

# PRESENTATION ON “Welding” (By kashish)



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## Manufacturing

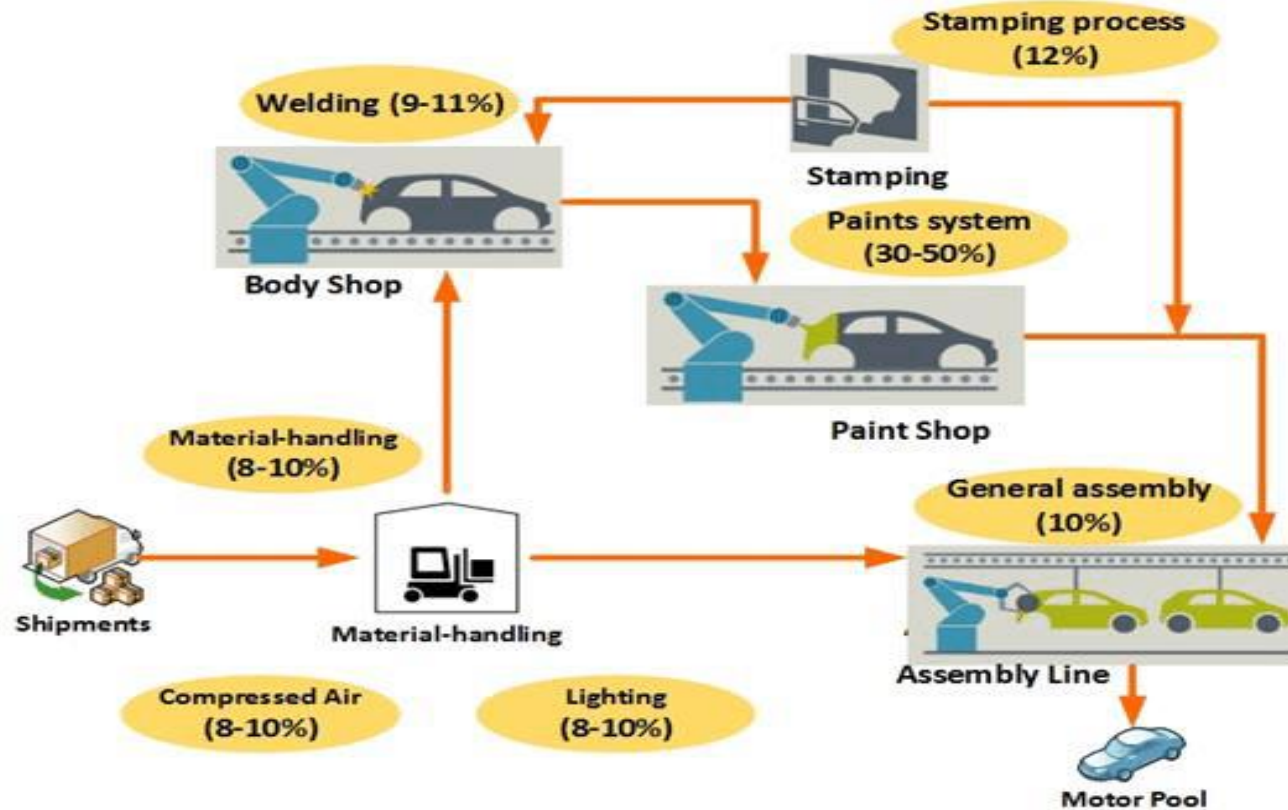
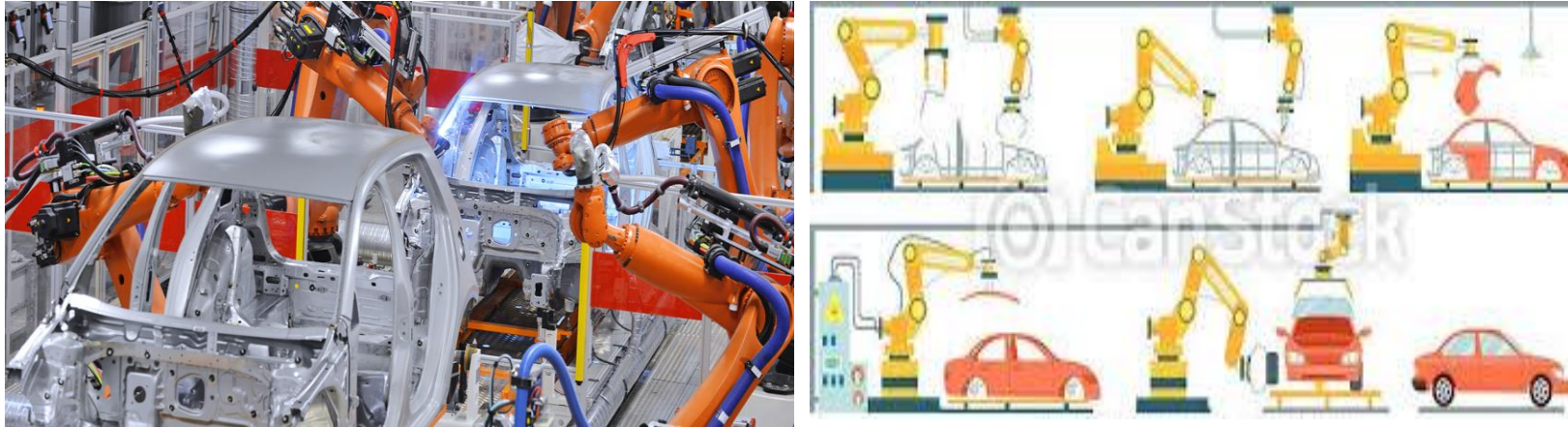
Manufacturing technology primarily involves:

