COMPREHENSIVE

Mold Design And Processing Conditions

A Guide to Processing
Injection Molding Grade Specialty Compounds

English/Standard and SI Metric

RTP Co.
Imagineering Plastics ®

web site: www.rtpcompany.com

General Molding Guidelines

Standard Molding Equipment

Machine Type: We recommend using a screw injection machine for molding reinforced thermoplastics. A screw injection machine improves melt homogeneity, reduces variations in the molded parts, and minimizes degradations and cold spots of the polymer melt.

Machine Size: The machine should be sized to use approximately 50-70% of machine barrel capacity per shot. This maintains a short barrel residence time and eliminates material degradation. The machine should have adequate clamp pressure to obtain 4-8 tons per square inch (55-110 N/mm^2) of projected surface area. Generally, a reinforced material requires 50-70% higher clamping pressures than a nonreinforced polymer of the same type.

Molding Conditions

Drying: Successful molding of reinforced thermoplastics requires adequate drying. Inadequate drying can cause extremely erratic molding conditions and less than perfect molded parts. Excessively wet materials outgas and can undergo a viscosity change during processing. This may cause brittleness, blisters, voids, silver streaking and poor surface finish. RTP Company materials are dried prior to packaging in moisture resistant containers. However, we recommend thoroughly drying the materials in a dehumidifying type dryer. This is important with hygroscopic materials but can also be essential for non-hygroscopic materials. Condensed surface moisture can dramatically affect high temperature molded parts. The recommended drying times are provided as guidelines; however, an actual moisture check is necessary.

Barrel Temperature: Refer to Processing Conditions in this guide for recommended starting temperatures. Typically the rear zone/zones are set 10-20 degrees F (6-12 degrees C) cooler than the front zone and nozzle. Some modifications may be needed depending on part size and configuration.

Melt Temperature: Refer to Processing Conditions in this guide for recommended starting temperatures.

Mold Temperature: Refer to Processing Conditions in this guide for recommended starting temperatures. Normally, reinforced materials require higher mold temperatures than nonreinforced materials. Higher mold temperatures will achieve a smoother, more blemish-free surface by providing a resin rich skin on reinforced materials.

Injection Pressure: Injection pressure should be set low initially and increased to the point of filling the part just short of causing flash. Maximum pressure without flash generates optimum physical properties for your RTP Company material.

Back Pressure: Low back pressure (approx. 50 psi or 0.34 MPa) minimizes fiber breakage and property deterioration.

Injection Speed: Generally, the fastest possible cavity fill time is best. This minimizes glass orientation and maximizes weld line integrity.

Screw RPM: The lowest possible rpm is recommended to minimize fiber breakage and screw recovery should be set accordingly. Slower rpm's result in a more uniform melt by minimizing shear heat buildup.

General Processing Tips

Machine Setting	Compounds with Fillers	Compounds with Fibers
Barrel Temperature	Slightly higher than unfilled resin	Glass fiber slightly higher than particulate; carbon fiber slightly lower than unfilled resin
Mold Temperature	Mineral slightly higher than unfilled resin; carbon black higher than mineral filled	Glass fiber higher than particulate; carbon fiber higher than glass or particulate
Injection Pressure	Must be higher than unfilled resin because of higher viscosities	Must be higher than unfilled resin because of higher viscosities
Back Pressure	50-100 psi (0.34-0.69 MPa)	50-100 psi (0.34-0.69 MPa)
Injection Speed	1-2"/sec (25-50 mm/sec)	Slowest speed without sacrificing appearance
Screw Speed	60-90 rpm	Minimum speed without causing delays in molding cycles

General Molding Guidelines

Tips to Improve Mechanical Properties

Property	Process
Tensile Strength	• Use hotter mold temperatures • Use high injection speed • Avoid high melt temperature • Injection pressure has little effect
Tensile Elongation	• Use hotter mold temperatures • Avoid high melt temperature
Flexural Modulus	• Use higher melt temperatures • Use high injection speed • Injection pressure has only moderate effect
Flexural Strength	• Use hotter mold temperatures • Avoid high melt temperature • Injection pressure has only moderate effect
Notched Izod Impact	• Use hotter mold temperatures (cold mold can cause 50% loss in impact strength) • Avoid high melt temperatures
Shrinkage	• Use cold mold to reduce shrinkage • Use high injection pressure • Avoid high screw rpm • Avoid high melt temperatures
Warpage	• Use longer hold time to reduce warpage • Reduce stress with high mold and melt temperatures
Regrind Usage	Generally, 20% regrind is acceptable. There are times when no regrind is permissible. The application should always be thoroughly tested. Regrind should always be kept clean, dry and uniformly mixed with the virgin material.

Tips To Improve Surface Conductivity

Compounds With Conductive Fillers

The parts may look beautiful but not be functional in static dissipative applications. The following processing conditions are important to successfully molding good, conductive parts.

1 All resins containing carbon black should be dried.

2. Slower fill rates improve surface conductivity. Fill rates less than 1 inch (25.4 mm) per second generally work best. Decreasing the fill speed has little effect when using subgates.

3. Higher melt temperatures and slower fill speeds tend to layer the carbon black particles on the part surface. A more conductive carbon black part typically has a more mottled, dull surface. A glossier surface is more resin rich and usually less conductive.

4. Decreased packing usually increases surface conductivity. Short shots can have much higher levels (one or two magnitudes) of surface conductivity, especially if measured at the edge of the flow front where the carbon particles lay closest to the surface.

5. Typical molding is usually less conductive near the gate and more conductive away from the gate, (i.e. 1K - 2K ohms with carbon black).

6. Mold temperature does not have a significant effect on conductivity.

7. Surface conductivity is usually independent of back pressure and screw speed.

Compounds With Conductive Fibers

Conductive materials based on carbon fiber typically require opposite molding conditions from conductive fillers.

1. Use the base resin drying requirements for carbon fiber reinforced compounds.

2. Increasing the fill speed usually increases surface conductivity 10^5 to $>10^4$ ohms/sq. (Caution: Excess fill speeds can break up carbon fibers and reduce mechanical properties.) All corners in the flow path should have generous radii.

3. With carbon fiber, high melt temperatures decrease surface resistivity (thereby increasing conductivity) because they increase the degree of packing. Short shots in carbon fiber are typically non-conductive.

4. A typical carbon fiber molding is more conductive near the gate.

5. Mold temperature does not have a significant effect on conductivity.

6. Back pressure and screw speed should be kept as low as possible, i.e. 25-50 psi (0.17-0.34 MPa) and 20-40 rpm respectively.

Processing Conditions

Specialty Compounds

RTP 100 Series Polypropylene (PP)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	380 - 420 °F	193 - 216 °C
Center zone	390 - 430 °F	199 - 221 °C
Front zone	400 - 440 °F	204 - 227 °C
Melt	375 - 450 °F	191 - 232 °C
Mold	90 - 150 °F	32 - 66 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 175 °F	2 Hrs @ 79 °C
Dew Point	n/a °F	n/a °C
Moisture Content	n/a %	n/a %

RTP 200 Series Nylon 6/6 (PA)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	525 - 540 °F	274 - 282 °C
Center zone	530 - 550 °F	277 - 288 °C
Front zone	540 - 560 °F	282 - 293 °C
Melt	530 - 570 °F	277 - 299 °C
Mold	150 - 225 °F	66 - 107 °C
Pressures		
Injection	10000 - 18000 psi	69 - 124 MPa
Hold	5000 - 12000 psi	34 - 83 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	2 - 3 in/sec	51 - 76 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 Hrs @ 175 °F	4 Hrs @ 79 °C
Dew Point	0.0 °F	-18 °C
Moisture Content	0.20 %	0.20 %

†Hygroscopic Material

RTP 200A Series Nylon 6 (PA)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	430 - 500 °F	221 - 260 °C
Center zone	450 - 510 °F	232 - 266 °C
Front zone	480 - 520 °F	249 - 271 °C
Melt	470 - 535 °F	243 - 279 °C
Mold	130 - 200 °F	54 - 93 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	4000 - 10000 psi	28 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	2 -3 in/sec	51 - 76 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 180 °F	2 Hrs @ 82 °C
Dew Point	0.0 °F	-18 °C
Moisture Content	0.20 %	0.20 %

