

OCR ENGINEERING: REVISION GUIDE & HOMEWORK BOOK

R109

MATERIALS:

Ferrous & Non Ferrous metals

- Iron
- Carbon Steel
- Stainless steel
- High Speed Steel

Non Ferrous metals

- Copper
- Brass
- Bronze
- Aluminium alloys
- Zinc
- Tin
- Lead
- titanium

Polymers – Thermo-plastics

- ABS
- Polythene
- HIPS
- PVC
- Nylon
- Polycarbonate
- Polypropylene

Polymers – Thermo-setting

- Polyester Resin
- Urea Formaldehyde
- Epoxy Resin
- Phenol-formaldehyde

Other materials

- Ceramics
- Tungsten Carbide
- Glass
- Ceramic bearing materials

Composites

- GRP
- Carbon Fibre
- Concrete

Smart Materials

- Shape memory alloys
- Thermochromic pigments
- Shape memory plastics
- QTC



Eat . Sleep . D&T . Repeat

PLASTIC: Thermo/Thermoset

Definition:

Examples:

Thermo Plastics

Product

Name

Definition:

Examples:

Thermo Setting Plastics

Product

Name

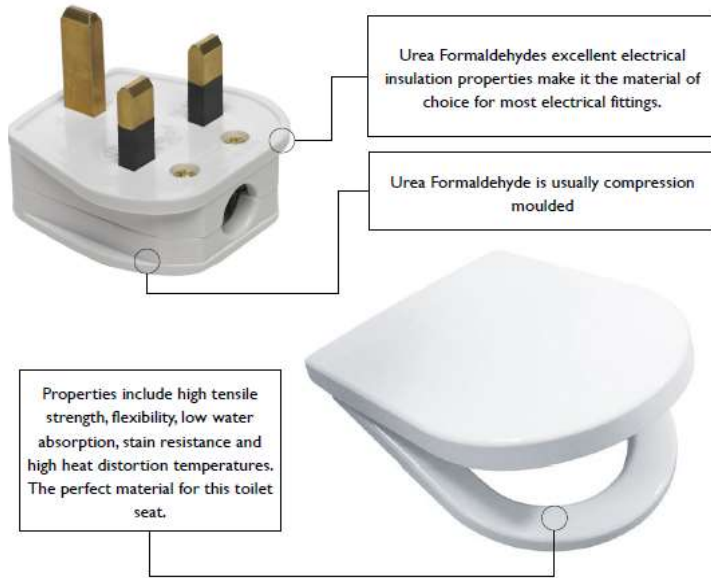
PLASTIC: THERMOSETTING



Urea Formaldehyde

Properties of Urea Formaldehyde

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Polyester Resin

Properties of Polyester Resin

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Possible manufacturing methods used to make these products from urea formaldehyde

Examples of products made from this plastic:

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Possible manufacturing methods used to make these products from urea formaldehyde



Examples of products made from this plastic:

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PLASTIC: THERMOSETTING

Epoxy Resin

Properties of Epoxy Resin

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Possible manufacturing methods used to make these products are

Phenol-formaldehyde

Properties of Phenol-formaldehyde

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Possible manufacturing methods used to make these products are

Examples of products made from this plastic:

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Examples of products made from this plastic:

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PLASTIC: THERMO

Polypropylene (PP)

Properties of PP



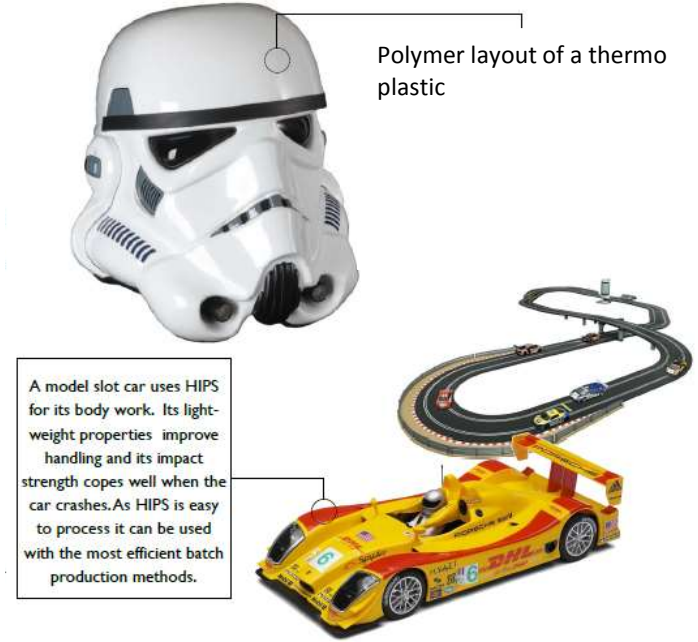
Possible manufacturing methods used to make these products are

