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WELDING

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FAKULTAS TEKNIK – UNIVERSITAS MALIKUSSALEH

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CONTENT

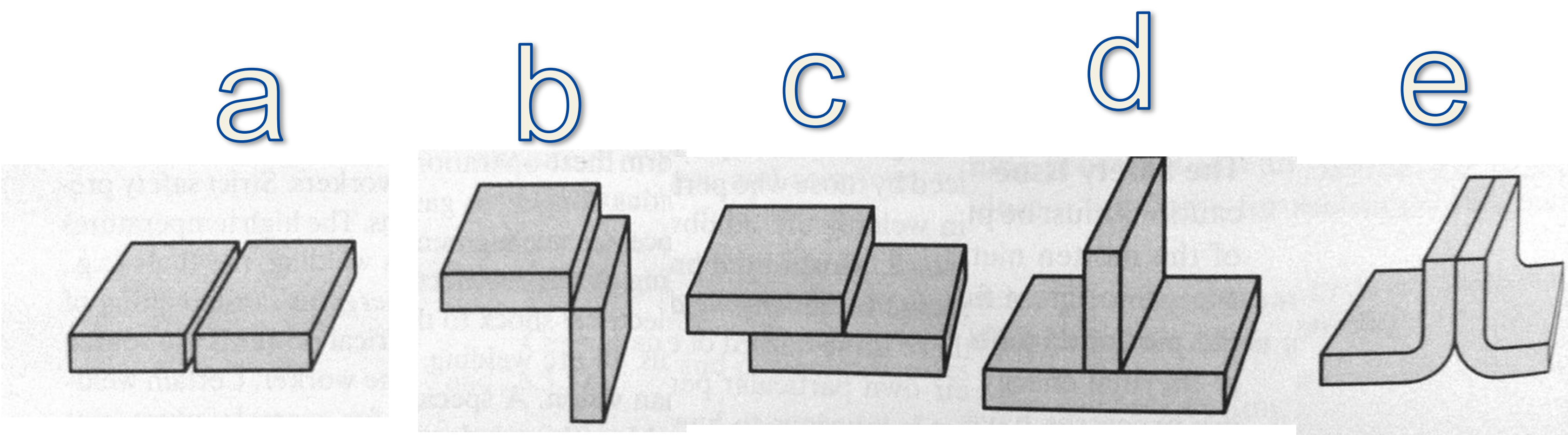
Definition

Welding is a material joining process in which two or more parts are coalesced at their contacting surfaces by a suitable application of heat/and or pressure

Types of joints

a) Butt joint
b) Corner joint
c) Lap joint

d) Tee joint
e) Edge joint

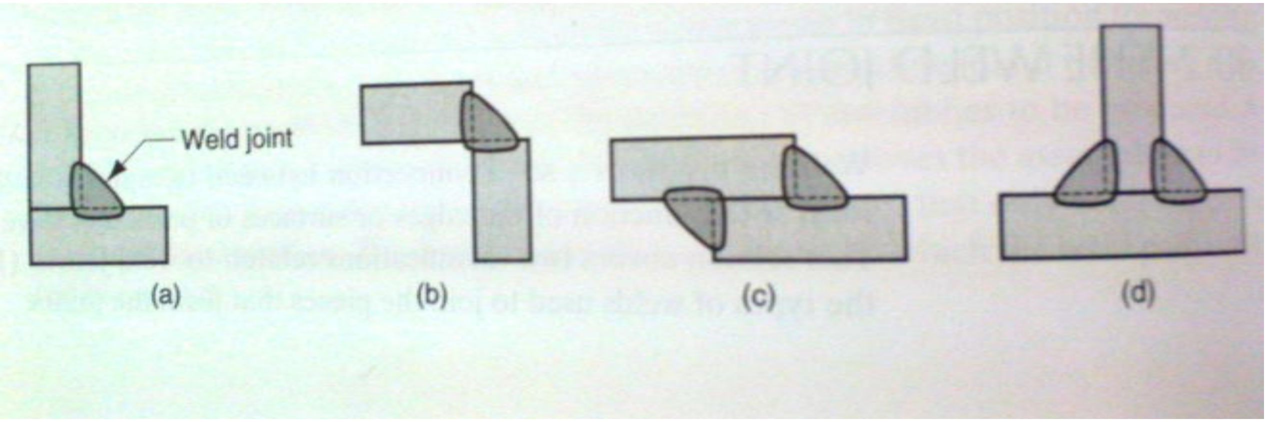


Types of welds

- **Fillet weld**
- **Groove weld**
- **Plug weld**
- **Slot weld**
- **Spot weld**
- **Seam weld**
- **Flange weld**
- **Surface weld**

Fillet welds

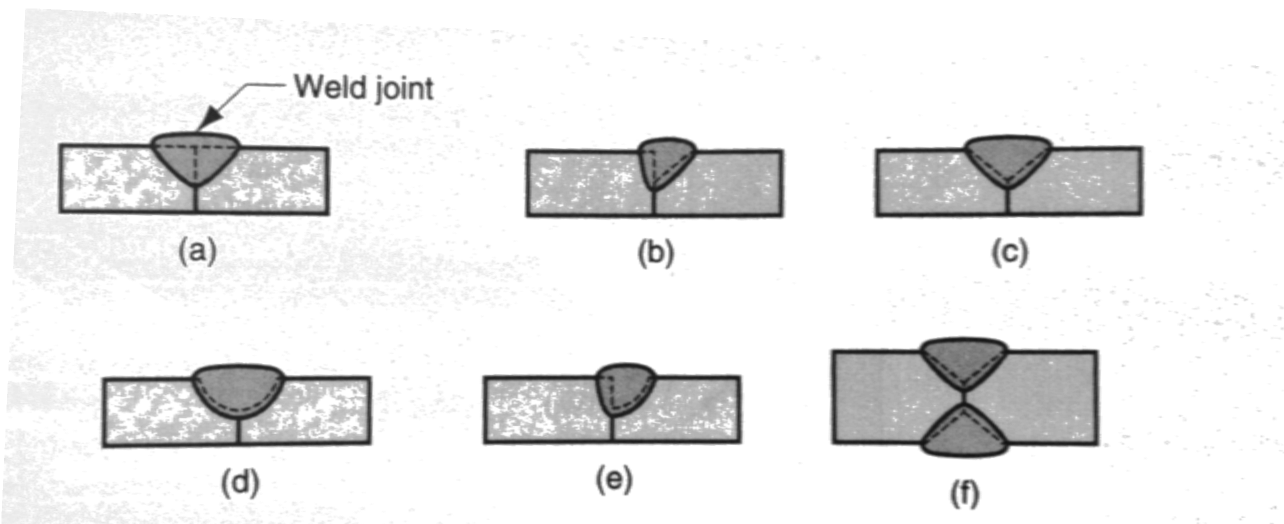
Used to fill in the edges of plates created by corner lap and T joints



Groove weld

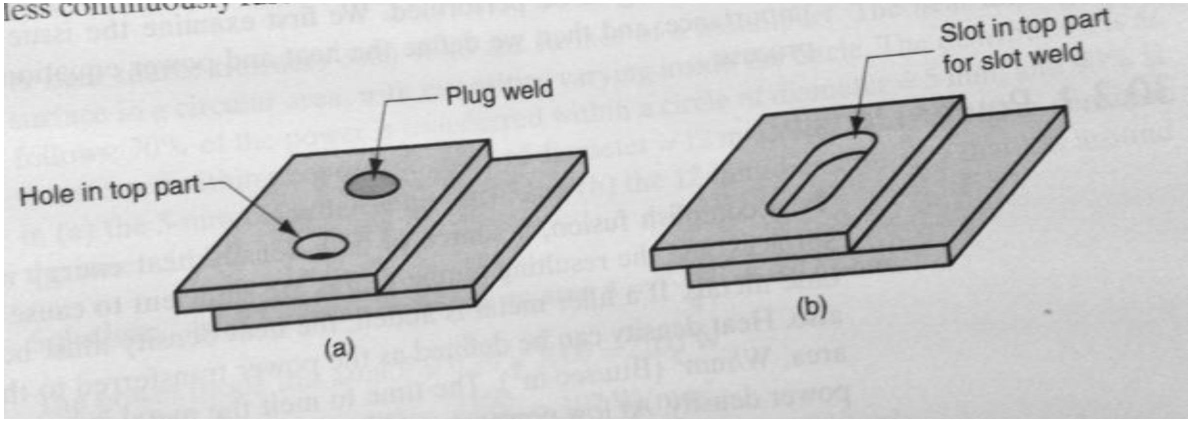
Usually require that the edges of the parts be shaped Into a groove to facilitate weld penetration.

A Grooved shapes in cloud square ,bevel ,V ,U , and J in single or double sides



Plug & Slot weld

Are used for attaching flat plates as it is shown. using one or more holes or slots in the top part and then filling with filler metal to fuse the tow parts together.



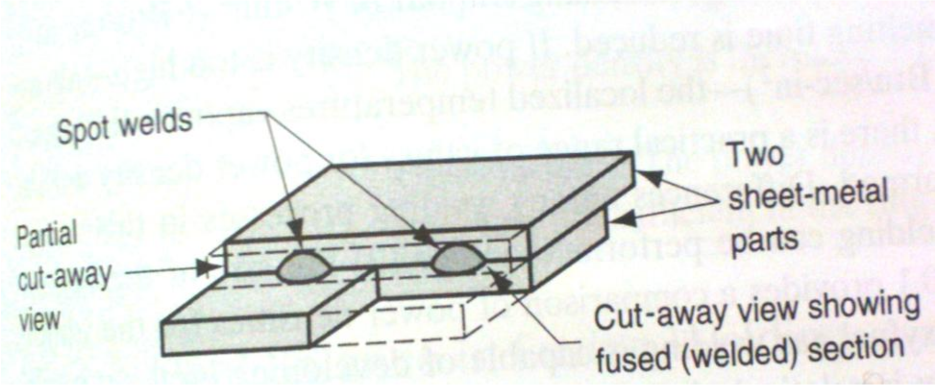
Spot & Seam weld

Spot weld:

is a small fused section between the surfaces of tow sheets or plates.

Seam welds:

is similar to spot weld but it consists of a more or less continually fused section between the two sheets or plates.



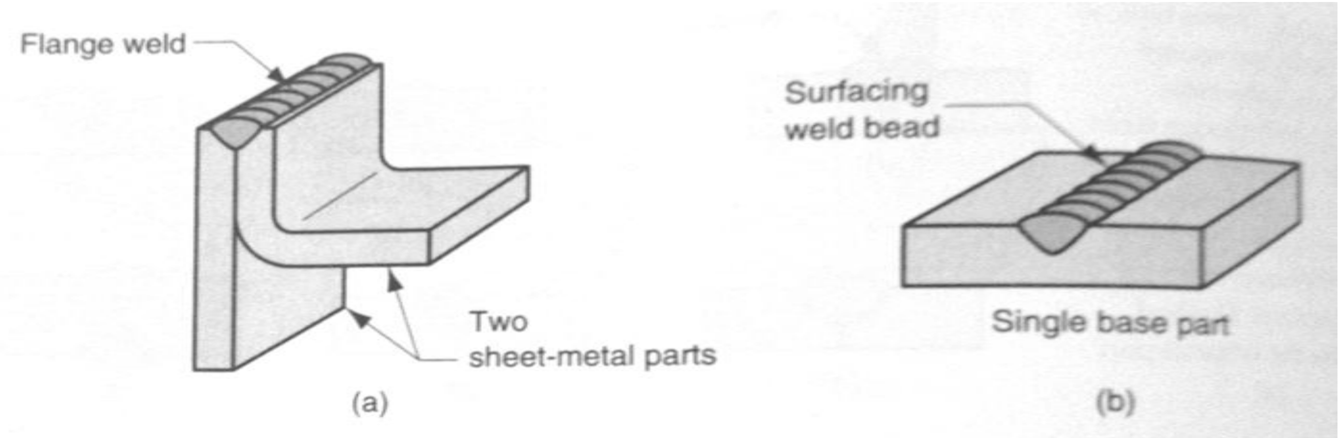
Flange & Surface weld

Flange weld:

Is made on the edge of tow parts

Surfacing weld:

Is not used to joint parts but rather to deposit filler metal onto the surface of a base part in one or more weld bead.



