SMARTAGRI
CAMBODIA

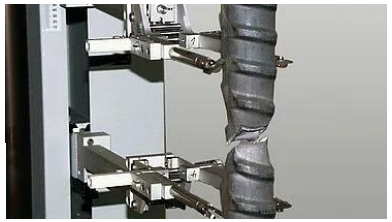
Technical Basics

Technical Basics

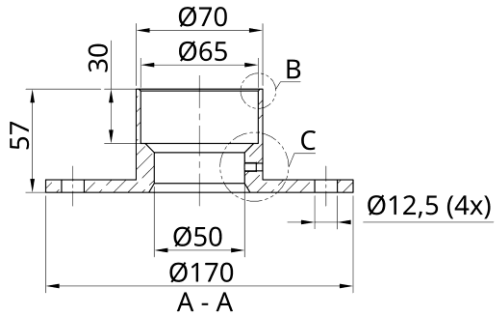
- Basic materials:
  - steels, cast irons, non-ferrous metals



- Basic properties រូបធាតុ (strength ភាពមាំ ឧ.អាចទ្រទម្ងន់បានមិនងាយបែក, hardness ភាពរឹង ឧ. ឈើ និងដែក, toughness ភាពតាន់ ឧ.ដែកពេលពត់សុខចិត្តកោង តែកែវប៉ៈទង្គិចបន្តិចបែក)



- Basic technical drawing:
  - reading technical drawings
  - basic dimensions and tolerances



Basic materials - steel

- What is Steel?

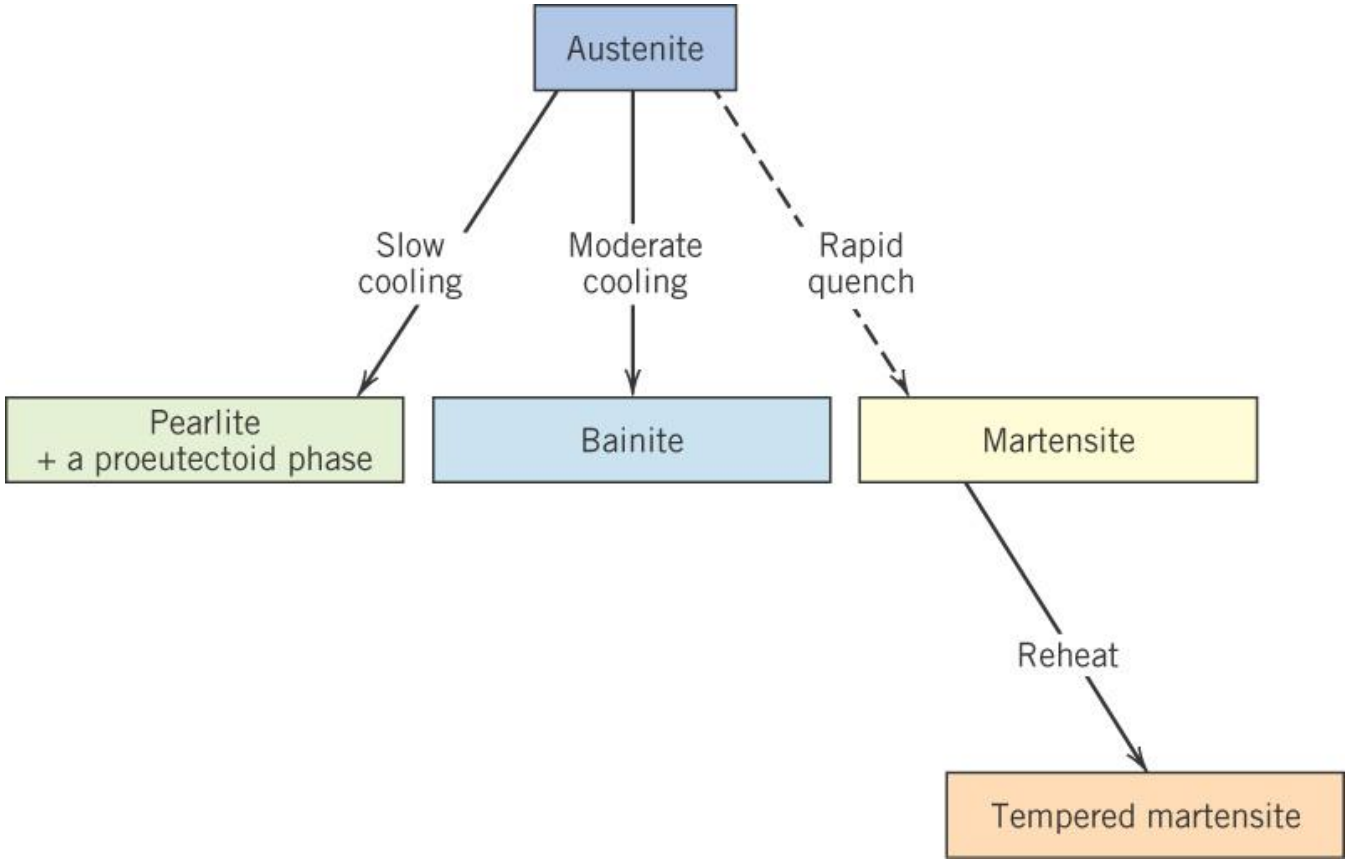
➢Steel is an alloy of iron and carbon

➢Carbon content is usually up to 2.11%

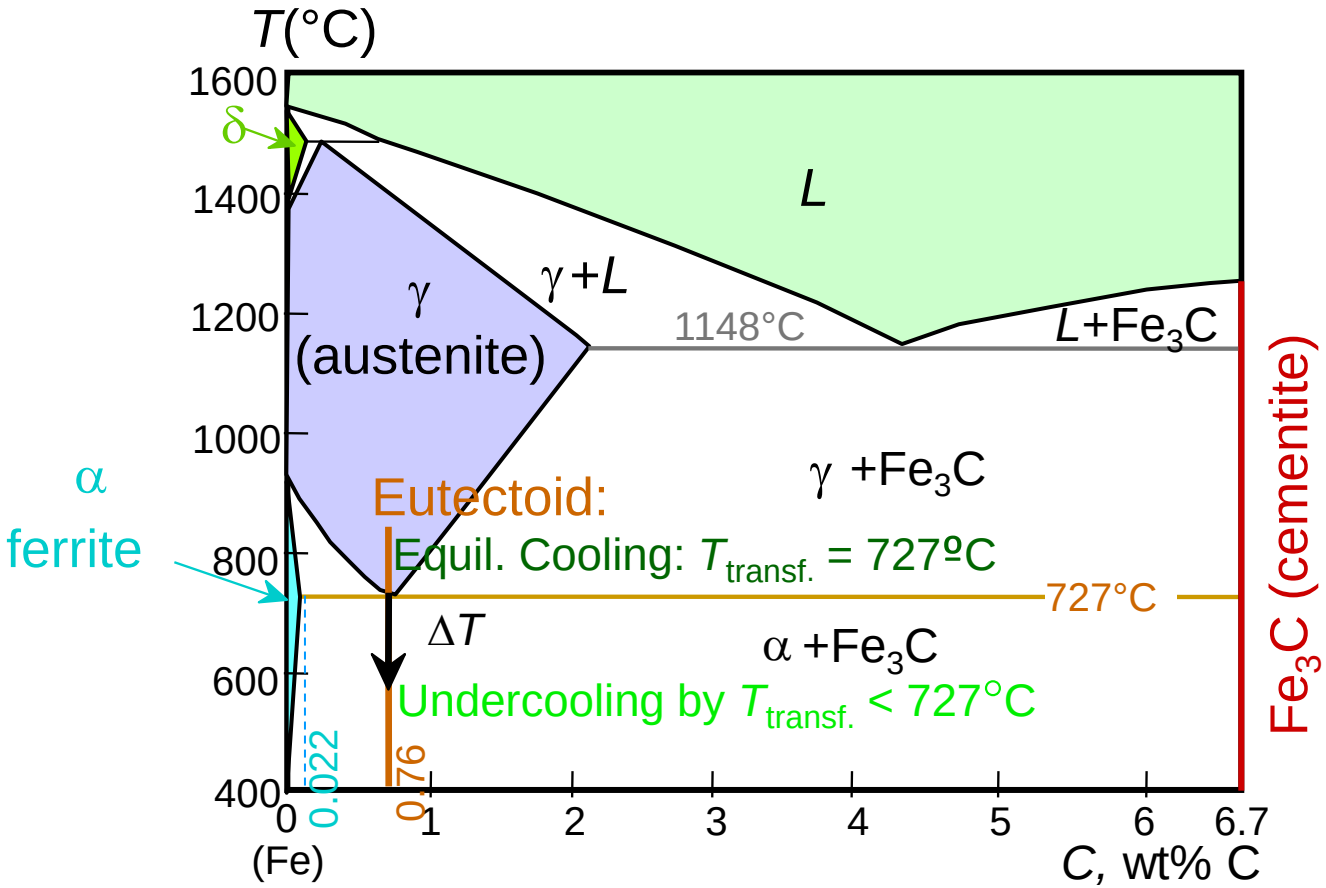
(higher than this = cast iron)

➢It is one of the most common engineering materials widely used in machines, tools, and structures

Basic materials - steel



Basic materials - steel



Basic materials - steel

- Composition of Steel

➢Iron is the main element

➢Carbon controls basic characteristics

➢Alloying elements (e.g. chromium, nickel) improve performance

Basic materials - steel

- Types of Steel

➢Carbon steel – simple composition, widely used

➢Alloy steel – contains additional elements for specific use

➢Stainless steel – contains chromium, resists corrosion

➢Tool steel – designed for cutting and forming tools

Basic materials - steel

- Production of Steel

➢Steel is produced from iron ore or recycled scrap

➢Material is melted in a furnace (high temperature process)

➢Impurities are removed during refining

➢Steel is cast into semi-finished products

Basic materials - steel

- Forms of Steel

➢Sheets and plates – used in structures and covers

➢Bars and rods – used for shafts and fasteners

➢Tubes and pipes – used for transport of fluids

➢Structural profiles – beams, angles, channels for construction

Basic materials - Cast Iron

- What is Cast Iron?

