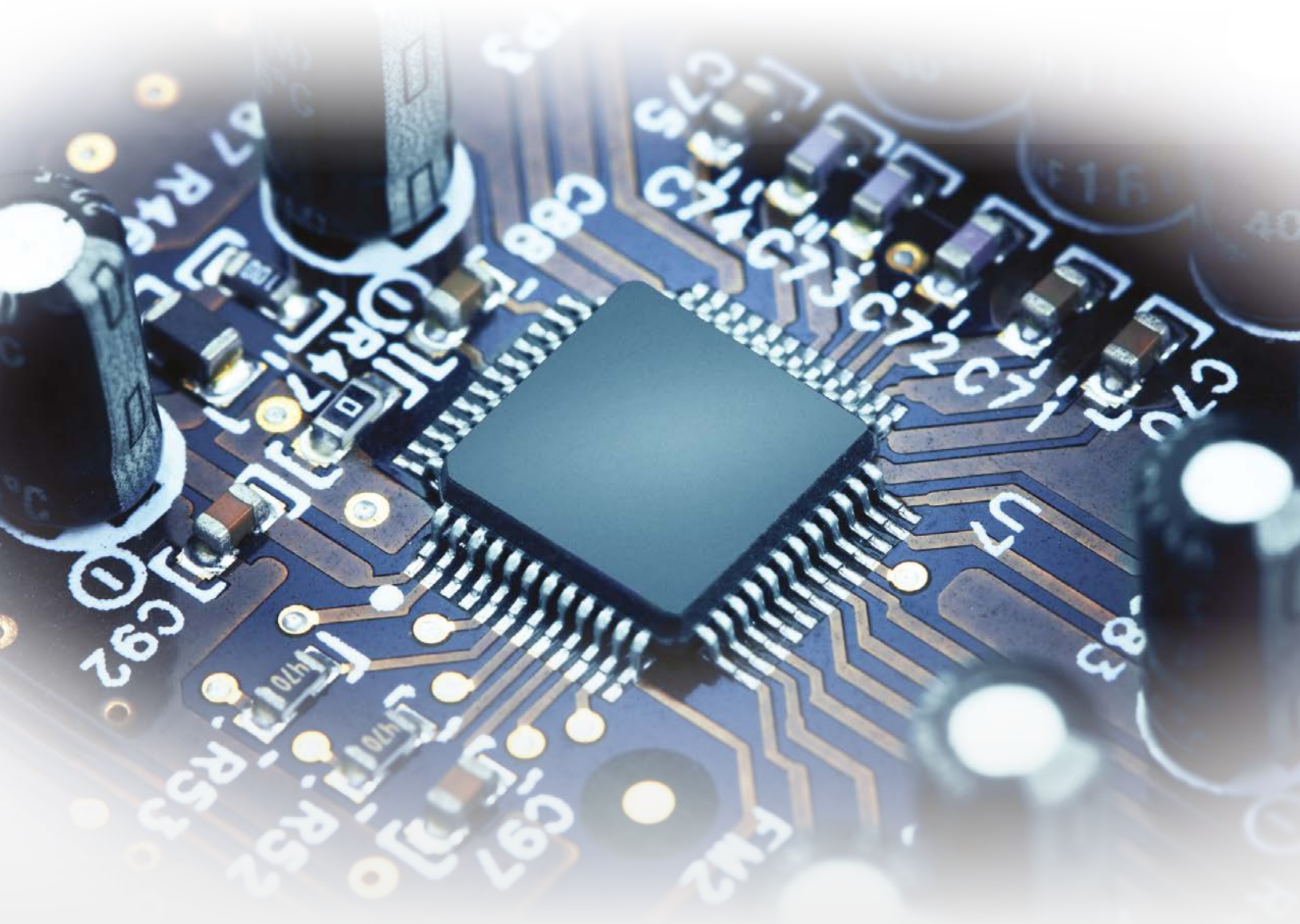
QUALITY PERFORMS.



LANXESS Bromine Solutions

Flame retardants product guide

QUALITY WORKS.

LANXESS
Energizing Chemistry

A GLOBAL LEADER IN FLAME RETARDANTS

INNOVATIVE. RELIABLE. SUSTAINABLE.

Resulting from decades of hard work, innovation and lessons learned, the LANXESS Bromine Solutions of today is positioned to be an excellent partner to our customers for bromine, phosphorus and antimony-based flame retardant needs, both now and far into the future.

For almost a century, we have helped our customers to meet their flame retardant needs with a broad portfolio of products and solutions. In late 2010, the Great Lakes Solutions business was introduced with a mission to build on its well-established heritage, by introducing differentiated, innovative products and greener, sustainable solutions while maintaining performance and quality.

We are proud of our history and look forward to helping our customers meet future performance, safety and compliance requirements by constantly improving our portfolio with new and improved products for maximum sustainability.

