Thermoplastic Mold Specification

Global Common

SD-1014

ISSUED November 30, 1995
REVISED January 19, 2021

Table of Contents

1. Scope

This specification outlines general requirements for the design and build of production injection molds. This specification is used in conjunction with a T-series Specification for the specific project. Any deviation from this specification must be approved by the Nexteer Plastics Engineer.

2. Injection Mold General Design

Mold designs must comply with Thermoplastic Mold Specification (SD-1014) and specific written instructions by the Nexteer Plastics Engineer. This specification is not intended to replace Nexteer Automotive's General Drawing and Manuals Specification (SD-003), but rather highlight minimum design requirements specific to injection molds. Nexteer Automotive's Preferred Components List (SD-007) contains preferred vendors for standard components.

NOTE: For the latest revision of these documents, please reference the Nexteer Data Exchange at www.nexteerdataexchange.com.

2.1 Assembly Drawings

2.1.1 Tie Bar Layout and Clamp Hole Layout shall be included on plan view.

2.1.2 Plan views of mold parting line surface (both cavity and ejector half).

2.1.3 Total stack-up height in addition to sectioned side and end views.

2.1.4 Shrink rate and Nexteer plastic product code shall be included on Sheet # 1.

2.1.5 Part number(s), revision level(s), and drawing date(s) of the product drawing to be included on Sheet # 1.

2.1.6 Slide areas and hydraulic core-outs require sectioned views

2.1.7 Total mold weight shall be included on Sheet # 1.

2.2 Mold Base Drawings

2.2.1 Dimensional information for mold base plates may be shown on assembly drawings.

2.2.2 Purchasing information to be shown on parts list and main assembly drawing for replacement or repair.

2.2.3 Detailed drawings of ejector and ejector retaining plates may be required. If required, drawing shall show the DME stop pins and the overall height as shown in Attachment #5.

2.3 Cavity and Core Sub-Assembly Drawings

2.3.1 A separate sub-assembly drawing is required, unless otherwise specified in the T-series Specification.

2.4 Detail Drawings (Optional – per the Nexteer Plastics Engineer)

2.4.1 Individual details (i.e. cavity, core, inserts, slides, etc.) may be adequately dimensioned so that they can be built separately to facilitate replacement or repair.

2.4.2 Details where cavity surfaces have been produced from CAD data, the part number, revision level and vendor's name need to be shown on detailed drawings.

2.4.3 Shut-off areas and related dimensions may be identified to facilitate fit stock requirements on spare tooling. Preferred symbol is "s". However, the symbol needs to be defined at the bottom of each sheet.

2.4.4 Compensated dimension (non-standard shrink rate) must be designated as such. Preferred symbol is "c". However, the symbol needs to be defined at the bottom of each sheet.

2.4.5 A Tolerance Specification (shown in Attachment #8) shall be used on cavity detail drawings (details that form the part).

2.5 Standard Mold Components

2.5.1 Standard purchased components, which are altered only for height, do not require a detailed drawing. Mold plates altered may require a detailed drawing.

2.5.2 Height of standard components should be clearly shown on assembly drawings. Length should be specified along the balloon leader line and on the stock list.

2.6 Electrical and Hydraulic Drawings

2.6.1 Mold design shall include electrical and hydraulic schematic drawings for proper mold operation.

2.6.2 Fittings and plugs shall be shown in proper positions.

2.7 Cooling Drawings

2.7.1 Mold design shall include an isometric water-flow schematic for both halves of the mold. Preferably, the schematic will be shown on the plan view assembly drawings.

2.8 Hot Tip Manifold Drawings, (should include the following):

2.8.1 Section view showing purchased components, (components to be listed on parts list also).

2.8.2 Heater layout / wiring diagram including zone identifications.

2.9 Mold Drawings (for submission to Nexteer Reprographics)

2.9.1 2D AutoCAD drawings of the files shall be submitted to Reprographics per the ME FOLDER PROCESSING GUIDE. This can be found on the Nexteer Supplier Portal at www.nexteerdataexchange.com under the VENDOR DOCUMENTS tab, under ME FOLDERS / CAD DRAWINGS ONLINE tab.

2.9.2 Whenever CAD files are utilized, particularly in mold rework situations, the original CAD data is considered the master. Care must be used insuring CAD data files are updated to the latest revision level shown on original drawings.

3. Mold Base Requirements

3.1 Mold Base Size

3.1.1 Utilize the recommended mold base width for the molding machine specified. See recommended mold base width of molding machines listed in Attachment #1.

3.1.2 Mold base length should not exceed the platen length (Dimension "C" + "D") as listed in Attachment #1.

3.2 Mold Base Material

3.2.1 Mold bases and standard components shall be designed using DME products or interchangeable equivalent, approved by the Nexteer Plastics Engineer.

