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Internal Assessment Test 2 – October 2018

Sub:	METAL CASTING AND WELDING					Sub Code:	15ME35A	Branch:	MECHANICAL
Date:	16/10/2018	Duration:	90 min's	Max Marks:	50	Sem/Sec:	3rd Sem A		OBE

	Answer any FIVE FULL Questions	MARKS	CO	RBT
1.	Explain with a neat sketch principle operation of seam welding.	[10]	CO6	L2
2.	Explain with a neat sketch laser beam welding process.	[10]	CO7	L2
3.	Explain with a neat sketch gravity die casting method.	[10]	CO1	L2
4. (a)	What is welding and explain types of welding. Give its classification.	[06]	CO6	L2
(b)	Write a short note on i. electrode ii. joint cleaning.	[04]	CO6	L1
5.	Explain with a neat sketch slush casting method.	[10]	CO1	L2
6.	Explain with a neat sketch pressure die casting.	[10]	CO1	L2
7.	Explain with a neat sketch principle and operation of TIG welding.	[10]	CO6	L2

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Scheme of Evaluation Internal Assessment Test 2 – October. 2018

Sub:	METAL CASTING AND WELDING					Sub Code:	15ME35A	Branch:	ME
Date:	16/10/2018	Duration:	90 min's	Max Marks:	50	Sem / Sec:	3rd A		

	Answer any 5 question	Split up	Max. MARKS
1	Explain with a neat sketch principle operation of seam welding. **Diagrams- 4 marks** **Construction and Working- 4 Marks** **Advantages and disadvantages-2 Marks**	 **4M** **4M** **2M**	[10]
2	Explain with a neat sketch laser beam welding process. **Diagrams- 4 marks** **Construction and Working- 4 Marks** **Advantages and disadvantages-2 Marks**	 **4M** **4M** **2M**	[10]
3	Explain with a neat sketch gravity die casting method. **Diagram- 4 Marks** **Construction and Working- 4 Marks** **Advantages and disadvantages-2 Marks**	 **4M** **4M** **2M**	[10]
4	(a) What is welding and explain types of welding. Give its classification (b) Write a short note on i. electrode ii. joint cleaning. **(a)Defining welding-1 Mark - 1 Mark** **Explaining types of welding-2 Marks** **Giving classification-3 Marks** **(b) i. Explaining electrode and types - 2 Marks** **ii. Explaining joint cleaning - 2 Marks**	 **1M** **2M** **3M** **2M** **2M**	[10]
5	Explain with a neat sketch slush casting method. **Diagram- 4 marks** **Construction and Working- 4 Marks** **Advantages and disadvantages-2 Marks**	 **4M** **4M** **2M**	[10]

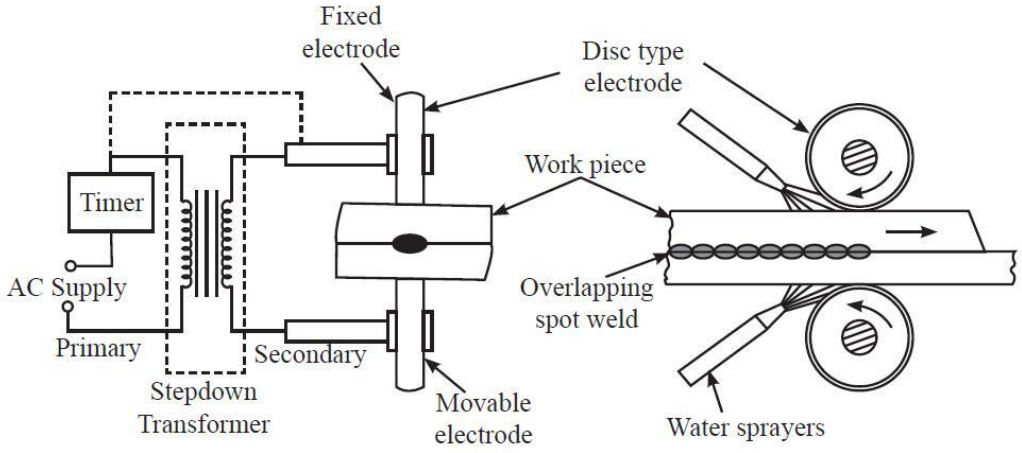
6	Explain with a neat sketch pressure die casting. **Diagram- 4 Marks** **Construction and Working- 4 Marks** **Advantages and disadvantages-2 Marks**	**4M** **4M** **2M**	[10]
7	Explain with a neat sketch principle and operation of TIG welding. **Diagram- 4 Marks** **Construction and Working- 4 Marks** **Advantages and disadvantages-2 Marks**	**4M** **4M** **2M**	[10]

