Example 33, Three-Plate Injection Mold with Stripping Device for a Precision Magazine

Integrated circuits (IC) are generally mounted automatically during production of electronic devices. This requires that they be stored in magazines. The magazine shown in Fig. 1 has an undercut U-shaped groove to hold the ICs and a recessed bottom that is reinforced by transverse ribs. Snap fits and mounting holes are located at either end of the magazine.

![Figure 1 Precision magazine to hold 50 integrated circuits](image)

Mold

In the mold (Figs. 2 to 11), the longitudinal axis of the molded part is transverse to the opening direction of the mold. The ribbed bottom faces the runner system. The cavity is filled via two pinpoint gates from a runner system and a heated sprue bushing (16) in a 3-plate design.

Mold Parting Line Operation

After a partial opening stroke of approx. 7 mm, the spring-loaded bolts (69) cause the gate to shear off. The sucker pins (22) hold the runner in the runner plate (5), and the snap fits as well as the mounting holes of the molded part are released by retraction of the slides (33). Mold plates (3) and (4) remain closed during this time.

Parting Line II (mold opening)

Parting line II (between plates 3 and 4) is opened during further opening of the injection mold. This phase of opening is concluded after a distance of 80 mm. During this opening motion, the ejector pin (36) is pushed into the eject position by the lever (29) with the aid of a stripper bolt (38). This lifts the hook-shaped detent on the molded part so that it can subsequently be stripped off the mold core.

Parting Line III

After a further opening stroke of 60 mm, parting line I opens completely through the action of stripper bolt (67). Two further stripper bolts (66) engage mold plate (4), pulling the runner plate (5) forward. The complete runner system is now pulled off the sucker pins (22) and away from the heated sprue bushing (16), dropping out of the mold. The spring-loaded strippers (72) prevent the runner from sticking to the runner plate (5). Shoulder bolts (68) prevent the mold plates from being pulled off the guide pins completely. They do not, however, serve as a mechanical stop. This is found on the molding machine.

Ejection (Stripping) of the Molded Part

During the opening sequence of the mold, the stripping device, which is mounted on the moving half of the mold, has moved into the ejection position. Only in this position will the limit switch initiate operation of the stripping device.

During the inward movement, the guide blocks (56) glide under the guide strips (31), the carefully adjusted latches (54) slide over the transverse stiffening ribs of the molded part and, once the stripping device is fully inserted, engage behind two of these ribs. A limit switch (58) is actuated simultaneously in this position to initiate the stripping operation. The molded part is now stripped off the entire length of the mold core (27), which is 162 mm long, and then drops out of the mold. Once the stripping device has returned to its starting position, limit switch (59) is actuated and another cycle can start if the infrared mold safety has also cleared the start.

The infrared mold safety monitors the lower mold half and checks whether the molded part and stripping device have cleared the tool area. Only when both conditions have been fulfilled are the machine controls able to initiate another molding cycle.
Example 125, Single-Cavity Injection Compression Mold for Thermoset V-Belt Pulley (Injection Transfer Mold)

The pulley (Fig. 1) for a Poly-V belt in a car engine has a diameter of 91.5 mm. It is located via its bore on a shaft and mounted with three bolts. The mold (Fig. 2), which measures 344 mm in diameter and 350 mm in height, is a core-embossing type.

The unique feature of this mold involves actuation of the compression core (1) by the yoke-shaped slide (2) with the aid of hydraulic cylinder (3). Before molding compound is injected, the core is retracted, so that the transfer chamber is considerably larger (Section A-A, bottom). After the metered amount of molding compound is injected, the core is moved to the right, forcing the molding compound into the actual cavity (Section A-A, top). The flange holes are formed without any flow lines.

