AGENDA

NFPA Technical Committee on Special Effects (SPE-AAA)
NFPA 160 and NFPA 1126 Second Draft Meeting (A2025)

October 3rd, 2024
1:00 p.m. – 4:00 p.m. (Eastern)

Web/Teleconference
To join the meeting, please contact Yvonne Smith (ysmith@nfpa.org)

1. **Call to order.** Brian Panther.
2. **Introductions.** See committee roster attached.
3. **Chair report.** Brian Panther.
4. **Staff liaison report.** Alex Ing.
5. **Previous meeting minutes.** October 2023 Quincy, MA. See attached.
6. **NFPA 160 First Draft.**
   a. **Public Comments.** See attached.
   b. **Task group report(s).**
      i. **Flame Effect**. Josh Lazarus .
      ii. **Flame Effect Classification and Control**. Eric Smith.
   c. **Committee Inputs.** See attached.
7. **NFPA 1126 First Draft.**
   a. **Public Comments.** See attached.
   b. **Committee Inputs.** See attached.
8. **Other Business.**
9. **Future meetings.**
10. **Adjournment.**

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MINUTES

NFPA Technical Committee on Special Effects (SPE-AAA)
NFPA 160/1126 First Draft Meeting (A2025)

October 24th, 2023
9:00 am – 5:00 pm (Eastern)

Quincy, MA

1. **Call to order.** Brian Panther, chair, called the meeting to order at 9:00 am on 10/24.
2. **Introductions.** Attendees introduced themselves and identified their affiliation and NFPA staff took attendance.
3. **Chair report.** Brian Panther welcomed attendees and provided an overview of the meeting.
4. **Staff liaison report.** Alex Ing provided an overview of the standards development process and the revision cycle schedule.
   a. The following Technical Committee Members disclosed the have been retained by another interest:
      i. Joshua Lazarus stated that he had been retained by Sparktacular on issues regarding RESquibs, and ESP.
5. **Previous meeting minutes.** The minutes from October 2019, Omaha, NE were approved without revision.
6. **NFPA 160 First Draft.**
   a. **Review of Public Inputs.** The Technical Committee reviewed the Public Inputs and developed First Revisions and Committee Inputs as necessary. These will be available in the First Draft Report at www.nfpa.org/160.
   b. **Task group report.** The following task groups provided their reports and recommendations.
      i. **Emerging Technologies**. Jimmy Beardmore. The task group provided a report. The task group was reconstituted to continue work.
      ii. **Flame Effect**. Brian Panther. The Brian ceded the chair temporarily to Josh Lazarus and provided the task group report, and revisions were made. The task group was reconstituted to continue work. The task group added members and the chair changed (see below)
   c. **Presentation(s).** The committee heard presentations from the following individuals.
      i. **Reusable Squib Technology.** Wayne Sawka. See related First Revisions

ii. **Flammable Liquid Fireball Effect.** Trip Barber. Presentation attached.

d. **New task groups.** The following task groups were appointed to work subsequent to the meeting:

i. **Flame Effect**. TG Chair: Josh Lazarus. Members: Eric Smith, Scott Schaffner, Bob Bauer, Daryl Marmon, Ed Kaminski, Ashley Bertling. The task group is charged with updating the flame effect appliance and performers chapters and maintaining coordination between them..

ii. **Flame Effect Classification and Control**. TG Chair: Eric Smith. Members: Glenn Birket, Nick Noch, Andy Nicholls, Ashley Bertling, Charley Weeth. The task group is to look at requirements and definitions in NFPA 160 around flame effect safety controllers and such variations such as control systems. The task group is also to look at the flame effect classification definitions as well.

7. NFPA 1126 First Draft.

a. **Review of Public Inputs.** The Technical Committee reviewed the Public Inputs and developed First Revisions and Committee Inputs as necessary. These will be available in the First Draft Report at www.nfpa.org/1126.

8. Other Business.

9. Future meetings. The next committee meeting will be in the September-November range. A meeting notification will be posted at www.nfpa.org/160next when the meeting is scheduled.

10. Adjournment. The meeting was adjourned at 6:13 pm on 10/24/23.

Attendees

Committee Members:

✓	**Panther, Brian**	Chair	Pyrotek Special Effects Inc.
	Bauer, Robert	Principal	The Doyle Street Group
✓	**Beardmore, James**	Principal	
✓	**Bertling, Ashley**	Principal	Pyrotechniq, Inc.
✓	**Birket, Glenn**	Principal	Birket Engineering, Inc.
✓	**Cappadocia, Peter***	Principal	ImageSFX
✓	**Christopoulos, Chris***	Principal	Universal Parks & Resorts
✓	**Dawe, Nicholas***	Principal	Cobb County Fire Marshal's Office
	Day, Richard	Principal	Michigan State Fire Marshal's Office
✓	**Dell, Jacob**	Principal	National Fireworks Association
	Desmares, Letisha	Principal	Jefferson Parish Fire Department
	Dumansky, Gregory	Principal	Global Asset Protection Services, LLC

	Fields, June	Principal	
	Frantz, H. Stephen	Principal	Pyro Solutions
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✓	**O'Lena, Mike**	Principal	US Bureau of Alcohol, Tobacco, Firearms
✓	**Robbins, Rachel**	Principal	National Rescue Consultants
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✓	**Streett, James***	Principal	International Alliance of Theatrical Stage
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✓	**Tran, Don***	Principal	CSA Group
✓	**Weeth, Charles***	Principal	Weeth & Associates, LLC
✓	**Wyman, Christopher***	Principal	National Association of State Fire
	Zmorenski, Tony	Principal	Walt Disney World
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	Stevens, Shawn	Alternate	US Bureau of Alcohol, Tobacco, Firearms
	Hagemann, Mark	Nonvoting Member	Occupational Safety & Health
✓	**Ing, Alex**	Staff Liaison	National Fire Protection Association

Guests:

Holly Burgess*	NFPA
Erin Grabe*	ESTA
John Canton	
Trip Barber	Pyrotechnics Chair/ NAR
Ronald Johnson*	

*Participated by teleconference
Total number in attendance: 38

6 AUG 2023 (Revised 9/7)

NFPA Task Group on Flammable Liquid Fireball Effects

Background.

This Task Group was a joint effort between the NFPA Pyrotechnics and Special Effects Committees, established by the Chairs of these two committees with the following charge:

1. Discuss and determine whether flammable liquid fireball effects properly belong in NFPA 1123, Code for Fireworks Displays, or if would it be more appropriate for them to be within the purview of NFPA 160, Standard for the Use of Flame Effects Before an Audience. The discussion and determination should be confined to the **concept** of placement within 1123 or 160 without developing any technical language or specifications on the effect itself.
2. Discuss what the consequences may be (i.e., licensure, credentials, enforcement and the like) if retained in NFPA 1123 or if transferred to NFPA 160 and how that may influence retention in NFPA 1123 or movement to NFPA 160.
3. Discuss and determine, to the best of the Task Group's ability, what changes would be needed to the scope of the PYR-AAA or SPE-AAA committees that would clarify and solidify retention in NFPA 1123 or movement to NFPA 160. (This would subsequently be put before the Standards Council for action.)

Members of the Task Group were as follows:

Trip Barber, TG Chair
John Steinberg
Mike O'Lena
Ed Kaminski
Jacob Dell
Scott Shaffner
Pete Cappadocia
Chad Beebe
Phil Grucci
Tony Zmorenski
Charley Weeth
Alex Ing, NFPA Liaison

Actions:

The Task Group met twice virtually (Teams), on February 1 and February 18, 2022, and had numerous e-mail exchanges among the members before and after these meetings.

The Task Group participants discussed the issue of placement of the "fireball effects" coverage within NFPA Codes from three perspectives. The discussion is summarized below.

Discussion of NFPA Code scope for the fireball effect.

These effects use a significant pyrotechnic charge, generally black powder (ignoring the use of high explosives, which are covered by other Codes), to aerosolize and ignite a substance (liquid or solid) that produces the fireball flame effect. If they are deemed to be fundamentally "pyrotechnic devices"

because they use such a charge (their current Code status) then the scope language for the Pyrotechnics Committee and NFPA 1123 sufficiently covers them. If they are deemed to be "flame special effects" and are further considered to be an effect that is not used before a proximate audience (with large quantities of flammable liquid/solid involved this appears to be true), then the scope language of the Special Effects Committee which is specifically focused on effects before a proximate audience, would have to be changed. The scope of NFPA 160 is not specifically confined to proximate audiences but covers flame effects for all audiences, so it would not need to be changed.

Discussion of licensing and permitting.

These flammable liquid fireball effects require the use of substantial black powder charges, which requires BATFE licensing as well as state pyrotechnics licensing of the operators and AHJ pyrotechnics permitting for an event using them. BATFE licensing is generally not required for proximate-audience pyrotechnics (at least when the operation is conducted strictly with UN 0431 "articles pyrotechnic" devices) or for flame effects. Operators of these events require a different state licensing and AHJ permitting that is based on which NFPA Code (160 or 1126) the event is operating under. So operators of shows with flammable liquid fireball effects require pyrotechnics licensing and permitting and a BATFE license, and have to meet the transportation, storage, and insurance requirements for pyrotechnics. This would be in addition to licenses and permits for flame effects, if these effects were in NFPA 160. The operators would not require flame effects licensing/permits if these effects were in NFPA 1123, as long as they are not mentioned in NFPA 160 and thereby appear to AHJ's to be "flame effects".

Discussion of Code Language.

NFPA 160 (and 1126) defines a "hybrid flame effect" as a "flame effect that is used in combination with a pyrotechnic material or device" and says "that portion of the hybrid flame effect that is governed by NFPA 1126 shall meet all of the requirements of NFPA 1126". An Annex to each of these two codes offers as one of the three examples of such an effect a "flammable liquid fireball effect" and says that the aerosolizing and igniting charges fall under the purview of NFPA 1126…or possibly NFPA 1123 (if bulk black powder is used rather than UN 0431 devices, which is generally the case). This language creates confusion. There is no language in either Special Effects Code (160 or 1126) providing standoff or safety requirements for flammable liquid fireball or hybrid flame effects, and unless they are quite small these fireballs are out of place in codes about effects done before a proximate audience and effects that are required to not drop burning material on the ground.

NFPA 1123 characterizes a "flammable liquid fireball effect" without defining it and does not mention or define any "hybrid flame effect" that should be covered in some manner by NFPA 1123 under that name based on the hand-off language used in NFPA 160 Annex A. This NFPA 1123 language also does not cover fireball effects that use solid powders rather than flammable liquids, so it appears to not be broad enough to cover the full range of fireball effects that use large pyrotechnic charges.