WELDING PROCESSES :

1- Fusion welding

2- Solid state welding

3-Soldering and brazing

1-FUSION WELDING

1-1. Arc welding

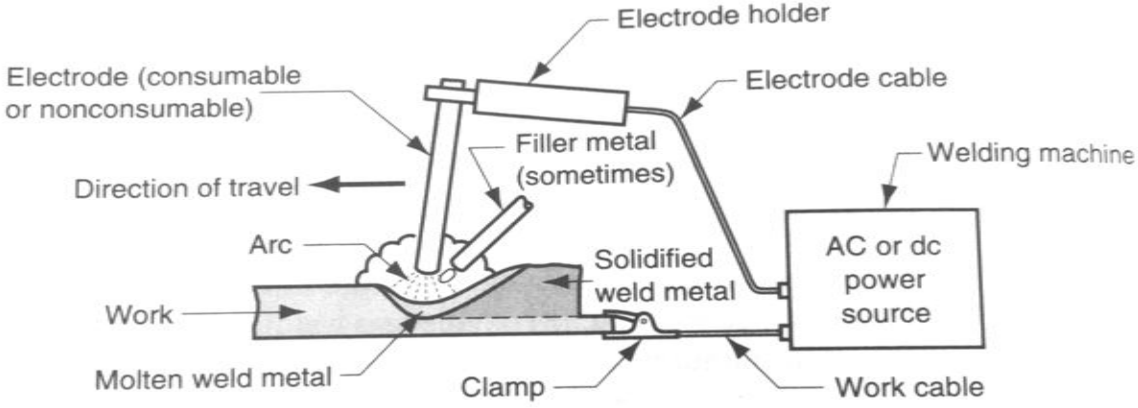
1-2. Resistance welding

1-3. Oxyfuel gas welding

1-4. Other fusion welding

1-1. ARS WELDING

AW is a fusion welding process in which coalescence of the metals is achieved by the heat from an electric arc between an electrode and the work.



Types of Arc welding

GTAW (Gas Tungsten Arc Welding) or TIG

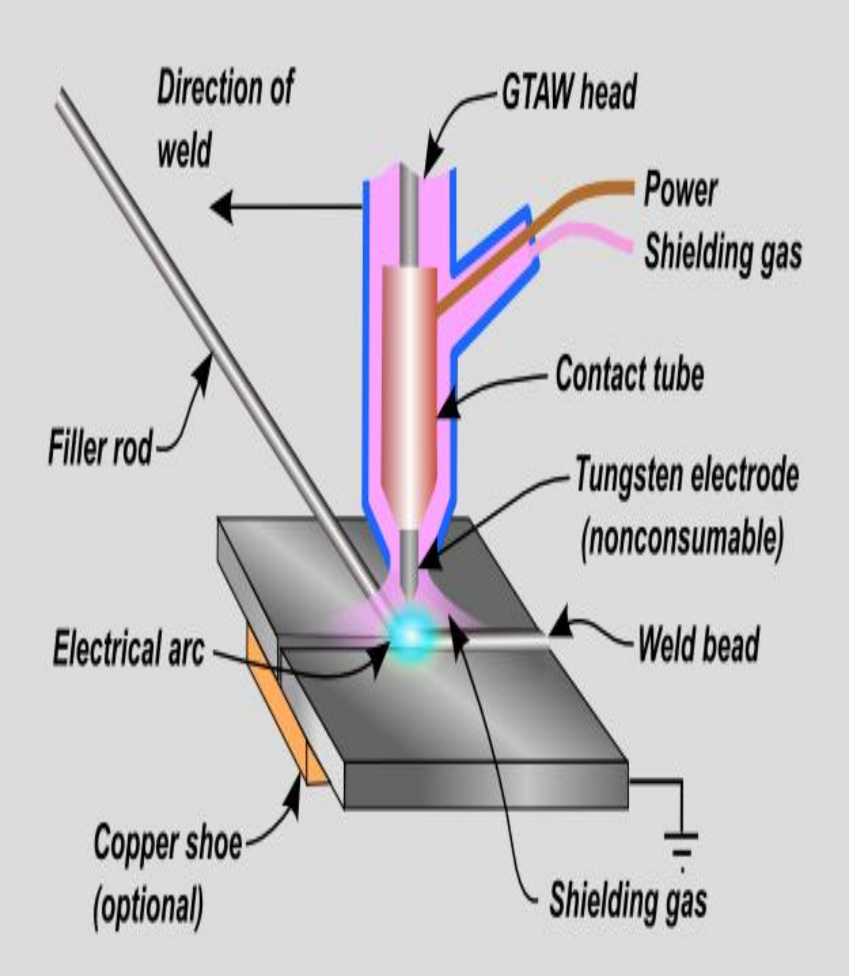
GMAW (Gas Metal Arc Welding) or MIG

PAW (Plasma Arc Welding)

GTAW Welding (TIG)

- In TIG welding an arc is formed between a non-consumable tungsten electrode and the metal being welded.

- Gas is fed through the torch to shield the electrode and molten weld pool. If filler wire is used, it is added to the weld pool separately.



TIG Welding Benefits

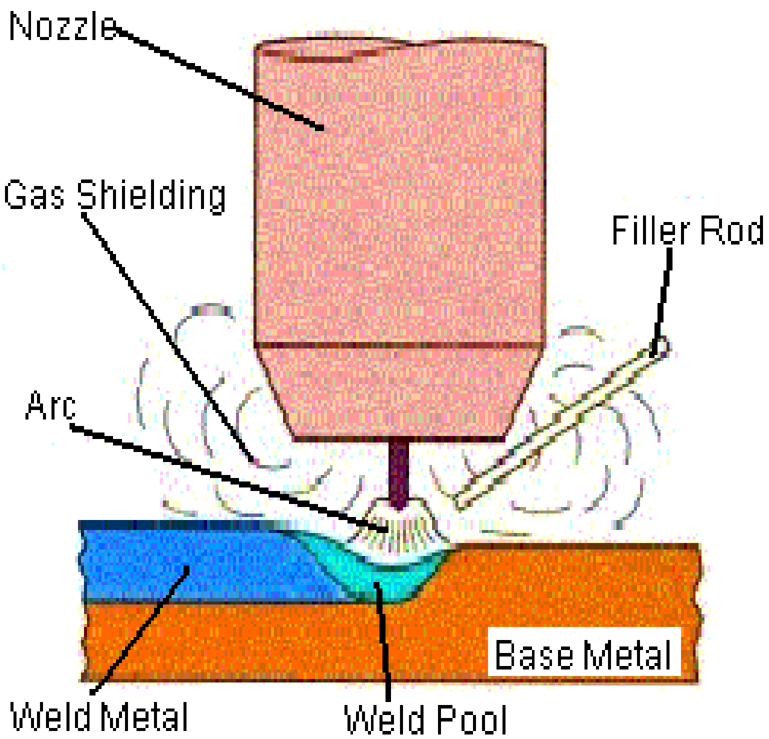
- ❑Superior quality welds
- ❑Welds can be made with or without filler metal
- ❑Precise control of welding variables (heat)
- ❑Free of spatter
- ❑Low distortion

GMAW (MIG) Welding

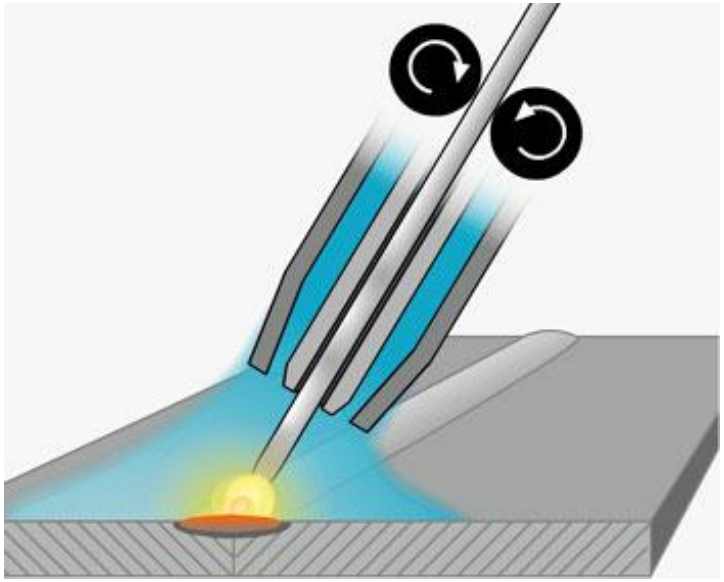
- ❑The heat is produced by an electric arc between the continuously fed metal electrode and the base metal.

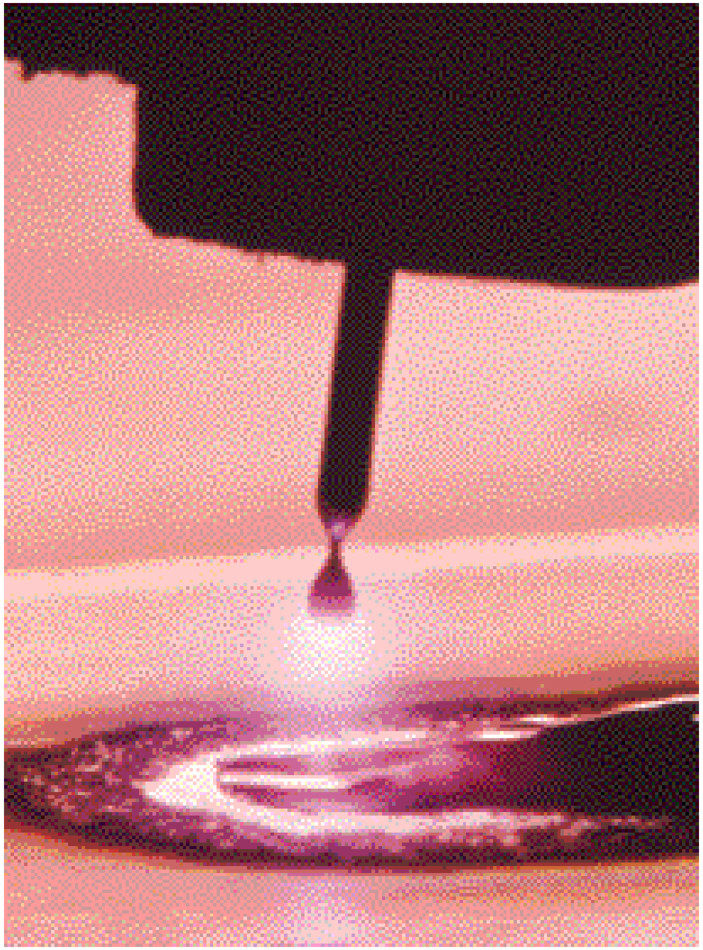
- ❑ MIG welding is therefore referred to as a semi-automatic welding process.

- ❑ Both the base metal and the filler are melt. The weld area is protected by inert shield gases.



