

## FLAME AND SMOKE REQUIREMENTS FOR MECHANICAL INSULATION

Flammability is critical to the safety of buildings, vehicles, and products. Flammability is of particular concern for mechanical insulation because it is installed on and in plenums where fire and smoke from one part of the building can spread quickly to other parts of a building. Therefore, the flammability and smoke potential of mechanical insulation must be very low, which is reflected by the strict limits required by building codes and standards. The following technical bulletin explains the major flame and smoke requirements for mechanical insulation and how Armacell products comply with these requirements.

### ASTM E84 and UL 723

ASTM E84 and UL 723 are test methods that use what's known as a Steiner Tunnel to evaluate the surface burning characteristics of building products. Both methods are essentially the same and a rating according to one method is usually accepted to be applicable to the other. The test consists of a 20" wide by 24' long tunnel where the material being tested is mounted to the roof of the tunnel. A flame is then applied to one end of the material and the distance the flame travels and smoke developed is measured during

the 10 minute test. The measured values are then converted to a flame spread and smoke developed index by comparing them to reference materials: fiber cement board and red oak.

It is important to understand that how the insulation material is mounted for the test greatly influences the results. As a result, ASTM E84 and UL 723 both specify that pipe and duct insulation products tested with these methods must be mounted according to ASTM E2231. This method describes exactly how the different types of insulation products must be mounted to obtain a valid flame and smoke rating.

It is also essential to know that the tested material must be representative of how the product will actually be installed. For example, if an insulation product is going to be installed with a facer used as protective covering or vapor retarder, the insulation must be tested to ASTM E84 or UL 723 with the facer installed as it will be in the building; or if the insulation is to be applied in multiple layers to achieve 3" thickness on a duct, a test must be completed with the insulation layered as it is going to be in the building.

ASTM E84 and UL723 are the primary methods used to evaluate the burning characteristics for building materials and are used extensively in building codes. There are 2 main rating classes that are required for insulation in buildings:

#### Class A

Flame spread index = 25

Smoke developed index = 450

#### Plenum Rating

Flame spread index = 25

Smoke developed index = 50

A minimum rating of Class A is required for any insulation put into a commercial or residential building. Since smoke can spread to other parts of a building through return air plenums, a lower smoke developed index of 50 is required for any material installed within a return air plenum in a commercial building. Since piping and ductwork is often run through plenum spaces, most mechanical insulation will need to have a 25/50 flame/smoke rating. A 25/50 rating is also required for any insulation installed on the outside or inside of a duct regardless if the duct is installed in a return air plenum or not.



UL tunnel pre burn



Samples placed for testing



Outside tunnel view mid burn



Smoke graph showing less than 50 smoke value

### ASTM E84/UL 723 Flame and Smoke ratings for Armacell Products

Most Armacell insulation products have a 25 flame spread index and a 50 smoke developed index. Please consult the Table 1 for the ratings of Armacell insulation products and the maximum thickness to which these ratings apply.

Product	Flame Spread Index	Smoke Developed Index	Maximum Thickness (inch)
AP Armaflex® Tubes	25	50	2
AP Armaflex Sheets and Rolls (including self-adhering)	25	50	1
AP Armaflex® FS Sheets and Rolls (including self-adhering)	25	50	2
AP Armaflex® Lap Seal	25	50	2
AP Armaflex® Duct Liner (including self-adhering)	25	50	2
AP Coilflex®	25	50	1-1/2
AP Spiralflex®	25	50	1
AP Armaflex® Insulation Tape	25	50	1/8
AP Armaflex® Fabricated Fittings	25	50	2
Armaflex® Lap Seal Tape	25	50	NA
Armaflex® Coil	25	50	1/2
AC Accoflex®	25	50	1
NH Armaflex®	Not Rated	Not Rated	NA
Proflex®	25	50	1
UT Solaflex	25	50	1
Imcoa® (including SS)	25	50	1
Tubolit® (including SS)	25	50	1

Table 1: ASTM E84/UL 723 ratings for Armacell products

### ASTM E814 and UL 1479

These methods are used to rate penetrations through fire rated walls and floors. Building codes and fire safety standards require fire-stop systems to be tested to one of these methods and achieve a specified hourly rating. Insulated pipes often pass through fire rated assemblies and therefore, fire-stop systems for the insulated pipes must be employed to meet building code requirements.