Conclusions:

1. These effects should be covered solely by NFPA 1123 because they use a significant pyrotechnic charge to function and require large and specified safety standoff distances like everything else in NFPA 1123; they are not used before proximate audiences. Although a flame effect is

produced, the way it is produced is through the use of a large charge of regulated pyrotechnic material.

2. These effects do not belong under the jurisdiction of the Special Effects Committee because they are not used before a proximate audience, which is the scope of that Committee.

3. The language about “hybrid flame effects” in Annex A to NFPA 160 that cites flammable liquid fireball effects that use significant pyrotechnic charges as an example of a “flame” effect should be removed to eliminate confusion as to where these effects belong.

4. The language in NFPA 1123 5.1.3.7 characterizing these effects as “flammable liquid Fireball effects” should be broadened to encompass solid fuel effects and should include the word “pyrotechnic” due to the nature by which they are created.

5. The language characterizing the scope of the Pyrotechnics Committee should be broadened to include jurisdiction over “pyrotechnic fireball effects”, potentially with appropriate adjustments to standoff distances and units of measure for solid fuel effects. Proposed language has been added to the report below.

All Material is new proposed material.

5.1.3.8* Solid Fuel Fireball Effects

5.1.3.8.1*

For effects using black powder or a black powder equivalent as a propellant and using solid fuels for fireball effects, whether discharged from mortars or other devices, the separation distance to the audience shall be as follows:

1. For round devices, the separation distances shall be 20 ft./in. (6.1 m/25 mm) of the internal diameter of the largest device to be fired.
2. For rectangular devices, the separation distances shall be 20 ft./in. (6.1 m/ 25 mm) of the largest dimension (width or length) of the largest device to be fired.
3. For volume-based calculation, Table 5.1.3.8.1(3) shall apply.

Table 5.1.3.8.1(3) Volume base separation distance

Volume (US gal)	Audience Separation Distance (ft)
<1	50
1 to 4	75
>4 to 10	150
>10 to 25	200
>25 to 100	250
>100 to 200	300
>200 to 400	350
>400	600

Note: 1 US gal is 3.8 liters

A.5.1.3.8.1: Calculated volume can be used to determine a lesser required separation distance consistent with industry experience and safety than the separation distance based upon device size. The volume of a cylinder in cubic inches is as follows:

$$V = \pi \times r^2 \times h$$

$$V = Volume\ (in^3)$$

$$r = radius\ (in)$$

$$h = height\ (in)$$

To obtain that volume in gallons, multiply the number of cubic inches by **0.0043** for converting into US gallons or by 0.0036 for Imperial gallons.

5.1.3.8.2

If multiple devices are separated by less than ten feet between each device to create a single fireball effect, the combined volume of all devices shall determine the audience separation distance.

5.1.3.8.3 If the solid fuel fireball effect contains any type of insert such as stars or other effects that split, burst, or provide additional effects other than simple combustion, the audience separation distances shall be increased by 50%.

5.1.3.8.4 Solid fuel fireball effects shall be fired from any of the following devices:

1. Display fireworks mortars.
2. Plastic containers, provided all handles, metal parts, and attachments are removed.
3. Cardboard containers
4. Metal containers with minimum wall thickness of 1/8” (3.18mm) for all containers with a volume over 5 gallons (0.02 m^3).

5.1.3.8.5* When prevailing winds are oriented toward the audience a 20% increase in audience separation distance shall be required.

A.5.1.3.8.5 Wind at the time of the display can differ from wind at the time of display set up and may require repositioning of fireball devices. 8.1.4.2 provides further guidance with respect to wind effects on display safety.

5.1.3.8.6 Solid fuel fireball effects shall be assembled in their respective firing locations and not moved or transported after assembly.

5.1.3.8.7* Solid fuel fireball effect devices using black powder or an equivalent propellant that are used in a display with projectile or other firework devices shall be protected from premature ignition from debris or other components of the projectile fireworks by means of a plastic or foil or similar covering.

A.5.1.3.8.7 If utilizing metal bowls to contain the black powder or other lift charge and the solid fuel is not to be immediately loaded, an opaque covering such as foil or similar cover to prevent premature ignition of the e-match or other igniter should be used.

Public Comment No. 2-NFPA 160-2024 [Section No. 1.1]

1.1* Scope.

This standard shall provide requirements for the protection of the audience, support personnel, performers, the operator, assistants, and property where flame effects are used from safety and fire hazards .

A.1.1

The health hazards associated with combustion byproducts and fuel chemicals also require a risk assessment and appropriate precaustions if the risk is significant.

Additional Proposed Changes

File Name	Description	Approved
NFPA-160_and_1126-proposed-revisions_PC_M_Rossol.pdf	NFPA 160_PublicComment_M.Rossol	

Statement of Problem and Substantiation for Public Comment

It is well-known that all burning fuels, gases, liquids, and solids, release toxic gases, vapors, and particles. NFPA 160 also covers some effects which could produce additional amounts of air pollutants such as those effects that utilize solid fuels such as wood and coal, and hybrid fire effects that use pyrotechnic igniters, combustible dusts and powders, or black powder lift charges.

The amounts and types of combustion products from burning all these diverse fuels will vary depending on the temperature of the burn, availability of oxygen, and many other factors.
Carcinogens have been found in the combustion products and smoke from all hydrocarbon fuels. The International Agency for Research on Cancer (IARC) lists the profession of fire fighting as a Group 1 Human Carcinogen. And smoke is the firefighters' primary exposure.

As written, NFPA 160 – 2021 is not designed to protect people, especially performers who may be children, elderly, and other high risk individuals. On film locations, in particular, there are very likely to be children and elderly actors in proximity.

Recently, I consulted on location safety for a film in which many fire bars were proposed for use to simulate a forest fire from which a man was attempting to rescue a bus-load of children by driving them through the inferno. In addition to fire bars, they proposed to fill the air with two fog effects at the same time, one glycol-water fog and the other methyl soyate, a diesel fuel and paint-stripping solvent that in a mist form causes the propane flames to burn with an orange color. (This bio fog product was recommended on ASEPO's website and has been used for some years according to the pyrotechnician on this project.)

Children and the elderly, whether working on the production or in the audience, are considered high risk individuals. They are particularly vulnerable to harm from exposure to airborne contaminants from fire effects or the residues such as polycyclic aromatic hydrocarbon residues from soot, metals from colored effects, lead from certain pyrotechnic devices, and other combustion products that remain on surfaces.

In another instance, multiple torches, candles, and oil lamps were used on a set which increased the particles in the air to the point that actors were blowing and coughing up black soot. We now have reduced the number of flame sources and have particle counters on that set to insure that actors and crew are not over exposed.

This additional monitoring expense should not have been instituted after people were exposed. Instead, the scope or purpose, of NFPA 160 must alert users before exposing people to the fire effect emissions. Currently, it is my experience the potential health hazards are almost never addressed on location when

fire effects are used. Altering the standard can help alert users to this additional risk.

Related Item

• Public Input No. 8

Submitter Information Verification

Submitter Full Name: Monona Rossol
Organization: Arts, Crafts & Theater Safety,
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Submittal Date: Mon May 20 13:06:23 EDT 2024
Committee: SPE-AAA

NFPA 160
1.1 Scope. This standard shall provide requirements for the protection of the audience, support personnel, performers, the operator, assistants, and property where flame effects are used.

1.2 Purpose. The purpose of this standard shall be to provide minimum requirements for the design, manufacture, and operation of flame effects.

PROPOSAL TO CHANGE 1.1 Scope

Original wording:
1.1 Scope. This standard shall provide requirements for the protection of the audience, support personnel, performers, the operator, assistants, and property where flame effects are used.

Proposed wording:
1.1 Scope. This standard shall provide requirements for the protection of the audience, support personnel, performers, the operator, assistants, and property where flame effects are used <u>from safety and fire hazards. (The health hazards associated with combustion byproducts and fuel chemicals also require a risk assessment and appropirate precautions if the risk is significant.)</u>

RATIONALE
It is well-known that all burning fuels, gases, liquids, and solids, release toxic gases, vapors, and particles. NFPA 160 also covers some effects which could produce additional amounts of air pollutants such as those effects that utilize solid fuels such as wood and coal, and hybrid fire effects that use pyrotechnic igniters, combustible dusts and powders, or black powder lift charges.

The amounts and types of combustion products from burning all these diverse fuels will vary depending on the temperature of the burn, availability of oxygen, and many other factors. Carcinogens have been found in the combustion products and smoke from all hydrocarbon fuels. The International Agency for Research on Cancer (IARC) lists the profession of fire fighting as a Group 1 Human Carcinogen. And smoke is the firefighters' primary exposure.

As written, NFPA 160 – 2021 is not designed to protect people, especially performers who may be children, elderly, and other high risk individuals. On film locations, in particular, there are very likely to be children and elderly actors in proximity.

Recently, I consulted on location safety for a film in which many fire bars were proposed for use to simulate a forest fire from which a man was attempting to rescue a bus-load of children by driving them through the inferno. In addition to fire bars, they proposed to fill the air with two fog effects at the same time, one glycol-water fog and the other methyl soyate, a diesel fuel and paint-stripping solvent that in a mist form causes the propane flames to burn with an orange color. (This bio fog product was recommended on ASEPO's website and has been used for some years according to the pyrotechnician on this project.)

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high risk individuals. They are particularly vulnerable to harm from exposure to airborne contaminants from fire effects or the residues such as polycyclic aromatic hydrocarbon residues from soot, metals from colored effects, lead from certain pyrotechnic devices, and other combustion products that remain on surfaces.

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This additional monitoring expense should not have been instituted after people were exposed. Instead, the scope or purpose, of NFPA 160 must alert users before exposing people to the fire effect emissions. Currently, it is my experience the potential health hazards are almost never addressed on location when fire effects are used. Altering the standard can help alert users to this additional risk.

I NEED THE CURRENT WORDING FOR A.3.3.24.

Even the definition, **A.3.3.24 Performer**, should be expanded. A suggestions would be:

> Performers can include, but are not limited to, fire performers, stunt people, actors, singers, musicians, and acrobats who may be of various ages and conditions including children, pregnant women, and the elderly.

NFPA 1126

1.1 Scope. This standard shall provide requirements for the protection of property, operators, performers, support personnel, and the viewing audiences where pyrotechnic effects are used indoors or outdoors with a proximate audience.

1.2 Purpose.
1.2.2 The purpose of this standard shall be to provide requirements for the reasonable protection of pyrotechnic operators, performers, support personnel, proximate audiences, proerty, and buildings where pyrotechnics are used indoors or outdoors from safety and fire hazards.

