

INJECTION MOLD DESIGN AND CONSTRUCTION STANDARDS

This document is intended to be a guide, **not** an absolute specification.

The intent is to design and build a tool that will produce a part as close to specification as possible, require the minimum of correction, and to achieve this goal in a timely and professional manner.

It is Mold 365's responsibility to provide or facilitate all requisite information, specification, clarification, and approval to assure compatibility of its customer's product specification with the mold constructors facilities and the customer's production facilities.

It is the mold designer/builder's responsibility to exercise experience, good judgment, and imagination to design and construct the best possible tool relative to part specifications.

MOLD365 welcomes any and all notification, cautions or suggestions that may be offered by the mold designer/constructor that will result in the correction of, solution of, or improvement to real or anticipated problems relating to part/mold/process issues.

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I. Mold design, communication, shipping and billing

Preliminary Mold Design Drawings displaying major features, general locations and dimensions (plan and elevation views of

mold-base, cavity & core layout, injection, ejection, cooling, etc.) must be submitted to and approved by Mold365 before the design is detailed, steel ordered or construction started.

Final Complete Mold Drawings are due at mold delivery. This documentation shall include and clearly represent all component details, dimensions, wiring diagrams, detailed Bill-of-materials, sources and specifications required to replace any fabricated component, purchased part, or the whole mold consistent with the original.

Bill-of-materials is to contain complete description of all materials that are used in the mold construction:

Material description, use location, key number, drawing location
Component description, number required, supplier, phone number, address.

Steel certification documentation is required for the core and cavity blocks, and for the mold-base if it is fabricated.

The **measurement systems** used shall be consistent with the part-print for part core/cavity details (Metric or English). The English system shall be used for the rest of the mold to assure compatibility with standard components and molding machine specifications, unless specified.

Communications, Changes, and Approvals are to be documented in letter or memo form, and are to reference all applicable descriptive information (Part name, Part number, Revision level, Mold numbers, Job numbers, etc.).

CAD data or Prints supplied by MOLD365 or MOLD365's customer.

Dimensional and feature questions or issues must be resolved before construction in the mold.

Weekly Status Reporting is required illustrating progress-- percent, features, tasks completed, and firm delivery date.

Delays impacting agreed upon delivery date must be communicated immediately with effect on schedule and with best new delivery date.

Molds not conforming to design, construction, or molded part specifications consistent with recommended or agreed upon materials

or workmanship will be returned to the vendor for correction or replacement.

Shipping

MOLD365 is responsible for shipping costs upon mold completion to final location. Vendor is responsible for obtaining and or creating suitable crate and or pallet for shipping. Proper care should be taken to be sure mold arrives in excellent condition

For correction of non-conforming design, materials or workmanship issues, the mold vendor is responsible for freight charges to and from MOLD365 , until the mold/parts are approved.

Packing slips and invoices must note:

MOLD 365's Customer, Part Name, Part Number, Rev-level
MOLD 365's PO Number
MOLD 365's Mold Number

Send invoices to:

MOLD365 llc.
P.O. Box 788
Noblesville, IN 46061

II. GENERAL MOLD CONSIDERATIONS

Press specification: size, platen size, tie-rod spacing, daylight, ejector pattern shall be specified by MOLD365

Locating-ring diameter: 3.990-in., unless specified otherwise.

Sprue-bushing radius: 0.5-in., unless specified otherwise.

Standard, Reversed-ejection or Three-plate mold shall be specified.

Standard-sprue, Hot-sprue, Hot-runner injection shall be specified.

Resin shall be specified.

Resin shrinkage factor specification will be provided by MOLD365. It is understood that the part may not shrink in accordance with the resin suppliers recommendation due to various factors, and that mold adjustment may be required at MOLD365's cost.

Nominal mold tolerances are to be the nominal mean (basic) dimension plus/minus 0.0005-in. (0.013-mm).

