A PROJECT REPORT ON

PORTABLE WELDING MACHINE

Submitted in partial fulfillment of the
Requirements for the award of

DIPLOMA

IN

MECHANICAL ENGINEERING

SUBMITTED BY

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2016-2017

DEPARTMENT OF MECHANICAL ENGINEERING

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PROJECT GUIDE

22.3.17

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ACKNOWLEDGEMENT

All endeavors over a long period can be successful only with the advice and support of many well-wishers. I take this opportunity to express my gratitude and appreciation to all of them.

We also express our special thanks to **Sri. G.V.RAMANA REDDY,** B.Tech, Principal and Head of the Mechanical Department for making us this much responsible to complete our project work successfully within the given time.

A successful project is a collaboration effort. I would like to express my thanks to my Project Guide **Sri. B.VEERA PRASAD,** AIME from Mechanical Engineering department, for his valuable guidance and continuous encouragement, which led the completion of the project work successfully.

This acknowledgement transcends the reality of formality when I would like to express deep gratitude and respect to all those people behind the screen who guided, inspired and helped me for the completion of this project work.

We are also thankful to all the staff members of Mechanical Department

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PREFACE

The project report on "PORTABLE WELDING MACHINE" Under the guidance of Sri. B.VEERA PRASAD, AIME Workshop superintendent in the department of Mechanical Engineering

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INTRODUCTION

The ***term joining*** is generally used for welding, brazing, soldering, and adhesive bonding, which form a permanent joint between the parts—a joint that cannot easily be separated. The term assembly usually refers to mechanical methods of fastening parts together. Some of these methods allow for easy disassembly, while others do not. We begin our coverage of the joining and assembly processes with welding. ***Welding*** is a materials joining process in which two or more parts are coalesced at their contacting surfaces by a suitable application of heat and/or pressure. Many welding processes are accomplished by heat alone, with no pressure applied; others by a combination of heat and pressure; and still others by pressure alone, with no external heat supplied. In some welding processes a filler material is added to facilitate coalescence. The assemblage of parts that are joined by welding is called a ***weldment.*** Welding is most commonly associated with metal parts, but the process is also used for joining plastics. Our discussion of welding will focus on metals. Welding is a relatively new process. Its commercial and technological importance derives from the following:

1- Welding provides a permanent joint. The welded parts become a single entity.
2- The welded joint can be stronger than the parent materials if a filler metal is used that has strength properties superior to those of the parents, and if proper welding techniques are used.
3- Welding is usually the most economical way to join components in terms of material usage and fabrication costs. Alternative mechanical methods of assembly require more complex shape alterations (e.g., drilling of holes) and addition of fasteners (e.g., rivets or bolts). The resulting mechanical assembly is usually heavier than a corresponding weldment.
4- Welding is not restricted to the factory environment. It can be accomplished ''in the field.''

Although welding has the advantages indicated above, it also has certain limitations and drawbacks (or potential drawbacks):

- Most welding operations are performed manually and are expensive in terms of labor cost. Many welding operations are considered ''skilled trades,'' and the labor to perform these operations may be scarce.

- Most welding processes are inherently dangerous because they involve the use of high energy.
- Since welding accomplishes a permanent bond between the components, it does not allow for convenient disassembly. If the product must occasionally be disassembled (e.g., for repair or maintenance), then welding should not be used as the assembly method.
- The welded joint can suffer from certain quality defects that are difficult to detect. The defects can reduce the strength of the joint.

Welding involves localized coalescence or joining together of two metallic parts at their faying surfaces. The faying surfaces are the part surfaces in contact or close proximity that are to be joined. Welding is usually performed on parts made of the same metal, but some welding operations can be used to join dissimilar metals.

SELECTION OF THE WELDING PROCESS

The selection of the joining process for a particular job depends upon many factors. There is no one specific rule governing the type of welding process to be selected for a certain job. A few of the factors that must be considered when choosing a welding process are:

- Availability of equipment
- Repetitiveness of the operation
- Quality requirements (base metal penetration, consistency, etc.)
- Location of work
- Materials to be joined
- Appearance of the finished product
- Size of the parts to be joined
- Time available for work
- Skill experience of workers
- Cost of materials
- Code or specification requirements

