



APPLICATION DATA FOR SUBMERGED ARC WELDING FLUXES

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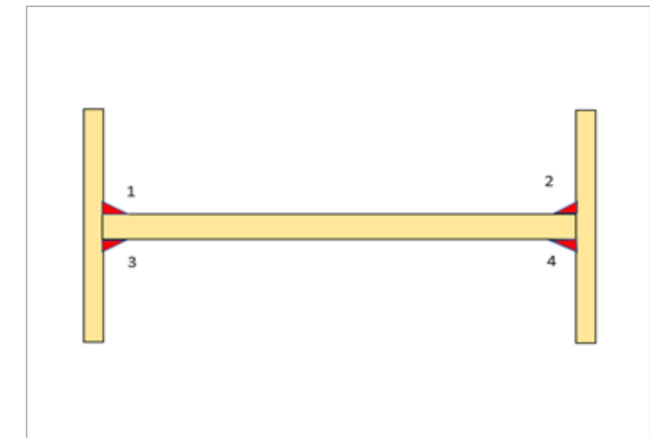
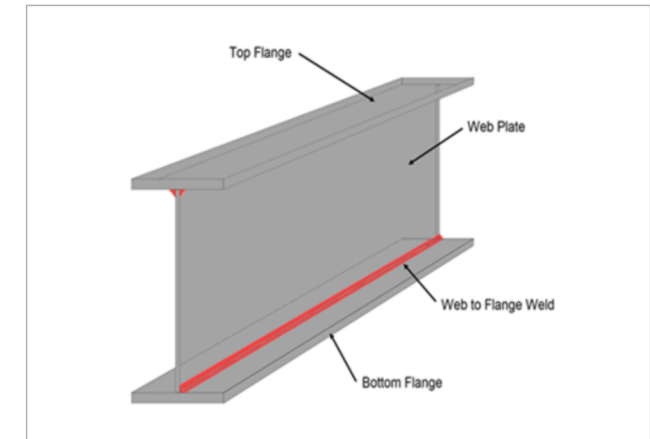
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Classification of Submerged Arc Welding Flux

Flux Classification Based on		Description
Flux Manufacturing Method	1. Agglomerated (ADOR WELDING LTD manufacturing Agglomerated type flux only)	Raw materials/ Minerals mixed with silicate & after forming required sieve size flux was baked at 700 - 1000 °C.
	2. Fused	Various mineral materials are mixed together and melted. Fused materials are queened in water, granulized and sieved.
	3. Bonded	Raw materials/ Minerals mixed with silicate & after forming required sieve size flux was baked at 350-500 °C.
Flux Basicity Index (B.I)	1. Acidic Flux (B.I <1.2)	$B \text{ (Basicity)} = \frac{\text{CaO} + \text{MgO} + \text{CaF}_2 + \text{Na}_2\text{O} + 1/2 (\text{MnO} + \text{FeO})}{\text{SiO}_2 + 1/2 (\text{Al}_2\text{O}_3 + \text{TiO}_2 + \text{ZrO}_2)}$
	2. Basic Flux (B.I >1.2)	
Alloy adding/removing behaviour of flux to weldmetal respect to Welding Parameters	1. Neutral Flux (Wall neutrality Number, N < 35)	Make two chemistry pads with same wire flux combination, same welding parameters, except voltage used for 2nd pad is increased by 8V. After analysing Silicon & Manganese contents in chemistry pads, calculate as per below formula. Wall Neutrality Number = 100 (Δ % Si + Δ % Mn)
	2. Active Flux (Wall neutrality Number, N > 35)	

Automelt A82 Flux

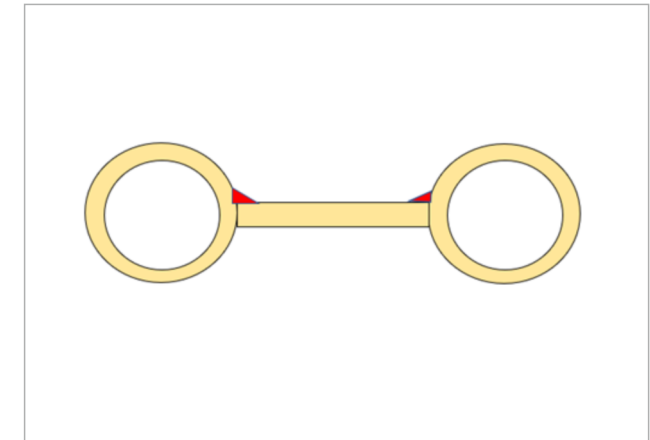
Plate Thickness	04 – 24 mm
Plate Grade	SA 516 Gr 60/70, IS 2062, C-Mn Steel
Type of Joint	Fillet, H Beam Both side Welding
Welding Position	2F
Welding Wire Used	EM12K – 1.60mm, Twin Wire Used
Current Used	500 to 800 A
Voltage Used	26 to 32 V
Travel Speed	1100 to 1800 mm/Min
Preheat	NA
Inter-pass Temperature	NA
Single or Multi-pass	Single Pass
Flux Specification	F7AZ/PZ – EM12K



