

Hot Runner

Troubleshooting Guide

version 1



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Section 1 - Troubleshooting

WARNING - HOT SURFACES

Extreme heat. Avoid contact with heated surfaces. To avoid serious burns wear safety clothing consisting of a protective heat resistant coat and heat-resistant gloves. Use adequate ventilation for fumes. Failure to do so can result in a serious injury.



WARNING - LOCKOUT / TAGOUT

Make sure the machine has been locked out and tagged out in accordance to the machines documented procedures. Failure to do so may lead to serious injury or death.



This troubleshooting information assumes that the Hot Runner has been operational.

Basic rules for troubleshooting are:

- Define the problem; what is seen is only a symptom of the underlying problem.
- Develop a method to isolate the problem.
- Test one item at a time to verify results.
- Monitor the final solution to verify that the problem has been solved. Repeat occurrences of the same symptom may indicate other problems.
- Document the solution so that a repeat occurrence can be solved quickly.
- Consult other resources to augment the troubleshooting information in this manual. One of the best resources may be your resin supplier.

1.1 Moisture Related Issues

Many common molding issues can be directly attributed to moisture contamination of the production resin. Generally, manufacturing resin is supplied from the manufacturer in ready to process pellets that are in sealed, airtight containers. Follow manufacturers storage instructions, keeping containers sealed until ready to use. Prior to using pellets, follow the drying instructions, as provided by the resin supplier and molding machine manufacturer, if applicable.

1.1.1 Resin Moisture Contamination

Moisture can be introduced into the resin in many ways:

- During transportation
- Environmental exposure (aging)
- Malfunctioning heater / dryer
- Extreme humidity in atmosphere
- Inadequate or malfunctioning facility HVAC

1.1.2 Resin Drying Issues

During the drying stage of the resin (if applicable), ensure that:

- The resin pellets are not overpacked

- Adequate air circulation is present
- The drying system is properly sealed, according to manufacturers instructions

1.1.3 Importance of Pre-Drying Resin

Thermoplastic resins can be hygroscopic, able to absorb moisture from the air. Under normal processing conditions, this can lead to degradation of the polymer during molding. Breakage of polymer chains changes the properties, resulting in possible blisters, streaks, splay or other defects described in this section.

Recycled resins can have higher hygroscopic properties due to greater surface area and should be dried separately from fresh resins.

If moisture issues are ruled out, continue with the troubleshooting tables in the following pages.

1.2 Pre-Molding Precautions

Prior to commencing production, ensure that the following conditions have been met. This will greatly reduce any future need to troubleshoot defective production.

1.2.1 History

- Review any documentation associated with your batch job regarding the recipe using the mold, molding machine, thermoplastic resin, environmental setting, etc.
- Review comments, notes, logbooks, blogs, and anything other resource material that pertains to the batch job.
- Verify that all settings such as all time, temperature, pressure, material, etc. are correct.

1.2.2 Material

- Ensure that the thermoplastic resin to be used is the right grade, and has been stored and / or prepared/dried, etc, according to manufacturer's specifications.
- Verify that the pigment / dye to be used meets manufacturer's specifications, and is compatible with the resin / molding machine / mold.
- Verify the correct recycle ratio and adjust settings accordingly.

1.2.3 Hardware

- Make sure the mold has been properly stored, and is dry, clean, free of rust, dirt, moisture, residual resin, pigment and any protective coating.
- Check that the temperature controller meets requirements, and is fully

tested and operational.

- The injection molding machine has been properly maintained, cleaned, lubricated; tolerances and dimensions verified.
- Make sure that the nozzles, cylinders, valves, gates, and any other variable that is appropriate for the batch job has been chosen.

1.2.4 Settings

Ensure that all batch job parameters are correct:

- Temperatures
- Pressures
- Injection Speed
- Back Pressure

1.3 Establishing Root Cause

This section is to be used as a reference tool only.

When a system that has been set up according to specification and was functioning normally suddenly produces sub-standard parts, the data in the following pages may be used to determine the possible cause, but only should be used as a guide.

A correct set up procedure that has been proven in will produce parts that meet design tolerances and specifications. A sudden change in any parameter indicates a possible fault. Rather than modify other settings to compensate for this variation, it is advisable to determine which of the original settings has changed.

1.4 Fault Identification

The operator will need to evaluate all the possible conditions which may have caused the defect.

- Identify the problem
- Determine the frequency
- Is the problem random or in the same location
- Review past history logs for similar occurrences and resolutions.

