Design guidelines for high-pressure castings

pedeo Die Casting Zink - Aluminium

Think high-pressure casting

On this sheet are some helpful hints to help you on your way as a designer of high-pressure castings. We nevertheless recommend consulting with the Pedeo casting technicians as early as possible to agree on the best part, both technically, functionally and economically.

1. Wall thicknesses and ejection angles

High-pressure castings are best designed with thin walls. Thinwalled parts cool quicker, producing a finer material structure with fewer porosities.

Thanks to its better liquid properties, Zamak can be cast with smaller wall thicknesses than aluminium.

Partly because of the difference in liquid properties, larger ejection angles (shakeout angles) are recommended for aluminium, and the ejectors for removing the part from the die also have to be larger.

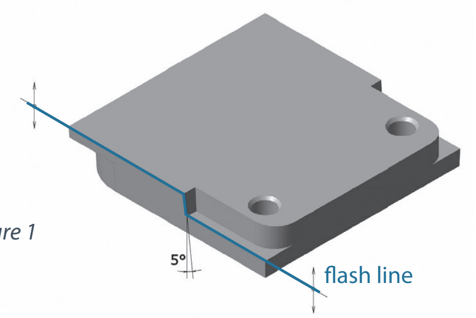

Figure 1

Property \ Alloy	ZAMAK	ALUMINIUM
	EN-ZL410 EN-ZL430	EN AC-46000 EN AC-47100
Minimum wall thickness (mm)	1-1,5	2-2,5
Minimum ejection angle (°)	1-1,5	1,5-2
Minimum diameter of ejector (mm)	2	4

Table 1: recommended wall thicknesses, ejection angles and ejector diameters depending on the chosen alloy

2. Flash line

Always try and design the part so that the flash line between the two halves of the die is as simple as possible, and preferably flat. If the design nevertheless requires a staggered flash line, ensure an angle of at least 5° where the line is staggered (see figure 1 below).

The flash line should ideally be placed on a corner of the casting to avoid part-seams on surfaces of the casting and to make it easier to remove filling channels and overflows.

3. Cores

Cores create cavities and holes in the castings. Cores perpendicular to the flash line are fixed in the die. Lateral cores are moved by slides (see figure 2). These slides increase the cost of the die, but reduce the amount of additional finishing work required on the casting.

Round cores are most common. Their length should be limited to three times their diameter for cores up to ø 5 mm and to five times their diameter for cores from ø 10 mm. For cores perpendicular to the flash line, the minimum ejection angles in the table should be respected. For cores moved by slides, a ejection angle of 0.5° can be used for zamak, and for aluminium 1°

Every casting shrinks when it cools. It is important to prevent the forces exerted by the casting on the die during cooling from having to be absorbed solely by the cores, as this can lead to fatigue failure of the cores. A good design can effectively absorb the shrink load on the cores. This is shown in figure 3 below.

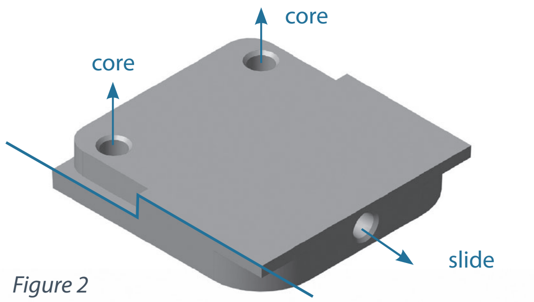

Figure 2

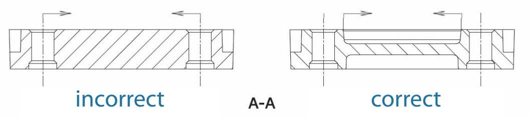

Figure 3

4. Screw thread

Internal screw threads are obtained by additional finishing work. The hole is precast to the desired core diameter with a minimum ejection angle. External screw threads can be cast directly. To prevent burs forming on the mould division in the thread, and also to absorb minor movements in the mould division, the thread is given two flat sides (figure 4). From a functional point of view this is generally not a problem.

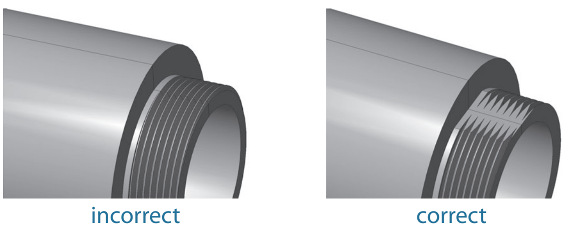

Figure 4

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5. Ejectors

Ejectors must be sufficiently dimensioned to be able to withstand the ejection forces. For aluminium, these forces are greater than for zamak and the required ejector diameter is larger (see table 1). On thin ribs it may be necessary to provide local thickening.

