

INTOUCH[®]

INFORMATION ON

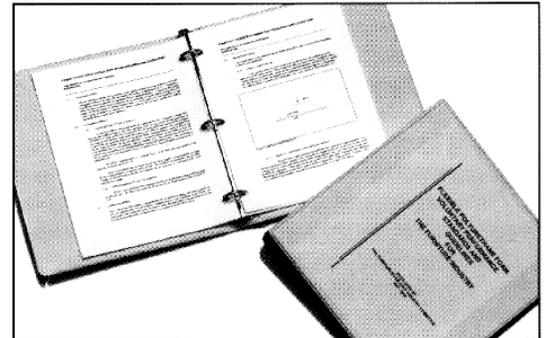
FLEXIBLE POLYURETHANE FOAM

INTOUCH is a regular publication of the Polyurethane Foam Association. It covers topics of interest to users of flexible polyurethane foam and is designed as a quick reference for background information on key issues. To get more detailed information about a particular topic, consult a PFA member.

Laboratory Tests Of Foam Performance

This issue of IN•TOUCH[®] previews the work of the Joint Industry Polyurethane Foam Committee (JIPFC) addressing the committee's work on physical testing for flexible foam. It provides observations that can help foam suppliers and end-users achieve greater consistency in laboratory tests on flexible polyurethane foam. The information is presented to encourage detailed study of the committee's first report entitled, "Flexible Polyurethane Foam Voluntary Test Standards And Performance Guidelines." IN•TOUCH[®] readers are urged to discuss foam performance and testing questions with their foam suppliers. It is the intent of the Polyurethane Foam Association to increase the understanding of flexible polyurethane foam and its performance capabilities. This bulletin provides the Polyurethane Foam Association's interpretation of portions of the JIPFC report and does not necessarily represent the views of the committee membership.

Laboratory testing of flexible foam performance properties provides important information for flexible polyurethane foam producers and end-users of foam products. For foam producers, physical testing serves two primary purposes. Physical tests on statistically selected production samples help foam producers maintain quality control in the production process. Physical test results are also used to grade foam for sale. Likewise, for end-users, physical tests on foam samples can be used for quality control purposes and to predict the performance of flexible foam in their cushioning applications.



This issue of INTOUCH[®] reviews a small portion of the 80-page JIPFC report. Readers are encouraged to purchase a copy and discuss its contents with their foam suppliers.

Understanding Testing Limitations

Foam performance consistency has historically been a controversial subject between foam producers and end-users. One of the key issues behind the controversy has been a lack of agreement on foam performance. End-users are unsure of what can be produced, measured and controlled by suppliers. And, foam suppliers may not clearly understand the needs and expectations of their customers.

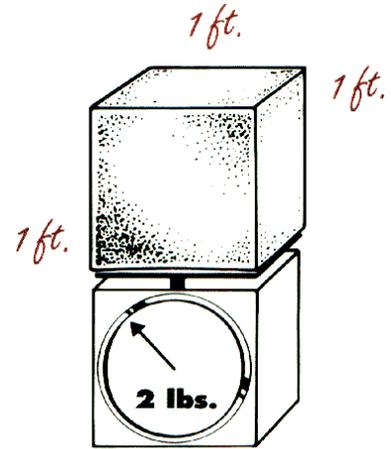
In many cases, performance properties cannot be controlled as tightly as end-users desire. Problems can be compounded by variations in testing results even under ideal laboratory conditions. As an example, foam firmness measured to be 28 IFD by the foam producer may be found to be 32 IFD by the end-user following the identical test procedure. Such an apparent variance can be frustrating for both parties.

In an effort to improve knowledge of foam performance issues and create a better understanding of industry expectations, the American Furniture Manufacturers Association established the Joint Industry Polyurethane Foam Committee (JIPFC) in 1987. A group of over eighty companies representing upholstered furniture manufacturers, foam producers and fabricators, chemical suppliers and related trade associations participated in the effort. Thousands of volunteer hours were invested in roundtable discussions, round-robin foam laboratory testing and data analysis to create the consensus report, "Flexible Polyurethane Foam Voluntary Test Standards And Performance Guidelines." The report has been described as a "living document" and will be updated as new foam technologies are accepted and furniture styling and constructions create a need for new approaches.

The Polyurethane Foam Association supports the voluntary guidelines presented in the report and encourages readers to study the findings of the Joint Committee and to consider participation in ongoing JIPFC discussions and research activities.

