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Smoke Detector Operability Survey Report on Findings *(revised)*

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I. Executive Summary

The Smoke Detector Operability Survey was done to fill a need for new field data on the numbers and types of smoke detectors installed in households, the proportion of installed smoke detectors that are working, the ways in which smoke detectors are failing, factors leading to non-working detectors, and types of households or housing that are more likely to have non-working smoke detectors. A total of 1,012 in-person interviews were conducted from October 1 through December 23, 1992: 811 from the main sample and an additional 201 field interviews of lower socioeconomic status (lower SES) households. All aspects of the full survey were conducted by Market Facts, Inc., under contract to the CPSC.

The results of the survey will provide support for the major elements of the National Smoke Detector Project, which are intended to increase the presence of working smoke detectors in U.S. households. The National Smoke Detector Project is a joint project among the Consumer Product Safety Commission (CPSC), the Congressional Fire Services Institute, the U.S. Fire Administration (USFA), and the National Fire Protection Association (NFPA). The Department of Housing and Urban Development and many other organizations are also project participants and have a strong interest in the results of the survey.

The survey found that an estimated 88 percent of households (84.5 million) have at least one installed smoke detector. Of these, about 5 million had detectors connected to a central alarm system. The remaining 79.5 million households (or about 83 percent of all households) had non-central system detectors, and were the subject of the Smoke Detector Operability Survey. Some major findings of the survey are:

- ★ About 71 percent of the smoke detectors tested in the study operated by battery power only, and about 26 percent operated by AC power; most of these (91 percent) were hard-wired, rather than plug-in. About 2 percent of detectors were operated by a combination of AC power with backup battery power. The power source of 1 percent of the detectors could not be determined.

- ★ 76 percent of detectors contained radioactive material labels, signifying that they were ionization detectors; 11 percent did not, signifying that they probably were photoelectric. Interviewers were unable to determine whether radioactive materials were present in another 13 percent of detectors.
- ★ Field operability testing found that 73 percent of detectors worked when subjected to the first series of smoke and button tests administered by the field interviewers. An additional 15 percent alarmed at the second series of tests (after the battery was replaced or power was restored). Two percent of detectors could not be tested by field interviewers.
- ★ An estimated 63.5 million households had at least one working non-central system detector in 1992 (based on the results of the first series of smoke and button tests); this was 66 percent of all households and 80 percent of all households with smoke detectors. An estimated 16.0 million households with installed smoke detectors had no working detectors (20 percent of households with smoke detectors). Adding these households to the estimated 11.1 million households without a smoke detector, the survey found that an estimated 28 percent of households were without a working smoke detector.
- ★ At least 26 percent of households with smoke detectors did not have enough detectors to meet the requirement of every-level-protection endorsed by fire services.
- ★ The field interviewers found that, for all households surveyed, nearly 20 percent of detectors did not have functioning power sources. This was by far the most common cause of smoke detector inoperability. About 5 percent of detectors had dead batteries, and the other 15 percent had missing or disconnected batteries or were disconnected from AC power. Almost 93 percent of detectors observed to have problems with power sources were powered by batteries only.
- ★ More than one-third of respondents providing reasons why power sources were missing or disconnected said that the battery or AC power supply was intentionally disconnected because of nuisance alarms. Cooking was most frequently cited as a source of nuisance alarms.

- ★ CPSC Engineering Laboratory evaluation of smoke detectors collected from the survey because of problems with nuisance alarms found three factors associated with nuisance alarms: 1) detector type -- 32 of 33 detectors collected for nuisance alarms were ionization detectors; 2) location -- 34 percent of the detectors collected for nuisance alarms were placed within 5 feet of the source of smoke, steam, or moisture; and 3) maintenance -- unless detectors are cleaned by vacuuming (recommended by many manufacturers), contaminants such as dirt, insects and spiders can increase their sensitivity, leading to an increase in nuisance alarms.
- ★ It appears that the significance of the low-battery warning "chirp" is widely misinterpreted as a nuisance alarm.
- ★ Households with incomes of less than \$15,000 comprised an estimated 23 percent of all households with detectors; however, they accounted for 33 percent of those without at least one working detector ("inoperative households").

II. Background

The Smoke Detector Operability Survey is a major element of a joint project among the Consumer Product Safety Commission, the Congressional Fire Services Institute, the U.S. Fire Administration, and the National Fire Protection Association. The Department of Housing and Urban Development and many other organizations are also project participants and have a strong interest in the results of the survey.

In 1989, approximately 85 percent of U.S. residences were estimated to have installed smoke detectors.¹ Although residential structural fire deaths fell about 25 percent between 1980 and 1990, the United States still has one of the highest fire death rates in the industrialized world. About 65 percent of home fire deaths occur in the small fraction of homes without smoke detectors.² Further, there is a serious concern that disabled or non-working smoke detectors are so common that they are preventing the U.S. from achieving the full potential of increased fire safety from smoke detectors. In 1987, about 35 percent of residential fire deaths occurred in homes that did have detectors.³ In addition to homes not having smoke detectors installed, a previous study suggested one-third of the households that had detectors and experienced a fire had non-working detectors.⁴

The Smoke Detector Operability Survey was done to fill a need for new field data on the proportion of installed smoke detectors that are working, the ways in which smoke detectors are failing, factors leading to non-working detectors, and types of households or housing that are more likely to have non-working smoke detectors. The results of the survey will also provide support for the major elements of the National Smoke Detector Project:

¹ *U.S. Experience with Smoke Detectors*. Report for NFPA by John Hall; June 1992.

² Based on data from The National Fire Incident Reporting System, USFA, 1987.

³ *Ibid.*

⁴ Hall, *op. cit.*

- ▶ renewed efforts to convince consumers to install detectors properly;
- ▶ additional efforts to expand adoption of smoke detector requirements by all jurisdictions;
- ▶ educational efforts to encourage consumers to maintain installed detectors and instruct them on how to avoid alarms when there is no fire ("nuisance alarms");
- ▶ efforts to stimulate development of new technology by industry; and,
- ▶ efforts to incorporate the new technology into standards and codes.

III. Description of the Survey and Sample

The survey sample was drawn using a clustered sample approach. A sample of 40 ZIP Codes was used for interviewing respondents in a primary sample and in a sample of lower socioeconomic status (lower SES) households. The sample locations were separated into urban and rural categories, with urban ZIP Codes defined as those residential ZIP Codes falling within a Metropolitan Statistical Area (MSA), and all others being categorized as rural ZIP Codes. Of the 40 ZIP Codes that comprised the sampling locations, 30 were urban and 10 were rural, a stratification that reflects census estimates.

A total of 1,012 in-person interviews were conducted from October 1 through December 23, 1992: 811 from the main sample and an additional 201 lower SES field interviews. The cooperation rate for the survey (completed interviews divided by completes plus refusals) was 74 percent. All aspects of the full survey were conducted by Market Facts, Inc., under contract to the CPSC (OMB Clearance No. 3041-0111). The survey questionnaire used by the field interviewers is attached as Appendix A. A more detailed description of the survey, including the sample design and sampling procedures, is provided in a report prepared by Market Facts, *Smoke Detector Operability Study - Final Report* (September 23, 1993), which is available from the Office of the Secretary of the CPSC.

IV. Findings of the Survey

A. Households with Smoke Detectors

Based on the responses to screening questions, about 88 percent of households are estimated to have had at least one installed smoke detector. With an estimated 95.7 million households in 1992, this leads to an estimate of 84.5 million U.S. households with at least one smoke detector. Of these, about 5 million households had detectors connected to a central alarm system. The remaining 79.5 million households were the subject of the Smoke Detector Operability Survey. Thus, the terms "households" and "detectors," when used in this report, refer to households with non-central-system smoke detectors, unless noted otherwise.