Round ejectors are preferred because of their lower die costs and reliability. However, where this is not functionally possible, square ejectors may be used.

Preferably place ejectors as deep as possible in the die, and make sure that there is always sufficient die steel to guide the ejector: at least 1.5 mm between the die wall and the ejector hole. This will significantly increase the life of the die (figure 5).

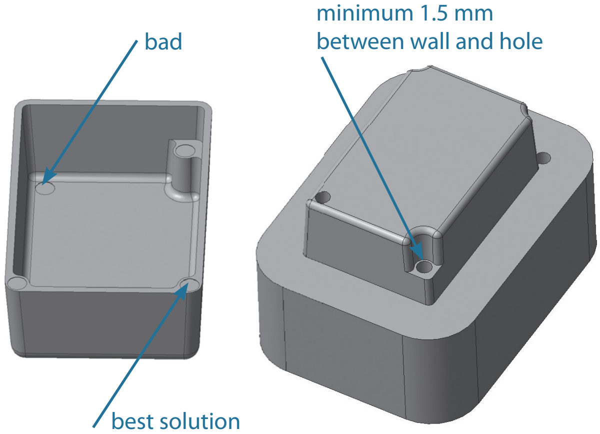

Figure 5

6. Logos, text

High-pressure casting allows extremely fine inscriptions, logos, numbers, etc. to be applied to the casting. These can either be sunk or in relief.

The way the text is applied to the die affects the cost. Figure 6 illustrates the various options in ascending order of cost.

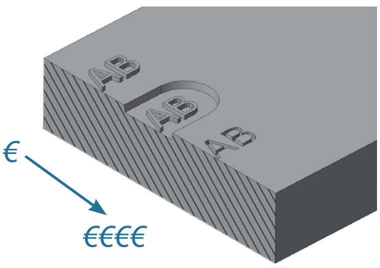

Figure 6

7. Pins - inserts

It is possible to integrate inserts made from other materials. As well as a good join, this also gives other local properties: strength, hardness, durability, heat conduction, etc.

Especially with inserts with a screw thread, certain precautions should be taken so that the screw thread section is not embedded in zamak or aluminium (figure 7).

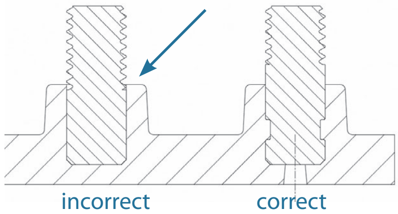

Figure 7

8. Radii of curvature

Because of the cost of the die, the angles on the flash line are best left sharp. Elsewhere, sharp angles should be avoided, as these adversely affect both the life of the die and the filling and strength of the casting.

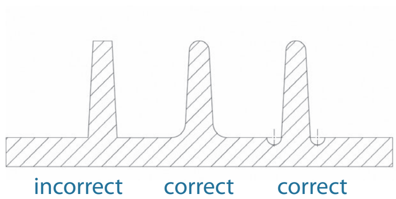

Figure 8

9. Tolerances

The close tolerances of high-pressure cast parts mean that in many cases there is no need for any additional finishing work. A distinction is made between tolerances on mouldaligned dimensions "V" (dimensions entirely in 1 half of the die - figure 9) and non-mould-aligned dimensions "NV" (dimensions that are formed by both halves of the die). The standards used are DIN1687 GTA12 for zamak, and DIN1688 GTA12/5 for aluminium alloys. Table 2 provides an overview of the tolerances on lengths. The complete standards are available on request.

For functional dimensions, closer tolerances can be agreed in consultation with the foundry.

Alloy	mould alignment	Tolerance on length A		
		A≤18	18<A≤30	30<a≤50
Zinc	mould-aligned	±0,09	±0,11	±0,13
	non-mould-aligned	±0,19	±0,21	±0,23
Aluminium	mould-aligned	±0,11	±0,14	±0,16
	non-mould-aligned	±0,21	±0,24	±0,2

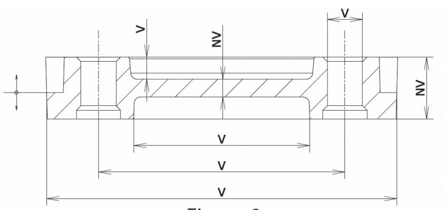

Figure 9

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