➢Cast iron is an alloy of iron and carbon

➢Carbon content is higher than in steel (usually above 2.11%)

➢It is commonly used for heavy and rigid machine parts

Basic materials - Cast Iron

- Composition of Cast Iron

➢Iron is the base material

➢High carbon content gives specific structure

➢Silicon is often added to improve casting properties

Basic materials - Cast Iron

- Types of Cast Iron

➢Gray cast iron – most common, good machinability

➢Ductile (nodular) iron – higher strength and toughness

➢White cast iron – very hard, brittle material

➢Malleable cast iron – improved ductility after heat treatment

Basic materials - Cast Iron

- Production of Cast Iron

➢Produced by melting iron and carbon materials

➢Melt is poured into molds (casting process)

➢Solidifies into final shape with minimal machining

Basic materials - Cast Iron

- Typical Applications

➢Engine blocks and housings

➢Machine frames and bases

➢Pipes and fittings

➢Brake discs and heavy components

Basic materials - Non-Ferrous Metals

- What are Non-Ferrous Metals?

➢Non-ferrous metals do not contain iron

➢They do not rust like steel

➢Commonly used in many technical applications

Basic materials - Non-Ferrous Metals

- Common Non-Ferrous Metals
  - ➢Aluminum – lightweight and widely used
  - ➢Copper – very good electrical conductivity
  - ➢Brass – copper and zinc alloy
  - ➢Bronze – copper and tin alloy

Basic materials - Non-Ferrous Metals

- Composition and Structure

➢Made from pure metals or alloys

➢Alloying improves specific properties

➢Often used where steel is not suitable

Basic materials - Non-Ferrous Metals

- Production and Processing
  - ➢Extracted from ores or recycled materials
  - ➢Melted and cast into shapes
  - ➢Can be formed, machined, or extruded

Basic materials - Non-Ferrous Metals

- Typical Applications

➢Electrical wiring and components (copper)

➢Lightweight structures (aluminum)

➢Bearings and fittings (bronze, brass)