Make sure the words in yellow remain in the purpose and add:

(Potential health hazards from pyrotechnic smoke and combustion byproducts require a risk assessment and appropriate precautions if the risk is significant.)

RATIONALE

Appendix A mentions that health effects are not considered, but no mention is made of the fact that there are OSHA and other regulations laws that required a risk assessment of these health effects before exposing workers as well.

One of these rules is the OSHA Hazard Communication (1910.1200). And in the worker training

requirements is addressing is the difference between safety and health hazards. Safety hazards are well-addressed by NFPA 1126. But NFPA 1126 does not address health hazards from exposure to the pyrotechnic reaction products that are made airborne during use of the effect.

There are many toxic metals given off by pyrotechnic effects that are regulated in the workplace air under OSHA and any potential exposure include a risk assessment. For examples, there are OSHA permissible exposure limits (PELs) for silver, lead, titanium, zirconium, antimony, chromium, and more. Other common pyrotechnic byproduct emissions for which there are OSHA PELs include nitrogen and sulfur oxides.

Production companies, in my experience, assume that meeting NFPA 1126 covers any and all hazards from these effects including health hazards. This was one of the reasons that the use of lead styphnate bullet hits were considered accepable for many years. Yet these small pyrotechnic effects, often used in multiples, exposed performers and crew to excessive lead fume.

The NFPA 1126 safety and fire precautions are excellent, but they are not enough. Users must be alerted upfront that the standard does not address the health hazards. These hazards also require a risk assessment and additional precautions if warranted.

Committee Input No. 9-NFPA 160-2023 [Global Input]

Add proposed new definitions and chapter 18

3.3.## * Chain Fusing.

A series of two or more aerial shells or other firework items fused to fire in sequence or simultaneously from a single ignition.

3.3.## Matchhead. The pyrotechnic composition over a pair of bridge wires on an electric match that ignites when it receives an electrical current.

3.3.## Shunt. The intentional shorting of the connecting wires on an electric match to reduce the potential of the unintended ignition of the electric match from a stray source of electrical energy.

3.3.## Shroud. A protective cover of the matchhead on an electric match to protect the pyrotechnic composition from ignition of the electric match from impact or friction.

3.3.## Lift charge. The propellant charge flame effect mines as well as aerial fireworks and pyrotechnic devices.

A.3.3.## Lift charges are typically blackpowder or another similar explosive.

3.3.7 Black Powder.

A low explosive consisting of an intimate mixture of potassium or sodium nitrate, charcoal, and sulfur.

3.3.12 * Electric Match.

An electric device that contains a small amount of pyrotechnic material that ignites when current flows through the device. [1123, 2018]

3.3.13 * Electrical Firing System.

Electrical equipment that provides and/or controls the ignition of pyrotechnics.

3.3.13 * Shooter

A member of the flame effects crew (either the operator or an assistant) who performs the actual ignition of the flame effects.

3.3.# * Manufacturing Area. An area at a performance where blackpowder lift charges or binary systems are manufactured, or enhancements, pyrotechnics or fireworks are prepared for a performance.

A.3.3.2# Manufacturing Area. The manufacturing area at a performance is similar to a preparation area at a fireworks display.

3.3.## * Misfire. Any flame effect that fails to fire when initiated or ignited, or that fails to fire as designed.

3.3.##.1 *Cold fire. A misfire where the flame effect fails to fire when initiated or ignited.

3.3.##.2 * Hangfire. A misfire of a flame effect mine where it when initiated or ignited, however the ignition fuse fired.

3.3.##.3 Dryfire. A misfire of a flame effect mine using a solid flammable or combustible fuel and the lift charge fired upon initiation or ignition, but the fuel failed to ignite or fully ignite resulting in fuel landing on the ground.

3.3.##.3 Wetfire. A misfire of a flame effect mine using flammable liquid and the lift charge fired upon initiation or ignition, but the fuel failed to ignite of fully ignite resulting in fuel landing on the ground.

3.3.# Sponsor. The organization (person, group, or government agency) that arranges with a flame effects supplier for its services in presenting flame effects at a performance.

NFPA 160 - Chapter 18 Flame Effect Mines

18.1 General

18.1.1 The use of flame effect mines before an audience shall comply with this chapter.

18.1.2 This chapter shall not apply to the use of flame effect mines at air shows or for television and movie productions without an audience.

18.2 Fuels, Coloring Agents and Enhancements for Flame Effect Mines

18.2.1 Permitted Flammable Liquid Fuels for Flame Effect Mines. The following shall be permitted flammable liquid fuels for flame effect mines:

(1) Gasoline

(2) Kerosene

(3) Fuel Oil

(4) Combinations of the above

18.2.2 Permitted Flammable Solid Fuels for Flame Effect Mines. The following shall be permitted flammable solid fuels for flame effect mines:

(1) Naphthalene

(2) Smokeless gunpowder (Nitrocellulose)

(3) Coal dust

(4) Combinations of the above

18.2.3 Permitted Combustible Solid Fuels for Flame Effect Mines. The following shall be permitted combustible solid fuels for flame effect mines:

(1) lycopodium

(2) non-dairy creamer

(3) calf milk replacer

(4) kiln dried hardwood sawdust

(5) ground walnut shells

(6) wheat flours

(7) other very fine, dry organic combustible materials

18.2.4 Permitted Coloring Agents for Flame Effect Mines.

The following shall be permitted coloring agents for flame effect mines:

(1) soluble lithium salts

(2) calcium chloride

(3) boric acid

(4) potassium iodide

(5) copper chloride

(6) barium chloride

(7) cupric chloride

18.2.4 Permitted Enhancements Fuels for Flame Effect Mines

The following shall be permitted enhancements for flame effect mines:

(1) titanium (metal)

(2) color stars (pyrotechnic)

(3) crackle stars (pyrotechnic)

(4) whistle inserts (pyrotechnic)

(5) hummer inserts (pyrotechnic)

(6) report inserts (explosive)

(7) serpent inserts (pyrotechnic)

(8) tourbillion inserts (pyrotechnic

(9) report inserts (explosive)

(10) fuse (flying fish)

(11) fuse (flying fish)

(12) Combinations of the above

18.2.5 Prohibited Chemicals for Flame Effect Mines. The following shall not be permitted chemicals in fuels, coloring agents or enhancements for flame effect mines:

(1) lead

(2) mercury

(3) formaldehyde

(4) polychlorinated biphenyls (PCBs)

(5) per- and polyfluoroalkyl substances (PFAS)

(6) poisons

(7) pesticides

(8) oxidizers

18.3 Lift Charges and Ignition Sources for Flame Effect Mines

18.3.1 Permitted Lift Charges for Flame Effect Mines. The following shall be permitted propellants for flame effect mines:

(1) blackpowder

(2) blackpowder substitutes

(3) smokeless gunpowder (Nitrocellulose)

(4) compressed air

18.3.1.1 Lift charges for flame effect mines consisting of blackpowder, blackpowder substitutes or smokeless gunpowder shall be manufactured at the performance site immediately prior to use by an ATF licensed manufacturer.

18.3.1.2 Lift charges manufactured for flame effect mines shall be limited to the number of lift charges required for each performance in a single day.

18.3.2 Permitted Containment Materials for Manufacturing Lift Charges for Flame Effect Mines. The following shall be permitted containment materials for manufacturing lift charges for flame effect mines:

(1) plastic bags

(2) plastic bottles

(3) electrical tape

(4) duck tape

(5) paperboard

(6) newsprint

(7) glues and bonding agents

(8) equivalent materials of the above

(9) combinations of the above

18.3.2 Prohibited Containment Materials for Manufacturing Lift Charges for Flame Effect Mines. The following shall be prohibited containment materials for manufacturing lift charges for flame effect mines:

(1) metal

(2) glass

(3) fiber reinforces plastic (FRP)

(4) acrylonitrile butadiene styrene polyvinyl chloride (ABS)

(5) polyvinylchloride (PVC)

(6) any material that is brittle

18.3.3 Lift charges for flame effects mines using flammable liquid fuels shall be manufactured using the permitted containment materials in 18.3.2 and sealed in such a manner that the flammable liquid fuels cannot leak or penetrate the lift charge.

18.3.4 Lift charges for flame effects mines using flammable solid fuels shall be manufactured by thoroughly mixing the blackpowder in the correct proportions with the flammable solid fuels directly in the mortar or vessel.

18.3.5 Lift charges for flame effects mines using combustible solid fuels shall be manufactured using the permitted containment materials in 18.3.2.

18.3.6 Lift charges manufactured on site for flame effect mines consisting of blackpowder, blackpowder substitutes or smokeless gunpowder shall be limited to the number of lift charges required for each performance in a single day.

18.3.7 Prohibited Lift charges for Flame Effect Mines. The following shall not be permitted propellants for flame effect mines:

(1) flash powder

(2) whistle composition

(3) ammonium perchlorate composite

18.3.8 Permitted Ignition Sources for Flame Effect Mines. The following shall be permitted ignition sources for flame effect mines:

(1) electric matches

(2) remote manual ignition

18.3.9 Prohibited Ignition Sources for Flame Effect Mines. The following ignition sources shall not be permitted ignition sources for flame effect mines:

(1) quickmatch leader fuses

(2) safety fuse

(3) time fuse

(4) igniter cord

(5) blasting caps

(6) firecracker fuse

18.3.10 * Remote Manual Ignition of Flame Effect Mines Using. Remote manual ignition of flame effect mines shall be permitted, provided the following standards are met:

(1) the shooter is wearing the required personal protective equipment

(2) the point of ignition on the ignition fuse is at least ten (10) feet from any flame effect mine at provides quickmatch fuses

(3) the ignition fuse is secured so that it will not break off the flame effect mine when ignited

(4) the ignition fuse includes time fuse or safety fuse that provides a minimum delay of 30 seconds to allow the shooter to retreat to a safe distance or a flame-resistant barricade

18.3.11 Prohibited Fusing Methods for Flame Effect Mines. Flame effect mines shall not be permitted to be chain fused or otherwise arranged to transfer fire from one flame effect mine to another.

18.3.12 Installation of Ignition Sources for Flame Effect Mines. The permitted ignition sources for flame effect mines in 18.3.10 following shall be installed so that the ignition source is secured in the lift charge and cannot be disconnected or removed during normal handling.

18.3.12 Safety Precautions for Ignition Sources for Flame Effect Mines.

18.3.12.1 Electric matches installed in lift charges for flame effect mines shall have a protective shroud over the matchhead and the connection wires shall remain shunted until connected to the electrical firing system.

