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United States  
**CONSUMER PRODUCT SAFETY COMMISSION**  
Washington, D.C. 20207

MAY - 6 1997

**MEMORANDUM**

**TO:** Dale Ray, EC,  
Project Manager, Upholstered Furniture

**Through:** Mary Ann Danello, Ph.D. *M. Danello*  
Associate Executive Director for Epidemiology and Health Sciences  
*Art*  
Art McDonald, Acting Director, Hazard Analysis Division (EHHA)

**FROM:** Kimberly Long, EHHA *K.L.*

**SUBJECT:** Response to Public Comments Received after Publication of the Advance Notice of Proposed Rulemaking on Upholstered Furniture

This memorandum presents the EHHA staff responses to injury data-related public comments received after the publication of the Advance Notice of Proposed Rulemaking (ANPR) regarding small open flame upholstered furniture fires. The corresponding response follows the statement of each comment.

**Small Open Flame Fire Data**

**Comment:** With regard to upholstered furniture fires started by small open flame sources, there has been a fairly steady and substantial decline in the number of fires, but the number of deaths and injuries have not shown such a clear or favorable trend. *National Fire Protection Association (NFPA)*.

**Comment (Restated):** The National Fire Information Council stated that the risk of injuries and deaths by fires associated with small open flame ignitions of upholstered furniture is significant. They presented fire statistics for upholstered furniture fires associated with the small open flame sources including matches, lighters and candles. *National Fire Information Council (NFIC)*.

**Response:** NFPA provided fire causality data for 1980 to 1992 for home structure fires where upholstered furniture was the material first ignited and the ignition sources were matches and lighters. Small open flames mainly consist of matches and lighters, but also include candles. EHHA staff agrees with the NFPA statement, but cautions not to examine only matches and lighters when assessing small open flame ignitions of upholstered furniture.

The annual average between 1990 and 1994 shows that approximately 80 percent of the fires reported as open flame ignitions of upholstered furniture resulted from use of matches (45%), lighters (26%), and candles (11%). (See Table 1.) Similarly, estimated deaths and injuries associated with matches, lighters, and candles accounted for approximately 80 percent of all open flame deaths and injuries.

The report submitted by NFIC summarized data collected from the National Fire Incident Reporting System (NFIRS). The statistics are based on relative frequencies of incidents and causalities. EHHA staff appreciate the professional support from the NFPA and NFIC.

**Table 1**  
**U.S. Residential Upholstered Furniture Related Fire Loss Estimates**  
**for Open Flame Ignition Sources, Annual Average for 1990 - 1994**

| <b>Fire Loss Estimate</b>     | <b>Fires</b> | <b>Deaths</b> | <b>Injuries</b> |
|-------------------------------|--------------|---------------|-----------------|
| <b>All Open Flame Sources</b> | <b>3800</b>  | <b>130</b>    | <b>530</b>      |
| Matches                       | 1700 (44%)   | 40 (31%)      | 190 (35%)       |
| Lighters                      | 1000 (26%)   | 40 (31%)      | 210 (39%)       |
| Candles                       | 400 (10%)    | 20 (15%)      | 60 (11%)        |
| Other Open Flame              | 300 (7%)     | 10 (8%)       | 20 (3%)         |
| Unknown Open Flame            | 500 (13%)    | 20 (15%)      | 60 (11%)        |

Source: U.S. Consumer Product Safety Commission / EHHA, from data obtained from the U.S. Fire Administration and the National Fire Protection Association.

Note: Detail may not add to total due to rounding. Fires are estimated to the nearest hundred, civilian deaths and injuries to the nearest ten. All statistics include proportional allocation of residential fires with form of material first ignited unknown and upholstered furniture fires with form of heat of ignition unknown.

**Comment:** In its briefing paper for Petition FP 93-1, the Commission staff notes that about one-fifth (150) of the deaths and one-fourth (580) of the injuries resulting from ignitions of upholstered furniture during 1991 were caused by open flame ignition. There is no breakdown of data as to the percentage of these figures caused by small open flames. *Polyurethane Foam Association.*

**Response:** The annual average between 1990 and 1994 shows that approximately 80 percent of the fires, deaths, and injuries recorded as open flame ignitions of upholstered furniture resulted from use of small open flame sources, such as matches, lighters, and candles. (See Table 1.) Less than ten percent of the fires (7%) consisted of other open flame sources, such as torch flames or welding equipment, open fires such as campfires, bonfires, warning flares, or open trash burners, backfires from combustion engines, other types of open flames or sparks. Eight percent of the deaths and only three percent of the injuries were associated with open flames other than matches, lighters, and candles. The remaining portions for fires, deaths, and injuries were associated with unknown open flame sources. Due to the small percentage for other open flame sources, the breakdown of the fire data presented in the petition generally reflects the hazard associated with small open flame ignitions of upholstered furniture.

**Comment:** At present, the CPSC data for deaths and injuries from small open-flame ignition of upholstered furniture are based on estimates and extrapolation and not actual data. *National Cotton Council.*

**Response:** The annual fires estimates are derived from data provided by the U.S. Fire Administration (USFA) and the National Fire Protection Agency (NFPA). Proportions observed in the USFA's National Fire Incident Reporting System (NFIRS) are applied to aggregate national fire loss estimates derived from a sample survey conducted by the NFPA. Combining these two data sources not only gives a good picture of the size of the fire problem but also provides details needed to identify what is causing and contributing to residential fires. While the reports capture only fires attended by fire departments participating in the NFIRS, the aggregate data provide the most reliable estimates of U.S. residential fire losses.<sup>1</sup>

### **Need for Ignition Scenario and Test Method Specific Data**

**Comment:** The available statistics indicate a relatively small, but certainly significant, number of deaths and injuries from fires initiated by small flames. However, the proper approach to addressing this problem is not clear. Unlike cigarette ignition, where the ignition scenario is generally known and reasonably constant, there seems to be no reliable information on the mechanics of small flame ignitions. In the absence of such information, AFMA believes it is virtually impossible to develop a meaningful ignition control strategy. *American Fiber Manufacturers Association.*

**Comment:** It is crucial that the Commission develop data in order to gauge the risk of injury posed by small open flame ignition of upholstered furniture. The same data also should identify the type of small open flame that was involved in the ignition so that a clear definition of small open flame can be developed. Finally, this data should provide insight into the fire scenario so that human factors information can be gathered. *Upholstered Furniture Action Council.*

**Comment:** ATMI requests that CPSC make available specific information which would define the ignition scenarios and the progression of these fires [ignition source; materials involved (chemical make-up of materials, age, and furniture characteristics); physical and mental condition of people associated with the ignition and those injured or killed by the fire; socioeconomic factors of the victims; use, availability and condition of fire detection and suppression equipment (smoke detectors, sprinklers, extinguisher)]. This information is necessary in order to develop an appropriate and realistic flammability test method to reduce the risk of injury/death associated with upholstered furniture and small-flame ignition sources. *American Textile Manufactures Institute.*

**Comment:** It would be particularly helpful to have better information on the intensity of the open flame ignitions cited as being responsible for fire deaths. This missing piece of data is

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<sup>1</sup> John R. Hall, Fr. and Beatrice Harwood, "The National Estimates Approach to U.S. Fire Statistics," *Fire Technology*, May 1989, Volume 25, Number 2, pp. 99-113.

essential to the development of a small open flame test that could be expected to reduce the risk of the injuries or deaths cited by the Commission in support to this proceeding. *The Society of the Plastics Industry.*

**Comment:** CPSC needs to develop data that adequately supports a finding of whether or not upholstered furniture presents an unreasonable risk of the occurrence of fire leading to death or personal injury or significant property damage from a small open-flame source. A study of actual cases would better define the ignition scenario. *National Cotton Council.*

**Response:** Following the May 1994 vote of the Commission, CPSC staff began a project addressing small open flame fire risks associated with upholstered furniture. As a part of this project, the Directorate for Epidemiology and Health Sciences conducted a study of small open flame ignitions of upholstered furniture occurring between October 1994 and February 1997<sup>2</sup>. In this study, items of interest included the source of small open flame (match, lighter, candle, etc.); the portion of the upholstered furniture first ignited, such as the seating area, the dust cover (underneath the furniture), or the skirt; general characteristics of upholstered furniture, such as the age and type of covering and filling materials; the age of the person involved in the ignition of the upholstered furniture; the presence and performance of smoke detectors in the residence; and household characteristics; and fire losses including deaths, injuries, and property loss.

Both the national fire data and the CPSC study show that the main flame sources involved in small open flame ignitions consist of matches, lighters and candles. The CPSC study indicated that the fire scenario most prevalently reported was children playing with lighters while sitting on the upholstered furniture. Thus, the portion of the upholstered furniture that was most frequently ignited was the seating area, consisting of the seating cushion and the inside arm and back of the furniture. Information about the covering and filling materials of the upholstered furniture was found in only a few fire reports. Characteristics of furniture associated with these incidents revealed that the median furniture age was five years and that most of the furniture was not reupholstered or slip-covered.

Data on the physical and mental condition of victims, particularly those who die, are inherently unavailable. Conclusions concerning the socioeconomic data were limited by the small sample size. However, the data suggest that renters are more likely to be susceptible to these fires than those who own their homes. In this study, the death rate for the nondetector-equipped households was higher than the death rate for those households that had a smoke detector. These results, while based on a relatively small number of fires, are consistent with the national fire experience where most households without smoke detectors have a higher tendency to have fatal fires<sup>3</sup>. The intensity of the fire can be characterized by the amount of fire damage or property loss to the residential structure. In the CPSC study, half of the fires investigated resulted in the fire being

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<sup>2</sup> Kimberly Long, "Small Open Flame Ignitions of Upholstered Furniture," U.S. Consumer Product Safety Commission Report, April 1997.

<sup>3</sup> Hall, John (1995). U.S. Fire Experience with Smoke Detectors and Other Fire Detectors. Quincy, MA: National Fire Protection Association.

confined to the room of origin and the other half consumed the floor of origin or more. Most of the fires investigated were said to have resulted in \$45,000 or less in property damage.

The ANPR comments referred to both test method specific and ignition scenario data. The CPSC investigation study will help to develop a test method that models the ignition source and the construction of upholstered furniture. The ignition scenario data will help to develop fire prevention education strategies.

### **Impact on Other Fires where Upholstered Furniture Not First Ignited**

**Comment:** These data [associated with open flame ignitions of upholstered furniture] woefully underestimate the problem we face with these particular fires. NFIRS lists upholstered furniture only when it is the first item ignited. However, whether it is the first or the tenth item ignited, upholstered furniture routinely converts small fires into big ones -- generating enormous quantities of heat and toxic gases. *National Association of State Fire Marshals.*

**Comment:** CPSC should note, however, that these estimates of deaths, injuries, and property losses associated with small open flame fires may be underestimated. To the extent that this information is based on National Fire Incident Reporting System data, which lists upholstered furniture when it is the fire item ignited, it may not capture all of the deaths, injuries, and property loss associated with escalation of upholstered furniture fires. *Consumer Federation of America.*

**Comment:** The Commission should address differences in the first item to be ignited as opposed to those situations where the upholstered furniture is the second or later item to be ignited. *Polyurethane Foam Association.*

**Comment:** We believe the data clearly demonstrates the need for a national standard. We would also add that the risk of injury and death from open flame ignitions of upholstered furniture can be greater than indicated. Because fires can spread in different ways, the first item ignited should not be the only item considered. A small fire from other than upholstered furniture may quickly spread to such furniture and accelerate quickly into a deadly situation. *California State Fire Marshall.*

**Response:** The potential benefits of a small open flame standard for upholstered furniture may be somewhat greater than the data indicate since the standard may help in controlling larger open flame upholstered furniture fires where the furniture was not first ignited. However, the potential extent of this effect is uncertain. In the CPSC study of small open flame ignitions of upholstered furniture, 201 probable small open flame ignitions of upholstered furniture cases were identified by the CPSC investigators. Of the 201 cases, 76 were determined to be in-scope. An in-scope fire was a residential structural fire that involved upholstered furniture as the first material ignited by a small open flame source. In several of the out-of-scope cases, items other than upholstered furniture were first ignited. Some fires involved children setting paper or some other material on fire and then placing the lit paper on or near the upholstered furniture.

Similarly eliminated were the cases where pillows or blankets lying on the upholstered furniture were first ignited. To the extent that small open flame ignition resistant furniture prevents or slows the growth of such fires, using only upholstered furniture ignitions probably yields a conservative estimate of the potential benefits.

