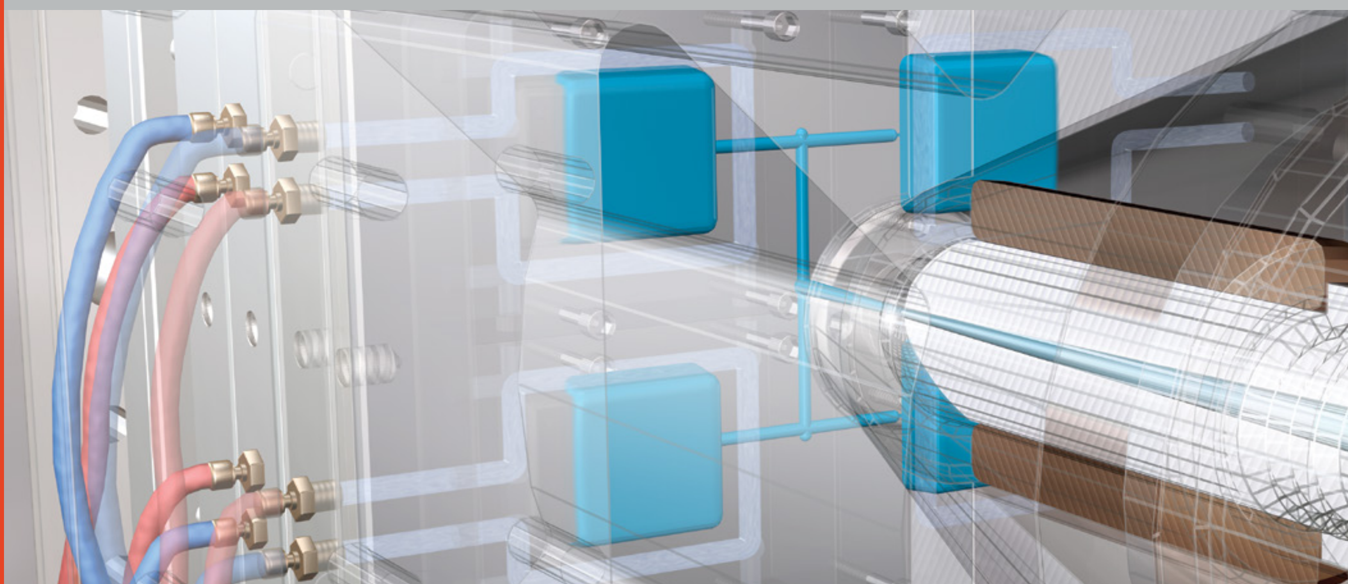
REFERENCE SERIES: DESIGN

Common Part Ejection Techniques



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

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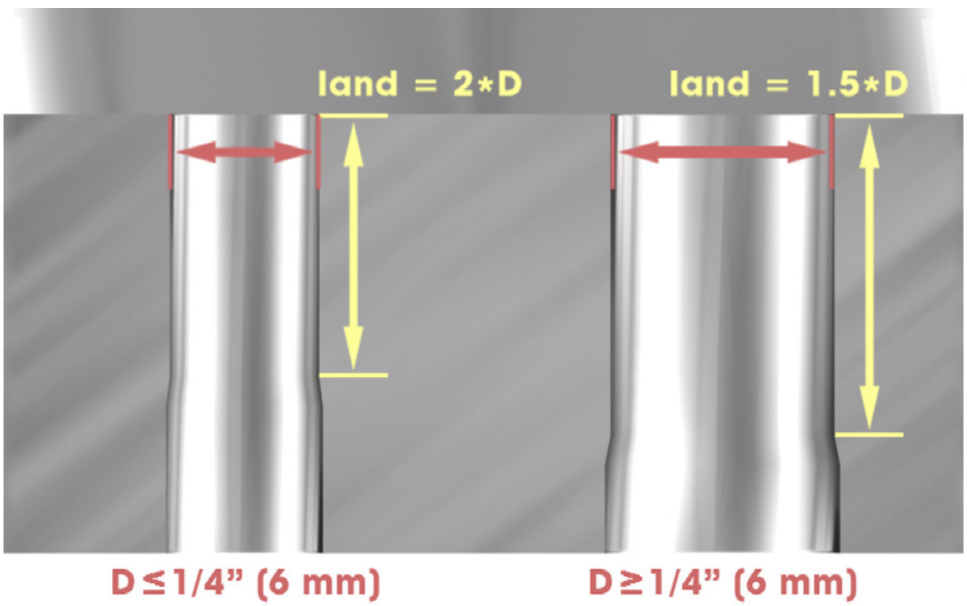
Ejector Pins

The most common form of part ejection is the use of ejector pins. This is due to their simplicity in design and their relatively low cost. Since ejector pins use a relatively small surface area to remove the part, multiple ejector pins are typically required.

