A View Of Common Facts On Hot Runner Molding

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The first thing to understand about hot runner (runnerless) molding is there are numerous suppliers of systems in the marketplace. Most of them have a success factor. There is no one system, when properly designed and operated, that can run every resin manufactured in today's market trouble-free. Hot runner suppliers are just suppliers, and most do not injection mold on a daily basis. This is where the most confusion and controversy lies. The proper system selection and start up for your specific use can be the difference between your success or failure.

During my years, I have been involved with numerous parts ranging from 1 gram (0.035 oz.) to 3,178 grams (112.1 oz.). Each part was unique and presented its own set of processing problems. There is very little published by suppliers on proper selection and start up of a system for a specific application. Most advice is given on feedback from their field service personnel. There are many successful system suppliers and molders who would not run anything but runnerless molds and most are reluctant to share information they have acquired. At the same time, there are many molders that, because of one bad experience, will not even bid a job with a hot runner system.

I have had the advantage of being a molder and working for a large resin supplier. If there is one thing I have learned about runnerless molding, it is to bring the molder, hot runner supplier, tool maker and resin supplier together in the early stages of a project. The knowledge of all these resources combined begins a successful project with minor headaches. When troubleshooting runnerless systems, I find that many times the processing or design problems are due to overlooking the basics.

The Basics

- *Selection of proper resin for the application.*
- *Understanding the processing window or range of the material selected.*
- *Part size and distance material must flow (volume versus shot size).*
- *Gate size and location (cosmetics may be an issue).*
- *Critical dimensional requirements.*
- *Frequency of color changes.*

Applications with a wide range of specifications and smaller cavitation will run in most any type of runnerless system versus

those which have very tight specifications. It is important to understand the types of systems available and their limitations, if any. This will allow proper selection of a system for your specific application.

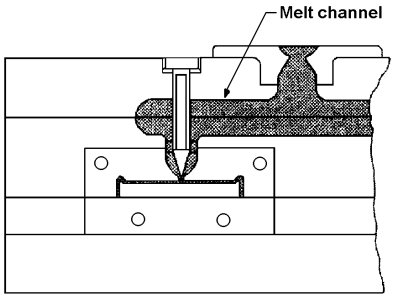
Manifolds -- What You Need To Know

A hot runner manifold can be envisioned as an extension of the barrel and nozzle of a molding machine. The purpose of any hot runner manifold is to convey the material to each gate location within a mold. There are three basic types of systems which cause this to occur:

- *Insulated runner*
- *Internally heated annular runners*
- *Externally heated hot manifolds*

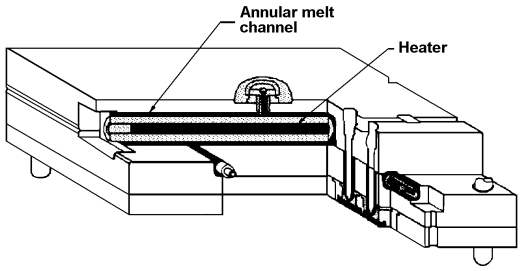
The insulated runner method is the oldest and simplest method of conveying the melt.

Insulated Runner Systems



These systems consist of a manifold fed by the machine nozzle. Its passages are not heated. The runner system in the manifold is considerably larger in diameter than those found in a hot manifold. During the first shot, the system is filled with a molten resin, the center of material remains fluid due to passage of resin with each cycle. The outer portion of the resin forms a solidified wall, or tube, through which the resin is delivered to the gates and cavity. Cycle interruption will cause the runner to solidify and freeze off. This results in removing the runner from the runner plate and starting again. Best resin candidates for insulated runner systems include polyethylene, polypropylene and polystyrene due to their large processing window. Because there is no heat in the system, higher injection pressures are utilized. Many times, this can result in distorted or bent cavity plates.

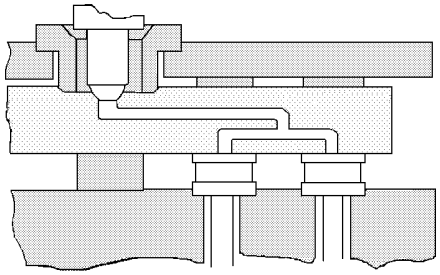
Internally Heated Annular Runners



The components of this system are commonly called distributor tubes or torpedoes. Instead of allowing the melt to flow unheated in the system, distributor tubes are installed to provide heat which keeps the system from freezing off but sets up a condition called annular flow. Despite the fact that a cartridge heater is present in the distributor tubes, there is still a presence of frozen material between the distributor tube and runner wall. Material must flow between the insulating wall and distributor tube. This, along with annular flow, creates a high pressure drop in the system. Therefore, balance is of the utmost importance. Internally heated systems are ideal for materials with large process windows

and balanced runners of equal distance to all drops. Unequal flow distances in an unbalanced system cause numerous processing problems. Many suppliers of heat-sensitive resins do not recommend this type of system.