3.2.2 Use DME standard "A" series mold bases with No. 2 steel (AISI 4130 steel pre-hardened to 300 Brinell).

3.2.3 The mold base "A" and "B" plates, including cavity pockets, may be coated with electroless nickel or black oxide.

3.3 Safety Hoist

3.3.1 Molds shall be designed to be installed from the top of a horizontal molding machine using OSHA approved safety hoist rings.

3.3.2 Molds shall be designed, installed, and delivered to Nexteer with a minimum of (1) Machined Type Swivel Safety Hoist Rings, but preferably (2).

3.3.3 All holes used for lifting or moving shall be drilled and tapped no less than 2 times the diameter of the safety hoist thread used for that location.

3.3.4 Molds weighing less than 500 lbs. shall have four 5/8" – 11 UNC tapped holes. One hole centered on top of the "A", "B", support plates and the Ejector Housing.

3.3.5 Molds weighing between 500 lbs. and 1000 lbs. shall have eight ¾" – 10 UNC tapped holes. One hole centered on top and bottom of the "A", "B", support plates and the Ejector Housing.

3.3.6 Molds weighing between 1000 lbs. and 6000 lbs. shall have eight 1" – 8 UNC tapped holes. One hole centered on top and bottom of the "A", "B", support plates and the Ejector Housing.

3.3.7 No molds shall be over 6000 lbs. unless written permission is obtained from the Nexteer Plastics Engineer.

3.3.8 Mold plates weighing over 200 lbs. shall have ½" – 13 UNC tapped hole on each side. (Four per plate).

3.3.9 Molds shall have a self-storing safety strap, on the operator's side.

3.3.10 Mold is to be balanced & hang level within 2 degrees when connected to overhead crane via one or two eyebolts.

3.3.11 Under NO circumstances should any limit switches, hydraulic cylinders, photo eyes, etc. be required to be removed to install the mold into the injection molding machine.

3.4 Sprue Bushing and Locating Ring

3.4.1 Sprue bushing to have 7/32" orifice and 7/8" spherical radius.

3.4.2 Clamp type locating ring with a 30 deg. lead-in angle to retain sprue bushing is required (i.e., DME Cat. 6524).

3.5 Mold Identification

3.5.1 The following information is to be stamped in ½" high letters on the top and operator's side of mold:

- Part Number, Tool Number, Cavity Number, and Total Mold Weight in Lbs.

3.5.2 The cooling lines shall be labeled "In" and "Out" next to the appropriate holes (one in and out per mold half).

3.5.3 When hoses are used to transfer coolant to different positions in the mold (i.e. slides) each "IN" and "OUT" shall be stamped in numerical sequence (i.e. 1-1, 2-2, 3-3, etc. …).

3.5.4 A supplied brass tag(s) (supplied by Nexteer Automotive) shall be attached within a machined pocket on the operator's side of the mold. See Attachment #3 for sketch of required pocket.

3.5.5 Molds with hot manifolds shall have additional brass or plastic tags identifying the zone wiring attached to the operator's side of the mold.

3.5.6 Molds with hydraulic cylinders shall have additional brass or plastic tags attached to the operator's side of the mold. The sequence of events is to be outlined on the tags (i.e. close mold, set core, pull core, open mold).

4. Hydraulic Cylinders

4.1 No pneumatic cylinders shall be utilized.

4.2 Limit switches or proximity switches must be installed to check both positions (open and closed) of each slide. When more than one slide is used, the switches checking the closed position shall be wired in series, and the switches checking the open position shall be wired in series.

4.3 Hydraulic cylinders mounted on stationary half of mold shall utilize a 4-prong plug (Hubbell Plug #2751). Hydraulic cylinders mounted on moving half of mold shall utilize a 2-prong plug (Hubbell Plug # 7102-C).

4.4 Limit switches shall be wired with #18/3 Koiled Wire 4ft. length (can use straight wire also – per the Nexteer Plastic Engineer's approval).

4.5 Mechanical interlock shall be utilized preventing damage to slide(s), ejector pin(s), or cavity surface(s). If not possible, electrical limit switch shall be required. (Cutler Hammer E-50 Series with 5 deg. pretravel).

4.6 Hydraulic cylinder to be installed using ½" steel Parker Hannifin Quick Disconnectors.

4.7 Cylinder pulls on the mold to be installed with female coupler. Cylinder set on the mold to be installed with male nipple.

