DOWNLOAD PDF ARC WELDING MILD STEEL AND GMAW/GTAW WELDING

Chapter 1 : ER70S-2 (GTAW) TIG | The Harris Products Group

Gas tungsten arc welding (GTAW), also known as tungsten inert gas (TIG) welding, is an arc welding process that uses a non-consumable tungsten electrode to produce the weld. The weld area and electrode is protected from oxidation or other atmospheric contamination by an inert shielding gas (argon or helium), and a filler metal is normally.

Development[edit] After the discovery of the short pulsed electric arc in by Humphry Davy [2] [3] and of the continuous electric arc in by Vasily Petrov , [3] [4] arc welding developed slowly. Coffin had the idea of welding in an inert gas atmosphere in , but even in the early 20th century, welding non-ferrous materials such as aluminum and magnesium remained difficult because these metals react rapidly with the air and result in porous, dross -filled welds. To solve the problem, bottled inert gases were used in the beginning of the s. A few years later, a direct current , gas-shielded welding process emerged in the aircraft industry for welding magnesium. Linde Air Products developed a wide range of air-cooled and water-cooled torches, gas lenses to improve shielding, and other accessories that increased the use of the process. Finally, the development of alternating current units made it possible to stabilize the arc and produce high quality aluminum and magnesium welds. Linde developed water-cooled torches that helped prevent overheating when welding with high currents. It affords greater control and improves weld quality by using a nozzle to focus the electric arc, but is largely limited to automated systems, whereas GTAW remains primarily a manual, hand-held method. Among the most popular are the pulsed-current, manual programmed, hot-wire, dabber, and increased penetration GTAW methods. Similar to torch welding, GTAW normally requires two hands, since most applications require that the welder manually feed a filler metal into the weld area with one hand while manipulating the welding torch in the other. Maintaining a short arc length, while preventing contact between the electrode and the workpiece, is also important. This spark is a conductive path for the welding current through the shielding gas and allows the arc to be initiated while the electrode and the workpiece are separated, typically about 1. While maintaining a constant separation between the electrode and the workpiece, the operator then moves the torch back slightly and tilts it backward about 10â€”15 degrees from vertical. Filler metal is added manually to the front end of the weld pool as it is needed. The filler rod is withdrawn from the weld pool each time the electrode advances, but it is always kept inside the gas shield to prevent oxidation of its surface and contamination of the weld. Filler rods composed of metals with a low melting temperature, such as aluminum, require that the operator maintain some distance from the arc while staying inside the gas shield. If held too close to the arc, the filler rod can melt before it makes contact with the weld puddle. As the weld nears completion, the arc current is often gradually reduced to allow the weld crater to solidify and prevent the formation of crater cracks at the end of the weld. Due to the absence of smoke in GTAW, the electric arc light is not covered by fumes and particulate matter as in stick welding or shielded metal arc welding , and thus is a great deal brighter, subjecting operators to strong ultraviolet light. The welding arc has a different range and strength of UV light wavelengths from sunlight, but the welder is very close to the source and the light intensity is very strong. Potential arc light damage includes accidental flashes to the eye or arc eye and skin damage similar to strong sunburn. Operators wear opaque helmets with dark eye lenses and full head and neck coverage to prevent this exposure to UV light. Modern helmets often feature a liquid crystal -type face plate that self-darkens upon exposure to the bright light of the struck arc. Transparent welding curtains, made of a polyvinyl chloride plastic film, are often used to shield nearby workers and bystanders from exposure to the UV light from the electric arc. The ozone and nitric oxides react with lung tissue and moisture to create nitric acid and ozone burn. Ozone and nitric oxide levels are moderate, but exposure duration, repeated exposure, and the quality and quantity of fume extraction, and air change in the room must be monitored. Welders who do not work safely can contract emphysema and oedema of the lungs, which can lead to early death. Similarly, the heat from the arc can cause poisonous fumes to form from cleaning and degreasing materials. Cleaning operations using these agents should not be performed near the site of welding, and proper ventilation is necessary to protect the welder. Many industries use GTAW for welding thin workpieces, especially nonferrous metals. It is used extensively in the manufacture of space vehicles, and is also frequently employed to weld small-diameter, thin-wall tubing such as those used in the bicycle industry. In addition, GTAW is often used to make root or first-pass welds for piping of various sizes. In maintenance and repair work, the process is commonly used to repair tools and dies, especially components made of aluminum and magnesium. In fact, no other welding process permits the welding of so many alloys in so many product configurations. Filler metal alloys, such as elemental aluminum and chromium, can be lost through the electric arc from volatilization. This loss does not occur with the GTAW process. Because the resulting welds have the same chemical integrity as the original base metal or match the base metals more closely, GTAW welds are highly resistant to corrosion and cracking over long time periods, making GTAW the welding procedure of choice for critical operations like sealing spent nuclear fuel canisters before burial. Maximum weld quality is assured by maintaining cleanlinessâ€”all equipment and materials used must be free from oil, moisture, dirt and other impurities, as these cause weld porosity and consequently a decrease in weld strength and quality. To remove oil and grease, alcohol or similar commercial solvents may be used, while a stainless steel wire brush or chemical process can remove oxides from the surfaces of metals like aluminum. Rust on steels can be removed by first grit blasting the surface and then using a wire brush to remove any embedded grit. These steps are especially important when negative polarity direct current is used, because such a power supply provides no cleaning during the welding process, unlike positive polarity direct current or alternating current. GTAW in windy or drafty environments increases the amount of shielding gas necessary to protect the weld, increasing the cost and making the process unpopular outdoors. Low heat input, caused by low welding current or high welding speed, can limit penetration and cause the weld bead to lift away from the surface being welded. If there is too much heat input, however, the weld bead grows in width while the likelihood of excessive penetration and spatter increase. Additionally, if the welding torch is too far from the workpiece the shielding gas becomes ineffective, causing porosity within the weld. This results in a weld with pinholes, which is weaker than a typical weld. Known as tungsten spitting, this can be identified with radiography and can be prevented by changing the type of electrode or increasing the electrode diameter. In addition, if the electrode is not well protected by the gas shield or the operator accidentally allows it to contact the molten metal, it can become dirty or contaminated. This often causes the welding arc to become unstable, requiring that the electrode be ground with a diamond abrasive to remove the impurity. Welding torch[edit] GTAW welding torches are designed for either automatic or manual operation and are equipped with cooling systems using air or water. The automatic and manual torches are similar in construction, but the manual torch has a handle while the automatic torch normally comes with a mounting rack. The angle between the centerline of the handle and the centerline of the tungsten electrode, known as the head angle, can be varied on some manual torches according to the preference of the operator. The torches are connected with cables to the power supply and with hoses to the shielding gas source and where used, the water supply. The tungsten electrode must be held firmly in the center of the torch with an appropriately sized collet , and ports around the electrode provide a constant flow of shielding gas. Collets are sized according to the diameter of the tungsten electrode they hold. The body of the torch is made of heat-resistant, insulating plastics covering the metal components, providing insulation from heat and electricity to protect the welder. The size of the gas nozzle depends upon the diameter of the electrode, the joint configuration, and the availability of access to the joint by the welder. The inside diameter of the nozzle is preferably at least three times the diameter of the electrode, but there are no hard rules. The welder judges the effectiveness of the shielding and increases the nozzle size to increase the area protected by the external gas shield as needed. The nozzle must be heat resistant and thus is normally made of alumina or a ceramic material, but fused quartz , a high purity glass, offers greater visibility. Devices can be inserted into the nozzle for special applications, such as gas lenses or valves to improve the control shielding gas flow to reduce turbulence and introduction of contaminated atmosphere into the shielded area. Hand switches to control welding current can be added to the manual GTAW torches. This is important because most applications of GTAW are manual or semiautomatic, requiring that an operator hold the torch. Maintaining a suitably steady arc distance is difficult if a constant voltage power source is used instead, since it can cause dramatic heat variations and make welding more difficult. Direct current with a negatively charged electrode DCEN is often employed when welding steels , nickel , titanium , and other metals. It can also be used in automatic GTAW of aluminum or magnesium when helium is used as a shielding gas. The ionized shielding gas flows toward the electrode, not the base material, and this can allow oxides to build on the surface of the weld. Instead of flowing from the electrode to the base material, as in DCEN, electrons go the other direction, causing the electrode to reach very high temperatures. As the electrons flow toward the electrode, ionized shielding gas flows back toward the base material, cleaning the weld by removing oxides and other impurities and thereby improving its quality and appearance. This causes the electron flow to switch directions constantly, preventing the tungsten electrode from overheating while maintaining the heat in the base material. Some power supplies enable operators to use an unbalanced alternating current wave by modifying the exact percentage of time that the current spends in each state of polarity, giving them more control over the amount of heat and cleaning action supplied by the power source. To remedy the problem, a square wave power supply can be used, as can high-frequency to encourage arc stability.

