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CAPITAL GOODS SKILL COUNCIL

Participant Handbook

Sector
Capital Goods

Sub-Sector
Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods

Occupation: **Welding and Cutting**

Reference ID: **CSC/ Q 0204, Version 1.0**
NSQF Level 3

Manual Metal Arc Welding/Shielded Metal Arc Welding

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Address: Federation House, 1, Tansen Marg, New Delhi 110001
E-mail: support@cgsc.in
Phone: +91 11 65002121

"Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission."

Shri Narendra Modi
Prime Minister of India

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Certificate

COMPLIANCE TO
QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

Capital Goods Skill Council

for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of
Job Role/ Qualification Pack: ' **MMAW/SMAW** ' QP No. ' **CSC/Q0204 NSQF Level 3** '

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Authorised Signatory
Capital Goods Skill Council

Acknowledgements

Capital Goods Skill Council would like to thank Capital Goods member company representatives for believing in our vision to enhance the employability of the aspiring workforce pool. CGSC facilitates this by developing and enabling the implementation of courses relevant to projected industry needs.

The aim is to address two key requirements, of closing the industry-academia skill gap, and of creating a talent pool that can reasonably meet current competitiveness requirements and weather future externalities in the Capital Goods Sector providing impetus to the Make in India program.

CGSC believes that this is an initiative of great importance for all stakeholders concerned – the industry, academia, and the aspirants. The tremendous amount of work and ceaseless support offered by the members of CGSC in developing a meaningful strategy for the content and design of program training materials has been truly commendable.

We would like to particularly thank **L&T, Thermax. JK Cement, KGC Engineering, Micromatic grinding** for bringing much needed focus to this effort.

Inder Gahlaut

CEO

CGSC

About this book

This Participant Handbook is designed to enable training for the specific Qualification Pack (QP) of Capital Goods Industry. MMAW Welder perform manual (semi-automatic) operations for metal Arc Welding also known as manual metal arc welding (MMAW) for welding joints in all positions as per welding procedure specification (WPS). It involves manual (semi-automatic) MMAW welding for a range of standard welding job requirements and weld different materials (carbon steel, aluminum and stainless steel) in various positions. The welder can prepare various joints including corner, butt, fillet and tee. Set-up and prepare for operations interpreting the right information from the WPS. Key Learning Objectives for the specific NOS mark the beginning of the Units for that NOS. The symbols used in this book are described below.

Symbols Used


Key Learning Outcomes


Steps


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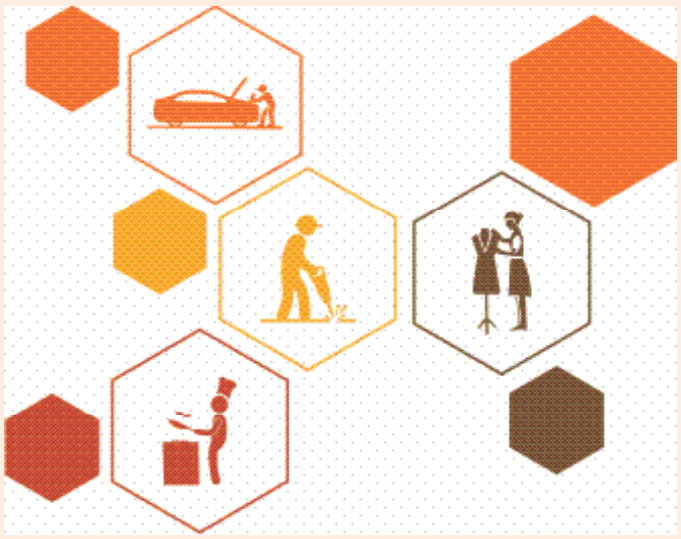
1. About Capital Goods Industry

Unit 1.1 - Understanding of capital goods industry

Unit 1.2 - Understanding various types of capital goods Industry

Unit 1.3 – Role of Welder in the Industry



Key Learning Outcomes

At the end of this module, you will be able to:

1. Discuss about capital goods industry
2. Discuss about development activities in industry
3. Discuss about employment opportunities in India
4. Explain about industry structure
5. List job responsibilities of a welder

Unit 1.1: Understanding of Capital Goods Industry

Unit Objectives

At the end of this unit, you will be able to:

1. Discuss about industry
2. Understand development activities in the industry
3. Know about manpower requirements in industry

1.1.1 Introduction

Capital Goods are used in producing other products but are not incorporated into the new product. Capital Goods industry involves plant and machinery, equipment / accessories required for manufacture / production, either directly or indirectly, of goods or for rendering services, including those required for replacement, modernization, technological up gradation and expansion. It also includes packaging machinery and equipment, refrigeration equipment, power generating sets, equipment and instruments for testing, research and development, quality and pollution control. The Capital Goods industry is the "mother" of all manufacturing industry. The capital goods industry contributes 1.8% to the GDP which is 12% of the total manufacturing sector. For achieving goal of 9% growth in GDP during the 12th Five Year Plan, it is essential for the manufacturing industry to grow at least by 11-13% per annum. The Capital Goods sector, which plays vital role in manufacturing sector, should grow at around 17-19%.