- ☐ Sizing
- ☐ Shaping
- ☐ Imparting desired combinations of **properties** to material

Primarily to have a component or engineering system being produced can perform indented function for design life.

These is achieved by surface engineering and heat treatment.

## Typical Example: Many manufacturing processes



- Different material
  - Aluminum alloys
  - Steel
  - Cast iron
- Different manufacturing processes:
  - Forming
  - Casting
  - Machining
  - Joining

## Fundamentals natures of manufacturing processes

Based on the way by which particular shape is given can be classified as: positive, negative and zero processes.

- Casting: Zero process (shifting of material)
- Forming: Zero process (shifting of material)
- Machining: Negative process (removal of material)
- Joining (Welding): Positive process (addition of extra material is added)

This grouping is based on the way that bulk materials processed for shaping.

## Why many manufacturing processes?

A wide range of manufacturing processes have been developed in order to produce the engineering components of

- Different geometries: simple to complex
- Using materials of different properties
  - Physical: melting, thermal expansion
  - Chemical: oxidation, corrosion
  - Mechanical: strength, ductility
  - Dimensions properties: tolerance, size

# 7. Additive Manufacturing

## 1. CASTING

Centrifugal Casting, Die Casting,  
Sand Casting, Permanent Mold  
Casting, Shell Molding

## 2. MOLDING

Injection Molding, Blow Molding,  
Extrusion Molding, Rotational  
Molding, Thermoforming, Powder  
Metallurgy

