



FUNDAMENTALS OF WELDING

1. Overview of welding technology
2. The weld joint
3. Physics of welding
4. Features of a fusion welded joint

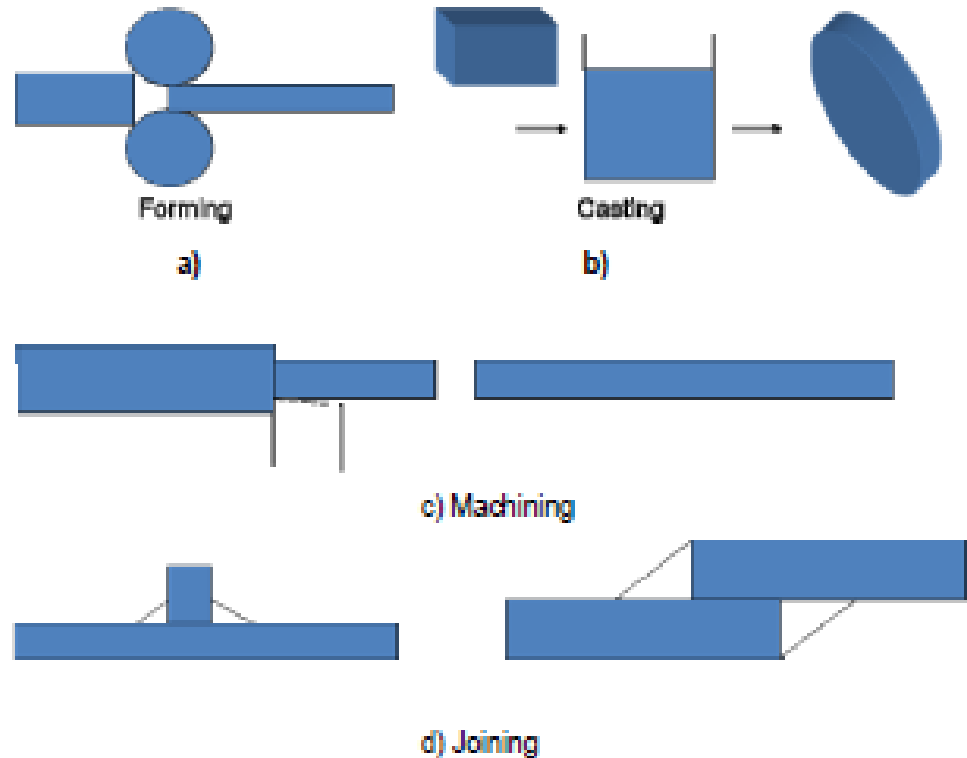


Manufacturing Processes

- casting,
- forming,
- machining and
- welding.

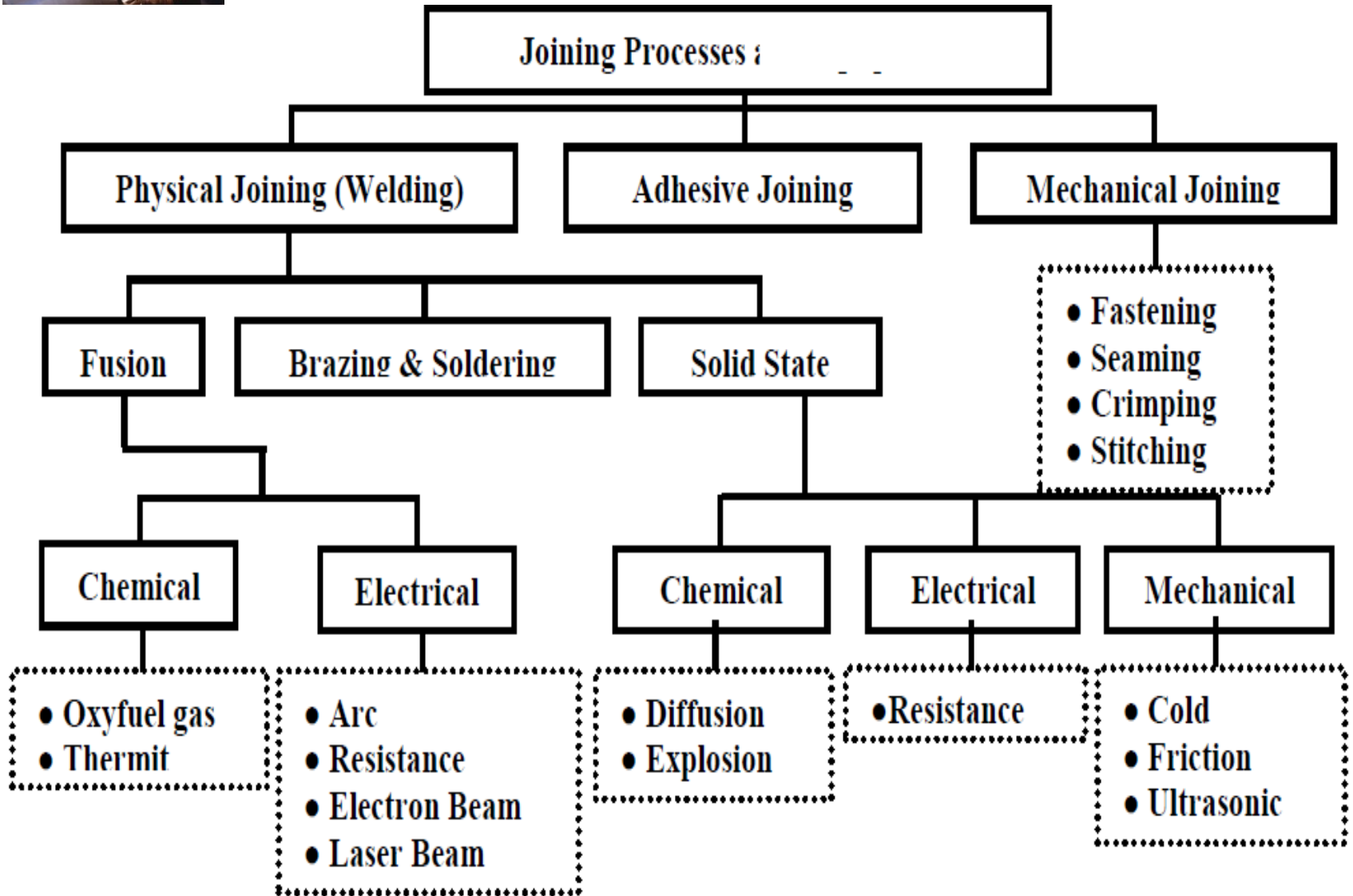
Selection of manufacturing process depends on:

