



**RESEARCH**



# **US Experience with Sprinklers**

## Supporting Tables

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## US Experience with Sprinklers: Supporting Tables

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The tables in this document are a [companion to the report](#) of the same name. The table topics are listed below.

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Most of the national estimates of fires and losses in this analysis are presented as 2015–2019 annual averages. Estimates were derived from the US Fire Administration’s National Fire Incident Reporting System (NFIRS) and NFPA’s annual fire department experience survey and include proportional shares of unknown or missing data. Fires are rounded to the nearest 10, deaths and injuries to the nearest one, and property loss to the nearest million dollars. Property loss was not adjusted for inflation. Percentages were calculated on unrounded estimates. Sums may not equal totals due to rounding errors. Estimates include proportional shares of fires with unknown data. For more information on how these estimates were calculated, please see the [full report](#) and [How NFPA’s National Estimates Are Calculated for Fires](#).

## Acknowledgments

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The National Fire Protection Association thanks all the fire departments and state fire authorities who participate in the National Fire Incident Reporting System (NFIRS) and the annual NFPA fire experience survey. These firefighters are the original sources of the detailed data that makes this analysis possible. Their contributions allow us to estimate the size of the fire problem.

We are also grateful to the US Fire Administration for its work in developing, coordinating, and maintaining NFIRS.

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**Table 1. Presence of Sprinklers in Structure Fires by Property Use (Excluding Properties Under Construction)**

Property Use	Number of Structure Fires with Equipment Present and Percentage of Total Structure Fires by Property Use						Any Sprinkler 2015–2019	
	Any Automatic Extinguishing System (AES) 1980–1984		1994–1998		2015–2019			
All public assembly	4,280	(13%)	4,380	(26%)	7,900	(49%)	4,120	(25%)
Variable-use amusement place	120	(8%)	140	(16%)	240	(21%)	210	(19%)
Place of worship or funeral property	50	(2%)	90	(5%)	330	(19%)	290	(16%)
Library or museum	80	(14%)	110	(28%)	190	(30%)	180	(28%)
Eating or drinking establishment	3,310	(16%)	3,240	(29%)	5,740	(62%)	2,300	(25%)
Passenger terminal	70	(20%)	60	(35%)	300	(40%)	250	(33%)
Educational property	1,620	(13%)	1,820	(24%)	2,000	(43%)	1,860	(40%)
Health care property*	6,920	(47%)	4,400	(68%)	3,820	(65%)	3,420	(58%)
Nursing home	2,250	(61%)	2,060	(76%)	2,170	(76%)	1,980	(69%)
Hospital	3,370	(47%)	1,650	(74%)	830	(80%)	640	(61%)
Prison or jail	370	(10%)	430	(19%)	300	(61%)	280	(58%)
All residential	7,090	(1%)	11,110	(3%)	32,370	(9%)	30,390	(8%)
Home (including apartment)	5,120	(1%)	8,440	(2%)	24,970	(7%)	23,570	(7%)
Hotel or motel	1,590	(15%)	1,690	(35%)	2,190	(56%)	2,090	(54%)
Dormitory or barracks	430	(16%)	620	(29%)	2,300	(60%)	2,130	(56%)
Rooming or boarding home	70	(4%)	230	(17%)	900	(31%)	860	(29%)
Residential board and care home or assisted living facility	Not available		Not available		860	(46%)	820	(43%)
Store or office	5,510	(13%)	5,230	(21%)	6,500	(34%)	4,940	(26%)
Grocery or convenience store	1,160	(15%)	1,190	(27%)	2,360	(53%)	1,250	(28%)
Laundry, dry cleaning, or other professional service	330	(8%)	310	(13%)	330	(19%)	330	(18%)
Department store	1,340	(44%)	1,100	(52%)	580	(51%)	520	(47%)
Office	1,240	(12%)	1,470	(25%)	1,000	(32%)	940	(30%)
Manufacturing facility	11,910	(44%)	6,400	(50%)	3,050	(58%)	2,720	(52%)
All storage	1,430	(2%)	1,090	(3%)	830	(4%)	810	(4%)
Warehouse (excluding cold storage)	1,060	(13%)	740	(22%)	500	(35%)	500	(34%)
All structures**	38,620	(4%)	37,100	(7%)	61,400	(13%)	51,000	(10%)

\* Health care property includes other facilities not listed separately. In 1980–1984 and 1994–1998, this category excludes doctors’ offices and elder care facilities without nursing staff (which are assumed to be residential board and care facilities). In 2015–2019, health care property includes nursing homes, hospitals, clinics, doctor’s offices, substance abuse recovery centers or developmental disability facilities.

