



FERROUS AND NON-FERROUS METALS

When attempting a project based on resistant materials you must consider metals as part of your research. A vast range of metals exist and they fit in two categories, 'ferrous' and 'non-ferrous' metals. These metals can be used to build/manufacture an equally large range of items. Study the properties of the materials below, you may find that they are useful for your project. You may need to investigate metals further.

FERROUS METALS - Metals that contain iron.

NON-FERROUS METALS - Metals that do not contain iron

Physical properties

The table summarises some typical **properties** of metals and non-metals.

Metals	Non-metals
Shiny	Dull
High melting points	Low melting points
Good conductors of electricity	Poor conductors of electricity
Good conductors of heat	Poor conductors of heat
High density	Low density
Malleable	Brittle

Some **elements** have properties that are not typical. For example:

mercury (a metal) has a low **melting point** and exists as a liquid at room temperature
graphite, a form of carbon (a non-metal), has a high **boiling point** and is also a good **conductor** of electricity

A substance with a high **density** means it has a high mass for its size.

Malleable substances can be bent or hammered into shape without shattering, while **brittle** substances shatter when bent or hit.

Ductile means that a substance can be drawn out into a long wire without snapping or breaking.

Metal foams are a strong but lightweight modern material produced by injecting a gas or **foaming agent** into **molten** metal. Typically, only 5-25 per cent of the foam is the metal, and this allows the material to retain much of its strength but without the **density** or weight of a solid metal. Metal foams are often used in vehicles such as planes and cars as they absorb shock effectively if the vehicle crashes.



SOME FERROUS METALS AND PROPERTIES

NAME	ALLOY OF	PROPERTIES	USES
Mild Steel	Carbon 0.1 - 0.3% Iron 99.9 - 99.7%	Tough. High tensile strength. Can be case hardened. Rusts very easily.	Most common metal used in school workshops. Used in general metal products and engineering.
Carbon Steel	Carbon 0.6 - 1.4% Iron 99.4 - 98.6%	Tough. Can be hardened and tempered.	Cutting tools such as drills.
Stainless steel	Iron, nickel and chromium.	Tough, resistant to rust and stains.	Cutlery, medical instruments.
Cast iron	Carbon 2 - 6% Iron 98 - 94%	Strong but brittle. Compressive strength very high.	Castings, manhole covers, engines.
Wrought iron	Almost 100% iron	Fibrous, tough, ductile, resistant to rusting.	Ornamental gates and railings. Not in much use today.

SOME NON - FERROUS METALS AND PROPERTIES

NAME	COLOUR	ALLOY OF;	PROPERTIES	USES
Aluminium	Light grey	Aluminium 95% Copper 4% Manganese 1%	Ductile, soft, malleable, machines well. Very light.	Window frames, aircraft, kitchen ware.
Copper	Reddish brown	Not an alloy	Ductile, can be beaten into shape. Conducts electricity and heat.	Electrical wiring, tubing, kettles, bowls, pipes.
Brass	Yellow	Mixture of copper and zinc 65% - 35% most common ratio.	Hard. Casts and machines well. Surface tarnishes. Conducts electricity.	Parts for electrical fittings, ornaments.
Silver	Whitish grey	Mainly silver but alloyed with copper to give sterling silver.	Ductile, Malleable, solders, resists corrosion.	Jewellery, solder, ornaments.
Lead	Bluish grey	Not an alloy.	Soft, heavy, ductile, loses its shape under pressure.	Solders, pipes, batteries, roofing.

If you use metals as part of a practical project a knowledge of the shape or ‘section’ of lengths of metals is important. The diagrams below show examples of solid lengths and also tubes. When you order metals you need to describe the section you want. A tube has more surface area and all the strength of the solid but much less weight so is much harder to bend.

SECTIONS - SOLIDS AND TUBES

ROUND SECTION



HEXAGONAL SECTION



SQUARE SECTION



L-SECTION



ROUND TUBE



HEXAGONAL TUBE



SQUARE TUBE



L-SECTION TUBE



QUESTIONS:

1. What is the advantage of tube compared to solid sections?

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2. How can you finish steel to prevent rust

- a.
- b.
- c.

3. How can you finish Aluminium .

- a.

4. What is the difference between a ferrous metal and a non-ferrous metal?

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Metal	Finishing methods to help prevent oxidation, discolouration or rust					
	Paint	Polish Smooth and shine the surface	Chrome plate Electroplate with chromium	Zink plate Electroplate with Zink	Anodise Electrically hardens the surface of aluminium or titanium	Not needed / does not corrode easily
Mild steel	/		/	/		
Cast iron	/		/	/		
Stainless steel		/				/
aluminium	/				/	
brass		/	/	/		
bronze						/
copper	/	/	/	/		
gold		/				/
silver		/				

Zink plating diagram – leaves a shiny silver corrosion resistant surface

Anodising aluminium diagram hardens to a corrosion resistant that can be coloured

