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Internal Assessment Test II – Nov. 2017

Sub:	Metal Casting & Welding					Sub Code:	15ME35A	Branch:	MECH
Date:	08/11/2017	Duration:	90 min's	Max Marks:	50	Sem / Sec:	3SEM / A & B		

Answer any FIVE FULL Questions

		MARKS	OBE CO	OBE RBT
1(A)	Define welding process with brief classification	[2+4]	CO6	L1
1 (B)	Briefly explain the parameters affecting HAZ	[4]	CO8	L1
2	Explain with the neat sketch construction and working of submerged arc welding process	[10]	CO6	L1
3	Explain with the neat sketch construction and working of atomic hydrogen welding process	[10]	CO6	L1
4	Explain with the neat sketch construction and working of LASER welding process	[10]	CO7	L1
5	Explain with the neat sketch construction and working of Holography inspection method	[10]	CO8	L1
6	Briefly explain any five welding defects with reason and remedies	[10]	CO7	L1
7(A)	Explain the different methods of relieving of residual stresses	[6]	CO8	L1
7(B)	Write the difference between soldering and brazing processes	[4]	CO8	L1

Metal Casting & Welding
2nd IA – Solution

Date: 13/11/17.

1 (A) Define Welding process with brief classification.

Ans Welding processes are classified based on the Basic principles employed as:

⇒ Plastic Welding: The parts to be joined are heated only up to the plastic state and then fused together by applying the external pressure. plastic Welding is also called as pressure Welding.

Ex: Forge Welding. Resistance Welding etc--

⇒ Fusion Welding: The joint is made by melting the parts at the interface so that after solidification, the components are fused of joining together. In many cases Extra metal is melted

Ex: Arc Welding. Gas Welding etc--

classification of Welding processes

(i) Oxy-Fuel Gas Welding processes
- → Air-Acetylene Welding
- → Oxy-Acetylene Welding
- → Oxy-Hydrogen Welding
- → pressure gas Welding.

(ii) Arc Welding processes
- → Carbon Arc Welding
- → Shielded Metal Arc Welding
- → Submerged Arc Welding
- → Gas Tungsten Arc Welding
- → Gas Metal Arc Welding
- → plasma Arc Welding
- → Atomic Hydrogen Welding.

→ Electro - Slag Welding
→ Stud Arc Welding
→ Electro - gas Welding.

(iii) Resistance Welding
→ Spot Welding
→ Seam welding
→ projection Welding
→ Resistance Butt Welding
→ Flash Butt Welding
→ percussion Welding
→ High Frequency Resistance Welding
→ High Frequency Induction Welding.

(iv) Solid - state Welding processes
→ Forge Welding
→ Cold pressure Welding
→ Friction Welding
→ Explosive Welding
→ Diffusion Welding
→ cold pressure Welding
→ Thermo - Compression Welding.

(V) Thermit Welding processes
→ Thermit Welding
→ pressure Thermit Welding

(Vi) Radiant Energy Welding processes
→ Laser Welding
→ Electron Beam Welding.

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1 B) Briefly Explain the parameters Affecting HAZ

(i) Thermal Conductivity : The metal with higher thermal conductivity processes Smaller HAZ because of the fast heat transfer and fast Removal of heat from the fusion zone.

(ii) Heat input : It is the quantity of heat added to the weld metal while welding. Heat input Rate must be fast as it induces less heat into the metal and Results in small HAZ for example laser welding and electron beam welding. If the heat input Rate is low as it possess tendency to increase the heat content in the metal and Results larger HAZ for example gas welding and Arc welding.

(iii) Cooling Rate : Higher cooling Rate Reduces the HAZ while slower cooling Rate increases the HAZ.

(iv) Welding Speed : If slow welding speed is maintained during welding process, heat input Rate is low and it Results larger HAZ. If high Welding speed is maintained, heat input Rate is large and it Results in smaller HAZ.

