WELDWELL

Quarterly newsletter of Weldwell Speciality Pvt. Ltd.

SERVICE TO THE WELDING COMMUNITY

Vol. 19 No. 4 Oct. - Dec., 2012

Weldwell Speciality stall at Engineering Expo 2012 exhibition at Ahmedabad on 5th October, 2012

HIGHLIGHTS

- Understanding 5 critical plasma torch consumable components
- GMAW Quiz
- How to perform tack welding successfully
- Future of Stainless Steel

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INSIDE

SPECTRUM

A Tribute to Satya Bhushan Girotra

It is with profound grief that we announce the sad and untimely demise of Mr. Satya Bhushan Girotra, a Senior Member of the Management Team of Weldwell Speciality Pvt. Ltd. and Nivek Agencies, and younger brother of Mr. C.C.Girotra.

He suffered a severe brain hemorrhage on Tuesday, the 18th September while in the office and succumbed to the injury on Sunday, the 23rd September, 2012.

We, members of Weldwell and Nivek family, pay tribute to our dear colleague and friend, fondly known as SCG. "We should manage people and get work done" was his belief and approach. Always kind and compassionate, he executed all work with relentless passion and commitment.

Some of the projects handled by him for equipment business will always carry his signature. Inimitable SCG brings to mind the affability and ease with which he mingled and interacted with all to create a well knit Weldwell family. He was politically and socially very active and contributed to society at large.

He was an exemplary human being and shall always remain alive in our hearts. Our heart refuses to believe and acknowledge the absence created by his sad demise.

SCG will always be remembered for his good thoughts and deeds that will continue to inspire us. We pray to the Almighty to grant his family the strength and fortitude to bear this irreparable loss and may his soul rest in peace !

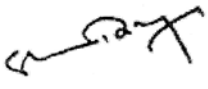
Editorial

Dear Reader,

It is with a heavy heart that we have to announce the passing away of our dear colleague, Mr. Satya Bhushan Girotra on 23rd September, 2012. We have lost a very dynamic member of our team and his spirit exhorts us to continue our work with dedication, sincerity and commitment. Life is uncertain but the show must go on.The recent announcements by our Prime Minister Dr. Manmohan Singh have given some hope of revival of economy and consequently the sagging welding business. The power sector is getting a face lift. This is a good news for us in the welding fraternity. Emphasis on investment in infrastructure is what we all are looking for. We hope the benefits of such decisions quickly trickle to welding activity.

It is said that there is no welding without cutting. This statement only emphasizes the importance of cutting in the welding industry. Plasma cutting has over the years established itself as one of the most efficient process of cutting. It is also known that the plasma torch consumables play an integral role in achieving a successful cut. What may not be widely known, however, is the relationship amongst the consumable components, and that even one faulty component can cause the others to suffer. The lead article describes interdependence of the major five plasma torch consumables and how they affect the economics of cutting. Time rusts our knowledge if not sharpened regularly. In the education section we have attempted to let you assess your knowledge of MIG wilding and grade yourself. We all know that often small issues lead to major problems. It is therefore, essential we pay due importance to issues like tack welding. The technical section covers possible areas of potential defect due to faulty tack welding. This edition covers the other sections like the earlier editions.

This edition is also available in soft copy as well. In case you are interested to get the soft copy we will be happy to forward the soft copy to you. Please let us know your preference.



Dr. S.Bhattacharya

Editor

Event

Central Council Meeting of IIW-India

Meeting of the Central Council of The Indian Institute of Welding was held on 29th September, 2012 at Kolkata. The institute elected a new President and four Vice-presidents representing four regions. The following are the new office bearers:

President - Mr. Pabitra Kumar Das

Vice Presidents -

North: Mr. Debashis Thakur

East: Mr. K. K. Kashyap

West: Mr. R. Srinivasan

South: Dr. Hasan Shaikh

Hony. Secretary General - Mr. Parimal Biswas

Collaboration with Australia

Members of IIW-India will be glad to learn that from now on copies of the WTIA - Australia journal and CWA journal will be uploaded onto the IIW-India website and IWJ onto WTIA and CWA website in the members restricted area on a regular basis.

From now on copies of the WTIA journal will be uploaded onto the IIW-India website and IWJ onto WTIA website in the members restricted area on a regular basis. Members of IIW-India can now Log into the Members area with their password to view the e-copy of WTIA journal Dec-2011 issue.

