INJECTION MOULDING OF THERMOPLASTIC ELASTOMERS AND VULCANIZATES

SCREW DESIGN & SIZE

Usually all general purpose plastic injection machines with a compression ratio around 2.5/1 and length/diameter ratio above 20/1 are suitable for processing thermoplastic elastomers and vulcanizates.

BARREL SIZE (SHOT SIZE)

We recommend selecting a machine such that the total weight of the moulded parts including the runners is no less than 20% and no more than 80% of the barrel/shot size. Excessively large barrel sizes will result in the thermal degradation of the materials, due to long residence time in the barrel. The ideal barrel capacity should be minimum 1.5 times, and maximum 4 times of the total weight of the parts and runners that will be produced in single shot.

NOZZLE

Thermoplastic Elastomers and Vulcanizates will not show any thermal degradation when processed in universal injection moulding machines. Although a special nozzle design is not necessary; we still recommend nozzle diameters larger than 3 mm.(0.118 in.)

INJECTION MOULDING CONDITIONS

GENERAL COMMENT

The melt viscosity of Thermoplastic Elastomers and Vulcanizates depends mainly on shear rate rather than melt temperature. Therefore increasing/decreasing the injection pressure and speed is always more effective than increasing/decreasing barrel temperatures, in order to modify the flow performance of the elastomers. If this does not solve your problem, specially designed formulations with very high or low flow rates can be developed.

PRE-DRYING

SBS and SEBS based thermoplastic elastomers as well as TPO's which are sold under the trade name ENSOFT do not require any pre-drying prior to injection moulding process. ENFLEX Thermoplastic vulcanizates, on the other hand require pre-drying at 90°C(195°F) for 2 hours. The pre-drying equipment should preferable have a dry circulating system

BARREL TEMPERATURES oC (oF)

	Thermoplastic Elastomers (ENSOFT)	Termoplastic Vulcanizates (ENFLEX)
Barrel rear	150-160 (300 - 320)	170-180 (340 - 360)
Barrel front	170-180 (340 - 360)	190-200 (375 - 395)
Nozzle	185-190 (365 - 375)	200-210 (395 - 410)
Melt temperature	190-200 (375 - 395)	210-220 (410- 430)
Mould	10-50 (50-120)	10-50 (50-120)

Injection moulding at the higher limits of the above mentioned temperatures will give the following advantages

1) Anisotropy (change in the properties of the material in the flow and cross flow direction) and hrinkage levels will be lower.
2) The part will have higher weld line strength.
3) The surface appearance will improve.

Our high flow grades (U and X series) can be injection moulded, at temperature levels 10-20°C (50-70°F) less than listed above

INJECTION PRESSURE

In order to ensure a rapid flow to the mould, injection pressure setting of 10MPa (14500 psi) will be sufficient. Holding pressure should be between 30-70% of the injection pressure.

For the materials with the hardness level of below 65 shore A, over packing of the material will result in deformities especially around the gate. Special care should be given not to force excessive material into the mould. On the other hand, under packing will result in sink marks and increase in shrinkage levels for the grades above 90 Shore a hardness level.

SCREW SPEED AND BACK PRESSURE

Usually high screw speeds (100-200 rpm) should be chosen for the injection molding of thermoplastic elastomers and vulcanizates. The back pressure should be at the minimum level. (Less than 0.5 MPa (72.5 psi)). If the material will be colored in the through addition of a color MB, the back pressure should be increased.

PURGING

Polypropylene or Polyethylene should be used to clean out or purge the machine.

REGRIND

Regrind addition up to 20% of the original compound should not give any negative effect. In the case of ENFLEX thermoplastic vulcanizates the recycled material should be predried before use.

INFORMATION ON SHRINKAGE LEVELS

Shrinkage levels of the elastomers and vulcanizates are closely related with the density, hardness and flow direction of the materials. The average shrinkage values are given below:

Hardness Shore	Density(gr/cm3)	Flow direction	Density	Flow Direction
45A	0.90-1.00	%3.5	1.00-1.20	%1.9
55A	0.90-1.00	%3.0	1.00-1.20	%1.8
65A	0.90-1.00	%2.7	1.00-1.20	%1.7
75A	0.90-1.00	%2.5	1.00-1.20	%1.7
85A	0.90-1.00	%2.0	1.00-1.20	%1.5

90A	0.90-1.00	%2.0	1.00-1.20	%1.5
40D	0.90-1.00	%2.0	1.00-1.20	%1.5

Hardness Shore	Density(lb/in³)	Flow direction	Density lb/in³	Flow Direction
45A	0.0325-0.0361	%3.5	0.0361-0.0433	%1.9
55A	0.0325-0.0361	%3.0	0.0361-0.0433	%1.8
65A	0.0325-0.0361	%2.7	0.0361-0.0433	%1.7
75A	0.0325-0.0361	%2.5	0.0361-0.0433	%1.7
85A	0.0325-0.0361	%2.0	0.0361-0.0433	%1.5
90A	0.0325-0.0361	%2.0	0.0361-0.0433	%1.5
40D	0.0325-0.0361	%2.0	0.0361-0.0433	%1.5

The post shrinkage levels can be decreased by processing at higher temperatures, higher injection speed and using proper cooling times (conforming to part thickness).