18.3.12.2 Quickmatch leader fuses, safety fuses, time fuses or igniter cords shall have a safety cap or equivalent cover over the exposed portion of the fuse and the safety cap or equivalent covering shall remain in place until removed by the shooter just prior to manual ignition.

18.4 Mortars and Vessels for Flame Effect Mines

18.4.1 Permitted Mortars for Flame Effect Mines Using Flammable Liquid or Flammable Solid Fuels. The following shall be permitted mortars for flame effect mines using flammable liquid or flammable solid fuels:

(1) steel

(2) aluminum

(3) 100% high density polyethylene (HDPE) [for methanol fuels only]

(4) 100% fiber reinforces plastic (FRP) [for methanol fuels only]

18.4.2 Prohibited Mortars for Flame Effect Mines Using Flammable Liquid or Flammable Solid Fuels. The following shall not be permitted mortars for flame effect mines using flammable liquid or flammable solid fuels:

(1) paper

(2) cast iron

(2) glass

(4) high density polyethylene (HDPE) with plugs

(5) fiber reinforces plastic (FRP) with wood plugs

(6) acrylonitrile butadiene styrene polyvinyl chloride (ABS)

(7) polyvinylchloride (PVC)

(8) polyethylene terephthalate (PET)

(9) any material that is porous, brittle or that can react or weaken from contact with flammable liquids or flammable solids

18.4.3 Permitted Mortars for Flame Effect Mines Using Combustible Solid Fuels. The following shall be permitted mortars for flame effect mines using combustible solid fuels:

(1) steel

(2) aluminum

(3) 100% high density polyethylene (HDPE)

(4) 100% low density polyethylene (LDPE)

(5) 100% fiber reinforces plastic (FRP)

18,3,4 Minimum Specifications for Mortar and Vessel Materials for Flame Effect Mines.

18.4.4.1 Steel mortars and vessels used for flame effect mine shall be made of at least Schedule 5 pipe or 1/8" thick cold rolled steel plate.

18.4.4.2 Aluminum mortars and vessels used for flame effect mines shall be made of at least Schedule 5 pipe and 1/8" thick aluminum sheets.

18.4.4.3 HDPE and FRP cylindrical and pan mortars and barrels used for flame effect mines shall be made of pipe, tube or sheets at least 1/8" thick.

18.4.4.4 LDPE vessels that are bags shall be at least 30 mil in thickness.

18.4.4.5 HDPE vessels that are jugs, buckets, barrels or bulk containers shall be at least 1/8" thick.

18.4.5 General Standards for Mortars and Vessels for Flame Effect Mines.

18.4.5.1 All mortars and vessels shall be in good condition with no cracks, holes or tears.

18.4.5.2 All cylindrical and pan mortars made of steel or aluminum shall have bases at least equal in thickness to the walls of the mortar.

18.4.5.3 All welds on steel and aluminum mortars shall be full and clean with no gaps.

18.4.5.4 All mortars and vessels other than HDPE jugs and LDPE bags shall be open at the top end.

18.4.5.5 HDPE jugs and LDPE bags used as vessels for flame effect mines shall be permitted to be fully enclosed provided no more than __% of the jug or bag contains fuel to allow for vapors.

18.4.6 Prohibited Mortars for Flame Effect Mines Using Combustible Solid Fuels. The following shall not be permitted mortars for flame effect mines using combustible solid fuels:

(1) paper

(2) cast iron

(3) glass

(4) copper

(5) high density polyethylene (HDPE) with plugs and fasteners

(6) low density polyethylene (LDPE) with plugs and fasteners

(7) fiber reinforces plastic (FRP) with plugs and fasteners

(8) acrylonitrile butadiene styrene polyvinyl chloride (ABS)

(9) polyethylene terephthalate (PET)

(10) polyvinylchloride (PVC)

(11) any material that is porous or brittle

18.4.7 Permitted Vessels for Flame Effect Mines Using Flammable Liquid, Flammable Solid or Combustible Solid Fuels. The following shall be permitted vessels for flame effect mines using flammable liquid, flammable solid or combustible solid fuels:

(1) low density polyethylene (LDPE) bags

(2) high density polyethylene (HDPE) jugs, buckets, barrels or bulk containers

18.4.8 Prohibited Vessels for Flame Effect Mines Using Combustible Solid Fuels. The following shall not be permitted vessels for flame effect mines using combustible solid fuels:

(1) paper

(2) cast iron

(2) glass

(4) high density polyethylene (HDPE) with plugs

(5) fiber reinforces plastic (FRP) with wood plugs

(6) acrylonitrile butadiene styrene polyvinyl chloride (ABS)

(7) polyethylene terephthalate (PET)

(8) polyvinylchloride (PVC)

(9) any material that is porous or brittle

18.5 Placement of Mortars and Vessels for Flame Effect Mines in a Performance Site

18.5.1 All mortars and vessels for flame effect mines shall be placed securely in or on the ground or platform in the performance site according to the flame effect plan such a manner that the mortar or vessel will not fall or tipover during the performance.

18.5.2 All mortars and vessels for flame effect mines shall be placed in such a manner that the recoil from firing the flame effect does not negatively impact the safe function of the flame effect mine, any nearby special effects or the platform,

18.5.3 All mortars and vessels for flame effect mines shall be placed and supported individually.

18.5.4 Bracing underneath mortars and vessels for flame effect mines shall be used to mitigate any negative impacts on the safe function from recoil.

18.5.5 Horizontal support for mortars and vessels for flame effect mines shall be used to mitigate any negative impacts on the safe function of the flame effect mine from recoil of firing and to prevent tipovers during.

18.5.6 Platforms where mortars and vessels for flame effect mines shall be capable of supporting the mortars and vessels and withstand the recoil from firing the flame effect mine.

18.5.7 Mortars and vessels for flame effect mines shall be separated from one another by at least _____ ### or _____, whichever is greater.

18.5.8 Mortars and vessels for flame effect mines shall be separated from aerial fireworks by at least _____ ### or _____, whichever is greater.

3.3.# Performance Site. The area immediately surrounding the location where flame effects are places and initiated and ignited at a performance.

18.6 Storage at the Performance of Blackpowder, Fuels and Enhancements for Flame Effect Mines

18.6.1 Blackpowder for flame effect mines shall be stored at the performance in the approved and enclosed containers or containers in the cargo box of the truck or trailer that delivered the blackpowder to the performance until ready for the manufacture of the black powder lift charge,

18.6.2 Fuels for flame effect mines shall be stored at the performance in the approved and enclosed containers in the cargo box or trailer that delivered the fuels to the performance until ready for loading into the mortars or vessels.

18.6.3 Enhancements for flame effect mines shall be stored at the performance in the approved and enclosed containers in the cargo box or trailer that delivered the enhancements to the performance until ready for adding to the blackpowder lift charge or loading into the mortars or vessels.

18.6.4 Flammable liquids and solid fuels for flame effect mines shall be stored at the performance in separate a cargo box or trailer from a cargo box or trailer with blackpowder, pyrotechnics or fireworks.

A.18.6.4 Flammable liquids and solid fuels are incompatible for transportation and storage in the same cargo box, trailer or magazine with explosives.

18.7 Storage of Fuels and Blackpowder for Flame Effects at a Performance

18.7.1 * Flammable Liquid and Solid Fuel Storage for Flame Effects at a Performance

18.7.1 * The storage of flammable liquid or solid fuels for flame effect mines shall remain enclosed in their approved containers in an enclosed truck or trailer that delivered the fuels or a similar enclosed structure at the performance site until ready for loading into mortars or vessels.

A.18.7.1 Keeping the flammable liquid and solid fuels for flame effect mines enclosed in their approved containers in an enclosed truck or trailer that delivered the fuels, or a similar enclosed structure protects them from the elements as well as any potential sources of ignition.

18.7.2 * Flammable liquid or solid fuels for flame effect mines shall not be stored with blackpowder, pyrotechnic devices or combustible solid fuels.

18.7.3 * Combustible Solid Fuel Storage for Flame Effects at Performance

18.7.3.1 * The storage of combustible solid fuels for flame effect mines shall remain enclosed in their approved shipping containers or equivalent in an enclosed truck or trailer that delivered the fuels or a similar enclosed structure at the performance site until ready for loading into mortars or vessels.

A.18.7.3.1 Keeping the combustible solid fuels for flame effect mines enclosed in the enclosed in their approved containers in an enclosed truck or trailer that delivered the fuels, or a similar enclosed structure protects them from the elements as well as any potential sources of ignition.

18.7.3.2 * Combustible solid fuels for flame effect mines shall be permitted to be stored with blackpowder or pyrotechnic devices.

18.7.4 * Blackpowder Storage

18.7.4.1 * The storage of blackpowder for flame effect mines shall remain enclosed in their approved containers in an enclosed truck or trailer that delivered the fuels or a similar enclosed structure at the performance site until ready for loading into mortars or vessels.

18.7.4.2 * Blackpowder for flame effect mines shall not be stored with flammable liquid or solid fuels for flame effects.

18.7.4.3 * Blackpowder for flame effect mines shall be permitted to be stored to be stored with pyrotechnic devices or combustible solid fuels.

A.18.7.4.1 Keeping the blackpowder for flame effect mines enclosed in the enclosed in their approved containers in an enclosed truck or trailer that delivered the fuels or a similar enclosed structure protects them from the elements as well as any potential sources of ignition.

18.7.5 * Storage of fuels and blackpowder for flame effect mines shall be located at or adjacent to the performance site.

(a) Any enclosed structure used for storage shall be substantially similar to an enclosed truck or trailer used to transport fuels or blackpowder for flame effects.

(b) Any enclosed structure that has utilities (electrical, gas, telephone, etc.) shall have the utilities turned off while fuels or blackpowder for flame effects are stored inside.

A.18.7.5 Storage for fuels or blackpowder for flame effects is not always the best option within the actual performance site. A location that is adjacent to the performance site may be a better option to provide security and maintain the proper distances.

18.7.6 * Performance site storage shall be attended by authorized personnel or meet the requirements of NFPA 30 or NFPA 1124 and all Federal regulations at all times any fuels and blackpowder for flame effect mines are present.

A.18.7.6 Typically fuels and blackpowder for flame effect mines fireworks and pyrotechnic articles are delivered to the performance site the day of the performance. However, there are many performances that may take days to prepare and set up so other means of security are required.

18.7.7 * Storage of blackpowder at a performance site shall be located at least 300 feet (91.4 m) from any public access, storage of flammable liquid or solid fuels, or blackpowder for flame effect mines, pyrotechnic devices, above ground bulk storage of hazardous materials, manufacturing area(s) and discharge site(s).