Flange holes are formed without any flow lines. After the part cures at a mold temperature of about 180°C (356°F), the mold opens. The radially guided splits (7) on the moving mold half are opened by the cam pins (8). The cured gate remnant is pulled out of the sprue bushing (4). After the mold opens, the pulley is pushed off the core by the stripper ring (9); pin (10) ejects any cull remnant.
Figure 2: Single-cavity injection transfer mold for thermoset V-belt pulley


Company illustrations: Hasco Normalien, Lüdenscheid, Germany
Example 127, Single-Cavity Injection Mold for a PE-HD Clothes Hanger Produced via Gas-Assisted Injection Molding

The clothes hanger (Fig. 1) is basically a bent round rod 16 mm in diameter with a hook at one end. An I-beam-shaped cross piece with a wall thickness of 2.2 mm connects the two ends of the rod. Two button-shaped projections for hanging women’s skirts are located on the bottom cross piece.

Molding Sequence

Molding of the clothes hanger begins with injection of a metered amount of resin. The injection pressure required is relatively low, because the mold is filled only partially and the large cross-section of the part does not create any significant resistance to flow. For the same reason, no resin flows into the air gap between the injection pin body (4) and gas injection needle (5). Next, nitrogen gas at a pressure of about 150 bar/2175 psi is introduced into the runner, and from there into the still-molten resin in the cavity, via the gas injection pin. An ever-larger bubble forms in the resin, while the still-molten core advances via fountain flow to the ends of the flow paths leading away from the gate. The result is a part with a tubular cross-section 16 mm in diameter and a wall thickness of 2.5 mm.

Part Release/Ejection

As the mold opens, the two loosely fitted mold inserts (6) release the bottom cross piece of the hanger from the stationary-side mold plate (2) under the action of springs (7). The sprue is pulled out of the sprue bushing and the hollow runner stem is pulled out of the gas injection pin. Once the mold has opened completely, the profiled ejector pins (8) and the runner ejector pins (9, 10) eject the molded part and runner, respectively. After the molded part has been degated, a hole about 3 mm in diameter that was formed by the nitrogen gas remains at the gate.
Example 128, Single-Cavity Injection Mold for a Syringe Shield Produced via Metal Injection Molding (MIM)

The pellets of molding compound used for metal injection molding (MIM) consist of a mixture of metal powder and a thermoplastic resin. The resin component imparts to the molding compound the flow characteristics of a highly filled thermoplastic. This means that injection molding machines can process the molding compound in molds with complex part-forming geometries.

With the MIM process, a plastic resin-containing part ("green part") is obtained from the initial step of injection molding. In a second step, heat and chemical means are employed to remove the resin binder from the injection molded part. The resulting part ("brown part") is then converted into a dense metal part by means of sintering – as in conventional powder metallurgy. In the course of this latter step, volumetric shrinkage occurs, resulting in a linear shrinkage of from 10 to over 15%. The injection molded item (Fig. 1) is the "green part". The finished item is a syringe shield in the metal alloy IMET N 200 comprising 1.5–2.5% Ni and the remainder Fe.

Mold

As Fig. 2 shows, the two mold inserts (1, 2) form the outer surface of the injection molded part, while the cores (3, 5) and slide (7) form the inner surface. The core (3) is actuated by the hydraulic cylinder (4). The end of the core seats and locates itself in the mating core (5), which is actuated by the cam pin (6). The opening in the side of the molded part has rounded edges on the outside, necessitating the use of slide (7), which is actuated by cam pin (9). When the mold is closed, the core (3) is held in place by the side lock (16), while the wedges (8) and (12) lock the core (5) and slide (7) in position.

Gating/Runner System

The part is filled via a large gate at the lower end. Since the risk of jetting is especially high when processing metal injection molding compounds, the gate is placed so that the incoming material impinges directly against the core (5).

Part Release/Ejection

As soon as the mold opens, the core (5) and slide (7) begin to withdraw from the molded part. Next, the core (3) is pulled and the molded part is carefully removed and deposited by means of a part handling device. The runner simply drops and, after being regranulated, is proportioned back into the virgin molding compound. The ball detents (10, 11) secure the core (5) and slide (7) in the retracted position.

Literature

2. F. Petzoldt: Advances in Controlling the Critical Process Steps of MIM. PM World Congress 1994/Paris
Figure 2 Single-cavity injection mold for a syringe shield produced via metal injection molding (MIM).


Company illustrations: Fraunhofer Institute IFAM, Bremen; Aicher, Freilassing, Germany.