The survey found little difference in the presence of smoke detectors in households located in urban and rural locations. An estimated 11.4 percent of households located in urban ZIP Codes were found to be without any type of smoke detector (central-system or non-central system), compared to an estimated 12.5 percent of households located in rural locations. Rural households were found to be slightly more likely to have non-central system smoke detectors (84.1 percent vs. 82.7 percent), and less likely to have central-system detectors (in an estimated 3.4 percent of rural households and 5.9 percent of urban households), although the difference was not statistically significant at a confidence level of 90 percent.

An estimated 58 percent of survey respondents (46.4 million households) lived in single family detached housing (compared to 69 percent of all households, as reported in the 1992 *Current Population Survey*), and 25 percent (20 million households) lived in apartments or condominiums (vs. 19 percent of all households). Only 5 percent of the survey respondents (3.7 million households) lived in mobile homes (compared to 7 percent of all households). The differences in the distribution of dwelling type observed in the sample compared to the national distribution found by the *Current Population Survey* (fewer single family detached homes and mobile homes and more apartments and condominiums) may reflect greater prevalence and ease of enforcement of smoke detector codes for rental dwelling units (a greater percentage of which are apartments) than for other housing types. A summary of smoke detector code provisions enforced in the localities covered by the survey is attached as Appendix C.

Forty-one percent of households with smoke detectors reported having more than one detector; only 13 percent reported having more than two detectors. The mean number of smoke detectors in households was 1.6. Table 1 below shows survey findings on the number of households with smoke detectors, by the number of detectors in the household. Fifty-five percent of households with smoke detectors had the same number of detectors as floors in their residence (including basements); 26 percent had fewer detectors than floors; and 19 percent had more detectors than floors. This means that at least 26 percent of households with smoke detectors did not have enough detectors to meet the requirement of every-level-protection endorsed by fire services. Some of the other 74 percent may not have had enough detectors to protect separated sleeping areas on the same floor.

The mean number of smoke detectors in lower SES households was 1.5, essentially the same as for households in the main survey sample. One-third (33 percent) of households in the lower SES sample had fewer smoke detectors than floors. However, the difference between this percentage and that found for the main sample (26 percent) was not statistically significant at a confidence level of 90 percent.

Table 1.
Households with Detectors
(Millions of Households)

Number of Detectors in Household	Households	%
One	47.3	59
More than One	32.2	41
Two	22.2	28
Three	6.1	8
Four or more	3.9	5
Total	79.5	
<i>Mean Number</i>	<i>1.6</i>	

B. Characteristics of Smoke Detectors in Use

About 71 percent of the smoke detectors tested in the study operated by battery power only. About 26 percent operated by AC power; most of these (91 percent) were hard-wired, rather than plug-in. About 2 percent of detectors were operated by a combination of AC power with backup battery power. The power source of 1 percent of the detectors could not be determined. Smoke detectors in owner-occupied dwellings were more likely to be battery powered than those occupied by renters. About 59 percent of detectors in rental units were battery powered only, compared to about 77 percent of the detectors in owned dwellings.

Interviewers were to observe whether detectors had radioactive material labels or markings, signifying that they were ionization-type detectors. Of detectors tested, 76 percent contained radioactive materials, and only 11 percent did not. Interviewers were unable to determine whether radioactive materials were present in another 13 percent of detectors.

Fifty-five percent of detectors were ceiling-mounted, and 40 percent were wall-mounted. Another 4 percent were mounted in some other location, or were not mounted. A statistically significant difference in mounting location was found for smoke detectors in the lower SES sample vs. the main sample: 48 percent of detectors for that group were wall-mounted and 47 percent were ceiling-mounted, whereas for the main sample, 39 percent of detectors were wall-mounted and 57 percent were ceiling-mounted.

Estimated percentages of smoke detectors with different characteristics presented above were based on analysis of data from the main sample of the survey, which best represents the general population. Characteristics of smoke detectors have also been cross-tabulated with each other and with characteristics of the households and the dwellings in which they are installed. To provide a more robust total sample for many of these analyses, data from the lower SES sample have been combined with the main sample. These findings are shown in Tables 2 through 5 on pages 6 through 9.

Table 2 shows the results of smoke detector power sources cross-tabulated with the presence of warnings or labels concerning radioactive materials in detectors (which, as noted above, signifies the likelihood that the detectors are ionization type, rather than photoelectric). As may be seen in Table 2, of those smoke detectors with radioactive material labels (probable ionization-type) for which the type of power source was known (comprising about 78 percent of detectors for which the type of power source was determined), an estimated 77 percent were powered by battery power only vs. only 54 percent of detectors without the labels (probable photoelectric detectors).

Table 2.
SMOKE DETECTOR POWER SOURCE
BY THE PRESENCE OF A RADIOACTIVE MATERIAL LABEL

POWER SOURCE				RADIOACTIVE LABEL OR WARNING (SIGNIFYING PROBABLE IONIZATION-TYPE)					
	TOTAL	% OF TOTAL	% OF KNOWN POWER	YES	% OF KNOWN POWER	NO	% OF KNOWN POWER	DON'T KNOW	% OF KNOWN POWER
BATTERY ONLY	1,123	70%	72%	946	77%	88	54%	84	50%
AC - HARDWIRED	366	23%	23%	222	18%	65	40%	76	45%
AC - PLUG-IN	39	2%	2%	34	3%	4	3%	1	0%
COMBINATION, AC & BATTERY	37	2%	2%	24	2%	4	3%	9	5%
UNDETERMINED	18	1%	--	3		0		15	
NO ANSWER	25	2%	--	0		0		0	
TOTAL (detectors)	1,608			1,229		161		184	
WITH KNOWN POWER	1,565	97%		1,226	78%	161	10%	169	11%
PERCENT OF TOTAL				76%		10%		11%	

Note: Based on detectors observed by survey field interviewers. Data from the lower SES sample have been combined with those from the main sample. Results have been weighted to account for over-sampling of low-income households.

Table 3 shows information on power sources cross-tabulated with information on the types of dwellings in which detectors are installed. This table shows that hard-wired AC-powered detectors are more commonly found in mobile homes and apartments or condominiums than in single-family site-built homes. Although hard-wired AC detectors comprised about 23 percent of all detectors in the survey, an estimated 32 percent of the detectors in apartments and condominiums were hard-wired AC-powered, a difference that is statistically significant at a confidence level greater than 95 percent. Mobile homes were also more likely to have hard-wired AC-powered detectors (an estimated 38 percent), although the difference was not statistically significant at a confidence level of 90 percent because of the smaller number of mobile homes in the survey.

Table 3.
POWER SOURCE, BY DWELLING TYPE
(ALL DETECTORS OBSERVED BY SURVEY INTERVIEWERS)

DWELLING TYPE	POWER SOURCE																TOTAL	
	BATTERY			AC HARD-WIRED			AC PLUG-IN			AC/Battery COMBO.			UNKNOWN / NO ANSWER					
	PERCENT			PERCENT			PERCENT			PERCENT			PERCENT					
	No.	HOUSING	BATTERY	No.	HOUSING	AC-HW	No.	HOUSING	AC-PLUG	No.	HOUSING	COMBO	No.	HOUSING	NO ANSWER	No.		
Apt. / Condo.	192	62%	17%	101	32%	28%	7	2%	17%	12	4%	31%	14	4%	32%	325	20%	
S.F. - Attached	165	79%	15%	27	13%	7%	10	5%	26%	6	3%	16%	4	2%	10%	213	13%	
S.F. - Detached	740	75%	66%	213	22%	58%	11	1%	29%	16	2%	43%	25	2%	58%	1,005	63%	
Mobile Home	23	38%	2%	23	38%	6%	11	18%	28%	4	6%	9%	0	0%	0%	60	4%	
No Answer	3	56%	0%	3	44%	1%	0	0%	0%	0	0%	0%	0	0%	0%	6	0%	
TOTAL DETECTORS	1,123	70%		366	23%		39	2%		37	2%		43	3%		1,608		
% OF KNOWN POWER		72%			23%			2%			2%			---				

Note: Based on detectors observed by survey field interviewers. Data from the lower SES sample have been combined with those from the main sample. Results have been weighted to account for over-sampling of low-income households.

