



NBS TECHNICAL NOTE **850**

U.S. DEPARTMENT OF COMMERCE / National Bureau of Standards

# Gasoline and Gasoline Container Fire Incidents

QC

100

.U5753

NO. 850

1975

C.2

## NATIONAL BUREAU OF STANDARDS

The National Bureau of Standards<sup>1</sup> was established by an act of Congress March 3, 1901. The Bureau's overall goal is to strengthen and advance the Nation's science and technology and facilitate their effective application for public benefit. To this end, the Bureau conducts research and provides: (1) a basis for the Nation's physical measurement system, (2) scientific and technological services for industry and government, (3) a technical basis for equity in trade, and (4) technical services to promote public safety. The Bureau consists of the Institute for Basic Standards, the Institute for Materials Research, the Institute for Applied Technology, the Institute for Computer Sciences and Technology, and the Office for Information Programs.

**THE INSTITUTE FOR BASIC STANDARDS** provides the central basis within the United States of a complete and consistent system of physical measurement; coordinates that system with measurement systems of other nations; and furnishes essential services leading to accurate and uniform physical measurements throughout the Nation's scientific community, industry, and commerce. The Institute consists of a Center for Radiation Research, an Office of Measurement Services and the following divisions:

Applied Mathematics — Electricity — Mechanics — Heat — Optical Physics — Nuclear Sciences<sup>2</sup> — Applied Radiation<sup>2</sup> — Quantum Electronics<sup>3</sup> — Electromagnetics<sup>3</sup> — Time and Frequency<sup>3</sup> — Laboratory Astrophysics<sup>3</sup> — Cryogenics<sup>3</sup>.

**THE INSTITUTE FOR MATERIALS RESEARCH** conducts materials research leading to improved methods of measurement, standards, and data on the properties of well-characterized materials needed by industry, commerce, educational institutions, and Government; provides advisory and research services to other Government agencies; and develops, produces, and distributes standard reference materials. The Institute consists of the Office of Standard Reference Materials and the following divisions:

Analytical Chemistry — Polymers — Metallurgy — Inorganic Materials — Reactor Radiation — Physical Chemistry.

**THE INSTITUTE FOR APPLIED TECHNOLOGY** provides technical services to promote the use of available technology and to facilitate technological innovation in industry and Government; cooperates with public and private organizations leading to the development of technological standards (including mandatory safety standards), codes and methods of test; and provides technical advice and services to Government agencies upon request. The Institute consists of a Center for Building Technology and the following divisions and offices:

Engineering and Product Standards — Weights and Measures — Invention and Innovation — Product Evaluation Technology — Electronic Technology — Technical Analysis — Measurement Engineering — Structures, Materials, and Life Safety<sup>4</sup> — Building Environment<sup>4</sup> — Technical Evaluation and Application<sup>4</sup> — Fire Technology.

**THE INSTITUTE FOR COMPUTER SCIENCES AND TECHNOLOGY** conducts research and provides technical services designed to aid Government agencies in improving cost effectiveness in the conduct of their programs through the selection, acquisition, and effective utilization of automatic data processing equipment; and serves as the principal focus within the executive branch for the development of Federal standards for automatic data processing equipment, techniques, and computer languages. The Institute consists of the following divisions:

Computer Services — Systems and Software — Computer Systems Engineering — Information Technology.

**THE OFFICE FOR INFORMATION PROGRAMS** promotes optimum dissemination and accessibility of scientific information generated within NBS and other agencies of the Federal Government; promotes the development of the National Standard Reference Data System and a system of information analysis centers dealing with the broader aspects of the National Measurement System; provides appropriate services to ensure that the NBS staff has optimum accessibility to the scientific information of the world. The Office consists of the following organizational units:

Office of Standard Reference Data — Office of Information Activities — Office of Technical Publications — Library — Office of International Relations.

<sup>1</sup> Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.

<sup>2</sup> Part of the Center for Radiation Research.

<sup>3</sup> Located at Boulder, Colorado 80302.

<sup>4</sup> Part of the Center for Building Technology.

3 1977

# Gasoline and Gasoline Container Fire Incidents

Technical note, no. 850

Elaine A. Tyrrell

Programmatic Center for Fire Research  
Institute for Applied Technology  
National Bureau of Standards  
Washington, D.C. 20234



---

U.S. DEPARTMENT OF COMMERCE, Frederick B. Dent, Secretary

NATIONAL BUREAU OF STANDARDS, Richard W. Roberts, Director

Issued January 1975

Library of Congress Catalog Card Number: 74-600163

National Bureau of Standards Technical Note 850

Nat. Bur. Stand. (U.S.), Tech. Note 850, 34 pages (Jan. 1975)

CODEN: NBTNAE

U.S. GOVERNMENT PRINTING OFFICE  
WASHINGTON: 1975

---

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402  
(Order by SD Catalog No. C13.46:850).

Price 85 cents

# CONTENTS

	page
1. INTRODUCTION . . . . .	1
2. DATA COLLECTION PROCEDURE. . . . .	2
3. FINDINGS . . . . .	4
3.1. Age and Sex of Persons Involved. . . . .	4
3.2. Gasoline Incidents . . . . .	9
3.2.1. Ignition-Causing Activities For Gasoline Incidents . . . . .	9
3.2.2. Major Ignition-Causing Activities For Gasoline Incidents . . . . .	11
3.2.3. Ignition Sources For Gasoline Incidents . . . . .	12
3.2.4. Major Ignition Sources For Gasoline Incidents . . . . .	14
3.3. Gasoline Container-Related Incidents . . . . .	15
3.3.1. Container Description For Gasoline Container-Related Incidents. . . . .	15
3.3.2. Ignition-Causing Activities For Gasoline Container-Related Incidents	17
3.3.3. Ignition Sources For Gasoline Container-Related Incidents. . . . .	20
3.4. Gasoline Can Incidents . . . . .	21
4. CONCLUSIONS. . . . .	23
5. RECOMMENDATIONS. . . . .	24
APPENDIX A. THE FLAMMABLE FABRICS ACCIDENT CASE AND TESTING SYSTEM (FFACTS). . . . .	26
APPENDIX B. SYSTEM DEvised FOR OBTAINING ADDITIONAL INFORMATION FROM FFACTS CONCERNING GASOLINE AND GASOLINE CONTAINER-RELATED INCIDENTS . . . . .	27



## GASOLINE AND GASOLINE CONTAINER FIRE INCIDENTS

Elaine A. Tyrrell

Gasoline was involved in 72 percent of the 645 volatile flammable liquids fire incidents found in the NBS Flammable Fabrics Accident Case and Testing System as of December 1973. These gasoline incidents, particularly those that were container-related, were studied in detail. Male victims out-numbered females approximately 5 to 1. Both males and females, ages 6-20, were injured more frequently than would have been expected if the incidents for each sex had been distributed uniformly over all age groups. Starting or tending an open fire caused ignitions most frequently and involved primarily males ages 13-45. Children were injured most from knocking over or dropping a container of gasoline close to an ignition source and playing with gasoline and an ignition source. Matches were the most frequent ignition source. Containers ranged from large gasoline cans to kitchen measuring cups, although gasoline cans were reported most often. The youngest children were involved most with some of the largest containers. The remaining victims were involved primarily with smaller, more easily managed containers. There was no indication that the gasoline containers, by themselves, contributed substantially to these incidents. The problem was one of human error - misuse or abuse of the gasoline, the container, or both.

Key words: Accidents; FFACTS; gasoline; gasoline containers; gasoline incidents; gasoline-related fires; ignition-causing activities; ignition sources; volatile flammable liquids; volatile flammable liquids incidents.

### 1. INTRODUCTION

Among some of the current problems associated with gasoline shortages and accompanying price increases are the tendencies of consumers to hoard gasoline. An increasing number of accidents associated with the storage and usage of this fuel are being reported via the news media.

Last year, an estimated 24,600 people<sup>1</sup> sought hospital emergency room attention for injuries sustained from flammable liquids. Approximately 60 percent of these injuries were attributable to gasoline.

