

SOLIMIDE® Polyimide Foam



EVONIK
INDUSTRIES

SOLIMIDE Foams



**Lightweight, Flexible, Thermal and Acoustic Insulating Materials
for Use Where Fire Resistance, Extreme Temperatures or
Weight Savings Are Critical Considerations**



Background



- **SOLIMIDE Foam is supplied by Evonik Foams, Formerly Imi-Tech / Inspec Foams, subsidiary of Evonik Industries**
- **Developed in conjunction with US NASA following APOLLO fire that resulted in three astronaut deaths**
- **Possesses unrivalled advantages over traditional insulating materials**
- **The thermal/acoustic insulation product of choice for solving tough problems aboard marine vessels, aircraft, aerospace and in industry worldwide**

Chemistry

- Polymer with predominantly imide linkages formed during polymerization
- High glass transition temperature [235°C]
- Good solvent/chemistry stability

Key Characteristics

- Open cell foam, low weight [5 to 9 kg/m³]
- Temperature stability [cryogenic to 300°C]
- Low off-gassing
- Flexible, semi-rigid, compression recovery
- Heat/Pressure formable to some degree

Marine Market

- **Thermal / Acoustic Hull Insulation**
- **Thermal / Acoustic Bulkhead Insulation**
- **Ceiling Panels**
- **Hangar Deck Insulation**
- **Beam Wrap**
- **Duct Wrap**



Rail Market



- Heating, ventilation & air conditioning systems
- Engine compartments
- General noise and thermal control

Cryogenic Market

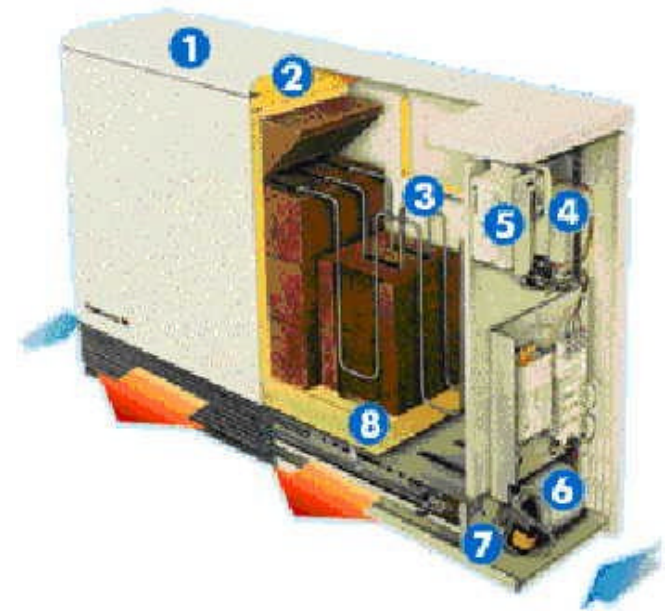
- **Expansion joints
for tanks / pipes**
- **Pipe supports**
- **Containers / tanks**



Appliance, Electronics, Instrumentation Markets



- Industrial high temperature applications up to 300°C
- Ovens
- Gaskets
- Space-constrained areas
- Sensitive optics / electronics



Aircraft / Aerospace Market



- Boeing SeaLaunch
- Ariane 5
- Atlas Centaur
- Atlas V
- NASA Space Shuttle
- International Space Station

Aircraft Benefits

- **Low weight with good thermal and acoustic insulating properties**
- **Excellent fire resistance – passes FAR 25.856 (a)**
- **Virtually no smoke or toxic gas emission**
- **Formaldehyde and fiber free**
- **Rigid, self-supporting foam; fewer fasteners for lower weight, faster installation and inspection**
- **Proven long term performance (retains properties, shape)**



Advantage: Low Weight

- **Weight Savings -- Densities from 5 to 32 Kg/m³**
- **Additional Weight Savings with Installation – fewer fasteners required**



Advantage: Acoustics



Open Cell Structure Provides Excellent Sound Absorption Performance at Frequencies From 500 to 2000 Cycles Per Second.

