

## Introduction to Metal joining Process:-

In these processes two or more pieces of Metal parts are united together to make sub assembly or final product. The joining processes can be carried out by fusing, Pressing, riveting or any other means of assembling.

Some of the most commonly used joining processes are:-

- (i) soldering
- (ii) welding
- (iii) Brazing
- (iv) Riveting
- (v) sintering

Metal joining processes are categorized as temporary joining process and permanent joining process & the joint made by them as temporary joints & Permanent joints respectively.

Temporary joint can be de-assembled and then re-assembled but a permanent joint can't be de-assembled.

The selection of method of joining depends upon some factors like required strength of joint, thickness & Type of metal to be joined, Mechanical properties of metal, leak proof capability of joint.

## Welding:-

### Definition:-

The welding is a process of joining two similar or dissimilar metals by fusion, with or without the application of pressure and with or without the use of filler material. A welding joint is a type of permanent and leak proof joint. The strength of the joint depends on thickness of weld, type of weld material and type of welding method employed.

### Principle / Concept of welding:-

The basic concept of fusion welding is that molten metal is filled in the gap between two metal pieces to be joined together and allowed to solidify. The solidified metal forms a welded joint b/w the two metal pieces. The concept of non-fusion welding is different in which the joint is made by applying pressure and bringing the molecules close together to activate inter molecular adhesion among them.

## Important Terms used in welding :-

### 1. Autogeneous welding :-

The process of joining similar metals by melting the edges together, without the addition of filler metal is called autogenous welding.

### 2. Homogeneous welding :-

The process of joining similar metals with the help of filler rod of the same metal is called homogeneous welding.

### 3. Heterogeneous welding :-

The process of joining dissimilar metals using filler rod is called heterogeneous welding.

### 4. weldability :-

weldability of the metal is the ease with which two similar or dissimilar metals are joined by fusion with or without the application of pressure and with or without the use of filler metal.

The main factors on which weldability of metal depends are :-

- 1) Composition of the metal.
- 2) welding Techniques, fluxing material and filler material.
- 3) Proper heat treatment before and after the deposition of metal.
- 4) Surface Condition.
- 5) Mechanical properties of metal to be welded like melting point, thermal conductivity & thermal expansion coefficient.

The common metals having weldability in the descending order are . iron, carbon steel, cast iron, low alloy steel and stainless steel.



### Weld Pass:-

A single movement of the welding torch or electrode along the length of the joint, which results in a bead, is called a weld pass.

### 6. Base metal:-

The metal to be joined or cut is termed as the base metal.

### 7. Bead:-

Bead is the metal <sup>added</sup> during welding.

### 8. Penetration:-

It is the depth upto which the weld metal combines with the base metal as measured from the top surface of the joint.

### 9. Root:-

It is the point at which the two pieces to be joined by welding are nearest to each other.

### 10. Weld Metal:-

The metal that is solidified in the joint is called weld metal. It may be only base metal or a mixture of base metal and filler metal.

### Classification/Types of welding:-

welding processes ~~are~~ ~~also~~ broadly divided into the following two groups:-

#### 1. Forge or pressure welding:-

In forge or pressure welding, the workpieces are heated to plastic state and then, the workpieces are joined together by applying external pressure on them. In this case no filler material is used. The forge or pressure welding is classified as follows:-

### Disadvantages:-

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- 1) Since, there is uneven heating and cooling during fabrication, therefore, the members may get distorted or additional stresses may develop.
- 2) jigs and fixtures are required to hold the parts in position.
- 3) Edge preparation is required before welding.
- 4) welding produces the harmful radiation, fumes & spatter.
- 5) Since there is no provision left for expansion and contraction in frame, therefore there is a possibility of cracks developing in it.

### Applications of welding:-

- 1) Automobile Construction.
- 2) Railroad equipment
- 3) Aircraft Construction.
- 4) Building, Bridges Construction.
- 5) Piping and pipe lines.
- 6) Fabrication of jigs, fixtures and machine tools.
- 7) Repair of broken and damaged parts.
- 8) Household furniture
- 9) Storage tanks.
- 10) Material handling equipments etc.