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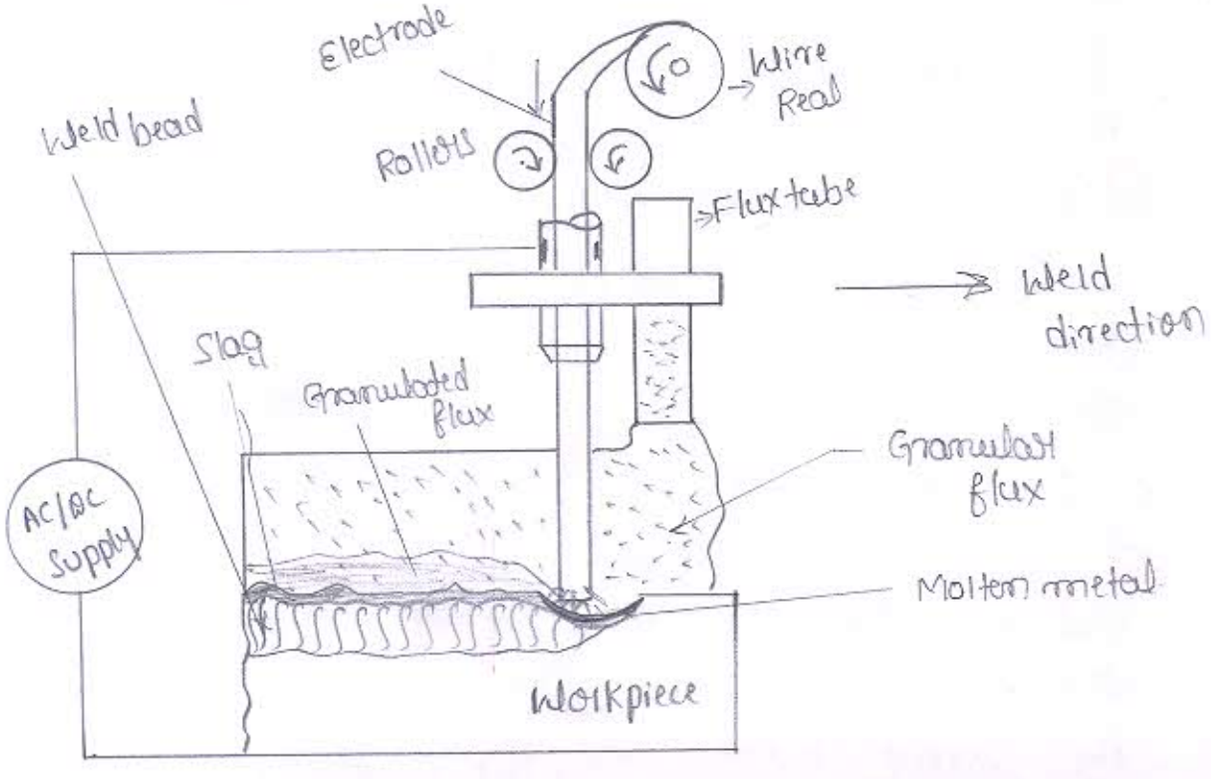
3. Explain with the Neat sketch construction and working of Submerged Arc Welding process.



Construction

* It consists of a welding head torch. which has a combination of electrode feeding nozzle and a flux feed hopper
* The wire feed motor equipped with grooved wire feed Rolls which fed the electrode continuously to the torch
* Flux supply is carried out via a hose from the flux container to the feeding hopper which is mounted on the torch head and is placed ahead of the electrode. It delivers the powered flux continuously into the prepared joint to be welded.
* The flux may contain oxides of calcium. silicon. magnesium. aluminum. or manganese along with the alloying elements depending on the environment.
* Submerged arc welding can be operated using either an A.C power source or a D.C power source where the electrode is normally connected to the positive terminal and. welding Advance is provided

Operation:

* At first the job is cleaned and all types of contaminants like grease, oil, dirt. Scale and paint are Removed. The surfaces of the electrodes are also made very clean.
* The flux starts depositing on the joint to be welded. The flux is non-conductor of electricity when it is cold. the arc is struck under a cover of flux.
* Flux otherwise is an insulator but once it melts due to heat of the arc. it becomes highly conductive and hence the current flow is maintained b/w the electrode and the workpiece through the molten flux.
* At the same time the upper portion of the flux. in contact with atmosphere. which is visible Remains granular and can be reused. The lower. flux melts and React with the molten weld pool to form a slag.

