WELDING TIPS

The original Winner Group Welding Manual produced containing valuable welding tips and procedures is being revised and we expect to publish an updated edition by early 2015 to compliment the Winner Group welding products.

An updated wall chart for Winner Group Welding Products will also be available for workshops to use as a quick reference guide for applications - contact us to register your interest for one.

We have compiled the following documents to assist welders with technical information covering various aspects of welding. They contain valuable and useful information and are available for downloading.

Cast Iron Welding - White Paper

Glossary Of Welding Terms

A Arc - The physical gap between the end of the electrode and the base metal. The physical gap causes heat due to resistance of current flow and arc rays.

Constant Current (CC) Welding Machine - These welding machines have limited maximum short circuit current. They have a negative volt-amp curve and are often referred to as "droppers". The voltage will change with different arc lengths while only slightly varying the amperage, thus the name constant current or variable voltage.

Constant-Speed Wire Feeder - Feeder operates from 24 or 115 VAC supplied by the welding power source.

Constant Voltage (CV), Constant Potential (CP) Welding Machine -"Potential" and "voltage" are basically the same in meaning. This type of welding machine output maintains a relatively stable, consistent voltage regardless of the amperage output. It results in a relatively flat volt-amp curve as opposed to the drooping volt-amp curve of a typical Stick (SMAW) welding machine.

Current - Another name for amperage. The amount of electricity flowing past a point in a conductor Per second.

Flux Cored Arc Welding (FCAW) - An arc welding process which melts and joins metals by heating them with an arc between a continuous, consumable electrode wire and the work. Shielding is obtained from a flux contained within the electrode core. Depending upon the type of flux-cored wire, added shielding may or may not be provided from externally supplied gas or gas mixture. Consumables: contact tips, flux cored wire, shielding gas (if required, depends on wire type).

Gas Welding. An mixture of fuel gas and oxy.

High Frequency - Covers the entire frequency spectrum above 50,000 Hz. Used in TIG welding for arc ignition and stabilization.

Inverter - Power source which increases the frequency of the incoming primary power, thus providing for a smaller size machine and improved electrical characteristics for welding, such as faster response time and more control for pulse welding.

Lift-Arc(TM) - This feature allows TIG arc starting without high frequency. Starts the arc at any amperage without contaminating the weld with tungsten.

MIG (GMAW or Gas Metal Arc Welding) - An arc welding process which joins metals by heating them with an arc. The arc is between a continuously fed filler metal (consumable) electrode and the workpiece. Externally supplied gas or gas mixtures provide shielding. Common MIG welding is also referred to as short circuit transfer. Metal is deposited only when the wire actually touches the work. No metal is transferred across the arc. Another method of MIG welding, spray transfer moves a stream of tiny molten droplets across the arc from the electrode to the weld puddle. Consumables: contact tips, shielding gas, welding wire.
Machine - Together with WINNER GROUP and 3k Green have these amazing welding machines that are the best on the market.

Pounds Per Square Inch (psi) - A measurement equal to a mass or weight applied to one square inch of surface area.
Pulsed MIG (MIG-P) - A modified spray transfer process that produces no spatter because the wire does not touch the weld puddle. Applications best suited for pulsed MIG are those currently using the short circuit transfer method for welding steel, 14 gauge (1.8 mm) and up. Consumables: contact tips, shielding gas, welding wire.
Pulsed TIG (TIG-P) - A modified TIG process appropriate for welding thinner materials. Consumables: tungsten electrode, filler material, shielding gas.
Pulsing - Sequencing and controlling the amount of current, the polarity, and the duration of the welding arc.

WINNER GROUP Welding. World leader in welding supplies.