### **Cigarette Lighter Rule Impact**

**Comment:** Since cigarette lighters are a "small open flame," it might stand to reason that child-proof lighters are an "alternative" to flammability standards for upholstered furniture. Indeed, they should help reduce the number of fires, but they are not an "alternative" if the term is meant to suggest a "substitute." *National Association of State Fire Marshals.*

**Response:** The cigarette lighter standard addresses the risk of fires started by young children (generally under age 5) playing with lighters; this rule is not intended to be a substitute for any standard regarding small open flame ignitions of upholstered furniture. A small open flame ignition standard for upholstered furniture would address all small open flame ignitions including those from matches and candles as well as lighters. Such a standard would also address the risk of fires started by older children and adults.

**Comment:** On July 12, 1994, the Commission's standard on disposable lighters became effective. The success of this standard as well as the nation's increasing awareness of the flammability dangers associated with many tobacco products can have a considerable impact on whether the risk of injury from upholstered furniture ignition from small open flame sources is an unreasonable one. *Upholstered Furniture Action Council.*

**Comment:** The small open-flame sources of concern to CPSC appear to be matches and lighters. CPSC should better define "small open-flame." CPSC already has a standard for disposable lighters, which they anticipate will prevent 85-120 deaths per year. *National Cotton Council.*

**Response:** The Commission anticipates that the new standard for disposable and novelty lighters will prevent between 80 and 105 deaths per year associated with various products including upholstered furniture, mattresses, and other items. The effective date for the lighter standard was July 1994 (the latest year for which fire data is available) after which manufacturers could produce only child resistant lighters. It is expected that non child resistant lighters were sold, but not produced, after the July 1994 effective date. Not until most of the non child resistant lighters are disposed by consumers, will the national fire data reflect the impact of the standard.

Table 2 presents the 1990 - 1994 annual average estimates of fire losses associated with child play fires where upholstered furniture was first ignited by open flame sources. An estimated 40 deaths resulted from child play with lighters in fires where upholstered furniture was first ignited (about 30% of all open flame ignited upholstered furniture fire deaths) and 20 deaths resulted from child play with matches. The cigarette lighter rule will reduce, but not eliminate, these deaths associated with lighters.

**Table 2**  
**U.S. Residential Upholstered Furniture Related Fire Loss Estimates**  
**for Child Play Fires by Open Flame Sources, Annual Average 1990 - 1994**

| <b>Fire Loss Estimate</b>     | <b>Fires</b> | <b>Deaths</b> | <b>Injuries</b> |
|-------------------------------|--------------|---------------|-----------------|
| <b>All Open Flame Sources</b> | <b>1620</b>  | <b>70</b>     | <b>310</b>      |
| Matches                       | 750          | 20            | 110             |
| Lighters                      | 760          | 40            | 180             |
| Candles                       | 40           | 0             | *               |
| Other Open Flame              | 30           | 0             | *               |
| Unknown Open Flame            | 30           | 10            | 10              |

Source: U.S. Consumer Product Safety Commission / EHHHA, from data obtained from the U.S. Fire Administration and the National Fire Protection Association.

Note: Detail may not add to total due to rounding. Asterisk denotes that estimate is less than five. Fires, civilian deaths and injuries are rounded to the nearest ten. All statistics include proportional allocation of residential fires with form of material first ignited unknown and upholstered furniture fires with form of heat of ignition unknown.

**Scope of Coverage (Products and Occupancies)**

**Comment:** The data presented in ANPR are overall statistics for fires in which upholstered furniture is the first material ignited. We do not believe that this data should be viewed as an accurate portrayal of fire statistics for all property categories. Hotels, motels, and casinos have substantially lower losses than this ANPR would seem to indicate. The NFPA fire statistics that show that hotels and motels represent less than one half of one percent of the upholstered furniture problem. *American Hotel and Motel Association.*

**Response:** During 1994 (the latest year available), there were approximately 130 hotel and motel fires involving ignitions of upholstered furniture that resulted in no deaths, about 20 injuries and approximately \$1.4 million in property damage. Of the 130 fires, approximately 70 fires were related to smoking material and 20 fires (about 0.5% of the residential open flame total for upholstered furniture) were attributed to open flame sources. Of the estimated 20 injuries, half were associated with smoking materials and the other half were associated with open flame sources. These data show that open flame fires in hotels and motels represent a small part of the open flame upholstered furniture problem in the residences defined above.

**Comment:** ATMI suggests that the agency provide information to address a definition of building occupancies over which the Commission has authority to regulate the upholstered furniture. *American Textile Manufacturers Institute.*

**Response:** CPSC has the authority to regulate in all residential occupancies. The fire data provided in the ANPR include all residential fire losses. Residences are defined as single family homes, apartment buildings or multi-family homes, rooming or boarding houses, hotels, motels, dormitories, and any other conventional residence.

**Comment:** Insofar as we can determine, no data are currently available that can distinguish between futon fire-related injury or death and injury or death from furniture or mattress-related fires. To our knowledge, neither the CPSC Information Clearinghouse nor petitioners have documentation of fire-related death nor injury specifically involving futons. *Futon Association International, International Sleep Products Association.*

**Response:** The commentor is correct, there are no national estimates where futons are identified in fires. The national fire data are based on coding that was first adopted in 1976 and does not contain the level of detail needed to identify fires associated with futons. The fire data collection system is currently being revised. However, CPSC's investigation database contains information on two fires involving futons. In a one fire occurring in April 1996 in California, a female victim place several candles in candleholders on the floor between the wall and her futon bed, and left them burning while she fell asleep. She woke up to flames in the area between the wall and bed, and tried to extinguish the fire with blankets, burning her hands in the process. The fire department arrived and extinguished the flames. The female was taken to the hospital where she was treated for thermal burns and later released. In a second fire in March 1995, a fire was started in a futon by a cigarette left burning in an ashtray that was laying on the futon.



United States  
**CONSUMER PRODUCT SAFETY COMMISSION**  
Washington, D.C. 20207

**MEMORANDUM**

**DATE:** April 25, 1997

**TO :** Dale Ray, Directorate for Economic Analysis,  
Project Manager Upholstered Furniture  
**Through:** Andrew G. Ulsamer, Ph.D., Associate Executive Director,  
Directorate of Laboratory Sciences  
**FROM :** Linda Fansler and John Murphy, Division of Engineering  
**SUBJECT:** Response to Comments

This memo provides the Laboratory Sciences' response to comments received as a result of publishing the Advanced Notice of Proposed Rule, and other technical comments received during the Upholstered Furniture Product in FY 96 and FY 97.

**COMMENTS RECEIVED AS A RESULT OF  
THE PUBLISHING THE ANPR**

**ISSUE:** Adequacy/Appropriateness Of California TB-117

The following comments deal with the National Association of State Fire Marshal's (NASFM) request that the Commission consider adopting California Technical Bulletin (TB) 117 as a mandatory standard. Seven commenters recommended that CPSC adopt TB 117, (National Association of State Fire Marshals, CF94-1-1a, Fire Retardant Chemicals Association, CF94-1-14, Consumer Federation of America, CF94-1-16, California State Fire Marshal, CF94-1-24, State of California Bureau of Home Furnishing and Thermal Insulation, CF94-1-26, and Chestnut Ridge Foam, Inc., CF94-1-57) One commenter, the Upholstered Furniture Action Council (UFAC) indicated a willingness to consider adopting parts of TB 117 into their voluntary program. Two other commenters, the American Fiber Manufacturers Association, Inc. and the National Fire Protection Association did not support the adoption of TB 117.

**COMMENT:** "Cal TB 117 is available and has proven to save lives." Fire Retardant Chemicals Association, CF94-1-14.

**COMMENT:** "CFA urges the Commission to adopt the California standard, TB-117, for small open flame. ... furniture complying with TB-117 allows more time for escape, detection and suppression of fire than furniture that does not comply." Consumer Federation of America, CF94-1-16.

**COMMENT:** "... UFAC will consider adopting the best aspects of California Technical Bulletin 117. Should its analysis demonstrate the effectiveness of Technical Bulletin 117, UFAC would anticipate adding the best aspects of Technical Bulletin 117 to UFAC's Construction Criteria." Upholstered Furniture Action Council, CF94-1-19.

**COMMENT:** " We believe the California data clearly demonstrates that TB 117 has been effective in California in reducing deaths and injuries from fires involving upholstered furniture. We therefore recommend that the Commission adopt TB 117 as a national standard. Such adoption would provide all individuals with the same protection as the residents of California." California State Fire Marshal, CF94-1-24.

**COMMENT:** "... Technical Bulletin #117 standard ... have provided an extra window of time in which response to and suppression of fires can occur before major property damage, human injury, or loss of life result." State of California Bureau of Home Furnishing and Thermal Insulation, CF94-1-26.

**COMMENT:** "The California 117 small ignition vertical test should be mandatory for all furniture components." Chestnut Ridge Foam, Inc., CF94-1-57.

**COMMENT:** "NFPA does not recommend TB 117 for continued use in the intended manner. NFPA believes instead that the state of the art in fire testing has advanced since 1975 to the point where a new testing protocol can be developed that will not have the significant and fundamental limitations that TB 117 has, ...". National Fire Protection Association, CF94-1-9.

**COMMENT:** "... AFMA does not support the use of California TB 117 test methodology for evaluating the ignition potential of upholstered furniture." American Fiber Manufacturers Association, Inc., CF94-1-18.

**RESPONSE:** All furniture offered for sale in the State of California is required to be fire and smolder (cigarette) resistant as defined by California Technical Bulletin 117.<sup>1</sup> TB 117 is a "minimum standard"<sup>2</sup>, in that it is based only on bench scale component fire tests.

TB 117 provides a test method to determine the flame resistance of each type of filling material. The specimen orientation depends on the type of filling material. For example, resilient cellular material such as foam is tested in a vertical orientation with the flame impinged on the lower edge. Flame retardant foam with low levels of flame retardants added are generally used to meet TB 117.<sup>3</sup> Man-made fiber filling materials such as polyester fiberfill, are tested at a 45° angle. Polyester fiberfill typically passes the requirements in TB 117. The type of gas used and the flame exposure time is also dependent on the specific test. The flame impingement times range from 1 to 3 seconds.

<sup>1</sup> Superscript refers to references on page 19.

TB 117 also provides a minimum test for ignition resistance of the upholstery fabric. Upholstery fabrics must pass a 45° angle test, the same test specified for wearing apparel sold in the United States. This test requires a 1 second flame impingement. In general, most upholstery fabrics will meet the flame requirements specified.<sup>3</sup>

Laboratory staff agree with those commenters that do not support adoption of TB 117. In a CPSC study, the predictive capability of TB 117 was found to be low when considering full scale upholstered furniture behavior to a small open flame ignition source.<sup>4</sup> Upholstered chairs manufactured to meet the California requirements for flammability ignited when a small butane flame was applied for times that could be reasonably expected from a child with a match or lighter. In some cases, filling material components taken from these same chairs and tested according to the procedures in TB 117, ignited. The discrepancies between the composite (full scale) and component (TB 117) test results reflect in large part, the longer flame exposure times. The ability of the upholstery fabric to protect the filling material below under more realistic conditions is also clearly important. The minimum requirement for upholstery fabric flammability in TB 117 is not stringent enough to prevent ignition; the upholstery fabric's ignition resistance was the key to the likelihood of ignition for the seating area.<sup>4</sup>

**ISSUE:** Adequacy Of The UK Approach

The following comment deals with the adequacy of the UK approach. The Fire Retardant Chemicals Association, CF94-1-14 commented that the standards adopted in the United Kingdom (BS 5852) are more stringent than TB 117.

**COMMENT:** "Test Standard BS5852 is more stringent than CAL TB 117, but not as stringent as CAL TB 133. There were industry complaints about BS5852 before it was made mandatory, but industry now is meeting this standard on an economical basis and thereby saving lives." Fire Retardant Chemicals Association, CF94-1-14.

**RESPONSE:** The Furniture and Furnishings (Fire) (Safety) Regulations of 1988 set levels of fire resistance for residential upholstered furniture in the United Kingdom (UK).<sup>5</sup> These regulations reference British Standard BS 5852 which provides a method of test for the ignitability of upholstered composites for seating areas by smokers' materials (matches).<sup>6</sup> The small open flame evaluation part of the UK Regulations requires that all filling materials be tested with a 100% flame retardant polyester upholstery fabric cover using the specified test procedure in BS 5852, Part 2.<sup>7</sup> The ignition source is dependent upon the type of filling material being tested, i.e., foam, fiberfill, etc., and ranges from a butane flame with a 40 second flame impingement time to a wooden crib. The wooden crib represents a thermal output approximating four double sheets of newspaper. Ignition requirements are specified depending upon the filling material. The UK regulations have essentially banned untreated polyurethane foams; combustion modified highly fire resistant foams will meet the British requirements. Upholstery fabrics are tested in combination with a

standard foam filling and must pass BS 5852, Part 1.<sup>6</sup> The ignition source is a small butane flame representing a burning match (20 second flame exposure time). An exemption is made for upholstery fabrics with specified fiber contents<sup>a</sup> that fail to meet the "match" test. Furniture constructed with exempted upholstery fabric must also have a "fire-resistant interliner which itself passes the specified test".<sup>6</sup>

Laboratory staff agree that the UK regulations are more stringent than TB 117 when considering the time that the flame is impinged on the test specimens and also that composite mockups are tested instead of individual components as in TB 117.

