Diagnosing Part Failure in Injection Molded Components

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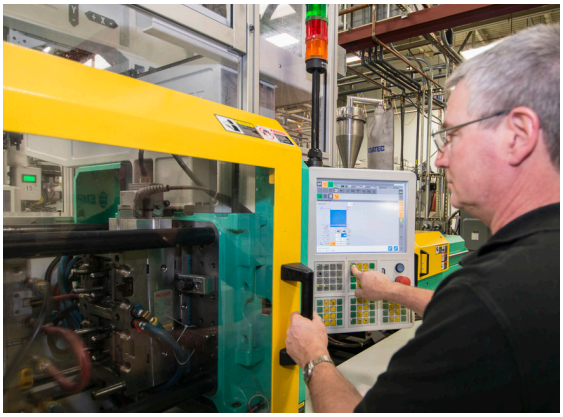
WHERE YOUR IDEAS TAKE SHAPE



A rigorous molding process helps to ensure consistent quality and prevent part failures. Learn about our PDW approach to quality control in Scientific Molding at http://www.empireprecision.com/resources.

Why Parts Under-perform

Experiencing new, sporadic, or worsening quality issues in your injection molded plastic parts? These issues can slow down your program and result in an unsatisfactory end product. Fortunately, a systematic approach can identify and resolve part failures to quickly get production back on track and your product back at top quality.

Assuming that the part was properly designed, the root cause of plastic part failure usually lies in one or more of the following areas:

1. **Premolding: Material handling and storage**
2. **Molding: Conditions within the cycle**
3. **Post Molding: Parts handling, finishing, and assembly operations, plus packaging and shipping**
4. **Application: Environmental factors or end use**

Types of Failure

Numerous factors both inside and outside of the molding process can impact the quality of a plastic part. Based on the cause, part failures can be placed in the following categories:

Mechanical failures are caused by an applied external force such as tension, compression, or impact. If these forces exceed the yield strength of a material, the part can deform, crack or break into pieces.

Thermo failures occur when parts are exposed to extreme temperatures. Too high a temperature can warp, twist, melt, or burn the materials. At low temperatures, plastic becomes brittle.

Chemical failures occur when chemicals causes the plastic to break down. Elevated temperatures, existing stress, or mechanical load on the part will amplify the effect of chemical exposure.

Environmental failures are caused by factors such as humidity, ozone, ultraviolet light radiation, and pollution. The effects can vary from a change in color or a slight crazing or cracking to a more severe breakdown of the polymer structure.

Common Part Failure Terms

Air Entrapment: Air is trapped in the mold cavity during the filling of the cavity and leaves a void in the part.

Aging: The process of, or the results of, exposure of plastics to natural or artificial environmental conditions for a prolonged period of time.

Broken Mold Marks: Part surface defects caused by mold damage.

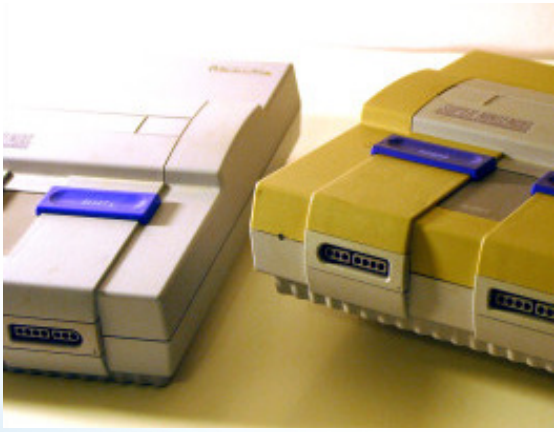
Bubbles: Air pockets that have formed in the material of the component. Bubbles may vary in size.

Burn Mark: A patch or streak of brown or black material on the component, caused by air or gases that have not been properly vented from the mold and have caused the plastic to overheat.

Contamination: Discoloration caused by foreign material embedded in the surface of a part.

Cracking: Splitting or fissures in the material caused by stress on the part.

Crazing: Multiple tiny cracks caused by stress on the part.



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The computer console on the right has aged badly, becoming warped and discolored.

Discoloration: Any change from the designated color of the material or component.

Distortion: Visual or physical anomalies such as cracks, pulls, pushing, or twisting of the part.

Drag Marks: A form of deep scratches on the surface of the component, usually caused by the ejection of the part.

Flash: Any excess material that is formed with, and attached to, the component along a seam or mold parting line.

Gas Marks: Dark streaks on the part caused by incomplete venting of gases generated during molding.

Gloss: The shininess of a surface. A too high or too low level of gloss on the surface of a part might be considered a defect.

Gouge: A surface imperfection of measurable depth caused by an abrasion that removes a small mount of material.

Haze: The cloudy appearance of a material caused by light scattered from within or from its surfaces.

Marbling: Colored streaks caused by incomplete mixing of two differently colored plastics. Also called Streaking.

Nick: Like a gouge but shorter. Caused by impact rather than abrasion.

