



# Zinc borate flame retardants





## Why U.S. Borax?

### Technical support

U.S. Borax has extensive knowledge about the use of zinc borate in polymers.

- U.S. Borax is the market leader
- We pioneered the use of zinc borate as a fire retardant with technical and formulation support from our leading industry expert
- There is extensive research data on the efficacy of U.S. Borax products for fire retardancy in polymers
- Our industry experts have decades of expertise in this application
- U.S. Borax provides formulation and process troubleshooting advice based on the following:
  - Application
  - Polymer used
  - Polymer processing temperature
  - Halogenated or halogen-free systems
  - Fire standard(s) to pass
  - Smoke restriction

### Product attributes

Consistency, quality, and reliability

- Made with high-quality zinc oxide and boric acid as raw materials
- Consistent round particle shape for improved powder flow
- Consistent bulk density and particle size distribution
- Supply reliability with a wide spread distribution chain

### Regulatory expertise

U.S. Borax provides support and guidance for regional and global regulatory issues

- Support with labeling requirements—both domestically and for export
- Advice on local and global regulations including REACH and CLP Classification

## Firebrake applications

*Firebrake* zinc borates are multi-functional flame retardants. They can display synergistic and beneficial effect with halogen containing flame retardants and non-halogenated flame retardants, such as metal hydroxides, nitrogen/phosphorus compounds, and silicon-based flame retardants.

They are used extensively in:

- Polyvinyl chloride (PVC)
- Polyamide (nylon)
- Polyolefin
- Epoxy
- Acrylics
- Silicones
- Various elastomers

*Firebrake* ZB Fine is recommended for applications where maximum fire test performance is needed, and physical properties such as film forming and adhesion are critical.

*Firebrake* 500 is used mostly in engineering polymers such as high temperature nylon, polyetherketones, and polyethersulfone processed at or above 300 °C in aircraft and electrical parts.

### Top industries and potential applications and associated polymer systems

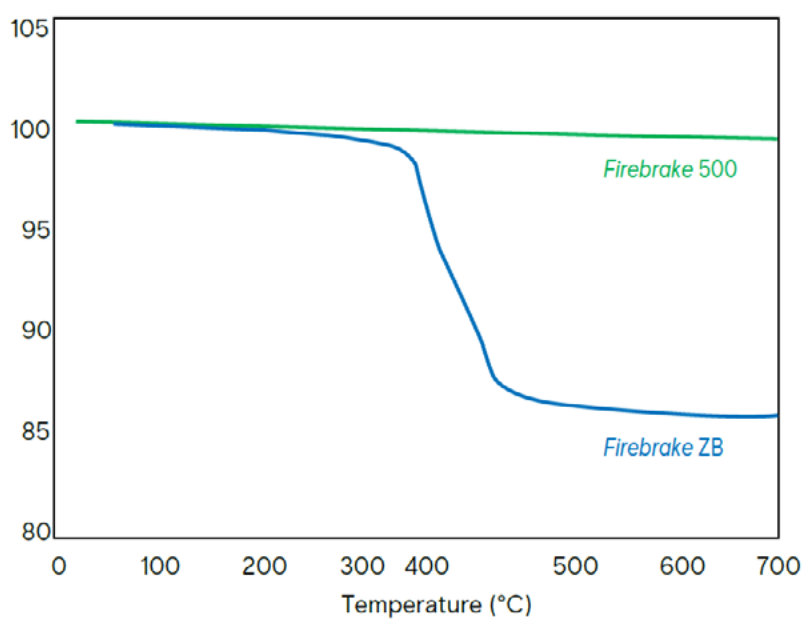
Industry				
Wire and cable and electronics	Construction	Transportation	Coatings	Textiles
Applications				
<ul style="list-style-type: none"> <li>• Wire and cable</li> <li>• Electrical connector</li> <li>• Semiconductor encapsulant</li> <li>• Switch relay</li> <li>• e-Meter covers</li> <li>• Wire jacketing and insulation</li> </ul>	<ul style="list-style-type: none"> <li>• Wall covering</li> <li>• Flooring</li> <li>• Roofing membrane</li> <li>• Foam insulation</li> <li>• Sealant / caulking</li> <li>• Coating</li> </ul>	<ul style="list-style-type: none"> <li>• Seat cover</li> <li>• Paneling</li> <li>• Flooring</li> <li>• Aircraft interiors</li> <li>• Mass transit interiors</li> <li>• Adhesives</li> </ul>	<ul style="list-style-type: none"> <li>• Intumescent coatings</li> <li>• Primer</li> </ul>	<ul style="list-style-type: none"> <li>• Tenting</li> <li>• Curtains</li> <li>• Upholstery</li> <li>• Textile back-coating</li> </ul>
Polymers				
<ul style="list-style-type: none"> <li>• PVC</li> <li>• Polyolefins</li> <li>• Chlorofluoropolymer</li> </ul>	<ul style="list-style-type: none"> <li>• PVC</li> <li>• Polyolefins</li> <li>• Acrylics</li> </ul>	<ul style="list-style-type: none"> <li>• PVC</li> <li>• Epoxy</li> <li>• Urethane</li> <li>• Polyamides</li> <li>• Acrylics</li> <li>• PET/PBT</li> </ul>	<ul style="list-style-type: none"> <li>• Epoxy</li> <li>• Acrylics</li> </ul>	<ul style="list-style-type: none"> <li>• PVC</li> <li>• Polyamides</li> </ul>