**ISSUE:** Adequacy Of Voluntary Action

The following comments address the adequacy a voluntary approach to a small open flame upholstered furniture standard. Most of the commenters favor a voluntary approach to an open flame upholstered furniture standard, while The California State Fire Marshal commented that a mandatory approach is necessary.

**COMMENT:** The National Association of State Fire Marshals commented that the Commission should adopt TB 117 as the best existing approach to dealing with small flame ignitions of upholstered furniture. The NASFM encourages the Commission to promulgate a mandatory federal standard, but does not automatically favor mandatory over voluntary approaches. They indicate that at the very least a voluntary program should meet the following criteria:

- \* The methodology should be applicable to the real world.
- \* There should be truly independent testing.
- \* Test results should be open to the public.
- \* There should be full disclosure of participants and nonparticipants.
- \* Performance goals should be proposed to the Commission, reflecting industry participation and compliance with record keeping.
- \* There should be external oversight.
- \* The program should conduct on-going research into improving upholstered furniture fire safety.

National Association of State Fire Marshals, CF94-1-1a.

**COMMENT:** The National Fire Protection Association commented that any test method should test actual upholstered furniture or mock-ups representing furniture and not individual components. The NFPA notes this kind of standard does not currently exist and recommends that a research program to develop such a test method be implemented. The test method should be incorporated into a CPSC regulation that would establish a threshold for fire safe performance. The NFPA also strongly recommends that both the test method and the safe threshold be developed through a private nationally recognized consensus process. National Fire Protection Association, CF94-1-9.

a. Fabrics made from yarns containing at least 75% by weight of: cotton, flax, viscose, modal, silk or wool, whether used separately or together and are not coated with polyurethane or a polyurethane preparation.

**COMMENT:** The National Cotton Batting Institute commented that in 1993 they worked closely with UFAC to establish a quality assurance program that benefitted both the furniture and cotton batting industries. The cornerstone of their program is ASTM D5238-93, a method to test the cigarette ignition resistance of cotton batting. NCBI indicates that the test method demonstrates an acceptable correlation with TB 117. National Cotton Batting Institute, CF94-1-17.

**COMMENT:** The Upholstered Furniture Action Council (UFAC) commented that UFAC will consider adopting the best aspects of TB 117 as part of the UFAC Construction Criteria for upholstered furniture. UFAC pledged to move forward expeditiously, but stated that its adoption of the best aspects of TB 117 will only occur if shown to be necessary after a thorough, objective analysis. Upholstered Furniture Action Council, CF94-1-19.

**COMMENT:** The California State Fire Marshal commented that "While there are times when voluntary standards are applicable, we do not believe this is one of them. TB 117 has been in place in California for nearly 20 years. During that time furniture manufacturers have provided Californians with furniture meeting that standard. In light of our nations current fire problem, and since furniture conforming to TB 117 is already being produced, we do not believe it is necessary or reasonable to provide a standard that is voluntary." California State Fire Marshals, CF94-1-24.

**COMMENT:** The Polyurethane Foam Association commented that if the existence of an unreasonable risk of the occurrence of fire in upholstered furniture from small open flame ignition is found, PFA would support Commission efforts to develop a small open flame test to be included in the UFAC voluntary program. Polyurethane Foam Association, CF94-1-21.

**RESPONSE:** There are currently no voluntary standards in the United States that address small open flame ignition of upholstered furniture. Several commenters indicated that a voluntary standard based on provisions in TB 117, a mandatory standard in the State of California, could be adopted as a national standard. In 1995 Commission staff evaluated the resistance of currently manufactured residential upholstered furniture to ignition from a small flame source<sup>4</sup>. As part of this program the small open flame tests in TB 117 were conducted on the filling materials taken from furniture manufactured to meet the State of California's regulation. TB 117 did not predict that the furniture would ignite in full scale. Another small open flame test, in BS 5852, a British Standard that tests composite mock-ups of furniture, was also evaluated. Tests indicate that a composite test such as BS 5852 was able to predict ignitions of the seating area of upholstered furniture.

Commission staff has developed a small open flame test method, based on BS 5852, that uses a mockup of the upholstery fabric with standard foam.<sup>8</sup>

**ISSUE:** Interactions With Cigarette Ignition Propensity

**COMMENT:** "Many materials that are used to resist smoldering cigarette ignition may perform poorly under conditions of open flame combustion and vice versa." Upholstered Furniture Action Council, CF94-1-19.

**COMMENT:** "Additionally, solutions to reduce small open-flame ignition should not cause an adverse effect on the smoldering cigarette ignition resistance of upholstered furniture. ... Changes in a furniture cushioning material that make it more resistant to open-flame ignition could have a detrimental effect on the resistance of the material to cigarette ignition and vice-versa." Polyurethane Foam Association, CF94-1-21.

**COMMENT:** "The science of smolder combustion and open-flame combustion are different. Treatments to prevent open-flame ignition for the most part do not prevent smolder combustion. ... Any solution by CPSC to reduce open-flame ignition should not adversely effect cigarette ignition resistance. National Cotton Council, CF94-1-22.

**COMMENT:** "Addressing open flame ignition should not be done in a way that compromises smoldering ignition resistance." Polyurethane Division, The Society of the Plastics Industry, Inc., CF94-1-28.

**RESPONSE:** Open flame ignition resistance and smoldering (cigarette) ignition resistance are two different phenomena. Upholstered furniture that is cigarette ignition resistant is not necessarily flame ignition resistant. Some individual components of upholstered furniture have good cigarette ignition resistance but poor small flame ignition resistance. For example, increasing the amount of thermoplastic material (fabric and filling) increases the cigarette ignition resistance because a large portion of the heat from the cigarette is consumed in melting the thermoplastic fibers and the thermoplastics do not smolder along with the cigarette. Thermoplastics generally shrink and curl away from an open flame, exposing the filling. They can also burn.<sup>3</sup>

Cellulosic materials behave quite differently. Increasing the amount of cellulosic materials (fabric and filling) decreases cigarette ignition resistance as cigarettes induce smoldering in cellulosic fabrics. Cellulosic fabrics char in response to open flame and, until the char breaks, protects the filling materials.<sup>3</sup> Thermoplastic/cellulosic fabric blends fall somewhere between 100% cellulosic and thermoplastic fabrics depending upon the percentage of thermoplastic fibers present in the blend. Again, the greater percentage of thermoplastic fibers present, the more likely the fabric will shrink, curl away from the open flame and burn.<sup>3</sup>

The commenters are correct in their assumption that CPSC staff carefully considered the effects on smoldering ignitions when developing solutions to reduce the small open flame ignition problem for upholstered furniture. The staff conducted considerable small open flame and cigarette ignition testing. CPSC laboratory tests

show promising results for both small open flame and cigarette ignition resistance for several upholstery fabrics.<sup>9</sup> CPSC laboratory tests indicate that open flame ignition resistance may confer cigarette ignition resistance depending, on the time of flame exposure. This was true of a wool and a heavy weight cotton fabric, some fire blocked backed fabrics and two fabrics with flame retardant backcoatings.<sup>9</sup>

While some upholstery fabrics, like certain heavier weight celluloseics may confer some small open flame ignition resistance at the expense of cigarette ignitability, the Commission staff is unaware of any studies where flame retardants added to filling materials increase the likelihood of cigarette ignition. The draft CPSC standard test incorporates a 20 second flame exposure time that would largely eliminate the use of cigarette ignition prone heavy celluloseics.<sup>8</sup>

**ISSUE:** Composite Vs. Component Test Approach

**COMMENT:** The National Fire Protection Association commented that a component approach is not the best approach given the feasibility of testing actual furniture and composite mockups. National Fire Protection Association, CF94-1-9.

**COMMENT:** "AFMA does not believe that there is currently a reasonable probability of developing valid predictive tests based on either component or composite testing." American Fiber Manufacturers Association, Inc., CF94-1-18.

**COMMENT:** "UFAC believes that it is essential that any testing and record keeping requirements be based on "product component" tests and not on "product composite" tests... ." Upholstered Furniture Action Council, CF94-1-19.

**RESPONSE:** A composite testing approach provides a way to evaluate the interaction between materials making up the upholstered furniture item. This approach may require more complex tests than component testing. However, the benefit of predictive behavior is a significant advantage over component testing. Testing individual components of upholstered furniture for resistance to small open flame ignition is not predictive of the behavior of an actual item of upholstered furniture.<sup>4</sup> Results obtained by the CPSC laboratory determined that the small scale component test in California's TB 117 did not predict the ignition resistance of chairs manufactured to meet the California requirements for flammability. The ignition performance of the small scale composite test, British Standard BS 5852, was consistently similar to that of the full scale chairs.<sup>4</sup> The CPSC draft standard is a mockup approach with the upholstery fabric tested over a standard foam.<sup>8</sup> Laboratory tests have shown that this approach is able to measure the protection provided by the outer upholstery fabric from the butane flame to the filling material below.<sup>9</sup>

**ISSUE:** Need For Predictive Test

**COMMENT:** The American Fiber Manufacturers Association believes it is impossible to develop a meaningful test at this time. American Fiber Manufacturers Association, Inc., CF94-1-18.

**COMMENT:** The Society of the Plastics Industry commented that it is essential that any tests are reasonably predictive of actual fire performance. Polyurethane Division, The Society of the Plastics Industry, Inc., CF94-1-28.

**RESPONSE:** Laboratory Sciences staff agrees that any test should be reasonably predictive of actual fire performance. Laboratory test results on full scale furniture and bench scale composite tests, show the importance of a predictive test to accurately evaluate the small open flame ignition resistance of upholstered furniture.<sup>4</sup> A goal of the Upholstered Furniture Project has been to develop a predictive test. The approach taken by Commission staff in requiring that upholstered furniture not ignite from a small open flame source, lends itself to a predictive bench scale test method. Laboratory Sciences staff disagrees with AFMA; a meaningful test can be developed.

**ISSUE:** Alternative Test Approaches

**COMMENT:** The European Union suggested that the Commission should consider adopting the European Match flame equivalent test (EN 1021-2) as a possible American standard for upholstered furniture small open flame ignition resistance. The European standard is based on an international standard (ISO 8191-2-1988) which is based on UK standards developed in 1988. The European Commission notes the following developments in the UK since 1988:

- Fire deaths attributed to upholstered furniture have fallen significantly. While part of this reduction may be due to other initiatives, such as increased use of smoke alarms, the improved flame resistance of soft furnishings has saved many lives.
- Prices to the consumer of upholstered furniture have not risen significantly.
- Manufacturers of furniture have implemented the changes without a significant impact on the industry.
- UK furniture manufacturers having introduced safer furniture are against any relaxation of regulations. They have maintained their export market.
- Other manufacturers are able to export furniture to the UK by meeting the regulations.

U.S. Department of Commerce, European Union, CF94-1-56.

**RESPONSE:** Since the European Union comment was received, the Commission staff has investigated and developed a test procedure that is very similar to EN 1021-2 and ISO 8191-2-1988. The CPSC test procedure, EN 1021-2, and ISO 8191-1988 are all ignition tests. The existing standards use a 35 mm butane flame as the ignition source. The standards use similar seating area mock-ups. The CPSC staff

developed protocol, tests both the dust cover and the seating area using an electro-mechanical test fixture that applies the flame to the test sample in a precise and repeatable manner.<sup>8</sup>

In 1995 the Commission staff evaluated the resistance of currently manufactured residential upholstered furniture to ignition from a small flame source<sup>4</sup>. Furniture manufactured for either the Upholstered Furniture Action Council's UFAC program, the State of California's furniture regulations, or the United Kingdom furniture and furnishings regulations was tested in full scale. Two small open flame test methods, the State of California's Technical Bulletin 117 and the British Standard (BS 5852) were evaluated for their ability to predict full scale test behavior. Results indicate there were no appreciable differences observed between the ignition behavior of comparable UFAC and California chairs. The UK chairs were, however, constructed with an ignitable cover fabric with fire resistant interliners. In the full scale tests the UK chairs ignited, but the fire resistant interliners offered protection to materials underneath. Another conclusion of the evaluation was that the small scale filling material component test in Cal 117 did not predict that the "California" chairs would ignite in the seating area largely due to the cover fabric used in the chairs. The small scale composite test based on BS 5852 appeared to predict the ignition propensity of the UK chairs in full scale tests. Ignitions occurred in both small and full scale tests. The ignitions reflected only the performance of the fabrics tested.

