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## Fire Incidents Involving Sleepwear Worn by Children Ages 6-12

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# Fire Incidents Involving Sleepwear Worn by Children Ages 6-12

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National Bureau of Standards

APR 29 1974

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## PREFACE

This report is a revision of an unpublished document that was used as supporting evidence by the Secretary of Commerce in determining the need for a flammability standard for children's sleepwear sizes 7 through 14. A "Notice of Finding that Flammability Standard May Be Needed and Institution of Proceedings" was published in the Federal Register on June 15, 1972 (vol. 37, no. 116, pp. 11896-11897). A finding of need and a proposed flammability standard for children's sleepwear (sizes 7-14) was subsequently published in the Federal Register on March 12, 1973 (vol. 38, no. 47, pp. 6700-6710). The conclusions and recommendations contained in this report were used as part of the basis for the finding of need and thus represent views prior to publication of the proposed standard.



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FIRE INCIDENTS INVOLVING SLEEPWEAR  
WORN BY CHILDREN AGES 6-12

James A. Slater

Sleepwear was the first fabric item ignited more frequently than any other item in over 1,900 fire incidents reported to the National Bureau of Standards Flammable Fabrics Accident Case and Testing System (FFACTS). Information acquired since promulgation of the current sleepwear flammability standard protecting children of ages 0-5 indicates a problem of comparable magnitude exists for children of ages 6-12. Of 316 incidents involving non-contaminated sleepwear that was first to ignite, about one-fourth involved children 0-5 years old and one-fourth involved children 6-12 years old. For the 6-12 group, sleepwear ignited first more often than all other garment items combined. Females outnumbered males 4-to-1 in the 6-12 group, due mostly to the involvement of nightgowns and kitchen ranges, the most common ignition source for this age group. Five of the 6-12 year old children died and 52 of 74 victims were hospitalized. Almost all of the first-to-ignite sleepwear in this group was cotton. Data from Shriners Burns Institute and the National Burn Information Exchange provide further evidence of the involvement of children ages 6-12 in garment fires. It is recommended that a new standard be issued covering sleepwear sizes 7 through 14 to effectively protect 6-12 year old children.

Key words: Accidents; burns; children; clothing fires; deaths; FFACTS; fire; flammable fabrics; injury; sleepwear; standards; statistics.

1. INTRODUCTION

The current mandatory standard [1]<sup>1</sup> for the flammability of children's *sleepwear*<sup>2</sup> applies to sleepwear sizes 0 through 6X. This standard is intended "to provide a high and effective level of protection to children approximately 5 years of age and younger against unreasonable risk of death or injury suffered as a result of ignition and continued burning of sleepwear garments, as defined in the standard, and/or as a result of the continued burning of molten or other material falling or dripping from the burning garments." The finding of need for the standard was based, in part, on information from the Flammable Fabrics Accident Case and Testing System (FFACTS) at the National Bureau of Standards (NBS).

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<sup>1</sup>Figures in brackets indicate the literature references at the end of this paper.

<sup>2</sup>Definitions of "sleepwear" and other italicized terms used in this report are given in the glossary at the end of the report.

Since the standard was promulgated, the FFACTS data base has increased from 580 cases in November 1971 to 1,964 cases as of December 1972. In the current data base, children under age 6 continue to be the most highly represented age group involved in sleepwear *incidents*. However, children of ages 6 through 12 were involved nearly as frequently as children in the 0-5 age group in fires involving sleepwear items. As a result, a finding of possible need for a flammability standard, covering sleepwear normally worn by children of ages 6-12 was issued by the Secretary of Commerce on June 15, 1972 [2]. The following is a summary and analysis of data from FFACTS and from outside sources on the involvement of children ages 6-12 in sleepwear-related fires.

## 2. THE FLAMMABLE FABRICS ACCIDENT CASE AND TESTING SYSTEM

Section 14(a) of the Flammable Fabrics Act,<sup>1</sup> as revised and amended December 14, 1967 [3], states that the Secretary of Health, Education, and Welfare in cooperation with the Secretary of Commerce shall conduct a continuing investigation of deaths, injuries and economic losses resulting from accidental burning of fabric products. The primary sources of information on accidental fires involving fabric products are state and local fire departments, voluntary public safety-oriented organizations, and Federal agencies such as the Food and Drug Administration (FDA) which send reports of these incidents along with the remains of fabric products involved to the Fire Technology Division of the National Bureau of Standards for analysis and testing. These reported incidents are not selected on a statistical basis and they do not, therefore, constitute a statistically representative sample of all fabric fire incidents in the United States. Nevertheless, they represent events investigated without known preference and may be roughly representative of incidents reported to the agencies from which the FDA and others obtain accident data.