Shielding Gas - Protective gas used to prevent atmospheric contamination of the weld pool.
Single-Phase Circuit - An electrical circuit producing only one alternating cycle within a 360 degree time span.
Stick Welding (SMAW or Shielded Metal Arc) - An arc welding process which melts and joins metals by heating them with an arc, between a covered metal electrode and the work. Shielding gas is obtained from the electrode outer coating, often called flux. Filler metal is primarily obtained from the electrode core. An AC/DC welder is recommended for Stick. For most applications, DC reverse polarity welding offers advantages over AC, including easier starts and out-of-position welding, smoother arc and fewer arc outages and sticking. Consumables: stick electrodes.
Submerged Arc Welding (SAW) - A process by which metals are joined by an arc or arcs between a bare metal electrode or electrodes and the work. Shielding is supplied by a granular, fusible material usually brought to the work from a flux hopper. Filler metal comes from the electrode and sometimes from a second filler rod.
Spot Welding - Usually made on materials having some type of overlapping joint design. Can refer to resistance, MIG or TIG spot welding. Resistance spot welds are made from electrodes on both sides of the joint, while TIG and MIG spots are made from one side only

Three-Phase Circuit - An electrical circuit delivering three cycles within a 360 degree time span, and the cycles are 120 electrical degrees apart.
TIG Welding (GTAW or Gas Tungsten Arc) - Often called TIG welding (Tungsten Inert Gas), this welding process joins metals by heating them with a tungsten electrode which should not become part of the completed weld. Filler metal is sometimes used and argon inert gas or inert gas mixtures are used for shielding. Consumables: tungsten electrode, filler metal, shielding gas.
Torch - A device used in the TIG (GTAW) process to control the position of the electrode, to transfer current to the arc, and to direct the flow of the shielding gas.
Touch Start - A low-voltage, low-amperage arc starting procedure for TIG (GTAW). The tungsten is touched to the workpiece; when the tungsten is lifted from the workpiece an arc is established.
Tungsten - Rare metallic element with extremely high melting point (3410 °Celsius). Used in manufacturing TIG electrodes.

Voltage - The pressure or force that pushes the electrons through a conductor. Voltage does not flow, but causes amperage or current to flow. Voltage is sometimes termed electromotive force (EMF) or difference in potential.
Voltage-Sensing Wire Feeder - Feeder operates from arc voltage generated by welding power source.

Volt-Amp Curve - Graph that shows the output characteristics of a welding power source. Shows voltage and amperage capabilities of a specific machine.

WaveWriter™ File Management - Includes all Axcess(TM) File Management functions, plus a simple, graphical wave-shaping program for the most demanding pulsed MIG applications.
Welding Machine - Together with WINNER GROUP and 3k Green our machines are the best on the market.
Weld at Idle™ - Allows PipePro(TM) 304 to automatically weld at a quieter, lower RPM, using less fuel. When more output is required, he machine goes to high speed without a change in arc. On the Trailblazer® Pro 350 D, a weld at idle lock switch allowed welding at low engine speed up to 180 amps.
Weld Metal - The electrode and base metal that was melted while welding was taking place. This forms the welding bead.
Weld Transfer - Method by which metal is transferred from the wire to the molten puddle. There are several methods used in MIG; they include: short circuit transfer, spray arc transfer, globular transfer, buried arc transfer, and pulsed arc transfer.
Weldex - Production welding electrode.
Why Stick - Stick, the most basic of welding processes, offers the easiest option for joining steel and other metals. Stick welding power sources deliver inexpensive options for welding versatility, portability and reliability. Stick joins metals when an arc is struck between the electrode and the work piece, creating a weld pool and depositing a consumable metal electrode into the joint. The electrode's protective coating also acts as a shielding gas, protecting the weld and ensuring its purity and strength. Best for windy conditions and adverse environments.
Wire Feed Speed - Expressed in in/min or mm/s, and refers to the speed and amount of filler metal fed into a weld. Generally speaking the higher the wire feed speed, the higher the amperage.
Workpiece Connection - A means to fasten the work lead (work cable) to the work (metal to be welded on). Also, the point at which this connection is made. One type of work connection is made with an adjustable clamp.
Workpiece Lead - The conductor cable or electrical conductor between the arc welding machine and the work.

