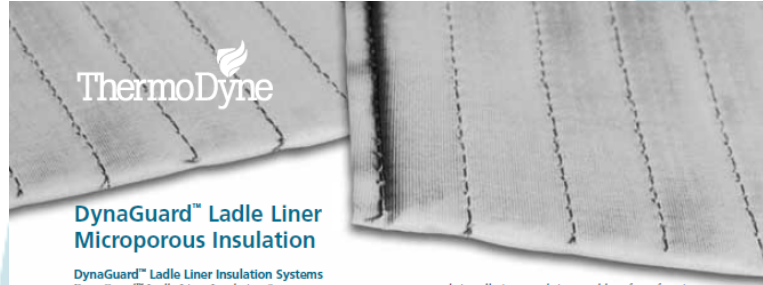
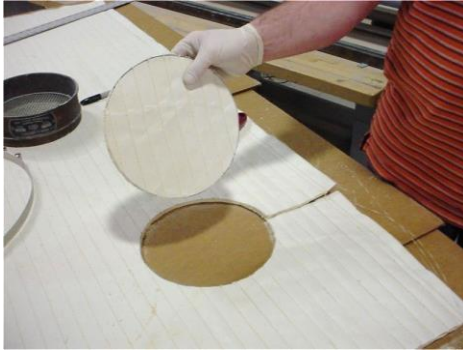


DynaGuard Ladle Liner Fabrication and Installation



DynaGuard™ Ladle Liner Microporous Insulation

DynaGuard™ Ladle Liner Insulation Systems

DynaGuard™ Ladle Liner Insulation Systems represent one of ThermoDyne's microporous products for primary use in industrial and commercial applications. Each DynaGuard™ Ladle Liner system is a flexible, textile encased, comparatively dense material with high compression resistance and exceptional strength, and its superior thermal performance allows the maximum amount of thermal protection to be provided within minimum space and weight requirements.

DynaGuard™ Ladle Liner systems are also specially formulated to minimize heat transfer via conduction, convection and radiation through the material by use of the following:

Ceramic Powders with Intrinsically Low Thermal Conductivity

The microporous core materials used in the manufacture of DynaGuard™ Ladle Liner systems possess a thermal conductivity even lower than that of still air, and minimize the solid conduction of energy through the material.

Microporous Structure

The microporous structure of the DynaGuard™ Ladle Liner system inherently minimizes the possibility for air current convection through the material as void spaces too small for air currents to exist form between the core material components.

Special Opacifiers

The introduction of special opacifiers into the DynaGuard™ Ladle Liner formulation ensures that the transmission of infrared radiation through the material is kept to the lowest possible levels.

DynaGuard™ Ladle Liner Materials of Construction

The DynaGuard™ Ladle Liner microporous core material is an 1,800°F continuous use formulation, and is compressed into a uniform thickness and density to ensure the proper distribution of the core material. After compression, the material is quilted on 1" parallel centers with high temperature thread in order to provide both flexibility and greater vibration resistance for the material.

Unlike other DynaGuard™ products, DynaGuard™ Ladle Liner also possesses a hydrophobic component in its core formulation. This material makes the microporous structure highly resistant to the presence of moisture during

use and installation, and is capable of performing at temperatures as high as 900°F before burning out of the microporous formulation.

In addition to the hydrophobic microporous core, DynaGuard™ Ladle Liner systems are supplied encased in a high temperature textile shell. This shell provides additional structure, strength, ease of handling and installation, and consistent distribution of the core material, and may also be used to increase the overall composite temperature use limit of the assembly as specified by individual customer needs.

DynaGuard™ Ladle Liner systems are supplied standard at 16 lbs/ft³ density, 36" x 72", in thicknesses of 1/8" to 1/2", and with a fiberglass textile shell (1,000°F use limit). Other densities, sizes, thicknesses and cloth facings are available upon request.

