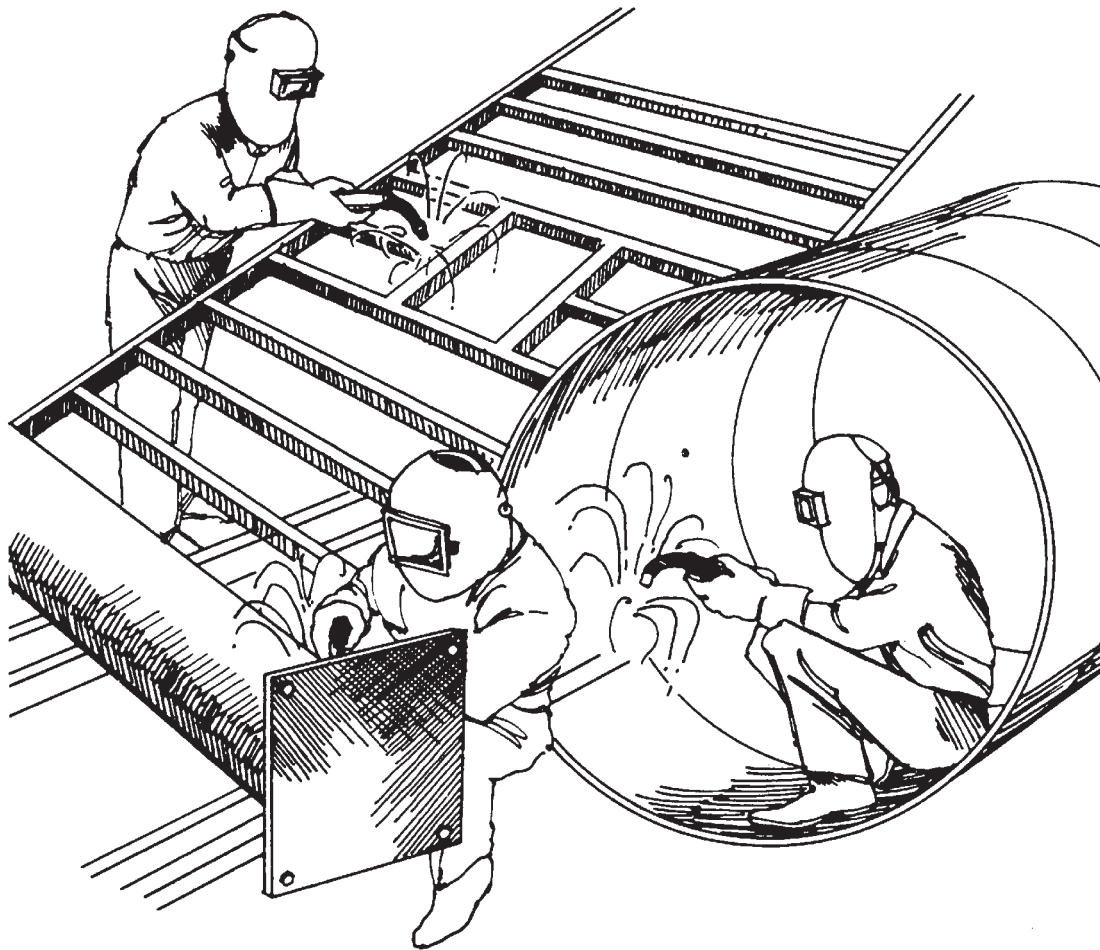


# ***ESAB Glossary of Technical Terms***



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**Acceptable Weld** - A weld that meets the applicable requirements.

**Active Fluxes** - Active fluxes produce changes in weld metal chemistry when welding is changed. Active fluxes are restricted to single or minimal multi-pass welding.

**Actual Throat** - The shortest distance between the weld root and the face of a fillet weld.

**Aging** - Process of holding metals or alloys at room temperature after subjecting them to shaping or heat treatment, for the purpose of increasing dimensional stability or to improve their hardness and strength through structural changes, as by precipitation.

**Air Carbon Arc Cutting** - A carbon arc cutting process variation that removes molten metal with a jet of air.

**Air Hardening** - Characteristic of a steel that it becomes partially or fully hardened (martensitic) when cooled in air from above its critical point. Not necessarily applicable when the object to be hardened has considerable thickness.

**AISI** - American Iron and Steel Institute

**Allotropic** - A material in which the atoms are capable of transforming into two or more crystalline structures at different temperatures.

**Allotropic Change** - Change from one crystal structure of a metal to another that has different physical properties.

**Alternating** - An electrical current which alternately travels in either direction in a Current conductor. In 60 cycles per second (60 Hz) AC, the frequency used in the U.S.A., the current direction reverses 120 times every second.

**Ampere** - Unit of electrical rate of flow. Amperage is commonly referred to as the "*current*" in an electrical circuit.

**Anneal** - The process of heating a metal to a temperature below the critical range, followed by a relatively slow cooling cycle to induce softness and remove stresses.

**Annealing** - Subjected to heat treatment. This usually involves heating, followed by relatively slow cooling of metals or alloys for the purpose of decreasing hardness and increasing the ease of machining or the cold-working characteristics. Annealing may be used to (a) remove effects of strain hardening resulting from cold work, (b) remove stresses found in castings, forgings, weldments and cold-worked metals, (c) improve machinability and cold-working characteristics, (d) improve mechanical and physical properties by changing the internal structure, such as by grain refinement, and to increase the uniformity of the structure and correct segregation, banding, and other structural characteristics.

**Arbide** - The chemical combination of carbon with some other element. A metallic carbide takes the form of very hard crystals.

**Arc Blow** - Welding with direct current may set up a magnetic field in the steel plate being welded. This magnetic field causes the arc to flutter and blow, creating difficulty in controlling the arc.

**Arc Energy** - References burn-off characteristics. Moderate arc energy is typical of Atom Arc. A 316L electrode has lower arc energy than a 7018 where as a 6010 has more.

**Arc Length** - The distance from the electrode to the attachment point on the workpiece.

**Arc Time** - The time during which an arc is maintained in making an arc weld.

**Arc Voltage** - The voltage across the welding arc.

**Arc Weld Deposition Efficiency** - The ratio of the weight of filler metal deposited in the weld to the weight of filler metal melted, expressed in percent.

**Arc Welding** - A group of welding processes that produces coalescence of workpieces by heating them with an arc. The processes are used with or without the application of pressure and with or without filler metal.

**Arc Welding Electrode** - A component of the welding circuit through which current is conducted and that terminates at the arc.

**Arc Welding Gun** - A device used to transfer current to a continuously fed consumable electrode, guide the electrode, and direct the shielding gas.

**Arc Welding Torch** - A device used to transfer current to a fixed welding electrode, position the electrode and direct the flow of shielding gas.

**As Cast Structures** - The crystalline structure before stress relief through rolling or hammer forging.

**As Welded** - Pertaining to the condition of weld metal, welded joints, and weldments after welding, but prior to any subsequent thermal, mechanical or chemical treatments.

**ASME** - American Society of Mechanical Engineers

**ASTM** - American Society for Testing and Materials

**Atom** - The smallest particle of an element that possesses all of the characteristics of that element. It consists of protons, neutrons, and electrons.

**Austenite** - High temperature crystal structure of carbon steel or the room temperature structure of chrome-nickel steel.

**Back-gouging** - The removal of weld metal and base metal from the weld root side of a welded joint to facilitate complete fusion and complete joint penetration upon subsequent welding from that side.