The head of each ejector pin is mounted into the ejector plate assembly, and passes through the support plate and core retainer plate through the use of relief holes. Just before reaching the mold cavity, the ejector pin also passes through the 'land' area. The land is a hole, machined into the core block, which guides the ejector pin as well as prevents flashing. An improper depth or diameter of the land can damage the ejector pin, or gall the ejector pin hole surfaces. When specifying the land diameter, it is important to consider the material and injection pressures being used.

When molding materials having a low viscosity, or when high injection pressures are needed, a low tolerance between the diameters of the pin and the land is required. This calls for the land to be finished using a wire EDM machine or a jig grinder.



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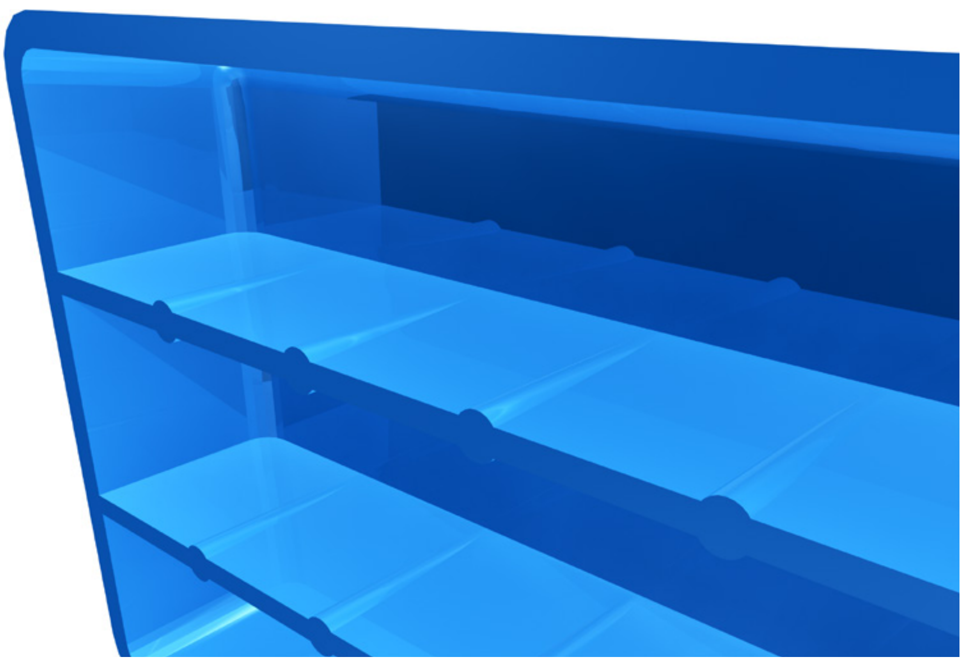
Materials with a high viscosity have a lower tendency to flash, and therefore more clearance can be used between the diameters of the ejector pin and the land. These diameters can be machined using a drill and a reamer. This allows gas to vent around the ejector pin, and reduces the amount of wear. Ejector pins up to one quarter of an inch, or six millimeters, in diameter should use a land depth equal to two times the ejector pin diameter. Pins larger than one quarter of an inch, or six millimeters, in diameter, should have a land depth equal to 1.5 times the diameter of the pin.

Ejector pins can be purchased in almost any diameter and length — as either 'through hardened' or 'case hardened'. 'Through hardened' ejector pins have a Rockwell "C" hardness of 65 to 72, and are recommended for high production molds. 'Case hardened' pins have a Rockwell "C" hardness of 60 to 65 on the perimeter, but are not hardened throughout, which make them more susceptible to bending and breaking, since they are softer and less rigid.

When ejector pins are used on contoured surfaces, a 'flat' needs to be ground on the ejector pin head, and a slot must be milled in the retainer plate. The ejector pin is mounted in the retainer plate, and is held in place using a key. This metal piece keeps the ejector pin from rotating during injection and ejection.