\*\* Includes properties not listed separately above.

Note: Post-1998 estimates are based only on fires reported in Version 5.0 of NFIRS and include fires reported as confined fires. After 1998, buildings under construction are excluded. Sprinkler statistics exclude partial systems and installations with no sprinklers in the fire area.

**Table 2. Type of Sprinkler System Reported in Structure Fires Where Equipment Was Present in Fire Area by Property Use (Excluding Properties Under Construction): 2015–2019 Annual Averages**

Property Use	Fires per year with any type of sprinkler		Wet pipe sprinklers		Dry pipe sprinklers		Other sprinklers*	
All public assembly	4,120	3,330	(82%)	330	(8%)	470	(11%)	
Variable-use amusement place	210	180	(85%)	30	(14%)	0	(1%)	
Place of worship or funeral property	290	220	(75%)	50	(16%)	20	(9%)	
Library or museum	180	170	(97%)	0	(2%)	0	(1%)	
Eating or drinking establishment	2,300	1,740	(76%)	160	(7%)	400	(17%)	
Passenger terminal	250	240	(98%)	0	(1%)	0	(0%)	
Educational property	1,860	1,590	(86%)	230	(12%)	30	(2%)	
Health care property**	3,420	2,960	(87%)	390	(12%)	70	(2%)	
Nursing home	1,980	1,730	(88%)	210	(11%)	40	(2%)	
Hospital	640	570	(89%)	60	(9%)	10	(1%)	
Prison or jail	280	250	(91%)	20	(8%)	0	(1%)	
All residential	30,390	27,030	(89%)	2,770	(9%)	590	(2%)	
Home (including apartment)	23,570	20,960	(89%)	2,130	(9%)	480	(2%)	
Dormitory or barracks	2,130	1,830	(86%)	260	(12%)	30	(2%)	
Hotel or motel	2,090	1,850	(88%)	190	(9%)	50	(2%)	
Rooming or boarding house	860	800	(94%)	50	(6%)	0	(0%)	
Residential board and care or assisted living facility	820	730	(89%)	70	(9%)	20	(2%)	
Store or office	4,940	4,270	(86%)	380	(8%)	290	(6%)	
Grocery or convenience store	1,250	980	(78%)	100	(8%)	180	(14%)	
Laundry, dry cleaning, or other professional service	330	300	(91%)	20	(5%)	10	(4%)	
Department store	520	460	(88%)	50	(10%)	10	(2%)	
Office	940	820	(87%)	80	(8%)	40	(5%)	
Manufacturing facility	2,720	2,290	(84%)	370	(14%)	60	(2%)	
All storage	810	620	(77%)	180	(22%)	10	(1%)	
Warehouse (excluding cold storage)	500	410	(81%)	90	(18%)	0	(1%)	
All structures ***	51,000	44,160	(87%)	5,040	(10%)	1,810	(4%)	

\* Includes deluge and pre-action sprinkler systems and may include sprinklers of an unknown or unreported type.

\*\* Nursing homes, hospitals, clinics, doctor's offices, substance abuse recovery centers or developmental disability facilities.

\*\*\* Includes properties not listed separately above.

Note: Row totals are shown in the left-most column of percentages and sums may not equal totals due to rounding errors. In NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the location where the fire started. This field was not required if the fire did not begin within the designed range of the system. Buildings under construction and partial systems were excluded.

Source: NFIRS and NFPA fire experience survey.

