

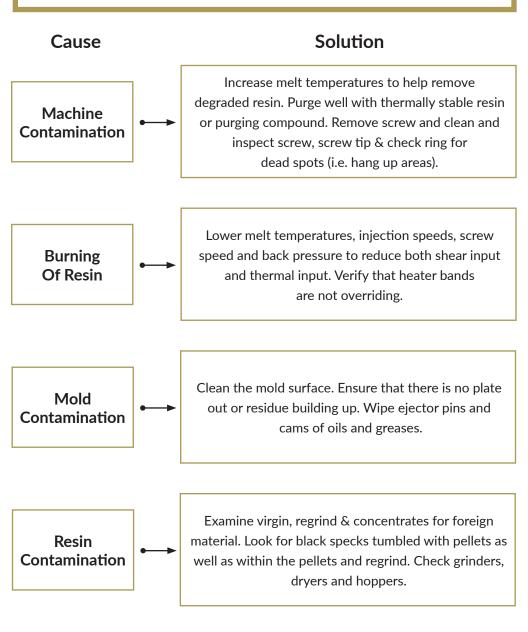
# TROUBLESHOOTING GUIDE FOR INJECTION MOLDING

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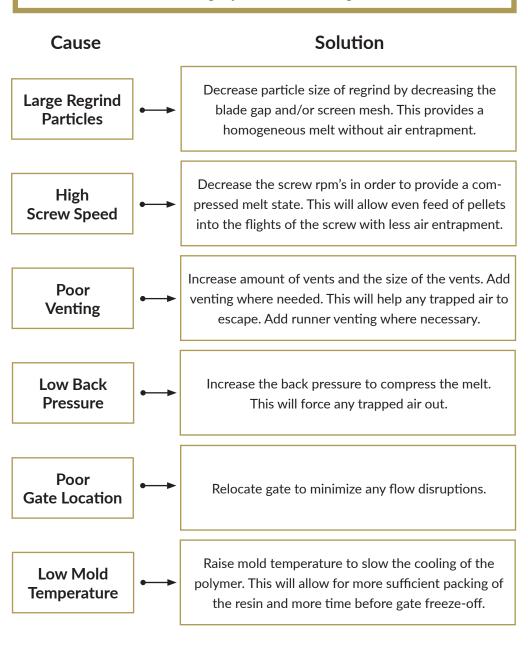
#### **Black Specks**

Black specks are non miscible particles only seen on the surface of an opaque part because pigments tend to hide them. With transparent parts they are visible throughout.



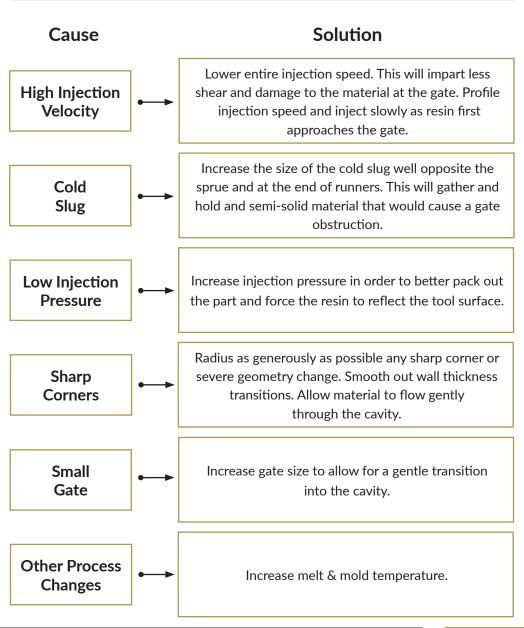
#### **Blisters**

Blisters are areas of trapped gas seen as surface irregularities or bumps on the surface of the molded part. They occur during injection or cooling.



