Fundamentals of Flux and Metal Cored Arc Welding

Welding Technique

Successful flux and metal cored arc welding depends on the following factors:

1. Selection of correct consumables
2. Selection of the correct power source
3. Selection of the correct shielding gas
4. Selection of the correct application techniques:
   - **a** Correct angle of electrode to work
   - **b** Correct electrical stick-out
   - **c** Correct travel speed
5. Selection of the welding preparation.

Selection of correct consumables

Chemical composition

As a general rule, the selection of a wire is straightforward, in that it is only a matter of selecting an electrode of similar composition to the parent material. However, there are certain applications for which electrodes will be selected on the basis of mechanical properties or the level of residual hydrogen in the weldmetal. The classification system for flux cored wires will provide an indication of the residual hydrogen level that can be expected in the weldmetal.

The following table gives a general overview of some of the BOC range of flux and metal cored wires for the most common materials. More detailed selection charts for specific materials can be found in the appropriate materials sections.

Common Materials Welded with Flux and Metal Cored Wire

Material	BOC MIG Wire
AS2074 C1, C2, C3, C4-1, C4-2, C5, C6	BOC SmoothCor 711, SmoothCor 70C6, SmoothCor 715
AS/NZS 3678-9 250, 300, 350, 400	BOC SmoothCor 711, SmoothCor 70C6, SmoothCor 715
AS1548-430, 460, 490	BOC SmoothCor 711, SmoothCor 70C6, SmoothCor 715
ASTM A36, A106, EN8, 8A	BOC SmoothCor 711, SmoothCor 70C6, SmoothCor 715
BS970 EN 43A, AS3597-500	BOC SmoothCor 811K2
BS970 EN24, AS3597-700	BOC SmoothCor 115
Stainless Steel	
Grade 304	Cigweld Shieldchrome 308LT
Stainless to mild steel	Cigweld Shieldchrome 309LT
Grade 316	Cigweld Shieldchrome 316LT

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Physical condition

Surface condition

BOC flux and metal cored wires are supplied as an in line baked product and therefore have a typical dark surface appearance.

The wire must, however, be free from any surface contamination, including surface rust. Most flux and metal cored wires have a thin film of graphite on the surface of the wire to assist with feedability.

BOC SmoothCor wires are supplied in tough vacuum packs to ensure performance as manufactured.

Cast and Helix

The AWS standard for flux cored wires do not specify a cast or helix, other than to stipulate that it should be of such a nature that the wire can be fed uninterrupted.

Selection of the Correct Power Source

Power sources for flux and metal cored welding are selected on a number of different criteria, including:

1. Maximum output of the machine
2. Duty cycle
3. Output control (voltage selection,wire feed speed control)
4. Portability

The following table gives an indication of the operating amperage for different size wires.

Wire Size (mm)	Direction	Amperage Range (A)
FCAW		
1.2	Horizontal	200–300
1.2	Vertical-up	150–250
1.6	Horizontal	300–400
1.6	Vertical-up	180–250
MCAW		
1.2	Horizontal	150–350
1.6	Horizontal	300–500

