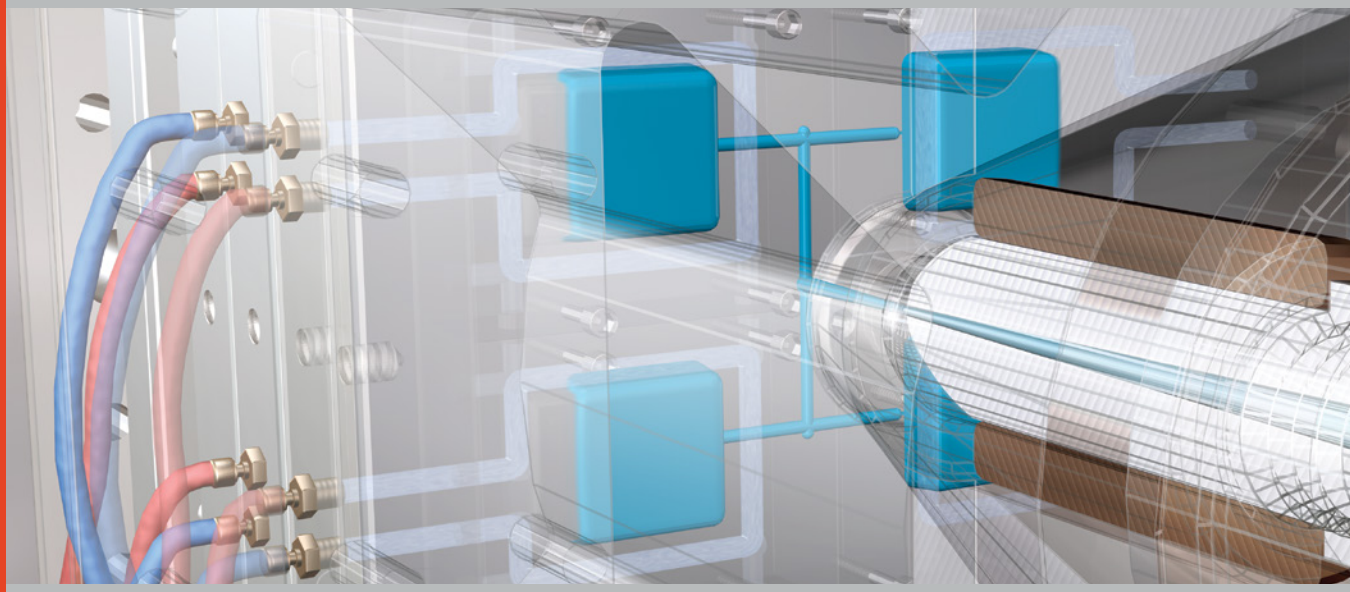
REFERENCE SERIES: DESIGN

Weld Lines & Meld Lines



nexeo plastics

Created exclusively for **Nexeo Plastics** by Routsis Training, this free guide contains excerpts from Routsis's ***Mold & Part Design Courses***.

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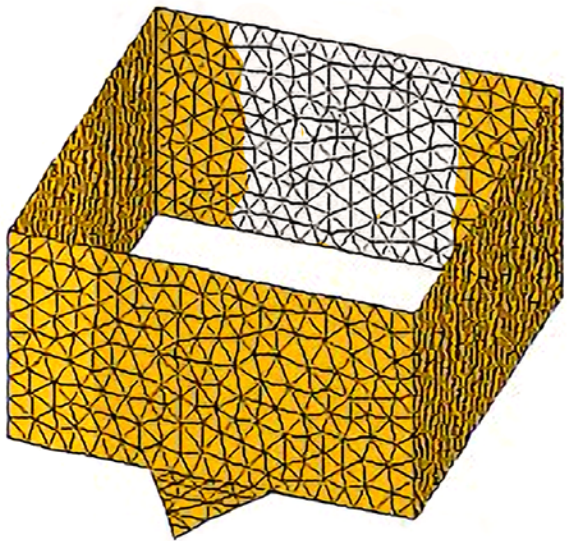
WELD LINES VS. MELD LINES

Weld and Meld Lines are points where melt fronts intersect. Meld Lines are formed when a melt front is divided by a mold feature, such as a core pin, and then meets afterward to continue flowing. When the melt flow continues after the melt fronts meet, the intersection is called a Meld Line.