## 3. FORMING

Forging, Bending, Stamping,  
Shearing

# MANUFACTURING PROCESS TREE

## 4. MACHINING

Milling, Turning, Shaping,  
Drilling, Honing, Finishing

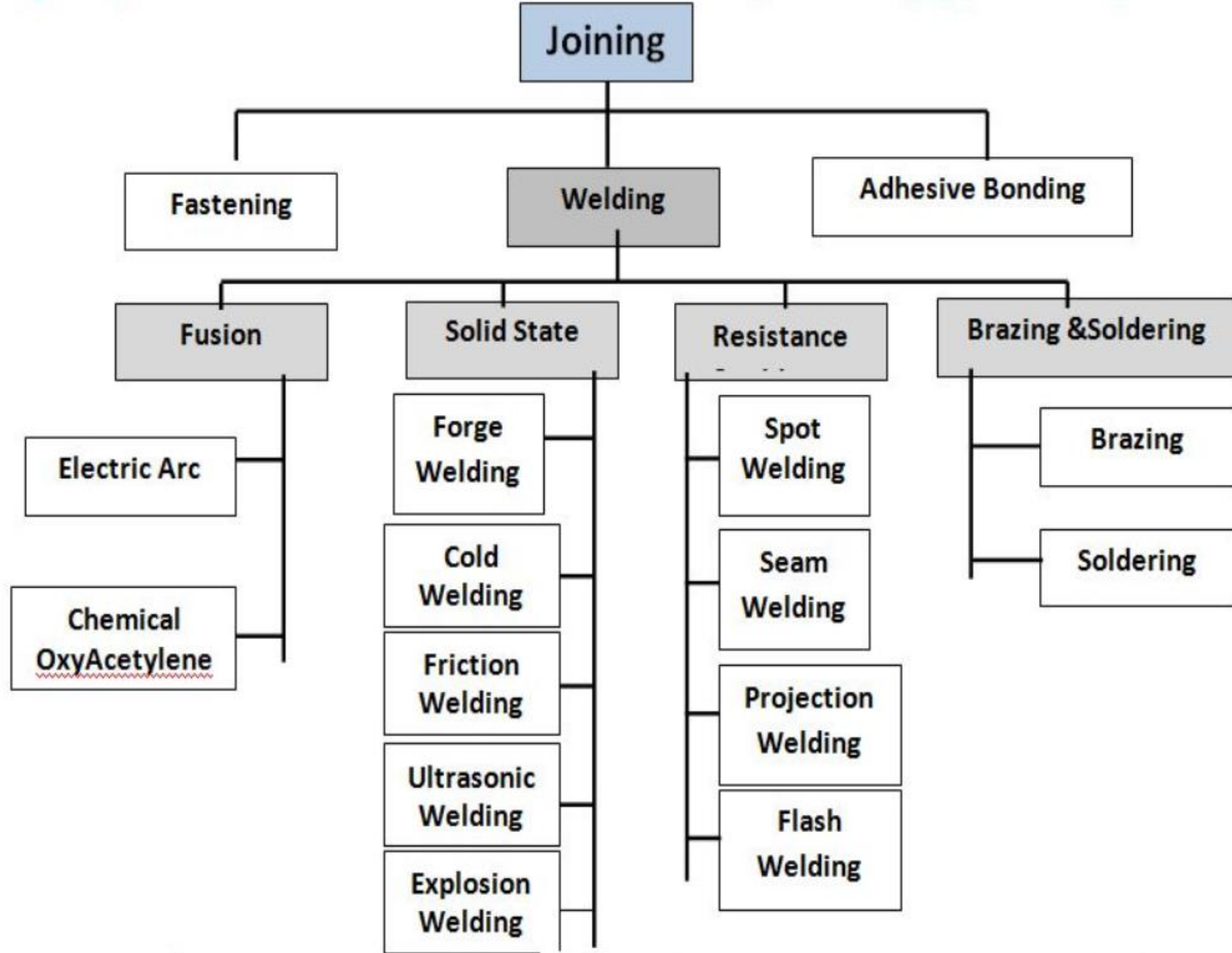
## 5. JOINING

Welding, Soldering, Brazing,  
Adhesive Joining, Fastening

## 6. COATING

Powder Coating, Electroplating,  
Sputter deposition





## Joining Process

A positive (addition) process used for assembling different members to get desired configuration.

Joining term covers processes such as:

1. **Welding**
2. Brazing and soldering
3. Adhesive bonding
4. Mechanical fastening

These processes are an important for the following reasons:

- The product is impossible to manufacture as a single piece.
- The product is easier and more economical to manufacture as individual components, which are then assembled.
- Transporting the product in individual components and assembled them at the customer's plant may be easier and less cost.



## How to select suitable of a joint?

Based on requirement of a joint:

- ☐ Temporary joint: rivets, nut-bolts, adhesive
- ☐ Permanent joints: weld joints, braze weld, solders

Based on compatibility between members to be joined:

- ☐ Similar: Welding
- ☐ Dissimilar: Brazing & soldering, adhesive, mechanical joints.

