Parting Surface

1.Flat parting surface

The parting surfaces of plastic injection mould are those portions of both plastic injection mould plates, adjacent to the impressions, which butt together to form a seal and prevent the loss of plastic material from the impression.

We can classify the parting surface as being either flat or non-flat. Examples of the latter type include stepped, profiled and angled parting surfaces.

In general, the flat parting surface is the simplest to manufacture and maintain. It can be surface ground, and is easily bedded down.

To bed down a pair of mould plates is the process of marrying the two mould surfaces together.This is accomplished by blueing one surface, momentarily bringing the two plates together and subsequently removing any high spots which will be apparent on the non-blued surface. The plates are said to be bedded down when an even film of blue is transferred from one plate to the other.

The nature of the parting surface depends entirely on the shape of the component. For instance, consider the rectangular moulding shown in Figure 1. 1. The cavity for this article can be die sunk into one mould plate.

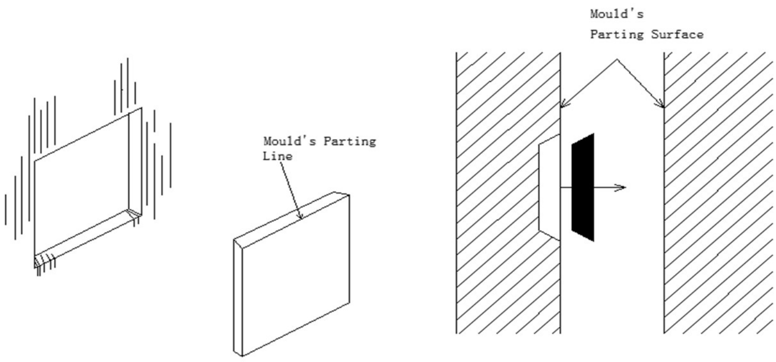


Figure 1. 1 Parting line of moulding and parting surface of mould

The position of the parting surface will therefore be at the top of the moulding , the parting surface itself being perfectly flat . For appearance this is the ideal arrangement as the parting line is not noticeable unless flash develops Flash is the name given to the wafer of material which escapes from the impression if the two mould halves are not completely closed .

A further consideration is that the parting surface must be chosen so that the moulding can be removed from the mould. Let us consider an example. Figure 1.2 shows a flat rectangular moulding which incorporates a double-bevel edge. Obviously the parting line for this component cannot be on its top surface (as for the previous case, Figure 1.1) as this will create an undercut in the mould [Figure 1.2(c)].The only suitable choice for the parting line is on the centre of the double-bevel which allows for half of the required form to be die sunk into each of the two mould halves[Figure 1.2 (b)] .