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FLAME RETARDANTS – SAVING LIVES

Fire kills thousands of people each year throughout the world, but many are spared because fires are slowed or never start due to the use of flame retardants. LANXESS Bromine Solutions is a global leader in flame retardant products and solutions for use in applications such as furniture foam, electronic components, electrical enclosures, building products and more.

LANXESS Bromine Solutions believes the public should not be forced to choose between environmental and fire safety and that we must have both. Our business demands the highest standards of both fire retardancy performance and environmental sustainability. To meet these increasingly complex challenges, LANXESS Bromine Solutions offers a wide range of flame retardant solutions that allow OEM's the versatility to meet their individual needs.

Brominated flame retardants are used in a variety of applications from electronic housings to printed circuit boards and electrical connectors to flexible and rigid polyurethane foam. Brominated flame retardants provide optimal processing while maintaining outstanding physical properties in a cost effective manner.

Synergists & smoke suppressants

Smokebloc® / BFR	Series of products with combined flame retardants and / or afterglow and / or smoke suppressing properties. Used as partial or complete replacement for antimony oxide in PVC formulations.
Ongard® 2 (Available in Europe)	Proprietary zinc/magnesium complex, effective smoke suppressant for PVC with excellent heat aging properties. Cost effective antimony oxide replacement for stringent rigid PVC applications.
Thermoguard® CPA	Flame retardant synergists for PVC with low smoke performance. Used as partial or complete replacement for antimony oxide in PVC applications.

ANTIMONY, SYNERGISTS & SMOKE SUPPRESSANTS

Antimony trioxide

Typical values	Antimony oxide content (as Sb_2O_3)	Arsenic content (as As) (max)	Iron content (as Fe) (max)	Lead content (asPb) (max)	Av. particle size (typical values)
TMS® / Timonox® Red Star / Fireshild® H / Thermoguard® S	99.3 %	0.25 %	0.003 %	0.20 %	1.0 – 1.5 µm
TMS® / Timonox® White Star	99.5 %	0.25 %	0.003 %	0.07 %	1.0 – 1.5 µm
TMS-HP® / Timonox® Blue Star Polymer Grade / Fireshild® HB / Fireshild® H-HPM / Thermoguard® HPM (Products registered in Europe)	99.5 %	0.09 %	0.003 %	0.10 %	0.9 – 1.5 µm
Trutint® 50	99.3 %	0.30 %	0.005 %	0.20 %	2.3 µm
Fireshild® L / Thermoguard® L	99.3 %	0.30 %	0.002 %	0.20 %	2.0 – 3.2 µm
Microfine® A05 / Microfine® A03 / Ultrafine™ II	99.3 %	0.30 %	0.003 %	0.20 %	0.3 – 0.9 µm

Sodium antimonate

Typical values	Antimony oxide content (as Sb_2O_3)	Arsenic content (as As) (max)	Iron content (as Fe) (max)	Lead con-tent (asPb) (max)	Av. particle size (typical values)
Pyrobloc® SAP-2 / Thermoguard® FR	60.4	0.09 %	0.005 %	0.09 %	2 µm

Zinc borate

Typical values	Stoichiometry (°C, % mass loss)	TGA	Av. particle size
ZB-223	$2ZnO.2B_2.O_3.3H_2O$	200 °C 1 % 245 °C 5 % 285 °C 10 %	4 µm
ZB-467	$4ZnO.6B_2.O_3.7H_2O$	280 °C 1 % 380 °C 5 % 420 °C 10 %	4 µm

FLAME RETARDANTS
SELECTION GUIDE

	Polyolefins	Polypropylene	Polyethylene	TPO (thermoplastic polyolefin)	EPDM	PVC	Styrenics	HIPS (high impact polystyrene)	ABS	PC/ABS (polycarbonate / ABS blends)
Bromine-based flame retardants										
Emerald Innovation® 3000										
PDBS-80™										
Firemaster® CP-44HF										
Firemaster® PBS-64HW										
PHT-4™ †										
PHT4-Diol™ †										
PHT4-Diol LV™ †										
Firemaster® 504										
Firemaster® 508										
DP-45™					■	■				
BA-59P™ †									■	
Firemaster® BZ-54*						■				
Firemaster® 600*										
Firemaster® 602*										
BC-52™										■
BC-58™										■
Firemaster® 2100R		■	■	■	■			■	■	■
PH-73FF™ †										
Antimony-based synergists										
TMS®/ Timonox® Red Star/Fireshield® H / Thermoguard® S*		■	■	■	■	■		■	■	■
Trutint®/ Fireshield® L / Thermoguard® L*		■	■	■		■				
Microfine®/ Ultrafine™ II*		■	■	■		■		■	■	■
Pyrobloc® SAP2 / Thermoguard® FR*										
Other synergists / smoke suppressants										
Zinc Borate ZB-223						■				
Zinc Borate ZB-467		■	■	■	■	■		■		
Smokebloc® blends						■				
Ongard® 2						■				
Thermoguard® CPA						■				

■ Recommended ■ Suitable † Reactive flame retardant used during polymerization. * Products not registered for sale in Europe.

