



All major amusement parks and family resorts in the United States rely on NFPA standards for pyrotechnic safety. ■ JOHN NICHOLSON

MANY OF THE LARGEST theme parks and resorts in the United States boast daily pyrotechnics and fireworks displays, which are as much of a draw at most large amusement venues as high-speed roller coasters or film-inspired thrill rides. In Orlando, Florida, for example, Universal Studios offers a variety of daily shows using special pyrotechnic effects, while neighboring SeaWorld Adventure Park has a single show nightly. And what would Pleasure Island at Walt Disney World be without the fireworks that cap off the nightly "New Year's Eve" celebration 365 days a year?

Despite the differences in their pyrotechnic shows, the large resorts and amusement parks in the United States rely on NFPA standards to keep their displays safe. For top pyrotechnics professionals, NFPA codes and standards are the definitive source of information and the basis of their own standard operating procedures.

"NFPA's standards are the preferred choice because they consider all types of venues and they have exhaustive technical support," says Jon Fuller of Universal Studios Florida.

The NFPA standards most commonly

used by the pyrotechnic community, according to Guy Colonna, NFPA assistant vice president of Hazardous Chemicals/Materials, are NFPA 160, *Flame Effects Before an Audience*, NFPA 1123, *Fireworks Displays*, NFPA 1124, *Manufacture, Transportation, and Storage of Fireworks and Pyrotechnic Articles*, and NFPA 1126, *Use of Pyrotechnics Before a Proximate Audience*.

Although NFPA's standards dealing with fireworks and pyrotechnics apply to a very small portion of the U.S. standards-using community, that portion is a extremely important to, and active in, the standards-

making process, Colonna says.

"Without the operational view, the standards wouldn't reflect the concerns of those who use pyrotechnics on a daily basis," says Colonna. "The users bring an exceptional value to the process because of the impact the standards have on them and their operations. They bring their concerns to the table. Without their input, the process would be missing a valuable component."

How the standards are used

With more than 1,000 fireworks shows a year, many to musical accompaniment, Walt Disney World Resort provides truly impressive pyrotechnics displays. During the Fantasy in the Sky display at the Magic Kingdom, visitors watch as Tinker Bell flies from the top of Cinderella's Castle to ignite the fireworks in a burst 700 feet (213 meters) in diameter. At Epcot, 12 barges in



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the World Showcase Lagoon launch fireworks nightly during IllumiNations. And at Sorcery in the Sky at Disney-MGM Studios, a 55-foot-tall (17-meter-tall) inflatable Sorcerer Mickey rises above the Chinese Theater, shooting fireworks from his fingertip.

According to T.J. Scammon, director of entertainment and global resources for Disney, there are numerous shows at Disney resorts throughout the country and internationally.

“On a minimum, there are four outdoor shows a night and numerous pyrotechnic special effects going on inside the various attractions,” he says.

“NFPA standards are the baseline documents for us at Disney. We take the basic information the standards apply, and we have created our own procedures for indoor and outdoor displays,” says NFPA member

Tony Zmorski, senior safety technician manager at Disney.

Disney also has its own code-compliance committee to ensure that all special effects are done in accordance with Disney’s procedures.

“We create an event for our visitors that is safe and enjoyable. We work very closely with all the performers, and each display, if performers are involved, is carefully choreographed,” Zmorski says.

Disney takes its safety procedures very seriously and is proud of the fact that many of the country’s top pyrotechnic specialists got their start at Disney.

“We were here long before the others arrived. Most of the people working at the other resorts trained and worked at Disney. We also continue to share our information with others in the industry, making it safe for everyone,” says Scammon.

Disney is considered an innovator in the field of pyrotechnics. Among other things, it has developed its own air launch system for fireworks using compressed air for the final discharge of airborne pyrotechnic materials.

At Universal Orlando Resort, a working film and television studio, there are two theme parks, Islands of Adventure and Universal Studios® Movie Theme Park. Integral to the excitement at Islands of Adventure are the special effects involving pyrotechnics at the Eighth Voyage of Sinbad show. Fireworks are also part of the special effects at the Monsters Revue and the Wild, Wild, Wild West Stunt Show at Universal Studios. Depending on attendance, there are also special events involving evening fireworks displays.

According to Fuller, compliance executive for Technical Services at Universal Studios, the pyrotechnic displays are carefully



planned in accordance with NFPA 1126, and every performer must be at a certain spot, or “mark,” for the effect to work. If the performers aren’t in position, the effect doesn’t take place, or “fire.” This fail-safe system is designed to protect those on stage and in the audience, says Fuller.

“All our daily shows are in a roofed building,” he says. “They are also being performed during the day, so there’s a very low display. We’re using the pyrotechnics as special effects for our shows.”

