

Basic Manufacturing Systems

[ME1083]

School Of Mechanical Engineering
KIIT Deemed to be University

Introduction to Welding Section

- What is **Welding**?
- Welding is a *fabrication process* whereby two or more parts are fused together by means of *heat, pressure or both* forming a join as the parts cool.
- Welding is usually used on *metals* and *thermoplastics* but can also be used on nonmetals.
- The completed welded joint may be referred to as a **weldment**
- The parts that are joined are known as a **parent material**. The material added to help form the join is called **filler or consumable**

Introduction to Welding Section

- **Advantages of Welding**
- Strong and tight joining
- Cost effectiveness
- Simplicity of welded structures design
- Welding processes may be mechanized and automated
- **Disadvantages of Welding**
- Internal stresses, distortions and changes of micro-structure in the weld region.
- Harmful effects: light, ultra violet radiation, fumes, high temperature.

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- **Applications of Welding**
- Buildings and bridges structures
- Automotive, ship and aircraft constructions
- Pipelines
- Tanks and vessels
- Railroads
- Machinery elements

Introduction to Welding Section

- **Classification of Welding?**
- Welding can be broadly classified as -
- **Arc welding**
- **Gas welding**
- Resistance welding
- Solid state welding
- Thermit welding
- Electron beam welding
- Laser welding

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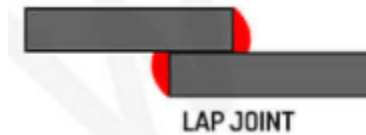
- **Arc welding**
- Arc welding is a welding process, in which heat is generated by an **electric arc struck between an electrode and the work piece.**
- It involves following parts –
 - Power supply (AC or DC);
 - Welding electrode;
 - Work piece;
 - Welding leads (electric cables) connecting the electrode and work piece to the power supply

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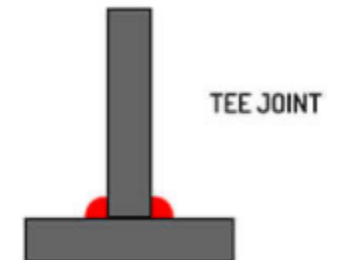
- Types of **Joints**
- **Butt joint** - A connection between the ends or edges of two parts making an angle to one another of $135-180^\circ$ inclusive in the region of the joint.



- **Lap joint** - A connection between two overlapping parts making an angle to one another of $0-5^\circ$ inclusive in the region of the weld or welds



- **T joint** – A connection between the end or edge of one part and the face of the other part, the parts making an angle to one another 90° in the region of the joint.

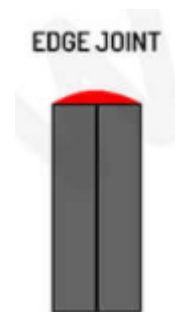


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- Types of **Joint configurations**
- **Corner joint** – A connection between the ends or edges of two parts making an angle to one another of more than 30° but less than 135° in the region of the joint.