* The slag floats on the surface providing thermal insulation the molten metal thereby allowing it to cool slowly
* The welding head is moved along the surface to be welded and the electrode at a predetermined speed is continuously fed to the joint to complete the weld.
* Finally, after complete solidification, the layer of slag formed on the weld portion is chipped out and the weld is cleaned.

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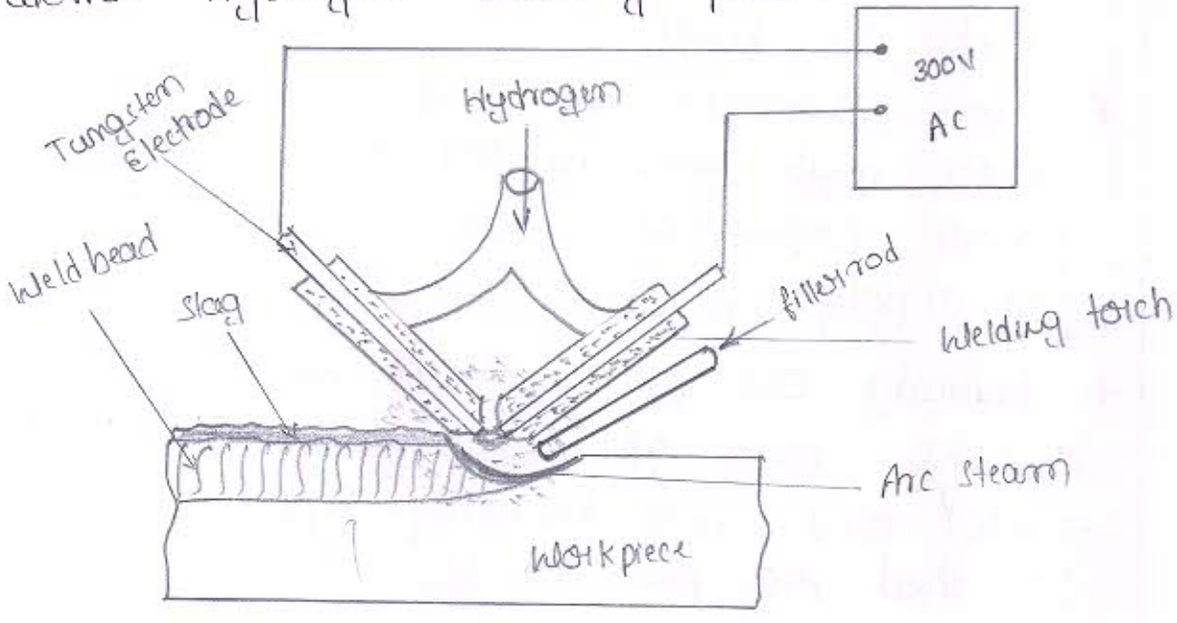
(3) Explain the neat sketch construction and working of atomic hydrogen welding process



Construction

* Twin electrode torch. used to hold the two non consumable electrodes at an angle. Usually an alloy of tungsten with zirconium or with thorium is used for the welding electrode material. to achieve higher current carrying capacity. Arc stability and Resist contamination.
* Hydrogen gas cylinder. used to supply hydrogen gas to both the torches. through the passage provided and then impinges on the workpiece through the nozzles.
* pressure Regulators and control valves are used to provide controlled flow of hydrogen gas.

* Inwelding power the power supply is connected only between the two electrodes and workpiece is free from the circuit. It required equal amount of heat to be supplied to both the electrodes. thus A.C power is more suitable compared to D.C

Operation

* At first the job is cleaned and all types of contaminants like grease, oil, dirt, scale and paint are removed. The surfaces of the electrodes are also made very clean. filler Rod of Required composition to suit the parent metal is selected.
* Two electrodes are held in the torch. are inclined at an angle and Adjusted to maintain a stable Arc. power connections are switched ON. The hydrogen gas supply is turned ON.
* Initially an Arc is struck b/w two electrodes by touching each other keeping away from the parent metal and instantaneously separated a distance of 2mm so that Arc Remains b/w the electrodes.
* At the same time hydrogen gas is passes through torch nozzle around the electrode and forms the gas blanket around the Arc. the heigh temperature of the arc dissociates some molecules of the hydrogen gas into atoms. a large quantity of heat being absorbed by the hydrogen during dissociation.

$$H_2 \leftrightarrow H + H - 422\ KJ$$

Each high energized hydrogen atoms will flow towards the low energized parent metal.

