
Tooling Requirements For New Tools

SPTech

Elizabethtown NC

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Table of Contents

	Page #
A. Introduction	1
B. Considerations	1
C. Mold Classification Guidelines	2
D. Mold Buyers Specification Checklist.....	2-3
E. Material Standards.....	4
F. Hot Runner and Valve Gate Systems.....	4
G. Electrical Systems.....	5
H. Hydraulic Core Pull Systems.....	5
I. Automation.....	5
J. Mold Safety Guidelines	6
K. Mold Numbering	6
L. Date Code.....	6
M. Cavity ID Numbering	7
N. Steel Treating and Lubrication	7
O. Documentation.....	8
P. Mold Shipping	8
Q. Mold Approval	9
R. Approved Mold Component and Material Suppliers	10
 Addendum 'A': Mold Classification Description	 11-23

A) Introduction

These Mold Spec Guidelines have been developed to meet or exceed customer expectations, and the demands that will be upon the tool.

These guidelines will further evolve, therefore communication between mold builder and mold buying Tooling Engineer is essential.

B) Considerations

Understand and incorporate customer requirements

Match the mold to the overall project requirements

Determine the optimal mold design

Standardize wherever possible

C) Mold Classification Guidelines

Overview:

These different classifications will dictate differences in design, construction, materials, and components of molds. Any deviations must be communicated to the Tooling Engineer prior to mold construction, in writing.

Class 1: Extremely High Volume

Extremely high volume production injection molds built for lifetime cycles exceeding one million.

Class 2: High Volume

Medium to high volume production injection molds built for lifetime cycles not to exceed one million.

Class 3: Medium Volume

Medium volume production injection molds built for lifetime cycles not to exceed 500,000.

Class 4: Low Volume

Low volume production injection molds built for lifetime cycles not to exceed 100,000.

Class 5: Prototype Only

Prototype only molds are built for lifetime cycles not to exceed 500.

Mold Classification Category	Extremely High Volume	High Volume	Medium Volume	Low Volume	Prototype Only
Total Runnerless Design (If Part Allows)	X				
Stainless Steel or Electroless Nickel Plated Mold Base	X				
Spare Parts for Tooling	X	X			
Stainless Steel or Electroless Nickel Plated Water Plates	X	X			
Automatic Molding Cycles & Part De-gating	X	X	X		
Full Detailed Mold Design	X	X	X		
Heat Treated Cavity & Core Inserts	X	X	X		
Parting Line Interlocks	X	X	X		
Guided Ejection	X	X	X		
Wear Plates on all Slides	X	X	X		
Automatic Side Actions	X	X	X		
Spring Loaded or Mechanically Operated KO System	X	X	X	X	
Cycle Counter Pocket	X	X	X	X	
Pre-Hardened Cavity & Core Inserts				X	X
Aluminum Cavity & Core Inserts or Aluminum Mold					X

D) Mold Buyers Specification Checklist

When issuing a RFQ, the specification check list on the following page is to be supplied.



Request For Quote

Last Updated: 7/1/2016

RFQ#: _____

Part Name: _____	Customer: _____	Date: _____
Part #: _____	Drawing #: _____	Revision: _____
Cavities: _____	Plastic Material: _____	Requestor: _____
Project Timing: _____	Design & Build: _____	Debug: _____ Weeks
	K.O. Date: _____	Due Date: 1/10/00 This is drop dead date
		Total: 0 Weeks

NOTE: Red items are Vendors Responsibility. Blue items are provided to Vendor by Danaher and should not be costed in Quote

Design & Build: ☐ Design Only ☐ Build Only ☒ Design and Build ☒ Provide Weekly Time Lines & Pictures of Progress ☒ Mold Flow Molding Press: <i>It is the vendors responsibility to ensure the mold fits and functions in selected Press</i> ☒ Press Size: Nissei 60 Ton Tie Bar Spacing: 12.8 x12.8 Max Ejector Stroke: 2.8 KO Pattern: C/L - 3.5	Ejection: ☒ Inch ☐ Metric ☐ "A" Side Ejection ☒ Stripper Plate (runner system) ☒ 2 Stage ☒ Guided Ejection ☒ Spring Return ☒ Return Pins ☒ Pins ☒ Sleeves ☒ Progressive Mold Counter Pocket ☒ Lifters
Mold Type: ☒ Base provided by: Danaher ☒ Base Size (Not To Exceed) W: 7.875 "A" Thickness: _____ ☐ Prototype ☒ Omni 13 plate X Series Runner Stripper ☒ Omni Round Cavity Size Diameter: 3.5 ☐ Omni Rectangular Pocket Base Size: _____ ☐ Three Plate Runner Stripper Mold ☐ Shuttle Series / Rotary Base Steel: ☐ DME #1 ☐ DME #2 ☐ DME #3 ☒ DME #7 Stainless (If watered) ☐ Aluminum	Other Components: ☒ Inch ☐ Metric ☒ Slide Locks ☐ Taper Locks ☐ Guides / Wear Plates ☒ Mold Strap (Hang mold from) ☒ Date Codes ☒ Insulator Plates "A" side ☐ Support Plate Insert ☐ Ejector Retainer Plate Insert Water: ☒ Inch ☐ Metric ☒ Mold Plates Which: "A" & "B" Plate ☒ Cavity Block ☐ Cores ☐ Slides Hardware: ☒ Inch ☐ Metric Max Regrind Allowed: 25% Finishes: ☒ Polish SPI Finish: C-1: 600 Stone ☒ "A" Side Tooling Plating: Lubriccoat ☒ "B" Side Tooling Plating: Armoloy
Mold Steel: ☒ Cavity Blocks = 420 SS ☒ Gate Inserts = D-2 ☐ Core Pins = _____ ☐ Slide Rails = _____ ☐ Slide Inserts = _____ ☒ Cavity Inserts = S-7 ☐ Heel Blocks = _____ ☐ Wear Plates = _____	Sampling: ☒ Engineering Samples Quantity: 100 Shots ☒ Quality Samples (individually bagged) Quantity: 15 Shots ☒ Customer Samples Quantity: _____ Shots
Gating: ☐ Edge Gate ☐ Tunnel Gate ☒ Pin Gates ☐ Other: _____ Steel: _____ Steel: _____ Quantity: 1 Location: _____ Location: _____ Location: Top Center (Recessed)	Processing: Vendor to supply process data to Danaher prior to shipping tool. ☒ Cycle Time: 20 seconds ☒ Decoupled Process ☒ Provide Process Parameters ☐ Run @ Rate: _____ Hours ☐ Vacuum Venting
Runner System: ☐ Cold Sprue ☒ Hot Sprue (2 Zone, 220 Volt) ☒ Minimal Runner ☒ Trapezoid ☒ 3 Plate ☐ Hot Runner Brand: _____ Ordered By: _____ ☒ To Cold Runner Brand: DME Connector: DME 5 Pin Parts / Drop: _____	Process Capability: ☒ Capability Study (CTQ's Dimensions) CPK of 1.33 all cavities and Mold: Dimension: 0.370 ±0.005 Dimension: 0.853 ±0.005 Dimension: _____ Dimension: _____ Dimension: _____ Dimension: _____
Inspection: ☐ Full PPAP ☒ 1st Article (FAI) ☐ Steel Injection Report (Including Highlighting all SPC dimensions) ☐ No Part Inspection * Approved by Danaher ** Parts to Print	

