



RESEARCH

WAREHOUSE FIRES, 2006-2015

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Table 1
Structure Fires in Warehouse Properties, by Sprinkler Presence
2006-2015 Annual Averages

Sprinkler Presence	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Sprinklers present	420	(32%)	1	(25%)	12	(57%)	\$62	(39%)
Non-confined	300	(23%)	1	(25%)	12	(57%)	\$62	(39%)
Confined	110	(9%)	0	(0%)	0	(0%)	\$0	(0%)
Partial system present	10	(1%)	0	(0%)	0	(0%)	\$3	(2%)
Non-confined	10	(0%)	0	(0%)	0	(0%)	\$3	(2%)
Confined	0	(0%)	0	(0%)	0	(0%)	\$0	(0%)
Not in fire area; did not operate (NFPA Change)	20	(1%)	0	(0%)	0	(1%)	\$1	(1%)
Non-confined	10	(1%)	0	(0%)	0	(1%)	\$1	(1%)
Confined	10	(1%)	0	(0%)	0	(0%)	\$0	(0%)
None present	860	(66%)	2	(75%)	9	(42%)	\$91	(58%)
Non-confined	690	(53%)	2	(75%)	9	(42%)	\$91	(58%)
Confined	170	(13%)	0	(0%)	0	(0%)	\$0	(0%)
Total	1,300	(100%)	3	(100%)	22	(100%)	\$158	(100%)
Non-confined	1,010	(78%)	3	(100%)	22	(100%)	\$157	(100%)
Confined	300	(23%)	0	(0%)	0	(0%)	\$0	(0%)

Note: Sums may not equal totals due to rounding errors.
Source: NFIRS and NFPA Fire Experience Survey.

Table 2
Structure Fires in Warehouse Properties, by Sprinkler and Detector Presence
2006-2015 Annual Averages

Sprinkler and Detector Presence	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Sprinklers present, Detectors present	310	(24%)	0	(15%)	9	(40%)	\$46	(29%)
Non-confined	210	(16%)	0	(15%)	9	(40%)	\$46	(29%)
Confined	90	(7%)	0	(0%)	0	(0%)	\$0	(0%)
Sprinklers present, No detectors present	120	(9%)	0	(10%)	4	(18%)	\$19	(12%)
Non-confined	100	(7%)	0	(10%)	4	(18%)	\$19	(12%)
Confined	20	(2%)	0	(0%)	0	(0%)	\$0	(0%)
No sprinklers present, Detectors present	100	(8%)	0	(6%)	1	(6%)	\$21	(13%)
Non-confined	60	(4%)	0	(6%)	1	(6%)	\$21	(13%)
Confined	50	(3%)	0	(0%)	0	(0%)	\$0	(0%)
No sprinklers present, No detectors present	760	(58%)	2	(69%)	8	(36%)	\$70	(45%)
Non-confined	630	(48%)	2	(69%)	8	(36%)	\$70	(45%)
Confined	130	(10%)	0	(0%)	0	(0%)	\$0	(0%)
Not in fire area, Detectors present	10	(1%)	0	(0%)	0	(1%)	\$1	(1%)
Non-confined	10	(1%)	0	(0%)	0	(1%)	\$1	(1%)
Confined	10	(1%)	0	(0%)	0	(0%)	\$0	(0%)
Total	1,300	(100%)	3	(100%)	22	(100%)	\$158	(100%)
Non-confined	1,010	(78%)	3	(100%)	22	(100%)	\$157	(100%)
Confined	300	(23%)	0	(0%)	0	(0%)	\$0	(0%)

Note: This table includes automatic extinguishing systems coded as "present" or "partial system present." Sums may not equal totals due to rounding errors.

Source: NFIRS and NFPA Fire Experience Survey.

Table 3
Structure Fires in Warehouse Properties, by Type of Automatic Extinguishing System (AES)
2006-2015 Annual Averages

Automatic Extinguishing Type	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wet pipe sprinkler	340	(80%)	1	(78%)	8	(68%)	\$58	(89%)
Dry pipe sprinkler	80	(18%)	0	(22%)	4	(30%)	\$7	(11%)
Other or unclassified AES system	10	(3%)	0	(0%)	0	(2%)	\$0	(0%)
Total	430	(100%)	1	(100%)	12	(100%)	\$65	(100%)

Note: This table includes automatic extinguishing systems coded as "present" or "partial system present." Sums may not equal totals due to rounding errors.