* Each hydrogen atom will come in contact with cold parent metal and Recombine forming molecules of hydrogen and liberating intense heat sufficient to melt surfaces to be welded $H + H \leftrightarrow H_2 + 422\ KJ$

* This intensity heat melts the workpiece metal & forms the molten pool. Simultaneously filler metal is inserted into the welding area so that filler metal also melts and fills the gap b/w the workpiece. forms the globules of molten metal.
* The hydrogen gas which is not ionized forms the blanket around the molten metal pole. to protect it from atmospheric contamination.
* The welding head is moved along the surface to be welded and the filler metal is continuously fed to the joint to complete the weld.

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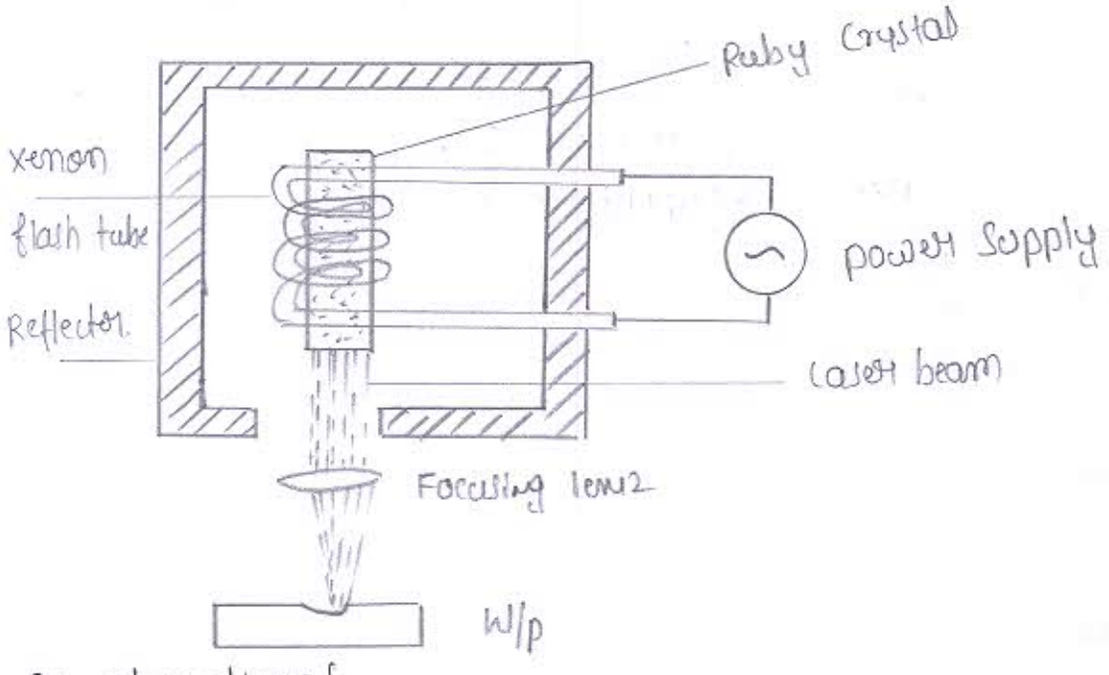
(4) Explain with the Neat sketch construction and working of LASER welding process



Constructions

* Ruby crystal: It is cylindrical in nature made of aluminium oxide with chromium sprinkled throughout it. The ends of cylinder are covered. in which one end is highly Reactive and other end is partial Reactive, is provided with small hole through which laser beam emerges out.
* Xenon flash tube: It is helical in nature. Surrounded by Ruby crystal. and is connected to the power supply.

* Cavity: the Ruby Crystal and xenon flash tube are located inside the optical cavity that is cooled Externally by a gas or liquid to protect laser source by high heat.
* Reflector: It is provided inside the cavity used to increase the intensity of the incident light on the Ruby Crystal.

