



Non-Destructive Testing

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A wide group of techniques used in science and industry to evaluate the properties of a material or component without causing damage

Hardness

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A measure of how easily the surface a material can be scratched or indented (often tend to be very brittle)

Toughness

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Measures a material's ability to absorb sudden blows or impact without fracture. (The opposite to brittleness)

Brittleness

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A material's tendency to break easily or suddenly without any extension first. (The opposite to toughness)





Elasticity

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A material's ability to return to its original shape and size after being freed from a load that was distorting it

Plasticity

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A material's ability to deform permanently when small forces are applied

Ductility

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The ability to be drawn out into a thin wire or threads. It is a measure of how easily a material can be worked.

Strength

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The general ability of a material to withstand an applied force





Tensile Strength

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A material's ability to withstand pulling or stretching forces (tension)

Durability

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A material's ability to withstand wear and tear through weather and corrosive attack etc.

Stiffness

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A material's ability to resist bending

Malleability

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The ability of a material to be flattened out in all directions without fracturing





**Thermal
conductivity**

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How well a
material
conducts heat

**Electrical
Conductivity**

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How well a
material conducts
electricity

Insulators

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Materials that
do not conduct
electricity

**Corrosion
Resistance**

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The ability of a material
to withstand
environmental attack and
decay





Tensile Testing

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Tests the strength of materials to see how they will react to forces exerted- Gives a measure for ductility and elasticity and can indicate brittleness

Extensometer

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Machine used to carry out tensile testing

Hardness Tests

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- Brinell Testing
- Vickers Testing
- Rockwell

Toughness Tests

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- Izod Test
- Charpy Test





Youngs Modulus of Elasticity (E)

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The slope of the elastic part of the stress/strain curve

$$\text{Stress} \div \text{Strain} \\ (\text{KN/mm}^2)$$

Ultimate Tensile Strength

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The maximum load the specimen can withstand before it will start to neck and fracture

$$\text{Maximum load} \div \text{Cross sectional area} \\ (\text{KN/mm}^2)$$

Metal Fatigue

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A failure due to on/off loading or cyclic stressing which begins as a minute crack which grows under the action of fluctuating stress

Metal Creep

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The slow deformation of a metal over time resulting from constant force acting on that material. More likely to occur if materials are subject to high temps or if the materials themselves have a low melting point





Dissolved Acetylene

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If acetylene is compressed into a cylinder, it would explode under high pressure. Acetylene cylinders are packed with a porous material that is filled with acetone; this can absorb 25 times its own volume of acetylene

Slag Inclusions

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Foreign matter becoming entrapped in the weld. Can be caused by welding on dirty surfaces, or contamination from the atmosphere

Porosity

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Usually caused by the presence of moisture in the weld, the presence of paint, oil or grease, or if the cylinder is out of gas

Multi-Run Welds

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A series of welds are run across the metals to be joined. A superior weld is produced as each weld has a post heating effect on the previous run. The finished weld is stronger and more refined in structure than single run welds





Flashback Arrestor

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Prevents the flame from returning to the cylinders in oxy-acetylene welding

Neutral Flame

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Flame used in oxy-acetylene welding and has a balanced proportion of oxygen and acetylene & working temperature of up to 3300°C

Carburising Flame

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Flame used in oxy-acetylene welding which contains excess acetylene.
Working temperature of up to 3150°C.
Flame is larger with the distinctive acetylene feather.

Oxidising Flame

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Flame used in oxy-acetylene welding that contains excess oxygen.
Working temperature of up to 3500°C.
Flame appears smaller.





Step-Down Transformer

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Used to change the mains voltage from 220V to a suitable level (80-100V) for welding, which will provide the high current needed for welding. This type has more turns on the primary coil than the secondary coil and will induce alternating current (AC) at a lower voltage.

Rectifier

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The rectifier changes alternating current (AC) to direct current (DC). It consists of four diodes which allows two of the diodes to conduct on each half-cycle of the AC supply.

Capacitor

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Used to provide a smooth supply of low voltage DC

Metal Machinability

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Refers to the ease with which a metal can be machined to an acceptable surface finish.





Tolerance

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The extent by which a dimension is allowed to deviate from the nominal or basic size

Reamer

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A type of rotary cutting tool – Used to enlarge the size of a previously formed hole by a small amount with a high degree of accuracy

Forming

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When the surface produced is a copy of the tool producing it. Form tool is customized to the profile of the part. A single plunge can machine a complex shape.

Generating

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The use of a single point cutting tool to machine a complex shape - Moves the tool in various directions until the required surface is machined





Gang Milling

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When milling cutters are mounted side by side on the arbour. This may be used to mill a complex shape in one pass. The cutting profile is generated by the size and shape of the cutter.