†Hygroscopic Material

RTP 200B Series Nylon 6/10 (PA)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	525 - 540 °F	274 - 282 °C
Center zone	530 - 550 °F	277 - 288 °C
Front zone	540 - 560 °F	282 - 293 °C
Melt	530 - 570 °F	277 - 299 °C
Mold	150 - 225 °F	66 - 107 °C
Pressures		
Injection	10000 - 18000 psi	69 - 124 MPa
Hold	5000 - 12000 psi	34 - 83 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	2 - 3 in/sec	51 - 76 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 175 °F	2 Hrs @ 79 °C
Dew Point	0.0 °F	-18 °C
Moisture Content	0.20 %	0.20 %

Processing Conditions

Specialty Compounds

RTP 200C Series Nylon 11 (PA)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	420 - 500 °F	216 - 260 °C
Center zone	435 - 515 °F	224 - 268 °C
Front zone	450 - 540 °F	232 - 282 °C
Melt	435 - 550 °F	224 - 288 °C
Mold	100 - 150 °F	38 - 66 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	7000 - 10000 psi	48 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 -3 in/sec	25 - 76 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 Hrs @ 175 °F	4 Hrs @ 79 °C
Dew Point	0.0 °F	-18 °C
Moisture Content	0.20 %	0.20 %

RTP 200D Series Nylon 6/12 (PA)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	485 - 515 °F	252 - 268 °C
Center zone	495 - 525 °F	257 - 274 °C
Front zone	500 - 535 °F	260 - 279 °C
Melt	480 - 545 °F	249 - 285 °C
Mold	140 - 200 °F	60 - 93 °C
Pressures		
Injection	10000 - 18000 psi	69 - 124 MPa
Hold	8000 - 12000 psi	55 - 83 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 3 in/sec	25 - 76 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 Hrs @ 175 °F	4 Hrs @ 79 °C
Dew Point	0.0 °F	-18 °C
Moisture Content	0.20 %	0.20 %

†Hygroscopic Material

RTP 200E Series Amorphous Nylon (PA)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	520 - 540 °F	271 - 282 °C
Center zone	530 - 550 °F	277 - 288 °C
Front zone	540 - 560 °F	282 - 293 °C
Melt	520 - 570 °F	271 - 299 °C
Mold	150 - 210 °F	66 - 99 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 Hrs @ 175 °F	4 Hrs @ 79 °C
Dew Point	-30 °F	-34 °C
Moisture Content	0.10 %	0.10 %

RTP 200F Series Nylon 12 (PA)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	420 - 490 °F	216 - 254 °C
Center zone	430 - 500 °F	221 - 260 °C
Front zone	440 - 510 °F	227 - 266 °C
Melt	430 - 525 °F	221 - 274 °C
Mold	150 - 220 °F	66 - 104 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 3 in/sec	25 - 76 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 Hrs @ 175 °F	4 Hrs @ 79 °C
Dew Point	-40 °F	-40 °C
Moisture Content	0.10 %	0.10 %

†Hygroscopic Material

Processing Conditions

Specialty Compounds

RTP 200H Series Impact-Modified Nylon 6/6 (PA)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	525 - 540 °F	274 - 282 °C
Center zone	530 - 550 °F	277 - 288 °C
Front zone	540 - 560 °F	282 - 293 °C
Melt	530 - 570 °F	277 - 299 °C
Mold	150 - 225 °F	66 - 107 °C
Pressures		
Injection	10000 - 18000 psi	69 - 124 MPa
Hold	5000 - 12000 psi	34 - 83 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	2 - 3 in/sec	51 - 76 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 Hrs @ 175 °F	4 Hrs @ 79 °C
Dew Point	0.0 °F	-18 °C
Moisture Content	0.20 %	0.20 %

RTP 300 Series Polycarbonate (PC)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	520 - 550 °F	271 - 288 °C
Center zone	540 - 570 °F	282 - 299 °C
Front zone	560 - 590 °F	293 - 310 °C
Melt	550 - 600 °F	288 - 316 °C
Mold	180 - 250 °F	82 - 121 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 12000 psi	34 - 83 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 Hrs @ 250 °F	4 Hrs @ 121 °C
Dew Point	-20 °F	-29 °C
Moisture Content	0.02 %	0.02 %

†Hygroscopic Material

RTP 400 Series Polystyrene (PS)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	400 - 430 °F	204 - 221 °C
Center zone	420 - 450 °F	216 - 232 °C
Front zone	430 - 460 °F	221 - 238 °C
Melt	410 - 480 °F	210- 249 °C
Mold	100 - 150 °F	38 - 66 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 180 °F	2 Hrs @ 82 °C
Dew Point	n/a °F	n/a °C
Moisture Content	n/a %	n/a %

†Hygroscopic Material

RTP 500 Series Styrene Acrylonitrile (SAN)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	430 - 460 °F	221 - 238 °C
Center zone	450 - 480 °F	232 - 249 °C
Front zone	470 - 500 °F	243 - 260 °C
Melt	460 - 535 °F	238 - 279 °C
Mold	125 - 180 °F	52 - 82 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 180 °F	2 Hrs @ 82 °C
Dew Point	n/a °F	n/a °C
Moisture Content	n/a %	n/a %

†Hygroscopic Material

Processing Conditions

Specialty Compounds

RTP 600 Series Acrylonitrile Butadiene Styrene (ABS)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	390 - 410 °F	199 - 210 °C
Center zone	400 - 430 °F	204 - 221 °C
Front zone	410 - 450 °F	210 - 232 °C
Melt	400 - 460 °F	204 - 238 °C
Mold	145 - 185 °F	63 - 85 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 180 °F	2 Hrs @ 82 °C
Dew Point	0.0 °F	-18 °C
Moisture Content	0.10 %	0.10 %

†Hygroscopic Material

RTP 700 Series High Density Polyethylene (HDPE)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	350 - 390 °F	177 - 199 °C
Center zone	370 - 420 °F	188 - 216 °C
Front zone	390 - 440 °F	199 - 227 °C
Melt	380 - 450 °F	193 - 232 °C
Mold	70 - 150 °F	21 - 66 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 175 °F	2 Hrs @ 79 °C
Dew Point	n/a °F	n/a °C
Moisture Content	n/a %	n/a %

RTP 700A Series Low Density Polyethylene (LDPE)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	350 - 390 °F	177 - 199 °C
Center zone	370 - 420 °F	188 - 216 °C
Front zone	390 - 440 °F	199 - 227 °C
Melt	380 - 450 °F	193 - 232 °C
Mold	70 - 150 °F	21 - 66 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 175 °F	2 Hrs @ 79 °C
Dew Point	n/a °F	n/a °C
Moisture Content	n/a %	n/a %

RTP 800 Series Acetal (POM)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	350 - 390 °F	177 - 199 °C
Center zone	360 - 400 °F	182 - 204 °C
Front zone	370 - 410 °F	188 - 210 °C
Melt	360 - 425 °F	182 - 218 °C
Mold	175 - 225 °F	79 - 107 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 12000 psi	34 - 83 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 250 °F	2 Hrs @ 121 °C
Dew Point	-25 °F	-32 °C
Moisture Content	0.15 %	0.15 %

Processing Conditions

Specialty Compounds

RTP 900 Series Polysulfone (PSU)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	610 - 650 °F	321 - 343 °C
Center zone	625 - 670 °F	329 - 354 °C
Front zone	635 - 680 °F	335 - 360 °C
Melt	630 - 700 °F	332 - 371 °C
Mold	200 - 300 °F	93 - 149 °C
Pressures		
Injection	10000 - 18000 psi	69 - 124 MPa
Hold	5000 - 15000 psi	34 - 103 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 Hrs @ 275 °F	4 Hrs @ 135 °C
Dew Point	-25 °F	-32 °C
Moisture Content	0.15 %	0.15 %