SOLUTION OF 2ND IAT

1. Principle of seam welding process is similar to spot welding, but in seam welding overlapping sheets are gripped between two wheels or roller disc electrodes and current is passed to obtain either the continuous seam (overlapping weld nuggets) or intermittent seam (weld nuggets are equally spaced). Welding current may be continuous or in pulses. The process of welding is illustrated in Figure

It consists of following parts

1. It consists of a set of mechanical driven wheel shaped electrode **made** of **copper alloy**, are used to allow flow of current to the workpieces.
2. These electrodes are connected to **secondary step down transformer** with a current controlling device, which converts low current high voltage supply into high current low voltage supply.
3. **Hydraulic or mechanical or pneumatic type of Piston-cylinder** mechanism is used to apply the external pressure/force on the electrodes.
4. **Timer,** used to control duration of flow of current to the electrodes and also controls the pressure apply.



Operation

1. The workpieces to be joined are properly cleaned so that surfaces to be welded are free from rust, dust, oil and grease.
2. Welding cycle starts with the placing an overlapped workpieces in between the roller disc electrodes and are held under pressure. These electrodes are driven mechanically in opposite directions.
3. The welding current is switched ON and current is passed in a series of pulses at proper intervals through the bearing of wheel electrodes for preset time.
4. For the current flow through the electrodes to the workpiece, heat is developed at the area of metals in contact (spot) and heat in this location shall be rapidly raised to welding temperature due to maximum resistance is exists at the contact surfaces of the workpieces.
5. The heat developed fuses the workpieces at the electrode spot and in order to obtain a strong joint, external pressure is applied on the electrodes by piston-cylinder mechanism

which squeezes the hot metal together thus completing the weld. In some cases external pressure is not required, holding pressure of electrodes is sufficient to create good joint.

6. In order to compensate for the short circuit of the adjacent welds, external cooling of the work by air or water is often employed.

Advantages

- Gas tight as well as liquid tight joints can be made.
- The Overlap is less than spot or projection welding.
- The production of single seam weld and parallel seams can be got simultaneously.

Disadvantages

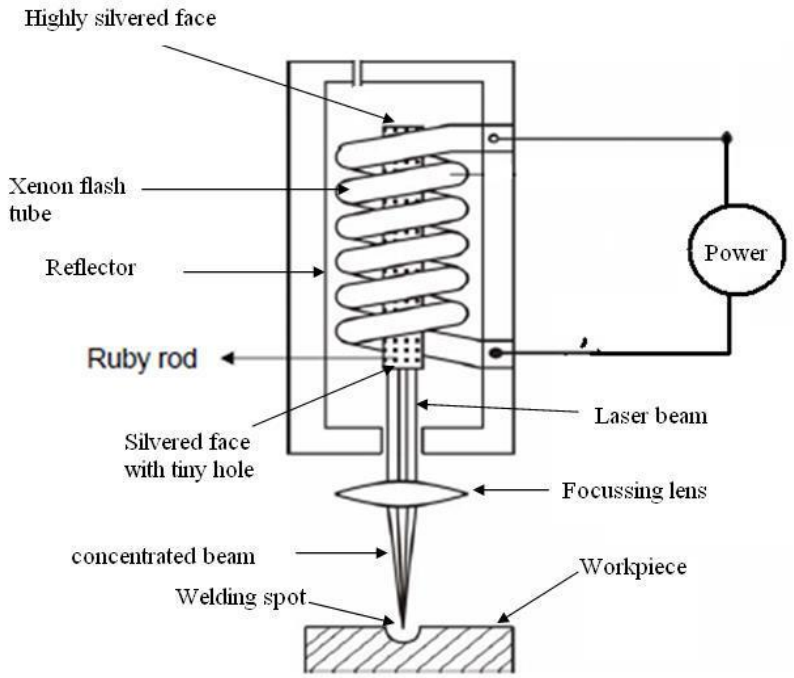
- The welding process is restricted to a straight line or uniformly curved line.
- The metals sheets having thickness more than 3mm can cause problems while welding.
- The design of the electrodes may be needed to change to weld metal sheets having obstructions.

