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What Is Ferrous Metal?

A metal with the descriptor "ferrous" means that it has iron in its composition. When the term ferrous metal is used, it also usually implies that iron is a large percentage of the elemental composition. If it is not the most abundant element, it would probably be the second or third most prolific. If a metal only contains trace amounts of iron, as many metals do, then that small amount is not considered enough to declare the metal ferrous.

What are the Common Properties of Ferrous Metals?

It is difficult to assign common properties to ferrous metals, since they can have a wide variety of alloying elements that greatly change their characteristics. For instance, many ferrous metals are magnetic; however, it is not true for all ferrous metals. Austenitic stainless steel, while considered a ferrous metal, is not magnetic because the large amount of nickel allows it to have a crystal structure that is predominantly austenite at room temperature. Austenite is not magnetic, although it does contain iron. Some ferrous metals, such as cast iron, are extremely strong and brittle. However, low carbon steel, another type of ferrous metal, can be quite soft and ductile because it does not contain as high of an amount of carbon as cast iron.

While it is difficult to place the properties of all ferrous materials under one umbrella, there are some generalizations that can be made with some accuracy. Ferrous metals often have relatively high amounts of strength, especially when compared with copper, tin, and lead alloys. Ferrous metals are also generally hard, and if they are not alloyed with many other elements or coated, can be subject to rust. Most ferrous materials, with the exception of austenitic stainless steel and some other grades, are magnetic.

Types of Ferrous Metals

There are many different types of ferrous metals. The common ones are :

- Carbon Steel (usually just referred to as "steel")
- Stainless Steel
- Cast Iron
- Alloy Steel

Carbon Steel

Carbon steels are possibly the most widely used type of ferrous metal. They are primarily made up of iron, with over 90% of their chemical composition being that element. The only other major alloying element in carbon steel is carbon. There are only trace amounts of other elements. Common applications of carbon steels include structures, furniture, and automotive components.

Stainless Steel

Stainless steel is another group of ferrous metals that are commonly used. In general, stainless steels have a high amount of chromium that helps them to resist corrosion better than carbon steels. Stainless steels can be further broken down into subgroups. Austenitic stainless steels have the most corrosion resistance, with high amounts of nickel and chromium. There are also ferritic, martensitic, and duplex stainless steels. Each has their own advantages and disadvantages depending on the application. Common applications of stainless steels include appliances, pharmaceutical and medical equipment, food-grade equipment, and knives.

Cast Iron

Cast iron is a type of ferrous metal that has more carbon than most other types. This gives it a high amount of strength. Although high in strength, it is quite brittle. The lack of other alloying elements outside of iron and carbon make it a relatively affordable ferrous metal. Common applications of cast iron include cookware, small components subject to wear such as gears, rods, and pins, and mining equipment.

Alloy Steel

Alloy steels are a type of ferrous metal specially formulated to serve specific purposes. While composed primarily of iron, differing amounts of copper, vanadium, tungsten, manganese, and other elements can be used to tailor an alloy steel to have higher toughness, ductility, tensile strength, hardness, and other properties. Common applications of alloy steels include tools, dies, and machining equipment.

How is Steel Made (1)?

Steel is one of the most widely used metals in the modern world. It is cheap, strong and incredibly versatile. With worldwide production running at approximately 750 million tonnes per year, steel is the second most mass-produced commodity next to cement.

Steel is completely recyclable and requires relatively little energy to produce. Due to the efforts of the steel industry, energy consumption and carbon dioxide emissions are less than half of what they were in the 1960s. This makes steel very environmentally friendly and sustainable.

Products made of steel are numerous but include railroads, oil and gas pipelines, skyscrapers, elevators, subways, bridges, automobiles, ships, knives and forks, razors and surgical instruments. Steel is everywhere!

The History of Iron

Iron is the fourth most abundant element, making up more than 5% of the earth's crust.

The production of iron by humans started in around 2000 BC in south-west or south-central Asia. This marked the beginning of the Iron Age which saw the widespread replacement of bronze with iron for tools and weapons. During this era, wrought iron was produced by blacksmiths who would heat the iron and hammer out impurities over an anvil. The resulting iron was tough but malleable.