Review the machine settings to ensure that there is no variation from the original set-up which was producing standard parts.

injection speed	melt heating
screw speed	locking
melt temperature	cushion
back pressure	mold heating

For a more thorough analysis of the defect, refer to the Troubleshooting Section in the following pages.

1.5 Defect Types, Causes and Remedies Index

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1.6 Troubleshooting Typical Problems

1.6.1 Dark Specks

The finished product contains dark specks. Usually occurs when transparent resins are used.



Probable Cause:

1. Molding Machine
 - Off-line for extended period
 - Barrel off-line for extended period
 - Barrel improperly purged
 - Contamination in plasticizer
 - Wrong nozzle
 - Use of wrong screw
2. Mold
 - Gate and / or runner has dead spots
3. Material
 - Physical contamination of raw material
 - Chemical contamination of raw material
 - Particulate contamination from machine barrel

Solution (in sequence):

1. Purge system with appropriate material
2. Trace source of contamination and repair, remove or discard
3. Adjust melt temperature if necessary
4. Inspect for dead spots: gates, runners, nozzle, back flow valve
5. Inspect feed screw for degradation

1.6.2 Blisters or Bubbles

The finished product contains small gas or air filled pockets or cooling voids.



Probable Cause:

1. Molding Machine
 - Low injection pressure
 - Back flow valve malfunctioning
 - Decompression cycle too long
 - Rapid plasticizing
 - Trapped air in feed
 - Feed error
2. Mold
 - Trapped or volatile gas
 - Low mold temperature
 - Poor thin/thick transition phase
 - Inadequate venting
3. Material
 - Overheating of resin

Solution (in sequence):

1. Verify control and / or holding pressure
2. Increase back pressure
3. Increase mold temperature
4. Inspect back flow valve
5. Ensure proper venting
6. Increase gate size
7. Decrease vent land length

1.6.3 Flow Marks

The finished product exhibits blush and flow marks, due to variations in material temperature from gradients between the machine nozzle and mold sprue bushing. Cold material in the nozzle tip section results in a halo around the direct sprue.



Probable Cause:

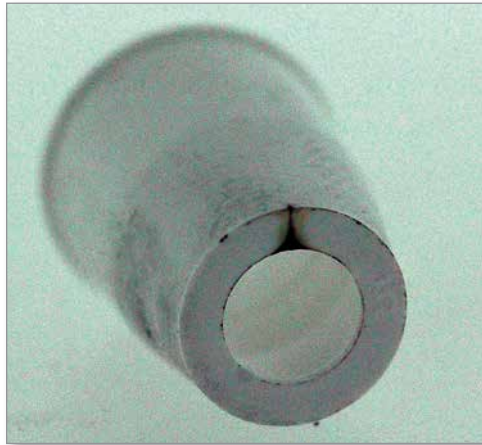
1. Molding Machine
 - Wrong injection speed
 - Wrong injection pressure
 - Hold pressure too long
2. Mold
 - Insufficient mold cooling
 - Temperature of mold too high around the gate
 - Temperature of mold too cool
 - Gate size is too small
 - Gate is in wrong location
 - Land length of gate is too long
 - Incorrect Hot Runner system
3. Material
 - Melt temperature is too low

Solution (in sequence):

1. Adjust injection speed
2. Add a large cold slug area
3. Add cold wells at the end of the runner system
4. Use hot sprue bushing
5. Identify and eliminate dead pockets / sections

1.6.4 Burn Marks

The finished product display brown streaks. This is from the material being overheated due to trapped air (diesel effect), which can lighten or darken the color.



Probable Cause:

1. Molding Machine
 - High injection speed
 - Backflow / check ring valve malfunctioning
 - High back pressure
2. Mold
 - Trapped or volatile gas
 - Burning due to friction
 - Incorrect sprue diameter
3. Material
 - Overheated / underheated melt, possible shear

Solution (in sequence):

1. Clear blocked vent channels
2. Lower injection speed
3. Lower injection pressure
4. Check heater functionality
5. Check thermocouple functionality
6. Reduce feed screw rotation
7. Reduce melt temperature
8. Increase mold cavity venting
9. Enlarge gate
10. Change gate position and / or size

1.6.5 Delaminating Parts

The finished product is separating into layers that can be peeled off; surface layers are flaking off. Insufficient layer bonding as a result of high shear stresses; non homogeneous material.



Probable Cause:

1. Molding Machine
 - High injection speed
2. Mold
 - Cold mold
 - Gate has sharp corners
 - Sharp corners causing shear heat
3. Material
 - Physical contamination of raw material
 - Chemical contamination of raw material
 - Melt too hot / poor melt
 - Incompatible color dye
 - High percentage of recycled material

Solution (in sequence):

1. Increase melt temperature
2. Increase mold temperature
3. Decrease injection speed
4. Eliminate contamination
5. Adjust regrind ratio
6. Adjust or change resin moisture content
7. Purge system
8. Reduce sharp corners at gate

1.6.6 Dimensional Irregularities

The finished product is of a different dimensional value than originally designed or previous production.



