HYUNDAI WELDING

Rev. 02

S-717 X M-12K
L-8
A-2

SUBMERGED ARC WELDING CONSUMABLES
FOR WELDING OF
HIGH TENSILE STEEL

2019.09

HYUNDAI WELDING CO., LTD.

S-717

❖ Specification

Flux	JIS Z 3352	EN ISO 14174	KS B ISO 14174
S-717	S A AB 1	S A AB 1	S A AB 1

Wire	AWS A5.17/A5.23	EN ISO 14171
M-12K	A5.17 F7A(P)6-EM12K	S2Si
L-8	A5.17 F6A(P)4-EL8	S1
A-2	A5.23 F8A0-EA2-A4 A5.23 F8PZ-EA2-A4	S2Mo

❖ Applications

Multi-layer welding of structural steels, offshore structures and thick, windmill, pressure vessels.

❖ Characteristics on Usage

Good weldability for all range of thickness of plate. Excellent impact value and crack-resistibility of welded metal. Inactive type flux is not affected by welding parameter, especially suitable for multi-layer welding of thick plate.

❖ Note on Usage

1. Dry the flux at 300~350℃(572~662°F) for 60minutes before use.

2. For the first layer in groove, keep the current and speed low in the case of multi-layer welding.

Welding consumable for test

❖ Flux

Consumable	Chemical Composition, wt%			
	SiO2+TiO2	Al2O3+MnO	CaO+MgO	CaF2
S-717	10	30	35	10

Consumable	Particle Size (Mesh)	Type of Flux	B.I	$H2O_{1000℃}$/ CO2(%)
S-717	10 × 48	Agglomerated	1.6	0.05/0.80

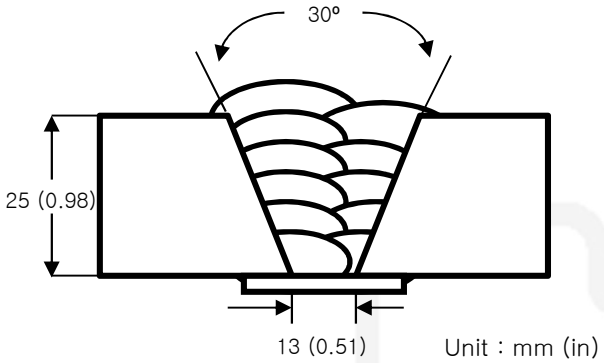
❖ Electrode

Consumables	Dia.	Chemical Composition, wt%					
	mm (in)	C	Si	Mn	P	S	Mo
M-12K	4.0(5/32)	0.09	0.20	1.02	0.016	0.006	-
AWS A5.17 EM12K		0.05-0.15	0.10-0.35	0.80-1.25	≤0.030	≤0.030	-
L-8	4.0(5/32)	0.05	0.02	0.52	0.017	0.012	-
AWS A5.17 EL8		≤0.10	≤0.07	0.25-0.60	≤0.030	≤0.030	-
A-2	4.0(5/32)	0.09	0.15	1.00	0.015	0.005	0.48
AWS A5.23 EA2		0.05-0.17	≤0.20	0.95-1.35	≤0.025	≤0.025	0.45-0.65

Mechanical Properties & Chemical Composition of All Weld Metal

❖ Welding Conditions

Method by AWS Spec.



[Joint Preparation & Layer Details]

Base metal	:	SS400
Particle size	:	10 x 48
Flux type	:	Agglomerated
Amp./ Volt./cpm	:	550 / 30 / 40
Stick-Out mm (in)	:	30 (1.18)
Pre-Heat ℃(℉)	:	R.T .
Interpass Temp. ℃ (℉)	:	<150 (302)
Polarity	:	AC

❖ Mechanical Properties of All weld metal

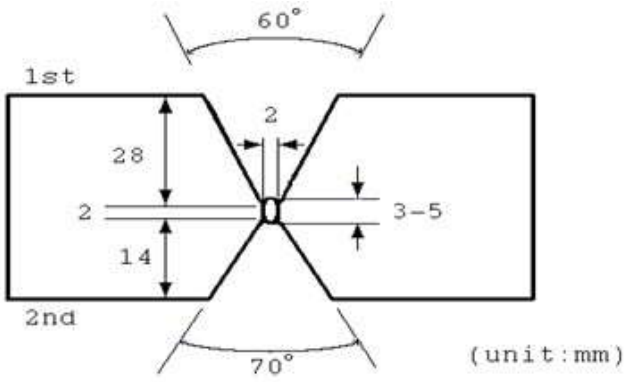
Consumables	PWHT Condition	Tensile Test			CVN Impact Test J (ft·lbs)	
		YS MPa(lbs/in2)	TS MPa(lbs/in2)	EL (%)		
S-717 X M-12K	As-welded	555 (81,000)	614 (89,000)	29	-51℃ (-60°F)	60 (44)
	620℃x1hr	493 (72,000)	590 (86,000)	31	-51℃ (-60°F)	94 (69)
AWS A5.17 F7A(P)6-EM12K	-	≥400	490~660	≥ 22	≥27J at -51℃	

