Product Information Sheet

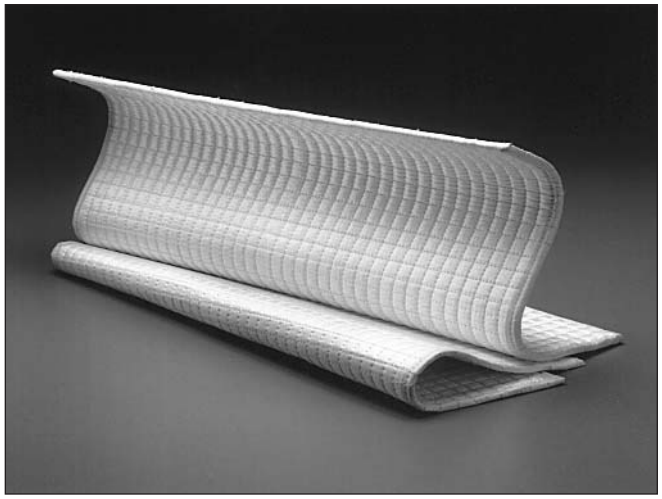
Fiberfrax® HSA™ Paper Composite Systems

Introduction

Fiberfrax® HSA™ Systems are a unique ceramic fiber insulation used in the fabrication of high-temperature heat shields. Multi-layers of a unique ceramic fiber paper are encapsulated between layers of high-temperature woven textile and quilted by lock stitching in one-inch squares. HSA Systems' excellent thermal resistance properties are related to the core material, which is composed of high-purity alumina-silica fibers. The fibers have a very fine diameter, and all unfiberized material has been removed. The fibers are randomly oriented to eliminate the need for an organic binder. Small cell structure, combined with the absence of unfiberized particles or loose fill, results in extremely low thermal conductivity. The high fiber index of HSA fibers offers a high resistance to mechanical and acoustical vibration. The material is not prone to settling or breaking down through internal abrasion.

The addition of a textile covering and quilting the composite gives it strength, while at the same time allows the system to remain flexible and formable, providing ease of fabrication. The finished HSA Systems are unaffected by moisture; if the material is wet by water or steam, all thermal and physical properties are restored upon drying. Also, a coating or foil cladding may be added to improve moisture and abrasion resistance.

HSA Systems' unique ceramic fiber paper core is free of organics and may easily be cut with an ordinary pair of scissors.



Multi-layers of HSA paper are built up to a predetermined thickness and density, then encapsulated in a high-temperature woven textile by quilting. The finished product is flexible and formable.

Fiberfrax HSA Systems have a nominal core density of 8 PCF. Since HSA insulation is very lightweight, aerospace engineers have the opportunity to design heat shield systems that ultimately contribute to a reduction in fuel consumption and/or space savings.

Providing high-temperature capability, HSA ceramic fiber is recommended for continuous use temperatures of 2300°F, and in some cases to the material softening point of greater than 3000°F.

Typical Applications

HSA Systems are used to achieve the maximum insulating value while utilizing the least amount of weight and space possible.

- **Space Exploration Program**
  HSA insulation is currently being evaluated and used on the latest heat shields for missiles, rockets, and space exploration equipment.
- **Aircraft**
  HSA insulation is currently being used on both commercial and military aircraft for thermal insulation and/or fire protection in critical areas including: engine struts, nacelles and cowls, fuselage, data recorder boxes, onboard computers, and heat exchangers.
- **Thermal Management**
  Other key applications for HSA insulation include nuclear power plants, formula one racing cars, computer systems, helicopters, and specialized industrial equipment.

Refer to the product Material Safety Data Sheet (MSDS) for recommended work practices and other product safety information.

HSA Systems Advantages

With an almost 100% fiber index, this high-purity alumina-silica product offers several major advantages over other insulation materials in this application.

- **Super insulation**
  HSA Systems made from Fiberfrax high surface area fibers offer the lowest thermal conductivity of any alumina-silica ceramic fiber material.
- **Vibration resistance**
  Totally free of shot (unfiberized material) or loose fill particles, HSA ceramic fiber is not prone to settling or breaking down through internal abrasion.
- **Lightweight**
  HSA Systems are available with a core density of 8 PCF, leading to potential for additional weight savings.
- **High temperature capability**
  HSA fiber is recommended for continuous temperature of 2300°F and in some cases to the material softening point of 3000°F.
- **Strong, interlocking fibers**
  Allow the paper to remain in place even if the lower temperature textile covering should burn away.
- **Not affected by moisture**
  Unlike some fill-based super insulation materials, if HSA insulation is wet by water or steam, all thermal and physical properties are totally restored upon drying.
- **Flexible**
  Can be easily cut and fabricated into complex configurations.
- **Chemical Properties**
  Fiberfrax HSA paper exhibits excellent chemical stability. It has good resistance to most chemicals with the exception of hydrofluoric and phosphoric acids and strong alkalies.

