

## NEED TO KNOW!

There are two families of plastic:

- Thermoplastics
- Thermoset Plastics

*Plastics can be manufactured to have a variety of properties, including strength, texture, colour and weight. They can be cut and shaped using a variety of manufacturing technologies.*

Plastic is a man-made material that has only been in common usage for the past 150 years. Most modern plastics are made from petrochemicals, derived from the fossil fuel, oil.

The first mass produced and recognisable plastic, Parkesine, was developed in 1856. It was produced from natural chemicals - cellulose, nitric acid and alcohol. In its natural state Parkesine is transparent, however pigments were added to add colour. It became a popular replacement for Ivory and was commonly used to manufacture snooker balls.

The first commercially used plastic to be derived from petrochemicals was Bakelite which was manufactured from the highly toxic chemicals, phenol and formaldehyde. Invented in 1907, it became very popular during the 1920's to produce electronic goods, such as telephones.

Plastics now dominate the design, manufacture and packaging of many products.

You will be expected to answer questions about plastics within your National 5 and Higher exams. You may also need to use plastics within your units or Course Assessment Task.





*Modern products rely on a range of plastics.*

Plastics are widely regarded as having a negative impact on the environment and are not considered a particularly sustainable material. Most plastics are reproduced from hydrocarbons derived from oil. Oil is classified as a fossil fuel, meaning that there is a finite supply within the earth - one that will eventually run out.

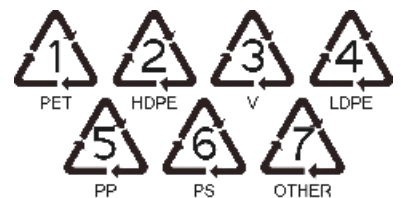
Plastics products are also problematic at the end of their life. If they are burnt, they release carbon dioxide into the atmosphere, contributing to climate change. If disposed in landfill they can take thousands of years to biodegrade. Even modern biodegradable plastics are considered bad for the environment, as they release methane gas which is extremely bad for the atmosphere.

Plastics do have some ecological advantages. Modern cars and aeroplanes have many components made from plastic, which are far lighter than their metal equivalents. This means cars and aeroplanes can use less fuel.

Thermoplastics can be recycled by heating and reshaping. Thermosetting plastics are more difficult to recycle and mostly ground-up and used as a filler within various items.

### NEED TO KNOW!

To help people know how to recycle various types of plastic, all plastic bottles products in the UK must be embossed with a symbol representing the type of plastic being used.



*Petrochemicals require huge refineries to convert the complex hydrocarbons of oil into useful products used for making diesel, petrol and plastics. These plants have a large environmental impact.*





# THERMOSET PLASTIC

## NEED TO KNOW!

Thermoset plastics cannot be reshaped after they have been used to manufacture a product.



The heat resistant nature of thermoset plastics make them ideal for kitchen surfaces. The plastic is applied as a veneer to a chipboard core.

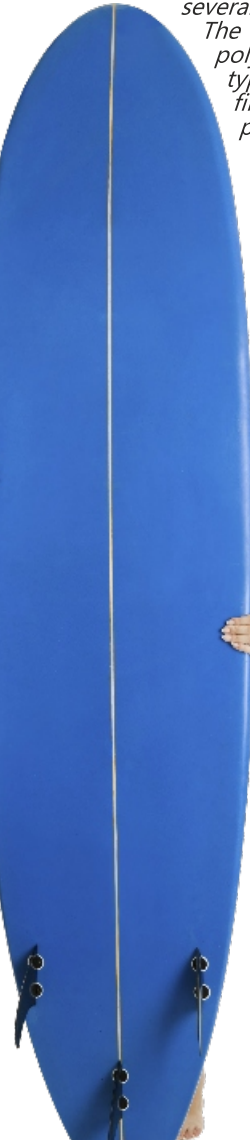


Thermoset plastics are locked, or 'cured', into their shape using heat or chemical reactions and once set, cannot be altered or changed.

Most thermoset plastics become resistant to heat once they are cured. This useful characteristic means thermoset plastics are typically used for products that may become warm or hot during their operation. Thermoset plastics will retain their shape, until the point where it is too hot and catches fire. The maximum temperature they can withstand is different, depending on the type of plastic.

Most thermoset plastics are stronger, can take heavier loads and are more durable against sunlight or chemicals than thermoplastics, however some can be brittle to impacts.

Modern surfboards are made from several thermoset plastics. The core is made from polyurethane. This is typically covered in fibreglass and a polyester finish.



Thermoset plastics are useful as they are strong, rigid, light, salt-water resistant and not affected by UV light from the sun.

Some thermoset plastics are used as a form of adhesive. Epoxy-resin is one such plastic used to fix differing materials. Epoxy-resin is supplied with two chemicals. One is the epoxy-resin, the other is a chemical that will change the resin into a solid plastic through an exothermic reaction. Epoxy-resin is incredibly strong.



However, all thermoset plastics, including epoxy-resin, are highly toxic so must never be used to join materials that touch drinking water or food.

## TABLE OF THERMOSET PLASTICS

NAME	PROPERTIES	USES
Urea Formaldehyde		
Melamine Formaldehyde		
GRP (Glass Reinforced Plastic)		
Epoxy Resin		
Bakelite (Polyoxybenzylmethyleneglycolanhydride)(!)		



## THERMOPLASTIC

Thermoplastics are a family of plastic that are naturally solid but can be reshaped once they are above a specific temperature. Once the plastic has cooled, it returns to a solid material. This process can be repeated numerous times.

There are a wide range of thermoplastics, however most of them are not as strong as thermoset.

Thermoplastics are commonly used by design engineers to manufacture prototypes as they can be easily shaped by a range of machine tools. Many types of 3D printers also use thermoplastics as the material to print models. The plastic is available in reels, where it can be reheated and printed into a shape. When it cools, it is set in shape.

*Thermoplastics are available in a wide range of formats, including large sheets.*

**NEED TO KNOW!**  
Acrylic is the most commonly used plastic in schools. Your National 5 exam may ask questions involving it.

## TABLE OF THERMOPLASTICS

NAME	PROPERTIES	USES
Acrylic (Polymethyl Methacrylate)	Brittle   Available in a range of colours	Models
PVC (Polyvinylchloride)		
Nylon (Polyamide)		
Polystyrene		
Polypropylene		
Expanded Polystyrene		Packaging
ABS (Acrylonitebutadienestyrene)		Toys Car bumpers



*Thermoplastics are available as reels for 3D printers, or granules for Injection Moulding.*

