Plastics Data File – ABS

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1. Introduction

ABS (Acrylonitrile - butadiene - styrene terpolymer) is a member of the styrene family of polymers and shares many properties with the PS type of polymer. The actual properties of a particular ABS material depend on the blend ratio of the three major constituents (Acrylonitrile, butadiene and styrene). The material properties can be tailored to give specific desired properties: the acrylonitrile component gives chemical resistance and heat stability; the butadiene gives toughness and impact strength and the styrene gives rigidity and processability. Varying the A-B-S ratios will change the properties significantly and the number of grades available is almost limitless.

The ABS material itself can also be 'alloyed' with other materials such as PC, PMMA, PBT, PA and even PVC. This creates an even greater choice of properties and processing opportunities and many ABS materials are created for a single application (mainly automotive).

The material can be readily processed by most of the common processing methods.

2. Typical applications

Mechanical: Office machine housings that are colour fast and fire retardant, pipes and fittings.

Consumer goods: Food containers, luggage shells, household equipment such as vacuum cleaners and hair driers, vacuum formed refrigerator liners, internal trays for refrigerators, telephone handsets.

Automotive: Safety helmets, electroplating possibilities give applications in fascia panels, body fittings, instrument clusters and radiator grilles. ABS is effectively the 'material of choice' for automotive interior applications.

Electrical: Computer housings and automotive fascias.

Miscellaneous: Dinghy hulls thermoformed from sheets give stiff, impact resistant hull that is unaffected by sea water. Plumbing fittings when electroplated.

3. Physical and mechanical properties

General

ABS is hard and tough even at temperatures as low as -40°C. It has a high resistance to temperature fluctuations but has very limited weathering resistance and the mechanical properties tend to degrade quickly in outdoor exposure. It has low water absorption.

Mechanical properties

Property	Approximate Value
Tensile strength	55 - 80 MN/m^2
Tensile Modulus	2 - 3 GN/m^2
Elongation at Break	10 - 50 %
Flexural Strength	<50 - 150 MN/m^2
Notched Impact Strength	10 - 20 kJ/m^2
Specific Heat	1.25 - 1.70 kJ/kg°C
Glass Transition Temperature	110°C

Heat Deflection Temperature	<100°C
Coefficient of Thermal Expansion	5 - 10 x 10^{-5} / °C
Long Term Service Temperature	<100°C
Specific Gravity	1.0 - 1.2
Mould Shrinkage	0.001 - 0.005 m/m
Water Absorption	0.1 - 0.5 % (50% rh)
Transparency	Opaque

4. Thermal, electrical and optical properties

Thermal properties

ABS has good high temperature performance and the softening point is generally higher than standard PS. The heat deflection temperature can be increased by several methods to between 120 to 130°C.

ABS can be used down to about -40°C.

Fire behaviour

Most ABS variants are flammable and will burn freely (giving off typical styrene odours). The flame and fire properties of ABS can be improved by blending bromine compounds at 15 - 20 pts phr – an expensive solution that seriously compromises the toughness of the material. Another method is to create an ABS/PVC blend and to let the chlorine on the PVC act as a fire retardant.

Electrical properties

ABS has relatively good electrical insulating properties and products are suitable for secondary insulating applications.

Optical properties

Natural ABS is milky-opaque but can be easily coloured in a wide variety of colours. Special glass clear versions are available.

5. Chemical resistance properties

ABS is resistant to most acids and alkalis, hydrocarbons, oils and fats. It is not resistant to acetone, ether, ethyl benzene, ethyl chloride and ethylene chloride.

ABS has a low water absorption.

A detailed chemical resistance chart for PS is given in Section 11.

Resistance to weathering

Most ABS blends have poor weathering resistance.

6. Advantages and limitations

Advantages	Limitations
1. Good stain resistance	1. Poor weathering resistance.
2. Good impact resistance even at low temperatures.	2. Must be dried before processing.
3. Good electrical insulator and the electrical properties are unchanged by changes in humidity.	3. Ordinary grades burn easily and continues to burn once the flame is removed.
4. Low water absorption.	4. Poor heat resistance.
5. Easily electroplated to give good finish.	5. Poor transparency but can be mixed with PMMA to improve.
6. Good scuff or abrasion resistance.	6. Scratches easily.
7. Tough and stiff.	7. Attacked by strong adds and alkalis, chlorinated solvents and can suffer from stress cracking in the presence of some greases.
8. Wide colour range possible (natural is ivory colour).	

7. Processing

ABS is an amorphous material and softens over a range of temperatures rather than melting quickly as do the crystalline materials. The materials have a broad processing window and can be processed on most standard machinery. ABS is available in standard and easy-flow grades and the easy flow grades are very good for complex mouldings.

Pre-drying is not always needed for injection moulding with a vented cylinder but if drying is needed then 4 hours at 80˚C is generally sufficient. Signs of moisture are stripes, streaks or bubbles in the moulding and if any of these are seen then the material should be pre-dried.

Injection moulding

Mould temperature is usually between 30 and 80˚C and the higher the mould temperature the better the surface quality. Weld lines may also become less prominent with increasing mould temperature.