Based on the materials to be joined:

- ☐ Melting point
- ☐ Selection size or thickness
- ☐ Thermal expansion coefficient

Based on service conditions for joints:

- ☐ Low or high temperature
- ☐ Corrosion (chemical environment)
- ☐ Type and magnitude of loading: Static or dynamic loading

# WELDING

- Welding is a materials joining process which produces coalescence of materials by heating them to suitable temperatures with or without the application of pressure or by the application of pressure alone, and with or without the use of filler material.
- Welding is used for making permanent joints.
- It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work and ship building.



## Common terms in welding

- **Base metal:** The base metal is the metal that is to be welded or cut. It is commonly referred to as the workpiece.
- **Butt weld:** A butt weld is a joint between two workpieces that are aligned on the same plane.
- **Cover pass:** The cover pass finishes the welded joint. It is higher than the adjacent surface and overlaps the groove.
- **Fillet weld:** A fillet weld is the joining of two workpieces with triangular cross-sections at approximately 90 degrees.
- **Polarity:** Polarity is the manner in which the electrode holder and workpiece connect to the electrical supply.
  - DCEN: direct current electrode negative (Straight polarity)
  - DCEP: direct current electrode positive (Reverse polarity)

- **Weld metal:** The weld metal is the portion of the base metal that is melted during the welding process.
- **Welding electrode:** In arc welding, the electrode is used to pass current through the workpiece to fuse the two pieces together.
- **Weld pass:** A weld pass is a single progression of welding along the joint. After a complete pass, it is referred to as a weld bead.
- **Weld groove:** Weld groove refers to a V- or U-shaped groove created by the beveling of the workpiece edges that will be joined.
- **Heat-affected zone:** The heat-affected zone is the area of metal near the weld metal that was not melted during welding, but did experience changes in its mechanical properties and/or microstructure due to the heat applied.

## Main components needed to create a weld

There are three main components needed to create a weld.  
These are:

- **Heat source:** an electric arc, a flame, pressure, or friction. The most common heat source is an electric arc. An arc is the physical gap between the end of the electrode and the base metal. The physical gap causes heat due to resistance of current flow and arc rays. The arc melts the metals to create the joint.
- **Shielding gas:** which is used to protect the weld from air as the weld is being formed. Oxygen from the air makes welds brittle and porous.
- **Filler material:** is the material used to join to the two pieces together.

# Welding

```
graph TD; A[Welding] --> B[Solid State Welding]; A --> C[Fusion Welding]; C --> D[Autogenous Welding]; C --> E[Homogeneous Welding]; C --> F[Heterogeneous Welding]; D --> G[No filler material]; E --> H[Filler material of composition same with base material]; F --> I[Filler material of composition different from base material];
```

Solid State  
Welding

Fusion  
Welding

Autogenous  
Welding

No filler  
material

Homogeneous  
Welding

Filler material  
of composition  
same with base  
material

Heterogeneous  
Welding

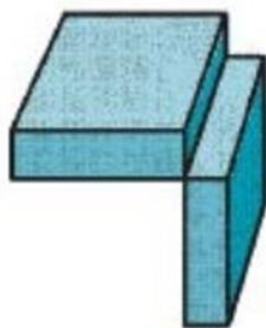
Filler material  
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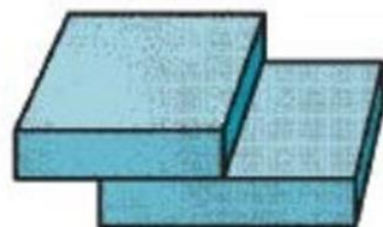
# Types of joints in welding