DynaGuard™ Ladle Liner Insulation Systems Advantages

Lowest Thermal Conductivity

Because DynaGuard™ Ladle Liner systems inherently possess a thermal conductivity lower than that of still air, even at elevated temperatures, they are ideal in environments where materials with low thermal conductivity, thermal diffusivity and heat storage are necessary.

Space and Weight Savings

Because smaller amounts of DynaGuard™ Ladle Liner are needed for thermal management, it is an ideal material for industrial and commercial applications where considerable space and/or weight savings are valuable in increasing capacity or efficiency without sacrificing the thermal performance of the system.

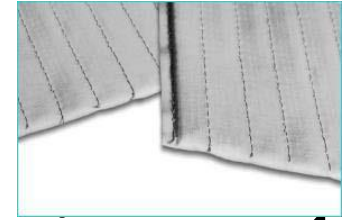
High Temperature Capability

DynaGuard™ Ladle Liner systems can be manufactured to meet continuous high temperature environments up to 1,800°F, but are also capable of performing in intermittent exposure to 2,000°F temperatures.

Easy Fabrication

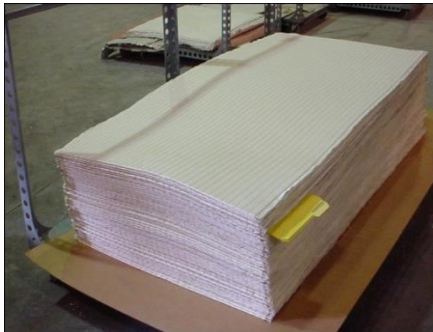
Shapes can be fabricated in the field by various cutting methods, but ThermoDyne also provides a virtually limitless range of custom pre-fabricated and intricate shapes upon request.

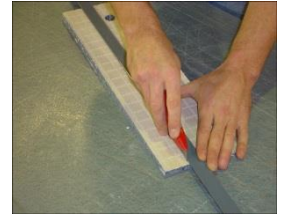




DynaGuard Ladle Liner Cutting Equipment

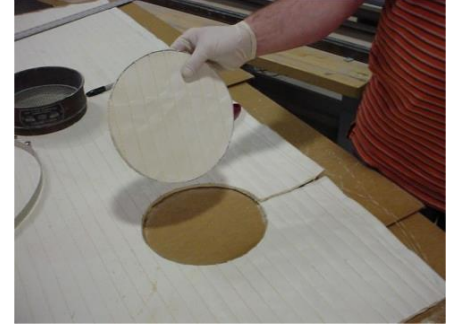
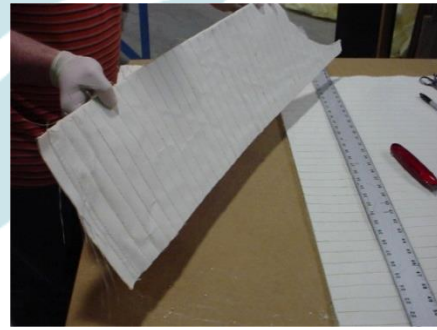
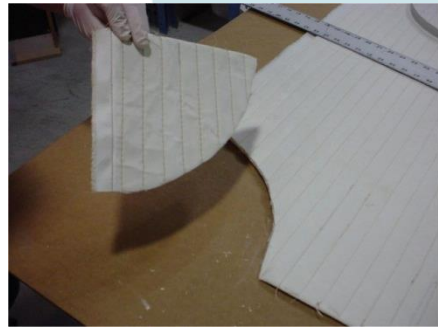
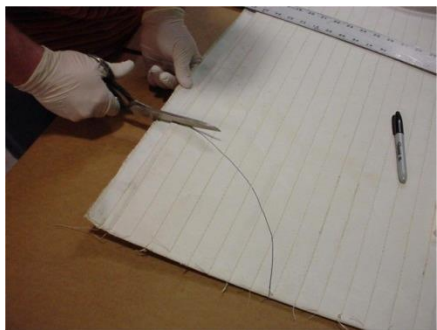
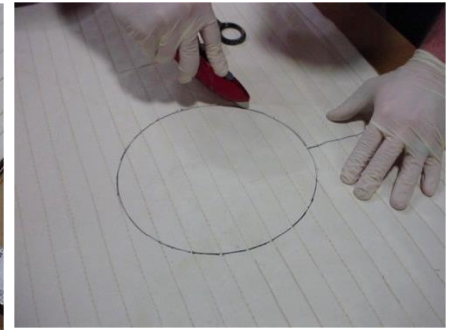
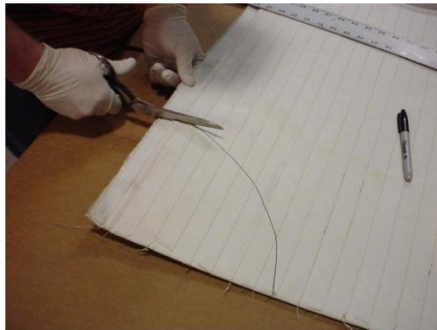
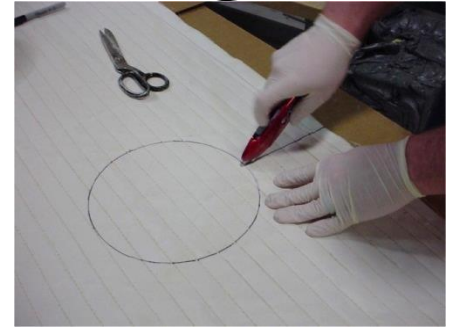
- Straight edge
- Razor knife
- Measuring device
- Marking device
- Scissors
- Gloves





