

# Current Welding Technology in Myanmar

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**Abstract:** This is the paper to describe briefly the resume about current welding technology of Myanmar. The application of metal joining in Myanmar started over a hundred years ago in the field of Shipbuilding, Bridges and Steel Structures by using mechanically joining methods, such as rivet, screws and shrinkage fit. Now, Myanmar is trying to establish a Myanmar Welding Society. This paper does not say about the new findings or new research in the field of welding techniques but it is just to review and resume about the welding processes being used, difficulties, problems, weak points, requirements dealing with our daily welding works. [Journal of American Science 2010;6(1):99-104]. (ISSN: 1545-1003).

**Key words:** Welding Technology, Welding Society, Welding Process

## 1. Introduction

Welding has been using for more than one century in the world. In the early 19<sup>th</sup> century, electricity was developed and at the same time, welding technology was remarkably changed by introducing electric arc welding. It can also be said that civilization was advanced one step with developing arc welding process. Manual metal arc welding can do on various metals by using different filler rods. It is sure to say that, welding is one of the important roles and it provides basic needs to build into modernized and developed nations.

## 2. Welding Processes using in Myanmar

At present, developed countries have been using the latest welding techniques and the most advanced welding technique by inventing robotic, semi and fully automatic welding equipments, such as narrow gap welding process, laser beam welding process, plasma arc welding process, friction stir welding process, under water welding process and so on. Everyday, they are doing researches to develop their advanced welding techniques more and more efficiently. Actually, we couldn't follow yet their up-to-date methods. We are still in the stages of just running or operating the processes they invented, only in the *manual* arc welding techniques. Among the processes, arc welding process is most widely used for metal-joining purpose. Table 1 indicates the various kinds of welding processes being mostly used in Myanmar.

### 2.1 Shielded Metal Arc Welding Process

Manual Metal Arc Welding or Shielded Metal Arc Welding (MMAW / SMAW) or stick welding process was invented in 1907, more than one century before. However, this process is still being widely used in Myanmar now. This process is very simple. Equipments

are not expensive, reliable, easy to maintain. It can also be used for both indoor and outdoor purposes. It is largely used in heavy industries such as Ship-construction & Ship-repair sites, Steel-structure fabrication works, building construction sites, hydro-power plants, penstock and most of the places. Almost all of the welders in Myanmar are very familiar to this process and equipments. Although there doesn't have exact data, it can be said that, 80% of all welding processes applied in Myanmar would be SMAW.

There is also called *Gravity Welding* which is used with SMAW power sources. Gravity welding is done with gravity welding electrode (bigger and longer than normal electrode) and control or handling device is operated by gravity force as shown in picture. It is semi-auto process but it doesn't use any other machine and electric source. One operator can apply at least 4 handling devices and so welding speed is also 4 times faster than manual welding. But, it can only be used for flat and horizontal fillet position of straight bead. So, it is very useful and economy for mass production of products. But it is hardly used in Myanmar.

### 2.2 Metal Active Gas Welding Process (MAGW)

Nowadays, the use of MAGW and FCAW-G processes become larger in capacities than MMAW in all parts of the world. The application of MAG welding (CO<sub>2</sub>) has been introduced in Myanmar since over 1990s. In those years, we have been using this process depending upon the customers' requirements. Some companies have been using this process in the production line of mass production products. Actually, this process is very fast, high deposition rate, semi-auto and fully auto available, no slag or thin layer of slag can be chipped-out easily and provides good penetration &

sound weld. They are very reasonable points to choose and use widely this process for mass production of products. However, Myanmar doesn't seem to be able to use efficiently in nationwide. The following points are challenging not to be able to utilize widely in Myanmar:

1. Power sources are very expensive
2. CO<sub>2</sub> gas is not so cheap
3. Consumable parts such as nozzle, contact tip and contact tip body are imported from abroad and result high cost
4. Spare parts of power source and feeder unit are very rare in local markets
5. Wires cannot be obtained in time at local markets when we need
6. Workers' daily charges are not high and so, semi or fully auto welding processes are not interested to substitute *workers*
7. Local customers/owners still want to make their products with cheaper cost and lesser grantee
8. No or very less export markets for products

### 2.3 Tungsten Inert Gas Welding Process (TIG) & Metal Inert Gas Welding Process (MIG)

TIG/GTAW & MIG processes are mainly used in industries and steel structure fabrication sites especially for Stainless Steel and Aluminum works. TIG process is best suited for root run of pipe welding. Inert gas is used as shielding gas and so weldment has no oxidation, no spatter and the appearance is very nice. This process is also used in ship-outfitting works of stainless steel and some steel furniture works. In contrast, inert gas is very expensive and deposition rate is slow. So, this process is still limited to use widely.