Processing of the reports and fabric samples received by NBS includes reviewing and screening of incident reports, laboratory testing and characterization of fabric products involved, data encoding, formatting, editing, and entry into a computer master file. Some 200 different data elements can be coded for an incident.

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<sup>1</sup>As of May 14, 1973, responsibility for regulation of flammable fabric products is under the jurisdiction of the Consumer Product Safety Commission. However, this report was researched prior to May 14 and thus the work being reported was done under the authority given to the Department of Commerce in the Flammable Fabrics Act [3].

### 3. FINDINGS FROM FFACTS

#### 3.1 General Involvement of Sleepwear

Sleepwear *items* were ignited in 413 fire incidents reported to NBS as a part of the 1,964 cases processed in FFACTS to date. Included in the general category of sleepwear are pajamas, nightgowns, robes and any other garments related specifically to sleeping. A total of 485 separate items of sleepwear were involved in the 413 incidents reported to have involved sleepwear. Table 1 shows the distribution of specific fabric products that were first to ignite in

Table 1. Distribution of Fabric Product Incidents in FFACTS  
For Fabric Items First to Ignite  
(Includes Items *Contaminated* With Flammable Liquids)

First Item Ignited	Number of Incidents	Percent of Total Incidents
Sleepwear . . . . .	335 <sup>a</sup>	25.8
Coats/Jackets . . . . .	36	2.8
Pants . . . . .	92	7.1
Dresses . . . . .	94	7.2
Shirts. . . . .	249	19.2
Underwear . . . . .	53	4.1
Other Garments. . . . .	96	7.4
Total Garments. . . . .	955	73.5 <sup>b</sup>
Bedspreads. . . . .	28	2.2
Blankets. . . . .	21	1.6
Mattresses/Pads . . . . .	58	4.5
Other Bedding . . . . .	47	3.6
Total Bedding . . . . .	154	11.8 <sup>b</sup>
Drapes/Curtains . . . . .	37	2.8
Carpets/Rugs. . . . .	19	1.5
Upholstered Furniture . . . . .	112	8.6
Other Furnishings . . . . .	22	1.7
Total Furnishings . . . . .	190	14.6
Other Fabric Products . . . . .	1	0.1
Total . . . . .	1,300	100.0

<sup>a</sup>Seventeen of these incidents involved sleepwear contaminated with flammable liquids.

<sup>b</sup>"Total Garments" and "Total Bedding" percentages do not equal the sum of individual item percentages due to rounding.



FFACTS incidents (including those items *contaminated* with flammable liquids). Sleepwear items were first to ignite more frequently than any other fabric product in the data base.<sup>1</sup> The 335 sleepwear incidents represent 35 percent of the total garments first to ignite and 26 percent of all fabric products that were ignited first.

Twenty-two of the 413 sleepwear incidents involved flammable liquid contamination or probable contamination.<sup>2</sup> (Seventeen of the 22 were incidents in which sleepwear ignited first.) Since only a small percentage of sleepwear ignitions involved flammable liquids and flammable liquid obscures the ignition hazard of the fabric product itself, sleepwear contaminated with flammable liquids will be excluded from the remainder of this report.

### 3.2 Age and Sex of Persons Involved in Sleepwear Incidents

Table 2 shows the age distribution and sex of persons involved in FFACTS sleepwear incidents in which no flammable liquid contamination occurred. In 318 of the incidents, sleepwear was the first item ignited. The 6-12 age group, in particular, was involved in 77 (24 percent) of the 316 incidents in which uncontaminated sleepwear ignited first (and for which the victim's age was known) and represented 79 (20 percent) of the 389 persons involved in all sleepwear incidents. In the 6-12 group, females were involved almost four times as frequently as males in sleepwear accidents; this differs from the more equal representation of males and females in the 0-5 age group, but it is typical of all the older age groups.

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<sup>1</sup>Prior to late 1970, FDA investigators concentrated almost exclusively on garment fires, resulting in garments being somewhat overrepresented in the FFACTS data. Since that time, however, all fabric fires have been investigated regardless of the type of fabric item involved, and enough non-garment data have been collected to firmly establish patterns of fabric item involvement for the most common ignition sources.