PPE/HIPS blends	XPS	EPS	Polyurethane	Rigid (polyurethane (PUR/PIR)	Flexible polyurethane	TPU	Thermosets	UPE (unsaturated polyester)	Epoxy	Phenolics	Engineering thermoplastics	PA 6	PA 66	HTPA	PBT	PET	PC
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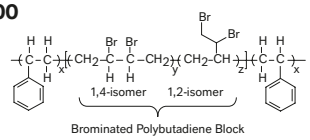
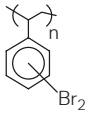
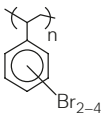
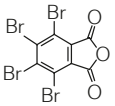
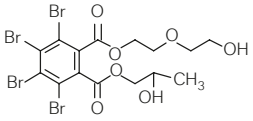
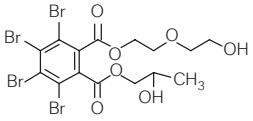
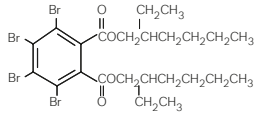
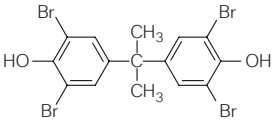
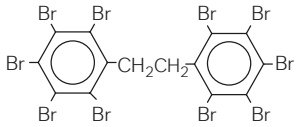
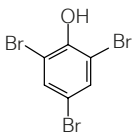
BROMINE-BASED
FLAME RETARDANTS

		Viscosity/ melting range °C	Volatility TGA, Wt. loss @ temp	Typical specific gravity	Bulk density g/ml	Solubility (g/100 g solvent @ 25 °C)	
Emerald Innovation® 3000 Brominated polymeric Bromine content: 64 %	 CAS No. 1195978-93-8	Softening 120	5 % @ 255 °C 10 % @ 260 °C 50 % @ 280 °C	1.9	0.5 (L) 0.7 (P)	Water Methylene chloride Methanol Styrene	<0.1 >20 <0.1 >20
PDBS-80™ Poly (dibromostyrene) Formula weight: 50,000 Bromine content: 59.0 %	 CAS No. 88497-56-7	Tg: 144	5 % @ 368 °C 10 % @ 378 °C 50 % @ 404 °C 95% @ 544 °C	1.9	1.11 (P)	Water Dichloromethane Toluene Methanol MEK	<0.1 C C <0.1 2
Firemaster® CP44-HF Copolymer of dibromostyrene Formula weight: ~16,000 Bromine content: 64 – 65 %	Proprietary CAS No. 88497-56-7	Tg: 147	1 % @ 316 °C 5 % @ 347 °C	2.0		Water Toluene Methylene chloride MEK Methanol Acetone	Insoluble C P P Insoluble Insoluble
Firemaster® PBS-64HW Poly (dibromostyrene) Formula weight: 40,000 Bromine content: 64.0 %	 CAS No. 88497-56-7	Tg: 156	5 % @ 356 °C 10 % @ 371 °C 50 % @ 401 °C	2.0	1.25 (P)	Water Dichloromethane Toluene Methanol MEK	<0.1 C C <0.1 P
PHT4™ Tetrabromophthalic anhydride Formula weight: 463.7 Bromine content: 68.2 %	 CAS No. 632-79-1	274 – 277	5 % @ 229 °C 10 % @ 242 °C 50 % @ 277 °C	2.9	1.37 (L) 2.09 (P)	Water Dichloromethane Toluene Methanol MEK	<0.1 1 6 1.6 2.6
PHT4-Diol™ Tetrabromophthalate diol Formula weight: 627.9 Bromine content: 46.0 %	 US CAS No. 77098-07-8 EU CAS No. 20566-35-2	90,000 cps @ 25°C	5 % @ 128 °C 10 % @ 166 °C 50 % @ 319 °C 95 % @ 380 °C	1.9		Water Dichloromethane Toluene Methanol MEK	<0.5 C C 9 C
PHT4-Diol™ LV Tetrabromophthalate diol Formula weight: 627.9 Bromine content: 43 %	 CAS No. 77098-07-8 EU CAS No. 20566-35-2	22,500 cps @ 25°C	5 % @ 127 °C 10 % @ 151 °C 50 % @ 325 °C 95 % @ 382 °C	1.7		Water Dichloromethane Toluene Methanol MEK	<0.5 C C 9 C
Firemaster® 504 Tetrabromophthalate diol blend Bromine content: 18 % (This product is not registered for sale in Europe)	Proprietary	350 – 500 cps @ 25°C	5 % @ 147 °C 10 % @ 167 °C 50 % @ 211 °C	1.45		Water Dichloromethane Toluene MEK Methanol MEK	<0.1 C C C C C
Firemaster® 508 Tetrabromophthalate diol blend Bromine Content: 37 % This product is not registered for sale in Europe)	Proprietary	8800 cps @ 25°C	5 % @ 136 °C 10 % @ 157 °C 50 % @ 285 °C	1.67		Water Dichloromethane Toluene MEK Methanol MEK	<0.1 C C C C C