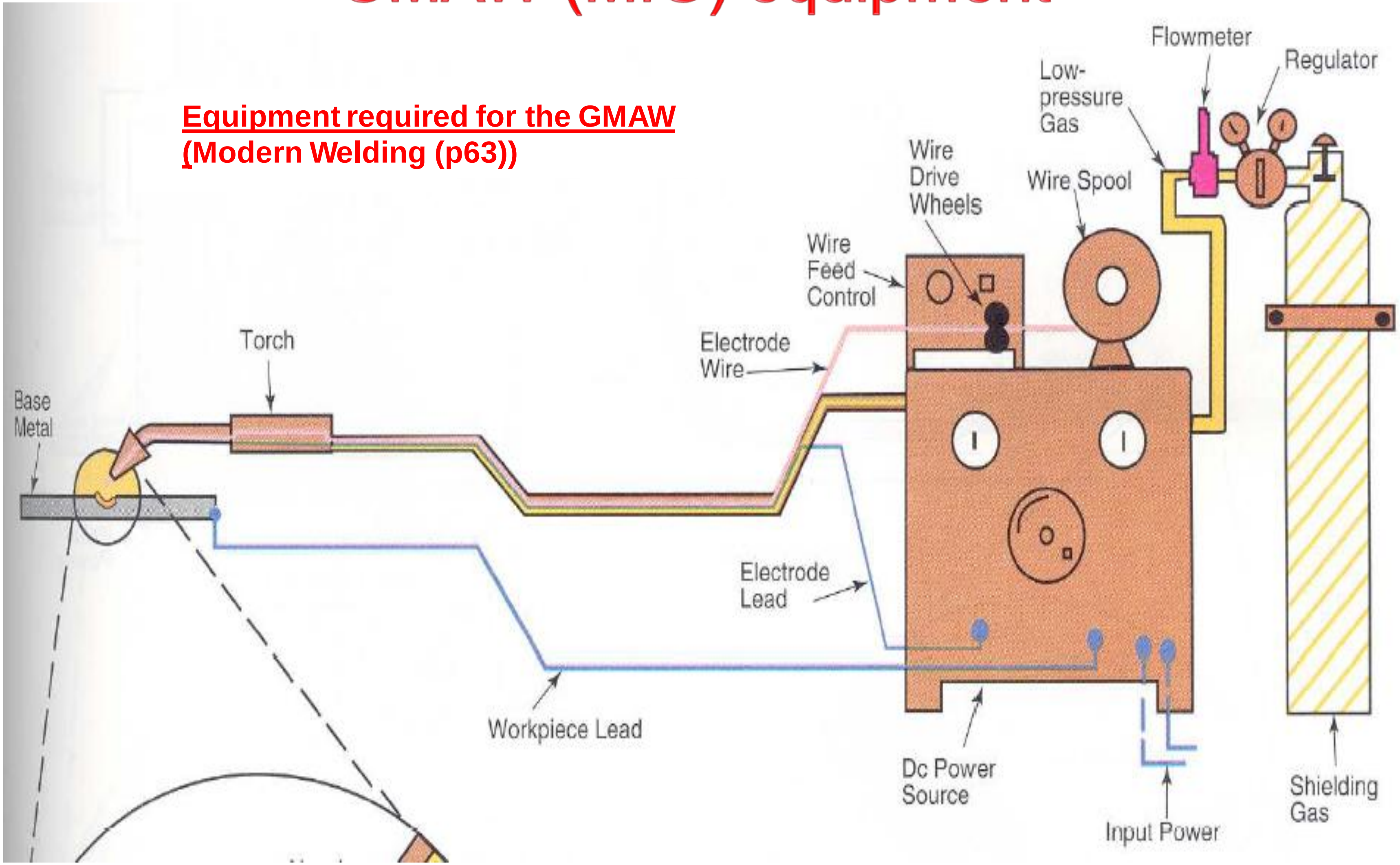
GMAW (MIG) Welding





GMAW (MIG) equipment

Equipment required for the GMAW (Modern Welding (p63))

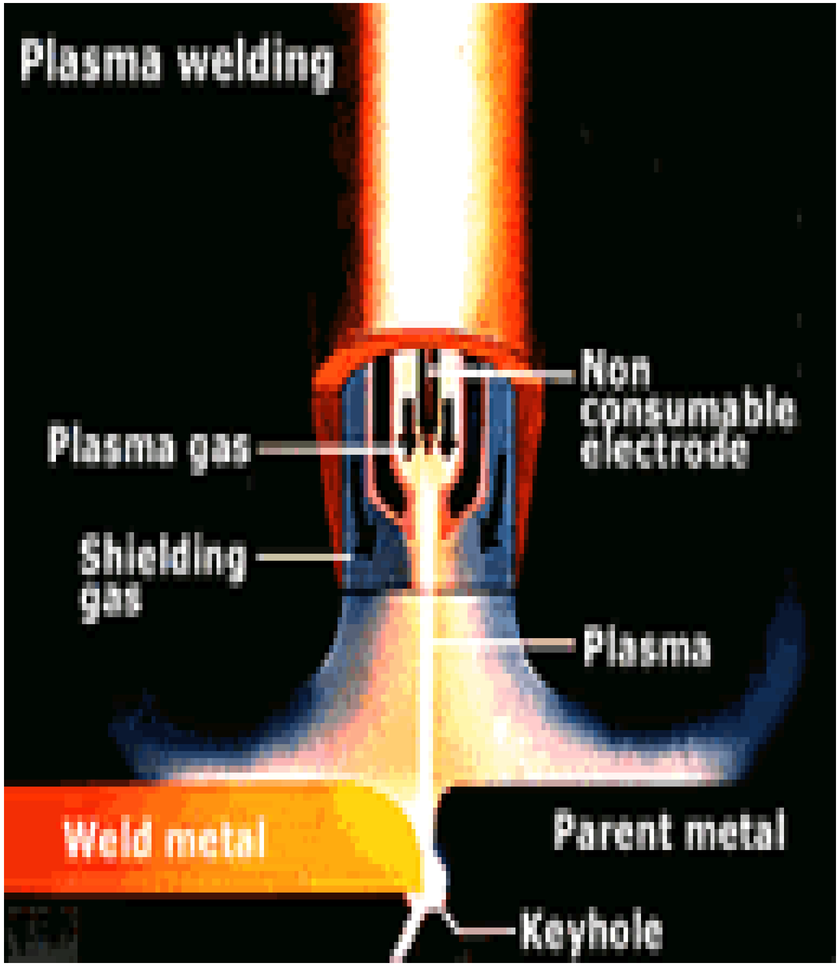


Plasma Arc Welding

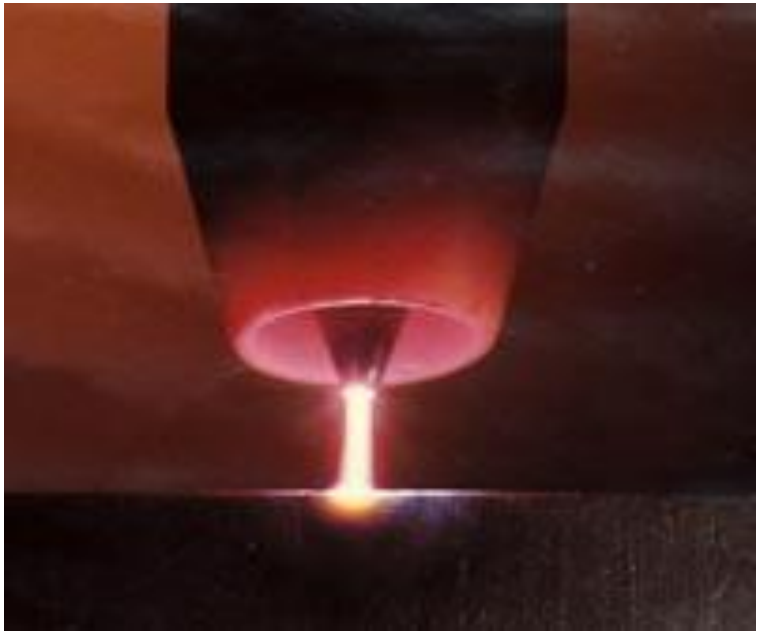
❑ Plasma welding is a kind of TIG, but with a constricted plasma arc which is produced by a specially designed nozzle that focuses high velocity stream

advantages:

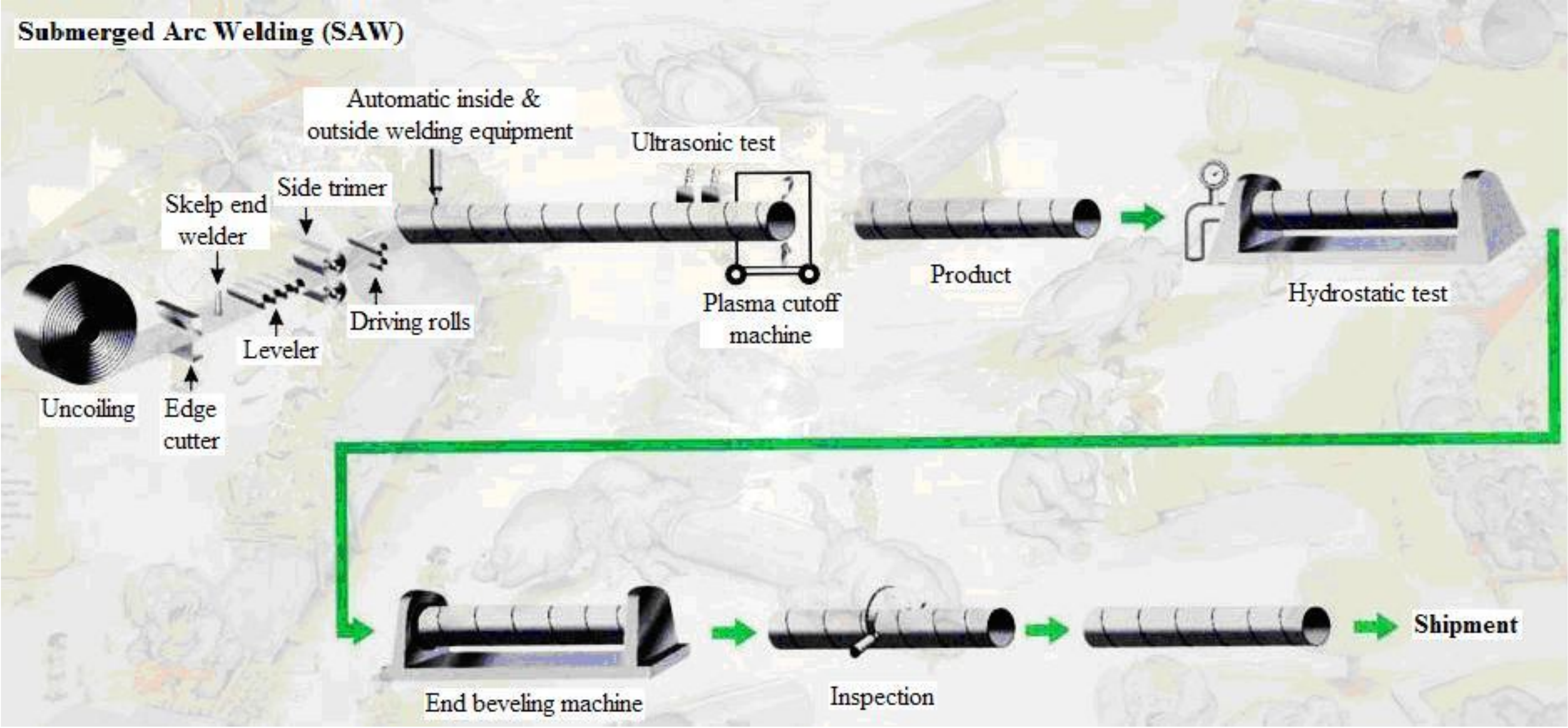
- greater energy concentration
  (Temperature can reach to 20000 C)
- can permit higher welding speeds
- less distortion
- has improved arc stability and welding quality



Plasma Arc Welding



One of Applications of arc Welding is pipe production



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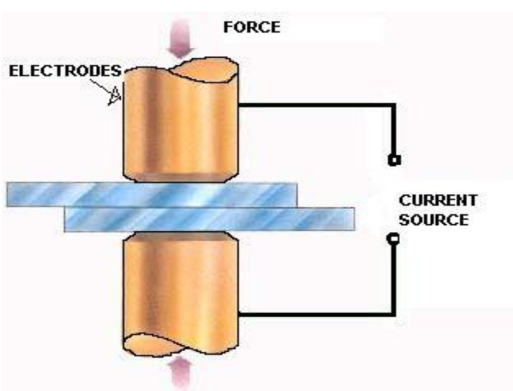
1-2. WERESISTANCE WELDING

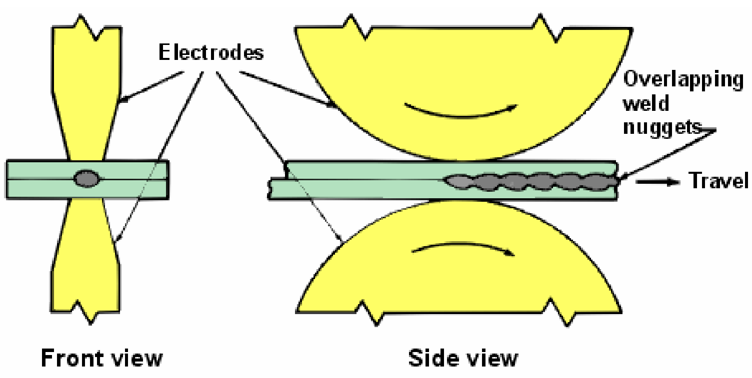
Resistance welding processes that involve the joining of two or more metal parts together in a localized area by the application of heat and pressure.