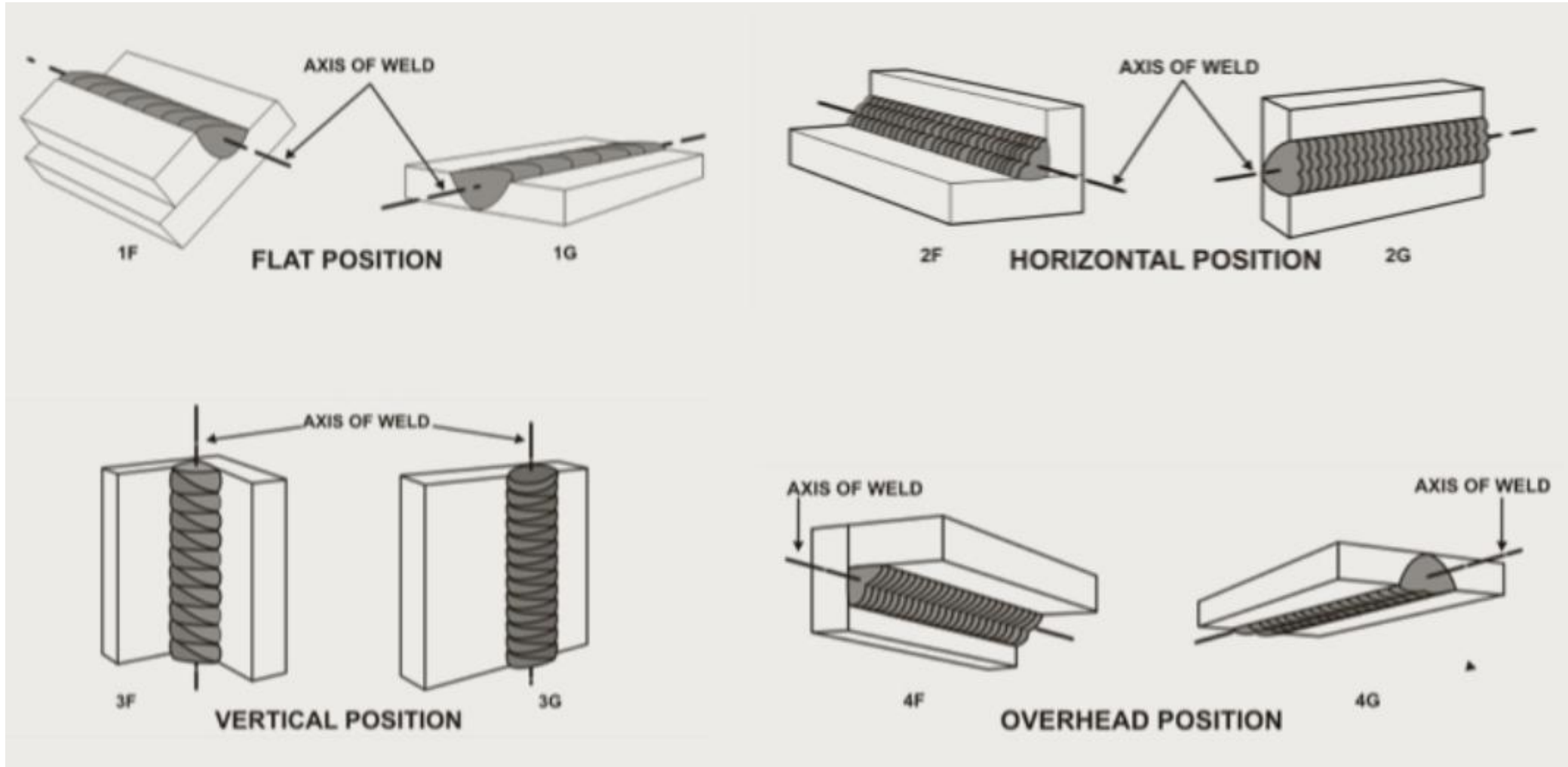


- **Edge joint** - A connection between the edges of two parts making an angle to one another of 0 to 30° inclusive in the region of the joint



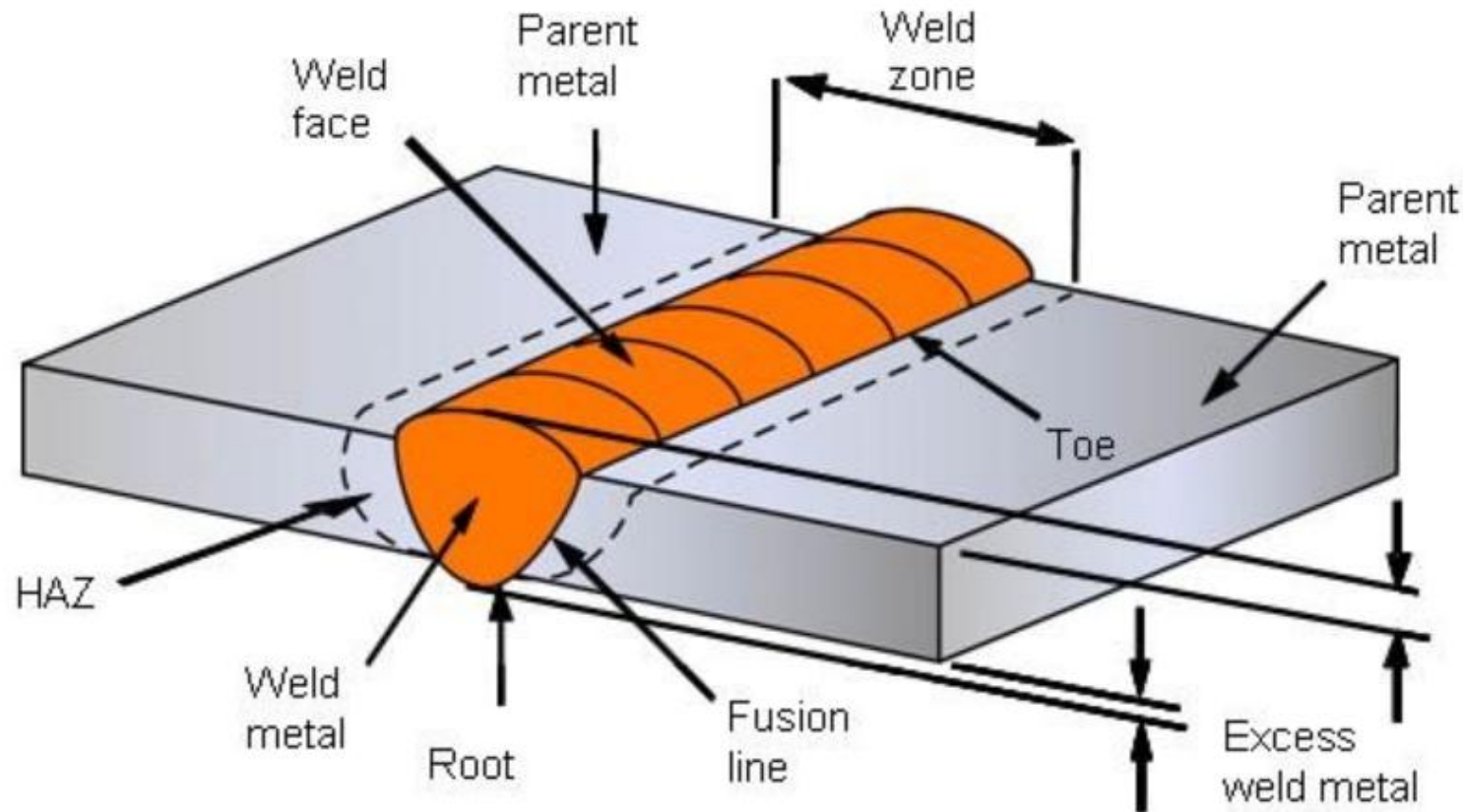
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- Welding Positions