Orange Peel: A rough, splotchy surface finish on a molded part, caused by moisture in the mold cavity, or by poor heat transfer or pressurization.

Parting Line Mismatch: Misalignment between cavity impressions that cross a parting line.

Pin Push: A protrusion or distortion caused by an ejector pin pushing too far into the part. Most evident on the surface opposite the ejector pin.

Pitting: Crater-like imperfections on the surface of the part.

Pulled Gate: Area where the part was connected to the sprue or runner that has been drawn out or stretched from the surface. Also called Strings.

Scratch: A surface imperfection of immeasurable depth caused by an abrasion that removes a small amount of material.

Short Shot: Failure to completely fill the mold or cavities of the mold. Part edges may appear melted. Also called Non-Fill.

Shrinkage: Contraction upon cooling of all or some areas of the part. Lower pack areas have lower areas of orientation and shrinkage.

Sink Mark: An indentation on the surface of the part caused by a significant local change in wall section. The mark will occur in the thicker area.

Splay Marks: Surface defects on a part caused by an abnormal racing of the melt in the mold. Also called Jetting.

Void: An unfilled space within a solid material.

Warpage: Distortion caused by non-uniform internal stresses.

Weld Line: Where melded material flows together during molding to form a visible line or lines on a finished part. These lines may cause the component to weaken or break.

Wisps: Similar to strings but smaller in size. These also might occur as slight flashing when the mold is over-packed or forced open slightly. Mold-parting-line wear or misalignment can also cause wisps.

Pinpoint the Problem: Failure Analysis Inquiry

To better isolate the category of failure, molders must ask a series of qualifying questions, called the "Failure Analysis Inquiry."

Application History

- Did the part work properly before?
- When did the problem start?
- How many parts are affected?
- Is the problem cavity-specific?

Material

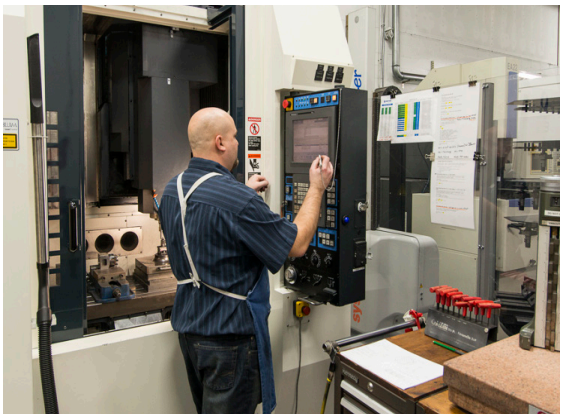
- What material is used?
- What grade?
- What is the lot number?
- If colored, what method was used?
- Was regrind used, and if so, how much?
- Was the resin dried properly? If not, was it under-dried or over-dried?

Design

- Is the part always failing in the same place?
- Is the part failing in a knit line location?
- Does the part match to print?
- Is there any radius?
- Are there sharp corners?

Molding

- Has the part run in this machine before? Have the following been checked:
    - Shot size?
    - Screw type?
    - Process transfer?
- Have there been any changes to the current molding machine?
    - Has the screw/check ring been changed?
    - Has machine operation changed?
    - Has there been any recent maintenance or repairs?
- Have there been any changes to auxiliary equipment?
    - Have dryer beds been changed?
    - Are mold temperature controllers operating correctly?
    - Is chilled water at proper temperature?
- Have there been any processing changes?
- Compared to previously made parts, do the new parts have problems with:
    - Flash?



Troubleshoot Your Tooling

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Sign up for a **free evaluation of your quality issue** by visiting injectionmolding.empireprecision.com/troubleshoot-tooling

Contact 1.800.541.7135 or info@empireprecision.com to speak with an expert who can who can guide you through multiple considerations for cost reduction and improved performance.

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Connect with us.

- Sink or non-fills?
- Surface finish?
- Streaks or discoloration?

Tooling

- Have there been changes in:
  - Cavity impression?
  - Finish?
  - Venting?
  - Sprue, runner, or gate?
  - Cooling?
- Is there wear in the tool or mold:
  - Cams?
  - Slides?
  - Locks?
  - Other mechanical components?

Secondary Operations

- Is there an inherent problem with any secondary operation?
- Have any secondary processes changed?

Environmental Factors

- Has the appearance of the part changed?
- Is there evidence of any weathering effect?
- Has chemical exposure been a factor?
  - Is there evidence of softening, cracking, or crazing?
  - Has the compatibility of time, temperature, or application method been checked?

Application-Specific Factors

- Has the end use changed?
- Have the shipping method or storage conditions changed?
- Is there abuse to the part caused by end use?

The causes and forms of plastic component failures are varied. By taking a systematic approach and working closely with your supplier, you can evaluate and find a workable solution to your part problem.

If you've tried to reach a solution with your current supplier and are still unhappy with the quality of your plastic molded parts, you might want to consider transferring your tool. Check out our Tool Transfer Survival Guide for need-to-know info on the tool transfer process, available at http://www.empireprecision.com/resources.