IN•TOUCH

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Foam Performance: Part 2—Joint Industry Guidelines

In the late 1980s, there were a number of concerns with the consistency and application of test methods used for flexible polyurethane foam (FPF) in furniture applications. To address this issue, the foam, furniture and furniture supply industries formed a joint industry committee to thoroughly analyze and evaluate foam testing, and recommend how test results could be used to build comfort and durability into upholstered furniture.

Begun in 1987, the Joint Industry Standards Committee published its report in 1994.

The Joint Industry Polyurethane Foam Committee began work in 1987, under the auspices of the American Home Furnishings Association (AHFA), with a total of more than 90 furniture manufacturers, foam producers, testing labs, and industry suppliers contributing to the project, which, after seven years of work, resulted in a published document.

The committee's report, *Flexible Polyurethane Foam Voluntary Test Standards And Performance Guidelines,* has helped foam suppliers and end-users better understand the uses and limitations of laboratory tests on flexible polyurethane foam.

The Polyurethane Foam Association, along with many PFA members, were active participants in the committee, and made significant contributions to its findings.

Information from the Joint Industry Polyurethane Foam Committee Report has also been used to enhance ASTM International's D3574 standard for flexible polyurethane foam. (See *InTouch: Foam Performance Testing Part 1*).

Flexible polyurethane foam is a key component in furniture construction, and works together with other components to provide support, comfort, and durability.

Understanding The Complexities Of Foam In A Furniture System

As the Joint Industry Committee began its work, it became clear that there was a need for increased education about the role of flexible polyurethane foam in upholstered furniture. Selecting the right foam for different applications is a complex process, and must take a spectrum of factors into account to provide the desired support, comfort, and durability required.

The committee evaluated a wide range of foam products used in furniture, including conventional foam, high resilience (HR) foam, filled conventional foams, and combustion modified foams.

Foam in a furniture system works in conjunction with a number of other elements, including decking materials like springs, fiber used to wrap cushions, and cover fabrics. Other elements that contribute include seat depth and height, seat angles, and other design considerations.

Depending on the retail price point of the finished product, economics can also be a consideration in material selection.

A conclusion of the Joint Industry Committee was that FPF alone is not the determining factor of furniture comfort and performance, and that while foam testing consistency needed to be enhanced, it is still vital to evaluate the entire seating system.

A Simplified Approach To Foam Performance Evaluation

Because of all the complexities involved in furniture design and foam specification, one task of the Joint Committee was to answer foam users' questions about which test procedures provide the most important information for evaluating foam performance.

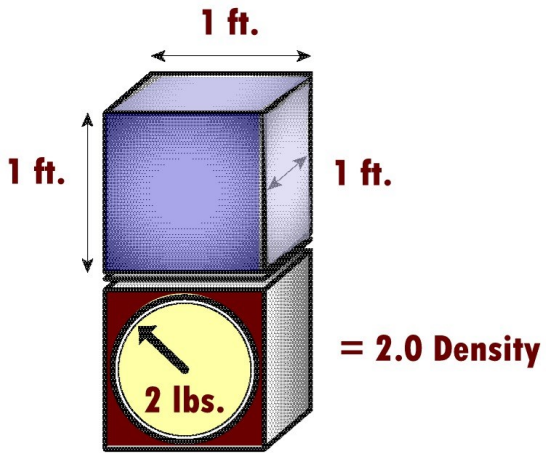
After much analysis, the committee identified four basic physical properties as essential to foam performance in most applications. They are:

- Density
- Firmness (IFD)
- Strength (Tensile, tear, and elongation tests)
- Flex Fatigue

It was determined that considering these four characteristics as part of routine evaluation of FPF can lead to more consistency and better quality in end-use applications.

Density

Foam density is a measurement of mass per unit volume, measured in pounds per cubic foot (pcf). This is different that just foam weight. Density is a function of the chemistry used to produce the foam, including any additives or fillers that may have been used to impart specific performance



features or to increase foam density. (For a more detailed explanation, see *InTouch, Vol. 1, No. 2, Density*.)

Density is measured by taking the weight of the foam sample in pounds, and then dividing by the sample size (length x width x height, measured in inches).

The Joint Industry Committee noted that an accurate measure of density was critical, and that to ensure an accurate measurement, several factors should be considered:

1. Use the largest foam sample possible to make the density measurement.
2. Realize that the formula for calculating density is based on a sample that is uniformly rectangular or square; any variations can affect the measurement.
3. Tools used for density measurement must be accurate. Rulers and scales should be calibrated, and the pan on the scale should be large enough to handle the foam sample without having to balance it.

Density should be evaluated by *polymer* weight, excluding any fillers that might be used to increase density. (Additives and fillers may have negative effects on foam performance and durability.) And since density can vary slightly within a foam block, specifying a ***nominal*** density can be a good practice.

For example, if the specification is for 1.8 pcf density foam, a nominal specification of plus or minus 0.1 pcf helps ensure the shipment can meet performance requirements and allow the receiver to properly evaluate the shipment.

The Joint Industry Committee also gave careful consideration to the relationship of foam density to foam quality and durability. Typically, higher polymer density equates to better foam performance. But other factors can affect how the foam works in a final application. The Committee approved this statement:

"Years of experience, supported by considerable test data, have given strong indications that polyurethane foams with polymer densities of 1.8 PCF or higher perform better in seating applications than foams with lower polymer density."

Firmness

Foam firmness is determined by compressing a foam sample to a specific level, and measuring the force required to do so. This measurement is called Indentation Force Deflection (IFD), formerly known as Indentation Load Deflection (ILD).