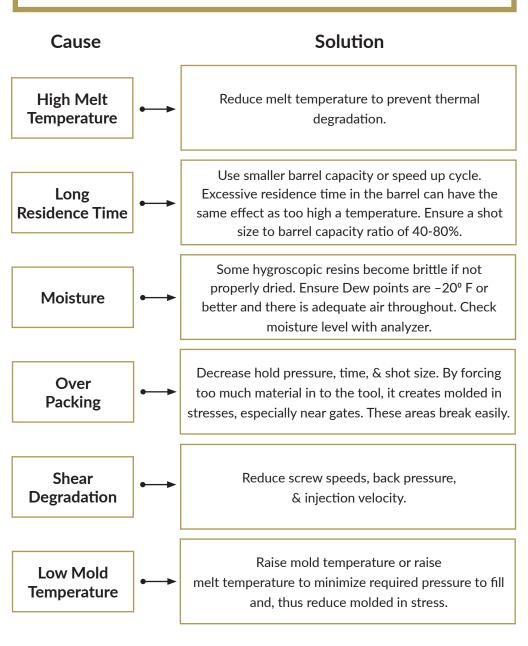
#### Blush

Blush often occurs near the gate or a flow disruptor such as a core pin or shutoff. It is also noticed near sharp corners or severe wall thickness transitions. It is the result of melt fracture. The part surface will appear dull (low gloss) or discolored and some flow marks will be visible.



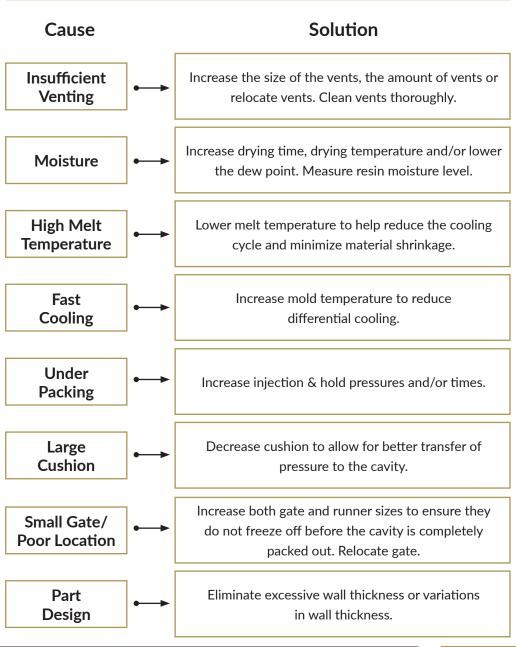
#### **Brittleness**

Brittleness occurs from degrading the resin and results in a reduction of physical properties. Brittleness can also be related to moisture in some materials prior to melt processing.



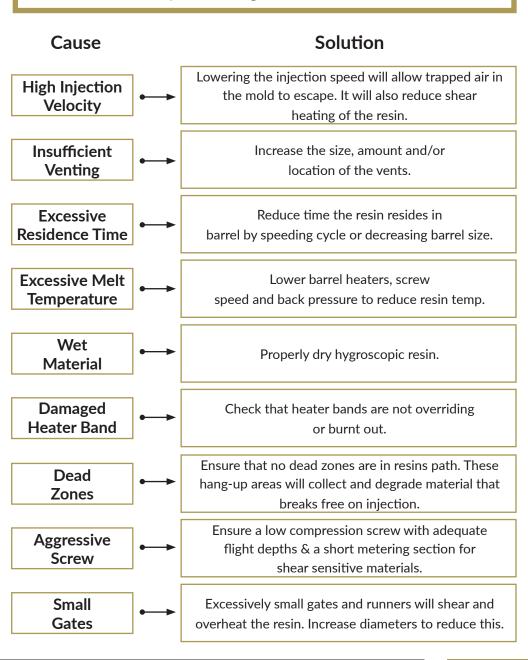
#### **Bubbles**

Regions within the molded part without plastic are referred to as internal voids or bubbles. They can be caused by differential cooling or air entrapment.