CLASSIFICATIONS OF WELDING

Welding Process					
Pressure Welding			Fusion Welding		
Forge Welding	Resistance Welding	Thermit Welding with Pressure	Gas Welding	Arc Welding	Chemical Reaction Welding
1. Lap Welding 2. Butt Welding	1. Spot Welding 2. Seam Welding 3. Projection Welding 4. Upset Butt Welding 5. Flash Butt Welding 6. Percussion Welding		1. Oxy-Acetylene Welding 2. Air-Acetylene Welding 3. Oxy-other Fuel	1. Metal Arc 2. Carbon Arc 3. Tungsten Arc 4. Argon Arc 5. Sub merged Arc 6. Atomic Hydrogen	

ARC-WELDING

4.1 Introduction

Arc welding is the fusion of two pieces of metal by an electric arc between the pieces being joined – the work pieces – and an electrode that is guided along the joint between the pieces. The electrode is either a rod that simply carries current between the tip and the work, or a rod or wire that melts and supplies filler metal to the joint. The basic arc welding circuit is an alternating current (AC) or direct current (DC) power source connected by a "work" cable to the work piece and by a "hot" cable to an electrode. When the electrode is positioned close to the work piece, an arc is created across the gap between the metal and the hot cable electrode. An ionized column of gas develops to complete the circuit.

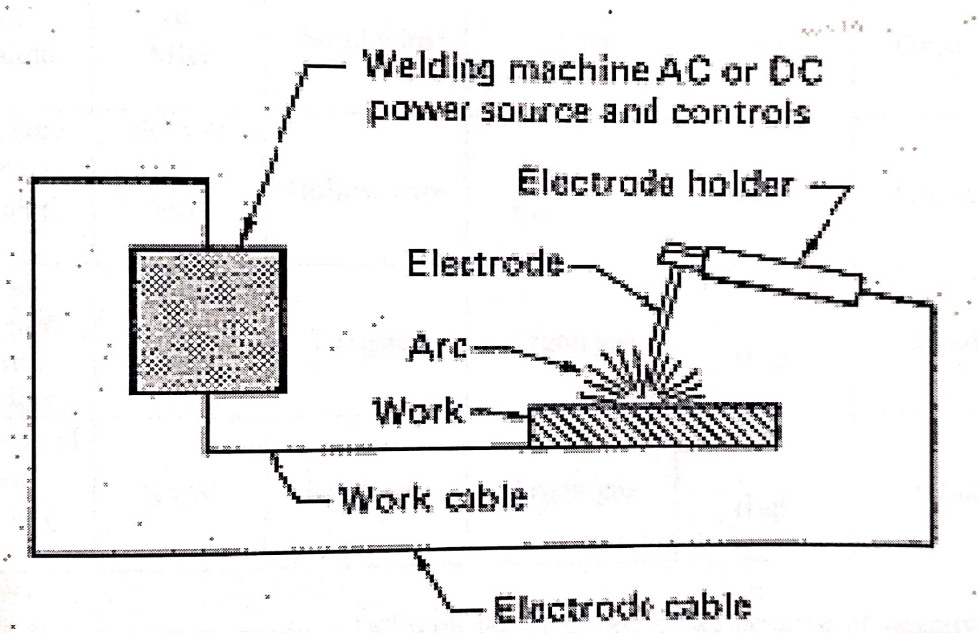


Figure: Basic Welding Circuit

The arc produces a temperature of about 3600°C at the tip and melts part of the metal being welded and part of the electrode. This produces a pool of molten metal that cools and solidifies behind the electrode as it is moved along the joint. There are two types of electrodes. Consumable electrode tips melt, and molten metal droplets detach and mix into the weld pool. Non-consumable electrodes do not melt. Instead, filler metal is melted into the joint from a separate rod or wire.

The strength of the weld is reduced when metals at high temperatures react with oxygen and nitrogen in the air to form oxides and nitrides. Most arc welding processes minimize contact between the molten metal and the air with a shield of gas, vapour or slag. Granular flux, for example, adds deoxidizers that create a shield to protect the molten pool, thus improving the weld.

4.2 The Five Most Common Arc Welding Processes

Process	Known as	Electrodes	Shielding	Operator skill required	Popularity
Shielded metal arc welding	SMAW or stick	Rigid metal	Stick coatings	Low	Diminishing
Gas metal arc welding	GMAW or MIG	Solid wire	CO_2 gas	Low	Growing
Flux core arc welding	FCAW or MIG	Hollow wire	Core materials	Low	Growing
Gas tungsten arc welding	GTAW or TIG	Tungsten	Argon gas	High	Steady
Submerged arc welding	SAW	Solid wire	Argon gas	High	Steady

Power sources produce DC with the electrode either positive or negative, or AC. The choice of current and polarity depends on the process, the type of electrode, the arc atmosphere and the metal being welded.