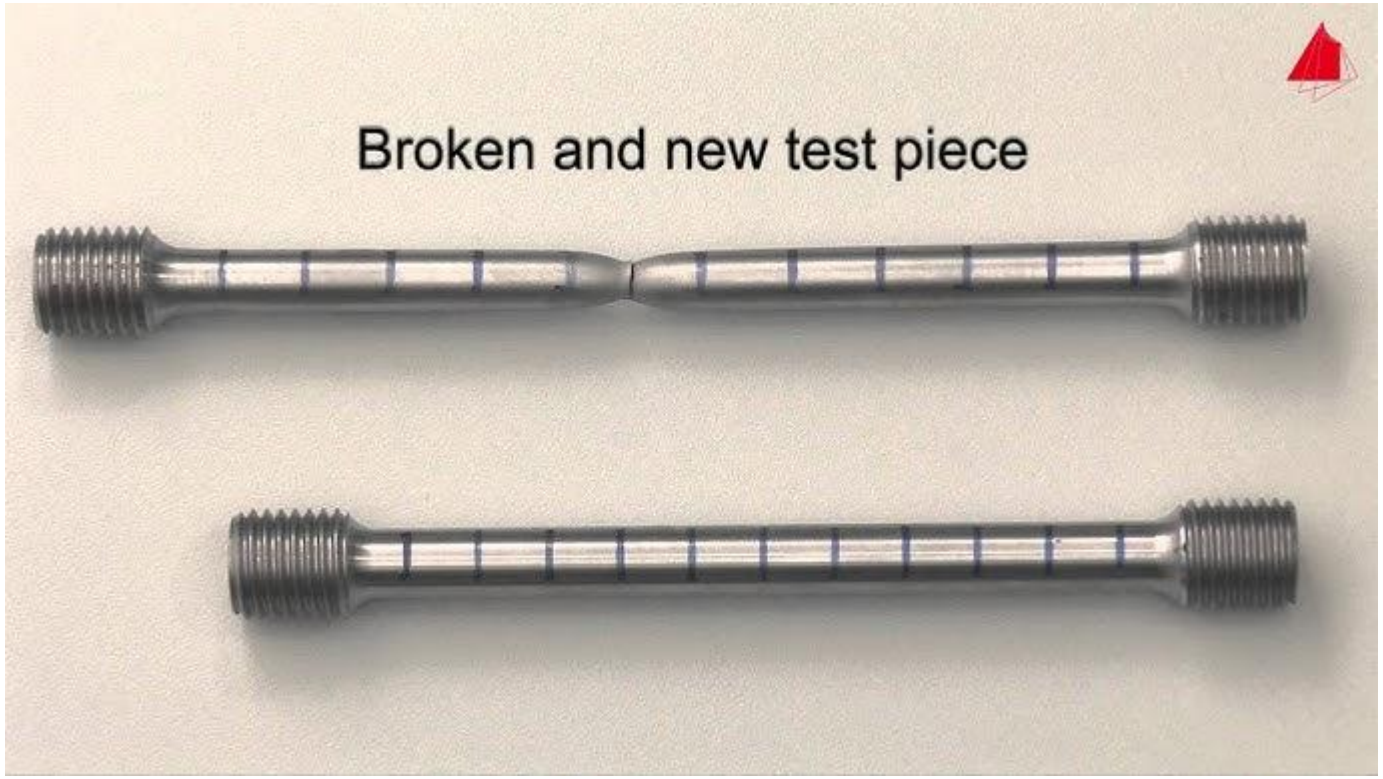
➢Pipes, radiators, and connectors

Material Properties

- Materials have different properties that define their behavior in use

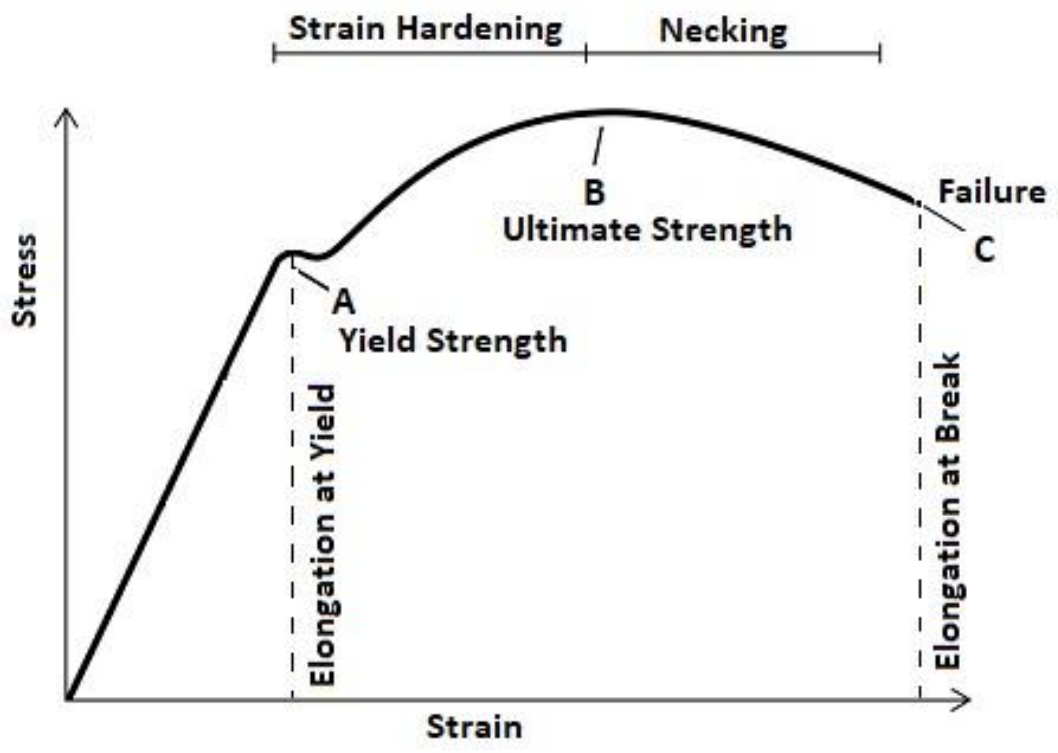
Material Properties - Strength

- Strength is the ability of a material to resist applied forces without failure



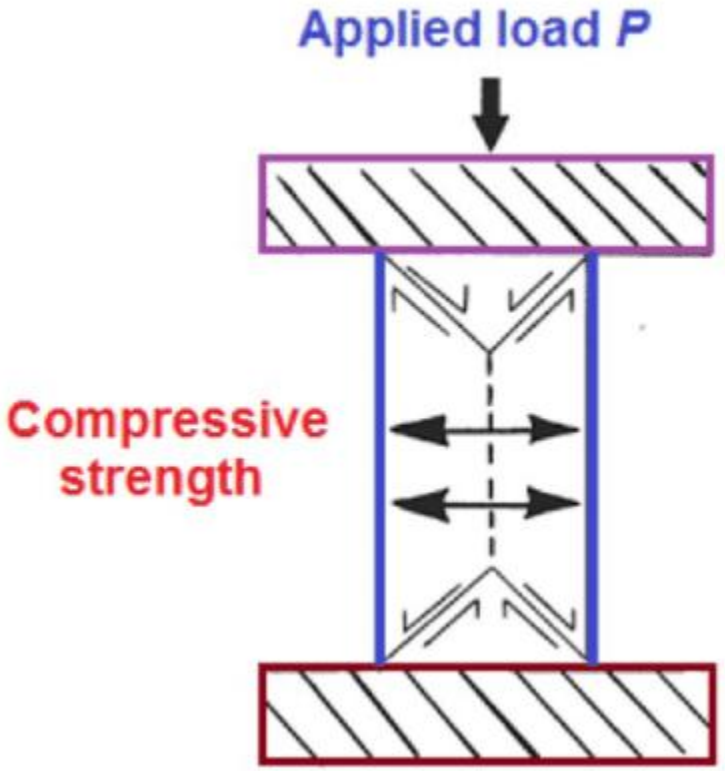
Material Properties - Tensile Strength

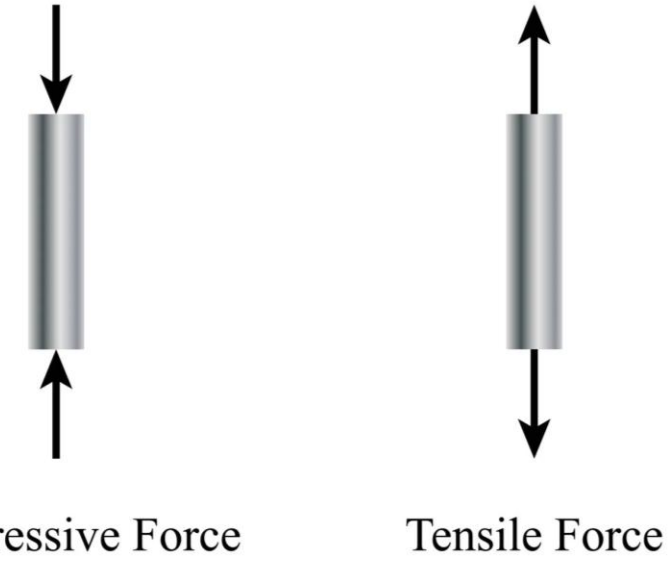
- Tensile strength is resistance to pulling forces



Material Properties - Compressive Strength

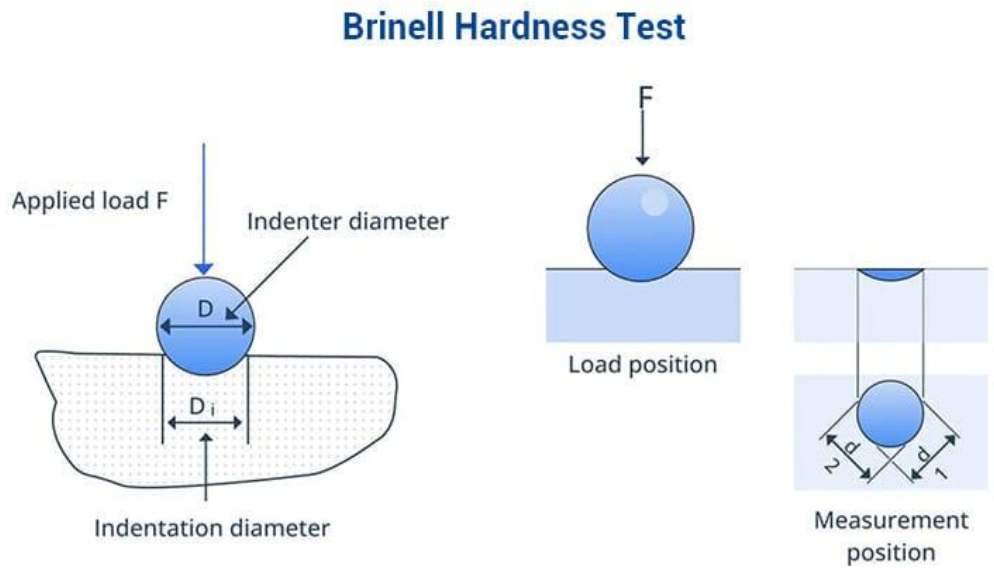
- Compressive strength is resistance to pressing forces





Material Properties - Hardness

- Hardness is the resistance of a material to surface deformation or scratching



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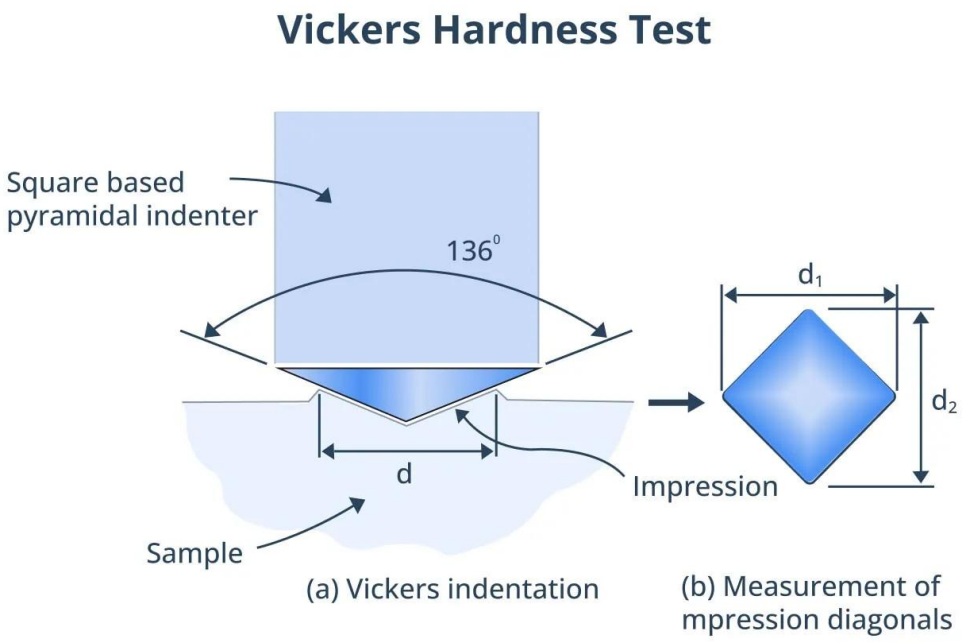