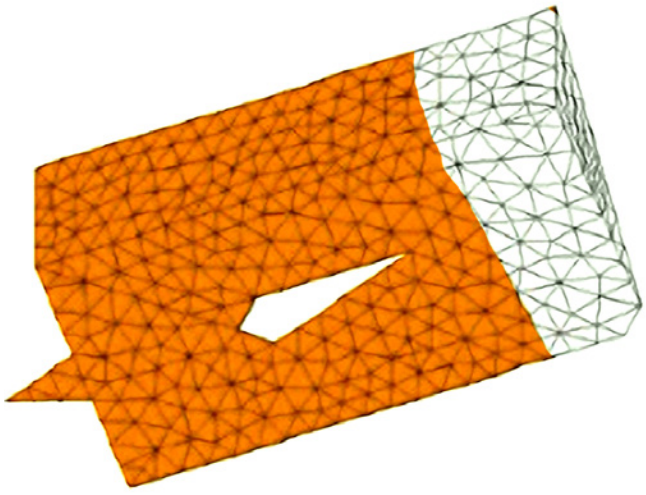
Weld Lines

Weld Lines are formed when two melt fronts meet with little or no flow afterwards. Since the polymer cools as it flows through the mold, the material at the head of the melt front has a lower temperature than the polymer behind it. When a Weld Line forms, the melt fronts are typically cooler than the original Melt Temperature, and thus form a weakened area in the part.



Meld Lines

Meld Lines are typically less problematic than Weld Lines. When Meld Lines occur, the melt front is still flowing, and therefore, melted material still flows at either side of the Meld Line — providing greater strength.



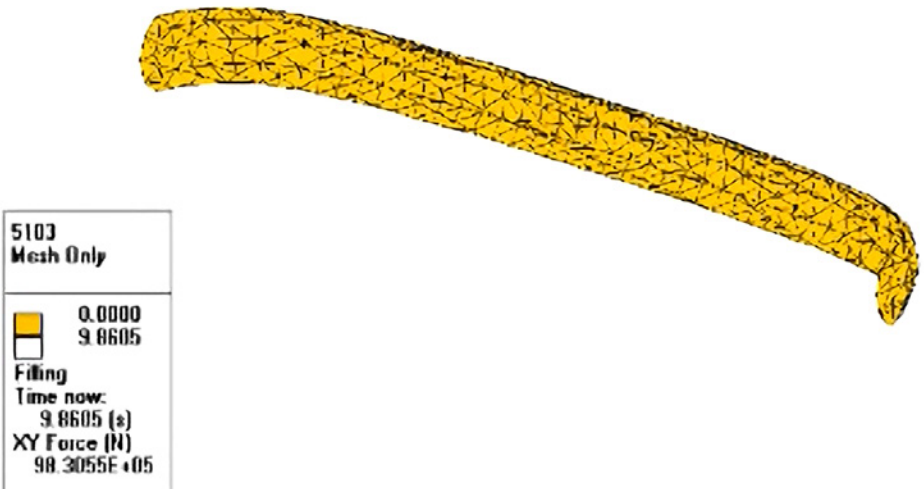
Weld Line Strength

Although Weld Lines have lower strengths than the rest of the part, there are many factors which affect Weld Line strength. These factors include Flow Length, Venting, Processing Variables and Material Variables.

The follow section discusses these variables and demonstrates how they can be manipulated to promote stronger Weld Lines.

