

## Min-K® Flexible

Datasheet Code US: 6-14-120

Updated: 02/2016

Flexible Min-K is a composite system consisting of a microporous core encapsulated between layers of high temperature cloth and quilted in 1in. (25mm) squares. The quilting maintains core distribution in high vibration environments and allows the insulation to be wrapped or bent to conform to unique geometric shapes during installation. Product thickness, core density and composition, and cloth selection vary with application.

### Features

- Very low thermal conductivity
- Benefits weight and space constraints
- Flexible and lightweight
- Composite temperature use limit ranges from 500°F up to 1832°F (260°C up to 1000°C)

### Core

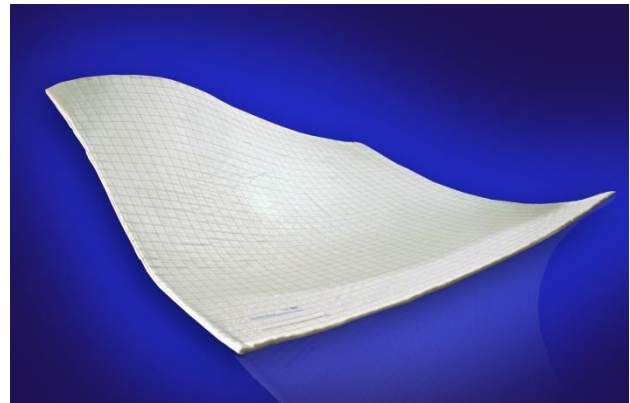
Maximum temperature use limit of the microporous core is a function of both shrinkage and degradation of thermal conductivity. At elevated temperatures, the cellular structure of the microporous insulation, which is responsible for the extremely low thermal conductivity, is compromised. The core components, including SiO<sub>2</sub>, particles, metal oxides and re-enforcement fibers, may melt or sinter together at elevated temperatures increasing both the solid conduction due to material contact, and molecular conduction of air due to the degradation of the microporous structure.

### Core Formulations

- **Mix F182** is utilized for temperatures up to 1832°F (1000°C) and where high vibration environments are seen.
- **Mix F150** is used for applications at 1200°F (649°C) and lower.

### Core and Textile Facing Selection

While thermal management requirements often dictate material thickness and core density, the maximum continuous use temperature seen in the application is the deciding factor for core and cloth selection. Because this is a composite material, the use limit is decided by the lowest use limit associated with the materials incorporated into the design.



### Cloth

Cloth selection is based on the maximum temperature use limit required by the application, but may also be determined according to other physical characteristics such as rigidity, permeability or durability. Some cloths (Nextel) are also used due to their qualification as an industry approved fire barrier. The maximum temperature use limit is based on the degradation of the strength of the material. Some cloths are rated for higher temperature use in other industries, the use limits here reflect the survivability of the Min-K product in demanding aerospace environments.

- 2116 E-Glass maximum use limits of 500°F (260°C), in harsh aerospace environments, used in 501 series of materials or Standard Flexible Min-K.
- S-Glass maximum use limit of 1200°F (649°C), in harsh aerospace environments, used in 1201 series of materials or Mid-Range Flexible Min-K.
- Quartz 503 maximum use limit of 1958°F (1070°C) and used in 1801 (limited by core) series of materials.
- Quartz 593 maximum use limit of 1958°F (1070°C). Offers increased durability over Quartz 503 due to increased thickness.
- Nextel maximum use limit of 2200 up to 2500°F (1204 up to 1371°C). Excellent strength and durability at elevated temperatures.

### Thread

Selection is based on maximum continuous use limit of the application and consistent with the cloth.

