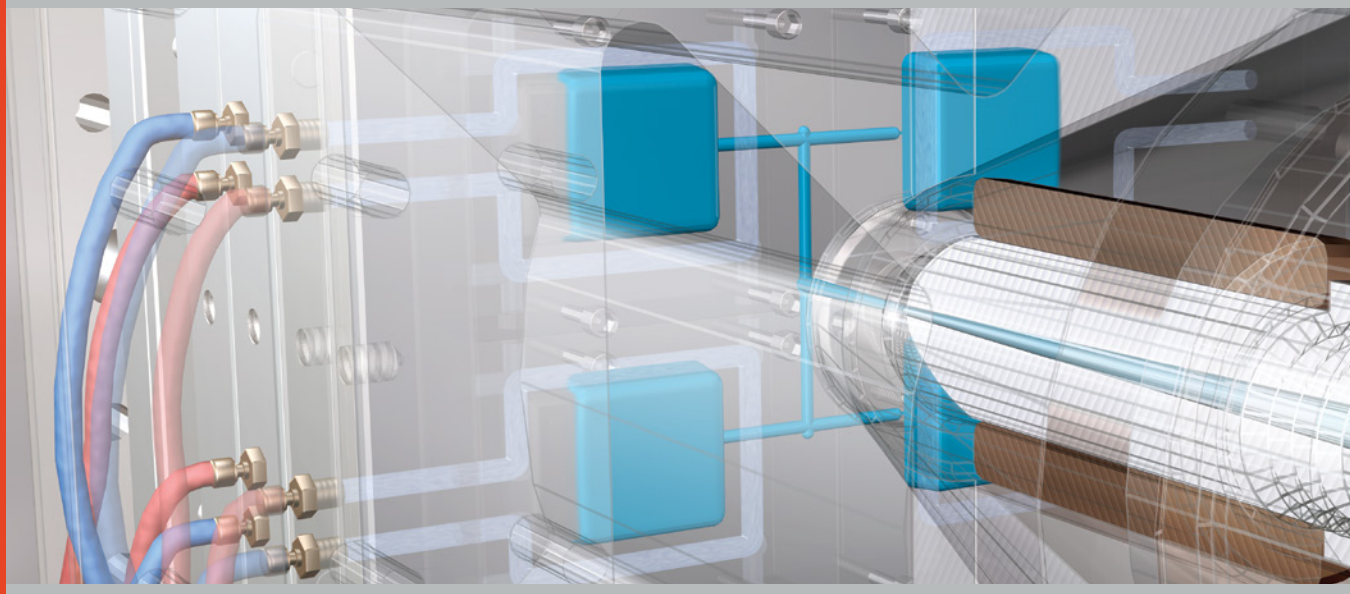
REFERENCE SERIES: PROCESSING

Scientific Troubleshooting: Sinks & Voids



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 SINKS & VOIDS

Sink are depressions on the part surface where the material shrinks away from the mold surface. These are most often located near the gate or at thick sections of the part and can be difficult to see on textured surfaces.

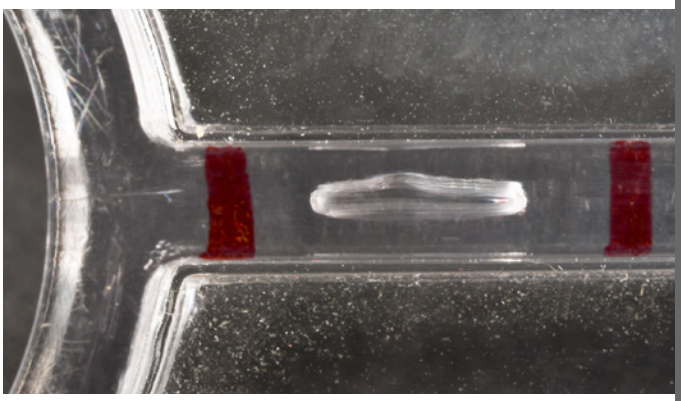
Voids are sections in the center of the part where material shrinks away from itself and leaves a small cavity within the part. Although they often appear as air bubbles, they are actually vacuums within the part where no gas is present. Voids are easy to spot within translucent materials and can be identified in solid parts through dissection, X-Ray, or comparing part weight.

To ensure the defect is a void and not a gas bubble, you can mold parts at different speeds. If the defect remains stationary from shot to shot, it is most likely a void.

Since both sinks and voids are the result of excessive material shrinkage, the causes and corrections are similar in most cases.

