

General information

Designation

Phenol formaldehyde (Unfilled, Casting Resin)

Tradenames

Bakelite; Durez; Ferroreg; Fiberite; Norsophen; Plaslok; Plenco; Polychem; Reliapreg; Resinoid; Texolite; Trolitan; Vyncolite

Typical uses

Electrical parts - sockets, switches, connectors, general industrial, water-lubricated bearings, relays, pump impellers, microwave cookware, handles, bottles tops, coatings, adhesives, bearings, foams and sandwich structures.

Composition overview

Compositional summary

PF casting resin

Material family	Plastic (thermoset)
Base material	PF (Phenol formaldehyde resin)
Polymer code	PF

Composition detail (polymers and natural materials)

Polymer	100	%
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Price

Price	* 0.749	-	0.849	USD/lb
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Physical properties

Density	0.0448	-	0.0477	lb/in^3
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Mechanical properties

Young's modulus	0.4	-	0.701	10^6 psi
Yield strength (elastic limit)	* 4	-	7.21	ksi
Tensile strength	5	-	9.01	ksi
Elongation	1.5	-	2	% strain
Compressive modulus	* 0.4	-	0.701	10^6 psi
Compressive strength	* 12	-	14.9	ksi
Flexural modulus	0.4	-	0.701	10^6 psi
Flexural strength (modulus of rupture)	11	-	17	ksi
Shear modulus	* 0.144	-	0.253	10^6 psi
Bulk modulus	* 0.755	-	0.793	10^6 psi
Poisson's ratio	* 0.378	-	0.394	
Shape factor	8.1			
Hardness - Vickers	* 8.3	-	14.9	HV
Hardness - Rockwell M	93	-	120	
Hardness - Rockwell R	* 121	-	133	
Fatigue strength at 10^7 cycles	* 2	-	3.6	ksi
Mechanical loss coefficient (tan delta)	* 0.00828	-	0.0145	

Impact & fracture properties

Fracture toughness	* 0.716	-	1.1	ksi.in^0.5
Impact strength, notched 23 °C	7.95e-4	-	0.00128	BTU/in^2

Thermal properties

Glass temperature	338	-	518	°F
Heat deflection temperature 0.45MPa	* 196	-	248	°F

Heat deflection temperature 1.8MPa	165	-	174	°F
Maximum service temperature	* 288	-	315	°F
Minimum service temperature	* -45.4	-	44.6	°F
Thermal conductivity	0.0815	-	0.0878	BTU.ft/hr.ft^2.°F
Specific heat capacity	* 0.35	-	0.364	BTU/lb.°F
Thermal expansion coefficient	66.7	-	69.4	µstrain/°F

Electrical properties

Electrical resistivity	3.3e18	-	3e19	µohm.cm
Dielectric constant (relative permittivity)	* 4	-	6	
Dissipation factor (dielectric loss tangent)	0.005	-	0.01	
Dielectric strength (dielectric breakdown)	250	-	399	V/mil
Comparative tracking index	125	-	225	V

Optical properties

Transparency	Opaque
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Magnetic properties

Magnetic type	Non-magnetic
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Bio-data

RoHS (EU) compliant grades?	✓
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Absorption & permeability

Water absorption @ 24 hrs	0.1	-	0.36	%
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Processing properties

Polymer injection molding	Unsuitable			
Polymer extrusion	Unsuitable			
Polymer thermoforming	Unsuitable			
Linear mold shrinkage	* 0.1	-	1	%
Mold temperature	302	-	338	°F
Molding pressure range	* 0.998	-	20	ksi

Durability

Water (fresh)	Excellent
Water (salt)	Excellent
Weak acids	Excellent
Strong acids	Limited use
Weak alkalis	Unacceptable
Strong alkalis	Unacceptable
Organic solvents	Excellent
Oxidation at 500C	Unacceptable
UV radiation (sunlight)	Good
Flammability	Self-extinguishing

Primary production energy, CO2 and water

Embodied energy, primary production	3.14e4	-	3.47e4	BTU/lb
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Sources

60 MJ/kg (Patel, 2003); 82 MJ/kg (Song, Youn, Gutowski, 2009); 88.2 MJ/kg (Hammond and Jones, 2008)

CO2 footprint, primary production	4.74	-	5.23	lb/lb
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Sources

4.98 kg/kg (Voet, van der and Oers, van, 2003)

NOx creation	* 0.0126	-	0.0139	lb/lb
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SOx creation	* 0.0377	-	0.0417	lb/lb
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Water usage	* 1.36e3	-	1.51e3	in^3/lb
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Processing energy, CO2 footprint & water

Polymer molding energy	* 1.15e4	-	1.26e4	BTU/lb
Polymer molding CO2	* 2.13	-	2.35	lb/lb
Polymer molding water	* 440	-	660	in^3/lb
Coarse machining energy (per unit wt removed)	* 499	-	551	BTU/lb
Coarse machining CO2 (per unit wt removed)	* 0.087	-	0.0962	lb/lb
Fine machining energy (per unit wt removed)	* 3.15e3	-	3.48e3	BTU/lb
Fine machining CO2 (per unit wt removed)	* 0.55	-	0.607	lb/lb
Grinding energy (per unit wt removed)	* 6.1e3	-	6.74e3	BTU/lb
Grinding CO2 (per unit wt removed)	* 1.06	-	1.18	lb/lb

Recycling and end of life

Recycle	✗			
Recycle fraction in current supply	0.672	-	0.742	%
Downcycle	✓			
Combust for energy recovery	✓			
Heat of combustion (net)	* 1.35e4	-	1.42e4	BTU/lb
Combustion CO2	* 2.86	-	3.01	lb/lb
Landfill	✓			
Biodegrade	✗			

Geo-economic data for principal component

Principal component	Phenol formaldehyde			
Annual world production	9.35e6	-	1.03e7	ton/yr
Reserves	2.34e8	-	2.59e8	l. ton

Eco-indicators for principal component

Eco-indicator 99	148		millipoints/lb
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Links

ProcessUniverse

Producers

Reference

Shape