

Fire protection systems - an important part of employee safety

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Risk Engineering



The fire problem

Year	Non-Residential Structure Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage In 2012 Dollars (Billions)
2006	111,500	85	1,425	\$3.00
2007	116,500	105	1,350	\$3.41
2008	112,000	120	1,400	\$4.11
2009	103,500	105	1,690	\$3.20
2010	98,000	90	1,620	\$2.70
2011	98,500	90	1,275	\$2.70
2012	99,500	65	1,525	\$2.60
2013	100,500	70	1,500	\$2.60

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Source: [Fire Loss in the United States 2013](#) Michael J. Karter, Jr., NFPA, September 2014 and previous reports in the series. Updated 9/14

The fire problem

- In the U.S., 3,340 structure fires, on average, were reported in office properties per year in 2007-2011
 - Average of 4 civilian deaths, 44 civilian fire injuries, and \$112 million in direct property damage per year

Source: *U.S. Structure Fires in Office Properties*, Richard Campbell, NFPA Fire Analysis and Research, Quincy, MA, August 2013

The fire problem

- In 2009-2013, U.S. fire departments responded to an estimated average of 37,000 fires in industrial and manufacturing properties
 - 20% were structure fires
 - These fires caused an annual average of 18 civilian deaths, 279 civilian fire injuries, and \$1 billion in direct property damage

Source: *U.S. Structure Fires in Industrial and Manufacturing Properties*, Richard Campbell, NFPA Fire Analysis and Research, Quincy, MA, April 2016

The fire problem

- U.S. fire departments responded to an estimated average of 1,210 structure fires per year in warehouse properties during 2009-2013
 - These fires caused an annual average of 3 civilian deaths, 19 civilian injuries, and \$155 million in direct property damage

Source: *Structure Fires in Warehouse Properties*, Richard Campbell, NFPA Fire Analysis and Research, Quincy, MA, January 2016

Learn from history

• Iroquois Theater	1903	602 dead
• Triangle Shirtwaist Co.	1911	146 dead
• Cleveland Clinic	1929	125 dead
• Ohio State Penitentiary	1930	320 dead
• Coconut Grove Nightclub	1942	492 dead
• Wincoff Hotel	1946	119 dead

Learn from history

- | | | |
|---------------------------------|------|----------|
| • Our Lady of the Angels School | 1958 | 95 dead |
| • Beverly Hills Supper Club | 1977 | 165 dead |
| • MGM Grand Hotel | 1980 | 87 dead |
| • Station Night Club | 2003 | 100 dead |

It's not just occupants who die in fires

- | | | |
|------------------------------------|------|---------------------|
| • Phoenix – Supermarket fire | 2001 | 1 firefighter dead |
| • Charleston – Sofa store fire | 2007 | 9 firefighters dead |
| • Wisconsin – Aluminum in dumpster | 2009 | 1 firefighter dead |

– In the first decade of the 21st century the rate of firefighter fatalities at structure fires hovered around 4 deaths per 100,000 fires

Source: [U.S. Fire Service Fatalities In Structure Fires, 1977-2009](#), NFPA

Hierarchy of risk control measures

- The Hierarchy of Controls applied to fire hazards
 - Elimination
 - Substitution
 - Reduction
 - Isolation
 - Control
 - Manual firefighting, smoke control, detection/warning systems, suppression systems
 - PPE

Source: Furness, Andrew, and Martin Muckett. *Introduction to Fire Safety Management*. Burlington: Butterworth and Heineman, 2007

Automatic sprinklers

- Sprinklered buildings generally don't burn
 - 97% success rate in controlling fires

Source: *U.S. Experience with Sprinklers and other Automatic Fire Extinguishing Equipment* – National Fire Protection Association, 2010

Automatic sprinklers

- NFPA records indicate that there has never been a multiple-fatality fire in a sprinklered building
 - NFPA has no record of a fire killing more than two people in a completely sprinklered building where the system was properly operating, except in an explosion or flash fire or where industrial fire brigade members or employees were killed during fire suppression operations.

Source: [U.S. Experience with Sprinklers and other Automatic Fire Extinguishing Equipment](#) – National Fire Protection Association, 2010

Automatic sprinklers

- Sprinklers are the preferred method of automatic suppression in most cases
 - Everything dries out – nothing unburns
 - Sprinklers don't rely on room tightness like gaseous systems

Automatic sprinklers

- Sprinklers can be used to protect almost any hazard
 - Class A
 - Class B
 - Electrical
 - Electronics – computer rooms
 - Communications

Some interesting stats from NFPA

- In **eating or drinking establishments**, deaths per thousand reported fires were 100% lower when wet pipe sprinklers were present, compared to fires with no automatic extinguishing equipment present.

Source: U.S. Experience with Sprinklers and other Automatic Fire Extinguishing Equipment – National Fire Protection Association, 2010

Stats

- In **eating or drinking establishments**, direct property damage per reported fire was 73% lower when wet pipe sprinklers were present, compared to fires with no automatic extinguishing equipment present.