SHIELDED METAL ARC WELDING (SMAW)

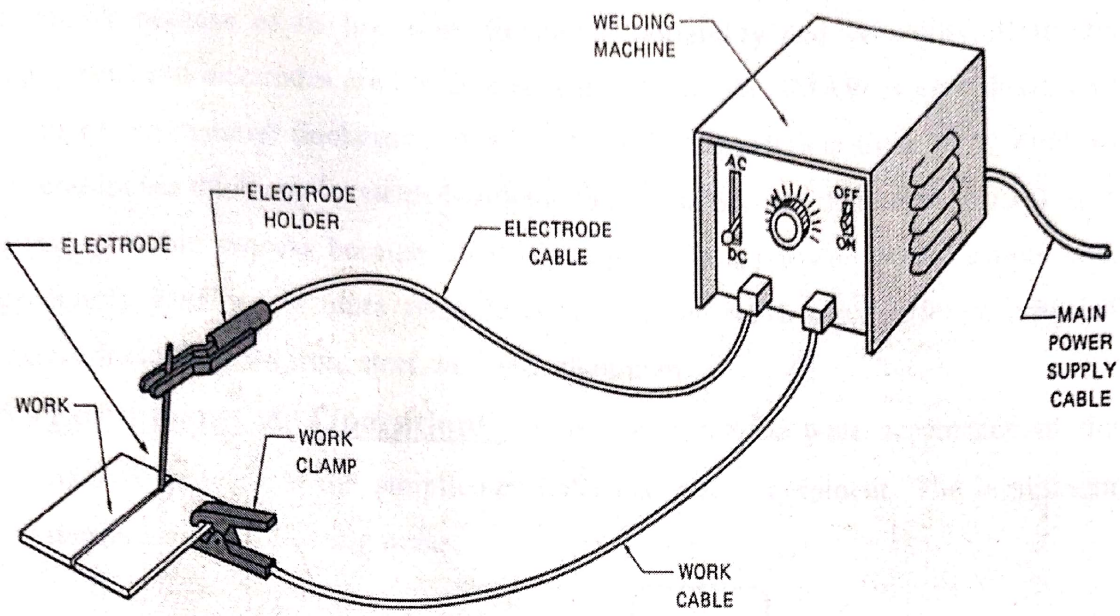


Figure: Shielded metal arc welding equipment

SMAW is a welding process that uses a flux covered metal electrode to carry an electrical current. The current forms an arc that jumps a gap from the end of the electrode to the work. The electric arc creates enough heat to melt both the electrode and the base material(s). Molten metal from the electrode travels across the arc to the molten pool of base metal where they mix together. As the arc moves away, the mixture of molten metals solidifies and becomes one piece. The molten pool of metal is surrounded and protected by a fume cloud and a covering of slag produced as the coating of the electrode burns or vaporizes. Due to the appearance of the electrodes, **SMAW is commonly known as 'stick' welding**.

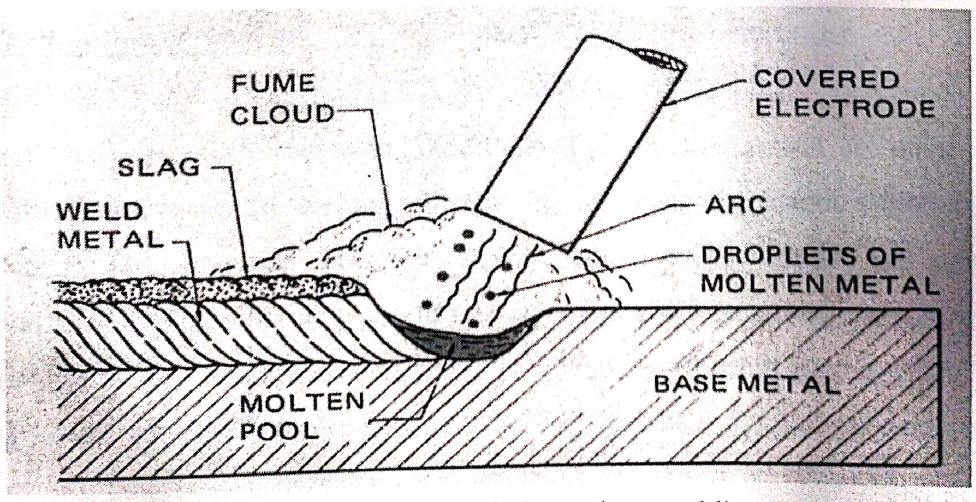
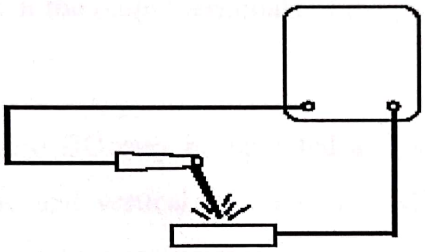