Sinks and voids can be caused by one of four major factors:

- Material Temperature
- 1st Stage Injection
- 2nd Stage Pressure
- Mold Temperature



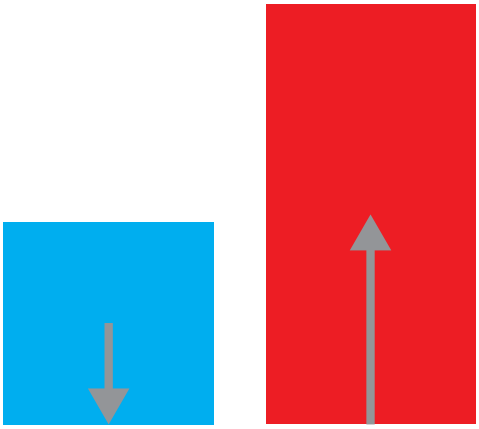
Material Temperature

Sinks and voids can result from a Melt Temperature that is either too low or too high.

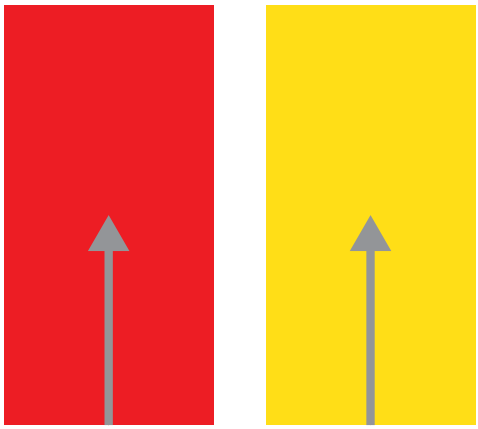
If a low temperature polymer is injected into the mold, the material viscosity increases, causing large pressure losses. These pressure drops can prevent adequate packing across the entire part and often results in sinks and voids near the end of fill, but not near the gate.

Increased Melt Temperature will cause additional shrinkage to occur during cooling, which may cause both sinks and voids to occur anywhere across the molded part.

When sinks and voids occur, the Melt Temperature should be measured, compared with the documented standard, and corrected if necessary.



Melt Temperature **Material Viscosity**



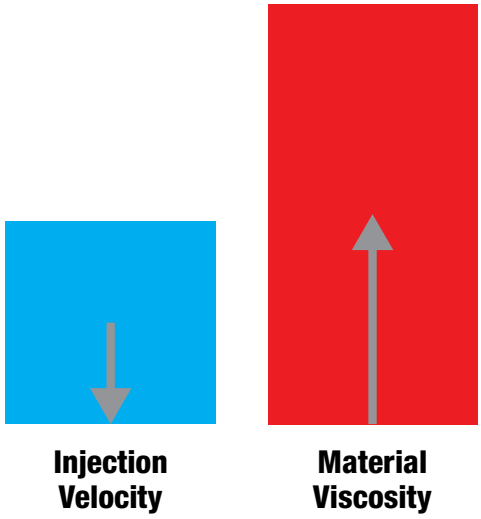
Melt Temperature **Shrinkage**

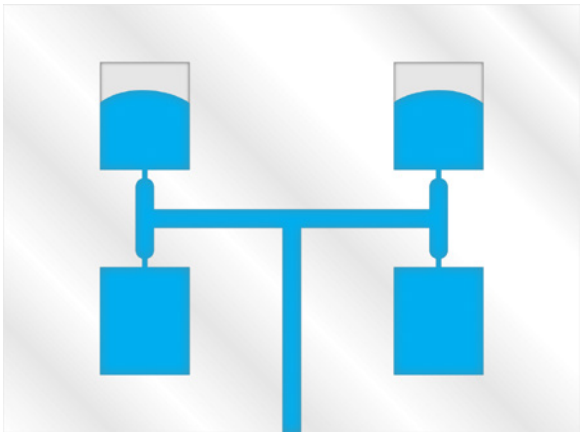
1st Stage Injection

With respect to 1st Stage Injection, sinks and voids can result from insufficient material injection, a low Injection Velocity, or a cavity filling imbalance.

If too little material is injected during 1st Stage, the subsequent 2nd Stage Packing Pressure may not be high enough to complete mold filling and compensate for shrinkage. It is best to have approximately 90-95% of the mold cavity filled during 1st Stage with a visible short shot present.

Using a low Injection Velocity will increase the material viscosity which may contribute to too little material to enter the mold during 1st Stage Fill. In many cases, a low injection speed will often result in sinks and voids near the end of fill.