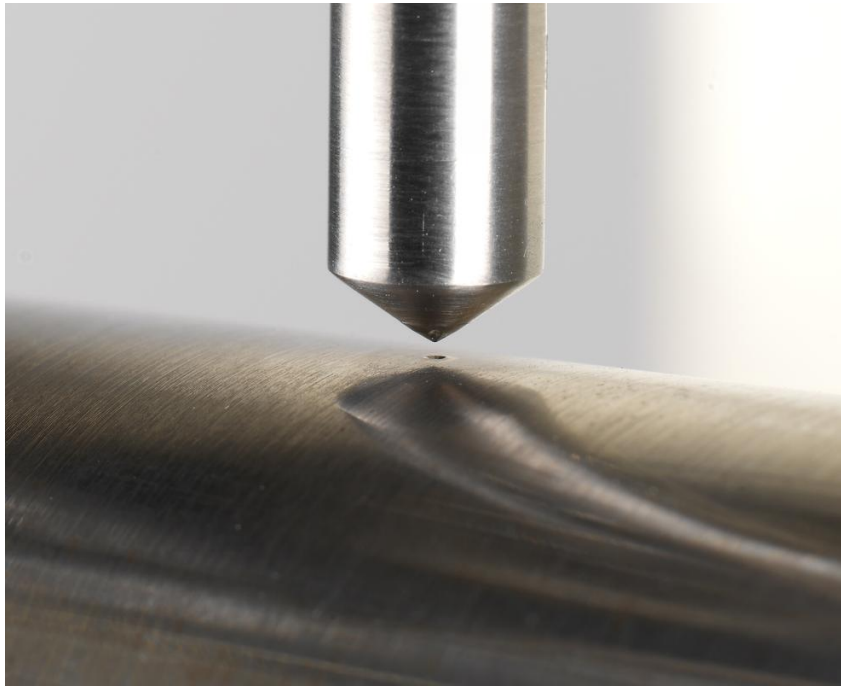

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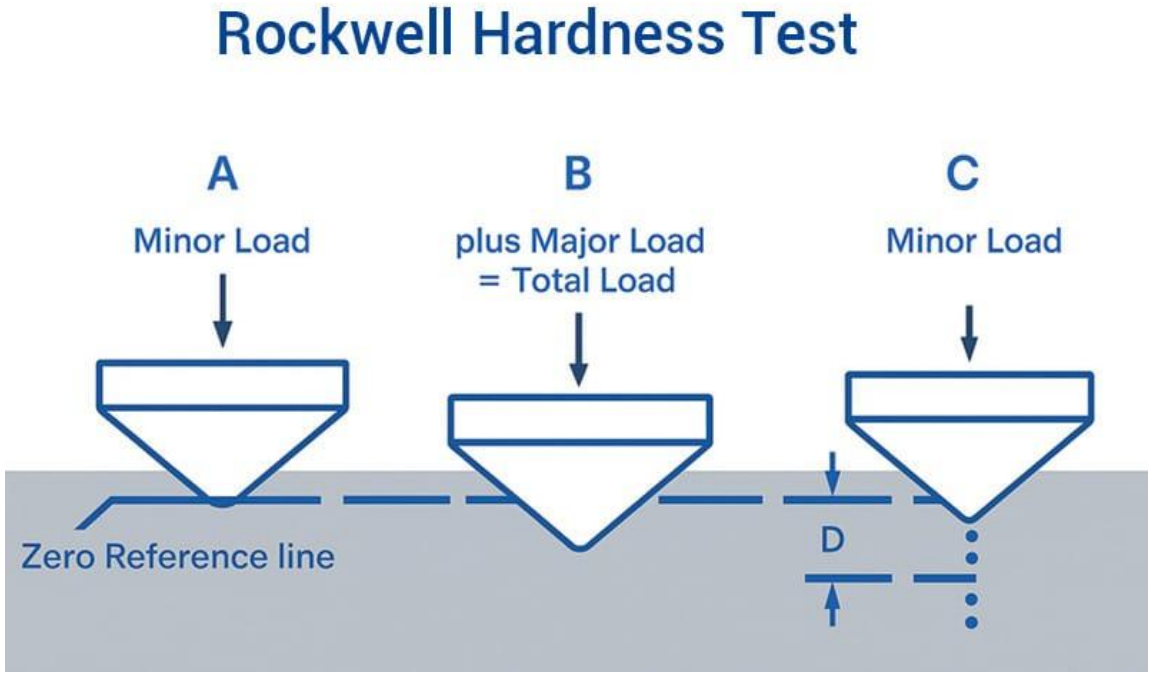
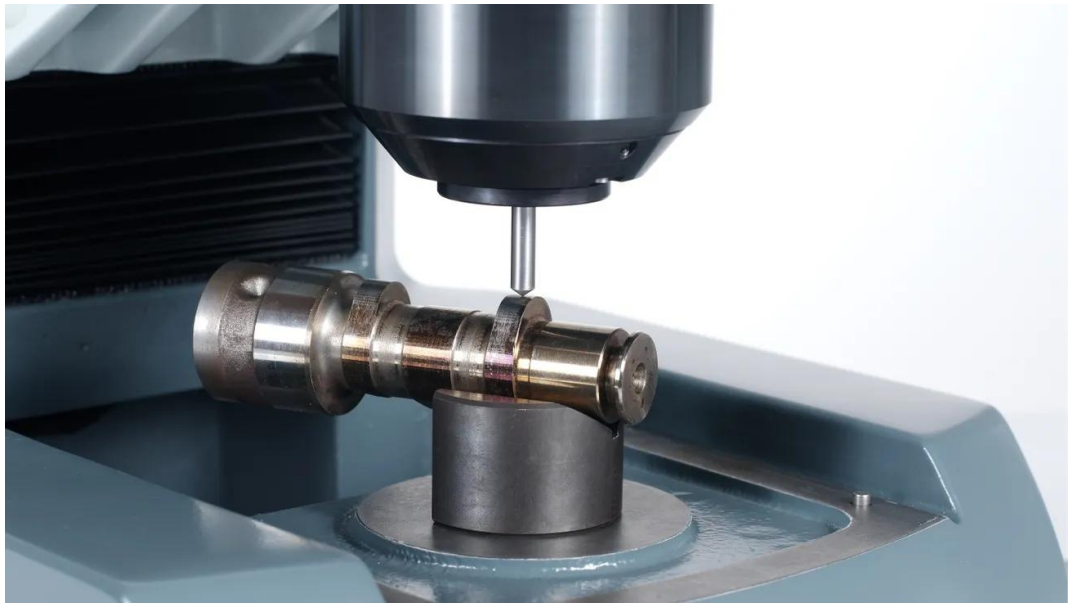


