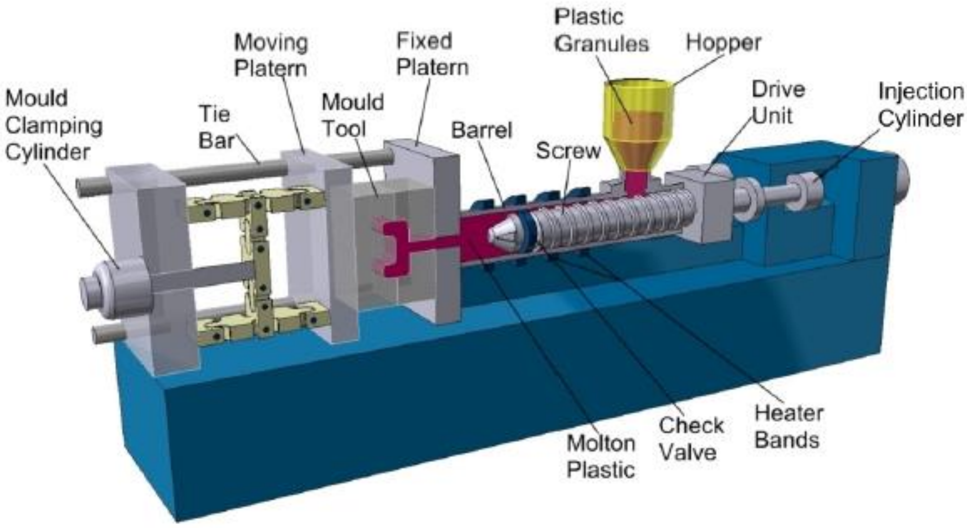
Plastic injection components

1. **Injection Cylinder**
2. **Drive Unit**
3. **Hopper**
4. **Screw**
5. **Barrel**
6. **Heater Bands**
7. **Check Valve**
8. **Molton Plastic**
9. **Fixed Platern**
10. **Mould Tool**
11. **Moving Platern**
12. **Tie Bar**
13. **Mould Clamping Cylinder**



Injection molding machine components

The injection system consists of a hopper, a reciprocating screw and barrel assembly, and an injection nozzle, as shown in Figure 1. This system confines and transports the plastic as it progresses through the feeding, compressing, degassing, melting, injection, and packing stages.

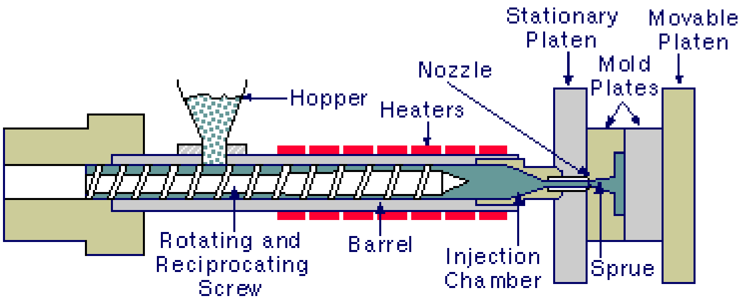


FIGURE 1. A single screw injection molding machine for thermoplastics, showing the plasticizing screw, a barrel, band heaters to heat the barrel, a stationary platen, and a movable platen.

1. Hopper

In the molding process the plastic materials are supplied in the form of small pellets. The hopper functions as the holder of these pellets. The pellets are then gravity fed from the hopper to the barrel.

Thermoplastic material is supplied to molders in the form of small pellets. The hopper on the injection molding machine holds these pellets. The pellets are gravity-fed from the hopper through the hopper throat into the barrel and screw assembly.

2. Screw

Also known as the reciprocating screw is used in compressing, melting and conveying the plastic material. The Screw consists of three zones – The feeding zone, the Transition zone and the metering zone. In the feeding zone there will be no change to the plastic materials and they will remain pellets and will be transferred to the next zone which is the transition zone, in this zone melting of the pellets will occur and the molten plastics will be transferred to the next zone which is the metering zone, in this zone the molten material will be ready for injection.

