 1403 included these structural integrity evaluation requirements, which relate to training facilities and not to live fire training evolutions. These requirements were in 1403 because the Training Committee deemed them important enough for firefighter safety to include them in 1403 even though they would have been better suited in a standard on training facilities, which did not exist in 2002.

In 2019, 1402 became a standard on training facilities and the requirements for structural integrity evaluations of live fire training structures was included in Chapter 7 of that document, with nearly identical language with what was in the 2018 edition of 1403. The intent was to then delete these requirements from 1403 in its next cycle.

Now that 1402 and 1403 have been merged into the 1400 Standard, these requirements are found in Chapters 7, 17, and 18 of the draft and should be trimmed to only one location for clarity and to eliminate risk of contradicting language from one chapter to the next. Given the scopes of the chapters, the requirements for structural integrity evaluations of live fire training structures are better suited for Chapter 7 (a facilities chapter) than for Chapters 17 and 18 (training operations chapters).

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 34-NFPA 1400-2023 [Section No. 18.2]	
Public Input No. 36-NFPA 1400-2023 [Sections A.17.2.6, A.17.2.7, A.17.2.8, A.17.2.9]	

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Public Input No. 49-NFPA 1400-2023 [Chapter 18]

Chapter 18 Non-Gas-Fired Live Fire Training Structures and Mobile Enclosed Live Fire Training Props (NFPA 1403)

18.1 Structures, Props, and Facilities.

18.1.1

This section pertains to all interior spaces where non-gas-fired live fire training exercises occur.

18.1.2

Live fire training structures and mobile enclosed live fire training props shall be left in a safe condition upon completion of live fire training evolutions.

18.1.3

Debris hindering the access or egress of firefighters shall be removed prior to the beginning of the training exercises.

18.2 Inspection and Testing.

18.2.1*

Live fire training structures and mobile enclosed live fire training props shall be inspected visually for damage prior to live fire training evolutions.

18.2.1.1*

Damage shall be documented, and the building/prop owner or AHJ shall be notified.

18.2.2

Where the ~~live fire training structure~~ damage is severe enough to affect the safety of the participants, training shall not be permitted.

18.2.3

All doors, windows and window shutters, railings, roof scuttles and automatic ventilators, mechanical equipment, lighting, manual or automatic sprinklers, and standpipes necessary for the live fire training evolution shall be checked and operated prior to any live fire training evolution to ensure they operate correctly.

18.2.4

All safety devices, ~~such as~~ including but not limited to thermal sensors, oxygen and toxic and combustible gas monitors, evacuation alarms, and emergency shutdown switches, shall be checked prior to any live fire training evolutions to ensure they operate correctly.

18.2.5*

The structural integrity of the live fire training structure shall be evaluated and documented annually by the building owner or AHJ.

18.2.5.1

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

18.2.6*

The structural integrity of the live fire training structure shall be evaluated and documented by a licensed professional engineer with live fire training structure experience and expertise or by another competent professional as determined by the AHJ at least once every 5 years or more frequently if determined to be required by the evaluator.

18.2.7*

All structures constructed with calcium aluminate refractory structural concrete shall be inspected by a structural engineer with expertise in live fire training structures every 3 years.

18.2.7.1

The structural inspection shall include removal of concrete core samples from the structure to check for delaminations within the concrete.

18.2.8*

Part of the live fire training structure evaluation shall include, once every five years, the removal and reinstallation of a representative area of thermal linings (if any) to allow inspections of the conditions hidden behind the linings.

18.3 Sequential Live Fire Burn Evolutions.

18.3.1

The AHJ shall develop and utilize a safe live fire training action plan when multiple sequential burn evolutions are to be conducted per day in each burn room.

18.3.2

A burn sequence matrix chart shall be developed for the burn rooms ~~in a~~ in live fire training structures and mobile enclosed live fire training ~~structure~~ props .

18.3.2.1

The burn sequence matrix chart shall include the maximum fuel loading per evolution and maximum number of sequential live fire evolutions that can be conducted per day in each burn room.

18.3.3*

The burn sequence for each burn room shall define the maximum fuel load that can be used for the first burn and each successive burn.

18.3.4*

The burn sequence matrix for each burn room shall also specify the maximum number of evolutions that can be safely conducted during a given training period before the burn room is allowed to cool.

18.3.5

The fuel loads per evolution and the maximum number of sequential evolutions in each burn room shall not be exceeded under any circumstances.

Statement of Problem and Substantiation for Public Input

These revisions were approved by the Training Committee at the October 2015 meeting. For some reason, presumably a mistake during final editing, the only approved revision that was incorporated into the final version of 1403 was the revision to the chapter title to include Mobile Enclosed Live Fire Training Props. The rest of the revisions to add mobile enclosed live fire training props to the chapter, however, were not incorporated. Those revisions are necessary to make Chapter 18 apply to mobile enclosed live fire training props in addition to live fire training structures.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 48-NFPA 1400-2023 [Chapter 17]	Similar edits for similar reasons.

Submitter Information Verification

Submitter Full Name: Roger LeBoeuf
Organization: Elliott, LeBoeuf & McElwain
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Submittal Date: Wed Aug 23 03:31:42 EDT 2023
Committee: FIY-AAA

Public Input No. 42-NFPA 1400-2023 [Chapter 18 [Title Only]]

Live Fire Training in Non-Gas-Fired Live Fire Training Structures and Mobile Enclosed Live Fire Training Props (NFPA 1403)

Statement of Problem and Substantiation for Public Input

This adds clarity that this chapter is solely for live fire training evolutions, not for designing/building facilities and not for training on respiratory protection, thermal imagers, RIC, etc.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 39-NFPA 1400-2023 [Chapter 15 [Title Only]]	Similar edit for similar reason.
Public Input No. 40-NFPA 1400-2023 [Chapter 16 [Title Only]]	Similar edit for similar reason.
Public Input No. 41-NFPA 1400-2023 [Chapter 17 [Title Only]]	Similar edit for similar reason.
Public Input No. 43-NFPA 1400-2023 [Chapter 19 [Title Only]]	
Public Input No. 44-NFPA 1400-2023 [Chapter 20 [Title Only]]	

Submitter Information Verification

Submitter Full Name: Roger LeBoeuf
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Submittal Date: Wed Aug 23 02:27:54 EDT 2023
Committee: FIY-AAA

Public Input No. 34-NFPA 1400-2023 [Section No. 18.2]

18.2 Inspection and Testing.

18.2.1*

Live fire training structures shall be inspected visually for damage prior to live fire training evolutions.

18.2.1.1*

Damage shall be documented, and the building owner or AHJ shall be notified.

18.2.2

Where the live fire training structure damage is severe enough to affect the safety of the participants, training shall not be permitted.

18.2.3

All doors, windows and window shutters, railings, roof scuttles and automatic ventilators, mechanical equipment, lighting, manual or automatic sprinklers, and standpipes necessary for the live fire training evolution shall be checked and operated prior to any live fire training evolution to ensure they operate correctly.

18.2.4

All safety devices, such as thermal sensors, oxygen and toxic and combustible gas monitors, evacuation alarms, and emergency shutdown switches, shall be checked prior to any live fire training evolutions to ensure they operate correctly.

~~**18.2.5** * –~~

~~The structural integrity of the live fire training structure shall be evaluated and documented annually by the building owner or AHJ.~~

~~**18.2.5.1** –~~

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

~~**18.2.6** * –~~

~~The structural integrity of the live fire training structure shall be evaluated and documented by a licensed professional engineer with live fire training structure experience and expertise or by another competent professional as determined by the AHJ at least once every 5 years or more frequently if determined to be required by the evaluator.~~

~~**18.2.7** * –~~

~~All structures constructed with calcium aluminate refractory structural concrete shall be inspected by a structural engineer with expertise in live fire training structures every 3 years.~~

~~**18.2.7.1** –~~

~~The structural inspection shall include removal of concrete core samples from the structure to check for delaminations within the concrete.~~

~~**18.2.8** * –~~

~~Part of the live fire training structure evaluation shall include, once every five years, the removal and reinstallation of a representative area of thermal linings (if any) to allow inspections of the conditions hidden behind the linings.~~

Statement of Problem and Substantiation for Public Input

Since its 2002 edition, 1403 included these structural integrity evaluation requirements, which relate to training facilities and not to live fire training evolutions. These requirements were in 1403 because the Training Committee deemed them important enough for firefighter safety to include them in 1403 even though they would have been better suited in a standard on training facilities, which did not exist in 2002.

In 2019, 1402 became a standard on training facilities and the requirements for structural integrity evaluations of live fire training structures was included in Chapter 7 of that document, with nearly identical language with what was in the 2018 edition of 1403. The intent was to then delete these requirements from 1403 in its next cycle.

Now that 1402 and 1403 have been merged into the 1400 Standard, these requirements are found in Chapters 7, 17, and 18 of the draft and should be trimmed to only one location for clarity and to eliminate risk of contradicting language from one chapter to the next. Given the scopes of the chapters, the requirements for structural integrity evaluations of live fire training structures are better suited for Chapter 7 (a facilities chapter) than for Chapters 17 and 18 (training operations chapters).

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 33-NFPA 1400-2023 [Section No. 17.2]	Same deletion for each section for same reasons.
Public Input No. 37-NFPA 1400-2023 [Sections A.18.2.5, A.18.2.6, A.18.2.7, A.18.2.8]	

Submitter Information Verification

Submitter Full Name: Roger LeBoeuf
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Submittal Date: Wed Aug 23 01:29:02 EDT 2023
Committee: FIY-AAA

Public Input No. 58-NFPA 1400-2023 [Sections 18.2.4, 18.2.5, 18.2.6, 18.2.7, 18.2.8]

~~**Sections 18.2.4, 18.2.5, 18.2.6, 18.2.7, 18.2.8**~~

~~**18.2.4** –~~

~~All safety devices, such as thermal sensors, oxygen and toxic and combustible gas monitors, evacuation alarms, and emergency shutdown switches, shall be checked prior to any live fire training evolutions to ensure they operate correctly.~~

~~**18.2.5** * –~~

~~The structural integrity of the live fire training structure shall be evaluated and documented annually by the building owner or AHJ.~~

~~**18.2.5.1** –~~

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

~~**18.2.6** * –~~

~~The structural integrity of the live fire training structure shall be evaluated and documented by a licensed professional engineer with live fire training structure experience and expertise or by another competent professional as determined by the AHJ at least once every 5 years or more frequently if determined to be required by the evaluator.~~

~~**18.2.7** * –~~

~~All structures constructed with calcium aluminate refractory structural concrete shall be inspected by a structural engineer with expertise in live fire training structures every 3 years.~~

~~**18.2.7.1** –~~

~~The structural inspection shall include removal of concrete core samples from the structure to check for delaminations within the concrete.~~

~~**18.2.8** * –~~

~~Part of the live fire training structure evaluation shall include, once every five years, the removal and reinstallation of a representative area of thermal linings (if any) to allow inspections of the conditions hidden behind the linings.~~

Additional Proposed Changes

File Name	Description	Approved
1403_PI_No_2.pdf	NFPA 1403 Public Input No. 2	

Statement of Problem and Substantiation for Public Input

In March 2018, the 1402 Committee had its second draft meeting in Austin and finalized the first edition of the new 1402 Standard. During that meeting, this item was identified as something that requires coordination with 1403.

