Standard for Mold Manufacturing Process

1. Purpose and scope of application

To ensure the rationality and consistency of the mold making and machining process, optimize the machining process, and improve the progress of mold making, it is hereby to lay out this standard.

2. Standard for Mold Machining Process

When preparing the process card, the process technician shall indicate process allowance, the direction of allowance, requirements of roughness, and precautions in detail in the process card.

Preparation principle of machining process flow card: On the premise of ensuring accuracy, and quality, equipment with high machining efficiency shall be used preferentially. The machining efficiency of milling machine, CNC, and grinding machine is higher than that of wire-electrode cutting, and electrical pulse, and especially, the machining efficiency of electrical pulse is the lowest. Dimensions on drawings shall not be modified randomly (only the technician is permitted to modify).

Principle of machining reserved allowance: For workpieces to be machined under heat treatment, prior to heat treatment, the dimension of feed preparation for appearance shall have the additional reserved allowance of 0.25 mm for the grinding machine on the single side; for parts of mold core and mold insert, which need to be roughly machined by CNC, the reserved allowance on the single side is 0.2mm; the reserved allowance of appearance for the rough milling of the fitter milling machine on the single side is -0.5mm; for workpieces that need to be machined by the grinding machine upon wire cutting, the reserved allowance of formed parts on the single side is 0.05mm, and the grinding allowance of 0.1mm is reserved for the rough machining of appearance; and upon CNC finish machining, and electrical pulse, mirror polishing shall be implemented, with the polishing allowance of 0.03mm on the single side.

Requirements on machining accuracy: The manufacturing accuracy of mold dimensions shall fall within the range of ～0.02mm; the perpendicularity shall fall within the range of ～0.02mm; the coaxiality shall fall within the range of ～0.03mm; and the parallelism of upper and lower planes of parting surfaces of movable and fixed molds shall fall within the range of ～0.03mm. Upon mold closing, the clearance between parting surfaces is smaller than the flash value of formed plastics. The parallelism of fitting surfaces of the rest mold plates shall fall within the range of ～0.02mm; the quality of fit of the fixed part shall fall within the range of ～0.02mm; in case of no plug-in requirements or small influence on dimensions in terms of the small core, the clearance fit of ～0.02mm on both sides can be selected; and the quality of fit of the sliding part includes H7/e6, H7/f7, and H7/g6. Note: In case of any mold insert attached to the step on the mirror polished surface, the fit shall not be too tight, or else, when the mold insert is knocked backwards from the front side, the mirror polished surface is easy to damage by the tool for knocking; and in case of no influence on product dimensions, the clearance fit of ～0.02mm on both sides can be selected.

Principle of removal of electrodes by CNC: In terms of the cavity and core of the mold, the major electrode for appearance shall be removed prior to the removal of other major electrodes, and finally, local electrodes are removed; for the electrode for the appearance of the fixed mold, overall machining shall be considered, wire-electrode cutting can be implemented for undercutting where CNC is inaccessible to ensure the appearance of the fixed mold is integral, without lapping defects; reinforcing ribs, fins, and posts in which the depths of the movable mold are similar shall be machined on one electrode together; deeper fins shall be equipped with mold inserts, and lateral electrical discharge machining shall be implemented separately to prevent carbon deposit during electrical pulse; the electrode of the movable mold shall avoid the case that undercutting must be conducted by wire-electrode cutting upon milling by CNC, and if

necessary, it is necessary to split the electrode or conduct wire-electrode cutting directly; and in case of interval exceeding 35mm for rib parts and ribs or posts of the movable mold, it is necessary to make them separately to save copper materials.