Probable Cause:

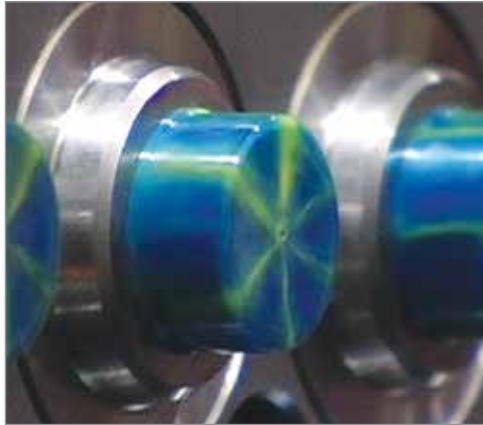
1. Molding Machine
 - Low injection pressure
 - Short hold pressure time
 - Damaged backflow / check ring valve
 - Short cycle time
 - Cylinder clearance too big
 - Nozzle heaters malfunctioning
2. Mold
 - Temperature setting too high
 - Small gate size resulting in wrong pressure
 - Incorrect gate location
 - Incorrect mold configuration / size
3. Material
 - Generally not a material related issue unless excessive regrind is used

Solution (in sequence):

1. Increase injection pressure
2. Increase cooling time
3. Increase mold temperature
4. Ensure cycle time is consistent
5. Monitor molding machine for irregularities
6. Balance regrind ratio
7. Increase gate size
8. Decrease gate land length
9. Balance the runner and / or gate system
10. Decrease cavity quantity

1.6.7 Discolored Parts

The finished product varies in color on different surfaces.



Probable Cause:

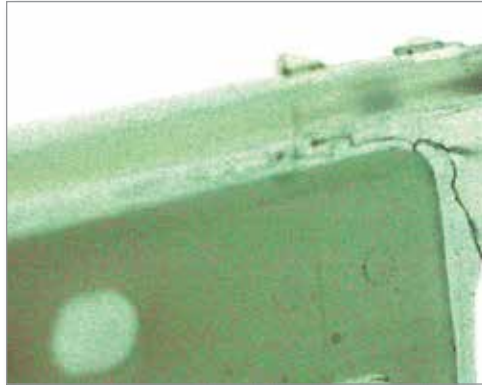
1. Molding Machine
 - Contamination
2. Mold
 - Incorrect sprue diameter
 - Inadequate venting
3. Material
 - Physical contamination of raw material
 - Chemical contamination of raw material
 - Melt too hot / poor melt
 - Incompatible color dye
 - Residence time too high

Solution (in sequence):

1. Purge heating cylinder
2. Lower resin temperature by:
 - reducing cylinder temperature
 - reducing screw speed
 - reducing back pressure
3. Decrease nozzle temperature
4. Adjust residence time
5. Adjust regrind ratio
6. Adjust cycle time
7. Check for external contamination sources
8. Ensure proper cooling in all areas
9. Increase mold venting

1.6.8 Flash

Also known as “fins” or “spew”. The finished product contains a thin film of material attached at the mold parting line.



Probable Cause:

1. Molding Machine
 - Low clamping pressure
 - High injection pressure
 - High injection speed
2. Mold
 - Inadequate mold supports
 - Low clamping force
 - Damaged mold
 - Projected area too large for machine capacity
3. Material
 - Low melt viscosity
 - High melt temperature

Solution (in sequence):

1. Reduce the injection speed
2. Reduce the injection pressure
3. Reduce the injection time
4. Increase clamping force
5. Inspect the mold for irregularities
6. Reduce the melt temperature
7. Inspect vent depth
8. Switch to higher tonnage clamping machine
9. Establish correct transfer position
10. Reduce hold pressure

1.6.9 Jetting

The finished product exhibits serpentine flow patterns on the surface as a result of the melt cooling prior to complete filling of the mold.