RTP 1000 Series Polybutylene Terephthalate (PBT)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	450 - 475 °F	232 - 246 °C
Center zone	460 - 485 °F	238 - 252 °C
Front zone	470 - 495 °F	243 - 257 °C
Melt	460 - 520 °F	238 - 271 °C
Mold	175 - 225 °F	79 - 107 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 Hrs @ 250 °F	4 Hrs @ 121 °C
Dew Point	-20 °F	-29 °C
Moisture Content	0.03 %	0.03 %

†Hygroscopic Material

RTP 1200 Series Polyurethane Thermoplastic Elastomer (TPU)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	320 - 360 °F	160 - 182 °C
Center zone	350 - 390 °F	177 - 199 °C
Front zone	370 - 410 °F	188 - 210 °C
Melt	365 - 425 °F	185 - 218 °C
Mold	100 - 140 °F	38 - 60 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	0.5 - 1 in/sec	13 - 25 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	6 Hrs @ 225 °F	6 Hrs @ 107 °C
Dew Point	0.0 °F	-18 °C
Moisture Content	0.01 %	0.01 %

• Desiccant type dryer required.
†Hygroscopic Material

RTP 1300 Series Polyphenylene Sulfide (PPS)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	550 - 570 °F	288 - 299 °C
Center zone	570 - 590 °F	299 - 310 °C
Front zone	590 - 610 °F	310 - 321 °C
Melt	585 - 625 °F	307 - 329 °C
Mold	275 - 350 °F	135 - 177 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 12000 psi	34 - 83 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	2 - 3 in/sec	51 - 76 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	6 Hrs @ 300 °F	6 Hrs @ 149 °C
Dew Point	n/a °F	n/a °C
Moisture Content	0.04 %	0.04 %

Processing Conditions

Specialty Compounds

RTP 1400 Series Polyethersulfone (PES)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	650 - 670 °F	343 - 354 °C
Center zone	660 - 680 °F	349 - 360 °C
Front zone	670 - 690 °F	354 - 366 °C
Melt	650 - 710 °F	343 - 377 °C
Mold	275 - 350 °F	135 - 177 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 -2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	6 Hrs @ 300 °F	6 Hrs @ 149 °C
Dew Point	-25 °F	-32 °C
Moisture Content	0.04 %	0.04 %

†Hygroscopic Material

RTP 1500 Series Polyester Thermoplastic Elastomer (TPE)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	380 - 410 °F	193 - 210 °C
Center zone	410 - 440 °F	210 - 227 °C
Front zone	420 - 450 °F	216 - 232 °C
Melt	410 - 460 °F	210 - 238 °C
Mold	70 - 120 °F	21 - 49 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	0.5 - 1 in/sec	13 - 25 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 - 4 Hrs @ 200 °F	2 - 4 Hrs @ 93 °C
Dew Point	n/a °F	n/a °C
Moisture Content	n/a %	n/a %

†Hygroscopic Material

RTP 1700 Series Modified Polyphenylene Oxide (PPO)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	450 - 500 °F	232 - 260 °C
Center zone	470 - 520 °F	243 - 271 °C
Front zone	490 - 540 °F	254 - 282 °C
Melt	480 - 550 °F	249 - 288 °C
Mold	150 - 200 °F	66 - 93 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 200 °F	2 Hrs @ 93 °C
Dew Point	0.00 °F	-18 °C
Moisture Content	0.10 %	0.10 %

RTP 1800 Series Acrylic (PMMA)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	350 - 390 °F	177 - 199 °C
Center zone	360 - 400 °F	182 - 204 °C
Front zone	370 - 410 °F	188 - 210 °C
Melt	360 - 425 °F	182 - 218 °C
Mold	175 - 225 °F	79 - 107 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 Hrs @ 200 °F	4 Hrs @ 93 °C
Dew Point	0.0 °F	-18 °C
Moisture Content	0.02 %	0.02 %

Processing Conditions

Specialty Compounds

RTP 1800A Series Polycarbonate/Acrylic Alloy (PC/PMMA)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	395 - 445 °F	202 - 229 °C
Center zone	445 - 485 °F	229 - 252 °C
Front zone	460 - 480 °F	238 - 249 °C
Melt	460 - 510 °F	238 - 266 °C
Mold	90 - 150 °F	32 - 66 °C
Pressures		
Injection	8000 - 12000 psi	55 - 83 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	3 - 4 Hrs @ 180 °F	3 - 4 Hrs @ 82 °C
Dew Point	0.0 °F	-18 °C
Moisture Content	0.02 %	0.02 %

RTP 2100 Series Polyetherimide (PEI)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	660 - 700 °F	349 - 371 °C
Center zone	670 - 710 °F	354 - 377 °C
Front zone	680 - 720 °F	360 - 382 °C
Melt	670 - 750 °F	354 - 399 °C
Mold	275 - 350 °F	135 - 177 °C
Pressures		
Injection	12000 - 18000 psi	83 - 124 MPa
Hold	8000 - 15000 psi	55 - 103 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 Hrs @ 300 °F	4 Hrs @ 149 °C
Dew Point	-20 °F	-29 °C
Moisture Content	0.04 %	0.04 %

†Hygroscopic Material

RTP 2200 Series Polyetheretherketone (PEEK)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	650 - 690 °F	343 - 366 °C
Center zone	670 - 710 °F	354 - 377 °C
Front zone	690 - 730 °F	366 - 388 °C
Melt	660 - 750 °F	349 - 399 °C
Mold	325 - 425 °F	163 - 218 °C
Pressures		
Injection	12000 - 18000 psi	83 - 124 MPa
Hold	8000 - 16000 psi	55 - 110 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 3 in/sec	25 - 76 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	3 Hrs @ 300 °F	3 Hrs @ 149 °C
Dew Point	-20 °F	-29 °C
Moisture Content	0.10 %	0.10 %

†Hygroscopic Material

RTP 2300A Series Rigid Thermoplastic Polyurethane (RTPU)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	400 - 430 °F	204 - 221 °C
Center zone	410 - 440 °F	210 - 227 °C
Front zone	420 - 450 °F	216 - 232 °C
Melt	430 - 470 °F	221 - 243 °C
Mold	125 - 200 °F	52 - 93 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	0.5 - 2 in/sec	13 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 - 6 Hrs @ 225 °F	4 - 6 Hrs @ 107 °C
Dew Point	-25 °F	-32 °C
Moisture Content	0.01 %	0.01 %

• Desiccant type dryer required.
• Critical moisture content requirement

†Hygroscopic Material

Processing Conditions

Specialty Compounds

RTP 2300C Series Rigid Thermoplastic Polyurethane (RTPU)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	430 - 460 °F	221 - 238 °C
Center zone	440 - 470 °F	227 - 243 °C
Front zone	450 - 480 °F	232 - 249 °C
Melt	460 - 500 °F	238 - 260 °C
Mold	200 - 250 °F	93 - 121 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	0.5 - 2 in/sec	13 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 - 6 Hrs @ 270 °F	4 - 6 Hrs @ 132 °C
Dew Point	-25 °F	-32 °C
Moisture Content	0.01 %	0.01 %

• Desiccant type dryer required.
• Critical moisture content requirement
†Hygroscopic Material

RTP 2500 Series Polycarbonate/ABS Alloy (PC/ABS)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	450 - 470 °F	232 - 243 °C
Center zone	470 - 490 °F	243 - 254 °C
Front zone	490 - 510 °F	254 - 266 °C
Melt	470 - 525 °F	243 - 274 °C
Mold	125 - 200 °F	52 - 93 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 Hrs @ 200 °F	4 Hrs @ 93 °C
Dew Point	-20 °F	-29 °C
Moisture Content	0.02 %	0.02 %

