

Firebrake[®]

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 and *Firebrake* ZB-XF are 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"> • Wire and cable • Electrical connector • Semiconductor encapsulant • Switch relay • e-Meter covers • Wire jacketing and insulation 	<ul style="list-style-type: none"> • Wall covering • Flooring • Roofing membrane • Foam insulation • Sealant / caulking • Coating 	<ul style="list-style-type: none"> • Seat cover • Paneling • Flooring • Aircraft interiors • Mass transit interiors • Adhesives 	<ul style="list-style-type: none"> • Intumescent coatings • Primer 	<ul style="list-style-type: none"> • Tenting • Curtains • Upholstery • Textile back-coating
Polymers				
<ul style="list-style-type: none"> • PVC • Polyolefins • Chlorofluoropolymer 	<ul style="list-style-type: none"> • PVC • Polyolefins • Acrylics 	<ul style="list-style-type: none"> • PVC • Epoxy • Urethane • Nylon • Acrylics • PET/PBT 	<ul style="list-style-type: none"> • Epoxy • Acrylics 	<ul style="list-style-type: none"> • PVC • Polyamide (nylon)

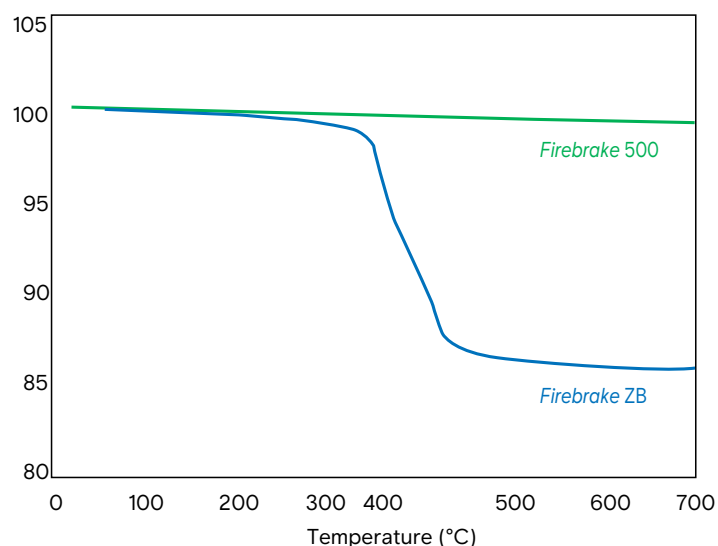
Use of Firebrake is not limited to the applications listed.



Firebrake Properties and Benefits

	<i>Firebrake ZB</i>	<i>Firebrake ZB-Fine</i>	<i>Firebrake ZB-XF</i>	<i>Firebrake 500</i>
Description	granular zinc borate	fine granular zinc borate	extra fine granular zinc borate	anhydrous zinc borate
Formula	$2ZnO \cdot 3B_2O_3 \cdot 3.5H_2O$	$2ZnO \cdot 3B_2O_3 \cdot 3.5H_2O$	$2ZnO \cdot 3B_2O_3 \cdot 3.5H_2O$	$2ZnO \cdot 3B_2O_3$
ZnO	37%	37%	37%	44%
B ₂ O ₃	48%	48%	48%	55%
H ₂ O	14%	14%	14%	-
Typical median particle size	9µm	2.3µm	1.8µm	9µm
Typical top size (Horiba)	-	-	12µm	-
Refractive index	1.58	1.58	1.58	1.58
Specific gravity	2.8	2.8	2.8	2.6
Solubility (wt %)	<0.28	<0.28	<0.28	-

Thermogravimetric analysis of Firebrake ZB and Firebrake 500



Morphology

- Consistent crystal morphology during a 40 year period allowing processing benefits such as viscosity
- Round micro-crystalline agglomerates for consistent powder flow

