Mould and Die Standard Parts

Mould standard parts can be divided into the following groups:

- Standard mould set with guide bars, guide sleeves and other guiding elements
- Ejector pins and special components for ejection
- Ejector set guiding elements
- Core pins
- Core moving elements
- Cold runner system components
- Hot runner system components
- Tempering device fixtures, insulating elements
- Fastening and closing elements, elements for lifting the mould

There are several mould standard part manufacturers, who have sales offices in Europe. (See table.)

**Table 1. Some of the mould and die standard part manufacturers**

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<th>Standard mould part manufacturers</th>
<th>Electrode materials</th>
<th>Hot runner systems</th>
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<td>- D-M-E</td>
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<td>- Superior Die Set</td>
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<th>Quick clamping systems</th>
<th>Core pulling cylinders</th>
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<td>- Hilma</td>
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Standard mould set with guide bars, guide sleeves and other guiding elements

Standard mould set consists of two clamping plates, two cavity plates, an optional back plate, risers and an ejector set (See image.). Core and cavity side are 3D-CAD terms. Most of the cavity is typically placed into the fixed side and most of the core into the moving side of the mould. This assures that the part is in the ejection side cavity after the mould has been opened.

Ejector set consists of two plates: an ejector retaining plate and an ejector plate. These are fastened together with four bolts and the ejectors are placed between them. Usually there are bumper plates between the ejector set and the clamping plate. (See image.) Risers determine the longest possible ejection distance.

Moving and fixed mould halves are guided towards each other with different guiding elements. Basic guiding elements, which usually are a part of the standard mould set, are guiding pillars, guiding sleeves and centering sleeves. If it is necessary to locate the cavity halves with more accuracy, the mould is equipped with cavity interlocks: straight side interlocks or tapered interlocks. (See images below and next page.)

Image 1. Standard mould set basic structure. Usually the standard mould part sales agents have suitable sets for injection moulding moulds except for the very biggest types. High pressure die casting moulds are normally manufactured to a set of flame cut steel plates, not to a pre-fabricated standard mould set.

Image 2. Ejector set components.

Tapered interlocks for accurate mould cavity halves positioning. These parts are fastened with screws from back side of the cavity plate.

Straight side interlocks. Easy maintenance. These parts can be replaced without disassembling the mould.

**Ejector pins and special components for ejection**

Basic parts in the mould ejection system are ejectors and sprue pullers. There are different types of ejectors. The main types are round ejector pins, flat ejector pins and ejector sleeves. Sprue pullers are specially shaped or specially placed ejectors, which stick to the sprue and pull it out from the sprue bushing. (See images.)

**Ejector pins**

Ejectors are attached between the ejector set plates with the collar in the end of the ejector. If the mould cavity surface is shaped, it is common to grind a flat surface to the collar. This flat surface sets the ejector to a fixed position. (See image below.)

![Image 7. Ejectors in a fixed position.](image)

Sprue pullers are either special components or specially shaped ejector pins. (See images below.)

![Image 8. Above left: Two cavity mould with a sprue puller sleeve. Above right: Sprue puller sleeve structure, a cross section image Part of the runner forms inside the sprue puller sleeve. Below left: Ejected part with the cold runner system. Below right: Sprue puller sleeve structure. Many standard part manufactures have this kind of constructions in their product range.](image)

![Image 9. Another sprue puller type. This type is fabricated to the ejector pin. No other components needed.](image)
There are also some special ejector types like tilting ejectors and stripper plates. Tilting ejectors are suitable for moulding small back draft details like snap fits and small slots. Stripper plates are very useful in ejecting high cup shaped parts. (See images.)

![Image 10. Tilting ejector in a closed and an open position. The ejector bends along the ejection movement. D-M-E.](image10.png)

![Image 11. Stripper plate. This type of ejection mechanism is practical if the part is very high. Ejector plate is not actually a standard part, but still a common structure.](image11.png)

**Ejector set guiding and returning elements**

Injection moulding mould ejector set is fixed to the moulding machine with one element in the centre of the mould. Without guides, the ejector pins are sole elements, which support these plates along with the fixture. Compared to the ejection pins strength and stiffness, the ejector set produces a relatively high load. Even the smallest imbalance will bend and in the worst case break the pins.

High pressure die casting die ejector set is fixed to the casting machine with four ejection bars. Four bars give rather good support, but it is still possible that the ejector set bends - for example if the part sticks to the die cavity from one side or there is some other kind of imbalance in the ejection. Usually the high pressure die casting machine ejector mechanism works with hydraulic cylinders. It returns the die ejector set to the back position with a cylinder backward movement.

In some injection moulding machine types the ejector mechanism is returned with the mechanism backward movement. In some machines the returning movement is done with a spring in the fixture. High pressure die casting hydraulic cylinders typically produce also the backward movement. In any of these cases it is recommended to place four ejector set returning pins to mechanically return the ejection system to the initial position.

The set of returning pins is also the lightest guiding construction. Returning pins are thick ejector pins, which are placed outside the cavity and extended to the mould parting surface. If the ejector set returning system does not work properly, these pins secure the ejector set to the initial position. (See image next page.)
If it is necessary to guide the ejector set more reliable and accurately, there are different guiding elements. Guide pillars and sleeves are available with or without bearings.

Cavity supporting elements

Usually the ejection side mould cavity is supported with supporting pillars. The fixed cavity plate has enough support from the moulding and casting machine base, but the ejection side cavity plate faces an open ejection box construction. The supporting pillar is placed between the clamping plate and the cavity or back plate under the cavity.
Core pins

Core pins are similar to the ejector pins, but the material is different. The core pins are placed to the mould cavity to shape deep and narrow holes in the part. (See image.)

