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DATA REPORT NO. 96

FLAMMABILITY OF AIRLINE STEWARDESS
UNIFORM FABRICS

PROJECT NO. 184-732-05X

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Purpose

A test program was conducted to determine the degree of flammability in relation to existing federal standards for clothing and cabin interior materials of a stewardess uniform involved in an Air Carrier accident.

Background

A request was made by the Eastern Region ACDO-31 Office in June 1972 to evaluate the fire hazards of a stewardess uniform. The accident which was responsible for this investigation is described as follows in the Flight Standards Mechanical Reliability Report of 19 June 1972:

"American Airlines Accident, 10 June 1972 at La Guardia Airport (N.Y.C.). During deplaning of last 6 passengers due necessary obtain wheel-chairs, one passenger felt nauseous. Flight attendant attempted to administer oxygen from walkaround bottle. Oxygen bottle ignited when opened causing two flight attendants to be burned and one flight attendant had smoke inhalation. Captain received minor burns in extinguishing fire. Location of incident was at seat 19D and caused damage to seat and blanket, rack and cabin ceilings in that area. Full investigation of incident to be made."

Flammability of clothing is one of the major working hazards to personnel normally engaged in activities which subject them unduly to fire exposure. The Flammable Fabrics Act of July 1954 was the first federal regulation designed to ban the sale of clothing which was then considered as extremely flammable, such as some types of imported sweaters. Because of the increased public clamor in recent years for greater consumer protection, the act was amended in 1967 to greatly enlarge its scope in the field of fire safety by authorizing the National Bureau of Standards to "conduct feasibility studies on reduction of flammability, develop flammability test methods and standards and offer appropriate training in the use of flammability test methods." A number of new flammability

standards have already evolved from the new activity. Of particular interest is that of the proposed standard for children's sleepwear (DOC FF 3-71) as published in the Federal Register, 17 November 1970, and which became effective on 29 July 1972.

Since 1947 federal regulations have been in effect which limited the flammability of airplane cabin interior furnishings, including drapery and upholstery fabrics to a maximum horizontal burn rate of 4 inches/minute. These requirements for certification of transport aircraft under FAR 25 continued unchanged until July 1969, when FAA proposed new standards that would require fabrics to be self-extinguishing in the more severe vertical test rather than just slow burning by the less severe horizontal test as in the past. The new standards issued under NPRM 69-33 in July 1967 were adopted by the aviation industry for the certification of the wide-bodied jet transports. These new standards were incorporated in FAR 25 as per Amendment 25-32, effective 1 May 1972. The severity of the test method contained in Appendix F of the above amendment and the maximum allowable burn length of the fabric under FAR 25.853 are nearly the same as for the test standards used for approval of children's sleepwear.

In response to demands for clothing fabrics that will resist rapid flame spread and tend to self-extinguish thereby limiting burns to the body, industry in recent years has been encouraged to develop new and safer materials. New and more permanent chemical treatments to inhibit the flaming of conventional fibers, both natural and synthetic, have been formulated to increase the flame resistance of fabrics. In addition, new synthetics - Nomex, Durette, Kynol, Dynel, Teflon, etc. are now available that are inherently slow burning and self-extinguishing as fibrous materials. Progress in the field of clothing fire protection has been held back by such considerations as increased discomfort, decreased serviceability, poorer appearance and increased cost as compared to the older materials.

However, the use of flame and/or fire resistant clothing can be expected to increase in the future as a result of legislation and its encouragement to materials technology for new products to meet the public needs.

This test facility has been involved in several instances in the past when due to fire injury to stewardesses, attention was drawn to possible deficiency in the quality of the garments to resist fire and limit the severity of the resulting burns. The first of these incidents was investigated here about 6 years ago. Tests were performed on two uniform materials, one consisting of 100% wool and the other a wool/dacron/mohair blend. At that time, the tests were conducted for and were of interest to the Air Line Pilots Association (Steward and Stewardess

Division) because of the safety implications to personnel. Although the test results were made known to ALPA by telephone, the report itself was never released or publicized (Technical Information Sheet No. 16, dated 25 March 1966).

Test Procedure

The clothing consisting of a red skirt and white blouse was cut to specimen size of 2 inches by 6 inches and 3 inches by 12 inches and conditioned at a temperature of 70° F and 50% humidity prior to test.

The flammability of the fabrics was determined from the standard laboratory tests under 3 different configurations: (1) horizontal, (2) inclined 45° and (3) vertical.

The horizontal test described in Appendix A was conducted in accordance with Federal Standard 191, Test Method 5906. This test method was used from 1947 to 1969/72 to certify interior materials, including fabrics, for transport aircraft.

The inclined 45° test described in Appendix B was conducted in accordance with Federal Standard 191, Test Method 5908 to certify clothing in accordance with the Flammable Fabrics Act of 1954 as amended 4 May 1967.

The vertical test described in Appendix C and D was conducted in accordance with Federal Standard 191, Test Method 5902/5903. This is the test method presently used by the aviation industry and required by FAA to establish self-extinguishing specifications for aircraft materials.

Discussion

Tests on the stewardess clothing were conducted both by the Office of Flammable Fabrics at the National Bureau of Standards and at the Fire Test Facility at NAFEC.

Test results furnished by NBS are contained in Tables 1 and 2. The degree of flammability of the two fabrics is rated by the time required for complete burning of the test specimen. Materials are judged superior based on the longer the time needed to burn completely. The difference in the test methods used to obtain the data is slight. In Table 1 the pilot flame used as an ignition source is extinguished as soon as the fabric catches fire and starts to flame. Instead, in Table 2 the pilot flame is allowed to continue to burn until the end of the test. The somewhat more severe fire exposure is reflected in the more rapid burning of the test specimens (i.e. shorter flame time). Based on the flame times recorded for the two fabrics, the data show that the clothing material exceeds the requirement of Commercial Standard CS 191-53

(maximum 4 seconds flame time) by 5 to 10 times as well as the requirements of NFPA Standard No. 702 for Class 1 material. Humidity and direction of the fabric weave are important factors in the way these materials burn with the more rapid rate of burning usually observed in the warp rather than in the fill direction. Tests were conducted with test specimens cut from the uniform in both directions.

Test results furnished by NAFEC are contained in Tables 3 and 4. The degree of flammability of the two fabrics by Test Method 5906 is judged by the rapidity of flame propagation over the horizontal surface of the specimen. This is expressed as burn rate. The test results show that the red skirt double knit fabric is more flammable than the white blouse fabric. However, both fabrics exceed the 4-inch per minute maximum burn rate under which cabin upholstery fabrics have in the past been certified for use in aircraft.

The degree of flammability of the two fabrics by Test Method 5903 is judged by the char and/or burn length of the test specimen prior to self-extinguishment. Other additional requirements are that when the burner flame is withdrawn the test specimen ceases to flame within a certain time limit and also the molten flaming droplets become extinguished within a few seconds. The data show that the fabrics exceed both the maximum 7-inch char length under Sleepwear Standard DOC FF 3-71 and the maximum 8-inch burn length under FAR 25.853. The fabrics also fail to meet the 10-second residual or flameout requirements under DOC FF 3-71 or the 15-second requirement under FAR 25.853. The data also show that the fabrics melt almost completely when burned with little or no char formation. Further, of particular interest is the extremely long time of 40 seconds or more during which the fabric continues to flame after removal of the ignition source.

The only difference between the FAR 25 and DOC FF 3-71 test procedures is that of the length of the longer fire exposure of the specimen to the Bunsen burner flame - 12 seconds as compared to 3 seconds. However, tests on a number of specimens did not show any effect on burn length due to increase burner exposure time.

A few tests were made by directing a stream of oxygen at a pressure of about 2 psi against a 3-inch by 12-inch fabric sample while undergoing burning. As expected, flaming was greatly accelerated. Maximum horizontal burn rate in the oxygen stream varied from 10 to 50 inches per minute which is an order of magnitude of 10 to 1 compared to tests in air. Much more rapid burning of the fabric which sputtered like gunpowder and burned with an intense white flame was observed indicating a very high temperature of combustion.

Summary of Test Results

The results of the investigation show no unusual flammability characteristics of the clothing fabrics constructed of synthetic fibers. The fabrics far exceed the very lenient requirements under the Flammable Fabrics Act but fail to meet the much more severe requirements for children's sleepwear under DOC FF 3-71. The most severe shortcoming of the fabric, identified by NBS as 100% polyester, is with its extreme tendency to melt and drip. Fabrics such as those made of wool or from some of the new synthetics previously mentioned, would provide more adequate protection against burns to the body because of the ability of the material to form a char surface. This char surface acts as an insulating layer to the skin against flame and heat penetration.