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Successful plasma cutting counts on consumables – Understanding 5 critical plasma torch consumable components*

The Product Marketing Manager of torch consumables at Hypertherm, discusses the five hand-held plasma consumable components. How they work with one another to achieve a successful cut and what operators should look for when evaluating whether consumables require replacing.

INTRODUCTION

It is no secret that plasma torch consumables play an integral role in achieving a successful cut. What may not be widely known, however, is the relationship amongst the consumable components, and that even one faulty component can cause the others to suffer. This article discusses the role of the torch consumables in a hand-held plasma cutting setup, outlines what signs to look for when a component is failing, and gives advice on how to maintain your torch properly to ensure consumables work the way they should. Always try and change out the electrode and nozzle at the same time. Switching them out individually compromises cut quality.

THE FIVE MAIN COMPONENTS

What are the main consumable components in a plasma torch, and how does each contribute to a successful cut? For most manual plasma cutting systems there are main five different components which comprise the torch consumables:

i. shield,
ii. retaining cap,
iii. nozzle,
iv. electrode, and
v. swirl ring.

i. The shield

It protects the rest of the consumables. With the plasma cutting process you tend to get an awful lot of sparks and molten metal. The shield's purpose is to prevent that from reaching the inner consumables. In some cases, the shield is a drag shield, which means it allows the operator to put the torch right on the metal without the need of an additional standoff. That is nice, especially for inexperienced cutters.

ii. Retaining cap

The retaining cap's duty is basically to cover and hold the consumable stackup together.

iii. Nozzle

The nozzle has two functions. First, it focuses the plasma arc. The larger the orifice, the less defined or wider the arc is. Nozzles with a wide orifice are used in gouging applications, while some have very small orifices that constrict and focus the arc. These are used for fine-feature, detailed cutting. Second, the nozzle helps to funnel gas flow, which also helps to shape and constrict the arc.

iv. Electrode

The electrode carries the current from the torch to the plate. It is a slender piece made of copper or silver and contains hafnium or tungsten. These materials have been found to be excellent conductors of electricity. The electricity comes from the machine out to the torch and goes into a cathode block, which the electrode is in contact with, and then focuses that charge on the end of the electrode through the hafnium / tungsten insert which then arcs to the plate. The nozzle takes that arc and really focuses it in a way that cuts metal, but the electrode carries the current.

The nozzle tends to get very hot because it is right in

** By Amanda Carlson, fabricator.com, Journal of Fabricators & Manufacturers Association Intl. published on July 9, 2010*

the midst of the superheated gas. So the back of the electrode has a cooling device attached that helps transfer the heat out of the electrode.

v. Swirl ring

The swirl ring channels the gas in a couple of different directions as it comes from the machine and down the torch. First, the gas goes forward in a spiral manner around the electrode, around the arc, down through the nozzle, and out through the torch. The reason the ring needs to swirl the gas is that it allows the gas, as it is going out through the nozzle, to be at different temperatures. The cooler gas travels along the outside - this gas is in contact with the nozzle and prevents it from burning up. If you do not have the swirl in there, gas mixing is inadequate and you could burn up your nozzle. The other purpose of the swirl ring is to channel the gas backward and pull the heat off the electrode.

VISUAL SIGNS OF WORN DOWN OR IMPROPER FUNCTIONING

What are the visual signs that one of the five consumables is worn down or functioning improperly?

You will see a number of things. With use, the nozzle orifice gets larger and out-of-round. Even though it is cooled by the gas swirling down through it, it is still very hot. Eventually the orifice widens and you lose that constricted arc. The kerf, which is the width of metal that you remove during the cut, gets wider and wider. In addition, your cut speed gets slower because you do not have that concentrated arc. As a result, you do not have as much heat concentrated it one place; it sort of fans out. A lot of this is caused by a worn nozzle. If you look at the end of the nozzle and see that the orifice is exceptionally big or oval-shaped, then you know it is time to change the nozzle.

Regular use of the electrode melts the hafnium / tungsten and it's pieces start to blow out through the nozzle as one cut further. It develops a pit at the front of the electrode. Once that pit depth is over 1⁄32", it is time to change the consumable. If you do not change the electrode and instead run it to failure mode, which means it really would not cut anymore, you are actually burning through the copper now because the hafnium / tungsten is gone. The arc looks like an ugly, green glow, if you can even cut at all. The whole top of the electrode will be burned off. You never want to get to that point because it introduces a tremendous amount of heat into that torch, which can cause a lot of damage.