†Hygroscopic Material

RTP 2700 Series Styrenic Thermoplastic Elastomer (TES)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	340 - 360 °F	171 - 182 °C
Center zone	350 - 370 °F	177 - 188 °C
Front zone	370 - 390 °F	188 - 199 °C
Melt	360 - 450 °F	182 - 232 °C
Mold	60 - 100 °F	16 - 38 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	0.5 - 1 in/sec	13 - 25 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 175 °F	2 Hrs @ 79 °C
Dew Point	n/a °F	n/a °C
Moisture Content	n/a %	n/a %

RTP 2800 Series Olefinic Thermoplastic Elastomer (TEO)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	340 - 360 °F	171 - 182 °C
Center zone	350 - 370 °F	177 - 188 °C
Front zone	370 - 390 °F	188 - 199 °C
Melt	360 - 410 °F	182 - 210 °C
Mold	60 - 150 °F	16 - 66 °C
Pressures		
Injection	12000 - 18000 psi	83 - 124 MPa
Hold	5000 - 12000 psi	34 - 83 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	0.5 - 1 in/sec	13 - 25 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 175 °F	2 Hrs @ 79 °C
Dew Point	0.0 °F	-18 °C
Moisture Content	0.03 %	0.03 %

†Hygroscopic Material

Processing Conditions

Specialty Compounds

RTP 3000 Series Polymethylpentene (PMP)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	480 - 520 °F	249 - 271 °C
Center zone	500 - 540 °F	260 - 282 °C
Front zone	520 - 560 °F	271 - 293 °C
Melt	510 - 580 °F	266 - 304 °C
Mold	150 - 200 °F	66 - 93 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	7000 - 9000 psi	48 - 62 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	0.5 - 2 in/sec	13 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 175 °F	2 Hrs @ 79 °C
Dew Point	n/a °F	n/a °C
Moisture Content	n/a %	n/a %

RTP 3100 Series Perfluoroalkoxy (PFA)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	600 - 630 °F	316 - 332 °C
Center zone	625 - 650 °F	329 - 343 °C
Front zone	640 - 690 °F	338 - 366 °C
Melt	650 - 725 °F	343 - 385 °C
Mold	300 - 450 °F	149 - 232 °C
Pressures		
Injection	8000 - 12000 psi	55 - 83 MPa
Hold	3000 - 7000 psi	21 - 48 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	0.5 - 1 in/sec	13 - 25 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 250 °F	2 Hrs @ 121 °C
Dew Point	n/a °F	n/a °C
Moisture Content	n/a %	n/a %

RTP 3200 Series Ethylene Tetrafluoroethylene (ETFE)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	525 - 575 °F	274 - 302 °C
Center zone	575 - 625 °F	302 - 329 °C
Front zone	585 - 635 °F	307 - 335 °C
Melt	560 - 650 °F	293 - 343 °C
Mold	150 - 300 °F	66 - 149 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 250 °F	2 Hrs @ 121 °C
Dew Point	n/a °F	n/a °C
Moisture Content	n/a %	n/a %

RTP 3300 Series Polyvinylidene Fluoride (PVDF)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	360 - 480 °F	182 - 249 °C
Center zone	380 - 500 °F	193 - 260 °C
Front zone	415 - 525 °F	213 - 274 °C
Melt	410 - 550 °F	210 - 288 °C
Mold	180 - 220 °F	82 - 104 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	0.5 - 1 in/sec	13 - 25 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 250 °F	2 Hrs @ 121 °C
Dew Point	n/a °F	n/a °C
Moisture Content	n/a %	n/a %

Processing Conditions

Specialty Compounds

RTP 3400-3 Series Liquid Crystal Polymer (LCP)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	635 - 650 °F	335 - 343 °C
Center zone	645 - 660 °F	341 - 349 °C
Front zone	655 - 670 °F	346 - 354 °C
Melt	630 - 690 °F	332 - 366 °C
Mold	150 - 250 °F	66 - 121 °C
Pressures		
Injection	12000 - 18000 psi	83 - 124 MPa
Hold	10000 - 15000 psi	69 - 103 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	2 in/sec	51 mm/sec
Screw	100 - 200 rpm	100 - 200 rpm
Drying		
Time & Temperature	8 Hrs @ 300 °F	8 Hrs @ 149 °C
Dew Point	-20 °F	-29 °C
Moisture Content	n/a %	n/a %

• The key to successfully molding this material is to start mold open cycles as soon as the screw reaches its retracted position.

RTP 3400-4 Series Liquid Crystal Polymer (LCP)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	680 - 715 °F	360 - 379 °C
Center zone	690 - 725 °F	366 - 385 °C
Front zone	700 - 735 °F	371 - 391 °C
Melt	685 - 750 °F	363 - 399 °C
Mold	150 - 200 °F	66 - 93 °C
Pressures		
Injection	10000 - 18000 psi	69 - 124 MPa
Hold	8000 -15000 psi	55 - 103 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	2 - 3 in/sec	51 - 76 mm/sec
Screw	100 - 200 rpm	100 - 200 rpm
Drying		
Time & Temperature	8 Hrs @ 300 °F	8 Hrs @ 149 °C
Dew Point	-20 °F	-29 °C
Moisture Content	n/a %	n/a %

• The key to successfully molding this material is to start mold open cycles as soon as the screw reaches its retracted position.

RTP 3500 Series Fluorinated Ethylene Propylene (FEP)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	600 - 625 °F	316 - 329 °C
Center zone	625 - 650 °F	329 - 343 °C
Front zone	690 - 700 °F	366 - 371 °C
Melt	650 - 725 °F	343 - 385 °C
Mold	200+ °F	93+ °C
Pressures		
Injection	3000 - 8000 psi	21 - 55 MPa
Hold	3000 - 7000 psi	21 - 48 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	0.5 - 1 in/sec	13 - 25 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 - 4 Hrs @ 250 °F	2 - 4 Hrs @ 121 °C
Dew Point	n/a °F	n/a °C
Moisture Content	n/a %	n/a %

RTP 4000 Series Polyphthalamide (PPA)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	565 - 595 °F	296 - 313 °C
Center zone	575 - 605 °F	302 - 318 °C
Front zone	585 - 615 °F	307 - 324 °C
Melt	575 - 625 °F	302 - 329 °C
Mold	275 - 325 °F	135 - 163 °C
Pressures		
Injection	10000 - 18000 psi	69 - 124 MPa
Hold	5000 - 12000 psi	34 - 83 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	6 Hrs @ 175 °F	6 Hrs @ 79 °C
Dew Point	-25 °F	-32 °C
Moisture Content	0.05 %	0.05 %

• Desiccant type dryer required.
†Hygroscopic Material

Processing Conditions

Specialty Compounds

RTP 4000A Series Hot Water Moldable Polyphthalamide (PPA)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	600 - 620 °F	316 - 327 °C
Center zone	610 - 630 °F	321 - 332 °C
Front zone	620 - 640 °F	327 - 338 °C
Melt	625 - 650 °F	329 - 343 °C
Mold	150 - 325 °F	66 - 163 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 12000 psi	34 - 83 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	3 - 5 in/sec	76 - 127 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	6 Hrs @ 175 °F	6 Hrs @ 79 °C
Dew Point	-20 °F	-29 °C
Moisture Content	0.10 %	0.10 %

- Desiccant type dryer required.
- Maintain resin dryness with a hopper dryer set at 175 F (79 C).
- Use of higher mold temperatures may improve part appearance.