Table 4 shows detector power sources depending on whether dwellings were owned or rented. An estimated 77 percent of detectors in owned dwellings were powered by battery-power only, compared to just 59 percent of detectors in rented dwellings. Conversely, although some form of AC-power was the power source of about 28 percent of the detectors surveyed for which the power type was determined, about 41 percent of detectors in rented dwellings were powered by AC. These findings, statistically significant at confidence levels greater than 95 percent, are linked to those discussed above for power source by dwelling type, since a much higher percentage of apartments and condominiums are rental units (85 percent) than is true for single family site-built homes (about 17 percent).

Table 4.
SMOKE DETECTOR POWER SOURCE,
BY OWNED OR RENTED DWELLINGS

POWER SOURCE	OWNED DWELLINGS		RENTED DWELLINGS		TOTAL	
	NUMBER OF DETECTORS	% OF KNOWN POWER	NUMBER OF DETECTORS	% OF KNOWN POWER	NUMBER OF DETECTORS	% OF KNOWN POWER
BATTERY ONLY	858	77%	264	59%	1,123	72%
AC/HARD WIRE	220	20%	146	33%	366	23%
AC/PLUG-IN	24	2%	14	3%	39	2%
AC/BATTERY BACKUP	17	2%	20	5%	37	2%
UNDETERMINED	8	--	10	--	18	--
NO ANSWER	21	--	5	--	25	--
TOTAL	1,147		459		1,608	
WITH KNOWN POWER SOURCE	1,119	72%	444	28%	1,565	
PERCENT OF TOTAL	71%		29%			

Note: Based on detectors observed by survey field interviewers. Data from the lower SES sample have been combined with those from the main sample. Results have been weighted to account for over-sampling of low-income households.

Residences that were built more recently were much more likely to have smoke detectors powered by AC, including AC-powered detectors with a battery backup, than were older residences. Nearly 70 percent of smoke detectors in residences built from 1980 through 1992 were AC-powered, compared to about 30 percent of the detectors found in residences built in the 1970's, and fewer than 20 percent of detectors in residences built before 1970. These findings are shown in Table 5 below. It is likely that this is attributable to changes in building practices brought about by revisions to building codes in recent years. Information on code requirements in the jurisdictions surveyed may be found at Appendix C to this report.

Table 5.
SMOKE DETECTOR POWER SOURCE
BY YEAR DWELLING WAS BUILT

YEAR DWELLING WAS BUILT	Total Number of Detectors		POWER SOURCE			
			BATTERY ONLY		AC POWER	
	% of Total		Number of Detectors	% of Known Power	Number of Detectors	% of Known Power
1980 - 1992	289	18%	87	31%	198	69%
1970's	271	17%	189	71%	79	29%
1960's	200	12%	160	82%	34	18%
1950's	184	11%	159	87%	23	13%
1940's	119	7%	109	96%	4	4%
Before 1940	257	16%	217	88%	30	12%
Unknown	285	18%	201	73%	73	27%
Totals	1,605		1,121	72%	442	28%

Note: Based on detectors observed by survey field interviewers. Data from the lower SES sample have been combined with those from the main sample. Results have been weighted to account for over-sampling of low-income households.

C. Respondents' Observations and Actions Concerning Smoke Detectors

1. Perceptions of Smoke Detector Operability

Before smoke detectors were tested by the interviewers, respondents were asked questions about whether their detectors were working. Respondents were asked to give reasons for believing that all of their detectors were working, or why they thought that one or more were not working. Information on these perceptions is summarized in Tables 6 through 8.

Table 6.
Perceptions of Operability
(Millions of Households)

	Households	%
All Detectors Work	62.0	78
At Least One Doesn't Work	8.6	11
Don't Know	8.8	11
	79.5	100

Table 7.

How Do You Know Detector(s) Work(s)?

	%
It Was Tested	58.2
Assume It Works/Unsure	16.3
Light Is On	16.2
Went Off With Smoke/Fire	14.3
Went Off While Cooking	1.9
New Detector/Batteries	1.8
Isn't Beeping/Battery Not Low	1.0
Other Reason	0.9
Steam/Bathroom Sets Off	0.7
Went Off (Not Specified)	0.4
Blew Smoke At It	0.2
No Answer	0.1

Totals > 100% because of multiple answers
(of those believing all detectors were working)

Table 8.

Why Do You Think Detector(s) Doesn't (Don't) Work?

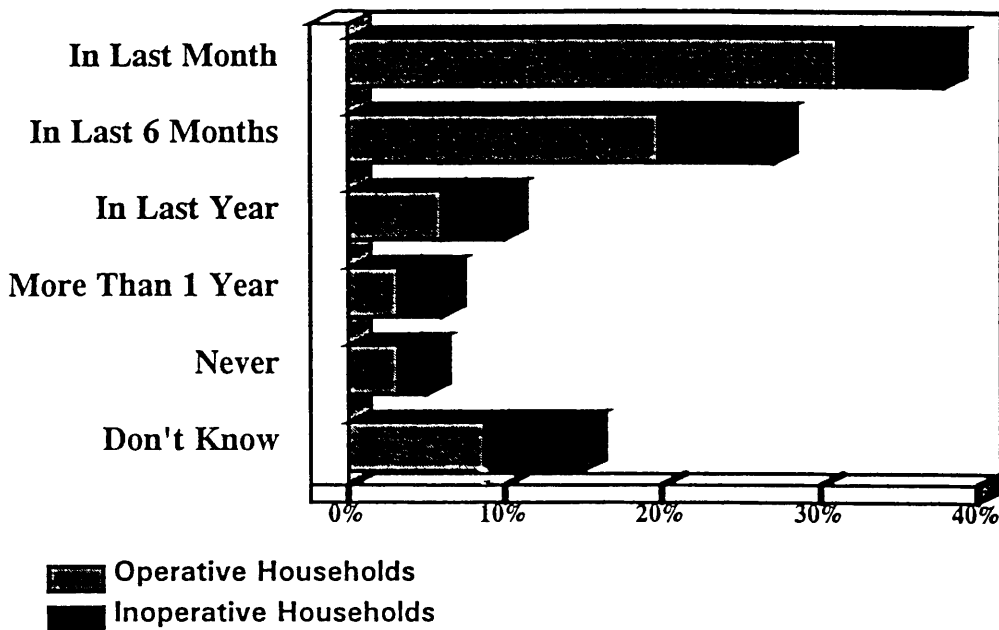
	%
Battery Removed/Disconnected	43.7
Dead Battery	29.0
Beeps Continuously/Randomly	5.9
Defective/Tested & It Didn't Work	5.3
Non-working/Had Fire & It Didn't Work	3.8
AC Power Disconnected	2.3
Light Not On/Cover Missing	0.6
Other Reason	5.5
Don't Know	16.5

Totals > 100% because of multiple answers
(of those thinking at least 1 detector wasn't working)

2. Testing of Smoke Detectors by Residents

As seen in Table 7, a majority of respondents who believed their detectors were working based that belief on the results of testing. Figure 1 shows the responses of those surveyed when asked when their detectors were last tested.

Figure 1.
When Were Detectors Last Tested?