- complexity of geometry of the component,
- number of units to be produced,
- properties of the materials (physical, chemical, mechanical and dimensional properties) to be processed and economics.





Joining Process Classification





Consumable Electrode

SMAW – Shielded Metal Arc Welding

GMAW – Gas Metal Arc Welding

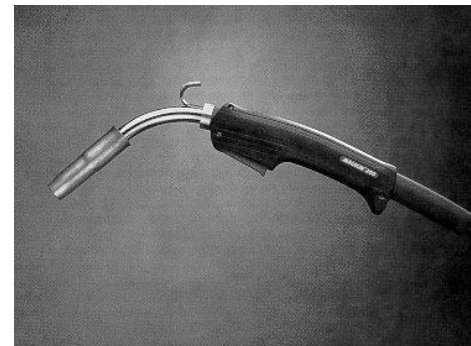
SAW – Submerged Arc Welding



Non-Consumable Electrode

GTAW – Gas Tungsten Arc Welding

PAW – Plasma Arc Welding



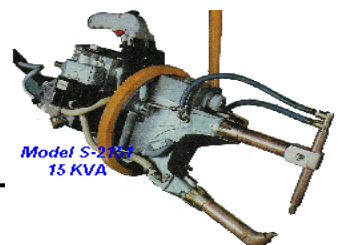
High Energy Beam

Electron Beam Welding

Laser Beam Welding



Resistance Welding



Model S-211
15 KVA



- Consumable electrode
 - Flux coated rod
 - Flux produces protective gas aro

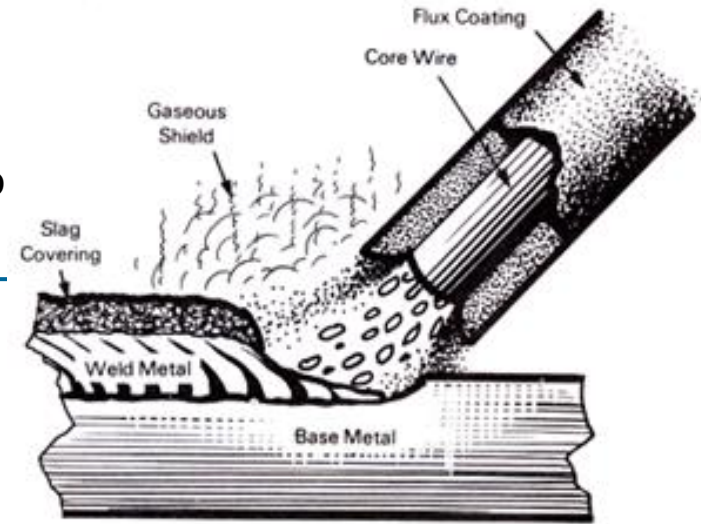


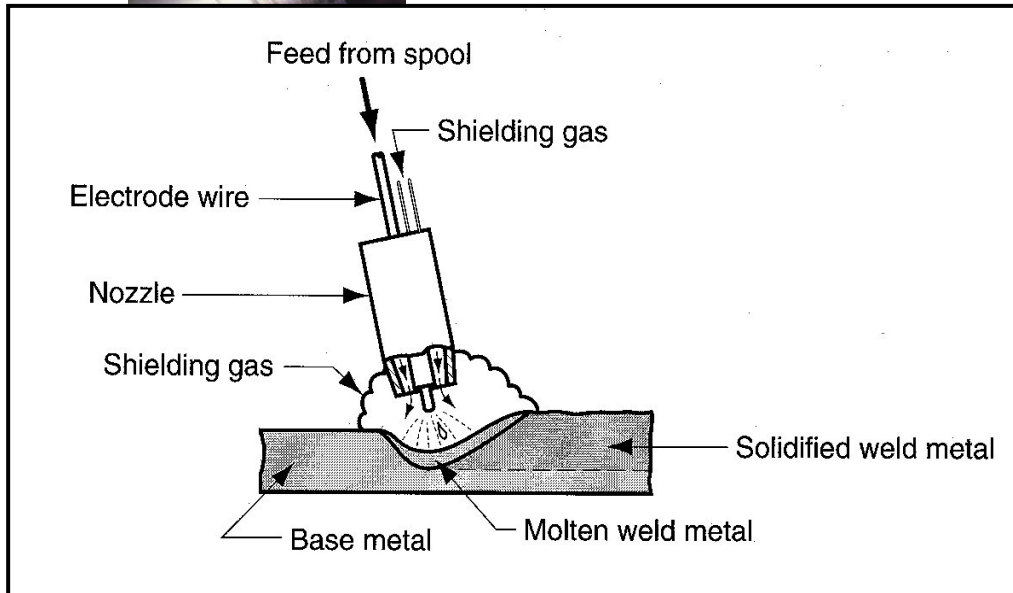