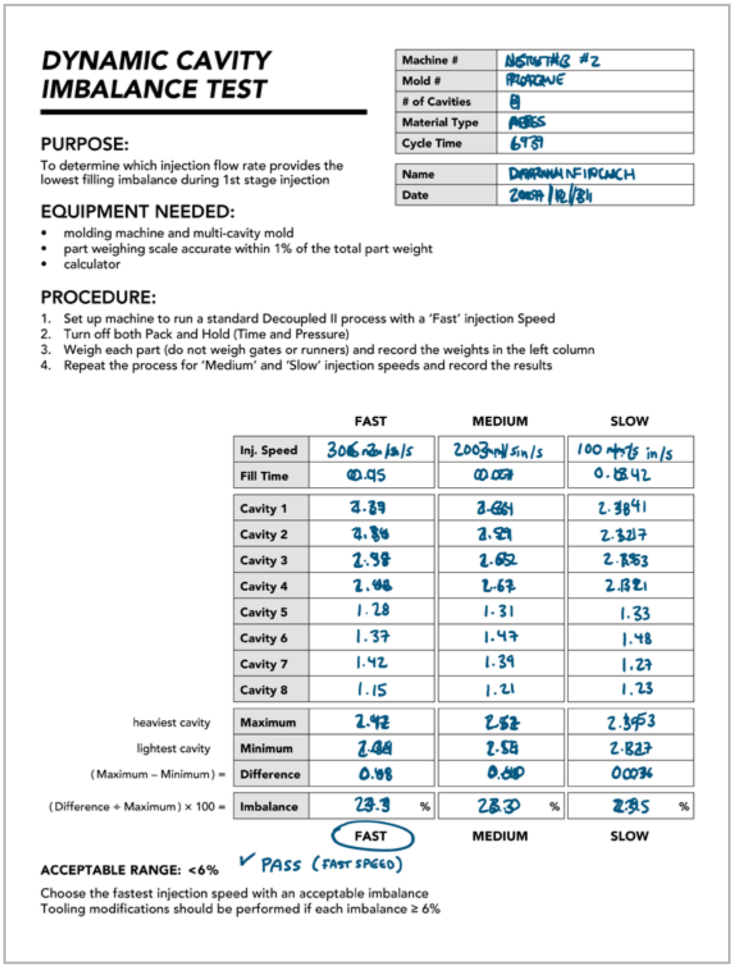
In multi-cavity molds, a large filling imbalance can result in some mold cavities filling and packing while other cavities are significantly short during 1st Stage.

An imbalance typically causes some mold cavities to exhibit sinks or voids while other cavities may have short shots or flash. This situation generally occurs when there is a filling imbalance in excess of 6-7%.

If you suspect a problem with 1st Stage Fill, it is best to begin troubleshooting by turning off 2nd Stage Packing. This will allow you to verify that correct filling occurs during 1st Stage Fill and ensure that the 1st Stage Fill-only Part Weight and 1st Stage Injection time are the same as the documented standard.

The first step in correcting a filling imbalance is to check the vents, runners and gates for blockages.

Next, a **Dynamic Cavity Imbalance Test** should be performed to ensure the best Injection Velocity is being used. Third, the tooling department should be involved to determine the best way to improve the cavity balance during 1st Stage Fill.



DYNAMIC CAVITY IMBALANCE TEST

Machine #	NESTATHB #2
Mold #	PROTANE
# of Cavities	8
Material Type	ABS
Cycle Time	6939

Name	DARAWAN FIRCACH
Date	2007/12/31

PURPOSE:

To determine which injection flow rate provides the lowest filling imbalance during 1st stage injection

EQUIPMENT NEEDED:

- molding machine and multi-cavity mold
- part weighing scale accurate within 1% of the total part weight
- calculator

PROCEDURE:

1. Set up machine to run a standard Decoupled II process with a 'Fast' injection Speed
2. Turn off both Pack and Hold (Time and Pressure)
3. Weigh each part (do not weigh gates or runners) and record the weights in the left column
4. Repeat the process for 'Medium' and 'Slow' injection speeds and record the results