Structural evaluations of live fire training structures are now listed in Chapter 7 of the 1402 Standard with mandatory (shall) language. Given the scopes of the two documents, this requirement is better

suited for 1402 (a facilities document) than for 1403 (a training document). Therefore, it should be deleted from 1403.

Submitter Information Verification

Submitter Full Name: Roger LeBoeuf
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Submittal Date: Thu Aug 24 09:24:02 EDT 2023
Committee: FIY-AAA

Public Input No. 2-NFPA 1403-2018 [Sections 7.2.5, 7.2.6, 7.2.7, 7.2.8]

~~**Sections 7.2.5, 7.2.6, 7.2.7, 7.2.8**~~

~~**7.2.5** * –~~

~~The structural integrity of the live fire training structure shall be evaluated and documented annually by the building owner or AHJ.~~

~~**7.2.5.1** –~~

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

~~**7.2.6** * –~~

~~The structural integrity of the live fire training structure shall be evaluated and documented by a licensed professional engineer with live fire training structure experience and expertise or by another competent professional as determined by the AHJ at least once every 5 years or more frequently if determined to be required by the evaluator.~~

~~**7.2.7** * –~~

~~All structures constructed with calcium aluminate refractory structural concrete shall be inspected by a structural engineer with expertise in live fire training structures every 3 years.~~

~~**7.2.7.1** –~~

~~The structural inspection shall include removal of concrete core samples from the structure to check for delaminations within the concrete.~~

~~**7.2.8** * –~~

~~Part of the live fire training structure evaluation shall include, once every five years, the removal and reinstallation of a representative area of thermal linings (if any) to allow inspections of the conditions hidden behind the linings.~~

Statement of Problem and Substantiation for Public Input

In March 2018, the 1402 Committee had its second draft meeting in Austin and finalized the first edition of the new 1402 Standard. During that meeting, this item was identified as something that requires coordination with 1403.

Structural evaluations of live fire training structures are now listed in Chapter 7 of the 1402 Standard with mandatory (shall) language. Given the scopes of the two documents, this requirement is better suited for 1402 (a facilities document) than for 1403 (a training document). Therefore, it should be deleted from 1403.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 1-NFPA 1403-2018 [Sections 6.2.6, 6.2.7, 6.2.8, 6.2.9]	

Submitter Information Verification

Submitter Full Name: Roger LeBoeuf

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Submittal Date:	Tue Mar 20 17:36:23 EDT 2018
Committee:	FIY-AAA

Public Input No. 43-NFPA 1400-2023 [Chapter 19 [Title Only]]

Live Fire Training at Exterior Live Fire Training Props (NFPA 1403)

Statement of Problem and Substantiation for Public Input

This adds clarity that this chapter is solely for live fire training evolutions, not for designing/building facilities and not for training on respiratory protection, thermal imagers, RIC, etc.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 39-NFPA 1400-2023 [Chapter 15 [Title Only]]	Similar edit for similar reason.
Public Input No. 40-NFPA 1400-2023 [Chapter 16 [Title Only]]	Similar edit for similar reason.
Public Input No. 41-NFPA 1400-2023 [Chapter 17 [Title Only]]	Similar edit for similar reason.
Public Input No. 42-NFPA 1400-2023 [Chapter 18 [Title Only]]	Similar edit for similar reason.
Public Input No. 44-NFPA 1400-2023 [Chapter 20 [Title Only]]	

Submitter Information Verification

Submitter Full Name: Roger LeBoeuf
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Submittal Date: Wed Aug 23 02:29:40 EDT 2023
Committee: FIY-AAA

Public Input No. 44-NFPA 1400-2023 [Chapter 20 [Title Only]]

Live Fire Training Reports and Records (NFPA 1403)

Statement of Problem and Substantiation for Public Input

This adds clarity that this chapter is solely for live fire training evolutions, not for designing/building facilities and not for training on respiratory protection, thermal imagers, RIC, etc.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 39-NFPA 1400-2023 [Chapter 15 [Title Only]]	Similar edit for similar reason.
Public Input No. 40-NFPA 1400-2023 [Chapter 16 [Title Only]]	Similar edit for similar reason.
Public Input No. 41-NFPA 1400-2023 [Chapter 17 [Title Only]]	Similar edit for similar reason.
Public Input No. 42-NFPA 1400-2023 [Chapter 18 [Title Only]]	Similar edit for similar reason.
Public Input No. 43-NFPA 1400-2023 [Chapter 19 [Title Only]]	Similar edit for similar reason.

Submitter Information Verification

Submitter Full Name: Roger LeBoeuf
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Submittal Date: Wed Aug 23 02:32:05 EDT 2023
Committee: FIY-AAA

Public Input No. 61-NFPA 1400-2023 [New Section after 22.1.5.1]

Emergency Breathing Procedures

Both sections 5.1.5 and 5.1.4 indicate that the AHJ should establish and enforce written standard operating procedures for training in the use of respiratory protection equipment.

Section 5.1.4 (2) mentions Emergency Evacuation Procedures and 5.1.5 makes reference to the importance of establishing an IAM (Individual Air Management) program.

Section 5.1.5.2 (3) states that immediate actions should be taken upon activation of the EOSTI and that the corresponding department's SOP/SOG should be followed,

As NFPA 1404 standard does not indicate two situations that can be faced while wearing an SCBA (1. Spatial disorientation of the wearer. 2. Mobility impairment or disability due to injury or entrapment) and that these scenarios represent potential risks, I suggest that a new subsection/text be added to section 5.1.5.1:

The SCBA wearer should be trained in emergency breathing procedures (maximum use of available air), such as: Skip Breathing, Box Breathing (Tactical Breathing) or Wheel Breathing.

Note: It should be taken into consideration that when any of these techniques is used, the remaining air duration can be extended up to five times. On SCBA's that meet NFPA 1981, 2018 Edition, the EOSTI alarm is activated when the cylinder air content reaches 35%. In the case of a 45-minute breathing apparatus, this would mean about 15 minutes. If one of the above emergency breathing procedures is applied ONCE THE ALARM IS ACTIVATED, THOSE 15 MINUTES WOULD TURN INTO 75 MINUTES, which is more than the nominal SCBA full cylinder duration.

Additional Proposed Changes

File Name	Description	Approved
1404_PI_No._2.pdf	NFPA 1404 Public Input No. 2	

Statement of Problem and Substantiation for Public Input

For SCBA wearer's safety during sctrucural firefighting and confined space operations, firefighters should be trained in emergency breathing procedures in case of disorientation or mobility impairment or disability. NFPA 1404 standard does not include guidelines or recommendations in that respect. Personally, as a firefighter, I have conducted training sessions on these procedures at my fire department and the results have always been successful: the remaining air duration has been extended by 5 times. Although NFPA 1404 standard indicates that individual air management should be incorporated into the SOP/SOG, given its importance, I suggest that it be added to this standard, Below you will find links referring to the importance and effectiveness of the indicated emergency breathing procedures:

https://mtntactical.com/research/mini-study-comparing-scba-emergency-breathing-techniques/
https://www.youtube.com/watch?v=yVQMDtmZiLo
http://www.cfbt-be.com/images/teksten/brand/The-ideal-breathing-for-firefighters-on-the-fireground.pdf
https://www.fireengineering.com/2008/04/01/229293/rethinking-emergency-air-management-the-reilly-emergency-breathing-technique/

Submitter Information Verification

Submitter Full Name: Patricio Levenzon
Organization: [Not Specified]
Street Address:
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State:
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Submittal Date: Fri Aug 25 14:45:52 EDT 2023
Committee: FIY-AAA

Public Input No. 2-NFPA 1404-2019 [New Section after 5.1.5.1]

Emergency Breathing Procedures

Both sections 5.1.5 and 5.1.4 indicate that the AHJ should establish and enforce written standard operating procedures for training in the use of respiratory protection equipment.

Section 5.1.4 (2) mentions Emergency Evacuation Procedures and 5.1.5 makes reference to the importance of establishing an IAM (Individual Air Management) program.

Section 5.1.5.2 (3) states that immediate actions should be taken upon activation of the EOSTI and that the corresponding department's SOP/SOG should be followed,

As NFPA 1404 standard does not indicate two situations that can be faced while wearing an SCBA (1. Spatial disorientation of the wearer. 2. Mobility impairment or disability due to injury or entrapment) and that these scenarios represent potential risks, I suggest that a new subsection/text be added to section 5.1.5.1:

The SCBA wearer should be trained in emergency breathing procedures (maximum use of available air), such as: _ Skip Breathing, Box Breathing (Tactical Breathing) or Wheel Breathing.

Note: It should be taken into consideration that when any of these techniques is used, the remaining air duration can be extended up to five times. On SCBA's that meet NFPA 1981, 2018 Edition, the EOSTI alarm is activated when the cylinder air content reaches 35%. In the case of a 45-minute breathing apparatus, this would mean about 15 minutes. If one of the above emergency breathing procedures is applied ONCE THE ALARM IS ACTIVATED, THOSE 15 MINUTES WOULD TURN INTO 75 MINUTES, which is more than the nominal SCBA full cylinder duration.