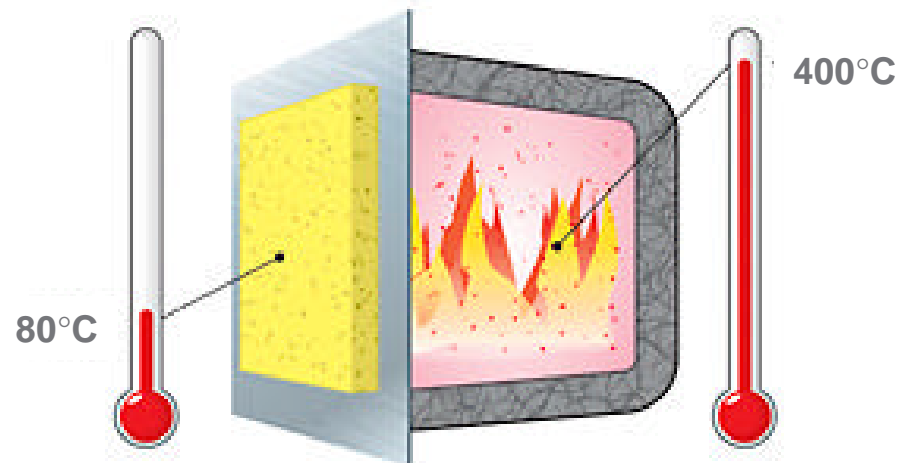
- Excellent Acoustic and Non-burning Combination
- Good Acoustic Absorption to Weight Ratio
- No Fibers to Release



Advantage: Thermal Control

Effective Thermal Insulation on a Per Unit-weight Basis

- Continuous use to 300°C
- Retains thickness and thermal resistance – even in hot and humid environments
- No phenol-formaldehyde binder to break down



Over 300°C Temperature Reduction With
25 mm Thick SOLIMIDE Foam Insulation

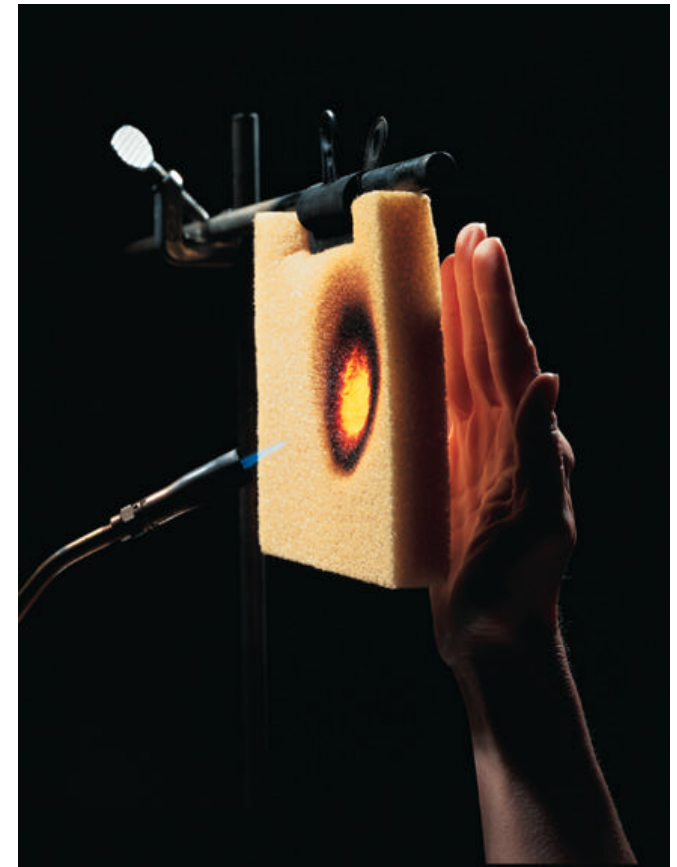
Advantage: Fire Resistance, Smoke



Inherently Fire Resistant – Will Not Support Combustion in Air

- Nearly Zero Flame Propagation – FAR25.856a
- Typically Exceeds Fire Regulations
- Numerous Test Results Available
 - NBS Smoke Chamber
 - OSU Heat Release
 - Boeing and Airbus Smoke/Toxicity tests

Emits Virtually No Smoke or Incapacitating Gases When Exposed to Open Flame



Advantage: Formaldehyde and Fiber-Free



Negligible Outgassing at Room Temperature / Minimal Outgassing at Elevated Temperatures

- Minimal Volatile Compounds Released
- No Odors for Consumer Products
- No “Burn In” Requirement or binder to burn out
- No respirable fibers
- No loss of thickness or sagging in hot, humid environments
- No breakdown or disintegration



Advantage: Easy Installation

Self-supporting, but flexible –
easy to handle and install



- Faster installation with fewer installers
- Fewer Fasteners – reduced weight
- Wrap Around Structures

Case Study – Qantas Experience



In the early 1990's, Qantas replaced fiber glass in the bilge areas of their 747 fleet.