2. Equipment

1. **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
2. **Xenon flash tube:** It is helical in nature, surrounded by ruby crystal and is connected to the power supply.
3. **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.
4. **Reflector:** it is provided inside the cavity, used to increase the intensity of the incident light on the ruby crystal.

Operation

1. The workpieces to be joined are cleaned to remove dirt and are kept below the laser source on the table.
2. When the high voltage power is supplied to the xenon flash tube, it emits the white light by converting electrical energy into light energy.
3. The ruby crystal absorbs this white light, causes the chromium atom to excite and pumped to higher energy level. The excited chromium atoms return to its normal energy level by emitting unidirectional red fluorescent light.
4. Oscillation of beam takes place by hitting one excited chromium atom to another chromium atom of the crystal gives of red light within the ruby. Numerous collisions between the red light wave and the chromium atoms take place within the ruby from the reflective ends, causes optical resonance and amplification o the energy.
5. Finally the intense beam of monochromatic radiation emerges from the tiny hole as a LASER BEAM. These beams are focused by an focusing lens to a point on the workpiece.
6. The intense laser beam melts the metal at tiny area forms the molten pool of metal at the joint area, and upon cooling the material become homogenous and forms the solid joint.



Advantages:

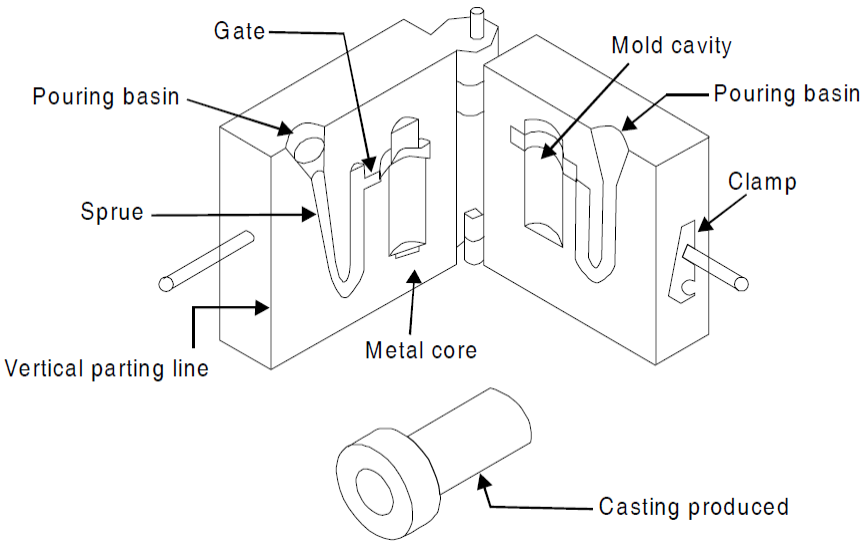
- precise working with exact placing of the energy spot
- welding of complicated joint geometry
- low heat application, therefore minor changes in microstructure
- low thermal distortion
- cavity-free welds
- low post weld operation times
- Large working distance is possible (welding up to 500 mm distance and also to inaccessible parts).

Dis-advantages

- The welding plants are expensive, depending upon the equipment.
- If filler material is necessary they are, because of the limited amount produced, relatively expensive. This disadvantage is counteracted by the low amount used compared to the welding time and also that there are few post welding operations.

3. This casting method is also popularly known as **Permanent mould casting**, where moulds are made up of metals, are permanent and can be used repeatedly. In this casting method molten metal is poured into the mould under gravity only; no external pressure is applied to force the liquid into the mould cavity, hence the name **Gravity die** casting.