TABLE 1 - FLAMMABILITY OF STEWARDESS UNIFORM MATERIAL IN 45° POSITION
TEST METHOD CS 191-53 (MODIFIED 5908)

Test No.	Material	1-Second Exposure Test	Flame Time Under Forced Surface Ignition (sec)	Melts	Drips	Meets CS 191-53 Class 1 Rating (4)
<u>White Uniform Fabric</u>						
- 100% Polyester						
1.		Did not ignite (1)	28.1 (2)	Yes	Yes	Yes
2.		-- -- --	Ignited but extinguished (3)	--	--	--
3.		-- -- --	21.2	--	--	--
4.		-- -- --	Ignited but extinguished	--	--	--
5.		-- -- --	22.2	--	--	--
<u>Red Uniform Fabric (5)</u>						
- 100% Polyester						
1.		Did not ignite	Ignited but extinguished	Yes	Yes	Yes
2.		-- -- --	19.8	--	--	--
3.		-- -- --	43.0	--	--	--
4.		-- -- --	Ignited but extinguished	--	--	--
5.		-- -- --	41.0	--	--	--

Notes:

- (1) Fabric did not ignite to a self-propagating flame.
- (2) Time required for 5-inch length of specimen to burn completely. Pilot flame exposure continued only until fabric ignited and became self-flaming, then was shut off.
- (3) Fabric ceased to flame and burn before reaching top of specimen.
- (4) Section 3.1.1.1 - "Textiles without nap, pile, tufting, flock, or other type of raised fiber surfaces, shall be classified as Class 1, when the time of flame spread is 4 seconds or more."
- (5) Double knit - No indication of direction of weave.

TABLE 2 - FLAMMABILITY OF STEWARDESS UNIFORM MATERIAL IN 45° POSITION
TEST METHOD NFPA NO. 702

Test No.	Material	Direction of Weave	Flame Time (1) (sec.)	Melts	Drips	NFPA No. 702(2) Classification
White Uniform						
Fabric - 100% Polyester						
1.		Warp	19.4	Yes	Yes	2
2.		Fill	26.8	Yes	Yes	1
3.		Fill	27.4	Yes	Yes	1
Red Uniform (3)						
Fabric - 100% Polyester						
1.		Warp	18.6	Yes	Yes	2
2.		Fill	37.8	Yes	Yes	1
3.		Fill	37.3	Yes	Yes	1

Notes:

- (1) Time required for 5-inch length of specimen to burn completely. Pilot flame exposure continued for entire duration of the test. (Flame Time).
- (2) Section 311 - Class 1 - 20 seconds or more, Class 2 - 8 to 19 seconds, Class 3 - 3 to 7 seconds and Class 4 - less than 3 seconds
- (3) Double knit

TABLE 3 - FLAMMABILITY OF STEWARDLESS UNIFORM MATERIAL IN HORIZONTAL POSITION
TEST METHOD 5906

Test No.	Material (1)	Time to Reach Start Wire (sec.)	Total Flaming Time (sec.)	Burn Length (in.)	Burn Rate (in./min.)	Flaming Time of Burning Droplets (sec.)	Meets FAR 25 Prior to May 1972 Amend.
<u>White Uniform Fabric</u> - 100% Polyester							
1.		17	136	Complete	5.1	10-15	No
2.		14	99	8.6	5.0	10-15	No
3.		13	127	Complete	5.3	10-15	No
<u>Red Uniform Fabric</u> - 100% Polyester							
1.		17	94	10.0	6.6	10-15	No
2.		12	75	Complete	8.2	10-15	No
3.		11	92	Complete	7.3	10-15	No
4.		13	91	Complete	7.7	10-15	No

Note:
(1) Tests conducted along most critical direction of weave.

TABLE 4 - FLAMMABILITY OF STEWARDLESS UNIFORM MATERIAL IN VERTICAL POSITION
TEST METHOD 5902 (5903)

Test No.	Material (1)	Flameout Time (sec.)	Glowing Time (sec.)	Burn Length (in.)	Char/Melt Length (in.)	Flaming Time of Burning Droplets (sec.)	Meets DOC FF 3-71 (2) Sleepwear or FAR 25(3) Fabric Standards
White Uniform (4)							
Fabric - 100% Polyester							
1.		48	0	11.1	11.1	None	No
Red Uniform							
Fabric - 100% Polyester							
1.		44	0	8.6	8.6	15 ⁺	No
2.		44	0	8.0	8.0	15 ⁺	No
3.		44	0	9.0	9.0	15 ⁺	No

Notes:

- (1) Tests conducted along most critical direction of weave (warp).
- (2) DOC FF 3-71, Standard for children's sleepwear - "No individual test specimen shall have a residual flame time and flaming of molten droplets exceeding 10 seconds. No individual specimen shall have a char length of over 10 inches and the average char shall not exceed 7 inches."
- (3) FAR 25.853, Category (b) materials (fabrics) shall not exceed a burn length of 8 inches, extinguish within a flameout time of less than 15 seconds and any flaming droplets on the floor shall extinguish within 5 seconds.
- (4) Enough material left for one test.

APPENDIX A

BURNING RATE OF CLOTH; HORIZONTAL

1. Scope

1.1 This method is intended for use in determining the comparative rates of burning of cloth. This method is satisfactory for cloth that has not been flameproofed, including pile and napped cloth. The rate of burning is slower in this method than in method 5902.

2. Test Specimen

2.1 Unless otherwise specified in the material specification, the specimen shall be a rectangle of cloth $4\frac{1}{2}$ inches by $12\frac{1}{2}$ inches, with the long dimension parallel to the warp direction of the cloth. It has been found that the pattern of some cloth may cause the cloth to be more hazardous in one direction than in the other, in which case the long dimension of the

specimen should be parallel to the more hazardous direction.

3. Apparatus (fig. 5906).

3.1 The cabinet (A) for protecting the specimen from drafts shall be metal, 8 inches wide, 15 inches long, and 14 inches high with a glass observation window (B) in the front. It shall have a removable cover (C) with a $\frac{1}{2}$ -inch ventilating clearance all around which contains two pyrex observation windows (D), one near each end of the cabinet. Each corner of the bottom shall have a support (J) so that the floor of the cabinet is raised $\frac{3}{8}$ inch above the table top or other surface upon which it is placed. The bottom of the cabinet shall have five equally spaced $\frac{3}{4}$ -inch ventilating holes (O) along each

HORIZONTAL RATE OF BURNING APPARATUS

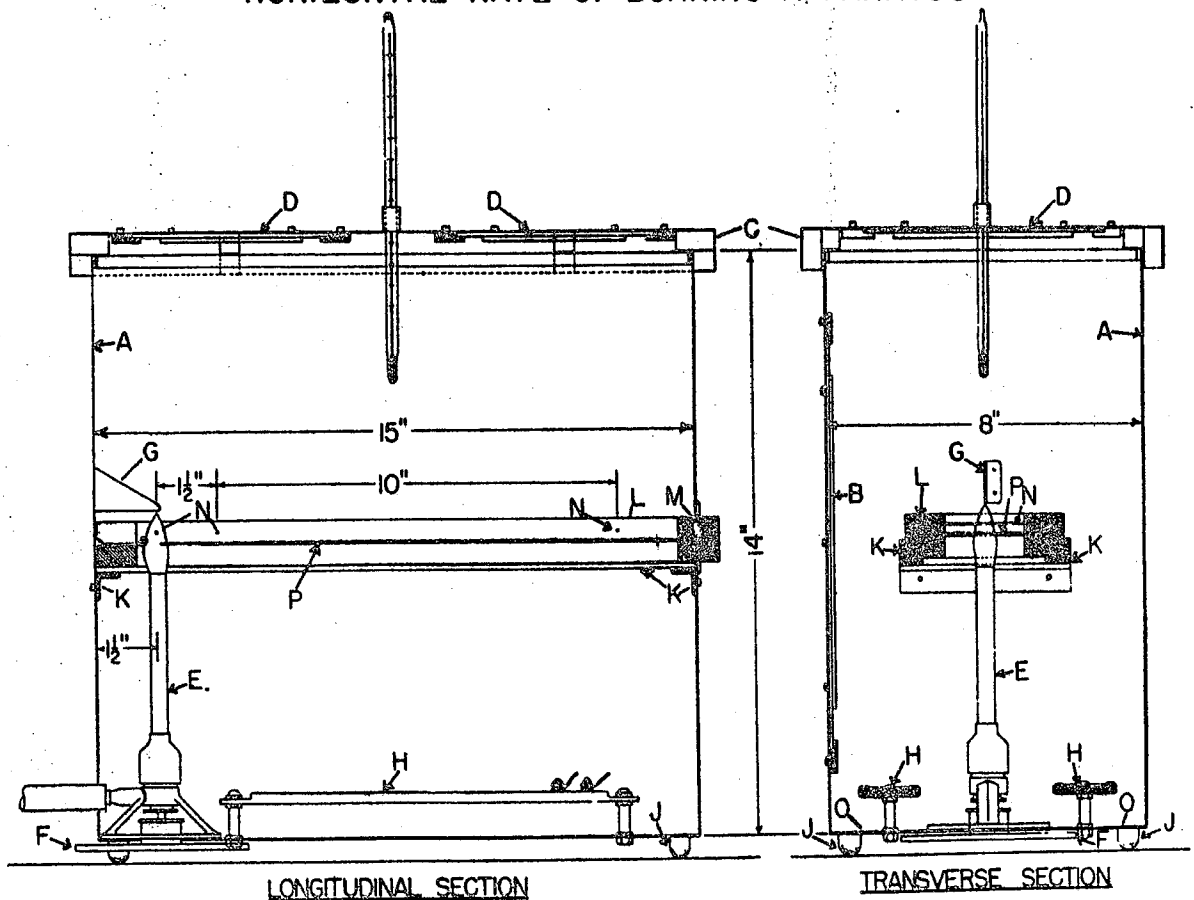


FIGURE 5906.