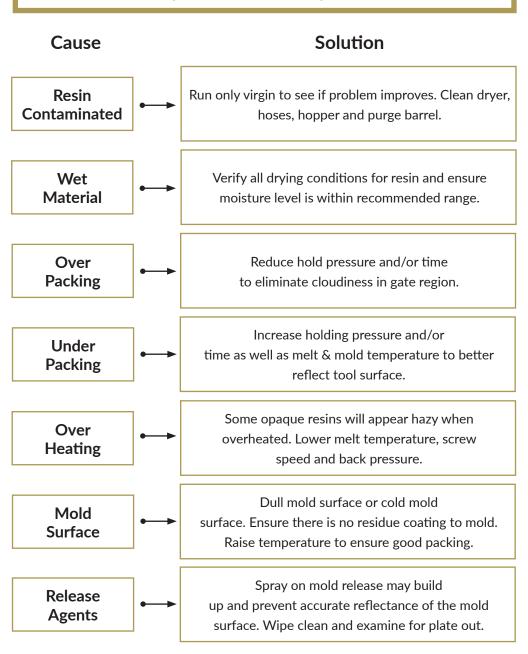
#### Burns

Burned resin can be the result of several things. High barrel temperatures, shear from screws or runner and gate systems, excessive residence time and poor venting will all cause the resin to discolor.



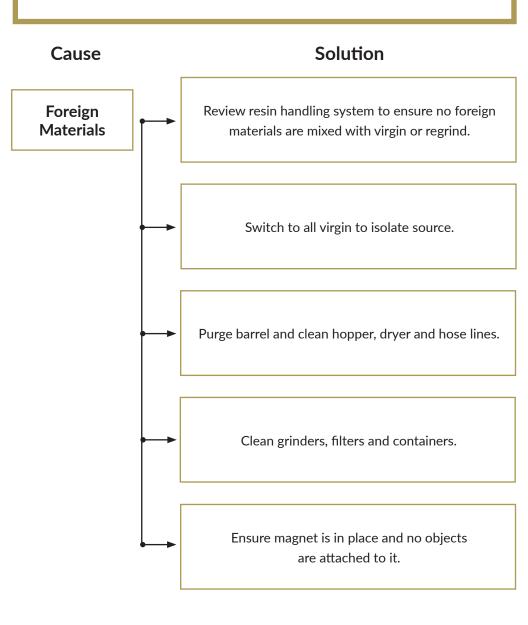
#### **Cloudiness/Haze**

Cloudiness in transparent resins can be the result of contamination. Other causes can be mold surfaces, mold temperature or resin temperature.



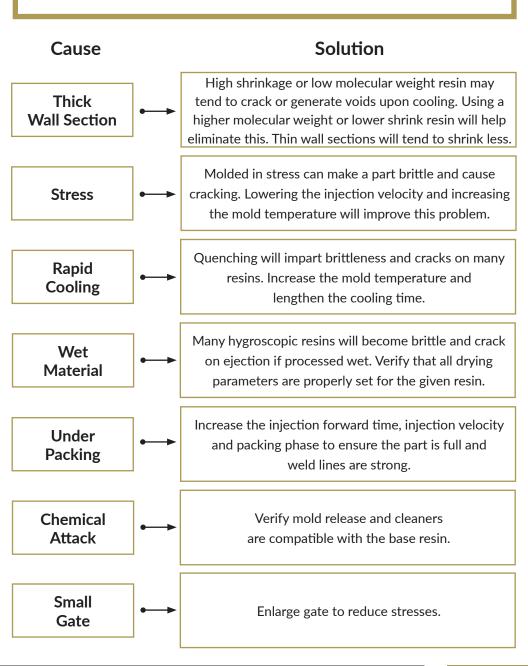
#### Contamination

Contaminants often show up as black specks or color streaks.



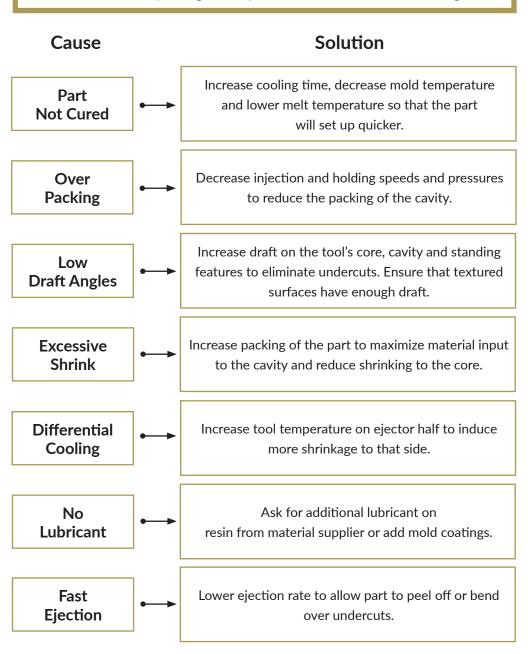
# Cracking/Crazing

Cracking and crazing can occur upon ejection from the mold. Many simple changes will improve the part quality after molding.