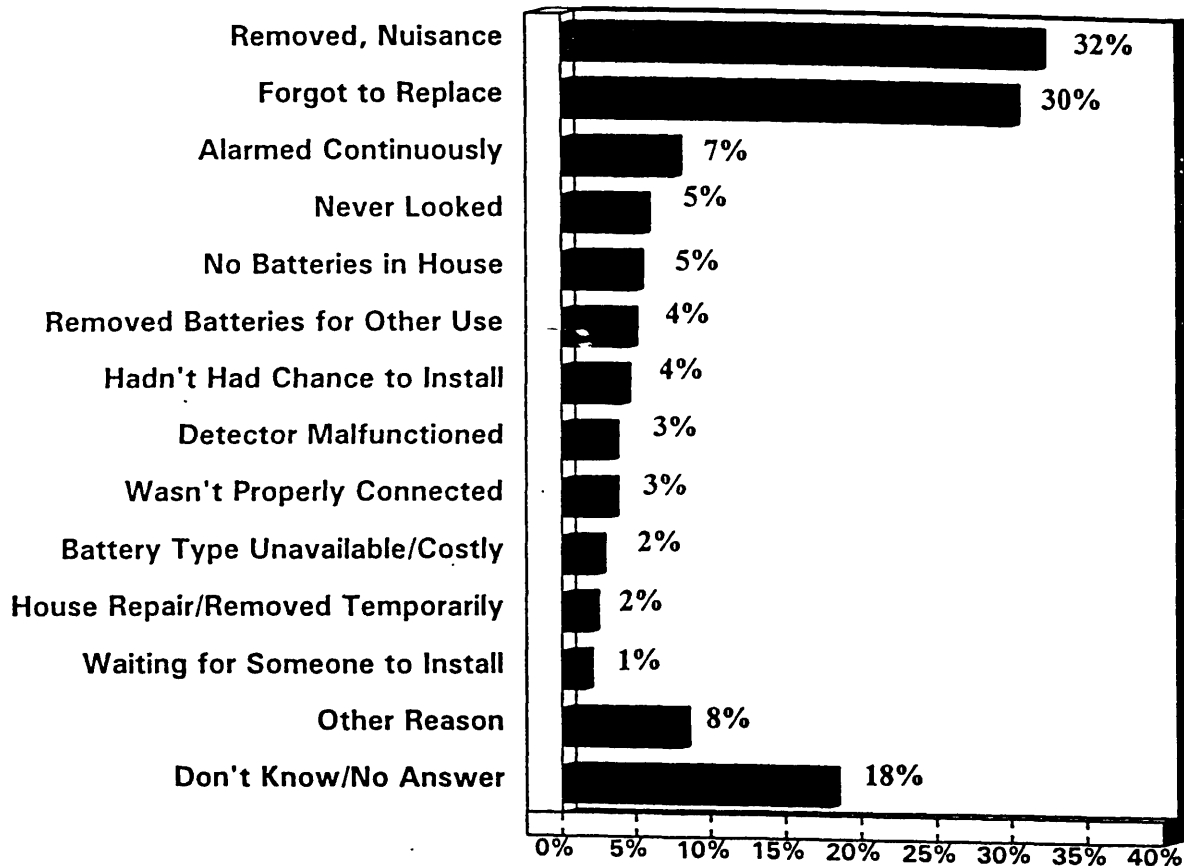
The majority of respondents who stated their testing frequency said that their smoke detectors were tested within the last month. Respondents in households that had at least one working detector ("operative households") (as found in smoke detector operability testing done by field interviewers) were more likely to have said that smoke detectors were tested in the last month or within the last six months than were respondents in households that did not have working detectors ("inoperative households"). Seventy percent of respondents in operative households said detectors had been tested within the last six months, compared to 45 percent of respondents in inoperative households.

3. Removed or Disconnected Power Sources

As seen in Table 8, most respondents who believed their detectors were not working thought the batteries had been either removed or disconnected, the batteries were dead, or the units were disconnected from AC power. The field

interviewers found that, for all households surveyed, nearly 20 percent of detectors did not have functioning power sources; about 5 percent of detectors had dead batteries, and the other 15 percent had missing or disconnected batteries or were disconnected from AC power. Owners of units with missing or disconnected batteries or units which were disconnected from AC power were asked why the detectors were not connected to a power source. Their responses are summarized in Figure 2.

Figure 2.
Reasons for Missing or Disconnected Batteries
or Disconnected AC Power
 (for 15 percent of detectors with missing or disconnected power sources)



As seen in Figure 2, just over 80 percent of respondents having detectors that were disconnected from power supplies provided reasons why this was the case. Among respondents who provided reasons, about 40 percent forgot to replace the batteries or did not check the detectors to see that they had power; somewhat less than 10 percent stated that detectors were not installed, installed

improperly, or were temporarily removed; more than 5 percent said that they did not have batteries, and; fewer than 5 percent had decided to use batteries for another purpose. Over 10 percent of respondents providing reasons why power supplies were disconnected said that the detector alarmed continuously or had some other malfunction. The most common reason that the battery or AC power supply was intentionally disconnected was because of nuisance alarms, cited for more than one-third of these detectors.

To gain more information about circumstances that may lead to nuisance alarms, respondents were asked other questions. All respondents to the survey were asked whether any of their detectors had ever gone off when there was no fire, other than when being tested. Just over half said that they had. By far the most common reason for alarms when there was no fire was cooking, cited by 80 percent of those who reported having such alarms. Low batteries were cited as a reason for nuisance alarms by 20 percent, followed by steam from bathrooms, mentioned by 6 percent. The "alarms" cited by most of those who said that the cause was low batteries probably were "chirps" many detectors are designed to emit when the battery power is low.

D. Results of Field Operability Testing

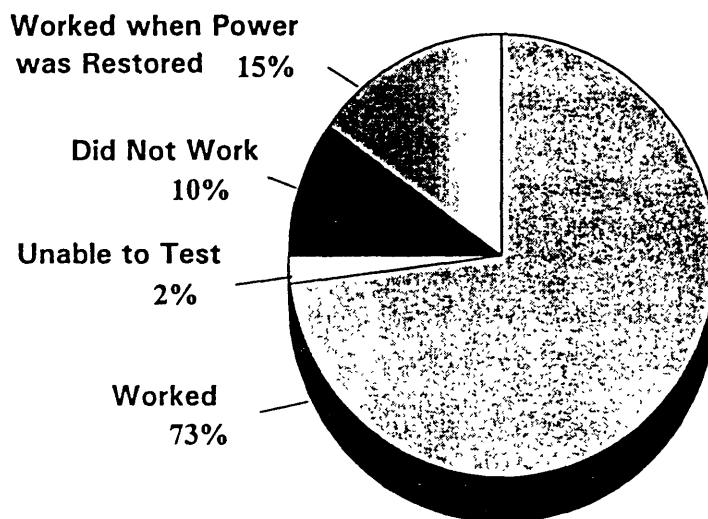
Field interviewers used a specific testing protocol to examine the operability of smoke detectors. Units were subjected to a smoke test, using an aerosol spray. If the detectors sounded in response to the smoke test, their test buttons were then pressed by the field interviewer for a specific period to see if they sounded (except for the 3 percent of detectors without test buttons). If detectors failed to alarm with either test, a new battery was installed or AC power restored (if possible), and the tests were repeated.

The field operability testing found that 73 percent of detectors worked when subjected to both the first smoke test and the first button test. After new batteries were installed or AC power was restored, an additional 15 percent of detectors alarmed when subjected to both the second smoke and button tests; however, 5 percent did not alarm with the second smoke test and 4 percent did not alarm with the second button test (some failed to alarm with both second tests). Six percent of detectors could not be restored to power in order to administer the second round of tests, and the owners of 2 percent of detectors did

not allow the field interviewer to test their units.

Figure 3 shows the results of the field testing done by the survey interviewers.

Figure 3.
The Results of the Field Operability Testing
(Percent of Detectors Surveyed)



Based on the results of the field operability testing, the percentage of households with one or more functioning smoke detectors is less than indicated by the perceptions of smoke detector owners. An estimated 63.5 million households had at least one working non-central system detector in 1992 (based on the results of the first series of smoke and button tests); this was 66 percent of all households and 80 percent of all households with smoke detectors. (The difference between the estimated 80 percent of households with a working detector ("operative households") and 73 percent of detectors working in response to the first series of tests reflects homes with more than one detector, not all of which were operational.) An estimated 16.0 million households with installed smoke detectors had no working detectors (20 percent of households with smoke detectors). An estimated 7.3 million (or 46 percent) of these "inoperative" households had been thought by the survey respondents to have all their detectors in working condition. Table 9 shows the results of operability testing related to respondents' perceptions of operability.