The reciprocating screw is used to compress, melt, and convey the material. The reciprocating screw consists of three zones (illustrated below):

- the feeding zone
- the compressing (or transition) zone
- the metering zone

While the outside diameter of the screw remains constant, the depth of the flights on the reciprocating screw decreases from the feed zone to the beginning of the metering zone. These flights compress the material against the inside diameter of the barrel, which creates viscous (shear) heat. This shear heat is mainly responsible for melting the material. The heater bands outside the barrel help maintain the material in the molten state. Typically, a molding machine can have three or more heater bands or zones with different temperature settings.

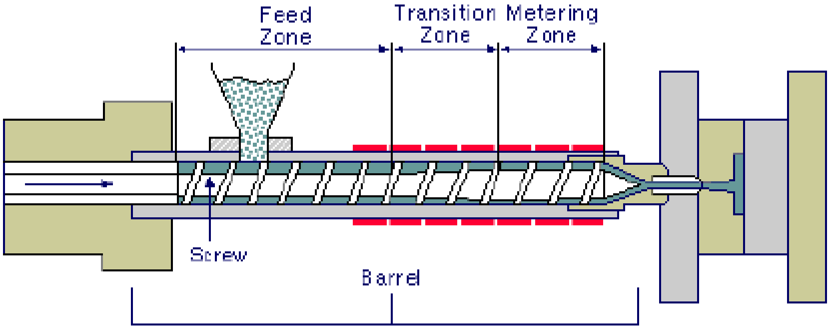


FIGURE 2. A reciprocating screw, showing the feeding zone, compressing (or transition) zone, and metering zone.

3. Barrel

The main use of the barrel is to give support for the screw. The Barrel consists of heater bands which function as a temperature recorder for each section of the barrel. As shown in Figure 1, the barrel of the injection molding machine supports the reciprocating plasticizing screw. It is heated by the electric heater bands.

4. The Nozzle

The nozzle connects the barrel to the sprue bushing of the mold and forms a seal between the barrel and the mold. The temperature of the nozzle should be set to the material's melt temperature or just below it, depending on the recommendation of the material supplier. When the barrel is in its full forward processing position, the radius of the nozzle should nest and seal in the concave radius in the sprue bushing with a locating ring. During purging of the barrel, the barrel backs out from the sprue, so the purging compound can free fall from the nozzle. These two-barrel positions are illustrated below.

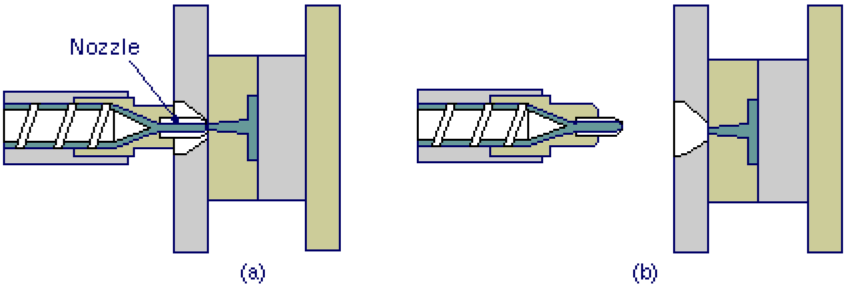


FIGURE 3. (a) Nozzle with barrel in processing position. (b) Nozzle with barrel backed out for purging.

5. Mold system

The mold system consists of tie bars, stationary and moving platens, as well as molding plates (bases) that house the cavity, sprue and runner systems, ejector pins, and cooling channels, as shown in Figure 4. The mold is essentially a heat exchanger in which the molten thermoplastic solidifies to the desired shape and dimensional details defined by the cavity.

