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CORRELATION STUDY OF SMALL SCALE FURNITURE MOCK-UP
SMOLDERING TESTS TO FULL SCALE CIGARETTE TESTS

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CIGARETTE SMOLDERING TESTS TO FULL SCALE TESTS

INTRODUCTION

For a number of years, the fire protection community in the U.S. and worldwide has been concerned about mitigation of fire losses where cigarettes and other smoking materials have been the first source of ignition. One method of reducing losses is to produce cigarettes with a lowered propensity to cause sustained smoldering combustion when placed in contact with building contents, especially items such as home furnishings, which may be easily ignited by cigarettes.

As a result of congressional approval of the Cigarette Safety Act of 1984, a 3-year study of the technical feasibility of producing a commercially viable cigarette with a low propensity to ignite home furnishings was mandated. This study was directed by a Technical Study Group. One request of the study group was to validate the use of small-scale furniture mock-ups as an aid in predicting the smoldering performance of finished articles of furniture. This task was assigned to the flammability laboratory of the California Bureau of Home Furnishings, since California law contains a standard for cigarette smolder resistance of furniture articles, and furniture samples are available on a continuous basis for correlation testing.

This voluntary standard, known as Bureau of Home Furnishings Technical Bulletin Number 116, "Requirements, Test Procedure and Apparatus for Testing the Flame Retardance of Upholstered Furniture," January, 1980 (see Appendix A) has been in effect since 1975, and becomes enforceable if a furniture manufacturer labels furniture as complying with the standard.

Since 1981, the California Bureau of Home Furnishings has tested about 600 articles of upholstered furniture for compliance with the Technical Bulletin 116 standard. The state's mandatory furniture flammability standard, Technical Bulletin Number 117, "Requirements, Test Procedure and Apparatus for Testing the Flame Retardance of Resilient Filling Materials Used in Upholstered Furniture," (Appendix B), requires that all fabrics and stuffings used in furniture offered for sale in California must meet minimum flammability performance standards, for flaming and smoldering. Section D, PT. II of Technical Bulletin 117 specifically states that all cellular foam pads used in California furniture, when tested in a small-scale seat/back crevice mock-up configuration with a standard 100% cotton velvet

fabric shall not lose more than 20% of their original weight when a lit cigarette is placed in the crevice, covered with a swatch of cotton sheeting and allowed to smolder. Other sections of the standard require that man-made fiber battings, cotton and other natural fiber battings and blended fiber battings containing mixtures of natural and man-made fibers all meet a specific smoldering standard which requires that the char length in any direction from the cigarette not exceed 2 inches when a 12 in. by 12 in. swatch is tested in a flat configuration, with a lit cigarette covered by cotton sheeting. However, Technical Bulletin 117 standard does not require that small-scale mock-ups, using fabrics and substrates identical to those found in the finished furniture article be smolder-resistant, either in the flat or crevice configuration. Thus, correlation tests had not been performed on all furniture articles cited above. The Bureau has, however, performed a total of 196 flat and crevice mock-up tests on fabrics and substrate materials taken from 100 finished furniture articles in an attempt to correlate these smoldering results with those from the Technical Bulletin 116 cigarette tests performed on finished articles. The finished furniture articles used in the study were sampled randomly in 1986 or 1987, by Bureau inspectors on the California retail market and represented a wide variety of manufacturers, styles, sizes, shapes, fabric types and underlying substrate materials. A summary description of the furniture articles tested; including style, upholstery fabric content, fabric weight, % fabric backcoating and filling contents of the seat, arms and back, etc., is given in Figure 1. Only the contents of the chair that were actually used in the small-scale mock-up tests are listed, although a number of the articles contained additional stuffings, remote from the cover fabric.

TEST PROCEDURE (FINISHED ARTICLES):

In performing the smoldering tests on finished articles of furniture, all applicable procedures outlined in Technical Bulletin 116 (see Appendix A) were followed as specified. Furniture samples and cigarettes were conditioned for at least 48 hours at a temperature of $70^{\circ}\text{F} \pm 50^{\circ}\text{F}$ and a relative humidity of less than 55%, before testing, and the furniture was tested under identical conditions. Cigarettes made from natural tobacco, without filters, were used as the standard smoldering ignition source and had the following dimensions: 85 ± 2 mm length, $0.3 \pm .02$ inch diameter and 1.1 ± 0.1 gram weight.

Actual smoldering tests were performed in a laboratory under a canopy type low draft hood to prevent employee exposure to combustion products. Each piece of furniture was tested with lit cigarettes at all horizontal surfaces large enough to support a cigarette and where a cigarette might reasonably be expected to land, including smooth surfaces, crevices, welt cords, quilted areas, decking surfaces, tops of arms and backs, tufts and buttons, if present. All areas were tested in triplicate if

sufficient area was available. For the purposes of this study, only the smooth surfaces, seat/back crevices and seat/arm crevices were used in correlation to small scale mock-up results. Tests were performed so that each differently-dyed area was included in the test locations. No cigarettes were placed closer than 6 inches apart. All cigarettes were covered, after lighting with one layer of cotton sheeting material meeting the following specifications: 3.7 ± 0.8 ounces per square yard fabric weight, color--white, no flame-retardant treatment. The sheeting was laundered and dried before use and 6 inch by 6 inch swatches were used for testing. Care was taken to insure that the sheeting contacted the cigarette surface by running one's finger across the sheet/cigarette interface. If a cigarette extinguished before burning its entire length, the test was repeated with a freshly lit cigarette on a different portion of the same location type. Each cigarette location was tested until three cigarettes had burned their full length, three cigarettes self-extinguished before burning their full length or one or more cigarettes led to a smoldering failure. Any furniture article, based on the criteria cited in Technical Bulletin 116, fails the standard if sustained smoldering occurs leading to a char length more than 2 inches in any direction from the cigarette, measured from its nearest point, or if obvious open flaming occurs.

All cigarette locations resulting in sustained smoldering failures were manually extinguished by application of water and/or char removal after ascertaining that an ignition had occurred, in order to save as much of the fabric and substrate material for the subsequent small-scale correlation tests.

TEST PROCEDURE (SMALL-SCALE MOCK-UPS):

After completion of the smoldering cigarette tests on the finished articles, each of these articles was broken down into its component parts and each substrate and upholstery fabric component was identified generically. Also, fabric weights, fiber blend percentages and percentage of backcoating were determined for each upholstery fabric.

Small-scale smoldering mock-up tests were then performed for each article for which adequate fabric and substrate material remained. Where possible, small-scale mock-up tests were performed on both smooth (seat) surface materials, using a "flat" mock-up test frame (see Figure 2) and also on materials from seat/back and seat/arm interfaces using a "crevice" mock-up test frame (see Figure 3). In some articles, no arms were present or no seat/arm or seat/back cushioning interface existed, so all mock-up tests were not performed. For any article, the maximum number of small-scale tests performed included, when possible, one smooth seat test, one seat/back crevice test and one seat/arm crevice test. No duplicate tests were performed for any chair location, due to a lack of sufficient test materials.

Substrates and fabrics were conditioned and small-scale mock-ups were tested under the conditions described earlier. All tests were conducted in the same laboratory area used for the full-scale furniture samples. Mock-up test frames were placed in P.M.M.A. test boxes specified in California Bureau of Home Furnishings Technical Bulletin Number 117, Section D, Pt. II (inside dimensions 48" x 21" x 18" high with no top) to minimize effects of surface ventilation on smoldering. The test boxes were located under a low-draft canopy type hood to minimize employees' exposure to combustion products.

The "crevice" mock-up test frame is shown in Figures 2 and 3. The frame, identical to the type specified in Technical Bulletin Number 117, Section D, Pt. II, is constructed from 3/4" thick plywood and is designed to accommodate a substrate with seat dimensions 2" x 8" x 4" and back dimensions 2" x 8" x 7.25", with a perpendicular seat/back interface. Unburned layers of the substrate fillings were cut to the sizes specified and placed in the test frame in the exact order in which the layers were positioned in the actual chair from which the substrates were removed, in order to approximate as nearly as possible a small 8 inch wide cross section of the seat/back or seat/arm interface of the chair (Figure 3). The mock-up seat was constructed of substrates from the chair seat area closest to the crevice and the back was constructed of substrates from the lower chair back area. Since the mock-up frame is designed to hold only a 2 inch thick sample, only 2 layers of substrate could be feasibly used in most cases in constructing the mock-up, although 3 layers were used in a few cases. In some cases, the seating layers extended slightly above 2 inches but ample crevice area remained for cigarettes. A weight in grams was determined to the nearest 0.1 grams for each substrate system before constructing the mock-up.

The seat and back substrate materials were then each covered with an uncharred swatch of upholstery fabric from the chair, with the fabric weave orientation relative to the crevice direction exactly as in the original furniture article. Fabric dimensions were 8" x 15" (vertical back panel) and 8" x 11" (horizontal seat panel). The back fabric panel was stapled to the plywood back frame to insure tightness. Since the majority of the furniture articles had been broken down before the study began, the exact tightness of the fabric in the furniture could not be duplicated in the mock-ups, but was approximated.

Cigarettes identical to the type described earlier in this report were used as an ignition source. After lighting, the cigarette was placed on the crevice and a 6" x 6" swatch of cotton sheeting, identical to the type described earlier in this report, was placed over the cigarette. To insure good fabric contact, a finger was run along the length of the covered cigarette, and the sheeting was supported by two straight pins placed in the vertical panel. Caution was taken to insure the cigarette made contact with both the vertical and horizontal panels of the crevice, and was equidistant from the edges of the sample.

Smoldering was allowed to continue until all evidence of combustion had ceased for at least 5 minutes. If a particular system exhibited vigorous sustained smoldering, it was manually extinguished before damage to the test frame could occur, and was considered to be an ignition. Upon completion of smoldering, the cover fabric was removed and the unburned substrate material was separated from the char, reweighed and a total weight loss percentage for the system was calculated.

Flat mock-up tests on fabrics and substrates from furniture seat surfaces were conducted in a similar fashion to the crevice tests, using the test frame shown in Figure 4, to accommodate the seating layers only. This frame, constructed of a 3/4" x 8" x 9" plywood base, with side support panels 2 inches wide, allowed for testing of a seating substrate cross section 5 inches wide x 8 inches long x approximately 1-1/2 to 2 inches deep. The substrate layers, selected from a portion of the chair seat were cut to dimensions of 5 inches x 8 inches, covered with a swatch of seat upholstery fabric from the same chair (8 inches wide and 9 inches long) and placed in the test frame so that the fabric fit snugly around the substrate and extended past the edges to the plywood base. An attempt was made to duplicate the original fabric tension of the furniture in the mock-ups.

A lit cigarette was placed on the flat surface in the lengthwise direction, equidistant from the edges and covered with a 6" x 6" swatch of cotton sheeting. Sample recovery, weighing, etc. was completed as for the crevice mock-ups.

Photographs of typical small-scale mock-up systems are shown in Figure 5.

TEST RESULTS

Results of small scale mock-up and Technical Bulletin 116 testing are summarized in Figure 6 for the 100 chairs tested. A total of 419 cigarette tests were performed on finished furniture articles by the Technical Bulletin 116 procedure, at the 3 types of locations equivalent to the mock-up tests. These consisted of 287 flat seat locations, 66 seat/back crevice locations, and 66 seat/arm crevice locations. For any specific chair, up to 4 Technical Bulletin 116 cigarette tests were performed at any one type of location, depending on available space and chair geometry.

After breakdown of the chairs, a total of 196 small-scale mock-up correlation tests were performed, consisting of 100 flat seat test locations, 63 seat/back crevice locations and 33 seat/arm crevice locations. Comparisons of smoldering results were then made between the Technical Bulletin 116 tests and the small-scale mock-up tests for each chair location. Figure 6 summarizes, for each chair, the number of cigarette tests showing no ignition

(i.e., passing the smolder criteria) versus the total number of tests performed for each location type. The ratios showing number of locations not igniting compared to number tested are listed side by side for the 2 types of tests conducted for easy comparison of small-scale and full-scale results. As stated earlier, a non-ignition location exhibited no sustained smoldering beyond a 2 inch char length. Perfect correlation was observed if all small-scale mock-up tests and Technical Bulletin 116 tests performed at any one location type of a specific chair exhibited the same results (i.e., sustained ignition or self-extinguishment). Those chair locations where the small-scale mock-ups test ignited and one or more Technical Bulletin 116 tests did not ignite or the small-scale mock-up test did not ignite and one or more Technical Bulletin 116 tests did ignite were defined to be non-correlating and are indicated by an asterisk in the mock-up column of Figure 6.

Based on these definitions, correlation to the Technical Bulletin 116 tests was observed in 180 of the 196 small-scale tests conducted for a correlation rate of 91.8%. Uncertain correlation or no correlation at all was observed in 16 of the 196 tests for a non-correlation rate of 8.2%. When correlations for the individual location types were examined, the poorest correlation was observed at the flat seat location, where 9 of 100 small-scale tests (9.0%) did not correlate. Also, non-correlation was observed in 4 of 63 (6.3%) of the small-scale seat/back crevice tests and in 3 of 33 (9.1%) of the small-scale seat/arm crevice tests.

Of the 16 small-scale test locations where poor or uncertain correlation was observed, all showed no ignition in the small-scale mock-up test but exhibited sustained smoldering in one or more of the Technical Bulletin 116 tests. However, tests of 6 of the chairs gave inconsistent results at specific locations. For example, in testing a chair crevice location, only one of three test locations might ignite. Under the criteria of Technical Bulletin 116, this is considered an ignition of that location and a failure of the chair. In the six equivalent tests, with no replicates, mock-up results correlated with "no ignition" chair locations, but not with the ignited locations on the same chair. Discounting these 6 locations of uncertain correlation, the correlation rate for the remaining 190 test locations increased to 94.7%, with 180 of 190 locations in good correlation. Complete lack of correlation, where the small-scale test did not ignite but all of the equivalent Technical Bulletin 116 tests ignited, was observed in 10 locations.