- **E-Glass** Standard with 2116 E- and S-Glass cloths
- **Quartz** Standard with higher temperature cloths

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Availability, Standard material offering			
High temperature composition, rated at 1832°F (1000°C)			
1801/8	Quartz 503 cloth	F182 core	8 pcf density
1801/10	Quartz 503 cloth	F182 core	10 pcf density
1801/16	Quartz 503 cloth	F182 core	16 pcf density
Mid-range composition, rated at 1200°F (649°C)			
1201/8	S-Glass cloth	F150 core	8 pcf density
1201/10	S-Glass cloth	F150 core	10 pcf density
1201/16	S-Glass cloth	F150 core	16 pcf density
Standard composition, rated at 500°F (260°C)			
501/8	2116 E-Glass cloth	F150 core	8 pcf density
501/10	2116 E-Glass cloth	F150 core	10 pcf density
501/16	2116 E-Glass cloth	F150 core	16 pcf density

### Acoustic Characteristics

Sound absorption values range from 0 to 1.0 with 0 representing no absorption (perfect reflections) and 1.0 representing 100 percent absorption

Material, 0.25in. (6mm)	Hz					
	125	150	500	1000	2000	4000
8 pcf (128 kg/m <sup>3</sup> ), F150 Core	0.025	0.032	0.066	0.272	0.331	0.253
16 pcf (256 kg/m <sup>3</sup> ), F150 Core	0.027	0.025	0.060	0.157	0.355	0.306
8 pcf (128 kg/m <sup>3</sup> ), F182 Core	0.028	0.028	0.052	0.132	0.322	0.258

Specific Heat	
Temperature, °F (°C)	Specific Heat, BTU/lb°F (J/kg°C)
100 (38)	0.18 (754)
400 (204)	0.23 (963)
800 (427)	0.26 (1089)

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### Thermal Conductivity

Microporous Product Name	Flexible Min-K 501			Flexible Min-K 1201			Flexible Min-K 1801		
<b>Thermal Conductivity, BTU·in/hr·ft<sup>2</sup>, per ASTM C201</b>									
<u>Density, pcf</u>	<u>8</u>	<u>10</u>	<u>16</u>	<u>8</u>	<u>10</u>	<u>16</u>	<u>8</u>	<u>10</u>	<u>16</u>
<u>Thickness, in</u>	<u>0.125</u>	<u>0.125</u>	<u>0.125</u>	<u>0.125</u>	<u>0.125</u>	<u>0.125</u>	<u>0.125</u>	<u>0.125</u>	<u>0.125</u>
200°F	0.23	0.21	0.2	0.23	0.23	0.22	0.26	0.26	0.25
400°F	0.28	0.25	0.24	0.28	0.27	0.26	0.28	0.28	0.27
600°F	0.34	0.3	0.28	0.35	0.33	0.32	0.31	0.3	0.29
800°F	0.42	0.37	0.35	0.42	0.39	0.38	0.38	0.34	0.32
1000°F	0.49	0.45	0.41	0.5	0.47	0.44	0.44	0.39	0.36
1200°F	-	-	-	0.6	0.56	0.52	0.49	0.44	0.41
1400°F	-	-	-	0.72	0.66	0.63	0.58	0.52	0.47
1500°F	-	-	-	-	-	-	0.68	0.61	0.56
1600°F	-	-	-	-	-	-	0.79	0.71	0.65
<u>Thickness, in</u>	<u>0.25</u>	<u>0.25</u>	<u>0.25</u>	<u>0.25</u>	<u>0.25</u>	<u>0.25</u>	<u>0.25</u>	<u>0.25</u>	<u>0.25</u>
200°F	0.2	0.19	0.18	0.21	0.21	0.2	0.23	0.23	0.22
400°F	0.25	0.23	0.22	0.26	0.24	0.23	0.25	0.25	0.24
600°F	0.31	0.27	0.26	0.32	0.29	0.28	0.27	0.27	0.26
800°F	0.38	0.34	0.32	0.39	0.35	0.34	0.34	0.3	0.28
1000°F	0.45	0.41	0.38	0.47	0.43	0.4	0.4	0.35	0.32
1200°F	-	-	-	0.56	0.52	0.48	0.45	0.4	0.37
1400°F	-	-	-	0.68	0.62	0.58	0.54	0.48	0.43
1600°F	-	-	-	-	-	-	0.65	0.57	0.51
1800°F	-	-	-	-	-	-	0.76	0.67	0.6
<u>Thickness, in</u>	<u>0.375</u>	<u>0.375</u>	<u>0.375</u>	<u>0.375</u>	<u>0.375</u>	<u>0.375</u>	<u>0.375</u>	<u>0.375</u>	<u>0.375</u>
200°F	0.19	0.19	0.18	0.2	0.2	0.2	0.22	0.22	0.21
400°F	0.24	0.23	0.21	0.25	0.23	0.22	0.24	0.24	0.23
600°F	0.3	0.26	0.25	0.3	0.27	0.26	0.26	0.26	0.25
800°F	0.37	0.33	0.31	0.37	0.33	0.32	0.33	0.29	0.28
1000°F	0.44	0.4	0.37	0.45	0.4	0.37	0.39	0.34	0.31
1200°F	-	-	-	0.53	0.49	0.45	0.44	0.39	0.35
1400°F	-	-	-	0.65	0.59	0.55	0.53	0.47	0.41
1600°F	-	-	-	-	-	-	0.64	0.56	0.5
1800°F	-	-	-	-	-	-	0.75	0.66	0.59