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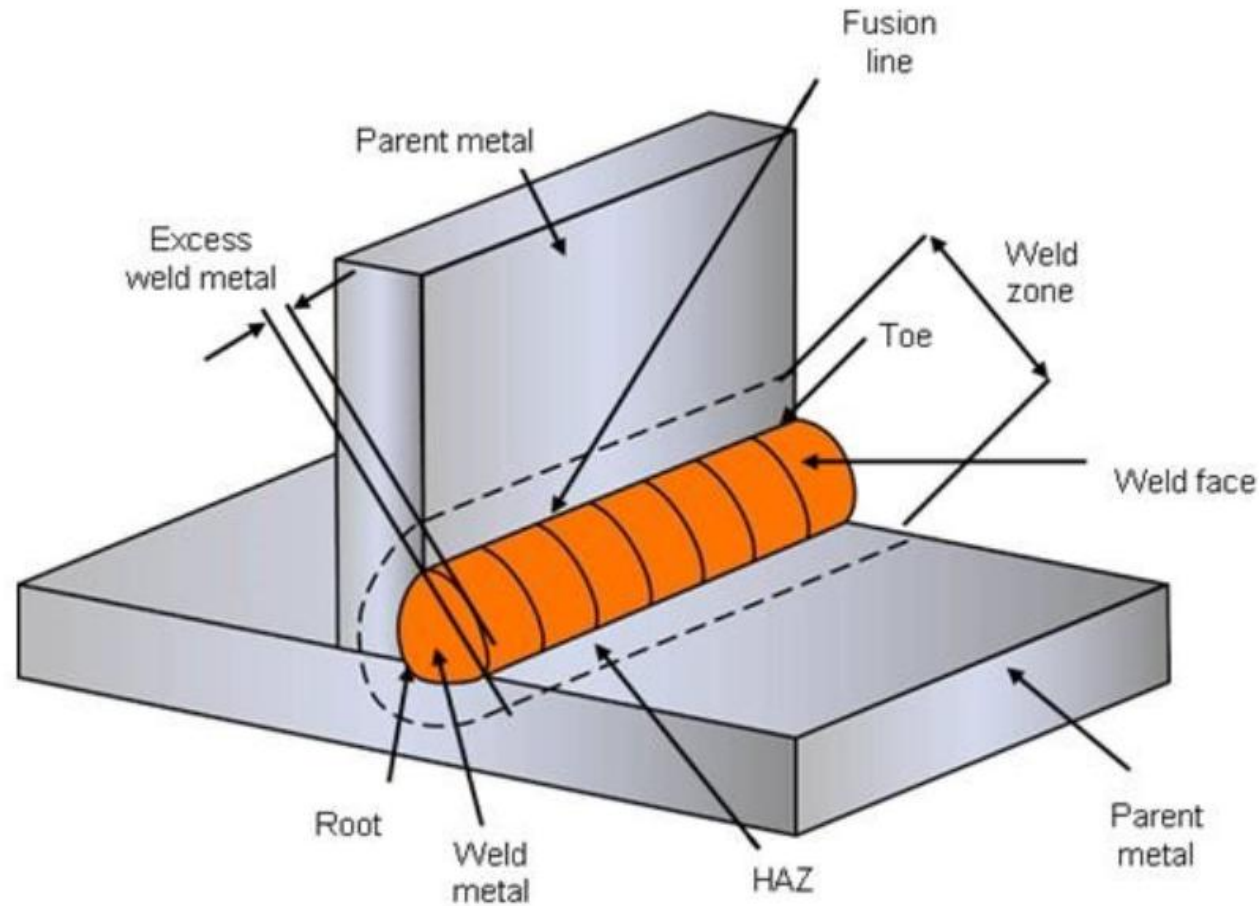
- Features of a completed *Butt* weld



Butt weld

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- Features of a completed *Fillet* weld