## Commonly used welded Base Metals:-

Ferrous materials which can be used in welding application are:-

- 1) wrought iron
- 2) Cast iron
- 3) Cast steel.
- 4) Alloy steel.
- 5) Stainless steels
- 6) Carbon steel (low, medium and high carbon steel)

Non ferrous materials, which can be used in welding applications are:-

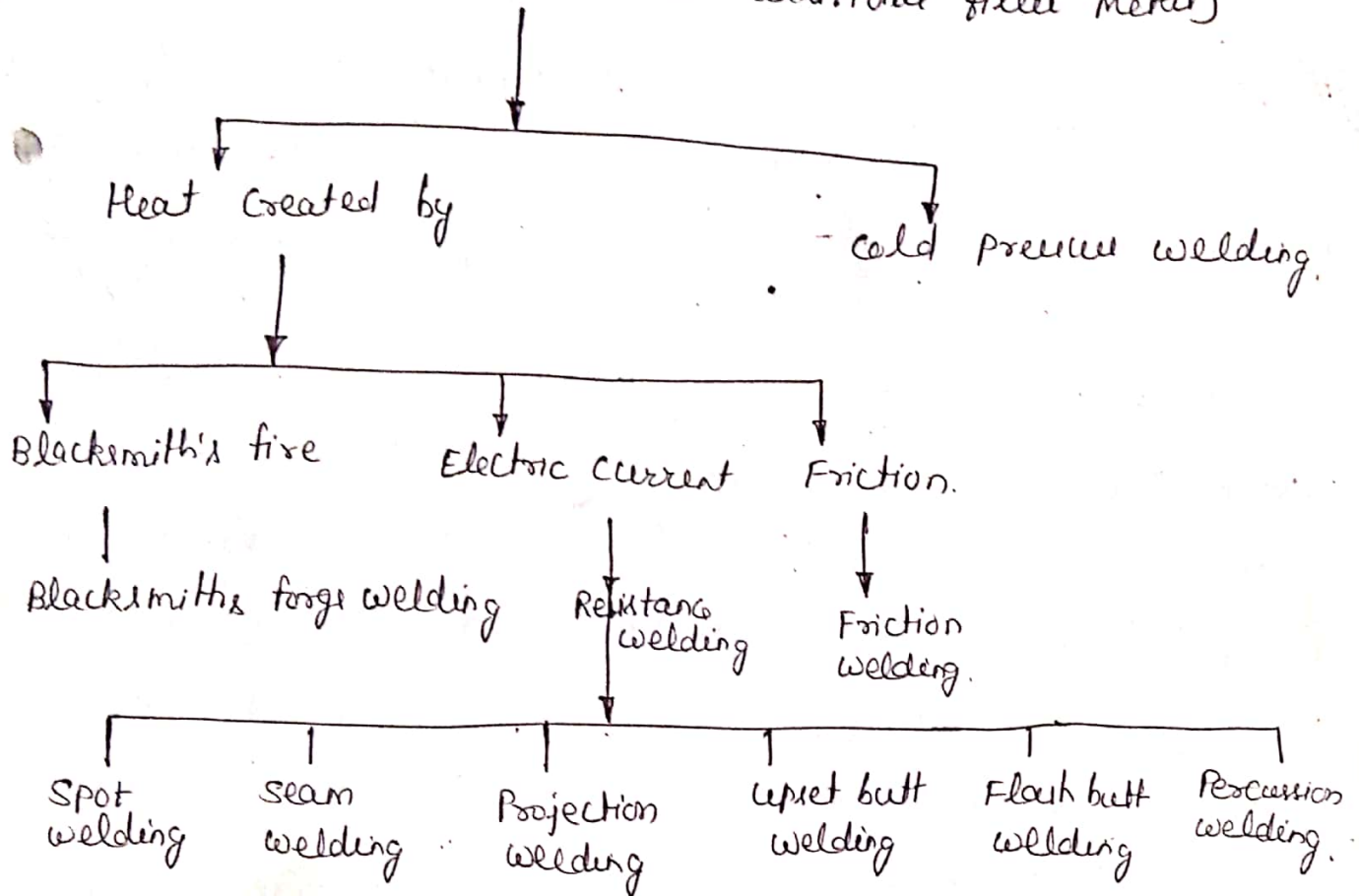
- 1) Aluminium and its alloys.
- 2) Copper and its alloys.
- 3) Magnesium and its alloys.
- 4) Nickel and its alloys.
- 5) Zinc and its alloys etc.