4.8 Hydraulic hose length (5' min.).

5. Preferred Components List

5.1 Hydraulic Cylinders

5.1.1 >1 ½" Bore – Milwaukee and </= 1 ½" Bore – Tom Thumb

5.2 Quick Disconnectors

5.2.1 Cooling Water – Parker Hannifin BH4-61 (Brass)

5.2.2 Hydraulic Oil – Female coupler (Parker Hannifin H4-62) and Male Nipple (Parker Hannifin H4-63).

5.3 Hose Fittings – Parker Hannifin, or DME Jiffy type

5.4 Hydraulic Motors – Char-Lynn

5.5 Electrical Limit Switches – Cutler-Hammer E-50 series

5.6 Standard mold components (i.e. ej. Pins, core pins, slide retainers, etc) – DME

5.7 A complete list of preferred components can be reviewed in Nexteer's Preferred Components List (SD-007).

6. Cooling Lines

6.1 No cooling line shall be closer than 1/8" to an ejector pin hole.

6.2 No cooling line shall be closer than 3/8" to a cavity wall or edge of a detail.

6.3 Utilize Parker standards for O-ring and O-ring pocket dimensions.

6.4 Only Viton O-rings are to be utilized.

7. Hydraulic Ejection

7.1 All molds must have a minimum of four (4) replaceable knock-out blocks installed on the ejector plate. Reference Attachment #2 for suggested knock-out block design.

7.2 The appropriate knock-out pattern will be specified of the specific mold specification (T-series spec.) The knock-out pattern will be reviewed and optimized at the design review.

8. Cavity Engraving

8.1 Each cavity must have the following information engraved, entire part number or last four digits when part space is limited, cavity number, and SAE recycling code.

8.2 The runner must have the Nexteer Automotive material code (Purchase Specification) engraved on it (supplied by the Nexteer Plastics Engineer).

8.3 A replaceable core pin with the part revision level may be required.

9. Project Timing

9.1 The mold vendor shall submit to the Nexteer Plastics Engineer a written progress report on a weekly basis. Pictures may be required to illustrate progress.

9.2 The progress report should include the following information:

9.2.1 Expected start and finish date for each major phase of the project (design, mold base order, cavity sub-assembly build, tryout, and ship.)

9.2.2 Actual start and finish date for each major phase.

9.2.3 The cavity sub-assembly build phase should be divided into the following categories:

- Mill & Lathe
- Grind
- EDM
- Heat Treat
- Assembly & Bench

9.2.4 An estimate of percent complete in each category shall be included with written progress report.

9.2.5 Included is a sample project timeline Attachment #6. This timeline is maintained on Microsoft Project software. If necessary, the specific project timing can be manually updated on this sheet. The Nexteer Plastics Engineer will then maintain the computerized timeline.

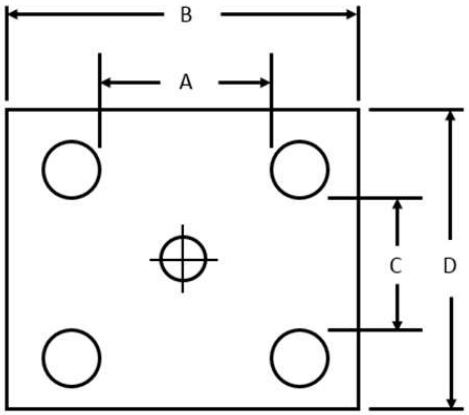
10. Mold Checklist

10.1 To facilitate communication the Nexteer Plastics Engineer will utilize the Mold Review Checklist Attachment #4 at the following milestones:

- Design Review
- Supplier Run-Off
- Plant Review

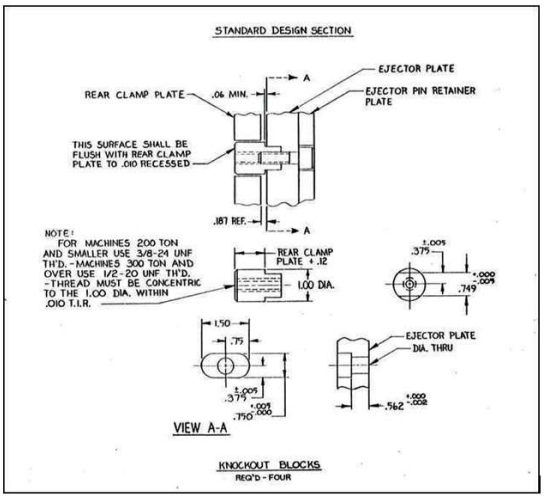
11. Attachments

- Tie Bar and Platen Height
- Knock-Out Block Design
- Mold Tag Pocket Design
- Mold Design Review Checklist
- Detailed Drawing of Ejector and Ejector Retaining Plates
- Sample Mold Timeline
- Sample Miscellaneous Tool Design Specifics
- Tolerance Specification for Cavity Detail Drawings
- Core Pull Electrical Plug Schematic #1
- Core Pull Electrical Plug Schematic #2