When assisting in the removal of ribbing, it is recommended that ejector pins be placed at rib intersections so that larger pins can be used. If ejector pins are required to push along a rib, **Ejector Pads** should be used. Ejector pads are thick sections added to the rib to create a larger surface area.



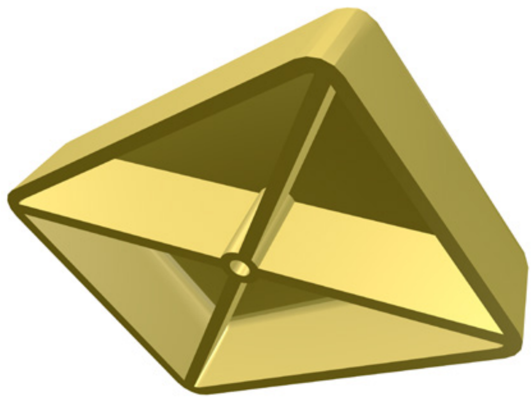
Since thinner ejector pins have a tendency to break, ejector pins can be purchased having shoulders. Shoulders are thicker sections near the head of the pin that improve their strength and performance. Ejector pins are used for ejecting a wide range of parts, and are commonly used in conjunction with other forms of ejection.

Ejector Sleeves

Ejector sleeves are designed to eject parts off of the perimeter of a stationary core, or a core pin. These sleeves are mounted in the ejector plates, and the stationary core is mounted to the clamping plate. The ejector plates actuate the ejector sleeves, which travel up the length of the core to remove the part. There is clearance between the center of the sleeve and the core, and a 'land' area at the top. Land is also machined into the core block, having clearance in both the core retainer plate and support plate.

Ejector sleeves are available with different inner diameters, outer diameters, and lengths. To reduce wear, these sleeves are typically made of tool steel with a Rockwell "C" hardness of 60 to 65.

Ejector sleeves are commonly used to remove 'bosses' and 'ribs', or to eject cylindrical parts. A boss is a deep, or recessed, hole in the part, and is ejected using a sleeve around a core pin. Bosses should be placed at rib intersections to provide better ejection force distribution. When ejecting cylindrical parts from the mold, ejector sleeves push on the entire perimeter of the part.

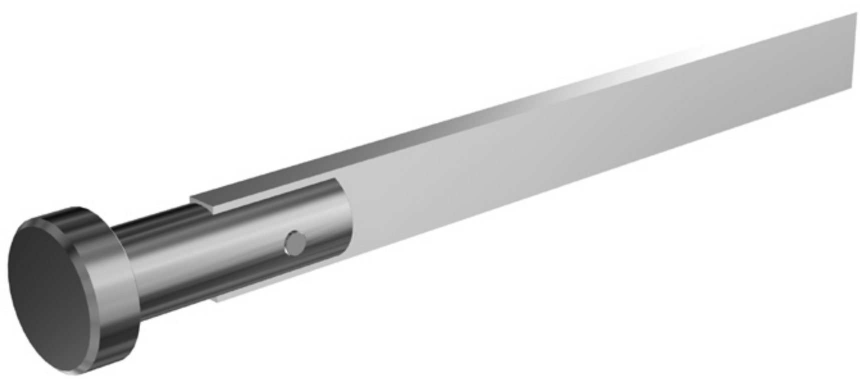


Ejector sleeves can also be used to eject parts from complex cores having contoured profiles. These provide a uniform ejection force around the whole perimeter of the core. Contoured ejector sleeves must be custom made, either in house or by suppliers, to fit the core. Ejector sleeves are commonly used to remove parts at rib intersections and bosses, as well as along the perimeter of cylindrical parts.

Ejector Blades

Ejector blades are wide, rectangular blades used to improve ejection force distribution along thin walls and ribs. These are often used in place of ejector pins. Ejector blades are mounted in the ejector plates and pass through the support and cavity retainer plates, as well as the core block. As with ejector pins, ejector blades are controlled by the back and forth movement of the ejector plates.

These blades are used as both one-piece and two-piece assemblies. One-piece ejector blades are available as both 'case hardened' and 'through hardened' and have a transition from a round head to a rectangular blade. One-piece blades are the stronger of the two designs, but are more expensive and are only available in limited sizes. Two-piece ejector blades consist of an ejector pin with a blade mounted to the top. This blade can be made from any material in custom sizes, and is easy to replace.



