THE USE OF FLEXIBLE CELLULAR PLASTICS AS ACCOUSTICAL AND ARCHITECTURAL PRODUCTS IN CONSTRUCTION AND INDOOR ENVIRONMENTS

There are literally hundreds of different cellular foam plastics on the market, however only a few have the proper physical characteristics, flexibility, and the required acoustic properties to be used in a wide variety of acoustical architectural products.

Essentially the field narrows to two classes of cellular materials, polyurethane-based products, and willtec®, a melamine-resin foam.

This tutorial, based on building codes, published technical data, and textbooks, is designed to assist you in determining the suitability of polyurethane or willtec for use in a variety of environments. One of the key things we will address is the fire performance of both of these materials.

Polyurethane

Polyurethane is actually a generic name for a large number of cellular and non-cellular plastics from which a number of commonly encountered materials are derived. The name polyurethane actually refers to a specific polymeric linkage that is unique to this class of materials. Polyurethanes can exhibit a wide variety of physical characteristics ranging from rigid to flexible, hard to soft, and solid or foam.

Polyurethane foams were the earliest cellular foam products on the market to exhibit properties that made them suitable for acoustical architectural applications. Unfortunately, along with the good attributes of urethane foam, there are also the bad. Because of their unique chemistry and their cellular structure, urethane foams are highly flammable. Attempts to make these foams more flame retardant have not been very successful, and the protective effects are not usually permanent.

Polyurethane foams have achieved a significant level of notoriety due to their tendency to flash fire due to their thin-walled cellular structure. And, unlike more flame-retardant products, they sustain combustion even after the ignition source is removed. These foams typically ignite at around 780°F, however what distinguishes polyurethanes from other polymers is that they begin to decompose at temperatures ranging from 428°F to 482°F.

In addition, when exposed to temperatures well below its ignition point. polyurethane begins to decompose, releasing small amounts of highly flammable gas. These gases are easily ignited and help to create a fast-moving fire. It does not take a significant flame to ignite polyurethane. Many fires have started with a very low heat source, such as heat and sparks from a broken light bulb.

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2175 Avon Industrial Dr.
Rochester Hills, MI 48309
Phone: 248.289.1123
Fax: 248.289.6317
Sales@memtechacoustical.com

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Uses for Polyurethane:
Based on polyurethane's limitations, it should not be represented as suitable for use under the following conditions:

- In building spaces that are not protected by a sprinkler or fire suppression system.
- In areas where the material is subjected to heat or infrared radiation.
- In process areas where flammable solvents or compounds are used.
- In any space or process area where there is an increased risk of fire, heat, or flame.
- In any space housing or enclosing handicapped or physically/mentally impaired occupants.
- In any space used to confine individuals with restricted access/egress.
- In any space or area where emergency egress is restricted or limited.
- In any emergency exit area or stairwell.

Please note that all possible uses and scenarios for a product of this type cannot be predicted, so we cannot list every potential problem situation. The purchaser must be aware of the increased risk of fire when using this product and must evaluate the risk versus benefit with each individual use. When properly used in a controlled environment, the polyurethane foams can provide years of service. However, when improperly used, or used in hazardous areas, the risks of fire are only enhanced by the presence of polyurethane foam.

Fire Retardant Treatments:
Due to the extreme flammability of polyurethane foams, most products on the market are fire-retarded, either through the application of a retardant coating or incorporation of a retardant into the foam during mixing.

The retardants work by vaporizing on exposure to heat, displacing oxygen so the fire is deprived of fuel, or by releasing moisture which cools the surface, delaying ignition.

Product Warnings for Polyurethane:
The Federal Trade Commission requires that products containing polyurethane carry a warning label regarding its flammability. The FTC requirement was in direct response to a series of catastrophic fires involving polyurethane foam plastics.

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WARNING!

The product you have requested has been produced using Polyurethane Foam.

POLYURETHANE FOAM IS FLAMMABLE.

