



Glossary of Terms  
Aluminium

**Ageing, Age Hardening, Precipitation Hardening** The second stage in the process (solution treatment and ageing) for those aluminium alloys that respond to heat treatment as a means of increasing their mechanical properties. It entails the precipitation of a constituent from a supersaturated solid solution. The rate of precipitation, and hence ageing, is both temperature and time dependent, with some alloys ageing at room temperature. It is more usual to perform ageing at higher temperatures. It should be noted that routinely operating aged alloys at unusually high ambient temperatures will permit further ageing and even over ageing leading to loss of properties. *Related terms: Aluminium*

*Alloy Classifications*

**Alloy** A combination of two or more metals, or of metals and other elements. An alloy is formed by adding the 'alloying elements' to the 'parent' metal in the molten state. The parent metal usually accounts for more than 50% of the resultant mixture.

**Alocroming, Chromating, Alocrom** A family of proprietary chemical conversion coating processes based on chromate (hexavalent chromium) solutions that act as a surface pre-treatment before painting or insulation foaming. This also increases the corrosion resistance. More environmentally benign processes based on trivalent chromium are being introduced.

**Alumina** Aluminium Oxide – A white powder that is produced from the aluminium ore Bauxite and then smelted to produce aluminium metals.

*Related terms: Hall Heroult Process*

**Aluminium Alloy Classifications** Wrought aluminium alloys are specified in British, European and other National standards and are classified in an agreed 4 digit system.

They fall into 2 distinct sub groups:-

1xxx, 3xxx and 5xxx series that develop strength by cold working, the number will be followed by the digit H and other numbers referring to the degree of annealing or cold work, e.g. 3105H22.

2xxx, 6xxx, 7xxx and 8xxx alloys that develop properties by solution treatment and precipitation hardening. The number is usually followed by a T and a number, defining the heat treatment condition of the alloy, e.g. 6082T6.

Thus the 4 digits, the letter and following digits for a product clearly define the chemical composition and the mechanical properties of that material. *Related terms: Temper Designations*

**Anodising** An electrochemical method for artificially thickening the naturally occurring oxide surface film on Aluminium and Aluminium Alloy surfaces to improve appearance and/or corrosion resistance. Not all alloy grades are suitable for decorative anodising, with the general rule being the purer the aluminium, the better it will anodise. The thickness and other film characteristics can be controlled to meet varied requirements for improved corrosion resistance, improved abrasion resistance, electrical insulation or as a pre-treatment for subsequently applied coatings. Colour can also be applied using dyes. Anodising film thickness is typically 5 to 25 microns. *Related terms: Anodising*

*Quality Material*

**Anodising Quality Material** Material with characteristics that make it suitable for decorative anodising after a suitable preliminary treatment

**Artificial Ageing, Precipitation Treatment** The thermal treatment of an alloy that increases the hardness and strength by precipitation of constituents from the super-saturated solid solution at above room temperature. *Related terms: Ageing, Age Hardening, Precipitation Hardening*

**As-Quenched Condition** The condition of an alloy during the time immediately following the quench and before the mechanical properties have been significantly raised by precipitation hardening (ageing).

**Back-End Defect** A defect found in extruded products due to incorrect extrusion procedures at the mill.

**Bauxite** The main ore of aluminium, found in great abundance in the earth's crust, near the surface. It is mined using open cast mining.

**Bayer Process** A chemical process used to refine the aluminium ore bauxite into alumina (aluminium oxide) from which the aluminium metal can be extracted by smelting

**Bend Radius** The radius of curvature of the former around which a specimen is bent.

**Bend Test** The bending of a specimen to conform with a predetermined radius and angle, to assess bending characteristics and ductility.

**Billet, Bloom** Cast aluminium in the form of large round (or occasionally square) bars.

**Blank** A work-piece prepared for subsequent processing e.g. by forming, bending, cupping, drawing, impact extrusion, pressing, etc.

**Bow** The deviation of the edges from the true longitudinal axis of a product seen as an arc.

**Buckle, Ripple** The variation in flatness represented by alternate bulges and hollows along the length of a rolled product, the edges of which remain reasonably flat.