Parts employing high shrinkage resin or tight tolerance dimensions require that the mold be constructed to the steel-safe side of tolerance or additional allowance, as specified, for ease of tune modifications.

Mold core and cavity material specification:

Use hardened steel typically for production core and cavity;
pre-hard steel for low production or large parts as applicable.

Use hardened steel or nitride finish when abrasive resins/fillers
are specified, especially for runner-blocks and gate inserts.

Use stainless steel (or nickel finish as specified) for corrosive
resin applications.

Use copper alloy details wherever mold feature cooling is
anticipated to be a problem.

Use toughened steels for details requiring resiliency.
High quality re-melt H-13 steel is to be used especially when the
cavity is to be textured, unless specified otherwise.
Cavity-inserts are to be of the same steel as the cavity to
assure uniformity in texturing.

Core and cavity inserts must be stress-relieved after finishing,
especially if there has been considerable machining, grinding and
polishing.

P-20 or similar steel molds and mold plates subject to machining
stresses, or in excess of 2,000 lb., must be stress relieved after rough
machining.

Steel-to-steel slide interface surfaces should be of dissimilar steel and
have at least a 10-point Rockwell hardness differential.

Slides/cams and other wear prone areas should have easily replaceable
inserted wear-plates of hardened steel or lamina-bronze.

Legibly mark all fabricated mold components to indicate material, grade
and hardness employed. This must be consistent with notations on the
mold drawings and on the bill of materials.

Purchased components are to be standard and readily available from common sources whenever possible. Avoid custom components unless there is an overriding consideration.

Mold A & B plates are typically to be of #2 steel (4130, Rc 28-34) with inserted core and cavity; #3 steel (P-20, Rc 29-36) if core and cavity are to be cut in the solid.

Mold-bases may be standard or custom, as long as materials and features are consistent with requirements and standards.

Mold base, mold plates, and cavity side-walls must be adequately sized to accommodate design, process, reliability and longevity requirements consistent with good mold making practices. Where there is question, use increased size, support, or quality, rather than compromise the application.

Support pillars must be of sufficient size, number, and uniform in placement to adequately support the cavity plate and assure the mold will not warp or deflect under production conditions; especially beneath the runner and the cavity parting-line.

Support pillars are to be pre-loaded 0.001-in. (0.03-mm) higher than the outer rails.

Cavity parting-line perimeter is to have 1 1/2 to 2-in. bearing surface shut-off with the excess surface relieved. This bearing surface must adequately support the press tonnage specified and resist parting-line hobbing or coining.

Core and cavity inserts are to be pre-loaded 0.002-in. (0.05-mm) higher than the overall mold base surface.

Parting-line locks must be provided to prevent shifting of core to cavity alignment where mold details will sustain high side loads, or where critically matched core/cavity parting-lines or details are present: parting-line surface bar-locks, or perimeter-locks installed at four sides are recommended. Do not use cone-locks.

Parting-line vents must be installed to sufficiently allow air/gas to escape at injection, and relief of vacuum at part ejection. Venting is typically to be done on the cavity parting surface.

Cavities are to be vented at the anticipated furthest (last) point(s) to fill, as well as, at corners, and nominal intervals in between.

Vents are to be of depth appropriate for the resin being molded.

Typically, 0.0015-0.0020-in. (0.03-0.05-mm) deep within 0.125-in. (3.18-mm) of cavity parting-line edge, then deepened to 0.030-in. (0.76-mm) to edge of mold.

Through-mold passive vents must encounter unrestricted venting to the atmosphere through drilled holes or machined channels.

Vent blind pockets (buried ribs, studs and features) to assure fill without burning and release, using active vented ejector-pins, or vented lifters, where possible. Use passive steel-line edge vents and channels at inserts or where active venting is not possible.

Mold safety-strap of adequate size for applicable mold size and weight is required to avoid inadvertent mold opening during handling.

The safety-strap is to be painted bright yellow for OSHA compliance.

Pry-slots are required at all plate-to-plate corner split-lines to facilitate die-bar separation of the mold plates.