Method 5906

side of the cabinet. An immersion thermometer shall be inserted through the center of the cover for registering the temperature of the cabinet. The cabinet shall have a slot in one end through which the specimen holder is inserted so as to slide on a horizontal supporting track (*K*) into test position (*P*), in which position the center of the end of the specimen is $\frac{3}{4}$ inch above the top of the burner.

3.2 Two electric strip heaters (*H*) for maintaining the required temperature in the cabinet, one on each side of the cabinet just above the ventilating holes in the bottom.

3.3 Specimen holder consisting of a clamp composed of two matching rectangular frames, each $15\frac{1}{2}$ inches long and 4 inches wide over-all. The two sections shall be aligned by means of two pins (*M*) at one end of the lower section which fit into corresponding holes in the upper section. The rectangular frames shall be 1 inch wide and $\frac{1}{2}$ inch in thickness, made from strips of nickel-plated steel, chrome-plated steel, or other material that will not corrode.

3.3.1 Heat-resistant marking wires (*N*) attached to the upper section in such a manner that they will not touch the specimen but will cross it at right angles. One wire shall be $1\frac{1}{2}$ inches from the inside edge of the frame at the ignition end, and one wire shall be located 1 inch from the other end so that there will be a distance of 10 inches between the two wires. A third wire shall be placed across the upper section, $\frac{1}{2}$ inch from the inside edge of the ignition end to serve as a guide for adjusting the position of the specimen in the holder. The open space framed inside the specimen holder shall be 2 inches wide and $13\frac{1}{2}$ inches long.

3.4 Combing device consisting of a flat metal base 6 inches wide and 24 inches long, carrying a bracket to which a comb support is hinged in such a manner as to permit raising and lowering the comb. The comb shall be $4\frac{1}{2}$ inches wide and shall have 7 to 8 smooth rounded teeth per inch. When the comb is in the lowered position, it shall rest on the base plate at an angle of 20° . Means shall be provided for applying a total load of 250 grams to the cloth when the comb is in contact with the cloth.

3.5 Stop (not shown in the figures) for use with double-napped cloth. The stop shall con-

sist of a cross strip of 26-gage sheet steel, $\frac{1}{4}$ inch wide, removable and fitted on the lower frame of the specimen holder, midway of its thickness or $\frac{1}{4}$ inch below the cloth mounting plane. It shall cross the under surface of the specimen about 8 inches from the end to be ignited and far enough below the cloth to have no effect on the burning on the upper surface while preventing a quick flash over the lower surface.

3.6 Tirrill or Bunsen gas burner (*E*) with a $\frac{3}{8}$ -inch inside diameter tube, so located in the cabinet that the center of the end of the specimen shall be directly above the tip of the flame when the specimen is in place.

3.7 Large wheel (*F*) extending outside the cabinet and attached to the gas supply valve of the burner so as to permit easy regulation of the height of the flame from outside the cabinet.

3.8 Means for gaging the height of the flame (*G*).

3.9 Stop watch or other timing device which will indicate the time to $\frac{1}{6}$ second.

4. Procedure

4.1 *Conditioning.*—The specimen shall be suspended vertically and heated in a circulating-air oven at a temperature of 60° to 62.8° C. (140° to 145° F.) for $4 \pm \frac{1}{4}$ hours before testing. Only one specimen shall be removed from the oven at a time and immediately subjected to the flame test.

4.2 *Plain cloth.*—The specimen shall be slipped into the holder which clamps each long edge leaving a center strip 2 inches wide and $12\frac{1}{2}$ inches long taut and exposed with $\frac{1}{2}$ -inch clearance between the frame and each end of the specimen.

4.2.1 With the burner flame turned as low as possible, the specimen holder containing the specimen shall be slipped through the slot in the end of the cabinet until the entire length of the specimen is barely within the cabinet. The specimen shall be held in this position in the cabinet for a 2-minute reconditioning period before the test is made. At the end of the reconditioning period, the specimen holder shall be drawn back to clear the burner and the burner adjusted to give a flame $1\frac{1}{2}$ inches in height with the air completely shut off.

4.2.2 The specimen holder containing the specimen shall then be slid on the supporting

track (*K*) into test position (*P*) so that the end of the specimen is $\frac{3}{4}$ inch above the top of the burner, and the specimen then ignited. The temperature of the inside of the cabinet shall be approximately 60° C. (140° F.) during the test. A $1\frac{1}{2}$ -inch length of the specimen shall be burned before the timing device is started.

4.2.3 The time required for the flame to travel across a 10-inch length of the specimen shall be determined.

4.3 *Napped cloth.*—If the cloth has a nap or tufting, the specimen shall be combed twice against the nap by drawing it slowly under the comb, taking 2 to 3 seconds for its passage. The cloth shall be maintained flat against the base of the combing device while it is drawn under the comb. The specimen shall be placed in the specimen holder so that the flame will travel in the direction of the lay of the nap.

4.3.1 If the cloth is double-napped a stop shall be used to prevent a flash from traveling across the underside of the cloth and igniting the other end of the specimen before the flash

has traveled across the upper surface. In other respects the procedure shall be as described for plain cloth, 4.2.

5. Report

5.1 Unless otherwise specified in the material specification, five specimens shall be tested from each Unit-of-Product. If the difference between any two individual results is less than 40 percent from the average of the specimens tested, the rate of burning of the Unit-of-Product shall be the average of the results obtained from the specimens tested.

5.1.2 If the difference between any two individual results obtained in 5.1 is more than 40 percent from the average, unless otherwise specified in the material specification, 10 specimens shall be tested from each Unit-of-Product and the average of the 5 highest values reported as the rate of burning of the Unit-of-Product.

5.2 The flash or rate of burning of the Unit-of-Product shall be reported to the nearest 0.5 inch per minute or per second as applicable.

APPENDIX B

BURNING RATE OF CLOTH; 45° ANGLE

1. Scope

1.1 This method is intended for determining the flammability of cloth by measuring the rate of burning or flashing and the ease of ignition. It is satisfactory for use with cloth that has not been flameproofed.

2. Test Specimen

2.1 Unless otherwise specified in the material specification, the specimen shall be a rectangle of cloth 2 inches by 6 inches with the long dimension parallel to the warp direction in plain cloth and to the lay of nap in napped cloth. It has been found that the pattern of some cloth may cause the cloth to be more hazardous in one direction than in the other, in which case the long dimension of the specimen should be parallel to the more hazardous direction.

3. Apparatus (figs. 5908A and 5908B).

3.1 Metal hood or cabinet (A) to prevent circulation of air around the specimen holder and the flame, permitting free ventilation for rapid oxidation. The top shall be adjustable and removable. A glass door (K, end view shown) which slides up and down in the grooves at the front of the cabinet shall be provided. The door shall have a catch mechanism (J) for holding the door in an open condition for inserting the specimen. A draft ventilating strip (not shown) shall be placed across the front opening to seal the space between the sliding door, when the door is in the lowered position, and the base on which the specimen holder is attached.

3.2 Specimen holder consisting of a metal framework 7 inches long and 4 inches wide strung horizontally with heat-transmitting wires (B). The holder shall be fixed at an angle of 45°.

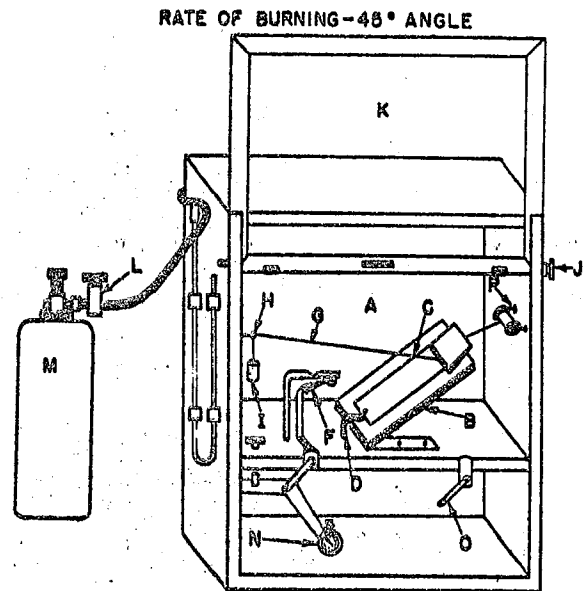


FIGURE 5908A.