Fig. 1.1.1 Capital Goods

1.1.2 Development activities in the industry

Sectors such as engineering, construction, infrastructure, and consumer goods play a strong base for Indian Capital industry. It can be further divided into ten broad sub-sectors namely heavy electrical equipment; Food Processing machinery; Printing Machinery; process plant equipment; earth moving equipment; dies, moulds and tool textile machinery; machine tools; metallurgical machinery and plastic processing machinery. It generates not only employment but also supports national security and hence boost to economy. 1.4 million people and is estimated to employ 2.8 million by 2017. The industry contributes 12% to the total manufacturing output of India and around 1.8% to the national GDP. The total market size of the industry around $92 billion and production valued at $32 billion. Instead of core industries such as power, railway, Infrastructure, etc, capital goods sector is growing year after year. There is a lack of domestic and global demand so this sector is currently facing insufficient off-take but it does not mean it has no potential. It is believed that it can boost the sector to approximately Rs. 7 lakh crore over next 4-5 years.

Fig. 1.1.2 Capital Goods Workshop

Increasing demand leads to the growth of the Capital Goods sector in India, and sectoral production has increased 2.5 times in 2013-15 as compared to 2004-05.

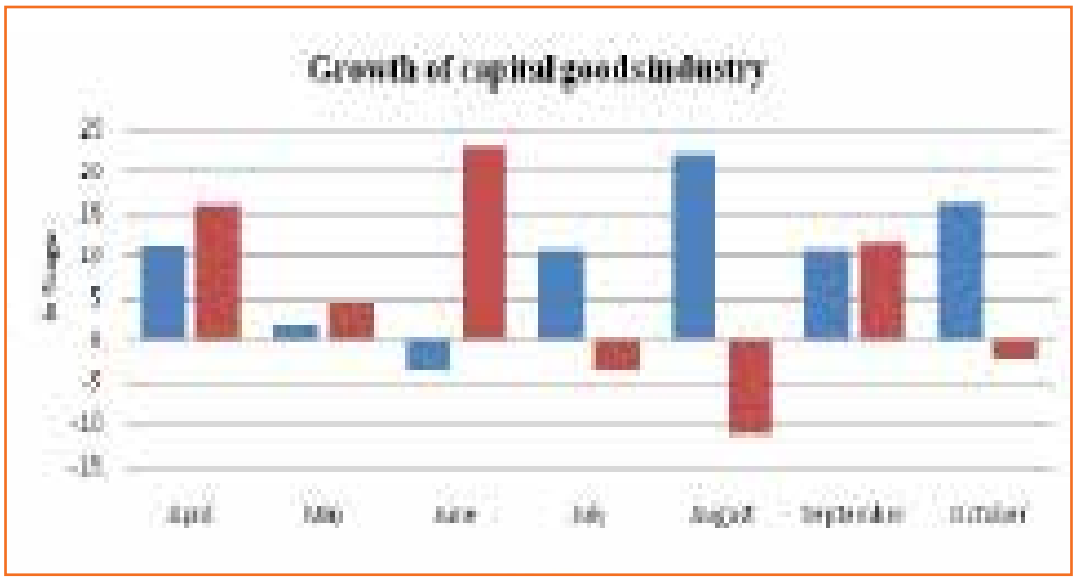


Fig. 1.1.3 Growth of Capital Goods Industry

1.1.3 Government policy of capital goods industry

There are some objectives of draft of a national capital goods policy:

- Increase total production: To achieve total production in excess of Rs. 50,000 crore by 2025 from the current Rs. 220,000 crore, there should be a friendly ecosystem for a globally competitive capital goods sector.
- Increase employment: To increase domestic employment from the current 1.4 million to at least 5 million by 2025 thus providing additional employment to over 3.5 million people.
- Increase domestic market share: It also envisages increasing the share of domestic production in capital's goods market from 56% to 80% by 2025 and for this improves domestic capacity utilization to 80-90%.
- Increase exports: To increase exports to 40% of total production (from Rs 62,000 crore to Rs 200,000 crore) by 2025, enabling India's share of global exports in capital goods to increase to 2.5%.
- Improve skill availability: To achieve higher productivity in the capital goods sector with enhance availability of skilled manpower by training 50 lakh people by 2025, and establish institutions to deliver the human resources with the skills, knowledge and capabilities to boost growth and profitability.
- Improve technology depth: To improve 'technology depth' in capital goods sub-sectors by increasing research intensity in India from 0.9% to at least 2.8% of GDP to rank amongst the Top-10 countries in research intensity and achieve global benchmarks for intellectual property in the capital goods sector.
- Promote standards: Technical and safety measure are up to the international standards and to achieve this, inflow of sub-standard capital goods need to be curb.
- Promote SMEs: To compete with established domestic and international firms and become national and global champions of capital goods in the future, growth and capacity of SMEs sector need to be increased.