Source: NFIRS and NFPA Fire Experience Survey.

Table 4
Structure Fires in Warehouse Properties, by Automatic Extinguishing System (AES) Operation
2006-2015 Annual Averages

Automatic Extinguishing System Operation	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Operated and effective	190	(44%)	0	(0%)	6	(47%)	\$24	(37%)
Non-confined	170	(40%)	0	(0%)	6	(47%)	\$24	(37%)
Confined	20	(5%)	0	(0%)	0	(0%)	\$0	(0%)
Fire too small to operate	180	(43%)	0	(0%)	3	(23%)	\$1	(2%)
Non-confined	90	(22%)	0	(0%)	3	(23%)	\$1	(2%)
Confined	90	(21%)	0	(0%)	0	(0%)	\$0	(0%)
Failed to operate	40	(10%)	0	(61%)	1	(10%)	\$18	(28%)
Non-confined	40	(9%)	0	(61%)	1	(10%)	\$18	(28%)
Confined	0	(1%)	0	(0%)	0	(0%)	\$0	(0%)
Operated and NOT effective	10	(2%)	0	(39%)	0	(4%)	\$13	(19%)
Non-confined	10	(2%)	0	(39%)	0	(4%)	\$13	(19%)
Confined	0	(0%)	0	(0%)	0	(0%)	\$0	(0%)
Unclassified operation of AES	0	(1%)	0	(0%)	2	(16%)	\$9	(13%)
Non-confined	0	(1%)	0	(0%)	2	(16%)	\$9	(13%)
Confined	0	(0%)	0	(0%)	0	(0%)	\$0	(0%)
Total	430	(100%)	1	(100%)	12	(100%)	\$65	(100%)
Non-confined	310	(73%)	1	(100%)	12	(100%)	\$65	(100%)
Confined	120	(27%)	0	(0%)	0	(0%)	\$0	(1%)

Note: This table includes automatic extinguishing systems coded as "present" or "partial system present." Sums may not equal totals due to rounding errors.

Source: NFIRS and NFPA Fire Experience Survey.

Table 5
Structure Fires in Warehouse Properties, by Flame Spread
2006-2015 Annual Averages

Extent of Flame Spread	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Confined or contained fire identified by incident type	300	(23%)	0	(0%)	1	(6%)	\$0	(0%)
Confined to object of origin	230	(17%)	0	(0%)	6	(25%)	\$5	(3%)
Confined to room of origin	270	(21%)	0	(7%)	4	(17%)	\$10	(6%)
Confined to floor of origin	70	(5%)	0	(8%)	3	(13%)	\$6	(4%)
Confined to building of origin	370	(28%)	1	(40%)	7	(31%)	\$103	(65%)
Beyond building of origin	70	(6%)	1	(44%)	2	(7%)	\$33	(21%)
Total	1,300	(100%)	3	(100%)	23	(100%)	\$158	(100%)

Note: Sums may not equal totals due to rounding errors.

Source: NFIRS and NFPA Fire Experience Survey.

Table 6
Structure Fires in Warehouse Properties, by Building Area
2006-2015 Annual Averages

Building Area	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Less than 1,000 square feet	370	(28%)	1	(44%)	2	(11%)	\$14	(9%)
1,000 to 5,000 square feet	150	(12%)	0	(6%)	3	(14%)	\$11	(7%)
5,000 to 9,999 square feet	340	(26%)	0	(6%)	5	(24%)	\$23	(15%)
10,000 to 19,999 square feet	270	(20%)	0	(10%)	3	(12%)	\$23	(14%)
20,000 to 49,999 square feet	240	(19%)	0	(17%)	3	(16%)	\$44	(28%)
50,000 to 74,999 square feet	130	(10%)	0	(5%)	1	(3%)	\$9	(6%)
75,000 square feet or more	210	(16%)	0	(14%)	8	(37%)	\$49	(31%)
Total	1,300	(100%)	3	(100%)	22	(100%)	\$158	(100%)

Note: Sums may not equal totals due to rounding errors.

