Performance Punched Parts

A Penn Fibre Company

ISO 9002 CERTIFIED

To Punch or Not to Punch

Every year, hundreds of millions of plastic parts are produced by stamping or die cutting. Many, if not most part users are unfamiliar with the process and when to use it as the process of choice vs. injection molding. This is the second in a three part series designed for engineers to understand the strengths and weakness of this process.

In our first we explored cost benefits in this section we will discuss unique materials. If you have more questions please contact us at sales@performancepunchedparts.com.

Punching or stamping is done from a sheet of material that has been extruded, calendared, blown or cast . By its nature, extrusion allows for material to be produced in thinner sections than can often be produced via injection molding. High viscosity resins such as very high molecular weight (MW) Polyethylene can not be molded in thin sections but are well suited for extrusion and stamping. Many punched parts are produced from materials as thin as .005" thick or less, but often have better properties as well.

It is well known that plastics generally have better properties as the molecular weight increases. UHMWPE is 3-4 times more abrasion resistant then HMWPE and 6 time more then an injection molding grade, but even a property like stress crack resistance improves. In table 1, we show the stress crack resistance of the same polymer types at different melt flow rates (molecular weight). Higher MFR resin has lower MW.

An injection molded seal in a spray bottle may crack in a chemically active environment, while the same plastic part may perform well if punched from a high molecular weight sheet. This is especially true when considering the effects of residual stress left in an injection molded part. There is very little residual stress in extruded materials.

This should be of consideration in batteries, pumps, plumbing or any other fluid handling device. Equipment that will see salt sprays, aggressive detergents are other candidates.

Table 1 Stress cracking testing ASTM D1693

Melt Index [g/10min]	Density [g/cm³]	Exposure Time [h]	Failures [%]
Polybutene-1			
0.4	0.913	15,000	0
2.0	0.911	15,000	0
Polypropylene			
3.5	0.902	1,123	75
0.7	0.904	15,000	40
Polyethylene			
0.2	0.921	20	50
0.2	0.921	40	100
0.7	0.915	15	100
4.5	0.922	17	100
5.6	0.959	16	100

The impact in figure 1 and 2 compares Delrin homopolymer acetal of differing molecular weight. The melt flow rate of Delrin 100 is 1, Delrin 500 is 6 and Delrin 900 is 11. The only chemical difference between these grades is the length of the molecule, however, Delrin 100 does not mold well but is the standard extrusion grade. All things being equal, a punched acetal part will be 30-50% tougher then its molded counterpart.

Figure 1 Delrin tensile impact properties

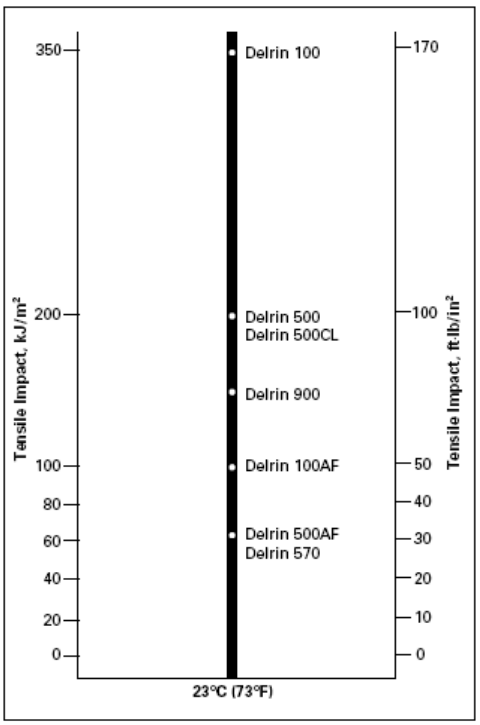

Figure 2 Delrin Izod impact properties

	Temperature			
	23°C (73°F)		−40°C (−40°F)	
Composition*	Notched Izod J/m (ft·lb/in)	Unnotched Izod J/m (ft·lb/in)	Notched Izod J/m (ft·lb/in)	Unnotched Izod J/m (ft·lb/in)
Delrin 100	123 (2.3)	>5300 (>100) (no break)	96 (1.8)	— (—)
Delrin 500	80 (1.5)	1280 (24)	64 (1.2)	— (—)
Delrin 900	70 (1.3)	850 (16)	53 (1.0)	— (—)

Also, unlike a punched part, all injection molded plastic parts that have a hole (such as a washer) will also have at least one knit line and gate that act as stress raisers. These imperfections further reduces impact and strength, and is especially true for glass reinforced products.

Another area that can take advantage of unique material properties in stamped parts is the ability to make multilayer structures before stamping through either lamination or co-extrusion. Consider co-extrusions of soft/hard materials, to get high friction and low friction/ wear resistance in the same part. Rigidity combined with compression set performance. Thermal or electrical conductivity can be created on one side with insulative properties on the other. Adhesives can be applied to one side with good release or low friction on the opposite. Fabric backing can change surface characteristics or impart strength.

Finally, it is possible to get properties in a sheet through orientation that are simply unachievable through injection molding. Oriented polymers such as Mylar PET film, Biaxially oriented polypropropylene (BOPP) and oriented nylon are available with tensile strength 5 to 10 times higher then the natural materials. The plastic materials becomes 2 to 5 times stiffer, harder, have better scratch and mar resistance, and in some cases become clear. These materials are widely used as films; candy and cigarette wrappers are BOPP and high quality balloons are metalized PET. However they may also be made in relatively thick sheet as well. An oriented nylon has a tensile strength of 70 kpsi and does not have a yield point. Properties are anisotropic, but can be used in a variety of stamped or die cut applications where strength is only need in one axis.

Want to know more?

Contact us at sales@performancepunchedparts.com

Or call us toll free at 877-445-PART (7278)