DATE 4/11/16

EXPERIMENT : 2

SHEET NO. 2.1

GAS METAL ARC WELDING (GMAW or MIG)

- **Objectives :**
  - To study the characteristics of GMAW process
    - The effect of heat input on bead parameter.
    - Influence of process parameters on the weld quality.
  - To study the importance of pulsed DC in an arc welding process.
- **Equipment :**
  - GMAW Machine
  - Argon cylinder with argon gas
  - Trolley to mount the work piece which moves in at variable speeds.
  - Vernier callipers, Microscope.
- **Theory :** Gas metal arc welding uses a continuously fed electrode wire to deposit weld bead in the inert gas atmosphere such as Argon. The GMAW machine can be operated in two modes. Either normal mode or Pulsed mode.
  - Consumable wire electrode is fed continuosly and automatically from a spool through the welding gun.
  - Inert Shielding gas protects the arc and the molten or hot, cooling weld metal from air. Also, provides desired arc characteristics through its effect on ionization.
  - No electrode coating
  - No flux or additional filler.
  - DCRP used (electrode +ve, work -ve)

Pulsed DC in arc Welding:

In normal mode the machine is operated at constant voltage and current. In Pulsed mode the heat input is supplied in the form of short pulses at the period in milli seconds. In the pulsed mode the machine is operated at peak current to melt the electrode wire for a very short period of time.

After the melting period the voltage and current are lowered to a very low value which can sustain the arc but not used in melting the electrode. This voltage and current termed as back ground voltage and background current. During this background period cooling of the weld takes place. The process of applying peak and background pulse are repeated during the welding process.

- Pulsed GMAW result in a very good bead shape with less amount of residual stress due to pulsing of current and voltage.
- The higher pulsing rates increase puddle agitation → a better grain molecular structure within the weld.
- High speed pulsing constricts and focuses the arc; Increases arc stability, penetration and travel speeds.
- Reduces arc blow (created by influence of magnetic field)
- A smaller heat-affected zone.
- 4 variables: peak amperage, background amperage, peak time and pulse rate.

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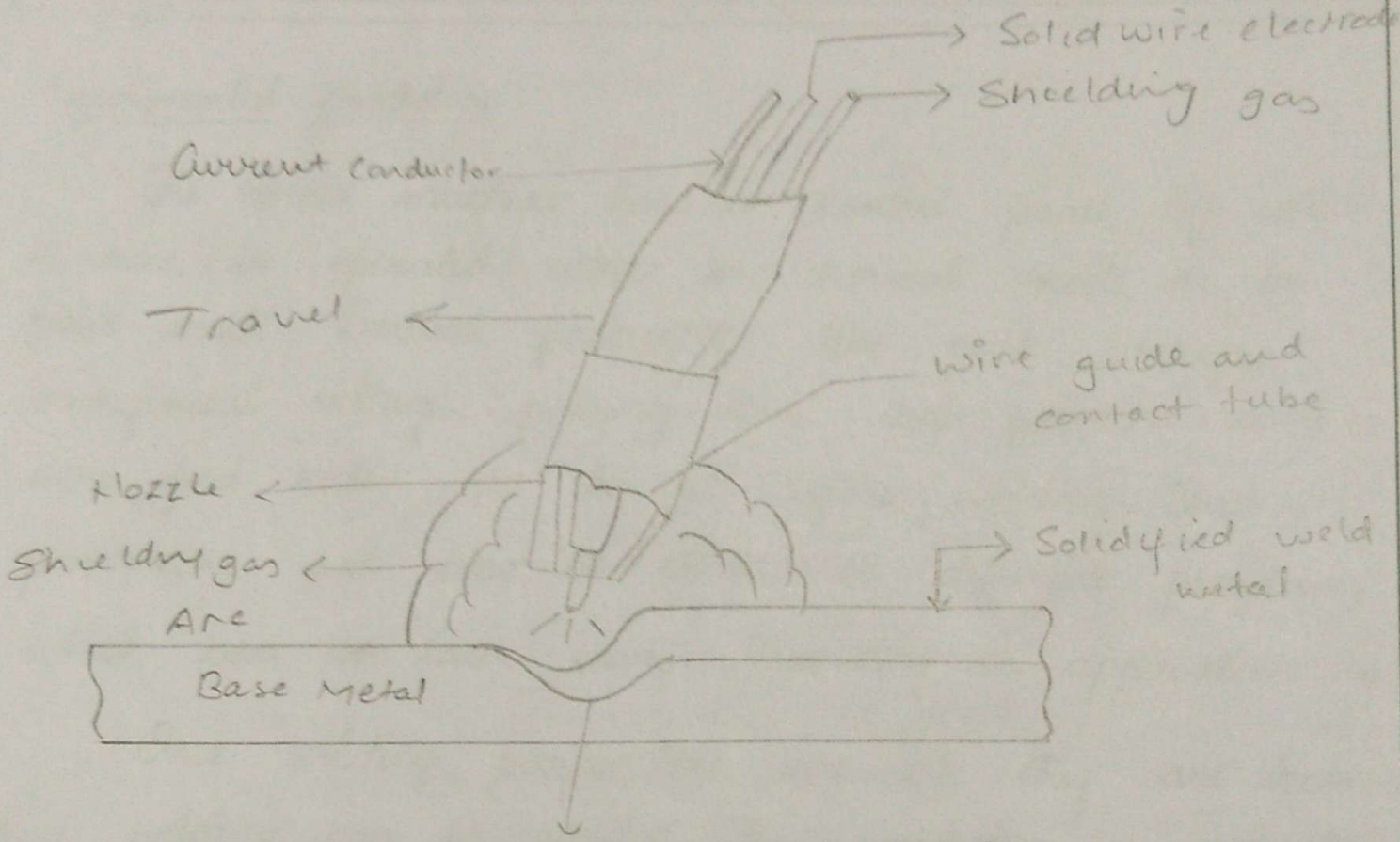
SHEET NO. 2-3



