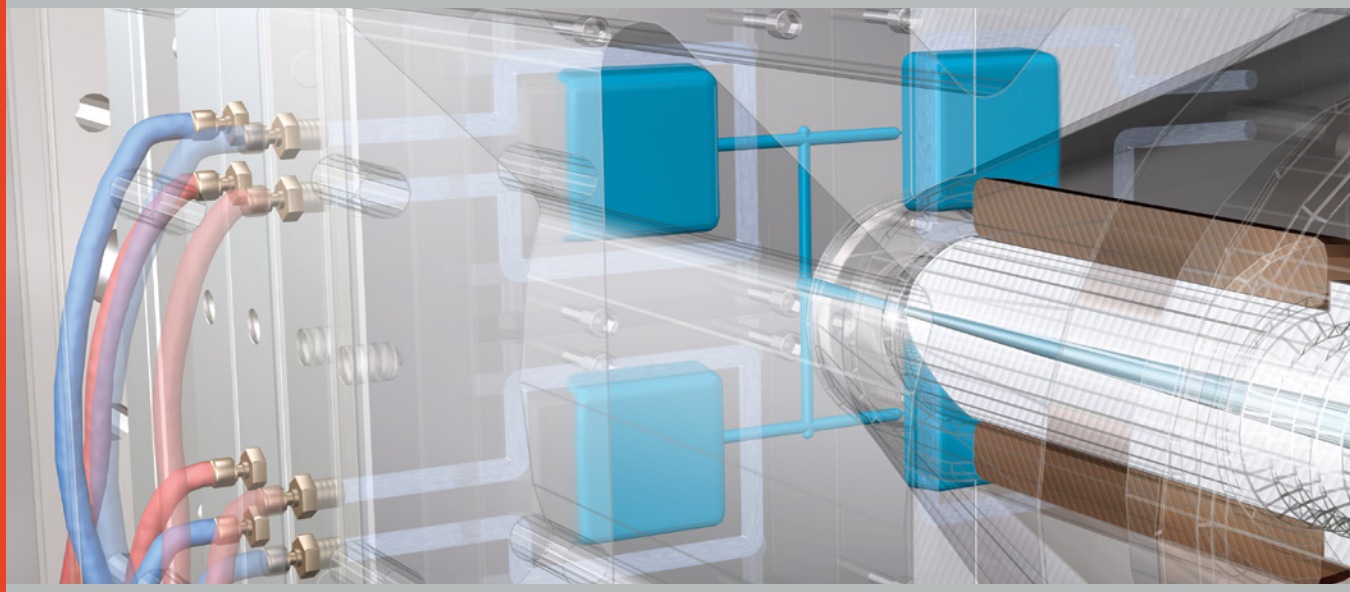
REFERENCE SERIES: PROCESSING

Scientific Troubleshooting: Brittleness, Cracking & Crazing



nexeo plastics

Created exclusively for **Nexeo Plastics** by Routsis Training, this free guide contains excerpts from Routsis's ***Scientific Molding Courses***.

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TROUBLESHOOTING BRITTLENESS, CRACKING & CRAZING

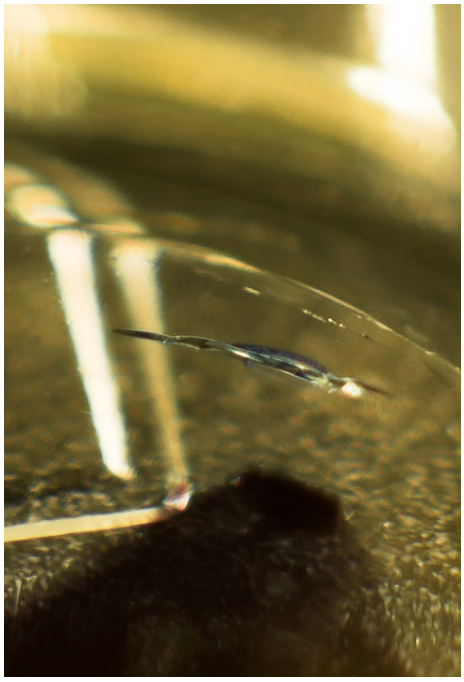
Brittleness is an increased tendency for a molded part to either break or have a reduction in impact resistance.