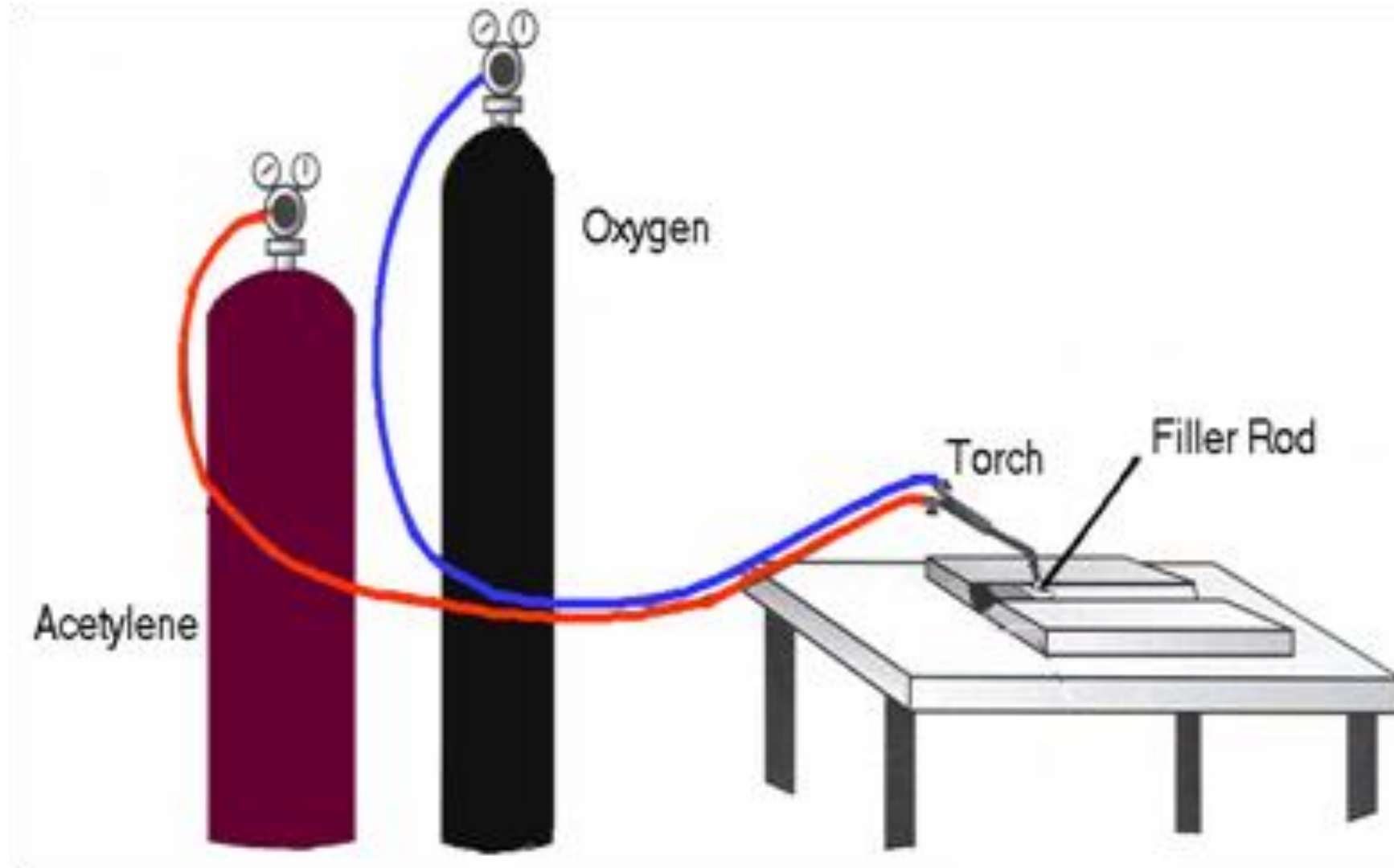


Fillet weld

Safety Precautions

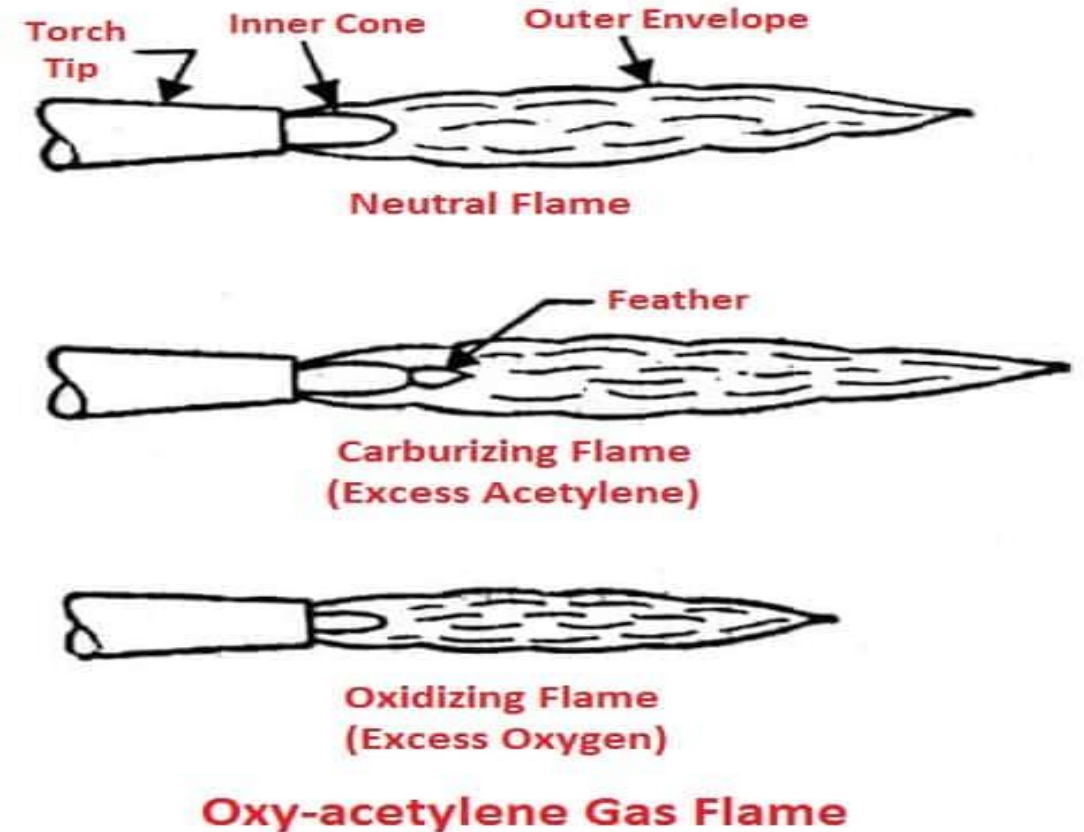
- Safety precautions to be followed in Welding section
 - Always wear gloves, to avoid injuries to hand by sharp edges and corners of the cut piece
 - Don't touch any live electrical parts to avoid shocks or burns
 - Ensure the welding cables and electrode holder are properly insulated
 - Don't see the welding arc through naked eye to avoid UV rays
 - Always use a tong for holding heated job piece