Source: *U.S. Experience with Sprinklers and other Automatic Fire Extinguishing Equipment* – National Fire Protection Association, 2010

Stats

- In **stores and offices**, deaths per thousand reported fires were 80% lower when wet pipe sprinklers were present, compared to fires with no automatic extinguishing equipment present.

Source: *U.S. Experience with Sprinklers and other Automatic Fire Extinguishing Equipment* – National Fire Protection Association, 2010

Stats

- In **stores and offices**, direct property damage per reported fire was 35% lower when wet pipe sprinklers were present, compared to fires with no automatic extinguishing equipment present.

Source: *U.S. Experience with Sprinklers and other Automatic Fire Extinguishing Equipment* – National Fire Protection Association, 2010

Stats

- In **manufacturing facilities**, deaths per thousand reported fires were 78% lower when wet pipe sprinklers were present, compared to fires with no automatic extinguishing equipment present.

Source: *U.S. Experience with Sprinklers and other Automatic Fire Extinguishing Equipment* – National Fire Protection Association, 2010

Stats

- In **manufacturing facilities**, direct property damage per reported fire was 34% lower when wet pipe sprinklers were present, compared to fires with no automatic extinguishing equipment present.

Source: *U.S. Experience with Sprinklers and other Automatic Fire Extinguishing Equipment* – National Fire Protection Association, 2010

Sprinkler basics

- It's not like the movies
 - One head at a time
 - Directly over the fire
- 89% of fires under wet-pipe systems required only 1 or 2 sprinklers for control

Source: *U.S. Experience with Sprinklers and other Automatic Fire Extinguishing Equipment* – National Fire Protection Association, 2010

- Sprinkler leakage is not common
 - Generally due to controllable factors
 - Physical abuse
 - Inadequate heat
 - Inadequate maintenance

Gaseous agent systems

- Carbon dioxide, halon, halon substitutes
 - Remove/reduce oxygen
 - CO₂, Inergen
 - Cooling
 - Novec 1230, FM-200, FE-13
 - Disrupt chemical chain reaction
 - Halons and replacements containing bromine or iodine

Gaseous agent systems

- Advantages
 - Clean agents
 - Non-conductive
 - Spread into spaces where sprinklers may not reach

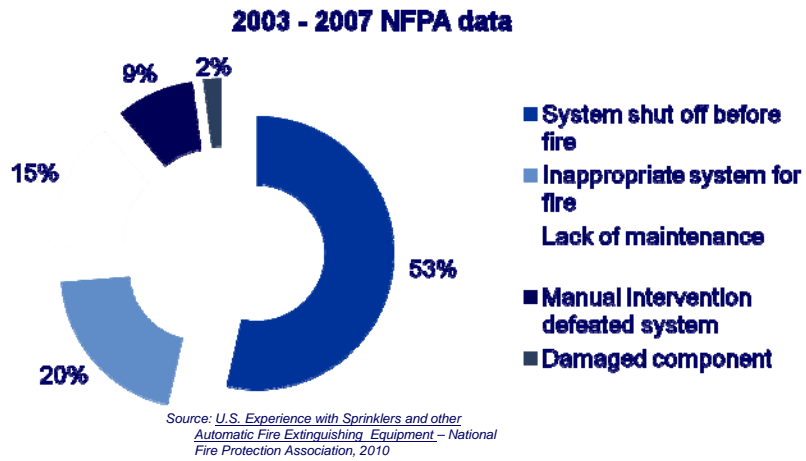
Gaseous/vaporizing liquid agent systems

- Disadvantages
 - High velocity
 - Space must be gas-tight (exc. 'local application' systems)
 - Toxicological /physiological issues
 - May be single-shot systems

Explosion suppression

- High visibility with OSHA (combustible dusts)
- Three components to system
 - Pressure detectors
 - Control panel
 - Fire suppressant system
 - (May also include mechanical or chemical duct/piping isolation system)

Why do systems occasionally fail?



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Keeping systems in service

- Inspection and testing requirements per NFPA 25
 - Sprinklers
 - Monthly pressure check
 - Monthly valve check
 - Annual visual inspection
 - Annual MDT
 - Semiannual alarm and supervision test
 - 5-year internal exam (flushing)
 - 50-year sprinkler head testing

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Keeping systems in service

- Inspection and testing requirements per NFPA standards
 - Gaseous/vaporizing liquid agent systems
 - Annual inspection/examination of system and components
 - Annual operational test
 - Annual inspection of enclosure
 - Semiannual check of cylinder pressure/agent quantity
 - 5-year visual cylinder check
 - Hydrostatic test of cylinders
 - 5-year hydrostatic test of hoses

Don't forget the fire pump!

- Weekly visual inspection of pump house, including heat
 - *(40 degree Fahrenheit minimum for Diesels without engine heaters)*
- Weekly visual inspection of pressure gauges and control valves
- Weekly automatic pump start
- Annual full flow test

Questions?

For more information

- Magazine articles
 - http://www.aist.org/safetyfirst/Safety_Dec09.pdf
- Zurich ITM white paper
 - <http://www.zurichservices.com/ZSC/REEL.nsf/3c1c9da9492c3e18c1257305004e0e3c/095408a0f4fcb1eac1257fed00213d53!OpenDocument>
 - Contact the author
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Thank you



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