Benefits reported:

- 300 lb. weight reduction (batting only)
- 60% reduction in blanket manufacturing time
- 80% reduction in blanket installation time
(1600 fasteners eliminated from FG design)
- 95% reduction in inspection time
- Moisture mitigation -- elimination of cover film penetrations
- Retention of blanket integrity



Advantage: Life-Cycle Performance



SOLIMIDE Foam maintains integrity and thickness in hot, humid environments



- In 2007, Qantas sent a 10-year old insulation blanket to Boeing for evaluation – it was in great shape!
- Fiber glass blankets disintegrate with moisture – more replacements required during inspection
- Fewer fasteners to begin with means fewer fasteners during inspections

In-Service Blanket Evaluation



In the 1990's:

Alaska Airlines In-Service Study:

- A sandwich configuration FG/Foam/FG was installed and flown for a year
- PI Foam retained 90% of thickness, FG only 50%
- PI Foam maintained coverage area, FG sagged

System Design, 737 Factory Installation:

- Blankets fabricated for factory installation trial – two frame bays, all fuselage above floor
- Blankets installed quickly with minimal fasteners – installers impressed with simplicity and speed

Aircraft / Aerospace Products



AC-530	<ul style="list-style-type: none">➤ Medium density (5.7 kg/m³)➤ Maximum continuous use temperature is 200°C
AC-550	<ul style="list-style-type: none">➤ Medium density (7.1 kg/m³)➤ Maximum continuous use temperature is 200°C
HT-340	<ul style="list-style-type: none">➤ “Orange” color, medium density (6.4 kg/m³)➤ Maximum continuous use temperature is 300°C

All SOLIMIDE polyimide foams are open-celled, flexible, low off-gassing, fire-resistant, thermal/acoustic insulation materials.

AC-530

- **Properties:**

- Low density (5.7 kg/m³)
- Good acoustical qualities
- Excellent hydrolytic stability

- **General Applications:**

- Aircraft fuselage insulation
- Aircraft equipment insulation
- Aircraft duct insulation



- **Specifications:**

- AIMS 04-14-004, BMS 8-300, MMS 04-001

AC-550

■ Properties:

- Best thermal conductivity
- Highest density (~7.1 kg/m³)
- Highest mechanical values
- Excellent hydrolytic stability

■ General Applications:

- Aircraft fuselage insulation
- Aircraft air-conditioning duct insulation
- Launch vehicle insulation

■ Specifications:

- AIMS 04-14-004, BMS 8-300, DMS 2330, Lockheed, General Dynamics, Northrup-Grumman, others



HT-340

Specific Market:

High temperature thermal insulation

Properties:

- Operational temperature to 300°C
- Chemical stability/resistance
- Excellent hydrolytic stability
- Low weight

Specification:

BMS 8-300



New Product – AC-310



AC-310

- **Lightest density (5.0 kg/m³)**
- **Maximum continuous use temperature is 200°C**

Currently under development for use in multiple Boeing aircraft, including the Boeing 787 fuselage.

