

# ABS & HIPS

Acrylonitrile butadiene styrene (ABS) is one of the most widely used plastics. As a result of its high impact resistance and suitability for heavy duty applications, ABS has found wide acceptance in the refrigeration and automotive industries, as well as for the printing and display markets. ABS is particularly suitable for vacuum forming.

ABS can be manufactured in a range of thicknesses from 200 micron to 5mm with a maximum width of 1600mm. It is available in leathergrain, fine grain and deep grain finishes on thicknesses of 1.5mm-3mm and specific colours can be made to order, subject to a minimum order requirement.

Specialised ABS products incorporating extruded layers of acrylic for superior resistance to UV attack can be manufactured.

High impact polystyrene (HIPS) sheet is manufactured by Ampaglas in thicknesses ranging from 200 micron to 4mm.

HIPS sheet has multiple applications in many markets, it can be vacuum formed, silk screened and machined. It is suitable for point of sale display units, indoor signage, showcases and packaging inserts.

HIPS sheet is also extensively used in the refrigeration and automotive markets, where its superior qualities for thermoforming make it a versatile choice.

It can be manufactured with a high gloss finish and is approved for food usage.

## Colours and stock sizes

ABS	Sheet thickness (mm)								
	0.9	1.0	1.5	2.0	2.5	3.0	4.0	5.0	
Sheet size and colour									
Black									
1600 x 800	•								
2500 x 1250		•	•	•		•			
Black matt leathergrain									
2500 x 1250			•	•	•	•			
2000 x 1000				•		•			
White semi gloss									
1460 x 290	•								
1765 x 150	•								
1765 x 190	•								
1770 x 440	•								
1600 x 800	•								
1765 x 880	•								
2000 x 1000	•	•	•	•	•	•	•	•	
2500 x 1250	•	•	•	•	•	•	•		
Colours : dark (avail in yellow)									
1600 x 800	•								
1765 x 880	•								
2500 x 1250		•							
White (cut price)									
150 x 150	•								
190 x 190	•								
290 x 290	•								
440 x 440	•								
Pack sizes are dependent on sheet size and thickness and generally range from 5 sheets per pack for the thicker sheet to 50 sheets per pack for the thinner material.									
HIPS	Sheet thickness (mm)								
	0.4	0.5	0.75	1.0	1.5	2.0	2.5	3.0	4.0
Sheet size and colour									
White matt									
2000 x 1000	•	•	•	•	•	•	•	•	
2500 x 1250				•	•	•	•	•	•
White high gloss									
2000 x 1000				•	•	•	•	•	
2500 x 1250				•	•	•	•	•	•
Black high gloss									
2000 x 1000				•	•	•		•	
2500 x 1250					•		•		
Mirror film									
2000 x 1000				•	•	•		•	

Pack sizes are dependent on sheet size and thickness and generally range from 5 sheets per pack for the thicker sheet to 30 sheets per pack for the thinner material. Polystyrene sheet may be supplied in rolls of up to 1.5mm thickness.

Over and above these standard sizes, Ampaglas can manufacture special sizes, thicknesses and colours to order.

## Characteristic properties

### ABS

Beneficial properties can be exploited in many fields of application.

- High impact and notched impact strength even at subzero temperatures
- Great mechanical strength and rigidity
- Very good resistance to heat deformation
- Good resistance to chemicals and environmental stress cracking
- High gloss
- Good scratch resistance and hardness
- Great dimensional stability
- Ease in processing

### HIPS

Together, general-purpose and high-impact polystyrene sheet form a class of materials with highly diversified properties.

General purpose PS

- Crystal-clear
- Very rigid
- Very good dielectric strength

High-impact PS

- Opaque
- Impact resistant
- Rigid to flexible depending on thickness

Both general-purpose and high-impact PS

- Are inherently stable
- Absorb very little water
- Are odourless and tasteless
- Can be processed rapidly without problems
- Undergo very little shrinkage
- Can be readily printed, welded, coated and thermoformed
- Can be recycled

## Thermoforming

### ABS

ABS sheet and film can be readily thermoformed to yield articles with a high gloss and good wall thickness distribution. The normal designs of compressed-air and vacuum machines on the market may be used, and best results are obtained at temperatures between 140° and 170°C.

Storage and packaging of extruded stock for thermoforming - A property common to all ABS sheeting is that they pick up moisture under adverse storage conditions. Although this does not appreciably alter their properties, it may be responsible for blisters that make thermoformed articles unserviceable. The extent of blistering is directly proportional to the moisture content, the heating-up time, the intensity of heating, and the thickness of the sheet.

Exposure for a few weeks or even days to a standard laboratory atmosphere of 23°C and 50% relative humidity would suffice to raise the moisture content of stored sheet to a level that might give rise to difficulties in thermoforming. The final moisture content would depend on the thickness of the sheet and the position of the individual panels in a stack.