Threaded lifting-ring (eye-bolt) holes are required on all sides of each mold half, on individual mold plates and on large inserts or slides weighing 20-lb. or more, located with respect to balance point and adequately sized for safe handling.

0-500	lb. wt.	.500-in. thd.	x	1.25-in. deep
500-2,000		.750		1.50
2-4,000		.750		1.50
4-8,000		1.00		1.50
8-12,000		1.00		1.50
12-20,000		1.50		3.00

Plate edges to have 45-degree x 1/16-in. (1.57-mm) or .030 R. chamfer.

Assembled plates and rails are to be doweled and bolted together.

Face-loaded inserts, are to fit a minimum of 3/4-in. (19-mm) deep into pocket; tapered sides, or with minimum of 50% depth from parting-line and remainder of insert relieved. Provide threaded jack-out diameter at

retaining bolt hole through plate or detail if face retained. Chamfer bottom edges of insert.

Logo or model number interchangeable inserts are to be inserted on the face of mold for ease of change-over whenever possible and steel-lines are not objectionable. This must be approved by MOLD365

For **Model number or Revision number on core-pin** or ejector-pin provide retainer screw access through to the back-plate so mold will not have to be torn down to change.

Different insert set-ups, if with ejector-pins, must have dedicated set of pins identified specifically relative to that set-up.

Leader-pins to be headed type, of sufficient size and standard component; 4 per mold (unless Unit-die insert). They must extend beyond any B-half details to insure aligned engagement of details and to provide protective stand-off for details.

Offset one of the four leader-pin bushings to assure proper mold halves orientation. Mark all plates with "O".

Leader-pin bushings are to be installed in through-holes to avoid trapping debris and to allow venting.

- . **Tall or narrow core inserts** where height above parting-line exceeds thickness, and where subject to high side loading from injection pressure and possible shifting, likely yielding uneven part wall-section, are to be constructed in one piece with sufficiently sized heel-flange, and installed from plate rear.

Also, consider for core stabilization, a tapered telescoping interface between any through-hole coring feature and mating surface.

Shut-off typical angle is 5-degree; 3-degree minimum.

- . **Mold clamp-slots** are to be full width of mold.

Ejector-pins are to be nitrided "EX" or through-hardened as required, per DME specs. or equivalent.

Core-pins are to be through-hardened "C" or "CX" per DME specs. or equivalent.

Stripper-rings, ejector-blades, ejector-bars or other such non-standard ejector items are to be nitrided.

Welding, if required, must be done expertly and with the approval of MOLD365.

Should welding be required due to an error in workmanship, MOLD 365 reserves the right to reject that cavity and require a new one be immediately constructed at the vendors expense.

Steels are to be thoroughly pre heated, hot-welded, and post stress-relieved per steel suppliers recommended procedure to assure proper bond to the parent metal and consistent hardness.

No shims are to be used in mold construction.

In **final assembly**, use FISKE BROS. REFINING, LUBRIPLATE FML-2 or equivalent grease on moving details that contact the molding surface and where there is a chance grease may migrate to the molding surface.

Mold shipment preparation must be completed with suitable surface protectant, adequate environment protection, and blocked and strapped to a pallet for shipment. All orifices are to be plugged or taped over to avoid moisture and debris entry.

III. FINISH CONSIDERATIONS

Cavity and core finish are to be per specification.

Unless noted, cavity finish is to be SPI #A3 (#15 micron range diamond buff); core finish #B3 (320-grit paper).

All cutter-marks and EDM-finish are to be removed from molding surfaces.

Draw-polish all vertical or near-vertical molding surfaces to an SPI #A3 finish; especially “buried “ ribs and bosses.

Engraving to be per specification, on surface or on insert.

Revision level alpha-numeric designations are to be engraved on changeable core-pin or ejector-pin when possible.

Individual cavity identification is required in multiple-cavity molds typically on the core-side where specified.

Surface texture is to be per specification.