Production Site



**Manufactured in Magnolia, Arkansas USA ...
...and Shipped Around the World**



Central Location in North America

Supply Chain: Fabrication Sites



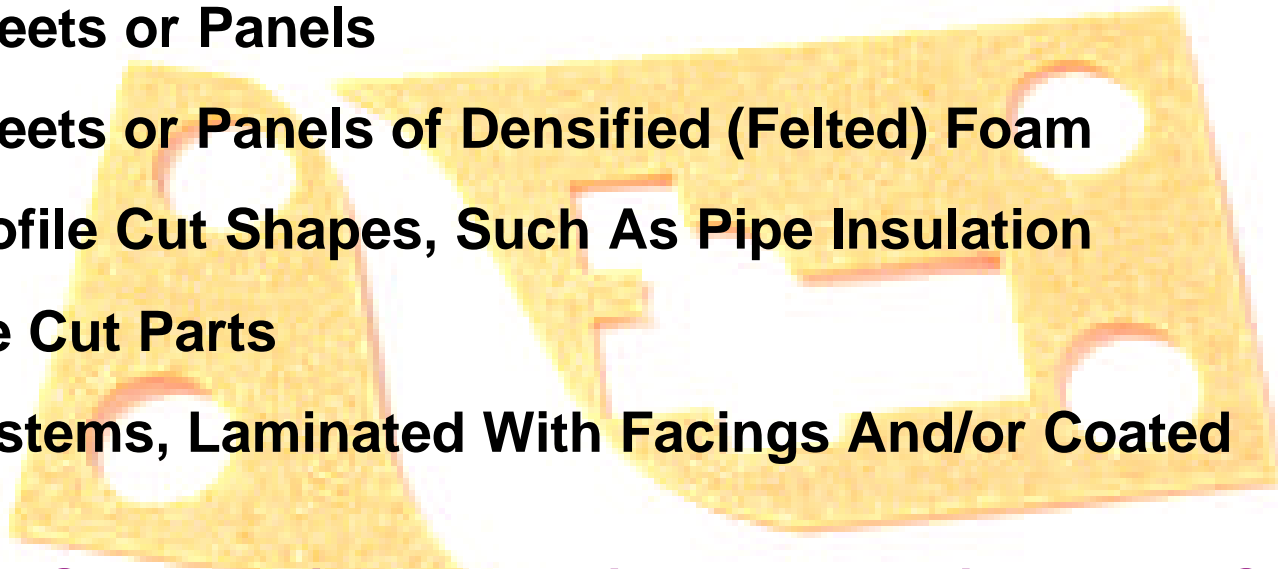
**Buns Are Converted Into Foam Parts by Authorized Fabricators
With Facilities Around the World:**

Australia	Canada	France
Germany	Italy	Japan
South Korea	Switzerland	United States

**Authorized Fabricators, Our Primary Customers,
Sell Fabricated Foam Parts/Systems to End Users.**

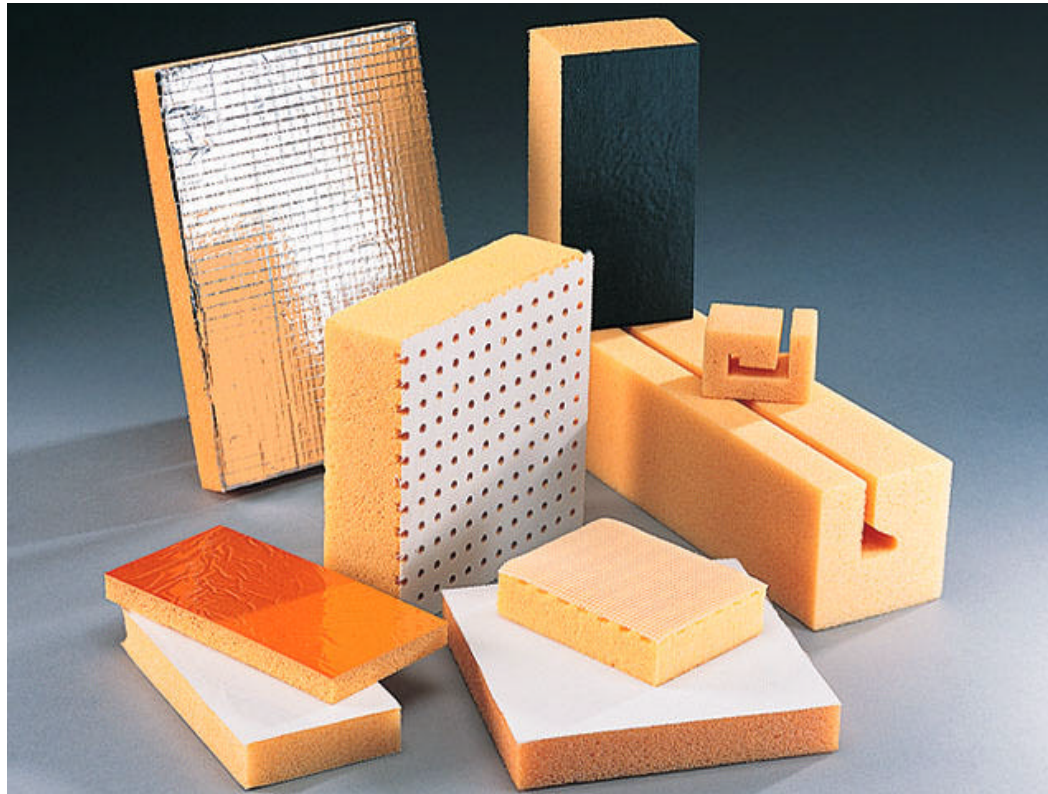
Fabricators Convert Large Foam Blocks Into:

