

Materials: Ferrous and Non-Ferrous Metals

Ferrous metals

- Metals that contain iron and are magnetic are ferrous metals.
- They are prone to rust and require a protective finish to prevent corrosion.

Cast iron is brittle if thin, can be cast in a mould, has strong compressive strength, good electrical and thermal conductivity, but poor resistance to corrosion. It is used for gates, manhole covers, drains and vices.

High carbon steel, also known as tool steel, is hard and brittle, less malleable than mild steel and is a good electrical and thermal conductor. Uses include tools, screwdrivers, and chisels.

Low carbon steel or mild steel is ductile and tough, easy to shape, braze and weld, a good conductor of heat and electricity, but again corrodes easily. Popular for nuts and bolts, screws, bicycle frames and car parts.

Alloys

An alloy is a mixture of metals with an element to improve its working properties or aesthetics.

- Brass is an alloy of copper and zinc.
- Bronze is an alloy of copper, aluminium and/or nickel.
- Stainless steel is an alloy of iron and chromium, nickel and magnesium.

Non-ferrous metals

- Metals that do not contain iron and are not magnetic are non-ferrous metals.
- They are metals that do not rust.

Aluminium is lightweight, malleable and strong. A good conductor of heat and electricity. Used in drinks cans, cycle frames and saucepans.

Copper is very malleable and an excellent conductor of electricity and heat – perfect for plumbing and central heating applications. It is orange/brown when polished, but will oxidise green.

Silver is a precious metal used in jewellery, it is soft and malleable when hot, highly corrosion-resistant and a good conductor.

Alloys: properties and uses

Brass is a non-ferrous alloy that is strong, ductile and a good conductor of heat. It works well when cast, is golden in colour but darkens with age. Used for taps, door fittings, hinges, locks and door handles. Due to its workability and durability, brass is commonly used for musical instruments.

Bronze is another non-ferrous alloy. It is hard and corrosion resistant, making it useful for bearings (due to its low friction) and outdoor mechanical components and monuments. Darker than copper, it is more reddish-brown. Bronze is also used in nautical applications due to its corrosion resistance.

Stainless steel is a ferrous alloy that is shiny silver when polished. It is hard and tough with good resistance to stains and corrosion. Used extensively in kitchen sinks, cutlery and hospital equipment. Stainless steel is also used in architecture, aerospace and general transport.

Properties of metals

- **Hardness** – a metal's ability to withstand friction and abrasion.
- **Toughness** – how well a metal can resist fracturing when force is applied.
- **Elasticity** – the rate at which a metal distorts in size and shape under stress.
- **Conductivity** – how well a metal allows electricity or heat to flow through it.
- **Ductility** – the ability of the metal to be drawn or deformed without fracture.
- **Tensile strength** – the amount of load a metal can withstand before failure.
- **Malleability** – the metal's ability to be bent or shaped easily.

Finishing metals

Metal finishing is the process of placing a coating onto a metal for cleaning, polishing or improving the surface in a functional or visual context. Finishing is the last step in the manufacturing process to provide environmental protection and improve aesthetic qualities. Popular finishing processes for metals include electroplating, anodising, powder coating, hot blackening, brushing, sand blasting and buff polishing.

Metals availability

Metals are sold in a variety of forms including sheet, bar, rod, tube and angle.