Note:

All Quotes must be submitted on this form to be considered!

Vendor Quote Information:	Design & Build Cost: _____	Debug Cost: _____	Total Cost: \$ _____	Date Submitted: _____
	Design & Build Timing: _____	Debug Timing: _____	Total Timing: _____	
Vendor Name: _____	Quoted By: _____	Vendor Quote #: _____		

E) Material Standards

- Production tooling shall be constructed using standard materials.
- Use quality named sources for mold steels and mold components.
- Quality mold steel suppliers will provide steel certifications per request.
- Utilize standard Lift Actions, Side Actions and Mold Components wherever possible. Exceptions must be approved by the Tooling Engineer in writing. See "R" Approved Supplier Standards".

F) Hot Runner and Valve Gate Systems

All hot runner or valve gate hot runner molds shall be designed using preferred systems specified by Tooling Engineer. The type/design of the hot runner or valve gate system will be determined by the part/mold design. Use of non-preferred hot runner or valve gate systems must be approved in writing by Tooling Engineer and Engineering Manager.

Considerations when selecting the hot runner or valve gate system should be:

- Standardization with existing systems wherever possible
- Uniform plastic material heating throughout system
- Ease of maintenance and disassemble/assembly
- Spares parts and service availability
- Hot runner and valve gate control system compatibility and availability
- Individual part cavity filling, cavity sealing, and gate aesthetics
- Standardization and ease of wiring
- Standardization of electrical connections
- Wiring and components compatible with local power requirements.

All electrical connectors in junction box shall be 24 pin connectors (See Picture). Both power and thermocouple connectors are 'male' type on the mold junction box and are 'female' type on the temperature controller cables.

Heater and thermocouple wires shall not be exposed and shall be secured in wire channels. Prefer wire channels to be in the cavity-side face of the hot runner plate assembly wherever possible. All wires should be easily accessible and not threaded through the mold wherever possible.

All heater and thermocouple junction boxes shall be securely mounted to the "top" half of the mold wherever possible.

The hot runner manifold shall have a 4-inch diameter locating ring and a 1/2-inch spherical radius sprue bushing unless otherwise noted by Tooling Engineer.

All hot runner or valve gate molds shall have Manifold and Cavity Zone Layout engraved on operator side of mold or identified on a plate attached to operator side of mold.

All hot runner or valve gate systems molds shall have an insulation plate securely attached to front face of mold.

Prefer manifolds to have leader pins for ease of assemble wherever possible.

G) Electrical Systems

- All heater and thermocouple junction boxes shall be securely mounted on the “top” of mold wherever possible.
- The junction box shall have a removable front panel to allow wiring access without disturbing the connectors wherever possible.
- All wiring shall be connected into terminal strips inside the junction box, with short runs to connectors wherever possible.
- All connections to the mold hot runner systems shall be made using standard type connectors.
- All connections shall be routed and installed into single connection plate box wherever possible.
- All mold designs shall contain a detailed electrical connection diagram.

H) Hydraulic Core Pull Systems

All molds with core pull and unscrewing mechanisms shall conform to the following guidelines unless otherwise noted by the Tooling Engineer:

- Hydraulic motors shall be specified by the Tooling Engineer.
- Motors shall be marked to identify “in” and “out” rotation ports except where an approved rack drive unscrewing is used.
- Preferred hydraulic cylinders shall be 3000 PSI with proximity switches as required.
- Hydraulic cylinders shall be Parker, Miller Brand or equivalent.
- All core pull or unscrewing molds shall have the mold mechanism sequence clearly stamped on operator side of mold.
- All unscrewing cores shall be of H-13 or 440 Stainless Steel materials and shall be heat treated to 52 Rockwell “C” hardness. For maximum wear also Nitride H-13 .005 / .007” Deep / side.
- All unscrewing molds shall be designed with a standard replaceable bushing housing on all unscrewing core details wherever possible to prevent wear to unwinding cores.

I) Automation

All Class 1: Extremely High Volume, Class 2: High Volume and Class 3: Medium Volume production molds must run fully automatic molding cycles.

Full automatic molding cycles can be accomplished by automatic ejection of parts that free-fall to conveyer or by removal of parts from mold using robot. All Class 1, Class 2 and Class 3 molds shall be designed to best accommodate the selected method of automated part removal from the mold.

J) Mold Safety Guidelines

Consideration should be given at the mold design stage to reduce potential safety issues for tool room and molding room personnel.