Externally Heated Systems



This is simply a solid block containing runner channels drilled through. Heaters are attached to the entire block. This type of system is more costly but has its advantages. There is no insulated layer of material or annular flow, resulting in less pressure loss in the system and less temperature variations. Systems can be balanced by runner diameter rather than length. Because of this technology, manifolds have become smaller and easier to install. As always, a balanced runner system of equal length provides a more versatile process to control.

Manifolds -- Construction

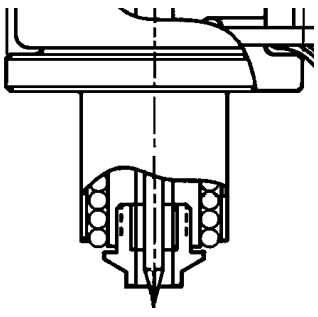
Proper construction of the manifold and its components is crucial. The location and bore diameter, as well as heater and thermocouple locations, are critical to temperature stability and material residence time in the system. During processing, good manifold construction provides:

- *Smooth bore channel with no dead spots.*
- *Uniform heating of the entire manifold with heaters not crossing above or below runners.*
- *Balanced runner flow paths to all drops.*
- *Designed for a volume of one shot or less (maximum of three).*

Because the entire manifold system is heated to processing temperatures, it is imperative there are no dead spots where material can stagnate and degrade. Regardless of heaters used, tubular or cartridge, good thermal contact between the heater and manifold block is essential to prolong heater life and provide uniform heating of the manifold.

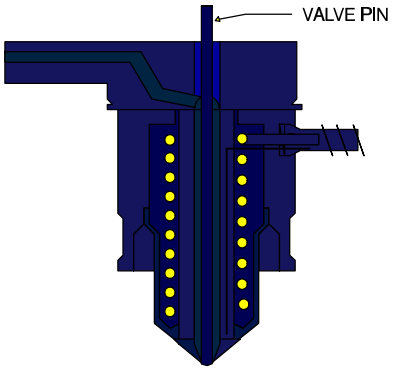
Gating and Nozzle Drops

Gate tip selection is critical for successful processing. There are numerous types of nozzle drops and gate inserts available in today's market. Each type of drop and gate insert will have its own special requirements. ***Sprue gate nozzles*** are the most popular because of their easy use. A standard straight flow-through nozzle with a removable tip allows versatility to contour the gate to the particular part being molded. It also contributes to excellent gate vestige on the molded part.

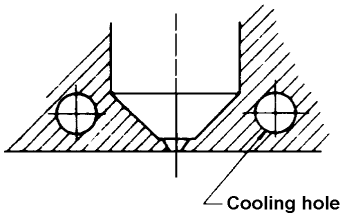


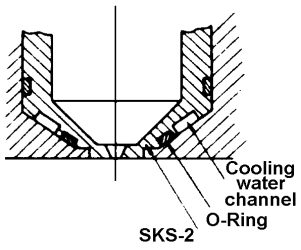
All gate inserts have a common function -- to allow the melt to enter the cavity without hesitation, and eliminate stringing and drooling during demolding. Typically, gate sizes are smaller than those utilized in cold runner molding.

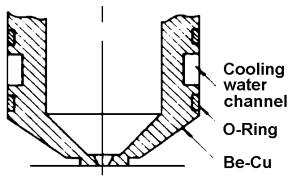
Valve gates nozzles open and close by means of hydraulic or pneumatic cylinders. Valve gating provides excellent gate vestige and prevents drooling and stringing, however, this type of system is more expensive than most conventional hot runner nozzles. It also requires the use of some secondary equipment to operate the valve.



The most common mistake made is lack of cooling around the gate insert. Allowing for cooling around all gate inserts lets the processor avoid premature freeze-off, excessive gate vestige and drooling. Each gate insert should have sufficient cooling provided by a separate supply. Looping water circuits often cause hot spots and poor control of gate vestige.







Basic Facts and Advice

It is impossible to say which system will work best in a specific application. Most important when selecting a system is paying attention to the basics. The more critical your requirements, the more important it is that the entire system be evenly heated, equal in flow lengths and balanced in the runner system. Suppliers are constantly introducing new products to improve efficiency. Remember -- suppliers are not molders. That's why it is important to bring molder, hot runner supplier, tool maker and resin suppliers together in the early stages of a project.