Extrusion

Processing Conditions

Controls
To ensure trouble-free processing, precise and constant control of the temperature, pressures and rate are necessary.

Barrel, die and melt temperatures
The temperature in the barrel should increase by roughly 10-20°C from the feeding zone to the metering zone. The die temperatures should be adjusted to suit the melt temperature.

Tables XII, XIII and XIV show the recommended barrel, die and melt temperatures of various ranges of hardness for the C, S, 600 and 1100 Series respectively. It is recommended to measure the melt temperature and to adjust the machine's temperature controllers accordingly.

Extrusion rates
Typically, due to their flexibility, good thermal insulation characteristics, initial tackiness and higher power requirement of TPU products, extrusion rates are slower than for most thermoplastics. Typical extruder screw speed is between 15 and 60 RPM. Typical line speeds are:

For tubing ..... (8-20) m/min.
……..25-60 ft./min.
For wire coating ... (20-100) m/min.
……...60-300 ft./min.
For thin film ..... (5-8) m/min.
…….. 15-25 ft./min.
For thick sheet ..... (3-5) m/min.
…….. 10-15 ft./min.

Barrel and die purge
The recommended cleaning procedure is dependent on anticipated production schedule. When the extruder is being shutdown overnight and started up the next morning, close off or empty the hopper (or hopper/dryer) and run the extruder until it is empty. Unclamp the adapter section and clean out the adapter zone and remove the screen packing. Turn the extruder's temperatures off. The extruder can be preheated the next morning and purged out with the Elastollan® grade being used.

When the extruder is being shutdown for several days, or if it has not been used for an extended period of time and had not been previously purged or cleaned, purge the extruder with a very low MFI polypropylene or LDPE. (HDPE can also be used, but only for very simple, easy to purge, die designs). The extruder, screw, and die can be cleaned by hand much easier after purging with PP or PE, then follow with the Elastollan® grade being used.

Table XII

Elastollan® Extrusion Conditions Guideline for C & S Series

Elastollan® Grade Hardness	Extruder Barrel				Adapter	Die Body	Die Tip
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
	°C (°F)	°C (°F)	°C (°F)	°C (°F)	°C (°F)	°C (°F)	°C (°F)
60AW	160 (320)	165 (330)	170 (340)	175 (350)	180 (355)	180 (355)	175 (345)
70AW	165 (330)	170 (340)	175 (350)	180 (360)	185 (365)	185 (365)	180 (355)
78A	170 (340)	175 (350)	180 (360)	190 (370)	190 (375)	190 (375)	185 (365)
85A	180 (360)	190 (370)	190 (380)	200 (390)	205 (400)	205 (400)	200 (390)
90A	190 (370)	190 (380)	195 (390)	205 (400)	210 (410)	210 (410)	205 (400)
95A	190 (380)	200 (390)	205 (400)	210 (410)	210 (415)	210 (415)	205 (405)

Extrusion

Processing Conditions

Table XIII

Elastollan® 600 Series Extrusion Conditions Guideline							
Elastollan® Grade Hardness	**Extruder Barrel**				**Adapter**	**Die Body**	**Die Tip**
	Zone 1	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 6**	**Zone 7**
	°C (°F)	°C (°F)	°C (°F)	°C (°F)	°C (°F)	°C (°F)	°C (°F)
685A	180 (355)	185 (365)	190 (375)	195 (385)	200 (390)	195 (385)	190 (375)
690A	180 (355)	185 (365)	190 (375)	195 (385)	200 (390)	195 (385)	190 (375)
695A	185 (365)	190 (375)	195 (385)	200 (390)	205 (400)	200 (390)	195 (385)

Table XIV

Elastollan® 1100 Series Extrusion Conditions Guideline							
Elastollan® Grade Hardness	**Extruder Barrel**				**Adapter**	**Die Body**	**Die Tip**
	Zone 1	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 6**	**Zone 7**
	°C (°F)	°C (°F)	°C (°F)	°C (°F)	°C (°F)	°C (°F)	°C (°F)
1175AW	160 (320)	165 (330)	170 (340)	175 (350)	180 (360)	180 (355)	175 (345)
1180A	170 (340)	175 (350)	180 (360)	190 (370)	190 (380)	190 (380)	190 (375)
1185A	180 (360)	190 (370)	190 (380)	200 (390)	205 (400)	200 (395)	195 (385)
1190A	190 (370)	190 (380)	200 (390)	205 (400)	205 (405)	205 (405)	200 (395)
1195A	190 (380)	200 (390)	205 (400)	205 (405)	210 (410)	205 (405)	200 (395)

Take-up / cooling / sizing
As previously mentioned, TPU products have lower melt strength, are tackier, and also require more cooling time than most other thermoplastic materials. Because of these factors, special precautions must be taken when extruding them.

When extruding profile or tube-shaped products, the following guidelines should be followed:

- Tubing/profile cannot be forced through a sizing ring/cooling block.

The final product must be sized via "free extrusion";

- Cooling trough should be set up as close to the die as possible;
- In order to add some lubricity to the surface, cooling water should come in contact with the extrudate before entering the trough. If needed, a slight amount of soap can be added to the water.
- When extruding tubing, sizing can be accomplished by applying pressure to the inside of the tube.
- A vacuum tank with a very low vacuum setting can also be used. In this case, the vacuum is designed to maintain roundness and not to expand the size of the tube.

Similar precautions should be taken, when practical, in other extrusion applications.

Pre-drying
Elastollan® TPU products should always be dried before processing. For more details, refer to the General Recommendations sections of this book.