❖ Chemical Analysis of All weld metal(wt%)

Consumables	C	Si	Mn	P	S
S-717 X M-12K	0.09	0.26	1.40	0.023	0.004

Multi-run Welding Test (44t)

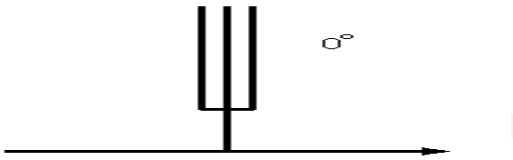
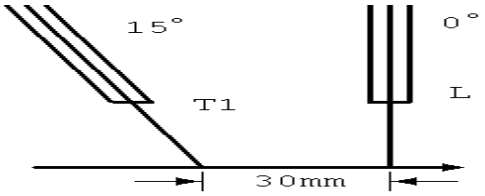
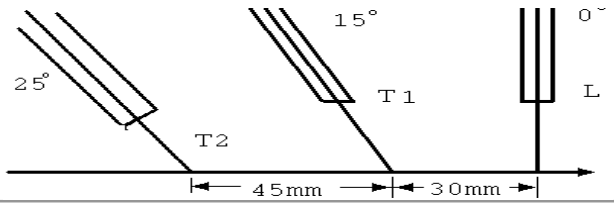
❖ Welding Conditions



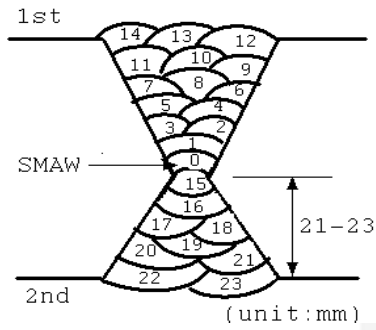
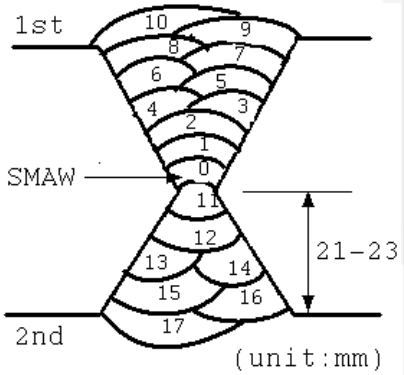
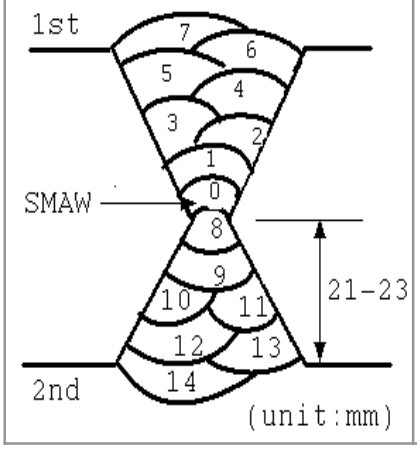
[Joint Preparation & Layer Details]

Base metal	:	BS4360 Gr. 50D
Particle size	:	12 X 60 (ASME)
Flux type	:	Agglomerated
Stick-Out mm (in)	:	44 (1.73)
Pre-Heat(℃)	:	R.T .
Interpass Temp. ℃ (°F)	:	<150 (302)
Polarity	:	DC+, AC

❖ Electrode shooting arrangement

Polarity	Shooting arrangement	Stick-out mm (in)
1 Pole DC+		30 (1.18)
2 Poles DC+, AC		30 (1.18)
3 Poles DC+, AC, AC		30~35 (1.18~1.38)

❖ Welding Conditions

Joint preparation and layer details (B.M. BS4360 Gr.50D 44mm)	POLES	Welding conditions							
		Side	Polarity		Amp. (A)	Volt (V)	Speed (CPM)	Heat input (kJ/cm)	Inter pass temp (℃)
	1	1	L	DC+	500	32	40	16.0	Max. 300
		2~14	L	DC+	600	36	50	25.9	
		Back gouging (Min. 5R, 35°) Completely remove SMAW weld							
		15	L	DC+	500	32	40	16.0	
		16~23	L	DC+	600	36	50	25.9	
	2	1	L	DC+	500	32	40	16.0	
		2~10	L T	DC+ AC	600 700	33 35	80	33.2	
		Back gouging (Min. 5R, 35°) Completely remove SMAW weld							
		11	L	DC+	500	32	40	16.0	
		12~17	L T	DC+ AC	600 700	33 35	80	33.2	
	3	1	L	DC+	500	32	40	16.0	
		2~7	L T1 T2	DC+ AC AC	600 650 700	33 35 38	90	46.1	
		Back gouging (Min. 5R, 35°) Completely remove SMAW weld							
		8	L	DC+	500	32	40	16.0	
		9~14	L T1 T2	DC+ AC AC	600 650 700	33 35 38	90	46.1	