Straddle Milling

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The milling cutters are mounted on the arbour and are separated by spacing cutter. Used to mill two surfaces that are parallel to each other.

Plain Milling

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The milling of a flat surface with the axis of the cutter parallel to the machining surface

End Milling

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The milling of a flat surface with the axis of the cutter perpendicular to the machining surface





Up-cut Milling

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When the cutter rotates in a direction opposite to the table feed

Down-cut Milling

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When the cutter rotates in the same direction as the table feed, also known as *Climb Milling*

Plug Gauge

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Used to accurately determine if a hole is within a specific range of limits

Snap Gauge

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Used to accurately check if an external diameter is within a specific range of limits





Telescopic Gauge

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Used to measure a gap or internal diameter that may be hard to reach with a conventional device

Slip Gauges

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Small blocks of alloy steel or tungsten carbide that are manufactured in a variety of precise sizes. Can be stacked to a specific size and can be used to check for accuracy or to calibrate instruments.

Clearance Fit

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The shaft is smaller than the part it fits into. There is a space to allow the parts to fit together easily.

Interference Fit

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The shaft is larger than the part it is intended to fit. The parts will have to be forced together.





Countersinking

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Enlarging the mouth of a hole to allow countersink screw heads to sit flush with the surface of the piece

Counterboring

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Increasing the diameter of the hole to a certain depth to allow a cheese head screw to lie flush with the surface of the piece

Pilot Hole

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A hole which is drilled prior to a larger hole being drilled and gives the larger hole a center to start

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Tapping Size Hole

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A hole drilled prior to threading. The hole is always smaller than the tap to be used. The pitch of the thread will determine the size of the tapping size hole.

Rake Angle

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The angle of the cutting face relative to the workpiece. Facilitates the lifting of the chip during cutting. Can be positive, negative or zero.

Clearance Angle

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Formed to allow one point of the cutting tool to contact the workpiece

Lubricant

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Reduces/Eliminates heat caused due to friction





Cutting Fluid

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Used to carry away heat caused by deformation and will reduce tool wear, give a better surface finish and tighter dimensional control

Rancidity

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Caused by bacteria and other microscopic organisms growing and eventually caused bad odours to form

Surface Grinding

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A metal cutting process in which flat and extremely smooth surfaces are produced

Loading

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(relating to grinding wheel)
When small particles of grinding debris become trapped in the space between the abrasive grains and the wheel





Glazing

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When a grinding wheel has a shiny appearance as the abrasive particles have lost their edge and failed to break away from the wheel

Dressing

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In the grinding process, wheel dressing is used to restore the cutting surface of any irregularities

Fixed steady

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Provides support for lengthy work which needs an intermediate support to prevent whip or wobble. This is useful where long lengths of bar are being machined at either end and need to be securely supported.

Vee Block and Clamp

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Precision metalworking jigs typically used to hold round metal rods or pipes for performing drilling or milling operations





Spur Gears

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Standard straight cut toothed gear

Helical Gears

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More gradual refined meshing which allows for smoother, quieter running than spur gears, also giving greater strength. The teeth are not parallel to the axis of rotation, but are set at an angle.

Idler Gears

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An additional gear used to change the direction of a gear train. Fits between the two main gears to ensure the driver and driven rotate in the same direction. Does not influence the gear ratio of the system.

Rack and Pinion

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In this mechanism, the rotational motion of the pinion is translated into the linear motion in the rack





Worm and Worm Wheel

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A worm gear is used in conjunction with a worm wheel to change the angle of rotation through 90° and to slow down a drive. It increases the torque of a driving motor.

Ratchet and Pawl

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A mechanical device that allows continuous linear or rotary motion in one direction only while preventing motion in the opposite direction

Chain and Sprocket

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A sprocket is a profiled wheel with cogs which mesh with a chain. The chain is used to transmit motion from one sprocket to another without slip. This system produces a strong drive.

Bearings

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These have an inner and outer race between which balls or rollers role. The outer race is usually fixed, allowing a press fit shaft to turn freely without friction in the inner race.





Stepped Cone Pulley Mechanism

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A mechanism used on a milling machine to allow for speed control

A Single Acting Hydraulic Ram

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A single acting hydraulic ram has a port at one end, supplied with hydraulic fluid for extension of the piston. The piston is retracted by a spring or gravity.

A Single Acting Cylinder

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A pneumatic output device that requires compressed air to make the piston move. If the air is removed the piston will return to its original position.

A Double Acting cylinder

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A double acting cylinder requires compressed air to move the piston. It will stay in this position if the air is turned off. Air from the opposite direction is needed to return the piston to its original position.