Fig. 6

- Slag keeps oxygen off weld bead during cooling

- General purpose welding—widely used
- Thicknesses 1/8” – 3/4”
- Portable

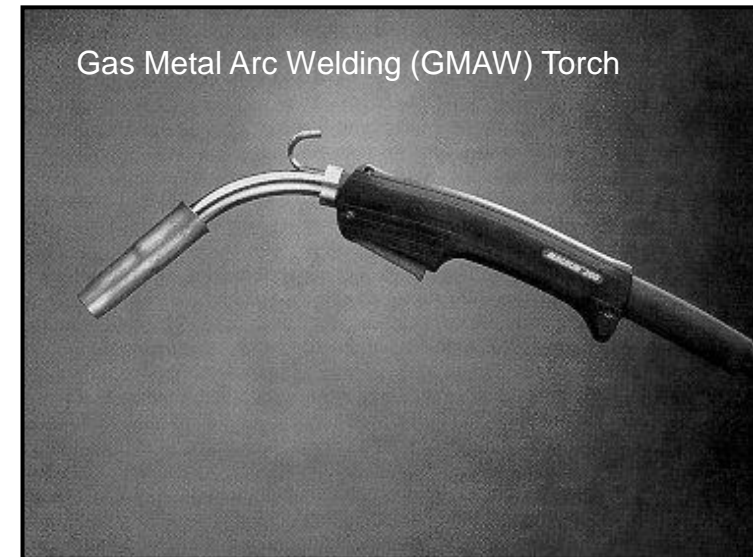
Power... Current I (50 - 300 amps)
Voltage V (15 - 45 volts)

$$\text{Power} = VI \approx 10 \text{ kW}$$



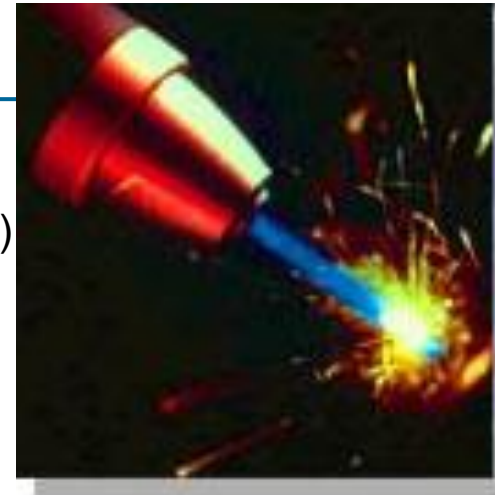
- DC reverse polarity - hottest arc
- AC - unstable arc

- MIG - Metal Inert Gas
- Consumable wire electrode
- Shielding provided by gas
- Double productivity of SMAW
- Easily automated





- Laser beam produced by a CO₂ or YAG Laser
- High penetration, high-speed process
- Concentrated heat = low distortion
- Laser can be shaped/focused & pulsed on/off
- Typically automated & high speed (up to 250 fpm)
- Workpieces up to 1" thick