DynaGuard Ladle Liner Cutting

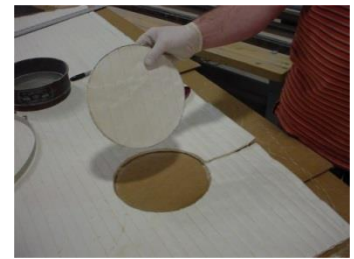
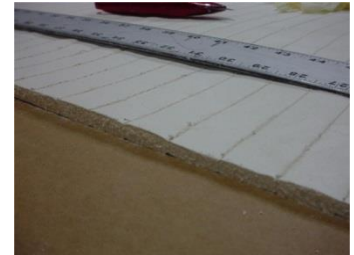
- ❑ Mark the desired cut line on the insulation.
- ❑ Place the straight edge on the insulation and apply pressure.
- ❑ Cut cleanly through the insulation with a sharp blade or cut with scissors.
- ❑ Remove the unwanted part.





DynaGuard Ladle Liner Cutting

- ❑ When cutting and handling move slowly with care so as not to disturb the core.
- ❑ Small amounts will come out , this is to be expected.
- ❑ Before the material is cut the material can be walked on with no adverse effects.
- ❑ After it is cut and is being put in place a more gentle approach is better.
- ❑ With gentle handling typically resealing the edge is not necessary.
- ❑ Also typically resealing the edge is not necessary with thinner material. ¼” and below.





