PRIMER ON MINIATURE ZINC DIE CASTING

Condensed overview for OEM product designers and engineers on Miniature Zinc & ZA-8 custom die casting for the cost-effective production of small, complex structural components

Chicago White Metal Casting, Inc.

Engineering Bulletin No. 76

Advances in multi-slide, hot-chamber miniature zinc die casting have made it the process of choice for many complex small precision components at part weights of fractions of an ounce up to .75 lbs. (.34 kg), in sizes from minuscule to 4 x 4 x 1 in. (10 x 10 x 2.5 cm).

It offers OEM engineers the benefits of flash-free, net-shape production capable of holding extremely tight tolerances, often with zero draft, at fast cycle speeds– in some cases up to 600 cycles per hour. It can offer design, tooling and production cost advantages over conventional die casting, even when compared with the latter at high-volumes using multiple-cavity dies.

The Specialized Miniature Die Casting Process

This production process and its intricate machinery are specificallly designed for the unique properties of zinc and ZA-8 die casting alloys.

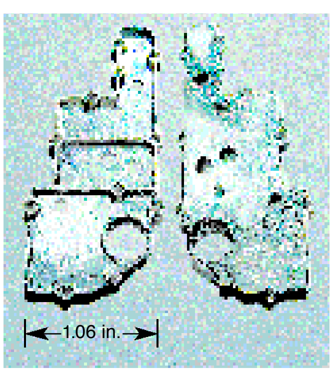
High-speed miniature die casting utilizes hydraulic slide actions which are part of the die casting machine itself, rather than built into each die set as is the case with conventional die cast production for larger parts. These movable machine components are programmed to come together with each cycle to form the complex miniature die cavity that receives the shot of injected metal. Typically, ejector pins first release the solidified part from the cavity, then a short burst of air is used to complete the separation for the next casting cycle.

Components That Qualify

Machines for miniature part production can employ all of the common zinc (ZAMAK) alloys (No. 2, 3, 5, & 7) plus ZA-8. Zn alloys 3 and 5 are the most cost-effective and most commonly used, with No. 5 offering greater strength at the same cost. Since zinc shares similar physical properties with brass, many brass screw machine parts are being converted to miniature zinc at substantial cost savings. Conversions from screw machine parts of steel are not recommended.

ZA-8 (zinc-aluminum) alloy can be specified for greater strength and additional creep resistance. However, this alloy causes greater die wear and involves additional production costs. Zn alloy No. 5 can often meet the designated specifications.

Critical center rib height (front side at left) is held to ±0.001 in. (±0.025 mm) for this net-shape miniature die cast part. It replaced machined brass at a 500% saving.



The process is most cost-efficient for quantities of 10K and over, with lower runs now practical. Cavity modules range from 2 x 2 to 8 x 8 in. (5.1 x 5.1 cm to 20.3 x 20.3 cm). Part designs should fit a square in this size range, including a typical 1-inch (2.5 cm) shut-off margin on the perimeter, and weigh less than .75 lbs. (.34 kg).

Miniature die casting machines use lower injection pressures than conventional equipment, which aids in holding tighter tolerances at higher cycle speeds. However, as-cast hardware finishes, with surfaces suitable for cosmetic mirror-chrome plating and polishing, are difficult to achieve at these lower pressures.

Additional Miniature Part Design Guidelines

Tolerance guidelines are ±0.002 in. (0.051 mm), with ±0.001 in. (±0.025 mm) achievable in specific designs. Diameters for shallow holes are an exception: for such holes created at the intersection of two moving slides, this tighter tolerance is not recommended.

Flatness can be held to 0.0015 in. (0.038 mm), with adequate ejection required. **Wall Thickness** minimums of 0.025 in. (0.635 mm) can be cast, but only in selected areas– and not in areas requiring a good as-cast surface finish. For such surfaces, specify a minimum thickness of 0.040 in. (1.016 mm). Surface finish quality is directly related to wall thickness; the thicker being better.

Fillet & Radii requirements are the same as for conventional die casting. **Draft** of one degree for miniature parts is optimal, with a 1/4 to 1/2 degree readily castable. In specific cases, zero draft can be achieved.

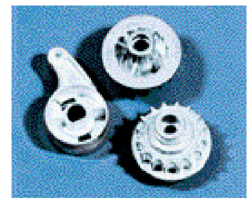
External threads are easily cast; however specifying a flat at the parting line will improve metal flow and reduce tooling costs. **Inserts** cannot be cast into a part.

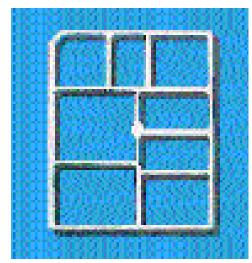
Finishes of virtually any type can be accepted by miniature Zn & ZA-8 parts, with the cautionary note regarding chrome plating, as discussed above.

Careful early review of part designs for the process is critical. All die functions interact with each other in a complex sequence, making any later die changes costly.

Cost and Lead-Time Considerations

Part intricacy is the key determinant of tooling costs, not part size. While no trim tool is required, dies must cast to closer tolerances to eliminate all flash. However, a simple 2 x 2 in. (5.1 x 5.1 cm) tool can be produced for as little as $7,500. Typical tooling lead times are 6 to 10 weeks.





Among the CWM miniature zinc die cast parts shown above are castings measuring a thickness of 0.094 in. (2.388 mm) and weighing less than .75 oz. (21.26 g).

For more design data see the Miniature-Specific Die Casting Design & Specification Standards Manual published by the North American Die Casting Assn. This 12-page manual is available free at CWM's web OEM Resource Center, Reference Manual Sec. Or contact your CWM Regional Sales-Engrg. Representative.

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8318 Printed in U.S.A.