In the Middle Ages, a new type of iron was developed using higher temperatures. This was known as cast iron, which was harder than wrought iron but more brittle.

Iron formed the material basis of human civilization for over three thousand years until the mass production of steel in 1870 AD.

The Composition of Steel

Steel is an alloy of iron and carbon. It can contain small quantities of silicon, phosphorus, sulphur and oxygen.

The carbon content of steel is between 0.08 to 1.5 percent. This makes it harder than wrought iron but not as brittle as cast iron. Steel has a unique balance of hardness, flexibility and tensile strength. It is more durable and holds a sharper edge better than the softer wrought iron. At the same time, it resists shock and tension better than the more brittle cast iron.

How Is Steel Made (2)?

To make steel, iron ore is heated and melted in furnaces where the impurities are removed and carbon added.

Today, most steel is made using one of two processes :

- Blast Furnace
- Electric Arc Furnace (EAF)

Blast furnaces use mainly raw materials (iron ore, limestone and coke) with some scrap steel to make steel, whereas Electric Arc Furnaces use mainly scrap steel.

What is a Blast Furnace?

The blast furnace was invented by an Englishman named Henry Bessemer in the mid 1850s. Bessemer devised a way of producing steel by blowing air through molten iron to oxidize the material and separate impurities.

The modern blast furnace is a large steel shell shaped like a cylinder and lined with heat-resistant brick. Iron ore, coke and limestone are fed into the furnace from the top and gradually sink down towards the bottom, getting hotter as they descend. Up to 30% of scrap steel can be used instead of iron ore. In the top half of the furnace, gas from the burning coke releases oxygen from the iron ore. In the bottom half of the furnace, limestone starts to react with the impurities in the ore and coke forming a slag.

At the bottom of the furnace, temperatures reach over 3000 Fahrenheit. The molten slag floats on top of the molten steel, allowing it to be drained via a slag notch in the furnace. The molten steel is released from the hearth of the furnace through a tap hole.

About 74% of the world's steel is produced using this method.

What is an Electric Arc Furnace (EAF)?

EAFs are mainly used to produce special quality steels which are alloyed with other metals. EAFs can also be used to produce ordinary, non-alloyed steels.

Unlike the furnaces, EAF's do not use hot metal. They use scrap steel from recycled products.

The scrap steel is tipped into the EAF from an overhead crane. When the furnace is full, the lid is swung shut covering the top of the furnace. The lid contains electrodes which are lowered into the furnace. The electrodes are charged with a powerful electric current which generates heat, thus melting the scrap.

As the scrap melts, other metals known as ferro-alloys are added to the steel to give it the desired chemical composition. Oxygen is blown into the furnace to purify the steel. Lime and fluorspar are added to fuse with the impurities and form slag. The molten slag floats on the top of the molten steel and can be poured off by tilting the furnace.

About 25% of the world's steel is produced using this method.

Steel is 100% infinitely recyclable.

Scrap Specifications

Insize Steel (G1A)

No 1 heavy melting steel (HMS1)
Maximum size of individual pieces must be under 150cm x 60cm
Thickness over 6mm

No 2 heavy melting steel (HMS2)
Maximum size of individual pieces must be under 150cm x 60cm
Thickness over 3mm

These grades of scrap are commonly referred to as **Insize** and can be exported as a 80 / 20 mix – meaning 80% HMS1 / 20% HMS2. They can also be sold as a 70 / 30 mix.

When on selling Insize it **must not** include any munitions or sealed units and it should be free of dirt, non-ferrous metals, foreign material of any kind, and excessive rust and corrosion.



Oversize Shear (G2AS)

This is heavy steel which is over the maximum size of Insize and can be 3 – 6mm thick.



Oversize Gas (G2AO)

This is heavy steel which is over the maximum size of Insize but is too thick to be shear-cut and needs to be gas-cut. Typically, this would be steel around 12mm thick plus.