In this casting method, metallic moulds called **dies** are used, which can withstand high temperatures of molten metal. The moulds are made of metals like steel, grey cast iron, graphite, copper etc. The metallic moulds are more advantageous than sand moulds; the solidification of the casting is faster because of chilling action. Fig 2.8 shows the gravity die casting.



Steps involved in operation

1. The permanent mould is made into two parts in order to facilitate easy removal of the casting from the mould.
2. Both the parts are hinged at one end and clamped at other end. Inner surface of mould is coated with refractory mould coat or core oil to facilitate easy removal of casting and prevent adherence of the molten metal to the mould.
3. Pouring cups, sprue, gates and riser are built in the mould halves itself. Mould is pre-heated to a temperature of about 250^0 C to 300^0 C by gas or oil flame before filling the molten metal.
4. Mould is closed with the help of clamp and molten metal of desired composition is poured into the mould under gravity.
5. After solidification mould is opened and casting is removed. Again it is closed to receive molten metal for another casting without preheating since heat from the previous cast is usually sufficient to maintain the mould temperature.

Advantages

1. Castings have close dimensional tolerance and accuracy.
2. Good surface finish and better appearance.
3. Economical for mass production.
4. Low overhead charges.

Dis-advantages

1. This method is not suitable for small production due to high cost of die.
2. This method is only suitable for low melting point metals and alloys.
3. Casting have poor elongation
4. Defects like stress and surface hardness occurs due to surface chilling effect.
5. Complicated shape products are difficult to produce by this method.
6. Mould life is limited.

4 . (a) Welding is a process of joining two similar or dissimilar metals by fusion. It joins different metals/alloys, with or without the application of pressure and with or without the use of filler metal.

Welding processes are classified based on the basic principles employed as;

1. Plastic welding.
2. Fusion welding.

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 joined together. In many cases extra metal is melted along the joint, to completely fill the joint region. Ex: Arc welding, Gas welding etc.

Welding process can be classified into different categories depending upon the following criteria:

1.. Oxy-Fuel Gas Welding Processes

- Air-acetylene welding
- Oxy-acetylene welding
- Oxy-hydrogen welding
- Pressure gas welding

2. 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

3. Resistance Welding

- Spot Welding
- Seam Welding
- Projection Welding
- Resistance Butt Welding
- Flash Butt Welding
- Percussion Welding
- High Frequency Resistance Welding
- High Frequency Induction Welding

4. Solid-State Welding Processes

- Forge Welding
- Cold Pressure Welding
- Friction Welding
- Explosive Welding

- Diffusion Welding
- Cold Pressure Welding
- Thermo-compression Welding

5. Thermit Welding Processes

- Thermit Welding
- Pressure Thermit Welding

6. Radiant Energy Welding Processes

- Laser Welding
- Electron Beam Welding

(b).

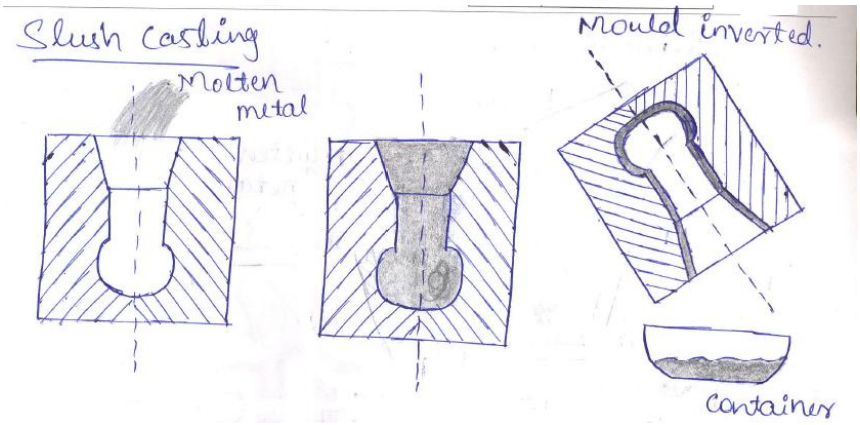
(i).

