

Description

Image



Caption

1. ABS pellets. © Shutterstock 2. ABS allows detailed moldings, accepts color well, and is non-toxic and tough enough to survive the worst that children can do to it. © Gettyimages

The material

ABS (Acrylonitrile-butadiene-styrene) is tough, resilient, and easily molded. It is usually opaque, although some grades can now be transparent, and it can be given vivid colors. ABS-PVC alloys are tougher than standard ABS and, in self-extinguishing grades, are used for the casings of power tools.

Compositional summary

Block terpolymer of acrylonitrile (15-35%), butadiene (5-30%), and styrene (40-60%).

General properties

Density	63.1	-	75.5	lb/ft ³
Price	* 1.13	-	1.36	USD/lb
Date first used	1937			

Mechanical properties

Young's modulus	0.16	-	0.421	10 ⁶ psi
Shear modulus	0.0462	-	0.15	10 ⁶ psi
Bulk modulus	0.551	-	0.58	10 ⁶ psi
Poisson's ratio	0.391	-	0.422	
Yield strength (elastic limit)	2.68	-	7.4	ksi
Tensile strength	4	-	8.01	ksi
Compressive strength	4.5	-	12.5	ksi
Elongation	1.5	-	100	% strain
Hardness - Vickers	5.6	-	15.3	HV
Fatigue strength at 10 ⁷ cycles	1.6	-	3.2	ksi
Fracture toughness	1.08	-	3.9	ksi.in ^{0.5}

Mechanical loss coefficient (tan delta)	0.0138	-	0.0446
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Thermal properties

Glass temperature	190	-	262	°F
Maximum service temperature	143	-	170	°F
Minimum service temperature	-190	-	-99.7	°F
Thermal conductor or insulator?	Good insulator			
Thermal conductivity	0.109	-	0.194	BTU.ft/h.ft^2.F
Specific heat capacity	0.331	-	0.458	BTU/lb.°F
Thermal expansion coefficient	47	-	130	µstrain/°F

Electrical properties

Electrical conductor or insulator?	Good insulator			
Electrical resistivity	3.3e21	-	3e22	µohm.cm
Dielectric constant (relative permittivity)	2.8	-	3.2	
Dissipation factor (dielectric loss tangent)	0.003	-	0.007	
Dielectric strength (dielectric breakdown)	351	-	551	V/mil

Optical properties

Transparency	Opaque			
Refractive index	1.53	-	1.54	

Processability

Castability	1	-	2	
Moldability	4	-	5	
Machinability	3	-	4	
Weldability	5			

Eco properties

Embodied energy, primary production	* 9.78e3	-	1.08e4	kcal/lb
CO2 footprint, primary production	* 3.64	-	4.03	lb/lb
Recycle	✓			

Recycle mark



Supporting information

Design guidelines

ABS has the highest impact resistance of all polymers. It takes color well. Integral metallics are possible (as in GE Plastics' Magix.) ABS is UV resistant for outdoor application if stabilizers are added. It is hygroscopic (may need to be oven dried before thermoforming) and can be damaged by petroleum-based machining oils. ASA (acrylic-styrene-acrylonitrile) has very high gloss; its natural color is off-white but others are available. It has good chemical and temperature resistance and high impact resistance at low temperatures. UL-approved grades are available. SAN (styrene-acrylonitrile) has the good processing attributes of polystyrene but greater strength, stiffness, toughness, and chemical and heat resistance. By adding glass fiber the rigidity can be increased dramatically. It is transparent (over 90% in the visible range but less for UV light) and has good color, depending on the amount of acrylonitrile that is added this can vary from water white to pale yellow, but without a protective coating, sunlight causes yellowing and loss of strength, slowed by UV stabilizers. All three can be extruded, compression molded or formed to sheet that is then vacuum thermo-formed. They can be joined by ultrasonic or hot-plate welding, or bonded with polyester, epoxy, isocyanate or nitrile-phenolic adhesives.

Technical notes

ABS is a terpolymer - one made by copolymerizing 3 monomers: acrylonitrile, butadiene and styrene. The acrylonitrile gives thermal and chemical resistance, rubber-like butadiene gives ductility and strength, the styrene gives a glossy surface, ease of machining and a lower cost. In ASA, the butadiene component (which gives poor UV resistance) is replaced by an acrylic ester. Without the addition of butyl, ABS becomes, SAN - a similar material with lower impact resistance or toughness. It is the stiffest of the thermoplastics and has excellent resistance to acids, alkalis, salts and many solvents.

Typical uses

Safety helmets; camper tops; automotive instrument panels and other interior components; pipe fittings; home-security devices and housings for small appliances; communications equipment; business machines; plumbing hardware; automobile grilles; wheel covers; mirror housings; refrigerator liners; luggage shells; tote trays; mower shrouds; boat hulls; large components for recreational vehicles; weather seals; glass beading; refrigerator breaker strips; conduit; pipe for drain-waste-vent (DWV) systems.

Tradenames

Claradex, Comalloy, Cycogel, Cycolac, Hanalac, Lastilac, Lupos, Lustran ABS, Magnum, Multibase, Novodur, Polyfabs, Polylac, Porene, Ronfalin, Sinkral, Terluran, Toyolac, Tufrex, Ultrastyr

Links

Reference

ProcessUniverse

Producers