Thorough correlation of small-scale mock-up tests to Technical Bulletin 116 tests was impossible because equal numbers of tests were not possible for each chair location by the two test methods. In most cases, one small-scale mock-up result was compared to one to four Technical Bulletin 116 results, for the same chair locations. Thus, for example, one flat surface failure of three Technical Bulletin 116 tests would constitute an

ignition, even though two other cigarette locations did not ignite. If the equivalent small-scale mock-up did not ignite, the comparison was defined to be a non-correlation. In order to more adequately assess the degree of correlation, equal numbers of small-scale mock-up and full-scale furniture tests should be conducted, for each chair location, which is usually not possible.

CONCLUSIONS

Since a limited number of chairs and locations were tested, the trends exhibited in correlation (i.e., lower correlation rate for flat seat surfaces than for crevices, etc.) may not be significant. This protocol does, however, show promise as a method for predicting whether a finished furniture article, filled with particular contents and covered with a particular fabric, will exhibit sustained smoldering ignition, at smooth surfaces or crevice locations. Correlations obtained were good, given the number of variables which influence the smoldering behavior of furniture. Based on the results of this preliminary study, the Bureau of Home Furnishings recommends continued research in this area to generate a larger data base and establish the efficacy of using small-scale substrate/fabric mock-ups to assess the smolder potential of finished articles of furniture.

FIGURE 1

CHAIR DESCRIPTIONS

<u>CHAIR NUMBER</u>	<u>CHAIR STYLE</u>	<u>FABRIC CONTENT</u> (%'s)	<u>FABRIC WEIGHT</u> (oz./sq.yd.)	<u>% FABRIC BACK-COATING</u>	<u>SUBSTRATES IN ARM</u> top to bottom layer	<u>SUBSTRATES IN BACK</u> top to bottom layer	<u>SUBSTRATES IN SEAT</u> top to bottom layer
1138-86	Loveseat	100% Leather	15.9	None	-----	Polyester Fiber Batting P.U. Foam Pad	Polyester Fiber Batting P.U. Foam Pad
1137-86	Chair/ Futon	100% Cotton	8.5	None	-----	Blended Fiber Batting (83% Cot. 17% P.Est) P.U. Foam Pad	Blended Fiber Batting (83% Cot. 17% P.Est) P.U. Foam Pad
1512-86	Chair/ Futon	100% Cotton	8.5	None	-----	Blended Fiber Batting (94% Cot. 6% P.Est) P.U. Foam Pad	Blended Fiber Batting (94% Cot. 6% P.Est) P.U. Foam Pad
1723-86	Chair/ Futon	100% Cotton	7.4	None	-----	Blended Fiber Batting (89% Cot. 11% P.Est) P.U. Foam Pad	Blended Fiber Batting (89% Cot. 11% P.Est) P.U. Foam Pad
1799-86	Chair/ Futon	100% Cotton	8.7	None	-----	Blended Fiber Batting (92% Cot. 8% P.Est) P.U. Foam Pad	Blended Fiber Batting (92% Cot. 8% P.Est) P.U. Foam Pad
2285-86	Chair/ Futon	100% Cotton	8.6	None	-----	Blended Fiber Batting (90% Cot. 10% P.Est) P.U. Foam Pad	Blended Fiber Batting (90% Cot. 10% P.Est) P.U. Foam Pad

FIGURE 1

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2286-86	Chair/ Futon	100% Cotton	8.2	None	-----	Blended Fiber Batting (90% Cot. 10% P.Est) P.U. Foam Pad	Blended Fiber Batting (90% Cot. 10% P.Est) P.U. Foam Pad
2412-86	Flip-Top Chair	100% Cotton	6.3	None	-----	P.U. Foam Pad	P.U. Foam Pad
2413-86	Flip-Top Chair	98% Polypropylene 2% Rayon	5.3	40.0%	-----	P.U. Foam Pad	P.U. Foam Pad
1189-86	Armchair	100% Rayon	9.9	None	P.U. Foam Pad	P.U. Foam Pad (1/2" thick) Blended Fiber Waste Batting: 27% Rayon 25% Polyester 15% Acetate 15% Cotton 10% Nylon 8% Acrylic	P.U. Foam Pad

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FIGURE 1

CHAIR DESCRIPTIONS

<u>CHAIR NUMBER</u>	<u>CHAIR STYLE</u>	<u>FABRIC CONTENT</u> (%'s)	<u>FABRIC WEIGHT</u> (oz./sq.yd.)	<u>% FABRIC BACK-COATING</u>	<u>SUBSTRATES IN ARM</u> top to bottom layer	<u>SUBSTRATES IN BACK</u> top to bottom layer	<u>SUBSTRATES IN SEAT</u> top to bottom layer
1210-86	Loveseat	53% Rayon 32% Acrylic 15% Polyester	10.8	None	P.U. Foam Pad (1/4" thick) Blended Fiber Waste Batting: 43% Rayon 19% Polyester 14% Acetate 10% Nylon 8% Cotton 6% Acrylic	P.U. Foam Pad (9/16" thick) Blended Fiber Waste Batting: (same as arm)	P.U. Foam Pad
2712-86	Chair/ Futon	100% Cotton	8.4	None	-----	Blended Fiber Batting (97% Cot. 3% P.Est) P.U. Foam Pad	Blended Fiber Batting (97% Cot. 3% P.Est) P.U. Foam Pad
1073-86	Armchair	100% Leather	17.1	None	Polyester Fiber Batting P.U. Foam Pad	Polyester Fiber Batting P.U. Foam Pad	Polyester Fiber Batting P.U. Foam Pad
1203-86	Armchair	100% Leather	17.8	None	Polyester Fiber Batting P.U. Foam Pad	Polyester Fiber Batting P.U. Foam Pad	Polyester Fiber Batting P.U. Foam Pad
1311-86	Armchair	100% Leather	17.9	None	Polyester Fiber Batting P.U. Foam Pad	Polyester Fiber Batting P.U. Foam Pad	Polyester Fiber Batting P.U. Foam Pad

FIGURE 1

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<u>CHAIR NUMBER</u>	<u>CHAIR STYLE</u>	<u>FABRIC CONTENT</u> (% 's)	<u>FABRIC WEIGHT</u> (oz./sq.yd.)	<u>% FABRIC BACK-COATING</u>	<u>SUBSTRATES IN ARM</u> top to bottom layer	<u>SUBSTRATES IN BACK</u> top to bottom layer	<u>SUBSTRATES IN SEAT</u> top to bottom layer
1398-86	Armchair	100% Leather	16.1	None	P.U. Foam Pad (7/8" thick)	P.U. Foam Pad	Polyester Fiber Batting Resinated Polyester Fiber Batting
1490-86	Armchair	100% Leather	21.7	None	Molded P.U. Foam Pad	Acrylic Fiber Batting Molded P.U. Foam Pad	Acrylic Fiber Batting P.U. Foam Pad
1508-86	Armchair	100% Leather	18.3	None	Polyester Fiber Batting P.U. Foam Pad	Polyester Fiber Batting P.U. Foam Pad	Polyester Fiber Batting P.U. Foam Pad
1705-86	Armchair	100% Leather	21.2	None	Polyester Fiber Batting P.U. Foam Pad	Polyester Fiber Batting P.U. Foam Pad	Polyester Fiber Batting P.U. Foam Pad
2392-86	Armchair	100% Leather	31.3	None	Resinated Acrylic Fiber Batting P.U. Foam Pad	Resinated Acrylic Fiber Batting P.U. Foam Pad	Resinated Acrylic Fiber Batting P.U. Foam Pad
2393-86	Armchair	100% Leather	23.0	None	Resinated Acrylic Fiber Batting P.U. Foam Pad	Resinated Acrylic Fiber Batting P.U. Foam Pad	Resinated Acrylic Fiber Batting P.U. Foam Pad

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FIGURE 1

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2713-86	Chair/ Futon	100% Cotton	8.4	None	-----	Blended Fiber Batting (97% Cot. 3% P.Est) P.U. Foam Pad	Blended Fiber Batting (97% Cot. 3% P.Est) P.U. Foam Pad
2533-86	Loveseat	100% Polypropylene	9.3	37.5%	P.U. Foam Pad	P.U. Foam Pad	P.U. Foam Pad
2895-86	Swivel Rocker	50% Polypropylene 38% Cotton 12% Polyester	12.9	12.3%	Blended Cotton Batting	Resinated Polyester Fiber Batting P.U. Foam Pad	P.U. Foam Pad
151-87	Chair/ Futon	100% Cotton	8.4	None	-----	Resinated Polyester Fiber Batting Blended Cotton Batting P.U. Foam Pad	Resinated Polyester Fiber Batting Blended Cotton Batting P.U. Foam Pad
2896-86	Swivel Rocker	72% Rayon 28% Polyester	8.2	10.9%	P.U. Foam Pad Blended Fiber Batting (96% Cot. 4% P.Est)	P.U. Foam Pad	P.U. Foam Pad
2902-86	Wingback Chair	48% Acrylic 42% Rayon 10% Polyester	13.1	5.8%	Blended Cotton Batting P.U. Foam Pad	Resinated Polyester Fiber Batting P.U. Foam Pad	Resinated Polyester Fiber Batting P.U. Foam Pad
2903-86	Swivel Rocker	69% Acrylic 31% Polyester	10.4	20.3%	Resinated Polyester Fiber Batting P.U. Foam Pad	Resinated Polyester Fiber Batting P.U. Foam Pad	Resinated Polyester Fiber Batting P.U. Foam Pad

FIGURE 1

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2904-86	Swivel Rocker	50% Polyester 34% Nylon 9% Rayon 7% Cotton	7.7	32.4%	P.U. Foam Pad Knit Fabric Quilted to 1/4" thick P.U. Foam Pad Cotton Waste Batting	Resinated Polyester Fiber Batting P.U. Foam Pad	P.U. Foam Pad
2905-86	Chair (Cane Arms)	100% Polyester	9.1	None	-----	P.U. Foam Pad	P.U. Foam Pad Blended Fiber Batting (92% Cot. 8% P.Est)
3009-86	Armchair	77% Rayon 23% Polyester	6.2	12.1%	P.U. Foam Pad (1-1/2" thick) Blended Resinated Fiber Waste Pad: 45% Acrylic 34% Polyester 9% Cotton 7% Rayon 3% Nylon 2% Acetate	Non-Woven Ticking Polyester Fiber Batting Blended Resinated Fiber Waste Pad (same as arm)	Resinated Polyester Fiber Batting P.U. Foam Pad
3010-86	Swivel Rocker	43% Cotton 31% Polypropylene 26% Rayon	11.2	20.1%	P.U. Foam Pad (1/2" thick)	Resinated Polyester Fiber Batting P.U. Foam Pad	Resinated Polyester Fiber Batting P.U. Foam Pad
825-87	Flip-Top Chair	Quilted Fabric: Woven Cotton Fabric P.Est Fiber Batting Non-Woven Scrim	9.9	None	-----	P.U. Foam Pad	P.U. Foam Pad

FIGURE 1

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1186-86	Parlor Chair	49% Cotton 48% Rayon 3% Polyester	15.9	None	-----	-----	P.U. Foam Pad (7/8" thick) Shredded P.U. Foam P.U. Foam (irregular shapes)
1194-86	Armchair	76% Rayon 24% Acrylic	6.9	None	-----	P.U. Foam Pad	P.U. Foam Pad
1199-86	Rocker	100% Cotton	8.8	None	-----	Polyester Fiber Batting Woven Fabric P.U. Foam Pad	Polyester Fiber Batting Woven Fabric P.U. Foam Pad
142-87	Chair	64% Acrylic 36% Polyester	8.9	2.3%	-----	-----	P.U. Foam Pad
1399-86	Barstool	55% Cotton 45% Rayon	4.8	None	-----	-----	P.U. Foam Pad Waste Material: Batting (syn.) Shredded Polyurethane Foam Cloth Scraps
3012-86	Rocker	48% Polypropylene 29% Polyester 12% Nylon 11% Acetate	8.3	36.3%	-----	-----	P.U. Foam Pad

FIGURE 1

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3027-86	Swivel Rocker	58% Polypropylene 42% Polyester	10.4	30.8%	P.U. Foam Pad	Resinated Polyester Fiber Batting P.U. Foam Pad	Resinated Polyester Fiber Batting P.U. Foam Pad
3011-86	Armchair/ Hide-A-Bed	100% Polypropylene	10.0	48.8%	P.U. Foam Pad	Resinated Polyester Fiber Batting P.U. Foam Pad	Resinated Polyester Fiber Batting P.U. Foam Pad
3013-86	Office Chair	70% Acrylic 20% Polyester 5% Rayon 4% Nylon 1% Acetate	7.4	None	-----	-----	P.U. Foam Pad
3026-86	Swivel Rocker/ Armchair	65% polyester 23% Rayon 12% Polypropylene	13.3	34.3%	P.U. Foam Pad Blended Cotton Batting	P.U. Foam Pad Blended Cotton Batting	Resinated Polyester Fiber Batting P.U. Foam Pad
3028-86	Armchair	55% Rayon 23% Polyester 22% Cotton	12.4	5.1%	P.U. Foam Pad	P.U. Foam Pad	Resinated Polyester Fiber Batting P.U. Foam Pad
3029-86	Chair	41% Nylon 36% Polyester 23% Cotton	7.9	50.2%	-----	-----	P.U. Foam Pad

