



Firebrake® ZB is a unique multi-functional fire retardant that can be used in both halogen-containing and halogen-free polymers. It can function as a flame retardant, smoke suppressant, afterglow suppressant, as well as anti-tracking agent in polymers. It has been used extensively as a fire retardant in products such as PVC, polyolefins, polyamides, polyester, epoxy, acrylic, urethane, and rubbers. A finer grade of *Firebrake* ZB, called *Firebrake* ZB Fine, is available for optimal performance.

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:

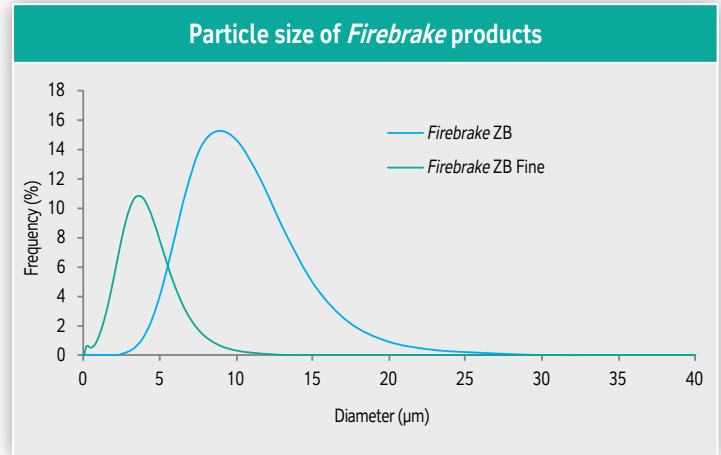
- Increase in fire retardancy performance
- Reduction of smoke density
- Homogeneous distribution of B₂O₃/glass formed by degradation of the zinc borate
- Better foam cell structure
- Higher mechanical strength
- Higher tensile elongation
- Better surface finish

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.

Figure 1: Characteristics of *Firebrake ZB Fine* vs *Firebrake ZB*

	<i>Firebrake ZB</i>	<i>Firebrake ZB Fine</i>
Description	granular zinc borate	fine granular zinc borate
Formula	$2ZnO \cdot 3B_2O_3 \cdot 3.5H_2O$	$2ZnO \cdot 3B_2O_3 \cdot 3.5H_2O$
ZnO	37%	37%
B ₂ O ₃	48%	48%
H ₂ O	14%	14%
Typical median particle size	9µm	2.3µm
Typical top size (horiba)	-	-
Refractive index	1.58	1.58
Specific gravity	2.8	2.8
Solubility (wt %)	<0.28	<0.28

Figure 2: Particle size distribution of *Firebrake ZB Fine* vs *Firebrake 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 9001:2015 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.