### **OTHER TECHNICAL COMMENTS RECEIVED**

The following commenter provided observations on the CPSC document, "Upholstered Furniture Flammability Testing: Full Scale Open Flame Data Analysis, February 26, 1996.

#### **Full Scale Furniture Tests**

**ISSUE:** Use Of Fire Resistant Interliners

**COMMENT:** "It should be noted that interliners are most often chosen by companies exporting to the UK since this enables them to use fabrics available locally. By contrast, UK furniture manufacturers usually prefer a "match resistant" fabric since this is a more cost effective solution." FMC Flame Retardants, March 20, 1997.

**RESPONSE:** As part of the CPSC full scale open flame tests<sup>4</sup>, upholstered chairs were purchased from three manufacturers. Nine of the chairs in the test program were intended for sale in the United Kingdom. Seven of the "U.K." chairs had a fire resistant interliner fabric above the dust cover fabric and all nine had fire resistant interliners between the upholstery fabrics and filling materials.

The chairs were tested in three locations, the dust cover, skirt and seating area following a research protocol developed by CPSC staff, using a burner similar to that

required in the British Standard, BS 5852. The upholstery fabrics on the nine "U.K." chairs ignited while the fire resistant interliners protected the materials underneath. In a related bench scale test, a composite mockup of one of the "U.K." chairs was ignited and allowed to burn to completion, approximately 17 minutes. Most of the upholstery fabric was consumed while the fire resistant interliner protected the filling materials underneath from igniting. Although these results indicate the filling material can be protected by using a fire resistant interliner, ignition of upholstered furniture, i.e., upholstery fabric, can still occur and spread to other household furnishings, as can ignitions of internal components unless a flame resistant dust cover is used.

**ISSUE: Conditioning Requirements**

**COMMENT:** CPSC should have conditioned the cellulosic fabrics at  $50 \pm 10\%$  relative humidity instead of the requirements in BS 5852 which requires conditioning of test samples for 72 hours at  $20 \pm 5^\circ\text{C}$  and  $50 \pm 20\%$  relative humidity. FMC Flame Retardants, March 20, 1997.

**RESPONSE:** BS 5852 requires a conditioning period of 16 hours at  $20 \pm 5^\circ\text{C}$  and  $50 \pm 20\%$  relative humidity. The 72 hours refers to the period of time specified at indoor ambient conditions.<sup>6</sup> The conditions specified in BS 5852 were followed for the composite mockup tests.<sup>4</sup>

The conditioning requirements in the research test protocol<sup>10</sup>,  $25 \pm 2^\circ\text{C}$  and less than 55% relative humidity were chosen after discussions with outside consultants. According to the consultants, the humidity content of cellulosic materials does not have a noticeable effect on fire behavior until it exceeds 60%.<sup>11</sup>

**ISSUE: Method For Extinguishing Ignitions**

**COMMENT:** "... a CO<sub>2</sub> deluge system was employed" to extinguish ignitions. This method was examined widely in the UK and found to be expensive and not always effective since "reignition could occur". The most effective means of extinguishment has been found to be a pressurized water mist spray. This method is not suitable if it is intended to carry out more than one test on a made up composite rig. FMC Flame Retardants, March 20, 1997.

**RESPONSE:** CPSC staff used a 50 lb tank of CO<sub>2</sub> with a nozzle attached. The CO<sub>2</sub> was directed at the fire and applied until ignition ceased, usually within seconds. CPSC staff found this to be a easy, convenient, effective and economical method to extinguish ignitions. In addition, most importantly, the use of CO<sub>2</sub> allowed for additional testing at a different location on the same piece of furniture. Using water for extinguishment (as suggested by the commenter) would generally render test samples unusable in subsequent laboratory tests. Firms conducting tests would not be required to use CO<sub>2</sub>.

The following comments address concerns with the CPSC Upholstered Furniture Test Program. Interested parties were invited to provide comments on a small scale test protocol and a prototype test fixture, that were both developed by Commission staff.<sup>12</sup>

### Draft Small Scale Test Protocol

#### ISSUE: Stringency Of Draft Test Method

**COMMENT:** "Our second concern is the severity of the test which is being designed. ... There are several small flame tests already available which may adequately simulate the scenario of flame contact once the scenario has been defined. We see no reason to adopt a more stringent test until there is data to support that need." Amoco Fabrics and Fibers Company, May 29, 1996.

**COMMENT:** "The proposed test is likely to improve the ignitability performance of furniture fabrics, and, therefore, be particularly effective in reducing the fire hazard due to ignition of skirt fabrics and dust cover fabrics. It is also likely to have an effect on overall seating fabric ignitability, for residential furniture which meets only the voluntary UFAC smoldering ignition criteria." GBH International, April 16, 1996.

**RESPONSE:** Laboratory staff agrees that the CPSC draft standard may be considered more stringent than TB 117 or another test method that specifies testing individual components not in a mockup arrangement, and the UFAC voluntary smoldering ignition test methods. The Directorate for Epidemiology is conducting a field study as part of the upholstered furniture project. The test should improve the ignitability performance of residential furniture.

#### ISSUE: Test Criteria

**COMMENT:** Ignition resistance and limiting flame spread appear to be criteria that will increase fire safety of furniture. Fire Retardant Chemicals Association, March 18, 1996.

**COMMENT:** The time to ignition and time to put the fire out is a poor criteria of performance because it is highly subjective and nonreproducible. Polyurethane Foam Association, May 3, 1996.

**RESPONSE:** CPSC laboratory tests confirm the importance of small open flame ignition resistance and limited flame spread, i.e., self-extinguishment of the test mockup.<sup>9</sup> This approach is taken in the draft CPSC small open flame standard which has a 20 second flame application time with the criteria that any combustion must self-extinguish within 120 seconds.<sup>8</sup>

Laboratory staff disagree that the time to ignition is not reproducible. Laboratory tests have shown this measurement to be a reproducible, however, the CPSC draft standard uses the approach described above as the performance criterion. Staff agrees that time to put out an ignition is subjective, it was never used as a criterion of performance.

**ISSUE:** Flame Impingement for Skirt and Seating Area

**COMMENT:** The flame should be impinged to the underside of the skirt at a 45° from vertical. American Fiber Manufacturers Association, Inc., March 11, 1996.

**RESPONSE:** Available hazard data do not suggest a typical flame impingement angle. For the purposes of gathering data, CPSC staff chose to impinge the flame to the bottom edge of the vertically oriented skirt as this is a more severe test of ignition resistance, and one that is similar to a reasonably foreseeable child play ignition scenario. The test is also simpler if allowed to hang vertically. The draft CPSC standard does not include a skirt test.

**COMMENT:** The seating area flame impingement should be at the center of the seat cushion. American Fiber Manufacturers Association, Inc., March 11, 1996.

**COMMENT:** The seat/back area is an unreasonable area to test. The center of the cushion, 2 inches from the seat/back intersection is more reasonable. The center of the seat is tested in TB-133/ASTM/NFPA. American Furniture Manufacturers Association, April 11, 1996.

**RESPONSE:** Back/seat and side/seat locations as well as seat cushions were observed in CPSC's fire investigation study of open flame ignitions. CPSC staff choose to impinge the flame to the crevice location of the seating area as this allows the back/seat and side/seat locations to be tested and is a more severe test of ignition resistance. A mockup representing either the back/seat or side/seat of furniture is used in the draft CPSC standard test. The flat surface of the cushion two inches from the back does not seem to be a surface that would be easy to approach with a lighter.

**ISSUE:** Flame Exposure Time

**COMMENT:** Use 12 seconds as the flame exposure time. The Society of the Plastics Industry, Inc., April 4, 1996.

**RESPONSE:** CPSC laboratory tests show that a 12 second flame exposure time does not discriminate among those upholstery fabrics likely to ignite and those that are more resistant to ignition from a small open flame.<sup>9</sup> In addition a 12 second flame application time does not adequately reflect potential flame exposure times

from matches and lighters. Nor does it discriminate adequately between fabrics that might resist an open flame but fail a cigarette test. However, any flame application time chosen for use in a standard will be based on both technical and economic feasibility considerations including potential costs and benefits.

### **Prototype Test Fixture**

**ISSUE:** Three Separate Test Fixtures

**COMMENT:** The apparatus should be redesigned so that there are three separate devices, so that more than one test can be run at a time. American Textile Manufacturers Institute, April 8, 1996.

**COMMENT:** "Good efficiency and productivity would be realized by three separate test fixtures." American Furniture Manufacturers Association, April 11, 1996.

**COMMENT:** "... the apparatus should be redesigned so that more than one test could be performed at a given time... ." National Cotton Council, April 23, 1996.

**RESPONSE:** The CPSC test fixture is modular in design so that components that are not needed for a specific could be eliminated. A separate test fixture for each test location would have advantages in productivity and in streamlining the designs. There is no requirement in the draft CPSC standard to prevent a lab from setting up more than one test fixture so that each could be dedicated to a specific test.

**ISSUE:** Size Of Test Fixture/Specimen Mockups

**COMMENT:** The test apparatus is too big to fit in a typical laboratory chemical hood. As currently designed, the apparatus can only be used in large fire science facilities with ventilated burn rooms, which makes it impractical for manufacturers. American Textile Manufacturers Institute, April 8, 1996.

**COMMENT:** The samples are too large to be tested in a simple lab hood; the sample size requires a large burn facility. Polyurethane Foam Association, May 3, 1996.

**COMMENT:** Size of test fixture excludes the test from being conducted in a laboratory hood. GBH International, April 16, 1996.

**COMMENT:** "... the overall test apparatus is too large to fit in a typical chemical hood ... ." National Cotton Council, April 23, 1996.

**RESPONSE:** The staff agrees that the original test apparatus was bulky. The test fixture has been redesigned since this comment was made. The design is now

modular allowing for easy movement of each component. The test fixture components can fit into a typical chemical hood that has been modified slightly by extending the base approximately 6 inches.

The following comments and responses address specific concerns with the test fixture and some of the components in the test fixture. The issue is identified as a critique of the test fixture and components.

### **Test Fixture**

#### **ISSUE: Critique Of Test Fixture And Components**

**COMMENT:** Too many adjustments are required from one test to another. American Textile Manufacturers Institute, April 8, 1996.

**COMMENT:** "... too many adjustments of parts are required to switch from one tester to another." National Cotton Council, April 23, 1996.

**RESPONSE:** The test fixture has been redesigned to minimize the need for between-test adjustments. CPSC laboratory staff note that with practice and increased familiarity the remaining adjustments are easy and become routine.

**COMMENT:** The automatic flame positioner is not effective. Manual positioning would be as accurate as the "automatic" positioner. American Furniture Manufacturers Association, April 11, 1996.

**RESPONSE:** CPSC's test procedure does require manual positioning to ensure consistent automatic flame delivery. In the dust cover testing, the burner tube, with the burner offset gauge in place, is positioned manually under the specimen, so when the flame is delivered automatically during testing, the tip of the flame impinges the specimen.<sup>8</sup> The test operator manually adjusts the height of the burner tube so that just the tip of the flame touches the specimen. CPSC laboratory tests confirm that accurate placement of the flame is critical to achieving consistent results.<sup>9</sup>

**COMMENT:** The flame shield produces a more severe flame until the flame reaches equilibrium. The flame shield was a good idea that did not work. American Furniture Manufacturers Association, April 11, 1996.

**RESPONSE:** The staff agrees that the original shield design adversely affected flame stability. The test fixture has been redesigned since this comment was made with a different shield design that allows more clearance. The flame shield is necessary for accurate flame application times for dust cover test and is not required for the seating area test.

**COMMENT:** The flame flickered too much, causing a variable heat flux. If three fixtures were used, they could be used in a fume hood, and greatly minimize flickering. American Furniture Manufacturers Association, April 11, 1996.

**RESPONSE:** CPSC staff agrees that an undisturbed flame is important to delivering a consistent and reliable ignition source to the specimen being tested. Actual testing needs to be conducted in a fume/chemical hood or under a canopy style hood or in some other undisturbed environment that can be exhausted.

**COMMENT:** Flame height calibration is needed. American Furniture Manufacturers Association, April 11, 1996.

**RESPONSE:** A burner flame gauge is used to set the height of the flame.<sup>8</sup> This provides adequate calibration of flame height after the flame is stabilized.