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FIGURE 1

CHAIR DESCRIPTIONS

<u>CHAIR NUMBER</u>	<u>CHAIR STYLE</u>	<u>FABRIC CONTENT</u> (%'s)	<u>FABRIC WEIGHT</u> (oz./sq.yd.)	<u>% FABRIC BACK-COATING</u>	<u>SUBSTRATES IN ARM</u> top to bottom layer	<u>SUBSTRATES IN BACK</u> top to bottom layer	<u>SUBSTRATES IN SEAT</u> top to bottom layer
3030-86	Chair	53% Rayon 30% Cotton 17% Polyester	9.6	4.4%	-----	-----	Polyester Fiber Batting P.U. Foam Pad
3041-86	Armchair	65% Rayon 35% Polyester	9.9	8.7%	Blended Fiber Batting (78% synthetic 22% cotton)	Blended Fiber Batting (78% synthetic 22% cotton) P.U. Foam Pad	Blended Fiber Batting (78% synthetic 22% cotton) P.U. Foam Pad
3129-86	Sofa/Hide-a-bed	49% Polypropylene 38% Polyester 13% Rayon	5.5	7.4%	P.U. Foam Pads	Resinated Polyester Fiber Batting P.U. Foam Pad	Resinated Polyester Fiber Batting P.U. Foam Pad
143-87	Barstool	100% Polyvinyl Chloride	10.8	24.5%	-----	-----	P.U. Foam Pad
144-87	Swivel Arm Chair	100% Polyvinyl Chloride	15.9	29.3%	P.U. Foam Pads	P.U. Foam Pads	P.U. Foam Pad
973-87	Swivel Office Chair	36% Polyester 29% Acrylic 15% Cotton 10% Rayon/10% Nylon	8.4	None	-----	-----	P.U. Foam Pad

FIGURE 1

CHAIR DESCRIPTIONS

<u>CHAIR NUMBER</u>	<u>CHAIR STYLE</u>	<u>FABRIC CONTENT</u> (%'s)	<u>FABRIC WEIGHT</u> (oz./sq.yd.)	<u>% FABRIC BACK-COATING</u>	<u>SUBSTRATES IN ARM</u> top to bottom layer	<u>SUBSTRATES IN BACK</u> top to bottom layer	<u>SUBSTRATES IN SEAT</u> top to bottom layer
974-87	Caneback Chair	100% Rayon	4.9	None	-----	-----	Polyester Fiber Batting P.U. Foam Pad
975-87	Barstool	75% Cotton 17% Polypropylene 8% Polyester	12.1	26.0%	-----	-----	Polyester Fiber Batting P.U. Foam Pad
976-87	Office Chair	100% Acrylic	12.9	None	-----	-----	P.U. Foam Pad
977-87	Caneback Chair	68% Acrylic 32% Polyester	9.1	10.8%	-----	-----	P.U. Foam Pad
978-87	Caneback Chair	68% Acrylic 32% Polyester	9.1	10.8%	-----	-----	P.U. Foam Pad
1187-86	Armchair	80% Rayon 13% Cotton 7% Polyester	15.4	None	-----	-----	P.U. Foam Pad

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FIGURE 1

CHAIR DESCRIPTIONS

<u>CHAIR NUMBER</u>	<u>CHAIR STYLE</u>	<u>FABRIC CONTENT</u> (% 's)	<u>FABRIC WEIGHT</u> (oz./sq.yd.)	<u>% FABRIC BACK-COATING</u>	<u>SUBSTRATES IN ARM</u> top to bottom layer	<u>SUBSTRATES IN BACK</u> top to bottom layer	<u>SUBSTRATES IN SEAT</u> top to bottom layer
1403-86	Rocker	68% Acrylic 32% Polyester	9.9	10.4%	-----	-----	P.U. Foam Pad
1733-86	Dinette Chair	66% Cotton 17% Polyester 14% Acrylic 3% Nylon	14.1	None	-----	-----	P.U. Foam Pad
1786-86	Dinette Chair	79% Cotton 9% Rayon 6% Polyester 6% Acrylic	12.2	5.0%	-----	-----	P.U. Foam Pad
2287-86	Dinette Chair	81% Cotton 19% Acrylic	8.6	None	-----	-----	P.U. Foam Pad
1130-86	Dinette Chair	72% Cotton 24% Rayon 4% Polyester	11.0	None	-----	-----	P.U. Foam Pad
1504-86	Dinette Chair	71% Cotton 21% Acrylic 8% Rayon	7.4	None	-----	-----	P.U. Foam Pads

FIGURE 1

CHAIR DESCRIPTIONS

<u>CHAIR NUMBER</u>	<u>CHAIR STYLE</u>	<u>FABRIC CONTENT</u> (%'s)	<u>FABRIC WEIGHT</u> (oz./sq.yd.)	<u>% FABRIC BACK-COATING</u>	<u>SUBSTRATES IN ARM</u> top to bottom layer	<u>SUBSTRATES IN BACK</u> top to bottom layer	<u>SUBSTRATES IN SEAT</u> top to bottom layer
1797-86	Dinette Chair	55% Rayon 25% Polyester 20% Cotton	8.9	35.9%	-----	P.U. Foam Pad	P.U. Foam Pad
2288-86	Dinette Chair	73% Cotton 27% Acrylic	8.1	None	-----	-----	P.U. Foam Pads
1185-86	Parlor Chair	56% Polyester 26% Cotton 18% Rayon	11.7	None	-----	-----	P.U. Foam Pad
1405-86	Rocker	100% Cotton	12.6	None	-----	P.U. Foam Pad	P.U. Foam Pad
3042-86	Swivel Armchair	81% Acetate 19% Nylon	19.1	4.0%	Blended Cotton Batting	P.U. Foam Pad	P.U. Foam Pad
589-87	Caneback Chair	72% Acrylic 28% Polyester	12.4	49.5%	-----	-----	Resinated Polyester Fiber Batting P.U. Foam Pad

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FIGURE 1

CHAIR DESCRIPTIONS

<u>CHAIR NUMBER</u>	<u>CHAIR STYLE</u>	<u>FABRIC CONTENT</u> (% 's)	<u>FABRIC WEIGHT</u> (oz./sq.yd.)	<u>% FABRIC BACK-COATING</u>	<u>SUBSTRATES IN ARM</u> top to bottom layer	<u>SUBSTRATES IN BACK</u> top to bottom layer	<u>SUBSTRATES IN SEAT</u> top to bottom layer
601-87	Office Chair	100% Acrylic	11.5	None	-----	-----	P.U. Foam Pad
1025-87	Dinette Chair	71% Cotton 29% Polyester	12.1	1.0%	-----	-----	P.U. Foam Pad
1027-87	Dinette Chair	100% Polyester	4.7	None	-----	-----	P.U. Foam Pad
1028-87	Dinette Chair	100% Cotton	8.4	None	-----	-----	P.U. Foam Pad
1029-87	Dinette Chair	100% Polypropylene	9.5	15.6%	-----	-----	P.U. Foam Pad
819-87	Chair	54% Rayon 32% Acrylic 14% Polyester	8.4	20.3%	-----	Resinated Polyester Fiber Batting P.U. Foam Pad	P.U. Foam Pad

FIGURE 1

CHAIR DESCRIPTIONS

<u>CHAIR NUMBER</u>	<u>CHAIR STYLE</u>	<u>FABRIC CONTENT</u> (%'s)	<u>FABRIC WEIGHT</u> (oz./sq.yd.)	<u>% FABRIC BACK-COATING</u>	<u>SUBSTRATES IN ARM</u> top to bottom layer	<u>SUBSTRATES IN BACK</u> top to bottom layer	<u>SUBSTRATES IN SEAT</u> top to bottom layer
823-87	Loveseat	100% Nylon	13.0	20.3%	-----	-----	P.U. Foam Pad
851-87	Computer Chair	59% Acrylic 28% Polyester 7% Nylon 4% Cotton/2% Rayon	12.8	None	-----	-----	P.U. Foam Pad
176-87	Hammock Chair	100% Cotton	6.3	None	-----	P.U. Foam Pad	P.U. Foam Pad
588-87	Armchair	79% Acrylic 13% Polyester 8% Rayon	9.7	5.6%	-----	P.U. Foam Pad	P.U. Foam Pad Resinated Polyester Fiber Pad
821-87	Computer Chair	72% Acrylic 28% Polyester	8.8	3.6%	-----	-----	P.U. Foam Pad
951-87	Rattan Chair	42% Cotton 37% Polyester 21% Nylon	11.6	6.8%	-----	-----	P.U. Foam Pad

FIGURE 1

CHAIR DESCRIPTIONS

<u>CHAIR NUMBER</u>	<u>CHAIR STYLE</u>	<u>FABRIC CONTENT</u> (% 's)	<u>FABRIC WEIGHT</u> (oz./sq.yd.)	<u>% FABRIC BACK-COATING</u>	<u>SUBSTRATES IN ARM</u> top to bottom layer	<u>SUBSTRATES IN BACK</u> top to bottom layer	<u>SUBSTRATES IN SEAT</u> top to bottom layer
1030-87	Armchair	55% Rayon 45% Cotton	13.9	None	P.U. Foam Pad	P.U. Foam Pad	P.U. Foam Pad
43-87	Rocker	54% Polyester 46% Cotton	8.6	None	-----	Polyester Fiber Batting P.U. Foam Pad	Polyester Fiber Batting P.U. Foam Pad
44-87	Armchair	68% Acrylic 32% Rayon	9.2	None	-----	Resinated Polyester Fiber Batting P.U. Foam Pad	Resinated Polyester Fiber Batting P.U. Foam Pad
73-87	Armchair	74% Acrylic 26% Polyester	12.7	31.3%	-----	Blended Cotton Batting P.U. Foam Pad	Blended Cotton Batting P.U. Foam Pad
74-87	Office Swivel Chair	64% Polypropylene 36% Polyester	10.3	26.4%	-----	P.U. Foam Pads	P.U. Foam Pad
75-87	Swivel Rocker	77% Acrylic 23% Polyester	11.8	13.1%	Blended Cotton Batting P.U. Foam Pad	Resinated Polyester Fiber Batting P.U. Foam Pad	Resinated Polyester Fiber Batting P.U. Foam Pad

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FIGURE 1

CHAIR DESCRIPTIONS

<u>CHAIR NUMBER</u>	<u>CHAIR STYLE</u>	<u>FABRIC CONTENT</u> (%'s)	<u>FABRIC WEIGHT</u> (oz./sq.yd.)	<u>% FABRIC BACK-COATING</u>	<u>SUBSTRATES IN ARM</u> top to bottom layer	<u>SUBSTRATES IN BACK</u> top to bottom layer	<u>SUBSTRATES IN SEAT</u> top to bottom layer
229-87	Stool	100% Cotton	8.3	None	-----	-----	P.U. Foam Pad
230-87	Deskchair	100% Cotton	5.9	None	-----	-----	P.U. Foam Pad
591-87	Armchair	73% Acrylic 27% Polyester	13.0	40.4%	-----	P.U. Foam Pad	Resinated Polyester Fiber Batting P.U. Foam Pad
1005-87	Armchair	85% Cotton 15% Polypropylene	9.8	22.5%	-----	P.U. Foam Pad (decubitus)	P.U. Foam Pad (decubitus)
233-87	Parlor Chair	43% Cotton 41% Acrylic 16% Polypropylene	10.3	None	-----	P.U. Foam Pad	P.U. Foam Pad
234-87	Parlor Chair	55% Polyester 26% Acrylic 19% Rayon	10.9	None	-----	P.U. Foam Pad	P.U. Foam Pad

FIGURE 1

CHAIR DESCRIPTIONS

<u>CHAIR NUMBER</u>	<u>CHAIR STYLE</u>	<u>FABRIC CONTENT (%'s)</u>	<u>FABRIC WEIGHT (oz./sq.yd.)</u>	<u>% FABRIC BACK-COATING</u>	<u>SUBSTRATES IN ARM top to bottom layer</u>	<u>SUBSTRATES IN BACK top to bottom layer</u>	<u>SUBSTRATES IN SEAT top to bottom layer</u>
820-87	Rocker	100% Polypropylene	6.9	37.8%	-----	P.U. Foam Pad	P.U. Foam Pad
590-87	Swivel Rocker	65% Acrylic 35% Polyester	11.9	23.6%	Blended Cotton Batting	P.U. Foam Pad	P.U. Foam Pad
1064-87	Swivel Desk Chair	62% Polyester 24% Nylon 14% Acrylic	8.9	18.6%	-----	-----	P.U. Foam Pad
1115-87	Rattan Chair	100% Cotton	4.5	None	-----	-----	Resinated Polyester Fiber Batting P.U. Foam Pad
1003-87	Wingback Chair	62% Nylon 38% Cotton	17.5	30.4%	P.U. Foam Pad	Blended Cotton Batting P.U. Foam Pad	
850-87	Armchair	61% Acetate 39% Nylon	8.5	21.8%	Blended Cotton Batting	Resinated Polyester Fiber Batting P.U. Foam Pad	P.U. Foam Pad

FIGURE 1

CHAIR DESCRIPTIONS

<u>CHAIR NUMBER</u>	<u>CHAIR STYLE</u>	<u>FABRIC CONTENT</u> (% 's)	<u>FABRIC WEIGHT</u> (oz./sq.yd.)	<u>% FABRIC BACK-COATING</u>	<u>SUBSTRATES IN ARM</u> top to bottom layer	<u>SUBSTRATES IN BACK</u> top to bottom layer	<u>SUBSTRATES IN SEAT</u> top to bottom layer
817-87	Swivel Rocker	73% Acrylic 27% Polyester	13.1	33.9%	Blended Fiber Batt- ing (93% Cotton/ 7% Polyester) P.U. Foam Pad	Shredded Poly- urethane Foam	Resinated Polyester Fiber Batting P.U. Foam Pad