Automelt A82 Flux (Tube to Plate Joining – Heat Exchanger)



Plate Thickness & Grade	06 mm - IS 2062
Pipe Dimension & Grade	63 mm OD & 4 mm Thickness – SA 210 Gr A1
Type of Joint	Fillet
Welding Position	2F
Welding Wire Used	EM12K – 1.60mm, Single Wire Used
Current Used	350 A
Voltage Used	25 V
Travel Speed	800 mm/Min
Preheat	NA
Inter-pass Temperature	NA
Single or Multi-pass	Single Pass
Flux Specification	F7AZ/PZ – EM12K



Note: If alloyed wires like: EB2, EB3 are used Automelt A81 Flux Preferable for this application

Automelt A82 Flux



As per AWS D1.1 Table 5.8 Minimum fillet weld size & welding Parameters to achieve the weld size

Sr. No.	Base Plate Thickness	Fillet Size, mm	Wire Dia, mm	Current (Amp)	Voltage (V)	Travel speed (mm/Min)
1	Up to 6 mm	3	1.6 mm - Twin Wire	400 - 550	26 - 28	1600 - 1800
2	6 to 12	5		500 - 630	27 - 31	1300 - 1500
3	12 to 20	6		500 - 630	27 - 31	1200 - 1400
4	Above 20 mm	8		550 - 650	30 - 33	1000 - 1400

Common customer assistance on Automelt A82 Flux



Problem	Reason for the Problem	Solution to the Problem
Porosity on weld centreline	1. Excess voltage leads to lack of fusion and it is reason for Porosity 2. Position of Welding Wire (Angle is more than 45° & Wire touching Flange)	1. Reduce the voltage Point by Point. Less voltage leads to Convex bead & it affect slag detachability 2. Maintain the inclined angle of welding wire as 45° to web
Undercut	1. Excess Voltage & Travel speed 2. Low Current or wire feed speed	1. Reduce the Voltage and travel speed 2. Increase the Current or wire feed rate
Slag Sticky	Convex Bead	Reduce the current or wire feed rate
Pock Marks	Rusty Base Plate	Clean the Plate & Weld
Porosity on Backside welding	Gases cannot escape from one side	Lower travel speed compared to first side is preferred (~100 mm/min low)

Automelt A81

Plate Thickness	8 – 20 mm
Plate Grade	IS 2062
Type of Joint	Fillet
Welding Position	2F
Welding Wire Used	EM12K – 1.6 mm, Twin Wire Used
Current Used	530 A
Voltage Used	28 – 29 V
Travel Speed	1200 mm/Min
Preheat	NA (Ambient Temperature: 30-40° Celsius)
Inter-pass Temperature	NA
Single or Multi-pass	Single Pass
Flux Specification	F7AZ – EM12K, Flux will be coarser than A82

Common customer assistance on Automelt A81 Flux



Problem	Reason for the Problem	Solution to the Problem
Porosity on weld centreline	1. Excess voltage leads to lack of fusion and it is reason for Porosity 2. Position of Welding Wire (Angle is more than 45° & Wire touching Flange)	1. Reduce the voltage Point by Point. Less voltage leads to Convex bead & it affect slag detachability 2. Set the welding wire at 45° to Flange
Undercut	1. Excess Voltage & Travel speed 2. Low Current	1. Reduce the Voltage and travel speed 2. Increase the Current
Slag Sticky	Convex Bead	Reduce the current or wire feed rate
Pock Marks	Rusty Base Plate	Clean the Plate & Weld

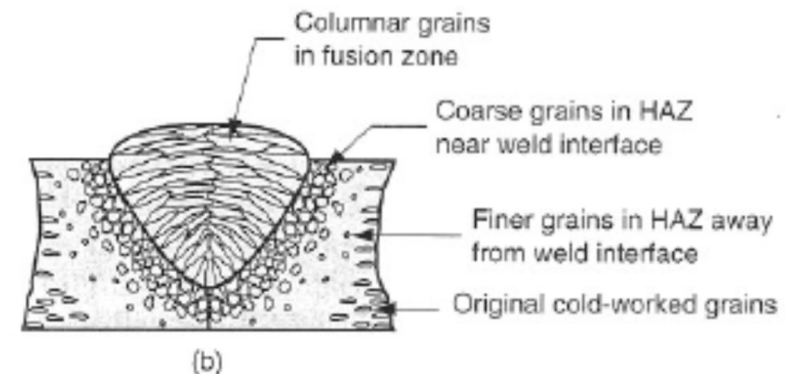
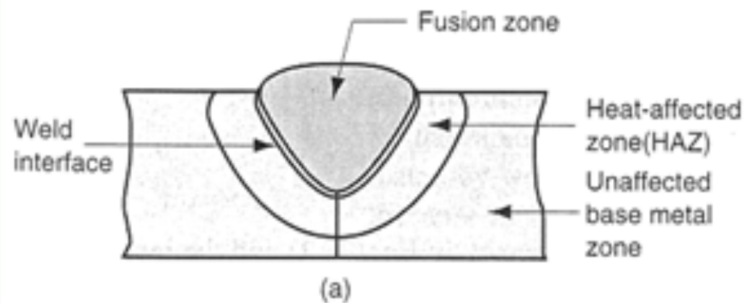
Automelt A55 (SPL) Flux