Steel is by far the most frequently welded metals and when the alloy and carbon content is known, the experienced welder can select an electrode that will be both compatible with the parent metal's chemistry and suitable to the welders structural needs. The welder will also know, by the carbon content of the steel, if the workpiece should be pre-heated to avoid stress, especially in the area near the weld.
Unlike the production welder who welds within prescribed limits and with known

materials, the maintenance and repair welder must, as a rule, be able to confidently weld a variety of steels.
By using WINNER GROUP Welding Products, Flame & welder will be able to produce superior welds on a wide selection of known and unknown steels.

Maintenance & Repair Welding Versus Production Welding

Production Welding is:
Executed under optimum welding conditions
By trained and experienced staff
In a controlled environment
To a prescribed recipe
With full knowledge and experience
Maintenance & Repair Welding is:
Expected to cope with unknown metals
Metals that are old, dirty, greasy and corroded
Difficult to access with welding equipment
Staff may be inexperienced welders
Repairs could be required under water or in dirty, wet conditions
The WINNER GROUP Difference:
Only premium products with special characteristics are produced
Products are manufactured from highest quality raw materials with the best possible physical properties
Products are made to unique WINNER GROUP specifications which are the most advanced available
Committed to minimizing down time
Cost Reductions
Wear and corrosion are of major concern to industry; they produce down time, loss of production, low efficiency, maintenance work and replacement parts. At the end of the year the cost affects the balance sheet and is an enormous drain on the economy.
The WINNER GROUP approach to combat wear and corrosion is to utilize alternative technologies (brazing, coating, welding or wear-plate) and appropriate consumables, which satisfy the mechanical property requirements and simultaneously offer an effective barrier against the harsh environment.
Cost reduction: The WINNER GROUP approach is cost effective even though the barrier is highly alloyed (and therefore expensive) as the barrier is thin and only used where the attack is occurring. Producing the whole part from such a specialist alloy would not only be unnecessary and prohibitively expensive, but may be impossible to manufacture or fail to have the desired mechanical properties.
In-situ repairs: Frequently the cost of taking equipment apart to remove a failed part is greater than the cost of the part itself. It is more cost effective to avoid the strip down and repair the part in-situ. If the part is repaired or coated correctly it will also last longer.
The Mechanism of Wear
The better you understand your problems, the easier it is for our experts to identify the unique solution to your particular needs.
Wear affects our everyday life. Take the car tires that wear and have to be replaced regularly. The tire gives us an idea of how broad and complex the wear phenomenon is as we know that tire wear is influenced by many external factors such as driving speed, road surface, type of car and type of driver.
Wear can be thought of as a "system" incorporating several elements. The base body is the part experiencing wear (our tire). It may be acted upon by an opposing body, either directly (the road) or via an intermediate body (broken glass on road). Wear may also be influenced by the environment in which the body operates (snow).
Wear is influenced by various factors or operating conditions:

Movement (impact; sliding)
Type of contact (sharp, flat, bearings)
Load
Type of materials (metal, sand, rocks)
Speed
Environment (corrosion; pressure; oxidation)
Temperature
Components are rarely subjected to only one type of wear. When several different types of wear mechanisms are operating simultaneously, the result is combined wear and other parameters (pressure, oxidation, corrosion, impact or temperature) which can also influence the choice of protection technology employed.

WINNER GROUP have the solution to these issues and we welcome your enquiry today.

Welding Cast Iron and Other Irons

Abstract:

The term cast iron is a rather broad description of many types of irons which are castings but which may have different properties and serve different purposes.
In most welding processes the heating and cooling cycle creates expansion and contraction, which sets up tensile stresses during the contraction period. For this reason, grey cast iron is difficult to weld without special precautions. On the other hand, the ductile cast irons such as malleable iron, ductile iron, and nodular iron can be successfully welded. For best results, these types of cast irons should be welded in the annealed condition.

The term cast iron is a rather broad description of many types of irons which are castings but which may have different properties and serve different purposes. In general, a cast iron is an alloy of iron, carbon, and silicon in which more carbon is present than can be retained in solid solution in austenite at the Eutectic temperature.