**Busbars** Bar or section for use as a common junction between electrical circuits.

**Cast, Heat, Melt** These terms are used interchangeably to refer to the product of a single melting furnace charge. Sometimes the furnace contents are tapped into two or more ladles when the product of each ladle may be called a separate cast.

It is always assumed that the chemical composition of an entire cast will be uniform. This is described as the "cast analysis" on a Certificate of Conformity etc.

**Chemical Brightening** A chemical treatment to improve the specular reflectivity of a surface.

**Chemical Conversion Coating** The treatment of material with chemical solutions by dipping or spraying to increase the thickness of the natural oxide film on the surface or to build up an oxide film bearing chromates or phosphates *Related terms: Alocrom*

**Circumscribing Circle** A circle that will just contain the cross section of an extrusion, usually designated by its diameter.

**Clad Material** Material that has a thin layer of Aluminium or Aluminium alloy metallurgically bonded to it usually by rolling, extruding or drawing. Most often it is used to provide a more corrosion resistant surface or to facilitate anodising.

**Cold Working** The permanent alteration of shape or dimensions by plastic deformation at room temperature by, e.g., cold rolling, cold reduction, drawing, pressing, forming, bending, swaging, etc.. Cold working increases strength and hardness but reduces ductility.

**Colour Anodising** Incorporation of colouring matter (dyes) into the film of anodised Aluminium during the anodising process.

**Concentricity** Strictly, this is the shift between the centres of the circles that are the Outside Diameter (OD) and Inside Diameter (ID/ Bore) of a round tube. Any such shift will cause a variation in wall thickness around the circumference of the tube, hence the tolerance on concentricity is determined by the wall thickness tolerance.

**Container** The key part of an extrusion press into which the billet is placed before extrusion. It is a hollow cylinder which is closed at one end by the die and at the other by the extrusion ram. It has to contain the substantial pressures generated during extrusion.

**Controlled Stretching** Stretching, under controlled tension, of plate and sheet products to a specified extension (percentage permanent set). It relieves internal stress and minimises distortion during machining as well as improving flatness and straightness.

**Critical Quenching Rate** The minimum mean cooling rate from the solution treatment temperature necessary to retain the alloying constituents in solid solution and thus permit the alloy to meet specified mechanical property requirements in the precipitation hardened (aged) condition.

**Deep Drawing** The forming of deeply recessed parts (such as beverage cans and hollow-ware) by means of plastic deformation of the material. As deep drawing does not uniformly cold work the blank there will be variations in the hardness and annealing response around the final part.

**Deep Drawing Sheet** Sheet produced with specific characteristics that permit deformation by deep drawing – such as softness, high ductility and low tensile strength.

**Delayed Ageing, Delayed Age Hardening** Retarding natural ageing by holding the alloy below room temperature. If the alloy is raised to room temperature then natural ageing will proceed at the expected rate. *Related terms: Ageing, Age Hardening, Precipitation Hardening*

**Die Drawing** A CAD Drawing of the extrusion die showing exact detail of the shape of the profile.

**Die Lines** Continuous longitudinal lines that are formed on extruded and drawn products by minor irregularities, or pick up, on the bearing surfaces of the die.

**Die, Extrusion Die** The hardened steel aperture through which a heated extrusion billet is pushed to form an extruded profile shape.

There are 3 types of die:

Flat Die – For extruding solid shapes

Porthole Die – For extruding hollow shapes – This leaves one or two 'weld' seams along the length of the extrusion so tube produced in this way is called Welded Tube.

Flat Die with Mandrel – For extruding seamless hollow shapes and seamless tube

**Differential Annealing** The localised heating of part of a blank so that only specific areas are annealed.

**Diffusion (in clad material)** The migration of alloying elements from the core into the cladding layer during thermal treatment. This can be detrimental to the properties and behaviour of both the core and cladding.