Gas Welding



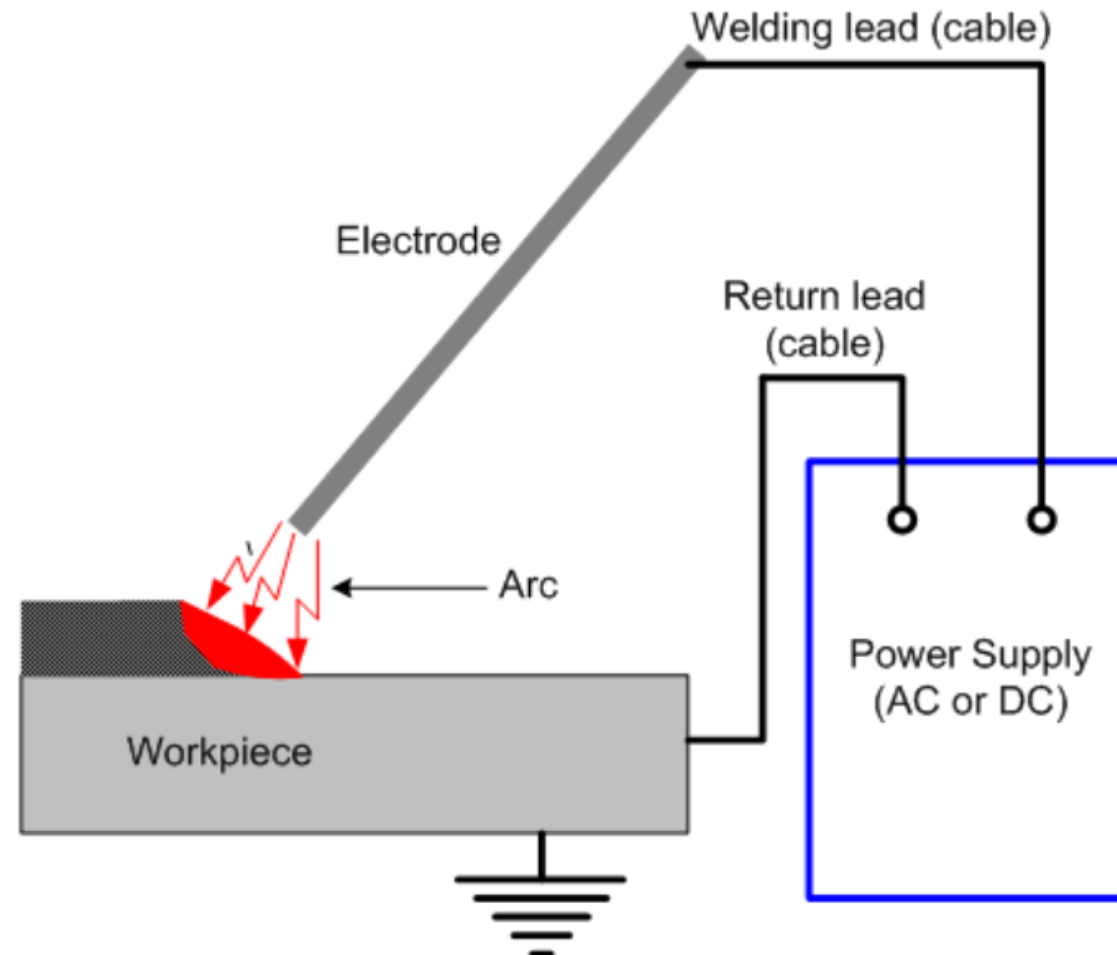
Gas Welding

- 1. Neutral Flame:** Acetylene and Oxygen in equal proportion. (3100°C) This flame is used to weld Mild Steel, Stainless Steel, Cast Iron, etc.
- 2. Carburising Flame :** Has excess of Acetylene than Oxygen gas and can be recognized by the feather. (2900°C) . Used to weld non-ferrous metals.
- 3. Oxidising Flame :** Has excess Oxygen than Acetylene. (3300°C). Used to weld Zinc, Copper, etc



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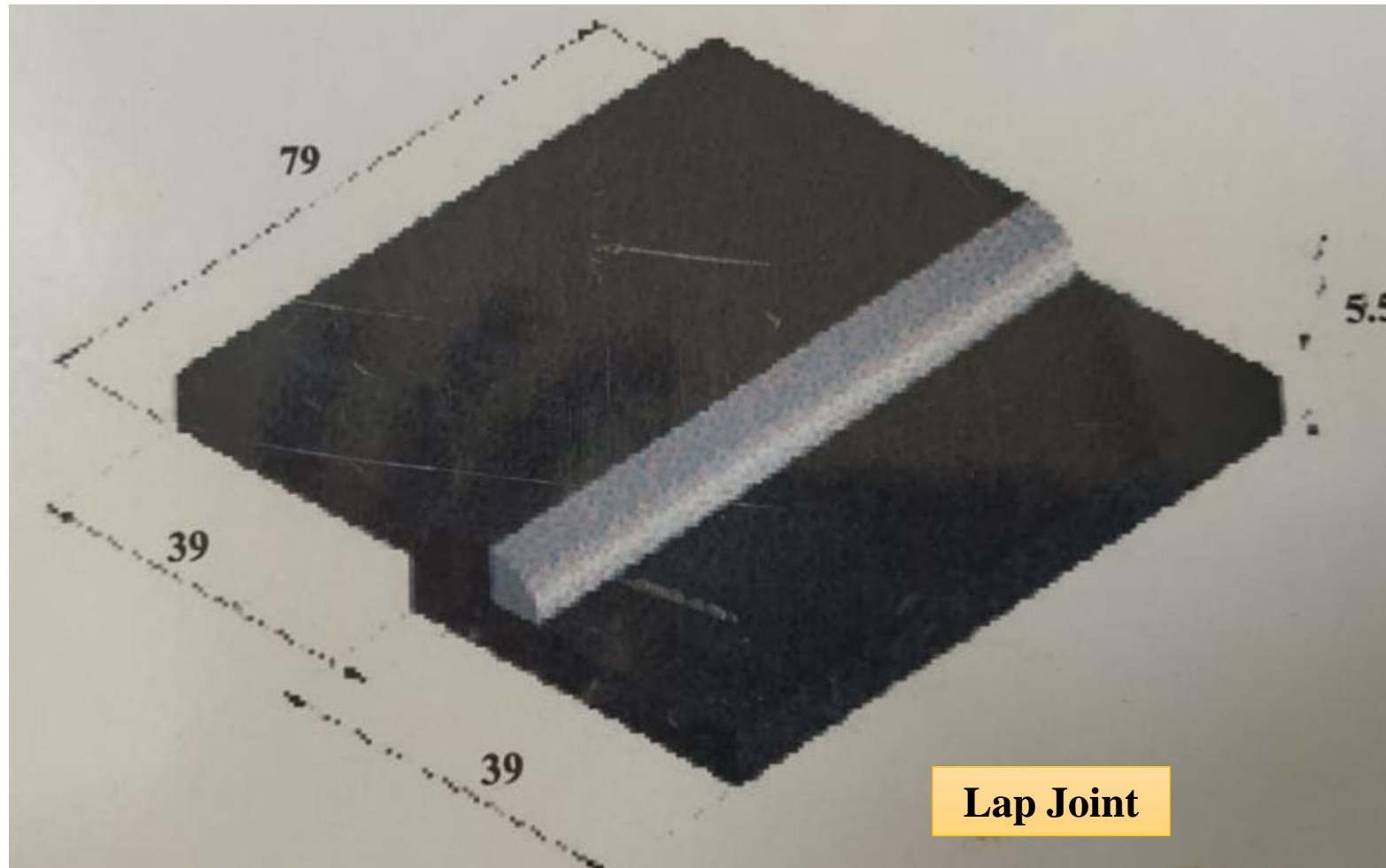
Arc Welding