A.18.7.7 Establishing safe distances for storage of blackpowder at a performance site is essential. Generally, 300 feet (91.4 m) is sufficient for the storage of blackpowder at a performance site, however the operator and AHJ may determine greater distances are required.

18.7.8 * Storage of flammable liquids or solids at a performance site shall be located at least 100 feet (30.5 m) from any public access, storage of flammable liquid or solid fuels, or blackpowder for flame effect mines, pyrotechnic devices, above ground bulk storage of hazardous materials, manufacturing area(s) and discharge site(s).

A.18.7.8 Establishing safe distances for storage of flammable liquids or solids at a performance. Generally, 100 feet (30.5 m) is sufficient for the storage of flammable liquids or solids at a performance site, however the operator and AHJ may determine greater distances are required.

18.7.9 * Removing, counting, inspecting, sorting, organizing and returning of enclosed and approved shipping cartons of blackpowder or pyrotechnic devices as well as the opening of shipping cartons and removal or replacement of individual pyrotechnic devices, and the enclosing of shipping cartons shall be the only activities permitted at blackpowder or pyrotechnic device site storage.

A.18.7.9 Limiting the activities where blackpowder and pyrotechnic devices are stored reduces the exposure of the blackpowder and pyrotechnic devices to unintended ignition and reduces risks.

18.7109 * Removing, counting, inspecting, sorting, organizing and returning of approved containers of flammable liquid and solid fuels or the enclosed containers of combustible solid fuels, and the sealing or enclosing of containers or shall be the only activities permitted at fuel site storage.

A.18.7.9 Limiting the activities where flammable liquid and solid fuels or combustible solid fuels are stored reduces the exposure of the flammable liquid and solid fuels or combustible solid fuels to unintended ignition and reduces risks.

18.7.10 * Under no circumstances shall the installation or removal of electric matches or fuses, the manufacture of blackpowder lift charges or binary systems, or the assembly or loading of pyrotechnic devices, or any repairs of pyrotechnic devices be conducted inside or within 300 feet (30.5 m) of the storage of blackpowder, flammable liquid or solid fuels, or pyrotechnic devices.

A.18.7.10 Prohibiting activities that increase the exposure of blackpowder, flammable liquid or solid fuels, or pyrotechnic devices to unintended ignition reduces risks.

18.7.11 * Only the quantity of blackpowder, flammable liquid or solid fuels, combustible solid fuels, or pyrotechnic devices that can be manufactured or loaded at one time shall be removed from the performance site storage.

A.18.7.11 Realistically, the operator and each assistant can only manufacture a limited number of blackpowder lift charges at one time. Or load a limited number of mortars or vessels with blackpowder lift charges and fuel for a flame effect mine at a time. Limiting the quantities of these explosives and energetic materials in one place at one time along with limiting the number of personnel increasing safety and most importantly survivability

18.7.12 * The door(s) of the enclosed truck, trailer or structure of storage of blackpowder or fuels for flame effect mines shall not open in the direction of any storage of fuels or blackpowder at a performance site, a discharge site or manufacturing area and shall remain closed at all times unless the operator or assistants are actively working inside.

A.18.7.12 Limiting the direction the doors open and keeping the doors closed to storage of fuels or blackpowder at a performance site, a discharge site or manufacturing area reduces the risks of potential source of external ignition reaching energetic materials inside.

18.7.13 Only authorized personnel shall be permitted inside the storage whenever blackpowder, fuels or pyrotechnic devices are present.

18.7.14 The number of persons inside blackpowder, fuels or pyrotechnic devices storage shall be limited to no more than those required to carry out the activities required.

A.18.7.14 Limiting the number of persons reduces the risks of unintended ignition inside performance site storage as well increasing the ability of the occupants to escape if such an event occurs.

18.7.15 Performance site storage shall be kept clean and orderly whenever blackpowder or fuels for flame effect mines or pyrotechnic devices are present.

18.7.16 Power equipment shall not be kept in performance site storage whenever blackpowder, fuels or pyrotechnic devices are present.

18.7.17 Blackpowder and fuels for flame effects shall be handled carefully whenever being loaded or unloaded from a truck or trailer, performance site storage, manufactured, or loaded into mortars or vessels.

18.7.18 Shipping cartons or containers for blackpowder and fuels for flame effects shall not be dropped, slid, or tossed.

18.7.19 Smoking, vaping or any source of open flame shall be kept at least 50 feet (15.3 m) from performance site storage.

18.7.20 Personnel shall not carry lighters, matches, smoking materials and vaping devices when handling blackpowder or fuels for flame effects.

18.8 Manufacturing of Blackpowder Lift Charges at a Performance

18.7.1 Blackpowder lift charges manufactured at a performance site shall only be conducted in a manufacturing area.

18.8.2 Only the operator and authorized assistants shall be permitted in the manufacturing area when blackpowder lift charges are being manufactured.

18.9 Loading of Mortars and Vessels for Flame Effect Mines

18.9.1 Flame effect mines shall be loaded into mortars or vessels prior to the start of a performance.

18.9.2 Flame effect mines shall not be reloaded during a performance.

18.9.2 Flame effect mines shall be permitted to be reloaded between performances.

18.9.3 Once flame effect mines are loaded, they shall be attended to by the operator or an assistant or otherwise secured from unauthorized access at all times until fired or removed.

18.9.4 Once flame effect mines are loaded, they shall be protected from the elements at all times until fired or removed.

18.10 Separation Distances for Flame Effect Mines

18.10.1 The performance area for flame effect mines shall be an open area.

18.10.2 Spectators, unauthorized vehicles, watercraft, or significant quantities of readily combustible materials shall not be located within the performance area during a performance.

18.10.3 Fire protection and other emergency response personnel and their vehicles shall remain at or beyond the perimeter of the performance area during the actual firing of the flame effect.

18.10.2 Flame effect mines with flammable liquid fuels shall be separated from spectators according to Table 18.10.1

Table 18.10.2

Gasoline Spectator Distance (Feet)	Gasoline Spectator Distance (Meters)	Gasoline Spectator Feet per Gallon	Methanol Spectator Distance (Feet)	Methanol Spectator Distance (Meters)	Methanol Spectator Feet pe Gallon
50.00	15.24	50.00	25.00	7.62	25.00
60.00	18.29	30.00	30.00	9.14	15.00
70.00	21.34	23.33	35.00	10.67	11.67
80.00	24.38	20.00	40.00	12.19	10.00
90.00	27.43	18.00	45.00	13.72	9.00
100.00	30.48	10.00	50.00	15.24	5.00
125.00	38.10	6.25	62.50	19.05	3.13
150.00	45.72	5.00	75.00	22.86	2.50
175.00	53.34	4.38	87.50	26.67	2.19
200.00	60.96	4.00	100.00	30.48	2.00
225.00	68.58	3.75	112.50	34.29	1.88
250.00	76.20	3.57	125.00	38.10	1.79
275.00	83.82	3.44	137.50	41.91	1.72
300.00	91.44	3.33	150.00	45.72	1.67
325.00	99.06	3.25	162.50	49.53	1.63
375.00	114.30	1.88	187.50	57.15	0.94
425.00	129.54	1.42	212.50	64.77	0.71
475.00	144.78	1.19	237.50	72.39	0.59
525.00	160.02	1.05	262.50	80.01	0.53
"+1 ft per gallon	"30.48 cm per gallon		**">500**	"+ 6" per gallon	"15.234m per gallo

18.10.3 Flame effect mines with flammable solid and combustible solid fuels shall be separated from spectators according to Table 18.10.3

Table 18.10.3

Solids Fuel (Pounds)	Naphthalene Spectator Distance (Feet)	Naphthalene Spectator Distance (Meters)	Naphthalene Feet per Pound	Solids Spectator Distance (Feet)	Solids Spectator Distance (Meters)	S
1.0	50.00	15.24	50.00	25.00	7.62	
2.0	60.00	18.29	30.00	30.00	9.14	
3.0	70.00	21.34	23.33	35.00	10.67	
4.0	80.00	24.38	20.00	40.00	12.19	

5.0	90.00	27.43	18.00	45.00	13.72
10.0	100.00	30.48	10.00	50.00	15.24
20.0	125.00	38.10	6.25	62.50	19.05
30.0	150.00	45.72	5.00	75.00	22.86
40.0	175.00	53.34	4.38	87.50	26.67
50.0	200.00	60.96	4.00	100.00	30.48
60.0	225.00	68.58	3.75	112.50	34.29
70.0	250.00	76.20	3.57	125.00	38.10
80.0	275.00	83.82	3.44	137.50	41.91
90.0	300.00	91.44	3.33	150.00	45.72
100.0	325.00	99.06	3.25	162.50	49.53
200.0	375.00	114.30	1.88	187.50	57.15
300.0	425.00	129.54	1.42	212.50	64.77
400.0	475.00	144.78	1.19	237.50	72.39
500.0	525.00	160.02	1.05	262.50	80.01
">500	"+1 ft per pound	"30.48 cm per pound		**">500**	"+ 6" per pound	"15

18.10.4 * Overhead objects such as tree branches, utility wires, buildings, structures or natural features with combustible vegetation shall be at least five times the diameter of the flame effect mines from the mortars or vessels with flame mines.

A.18.10.4 The flame effects from flame effect mines can drift significantly downrange, even with little to no wind. For example, a series of flame effect mines clustered together create a series of fireballs that are 100-yard-wide that can drift downrange another few hundred yards, even with little to no wind.

18.10.5 * When multiple flammable liquid or solid fueled flame effect mines are clustered together with distances of less than 10 ft (3.05 m) between each gasoline fueled flame effect mine, the aggregate of the shall be taken to determine the separation distance in Table 18.10.3.

A.18.10.5 Flammable liquid and solid fueled flame effect mines create significantly greater thermal energy than combustible solid fueled flame effect mines and this combined thermal energy of a combination of dramatically increases the fireballs of flammable liquid or solid fueled flame effect mines that are clustered closely together.

18.10.6 * When prevailing winds are oriented toward the audience or overhead objects, an increase of 5% for every 10 mph (16 kph) of wide speed shall be required.

18.10.7 * The operator and assistants as well as any performers and support personnel shall be at least one-quarter (1/4) the distance from flame effect mines as specified in Table 18.10.2 or 18.10.3, or behind a protective barricade or wearing personal protective equipment when flame effect mines are fired.

A.18.10.7 The personal protective equipment (PPE) specified in this chapter is often more than sufficient for many flame effect mines, however additional measures are recommended for large flame effect mines, especially a series using gasoline as the fuel. A protective barricade can be as simple as a plywood screen or an earthen berm or the like that will deflect the radiant heat from a flame effect mine.