Reservoir

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Used to create a time delay in a pneumatic circuit

Pneumatic Flow Regulators

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Valves that control the flow of pressurised air in one direction in a pneumatic circuit. They can be activated manually or electronically.

SPST Switch

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A simple on/off switch. If used in a circuit with a motor it will only allow the motor to rotate in one direction.

DPDT Switch

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Used where forward and reverse is required. If a motor is required to rotate in both directions a DPDT switch is used.





Resistor

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A resistor will limit current flow and is used to protect electronic

Toggle Mechanism

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Commonly used as a clamping mechanism and can be seen on a vice grips. Consists of a linkage that is controlled by a lever. A small amount of force on the lever results in a large amount of force on the output linkage.

Cam and Follower Mechanism

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Converts rotary motion into reciprocating motion

Capacitor

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A capacitor is used to store charge which can be released when needed





Thermostat

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A component of a control system which senses the temperature of a system so that the system's temperature can be maintained near a desired set-point

Relay

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An electromagnetic device that changes switching contacts when it receives an electric signal. It consists of a wire coil with a soft iron core.

Solenoid

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An electrical device where a coil of wire, wound around a soft iron core, is energised. The magnetic force induced by the current pushes the bar towards the centre. A solenoid spring will return the bar to its original position.

Heat Sink

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A heat sink is an environment or object that absorbs and dissipates heat from another object using thermal contact





Thermoplastics

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Can be reheated
and reshaped over
and over

Thermosetting Plastics

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Have a reasonably high melting
point, good thermal insulation,
can withstand high
temperatures without losing its
rigidity, stiff and less flexible

Elastic Memory

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(In thermoplastics) The ability of
the polymer to return to its original
state from a deformed state. If a
thermoplastic has been bent to a
specific shape, when reheated it
will return to its original shape.

Monomer

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A molecule of a
compound which can
react with other
molecules to form a
polymer





Amorphous Polymers

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Amorphous polymers do not have a pattern in the arrangement of their atoms but are of a more random structure

Crystalline Polymers

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These have atoms that are bonded together in a pattern that is repeated

Copolymer

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A polymer formed when two different mers are linked together in the same polymer chain. This new polymer may have a new mixture of new improved properties. It is similar to alloying in metals.

Van Der Waal Forces

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These are bonding forces between polymer chains produced by addition polymerization. They are weak, secondary covalent bonds that may be disrupted by heat or pressure.





Catalyst

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Used to alter the speed of a chemical reaction. They are used to initiate the polymerisation process.

Inhibitor

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Prevents certain chemical reactions from happening or slow down

Fillers

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These additives control the mechanical properties of the polymer such as material strength. They reduce the amount of expensive polymer used.

Stabiliser

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Helps prevent the degrading effects that heat, UV light and other environmental conditions place on the polymer





Glass Reinforced Plastic (GRP)

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The addition of glass fiber to polyester resins greatly increases strength

Laminate

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Thin layers of material are bonded together. Produces a high strength plastic where layers of paper or cloth are bonded together. Heat and pressure can be used.

Foaming agent

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Substances which add bubbles to a polymer, increasing bulk and making the polymer lighter.

Glass Transition Temperature

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Describes the temperature at which amorphous polymers undergo a transition from a rubbery, viscous amorphous liquid to a brittle, glassy amorphous solid. Can be engineered by altering the degree of branching or crosslinking in the polymer or by the addition of a plasticiser.





Elastomers

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A group of polymers consisting of linear chains that are coiled, entangled and are subject to minimal cross-linking.

Natural Rubber

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This is the sap from the rubber tree. Its polymer chains are of a folded nature and are bonded by weak Van-der-Waals forces. It is both plastic and elastic.

Synthetic Rubber

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This is natural rubber that has been processed with Sulphur, which produces cross-links between the folded chains. This process is called vulcanisation. This gives a stronger bond which is more durable and less flexible than natural rubber.

Plasticisers

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Added to polymers to improve their flexibility. They achieve this by altering the forces of attraction between molecules of the polymer.





Lubricants

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Make the polymer easier to mould. Various types of waxes are used in small amounts for this purpose.

Pigments

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Have the function of giving colour to the polymer

Ionic Bonding

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An ionic bond is the force of attraction between oppositely charged ions in a compound

Ion

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An ion is an atom that has gained or lost an electron





Cation (+ve)

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An atom that has lost an electron. Metals tend to form cations as they are prone to losing their outer electron to other ions.