Welding Section Experiment

- **Aim of experiment:** To prepare a **Lap Joint** (single fillet weld) by shield metal arc welding (SMAW) process
- **Raw Material Required:** Two MS Flat [80x40x6 mm]
- **Tools required:** SMAW machine (Inverter or transformer type), Bench vice, Flat file, Hacksaw, Steel rule, Try square, Chipping Hammer, Wire brush, tong, Welding screen
- **Welding Consumables:** Flux coated electrodes [3.15 mm dia, *Cellulose coated AWS E6010*]
- **Operations involved**
 - Measuring and marking
 - Filing
 - Welding
 - Chipping

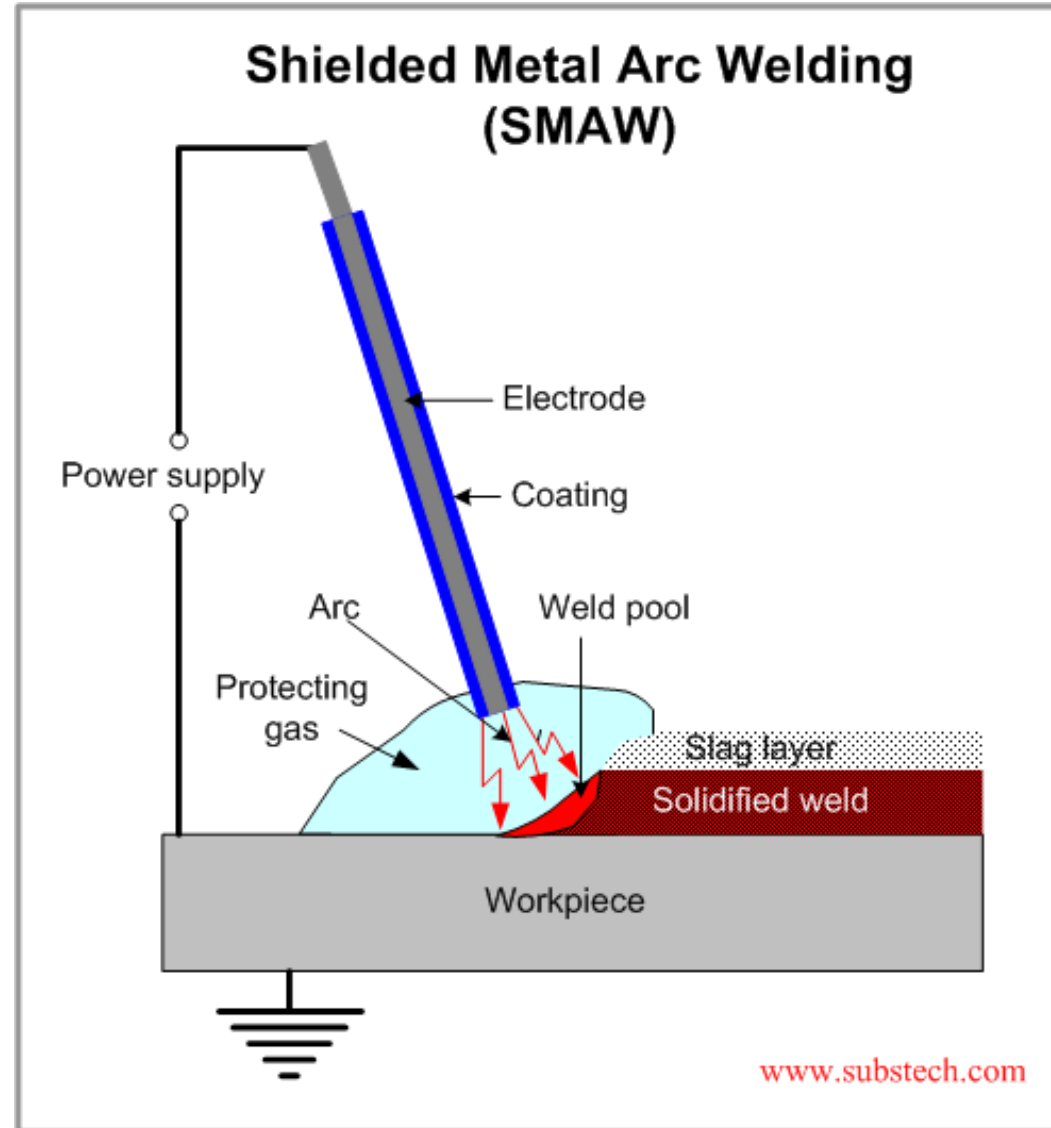
Layout of the Job



Shielded Metal Arc Welding [SMAW]

