

Precision in Mold Making: General Mold Standards & Classifications at GEMS Manufacturing

INTRODUCTION

This general molding making guide within Mold Standards & Classifications aims to simplify the process of obtaining and using molds, promoting transparency and collaboration between buyers and vendors for effective outcomes. As a reputable mold manufacturing factory in the industry, GEMS Manufacturing is committed to addressing the mold standard with precision and professionalism.

Molders and Moldmakers within our facility are adept at employing diverse methodologies, ranging from rapid and cost-effective prototype molds to the construction of high-quality, long-lasting production molds. The challenge lies in ensuring everyone involved is "on the same page" during the mold quoting process.

To address this problem, GEMS Manufacturing meticulously outlines our standard mold specifications, meticulously serving as the benchmark for quoting standard production molds within our esteemed facility. Our specifications are crafted with a commitment to excellence, aligning with industry best practices and standards.

THE GENERAL SPECIFICATION OF MOLD STANDARDS

1. **Material Selection:**

When choosing materials for molds, engineers consider factors crucial to the molding process. Commonly, tough steels such as P20, NAK80, H13, 2344, 2738 or S136 stainless steels are preferred for their exceptional qualities. For example, P20 is known for its versatility and ease of machining, while H13 provides high heat resistance, making it suitable for prolonged production cycles. The choice of material depends on the specific requirements of the molding process, the type of material being molded, and the expected production volume.

2. **Mold Base Hardness:**

The mold base serves as the foundational structure of the entire mold. Its hardness, often measured on the Rockwell C scale, is a critical aspect of ensuring the mold's durability and resistance to deformation. Achieving a minimum hardness of 28 R/C is standard practice to maintain structural integrity under the pressures and forces exerted during the injection molding process. Proper heat treatment techniques, including quenching and tempering, are employed to attain the desired hardness, contributing to the longevity and stability of the mold.

3. **Surface Hardening:**

Surface hardening is a specialized treatment applied to specific mold components, especially cavities and cores. These components are subjected to high levels of wear and abrasion during the molding process. By increasing the surface hardness to a minimum of 48 R/C, typically through techniques like nitriding or nitrocarburizing, engineers create a durable outer layer that withstands the harsh conditions of molding. This surface hardening ensures the dimensional accuracy and longevity of critical mold features.

4. **Tolerances:**

Tolerances in mold engineering refer to the allowable deviation from the intended dimensions. Achieving tight tolerances is paramount in injection molding to ensure that the molded parts precisely match the design specifications. Advanced machining processes, including Computer Numerical Control (CNC) milling and Electrical Discharge Machining (EDM), play a pivotal role in achieving these precise tolerances. CNC milling utilizes computer-controlled cutting tools for accurate and consistent material removal, while EDM employs electrical discharges for intricate shaping of hardened materials, ensuring the highest precision in mold components.

5. **Ejection System:**

The ejection system is a critical component in the mold design, responsible for efficiently and reliably removing the molded part from the mold cavity. Guided ejection ensures that the part is guided out in a controlled manner, minimizing the risk of damage or distortion. Parting line locks, another essential feature, secure the mold halves during the injection molding process, preventing misalignment that could compromise part quality. The combination of guided ejection and parting line locks contributes to smooth and consistent ejection cycles, ensuring the integrity of the molded parts.

6. Temperature Control:

Temperature control is a key consideration in mold engineering to manage the heat generated during the molding process effectively. Cooling channels strategically integrated into the mold, specifically in cavities, cores, and slide cores, play a crucial role in regulating temperature. The goal is to achieve uniform cooling across the mold, preventing issues such as warping or uneven curing of the molded material. Engineers design these cooling channels with precision, considering the material properties, mold geometry, and heat dissipation requirements for optimal temperature control.

7. Wear Plates and Slide Components:

Wear plates are integral components in mold design, strategically placed in areas prone to friction and wear. These plates act as protective layers, minimizing the impact of abrasion and extending the lifespan of moving parts, such as slides. In engineering wear-resistant solutions, material selection is crucial. Engineers often opt for materials with high hardness and wear resistance, ensuring that wear plates effectively reduce friction and withstand the repetitive movements inherent in the molding process. The inclusion of wear plates enhances the overall durability and reliability of the mold, contributing to prolonged operational efficiency.