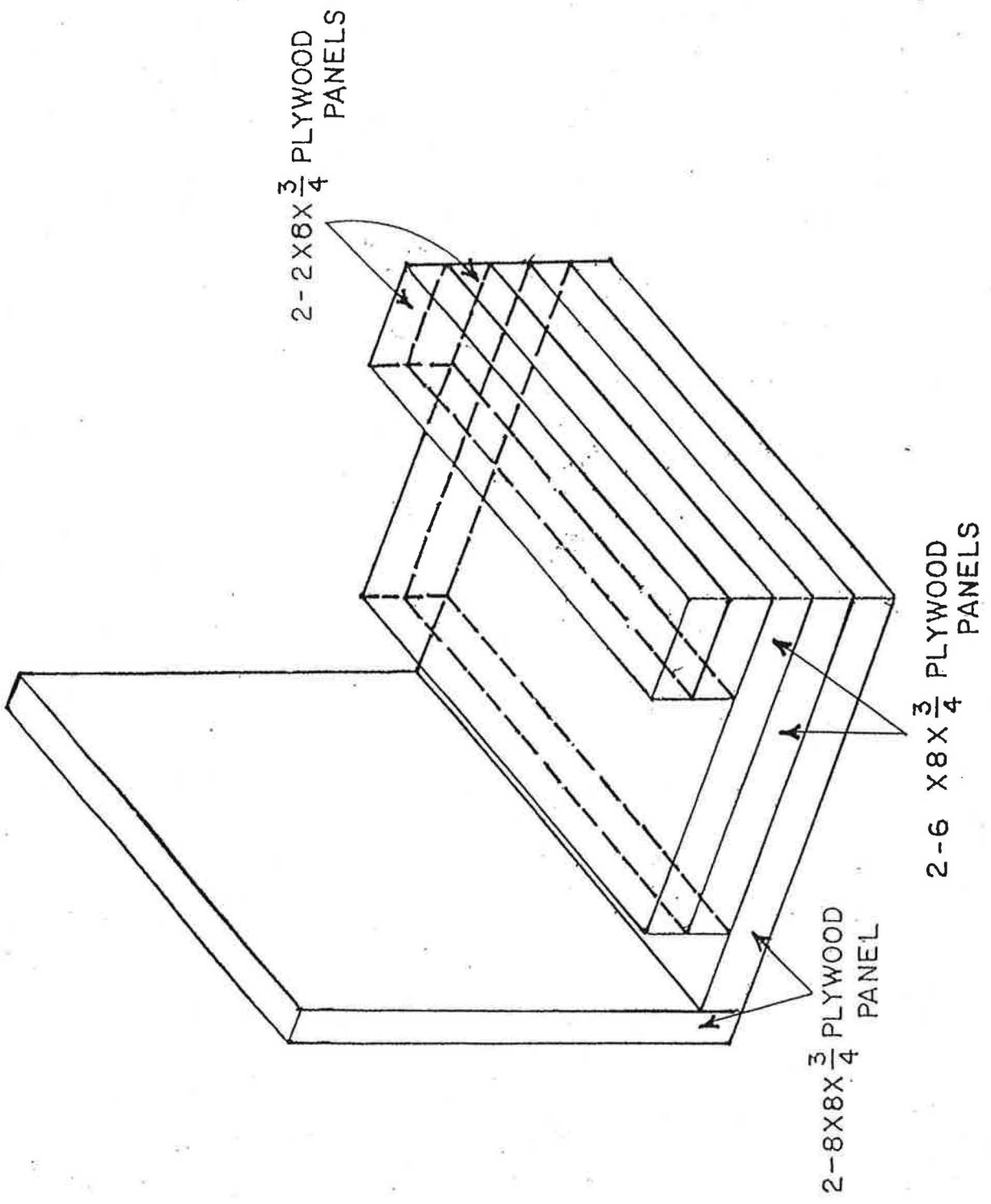


Figure 2

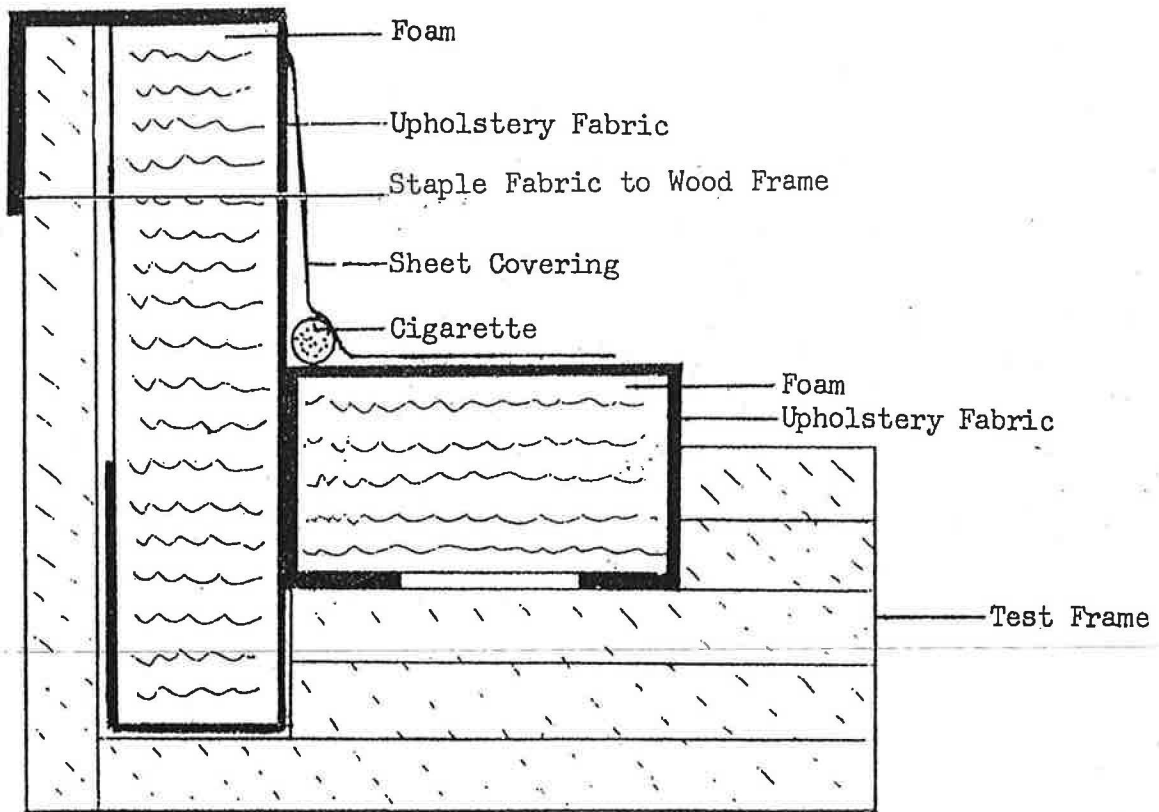


Figure 3

FIGURE 4

FLAT MOCK-UP TEST FRAME

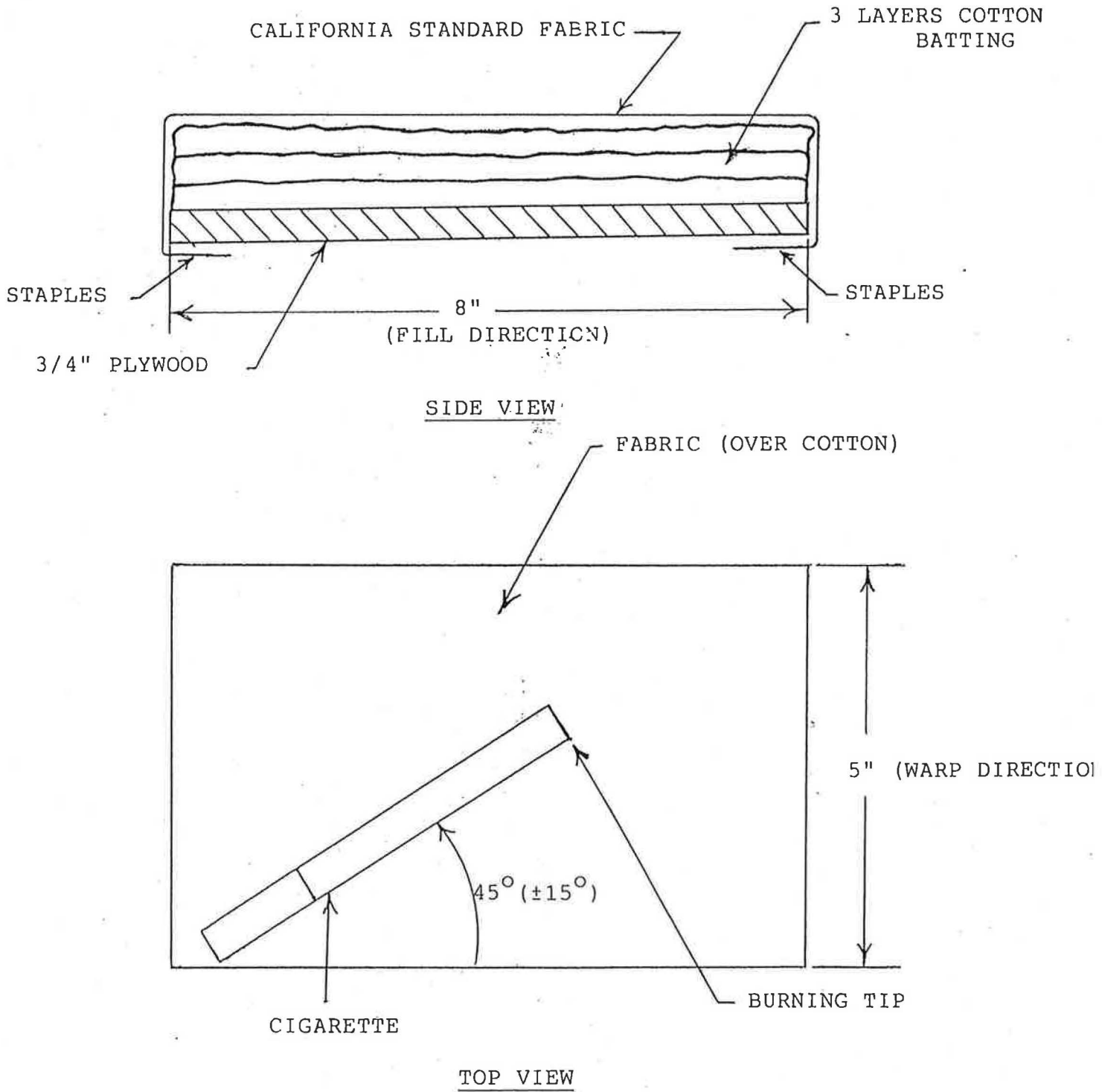
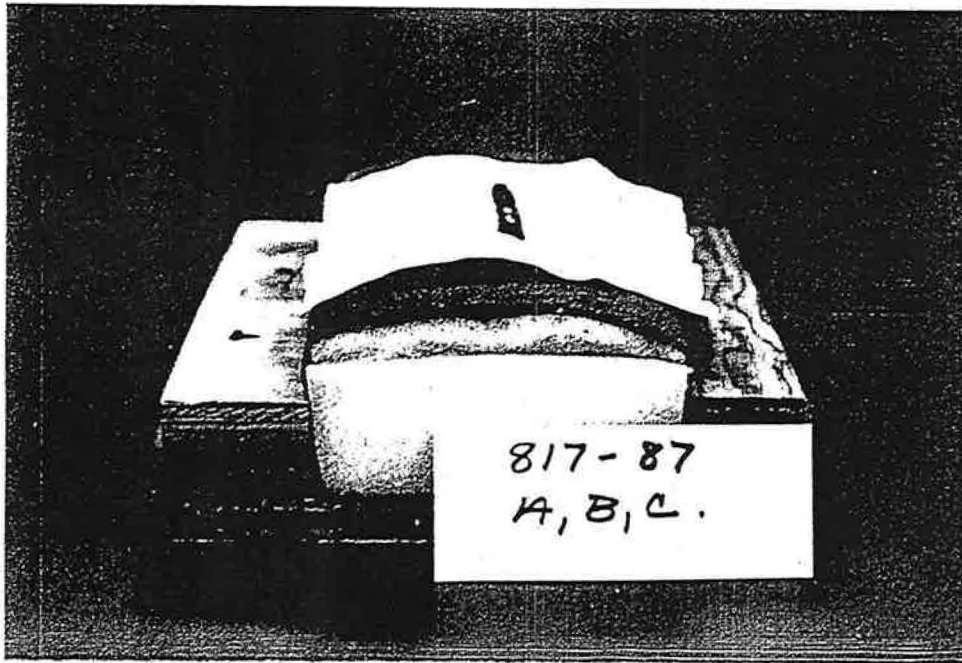
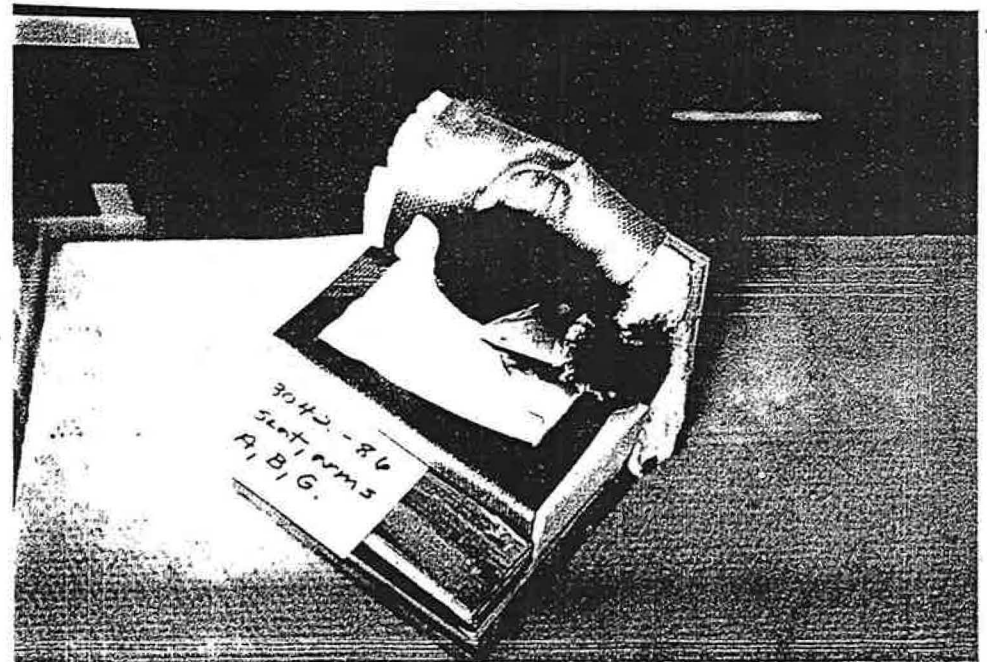