Image 15. Left: Core pin. Middle: Core pin in the mould cavity. Right: The molded part.

Core moving elements

Core moving elements are different hydraulic or pneumatic cylinders, electric equipment or slide mechanisms, which will move the moving core out of the mould cavity to enable part ejection.

Slide mechanism is pure mechanical. It moves by the mould opening movement. Main parts in the slide mechanism are angle pin, slide locking parts, slide guiding and slide. Moving faces are typically covered with war plates. Some of the standard part manufacturers sell complete slide sets with all necessary parts in them. Some sell only angle pins and wear components. There is also a special standard mould set for constructing sliding core moulds. (See images.)

Image 17. Compact ready made slide mechanism, CUMSA.

Image 18. Sliding core mould set. The slides move with a sideward movement while mould opens.

If the moving core is relatively long, it is more practical to use core pulling cylinders. The slide opening movement is restricted by the angle pin length. In average size moulds and dies, the typical core movement is less than 50 mm. Core pulling cylinder stroke varies between 100 – 250 mm, even 300 mm if required.

Image 19. One core pulling cylinder type. Basically it is possible to use any bidirectional guided hydraulic or pneumatic cylinders. The injection moulding or high pressure die casting machine forces the cylinder opening and closing movements. Depending on the machine control unit, it is possible to force single or multiple opening or closing instructions. It is common to use end position sensors to secure the mould opening.
Runner system components for injection moulding moulds

The purpose of the injection moulding mould runner system is to provide the melted plastic a route from the injection moulding machine nozzle to the mould cavities. There are basically three runner types: cold runner, hot runner and combined system. The plastic solidifies inside the cold runner system. For that reason the cold runner system is removed from the mould cavity with the moulded part. Hot runner system keeps the plastic in liquid form and only the part is ejected.

Cold runner system consists of a central gate (sprue bushing), runners, gates and ingates. Runners, gates and ingates are mainly machined channels in the mould plates. The most common standard cold runner system parts are sprue bushings and rings for centering the injection moulding machine nozzle to the sprue head. Some standard part manufacturers produce also special tunnel gate components for injecting the cavity below.

Image 20. Sprue bushings and a centering ring. These bushings are flat on the top. Sprue bushings are available with different hemisphere shapes on the top. The hemisphere radius is selected to fit the machine nozzle radius.

Image 21. The sprue bushing and the centering ring assembled to a standard mould set.

Hot runner system consists of a sprue bushing, manifold, nozzles and gate bushings. There are basically three hot runner system types: externally heated system, internally heated system and combined system. In the image below there are some typical components of an externally heated system.

Image 23. Left: A heated manifold for an externally heated hot runner system. There are manifolds in different shapes and sizes. Right: A heated nozzle to be attached to the manifold. Manifold is similar to the runner system in an injection moulding mould cold runner system.

Image 24. Left: A heated sprue bushing for the externally heated hot runner system. Right: Gate bushing.

Image 25. Hot runner system assembly. This structure is placed to the fixed mould half inside and behind the cavity plate. Mould with hot runners is reasonably high and complicated compared to the cold runner mould.

Internally heated system is constructed with the similar components. The difference is in heating the channels. Internally heated system has internally heated channels. Externally heated system has externally heated channels.
Tempering channel fixtures and other components

Injection moulding mould tempering is typically done with straight and/or conformal cooling channels. The cooling liquid is water. High pressure die casting die tempering liquid is some heat transfer oil. The channels are similar, but due to a higher strength demands, simpler.

Mould and die standard part manufacturers have different small equipments for building the tempering channels. These equipments include fittings for connecting the tempering machine to the channels with pipes and also for connecting channels with each other. It is common to extend the tempering channels externally with pipes.

Image 26. Fittings for connecting tempering devices and tempering / cooling channels.

There are also equipments to cascade the tempering liquid with the aim to strengthen the cooling effect. These equipments include cascading liquid junctions, cooling baffles and cooling cores. Typically these equipments are placed inside high and relatively narrow cores.

Image 27. From left: A cooling core, a straight baffle and a spiral baffle.

Image 28. Left: A spiral baffle inside a high core. Right: A cooling core inside a high core.
Fastening and closing elements, elements for lifting the mould

Injection moulding moulds and die casting dies are fastened to the machine platens with similar components. The two most common components are clamps and screws or only screws. High pressure die casting machine platens are typically equipped with T-slots. Injection moulding machine platens with threaded holes. The clamps and fastening screws are quite similar (See images).

Some manufacturers have also different quick-clamping systems. These systems include magnetic and hydraulic clamping systems and different mechanical systems.

Moulds and dies are quite often lifted to the machine with a crane. To make short work of the lifting, the mould and dies are equipped with at least two pairs of eyebolts. If it is necessary to lift the mould or die halves separately, it is important to place two eyebolt pairs to the moving half and one pair to the fixed half. Otherwise the heavy moving half will not be balanced.

Clamps

Quick clamping

Eyebolt for lifting
Injection moulding machines typically have several different ways of clamping the mould ejection plates to the machine ejection system. There is only one point of attachment, but the equipments for attaching are numerous. The simplest clamping system is one ejector rod. But there are also different couplings for pneumatic or mechanical quick-clamping devices. (See images.) The point of attachment is in the middle of the mould ejector plates.

High pressure die casting machines use different system. The machine ejection system is hydraulic. There are four ejector bars, which are attached to the machine ejection cylinders through holes in the machine moving platen.