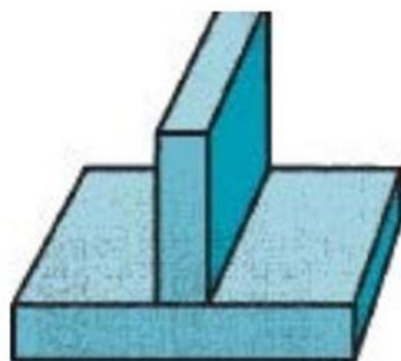
Butt joint



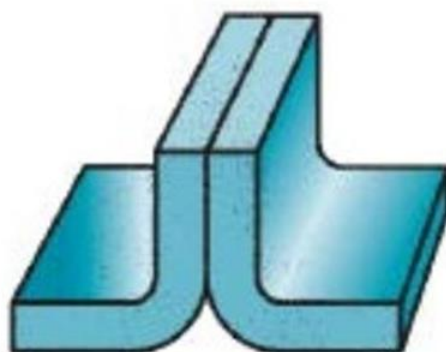
Corner joint



Lap joint




Tee joint



Edge joint

# *Applications of welding*

- ▶ Buildings and bridges structures;
  - ▶ Automotive, ship and aircraft constructions;
  - ▶ Pipe lines;
  - ▶ Tanks and vessels;
  - ▶ Railroads;
  - ▶ Machinery elements
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# Some application areas of welding