Plate Thickness	10 – 30 mm
Plate Grade	SA516 Gr 60 To SA 516 Gr 60 / SA 516 Gr 60 to SA 836 class 1
Type of Joint	Groove - Single V
Joint Design	Ceramic Backing, Root Gap 1 -2 mm, Root Face 2-3 mm
Welding Position	1G
Welding Wire Used	EL8 – 3.15 mm, Single Wire Used
Current Used	360 to 400 A
Voltage Used	27 to 29 V
Travel Speed	280 mm/Min
Preheat	NA (Ambient Temperature: 30 ^o Celsius)
Inter-pass Temperature	205 ^o Celsius, Max
Single or Multi-pass	Multi Pass
Flux Specification	F7AZ – E18
Flux Behaviour	Self slag From ROOT Run 8

Common customer assistance on Automelt A55 Spl Flux

Problem	Reason for the Problem	Solution to the Problem
Slag Sticky on Root Run	1. Higher Voltage 2. Lower Travel speed 3. Fine Flux	1. Reduce the voltage point by point 2. Increase the travel speed slightly 3. Coarse Flux was suitable



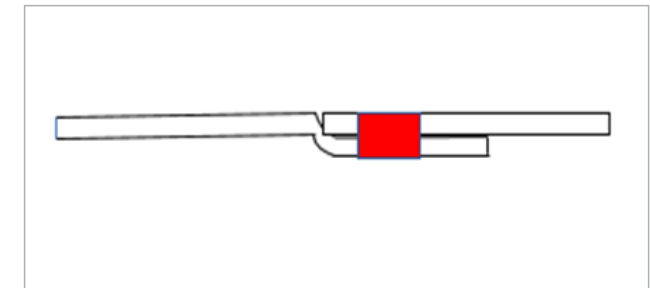
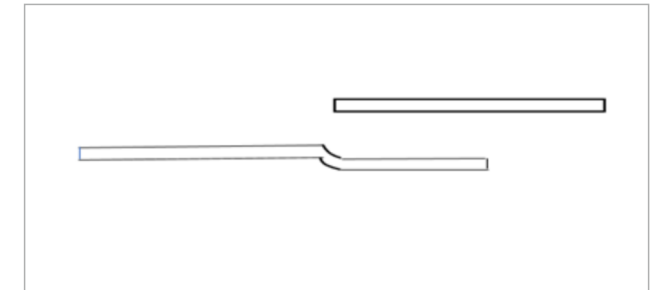
Weld Joint Cross section view

Automelt A57

Plate Thickness	12 mm – Pipe Longitudinal weld
Plate Grade	C-Mn Steel
Type of Joint	Groove - Double V
Welding Position	1G
Welding Wire Used	EL8 – 3.15 mm, Single Wire Used
Current Used	400 to 500 A
Voltage Used	38 to 40 V
Travel Speed	300 to 340 mm/Min
Preheat	NA (Ambient Temperature: 30° Celsius)
Inter-pass Temperature	NA
Single or Multi-pass	Two Pass
Flux Specification	F7AZ – E18

Automelt A57 - Cylinder Manufacturing

Plate Thickness	3 mm
Plate Grade	C-Mn Steel
Type of Joint	Butt Joint Type
Joint Design	3mm + 3mm = 6mm Bead on Plate
Welding Wire Used	EL8 – 2.50 mm, Single Wire Used
Current Used	450 A
Voltage Used	27 - 28V
Travel Speed	1200 mm/Min
Preheat	NA (Ambient Temperature: 30° Celsius)
Inter-pass Temperature	NA
Single or Multi-pass	Single Pass
Flux Specification	F7AZ – E18