<sup>2</sup>In 12 cases sleepwear items were definitely contaminated while in 10 other cases, contamination was likely but could not be definitely established from reports of the incidents.

Table 2. Age Distribution and Sex of Persons Involved in Sleepwear Incidents<sup>a</sup>

Age	All Sleepwear Incidents			First-to-Ignite Sleepwear Incidents		
	Male	Female	Total	Male	Female	Total
0-5 . . . . .	40	54	94	36	50	86
6-12. . . . .	18	61	79	16	61	77
13-20. . . . .	4	12	16	4	11	15
21-45. . . . .	8	49	57	4	38	42
46-65. . . . .	9	61	70	6	41	47
66+ . . . . .	14	59	73	9	40	49
Total Known	93	296	389	75	241	316
Unknown. . . . .	-	2	2	-	2	2
Total. . . . .	93	298	391	75	243	318

<sup>a</sup>22 incidents involving sleepwear items contaminated with flammable liquids have been excluded; 17 of the 22 were "first-to-ignite sleepwear incidents".

Table 3 compares the age distribution of *persons involved* in FFACTS sleepwear incidents, persons involved in all FFACTS incidents, and the United States as a whole. Only those incidents in which the fabric item was first to ignite are considered in the table and all contaminated items have been excluded, as in table 2. The total number of persons involved in sleepwear ignitions and in all FFACTS ignitions (with the above qualifications), on which the percentages in table 3 are based, are 316 and 1,023, respectively.

The 6-12 group represents 15 percent of the FFACTS data base and 14 percent of the U.S. population, yet 24 percent of the persons involved in first-to-ignite sleepwear incidents were in this age bracket. Considering that 14 percent of the U.S. population is between ages 6 and 12, one might expect 14 percent, or 44, of the 316 incidents where sleepwear ignited first to involve children 6-12; however, 6-12 year olds in the FFACTS data base were involved in 77 incidents in which sleepwear ignited first, or 1.8 times as frequently as expected. Females were much more frequently involved in these incidents than males. The percentage of females 6-12 years old involved in sleepwear incidents is 1.9 times greater than their overall representation in the FFACTS data base and 2.7 times their representation in the total U.S. population.

Table 3. Age Distributions and Sex of Persons Involved  
in FFACTS Sleepwear Incidents, in All FFACTS  
Incidents and in the U.S. Population

Age	Persons Involved, as % of the Total <sup>a</sup>						Percent of Total U.S. Population <sup>b</sup>		
	Sleepwear			All FFACTS			Female	Male	Total
	Female	Male	Total	Female	Male	Total			
0-5 . . .	16	11	27	11	10	21	5	5	10
6-12. . .	19	5	24	10	5	15	7	7	14
13-20. . .	3	1	5 <sup>c</sup>	3	4	7	8	8	16
21-45. . .	12	1	13	13	12	25	16	15	31
46-65. . .	13	2	15	9	8	17	10	9	19
66+ . . .	13	3	16	10	5	15	6	4	10
Total. .	76	24	100	56	44	100	52	48	100

<sup>a</sup>For incidents in which a fabric item involved was the first item ignited and was not contaminated by flammable liquids.

<sup>b</sup>Derived from 1970 U.S. Bureau of the Census population statistics [4].

<sup>c</sup>Percentages were computed independently and therefore total percentages may not equal the sum of individual percentages.

### 3.3 Ignition of Sleepwear For Ages 6-12

Sleepwear was the first item ignited more often than all other garments combined in incidents involving the 6-12 age group (55 percent of the garments first to ignite). Table 4 shows these garment data and the particular ignition sources involved. Ignitions of sleepwear outnumbered by 4-to-1 the ignitions of any other single apparel item for persons in the 6-12 age group. Kitchen range ignitions of sleepwear stand out as the most common type of garment ignition in this age group.

A further breakdown of the sleepwear items is given in table 5. Of the 77 sleepwear items ignited first in incidents involving 6-12 year olds, 40 were pajamas, 31 were nightgowns and 6 were robes. Females accounted for 32 of 38 kitchen range ignitions of sleepwear; two-thirds of the 32 involved pajamas and one-third nightgowns. In 12 incidents initiated by heaters or furnaces, nightgowns were ignited first 9 times and 10 of the 12 persons involved were females.