Cracking appear as fractures that pass through the part, and are typically located at areas of stress concentration – such as corners, ribs, and bosses.

Crazing is similar to cracking, and typically appears as miniature striations on the part surface, but do not pass all the way through the part. Crazing can be located anywhere on the part surface.

Although different in appearance, all three defects have similar origins that contribute to premature part failure. These can be caused by one of several major factors:

- Material Handling
- Material Temperature
- 1st Stage Injection
- 2nd Stage Packing
- Mold Temperature
- Machine Setup
- Mold Design

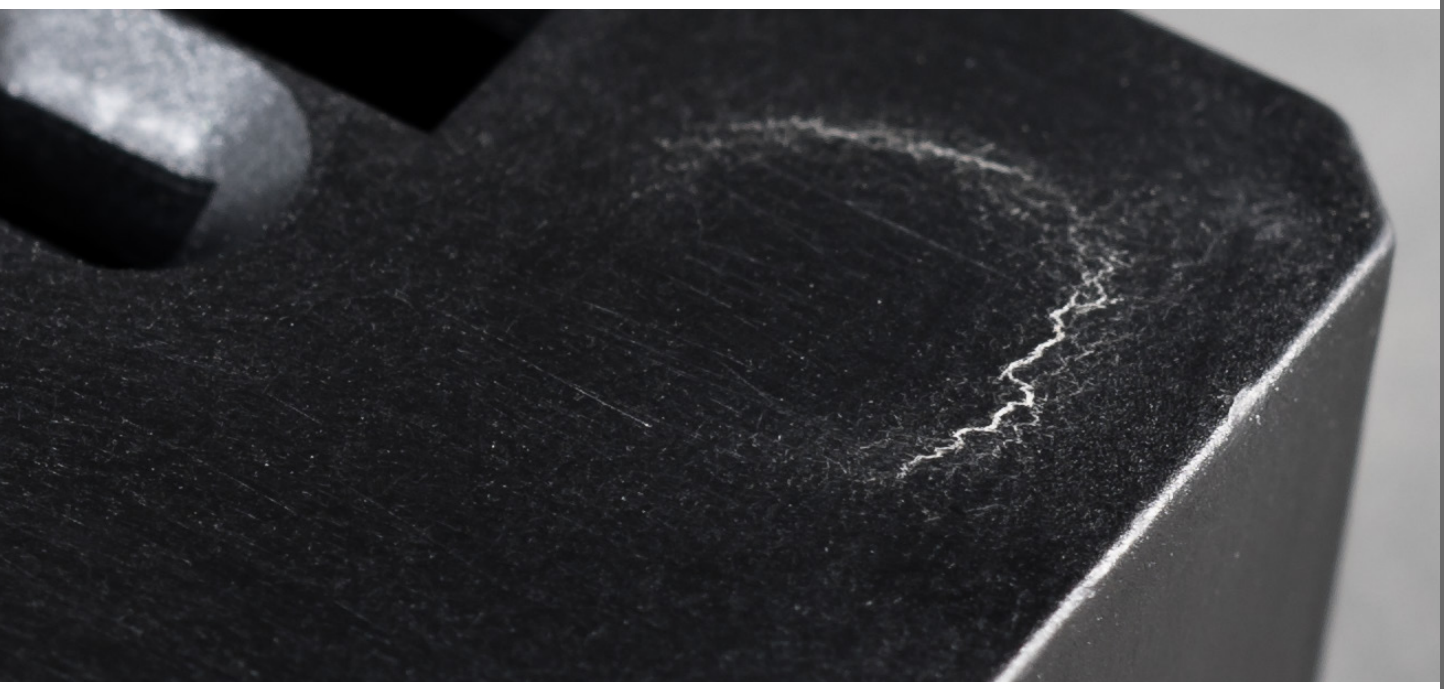


Material Handling

With respect to material handling, brittleness, cracking, and crazing can result from either the improper drying of a hygroscopic material or contamination.