**Backhand Welding** - A welding technique in which the welding torch or gun flame is directed towards the finished weld.

**Backing Ring** - Backing in the form of a ring, generally used in the welding of pipe.

**Base Metal** - The metal or alloy that is welded, brazed, soldered, or cut.

**Bevel** - An angular edge shape.

**Bevel Angle** - The angle formed between the cut surface and a theoretical plane perpendicular to the plate surface. Plasma arc cutting tends to remove more metal from the top than from the bottom, producing a cut angle. (Also referred to as cut angle).

**Bevel Cutting** - A plasma arc cutting technique that uses a tilted torch to produce an angle on the edge of parts being cut.

**Bevel Groove Weld** - A type of groove weld.

**Binary Alloy** - An alloy composed of two elements.

**Blowhole** - A defect in metal caused by hot metal cooling too rapidly when excessive gaseous content is present. Specifically, in welding, a gas pocket in the weld metal resulting from the hot metal solidifying without all of the gases having escaped to the surface.

**Bonded Fluxes** - Bonded fluxes are manufactured by binding an assortment of powder together and then baking at a low temperature. The major advantage is that additional alloying ingredients can be added to the mixture.

**Braze** - A weld produced by heating an assembly to the brazing temperature using a filler metal having a liquidus above 450 deg C (840 deg F) and below the solidus of the base metal. The filler metal is distributed between the closely fitted faying surfaces of the joint by capillary action.

**Brittleness** - The tendency of a material to fail suddenly by breaking, without any permanent deformation of the material before failure.

**Buildup** - A surfacing variation in which surfacing material is deposited to achieve the required dimensions. See also buttering, cladding and hard-facing.

**Carbide** - The chemical combination of carbon with some other element. A metallic carbide takes the form of very hard crystals.

**Carbide Precipitation** - As a result of prolonged heating or of slow cooling after partial or full transformation, atoms of carbon and a metallic element migrate to the grain boundaries. The atoms here gather and combine as carbides. In high chromium alloys, the affinity (attraction) of chromium and carbon for each other leads to the formation of a thin inter-granular layer of chromium carbides.

**Carbide Precipitation** - The formation of chromium carbide in austenitic stainless steel that allows inter-granular corrosion in corrosive service.

**Carbon Steel** - Steel whose physical properties are chiefly the result of the percentage of carbon contained in it; and iron-carbon alloy in which the carbon is the most important constituent, ranging from 0.04%-1.40%. It is also referred to as plain carbon steel or straight carbon steel. Minor elements also present in carbon steel include manganese, phosphorus, sulfur, and usually silicon.

**Casehardening** - A heat-treatment process, applied to steel or iron-carbon alloys, by which a harder outside is obtained over a softer interior; depth or increased hardness depends upon length of treatment.

**Cast of Continuous Welding Electrodes** - The diameter of the circle a length of the electrode assumes when lying free on a smooth surface.

**Cast steel** - Molten steel cooled and solidified in a mold.

**Cellulose** - A chemical of carbon, hydrogen and oxygen. As used in mild steel electrode coatings, it consists of wood pulp or flour.

**Cementite** - Chemical compound of iron and carbon, containing 93.33% iron combined with 6.67% carbon by weight; also called iron carbide. Chemical formula for cementite is  $Fe_3C$ .

**Chip Test** - A test used to identify a metal. The metal is chipped off using a cold chisel and hammer. The resulting underlying pattern in the metal is unique to several classes of ferrous metals.

**Chopper** - A high performance plasma arc power source design using semiconductor switching techniques.

**Cladding** - A surfacing variation that deposits or applies surfacing material usually to improve corrosion or heat resistance.

**Clear Puddle** - A puddle that is not crowded by slag or an erratic arc.

**Coating Concentricity** - Refers to equal coating thickness on the core wire/rod.

**Coefficient of Friction** - A value used in engineering calculations which is an indicator of the ability of one material to slide on another. A low coefficient of friction indicates a low rate of wear between sliding surfaces.

**Cold Drawing** - Reducing the cross-section of a metal by pulling it through a die while its temperature is below the re-crystallization temperature.

**Cold Rolling** - Reducing the cross-section of a metal by means of a rolling mill while the metal is cold or below its re-crystallization temperature.

**Cold Working** - The permanent deformation or crystal distortion of a metal below its lowest temperature of re-crystallization, resulting in work hardening.

**Complete Fusion** - Fusion over the entire fusion faces and between all adjoining weld beads.

**Complete Joint Penetration** - A joint root condition in a groove weld in which weld metal extends through the joint thickness.

**Complete Joint Penetration Weld** - A groove weld in which weld metal extends through the joint thickness.

**Composite Electrode** - A filler metal electrode used in arc welding, consisting of more than one metal component combined mechanically. It may or may not include materials which protect the molten metal from the atmosphere, improve the properties of the weld metal or stabilize the arc.

**Compressive Strength** - The resistance of a material to a force which is tending to deform or fail it by crushing.

**Conductor** - A material which has a relatively large number of loosely bonded electrons which may move freely when voltage (electrical pressure) is applied. Metals are good conductors.

**Constant Current** - (As applied to welding machines.) A welding power source which will produce a relatively small change in amperage despite changes in voltage caused by a varying arc length. Used mostly for welding with coated electrodes.

**Constant Current Power Source** - An arc welding power source with a volt ampere relationship yielding a small welding current change from a large arc voltage change.

**Constant Voltage** - (As applied to welding machines) A welding power source which will produce a relatively small change in voltage when the amperage is changed substantially. Used mostly for welding with solid or flux cored electrodes.

**Constant Voltage Power Source** - An arc welding power source with a volt-ampere relationship yielding a large welding current change from a small arc voltage change.

**Constricted Arc** - A plasma arc column that is shaped by the constricting orifice in the nozzle of the plasma arc torch or plasma spraying gun.

**Consumables** - Torch parts that are eroded or otherwise worn during normal cutting or gouging operations, such as, electrodes, nozzles, shields, caps and swirl rings.

**Contact Tip** - That part of a gas metal arc welding gun or flux cored arc welding gun that transfers the welding current to the welding wire immediately before the wire enters the arc.

**Contact Tube** - A device that transfers current to a continuous electrode.

**Contact Tube Setback** - The distance from the contact tube to the end of the gas nozzle.

**Convex Fillet Weld** - A fillet weld having a convex face.

**Convexity** - The maximum distance from the face of a convex fillet weld perpendicular to a line joining the weld toes.

**Covered Electrode** - A composite filler metal electrode consisting of a core of a bare electrode or metal cored electrode to which a covering sufficient to provide a slag layer on the weld metal has been applied. The covering may contain materials providing such functions as shielding from the atmosphere, de-oxidation, and arc stabilization, and can serve as a source of metallic additions to the weld.

**Crack** - A fracture type discontinuity characterized by a sharp tip and high ratio of length and width to opening displacement.

**Crater** - A depression in the weld face at the termination of a weld bead.

**Creep** - The slow deformation (for example, elongation) of a metal under prolonged stress. Not to be confused with deformation which results immediately upon application of a stress.

**Critical Cooling Rate** - A rate of cooling that is fast enough to transform austenite into 100% martensite.

**Cryogenic Temperatures** - Extremely low temperatures usually associated with liquified gases in the range of -100°F to -400°F.