Statement of Problem and Substantiation for Public Input

For SCBA wearer's safety during sctrucural firefighting and confined space operations, firefighters should be trained in emergency breathing procedures in case of disorientation or mobility impairment or disability. NFPA 1404 standard does not include guidelines or recommendations in that respect. Personally, as a firefighter, I have conducted training sessions on these procedures at my fire department and the results have always been successful: the remaining air duration has been extended by 5 times. Although NFPA 1404 standard indicates that individual air management should be incorporated into the SOP/SOG, given its importance, I suggest that it be added to this standard, Below you will find links referring to the importance and effectiveness of the indicated emergency breathing procedures:

https://mtntactical.com/research/mini-study-comparing-scba-emergency-breathing-techniques/
https://www.youtube.com/watch?v=yVQMDtmZiLo
http://www.cfbt-be.com/images/teksten/brand/The-ideal-breathing-for-firefighters-on-the-fireground.pdf
https://www.fireengineering.com/2008/04/01/229293/rethinking-emergency-air-management-the-reilly-emergency-breathing-technique/

Submitter Information Verification

Submitter Full Name: Patricio Levenzon
Organization: Impomak S A
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Submittal Date: Sat Dec 28 12:14:33 EST 2019
Committee: FIY-AAA

Public Input No. 85-NFPA 1400-2023 [Section No. 23.3.4]

23.3.4

SCBA shall have been manufactured to meet the requirements of NFPA 1981 or NFPA 1970 .

Statement of Problem and Substantiation for Public Input

The addition of NFPA 1970 will cover SCBAs manufactured under the consolidated standard.

Submitter Information Verification

Submitter Full Name: Michael Shahan
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Submittal Date: Mon Aug 28 15:29:57 EDT 2023
Committee: FIY-AAA

Public Input No. 104-NFPA 1400-2023 [Section No. 42.2.2]

42.2.2

~~The initial attack line shall provide~~ Establishment of an effective water flow application rate of 300 gpm (1140 L/min) from two handlines, each of which has a minimum flow rate of 100 gpm (~~379~~ 380 L/min) ~~from the nozzle~~ with each handline operated by a minimum of two members to effectively and safely maintain the line .

Additional Proposed Changes

File Name	Description	Approved
1410_F2019_Held_PC_2.pdf	1410_HELD Public Comment No. 2	

Statement of Problem and Substantiation for Public Input

NOTE: This Public Input appeared as “Rejected but Held” in Public Comment No. 2 of the (F2019) Second Draft Report for NFPA 1410 and per the Regs. at 4.4.8.3.1.

Substantiation:

Submitted through me because government has single NFPA account.

Chief Buchanan,

It's the same change I sent to you previously, dealing with the primary and backup lines flow rates. Changing the
wording to say the same as NFPA 1710.

Current version: Section 8.2.2, The initial attack line shall provide a minimum flow of 100 gpm (400 L/min) from the
nozzle. Section 8.2.3, The required flow from the backup line shall be a minimum of 200 gpm (750 L/min).

Change to: Establishment of an effective water flow application rate of 300 gpm (1140 L/min) from two handlines,
each of which has a minimum flow rate of 100 gpm (380 L/min) with each handline operated by a minimum of two
members to effectively and safely maintain the line.

Thank you again.

V/R
Charles A. Volhein Jr.
Captain
NSA Naples Fire & Emergency Services
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Submitter Information Verification

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Submittal Date:	Thu Aug 31 13:00:42 EDT 2023
Committee:	FIY-AAA

Public Comment No. 2-NFPA 1410-2018 [Section No. 8.2.2]

8.2.2

~~The initial attack line shall provide~~ Establishment of an effective water flow application rate of 300 gpm (1140 L/min) from two handlines, each of which has a minimum flow rate of 100 gpm (~~400~~ 380 L/min) ~~from the nozzle~~ with each handline operated by a minimum of two members to effectively and safely maintain the line .

Statement of Problem and Substantiation for Public Comment

Submitted through me because government has single NFPA account.

Chief Buchanan,

It's the same change I sent to you previously, dealing with the primary and backup lines flow rates. Changing the wording to say the same as NFPA 1710.

Current version: Section 8.2.2, The initial attack line shall provide a minimum flow of 100 gpm (400 L/min) from the nozzle. Section 8.2.3, The required flow from the backup line shall be a minimum of 200 gpm (750 L/min).

Change to: Establishment of an effective water flow application rate of 300 gpm (1140 L/min) from two handlines, each of which has a minimum flow rate of 100 gpm (380 L/min) with each handline operated by a minimum of two members to effectively and safely maintain the line.

Thank you again.

V/R
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Related Item

• Section 8.2.2

Submitter Information Verification

Submitter Full Name: W. Edward Buchanan
Organization: Hanover Fire EMS Department
Affiliation: Comment from Charles Volhein,
Street Address:
City:
State:
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Submittal Date: Mon Oct 08 13:44:13 EDT 2018
Committee: FIY-AAA

Committee Statement

Committee Action: Rejected but held

Resolution: The committee is taking this action as it is new material, however by holding the comment it will force the committee to address it during the next revision cycle.

Public Input No. 103-NFPA 1400-2023 [Chapter 44]

Chapter 44 Required Performance for Automatic Sprinkler System Support (NFPA 1410)

44.1 General.

44.1.1*

The required performance for automatic sprinkler system support shall consist of providing two supply lines to an automatic sprinkler connection.

44.1.2

Automatic sprinkler system support evolutions shall be performed by the first arriving unit(s) staffed with the average number of personnel that ordinarily respond.

44.1.3*

For evolutions employing two or more companies, there shall be a 30-second delay between the arrival of each company.

44.2 Required Flow.

44.2.1

The total flow of the required lines to the sprinkler connection shall be 500 gpm (1900 L/min).

44.2.2*

The evaluator shall determine that required pressures and flows, in accordance with 44.2.1 and 44.2.2.1, are provided to the sprinkler connections.

44.2.2.1

A minimum of 150 psi (1035 kPa) pump discharge pressure shall be used to supply the sprinkler system.

44.2.2.2

Pressures shall be within a range of ±10 percent.

44.3 Hose Evolutions.

44.3.1

The supply lines shall be laid by an engine for a distance of 300 ft (90 m) to or from the water source, and for a distance of 100 ft (30 m) from an engine to the sprinkler connection.

44.3.2

Apparatus water tanks shall not be used as a water supply for these evolutions.

44.4 Method of Evaluation.

44.4.1

When the order to begin the evolution is given, a water supply shall be established for the engine(s) and two supply lines laid to the sprinkler connection.

44.4.2*

The evaluation shall be based on the ability to deliver a minimum of 500 gpm (1900 L/min) through two supply lines to the sprinkler connections.

44.4.3

The flows shall continue until the evaluation is complete.

44.4.4

Failure to supply the sprinkler system shall be considered a serious deficiency in operations.

44.4.5* Interruptions.

44.4.5.1

Failure to maintain water pressure in any line until all lines are operating as required shall be considered an unacceptable interruption.

44.4.5.2

Interruptions of less than 10 seconds shall be considered acceptable.

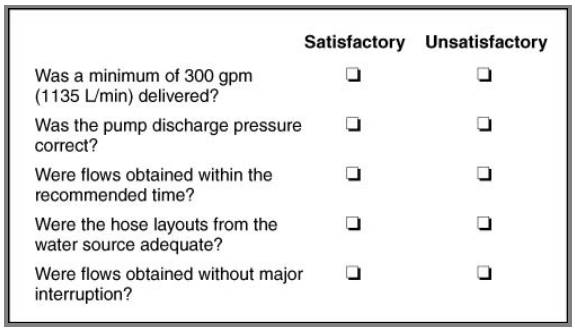
44.4.6

The evolution shall not be concluded until the evaluator is satisfied that the required flows have been provided.

44.5 Evaluation.*

Performance shall be evaluated in accordance with Figure 44.5.

Figure 44.5 Example of an Evaluation Form for Automatic Sprinkler System Support.



	Satisfactory	Unsatisfactory
Was a minimum of 300 gpm (1135 L/min) delivered?	❑	❑
Was the pump discharge pressure correct?	❑	❑
Were flows obtained within the recommended time?	❑	❑
Were the hose layouts from the water source adequate?	❑	❑
Were flows obtained without major interruption?	❑	❑

Add new Chapter (following chapter 44)

Required Performance for Standpipe System Support (NFPA 1410)

45.1 General

45.1.1 The required performance for standpipe system support shall consist of providing two initial supply lines to a standpipe or combined fire department connection.

45.1.1.2 Standpipe system support shall consist of supplying all inlets needed to provide standpipe system demand.

45.1.2 Standpipe system support evolutions shall be performed by the first arriving unit(s) staffed with the average number of personnel that ordinarily respond.

45.1.3 For evolutions employing two or more companies, there shall be a 30-second delay between the arrival of each company.

45.2 Required Flow.

10.2.1 The total flow of the required lines to the standpipe or combined fire department connection shall provide standpipe system demand.

45.2.2 The evaluator shall determine that required pressures and flows, in accordance with 45.2.1, 45.2.1.2 and 45.2.2.1, are provided to the standpipe or combined fire department connections.

45.2.2.1 A minimum of 150 psi plus 5psi per floor of elevation of pump discharge pressure shall be used to supply the standpipe or combined system.

45.2.2.2 Pressures shall be within a range of ±10 percent.

45.3 Hose Evolutions.

45.3.1 The supply lines shall be laid by an engine for a distance of 300 ft (90 m) to or from the water source, and for a distance of 100 ft (30 m) from an engine to the standpipe or combine fire department connection.

45.3.2 Apparatus water tanks shall not be used as a water supply for these evolutions.

45.4 Method of Evaluation.

45.4.1 When the order to begin the evolution is given, a water supply shall be established for the engine(s) and two supply lines laid to the standpipe or combined fire department connection.

45.4.2 The evaluation shall be based on the ability to deliver a minimum of 500 gpm through two supply lines to the standpipe or combined fire department connections.

45.4.3 The flows shall continue until the evaluation is complete.

45.4.4 Failure to supply the standpipe or combined system shall be considered a serious deficiency in operations.

45.4.5 Interruptions.

45.4.5.1 Failure to maintain water pressure in any line until all lines are operating as required shall be considered an unacceptable interruption.

45.4.5.2 Interruptions of less than 10 seconds shall be considered acceptable.

45.4.6 The evolution shall not be concluded until the evaluator is satisfied that the required flows have been provided.

45.5 Evaluation. Performance shall be evaluated in accordance with Figure 45.5.

Figure 45.5 (add)

	Satisfactory	Unsatisfactory
Was a minimum of 300 gpm (1135 L/min) delivered?	❑	❑
Was the pump discharge pressure correct?	❑	❑
Were flows obtained within the recommended time?	❑	❑
Were the hose layouts from the water source adequate?	❑	❑
Were flows obtained without major interruption?	❑	❑

Statement of Problem and Substantiation for Public Input

Substantiation: Standpipes are an integral part of fire department operations in high-rise and large structures. Currently the standard does not include standpipe system training guidance which is regularly conducted in the fire service. While their are similarities with fire sprinkler systems, as they are both water based fire protection systems, incorporating into chapter 44 might be confusing. Having it standalone clarifies the specific requirements for standpipes.