Examples of products made from this plastic:

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High Impact Polystyrene (HIPS)

Properties of HIPS



Examples of products made from this plastic:

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PLASTIC: THERMOPLASTICS

Acrylonitrile-Butadiene-styrene (ABS)



High Impact Polystyrene (HIPS)



Possible manufacturing methods used to make these products are

Properties of ABS

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Possible manufacturing methods used to make these products are

Examples of products made from this plastic:

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Properties of HIPS

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Examples of products made from this plastic:

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PLASTIC: THERMOPLASTICS

Polyethylene



Nylon



Possible manufacturing methods used to make these products are

Properties of Nylon

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Possible manufacturing methods used to make these products are

Examples of products made from this plastic:

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Examples of products made from this plastic:

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PLASTIC: THERMOPLASTICS

Polyvinyl Chloride (PVC)



Polycarbonate



Possible manufacturing methods used to make these products are

Properties of Polycarbonate

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Possible manufacturing methods used to make these products are

Examples of products made from this plastic:

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Examples of products made from this plastic:

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Metals: Ferrous/Non Ferrous Alloys



Definition:

Examples:

Definition:

Examples:

Definition:

Examples:

METALS: FERROUS

High Carbon Steel

The higher carbon makes this steel harder but less ductile. It is used commonly in the manufacture of hand tools.

High Carbon Steels offer respond better to heat treatment and have a longer service life than mild-steels.

High-carbon steels typically have high wear resistance due to their superior surface hardness.



Properties of high carbon steel

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Examples of products made from this metal:

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Low Carbon Steel / Mild Steel

Properties of low carbon/ mild steel

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Mild Steel is easily shaped into car body panels



Due to its poor corrosion-resistance, it must be painted or otherwise protected and sealed in order to prevent rust from damaging it.

Mild Steel has good tensile strength and ductility which make it ideal for the function and manufacture of this chain.



Examples of products made from this metal:

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METALS: FERROUS

Cast Iron

Properties of Cast Iron

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With its relatively low melting point, ability to be casted, excellent machinability, resistance to deformation and wear resistance, cast irons have become an engineering material with a wide range of applications such as engine blocks.

Examples of Cast Iron Products:



Examples of products made from this metal:

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Mild Steel Angle Bars

Properties of low carbon/ mild steel

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Examples of Low carbon Steel Products:



Examples of products made from this metal:

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Low Carbon Steel

METALS: FERROUS

Stainless Steel



Properties of Stainless Steel

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Possible manufacturing methods used to make these products are

Examples of products made from this metal:

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High Speed Steel



Properties of High Speed Steel

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Possible manufacturing methods used to make these products are

Examples of products made from this metal:

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METALS: NON-FERROUS

Aluminium

A guiding philosophy behind Audi's aluminium car bodies is to reduce weight and to increase performance. Making the car nimble, ridged. And corrosion resistant.



Properties of Aluminium:

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for heat exchanger components.

Manufacturing processes used in making aluminium parts are:

Aluminium is second to steel as the most widely used metal.

Aluminium has a winning combination on strength, low weight, corrosion resistance and it's recyclable.

Aluminium is extremely energy intensive to produce.

Aluminium is 100% recyclable and nearly three quarters of all aluminium ever made remains in use today!



Apple's MacBook's are made from a single piece of aluminium called the unibody, which is milled using a CNC machine. It makes the MacBook rigid, strong and light.

Examples of Aluminium Products:



Properties of Cast Iron

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Examples of Copper Products:

Copper



Examples of products made from this metal:

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METALS: NON FERROUS

Titanium

Properties of Titanium

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Possible manufacturing methods used to make these products are

Examples of products made from this metal:

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Lead



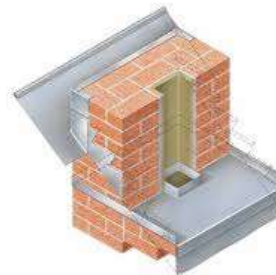
Properties of Lead

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Possible manufacturing methods used to make these products are

Examples of products made from this metal:

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METALS: ALLOY

Zinc



Tin



Possible manufacturing methods used to make these products are

Properties of Zinc

Properties of Tin

Possible manufacturing methods used to make these products are

Examples of products made from this metal:

Examples of products made from this metal:



© APS Auto Parts

METALS: ALLOY

Brass

Properties of Brass

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Possible manufacturing methods used to make these products are

Examples of products made from this metal:

