HALLSTAR

UNIPLEX™ FRP-45

TETRABROMOPHTHALATE ESTER

APPLICATION GUIDE FOR ELASTOMERS

Hallstar works collaboratively with companies around the world to deliver chemistry solutions that enhance next-generation products.

As manufacturers find themselves under pressure to innovate, their ability to compete globally depends increasingly on how well they can leverage the knowledge of technology suppliers.

Hallstar's expertise in polymer modification and optimization, coupled with our application knowledge across a wide range of industrial products, is unique in the specialty chemical industry. Our ability to continually invent and formulate chemistry solutions to meet the unmet needs of our customers—is based on years of specialized esterification experience.

Taking a collaborative approach to new chemistry solutions is what Hallstar is all about. Together we can explore new approaches and possibilities, and anticipate what it takes to succeed tomorrow, next year and for years to come. Explore what our innovative plasticizers can do, then give us a call.

LET'S WORK WONDERS®

UNIPLEX™ FRP-45 TETRABROMOPHTHALATE ESTER

FRP-45 is a liquid flame retardant with plasticizer functionality. It is compatible with PVC, adhesives, coatings and SBR, CR and EPDM. The properties of FRP-45 are:

- High flame retarding efficiency
- Excellent plasticizing efficiency
- Good heat stability
- Compatibility with multiple types of plasticizers
- Low emissions
- Good dielectric properties

As a special FR functioning plasticizer, FRP-45's main use is for PVC wire and cable insulation jackets, as well as fabric coatings and films. In wire and cable, it passes the plenum (UL910) fire retardant test. In order to improve FRP-45 efficiency, a small volume of Sb_2O_3 should be used as an enhancer. If Sb_2O_3 cannot be used, adding more FRP-45 can achieve the targeted FR performance.

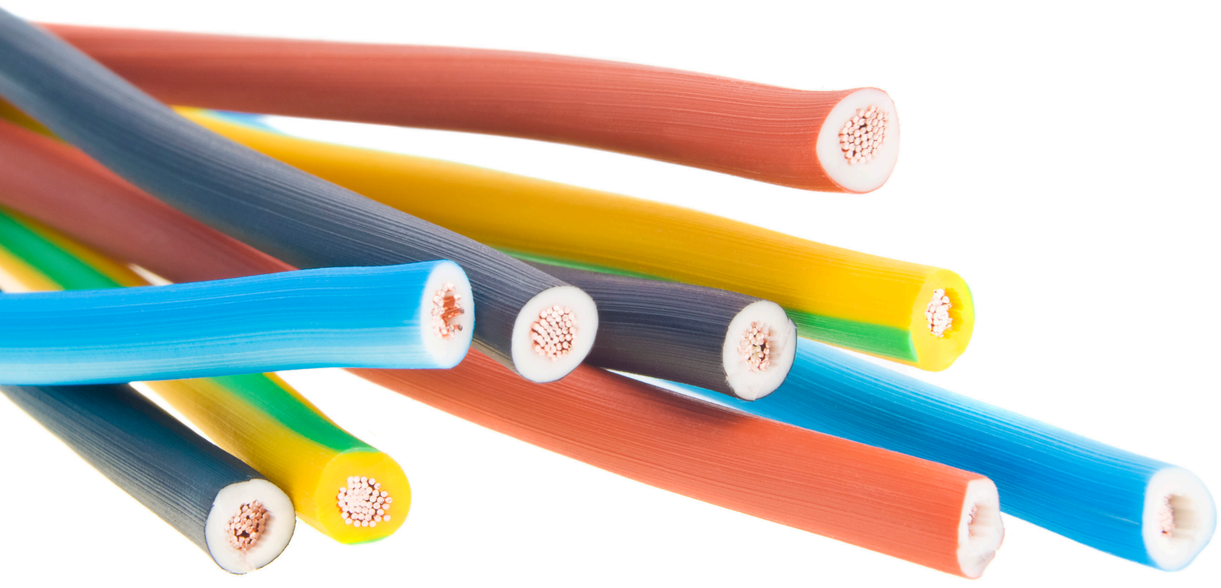
Physical Properties	
Appearance	Amber clear liquid
Viscosity, cps, @25°C	1800
Pour Point, °C	-20
Specific Gravity	1.54
Density lb/gal	13
Bromine Content, %, min.	45
Gardner, max.	3
Acid Value, mg KOH/g, max.	0.05
Assay %, min.	95

FRP-45 IN CPE

FRP-45 has both FR and plasticizing function, in comparison to chlorinated paraffin, phosphates and other halogen additives, FRP-45 has the following performance advantages:

- High efficiency in FR – Use less to achieve same targeted oxygen index or UL94V-0 grade
- Low Smoking – in NBS smoke density test, FRP-45/CPE shows less smoking
- Lower cost – in bulk density, FRP-45 formulation cost to achieve UL94 V-0 is cheaper by 5-20%

Recipe	Loading (PHR)
CPE	100
$CaCO_3$	150
Carbon Black	35
DOP	Variable
Flame Retardant	Variable
Stabilizer	12
Peroxide	5
Sb_2O_3	2



FRP-45 IN CPE

Lowest loading needed to achieved oxygen index of 30 (V-0) UL-94.