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Committee: FIY-AAA

Public Input No. 102-NFPA 1400-2023 [Section No. 44.2.2.1]

44.2.2.1 – A minimum of

~~150 psi (1035 kPa)~~

150psi pump discharge pressure shall be ~~used~~ maintained to supply the sprinkler system.

Statement of Problem and Substantiation for Public Input

Substantiation: NFPA 13 requires fire department connection on sprinkler systems to be able to provide supplemental water supply for automatic fire sprinklers. The pressure should be maintained to provide a supplemented water supply as more sprinklers activate beyond the design area, exceeding the automatic water supply.

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Public Input No. 66-NFPA 1400-2023 [Section No. 47.2.1]

47.2.1

All ~~FESO vehicles~~ FESO vehicles (except Off Highway Vehicles) shall shall meet the minimum safety standards outlined in the 2017 edition of NFPA 414 and the 2016 edition of NFPA 1901 for fire apparatus; US General Service Administration KKK-A-1822-F, “Star of Life Ambulance Specifications,” and the 2016 edition of NFPA 1917 for ambulance specifications; and US Department of Transportation (DOT) regulations as applicable on the date of construction.

Additional Proposed Changes

File Name	Description	Approved
1451_PI_No._1.pdf	NFPA 1451 Public Input No. 1	

Statement of Problem and Substantiation for Public Input

In recent years Off highway vehicles like ATVs and UTVs have become increasingly popular and in wide spread use by fire services. Although these vehicles may meet DOT/CMVSS requirements, they are not, nor can be NFPA 1901 or 414 compliant.

Operator training or these Off Highway Vehicles is a challenge for fire services in many areas.

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Public Input No. 1-NFPA 1451-2018 [Section No. 4.1.1]

4.1.1

All ~~FESO vehicles shall~~ FESO vehicles (except Off Highway Vehicles) shall meet the minimum safety standards outlined in NFPA 414 and NFPA 1901 for fire apparatus; U.S. General Service Administration KKK-A-1822-F, “Star of Life Ambulance Specifications,” and NFPA 1917 for ambulance specifications; and U.S. Department of Transportation (DOT) regulations as applicable on the date of construction.

Statement of Problem and Substantiation for Public Input

In recent years Off highway vehicles like ATVs and UTVs have become increasingly popular and in wide spread use by fire services. Although these vehicles may meet DOT/CMVSS requirements, they are not, nor can be NFPA 1901 or 414 compliant.

Operator training or these Off Highway Vehicles is a challenge for fire services in many areas.

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Committee: FIY-AAA

Copyright Assignment

I, Paul Prevost, hereby irrevocably grant and assign to the National Fire Protection Association (NFPA) all and full rights in copyright in this Public Input (including both the Proposed Change and the Statement of Problem and Substantiation). I understand and intend that I acquire no rights, including rights as a joint author, in any publication of the NFPA in which this Public Input in this or another similar or derivative form is used. I hereby warrant that I am the author of this Public Input and that I have full power and authority to enter into this copyright assignment.

☑ By checking this box I affirm that I am Paul Prevost, and I agree to be legally bound by the above Copyright Assignment and the terms and conditions contained therein. I understand and intend that, by checking this box, I am creating an electronic signature that will, upon my submission of this form, have the same legal force and effect as a handwritten signature

Public Input No. 63-NFPA 1400-2023 [Section No. 48.3.9]

48.3.9

FESOs shall train operators for inclement weather driving conditions, with emphasis on handling of vehicles, particularly where auxiliary braking devices are to be used. Driver Training Simulator (DTS) training can be of valuable assistance allowing the student to train prior to actual inclement weather begins and affords the training department to preschedule the training in advance of any unforseeable weather conditions.

Additional Proposed Changes

File Name	Description	Approved
1451_PI_No._8.pdf	NFPA 1451 Public Input No. 8	

Statement of Problem and Substantiation for Public Input

Informational statement intended to assist the training staff into considering adding simulation training to their curriculum.

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Committee: FIY-AAA

Public Input No. 8-NFPA 1451-2020 [Section No. 5.3.9]

5.3.9

FESOs shall train operators for inclement weather driving conditions, with emphasis on handling of vehicles, particularly where auxiliary braking devices are to be used. Driver Training Simulator (DTS) training can be of valuable assistance allowing the student to train prior to actual inclement weather begins and affords the training department to preschedule the training in advance of any unforseeable weather conditions.

Statement of Problem and Substantiation for Public Input

Informational statement intended to assist the training staff into considering adding simulation training to their curriculum.

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Committee: FIY-AAA

Public Input No. 62-NFPA 1400-2023 [New Section after 48.3.15]

Minimum Training Requirements

The FESO driver training program shall consist of the following elements:

- **Classroom training on the general principles of operating emergency vehicles operated by the AHJ,**
- **State regulations applicable to the safe operation of emergency vehicles in the state of the AHJ,**
- **Hands-on training relating to emergency vehicle inspection process and procedures for vehicles operated by the FESO,**
- **Hands-on training on a road (cone) course as determined by the AHJ,**
- **Hands-on training of emergency response situations on a driver training simulator; simulation shall be no less than 10% of the overall program. Simulator requirements are listed in the appendix C of 1451.**
- **Hands-on training on an over the road course under direct supervision of an AHJ qualified driver training instructor, after successful completion of the cone course.**

The FESO driver training program shall consist of a minimum of 16 hours of classroom, hands-on, simulator, and road course driving as required by Table 5.3.X

TABLE 5.3.X

Format	Lesson	Minimum Time Required
Classroom	General Operating Principles for Fire and Emergency Vehicles	6 hours
Classroom	State Specific Regulations Module	1 hour
Hands -on	Pre-Trip Inspection Process/Procedures (AHJ Skill Sheet)	2 hours
Hands-on	Cone Course (AHJ developed Skill Sheet) and Driver Training Simulator	4 hours
Hands-on	Road Course (AHJ developed Skill Sheet)	3 hours

Additional Proposed Changes

File Name	Description	Approved
1451_PI_No._3.pdf	NFPA 1451 Public Input No. 3	

Statement of Problem and Substantiation for Public Input

This outlines the minimum time and curriculum standard for Driver Training. Currently there is no standard for the training.

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Public Input No. 3-NFPA 1451-2020 [New Section after 5.3.15]

Minimum Training Requirements

The FESO driver training program shall consist of the following elements:

- Classroom training on the general principles of operating emergency vehicles operated by the AHJ,
- State regulations applicable to the safe operation of emergency vehicles in the state of the AHJ,
- Hands-on training relating to emergency vehicle inspection process and procedures for vehicles operated by the FESO,
- Hands-on training on a road (cone) course as determined by the AHJ,
- Hands-on training of emergency response situations on a driver training simulator; simulation shall be no less than 10% of the overall program. Simulator requirements are listed in the appendix C of 1451.
- Hands-on training on an over the road course under direct supervision of an AHJ qualified driver training instructor, after successful completion of the cone course.

The FESO driver training program shall consist of a minimum of 16 hours of classroom, hands-on, simulator, and road course driving as required by Table 5.3.X

TABLE 5.3.X

Format	Lesson	Minimum Time Required
Classroom	General Operating Principles for Fire and Emergency Vehicles	6 hours
Classroom	State Specific Regulations Module	1 hour
Hands -on	Pre-Trip Inspection Process/Procedures (AHJ Skill Sheet)	2 hours
Hands-on	Cone Course (AHJ developed Skill Sheet) and Driver Training Simulator	4 hours
Hands-on	Road Course (AHJ developed Skill Sheet)	3 hours

Statement of Problem and Substantiation for Public Input

This outlines the minimum time and curriculum standard for Driver Training. Currently there is no standard for the training.

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Public Input No. 25-NFPA 1400-2023 [Section No. A.3.3.88]

A.3.3.88 Live Fire Training Structure.

Commonly referred to as *burn buildings* or *burn towers*, live fire training structures include structures built of noncombustible conventional building materials, such as concrete, masonry, and steel, as well as containerized training structures in which live fire training evolutions are conducted. This includes fixed structures that are marketed as *mobile props*, such as the following:

(1) Pre-engineered metal structures that can be disassembled~~ and transported to~~ , transported to, and reassembled at a new site

(2) Containerized structures in which one or more containers are assembled, whether single story or multistory

Live fire training structures do not include the following:

(1) Fire behavior labs (also known as *flashover containers*) that are made from two offset shipping containers for the sole purpose of demonstrating fire behavior

(2) Mobile live fire training props

(3) Fire investigation training structures and props

(4) Acquired structures used for live fire training unless the acquired structure is intended to be used for live fire training evolutions for more than 3 days total, in which case it would need to follow the requirements of Chapter 7 of this standard

(5) Structures that are used for training in the use of SCBA where only smoke conditions are created, without a live fire, and the participants are not subjected to risk of the effects of fire other than the smoke produced

(6) Structures that simulate industrial applications under live fire conditions in which no personnel enter or stand upon the structure, such as a refinery fire simulation

Live fire training structures could be designed to support the following training objectives:

(1) Fire behavior

(2) Fire spread or extension

(3) Interior fire attack

(4) Rescue

(5) Ventilation

(6) Forced entry

(7) Laddering

(8) Various simulated occupancies similar to those found in the surrounding region

Statement of Problem and Substantiation for Public Input

The first edit provides clarity because if it is not reassembled at the new site, then it is no longer a structure.