At 23°C and 50% relative humidity, the equilibrium moisture content is about 0.5% in sheet of 1.5mm thickness and is attained

after approximately 20 days extrusion. However, a moisture content of between 0.05 and 0.1% is sufficiently high to yield thermoformed sheet of inferior finish.

An efficient means of preventing moisture absorption is to seal the panels in polyethylene film of a least 100µm gauge. Although this packaging greatly inhibits moisture absorption, it does not prevent it altogether. Hence, ABS sheet should always be stored in a dry place, even if it is packed in this manner.

### HIPS

By virtue of their wide viscoelastic range, Ampaglas PS sheet and film can be very readily thermoformed at temperatures between 130° and 150°C. In the thermoforming of beakers and refrigerator inner door liners, high draw ratios, e.g., 5:1, are quite common. In fact, some parts of refrigerator liners involve ratios that are a multiple of 5:1. Examples are the reinforcing ribs at the bottom of the compartments, recesses to accommodate corrugations, and chases. Care must be taken when selecting a particular material for an article which is to be foamed in situ due to the corrosive effect of some blowing agents. The technical department at Ampaglas can assist in the correct selection.

## Machining

### ABS

Extruded ABS stock can be readily punched, cold bent, sawn, drilled, milled, turned etc., on conventional metalworking or wood-working machines. The tools may be the same as those for working brass and bronze; but, owing to the poor thermal conductivity, it is often necessary to cool with water even at low cutting speeds.

### HIPS

Ampaglas PS stock can be easily machined, i.e., punched, sawn, drilled, milled, turned etc., by the conventional tools used in metal-working and woodworking. Owing to the poor thermal conductivity and the comparatively low softening temperature, the cut surfaces must be cooled with water or a current of air. The high-impact PS sheets splinter less and can be more easily machined.

## Welding

Preference is given to ultrasonic techniques. Bonding with adhesives: Articles can be bonded together with the aid of solvents, but this applies only to articles produced from the same material.

We recommend that all questions on bonding be referred to our technical department at Ampaglas.

## Finishing

### Printing and surface coating:

ABS/HIPS can be easily printed and coated by various techniques. In individual cases, we recommend that a manufacturer of surface coatings or printing inks be consulted.

### Vacuum metallizing:

Articles with a spectacular metallic gloss can be obtained by vacuum metallizing.

## Properties

	UNITS	ASTM METHOD	ABS	HIPS
Density	g/cm <sup>3</sup>	D-792	1.1	1.06
Water Absorption (24hrs @ 23°C)	%	D-570	0.4	<0.10
<b>MECHANICAL</b>				
Tensile strength at yield	MPa	D-638	45	28
Tensile strength at break	MPa	D-638	35	30
Tensile Modulus	MPa	D-638	2400	2100
Tensile Elongation (at break)	%	D-638	30	40
Flexural strength	MPa	D-790	70	45
Flexural modulus	MPa	D-790	2500	2100
Compressive strength	MPa	D-695	45	30
Impact strength <sup>1</sup>	Nm	Gardener	30.5	4.5
Rockwell hardness	-	D-785	80	50
<b>THERMAL</b>				
Specific heat	J/g°C	C-351	1.3	1.4
Thermal conductivity	W/m°C	C-177	0.17	0.17
Linear expansion coefficient (x10 <sup>-5</sup> ) <sup>4</sup>	mm/mm°C	D-696	8.5	9.0
Heat distortion temp(1,82MPa)	°C	D-648	95	76
	(0,46MPa)	D-648	105	89
Vicat softening point <sup>4</sup>	°C	D-1525	99	100
Maximum working temp (continuous)	°C	-	80	70
Vacuum forming temperature <sup>2</sup>	°C	-	150	150
Mould shrinkage <sup>3</sup>	%	D-955	0.5	0.4-0.7
<b>ELECTRICAL</b>				
Dielectric strength <sup>4</sup> (3,2mm)	KV/mm	D-149	160	150
Volume resistivity <sup>4</sup> (23°C dry)	ohm/cm	D-257	>10 <sup>15</sup>	>10 <sup>16</sup>
Dielectric constant <sup>4</sup> (10 <sup>6</sup> Hz)	-	D-150	3.00	2.50
Dielectric dissipation factor <sup>4</sup> (10 <sup>6</sup> Hz)	-	D-150	1.2x10 <sup>-2</sup>	4x10 <sup>-4</sup>
<b>FLAMMABILITY</b>				
Rating -		UL94	HB	HB

1. Gardener dart impact test using 3mm thick sample.
2. Dependent on sheet thickness. It must be remembered that ABS is hygroscopic and will absorb moisture in sheet form.  
To ensure no problems during vacuum forming, it is recommended that the sheeting be dried at ABS 85°C for 2-4 hours.
3. Dependent on built in stresses.
4. These values were measured on specimens compression moulded at 200-220°C.

The values quoted are typical values of raw material and are intended for comparative purposes only. The quoted values are valid for uncoloured material. Fluctuations may occur with coloured specimens to an extent depending on the colour.

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