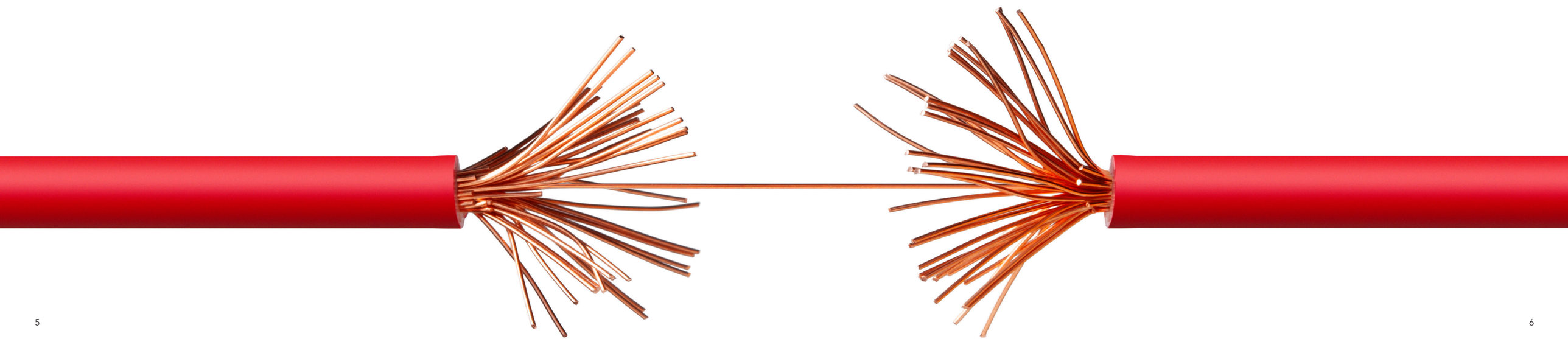
	Control (no additive)	FRP-45	Chlorinated Paraffin	Polybromodiphenyl Ether	Phosphate Ester
PHR	–	18	23	23	29
DOP, PHR	38	25	22	38	10
Oxygen Index	24	30	30	30	30
UL94, 1/16”	No Pass	V-0	V-0	V-0	V-0
NBS Smoke Test					
Flame	120	130	145	240	130
Smolder	80	90	105	170	100
Physical Properties					
Tensile (psi)	1400	1440	1360	1370	1350
Modulus @100%	1920	2050	2300	2240	1560
Modulus @300%	710	780	970	890	720
Elongation (%)	530	550	480	460	560
Shore A	77	78	79	78	75
Heat Aging - 240 Hours @150°C					
Tensile Strength					
Retaining	1500	1467	1710	1650	1810
Change (%)	+7	+2	+26	+21	-34
Elongation	530	280	120	160	110
Change (%)	(-51)	(-49)	(-75)	(-65)	(-80)
Hardness (Shore A)	89	86	90	89	91

FRP-45 IN EPDM

FRP-45 is a liquid FR, with both FR and plasticizing functions. In EPDM, it can be used to replace most oil plasticizers.

- Excellent FR efficiency
- Excellent plasticizing efficiency
- High heat stability
- NBS low smoke volume
- Good physical properties
- UV stable

Recipe	Loading (PHR)
EPDM	100
Talc	60
Tio2	30
Paraffinic Process Oil	Variable
Stabilizer and Processing Aid	19
Sb_2O_3	7
Sulfur	1.5
Flame Retardant	Variable



FRP-45 IN EPDM

Recipe	I	II	III
FRP-45, PHR	–	40	–
Polybromodiphenyl Ether, PHR	–	–	53
PHR Plasticizing Oil, PHR	60	35	60
Physical Properties			
Shore A	61	63	63
Tensile (psi)	1400	1460	1330
Modulus (psi)	260	250	270
Elongation (%)	680	610	620
ΔE - * UV Stability - Color	5.5	8.8	11.4
* UV Stability - Yellowing	-7.6	-4.9	-7.6
FR Properties			
Oxygen Index	18	27	27
NBS flame smoke	220	300	400
UL1581 - 105°C (135°C) 135°C for 7 days			
Tensile Strength (psi)	86	90	78
Elongation (%)	40	44	28
Shore A	70	67	76

* 300 (Xenon Arc) Expose to UV 300 hours

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