**Diffusion Staining** Patchy surface discolouration that can occur as a result of diffusion in clad material.

**Direct Extrusion, Extrusion** The extrusion process in which a preheated billet is placed in the container and is pushed by the ram through the stationary die to form the extruded section. *Related terms: Container*

**Directional Properties** Deformation by cold working causes changes to the grain structure and, sometimes, variations in mechanical properties across and along a work-piece. Properties measured along the direction of deformation are described as longitudinal, whilst those measured at a right angle to the direction of working are called transverse.

**Drawing, Cold Drawing** The pulling of a work-piece through a fixed die at room temperature. It can reduce the size, change the cross section or shape, improve surface finish, improve tolerances or work-harden the material.

**Drawn Tube** A hollow product of uniform wall thickness, produced by cold drawing. *Related terms: Drawing, Cold Drawing*

**Drift Test, Flaring Test** A test for the weld integrity of a welded tube, usually carried out to BS1139. All batches of Scaffolding Tube undergo this test. *Related terms: Scaffolding Tube*

**Duplex Ageing** A two stage age-hardening heat treatment conducted at different temperatures.

**Dye Penetrant Test** A non-destructive test for surface defects and flaws. A clean and degreased work-piece is dipped in, or otherwise coated by, a fluid containing a brightly coloured dye. This fluid is often called dye penetrant ink. After a predetermined time the ink is removed, usually by washing, and a, usually white, developer applied. The dye seeps out from any flaws and cracks, thereby making them easily visible.

**Etching** The production of a uniform matt, surface finish on a work-piece by controlled chemical or electrochemical attack. The etching agent can be either acid or alkali in nature.

**Etching Test** The use of a chemical reagent to reveal the macrostructure of a sample from a work-piece. The test is usually made on a cross section from the work-piece so is destructive.

**Extrusion Ratio** The ratio of the cross-sectional area of the extrusion container to that of the extruded product.

**Finstock** Narrow strip in the thickness range 0.2mm to 0.4mm used for finning of heat exchanger tubes in applications such as air conditioning.

**Fixed Mandrel** A device for producing hollow extrusions of regular cross section. The tapered mandrel is attached to the main extrusion ram and passes through the hollow billet. As the ram moves forward the mandrel passes, with the billet, through the die giving a product slightly tapering in wall thickness along its length. The mandrel is tapered to facilitate its removal when extrusion is complete.

**Flash Annealing** Annealing of a work-piece by rapid heating and a short dwell time at the appropriate temperature.

**Flatness** The property of having a horizontal surface without any slope, tilt, or curvature, i.e. that of a flat plane. In practice a perfectly flat surface is probably unobtainable so there will be a flatness tolerance. *Related terms: Flatness Tolerance*

**Flatness Tolerance** A three-dimensional geometric tolerance that controls how much a product surface can deviate from a flat plane. The permitted deviation will depend upon the thickness of the sheet or plate varying between 0.2% and 0.5% of its width and length, usually measured over a 1 metre length.

**Floating Mandrel** A tapered mandrel that is inserted into the hollow extrusion billet. It is not attached to the extrusion ram so is left free to centre itself in a hollow billet as it moves forward through the die as the ram advances and extrusion proceeds. The resulting product tapers slightly in wall thickness along the length. *Related terms: Fixed Mandrel*

**Foil, Tin Foil, Kitchen Foil, Cooking Foil** Cold rolled aluminium flat product less than 250 microns in thickness. Usage includes kitchen foil (cooking foil) and foil trays for food. Kitchen Foil is often incorrectly referred to as Tin Foil.

**Forging** Hot working using a forge with shaped tools that 'hammers' the work-piece into a predetermined shape.

**Fracture Test, Impact Test, Charpy Test, Izod Test** A test in which the test piece is notched and broken. The fracture surface examined to assess grain structure and freedom from defects. Also used to determine toughness, often at varying temperatures to establish at what reduced temperature the material becomes brittle.

**Free Machining Alloy (FMA)** An alloy designed to give, when machined, small broken chips, lower power consumption, better surface finish and/or longer tool life. Chemical composition and microstructure both influence this property.

**Full Heat Treatment** For alloys in the 2xxx, 6xxx, 7xxx and 8xxx series this is the heat treatment cycle consisting of solution treatment followed by artificial age hardening.