- Break sharp corners and edges wherever possible.
- Guard pinch points such as in unscrewing mold cylinder structures.
- Locate eyebolt holes in large plates and large inserts.
- Provide a lift hole at the center of the mold's gravity.
- Provide a mold strap to prevent unintended opening of the tool.
- All eyebolt holes should be inch standard.
- Stamp MM next to any metric eyebolt holes.

K) Mold Numbering

The designated mold number shall be supplied by Tooling Engineer.

All Class 1: Extremely High Volume, Class 2: High Volume, Class 3: Medium Volume and Class 4: Low Volume production molds shall be identified with the following information engraved/stamped onto side or top of mold or by an identification plate attached to the side or top of mold:

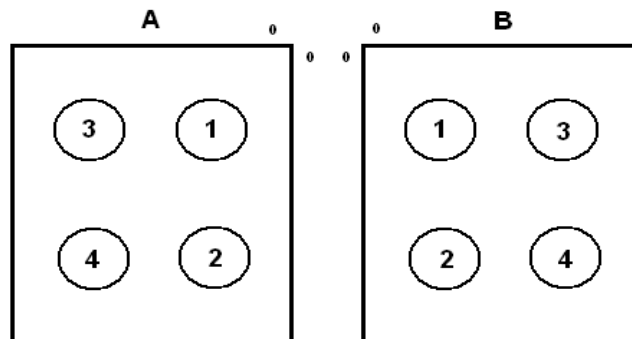
- Mold Number
- Number of Mold Cavities
- Mold Weight, (pounds)

L) Date Code

- All Part Numbering and Date Code identification in mold cavities shall be according to the approved Part Drawing when available.
- Size and location of all Part Numbering and Date Code identification in mold cavities shall be identified according to the approved Part Drawing when available.
- Use quality, approved, standard Date Codes and Plugs. See Approved Mold Standards.
- All methods to establish the Part Numbering and Date Code identification in mold cavities shall be approved by the Tooling Engineer prior to start of mold construction.
- Any deviation of Part Numbering or Date Code identification as supplied by the approved Part Drawing must be approved by the Tooling Engineer prior to start of mold construction.

M) Cavity ID Numbering

Cavity identification locations must be document on the mold layout and approved by the Tooling Engineer. The layout will be based on the following chart, using the zero corner of the mold as a reference.



N) Steel Treating and Lubrication

Determine with the Tooling Engineer's input and approval, the appropriate steel coatings and treatments.

Learn any lubrication restrictions that the mold will be subjected to in order to determine the appropriate bushings, wear plates, and the required need for coatings within the mold.

O) Documentation

All production molds, (Extremely High Volume, High Volume, and Medium Volume), shall be supplied from the moldmaker with a full mold documentation package that includes:

Electronic copies of all detailed 3D CAD files and mold drawings. Files must contain a minimum of the following:

- Bill of materials for all materials and components including type of steel/material and hardness where appropriate.
- Detailed plan view of assembly drawings including core and cavity halves.
- Detailed layouts of all inserts, (front, top, right, and bottom).
- Section drawings of all critical areas such as slides, critical mold details, gates, etc.
- Runner, gating, and ejector pin layout, (size and location).
- Detailed hot runner or valve gate drawings showing complete manifold, all hot runner components, electrical wiring diagram and bill of materials.
- Detailed water line and cooling diagram.
- 1x hard copy of detailed mold drawing with receipt of mold.
- Mold maker shall supply a Mold Manual at time of mold delivery that includes a minimum of the following:
 - Mold Drawings and CAD files as requested above.
 - Gage Drawings if applicable.
 - Last documented inspection report.
 - Documentation of all mold and molding machine process data from Moldmaker Qualification Approval of mold at moldmaker. (See Mold Approval Section.)
 - Recommended spare parts list and suppliers of critical, potential high wear, and long lead time items.
 - Recommended mold maintenance checklist and maintenance intervals of critical, potential high wear, and long lead time components.
 - All molds, (Low Volume and Prototype), shall be supplied from the moldmaker with documentation as requested by the Tooling Engineer at time of quotation.
 - Mold maker shall provide Tooling Engineer with updated electronic files of all 3D CAD files and mold drawings within 30 days of confirmation of mold approval. The Tooling Engineer will provide the mold maker with documentation of any mold revisions or changes made to mold, (if applicable). Tooling Engineer will confirm mold approval date to moldmaker.

P) Mold Shipping

- Eliminate fluid from cooling lines, and spray the mold with a rust inhibiting mold spray.
- Wrap the mold with a polybag wrap to completely cover the tool.
- Utilize two tie straps per side of the tool, to ensure that shift does not occur along the skid and within the crate.

Q) Mold Approval

The mold approval procedure shall consist of two stages:

1. Qualification of the injection mold for shipment from the moldmaker:

Moldmaker Qualification - All production molds shall be run as close to the defined production process, (estimated production molding cycle), as can be achieved with the equipment available at the moldmaker. The mold maker must also refer to the resin supplier recommended process parameters when establishing the process for the mold. Any deviation from the recommendations from the resin supplier must be approved by the Tooling engineer. A decoupled process must be used when establishing the process. The mold shall run long enough duration to normalize all parameters of the mold and of the molding machine. Once normalization is achieved, parts from the mold shall be gathered and identified by shot number and by cavity ID number. All Critical Dimensions, (and any additional dimensions or part features as identified by the Tooling Engineer), shall be measured, documented, and confirmed correct in accordance with the approved Part Drawing. The Moldmaker Qualification approval process is intended to confirm that the mold meets or exceeds all functionality and Process ability requirements as identified by the Tooling Engineer and Designated Process Engineer. Molds shall not be approved as ready to ship from Moldmaker without full authorization of Tooling Engineer. Insure all water lines are clear of chips and debris.