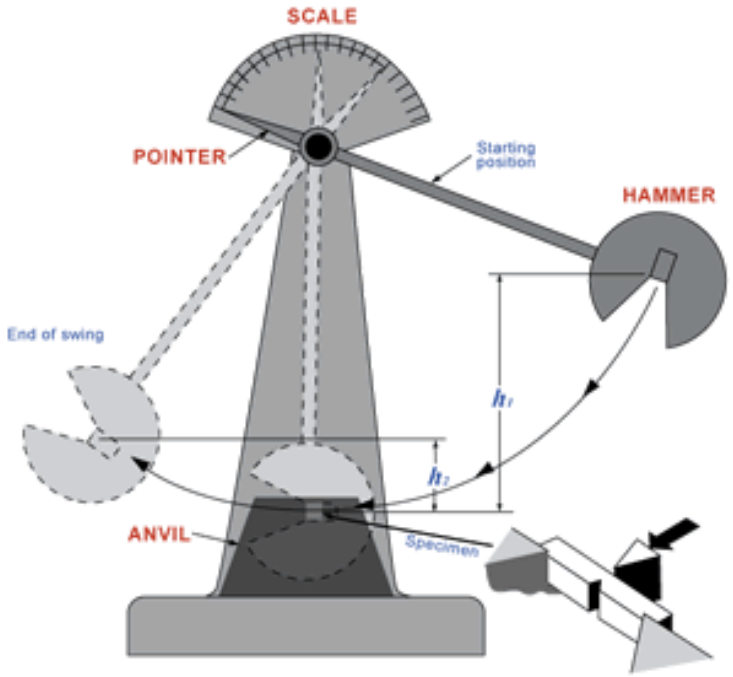


Material Properties - Hard vs. Soft Materials

- Hard materials resist wear, soft materials deform more easily

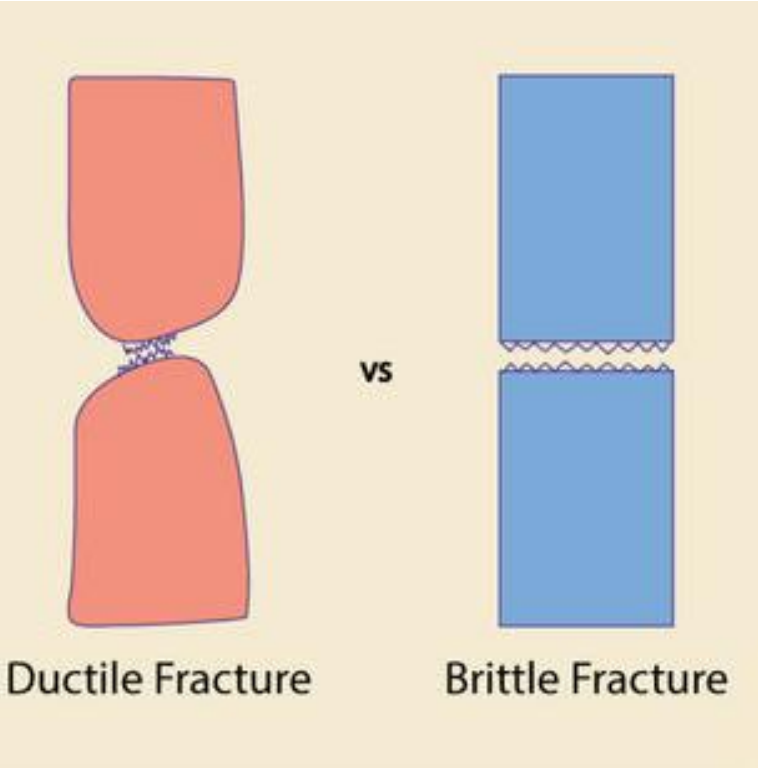
Material Properties - Toughness

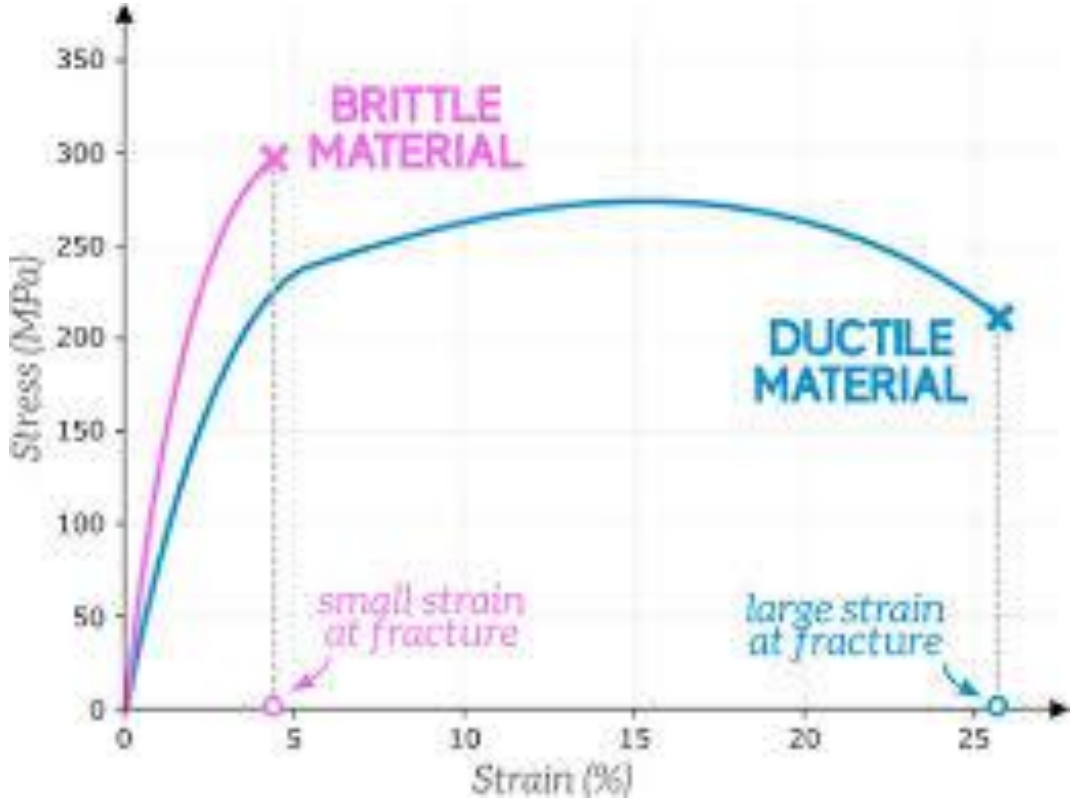
- Toughness is the ability of a material to absorb energy without breaking



Material Properties - Brittle vs. Tough

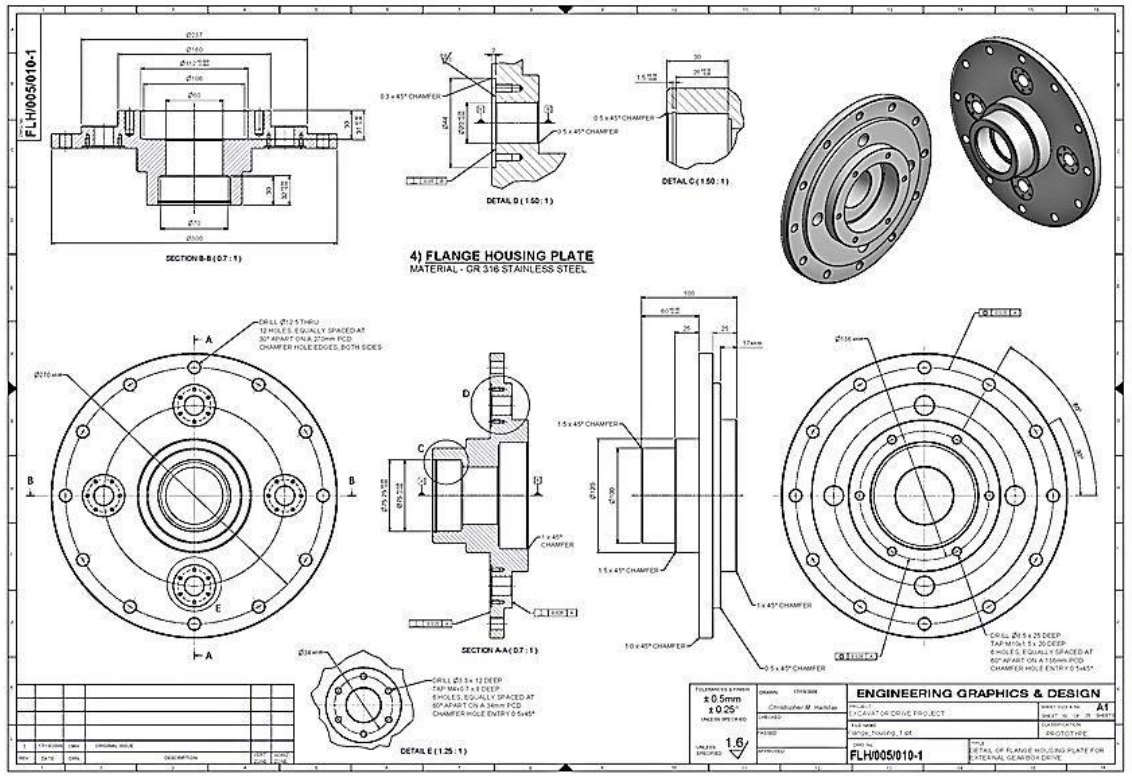
- Brittle materials break easily, tough materials deform before failure





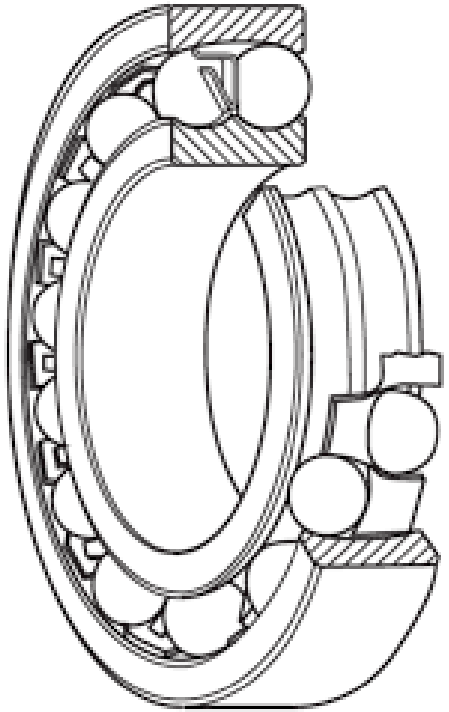
Technical Drawing

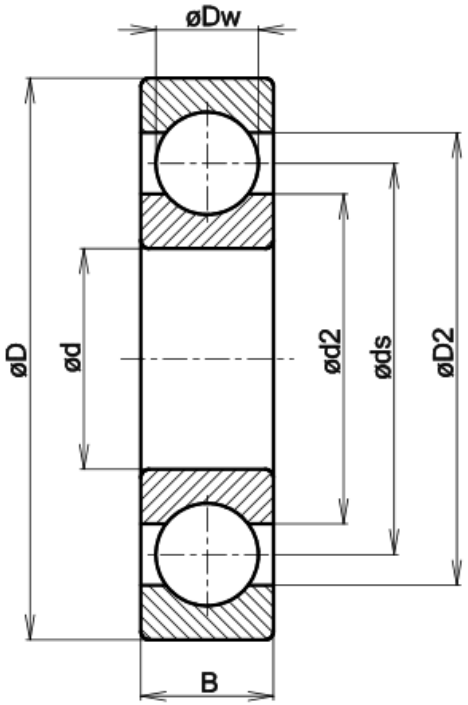
- Technical drawing is a universal language used to describe parts and machines