IFD is measured by compressing a foam sample 25 percent from its original height and measuring the force (in pounds) required, using a test machine with a platen that is 50 square inches in diameter. The minimum sample size is 15 inches x 15 inches by 4 inches, but the committee preferred 20 inches x 20 inches x 4 inches. Committee acknowledged that foam sample sizes may vary, as manufacturers may choose sample sizes more in line with their actual cushion size.

The Committee report went into depth to explain how foam sample size (especially thickness) can change IFD measurement, and provided guidance on how to create consistency with testing by using consistent sample sizes and the same properly calibrated IFD testing equipment.

The Committee also provided guidance for testing different size and thickness foams based on one inch deflection (again for consistency and comparison), and also guidance on how to determine IFD for tapered cushions and convoluted foam, since these products have characteristics that may not give an accurate firmness reading with a standard vertical compression IFD test.

In addition, the Committee addressed convoluted foam and shredded foam firmness measurement.

Strength

There are numerous tests for foam strength. The Joint Industry Committee concluded that three key strength tests were important for furniture manufacturers to evaluate. These include: **tear strength, tensile strength**, and **elongation**.

Tear strength is the force required to propagate a tear, divided by the sample thickness.

Tensile strength and elongation are related. Tensile is the stress required to pull the foam apart. As the foam is being pulled, elongation is a measure of how much the foam stretches before it comes apart.

The Joint Industry Committee recommend that these three tests be conducted to ASTM D3574 specifications, and acknowledged that these tests alone may not provide a full determination of foam strength. The Committee urged manufacturers to consider inconsistencies or significant variations in these tests between shipments of foam as reason for further examination.

Flex Fatigue

The Joint Industry Committee acknowledged that a variety of fatigue tests have been used in the furniture industry, but results could vary significantly. Therefore, the Committee chose to focus on the roller shear tests included in ASTM D3574. Several papers presented at technical conferences allowed the Committee to relate roller shear testing to real world results.

View The Joint Industry Standards In Their Entirety On The AHFA Website

Testing showed that all foams will lose some IFD firmness through use, and that lower density foams exhibhit greater IFD loss. For 4" thick seating foams, the Committee recommended that IFD loss after roller shear testing be 6 pounds or less.

The Lasting Legacy of the Joint Industry Guidelines

Obviously, the FPF and furniture industries have changed significantly in the two decades since the Joint Industry Committee completed its work. But the guidelines the Committee produced have ongoing value and importance.

The guidelines gave the foam and the furniture industries common ground. They could evaluate FPF through testing focused on how the product is used in upholstered furniture. The guidelines also made it possible for FPF and furniture manufacturers to communicate effectively with each other, resolving conflicts. The framework created by the Joint Industry Committee continues to pay dividends to this day.

The Joint Industry Guidelines emphasized Density, IFD, Strength, and Flex Fatigue in FPF evaluation, but the guidelines also address a spectrum of specific issues related to FPF in furniture (see the Chapter List on the right).

View The Joint Industry Standards In Their Entirety On The AHFA Website

Flexible Polyurethane Foam Voluntary Test Standards And Performance Guidelines

Chapter Topics

0. Introduction to the Physical Properties of Flexible Polyurethane Foam In Furniture
1. Density Standards and Guidelines
2. Tensile Strength, Tear Strength, and Elongation Standards and Guidelines
3. Identification and Marking Of Fabrication Components and Guidelines
4. Indentation Force Deflection (IFD) Standards and Guidelines
5. One Inch Deflection IFD Standards and Guidelines
6. Tapered Cushion IFD Standards and Guidelines
7. Testing of Cushions Constructed with Convoluted Foam Guidelines
8. Shredded Foam Standards and Guidelines
9. Flex Fatigue or In-Use Softening Standards and Guidelines
10. Standards and Guidelines For Dimensional Tolerances Of Polyurethane Foam
11. Vertical Adhesive Seams Standards And Guidelines
12. Seating Foam Performance Standards And Guidelines
13. Arm And Back Foam Performance Standards and Guidelines
14. Flammability*

*Regulations on flammability have changed substantially with the adoption of a National Flammability Standard for upholstered furniture. Please see *InTouch Vol 15, No. 1, California Technical Bulletin 117-2013, February 2017 (Updated to include National Flammability Standard For Upholstered Furniture 2021)*

Summary

1. In the late 1980s, there was concern in the furniture industry over application and consistency in flexible polyurethane foam testing for furniture applications. The American Home Furnishings Alliance (AHFA) oversaw a comprehensive joint industry effort between furniture manufacturers, foam producers, industry suppliers, and trade associations to review foam testing methods and educate furniture manufacturers how to use test data in designing furniture comfort, performance, and durability.
2. The Joint Industry Committee began work in 1987 and publish its results in 1994.
3. The committee's report, *Flexible Polyurethane Foam Voluntary Test Standards And Performance Guidelines*, has helped foam suppliers and end-users better understand the uses and limitations of laboratory tests on flexible polyurethane foam, and how to communicate with each other.
4. The report has also been used to make changes to ASTM International's D3574, the most commonly used testing protocols for flexible polyurethane foam.
5. The Joint Industry Committee focused on four key criteria for flexible polyurethane foam: density, firmness (IFD), strength, and flex fatigue. Guidance in these areas provided furniture manufacturers with core information for evaluating foam shipments and working with their foam suppliers.
6. The full Joint Industry Guidelines are available on the AFHA website: https://ahfa.us/downloads/standards/polyurethane-foam-standards.pdf

Visit the training section at **www.pfa.org** for a complete, downloadable library of IN•TOUCH Bulletins. For video training and to learn about entry-level jobs in the FPF industry, visit **www.flexfoamjobs.com**.

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