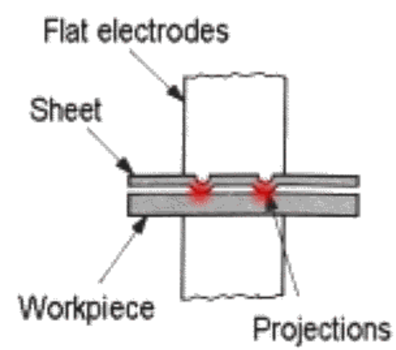
The heat is generated within the material being joined by the resistance to the passage of a high current through the metal parts, which are held under a pre-set pressure.

Resistance welding types:

1- spot welding 2-seam welding 3- projection welding







1-3. OXYFUEL GAS WELDING

Mixture of oxygen and asetylene used to produce a hot flame for melting the base metal and filler metal.

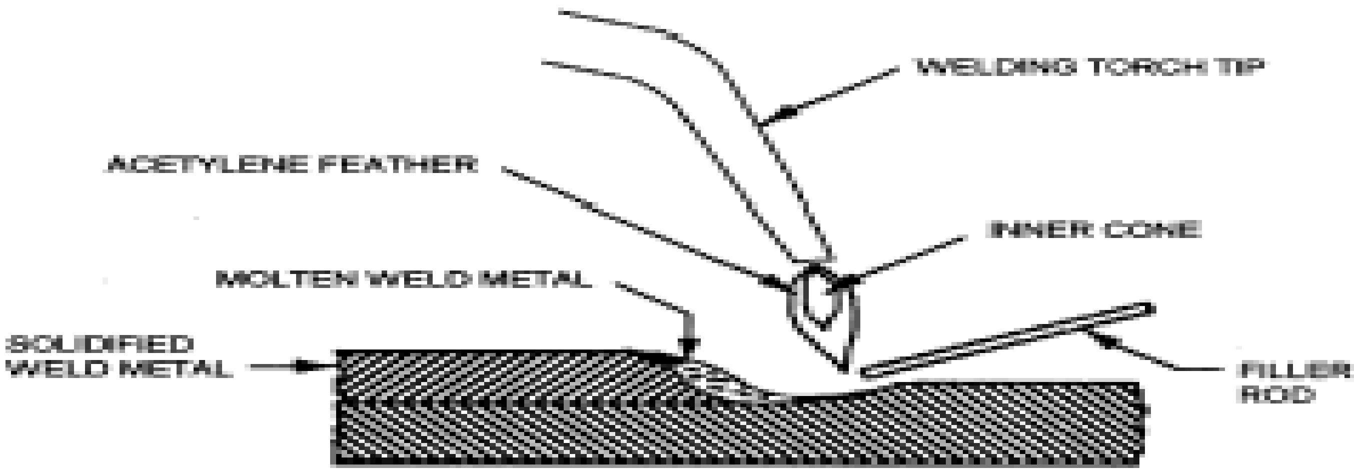


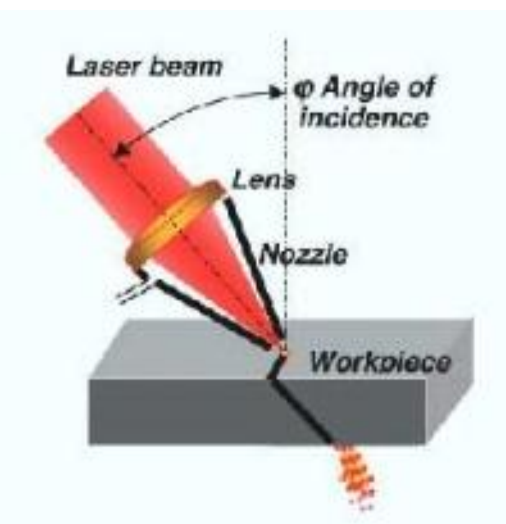
Figure 3-2.—Oxyfuel gas welding (OFW).

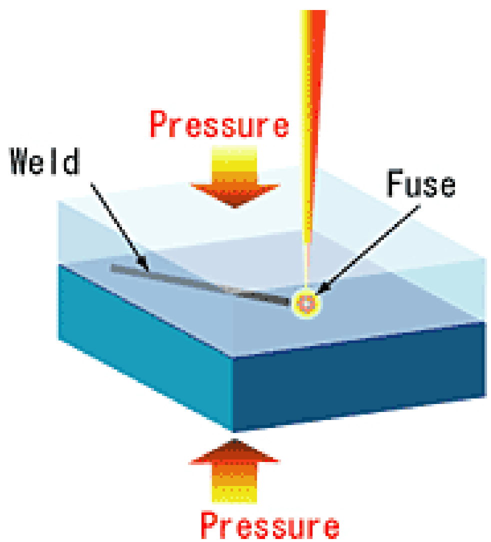
1-4. OTHER FUSION WELDING

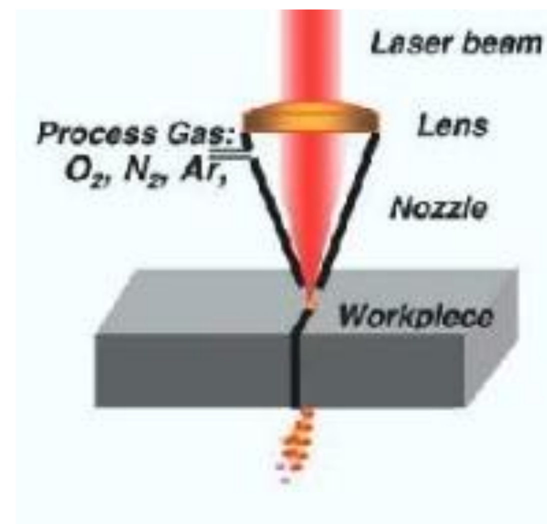
1. Laser beam welding
2. Thermit welding
3. Electron beam welding
4. Electroslag welding

Laser beam welding

- ❑ LASER is an acronym which stands for Light Amplification by Stimulated Emission of Radiation.
- ❑ Energy is amplified to extremely high intensity by an atomic process called stimulated emission.
- ❑ Radiation word refers to kind of energy transfer.

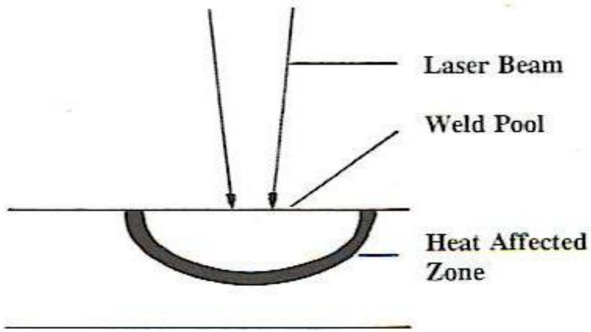




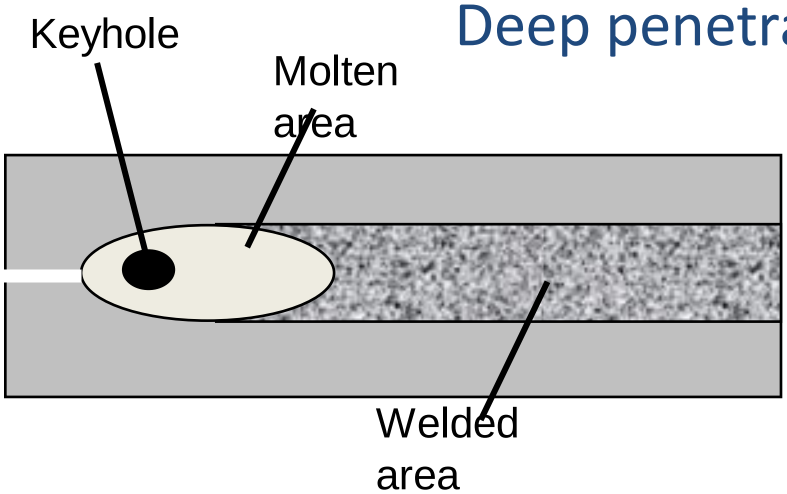


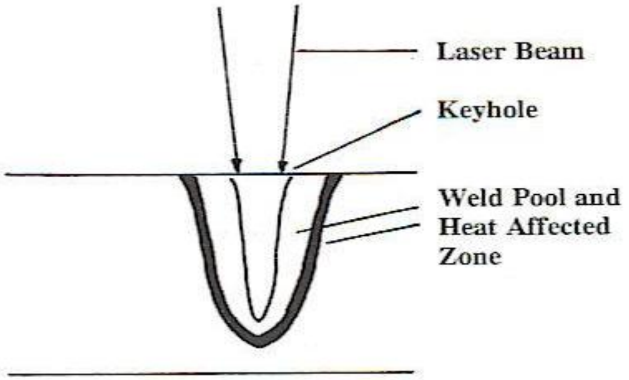
Laser beam welding

Heat conduction laser welding



Deep penetration laser welding





Laser beam welding

Advantages

- Small welding spot size
- Narrow HAZ and fusion zone
- Increased travel speeds (High Velocity)
- High weld precision in difficult areas
- Excellent metallurgical quality will be established in welds
- High production rates and process flexibility
- Flexibility, almost unlimited processing possibilities related production needs

Disadvantages

- Requires close fitting joints or filling material
- Accurate beam-joint alignment is necessary
- Total equipment operating costs are high

Thermit welding

Thermit Welding usually uses the exothermic reaction of a mixture of iron oxide and aluminum powder or other similar mixtures to weld or repair large forgings and castings, and join pipes and railroad rails.