**Current (Weld)** - The amount of electric charge flowing past a specified circuit point per unit time. Current is the main parameter for welding and has to be chosen to plate thickness and welding speed with respect to the weld quality. The weld current affects penetration and deposition rate. A high current results in a higher and narrower weld with a greater penetration depth. Too high a welding current can result in undercuts, an uneven weld convexity, burn-through, thermal cracking, an inappropriate merging angle with the body material and undercutting.

**Current Density** - A measure of the degree of arc constriction achieved with a plasma torch. The amperes per square inch of a cross-sectional area of an electrode. High current density results in high electrode melt-off rate and a concentrated, deep penetrating arc.

**Cut Angle** - The angle formed between the cut surface and a theoretical plane perpendicular to the plate surface. Plasma arc cutting tends to remove more metal from the top than from the bottom, producing a cut angle. (Also referred to as bevel angle).



**Cutting Gas** – A gas directed into the torch to surround the electrode, which becomes ionized by the arc to form a plasma and issues from the torch nozzle as a plasma jet. (Also referred to as plasma gas or orifice gas).

**Cylindrical Nozzle Design** - A simple cylindrical metering orifice. These are operated at 25-60 psig depending on manufacture.

**DCEN** - The arrangement of direct current arc welding leads in which the electrode is the negative pole and workpiece is the positive pole of the welding arc.

**DCEP** - The arrangement of direct current arc welding leads in which the electrode is the positive pole and the workpiece is the negative pole of the welding arc.

**Defect** - A discontinuity or discontinuities that by nature or accumulated effected (for example total crack length) render a part or product unable to meet minimum applicable acceptance standards or specifications. The term designates rejectability.

**Deoxidizers** - Elements, such as manganese, silicon, aluminum, titanium, and zirconium, used in welding electrodes and wires to prevent oxygen from forming harmful oxides and porosity in weld metal.

**Deposited Metal** - Filler metal that has been added during welding, brazing or soldering.

**Deposition Efficiency** - The relationship of the electrode used to the amount of the weld metal deposited, expressed in percent, i.e.;  $DE = \text{Weight of Weld Metal} \div \text{Weight of Electrode Used}$

**Deposition Rate** - The weight of weld metal deposited compared to the time of welding. It is usually expressed in pounds per hour.

**Depth of Bevel** - The perpendicular distance from the base metal surface to the root edge or the beginning of the root face.

**Depth of Fusion** - The distance that fusion extends into the base metal or previous bead from the surface melted during welding.

**Digging** - Refers to the arc characteristics that you normally see with a 6010 electrode. A “digging” arc is one in which you can see parent metal being penetrated at the arc.

**Dilution** - The change in chemical composition of a welding filler metal caused by the admixture of the base metal or previous weld metal in the weld bead. It is measured by the percentage of base metal or previous weld metal in the weld bead.

**Direct Current** - An electrical current which flows in only one direction in a conductor. Direction of current is dependent upon the electrical connections to the battery or other DC power source. Terminals on all DC devices are usually marked (+) or (-). Reversing the leads will reverse the direction of current flow.

**Discontinuity** - An interruption of the typical structure of a material, such as a lack of homogeneity in its mechanical, metallurgical, or physical characteristics. A discontinuity is not necessarily a defect.

**Distortion** – All fusion welding methods produce the weld by moving a molten pool along the weld joint. When the heated metal cools the shrinkage introduces distortion in (or a change in the shape of) the welded structure.

**Divergency** - The tapered part of the oxygen bore directly behind the throat in high pressure (high speed) nozzle designs. The divergency allows the high pressure to become close to atmospheric before it leaves the nozzle. This increases stream velocity and improves cut quality by keeping stream uniform. The increased velocity produces 10–15% higher cutting speeds.

**Double Arcing** – A condition in which the welding or cutting arc of a plasma arc torch does not pass through the constricting orifice but transfers to the inside surface of the nozzle. A secondary arc is simultaneously established between the outside surface of the nozzle and the workpiece.

**Downhill** - Welding with a downward progression.

**Drag** – The offset distance between the entrance and exit points of the gas stream on the plate being cut, measured on the cut edge. Drag will increase and decrease with varying conditions such as speed, oxygen pressure, plate thickness, oxygen purity, etc.

**Drag Angle** – The angle between the impinging jet stream centerline and a direction perpendicular to the plate surface.

**Dross** – Re-solidified molten metal and oxides adhering to the top or bottom edge during thermal cutting.

**Ductility** - The ability of a material to become permanently deformed without failure.

**Duty Cycle** – A power source specification describing the percentage of time a system can be operated at a given current level. Based on a ten minute cycle.

**Edge Preparation** - The preparation of the edges of the joint members, by cutting, cleaning, plating or other means.

**Effective Throat** - The minimum distance minus any convexity between the weld root and the face of a fillet weld.

**Elastic Limit** - The maximum stress to which a material can be subjected without permanent deformation or failure by breaking.

**Elasticity** - The ability of a material to return to original shape and dimensions after a deforming load has been removed.

**Electrical Stick-Out** - In any welding process using a solid or flux cored wire, the electrical stick-out is the distance from the contact tip to the un-melted electrode end. Sometimes called the “amount of wire in resistance”. This distance influences melt-off rate, penetration, and weld bead shape.

**Electrode** – The plasma arc torch part from which arc current is emitted.

**Electrode Coating** - The mixture of chemicals, minerals and metallic alloys applied to the core wire. The coating controls the welding current, the welding position, and provides a shielding atmosphere, deoxidizers to clean the weld metal, and the welding slag that absorbs impurities from the weld metal. It also helps shape the weld bead and becomes an insulating blanket over the weld bead.

**Electrode Core Wire** - The steel wire about which the coating is applied. The electrode size is determined by the diameter of the core wire.

**Electrode Extension** - The length of electrode extending beyond the end of the contact tube.

**Electrode Holder** - A device used for mechanically holding and conducting current to an electrode during welding or cutting.

**Electron** - Negatively charged particles that revolve around the positively charged nucleus in an atom.

**Element** - A substance which can't be broken down into two other substances. Everything on Earth is a combination of such elements, of which there are only 103.

**Elongation** - Permanent elastic extension which a metal undergoes during tensile testing; the amount of elongation is usually indicated by the percentage of an original gage length.

**Endurance Limit** - The maximum stress that a material will support indefinitely under variable and repetitive load conditions.

**Erratic** - When the arc or burn-off characteristics are not smooth and difficult to handle. Can't control where the puddle goes.

**Eutectic Alloy** - Alloy of a composition that solidifies at a lower temperature than the individual elements of the alloy and freezes or solidifies at a constant temperature to form a fine mixture crystals made up of two or more phases.

**Extrusion** - Forcing plastic metal through a die to produce a new form.

**Face** - The part of the weld bead between the “toes”.

**Face Bend Test** - A test in which the weld face is on the convex surface of a specified bend radius.

**Face Reinforcement** - Weld reinforcement on the side of the joint from which welding was done.

**Fatigue Failure** - The cracking, breaking or other failure of a material as the result of repeated or alternating stressing below the material's ultimate tensile strength.

**Fatigue Limit** - The maximum stress that a material will support indefinitely under variable and repetitive load conditions.

**Fatigue Strength** - The resistance of a material to repeated or alternating stressing, without failure.

**Ferrite** - The normal crystal structure of low carbon steel at room temperature.

**Ferrite in Austenitic Stainless Steel** - The magnetic finely dispersed crystal structure in austenitic steels that causes the austenite grains to become smaller and crack resistant.