It is always recommend that one change the electrode and nozzle together. That way when you throw in a new set of consumables, you have the perfect orifice and the perfect pit depth every time. If you tend to just swap them out individually, you can compromise cut quality. You can put in a new electrode, but if your nozzle orifice is wider than it should be, you have given up some of the performance.

Nothing really deteriorates in the swirl ring, although it can crack as a result of being dropped or from the heating and cooling over time. Once it is cracked, it cannot channel the gas the way it should, so it is time to change it. For every five to 10 sets of electrodes / nozzles, one should change the swirl ring.

With the retaining cap, look for cracks that would come from drops. Slag built up on the end of the shield can constrict the airflow coming off the shield. Make sure you avoid excessive buildup there.

REGULAR MAINTENANCE PRACTICES

It is very important to replace consumables routinely, especially when you see that pit depth increase, the orifice widen, or slag build up on the shield. Besides replacing the consumables, you need to perform regular maintenance of the torch, such as replacing the torch leads when necessary. You should change the torch as needed as well. There is no set time in which to do that, but when you start to see things like cracks in the torch's body shell, or a cut into the torch lead's jacket that exposes wires, you need to address them immediately.

There is not a tremendous amount on a hand-held system to replace, but we do encounter damage

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GMAW Quiz*

In recent times the popularity of application of GMAW process is increasing in India. As a welding technologist it is often necessary to refresh our knowledge and associated information. We have presented here some of the fundamentals of GMAW process in quiz format. Let us assess how much are you conversant with the process and grade yourselves.

1. In the GMAW process, what is the primary source of deoxidizers and alloying elements that contribute to the purity and mechanical properties of the weld metal?

A. The wire
B. The shielding gas
C. The mode of transfer
D. The weld parameters

2. What is the purpose of copper coating on GMAW wires?

A. To prevent rust
B. To increase contact tip life
C. To assure good electrical conductivity
D. All the above

3. What elements are most commonly added to GMAW wires as deoxidizers?

A. Molybdenum and Copper
B. Nickel and Molybdenum
C. Manganese and Silicon
D. Silicon and Chromium

4. Rust is a source of:

A. Silicon
B. Oxygen
C. Manganese
D. Nickel

5. In GMAW, using 100% CO_2 shielding gas produces:

A. less spatter and concave welds
B. more spatter and convex welds
C. more spatter and flatter welds

6. What type of power supply is commonly used for general GMAW welding?

A. Constant Current
B. Constant Voltage
C. Pulse
D. Syncrowave

7. As the percentage of CO_2 in the shielding gas increases, the amount of alloy recovered in the weld metal:

A. increases
B. decreases
C. stays the same

8. What does the “D” indicate on a wire classified as an ER 80S-D2?

A. Downhand use only
B. 0.5% Molybdenum
C. No preheating required
D. 1% Molybdenum

9. What limitation exists for use of GMAW-Spray transfer?

A. Position of welding
B. Polarity
C. Mechanical Properties
D. Higher Diffusable Hydrogen

10. Cold Lap can occur with:

A. Short circuit transfer
B. Globular transfer
C. Spray transfer
D. All of the above

**ESAB News Letter, March 2009*

11. For Globular transfer in GMAW, what shielding gas is used?

A. 75% Argon, 25% CO_2
B. 100% CO_2
C. 92% Argon, 8% CO_2
D. 85% Argon, 15% CO_2

12. What is the major reason for using a Modified Spray?

A. Increased travel speed
B. Higher Deposition efficiency
C. Uses less shielding gas
D. Better mechanical properties

13. Generally, what is the minimum Argon percentage required to achieve a “true” spray transfer?

A. 75%
B. 70%
C. 80%
D. 90%

14. What is the major advantage of GMAW over SMAW?

A. Higher Deposition
B. Simplicity of equipment
C. Portability
D. Versatility

15. What limits the short circuit current?

A. Inductance
B. Slope
C. Wire Feed Speed
D. Voltage

16. Why would you use the GMAW Pulse-Spray mode of transfer?

A. Increased deposition rate over spray
B. All position capability
C. Uses less shielding gas
D. Higher current levels

For answers please refer to page No. 11.

continued from Page 5 ....

resulting from water or oil in the air. Frequently hand-held plasma uses shop air (from a compressor), and some dryers in air compressors are better than others. If oil or water is present in the line, it can be very detrimental to the consumables and the system. Not only do they result in poor cut quality, they also have a negative impact on consumables life. Keeping a close eye on plasma consumables is important, but so is performing regular maintenance on the torch itself. For example, replace torch leads and ensure the lines stay free of oil and water.