The second edit provides clarity because the previous wording, which was in 1402, referenced just 1402, not all of 1400.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 67-NFPA 1400-2023 [Section No. A.3.3.138.2]	

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Public Input No. 67-NFPA 1400-2023 [Section No. A.3.3.138.2]

~~**A.3.3.138.2** – Live Fire Training Structure. –~~

~~Live fire training structures include structures built of conventional building materials, such as concrete, masonry, and steel, as well as structures built of containers, in which live fire training evolutions are conducted. This includes fixed structures that are marketed as mobile props, such as the following:~~

(1) ~~Pre-engineered metal structures that can be disassembled and transported to a new site~~

(2) ~~Containerized structures in which one or more containers are assembled, whether single story or multistory, for purposes of interior live fire training evolutions~~

~~Live fire training structures also include fire behavior labs (also known as flashover containers) and mobile live fire training props.~~

~~Live fire training structures do not include structures that are used for training in the use of SCBA where only smoke conditions are created, without a live fire, and the participants are not subjected to risk of the effects of fire other than the smoke produced.~~

Statement of Problem and Substantiation for Public Input

The definition was deleted in the main body of the standard because it was redundant and should be deleted from Annex A, too. A.3.3.88 provides better explanatory language for the definition of Live Fire Training Structure, especially because the definition of a live fire training structure should NOT include fire behavior labs (flashover containers) and mobile live fire training props.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 24-NFPA 1400-2023 [Section No. 3.3.138]	Deleted section in standard to which this should-be-deleted annex language is tied.
Public Input No. 25-NFPA 1400-2023 [Section No. A.3.3.88]	PI 25 is the better Annex language for live fire training structure definition that should be kept.

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Public Input No. 56-NFPA 1400-2023 [Section No. A.15.14.1]

A.15.14.1

~~Acceptable fuels include pine excelsior, wooden pallets, straw, hay, and other wood-based products.~~

Additional Proposed Changes

File Name	Description	Approved
1403_PI_No_19.pdf	NFPA 1403 Public Input No. 19	

Statement of Problem and Substantiation for Public Input

Delete appendix note and move info to text with in the standard

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 54-NFPA 1400-2023 [Section No. 15.14.1 [Excluding any Sub-Sections]]	

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Public Input No. 19-NFPA 1403-2020 [Section No. A.4.13.1]

A.4.13.1

~~Acceptable fuels include pine excelsior, wooden pallets, straw, hay, and other wood-based products.~~

Statement of Problem and Substantiation for Public Input

Delete appendix note and move info to 4.13.1 text with in the standard

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Committee: FIY-AAA

Public Input No. 57-NFPA 1400-2023 [Section No. A.15.14.6]

A.15.14.6

An excessive fuel load can contribute to conditions that create unusually dangerous fire behavior. This can jeopardize structural stability, egress, and the safety of participants.

Excess fuel load can result in a ventilation-controlled fire, which can result in flameover (rollover) or flashover. These fire conditions increase the amount of thermal energy (the heat release rate of the fire) that is being transferred by conduction, convection, and radiation to any firefighters in the compartment, which can lead to the degradation of protective equipment and injury or death. Venting a ventilation-controlled fire can result in an increase in heat release rate in the fire structure.

UL FSRI examined the burning properties of training fuel packages ranging from a bale of hay opened up on a fire grate to combinations of pallets and hay with oriented strand board (OSB). The range of training fuel packages tested had peak heat release rates (HRRs) of 1 MW to 3.6 MW with total heat release values ranging from 210 MJ to 1815 MJ. The effective heat of combustion for all of the training fuel packages was found to be 14.2 MJ/kg. Table XXXX provides a description of training fuel package arrangement and components, the peak HRR, the total heat realeased, and the peak burning duration in minutes. The peak burning duration was defined as the time period where the HRR was greater than or equal to 80% of the peak HRR. These fuel configurations and burning characteristics may be used by instructors to assess the fuel package they are using in terms of safely meeting the needs of the training objective.

Additional Proposed Changes

File Name	Description	Approved
1403_PI_No_21.pdf	NFPA 1403 Public Input No. 21	
Training_Fuel_Package_Table.1593561753218.docx	UL FSRI Training Fuel Package Table	
Training_Fuel_Packages.1593561844834.JPG	Photos of Training Fuel Packages	

Statement of Problem and Substantiation for Public Input

Adding information to the appendix to quantify burning characteristics of training fuel packages ranging from a bale of straw up through 3 to 7 pallets with straw. This can be useful to aid instructors in determining the appropriate fuel package to use for a given training objective. Ref: Heat Release Rate Characterization of NFPA 1403 Compliant Training Fuels, by John W. Regan, UL FSRI , submitted to Fire Technology, May 2020.

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Committee: FIY-AAA

Public Input No. 21-NFPA 1403-2020 [Section No. A.4.13.6]

A.4.13.6

An excessive fuel load can contribute to conditions that create unusually dangerous fire behavior. This can jeopardize structural stability, egress, and the safety of participants.

Excess fuel load can result in a ventilation-controlled fire, which can result in flameover (rollover) or flashover. These fire conditions increase the amount of thermal energy (the heat release rate of the fire) that is being transferred by conduction, convection, and radiation to any fire fighters in the compartment, which can lead to the degradation of protective equipment and injury or death. Venting a ventilation-controlled fire can result in an increase in heat release rate in the fire structure.

UL FSRI examined the burning properties of training fuel packages ranging from a bale of hay opened up on a fire grate to combinations of pallets and hay with oriented strand board (OSB). The range of training fuel packages tested had peak heat release rates (HRRs) of 1 MW to 3.6 MW with total heat release values ranging from 210 MJ to 1815 MJ. The effective heat of combustion for all of the training fuel packages was found to be 14.2 MJ/kg. Table XXXX provides a description of training fuel package arrangement and components, the peak HRR, the total heat realeased, and the peak burning duration in minutes. The peak burning duration was defined as the time period where the HRR was greater than or equal to 80% of the peak HRR. These fuel configurations and burning characteristics may be used by instructors to assess the fuel package they are using in terms of safely meeting the needs of the training objective.

Additional Proposed Changes

File Name	Description	Approved
Training_Fuel_Package_Table.docx	UL FSRI Training Fuel Package Table	
Training_Fuel_Packages.JPG	Photos of Training Fuel Packages	

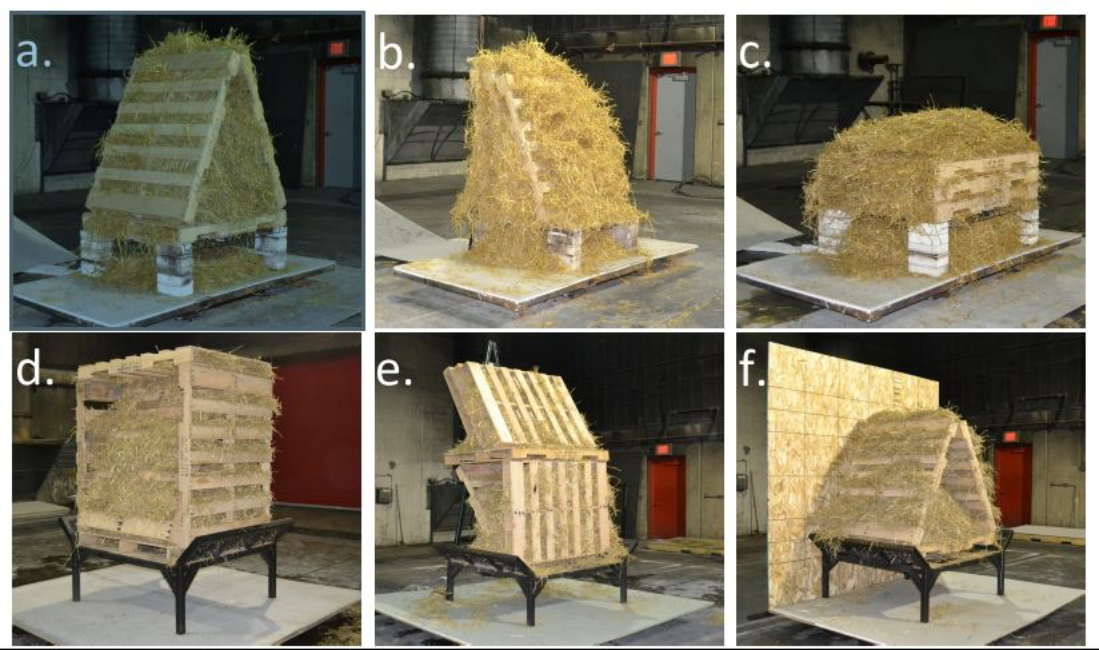
Statement of Problem and Substantiation for Public Input

Adding information to the appendix to quantify burning characteristics of training fuel packages ranging from a bale of straw up through 3 to 7 pallets with straw. This can be useful to aid instructors in determining the appropriate fuel package to use for a given training objective. Ref: Heat Release Rate Characterization of NFPA 1403 Compliant Training Fuels, by John W. Regan, UL FSRI , submitted to Fire Technology, May 2020.

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Committee: FIY-AAA

	Fuel Package Configuration	Number of Pallets	Bale of Straw	Peak HRR (MW)	Total Energy Release (MJ)	Peak Burning Duration (min)
a	Triangle	3	1	1.9	850	3
b	Vertical Stack	3 to 7	1	2.0 - 3.4	815 - 1815	5.3 - 3.5
c	Horizontal Stack	3	1	1.2	925	7
d	Boxed Triangle	6	1	3.6	1580	3.8
e	Inverted Triangle	6	1	3.8	1605	2.8
f	Triangle with 2 OSB Sheets	3	1	2.4	1550	3.5
	Bale of Straw - opened	0	1	1	210	1
	Bales of Straw - opened	0	2	2.1	390	1
	Bale of Aspen Excelsior - opened	0	1	1.7	325	1.5
	Bales of Aspen Excelsior - opened	0	2	1.6	785	4


a.
b.
c.
d.
e.
f.