Moulding is carried out with an injection pressure of 1000 to 1500 bar and using a follow-up pressure of relatively short length but in the region of 30 - 60% of the injection pressure.

Back pressure using a normal cylinder is 100 - 250 bar and should be kept high to avoid air scorching of the material, a vented cylinder uses 20 - 50 bar and if this is too high then the easy flow grades will ooze from the vent port.

Screw speeds can be high but should be set to ensure complete plastification.

Injection speeds can be high but it is best to start slowly and then to inject rapidly.

Extrusion

Screws should be chrome plated, single lead, full flighted constant pitch screws. Compression ratio should increase from around 2:1 to 2.5:1. In the absence of special ABS screws, low-compression PVC or shallow flighted PS screws can be used at low production rates.

Reprocessing of up to 30% can be used provided the regrind has not been subjected to previous thermal degradation.

Process selector

Processing Method	Applicable
Injection Moulding	Yes
Extrusion	Yes
Extrusion Blow Moulding	No
Injection Blow Moulding	No
Rotational Moulding	Yes
Thermoforming	Yes
Casting	Yes
Bending and joining	Yes

8. Finishing

Machining

ABS can be easily machined using most conventional methods. The chips formed during machining will tend to melt unless coolants are used. Tools should be sharp and have good clearance and cutting angle.

Surface treatment

ABS can be electroplated and can easily be polished to an excellent surface finish.

Welding

All processes suitable for thermoplastics can be used e.g., high frequency, hot gas, ultrasonic, friction, hot plate and heat impulse welding.

Bonding

ABS can be readily bonded with solvent cements such as MEK, tetrahydofuran, and methylene chloride. Bonds should use the minimum amount of solvent and be held under slight pressure until complete.

9. Health and safety

ABS does not constitute a health hazard.

10. Other information

Identification

ABS is flammable and continues to burn when the source of ignition is removed.

11. Detailed chemical resistance

Important Note:

Whilst we try to ensure that this table is as accurate as possible, we cannot guarantee that the data contained in the tables is accurate for all blends and grades. In all cases the supplier of the material should be contacted to determine the exact chemical resistance of the material.

R = Resistant, LR = Limited Resistance, NR = Not Recommended, ND = No Data

Chemical	Resistance		
	20°C	60°C	100°C
Acetaldehyde	NR	NR	ND
Acetic acid (10%)	R	NR	ND
Acetic acid (glac./anh.)	NR	NR	ND
Acetic anhydride	NR	NR	ND
Aceto-acetic ester	NR	NR	ND
Acetone	NR	NR	ND
Other ketones	NR	NR	ND
Acetonitrile	ND	ND	ND
Acetylene	ND	ND	ND
Acetyl salicylic acid	NR	NR	ND
Acid fumes	NR	NR	ND
Alcohols	NR	NR	ND
Aliphatic esters	NR	NR	ND
Alkyl chlorides	NR	NR	ND
Alum	R	R	ND
Aluminium chloride	R	R	ND
Aluminium sulphate	R	R	ND
Ammonia, anhydrous	R	NR	ND
Ammonia, aqueous	R	NR	ND
Ammonium chloride	R	R	ND
Amyl acetate	NR	NR	ND

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Chemical	Resistance		
	20°C	60°C	100°C
Aniline	NR	NR	ND
Antimony trichloride	R	R	ND
Aqua regia	NR	NR	ND
Aromatic solvents	NR	NR	ND
Ascorbic acid	NR	NR	ND
Beer	R	R	ND
Benzaldehyde	R	ND	ND
Benzene	NR	NR	ND
Benzoic acid	R	R	ND
Benzoyl peroxide	R	ND	ND
Boric acid	R	R	ND
Brines, saturated	R	R	ND
Bromide (K) solution	R	R	ND
Bromine	NR	NR	ND
Bromine liquid, tech.	NR	NR	ND
Bromine water, saturated aqueous	NR	NR	ND
Butyl acetate	ND	ND	ND
Calcium chloride	R	R	ND
Carbon disulphide	NR	NR	ND
Carbonic acid	R	R	ND
Carbon tetrachloride	NR	NR	ND
Caustic soda & potash	R	R	ND
Cellulose paint	ND	ND	ND
Chlorates of Na, K, Ba	R	R	ND
Chlorine, dry	R	R	ND
Chlorine, wet	R	R	ND

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Chemical	Resistance		
	20°C	60°C	100°C
Chlorides of Na, K, Ba	R	R	ND
Chloroacetic acid	NR	NR	ND
Chlorobenzene	NR	NR	ND
Chloroform	NR	NR	ND
Chlorosulphonic acid	NR	NR	ND
Chromic acid (80%)	R	NR	ND
Citric acid	R	R	ND
Copper salts (most)	R	R	ND
Cresylic acids (50%)	NR	NR	ND
Cyclohexane	NR	NR	ND
Detergents, synthetic	R	NR	ND
Emulsifiers, concentrated	ND	ND	ND
Esters	NR	NR	ND
Ether	NR	NR	ND
Fatty acids (>C6)	R	R	ND
Ferric chloride	R	R	ND
Ferrous sulphate	R	R	ND
Fluorinated refrigerants	NR	NR	ND
Fluorine, dry	NR	NR	ND
Fluorine, wet	NR	NR	ND
Fluorosilic acid	NR	NR	ND
Formaldehyde (40%)	R	R	ND
Formic acid	R	R	ND
Fruit juices	R	R	ND
Gelatine	R	R	ND
Glycerine	R	R	ND

