

High Impact Polystyrene**Product Characteristics**

Good Environmental Stress Crack Resistance (ESCR) and practical toughness
 Good practical toughness
 Deep draw thermoforming capable
 Good low temperature impact
 Food Contact Compliant⁽¹⁾

Typical Applications

Packaging for foods such as yogurt, sour cream, delicatessen salads and gravy
 Containers and lids
 Cold temperature packaging
 Portion dairy containers

Properties ⁽⁴⁾	English System		International System		ASTM Method
	Value	Units	Value	Units	
Physical Properties					
Melt Flow Index (200°C/5 Kg)	3.2	g/10 min	3.2	g/10 min	D-1238
Specific Gravity	1.04		1.04		D-792
Coefficient of Linear Thermal Expansion (10 ⁻⁵)	5	in/in/°F	9	cm/cm/°C	D-696
Rockwell Hardness – R scale	93		93		
Mold Shrinkage(10 ⁻³)	4 to 8	in./in.	4 to 8	cm/cm	D-955
Injection Molded Properties					
Mechanical Properties					
Tensile Strength	2900	psi	22	MPa	D-638
Tensile Rupture	3100	psi	22.7	MPa	D-638
Elongation	75	%	75	%	D-638
Tensile Modulus	210000	psi	1400	MPa	D-638
Flexural Strength	4100	psi	28	MPa	D-790
Flexural Modulus	210000	psi	1400	MPa	D-790
Izod Impact @ 23°C	2.7	ft-lb/in	144	J/m	D-256
Izod Impact @ 23°C CCompression Molded)	2.0	ft-lb/in	113	J/m	D-256
Thermal Properties					
Heat Deflection Temperature					
@ 264 psi	175	°F	79	°C	D-648
@ 66 psi	193	°F	89	°C	D-648
Vicat Softening Temperature	213	°F	100	°C	D-1525

1. When used unmodified for the manufacture of food contact articles, this product will comply with Food Additive Regulation 21 CFR 177.1640 under the U.S. FDA's, Food, Drug, and Cosmetic Act. Such uses are subject to good manufacturing practices and any other limitations which are part of the statute or regulations. These should be consulted for complete details.

2. www.UL.com file E326906

3. Americas Styrenics will not knowingly sell or sample any product or service ("Product") into any commercial or development application that is intended for:
 permanent (Long term) contact with internal body fluids or internal body tissues. Long term is a use which exceeds 72 continuous hours;
 use in cardiac prosthetic devices regardless of the length of time involved (cardiac prosthetic devices include, but are not limited to, pacemaker leads and devices, artificial hearts, heart valves, intra-aortic balloons and control systems and ventricular bypass assisted devices);
 use as a critical component in medical devices that support or sustain human life; or
 use in applications designed specifically to promote or interfere with human reproduction.

Additionally, all Products intended for use in pharmaceutical applications must pass the then current Pharmaceutical Liability Guidelines.

4. Typical Properties, not to be considered specification limits.

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Typical Processing Conditions

Injection Molding

Typical Molding Machine Settings

Zone	International System		English System	
Nozzle	213	- 243	° C	415 - 470 ° F
Zone # 1	218	- 249	° C	425 - 480 ° F
Zone # 2	218	- 249	° C	425 - 480 ° F
Zone # 3	199	- 213	° C	390 - 415 ° F
Back Pressure	2	- 12	bar	25 - 175 psi

Mold Temperatures

High mold temperatures produce higher surface gloss and minimize flow marks and weld lines. Orientation is also reduced, thereby improving the properties of the part. However, high mold temperatures can require longer cycles in order to set up the polymer. Low mold temperatures are used for faster cycles. The parts will lack gloss, have poorer weld lines and a higher level of molded-in stress. Recommended mold surface temperatures for polystyrene range from 60° to 150° F. Use the highest temperature possible where you can maintain the desired cycle time.

Feed

The feed control should be adjusted to equal the desired shot weight. A general rule of molding parts with a minimum amount of internal stress and free of sink marks is to adjust the feed to keep the plunger from bottoming out. The feed should be adjusted to give a cushion of about ¼ inches. A larger cushion should be used only if the material contains moisture, air and/or excessive volatile content that show up as silver or black streaks in the molded part.

Fill Rate

Fast fill rates generally provide better uniformity in part size and quality. Rapid fill rates are possible if gate sizes and locations are properly selected. Gates too small for a particular part thickness can cause problems when filled at rapid speeds. Use the fastest fill rate the mold design and part will tolerate understanding that not all applications can tolerate a fast fill rate. Heavy section parts require a slow fill to avoid flow and weld marks on the surface of the part.

Screw Forward

Screw forward time should be controlled to prevent the plastic from flowing into or back from the cavity. Screw forward time is a function of mold and material temperature, part thickness, gate and runner size. Decreasing screw forward time increases part shrinkage. Allowances must be made in the screw forward time and hold pressure to minimize shrinkage and sink marks. Excessive screw forward time can over-pack the runner system or sprue, causing sticking.

Extrusion

Typical Extruder Settings

Zone	International System		English System	
Zone # 1	177	- 193	° C	350 - 380 ° F
Zone # 2	182	- 204	° C	360 - 400 ° F
Zone # 3	188	- 210	° C	370 - 410 ° F
Zone # 4	199	- 216	° C	390 - 420 ° F
Zone # 5	204	- 221	° C	400 - 430 ° F
Zone # 6	204	- 221	° C	400 - 430 ° F
Melt Pump, Adapter, Pipes, Screen Changer	193	- 232	° C	380 - 450 ° F
Die	199	- 232	° C	390 - 450 ° F
Polish Rolls	66	- 104	° C	150 - 220 ° F
Melt Temperature	193	- 232	° C	380 - 450 ° F
Head Pressure	10	- 21	MPa	1500 - 3000 psi

Extrusion Conditions

A lower temperature value within the typical temperature range denotes usage of the material with a styrene butadiene block copolymer in impact-modified blends. A screw design with a mixing head and a compression ratio of roughly 4:1 or a static mixing device is recommended for proper dispersion when using colorants or other additives.

The extruder die should be set from 110-150% of the required sheet thickness. The first polish roll gap should be set roughly 95% of the finished sheet thickness while the second polish roll gap can be set greater than or equal to 100% of the sheet thickness depending on what surface needs to be imparted upon the sheet by the final roll.

For all polystyrene products except OPS, the sheet orientation should not exceed 30%. Brittleness and tear strength of the sheet, especially in the machine direction, is drastically deteriorated at orientation levels >30%. Recommended temperatures are typical ranges only.

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