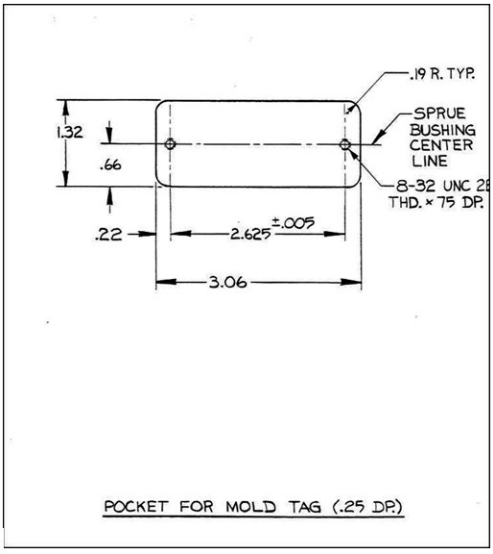


MACHINE	A	B	C	D	# OF MACHINES
150 TON HPM	18.00	26.24	16.00	24.24	12
165 TON ROBOSHOT	22.00	29.50	20.10	31.50	10
200 TON NEW BRITAIN	21.00	31.00	18.24	28.76	24
330 TON ROBOSHOT	28.00	40.50	25.00	37.80	4
500 TON VAN DORN	32.50	47.00	32.50	47.00	6
500 TON NEW BRITAIN	30.00	45.00	28.00	45.00	3
500 TON HPM	32.50	49.00	32.50	45.00	3

Attachment 1: Tie Bar and Platen Height



Attachment 2: Knock-Out Block Design



Attachment 3: Mold Tag Pocket Design

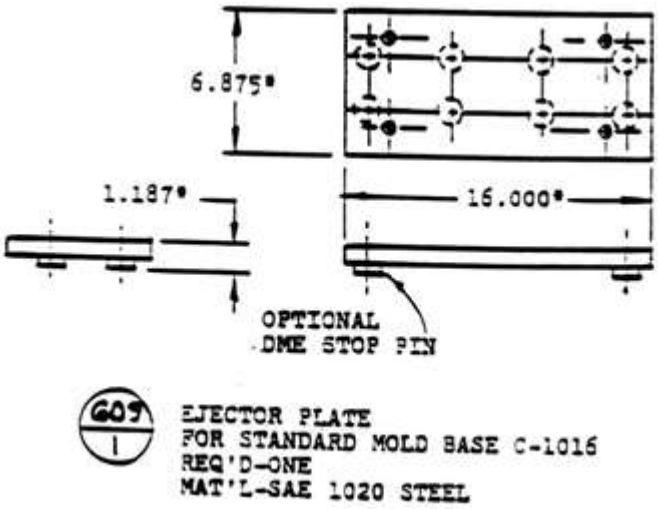
Plastics Engineering Mold Design Review Checklist (Rev 2016-02-02)