Source: NFIRS and NFPA Fire Experience Survey.

Appendix A.

How National Estimates Statistics Are Calculated

The statistics in this analysis are estimates derived from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual survey of U.S. fire departments. NFIRS is a voluntary system by which participating fire departments report detailed factors about the fires to which they respond. Roughly two-thirds of U.S. fire departments participate, although not all of these departments provide data every year. Fires reported to federal or state fire departments or industrial fire brigades are not included in these estimates.

NFIRS provides the most detailed incident information of any national database not limited to large fires. NFIRS is the only database capable of addressing national patterns for fires of all sizes by specific property use and specific fire cause. NFIRS also captures information on the extent of flame spread, and automatic detection and suppression equipment. For more information about NFIRS visit <http://www.nfirs.fema.gov/>. Copies of the paper forms may be downloaded from http://www.nfirs.fema.gov/documentation/design/NFIRS_Paper_Forms_2008.pdf.

NFIRS 5.0 includes a category of structure fires collectively referred to as "confined fires," identified by incident type. These include confined cooking fires, confined chimney or flue fires, confined trash fires, confined fuel burner or boiler fires, confined commercial compactor fires, and confined incinerator fires (incident type 113-118). Losses are generally minimal in these fires, which by definition, are assumed to have been limited to the object of origin. Although causal data is not required for these fires, it is sometimes present. Confined and non-confined fires were analyzed separately.

Methodology may change slightly from year to year.

NFPA is continually examining its methodology to provide the best possible answers to specific questions, methodological and definitional changes can occur. *Earlier editions of the same report may have used different methodologies to produce the same analysis, meaning that the estimates are not directly comparable from year to year.*

NFPA's fire department experience survey provides estimates of the big picture.

Each year, NFPA conducts an annual survey of fire departments which enables us to capture a summary of fire department experience on a larger scale. Surveys are sent to all municipal departments protecting populations of 50,000 or more and a random sample, stratified by community size, of the smaller departments. Typically, a total of roughly 3,000 surveys are returned, representing about one of every ten U.S. municipal fire departments and about one third of the U.S. population.

The survey is stratified by size of population protected to reduce the uncertainty of the final estimate. Small rural communities have fewer people protected per department and are less likely to respond to the survey. A larger number must be surveyed to obtain an adequate sample of those departments. (NFPA also makes follow-up calls to a sample of the smaller fire departments that do not respond, to confirm that those that did respond are truly representative of fire departments their size.) On the other hand, large city departments are so few in number and protect such a large proportion of the total U.S. population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate.

The survey includes the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined in NFIRS; (2) the number of on-duty firefighter injuries, by type of duty and nature of illness; (3) the number and nature of non-fire incidents; and (4) information on the type of community

protected (e.g., county versus township versus city) and the size of the population protected, which is used in the statistical formula for projecting national totals from sample results. The results of the survey are published in the annual report [Fire Loss in the United States](#).

Projecting NFIRS to National Estimates

As noted, NFIRS is a voluntary system. Different states and jurisdictions have different reporting requirements and practices. Participation rates in NFIRS are not necessarily uniform across regions and community sizes, both factors correlated with frequency and severity of fires. This means NFIRS may be susceptible to systematic biases. No one at present can quantify the size of these deviations from the ideal, representative sample, so no one can say with confidence that they are or are not serious problems. But there is enough reason for concern so that a second database -- the NFPA survey -- is needed to project NFIRS to national estimates and to project different parts of NFIRS separately. This multiple calibration approach makes use of the annual NFPA survey where its statistical design advantages are strongest.

Scaling ratios are obtained by comparing NFPA's projected totals of residential structure fires, non-residential structure fires, vehicle fires, and outside and other fires, and associated civilian deaths, civilian injuries, and direct property damage with comparable totals in NFIRS. Estimates of specific fire problems and circumstances are obtained by multiplying the NFIRS data by the scaling ratios. Reports for incidents in which mutual aid was given are excluded from NFPA's analyses.