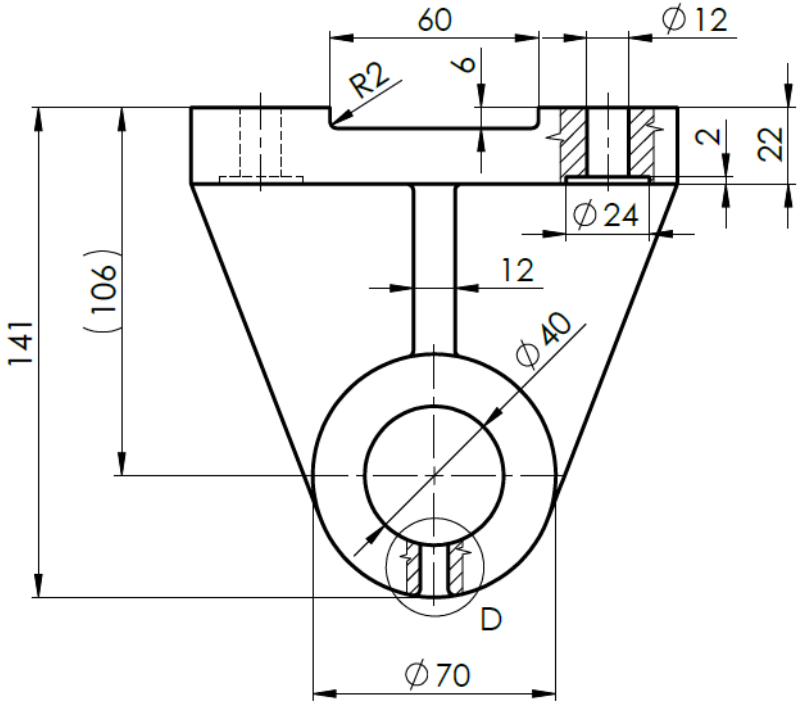


Technical Drawing - Purpose of Drawings

- Drawings show shape, size, and details of a part

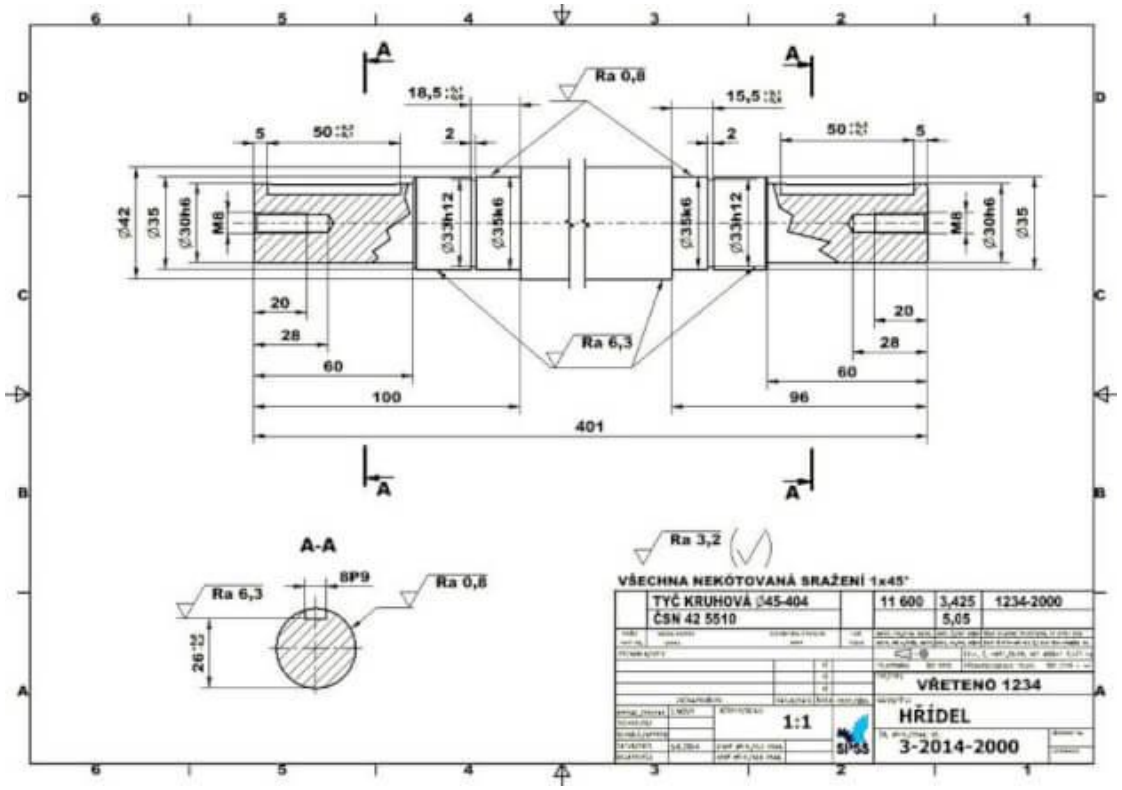






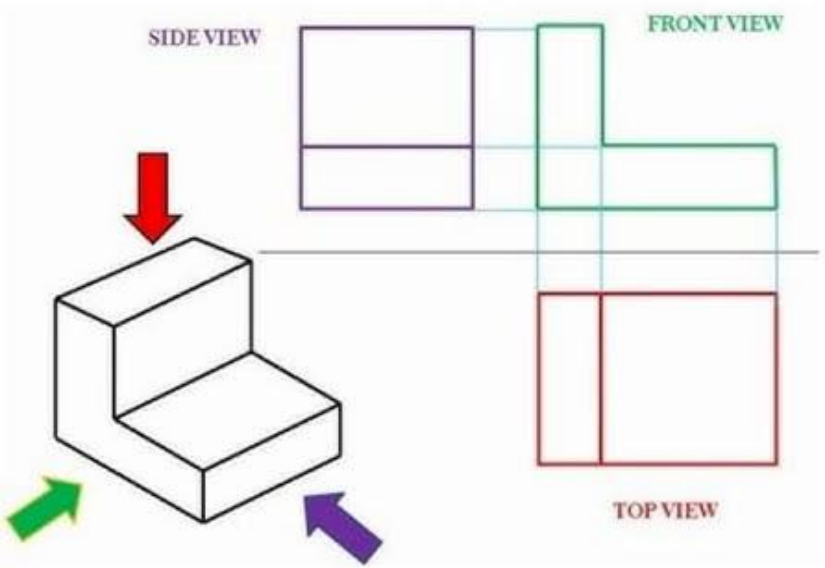
Technical Drawing - Reading Drawings

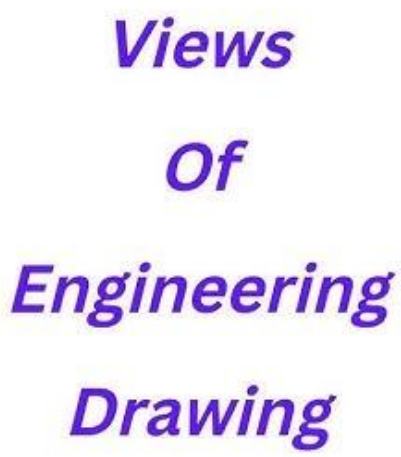
- Reading a drawing means understanding all information shown on it