1.1.4 Spread of capital goods industry in India

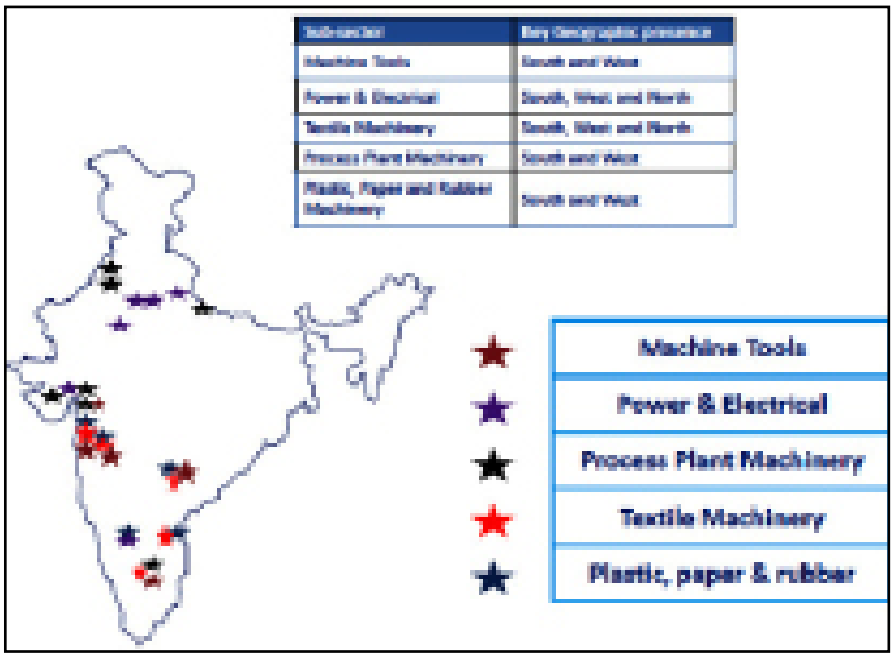


Fig. 1.1.4 Spread of capital goods industry in India

1.1.5 Manpower requirement in the industry

KPMG supported by NSDC, FICCI and CGSC study on Human Resource and Skills Requirement in the field of Capital Goods Sector and assign manpower requirement in 2017 across the six sub-sectors is approximately 2,085,000. The distribution of the same across subsectors and functions are as follows:

Manpower requirement in 2017							
Function	Machine Tools	Power & Electrical	Process Plant Machinery	Textile Machinery	Plastic, Paper & Rubber Machinery	Light Engineering Goods	Total
Production	237,200	679,000	227,500	1,313,000	90,700	573,300	1,939,400
Support Functions	17,900	51,100	17,100	9,900	6,800	43,100	146,000
	255,000	730,100	244,600	141,700	97,500	616,400	2,085,400

Table 1.1.1 Manpower requirement in 2017

The study projects the manpower requirement in 2022 across the six sub-sectors is approximately 3,940,800. The distribution of the same across subsectors and functions are as follows:

Manpower requirement in 2022							
Function	Machine Tools	Power & Electric-als	Process Plant Ma-chinery	Textile Ma-chinery	Plastic, Paper & Rubber Ma-chinery	Light En-gineering Goods	Total
Produc-tion	477,500	1,240,000	385,400	226,300	215,600	11,203,000	3,665,100
Support Functions	35,900	93,300	29,000	17,000	16,200	843,000	275,700
Total	513,400	1,333,300	414,400	243,300	231,800	1,204,600	3,940,800

Table 1.1.2 Manpower requirement in 2022

Notes

Unit 1.2: Understanding structure of Capital Goods Industry

Unit Objectives

At the end of this unit, you will be able to:

1. Discuss about capital goods industry structure
2. Know about features of industry

1.2.1 Capital goods sub-sectors

On the basis of end-usage, the sector is normally divided into 8-10 major sub-sectors. The main sub-sectors thus identified as sub-sectors of the capital goods sector are:

S. No	Sub Sectors	Brief Description
1	Machine Tools	Constitutes machines related to metal cutting and forming
2	Power & Electrical equipment	Constitutes machines related to power generation, transmission and distribution
3	Process Plant Machinery	Constitutes machines such as pressure vessels, evaporators, stirrers, heat exchangers etc. are used in energy, metallurgy, oil and gas, industry etc.
4	Textile Machinery	Constitutes machines used in various steps of textile fabrication such as spinning weaving, processing, testing etc.
5	Plastic, Paper & Rubber Machinery	Constitutes machinery used in various fabrication steps of paper, plastic and rubber manufacturing
6	Light Engineering Goods	Constitutes machines related to roller bearing, process control, instruments, castings, steel forgings, and pipes etc used in oil & gas, power, automotive etc. industries
7	Earthmoving, Construction and Mining Equipment	Constitutes machines such as graders, dozers, excavators etc for mining and mixers, tippers, road millers etc. For constructions.
8	Material Handling and Lifting Equipment	Constitutes primarily of forklifts and cranes.
9	Agricultural Machinery	Constitutes machines used in various steps of agriculture such as land development, sowing weeding, harvesting etc.

Table 1.2.1 Sub Sectors of Capital Goods Industry

1.2.2 Features of capital goods industry

- Economic performance of the sector is linked with that of manufacturing industry which is the key end-user of the Capital Goods industry.

Fig. 1.2.1 Economic performance of the Industry

- Capability to manufacture most of the major capital goods limited to domestic purpose. However, imported machineries from foreign give a stiff competition because of better technology and competitive pricing.
- The output of the sector is concentrated with a top few companies in most product groups, followed by a section of companies comprising medium to small scale players.
- Indian companies primarily target on the domestic market leaving export market intact. However, some of the larger players are exploring export market growth targeted especially towards the Middle East and Asian markets. The sector is expected to depend on government support on areas like export financing and promotion to tap vast global capital goods market opportunity.