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Bronze



Properties of Bronze

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Possible manufacturing methods used to make these products are

Examples of products made from this metal:

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CERAMICS:

Tungsten Carbide

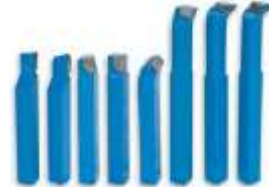
Properties of Tungsten Carbide

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Possible manufacturing methods used to make these products are

Examples of products made from this material:

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Glass



Properties of Glass

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Possible manufacturing methods used to make these products are

Examples of products made from this material:

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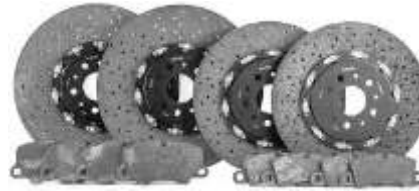


CERAMICS:

Ceramic bearing materials



Ceramic friction materials



Possible manufacturing methods used to make these products are

Properties of Ceramic friction materials

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Possible manufacturing methods used to make these products are

Examples of products made from this material:

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Examples of products made from this material

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COMPOSITES:

Glass Reinforced Plastic (GRP)



Carbon Fibre



Possible manufacturing methods used to make these products are

Properties of GRP

Properties of Carbon Fibre

Possible manufacturing methods used to make these products are

Examples of products made from this material:



Examples of products made from this material:

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COMPOSITES:

Concrete

Properties of Concrete



Further notes:

Possible manufacturing methods used to make these products are

Examples of products made from this material:



SMART MATERIALS:

What is the definition of a smart material?

Stick example here:

What are some example products that use smart materials?

Stick example here:

What are the advantages of using smart materials on these products?

Stick example here:

Stick example here:

Stick example here:

What is the definition of a Combined/Composite material:

What are some example products that use Combined/Composite materials?

What are the advantages of using Combined/Composite materials on these products?

COMBINED/COMPOSITE MATERIALS:

SMART MATERIALS:

Shape Memory Alloys

Shape Memory Alloy (SMA), such as 'Nitonol' (Nickel-Titanium alloy).

Properties of shape memory alloy

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Possible manufacturing methods used to make these products are

Examples of products made from this material:

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Shape Memory Plastics



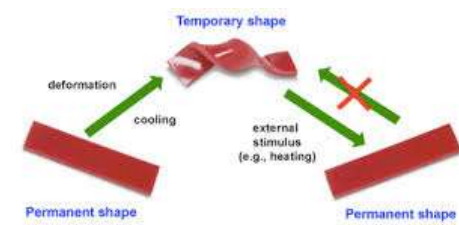
Properties of shape memory plastics

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Possible manufacturing methods used to make these products are

Examples of products made from this material:

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SMART MATERIALS:

Quantun Tunnelling Composite (QTC)



Properties of QTC

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Possible manufacturing methods used to make these products are

Examples of products made from this material:

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Thermochromic materials



Properties of Thermochromic materials

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Possible manufacturing methods used to make these products are

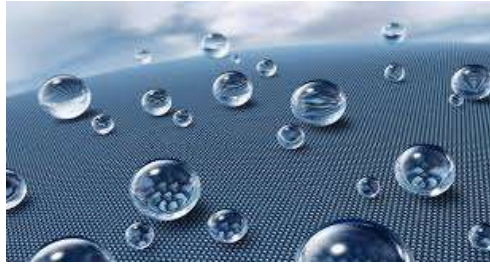


Examples of products made from this material:

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NEW AND EMERGING MATERIALS:

Nano technology



Advanced Metal Alloys



Possible manufacturing methods used to make these products are

Properties of nano technology

Properties of Advance metal alloys

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Possible manufacturing methods used to make these products are

Examples of products made from this material:



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Examples of products made from this material:



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TESTING METHODS:

What is the purpose of testing materials?

What two main categories of testing are there?

Can you name types of testing for these two categories?

Why is it important to test materials?

Further notes:

Material characteristics

For the following materials can you describe the engineering characteristics of that material – an example has been completed for you

	Aluminium	Tungsten Carbide	High Speed Steel	Carbon Fibre	Copper	ABS
Relative cost	£1.50-£2.50 per kg					
Availability	Readily available either in raw state or as recycled product 3 rd most common element					
Ease of use	Easy to work and shape, easy to form due to lower melting temperature and lower density when compared with steel					
Safety in use	Aluminium working especially grinding, sanding and finishing can be dangerous due to the very small particles created.					
Forms of supply	Bar, rod, sheet, ingot					
Sustainability	Aluminium is one of the easiest metals to recycle and has made it an increasingly popular choice for manufacturing because of this					