FIGURE 5

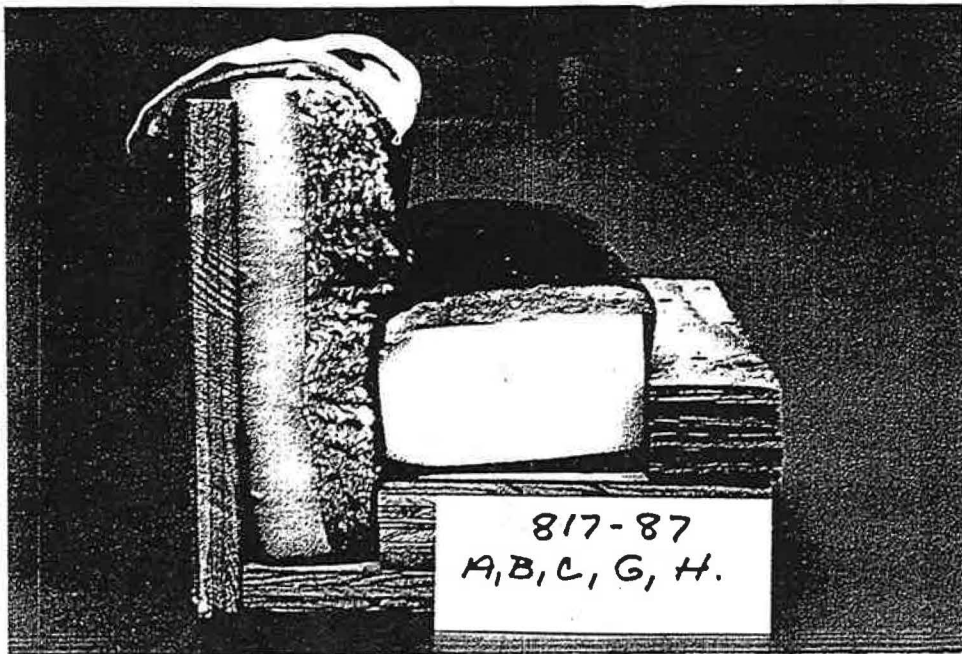
Typical Small-Scale Mock-Up Systems Tested



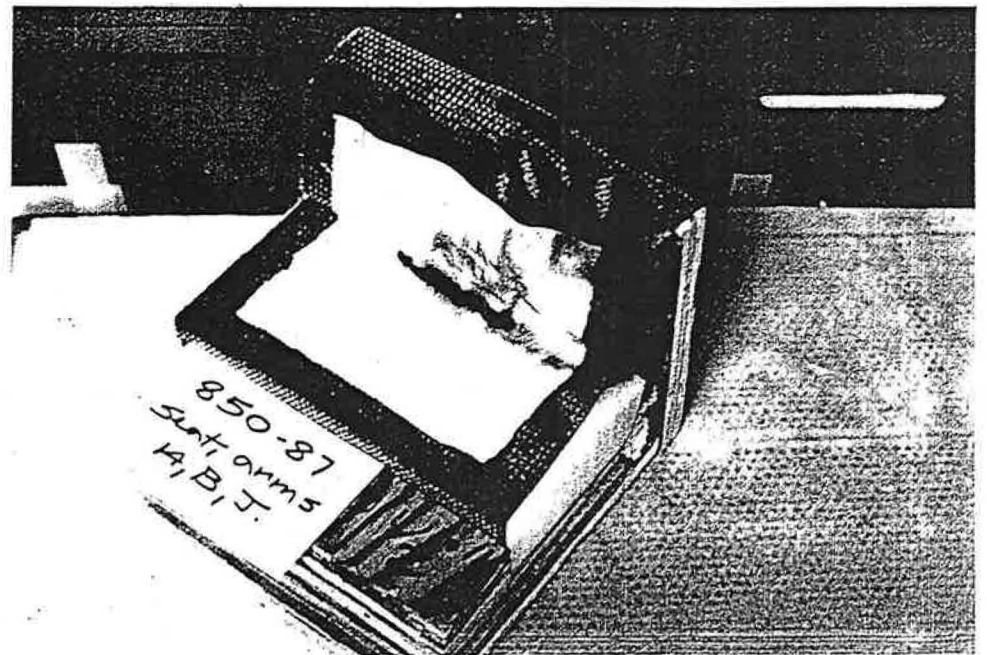
817-87: Flat Seat Mock-Up



3042-86: Seat/Arm Crevice Mock-Up (Failure)



817-87: Seat/Arm Crevice Mock-Up



850-87: Seat/Arm Crevice Mock-Up (Failure)

FIGURE 6

TECHNICAL BULLETIN #116/SMALL-SCALE MOCK-UP CORRELATION RESULTS

(Number of locations not igniting/Number of locations tested)

CHAIR NUMBER	SEAT/BACK CREVICE		SEAT/ARM CREVICE		FLAT SEAT	
	MOCK-UP	T.B.116	MOCK-UP	T.B.116	MOCK-UP	T.B.116
1138-86	1/1	2/2	----	2/2	1/1	4/4
1137-86	0/1	0/1	----	----	1/1*	0/2
1512-86	0/1	0/1	----	----	1/1*	0/1
1723-86	0/1	0/1	----	----	1/1*	1/2
1799-86	0/1	0/1	----	----	1/1*	0/1
2285-86	0/1	0/1	----	----	1/1	3/3
2286-86	0/1	0/1	----	----	1/1	3/3
2412-86	1/1*	0/1	----	----	1/1	3/3
2413-86	1/1	1/1	----	----	1/1	3/3
1189-86	1/1	1/1	1/1	2/2	1/1	3/3
1210-86	1/1	1/1	1/1	2/2	1/1	3/3
2712-86	0/1	0/1	----	----	1/1	1/1
1073-86	1/1	1/1	1/1	2/2	1/1	3/3
1203-86	1/1	1/1	1/1	2/2	1/1	3/3
1311-86	1/1	1/1	1/1	2/2	1/1	3/3
1398-86	1/1	1/1	1/1	2/2	1/1	2/2
1490-86	1/1	1/1	1/1	2/2	1/1	3/3
1508-86	1/1	1/1	1/1	2/2	1/1	3/3
1705-86	1/1	1/1	1/1	1/1	1/1	3/3
2392-86	1/1	1/1	1/1	2/2	1/1	3/3
2393-86	1/1	1/1	1/1	2/2	1/1	3/3

* Does not correlate

FIGURE 6

TECHNICAL BULLETIN #116/SMALL-SCALE MOCK-UP CORRELATION RESULTS

(Number of locations not igniting/Number of locations tested)

CHAIR NUMBER	SEAT/BACK CREVICE		SEAT/ARM CREVICE		FLAT SEAT	
	MOCK-UP	T.B.116	MOCK-UP	T.B.116	MOCK-UP	T.B.116
2713-86	0/1	0/1	----	----	1/1	1/1
2533-86	1/1	1/1	1/1	2/2	1/1	3/3
2895-86	1/1	1/1	1/1*	1/2	1/1	3/3
151-87	1/1	1/1	----	----	1/1	1/1
2896-86	1/1	1/1	1/1	2/2	1/1	3/3
2902-86	1/1	1/1	1/1	2/2	1/1	3/3
2903-86	1/1	1/1	1/1	2/2	1/1	3/3
2904-86	1/1	1/1	1/1	2/2	1/1	3/3
2905-86	1/1	1/1	----	----	1/1	3/3
3009-86	1/1	1/1	1/1	2/2	1/1	3/3
3010-86	1/1	1/1	1/1	2/2	1/1	3/3
825-87	1/1	1/1	----	----	1/1	3/3
1186-86	----	----	----	----	1/1*	2/3
1194-86	1/1	1/1	----	----	1/1	3/3
1199-86	1/1	----	----	----	1/1	3/3
142-87	----	----	----	----	1/1	2/2
1399-86	----	----	----	----	1/1	3/3
3012-86	----	----	----	----	1/1	3/3
3027-86	1/1	1/1	1/1	2/2	1/1	3/3
3011-86	1/1	1/1	1/1	2/2	1/1	3/3
3013-86	----	----	----	----	1/1	3/3
3026-86	1/1	1/1	1/1	2/2	1/1	3/3

* Does not correlate

FIGURE 6

TECHNICAL BULLETIN #116/SMALL-SCALE MOCK-UP CORRELATION RESULTS

(Number of locations not igniting/Number of locations tested)

CHAIR NUMBER	SEAT/BACK CREVICE		SEAT/ARM CREVICE		FLAT SEAT	
	MOCK-UP	T.B.116	MOCK-UP	T.B.116	MOCK-UP	T.B.116
3028-86	1/1	1/1	1/1	2/2	1/1	3/3
3029-86	----	----	----	----	1/1	3/3
3030-86	----	----	----	----	1/1	3/3
3041-86	1/1	1/1	1/1	2/2	1/1	3/3
3129-86	1/1	3/3	1/1	2/2	1/1	6/6
143-87	----	----	----	----	1/1	3/3
144-87	1/1	1/1	1/1	2/2	1/1	3/3
973-87	----	----	----	----	1/1	3/3
974-87	----	----	----	----	1/1	3/3
975-87	----	----	----	----	1/1	3/3
976-87	----	----	----	----	1/1	3/3
977-87	----	----	----	----	1/1	2/2
978-87	----	----	----	----	1/1	2/2
1187-86	----	----	----	----	1/1	3/3
1403-86	----	----	----	----	1/1	3/3
1733-86	----	----	----	----	1/1	3/3
1786-86	----	----	----	----	1/1	3/3
2287-86	----	----	----	----	1/1	3/3
1130-86	----	----	----	----	1/1	3/3
1504-86	----	----	----	----	1/1	3/3
1797-86	1/1	1/1	----	----	1/1	4/4
2288-86	----	----	----	----	1/1	3/3

* Does not correlate

FIGURE 6

TECHNICAL BULLETIN #116/SMALL-SCALE MOCK-UP CORRELATION RESULTS

(Number of locations not igniting/Number of locations tested)

CHAIR NUMBER	SEAT/BACK CREVICE		SEAT/ARM CREVICE		FLAT SEAT	
	MOCK-UP	T.B.116	MOCK-UP	T.B.116	MOCK-UP	T.B.116
1185-86	----	----	----	----	1/1	3/3
1405-86	1/1*	0/2	----	----	1/1	3/3
3042-86	1/1	1/1	0/1	0/1	1/1	3/3
589-87	----	----	----	----	1/1	3/3
601-87	----	----	----	----	1/1	3/3
1025-87	----	----	----	----	1/1	3/3
1027-87	----	----	----	----	1/1	3/3
1028-87	----	----	----	----	1/1	3/3
1029-87	----	----	----	----	1/1	3/3
819-87	1/1	1/1	----	----	1/1	3/3
823-87	----	----	----	----	1/1	3/3
851-87	----	----	----	----	1/1	3/3
176-87	1/1*	0/1	----	----	1/1	3/3
588-87	1/1	1/1	----	----	1/1	3/3
821-87	----	----	----	----	1/1	3/3
951-87	----	----	----	----	1/1*	0/3
1030-87	0/1	0/1	0/1	1/2	1/1	3/3
43-87	1/1	1/1	----	----	1/1	3/3
44-87	1/1	1/1	----	----	1/1	3/3
73-87	1/1*	0/1	----	----	1/1*	2/3**
74-87	1/1	1/1	----	----	1/1	3/3
75-87	1/1	1/1	1/1	2/2	1/1	3/3

* Does not correlate

* 73-87 Flat Seat TB 116 test was on tuft.

FIGURE 6

TECHNICAL BULLETIN #116/SMALL-SCALE MOCK-UP CORRELATION RESULTS

(Number of locations not igniting/Number of locations tested)

CHAIR NUMBER	SEAT/BACK CREVICE		SEAT/ARM CREVICE		FLAT SEAT	
	MOCK-UP	T.B.116	MOCK-UP	T.B.116	MOCK-UP	T.B.116
229-87	----	----	----	----	1/1	3/3
230-87	----	----	----	----	1/1	3/3
591-87	1/1	1/1	----	----	1/1	3/3
1005-87	0/1	0/1	----	----	1/1*	0/1
233-87	1/1	1/1	----	----	1/1	3/3
234-87	1/1	1/1	----	----	1/1	3/3
820-87	1/1	1/1	----	----	1/1	3/3
590-87	1/1	1/1	1/1	2/2	1/1	3/3
1064-87	----	----	----	----	1/1	3/3
1115-87	----	----	----	----	1/1	3/3
1003-87	1/1	1/1	1/1*	0/2	1/1*	1/3
850-87	1/1	1/1	0/1	0/2	1/1	3/3
817-87	1/1	1/1	1/1*	1/2	1/1	3/3

* Does not correlate

APPENDIX A

STATE OF CALIFORNIA
DEPARTMENT OF CONSUMER AFFAIRS
BUREAU OF HOME FURNISHINGS
NORTH HIGHLANDS, CALIFORNIA

TECHNICAL INFORMATION BULLETIN 116

REQUIREMENTS, TEST PROCEDURE AND APPARATUS FOR
TESTING THE FLAME RETARDANCE OF UPHOLSTERED FURNITURE

JANUARY 1980

TECHNICAL BULLETIN NO. 116

REQUIREMENTS, TEST PROCEDURE AND APPARATUS FOR
TESTING THE FLAME RETARDANCE OF UPHOLSTERED FURNITURE

- I. Upholstered furniture means any product as set forth in Section 19006 of the State of California Home Furnishings Act.