**COMMENT:** There are too many clamps on the dust cover holder. It would be better to have a single "press fitting" picture frame type clamp, with wing nuts to give more positive control over flatness and tautness of the sample. American Furniture Manufacturers Association, April 11, 1996.

**RESPONSE:** A specially designed clamp could be used by testing organizations to attach the fabric to the frame. CPSC's laboratory experience has shown that the time and effort required to attach the dust cover specimens consistently and with sufficient tautness is not excessive.

**COMMENT:** A means should be provided to prevent the burner from clogging from any dripping/melting. American Furniture Manufacturers Association, April 11, 1996.

**RESPONSE:** The CPSC test experience has not indicated that burner clogging is a problem, even though the burner has been inspected between tests to make sure that there was no blockage. If a blockage were to be found, it could be cleaned with methyl alcohol and a size No. 6, 8 or 10 threaded brass rod.

**COMMENT:** The mock-up for the seat/back test concerns us. The mock-up creates a gap and does not represent a large part of the upholstery market, "tight-seat" construction. The UFAC jig gives a good approximation of both loose and tight seats, and should be used with metal frames. American Furniture Manufacturers Association, April 11, 1996.

**RESPONSE:** Modifications to the size of the filling material (foam) used with the seat mock-up have eliminated this concern. An arrangement of the foam similar to the UFAC arrangement is now specified.<sup>8</sup>

Several comments were received addressing the issue of the gas supply system used with the test fixture. Specifically, comments were received on the use of a flow meter, gas flow duration, the use of STP units for outlet pressure, the need for calibration of both the gas flow and flame and the need for a reproducible gas flame.

### **Gas Supply System**

**ISSUE:** Gas Supply System

**COMMENT:** A flow meter is called for in the protocol, however, during CPSC demonstrations, no flow meter was used. American Furniture Manufacturers Association, April 11, 1996.

**RESPONSE:** A flow meter is required to maintain consistent gas flow during tests. At the March 5, 1996, demonstration meeting held at the Engineering Laboratory, a flow meter was used during the demonstrations and was located in the observation room.

**COMMENT:** "The description of the gas flow should also include the duration of the test, rather than being presented separately." GBH International, April 16, 1996.

**RESPONSE:** In the CPSC draft standard, the gas flow rate to the burner is specified at  $45 \pm 2$  ml/min during the test. A 35 mm butane flame is applied to the specimen for 20 seconds then automatically withdrawn from the specimen. The butane flame can remain lit while observations are being made and between specimens runs thereby maintaining the specified gas flow rate. The draft standard specifies that whenever the gas is lit, the flame is allowed to stabilize for at least 2 minutes. In addition, the flame height should always be checked before testing begins.

**COMMENT:** "The gas pressure should be corrected to STP (standard temperature and pressure conditions)." GBH International, April 16, 1996.

**RESPONSE:** The CPSC draft standard specifies an outlet pressure of 27.5 mbar (0.4 psi), which provides the precision necessary for this standard.

**COMMENT:** A flame calibration procedure, such as ASTM D-5207, should be used to verify the heat flux profile of the test flame. The Society Of The Plastics Industry, Inc., April 4, 1996.

**RESPONSE:** CPSC staff agrees that there is some minor variability within the flame, however, the temperature profile of the burner flame shows the test flame to yield reasonably consistent temperatures at 35 mm above the burner. ASTM D-5207 may provide reasonable calibration; however, the use of a heat flux method may be more time consuming and expensive if the apparatus has to be acquired.

**COMMENT:** Calibration requirements for the gas flow meter are needed to assure reproducibility. The Society of the Plastics Industry, Inc., April 4, 1996.

**RESPONSE:** CPSC's Engineering Laboratory practice is to check all instrumentation for accuracy before use and to properly calibrate it if necessary. This caution is included in the staff's test procedures.

**COMMENT:** The gas flame is not reproducible when flame height, position and exposure time is varied. The fabric once ignited, becomes the ignition source for the foam which in turn become a "large ignition" source. Polyurethane Foam Association, May 3, 1996.

**RESPONSE:** A CPSC laboratory study monitored the gas flow rate, outlet pressure and flame height for the butane flame specified in the test protocol. This study indicated that using a gas flow rate of  $45 \pm 2$  ml/min and outlet pressure of 0.4 psi (as specified in the CPSC draft standard), a butane flame with a height of approximately 35 mm can be consistently delivered to the test specimen.

The commenter correctly points out that, the ignition source for the filling material underneath is often the upholstery fabric on the top surface. Small open flame ignition resistant materials, including upholstery fabrics, should not sustain or promote combustion of the mockup test sample.

The remaining comments concern fabric related issues.

### **Fabric Issues**

**ISSUE:** Length Of Time Allowed Before Start Of Test

**COMMENT:** Allowing the test specimens to stand in a room for 10 minutes prior to testing is too long. Cellulosics can absorb moisture and affect fire performance. American Fiber Manufacturers Association, Inc., March 11, 1996.

**RESPONSE:** The staff agrees that samples, once removed from the conditioning room, should be tested as soon as reasonably possible. The CPSC draft standard test requires testing to begin within 10 minutes after the specimens are removed from the conditioning area if the atmosphere of the testing area does not have a temperature between 10 and 30°C and a relative humidity between 20 and 70% RH. A 10 minute period is often used with flammability testing to allow time for setting up the test and should not appreciably influence fabric humidity except possibly under extreme conditions.

**ISSUE:** Conditioning Requirements

**COMMENT:** Standard ASTM requirements for sample conditioning should be used; Temperature ( $23 \pm 3^{\circ}\text{C}$ ) and humidity ( $50 \pm 5\%$ ). The Society Of The Plastics Industry, Inc., April 4, 1996.

**RESPONSE:** See response to previous comment, (FMC Flame Retardants, March 29, 1997).

**ISSUE:** Ability Of Char To Protect Foam

**COMMENT:** It is possible to design a fabric to char and self-extinguish, but the char would not have the integrity to prevent the foam from igniting. Ventex, March 29, 1996.

**RESPONSE:** In tests conducted at the CPSC laboratory, two char forming upholstery fabrics, a wool and a cellulosic/thermoplastic blend, have the potential to self-extinguish and protected the foam filling underneath from igniting.<sup>9</sup> The draft CPSC standard requires that no continued combustion of either upholstery or filling material, can occur more than two minutes after flame exposure.

**ISSUE:** Include Fabrics With Different Performance Levels

**COMMENT:** "... why it is imperative that fabric selection for the round robin should include easily ignited fabrics, difficult to ignite fabrics, and some fabrics on the borderline of difficult and easy to ignite." American Furniture Manufacturers Association, April 11, 1996.

**RESPONSE:** The commenter is referring to the proposed interlab evaluation. A range of dust cover and upholstery fabrics were included in the preliminary interlaboratory study. The fabrics were chosen to represent a range of resistance to ignition from a small flame source to allow for a better estimation of laboratory comparability. A complete description of the fabrics can be found in reference number 9.

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United States  
CONSUMER PRODUCT SAFETY COMMISSION  
Washington, D.C. 20207

MEMORANDUM

DATE: July 25, 1997

TO : Dale Ray  
Project Manager, Upholstered Furniture  
Economic Analysis

Through: Andrew G. Stadnik, AED Engineering Sciences *Andrew G. Stadnik*  
Nicholas V. Marchica, Director, Mechanical Engineering *NVM*

FROM : Rikki Khanna  
Fire Protection Engineer *Rikki Khanna*  
Engineering Sciences

SUBJECT: Response to Upholstered Furniture ANPR Comments

This memorandum presents Engineering Sciences staff responses to relevant public comments received after publication of the Advance Notice of Proposed Rulemaking (ANPR) for the development of a small open flame furniture standard. In cases where there are opposing comments on a common issue, the response is combined to describe Engineering Science's position on the matter.

**Adequacy/appropriateness of TB-117**

The following comments deal with the appropriateness of the National Association of State Fire Marshals (NASFM) request to adopt California Technical Bulletin (TB) 117 as a mandatory national standard. Some comments support the adoption of TB-117, while others feel that TB-117 is not an adequate standard to address small open flame hazard of upholstered furniture.

**Comment:** *"TB-117 provides occupants more escape time from upholstered furniture fires" - National Association of State Fire Marshals, Flame Retardant Chemicals Association*

**Response:** Engineering agrees with the statement that a delay in fire propagation can have a positive effect on life safety for occupants in structural fires. However, Engineering does not agree that TB-117 is the most effective standard to meet this end. A test program<sup>1</sup> was conducted by the CPSC to observe full scale fire behavior of upholstered furniture. In those tests, TB-117 chairs did not provide appreciably greater small open flame ignition resistance than conventional residential furniture.

Preventing ignition is a more effective approach than evaluating fire growth rate in

addressing the small open flame hazard of upholstered furniture in a residential fire scenario. The CPSC test approach is focused on increasing the ignition resistance of furniture to small open flames.

**Comment:** *"NFPA believes that the state of the art in fire testing has advanced since 1975 to the point where a new testing protocol can be developed that will not have the significant and fundamental limitations of TB-117."* - National Fire Protection Association

**Comment:** *"Adopt TB-117 as an initial test, because it will save lives and has been proven both technically and economically. If improvements are warranted, they can better be developed if Cal TB-117 is used on a nationwide basis."* - Fire Retardant Chemicals Association (FRCA)

**Comment:** *"Test adequately addresses risk"* - Chestnut Ridge Foam, Inc.

**Response:** Engineering does not agree with the FRCA and Chestnut that TB-117 is a technically appropriate standard for adoption as a mandatory national standard. As described above, TB-117 did not provide greater open flame ignition resistance in CPSC tests. In addition, the TB-117 standard has fundamental limitations that cannot be resolved by improvements in the test method. The primary limitation of TB-117 is that materials used in upholstered furniture materials are tested individually as separate components. The component approach does not adequately evaluate the synergistic effects of the fabric and filling materials which play an important role in assessing the fire behavior of upholstered furniture. The Full Scale Study<sup>1</sup> conducted by CPSC revealed that cover fabrics play an important role in the ignition of upholstered furniture. The only provision for cover fabrics in TB-117 is that fabrics be Class 1 per the General Wearing Apparel Standard<sup>2</sup> (16 CFR Part 1610). This minimal standard does not adequately evaluate the flammability of the range of cover fabrics used in upholstered furniture. The CPSC study<sup>1</sup> demonstrates that cover fabrics that meet 16 CFR Part 1610 readily ignite when exposed to a small open flame ignition source similar to a match or cigarette lighter.

Engineering agrees with the NFPA that improvements in fire testing allow for the development of an open flame test standard more technically appropriate than TB-117. The CPSC has developed a draft upholstered furniture standard<sup>3</sup> that evaluates the flammability of relevant materials (e.g. cover fabrics and any barrier materials used) in combination with standard filling material. With this mock-up approach, the CPSC proposed standard is more realistic than the TB-117 component standard.

**Comment:** *"...The technology is clearly available."* - Consumer Federation of America

**Response:** Engineering agrees with the CFA that the technology exists to meet the requirements of TB-117. TB-117 requires fabrics to be "Class 1, Normal Flammability", when tested according to the method in the General Wearing Apparel Standard<sup>2</sup>. Most conventional fabrics meet this requirement as the intent of this standard is to eliminate dangerously flammable textiles from the apparel market. As mentioned in a previous

response, the General Wearing Apparel Standard is not an appropriate standard for small open flame ignition of cover fabrics. The test requirements for the various other filling materials called for in TB-117 can be readily met with available flame retardant treatments.

**Comment:** *"AFMA does not support the use of TB-117 test methodology for evaluating the ignition potential of upholstered furniture....These positions are based on a large body of research which demonstrates the inability of component testing to accurately reflect fire performance of composite materials" - American Fiber Manufacturers Association.*

**Response:** Engineering agrees with AFMA that the component approach used by TB-117 is not an accurate method to evaluate the fire performance of furniture composites. The ignition behavior of individual component materials differs significantly from that of assembled composites that comprise finished articles of upholstered furniture. Laboratory testing<sup>1</sup> by CPSC has confirmed the inability of TB-117 to predict full scale behavior of upholstered furniture. The CPSC test method<sup>3</sup> utilizes a mock-up approach which is more predictive of the actual flammability performance of upholstered furniture. The draft CPSC standard calls for testing of the actual cover fabrics and any barrier materials that are used in furniture construction. CPSC full scale tests<sup>1</sup> demonstrate that filling material has a negligible effect on the small open flame ignition resistance of upholstered furniture.

**Comment:** *"UFAC will consider adopting the best aspects of California Technical Bulletin 117." Upholstered Furniture Action Council*

**Response:** TB-117 is not a technically adequate standard for small open flame ignition of upholstered furniture. The component test approach has fundamental shortcomings. The adoption of any aspects of the TB-117 would not result in an appreciable improvement in the small open flame performance of furniture.