Materials of Construction

HSA Systems are comprised of a Fiberfrax HSA paper core in a predetermined thickness and density. This core is encapsulated in a high-temperature woven textile by quilting in one-inch squares.

The standard core density of HSA Systems is 8 PCF. HSA Systems with a 16 PCF core density are also available by inquiry.

The textile covering is determined by design requirements. Our standard textiles include the following:

- Fiberglass textile (FG) for continuous use up to 600°F.
- E-Grade Fiberglass textile (EG) for continuous use up to 1200°F.
- Quartz textile (QTZ) for continuous use up to 2000°F.
- Various non-standard textiles are also available (by inquiry).

Note: HSA paper is available in standard sheet or roll form in an 8 PCF density.

Vibration Resistance

HSA Systems have undergone random vibrational testing per MIL-STD-810D, Method 514.3.25 (modified) for a duration of 6 hours (2 hrs. in each of 3 axis). The results showed no physical damage to the material, and no effect on the thermal properties of HSA Systems.

Thermal Stability

HSA Systems were tested for thermal stability under extreme temperature conditions. The material was exposed to a temperature of 2000°F for 24 hours. HSA Systems with an 8 PCF density exhibited only 2.4% linear shrinkage.

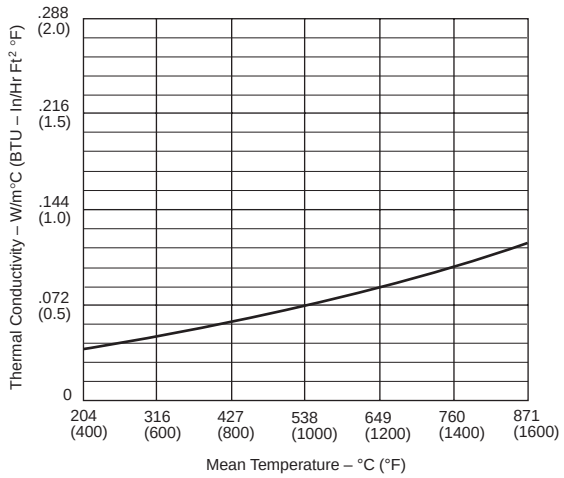
Specifications of HSA Paper Core

Typical Chemical Analysis:	**(%)**
Al_2O_3	35-55
SiO_2	35-55
TiO_2	0-18
Others	<1

Typical Physical Properties:	
Color:	White
Continuous Use Limit:	1260°C (2300°F)
Melting Point:	1790°C (3260°F)
Density:	112 kg/m^3 (8 lb/ft^3)

HSA Paper Core Measured Thermal Conductivity Values

Thermal Conductivity vs. Mean Temperature (per ASTM C-177) at 8 PCF**



HSA Systems Calculated Thermal Conductivity Values

Thermal Conductivity vs. Mean Temperature (BTU – In/Hr Ft² °F)

8 PCF Core Density

	Thickness (Inches) of Quilted System			
Mean Temperature (°F)	⅛	¼	⅜	½
400	0.34	0.33	0.31	0.31
600	0.42	0.40	0.39	0.38
800	0.51	0.48	0.47	0.46
1000	0.61	0.59	0.58	0.57
1200	0.72	0.70	0.69	0.68
1400	0.86	0.84	0.83	0.82

**AII thermal conductivity values for Fiberfrax materials have been measured in accordance with ASTM Test Procedure C-177. When comparing similar data, it is advisable to check the validity of all thermal conductivity values and ensure the resulting heat flow calculations are based on the same condition factors. Variations in any of these factors will result in significant differences in the calculated data.

For additional information about product performance, to identify the recommended product for your application, or for a specific heatflow calculation, please contact the Unifrax Application Engineering Group at 716-278-3888.

Data are average results of tests conducted under standard procedures and are subject to variation. Results should not be used for specification purposes.

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