Thermal Stability

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

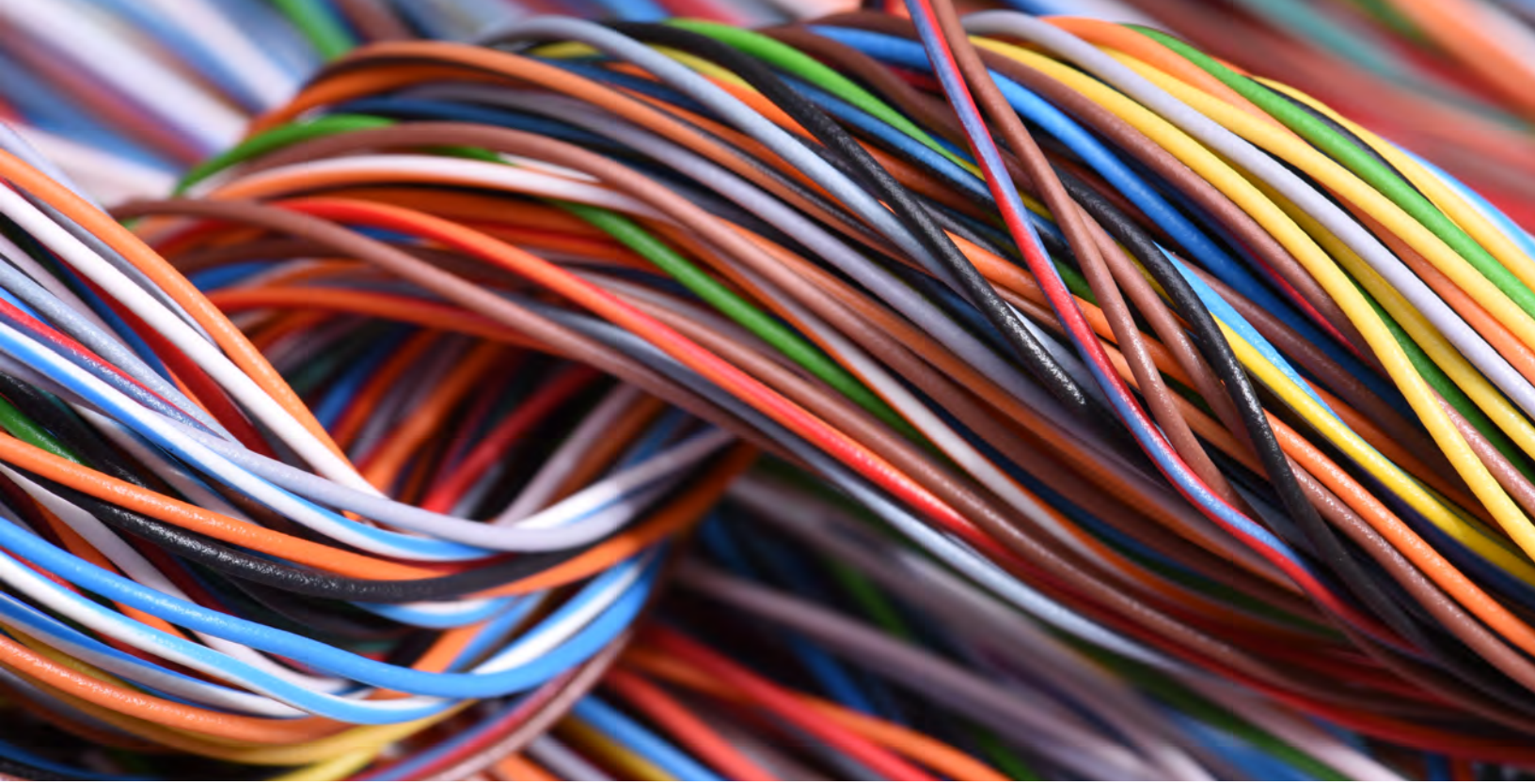
Bulk Density

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, *Firebrake* zinc borates 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
- PH₃ 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



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		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 Cover	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 Connector		x										x				
	Wire Insulation				x												
	Epoxy Molding Compound					x											
	Encapsulants					x											
Textile	PVC/Glass Fiber	x															
	Tenting	x															
Mining	Conveyor Belting	x			x			x	x								