Common customer assistance on Automelt A57 Flux

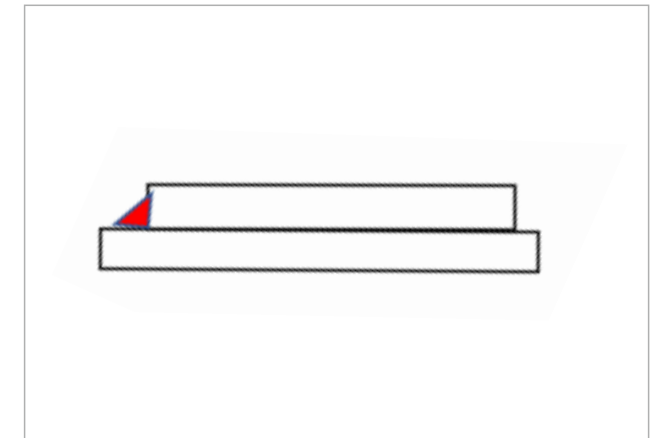
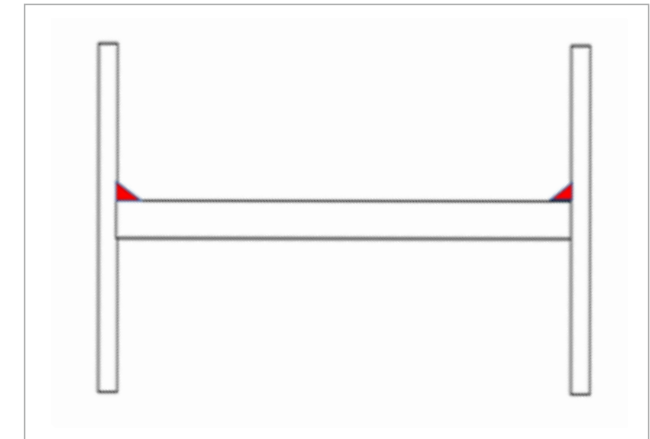
Problem	Reason for the Problem	Solution to the Problem
Pock Marks	1. Rusty base plates 2. Moisture in flux	1. Remove the rust from base plates 2. Redry flux at 300° Celsius for 2 Hr
Porosity	1. Excess Voltage	1. Reduce the voltage point by point



Moisture in flux leads to pockmarks

Automelt B31 / Grade 1V Flux

Plate Thickness	18 - 36 mm
Plate Grade	C –Mn Steel
Type of Joint	Fillet Joint & Lap Joint
Welding Position	1F
Welding Wire Used	EL8 / Grade A (W1) – 4.00 mm, Single Wire Used
Current Used	600 – 625 A
Voltage Used	27 to 29 V
Travel Speed	300 - 320 mm/Min
Preheat	NA (Ambient Temperature: 30° Celsius)
Inter-pass Temperature	NA
Single or Multi-pass	Single Pass
Flux Specification	F6A0 – EL8 or F7A4-EH14
Flux Behaviour	Self slag Removal from root run



Common customer assistance on Automelt B31 / Grade IV



Problem	Reason for the Problem	Solution to the Problem
Porosity on root run	1. Excess voltage will not melt the fillet weld root. 2. Slow Travel speed will make the bridging effect	1. Reduce the voltage. Recommended Voltage was 28 – 30 V 2. Increase the Travel speed, Minimum 270 mm/Min Required
Gas Marks & Pock Marks	1. Rusty Base Plate 2. Moisture in flux	1. Remove the rust by grinding 2. Redry the flux at 300° Celsius for 2 Hours
Irregular Weld bead or Flux Boiling	1. Excess Voltage or High Heat input 2. Excess stick out distance used	1. Reduce the Voltage or Heat Input 2. Remove the flux Connector & check the stick out distance. Stick out distance should be 7 to 9 Times of Welding wire Diameter

Automelt B71 Flux



Plate Thickness	12 - 72 mm
Plate Grade	IS 2062
Type of Joint	Groove
Joint Design	Single / Double V butt joint, Root gap-0 to 3mm, Root face: 04 mm, Included angle 60°
Welding Position	1G
Welding Wire Used	EM12K – 4.00 mm, Single Wire Used
Current Used	320 - 360 A for root run & 450 to 500 For Subsequent Passes
Voltage Used	29 to 33 V
Travel Speed	300 - 360 mm/Min
Preheat	100° Celsius for above 25 mm
Inter-pass Temperature	150° Celsius
Single or Multi-pass	Multi Pass
Flux Specification	F7A4-EM12K
Flux Behaviour	Self slag Removal from root run

Automelt B71 Flux (Fillet 2F Application)

Plate Thickness	16, 40, 50 mm
Plate Grade	IS 2062
Type of Joint	Fillet
Welding Position	2F
Welding Wire Used	EM12K – 3.15 mm, Single Wire Used
Current Used	480 A
Voltage Used	29 V
Travel Speed	500 – 550 mm/min for root run & 300 mm/min for subsequent passes
Preheat	80° Celsius
Inter-pass Temperature	NA
Single or Multi-pass	Multi Pass
Flux Specification	F7A4-EM12K
Flux Behaviour	Self slag Removal from root run

