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Permanent Mold Life

A permanent mold is tooling, and it is replaced or repaired on a schedule its life sets. That life runs from as few as 100 pours to as many as 250,000, and the published guidance puts the difference down to operating variables plus the way the mold and its cores are designed.

Reference only. This is a reference summary of published practice and it is not a specification of ours. Mold life figures are typical published values, and a different casting alloy, mold design or operating discipline will move them.

How long a permanent mold lasts

Mold life can vary from as few as 100 pours to as many as 250,000 pours or more. An aluminum piston mold can produce 250,000 castings before repair, 250,000 more after a repair, and as many as 3.5 million with repeated repairs and overhauls.

Magnesium alloys are kinder to a mold than aluminum alloys, because molten magnesium does not attack ferrous metal molds. Cast iron resists attack by molten aluminum better than steel does, while steel is weldable and easier to repair.

The variables that shorten mold life

Variable	Effect on mold life
Pouring temperature	The hotter the casting metal is poured, the hotter the mold is operated, which leads to rapid weakening of the mold metal.
Weight of casting	Mold life decreases as casting weight increases.
Casting shape	Mold walls must dissipate more heat from castings with thick sections than from those with thin sections. A large variation in section thickness sets up a temperature differential across the mold, and mold life falls as that differential grows.
Cooling methods	Water cooling is more effective than air cooling, but it substantially decreases mold life.
Heating cycles	A continuous run, with the mold held at a uniform temperature, gives maximum mold life. Repeated heating and cooling over a wide range shortens it.
Preheating the mold	Preheating to operating temperature with a gas flame or electric heaters greatly increases mold life. Thermal shock is one of the principal causes of mold failure.
Mold coating	The coating protects the mold from erosion and soldering by keeping the metal off the mold surface, and it increases mold life.
Mold material	The material chosen from the published selection sets the ceiling on mold life.
Storage	Improper storage leads to rusting and pitting of the mold surfaces, which reduces mold life.
Cleaning	Abrasive blasting, dipping in caustic solution and wire brushing are all used. Caustic is hazardous to the operator, and blasting and brushing cause excessive mold wear if they are not carefully controlled. Glass beads are the safest blast material.
Gating	A poor gating system reduces mold life greatly by causing excessive turbulence and washout at the gate areas.
Method of mold operation	The same materials are used on automatic and hand-operated equipment, but tooling on hand-operated equipment has the shorter life because of the abuse it takes. Tools on automatic equipment can last up to twice as long.
End use of the casting	Where the structural function counts for more than appearance, a mold can be run for more pourings before it is discarded.

How mold design shortens life

Variation in mold wall thickness and abrupt thickness changes without generous fillets cause premature failure by cracking. Small fillets and radii reduce life because checking and cracking start there, and projections in the cavity run extremely hot and are easily damaged on ejection.

Mold surface	Draft
Internal mold surfaces	3 degrees
External mold surfaces	2 degrees
Desirable practice	5 degrees

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Aobo Steel supplies tool steel to distributors and mold, tool and die shops, including H13, H11, H10, H21, D2, D3, O1, A2, S7, M2, M42, L6, P20 and 420 and 440C stainless. Forged or hot rolled, annealed or pre-hardened, cut to your sizes, with test certificates.

Source, Permanent Mold Casting, in ASM Handbook, Volume 15, Casting, ASM International, 1988.

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