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4. Concepts of Welding

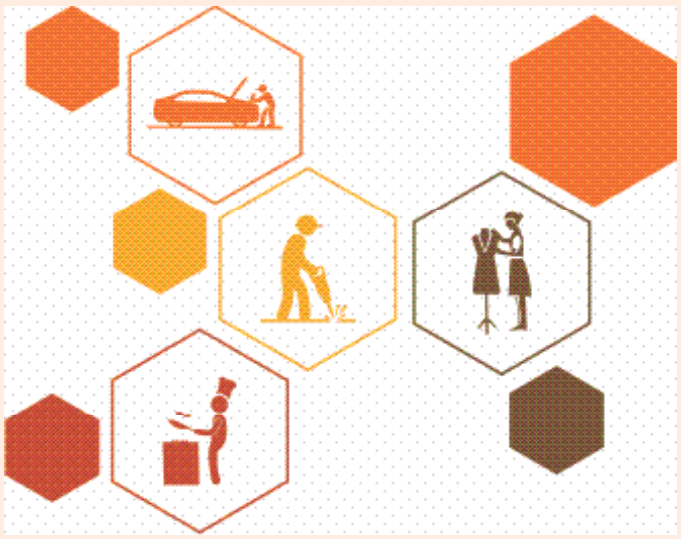
Unit 4.1 – Basic welding introduction

Unit 4.2 – Manual metal arc welding (MMAW)

Unit 4.3 – Welding joints

Unit 4.4 – Weld types and positions

Unit 4.5 – Drawing and symbols



CSC/N0204

Key Learning Outcomes

At the end of this module, you will be able to:

1. Know about welding and welding process
2. Know about different types of welding
3. Know about MMAW welding process
4. Know about advantages and limitations of MMAW welding
5. Know about welding joints and design
6. Know about types of joints
7. Know about welding positions
8. Know about welding drawings
9. Know about welding symbols

Unit 4.1: Basic welding introduction

Unit Objectives

At the end of this unit, you will be able to:

1. Know about welding process
2. Know about types of welding
3. Know about basis of welding process selection

4.1.1 Welding

It is a material joining procedure in which at least two sections are consolidated by reasonable use of heat as well as force.

A weld is being made when cut off pieces of metal are joined and make one piece when heated to a temperature suitably high to cause it melt and flow together. Pressure might be or might not be utilize to drive the pieces together. Sometimes parts are united together by of pressure only without external heat.

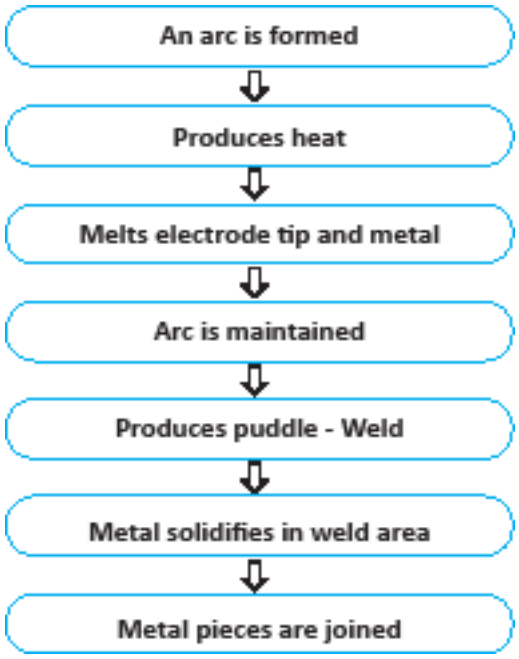


Fig 4.1.1 Welding process flow

In some instances, pressure alone may be sufficient to force the split pieces of material to join in

one piece. We add filler material to form a finished weld in the joint whenever needed. It is very essential to note down that the word material is used because today welds can be made from a growing list of materials, such as plastic, glass and ceramics.

4.1.2 Classification of welding processes

Welding procedure can be ordered into various classifications depends on the following criteria:

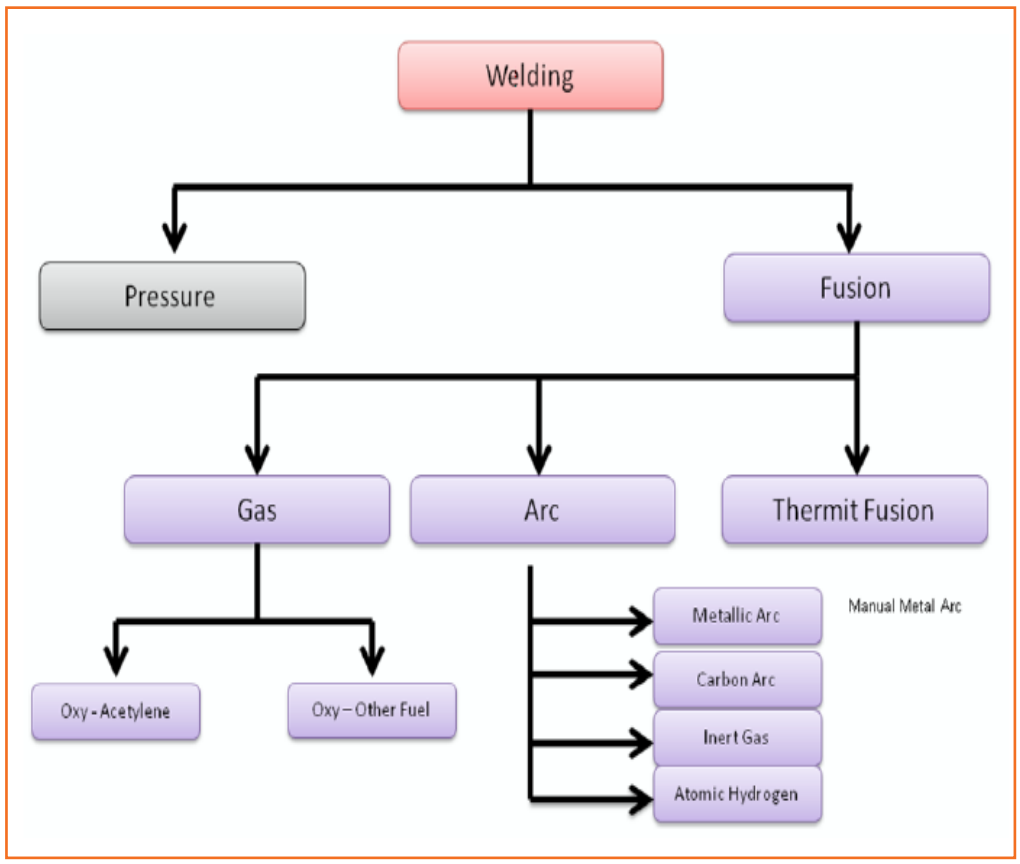


Fig 4.1.2 Welding classification

a) Welding processes are classified as fusion welding and pressure welding. Both the processes depend on the heat application during the welding. In pressure welding, heat application is not needed.

b) Fusion welding can be classified as low temperature welding and high temperature welding. In low temperature welding, heat generated builds up low temperature. Soldering and brazing are examples of low temperature welding.

c) Fusion welding is further classified into Gas, arc and thermit fusion process.

Fusion welding is a method whereby the parts to be joined are heated until they melt and flow together. On cooling they solidify into one unit.

d) Gas welding is generally used for metal cutting process which can be done by using oxy - acetylene or by using any other suitable gas with oxygen.

e) Arc welding is further classified into metal arc welding, inert gas welding, and tungsten electrode welding and or sometimes carbon can be used for the welding.

Welding is a hazardous job, requires appropriate safety precautions for avoiding hazards like burns, electric shock, electrocution, eyesight problems, fire and explosion, breathing of toxic gases.

4.1.3 Selection of joining process

The choice of the joining procedure for a specific job relies on many variables. There is no such rule which manages the welding procedure to be chosen for a specific employment. A couple of the components which should be taken into consideration while picking a joining procedure incorporate:

- **Accessibility of tools:** The types, ability and state of tools which is being used to make the welds.
- **Repetitiveness of the procedure:** what number of the welds will be required to finish the employment, and are they all the similar?
- **Quality prerequisites:** Is this weld going to be utilized on furniture, to repair a piece of tool, or to join a pipeline?
- **Place of work:** Will the weld be in a store or on a remote work location**?**
- **Supplies to be attached:** Does the parts which are being used made out of a normal metal or some exotic alloy?
- **Look of the completed manufactured goods:** Is the weldment made needed only to experiment a thought, or is it a final construction?
- **Size of the parts to be fixed:** Are the parts little, huge, or distinctive sizes, and would they be able to be moved or should they be welded in position?
- **Time accessible for work:** Is this a surge work requiring a quick repair, or is there time to

take into consideration pre-and post-weld cleanup?

- **Ability or practice of specialists:** Do the welders have the skill to carry out the occupation?
- **Cost of equipment:** Will the weldment be justified regardless of the cost of unique hardware materials or completing time?
- **Code or specification requirements:** Often the selection of the process is dictated by the governing agency, codes or standards.

The welding engineer and/or the welder must settle on the welding procedure as well as select the strategy for applying it. The mentioned techniques are used to perform welding, cutting or brazing operations.

- **Manual:** The welder is required to control the whole procedure.
- **Partially automatic:** The filler metal is included naturally, and all other control is done manually by the welder.
- **Machine:** Operations are done mechanically under the inspection and correction of a welding worker.
- **Automatic:** Operations are performed repeatedly by a machine that has been programmed to do an entire operation without interaction of the operator.
- **Automated or robot:** Operations are performed repeatedly by a robot or other machine that is programmed flexibly to do a variety of processes.

Exercise

1 Which of the following joint have high corrosion resistance?

(a) Welding joint (b) Riveted joint (c) Bolted joint (d) None of the above

2 Which of the following ray is not produced during welding?

(a) Gamma rays (b) Visible light rays (c) Infrared ray (d) Ultra violet rays

3 The metals having good weldability, in descending order are

(a) cast steel, iron, carbon steel, cast iron (b) carbon steel, iron, cast steel, cast iron

(c) iron, carbon steel, cast steel, cast iron (d) cast iron, iron, carbon steel, cast steel

4 In fusion welding, penetration is the ratio of

(a) width of the weld to its depth (b) length of the weld to its depth

(c) depth of the weld to its width (d) depth of the weld to its length

Unit 4.2: Manual metal arc welding (MMAW)

Unit Objectives

At the end of this unit, you will be able to:

1. Know about MMAW welding
2. Know about MMAW welding process
3. Know about advantages and disadvantages of MMAW welding

4.2.1 Arc welding

The arc welding is a type of fusion welding in which an electric arc strike between the work and an electrode, and generates the heat. The heat generated is of the temperature range 6000°C to 7000°C. For arc welding, both D.C. and A.C. supply can be utilized. When work is connected with positive terminal of the D.C welding machine and electrode to negative terminal, then welding machine is on straight polarity. If terminals are in opposite state, then machine is on switched polarity. The straight polarity is ideal for welds.