Table 9.
Pre-Testing Perceptions of Operability vs.
Household Detector Status
(thousands of households, estimated)

Perceptions of Operability	Pre-Testing Perceptions		Household Detector Status			
	Households ¹	%	Operative ²		Inoperative	
			Number	%	Number	%
Thought that all detectors worked	62,045	78	54,736	86	7,309	46
Thought that at least one was not working	8,640	11	3,459	5	5,182	31
Didn't know	8,793	11	5,329	8	3,464	23
Total	79,478	100	63,524	80	15,954	20

¹ Base is all 811 main sample households.

² An operative household is defined as one that had at least one smoke detector working in response to the first smoke and button tests.

As would be expected, the more smoke detectors that households had, the greater was the likelihood of having at least one working detector. The mean number of detectors was 1.6 for all households, 1.7 for operative households, and 1.3 for inoperative households. About 74 percent of households with only one detector were operative households, compared to 89 percent of households with two or more detectors. Although households with only one detector accounted for 59 percent of all households with detectors, they comprised about 78 percent of all inoperative households.

The percentages of households found to have no operating smoke detectors did not show statistically significant differences across dwelling types, although apartments and condominiums were slightly more likely to be inoperative households (almost 22 percent were inoperative vs. 20 percent for

all dwelling types), and single family detached houses were somewhat more likely to be operative households (81 percent vs. 80 percent for all dwelling types).

As discussed previously, 55 percent of households had the same number of detectors as floors in the residence, and 26 percent had fewer detectors than floors. Because of the presence of non-working detectors, a higher percentage of households had fewer working detectors than the number of floors. An estimated 43 percent of households in the main sample had fewer working detectors than floors. The estimated percentage of households in the lower SES sample with fewer working detectors than floors was 53 percent. (However, the calculated difference between the main and lower SES samples was not statistically significant at a 90 percent confidence level.)

Of detectors whose types of power supplies were determined, about 72 percent operated by battery power only and about 28 percent operated by hard-wired AC, plug-in AC, or combinations of AC power with a battery backup. Battery powered smoke detectors were less likely to alarm when subjected to the first smoke and button tests than those powered by AC; about 69 percent of these units alarmed in response to the first series of tests, compared to about 84 percent of AC-powered detectors.

About 76 percent of detectors were determined to have radioactive material labels (signifying they are ionization-type detectors, although a small but undetermined number could be ionization/photoelectric combination units). About 72 percent of such detectors alarmed when subjected to the first series of tests. This was somewhat lower than detectors without such labels (presumed to be photoelectric models), 79 percent of which alarmed (although the difference was not statistically significant at a 90 percent confidence level). Much of the difference in percentages found to be working may be attributable to the fact that probable ionization-type detectors were more likely to be battery powered; 77 percent were powered by batteries, compared to about 55 percent of detectors without radioactive material labels.

Households in more recently-constructed dwellings, those built in the 1980's and 1990's (and, to a lesser degree, those built in the 1970's), were found to be more likely to have one or more working smoke detectors. About 92 percent of households in dwellings built from 1980 through 1992 and about

82 percent of those in dwellings built in the 1970's were operative households, compared to about 74 percent of households in dwellings built before 1970. As noted previously, smoke detectors in dwellings built in more recent years were much more likely to be AC-powered, a higher percentage of which alarmed in response to the first series of field tests.

To obtain representative data as efficiently as possible, the survey sample was stratified by population density to reflect census estimates. Therefore, about 75 percent of households interviewed were located in urban areas vs. 25 percent in rural areas (as defined by ZIP Code). There was not a statistically significant difference in the percentages of urban and rural households that had at least one working smoke detector.

Regarding other demographic data, the operability survey found no significant differences in race between operative and inoperative households. Respondents from inoperative households were somewhat more likely to have a high school degree (or the equivalent) or less. These respondents' households comprised 46 percent of the operative households and 53 percent of the inoperative households. Inoperative households were much more likely to report household income levels of less than \$15,000 than were operative households. Households with incomes of less than \$15,000 comprised an estimated 23 percent of all households with detectors; however, they accounted for 33 percent of inoperative households and 20 percent of operative households. Conversely, households with incomes of \$50,000 or more comprised an estimated 12 percent of all households with smoke detectors, but they accounted for only 7 percent of households without a working detector.

E. Conditions of Inoperative Detectors that were Noted by Field Interviewers

If smoke detectors did not pass the first series of smoke and button tests (and did not alarm continuously when restored to power), the field interviewers examined them and noted conditions that were found. Table 10 on page 18 summarizes the conditions found by the presence of radioactive materials labels (presumed to signify that the detectors were ionization-type) and by power sources.

As reported previously, about 20 percent of smoke detectors were found to be without functioning power sources. Table 10 shows that detectors with radioactive material labels, that is, those presumed to be ionization-type, comprised about 85 percent of detectors found to have dead batteries, or missing or disconnected power sources. This is greater than the percentage of detectors in the survey found to have such labels, 76 percent.

Most observations of non-functioning power sources involved detectors powered by batteries only. Such detectors comprised almost 93 percent of detectors observed to have problems with power sources. Of detectors for which the power supplies were determined, 72 percent were battery-powered.

Table 10.

CONDITIONS OF DETECTORS OBSERVED

FOR ALL DETECTORS, AND BY THE PRESENCE OF RADIOACTIVE LABELS AND POWER SOURCES

CONDITION OBSERVED	TOTAL % OF ALL DETECTORS		RADIOACTIVE LABEL						POWER SOURCE					
			YES	%	NO	%	UNCERTAIN	%	BATTERY	%	AC	%	COMBO	%
MISSING BATTERY	184	11.4%	154	84%	17	9%	13	7%	181	98%			2	1%
DISCONNECTED BATTERY	48	3.0%	46	96%	2	4%			48	100%				
DEAD BATTERY	84	5.2%	71	85%	6	7%	7	8%	84	100%				
DISCONNECTED FROM AC	22	1.4%	17	77%	3	14%	2	9%			21	95%	1	5%
COVER HANGING OPEN	12	0.7%	9	75%			3	25%	9	75%			2	17%
MISSING COVER	23	1.4%	16	70%	4	17%	3	13%	13	57%	8	35%	1	4%
INSECTS / COBWEBS	15	0.9%	9	60%	1	7%	5	33%	11	73%	4	27%		
CLOGGED w/ DIRT / DUST	45	2.8%	38	84%	5	11%	2	4%	28	62%	17	38%	1	2%
< 1' OF WALL-CEILING MEETING	80	5.0%	63	79%	11	14%	6	8%	58	73%	21	26%	1	1%
< 5' OF AIR DUCT/VENT	13	0.8%	12	92%			1	8%	6	46%	7	54%		
CATHEDRAL CEILING-COULDNT REACH	3	0.2%	2	67%			1	33%	1	33%	2	67%		
IN STORAGE / NOT YET INSTALLED	16	1.0%	14	88%			2	13%	14	88%	2	13%		
ALARMS CONTINUOUSLY	4	0.2%	4	100%					4	100%				
REMOVED / DISCONNECTED-NOT WORKING	5	0.3%	5	100%					5	100%				
PARTS GLUED / BROKEN OFF	7	0.4%	4	57%	1	14%	2	29%	5	71%	1	14%		
NOT MOUNTED / IN VIEW	4	0.2%	4	100%					4	100%				
BATTERY DOESN'T FIT PROPERLY	3	0.2%	3	100%					3	100%				
NOT WORKING (UNSPECIFIED)	2	0.1%	1	50%			1	50%			2	100%		
HANGING FROM WIRES	1	0.1%	1	100%							1	100%		
CONTACT POOR	1	0.1%	1	100%							1	100%		

Note: Observed detectors were those which did not pass the first series of smoke and button tests, and which did not alarm continuously when restored to power. Data from the lower SES sample have been combined with those from the main sample. Results have been weighted to account for over-sampling of low-income households.