Guiding Fuller and his staff at Universal are several NFPA standards. The show’s technical director follows NFPA 1123 and the precautions it outlines for the safe discharge of the effect.

“In all instances, we meet or exceed NFPA (requirements),” Fuller says. “Using NFPA standards eliminates any guest (protection) issues.”

At SeaWorld Orlando, a 200-acre marine adventure park owned by Anheuser-Busch Companies, more than 80 million visitors have explored the mysteries of the sea with up-close encounters with killer whales, dolphins, sea lions, stingrays, and more. The park also has shows and state-of-the-art rides.

Martin Steinke manages theatrical services at the resort, including the pyrotechnics, the storage and transportation of fireworks, and training. Because SeaWorld is part of Busch Entertainment, Steinke also helps train personnel and plan pyrotechnic displays at other Anheuser-Busch venues.

At the heart of SeaWorld’s guidelines are NFPA standards. Steinke regularly consults NFPA 1123, 1124, 1126, and 160.

“Then we have our own guidelines that go a step further,” he says. “NFPA 1124 is important to us because we have our own fireworks storage area.”

Because SeaWorld’s main entertainment thrust is marine life, fireworks displays and

pyrotechnics aren’t extensive, but that doesn’t lessen the need for safe practices.

“We have a fireworks display called Red, Bright, and Blue that was offered on a seasonal basis. About five years ago, it became very popular, so it’s offered every night,” says Steinke.

In addition to its own shows, SeaWorld works with people outside the resort who want to use the park for their own events, which often include fireworks. These shows are either done by SeaWorld’s trained pyrotechnic staff or by a licensed contractor. In all instances, displays are conducted in accordance with NFPA standards.

The process of planning a daily fireworks display is the same used when planning a single event, says Steinke.

Part of the process, as set forth in NFPA 1123, is developing a full site plan pinpointing the location of every structure and everywhere an audience will gather. The planners then choose the equipment for the display and decide what design to use. Ten to 30 people are involved in the process, guaranteeing unanimity on the best practice.

“We then gather input from all those involved, and there is a rehearsal before the show is presented. This gives us an opportunity to make sure all our equipment is operational and any equipment that needs replacement gets replaced,” Steinke says.

Steinke says a daily event is riskier than a single show because a daily event can lead to complacency, and complacency can lead to dangerous shortcuts. Complacency can be avoided, he says, by strictly adhering to NFPA codes and standards and to the venue’s own standard operating procedures.

“We also regularly rotate our personnel so everyone is fresh,” Steinke says.

“By requiring proficiencies, training, and licensing, the standards ensure the professional isn’t complacent, or they make it difficult to be complacent,” says Colonna. “Those using the standards are skilled in the safety requirements of NFPA.”

Impact on the industry

Both Steinke and Fuller agree that NFPA fireworks and pyrotechnics standards are vital to the industry, especially to those working with the local authority having jurisdiction.

According to Steinke, “NFPA is a huge help to us when it comes to collaborating with local fire marshals” who may not be knowledgeable about all the facets of fireworks displays. But NFPA’s standards provide a “common tool for communication,” Steinke says. In the state of Florida, the state fire marshals’ office actually requires the use of NFPA standards and codes.

“NFPA 160 represents a footprint that can be used throughout the industry,” notes Fuller, a member of the Technical Committee on Special Effects, which has oversight of NFPA 160. “It’s a true guideline and without it, everyone (licensed in pyrotechnics) would have their own interpretation of what should be done and how a display should be set up. In the industry, NFPA 160 is followed and known as a definitive standard.”

“The true intent of the standard is to provide the licensed professional the information needed for safe special effects,” Colonna says. “It’s intentionally straightforward and isn’t difficult for trained people to follow.”

However, giving NFPA 160 to an authority having jurisdiction also gives him or her a firm guide to planning a fireworks display.

“NFPA provides good, strong language,” says Fuller.

In addition to the specific fireworks standards, Universal, SeaWorld, and Disney all follow NFPA 1, *Fire Prevention Code*, and NFPA 101®, *Life Safety Code*®.

“NFPA 101 is the bible,” Fuller says. “Its contents are extremely convincing because all the recommendations make sense, and it’s enforceable.”

FOR MORE INFORMATION
ABOUT NFPA’S PYROTECHNIC
AND FIREWORKS STANDARDS,
GO TO WWW.NFPA.ORG.

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History of the standards

The Technical Committee on Special Effects originally developed NFPA 160 in 1994 to help public safety officials, designers, and operators of flame effects protect both audiences and performers. For the 2001 edition, the committee revised NFPA 160 to amend standardized definitions and to harmonize with the pyrotechnic special effects document. In addition, editorial changes were made to bring the standard into compliance with the NFPA *Manual of Style*.