Public Input No. 36-NFPA 1400-2023 [Sections A.17.2.6, A.17.2.7, A.17.2.8, A.17.2.9]

~~**Sections A.17.2.6, A.17.2.7, A.17.2.8, A.17.2.9**~~

~~**A.17.2.6**~~ —

~~Personnel making the annual structural integrity evaluation should understand the structural system that is being evaluated and where damage is most likely to occur, given the unique design of that live fire training structure. For example, live fire training structures constructed of hollow core plank roofs and floors supported on masonry bearing walls tend to exhibit several problems, such as the following, listed below, which would be helpful to know when conducting the evaluation:~~

(1) ~~Cracks occur in the topping slabs directly over the joints between the planks, causing leaks into the structure and onto thermal linings below.~~

(2) ~~Cracks occur in the ends of the planks and at the two courses of masonry block below the plank bearing points.~~

(3) ~~Vertical cracks occur in masonry bearing walls at building corners.~~

(4) ~~Cracks in the bottoms of the planks occur below the hollow cells and at the bottom corners of the planks.~~

(5) ~~Topping slabs separate from the tops of the planks, reducing the structural capacity of the structural system.~~

(6) ~~Cracks in the topping slabs near guardrail anchor points could cause guardrails to loosen.~~

~~Ideally, the architect/engineer that designed the live fire training structure would have provided a description of what to look for during the periodic evaluations. If no such description was obtained when the live fire training structure was first built, then the AHJ should retain a licensed professional engineer with live fire training structure experience and expertise or other competent professional as determined by the building owner or AHJ to help create such a description.~~

~~**A.17.2.7** —~~

~~Routine maintenance is important to providing a safe, durable live fire training structure for live fire training. Periodic engineering evaluations are one step in that process. Live fire training structures present unique engineering problems that are not taught to engineers in college or in their daily practice of engineering office buildings, schools, and fire stations. Before a registered (licensed) Professional Engineer (P.E.) understands live fire training structure engineering, it takes significant efforts on the part of the P.E. to learn how live fire training structures are used, how repetitive live fire training affects structural and nonstructural elements within the live fire training structure, and what materials have been proven to work (or not work) within such a harsh environment. This effort typically requires research and educational efforts and experience with live fire training structure projects.~~

~~Because the required evaluation is for structural integrity, the P.E. performing the evaluation should be a structural engineer or teamed with a structural engineer to perform the evaluation. Many states do not license P.E.s by discipline; "P.E." could refer to a structural engineer or to some other engineering discipline, such as electrical, mechanical, fire protection, or aeronautical. State laws require P.E.s to offer engineering services for only those branches of engineering for which they are qualified. Therefore, a P.E. who is an electrical engineer or fire protection engineer with no structural qualifications would not be allowed, under law, to evaluate the structural integrity of a live fire training structure.~~

~~Note that a P.E. with refractive materials experience and expertise, but not live fire training structure experience and expertise, might not have sufficient understanding of how refractory concrete performs in a live fire training structure environment. Many P.E.s with refractive materials experience have gained that experience working with industrial applications in which furnaces are heated and cooled slowly. Certain applications of refractory concrete work well under those furnace conditions. However, the same applications of refractory concrete at times work poorly in the live fire training structure environment, where rapid heating, rapid cooling, and thermal shock deteriorate refractory concrete differently than a furnace application would. Many P.E.s with only refractive materials experience, but no live fire training structure experience, do not know this. As a result, the requirement for live fire training structure experience and expertise has been added to the standard. In many cases, the P.E. retained to evaluate the integrity can also, under the same contract, be required to make recommendations for how to repair, maintain, or improve the live fire training structure.~~

~~The phrase "with live fire training structure experience and expertise" must be interpreted by each entity following its own local and state laws and guidelines. The intent is for the P.E. to have performed at least one live fire training structure project previously, so that the entity hiring the P.E. will benefit from the educational and research efforts performed, and experience gained, by the P.E. for the previous live fire training structure project(s). This experience could include a previous live fire training structure evaluation, the repair or renovation to an existing live fire training structure, or the design of a new live fire training structure. In many cases, it would be acceptable for a P.E. without live fire training structure experience or expertise to perform the evaluation as long as he or she has teamed with a P.E. with live fire training structure experience or expertise.~~

~~**A.17.2.8** —~~

~~Refractory concrete should not be used as a structural element. Structural calcium aluminate refractory concrete has been found to delaminate (crack and lose bond) along the lines of reinforcing within walls and suspended slabs, presenting serious structural deficiencies that threaten the life and safety of training personnel.~~

~~**A.17.2.9** —~~

~~Heat can soak through thermal linings and reach the protected structure, especially if the linings are cracked or otherwise require maintenance when live fire training occurs. This heat could damage the structure, a hidden condition that would otherwise go undetected if the panels are not occasionally removed to expose the hidden conditions.~~

Statement of Problem and Substantiation for Public Input

Deleting Annex A material for sections that were deleted from the standard because they are already covered in 7.2.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 33-NFPA 1400-2023 [Section No. 17.2]	Deleting Annex A material for sections that were deleted from the standard.

Submitter Information Verification

Submitter Full Name: Roger LeBoeuf
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Submittal Date: Wed Aug 23 01:54:21 EDT 2023
Committee: FIY-AAA

Public Input No. 37-NFPA 1400-2023 [Sections A.18.2.5, A.18.2.6, A.18.2.7, A.18.2.8]

~~**Sections A.18.2.5, A.18.2.6, A.18.2.7, A.18.2.8**~~

~~**A.18.2.5**~~ —

~~See A.17.2.6.~~

~~**A.18.2.6**~~ —

~~See A.17.2.7.~~

~~**A.18.2.7**~~ —

~~See A.17.2.8.~~

~~**A.18.2.8**~~ —

~~See A.17.2.9.~~

Statement of Problem and Substantiation for Public Input

Deleting Annex A material for sections that were deleted from the standard because they are already covered in 7.2.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 34-NFPA 1400-2023 [Section No. 18.2]	Deleting Annex A material for sections that were deleted from the standard.

Submitter Information Verification

Submitter Full Name: Roger LeBoeuf
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Committee: FIY-AAA

Public Input No. 64-NFPA 1400-2023 [New Section after A.50.1.1]

Use of Driver Training Simulation

A.7.1

Simulators and simulation training are an integral part of the professional skills training. Simulation training is conducted in all professsional fields for cognitive, decision, and judgment training, allowing students to experience real world situations without real world consequesnces of their actions (i.e. hazard recognition and avoidance, vehicle failure, etc.). Studies have proven that organizations that utilize simulation training within the scope of their driver training program have had on average a 38 percent reduction in collisions. Simulation can also be utilized for variocous types of driving conditions that cannot be perscheduled or forseen (i.e. rain, snow, etc.)

Additional Proposed Changes

File Name	Description	Approved
1451_PI_No._5.pdf	NFPA 1451 Public Input No. 5	

Statement of Problem and Substantiation for Public Input

Simulation is and effective and efficient method of training personnel in dangerous conditions. Training how to clear an intersection or drive left of center in the real world is both dangerous and illegal unless responding to an actual emergency. Doing so is both the wrong time for the driver to be learning and the wrong time for the officer to be training.

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Committee: FIY-AAA

Public Input No. 5-NFPA 1451-2020 [New Section after A.7.1.1]

Use of Driver Training Simulation

A.7.1

Simulators and simulation training are an integral part of the professional skills training. Simulation training is conducted in all professsional fields for cognitive, decision, and judgment training, allowing students to experience real world situations without real world consequesnces of their actions (i.e. hazard recognition and avoidance, vehicle failure, etc.). Studies have proven that organizations that utilize simulation training within the scope of their driver training program have had on average a 38 percent reduction in collisions. Simulation can also be utilized for variocous types of driving conditions that cannot be perscheduled or forseen (i.e. rain, snow, etc.)

Statement of Problem and Substantiation for Public Input

Simulation is and effective and efficient method of training personnel in dangerous conditions. Training how to clear an intersection or drive left of center in the real world is both dangerous and illegal unless responding to an actual emergency. Doing so is both the wrong time for the driver to be learning and the wrong time for the officer to be training.

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Submittal Date: Thu Jan 09 11:26:55 EST 2020
Committee: FIY-AAA

Public Input No. 65-NFPA 1400-2023 [New Section after M.1.1.7]

RFP Requirements

Authority having jursidiction (AHJ) can use this section when developing a Request for Proposal (RFP) for a Driver Training Simulator (DTS). Requirements can be enforced by changing the language from "should" to "shall" within the body to help meet the specifications when purchasing a Driver Training Simulator (DTS)

Additional Proposed Changes

File Name	Description	Approved
1451_PI_No._7.pdf	NFPA 1451 Public Input No. 7	

Statement of Problem and Substantiation for Public Input

This is an informational statement to help the AHJ when deciding to write and RFP for purchase of a driver training simulator.

Submitter Information Verification

Submitter Full Name: Robert Raheb
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Submittal Date: Fri Aug 25 15:53:59 EDT 2023
Committee: FIY-AAA

Public Input No. 7-NFPA 1451-2020 [New Section after C.1.1]

RFP Requirements

Authority having jurisdiction (AHJ) can use this section when developing a Request for Proposal (RFP) for a Driver Training Simulator (DTS). Requirements can be enforced by changing the language from "should" to "shall" within the body to help meet the specifications when purchasing a Driver Training Simulator (DTS)

Statement of Problem and Substantiation for Public Input

This is an informational statement to help the AHJ when deciding to write and RFP for purchase of a driver training simulator.

Submitter Information Verification

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Submittal Date: Thu Jan 09 12:23:38 EST 2020
Committee: FIY-AAA

Public Input No. 3-NFPA 13E-2023 [New Section after 3.3.2.3]

3.3.X* Impairment.

A condition where a fire protection system or unit or portion thereof is out of order, and the condition can result in the fire protection system or unit not functioning in a fire event. [**25** , 2023]

A.3.3.X Impairment.

The use of the phrase *fire protection system or unit* is a broad reference to those terms used in titles of Chapters 5 through 12 . Some fire protection features are referred to as systems in the installation standards (e.g., sprinkler, standpipe, water spray, foam-water, and water mist), or are referred to as units (e.g., fire pumps), and others use neither term (e.g., private service fire mains and water tanks). For the purpose of this standard, the term *unit* refers to a fire pump and its connections required by NFPA 20, or a water storage tank and its connections required by NFPA 22, or a private service fire main and its connections required by NFPA 24. The use of the term *unit* in the definitions of impairment, deficiency, critical deficiency, and noncritical deficiency is not referring to an individual component such as a sprinkler, valve, fitting, switch, piece of pipe, and so forth.

Temporarily shutting down a system as part of performing the routine inspection, testing, and maintenance on that system while under constant attendance by qualified personnel, and where the system can be restored to service quickly, should not be considered an impairment. Good judgment should be considered for the hazards presented. [**25** ,2023]

3.3.X.1* Emergency Impairment.

A condition where a water-based fire protection system or portion thereof is out of order due to an unplanned occurrence, or the impairment is found while performing inspection testing or maintenance activities. [**25** , 2023]

A.3.3.X.1 Emergency Impairment.

Examples of emergency impairments might include a ruptured pipe, an operated sprinkler, or an interruption of the water supply to the system. [**25** , 2023]

3.3.X.2 Preplanned Impairment.