**Ferrite Number** - Ferrite Numbers (FN) are the current industry accepted figures for specifying ferrite content in austenitic stainless steel weld metal, as approved by the Welding Research Council (WRC), American Welding Society (AWS) and other organizations. Adopted during the 1970's, "*ferrite number*" is not to be confused with "*Percent Ferrite*" that is still used in some cases.

**Ferrous** - Containing iron. Example: carbon steel, low alloy steels, stainless steel.

**Filler Metal** - The metal or alloy to be added in making a welded, brazed, or soldered joint.

**Filler Wire** - Filler metal supplied as a wire on spools or reels. Wire material and diameter vary with the welding application.

**Fillet Weld** - A weld of approximately triangular cross section joining two surfaces approximately at right angles to each other in a lap joint, T-joint, or corner joint.

**Fillet Weld Leg** - The distance from the joint root to the toe of the fillet weld.

**Fillet Weld Size** - For equal leg fillet welds, the leg lengths of the largest isosceles right triangle that can be inscribed within the fillet weld cross section. For unequal leg fillet welds, the leg lengths of the largest right triangle that can be inscribed within the fillet weld cross section.

**Flame Spraying (FLSP)** - A thermal spraying process in which an oxy/fuel gas flame is the source of heat for melting the surfacing material. Compressed gas may or may not be used for atomizing and propelling the surfacing material to the substrate.

**Flashback** - When gases "flashback" the flame regresses from outside (off of) the tip in use into the torch body itself. That flame will head to the point where the gases are mixed. The flame will continue to burn at that mixing point as long as fuel and oxygen are present and allowed to flow. Virtually all torches in flashback mode will "whistle, howl, screech," etc. If the operator does NOTHING, the torch will begin to destroy itself in a matter of seconds, with the flame burning through the torch at some weak point. In addition, if unchecked, the flame may continue to migrate upstream seeking fuel/oxygen to continue burning. Ultimately, that "flame front" could end up at the gas source itself destroying parts and pieces along the way. Even if the fuel gas is shut off, with oxygen still flowing, the "guts" of the torch can continue to burn.

**Flat Welding Position** - The welding position used to weld from the upper side of the joint at a point where the weld axis is approximately horizontal, and the weld face lies in an approximately horizontal plane.

**Flux** - In arc welding, fluxes are formulations that, when subjected to the arc, act as a cleaning agent by dissolving oxides, releasing trapped gases and slag and generally cleaning the weld metal by floating the impurities to the surface where they solidify in the slag covering. The flux also serves to reduce spatter and contributes to weld bead shape. The flux may be the coating on the electrode, inside the electrode as in flux cored types, or in a granular form as used in submerged arc welding.

**Flux Cored Electrodes** - A composite tubular filler metal electrode consisting of a metal sheath and a core of various powdered materials, producing an extensive slag cover on the face of a weld bead. External shielding may be required.



**Flux Voids** - Section of a flux cored electrode which contains no flux. Voids can cause serious problems, especially in low alloy types.

**Forging** - Deforming into new shape by compressive force.

**Forehand Welding** - A welding technique in which the welding torch or gun flame is directed away from the finished weld.

**Friction Stir Welding** - A process in which metals are welded together by friction created by a rotating tool which softens but does not melt the metal. No metal is actually cut.

**Fuel Efficiency** - The factor relating to the volume of fuel in cu. ft. needed to duplicate the efficiency of acetylene which is designated as 1.0 cu. ft.

**Full Annealing** - Heating of steels or iron alloys to above their critical temperature range, soaking at the annealing temperature until they are transformed to a uniform austenitic structure, followed by cooling at a predetermined rate, depending upon the type of alloy and structure required; in general the cooling rate is relatively slow.

**Fumes** - Airborne solid particulate matter generated by the welding or cutting process. Fume particles are usually sub-micron in size and thus tend to remain airborne and drift with the air currents.

**Fused Fluxes** - Fused fluxes are melted ingredients which have been chilled and ground to a particular particle size. The advantage of this type flux is the low moisture pick-up and improved recycling capabilities.

**Fusion** - The melting together of filler metal and base metal, or of base metal only, to produce a weld.

**Fusion Zone** - The area of base metal melted as determined on the cross section of a weld.

**Galling** - The condition between rubbing surfaces where high spots or protrusions on a surface become friction welded to the mating surface, resulting in spalling and further deterioration.

**Gas Ions** - Shielding gas atoms that, in the presence of an electrical current, lose one or more electrons and therefore, carry a positive electrical charge. They provide a more electrically conductive path for the arc between the electrode and the work piece.

**Gas Metal Arc Welding (GMAW)** - An arc welding process wherein coalescence is produced by heating with an arc between a continuous filler metal (consumable) electrode and the work. Shielding is obtained entirely from an externally supplied gas, or gas mixture. Some methods of this process are called MIG (Metal Inert Gas) or CO<sub>2</sub> welding. MIG welding requires the use of an inert shield gas.

**Gas Nozzle** - A device at the exit end of the torch or gun that directs shielding gas.

**Gas Regulator** - A device for controlling the delivery of gas at some substantially constant pressure.

**Gas Tungsten Arc Welding (GTAW)** - An arc welding process wherein coalescence is produced by heating with an arc between a single tungsten (non-consumable) electrode and the work. Shielding is obtained from a gas or gas mixture. Pressure may or may not be used and filler metal may or may not be used. (This process is frequently called TIG welding.)

**Globular** - Refers to the arc transfer when you can see the globules burning off and falling into the puddle as opposed to a "smooth arc".

**Globular Transfer** - Mode of metal transfer across the arc where a molten ball larger than the electrode diameter forms at the tip of the electrode. On detachment, it takes on an irregular shape and tumbles towards the weld puddle sometimes shorting between the electrode and work at irregular intervals. Occurs when using shielding gases other than those consisting of at least 80% argon and at medium current settings.

**Gray Iron** - A cast iron with 2%-4% carbon, in which the carbon is mostly in the form of graphite.

**Groove Angle** - The total included angle of the groove between workpieces.

**Hadfield Steel** - The name sometimes used for austenitic manganese steel derived from its inventor.

**Hafnium** - The metal used most commonly for the electrode emitter for air or oxygen plasma gases.

**Hardenable Steel** - An alloy of iron that is subject to hardening when rapidly cooled.

**Hardening** - Operation of quenching steels from the austenitic temperature range so as to produce martensite or a hard structure.

**Harsh** - References the weld arc as being noisy, spattery or erratic.

**Heat Affected Zone** - The area of the base metal that did not become molten in the welding process, but did undergo a microstructure change as a result of the heat induced into that area. If the HAZ in hardenable steels is cooled rapidly, the area becomes excessively brittle.

**Heat Shield** - A device which is located on the very front of a mechanized torch. Its purpose is to provide electrical isolation from the nozzle during piercing and cutting operations. In addition, it provides the path in which the shield gas impinges the arc at the exit orifice of the heat shield.

**Heat Treatment** - Any operation involving the heating and cooling of metals or alloys.

**Heat Affected Zone** - The portion of the base metal, adjacent to a weld, the structure or properties of which have been altered by the heat of welding.

**Helix of Continuous Welding Electrodes** - The tendency of a length of the electrode to form a spiral when lying free on a smooth surface.

**Hertz** - Hertz (Hz) is the symbol which has replaced the term "cycles per second." Today, rather than saying 60 cycles per second or simply 60 cycles, we say 60 Hertz or 60 Hz.

**High Alloy Steels** - Steels containing in excess of 10% alloy content. Stainless steel is considered a high alloy because it contains in excess of 10% chromium.