		Viscosity/ melting range °C	Volatility TGA, Wt. loss @ temp	Typical specific gravity	Bulk density g/ml	Solubility (g/100 g solvent @ 25 °C)	
DP-45™ Tetrabromophthalate ester Formula weight: 706.1 Bromine content: 45 %	 CAS No. 26040-51-7	1800 cps @ 25°C	5 % @ 211 °C 10 % @ 226 °C 50 % @ 268 °C 95 % @ 291 °C	1.6		Water Dichloromethane Toluene Methanol MEK	<0.1 C C 5.7 C
BA-59P™ Tetrabromobisphenol A Formula weight: 543.7 Bromine content: 59 %	 CAS No. 79-94-7	179 – 182	5 % @ 244 °C 10 % @ 261 °C 50 % @ 301 °C	2.2	0.96 (L) 1.36 (P)	Water Acetone Dichloromethane Toluene Methanol MEK	<0.1 225 27 6 80 168
Firemaster® BZ-54 Tetrabromophthalic anhydride derivative Bromine content: 54% (This product is not registered for sale in Europe)	Proprietary	800 cps @ 25°C	5 % @ 211 °C 10 % @ 226 °C 50 % @ 268 °C 95 % @ 291 °C	1.7		Water Dichloromethane Toluene Methanol MEK	<0.1 C C 5.7 C
Firemaster® 600 Tetrabromobenzoate ester composition Bromine content: 27% Phosphorus content: 4% (This product is not registered for sale in Europe)	Proprietary Blend	200 cps @ 25°C	5 % @ 210 °C 10 % @ 226 °C 25 % @ 249 °C 50 % @ 269 °C	1.4		Water Dichloromethane Toluene Methanol MEK	<0.1 C 9.47 C C
Firemaster® 602 Tetrabromobenzoate ester composition Bromine content: 27% Phosphorus content: 4% (This product is not registered or sale in Europe)	Proprietary Blend	200 cps @ 25°C	5 % @ 217 °C 10 % @ 234 °C 25 % @ 257 °C 50 % @ 279 °C	1.4		Water Dichloromethane Toluene Methanol MEK	<0.1 C 9.40 C C
BC-52™ Phenoxy-terminated carbonate oligomer of Tetrabromobisphenol A Formula Weight: ~2,500 Bromine Content: 52%	Proprietary CAS No. 94334-64-2	180 – 210	5 % @ 408 °C 10 % @ 438 °C 50 % @ 480 °C	2.2	0.61 (L) 1.00 (P)	Water Dichloromethane Toluene Methanol MEK	<0.1 C 14 <0.1 C
BC-58™ Phenoxy-terminated carbonate oligomer of tetrabromobisphenol A Formula weight: ~3,500 Bromine content: 58%	Proprietary CAS No. 71342-77-3	200 – 230	5 % @ 380 °C 10 % @ 423 °C 50 % @ 475 °C	2.2	0.66 (L) 1.02 (P)	Water Dichloromethane Toluene Methanol MEK	<0.1 C 14 <0.1 C
Firemaster® 2100R Decabromodiphenyl ethane Formula weight: 971.2 Bromine content: 81-82%	 CAS No. 84852-53-9	348 – 353	1 % @ 314 °C 5 % @ 344 °C 50 % @ 402 °C 90 % @ 423 °C	3.2	1.19 (L) 1.39 (P)	Water Dichloromethane Toluene Methanol MEK	<0.01 <0.01 <0.01 <0.01 <0.01
PH-73FF™ 2,4,6 Tribromophenol Formula weight: 330.8 Bromine content: 72.5%	 CAS No. 118-79-6	91 – 95	5 % @ 122 °C 10 % @ 134 °C 50 % @ 167 °C 95 % @ 183 °C	2.2	1.4 (L) 1.41 (P)	Water Dichloromethane Toluene Methanol MEK	<0.1 36 50 84 225

Notes:

TGA:
10 mg @ 10 °C/min., N_2

Bulk Density:
L denotes loose
P denotes packed

Solubility:
C denotes complete solubility (100 g/100 ml)
P denotes partial solubility

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