A condition where a water-based fire protection system or a portion thereof is out of service due to work planned in advance, such as revisions to the water supply or sprinkler system piping. [**25** , 2023]

Statement of Problem and Substantiation for Public Input

Impairments are referenced in this document and it would be appropriate to extract the definitions from NFPA 25 for context within this document.

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Submittal Date:	Tue Feb 14 14:15:22 EST 2023
Committee:	FIY-AAA

Public Input No. 6-NFPA 13E-2023 [New Section after 3.3.3]

TITLE OF NEW CONTENT

3.3.3.1 Pressure-Reducing Valve. A valve designed for the purpose of reducing the downstream water pressure under both flowing (residual) and nonflowing (static) conditions. [14, 2024] .

Statement of Problem and Substantiation for Public Input

Substantiation: The current edition of NFPA 13E currently defines the umbrella term pressure-regulating devices but does not address the more specific terms used in NFPA 14 of Pressure-restricting devices and pressure-reducing valves. This extract is needed for better clarification of the difference between regulating, reducing valves and restricting devices.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 7-NFPA 13E-2023 [New Section after 3.3.3]	
Public Input No. 7-NFPA 13E-2023 [New Section after 3.3.3]	

Submitter Information Verification

Submitter Full Name: Terin Hopkins
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Submittal Date: Thu Aug 31 11:04:08 EDT 2023
Committee: FIY-AAA

Public Input No. 7-NFPA 13E-2023 [New Section after 3.3.3]

TITLE OF NEW CONTENT

3.3.3.2 Pressure-Restricting Device. A valve or device designed for the purpose of reducing the downstream water pressure under flowing (residual) conditions only. [14, 2024]

Statement of Problem and Substantiation for Public Input

Substantiation: The current edition of NFPA 13E currently defines the umbrella term pressure-regulating devices but does not address the more specific terms used in NFPA 14 of Pressure-restricting devices and pressure-reducing valves. This extract is needed for better clarification of the difference between regulating, reducing valves and restricting devices. Relates to PC 6

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 6-NFPA 13E-2023 [New Section after 3.3.3]	
Public Input No. 6-NFPA 13E-2023 [New Section after 3.3.3]	

Submitter Information Verification

Submitter Full Name: Terin Hopkins
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Submittal Date: Thu Aug 31 11:06:57 EDT 2023
Committee: FIY-AAA

Public Input No. 1-NFPA 13E-2023 [Section No. 4.2.1]

4.2.1

Fire personnel should thoroughly understand the following about properties protected by automatic sprinklers and standpipe systems:

(1) The construction, contents, and layout of the buildings, the nature of the occupancies protected by automatic sprinklers or standpipes, the extent of this protection, and the type of fire protection systems.

(2) The water supply to the fire protection systems, including the source and type of supply, the flow and pressure normally available, and the anticipated duration of the available supply.

(3) * The location of all sprinkler or standpipe control valves, the area controlled by each valve, and the consequence of shutting off each valve.

(4) The location of fire department connections to fire protection systems, the specific area each connection serves, and the water supply, hose, and pumper layout that will be used to feed the fire department connections. *(See Figure 4.2.1.)*

(5) The location of water supplies for handlines that can be used without jeopardizing the water supply to the operating sprinklers.

(6) ~~An alternative means for supplying water to the system in case of damage to the fire department connection.~~ Provide an **alternate means** for a water supply to any system with a **damaged** (FDC) fire department connection **&** carry a **portable** missing swivel adapter on all fire apparatus for urgent replacement of **missing or stolen** brass (input) swivels from the FDC.

(7) The location of spare or replacement sprinklers.

(8) The location of water flow indicators and annunciator panels associated with the fire protection systems.

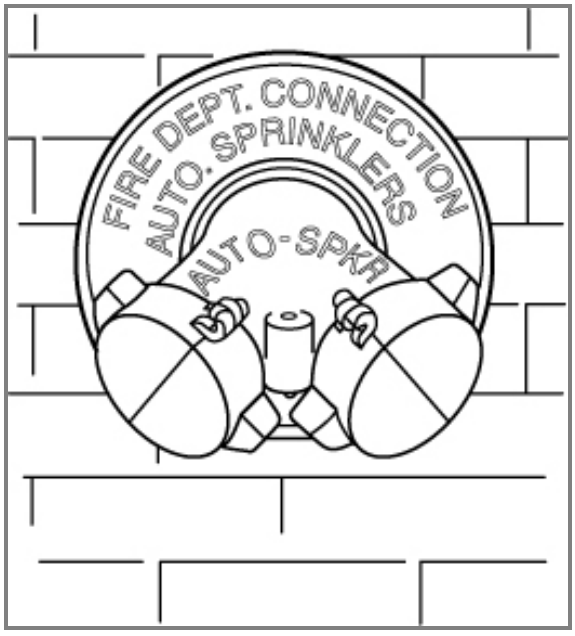
(9) Keyholder information for contact in case of emergency. Arrangements should be made with the property owners for entering the building as quickly as possible following activation of sprinkler systems when the building is unattended in order to avoid using forcible entry equipment and the resulting damage.

(10) The company assigned responsibility for charging the fire department connection.

(11) Fire department personnel should periodically verify that fire department connection inlet caps or plugs and inlet swivel(s) are operational and free from debris.

(12) Standpipe hose threads should be checked for compatibility with fire department threads.

Figure 4.2.1 Fire Department Connection to Automatic Sprinkler Systems.



Additional Proposed Changes

File Name	Description	Approved
.1682352573666	revisions suggested for 13-E	
.1682352629165		
.1689611941817	Suggested for 13-E 14.2 #6 MJC	

Statement of Problem and Substantiation for Public Input

NFPA 13-E 4.2 line #6 as written, implies that a “damaged” (FDC) connection is the ONLY problem that firefighters will encounter that will require an alternate means/solution for a water supply. The current recommendation has not clearly identified the problems that are more epidemic NOW. Most circumstances that cause significant “damage” to an FDC are caused by an explosion, a terrorist or a vehicle crashed into the structure. Damaged FDC’s are usually noticed quickly and repaired immediately. On the other hand, the “Elephant in the room” is Brass Theft, missing swivels, and neglected system maintenance. FDC’s with stolen brass fittings may not be noticed for weeks, months or years unfortunately.
Thank you.

Submitter Information Verification

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Submittal Date: Fri Feb 10 10:59:27 EST 2023
Committee: FIY-AAA

Public Input No. 10-NFPA 13E-2023 [New Section after 4.2.3.4]

TITLE OF NEW CONTENT

4.2.3.4.3 Pressure-reducing valve (PRV) test connections should be properly identified, and caution should be used to prevent accidental fire department use.

Statement of Problem and Substantiation for Public Input

Substantiation: Pressure-reducing valves are provided to prevent firefighter injuries by reducing pressures in excess of 175psi. Indirect pressure-reducing valve must have a means for testing and may have a standard hose valve installed as a test connection. This hose valve is not intended for firefighter operations and could cause harm. They should be properly identified during pre-planning and caution should be used to prevent accidental use.

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Committee: FIY-AAA

Public Input No. 8-NFPA 13E-2023 [New Section after 4.2.3.4]

TITLE OF NEW CONTENT

4.2.3.4.1 Verification should be made that all pressure-regulating devices, both pressure-reducing valves (PRV) and pressure-restricting devices (PRD) flow every five years and meet the requirements of NFPA 25.

Statement of Problem and Substantiation for Public Input

Substantiation: Standpipe hose connection equipped with pressure-regulating devices, both pressure-reducing valves (PRV) and pressure-restricting devices (PRD) are required to be flow tested every five years by NFPA 25 and should be verified in the pre-planning of a building and its systems. Hose connections are vital to fire department operations and should be verified to be fully operational and capable of flowing the required design.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 9-NFPA 13E-2023 [New Section after 4.2.3.4]	
Public Input No. 9-NFPA 13E-2023 [New Section after 4.2.3.4]	

Submitter Information Verification

Submitter Full Name: Terin Hopkins
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Submittal Date: Thu Aug 31 11:09:43 EDT 2023
Committee: FIY-AAA

Public Input No. 9-NFPA 13E-2023 [New Section after 4.2.3.4]

TITLE OF NEW CONTENT

4.2.3.4.2 Pressure-Restricting Devices found in older standpipe system design should be evaluated for performance and considered for replacement with standard hose valves when not exceeding the maximum allowable pressure of 175psi.

Statement of Problem and Substantiation for Public Input

Substantiation: Pressure-Restricting Devices are no longer allowed in standpipe design but were used in early pre-1993 standpipe design to restrict flowing water to a maximum of 100psi. The current edition of NFPA 1 and NFPA 14 now authorize the authority having jurisdiction (AHJ) to replace a PRD with a standard hose connection where system pressures do not exceed 175psi, allowing department to take advantage of the post-1993 allowable maximum pressures of 175psi.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 8-NFPA 13E-2023 [New Section after 4.2.3.4]	
Public Input No. 8-NFPA 13E-2023 [New Section after 4.2.3.4]	

Submitter Information Verification

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Submittal Date: Thu Aug 31 11:11:15 EDT 2023
Committee: FIY-AAA

Public Input No. 14-NFPA 13E-2023 [New Section after 5.1.4]

TITLE OF NEW CONTENT

5.1.4.1 When supplementing sprinkler systems, consideration should be given to the system type and water supply demand. Control mode density area (CMDA), Control Mode Specific Application (CMSA) and Early Suppression Fast Response sprinklers (ESFR) with higher flows may require significantly higher demands at the fire department connection.

Statement of Problem and Substantiation for Public Input

Substantiation: Higher hazard buildings are often equipped with very large fire sprinkler systems capable of flowing large quantities of water. These systems may require a greater volume of water to supplement the system in large fires. Considerations for water supplies and providing volume at the fire department connection need to be pre-planned and considered. This should include the use of multiple water sources, both private and public.

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Submittal Date: Thu Aug 31 11:23:21 EDT 2023
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Public Input No. 13-NFPA 13E-2023 [Section No. 5.1.4]

5.1.4*

5.1.4 * When arriving at a property protected by an automatic sprinkler system, fire companies should take prompt action to ~~supply~~ supplement the system. [See Figure 5.1.4(a) and Figure 5.1.4(b).] A minimum of one sprinkler supply line should be connected to the fire department connection and should be supplemented according to fire conditions. The supply line should be pumped ~~and the line charged~~ ~~charge~~ and maintained to a pressure of ~~150 psi~~ 150 psi (10.3 bar) unless the system is posted for a different pressure. Additional hose lines should be stretched to the fire area as directed by the incident commander in charge. [See Figure 5.1.4(c).]