**High Carbon Steel** - Steel with carbon content usually below 1.3% carbon, but may range from 1.0-2.0%.

**High Frequency** - (as applied to gas-tungsten arc welding) An alternating current consisting of over 50,000 cycles per second at high voltage, low amperage that is superimposed on the welding circuit in GTAW power sources. It ionizes a path for non-touch arc starting and stabilizes the arc when welding with alternating current.

**High Frequency Discharge** - High voltage power supplied to the plasma torch, which breaks down the air gap between the nozzle and electrode in order to initiate the plasma stream.

**High Speed Nozzle Design** - Operates between 60-110 psig depending upon brand. Uses high pressure and divergency to produce 10-15% faster cutting speeds.

**High Sulfur Steel** - Steel which has a sulfur content ranging from 0.12-0.33% and which then exhibits free cutting properties. Made expressly for screw machine products.

**High Speed Steel** - Special alloy steel used for high-speed cutting and turning tools, as lathe bits; so named because any tools made of it are able to remove metal much faster than tools of ordinary steel.

**High Strength Cast Iron** - Cast gray iron with a tensile strength in excess of 30,000psi (206,900kN/M<sup>2</sup>).

**Horizontal Welding Position** - The welding position in which the weld face lies in an approximately vertical plane and the weld axis at the point of welding is approximately horizontal.

**Hot Crack** - Also known as "auto crack," resulting from stress concentration in relatively thin weld metal that is last to freeze. Both root cracks and crater cracks are forms of hot cracking.

**Hot Quenching** - Cooling of heated metals or alloys in a bath of molten metal or salt, instead of using water or oil cooling medium.

**Hot Short** - Metal that is brittle and unworkable above room temperature. Sulfur in steel causes a hot short condition.

**Inclusion** - Entrapped foreign solid material, such as slag, flux, tungsten, or oxide.

**Impact Test** - Measurement of the amount of energy required to rupture metals with sudden or shock loads.

**Incomplete Fusion** - A weld discontinuity in which fusion did not occur between weld metal and fusion faces or adjoining weld beads.

**Incomplete Joint Penetration** - A joint root condition in a groove weld in which weld metal does not extend through the joint thickness.

**Induced Current or Induction** - The phenomena of causing an electrical current to flow through a conductor when that conductor is subjected to a varying magnetic field.

**Inductance** - (as applies to short circuiting arc welding) A feature in welding power sources designed for short circuiting arc welding to retard the rate of current rise each time the electrode touches the weld puddle.

**Inert Gas** - A gas, such as helium or argon, which does not chemically combine with other elements. Such a gas serves as an effective shield of the welding arc and protects the molten weld metal against contamination from the atmosphere until it freezes.

**Ingot** - Casting of steel (weighing up to 200 tons) formed at mill from melt of ore, scrap limestone, coke, etc.

**Insulator** - A material which has a tight electron bond, that is, relatively few electrons which will move when voltage (electrical pressure) is applied. Wood, glass, ceramics and most plastics are good insulators.

**Inter-pass Temperature** - When making multiple-pass welds, the lowest temperature of the deposited weld metal at the time the next pass is started.

**Inverter Power Source** - A high performance plasma power source design which takes advantage of advanced power semiconductor circuitry to reduce the size and weight of the transformer and hence the overall size of the power source.

**Joint Geometry / Design** - The shape and dimensions of a joint in cross section prior to welding.

**Joint Penetration** - The distance the weld metal extends from the weld face into a joint, exclusive of weld reinforcement.

**Joint Root** - That portion of a joint to be welded where the members approach closes to each other. In cross section, the joint root may be either a point, a line, or an area.

**Joint Type** - A weld joint classification based on five basic joint configurations such as a butt joint, corner joint, edge joint, lap joint, and T-joint.

**Kerf** - Opening through the plate where material is removed during the any kind of cutting operation.

**Killed Steel** - Steel which has been sufficiently deoxidized during the melting cycle to prevent gases from evolving during the solidification period.

**Kilowatt** - 1,000 watts

**Lack of Fusion** - A nonstandard term for incomplete fusion.

**Lack of Penetration** - A nonstandard term for incomplete joint penetration.

**Lap Joint** - A joint between two overlapping members in parallel planes.

**Level Wound** - Spooled or coiled filler metal that has been wound in distinct layers such that adjacent turns touch.

**Linear Discontinuity** - A discontinuity with a length that is substantially greater than its width.

**Linear Indication** - A test result in which a discontinuity in the material being tested is displayed as a linear or aligned array.

**Local Preheating** - A specific portion of a structure.

**Longitudinal Bend Test** - A test in which a specimen is bent to a specified bend radius.

**Longitudinal Crack** - A crack with its major axis orientation approximately parallel to the weld axis.

**Low Alloy Steels** - Steels containing small amounts of alloying elements (usually 1½% to 5% total alloy content) which drastically improves their properties.

**Low Carbon Electrodes** - A non-filler metal electrode used in arc welding and cutting, consisting of a carbon or graphite rod, which may be coated with copper or other materials.

**Low Hydrogen Electrodes** - Stick electrodes that have coating ingredients that are very low in hydrogen content. The low hydrogen level is achieved primarily by keeping the moisture content of the coating to a bare minimum.

**Macroetch Test** - A test in which a specimen is prepared with a fine finish, etched, and examined under low magnification.

**Malleableizing** - Annealing operation used in connection with the change of white cast iron to a malleable cast iron.

**Manual Arc Welding** - Welding with a coated electrode where the operator's hand controls travel speed and the rate the electrode is fed into the arc.

**Martensite** - A structure resulting from transformation of austenite at temperature considerably below the usual range, achieved by rapid cooling. It is made up of ultra-hard, needlelike crystals that are a supersaturated solid solution of carbon in iron.

**Matrix** - The principal, physically continuous metallic constituent in which crystals or free atoms of other constituents are embedded. It serves as a binder, holding the entire mass together.

**Mechanized Welding** - Pertaining to the control of a process with equipment that requires manual adjustment of the equipment controls in response to visual observation of the operation, with the torch, gun, wire guide assembly, or electrode holder held by a mechanical device.

**Melt Through** - Visible root reinforcement produced in a joint welded from one side.

**Metal Active Gas (MAG) Welding** - Similar to Metal Inert Gas (MIG) Welding.

**Metallurgically Similar Steels** - Multiple steel compositions that have essentially the same crystal structure, such as austenite or ferrite.

**Metallurgy** - The science and technology of extracting metals from their ores, refining them, and preparing them for use.

**Microstructure** - Structure that is visible only at a high magnification, with the aid of a microscope after preparation, such as polishing or etching.

**Metal Inert Gas (MIG) Welding** - An arc welding process wherein coalescence is produced by heating with an arc between a continuous filler metal (consumable) electrode and the work. Shielding is obtained entirely from an externally supplied gas, or gas mixture. MIG welding requires the use of an inert shield gas.

**Mild Steel** - An alloy of mostly iron with low content of alloying elements such as carbon and manganese.

**Mill Scale** - The iron oxide (FeO) coating normally found on the surface of hot rolled steels.

**MMA (Manual Metal Arc) Welding** - An arc-welding process wherein coalescence is produced by heating with an arc between a covered metal (stick) electrode and the work. Shielding is obtained from decomposition of the electrode covering. Pressure is not used and filler metal is obtained from the electrode.