RTP 4200 Series Thermoplastic Polyimide (TPI)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	700 - 730 °F	371 - 388 °C
Center zone	730 - 750 °F	388 - 399 °C
Front zone	750 - 770 °F	399 - 410 °C
Melt	750 - 780 °F	399 - 416 °C
Mold	350 - 450 °F	177 - 232 °C
Pressures		
Injection	20000 - 28000 psi	138 - 193 MPa
Hold	8000 - 12000 psi	55 - 83 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	3 - 5 in/sec	76 - 127 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	6 Hrs @ 400 °F	6 Hrs @ 204 °C
Dew Point	-40 °F	-40 °C
Moisture Content	0.01 %	0.01 %

†Hygroscopic Material

RTP 4300 Series Polysulfone/Polycarbonate Alloy (PSU/PC)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	530 - 560 °F	277 - 293 °C
Center zone	550 - 570 °F	288 - 299 °C
Front zone	560 - 580 °F	293 - 304 °C
Melt	540 - 620 °F	282 - 327 °C
Mold	150 - 210 °F	66 - 99 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 Hrs @ 250 °F	4 Hrs @ 121 °C
Dew Point	-20 °F	-29 °C
Moisture Content	0.02 %	0.02 %

RTP 4400 Series High Temperature Nylon (NHT)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	580 - 610 °F	304 - 321 °C
Center zone	590 - 620 °F	310 - 327 °C
Front zone	600 - 630 °F	316 - 332 °C
Melt	590 - 650 °F	310 - 343 °C
Mold	275 - 325 °F	135 - 163 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	7000 - 12000 psi	48 - 83 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	2 - 3 in/sec	51 - 76 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 Hrs @ 175 °F	4 Hrs @ 79 °C
Dew Point	-40 °F	-40 °C
Moisture Content	0.10 %	0.10 %

Processing Conditions

Specialty Compounds

RTP 4500 Series Aliphatic Polyketone (PK)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	430 - 440 °F	221 - 227 °C
Center zone	445 - 460 °F	229 - 238 °C
Front zone	465 - 480 °F	241 - 249 °C
Melt	430 - 500 °F	221 - 260 °C
Mold	180 - 300 °F	82 - 149 °C
Pressures		
Injection	12000 - 18000 psi	83 - 124 MPa
Hold	8000 - 10000 psi	55 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	2 in/sec	51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 Hrs @ 140 °F	4 Hrs @ 60 °C
Dew Point	-25 °F	-32 °C
Moisture Content	0.02 %	0.02 %

RTP 4600 Series Syndiotactic Polystyrene (SPS)

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	520 - 580 °F	271 - 304 °C
Center zone	540 - 600 °F	282 - 316 °C
Front zone	560 - 620 °F	293 - 327 °C
Melt	560 - 620 °F	293 - 327 °C
Mold	160 - 300 °F	71 - 149 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	2 - 3 in/sec	51 - 76 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	2 Hrs @ 180 °F	2 Hrs @ 82 °C
Dew Point	-20 °F	-29 °C
Moisture Content	0.02 %	0.02 %

RTP 4700 Series Polytrimethylene Terephthalate (PTI)†

Typical Injection Molding Conditions	English/Standard	SI Metric
Temperatures		
Rear zone	450 - 465 °F	232 - 241 °C
Center zone	460 - 475 °F	238 - 246 °C
Front zone	470 - 485 °F	243 - 252 °C
Melt	450 - 500 °F	232 - 260 °C
Mold	190 - 250 °F	87 - 120 °C
Pressures		
Injection	10000 - 15000 psi	69 - 103 MPa
Hold	5000 - 10000 psi	34 - 69 MPa
Back	50 - 100 psi	0.34 - 0.69 MPa
Speeds		
Fill	1 - 2 in/sec	25 - 51 mm/sec
Screw	60 - 90 rpm	60 - 90 rpm
Drying		
Time & Temperature	4 - 6 Hrs @ 260 °F	4 - 6 Hrs @ 127 °C
Dew Point	-40 °F	-40 °C
Moisture Content	0.01 %	0.01 %

†Hygroscopic Material

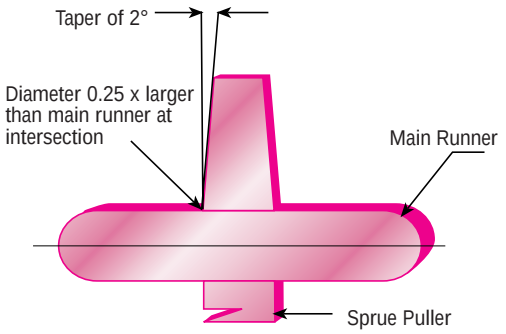
Mold Design

Injection molds must be properly designed to ensure quality plastic components. Mold design impacts productivity and profitability of your molding operation. This section offers guidelines for designing an efficient injection mold.

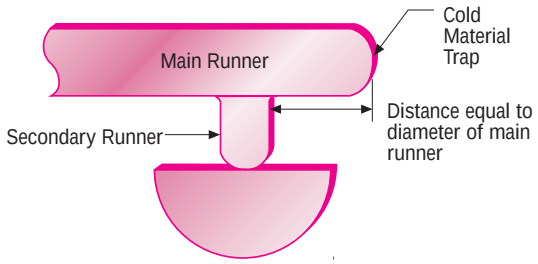
Sprue/Cold Material Trap Design

Sprues connect the nozzle of the injection molding machine to the main runner or cavity. The sprue should be as short as possible to minimize material usage and cycle time. The bushing should have a smooth, tapered internal finish that has been polished in the direction of the draw to ensure clean separation of the sprue and the bushing.

Sprue Puller - An area used to pull sprue out of the bushing as the mold opens.



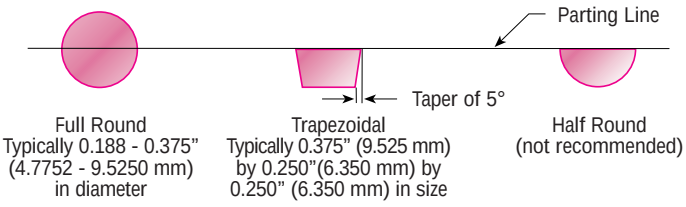
Cold Material Trap - A space provided to trap cooled material during flow.



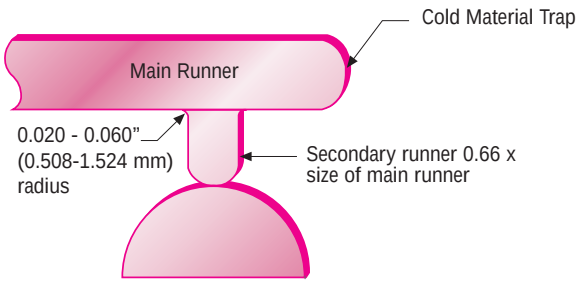
Runner Design

Runner systems convey the melted plastic from the sprue to the gate or part. The most efficient profile for a runner is circular (full-round). A less expensive, yet adequate, profile is a trapezoid, with tapers as shown in the diagram to ensure a good volume-to-surface area ratio. Half rounds are not recommended because of their poor perimeter to area ratio.

Main Runner - A channel that connects the sprue to the gate or part.



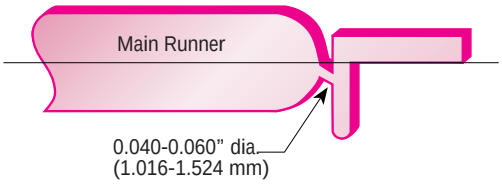
Secondary runner - A runner system located between the main runner and the molded part.



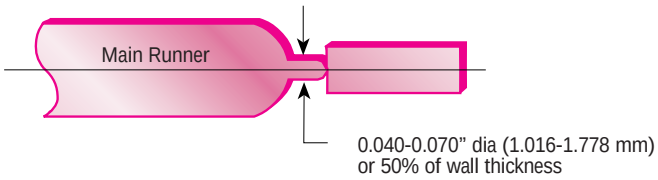
Gate Design

The gate serves as the entrance to the cavity and should be designed to permit the mold to fill easily. A cavity can have more than one gate. Gates should be small enough to ensure easy separation of the runner and the part but large enough to prevent early freeze-off of polymer flow, which can adversely affect the consistency of part dimensions. A variety of gate designs and locations are shown below:

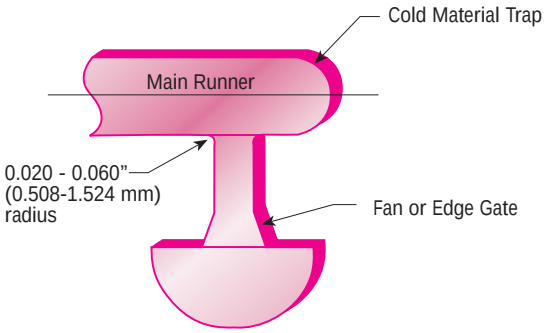
Submarine or Tunnel Gate - An edge gate located below the parting line or molded surface.