**Gauge Length** In a tensile test this is the prescribed part of the cylindrical or prismatic portion of the test piece on which elongation is measured at any moment during the test. In particular, a distinction should be made between the following:  
~ The original gauge length, i.e. the gauge length before the test is started.  
~ The final gauge length – The gauge length after the test is completed and the test piece has fractured. The broken pieces are carefully fitted together to lie in a straight line so that it can be measured.

**Grain Flow** Elongation of the grain structure in the direction of cold working.

**Grain Growth** Coarsening of the grain structure that occurs under certain conditions of heating. It is generally undesirable and is deleterious.

**Grain Size** A measure of the area or volume of grains in polycrystalline material. Grain size is reported in a number of ways  
1. number of grains per unit of area or volume,  
2. average diameter,  
3. as a grain size number derived from area measurements and comparison with a standard chart.

**Hall Heroult Process, Smelting** The main process used for the production of Aluminium metal whereby Alumina is dissolved in a salt bath of molten cryolite and subject to an electrolysis process. Often referred to as Smelting, this process uses very large amounts of electricity. Named after two scientists who developed the process independently of each other at around the same time.

**Hall-Heroult Process** The main process used for the production of Aluminium metal whereby Alumina is dissolved in a salt bath of molten cryolite and subject to an electrolysis process. Often referred to as Smelting, this process uses very large amounts of electricity. Named after two scientists who developed the process independently of each other at around the same time – Hall, English and Heroult, French. *Related terms: Smelting*

**Hardness Test** A test conducted to measure Hardness. A load is applied to an indenter to press it into the surface of the test piece. The indenter can be either a ball of various standard diameters or a diamond of one of several specified geometric profiles. The result of the test is reported as a Hardness Number which is derived from either a measurement of the depth to which the indenter penetrates or from the surface area of the impression left by the indenter. *Related terms: Hardness*

**Hardness, Vickers Hardness, Brinell Hardness, Rockwell Hardness** The resistance of a metal to plastic deformation usually by indentation using a diamond or a hardened steel ball. There are various recognised hardness scales including Vickers (VPN), Brinell and Rockwell. N.B. The empirical, but robust, relationship between hardness and tensile properties that applies in steels does not apply, and the steel tables must not be used for aluminium and its alloys. A less rigorous relationship has been established for some aluminium alloys but it is not widely used.

**Heat Treatable Alloy** Any of the 2xxx, 6xxx, 7xxx and 8xxx series of wrought aluminium alloys whose mechanical properties can be increased by a solution treatment and age hardening heat treatment cycle.

**Heat Treatment** The thermal processing of a work-piece specifically to alter its mechanical properties. It includes:-  
1. Annealing to soften and improve ductility.  
2. Solution treatment and precipitation hardening to increase strength. It does not include heating before hot rolling, forging or extrusion etc.

**Homogenisation** The structure of as cast semi finished products e.g. slab, extrusion billet or forging blanks is invariably chemically segregated - that is the alloying elements are concentrated locally rather than uniformly distributed within the microstructure.

Homogenising is a way of mitigating this as the work-piece is held at a suitably high temperature for sufficient time to eliminate, or at least decrease, chemical segregation by diffusion of the alloying elements.

**Hot Working** Plastic deformation, e.g. hot rolling, extrusion or forging, of a work piece in a temperature range and at a rate such that strain hardening does not occur.

**Indirect Extrusion, Backwards Extrusion** The extrusion method in which there is no relative movement between the billet and the container.

This is accomplished by:-

Either pushing the die held on the end of a long, hollow, stem through the billet.

Or moving the billet and container together over the die, again held on the end of a long, hollow, stem.

As there is no movement between the billet and container the friction, and hence extrusion loads, are reduced by up to 30% compared to direct extrusion and grain structures can be improved. The process is limited by the size, length and strength of the stem which holds the die.

*Related terms: Direct Extrusion*

**Ingot** A cast product that may be various shapes including slab, billet, bloom or more complex shapes.

Produced by pouring liquid aluminium into a shaped mould and allowing it to cool.