Of other conditions noted by the field interviewers, the conditions that accounted for more than an estimated 1 percent of all detectors in surveyed households were: being located less than 1 foot from the joining of a wall and ceiling; being clogged with dirt and dust; and, having a cover either missing or hanging open. Note that conditions were observed only if detectors did not pass the first series of tests; therefore, with the exception of conditions involving power sources, several of the conditions noted in Table 10 may be more prevalent in the field than indicated by the survey. Also, the condition of "Alarming Continuously" when powered is understated by the table, because such detectors were intended to be labeled for collection -- with no intent to note this as a condition.

Conditions of inoperative detectors observed by field interviewers depending on whether households reportedly had annual incomes of less than \$15,000 or \$15,000 and more are summarized in Table 11 on the next page. Households with annual incomes of less than \$15,000 comprised an estimated 23 percent of households with smoke detectors and 22 percent of detectors. As seen in Table 11, lower-income households were somewhat over-represented for several conditions observed, such as problems with power sources and dirt and insect contamination. However, the total numbers of observations for some of these conditions were relatively small.

About 31 percent of the battery powered detectors failed either the first smoke or button test, or the respondents volunteered that the detectors were without batteries. The field interviewers asked respondents if they had heard a chirp or beep from these detectors to indicate that they had low batteries. Of those responding, owners of 39 percent of the detectors said that they had heard chirps or beeps; owners of 51 percent said they had not; and owners of 11 percent didn't know whether they had heard chirps or beeps. For those detectors found by the field interviewer to have dead batteries (accounting for more than 7 percent of battery-powered detectors), owners of an estimated 37 percent reportedly did not hear chirps or beeps indicating low batteries. The CPSC Engineering Laboratory conducted low-battery alarm tests on 111 smoke detectors that were collected from survey respondents. (Collected detectors failed to alarm in the second series of field testing, or were reported to have problems; therefore, detectors tested by the laboratory comprised a subset of the broader sample discussed above.) Twenty-three (or about 21 percent of those tested by the Laboratory) failed the low-battery test, and 19 of these (about 83 percent of those failing the test) had electromagnetic horn elements, a type of

horn that has been replaced by piezoelectric horn elements in the manufacture of smoke detectors. Other results of the analysis of the Engineering Laboratory are summarized in Section V., and the report on the analysis is attached as Appendix B, (*Smoke Detector Operability Survey - Engineering Laboratory Analysis*, October 1994, by Julie I. Shapiro, Directorate for Engineering Sciences).

Table 11.

**CONDITIONS OF DETECTORS OBSERVED
BY REPORTED ANNUAL HOUSEHOLD INCOME**

CONDITION OBSERVED	HOUSEHOLD INCOME			
	< \$15,000		\$15,000 OR MORE	
MISSING BATTERY	48	28%	123	72%
DISCONNECTED BATTERY	12	26%	35	74%
DEAD BATTERY	23	28%	60	72%
DISCONNECTED FROM AC POWER	5	22%	18	78%
COVER HANGING OPEN	3	27%	8	73%
MISSING COVER	6	30%	14	70%
INSECTS / COBWEBS	10	63%	6	38%
CLOGGED w/ DIRT / DUST	17	39%	27	61%
< 1' OF WALL-CEILING MEETING	25	32%	53	68%
< 5' OF AIR DUCT/VENT	3	25%	9	75%
CATHEDRAL CEILING-COULDN'T REACH	1	33%	2	67%
IN STORAGE / NOT YET INSTALLED	3	19%	13	81%
ALARMS CONTINUOUSLY	3	75%	1	25%
REMOVED / DISCONNECTED - NOT WORKING	1	25%	3	75%
PARTS GLUED / BROKEN OFF	2	33%	4	67%
NOT MOUNTED / IN VIEW	1	25%	3	75%
BATTERY DOESN'T FIT PROPERLY	1	50%	1	50%
NOT WORKING (UNSPECIFIED)			2	100%
CONTACT POOR			1	100%
NUMBER OF DETECTORS OBSERVED	105	28%	274	72%

Note: Observed detectors were those which did not pass the first series of smoke and button tests, and which did not alarm continuously when restored to power. Data from the lower SES sample have been combined with those from the main sample. Results have been weighted to account for over-sampling of low-income households.

The results of the testing done by the Engineering Laboratory indicate that failure of smoke detectors installed in households to emit low battery warnings (and, therefore, decreased likelihood that consumers would be aware that new batteries are required) may be related to the ages of detectors. Also, responses to other questions asked about "alarming" when there was no fire indicate that some consumers misinterpret low battery warnings.

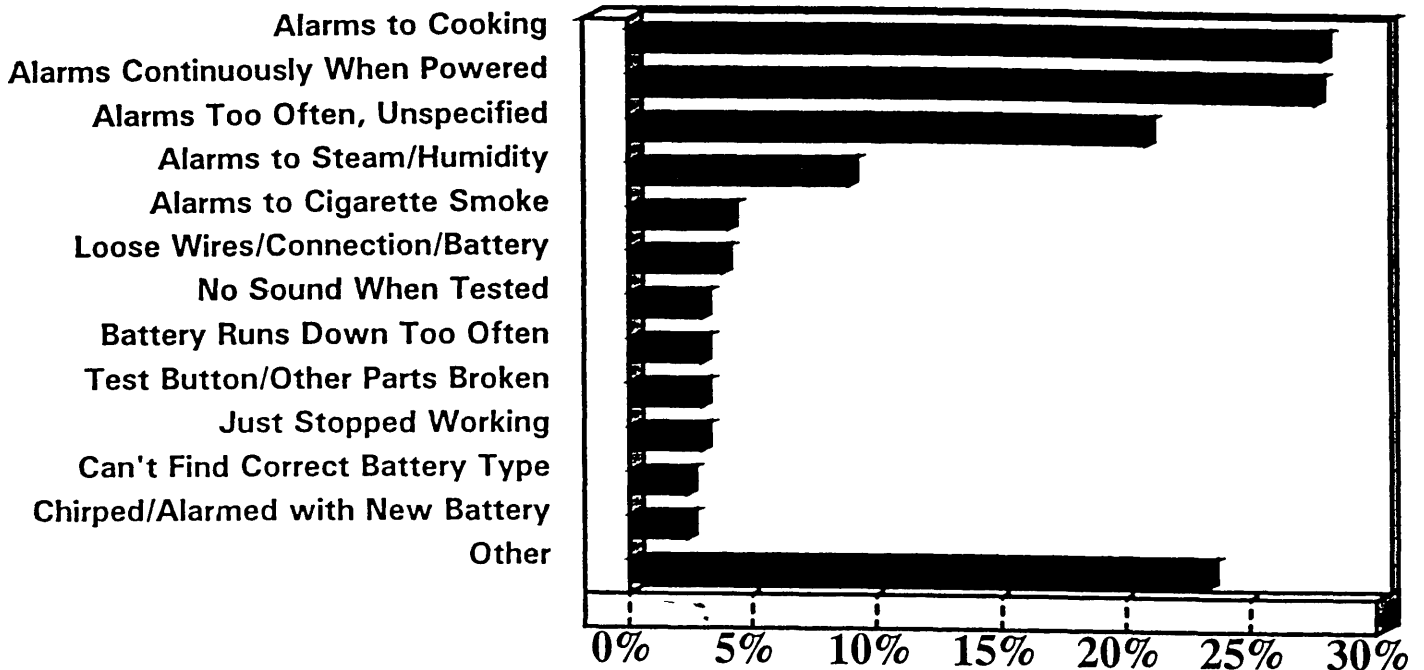
F. Problems Reported by Consumers

Respondents having detectors that were found by field interviewers to have dead batteries, or to have missing or disconnected power sources (encompassing about 20 percent of all detectors in the survey), were asked if they had experienced any problems with the detectors. Twenty-six percent of these detectors, or about 5 percent of all detectors in surveyed households, reportedly had experienced some problems. Respondents were asked to describe the problems they had experienced with the smoke detectors; the findings are summarized in Figure 4 on page 22.

As seen in Figure 4, among those detectors with dead batteries or missing/disconnected power sources, the three types of problems mentioned most frequently by survey respondents were *Alarms to Cooking* (28 percent); *Alarms Continuously When Powered* (27 percent); and, *Alarms Too Often, Unspecified* (21 percent). *Alarms To Cooking* was mentioned most frequently by households without at least one working detector (inoperative households) and which reported problems (35 percent), and *Alarms Continuously When Powered* was mentioned most frequently by lower SES households (38 percent).