8. Runner and Gate Design:

The design of runners and gates is a critical aspect of mold engineering that directly influences the efficiency of the injection molding process. Runners are channels through which molten plastic flows into the mold cavity, while gates control the entry point of the plastic or metal. Engineers meticulously design these elements to minimize waste, ensure uniform filling of the mold, and prevent defects such as air traps or excessive shear. The optimization of runner and gate design involves considerations of material flow, pressure distribution, and cooling to achieve the desired balance between production efficiency and high-quality part formation. Computer-aided simulations and flow analyses assist engineers in fine-tuning these designs for optimal molding outcomes.

9. Maintenance Recommendations:

Maintenance is a crucial aspect of ensuring the lifecycle and consistent performance of molds throughout their operational life. Engineers incorporate proactive maintenance recommendations into the design, emphasizing regular inspections, cleaning, and lubrication of moving parts. The goal is to identify and address potential issues before they escalate, minimizing downtime and preventing disruptions to production. Detailed documentation of the mold's construction, materials used, and wear patterns provides valuable insights for maintenance personnel. Engineering molds with accessibility in

mind, allowing for easy disassembly and inspection of critical components, facilitates efficient maintenance procedures. By adhering to a comprehensive and maintenance plan, engineers contribute to prolonged mold life and sustained production quality.

10. Corrosion Resistance:

Corrosion resistance is a crucial consideration in mold engineering, particularly concerning cooling channels within the mold. Over time, corrosion in these channels can decrease cooling efficiency, leading to degraded part quality and increased cycle times. To address this, engineers employ corrosion-resistant materials for cooling channel plates or apply protective coatings. Stainless steels, known for their corrosion resistance, are commonly used in these applications. Alternatively, coatings such as nickel plating provide an additional layer of protection against corrosion. By integrating corrosion-resistant measures into the mold design, engineers ensure consistent cooling performance and prevent the detrimental effects of corrosion on molded parts.

11. Mold Classes and Cycles:

Mold classification into different classes guides engineers in tailoring the design to meet specific production requirements. Each class is associated with an expected cycle life and dictates the level of precision, durability, and cost-effectiveness required. Class 101 molds, which are designed for over a million cycles, demand meticulous engineering with a focus on precision machining, high-quality materials, and detailed mold design. As the mold class decreases, engineering considerations may involve trade-offs to accommodate shorter production runs and cost constraints while maintaining acceptable quality standards. Engineers carefully balance these factors to ensure that the mold design aligns with the intended production volume, cycle life, and overall cost-effectiveness.

12. Prototyping Considerations:

Prototyping molds present unique engineering challenges centered around cost-effective construction for limited production runs. Engineers prioritize materials that balance affordability with the ability to accurately replicate part geometries for prototyping purposes. The emphasis is on creating molds that can produce a small quantity of prototype pieces efficiently and economically. Depending on the specific requirements of the prototyping process, engineers may choose construction materials such as cast metals, epoxy, or other alternatives that offer sufficient strength for short production runs. The engineering approach involves optimizing the design for simplicity, cost-effectiveness, and the rapid production of prototype parts to facilitate testing and validation of design concepts.

13. Documentation Standards:

Comprehensive documentation is a cornerstone of effective mold engineering, providing a clear reference for mold makers, operators, and maintenance personnel. Engineers document detailed mold designs, including material specifications, machining processes, and assembly instructions. Advanced Computer-Aided Design (CAD) systems play a pivotal role in generating precise and detailed documentation. This documentation serves as a valuable resource throughout the mold's lifecycle, aiding in manufacturing, assembly, maintenance, and troubleshooting. By adhering to rigorous documentation standards, engineers ensure consistency, accuracy, and effective communication across all stages of the mold's development and use.

14. Quality Assurance:

Quality assurance in mold engineering involves implementing measures to ensure that molds consistently meet specified standards and produce high-quality parts. Engineers design molds with features that facilitate process monitoring, such as sensors for temperature and pressure. These features contribute to maintaining optimal molding conditions and detecting deviations that could impact part quality. Additionally, engineers design molds for ease of inspection and quality control, incorporating features that enable thorough examination of critical components. Iterative testing and validation processes form a crucial part of the engineering approach, allowing engineers to refine mold designs and manufacturing processes continually. By prioritizing quality assurance in mold engineering, engineers contribute to the production of reliable, defect-free parts.