*Use of Firebrake is not limited to the applications listed*

# Firebrake properties and benefits

	<i>Firebrake ZB</i>	<i>Firebrake ZB Fine</i>	<i>Firebrake 500</i>
Description	Zinc borate powder	Fine zinc borate powder	Anhydrous zinc borate powder
Formula	$2\text{ZnO} \cdot 3\text{B}_2\text{O}_3 \cdot 3.5\text{H}_2\text{O}$	$2\text{ZnO} \cdot 3\text{B}_2\text{O}_3 \cdot 3.5\text{H}_2\text{O}$	$2\text{ZnO} \cdot 3\text{B}_2\text{O}_3$
ZnO	38%	38%	44%
$\text{B}_2\text{O}_3$	48%	48%	55%
$\text{H}_2\text{O}$	14%	14%	—
Typical media particle size	8–9 $\mu\text{m}$	2–3 $\mu\text{m}$	8–9 $\mu\text{m}$
Typical top size (Horiba)	—	—	—
Refractive index	1.58	1.58	1.58
Specific gravity	2.8	2.8	2.6
Solubility (wt %)	<0.28	<0.28	—

## Thermogravimetric analysis of *Firebrake ZB* and *Firebrake 500*



### Morphology

- Consistent crystal morphology allowing processing benefits such as viscosity
- Round micro-crystalline agglomerates for consistent powder flow

### Thermal stability

- *Firebrake ZB* is thermally stable up to 290 °C
- *Firebrake 500* is thermally stable up to 600 °C for applications with higher processing temperatures