The product has been tested by the United States Testing Company, Inc. using ASTM E84.

Thickness	Flame Spread	Smoke Density	ASTM E-84 Class
2"	75	340	II
3"	75	380	II
3-3/4"	300	450	unrated

The Federal Trade Commission considers that there are no existing testing methods or standards regarding flammability that are accurate indicators of the performance of cellular plastic material under actual fire conditions. Any results of existing test methods, such as ASTM D-1692, ASTM E-84 and UL 94 are intended only as measurements of the performance of such materials under specific controlled test conditions. The terminology associated with the test of standards, such as "non-burning", "self-extinguishing" or "non-combustible" is not intended to reflect properties of such products under actual fire conditions.

The end user/specifier is responsible for determining suitability for this material with respect to its intended use. The material should only be used in sprinkled rooms meeting the applicable fire protection codes.

IMPROPER HANDLING DURING STORAGE, INSTALLATION AND/OR USE PRESENTS RISK OF FIRE AND RESULTING RISKS FROM SMOKE AND TOXIC GASES, INCLUDE SUFFOCATION AND DEATH.

willtec®

willtec is a lightweight, cellular foam plastic made from porous melamine. A much less flammable product than polyurethane, melamine's acoustical performance is comparable to, and often exceeds, that of urethane foam products. Historically, melamine was more expensive than polyurethane but technical and manufacturing advances have made it more price competitive.

The primary difference between the fire performance of the polyurethane foams and willtec foam is the degradation temperature and the mechanism of decomposition. Where the urethanes decompose at relatively low temperatures (428°F-482°F), the chemical structure of willtec's polymeric material is reported to be stable to over 1200°F. (Melamine foam products like willtec are Class 1 fire

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rated, meaning they are the least flammable. Read more about this in the "Flammability Testing" section of this tutorial.)

During combustion, the surface of the willtec foam chars, insulating the undamaged foam and removing the fuel source from exposure to the flame. Unlike polyurethane, willtec will not support combustion and will not sustain ignition when the heat source is removed.

No Fire-Retardant Treatment is Needed:
willtec foam's fire resistance is due to the actual chemical structure of the polymer so it is not dependent on the addition of retardant materials.

FLAMMABILITY RATINGS
Foam and Fire

Testing:
There are literally hundreds of different flammability tests from a wide variety of state, federal, international and private organizations. This tutorial focuses on the most commonly encountered flammability tests that relate to suitability testing for use of materials within occupied spaces as a building finish or decorative material.

Building materials, such as acoustic foam, are tested and rated according to their fire-retardant capabilities. In many instances, established test procedures developed by one organization have been adopted and modified by another group to address a specific concern. One such example is the ASTM corner room burn test which was later adopted by the Uniform building code and revised into a full room fire test.

It should be stressed that while each of these testing procedures is designed to simulate various fire conditions and allow comparison of the performance characteristics of various test materials, the test results are not a guarantee of actual fire performance.

The most common method of ranking a material's flammability is the **class system.** Materials are tested in accordance with ASTM E-84, the most commonly encountered fire test used to determine the flame spread and smoke density of a material while it is burned in an inclined tunnel.

Using the test results, foam and other building materials are rated as a Class I, Class II, or Class III material.

Ratings:
The Class rating system is based on two components, flame spread and smoke density. Both are rated on a scale from 1 to 100, with 1 being the lowest and 100 the highest. Flame spread rates how quickly fire travels across the material being

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burned. Smoke density rates how thick smoke becomes when the material being tested is burned. These measurement terms are meant for laboratory use. They do not correspond to, and cannot be compared with, actual "real-world" measurements. For example, a flame spread of 0 - 25 cannot be defined in inches or feet.

Class I-rated materials are the least flammable and will not catch fire when exposed to flame. They will turn to ash. Class 1-rated materials have a flame spread index of 0-25.