Table 4. Ignition Sources For First-to-Ignite Garment Items<sup>a</sup>  
For the 6-12 Age Group

Ignition Source	First Item Ignited								Total
	Sleepwear	Coats/Jackets	Pants	Dresses	Shirts	Sweaters/Sweatshirts	Underwear	Other	
Kitchen Range. . .	38	1	-	7	10	-	-	-	56
Match/Lighter. .	13	-	4	4	5	-	6	2	34
Heater/Furnace. .	12	-	-	5	1	-	-	-	18
Open Fire. . .	9	-	3	-	1	1	2	-	16
Candle/Lantern. .	5	1	-	-	-	-	1	2	9
Other . . .	-	-	-	4	1	1	1	1	8
Total . . .	77	2	7	20	18	2	10	5	141

<sup>a</sup>Items contaminated with flammable liquids are excluded.

Table 5. Ignition Sources For Specific First-to-Ignite Sleepwear Items For the 6-12 Age Group

Ignition Source	First Item Ignited						
	Pajamas		Nightgowns		Robes		All Sleepwear
	Male	Female	Male	Female	Male	Female	
Kitchen Range. .	5	22	-	9	1	1	38
Match/Lighter. .	4	1	-	6	-	2	13
Heater/Furnace. .	2	1	-	9	-	-	12
Open Fire. . . .	1	1	1	5	1	-	9
Candle/Lantern. .	1	2	-	1	-	1	5
Total. . . . .	13	27	1	30	2	4	77

### 3.4 Extent of Injury For the 6-12 Age Group

Table 6 shows the disposition of persons 6-12 years old involved in garment fires and the fabric item that was ignited first in each incident. Fifty-two of 74 victims (whose disposition was known) of sleepwear ignitions required hospitalization while 5 other victims died from injuries sustained during these incidents.

For those garments that were not contaminated with flammable liquids and were first to ignite, the percent of body area burned due to the garments is given in table 7 for victims of these incidents.



Twenty-seven of 74 victims of sleepwear ignitions with known burn injuries had 11-30 percent body burns attributable to the sleepwear. Seventeen of the 74 victims had over 30 percent body burns due to sleepwear ignition.

Table 6. Injury Disposition of Persons in the 6-12 Age Group by Garment Item<sup>a</sup> First to Ignite

First Item Ignited	No Injury	First Aid/Treated & Released	Hospitalized	Died	Un-known	Total Persons Involved
Sleepwear. . .	-	17	52	5	3	77
Coats/Jackets.	1	-	1	-	-	2
Pants. . . . .	-	5	3	-	-	8
Dresses. . . . .	-	4	15	1	-	20
Shirts . . . . .	-	10	6	-	3	19
Sweaters/ Sweatshirts .	-	2	-	-	-	2
Underwear. . .	-	3	7	-	-	10
Other. . . . .	-	1	4	-	-	5
Total. . . . .	1	42	88	6	6	143

<sup>a</sup>Items contaminated with flammable liquids are excluded.

Table 7. Total Body Area Burned For Persons in the 6-12 Age Group by Garment Item<sup>a</sup> First to Ignite

First Item Ignited	Total Body Area Burned						Total Persons Involved
	No Burn	1-10%	11-30%	31-60%	Over 60%	Un-known	
Sleepwear. . .	-	30	27	12	5	3	77
Coats/Jackets.	1	-	1	-	-	-	2
Pants. . . . .	-	6	-	1	-	1	8
Dresses. . . . .	-	7	9	2	1	1	20
Shirts . . . . .	-	10	6	-	-	3	19
Sweaters/ Sweatshirts .	-	2	-	-	-	-	2
Underwear. . .	-	3	6	-	-	1	10
Other. . . . .	-	3	2	-	-	-	5
Total. . . . .	1	61	51	15	6	9	143

<sup>a</sup>Items contaminated with flammable liquids are excluded.



### 3.5 Fabric Analysis

Of the 77 first-to-ignite sleepwear items, fabric remnants of 31 of the pajamas, 22 of the nightgowns and 5 of the robes were tested at NBS. The outer layer fiber content and surface construction of these garments are given in table 8 along with the "reported" fiber content and construction of the 19 sleepwear items for which no remnants were available for testing.

