

# Factors to be considered for selecting a suitable type of welding current and polarity

This chapter describes the factors to be considered for selection of suitable type of welding current and polarity. Further, the coating factor and its influences of quality of weld metal have also been elaborated. Mode of metal transfer in shielded metal arc welding and factor affecting the same have been presented.

**Keywords:** Selection of welding current, polarity, coating factor, weld bead, metal transfer in SMAW

## 12.1 Selection of type of welding current

It is important to consider various aspects while selecting suitable type of welding current for developing weld joints in a given situation. Some of the points need careful considerations for selection of welding current are given below.

1. Thickness of plate/sheet to be welded: DC for thin sheet to exploit better control over heat
2. Length of cable required: AC for situations where long cables are required during welding as they cause less voltage drop i.e. loading on power source
3. Ease of arc initiation and maintenance needed even with low current: DC preferred over AC
4. Arc blow: AC helps to overcome the arc blow as it is primarily observed with DC only.
5. Odd position welding: DC is preferred over AC for odd position welding (vertical and overhead) due to better control over heat input.
6. Polarity selection for controlling the melting rate, penetration and welding deposition rate: DC preferred over AC
7. AC gives the penetration and electrode melting rate somewhat in between that is offered by DCEN&DCEP.

DC offers the advantage of polarity selection (DCEN&DCEP) which helps in controlling the melting rate, penetration and required welding deposition rate (Fig. 12.1). DCEN results in more heat at work piece producing high welding speed but with shallow penetration. DCEN polarity is generally used for welding of all types of steel. DCEP is commonly used for welding of non-ferrous metal besides other metal systems. AC gives the penetration and electrode melting rate somewhat in between of that is offered by DCEN&DCEP.

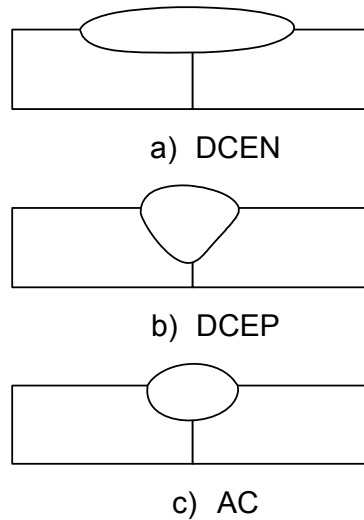


Fig. 12.1 Schematic diagram showing effect of welding current and polarity

### 12.1 Electrode size and coating factor

Diameter of the core wire of an electrode refers to electrode diameter ( $d$ ). Diameter of electrode with coating ( $D$ ) with respect to that of core wire ( $d$ ) is used to characterize the coating thickness (Fig. 12.2). The ratio of electrode diameter with coating and core diameter ( $D/d$ ) is called coating factor. Coating factor usually ranges from 1.2 to 2.2. According to the coating factor, coated electrodes can be grouped into three categories namely light coated (1.2-1.35), medium coated (1.4-1.7) and heavy coated (1.8-2.2). Stick electrodes are generally found of length varying from 250 to 400 mm. During the welding, length of the electrode is determined by welder's convenience to strike the arc and current carrying capacity of electrode without causing excessive heating of coating materials due to electric resistive heating caused by flow of current through the core wire. Bare end of electrode is used to make electrical connection with power source with the help of suitable connectors.

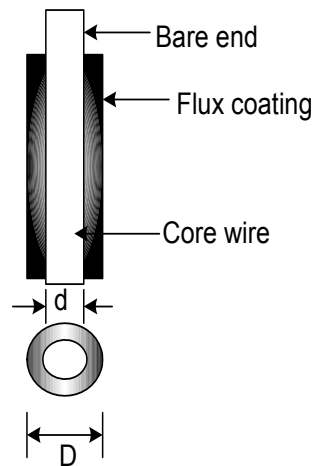


Fig. 12.2 Schematic of electrode showing electrode size and its different components

### 12.3 Weld beads

Two types of beads are generally produced in welding namely stringer bead and weaver bead. Deposition of the weld metal in largely straight line is called stringer bead (Fig. 12.3 a). In case of weaver bead weld metal is deposited in different paths during the welding i.e. zigzag, irregular, curved (Fig. 12.3 b). Weaver bead helps to apply more heat input per unit length during welding than stringer bead. Therefore, weaver beads are commonly used to avoid problems related with welding of thin plates and that in odd position (vertical and overhead) welding in order to avoid melt through and weld metal falling tendency.

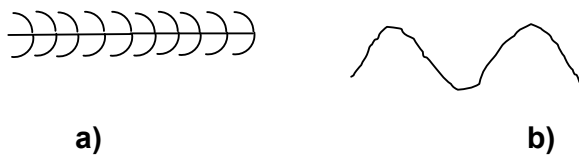


Fig. 12.3 Schematic diagram showing weld bead a) stringer bead and b) weaver bead

### 12.4 Metal transfer in SMAW

Metal transfer refers to the transfer of molten metal droplets from the electrode tip to the weld pool in consumable arc welding processes. Metal transfer in SMA welding is primarily affected by surface tension of molten metal at the electrode tip. Presence of impurities and foreign elements in molten metal lowers the surface tension which in turn facilitates easy detachment of molten metal drop from the electrode tip. For

details of different types of metal transfer modes see section 17.5. Therefore, type and amount of coating on electrode and effectiveness of shielding of arc zone from the atmospheric gases appreciably affect the mode of metal transfer. Acidic and oxide type electrodes produce molten metal with large amount of oxygen and hydrogen. Presence of these impurities in the molten weld metal lowers the surface tension and produces spray like metal transfer. Rutile electrodes are primarily composed of  $\text{TiO}_2$  due to which molten metal drop hanging at tip of electrode is not much oxidized and therefore surface tension of the molten weld metal is not reduced appreciably. Hence, rutile electrodes produce more drop and less spray transfer. Basic electrode contains deoxidizers and at the same time moisture is completely driven off to render low hydrogen electrodes. Therefore, melt droplets at the tip of the electrode are of killed steel type having high surface tension. Since high surface tension of molten metal resists the detachment of drops from the electrode tip and hence the size of drop at tip of electrode increases to a great extent before it is detached under the effect of gravitational and electro-magnetic pinch forces. These conditions results in globular transfer with basic electrode.

In case of light coated electrodes incomplete de-oxidation (due to lack of enough flux), CO is formed which remains with single molten weld metal droplet until it grows to about half of electrode diameter. Eventually, drops with bubble of CO bursts which in turn results in metal transfer in form of fine drops and spatter. In case of basic electrode, metal transfer occurs by short circuiting mode if molten metal drop touches the weld pool and melt is transferred to weld pool by surface tension effect.

### **References and books for further reading**

- Metals Handbook-Welding, Brazing and Soldering, American Society for Metals, 1993, 10<sup>th</sup> edition, Volume 6, USA.
- R S Parmar, Welding process and technology, Khanna Publisher, New Delhi
- Richard Little, Welding and Welding Technology, McGraw Hill, 2001, 1<sup>st</sup> edition.
- H Cary, Welding Technology, Prentice Hall, 1988, 2<sup>nd</sup> edition.
- S V Nadkarni, Modern Arc Welding Technology, Ador Welding Limited, 2010, New Delhi.

- Welding handbook, American Welding Society, 1987, 8th edition, volume 1 & 2, USA.

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