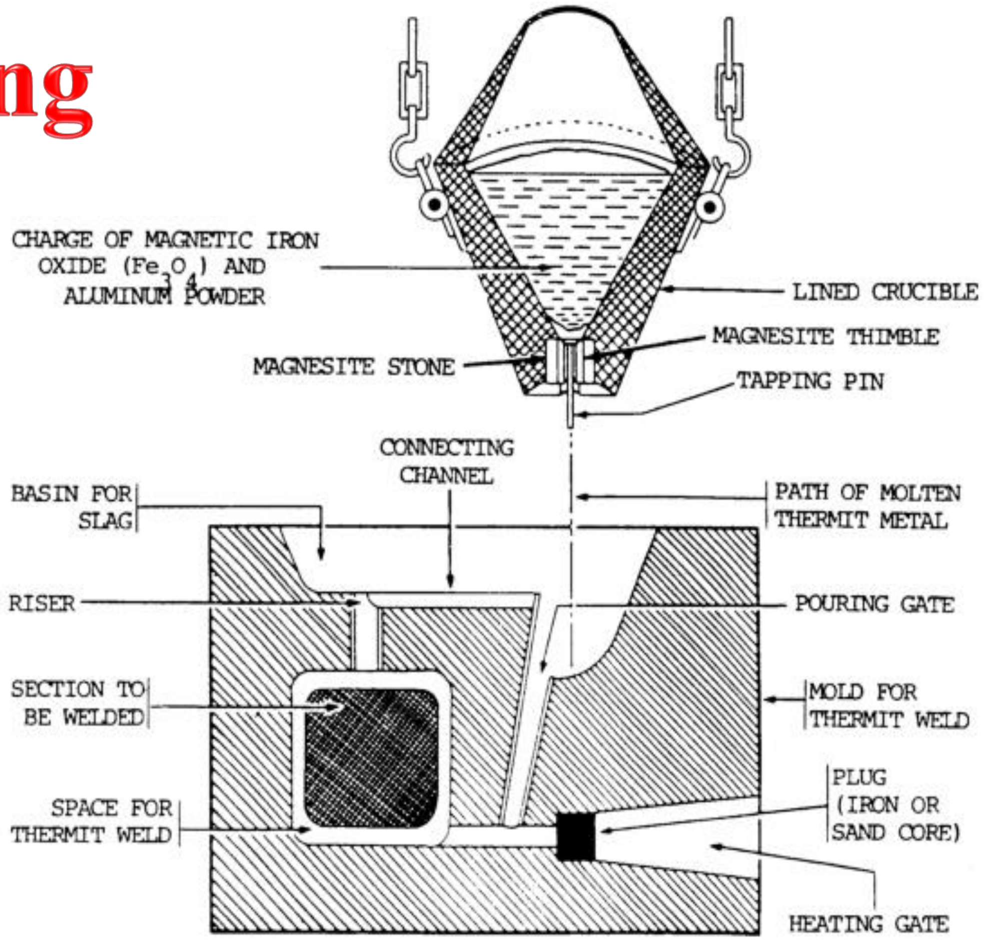
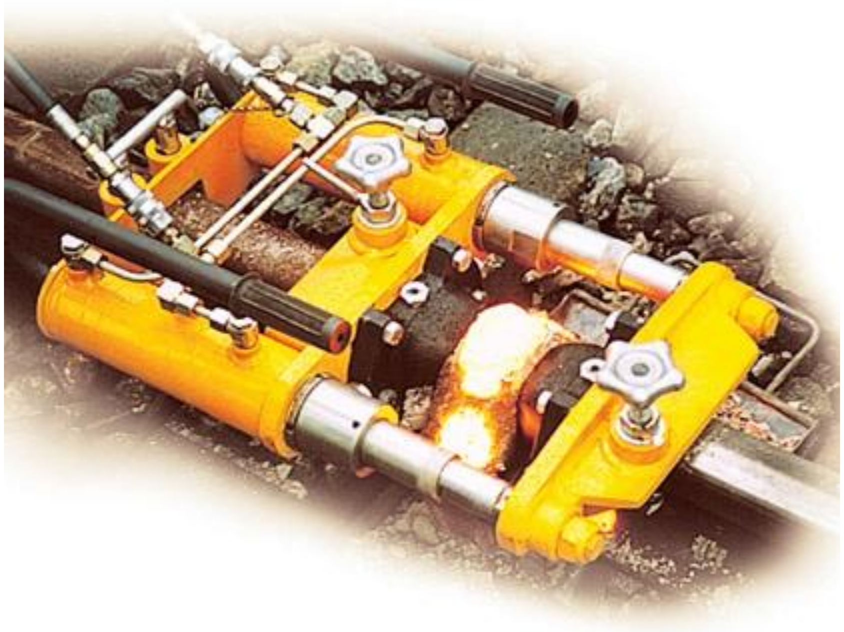


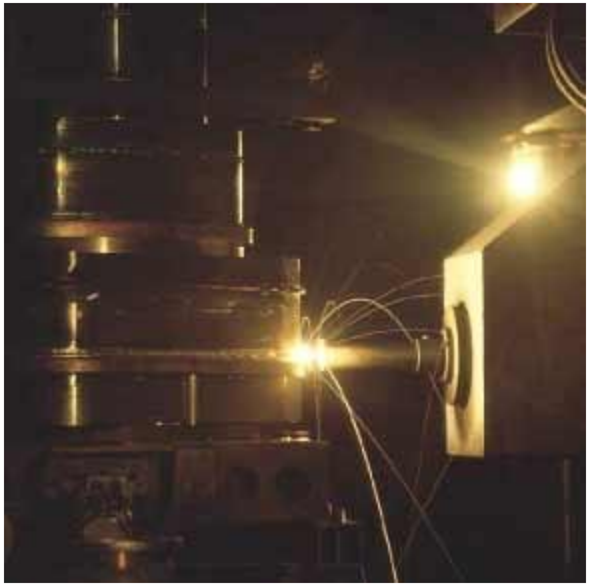
Figure 5-41. Thermit welding crucible and mold.

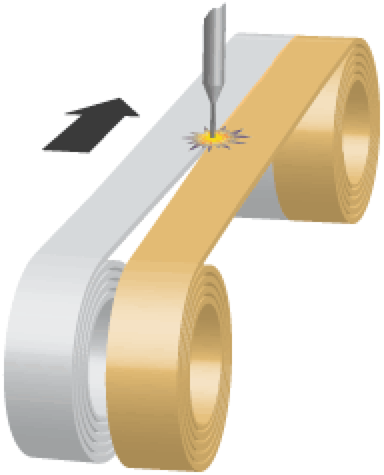
Thermit welding



Electron beam welding

EBW is fusion welding process in which the heat for welding is produced by highly focused, high-intensity stream of electrons and beam currents are low





Electron beam welding

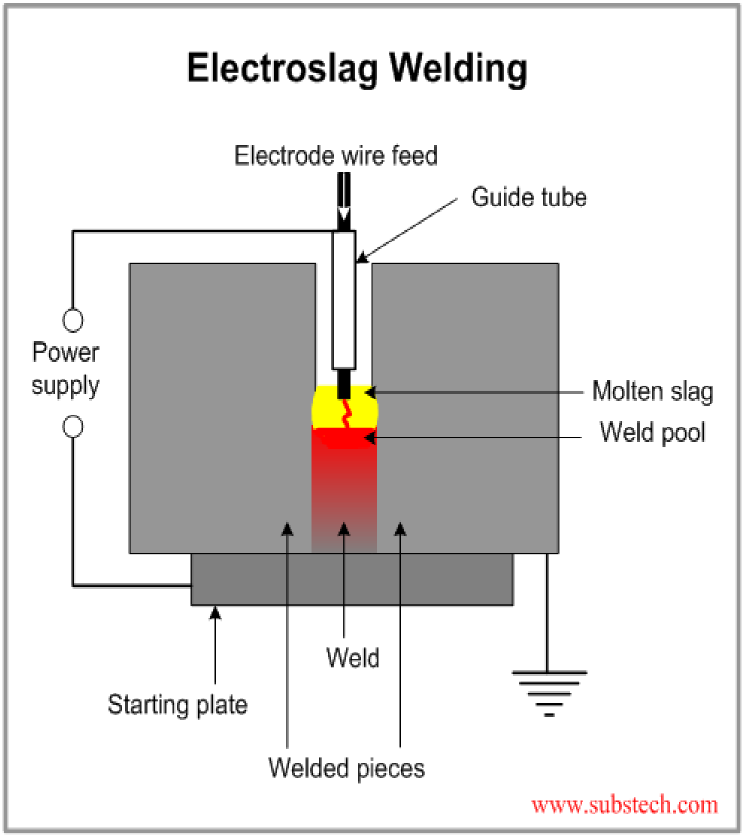
❑ Electron beam welding is a process favoured in the Aerospace industry for its ability to make precise, low distortion welds under clean vacuum conditions which promote the formation of high quality welds in many materials.

❑ As conventionally applied, the technique can make welds with very low heat inputs, at relatively high weld speeds, and it is this that the process is best known for the industry.

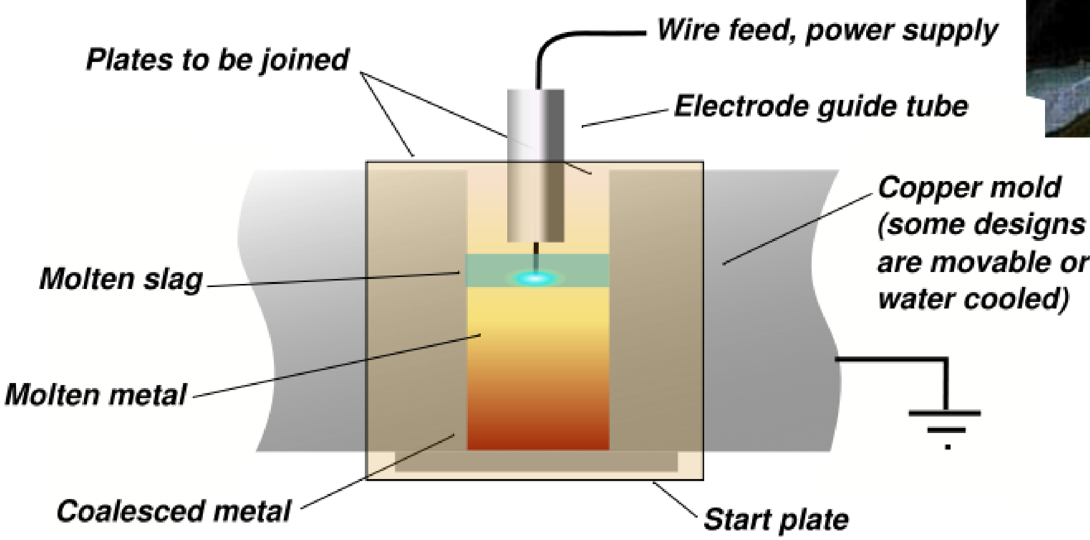
Electroslag welding

- ESW is a fusion welding process in which coalescence is achieved by hot , electrically conductive molten slag acting on the base parts and filler metal

- ESW uses the same basic equipment as some of the arc welding process , and it uses arc to initiate the welding operation

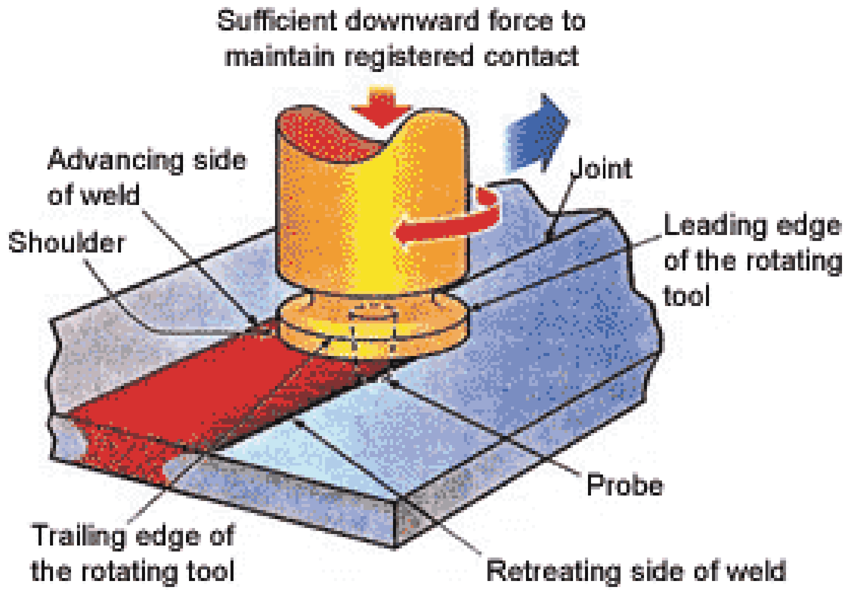


Electroslag welding



2. SOLID STATE WELDING

- **Solid-state welding**: Joining process is provided by pressure alone or pressure and heat together. When the pressure is used alone, the heat is below the melting point.