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Chapter 2 : Stainless Steel Welding Wires â€“ Creative

Gas Tungsten Arc Welding âˆ' GTAW âˆ' (40 Hours Course) With technical assistance from: GERMAN DEVELOPMENT SERVICE August Dear Reader, I would like to comment this handout, because otherwise you might get a little confused while studying it.

Check new design of our homepage! How to Arc Weld Stainless Steel? If you are a fan of the DIY method , and are constantly working on home improvement projects, then welding is an important skill that you should know. In this HomeQuicks article, we give you tips on arc welding to satisfy the workman in you HomeQuicks Staff Welding is a crucial aspect of metal work. Normally welding is done by professionals, but knowing to weld can be pretty useful, even if you do not need to do it all the time. For minor welding work around the house, you can save quite a bit of money doing it yourself. Even in cases where you opt for a professional, know about welding can help you keep tabs on what is going on. Arc Welding Stainless Steel Shielded Metal Arc Welding SMAW Also, known as stick electrode welding, this type of electric arc welding uses heat for welding, with the help of an electric arc between a covered metal electrode and the base metal. Again, the heat needed is generated by an electric arc between the end of a non-consumable tungsten electrode and the base metal. It hardly needs any post welding cleaning. In this process, heat is generated by an arc between a continuously fed filler metal electrode and the base metal. Flux Cored Arc Welding FCAW In this type of welding, a flux is present within the electrode for providing shielding, arc stabilization, and deoxidization. For arc welding stainless steel to mild steel, safety glasses or goggles will also be needed. Step 1 After you have gathered everything, plug your welder in a volt outlet, and in the ground cord. Along with this, do not forget to connect the welder electrode holder cord in the welder. Step 2 Now, as welding is a specialized task and not a routine task, a specific electrode is needed. It will require an AWS E stick electrode. After you get the electrode, make sure that the surface which has to be welded is clean. It can be cleaned with the help of a wire brush. Step 3 The next step is to clamp the grounding cord from the welder to the piece to be welded. Then place the electrode in the holder and position it near the place where the welding will start. Note that it is very important is to wear safety gear before you begin. Step 4 Now, tap the electrode on the steel till an arc is formed, then start weaving the stick from one side to another. While doing this, it is essential to remember that the arc has to be kept half a centimeter or less from the piece to be welded. Step 5 Finally, let the weld cool down for a minute or so. Use a welding hammer to chip off the slag developed as a result of welding. To state the obvious, touching live electrical parts can be dangerous, so avoiding that is essential.

Chapter 3 : Types Of Welding Processes

Gas Tungsten Arc Welding. Gas tungsten arc welding (GTAW) produces very little spatter, even compared to SAW. If welders are using filler rod or wire, GTAW has a moderate cost per pound, but it also requires high skill and typically the most complex equipment.