Fig 4.2.1 Arc welding

Following are the two sorts of arc segment welding relying on the kind of terminal:

A. **Un- Shielded arc welding**: When a filler rod is utilized for welding, it is said to be un-shielded arc welding.

B. **Shielded arc welding**: When the welding rods covered with fluxing material are utilized, it is called shielded arc welding

Arc welding Procedures: The following are the different welding forms usually utilized:

1. **Carbon arc welding**: In carbon arc welding, the welding heat is generated from an electric arc between a carbon electrode and the work.
2. **Metal arc welding**: In metal arc welding, the arc is created between the metal electrode

and the work piece. Electrode is dissolved by the heat of the arc and fused with the work piece. The temperature delivered by the heat is around 2400° C to 2700° C

3. **Metallic inert gas (MIG) Arc welding**: In MIG welding, the electrode is consumable; the filler metal is saved by the bend which is totally encompassed by an inert gas.
4. **Tungsten inert gas (TIG) arc welding**: In TIG welding, the heat is generated from an arc between non-consumable tungsten electrode and work piece. The welding zone is protected by the inert gases i.e. helium or argon.
5. **Atomic hydrogen welding**: In atomic hydrogen welding, the arc segment is acquired between two tungsten electrodes, whereas hydrogen gas goes by the arc and covers the welding zone.
6. **Submerged arc welding:** In submerged welding, the arc is delivered between an exposed metal electrode and the work piece. The submerged arc welding is generally done on low carbon and compound steels**.**
7. **Thermit welding:** In this welding, a blend of iron oxide and aluminum which is also called thermit, is utilized. The blend is ignited just at a high temperature of around 1500°C.

4.2.2 Manual metal arc welding

Manual metal arc welding (MMAW), additionally be known as shielded metal arc welding (SMAW) is a welding procedure that uses a flux secured metal terminal to convey an electrical current. The current creates a arc over the gap between the finish of the terminal and the work. The electric arc makes adequate heat to dissolve both the electrode and the work. The finish of the terminal and liquid pool of metal are encompassed, purified and secured by a gaseous cloud and a covering of slag created as the flux covering of the electrode consumes or vaporizes.As the arc moves away, the blend of melted electrode and base metal cements and ends up noticeably one piece.

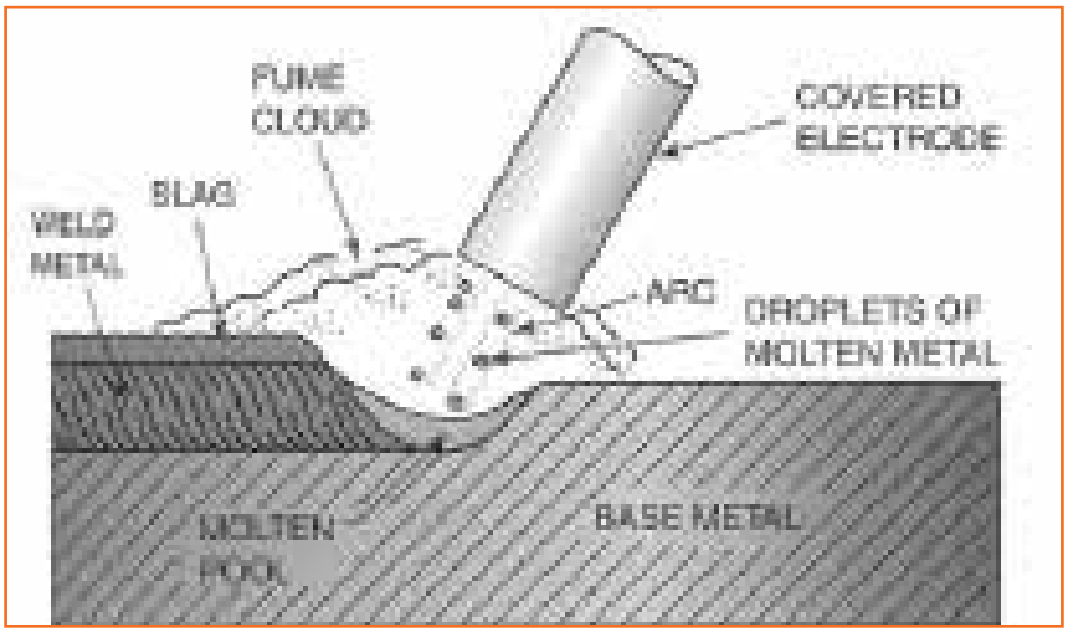


Fig 4.2.2 Manual metal arc welding

- MMAW is the practically generally utilized welding methodology due to its low cost, flexibility, portability Also flexible. Those MMAW procedure may be extremely adaptable As far as the metal thicknesses that might a chance to be welded and the mixed bag about positions it could a chance to be utilized within..
- MMAW will be a convenient procedure on account of it is not difficult on move those supplies. Also those set amount for supplies required to those transform makes moving simple.
- The procedure will be versatile, What's more it may be used to weld Just about At whatever metal alternately alloy, including cast iron, aluminum, stainless steel and nickel.
- Due to those flexible of the methodology and the effortlessness for its supplies and operation, protected metal arc welding is a standout amongst the world's first and practically well known welding forms. It dominates different welding forms in the maintenance and repair industry, Furthermore if flux-cored arc welding is developing clinched alongside popularity, SMAW keeps on being utilized extensively in the development of overwhelming steel structures Furthermore in industrial fabrication.