The Flammable Fabrics Accident Case and Testing System (FFACTS)<sup>2</sup> at the National Bureau of Standards (NBS) was searched for fire incidents involving gasoline with the knowledge that data collected for this system is flammable fabrics oriented and, therefore, any information pertaining to the causal effects of flammable liquids or flammable liquid containers may be biased. In a FFACTS data base of 3,043 cases as of December 1973, 668 victims were involved in 645 separate incidents<sup>3</sup> in which intermediary materials<sup>4</sup> in the form of volatile flammable liquids were present in the ignition sequence. Gasoline represented 72 percent of these flammable liquids.

Because gasoline represents a high proportion of the flammable liquids cases in FFACTS and because of an increasing concern for how this short-supply fuel is being used and stored by the consumer, an in-depth investigation was made of the gasoline incidents. Special emphasis was given to those gasoline incidents that were container-related, that is, incidents in which the containers were causally involved in the ignition sequence. The objective of this investigation was to determine if any patterns or trends exist which may aid in the reduction or elimination of some of these accidents.

## 2. DATA COLLECTION PROCEDURE

In table 1, a breakdown of the volatile flammable liquids is shown for the 645 incidents. Of the 462 gasoline incidents, 10 incidents were described as involving white (unleaded) gasoline. In these 10 incidents, it was noted that the flammable liquid involved was a product packaged, labeled, and sold specifically for use as a fuel for camping equipment. These incidents were excluded from the study. The remaining 452 gasoline incident case histories were collected and studied in detail.

---

<sup>1</sup>This is an estimated number of injuries for calendar year 1973 based on flammable liquid accident reports from the 119 hospitals participating in the National Electronic Injury Surveillance System (NEISS).

<sup>2</sup>See Appendix A for a description of the FFACTS data base.

<sup>3</sup>An incident is defined as a single ignition from a single heat source which may involve one or more fabric items and/or persons.

<sup>4</sup>An intermediary material is a non-fabric item which is ignited by the ignition source and in turn ignites fabric items thereby forming a link in the causality chain.



Table 1. Volatile Flammable  
Liquids Incidents in FFACTS  
(FFACTS, December 1973)

Flammable Liquid	Number of Incidents	Percent of Incidents	
Gasoline	462	72	
Lighter Fluid	36	6	
Alcohol	27	4	
Paint Thinner	23	4	
Solvents	13	2	
Adhesives	13	2	
Kerosene	11	2	
Flammable Liquids (Unspecified)	11	2	
Oils	8		
Fuel	8		
Turpentine	5		
Charcoal/Starter Fluid	5		
Cleaning Fluid	5		
Paint	5		
Mix of Chemicals	4		6
Acetone	2		
Shellac	2		
Hair Spray	2		
Window De-Icer	1		
Antifreeze	1		
Fabric Softener	1		
Total	645	100	

From a review of these case histories it was noted that they often contained specific information regarding the container itself and the victim's activity with respect to the container prior to the ignition, as well as information about the container during the ignition sequence. None of this information can be retrieved from the computerized data file. It was observed that patterns involving the above cited parameters appeared repeatedly in these incidents which suggested that categorization of container types and container-related activities leading up to the ignition might be possible.

A system<sup>1</sup> was devised for obtaining this information from the 452 gasoline-related incidents. The following sections of

<sup>1</sup>See Appendix B for a description of this system.

this report describe the findings of this system as well as the involvement of the primary victim<sup>1</sup> for each of these incidents.

### 3. FINDINGS

#### 3.1. Age and Sex of Persons Involved

The age and sex distribution of the primary victims involved in the FFACTS 452 gasoline incidents are shown in table 2. A subset of these data was obtained which represents the gasoline container-related incidents, from which gasoline can incidents (cans designed specifically for containing gasoline) were determined. These groups of data are shown in table 2 also. For purposes of analysis, the victim population was divided into six age groups which roughly represent six types of behavior patterns. The age groups represent infants and toddlers, ages 0-5; children, ages 6-12; youth, ages 13-20; young adults, ages 21-45; adults, ages 46-65; and the elderly, age 66 and over.

Table 2. Age and Sex Distribution of Persons Involved in Gasoline, Gasoline Container-Related, and Gasoline Can Incidents (FFACTS, December 1973)

Age Group	Gasoline Incidents			Container-Related Incidents			Gasoline Can Incidents		
	M	F	Total	M	F	Total	M	F	Total
0-5	22	12	34	21	11	32	6	2	8
6-12	90	18	108	66	16	82	8	4	12
13-20	100	12	112	57	7	64	9	1	10
21-45	102	13	115	52	9	61	8	0	8
46-65	55	11	66	21	6	27	3	0	3
66+	12	3	15	6	0	6	0	0	0
Total Known	381	69	450	223	49	272	34	7	41
Unknown	2	-	2	1	-	1	-	-	-
Total	383	69	452	224	49	273	34	7	41

<sup>1</sup>The primary victim is defined as the person who was most involved in the causality chain with the most important role being that of sustaining an injury. If there were no injuries reported, then the primary victim became the person who initiated the fire or was in some way directly involved.

As can be seen from these data, males outnumbered females approximately 5 to 1 in all three groups of incidents. In addition, the age distributions are roughly similar for all three groups of incidents. For a more realistic discussion of these data, the gasoline incidents were separated by sex and the total number of victims for each sex was redistributed over the six age groups<sup>1</sup> in proportion to their representation in the U.S. population. These data are shown in table 3. The resulting distributions indicate the number of victims which might be expected for each age group if these gasoline incidents had been distributed uniformly over all age groups.

Table 3. Age Distribution by Sex of Persons Involved in Gasoline Incidents vs. Age Distributions For the U.S. Population (FFACTS, December 1973)

a. Males

Age Group	Number of Victims	Percent of U.S. Population <sup>a</sup>	Expected Number of Victims Based on Population Percentage
0-5	22	11	42
6-12	90	15	57
13-20	100	16	61
21-45	102	31	118
46-65	55	19	72
66+	12	8	31
Total	381	100	381

b. Females

Age Group	Number of Victims	Percent of U.S. Population <sup>a</sup>	Expected Number of Victims Based on Population Percentage
0-5	12	10	7
6-12	18	13	9
13-20	12	15	10
21-45	13	31	21
46-65	11	20	14
66+	3	11	8
Total	69	100	69

<sup>a</sup>Figures are based on 1970 U.S. Bureau of the Census statistics.

<sup>1</sup>The two male victims of unknown age were excluded from table 3.

A visual representation of these data is given in figure 1 and figure 2. In figure 1, the histograms represent the number of victims reported for the gasoline incidents found in FFACTS. The number of victims which might be expected for each age group (if the incidents were distributed uniformly over the age groups in proportion to their representation in the U.S. population) are superimposed over the histograms. In figure 2, the histograms represent the number of victims reported for all three types of gasoline-related incidents in FFACTS.

For the gasoline incidents, males in the 6-12 and 13-20 age groups were injured far more frequently than would have been expected for their age groups if the incidents were distributed randomly over the male population. Being of an age for "experimentation," males in the 6-12 age group were found to be injured most frequently from playing with gasoline and an ignition source. Having gained in sophistication, males in the 13-20 age group were injured most frequently from starting or tending open fires (type 1 and type 2)<sup>1</sup> - activities which might still be considered as play activities in some instances even though they may have been assigned chores.

Although males in the 21-45 age group were represented more often than all other age groups in the FFACTS data, this age group also represents the largest portion of the male population among the six age groups used throughout this paper. Hence, males in this age group were injured about as frequently as would have been expected if the 381 gasoline incidents involving males were distributed uniformly across the male population. These victims were involved primarily with starting or tending open fires type 1 and priming carburetors.

In all three groups of incidents - gasoline, container-related, and gasoline can incidents - males between the ages of 6 and 65 were injured most often with a marked decline in injuries for the very young and the elderly. This roughly follows the developmental patterns one might expect for the previously defined six age groups.

