Your notes

GCSE Engineering: revision notes

Heat treatments and surface finishes

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Heat treatments for steel

- **Annealing**: heat the steel and cool it very slowly. It becomes softer, more ductile and easier to work, and internal stresses are relieved.
- Normalising: heat and cool in still air. It refines the grain structure, making the steel tougher.
- **Hardening**: heat medium or high carbon steel until red hot, then quench it quickly in water or oil. It becomes very hard, but brittle.
- **Tempering**: reheat hardened steel to a lower temperature, then cool. It reduces brittleness and increases toughness, for tools such as chisels.
- **Case hardening**: add carbon to the surface of low carbon steel, then heat and quench. The part has a hard, wear-resistant surface and a tough core.
- Work **hardening**: bending or hammering metal makes it harder and more brittle; **annealing** reverses this.

Surface finishes

- Finishes protect against corrosion and wear, and improve appearance.
- Painting and **powder coating**: **powder coating** sprays charged powder onto metal, then bakes it into a tough layer.
- **Galvanising**: dipping steel in molten zinc. The zinc protects steel even if scratched.
- **Anodising**: thickening the oxide layer on aluminium, which can be dyed.
- Electroplating: using electrolysis to coat a part with a thin layer of another metal, such as chrome.

Other finishes and choosing one

- Plastic dip coating: dipping heated metal into plastic powder, as on tool handles.

- Polishing and lacquering give a shiny finish; oiling protects tools.
- Choose a finish by thinking about where the product will be used (indoors or outdoors), the material, how hard-wearing it must be, how it should look, and cost. A garden gate might be galvanised then powder coated; a bike frame might be powder coated; an aluminium torch might be anodised.

Your notes

Key terms

Annealing	Heating and slowly cooling metal to soften it and relieve stress.
Hardening	Heating steel and quenching it to make it hard.
Quenching	Cooling hot metal rapidly in water or oil.
Tempering	Reheating hardened steel to reduce brittleness.
Case hardening	Hardening only the surface of low carbon steel.
Galvanising	Coating steel with zinc to prevent rusting.
Anodising	Thickening the oxide layer on aluminium.
Powder coating	Baking a charged powder onto metal to form a tough coating.

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. What does annealing do?
2. What is quenching?
3. Why is steel tempered after hardening?
4. What does case hardening produce?
5. What is galvanising?
6. Which finish is used on aluminium and can be dyed?
7. What is work hardening?
8. Which carbon steel can be hardened by heating and quenching?

Answers

1. Softens metal and relieves internal stress
2. Cooling hot metal rapidly in water or oil
3. To reduce brittleness and increase toughness
4. A hard surface with a tough core
5. Coating steel with zinc
6. Anodising
7. Metal becoming harder and more brittle from being bent or hammered
8. Medium or high carbon steel

What to do next

Practise 10 questions on this topic

Try 3 exam questions, with mark schemes

Read the lesson, one step at a time

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