Anion (-ve)

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An atom that has gained an electron. Non-metals tend to gain electrons (Electron acceptors)

Metallic Bond

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A rigid lattice of positive ions (cations) suspended in a 'sea' of electrons. Produce high melting points, ductility and malleability in materials.

Covalent Bonding

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Covalent bonding is the sharing of electrons





Ferrite

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Iron that contains less than 0.02% carbon dissolved in solution, it is almost pure iron. It has a body centered cubic structure.

Pearlite

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A mixture of alternate layers of ferrite and cementite. It is mostly ferrite and gives off sheen similar to mother of pearl. Formed at 0.83% carbon.

Eutectic Point

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A liquid to solid change occurs at this point. It happens at 1140°C for the iron carbon alloy with 4.3% carbon. Liquid steel changes to solid austenite and cementite.

Eutectoid Point

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A reaction that occurs in the solid state when solid austenite changes to solid pearlite. It happens at 723°C for the iron carbon alloy with 0.83% carbon.





Allotropy

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The ability of a material to exist in more than one crystalline form. Steel has a BCC form when cold but exists as FCC austenite when heated above the upper critical temperature.

Partial Solubility Alloy

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An alloy of two metals will dissolve in each other to a limited degree, The lead-tin alloy is an example.

Solid Solution Alloy

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When two metals are completely soluble in each other in both the liquid and solid states. When viewed under a microscope, a solid solution appears like a pure metal. E.g. copper-nickel and iron-chromium.

Eutectic Alloy

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A mixture of metals that is completely soluble in the liquid state but insoluble in the solid state. E.g. The cadmium and bismuth combination.





Solvus

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The transition from one solid form to another solid form of an alloy is called the solvus line. It is shown on the lead-tin diagram.

Solidus

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A solidus line represents the end of solidification in an alloy

Re-crystallisation

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During cold working, distorted nuclei are formed and then replaced by new crystals during re-crystallisation. This is achieved by heating and cooling the component during annealing and allowing large grains to form.

Optical Pyrometer

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This method compares the intensity of light from the filament of a lamp. Current flow from the lamp can be adjusted, using a variable resistor, to match the light from the furnace. When the filament seems to 'disappear', a temperature reading can be taken.





Thermocouple Pyrometer

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A galvanometer measures the electrical current generated by a rise in temperature of two dissimilar metals joined together. A temperature output is converted from the electrical units.

Narcotic Effects

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Result of the inhalation of toxic substances which can lead to loss of sensibility, drowsiness, unconsciousness and possible death.

Systematic Effects

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The result of toxins entering the bloodstream or body system through skin, mouth, etc. and attacking fundamental organs and functions.

Safety Signs

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Safety signs in the workshop are designed to an international standard to include shape and colour. The standardisation of colour codes allows workshop users to be uniformly aware of hazards in the workplace.





Green

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Green is a positive action to safe condition, emergency exit or first aid

Red

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Red is prohibition signs to include danger and fire safety

Blue

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Blue denotes mandatory or information signage

Yellow

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Yellow alerts to a caution or possible danger



LC Engineering– Key Definitions



Factor of Safety

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The degree of structural capacity beyond applied loads. Structural design must take into account excessive weight and weather conditions which could lead to 'over design' of the structure.

Adhesive

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A substance used for sticking objects or materials together. When used on plastics, hazards include creation of fumes, bonding skin, chemical reaction of adhesive and plastic.

Clutch

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Used in a transmission system to break and make the drive between the engine and the wheels. When the clutch engages, the pressure plate and the friction plate are pushed together.

Prototype

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A first or preliminary version of a device or vehicle from which other forms are developed. Used for testing.

Cut dotted horizontal lines. Fold vertical line.



LC Engineering – Acronyms



IC

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Integrated
Circuit

PCB

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Printed Circuit
Board

LCD

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Liquid Crystal
Display

HSS

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High Speed
Steel



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LC Engineering – Acronyms



ISP

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Internet
Service

LDR

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Light
Dependent
Resistor

RAM

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Random
Access
Memory

CAD

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Computer
Aided Design

Cut dotted horizontal lines. Fold vertical line.



LC Engineering – Acronyms



CAM

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Computer
Aided
Machining

CPU

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Central
Processing
Unit

LAN

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Local Area
Network

Http

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Hypertext
transfer
protocol

Cut dotted horizontal lines. Fold vertical line.



LC Engineering – Acronyms



GRP

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Glass-
Reinforced
Plastic

LED

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Light-Emitting
Diode

ROM

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Read Only
Memory

VDU

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Visual Display
Unit

Cut dotted horizontal lines. Fold vertical line.





SPST switch

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Single Pole
Single Throw
switch

DPDT
switch

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Double Pole
Double Throw
switch

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