**Integral Colour Anodising** Coloured surfaces developed either by anodising certain Aluminium alloys and/or by using special organic electrolytes that produce colours during anodising.

**Internal Stress** Stresses within a work-piece caused by previous treatments, e.g. casting, thermal treatment or fabrication.

**Isothermal Quenching** A procedure in which the work piece is quenched, and held for some time, in a fluid which is held at a constant temperature between the solution treatment temperature and room temperature. This permits precipitation hardening.

**Lateral Curvature, Edge Curvature** The lateral departure, in arc form, of an edge from linear straightness.

**Lüders Lines** Surface marks caused by localised flow that appears on some alloys after light straining. They run parallel to the direction of maximum shear stress i.e. at 45° to the direction of the deforming stress.

**Mean Diameter** The sum of any two diameters at right angles divided by two.

**Mean Wall Thickness** For a tube this is the sum of four wall thickness measurements, made at 90° intervals around the diameter, divided by four.

**Multi-Hole Die** An extrusion die, with more than one hole, allowing multiple extrusions to be made simultaneously from one billet.

**Natural Ageing** The process that can alter the hardness and strength in some alloys after a period of time at ambient (room) temperature. It is caused by the spontaneous precipitation of constituents from a super-saturated solid solution. Generally it increases mechanical properties but can also, in some circumstances, cause loss of

properties by over-ageing. *Related terms: Ageing, Age Hardening, Precipitation Hardening, Over-ageing*

**Non-Heat Treatable Alloy** An alloy, from the 1xxx, 3xxx and 5xxx series that are incapable of being strengthened by thermal treatment. These alloys gain their strength from cold-working.

**Oil Staining** Surface staining caused by the partial decomposition during thermal treatment of residual lubricant.

**Orange Peel** A roughening, on subsequent cold deformation, of the surface of sheet or strip when the grain size is too coarse. Has the appearance of an orange skin.

**Ovality** Any variation from a true circle of the cross section of a round tube, bar or wire.

**Over-ageing** Artificial ageing treatment at too high a temperature, or for too long a time, after the maximum hardening effect has been achieved. It causes some loss of properties.

In some cases it may be a deliberate act, e.g. to improve resistance to stress corrosion or to minimise any further loss of properties in alloys operating at higher temperatures.

**Partial Annealing** Thermal treatment, after cold working, of a work-piece to reduce its strength to a controlled, but not fully softened, level.

**Percentage Elongation after Fracture (A)** The gauge length elongation after fracture expressed as a percentage of the original gauge length.

**Peripheral Coarse Grain, Peripheral Grain Band** An effect shown in extruded products and also forgings made from extruded stock. It is an area of recrystallised grains at the periphery which has lower properties than the non-recrystallised core.

**Pick-up** Irregular surface roughness or damage caused by adhesion and subsequent fracture or tearing between the forming tools and the work piece.

**Pips, Pip Lines, Pip Marks, Ident Pips** A marking on an extrusion (on a non-visible surface) placed there by the extrusion mill's die to allow the mill to identify extrusions produced by that mill.

**Pitting Corrosion** Non uniform corrosion of the surface that causes small pits or craters to develop.

**Plate** A hot rolled flat product of rectangular section, typically over 10mm thick. Control of surface finish is less rigorous than for sheet.

*Related terms: Sheet, Shate*

**Porthole Dies** Dies that produce extruded hollow products from solid extrusion ingots.

They incorporate a mandrel as an integral part of the die assembly and leave one or two 'weld' seams along the extrusions.. Bridge, spider, duo and self-stripping dies are particular types of porthole die.

**Powder Coating** Application of an even layer of colour to aluminium extrusions by spraying powdered paint using an electrostatic process then baking on (stove enamelling).

**Pre-Ageing** A thermal treatment after quenching and before the end of the precipitation incubation period.

**Precipitation Annealing** The heating of a quenched and precipitation hardened work piece for some time at a temperature between the artificial ageing temperature and the solution treatment temperature. It produces significant softening by coalescing the hardening precipitates.