2. Qualification of the mold by the Designated Manufacturing Plant:

Manufacturing Plant Qualification - All production molds shall be qualified by the Manufacturing Plant in accordance with Plant Certification Procedures. This Procedure combines all individual mold qualification and certification procedures into one single pack of documents. The individual mold qualification procedures are:

- Sampling Procedure for Injection Molded Parts
- Process Capability for Injection Molded Parts
- Gage Repeatability & Reproducibility Study
- Cooling Study
- Process Dimension Correlation Study
- Qualification & Certification of Injection Molded Parts

R) Approved Supplier Standards

All production molds, (Class 1: Extremely High Volume, Class 2: High Volume, Class 3: Medium Volume and Class 4: Low Volume), shall be constructed using only approved steels, materials, and components as identified in this Mold Standard. All exceptions must be approved by the Tooling Engineer in writing prior to start of mold construction. All steels, materials, and components designated as 'Equivalent' used to construct production molds must be approved by the Tooling Engineer prior to start of mold construction.

ITEM	PREFERRED STEEL AND SUPPLIERS
Hot Runner and Valve Gate Manifolds and Components	Supplier: <u>DME</u> Model: _____
Hot Runner and Valve Gate Temperature Controllers	Supplier: <u>DME</u> Model: _____
Cycle Counters	<u>Pocket for counters only</u>
Locating Ring	Series #: _____ PCS
Support Blocks/Pillars	<u>Pre-hardened to 35RC or equivalent</u>
Cavities and Cores	Cavity _____, Core _____ Each steel, hardness and treatment should be selected to suit the steel and application.
Leader Pins & Bushings	<u>PCS</u>
Parting Line Interlocks	<u>PCS</u>
Guide Bushings	<u>PCS</u>
Ejector Pins, Core Pins, Sleeves	<u>PCS</u>
Daters	<u>PCS</u>
Lifting Strap	
Water Fittings	<u>PPE</u>
Parting Line Sequence Control	
Cavity Pressure Transducers	<u>RJG</u>
Undercut Release Lifters	
Limit Switches	
Three Plate Puller Pin Bushings	
Treatments/Coatings	<u>Armiloy - Lubriccoat</u>
Mechanical Plate Staging Device	

Addendum “A”

Table of Contents:

Mold Standards Class Description:	Page #
A. Class 1: Extremely High Volume Mold Standards	12-14
B. Class 2: High Volume Mold Standards	15-17
C. Class 3: Medium Volume Mold Standards	18-20
D. Class 4: Low Volume Mold Standards	21-22
E. Class 5: Prototype Mold Standards	23

Class 1: Extremely High Volume Mold Standards:

Class 1: General Information

- Greater than 1,000,000 lifetime cycles are expected from this mold.
- Weekly updates on the progression of the build are required.
- Mold spare parts shall be included in mold quotation package as a separate line item.
- Quote 25% spares for all unique non-standard mold components and details.
- Itemize spare parts quote.
- Mold shall run full automatic cycle.
- Mold shall produce acceptable parts at or below target estimated molding cycle as supplied by Tooling Engineer.
- Mold shall be built to produce 1.33 Cpk quality parts.
- Approved shrink factors for the selected plastic molding material shall be supplied by vendor.
- Engineering shall supply IGES/CAD files for part dimensions, part prints, and approved title block upon release of purchase order.
- Tooling Engineer shall supply molding machine platen layout and ejector KO pattern in writing.
- Preliminary mold design shall be approved by Tooling Engineer prior to start of mold construction.
- Detailed mold design shall be supplied to after tool approval.
- Final mold designs must be updated with all mold changes prior to mold approval. See Mold 'Drawings and Documentation' section of this standard for complete details.
- All slides shall have wear plates with grease grooves. Prefer wear plate thickness of 1/4 inch. Wear plate material shall be Ampco or Lamina. Slides shall have positive stops and locking details.
- All screws, bolts, leader pins/bushings, ejector pins, ejector blades, etc. shall be standard stock items wherever possible.

Class 1: Mold Base (Extremely High Volume)

- Mold base steel hardness shall be 280 BHN minimum.
- All mold base plates shall be Stainless Steel material or electroless nickel plated.
- All steels moving against one another shall be of a dissimilar material and shall have a hardness differential of at least 4-7 Rockwell "C".
- Straight parting line interlocks shall be on both sides of vertical and horizontal axis wherever possible.
- Eye bolt holes shall be located on all four sides and both halves of the mold base minimum. Individual plates shall have eye bolt holes located on all four sides. Eye bolt hole thread size shall be stamped near lift hole.
- Mold base shall be provided with a safety strap installed across parting line to insure mold does not open during shipment, installation, or removal.
- Mold base must have 4-inch diameter locating ring and 1/2-inch spherical radius sprue bushing, unless otherwise specified by Tooling Engineer.
- All mold base plates to be chamfered approximately 1/16-inch X 45 degrees.
- Mold base to have off-set Leader Pin/Bushings and Return Pins.
- Mold to have ample support pillars with minimum of 1/8-inch clearance on pillar diameter. (See page 31 for approved design.)
- Pry bar slots shall be located on all mold base plates. Pry bar slots to be 7/8-inch-wide minimum by 3/16-inch-deep minimum. Pry bar slots may be placed on corner of plates at 45 degrees angle only if no room for preferred locations.
- Multiple dowel pins shall be installed between plates to insure proper alignment of plates.

- Stamp "TOP" on top of mold, minimum 5/16 inch high.
- Leader Pins and Leader Pin Bushing shall be long enough to engage at least 1/2 inch prior to any other mold components. Bushings shall be self lubricating.
- Mold base shall have clamp slots in both halves of mold. Preferred dimension of clamp slot is 13/16-inch-high X 5/8-inch-deep where possible, 7/8 or 1 3/8 off top and bottom of mold. Direct bolting holes may be implemented if necessary.