DynaGuard Ladle Liner overlapping

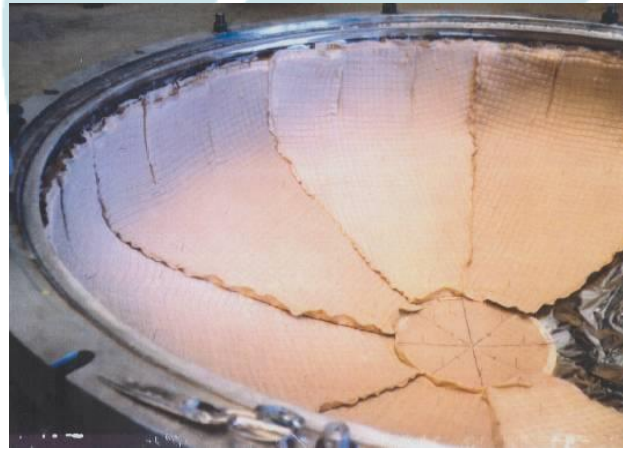
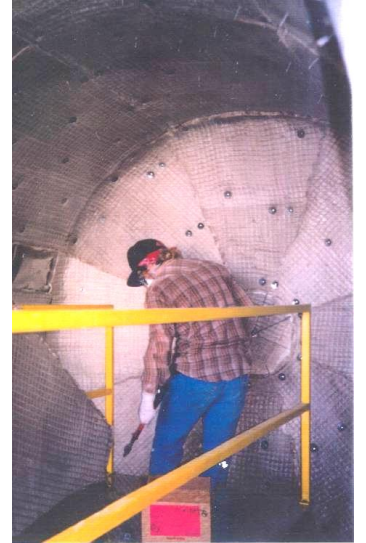
- ❑ Typically an overlap of 1" to 2" is adequate.
- ❑ For ease of installation on very contoured shapes larger overlaps are acceptable in lieu of cutting down the overlap.
- ❑ Because the material is so thin having a larger overlap here and there will not cause problems with the final covering.
- ❑ Typically on large tube tank type installations the material is banded on with sst bands every 18 inches or so.
- ❑ Typically there is a band over the overlap.
- ❑ Typically sheets are banded around tanks with bungees to hold them in place to situate them, then they are banded.





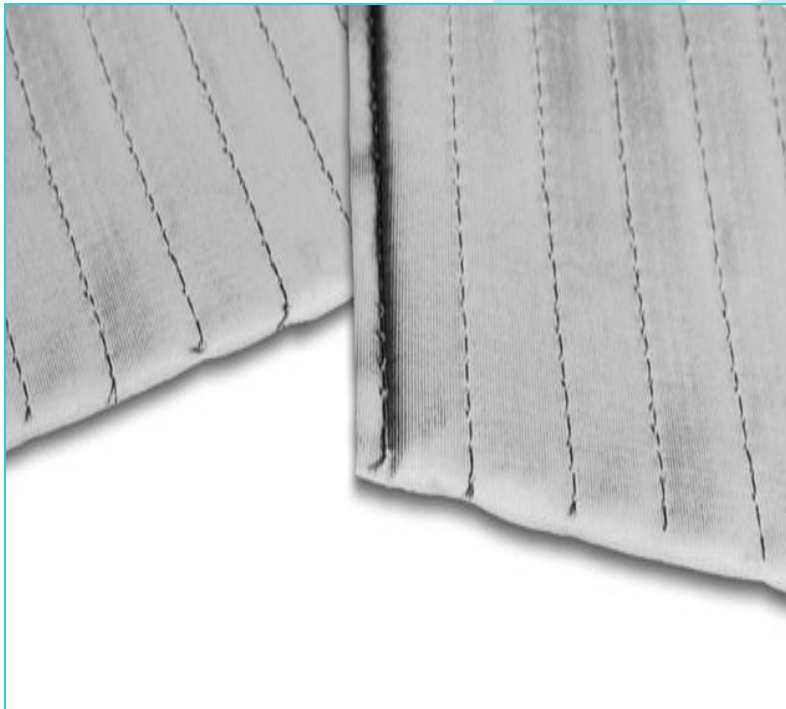
DynaGuard Ladle Liner attaching

- ❑ Typical attachment methods for Dynaguard are bands, pins, tape, spray adhesive and others.
- ❑ The material should be secured by the appropriate method for the application.
- ❑ Walking on the material in progression of the install is not a problem.



Microporous Insulation Product Forms

Ladle Liner Product Forms: ThermoDyne Ladle Liner products are comprised of a light-weight, hydrophobic Microporous core material encapsulated between two layers of high temperature cloth and multi-stitched with high temperature thread.



- Ladle Liner product forms can be easily fit around curves, contours and irregular shapes.
- Ladle Liner product forms are highly resistant to vibration, and can easily be encapsulated by metal or other materials to achieve additional moisture, abrasion, or vibration resistance.
- Ladle Liner product forms are ideal for environments where the microporous core material may come in contact with substantial moisture (Note: the hydrophobic component of the material burns out of the mixture at between 600 - 900°F).