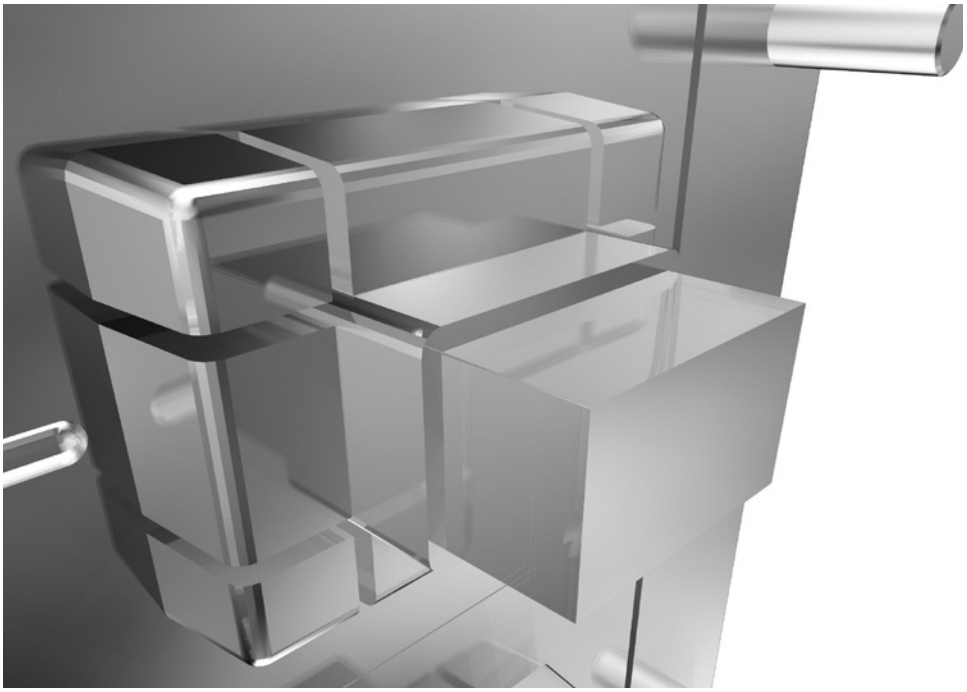
The easiest and most common method of machining an ejector blade hole is to grind or mill a slot into the side of a core insert. When the core insert is placed into the mold, a rectangular hole is formed to house the ejector blade. When this is not possible, the ejector blade hole must be 'wire EDM'ed' directly into the core. The inherent corners of the wire make it difficult to fit the ejector blade into the hole, and often require the corners of the blade to be ground.

The ejector blade hole should have clearance in the back with a land depth of approximately twice the thickness of the blade. Blades are ideal for ejecting parts having thin walls or ribs, especially when they are located on the edges of core inserts.

Lifters

Straight or angled lifters distribute the ejection force over a large surface area.

Straight lifters are mounted directly into the ejector plates and pass through the core block. These lifters are used to help eject part features that may stick to the mold, such as deep ribs and thin sections.



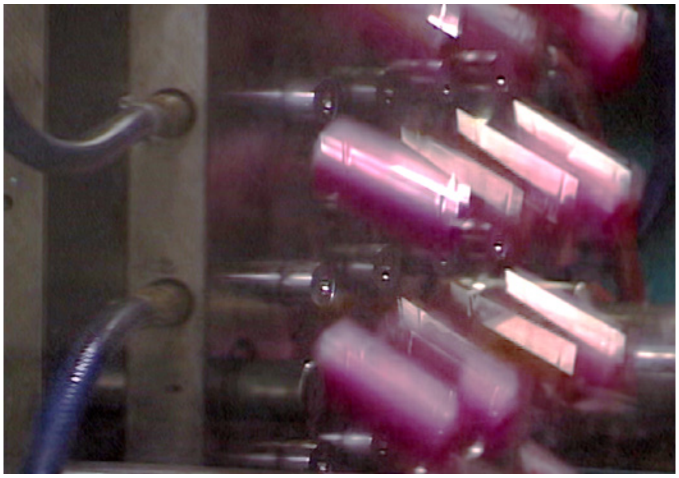
Angled lifters are also mounted in the ejector plates; yet pass through the core at an angle. These are used to remove internal or external undercuts from the mold, and can also help eject the part from the mold.