Females represented only 18 percent of the victims in the FFACTS gasoline incidents, but their distribution in the three groups of incidents is similar to that for the males. Females in the 0-5, 6-12, and 13-20 age groups were injured most frequently in proportion to their respective representation in the female population. Possible explanations for the small frequency of female involvement in gasoline incidents will be discussed in later sections.

<sup>1</sup>Type 1 fire refers to any open fire which is contained in a receptacle designed for a fire (i.e., charcoal grill, camp fire, fireplace, incinerator, etc.). Type 2 fire refers to any open fire which has been started on the ground in an open area (i.e., bonfire, fire to clear trash, leaves, or other debris, etc.).

FIGURE I. MALE AND FEMALE AGE DISTRIBUTIONS FOR GASOLINE INCIDENTS AND FOR THE U.S. POPULATION  
(Expected Number of Victims Superimposed)

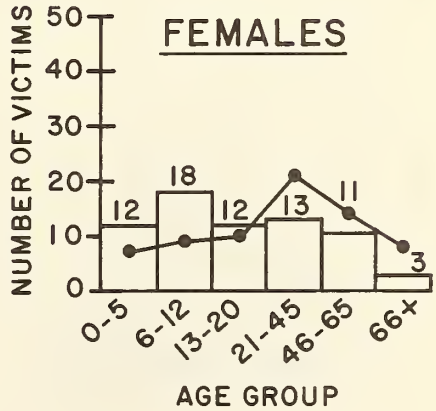
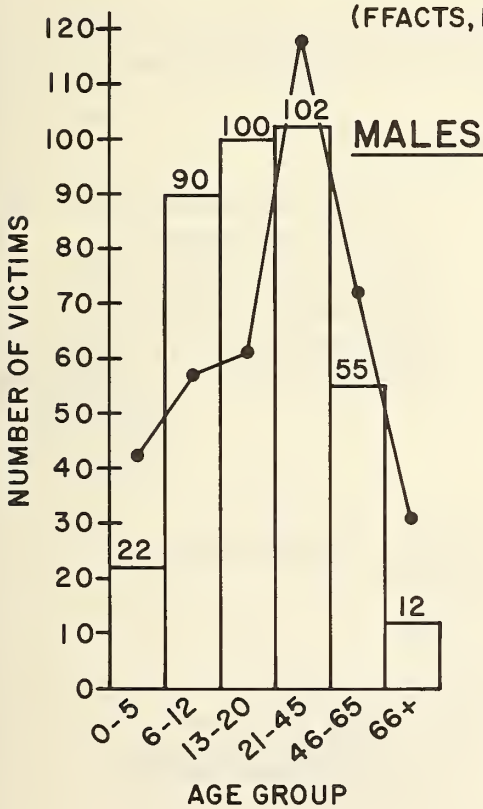
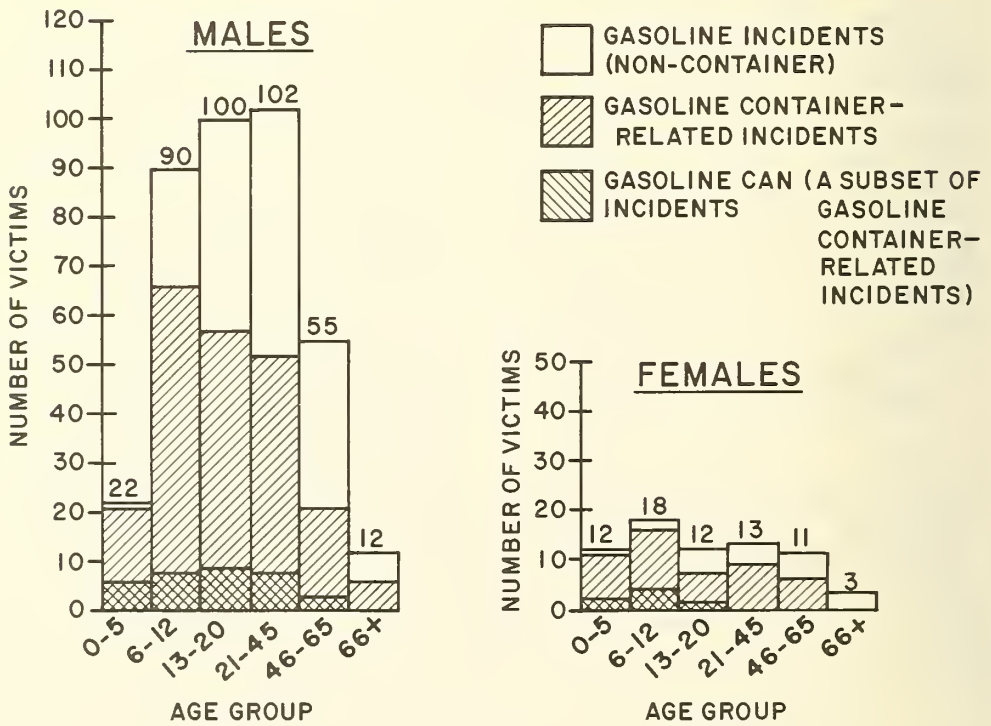


FIGURE 2. MALE AND FEMALE INVOLVEMENT IN GASOLINE INCIDENTS, CONTAINER-RELATED INCIDENTS, AND GASOLINE CAN INCIDENTS BY AGE GROUPS

(FFACTS, December 1973)



## 3.2. Gasoline Incidents

### 3.2.1. Ignition-Causing Activities For Gasoline Incidents

In classifying the gasoline incidents by the activity which led to the accident, it was observed that several of the activity classifications previously determined might apply to any one given incident. Therefore, the activity that most closely identified with the ignition sequence was selected for these incidents. The activity thus coded may not necessarily indicate the activity of the primary victim representing the incident. These ignition-causing activities are shown in table 4.

Starting or tending an open fire type 1 represented 68 (15 percent) of the gasoline incidents. In comparison, 54 (12 percent) of the incidents were the result of playing with gasoline and an ignition source; 40 (9 percent) of the incidents were the result of knocking over or dropping a container of gasoline in the presence of an ignition source; 39 (9 percent) of the incidents were the result of starting or tending an open fire type 2; and 37 (8 percent) were the result of cleaning or repairing machinery or equipment.

Using gasoline as a cleaning agent meant the removal of tar, paint, etc. from floors, counter tops, paint brushes, etc.; driving or riding in a vehicle generally involved a collision; using work tools referred to those tools which generate heat or sparks such as soldering irons and drills; and using gasoline as an exterminating agent meant using this volatile liquid to drown or burn out insects or their nests.

Males and females in the 0-5 age group were frequently involved in incidents caused by knocking over or dropping a container of gasoline in the presence of an ignition source with 4 incidents being reported for the males and 6 incidents being reported for the females which represent half of the female injuries for this age group. Males in this age group were involved equally as often in incidents caused by spilling or splashing gasoline on themselves prior to the ignition and playing with gasoline in the presence of an ignition source. The ignition source for these activities were generally hot water heaters or matches. Males and females in the 6-12 age group were the chief victims of incidents caused by playing with both gasoline and an ignition source which often involved open fires, incinerators, camp fires, etc. Thirty-three of the 90 males and 8 of the 18 females were injured as a result of this activity, which represents 77 percent of the injuries for the age group.

Table 4. Ignition-Causing  
Activities For Gasoline Incidents  
(FFACTS, December 1973)

Activity	Number of Incidents	Percent of Total Incidents
Starting or tending an open fire type 1 <sup>a</sup> . . . . .	68	15
Playing with gasoline and ignition source . . . . .	54	12
Knocking over or dropping container of gasoline . . . . .	40	9
Starting or tending an open fire type 2 <sup>a</sup> . . . . .	39	9
Cleaning or repairing machinery. . . . .	37	8
Priming carburetor . . . . .	33	7
Spilling or splashing gasoline . . . . .	32	7
Using gasoline as cleaning agent . . . . .	27	6
Driving or riding in vehicle . . . . .	15	3
Using work tools . . . . .	14	3
Refueling power machinery and vehicles . . . . .	12	3
Playing with gasoline. . . . .	9	2
Using gasoline as exterminating agent. . . . .	8	2
Using matches or lighter . . . . .	8	2
Transferring gasoline. . . . .	6	
Unknown. . . . .	6	
Standing near gasoline . . . . .	6	
Stirring, stomping or disturbing an open fire . . . . .	5	
Carrying or transporting gasoline. . . . .	5	
Using machinery or equipment . . . . .	4	
Playing with matches or lighter. . . . .	4	
Smoking. . . . .	4	12
Using gasoline to ignite a heating source . . . . .	3	
Standing by an open fire . . . . .	3	
Assault/suicide. . . . .	3	
Helping another person involved in incident . . . . .	2	
Suspected arson. . . . .	2	
Standing near ignition source. . . . .	2	
Warming self . . . . .	1	
Total . . . . .	452	100

<sup>a</sup>Starting or tending an open fire type 1 refers to any open fire which is contained in a receptacle designed for a fire. Starting or tending an open fire type 2 refers to any open fire which has been started on the ground in an open area.