Knowing the correct consumables, equipment, and preweld preparation necessary will help the welder troubleshoot welding problems. Gas tungsten arc welding GTAW is an electric arc welding process that produces an arc between a nonconsumable electrode and the work to be welded. The weld is shielded from the atmosphere by a shielding gas that forms an envelope around the weld area see Figure 1. The GTAW process is versatile and can be used on ferrous and nonferrous metals. An arc is produced between a nonconsumable electrode and the work to be welded. The weld is shielded from the atmosphere by a shielding gas that forms an envelope around the weld area. GTAW is versatile and can be used on ferrous and nonferrous metals and, depending on the base metal, in all welding positions. The process can be used to weld thin or thick materials with or without a filler metal. When welding thinner materials, edge joints, and flange, filler metals are not used. For thicker materials, an externally fed filler wire is generally used. The type of filler metal wire to be used is based on the chemical analysis of the base metal. The size of the filler metal wire depends on the thickness of the base metal, which usually dictates the welding current. The methods of operation for GTAW can be manual or automatic. Welding Procedure Variables and Joint Configurations Welding procedure variables control the welding process and the quality of the welds produced. Joint configuration is determined by the design of the weldment, the metallurgical analysis, and by the process and procedure required by the weldment. Welding variables are selected after the base metal, filler metal, and joint configuration have been selected. The fixed welding variables include the type of filler metal, electrode type and size, the type of current, and the type of shielding gas. The adjustable variables control the shape of the weld by affecting things such as bead height, bead width, penetration, and weld integrity. The primary adjustable variables for GTAW are welding current, arc length, and travel speed. Secondary variables also aid in controlling the welding process, but it is more difficult to calculate the extent of effect. The secondary variables include work and travel angle and the distance the electrode extends beyond the end of the cup. Tungsten has one of the highest melting temperatures of any metal, about 6, degrees Fahrenheit 3, degrees Celsius. The size of an electrode to be used is determined by the welding current required. Larger electrodes permit higher currents to be used. Smaller diameter electrodes may be used for welding thinner materials or while welding out of position. Following is a list of various types of tungsten alloys used: Pure tungstenis used on nonferrous metals, such as aluminum and magnesium, and is typically used with a balled-end preparation on alternating current AC see Figure 2. Pure tungsten is typically used with a balled-end preparation. Thoriated tungstenis the most common type of tungsten electrode for use on carbon and stainless steel. It can be purchased with 1 or 2 percent thorium. The thoriated tungsten starts readily and maintains a stable arc. It has a greater resistance to contamination and will maintain a sharp point and will not break down as readily as pure tungsten. Zirconiated tungstenis typically used for welding with higher AC currents on nonferrous metals. Preparing a point or using an electrode taper angle applies to thoriated tungsten. Thoriated tungsten electrodes are ground to a point to give better arc starting, with high frequency added. This provides the arc ignition and keeps the electrode from contacting the work. It also aids in stabilizing the arc. The degree of taper affects the shape and amount of penetration of a weld. To reduce the number of times the electrode must be sharpened, the welder needs to develop the skill of not touching the tungsten to the work during the welding process. Proper electrode tip preparation is essential for achieving proper weld penetration. The characteristics most desirable for shielding purposes are the chemical inertness of the gases and their ability to produce smooth arc action at high currents. Both gases are inert, causing an ionization effect in the welding arc. They protect the tungsten electrode and the molten weld pool from the atmosphere. Gas purity affects a weld. Metals will withstand small amounts of impurities, but, for the best results, the percent of inert gas used should be at least Argon is heavier than helium and may be supplied in liquid or gaseous form. Argon provides for good cleaning action. The flow rates are determined by the size of the tungsten and the gas cup diameter. Argon is suitable for welding similar and dissimilar metals and works well while welding in the vertical and overhead welding positions. Helium is a lighter inert gas. It can be distributed as a liquid, but is used more often as a compressed gas. It leaves the weld area faster than argon, and higher flow rates are necessary when using it. Helium produces a narrow but deep heat-affected zone HAZ , which is good for welding on heavier metals. It is suitable for welding at high speeds and gives good coverage in vertical and overhead welding positions. It helps to increase the penetration, and when used as a back purge, it tends to flatten the pass of the weld bead. Helium is suitable for use on thicker nonferrous metals. Argon and helium mixtures are used when welders need the control of the argon and the penetration of the helium. This mixture is not necessary when welding plain carbon steels. Typical mixtures vary, depending on the application. It is often used for automatic welding applications. This mixture should not be used when welding plain carbon steels. The typical mixture is a 95 percent argon and 5 percent hydrogen. Nitrogen can also be used as a shielding gas, but is rarely used because of its higher current requirements. It is suitable for welding copper. Welding Current, Joint Design The current depends primarily on the type of metal to be welded, the current levels required, and the availability of the machine that produces that type of welding current. Direct current electrode positive DCEP reverse polarity is sometimes used to weld very thin nonferrous metals, and is also used for balling the tungsten electrode. Direct current electrode negative DCEN straight polarity is used most commonly to weld stainless steel and ferrous metals. AC current, with the addition of high frequency, is most commonly used for welding some nonferrous metals such as aluminum and magnesium. It provides good cleaning action and gives moderate penetration. Weld Joint Design The five basic types of joints are the butt joint, the corner joint, the edge joint, the lap joint, and the tee joint see Figure 4. Of the five types of joint designs, the butt and the tee joint are the most commonly used. Figure 4 The strength of a weld joint is another factor contributing to weld joint design. Weld joints can be either partial or full penetration, depending on the strength required of the joint. Weld joint design or weldment configuration for GTAW is determined by the type of metal, configuration of the weldment, designated codes and specifications, and the metallurgical analysis. Several factors influence the joint design to be used, including the strength required, the welding position, the metal thickness, and how accessible the joint is to the welder. The purpose of any joint design is to produce a sound weld deposit with the desired properties as economically as possible. The edge and joint preparation are important because they will affect both the quality and the cost of welding. Preweld Preparations Before using GTAW, several steps must be taken to prepare the electrode and the weld joint, fixture the weldment, set the variables, and preheat the base metal, if necessary. The amount of preparation depends on the size of the weldment, type of base material, fit-up, and the quality requirements. Electrode preparation depends on the type of electrode and the welding application. The tip may have a ground point or a ball end for welding with AC. To prepare an electrode with a point, the grind marks should run parallel to the electrode. To prepare a ball on the end of a tungsten, the power supply must be switched to DCEP reverse polarity. Then, after starting the arc between the electrode and a piece of scrap metal or copper, it must be maintained at a moderate current level. The tip of the ball should be perfectly clean, shiny, and have a mirror-like finish. Preparing the Weld Joint. When preparing the weld joint, several different methods can be used, including oxyfuel cutting, plasma cutting, shearing, machining, air carbon arc gouging, grinding, or chipping. Remember, preparing the weld joint properly will help produce a sound weldment and meet the requirements of quality standards for welding. Cleaning the material to be welded is important. GTAW welds are often susceptible to contamination during welding. The surface to be welded must be free from oil, grease, paint, dirt, oxides, and other foreign material. Aluminum has an oxide coating that, if not removed, will contaminate the weld area. Cleaning solutions, wire brushes, grinders, and abrasive blasting are some of the methods used to remove these contaminants. Fixturing and positioning will also affect the shape, size, and uniformity of a weld. Fixtures hold the weldment in place while controlling distortion, helping to locate and maintain parts in their position relative to the weldment. When fixturing is employed, it can reduce the time for welding. Positioning will help move the weldment into a flat position to improve productivity for the welder. Chill blocks, heat sinks, or backing bars may be used when welding some metals to prevent burn-through, reduce base material temperatures, or to minimize distortion. Depending on the alloying elements in the base material, the thickness of the steel, and the configuration of the joint, preheat is sometimes needed.