Class 1: Cavity and Cores (Extremely High Volume)

- All molding surfaces shall be made of hardened tool steel and heat treated to a minimum of 48 Rockwell "C" hardness.
- All mold details such as slides, heel blocks, gibs, wedge blocks, etc. shall be made of hardened tool steel and heat treated to a minimum of 48 Rockwell "C" hardness.
- Hardened Stainless Steel cavities, cores, and core pins shall be used wherever possible if selected plastic resin is highly corrosive.
- Cavities, cores, core pins, and all other molding surfaces shall be flash chrome or TIN plated wherever possible if selected plastic resin is highly abrasive. Tooling Engineer to specify type and thickness of plating.
- Leader pins shall be long enough to engage at least 1/4 inch before core details engage cavities
- All core pins shall be full-through hardened.
- All part undercuts must be formed with mechanical, hydraulic, or pneumatic slides, lifters, etc.
- All shut-off angles to be minimum of 3 degrees with a minimum 1/10-inch step, (assumes part design allows). Preferred shut-off angle is 5 degrees for all matching surfaces.
- All insert pockets shall have appropriate lead-in to assist in assembly.
- Excellent venting is required and shall be in accordance to plastic resin specifications. Last to fill areas must always have appropriate venting to insure ease of processing. Deep pockets must be vented wherever possible.
- Potential high breakage areas shall be inserted design for ease of replacement.
- All cavity and core details to have steel type and hardness stamped into recessed pockets wherever possible.

Class 1: Cooling (Extremely High Volume)

- Water lines shall be in both mold halves and in cavities, cores, and slides wherever possible to allow for optimized molding cycles.
- Water inlet and outlet locations shall be positioned so as not to interfere with molding machine tie bars and mold clamp slots.
- All water inlets and outlets shall be stamped and identified on mold base. Identify inlets as "IN 1", "IN 2", etc. Identify outlets as "OUT 1", "OUT 2", etc. All water inlets and outlets must also be identified by their appropriate level on mold base.
- All water inlets and outlets shall be fitted with Progressive Components, DME, Jiffy type or equivalent quick disconnect fittings.
- Water inlets and outlets shall be recessed and installed below the mold base surface wherever possible.
- Water lines shall be 7/16-inch diameter or larger wherever possible.
- Bubblers and baffles shall be stainless steel, (preferred), or brass. Plastic bubblers and baffles are not acceptable. Baffles shall be keyed in place and secured with a set screw wherever possible.
- Spiral baffles shall be used wherever possible for turbulent flow.
- Air and vacuum fittings shall be different from water fittings to prevent misconnection and for ease of installation.
- Mold shall be designed with "O" ring installations such that "O" rings do not shear or become damaged during proper mold assembly.

- Water channels to be flash chromed when using steel other than 420 (or stainless).

Class 1: Ejection (Extremely High Volume)

- Ejector plates shall run on guided bushings. Recommend four pins and bushings wherever possible.
- Bushings shall be self lubricated.
- Ejector plates shall have one off-set return pin.
- Ejector plate travel must be sufficient for full part ejection and consistent automatic molding cycle operation.
- Ejector pins and sleeves shall be through hardened. Ejector sleeves shall be nitrided on all inside and outside surfaces.
- Ejector pins and sleeves shall be industry standard sizes wherever possible. All exceptions must be noted and approved by Engineer in writing.
- Contoured ejector pins located flush with core surfaces must be keyed into place to maintain core contour alignment.
- Cavity cores shall have ejector pin clearance of 1/64 inch larger than ejector pin diameter. Land distance shall be sized to optimize mold wear and fit characteristics.
- Ejector pin clearance holes in "B" plate shall be 1/32 inch larger than ejector pin diameter wherever possible.
- Ejector pin holes shall be 1/8 inch minimum from core side wall wherever possible.
- Knock-out clearance holes shall be 1 1/4-inch diameter. Tapped holes for knock-out pins/adaptors shall be 1/2 inch-13 thread size. Knock-out adaptors shall be flush with back half of mold.
- Standard SPI knock-out patterns shall be used. Multiple KO is preferred. Tooling Engineer to provide mold supplier appropriate KO pattern to match molding machine configuration.
- All ejector plates shall have return springs where mold design and mold operation allows. Springs shall be standard sizes and not cut to length. Springs shall have standard diameter counter bore holes wherever possible. Springs to be installed around return pins or have separate pins in the event brokerage occurs.

Class 2: High Volume Mold Standards:

Class 2: General (High Volume)

- Up to 1,000,000 lifetime cycles is expected from this mold.
- Weekly updates on the progression of the build are required.
- Mold spare parts shall be included in mold quotation package as a separate line item. Quote 25% spares for all unique non-standard mold components and details. Itemize spare parts quote.
- Mold shall run full automatic cycle.
- Mold shall produce acceptable parts at or below target estimated molding cycle as supplied by Tooling Engineer.
- Mold shall be built to produce 1.33 Cpk quality parts.
- Approved shrink factors for the selected plastic molding material shall be supplied by vendor.
- Engineering shall supply IGES/CAD files for part dimensions, part prints, and approved title block upon release of purchase order.
- Tooling Engineer shall supply molding machine platen layout and ejector KO pattern in writing.
- Preliminary mold design shall be approved by Tooling Engineer prior to start of mold construction.
- Detailed mold design shall be supplied to after tool approval. Final mold designs must be updated with all mold changes prior to mold approval. See Mold 'Drawings and Documentation' section of this standard for complete details.
- Mold shall have approved vendor (Progressive Components) cycle counter.
- All slides shall have wear plates with grease grooves. Prefer wear plate thickness of 1/4 inch. Wear plate material shall be Ampco or Lamina. Slides shall have positive stops and locking details.
- All screws, bolts, leader pins/bushings, ejector pins, ejector blades, etc. shall be standard stock items wherever possible.

Class 2: Mold Base (High Volume)

- Mold base steel hardness shall be 280 BHN minimum.
- All mold base plates containing water cooling lines shall be Stainless Steel material or electroless nickel plated.
- All steels moving against one another shall be of a dissimilar material and shall have a hardness differential of at least 4-7 Rockwell "C".
- Straight parting line interlocks, (Progressive Components or equivalent), shall be on both sides of vertical and horizontal axis wherever possible. Size and location shall be approved by Tooling engineer.
- Eye bolt holes shall be located on all four sides and both halves of the mold base minimum. Individual plates shall have eye bolt holes located on all four sides. Eye bolt hole thread size shall be stamped near lift hole.
- Mold base shall be provided with two safety straps installed across parting line to insure mold does not open during shipment, installation, or removal.