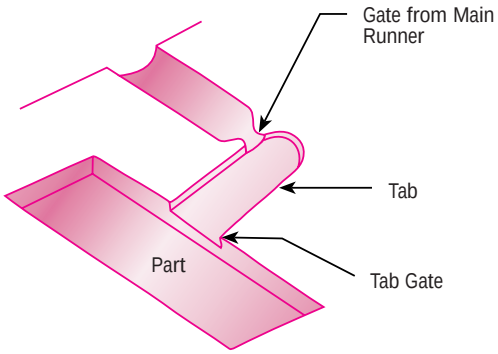
Pinpoint or Restricted Gate - A restricted opening between the runner and molded part. Normally used with thin wall parts.



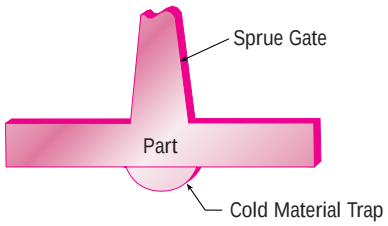
Fan or Edge Gate - A common gate located in the sidewall of the part to prevent restriction of resin flow. Normally used with multi-cavity, two-plate molds.



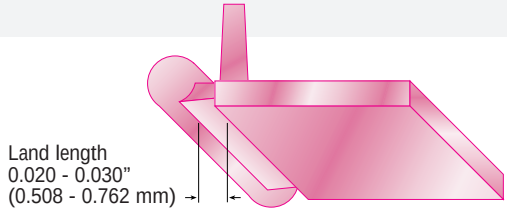
Tab Gate - Used for melt orientation when a large volume is needed for mold fill. The tab helps avoid surface splotches due to high shear, direct gating, or jetting.



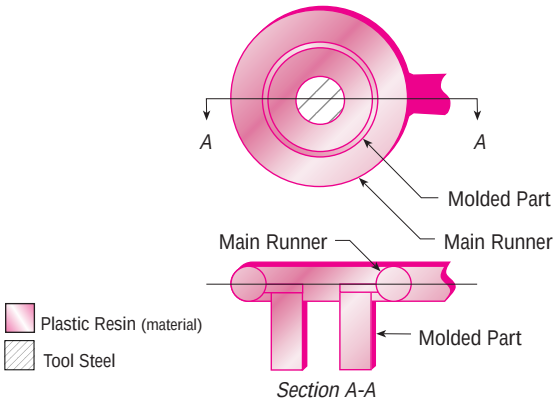
Sprue Gate - Recommended for single cavity molds requiring symmetrical filling. Usually used with circular parts.



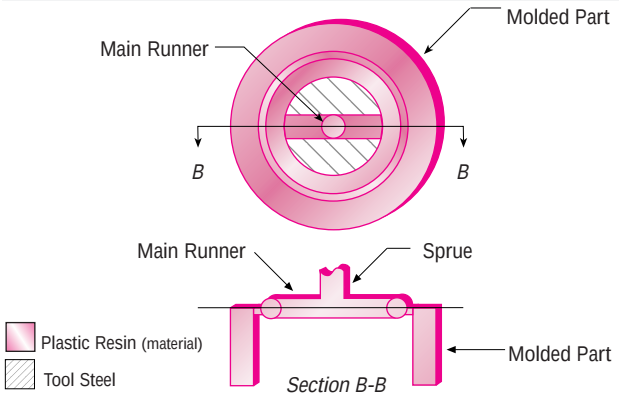
Flash Gate - A long, shallow, rectangular edge gate.



External Ring Gate - A system used when concentricity and a smooth interior surface are important. Can be used in multi-cavity molds.

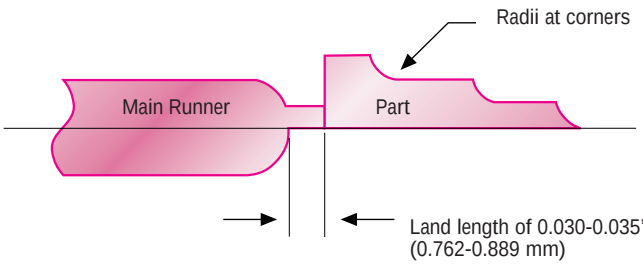


Internal Ring Gate - A system used with large circular parts when concentricity and smooth outer surface are required. Can only be used with single-cavity molds.



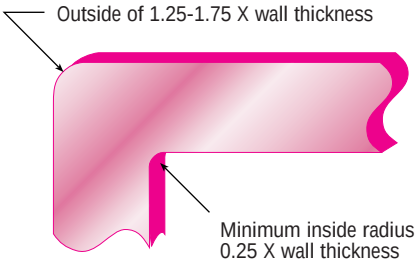
Thick to Thin Wall Gating

Avoid sudden changes in wall thickness by using transition zones to eliminate stress concentrations and reduce sinks, voids, and warping in the molded part.



Adjoining Walls

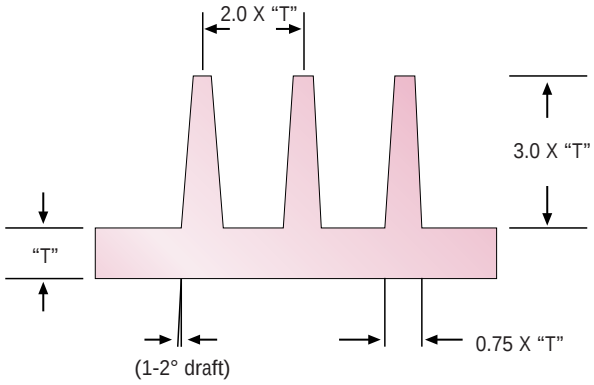
The connection point between two molded surfaces.



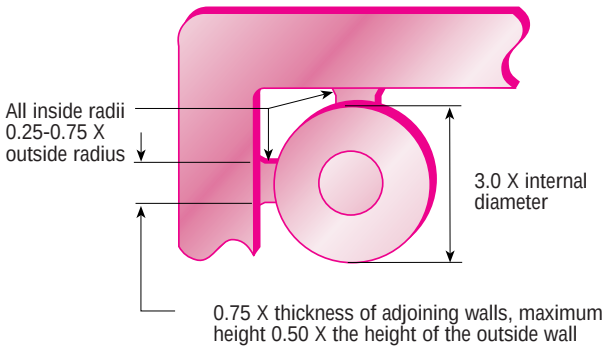
Ribs

Ribs should follow the proportional thickness guidelines shown below. If the rib is too thick in relation to the part wall, you may experience sinks, voids, warpage, weld lines, and longer cycle times. Position ribs in the line of flow to improve filling and prevent air entrapment.