LIFE OF PROPERLY MAINTAINED CONSUMABLES

There is really no right answer. First, we are talking about hand-held systems; therefore, every operator is different. Inexperienced operators may cut slowly, essentially burning through the consumables because they are introducing so much heat into the system. Also, material thickness has a tremendous amount to do with longevity. It takes a lot more energy to cut 1-in. material than it does thin-gauge material. As you cut thicker material, you have to increase your amperage. The more power or amperage you use, the shorter your consumable life will be.

In a hand-held system the consumables are air-cooled. If your torch lead leaks, is kinked, or whatever the case may be, then you are not getting proper airflow to the torch. That means it is running hotter than it should, and you are getting shorter consumable life.

The core message is if you maintain your system, meaning you make sure your leads are in good condition, that you are installing good consumables into the system, and you are making sure the air feeding into the machine is free of water and oil, you will maximize life of your consumables.

TIPS TO REMEMBER

- Be sure to match the consumables to the application. Never use low-amperage consumables for high-amperage cutting, or vice versa.

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How to perform tack welding successfully*

Tack welding, a necessary preliminary step in many welding projects, must be performed correctly to achieve optimal results from the final weld and to minimize part defects. Quality is as important in tack welding as it is in the final weld. This article describes proper tack welding conditions.

INTRODUCTION

After items to be welded together have been positioned as required, generally by clamping them using suitable fixtures, tack welds are used as a temporary means to hold the components in the proper location, alignment, and distance apart, until final welding can be completed.

In short-production-run manual welding operations, tack welding can be used to set up the workpieces without using fixtures. Typically, tack welds are short welds. In any construction, several tack welds are made at some distance from each other to hold the edges together.

An advantage of this provisional assembly procedure is that if the alignment for final welding is found to be incorrect, the parts can be disassembled easily, realigned, and tack welded again.

In general, tack welding is performed by the same process that is used for the final weld. For example, aluminum-alloy assemblies to be joined by friction stir welding are tack-welded by the same process using a small tool developed for this purpose. Or electron beam tack welds, created with reduced power, are used to supplement or replace fixturing and to maintain the correct shape and dimensions during final electron beam welding.

If the final welding is performed while the elements are still clamped in a fixture, tack welding must keep the elements in place and resist considerable stresses, not sufficiently contrasted by clamping devices that tend to separate the components.

IMPORTANCE

The temporary nature of tack welds may give the false impression that the quality of these auxiliary joining aids is not as important as that of final weld and that this operation does not have to be properly programmed, performed, and inspected. This is not true.

Tack welding is real welding, even if the welds are deposited in separate short beads. It performs the following functions:

- Holds the assembled components in place and establishes their mutual location
- Ensures their alignment
- Complements the function of a fixture, or permits its removal, if necessary
- Controls and contrasts movement and distortion during welding
- Sets and maintains the joint gap
- Temporarily ensures the assembly's mechanical strength against its own weight if hoisted, moved, manipulated, or overturned

DEFECTIVE TACK WELDING RISKS

When hoisted, improperly tack welded assemblies can rupture, and portions or subassemblies can fall and endanger people or damage property.

Tack welding must not interfere with or degrade the quality of final welding. It must not introduce weld defects, such as arc strikes, craters, cracks, hard spots, and slag left in place.

Many steels used in fabricating pipes and vessels are sensitive to rapid cooling or quenching, especially following short tack welds, because of the limited heat input required to tack weld. (Higher heat input slows the cooling rate, which minimizes the occurrence of hard and brittle microstructures.)

** Adapted from an article by Elia Levi in fabricator.com, Journal of Fabricators & Manufacturers Association Intl, April 11, 2006*

Hard, brittle, and crack-sensitive microstructures may form in the heat-affected zone (HAZ) if the metal is rapidly quenched. In this case, even removing the whole tack weld by grinding may leave dangerous, invisible cracks in the base metal. The brittle metal can crack during solidification of the weld metal or when stressed. Underbead cracks cannot be readily detected by visual inspection, and more thorough nondestructive tests may not be performed if they are deemed unimportant for such limited welds. However, these small cracks can cause the whole structure to fail.