Automelt B71 Flux (Tandem Application)

Plate Thickness	10 – 100 mm
Plate Grade	SA 515 Gr 70
Type of Joint	Groove - Longitudinal Pipe
Joint Design	Single V - 60° Bevel
Welding Position	1G
Welding Wire Used	EM12K – 4.00 mm, Tandem Wire.
Preheat	NA (Ambient Temperature: 30° Celsius)
Inter-pass Temperature	NA
Single or Multi-pass	Multi Pass
Flux Specification	F7A4-EM12K
Flux Behaviour	Self slag Removal from root run



Tandem welding machine contains more than one wire feeding nozzle & same number of power sources

Welding Parameters for Tandem Welding

Root Run			Subsequent Passes		
	DC power Source EL8 Wire - 4.00 mm	AC Power Source EL8 Wire - 4.00 mm	DC power Source EL8 Wire - 4.00 mm	AC Power Source EL8 Wire - 4.00 mm	2 nd AC Power Source EL8 Wire - 4.00 mm
Current (A)	450	425	700	700	700
Voltage (V)	28	32	32	34	36
Travel Speed (mm/Min)	600	600	525	525	525

Common customer assistance on Automelt B71 Flux



Problem	Reason for the Problem	Solution to the Problem
Gas Marks & Pock Marks	1. Rusty Base Plate 2. Moisture in flux	1. Remove the rust by grinding 2. Redry the flux at 300° Celsius for 2 Hours
Slag Removal in root run	1. Excess Voltage & slow travel speed are leads to Slag sticky at root run 2. Higher Diameter wire makes slag detachability issue	1. Reduce the voltage to 27 – 28 for root run & Increase the travel speed to 550 – 600 mm/Min. 2. 3.15 mm wire is better option for root run & 450 Ampere is preferable
Flux Boiling	High Heat input or Tandem welding Process	Suitable up to 6KJ/mm Heat input Process & Two Tandem wire Process

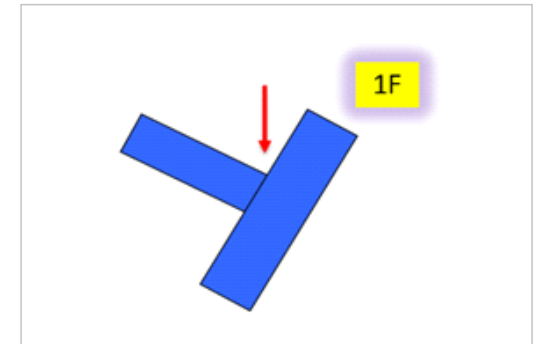
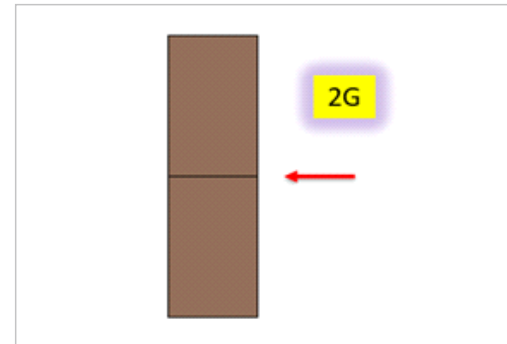
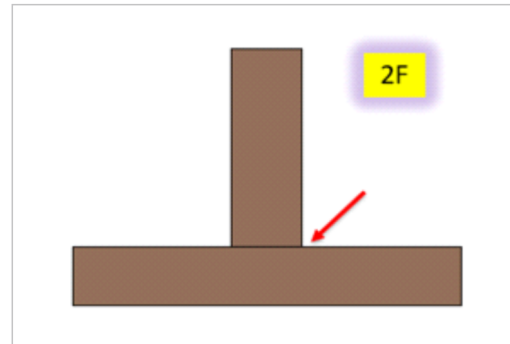
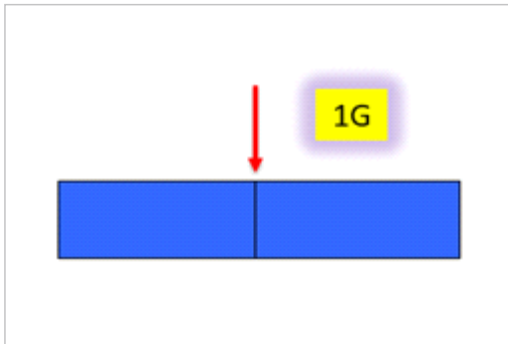
Automelt B22 Plus Flux