Table 8. Fiber Content and Outer Layer Surface Construction of First-to-Ignite Sleepwear Items<sup>a</sup> For the 6-12 Age Group

Outer Layer Fiber Construction	Pajamas		Nightgowns		Robes <sup>b</sup>	
	Tested	Reported	Tested	Reported	Tested	Reported
Cotton/Flannel <sup>c</sup> . . .	22	2	17	6	1	-
Cotton/Plain . . . .	7	-	4	-	2	-
Cotton/Knit . . . . .	1	-	-	-	-	-
Cotton/Terrycloth. .	-	-	-	-	1	-
Cotton/Unknown . . .	-	3	-	3	-	1
Acetate/Knit . . . . .	-	-	-	-	1	-
Rayon-Cotton/Flannel	1	-	-	-	-	-
Acetate-Nylon/Knit .	-	-	1	-	-	-
Total Known. . . . .	31	5	22	9	5	1
Unknown. . . . .	-	4	-	-	-	-
Total. . . . .	31	9	22	9	5	1

<sup>a</sup>Fabrics presented in this table are separated into "tested" and "reported". "Tested" fabrics were examined in the Fire Technology Division's laboratories. "Reported" fabrics were not tested at NBS and information regarding fiber content and construction was obtained from reports of the incident.

<sup>b</sup>Two of the cotton robes and the acetate robe were quilted with a polyester middle layer and acetate inner layer.

<sup>c</sup>Flannelette construction is included in this category.

All but three garments (1 pajama, 1 nightgown, 1 robe) were found, from tests or reports, to be cotton; it should be remembered, however, that as of 1970 cotton and cotton blends held over 70 percent of the market for sleepwear sizes 7-14 [5]. Flannel was the most common construction of the sleepwear that was tested; two-thirds (22)

of the pajamas and three-fourths (17) of the nightgowns were cotton flannel. Plain cotton was the only other significantly represented fabric accounting for 23 percent of the tested pajamas and 18 percent of the tested nightgowns.

Fabric weight determinations were made for 55 fabric remnants that were of sufficient size to test. Table 9 shows the distribution of weights for pajama, nightgown and robe fabrics tested. Pajama and nightgown weights are clustered around 3.5 - 4.0 oz./sq.yd. and almost all were under 4.5 oz./sq.yd.

Table 9. Fabric Weights of First-to-Ignite Sleepwear Items For the 6-12 Age Group

Weight (oz./sq. yd.)	Pajamas	Nightgowns	Robes	All Sleepwear
Less than 2.6	3	-	-	3
2.6 - 3.0	4	5	-	9
3.1 - 3.5	6	3	-	9
3.6 - 4.0	10	10	1	21
4.1 - 4.5	5	2	1	8
Greater than 4.5	1	2	2	5

#### 4. FINDINGS FROM OTHER SOURCES

Additional independent information from Shriners Burns Institute [6] and the National Burn Information Exchange (NBIE) [7] provide further evidence of the hazard facing children in the 6-12 age group. The Burns Institute compiled data on children age 16 or younger admitted to their hospital during the period March 1966 to December 31, 1970. The number of clothing ignitions (165) for the 6-12 age group slightly outnumbered those (153) for the 0-5 age group as can be seen in table 10. Eighty-nine percent of the ignitions involved children age 12 or younger.

From reports, by 324 patients, of specific garment items ignited, 76 of 539 garments listed were sleepwear. As in the FFACTS data, girls' sleepwear was more frequently involved than boys'. Out of 279 girls' garments, 60 (21.5 percent) of the items were sleepwear. This is almost four times the 16 sleepwear items reported for boys. Table 11 details these figures. Note that the garment data from Shriners include all items involved in the incidents reported, whereas the FFACTS data (tables 1-9) include only those items first to ignite. Although table 11 indicates a relatively high involvement for underwear items (22 percent of all items involved), the FFACTS data in table 1 show that underwear was first to ignite in only 6 percent of the 995 garment incidents reported. Shirts and sleepwear, on the

other hand, show a substantial involvement in both the FFACTS data and Shriners data since they are often the first items ignited in fire incidents (table 1).