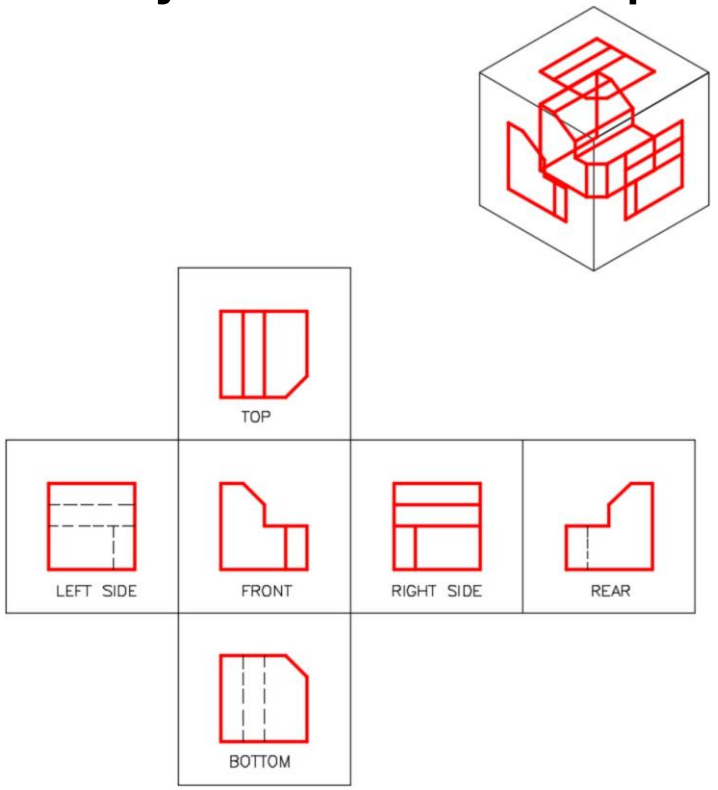


Technical Drawing - Views

- Different views (front, top, side) show the object from multiple directions

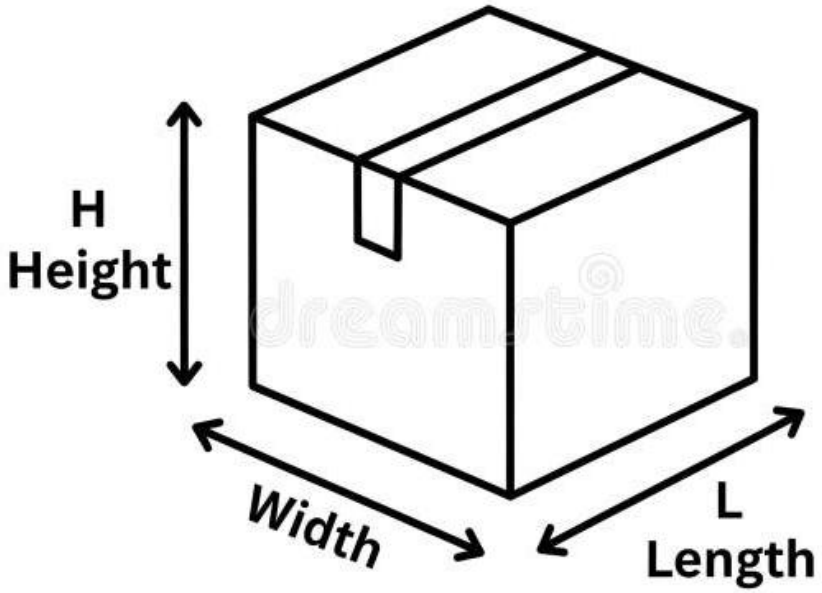


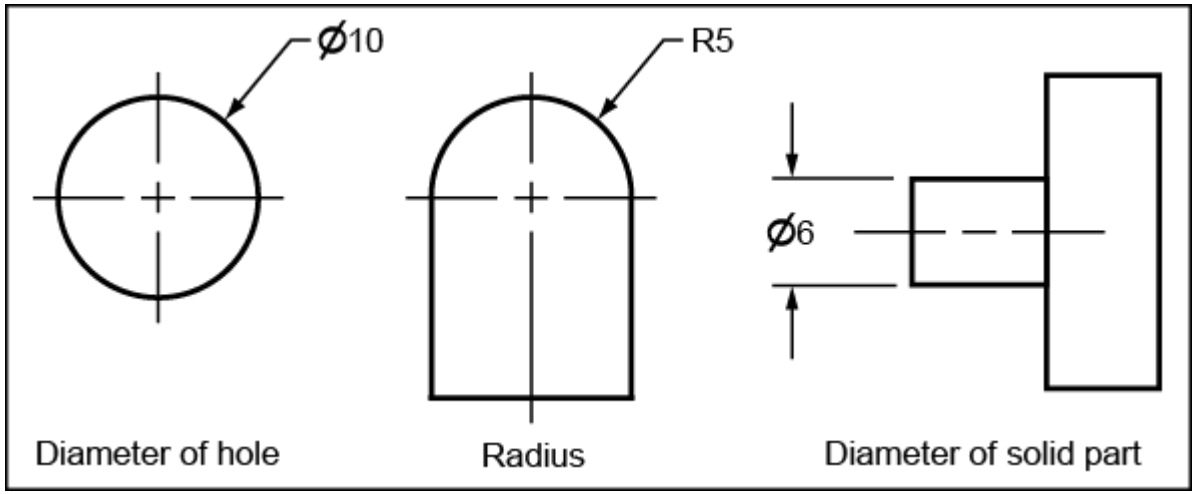




Technical Drawing - Dimensions

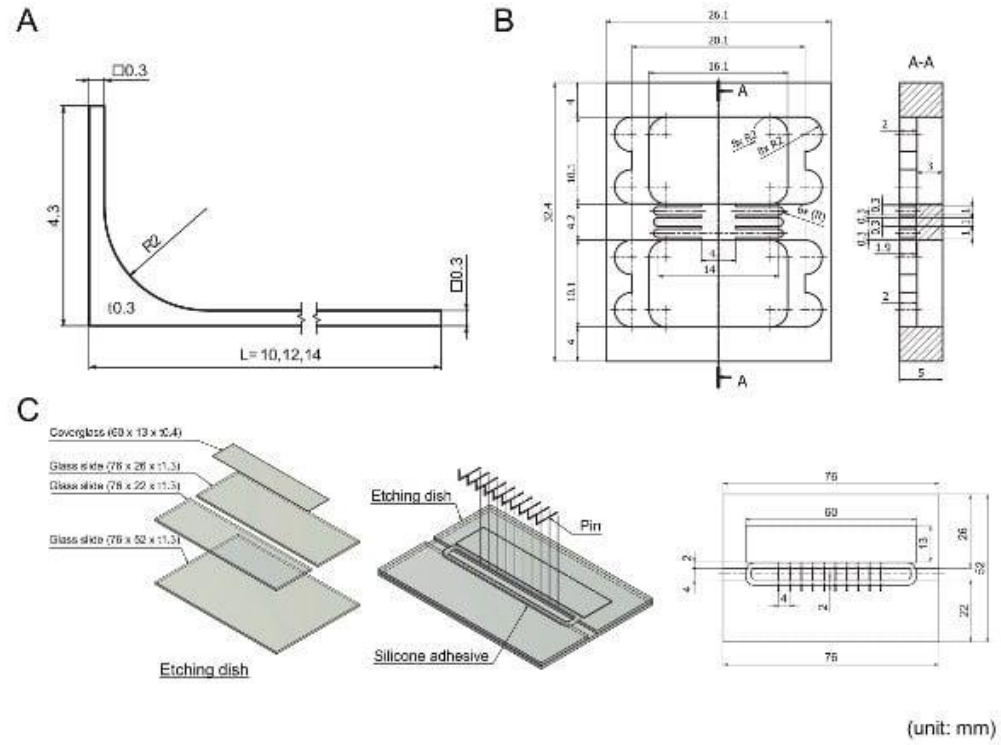
- Dimensions define the size of a part (length, width, diameter)

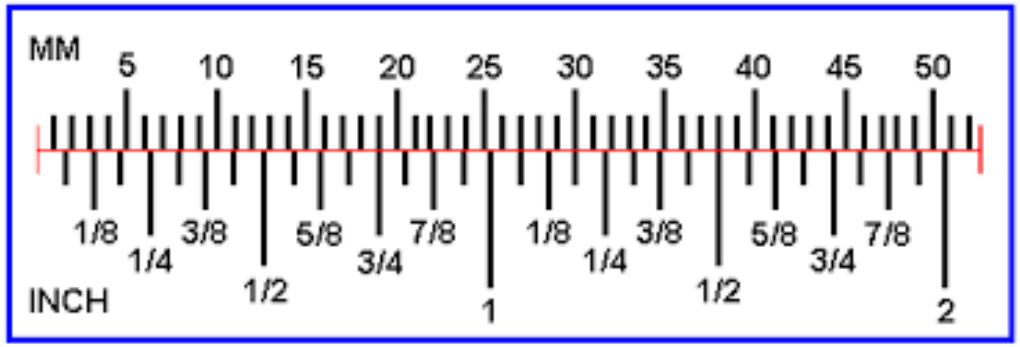




Technical Drawing - Dimension Units

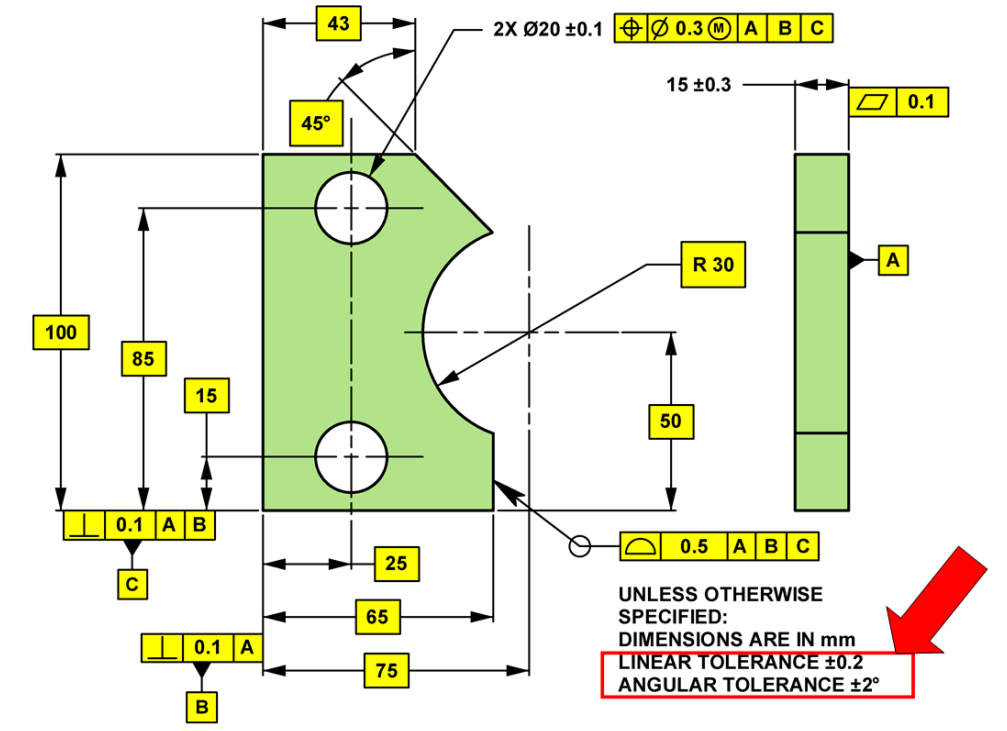
- Dimensions are usually given in millimeters (mm)