Males in the 13-20 and 21-45 age groups were involved most frequently in starting or tending fires. For males in the 13-20 age group, this frequently meant open fires followed by incinerator fires. Males in the 21-45 age group, however, were heavily involved in charcoal grill fires. Priming carburetors was the second most frequently reported activity for males in the 21-45 age group.

Males in the 46-65 age group were injured most frequently while involved in machinery and equipment-related activities. Ten incidents were reported where cleaning or repairing machinery was involved and 7 incidents were reported where priming carburetors was the activity which led to an ignition.

Starting or tending an open fire type 1 was the activity reported as causing the most injuries to females ages 13-65 with charcoal grills being reported most frequently. For females in the 13-20 and 21-45 age groups, this activity was followed in frequency of occurrence by that of using gasoline as a cleaning agent.

The elderly, both male and female, were involved in accidents most frequently while burning trash, leaves, or other debris in an open area. The males were involved equally as often in incidents caused by cleaning or repairing machinery.

### 3.2.2. Major Ignition-Causing Activities For Gasoline Incidents

Many of the activities discussed above can be regrouped roughly into four major activities as seen in table 5. Being involved with an open fire, which includes starting or tending an open fire types 1 and 2, stirring, stomping or disturbing an open fire, and standing by an open fire, represents 115 (25 percent) of the incidents. Being involved with machinery, equipment, or tools, which includes cleaning or repairing machinery, priming a carburetor, using work tools, refueling equipment, and using machinery or equipment, represents 100 (22 percent) of the incidents. A physical action involving gasoline, which includes knocking over or dropping a container of gasoline, spilling or splashing gasoline, transferring gasoline, and carrying or transporting gasoline, represents 83 (18 percent) of the incidents. Playing with gasoline, an ignition source, or both, represents 67 (15 percent) of the incidents.

Many of the injuries sustained as a result of these activities probably could have been alleviated if a more appropriate product had been used instead of gasoline. Many less volatile products are sold expressly as fire-starting fuels, solvents, etc. Storage of these less volatile products possibly could have lessened the number and extent of injuries sustained

Table 5. Major Ignition-Causing Activities For Gasoline Incidents (FFACTS, December 1973)

Activity	Number of Incidents	Percent of Total Incidents
Being involved with an open fire	115	25
Being involved with machinery, equipment, or tools	100	22
A physical action involving gasoline	83	18
Playing with gasoline, an ignition source, or both	67	15
All others	87	20
Total	452	100

by children who played with the highly volatile gasoline they found stored for some of these activities.

### 3.2.3. Ignition Sources For Gasoline Incidents

The ignition sources for the gasoline incidents are tabulated in table 6. Matches were involved most frequently, being represented in 87 (19 percent) of the 452 gasoline incidents. Combustion engines were the second most frequently reported ignition source, being reported in 65 (14 percent) of the incidents, followed by hot water heaters, representing 48 (11 percent) of the incidents; open fires, representing 44 (10 percent) of the incidents; charcoal grills, representing 33 (7 percent) of the incidents; and incinerators, representing 32 (7 percent) of the incidents.

Hot water heaters and matches were the most frequent ignition sources for both sexes in the 0-5 age group with 8 and 6 incidents, respectively, being reported for the males and 3 and 2 incidents, respectively, being reported for the females. This represents 64 percent of the males and 42 percent of the females in the age group. The water heater incidents generally involved knocking over a gasoline container near the ignition source while the match incidents were primarily "playing with matches" incidents. Males in the 6-12 age group were involved most frequently in accidents where matches were the ignition source. Matches represented 38 percent of the ignitions involving these males. The second most frequent

ignition source for males in this age group was open fires. Matches and open fires were also the most frequent ignition sources for females in the 6-12 age group.

Table 6. Ignition Sources For Gasoline Incidents  
(FFACTS, December 1973)

Ignition Source	Number of Incidents	Percent of Total Incidents
Matches. . . . .	87	19
Combustion Engine. . . . .	65	14
Hot Water Heater . . . . .	48	11
Open Fire . . . . .	44	10
Charcoal Grill . . . . .	33	7
Incinerator. . . . .	32	7
Unknown. . . . .	23	5
Camp fire . . . . .	15	3
Cutting/Welding Torch & Other Ignition Source Equipment. . . . .	12	3
Space Heater . . . . .	11	2
Hot Coals or Smoldering Sticks . . . . .	10	2
Furnace . . . . .	9	2
Gas Range or Oven. . . . .	9	2
Miscellaneous. . . . .	7	2
Cigarettes . . . . .	7	2
Other Work Tools . . . . .	6	-----  9
Electrical Wiring . . . . .	5	
Sparks and Shorts . . . . .	5	
Light Bulbs . . . . .	4	
Fireplace . . . . .	4	
Other Appliances . . . . .	3	
Lantern/Candle . . . . .	3	
Lighter . . . . .	3	
Matches or Lighter . . . . .	2	
Other Heaters. . . . .	1	
Clothes Dryer. . . . .	1	
Camp Stove . . . . .	1	
Extension Cord . . . . .	1	
Fireworks . . . . .	1	
<b>TOTAL</b>	<b>452</b>	

Matches and open fires were the most frequent ignition sources reported for males in the 13-20 age group representing 20 and 12, respectively, of the incidents. Combustion engines were reported most frequently as the ignition source for males in the 21-45 and 46-65 age groups. For males ages 21-45 this meant primarily priming carburetors. For males ages 46-65 this involved cleaning or repairing machinery most frequently. For the males in the 21-45 age group, carburetor-priming was followed by charcoal grills.

Females in the 13-20 age group were involved with hot water heaters most frequently. Females ages 21-65 were involved with charcoal grills most frequently. In addition, females in the 21-45 age group were often involved with space heaters and females in the 46-65 age group were often involved with hot water heaters, cigarettes, and matches.

### 3.2.4. Major Ignition Sources For Gasoline Incidents

Although some 27 different ignition sources have been identified, 81 percent of the 452 gasoline incidents occurred as the result of 4 major types of ignition sources which appear in table 7. Open fires, which include charcoal grills, incinerators, camp fires, furnaces and fireplaces, represent 30 percent of the ignitions; matches and lighters represent 20 percent; hot water heaters and other appliances, which include space heaters, gas ranges or ovens, light bulbs, a clothes dryer, and a camp stove, represent 17 percent, and combustion engines represent 14 percent.

Table 7. Major Ignition Sources For Gasoline Incidents  
(FFACTS, December 1973)

Ignition Source	Number of Incidents	Percent of Total Incidents
Open Fires	137	30
Matches and Lighters	92	20
Hot Water Heaters and Other Appliances	78	17
Combustion Engines	65	14
All Others	80	19
Total	452	100

Open fires and matches and lighters, which were the most frequent ignition sources, were generally found to entail a similar sequence of events. Gasoline either was poured onto the material to be ignited or was used to rekindle an existing fire. Under the first set of circumstances, a match or lighter was ignited which instantaneously ignited the highly volatile gasoline fumes. An explosion generally ensued. Under the second set of circumstances, hot coals or embers generally ignited the gasoline as it was being poured from the container, and the flames flashed back along the vapor stream to the container. In both sets of circumstances, the victims were reported to be engulfed in flames as the gasoline vapors had already surrounded and permeated their clothing.