Schematic of Gas Metal Arc welding (GMAW)

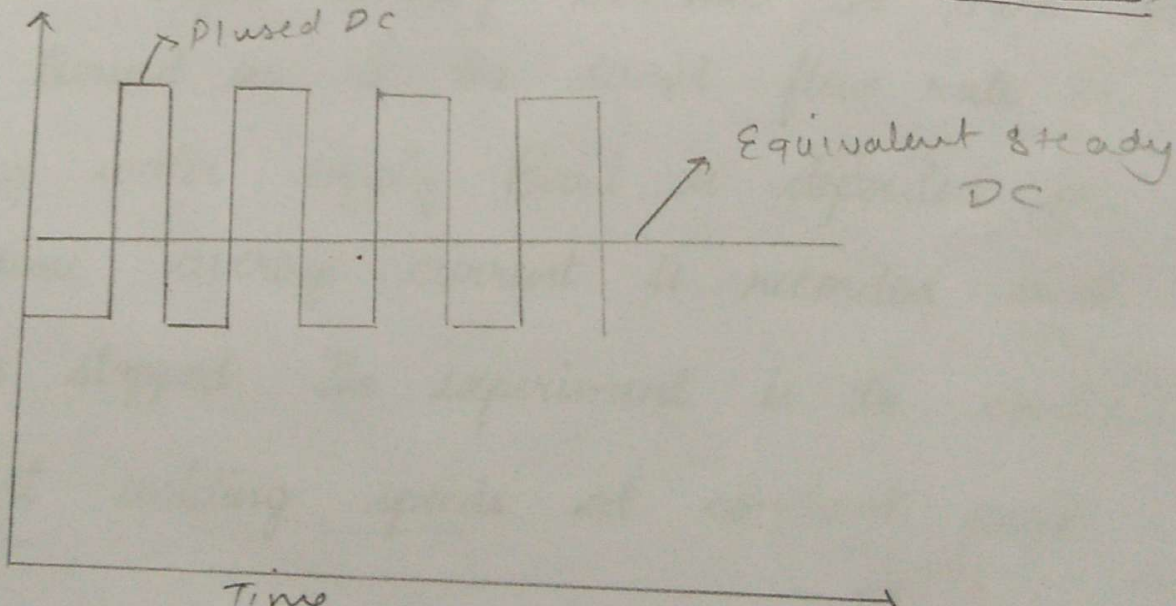


fig 2: Pulsed DC

Experimental procedure :-

The GMAW machine has a control panel by which it can be operated either in normal mode or in pulse mode. Derived parameters like peak voltage, background voltage, pulsing time, arc pressure and wire feed rate can be set before welding. These parameters can also be stored in different programs which can be later using depending on application.

Once welding parameters are set they are locked and welding can be started. The workpiece is mounted on the ~~welding~~ trolley which is set at required welding speed. Before striking the arc the inert gas supply is turned on at the desired flow rate and also cooling water supply. Bead is deposited for stipulated time, average current is recorded and welding is stopped. The experiment is to continue at different welding speeds at constant peak

voltage background current, arc pressure and welding wire feed rate. After the depositing the weld beads the average bead heights and widths are measured by a Vernier.

OBSERVATION TABLE

Table-1

Sl. No	feed rate / welding speed (mm/min	Average Bead width (mm)	Average Bead Height (mm)
1	6	5.317	3.483
2.	7	10.067	2.567
3	8	11.317	2.183

Heat input = $\frac{\eta V I}{\theta}$ J/min

where η = efficiency of welding

V = Avg. Voltage

I = Avg Current

Table-2

Sl No.	feed rate. welding speed (mm/min	Average Voltage V	Current Average I	Efficiency (%)
1	6	30.56	126.67	18.1
2.	7	30.15	196.25	20.3
3.	8	30	201	22.8

Discussions:

1. Why do we use a constant voltage supply?

→ We use constant voltage power supply so that any change in arc length (which is directly proportional to voltage) results in large change in heat input and current. A shorten arc length causes a much greater heat input, which makes the wire electrode melt more quickly and thereby restore the original arc length. Thus, it helps operators keep the arc length consistent even when manually welding with hand held welding guns.

2. Which mode (normal or pulse) gives better bead quality?

→ Between normal and pulse, pulse voltage is better. This is because a pulsed voltage allows the bead to cool between each successive pulse. This relieves the bead of residual stresses and improves the shape parameter of the bead. A pulsed voltage reduces arc blow and constricts the arc which improves the weld bead quality.

3. Influence of welding speed / feed rate on the bead quality?

→ Feed rate should be properly set according to the power supply. If the feed rate is reduced, it results in less heat input and thus affect the arc length and bead quality. If the feed rate increases heat input increases and results in higher deposition of metal. With increasing feed rate width of the weld bead increases and the height decreases, which means higher heat affected zone.

4. What are the factors affecting the efficiency?

→ Efficiency depends on
- Heat input
- Power supply voltage
- Current supply
- Welding speed.