### 2.4 Submerged Arc Welding Process (SAW)

Submerged Arc Welding process is not used as widely as SMAW. This process is limited and best suited to down-hand welding position and horizontal position of straight bead but it can be applied with high deposition rate with more than one electrode wire. As deposition rate is very high, Initial investment cost for power source also very high. However it is very economy for fillet and butt joints of mass production products with thick-section. Thick steel plates can be joined by only one travel pass. It is being used in some Industrial Zones to fabricate I-Beams and H-Beams for steel structure and bridges now.

Most of the shipyards in Myanmar are mainly manufacturing inland going vessels such as landing crafts, cargo barges, pushing tug, passenger ships and coastal cargo ships too. Their thickness of the hull plate is not more than 10mm and their capacity is under 2500dwt. Very small. So it is not convenient to use SAW in the process of ship construction. SAW takes some time for preparation works before start and it is

not economy for thin plates joining and small production works. So, it is hardly used in Shipyards.

### 3. Welding Power-sources and Equipments

Myanmar is mostly using both AC and DC arc welders made by China, Malaysia, Japan, Sweden, England, America and so on... Some China made welding transformers are cheaper than others but not so durable and reliable for long run. Now, local made welding transformers are available with both AC and DC type. Most of the transformers are operated by moving core type.

Foreign made Inverter and IGBT type power sources (light and compact designs) are available in the local market now. Some companies are importing Europe made SAW & SMAW power sources, CNC Plasma cutting machines, China made TIG welding machines, Japan and Malaysia made MIG & MAG welding machines. Laser cutting system is particularly used only in the medical treatments. There are some difficulties in repairing due to lack of a few or no service centers in Myanmar, to make in good order if some problems are happened to the high tech-power sources.

Apart from power sources, welding gauges and other measuring instruments in enough quantity and good quality can't be available in the local markets.

### 3.1 Workshop Facility

Most of the workshops are old in design and out of date now in Myanmar. Some metal handling equipments and machines are needed to be substituted with new and more powerful equipments. While shops still need to be equipped with machines so as products are to be manufactured step by step in production line for mass production. Modernized positioners, welding jigs and fixtures are also essentials in modern workshops.

### 3.2 Parent Metal

Now, steel industrial zones are set up in large cities such as Yangon and Mandalay, where, it can be produced and sold various kinds and types of metals, steel sheets, bars, angles, pipes, channels, etc. Most of the metals come from neighboring countries and they have no mill certificates. Anybody can buy what they have in the local markets but it is difficult to get what you want exactly such as material grade, type, size, quality and certificate. We cannot trace the material we bought. It is a problem.

Table 1. Various kinds of welding processesb mostly used in Myanmar.

ISO Reference Number	Welding Process	AWS Designation
<b>1</b>	<b>Arc Welding</b>	(AW)
111	Manual metal arc welding	(SMAW)
114	Self-shielded tubular-cored arc welding	(FCAW-S)
12	Submerged arc welding	(SAW)
<b>13</b>	<b>Gas-shielded metal arc welding</b>	<b>(GMAW)</b>
131	Metal inert gas welding: MIG welding	(GMAW)
135	Metal active gas welding: MAG welding	(GMAW)
136	Tubular cored metal arc welding with Active gas shield	(FCAW-G)
141	Tungsten inert gas welding: TIG welding	(GTAW)
<b>2</b>	<b>Resistance Welding</b>	(RW)
21	Spot welding	(RSW)
22	Seam welding	(RSEW)
22	Resistance butt welding	(UW)
<b>3</b>	<b>Gas Welding</b>	(OFW)
311	Oxy-acetylene welding	(OAW)
<b>8</b>	<b>Cutting</b>	
81	Flame cutting (Oxy-fuel cutting)	(OFC)
83	Plasma cutting	(PAC)

### 3.3 Welding Consumables

Generally using welding electrodes, wires, filler rods and flux powder can be bought somewhat quantities in the local market, imported from neighboring countries, most likely China and Thailand. In general, E-6013 (RB-26, J-38, Kobe-30) welding electrodes are being mostly used in shipyards and construction sites. It is because most of the base metals we used are mild steel in Myanmar.

### 3.4 Health and Safety

Safety equipments are also very expensive if compare to daily income. Some safety apparatuses cannot be readily available in the local markets. Some workers are still lack of safety shoes or safety glasses or safety helmets or ear plugs even at work sites. Some employers issue Personal Protective Equipments to all its employees but some do not wear PPE because of low knowledge.

Most of the work-sites (at assembly stages) are in the open space, not enough shelter under sunshine and rain. Although fabrication works can be done inside the workshops, there are limited for product size and weight because of overhead crane facility and transportation problems. So, everybody has to take much care oneself, not to occur danger and electric hazards, especially in the rainy season.

