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Permanent Mold and Core Materials

Permanent mold casting pours metal into a reusable metal mold under gravity. The mold and its cores are the tooling, and what they are made from is settled by the casting alloy, the size of the casting, the number of pours and the cost of the mold material.

Reference only. This is a reference summary of published practice and it is not a specification of ours. A different casting alloy, a different pour count or a different mold design will move the choice. Final selection is made against the casting drawing and the machine the mold runs on.

Recommended permanent mold materials

The three main columns are the number of pours the mold has to make, at 1,000, 10,000 and 100,000.

Casting alloy	1,000	10,000	100,000
For small castings (25 mm, or 1 in., maximum dimension)			
Zinc	Gray iron; 1020 steel	Gray iron; 1020 steel	Gray iron; 1020 steel
Aluminum, magnesium	Gray iron; 1020 steel	Gray iron; 1020 steel	Gray iron with AISI H14 inserts; 1020 steel
Copper	Gray iron	Gray iron	Alloy cast iron
Gray iron	Gray iron(a)	Gray iron(a)	Quantity not poured
For medium and large-size castings (up to 915 mm, or 36 in., maximum dimension)			
Zinc	Gray iron; AISI H11(b)	Gray iron; AISI H11(b)	Gray iron; AISI H11(b)
Aluminum, magnesium	Gray iron	Gray iron	Gray iron; AISI H11 or H14(c)
Copper	Alloy cast iron	Alloy cast iron	Alloy cast iron(d)
Gray iron	Gray iron(a)	Gray iron(a)	Quantity not poured

Recommended permanent mold materials, reproduced from Table 1 of Permanent Mold Casting. (a) Same composition as being poured. (b) AISI H11 is used when polish is required on medium-size castings. (c) For medium-size parts; large parts use gray iron with H11 inserts or solid H11 die steel. (d) For medium-size parts; large parts are not poured in this quantity.

Recommended core materials

Casting alloy	Recommended core materials(a)
Zinc	Sand, plaster, gray iron, 1020 steel
Aluminum, magnesium	1010 or 1020 steel, sand, plaster, H11 die steel or equivalent(b), carbon(c)
Copper	Sand, 1020 steel, gray iron, plaster(d), graphite(c)
Gray iron	Sand, graphite, carbon, gray iron

Recommended materials for small cores, below 76 mm (3 in.) in diameter and 255 mm (10 in.) long. (a) Materials are listed in descending order of preference. (b) Hardened to 42 to 45 HRC. (c) For use with relatively few pours. (d) For casting of aluminum bronzes.

Casting alloy	1,000	10,000	100,000
Zinc	Gray iron, 1020 steel	Gray iron, 1020 steel	Gray iron, 1020 steel
Aluminum, magnesium	Gray iron, gray iron with 1020 steel inserts(b), sand, plaster(b)	Gray iron(b), gray iron with 1020 or H11 inserts(b), sand, plaster(b)	Gray iron(b), gray iron with H11 inserts(b), H11 die steel
Copper	Sand	Sand	Quantity not poured

Recommended materials for large cores, above 76 mm in diameter and 255 mm long, from Table 3 of Permanent Mold Casting. (a) Descending order of preference. (b) Except for openings with complex shapes, which require expendable sand cores.

Relative machining cost of identical molds

Mold material	Relative machining cost
Gray iron	1.0
Cast low-alloy steel	1.44
Gray iron with tool steel inserts	1.73
Cast tool steel	2.16

Gray iron is taken as 1.0, and heat treatment is included where it is required.

Aobo Steel, tool steel supplier

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, Tables 1, 2 and 3 of Permanent Mold Casting, in ASM Handbook, Volume 15, Casting, ASM International, 1988.

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