The Advantages of MMA Welding

- Flux Shielded Manual Metal Arc Welding is those simplest about every last one of arc welding procedures.
- The tools can be handy and reasonably low in cost.
- This procedure finds numerous applications, because there is large selection of electrodes.
- An extensive variety of metals and their alloys can be welded.
- Welding can be done in any position.
- That procedure could a chance to be delicately utilized for difficult facing and metal depositions to recover parts or with create other qualities such as wear safety and so on.
- Joints, which due to their position are troublesome can be welded by automatic welding machines.

The Disadvantages of MMA Welding

- Due to those restricted period about every electrode and fragile flux coating, it is troublesome with computerize those procedure.
- In welding long joints (e.g., in pressure vessels), as one electrode completes, the weld is to be advanced with the next electrode. An imperfection like slag composition may happen if welding has to start again with the new electrode.
- It is slower than MIG welding.

Unit 4.3: Welding joints and joint preperation

Unit Objectives

At the end of this unit, you will be able to:

1. Know about welding joint types
2. Know about design preparation

4.3.1 Joint types

Welds are made by joining different pieces of metal to make the weldment. Components used for creating the weldment might be sheet, rolled plate, channels, forgings, casting or billets etc. Welding joints are of five types and characterized as:

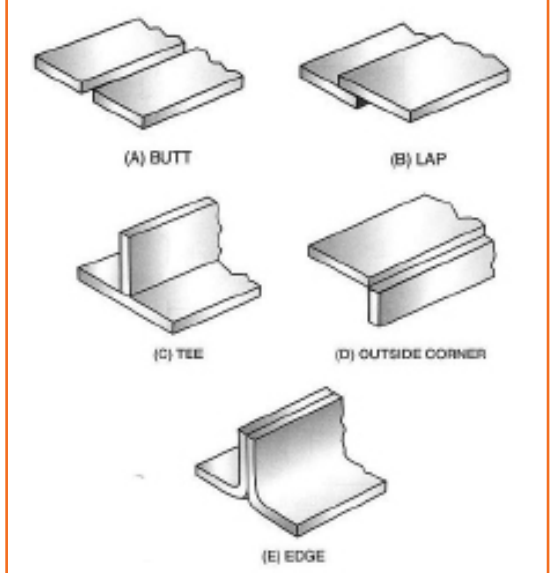


Fig 4.3.1 Joint types

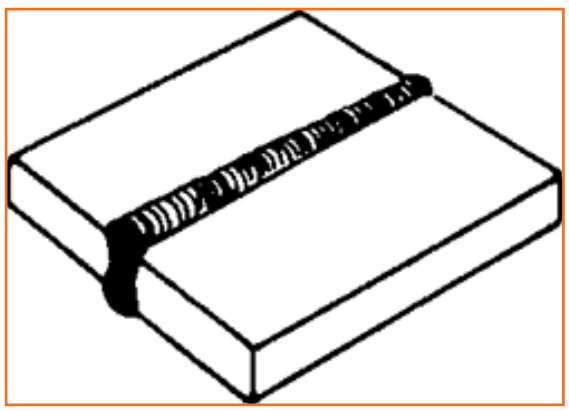


Fig 4.3.2 Butt joint

1. **Butt Joints:** Butt welds are welds where two pieces of metal are joined at surfaces that are at 90 degree edges to the surface. Butt joints are utilized with thin sheet metals which are welded with a solitary pass. Problems occur with butt welds are the slag formation, porosity, or breaking of sheet.

   Types of butt welds are: single welded butt joints, twofold welded butt joint, and open or closed butt joints

Basic butt joints are:

- **Square butt joint** - The square-groove is a type of butt joint in which two meal sheet pieces are level and parallel to each other. This joint is easy to get ready, efficient to utilize, and gives agreeable quality, yet is constrained by joint thickness.
- **V-Joint -** Single-V butt welds need aid comparative with an angle joint, yet all the as opposed to special case side hosting beveled edges. When thick metal sheets have to weld from both sides, use V- butt joint.
- **J-Joints** - Single-J butt welds makes particular piece of the weld which can be fit as a fiddle of a j but filler material used and the other metal piece can be square in shape.
- **U-Joints** - Single-U butt welds both edges of the metal surface formed like a J, Be that as when they weld together, they form an U.

2. **T-Joints:** When one section of metal piece has to be joined to the focal point of another part and makes shape of a "T", then T-joints can be used. Techniques for welding tee joints include welding the two joints between the parts, with either a high or low energy density beam.