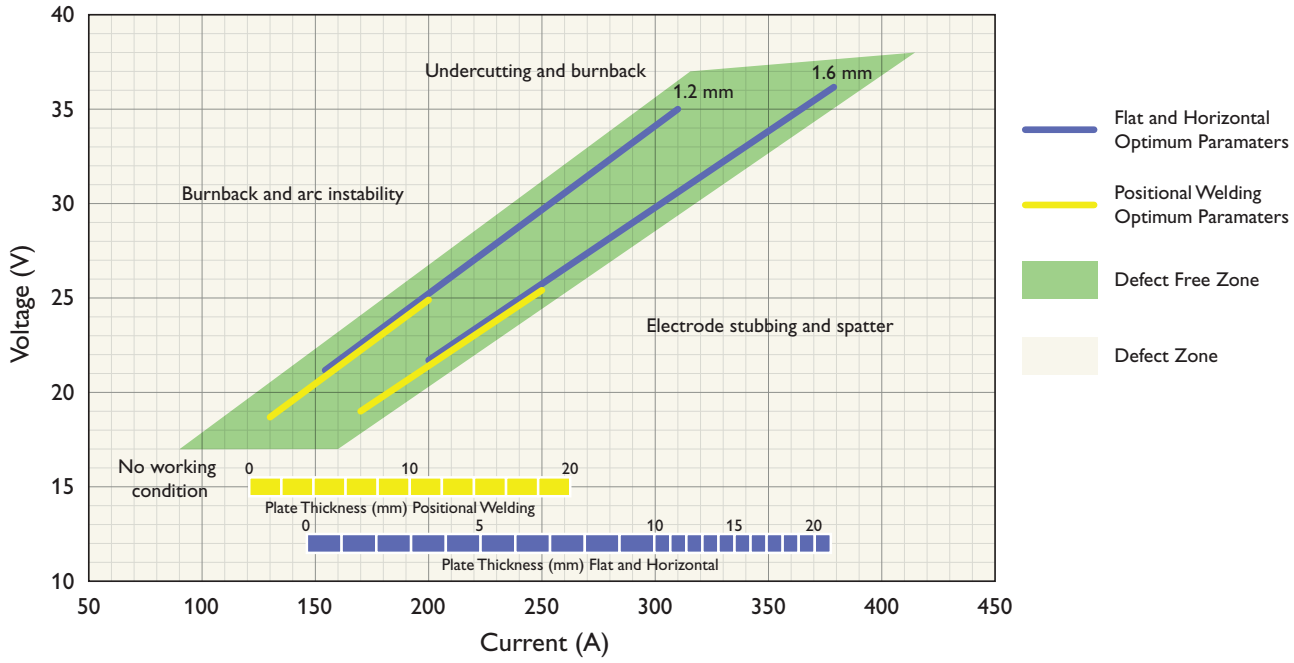
A BOC power sources selection chart is contained in the arc equipment section of this manual (see pages 240–241).

Selection of the Correct Shielding Gas

The selection of the shielding gas has a direct influence on the appearance and quality of the weldbead.

Flux cored wires are manufactured to be welded with either 100% CO_2 or an Argon / CO_2 gas mixture. Mostly, these mixtures will contain 25% CO_2, as is the case with BOC Argoshield 52.

Current / Voltage Envelope for Argoshield 52



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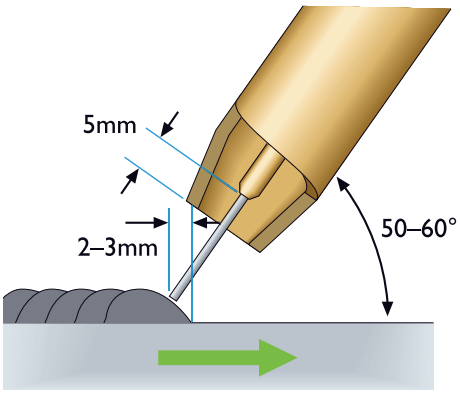
Correct Application Techniques

Direction of travel

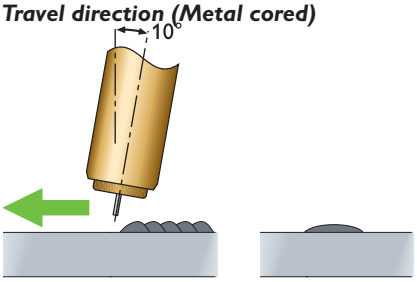
Flux cored welding is normally performed using a 'drag' technique. The welding gun is tilted to a 50–60° backhand angle. If, however, a flatter bead profile is required the backhand angle can be reduced.

Metal cored wire, because of it's similarity to solid wires (no slag formers added to the core mainly metallic powders), are normally welded with the 'push' technique

Travel direction (Flux cored)

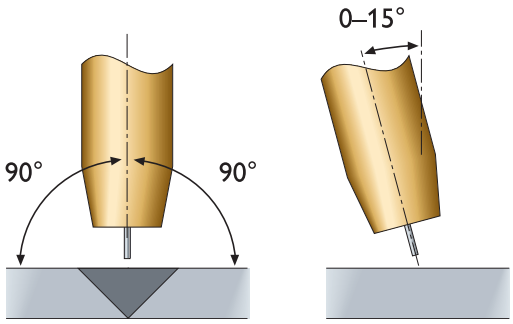


Travel direction (Metal cored)

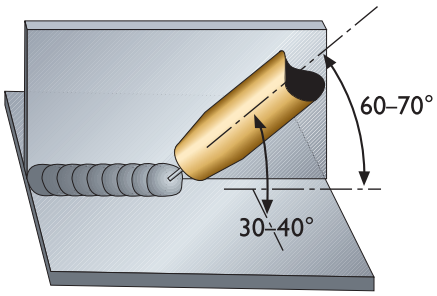


When welding butt welds with flux or metal cored wires, the torch should be positioned within the centre of the groove and tilted at an angle of ±20°. Flux cored welding is still performed with the 'drag' technique and metal cored welding with the 'push' technique.

