

REFERENCE

Materials Selection Reference: Alloys and Resins

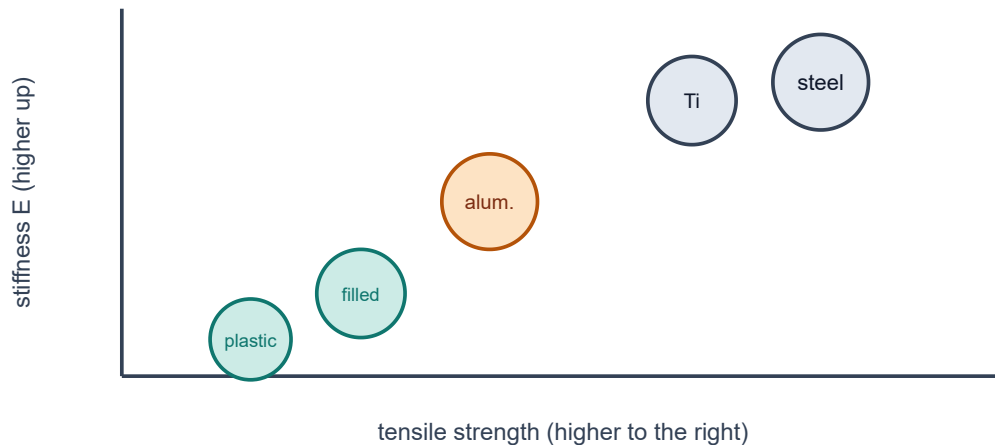
The metal and plastic families we work in, the properties that separate them, and how to narrow from a family to a grade that both performs and manufactures cleanly.

Material choice sets what a part can do and much of what it costs to make. A grade that is stiffer, tougher, or more corrosion-resistant than the job needs adds price and often machines or molds harder; one that falls short fails in service. This reference lays out the families we work in, the properties that separate them, and how to narrow from a family to a grade. The numbers are typical published values for screening, not lot-certified specifications.

Every property below comes from public sources: producer datasheets, the UNS and AISI/SAE designation systems, and standard references such as the ASM handbooks. Confirm the exact figure against the applicable specification for a given lot and temper before you commit a critical design.

Choosing a family

Stiffness and strength by family



Pick the family first by stiffness and strength, then the grade by finish, corrosion, and heat.

Work from function to family. Load-bearing metal parts start with aluminum or steel; corrosion or hygiene points to stainless or certain plastics; light weight favors aluminum, magnesium, or filled polymers; electrical or thermal conductivity points to copper alloys. Then pick the grade by the secondary needs: finish, temperature, wear, and cost.

Metals

Family	Common grades	E (GPa)	Tensile (MPa)	Notes
Aluminum	6061-T6, 7075-T6, 5052, 2024, 6063	~69	240 to 570	Light, machines well; 7075 strongest, 5052 for sheet, 6061 the all-rounder
Carbon and alloy steel	1018, 1045, 4140, 4340	~205	440 to 1280	Strong and low-cost; 4140 and 4340 heat-treatable; rusts unless coated
Stainless steel	303, 304, 316, 17-4 PH, 416, 430	~193 to 200	485 to 1310	Corrosion-resistant; 316 for marine and chemical, 303 and 416 free-machining, 17-4 PH hardenable
Copper alloys	Brass C360, C260, bronze C932, beryllium copper	~97 to 128	300 to 1400	Conductive; C360 the free-machining benchmark, bronze for bearings

Family	Common grades	E (GPa)	Tensile (MPa)	Notes
Titanium	Ti-6Al-4V	~114	1170	High strength-to-weight, corrosion-resistant, hard to machine
Magnesium, zinc (cast)	AZ91D, AM60B, Zamak 3, Zamak 5	~45, ~96	200 to 360	Die-cast; magnesium lightest structural metal, zinc casts finest detail

Machinability tracks with these families: free-machining grades (aluminum 6061, brass C360, stainless 303 and 416) cut fast and low-cost, while austenitic stainless (304, 316), titanium, and hardened tool steels cut slowly and cost more. A grade chosen for easy machining can lower part cost without changing function.

Plastics and resins

Resin	Class	Character	Typical use
ABS	Amorphous	Tough, easy to mold and machine	Housings, consumer parts
Polycarbonate (PC)	Amorphous	Very tough, clear, higher heat	Guards, lenses, enclosures
Polypropylene (PP)	Semi-crystalline	Chemical-resistant, living hinges	Containers, hinged parts
Nylon (PA6, PA66)	Semi-crystalline	Strong, wear-resistant, absorbs moisture	Gears, bushings, brackets
POM (acetal)	Semi-crystalline	Stiff, low friction, best-machining plastic	Gears, precision parts
PEEK, PEI (Ultem)	High-performance	High heat and chemical resistance	Demanding thermal or chemical parts
Glass-filled grades	Filled	Much stiffer, less shrink, more abrasive	Structural molded parts

Amorphous resins (ABS, PC, PEI) shrink little and hold tighter tolerances; semi-crystalline resins (PP, nylon, POM) are tougher and more chemical-resistant but shrink more, so their molded tolerances are looser. Glass fill raises stiffness and

cuts shrinkage but warps anisotropically and wears tooling, so treat a filled grade as its own material, not a stiffer version of the base resin.

Matching material to process

Not every grade runs in every process. Wrought bar and plate machine; sheet grades bend; die casting uses specific aluminum, zinc, and magnesium alloys; injection molding uses molding grades, which differ from the machinable cast or extruded stock of the same polymer. When you pick a material in a quote, we confirm it against the chosen process so the grade is one the process actually runs.

How FabWorks uses this

Our capability data ties each material to the processes that can run it and to the DFM thresholds, wall, radius, and tolerance, that depend on it, so when you choose a grade the engine checks your geometry against that grade rather than a generic default. Tell us the function, temperature, and environment and we will confirm a grade that both performs and manufactures cleanly.