3.2.1 Metal shield running the length of the specimen and covering the whole specimen except for a strip 1½ inches wide. The shield shall be controlled by a hand lever, raised for the insertion of the specimen, and brought to bear on the face of the specimen before the start of the test.

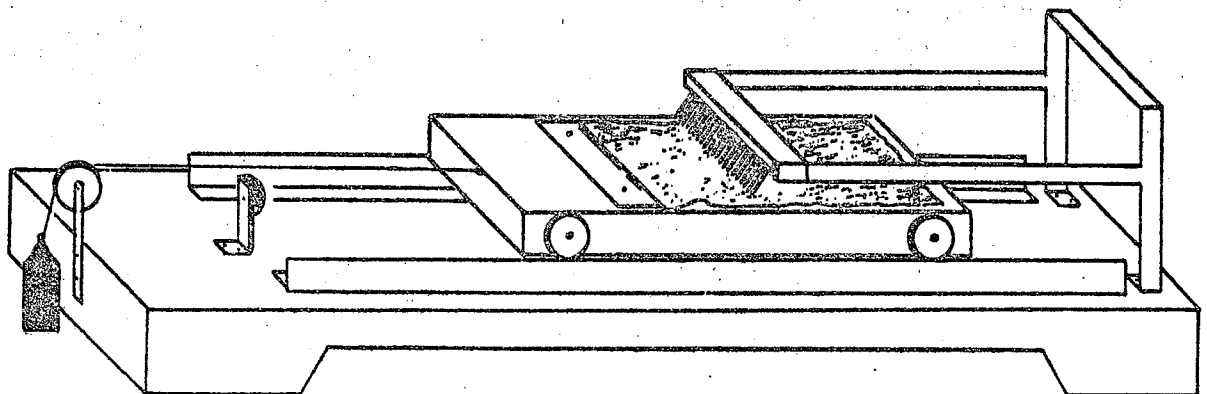


FIGURE 5908B.

Method 5908

3.2.2 Specimen rack, held in position by two knobs, which can be reached under the stage of the cabinet. When the knobs are loosened the holder can be moved forward and backward.

3.2.3 An indicating finger to compensate for the thickness of the specimen through the throw of the gas nozzle (*D*). The fore part of the finger shall rest on the wire lacings when the specimen rack is brought all the way forward.

3.3 Gas jet consisting of a 36-gage hypodermic needle protected by a copper shield (*F*).

3.4 Stopcord supplied from a spool of No. 50 mercerized cotton sewing thread which is fastened to the side of the chamber (*P*). The cord can be withdrawn by releasing the thumb-screw holding the spool in position. The cord for measuring the vertical flame height shall be stretched from the spool down over the top of the holder, through the loops in the shield, and across through a pulley or eye on the opposite side of the cabinet (*H*).

3.4.1 A weight (*I*) shall be attached to the end of the cord in such a position that when it drops it actuates the mechanism which stops the timing device.

3.4.2 Another loop shall be installed on the rear panel of the cabinet behind "*G*" (not shown in figure) so that the cord is drawn away from directly over the flame.

3.5 Fuel supply consisting of a No. 4 cylinder of c. p. butane (*M*), of 2-pound capacity.

3.6 Sensitive valve (*L*) for regulating the fuel supply at the tank. The valve ends in a 1/2-inch female connection for attachment to the standard butane tank.

3.7 Flow meter (not shown) to bring the fuel supply to test level by means of the control valve. The flow meter shall consist of a U-shaped glass tube cut into the gas line so as to register the gas pressure delivered to the microburner. A movable metal plate with two parallel horizontal lines 1 inch apart shall be attached to the case wall behind the flow meter. When the pressure is off, the plate is so regulated that the water level in both sides of the U-tube meets the lower line. When the test is made, the pressure shall be so adjusted that the highest liquid level in the U-shaped tube meets the upper line.

3.8 Stop watch (*N*) or other timing device to indicate the time to 1/8 second.

3.9 Driving mechanism on the rear of the cabinet (not shown) to move the gas jet to its most forward position and to automatically start the timing device at the moment of flame impact. When the cord (*G*) is severed by the flame, the falling weight (*I*) stops the watch.

3.10 Starting lever (*O*) which can be operated from left to right in one stroke and which, when released, shall operate the gas jet.

3.11 Combing device (fig. 5908B) consisting of a baseboard over which a smaller carriage is drawn by means of a 228-gram counterweight. The carriage shall run on parallel tracks attached to the edges of the upper surface of the baseboard. The comb shall be hinged with pin hinges at the rear edge of the baseboard. It shall rest on the carriage at an angle of 30° with the vertical and, when in place, shall exert a total force of 150 grams on the specimen. A cord shall be attached to the counterweight and run over a pulley to the carriage.

4. Procedure

4.1 Preparation of specimen.

4.1.1 *Napped or pile cloth*.—The direction of the lay of the nap or pile face shall be determined. Unless otherwise specified in the material specification, a rectangle 2 inches by 6 inches with the long dimension parallel to the lay of the nap or pile shall be marked on the specimen back. Before cutting, the specimen shall be marked with a staple in the center of the end toward which the nap or pile points. As the required number of specimens are cut, each specimen shall be placed on the combing device and drawn under the comb once against the lay of the napped or pile surface as described in 4.3. The specimen shall be immediately conditioned as described in 4.2.

4.1.1.1 *Combing*.—The specimen shall be placed on the carriage and fastened by a clip. The comb shall be raised, the carriage pushed to the rear (toward the comb), and the comb lowered on the face of the specimen. The carriage shall be released and drawn forward by means of the counterweight.

4.1.2 *Plain cloth*.—The specimen shall be the same size and prepared in the same manner as

that from pile or napped cloth, 4.1.1, except that it shall not be combed. The specimen shall be immediately conditioned as described in 4.2.

4.2 Conditioning of specimen.—The specimen shall be suspended vertically and heated in a circulating-air oven at a temperature of 60° to 62.8° C. (140° to 145° F.) for $4 \pm \frac{1}{4}$ hours before testing. Only one specimen shall be removed from the oven at a time and immediately subjected to the test.

4.3 Flammability test.

4.3.1 The control valve from the fuel supply shall be opened and adjusted to the test level. Some time is required to drive all the air from the fuel line. After this interval, normally approximately 5 minutes, the gas shall be ignited. The flame under conditions of test should be approximately $\frac{5}{8}$ inch in length.

4.3.2 Individual specimens shall be removed from the oven. In the case of napped or pile cloth the specimen shall be combed one time in the direction of the lay of the napped or pile surface. Plain cloth shall not be combed. The specimen shall be placed on the grid of the specimen holder of the flammability tester. Not more than 45 seconds shall elapse from the time the specimen was removed from the oven until the application of the flame.

4.3.3 The specimen holder with the specimen in position (stapled end at top of rack) shall be brought forward to the point where the indicating finger touches the face of the specimen. The

specimen holder shall then be locked. When in this position, the nozzle shall be $\frac{5}{16}$ inch from the face of the specimen when the tester is operating. The shield shall be over the specimen when the above adjustments are made.

4.3.4 The cord shall be strung through the loops in the shield across the top of the specimen through the loop on the rear panel and over the guide ring (*H*). The weight shall be hooked in place close to and just below the guide and the slide door closed. The stop watch shall be set at zero. The apparatus shall be at room temperature at the start of the test, and the test conducted in a draft-free room.

4.3.5 The starting lever shall be brought over to the extreme right and released. This starts the timing mechanism and applies the gas jet to the face of the specimen for a period of 1 second. The timing shall be automatic, starting upon the application of the flame and ending when the cord burns through at the end of the specimen, and the weight is released. Total time shall be recorded to the nearest $\frac{1}{8}$ second.

5. Report

5.1 Unless otherwise specified in the materials specification, five specimens shall be tested from each Unit-of-Product.

5.2 The flammability of the Unit-of-Product shall be the average of the results obtained from the specimens tested and shall be reported to the nearest $\frac{1}{8}$ second.

APPENDIX C

DEPARTMENT OF COMMERCE

Office of the Secretary

[15 CFR Part 7]

CHILDREN'S SLEEPWEAR

Proposed Flammability Standard

On January 24, 1970, there was published in the FEDERAL REGISTER (35 F.R. 1019) a notice of finding that a flammability standard or other regulation, including labeling, may be needed for children's wearing apparel, specifically including sleepwear, and fabrics, or related materials intended to be used, or which may reasonably be expected to be used, for such apparel, to protect the public against unreasonable risk of the occurrence of fire leading to death, injury, or significant property damage, and of institution of proceedings for the development of appropriate flammability standards or other regulations for children's wearing apparel, including the specific category of sleepwear.