❖ Mechanical Properties of All weld metal

Consumables	Poles	Tensile Test			CVN Impact Test (Joule)	
		YS MPa(lbs/in2)	TS MPa(lbs/in2)	EL (%)	0℃ (32°F)	-20℃ (-4°F)
S-717 X M-12K	1	512 (74,000)	577 (84,000)	28	104 (77)	76 (56)
	2	508 (74,000)	574 (83,000)	27	105 (77)	78 (58)
	3	544 (79,000)	601 (87,000)	30	106 (78)	85 (63)

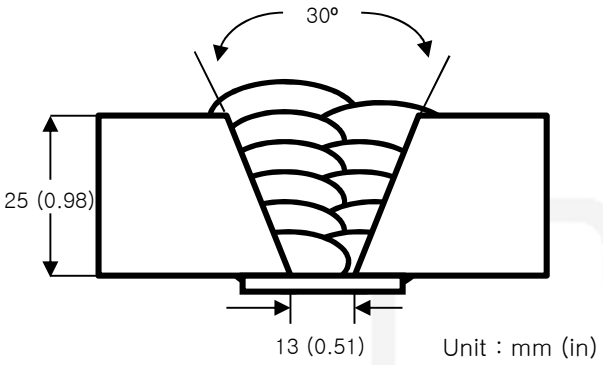
❖ Chemical Analysis of All weld metal(wt%)

Consumables	Poles	C	Si	Mn	P	S
S-717 X M-12K	1	0.08	0.54	1.47	0.025	0.018
	2	0.09	0.44	1.47	0.024	0.015
	3	0.10	0.43	1.44	0.024	0.014

Mechanical Properties & Chemical Composition of All Weld Metal

❖ Welding Conditions

Method by AWS Spec.



[Joint Preparation & Layer Details]

Base metal	:	SS400
Particle size	:	10 x 48
Flux type	:	Agglomerated
Amp./ Volt./cpm	:	550 / 30 / 40
Stick-Out mm (in)	:	30 (1.18)
Pre-Heat ℃(°F)	:	R.T .
Interpass Temp. ℃ (°F)	:	<150 (302)
Polarity	:	DC+

❖ Mechanical Properties of All weld metal

Consumables	PWHT Condition	Tensile Test			CVN Impact Test J (ft·lbs)	
		YS MPa(lbs/in2)	TS MPa(lbs/in2)	EL (%)	-40℃ (-40°F)	-51℃ (-60°F)
S-717 X L-8	As-welded	435 (63,000)	514 (75,000)	36	141 (104)	97 (72)
	620℃x1hr	407 (59,000)	500 (73,000)	37	170 (125)	127 (94)
AWS A5.17 F6A(P)4-EL8	-	≥330	410~550	≥ 22	≥27J at -40℃	

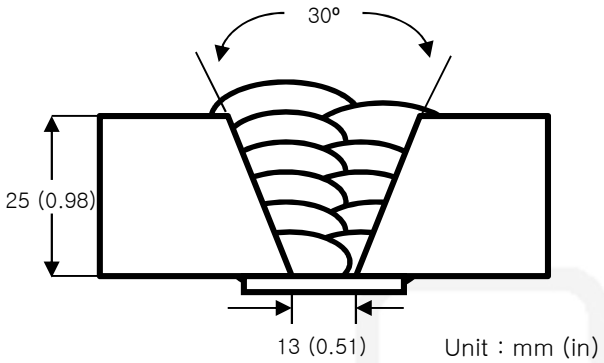
❖ Chemical Analysis of All weld metal(wt%)

Consumables	C	Si	Mn	P	S
S-717 X L-8	0.078	0.20	1.08	0.024	0.004

Mechanical Properties & Chemical Composition of All Weld Metal

❖ Welding Conditions

Method by AWS Rules



[Joint Preparation & Layer Details]

Base metal	:	SM570
Particle size(mesh)	:	10 X 48
Flux type	:	Agglomerated
Amp./ Volt./CPM	:	550 / 30 / 40
Stick-Out mm (in)	:	30 (1.18)
Pre-Heat ℃(℉)	:	RT
Interpass Temp. ℃ (℉)	:	<164(327)
Polarity	:	DC+