Chapter 4 : Gas tungsten arc welding - Wikipedia

Gas metal arc welding (GMAW), sometimes referred to by its subtypes metal inert gas (MIG) welding or metal active gas (MAG) welding, is a welding process in which an electric arc forms between a consumable wire electrode and the workpiece metal(s), which heats the workpiece metal(s), causing them to melt and join.

A shielding gas is also sent through the welding gun and protects the weld pool from contamination. In fact, MIG stands for metal inert gas. The technical name for it is gas metal arc welding or GMAW , and the slang name for it is wire welding. Safety first Before tackling any welding project, you need to make sure you have the proper safety apparel and that any potential fire hazards are removed from the welding area. Basic welding safety apparel includes leather shoes or boots, cuff-less full-length pants, a flame-resistant and long-sleeve jacket, leather gloves, a welding helmet, safety glasses and a bandana or skull cap to protect the top of your head from sparks and spatter. Metal preparation Unlike stick and flux-cored electrodes, which have higher amounts of special additives, the solid MIG wire does not combat rust, dirt, oil or other contaminants very well. Use a metal brush or grinder and clean down to bare metal before striking an arc. Make sure your work clamp connects to clean metal, too. Any electrical impedance will affect wire feeding performance. To ensure strong welds on thicker metal, bevel the joint to ensure the weld fully penetrates to the base metal. This is especially important for butt joints. Both a grinder or a wire brush work well to remove rust and other surface contaminants from the metal prior to welding. Equipment preparation Check your cables. Before striking an arc, check your welding equipment to make sure all of the cable connections are tight fitting and free of fraying or other damage. MIG welding requires DC electrode positive, or reverse polarity. The polarity connections are usually found on the inside of the machine. Turn on the shielding gas and set the flow rate to 20 to 25 cubic feet per hour. If you suspect leaks in your gas hose, apply a soapy water solution and look for bubbles. If you spot a leak, discard the hose and install a new one. Too much or too little tension on either the drive rolls or the wire spool hub can lead to poor wire feeding performance. Remove excess spatter from contact tubes, replace worn contact tips and liners and discard the wire if it appears rusty. A thorough check of your power source, gun and gas cylinders is recommended prior to taking on any MIG welding project. Wire selection For steel, there are two common wire types. Use ER70S-6 wire when more deoxidizers are needed for welding on dirty or rusty steel. As for wire diameter,. For welding thinner material, use a. For welding thicker material at higher total heat levels, use. All you need to do is set it to the correct material thickness and wire diameter. Voltage and amperage How much voltage and amperage a weld requires depends on numerous variables, including metal thicknesses, type of metal, joint configuration, welding position, shielding gas and wire diameter speed among others. Miller provides two tools to simplify setting proper voltage and amperage: Auto-Set then selects the proper voltage, amperage and wire feed speed for you Using either method will get you in the ballpark. From there, you can then fine-tune the welding arc to your personal preferences. Wire stick-out Stick-out is the length of unmelted electrode extending from the tip of the contact tube and it does not include arc length. If the arc sounds irregular, one culprit could be that your stickout is too long, which is an extremely common error. Try to maintain this stickout length while welding. The push or forehand technique involves pushing the gun away from ahead of the weld puddle. Pushing usually produces lower penetration and a wider, flatter bead because the arc force is directed away from the weld puddle. With the drag or backhand technique also called the pull or trailing technique , the welding gun is pointed back at the weld puddle and dragged away from the deposited metal. Dragging typically produces deeper penetration and a narrower bead with more buildup. When MIG welding mild steel, you can use either the push or pull technique, but note that pushing usually offers a better view and enables you to better direct wire into the joint. Travel angle Travel angle is defined as the angle relative to the gun in a perpendicular position. Normal welding conditions in all positions call for a travel angle of 5 to 15 degrees. Travel angles beyond 20 to 25 degrees can lead to more spatter, less penetration and general arc instability. Work angle Work angle is the gun position relative to the angle of the welding joint, and it varies with each welding position and joint configuration see below. Hold the MIG gun at a degree angle to each piece of metal when welding a butt joint to direct the heat and filler metal equally to each piece of material. A small, back-and-forth motion with the gun can help fill a large gap or when making multiple passes. A slight pausing at the side of a weave bead can help avoid undercut. Keep the gun at a degree angle, or equal distance from each piece. When making multiple weld passes, the work angles change slightly. This helps avoid uneven weld beads and undercuts. Angle the gun between 60 and 70 degrees. The thicker the metal being welded, the greater the angle. A 60 to 70 degree angle is usually best. A fillet weld, shown here, is one of the most common types of welds. In the flat position, keep the gun angled at 45 degrees from each piece. Horizontal position Because of the effects of gravity, the gun work angle must be dropped slightly by 0 to 15 degrees. Without changing the work angle, the filler metal may sag or rollover on the bottom side of the weld joint. The travel angle, whether using a push or a drag technique, generally remains the same as for a weld joint in the flat position. When making multi-pass welds on thick metal, or to bridge a slight gap where fit-up is poor, weave beads may be used to fill a weld joint. A slight hesitation at the top toe of the weld helps prevent undercut and ensure proper tie-in of the weld to the base metal. Voltage and amperage settings for welding in the horizontal position are usually the same or slightly less than settings for welding in the flat position. A horizontal weld is trickier than a flat position weld and requires you to angle the gun slightly upward toward the top piece of material. Vertical positions Vertical welding, both up and down, can be difficult. This makes pre-weld set-up very important for making high quality welds. Since you are fighting gravity, consider reducing the voltage and amperage 10 to 15 percent from the settings for the same weld in the flat position. The vertical down technique helps when welding thin metals because the arc penetrates less due to the faster travel speed. Because vertical down welding helps avoid excessive melt-through, welders sometime place very thin materials in the vertical position even if they can weld them in the flat position. When welding vertical down, begin at the top of a joint and weld down. For thin metal where burn-through is a concern, direct the wire away from the weld puddle. Keep the electrode wire on the leading edge of the weld puddle. A very slight weave may help flatten the weld crown. The vertical up technique is beginning at the bottom of a joint and welding up. The travel angle of the gun is a 5 to 15 degree drop from the perpendicular position. A slight weaving motion can help control the size, shape and cooling effects of the weld puddle. Whether you weld vertical up or down will depend on the application and the thickness of the material you are welding. Overhead position Drag, push or perpendicular gun techniques can be used for welding overhead. But because of gravity, travel speeds must be fast enough so that the weld metal does not fall out of the joint. Also for this reason, weave beads should not be too wide. Lowering the voltage and amperage help keep the weld puddle small and more controllable which is why you might want to consider using a smaller diameter wire. Gravity is the enemy when making an overhead weld. Be careful not to stand directly under the weld bead to avoid molten metal that can fall from the joint. Note that travel speed â€” the rate at which you move the gun along the joint â€” influences the shape and quality of a weld bead to a significant degree. Many experienced MIG welders determine the correct travel speed by judging the weld puddle size in relation to the joint thickness. Knowing that a weld bead needs to be no larger than the thinnest section of metal being welded, they adjust their travel speed accordingly. Most people can create good looking, high quality MIG welds with a combination of practice and following the techniques discussed.