Excluding those detectors with dead batteries, and considering only detectors with missing or disconnected power sources (encompassing about 15 percent of all detectors in the survey), the most frequently mentioned problem for detectors was *Alarms to Cooking*, mentioned for 32 percent of these detectors. The most frequently mentioned problem for detectors with dead batteries was *Alarms Continuously When Powered*, mentioned for 43 percent. For some of these detectors, the "problem" being reported may actually have been the low battery "chirp."

Figure 4.
Problems Reported For Detectors
 (% of Detectors with Dead Batteries or Missing/Disconnected Power Sources & which were Reported to Have Problems)



V. Sample Collection and Engineering Analysis

An important component of the project was to identify reasons for smoke detector inoperability. Detectors that were non-working (following installation of new batteries or connection of AC power) or exhibited other possible malfunctions were collected and sent to the CPSC's Engineering Laboratory for analysis. Respondents were provided with a replacement detector and \$25 towards installation. A total of 159 detectors from the survey were sent to the laboratory. Four detectors were determined to have been improperly collected, bringing the total number of samples for evaluation to 155.

Four major problems resulting in smoke detectors failing to operate in residences were revealed by work at the Engineering Laboratory. The first was related to deterioration and corrosion of horn elements. The Engineering Laboratory found that out of 73 detectors collected because they failed the simulated smoke test in the field, 6 had deterioration and corrosion of the horn elements that also caused them to fail the Gross Smoke Test in laboratory testing. Such deterioration and corrosion are also the suspected causes of failure for an additional 24 detectors that failed the field smoke test, but were suspected of being restored to functionality by the effects of shipping and handling.

A second category of problems identified by the survey was nuisance alarms. Thirty-three smoke detectors were collected because of complaints about nuisance alarms. The Engineering Laboratory found that these units had greater average sensitivity than the entire population of detectors collected. One-third of these units were found to have significant accumulations of debris. Also, one-third of the 33 detectors were reportedly placed in locations that increased the likelihood of nuisance alarms, often fewer than 5 feet from the nuisance source.

Continuous or periodic alarms when detectors are powered comprised a third major category of problems evaluated by the Engineering Laboratory, and were the reasons for collection of 32 of the 155 evaluated samples. Fifteen of these detectors worked properly when initially tested in the laboratory, but 17 other units exhibited some problems. In addition to these, eight other battery-powered detectors collected for failing the simulated smoke test in the field alarmed continuously when new batteries were installed by laboratory personnel. Additional analysis and assistance from smoke detector manufacturers is needed to determine the exact causes of the malfunctions that lead to continuous alarming.

The fourth category of problems evaluated by the Laboratory encompass a variety of problems, including battery-related problems, defective electrical components, and defective mechanical components.

Based on release dates for smoke detector label issue numbers (provided by Underwriters Laboratories), all of the detectors collected for analysis by the Engineering Laboratory were at least a few years old; 1987 was the most recent release date. It should be noted, however, that UL officials informed the CPSC that label issue numbers might not be used until years after their release dates, and are, therefore, not reliable indicators of manufacture dates.

Further research addressing these problem areas will be done with the goal of increasing the reliability of smoke detectors installed in households. Detailed findings of the engineering analysis are given in a separate report by the Directorate for Engineering Sciences, which is attached as Appendix B.

VI. Conclusion

The Smoke Detector Operability Survey provided a great deal of information on conditions related to non-working detectors. The related demographic and housing data, and the laboratory analysis of detectors collected during the survey will be instrumental in focusing activities of public and private agencies and industry aimed at reducing the national fire hazard through the use of working smoke detectors.

The findings that a high percentage of U.S. households now have smoke detectors installed is encouraging, and indicates that efforts by government agencies and private groups to convince consumers of the increased safety afforded by smoke detectors have achieved some success. Lower smoke detector prices also may have led to more detectors being purchased by consumers. Nearly 90 percent of households now have either central system or single-station smoke detectors installed.

Although some of the findings are encouraging, the survey also points to areas in which additional efforts are required. More than an estimated 11 million households in 1992 had no smoke detectors installed, and an even greater number, about 16 million households, had detectors, but none were working. Also, 26 percent of households had fewer detectors than floors, and, because of the presence of non-working detectors, an estimated 43 percent of households had fewer **working** detectors than floors. These findings indicate that in future efforts to improve the safety of household residents, actions to address reasons for the failure of detectors to function may be at least as important as those seeking to increase the presence of detectors in homes.

A high percentage of inoperative smoke detectors in households had dead batteries, or missing or disconnected batteries or AC power sources. Many respondents forgot to replace batteries, or were unaware that batteries were missing or disconnected. A significantly higher percentage of battery-powered detectors was inoperative than was found for those powered by AC. Over half

of all respondents reported the detectors had alarmed when there was no fire, and such nuisance alarms were also a major reason for missing or disconnected power sources. It appears that future efforts, addressing both smoke detector design and increased consumer awareness of proper installation and selection of smoke detectors, could lead to decreased likelihood of nuisance alarms, with an associated decrease in intentional disconnection of power sources.

Appendix A.
Survey Questionnaire

We are asking people in your community a few questions about their smoke detectors, and doing some simple tests to make sure the detectors work properly. If the batteries in your detector need to be replaced, we have new batteries to give out, free of charge. Also, if any of your smoke detectors do not work, we have new ones to replace them, again free of charge. As you probably know, properly operating smoke detectors can help protect you and your family in the event of a fire. We would like to collect any detectors that don't work and send them to the Consumer Product Safety Commission's lab to find out why they don't work. In addition, even if all of your detectors work I will give you a free smoke detector (SHOW DETECTOR) in appreciation for your participation in the survey.

.....

2. How many smoke detectors do you have in your home?

- | | | | | |
|-------------|------|----------------------|------|------|
| One | []1 | Five | []5 | |
| Two | []2 | More than Five | []6 | |
| Three | []3 | Don't know | []9 | |
| Four | []4 | | | (16) |

3. Do you or another member of your household own your home or do you rent?

- | | | | |
|------------------|------|--|------|
| Own | []1 | | |
| Rent | []2 | | |
| Don't know | []9 | | (17) |

3a. How long have you and your family lived in this (apartment/house)? Would that be... (READ LIST, CHECK ONLY ONE)

- | | | | | |
|-----------------------|------|-------------------------|------|------|
| Less than 6 months, . | []1 | 6 to 10 years, or | []5 | |
| 6 to 11 months, | []2 | 11 years or more? .. | []6 | |
| 1 to 5 years, | []3 | Don't know | []9 | (18) |

4. How many floors are there in your home? Include the basement if you have one, but don't include an unfinished attic.

- | | | | | |
|-------------|------|----------------------|------|------|
| One | []1 | Five | []5 | |
| Two | []2 | More than Five | []6 | |
| Three | []3 | Don't know | []9 | |
| Four | []4 | | | (19) |

5. When was this (house/building) built? Was it ... (READ LIST, CHECK ONLY ONE)

- | | | | | |
|---------------------|------|----------------------|------|------|
| 1990 or later | []1 | 1950's | []6 | |
| 1985 to 1989 | []2 | 1940's or | []7 | |
| 1980 to 1984 | []3 | before 1940 | []8 | |
| 1970's | []4 | (DO NOT | | |
| 1960's | []5 | READ)-> Don't know . | []9 | (20) |

10. Why do you think the detector went off when there was no fire? (DO NOT READ LIST, CHECK ALL THAT APPLY)

- Cooking []1
 - Fireplace []2
 - Tobacco []3
 - Steam from Bathroom []4
 - Low Battery []5
 - Other (Specify) _____ []6
 - Don't know/no apparent reason []9
- (36-42)

11. When was the last time you or someone else tested the smoke detector(s) in your current home? (READ LIST, CHECK ONLY ONE)

- within the last week, []1
 - within the last month, []2
 - within the last 6 months, []3
 - within the last year, []4
 - more than one year, or []5
 - (DO NOT never? []6
 - READ)-> don't know []9
- (43)

Now I'd like to test your smoke detector(s) to make sure that they are working properly. Would you show me the first smoke detector?