To reduce wear, lifters are commonly made from shock resistant S7, or hardened H13, steel. If lifter cooling is needed, lifters can be made from materials having improved thermal conductivity, such as beryllium copper or 'Kal' tool. Another option is to add cooling lines in the lifters, yet this is usually reserved for larger lifters.

Angled seal offs should be used at the bottom of lifters to significantly reduce the possibility of flash. Lifter guides should be inserted either in the support plate or the clamping plate to keep the lifter in the correct position during ejection. To reduce lifter wear, lifter guides are typically made out of bronze-coated or graphite impregnated materials. Lifters are often used to remove delicate detail that can be damaged by ejector pins or blades when molding softer polymers. They are also used to remove larger part features; such as ribbed sections and deep cores.

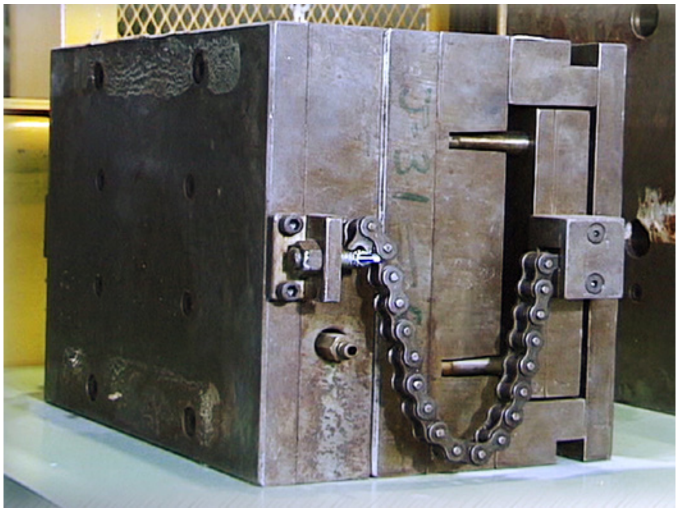
Stripper Plates

Stripper Plates are ejection systems that encircle the core, and remove the part by pushing on its outer edges. By doing so, a uniform ejection force is applied along the perimeter of the part. Since the stripper plate is an additional plate, it is the only ejection method not to interfere with the cooling line layout in the core. Stripper plates should be used whenever possible, since an even force distribution is provided.



An angle is ground into the bottom of the stripper plate, and seals with an angle at the base of the core. These mating surfaces should be made of hard, shock resistant materials, such as S7 or H13, to reduce wear. Leader pins and leader pin bushings guide the stripper plate as it moves back and forth during ejection. Plastic inserts, or springs, can be placed between the stripper plate and the core retainer plate to reduce the amount of stress incurred as the mold closes. Individual stripper rings can be used at each mold cavity. These come in contact with the core block and are mounted into a larger stripper plate for multi-cavity molds.

Mounting chains to the stripper plate and the "A" half of the mold is also a form of actuating the stripper plate. This is the simplest method of stripper plate actuation, but is only recommended for use in prototype environments since the chain assembly breaks easily.



Another method of stripper plate actuation is to mount a latch system to both the "A" and "B" halves of the mold. Like the shoulder bolt assembly, the latch system also reduces the overall stack height of the mold, yet its' durability allows it to be used in virtually any stripper plate assembly.

Actuating the stripper plate can also be accomplished through the use of return, or ejector, pins. These pins attach the ejector plate to the stripper plate and use the machine's ejection system to control the stripper plate movement. This method is durable, easy to implement, and allows for other forms of ejection to be added when needed.

The final method mentioned uses hydraulic or pneumatic cylinders to actuate the stripper plate. Such systems can also eject from the stationary side of the mold and do not require the use of the machine's ejection system.

Air Poppet Valves

Air Poppet Valves supply air to the top of the core. These valves are used to reduce vacuum forces, or as a lone form of ejection. Since air poppet valves provide less ejection force than other methods, these can only be used as a sole form of ejection for lightweight and thin-wall parts. Air poppet valves are more commonly used with other forms of ejection by reducing the vacuum forces under the parts.

A spring-loaded valve is mounted in the core block. This valve remains in the seated position during injection, and is then forced forward by air during ejection. When using air poppet valves, a clean, consistent air supply must be used to prevent inconsistent ejection and surface contamination. Air poppet valves are typically used for ejecting light, thin-wall parts, such as food containers and cups. They are also used to aid in ejection for parts with deep cores, by reducing vacuum forces.