Thermodyne Dynaguard thermal insulation Material Product Forms. Dynaguard and Excelflex product lines

DynaGuard 1600 and 1600 H Microporous silica Insulation

Excelflex Insulation System
 Dynaguard 1600 microporous silica insulation system represents the most advanced thermal protection in its class. It is designed for high temperature applications. The Dynaguard 1600 H system is designed for high temperature applications. The Dynaguard 1600 H system is designed for high temperature applications. The Dynaguard 1600 H system is designed for high temperature applications.

Thermal Conductivity Data (Thickness of 1" / 25.4mm)

Material	Thermal Conductivity (W/m·K)
DynaGuard 1600	0.031
DynaGuard 1600 H	0.031

Excelflex Insulation System
 Excelflex insulation system represents the most advanced thermal protection in its class. It is designed for high temperature applications. The Excelflex system is designed for high temperature applications. The Excelflex system is designed for high temperature applications.

Thermal Conductivity Data (Thickness of 1" / 25.4mm)

Material	Thermal Conductivity (W/m·K)
Excelflex 1600	0.031
Excelflex 1600 H	0.031

DynaGuard 1800 Compression Data For 12 Bar 1

Thermal Conductivity Data (Thickness of 1" / 25.4mm)

Material	Thermal Conductivity (W/m·K)
DynaGuard 1800	0.031

Excelflex Insulation System
 Excelflex insulation system represents the most advanced thermal protection in its class. It is designed for high temperature applications. The Excelflex system is designed for high temperature applications. The Excelflex system is designed for high temperature applications.

Thermal Conductivity Data (Thickness of 1" / 25.4mm)

Material	Thermal Conductivity (W/m·K)
Excelflex 1800	0.031

DynaGuard Flexible Microporous Insulation

Excelflex Insulation System
 Excelflex insulation system represents the most advanced thermal protection in its class. It is designed for high temperature applications. The Excelflex system is designed for high temperature applications. The Excelflex system is designed for high temperature applications.

Thermal Conductivity Data (Thickness of 1" / 25.4mm)

Material	Thermal Conductivity (W/m·K)
Excelflex 1800	0.031

DynaGuard Microporous Insulation

Excelflex Insulation System
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Thermal Conductivity Data (Thickness of 1" / 25.4mm)

Material	Thermal Conductivity (W/m·K)
Excelflex 1800	0.031

DynaGuard Ladle Liner Microporous Insulation

Excelflex Insulation System
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Thermal Conductivity Data (Thickness of 1" / 25.4mm)

Material	Thermal Conductivity (W/m·K)
Excelflex 1800	0.031

Excelflex Microporous Insulation

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Thermal Conductivity Data (Thickness of 1" / 25.4mm)

Material	Thermal Conductivity (W/m·K)
Excelflex 1800	0.031

DynaGuard Alumina Board Microporous Insulation

Excelflex Insulation System
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Thermal Conductivity Data (Thickness of 1" / 25.4mm)

Material	Thermal Conductivity (W/m·K)
Excelflex 1800	0.031

DynaGuard 1600 and 1600 H Microporous silica Insulation Block 14 to 36" x 14" x 12"

Excelflex Insulation System
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Thermal Conductivity Data (Thickness of 1" / 25.4mm)

Material	Thermal Conductivity (W/m·K)
Excelflex 1800	0.031

DynaGuard Ladle Liner 3600 Microporous Insulation

Excelflex Insulation System
 Excelflex insulation system represents the most advanced thermal protection in its class. It is designed for high temperature applications. The Excelflex system is designed for high temperature applications. The Excelflex system is designed for high temperature applications.

