MANUFACTURING EQUIPMENT PURCHASE SPECIFICATION
NEXTEER AUTOMOTIVE

TITLE:	THERMOPLASTIC MOLD SPECIFICATION			**NUMBER:**	SD-1014
ISSUED BY:	RANDY SOCHA	**DATE:**	9/26/2013	**APPROVED BY:**	Michael Kettler
REVISION:	C	**DATE:**	9/26/2013	**SHEET:**	1 of 9

1.0 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 specification must be approved by the engineer-in-charge.**

2.0 INJECTION MOLD GENERAL DESIGN

Mold design must comply with Thermoplastic Mold Specification (SD-1014) and specific written instructions by plastics engineer. This specification is not intended to replace Nexteer Automotives General Drawing and Manuals Specification (SD-003) revised May 31, 2009; but rather, highlight minimum design requirements specific to injection molds. Nexteer Automotives Preferred Components List (SD-007) revised May 31, 2009 contains preferred vendors for standard components.

1. Assembly Drawings.
   a. Tie Bar Layout and Clamp Hole Layout shall be included on plan view.
   b. Plan views of mold parting line surface (both cavity and ejector half).
   c. Total stack-up height in addition to sectioned side and end views.
   d. Shrink rate and Nexteer plastic product code shall be included in title block.
   e. Part number(s), revision level(s), and drawing date(s) of the product drawing to be included in title block.
   f. Slide areas and hydraulic core-outs require sectioned views
   g. Total mold weight shall be included in the title block.

2. Mold Base Drawings
   a. Dimensional information for mold base plates may be shown on assembly drawings.
   b. Purchasing information to be shown on parts list and main assembly drawing for replacement or repair.
   c. 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.

3. Cavity and Core Sub-Assembly Drawings
   a. A separate sub-assembly drawing is required, unless otherwise specified in the T-series Specification.

4. Detail Drawings
   a. 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.
   b. 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.
   c. 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.
   d. 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.
   e. A decal shown in attachment #8 shall be used only on cavity detail drawings (details that form the part).

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

b. 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.

6. Electrical and Hydraulic Drawings
   a. Mold design shall include electrical and hydraulic schematic drawings for proper mold operation.
   b. Fittings and plugs shall be shown in proper positions.

7. Cooling Drawings
   a) Mold design should include an isometric water-flow schematic for both halves of the mold. Preferably, the schematic will be shown on the plan view assembly drawings.

8. Hot Tip Manifold Drawings, (Should include the following):
   a) Section view showing purchased components, (components to be listed on parts list also).
   b) Heater layout/wiring diagram including zone identifications.

9. Mold Drawings
   a) If mold is designed utilizing CAD, copies of the files shall be submitted to Reprographics per Attachment #10.
   b) 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.

3.0 MOLD BASE REQUIREMENTS

1. Mold Base Size
   a) Utilize the recommended mold base width for the molding machine specified. See recommended mold base width of molding machines listed in attachment #1.
   b) Mold base length should not exceed the platen length (Dimension "C" + "D") as listed in attachment #1.

2. Mold Base Material
   a) Mold bases and standard components shall be designed using DME products or interchangeable equivalent, approved by engineer.
   b) Use DME standard "A" series mold bases with No. 2 steel (AISI 4130 steel prehardened to 300 Brinell).
   c) The mold base "A" and "B" plates, including cavity pockets may be coated with electroless nickel or black oxide.

3. Safety Hoist
   a) Molds shall be designed to be installed from the top of a horizontal molding machine using OSHA approved safety hoist rings.
   b) Molds shall be designed, installed, and delivered to Nexteer with a minimum of (2) Machined Type Swivel Safety Hoist Rings.
   c) 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.
   d) 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.]
   e) 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.
   f) 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.
   g) No molds shall be over 6000 lbs. unless written permission is obtained from Nexteer engineering.
   h) Mold plates weighing over 200 lbs. shall have ½" – 13 UNC tapped hole on each side. (Four per plate).
   i) Molds shall have a self storing safety strap, on the operator's side.
   j) Mold is to be balanced & hang level within 2 degrees when connected to overhead crane via one or two eyebolts.
   k) **Under NO circumstances should any of the following mold components (limit switches, hydraulic cylinders, and photo eyes) be required to be removed to install the mold.**

4. Sprue Bushing and Locating Ring
   a) Sprue bushing to have 7/32" orifice and ¾" spherical radius.
   b) Clamp type locating ring with a 30 deg. Lead-in angle to retain sprue bushing is required (i.e., DME Cat. 6524).

5. Mold Identification
   a) 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.)
   b) The cooling lines shall be labeled "In" and "Out" next to the appropriate holes (one in and out per mold half).
   c) 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. 1in, 2out, 3in, 4out …).
   d) 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.
   e) Molds with hot manifolds shall have additional brass or plastic tags identifying the zone wiring attached to the operator's side of the mold.
   f) 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).