3.3. # Performance Area. The area where a performance with flame effects is conducted, including the performance site and the required separation distance from the flame effects to the spectators.

18.11 Fire prevention for Flame Effect Mines

18.11.1 The loading of blackpowder lift charges and fuels for flame effect mines into mortars or vessels shall be done carefully and minimize spills of the fuels onto the ground or platform adjacent to the mortar or vessel.

18.11.2 Any spills of the fuels during the loading of the mortars or vessels onto the ground or platform adjacent to the mortar or vessel shall be removed prior to the performance, or other measures taken to mitigate the propagation of fire.

18.11.3* The ground or platform adjacent to mortars or vessels for flame effect mines shall be cleared of combustible materials, covered with fire resistant materials, wet down prior to the performance, or otherwise protected with similar measures.

A18.11.3 Flame effects with flammable liquids tend to have a propensity to drop burning fuel onto the ground adjacent to mortars and vessels, which can then ignite any combustible materials. In most instances, these small fires burn out quickly and do not spread, but depending on the conditions, they can spread around the performance site or start wildfires. Clearing combustible materials around mortars and vessels may involve cutting vegetation down to the ground, while sprinkling a layer of sand, placing fire blankets or roofing felt on the ground, wetting vegetation or the platform down with water, or similar measures around mortars and vessels for flame effects can mitigate the spread of fire from flame effect mines.

18.11.4 * The operator and the shooter prior to the performance and the firing of any flame effect mines shall consider the type and distance of any overhead objects from flame effect mines together with the wind speed and direction.

A.18.11.4 Flame effect mines can and will drift with little to no wind due to the rapid rise in air temperature and the expansion of the burning fuels in the air. The fireball can drift significantly and thus pose a risk of ignition or damage to overhead objects.

18.12 Fire protection for Flame Effect Mines

18.12.1 * **Portable Fire-Fighting Equipment**.

(1) A minimum of four portable fire extinguishers of the classifications and sizes as approved by the authority having jurisdiction shall be readily accessible while the fuels and blackpowder for flame effect mines are stored and manufactured for a performance.

(2) A minimum of four portable fire extinguishers of the classifications and sizes as approved by the authority having jurisdiction shall be readily accessible at each discharge site for flame effect mines at a performance.

A.11.1 Attempting to fight fires with portable fire-fighting equipment in or near fuels or blackpowder that are stored or blackpowder lift charges being manufactured at a performance site is not recommended. No attempt should be made to fight exploding blackpowder lift charges with portable fire-fighting equipment. Any attempt to fight fires of stored fuels or blackpowder should be considered carefully based upon the type and location of the fire and the stored fuels or blackpowder. No attempt should be made to fight fires of exploding blackpowder lift charges or flame effect mines loaded in mortars or vessels with portable fire-fighting equipment.

Portable fire-fighting equipment should be chosen and placed to fight any potential secondary fires.

18.12.1.2 * At a minimum, the following shall be provided for the use of flame effect mines.

(1) Two pressurized water extinguishers, each with a minimum rating of 2-A

(2) Two fire extinguishers, each with a minimum rating of 10-B:C

A.18.12.1.2 Shovels, rakes, brooms, buckets of water, Indian tanks and fire swatters are additional portable fire-fighting equipment that also may be considered appropriate.

18.12.1.3 The portable fire extinguishers shall be placed so that at least one of each classification is located on each opposing side where fuels and blackpowder are stored and blackpowder lift charges are manufactured at a performance site, and on each side of discharge site for flame effect mines.

18.12.1.4 Additional portable fire-fighting equipment shall be provided as required by NFPA 10, the authority having jurisdiction and the operator.

A.18.12.1.4 The types and quantities of portable fire-fighting equipment are dependent on the flame effect mines conditions at the performance site(s) and each discharge site at a performance. The types and quantities of fuels used in flame effect mines in combination with the conditions of any combustible materials at the performance site along with the weather conditions, topography, accessibility, available personnel and equipment, etc. should be assessed by the operator and AHJ in order to determine the best types and quantities of portable fire-fighting equipment for a particular fireworks display.

18.12.1.5 The operator shall ensure assistants that have a working knowledge of the use of the portable fire-fighting equipment shall be present while fuels or blackpowder that are stored or blackpowder lift charges being manufactured at a performance site.

18.12.1.6 The operator shall ensure assistants that have a working knowledge of the use of the portable fire-fighting equipment shall be present while fuels and blackpowder lift charges are being loaded into mortars and vessels at a performance site.

18.12.1.7 The operator shall ensure assistants that have a working knowledge of the use of the portable fire-fighting equipment shall be present while flame effect mines until all flame effects mines are fired or unloaded.

18.12.2 Fire-Fighting Equipment and Personnel.

18.12.2.1 * Fire-fighting equipment such as pumpers or charged fire hoses or similar shall be at the ready at a performance with flame effect mines as required by the operator or AHJ.

A.18.12.2.1 Other fire-fighting equipment such as pumpers or charged fire hoses shall be at the ready at a performance with flame effect mines as required by the operator or AHJ.

18.12.2 * Personnel staffing fire-fighting equipment such as pumpers or charged fire hoses or similar shall be in wildland fire gear or comparable PPE and remain outside the performance site until expressly directed to respond by the operator.

A.18.12.2 Attempting to fight fires in or near flame effect mines is not recommended. No attempt should be made to fight exploding blackpowder lift charges. Any attempt to fight fires of flame effect mines should be considered carefully based upon the type and location of the flame effect mines. No attempt should be made to fight fires of exploding blackpowder lift charges or flame effect mines loaded in mortars or vessels.

18.13 Personal Protective Equipment (PPE) for Flame Effect Mines

18.12.1 All personnel in a manufacturing area at a performance when blackpowder lift charges are being manufactured shall wear clothing made up primarily of natural fibers and wear ANSI rated safety glasses.

18.12.2 All personnel where blackpowder lift charges and fuels are loaded into mortars and vessels shall wear clothing made up primarily of long sleeved natural fibers and wear ANSI rated safety glasses.

18.12.3 All personnel, including the operator and assistants, performers and support personnel, in the performance area where flame effect mines are fired during a performance shall wear clothing made up primarily of long sleeved natural fibers and wear ANSI rated hard hat and safety glasses.

18.14 Firing Procedures for Flame Effect Mines

18.14.1 Flame effect mines shall be fired using an electrical firing system or a remote means of manual ignition.

18.14.2 A remote means of manual ignition of flame effect mines shall provide at least __ seconds for the shooter to retreat to the minimum safety distance of __ feet from the flame effect mines or behind a barricade.

18.14.3 Flame effect mines shall be fired only when in clear view of the flame effects shooter or assistants that are in direct communication with the shooter.

A.18.14.3 Direct communication should at a minimum consist of verbal, radio or cellular communications, hand signals, or light signals.

18.15 Safe Handling of Misfired for Flame Effect Mines

18.15.1 * In the event that a flame effect mine misfires during a performance, it shall be marked and all personnel in the performance site alerted to the hazard.

18.15.2 * The operator or an authorized assistant shall inspect the flame effect mine immediately following the performance to determine what type of misfire occurred and the measures to safely handle the misfired flame effect mine.

18.15.3 * In the event that the misfire of a flame effect mine is determined to be a coldfire, it shall be permitted to be fired after a performance, provided all applicable requirements are followed.

18.15.4 * In the event that the misfire of a flame effect mine is determined to be a coldfire, the operator or an authorized assistant shall be permitted to:

a) disconnect the electric match from the firing system and shunt the wires, or

b) ensure a safety cap is on the exposed ignition fuse

c) remove the blackpowder lift charge and fuel from the flame effect mine into an approved container

18.15.5 * The operator or an authorized assistant shall be permitted to correct or manipulate the flame effect mine that misfired in order to fire it after a performance.

18.15.6 * In the event that the misfire of a flame effect mine is determined to be a hangfire, the flame effect mine shall not be approached or touched for at least 30 minutes, after which time the operator or an authorized assistant shall carefully:

a) disconnect the electric match from the firing system and shunt the wires.

b) cut the ignition fuse at the closest point possible to the flame effect mine

18.15.7 * Hangfires of a flame effect mine using flammable liquid fuels shall have the lift charge removed and returned to an approved containers prior to pouring, siphoning or pumping the flammable liquid fuel from the flame effect mine into an approved container.

18.15.8 * Hangfires of a flame effect mine using mix of flammable solid fuels with blackpowder shall be corrected or manipulated in order to fire it after a performance.

18.15.9 * Hangfires of a flame effect mine using combustible solid fuels shall have the combustible solid fuel and blackpowder lift charge removed and returned to their respective approved containers.

18.15.10 * Dryfires of a flame effect mine using flammable or combustible solid fuels shall have the flammable or combustible solid fuel and any unfired blackpowder removed and returned to their respective approved containers.

18.15.11 * Any combustible solid fuels that land on the ground from a dryfire of a flame effect mine shall be permitted to have the fuel on the ground wet swept up, down or otherwise dispersed.

18.15.12 * Any flammable liquid or solid fuels that land on the ground from a wetfire dryfire of a flame effect mine shall be permitted to be ignited in a controlled burn after the performance, provided all applicable requirements are followed.

18.15.13 * Any blackpowder from a misfire of flame effect mine shall be permitted to be ignited in a controlled burn after the performance, provided all applicable requirements are followed.

18.16 Operator and Assistant Qualifications for Flame Effect Mines

18.16.1 * The operator and assistants that use flame effect mines at a performance shall be trained to properly manufacture, load, and fire flame effect mines as well as the electrical firing systems, mortars and vessels, and methods to address misfires.

18.16.2 * The operator shall be at least 21 years old and licensed or approved by the AHJ in accordance with any and all applicable federal, state, and local laws.

18.16.3 * Applicants for licensing as an operator of flame effect mines at a performance shall provide evidence of training and actual experience as an operator or assistant as part of demonstrating competency to the AHJ.

18.16.4 Applicants for licensing as an operator of flame effect mines at a performance shall successfully complete a written examination of laws, regulations, and safety practices pertaining to the use of flame effect mines at a performance that shall be administered by the AHJ or shall otherwise demonstrate knowledge of these subjects.

18.16.5 All assistants shall be trained in the duties they are to carry out using flame effect mines at a performance, be under the direct supervision of the operator, and be at least 18 years old.

18.17 Permit Requirements for Flame Effect Mines at a Performance

18.17.1 * Prior to a performance with flame effect mines, the operator, supplier, or sponsor shall obtain a permit from the AHJ.