Table 10. Frequency of Clothing Ignition - Acute Admissions (SBI)<sup>a</sup>

Age	Number of Clothing Ignitions		
	Male	Female	Total
0-1	1	1	2
1-2	4	5	9
2-3	10	12	22
3-4	15	15	30
4-5	14	29	43
5-6	18	29	47
6-7	12	18	30
7-8	11	12	23
8-9	16	14	30
9-10	18	13	31
10-11	14	6	20
11-12	10	10	20
12-13	10	1	11
13-14	9	6	15
14-15	12	3	15
15-16	6	3	9
Total	180	177	357

<sup>a</sup>Source: Shriners Burns Institute [6].

Table 11. Frequency of Specific Garment Item Ignition For Children Ages 0-16 (SBI)<sup>a</sup>

Garment Item	Males		Females		Total	
	Number	Percent	Number	Percent	Number	Percent
Shirts/Blouses	79	30.4	24	8.6	103	19.1
Trousers . . .	64	24.6	-	-	64	11.9
Underwear . . .	50	19.2	70	25.1	120	22.2
Sleepwear . . .	16	6.2	60	21.5	76	14.1
Dresses/Skirts	-	-	86	30.8	86	16.0
Miscellaneous.	51	19.6	39	14.0	90	16.7
Total . . . .	260	100.0	279	100.0	539	100.0

<sup>a</sup>Source: Shriners Burns Institute [6].

Table 12 shows the distribution of 3,982 clothing items ignited in 3,553 NBIE cases from civilian hospitals. These data again include all clothing ignited, not just the garments first to ignite. Fifteen percent of the garments in the 6-14 age group were sleepwear items compared to 16 percent for the 0-5 age group. The number of sleepwear items ignited for the 0-5 and 6-14 groups combined represents 46 percent of all the sleepwear items involved in these cases.

Table 12. Distribution of Clothing Ignited by Age Group<sup>a</sup>  
(NBIE)

Garment Item	Ages of Persons Involved						Total	
	0-5 Years		6-14 Years		Over 14 Years			
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Shirt/Blouse .	135	20	261	28	716	30	1,112	28
Pants/Slacks .	108	16	213	23	620	26	941	24
Dress/Skirt. .	158	24	148	16	143	6	449	11
Underwear. . .	84	13	93	10	263	11	440	11
Sleepwear. . .	109	16	140	15	287	12	536	13
Sweater. . . .	9	1	9	1	48	2	66	2
Other Clothing	49	7	55	6	264	11	368	9
Non-Clothing .	13	2	9	1	48	2	70	2
Total. . . .	665	99	928	100	2,389	100	3,982	100

<sup>a</sup>Derived from NBIE data in [7].

## 5. CONCLUSIONS

The data presented in the preceding sections indicate that the flammability of sleepwear is a hazard to children of ages 6 through 12. In the FFACTS data base as a whole, sleepwear is the fabric item which is most frequently first to ignite. Almost one-fourth of these sleepwear incidents involved children in the 6-12 age group, while another one-fourth involved children under age 6. Thus, children under age 13 represent half of the persons involved in first-to-ignite sleepwear incidents in FFACTS. High susceptibility to sleepwear ignitions is not limited to children under age 6, for whom a standard already exists, but appears to extend uniformly through age 12. Data from Shriners Burns Institute and NBIE corroborate the relatively equal involvement of the 0-5 and 6-12 age groups in garment fires (tables 10, 12).

Females 6-12 years old were much more vulnerable than males of the same age to ignitions of sleepwear. Sixty-one of 77 children 6-12 years old involved in first-to-ignite sleepwear incidents were female (table 2). This represents a much higher female involvement than in the 0-5 age group. It also is the beginning of a pattern which is evidenced in all higher age groups - the complete dominance of females



in fabric fires started by ignition of sleepwear. The Shriners Burns Institute study provides additional evidence of the high ratio of females-to-males involved in sleepwear ignitions (table 11).

Market data on children's sleepwear help place the FFACTS data in perspective. According to a 1972 study [8] by the American Apparel Manufacturers' Association (AAMA), girls and boys shared equally the size 7-14 (ages 6-12) sleepwear market. Girls in this age group therefore seem to face a much greater risk than boys in the same age group.

Kitchen ranges and nightgowns appear to be the two major factors that contributed to the relatively high female involvement in the 6-12 age group. Kitchen ranges were responsible for 38 of the 77 sleepwear ignitions in this group and females were involved in 32 of the 38 (table 5). If it is true that girls spend more time in the kitchen than boys, and accordingly come in contact with kitchen ranges more frequently, then this would account, in part, for the low representation of males in incidents stemming from sleepwear ignition.