Accidents caused by pilot lights from gas appliances and sparks from combustion engines igniting the gasoline with which the victims were involved, have similar ignition sequences. Although many of these ignition sources were being misused or abused at the time of the ignition, they could not have been changed or redesigned to make conditions safer for the victims of these incidents who were carelessly and often improperly using the highly volatile flammable liquid - gasoline.

### 3.3. Gasoline Container-Related Incidents

The trends described for the gasoline incidents were present generally in the 273 gasoline container-related incidents where a container description was also given.

#### 3.3.1. Container Description For Gasoline Container-Related Incidents

Of the 452 incidents involving gasoline, 273 were found where a container type was reported to have been involved in the ignition sequence. Although more than one container type may have been mentioned in the case history report, only the container that was in use at the time of or otherwise involved in the ignition sequence was coded. In table 8, the distribution of container types that were found in the gasoline incidents is given.

Gasoline cans, which included one-, two- and five-gallon gasoline cans, were involved in 41 (15 percent) of the 273 container-related incidents. This means that in 41 of the incidents, the container involved was actually referred to as a "gasoline can" or a can specifically designed for holding gasoline. If the case history referred to the container as a "can of gas," one-, two- or five-gallon can of gasoline, etc., it was considered inappropriate to presume that the container had been designed specifically for gasoline. These containers

Table 8. Distribution of Container Types  
in Gasoline Container-Related Incidents  
(FFACTS, December 1973)

Container Type	Number of Incidents	Percent of Total Incidents
Gasoline Can	41	15
Glass Container	37	14
Can (Unspecified)	35	13
Open Can	29	11
Coffee Can	26	10
Plastic Container (Unspecified)	23	8
Open, Shallow Pan	15	6
Cup	11	4
One-Gallon Can	9	3
Five-Gallon Can	8	3
Pail or Bucket	7	3
Oil Can	6	2
"Non-approved" Metal Can	4	2
Two-Gallon Can	3	
Paint Can	2	
Bowl	2	
Paint-roller Tray	2	
Three-Gallon Can	2	
Can with Spout	2	
Charcoal Lighter Fluid Spray Can	1	
Insecticide Spray Can	1	6
Tea Kettle	1	
Water Can	1	
Milk Can	1	
Thirty-Gallon Can	1	
Milk Can Lid	1	
"Rusty" Can	1	
Antifreeze Can	1	
Total	273	100

were coded under other classification listings. Therefore, the percentage of gasoline cans which were actually involved in an ignition sequence may be somewhat higher if it were known what percent of the containers classified under unspecified containers and various other classifications were gasoline cans.

Glass containers, which include pop and beer bottles, baby food jars, peanut butter jars, and Mason jars, were involved in 37 (14 percent) of the incidents. Open cans, which include tin cans, as well as cans designed specifically for food, juice, ham, lard, oysters and soda pop, were reported in 29 (11 percent) of the incidents. Coffee cans, primarily of the one-

or two-pound variety, were reported in 23 (8 percent) of the incidents.

Cups were generally paper or plastic, but occasionally a kitchen measuring cup was reported. Pails and buckets were made of a variety of materials including plastic.

Without exception, all of these containers were open at the time of the ignition, which, in fact, helped bring about the ignition in some instances. In most of the gasoline can incidents, the container was described as being primarily a storage receptacle. The rest of the containers, however, were viewed by the victims generally as being temporary receptacles chosen for easy maneuverability while using gasoline.

The youngest age group was involved most frequently with some of the largest containers. Of all the age groups, the 0-5 age group was involved most frequently with gasoline cans, which, for this age group, were designated generally as being one gallon in size. These small toddlers were also involved frequently with one- and two-pound coffee cans. This fact can best be understood when coupled with the most frequently reported activity for this age group which was knocking over or dropping containers of gasoline.

In contrast, the rest of the age groups were involved most frequently with smaller, more easily managed containers. For the 6-12 and 13-20 age groups this meant primarily glass containers which generally are readily found in the storage area of most homes. The remaining three age groups, which represent adults, were involved most frequently with open cans (i.e., food and juice cans) and coffee cans which probably were saved for a specific purpose by these victims as soon as the original contents had been emptied.

There was no indication in the FFACTS data that one type of container was more hazardous than another either by size, shape, material, or construction. All of the containers in these incidents had their inherent strengths and weaknesses based on these four components. The one feature common to all of these containers was that they were open at the time of the accident.

### 3.3.2. Ignition-Causing Activities For Gasoline Container-Related Incidents

As was observed for the gasoline incidents in general, several of the activity classifications could apply to any given incident in the 273 gasoline container-related incidents. Again, the activity that most closely identified with the gasoline container and the ignition sequence was chosen for

the incident in question which meant the activity selected may not indicate the activity of the primary victim of the incident. The ignition-causing activities for these gasoline container-related incidents are given in table 9.

Table 9. Ignition-Causing Activities  
in Gasoline Container-Related Incidents  
(FFACTS, December 1973)

Activity	Number of Incidents	Percent of Total Incidents
Starting or tending an open fire type 1. . . . .	57	21
Playing with gasoline and ignition source . . . . .	44	16
Knocking over/dropping container of gasoline . . . . .	40	15
Starting or tending an open fire type 2. . . . .	22	8
Priming carburetor. . . . .	18	7
Spilling or splashing gasoline. .	14	5
Using gasoline as cleaning agent	12	4
Using gasoline as exterminating agent . . . . .	8	3
Playing with gasoline . . . . .	7	3
Refueling power machinery . . . .	7	3
Cleaning or repairing machinery	6	2
Transferring gasoline . . . . .	6	2
Carrying or transporting gasoline	5	2
Using matches or lighter. . . . .	5	2
Standing near gasoline. . . . .	5	2
Playing with matches or lighter .	3	
Stirring, stomping, or disturbing open fire . . . . .	3	
Smoking . . . . .	3	
Using gasoline to ignite heating source . . . . .	1	
Standing by open fire . . . . .	1	5
Using work tools. . . . .	1	
Driving or riding in vehicle . .	1	
Helping other person involved in incident. . . . .	1	
Suspected arson . . . . .	1	
Assault/suicide . . . . .	1	
Unknown . . . . .	1	
Total . . . . .	273	100



Starting or tending an open fire type 1 represented 57 (21 percent) of the incidents that were gasoline container-related. In comparison, 44 (16 percent) of the incidents involved playing with gasoline and an ignition source; 40 (15 percent) of the incidents involved knocking over or dropping a container of gasoline; 22 (8 percent) involved starting or tending an open fire type 2; 18 (7 percent) of the incidents involved priming carburetors; and 14 (5 percent) of the incidents represented the victim or someone else spilling or splashing gasoline onto the victim prior to the ignition.

Gasoline used as an exterminating agent included gasoline soaked rags, jars containing small amounts of gasoline, etc., to destroy bugs and insects. The only activity involving the use of machinery or equipment, for these container-related incidents, was lighting a lantern. Driving or riding in vehicles included the involvement of vehicles in collisions.

Youth ages 13-20 and adults between the ages of 21-65 were injured most frequently while involved in starting or adding gasoline to an existing open fire type 1. The elderly were injured most while involved with an open fire type 2. These activities correlate with the small container types most frequently used by these victims which were primarily food, juice, and coffee cans.

Young children in the 0-5 age group were injured most frequently from knocking over or dropping a container of gasoline in the presence of an ignition source. Males in this age group were also injured about as frequently from spilling or splashing gasoline on themselves prior to an ignition and playing with gasoline in the presence of an ignition source. These activities do not require a great deal of manual dexterity on the part of the victim which is demonstrated by the fact that most of these victims were involved with container types too large or heavy for them to lift or carry with ease.

Children in the 6-12 age group were injured most frequently while playing with gasoline and an ignition source. Children this age are generally more concerned about concealing play activities that may have been designated dangerous or harmful than toddlers who have not yet developed reasoning abilities. These older children, who also have better developed motor skills, often transferred gasoline to smaller, more manageable containers and experimented with it in the presence of ignition sources - generally matches and open fires.

