



## Methodology used in calculating national estimates from NFPA’s 2021 fire experience survey

### Sample Selection

The NFPA Fire Service Inventory (FSI) currently lists 28,831 public fire departments in the US. Based on the desired levels of statistical precision and available resources, NFPA set a target of 2,700 fire department survey responses for the 2021 sample. We fell short of this number due partially to declining response rates and likely due to the COVID-19 pandemic. Our data collection runs from January through May, coinciding with a very difficult and busy time for first responders.

Because of variation in fire loss results by community size, fire departments are placed in one of the following 10 strata by the size of the community they protect (Table 1).

**Table 1. Fire Department Stratum by Size of Community Protected**

Stratum	Population Size of Community Protected
1	1,000,000 and up
2	500,000 to 999,999
3	250,000 to 499,999
4	100,000 to 249,999
5	50,000 to 99,999
6	25,000 to 49,999
7	10,000 to 24,999
8	5,000 to 9,999
9	2,500 to 4,999
10	2,499 and under

Sample sizes for the individual strata were chosen to ensure the best estimate of civilian deaths in one- and two-family dwellings, the statistic that most aptly reflects the overall severity of the fire problem. All fire departments that protect 5,000 people or more were included. The 8,804 departments in the eight highest strata protect a population of 288 million, or 87 percent of the US population as of July 2021.

The rest of the sample included 16,331 randomly selected departments from strata 9 and 10 (less than 5,000 population protected), for a total sample size of 25,135, or 87 percent of all the fire departments in the United States known to NFPA.

Questions on the survey are designed to be compatible with the US Fire Administration’s [National Fire Incident Reporting System](#) (NFIRS). NFIRS codes are provided to ease data retrieval and some NFIRS software vendors include the NFPA survey in their suites of output reports.

## Data Collection

Surveys were mailed in early January 2022 and again in March 2022. Departments for which we have an email address were contacted via email as well. A total of 2,239 departments responded to the questionnaire. Of the respondents, 74 percent completed the survey online and 26 percent returned paper surveys.

Table 2 shows the number of departments that responded by region and community size.

**Table 2. Number of Fire Departments That Responded to 2021 NFPA Survey, by Region and Community Size**

Population of Community	All	Northeast	Midwest	South	West
1,000,000 or More	9	1	0	3	5
500,000 to 999,999	26	1	5	13	7
250,000 to 499,999	33	0	7	13	13
100,000 to 249,999	108	13	19	40	36
50,000 to 99,999	192	13	79	59	41
25,000 to 49,999	299	51	131	83	34
10,000 to 24,999	517	100	240	119	58
5,000 to 9,999	344	87	148	84	25
2,500 to 4,999	260	59	121	44	36
Fewer than 2,500	451	75	235	87	54
Total	2,239	400	985	545	309

Source: NFPA's fire experience survey.

The overall response rate was 10.1 percent based on a sample of 25,135 fire departments. Response rates were considerably higher for departments protecting larger communities than they were for departments protecting smaller communities. The overall response rate was 40 percent for departments protecting communities with populations of 50,000 or more (less than the previous survey); 20 percent for departments protecting communities of 10,000 to 49,999 (slightly more than the previous survey); and 4.3 percent for departments protecting communities with populations of less than 10,000, which are comprised of mostly volunteers (slightly less than the previous survey). Some fire departments were moved into different population strata when they reported changes in the size of the population they protect. The 2,239 departments that did respond protect 99 million people, or 30 percent of the total US population.

Technical staff members of the Data and Analytics group reviewed the submitted surveys for completeness and consistency. When appropriate, they followed up on questions with a telephone call.

After the edit procedures were completed, the survey data were compiled and additional checks were made. The file was then ready for data analysis and estimation procedures.

## Estimation Methodology

The estimation method used for the survey was ratio estimation<sup>1</sup> with stratification by community size. For each fire statistic, a sample loss rate was computed for each stratum. This rate consisted of the total for that particular statistic from all the fire departments reporting it divided by the total population protected by the departments reporting the statistic. Note that this means that the departments used in calculating each statistic could be

<sup>1</sup>William G. Cochran. *Sampling Techniques* (New York City: John Wiley, 1977), pp.150–161.

different, reflecting differences in unreported statistics. The sample fire loss rates by stratum were then multiplied by the population weighting factors to determine the estimates and then combined to provide the overall national estimate.

If this method of estimation is to be effective, estimates of the total number of fire departments and the total population protected in each stratum must be accurate. The NFPA makes every effort to ensure that this is the case. The population weights used for the national estimates were developed using the NFPA FSI and US Census population figures.

State fire authorities were also surveyed to ensure that NFPA was aware of fires that caused \$10 million or more in property loss, five or more residential fire deaths, or three or more other fire deaths. If these were not captured by the fire experience survey, they were added to the results.

For each estimate, a corresponding standard error was also calculated. The standard error is a measure of the error caused by the fact that estimates are based on a sampling of fire losses rather than on a complete census of the fire problem. Due to the fact that the survey is based on a random sample of the smaller departments, we can be confident, based on the data we received, that the actual value falls within the percentage noted in parentheses for the overall national fire loss statistics: number of fires (2 percent), number of civilian deaths (12 percent), number of civilian injuries (7 percent), and property loss (3 percent) before the addition of information from state fire authorities.

**Table 3. Estimates of 2021 Fires, Civilian Deaths, Civilian Injuries, and Property Loss in the United States**

	Estimate	Range <sup>1</sup>	Percent Change from 2020
Number of Fires	1,353,500	1,321,521 to 1,385,479	-2.5%
Number of Civilian Deaths	3,800	3,390 to 4,210	8.6%
Number of Civilian Injuries	14,700	13,300 to 16,100	-3.3%
Property Loss <sup>2</sup>	\$16.0 Billion	\$15.4 to \$16.5 Billion	-27%

Occasionally, documentation cannot be found to provide specific costs for very large fires. Without that documentation, these incidents are not included in the analysis.

The editors of the survey data attempted to verify all the reported civilian deaths in vehicle fires. They contacted most of the fire departments that reported fire-related deaths in vehicles and found that many of the deaths were indeed the result of fire. In some instances, however, impact was found to have been the cause of death. This can have a considerable impact on the estimates.

The results presented in this report are based on fire incidents attended by public fire departments protecting resident populations. No adjustments were made for unreported fires and losses (e.g., fires extinguished by the occupant without a fire department response). Also, no adjustments were made for fires attended solely by private fire brigades (e.g., industry and military installations) or for fires extinguished by fixed suppression systems with no fire department response.

Increases or decreases in reported fires from 2020 to 2021 that were significant at the .05 level were noted in the text.

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