**Table 3. Estimated Reduction in Civilian Deaths per Thousand Fires Associated with All Types of and Wet Pipe Sprinklers by Property Use (Excluding Properties Under Construction): 2015–2019 Annual Averages**

Property Use	Without AES	With sprinklers of any type	Percent reduction from no AES	With wet pipe sprinklers	Percent reduction from no AES
All public assembly	1.9	0.1	97%	0.1	96%
Health care*	1.2	0.8	33%	0.5	58%
Residential	8.0	0.9	89%	1.0	88%
Home (including apartment)	8.1	1.0	88%	1.0	87%
Dormitory or barracks	1.0	0.2	84%	0.2	81%
Hotel or motel	8.6	0.2	98%	0.2	98%
Rooming or boarding house	6.5	3.3	49%	3.5	46%
Residential board and care or assisted living facility	3.2	1.4	57%	1.5	52%
Store or office	1.2	0.5	57%	0.4	64%
Manufacturing facility	1.0	0.6	34%	0.7	22%
Warehouse (excluding cold storage)	2.1	0.0	100%	0.0	100%
All structures**	6.7	0.7	89%	0.7	89%

\* Includes nursing homes, hospitals, clinics, doctor’s offices, substance abuse recovery centers or developmental disability facilities.

\*\* Includes properties not listed separately above.

Note: These are national estimates of structure fires reported to US municipal fire departments based on fires reported in NFIRS and so exclude fires reported only to federal or state agencies or industrial fire brigades.

Source: NFIRS and NFPA fire experience survey.

**Table 4. Estimated Reduction in Average Direct Property Loss per Fire Associated with Any Type of and Wet Pipe Sprinklers by Property Use (Excluding Properties Under Construction): 2015–2019 Annual Averages**

<b>Property Use</b>	<b>Loss without AES</b>	<b>Loss with sprinklers of any type</b>	<b>Percent reduction</b>	<b>Loss with wet pipe sprinkler system</b>	<b>Percent reduction from no AES</b>
All public assembly	\$31,500	\$11,600	63%	\$12,000	62%
Health care*	\$13,900	\$3,800	73%	\$4,000	71%
Residential	\$21,200	\$8,500	60%	\$9,000	57%
Home (including apartment)	\$21,700	\$8,200	62%	\$8,800	59%
Dormitory or barracks	\$3,700	\$1,500	58%	\$1,700	53%
Hotel or motel	\$29,800	\$22,400	28%	\$22,700	24%
Rooming or boarding house	\$7,700	\$3,600	52%	\$3,700	51%
Residential board and care or assisted living facility	\$4,600	\$6,700	-44%	\$7,300	-58%
Store or office	\$59,400	\$17,600	70%	\$17,900	70%
Manufacturing facility	\$141,000	\$170,300	No reduction	\$192,100	No reduction
Warehouse (excluding cold storage)	\$112,300	\$144,000	No reduction	\$149,400	No reduction
All structures	\$22,200	\$19,800	11%	\$20,600	7%

\* Includes nursing homes, hospitals, clinics, doctor’s offices, substance abuse recovery centers or developmental disability facilities.

\*\* Includes properties not listed separately above.

Note: These are national estimates of structure fires reported to US municipal fire departments based on fires reported in NFIRS and so exclude fires reported only to federal or state agencies or industrial fire brigades.

Source: NFIRS and NFPA fire experience survey.

**Table 5. Percentage of Fires with Fire Spread Confined to Room of Origin in Fires with Sprinklers Present vs. No Automatic Extinguishing System: 2015–2019 Annual Averages**

Property Use	Percentage of fires confined to room of origin excluding structures under construction and sprinklers not in fire area		
	With no AES	With sprinklers of any type	Difference (in percentage points)
Public assembly	77%	93%	16%
Religious property	73%	94%	22%
Library or museum	83%	96%	13%
Eating or drinking establishment	72%	91%	19%
Educational	89%	97%	8%
Health care property*	92%	98%	6%
Residential	74%	97%	23%
Home (including apartment)	74%	97%	23%
Dormitory or barracks	97%	99%	3%
Hotel or motel	84%	96%	13%
Store or office	67%	92%	24%
Grocery or convenience store	72%	94%	22%
Department store	65%	90%	25%
Office building	75%	93%	19%
Manufacturing facility	64%	84%	21%
Storage	25%	80%	55%
Warehouse (excluding cold storage)	52%	79%	27%
All structures**	71%	95%	24%

\* Includes nursing homes, hospitals, clinics, doctor’s offices, substance abuse recovery centers or developmental disability facilities.