After review and analysis of the comments received, and after review of information including that previously cited in the January 24, 1970, FEDERAL REGISTER (35 F.R. 1019) and more recent additions thereto, it is hereby found that a flammability standard for sleepwear normally worn by young children (5 years and under) is needed to protect the public against unreasonable risk of the occurrence of fire leading to death, injury, or significant property damage.

Proposed standard. It is preliminarily found that the proposed flammability standard (DOC PFF 3-70) as set out in full at the end hereof:

a. Is needed for young children's sleepwear to protect the public against unreasonable risk of the occurrence of fire leading to death, personal injury, or significant property damage;

b. Is reasonable, technologically practicable, and appropriate, and is stated in objective terms; and

c. Is limited to young children's sleepwear, and fabrics or related materials which are intended to be used or which may reasonably be expected to be used in children's sleepwear, and which have been determined to present such unreasonable risk.

Basis for proposed flammability standard. Although there now exists a flammability standard for all wearing apparel (Flammable Fabrics Act, as amended in 1954 (15 U.S.C. 1191, 67 Stat. 111)), analysis by the Department of Commerce of data including those supplied by the Department of Health, Education, and Welfare (HEW) has led to the conclusion that the existing standard does not adequately protect children against flammable sleepwear fires. The National Advisory Committee for the Flammable Fabrics Act concurs with this conclusion.

The finding that a flammability standard or other regulation is needed for children's sleepwear is based on the analysis of data developed by investigations of deaths and injuries due to wearing apparel fires and on results of laboratory research involving garments and fabrics for children's sleepwear. The

analysis of accident data indicates that children are injured at particularly high frequencies from ignition and burning of sleepwear. Laboratory research indicates that children's sleepwear garments, and fabrics for such garments, present a significant burn hazard to children.

In the course of the development of this finding, the Department of Commerce has analyzed data from 580 cases investigated by HEW. The reports of HEW indicated that, in the cases investigated by them, 1059 separate garments were ignited, causing deaths of 76 persons and injury to 504. The remains of 413 garments were recovered from 258 of the cases, including 36 cases in which death resulted. Tests conducted by the Department of Commerce on the remains of the garments recovered showed that none of the tested garments exceeded the rapid and intense burn limits established by the existing standard (CS 191-53, "Flammability of Clothing Textiles").

Of the 580 cases, 174 involved the spillage of flammable liquids on the garments. These 174 cases were not considered in further analyses of either accident reports or flammability test behavior of the recovered garments. Analysis of the remaining 406 cases, involving 713 garments, showed that children in the 0-5 age group are injured at particularly high frequencies by burning of sleepwear: girls 1.6 times and boys 3.0 times as often as would be expected on the basis of their percentage of total population of the nation. The Department of Commerce has also determined that, within the scope of the sample, these conclusions are statistically meaningful.

Children in the 0-5 age group were the victims in 86 cases (21.2 percent of the 406 cases not having flammable-liquid contamination of the garments), involving 138 garments of all categories and leading to 9 deaths and 77 injuries; 37 of these cases (43 percent of the 0-5 age group cases) were reported as involving 41 sleepwear garments and as leading to 3 deaths and 34 injuries; 17 sleepwear garments were recovered from 15 of the 37 cases and sent to the National Bureau of Standards for testing. In these 15 cases, there were two deaths and 13 injuries reported.

Of the 17 sleepwear garments recovered and forwarded to NBS by HEW, the parts of the garments remaining after the accident and after testing by the present standard (CS 191-53), permitted testing of 11 garments by the proposed standard. The results showed that none passed the proposed standard. Therefore, the proposed standard is appropriate in that, had it been in effect during the past several years, it would have protected the public by keeping off the market the garments involved in those particular children's burn cases.

Research indicated that purchased items of children's sleepwear were readily ignited by a small ignition source. Exposure to a 1½-inch natural gas flame for 3 seconds resulted in ignition and burning of many such items. Burning of such items in their usual, vertical configuration was rapid.

Simulation of real-life accident con-

ditions was accomplished by dressing child-size mannequins in purchased items of children's sleepwear. Brief exposure of these assemblies to small flames resulted in extensive damage to the mannequins. These experiments indicate the children wearing such garments would have been seriously injured.

The proposed standard is reasonable and technologically practicable. In the course of the development of the proposed standard, NBS purchased garments on the open market that comply with the proposed standard. These garments are being marketed nationally by major distributors, both through their retail outlets and through catalog sales.

The proposed standard, which the Department of Commerce finds is needed to protect the public against unreasonable risk of the occurrence of fire leading to death, personal injury or significant property damage, is limited to young children's sleepwear.

Participation in proceedings. All interested persons are invited to submit written comments relative to the proposed flammability standard within 30 days after the date of publication of this notice in the FEDERAL REGISTER. Written comments should be submitted in at least four (4) copies to the Assistant Secretary for Science and Technology, Room 3382, U.S. Department of Commerce, Washington, D.C. 20230, and may include any data or other information pertinent to the subject.

Inspection of relevant documents. The written comments received pursuant to this notice will be available for public inspection at the Central Reference and Records Inspection facility of the Department of Commerce, Room 2122, Main Commerce Building, 14th Street between E Street and Constitution Avenue NW., Washington, D.C. 20230. A supporting document relating to data from burn cases is also available, for public examination or copying, in this facility.

Issued: November 12, 1970.

MYRON TRIBUS,
Assistant Secretary for
Science and Technology.

CHILDREN'S SLEEPWEAR

PROPOSED STANDARD FOR THE FLAMMABILITY OF CHILDREN'S SLEEPWEAR

(DOC PFF 3-70)

- 1 Definitions.
- 2 Scope and application.
- 3 General requirements.
- 4 Test procedure.
- 5 Labeling requirements.

1 **Definitions.** In addition to the definitions given in section 2 of the Flammable Fabrics Act, as amended (sec. 1, 81 Stat. 586; 15 U.S.C. 1191), and § 7.2 of the Procedures (33 F.R. 14642, Oct. 1, 1968), the following definitions apply for the purposes of this Standard:

(a) "Children's Sleepwear" means any product of wearing apparel up to and including size 6K, such as nightgowns, pajamas, or similar or related items, such as robes, intended to be worn primarily for sleeping or activities related to sleeping. Diapers and underwear are not included in this definition.

wall thickness. The flat bottom of the box shall be made of the same material as the sides and shall be easily removable. The sides shall be fastened together with screws or brackets and taped to prevent air leakage into the box during use.

NOTE: A minimum of two chambers and two extra bottoms is suggested for efficient operation.

(2) *Flattening frame.* A steel plate, 22.86 x 22.86 cm. (9 x 9 in.), 6.35 mm. (1/4 in.) thick with a 20.32 cm. (8 in.) diameter hole in its center is required to hold the specimen flat during the course of the test. It is recommended that one be provided for each test chamber.

(3) *Standard igniting source.* No. 1588 methenamine timed burning tablet or an equal tablet. These tablets shall be stored in a desiccator over a desiccant for 24 hours prior to use. (Small quantities of sorbed water may cause the tablets to fracture when first ignited. If a major fracture occurs, any results from that test shall be ignored, and it shall be repeated.)

(4) *Test specimens.* Each test specimen shall be a 22.86 x 22.86 cm. (9 x 9 in.) section of the small carpet or rug to be tested. Eight specimens are required.

(5) *Circulating air oven.* A forced circulation drying oven capable of removing the moisture from the specimens when maintained at 105° C. (221° F.) for 2 hours.²

(6) *Desiccating cabinet.* An airtight and moisture-tight cabinet capable of holding the floor covering specimens horizontally without contacting each other during the cooling period following drying, and containing silica gel desiccant.

(7) *Gloves.* Nonhygroscopic gloves (such as rubber or polyethylene) for handling the sample after drying and raising the pile on specimens prior to testing.

(8) *Hood.* A hood capable of being closed and having its draft turned off during each test and capable of rapidly removing the products of combustion following each test. The front or sides of the hood should be transparent to permit observation of the tests in progress.

(9) *Mirror.* A small mirror mounted above each test chamber at an angle to permit observation of the specimen from outside the hood.

(10) *Vacuum cleaner.* A vacuum cleaner to remove all loose material from each specimen prior to conditioning. All surfaces of the vacuum cleaner contacting the specimen shall be flat and smooth.

(b) *Sampling—(1) Selection of samples.* Select a sample of the material representative of the lot and large enough to permit cutting eight test specimens 22.86 x 22.86 cm. (9 x 9 in.) free from creases, fold marks,

² Option 1 of ASTM D 2654-67T, "Methods of Test for Amount of Moisture in Textile Materials," describes a satisfactory oven. ("1969 Book of ASTM Standards," Part 24, published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

delaminations or other distortions. The representative sample of material may require the use of more than one small carpet or rug. The test specimens should contain the most flammable parts of the traffic surface at their centers. The most flammable area may be determined on the basis of experience or through pretesting.