The test itself is pretty simple. The insulated pipe with fire-stop system is installed through a fire rated wall, floor, or roof. One side of the assembly is subjected to a high temperature furnace and the results are based on the effects on the unexposed side. "F" ratings are obtained by the time it takes for a resulting fire to penetrate to the unexposed side and "T" ratings are obtained based on the maximum

temperature rise on the unexposed side.

### ASTM E814 and UL 1479 ratings for Armacell Products

Armacell products do not themselves have hourly ratings per ASTM E814 or UL 1479 but Armacell insulation is used in a number of fire-stop systems for wall and floor penetrations that are maintained by companies that make fire stop products such as Hilti and 3M. Based on the size and type of pipe, what the insulated pipe will be penetrating, and the required ratings, these companies, and others, can provide the proper fire stop system that includes Armacell insulation. Typically, the insulation specified in these systems that refers to Armaflex insulation is "acrylonitrile butadiene/poly vinyl chloride" or AB/PVC.

### UL 94

UL 94 is used to qualify products as plastic components within a UL Listed appliance. UL 94 is a small scale flame test consisting of burning a small sample in either a vertical or horizontal orientation with a Bunsen burner. Depending on the orientation of the sample and the type or desired rating, various data points are measured including burn rate, afterglow, afterflame, and dripping. Generally, vertical ratings indicate lower flammability than horizontal.

Vertical ratings for a 50 watt burner range from V0 – V2 with V0 being the least flammable. There are also ratings for a 500 watt burner that are 5 VA and 5VB with 5VA indicating lower flammability.

**UL 94 Ratings for Armacell Insulation Products**

Many Armacell insulation products are rated at V0 and 5VA. Therefore, they are in the least flammable category in the UL 94 standard. Please see Table 2 for a complete list of products and ratings. These ratings can also be found in the UL Certification Database under file E55798.

Product	50 W Vertical Rating	500 W Vertical Rating	Horizontal Rating
AC Accoflex®	V0	5VA	No rating
AP Armaflex®	V0	5VA	No rating
NH Armaflex®	V0	No rating	HF-1
OE Armaflex®	V0	5VA	No Rating
Tubolit®	No rating	No rating	HBF

Table 2: UL 94 ratings for Armacell insulation products

**ASTM E162 and ASTM E662**

These tests are commonly used in the transportation industry to test insulation and other interior products for flammability. Primarily rail cars and commercial buses use NFPA 130 to regulate flammability which outlines flammability requirements based on ASTM E162 and E662. ASTM E162 is a flame spread test that uses a radiant heat source to test the flammability of a 6" x 18" sample. The sample is exposed to the radiant heat source for a maximum of 15 minutes and the flame progression is recorded.

E662 is a smoke developed test that uses a radiant heat source or a flame. A 3" x 3" sample is exposed to the radiant panel or flame and the amount of smoke is measured by means of a light beam and a photodetector that measures the obscuration of the

light by the smoke. The smoke obscuration at a specific time and the maximum obscuration are reported. The smoke generated during the test is often analyzed according to BSS 7239 (Boeing safety standard) to assess the toxicity of the smoke.

**ASTM E162 and ASTM E662 for Armacell Products**

AP Armaflex is the only Armacell product that is routinely tested to ASTM E162 and E662 and it meets the requirements of NFPA 130 in 1/2 inch thickness and less.

**IMO A.653(16)**

This test method, along with IMO Resolution MSC 61(67): Annex 1: Part 5, outline the surface flammability requirements for materials on ships subject to Safety of Life at Sea, 1974 (SOLAS 1974). A rating of "limited

combustibility" is required for insulation installed on ducts in ships subject to these standards.

IMO A.653(16) uses a radiant panel to ignite a 155 mm x 800 mm (≈6" x 30") sample mounted in the vertical orientation. The results obtained from the test include heat for ignition, heat for sustained burning, critical flux at extinguishment, and total heat release during burning.

**IMO A.653(16) Results for Armacell Products**

NH Armaflex is the only Armacell product tested to IMO A.653(16) and it meets the requirements of MSC Resolution MSC 61(67): Annex 1:Part 5 in 1' thickness and less.