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Microporous Product Name	Flexible Min-K 501			Flexible Min-K 1201			Flexible Min-K 1801		
<b>Thermal Conductivity, W/m•K, per ASTM C201</b>									
Density, kg/m <sup>3</sup>	<u>128</u>	<u>160</u>	<u>256</u>	<u>128</u>	<u>160</u>	<u>256</u>	<u>128</u>	<u>160</u>	<u>256</u>
Thickness, mm	<u>3.2</u>	<u>3.2</u>	<u>3.2</u>	<u>6.4</u>	<u>6.4</u>	<u>6.4</u>	<u>9.5</u>	<u>9.5</u>	<u>9.5</u>
93°C	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04
149°C	-	-	-	-	-	-	-	-	-
204°C	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04
260°C	-	-	-	-	-	-	-	-	-
316°C	0.05	0.04	0.04	0.05	0.05	0.05	0.04	0.04	0.04
427°C	0.06	0.05	0.05	0.06	0.06	0.05	0.05	0.05	0.05
538°C	0.07	0.06	0.06	0.07	0.07	0.06	0.06	0.06	0.05
649°C	-	-	-	0.09	0.08	0.07	0.07	0.06	0.06
760°C	-	-	-	0.1	0.1	0.09	0.08	0.07	0.07
Thickness, mm	<u>6.4</u>	<u>6.4</u>	<u>6.4</u>	<u>0.25</u>	<u>0.25</u>	<u>0.25</u>	<u>0.25</u>	<u>0.25</u>	<u>0.25</u>
93°C	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
149°C	-	-	-	-	-	-	-	-	-
204°C	0.04	0.04	0.04	0.04	0.03	0.03	0.04	0.04	0.03
260°C	-	-	-	-	-	-	-	-	-
316°C	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04
427°C	0.06	0.06	0.05	0.06	0.05	0.05	0.05	0.04	0.04
538°C	0.07	0.07	0.06	0.07	0.06	0.06	0.06	0.05	0.05
649°C	0.09	0.08	0.07	0.08	0.07	0.07	0.06	0.05	0.05
760°C	0.1	0.1	0.09	0.1	0.09	0.08	0.07	0.07	0.05
816°C	-	-	-	-	-	-	-	-	-
871°C	-	-	-	-	-	-	0.09	0.08	0.07
982°C	-	-	-	-	-	-	0.11	0.1	0.09
Thickness, mm	<u>9.5</u>	<u>9.5</u>	<u>9.5</u>	<u>0.375</u>	<u>0.375</u>	<u>0.375</u>	<u>0.375</u>	<u>0.375</u>	<u>0.375</u>
93°C	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03
149°C	-	-	-	-	-	-	-	-	-
204°C	0.04	0.04	0.04	0.04	0.03	0.03	0.04	0.04	0.03
260°C	-	-	-	-	-	-	-	-	-
316°C	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
427°C	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04
538°C	0.06	0.06	0.05	0.06	0.06	0.06	0.06	0.05	0.05
649°C	0.07	0.06	0.06	0.07	0.07	0.07	0.06	0.05	0.05
760°C	0.08	0.07	0.07	0.09	0.09	0.08	0.07	0.07	0.05
816°C	0.1	0.09	0.08	-	-	-	-	-	-
871°C	0.11	0.1	0.09	-	-	-	0.09	0.08	0.07
982°C	-	-	-	-	-	-	0.11	0.1	0.09

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