### 3.3.3. Ignition Sources For Gasoline Container-Related Incidents

A distribution of the ignition sources found for the gasoline container-related incidents is given in table 10. Matches were involved most frequently, representing 62 (23 percent) of the incidents. In comparison, open fires and hot water heaters each were the ignition sources for 30 (11 percent) of the incidents; and incinerators and charcoal grill fires each were involved in 27 (10 percent) of the incidents.

Table 10. Ignition Sources For  
Gasoline Container-Related Incidents  
(FFACTS, December 1973)

Ignition Source	Number of Incidents	Percent of Total Incidents	
Matches	62	23	
Open Fire	30	11	
Hot Water Heater	30	11	
Incinerator	27	10	
Charcoal Grill	27	10	
Combustion Engine	23	8	
Camp fire	12	4	
Hot Coals or Smoldering Sticks	9	3	
Unknown	9	3	
Furnace	7	3	
Space Heater	6	2	
Gas Range or Oven	6	2	
Sparks or Shorts	5	2	
Fireplace	4		
Cigarette	3		
Lighter	3		
Lantern/Candle	2		
Cutting/Welding Torch & Other Ignition Source Tools	2		7
Clothes Dryer	1		
Camp Stove	1		
Other Appliances	1		
Extension Cord	1		
Matches or Lighter	1		
Other Work Tools	1		
Total	273		100

Youth in the 13-20 age group were involved in incidents most frequently where matches and incinerator fires were the ignition sources. Adults in the 21-45 age group were involved most frequently by pouring gasoline on a charcoal grill. Adults over the age of 45 were involved primarily with open fires. Combustion engines (priming carburetors) were also the cause of many injuries for adults ages 21-65.

Children in the 0-5 age group were victims of incidents where the most frequent ignition source was found to be hot water heaters. Children in the 6-12 age group were involved most frequently in incidents where matches were the ignition source. Activities coupled with ignition sources for these two age groups demonstrate the greater physical capabilities of the 6-12 year olds as compared with the toddlers. For the 6-12 age group, the activities generally involved "experimentation" which meant the ignition sequences were usually intentional. The activities involving the 0-5 age group, however, generally were not predetermined which meant these small children usually became the victims of an existing set of circumstances.

#### 3.4. Gasoline Can Incidents

As seen in table 8 above, gasoline cans were involved in gasoline container-related incidents more frequently than any other container type. The ignition-causing activity engaged in most often was knocking over or dropping the container which occurred in 10 (24 percent) of the incidents, followed by starting or tending an open fire type 1 which occurred in 9 (22 percent) of the incidents, and playing with an ignition source and gasoline which occurred in 6 (15 percent) of the incidents.

Matches were the most frequent ignition source for this group of incidents, being reported in 16 of the incidents, followed by 6 incinerator fires, 5 hot water heater fires, and 3 combustion engine fires.

When the activities and ignition sources were correlated for these 41 gasoline can incidents (table 11), the combinations which occurred most frequently were playing with gasoline and matches which occurred 5 times, starting or tending an open fire type 1 in an incinerator which occurred 4 times, and knocking over or dropping a gasoline can in the presence of a hot water heater and using matches near gasoline, each of which occurred 3 times.

Nine of these 41 gasoline cans were reported to have exploded at the time of the ignition with 4 of these explosions occurring near open fires. Three other containers also exploded at the time of the ignition; two of these containers

Table 11. A Comparison Between Activities and Ignition Sources For the 41 Gasoline Can Incidents (FFACTS, December 1973)

	Space Heater	Hot Water Heater	Lantern/Candle	Open Fire	Fireplace	Camp Fire	Incinerator	Cigarette	Matches	Lighter	Combustion Engine	Sparks/Shorts	Unknown	Total
Starting or tending an open fire type 2									1					1
Starting or tending an open fire type 1				1	1	1	4		2					9
Refueling equipment									1					1
Spilling or splashing gasoline	1	1							1					3
Knocking over or dropping container		3		1		1	2	1	1			1		10
Cleaning or repairing machinery		1												1
Priming carburetor											2			2
Driving or riding in vehicle											1			1
Using matches or lighter									3					3
Smoking									2					2
Using gasoline as cleaning agent										1				1
Unknown													1	1
Playing with gasoline and ignition source			1						5					6
Total	1	5	1	2	1	2	6	1	16	1	3	1	1	41

were glass and one was a coffee can. These three containers were being used near an open fire.

#### 4. CONCLUSIONS

The FFACTS data base was searched for fire incidents involving gasoline even though the data base is structured to collect detailed information about fabrics involved in fire incidents. The information gleaned from these case history reports concerning gasoline and gasoline containers was additional information provided by the field investigators in their attempt to depict as accurately and precisely as possible the sequence of events which led to the ignition of fabric items. As such, it is recognized that this information on gasoline and gasoline containers is biased to fabric-ignited fires only and cannot be considered as typical or conclusive of gasoline and gasoline container fires in general.

Males outnumbered females in the gasoline-related incidents in about a 5 to 1 ratio. When the numbers for both sexes were examined by age groups, it was observed that although males in the 21-45 age group were represented most often in the FFACTS data, they were injured about as frequently as would have been expected if the gasoline incidents were distributed uniformly across the male age groups. Males in this age range were involved in tasks for which it was necessary to use a flammable liquid. Unfortunately, gasoline instead of a more appropriate product was used. Males in the 6-12 and 13-20 age groups were injured much more frequently than would have been expected for their age groups if the incidents were distributed randomly over the male population. These are the developmental and maturing years for males in these two age groups which may have a direct bearing on their high frequency of experimentation with gasoline and their involvement in gasoline-related fire accidents. Activities for these age groups centered around different levels of experimentation, that is, playing with gasoline and an ignition source appealed to the younger boys and, on a more sophisticated level, starting or tending open fires with gasoline attracted the older youth.

A possible explanation for the small number of female injuries as compared to male injuries is that most of the ignition-causing activities for these gasoline-related incidents are traditionally male-oriented. Most of the females injured in the 0-5 age group were innocent bystanders, being injured as the result of the actions of males of all ages. Females in the 6-12 age group, although being frequently injured by the actions of others (both male and female) were often a party to the sequence of events which led to the ignition. Females between the ages of 13-65 were involved in activities that may not have been very familiar to them (i.e., spilling gasoline while in the process of filling the tank of a lawn mower, removing tile from a kitchen or laundry room floor, starting a charcoal grill, etc.).

Many of these incidents may be related to physical as well as behavioral development of the victims involved when the various container types, activities engaged in at the time of the ignition, and the ignition sources are considered for each age group for both males and females. For the very young children as well as the elderly, physical movements could often be interpreted as being clumsy and awkward. For the toddlers this meant a lack of development of motor skills. For the elderly, however, this indicated a tendency towards deterioration in manual dexterity. This may be reflected in the comparatively low injury rates recorded for the youngest and oldest age groups when collated with the other age groups. The youth and the adults were often injured because of their carelessness and/or a lack of knowledge as to the characteristics of this highly volatile flammable liquid.

In many of the container-related incidents and gasoline can incidents, improper storage (both in terms of container choice and physical location) and inappropriate use was indicated. Although containers specifically designed for gasoline may have some inherent safety problems<sup>1</sup> of their own, there was no indication in the FFACTS data that either these "approved" containers or any of the other containers, by themselves, contributed substantially to the gasoline-related incidents. These incidents were the products of human error, where a lack of knowledge or judgement resulted in misuse or abuse of the flammable liquid, the container, or both.

## 5. RECOMMENDATIONS

From the FFACTS data, it seems evident that people of all ages need to be made aware of the fact that gasoline is a highly volatile flammable liquid with limited intended use. This generalization is reinforced by daily accounts from the news media which relate the reactions of the public to the current gasoline crisis in terms of attempts to use, hoard, or store this short-supply fuel, often with serious consequences.