Plate Thickness	45 mm
Plate Grade	SA 516 Gr 60/70
Type of Joint	Fillet
Joint Design	Single V butt joint, Included angle 60° Celsius
Welding Position	1F
Welding Wire Used	EM12K – 4.00 mm, Single Wire Used
Current Used	450 – 600 A
Voltage Used	28 to 32 V
Travel Speed	250 - 400 mm/Min
Preheat	NA (Ambient Temperature: 30° Celsius)
Inter-pass Temperature	150° Celsius
Single or Multi-pass	Single Pass
Flux Specification	F7A5-EM12K
Flux Behaviour	Self slag Removal from root run

Common customer assistance on Automelt B22 Plus Flux

Problem	Reason for the Problem	Solution to the Problem
Gas Marks & Pock Marks	1. Rusty Base Plate 2. Moisture in flux	1. Remove the rust by grinding 2. Redry the flux at 300° Celsius for 2 Hours



Welding Positions used in Submerged Arc Welding

G - Groove

F - Fillet

Automelt B20 Plus Flux



Plate Thickness	40 mm
Plate Grade	C –Mn Steel
Type of Joint	Groove
Joint Design	Single V butt joint, Included angle 60° Celsius
Welding Position	1G
Welding Wire Used	EM12K – 4.00 mm, Single Wire Used
Current Used	520 to 580 A
Voltage Used	28 to 30 V
Travel Speed	190 – 280 mm/Min
Preheat	120° Celsius
Inter-pass Temperature	150° Celsius
Single or Multi-pass	Multi Pass
Flux Specification	F7A8-EM12K
Flux Behaviour	Self slag Removal from root run & provide less impurity weldmetal

Common customer assistance on Automelt B20 Flux



Problem	Reason for the Problem	Solution to the Problem
Porosity & Flux Boiling	Higher Voltage	1. Reduce the voltage & use maximum of 36 Voltage in groove
Gas Marks & Pock Marks	1. Rusty Base Plate 2. Moisture in flux	1. Remove the rust by grinding 2. Redry the flux at 300° Celsius for 2 Hours
Slag Removal in root run	1. Excess Voltage & slow travel speed are leads to Slag sticky at root run 2. Higher Diameter wire makes slag detachability issue	1. Reduce the voltage to 27 – 28 for root run & Increase the travel speed to 550 – 600 mm/Min. 2. 3.15 mm wire is better option for root run & 450 Ampere is preferable

Automelt B41 Flux



Plate Thickness	58 - 60 mm
Plate Grade	SA 516 Gr 60/70
Type of Joint	Groove
Joint Design	Double V - 45° Angle - SMAW Root run
Welding Position	1G
Welding Wire Used	EH14 – 3.15 mm, Single Wire Used
Current Used	400 - 550A
Voltage Used	27 to 30 V
Travel Speed	400 – 600 mm/Min
Preheat	100° Celsius
Inter-pass Temperature	200° Celsius
Single or Multi-pass	Multi Pass
Flux Specification	F7A6/P6-EH14
Flux Behaviour	Self slag Removal from root run

Automelt B41 Flux (2G Application)



Plate Thickness	58 - 60 mm
Plate Grade	SA 516 Gr 60/70
Type of Joint	Groove
Joint Design	Double V - 45° Angle - SMAW Root run
Welding Position	2G
Welding Wire Used	EH14 – 2.5 mm, Single Wire Used
Current Used	350 - 400A
Voltage Used	23 to 25 V
Travel Speed	360 - 370 mm/Min
Preheat	100° Celsius
Inter-pass Temperature	200° Celsius
Single or Multi-pass	Multi Pass
Flux Specification	F7A6/P6-EH14