### **Composite vs. Component Approach**

**Comment:** *"Composite mock-up is more realistic" - National Fire Protection Association*

**Comment:** *"Component not predictive of composite" - American Fiber Manufacturers Association*

**Response:** Engineering agrees with the NFPA and AFMA that composite mock-up testing is more realistic than component testing. The shortcomings in a component test were clearly evident from the CPSC study of full scale behavior of upholstered furniture, in which furniture meeting TB-117 component requirements did not perform appreciably better in full scale tests than conventional furniture. CPSC's draft standard is based on a mock-up seating area test approach. The test can be considered a modified component approach, in that the test evaluates the ignition resistance of the cover fabrics and any barriers used in actual finished item construction in combination with a standard filling

material. CPSC tests<sup>1</sup> demonstrate that the properties of actual filling materials had little effect on the ignition resistance in full scale chairs. Thus, there is no need to require testing of the actual filling materials. However, there are provisions in the proposed standard to allow manufactures to test a true composite of the actual filling materials used in construction of the upholstered item.

### **Adequacy of U.K. Approach**

The following comments deal with the adequacy of the approach used by the U.K. Standard. Some comments support the U.K. approach, while other commentors feel it may be overly stringent.

**Comment:** *"The British government has gone much further than what NASFM proposes. The British regulation mandates that all new and used furniture adhere to strict smoldering and open-flame performance requirements." - National Association of State Fire Marshals*

**Response:** Staff agrees that the British regulation has more comprehensive requirements than NASFM has proposed. Although the scope of the British regulations for upholstered furniture may be broader than CPSC's draft standard, the CPSC draft standard incorporates elements from the British 5852 Standard<sup>4</sup> to address small open flame hazard. The British/CPSC mock-up approach has been shown by CPSC tests<sup>1</sup> to be more predictive than the component approach<sup>5</sup> used in TB-117.

U.K. furniture manufacturers have successfully developed products that meet the U.K. mandatory flammability regulations. This suggests that the technology for meeting open flame standards is available and feasible for the furniture industry.

**Comment:** *"The British Standard has essentially banned the use of most polyurethane foams, except the highly fire-resistant combustion modified type. The banning of this type of product appears to be consistent with research findings on the fire hazards associated with many polyurethane and polyisocyanurate foams. - New York Department of State*

**Response:** Engineering agrees that polyurethane and polyisocyanurate foams have an important role in the fire hazard associated with upholstered furniture. Foams are the primary combustible material in upholstered furniture. Treatments can be made to foams with fire retardant chemicals and foam density can be increased to improve the overall flammability performance of foams. These techniques result in Combustion Modified High Resiliency (CMHR) foams. The U.K. regulations has essentially banned<sup>6</sup> the use of untreated foams and resulted in the use of CMHR foams typically treated with the flame retardant melamine or graphite. The use of CMHR foams in combination with fire barriers and fabric backcoatings is an effective approach to meeting U.K. fire safety requirements. CPSC tests have shown that some FR foams readily ignited and the primary determinant of ignition is the cover fabric. The use of untreated foam with fire barriers and fabric backcoatings has been effective against small open flame exposures<sup>9</sup>,

therefore Engineering believes that the use of CMHR/FR foams may not provide as significant protection from a small open flame source as applying an FR treatment to cover fabrics.

### **Need to Demonstrate Risk of Injury**

**Comment:** *"..there seems to be no reliable information on the mechanics of small flame ignition. In the absence of such information, AFMA believes it is virtually impossible to develop a meaningful ignition control strategy." - American Fiber Manufacturers Association*

**Comment:** *"An actual study of cases would better define the ignition scenario" - National Cotton Council*

**Response:** Engineering agrees that obtaining information on the fire scenarios is critical in developing a meaningful standard for small open flame ignition of furniture. A study<sup>7</sup> of small open flame ignited furniture fires was conducted to assist CPSC staff in developing a performance standard. The study provided information on the item and age of furniture involved, the type of small open flame ignition source, the location of flame impingement on the furniture, and the age of persons involved.

Valuable information was learned from the field study on the location of flame impingement and the types of ignition sources that were involved in the fires. The data provided by the study was sufficient to provide staff with information in developing a meaningful standard to address the risk of small flame ignition of furniture. Based on the Field Study, staff learned that most small open flame ignitions occurred in the seating area and some ignitions were in the lower/dust cover area. This information led to the development of the draft standard to address these two locations.

**Comment:** *"Risk assessment principles should be the basis of regulation." - Society of the Plastics Industry*

**Response:** Engineering agrees with the SPI for the need to apply risk assessment principles in the regulatory process. The CPSC staff has applied risk assessment principles in evaluating the hazard associated with small flame ignition of upholstered furniture by analyzing fire data (e.g., national estimates and field investigations) and laboratory testing to develop a performance standard to address the risk of small open flame ignited upholstered furniture fires. The staff will use this information to predict the reduction of risk associated with regulatory options and assess the relation of costs to benefits for regulatory action.

### **Adequacy of Voluntary Action**

**Comment:** *"While we question the furniture industry's commitment to a truly effective voluntary program, we also provide criteria for an acceptable voluntary program" - National Association of State Fire Marshals*

**Response:** There are no existing voluntary standards that address small open flame ignition of furniture in the U.S. Voluntary industry action has been focused the hazard of smoldering ignition of upholstered furniture via the Upholstered Furniture Action Council (UFAC) Program. A technically adequate voluntary standard should include a reliable and realistic test method which effectively reduces the risk small open flame ignited fires.

**Comment:** *"The private standards developing organizations (NFPA, ASTM) can and should play a central role in this exercise" - National Fire Protection Association*

**Response:** Engineering believes that private standards organizations such as NFPA and ASTM could play an important role in the development of a possible voluntary small open flame upholstered furniture standard. These organizations have the ability and infrastructure to develop and update consensus standards. ASTM has begun a process that may lead to a small open flame standard. This process may provide the Commission with a viable option for deferral to a voluntary standard. The staff's technical work on the draft CPSC standard may provide a basis for an adequate voluntary standard.

**Comment:** *"We urge the CPSC to refrain from setting mandatory regulations regarding flammability for upholstered furniture. However, we feel that properly treated cotton batting will perform in an excellent fashion no matter what regulations are used" - National Cotton Batting Institute*

**Response:** Engineering agrees that use of properly treated cotton batting will impart some improved smolder resistant (SR) and flame resistant (FR) properties. However, no data were provided regarding the performance of treated batting in combination with cover fabrics and other filling materials with small open flame ignition. CPSC tests show that upholstery cover fabrics are the primary determinant of ignition resistance and filling materials do not significantly affect the small open flame ignition behavior of composite assemblies found in finished articles of upholstered furniture. Engineering concludes that evaluating the performance of cotton batting alone is not an adequate approach to predict the flammability performance of upholstered furniture.

**Comment:** *"PFA would support the study of a small open flame test that could be included in the UFAC voluntary action program. This would be the most technologically feasible and economical way to address whatever problems might exist with small open flame ignition." Polyurethane Foam Association*

**Response:** Engineering agrees that a small open flame test incorporated into the UFAC Program is a technically feasible approach to addressing small open flame ignition of furniture.

## Interaction with Cigarette Ignition Propensity

**Comment:** *"Many materials that are used to resist smoldering cigarette ignition may perform poorly under conditions of open flame combustion" - UFAC*

**Response:** Engineering agrees that some materials that are smoldering ignition resistant may perform poorly when exposed to an open flame. Untreated cellulosic materials tend to be susceptible to cigarette ignition by transferring the smoldering from the tobacco column to the exposed cellulosic surface<sup>5</sup>. The smoldering ignition resistance of cellulosic fabrics is inversely related to the weight of the fabric. For open flame ignition resistance, heavier cellulosic fabrics perform better than lightweight since the heavier cellulose require more energy to ignite and have more char-forming potential to insulate interior filling materials. Thus, the trend towards use of smolder resistant thermoplastic fabrics by the furniture industry may have worsened the open flame ignition performance of upholstered furniture. CPSC's laboratory tests<sup>8</sup> show, however, that heavyweight cellulose will generally ignite when tested according to the Proposed CPSC Standard.

Thermoplastic fabrics exhibit the opposite ignition behavior of cellulose. Thermoplastic fabrics tend to have a high resistance to smoldering ignition<sup>5</sup>. In contrast, for open flame ignition thermoplastic fabrics tend to melt away from the flame and expose interior filling materials. When tested according to the CPSC draft standard, conventional thermoplastic fabrics with fire retardant treated foam fillings ignite and sustain combustion.

**Comment:** *"Additionally, solutions to reduce small open flame ignition should not cause an adverse effect on the smoldering cigarette ignition resistance of upholstered furniture" - Polyurethane Foam Association, National Cotton Council, Society of the Plastics Industry*

**Response:** Engineering agrees with the commentors that a regulation for small open flame ignition of furniture should not adversely affect cigarette ignition resistance of upholstered furniture. Engineering is concerned with the potential of increased use of cellulosic materials by the industry to meet an open flame standard and the impact that would have on smoldering ignition. CPSC conducted tests on fabrics that are both small open flame ignition resistant and are cigarette ignition resistant. Based on preliminary laboratory testing staff concludes the technology exists to improve both open flame and cigarette ignition of upholstered furniture. This can be achieved through the use of naturally ignition resistant fabrics such as wool or leather, backcoating fabrics with flame retardants, other flame retardant chemical treatments to fabrics/filling materials, and use of fire barriers.

## REFERENCES

- 1 "Upholstered Furniture Flammability Testing: Full Scale Open Flame Data Analysis", Consumer Product Safety Commission, February 1996.
- 2 "Standard for the Flammability of Clothing Textiles", CFR Part 1610.
3. "Bench Scale Test Method for Upholstered Ignition Resistance to Small Open Flame Source", Consumer Product Safety Commission, February 1996.
4. BS 5852: Fire Tests for Furniture, Part 2, British Standards Institute, March, 1982.
5. NBS Monograph 173, Fire Behavior of Upholstered Furniture, National Bureau of Standards, November 1985.
6. "British Ban - Untreated Polyurethane Foam", CPSC Memorandum, May 18, 1988.
7. "Small Open Flame Ignitions of Upholstered Furniture", April 1997, Consumer Product Safety Commission.
8. "Summary of Upholstered Furniture Tests", CPSC Memorandum, May 22, 1997.



**United States  
CONSUMER PRODUCT SAFETY COMMISSION  
Washington, D.C. 20207**

**MEMORANDUM**

**DATE:** June 23, 1997

**TO** : Dale R. Ray, ECPA  
Project Manager, Upholstered Furniture  
**Through** : Warren J. Prunella, AED, EC *WJP*  
**FROM** : Charles L. Smith, EC (504-0962, ext 1325) *CLS.*  
**SUBJECT** : ANPR - Small Open Flame Ignition Hazards of Upholstered Furniture:  
Analysis of Comments on Economic Issues

This memorandum discusses comments on economic issues received in response to the June 15, 1994, Advance Notice of Proposed Rulemaking (ANPR) on the need for a rule addressing small open flame ignitions of upholstered furniture.

**Issue: The Adequacy of California Technical Bulletin 117 in Addressing Risks of Small Open Flame Ignitions of Upholstered Furniture**

**Comments:** The National Association of State Fire Marshals (NASFM) commented that California's Technical Bulletin 117 (TB 117) has been effective in reducing the hazard of small open flame fire involving upholstered furniture in the state at an average increase in cost of furniture to the consumer of about 5 percent. NASFM states that the furniture industry is able to comply with TB 117, and there has been no evidence that consumer choice has been diminished in any way. Further, they cite Gordon Damant, former Director of the California Bureau of Home Furnishings, who states that testing has shown that, when ignited by small open flames, furniture complying with TB 117 has dramatically greater time for detection, suppression, and escape than noncomplying furniture. Mr. Damant's views were also cited in a comment submitted by the Consumer Federation of America. Similar comments in favor of TB 117 as a cost effective means to save lives (including the resulting increased escape time in the event of a fire) were filed by the Fire Retardant Chemicals Association (FRCA) and California's Bureau of Home Furnishings and Thermal Insulation (BHF).