Figure: Shielded metal arc welding

SMAW is one of the oldest and most popular methods of joining metal. Moderate quality welds can be made at low speed with good uniformity. SMAW is used primarily because of its low cost, flexibility, portability and versatility. Both the equipment and electrodes are low in cost and very simple. SMAW is very flexible in terms of the material thicknesses that can be welded (materials from 1/16" thick to several inches thick can be welded with the same machine and different settings). It is a very portable process because all that's required is a portable power supply (i.e. generator). Finally, it's quite versatile because it can weld many different types of metals, including cast iron, steel, nickel & aluminum.

5.1 Equipments & Operations - One reason for the wide acceptance of the SMAW process is the simplicity of the necessary equipment. The equipment consists of the following items.



1. Welding power source
2. Electrode holder
3. Ground clamp
4. Welding cables and connectors
5. Accessory equipment (chipping hammer, wire brush)
6. Protective equipment (helmet, gloves, etc.)

Welding Power Sources - Shielded metal arc welding may utilize either alternating current (AC) or direct current (DC), but in either case, the power source selected must be of the constant current type. This type of power source will deliver a relatively constant amperage or welding current regardless of arc length variations by the operator. The amperage determines the amount of heat at the arc and since it will remain relatively constant, the weld beads produced will be uniform in size and shape. Whether to use an AC, DC, or AC/DC power source depends on the type of welding to be done and the electrodes used. The following factors should be considered:

Electrode Selection - Using a DC power source allows the use of a greater range of electrode types. While most of the electrodes are designed to be used on AC or DC, some will work properly only on DC.

Metal Thickness - DC power sources may be used for welding both heavy sections and light gauge work. Sheet metal is more easily welded with DC because it is easier to strike and maintain the DC arc at low currents.

Distance from Work - If the distance from the work to the power source is great, AC is the best choice since the voltage drop through the cables is lower than with DC. Even though welding cables are made of copper or aluminum (both good conductors), the resistance in the cables becomes greater as the cable length increases. In other words, a voltage reading taken between the electrode and the work will be somewhat lower than a reading taken at the output terminals of the power source. This is known as voltage drop.

Welding Position - Because DC may be operated at lower welding currents, it is more suitable for overhead and vertical welding than AC. AC can successfully be used for out-of-position work if proper electrodes are selected.

Electrode Holder - The electrode holder connects to the welding cable and conducts the welding current to the electrode. The insulated handle is used to guide the electrode over the weld joint and feed the electrode over the weld joint and feed the electrode into the weld puddle as it is consumed. Electrode holders are available in different sizes and are rated on their current carrying capacity.

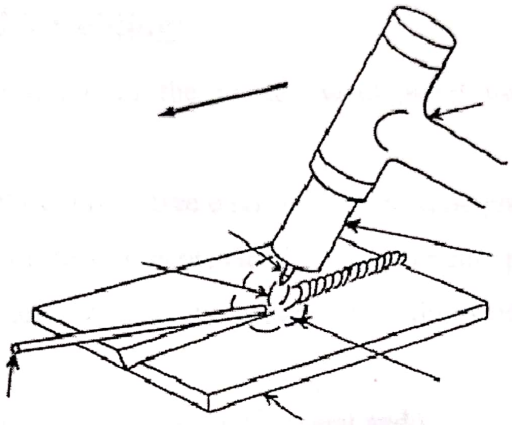
Ground Clamp - The ground clamp is used to connect the ground cable to the work piece. It may be connected directly to the work or to the table or fixture upon which the work is positioned. Being a part of the welding circuit, the ground clamp must be capable of carrying the welding current without overheating due to electrical resistance.