Common customer assistance on Automelt B41 Flux

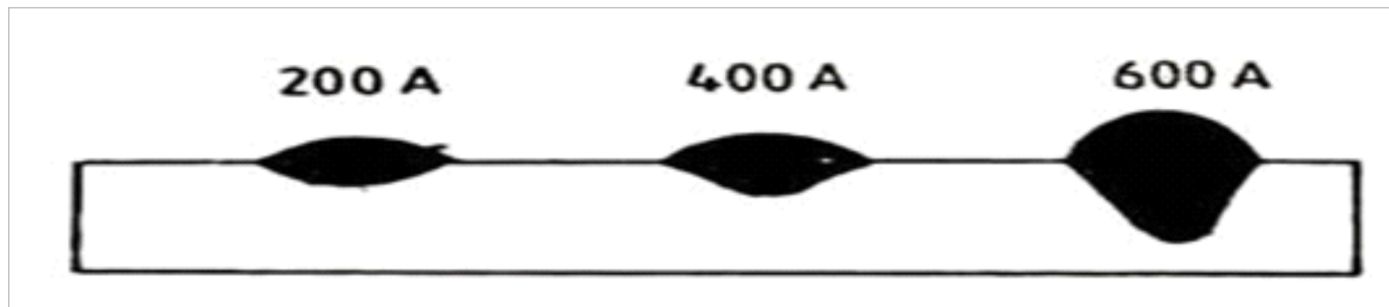


Problem	Reason for the Problem	Solution to the Problem
Porosity & Flux Boiling	Higher Voltage	1. Reduce the voltage & use maximum of 36 Voltage in groove
Gas Marks & Pock Marks	1. Rusty Base Plate 2. Moisture in flux	1. Remove the rust by grinding 2. Redry the flux at 300° Celsius for 2 Hours
Slag Removal in root run	1. Excess Voltage & slow travel speed are leads to Slag sticky at root run 2. Higher Diameter wire makes slag detachability issue	1. Reduce the voltage to 27 – 28 for root run & Increase the travel speed to 550 – 600 mm/Min. 2. 3.15 mm wire is better option for root run & 450 Ampere is preferable

Process variables

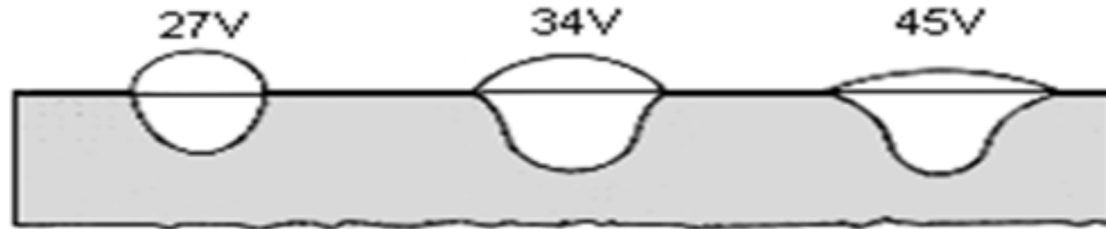
- Current
- Voltage
- Travel speed
- Polarity

Effect of welding Current

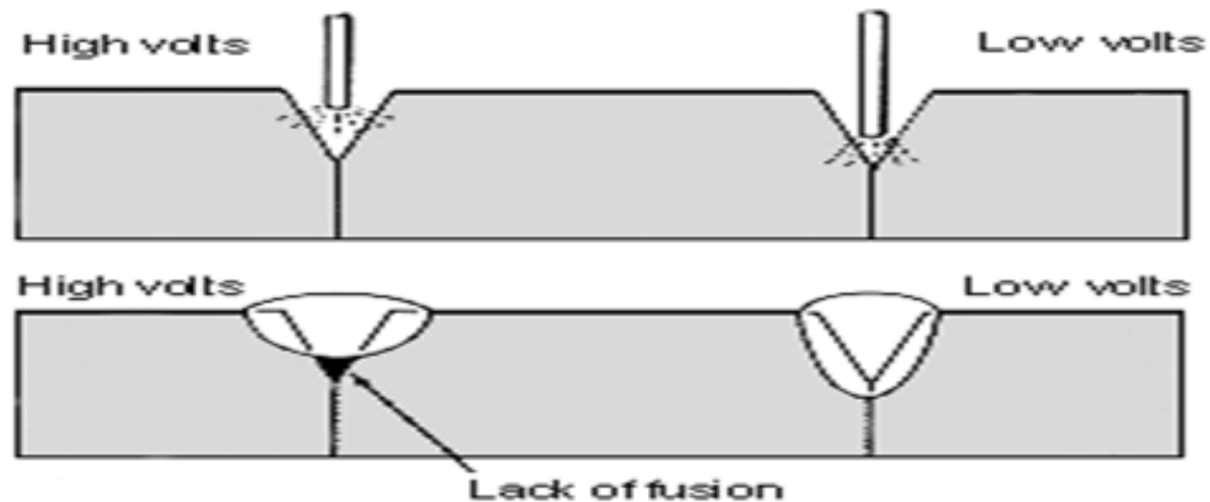


Higher current leads to higher penetration & Dilution

Effect of welding Voltage

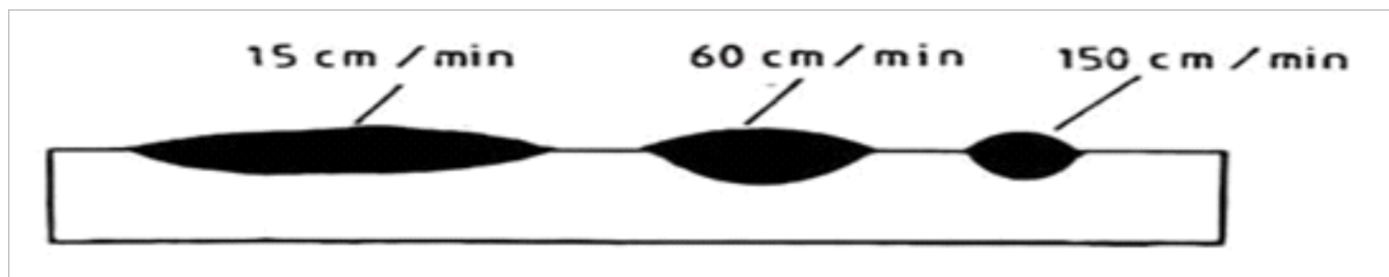


Higher Voltage increases the weld bead width & Flux consumption



High welding voltage leads to lack of fusion in root run welding of groove & fillet