Chapter 5 : How to Weld Aluminum To Steel | ESAB Knowledge Center

MIG welding is a common welding process for beginners. Learn the basics for MIG welding mild steel with your MillermaticÂ® MIG welder. MIG welding is an arc welding process in which a continuous solid wire electrode is fed through a welding gun and into the weld pool, joining the two base materials.

Jonathan Will When choosing a process and filler metal for welding stainless steel, fabricators need to consider the upfront cost and characteristics of the filler metal, required productivity, equipment complexity, and operator skill set. While there is no such thing as the perfect welding process for stainless steel, keeping some key considerations in mind when selecting the process and filler metal can help ensure success and cost savings. Stainless steel continues to gain popularity in applications across the fabrication industry, mainly thanks to its corrosion resistance, strength, and toughness. Compared to mild steel, however, the material poses some welding challenges, especially for less experienced welders. Stainless steel can be three to five times more expensive than mild steel; any welding mistake can compound the overall costs for rework. Choosing the right welding process is key. There is a give-and-take with every option, and no single process provides a perfect solution. To determine the best option, fabricators need to consider the upfront cost and characteristics of the filler metal, required productivity, equipment complexity, and operator skill set. Benefits and Challenges Stainless steel resists corrosion and maintains strength at extremely hot and cold service temperatures, hence its popularity in the piping and petrochemical industries. Stainless also has a low susceptibility to bacterial growth on its surface, making it well-suited for food-preparation and medical equipment. Its many benefits are now lending themselves to the wave of craft breweries cropping up across the U. Common stainless steels come in chromium-nickel austenitic, or series or straight chromium martensitic and ferritic, or series grades. Compared to chromium-nickel stainless, straight chromium stainless grades and carbon steel have similarly low coefficients of linear expansion, which determines how materials expand and contract under temperature and pressure. Straight chromium grades also have a lower melting point than carbon steel but a higher melting point than chromium-nickel stainless. Still, compared to carbon steel, both straight chromium and chromium-nickel grades share high electrical resistance and low thermal conductivity. As some fabricators seek to expand their capabilities, taking on stainless steel welding projects can help increase their competitiveness. Considering two key factors can help fabricators achieve the best results. First, the alloy content of stainless steel makes it a greater heat insulator than carbon steel. This can lead to warping, burn-though, and oxidation. Choosing the proper welding process and filler metal can help control the heat input. Second, stainless steel is prone to discoloration. Known as sugaring, such discoloration indicates that some of the chrome has been pulled out of the material, making it more susceptible to corrosion. In stainless steel pipe welding, sugaring is not allowed for aesthetic or quality reasons, and in any application it can lead to costly rework. Again, stainless steel and the filler metals used to weld it generally are more expensive than carbon steel. In addition to welder skill and equipment availability, the application prioritiesâ€”cost, productivity, and bead appearance, for exampleâ€”influence which stainless steel welding process fabricators ultimately choose. But SMAW, or stick welding, is less productive than other processes and can produce a lot of spatter, which increases time and cost for cleanup. For fabricators who have not welded stainless steel before, SMAW is a good entry point. Compared to carbon steel, stainless steelâ€”both straight chromium martensitic and ferritic and the nickel-chromium austenitic varietyâ€”have more electrical resistance and less thermal conductivity. The cost per pound for these electrodes is mid-rangeâ€—less than flux-cored or metal-cored arc welding wires and slightly more than solid wires. Fabricators can purchase SMAW electrodes in small quantities, such as 6- or 8-pound packages, which is helpful for small jobs and can keep costs down. A or SMAW electrode is a good choice for stick welding stainless steel, especially for maintenance or repair applications. Gas Metal Arc and Flux-cored Arc Welding When productivity is a priority for stainless steel welding, wire feed processes offer efficiency and good bead appearance.