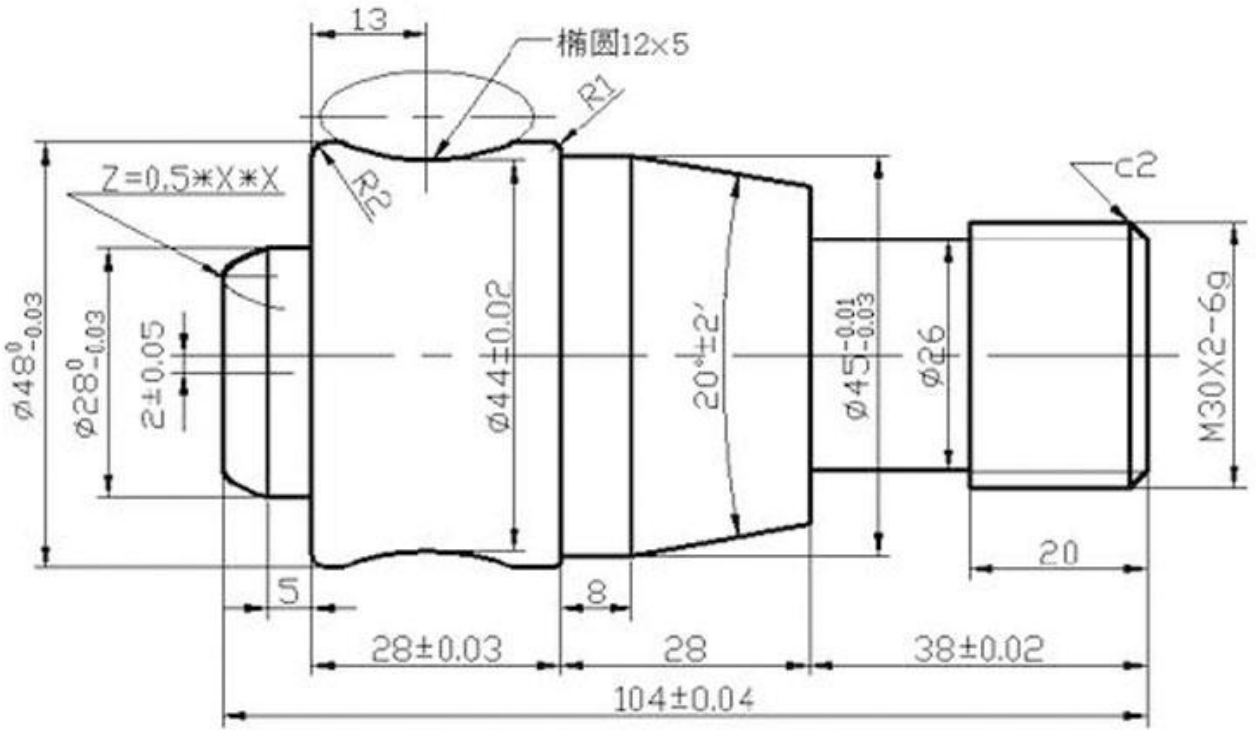
Technical Drawing - Tolerances

- Tolerance is the allowed variation in size



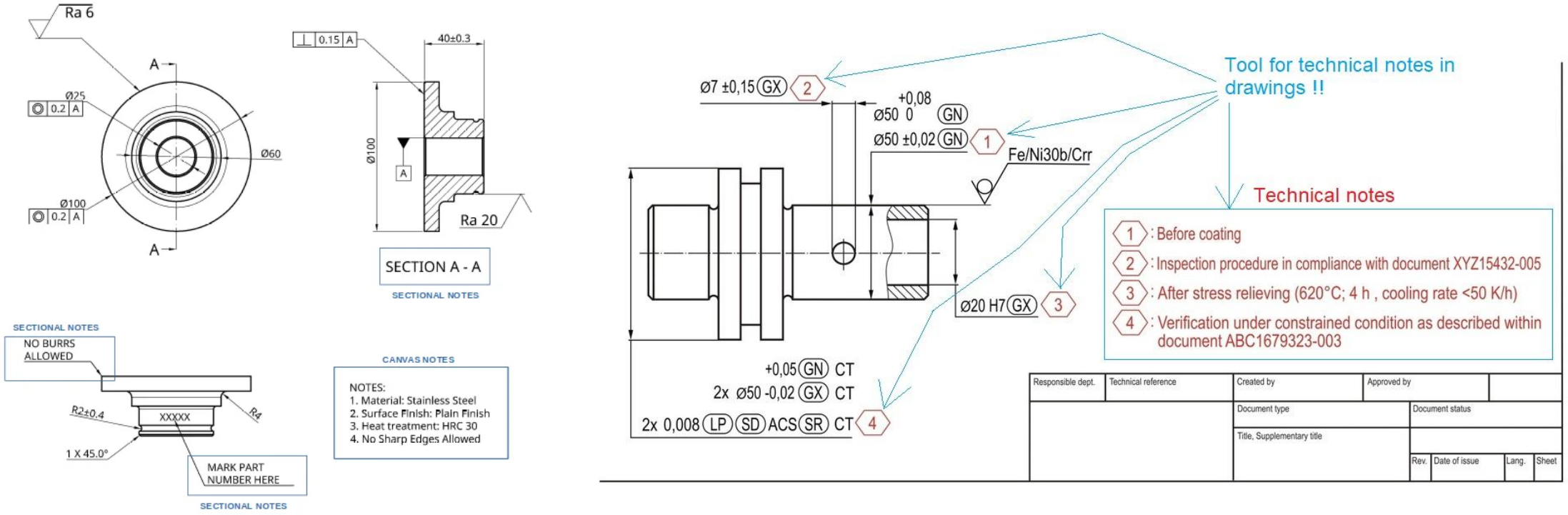
Technical Drawing - Why Tolerances Matter

- Tolerances ensure that parts fit and function correctly



Technical Drawing - Symbols and Notes

- Drawings use symbols and notes to give additional information



Mechanical Properties

- Hardness
- Brinell, Rockwell
- Yield Strength
- Tensile Strength
- Ductility
- % Elongation
- Effect of Carbon Content

Quenching - Hardenability

- This is dependent upon the chemical composition of the steel alloy.
- The addition of Nickel, Chromium and Molybdenum will slow the transformation to other phases and allow more martensite to form.
- Most heat treatable steels are alloys rather than plain carbon steels.

Quenching Media

Four commonly used quenching media:

- Brine – the fastest cooling rate (1000 °C/s)
- Water – moderate cooling rate (600 °C/s)
- Oil – slowest cooling rate (40 – 200 °C/s)
- Gas – used in automatic furnaces, usually liquid nitrogen, can be very fast cooling. (more than 5000 °Cs/)
- Air – used for very slow cooling rate (1 – 25 °C/s)

Depth of Hardening

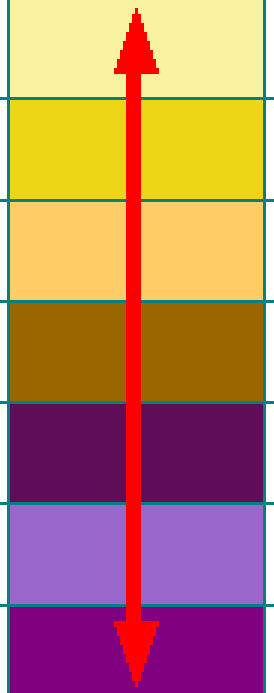
- Due to the *mass effect*, not all the section of a large component may be hardened due to too slow a cooling rate.
- This may leave a soft core, or in extreme cases prevent hardening altogether.

Tempering

- The brittleness of martensite makes hardened steels unsuitable for most applications.

- This requires the steel to be tempered by re-heating to a lower temperature to reduce the hardness and improve the toughness. This treatment converts some of the martensite to another structure called bainite.

Tempering Temperatures

COLOUR	HARDEST	APPROXIMATE TEMPERATURE (°C)	USES
Pale straw		230	Lathe tools, scrapers, scribers
Straw		240	Drills, milling cutters
Dark straw		250	Taps & dies, punches, reamers
Brown		260	Plane blades, shears, lathe centres
Brown/purple		270	Scissors, press tools , knives
Purple		280	Cold chisels, axes, saws
Dark purple		290	Screwdrivers, chuck keys
Blue	TOUGHEST	300	Springs, spanners, needles

Material selection

Requirements X Possibilities

Strength
X
Formability, weldability

Required for safety

Required for making (technology)

Material selection

Requirements X Possibilities

Strength
X
weldability

Required for low weigth

Required for making (technology)

Material selection

Requirements X Possibilities

Hardness, toughness
X
Formability, hardnessability

Required for low mass lost

Required for making (technology)