Thermal Conductivity Data (Thickness of 1" / 25.4mm)

Material	Thermal Conductivity (W/m·K)
Excelflex 1800	0.031

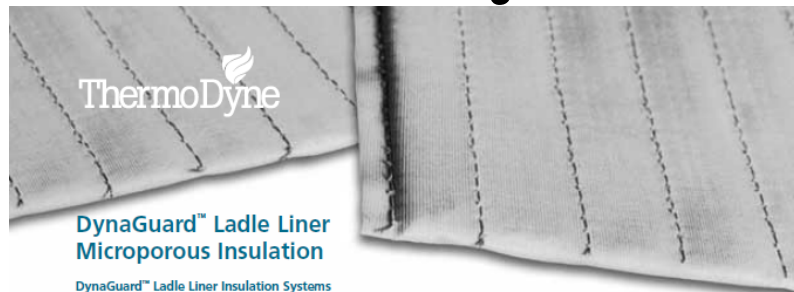
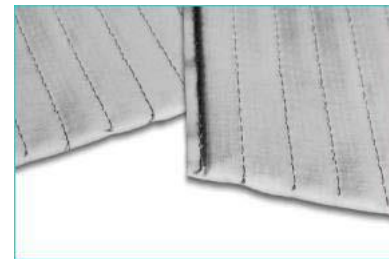
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Excelflex Insulation System
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Thermal Conductivity Data (Thickness of 1" / 25.4mm)

Material	Thermal Conductivity (W/m·K)
Excelflex 1800	0.031

DynaGuard Ladle Liner



DynaGuard™ Ladle Liner Microporous Insulation

DynaGuard™ Ladle Liner Insulation Systems

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DynaGuard™ Ladle Liner systems are also specially formulated to minimize heat transfer via conduction, convection and radiation through the material by use of the following:

Ceramic Powders with Intrinsically Low Thermal Conductivity

The microporous core materials used in the manufacture of DynaGuard™ Ladle Liner systems possess a thermal conductivity even lower than that of still air, and minimize the solid conduction of energy through the material.

Microporous Structure

The microporous structure of the DynaGuard™ Ladle Liner system inherently minimizes the possibility for air current convection through the material as void spaces too small for air currents to exist form between the core material components.

Special Opacifiers

The introduction of special opacifiers into the DynaGuard™ Ladle Liner formulation ensures that the transmission of infrared radiation through the material is kept to the lowest possible levels.

DynaGuard™ Ladle Liner Materials of Construction

The DynaGuard™ Ladle Liner microporous core material is an 1,800°F continuous use formulation, and is compressed into a uniform thickness and density to ensure the proper distribution of the core material. After compression, the material is quilted on 1" parallel centers with high temperature thread in order to provide both flexibility and greater vibration resistance for the material.

Unlike other DynaGuard™ products, DynaGuard™ Ladle Liner also possesses a hydrophobic component in its core formulation. This material makes the microporous structure highly resistant to the presence of moisture during

use and installation, and is capable of performing at temperatures as high as 900°F before burning out of the microporous formulation.

In addition to the hydrophobic microporous core, DynaGuard™ Ladle Liner systems are supplied encased in a high temperature textile shell. This shell provides additional structure, strength, ease of handling and installation, and consistent distribution of the core material, and may also be used to increase the overall composite temperature use limit of the assembly as specified by individual customer needs.

DynaGuard™ Ladle Liner systems are supplied standard at 16 lbs/ft³ density, 36" x 72", in thicknesses of 1/8" to 1/2", and with a fiberglass textile shell (1,000°F use limit). Other densities, sizes, thicknesses and cloth grades are available upon request.

DynaGuard™ Ladle Liner Insulation Systems Advantages

Lowest Thermal Conductivity
Because DynaGuard™ Ladle Liner systems inherently possess a thermal conductivity lower than that of still air, even at elevated temperatures, they are ideal in environments where materials with low thermal conductivity, thermal diffusivity and heat storage are necessary.

Space and Weight Savings

Because smaller amounts of DynaGuard™ Ladle Liner are needed for thermal management, it is an ideal material for industrial and commercial applications where considerable space and/or weight savings are valuable in increasing capacity or efficiency without sacrificing the thermal performance of the system.