Hygroscopic materials have a chemical attraction to water, and when heated, the water can hydrolyze, and break up the molecules into hydrogen and oxygen. These atoms can attack the polymer chains causing then to break-up and degrade, thus weakening the part. Such materials should be dried using the manufacturer's settings using a desiccant, vacuum, or compressed air dryer. Be sure to keep all containers and hoppers covered at all times to prevent any material contamination.

Contaminants such as fluids, grease, and oils – as well as incompatible plastics or additives – can interfere with the desired physical properties of the molded part.



Material Temperature

Low Melt Temperature increases the viscosity of the polymer during injection. This increased viscosity also increases the shear stress applied to the polymer during injection. If this stress exceeds what the polymer can withstand, the polymer chains will break and weaken during injection. This degradation of the material causes Brittleness, Cracking, or Crazing to appear on the molded parts.

When such defects occur, it is important to verify that both the **Melt Temperature** and the **Back Pressure** are in accordance with the documented standard.

1st Stage Injection

High **Injection Velocity** during 1st Stage can also cause Brittleness, Cracking, and Crazing. If the **Plastic Flow Rate** is too high, the polymer may encounter too much shear. Excessive shear will cause the polymer chains to break, which can contribute to brittleness, cracking, and crazing.

Turn off 2nd Stage Packing to ensure that the **1st Stage Fill-only Part Weight** and the 1st Stage Injection time match the documented standard.

2nd Stage Packing

If the **Packing Pressure** is too high, the part will become over-stressed in the mold. For many applications, the extra internal pressure will reduce the flexibility and toughness of the molded part. In other cases, over-packing can cause the part to stick to the cavity or core half, resulting in part damage during mold opening or part ejection.

Verify that the 2nd Stage Packing Pressure and 2nd Stage Packing Time match the documented standard.

Mold Temperature

A low Mold Temperature may cool the part too quickly and result in unwanted molded-in stresses. Although brittleness tends to occur right away, cracking and crazing may not be found until the part is being used by the customer.

A long **Cooling Time** may also cause molded-in stresses. These stresses may cause the part to stick to the mold and become damaged during mold opening or part ejection.

Verify the coolant temperatures entering and leaving the mold as well as the Cooling Time. Since the molded part begins cooling during part packing, the **2nd Stage Packing Time** should also be verified to ensure packing time has not increased.

Machine Setup

Brittleness, cracking, and crazing can result from an excessive breakaway speed, inadequate mold breakaway distance, or excessive ejection speed.

Breakaway Speed is the speed at which the two mold halves separate. This is typically set at a slow rate to help the part separate the part from the mold cavity. If this is too fast, the part can become damaged.

The **Breakaway Distance** is the distance the mold travels at the reduced Breakaway Speed. If the part features are not properly cleared during breakaway, the part can be damaged when the mold opening speed increases.

If the part is removed from the core too quickly, the part can also become damaged or weakened. Check that **Ejection Speed** is set appropriately.

Mold Design

Sharp **thickness transitions** create stress concentrations due to variations in shrinkage. Thick sections have more unpredictable shrinkage, and can contribute to molded-in stresses. In addition, **sharp corners** can create stress concentrations which can cause the part to buckle as the part shrinks.

Smooth transitions from thin to thick sections should be used and thick sections should be cored out to make room for strengthening ribs when possible. The addition of fillets and chamfers at sharp corners will also help reduce stress concentrations. Gussets and strengthening ribs can also provide additional dimensional stability in both corners and bosses.