Requirements:

- (1) An article of upholstered furniture fails to meet the provisions of law if any of the following conditions occur:
 - (A) If obvious flaming combustion occurs.
 - (B) If a char develops more than two inches in any direction from the cigarette, measured from its nearest point.
- (2) Flame retardant properties shall be retained by the furniture under all normal conditions of temperature, humidity and use.

II. Test Materials

- (1) Cigarettes. Cigarettes shall be made from natural tobacco and shall be 85 ± 2 mm long with a diameter of 0.3 ± 0.02 inches and a weight of $1.1 \text{ gms} \pm 0.1 \text{ gms}$. Filter tip cigarettes shall not be used.
- (2) Furniture. The article of upholstered furniture tested shall be:
 - (a) the finished product ready for sale to the consumer; or
 - (b) a prototype mock-up of actual components which duplicate the design and structure of the finished product.

III. Preparation of Test Materials

Furniture and cigarettes shall be conditioned for not less than 48 hours at a temperature of 65 - 80°F and a relative humidity of less than 55% immediately prior to test. Furniture shall be positioned so as to allow for maximum surface exposure to conditioning environment.

IV. General Requirements

- (1) The furniture shall be tested under conditions of between 65 - 80°F temperature and less than 55% relative humidity.
- (2) Test shall be performed in such a manner that each differently-dyed area of the furniture fabric is included in the test locations.
- (3) If a cigarette extinguishes before burning its full length, the test is considered "no test" and must be repeated with a freshly lit cigarette on a different portion of the same type of location on the furniture.
- (4) Location of the test cigarettes on the furniture shall be no less than 6 inches apart.

- (5) All exposed horizontal surfaces (including smooth, welted, quilted, decking, tops of arms and backs, tufted, or button locations plus all crevices created by the orientation of seat cushions and furniture side and back panels) shall be tested.
- (6) Horizontal surfaces include all surfaces which may be vertical in normal use but which are designed to become horizontal surfaces in special use, e.g., recliners, etc.
- (7) Horizontal surfaces which are not of sufficient size to support a cigarette need not be tested.

V. Testing

Each furniture surface shall be tested until either (a) three cigarettes have burned their full length, (b) three cigarettes have extinguished before burning their full length, or (c) one cigarette has resulted in failure as outlined in (I), (A) and (B).

- VI. (1) Smooth Surface and Decking Tests. Three burning cigarettes (well lighted but not burned more than 4mm (0.16 inch) shall be placed directly on a smooth surface location on the test furniture. The cigarettes should burn their full lengths on a smooth surface without burning across a tuft or stitching of a quilted area. However, if this is not possible because of furniture design, then the cigarettes shall be positioned on the furniture in a manner which will allow as much of the butt ends as possible to burn on smooth surfaces.
- (2) Welt Test. Three burning cigarettes shall be placed in the depression created by the upholstered furniture and the welt parallel to the welt. If there is no depression at the welt, hold the cigarettes in place along the edge and parallel to the edge with straight pins. Three straight pins may be inserted through the edge at a 45° angle such that one pin supports the cigarette at the top, one at the center, and one at the butt. The heads of the pins must be below the upper surface of the cigarette.
- (3) Quilted Location Test. Three burning cigarettes shall be placed on quilted locations of the test furniture. The cigarettes shall be positioned directly over the thread in the depression created by the quilting process. If the quilt design is such that the cigarettes cannot burn their full lengths over the thread, then the cigarettes shall be positioned in a manner which will allow as much of the butt ends as possible to burn on the thread.
- (4) Tufted Location Test. Three burning cigarettes shall be placed on tufted locations of the test furniture. The cigarettes shall be positioned so that they burn down into the depression caused by the tufts and so that the butt ends of the cigarettes burn out over the buttons or laces used in the tufts.

- (5) Crevices. If crevices exist, created by the orientation of seat cushions and side or/and back panels, then at least three cigarettes shall be placed at the crevice location so that it burns between the seat cushion and the upholstered panel.
- (6) Tops of Arms and Backs. Three burning cigarettes shall be placed on tops of arms and tops of backs where present.

VII. Covering Material

All test cigarettes shall be covered with one layer of sheeting material during test. Cotton or cotton/polyester blend bed sheeting material 3.7 ± 0.8 OZ/YD², white in color, and not treated with flame retardants shall be used. The sheeting shall be laundered and dried at least once before use. 6 x 6 inch pieces of sheeting shall be used for test.

APPENDIX B

STATE OF CALIFORNIA
DEPARTMENT OF CONSUMER AFFAIRS
BUREAU OF HOME FURNISHINGS
NORTH HIGHLANDS, CALIFORNIA

TECHNICAL INFORMATION BULLETIN 117

REQUIREMENTS, TEST PROCEDURE AND APPARATUS FOR
TESTING THE FLAME RETARDANCE OF RESILIENT FILLING MATERIALS
USED IN UPHOLSTERED FURNITURE

JANUARY 1980

TECHNICAL BULLETIN NO. 117

REQUIREMENTS, TEST PROCEDURE AND APPARATUS FOR
TESTING THE FLAME RETARDANCE OF RESILIENT FILLING MATERIALS
USED IN UPHOLSTERED FURNITURE

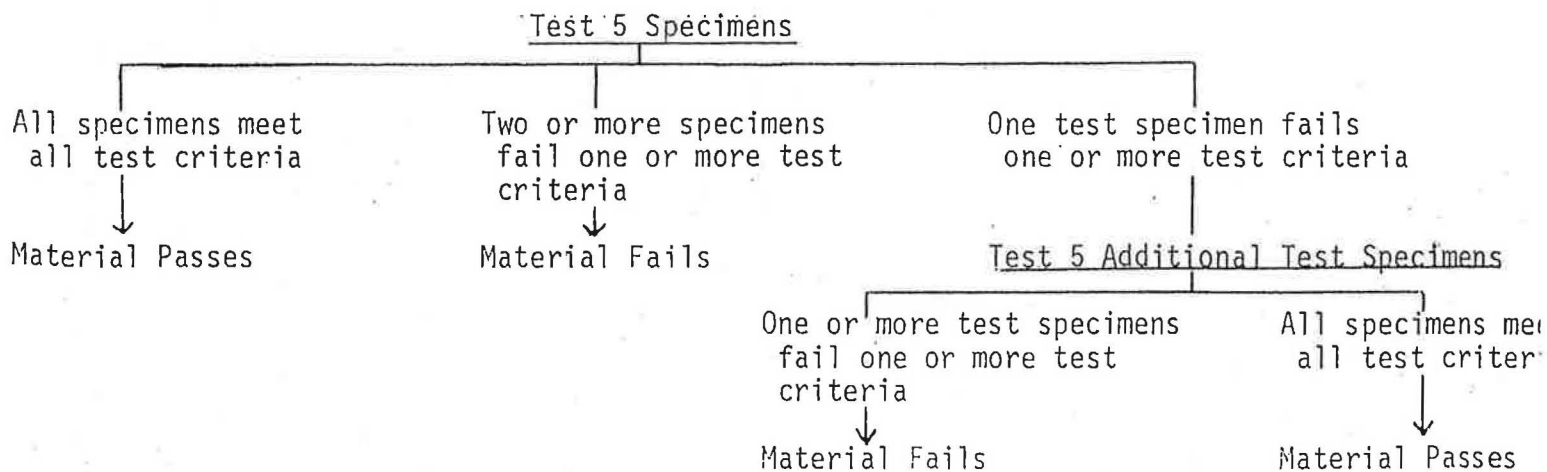
SECTION A

PART I

Resilient Cellular Materials

I. Requirements

1. The average char length of all specimens shall not exceed 6 inches.
2. The maximum char length of any individual specimen shall not exceed 8 inches.
3. The average afterflame, including afterflame of molten material or other fragments dropping from specimens, shall not exceed 5 seconds.
4. The maximum afterflame of any individual specimen, including afterflame of molten material or other fragments dropping from the specimen, shall not exceed 10 seconds.
5. The average afterglow, including afterglow of molten material or other fragments dropping from the specimen, shall not exceed 15 seconds.
6. Resilient cellular materials shall meet the above requirements both before and after aging for 24 hours in a forced air circulating oven at 220°F (104°C).
7. A minimum of 10 test specimens shall be tested; 5 specimens before aging and 5 specimens after aging.
8. Test requirements for resilient cellular materials shall be evaluated according to the following sampling procedure both before and after aging:



II. Test Procedure

1. Scope

This procedure is intended for use in determining the resistance of resilient cellular materials to flame and glow propagation and tendency to char.

2. Test Specimen

Test specimens shall be rectangles of cellular materials 12 x 3 x 1/2 inches.

3. Apparatus

3.1. Cabinet - A test cabinet fabricated in accordance with the requirements of Federal Test Method Standard No. 191 Method 5903.2 or FF 3-71 shall be used.

3.2. Burner - The burner shall be in accordance with the requirements of Federal Test Method Standard No. 191 Method 5903.2 or FF 3-71.

3.3. Gas - The test gas shall be Matheson Gas B.

3.4. Specimen Holder - A stainless steel specimen holder fabricated in accordance with the requirements specified in Figure 117A shall be used.

4. Procedure

4.1. All specimens shall be tested, and conditioned for a minimum of 24 hours, at 70 \pm 5°F and less than 55 percent relative humidity.

4.2. The specimen in its holder shall be suspended vertically in the cabinet in such a manner that the lower end of the specimen is 0.75 inches above the top of the burner.

4.3. The burner flame shall be adjusted by means of a needle valve in the base of the burner to give a flame height of 1.5 inches with air supply to the burner permanently shut off.

4.4. After inserting the specimen, the burner flame shall be applied vertically at the middle of the lower edge of the specimens for 12 seconds.

4.5. The cabinet door shall remain shut during testing.

III. Definitions

1. Afterflame

The afterflame time shall be the time the specimen continues to flame after the burner flame is extinguished, and shall include afterflame of molten drops of material.

2. Afterglow

The afterglow time shall be the time the specimen continues to glow after it has ceased to flame, and shall include afterglow of molten drops of material.

3. Char Length

The char length shall be the distance from the end of the specimen which was exposed to the flame, to the upper edge of the void area. In the measurement of char length all readily removeable portions of carbonaceous char shall be removed prior to measurement.

IV. Test Results

1. The char length of each specimen shall be recorded to the nearest 0.1 inches and the afterflame time and afterglow time to the nearest 0.1 seconds.
2. Maximum and average char length, afterglow and afterflame shall be determined for each resilient cellular material.

SECTION A

PART II

Shredded Resilient Cellular Materials (e.g. shredded polyurethane foams)

Shredded resilient cellular materials shall meet the following requirements.

1. The resilient cellular material used for shredding shall meet the requirements of Section A and D of this Technical Bulletin prior to shredding, or a post flame treated shredded foam may be used.
2. All resilient cellular material shall be encased in a fabric/ticking, and the requirements of the following test procedure shall be met.
3. A 13 x 13 inch (finished size) pillow/cushion fabricated from the fabric/ticking and filled with the flame retardant foam, shall be used for testing.
4. The packing density of the shredded foam shall approximate that of intended use.
5. The pillow/cushion shall not lose more than 5 percent in weight when subjected to a 1.5 inch flame from a Bunsen Burner for 12 seconds.
6. The burner shall be positioned 0.75 inches below the center of the bottom lateral surface of the horizontally positioned pillow/cushion.
7. The pillow/cushion shall be supported in such a manner that a minimum 10 inch diameter circular portion of the lower fabric surface be directly exposed to the burner flame.
8. The pillow/cushion shall meet the test requirements both before and after aging for 24 hours at 220°F (104°C).
9. The test gas shall be Matheson Gas B, and all pillow/cushions shall be conditioned for a minimum of 24 hours at 70 ±5°F and less than 55 percent relative humidity.

10. The burner flame shall be adjusted by means of a needle valve in the base of the burner to give a flame height of 1.5 inches with air supply to the burner permanently shut off.
11. The fabric/ticking used to encase the shredded resilient cellular material shall meet the requirements of Technical Bulletin 117, Section A, Requirements 1, 2, 3, 4 and 5, when tested in accordance with Federal Test Method Standard No. 191 Method 5903.2. The burner flame shall be applied vertically at the middle of the lower edge of the specimens for both 3 seconds and 12 seconds.
12. A total of 20 fabric specimens shall be tested as follows:

<u>Test Flame</u>	<u>Yarns Vertical</u>	<u>Specimens</u>
3 Sec.	Warp	5
3 Sec.	Fill	5
12 Sec.	Warp	5
12 Sec.	Fill	5

SECTION A
PART III

Expanded Polystyrene Beads

A. Requirements

1. Weight loss shall not exceed 5 percent in any of five consecutive tests.
2. Materials shall meet the above requirement after aging for 48 hours in an air circulating mechanical convection oven at 150 \pm 5°F.

B. Apparatus

1. Oven - A mechanical convection air circulating oven capable of maintaining 150 \pm 5°F.
2. Laboratory Hood - The test shall be conducted in a laboratory fume hood.
3. Test Basket - 3-inch deep, 8-inch square, wire mesh basket. (U.S. mesh No. 12 or finer)
4. Aluminum Foil - To catch molten material.
5. Methenamine reagent tablets - Eli Lilly No. 1588.
6. Tongs.