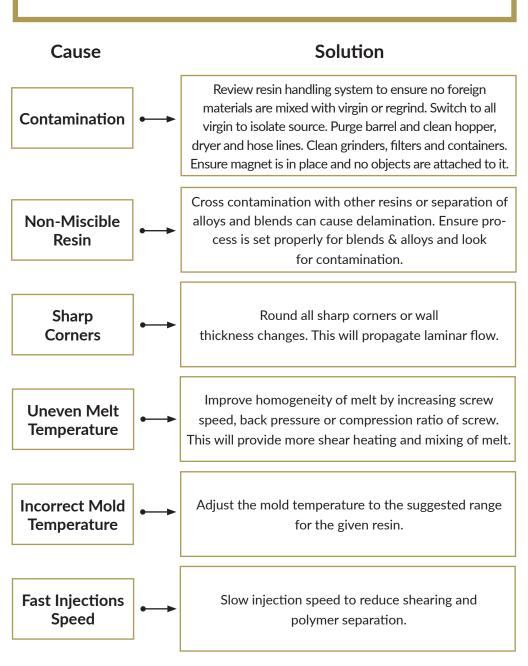
#### **Deformation**

Upon ejection, parts can stick to the tool causing the geometry to be deformed as the ejectors push forward. Deformation can also be caused on mold opening if the part tries to stick to the wrong half.



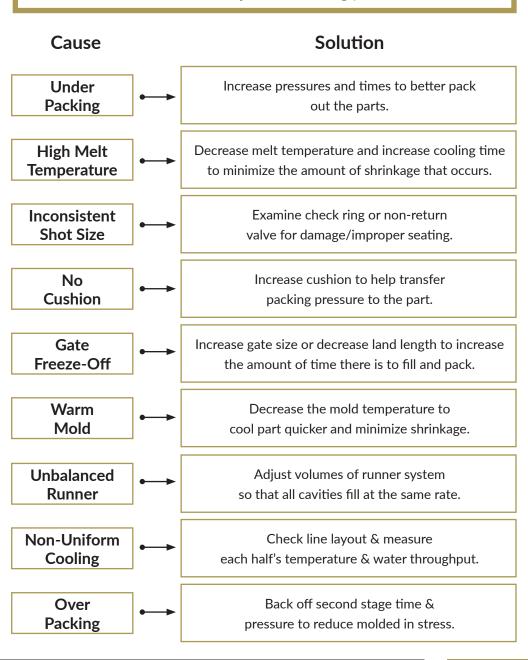
#### **Delamination**

Delamination is a separation of layers of the molded part. These layers can develop from contamination or improper processing.



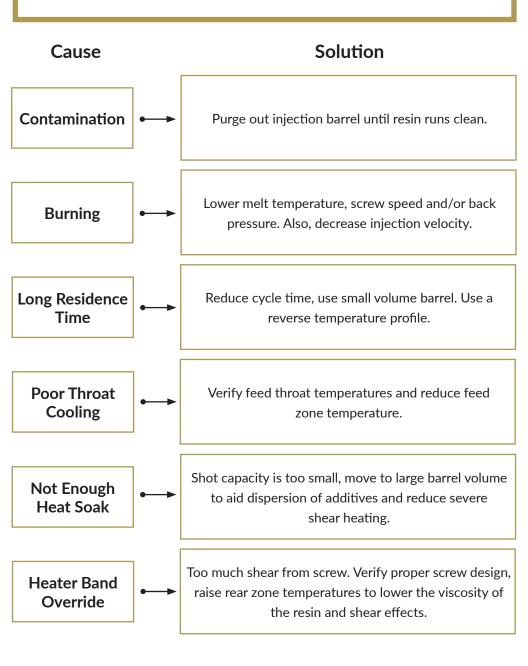
#### **Dimensional Instability**

Dimensional instability or warpage in a molded part can be the result of differential material shrinkage, molded-in-stress relief, or an inconsistent injection molding process.