NFPA 1123 was developed in 1975 when the Technical Committee on Pyrotechnics received a proposed standard from the American Pyrotechnics Association. The proposed standard was redrafted and officially adopted by NFPA at its 1978 Fall Meeting. The 1978 edition was amended in 1980, and the amended version was adopted at the 1981 Fall Meeting.

In the 1990 edition of NFPA 1123, the committee completely revised the document to incorporate details pertaining to the operation of outdoor fireworks displays, including an increase in audience separation distances. The committee also addressed the electrical firing of outdoor fireworks displays, a new technology at the time. Generally, the committee provided performance requirements, rather than specific prescriptions for meeting those requirements.

In 1995, NFPA 1123 was revised editorially in accordance with the *Manual of Style* to make it more user-friendly. The committee also updated the definitions of fireworks to make them consistent with the terminology used in U.S. Department of Transportation regulations incorporating the United Nations' shipping designations for fireworks. In addition, the committee incorporated a new chapter containing requirements for electrically firing fireworks displays and refined the provisions for manual firing of large-diameter aerial shells.

The latest edition of NFPA 1123 is the 2000 edition, which contains three significant changes. The first is a new chapter on display fireworks from floating vessels and platforms, which provides guidance

on construction, sizing, operation, and egress requirements. The second is the addition of requirements for mortar installation and placement. And the third is a revision and expansion of the tables in Appendix A that provide guidance on mortar wall thickness for steel, paper, high-density polyethylene, and fiberglass mortars.

NFPA 1124, originally designated NFPA 44A, was developed by the Technical Committee on Explosives of the NFPA Committee on Chemicals and Explosives, and adopted as a Tentative Code at the 1972 NFPA Annual Meeting. It was further revised and officially adopted at the 1973 Annual Meeting. A revised edition was adopted in 1974.

In 1980, the Technical Committee on Explosives and the Committee on Pyrotechnics voted to transfer responsibility for NFPA 44A to the Committee on Pyrotechnics. The Correlating Committee on Chemicals and Explosives agreed, and the Standards Council approved the change in June 1981.

Over the next few years, the Committee on Pyrotechnics reviewed the 1974 edition of NFPA 44A and renumbered the document NFPA 1124 so it was consistent with the other documents relating to pyrotechnics. The revised NFPA 1124 was issued in 1984.

The 1988 edition of the standard updated the references and incorporated the latest separation distances as approved by the Institute of Makers of Explosives in May 1983. It also included new provisions for salute manufacturing and for storing salute powder.

The 1995 edition included editorial revisions that improved its usability and brought it into line with the *Manual of Style*. The committee also incorporated the latest separation distances, as approved by the Institute of Makers of Explosives in June 1991, and updated the definitions of fireworks to make them consistent with the new terminology used in Department of Transportation regulations.

A definition and clarification of the storage requirements and separation dis-

stances were also added, and the requirements for fireworks laboratories were clarified. In addition, the committee incorporated an appendix that extracts language from the American Pyrotechnics Association Standard 87-1, providing document users with the definitions used in the federal regulations for fireworks, novelties, and theatrical pyrotechnics.

The latest edition of NFPA 1124 is the 1998 edition, which amends the separation distances for fireworks manufacturing plants based upon gross weight, clarifies the storage requirements for manufacturing facilities, and provides requirements for fireworks storage at non-manufacturing facilities such as warehouses and distribution facilities.

NFPA 1126, which covers the use of pyrotechnics in theatrical, musical, or similar productions before a proximate audience, performers, or support personnel, was first published in 1992. It was developed by the Pyrotechnics Committee to provide public safety officials with guidance on the safe use of pyrotechnic special effects indoors and out.

For the 1996 edition, several new definitions were added, including "producer" and "venue manager." In addition, the requirements for labeling pyrotechnic preloads were clarified, and the standard was revised editorially to conform with the *Manual of Style*. Revisions made regarding the use of pyrotechnics incorporated a tentative interim amendment addressing measures of safeguarding performers.

The 1996 edition of NFPA 1126 was the first completed by the Committee on Special Effects, which is now responsible for flame and pyrotechnic special effects before a proximate audience. The previous editions were the responsibility of the Committee on Pyrotechnics, but NFPA 1126 was reassigned when activity began on NFPA 160 so that the requirements of both proximate audience documents would be consistent.

"With the continued input from organizations like Disney, SeaWorld, and Universal, NFPA standards will continue to reflect the needs and recommendations of those in pyrotechnics," says Colonna. ♦