**Response:** The most important difference between furniture intended for sale in California and furniture intended for other markets is the use of urethane foam that has been treated with fire retardant (FR) chemicals. None of the information available to the Commission, including the results of full-scale testing by the CPSC Directorate for Laboratory Sciences, indicates that furniture complying

with TB 117 is less likely to ignite than other furniture when exposed to a small open flame for several seconds. Translating laboratory data on possibly lower rates of fire growth with furniture having FR treated urethane to reductions in deaths, injuries, and property damage is speculative. A major manufacturer of fire retardant chemicals for urethane foam commented in 1993 in support of the NASFM petition that the increased manufacturing costs to produce furniture complying with Technical Bulletin 117 range from less than \$5 to \$10 per sofa. The Directorate for Economic Analysis estimated the total nation-wide cost increases to comply with Technical Bulletin 117 may be about \$105 million dollars annually, not counting the approximately 15 percent of furniture produced for the California market. Costs borne by consumers may total more than \$250 million annually. Given the results of CPSC laboratory testing, which found that the component-based testing of TB 117 was not predictive of ignitability when subjected to small open flame sources in full-scale testing, these costs cannot be justified by offsetting benefits.

**Issue: The Adequacy of the Approach Taken by the British Regulations in Addressing Risks of Small Open Flame Ignitions**

The United Kingdom has incorporated the "Match Test" from the British standard, BS-5852, in its regulations governing the flammability of upholstered furniture. This requires testing of upholstery fabrics over standard urethane foam; a small flame is impinged on the fabric for 20 seconds. Although the test is on fabrics over standard urethane foam to qualify fabrics for use, that type of foam is not acceptable for use in furniture under the regulations; combustion-modified high resiliency (CMHR) foams must instead be used to manufacture furniture. Fabrics chemically treated to pass the test must be rinsed before testing. This assures that treatments with some durability are used. In addition to requirements addressing open flame ignition hazards, the British standard includes tests related to cigarette ignition resistance of furniture.

Comments: The NASFM comments that it hopes the U.S. would some day adopt regulations similar to the British standard; however, for now, they believe the adoption of TB 117 is a reasonable approach.

The New York State Office of Fire Prevention and Control comments in favor of adopting TB 117, but it also supports the U.K. requirement for CMHR foam.

The Fire Retardant Chemicals Association (FRCA) commented that the British furniture industry "now is meeting this standard on an economical basis and thereby saving lives." However, as noted above, the FRCA recommends adopting TB 117 as an initial standard to address hazards of small open flame ignitions of furniture.

The European Union (EU) commented that, since the U.K. standard covered open flame ignitions in 1988: upholstered furniture fire deaths have fallen

significantly; upholstered furniture prices have not risen significantly; manufacturers have implemented the changes without a significant impact on their operations; U.K. furniture manufacturers are against any relaxation of regulations and have maintained their export market, and; foreign firms are able to comply with the regulation and export to the U.K.

**Response:** The CPSC's engineering staff states that a component test similar to that in BS-5852, in which a fabric and filling material assembly is subjected to a small open flame source, could provide a meaningful basis for addressing furniture flammability. The staff work suggests that the component tests of TB 117 are not predictive of full-scale results. The fact that furniture manufacturers and fabric suppliers have operated under the British standard for several years suggests technical and commercial feasibility if similar provisions were included in a rule issued by the CPSC. (Information on the costs of compliance with the British standard appears in the discussion of "Potential Economic Impacts" below.)

**Issue: The Impact of Measures Taken to Address Small Open Flame Ignitions Involving Other Ignition Sources**

**Comments:** Several parties that submitted comments expressed the view that measures taken to address hazards presented by small open flame ignitions will also reduce risks of deaths, injuries, and property damage when furniture is ignited by other ignition sources, and when furniture is not the first item ignited. This may result from increased time provided to detect, suppress, and escape the fire that does occur. Consideration of the impact on fires in which furniture pieces are the first items ignited by small open flames would, therefore, understate the potential benefits to society.

**Response:** The Directorate for Economic Analysis agrees that fire losses other than those attributable to small open flame ignitions could be avoided as a result of the draft CPSC standard. The magnitude of these benefits would depend on the types of product modifications made. Reductions in fire losses from other open flame ignition sources, or from fires in which furniture is not the first item ignited are not readily quantifiable, and, therefore, are not included in the calculation of potential benefits in the regulatory analysis.

**Issue: Potential Effects on Cigarette Ignition Propensity**

**Comments:** The Upholstered Furniture Action Council (UFAC) comments that "many materials that are used to resist smoldering cigarette ignition may perform poorly under conditions of open flame combustion and vice versa." The Polyurethane Foam Association (PFA), the National Cotton Council (NCC),

and the Polyurethane Division of the Society of the Plastics Industry (SPI) commented that actions taken to address small open flame ignitions of furniture should not adversely affect the resistance of furniture to ignition from smoldering ignition sources, like cigarettes.

**Response:** The staff agrees that possible detrimental outcomes, such as increased risk of smoldering ignitions, should be considered. A comprehensive consideration of costs and benefits expected to result from changes in materials and manufacturing methods facilitates the most appropriate decision for society. CPSC laboratory experiments suggest that likely product changes addressing small open flame ignitions may lead to reductions in losses from fires started by cigarettes, as well. If FR treatments eliminate 50 percent of the expected losses from cigarette ignitions of upholstered furniture, the estimated additional benefits would be about \$29 per item of furniture, on average. Total expected benefits from reduced cigarette ignitions (at 50 percent effectiveness) would range from about \$570 million to \$690 million for each year's production of upholstered furniture.

**Issue:        The Impact of the CPSC Lighter Rule**

**Comments:** Some commenters discussed the potential impact of the CPSC lighter standard in reducing risks of small open flame ignitions of upholstered furniture. The NASFM expressed their hopes and expectations that child resistant lighters will reduce these risks; however, they believe that the standard addresses only part of the problem, and should not be considered as an alternative to flammability standards for upholstered furniture. UFAC and NCC cited CPSC estimates that the lighter rule may prevent between 85 and 120 deaths per year. UFAC and NCC suggested that technological advances could lead to changes to matches that would further reduce the risks from this other major small flame ignition source. NCC suggested that the CPSC consider a voluntary or mandatory program to make matches more "fire safe."

**Response:** The reduction in fire losses projected to result from the CPSC lighter standard includes fires in which upholstered furniture would have been the first item ignited. The staff's assessment of the potential benefits from a rule affecting the flammability of upholstered furniture considers the impact of the lighter standard on risks that are being addressed. If projected reductions in lighter fires involving childplay are considered, remaining estimated annual losses from lighter, match, and candle ignitions of upholstered furniture are about 75 deaths, 360 injuries, and \$40 million in property losses. The estimated value of these losses totals about \$470 million annually.

**Issue: The Adequacy of Voluntary Standards in Addressing Risks**

Comments: The NFPA encourages the CPSC to turn to the private standards developing organizations, the NFPA and ASTM, to develop a consensus standard.

The National Cotton Batting Institute (NCBI) commented in support of the UFAC Voluntary Action Program, and urged against setting mandatory standards for upholstered furniture. However, they did state their belief that FR treated cotton batting would perform well under a small open flame standard.

UFAC comments that it will consider adopting "the best aspects of TB 117 as part of the UFAC Construction Criteria" in its voluntary program, should a thorough analysis demonstrate the effectiveness of TB 117.

The PFA commented that it would support the study of a small open flame test of all cushioning components to be included in the UFAC Voluntary Action Program. They believe this would be the most technologically feasible and economical way to address whatever problem might exist.

The California State Fire Marshal commented that a mandatory standard based on TB 117 would create a level playing field, whereas a "voluntary approach could be confusing to the consumer and create an inventory and marketing nightmare."

Response: If provisions that adequately address small open flame hazards of upholstered furniture were included in a voluntary standard, and if a substantial proportion of furniture production complied with the provisions, the potential benefits of a mandatory rule could be significantly reduced. No such voluntary rule currently exists. Adopting TB 117 as a mandatory standard would probably not significantly reduce the small open flame ignition hazard associated with upholstered furniture.

**Issue: The Scope of Coverage**

Comments: The Futon Association International (FAI) and the International Sleep Products Association (ISPA) commented that futons are already subject to regulation for cigarette ignition resistance under the Standard for the Flammability of Mattresses and Mattress Pads. FAI and ISPA state that futons are principally bedding, and, therefore, should not be subject to regulations addressing the flammability of upholstered furniture. They claim that subjecting futons to two sets of possibly conflicting regulations would be unfair and unwarranted.

Response: Futons have gained in popularity in recent years as dual purpose furniture. Although the glossary of the Standard for the Flammability of Mattresses and Mattress Pads defines futon as "a flexible mattress generally used on the floor that can be folded or rolled up for storage," that does not appear to be the

**Response:** Futons have gained in popularity in recent years as dual purpose furniture. Although the glossary of the Standard for the Flammability of Mattresses and Mattress Pads defines futon as "a flexible mattress generally used on the floor that can be folded or rolled up for storage," that does not appear to be the norm regarding futons marketed today. Futons are usually marketed for use with an adjustable frame that converts to either a flat sleeping surface or a furniture item similar to a sofa, with the folded futon serving as both the seat and back cushion. In their "furniture" configuration, futons appear similar in design function to sofas. Therefore, they might present similar risks of being subjected to small open flame sources. The fact that futons are already covered by the standard addressing cigarette ignition hazards of mattresses does not argue for their exclusion from a standard addressing small open flame hazards. However, futons have not been observed in fire incident reports on either upholstered furniture or mattress investigations. Furthermore, futons may be purchased for use on the floor or on a platform base, and when purchased for use with a furniture-like frame, they typically are covered by futon covers that are purchased separately. For these reasons, futons are not covered by the draft standard.

**Issue: Potential Economic Impacts**

**Comment:** UFAC concurred with the Directorate for Economic Analysis estimate that mandating TB 117 could result in increased costs to consumers of about \$250 million annually.

**Response:** Most of the impact of TB 117 is related to higher costs for FR treated polyurethane foam. The costs associated with the draft CPSC standard would largely be associated with changes to fabrics; FR foams would generally not be required.

**Comments:** The National Cotton Council of America (NCC) submitted information developed by Peter Greenwood, a flammability consultant in the U.K., on the cost impacts of FR fabric treatments used to comply with the British standard for furniture. Processing costs for durable treatment using Proban were said to range from £0.80 to £1.50 per meter of 60-inch wide fabric, depending on weight. Similar treatments by other brands, Pyrovatex or Aflammit, may be somewhat less, while unbranded treatments could be 15 percent less. Many semi-durable finishes in the U.K. are applied by backcoating. One common FR applied in this way was said to be Myflam, which is based on antimony trioxide. FR backcoating processing costs were said to be in the range of £0.50 to £0.80 for 54-inch to 60-inch wide fabric, depending on fabric weight. NCC cites Mr. Greenwood's estimate of about \$0.75 to \$2.25 per meter of 54-inch to 60-inch wide fabric as the increased fabric cost to comply with the British standard. The NCC stated that the increased cost of FR-treated fabric

to the furniture manufacturer, retailer, and consumer would be a 2-times markup at each step, or about 4 to 6 times the original cost.

**Response:** According to information provided by an official of the British FR chemical manufacturer that reportedly produces most of the FR chemicals used in backcoating in the U.K., the increased cost to the furniture manufacturer to have fabric shipped to a converter to be backcoated is about \$.90 per linear yard of fabric (£.60 per meter), including inspection and transportation. That official also reported that the increased costs to treat fabrics were similar for FR treatment methods that did not involve backcoating. Comparable cost estimates were provided by the director of a major testing facility (which is a division of the largest British upholstered furniture manufacturer). That official, who was previously Technical Director of the British Furniture Manufacturers (trade association), estimated that the treatment with FR backcoatings results in increased fabric costs to furniture manufacturers in the range of £.70 to £.80 per linear meter, which converts to about \$1.05 to \$1.20 per linear yard of fabric at current exchange rates. Also, an official of a British textile trade organization estimated that treatment with FR chemicals not incorporated in backcoating generally adds \$1.25 to \$1.50 per linear meter to the cost of fabric. This converts to about \$1.15 to \$1.35 per linear yard of fabric. For the purposes of assessing impacts on U.S. firms, the British experience with a small open flame testing requirement suggests increased fabric costs to furniture manufacturers generally in the range of \$1.00 to \$1.25 per linear yard would result. This estimate is within the range estimated by the National Cotton Council.

The Directorate for Economic Analysis does not agree with NCC's statement that increased fabric costs would be subject to markups to the retail level resulting in 4 to 6 times the original cost paid by the furniture manufacturers. Based on information previously provided by the furniture industry, increases in manufacturing costs would more likely be subjected to markups to the retail level of about 2.5 times.

**Comments:** NCC expressed concern that mandatory action by the CPSC could limit consumer choice. Also, they note that about 70 percent of the population does not smoke, so they would be at greatly reduced risk from fires caused by matches and lighters.