From the FFACTS data it can be seen that kitchen ranges were the predominant source of ignition for girls' pajamas in the 6-12 age group. Twenty-two of 27 girls' pajamas were ignited by ranges. Kitchen range ignitions of girls' nightgowns, however, represent a much smaller proportion of nightgown ignitions. Thirty-one of the 77 first-to-ignite sleepwear items were nightgowns, all but one worn by females; yet, only 9 of the girls' nightgowns were ignited by kitchen ranges.

There are several possible reasons for the apparent differences in the interactions of kitchen ranges with pajamas and nightgowns. A primary factor is garment construction and its relationship to various ignition sources and activity patterns of persons involved in these incidents. Pajamas are generally in two pieces - a loose shirt top and a pants bottom - while nightgowns are one piece and by nature loose fitting and flowing. In ignitions of these garments by kitchen ranges, there are four distinct areas that are particularly vulnerable: (1) the cuffs and sleeves of both pajamas and nightgowns, (2) the pajama tops, (3) the midsection of nightgowns and (4) the hemmed edge at the bottoms of nightgowns. Range ignition of the hemmed bottoms of nightgowns most frequently involved 0-5 year olds who, because of their limited height and reach, often climbed up on the range top. Children over age 5 usually are taller than the range and are able to reach for what they want without climbing, although there are a few cases of climbing in the 6-12 age group. This factor therefore appears to be only a minor problem in the 6-12 age group; the hemmed lower edges of pajamas and nightgowns were not ignited frequently by ranges.

Since the average heights of 6-12 year olds range from under 4 feet to 5 feet [9,10] and kitchen ranges are approximately 3 feet high, many children in this group are tall enough to see and reach things on or above the range. Clearly, in reaching across or leaning against a kitchen range children in the 6-12 age group expose above-the-waist sections of their garments to ignition. The minimal clearance between a child's extended arm and a range burner presents a hazard to the cuffs and sleeves of nightgowns as well as pajamas. Pajama tops, though, may be more vulnerable to ignition than the top portion of nightgowns since the top of a pajama is loose and able to drape over a burner. A nightgown clings closer to the upper part of the body due to the weight of the material in the lower portion of the garment. This limits the opportunity for the nightgown top to drape over a burner especially considering the 4-5 feet heights of the children involved. In this way, garment construction may partially explain the predominance of girls' pajamas in kitchen range incidents.

Market data from the AAMA study [8] show that pajamas represent 60 percent and nightgowns 40 percent of the girls' sleepwear market for sizes 7-14. Therefore, one might expect 50 percent more pajama ignitions than nightgown ignitions if pajamas and nightgowns were equally hazardous in the same situations. This may be partially responsible for the ratio (22 to 9) of girls' pajamas to nightgowns in kitchen range ignitions assuming the garments to have relatively equal hazards above the waist. However, these market data cannot explain the fact that, when all ignition sources are considered, approximately equal numbers of females' pajamas and nightgowns are ignited. For ignition sources other than ranges (matches, lighters, heaters and open fires), the construction of nightgowns makes them more prone than pajamas to ignition below the waist. The flowing, loose nature of nightgowns inadvertently exposes the hems to heat sources such as space heaters and fireplaces which pajama bottoms would not ordinarily come in contact with. Ignition sources other than kitchen ranges ignited 21 girls' nightgowns and only 5 girls' pajamas in FFACTS incidents involving the 6-12 age group.

An interesting characteristic of sleepwear fires involving 6-12 year olds as well as all other age groups is the almost complete absence of flammable liquids in the ignition sequences. Contamination by flammable liquids does not appear to be a significant problem in sleepwear ignitions.

Finally but most important are the injuries suffered by these children. Of 77 children ages 6-12 whose sleepwear was first to ignite in FFACTS incidents, 52 were hospitalized and 5 died. No one was known to have escaped injury. These children probably would not have been severely burned had the sleepwear they were wearing been flame retardant. But no conclusions could be drawn as to the

relationships between the severity of the injury and the fabric weight of the sleepwear, since virtually all fabrics were within a narrow weight range.

## 6. RECOMMENDATIONS

Since the present children's sleepwear flammability standard, DOC FF3-71, applies to sizes 0-6X only, children over age 5 are not afforded the protection of the standard. Yet, children between the ages of 6 and 12 face a flammability hazard similar to that of children under age 5. It is therefore recommended that a new flammability standard be issued to cover sleepwear worn by the 6-12 age group, or sizes 7 through 14.