4.0 HYDRAULIC CYLINDERS

1. No pneumatic cylinders shall be utilized.
2. Limit 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.
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. Limit switches shall be wired with #18/3 Koiled Wire 4ft. length.
5. Mechanical interlock shall be utilized preventing damage slide(s), ejector pin(s), and/or cavity surface(s). If not possible, electrical limit switch shall be required. (Cutler Hammer E-50 Series with 5 deg. pretravel).
6. Hydraulic cylinder to be installed using ½" steel Parker Hannifin Quick Disconnectors.
7. Cylinder pulls on the mold to be installed with female coupler. Cylinder set on the mold to be installed with male nipple.
8. Hydraulic hose length (5' min.).

5.0 PREFERRED COMPONENTS LIST

1. Hydraulic Cylinders
   a) >1 ½" Bore – Milwaukee and </= 1 ½" Bore – Tom Thumb
2. Quick Disconnectors
   a) Cooling Water – Parker Hannifin BH4-61 (Brass)
   b) Hydraulic Oil – Female coupler (Parker Hannifin H4-62) and Male Nipple (Parker Hannifin H4-63).
3. Hose Fittings – Parker Hannifin, or DME Jiffy type
4. Hydraulic Motors – Char-Lynn
5. Electrical Limit Switches – Cutler-Hammer E-50 series
6. Standard mold components (i.e. ej. Pins, core pins, slide retainers, etc) – DME
7. A complete list of preferred components can be reviewed in Delphi Saginaw's Preferred Components List (SD-007) revised May 31, 2009.

6.0 COOLING LINES

1. No cooling line shall be closer than ¼" to an ejector pin hole.
2. No cooling line shall be closer than 3/8" to a cavity wall or edge of a detail.

3. Utilize Parker standards for O-ring and O-ring pocket dimensions.
4. Only Viton O-rings are to be utilized.

7.0 HYDRAULIC EJECTION

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.
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.

8.0 CAVITY ENGRAVING

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.
2. The runner must have Nexteer Automotive material code engraved on it.
3. A replaceable core pin with the part revision level may be required.

9.0 PROJECT TIMING

1. The mold vendor shall submit to the plastics engineer a written progress report on a weekly basis. Pictures may be required to illustrate progress.
2. The progress report should include the following information:
   a) Expected start and finish date for each major phase of the project (design, mold base order, cavity sub-assembly build, tryout, and ship.)
   b) Actual start and finish date for each major phase.
   c) The cavity sub-assembly build phase should be divided into the following categories:
      I. Mill & Lathe
      II. Grind
      III. EDM
      IV. Heat Treat
      V. Assembly & Bench
   d) An estimate of percent complete in each category shall be included with written progress report.
   e) 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 plastics engineer will then maintain the computerized timeline.

10.0 MOLD CHECKLIST

1. To facilitate communication the plastics engineer will utilize the Mold Review Checklist Attachment #4 at the following milestones:
   a) Design Review
   b) Supplier Run-Off
   c) Plant Review

11.0 ATTACHMENTS

1. Tie Bar and Platen Height
2. Knock-Out Block Design
3. Mold Tag Pocket Design
4. Mold Review Checklist
5. Detailed Drawings of Ejector and Ejector Retaining Plates
6. Mold Timeline (Sample)
7. Sample Purchase Spec
8. Decal for Cavity Detail Drawings
9. Core Pull Electrical Plug Schematic

10. Data submissions - Vendor Requirements Checklist

TIE BAR LOCATION AND PLATEN HEIGHT

	A	B	C	D	NO. OF MACHINES
150 TON H.P.M.	18.00	26.24	16.00	24.24	12
165 TON ROBOSHOT	22.00	31.50	20.10	29.50	4
200 TON NEW BRITAIN	21.00	31.00	18.24	28.76	24
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 H.P.M.	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 09-23-2013)

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

	Design Review	Supplier Runoff	Plant 6 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			
- 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?			
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-G)**			
- T/C mounting box **(DME MTC-8-G)**			
- 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)			
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' cord			
- 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 **(HBL5266C)**			
- 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 Review Checklist)

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EJECTOR PLATE
FOR STANDARD MOLD BASE C-1016
REQ'D-ONE
MAT'L-SAE 1020 STEEL

Attachment #5 (Detailed Drawings of Ejector and Ejector Retaining Plates)

Attachment #6 (Mold Timeline (Sample))

MANUFACTURING EQUIPMENT PURCHASE SPECIFICATION
NEXTEER AUTOMOTIVE

TITLE: _____ Number: _____
Issued by: _____ Date:_____ Approved By:_____
Rev. _____ Rev.Date: Sheet: 1 of 1