Class II-rated materials will flame but their fire retardant properties help extinguish flames as it burns. These materials have a flame spread of 26-75.

Class III-rated materials have the highest flammability, with a flame spread of 76-200.

In all classes the smoke density is limited to 450.

Examples of Flame Spread Ratings for Common Materials

• Asbestos cement board	0
• Brick or concrete block	0
• willtec foam, natural	5
• willtec foam, fire-rated paint on surface	10
• Gypsum board with paper face	10-25
• Mineral-fiber sound absorbing panels	10-25
• Carpeting	10-600
• Shredded wood fiber board (treated)	20-25
• Polyurethane acoustical foam, 2" thick	30
• Polyurethane acoustical foam, 3" thick	75
• Plywood paneling (untreated)	75-275
• Plywood paneling (treated)	100

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Flammability and Product Liability

Product liability litigation has become one of the major economic factors in product safety. Fire safety standards came under scrutiny as early as 1945, following a number of catastrophic fires.

In the early 1970's, fire safety experts began focusing on the use of plastics in building construction and their use as interior finishes or decorative products. There interest was due to the large number of fires where the loss of life and property were directly attributable to the presence of significant quantities of plastics, most specifically polyurethane foams. Fire safety requirements, building codes, and flammability test procedures were radically modified to address the significantly increased risk posed by these products.

Currently whenever there is a fire with an attendant loss there is subsequent litigation. Because of the attention and the magnitude of these early losses, the use of polyurethane foams has become a complicated and highly restricted process.

Product liability litigation has grown in scope and complexity over the years from a relatively simple concept into a sophisticated technology.

REGULATORY REQUIREMENTS
Acceptable and Restricted Uses for Cellular Foam Plastics

When specifying or recommending a product for use, it is important to determine if the conditions of use or the facility's intended function is going to pose any special hazards. In many areas, polyurethane foams are an adequate material, however in many applications where there is a potential ignition source, such as manufacturing, or a confined space such as a mechanical room with one exit, polyurethane foam is not a suitable choice due to its flammability.

Building and Fire Codes:
Building and fire safety codes are legal documents, and are designed to regulate construction to protect the health, safety and welfare of people. These codes establish minimum standards for materials and construction procedures.

There are provisions in the building codes allowing for the use of materials with class ratings of II or III to be used in structures if they have sprinklers and depending on the use and the specific area involved. For example, a class II material could be used in a hallway if it were protected by a sprinkler system but could not be used in a hospital room, even with a sprinkler.

Typically, codes set requirements for sanitary facilities, electrical lighting, ventilation, building construction, building materials, fire safety, planning and energy conservation.

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Up until February 1, 2003, building codes were local laws, each municipality enforced its own set of regulations. While some municipalities adopted many of the same codes, the system was confusing and difficult to navigate.

Now the process has been streamlined with the consolidation of the International Code Council (ICC), which will produce codes for use across the country and around the globe. The new ICC brings together Building Officials and Code Administrator International (BOCA), International Conference of Building Officials (ICBO) and Southern Building Code Congress International (SBCCI).

The agency's new international codes (I-Codes™), are a single set of 14 building and fire safety codes, aimed at improving public safety and improving the building process. The I-Codes are used around the world.

Copies of the new I-Codes can be ordered at the website of the International Code Council, www.iccsafe.org. Or you can call one of the following phone numbers:
800-877-2224 (Birmingham, AL)
800-214-4321 (Chicago, IL)
800-284-4406 (Los Angeles, CA)
888-699-0541 (Olathe, KS)

This tutorial was researched and written by Bill Welbes, laboratory director and principal of Legend Technical Services.

FOR YOUR SAFETY
We hope this information has been of help to you. Please remember, this information is intended only as a guide. When choosing materials for any building project, be sure to consult with professionals who can help you determine the appropriate acoustic control product, and help you understand the building codes under the new ICC system, test results and ratings of materials, and other important information before you begin.

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