FyreWrap® LiB Boards, Blankets and Felts

Introduction
FyreWrap® LiB (Lithium-ion Battery) Boards, Blankets and Felts are a family of high-temperature, lightweight insulating materials that are designed to help prevent thermal runaway propagation in lithium-ion battery applications. Unifrax combines material science with industry knowledge to tackle one of the most important safety issues in today's large format lithium-ion battery applications. From cell-to-cell isolating thermal barriers to whole pack solutions, Unifrax delivers an engineered platform with unparalleled designs to offer the ultimate fire protection in lithium-ion battery containment.

Building on Unifrax’s thermal management expertise and manufacturing excellence, combined with extensive experience in aerospace, automotive, and fire protection applications, Unifrax offers customized solutions for lithium-ion thermal runaway propagation prevention. The base of its technology starts with its fiber manufacturing techniques. Unifrax produces multiple fiber chemistries such as alkaline earth silicate fibers, refractory ceramic fibers, micro-fine glass fibers and polycrystalline fibers. Dependent upon the desired characteristics of the finished product, Unifrax converts the fibers into different product forms with varying options for additional enhancements.

Common Properties
- Fire resistant, flame barrier
- Electrically insulating
- Low thermal conductivity/thermal insulating
- Suitable for temperatures up to 1200°C
- Excellent chemical stability
- Exceptionally resistant to thermal shock

Markets
- E-Mobility
- Grid Storage
- Energy Storage Systems (ESS)
- Military
- Aerospace
- Consumer Electronics
- Medical
- Transportation packaging

Board Properties
- Easy to cut with standard tools
- Uniform, lightweight option available
- Non-woven compressible fiber matrix forms available

Felt Properties
- Easy to wrap, shape, or cut
- Uniform, lightweight, easy-to-cut sheets
- Non-woven compressible fiber matrix

Blanket Properties
- Flexible, strong, and lightweight
- Low thermal conductivity
- Excellent thermal shock resistance

Applications
- Cells (external to cell)
- Battery modules
- Battery packs
- Packaging for transportation

Capabilities
- Thermal runaway propagation prevention
- Short circuit prevention and electrical protection
- Cascading fire prevention
- Thermal isolation and containment
Additional Capabilities
Customer requirements are unique and Unifrax offers solutions that cater to each application’s performance criteria, cost structure, and product handling needs. The information presented refers to our core products and their typical characteristics. Unifrax offers application support for many specifications and/or enhancements, such as:

- Adhesive and foil backings
- Encapsulation and lamination
- Hybrid fiber systems
- Rigidization of components

Please contact the LiB team to discuss additional enhancement requirements at +01-716-768-6472.

FyreWrap LiB Boards, Blankets and Felts Typical Product Properties

<table>
<thead>
<tr>
<th>Product Grade</th>
<th>Color</th>
<th>Temperature Grade °F °C</th>
<th>Melting Point °F °C</th>
<th>Density lb/ft³ kg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN70 Blanket</td>
<td>White</td>
<td>2300 1260</td>
<td>2390 1310</td>
<td>4 - 8 64 - 128</td>
</tr>
<tr>
<td>IN70 Felt</td>
<td>White</td>
<td>2300 1260</td>
<td>2390 1310</td>
<td>10 - 17 160 - 275</td>
</tr>
<tr>
<td>IN70 Board</td>
<td>White</td>
<td>2300 1260</td>
<td>2390 1310</td>
<td>17 275</td>
</tr>
<tr>
<td>IN70 XT-Board</td>
<td>White</td>
<td>2300 1260</td>
<td>2390 1310</td>
<td>22 360</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOI² Including Binder, % Wt</th>
<th>Modulus of Rupture</th>
<th>Thermal Conductivity (W/mK)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PSI kPa</td>
<td>400°C 600°C 800°C 1000°C</td>
</tr>
<tr>
<td>IN70 Blanket</td>
<td>0</td>
<td>0.08 0.12 0.18 0.25</td>
</tr>
<tr>
<td>IN70 Felt</td>
<td>7</td>
<td>0.08 0.1 0.15 0.2</td>
</tr>
<tr>
<td>IN70 Board</td>
<td>&lt;9 &gt;100 &gt;700</td>
<td>0.07 0.1 0.14 —</td>
</tr>
<tr>
<td>IN70 XT-Board</td>
<td>&lt;7 &gt;100 &gt;700</td>
<td>0.1 0.12 0.15 —</td>
</tr>
</tbody>
</table>

Available Thickness, mm (other material sizes available upon request)

| Available in 13mm and 25mm Thicknesses
<table>
<thead>
<tr>
<th>3 5 6 9 10 12 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN70 Blanket</td>
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<tr>
<td>IN70 Felt</td>
</tr>
<tr>
<td>IN70 Board</td>
</tr>
<tr>
<td>IN70 XT-Board</td>
</tr>
</tbody>
</table>

The following is a registered trademark of Unifrax: FyreWrap.
The test data shown 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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