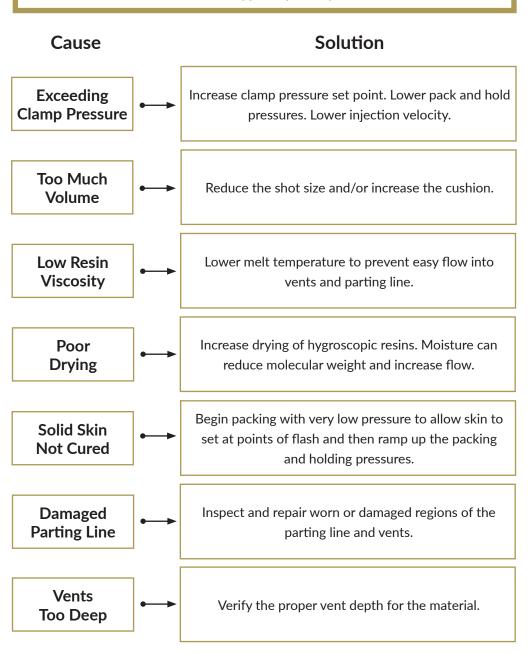
#### **Discoloration**

Discoloration can be caused by several factors and can occur to the actual pellets prior to molding as well as the final part.



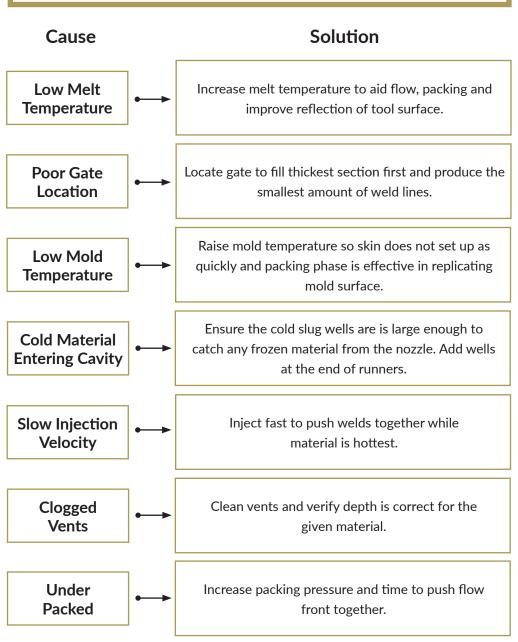
#### **Flash**

Flash is caused when resin flows out of the cavity at the parting line. This can be a function of many machine, mold and material variations and is typically easily corrected.



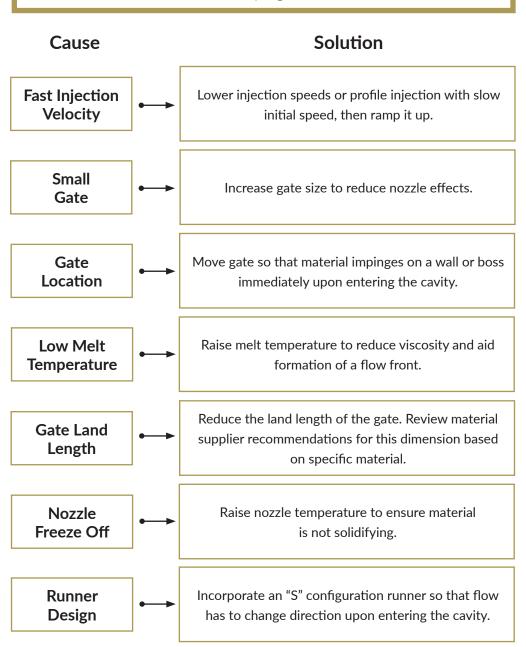
#### **Flow Lines**

Flow lines, weld lines, meld lines, knit lines and ripples or folds are all a result of a disturbance in the flow path of the resin. When smooth laminar flow is interrupted, the polymer may not accurately reflect the surface of the tool.