		FAST	MEDIUM	SLOW
	Inj. Speed	306 in/s	200 in/s	100 in/s
	Fill Time	0.95	0.07	0.1342
	Cavity 1	2.39	2.64	2.3841
	Cavity 2	2.36	2.59	2.3217
	Cavity 3	2.38	2.62	2.3553
	Cavity 4	2.48	2.67	2.3321
	Cavity 5	1.28	1.31	1.33
	Cavity 6	1.37	1.47	1.48
	Cavity 7	1.42	1.39	1.27
	Cavity 8	1.15	1.21	1.23
heaviest cavity	Maximum	2.42	2.52	2.3953
lightest cavity	Minimum	2.44	2.58	2.3237
(Maximum – Minimum) =	Difference	0.48	0.40	0.0036
(Difference ÷ Maximum) × 100 =	Imbalance	23.3 %	28.30 %	23.5 %
		FAST (circled)	MEDIUM	SLOW

ACCEPTABLE RANGE: <6% ✓ PASS (FAST SPEED)

Choose the fastest injection speed with an acceptable imbalance
Tooling modifications should be performed if each imbalance ≥ 6%

This free reference guide contains excerpts from Routsis Training's ***Scientific Injection Molding*** *courses. Click here for more information.*

2nd Stage Packing

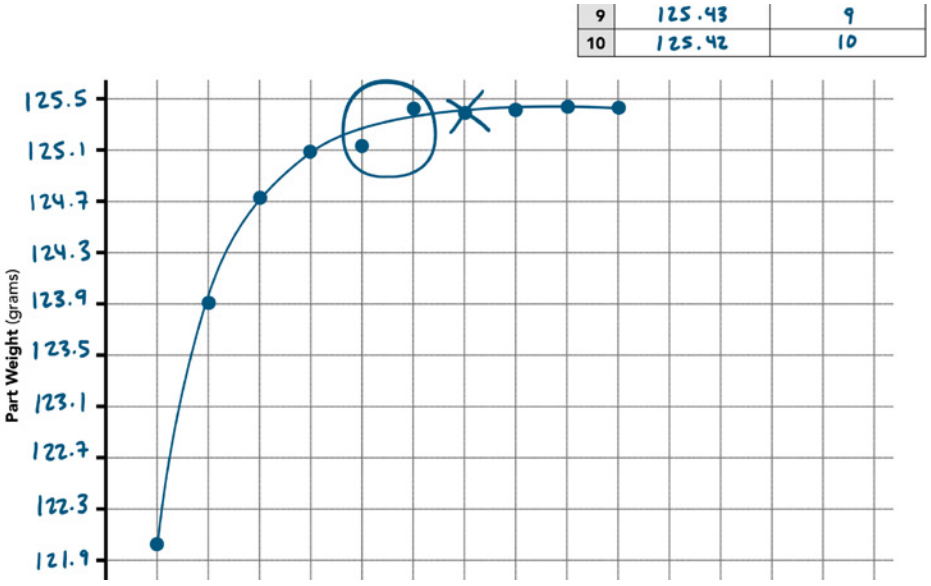
With respect to 2nd Stage Packing, sinks and voids can result from either an insufficient **Packing Pressure** or **Packing Time**.

If too little pressure is used during 2nd Stage Packing, insufficient material will enter the cavity and cannot compensate for material shrinkage. This condition typically results in sinks or voids and can be present anywhere on the part.

If insufficient 2nd Stage Time is used, material will flow back through the gate before it seals and result in sinks or voids on the part in areas near the gate.

If 2nd Stage parameters are suspect, return the 2nd Stage Packing Pressure and Packing Time to the documented standard. It is critical that you verify all the process outputs to ensure they match the documented standard before adjusting the 2nd Stage Packing Pressure or time from the documented standard.

It is recommended to perform a **Gate Seal Worksheet** before altering the 2nd Stage Time. The objective is to determine the gate seal time by graphing part weight versus 2nd Stage Time. Using this graph, you will be able to determine the **Gate Seal Time** and the **Optimal 2nd Stage Time**.



Mold Temperature

Both sinks and voids can result from a Mold Temperature that is set too high — while only voids will result from a Mold Temperature that's too low.

Using a high Mold Temperature will increase the amount of shrinkage that occurs in the mold and results in either sinks or voids anywhere on the part. Shrinkage increases significantly when molding semi-crystalline polymers.

Using a low Mold Temperature can cause the polymer touching the mold surface to freeze too quickly. This can cause the material to shrink away from itself inside of the part — resulting in voids.

The temperature of the water, both entering and exiting the mold, should be measured using a surface temperature probe and returned to the documented standard. If the difference between the water entering and exiting the mold is significantly higher than the standard, it is possible that insufficient water is passing though the water lines.

This difference is often the result of an undersized thermolator, a malfunctioning thermolator, a restricted water flow valve, or a blocked water line. On the other hand, a small difference between the water entering and exiting the mold indicates an oversized thermolator that's providing too much water to the mold.