PART No._____ SPEC No._____
TOOL No._____ MOLD No._____

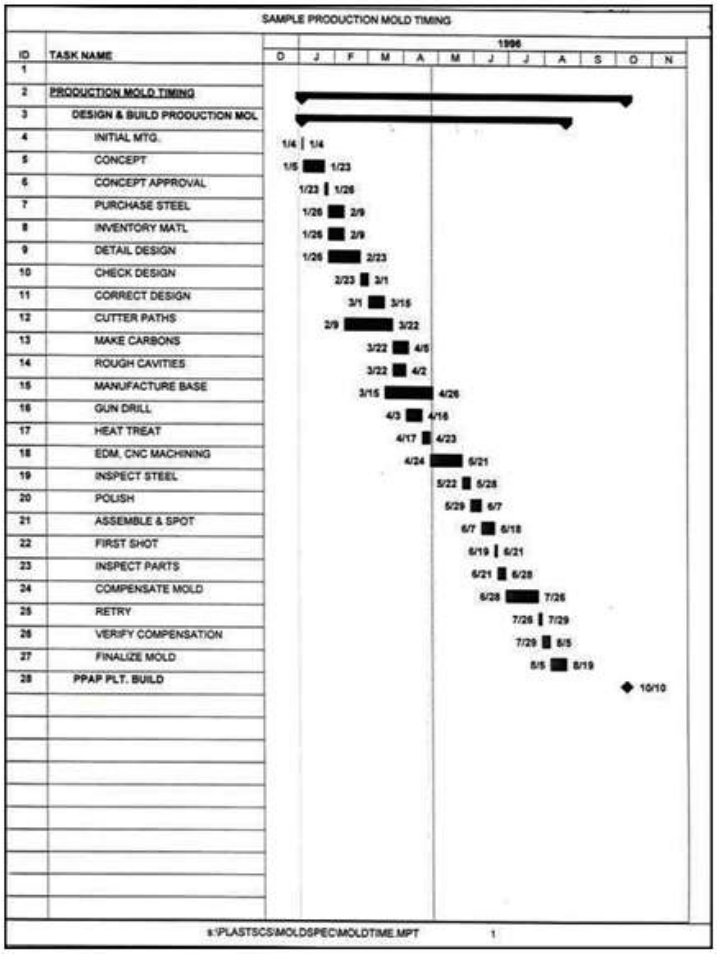
	Design Review	Supplier Runoff	Plant 8 Review
Date Completed:			
Design			
I. Assembly Drawings			
- Total Stack-up Height			
- Shrink Rate (Compensated Dim's Identified)			
- Part Number, Rev. Date, Drawing Date, Total Mold Weight			
- Machine Tie Bars & Clamp Hole Pattern			
- Cavity / Core Sub-Ass'y			
- Plan Views (Both Cavity and Core)			
- Section Views (slide areas and shut-offs)			
II. Standards Components			
- Mold base plates (detail ejt pins, insert screws, pockets, etc)			
- Height of Std Components Listed			
- Detailed Drawings of Modified Components			
III. CAD Files			
- Revision level of CAD surface stated on drawings			
- Mold design on CD			
IV. Misc Drawings			
- Hot Manifold Design			
- Cooling Water Schematics			
- Electrical and Hydraulic Schematics			
Mechanical			
I. Handling			
- Sufficient eyebolt holes for plates & details weighing > 50lbs.			
- Add handling holes for eyehooks on large slides as needed			
- Mold weight (lbs) stamped in 1/2" high letters on top of mold (near operator side towards stationary platten)			
- (2) Swivel type safety hoists installed on top of mold.			
- Balance with (2) swivel type safety hoists			
- Provide safety strap on operator side (minimum 1/2" diameter bolt size)			
- Pry bar slots			
II. Mold/Machine Interface			
- Sprue bushings: 7/8 in. spherical radius, 7/32 in. dia. orifice			
- New tapered lead in design (ref TL-298661)			
- Retained by locating ring (radially locked if required)			
- Verify sufficient daylight			
- Min mold thickness for 150/200 Ton presses is 14" or a spacer plate has to be used. Prefer to add additional height to ejector half as some presses don't have long enough nozzle extensions (or split difference on both halves).			
- Waterlines: clear tiebars, platens, and each other			
- Provide min 1/8 in. clearance with cored holes, etc.			
- Proper location of baffles and plugs			
- **Parker Push-Lok 836 High Temperature Hose (Blue)**			
- Main in's & out's (both **Parker BH4-61** male fittings)			
- Specify appropriate steels and heat treat for various details			
- Identify all repair welded details			
- Sufficient Clamp Hole Distance			
- Mold can easily be loaded in machine			
III. Mold Operation			
- Leader pins: engage bushings first, one offset, grease grooves			
- Leader bushings: provide clearance holes behind bushings			
- Slides: to be held in detented open position			
- Wear surfaces to have grease grooves			
- Wear surfaces to have wear plates (steel/bronze per Eng)			
- For slide keepers, place them under wear plates if possible to prevent them from damaging slides if retaining bolt fails			
IV. Cavities			
- Gating: proper location, size, function, flow and polished			
- Make sure to add extra clearance around sucker pins so flow is not "choked" off			
- Verify insert surface finish (no tool marks)			
- Check for burrs/nicks on parting line, ejector sleeves, etc.			
- Venting: check parting line and areas of burn			
- Relieve 75% of bottom of insert			
- Provide method to remove inserts (i.e. jack screws)			
- Radii (0.030" min) to reduce stress (where possible)			