Furthermore, it is also suggested that the role of kitchen ranges in garment fires be thoroughly studied in light of the large number of fire incidents apparently started by direct ignition from range burners. Subsequently, some attention should be given to possible remedial action that would diminish the ignition hazards resulting from the interaction of ranges with garments and children.

## 7. GLOSSARY

*Contaminated item:* A fabric item soaked with or in contact with flammable liquids at the time of ignition.

*Incident:* A single ignition event originating from a single heat source and involving (possibly via an intermediary material) one or more fabrics or fabric products and any and all persons directly involved in the resulting fire.

*Intermediary material:* Any non-fabric material, such as wood, gasoline or natural gas, which acts as a link in the ignition sequence transferring heat from an initial source of ignition to fabric items which subsequently become involved in the fire.

*Item:* Any fabric, fabric product or related material intended or promoted for use.

*Person involved:* Any individual who initiates a fabric fire incident or who is injured in such an incident or who is in some way directly involved in an incident.

*Sleepwear:* Any product of wearing apparel such as a nightgown, pajama, or similar or related item, such as a robe, intended to be worn primarily for sleeping or activities related to sleeping. Diapers and underwear are excluded from this definition.



## 8. REFERENCES

- [1] The Standard For the Flammability of Children's Sleepwear, DOC FF3-71, Federal Register, Vol. 37, No. 141 (July 21, 1972), 14624-14632 (Revised).
- [2] Children's Sleepwear, Notice of Finding That Flammability Standard May Be Needed and Institution of Proceedings, Federal Register, Vol. 37, No. 116 (June 15, 1972), 11896-11897.
- [3] The Flammable Fabrics Act, 81 Stat. 568, 15 U.S.C. 1191, as amended and revised Dec. 14, 1967.
- [4] U.S. Bureau of the Census, 1970 Census of Population, United States, General Population Characteristics, Advance Report, PC(V2)-1 (Feb. 1971).
- [5] National Cotton Council of America, Cotton Counts Its Customers, 1965-1971, Special Edition (Feb. 1973), 26,38.
- [6] Shriners Burns Institute, Study of Children Admitted to S. B. I., Whose Injuries Resulted From Ignition and Burning of Clothing, unpublished report.
- [7] U.S. Department of Health, Education and Welfare, Third Annual Report to the President and the Congress, Studies of Deaths, Injuries and Economic Losses Resulting From Accidental Burning of Products, Fabrics, or Related Materials (1971), 115.
- [8] American Apparel Manufacturers' Association, Cost Consequences to the Consumer Regarding Certain Aspects of a Children's Sleepwear Standard, Sizes 7 to 14, Report to Acting Assistant Secretary of Commerce For Science and Technology (Dec. 15, 1972).
- [9] U.S. Department of Health, Education and Welfare, Vital and Health Statistics Series 11, No. 104, Height and Weight of Children - United States.
- [10] U.S. Department of Health, Education and Welfare, Vital and Health Statistics Series 11, No. 124, Height and Weight of Youths 12-17 Years - United States.



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<p>16. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)</p> <p>Sleepwear was the first fabric item ignited more frequently than any other item in over 1,900 fire incidents reported to the National Bureau of Standards Flammable Fabrics Accident Case and Testing System (FFACTS). Information acquired since promulgation of the current sleepwear flammability standard protecting children of ages 0-5 indicates a problem of comparable magnitude exists for children of ages 6-12. Of 316 incidents involving non-contaminated sleepwear that was first to ignite, about one-fourth involved children 0-5 years old and one-fourth involved children 6-12 years old. For the 6-12 group, sleepwear ignited first more often than all other garment items combined. Females outnumbered males 4-to-1 in the 6-12 group, due mostly to the involvement of nightgowns and kitchen ranges, the most common ignition source for this age group. Five of the 6-12 year old children died and 52 of 74 victims were hospitalized. Almost all of the first-to-ignite sleepwear in this group was cotton. Data from Shriners Burns Institute and the National Burn Information Exchange provide further evidence of the involvement of children ages 6-12 in garment fires. It is recommended that a new standard be issued covering sleepwear sizes 7 through 14 to effectively protect 6-12 year old children.</p>			
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