Pulse translation clearance table:

Classification of electrodes	Spark gap	Current	Special	Current	Detailed description of special electrode	Rem arks
Big electrode (appearance or principal part of product)	Rough blanking s		Rough blanking s	7A	Principal electrode, local dimension≤1m m	
	Fine blanking s		Fine punching s	4A		
Common electrode (shut-off and kiss-off, which is smaller than product appearance)	Rough blanking s		Rough blanking s	5A	Common electrode, local dimension ≤1mm	
	Fine blanking s		Fine punching s	3A		
Rib electrode	Rough blanking s		Rough blanking s	5A	The rib electrode is higher than 8mm	
	Fine blanking s		Fine punching s	3A		
Special rib (-0.7mm)	Fine blanking s					

CNC machining principle: For parts of mold cores and mold inserts, where CNC rough machining is required, the reserved allowance on the single side is 0.2mm; for workpieces that need to be accurately machined by CNC, CNC can machine cavity and core of the mold, which are in place, under the permission of product appearance; and CNC machining is preferred, and in case of failure in the machining of the electrode that is place, it shall be machined with electrical pulse.

Machining process of movable and fixed mold cores: ① Preparation of materials; ② Machining of milling machine: Drilling of water carrying holes (the distance from the deepest position of the choke plug of the water carrying hole to the water carrying hole is 3 to 4mm), drilling and tapping of wire threading holes and threaded holes, drilling and reaming of center holes, mold numbering, benchmark angle, and demising of hanging table; ③ CNC machining: Rough machining; ④ Machining by heat treatment: Indicate hardness requirements; ⑤ Machining by grinding machine: Grinding of six-sided angle square, the appearance is based on the fitting dimension of the mold frame during grinding (in case of one mold core, the boundary dimension is 0.03mm-0.05mm smaller than the drawing dimension, and in case of two mold cores, the sum of the boundary dimensions of two mold cores in the spliced direction is 0.03mm-0.05mm smaller than the drawing dimension)⊥, ∥, and the part that can be formed by the grinding machine must be formed by grinding; ⑥ In case of any mold core that is accurately machined by CNC, it shall be accurately machined by CNC, and in case of any word and mold number on the cavity, it is necessary to conduct lettering; ⑦ Wire-electrode cutting: Central thread machining mold insert holes, lifter holes, center holes, sprue holes, and other holes; ⑧ Electro-discharge machining: Separate machining as indicated by drawings and pulse; ⑨ Polishing: The roughness and requirements of polishing shall be indicated on the process flow card, the polishing area is

indicated on workpieces with the marking pen, and where there are requirements on the mirror surface, but failure to meet the requirements within one cycle, rough polishing can be conducted, and upon mold testing, elaborate polishing is conducted; ⑩ Assembly; ⑪Mold testing.

Machining process of movable and fixed mold cores: ① Preparation of materials: The process technician, according to the sizes and shapes of workpieces, defines whether or not single workpiece machining or multi-workpiece machining is conducted, and in case of multi-workpiece machining, the process technician shall make drawing for the machining arrangement of workpieces; ② Machining by milling machine: The fitter conducts machining and drill water carrying holes according to the drawings of workpieces or the arrangement drawing made by the process technician (the distance from the deepest position of the choke plug of the water carrying hole to the water carrying hole is 3 to 4mm), drilling and tapping of wire threading holes and threaded holes, drilling and reaming of center holes, mold numbering, benchmark angle, and demising of hanging table; ③ CNC machining: Rough machining; ④ Machining by heat treatment: Indicate hardness requirements; ⑤ Machining by grinding machine: Six-sided angle square is ground, and the appearance is ground accurately ⊥, //, and the part that can be formed by the grinding machine must be formed by grinding; ⑥ In case of any mold core that is accurately machined by CNC, it shall be accurately machined by CNC, and in case of any word and mold number on the cavity, it is necessary to conduct lettering; ⑦ Wire-electrode cutting: Central thread machining mold insert holes, lifter holes, center holes, sprue holes, and other holes; ⑧ Electro-discharge machining: Separate machining as indicated by drawings and pulse; ⑨ Polishing: The roughness and requirements of polishing shall be indicated on the process flow card, the polishing area is indicated on workpieces with the marking pen, and where there are requirements on the mirror surface, but failure to meet the requirements within one cycle, rough polishing can be conducted, and upon mold testing, elaborate polishing is conducted; ⑩ Assembly; ⑪Mold testing.