The amount of carbon is usually more than 1.7% and less than 4.5%. There are many types of cast iron; in fact, pig iron, which is the product of the blast furnace, can be considered cast iron since it is iron cast into pigs or ingots for later re-melting and casting into the final form. The most widely used type of cast iron is known as grey iron. Its tonnage production exceeds that of any other cast metal.

Grey iron has a variety of compositions but it is usually such that the matrix structure is primarily pearlite with many graphite flakes dispersed throughout. Grey cast iron is used in the automotive industry for: engine blocks and heads, automatic transmission housings, differential housing, water pump housing, brake drums, and engine pistons. There are exceptions to this but the exceptions are usually aluminium, which is readily identifiable from cast iron.

There are also alloy cast irons which contain small amounts of chromium, nickel, molybdenum, copper, or other elements added to provide specific properties. These usually provide higher strength cast irons. One of the major uses for the higher strength irons is casting automotive crankshafts. These are sometimes called semi steel or proprietary names.

Another alloy iron is the austenitic cast iron which is modified by additions of nickel and other elements to reduce the transformation temperature so that the structure is austenitic at room or normal temperatures. Austenitic cast irons have a high degree of corrosion resistance.

White cast iron is another type of iron, in which almost all the carbon is in the combined form. This provides a cast iron with higher hardness which is used for abrasion resistance.

Another class of cast iron is called malleable iron. This is made by giving white cast iron a special annealing heat treatment to change the structure of the carbon in the iron. By so doing, the structure is changed to pearlitic or ferritic which increases its ductility.

There are two other classes of cast iron which are more ductile than grey cast iron. These are known as nodular iron and ductile cast iron. These are made by the addition of magnesium or aluminium which will either tie up the carbon in a combined state or will give the free carbon a spherical or nodular shape rather than the normal flake shape in grey cast iron. This structure provides a greater degree of ductility or malleability of the casting.

The grey cast iron has a very low ability to bend and low ductility. Possibly a maximum of 2% ductility will be obtained in the extreme low carbon range. The low ductility is due to the presence of the graphite flakes which act as discontinuities.

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Preparation for Welding

In preparing the casting for welding it is necessary to remove all surface materials to completely clean the casting in the area of the weld. This means removing paint, grease, oil, and other foreign material from the weld zone. It is desirable to heat the weld area for a short time to remove entrapped gas from the weld zone of the base metal.

Where grooves are involved a V groove from a 60-90° included angle should be used. Complete penetration welds should always be used since a crack or defect not completely removed may quickly reappear under service conditions.

Preheating is desirable for welding with any of the welding processes. It can be reduced when using extremely ductile filler metal. Preheating will reduce the thermal gradient between the weld and the remainder of the case iron. Preheat temperatures should be related to the welding process, the filler metal type, the mass and the complexity of the casting.

Arc Welding

The shielded metal arc welding process can be utilized for welding cast iron. There are four types of filler metals that may be used: cast iron covered electrodes, covered copper base alloy electrodes, covered nickel base alloy electrodes and mild steel covered electrodes. There are reasons for using each of the different specific types of electrodes as follows: the machinability of the deposit, the colour match of the deposit, the strength of the deposit, and the ductility of the final weld.

When arc welding with the cast iron electrodes, preheat to between 120° and 425°C is necessary, depending on the size and complexity of the casting and the need to machine the deposit and adjacent areas. In general, it is best to use small-size electrodes and a relatively low current setting. A medium arc length should be used and if at all possible welding should be done in the flat position.

Arc welding contd.

There are two types of copper-base electrodes, the copper tin alloy (ECuSn-A and C) and the copper aluminium (ECuAl-A2) types. The copper zinc alloys cannot be used for arc welding electrodes because of the low boiling temperature of zinc. Zinc will volatilize in the arc and will cause weld metal porosity. The copper tin electrodes will produce a braze weld having good ductility. The ECuSn-A has less amount of tin. It is more of a general purpose electrode. The ECuSn-C provides a stronger deposit with higher hardness.

The copper aluminium alloy electrode (ECuAl-A2) provides much stronger welds and is used on the higher strength alloy cast irons.