A Simplified Approach To Foam Performance

After examining numerous approaches, the Joint Committee recommends four basic physical properties essential to evaluating flexible foam performance. They are Density, Firmness, Strength and Flex Fatigue. The American Society For Testing And Materials bulletin ASTM D3574 describes in detail the standardized test protocols used to determine these foam physical properties. (For a basic description of the test procedures, see IN•TOUCH® Volume 1, Number 1: "Flexible Polyurethane Foam: A Primer.") Despite sophisticated standardization procedures, the ASTM-recognized tests used to determine key properties for flexible polyurethane foam are subject to significant error that can contribute to inconsistent product information and unnecessary anxiety. Conducting even the simplest test can be difficult and requires exact adherence to ASTM D3574 procedures.



$$\text{Density} = \frac{\text{Weight}}{\text{Length} \times \text{Width} \times \text{Height}}$$

Flexible polyurethane foam density is measured in pounds per cubic foot (pcf). Care must be taken in weighing and measuring the foam sample.

Density Requires Accurate Measurements

Density is the mass per unit volume. (See also IN•TOUCH® Vol. 1, No. 2: "The Importance Of Density.") In the United States, density is expressed in pounds per cubic foot of volume (pcf). Determining accurate density is dependent on precise measurement of the sample volume (length x width x height) and weight. Foam samples must have square corners and straight edges. A large caliper is helpful for measuring sample dimensions, but a finely scaled mechanical ruler will suffice if read carefully. Avoid small sample sizes. The smaller the sample, the greater the percentage of error that will occur if measurements are not accurate.

Determining sample weight requires the right equipment. While electronic scales showing pounds and fractional ounces may be fine for weighing fiberfill, a calibrated scientific scale capable of measuring to 1/10th of a metric gram will help alleviate another possibility for error. The weighing pan must be large enough to accommodate the entire foam sample without need for a "helping hand" to balance the sample on the scale. Resulting grams must be converted to pounds and decimal fractions.

After the density in pounds per cubic foot has been calculated, the result should be rounded to the nearest tenth of a pound. That's the limit of accuracy for density in foam production. More precise density tolerances can be specified, but may require expensive piece-by-piece screening. Density specifications should be discussed with your foam supplier and matched to your application requirements.

The Importance Of Density

The JIPFC report helps put the importance of density into proper perspective. Quality is subjective and dependent on the intended foam use. Density is closely tied to foam performance. Although there are many physical factors that work together to determine overall foam performance, the Joint Committee emphasizes, "Years of experience, supported by considerable test data, have given strong indications that polyurethane foams with polymer densities of at least 1.8 pcf perform better in seating applications than foams with lower polymer densities."

Understanding Variation In Firmness Test Results

For the end-user of flexible polyurethane foam, measuring firmness is a persistent challenge. Variation in firmness test results provides a constant source for industry debate. Based on the findings of the Joint Committee, the firmness test procedure detailed in ASTM D3574 is subject to many possibilities for error - human, mechanical and environmental. The traditional ASTM D3574 test method for determining 25% Indentation Force Deflection (IFD) (See IN•TOUCH® Vol. 1, No.1) requires accurate measurement of the foam sample thickness, careful control of sample pre-flexing, and precisely timed gauge readings. In addition, comparing IFD test results between supplier and end-user requires exact calibration of one machine to the other. Calibration may be extremely difficult if the devices are from different equipment manufacturers.

IFD test results are greatly affected by sample size. (See IN•TOUCH® Vol. 3, No. 1.) Length, width and thickness must be consistent to compare results. The Joint Committee recommends using minimum 20" x 20" x stated thickness samples to more closely represent actual cushion dimensions. Larger samples also reduce variation in 25% IFD readings attributed to "edge effect." IFD increases disproportionately with thickness. Conversion formulas cannot be relied upon to accurately convert IFD read at one thickness to another.

Ambient temperature and humidity within the testing environment can also affect IFD. Warmer, more humid conditions may contribute to temporary softer readings. The JIPFC report also discusses other conditions that can distort the accuracy of IFD testing.

End-users are urged to discuss IFD specifications with their foam suppliers to develop a manageable firmness control program.



Flex fatigue tests vary but are designed to see how well foam retains its firmness and height. Roller shear is a particularly tough test of foam durability.

Strength Property Consistency Is Important

Most foam grades used in residential home furnishings display adequate strength properties. Strength properties are determined using tensile strength, tear resistance and elongation tests as specified in ASTM D3574. (See IN•TOUCH® Vol. 1, No. 1.)

Tests for strength are convenient barometers of other physical performance characteristics. The Joint Committee recommends that strength tests be conducted routinely, watching for significant variation in properties. Large strength property variation may be symptomatic of other performance problems. Careful inspection of foam samples prior to testing is necessary. Samples containing voids (gaps in the cell structure), rough edges or nicks cannot be used in strength tests. Samples must be securely fastened in equipment jaws. For comparison purposes, test equipment must be calibrated to pull samples at identical speeds.