It is recommended that an educational program be established to inform the public about the properties and characteristics of gasoline which make it an inherently dangerous flammable liquid. This program should warn against casually using this volatile liquid around the home in place of specially prepared cleaners, solvents, fire-starters, etc. and should provide information on how to store this fuel properly.

<sup>1</sup>Consumer Reports, Gasoline Cans, Vol. 38, No. 5 (May 1973), 332-335.

Short messages prepared for radio and television airing should address the specific users of gasoline and describe some of the activities that frequently result in burn injuries. Specifically, these messages should:

1. advise adults, particularly men, to use charcoal lighter fluid, not gasoline, to start charcoal fires.
2. advise teenagers to use commercially prepared solvents, not gasoline, to clean engine parts.
3. advise adults, primarily women, to use specially prepared cleaners to clean floors and prepared solvents to remove tiles from floors, not gasoline.

These messages should then give tips on how to use these commercially prepared products safely and what actions to take in the event a fire should occur.

Radio and television spots should be used to advise the public to store gasoline in a cool, well-ventilated area, preferably away from the house, in a can designed specifically for that purpose. The public should be warned against storing gasoline in the following manner:

1. on "child-level" shelves in discarded food or drink containers.
2. on window sills where the container could easily be knocked off or where heat from the sun could create an explosive mixture.
3. in close proximity to other flammable liquids where a mixture of the vapors could prove to be lethal or produce an explosive mixture.
4. close to ignition sources such as gas appliances.

The activities which involved the use of gasoline appeared repeatedly in the FFACTS data, which roughly represents a nine year period. Since it is reasonable to assume that these activity patterns will continue to be reflected in accident data as long as gasoline is sold to the consuming public, an educational program such as the one described above will be needed to help reduce or eliminate some of these gasoline fire accidents.

APPENDIX A. THE FLAMMABLE FABRICS ACCIDENT  
CASE AND TESTING SYSTEM (FFACTS)

The National Bureau of Standards (NBS) Flammable Fabrics Accident Case and Testing System (FFACTS) was developed under the mandate of the Flammable Fabrics Act, as amended in 1967<sup>1</sup>. The Consumer Product Safety Act of 1972<sup>2</sup> transferred the responsibilities of the Flammable Fabrics Act to the new Consumer Product Safety Commission (CPSC), but NBS continues to provide technical support to the Commission which includes the maintenance and analysis of data incorporated in FFACTS.

The primary source of the accident data incorporated in the FFACTS data base are in-depth investigative reports on flammable fabric accidents supplied to NBS by CPSC. Using report forms developed jointly by NBS and CPSC, investigators from CPSC and other participating organizations follow and report on accidental fires involving fabric products from around the country. These reports, together with any available remains of fabric products involved, are sent to the Office of Information and Hazard Analysis, FTD, for processing. If the reports meet the FFACTS requirements of relevance and adequacy, the fabrics, if any, are analyzed for fiber composition, fabric construction, and weight. If appropriate test methods exist, flammability characteristics for these fabrics are also determined. The information from the accident reports is then reviewed in light of results of the laboratory tests, coded, and entered into the FFACTS computerized data base. Some 130 different data elements can be coded for an incident.

It should be noted that the incidents chosen for FFACTS are not selected on a statistical basis and therefore, do not constitute a statistically representative sample of all fabric fire accidents in the United States. However, they do represent events investigated without known preference and therefore may be roughly representative of incidents reported to the agencies from which the CPSC and others obtain accident data.

---

<sup>1</sup>The Flammable Fabrics Act, 81 Stat. 568, 15 U.S.C. 1191, as amended and revised Dec. 14, 1967.

<sup>2</sup>Consumer Product Safety Act. 86 Stat. 1221, 15 U.S.C. 2064B, May 14, 1973.



APPENDIX B. SYSTEM DEvised FOR OBTAINING  
ADDITIONAL INFORMATION FROM FFACTS CONCERNING  
GASOLINE AND GASOLINE CONTAINER-RELATED INCIDENTS

Summaries were made for each of the 452 gasoline-related case histories. The FFACTS case number, age and sex of the primary victim, and a short paragraph noting the type of container used for the gasoline, if mentioned, and the circumstances leading up to the ignition sequence as they related to the container were recorded for each incident. Three classification lists were made which described as clearly and as concisely as possible the container types involved, human activities with respect to the containers prior to the ignitions, and the ignition sources. The 452 gasoline incidents were coded and tabulated according to this scheme. The three classification listings thus devised appear below.

## I. Containers Involved

1. Gasoline Can
2. One-Gallon Can
3. Two-Gallon Can
4. Three-Gallon Can
5. Five-Gallon Can
6. Thirty-Gallon Can
7. Open Can
8. Water Can
9. Milk Can
10. Coffee Can
11. Oil Can
12. Paint Can
13. Charcoal Lighter Fluid Spray Can
14. Antifreeze Can
15. Can with Spout
16. "Rusty" Can
17. "Non-approved" Metal Can
18. Can (Unspecified)
19. Pail or Bucket
20. Glass Container
21. Plastic Container (Unspecified)
22. Cup
23. Open, Shallow Pan
24. Insecticide Spray Bottle
25. Tea Kettle
26. Milk Can Lid
27. Bowl
28. Paint-roller Tray

## II. Activities

1. Playing with gasoline and an ignition source
2. Playing with gasoline
3. Playing with matches or lighter
4. Playing with an open fire
5. Starting or tending an open fire type 1 (camp fire, fire-place, grill, incinerator, etc.)
6. Starting or tending an open fire type 2 (bonfire, fire to clear brush, leaves, etc.)
7. Stirring, stomping, or disturbing an open fire
8. Standing by an open fire (gasoline on clothes)
9. Warming self
10. Standing near gasoline
11. Standing near ignition source - gas appliances (gasoline on clothes)
12. Transferring gasoline
13. Carrying or transporting gasoline
14. Refueling power machinery and vehicles
15. Spilling or splashing gasoline
16. Knocking over or dropping container of gasoline
17. Cleaning or repairing machinery or equipment
18. Priming carburetor
19. Using machinery or equipment (using or attempting to use (lanterns, appliances, vehicles, etc. when malfunctioning or explosion occurred).
20. Using welding torch, soldering iron, or other work tools which resulted in being ignition source equipment
21. Using matches or lighter
22. Using gasoline as a cleaning agent (solvent)
23. Using gasoline as an exterminating agent
24. Using gasoline to ignite a heating source
25. Smoking
26. Driving or riding in automobile, tractor, motorcycle, airplane, etc. (collision, etc.)
27. Helping another person involved in an ignition incident
28. Suspected arson
29. Assault/suicide
30. Miscellaneous
31. Unknown

### III. Ignition Sources

#### HEATERS

1. Furnace (gas)
2. Space heater
3. Hot water heater
4. Unspecified heater
5. Other heater

#### APPLIANCES

6. Clothes dryer
7. Gas range or oven
8. Light bulbs
9. Camp stove
10. Other

#### OTHER OBJECTS

11. Electrical wiring
12. Extension cord
13. Lantern/candle
14. Open fire (unspecified)
15. Fireplace
16. Camp fire
17. Incinerator
18. Charcoal grill
19. Hot coals or smoldering sticks
20. Smoking materials (unspecified)
21. Cigarette
22. Cigar/pipe
23. Matches or lighter
24. Matches
25. Lighter
26. Cutting/welding torch & other special ignition sources
27. Other work tools
28. Combustion engine
29. Fireworks
30. Sparks or shorts
31. Miscellaneous
32. Unknown