18.17.2 * If the permit for using flame effect mines at a performance is denied by the AHJ, the AHJ shall notify the permit applicant and specify in writing the reasons for the denial.

18.17.3 The permit applicant shall be permitted to resubmit the permit application for using flame effect mines at a performance to address the reasons specified by the AHJ for denial of the display permit.

18.17.4 As part of the permit process, the operator, supplier, or sponsor shall demonstrate financial responsibility for using flame effect mines at a performance to the AHJ by providing proof of insurance or by other approved means.

18.17.5 As part of the permit process, the operator shall provide documentation of the operator and assistant qualifications with a flame effects plan that describes in detail the proposed use of flame effect mines at a performance.

18.17.6 As part of the permit process, the operator shall provide a diagram of the manufacturing area and performance site with the flame effect mines showing the separation distances required in this standard.

18.17.7 As part of the permit process, the operator shall provide details of the fire prevention and fire protection measures for the flame effect mines required in this standard.

18.17.8 As part of the permit process, the operator shall provide details of the security and crowd control measures for the flame effect mines required in this standard.

18.17.9 The operator or supplier shall maintain any federal or state permit(s) or license(s) required to possess, manufacture and use blackpowder and flame effects mines.

18.17.10 The AHJ shall meet all the requirements of this standard if the AHJ acts as the operator of the display.

Submitter Information Verification

Committee: SPE-AAA
Submittal Date: Tue Oct 24 14:48:43 EDT 2023

Committee Statement

Committee Statement: In order to properly address the many issues regarding Flame Effect Mines, from fuels and propellants, to storage and manufacturing, to mortars and vessels, to equipment and

placement, to preparing and loading, to firing methods and misfires, to personnel and personal protective equipment, to distances to spectator, structures and buildings, to distances to spectators and personnel, to fire prevention and fire protection, and more a separate chapter is needed to in addition to specific definitions for this unique technology to create fireballs with flammable liquids and solids as well as combustible solids with blackpowder propellants.

Additional advisory and explanatory information should be developed based on the final outcome of this proposal to better assist operators and AHJs.

Response Message: CI-9-NFPA 160-2023

Ballot Results

This item has not been balloted

Public Comment No. 3-NFPA 1126-2024 [Sections 1.1, 1.2]

Sections 1.1, 1.2

1.1 Scope.

This standard shall provide requirements for the protection of property, operators, performers, support personnel, and the viewing audiences where pyrotechnic effects are used indoors or outdoors with a proximate audience.

1.2 Purpose.

1.2.1

The purpose of this standard shall be to provide ~~minimum~~ requirements ~~to~~ for the reasonable protection of pyrotechnic operators, performers, support personnel, proximate audiences, property and manufacturers for the safe operation of pyrotechnic effects.

1.2.2*

The purpose of this standard shall be to provide requirements to protect pyrotechnic operators, performers, support personnel, proximate audiences, property, and buildings ~~from safety and fire hazards~~ where pyrotechnics are used indoors or outdoors from safety and fire hazards .

A. 1.2. 2

Potential health hazards from pyrotechnic smoke and combustion byproducts require a risk assessment and appropriate precautions if the risk is significant.

1. 2.2. 1

The purpose of this standard shall be to provide guidelines to the authority having jurisdiction for approval of the use of pyrotechnics as specified in 1.2.2.

1.2.2.2

The purpose of this standard shall be to provide requirements for local permits.

Additional Proposed Changes

File Name	Description	Approved
NFPA-160_and_1126-proposed-revisions_PC_M_Rossol.pdf	NFPA 1126_PublicComment_M.Rossol	

Statement of Problem and Substantiation for Public Comment

Appendix A mentions that health effects are not considered, but no mention is made of the fact that there are OSHA and other regulations laws that required a risk assessment of these health effects before exposing workers as well.

One of these rules is the OSHA Hazard Communication (1910.1200). And in the worker training

requirements is addressing is the difference between safety and health hazards. Safety hazards are well-addressed by NFPA 1126. But NFPA 1126 does not address health hazards from exposure to the pyrotechnic reaction products that are made airborne during use of the effect.

There are many toxic metals given off by pyrotechnic effects that are regulated in the workplace air under OSHA and any potential exposure include a risk assessment. For examples, there are OSHA permissible exposure limits (PELs) for silver, lead, titanium, zirconium, antimony, chromium, and more.

Other common pyrotechnic byproduct emissions for which there are OSHA PELs include nitrogen and sulfur oxides.

Production companies, in my experience, assume that meeting NFPA 1126 covers any and all hazards from these effects including health hazards. This was one of the reasons that the use of lead styphnate bullet hits were considered accepable for many years. Yet these small pyrotechnic effects, often used in multiples, exposed performers and crew to excessive lead fume.

The NFPA 1126 safety and fire precautions are excellent, but they are not enough. Users must be alerted upfront that the standard does not address the health hazards. These hazards also require a risk assessment and additional precautions if warranted.

Related Item

• First Revision No. 6

Submitter Information Verification

Submitter Full Name: Monona Rossol
Organization: Arts, Crafts & Theater Safety,
Street Address:
City:
State:
Zip:
Submittal Date: Mon May 20 13:23:16 EDT 2024
Committee: SPE-AAA

NFPA 160
1.1 Scope. This standard shall provide requirements for the protection of the audience, support personnel, performers, the operator, assistants, and property where flame effects are used.

1.2 Purpose. The purpose of this standard shall be to provide minimum requirements for the design, manufacture, and operation of flame effects.

PROPOSAL TO CHANGE 1.1 Scope

Original wording:
1.1 Scope. This standard shall provide requirements for the protection of the audience, support personnel, performers, the operator, assistants, and property where flame effects are used.

Proposed wording:
1.1 Scope. This standard shall provide requirements for the protection of the audience, support personnel, performers, the operator, assistants, and property where flame effects are used <u>from safety and fire hazards. (The health hazards associated with combustion byproducts and fuel chemicals also require a risk assessment and appropirate precautions if the risk is significant.)</u>

RATIONALE
It is well-known that all burning fuels, gases, liquids, and solids, release toxic gases, vapors, and particles. NFPA 160 also covers some effects which could produce additional amounts of air pollutants such as those effects that utilize solid fuels such as wood and coal, and hybrid fire effects that use pyrotechnic igniters, combustible dusts and powders, or black powder lift charges.

The amounts and types of combustion products from burning all these diverse fuels will vary depending on the temperature of the burn, availability of oxygen, and many other factors. Carcinogens have been found in the combustion products and smoke from all hydrocarbon fuels. The International Agency for Research on Cancer (IARC) lists the profession of fire fighting as a Group 1 Human Carcinogen. And smoke is the firefighters' primary exposure.

As written, NFPA 160 – 2021 is not designed to protect people, especially performers who may be children, elderly, and other high risk individuals. On film locations, in particular, there are very likely to be children and elderly actors in proximity.

Recently, I consulted on location safety for a film in which many fire bars were proposed for use to simulate a forest fire from which a man was attempting to rescue a bus-load of children by driving them through the inferno. In addition to fire bars, they proposed to fill the air with two fog effects at the same time, one glycol-water fog and the other methyl soyate, a diesel fuel and paint-stripping solvent that in a mist form causes the propane flames to burn with an orange color. (This bio fog product was recommended on ASEPO's website and has been used for some years according to the pyrotechnician on this project.)

Children and the elderly, whether working on the production or in the audience, are considered

high risk individuals. They are particularly vulnerable to harm from exposure to airborne contaminants from fire effects or the residues such as polycyclic aromatic hydrocarbon residues from soot, metals from colored effects, lead from certain pyrotechnic devices, and other combustion products that remain on surfaces.

In another instance, multiple torches, candles, and oil lamps were used on a set which increased the particles in the air to the point that actors were blowing and coughing up black soot. We now have reduced the number of flame sources and have particle counters on that set to insure that actors and crew are not over exposed.

This additional monitoring expense should not have been instituted after people were exposed. Instead, the scope or purpose, of NFPA 160 must alert users before exposing people to the fire effect emissions. Currently, it is my experience the potential health hazards are almost never addressed on location when fire effects are used. Altering the standard can help alert users to this additional risk.

I NEED THE CURRENT WORDING FOR A.3.3.24.

Even the definition, **A.3.3.24 Performer**, should be expanded. A suggestions would be:

> Performers can include, but are not limited to, fire performers, stunt people, actors, singers, musicians, and acrobats who may be of various ages and conditions including children, pregnant women, and the elderly.

NFPA 1126

1.1 Scope. This standard shall provide requirements for the protection of property, operators, performers, support personnel, and the viewing audiences where pyrotechnic effects are used indoors or outdoors with a proximate audience.

1.2 Purpose.
1.2.2 The purpose of this standard shall be to provide requirements for the reasonable protection of pyrotechnic operators, performers, support personnel, proximate audiences, proerty, and buildings where pyrotechnics are used indoors or outdoors from safety and fire hazards.

Make sure the words in yellow remain in the purpose and add:

(Potential health hazards from pyrotechnic smoke and combustion byproducts require a risk assessment and appropriate precautions if the risk is significant.)

RATIONALE

Appendix A mentions that health effects are not considered, but no mention is made of the fact that there are OSHA and other regulations laws that required a risk assessment of these health effects before exposing workers as well.

One of these rules is the OSHA Hazard Communication (1910.1200). And in the worker training

requirements is addressing is the difference between safety and health hazards. Safety hazards are well-addressed by NFPA 1126. But NFPA 1126 does not address health hazards from exposure to the pyrotechnic reaction products that are made airborne during use of the effect.

There are many toxic metals given off by pyrotechnic effects that are regulated in the workplace air under OSHA and any potential exposure include a risk assessment. For examples, there are OSHA permissible exposure limits (PELs) for silver, lead, titanium, zirconium, antimony, chromium, and more. Other common pyrotechnic byproduct emissions for which there are OSHA PELs include nitrogen and sulfur oxides.

Production companies, in my experience, assume that meeting NFPA 1126 covers any and all hazards from these effects including health hazards. This was one of the reasons that the use of lead styphnate bullet hits were considered accepable for many years. Yet these small pyrotechnic effects, often used in multiples, exposed performers and crew to excessive lead fume.

The NFPA 1126 safety and fire precautions are excellent, but they are not enough. Users must be alerted upfront that the standard does not address the health hazards. These hazards also require a risk assessment and additional precautions if warranted.

Public Comment No. 5-NFPA 1126-2024 [Section No. 3.3.39]

3.3.39 Professional-Use-Only ~~Product.~~ Pyrotechnics

Fireworks and pyrotechnic special effects ~~materials~~ other than those explicitly marked, designed, designated, or approved as consumer fireworks or novelty devices and intended for use only by pyrotechnic professionals.