Figure 5.1.4(a) Public Water Supply to the Sprinkler System.

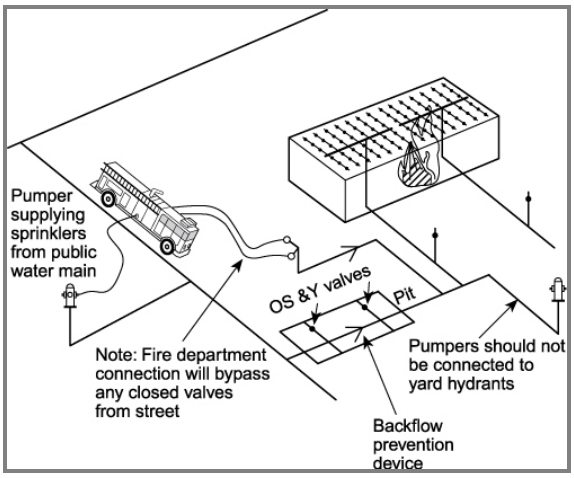


Figure 5.1.4(b) Water Supply to the Fire Department Connection.

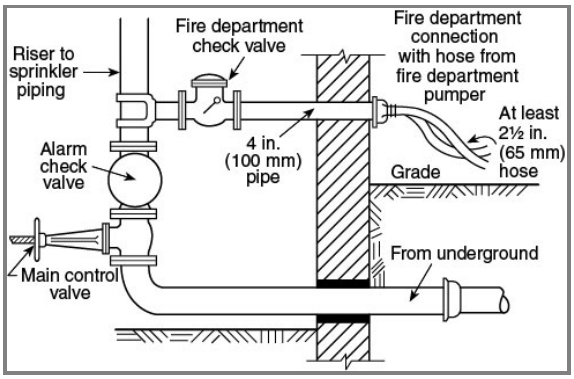
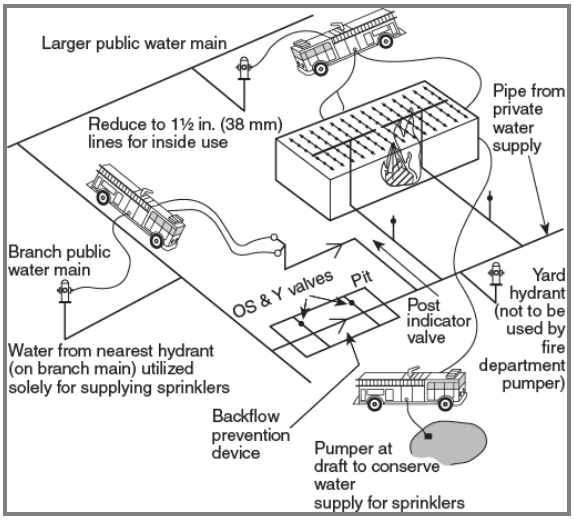


Figure 5.1.4(c) Pumper Supply Options That Should Be Considered.



Statement of Problem and Substantiation for Public Input

Substantiation: NFPA 13 requires fire department connection on sprinkler systems to be able to provide supplemental water supply for automatic fire sprinklers. Fire sprinkler systems have automatic water supplies and only require supplementation. The pressure should be maintained to provide a supplement water supply as more sprinklers activate beyond the design area, exceeding the automatic water supply.

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Committee: FIY-AAA

Public Input No. 17-NFPA 13E-2023 [New Section after 6.2.4.1]

TITLE OF NEW CONTENT

6.2.4.2 A minimum of two standpipe supply lines should be connected to the fire department connection and should be supplemented according to fire conditions. The supply line should be pumped to a pressure of 150 psi, +/- 5psi per floor for elevation, unless the system is posted for a different pressure.

Statement of Problem and Substantiation for Public Input

Substantiation: NFPA 13E provides recommendation for minimum pump pressure at a sprinkler fire department connection (FDC) but does not provide any guidance on supplementing and supplying automatic standpipe systems. 150psi is considered the minimum with pressure above having to be noted with signage. The minimum should include the commonly used +/- 5psi for each floor of a building.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 18-NFPA 13E-2023 [New Section after 6.3.1]	

Submitter Information Verification

Submitter Full Name: Terin Hopkins
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Submittal Date: Thu Aug 31 11:36:29 EDT 2023
Committee: FIY-AAA

Public Input No. 21-NFPA 13E-2023 [New Section after 6.2.4.1]

TITLE OF NEW CONTENT

6.2.4.3 Manual standpipes should be fully supplied from the fire department connection (FDC) as firefighters entering the building and prior to engaging in fire operations in any area considered to be immediately dangerous to life or health (IDLH).

Statement of Problem and Substantiation for Public Input

Substantiation: Firefighters should not enter any area identified as immediately dangerous to life or health (IDLH) without a fully charged hose line. A manual system relying on the fire department to supply pressure and flow from the fire department connection and should be fully supplied prior to any fire attack being indicated. Consideration should allow firefighters to drop dry hose lines in protected areas of a building, like require protected stairways, but no fire attack should begin until the fire department connection (FDC) is fully supplied.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 22-NFPA 13E-2023 [New Section after 6.2.4.1]	
Public Input No. 22-NFPA 13E-2023 [New Section after 6.2.4.1]	

Submitter Information Verification

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Submittal Date: Thu Aug 31 12:06:21 EDT 2023
Committee: FIY-AAA

Public Input No. 22-NFPA 13E-2023 [New Section after 6.2.4.1]

TITLE OF NEW CONTENT

6.2.4.4 Combined systems automatically provide the fire sprinkler demand, but the manual wet standpipe system demand must be supplied by the fire department prior to flowing water from any of the hose connections.

Statement of Problem and Substantiation for Public Input

Substantiation: Manual standpipes that are a part of the combined system are not designed with a water supply. The water supply in the system provides the automatic fire sprinkler system design and will not support the manual wet standpipe system. A manual wet standpipe combined system relies solely on the fire department to supply pressure and flow from the fire department connection and should be fully supplied prior to any fire attack being indicated. Consideration should allow firefighters to drop dry hose lines in protected areas of a building, like require protected stairways, but no fire attack should begin until the fire department connection (FDC) is fully supplied.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 21-NFPA 13E-2023 [New Section after 6.2.4.1]	
Public Input No. 21-NFPA 13E-2023 [New Section after 6.2.4.1]	

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Submittal Date: Thu Aug 31 12:11:40 EDT 2023
Committee: FIY-AAA

Public Input No. 18-NFPA 13E-2023 [New Section after 6.3.1]

TITLE OF NEW CONTENT

6.3.2 A minimum of two standpipe supply lines should be connected to the fire department connection and should be supplemented according to fire conditions. The supply line should be pumped to a pressure of 150 psi, +/- 5psi per floor for elevation, unless the system is posted for a different pressure.

Statement of Problem and Substantiation for Public Input

Substantiation: NFPA 13E provides recommendation for minimum pump pressure at a sprinkler fire department connection (FDC) but does not provide any guidance on supplementing and supplying automatic standpipe systems. 150psi is considered the minimum with pressure above having to be noted with signage. The minimum should include the commonly used +/- 5psi for each floor of a building.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 17-NFPA 13E-2023 [New Section after 6.2.4.1]	

Submitter Information Verification

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Submittal Date: Thu Aug 31 12:00:50 EDT 2023
Committee: FIY-AAA

Public Input No. 19-NFPA 13E-2023 [New Section after 6.3.2]

TITLE OF NEW CONTENT

6.3.4 Fire personnel should be aware of department pump capabilities and how to determine the limitation. Buildings “above the level of fire department pump capabilities” are required to have complete automatic standpipe redundancy.

Statement of Problem and Substantiation for Public Input

Substantiation: The 2024 edition of NFPA 14 will require fully automatic redundancy when buildings are “above the level of fire department pump capabilities”. Fire departments will need to better understand their pumping limits and to determine capabilities.

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Committee: FIY-AAA

Public Input No. 20-NFPA 13E-2023 [New Section after 6.3.2]

TITLE OF NEW CONTENT

6.3.5 Operational plans for supplementing or supplying high-rise buildings should be developed along with considerations for apparatus capabilities. This should include clear expectations on relay, dual or tandem pumping.

Statement of Problem and Substantiation for Public Input

Substantiation: High-rise, very tall and above the level of above the level of fire department pump capabilities need to be considered in fire department operational plans. Clear expectations of apparatus capabilities should be pre planned and include and the abilities of relay, dual or tandem pump capabilities.

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Submittal Date: Thu Aug 31 12:04:00 EDT 2023
Committee: FIY-AAA

Public Input No. 23-NFPA 13E-2023 [New Section after 6.3.2]

TITLE OF NEW CONTENT

6.3.6 High-rise buildings are required to have two separate fire department connections with the sum of all inlets equal to system demand. Fire Departments should consider their apparatus pump capabilities and determine the needed intake at any single FDC.

Statement of Problem and Substantiation for Public Input

Substantiation: Two connections on a high-rise building particularly in buildings reaching above the abilities of fire department pump capabilities may be difficult to supply from two different FDC, where the sum of the connections equal system demand. Many departments have a mix of fire engine pump capabilities and will not be able to pump two separate FDC's where the total sum of inlets is provided on multiple FDC's. Some buildings may require one specific fire department pump to provide total system demand from a single fire department connection. In these cases, the building should be equipped with two FDC both sized for system demand.

Submitter Information Verification

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Submittal Date: Thu Aug 31 12:14:41 EDT 2023
Committee: FIY-AAA

Public Input No. 2-NFPA 13E-2023 [Section No. 10.1]

10.1 Inspection, Testing, and Maintenance for Sprinkler and Standpipe Systems.

~~Sprinkler and standpipe systems should be evaluated in accordance with NFPA 25~~ 10.1.1

The building owner or their authorized agent should evaluate sprinkler and standpipe systems in accordance with NFPA 25.

10.1.2

Compliance with NFPA 25 should be verified by the appropriate enforcement agency in accordance with the locally adopted fire code .

Statement of Problem and Substantiation for Public Input

This section should be modified to clarify the intent of NFPA 25. NFPA 25 is an owner's document and it is the owner's responsibility to maintain their water-based fire protections systems. Within the scope of NFPA 13E, the local fire department should verify compliance with NFPA 25. The fire department should work with the local fire code official to review the documents produced from routine ITM activities including any deficiencies.

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