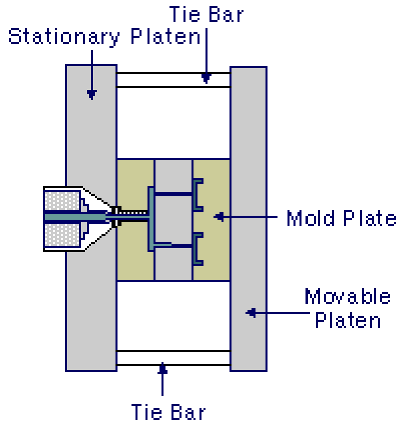
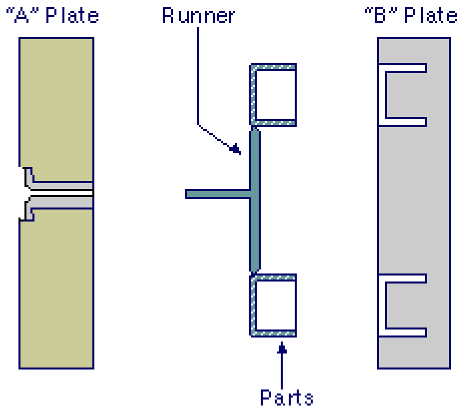


FIGURE 4. A typical (three-plate) molding system.

A mold system is an assembly of platens and molding plates typically made of tool steel. The mold system shapes the plastics inside the mold cavity (or matrix of cavities) and ejects the molded part(s). The stationary platen is attached to the barrel side of the machine and is connected to the moving platen by the tie bars. The cavity plate is generally mounted on the stationary platen and houses the injection nozzle. The core plate moves with the moving platen guided by the tie bars. Occasionally, the cavity plate is mounted to the moving platen and the core plate and a hydraulic knock-out (ejector) system is mounted to the stationary platen.

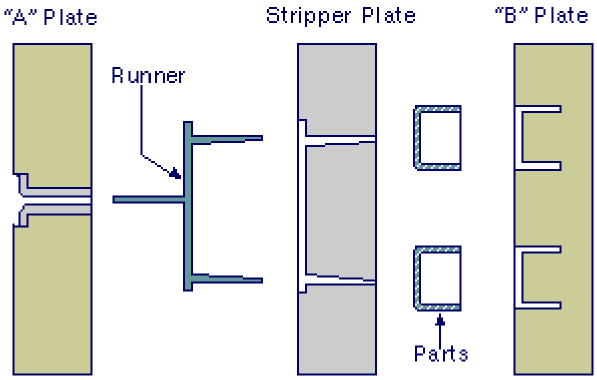
6. Two-plate mold

The vast majority of molds consist essentially of two halves, as shown below. This kind of mold is used for parts that are typically gated on or around their edge, with the runner in the same mold plate as the cavity.



7. Three-plate mold

The three-plate mold is typically used for parts that are gated away from their edge. The runner is in two plates, separate from the cavity and core.

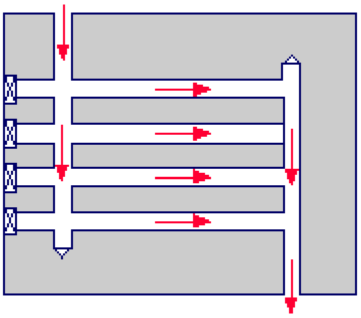


8. Cooling channels (circuits)

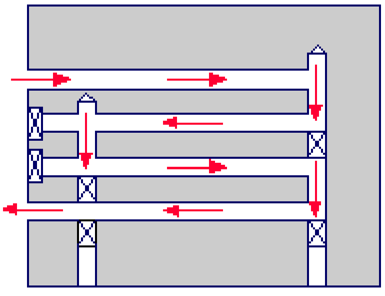
Cooling channels are passageways located within the body of a mold, through which a cooling medium (typically water, steam, or oil) circulates. Their function is the regulation of temperature on the mold surface. Cooling channels can also be combined with other temperature control devices, like bafflers, bubblers, and thermal pins or heat pipes.