- Mold base must have 4-inch diameter locating ring and 1/2-inch spherical radius sprue bushing, unless otherwise specified by Tooling Engineer.
- All mold base plates to be chamfered approximately 1/16-inch X 45 degrees.
- Mold base to have off-set Leader Pin/Bushings and Return Pins.
- Mold to have ample support pillars with minimum of 1/8-inch clearance on pillar diameter.
- Pry bar slots shall be located on all mold base plates. Pry bar slots to be 7/8-inch-wide minimum by 3/16-inch-deep minimum. (See page 32 for recommended locations.) Pry bar slots may be placed on corner of plates at 45 degrees angle only if no room for preferred locations.
- Multiple dowel pins shall be installed between plates to insure proper alignment of plates. Stamp "TOP" on top of mold, minimum 5/16 inch high.
- Leader Pins and Leader Pin Bushing shall be long enough to engage at least 1/2 inch prior to any other mold components. Bushings shall be self lubricating.
- Mold base shall have clamp slots in both halves of mold. Preferred dimension of clamp slot is 13/16-inch-high X 5/8-inch-deep where possible, 7/8 or 1 3/8 off top and bottom of mold. Direct bolting holes may be implemented if necessary.

Class 2: Cavity and Cores (High Volume)

- All molding surfaces shall be made of hardened tool steel and heat treated to a minimum of 48 Rockwell "C" hardness.
- All mold details such as slides, heel blocks, gibs, wedge blocks, etc. shall be made of hardened tool steel.
- Hardened Stainless Steel cavities, cores, and core pins shall be used wherever possible if selected plastic resin is highly corrosive.
- Cavities, cores, core pins, and all other molding surfaces shall be flash chrome or TIN plated wherever possible if selected plastic resin is highly abrasive. Tooling Engineer to specify type and thickness of plating.
- Leader pins shall be long enough to engage at least 1/4 inch before core details engage cavities.
- All core pins shall be full-through hardened.
- All part undercuts must be formed with mechanical, hydraulic, or pneumatic slides, lifters, etc.
- All shut-off angles to be minimum of 3 degrees with a minimum 1/10-inch step, (assumes part design allows). Preferred shut-off angle is 5 degrees for all matching surfaces.
- All insert pockets shall have appropriate lead-in to assist in assembly.
- Excellent venting is required and shall be in accordance to plastic resin specifications. Last to fill areas must always have appropriate venting to insure ease of processing. Deep pockets must be vented wherever possible.
- Potential high breakage areas shall be inserted design for ease of replacement.
- All cavity and core details to have steel type and hardness stamped into recessed pockets wherever possible.

Class 2: Cooling (High Volume)

- Water lines shall be in both mold halves and in cavities, cores, and slides wherever possible to allow for optimized molding cycles.
- Water inlet and outlet locations shall be positioned so as not to interfere with molding machine tie bars and mold clamp slots.
- All water inlets and outlets shall be stamped and identified on mold base. Identify inlets as "IN 1", "IN 2", etc. Identify outlets as "OUT 1", "OUT 2", etc. All water inlets and outlets must also be identified by their appropriate level on mold base.
- All water inlets and outlets shall be fitted with Progressive Components, DME, Jiffy type or equivalent quick disconnect fittings.

- Water inlets and outlets shall be recessed and installed below the mold base surface wherever possible.
- Water lines shall be 7/16-inch diameter or larger wherever possible.
- Bubblers and baffles shall be stainless steel, (preferred), or brass. Plastic bubblers and baffles are not acceptable. Baffles shall be keyed in place and secured with a set screw wherever possible.
- Spiral baffles shall be used wherever possible for turbulent flow.
- Air and vacuum fittings shall be different from water fittings to prevent misconnection and for ease of installation.
- Mold shall be designed with "O" ring installations such that "O" rings do not shear or become damaged during proper mold assembly.
- Water channels to be flash chromed when using steel other than 420 (or stainless).

Class 2: Ejection (High Volume)

- Ejector plates shall run on guided bushings. Recommend four pins and bushings wherever possible.
- Bushings shall be self lubricated.
- Ejector plates shall have one off-set return pin.
- Ejector plate travel must be sufficient for full part ejection and consistent automatic molding cycle operation.
- Ejector pins and sleeves shall be through hardened. Ejector sleeves shall be nitrided on all inside and outside surfaces.
- Ejector pins and sleeves shall be industry standard sizes, (Progressive Components, DME or equivalent), wherever possible. All exceptions must be noted and approved by Tooling Engineer in writing.
- Contoured ejector pins located flush with core surfaces must be keyed into place to maintain core contour alignment.
- Cavity cores shall have ejector pin clearance of 1/64 inch larger than ejector pin diameter. Land distance shall be sized to optimize mold wear and fit characteristics.
- Ejector pin clearance holes in "B" plate shall be 1/32 inch larger than ejector pin diameter wherever possible.
- Ejector pin holes shall be 1/8-inch minimum form core side wall wherever possible.
- Knock-out clearance holes shall be 1 1/4-inch diameter. Taped holes for knock-out pins/adaptors shall be 1/2 inch-13 thread size. Knock-out adaptors shall be flush with back half of mold.
- Standard SPI knock-out patterns shall be used. Multiple KO is preferred. Tooling Engineer to provide mold supplier appropriate KO pattern to match molding machine configuration.
- All ejector plates shall have return springs where mold design and mold operation allows. Springs shall be standard sizes, (Progressive Components, DME or equivalent), and not cut to length. Springs shall have standard diameter counter bore holes wherever possible. Springs to be installed around return pins or have separate pins in the event breakage occurs.