Solid state welding

2-1. Cold welding

2-2. Forge welding

2-3. Friction welding

2-4. Diffusion welding

2-5. Flash welding

2-6. Hot pressure welding

2-7. Role welding

2-8. Ultrasonic welding

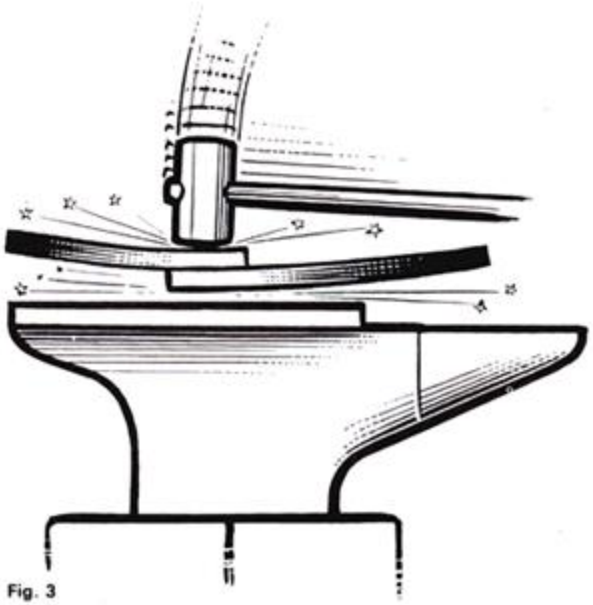
2-9. Explosion welding

2-1.COLD WELDING

- In cold welding, pressure is applied to work pieces, through either dies or rolls. Because of the plastic deformation involved, it is necessary that at least one, but preferably both, of the parts be ductile.
- Prior to welding, interface is decreased, wire brushed, and wipe to remove oxide smudge.
- Cold welding can be used to join small workpiece made of soft, ductile metals.

2-2. FORGE WELDING

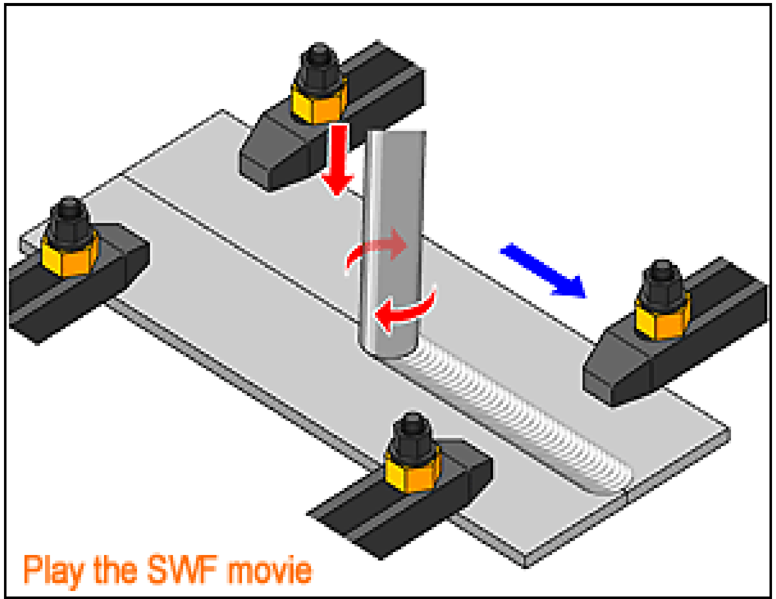
Forge welding is a welding process in which the components to be joint are heated to hot working temperatures and then forged together by hammer or other means.



2-3. Friction welding

In friction welding, the required for welding is generated through, as the name implies, friction at the interface of the two components being joined.

- Friction stir welding
- Rotary friction welding
- Linear friction welding
- Radial friction welding



2-4. Diffusion welding

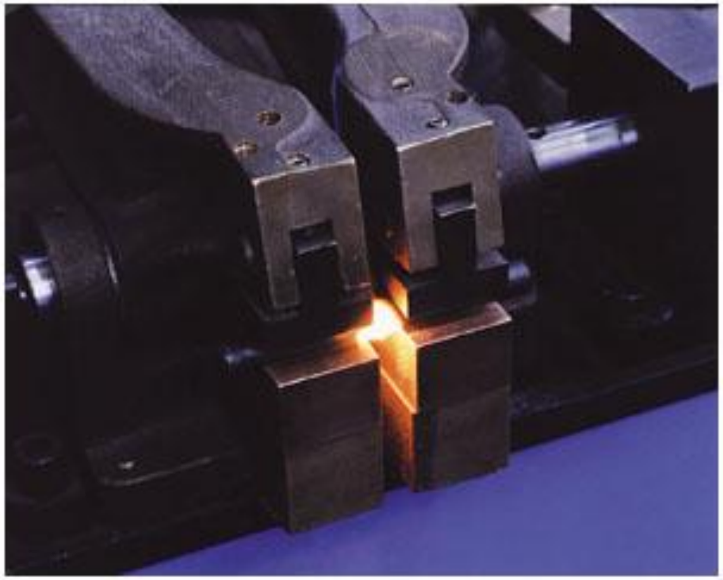
- DFW is a solid state welding process that results from the application of heat and pressure ,usually in a controlled atmosphere , with sufficient time allowed for diffusion and coalescence to occur.

Application :

Joining of high strengths and refractory metals in the air space and nuclear industry.

2-5. Flash welding

Flash Welding is a form of resistance welding that involves pressing two ends together, while simultaneously running a current between them. This has the effect of forming a joint between the two metals that is free of oxides as the surfaces of the two joining parts is forced out the sides of the joint and is known as "flash.



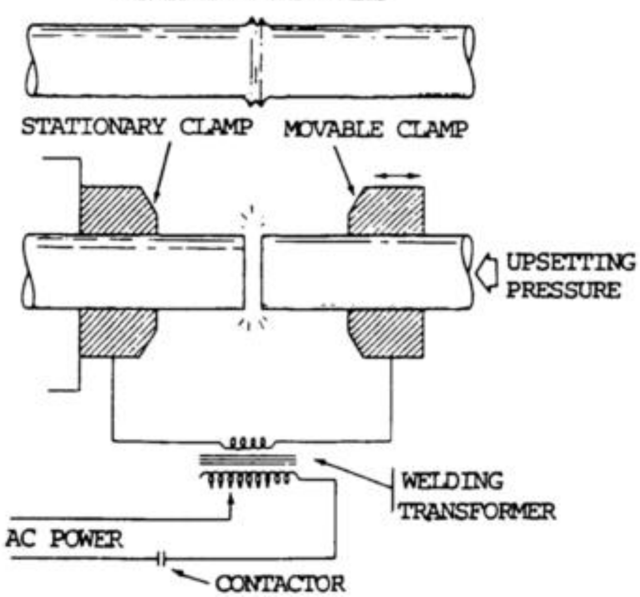


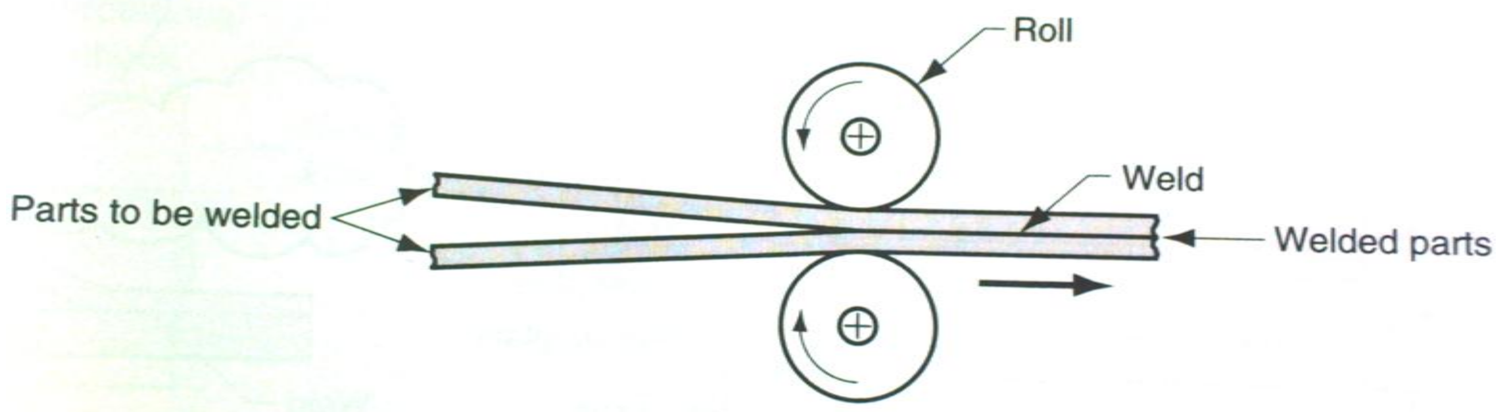
Figure 10-78. Flash welding.

2-6. Hot pressure welding

HPW is another variation of forge welding in coalescence occurs from the application of heat and pressure sufficient to cause considerable deformation of the base metals.

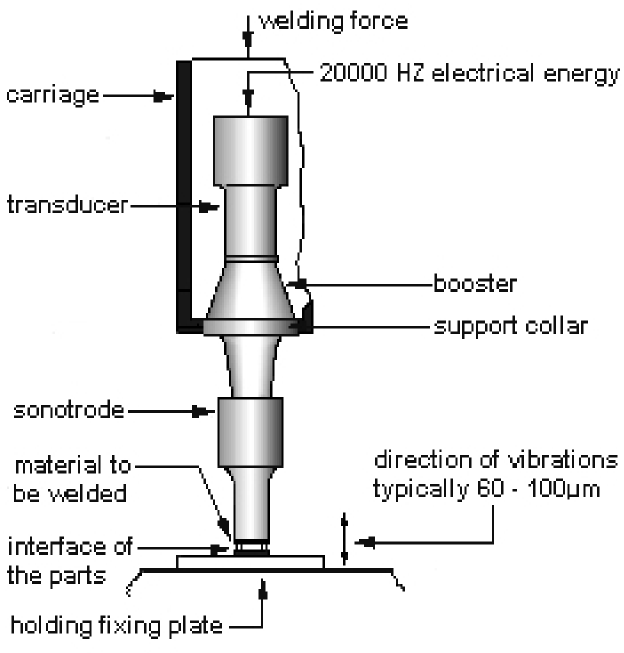
2-7. Role welding

ROW is a solid state welding process in which pressure sufficient to cause coalescence is applied by means of rolls, either with or without external application of heat.

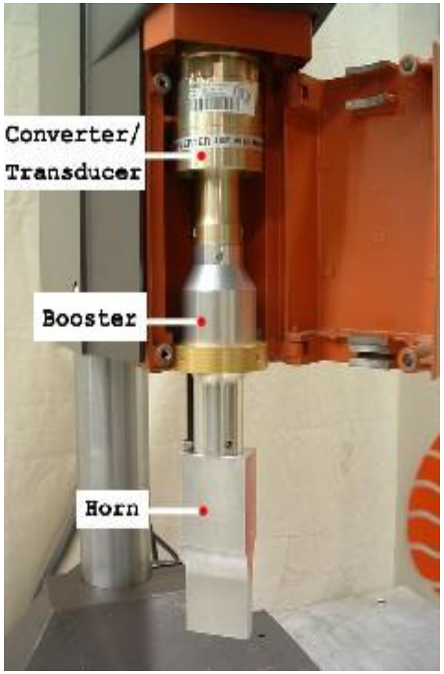


2-8. Ultrasonic welding

Moderate pressure between two parts hold together and an ultrasonic oscillation frequency send through in the direction parallel to the surface of contact.



