SELECTING METALS

There are two classes of metals:

Ferrous - metals that **contain iron** and are affected by magnetism (apart from stainless steel).

Non-ferrous - metals that **do not contain iron** and are not affected by magnetism.

Metals can also be grouped into:

Pure metals - metals made up from only one chemical element e.g. copper or aluminium.

Alloys - metals made up from a mixture of elements, e.g. copper + zinc (brass) or lead + tin (solder)

Alloying

Metals are alloyed to improve the qualities of the individual pure metals e.g. both copper and tin as pure metals are both soft metals that are easily bent and scratched. When alloyed together (90% copper plus 10% tin) they produce bronze which is hard, rigid and resists scratching. Bronze is used for our 'copper' coins.

Corrosion

When choosing metals, resistance to corrosion may be an important factor.

Corrosion is caused by oxygen in the air combining with the atoms of metal, at the surface of the metal, to create a new chemical called an oxide, e.g. iron oxide is called **rust**.

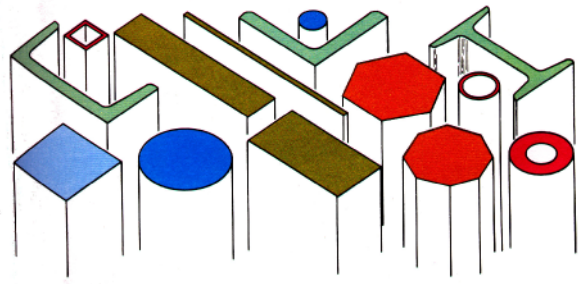
In steel the rust layer is loose and can fall away; this exposes new atoms that will combine with oxygen to form new rust.

In non-ferrous metals the oxide layer is dense and does not fall away; this creates a barrier to the oxygen in the air and new corrosion occurs very slowly. The layer is called **tarnish**.

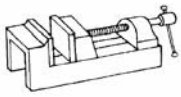
Properties

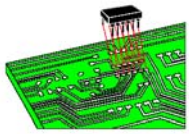
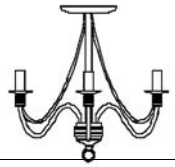
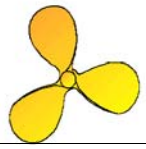
Both physical and mechanical properties vary greatly between different metals and alloys and are an important part of the selection process. (see worksheet 5a)

Available forms



FERROUS METALS

NAME	COMPOSITION	PROPERTIES	USES
Cast Iron	Iron + 3.5% carbon	Smooth skin with soft core, strong when compressed, self lubricating, cannot be bent or forged.	Vices, lathe beds, garden bench ends, car brake drums, etc 
Mild Steel	Iron + 0.15 - 0.35% carbon	Ductile, malleable & tough, high tensile strength, poor resistance to corrosion, easily welded.	Car bodies, washing machine bodies, nuts & bolts, screws, nails, girders, etc. 
High Carbon Steel (tool steel)	Iron + 0.8 - 1.5% carbon	Very hard, rather brittle, difficult to cut, poor resistance to corrosion.	Tool blades e.g. saws, chisels, screwdrivers, punches, knives, files, etc. 
High Speed Steel	Iron + tungsten chromium vanadium	Very hard, heat resistant, remains hard when red	Drills, lathe cutting tools, milling cutters, power hacksaw blades etc. 
Stainless Steel	Iron + chromium nickel magnesium	Tough and hard, corrosion resistant, wears well, difficult to cut, bend and file.	Cutlery, sinks, teapots, dishes, saucepans, etc. 

NAME	COMPOSITION	PROPERTIES	USES
Aluminium	pure metal	Good strength/weight ratio, malleable and ductile, difficult to weld, non-toxic, resists corrosion. Conducts heat and electricity well. Polishes well.	Kitchen foil, saucepans, drinks cans, etc. 
Duralumin	aluminium + manganese magnesium	Stronger than pure aluminium, nearly as strong as mild steel but only one third the weight.	Greenhouses, window frames, aircraft bodies, etc. 
Copper	pure metal	Tough, ductile and malleable. Conducts heat and electricity well. Corrosion resistant solders well. Polishes well.	Electrical wire, central heating pipes, circuit boards, saucepan bases 
Brass	copper + zinc	Quite hard, rigid, solders easily. Good conductor of heat and electricity. Polishes well.	Water taps, lamps, boat fittings, Ornaments, door knockers. 
Bronze	copper + tin	Tough, strong, wears very well, good corrosion resistance.	Coins, wheel bearings statues boat fittings 
Tin	pure metal	Weak and soft, malleable and ductile, excellent corrosion resistance, low melting point.	Solder (with lead) Coating over mild steel (tin can) 
Lead	pure metal	Soft, malleable, very heavy, corrosion resistant, low melting point, casts well, conducts electricity well.	Roof covering, Solder (with tin) Car battery plates 
Zinc	pure metal	Poor strength/weight ratio, weak, ductile and malleable, low melting point. Casts well.	Coating over mild steel (galvanising) Die castings used in cars e.g. Carburettor 

1. What is the difference between ferrous and non-ferrous metals?
2. What is an alloy and what advantages does it have over pure metal?
3. What is the difference between the corrosion of ferrous and non-ferrous metals?
4. What are the differences between mild steel and tool steel?
5. What is the main advantage of using stainless steel instead of mild steel?

A List as many objects or parts of objects, that you can find at home that are made from stainless steel.

6. Why is duralumin used in aircraft?
7. What property of copper makes it suitable for saucepan bases?
8. Why is copper used for water pipes but not the taps on the end of the pipes?
9. Which properties of bronze make it suitable for making into coins?
10. Why do you not get everyday objects made from solid tin?

B Which metal would you choose to make the following objects from and why?
Wheelbarrow body: Cheese grater: Filing cabinet: Spanner: Drawer handles.

Worksheet 24b