- **SMAW** (Stick welding, Manual metal arc welding) uses a *metallic consumable electrode* of a proper composition for generating arc between itself and the parent work piece. The molten electrode metal fills the weld gap and joins the work pieces
- The electrodes are coated with a shielding flux of a suitable composition. The flux melts together with the electrode metallic core, forming a gas and a slag, shielding the arc and the weld pool.
- The flux cleans the metal surface, supplies some alloying elements to the weld, protects the molten metal from oxidation and stabilizes the arc.
- The slag is removed after Solidification.

Shielded Metal Arc Welding [SMAW]



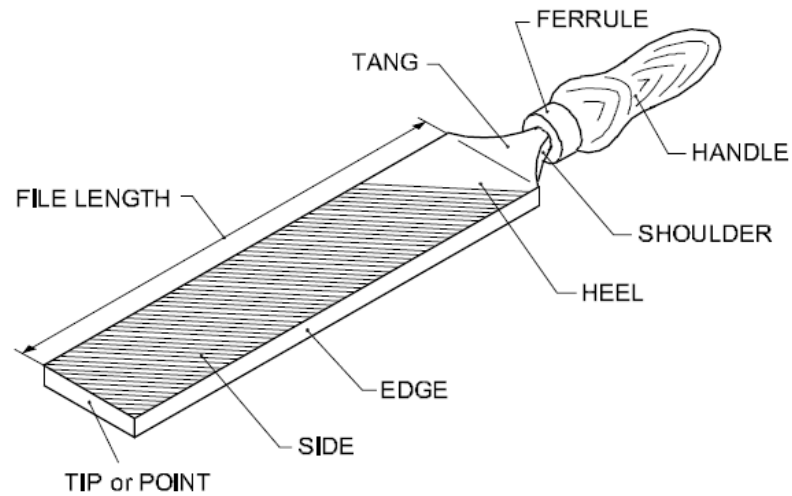
Arc Welding

- **Arc Length** - It is the straight distance between the electrode tip and the job surface when an arc is formed
- **Types of Arc length** –
- *Normal Arc Length* - The correct arc length or normal arc length is approximately equal to the diameter of the core wire of the electrode.
- *Long Arc Length* – If the distance between the tip of the electrode and the base metal is more than the diameter of the core wire, it is called ‘Long arc’.
- *Short Arc Length* – If the distance between the tip of the electrode and the base metal is less than the dia. of the core wire, it is called a ‘short arc’.

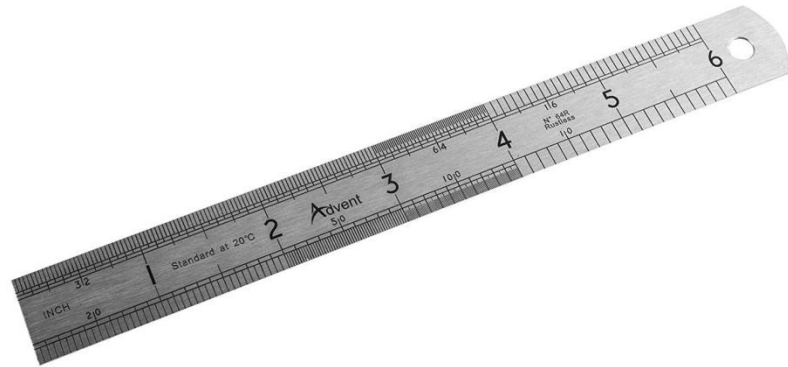
Measuring and Marking Operations

- The measuring and the marking operations are the basic operations to prepare the prime workpieces as per required dimension by the help of different tools
- Tools used are:
 - Steel rule
 - Try square
 - Hacksaw
 - Flat file