**Mottled Iron** - Cast iron with a structure consisting of a mixture of free cementite, free graphite, and pearlite.

**Neutral Flame** - An oxy/fuel gas flame that has characteristics neither oxidizing nor reducing.

**Neutral Fluxes** - Neutral fluxes produce little change to mechanical properties when adjusting the voltage. Best utilized when welding on plate thickness of one inch or more.

**Nondestructive Examination (NDE)** - The act of determining the suitability of some material or component for its intended purpose using techniques that do not affect its serviceability.

**Non-Ferrous** - Containing no iron. Example: Aluminum, copper, copper alloys.

**Non-transferred Arc** – An arc established between the electrode and the constricting nozzle of the plasma arc torch. The workpiece is not in the electrical circuit.

**Nozzle** – A “consumable” torch part containing a hole or orifice through which the arc passes.

**Nozzle Diameter** – The diameter of the nozzle through which the plasma arc passes. (Also referred to as orifice diameter).

**Off-Center** - Refers to the coating being eccentric and thicker on one side of the electrode than the opposite side. Also referred to as “Fingernailing”, which isn’t always due to coating eccentricity. Could be a result of formulation as well.

**Ohm** - Unit of electrical resistance to current flow.

**Open Circuit Voltage** – The voltage present at the electrode in the brief interval before the torch ignites and whenever the arc is extinguished with the power source still active.

**Orifice Diameter** - The diameter of the nozzle through which the plasma arc passes. (Also referred to as nozzle diameter).

**Orifice Gas** - A gas directed into the torch to surround the electrode, which becomes ionized by the arc to form a plasma and issues from the torch nozzle as a plasma jet. (Also referred to as plasma gas or cutting gas).

**Out-of-Position Welds** - Welds made in positions other than flat or horizontal fillets.

**Overlap** - The protrusion of weld metal beyond the weld toe or weld root.

**Oxy/Fuel Ratio** - The relationship of cu. ft. of oxygen to cu. ft. of fuel gas mixture necessary to achieve maximum flame temperature. This ratio varies with fuel characteristics.

**Oxygen Bore** - The orifice in the cutting nozzle through which oxygen is directed at the plate for cutting. It controls the amount of oxygen consumed during cutting.

**Oxygen Factor** - The fuel efficiency times the oxy/fuel ratio for a given fuel to determine the multiples of oxygen needed to duplicate the performance of acetylene. The acetylene oxygen factor is 1.5.

**Pearlite** - Eutectoid alloy of iron and 85% carbon consisting of layers or plates of ferrite and cementite.

**Peening** - The mechanical working of metal by means of hammer blows to relieve stresses and reduce distortion. Peening is recommended for thicker sections (over 1” or 2”) of some alloys on each successive pass. Experience has shown that peening helps to reduce cracking. Peening may decrease the ductility and impact properties; however, the next pass will nullify this condition. For this reason, the last surface layers should not be peened.

**Penetration** - (1) The depth below the surface of the base metal to which welding heat is sufficient for the metal to melt and become liquid or semi-liquid. Also called the depth of fusion. (2) The ability of arc or electrode to reach into the root of the groove between two members being welded.

**Phase Transformation** - The changes in the crystalline structure of metals caused by temperature and time.

**Piercing** – A method of starting a plasma arc cut in which the arc plunges into and through the workpiece before cutting begins.

**Pig iron** - The product of the blast furnace cast into blocks convenient for handling or storage; iron alloy as recovered from the ore. A brittle material of high carbon content (5%).

**Pilot Arc** – A low current arc between the electrode and the constricting nozzle of the plasma arc torch to ionize the gas and facilitate the start of the welding / cutting arc.

**Pilot Hole** – A punched hole at (near) the plate edge of which the plasma arc cut is started.

**Plasma** – A gas that has been heated by an arc to at least a partially ionized condition, enabling it to conduct an electric current.



**Plasma Arc Cutting (PAC)** – An arc cutting process that uses a constricted arc and removes the molten metal in a high velocity jet of ionized gas issuing from the constricting orifice. Plasma arc cutting is a direct current electrode negative (DCEN) process.

**Plasma Gas** – A gas directed into the torch to surround the electrode, which becomes ionized by the arc to form a plasma and issues from the torch nozzle as the plasma jet. (Also referred to as orifice gas or cutting gas).

**Plasma Arc Gouging** – Gouging utilizing a plasma arc for metal removal. An electric arc contained inside a gas shield is passed through a constricting orifice in order to generate extremely high temperatures and a high velocity stream of ionized gas. This stream rapidly melts the metal on which it is focused and then blows the molten material away.

**Plasticity** - Ability of a metallic state to undergo permanent deformation without rupture.

**Plunger** - It is installed behind the removable seat in a plasma torch head to enable the safety interlock.

**Porosity** - The scattered presence of gas pockets or inclusions in a metallic solid.

**Post Weld Heat Treatment** - Reheating the weldment to 1100°F to 1350°F after welding and holding at that temperature for a specified length of time. Heat treating allows additional hydrogen to escape, lowers the residual stresses due to welding, and restores toughness in the heat affected zone.

**Post-heating** - Heat applied to the base metal after welding or cutting, for the purpose of tempering, stress-relieving, or annealing.

**Power Source** - An apparatus for supplying current and voltage suitable for welding, cutting, etc.

**Preheat** - The heating of the parts of a structure to be welded before welding is started to minimize thermal shock and of slowing the cooling rate.

**Preheat Temperature** - The temperature to which many of the low alloy steels must be heated before welding. Preheating retards the cooling rate, allowing more time for the hydrogen to escape, which minimizes under-bead cracking. Preheat temperatures can vary from 10°F to 500°F on ½" sections to 300°F to 600°F on heavy sections, depending upon the alloy.

**Preheating** - The heating of parent metal prior to welding or cutting for the purpose of minimizing thermal shock and of slowing the cooling rate.

**Procedure** - The detailed elements of a process or method used to produce a specific result.

**Proton** - Positively charged particles which are part of the nucleus of atoms.

**Pulsed MIG Welding** – Process is used mainly for welding aluminum and stainless steel. The method of controlling the transfer of the droplets by current pulses from the power source makes it possible to extend the spray range down. The process provides a stable and spatter free arc.

**Pulsed Power Welding** - An arc welding process variation in which the power is cyclically programmed to pulse so that effective but short duration values of power can be utilized. Such short duration values are significantly different from the average value of power. Equivalent terms are pulsed voltage or pulsed current welding.

**Pulse Transfer** - Mode of metal transfer somewhat between spray and short circuiting. The specific power source has built into it two output levels: a steady background level, and a high output (peak) level. The later permits the transfer of metal across the arc. This peak output is controllable between high and low values up to several hundred cycles per second. The result of such a peak output produces a spray arc below the typical transition current.

**Push Angle** - The travel angle when the electrode is pointing in the direction of weld progression. This angle can also be used to partially define the position of guns, torches, rods and beams.

**Quench / Quenching** - Process of fast-cooling metals or alloys such as steel in the process of hardening, as air quenching, oil quenching, water quenching, etc.

**Radial crack** - A crack originating in the fusion zone and extending into the base metal, usually at right angles to the line of fusion. This type of crack is due to the high stresses involved in the cooling of a rigid structure.

**Radiographic quality** - Soundness of a weld that show no internal or under-bead cracks, voids or inclusions when inspected by X-ray or gamma ray techniques.

**Rectifier** - An electrical device used to change alternating current to direct current.

**Reduced Section Tension Test** - A test in which a transverse section of the weld is located in the center of the reduced section of the specimen.