Voltage reducing devices are needed to install to welding power sources for narrow and high location jobs. Welding power sources are not still properly used with return cable at some worksites. Welders sometimes use steel wasted parts or sticks by tack-welds instead of using safe return cable. For this reason, power loss is occurred at loose connection points and it is difficult to control arc stability and result welding defects. Over heated is usually occurred at loose connection point and it is very dangerous to neighboring.

Air blowers and extractors are required to use more at narrow and confined spaces to get proper ventilation. Face masks or nose masks are also needed to be used at sites appropriately.

### 3.5 Welding Products and Heat Treatment

In Myanmar, there are lots of projects relating with welding products such as pressure vessels, ships, tanks, rolling stocks, automobiles, bicycles, steel furniture and steel utensils, piping, penstocks, bridges, steel structures and so on. Almost all of the products are used for local market only, not or very less export markets.

Some of welding products may be required to apply heat treatment before or during or after the welding works for the sake of reduce distortion, avoid cold cracking, improve mechanical properties and decrease stress. But it is very scarce to take into consideration. So it is necessary to pay much attention to the welding of

high strength steel or thicker plate having more than one inch and to follow heat treatment procedures.

### 3.6 Welding Training Centers and Material Testing Lab

These training schools or centers are essentials to bear out qualified welders. Qualified welders are those who understand about the welding sequences, welding symbols, welding techniques, dos and don'ts of before, during and after a welding work, according to their grades. There are only a few welding training centers in Myanmar. They are needed more.

After some training period of time, trainees who passed written and practical examinations, attain their qualification certificates with different grades e.g. 1G, 2G, 6G etc. Here, these certificates should be prepared to be able to use not only in every part of mother country but also in other foreign countries. So, training curriculums are to be updated and added advanced welding technologies. Welding tests are to be carried out according to one of the international classification society's codes and standards.

It is needed to enhance training facilities to these welding training schools by providing training equipments and testing equipments. And it is also needed to arrange training programs and send trainers to developed countries and study the advanced welding technology. After attending training and arriving back to mother country, it needs to get chances in order to share their knowledge gained and materials and technical knowhow to colleagues and any other relating persons in their respective fields. This is, what we called, technology transfer we need.

Material testing lab must has non destructive and destructive (NDT & DT) equipments such as tensile and bending testing machine, impact load testing machine, surface hardness testing equipment, hydraulic breaking test machine, microscope and micro-etching equipments for DT and radiographic testing equipment, ultrasonic testing equipment, penetrate testing equipment, magnetic particles testing equipments for NDT. Class room, library room, X-ray shooting room, dark room and material testing room are also included.

Some training centers in Myanmar are equipped with much facility but training fees are also very high. Normal workers cannot attend to such kind of training centers. So, training fees should be compromised not to be so high. Some government organization has its own testing equipments and inspection team grouped by well experienced and trained persons as well.

### 3.7 Testers

Here, we need to establish a team to carry out non destructive tests and destructive tests for welder qualification or certification systems, material verification and any other material tests. This team must

play as a third party and it should be one of the branches of Myanmar Welding Engineering Society or something like this. So, it is here also necessary to establish a material testing center in which various kinds of testing machines are to be equipped depending on the qualification standards or code requirements.

Some testing equipments were already set up in some government and private sectors. We have to collect these data and can manage to co-operate each other in order to perform welding technology for the development of Myanmar.

### 4. Welders/Welding Operator

Generally, most of the welders in Myanmar are not the qualified welders trained from welding training centers. First, they enter to the companies as general workers or helpers. After some years, they become pipe fitters, steel structure fabricators, welders and medium skilled labors depending upon their interests, efforts and talents. Most of welders do not have enough knowledge about welding even though they are very skill in their practical works. Some cannot explain you about E-6013, if you ask them. Some become experts in their specialization after much experience, but no certificates. Some skilled persons try to work at aboard for their better lives. They do not earn reasonable salary because of no competent certificates, even though they can perform their jobs to the best.

There are some certified welders from various classes in Myanmar. They are employed in both private sectors and government organizations. Government and private sectors have their own certified welders of various classes according to their specific jobs and projects. However, the total amount of certified welders in Myanmar are still very less.

### 5. Welding Procedure Specification (WPS)

It is so called as WPS, Welding Procedure Specification, which is very popular and fundamental and as well as key point for welding relating works. In Myanmar, most of the people, who have been working in welding fields for years, do not understand WPS very well. Some persons have never heard about it. Some know what WPS and PQR are and what the advantages are, but do not use it. Why? Why don't they follow it? Why don't they use it? In fact, they also feel that WPS brings some complicated works and needs so many steps before starting job, it takes time and is especially costing.

WPS is one of paper document forms that needs to fill up the blanks with technical data received from the procedure test, that are to be followed in actual process of production. After welding is done according to the preliminary welding procedure specification (pWPS), NDT and DT tests are made and observed whether it achieves the required quality or not. If still not, try again

the procedure test with new data until it meets the designed requirements.