Textured side-walls must have 1-degree of draft in addition to 1-degree of draft for every 0.001-in. (0.025-mm) of texture depth.

Should this not be accommodated in the part design, please confirm to the Tool Engineer for review with the customer.

Molds specified to include texture or engraving must be sampled and dimensionally approved and/or corrected prior to completion, unless subject to prior agreement. An additional 2 to 3-weeks should be figured into the schedule to cover this interval, after mold is dimensional approved.

IV. INJECTION CONSIDERATIONS

Size sprue, runner, and gate per resin suppliers minimum recommendations for acceptable fill pressure, rate, and shear.

Sprue, runner and gate are to be smooth, uniform and free of cutter-marks, edges or abrupt linear transitions.

Sprue to have **sprue-puller** detail; typically reverse taper, however, undercut-ring, and Z-puller styles also are acceptable. Do not use Z-puller if mold can run automatic.

Keep **sprue length** as short as practical.

Sprue-bushings are to be keyed and retained in place with two screws.

Employ **balanced runner designs** with a minimum of sharp corner turns, arranged so equal flow reaches cavities simultaneously, and sized appropriately for the cavity volume; unless computer flow analysis is utilized.

Preferred runner shape is full-round; alternative is trapezoidal with 10-degree taper for stripper or three-plate applications.

Runners are to have a **cold-well** at each 90-degree runner-leg change in direction, two times the runner diameter in length.

Provide **ejector-pins** at intersection of runner-legs and close enough to gates to assure smooth ejection.

Vent runners at each cold-well and on each ejector-pin.

Install **runner block-off** details in dissimilar part family molds, or make allowance for indexing sprue-bushing.

Provide sufficiently deep **sub-gate ejector-pin stool** to insure uniform ejection of gate.

Hot sprue-bushing connector to be single-zone power/thermocouple: CKPTIC-1.

Hot internal-nozzle in a reversed mold must be serviceable from A-clamp-plate without having to disassemble mold.

Insure adequate support around internal-nozzle, and provide a drool-sleeve.

Recessed sprue-bushing clearance bore must be minimum 2.5-in. (63.5-mm) diameter, plus taper for ease of resin drool removal.

Hot-runner molds must have generous **wire-raceway** in plates with wire-retainors or covers to accommodate wiring without binding or damage, and to allow removal of hot-runner components without having to remove all wiring and connectors.

Heater accessories are to be standard stock items when possible: 220/240-volt.

Electrical splices are to be insulated with high-temperature electrical tape and in compliance with electrical codes.

Hot-runner multiple-zone power connectors are to be: 5-zone DME PIC-5G or 12-zone DME PIC-12-G.

Hot-runner multiple-zone thermocouple connectors are to be: 5-zone DME MTC-5-G or 12-zone DME MTC-12-G.

Do not splice thermocouple leads.

Adequately **support hot-runner manifold** opposite the nozzle seat.

Employ **sufficient bolt clamping of hot-runner** system to avoid system leakage.

Hot-runner manifold is to be installed so as to minimize heat transfer to the adjacent cooled plates.

Insulation-board is to be employed to form a thermal barrier between the mold clamp-plates and the platens when molds are to be heated, or mold is hot-runner type.

Electrical components must be listed on Mold Drawing Bill-of-materials: make, model, size, voltage, wattage, etc.

Valve-gate hydraulic ports (Mold-Masters, etc.) must be appropriately identified: Gate-open & Gate-closed.

V. EJECTION CONSIDERATIONS

Ejection features must be adequate to assure balanced, uniform, undistorted ejection of parts and features. Mold release spray use is not a reasonable option. Use too many rather than too few ejection details.

Ejection systems must be guided on a minimum of four guide-pins and bushings.

Return-pins and return-springs are required. Spring loading of the ejector-plate is to be balanced and sufficient to preclude “cocking” the plate.

Return pins are to be located so as not to interfere with efficient part removal by an operator.