**Residual Stresses** - Internal stresses that exist in a metal at room temperature as the result of (1) previous non-uniform heating and expansion, or (2) a composite structure composed of a ductile constituent and a brittle one.

**Reverse Polarity** - Welding condition when the electrode is connected to the positive terminal and the work is connected to the negative terminal of the welding power source.

**Root** - The narrowest point in the gap between two members to be welded, or the point in the gap furthest removed from the electrode. Usually these points are one and the same.

**Root Bend Test** - A test in which the weld root is on the convex surface of a specified bend radius.

**Root Crack** - A weld crack originating in the root bead, which is usually smaller and of higher carbon content than subsequent beads. Crack is caused by shrinkage of the hot weld metal as it cools, placing the root bead under tension.

**Root Opening** - The intentional gap between members to be joined to assure 100% penetration in groove type welds.

**Root Pass** - The initial weld bead deposited in a multi-pass weld requiring high weld integrity.

**Root Penetration** - The distance the weld metal extends into the joint root.

**Root Radius** - A nonstandard term for groove radius.

**Root Reinforcement** - Weld reinforcement opposite the side from which welding was done.

**Rutile** - The natural form of the mineral titanium dioxide (TiO<sub>2</sub>).

**SAE** - Society of Automotive Engineers

**SCR Power Source** - A type of power source that uses a semiconductor device known as the silicon controlled rectifier in the main power circuit.

**Secondary Gas** - Unlike the plasma gas, the secondary gas (also referred to as shielding gas) does not pass through the orifice of the nozzle. It passes around the nozzle and forms a shield around the arc.

**Self Hardening Steels** - Steels that become martensitic or fully hard by air cooling from above their critical temperature or from the austenitizing temperature.

**Self Shielded Flux Cored Arc Welding (FCAW-S)** - A flux cored arc welding process variation in which shielding gas is obtained exclusively from the flux within the electrode.

**Semi-Automatic Welding** - Welding with a continuous solid wire or flux cored electrode where the wire feed speed, shielding gas flow rate, and voltage are preset on the equipment, and the operator guides the hand held welding gun along the joint to be welded.

**Shear** - A force which causes deformation or fracture of a member by sliding one section against another in a plane or planes which are substantially parallel to the direction of the force.

**Shielded Metal Arc Welding (SMAW)** - An arc-welding process wherein coalescence is produced by heating with an arc between a covered metal electrode and the work. Shielding is obtained from decomposition of the electrode covering. Pressure is not used and filler metal is obtained from the electrode.

**Shield / Shielding Gas** - Unlike the plasma gas, the secondary gas (also referred to as secondary gas) does not pass through the orifice of the nozzle. It passes around the nozzle and forms a shield around the arc.

**Short Circuit Gas Metal Arc Welding (GMAW-S)** - A gas metal arc welding process variation in which the consumable electrode is deposited during repeated short circuits.

**Short Circuiting Transfer** - Mode of metal transfer in gas metal arc welding at low voltage and amperage. Transfer takes place each time the electrode touches or short-circuits to the weld puddle, extinguishing the arc. The short-circuiting current causes the electrode to neck down, melt off, and then repeats the cycle.

**Slag** - The brittle mass that forms over the weld bead on welds made with coated electrodes, flux cored electrodes, submerged arc welding and other slag producing welding processes. Welds made with the gas metal arc and the gas tungsten arc welding processes are slag free. Less oxidation generally makes slag more difficult to remove. Reducing speed usually helps.

**Slag Follow** - Refers to how the slag follows the puddle. If the slag is close, it "crowds" the puddle, making it more difficult for the welder to observe the arc. If the slag follows fast, it allows for faster travel speeds. "Good" slag follow is when the puddle is clear with the travel speed at a rate that keeps the puddle oblong.

**Slag Inclusion** - A weld defect where slag is entrapped in the weld metal before it can float to the surface.

**Slope or Slope Control** - A necessary feature in welding power sources used for short circuiting arc welding. Slope Control reduces the short circuiting current each time the electrode touches the weld puddle.

**Smooth** - The arc transfer is very consistent.

**Spalling** - The loss of particles or pieces from a surface due to cracking.

**Spark Test** - A test used to identify a metal. The metal is brought into contact with a power driven, high speed grinding wheel which produce spark patterns. These patterns are unique to several classes of ferrous metals.

**Splatter** - Weld reinforcement opposite the side from which welding was done.

**Spiral Arc Welding (SAW)** - arc welding process / procedure used in the pipe industry.

**Spot Welding** - A resistance welding method commonly used to join thin sheet materials by overlapping joints.

**Spray Arc Transfer** - Mode of metal transfer across the arc where the molten metal droplets are smaller than the electrode diameter and are axially directed to the weld puddle. Requires high voltage and amperage settings and a shielding gas of at least 80% argon.

**Spray Arc Welding** - A welding process by which molten material is transferred in the form of many small droplets, the diameter of which is less than that of the filler wire.

**Stabilized Stainless Steel** - A high-chromium steel that does not lose its chromium from solid solution by precipitation, because of the addition of elements that have a greater attraction for carbon than does chromium.

**Standoff Distance** - The distance between the outer most portion of the torch and the work surface.

**Standoff Guide** - Used with plasma torches to drag cut. It maintains a fixed distance from the torch tip to the workpiece.

**Steel** - An alloy of iron with up to 1.4% carbon, usually less.

**Straight Polarity** - Welding condition when the electrode is connected to the negative terminal and the work is connected to the positive terminal of the welding power source.

**Strain** - The physical effect of stress, usually evidenced by stretching or other deformation of the material.

**Stress** - The load, or amount of a force, applied to a material, tending to deform or break it.

**Stress Crack** - See "radial crack".

**Stress Relieved** - The reheating of a weldment to a temperature below the transformation temperature and holding it for a specified period of time. A frequently used temperature and time is 1150°F. for 1 hr. per inch of thickness. This reheating removes most of the residual stresses put in the weldment by the heating and cooling during welding.

**Stick-out** - The length of un-melted electrode extending beyond the end of the gas nozzle.

**Stringer Bead** - A straight weld bead opposed to a weaving bead. In surfacing, the weaving bead produces less dilution because the weld puddle is always in contact with the part of the bead produced on the previous oscillation rather than the base metal.

**Stub** - The short length of filler metal electrode, welding rod, or brazing rod that remains after its use for welding or brazing.

**Submerged Arc Welding** - An arc welding process that uses an arc or arcs between a bare metal electrode or electrodes and the weld pool. The arc and molten metal are shielded by a blanket of granular flux on the workpieces. The process is used without pressure and with filler metal from the electrode and sometimes from a supplemental source (welding rod, flux, or metal granules).

**Swirl Baffle** - It serves as a mounting platform for the nozzle, sets up a swirling direction of the gas through the small holes in the swirl baffle and carries the electrical current to the work piece.

**Tack Weld** - A weld made to hold the parts of a weldment in proper alignment until the final welds are made.

**Temper** - (1) The amount of carbon present in the steel: 10 temper is 1.00% carbon. (2) The degree of hardness that an alloy has after heat treatment or cold working, via the aluminum alloys. This usually lowers the hardness and strength and increases the toughness of the steel.

**Temper of Continuous Welding Electrodes** - The stiffness or strength of the electrode.

**Tensile Strength** - The resistance of a material to a force which is acting to pull it apart.

**Tension Test** - A test in which a specimen is loaded in tension until failure occurs.

**Thoriated Tungsten** - A metal used as the plasma cutting electrode emitter for a non-oxidizing plasma gas such as nitrogen.