Operation

* The workpieces to be joined are cleaned to Remove dirt and are kept below the laser source on the table
* When the high voltage power is supplied to the xenon flash tube. it emits the white light by converting Electrical energy into light energy.
* The Ruby Crystal absorbs this white light causes the Chromium atom to excite and pumped to higher energy level. The excited chromium atoms take place within the Ruby from the Reflective ends. causes optical Resonance and Amplification the energy.
* Finally the intense beam of monochromatic Radiation Emerges from the tiny hole as a LASER BEAM. their beams are focused by an focusing lens to a point on the workpiece

(5) Explain with the sketch construction & working of Holography inspection method.

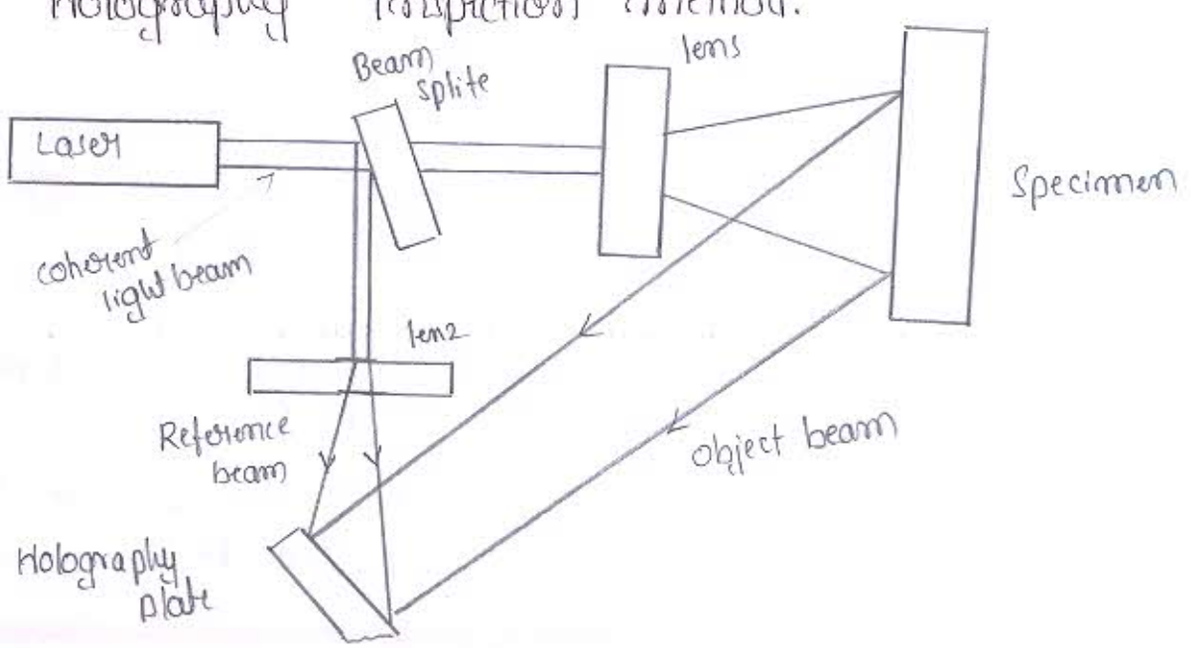


Figure shows the arrangement of holographic interferometry for the inspection of parts with varying shapes and surface conditions.

The arrangement consists of laser from which a beam of coherent light is made to pass through the beam splitter and laser is split into two parts. using a beam splitter. A part of beam passes though the lens. which diverge the beam and falls on the surface of the specimen to be inspected. The Remaining part of the beam passes through the diverging lens and finally falls on the photographic plate to act as a Reference beam. The beam which falls on the Specimen to be inspected gets Reflected and falls on the photographic plate. This beam is called object beam.

Now two Rays are illuminated on the photographic plate one from the object and other from the Reference beam. These two beams interfere with each other: their Resultant get projected onto it film, and forms Speckle pattern on the plate, as a holographic image.

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(6) Briefly Explain any five Welding defects with Reason and Remedies.

(i) Cracks : Cracks may be of micro or macro size and may appear in the weld metal or base metal or base metal and weld metal boundary. Different categories of cracks are longitudinal cracks, transverse cracks or Radiating/Star cracks and cracks in the weld crater.

causes

→ These stresses are developed due to Shrinkage during Solidification of Weld metal.