Class 3: Class Medium Volume Mold Standards:

Class 3: General (Medium Volume)

- Up to 500,000 lifetime cycles is expected from this mold.
- Weekly updates on the progression of the build are required.
- Prefer mold to run full automatic cycle and automatic part de-gating.
- Mold shall produce acceptable parts at or below target estimated molding cycle as supplied by Tooling Engineer.
- Mold shall be built to produce 1.33 Cpk quality parts minimum.
- Approved shrink factors for the selected plastic molding material shall be supplied by vendor.
- Engineering shall supply IGES/CAD files for part dimensions, part prints, and approved title block upon release of purchase order.
- Tooling Engineer shall supply molding machine platen layout and ejector KO pattern in writing.
- Preliminary mold design shall be approved by Tooling Engineer prior to start of mold construction.
- Detailed mold design shall be supplied to after tool approval. Final mold designs must be updated with all mold changes prior to mold approval. See Mold 'Drawings and Documentation' section of this standard for complete details.
- Mold shall have approved vendor (Progressive Components) cycle counter.
- All slides shall have wear plates with grease grooves. Slides shall have positive stops and locking details.
- All screws, bolts, leader pins/bushings, ejector pins, ejector blades, etc. shall be standard stock items wherever possible.

Class 3: Mold Base (Medium Volume)

- Mold base steel hardness shall be 165 BHN minimum.
- All steels moving against one another shall be of a dissimilar material and shall have a hardness differential of at least 4-7 Rockwell "C".
- Straight parting line interlocks shall be on both sides of vertical and horizontal axis wherever possible.
- Size and location shall be approved by Tooling Engineer.
- Eye bolt holes shall be located on all four sides and both halves of the mold base minimum. Individual plates shall have eye bolt holes located on all four sides. Eye bolt hole thread size shall be stamped near lift hole.
- Mold base shall be provided with two safety straps installed across parting line to insure mold does not open during shipment, installation, or removal.
- Mold base must have 4 inch diameter locating ring and 1/2 inch spherical radius sprue bushing, unless otherwise specified by Tooling Engineer.
- All mold base plates to be chamfered approximately 1/16-inch X 45 degrees.
- Mold base to have off-set Leader Pin/Bushings and Return Pins.
- Mold to have ample support pillars with minimum of 1/8-inch clearance on pillar diameter.
- Pry bar slots shall be located on all mold base plates. Pry bar slots to be 7/8-inch-wide minimum by 3/16-inch-deep minimum. Pry bar slots may be placed on corner of plates at 45 degrees angle only if no room for preferred locations.

- Multiple dowel pins shall be installed between plates to insure proper alignment of plates.
- Stamp "TOP" on top of mold, minimum of 5/16 inch high.
- Leader Pins and Leader Pin Bushing shall be long enough to engage at least 1/2 inch prior to any other mold components.
- Mold base shall have clamp slots in both halves of mold. Preferred dimension of clamp slot is 13/16-inch-high X 5/8-inch-deep where possible, 7/8 or 1 3/8 off top and bottom of mold. Direct bolting holes may be implemented if necessary.

Class 3: Cavity and Cores (Medium Volume)

- All molding surfaces shall be made of hardened tool steel and heat treated to a minimum of 48 Rockwell "C" hardness.
- All mold details such as slides, heel blocks, gibs, wedge blocks, etc. shall be made of hardened tool steel heat treated to a minimum of 48 Rockwell "C" hardness.
- Hardened Stainless Steel cavities, cores, and core pins shall be used wherever possible if selected plastic resin is highly corrosive.
- Cavities, cores, core pins, and all other molding surfaces shall be flash chrome or TIN plated wherever possible if selected plastic resin is highly abrasive. Tooling Engineer to specify type and thickness of plating.
- Leader pins shall be long enough to engage at least 1/4 inch before core details engage cavities.
- All core pins shall be full-through hardened.
- Prefer undercuts formed with mechanical, hydraulic, or pneumatic slides, lifters, etc. Exceptions must be approved by Tooling Engineer prior to start of mold construction.
- All shut-off angles to be minimum of 3 degrees with a minimum 1/10 inch step, (assumes part design allows). Preferred shut-off angle is 5 degrees for all matching surfaces.
- Excellent venting is required and shall be in accordance to plastic resin specifications. Last to fill areas must always have appropriate venting to insure ease of processing. Deep pockets must be vented wherever possible.
- All cavity and core details to have steel type and hardness stamped into recessed pockets wherever possible.

Class 3: Cooling (Medium Volume)

- Water lines shall be in both mold halves and in cavities, cores, and slides wherever possible to allow for optimized molding cycles.
- Water inlet and outlet locations shall be positioned so as not to interfere with molding machine tie bars and mold clamp slots.
- All water inlets and outlets shall be stamped and identified on mold base. Identify inlets as "IN 1", "IN 2", etc. Identify outlets as "OUT 1", "OUT 2", etc. All water inlets and outlets must also be identified by their appropriate level on mold base.
- All water inlets and outlets shall be fitted with Progressive Components, DME, Jiffy type or equivalent quick disconnect fittings.
- Water inlets and outlets shall be recessed and installed below the mold base surface wherever possible.
- Water lines shall be 7/16-inch diameter or larger wherever possible.
- Bubblers and baffles shall be stainless steel or brass. Plastic bubblers and baffles are not acceptable.
- Baffles shall be keyed in place and secured with a set screw wherever possible.
- Spiral baffles shall be used wherever possible for turbulent flow.
- Air and vacuum fittings shall be different from water fittings to prevent misconnection and for ease of installation.

- Mold shall be designed with “O” ring installations such that “O” rings do not shear or become damaged during proper mold assembly.