**Throat** - The cylindrical part of the orifice which controls the quantity of oxygen which is consumed.

**Tight** - References the removal of slag, tight means it does not release readily, and will require moderate chipping to remove.

**TIG (Tungsten Inert Gas) Welding** - An arc welding process wherein coalescence is produced by heating with an arc between a single tungsten (non-consumable) electrode and the work. Shielding is obtained from a gas or gas mixture. Pressure may or may not be used and filler metal may or may not be used. (Also called Gas Tungsten Arc Welding – GTAW)

**Tip to Work Distance** - The distance between the outer most portion of the contact tube or tip and the work surface.

**Titania** - The synthetic form of titanium dioxide (TiO<sub>2</sub>). In this text the terms rutile and titania have the same significance.

**T-Joint** - A joint between two members located approximately at right angles to each other in the form of a T.

**Toe** - The point on the weld bead that meets the parent metal. Every weld bead has two “toes”.

**Toe Crack** - A crack originating at the junction between the face of the weld and the base metal. It may be any one of three types: (1) radial or stress crack; (2) under-bead crack extending through the hardened zone below the fusion line; or (3) the result of poor fusion between the deposited filler metal and the base metal.

**Torch to Work Distance** - The distance between the outer most portion of the torch and the work surface.

**Transferred Arc** – A plasma arc established between the electrode of the plasma arc torch and the workpiece.

**Transformation** - The changes in the crystalline structure of metals caused by temperature and time.

**Transformation Temperature** - The temperature at which the crystal structure of the steel changes, usually about 1600°F.

**Transformer** - An electrical device used to raise or lower the voltage and inversely change the amperage.

**Transition Temperature** - The temperature at which the crystal structure of steel changes, usually in the range of 1500-1600°F.

**Transverse Crack** - A crack with its major axis oriented approximately perpendicular to the weld axis.

**Transverse Weld Test Specimen** - A weld test specimen with its major axis perpendicular to the weld axis.

**Travel Angle** - The angle less than 90 degrees between the electrode axis and a line perpendicular to the weld axis, in a plane determined by the electrode axis and the weld axis. This angle can also be used to partially define the position of guns, torches, rods, and beams.

**Trimix or Triple Mix** - A shielding gas consisting of approximately 90% helium, 7-1/2% argon, and 2-1/2% carbon dioxide used primarily for short-circuiting arc welding of stainless steels. Maintains corrosion resistance of the stainless steel and produces good wetting and excellent weld bead shape.

**Tungsten Electrode** - A non-filler metal electrode used in arc welding, arc cutting and plasma spraying, made principally of tungsten.

**Ultimate tensile strength** - The maximum pulling force to which the material can be subjected without failure.

**Ultraviolet Light** – Short wavelength light emitted during arc cutting and welding processes that is harmful to the eyes and skin.

**Under-bead Crack / Cracking** - A weld defect that starts in the heat affected zone and is caused by excessive molecular hydrogen trapped in that region. It is sometimes referred to as cold cracking, since it occurs after the weld metal has cooled.

**Undercut** - A groove melted into the base metal adjacent to the toe or root of a weld and left unfilled by weld metal.

**Uphill** - Welding with an upward progression.

**Vertical Weld** - The welding position in which the weld axis, at the point of welding, is approximately vertical and the weld face lies in an approximately vertical plane.

**V-Groove Weld** - A type of groove weld.

**Volt** - Unit of electromotive force, or electrical pressure which causes current to flow in an electrical circuit.

**Vortex** – An intense swirling gas similar to a tornado. Most plasma arc cutting systems develop a vortex of some extent in the nozzle during cutting.

**Watt** - A unit of electrical power. Watts = Volts x Amperes

**Weathering Steel** - Low alloy steel that is specially formulated to form a thin tightly adhering layer of rust. This initial layer prevents further rusting and thus, the need to paint the steel is eliminated. The main alloys in this steel are copper and chromium.

**Weld / Welding** - A localized coalescence of metals or nonmetals produced either by heating the materials to the welding temperature, with or without the application of pressure, or by the application of pressure alone and with or without the use of filler material.

**Weldability** - The capacity of material to be welded under the imposed fabrication conditions into a specific, suitably designed structure and to perform satisfactorily in the intended service.



**Work Clamp** – An assembly used to hold the workpiece, generally using hydraulic pressure for clamping force.

**Weld Crack** - A crack located in the weld metal or heat affected zone.

**Welder Certification** - Written verification that a welder has produced welds meeting a prescribed standard of welder performance.

**Weld Face** - The exposed surface of a weld on the side from which welding was done.

**Welding Arc** - A controlled electrical discharge between the electrode and the workpiece that is formed and sustained by the establishment of a gaseous conductive medium, called an arc plasma.

**Welding Filler Metal** - The metal or alloy to be added in making a weld joint that alloys with the base metal to form weld metal in a fusion welded joint.

**Welding Operator** - One who operates adaptive control, automatic, mechanized, or robotic welding equipment.

**Welding Power Source** - An apparatus for supplying current and voltage suitable for welding.

**Welding Procedure** - The detailed methods and practices involved in the production of a weldment.

**Welding Rod** - A form of welding filler metal, normally packaged in straight lengths, that does not conduct the welding current.

**Welding Symbol** - A graphical representation of a weld.

**Welding Technique** - The details of a welding procedure that are controlled by the welder or welding operator.

**Welding Wire** - A form of welding filler metal, normally packaged as coils or spools that may or may not conduct electrical current depending upon the welding process with which it is used.

**Weldment** - An assembly whose component parts are joined by welding.

**Weld Metal** - The portion of a fusion weld that has been completely melted during welding.

**Weld Pass** - A single progression of welding along a joint. The result of a pass is a weld bead or layer.

**Weld Pool** - The localized volume of molten metal in a weld prior to its solidification as weld metal.

**Weld Puddle** - A nonstandard term for weld pool.

**Weld Reinforcement** - Weld metal in excess of the quantity required to fill a joint.

**Wetting** - The phenomenon whereby a liquid filler metal or flux spreads and adheres in a thin continuous layer on a solid base metal.

**Wire Feed Speed** - The rate at which wire is consumed in arc cutting, thermal spraying, or welding.

**Work Angle** - The angle less than 90deg. between a line that is perpendicular to the cylindrical pipe surface at the point of intersection of the weld axis and the extension of the electrode axis, and a plane determined by the electrode axis and a line tangent to the pipe at the same point. In a T-joint, the line is perpendicular to the non-butting member. This angle can also be used to partially define the position of guns, torches, rods and beams.

**Work Hardening** - The capacity of a material to harden as the result of cold rolling or other cold working involving deformation of the metal such as forming, bending, or drawing.

**Workpiece** – The piece of material to be cut or gouged.

**Wrought Iron** - A commercial form of iron that is tough, malleable, and relatively soft; less than 0.3% carbon.

**Yield Strength** - The stress point at which permanent deformation results.

**Zirconium** – An element used in some electrodes as a plasma arc cutting electrode emitter. Although similar to hafnium, zirconium provides a shorter service life.

**NOTE:**

For an extensive listing of standard welding terms and definitions the following publication is highly recommended. An electronic or hardcopy version can be purchased through the AWS website at [www.aws.org](http://www.aws.org)

**Standard Welding Terms and Definitions**  
**American Welding Society**  
**ANSI / AWS A3.0**