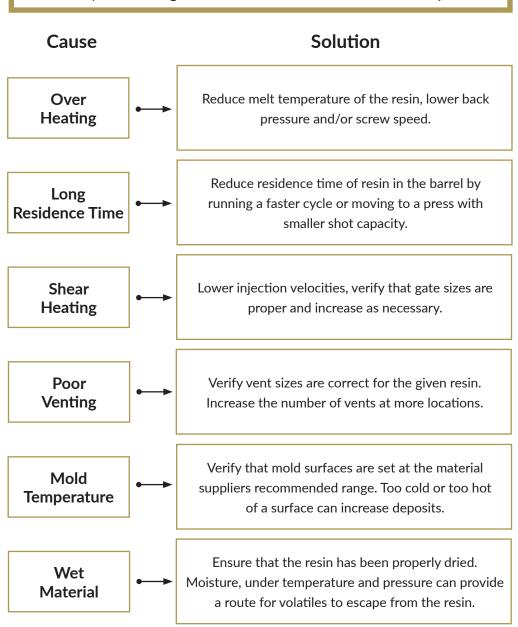
### **Jetting**

Jetting or worming is caused by excessive injection force without a barrier for the melt to hit. The material cannot develop a laminar flow front unless it impinges on a wall or boss.



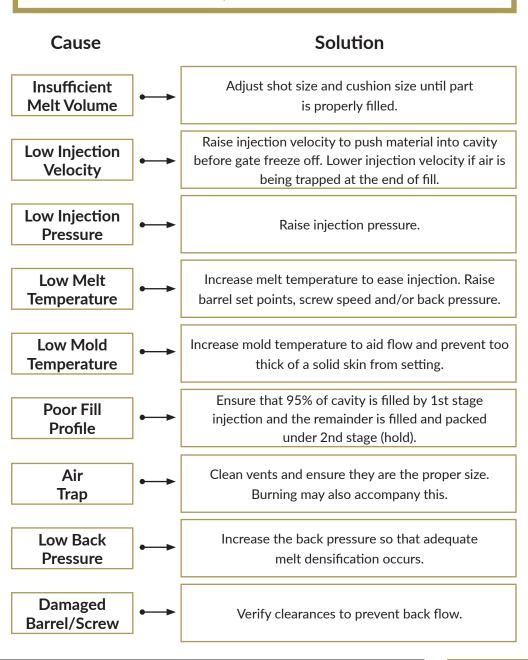
#### **Mold Deposits**

Under the high temperatures and pressures of the injection molding process, additives and residual monomer can be volatized and separated from the resin. These materials can end up as residue on the mold surface and require cleaning or leave surface defects on the molded parts.



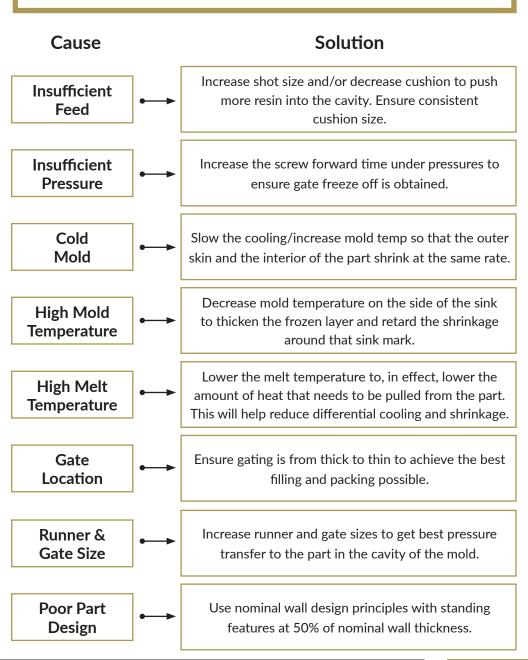
#### **Short Shots**

A short shot occurs when insufficient material is injected and does not completely fill or pack out all of the cavities in the mold. Shorts can be caused by machine, mold or material.