Welding Cables - The electrode cable and the ground cable are important parts of the welding circuit. They must be very flexible and have a tough heat-resistant insulation. Connections at the electrode holder, the ground clamp, and at the power source lugs must be soldered or well crimped to assure low electrical resistance. The cross-sectional area of the cable must be sufficient size to carry the welding current with a

minimum of voltage drop. Increasing the cable length necessitates increasing the cable diameter to lessen resistance and voltage drop.

Coated Electrodes - Various types of coated electrodes are used in shielded metal arc welding. Electrodes used for welding mild or carbon steels are quite different than those used for welding the low alloys and stainless steels. Details on the specific types will be covered in subsequent lessons.

Gas Tungsten Arc Welding is a welding process performed using the heat of an arc established between a nonconsumable tungsten electrode and the work piece.



The electrode, the arc, and the area surrounding the molten weld puddle are protected from the atmosphere by an inert gas shield. The electrode is not consumed in the weld puddle as in shielded metal arc welding. If a filler metal is necessary, it is added to the leading the molten puddle. Gas tungsten arc welding produces exceptionally clean welds no slag is produced, the chance inclusions in the weld metal is and the finished weld requires virtually no cleaning. Argon and Helium, the primary shielding gases employed, are inert gases. Inert gases do not chemically combine with other elements and therefore, are used to exclude the reactive gases, such as oxygen and nitrogen, from forming compounds that could be detrimental to the weld metal. Gas tungsten arc welding may be used for welding almost all metals — mild steel, low alloys, stainless steel, copper and copper alloys, aluminum and aluminum alloys, nickel and nickel alloys, magnesium and magnesium alloys, titanium, and others. This process is most extensively used for welding aluminum and stainless steel alloys where weld integrity is of the utmost importance. Another use is for the root pass (initial pass) in pipe welding, which requires a weld of the highest quality. Full penetration without an excessively high inside bead is important in the root pass, and due to the ease of current control of this process, it lends itself to

control of back-bead size. For high quality welds, it is usually necessary to provide an inert shielding gas inside the pipe to prevent oxidation of the inside weld bead.

Gas tungsten arc welding lends itself to both manual and automatic operation. In manual operation, the welder holds the torch in one hand and directs the arc into the weld joint. The filler metal is fed manually into the leading edge of the puddle. In automatic applications, the torch may be automatically moved over a stationary work piece or the torch may be stationary with the work moved or rotated in relation to the torch. Filler metal, if required, is also fed automatically.

5.2 Shielding in SMA welding:

To avoid contamination of the molten weld metal from atmospheric gases present in

and around the welding arc, protective environment must be provided. In different arc welding processes, this protection is provided using different approaches (Table 1). In case of shielded metal arc welding, the protection to the weld pool is provided by covering of

a) slag formed over the surface of weld pool/metal and

b) inactive gases generated through thermal decomposition of flux/coating materials on the electrode .

However, relative effect of above two on the protection of the weld metal depends on type of flux coating. Few fluxes (like cellulosic coating) provide large amount of inactive gases for shielding of weld while other fluxes form slag in ample amount to cover the weld pool. Shielding of the weld pool by inactive gases in SMAW is not found very effective due to two reasons a) gases generated by thermal decomposition of coating materials don't necessarily form proper cover around the arc and welding pool and b) continuous movement of arc and varying arc gap during welding further decreases the effectiveness of shielding gas. Therefore, SMAW weld joints are often contaminated and are not very clean for their possible application to develop critical joints. Hence, it is not usually recommended for developing weld joints of reactive metals like Al, Mg, Ti, Cr and stainless steel. These reactive metal systems are therefore commonly welded using welding processes like GTAW, GMAW etc. that provide more effective shielding to the weld pool from atmospheric contamination.