Aircraft industry



Ship building

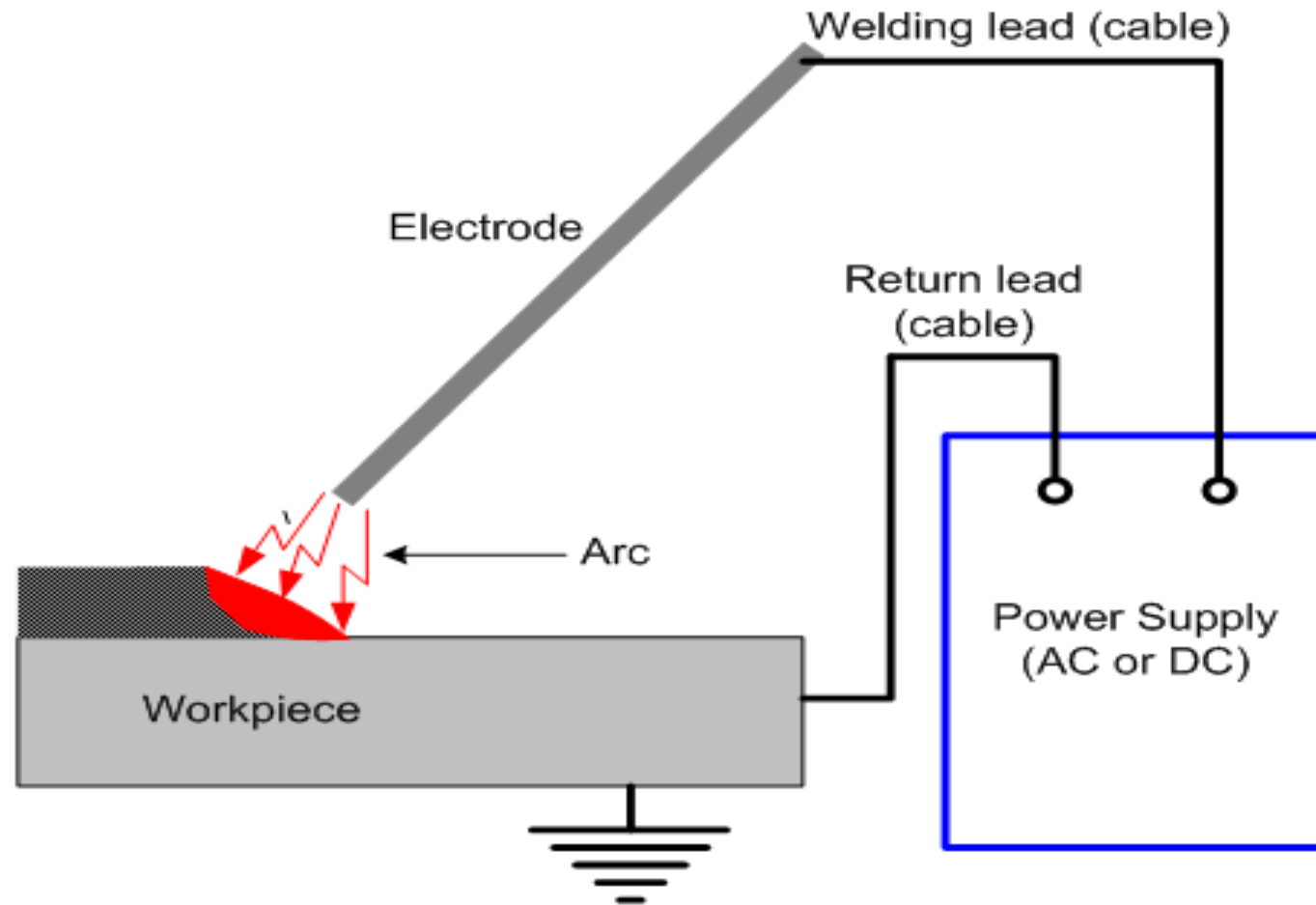


Automotive industry

## Arc Welding

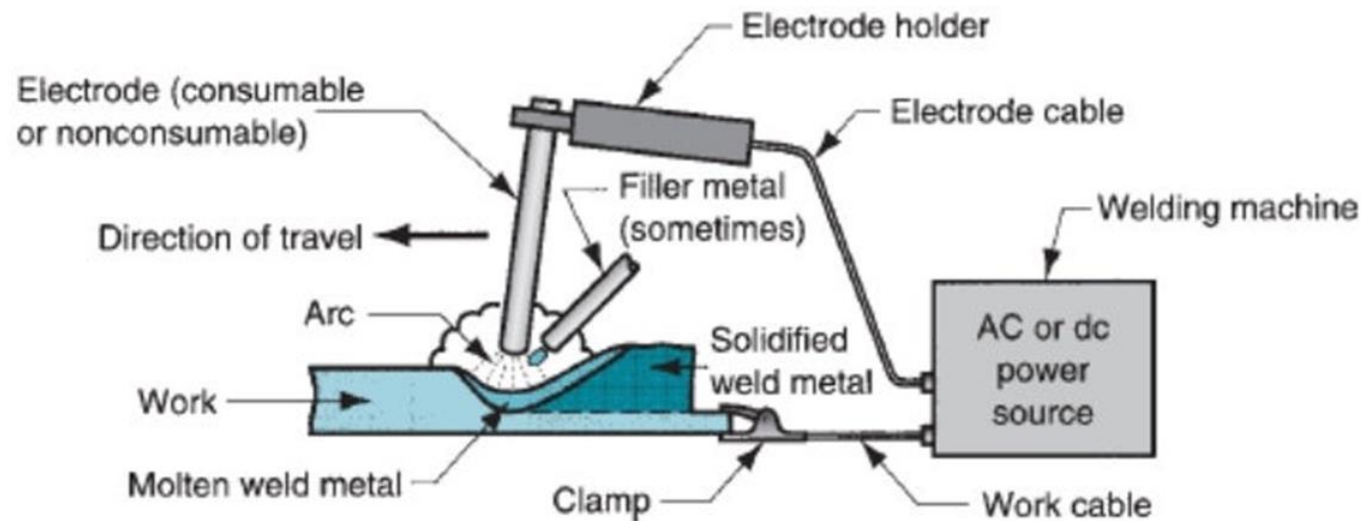
- ❑ Arc welding is a **fusion welding** process which uses an electric arc to produce the heat required for melting the metal.
- ❑ Mostly arc welding is done **without pressure** and **with/without filler metal** depending upon plate thickness.
- ❑ Arc is generated by electrons flowing from negative (-ive) to positive (+ive) terminal and electrical energy is changed in the arc into heat and light.
- ❑ An AC/DC welding power supply, is used to form an electric arc.
- ❑ It is manual arc welding process that uses a consumable electrode coated in flux to lay the weld

# Arc Welding



Basic diagram of arc welding

# Arc welding (AW)- Basic configuration



	Arc welding Types
Consumable electrode	SMAW, GMAW (MIG), Submerged arc welding
Non consumable Electrode	GTAW(TIG)



## Advantages of Arc Welding

- ❖ Cost – equipment for arc welding is well-priced and affordable, and the process often requires less equipment in the first place because of the lack of gas.
- ❖ Portability – these materials are very easy to transport.
- ❖ Works on dirty metal.
- ❖ Shielding gas isn't necessary – processes can be completed during wind or rain, and spatter isn't a major concern.