High Temperature Capability

DynaGuard™ Ladle Liner systems can be manufactured to meet continuous high temperature environments up to 1,800°F, but are also capable of performing in intermittent exposure to 2,000°F temperatures.

Easy Fabrication

Shapes can be fabricated in the field by various cutting methods, but Thermo Dyne also provides a virtually limitless range of custom pre-fabricated and intricate shapes upon request.

Thermal Conductivity Data (Btu - in/hr - ft² - °F)

DynaGuard™ Ladle Liner 16 lbs/ft ³	
Mean Temp. °F (°C)	Thermal Conductivity
0°F (-17°C)	0.16 (.023 W(m-K))
500°F (260°C)	0.20 (.029 W(m-K))
1,000°F (538°C)	0.29 (.042 W(m-K))
1,500°F (816°C)	0.43 (.062 W(m-K))

*NOTE: All thermal conductivity values 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.

Typical Characteristics

Core Density	16 lbs/ft ³ (258kg/m ³) Standard
	10 lbs/ft ³ (161kg/m ³) Lightweight
Thickness	1/8" to 1/2" (3.17mm to 12.7mm)
Pad Size	36" x 72" (91.44cm x 182.88cm) Standard

NOTE: Other non-standard sizes are available in many thicknesses and densities.

Application Comparison Example

Material	DynaGuard™ Ladle Liner 16 lbs/ft ³	Ceramic Fiber Blanket 8 lbs/ft ³
Thickness	1" (24.5mm)	1" (24.5mm)
Ambient	80°F (26.7°C)	80°F (26.7°C)
Convection	Natural	Natural
Hot Face	1,800°F (982°C)	1,800°F (982°C)
Resultant Cold Face	281°F (138°C)	470°F (243°C)
Heat Flux	484 Btu/hr/ft ² /F	1,335 Btu/hr/ft ² /F

NOTE: Figures are based on computer simulations using thermal performance calculations conforming to ASTM C-680, and should be used for comparisons and approximations rather than for exact design specifications.

For technical and installation support for DynaGuard™ Microporous Insulation, please contact Thermo Dyne's application engineering team.

Approximate Energy Savings Comparison

The two materials used in the above example have the following differences in temperature and heat flux:
 Difference in Cold Face Temperature = 189°F (87°C)
 Difference in Heat Flux = 851 Btu/hr/ft²/F
 Result = DynaGuard™ Ladle Liner saves approximately \$0.16/kilowatt hr/ft² over Ceramic Fiber Blanket of equal thickness.

NOTE: Assumes 18 Wb = 3,413 Btu, \$0.0658/Wb estimated energy cost.

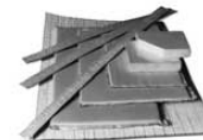
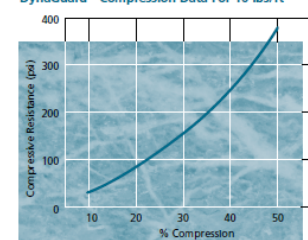
DynaGuard™ Space Savings

A 3" layered thickness (66% more material) of 8 lbs/ft³ Ceramic Fiber Blanket is necessary to achieve equal thermal performance of 1" DynaGuard™ Ladle Liner 16 lbs/ft³.

DynaGuard™ Weight Savings

Amount of weight saved by using 1" of DynaGuard™ Ladle Liner 16 lbs/ft³ as opposed to 3" of 8 lbs/ft³ Ceramic Fiber Blanket = .7 lbs/ft².

DynaGuard™ Compression Data For 16 lbs/ft³



DynaGuard™ products offer a variety of solutions.

- Industrial
 - Power plant pipes, ducts
 - Incinerators
 - Molten metal ladle backup
 - Glass tank forehearth
 - Fuel cells
- Commercial
 - Lab furnaces
 - Gas boilers
 - Appliances
 - Night storage heaters
 - Vending machines
 - Exhaust systems