When the copper base electrodes are used, a preheat of 120-200°C is recommended and small electrodes and low current should be used. The welding technique should be to direct the arc against the deposited metal or puddle to avoid penetration and mixing the base metal with the weld metal. Slow cooling is recommended after welding. The copper-base electrodes do not provide a good colour match.

There are three types of nickel electrodes used for welding cast iron. The ENiFe-CI contains approximately 50% nickel with iron, the ENiCI contains about 85% nickel and the ENiCu type contains nickel and copper. The ENiFeCI electrode is less expensive and provides results approximately equal to the high-nickel electrode. These electrodes can be used without preheat; however, heating to 40°C is recommended. The nickel and nickel iron deposits are extremely ductile and will not become brittle with the carbon pickup. The hardness of the heataffected zone can be minimized by reducing penetration into the cast iron base metal. The copper nickel type comes in two grades; the ENiCu-A with 55% nickel and 40% copper and the ENiCu-B with 65% nickel and 30% copper. Either of these electrodes can be used in the same manner as the nickel or nickel iron electrode with about the same technique and results. The deposits of these electrodes do not provide a colour match.

Mild steel electrodes (E St) are not recommended for welding cast iron if the deposit is to be machined. The mild steel deposit will pick up sufficient carbon to make a high-carbon deposit which is impossible to machine. Additionally, the mild steel deposit will have a reduced level of ductility as a result of increased carbon content. This type of electrode should be used only for small repairs and should not be used when machining is required.

Minimum preheat is possible for small repair jobs. Here again, small electrodes at low current are recommended to minimize dilution, and to avoid the concentration of shrinkage stresses. Short welds using a wandering sequence should be used and the weld should be peened as quickly as possible after welding. The mild steel electrode deposit provides a fair colour match.

Oxy-Fuel Gas Welding

The oxy-fuel gas process is often used for welding cast iron. Most of the fuel gases can be used. The flame should be neutral to slightly reducing. Flux should be used. Two types of filler metals are available: The cast iron rods (RCI and A and B) and the copper zinc rods (RCuZn-B and C). Welds made with the proper cast iron electrode will be as strong as the base metal. The RCI classification is used for ordinary grey cast iron. The RCI-A has small amounts of alloy and is used for the high strength alloy cast irons and the RCI-B is used for welding malleable and nodular cast iron. Good colour match is provided by all of these welding rods. The optimum welding procedure should be used with regard to joint preparation, preheat, and post heat.

The copper zinc rods produce braze welds. There are two classifications: RCuZn-B, which is manganese bronze and RCuZn-C, which is a low-fuming bronze. The deposited bronze has relatively high ductility but will not provide a colour match.

Gas Metal Arc Welding

The gas metal arc welding process can be used for making welds between malleable iron and carbon steels. Several types of electrode wires can be used, including:

- Mild Steel (E70S-3) using 75% Argon + 25% CO_2 for shielding.
- Nickel Copper (ENiCu-B) using 100% Argon for shielding.
- Silicon Bronze (ECuZn-C) using 50% Argon +50% Helium for shielding.

In all cases small diameter electrode wire should be used at low current. With the mild penetration. In the case of the nickel base filler metal and the copper base filler metal the deposited filler metal is extremely ductile. The mild steel provides a fair colour match. A higher preheat is usually required to reduce residual stresses and cracking tendencies.

Flux-Cored Arc Welding

This process has recently been used for welding cast irons. The more successful application has been using a nickel base flux-cored wire which produces a weld deposit very similar to the 50% nickel deposit provided by the ENiFe-CI covered electrode.

This electrode wire is normally operated with CO2 shielding gas but when lower mechanical properties are not objectionable it can be operated without external shielding gas. The minimum preheat temperatures can be used. The technique should minimized penetration into the cast iron base metal. Post heating is normally not required. A colour match is not obtained.

Flux-cored self-shielding electrode wires (E60T-7), operating with electrode negative (straight polarity), have also been used for certain cast iron to mild steel applications. In this case, a minimum penetration type weld is obtained and by the proper technique penetration should be kept to a minimum. It is not recommended for deposits that must be machined.