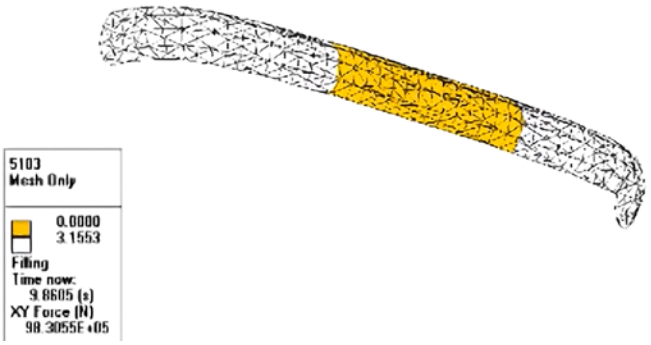
Flow Length

Flow Length is a significant factor in Weld Line strength. Typically, the farther the weld line is from the gate, the cooler the melt front becomes. In the example of a car bumper, gating the bumper from either end would result in a significantly large Pressure Drop.

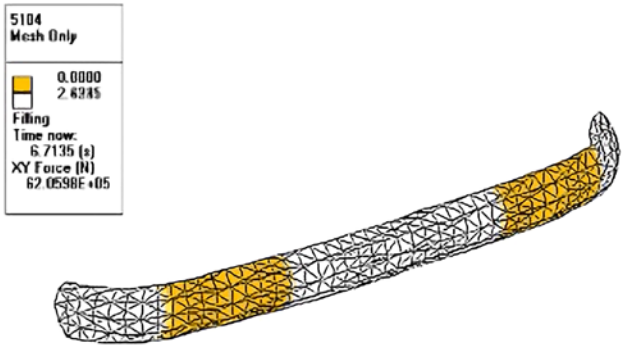


In order to reduce the Pressure Drop — as well as promote uniform packing and reduce the risk of warpage, the flow lengths must be decreased.

Gating the part in the center reduces the flow length, but is still considered inadequate because of the long flow lengths and high pressure drop.

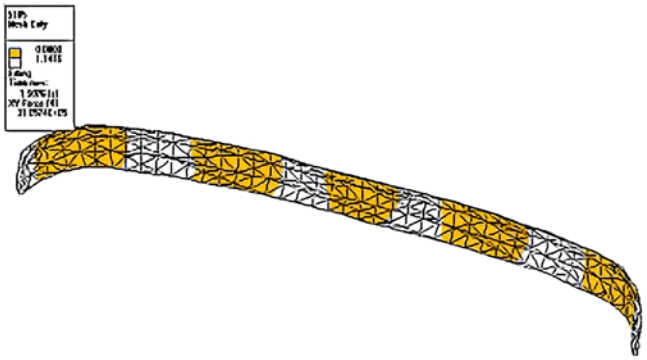


Using two gates on the bumper may decrease the flow length and pressure drop to an acceptable level. However, the distance the material must flow before the melt fronts meet may reduce the strength of the Weld Line.



Using 5 gates increases the amount of Weld Lines. However, the flow lengths have been drastically decreased, which ultimately increases the strength of the weld.