5.3 Coating on electrode:

The welding electrodes used in shielded metal arc welding process are called by different names like stick electrode, covered electrode and coated electrode. Coating or cover on the electrode core wire is provided with various hydrocarbons, compound and elements to perform specific roles. Coating on the core wire is made of hydrocarbons, low ionization potential element, binders etc. Na and K silicates are invariably used as binders in all kinds of electrode coatings. Coating on the electrode for SMAW is provided to perform some of the following objectives:

- To increase the arc stability with the help of low ionization potential elements like Na, K.
- To provide protective shielding gas environment to the arc zone and weld pool with the help of inactive gases (like carbon dioxide) generated by thermal decomposition of constituents present in coatings such as hydrocarbon, cellulose, charcoal, cotton, starch, wood flour.
- To remove impurities from the weld pool by forming slag as constituents present in coatings such as titania, fluorspar, china-clay react with impurities and oxides in present weld pool (slag being lighter than weld metal floats over the surface of weld pool which is removed after solidification of weld).
- Controlled alloying of the weld metal (to achieve specific properties) can be done by incorporating required alloying elements in electrode coatings and during welding these elements get transferred from coating to the weld pool. However, element transfer efficiency from coating to weld pool is influenced by the welding parameter and process itself especially in respect of shielding of molten weld pool.
- To deoxidize weld metal and clean the weld metal: Elements oxidized in the weld pool may act as inclusions and deteriorate the performance of the weld joint. Therefore, metal oxides and other impurities present in weld metal are removed by de-oxidation and slag formation. For this purpose, deoxidizerslike Ferro-Mn, silicates of Mg and Al are frequently incorporated in the coating material.
- To increase viscosity of the molten metal and slag so as to reduce tendency of falling down of molten weld metal in horizontal, overhead and vertical welding. This is done by adding constituents like TiO_2 and CaF_2 in the coating material. These constituents increase the viscosity of the slag.

5.4 Role of common constituents added in flux of SMAW electrode:

Constituent in flux	Role on welding arc features
Quartz (SiO_2)	Increases current-carrying capacity
Rutile (TiO_2)	Increases slag viscosity,good re-striking
Magnetite (Fe_3O_4)	Refines transfer of droplets through the arc
Calcareous spar ($CaCO_3$)	Reduces arc voltage, produces inactive shielding gas, slag formation
Fluorspar (CaF_2)	Increases slag viscosity of basic electrodes,decreases ionization
Calcareous- fluorspar (K_2O Al_2O_3 $6SiO_2$)	Improves arc stability by easy ionization
Ferro-manganese andferro-silicon	Acts as deoxidant
Cellulose	Produces inactive shielding gas
Potassium Sodium Silicate (K_2SiO_3 / Na_2SiO_3)	Acts as a bonding agent

5.5 Common types of SMAW electrodes:

The steel electrode of a given composition is made available with different types of flux coating in order to make them suitable for different arc characteristics, welding position, welding speed, deposition rate, weld metal recovery, weld metal properties and variety of quality requirements. The selection of correct type of electrode coating results in weld metal with desired quality characteristics at low cost. In general, welding electrode is selected in such a way that characteristics of weld metal are similar to or better than the base material while keeping in mind the welding position and weld joints design as they significantly affect the properties of the weld.

a. Rutile electrode:

These electrodes predominantly contain rutile (TiO_2) besides other constituents and are known to offer almost 100% weld metal recovery, easy arc striking and restriking. These are found suitable for a) fillet welds, b) welding of sheet metal, c) good gap bridging capability, d) free from spatter losses and e) all position welding. These are recommended for welding low strength steel (<440 MPa). For welding of high strength steel (>440 MPa) generally weld metal should have low

hydrogen level and therefore weld joints is developed using basic, rutile, basic-rutile and Zircon based electrode.

b. Cellulosic electrodes:

These electrodes are composed of large amount of hydrocarbon compounds and calcium carbonates besides other constituents and are found suitable for a) all welding positions especially for vertical and overhead welding position and b) realizing high mechanical properties in a weld metal of radiographic quality. These are preferred for vertical downward welding. However, these produce high hydrogen content in weld metal besides deep penetration.

c. Acidic electrode:

Acidic electrodes offer a) easier arc striking than basic electrodes but poorer arc striking than rutile electrodes, b) moderate welding speed, c) smooth weld bead d) good slag detachability. However, acidic electrode has been replaced by rutile electrode and basic electrode for flat and positional welding respectively. The ductility and toughness weld metal developed by acidic electrode are better than those developed from rutile electrodes however yield and ultimate tensile strength are found inferior. This type of electrode results in minimal penetration which is good for very thin sheet but these are sensitive to moisture pick up.

d. Basic electrode:

These electrodes have basic (alkali) coatings containing calcium carbonate / calcium fluoride. The basic electrodes are preferred over other electrode for developing weld joints of high strength steel (480-550 MPa) with weld metal having a) low hydrogen,
b) good low temperature toughness, c) resistance to hot and cold cracking. However, these electrodes suffer from comparatively poor slag detachability. The welding speed and deposition rate offered by the basic electrodes especially in vertical welding position is much higher than the rutile and acidic electrode. Basic electrodes can sustain higher welding current even in vertical welding position.

e. Basic-rutile electrode:

This type of electrode combines positives of both basic as well as rutile electrodes and therefore recommended for horizontal–vertical fillet welds of high strength steels.