15. Compliance and Certification:

Mold engineering must align with industry and regulatory standards to ensure safety, quality, and environmental compliance. Engineers carefully consider and adhere to established standards, incorporating design features and manufacturing processes that meet or exceed these requirements. Thorough testing and validation procedures are integrated into the engineering process to demonstrate compliance and obtain certifications. These certifications serve as assurances that the mold meets the necessary criteria for safe and effective operation. By prioritizing compliance and certification in mold engineering, engineers contribute to the reliability, consistency, and safety of the molding process while adhering to industry best practices and regulatory guidelines.

SPI MOLD CLASSIFICATIONS AND FEATURES

1. CLASS 101 MOLD

- **Cycles:** One million or more
- **Description:** Built for extremely high production, this is the highest priced mold made with the highest quality materials.
- **Detailed Features:**
 - Mold base minimum hardness of 28 R/C.
 - Molding surfaces (cavities and cores) hardened to a minimum of 48 R/C.
 - All other details (sub-inserts, slides, heel blocks, etc.) made of hardened tool steels.
 - Guided ejection, slides with wear plates.
 - Temperature control provisions in cavities, cores, and slide cores.
 - Corrosion-resistant material or treatment for cooling channel plates/inserts.
 - Parting line locks required.

2. CLASS 102 MOLD

- **Cycles:** Not exceeding one million
- **Description:** Medium to high production mold, suitable for abrasive materials and/or parts requiring close tolerances. High quality, fairly high priced.
- **Detailed Features:**
 - Mold base minimum hardness of 28 R/C.
 - Molding surfaces hardened to a 48 R/C range.
 - Temperature control provisions in cavities, cores, and slide cores.
 - Parting line locks recommended.
 - Guided ejection, slide wear plates, corrosive-resistant temperature control channels, plated cavities may be required depending on anticipated production quantities.

3. CLASS 103 MOLD

- **Cycles:** Under 500,000
- **Description:** Medium production mold, a popular choice for low to medium production needs. Common price range.

- **Detailed Features:**
 - Mold base minimum hardness of 8 R/C.
 - Cavity and cores must be 28 R/C or higher.
 - Other extras optional.

4. CLASS 104 MOLD

- **Cycles:** Under 100,000
- **Description:** Low production mold, used for limited production with non-abrasive materials. Low to moderate price range.
- **Detailed Features:**
 - Mold base can be mild steel or aluminum.
 - Cavities can be aluminum, mild steel, or other agreed-upon metals.

5. CLASS 105 MOLD

- **Cycles:** Not exceeding 500
- **Description:** Prototype only. Constructed in the least expensive manner possible for a very limited quantity of prototype parts.
- **Construction:**
 - May be constructed from cast metal, epoxy, or any material offering sufficient strength for minimum prototype pieces.

STATEMENT

The classifications presented here are fundamental guidelines within Mold Standards & Classifications. They help in obtaining quotes and placing orders for standard mold types, aiming to streamline the process and enhance customer satisfaction.

It's important to note that these classifications, falling under Mold Standards & Classifications, focus solely on mold specifications. They don't guarantee workmanship quality. Therefore, it's crucial for buyers to engage with reliable vendors following Mold Standards & Classifications. The variability in part design and mold conditions, as per Mold Standards & Classifications, means we can't guarantee mold life. This guide aims to provide approximate cycles for each mold type within Mold Standards & Classifications,

excluding wear from material abrasion, poor mold maintenance, and improper molding techniques.

Maintenance responsibilities are clearly outlined in Mold Standards & Classifications: the moldmaker isn't responsible for routine maintenance. Molders are expected to handle standard maintenance tasks as per Mold Standards & Classifications. When deciding on the mold classification within Mold Standards & Classifications, it's essential to carefully consider mold rework costs. Importantly, this document within Mold Standards & Classifications doesn't serve as a warranty or guarantee by GEMS Manufacturing for the outlined classifications or specifications.

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