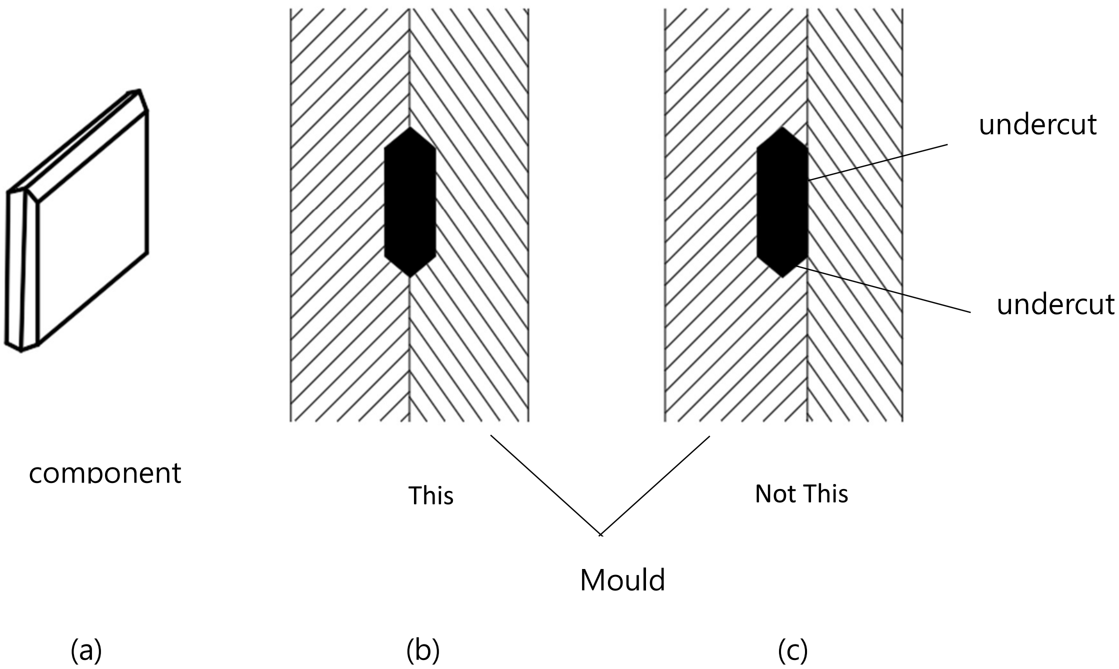


Figure 1.2 Practicable and impracticable choice of parting surface

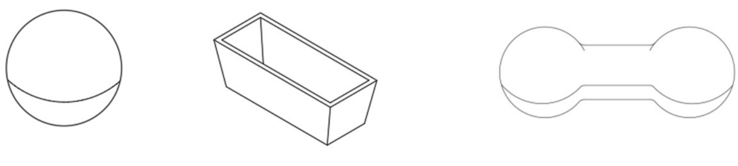
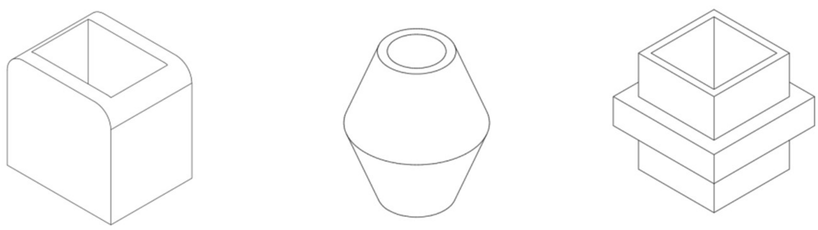


Figure 1.3 Typical moulding which permit flat parting surface to be adopted



To summarise the above two points we can say that the parting line must occur along the line round the position of maximum dimension when viewed in the draw direction. Then if this line lies on a plane the parting surface will be flat.

A number of typical mouldings which permit a flat parting surface to be adopted are shown in Figure 1.3.the arrows indicate the parting line on each moulding.

2 .Non-flat parting surface

Many moulding are required which have a parting line which lies on a non planar or curved surface. In these cases the mould' s parting surface must either be stepped, profiled or angled.

Stepped parting surface: Consider the Z-plate component shown in Figure 1.4.The maximum dimension of this component.when viewed in the draw direction occurs at the top of the Z-form. Thus, as this form is stepped , the mould 's parting surface must likewise be stepped as shown . Note that as the edge of the component is square with the face(apart from moulding draft) the entire moulding form can be accommodated in one mould half . However , had the edge incorporated a radius, then in addition to the mould having a stepped parting surface, the required edge form would have to be die sunk into each of the two mould halves.

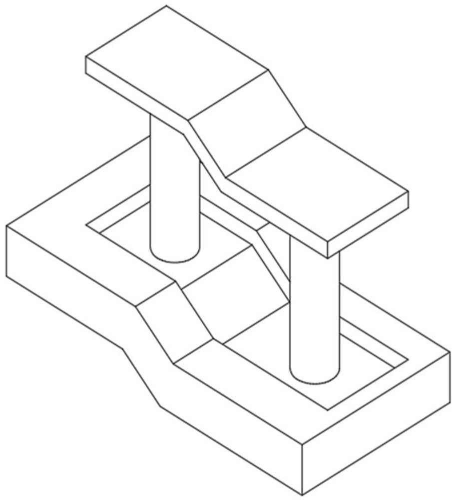


Figure 1.4 Z-plate type moulding

Profiled parting surface : An example of the profiled case is shown in Figure 1.5 .The moulding is shown at (a) . It will be noted that in cross -section the moulding form is constant; the general form (side view) incorporates curves . As the edge of the component is square with the face (apart from moulding draft) the entire for can be die-sunk into one mould plate.Thus the general form of the parting surface will follow the inside surface of the moulding(b) . To simplify the manufacture of a multi-impression mould it is often convenient to extend the profiled surface completely across the mould(c) . The individual impressions can then be die sunk as required .