5.6 Welding parameters for SMAW

SMA welding normally uses constant current type of power source with welding current 50-600A and voltage 20-80V at 60% duty cycle. Welding transformer (AC welding) and generator or rectifiers (DC welding) are commonly used as welding power sources. In case of AC welding, open circuit voltage (OCV) is usually kept 10-20% higher than that for DC welding to overcome the arc un-stability related problems due to fact that in case AC both current magnitude and direction changes in every half cycle while those remain constant in DC. OCV setting is primarily determined by factors like type of welding current and electrode composition which significantly affect the arc stability. Presence of low ionization potential elements (Ca, K) in coating and reduce the OCV required for stable arc.

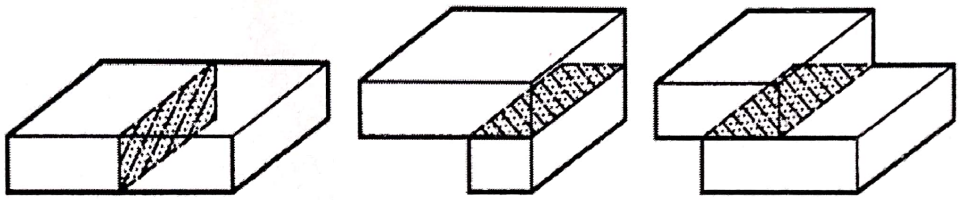
MACHINE SPECIFICATIONS

1.	Model	:	MMA 200 Arc
2.	Type	:	Inverter
3.	Portable	:	Yes
4.	Power requirement	:	200V/50Hz
5.	Current rating	:	200A

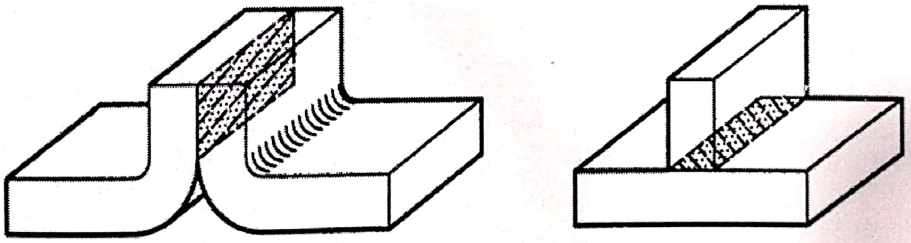
TYPES OF JOINTS

There are five basic types of joints for bringing two parts together for joining. The five joint types are not limited to welding; they apply to other joining and fastening techniques as well. The five joint types can be defined as follows: ***(a) Butt joint.*** In this joint type, the parts lie in the same plane and are joined at their edges. ***(b) Corner joint.*** The parts in a corner joint form a right angle and are joined at the corner of the angle. ***(c) Lap joint.*** This joint consists of two overlapping parts. ***(d) Tee joint.*** In a tee joint, one part is perpendicular to the other in the approximate shape of the letter "T." ***(e) Edge joint.*** The parts in an edge joint are parallel with at least one of their edges in common, and the joint is made at the common edge(s).