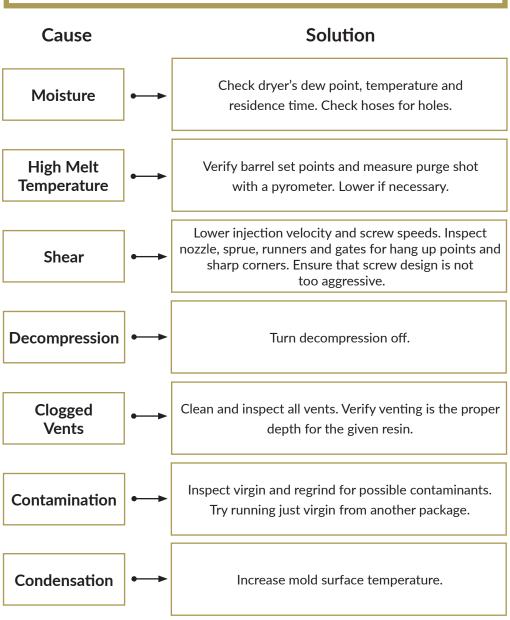
#### Sink Marks

Sink marks can be the result of a poor fill (short shot) or the result of differential cooling when wall sections vary greatly in thickness.



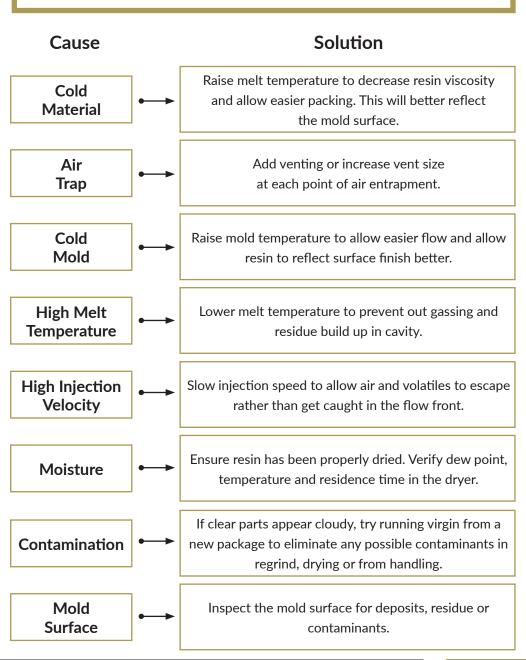
### Splay

Three types of splay are often encountered in injection molding. Splay due to moisture usually results in silver streaks on the surface and slight delaminating of a film layer. Heat splay, caused by degradation or hangup, looks similar but is often accompanied by black specks or yellowness. Splay due to contamination is often accompanied by severe delamination.



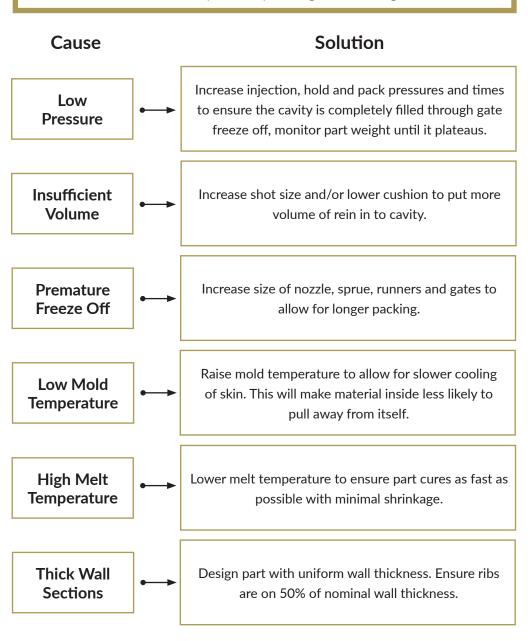
## **Surface Finish**

A dull surface finish or poor reflection of mold surface can be easily corrected.



#### **Voids/Bubbles**

Internal voids on a part are simply gaps or pockets with no material. The are often invisible but can greatly reduce the strength. These are caused by under packing or shrinkage.



# GENERAL POLYMER PROCESSING GUIDE INTRO

Polymer families tend to have a wide range of processing conditions so supplier specific information and grade specific information should be used whenever possible when designing molds or setting up processing conditions.