\*\* Includes properties not listed separately above.

Note: All fires with one of the six NFIRS confined structure fire incident types were considered confined to the object of origin by definition. Fires that were confined to the room of origin include fires confined to the object of origin. In NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the location where the fire started. This field is not required if the fire did not begin within the designed range of the system.

Source: NFIRS and NFPA fire experience survey.

**Table 6. Sprinkler Reliability and Effectiveness When Fire Was Coded as Not Confined, Was Large Enough to Activate Sprinkler, and Sprinkler Was Present in Area of Fire by Property Use: 2015–2019 Annual Averages**

**A. All Sprinklers**

Property Use	Number of fires per year where sprinklers were present	Non-confined fires too small to activate or unclassified operation	Fires coded as confined fires	Number of qualifying fires per year	Percent where equipment operated (A)	Percent effective of those that operated (B)	Percent where equipment operated effectively (A x B)
All public assembly	4,120	720	2,580	820	89%	92%	82%
Eating or drinking establishment	2,300	410	1,360	530	88%	91%	80%
Educational property	1,860	420	1,220	220	84%	97%	82%
Health care property*	3,420	650	2,390	380	86%	98%	84%
All residential	30,390	2,600	23,310	4,480	94%	97%	91%
Home (including apartment)	23,570	1,890	18,030	3,650	95%	97%	92%
Hotel or motel	2,090	400	1,280	410	91%	97%	88%
Store or office	4,940	1,150	2,450	1,340	90%	96%	86%
Grocery or convenience store	1,250	280	730	240	85%	94%	80%
Department store	520	180	220	120	89%	97%	86%
Office	940	210	510	220	88%	97%	85%
Manufacturing facility	2,720	650	900	1,170	91%	94%	86%
All storage	810	140	280	380	86%	95%	84%
Warehouse (excluding cold storage)	500	90	160	250	88%	95%	84%
All structures**	51,000	6,780	34,830	9,390	92%	96%	88%

\* Includes nursing homes, hospitals, clinics, doctor’s offices, substance abuse recovery centers or developmental disability facilities.

\*\* Includes properties not listed separately above.

Note: In NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the location where the fire started. This field is not required if the fire did not begin within the designed range of the system.

Source: NFIRS and NFPA fire experience survey.



**Table 6. Sprinkler Reliability and Effectiveness When Fire Was Coded as Not Confined, Was Large Enough to Activate Sprinkler, and Sprinkler Was Present in Area of Fire by Property Use: 2015–2019 Annual Averages, (Continued)**

**B. Wet Pipe Sprinkler Systems Only**

<b>Property Use</b>	<b>Number of fires per year where sprinklers were present</b>	<b>Non-confined fires too small to activate or unclassified operation</b>	<b>Fires coded as confined fires</b>	<b>Number of qualifying fires per year</b>	<b>Percent where equipment operated (A)</b>	<b>Percent effective of those that operated (B)</b>	<b>Percent where equipment operated effectively (A x B)</b>
All public assembly	3,330	600	2,030	700	90%	94%	85%
Eating or drinking establishment	1,740	330	980	430	90%	93%	84%
Educational property	1,590	370	1,020	200	85%	97%	83%
Health care property*	2,960	570	2,050	330	88%	97%	85%
All residential	27,030	2,330	20,560	4,150	95%	97%	92%
Home (including apartment)	20,960	1,690	15,870	3,390	95%	97%	92%
Hotel or motel	1,850	350	1,130	370	92%	97%	90%
Store or office	4,270	1,030	2,030	1,210	91%	97%	88%
Grocery or convenience store	980	250	520	210	87%	95%	83%
Department store	460	160	190	110	88%	98%	86%
Office	820	190	440	180	89%	97%	86%
Manufacturing facility	2,290	540	770	980	92%	94%	87%
All storage	620	110	220	300	91%	95%	87%
Warehouse (excluding cold storage)	410	80	120	210	90%	96%	86%
All Structures**	44,160	5,920	29,870	8,370	92%	96%	89%

\* Includes nursing homes, hospitals, clinics, doctor’s offices, substance abuse recovery centers or developmental disability facilities.