(ii) Methods of Cleaning

- **Flame-Cleaning** -used to remove rust, scale, and moisture is one of the most effective means of eliminating porosity in submerged arc welding.
- **Grinding -** may be used to remove mill scale or rust. Grinders can be manually guided or mounted on the welding machine.
- **Wire Brushing** - is useful for removing light rust and dirt only. Some types of paint can be removed by wire brushing but generally paint remover, flame cleaning or grinding is necessary.
- **Paint Removers** - should be applied to painted surfaces, the loose paint scraped off, then wire brushed, and washed with a volatile solvent.
- **Sandblasting or Shot blasting** -readily removes heavy rust, mill scale and paint. Sheared edges are not satisfactorily cleaned by this method.
- **Pickling** - may be used to remove mill scale and rust. The pickling bath should contain inhibitors and a neutralizing rinse should be used to prevent hydrogen absorption.
- **Degreasing** - used especially for cleaning cold formed parts.

5. This is the special type of permanent mould casting in which hollow castings are produced without cores since solidification of molten metal starts from mould surface towards center. Slush casting method is used to produce castings with having external shape is important.

In this method, molten metal is poured into the metal mould and allowed to solidify up to the required thickness for few seconds. Then mould is inverted and remaining molten metal is drained out into a container and a casting of desired thickness is obtained in the mould. The thickness of casting is depends upon the time for which the metal is allowed to solidify into the metal mould. Metal mould is made into two parts to facilitate easy removal of casting. The mould is opened and thin layered hollow casting is taken out. This method is to casting of ornaments, toys, hollow lamp stand etc.



Advantages

1 Better quality
2 Produce casting quickly and more economical than other methods
3 Good surface finish
4 It can produce the component, which is not possible from other methods.

Dis-advantages

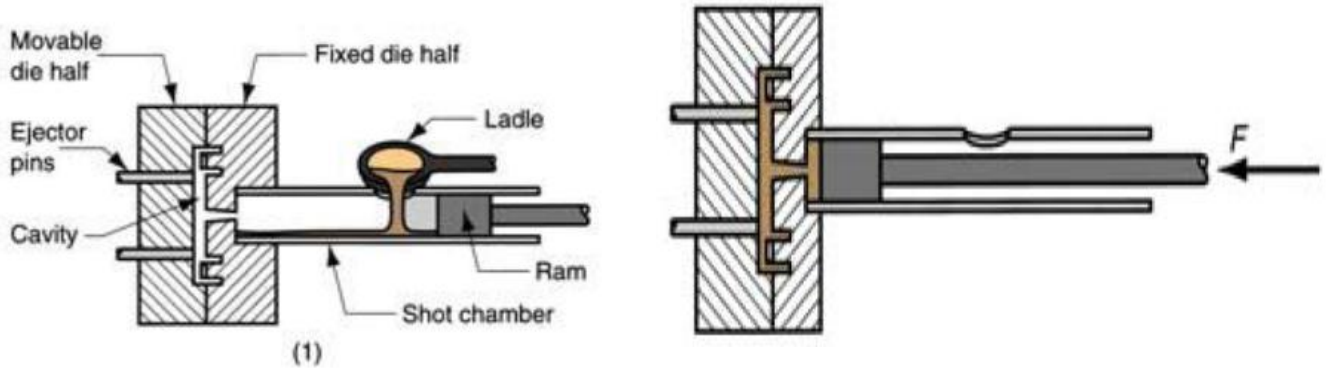
1. Casting must be symmetric
2. Metallic composition of alloys in not uniform throughout the casting

6. This method is suitable to cast high melting point non-ferrous alloys such as aluminium, magnesium and brass which require higher pressure and higher temperature for melting. In this method, the metal is melted separately in a furnace and transferred to shot chamber by means of ladle. Figure 2.11 shows cold chamber die casting.

1. It consists of a long cylindrical chamber, where one end of the chamber is connected to the piston arrangement and other end is connected to the die assembly.
2. Chamber has large opening at the top, through which molten metal is transferred into the chamber by means of ladle.
3. The die or mould is made into two halves in order to facilitate easy removal of the casting, in which one half is **fixed die** and other half is **movable die**. The dies are aligned in position with the help of ejector pins which also facilitates easy removal of casting from the dies.
4. In operation, required quantity molten metal is charged into the chamber with the help of ladle.
5. Molten metal from the chamber is forced into the die cavity by hydraulically operated plunger and the metal is held under pressure until it solidifies. When solidification is complete, casting is ejected out with the help of ejector pins.