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Advancements in equipment and filler metal have made these processes easier to use, even for those newer to welding stainless steel. Many fabricators perform gas metal arc welding GMAW of stainless steel with a solid wire. GMAW has moderate equipment complexity and operator skill requirements, and for stainless steel welding, it can be used in pulse or spray transfer mode. The cost per pound for solid wire is less than other choices, but the shielding gas is an added expense. A fabricator new to welding stainless steel would probably not need to invest in a different type of gas or delivery system. Metal-cored arc welding, either with pulsed or standard spray methods, provides fast travel speeds that input less heat into the weld. This helps prevent warping and distortion when welding stainless steel. Although metal-cored welding produces less spatter than other forms of wire welding, the price per pound for the stainless steel filler metal is the highest. When deciding on this filler metal and process, fabricators should weigh the upfront cost versus the productivity gains and the potential reduction in rework and cleanup. Submerged Arc Welding Many fabricators have submerged arc welding SAW systems in place for welding carbon steel, but SAW also offers significant benefits for stainless steel, including greater productivity and extremely low spatter levels, which help save time and money on cleanup. SAW is well-suited for thick materials and large applications such as storage or liquid natural gas tanks. When using SAW on stainless steel, fabricators employ a neutral or nonalloying flux, which does not add alloys that could alter the chemistry of the completed weld. Stainless steel continues to gain popularity in applications across the fabrication industry, thanks mainly to its corrosion resistance, strength, and toughness. If welders are using filler rod or wire, GTAW has a moderate cost per pound, but it also requires high skill and typically the most complex equipment. While aesthetics and bead appearance with GTAW are very high, the productivity is the lowest compared to other choices. GTAW on stainless steel typically uses percent argon shielding gas, often with a secondary tank of argon on hand for a backpurge between passes. Most operations that use GTAW for stainless steel do so for aesthetic reasons, simply because the process produces such a clean, precise weld. Selecting the Right Process As the use of stainless steel continues to grow, more companies will have to become familiar with welding the material. Cost may be the key consideration for some operations, while reducing downtime and improving productivity may be the keys for others. Each process and filler metal choice comes with trade-offs. You May Also Like.

Chapter 6 : Charts & Technical Data

GAS TUNGSTEN ARC WELDING (GTAW-TIG) Course Description. The Gas Tungsten Arc Welding course is designed to teach students about arc welding safety and the Gas Tungsten Arc Welding process (GTAW-TIG) and proper techniques for welding.

The process is quite simple â€” the electric arc is initiated between the base metal and tungsten electrode non-consumable and suitable filler wire or rod is introduced in the weld pool. The electric DC amperage is provided to the welding process to initiate the arc and the shielding gas, either argon or helium gas, protects the molten metal from getting contaminated. Precise weld TIG welding produces perfect, precise welds and with suitable selection of proper welding rods or wires, it can be easily applied for exotic metals. Infact, whenever high quality and precise welding joints are demanded in the shop floor, welders usually go for TIG welding. Ability to weld various metals With the help of TIG welding, it is possible to weld most of the common metals or alloys such as mild steel, stainless steel, Titanium, Aluminium and copper. And only the shielding gas, current requirement, and filler wire changes for every base metal that needs to be welded. As Argon performs well at high arc voltages, it easily starts the arc and hence commonly employed for mild steel, aluminium, and titanium. On the other hand, helium as shielding gas is employed when higher heat input is required. Again this is very well used to increase the weld speed or penetration. Helium is commonly used as shielding gas in TIG to weld copper, stainless steel, mild steel, and titanium. Where very hot arc is required, for instance, aluminium and its alloys, a combination of helium and argon are employed. In short, TIG can be extensively used for welding in most of the common alloys and metals, says Venus wires, one of the reputed TIG wire suppliers, India. Less amperage TIG welding uses less amperage when compared with other process. At the outset, it may seem to be a huge disadvantage, but in reality it assists a TIG welder to great extent. Higher amperage is good for thick bars or sections, but it produces undesirable results for thin pieces of job. As TIG welding uses less amperage, the welder easily accomplishes the task. In fact, less amperage TIG welding is a boon for certain alloys and metals, where high current arc is not recommended. Clean welds Many of the weld processes leave a slag coating on the weld surface and welder needs to poke those deposits to clear them. TIG, being a clean welding process, does not leave any sort of deposition over the weld bead. High control With the foot mechanism and low amperage, a skilled welder can easily control the weld process. Moreover, the welding mechanism is held like a pen, superior control over the welding process is obtained. As a word of caution, it requires immense practice to achieve good control over the welding process. Intricate works TIG is the preferred choice in most of the intricate works, where shape of each and every weld joint counts. For instance, demand of good weld control is evident in jewelery, dentistry, and high precision mechanical component fabrications and it is met by TIG. Infact TIG is finding far flung versatile applications, which were being served only by micro-plasma welding. In a nutshell, TIG is a very good welding process, where precision, good, and clean weld is of concern rather than speed of weld. Venus wires, one of the high quality TIG wire manufacturers in India , has been producing several grades of welding consumables suitable for most of the applications.

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Chapter 7 : Miller TIG Welders - TIG Welding and GTAW Welding Machines | MillerWelds

Creative Engineer have earned a name as reputed and trusted Authorised distributor catering to special and specific needs of the welding industry.