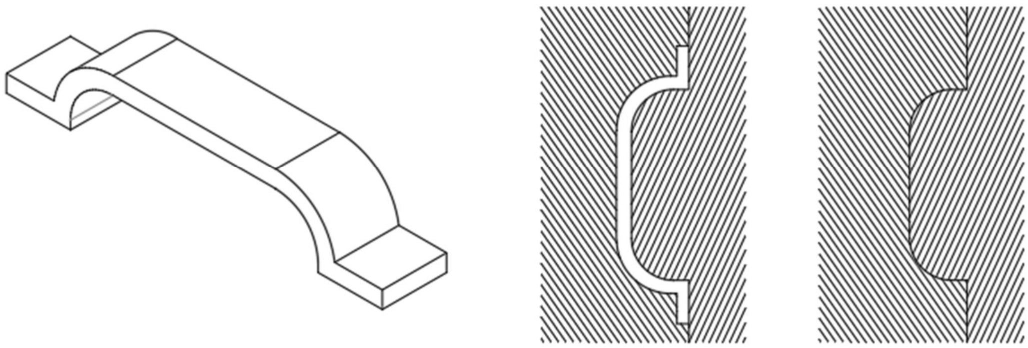
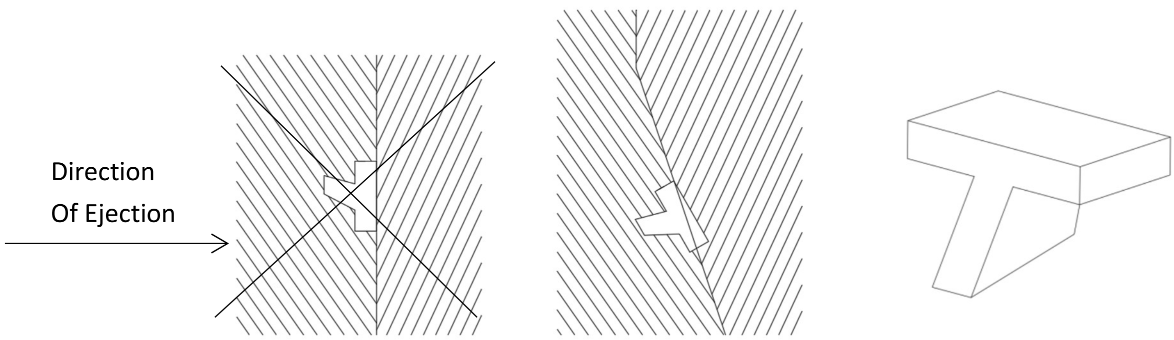


Figure 1.5 Profiled parting surface

Angled parting surface : The designer is frequently confronted with a component which , while fairly regular in form , cannot be ejected from the mould if a flat parting surface is adopted . Figure 1.6 (a) illustrates such a case [the component is shown at(c)] . However , by adopting an angled parting surface (b) all parts of the moulding are in line of draw and it can therefore be ejected .

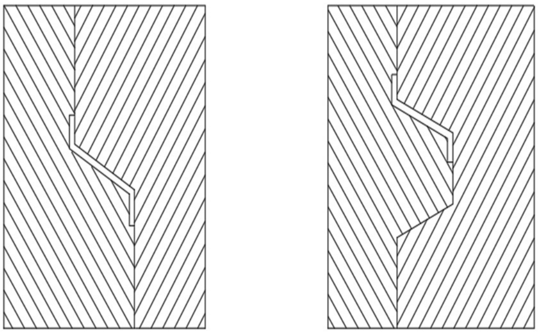


(a) (b) (c)

Figure 1.6 Angled parting surface : (a) impracticable design

(b) practicable design ; (c) moulding

Balancing of mould surfaces : When the parting surface is not flat , there is the question of unbalanced forces to consider in certain instances.This is best illustrated by an example . Figure1.7 shows a mould with a stepped parting surface . The plastic material when under pressure within the impression, will exert a force which will tend to open the mould in the lateral direction(X).If this happens some flashing may occur on the angled face. The movement between the two



ace:

mould halves will be resisted by the guide pillars, but even so, because of the large forces involved, it is desirable to balance the mould by reversing the step[Figure 1.7(b)] so that the parting surface continues across the mould as a mirror image of the section which includes the impression.It is often convenient to specify an even number of impressions when considering this type of mould, as impressions positioned on opposite sides of the mould' s centre-line serve to balance the mould(Plate 3) .

When balancing is not practicable, due to size, then very sturdy guide pillars must be incorporated .

3.Relief of parting surfaces

We have, up to now, assumed that the parting surfaces of the mould are bedded down over the entire surface . However , this is not practicable , for no only would it be extremely expensive , but it would also affect the efficient functioning of the mould .

Consider the effect of injection pressure and locking force with respect to the area of contact between the two surfaces . The injection pressure , that is the pressure exerted by the plastics melt , is theoretically calculated using the basis hydrostatic formula

$$P = \frac{F}{A}$$

Where p=the theoretical injection pressure (N/m^2 or lbf/in^2)

F=the applied force (N or lbf)

A=the area of the injection ram (m^2 or in^2)

The actual pressure exerted within the impression will be considerably less than this theoretical value for the following reasons .