If the small carpet or rug has had a fire-retardant treatment, or is made of fibers which have had a fire-retardant treatment, the selected sample or oversized specimens thereof shall be washed, prior to cutting of test specimens, either 10 times under the washing and drying procedure prescribed in Method 124-1967 of the American Association of Textile Chemists and Colorists [washing procedure 6.2 (III) with a water temperature of 80±2.8° C (140±5° F), drying procedure 6.3.2(B), maximum load 3.34 kg (8 pounds)]³ or such number of times under such other washing and drying procedures as shall previously have been found to be equivalent by the Federal Trade Commission. Alternatively, the selected sample or oversized specimens thereof may be washed, dry-cleaned, or shampooed 10 times, prior to cutting of test specimens, in such manner as the manufacturer or other interested party shall previously have established to the satisfaction of the Federal Trade Commission is normally used for that type of small carpet or rug in service.

(2) *Cutting.* Cut eight 22.86±0.84 cm (9±1/4 in.) square specimens of each small carpet or rug to be tested to comply with section 4(b)(1).

(c) *Conditioning.* Clean each specimen with the vacuum cleaner until it is free of all loose ends left during the manufacturing process and from any material that may have been worked into the pile during handling.⁴ Care must be exercised to avoid "fuzzing" of the pile yarn.

Place the specimens in the drying oven in a manner that will permit free circulation of the air at 105° C (221° F) around them for 2 hours.⁵ Remove the specimens from the oven with gloved hands and place them horizontally in the desiccator with traffic surfaces up and free from contact with each other

³ Technical Manual of the American Association of Textile Chemists and Colorists, vol. 46, 1969, published by AATCC, Post Office Box 12216, Research Triangle Park, NC 27709.

⁴ The vacuum cleaning described is not intended to simulate the effects of repeated vacuum cleaning in service.

⁵ If the specimens are moist when received, permit them to air-dry at laboratory conditions prior to placement in the oven. A satisfactory pre-conditioning procedure may be found in ASTM D 1776-67, "Conditioning Textiles and Textile Products for Testing." ("1969 Book of ASTM Standards," Part 24, published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

until cooled to room temperature, but in no instance less than 1 hour.

(d) *Testing.* Place the test chamber in the draft-protected environment (hood with draft off) with its bottom in place. Wearing gloves, remove a test specimen from the desiccator and brush its traffic surface with a gloved hand in such a manner as to raise its pile. Place the specimen on the center of the floor of the test chamber, traffic surface up, exercising care that the specimen is horizontal and flat. Place the flattening frame on the specimen and position a methenamine tablet on one of its flat sides in the center of the 20.32 cm. (8 in.) hole.

Ignite the tablet by touching a lighted match or an equivalent igniting source carefully to its top. If more than two minutes elapse between the removal of the specimen from the desiccator and the ignition of the tablet, the conditioning must be repeated.

Continue each test until one of the following conditions occur:

(1) The last vestige of flame or glow disappears. (This is frequently accompanied by a final puff of smoke.)

(2) The flaming or smoldering has approached within 2.54 cm. (1.0 in.) of the edge of the hole in the flattening frame at any point.

When all combustion has ceased, ventilate the hood and measure the shortest distance between the edge of the hole in the flattening frame and the charred area. Record the distance measured for each specimen.

Remove the specimen from the chamber and remove any burn residue from the floor of the chamber. Before proceeding to the next test, the floor must be cooled to normal room temperature or replaced with one that is normal room temperature.

(e) *Report.* The number of specimens of the eight tested in which the charred area does not extend to within 2.54 cm. (1.0 in.) of the edge of the hole in the flattening frame shall be reported.

(f) *Interpretation of results.* If the charred area does not extend to within 2.54 cm. (1.0 in.) of the edge of the hole in the flattening frame at any point for at least seven of the eight specimens, the small carpet or rug meets the acceptance criterion.

Labeling requirement. (a) If a small carpet or rug does not meet the acceptance criterion, it shall, prior to its introduction into commerce, be permanently labeled, pursuant to rules and regulations established by the Federal Trade Commission, with the following statement: **FLAMMABLE (FAILS U.S. DEPARTMENT OF COMMERCE STANDARD #2-70); SHOULD NOT BE USED NEAR SOURCES OF IGNITION.**

(b) If a small carpet or rug has had a fire-retardant treatment or is made of fibers which have had a fire-retardant treatment, it shall be labeled with the letter "T" pursuant to rules and regulations established by the Federal Trade Commission.

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(b) "Size 6X" means the size defined as 6X in Department of Commerce Voluntary Product Standard, previously identified as Commercial Standard, CS 151-50, "Body Measurements for the Sizing of Apparel for Infants, Babies, Toddlers, and Children."¹

(c) "Char Length" means the distance from the original lower edge of the specimen exposed to the flame in accordance with the procedure specified herein in "4 Test Procedure" to the end of the tear or void in the charred, burned, or damaged area, the tear being made in accordance with the procedure specified herein in 4(d)(2).

(d) "Item" means any product of children's sleepwear, or any fabric or related material intended for use in children's sleepwear, or which may reasonably be expected to be used in children's sleepwear.

(e) "Acceptance Criterion" means that set of char length and afterflame properties which an item must exhibit in order to comply with this standard.

(f) "Trim" means decorative materials, such as ribbons, laces, ornaments, or functional materials (findings) such as zippers used to construct the garment.

(g) "Afterflame Time" means the time in seconds that molten material or other fragments dropping from the specimen continue to flame after the burner flame has been removed.

(h) "Afterglow" means the continuation of glowing of parts of a specimen after flaming has ceased.

2 *Scope and application.* (a) This Standard provides a test method to determine the flammability of items of children's sleepwear.

(b) All items of children's sleepwear must meet the acceptance criterion.

3 *General requirements—(a) Summary of test method.* Five conditioned specimens, 7.0 x 25.4 cm. (2 3/4 x 10 in.), are suspended one at a time vertically in holders in a prescribed cabinet and subjected to a standard flame along their bottom edges for a specified time under controlled conditions. The afterflame time and char length are measured.

(b) *Acceptance criterion.* An item meets the acceptance criterion if: (1) The average char length of five specimens does not exceed the appropriate value given in Table 1, (2) no individual specimen has a char length of 25.4 cm. (10 in.), and (3) the average afterflame time of molten material or other fragments dropping from the specimen does not exceed 2 seconds when the testing is done in accordance with "4 Test Procedure"

TABLE 1

Original fabric weight		Char length	
g./sq. in.	(oz./sq. yd.)	cm.	(in.)
Less than 207.....	(Less than 6.0).....	18.0	(7.09)
207-348, inclusive....	(6.0-10.0).....	15.5	(6.10)
Greater than 348....	(Greater than 10.0).....	13.0	(5.12)

¹Copies available from the National Technical Information Service, 5285 Port Royal Street, Springfield, Va. 22151.

4 *Test procedure—(a) Apparatus—*

(1) *Test chamber.* The test chamber shall be a stainless steel cabinet with inside dimensions of 30.5±2.5 cm. (12±1 in.) wide, 30.5±2.5 cm. (12±1 in.) deep and 78.7±2.5 cm. (31±1 in.) high. It shall have a frame which permits the suspension of the specimen holder over the center of the base of the cabinet at such a height that the bottom of the specimen holder is 1.71±0.03 cm. (2/3±1/32 in.) above the top of the gas burner specified in 4(a)(3) and perpendicular to the front of the cabinet. The front of the cabinet shall be a hinged or sliding door with a glass insert to permit observation of the entire test. The specified cabinet is illustrated in Figure 1.

(2) *Specimen holder.* The specimen holder is designed to permit suspension of the specimen in a fixed vertical position and to prevent curling of the specimen when the flame is applied. It shall consist of two U-shaped 0.32 cm. (1/8 in.) thick stainless steel plates, 40.64 cm. (16 in.) long and 7.62 cm. (3 in.) wide between which the specimen shall be fixed and which shall be held together with side clamps. The openings in the plates shall be 6.1 x 38.6 cm. (3 x 14 in.). The plates shall be hinged to assure alignment. The specified holder is illustrated in Figure 2.

(3) *Burner.* The burner shall be a Tirrell Burner, 18.24 cm. (8 in.) in height. It shall have a tube of 1.3 cm. (1/2 in.) inside diameter. It shall have a variable orifice to adjust the height of the flame, and the air vents at its base shall be closed and taped shut. A centering device shall be built into the floor of the test chamber so that the burner may be moved quickly under the test specimen and away from it, as illustrated in Figure 1. The burner shall be connected to the gas source by rubber or other flexible tubing.

