Zinc borate flame retardant
Zinc borate is an efficient flame retardant in many polymers. In halogen-free systems, zinc borates can be used either alone or in combination with other flame retardants such as metal hydroxides (ATH, MDH), phosphorus, and silicone. They promote:
• Char/residue formation
• Stabilization of the char and inhibition of the oxidation of the char (afterglow suppression)
• Smoke suppression
• Sintering between inorganic filler particles
• Anti-tracking and anti-arcing
• Dripping prevention
In halogen containing systems, zinc borates are synergist of halogen sources. They can function both as smoke suppressant and afterglow suppressant. They can also improve thermal stability and provide anti-tracking and anti-arcing properties.

In certain systems such as rigid PVC, epoxy, unsaturated polyester, and polyphenylene oxide, zinc borate can be used alone. In other systems such as PVC and polyolefins, it is preferable to use it in conjunction with antimony trioxide for maximum effectiveness as zinc borate displays synergism with antimony trioxide. But in contrast to antimony trioxide which promotes smoke formation, zinc borate is an efficient smoke suppressant. It is also considered non-toxic and less expensive than antimony trioxide, making it a better alternative. Zinc borate also displays strong synergism with metal hydroxides such as alumina trihydrate (ATH) in reducing smoke and retarding flame.

What is Firebrake ZB Fine?
Firebrake ZB Fine is recommended for applications where maximum fire test performance is needed and physical properties are critical.

It is a white, crystalline powder with a median particle size below 2.3 µm. It is produced by milling of the granular grade Firebrake ZB to reduce the size for optimal effects. It also has a tighter distribution of particle size for greater product stability and uniform product quality.

As with the granular grade Firebrake ZB, Firebrake ZB Fine retains its water of hydration at temperatures as high as 300°C, allowing it to be used in polymers requiring high processing temperatures.

Firebrake ZB Fine can be used in a wide range of polymers:
• Polyvinyl chloride (PVC)
• Polyamide (nylon)
• Polyolefins
• Epoxy
• Acrylics
• Phenolics
• Silicones
• Polyether Sulfones
• Various elastomers

The benefits of fine particles with Firebrake ZB Fine
Particle size affects end products quality and properties. Smaller particle size means that the surface area increases for a given volume of material compared to larger particles. Smaller particle size and higher surface area provide benefits such as:
• Increase in fire retardancy performance
• Reduction of smoke density
• Homogeneous distribution of B₂O₃/glass formed by degradation of the zinc borate
• Better foam cell structure
• Higher mechanical strength
• Higher tensile elongation
• Better surface finish

Fine particles have a tendency to agglomerate due to stronger inter-particle attraction. Good mixing equipment should be used during processing as poor mixing could result in the agglomeration of the fine particles and decrease the performance.
<table>
<thead>
<tr>
<th>Description</th>
<th>Firebreak ZB</th>
<th>Firebreak ZB Fine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formula</td>
<td>2ZnO•3B₂O₃•3.5H₂O</td>
<td>2ZnO•3B₂O₃•3.5H₂O</td>
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<tr>
<td>ZnO</td>
<td>37%</td>
<td>37%</td>
</tr>
<tr>
<td>B₂O₃</td>
<td>48%</td>
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</tr>
<tr>
<td>H₂O</td>
<td>14%</td>
<td>14%</td>
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<tr>
<td>Typical median particle size</td>
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<td>2.3μm</td>
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<tr>
<td>Typical top size (horiba)</td>
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<td>-</td>
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<tr>
<td>Refractive index</td>
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<td>1.58</td>
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<tr>
<td>Specific gravity</td>
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<td>2.8</td>
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<tr>
<td>Solubility (wt %)</td>
<td>&lt;0.28</td>
<td>&lt;0.28</td>
</tr>
</tbody>
</table>

Figure 1: Characteristics of Firebreak ZB Fine vs Firebreak ZB

Figure 2: Particle size distribution of Firebreak ZB Fine vs Firebreak ZB

About U.S. Borax
U.S. Borax, part of Rio Tinto, is a global leader in the supply and science of borates—naturally-occurring minerals containing boron and other elements. We are 1,000 people serving 500 customers with more than 1,700 delivery locations globally. We supply 30% of the world’s need for refined borates from our world-class mine in Boron, California, about 100 miles northeast of Los Angeles. We pioneer the elements of modern living, including:

- **Minerals that make a difference:** Consistent product quality secured by ISO 9000:2001 registration of its integrated quality management systems
- **People who make a difference:** Experts in borate chemistry, technical support, and customer service
- **Solutions that make a difference:** Strategic inventory placement and long-term contracts with shippers to ensure supply reliability

About 20 Mule Team® products
20 Mule Team® borates are produced from naturally occurring minerals and have an excellent reputation for safety when used as directed. Borates are essential nutrients for plants and key ingredients in fiberglass, glass, ceramics, detergents, fertilizers, wood preservatives, flame retardants, and personal care products.