## Advantages of welding:-

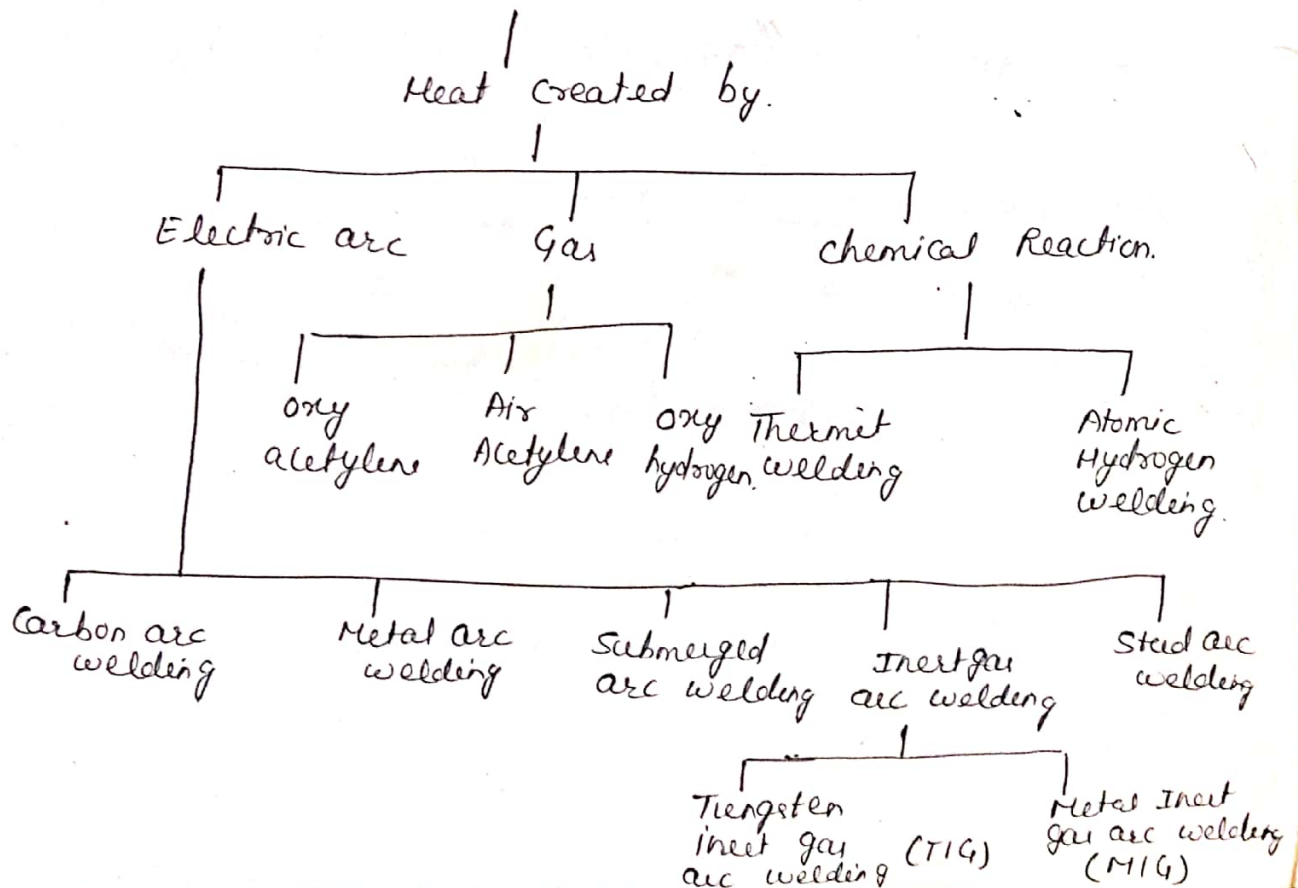
- 1) A good weld is as strong as the base metal.
- 2) A large no. of metal and alloys can be joined by welding.
- 3) Repair by welding is very easy.
- 4) welding can be easily mechanized.
- 5) Portable welding equipment is available.
- 6) General welding equipment is not very costly.
- 7) Total joining cost/time is less in case of welding joint.
- 8) welded structures are normally lighter than riveted or bolted structures.
- 9) Alterations and additions can be easily made in the existing structures.
- 10) welded joint provides maximum efficiency which is not possible in other types of joints.



# 1. Forge or Pressure welding. (Under pressure without additional filler metal)



## 2. Fusion or Non pressure welding. (with addition filler metal)



## fusion or non-pressure welding :-

In fusion or non-pressure welding, the edge of workpiece to be joined and the filler material are heated to a temperature above the melting point of the metal and then allowed to solidify. The fusion or non pressure welding is further classified as follows :-

Fig. 2

### Cold pressure welding :-

In this process certain similar and dissimilar metals are joined without any source of heat. The two parts to be welded are subjected to high pressure which results in inter-surface molecular fusion of the parts to be joined. This process is mainly used for welding non-ferrous metals particularly aluminium and copper.