V. Ejection			
- Pin location: flush with surface, no nicks/burrs, keyed if req'd			
- Ejector stud size (1/2 in. x 20 UNF) and flush w/clamp plate			
- Sufficient # of bolts to prevent plate separation			
- Return pins present and longer than ejector pins			
- Verify consistent/defect free ejection without damage to part			
- Knock out pattern matches assigned machine			
- Provide return springs when necessary			
- Provide ejector pins on deep ribs, bosses,& all blind surfaces			
- Sufficient clearance with waterlines (1/8" min)			
- Do guided ejection pins come from the support plate side?			
- Are ejector pins long enough to enter into bearing area when mold is being assembled? Sometimes springs push plate back too far and pins don't engage in bearing area and it makes assembling the mold difficult without compressing the springs first.			
VI. Finish and Appearance			
- Verify proper I.D.: Brass tags (Mold number & Owner)			
- See "Mold Dim & Note" tab below for correct pocket size & note			
- Double left click on image to open up full size in Adobe reader			
- Special instructions, material code on runner			
- Insert details: TL #, Det #, Mat & R/C #, Cav # on maj details			
- Check for undercuts, nicks, scratches, pitted surfaces (EDM)			
- Check uniformity of wall stock for alignment of inserts			
- Part Revision Core Pin Insert			
- P/N, Tool #, Cavity #, Mold Weight stamped on tool			
VII. Mold Performance			
- Perform short shot study for balance and uniform cavity fill			
- Gate freeze-off study			
Hydraulic			
I. Cylinder-Type			
- Design: proper size, mounting, durable connection, cushion			
- Hoses: type and length (5' min)			
- Motor: type and size			
- Connectors: types, proper orientation, location and length			
Electrical			
I. Define Sequence on Assembly Drawing & Verify Elec. Seq.			
II. Hot Tip Manifold			
- Power mounting box **(DME PIC-8-0)**			
- T/C mounting box **(DME MTC-8-0)**			
- Plugs: location, wiring, and type			
- Standard hot drops (Mold-Masters typical)			
- Heaters: type 5/8 in. standard (method of installation)			
- Specify controller to cavity zone layout (ex. Zone 1 = Cav 1, Zone 2 = Cav 2, Zone 3 = Manifold, Zone 4 = Sprue Bushing)			
- Add slot in manifold plate to allow water to escape			
- Add note on 2D prints to caulk around electrical plug and plate interface lines			
III. Thermocouples			
- Standard washer type, serviceability and accessible			
- Design: proper size (i.e. sensitivity and range)			
IV. Junction Boxes			
- Number of zones			
V. Limit Switch: Cutler Hammer E50AR1 (Head, Receptacle & Body) w/ E50KL465 precision arm			
- Mechanical: check location, actuator durability			
- Proper setting, verify with description of method to set			
- Electrical: verify current rating, coil cord, check length (4' Min)			
- 20A/250V Hubbell limit switch plug: two prong, two conductor **(HBL7102C)** - for limit & thin switches			
- Thinswitch **(TSW2220)** comes with 6' brown cord			
- To prevent Thinswitch wire damage, have brown Thinswitch wire securely run from switch to Hoffman box. Hoffman box will then have a heavy Carol 16/4 wire connected to the Hubbell power plug. See 1st image for stock list for Hoffman box (1004), small strain relief (1008), large strain relief (1007), Carol wire (1005) & plug (1006) callouts.			
- See "Thinswitch Info" tab below for more information			
- Double left click on image to open up full size in Adobe reader			
- Plug identified with core #, verify machine core pull logic			
- Wire routing: no pinch points, proper length, agrees w/ design			
- 15A/125V Hubbell power plug for photo-eyes **(HBL5286C)**			
- See "Shroud Photo Eye Design" tab below for more information			
- Double left click on image to open up full size in Adobe reader			
- See "Photo Eye Elect Schematic" tab for junction box wiring diagram			
- Double left click on image to open up full size in Adobe reader			

Attachment 4: Mold Design Review Checklist



Attachment 5: Detailed Drawings of Ejector and Ejector Retaining Plates



Attachment 6: Sample Mold Timeline

MISCELLANEOUS TOOL DESIGN SPECIFICS:

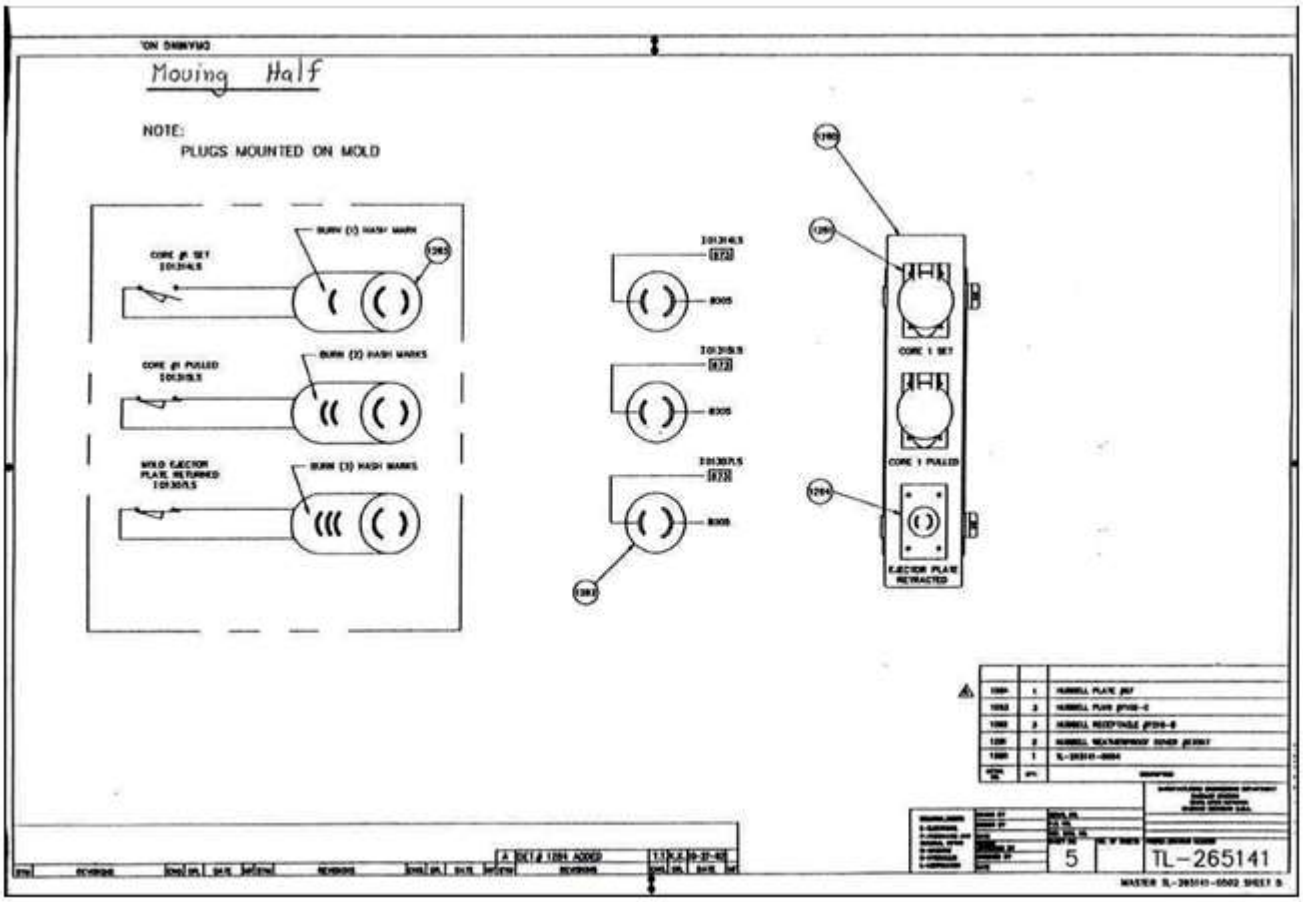
Type of Mold		Cooling		Additional Features	
Conventional 2 plate	x	Cavity	x	Refer to T-Spec TMOLD-048	x
Hot Manifold		Cores	x	Insulator plates (cover & ejector)	
Three Plate		Slides		Parting Line Locks	x
Cavity Material		Top Clamp Plate		Mold Cycle Counter	x
S-7	x	A-Plate		Clamp Slots (SD-1014)	
H-13		B-Plate		Cover Half (Top, Bottom, & Sides)	x
P-20		Support Plate		Ejector Half (Top, Bottom, & Sides)	x
420ss		Bottom Clamp Plate		Slides (Lock Required)	
Core Material		Parallel Path		Mechanical	
S-7	x	Series	x	Hydraulic	
H-13		Cavity Finish		Enclosures	
P-20		SPI-SPE #1		Product Drawing	x
420ss		SPI-SPE #2		Mold Concept	
Ejection		SPI-SPE #3		Mold Drawings (Hard Copy)	
Ejector Pins	x	Draw Polish	x	Mold Drawings (Math Data)	
Sleeve		Texture Per Drawing		Mold Review Checklist	x
Stripper Plate		Vapor Blast		Part Material	
Lifter Mechanism		Core Finish		5300	x
Type of Runner		SPI-SPE #1		Shrink Rate	
Full Round	x	SPI-SPE #2		0.018 in/in	x
Half Round		SPI-SPE #3		Quantity	
Trapezoid		Draw Polish	x	1 Mold (1103)	x
Hot Runner		Texture Per Drawing		Number of Cavities	
Mold Base Material		Vapor Blast		4	x
Existing		Engraving		Tool Number	
DME #2 Steel	x	Cavity Number	x	TL-304658	x
Standard DME	x	Part Number	x	Machine Information	
Mold Base Size		Recycle Symbol	x	150 Ton HPM	
				200 Ton New Britain	
Cavity Hardness		Part Revision Core Pin		165 Ton Cincinnati Roboshot	x
40-44 Rc		Date Codes			
46-48 Rc		Knock-Out Pattern			
54-56 Rc	x	8" x 2" Vertical (4 Holes)			
Core Hardness		8" x 2" Horizontal (4 Holes)			
40-44 Rc		3.5" x 3.5" Square (4 Holes)			
46-48 Rc		5" x 5" Diamond (4 Holes)			
54-56 Rc	x	3.5" x 3.5" Diamond (4 Holes)	x		
Gates		Ejectors			
Sub-gate	x	Mechanical			
Size		Hydraulic (1/2" – 20 Thread)	x		
Other					