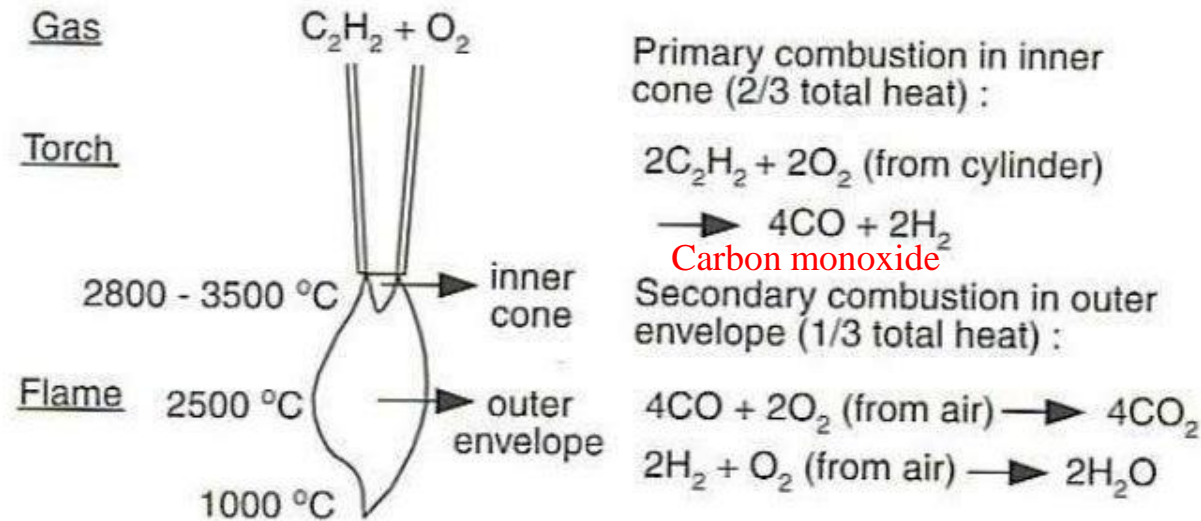
## Disadvantages of Arc Welding

- ❖ Lower efficiency – more waste is generally produced during arc welding than many other types, which can increase project costs in some cases.
- ❖ High skill level – operators of arc welding projects need a high level of skill and training, and not all professionals have this.
- ❖ Thin materials – it can be tough to use arc welding on certain thin metals

## Basic of Gas Welding: Oxyacetylene welding

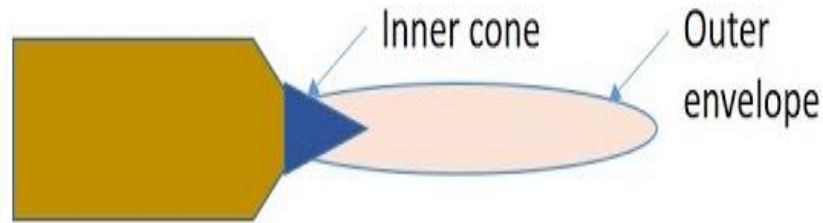
- ☐ Gas welding is a welding process that melts and join metals by heating them with a **flame** caused by a reaction of fuel gas and oxygen.
- ☐ The most commonly used method is Oxyacetylene welding, due to its high flame temperature.
- ☐ The flux may be used to deoxidize and cleanse the weld metal.
- ☐ The flux melts, solidifies and forms a slag skin on weld metal.
- ☐ It utilizes oxygen and fuel gas to heat metal until it is in a molten state and fuse multiple pieces of metal together.