(4) *Gas supply system.* There shall be a control valve system with a delivery rate designed to furnish gas to the burner under a pressure of 129±13 mm. Hg. (2 1/2 ± 1/4 lbs. per sq. in.) at the burner inlet. The manufacturer's recommended delivery rate for the valve system shall include the required pressure.

(5) *Gas.* The gas shall be C.F. methane (99% purity).

(6) *Hooks and weights.* Metal hooks and weights shall be used to produce a series of loads used to determine char length. The metal hooks shall consist of No. 19 gauge steel wire, or equivalent, and shall be made from 7.8 cm. (3 in.) lengths of the wire, bent 1.3 cm. (1/2 in.) from one end to a 45° angle hook. One end of the hook shall be fastened around the neck of the weight to be used and the other in the lower end of each burned specimen to one side of the burned area. The requisite loads are given in Table 2.

²Engineering drawings may be purchased from the Central Reference and Records Inspection Facility, Room 2122, Department of Commerce Building, Washington, D.C. 20230.

TABLE 2

Original fabric weight		Loads	
g./sq. in.	(oz./sq. yd.)	g.	(lb.)
Less than 207.....	(Less than 6.0).....	113.5	(0.25)
207-348, inclusive....	(6.0-10.0).....	227.0	(0.50)
Greater than 348....	(Greater than 10.0).....	340.5	(0.75)

(7) *Stopwatch.* A stopwatch or similar timing device shall be used to measure time to 0.1 second.

(8) *Scale.* A linear scale graduated in 0.25 cm. (0.1 in.) divisions shall be used to measure char length.

(9) *Circulating air oven.* A forced circulation drying oven capable of maintaining the specimens at 105° C. (221° F²), shall be used to dry the specimens while mounted in the specimen holders.

(10) *Desiccator.* An air-tight and moisture-tight desiccating chamber shall be used for cooling mounted specimens after drying. Anhydrous silica gel shall be used as the desiccant in the desiccating chamber.

(11) *Hood.* The test shall be conducted under a hood capable of being closed and having its draft turned off during each test, and capable of rapidly removing the products of combustion following each test. The hood fan shall be turned off during the test and shall be turned on after testing to remove fumes.

(12) *Sewing machine.* A machine capable of carrying out the operations in 4(b)(3) shall be used whenever sewing is required.

(b) *Specimens and sampling—(1) Selection of fabric samples.* Select a sample of the item representative of the lot and large enough to permit cutting five specimens, as described in 4(b)(2) or (3) from the most flammable part of the item. More than one item of the lot may be used if necessary. The most flammable part or direction of the item may be determined on the basis of experience or through pretesting, and may be in the machine or cross-machine direction or on the bias, and may contain trim or seams.⁴ If pretesting has shown that significantly different results are obtained for specimens cut with their long dimensions in different directions, the official test specimens shall be cut such that they are tested in the direction that gives the greatest flammability.

(2) *Cutting.* Cut five specimens, 7.0 x 25.4 cm (2-3/4 x 10 in.) from the sample selected in 4(b)(1). If the sample is wrinkled, it may be ironed. If possible, specimens shall be cut so that each contains different machine direction yarns and different cross-machine direction yarns.

(3) *Cutting and preparation of specimens from finished sleepwear.* If the most flammable part of a garment contains seams or trim, the specimens shall

⁴Option 1 of ASTM D 2654-87T, "Method of Test for Amount of Moisture in Textile Materials," describes a satisfactory oven. ("1970 Book of ASTM Standards," Part 24, published by the American Society for Testing and Materials, 1016 Race Street, Philadelphia, Pa. 19103).

⁵For pretesting, it is recommended that five specimens be cut from each significantly different part of the item.

be cut such that the seam or trim is down the center of the long dimension of the specimen.

For items with attached trim whose configuration does not allow placement in the specimen holder as described above, specimens shall be prepared by sewing or attaching the trim to the center of the vertical axis of an appropriate sample of untrimmed fabric chosen from another portion of the item, beginning the sewing or attachment at the lower edge of each specimen. The sewing or attachment shall be made in a manner as nearly identical as possible to the manner in which trim was attached in the item. In such cases, trim shall be removed from the item with due care to avoid damage to the trim, and with due care to remove all remnants of thread, other fastening material and base fabric from the trim. Sewing or otherwise attaching the trim shall be done with thread or fastening material of the same (or as close to the same as possible) composition and size as used for this purpose in the original item. The trim shall be sewed the entire length (if possible) of representative samples of the item. For items in which the seam length is less than 25.4 cm. (10 in.) specimens shall be cut with the seam beginning at the lower edge of each specimen.

(c) *Mounting and conditioning of specimens.* The specimens shall be placed in specimen holders so that the bottom edge of each specimen is even with the bottom edge of the specimen holder. Mount the specimens in as close to a flat configuration as possible. The sides of the specimen holder shall cover 1 cm. (3/8 in.) of the specimen width along each long edge of the specimens, and thus shall expose 5.1 cm. (2 in.) of the specimen width. The sides of the specimen holder shall be clamped with a sufficient number of clamps or with tape to prevent the specimen from being displaced during handling and testing. The specimens may be taped in the holders if the clamps fail to hold them.

Place the mounted specimens in the drying oven in a manner that will permit free circulation of air at 105° C. (221° F.) around them for 30 minutes.*

(d) *Testing*—(1) *Burner adjustment.* With the hood fan turned off, use the variable orifice at the burner to adjust the flame height to be 3.8 cm. (1 1/2 in.). Move the burner so it is not in the center of the cabinet.

(2) *Specimen burning and evaluation.* Remove the mounted specimens from the oven and place them in the desiccator for 30 minutes to cool. No more than five specimens shall be placed in a desiccator at one time. Specimens shall remain in the desiccator no more than 60 minutes. One at a time, the mounted

specimens shall be removed from the desiccator and suspended in the cabinet. The cabinet door shall be closed and the burner flame impinged on the bottom edge of the sample for 3.0±0.2 seconds.⁶ Flame impingement is accomplished by moving the burner under the specimen for this length of time, and then removing it. Afterflame time shall be measured to the nearest 0.1 second. If the char length of an individual specimen equals 25.4 cm. (10 in.) that item fails to meet the acceptance criterion and testing may be stopped. If the visual estimate of the char length caused by 3 seconds exposure to the flame is less than 25.4 cm. (10 in.) immediately apply the flame to that same specimen for an additional 12 seconds. Afterflame time shall be measured to the nearest 0.1 second.

When afterglow has ceased, remove the specimen from the cabinet and holder, and place it on a clean flat surface. Fold the specimen lengthwise along a line through the highest peak of the charred area; crease the specimen firmly by hand. Unfold the specimen and insert the hook with the correct weight as shown in Table 2 in the specimen on one side of the charred area 6.4 mm. (1/4 in.) from the lower edge. Tear the specimen by grasping the corner of the fabric at the opposite edge of the char from the weight and gently raising the specimen and weight clear of the supporting surface. Measure the char length as the distance from the edge of the specimen exposed to the flame to the end of the tear.

(3) *Report.* Report separately the values of char length in centimeters (inches), and afterflame time in seconds, for each specimen as well as the average of these quantities for the set of five specimens.

(4) *Laundrying.* The procedures described under 4 (b), (c) and (d) shall be carried out on items in the condition in which they are intended to be sold, and after they have been washed and dried 50 times⁷ according to Test Method AATCC 124-1967,⁸ Washing procedure 6.2(III) with a water temperature of 60°±2.3° C. (140°±5° F.), drying procedure 6.3.2 (B), maximum load 3.34 kg. (8 pounds) shall be used. Alternatively, a different number of times under another washing and drying procedure may

* If more than 18 seconds elapse between removal of a specimen from the desiccator and the initial flame impingement, that specimen shall be reconditioned prior to testing.

⁷ A figure showing how this is done is given in AATCC 34-1969, Technical Manual of the American Association of Textile Chemists and Colorists, Vol. 46, 1969, published by AATCC, Post Office Box 12216, Research Triangle Park, N.C. 27709.

⁸ If changes in an item occur during laundrying which appear to affect the flammability of that item sufficiently to make it fail the acceptance criterion, that item may be tested after fewer than 50 laundryings. If the item fails, further laundryings are unnecessary.

⁹ Technical Manual of the American Association of Textile Chemists and Colorists, Vol. 46, 1969, published by AATCC, Post Office Box 12216, Research Triangle Park, N.C. 27709.

be specified and used, if that procedure has previously been found to be equivalent by the Federal Trade Commission.

5 *Labeling requirements.* All items of children's sleepwear shall be labeled with precautionary instructions to protect the items from agents or treatments which are known to cause deterioration of their flame resistance. Such labels shall be permanent and otherwise in accordance with rules and regulations established by the Federal Trade Commission.