Probable Cause:

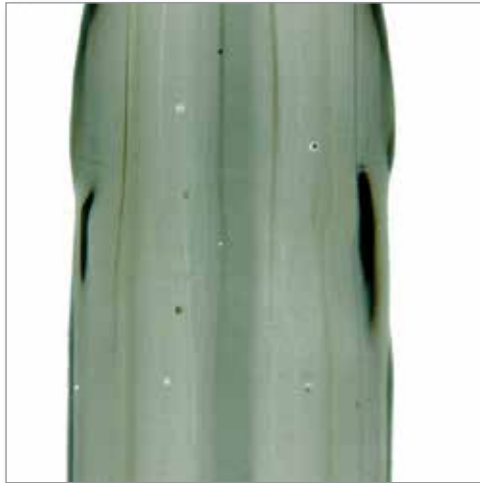
1. Molding Machine
 - High injection speed
2. Mold
 - Cold mold
 - Small gate
 - Wrong gate land length
 - Wrong gate location
3. Material
 - Cold melt

Solution (in sequence):

1. Decrease injection speed
2. Verify nozzle temperature
3. Increase mold temperature
4. Increase melt temperature
5. Increase gate size
6. Modify gate location

1.6.10 Pitted Parts

The finished product contains unmelted particles or small holes on the surface.



Probable Cause:

1. Molding Machine
 - Improper or worn out feed screw
 - Low melt temperature
 - Low injection speed
2. Mold
 - Gating shear
 - Sharp corners
3. Material
 - Resin used is not homogeneous
 - External contamination

Solution (in sequence):

1. Reduce shear
2. Reduce back pressure
3. Reduce injection speed
4. Modify temperature
5. Modify regrind ratio
6. Modify shot size
7. Inspect Hot Runner and nozzles

1.6.11 Rough Surface

The finished product exhibits patterns on the surface similar to grooves on a record, due to rapid cooling of the melt as it nears mold surface, followed over and over again by fresh melt.



Probable Cause:

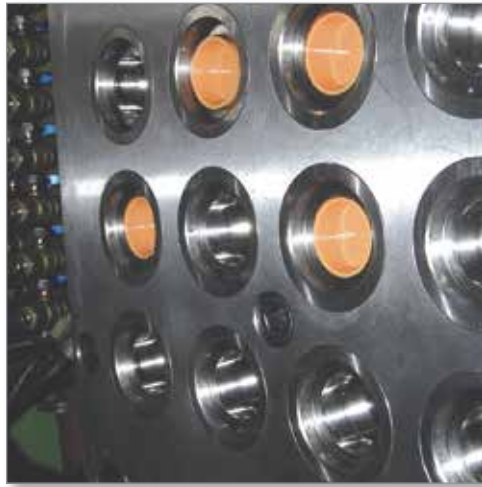
1. Molding Machine
 - Low injection speed
 - Low injection pressure
2. Mold
 - Cold mold
 - Irregularities in mold surface, defective polishing
3. Material
 - Cold melt

Solution (in sequence):

1. Increase injection speed
2. Increase injection pressure
3. Increase melt temperature
4. Increase mold temperature
5. Inspect mold surface

1.6.12 Parts Sticking to Cavity

The finished product does not properly release from the mold (female side).



Probable Cause:

1. Molding Machine
 - High injection pressure
 - High injection speed
 - Long holding time
 - High material feed
2. Mold
 - Hot cavity
 - Cold mold
 - Defective mold surface
3. Material
 - Melt too hot

Solution (in sequence):

1. Confirm cycle time for cooling
2. Reduce injection pressure
3. Reduce injection hold time
4. Reduce injection speed
5. Reduce injection time
6. Adjust feed
7. Inspect mold finish
8. Increase mold opening cycle
9. Lower mold temperature
10. Adjust differential temperatures
11. Inspect for appropriate mold release

1.6.13 Parts Sticking to Core

The finished product does not properly release from the mold (male side).



Probable Cause:

1. Molding Machine
 - High injection pressure
2. Mold
 - Hot core
 - Bending of core
 - Presence of vacuum
3. Material
 - Generally not a material related issue

Solution (in sequence):

1. Confirm cycle time for cooling
2. Reduce injection pressure
3. Reduce injection hold time
4. Reduce injection time
5. Adjust feed
6. Reduce mold closed time
7. Increase core temperature
8. Decrease nozzle temperature
9. Inspect mold for undercuts and / or improper draft
10. Verify mold bending ratio

1.6.14 Short Parts

The finished product is not completely formed.