# Chemical reactions and temperature distribution in a neutral oxyacetylene



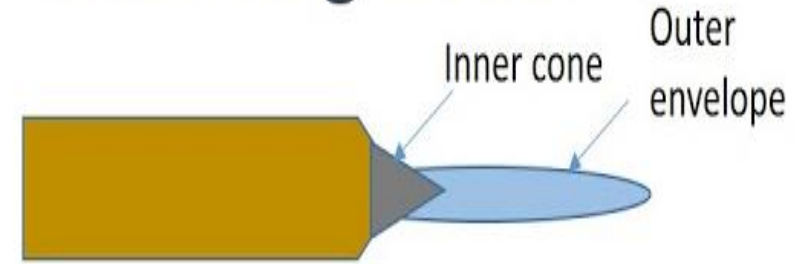
The secondary combustion is also called the protection envelope since CO and H<sub>2</sub> here consume the O<sub>2</sub> entering from surrounding air, thereby protecting the weld from oxidation.

# Neutral flame



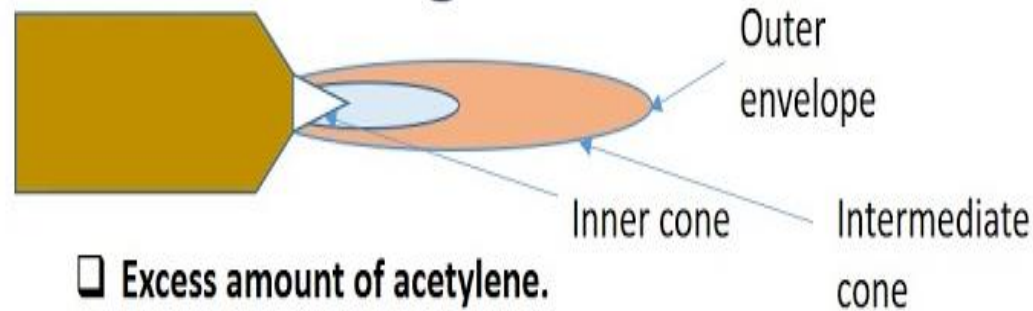
- ☐ Equal amount of oxygen and acetylene.
- ☐ Also known as balance flame.
- ☐ Used for mild steel and stainless steel

# Oxidising flame



- ☐ Excess amount of oxygen.
- ☐ Inner cone is less luminous and shorter.
- ☐ Outer envelope is short and narrow.
- ☐ Used on copper and zinc

# Carburising flame



- ☐ Excess amount of acetylene.
- ☐ It has three sections:-An inner cone
- ☐ An intermediate cone with whitish colour
- ☐ An outer cone of bluish colour.
- ☐ Used for high carbon steel & cast iron

## Advantages of Gas Welding

- ❑ It can be used to join many different types of metal: - Gas welding can be used to weld ferrous and non-ferrous metals together. This is one of its greatest strengths compared to other welding processes.
- ❑ It does not require the use of electricity: - When we compare gas welding to the other popular weld methods like arc welding, gas welding, gas welding does not require any electricity to operate. Hence, you can use gas welding in places that do not have access to electricity.
- ❑ Cheap Equipment costs:- The initial required capital for gas welding is very low when compared to other forms of welding. For some applications, this is very beneficial.
- ❑ Doesn't require specialized labor: Gas welding doesn't require highly specialized labor. This makes it easier to find gas welders, as well as keeps the labor charge low.
- ❑ Gas welding gear is very portable: The whole setup for gas welding is relatively easy to pick up and move around, unlike some other forms of welding.



## Disadvantages of Gas Welding

- ☐ Not suitable for thick sections.
- ☐ Gas welding tends to provide a low surface finish. This means its welds usually need post-weld finishing if aesthetics are important.
- ☐ Cannot be used for high-strength steel. This is because, but in its very nature, the heated zone can affect the mechanical properties of the parent metals.
- ☐ The slow rate of heating and metal joining compared to other forms of welding.
- ☐ Cannot reach the temperatures of arc welding
- ☐ Doesn't have a dedicated flux shielding system. This can result in some very serious weld defects.

**THANK YOU**