An ultrasonic welding system for joining thermoplastics



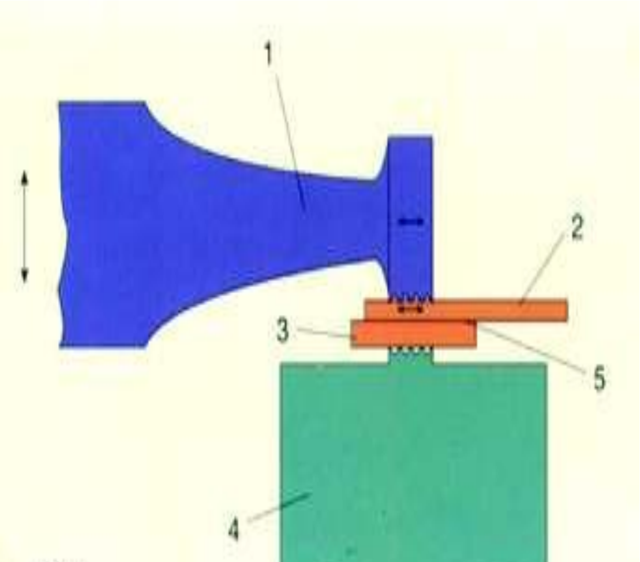


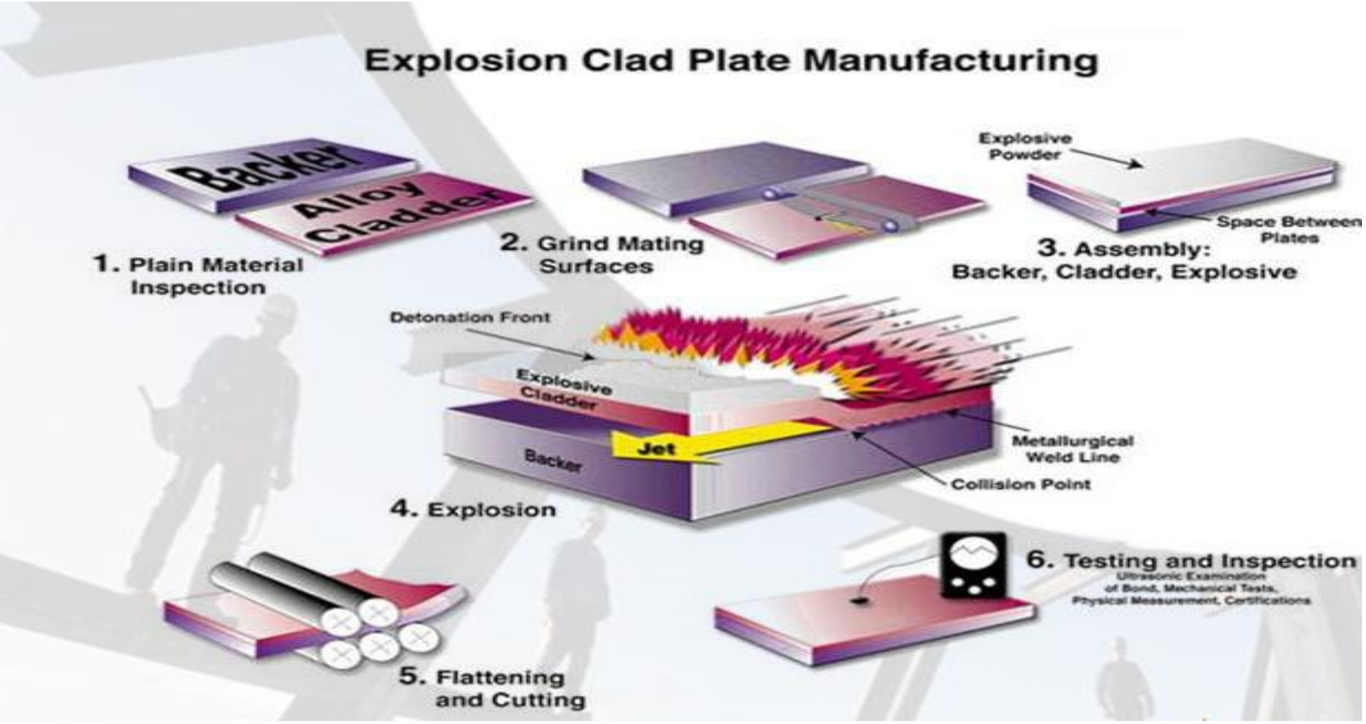
Fig. 6

2-8. Ultrasonic welding (CONT.)

- In ultrasonic welding, the static nfaying surface of the two components are subjected to aormal force and oscillating shearing (tangential) stresses.
- The shearing stresses are applied by tip of a transducer, similar to that used for ultrasonic machining.
- The frequency of oscillation is generally in the range of 10kHz to 75 kHz, although an even lower or higher frequency can be employed.
- Proper coupling between the transducer and tip (called a sonotrode, from the word sonic,by analogy with electrode) is important for efficient operation.

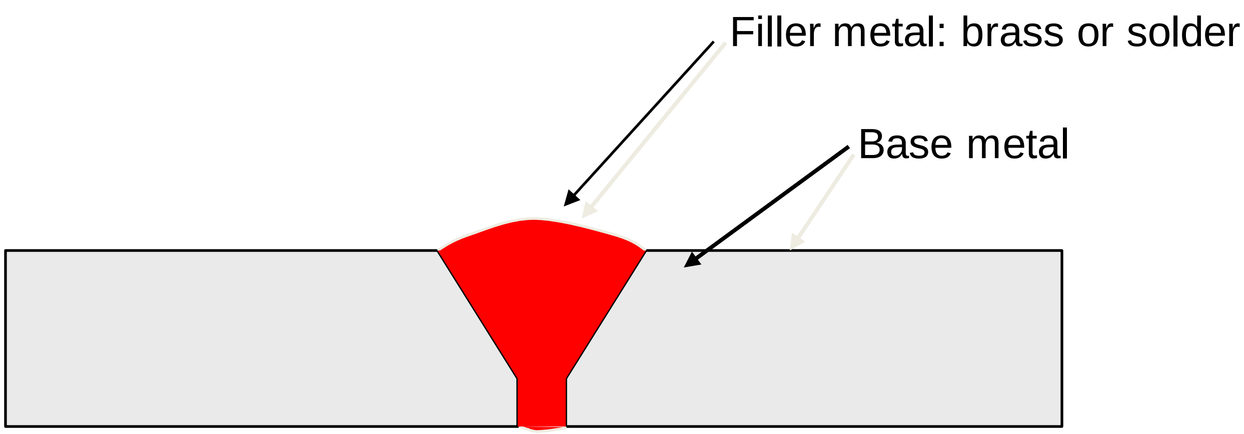
2-9. Explosion welding

EXW is a solid state welding process in which rapid coalescence of tow metallic surfaces is caused by the energy of a detonated explosive



3-SOLDERING AND BRAZING

in these processes, only the filler metals which join the two pieces to be welded are melted and not the base metal. The braze metals have higher melting temperatures than the solder metals.



Under Water Welding

- Hyperbaric welding can either take place *wet* in the water itself or *dry* inside a specially constructed pressure chamber and hence a 'dry' environment.
- It is often used to repair ships, offshore oil platforms, and pipelines. Steel is the most common material welded.
- Under water welding divided into Wet and Dry welding.

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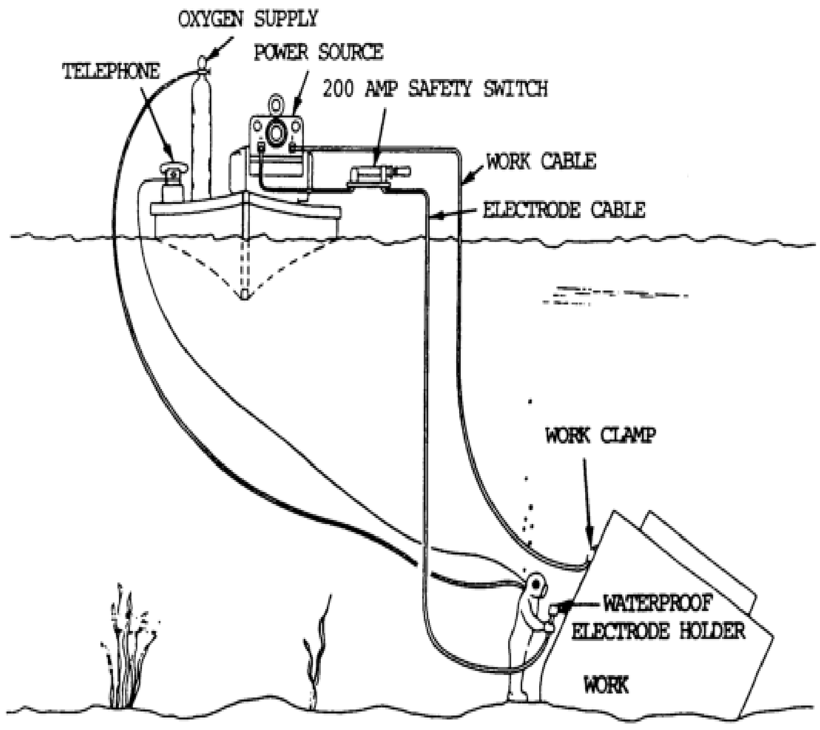
Wet welding



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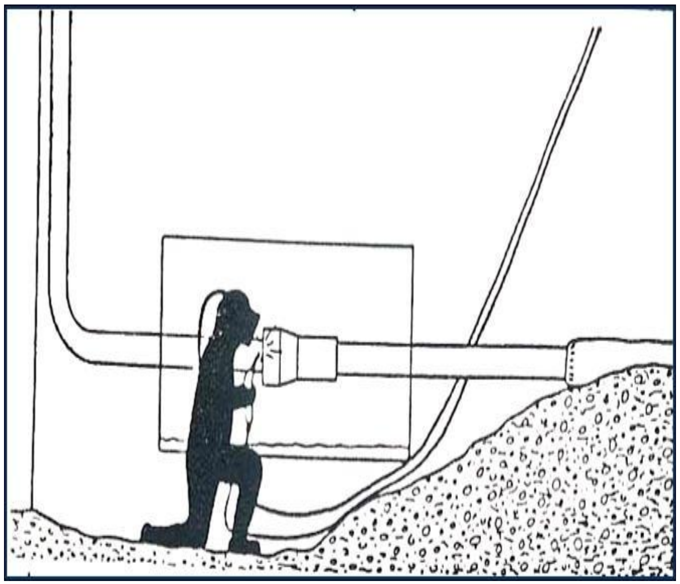
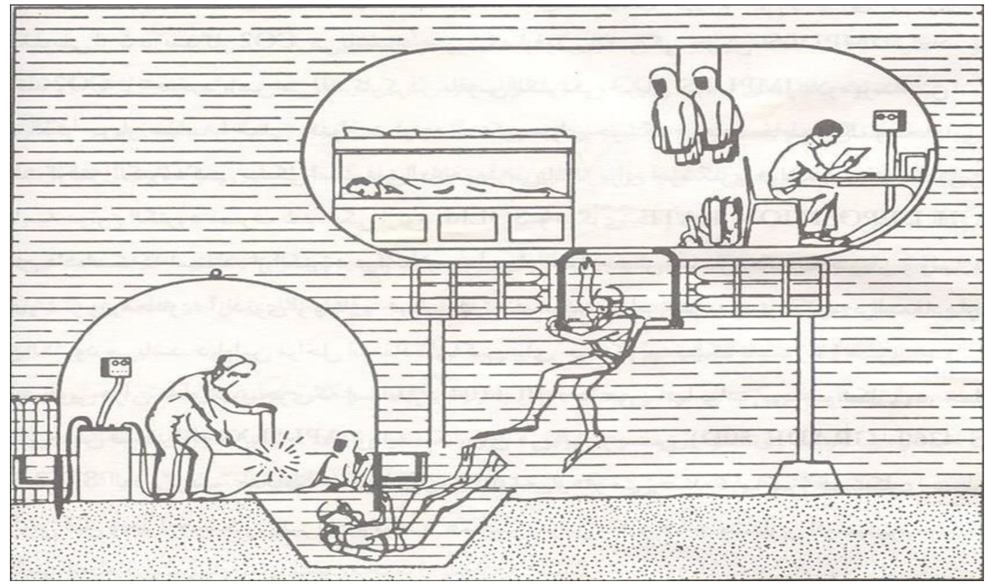
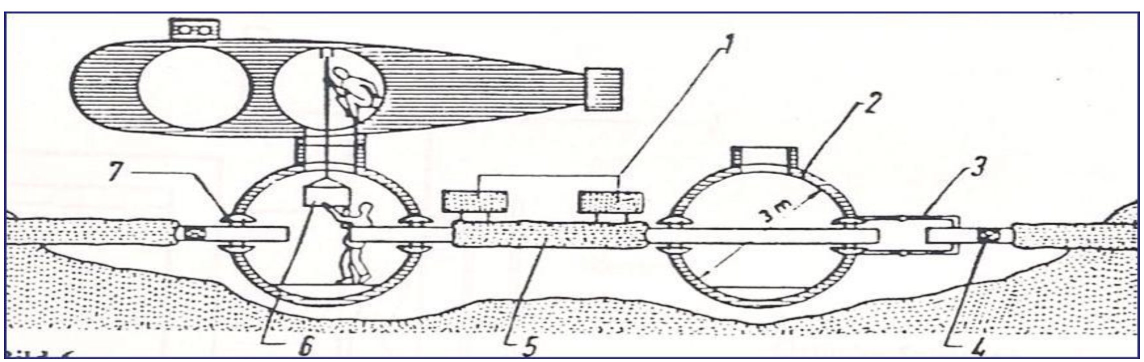
Dry welding