Types of cooling channels

Cooling-channel configurations can be serial or parallel. Both configurations are illustrated in Figure 1 below.



Parallel Cooling Channels



Serial Cooling Channels

- **Parallel cooling channels**

Parallel cooling channels are drilled straight through from a supply manifold to a collection manifold. Due to the flow characteristics of the parallel design, the flow rate along various cooling channels may be different, depending on the flow resistance of each individual cooling channel. These varying flow rates in turn cause the heat transfer efficiency of the cooling channels to vary from one to another. As a result, cooling of the mold may not be uniform with a parallel cooling-channel configuration.

Typically, the cavity and core sides of the mold each have their own system of parallel cooling channels. The number of cooling channels per system varies with the size and complexity of the mold.

- **Serial cooling channels**

Cooling channels connected in a single loop from the coolant inlet to its outlet are called serial cooling channels. This type of cooling-channel configuration is the most commonly recommended and used. By design, if the cooling channels are uniform in size, the coolant can maintain its (preferably) turbulent flow rate through its entire length. Turbulent flow enables heat to be transferred more effectively. Heat transfer of coolant flow discusses this more thoroughly. However, you should take care to minimize the temperature rise of the coolant, since the coolant will collect all the heat along the entire cooling-channel path. In general, the temperature difference of the coolant at the inlet and the exit should be within 5ºC for general-purpose molds and 3ºC for precision molds. For large molds, more than one serial cooling channel may be required to assure uniform coolant temperature and thus uniform mold cooling.

9. Hydraulic system

The hydraulic system on the injection molding machine provides the power to open and close the mold, build and hold the clamping tonnage, turn the reciprocating screw, drive the reciprocating screw, and energize ejector pins and moving mold cores. A number of hydraulic components are required to provide this power, which include pumps, valves, hydraulic motors, hydraulic fittings, hydraulic tubing, and hydraulic reservoirs.

10. Control system

The control system provides consistency and repeatability in machine operation. It monitors and controls the processing parameters, including the temperature, pressure, injection speed, screw speed and position, and hydraulic position. The process control has a direct impact on the final part quality and the economics of the process. Process control systems can range from a simple relay on/off control to an extremely sophisticated microprocessor-based, closed-loop control.

11. Clamping system

The clamping system opens and closes the mold, supports and carries the constituent parts of the mold, and generates sufficient force to prevent the mold from opening. Clamping force can be generated by a mechanical (toggle) lock, hydraulic lock, or a combination of the two basic types.

12. Molded system

A typical molded system consists of the delivery system and the molded part(s), as shown in Figure 6.

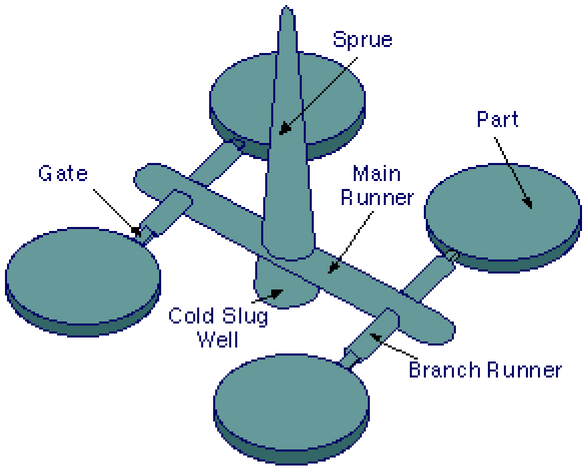


FIGURE 6. The molded system includes a delivery system and molded parts.

The delivery system

The delivery system, which provides passage for the molten plastic from the machine nozzle to the part cavity, generally includes:

- a sprue
- cold slug wells
- a main runner
- branch runners
- gates

The delivery system design has a great influence on the filling pattern and thus the quality of the molded part.