7. Matches.

8. Balance - Capable of measuring to the nearest 0.1 gram.

C. Test Procedure

1. All test material shall be aged for a minimum of 48 hours at $150 \pm 5^\circ\text{F}$, and conditioned for a minimum of 24 hours at $70 \pm 5^\circ\text{F}$ and less than 55 percent relative humidity before testing.
2. A pre-weighed wire basket shall be filled to the 3-inch level with the aged material, and the weight of the test material determined.
3. Place the test basket on a sheet of aluminum foil in a fume hood. The hood fan should remain off during the test.
4. Hold a methenamine tablet with tongs and ignite with a match.
5. Place the burning tablet gently on the top center of the test material.
6. Continue the test until all flames are completely extinguished.
7. After cooling, reweigh the basket and record percentage weight loss. Molten material which remains in the basket or on the aluminum foil is not considered as weight loss.
8. A total of five test samples of each material shall be evaluated.

SECTION B

PART I

Non-Man-Made Filling Materials

- I. Non-man-made filling materials shall meet all the requirements under Section A of this technical bulletin with the following modifications:
1. Specimens shall not be mounted in a specimen holder, but shall be vertically suspended into the flame. The upper 1/2 inch of the specimen may be used for suspension.
 2. Specimens size shall be 12 x 3 inches and in the thickness in which the batting is to be used up to 1 inch. If the filler is to be used in thicknesses of greater than one inch, specimens shall be cut to one inch thickness prior to testing.
 3. Non-man-made products shall not be aged for 24 hours at 220°F (104°C).

SECTION B

PART II

Shredded and Loose Fill Materials

Feathers and Down

Feathers and down may be used in articles of upholstered furniture provided that the following requirements are met:

1. The feathers and down shall be encased in a flame retardant fabric/ticking.
2. The fabric/ticking shall meet the requirements of Technical Bulletin 117, Section A, Requirements 1, 2, 3, 4 and 5, when tested in accordance with Federal Test Method Standard No. 191 Method 5903.2.
3. The burner flame shall be applied vertically at the middle of the lower edge of the specimens for both 3 seconds and 12 seconds.
4. Specimen size shall be 12 x 2 3/4 inches.
5. Twenty specimens shall be tested as follows:

<u>Test</u>	<u>Yarn Vertical</u>	<u>Specimens</u>
3	Warp	5
3	Fill	5
12	Warp	5
12	Fill	5

SECTION C

Man-Made Fiber Filling Materials

I. Requirements

1. The average flame spread of all specimens shall not be less than 10 seconds.
2. The minimum flame spread of any individual specimens shall not be less than 7 seconds.
3. Man-made fiber fillers shall meet these requirements when tested both with and without any attached woven or non-woven materials such as scrims, cheese cloth, etc.
4. Man-made fiber fillers shall meet these requirements when tested in both machine (or linear) and transverse directions.

II. Test Procedure

1. Scope
This procedure is intended for use in determining the resistance of resilient man-made fiber filling materials to flame spread, when tested using a modified version of Commercial Standard 191-53.
2. Test Specimen
Test specimens shall be rectangles of fillers 6 x 3 inches and in the thickness in which the fillers are to be used. A minimum of 5 specimens shall be tested.
3. Apparatus
 - 3.1. Cabinet - A test cabinet fabricated in accordance with the requirements of Commercial Standard 191-53 shall be used.
 - 3.2. Burner and Gas - The burner and gas specified in Commercial Standard 191-53 shall be used.
 - 3.3. Specimen Holder - A modified stainless steel specimen holder fabricated in accordance with the requirements of Figure 117B shall be used.
4. Summary of Method
 - 4.1. All specimens shall be tested, and conditioned for a minimum of 24 hours, at 70 \pm 5°F and less than 55 percent relative humidity.
 - 4.2. The specimen in its holder shall be supported at an angle of 45 degrees.
 - 4.3. The burner flame, adjusted to a length of 5/8 inches, shall be applied to the specimen near the lower edge for 5 seconds.

4.4. The time required for the flame to proceed up the batting a distance of 5 inches shall be recorded.

4.5. The cabinet door shall remain shut during testing.

III. Definitions

1. Flame Spread - The time in seconds from application of the burner until the specified burn end point is reached.
2. Self-Extinguishing Time - The time in seconds from application of the burner until the specimen flame extinguishes, provided the flame front has not reached the specified burn end point.

IV. Test Results

1. The time of flame spread of individual specimens shall be noted. Average flame spread shall be determined.
2. If a specimen burn does not reach the specified end point, the self-extinguishing time shall be noted.

V. NOTE: Mixed Fiber Fillers

1. Fillers consisting of 60 percent or greater of non-man-made fibers (e.g. cottons, kapok, hair, etc.) must meet the requirements of Section B, Part I.
2. Fillers consisting of 60 percent or greater of man-made fibers must meet the requirements of Section C.
3. Fillers not classified in V.1. and V.2. above must meet the requirements of both Section B, Part 1 and Section C.

FLAMMABILITY TEST FRAME

FLEXIBLE FOAMS

1/8" STAINLESS STEEL
ROD

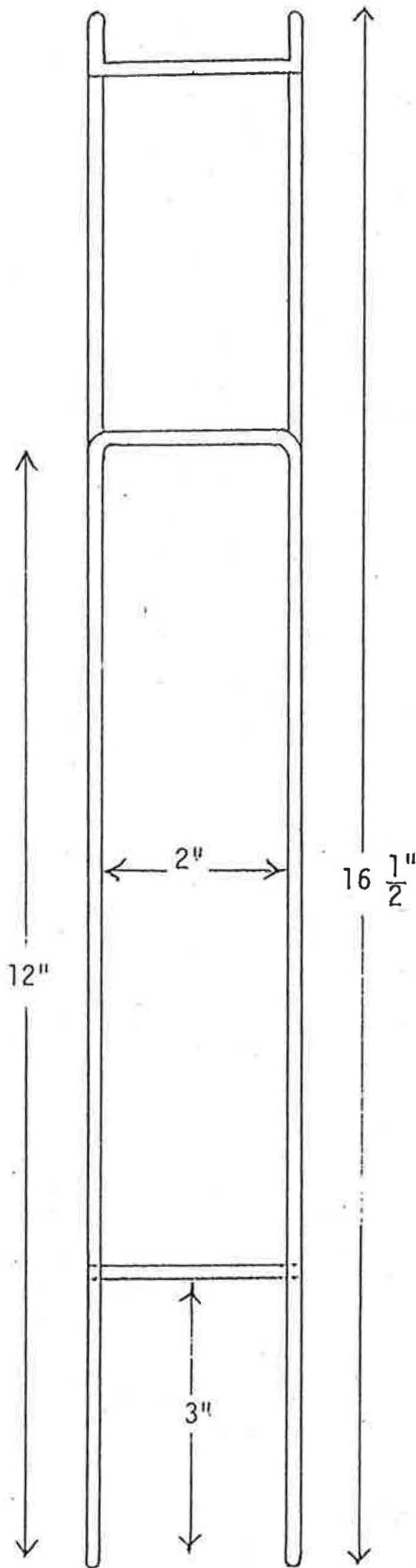


FIGURE A

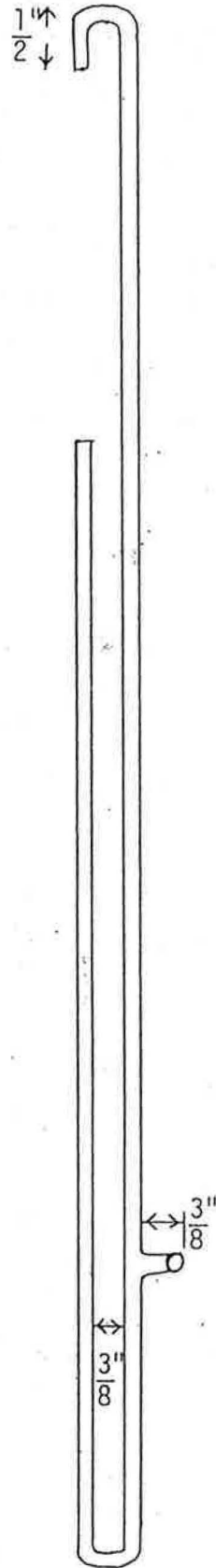


FIGURE B

FIGURE 117 - A

FLAMMABILITY TEST FRAME - MODIFIED CS 191-53

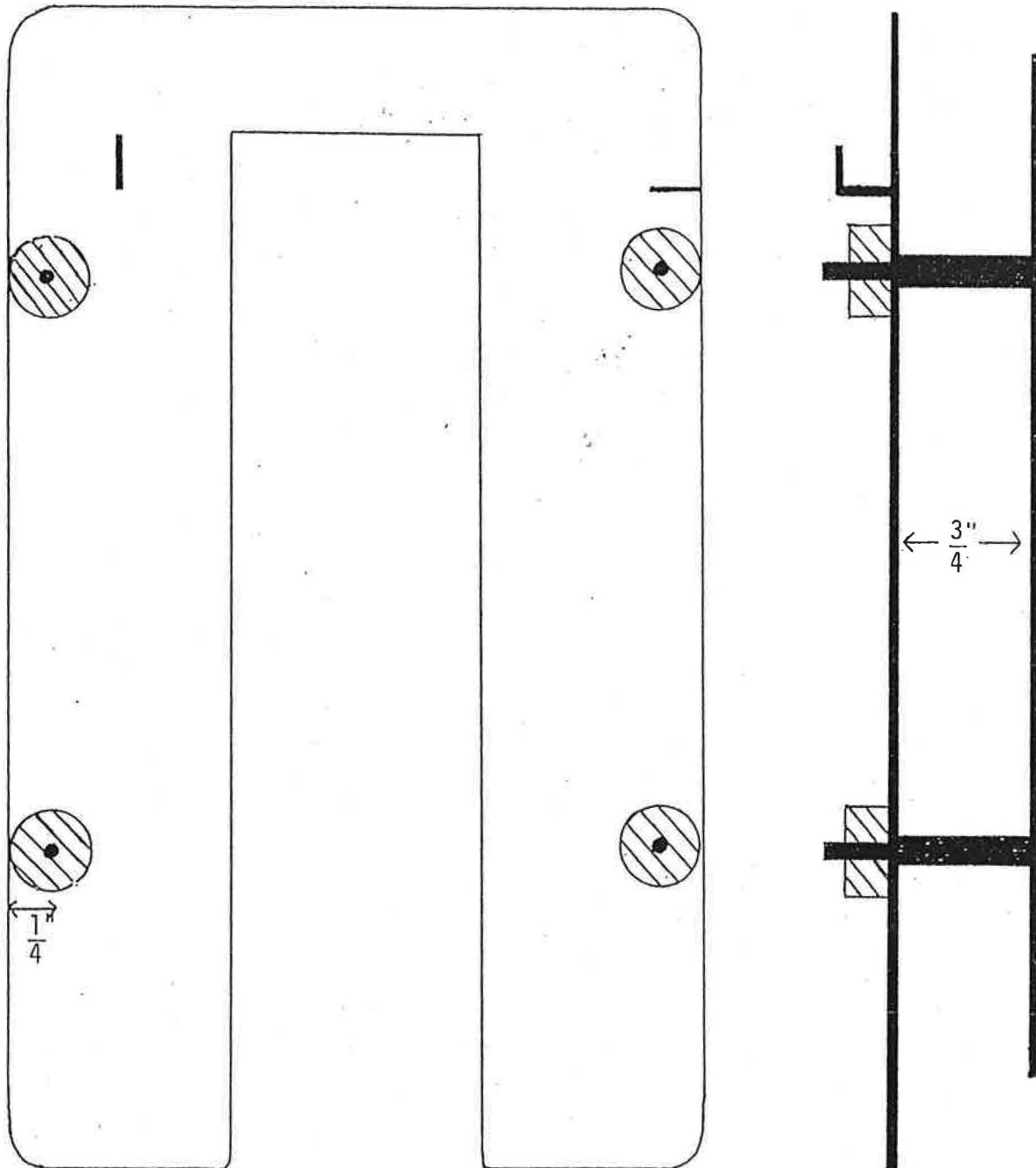


Figure 117B

SECTION D
PART I

Resilient Filling Materials - Cigarette Resistance

I. Requirements

1. All resilient filling materials other than cellular materials (such as foams) shall meet the requirements of this procedure.
2. The maximum char length of any specimen shall not exceed 2 inches in any direction from the cigarette.
3. Resilient cellular materials shall meet the requirements of Section D Part II.

II. Test Procedure

1. Specimens no less than 12 x 12 inches and in the thickness of intended use shall be tested.
2. Cigarettes, meeting the cigarette specification of DOC FF 4-72, shall be burned on the surface, at the center of the specimen.
3. Specimens shall be tested with cigarettes both uncovered, and covered with one layer of sheeting material.
4. Sheeting materials shall meet the sheet specifications of Section D Part II 2.2.4.
5. A minimum of 3 specimens both covered and uncovered shall be tested.
6. All test materials shall be conditioned for at least 24 hours prior to testing at 70 ± 5 °F and less than 55 percent relative humidity.

III. Test Results

1. The char dimensions of each specimen shall be measured to the nearest 0.1 inches.

SECTION D
PART II

Resilient Cellular Materials - Smoldering Screening Test

1. Apparatus

- 1.1. Test Stand - A test stand constructed as shown in Figure 1 shall be used in all tests. Construction material shall be 3/4 inch plywood.
- 1.2. Test Enclosure - To prevent extreme changes in surface ventilation rate, tests should be performed inside an enclosure measuring 48 inches long, 21 inches deep and 18 inches high, with an integral bottom, but without top. The enclosure is designed such that three individual test stands may be positioned simultaneously. Individual test stands should be at least six (6) inches apart. The enclosure construction material may be wood, transite, sheet metal, PMMA or other similar materials. It is desirable that the enclosure contain an observation window so that tests may be visually monitored.
- 1.3. Test Hood - The test enclosure shall be placed under a canopy type hood or in a conventional laboratory hood for all testing. Ventilation shall be controlled such that air flow for the particular hood shall be just sufficient to remove products of combustion. Extreme or excessive air flow is not desirable and may affect test results.
- 1.4. Caution - Products of combustion can be irritating and dangerous to test personnel. Test personnel must avoid exposure to smoke and gases produced during testing as much as possible. Flaming combustion is a possibility in tests such as these, therefore tests should not be left unattended. If flaming combustion should occur, the test should be immediately terminated. The availability of a functioning fire extinguisher is advisable.