Place **ejector-plate rest-buttons** behind return-pin locations, lifters and other large surface ejector details, and additional uniformly distributed locations to support the ejector plate.

Use **blade-ejectors** only where there is not a reasonable alternative.

Ejector travel must be sufficient to clear part and runner of all features.

Employ **two-stage ejection or accelerated ejection** if required to assure release from details, slides, lifters, and processing efficiency.

Press Ejector-pattern is to be per designated press layout.

Ejector-pins, ejector-sleeves, etc. are to be standard DME or equivalent quality--Metric or English.

Minimum ejector-pin diameter to be 1/16-in. (1.5-mm).

Minimum ejector-pin bearing surface is to be 5/8-in. (16-mm) up to 7/16-in. (11-mm) diameter pin; pins over 7/16-in. (11-mm) diameter must have a bearing surface equal to 1.5 times the pin diameter.

Ejector-pins are typically to be flush to 0.005-in. (.13-mm) above surface (into part).

Contoured-end ejector-pins must be keyed for proper orientation.

Ejector pin-plate must be marked with respective ejector-pin marked designation number.

Boss details must have sleeve-ejection or balanced adjacent ejector-pins for straight ejection.

Lifter tops are to be at least 0.005-in. (0.13-mm) short of the molding surface to provide a bearing surface, so the lifter does not catch on the adjacent lifter parting-line molded edge, when in action. Lifter tops are to be polished: SPI #B1.

Lifters must release cleanly. If there is a chance that parts may hang-up or be retained in lifter detail, parts must be guided by part feature or by imbedded ejector-pins to assure aligned parting. This may require secondary or accelerated ejection features to insure release from the imbedded pins.

Moving actions are to be mechanical if practical. Pay attention to functional fit tolerances, mold operating temperature and action timing for smooth operation.

Slide/cam travel must clear part by at least 0.062-in. (1.5-mm).

Slide/cam must be retained so it will not inadvertently leave the mold.

Slide/cam must be spring loaded in the open-position to avoid damage should slides be left in the in-position. Do not use spring-ball detent (Vlier) for this application.

Slide/cam spring and spring-guides should be kept internal, if possible; if not, provide protection bracket.

Employ internal **double wedge-locks** for parting-line slide/cam positive engagement. These are to be face mounted to the A-side whenever possible for ease of adjustment.

Slide/cam should have inserted **wear-plates and gibs** of hardened steel or lamina-bronze.

Steel-to-steel slide interface surfaces should have at least a 10-point Rockwell hardness differential.

Provide **cross-hatch grease-grooves** on slide/cam bottoms for grease retention and micro-trash well.

Hydraulic cylinders to be rated to 2000-psi.

Hydraulic fittings are to be NPT, unless otherwise specified. Hydraulic cylinders are to be equipped with **valved quick-connect fittings**: Parker 6601-66 steel female coupling.

Equip hydraulic side actions with **limit-switches** to signal IN and OUT positions.

Action sequence must be stamped on mold and switch schematic detailed on mold prints.

Avoid ejector-pins under hydraulic side-actions.

If there is any possibility of actuated features contacting ejector features or opposite mold half features prior to positive return of the ejector system, a mechanical **positive-early-ejector-return** mechanism must be installed (DME Toggle-lock or Early-return return-pins).

This will avoid closing the mold with features forward, as well as, avoid opening the mold with features stuck forward in the molding position, overcoming the return springs.

Critical or delicate situations such as these also require the back-up safety feature of installed limit switches.

Prominently mark the mold to warn that damage will occur if inappropriately activated.

Externally projecting actions or features must have protective bracket or steel rounds attached to the mold-base for stand-off protection and safety when in operation or in handling. If there is an action projecting

from the bottom of the mold, legs or a protective bracket must be in place to allow the mold to sit level on the floor.

“Buried” ribs or details on the non-ejector side of the mold, must be evaluated for the need of ejector mechanism, and/or ejector/vent-pins to assure fill, ejection, and relief of trapped gas.