Premium Light Gauge (G1B)

This is a light grade steel up to 3mm thick and must contain no foreign material, dirt, non-ferrous metals or other attachments. It will consist of such material as roofing iron, mild steel etc.

This product can either be baled and exported or sold to a local scrap dealer with a shredder. It must be free of munitions and sealed units as these can explode during the remelt and / or shredding process.



Steel Shredder (contaminated light grade / 'dirty') - (G4)

This is light grade steel with non-metallic attachments. It will consist of such items as whiteware, general household articles etc.

This product is usually sold to a local scrap dealer with a shredder operation. It must be free from munitions and sealed units as these can explode during the shredding process. Excessively oily product, such as oil filters, cannot be accepted in this grade as the contamination level is too high. Aerosol cans are also classified as a sealed unit and are not acceptable.



Steel Cans

These can be graded as contaminated light grade.

Steel Cars – Whole (CBW), Stripped (CBS)

This product is usually sold to a local scrap dealer with a shredder operation. Cars must be free of fuels and oils with the battery removed.

Steel Swarf (SWA)

These are turnings from machining steel.

Rebar/Reo Wire (REO)

If this is new product, then this should be graded as either insize or oversize depending on its dimensions. If this is demo recovery scrap, it will be twisted and possibly contaminated with concrete attachments. This is harder to process and must be purchased as rebar/reo wire at a lower value to allow for extra processing. Rebar is high-tensile steel so is harder on the gear.



Manganese Steel (MANG)

Mangalloy, also called manganese steel or Hadfield steel, is an alloy steel containing an average of around 13% manganese. It is known for its high impact strength and resistance to abrasion once in its work-hardened state. It is a unique non-magnetic steel with extreme anti- wear properties. The material is very resistant to abrasion.

Mangalloy is used in the mining industry, cement mixers, rock crushers, railway switches and crossings, crawler treads for tractors and other high impact and abrasive environments. It is also used in high impact environments like inside a shot peening machine.

Tungsten Steel (TUN)

Tungsten steel is any steel that has tungsten as its alloying element with between 2% and 18% tungsten along with small amounts of molybdenum and vanadium, creating an alloy with exceptional heat, corrosion, and wear resistance. Tungsten steel is used for manufacturing micro-drill bits, high-durability self-sharpening rotary cutting blades, and rocket engine nozzles, among many other applications.



Prohibited Materials in Steel Scrap

When accepting, grading or preparing steel for on-selling, it is crucial that the material does not include any prohibited material that has the potential to cause harm and/or kill the processor. It is very easy for suppliers to 'hide' undesirable material in skips, bins or truck loads of steel.

Sealed Units - this is any scrap

- that has the potential to contain a substance, liquid or gas
- where the inside of the vessel cannot be seen
- where the vessel has not been opened to allow drainage
- that has hazardous substance labels on

Examples of sealed units are

- shock absorbers
- LPG bottles (unpunctured and with valves in place)
- any cylinder with valve in place
- fire extinguishers
- fridge and A/C compressors
- hydraulic accumulators





Fire extinguishers / LPG cylinders

Fridge motors







Hydraulic accumulators

Shock absorber

These items run the risk of causing explosions / fires during gas-cutting/ shredding / shearing/ baling etc and / or chemical spills.

Drums

Make sure they are open, lids off, and contain no residue. Also check any labelling and make sure they have not contained a dangerous substance.

Munitions / Ordnance

There is no guarantee that rounds have been fired, these will explode during processing.

Hydrocarbons / Fuels

Ensure oils/fuels have been drained from scrap such as vehicles, plant & machinery, drums etc.

Asbestos

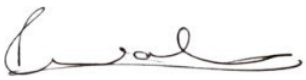
Do not accept decramastic roof tiling unless the supplier can provide a certificate that it is asbestos-free.

PCB's

Do not accept transformers unless they have been drained of oil.

Wood / Tyres / Rubbish

We are a metal recycling facility not a rubbish dump! Unless the 'rubbish' is part of an item graded as shredder, do not accept.



Rob Walton – Business Development Partner
Phoenix Recycling Group