**Response:** The staff shares NCC's concern that a reduction in consumer choice would be an adverse impact of a product safety standard. This possibility would be a factor to be considered in rulemaking. Although a number of product and non-product-related factors may affect the relative risks faced by nonsmoking households, the 1990 CPSC survey of lighter and match ownership found that many households with lighters and matches mainly had them on hand for purposes other than to light cigarettes or other smoking materials. Only about

12 percent of households were estimated to have had no lighters or matches present.

**Comment:** California's Bureau of Home Furnishings and Thermal Insulation (BHF) commented that, because the furniture industry, including firms located in other states, has been producing furniture in compliance with TB 117, "adoption of an open flame standard that is significantly different from TB 117 could cause disruption to the furniture industry. Manufacturers and suppliers of raw materials that are required to meet a new, more stringent flammability standard may require substantial changes in raw materials, methods of construction, quality control, and labeling. These changes would undoubtedly have significant financial impact on the industry. Adoption of existing California standards, on the other hand, would minimize the impact of a mandatory national standard."

**Response:** The staff believes that a standard that adequately addresses risks of small open flame ignitions of furniture should include testing provisions that provide some assurance that the finished item will not result in a progressive ignition when a small flame source is impinged on the fabric for a reasonable period of time. The staff does not believe such assurance is provided by TB 117, and, therefore, cannot recommend its adoption as a mandatory standard. The Directorate for Economic Analysis agrees that adoption of more stringent requirements, while resulting in greater benefits in the form of hazard reduction, also could lead to the impacts on the industry cited by BHF. The preliminary regulatory analysis concludes that a small open flame rule based on the draft CPSC standard would probably have significant net benefits to consumers, and that these benefits would probably exceed those of a rule based on TB 117.



United States  
**CONSUMER PRODUCT SAFETY COMMISSION**  
Washington, D.C. 20207

**MEMORANDUM**

**DATE:** JUN 13 1997

**TO :** Dale Ray, Project Manager for Upholstered Furniture, Directorate for Economic Analysis

**Through :** *Akan for* Mary Ann Danello, Ph.D., Associate Executive Director for Epidemiology and Health Sciences

Marilyn L. Wind, Ph.D., Director, Division of Health Sciences *mlw*

**FROM :** Michael A. Babich, Ph.D., Chemist, Division of Health Sciences *maB*

**SUBJECT :** Responses to Public Comments on Upholstered Furniture

The purpose of this memorandum is to respond to written comments that the Consumer Product Safety Commission (CPSC) received as a result of publishing an advance notice of proposed rulemaking (ANPR) on upholstered furniture. This memorandum responds to comments relating to the possible toxicity of flame retardant chemicals and their combustion products. The comments are on file in the Office of the Secretary. The numbers in brackets following each comment are the comment numbers assigned by the Office of the Secretary.

**1. Comment--Possible Toxicity of Fire Retardant Chemicals**

The Austrian Ministry for Economic Affairs stated that fire retardant chemicals should not be used because they may be a source of indoor air pollution and present a toxic hazard to consumers. [CF-94-1-39] The Flame Retardant Manufacturers Association and the European Commission (EC) argued that there is no evidence that fire retardant chemicals are toxic, citing a report<sup>1</sup> prepared for the European Commission (EC). [CF-94-1-56, page 3] [CH-94-3-14, pages 2-3; attachment B, page 7]

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<sup>1</sup> L. Binetti (1992) Preparation of a document on toxicity and ecotoxicity of flame retardants used in the industry of upholstered furniture and related articles. Final Report. December 1992. Contract no. ETD/91/B8-5300/MI/44.

## Response

In the view of the staff, the EC report does not support the conclusion that there is no evidence that fire retardant chemicals are toxic. According to the report, the available toxicological data on fire retardant chemicals is "generally poor, so that a complete and exhaustive evaluation is not possible." [see CF-94-1-56; attachment, pages 30-36] Nonetheless, the report reviewed the available data on the toxicity of flame retardant chemicals. For example, tris-(2,3-dibromopropyl)phosphate (TRIS) and tris-(1,3-dichloro-2-propyl)phosphate are mutagenic and carcinogenic. Some triarylphosphates exhibit delayed neurotoxicity. The polymeric reaction product of tetrakis-(hydroxymethyl)phosphonium chloride and urea is a respiratory, skin, and eye irritant. Boric acid is a male reproductive toxicant and some other inorganic fire retardant chemicals also are toxic. According to the EC report, some fire retardant chemicals are not associated with any known toxic effects, including aluminum hydroxide, the ammonium salt of polyphosphoric acid, and decabromobiphenyl oxide.

Under the Federal Hazardous Substances Act (FHSA), manufacturers are responsible for ensuring that their products do not present a hazard to consumers during "reasonably foreseeable handling and use," or that they are properly labeled. The FHSA applies to both acute and chronic hazards. The Commission has issued guidelines to assist manufacturers in assessing chronic hazards. According to the guidelines, manufacturers should consider all available toxicity information.

Under the FHSA, exposure and bioavailability (the degree to which a substance is absorbed by the body) must be considered in determining whether the substance may present a hazard. Even if a substance is "toxic" under the FHSA, it is not "hazardous" if there is insufficient exposure to cause illness or injury, or if it is not absorbed by the body. For example, to manufacture upholstered furniture that is resistant to small open flame ignition, flame retardant chemicals may be applied to back of the covering or incorporated into the fabric or fiber. Thus, exposure would depend, in part, on the ability of the flame retardant to migrate to the surface. The potential for exposure would be greater if the flame retardant were applied to the outer surface of the fabric.

Considering the relative lack of toxicity data for some fire retardant chemicals and the known toxicity of certain other fire retardants, the staff concludes that additional information on fire retardant chemicals is needed to assess whether they may be hazardous under the FHSA. Data relating to chronic toxicity, exposure, and bioavailability would be particularly helpful. In addition to contact with the skin during normal use, other exposure scenarios should be considered, such as mouthing behavior by small children, and inhalation of volatile chemicals.

## 2. Comment--Exposure Assessment

The EC report included an exposure assessment for flame retardant chemicals in fabrics used to cover upholstered furniture. The report assumes that the covering contains 2 grams of flame retardant chemical per square decimeter (2 g/dm<sup>2</sup>) and that this is released over a period of 1,000 days. Thus, it is released at a rate of 0.08 milligrams per hour (mg/h). [CF-94-1-56; attachment, page 59]

### Response

Actual experimental measurements of the release (that is, migration to the surface) of flame retardant chemicals would permit a more reliable assessment of exposure than the hypothetical analysis in the EC report.

## 3. Comment--Possible Smoke Toxicity of Fire Retardant Chemicals

The National Association of State Fire Marshals (NASFM) cited a report produced by the National Institute of Standards and Technology (NIST) (formerly the National Bureau of Standards) for the Fire Retardant Chemicals Association that compared fire retarded and non-fire retarded products.<sup>2</sup> According to the report, fire retarded products produced two-thirds less toxic gas than non-fire retarded products. [CF-94-1-1a, page 7] The EC report also cited the NIST study, concluding that no unusual toxicity resulted from the combustion of fire retarded products, but that additional tests are needed. The EC report cited other studies that gave results similar to the NIST study [CF-94-1-56; attachment, page 68]

### Response

The possible smoke toxicity of fire retardant chemicals is important, because more fire-related fatalities result from smoke inhalation, mainly due to carbon monoxide, than burns. Furthermore, there have been reports of certain polyhalogenated compounds that produced decomposition products of unusually high acute toxicity when they were exposed to high temperatures. When decabromobiphenyl oxide is heated, such as during processing or combustion, it releases polybrominated furans, chemical analogues of dioxin that exhibit a variety of toxic effects. Furniture that is designed to resist ignition by small open flames could burn if exposed to a larger flame. It would be a concern if the combustion products from flame retarded furniture were substantially more toxic than non-flame retarded furniture.

While the possible release of highly toxic compounds in a fire is a valid concern, it is not very likely. The smoke toxicity of most materials does not vary greatly, and is

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<sup>2</sup> Babrauskas, V., et al. (1988) Fire hazard comparison of fire-retarded and non-fire-retarded products. U.S. Department of Commerce. National Bureau of Standards Special Publication 749. July 1988.

primarily due to carbon monoxide. Concerns about the smoke toxicity of fire retarded products can be addressed through smoke toxicity testing (see below). The polybrominated furans resulting from decabromobiphenyl oxide might pose a chronic hazard, depending on the amount produced. However, the possible chronic hazard should be weighed against the well-established acute hazards associated with residential fires.

The conclusion of the NIST study, that fire retarded products produced fewer toxic combustion products than non-fire retarded products is not surprising, since fire retarded products are expected to burn more slowly. However, although a product that burns more slowly will produce smoke at a lower rate, the amount of smoke per unit of mass consumed may be greater, especially during smoldering combustion.

The staff agrees with the EC report's assessment of the NIST study. NIST reported that the smoke toxicity of fire retarded products could generally be explained by the levels of carbon dioxide, carbon monoxide, hydrogen cyanide, and oxygen in the combustion atmosphere. No compounds of unusually high toxicity were found, and unidentified compounds (probably hydrogen chloride or hydrogen bromide) contributed little to the smoke toxicity. This suggests that the fire-retarded products that NIST studied do not produce unusually toxic combustion products. However, the staff also agrees with the EC report that additional tests on a broader sample of fire retardant chemicals are needed. The staff will consider the NIST study and related studies in the continuing development of the proposed rule.



United States  
**CONSUMER PRODUCT SAFETY COMMISSION**  
Washington, D.C. 20207

**MEMORANDUM**

**DATE:** April 3, 1997

**TO:** Dale Ray, EC, Project Manager, Upholstered Furniture

**Through:** Andrew G. Stadnik, PE, Associate Executive Director, ES *Andrew G. Stadnik*  
Robert B. Ochsman, Ph.D., Director, ESHF *Robert B. Ochsman*

**FROM:** Timothy P. Smith, Engineering Psychologist, ESHF *Timothy P. Smith*

**SUBJECT:** Human Factors Response to Upholstered Furniture ANPR Comments

This memorandum answers a request for Human Factors to respond to submitted comments regarding the upholstered furniture ANPR.

Attachments

## **ISSUE: Adequacy of Labeling/I&E**

The Consumer Federation of America (CFA) opposes labeling as an alternative to a mandatory flammability standard for small open flame ignition. They feel that a warning label that urges consumers to be careful when using small open flame ignition sources would be useless since consumers are aware of the dangers of fire and the fires are unintentional. In addition, the CFA feels that labeling will have no effect on fires started by children. The CFA also believes that while fire education programs can and should repeat messages about reducing fire risk, these fires will continue to occur.

Contrary to this opinion, the Upholstered Furniture Action Council (UFAC) feels that because there is an ongoing downward trend in the number of people who smoke, and consequently a reduction in the use of small open flame sources, a labeling regulation might be the most cost-effective method of addressing these incidents. The Society of Plastics Industry, Inc. (SPI) also feels that consumer education, via labeling, public service announcements, etc., to remind consumers of the fire hazards presented by careless handling of matches, lighters, and smoking materials can make a positive contribution to reducing risk. SPI feels that the CPSC should consider these alternatives in addition to or as an alternative to small scale tests. The National Cotton Council of America (NCC) also feels that the CPSC should consider developing an "Information & Education" program concerning the fire risk associated with upholstered furniture.

## **RESPONSE: Human Factors**

Warning labels and information & education campaigns are likely to have relatively little effect in preventing small open flame ignitions compared to product changes. Designing the hazards out of a product and implementing product safety regulations protect users automatically and do not rely on the user modifying behavior. Passive measures have been found to be more effective and have a greater chance of success than either labeling or information & education campaigns.

For a warning label to have any chance of improving the safety of a product it must be aimed towards those people whose behavior needs to be changed (Ayers, 1989 & Horst, 1986). According to EHHA's April 1997 report on small open flame upholstered furniture fires, the majority of open flame ignitions of upholstered furniture are caused by children playing with lighters or matches. Even the best-designed label would probably not significantly reduce small open flame fire deaths and injuries since the label would not target, and would not be read by, the children most likely to be involved.

Information and education (I&E) programs suffer from many of the same problems as warning labels, particularly because the primary cause of incidents is children playing. The effectiveness of I&E programs also require the consumer to take an active role in learning about the hazards of a product, and to have the motivation to act upon what they learn. Campaigns such as these often require a high degree of commitment of time and resources,

and while the staff does not completely discount these programs as helpful, they often meet with limited success. In general, information & education campaigns reach less than half of the target audience, only a fraction of which will change their behavior and have this change of behavior persist over time (Adler, 1984). Thus the staff concludes that a flammability standard will have a significantly greater impact on these fires than warning labels or I&E campaigns.

## References

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