2. Test Materials

- 2.1. Ignition Source - Shall be cigarettes without filter tips made from natural tobacco 85 ± 2 m.m. long with a packing density of 0.27 ± 0.02 gms/cm³, and a total weight of 1.1 ± 0.1 gms.
- 2.2. Test Foams - Shall be 7.25 x 8 x 2 inches for vertical panels, and 8 x 4 x 2 inches for horizontal panels.
- 2.3. Standard Test Fabric - (see Note 6.2) The standard test fabric shall be 15 x 8 inches for vertical panels, and 11 x 8 inches for horizontal panels.

2.4. Cover Sheeting Material - Cotton or cotton/polyester blend bed-sheeting material 3.7 ± 0.8 oz/yd², white in color, and not treated with flame retardants shall be used to cover test cigarettes. The sheeting shall be laundered and dried at least once before use. 6 x 6 inch pieces of sheeting shall be used for test.

3. Procedure

3.1. Weigh foam test panels correct to the nearest 0.1 gms.

3.2. Assemble the foam test panels, standard fabric, cigarette and cover fabric as shown in Figure 2. Straight pins may be used to support the cover fabric. The cigarette shall be placed at the crevice created by the abutment of the vertical and horizontal panels, such that the cigarette contacts both horizontal and vertical panels, and shall be equidistant from the edges of the test panels.

3.3. Light the cigarette (but no more than 4 mm burn), attach cover sheeting material and cover cigarette. (Note. A finger shall be run along the length of the covered cigarette to ensure good cover fabric - to - cigarette contact.)

3.4. Continue test until all evidence of combustion has ceased for at least 5 minutes. If a test is inadvertently interrupted it must be repeated from the beginning.

3.5. After all combustion has ceased remove cover fabric and remains of standard test fabric. Carefully remove foam test panels, clean all carbonaceous char from panels by scraping with a spatula and weigh the non burned portions of the test panels to the nearest 0.1 gms.

4. Test Measurements

4.1. The following weight measurements of the foam test panels shall be made:

(a) Pre-test weight - A

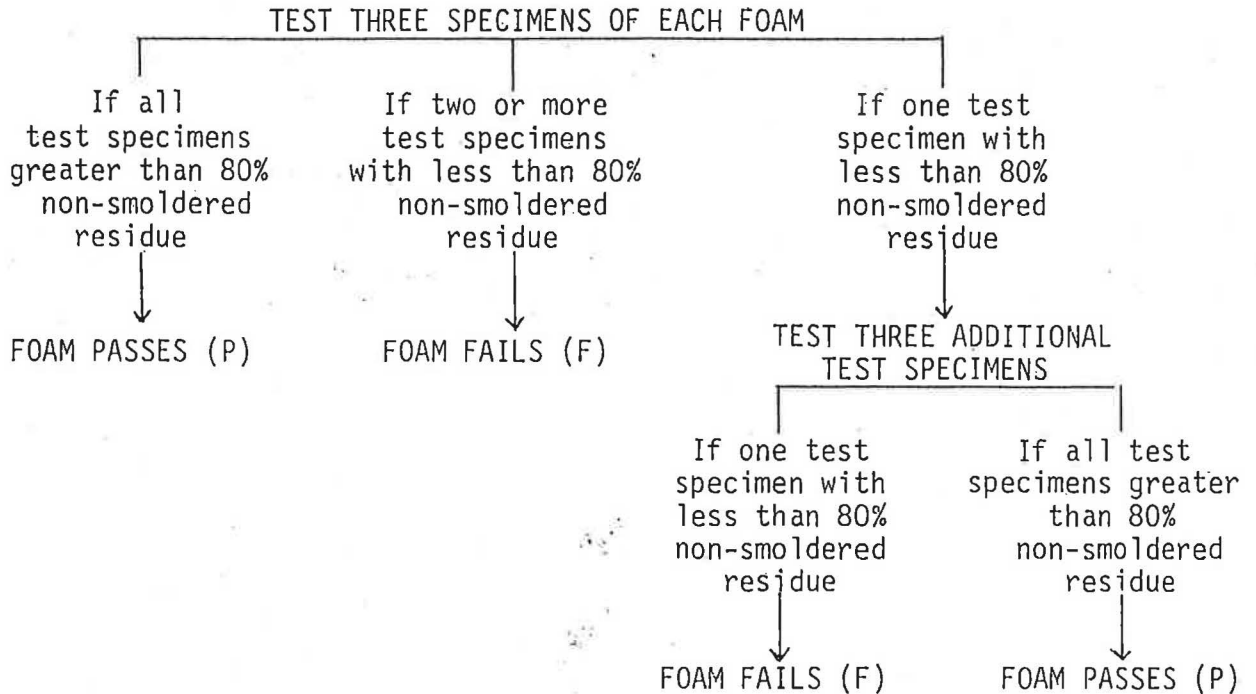
(b) Post test weight of non-smoldered foam - B.

4.2. Calculate the percent non-smoldered foam.

$$\frac{100 B}{A}$$

4.3. Tests on each foam formulation shall be conducted in triplicate.

5. Test Criteria



6. Notes

6.1. Conditioning - All test foams, standard fabric, cover sheeting and cigarettes shall be maintained at 70°F ± 5°F (21.1°C ± 2.8°C) and less than 55 percent relative humidity for at least 24 hours prior to test.

6.2. Standard Fabric - The standard upholstery test fabric shall have the following specifications:

FABRIC	:	Pattern 8500
COLOR	:	Beige
FIBER CONTENT	:	100% Cotton Velvet
WEIGHT/LINEAL YD.:	:	14.5 oz. (54 inches)
BACKCOATING	:	None
MANUFACTURER	:	J.B. Martin
AVAILABLE FROM	:	VAN WATERS AND ROGERS 16300 Shoemaker Avenue Cerritos, CA 90701 (213) 926-0441

NOTE: This fabric was changed pursuant to a note to interested parties dated December 2, 1982. The change was caused by unavailability of previous fabric.

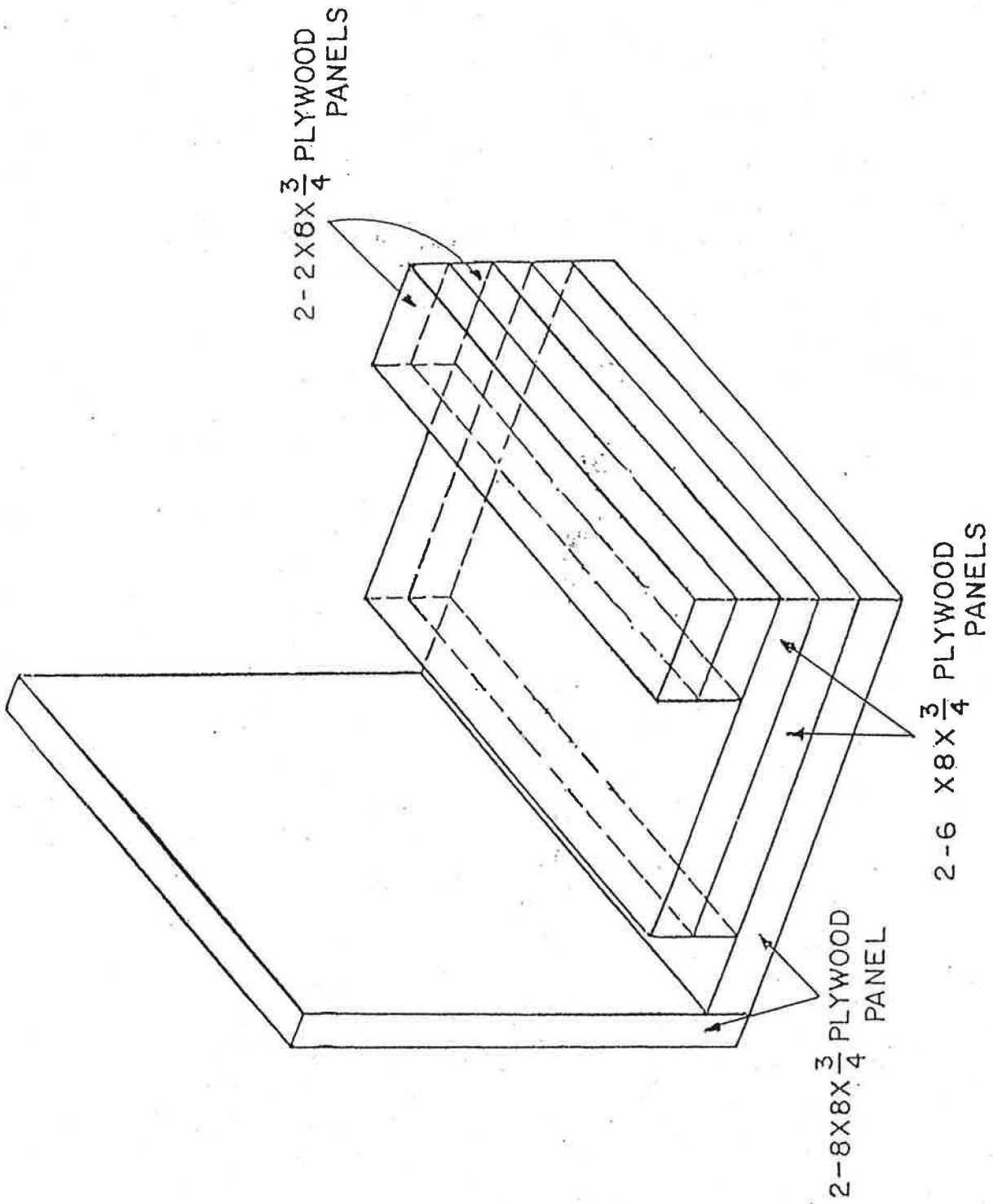


Figure 1

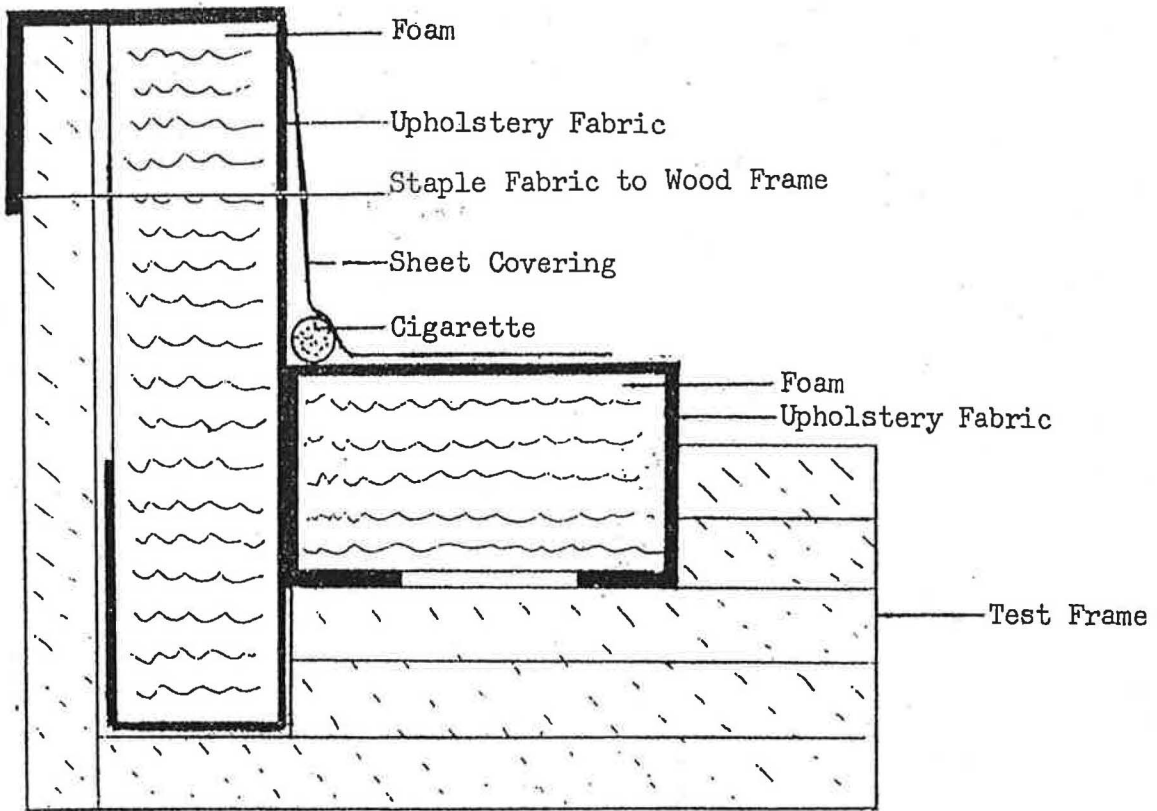


Figure 2

SECTION E
PART I

Upholstery Fabrics

1. Fabrics which do not meet the Class 1 requirements of U.S. Department of Commerce commercial standard 191-53 shall not be used on articles of upholstered furniture.
2. Both surfaces of the fabric shall be tested to determine conformance with C.S. 191-53.
3. Specimens shall not be laundered or dry cleaned prior to testing.
4. Test a minimum of 5 specimens with the warp yarns in the long direction of test and 5 specimens with the fill yarns in the long direction of test.