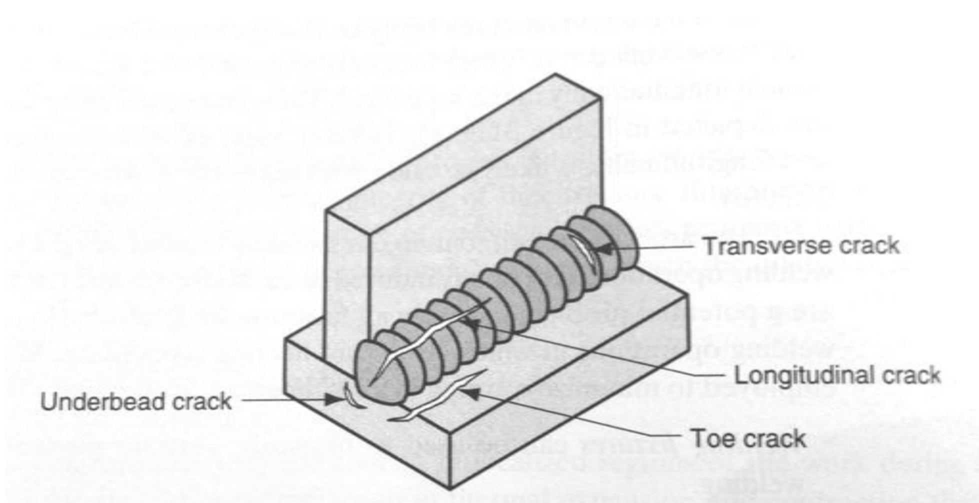




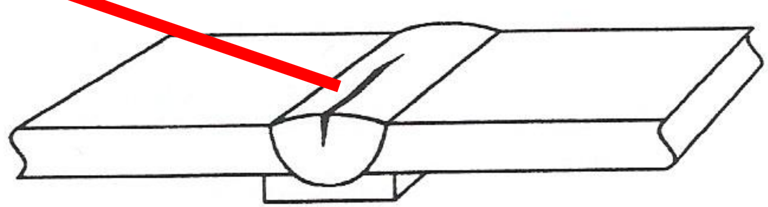


Welding defects

- There are some type of defects in welding that briefly introduced

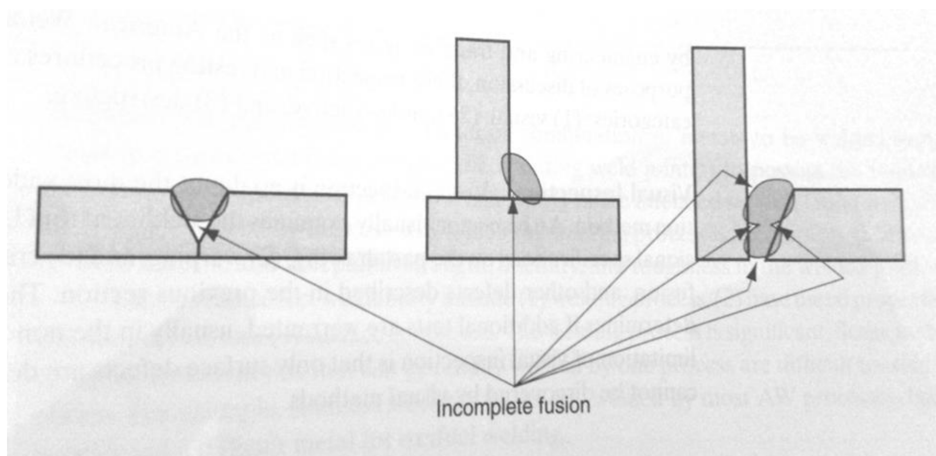


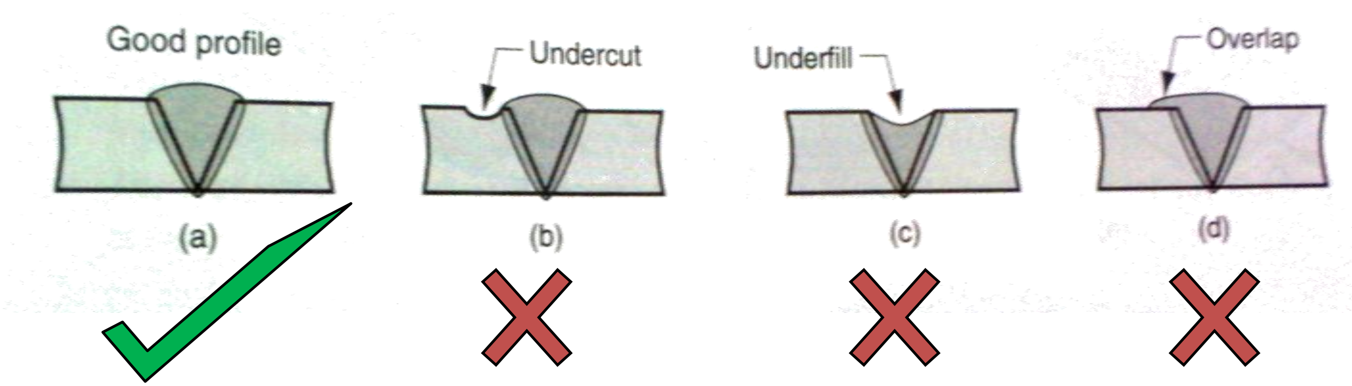
Cracking



Welding defects

Incomplete Fusion is also known as lack of fuison





Testing quality of welds

❑ A variety of inspection and testing method are available to check the quality of the welded joint.

❑These methods can be divaded in to
- •visual inspection
- •Nondestructive inspection
- •Destructive inspection

Testing quality of welds

visual inspection:
is the most widely used welding inspection that inspector visually examines the welds.

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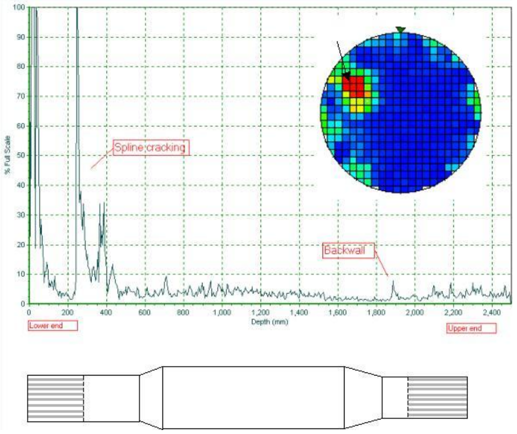
Testing quality of welds

Nondestructive inspection

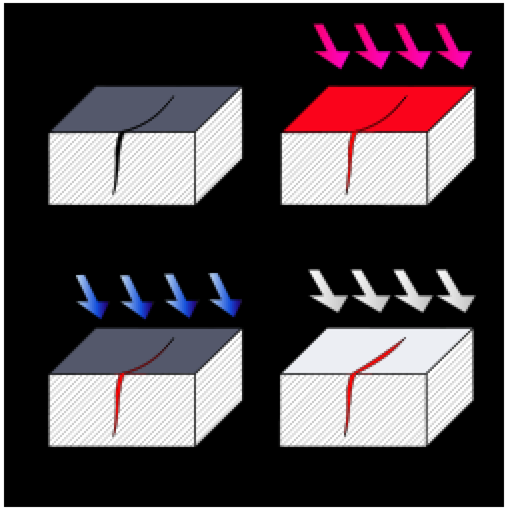
Consists of variety of inspection methods that do not damage the specimen being evaluated. Like :Magnetic particle, ultrasonic testing, Radiographic testing

Ultrasonic testing Test Equipment



Testing quality of welds

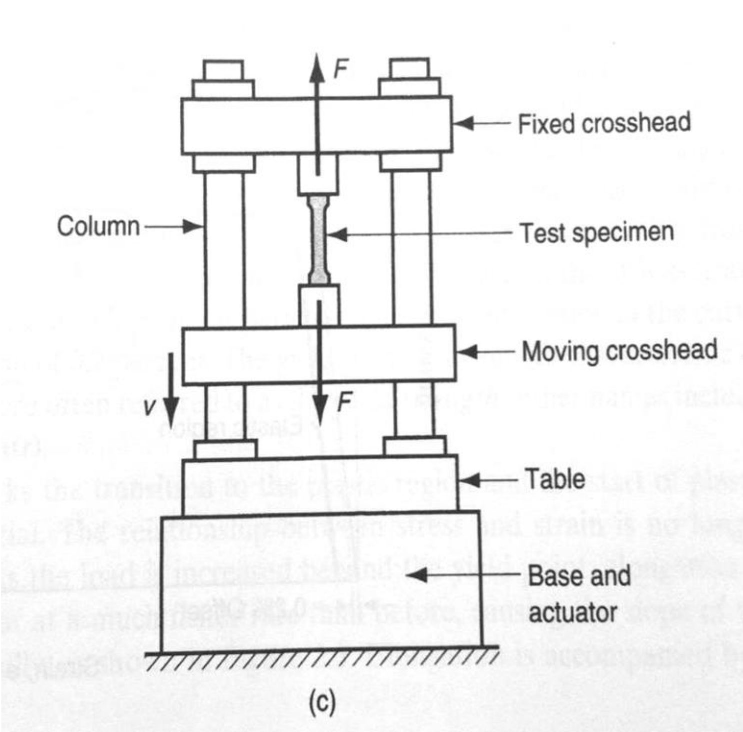
Nondestructive Testing methods



- Liquid penetrate testing (PT or LPI)
- Ultrasonic testing (UT)
- Radiographic testing (RT)
- Impulse excitation technique (IET)
- Electromagnetic testing (ET)
- Acoustic emission testing (AE)
- Positive Material Identification (PMI)
- Hardness testing (Brinell) (HT)
- Infrared and thermal testing (IR)
- Laser testing
- Leak testing or Leak detection (LT)
- Magnetic resonance imaging and NMR spectroscopy
- Visual Inspection (VT)

Destructive inspection

These are methods in which the weld is destroyed either during the test or to prepare the test specimen.



Future of welding

experts predict that welding will improve in these areas:

GTA (Gas tungsten arc) welding because of the increasing need for accuracy and precision in welding new metals;

GMA (Gas metal arc) welding with mixed gas shielding;

sheet metal industry;

construction industry;

infrastructure repair; marine structures; aerospace; and automotive, especially its use of aluminum alloys.

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Sila lihat vidio untuk masing-masing welding di : http://repository.unimal.ac.id/view/creators/Sayuti=3AM=3A=3A.html