Statement of Problem and Substantiation for Public Comment

Accuracy.

The subject is "pyrotechnics". Products could be anything, so it is better to be specific.

The correct term is pyrotechnic special effects, which includes both pyrotechnic devices and materials.

Fireworks and pyrotechnic special effects that are not consumer fireworks are marked "For Professional Use Only".

Related Item

• First Revision No. 12

Submitter Information Verification

Submitter Full Name: Charles Weeth
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Submittal Date: Thu May 30 14:59:53 EDT 2024
Committee: SPE-AAA

Public Comment No. 1-NFPA 1126-2024 [Section No. 3.3.45]

3.3.45* Pyrotechnic Professional.

A person who has demonstrated proficiency and knowledge of NFPA 1123 ~~and~~ or NFPA 1126 via documented training and experience in the use of fireworks, pyrotechnic special effects materials, or professional-use-only products and who complies with the requirements of this standard .

Statement of Problem and Substantiation for Public Comment

This would bring the definition in line with the submissions for NFPA 1123 and NFPA 1124.

Related Item

• NFPA 1123 • NFPA 11124

Submitter Information Verification

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Submittal Date: Mon Mar 18 13:13:00 EDT 2024
Committee: SPE-AAA

Public Comment No. 2-NFPA 1126-2024 [Section No. 6.5.1 [Excluding any Sub-Sections]]

All pyrotechnic operators shall be pyrotechnic professionals, at least 21 years old, and licensed or approved by the authority having jurisdiction in accordance with any and all applicable laws.

Statement of Problem and Substantiation for Public Comment

This makes NFPA 1126 consistent with the lead operator requirements of NFPA 1123

Related Item

• CI

Submitter Information Verification

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Submittal Date: Thu Apr 04 11:09:44 EDT 2024
Committee: SPE-AAA

Public Comment No. 4-NFPA 1126-2024 [Section No. A.3.3.34]

A.3.3.34 Performer.

Performers can include, but are not limited to, fire performers, stunt people, actors, singers, musicians, and acrobats who may be of various ages and conditions including children, pregnant women, and the elderly .

Additional Proposed Changes

File Name	Description	Approved
NFPA-160_and_1126-proposed-revisions_PC_M_Rossol.pdf	NFPA 1126_PublicComment_M.Rossol	

Statement of Problem and Substantiation for Public Comment

Appendix A mentions that health effects are not considered, but no mention is made of the fact that there are OSHA and other regulations laws that required a risk assessment of these health effects before exposing workers as well.

One of these rules is the OSHA Hazard Communication (1910.1200). And in the worker training

requirements is addressing is the difference between safety and health hazards. Safety hazards are well-addressed by NFPA 1126. But NFPA 1126 does not address health hazards from exposure to the pyrotechnic reaction products that are made airborne during use of the effect.

There are many toxic metals given off by pyrotechnic effects that are regulated in the workplace air under OSHA and any potential exposure include a risk assessment. For examples, there are OSHA permissible exposure limits (PELs) for silver, lead, titanium, zirconium, antimony, chromium, and more. Other common pyrotechnic byproduct emissions for which there are OSHA PELs include nitrogen and sulfur oxides.

Production companies, in my experience, assume that meeting NFPA 1126 covers any and all hazards from these effects including health hazards. This was one of the reasons that the use of lead styphnate bullet hits were considered accepable for many years. Yet these small pyrotechnic effects, often used in multiples, exposed performers and crew to excessive lead fume.

The NFPA 1126 safety and fire precautions are excellent, but they are not enough. Users must be alerted upfront that the standard does not address the health hazards. These hazards also require a risk assessment and additional precautions if warranted.

Related Item

• First Revision No. 6

Submitter Information Verification

Submitter Full Name: Monona Rossol
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Submittal Date: Mon May 20 13:33:32 EDT 2024
Committee: SPE-AAA

NFPA 160
1.1 Scope. This standard shall provide requirements for the protection of the audience, support personnel, performers, the operator, assistants, and property where flame effects are used.

1.2 Purpose. The purpose of this standard shall be to provide minimum requirements for the design, manufacture, and operation of flame effects.

PROPOSAL TO CHANGE 1.1 Scope

Original wording:
1.1 Scope. This standard shall provide requirements for the protection of the audience, support personnel, performers, the operator, assistants, and property where flame effects are used.

Proposed wording:
1.1 Scope. This standard shall provide requirements for the protection of the audience, support personnel, performers, the operator, assistants, and property where flame effects are used <u>from safety and fire hazards. (The health hazards associated with combustion byproducts and fuel chemicals also require a risk assessment and appropirate precautions if the risk is significant.)</u>

RATIONALE
It is well-known that all burning fuels, gases, liquids, and solids, release toxic gases, vapors, and particles. NFPA 160 also covers some effects which could produce additional amounts of air pollutants such as those effects that utilize solid fuels such as wood and coal, and hybrid fire effects that use pyrotechnic igniters, combustible dusts and powders, or black powder lift charges.

The amounts and types of combustion products from burning all these diverse fuels will vary depending on the temperature of the burn, availability of oxygen, and many other factors. Carcinogens have been found in the combustion products and smoke from all hydrocarbon fuels. The International Agency for Research on Cancer (IARC) lists the profession of fire fighting as a Group 1 Human Carcinogen. And smoke is the firefighters' primary exposure.

As written, NFPA 160 – 2021 is not designed to protect people, especially performers who may be children, elderly, and other high risk individuals. On film locations, in particular, there are very likely to be children and elderly actors in proximity.

Recently, I consulted on location safety for a film in which many fire bars were proposed for use to simulate a forest fire from which a man was attempting to rescue a bus-load of children by driving them through the inferno. In addition to fire bars, they proposed to fill the air with two fog effects at the same time, one glycol-water fog and the other methyl soyate, a diesel fuel and paint-stripping solvent that in a mist form causes the propane flames to burn with an orange color. (This bio fog product was recommended on ASEPO's website and has been used for some years according to the pyrotechnician on this project.)

Children and the elderly, whether working on the production or in the audience, are considered

high risk individuals. They are particularly vulnerable to harm from exposure to airborne contaminants from fire effects or the residues such as polycyclic aromatic hydrocarbon residues from soot, metals from colored effects, lead from certain pyrotechnic devices, and other combustion products that remain on surfaces.

In another instance, multiple torches, candles, and oil lamps were used on a set which increased the particles in the air to the point that actors were blowing and coughing up black soot. We now have reduced the number of flame sources and have particle counters on that set to insure that actors and crew are not over exposed.

This additional monitoring expense should not have been instituted after people were exposed. Instead, the scope or purpose, of NFPA 160 must alert users before exposing people to the fire effect emissions. Currently, it is my experience the potential health hazards are almost never addressed on location when fire effects are used. Altering the standard can help alert users to this additional risk.

I NEED THE CURRENT WORDING FOR A.3.3.24.

Even the definition, **A.3.3.24 Performer**, should be expanded. A suggestions would be:

> Performers can include, but are not limited to, fire performers, stunt people, actors, singers, musicians, and acrobats who may be of various ages and conditions including children, pregnant women, and the elderly.

NFPA 1126

1.1 Scope. This standard shall provide requirements for the protection of property, operators, performers, support personnel, and the viewing audiences where pyrotechnic effects are used indoors or outdoors with a proximate audience.

1.2 Purpose.
1.2.2 The purpose of this standard shall be to provide requirements for the reasonable protection of pyrotechnic operators, performers, support personnel, proximate audiences, proerty, and buildings where pyrotechnics are used indoors or outdoors from safety and fire hazards.

Make sure the words in yellow remain in the purpose and add:

(Potential health hazards from pyrotechnic smoke and combustion byproducts require a risk assessment and appropriate precautions if the risk is significant.)

RATIONALE

Appendix A mentions that health effects are not considered, but no mention is made of the fact that there are OSHA and other regulations laws that required a risk assessment of these health effects before exposing workers as well.

One of these rules is the OSHA Hazard Communication (1910.1200). And in the worker training

requirements is addressing is the difference between safety and health hazards. Safety hazards are well-addressed by NFPA 1126. But NFPA 1126 does not address health hazards from exposure to the pyrotechnic reaction products that are made airborne during use of the effect.

There are many toxic metals given off by pyrotechnic effects that are regulated in the workplace air under OSHA and any potential exposure include a risk assessment. For examples, there are OSHA permissible exposure limits (PELs) for silver, lead, titanium, zirconium, antimony, chromium, and more. Other common pyrotechnic byproduct emissions for which there are OSHA PELs include nitrogen and sulfur oxides.

Production companies, in my experience, assume that meeting NFPA 1126 covers any and all hazards from these effects including health hazards. This was one of the reasons that the use of lead styphnate bullet hits were considered accepable for many years. Yet these small pyrotechnic effects, often used in multiples, exposed performers and crew to excessive lead fume.

The NFPA 1126 safety and fire precautions are excellent, but they are not enough. Users must be alerted upfront that the standard does not address the health hazards. These hazards also require a risk assessment and additional precautions if warranted.

Committee Input No. 7-NFPA 1126-2023 [Global Input]

3.3.34.1* Performer, Non-Pyrotechnic.

Any person active in a performance during which pyrotechnics are used but not directly involved with the pyrotechnics and who is not part of the audience or support personnel.

3.3.34.2 * Performer, Pyrotechnic

Any person active in a performance during which pyrotechnics are used and is directly involved with the pyrotechnics and who is not part of the audience or support personnel.

A.3.3.34 Performer.
Performers can include, but are not limited to, actors, singers, musicians, dancers, acrobats and stunt people.

A.3.3.34.1 Performer, Non-Pyrotechnic
Non-pyrotechnic performers do not initiate or handle pyrotechnics during a performance.

A.3.3.34.2 Performer, Pyrotechnic
Pyrotechnic performers initiate or handle pyrotechnics during a performance. A stunt person that activates an enabler switch, a musician that has a pyrotechnic device on an instrument, or a dancer that holds a pyrotechnic device.

Add a new standard(s) for pyrotechnic performers regarding the use of pyrotechnics by performers.

Submitter Information Verification

Committee: SPE-AAA
Submittal Date: Tue Oct 24 17:09:43 EDT 2023

Committee Statement

Committee Statement: The technical committee is looking to add proposed text on pyrotechnic performers and define who is a pyrotechnic performer and who is a non pyrotechnic performer to cover those who perform with pyrotechnics.

Response Message: CI-7-NFPA 1126-2023

Ballot Results

This item has not been balloted