Analysts at the NFPA, the USFA and the Consumer Product Safety Commission developed the specific basic analytical rules used for this procedure. "[The National Estimates Approach to U.S. Fire Statistics](#)," by John R. Hall, Jr. and Beatrice Harwood, provides a more detailed explanation of national estimates. A copy of the article is available online or through NFPA's Research, Data and Analytics Division.

Version 5.0 of NFIRS, first introduced in 1999, used a different coding structure for many data elements, added some property use codes, and dropped others. The essentials of the approach described by Hall and Harwood are still used, but some modifications have been necessary to accommodate the changes in NFIRS 5.0.

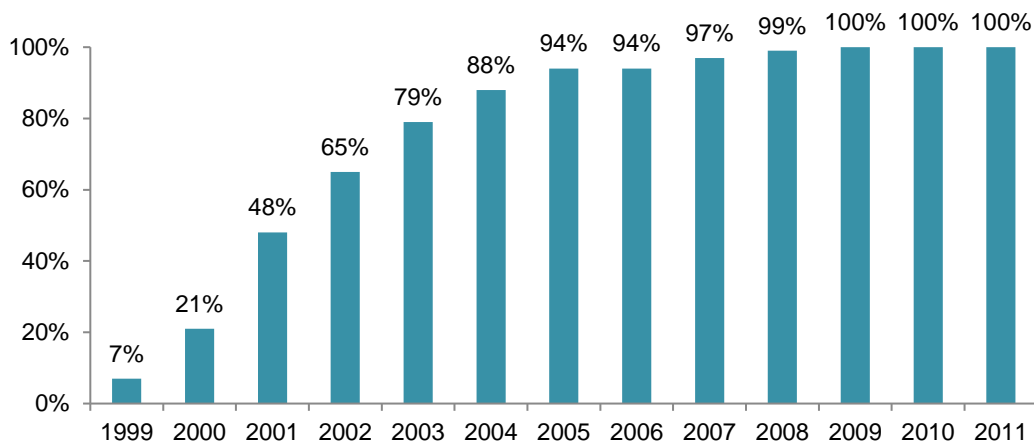
Figure A.1 shows the percentage of fires originally collected in the NFIRS 5.0 system. Each year's release version of NFIRS data also includes data collected in older versions of NFIRS that were converted to NFIRS 5.0 codes.

From 1999 data on, analyses are based on scaling ratios using only data originally collected in NFIRS 5.0:

$$\frac{\text{NFPA survey projections}}{\text{NFIRS totals (Version 5.0)}}$$

For 1999 to 2001, the same rules may be applied, but estimates for these years in this form will be less reliable due to the smaller amount of data originally collected in NFIRS 5.0; they should be viewed with extreme caution.

Figure A.1. Fires Originally Collected in NFIRS 5.0 by Year



NFIRS 5.0 introduced six categories of confined structure fires, including:

- cooking fires confined to the cooking vessel,
- confined chimney or flue fires,
- confined incinerator fire,
- confined fuel burner or boiler fire or delayed ignition,
- confined commercial compactor fire, and
- trash or rubbish fires in a structure with no flame damage to the structure or its contents.

Because this analysis focused on fatalities only, no distinction was made between confined and non-confined fires.

For most fields other than Property Use and Incident Type, NFPA allocates unknown data proportionally among known data. This approach assumes that if the missing data were known, it would be distributed in the same manner as the known data. NFPA makes additional adjustments to several fields. *Casualty and loss projections can be heavily influenced by the inclusion or exclusion of unusually serious fire.*

In the formulas that follow, the term “all fires” refers to all fires in NFIRS on the dimension studied. The percentages of fires with known or unknown data are provided for non-confined fires and associated losses, and for confined fires only.

Rounding and percentages. The data shown are estimates and generally rounded. An entry of zero may be a true zero or it may mean that the value rounds to zero. Percentages are calculated from unrounded values. It is quite possible to have a percentage entry of up to 100% even if the rounded number entry is zero. The same rounded value may account for a slightly different percentage share. Because percentages are expressed in integers and not carried out to several decimal places, percentages that appear identical may be associated with slightly different values.