Perform tests, record observations for/ask respondent questions 12 - 28. Use 1 questionnaire for each household; ask questions 12 - 28 for detector #1 before going to detector #2, continue for all detectors. If more than 5 detectors in the household, ask questions and test each one and note answers/observations in margins.

If respondent volunteers that the detector has no batteries or power,
DO NOT TEST DETECTOR -> (SKIP TO Q.14.)

Detector # 1 [] 2 [] 3 [] 4 [] 5 []

(44-48)

14. (OBSERVE) Is this detector wall-mounted or ceiling mounted?

Detector #	1	2	3	4	5	
Wall-mounted	1	1	1	1	1	
Ceiling-mounted	2	2	2	2	2	
Other/Unknown/don't know	9	9	9	9	9	(59-63)

15. (OBSERVE) What type of power supply does the detector have? (REMOVE COVER OR REMOVE FROM WALL/CEILING AS NECESSARY)

Detector #	1	2	3	4	5	
Battery-only	1	1	1	1	1	
AC/ Hard wire	2	2	2	2	2	
AC/ Plug-in (with cord) ..	3	3	3	3	3	
Combo AC/battery backup	4	4	4	4	4	
Undetermined	9	9	9	9	9	(64-68)

16. (OBSERVE) Does the detector have a radioactive material label or marking, either on the enclosure or inside?

Detector #	1	2	3	4	5	
Yes	1	1	1	1	1	
No	2	2	2	2	2	
Don't know	9	9	9	9	9	(69-73)

17. (OBSERVE) Does the detector have 2 test buttons?

Detector #	1	2	3	4	5	
Yes	1	1	1	1	1	
No	2	2	2	2	2	
No test buttons	3	3	3	3	3	(73-77)

(78 Open)
1-80

18. (OBSERVE) Note all identifying information:

Detector #	<u>Brand Name</u>	<u>Model #</u>	<u>UL Issue #</u>	<u>UL Control #</u>
# 1.	_____	_____	_____	_____
# 2.	_____	_____	_____	_____
# 3.	_____	_____	_____	_____
# 4.	_____	_____	_____	_____
# 5.	_____	_____	_____	_____

IF YES OR NO IN Q. 20

- Press and hold test button(s) one at a time. Only press test buttons.
- If button is marked "Push to Test" (or contains radioactive materials) hold the test button for a maximum of 10 seconds to test operability.
- If button is marked "Push and hold to test" (or does not contain radioactive materials) hold the button a maximum of 30 seconds to test operability.

21. (OBSERVE) Did the detector sound in response to the test button?

Detector #	1	2	3	4	5
Yes (all buttons)	1	1	1	1	1
No (all buttons) (Label)	2	2	2	2	2
2 buttons, only 1 worked (Label)	3	3	3	3	3
No test button on unit	4	4	4	4	4

21a. (OBSERVE) Note condition of detector as you found it. (CIRCLE AS MANY AS APPLY)

Detector #	1	2	3	4	5
Missing Battery	1	1	1	1	1
Battery in Detector but Disconnected ..	2	2	2	2	2
Dead Battery	3	3	3	3	3
Disconnected from AC Power	4	4	4	4	4
Missing Cover	5	5	5	5	5
Insects/Cobwebs	6	6	6	6	6
Clogged with Dust/Dirt	7	7	7	7	7
Located within 1 foot of wall/ceiling meeting, or inside corner of 2 walls ..	8	8	8	8	8
Located within 5 feet of air duct or vent (ignore doors & windows)	9	9	9	9	9
Located on cathedral ceiling	0	0	0	0	0
None of the above	X	X	X	X	X
Other (Specify:)	R	R	R	R	R

Detector # 1 Specify _____

Detector # 2 Specify _____

Detector # 3 Specify _____

Detector # 4 Specify _____

Detector # 5 Specify _____

(5-59)
(5-9)

24a. (READ) Why do you think: (IF BATTERY OPERATED: SAY "the battery was (missing/disconnected)?" OR IF AC POWERED: SAY "the power was disconnected?" (DO NOT READ LIST. CIRCLE ALL THAT APPLY.)

Detector #	1	2	3	4	5	
Forgot to replace	1	1	1	1	1	
Removed, nuisance	2	2	2	2	2	
Alarmed continuously with power .	3	3	3	3	3	
Removed, needed elsewhere	4	4	4	4	4	
Never looked	5	5	5	5	5	
Don't know	6	6	6	6	6	
Other (specify)	7	7	7	7	7	(25-59)

Detector # 1 Specify _____

Detector # 2 Specify _____

Detector # 3 Specify _____

Detector # 4 Specify _____

Detector # 5 Specify _____

• If battery was dead in Q. 23 and no chirp was heard in Q. 22. LABEL FOR COLLECTION.

• If YES in Q. 24 and "Removed, nuisance" in Q. 24a. LABEL FOR COLLECTION.

25. (READ) Have you had any problems with this detector?

Detector #	1	2	3	4	5	
Yes (LABEL FOR COLLECTION) ...	1	1	1	1	1	
No ->(SKIP TO BOX BEFORE Q. 27)	2	2	2	2	2	(65-69)

(70-78 Open)
7-80

27. (READ) It is important that we determine why smoke detectors don't work.

IF BATTERY: I would like to collect this smoke detector and . . .

IF AC POWER: I would like to give you this box so you can . . .

. . . send it to the U.S. Consumer Product Safety Commission's lab for analysis to find out why it does not work properly. I am able to offer \$25 to reimburse you for this smoke detector and to install a replacement detector. We will provide you with a free replacement detector. (May I collect this detector/Would you send this detector to the Consumer Product Safety Commission)?

Detector #	1	2	3	4	5
Yes (REMOVE DETECTOR/GIVE BOX THEN CONTINUE)	1	1	1	1	1
No (GIVE REPLACEMENT DETECTOR AND SKIP TO Q. 28)	2	2	2	2	2
					(10-14)

CAREFULLY PACKAGE DETECTOR

27a. (AFTER SMOKE DETECTOR HAS BEEN REMOVED/BOX GIVEN; SAY:) Here is a replacement smoke detector. I'm going to test it now to be sure it works.

PERFORM BUTTON TEST:

- If detector alarms, give respondent replacement detector
- If detector does not alarm, select & test another detector.

Here is \$25 to reimburse you for your old detector and for any costs you might encounter in installing this new detector. Please read and sign the following statement to acknowledge that you received the \$25. **HAND RESPONDENT ACKNOWLEDGEMENT A.**

28. NOTE ACTION TAKEN: (CIRCLE ALL THAT APPLY) (15-69)
(70-78 Open)
8-80

Detector #	1	2	3	4	5
No action required	1	1	1	1	1
Replaced Battery/Restored Power . . .	2	2	2	2	2
Refused Battery replacement	3	3	3	3	3
Collected Detector (Left Replacement)	4	4	4	4	4
Advised Replacement (AC/hard wired)	5	5	5	5	5
Replacement refused/could not replace (battery models)	6	6	6	6	6
					(5-34)

**Be sure each detector collected is labeled with detector number and Sample ID.
Make sure all replacement detectors have been tested and are working properly.**

SAY: And may I have your telephone number for validation purposes?

Phone # () _____ (43-52)

SAY: Thank you, here is your free smoke detector for your time and cooperation in this study.

IF SAMPLE COLLECTED, SAY: "Someone from the U.S. Consumer Product Safety Commission may wish to contact you to follow-up for more information, in which case you would be told about laboratory analysis results for collected samples. Could I have your name and address in case CPSC needs to contact you for more information?"

CHECK HERE IF PERMISSION GIVEN FOR FOLLOW-UP CONTACT (53)

Name _____

Address _____