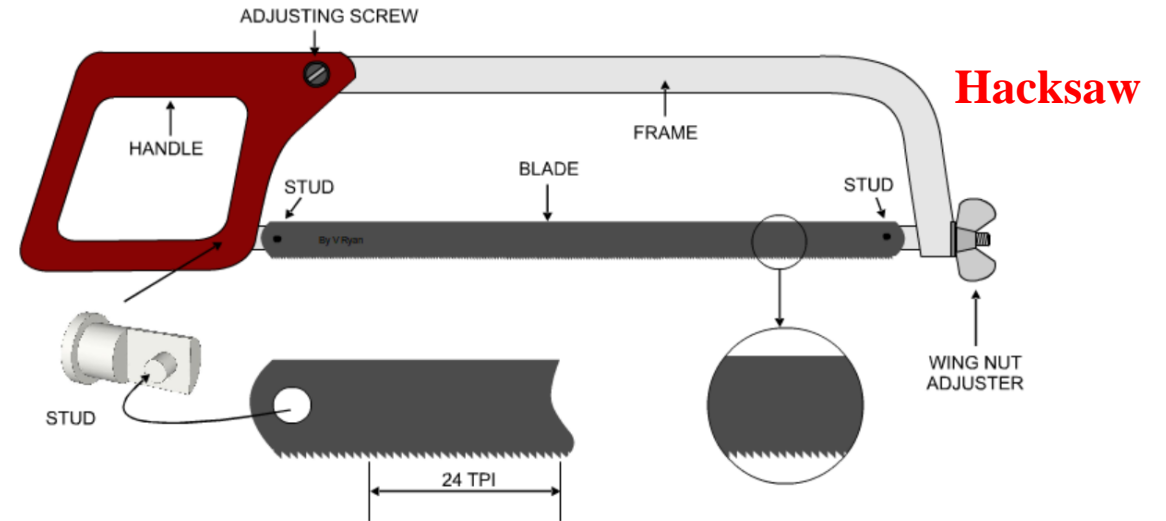
Measuring and Marking Operations



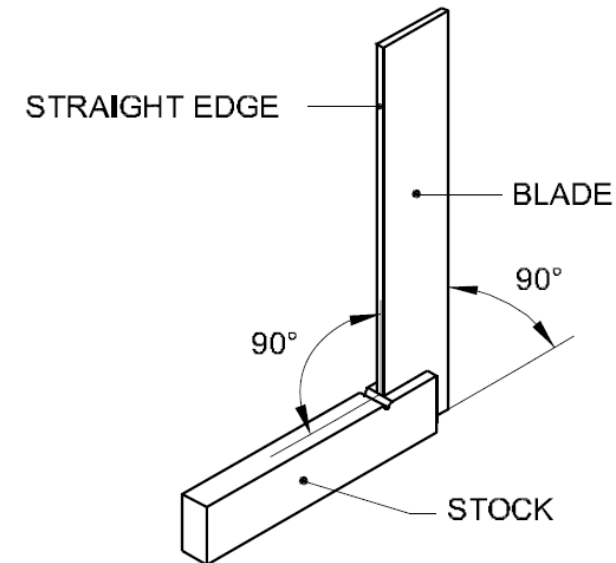
Flat file



Steel rule



Hacksaw



Try Square

Procedure

- **Step by step procedure**

- Mark and cut two pieces of *MS Flat* as per the required dimensions [*i.e.* **80x40x6 mm**].
- Remove any contaminations from the surfaces to be weld by Filing operation
- After filing the final dimension of the pieces should be **79x39x5.5 mm**
- Set the welding machine with suitable parameter and the electrodes should be fixed in the holder
- For the given thickness, the *Current* value would be *90 to 110 amps.* and the *voltage* value would be *40 to 60 volts.*
- Select the right polarity to achieve better weld quality. [DC output with constant voltage and electrode as negative is called **Direct Current Straight Polarity (DCSP)**; when polarity is negative and electrode is positive, it's called as **Direct current Reverse Polarity (DCRP)**]
- Then, the workpieces can be placed in the welding booth

Procedure

- **Step by step procedure**

- The operator must equip with all Personal Protective Equipment (PPE) such as Safety shoes, Apron, welding screen and leather gloves before starting the welding process
- First, tack the job at its two extreme ends
- Start the welding with suitable welding speed and position. For the given thickness, single pass welding will be enough
- After finishing the welding, take out the job from the booth using a tong and let it cool down at room temperature
- Then, do the chipping operation using a chipping hammer to remove any spatter, slag and any other contaminations
- Finally, clean the weldment using a wire brush
- Submit your completed job to the concerned person in the lab mentioning your Name and Roll No.

Cutting Operation

- The required raw materials [**Two MS flats of 80mm length**] should be cut from a given long flat
- Initially, the long flat must be marked and then fixed in the bench vice
- After fixing, using the hacksaw the flat has to be cut into two required pieces
- Tools used
 - Bench vice
 - Hacksaw



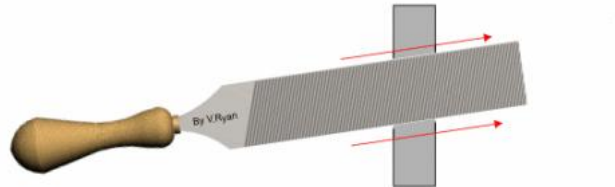
Hacksaw



Bench vice

Filing Operation

- After the cutting operation, the cut pieces will be filed to smooth the surfaces and to remove any unwanted rust from the surfaces
- For this operation, the pieces will be fixed in the bench vice and filed using the *flat file*
- After, filing the try square can be used to check the perpendicularity of two adjacent sides of the workpieces
- Tools used
 - Flat file
 - Try Square



Filing Operation using Flat file



Try Square

Welding Operation

- The welding operation (arc welding) will be carried out to prepare the required lap joint using arc welding machine (SMAW)
- Tools used:
 - SMAW machine
 - Electrode holder
 - Flat tong
 - Hand screen

Welding Operation



SMAW machine



Electrode Holder



Hand Screen



Flat Tong

Cooling Operation

- After the completion of welding operation, the weldment temperature is very high and therefore, its cooled down to room temperature by dipping inside a sand bucket
- Tools used:
 - Flat tong
 - Sand bucket

Chipping Operation

- **What is chipping operation?**
- A method of removing surface defects with a chipping hammer, so that the defects will not be worked into the finished product
- Chipping is used to remove scale, rust, or other foreign materials from the workpiece.
- It can also be used between beads to remove slag, and after welding to ensure a neatly finished weld.
- Chipping is often used in combination with wire brushing to prepare surfaces
- Tools used
 - Chipping hammer
 - Tong
 - Wire brush



Chipping hammer



Wire brush