Class 3: Ejection (Medium Volume)

- Ejector plates shall run on guided bushings. Recommend four pins and bushings wherever possible.
- Ejector plates shall have one off-set return pin.
- Ejector plate travel must be sufficient for full part ejection and consistent molding cycle operation.
- Ejector pins and sleeves shall be through hardened. Ejector sleeves shall be nitrided.
- Ejector pins and sleeves shall be industry standard sizes wherever possible. All exceptions must be noted and approved by Tooling Engineer in writing.
- Contoured ejector pins located flush with core surfaces must be keyed into place to maintain core contour alignment.
- Cavity cores shall have ejector pin clearance of 1/64 inch larger than ejector pin diameter. Land distance shall be sized to optimize mold wear and fit characteristics.
- Ejector pin clearance holes in “B” plate shall be 1/32 inch larger than ejector pin diameter wherever possible.
- Ejector pin holes shall be 1/8-inch minimum form core side wall wherever possible.
- Knock-out clearance holes shall be 1 1/4-inch diameter. Taped holes for knock-out pins/adaptors shall be 1/2 inch-13 thread size. Knock-out adaptors shall be flush with back half of mold.
- Standard SPI knock-out patterns shall be used. Multiple KO is preferred. Tooling Engineer to provide mold supplier appropriate KO pattern to match molding machine configuration.
- All ejector plates shall have return springs where mold design and mold operation allows. Springs shall be standard sizes and not cut to length. Springs shall have standard diameter counter bore holes wherever possible. Springs to be around return pins or have separate pins in the event breakage occurs.

Class 4: Low Volume Mold Standards:

Class 4: General (Low Volume)

- Up to 100,000 lifetime cycles is expected from this mold.
- Weekly updates on the progression of the build are required.
- Mold shall produce acceptable parts at or below target estimated molding cycle as supplied by Tooling Engineer.
- Mold shall be built to produce 1.33 Cpk quality parts minimum.
- Approved shrink factors for the selected plastic molding material shall be supplied by vendor.
- Engineering shall supply IGES/CAD files for part dimensions, part prints, and approved title block upon release of purchase order.
- Tooling Engineer shall supply molding machine platen layout and ejector KO pattern in writing.
- Preliminary mold design shall be approved by Tooling Engineer prior to start of mold construction.
- Basic mold design shall be supplied to after tool approval. See Mold Drawings and Documentation section of this standard for complete details.
- Mold shall have approved vendor (Progressive Components) cycle counter.
- All screws, bolts, leader pins/bushings, ejector pins, ejector blades, etc. shall be standard stock items wherever possible.

Class 4: Mold Base (Low Volume)

- Mold base may be of mild steel material.
- All steels moving against one another shall be of a dissimilar material and shall have a hardness differential of at least 4-7 Rockwell "C".
- Eye bolt holes shall be located on all four sides and both halves of the mold.
- Mold base shall be provided with two safety straps installed across parting line to insure mold does not open during shipment, installation, or removal.
- Mold base must have 4 inch diameter locating ring and 1/2 inch spherical radius sprue bushing, unless otherwise specified by Tooling Engineer.
- All mold base plates to be chamfered and de-burred.
- Mold to have ample support pillars.
- Pry bar slots shall be located on all mold base plates.
- Stamp "TOP" on top of mold, minimum of 5/16 inch high.
- Leader Pins and Leader Pin Bushing shall be long enough to engage prior to any other mold components.
- Mold base shall have clamp slots in both halves of mold. Preferred dimension of clamp slot is 13/16 inch high X 5/8 inch deep where possible, 7/8 or 1 3/8 off top and bottom of mold. Direct bolting holes may be implemented if necessary.

Class 4: Cavity and Cores (Low Volume)

- All molding surfaces shall be made of pre-hardened tool steel or tool grade aluminum approved by Tooling Engineer.
- All mold details such as slides, heel blocks, gibs, wedge blocks, etc. shall be made of pre-hardened steel.
- Leader pins shall be long enough to engage before cores engage.
- Part undercuts may be formed with hand loaded inserts, or may be formed as a manual secondary operation.
- Venting is required to properly fill part.

Class 4: Cooling (Low Volume)

- Water lines shall be in both mold halves.
- Water inlet and outlet locations shall be positioned so as not to interfere with molding machine tie bars and mold clamp slots.
- All water inlets and outlets shall be stamped and identified on mold base. Identify inlets as "IN 1", "IN 2", etc. Identify outlets as "OUT 1", "OUT 2", etc.
- All water inlets and outlets shall be fitted with Progressive Components, DME, Jiffy type or equivalent quick disconnect fittings.
- Water lines shall be 7/16" diameter or larger wherever possible.
- Bubblers and baffles shall be stainless steel or brass.

Class 4: Ejection (Low Volume)

- Ejector plate travel must be sufficient for full part removal.
- Ejector pins and sleeves shall be industry standard sizes wherever possible.
- Contoured ejector pins located flush with core surfaces must be keyed into place to maintain core contour alignment.
- Knock-out clearance holes shall be 1 1/4-inch diameter. Taped holes for knock-out pins/adaptors shall be 1/2 inch-13 thread size.
- Standard SPI knock-out patterns shall be used. Tooling Engineer to provide mold supplier appropriate KO pattern to match molding machine configuration.
- All ejector plates shall have return springs where mold design and mold operation allows.

Class 5: Prototype Mold Standards:

Class 5: General (Prototype)

- Mold is for prototype purpose only. Lifetime cycles are not expected to exceed 500.
- Approved shrink factors for the selected plastic molding material shall be supplied by the vendor.
- Engineering shall supply documentation for part dimensions.
- Mold design is not required. Tooling Engineer may request preliminary mold construction concept.

Class 5: Mold Base (Prototype)

- Mold base may be of mild steel material or aluminum.
- Eye bolt holes shall be located per request of Tooling Engineer.
- Mold base shall have clamp slots located per request of Tooling Engineer.

Class 5: Cavity and Cores (Prototype)

- Cores and cavities details may be cut directly into mold base material.
- All molding surfaces can be of mild steel, aluminum, or cast material as approved by Tooling Engineer.
- Part undercuts may be formed with hand loaded inserts or may be formed as a manual secondary operation.

Class 5: Cooling (Prototype)

- Water lines, if required, shall be located per request of Tooling Engineer.

Class 5: Ejection (Prototype)

- Ejector plate and ejector pins can be used or part may be manually removed from the mold.