→ poor ductility of base metal. High Sulphur and carbon contents
→ High Arc travel speed

Remedy:
→ Design the structure and develop a welding procedure
→ Do not use too small weld b/w heavy plates
→ pre-heating parts to be welded sometimes will be helpful.

(ii) porosity

porosity Results when the gases are entrapped in the solidify weld metal. These gases are generated from the flux or coating constituents of the electrode or shielding gases used during welding or from absorbed moisture in the coating. Rust, dust, oil and grease present on the surface of work pieces or on electrodes are also source of gases during welding.

Causes
→ Improper welding procedure
→ Non-Sufficient paddling time to allow entrapped gas to escape
→ poor base metal.

Remedy
→ work pieces are properly cleaned from Rust, dust etc.
→ Further, porosity can also be controlled if excessively high welding currents faster welding speeds
→ Long arc lengths are avoided flux and coated electrodes are properly baked.

(iii) Solid Conclusion

Solid conclusion may be in the form of slag or any other non-metallic material entrapped in the weld metal as these may not able to float on the surface of the solidifying weld metal.

However, if the molten weld has high viscosity or too low temperature or cools Rapidly then the slag may not be Released from the weld pool and may cause inclusion.

Causes
→ Use of large size Electrodes in a narrow groove
→ Low currents that are insufficient for melting metal
→ High Viscocity of the weld metal.

Remedy
→ proper groove is selected
→ All the slag from the previously deposited bead is Removed.
→ Too high or too low welding currents and long arcs are avoided

(iv) Lack of fusion

Lack of fusion is the failure to fuse together either the base metal and subsequent beads in multi pass welding because of failure to Raise the temperature of base metal or previously deposited weld layer to melting point during welding

Causes
→ Improper diameter of electrode
→ Improper welding current
→ Improper welding technique

Remedy
→ Lack of fusion can be avoided by properly cleaning of surfaces to be weld.
→ Selecting proper current
→ proper welding technique and correct size of electrode.

(v) Incomplete penetration

Incomplete penetration means that the weld depth is not upto the desired level of Root faces have not Reached to melting point in a groove joint.

causes

→ use of too large diameter of electrode
→ Too fast welding speed.
→ Insufficient welding current.

Remedy

→ Do not excessive penetration from an electrode
→ use small diameter electrodes in narrow welding grooves
→ use sufficient welding current to obtain proper penetration.

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7. (A) Explain different methods of Relieving of Residual stresses.

(i) Thermal Method: The thermal method involves changing the temperature of the entire part uniformly. either through heating or cooling. when parts are heated for Stress Relief. the process may be also known as Stress Relief bake. cooling parts for stress Relief is known as cryogenic stress Relief and is Relatively uncommon.

(ii) Stress- Bake Relief bake: Most metals when heated. Experience a Reduction in Yield strength. If the material's Yield Strength is sufficiently lowered by heating. locations within the material that Experienced Residual Stresses greater than the Yield strength should Yield or deform. This leaves the material with Residual Stresses that are at most as high as the Yield strength of the material

Stress - Relief bake should be not be confused with annealing or tempering. which are heat treatments to increase ductility of a metal. Although those procelles also involves heating the material to high temperatures and Reduce Residual Stresses. they also involves a change in metallurgical properties. which may be undesired.

For certain material such as low alloy steel, care must be taken during Stress. Relief bake so as not so Exceed the temp at which the material achieves max hardness

(iii) Cryogenic Stress Relief: Cryogenic Stress Relief involves placing the material into a Cryogenic environment such as liquid nitrogen. In this procell. The material to be Stress Relieved will be cooled to a cryogenic temperature for a long period and then slowly brought back to Room temperature.

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7. (B) Write the difference between Soldering and Brazing

Soldering	Brazing
→ filler material is used in Soldering called Solder.	→ In Brazing filler material is used. called Spelter
→ Melting point is above 450°C	→ Melting point is below 450°C
→ Soldering joints are comparatively low	→ joints produce is stronger
→ Solder is Non-corrosion Resistance.	→ Brazed is corrosion Resistance
→ It is Not Required Skilled labours	→ It is Required Skilled labours