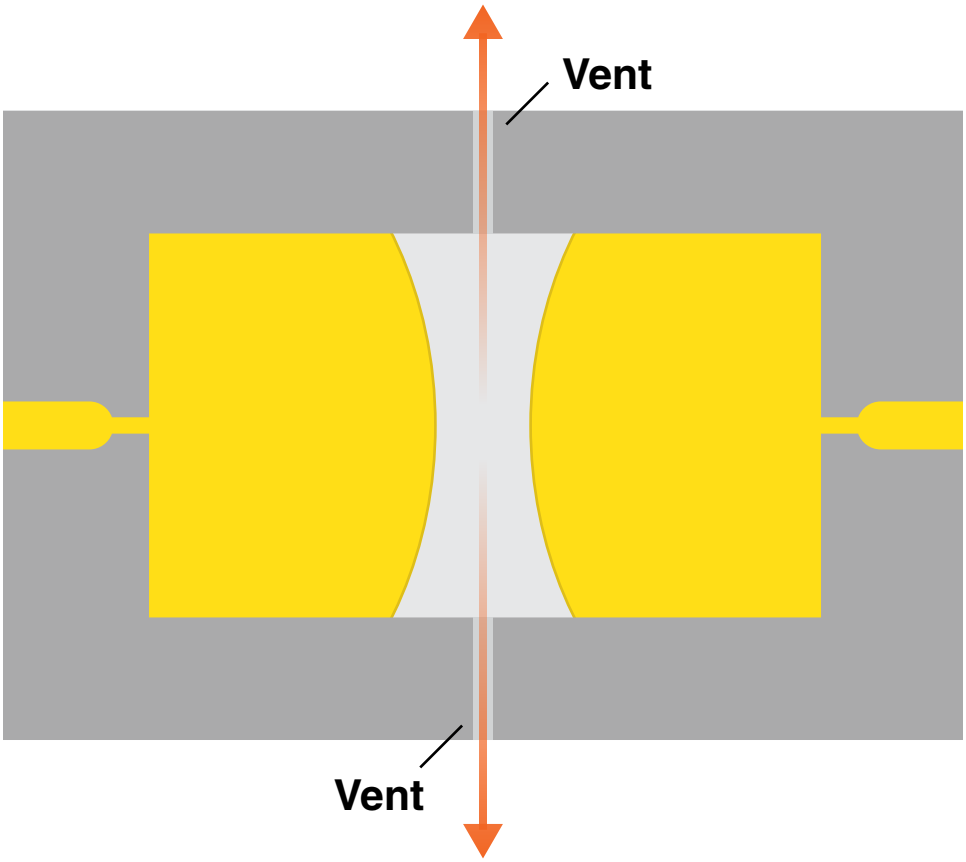
Multiple gates also promote a more uniform flow pattern, which typically results in more uniform dimensions and properties.



Venting

Improper venting can also significantly reduce Weld Line strength. When a Weld Line forms, gas becomes trapped in the front and is pushed to the surface. Trapped air forms a V-shaped notch at the mold surface. This V notch acts as a crack or stress concentration, which weakens the Weld Line.

Good venting at the Weld Line site allows more gas to escape. This helps the polymer make a stronger weld. Venting at the Weld Line site can be improved by adding edge vents, ejector pins, or a vent pin. Porous steel can also be purchased for applications where critical cavity detail at the Weld Line site must be maintained.



Processing Variables

There are many processing variables that have an impact on Weld Line strength and appearance. Melt Temperature can play an important role in Weld Line strength. Low Melt Temperatures reduce the material temperature as the Weld Lines form. Using a slightly higher Melt Temperature allows the melt fronts to better flow into each other.

Using a higher Mold Temperature slows the material cooling during injection. Increased Mold Temperatures (like higher Melt Temperatures) help keep the polymer warm as the Weld Line forms.

However, a higher Mold Temperature keeps the material on the surface from cooling as quickly. This slower cooling allows the surface material time to remove the trapped gas — creating the V-notch.

Most importantly, Injection Speed should be as fast as possible. Faster injection speeds allow the material to reach the weld site quickly without losing much heat. The Shear Heating caused by the High Shear Rate can also counter the cooling effects of the mold.

Material Variables

There are many material aspects that affect Weld Line strength. Materials with fillers and reinforcements usually experience more strength loss than those without fillers. Since the material flows from the center out to the walls, the fibers at the melt front are aligned perpendicular to the direction of flow. As few fibers are able to pass through the Weld Line, a significant strength loss often occurs where the melt fronts meet.

Also, many fillers and reinforcements conduct heat better than the base polymer. For fillers such as metallic and mineral fillers, the material cools quicker during injection.

Other additives such as lubricants, colorants, and flame retardants also decrease weld line strength. These additives get pushed to the melt front and interfere with weld line formation. The additives can also volatize and create a larger V notch.

Semi-crystalline materials can be difficult to weld. If the temperature at the melt front becomes lower than the melting point, the polymer freezes quickly, and the Weld Line looses a great deal of strength. In order to increase the weld line strength, be sure that the Mold Temperature, Melt Temperature and Injection Speed are high enough to keep the melt front from freezing during injection.