For technical information, contact_____ Phone: Fax #: _____
Part Name _____ Part No._____ Rev._____ Date: _____
Material: _____ Shrink rate: _____in./in.
Quantity: _____ Mold Tool No. _____ Cavities: ____ New: ___ Re-work: ___
Primary Machine: _____ Ton: _____ Model Year: _____ SSG: _____
Required Delivery (Wks.) _____ Est. Project Timing: Start Date :_____ End Date _____

Mold Tryout (300 Pcs.) Required (Y/N)_____ (Material To Be Supplied By Delphi Saginaw)

Type of mold
____ Conventional
____ Hot manifold
____ Three-plate
____ Family
____ _____

Material
Cav. Cores
____ H-13 ____
____ P-20 ____
____ 420ss ____
____ ____ ____

Ejection
____ Std. Ejector pins
____ Sleeve
____ Stripper Plate
____ _____
____ _____

Type of Runner
____ Full Round
____ Half Round
____ Trapezoid
____ Hot Runner
____ _____

Mold Base Material
____ Existing
____ DME #2 steel
____ _____
____ _____
_____

Hardness
Cav. Cores
____ 46-48 R/C ____
____ 40-44 R/C ____
____ _____ ____
____ _____ ____

Gates
Sub or tunnel _____
Size _____
Other _____
_____
_____
Gate Location(s): ____
_____
_____

Cooling
____ Cavities
____ Cores
____ Slides
____ Frt. Clamp Plate
____ A Plate
____ B Plate
____ Support Plate
____ Rear Clamp Plate

Finish
Cav. Core
____ SPI-SPE #1 ____
____ SPI-SPE #2 ____
____ SPI-SPE #3 ____
____ Draw Polish ____
____ per Drawing ____
____ Vapor Blast ____
____ _____ ____

Engraving
____ Cavity Number
____ Part Number
____ Recycle Symbol (i.e. >PA66<)
____ Part Rev. Core Pin
____ Date Codes
____ _____

____ Parallel Path
____ Series

Knock-out Pattern
____ 8x2 Vertical (4 Holes)
____ 3.5x3.5 Square (4 Holes)
____ 8x2 Horizontal (4 Holes)
____ 5x5 Diamond (4 Holes)
____ 3.5x3.5 Diamond (4 Holes)
____ _____
____ _____

Enclosures
____ Product B/P
____ Mold Concept
____ _____

Ejectors
___ Mechanical
____ Hydraulic

Additional Features
____ Refer to T-Spec
____ Cav. Psi Transducer

Clamp Slot Height
____ Cover Half
____ Ejector Half

Slides (Lock Required)
____ Mechanical
____ Hydraulic

Attachment #7 (Sample Purchase Spec)

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 (Decal for Cavity Detail Drawings)

Attachment #9A (Core Pull Electrical Plug Schematic)

Attachment #9B (Core Pull Electrical Plug Schematic)

(T6-456 ELECTRONIC MOLD DESIGNS / DATA SUBMISSIONS - VENDOR REQUIREMENTS CHECKLIST):

NEW VENDORS:

- [ ] Vendor establishes an account at www.delphisuppliers.com - (Delphi Reprographics Department will email Your company confirming your account is available for your use in submitting / receiving files)
- [ ] Vendor emails Delphi Reprographics Dept. its company name and their data management contact name at Usmisag.eng.repro.saginaw@delphi.com

NEW ELECTRONIC MOLD DESIGNS SUBMISSION:

- [ ] Vendor requests latest drawing naming conventions from Delphi Reprographics Dept. contacts (at bottom)
- [ ] Vendor fills out **Request for Folder** form forwarded with original Delphi Reprographics Department emailing
- [ ] Vendor uploads mold drawings and **ME Folder Request for Change Form** to delphisuppliers.com ATTN: Delphi Reprographics Department following Plastic Engineers approval

UPDATING PREVIOUSLY SUBMITTED MOLD DESIGNS:

- [ ] Vendor fills out **Request for Folder** form forwarded with original Delphi Reprographics Department emailing
- [ ] Vendor emails the completed **Request for Folder** form to the appropriate Plastics Engineer – (The Delphi Reprographics Department will upload the data to the vendor and email advise them of the upload when the Plastics Engineer forwards them the approved Request for Folder form)
- [ ] Vendor forwards drawing changes to the responsible Plastics Engineer for approval – (The Plastics Engineer will email his approval on the changes)
- [ ] Vendor uploads mold drawings and **ME Folder Request for Change Form** to delphisuppliers.com ATTN: Delphi Reprographics Department

Delphi Reprographics Department Contacts:
(989)-757-4251 or (989)-757-5880

General E-mail - nexteer.eng.repro.saginaw@nexteer.com

Maria DeLaGarza - maria.delagarza@nexteer.com

Attachment #10 (Data Submissions - Vendor Requirements Checklist)