



**GAS ASSIST
INJECTION MOLDING**

THE METHODS OF GAS ASSIST

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METHODS OF INJECTING GAS

Two methods of injecting gas are used in the gas assist process – the nozzle method, where gas is injected directly through the nozzle of the injection molding machine, and the in-article method, in which gas pins are used to inject gas directly into the part or runner.

Through the nozzle

Gas injection through the nozzle requires replacement of the standard injection molding machine nozzle with a specially modified gas injection nozzle. A gas injection nozzle must have a means of connecting, near the tip, a high-pressure gas line with a small hole that directs the gas into the resin stream. The hole should be small enough to prevent the resin from easily backing up into the gas line. Usually, a check valve is fitted to the gas line to prevent gas or resin from flowing back into the gas line.

A resin shutoff valve between the gas entry point and the molding machine barrel must also be used to prevent the gas from entering the barrel. If gas enters the barrel, it will force the screw back and shot-to-shot consistency will be impossible to maintain. Any positive resin shutoff valve will work, as long as it is capable of withstanding the pressure of the gas.

Some excellent gas assist nozzles are available that incorporate the resin shutoff valve and the gas injection apparatus in one, thus allowing for quick process changes from conventional molding to gas assist. Some of these gas nozzle systems shut off mechanically, eliminating the need for hydraulics.

When gas is injected through the nozzle, sprue break is generally used as the means of venting the gas to the atmosphere before the mold is opened. Sprue break occurs as the barrel is retracted before the mold and the seal between the nozzle tip and sprue bushing is broken. The high-pressure gas that was injected into the cavity is released through this opening to the atmosphere.

In-Article Method (Gas Injection Pins)

For many gas assist applications, particularly when using a hot runner system as noted above, injecting gas through the nozzle is not practical. It is also impractical when the objective may be to inject gas in more than one location within the mold cavity and at different times or pressures. For applications where gas will be injected directly into the mold, or in-article, the gas injection pins must be used.

Gas injection pins, gas needles, or simply gas pins, are placed somewhere in the melt stream of the part or runner. They are then connected to a nitrogen control unit via a gas supply line in order to direct nitrogen to the process. The gas pin must have an opening large enough to prevent molten resin from entering, and it must have a means of connecting to a nitrogen control unit.

The tip of the gas pin from which gas actually flows must be placed far enough into the melt that it will seal when molten resin freezes off around the pin. If the pin does not seal properly, the gas will flow between the part and the cavity surface and flow out from between the mold halves.

Gas pins are usually fitted to the mold surface in the line of draw. If gas pins must be installed out of the line of draw, they may be mounted on hydraulic cylinders so that they can be pulled before the mold opens. They may also be located on mechanical slides or lifters.

Benefits of Gas Channels

With thick parts, such as handles, the tooling modifications needed to introduce gas are relatively simple. Thin wall parts, such as a television cabinet, require the addition of gas channels.

Gas channels are flow runners cut into a mold to direct the flow of resin within the cavity. These channels are then cored out with gas to provide the packing force necessary to produce a high-quality injection molded part.

Gas channels should begin either at the material feed gate or at a gas pin. If you are injecting gas through the machine nozzle, the channel must begin at the gate so the gas will travel in the proper direction. If you are using gas pins in the mold, the channel may be cut away from the gate but the gas and the resin must flow in the same direction away from the gas pin; more simply, the gas and the resin should flow in the same direction.

When gas channels are designed properly, they provide certain benefits that cannot be obtained with the conventional molding process.

Increase in Length of Resin Flow

By adding gas channels to thin-wall moldings, material flow lengths are greatly increased. The channel should be considered a resin flow channel before it becomes a gas channel. For better understanding, consider a part such as a trim molding with a runner system and multiple gates.

The runner system is designed into the part rather than on the outside of the part. This provides much greater flow length so the number of gates and knit lines are reduced. The need for hot runner systems can also be eliminated in many molds.

Reduction in Injection Pressure

Adding gas channels to a part lets the resin flow more easily through the mold cavity, which means less injection pressure is required. By reducing the cavity pressure in the resin-injection stage, molded-in stresses and the chance of warpage during cooling are reduced. Resin shear is also reduced as a result of the lower velocity of the resin within the mold cavity.

Reduction in Clamp Tonnage

When gas channels lower the injection pressure within a cavity, the amount of clamp force required is reduced. With most gas assist parts, the cavity is not completely filled with resin before gas is introduced. The gas pressure used to complete the filling is normally significantly lower than that used in conventional molding; clamp force can be reduced by as much as 70 percent.

Greater and More Even Packing in the Mold

After the gas channels have aided in filling the cavity, they are cored out during gas injection. The gas is then held in the channels at a set pressure to provide sufficient packing force. The distance from the pack-pressure point is reduced, resulting in lower pressure differentials within the mold cavity.

With conventional molding that lacks a gas channel, pack pressure is supplied from a single gate. As the part is packed out by means of hydraulic pressure, resin is actually being forced into the gate at high pressure. The material will continue to enter the part until the gate freezes off. As the resin is being forced into this gate to pack out the part, freeze-off is occurring at the end opposite the gate. This causes a wide pressure differential range within the cavity. As a result, more resin will be packed into the gate end of the part than the opposite end. As the part cools, shrinkage occurs. Because the two ends of the part shrink at different rates, the part will warp.

Suppose we add a gas channel from the gate to the far end of this same test plaque. When the gas channel is cored out and pressurized during gas injection, the packing force is distributed evenly throughout the part's entire length.

With gas assist, gate freeze-off is not a factor, because packing does not take place at the material feed gate. As long as the gas channel is pressurized, packing force will be applied evenly to the part. This will reduce stress and the tendency for warping.

Increase in Strength and Rigidity of Part

When gas channels are cored out after gas is injected, they become tubular by design, adding greater strength and rigidity to the part. The gas channels actually provide more area to the thin wall or existing rib.

Strength can also be added to the part by increasing rib thickness. With gas assist, it is unnecessary to maintain a 30 percent rib-to-wall-thickness ratio. Ribs can actually be designed thicker than the nominal wall. The reduction of molded-in stress also adds strength to the finished part.

Reduction in Sink Marks

Gas channels are usually cut directly over, or close to, existing ribs and bosses prone to sink marks. When gas is injected, it will either core out the area behind the ribs and bosses or supply packing force to these areas due to their close proximity. With the pressure evenly distributed throughout the part, the possibility of sink marks is avoided.

Improved Aesthetics

Gas channels can also be used to add to a part certain features that would otherwise be impossible. For example, thick edges on map-pocket openings or thick handles connected to thin-wall parts are definitely doable.

Also, features that are normally bonded to a part in a secondary operation, such as a CRT mounting bracket on a television cabinet, can be incorporated into the part design with gas assist.

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