September 02, 2 comments Working with metal can be intimidating but at the same time it can also be empowering. Welding is the process of fusing materials such as metals or thermoplastics in order to seamlessly join them. The welding process involves applying heat and pressure to the materials being combined, in addition to a filter material. With the advent of technology, the process of welding has evolved over the years. Today many processes can be done by automated equipment, however some projects require professional help in order to manually customize the product. You can learn about the different types of welding processes for your understanding: The concept of combining two pieces of metal together with a wire that is connected to an electrode current, is referred to as Metal Inert Gas MIG welding. In this type of welding process, a shielded gas is used along the wire electrode, which heats up the two metals to be joined. A constant voltage and direct current power source is required for this method, and this is the most common industrial welding process. This is the most basic of all welding types. The welding stick uses electric current to form an electric arc between the stick and the metals to be joined. To weld iron and steel, this type of welding is often used in the construction of steel structures and in industrial fabrication. Stick welding can be used for manufacturing, construction and repair work. A non-consumable tungsten electrode is used in this type of welding process. This tungsten electrode is made use of to heat the base metal and create a molten weld puddle. By melting two pieces of metal together, an autogenous weld can be created. This welding process is employed to carry out high-quality work when a superior standard finish is required, without making use of excessive clean up by sanding or grinding. As an alternative to shield welding, Flux-cored Arc Welding was developed. This welding process is quite similar to MIG or GMAW process, except for the fact that in FCAW a special tubular wire filled with flux is used and shielding gas is not always needed, depending on the filler. This type of welding is well-known for being extremely inexpensive and easy to learn. However, there are several limitations in its applications and the results are not often aesthetically pleasing as some of the other welding methods. The semi-automatic arc is often used in construction projects, thanks to its high welding speed and portability. Professional steel fabricators at Northern Weldarc are well-trained to construct structural steel for various projects across industries. Structural steel can be transformed for various purposes and it can be utilized for a number of applications too. We at Northern Weldarc make use of high-tech equipment to produce steel and fabricate it for different utilities.

Chapter 8 : Arc Welding Equipment and Arc Welding Supplies from calendrierdelascience.com

6 calendrierdelascience.com GMAW The history of GMAW, gas metal arc welding, had its industrial introduction in the late 's. The site was the Battelle Memorial Institute, and it was there that Hobart and Devers.