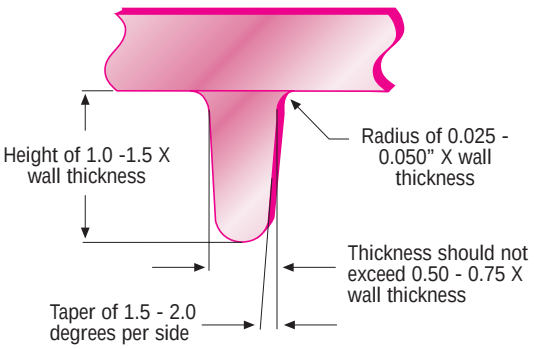
Rib Details



Support Ribs



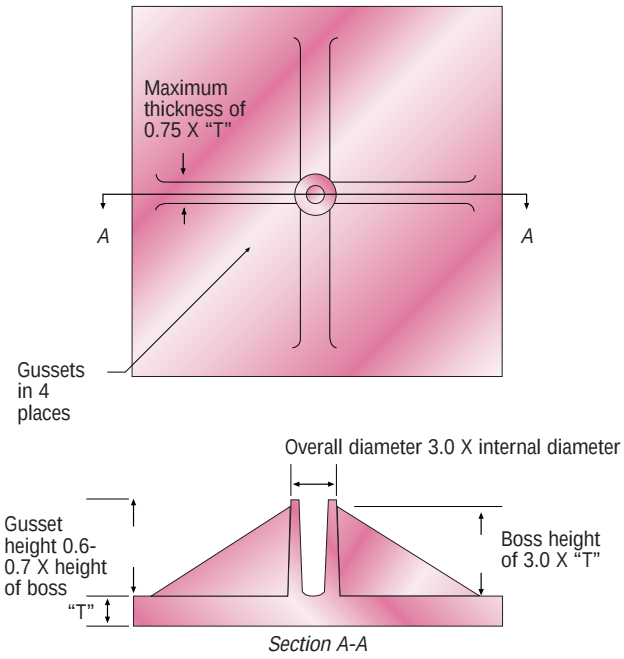
Boss or Rib - A reinforced or protrusion on a mold part for strength or alignment during assembly or fastening.



Bosses & Gussets

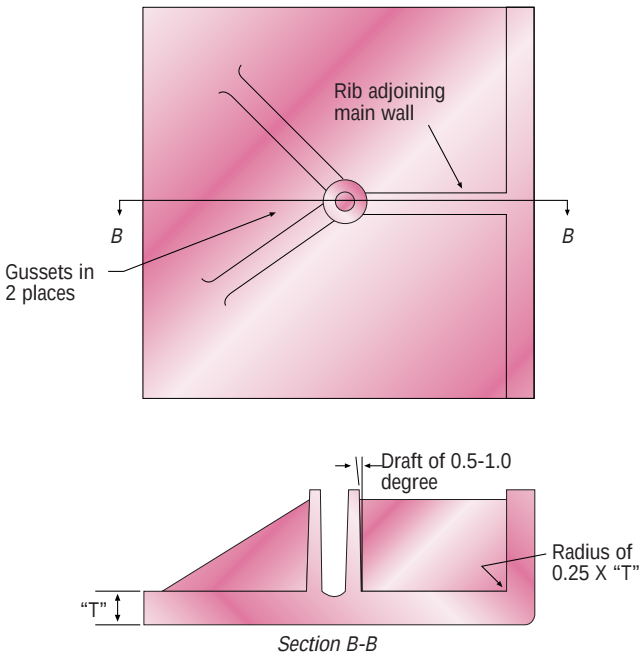
Bosses are used in parts that will be assembled. Connect the boss to a wall or rib with a connecting rib as shown in Figure 1.
If the distance of the boss from the wall makes a connecting rib impractical, design the boss with gussets as shown in Figure 2.