Effect of Travel speed



Weld bead width was directly proportional to travel speed

Effect of polarity

Welding polarity	Current (A)	Voltage (V)	Welding speed (mm/Min)	Stick out distance (mm)	Reinforcement Height (mm)	Width (mm)	Depth of penetration (mm)	Wire feed rate (mm/min)	Metal deposition rate (Gram/Min)	Flux consumption rate (Gram/Min)
DCEP	450 - 500	28	450	20	3.15	16.25	6.49	177.25	102.49	86.70
DCEN					4.71	16.12	4.40	247.42	141.91	102.49

Higher penetration achieved in DCEP Polarity
higher deposition rate achieved in DCEN Polarity



Flux Selection Guide



- SAW Flux & Wire selection for the particular application is depend on Application type & Mechanical requirements of the joint. (ADOR representative should collect both these details)
- Application details are type & Thickness of base material to be weld, Joint design, welding speed & Welding machine type.

Base Plate Type/Grade	Based on grade weldmetal mechanical requirements will vary
Base Plate thickness	Base Plate thickness affect the Cooling rate of the weldmetal & Slag detachability
Joint Design	Based on Joint design & Groove type , flux selection should select
Welding Speed	Basic fluxes not suitable for High speed welding
Welding machine Type	Single Wire / Twin Wire / Tandem Wire / AC / DC power source

Flux Selection Guide

Application	Plate Thickness (mm)	Welding Parameters (Travel Speed)	Welding Machine Type	Welding Consumables	AWS Classification
Structural Fabrication	4 - 24	800 - 1800 mm/min	Single Wire / Twin Wire	Automelt A82 + Automelt EM12K (1.6mm)	F7AZ-EM12K
	6 - 24	400 - 1200 mm/min	Single Wire / Twin Wire	Automelt A81 + Automelt EM12K (1.6mm)	F7AZ-EM12K
	10 – 30 Fillet Joint	Below 800 mm/min	Single Wire / Twin Wire	Automelt A55 + Automelt EM12K / EI8	F7AZ-EL8 F7A0-EM12K
Cylinder Manufacturing	3- 6 (Similar to Bead on Plate)	Upto 1200 mm/min	Single Wire	Automelt A57 + Automelt EI8	F7AZ-EL8
Railway (RDSO)	More than 10 mm	400 - 600 mm/min	Single Wire	Automelt Grade IV + Automelt Grade A	F6A0-EL8
		400 - 600 mm/min	Single Wire	Automelt B71 + Automelt Grade EM12K	F7A4-EM12K

Flux Selection Guide

Application	Plate Thickness (mm)	Welding Parameters (Travel Speed)	Welding Machine Type	Welding Consumables	AWS Classification
General Fabrication / Pressure vessels / Heavy Equipment fabrication / Long Seam and Cir Seam Welding of Pipes	10 - 30	400 - 600 mm/min	Single Wire / Twin Wire	Automelt B71 + Automelt EM12K	F7A4-EM12K
	6 - 24	400 - 600 mm/min	Tandem Wire	Automelt B71 + Automelt EM12K	F7A4-EM12K
	30 - 100 Fillet Joint	400 - 600 mm/min	Single Wire / Twin Wire	Automelt B71 + Automelt EH14	F7A4-EH14
Heavy thickness applications / Long PWHT	10 - 100	400 - 600 mm/min	Single Wire	Automelt B41 + Automelt EH10K/ EH12K /EH14	F7A8-EH12K / F7A8-EH14 / F7A8-EH10K
Narrow Gab Welding & Cr-Mo Joints	10 - 100	400 - 600 mm/min	Single Wire / Twin Wire	Automelt B20 Plus + Automelt EH10K/ EB2R/EB3R	F7A8-EH10K / F8P0-EB3R-B3R

SAW Flux application - Enquiry Form



- Plate Thickness :
- Plate Grade :
- Type of Joint :
- Joint Design :
- Welding Position :
- Welding Wire Used :
- Current Used :
- Voltage Used :
- Travel Speed :
- Preheat :
- Inter-pass Temperature :
- Single or Multi-pass :
- Flux Specification :
- Weld metal Chemical Requirements :
- PWHT Conditions :
- Corrosion / Hardness requirements :



Thank You!