Typical laser welding applications :

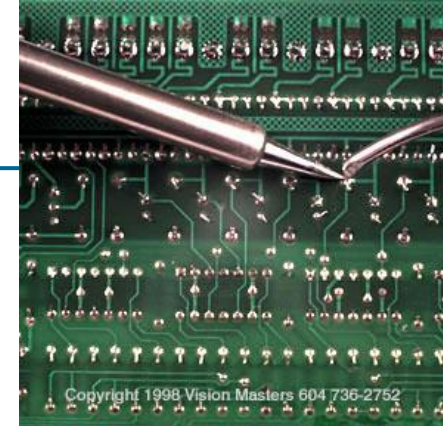
- Catheters & Other Medical Devices
- Small Parts and Components
- Fine Wires
- Jewelry
- Small Sensors
- Thin Sheet Materials Down To 0.001" Thick



Soldering

Solder = Filler metal

- Alloys of Tin (silver, bismuth, lead)
- Melt point typically below 840 F



Flux used to clean joint & prevent oxidation

- separate or in core of wire (rosin-core)

Tinning = pre-coating with thin layer of solder

Applications:

- Printed Circuit Board (PCB) manufacture
- Pipe joining (copper pipe)
- Jewelry manufacture

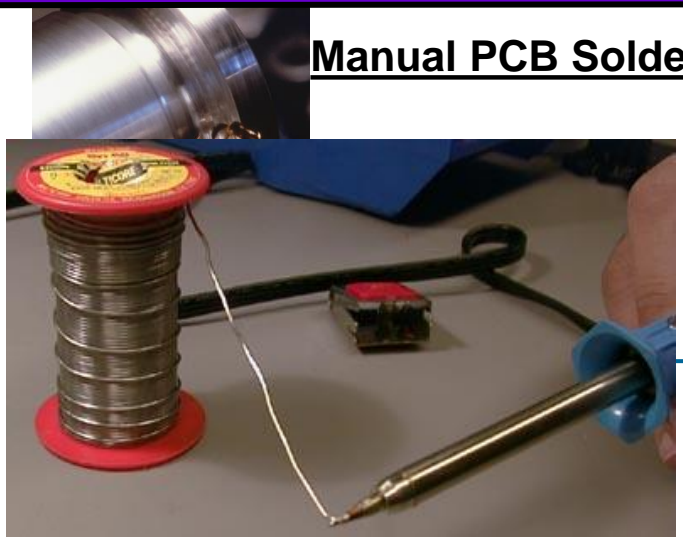


Easy to solder: copper, silver, gold

Difficult to solder: aluminum, stainless steels

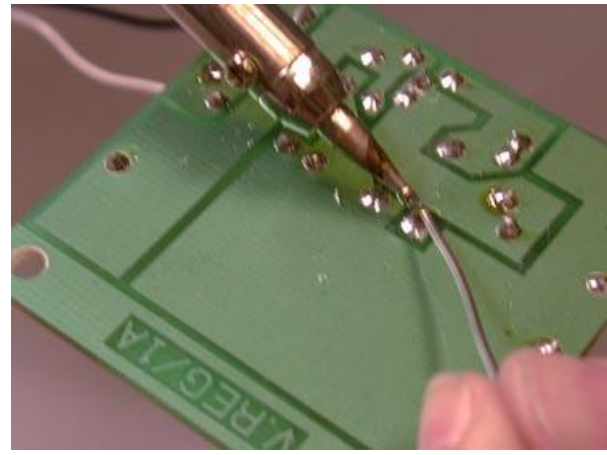
Manual PCB Soldering

PTH - Pin-Through-Hole connectors

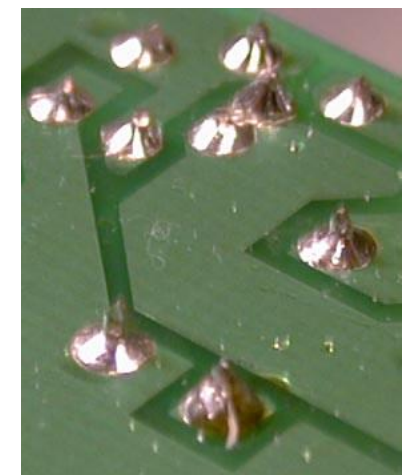


- Soldering Iron & Solder Wire

- Heating lead & placing solder



- Heat for 2-3 sec. & place wire opposite iron



- Trim excess lead



Advantages of Welding as a Fabrication Technique

- Permanent joint is produced, which becomes an integral part of work piece.
- Joints can be stronger than the base metal if good quality filler metal is used.
- Economical method of joining.
- It is not restricted to the factory environment.