Machining process of shaped mold inserts:
2.8.1: ① Machining by wire-electrode cutting: During medium-speed wire cut, the boundary dimension shall be accurate (view A/B), and during pulling-on, the allowance of the grinding machine is reserved for thickness, and rough machining is implemented at the forming position; ② Machining by grinding machine: Thickness and gradient of grinding, and forming; ③ Electro-discharge machining; and ④ Polishing.
2.8.2: ① Machining by wire-electrode cutting: During medium-speed wire cut of appearance, mold insert holes, and center holes, dimensions shall be accurate (view C), and rough machining is implemented at the hanging table and the forming position; ② Machining by grinding machine: Height, hanging table, and gradient are ground for forming; ③ Electro-discharge machining; and ④ Polishing.

Simple machining process of mold inserts: ① Machining by wire-electrode cutting: During fast cutting, the allowance of the grinding machine is reserved for appearance (view A/B), and during pulling-on, the allowance of the grinding machine is reserved for thickness; ② Boundary dimensions shall be ground accurately, and the hanging table and gradient are ground for forming; ③ Electro-discharge machining; and ④ Polishing.
Machining process of round mold inserts: ① Centerless grinding machine: The boundary dimensions are ground accurately; ② Machining by grinding machine: Undercutting at the

hanging table; ③ Machining by wire-electrode cutting: Fast-cutting length (the allowance of 0.1mm for grinding machine is reserved on single side), and center hole and exhaust vent are cut; and ④ Machining by grinding machine: The length is ground for forming.
Machining process of lifter: ① Machining by wire-electrode cutting: During medium-speed wire cut of appearance, the allowance of the head plug-in surface is reserved for grinding-in, the rest dimensions shall keep accurate during grinding, during pulling-on, the allowance is reserved for thickness, and during the rough machining of the I-groove, the allowance of grinding machine is reserved; ② Machining by grinding machine: Thickness and I-groove are ground; ③ Assembly; ④ Pulse ⑤ Polishing; ⑥ Oil groove is formed by the milling machine.

Machining process of lifter set: ① Preparation of strips by fitter: 1.5mm is reserved respectively on both sides for height, 0.5 mm is reserved respectively on both sides in width direction, and 5 mm is reserved respectively on both sides in length direction, which facilitate wire-electrode cutting and clamping; ② Machining by milling machine: Drilling and tapping of threaded holes; ③ Heat treatment; ④ Machining by grinding machine: Six-sided angle square is ground, and width is ground accurately; ⑤ During the fast-cut wire-electrode cutting, the I-groove shall be accurate, during pulling-on, the allowance of the grinding machine is reserved for thickness, and height is +1.2 mm; and ⑥ Machining by grinding machine: The boundary dimensions of grinding machine, the ejector pin plate is equipped, and height is +1mm.
Machining process of lift guide block: ① Machining by wire-electrode cutting: During fast cutting of appearance, the allowance of grinding machine is reserved; ② Machining by grinding machine: Six-sided angle square is ground, and appearance is ground accurately; ③ Machining by milling machine: Wire threading holes, and penetration of screws through holes; and ④ Machining by wire-electrode cutting: Fast cutting of lifter guide hole.
Machining process of slider base: ① Preparation of materials; ② Machining by grinding machine: Six-sided angle square is ground, and appearance is ground accurately; ③ Machining by milling machine: Drilling of wire threading holes, and drilling and tapping of threaded holes; ④ Machining by wire-electrode cutting: Fast cutting of slider angle pin holes; and ⑤ CNC finish machining, the forming position shall be milled accurately.
Machining process of pressure block: ① Preparation of materials; ② Machining by milling machine: Penetration of screws through holes, and rough machining at forming position (allowance of grinding machine is reserved on single side); and ③ Machining by grinding machine: Six-sided angle square is ground, and appearance is ground accurately for forming.
Machining process of locking block: ① Preparation of materials; ② Machining by grinding machine: Six-sided angle square is ground, and appearance is ground accurately; ③ Machining by wire-electrode cutting; fast-cut forming; and ④ Machining by milling machine: Drilling and tapping of threaded holes.
Machining principle of ejector pin holes: Ejector pin holes with Φ3 above (including Φ3, Φ4, Φ5, and Φ6) are drilled and reamed with the milling machine; and ejector pin holes with Φ3 below or non-standard holes are machined with wire-electrode cutting, and clearance is ensured at the bottom.
Machining principle of wire threading holes: During the wire-electrode cutting of holes, the circumference of the inner wall is above Φ3 (including Φ3), it is necessary to drill wire threading holes.

