Advantages, disadvantages of GMAW over SMAW process and applications

Objectives: At the end of this lesson you shall be able to
- **state the advantages and disadvantages of Co_2 welding over shielded metal arc welding process**
- **state the applications of Co_2 welding.**

Advantages: Welding is economical due to less edge preparation and no stub loss.

Produces joints with deep penetration.

Thin and thick materials can be welded.

It can be used for welding of carbon steels, alloy steel, stainless steel, copper and its alloys, aluminium and its alloys.

Welding in all positions can be done.

Deposition rate is more.

No solid flux is used. So needs no cleaning of slag after each run.

Reduced distortion.

Disadvantages

Welding equipment is costly, more complex and less portable.

Since air drifts may disturb free flow of the shielding gas, GMAW may not work well in outdoor welding.

Applications: This process can be used for welding carbon, steel alloy steels, stainless steel, aluminium, copper, nickel and their alloys, titanium etc.

Light and heavy fabrication work.

This process is successfully used in ship building fabrication of pressure vessels and automobile industries.

Process variables of GMAW

Objectives: At the end of this lesson you shall be able to

- **state the type of edge preparation done for CO_2 welding**
- **state and explain different welding parameters to be set for CO_2 welding**
- **explain the welding procedure while using CO_2 welding process.**

GMA welding process parameters/variables

The following parameters must be considered in the welding procedure of GMAW/CO_2 welding.

Electrode size

Rate of wire feed (Welding current)

Arc voltage

Stick out

welding position

Shielding gas

Travel speed

electrode position

Electrode: Best results are obtained by using the proper size wire for the thickness of the metal to be welded and the position in which the welding is to be done.

Electrode wires should be of the same composition as that of the material being welded.

Basic wire diameters are 0.8 mm, 1.0 mm, 1.2 mm, 1.6 mm and 2.4 mm.

Welding current: The wire feed speed will control the current. A wide range of current values can be used with each wire diameter. This permits welding metal of various thicknesses without having to change the wire diameter. The current selected should be high enough to secure the desired penetration and low enough to avoid under-cutting or burn through.

The success of GMA welding is due to the concentration of high current density at the electrode tip.

General data on current selection is given in the table given below.

The current varies as the wire feed varies.

Ranges of wire feed rate in CO_2 welding (Current is shown in brackets)
Wire feed speed, m/min]

Wire dia. (mm)	Spray type arcs (28 - 32 V)	Short circuiting arcs (16-22 V)
0.8	5.0-15 (150-250 amps)	2.5-7.5 (60-160 amps)
1.2	5.0-15 (200-350 amps)	2.0-3.8 (100-175 amps)
1.6	5.0-8.8 (350-500 amps)	1.5-2.0 (120-180 amps)

Arc voltage: This is a very important variable in GMAW/CO_2 welding process, mainly because it determines the type of metal transfer by influencing the rate of droplet transfer across the arc. The arc voltage to be used depends on the base metal thickness, type of joint, electrode composition and size, shielding gas composition, welding position, type of weld and other factors.

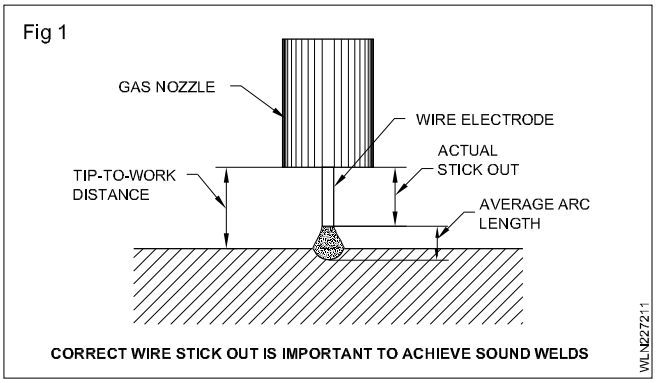
For details refer to the table of General guide to welding conditions.

Arc travel speed: The linear rate at which the arc moves along the joint, termed arc travel speed, affects the weld bead size and penetration.

If the arc travel speed is lowered, the weld pool becomes larger and shallower. As the travel speed is increased, the heat input rate of the arc is decreased; consequently there is decreased penetration and narrower weld bead. When the travel speed is excessive, undercutting occurs along the weld bead, because the deposition of the filler metal is not sufficient to fill the paths melted by the arc.

Stick out: It is the distance between the end of the contact tube and the tip of the electrode. (Fig 1)

Fig 1



CORRECT WIRE STICK OUT IS IMPORTANT TO ACHIEVE SOUND WELDS

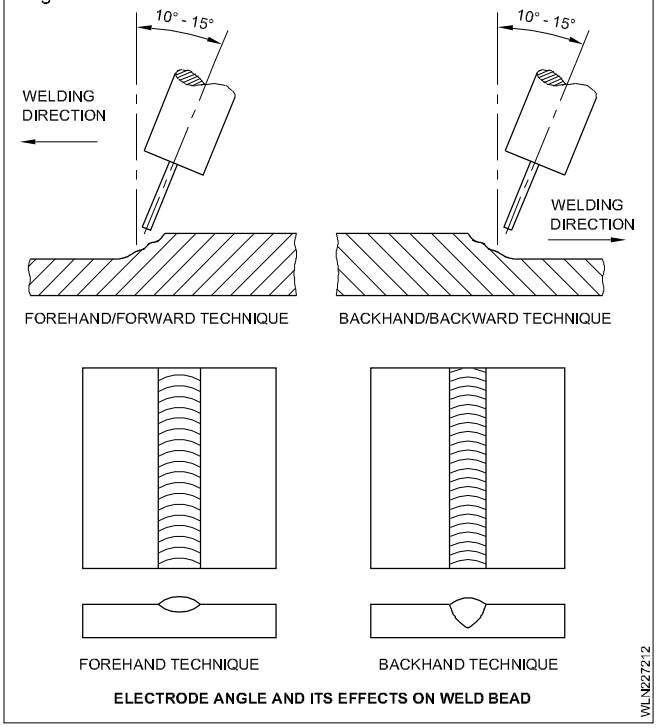
Too long a stick out results in excess weld metal being deposited at low arc heat, giving rise to badly shaped weld and shallow penetration.

When the stick out is too short, excessive spatter gets deposited on the nozzle, which can restrict the shielding gas flow and cause porosity in the weld.

Recommended stick out is 6 to 13 mm for a short circuiting arc, and 13 to 25 mm for the spray transfer arc.

Electrode position: In all welding processes, the position of the gun and electrode with respect to the joint affects the weld bead shape and penetration. The welding can be done either by using Forehand/Forward technique or by using Backhand/ Backward technique. The gun angles are usually maintained within 10 to 15° as shown in Fig 2.

Fig 2



ELECTRODE ANGLE AND ITS EFFECTS ON WELD BEAD

Modes of metal transfer in GMAW

Objective: At the end of this lesson you shall be able to
- **state and explain the different types of metal transfer in CO_2 welding.**

Types of metal transfer: In GMAW/CO_2 welding process, the weld metal is transferred from the electrode wire to the base metal in different methods/modes. Though there are many methods, only the following four methods are used popularly used in industries.

– Spray transfer (Free flight)

– Globular transfer (Intermediate)

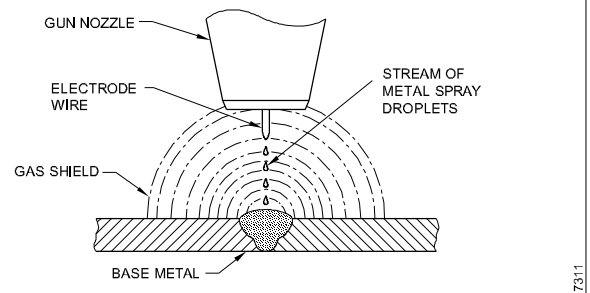
– Short circuit or Dip transfer

– Pulsed transfer

The type of metal transfer that occurs will depend on the electrode wire size, shielding gas, **arc voltage** and welding current.

Spray transfer: In spray transfer very fine droplets of the electrode wire are rapidly projected through the arc from the end of the electrode to the workpiece. (Fig.1) Spray transfer requires high current density (28 to 32V).

Fig 1



SPRAY TRANSFER OF METAL.

To obtain a good spray mode of welding shielding gases containing a blend of argon is used. The spray method of metal transfer can be used with most of the common welding wire electrodes (eg mild steel, aluminium, stainless steel).

The advantages of metal spray transfer are

i high deposition rates

ii good travel speeds

iii good looking weld appearance

iv little weld spatter

v good weld fusion

vi very good on heavy sections

The disadvantages of the spray mode are

i higher capacity power source needed

ii weld position is limited to flat and horizontal fillet

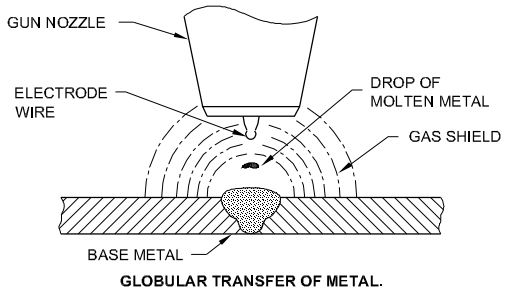
iii the cost of using a more expensive mixed gas

iv higher radiated heat is produced so extra protection is needed

Globular transfer: In globular transfer, only a few drops are transferred per second at low current values, while many drops are transferred at high current values. This transfer occurs when the welding current is low. (Fig. 2). The voltage range is 23 to 27V.

The spatter produced in this transfer is more and hence it is less preferred. But this is a good transfer method for using CO_2 gas as a shielding gas.

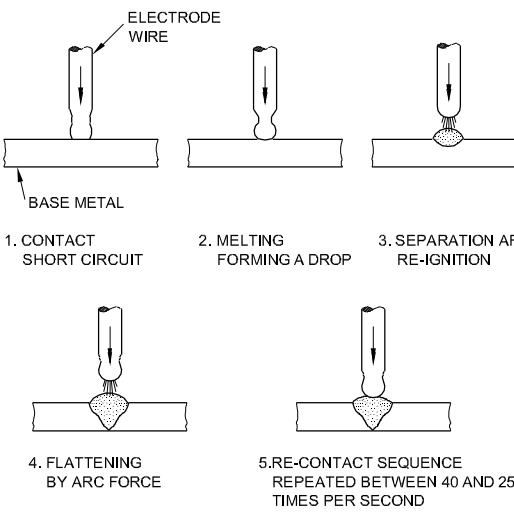
Fig 2



GLOBULAR TRANSFER OF METAL.

Short circuit transfer (DIP transfer): In short circuit transfer, as the molten wire is transferred to the weld, each drop touches the weld puddle before it breaks away from the advancing electrode wire. The circuit is shorted and the arc is extinguished. (Fig 3). The voltage range is 16 to 22V.

Fig 3

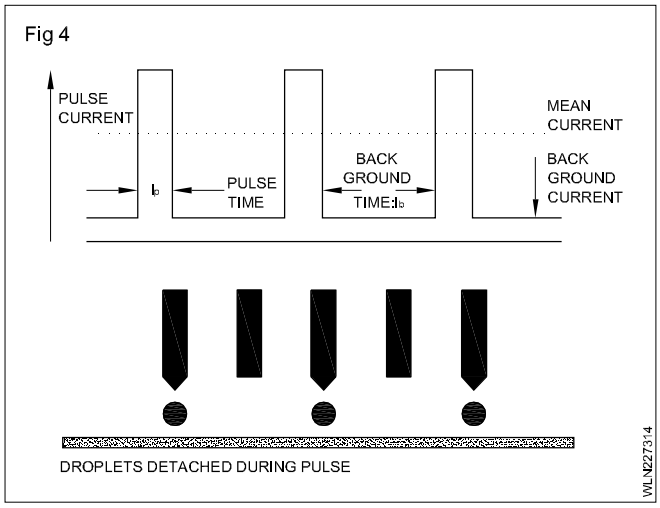


It permits welding thinner sections with greater ease, and is extremely practical for welding in all positions.

Pulsed spray transfer (Fig 4)

Pulsed spray transfer has a steady stream of metal droplets crossing the welding arc. The pulsed power source supplies the welding arc with two types of welding current.

Fig 4



1 **Peak current -** this current allows the formation of metal droplets which then cross the welding arc.

2 **Background current -** the background current will keep the arc alive, but doesn't allow for any weld metal transfer.

Pulsed spray transfer allows time for the weld puddle to freeze a little on the background current cycle, which allows for

i more control of the weld puddle.

ii more time for impurities to float to the top of the weld pool resulting in cleaner and stronger welds.

Advantages

i able to spray thinner metals

ii less heat input

iii stronger welds

iv more weld control

v out-of-position welding

vi Little spatters

Disadvantages

i higher set up costs

ii needs operator training

iii lower deposition rate