\*\* Includes properties not listed separately above.

Note: In NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the location where the fire started. This field is not required if the fire did not begin within the designed range of the system.

Source: NFIRS and NFPA fire experience survey.

**Table 6. Sprinkler Reliability and Effectiveness When Fire Was Coded as Not Confined, Was Large Enough to Activate Sprinkler, and Sprinkler Was Present in Area of Fire by Property Use: 2015–2019 Annual Averages, (Continued)**

**C. Dry Pipe Sprinkler Systems Only**

<b>Property Use</b>	<b>Number of fires per year where sprinklers were present</b>	<b>Non-confined fires too small to activate or unclassified operation</b>	<b>Fires coded as confined fires</b>	<b>Number of qualifying fires per year</b>	<b>Percent where equipment operated (A)</b>	<b>Percent effective of those that operated (B)</b>	<b>Percent where equipment operated effectively (A x B)</b>
All residential	2,770	230	2,280	260	91%	97%	89%
Homes	2,130	160	1,770	190	92%	98%	90%
Store or office	380	100	190	90	83%	94%	78%
Manufacturing facility	370	100	110	160	89%	93%	83%
All storage	180	30	70	80	79%	94%	74%
All structures*	5,040	690	3,540	800	87%	94%	82%

\* Includes properties not listed separately above.

Note: These are percentages of fires reported to US municipal fire departments and so exclude fires reported only to federal or state agencies or industrial fire brigades. In NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the location where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction were excluded. Percentages are based on estimated total fires reported in NFIRS with the indicated type of automatic extinguishing system and system performance not coded as fire too small to activate systems. Fires were excluded if the reason for failure or ineffectiveness was “system not present in area of fire.” Fires were recoded from “operated but ineffective” to “failed to operate” if the reason for failure or ineffectiveness was “system shut off.” Fires were recoded from “failed to operate” to “operated but ineffective” if the reason for failure or ineffectiveness was “not enough agent” or “agent did not reach fire.”

Source: NFIRS and NFPA fire experience survey.

**Table 7. Number of Sprinklers That Operated in Structure Fires by Type of Sprinkler System (Excluding Properties Under Construction): 2015–2019 Annual Averages**

Number of Sprinklers Operating	Percentage of structure fires where that many sprinklers operated		
	Wet Pipe	Dry Pipe	All Sprinklers (Including “other”)
1	80%	47%	77%
1 or 2	91%	63%	89%
1 to 3	94%	71%	92%
1 to 4	96%	83%	95%
1 to 5	97%	90%	97%
1 to 10	99%	99%	99%

Note: Percentages are based on structure fires reported in NFIRS to US municipal fire departments and so exclude fires reported only to federal or state agencies or industrial fire brigades. Percentages are based on fires where sprinklers were reported as present and operating and there was reported information on the number of sprinklers that operated. Fires were excluded if the reason for failure or ineffectiveness was coded as “system not present in area of fire.” Fires were recoded from “operated but ineffective” to “failed to operate” if the reason for failure or ineffectiveness was “system shut off.” Fires were recoded from “failed to operate” to “operated but ineffective” if the reason for failure or ineffectiveness was “not enough agent” or “agent did not reach fire.” In NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the location where the fire started. Buildings under construction were excluded, as were partial systems and fires reported as confined fires.

Source: NFIRS and NFPA fire experience survey.