Lifters and details that telescope into the opposite side of the mold are to have venting features where practical to assure fill, and relief of trapped gas and vacuum.

Reversed molds must have hydraulic ejection actuation. Hooks and chains are not acceptable.

Ejector-plate positive actuation (press pull-back) accommodation when specified is to be 1/2-13 tapered PKO-extensions flush with back plate.

VI. COOLING CONSIDERATIONS

Layout water-lines for maximum temperature control and even distribution. Pay particular attention to heavy wall-sections and boss details.

Use **Copper alloy material** for improved heat transfer wherever mold feature cooling is an anticipated problem.

Preferred water-line sizes depending on mold size are 11/32-in., 7/16-in., 9/16-in. diameter.

Place water-lines in core/cavity inserts with clearance through the mold base; or, directly in plates, if in the solid; and, in large slide/cam details.

Avoid O-ring seals, if at all possible.

Water-line INs and OUTs must be stamped on mold and detailed on mold drawings.

Water-lines, typically, are to be no closer than:

- * 5/8-in. (15.8-mm) for 9/16-in. diameter, or 1/2-in. (12.7-mm) for 7/16-in. diameter to any cavity/core molding surface

- * 3/8-in. (9.5-mm) to an insert detail, lifter, or side action molding surface

- * 1/4-in. (6.3-mm) to an ejector-pin or core-pin.

* 1 3/16-in. (30-mm) center/center.

Pay attention to deep drilled **water-line run-out**.

Use only **brass pipe-plugs**.

Use only **brass baffle-plugs and baffles** (1/16-in. stock). Do not use plastic or light-weight brass baffle stock.

Molds are to be supplied with recessed **quick-connect fittings**: DME Jiffy-tite 3/8-in.-ID male (JP-352, 353, 354), or equivalent.

Fittings are to be recessed in 1 1/8-in. (28.5-mm) diameter clearance counter-bores with 1/16-in. (1.6-mm) 45-degree chamfered edge.

Nipples and fittings should only protrude where there is no reasonable alternative. If they do, they should be protected from damage by a stand-off or bracket.

Nipples and fittings are not to interfere with clamp slots, side actions, other mold features, or molded part removal by an operator.

Plugs and fittings must be sealed, tight, non-leaking--pressure test to at least 200-psi for 15-min. Use Teflon tape or Teflon sealant.

Cascade-fountains may be used where through water-lines are not practical.

If water lines are to be located on the top of the mold, a **drain-channel** must be provided connecting recessed-fitting holes and the mold edge, to assure water will not run into cavity should there be a loose fitting.

VII. MARKING CONSIDERATIONS

Stamp on outside of mold in minimum 3/8-in. (9.5-mm) high letters:

- a. Mold Number
- b. Owner: "PROPERTY OF"
- d. Part Name, Part Number
- e. Owner Mold or Asset Number, if specified.
- f. Vendor Name and Address
- g. Vendor Job Number
- h. Mold weight
- i. Shrink factor utilized

- j. Ejection stroke
- k. Water-line INs and OUTs, and Circuit Numbers.
- l. Side-action sequence, if applicable.

- * If Hot-runner, or Hot-bushing:
- m. Make and Model of system components
- n. Zone, heater size, voltage/wattage

This information should also appear on the final mold prints delivered with the mold.

Mark multiple cavities with cavity-number where specified.

Mark alternative configuration set-up inserts alphabetically or as specified.

Mark cavity and core inserts, ejector-pins, slides, lifters, etc. and corresponding pocket, holes, etc., alpha-numerically to assure proper assembly location.

Inserts and pockets shall have matched markings across edges, or where practical, to assure proper orientation: >/< or -/-.

Mark -0- corner for mold dimensional orientation on all plates.

Material grade and hardness must be marked on all mold plates, cores, cavities, details, slides, cams, lifters, etc..

Valve-gate hydraulic ports (Mold-Masters, etc.) must be appropriately identified: Gate-open & Gate-closed.