Free Standing Boss With Four Gussets



Section A-A

Free Standing Boss With Two Gussets



Section B-B

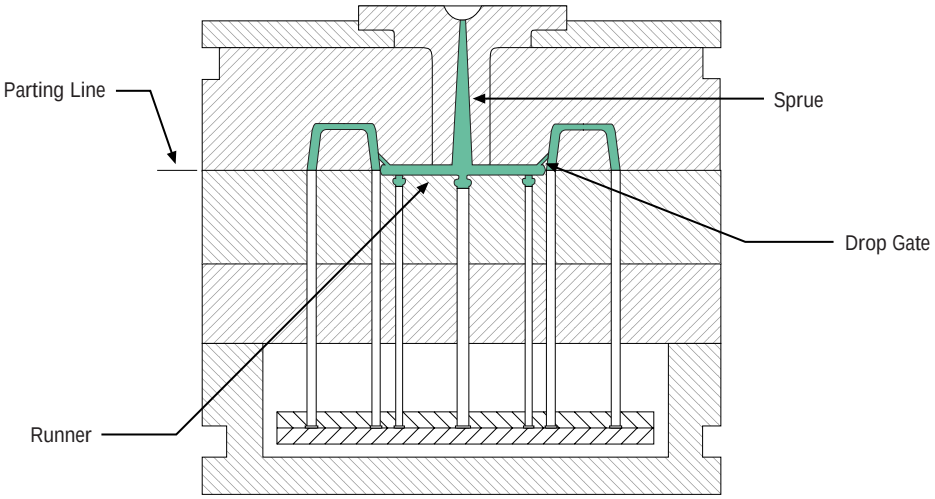
Mold Design

Solidified Resin

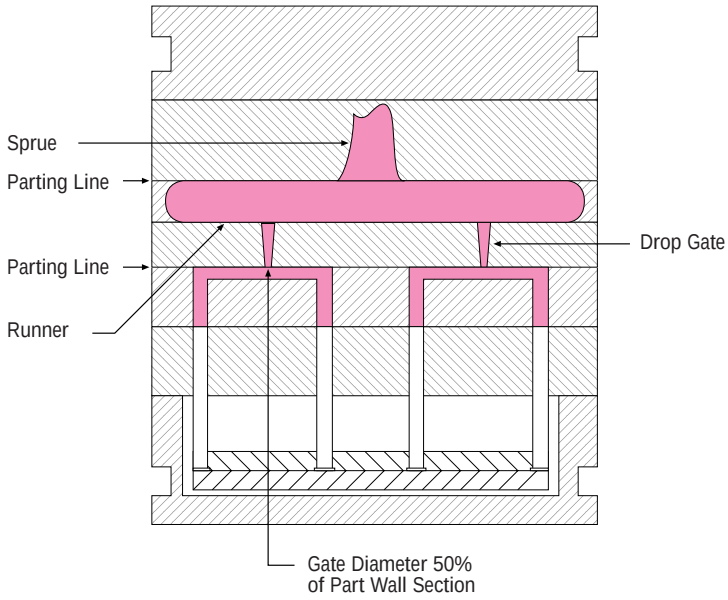
Molten Resin

Tool Steel

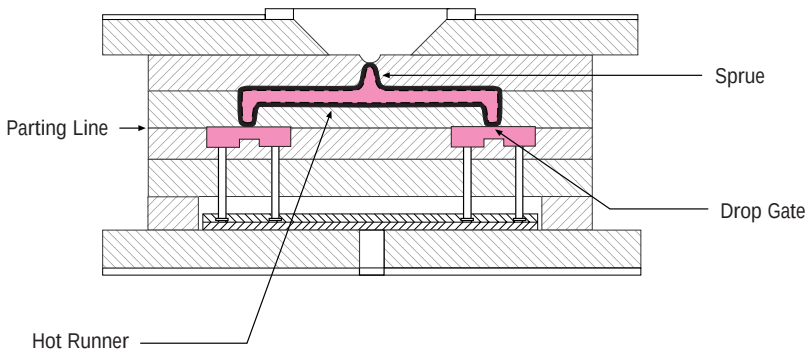
Two Plate Mold



Three Plate Mold



Insulated Runner Mold

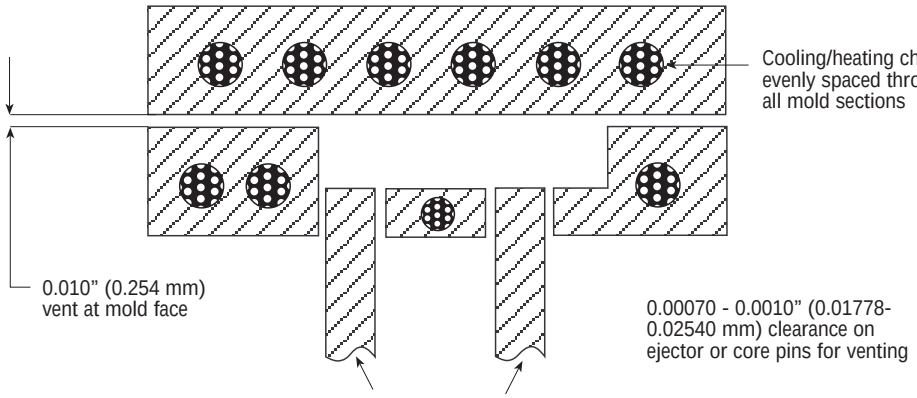


Venting & Cooling

Cooling

Plastic Resin Tool Steel

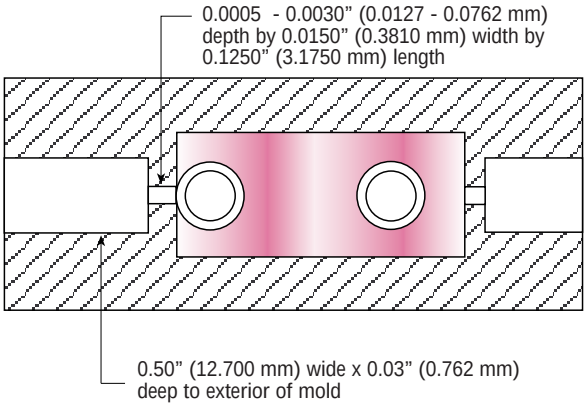
Molds must be provided with adequate cooling to take advantage of the faster cooling rates of reinforced compounds. Poor cooling results in rising mold temperatures and longer cycle times. Inadequate heating can result in voids, shorts and poor surface finish. Cooling and heating channels should be located directly in the mold inserts and cores if mold design permits.

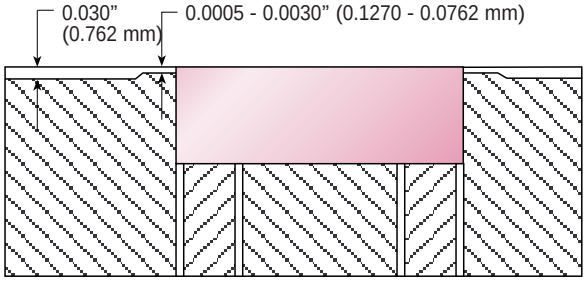


Ejector Pins: ***Should be located on the heaviest sections of the part to minimize distortion when it leaves the core They should be balanced as much as possible over the part's surface. Reinforced thermoplastics require more pins due to lower mold shrinkage and greater potential for drag during ejection.***

Venting

Proper venting of cavities is very important. Inadequate venting can result in gas burns, poor weld line strength and nonfilled parts. Too much venting can result in excessive flash and poor weld lines due to inadequate pressure buildup. Venting should primarily be located at the last point of fill and where weld lines occur. Vent size depends on the viscosity of the polymer and can vary from 0.0005 - 0.0030" (0.0127 mm to 0.0762 mm) deep. Venting can also be used around knockout pins, moving cores and mold inserts.



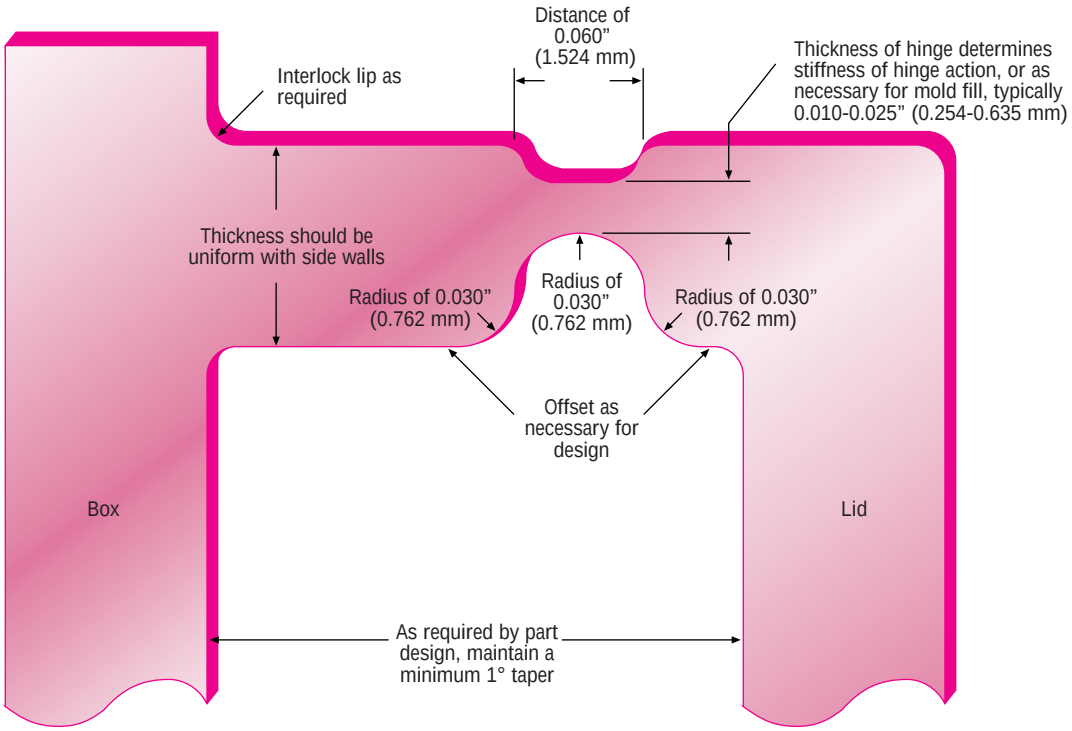


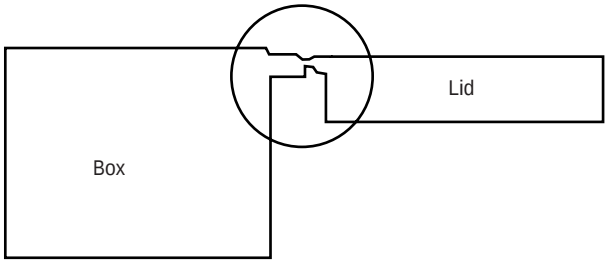
Hinge Design

Living Hinge

This design is simply a modification of a flash gate into a cavity. The web will neck down the first time it is flexed. To ensure a good flex life, the hinge should be flexed several times immediately after being molded, since orientations of the web is what gives it strength.

For use with polypropylene and polyethylene resins only.





Troubleshooting Guide

SUGGESTED REMEDIES Perform in numerical order by column	PROBLEM Blisters	Brittleness	Excessive Flash	Gas Burns	Oversized Part	Poor Surface Finish	Poor Weld Lines	Short Shots	Silver Streaking	Sink Marks	Undersized Part	Voids	Warping
Change Gate Location								8					6
Clean Mold Faces			4	5		6							
Clean Vents	5			2			5	11				12	
Check for Material Contamination	6	4							4				
Check for Uneven Mold Temperature													1
Check Mold Faces for Proper Fit			5										
Dry Material	1	6	6	6		7			1			11	
Increase Amount of Material							4	1		8	7	10	
Increase Back Pressure						5		6			6		
Increase Clamp Pressure			2										
Increase Cooling Time										10			9
Increase Holding Pressure						8		12		11	1		
Increase Injection Hold Time							2			2	2	2	
Increase Injection Pressure						2	1	2		1		1	2
Increase Injection Speed						3	9	3	2		8		
Increase Injection Time										12	5		
Increase Mold Temperature		7			5	1	3	7			9	8	3
Increase Size of Gates								8	6	4	10	4	
Increase Size of Runners								9		5	11	5	
Increase Size of Sprue								10		6		6	
Increase Size of Vent				4			6	4					
Locate Gates Near Heavy Cross Sections										7		7	
Raise Material Temperature					7	4	10	5			4		
Redesign Ejection Mechanism													10
Reduce Amount of Regrind		5											
Reduce Back Pressure		2							7				
Reduce Cylinder Temperature	2	1	8	3	4				3				7
Reduce Holding Pressure			7		3								8
Reduce Injection Pressure			3		2								
Reduce Injection Speed	3		1	1	1	9	7		8	3		3	
Reduce Mold Temperature										9	3	9	4
Reduce Molded Stress		8											5
Reduce Overall Cycle Time					6								
Reduce Screw Speed	4	3							5				

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