**Table 8. Reasons for Sprinkler Failure or Ineffectiveness in Structure Fires Large Enough to Activate Sprinkler Present in Fire Area (Excluding Fires with Confined Structure Fire Incident Types and Fires in Properties Under Construction): 2015–2019 Annual Averages**

**A. Reason Sprinkler Failed to Operate**

<b>Reason</b>	<b>All sprinklers</b>		<b>Wet pipe</b>		<b>Dry pipe</b>	
System shut off	430	(57%)	340	(56%)	70	(64%)
Manual intervention defeated system	130	(18%)	120	(20%)	10	(8%)
Lack of maintenance	70	(10%)	60	(9%)	10	(12%)
System components damaged	70	(9%)	50	(9%)	10	(12%)
Inappropriate system for type of fire	40	(6%)	40	(6%)	0	(4%)
<b>Total</b>	<b>750</b>	<b>(100%)</b>	<b>610</b>	<b>(100%)</b>	<b>100</b>	<b>(100%)</b>

**B. Reason Operating Sprinkler Was Ineffective**

<b>Reason</b>	<b>All sprinklers</b>		<b>Wet pipe</b>		<b>Dry pipe</b>	
Water did not reach the fire	170	(50%)	140	(53%)	10	(36%)
Not enough water released	100	(31%)	70	(27%)	20	(50%)
Inappropriate system for type of fire	20	(7%)	20	(8%)	0	(3%)
System components damaged	20	(7%)	20	(8%)	0	(3%)
Lack of maintenance	10	(3%)	0	(1%)	0	(7%)
Manual intervention defeated system	10	(2%)	10	(3%)	0	(0%)
<b>Total</b>	<b>340</b>	<b>(100%)</b>	<b>270</b>	<b>(100%)</b>	<b>40</b>	<b>(100%)</b>

**C. Reasons for Sprinkler Failure or Ineffectiveness Combined**

<b>Reason</b>	<b>All sprinklers</b>		<b>Wet pipe</b>		<b>Dry pipe</b>	
System shut off	430	(39%)	340	(39%)	70	(47%)
Water did not reach the fire	170	(16%)	140	(16%)	10	(10%)
Manual intervention defeated system	140	(13%)	130	(15%)	10	(6%)
Not enough water released	100	(10%)	70	(8%)	20	(14%)
System components damaged	90	(8%)	80	(9%)	10	(10%)
Lack of maintenance	80	(8%)	60	(7%)	20	(11%)
Inappropriate system for type of fire	70	(6%)	60	(7%)	10	(4%)
<b>Total</b>	<b>1,080</b>	<b>(100%)</b>	<b>880</b>	<b>(100%)</b>	<b>140</b>	<b>(100%)</b>

Note: Buildings under construction were excluded, as were partial systems and fires reported as confined fires. Fires reported with unclassified reasons for failure were treated as cases of unknown reasons for failure.

Source: NFIRS and NFPA fire experience survey.

**Table 9. Characteristics of Fatal Victims in Fires with Sprinklers vs. No Automatic Extinguishing Equipment: 2015–2019 Annual Averages**

**A. Number of Victims by Sprinkler Presence and Performance**

<b>Sprinkler/AES Status</b>	<b>Deaths when sprinklers present</b>		<b>Deaths when no AES present</b>	
Total civilian deaths	36	(100%)	2,816	(100%)
<i>Operated and effective</i>	18	(51%)		
<i>Operated but ineffective</i>	3	(8%)		
<i>Fire too small to operate</i>	9	(24%)		
<i>Failed to operate</i>	3	(9%)		
<i>Unclassified operation</i>	3	(8%)		

**B. Characteristics in Fires with Operating Sprinklers vs. No AES**

<b>Fire or Victim Characteristic</b>	<b>Deaths when sprinklers present</b>		<b>Deaths when no AES present</b>	
With operating sprinklers	21	(100%)	2,816	(100%)
Victim in area of origin	18	(87%)	1,319	(50%)
<i>Involved in ignition</i>	14	(66%)	976	(35%)
<i>Not involved in ignition</i>	4	(21%)	446	(16%)
Victim 65 or older	11	(53%)	1,001	(36%)
Clothing on fire	8	(39%)	193	(7%)
Unable to act	7	(32%)	331	(12%)

Note: Here is an example of how to read this table: Almost nine out of every 10 people (87 percent) who died in fires despite the presence of operating sprinklers were located in the area of fire origin. Being closer to the fire makes it harder to escape. In comparison, only half of the fatal victims (50 percent) in fires in which no automatic extinguishing equipment was present were located in the area of fire origin.

Source: NFIRS and NFPA fire experience survey.