(i) The melt is non-Newtonian.

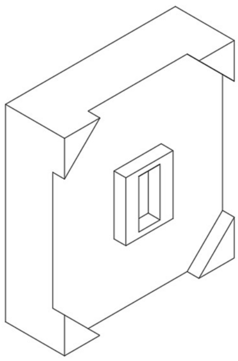
(ii)The viscosity of the melt progressively increases as it passes through the mould due to cooling.

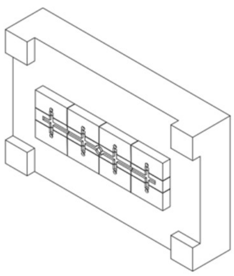
(iii)The actual pressure within the impression depends on the length of the flow path, i. e. sprue, runners , etc.

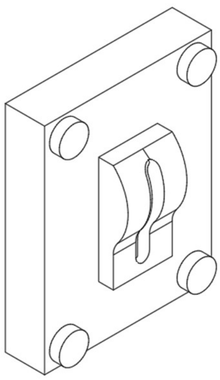
The calculated value for the injection pressure can , therefore , only be used as a guide to the actual pressure within the cavity . In practice , a value for the effective injection pressure of between 25% and 45% of the theoretical is used , depending on the material and on the wall section of the moulding ; i . e. a very fluid material , such as nylon , will transmit a higher pressure than the more viscous melts .

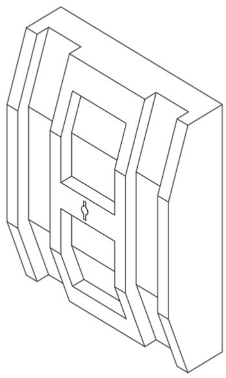
This effective injection pressure is transmitted to the projected area of the impressions , the runners and the gates (the latter being neglected for calculation purposes), and produces a force which tends to open the mould.This tendency to open is resisted by a locking or clamping force . It is generally desirable that the clamping force exceeds the opening force by at least 15% .

Bearing in mind the foregoing , a simple calculation enables the mould designer to calculate the maximum projected area of the impressions and the runner which he can accommodate within the mould . It will be apparent that this calculation depends on the parting surface being perfect for,should flash occur , the force tending to open the mould will be increased since the projected area of the flash must now be taken into consideration . To safeguard against very high opening forces being developed due to flash the parting surface adjacent to the impression and runner is bedded down on a relatively small area . The remainder of the surface in the vicinity is relieved to a depth of at least 2.4 mm ($^{3}/_{32}$ in) .









This small area adjacent to the impression and runner is termed the land. The land width , i . e . the distance between the impression and the relief , is normally made between 5 mm (3/16 in) and 25 mm (1 in) , depending on the shape and complexity of the impression . Note that a small width of land permits venting to be added where required very easily . It is simply a matter of scribing fine grooves across the surface of the land from the impression to the relief area .

Large clamping forces are provided by the machine manufacturers , and it is likely that if small land widths are adopted the effective land area will be insufficient to withstand the applied force and the relatively narrow steel projection will deform . To overcome this possible hazard the land area is increased by ensuring that other areas of the mould face are left proud in places unlikely to by affected by flash, for example at the corners of the mould (Figure 1.8) .

4 .Venting

When plastics material enters an impression air is displaces . Normally the air can escape between the two mating mould plates . However,should the plates have a very fine lapped finish the air may be trapped within the impression so that mould defects , such as discoloration , sinks , incomplete filling , etc ., develop .

It is good design practice to provide vents in the mould to allow air(and other gases when present)to escape freely . It is not usually possible to pre-determine where the vent will be required , so the vent is normally machined into the mould plate once the mould has been tried out .

The vent is normally a shallow slot,not more than 0.05 mm(0.002 in) deep by 3 mm ($^1/_8$ in) wide , machined in the land . If a greater depth is adopted there is the likelihood of plastics material passing through the slot and the resultant undesirable flash mark being left in the moulding .

Position where a vent is likely to required are(i)at the point furthermost from the gate on symmetrical mouldings , (ii)at the point where flow paths are likely to meet and (iii) at the bottom of projections (i . e . blind recesses in cavities) . Now the latter case cannot be vented by the surface vents discussed above . It is necessary in this case to provide a vent through the mould plate . This is most conveniently achieved by incorporating an ejector pin in the required position . The minute gap between the ejector pin and the mould plate hole is sufficient to allow the air to escape .