CONTROLLING TACK WELD QUALITY

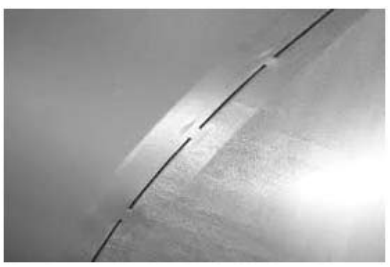
To ensure quality, most codes require that tack welding be performed only according to qualified welding procedures by welders fully certified in the process used for the final weld.

The requirements of tack welding are same as applicable for any welding process used.

Distortion Control Procedures

In all fusion welding processes, the sequence and the direction of the tack welds are important for distortion control. Besides maintaining the joint gap, tack welds must resist transverse shrinkage to ensure sufficient weld penetrations.

For a long seam, tack welding should start at the middle and proceed along the joint length, alternating in both directions, in proper back step or skip sequence to avoid stress buildup and deformation. Tack welds also can be placed at the joint ends and then added in the middle of each resulting distance between those already done, until the whole length is covered with the required number at the needed spacing.



The tack welds must be done in sequences because if the tack welds are placed progressively from one end to the other, shrinkage can close the gap at the opposite end and might even cause one sheet end to overlap the other. Because of greater thermal expansion in austenitic stainless steels, the spacing between tack welds on these materials should be much shorter than for mild steel.

Special Requirements

Tack welding is an essential step in preparing pipes for welding. Thorough attention should be given to obtain adequate alignment and consistent root opening (joint gap) that control the success of the most important root pass. Although this work could be assigned to fitters, it should be supervised closely to make sure that the workers are properly qualified. The number and size of tack welds depend on pipe diameter and wall thickness. Tack welds with complete fusion should be the same quality as the final weld.

All tack welds must be thoroughly cleaned before proceeding with the final weld. Both ends of each tack weld, representing start and stop (which are weak points often having unacceptable defects), must be ground to remove possible flaws and to present a very gradual slope that blends the weld's sides into the metal

Additional Precautions

When tack welding is used as fixturing for brazing, the area surrounding the tack must be thoroughly cleaned to remove oxides developed during welding.

In semiautomatic and automatic welding, the meeting points of the final weld electrode with tack welds can impair arc voltage control and filler wire feeding, making manual assistance especially important for maintaining quality.

CONCLUSION

Tack welding is an essential ingredient in a successful welding project, be it simple or complex. It is therefore very important to perform the process properly and minimize the risks associated with poor tack welding.

Future of Stainless Steel*

In this review we have looked back the rapid growth in development and usage of stainless steel over the past 100 years. In 1914, the worldwide production of stainless steel was likely in the order of 100 tonnes. In 1934, the U.S. production alone was estimated at about 42,000 tonnes. In 2011 over 32,000,000 tonnes were produced worldwide.

Despite all the alloy developments and the economic turmoil of this past decade, the nickel-containing stainless steel in the 300 series still account for approximately two thirds of all stainless steel production worldwide. In addition, there is nickel in the 200 series, duplex and precipitation hardening families as well as some of the martensitic and super-ferritic alloys. Why do the nickel-containing alloys continue to be in great demand? The simple answer is that there is great value placed on the properties that nickel provides. This Centenary issue of “Nickel” illustrates many, but not all of those diverse properties; for example, good weldability and formability of the 300 series stainless steels.

What does the future of stainless steel hold? Nothing is certain of course, though some reasonable guesses can be made. Here are they:

Demand for all stainless steels, both nickel-containing and nickel free, will continue to grow. As the population of the world increases and income levels rise, people will buy high-quality goods that are long-lasting and easy to maintain.

In the food and beverage industry, both the public and government desire high standards to ensure bacteria do not contaminate the food supply. This in turn increases the demand for stainless steels. Already, we see milking equipment and stalls in barns are made of stainless steels to allow easy disinfection after each use. Hygienic standards are also high in the potable water and waste water industry.

Apart from desalination plants, which treat brackish or seawater and therefore need high alloyed stainless steels, the equipment used will continue to consist largely of 304L and 316L.

Prestigious buildings with long-lasting stainless steel facades will continue to be popular, while the use of stainless steel for “hidden” applications such as water pipes, fasteners and fire safety will increase.