**Pressure Test** A hydraulic or pneumatic test for tubes to prove that they material can withstand a specified pressure for a specified time without leakage or rupture.

**Proof Stress (Rp)** The stress or applied load which produces a permanent elongation equal to a specific percentage of the original gauge length. In alloys that do not exhibit a yield point it is used as an equivalent to the elastic limit.

If a proof stress is specified, the non-proportional elongation must be stated. The most common values used in specifications is 0.2% or 1.0% and the RP symbol used for the stress will be supplemented by an index giving this prescribed percentage of the original gauge length, e.g. RP0.2 = 0.2% Proof Stress

**Quenching** The rapid cooling a metal or alloy from the solution treatment temperature by contact with a solid, a liquid or a gas to retain the hardening constituents in solid solution. Quenching is often carried out by immersion in cold water. Extrusions are quenched after extrusion by air blasts.

**Recrystallisation Annealing** A heat treatment that softens a cold worked metal or alloy by complete recrystallisation.

**Rectification** Work done to correct dimensional errors.

**Residual Stress** Any stress in a finished product after fabrication (mainly cold work) which exists without the presence of any service or external loads, even after stress relieving.

**Roller Levelling, Tension Levelling** Flattening of sheet, strip or coil metal by passing it through a roll train staggered rolls. Levelling is achieved by precisely bending metal strip back and forth as it's passed through a series of small-diameter offset rolls. The material is usually also under tension loading.

**Roller Straightening** The straightening of extrusions by passage through a series of small diameter, staggered, rolls.

**Scaffolding Tube** A 'welded' tube, size 1 29/32 inch O/D x 7 swg wall thickness (7swg = 0.176 inch / 4.47mm) used for scaffolding that has been Drift Tested

**Scalping** Mechanical removal of oxide and contamination from surface of a cast slab prior to hot rolling.

**Sealing of Anodic Coatings** A post anodising treatment to close layer porosity and reduce absorbency.

**Segregation** The non uniform distribution in the microstructure of alloying elements during the solidification of an ingot, billet or slab. Some non metallic impurities may also be segregated during solidification.

**Self-Quenching Alloy** An alloy whose critical quench rate from its solution treatment temperature is slower than the rate of cooling in still air. This means that the alloying elements will be held in solid solution even after cooling in still air.

**Shate** A term used for rolled material where the thickness lies between that of cold rolled sheet and hot rolled plate, typically 4 to 10 mm. the finish may be hot or cold rolled.

**Shear Strength** The maximum stress that a material can sustain when loaded in shear.

As a very rough guide for aluminium alloys the maximum shear strength is about 60 to 65% of the ultimate tensile strength and the yield strength in shear is 50 to 55% of the 0.2% Proof Stress.

**Shear Test** A test in which the test piece is progressively loaded to fracture in shear to measure its shear strength.

**Sheet** Usually defined as cold rolled flat product in the thickness range 0.25mm to 3.25mm.

**Short Transverse Direction** The minor axis at right angles to the major, longitudinal, axis.

**Single-Hole Die** An extrusion die with one hole, therefore capable of producing just one extrusion per cycle. *Related terms: Multi-Hole Die*

**Slab, Rolling Slab** A cast product that will be used for hot rolling. Size up to 300mm thick, 2000mm wide and 10/15 metres long with weight up to 15 tonnes.

**Slitting** The simultaneous cutting of a coil or wide strip into a number of narrower strips by means of rotary cutters.

**Stop Mark** A transverse peripheral ridge on a product arising from a stoppage during rolling, extrusion or drawing.

**Strain Hardening, Work Hardening** The increase in strength and hardness with a general loss of ductility that results from cold working of a work-piece. *Related terms: Cold Working*

**Stretching, Stretcher Levelling** A term used to describe both the levelling of rolled materials and the straightening of extruded and drawn materials by imparting sufficient permanent extension to remove distortion.

**Stress Corrosion** This is the frequently rapid, sudden, failure of normally ductile alloys when experiencing tensile stresses in certain and specific corrosive environments. These stresses may be residual internal stresses or from external loading.

**Stretcher Grip Marks** Transverse indentations left by the gripper jaws of the stretching machine on the ends of a product.