Advantages

1. High production rate.
2. Good dimensional accuracy and good surface finish.
3. It requires less floor place.
4. Because of high pressure, thin sections (0.4mm) can easily produce.
5. No risers used due to high pressure injection of molten metal.
6. Castings are less defective.



Limitations

1. The cost of die and equipment is high
2. The process is economical only for mass production.
3. Die casting has porosity problems as gases tends to be entrapped.
4. The life of die is decreases rapidly if metal temperature is high.
5. The size of casting is small.

7. Main component of TIG

1. **Welding torch**- used to hold the electrode wire rigidly with the help of collet.

2. **Shielding gas cylinder:** shielding gas is flows from the cylinder to the torch, through the passage provided in the torch and then impinges on the workpiece through the torch nozzle as shown in figure 4.6.

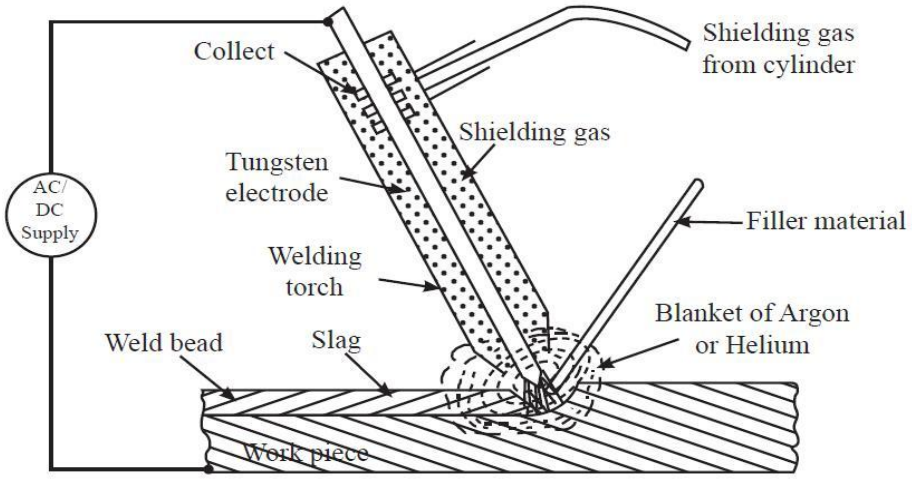
3. **Pressure regulators and control valves** are used to provide controlled flow of shielding gas.

4. **Welding power**: Either A.C. or D.C. power is used. Thoriated Ti electrodes have high emissivity, better current carrying capacity and longer life and normally preferred in DC welding. Pure Ti electrodes are usually preferred for AC welding of aluminium and magnesium. The current carrying capacity is lower than that of alloyed electrodes.

Operation

1. 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.

2. Power connections are switched ON. The inert gas supply is turned ON through the regulator. An arc is then struck with the actual workpiece to be welded and instantaneously the electrode is separated from the workpiece by a small distance of about 2-4 mm so that arc remains between the electrode and the workpiece.



3. The arc thus struck, due to high intensity of arc melts the workpiece metal and forms the molten pool.

4. Simultaneously filler metal is inserted manually into the welding area so that filler metal also melts and fills the gap between the workpiece, forms the globules of molten metal.

5. At the same time shielding gas is impinges on the workpiece and covered the molten pool completely to protect it from atmospheric contamination.

6. 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.

7. As the welding is continued forward, the preceding molten metal starts solidifying and forms the strong joint between the workpiece.

Advantages of Tungsten Inert Gas Arc Welding:

- Weld composition is close to that of the parent metal;
- High quality weld structure
- Suitable for thin metals.
- Weld zone is clearly visible, hence control is easier.
- There are no weld cracks and no weld spatter.
- Slag removal is not required (no slag);
- Thermal distortions of work pieces are minimal due to concentration of heat in small zone.

Disadvantages of Tungsten Inert Gas Arc Welding :

- Low welding rate;
- Relatively expensive;
- Requires high level of operators' skill.
- Not suitable for heavier sections