An increasing amount of stainless steel will be used in the manufacture of mass transit vehicles, reflecting the need for long life and low maintenance, reduced vehicle weight and increasing passenger safety.

New grades will be developed as applications expand. For example, in the power industry, where high steam temperatures mean greater conversion efficiency of the fuel, new cost-effective stainless steel grades are needed.

In the chemical processing industry, concerns about safety and environmental protection will lead to increased use of austenitic and duplex stainless steels.

In the next hundred years, the worldwide standardization and rationalization of stainless steel alloys, already under way, will be completed. This will provide cost benefits. However, 304 type stainless steel will continue to be the most common alloy produced.

The rate of end-of-life recycling of stainless steels, already quite high at about 90%, will increase even further as more and more people understand the importance of recovering the valuable elements contained in stainless steels.

The last 100 years has seen increasing use of stainless steel throughout our society. We can only speculate as to what might happen in the next hundred years, though there is one thing of which we are certain: nickel containing stainless steels

** Gary Coates, Garcoa Metallurgical Services, Consultant to the Nickel Institute, Published in Nickel Special Edition, May 2012*

will continue in widespread use providing valuable service to the mankind.

Answers of the quiz on page 6…..

1. The answer is A. The wire is mostly responsible for the deoxidizing that occurs in the weld puddle. Although the shielding gas can play a role, it isn't the primary source of the elements that help purify the weld metal.

2. If you chose D, you are correct. Cu-coated wire contributes to rust inhibition, increasing tip life and assuring good electrical conductivity.

3. The correct answer is C, Manganese and Silicon. These two elements purify the weld metal. They can be assisted with a higher CO_2 level in the shielding gas.

4. The answer is B, oxygen, which isn't a desirable element in weld metal. The higher the oxygen level, typically the lower the impact values. When welding over rust using the GMAW process the arc is much more violent compared to welding on clean material. This is the result of the increased impurities in the puddle. If the level of oxides and/or rust is excessive, porosity will occur.

5. The correct answer is B, more spatter and a tendency towards a convex weld bead profile.

6. The answer is B, constant voltage, also referred to as constant potential. Although the use of pulse equipment is increasing, pulse is typically used in more demanding applications where spatter, distortion and/or fume reduction is needed or out-of-position capabilities are necessary.

7. The correct answer is B. CO_2 is in the shielding gas reacts with the puddle and is broken down into carbon monoxide and free oxygen. The oxygen reacts with the elements transferring across the arc. With higher percentages of CO_2, the reaction with the elements in the arc increases, resulting in a lower level of these elements in the weld metal.

8. The answer is B, 0.5% molybdenum. This wire can be used for welding the chrome/moly types when post weld heat treatment will not be used.

9. The correct answer is A. When using spray transfer, overhead welding is very difficult and vertical-up welding is not possible.

10. D is the correct answer. All modes of transfer can generate cold lap if improper technique is used.

11. The answer is B, 100% CO_2. Usually reserved for non-critical welds where appearance isn't a factor, the Globular mode of transfer is used very little today.

12. The correct answer is A. In applications where speed is the primary objective, an Argon mix shielding gas is used with lower voltage in an effort to increase travel speeds.

13. The answer is C, 80%. Although a spray can be achieved with around 78% Argon, we generally say a "true" spray requires 80%.

14. The answer is A, higher deposition. SMAW generally produces around 4-9 lbs./hr. deposition for a 3/16" electrode. A 1/16" MIG wire can easily deposit more than 9 lbs./hr. with an efficiency of more than 90%, while the GMAW process usually has an efficiency of 60% when stub length is considered.

15. The correct answer is B, Slope, usually noted in terms of volts per 100 amps. By limiting the short circuit current, spatter is reduced.

16. The correct answer is B, all-position capability. Pulse is also used to lower fume and distortion.

(0 – 7 Need to refresh knowledge, 8 – 11 Average knowledge, 12 – 14 Good, 15 – 16 You are a MASTER)

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continued from Page 7 ....

- When using unshielded consumables, always keep the torch at the proper distance from the workpiece when performing a cut.

- Remember to cut at the appropriate speed. Cutting too fast will result in an incomplete cut. Cutting too slow will put unnecessary strain on the consumables, causing them to burn out quickly.

- Remember to match plasma consumables with the application. Failing to do so will only shorten the life of the consumables and in some cases compromise desired cut quality.

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