**Stretcher Strain Markings** These are permanent surface distortions that can occur on stretching. They can appear as either flamboyant patterns or Lüders lines. Their onset and extent depends on the type of material and the degree of stretching. *Related terms: Stretching, Lüders Lines*

**Super Annealing** An annealing cycle for heat treatable alloys that utilises a slow, controlled, cooling rate to produce a structure with maximum ductility and the minimum tendency to natural ageing.

**Surface Bloom** A general term for any surface discolouration caused by thermal treatment or from exposure to moist atmospheres.

**Temper** The characteristic structural and mechanical properties produced by mechanical working and/or thermal treatments. *Related terms: Temper Designations*

**Temper Designations** There are two systems of letters and digits used, after the alloy designation number, to define and describe the temper of an aluminium alloy.

The following is only an outline guide to these systems.

For the strain hardening alloys of 1xxx, 3xxx and 5xxx series the following is used:-

O = Annealed, soft

F = As Fabricated

H1x = Strain Hardened only

H2x = Strain Hardened and partly annealed.

H3x = Strain Hardened and stabilised

H4x = Strain Hardened and organically coated with an oven cure.

The second number shown as x above indicates the final degree of hardness or strength.

2 = quarter hard

4 = half hard

6 = three quarter hard

8 = fully hard.

For the heat treatable alloys of the 2xxx, 6xxx, 7xxx and 8xxx series the following applies.

T1 = cooled from a high temperature forming process and naturally aged.

T2 = cooled from a high temperature forming process cold worked and naturally aged.

T3 = solution treated, cold worked and naturally aged.

T4 = solution treated and naturally aged.

T5 = cooled from a high temperature forming process and age hardened by heat treatment.

T6 = solution treated and age hardened.

T7 = solution treated and deliberately overaged

T8 = solution treated, cold worked and age hardened

T9 = solution treated, age hardened then cold worked.

Additional numbers may also appear to indicate variations in treatment that can significantly influence the condition of the alloy.

**Temper Rolling** A controlled cold rolling procedure performed to develop specific mechanical properties in a work piece.

**Tensile Strength, Ultimate Tensile Strength (UTS)** The maximum load, in tension, that a material can withstand before breaking. It is calculated as a breaking load for a standard cross section area.

**Tensile Test** A procedure to measure the mechanical properties of a representative test piece in tension. The test piece is progressively loaded in tension and its gauge length plotted against the applied load generally to the point of fracture. The Proof Stress (Rp) and Tensile Strength (Rm) values are then determined.

**Tolerance** The permissible limit, or limits, of variation to a specified parameter such as a dimension or weight, usually expressed as 'plus' or 'minus' value or percentage on that quantity.

**Torsion Test** A test in which a sample is twisted axially for a given number of revolutions. It may be conducted to destruction or to demonstrate that the material can withstand a specific amount of twisting.

**Traffic Marks, Fretting** Abrasions, usually dark in colour, resulting from relative movement, or rubbing, between contacting metal surfaces during transit.

**Transition Joint, Triplate** An explosively bonded bimetal flat bar that comprises a layer each of steel and marine-grade aluminium (alloy 5083) usually with an interlayer of pure aluminium. It is used for the on site welding of aluminium to steel, especially in shipyards and for offshore structures.

**Ultrasonic Test** A non-destructive test method using ultra high frequency sound waves to locate and assess the size of internal material defects.

**Under-Ageing** An artificial ageing treatment that fails to achieve maximum or optimum increase in mechanical properties/hardening. It is caused either by processing for an insufficient time or at too low a temperature.

**Upper Critical Strain** The minimum amount of cold work needed prior to annealing or solution treatment to produce a fine recrystallized equiaxed grain structure by eliminating the cold worked structure of elongated grains.

**Water Staining** A residue left on aluminium that has been wet and allowed to dry naturally. This is very difficult to remove and cannot be improved by polishing or anodising.

**Wrought Product** A product made by hot, or hot and cold, plastic deformation by the rolling, extruding or forging of a cast product.

#### CONTACT

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