Torch position for butt welds

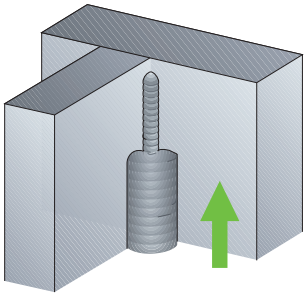


Torch angle for fillet welds



When welding horizontal-vertical fillet welds, the wire tip must be aimed exactly in the corner of the joint. For the first bead, the welding gun is tilted at an angle of 30–40° from the horizontal plane. Flux cored welding is still performed with the 'drag' technique and metal cored welding with the 'push' technique.

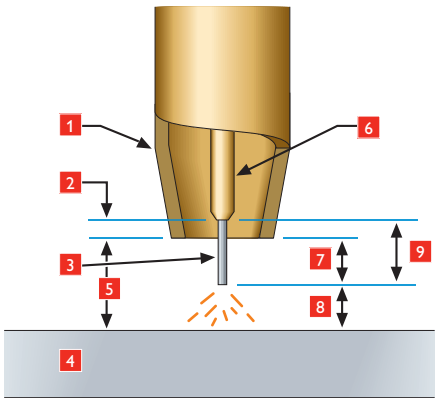
Vertical-up



Vertical-up welding can be undertaken in a similar way, as MMA with a slight weave motion.

Vertical-up welding with metal cored wire can successfully be undertaken with pulsed MIG welding equipment.

Electrical stick-out



1	Gas Nozzle
2	Contact Tube Setback
3	Consumable Electrode
4	Workpiece
5	Standoff Distance
6	Contact Tube
7	Visible Stick-out
8	Arc length
9	Electrical Stick-out

The electrical stick-out is the distance between the end of the contact tip and the end of the wire. An increase in the electrical stick-out results in an increase in the electrical resistance. The resultant increase in temperature has a positive influence in the melt off rate of the wire that will have an influence on the weldbead profile.

Travel speed

The construction of flux and metal cored wires ensures the highest current density for a given current setting compared to all other welding processes.

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High current densities produce high deposition rates.

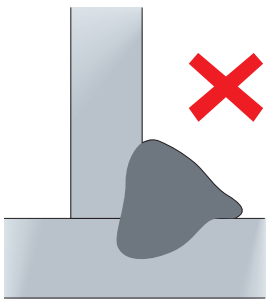
$$\text{Current Density} = \frac{\text{Amperage}}{\text{Cross-sectional area of wire}}$$

$$\text{or J} = \frac{I}{A}$$

Electrode/Wire	Dia. (mm)	Cross section area (mm^2)	Current (A)	Current Density (A/mm^2)	Deposition rate (kg/h)
MMA electrode (E7024)	4	12.57	235	18.7	3.0
FCAW wire (E71T-1)	1.2	0.625	235	376	3.8
MIG wire (ER70S-6)	1.2	1.130	235	287.5	3.3
MCAW wire (E70C-6M)	1.2	0.625	300	480	5.2

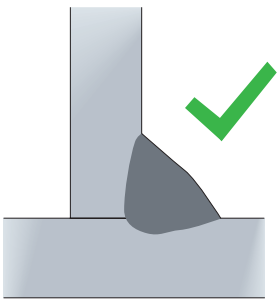
Consequently, travel speed must be increased proportionately to maintain control of the weld pool and bead shape, and to balance the deposited weld metal versus fusion obtained.

Travel speed too slow



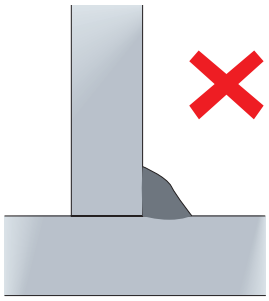
Excessive penetration
Excessive weld metal deposited
Roll over of weld metal on horizontal plate

Correct travel speed



Recommended penetration depth
Proper sidewall fusion without roll over or undercut

Travel speed too fast



Weld bead too small
Inadequate sidewall fusion
Lack of root penetration

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