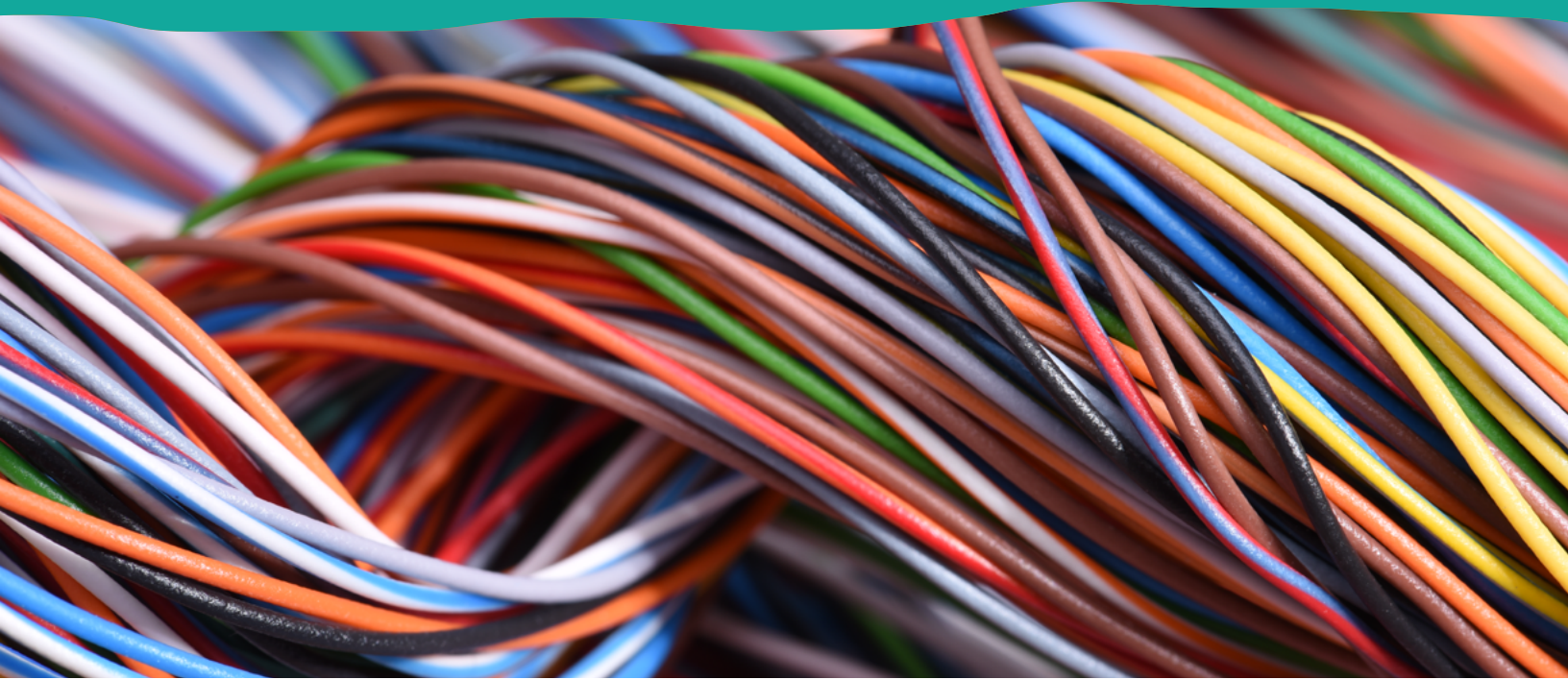
### Bulk density

- Consistent bulk density allows for reliable feeding and processing

### Consistent quality vs competition

Made from high quality ZnO and boric acid for low impurities. Product quality consistent with tight production specifications.

Competitive producers can potentially have higher levels of heavy metals and often contain significant levels of impurities such as sodium sulfate, which have negative impact on polymers such as on electrical properties.



## **Firebrake fire retardancy: Benefits in application**

*Firebrake ZB and Firebrake 500* can be fed to extruders, calenders, or injection moulding equipment in the same way as other solid polymer additives.

### **Firebrake ZB products exhibit these properties**

In halogenated systems:

- Lower cost Firebrake zinc borates can partially or completely replace more expensive antimony oxide in many flame retardant formulations and result in better flame retardancy and lower smoke. In some systems, they display synergistic fire retardancy performance and
- Improves thermal stability of aromatic bromine/Sb system

In non-halogenated systems:

- Can be used either alone in combination with many other flame retardants.
- Functions as a flame retardant in many different halogen-free polymers (B/metal hydroxide, B/P, B/N, B/Si)

### **Additional benefits and fire retardant properties**

- Smoke suppressant
- Afterglow suppressant
- Anti-tracking agent/anti-arcing agent
- Improves aged elongation properties of polyolefins
- Can promote char formation and prevent dripping
- Provides corrosion resistance
- PH<sub>3</sub> scavenger
- Refractive index similar to that of most polymer systems, results in the retention of considerable translucency and allows the use of low pigment loading

		Zinc borates are commonly used in these polymers/applications						Zinc borates are less commonly used in these polymers/applications									
		Common polymers						Elastomer				Other polymers					
Industry	Application	PVC	Nylon	Acrylics	Silicone	Epoxy	Phenolics	Neoprene	SBR/ Natural	EPDM	Urethane/ TPU	Polyolefins	PBT/ PET	PC/ ABS	Unsaturated polyester	Chlorofluoro- polymer	CPE
Coatings	Coating			X		X					X						
	Intumescent coating			X		X											
Construction	Sealant/caulking			X	X						X						
	Foam insulation									X		X					
	Carpeting	X							X			X					
	Flooring	X				X			X		X						
	Roofing membrane	X								X		X					
	Wall coverings	X															
	Roofing tile											X					
	Construction/ transportation	Foam										X					
Transportation	Seating covers	X															
	Paneling/grating						X								X		
	Adhesives	X	X	X		X					X		X				
Electrical	Electrical parts		X				X	X						X			
	Wire and cable	X			X			X				X					X
	Electrical connectors		X										X				
	Wire insulation				X												
	Epoxy molding compounds					X											
	Encapsulants					X											
Textile	PVC/glass fiber	X															
	Tenting	X															
Mining	Conveyor belting	X			X			X	X								

#### About U.S. Borax

U.S. Borax 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 our customers with more than 1,200 delivery locations globally. We supply around 30% of the world's need for refined borates from our world-class mine in Boron, California, about 100 miles northeast of Los Angeles.



#### About 20 Mule Team products

U.S. Borax produces the *20 Mule Team*® borates family of products from naturally occurring minerals and have an excellent reputation for purity and safety when used as directed. Borates are key ingredients in a number of industrial applications including fiberglass, glass, ceramics, batteries and capacitors, wood preservatives, and flame retardants.

High quality, high reliability, high performance borate products. It's what we're known for.