The drying conditions, melt and mold temperature ranges provided should only be used as a general guide. Because the specific processing conditions can vary with different grades of a specific material as well as from supplier-to-supplier it is strongly suggested to refer to the suppliers data sheet for information specific to a given grade of material.

The mold shrinkage values provided are general ranges and are only intended to be used to allow comparisons to other materials and should only be used as a general guide. The mold shrinkage values provided are the "flow-direction" shrinkage and are based on 1/8" thick injection molded test specimens tested per ASTM D955. Actual material shrinkage is based on a number of factors including part design, wall thickness, tool configuration, mold cooling layout and processing parameters. Entec's recommendation would be to use shrinkage values observed in other molds currently running the material that produce parts with a similar geometry and wall thickness, and proceed to machine the mold cores and cavities in a "steel safe" manner.

# GENERAL POLYMER PROCESSING GUIDE

Resin	Specific Gravity	Drying Parameters Temperature (F)/Time	Mold Temperature (F)	Melt Temperature (F)	Mold Shrinkage (in./in.)
ABS Flame Retardant	1.18	180 / 3 hrs	105 - 160	345 - 365	.003007
ABS/TPU	1.1	170 / 4 hrs	80 - 100	390 - 415	.005007
ASA	1.07	175 / 2-4 hrs	105 - 175	465 - 535	.004007
EVA	.920970	None Required	60 - 105	300 - 425	.001016
GPPS	1.04	170 / 2 hrs	60 - 160	390 - 475	.003007
HIPS	1.05	170 / 2 hrs	60 - 160	390 - 475	.003007
LCP Reinforced	1.50 - 1.90	250 - 300 / 4 hrs	175 - 250	555 - 650	.000004
PA 6 (Nylon 6)	1.13	165 / 2-4 hrs	160 - 200	460 - 520	.010015
PA 6 Reinforced	1.18 - 1.49	165 / 2-4 hrs	160 - 220	515 - 565	.0015003
PA 6/6 (Nylon 6/6)	1.14	165 / 2-4 hrs	175 - 200	520 - 530	.012020
PA 6/6 Reinforced	1.22 - 1.49	165 / 2-4 hrs	175 - 220	540 - 570	.003005
PBT	1.31	250 / 3-4 hrs	100 - 200	460 - 500	.017023
PBT Reinforced	1.52	250 / 3-4 hrs	140 - 220	480 - 525	.003006
PC	1.2	250 / 4 hrs	160 -200	550 - 600	.005007
PC Reinforced	1.25 - 1.52	250 / 6 hrs	190 - 250	600 - 650	.001005
PC/ABS	1.08 - 1.22	250 / 3 hrs	150 - 190	460 - 500	.005007
PE	.905968	None Required	85 - 105	320 - 450	.015035
PET Reinforced	1.58 - 1.73	250 / 3 hrs	180 - 250	540 - 580	.002006
PMMA (Acrylic)	1.19	170 / 3 hrs	85 - 160	350 - 450	.004006
POM (Acetal)	1.41	180 / 1 hr	170 - 200	370 - 390	.015022
PP	0.9	None Required	80 - 150	375 - 500	.010025
PPO	1.04 - 1.28	220 - 250 / 6 hrs	160 - 220	550 - 620	.004007
PPS Reinforced	1.4 - 2.0	265 - 285 / 3-4 hrs	285 - 320	560 - 650	.002007
SAN	1.06	175 / 3 hrs	105 - 175	390 - 480	.003007
TPU	1.01 - 1.23	160 - 220 / 3 hrs	50 - 110	365 - 435	.00501



The information presented in this document was assembled from literature of the resin product producer(s). The information is believed to be accurate however Entec Polymers ("Entec") makes no representations as to its accuracy and assumes no obligation or liability for the information, including without limitation its content any advice given, or the results obtained. ENTEC DISCLAIMS ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING FITNESS FOR A PARTICULAR PURPOSE. The customer shall use its own independent skill and expertise in the evaluation of the resin. product to determine suitability for a particular application and accepts the results at its sole risk.

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