After successful, it is recorded with the final data in the PQR (Procedure Qualification Record) form including NDT & DT test- records and WPS becomes approved document. After that, plate joining works can be done by qualified welders of suitable grades by following this WPS for such kind of joints. If the type of joint or the material or welding consumable or welding process is different or metal thickness is out of applicable range, another WPS and PQR are needed.

## 6. Control of Welding and Related Works

Another aspect we should understand is good weld quality. It can only be achieved by managing not only the actual welding but also the related work. One of the important points to get the quality products is depending upon the responsibilities of welding coordination personnel or welding engineers.

Welding related works are management of base metal, welding consumable, welding power sources, electric sources, plate cutting and beveling, WPS attaining, plate forming, fabricating, assembling, heat treatment before and after welding, back gouging, grinding, fairing, finishing, inspecting and testing.

Here, I would like to present my papers by discussing some future upcoming activities according to current welding technology conditions of Myanmar.

First, welding capabilities, before start we must consider and understand ourselves that how much we can do, what process we can follow, how many certified welders, welding supervisors, inspectors and equipments we have, how fast we can perform, what workshop-facilities we have, how much electricity is available and so on. Actually, we cannot consider all the things to be 100% perfect at one time. But we need to understand actual conditions and have to decide the best ways.

Before starting a project, it is needed to cooperate between designer and welding engineer. They have to discuss about how welding is made. Sometimes designer's structure connections are very difficult to fabricate by welding, in actual condition. Besides, complicated structure gives harmful effects, such as weld defects tend to occur than normal, result residual stress, more distortion are likely to be happened, more skilled welders are required to perform welding and so on.

The second point is weld design. This is very important. Under this activity, the following points are needed to be predetermined. What welding standard to be followed? What are design requirements? How inspection and testing methods should apply? How joint details are? How is the quality standard? What are the acceptance criterion requirements? ....

Sometimes, builders do not clear themselves what

welding standard or code they are using although running their jobs. Although it seems they follow a standard, you will see that they cannot apply it deeply or fully when you watch details in the processes of production, for instant, there is no WPS. Sometimes, they apply a welding standard only for some limited amount of products, not for all. Other different products are being manufactured without complying any welding standards, at the same time.

Actually, we must strictly follow at least one std. e.g. JIS (Japanese Industrial Standard) or AWS (American Welding Society) or ISO (International Organization for Standardization) or any other else. Our people, not only the builders but also the owner and customers, do need to understand more and be familiar to the welding standards and how these standards benefit to us. Sometimes, foreign customers order products to produce with a specific standard, but builders encounter many difficulties to follow the standard, such as lack of certified welders, WPSs, qualified parent metals, welding consumables, welding power sources, limited time and so on.

Next, according to the design requirements, the following points are needed to be predetermined clearly and definitely. They are weld joint details, welding schedule, parent material selection, subsequent inspection, tests and acceptance criteria limits. These facts are to be convenient to the actual service conditions. And then WPS is to be prepared.

Roles of skilled workers who make steel plate works, so we called "Platers", are also very important. Good edge preparation and fitting of joints help to get good quality of weld joints. But most of the construction sites in developing countries are still using manual flame cutting techniques (oxy-acetylene cutting). So, it is required to assign enough welding supervisors to check at conditions of joint preparation such as misalignment, root gap, root face, groove angle, free of moisture, dust, slag, paint, oil at sites, according to the approved WPS before welding.

For the last point, visual inspection is very fundamental method among the non-destructive examinations. Everybody can do it at every step easily and immediate repair can be applied if defects are found. Welding supervisors are responsible to check throughout the welding operations, before, during and after the welding, if all steps are going according to the approved WPS. If something is wrong or required quality couldn't be achieved, immediate action must be given to rectify the problems. So PDCA circle (Plan, Do, Check, Action) rotates smoothly and hence it will help to get good quality products.

The quality and reliability of welding construction and products are guaranteed only when welding is carried out under the supervision of qualified welding engineer and inspector who have adequate knowledge

and experience in the field of welding technology and inspection technique.

Therefore, roles of qualified welding coordination personnel or welding engineers who are able to manage practical and theoretical aspects of welding technology and inspection technique as they apply to the day-to-day running of welding fabrication, construction or maintenance, are also important as mention above and enough personnel are being required more and more throughout the nation, as long as advanced welding techniques are being applied increasingly.

## 7. Conclusion

Good weld quality is best accomplished by good communication and cooperation between every section related to the welding work, with good control and performance of not only the welding itself, but also all related activities as well. Good communication and cooperation between all related activities are very important for all welding techniques, whichever it may be low or high. So, every related person needs to have enough knowledge, to pay much attention and to obey all instructions and welding disciplines throughout the

whole process of production to upgrade welding technology of Myanmar.

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