During the machining of trade marks, the mold for mirror polishing shall be used, ① The allowance is reserved at trade marks upon the CNC finish-milling of the mold core; ② Medium-speed wire cut: Trade mark mold insert hole; ③ Electro-discharge machining: The depth of the hanging table is accurate; ④ The trade mark core is equipped, and the fixture is installed; and ⑤ Allowance at trade marks is made up with pulse; and ⑥ Polishing.

Machining process of mold base: ① Machining by milling machine: Interior casing is chamfered, threaded hole, center hole, waterline hole, sprue cup through hole, and lifter through hole are drilled; ② CNC machining: Counter bore of iron sprue cup, lifter set hole, guide block hole, slide groove, and plate A of hot runner mold shall be machined through CNC, and mold leg is lettered.

Core machining process of mounting rack with grid reinforcing ribs: During the machining of core ribs of such mounting rack, different machining processes are selected based on different mold categories. ① For Class A molds, we use the integral electrode to ensure the uniformity of products; and ② During the selection of machining processes of non-Class A molds, adjustment can be conducted based on the actual machining volume. The electrode can be divided into split electrode and integral electrode, and if the rib is the straight slot, wire-electrode cutting can be conducted for rough machining before fine trimming by grinding machine.
The machining flow of part of workpieces (e.g., multi-functional dual-jack core) that need wire cut fixture or electrode, and workpieces that need batch pulses is as below: ① CNC arrangement drawing is made; ② The fixture or the electrode is machined by wire-electrode cutting based on the dimensions of the drawing; ③ Upon wire-electrode cutting, if the electrode needs to be machined by CNC, it is delivered to CNC, and the fixture is delivered to the fitter; ④ The electrode is machined by CNC, and the discharge diagram is made; ⑤ Pulse machining; and ⑥ Polishing.
Calculation of height of support pillar: The height of the support pillar for the mold base with less than 3030 is -0.1mm higher than the mold leg, the mold base with 3030 is 0.1mm higher than the mold leg, the mold base with 3535 is -0.12mm higher than the mold leg, and the mold base with more than 3535 is -0.15mm higher than the mold leg.

Machining process of ejector pin:
2.24.1 ① For the grinding machine for ejector pins with Φ2 and above, the allowance of the grinding machine is reserved for cutting length; and ② Machining by grinding machine: Length shall be accurate (machined by the fitter).
2.24.2 ① During the wire-electrode cutting of ejector pins with less than Φ2, cutting dimensions shall be accurate.
2.24.3 ① For the wire-electrode cutting of flat ejector pins and ejector sleeve, the allowance of the grinding machine is reserved for cutting length; and ② Machining by grinding machine: Length shall be accurate.

3. Machining process of special mold (test mold)
Design principle: If multiple products with the same injection molding material are made on one mold, splicing design is used preferentially.
Machining principle: Equipment with high machining efficiency is used preferentially. It doesn't have requirements on appearance, which only needs to ensure assembly dimensions.

4. Application of process

The above mentioned is only the basic machining process, and special cases are required separately.

Each machining group shall machine in strict accordance with the requirements of the process card, and in case of improper process, please reflect it to the superior.

Prepared by: Reviewed by: Approved by: