Published on *Collaboration American Precision Products* (_____

Tooling Specifications APP3760482

Following [1] Report as inappropriate [2]

The following defines APP's minimum tooling specifications for all tool builds, both internal and external. Exceptions are allowed (see document precedence).

1. Tooling Classes and Requirements

Requirements Matrix

General								
	101 Extremely High Volume	102 High Volume	103 Medium Volume	104 Low Volume	105 Very Low Voume	I Unit Insert	II Unit Insert	III Unit Insert
Tool Life Cycles (up to)	1,000,000 +	1,000,000	500,000	100,000	500	500,000+	100,000	500
2D Design Drawings	X	X	X	X		X	X	
3D Design Drawings	X	X	X			X		
Component ID	X	X	X			X		
Tool Steel ID	X	X	X			X		
Cycle Counter	X	X						
Spare Wear Parts	X							
Spare Parts List	X	X	X					
Fully Automatic Operation	X	X	X			X	X	
DFM Report	X	X	X	X		X	X	
Cpk Requirement	1.5	1.5	1.33	1.33		1.33	1.33	
Cycle Time Target	X	X	X			X	X	
Critical Dimensions	10%	10%						
Minor Dimensions	25%	25%						
Self Lubricating Hardware	X	X	X			X		
Certified Tool Steel	X	X	X			X	X	
Mold Flow Analysis	X	X						
Mold Dimensional Study	B1	B1						

Part Dimensional Study	X	X	B1	B1	B1	B1	B1	B1
Mold Base								
	101 Extremely High Volume	102 High Volume	103 Medium Volume	104 Low Volume	105 Very Low Voume	I Unit Insert	II Unit Insert	III Unit Insert
Thermocouple ports	X	X	X			X		
Stock Hardware Components	X	X	X			X	X	
Sprue Bushing	X	X	X	X		X		
Bushings	X	X	X			X		
Self Lubricating Bushings	X	X						
Side Locks	X	X	X			X		
Mold Plates Doweled	X	X	X			X		
Dissimilar Metals	X	X						
Safety Straps	X	X	X			X		
Chamfered Plates	X	X	X			X		
Actions								
	101 Extremely High Volume	102 High Volume	103 Medium Volume	104 Low Volume	105 Very Low Voume	I Unit Insert	II Unit Insert	III Unit Insert
Cam/Moving Features wear plates	X	X	X			X		
Positive Stops	X	X				X		
Hardened	48 C	48C	C1			C1		
Hand Load Inserts Allowed			X	X	X	X	X	X
Standard Components for actions	X	X	X			X		
Runner System								
	101 Extremely High Volume	102 High Volume	103 Medium Volume	104 Low Volume	105 Very Low Voume	I Unit Insert	II Unit Insert	III Unit Insert
Full Hot Runner	X							

Inserted Runner		C1						
Inserted Gates		C1	C1					

Cooling

	101 Extremely High Volume	102 High Volume	103 Medium Volume	104 Low Volume	105 Very Low Voume	I Unit Insert	II Unit Insert	III Unit Insert
Plated Water Lines	X	X						
ID Ports	X	X	X			X		
Recessed fittings	X	X	X					

Cavity & Cores

	101 Extremely High Volume	102 High Volume	103 Medium Volume	104 Low Volume	105 Very Low Voume	I Unit Insert	II Unit Insert	III Unit Insert
Cavities/Cores Inserted	X	X	X					
Hardened	48 C	48C	C1			C1		
Plated/Coated	C1	C1	C1			C1		
Hardened Core Pins	X	X						
Mold inserts removable in Press	X	X	X					
Cavity # Marking	X	X	X	X		X	X	
Venting	X	X	X	X	X	X	X	X
Insert Fragile Features	X	X	X			X		

Ejection

	101 Extremely High Volume	102 High Volume	103 Medium Volume	104 Low Volume	105 Very Low Voume	I Unit Insert	II Unit Insert	III Unit Insert
Guided Bushings	X	X	X			X	X	
Plate Return Switches	X	X	E2			E2		
Return Pin	X	X	X			X		
Hardened Pins	X	X	X			X		
Hardened Sleeves	E1	E1						
Nitrided Sleeves	E1	E1						

Standard SPI Pattern	X	X	X			X	X	
Spring Return	X	X	X			X	X	
Manual Ejection Allowed					X			X

- B1 Key and Critical characteristics only
- C1 Hardened if corrosive or abrasive materials
- E1 When utilized
- E2 Required when mold damaged may occur if malfunction

2. Document Precedence

A. Purchase Order
B. Tooling Engineer written changes and authorizations
C. Part and order documentation packages
D. Tooling documentation

All exceptions from this specification shall be authorized by appropriate APP personnel and clearly identified in one or more of the above methods.

3. General Requirements

APP shall:

A. Supply all Machine specifications, KO patterns, locator ring size, nozzle radius, tie bar, per APPXXXXXX or equivalent
B. Supply Mold Shrinkage and material specification.
C. Supply part documentation package.
D. Approve Gate & KO location

General

A. All other hardware can be be metric or US standard but cannot be a mixture of both except all tapped water fittings shall be US.
B. Preliminary mold design shall be approved by Tooling Engineer prior to start of mold construction.
C. When drawings are required Detailed mold design shall be supplied after tool approval. See Mold ‘Drawings and Documentation’ section of this standard for complete details.

Mold Base

A. 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.
B. Stamp “TOP” on top of mold, minimum 5/16 inch high.
C. 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.
D. 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.
E. All insert pockets shall have appropriate lead-in to assist in assembly.

Cooling

A. Water lines shall be in both mold halves and in cavities, cores, and slides wherever possible to allow for optimized molding cycles.
B. Water inlet and outlet locations shall be positioned so as not to interfere with molding machine tie bars and mold clamp slots.

C. Water lines shall be 7/16 inch diameter or larger wherever possible.
D. Baffles shall be keyed in place and secured with a set screw wherever possible.
E. Spiral baffles shall be used wherever possible for turbulent flow.
F. Air and vacuum fittings shall be different from water fittings to prevent misconnection and for ease of installation.
G. Mold shall be designed with “O” ring installations such that “O” rings do not shear or become damaged during proper mold assembly
H. Whenever possible cams and moving features should have cooling.

Ejection

A. Ejector pins and sleeves shall be industry standard sizes wherever possible.
B. Contoured ejector pins located flush with core surfaces shall be keyed into place to maintain core contour alignment.
C. 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.
D. Ejector pin clearance holes in “B” plate shall be 1/32 inch larger than ejector pin diameter wherever possible.
E. Ejector pin holes shall be 1/8 inch minimum from core side wall wherever possible.
F. 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 adapters shall be flush with back half of mold.
G. 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.
H. Ejector plate travel shall be sufficient for full part ejection and consistent molding cycle operation.

Hardware Sizes

Component/ Press Size (up to)	150 tons	250 tons	500 tons	> 500 tons
Locator Ring	4"	4"		
Nozzle Radius	1/2"	1/2"		
Water Fittings	1/4-19 NPTF or 3/8-18 NPTF	1/4-19 NPTF or 3/8-18 NPTF		

Eyebolt Requirement

Mold Weight (lb)	Eyebolt Size
1,000	1/2-13 x .88"
2,000	5/8-11 x 1.125
3,000	3/4-10 x 1.375
6,000	1.0-8 x 1.625

4. Tooling Feature Requirements

A. Three Plate Mold:

1. External cams/arms are preferred over internal friction pulls.
2. Robot access from top

B. Electrical Systems

1. All heater and thermocouple junction boxes shall be securely mounted on the “top” of mold wherever possible.
2. The junction box shall have a removable front panel to allow wiring access without disturbing the connectors wherever

possible.
3. All wiring shall be connected into terminal strips inside the junction box, with short runs to connectors wherever possible.
4. All connections to the mold hot runner systems shall be made using standard type connectors.
5. All connections shall be routed and installed into single connection plate box wherever possible.
6. All mold designs shall contain a detailed electrical connection diagram.

C. 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:

1. Hydraulic motors shall be specified by the Tooling Engineer or PO.
2. Motors shall be marked to identify “in” and “out” rotation ports except where an approved rack drive unscrewing is used.
3. Preferred hydraulic cylinders shall be 2000 PSI with proximity switches as required.
4. Hydraulic cylinders shall be Parker, Miller Brand or approved equivalent.
5. All core pull or unscrewing molds shall have the mold mechanism sequence clearly stamped on operator side of mold.
6. 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.
7. 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

D. 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 shall be approved in writing by Tooling Engineer.

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

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

B. Requirements

1. All electrical connectors in junction box shall be XXXX pin connectors or Equivalent. Both power and thermocouple connectors are ‘male’ type on the mold junction box and are ‘female’ type on the temperature controller cables.
2. 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.
3. All heater and thermocouple junction boxes shall be securely mounted to the “top” half of the mold wherever possible.
4. The hot runner manifold shall have a locating ring and bushings per table Hardware General Requirements unless otherwise noted by Tooling Engineer.
5. 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.
6. All hot runner or valve gate systems molds shall have an insulation plate securely attached to front face of mold.
7. Prefer manifolds to have leader pins for ease of assemble wherever possible.

5. Mold Safety Guidelines

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

A. Break sharp corners and edges wherever possible.
B. Guard pinch points such as in unscrewing mold cylinder structures.
C. Locate eyebolt holes in large plates and large inserts.
D. Provide a lift hole at the center of the mold's gravity.
E. Provide a mold strap to prevent unintended opening of the tool.
F. All eyebolt holes should be inch standard.