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Chemical	Resistance		
	20°C	60°C	100°C
Glycols	NR	NR	ND
Glycol, ethylene	R	R	ND
Glycolic acid	NR	NR	ND
Hexamethylene diamine	ND	ND	ND
Hexamine	NR	NR	ND
Hydrazine	ND	ND	ND
Hydrobromic acid (50%)	R	NR	ND
Hydrochloric acid (10%)	R	R	ND
Hydrochloric acid (conc.)	R	NR	ND
Hydrocyanic acid	R	R	ND
Hydrofluoric acid (40%)	R	NR	ND
Hydrofluoric acid (75%)	NR	NR	ND
Hydrogen peroxide (30%)	R	NR	ND
Hydrogen peroxide (30 - 90%)	NR	NR	ND
Hydrogen sulphide	ND	ND	ND
Hypochlorites	R	R	ND
Hypochlorites (Na 12-14%)	R	NR	ND
Iso-butyl-acetate	ND	ND	ND
Lactic acid (90%)	R	R	ND
Lead acetate	R	R	ND
Lead perchlorate	ND	ND	ND
Lime (CaO)	R	R	ND
Maleic acid	R	R	ND
Manganate, potassium (K)	R	R	ND
Meat juices	R	R	ND
Mercuric chloride	R	NR	ND

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Chemical	Resistance		
	20°C	60°C	100°C
Mercury	R	R	ND
Methanol	NR	NR	ND
Methylene chloride	NR	NR	ND
Milk products	R	NR	ND
Moist air	R	R	ND
Molasses	R	NR	ND
Monoethanolamine	NR	NR	ND
Naptha	R	NR	ND
Napthalene	NR	NR	ND
Nickel salts	R	R	ND
Nitrates of Na, K and NH3	R	R	ND
Nitric acid (<25%)	NR	NR	ND
Nitric acid (50%)	NR	NR	ND
Nitric acid (90%)	NR	NR	ND
Nitric acid (fuming)	NR	NR	ND
Nitrite (Na)	R	NR	ND
Nitrobenzene	NR	NR	ND
Oils, diesel	ND	ND	ND
Oils, essential	R	R	ND
Oils, lubricating + aromatic additives	NR	NR	ND
Oils, mineral	R	R	ND
Oils, vegetable and animal	R	R	ND
Oxalic acid	R	NR	ND
Ozone	NR	NR	ND
Paraffin wax	R	R	ND
Perchloric acid	ND	ND	ND

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Chemical	Resistance		
	20°C	60°C	100°C
Petroleum spirits	NR	NR	ND
Phenol	NR	NR	ND
Phosphoric acid (20%)	R	NR	ND
Phosphoric acid (50%)	R	NR	ND
Phosphoric acid (95%)	R	NR	ND
Phosphorous chlorides	ND	ND	ND
Phosphorous pentoxide	ND	ND	ND
Phthalic acid	ND	ND	ND
Picric acid	ND	ND	ND
Pyridine	NR	NR	ND
Salicyl aldehyde	R	ND	ND
Sea water	R	R	ND
Silicic acid	R	R	ND
Silicone fluids	ND	ND	ND
Silver nitrate	R	R	ND
Sodium carbonate	R	R	ND
Sodium peroxide	R	ND	ND
Sodium silicate	R	NR	ND
Sodium sulphide	R	NR	ND
Stannic chloride	NR	NR	ND
Starch	R	NR	ND
Sugar, syrups & jams	R	R	ND
Sulphamic acid	ND	ND	ND
Sulphates (Na, K, Mg, Ca)	R	R	ND
Sulphites	R	NR	ND
Sulphonic acids	ND	ND	ND

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Chemical	Resistance		
	20°C	60°C	100°C
Sulphur	R	ND	ND
Sulphur dioxide, dry	R	NR	ND
Sulphur dioxide, wet	R	NR	ND
Sulphur dioxide (96%)	NR	NR	ND
Sulphur trioxide	R	R	ND
Sulphuric acid (<50%)	NR	NR	ND
Sulphuric acid (70%)	NR	NR	ND
Sulphuric acid (95%)	NR	NR	ND
Sulphuric acid, fuming	NR	NR	ND
Sulphur chlorides	ND	ND	ND
Tallow	R	R	ND
Tannic acid (10%)	ND	ND	ND
Tartaric acid	R	R	ND
Trichlorethylene	NR	NR	ND
Urea (30%)	R	R	ND
Vinegar	R	R	ND
Water, distilled.	R	R	ND
Water, soft	R	R	ND
Water, hard	R	R	ND
Wetting agents (<5%)	R	R	ND
Yeast	R	NR	ND
Zinc chloride	NR	NR	ND