Attachment 7: Sample Miscellaneous Tool Design Specifics

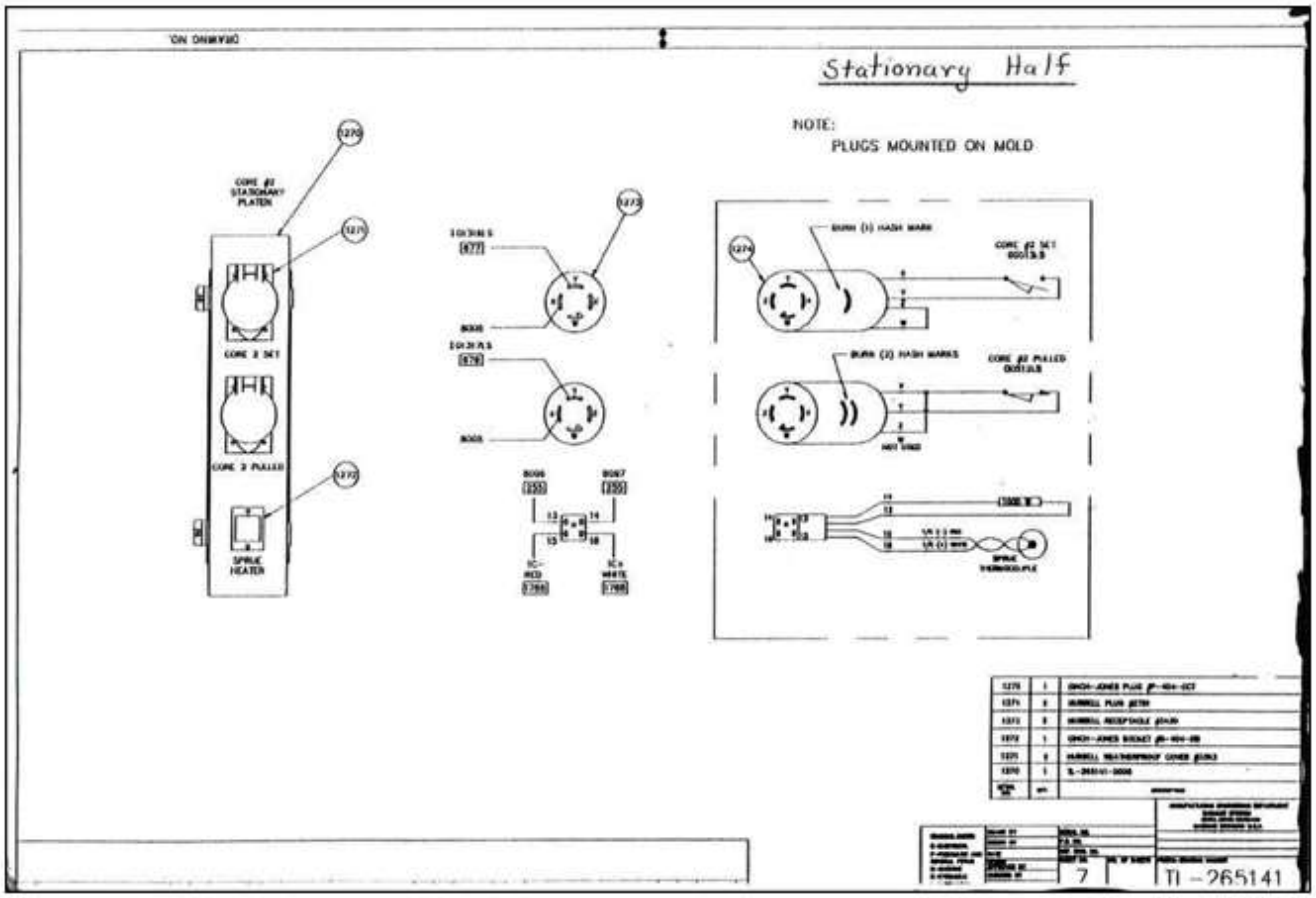
UNLESS OTHERWISE SPECIFIED

THREE PLACE DECIMAL LIMITS ±.001
FOUR PLACE DECIMAL LIMITS ± .0005
LEAVE EDGES SHARP.
DIAMETERS MARKED ⌀ ARE TO BE CONCENTRIC WITHIN T.I.R.
SURFACES MARKED ⌑ ARE TO BE SQUARE TO EACH OTHER WITHIN T.I.R.
SURFACES MARKED ▽ TO HAVE A MICROFINISH.
SURFACES MARKED ⌀ TO BE FREE OF TOOL MARKS AND HAVE A S.P.E. NO. FINISH.

Attachment 8: Tolerance Specification for Cavity Detail Drawing



Attachment 9: Core Pull Electrical Plug Schematic #1



Attachment 10: Core Pull Electrical Plug Schematic #2

RECORD OF REVISIONS

Revision No	Date	Section	Description
001	30NO95	ALL	Initial Release
002	09MR17	ALL	Updated
003	19JA21	ALL	Reformatted to post on the Data Exchange.