❖ Mechanical Properties of All weld metal

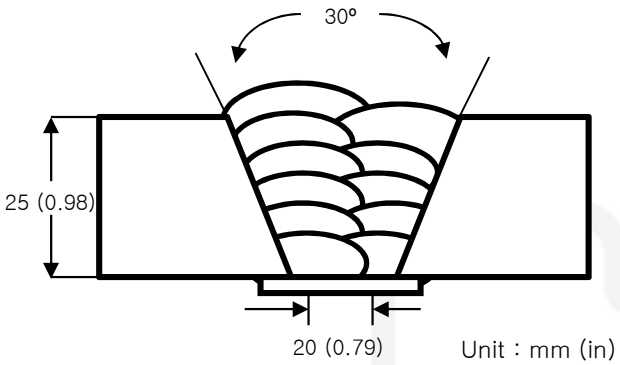
Consumables	PWHT Condition	Tensile Test			CVN Impact Test J (ft·lbs)	
		YS MPa(lbs/in2)	TS MPa(lbs/in2)	EL (%)	0℃ (32°F)	-20℃ (-4°F)
S-717 X A-2	As welded	542 (79,000)	650 (94,000)	29	89 (66)	60 (44)
	620℃x1hr	529 (76.7)	640 (92.8)	30	49 (36)	27 (20)
	550℃x20hr	553 (80,000)	642 (93,000)	29	56 (41)	22 (16)
AWS A5.23 F8A0-EA2-A4 AWS A5.23 F8PZ-EA2-A4		≥470	550~690	≥ 20	≥27J at -18℃ Not specified	

❖ Chemical Analysis of All weld metal(wt%)

Consumables	C	Si	Mn	P	S	Mo
S-717 X A-2	0.08	0.35	1.58	0.023	0.005	0.49
AWS A5.23 A4	≤0.15	≤0.80	≤1.60	≤0.030	≤0.030	0.40-0.65

Mechanical Properties & Chemical Composition of All Weld Metal

❖ Welding Conditions



[Joint Preparation & Layer Details]

Base metal	:	SM570
Particle size(mesh)	:	10 X 48
Flux type	:	Agglomerated
Amp./ Volt./CPM	:	L(DC+) 750 / 30 / 60 T(AC) 700 / 32
Stick-Out mm (in)	:	30 (1.18)
Pre-Heat ℃(°F)	:	R.T .
Interpass Temp. ℃ (°F)	:	<164(327)
Polarity	:	Tandem DC+, AC

❖ Mechanical Properties of All weld metal

Consumables	PWHT Condition	Tensile Test			CVN Impact Test J (ft·lbs)	
		YS MPa(lbs/in2)	TS MPa(lbs/in2)	EL (%)	0℃ (32°F)	-18℃ (0°F)
S-717 X A-2	As welded	542 (79,000)	650 (94,000)	32	75 (55)	59 (44)

❖ Chemical Analysis of All weld metal(wt%)

Consumables	C	Si	Mn	P	S	Mo
S-717 X A-2	0.09	0.24	1.39	0.022	0.005	0.42

Diffusible Hydrogen Content

❖ Welding Conditions

wire	:	**M-12K**	**Amps(A) / Volts(V)**	:	625/30
Diameter(mm)	:	4.0(5/32)	**Stick-Out(mm)**	:	30
Flow Rate(ℓ /min.)	:	–	**Welding Speed**	:	60 cpm
Welding Position	:	1G	**Current Type & Polarity**	:	DC(+)

❖ Result(㎖/100g Weld Metal)

X1	X2	X3	X4
6.40	**6.35**	**6.05**	**6.24**

Average Hydrogen Content 6.26㎖ / *100g Weld Metal*

Approvals

❖ Authorized Approval Details

Consumables	KR	ABS	LR	BV	DNV	GL	NK	MRS
S-717 X M-12K	3M 3YM 2.4~6.4	3M 3YM 2.4~6.4	3YM 2.4~6.4	A3M A3YM 2.0~6.4	IIIYM 2.0~6.4	3YM 2.0~6.4	KAW53M 2.0~6.4	3YM 1.2~6.4

	CWB	TUV	CE-Mark
S-717 X M-12K	CSW W48-06 F49A5-EM12K CSW W48-06 F49P5-EM12K 1.2~6.4	EN 756 S2Si (Wire) EN 760 SA A B 1 (Flux) 1.6~5.0	EN 756 S2Si (Wire) EN 760 SA A B 1 (Flux) 1.6~5.0

	DB
S-717 X M-12K	S2Si DIN EN 756 (M-12K) S A AB 1 DIN EN 760 (S-717) 1.2~6.4