Flex Fatigue Testing Options

Flex fatigue testing is intended to determine foam durability, or how well foam retains its firmness and height properties after repeated compression. A number of standardized laboratory tests and customized tests created by upholstered furniture manufacturers are available to help evaluate flex fatigue. Dynamic fatigue by roller shear at constant force (See IN•TOUCH® Vol. 1, No. 1) is a preferred laboratory test method for determining flex fatigue in seating foam, but requires a large investment in equipment and technical support to maintain calibration. Several studies have successfully correlated the results of roller shear testing with those found in custom furniture manufacturer (non-ASTM) test methods, such as "Squirming Irma," "Bouncing Betty," and the rollator test used by the mattress industry. These tests all reach a similar conclusion. Firmness loss in fatigue testing of flexible polyurethane foam happens early in the testing cycle. The majority of loss typically occurs within the first 1,000 test cycles.

The JIPFC Report Covers A Range Of Topics

In addition to the selection of topics previewed in this issue of IN•TOUCH®, the JIPFC report also presents voluntary standards and recommendations for density, tensile strength, tear strength and elongation, and for flex fatigue. Guidelines are also provided for IFD specification tolerance. An alternate One Inch Deflection Test Method for determining IFD is also described. There are additional sections on foam identification and marking, tapered cushion IFD testing, and recommendations for measuring the physical properties of convoluted foam. A set of voluntary standards for dimensional tolerances of polyurethane foam is provided, as well as separate performance recommendations for seating foam and foam used in backs and arms. A section on flammability will be valuable to all participants in the home furnishings industry. And, the comprehensive glossary of industry terminology alone may be worth the price of the entire publication.

Summary

- ▶ 1. The Joint Industry Polyurethane Foam Committee report represents a huge investment in sampling and technical research by the upholstered furniture and flexible foam industries.
- ▶ 2. By working together, JIPFC members were able to create a set of voluntary test standards that represent the "state-of-the-art" in foam performance measurement for use by upholstered furniture manufacturers and their suppliers.
- ▶ 3. The JIPFC report identifies numerous possibilities for testing error in evaluating flexible foam performance.
- ▶ 4. Testing error may be the root of much anxiety between upholstered furniture manufacturers and their foam suppliers.
- ▶ 5. The Joint Committee strongly emphasizes the precise approach that must be used when testing the properties of flexible foam. Seemingly insignificant shortcuts can have disastrous effects on test results.
- ▶ 6. This bulletin addresses only a narrow selection of topics included in the JIPFC report. The Polyurethane Foam Association urges readers to obtain the report and become familiar with its contents.

To Purchase a Copy of the Complete JIPFC Report Contact:

American Furniture Manufacturers Association
P.O. Box HP-7
High Point, North Carolina 27261
(910) 884-5000 fax (910) 884-5303

This information is provided as a service of the Polyurethane Foam Association to improve the understanding of key issues that affect flexible polyurethane foam cushioning. To learn more about specific foams, contact your foam supplier.

This bulletin is intended to serve as a reference regarding the general properties and uses of polyurethane foam, and has been developed as a service for the Polyurethane Foam Association's (PFA) members and their customers. The information contained in this bulletin is offered in good faith, developed from sources deemed to be reliable, and believed to be accurate when prepared, but is offered without warranty, express or implied, as to merchantability, fitness for a particular purpose, or any other matter. The PFA and its member disclaim all responsibility for any loss or damage arising from reliance on such information by any party. This bulletin is not intended to be all inclusive on any subject matter. The PFA makes no endorsements, assurances, warranties, or guarantees concerning the quality, uses, or applications of polyurethane foam or specific products produced from polyurethane foam. PFA does not endorse the proprietary products or processes of any manufacturer. PFA and its members do not assume any responsibility for compliance with applicable laws and regulations. The PFA makes no representations regarding the combustibility of polyurethane foam under different applications or in different formulations. It is the responsibility of readers and purchasers or users of polyurethane foam to acquaint themselves with its combustibility characteristics both as to usage and storage, and any questions concerning applications and the combustibility of polyurethane foam must be directed to individual foam manufacturers or suppliers.

Subscription Prices: PFA members, \$20/year; non-members, \$60/year. Add \$15 for subscriptions outside continental USA.

©1994, Polyurethane Foam Association, Inc. All rights reserved. This document may not be reproduced in whole or in part without the written permission of the Polyurethane Foam Association.

INTOUCH® and the FOAM design are registered service marks of the Polyurethane Foam Association.