6. Mold Identification

All molds will be identified with the following:

A. Owner
B. Owner tool ID (when avaailable)
C. APP tool ID
D. Mold Maker tool ID
E. Part Number, (s) and cavity count
F. Mold Number
G. Mold Manufacture Date
H. Mold Weight, (pounds)
I. Mold Units (mm/in)

7. Documentation

All production molds, shall be supplied from the moldmaker with a full mold documentation package in electronic format that includes:

A. Electronic copies of all detailed 3D CAD files and mold drawings in suitable format.
B. Bill of materials for all materials and components including type of steel/material and hardness where appropriate.
C. Detailed plan view of assembly drawings including core and cavity halves.
D. Detailed layouts of all inserts, (front, top, right, and bottom).
E. Section drawings of all critical areas such as slides, critical mold details, gates, etc.
F. Runner, gating, and ejector pin layout, (size and location).
G. Detailed hot runner or valve gate drawings showing complete manifold, all hot runner components, electrical wiring diagram and bill of materials.
H. Detailed water line and cooling diagram.
I. Documentation of all mold and molding machine process data from Moldmaker Qualification Approval of mold at moldmaker.
J. Documentation of actual mold steel dimensions, (all cavities), for all dimension identified as critical according to the approved Part Drawing. Tooling Engineer to determine format of documentation.
K. Documentation of actual mold steel dimensions, (all cavities), for any additional dimension or mold detail as requested by Tooling Engineer. Tooling Engineer to determine format of documentation.
L. Certifications for steel and components.
M. Recommended spare parts list and suppliers of critical, potential high wear, and long lead time items.
N. Recommended mold maintenance checklist and maintenance intervals of critical, potential high wear, and long lead time components.
O. Moldmaker 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 moldmaker with documentation of any mold revisions or changes made to mold, (if applicable). Tooling Engineer will confirm mold approval date to moldmaker.
P. Certifications from suppliers shall be in English or pertinent portions translated into English.

8. Mold Approval

The mold approval procedure shall consist of two stages:

A. 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.

1. The mold shall run long enough duration to normalize all parameters of the mold and of the molding machine.
2. Once normalization is achieved, parts from the mold shall be gathered and identified by shot number and by cavity ID number. Typical runner systems (if any) shall be submitted as wel.
3. 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. Molds shall not be approved as ready to ship from Moldmaker without full authorization of Tooling Engineer.

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

Designated Manufacturing Plant Qualification - All production molds shall be qualified by the Designated 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:

1. Sampling Procedure for Injection Molded Parts
2. Process Capability for Injection Molded Parts
3. Gage Repeatability & Reproducibility Study
4. Cooling Study
5. Process Dimension Correlation Study
6. Process Dimension window Study
7. Qualification & Certification of Injection Molded Parts

9. Shipping

Preferred:

Heavy gauge poly bag, vacuum evacuated, desiccant bags, fully crated.

Eliminate fluid from cooling lines, and spray the mold with a rust inhibiting mold spray.

Inhibit mold from moving in the crate.

10. Approved Supplier Standards

All production molds, shall be constructed using only approved steels, materials, and components as identified in this Mold Standard. All steels, materials, and components designated as ‘Equivalent’ used to construct production molds shall be approved by the Tooling Engineer prior to start of mold construction.

ITEM	PREFERRED SUPPLIERS	Class 101	Class 102	Class 103	104	105
Mold Base	DME, Progressive, LKM, Hasco	SS Hardness:HB 170-360 Steel: 420 SS, LKM420H	Hardness:HB 170-220 Steel: S50C, S55C, 1050, 1055		Mild Steel/ Aluminum/	Mild Steel, Aluminum
Tool Steel	DME, LKM, Hasco	H13, SS	H13, SS		P20, Aluminum	P20, Mild Steel, Aluminum

ITEM	PREFERRED SUPPLIERS	Class 101	Class 102	Class 103	104	105
Hot Runner and Valve Gate Manifolds and Components	Supplier:_____ Model: _____					
Hot Runner and Valve Gate Temperature Controllers	Supplier: _____, Model: _____					
Cycle Counters						
Locating Ring	Series #: _____					
Support Blocks/Pillars		Pre-hardened to 35RC or equivalent				
Cavities and Cores	Cavity _____, Core _____ . Each steel, hardness and treatment should be selected to suit the steel and application.					
Leader Pins & Bushings		Self Lubricting	Self Lubricting			
Parting Line Interlocks						
Guide Bushings	self lubricated					
Ejector Pins, Core Pins, Sleeves						
Daters						
Lifting Strap						
Water Fittings	Progressive Components, DME, Jiffy type or equivalent quick disconnect fittings.		stainless steel or brass.			