- **Sheets or Panels**
- **Sheets or Panels of Densified (Felted) Foam**
- **Profile Cut Shapes, Such As Pipe Insulation**
- **Die Cut Parts**
- **Systems, Laminated With Facings And/or Coated**



Materials Such As Films, Adhesive, Release Liners, Etc. Can Be Added.

Sheet Parts

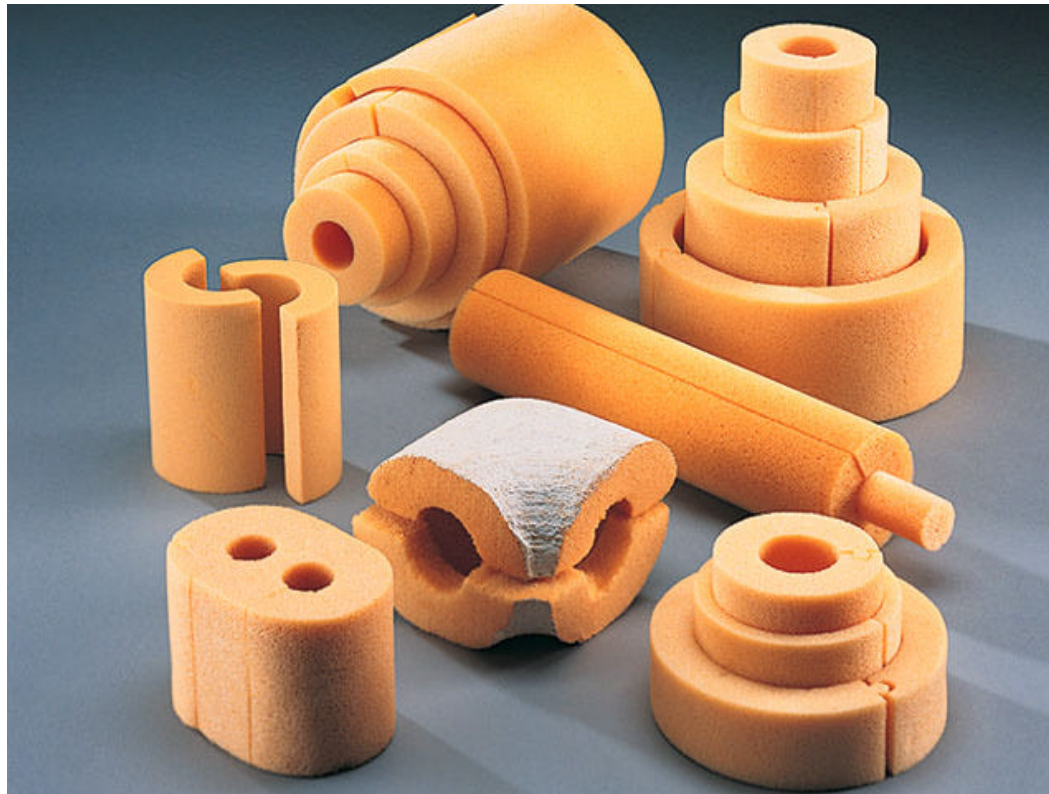


Thickness from 5mm, Sizes to 1.2m x 2.4m



Solimide Foams Readily Accept Protective Surface Treatments

Profile/Pipe Cut



Inner Diameter Cuts From 6 mm Diameter

Questions?