STANDARD WELD JOINTS

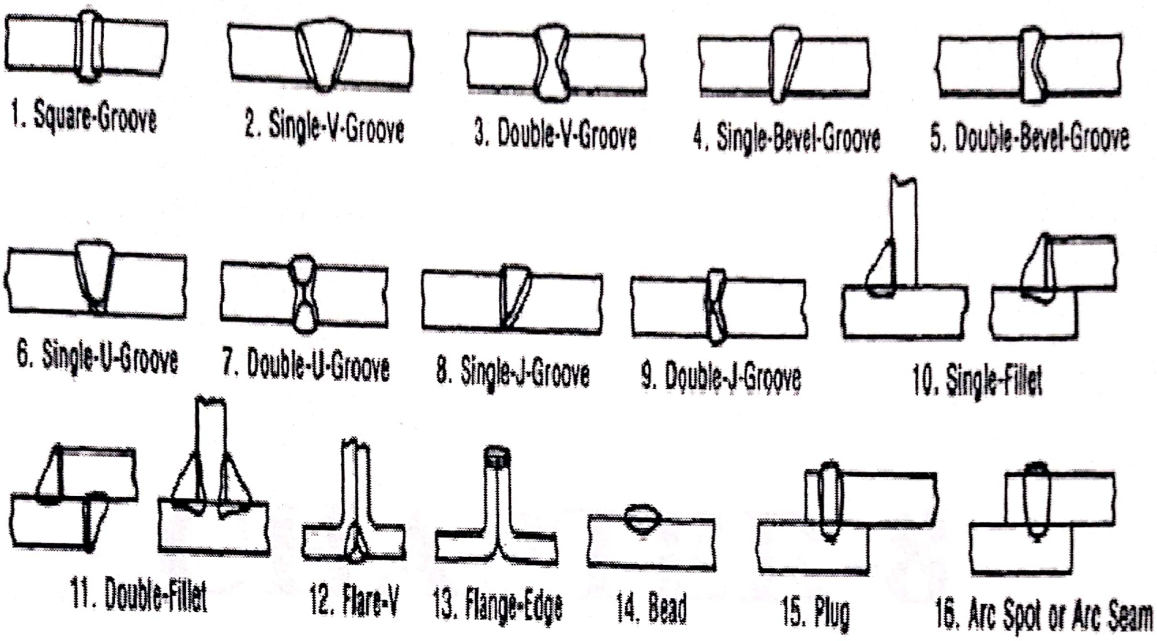


A. BUTT JOINT B. CORNER JOINT C. LAP JOINT



D. EDGE JOINT E. TEE JOINT

Examples of Welds:



ADVANTAGES

1. Welded structures provide better and improved mechanical properties.
2. The weight of welded structures is less than that of structures joined by other means.
3. Welding eliminates patterns. Welding as such do not require pattern and hence cost towards its design, manufacture and storage is saved.
4. Greater design flexibility and lower design cost.
5. Almost all engineering materials can be easily welded with the help of specially developed welding processes.
6. The welded structures have better appearance; hence, they have better sales in the market.
7. Welded joints have high corrosion resistance.
8. Many different types of joints are possible in welded joints.
9. As in riveting, no holes are there in welding and the entire section is welded thus, saving material.
10. A welded joint is as strong as the basement.

SAFETY PRECATIONS

1. Wear approved safety glasses with side shields even under your welding helmet.
2. Keep your head out of the fumes. Don't breathe the fumes.
3. If ventilation is poor, wear an approved air-supplied respirator.
4. Wear dry, hole-free insulative gloves and body protection.
5. Don't use worn, damaged, under sized or poorly spliced cables.
6. Turn off all equipment when not in use.

APPLICATIONS

The principal applications of welding are

1. Construction, such as buildings and bridges.
2. Piping, pressure vessels, boilers, and storage tanks.
3. Shipbuilding.
4. Aircraft and aerospace.
5. Automotive and railroad.
6. Machine tool industry.
7. General machine work.
8. High speed and rail road cars.

Welding is performed in a variety of locations and in a variety of industries. Owing to its versatility as an assembly technique for commercial products, many welding operations are performed in factories. However, several of the traditional processes, such as arc welding and oxyfuel gas welding, use equipment that can be readily moved, so these operations are not limited to the factory. They can be performed at construction sites, in shipyards, at customers' plants, and in automotive repair shops. Most welding operations are labor intensive. For example, arc welding is usually performed by a skilled worker, ***called a welder***, who manually controls the path or placement of the weld to join individual parts into a larger unit. In factory operations in which arc welding is manually performed, the welder often works with a second worker, called a *fitter*. It is the fitter's job to arrange the individual components for the welder prior to making the weld. Welding fixtures and positioners are used for this purpose.

REFERENCES

1. http://www.esabna.com/EUWeb/AWTC/Lesson1_1.htm
2. http://teacher.buet.ac.bd/shabnam/14250_ch3.pdf
3. http://ebookbrowse.com/chapter2-manual-metal-arc-welding-pdf-d79324541
4. http://www.esab.ch/de/de/support/upload/XA00136020-Submerged-Arc-weldingh andbook.pdf