ITEM	PREFERRED SUPPLIERS	Class 101	Class 102	Class 103	104	105
Bubblers, Bafflers		SS preferred, brass	SS, Brass			
Parting Line Sequence Control						
Cavity Pressure Transducers						
Undercut Release Lifters						
Limit Switches						
Three Plate Puller Pin Bushings						
Treatments/Coatings						
Mechanical Plate Staging Device						
Side locks						
Wear Plates		Ampco or Lamina, grease grooves	Ampco or Lamina, grease grooves			

11. Definitions

Term	Definition
General	
Tool Life Cycles (up to)	Number of molding cycles the tooling should produce
2D Design Drawings	See Documentation
3D Design Drawings	See Documentation
Component ID	Non-hardware items marked with identification traceable to the mold documentation
Tool Steel ID	Steel identification traceable to the mold documentation
Spare Wear Parts	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

Spare Parts List and suppliers	List of all spare parts and suppliers as part of the Documentation
Fully Automatic Operation	Mold shall run fully automatically without and operator. Robot designed auto-operation allowed
DFM Report	Design for Manufacturing Report shall be completed and approved before mold build. All part model changes shall be approved. Report include: KO locations, gate locations, parting line, split lines, mold flow analysis (when required), cosmetic issues, dimensional issues
Cpk Requirement	Required Cpk requirement for critical dimensions
Cycle Time Target	Mold cycle time shall meet or exceed targets while producing parts within the Cpk requirements
Critical Dimensions	Percentage of print tolerance to nominal.mold cavity dimensions of critical dimensions shall be held within.
Minor Dimensions	Percentage of print tolerance to nominal.mold cavity dimensions of critical dimensions shall be held within.
Self Lubricating Hardware	Hardware that sees movement should be self lubricating per hardware requirements.
Certified Tool Steel	Tool steel shall be certified from steel provider.

Mold Base

Thermocouple ports	Ports for type J thermocouples in A & B plates
Stock Hardware Components	No customer hardware components allowed.
Sprue Bushing	Sprue bushing required
Bushings	Bushings on all pins required.
Self Lubricating Bushings`	Bushings must be self-lubricating (graphite, etc).
Side Locks	Straight parting line interlocks shall be on both sides of vertical and horizontal axis wherever possible.
Mold Plates Doweled	Multiple dowel pins shall be installed between plated to insure proper alignment of plates
Dissimilar Metals	All steels moving against one another shall be of a dissimilar material and if hardened shall have a hardness differential of at least 4-7 Rockwell “C”
Safety Straps	Mold base shall be provided with adequate safety straps installed across parting line to insure mold does not open during shipment, installation, or removal.
Chamfered Plates	All mold base plates to be chamfered approximately 1/16 inch X 45 degrees

Actions

Cam/Moving Features wear plates	All slides shall have wear plates with grease grooves.
Positive Stops	Positive stops required for cams
Hardened	Cam hardness requirement
Hand Load Inserts Allowed	Hand load inserts allowed for undercuts and other features.

Standard Components for actions	No custom components allowed

Runner System

Full Hot Runner	Full hot runner system, direct to part gating
Inserted Runner	Runner shall be an insert.
Inserted Gates	Gates shall be an insert

Cooling

Plated Water Lines	Water channels to be flash chromed when using steel other than 420 (or stainless).
ID Ports	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 also be identified by their appropriate level on mold base.
Recessed fittings	Water inlets and outlets shall be recessed and installed below the mold base surface wherever possible

Cavity & Cores

Cavities/Cores Inserted	Cavity and cores shall be inserted and not cut directly into mold plates.
Hardened	Cavity and core hardness requirement
Plated/Coated	Coating or plating required to protect core and cavity
Hardened Core Pins	Shall be through hardened
Removable mold inserts in Press	Mold inserts shall be removable while mounted in the press without major disassembly
Cavity # Marking	Multi-cavity tools shall have cavity identification on parts.
Venting	Excellent venting is required and shall be in accordance to plastic resin specifications. Last to fill areas shall always have appropriate venting to insure ease of processing. Deep pockets shall be vented wherever possible.
Insert Fragile Features	Features prone to damage shall be replaceable.

Ejection

Guided Bushings	Ejector plates shall run on guided bushings. Recommend four pins and bushings wherever possible
Plate Return Switches	Ejector plate return switches required.
Return Pin	Return pin on ejector plate.
Hardened Pins	Ejector pins shall be through hardened.
Hardened Sleeves	Ejector sleeves, when utilitzed, shall be through hardened.
Nitrided Sleeves	Ejector sleeves, when utilitzed, shall be nitrited for wear.
Standard SPI Pattern	Molds with utilize SPI standard knockout pattern

Spring Return	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.
Manual Ejection Allowed	Part may be ejected manually by an operator.

APP Doc ID:

5 630

Groups:

Quality Documents [3]