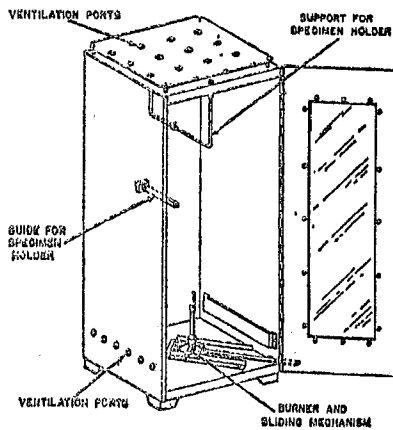


FIGURE 1
VERTICAL TEST CABINET

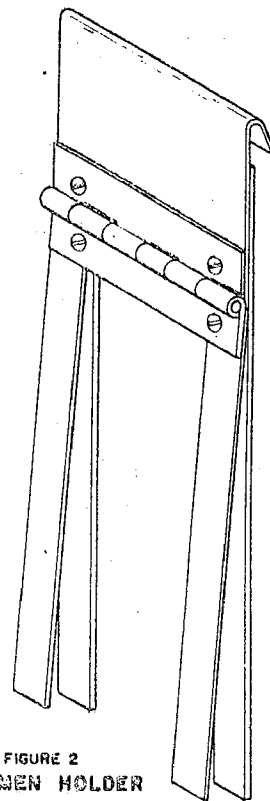


FIGURE 2
SPECIMEN HOLDER

[F.T.C. Doc. 70-18423; Filed, Nov. 18, 1970;

8:45 a.m.]

* If the specimens are moist when received, permit them to air-dry at laboratory conditions prior to placement in the oven. A satisfactory pre-conditioning procedure may be found in ASTM D 1776-67, "Conditioning Textiles and Textile Products for Testing," ("1969 Book of ASTM Standards", Part 23, published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.)

APPENDIX D

[An Acceptable Test Procedure for Showing Compliance With §§ 25.853, 25.855, and 25.1359

[(a) *Conditioning.* Specimens must be conditioned to 70° F., plus or minus 5° and at 50 percent plus or minus 5 percent relative humidity until moisture equilibrium is reached or for 24 hours. Only one specimen at a time may be removed from the conditioning environment immediately before subjecting it to the flame.

[(b) *Specimen configuration.* Except as provided for materials used in electrical wire and cable insulation and in small parts, materials must be tested either as a section cut from a fabricated part as installed in the airplane or as a specimen simulating a cut section, such as: a specimen cut from a flat sheet of the material or a model of the fabricated part. The specimen may be cut from any location in a fabricated part; however, fabricated units, such as sandwich panels, may not be separated for test. The specimen thickness must be no thicker than the minimum thickness to be qualified for use in the airplane, except that: (1) thick foam parts, such as seat cushions, must be tested in 1/2-inch thickness; (2) when showing compliance with § 25.853(b-3) for materials used in small parts that must be tested, the materials must be tested in no more than 1/8-inch thickness; (3) when showing compliance with § 25.1359(d) for materials used in electrical wire and cable insulation, the wire and cable specimens must be the same size as used in the airplane. In the case of fabrics, both the warp and fill direction of the weave must be tested to determine the most critical flammability condition: When performing the tests prescribed in paragraphs (d) through (e) of this Appendix, the specimen must be mounted in a metal frame so that; (1) in the vertical tests of paragraph (d), the two long edges and the

upper edge are held securely; (2) in the horizontal test of paragraph (e), the two long edges and the edge away from the flame are held securely; (3) the exposed area of the specimen is at least 2 inches wide and 12 inches long, unless the actual size used in the airplane is smaller; and (4) the edge to which the burner flame is applied must not consist of the finished or protected edge of the specimen but must be representative of the actual cross-section of the material or part installed in the airplane. When performing the test prescribed in paragraph (f) of this Appendix, the specimen must be mounted in a metal frame so that all four edges are held securely and the exposed area of the specimen is at least 8 inches by 8 inches.

[(c) *Apparatus.* Except as provided in paragraph (h) of this Appendix, tests must be conducted in a draft-free cabinet in accordance with Federal Test Method Standard 191 Method 5903 (revised Method 5902) for the vertical test, or Method 5906 for horizontal test (available from the General Services Administration, Business Service Center, Region 3, Seventh & D Streets, S.W., Washington, D.C., 20407) or other approved equivalent methods. Specimens which are too large for the cabinet must be tested in similar draft-free conditions.

[(d) *Vertical test, in compliance with § 25.853(a) and (b).* A minimum of three specimens must be tested and the results averaged. For fabrics, the direction of weave corresponding to the most critical flammability conditions must be parallel to the longest dimension. Each specimen must be supported vertically. The specimen must be exposed to a Bunsen or Tirrill burner with a nominal 3/8-inch I.D. tube adjusted to give a flame of

1½ inches in height. The minimum flame temperature measured by a calibrated thermocouple pyrometer in the center of the flame must be 1550° F. The lower edge of the specimen must be three-fourths inch above the top edge of the burner. The flame must be applied to the center line of the lower edge of the specimen. For materials covered by § 25.853 (a), the flame must be applied for 60 seconds and then removed. For materials covered by § 25.853 (b), the flame must be applied for 12 seconds and then removed. Flame time, burn length, and flaming time of drippings, if any, must be recorded. The burn length determined in accordance with paragraph (g) of this Appendix must be measured to the nearest one-tenth inch.

[(e) *Horizontal test in compliance with § 25.853(b-2) and (b-3).* A minimum of three specimens must be tested and the results averaged. Each specimen must be supported horizontally. The exposed surface when installed in the aircraft must be face down for the test. The specimen must be exposed to a Bunsen burner or Tirrill burner with a nominal three-eighths inch I.D. tube adjusted to give a flame of 1½ inches in height. The minimum flame temperature measured by a calibrated thermocouple pyrometer in the center of the flame must be 1550° F. The specimen must be positioned so that the edge being tested is three-fourths of an inch above the top of, and on the center line of, the burner. The flame must be applied for 15 seconds and then removed. A minimum of 10 inches of the specimen must be used for timing purposes, approximately 1½ inches must burn before the burning front reaches the timing zone, and the average burn rate must be recorded.

[(f) *Forty-five degree test, in compliance with § 25.855(a-1).* A minimum of three specimens must be tested and the results averaged. The specimens must be supported at an angle of 45° to a horizontal surface. The exposed surface when installed in the aircraft must be face down for the test. The specimens must be exposed to a Bunsen or Tirrill burner with a nominal three-eighths inch I.D.

tube adjusted to give a flame of 1½ inches in height. The minimum flame temperature measured by a calibrated thermocouple pyrometer in the center of the flame must be 1550° F. Suitable precautions must be taken to avoid drafts. One-third of the flame must contact the material at the center of the specimen and must be applied for 30 seconds and then removed. Flame time, glow time, and whether the flame penetrates (passes through) the specimen must be recorded.

[(g) *Sixty degree test in compliance with § 25.1359(d).* A minimum of three specimens of each wire specification (make and size) must be tested. The specimens of wire or cable (including insulation) must be placed at an angle of 60° with the horizontal in the cabinet specified in paragraph (c) of this Appendix with the cabinet door open during the test or must be placed within a chamber approximately 2 feet high x 1 foot x 1 foot, open at the top and at one vertical side (front), and which allows sufficient flow of air for complete combustion, but which is free from drafts. The specimen must be parallel to and approximately 6 inches from the front of the chamber. The lower end of the specimen must be held rigidly clamped. The upper end of the specimen must pass over a pulley or rod and must have an appropriate weight attached to it so that the specimen is held tautly throughout the flammability test. The test specimen span between lower clamp and upper pulley or rod must be 24 inches and must be marked 8 inches from the lower end to indicate the central point for flame application. A flame from a Bunsen or Tirrill burner must be applied for 30 seconds at the test mark. The burner must be mounted underneath the test mark on the specimen, perpendicular to the specimen and at an angle of 30° to the vertical plane of the specimen. The burner must have a nominal bore of ⅜ inch, and must be adjusted to provide a 3-inch high flame with an inner cone approximately one-third of the flame height. The minimum temperature of the hottest portion of the flame, as measured with a calibrated thermocouple pyrometer, may not be

less than 1750° F. The burner must be positioned so that the hottest portion of the flame is applied to the test mark on the wire. Flame time, burn length, and flaming time of drippings, if any, must be recorded. The burn length determined in accordance with paragraph (g) of this Appendix must be measured to the nearest $\frac{1}{10}$ -inch. Breaking of the wire specimens is not considered a failure.

[(h) *Burn length.* Burn length is the distance from the original edge to the farthest evidence of damage to the test specimen due to flame impingement, including areas of partial or complete consumption, charring, or embrittlement, but not including areas sooted, stained, warped, or discolored, nor areas where material has shrunk or melted away from the heat source.]