Development[edit] The principles of gas metal arc welding began to be understood in the early 19th century, after Humphry Davy discovered the short pulsed electric arcs in At first, carbon electrodes were used in carbon arc welding. By , metal electrodes had been invented by Nikolay Slavyanov and C. Nobel of General Electric. It used direct current with a bare electrode wire and used arc voltage to regulate the feed rate. It did not use a shielding gas to protect the weld, as developments in welding atmospheres did not take place until later that decade. In another forerunner of GMAW was released, but it was not suitable for practical use. It used a smaller diameter electrode and a constant voltage power source developed by H. It offered a high deposition rate, but the high cost of inert gases limited its use to non-ferrous materials and prevented cost savings. In , the use of carbon dioxide as a welding atmosphere was developed, and it quickly gained popularity in GMAW, since it made welding steel more economical. In and , the short-arc variation of GMAW was released, which increased welding versatility and made the welding of thin materials possible while relying on smaller electrode wires and more advanced power supplies. It quickly became the most popular GMAW variation. The spray-arc transfer variation was developed in the early s, when experimenters added small amounts of oxygen to inert gases. More recently, pulsed current has been applied, giving rise to a new method called the pulsed spray-arc variation. There, the method is often used for arc spot welding , replacing riveting or resistance spot welding. It is also popular for automated welding , where robots handle the workpieces and the welding gun to accelerate manufacturing. The control switch, or trigger, when pressed by the operator, initiates the wire feed, electric power, and the shielding gas flow, causing an electric arc to be struck. The contact tip, normally made of copper and sometimes chemically treated to reduce spatter, is connected to the welding power source through the power cable and transmits the electrical energy to the electrode while directing it to the weld area. It must be firmly secured and properly sized, since it must allow the electrode to pass while maintaining electrical contact. On the way to the contact tip, the wire is protected and guided by the electrode conduit and liner, which help prevent buckling and maintain an uninterrupted wire feed. The gas nozzle directs the shielding gas evenly into the welding zone. Inconsistent flow may not adequately protect the weld area. Larger nozzles provide greater shielding gas flow, which is useful for high current welding operations that develop a larger molten weld pool. A gas hose from the tanks of shielding gas supplies the gas to the nozzle. Sometimes, a water hose is also built into the welding gun, cooling the gun in high heat operations. Most models provide the wire at a constant feed rate, but more advanced machines can vary the feed rate in response to the arc length and voltage. Some wire feeders can reach feed rates as high as Compressed air circulates through it to maintain moderate temperatures. It is used with lower current levels for welding lap or butt joints. The second most common type of electrode holder is semiautomatic water-cooled, where the only difference is that water takes the place of air. It uses higher current levels for welding T or corner joints. The third typical holder type is a water cooled automatic electrode holderâ€"which is typically used with automated equipment. As a result, any change in arc length which is directly related to voltage results in a large change in heat input and current. A shorter arc length causes a much greater heat input, which makes the wire electrode melt more quickly and thereby restore the original arc length. This helps operators keep the arc length consistent even when manually welding with hand-held welding guns. To achieve a similar effect, sometimes a constant current power source is used in combination with an arc voltage-controlled wire feed unit. In this case, a change in arc length makes the wire feed rate adjust to maintain a relatively constant arc length. In rare circumstances, a constant current power source and a constant wire feed rate unit might be coupled, especially for the welding of metals with high thermal conductivities, such as aluminum. This grants the operator additional control over the heat input into the weld, but requires significant skill to perform successfully. Since the anode tends to have a greater heat concentration, this results in faster melting of the feed wire, which increases weld penetration and welding speed. The polarity can be reversed only when special emissive-coated electrode wires are used, but since these are not popular, a negatively charged electrode is rarely employed. Electrode selection greatly influences the mechanical properties of the weld and is a key factor of weld quality. In general the finished weld metal should have mechanical properties similar to those of the base material with no defects such as discontinuities, entrained contaminants or porosity within the weld. To achieve these goals a wide variety of electrodes exist. All commercially available electrodes contain deoxidizing metals such as silicon , manganese , titanium and aluminum in small percentages to help prevent oxygen porosity. Some contain denitriding metals such as titanium and zirconium to avoid nitrogen porosity. The smallest electrodes, generally up to 1. Shielding gases are necessary for gas metal arc welding to protect the welding area from atmospheric gases such as nitrogen and oxygen , which can cause fusion defects, porosity, and weld metal embrittlement if they come in contact with the electrode, the arc, or the welding metal. This problem is common to all arc welding processes; for example, in the older Shielded-Metal Arc Welding process SMAW , the electrode is coated with a solid flux which evolves a protective cloud of carbon dioxide when melted by the arc. In GMAW, however, the electrode wire does not have a flux coating, and a separate shielding gas is employed to protect the weld. This eliminates slag, the hard residue from the flux that builds up after welding and must be chipped off to reveal the completed weld. Pure inert gases such as argon and helium are only used for nonferrous welding; with steel they do not provide adequate weld penetration argon or cause an erratic arc and encourage spatter with helium. Pure carbon dioxide , on the other hand, allows for deep penetration welds but encourages oxide formation, which adversely affects the mechanical properties of the weld. Generally, in short circuit GMAW, higher carbon dioxide content increases the weld heat and energy when all other weld parameters volts, current, electrode type and diameter are held the same. Excessive oxygen, especially when used in application for which it is not prescribed, can lead to brittleness in the heat affected zone. Argon-helium mixtures are extremely inert, and can be used on nonferrous materials. However, it should not be used on steel, aluminum or magnesium because it can cause porosity and hydrogen embrittlement. Mixtures of argon, carbon dioxide and oxygen are marketed for welding steels. Other mixtures add a small amount of helium to argon-oxygen combinations, these mixtures are claimed to allow higher arc voltages and welding speed. Helium also sometimes serves as the base gas, with small amounts of argon and carbon dioxide added. However, because it is less dense than air, helium is less effective at shielding the weld than argonâ€"which is denser than air. It also can lead to arc stability and penetration issues, and increased spatter, due to its much more energetic arc plasma. Helium is also substantially more expensive than other shielding gases. Other specialized and often proprietary gas mixtures claim even greater benefits for specific applications. Welding flat surfaces requires higher flow than welding grooved materials, since gas disperses more quickly. Faster welding speeds, in general, mean that more gas must be supplied to provide adequate coverage. Additionally, higher current requires greater flow, and generally, more helium is required to provide adequate coverage than if argon is used. The spray transfer variation normally requires more shielding-gas flow because of its higher heat input and thus larger weld pool. For most of its applications gas metal arc welding is a fairly simple welding process to learn requiring no more than a week or two to master basic welding technique. Even when welding is performed by well-trained operators weld quality can fluctuate since it depends on a number of external factors. All GMAW is dangerous, though perhaps less so than some other welding methods, such as shielded metal arc welding. As much of the process is automated, GMAW relieves the weldor operator of the burden of maintaining a precise arc length, as well as feeding filler metal into the weld puddle, coordinated operations that are required in other manual welding processes, such as shielded metal arc. Additional skill includes knowing how to adjust the welder so the voltage, wire feed rate and gas flow rate are correct for the materials being welded and the wire size being employed. Maintaining a relatively constant contact tip-to-work distance the stick-out distance is important. Excessive stick-out distance may cause the wire electrode to prematurely melt, causing a sputtering arc, and may also cause the shielding gas to rapidly disperse, degrading the quality of the weld. Stick-out distance varies for different GMAW weld processes and applications. It should be held so as to bisect the angle between the workpieces; that is, at 45 degrees for a fillet weld and 90 degrees for welding a flat surface. The travel angle, or lead angle, is the angle of the gun with respect to the direction of travel, and it should generally remain approximately vertical. In position welding, gravity tends to cause molten metal to run out of the puddle, resulting in cratering and undercutting, two conditions that produce a weak weld. Weaving constantly moves the fusion zone around so as to limit the amount of metal deposited at any one point. Surface tension then assists in keeping the molten metal in the puddle until it is able to solidify. Development of position welding skill takes some experience, but is usually soon mastered. If not controlled, they can lead to weaker, less ductile welds. Dross is an especially common problem in aluminium GMAW welds, normally coming from particles of aluminium oxide or aluminum nitride present in the electrode or base materials. Electrodes and workpieces must be brushed with a wire brush or chemically treated to remove oxides on the surface. Any oxygen in contact with the weld pool, whether from the atmosphere or the shielding gas, causes dross as well. As a result, sufficient flow of inert shielding gases is necessary, and welding in moving air should be avoided. The gas can come from impurities in the shielding gas or on the workpiece, as well as from an excessively long or violent arc. Generally, the amount of gas entrapped is directly related to the cooling rate of the weld pool. Because of its higher thermal conductivity , aluminum welds are especially susceptible to greater cooling rates and thus additional porosity. To reduce it, the workpiece and electrode should be clean, the welding speed diminished and the current set high enough to provide sufficient heat input and stable metal transfer but low enough that the arc remains steady. Preheating can also help reduce the cooling rate in some cases by reducing the temperature gradient between the weld area and the base metal. Since GMAW employs an electric arc, weldors must wear suitable protective clothing, including heavy gloves and protective long sleeve jackets, to minimize exposure to the arc itself, as well as intense heat, sparks and hot metal. Conventional welding helmets contain dark face plates to prevent this exposure. Newer helmet designs feature a liquid crystal -type face plate that self-darkens upon exposure to the arc. Transparent welding curtains, made of a polyvinyl chloride plastic film, are often used to shield nearby workers and bystanders from exposure to the arc. GMAW produces smoke containing particles of various types of oxides , and the size of the particles tends to influence the toxicity of the fumes. Smaller particles present greater danger. Concentrations of carbon dioxide and ozone can prove dangerous if ventilation is inadequate.

Chapter 9 : Welding Wire, Flux and Rods | Lincoln Electric

This document presents recommended practices for welding mild steel pipe. It is intended to cover piping systems such as for low pressure heating, air conditioning, refrigeration, water supplies, as well as some gas or chemical systems.