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET		1. PUBLICATION OR REPORT NO. NBS TN-850	2. Gov't Accession No.	3. Recipient's Accession No.
4. TITLE AND SUBTITLE Gasoline and Gasoline Container Fire Incidents			5. Publication Date January 1975	
			6. Performing Organization Code	
7. AUTHOR(S) Elaine A. Tyrrell			8. Performing Organ. Report No. NBS TN-850	
9. PERFORMING ORGANIZATION NAME AND ADDRESS NATIONAL BUREAU OF STANDARDS DEPARTMENT OF COMMERCE WASHINGTON, D.C. 20234			10. Project/Task/Work Unit No. 4903235	
			11. Contract/Grant No.	
2. Sponsoring Organization Name and Complete Address (Street, City, State, ZIP) same as No. 9			13. Type of Report & Period Covered Final	
			14. Sponsoring Agency Code	
5. SUPPLEMENTARY NOTES Library of Congress Catalog Card Number: 74-600163				
6. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.) Gasoline was involved in 72 percent of the 645 volatile flammable liquids fire incidents found in the NBS Flammable Fabrics Accident Case and Testing System as of December 1973. These gasoline incidents, particularly those that were container-related, were studied in detail. Male victims out-numbered females approximately 5 to 1. Both males and females, ages 6-20, were injured more frequently than would have been expected if the incidents for each sex had been distributed uniformly over all age groups. Starting or tending an open fire caused ignitions most frequently and involved primarily males ages 13-45. Children were injured most from knocking over or dropping a container of gasoline close to an ignition source and playing with gasoline and an ignition source. Matches were the most frequent ignition source. Containers ranged from large gasoline cans to kitchen measuring cups, although gasoline cans were reported most often. The youngest children were involved most with some of the largest containers. The remaining victims were involved primarily with smaller, more easily managed containers. There was no indication that the gasoline containers, by themselves, contributed substantially to these incidents. The problem was one of human error - misuse or abuse of the gasoline, the container, or both.				
7. KEY WORDS (six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons) Accidents; FFACTS; gasoline; gasoline containers; gasoline incidents; gasoline-related fires; ignition-causing activities; ignition sources; volatile flammable liquids; volatile flammable liquids incidents.				
8. AVAILABILITY <input checked="" type="checkbox"/> Unlimited <input type="checkbox"/> For Official Distribution. Do Not Release to NTIS <input checked="" type="checkbox"/> Order From Sup. of Doc., U.S. Government Printing Office Washington, D.C. 20402, SD Cat. No. C13, 46:850 <input type="checkbox"/> Order From National Technical Information Service (NTIS) Springfield, Virginia 22151		19. SECURITY CLASS (THIS REPORT) UNCLASSIFIED		21. NO. OF PAGES 34
		20. SECURITY CLASS (THIS PAGE) UNCLASSIFIED		22. Price .85¢



# NBS TECHNICAL PUBLICATIONS

## PERIODICALS

**JOURNAL OF RESEARCH** reports National Bureau of Standards research and development in physics, mathematics, and chemistry. Comprehensive scientific papers give complete details of the work, including laboratory data, experimental procedures, and theoretical and mathematical analyses. Illustrated with photographs, drawings, and charts. Includes listings of other NBS papers as issued.

Published in two sections, available separately:

- **Physics and Chemistry (Section A)**

Papers of interest primarily to scientists working in these fields. This section covers a broad range of physical and chemical research, with major emphasis on standards of physical measurement, fundamental constants, and properties of matter. Issued six times a year. Annual subscription: Domestic, \$17.00; Foreign, \$21.25.

- **Mathematical Sciences (Section B)**

Studies and compilations designed mainly for the mathematician and theoretical physicist. Topics in mathematical statistics, theory of experiment design, numerical analysis, theoretical physics and chemistry, logical design and programming of computers and computer systems. Short numerical tables. Issued quarterly. Annual subscription: Domestic, \$9.00; Foreign, \$11.25.

**DIMENSIONS/NBS (formerly Technical News Bulletin)**—This monthly magazine is published to inform scientists, engineers, businessmen, industry, teachers, students, and consumers of the latest advances in science and technology, with primary emphasis on the work at NBS.

**DIMENSIONS/NBS** highlights and reviews such issues as energy research, fire protection, building technology, metric conversion, pollution abatement, health and safety, and consumer product performance. In addition, **DIMENSIONS/NBS** reports the results of Bureau programs in measurement standards and techniques, properties of matter and materials, engineering standards and services, instrumentation, and automatic data processing.

## NONPERIODICALS

**Monographs**—Major contributions to the technical literature on various subjects related to the Bureau's scientific and technical activities.

**Handbooks**—Recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

**Special Publications**—Include proceedings of high-level national and international conferences sponsored by NBS, precision measurement and calibration volumes, NBS annual reports, and other special publications appropriate to this grouping such as wall charts and bibliographies.

**Applied Mathematics Series**—Mathematical tables, manuals, and studies of special interest to physicists, engineers, chemists, biologists, mathematicians, computer programmers, and others engaged in scientific and technical work.

**National Standard Reference Data Series**—Provides quantitative data on the physical and chemical properties of materials, compiled from the world's literature and critically evaluated. Developed under a world-wide program coordinated by NBS. Program under authority of National Standard Data Act (Public Law 90-396).

**Building Science Series**—Disseminates technical information developed at the Bureau on building materials, components, systems, and whole structures. The series presents research results, test methods, and performance criteria related to the structural and environmental functions and the durability and safety characteristics of building elements and systems.

**Technical Notes**—Studies or reports which are complete in themselves but restrictive in their treatment of a subject. Analogous to monographs but not so comprehensive in scope or definitive in treatment of the subject area. Often serve as a vehicle for final reports of work performed at NBS under the sponsorship of other government agencies.

**Voluntary Product Standards**—Developed under procedures published by the Department of Commerce in Part 10, Title 15, of the Code of Federal Regulations. The purpose of the standards is to establish nationally recognized requirements for products, and to provide all concerned interests with a basis for common understanding of the characteristics of the products. The National Bureau of Standards administers the Voluntary Product Standards program as a supplement to the activities of the private sector standardizing organizations.

**Federal Information Processing Standards Publications (FIPS PUBS)**—Publications in this series collectively constitute the Federal Information Processing Standards Register. The purpose of the Register is to serve as the official source of information in the Federal Government regarding standards issued by NBS pursuant to the Federal Property and Administrative Services Act of 1949 as amended, Public Law 89-306 (79 Stat. 1127), and as implemented by Executive Order 11717 (38 FR 12315, dated May 11, 1973) and Part 6 of Title 15 CFR (Code of Federal Regulations). FIPS PUBS will include approved Federal information processing standards information of general interest, and a complete index of relevant standards publications.

**Consumer Information Series**—Practical information, based on NBS research and experience, covering areas of interest to the consumer. Easily understandable language and illustrations provide useful background knowledge for shopping in today's technological marketplace.

**NBS Interagency Reports**—A special series of interim or final reports on work performed by NBS for outside sponsors (both government and non-government). In general, initial distribution is handled by the sponsor; public distribution is by the National Technical Information Service (Springfield, Va. 22151) in paper copy or microfiche form.

Order NBS publications (except Bibliographic Subscription Services) from: Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

## BIBLIOGRAPHIC SUBSCRIPTION SERVICES

The following current-awareness and literature-survey bibliographies are issued periodically by the Bureau:

**Cryogenic Data Center Current Awareness Service** (Publications and Reports of Interest in Cryogenics). A literature survey issued weekly. Annual subscription: Domestic, \$20.00; foreign, \$25.00.

**Liquefied Natural Gas.** A literature survey issued quarterly. Annual subscription: \$20.00.

**Superconducting Devices and Materials.** A literature survey issued quarterly. Annual subscription: \$20.00. Send subscription orders and remittances for the pre-

ceding bibliographic services to the U.S. Department of Commerce, National Technical Information Service, Springfield, Va. 22151.

**Electromagnetic Metrology Current Awareness Service** (Abstracts of Selected Articles on Measurement Techniques and Standards of Electromagnetic Quantities from D-C to Millimeter-Wave Frequencies). Issued monthly. Annual subscription: \$100.00 (Special rates for multi-subscriptions). Send subscription order and remittance to the Electromagnetic Metrology Information Center, Electromagnetics Division, National Bureau of Standards, Boulder, Colo. 80302.

**U.S. DEPARTMENT OF COMMERCE**  
**National Bureau of Standards**  
Washington, D.C. 20234

OFFICIAL BUSINESS

Penalty for Private Use, \$300

POSTAGE AND FEES PAID  
U.S. DEPARTMENT OF COMMERCE  
COM-215

Fourth Class Mail