Probable Cause:

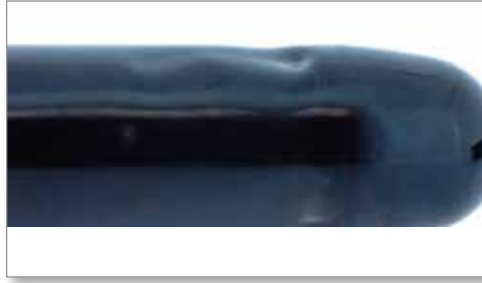
1. Molding Machine
 - Bad feed
 - Low injection pressure
 - Low injection speed
 - Short injection time
 - Back flow valve / check ring faulty
 - Improper venting
2. Mold
 - Insufficient venting
 - Cold mold
3. Material
 - Low melt temperature
 - Viscous material

Solution (in sequence):

1. Increase feed
2. Increase injection pressure
3. Increase feed temperature by increasing cylinder temperature
4. Increase injection time
5. Increase mold temperature
6. Increase nozzle diameter
7. Inspect for restrictions
8. Increase gate size of sprue and runner system

1.6.15 Sinks or Voids

The finished product has hollows and pockets in areas that do not cool sufficiently, causing contraction.



Probable Cause:

1. Molding Machine
 - Low injection pressure
 - Short injection time
 - Insufficient material in cavity
 - High injection speed
 - Low back pressure
 - Damaged backflow valve / check ring
2. Mold
 - Mold not at required temperature
 - Small gate leading to early freezing
 - Gate land length too long
 - Incorrect rib / wall dimensions
 - Material flow incorrect
 - Thick wall part
3. Material
 - Hot material
 - Material wrong grade for application

Solution (in sequence):

1. Adjust injection speed
2. Increase injection hold time
3. Increase injection pressure
4. Adjust melt temperature
5. Adjust mold temperature
6. Inspect for hot spots
7. Enlarge and / or add vents to mold parting line
8. Increase sprue or runner size
9. Increase gate size / reduce gate land length
10. Relocate gate closer to heavy / thicker areas
11. If possible, core out heavy wall sections

1.6.16 Splay

The finished product display splay / splash marks and / or silver streaks.



Probable Cause:

1. Molding Machine
 - Resin degraded from overheating
 - Cylinder contains hot spots
 - Material trapped at nozzle tip
 - Wrong injection pressure
 - Wrong injection speed
 - Low back pressure
2. Mold
 - Friction related burning in gate, nozzle or Hot Runner
 - Trapped volatile compounds
3. Material
 - Hot melt
 - Contaminated resin (moisture, dirt, organics)
 - Degraded resin

Solution (in sequence):

1. Dry resin according to procedure; check drying equipment for functionality
2. Reduce nozzle temperature
3. Reduce material temperature:
 - lower cylinder temperature
 - reduce screw speed
 - reduce back pressure
4. Decrease injection speed
5. Increase mold temperature
6. Decrease or eliminate screw decompression
7. Reduce cycle time
8. Check for drooling
9. Check for contamination in mold cavity
10. Open gates
11. Try mold in smaller shot-size press

1.6.17 Streaks

The finished product has large, dull and laminate appearance areas on the surface.



Probable Cause:

1. Molding Machine
 - Back flow valve ring damaged
2. Mold
 - Hot spots
 - Material trapped in certain areas
3. Material
 - Contamination of resin or machine
 - If pattern is identical, cause may be the machine
 - If pattern is erratic, cause may be the material or coloring
 - Degraded or unstable material

Solution (in sequence):

1. Check for contamination
2. Check barrel purging
3. Inspect back flow ring for wear or cracks
4. Inspect feed screw for wear and tear
5. Inspect screw / barrel for tolerances
6. Verify heater operation
7. Verify thermocouple operation

1.6.18 Stringing

The finished product has thin plastic strings attached to the sprue.



Probable Cause:

1. Molding Machine
 - High back pressure
 - High nozzle temperature
2. Mold
 - Incorrect sprue
3. Material
 - Melt strength inadequate

Solution (in sequence):

1. Reduce back pressure
2. Modify nozzle temperature
3. Modify temperature profile
4. Eliminate sprue breaks
5. Increase cooling time
6. Decrease mold temperature at the gate

1.6.19 Warped Parts

The finished product has pressure differences / stress on its surface, causing the part to be disfigured.



Probable Cause:

1. Molding Machine
 - Wrong cooling time
 - High injection pressure
2. Mold
 - Gate located in wrong area
 - Undercuts too big
 - Cavity too hot
 - Part is wrong design or too heavy
3. Material
 - Fillers have wrong orientation
 - Incorrect material

Solution (in sequence):

1. Ensure temperature in both mold halves is equal
2. Monitor part ejection from mold for uniformity
3. Monitor part handling following ejection
4. Verify part weight following ejection
5. Increase injection hold time
6. Increase cooling time
7. Adjust injection pressure
8. Adjust mold temperature; set sequential temperatures based on part geometry
9. Check gate dimensions, quantities and locations
10. Re-design part if necessary



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