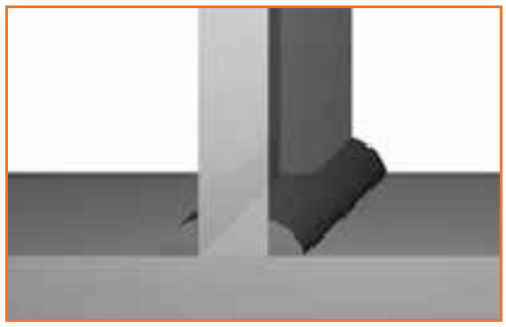


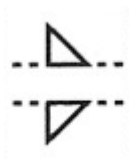
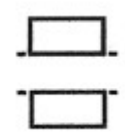
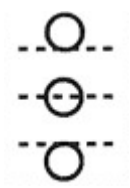
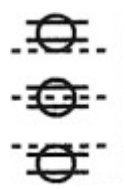
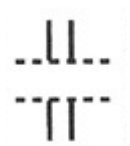
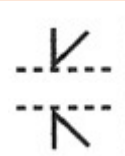
Fig 4.3.3 T-Joint

3. **Lap joint:** A Lap joint is framed when one piece to be welded is set down and another piece is covered to shape an edge for filet welding or a range to permit attachment or opening welding. Lap joints are regularly utilized when attachment or opening welding more slender areas. Different welds might be connected to laps, for example, projection, or crease welding.
4. **Corner joint:** A corner joint is framed by putting one piece to be welded on the other so that a corner is shaped. The corner might be Flush; Half Open; or Fully Open. An edge planning might be connected to one, or both of the bits of the joint for infiltration and quality.
5. Edge joint: When two edges of the pieces to be welded come together then an Edge joint is formed. This joint might be shaped as an aftereffect about in turn structural state also is not similarly as broadly utilized Likewise some of the other joints.

4.3.2 Weld joints

In order to produce weldments, it is necessary to combine the joint types with weld types to produce weld joints for joining the separate members. Each weld type cannot always be combined with each joint type to make a weld joint. The table below shows the welds applicable to the basic joints.

Welds applicable to basic joint combinations

Weld type	Symbol	Butt	Corner	Edge	Lap	Tee
Fillet		Special	Yes	Special	Yes	Yes
Plug or slot					Yes	Yes
Spot or projection					Yes	Special
Seam			Special		Yes	Special
Square groove		Yes	Yes	Yes		Yes
Vee groove		Yes	Yes	Yes		Yes
Bevel groove		Yes	Yes	Yes	Yes	Yes

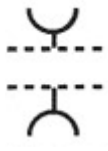
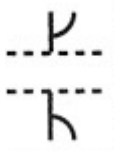
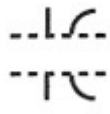
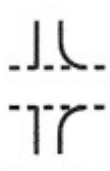
Weld type	Symbol	Butt	Corner	Edge	Lap	Tee
U groove		Yes	Yes	Yes		
J groove		Yes	Yes	Yes	Yes	Yes
Flare V groove		Yes	Yes			
Flare bevel groove		Yes	Yes		Yes	Yes
Backing weld		Com-bined	Com-bined			Com-bined
Surfacing						
Flange edge				Yes		
Flange corner			Yes			

Table 4.3.1 Weld joints basic information

4.3.3 Weld Joint Design and Preparation

A. **Function:** Weld joints are designed to exchange the focus on components of the joint. Forces and loads are introduced at special points and are passed on to special areas during the weldment. For designing weld joint, information of load and service of weldment is necessary.

B. **Categories:** All weld joints can be arranged into two essential classifications:

- full penetration joints
- half penetration joints

In full penetration joint arc penetrates the whole cross-segment of the weld joint.

In half penetration joint, there is an unfused zone and arc does not enter the joint completely.

C. **Strength:** The quality of weld joints depends on the span of the weld, as well as on weld metal quality.

When welding heat treated materials, extra safety is required to ensure no wipe out of heat treatment of the base metal by welding heat; otherwise weld will be of poor quality.

D. **Design:** The weld joint is planned in such a way that the cross-sectional region of weldment is as minimum as possible. The cross-sectional area is an estimation of the amount of weld metal which is utilized for making the joint.

Carbon and low alloy joint design and preparation: These joints are made by cutting, machining or crushing. Before welding, clean the joint surface from dirt, paint, scale or rust. Clean the surface by cleaning agents or solvents. Don't scratch the joint surface because scratches may obstruct the welding operation and make imperfections.

Aluminium and aluminium alloy joint design and preparation: Check your plan to stay away from blunders. Before welding, clean the joint surface from dirt, paint, scale or rust. Clean the surface by cleaning agents or solvents. Don't scratch the joint surface because scratches may obstruct the welding operation and make imperfections.

Stainless steel alloy joint design and preparation: These weld joints are made by plasma arc cutting or by machining or grinding. Before welding, clean the joint surface from dirt, paint, scale or rust. Clean the surface by cleaning agents or solvents. Don't scratch the joint surface because scratches may obstruct the welding operation and make imperfections.

Exercise

1 Which of the following is an example of plastic welding?

(a) Gas welding (b) Arc welding

(c) Forge welding (d) Thermit welding

2 Which of the following is an example of fusion welding?

(a) Arc welding (b) Forge welding

(c) Resistance welding (d) Thermit welding with pressure

3 Single-V and single-U butt welds are used for sheets of thickness

(a) upto 10mm (b) 5-15mm

(c) 10-20mm (d) 15-25mm

4 Double-V and double-U butt welds are used for plates of thickness

(a) 1-5mm (b) 5-10mm

(c) 10-15mm (d) Over 15mm

5 Which of the following types is not fillet weld?

(a) butt joint (b) lap joint

(c) T-joint (d) Corner joint

6 The voltage used in resistance welding is generally kept between

(a) 4-12 volts (b) 12-20 volts

(c) 20-28 volts (d) 28-36 volts

7 Heat is created by chemical reaction in

(a) Resistance welding (b) Oxy-acetylene welding

(c) Tungsten arc welding (d) Thermit welding

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