STRIP & FLUX COMBINATIONS FOR CLADDING

Stainless steel strips and Fluxes for Submerged Arc and Electroslag Cladding

DESCRIPTION

Nowadays, the two most productive systems for surfacing large components that are subject to corrosion or wear are submerged arc and electroslag cladding, using a strip electrode. Both processes are characterised by a high deposition rate and low dilution.

TYPICAL APPLICATIONS

They are suitable for surfacing flat and curved objects such as heat exchanger plates or pressure vessels of different kinds. Submerged Arc Strip Cladding (SASC) is the most frequently - used process, but if higher productivity and restricted dilution rates are required, Electroslag Strip Cladding (ESSC) is used. These strips are finding increasing use in petroleum industry in hydrocracking, hydro-sulphurisation and catalytic refining processes and in the chemical and petrochemical industries.

Fluxes for SASC and ESSC

Process	Product	Basicity Index	Density Kg/dm3
SASC ESSC	OK Flux 10.05 OK Flux 10.10	1.1 4.0	0.7 1.0

Dimension & packing

Product	Type	Size	Weight
Strips Fluxes	OK Band OK Flux	60 x 0.5 mm -	25 or 50 Kg coils 25 Kg bags

Other sizes available on request.

Stainless steel welding strips for SASC

Product	AWS A5.9	Typical strip composition						
		%C	%Si	%Mn	%Cr	%Ni	%Mo	Other
OK Band 308L	EQ308L	≤0.03	0.5	1.8	20.3	10.0	≤0.03	-
OK Band 347	EQ347	≤0.03	0.5	1.8	20.0	10.0	≤0.03	Nb≤1.0
OK Band 316L	EQ316L	≤0.03	0.5	1.8	19.0	12.5	2.8	-
OK Band 309 L	EQ309L	≤0.03	0.5	1.8	24.0	13.0	≤0.03	-

Stainless steel welding strips for ESSC

Product	Typical strip composition						
	%C	%Si	%Mn	%Cr	%Ni	%Mo	Other
OK Band 309L ESW	≤0.03	0.3	1.8	21.0	11.0	≤0.5	-
OK Band 309L Nb ESW	≤0.02	0.3	1.8	21.0	11.0	≤0.5	Nb≤0.8
OK Band 309LMo ESW	≤0.02	0.3	1.8	20.5	13.5	3.1	-

Other welding strips for SASC

To be used with	AWS A5.14	Typical strip composition						
		%C	%Si	%Mn	%Cr	%Ni	%Mo	Other
OK Band NiCrMo3	ERNiCrMo-3	≤0.10	≤0.2	≤0.5	21.5	Bal.	9.0	Fe≤2.0
OK Band NiCr3	ERNiCr-3	≤0.10	≤0.5	3.0	20.0	Bal.	1.8	Fe≤3.0

Notes:
1) Other types of strips also available on demand.
2) OK Flux 10.05 and OK Flux 10.10 have to be redried at 300-305°C for 2 hours before use.
3) Typical Weldmetal composition is available on demand.
4) OK Band 309L ESW together with OK Flux 10.10 produces 308L type weld deposit (single layer).
5) OK Band 309LNb ESW together with OK Flux 10.10 produces 347 type weld deposit (single layer).
6) OK Band 309LMo ESW together with OK Flux 10.10 produces 316L type weld deposit (single layer).

WIRE & FLUX COMBINATIONS

Wires and Fluxes for overlaying by SAW

DESCRIPTION

ESAB hard surfacing consumables are ideal for surfacing components that are worn-out or to resist wear against abrasion and impact with work hardening properties.

WIRES

ESAB WRAS has the following composition. OK AUTOROD 12.08L and OK AUTOROD 12.40L could also be used.

FLUXES

ESAB AGGLOWELD HFG and ESAB AGGLOWELD HFS are agglomerated basic fluxes designed for hard surfacing applications by providing necessary alloying elements to the weld deposit. ESAB AGGLOWELD HFG Weldmetal is a tough machinable alloy resisting compressive load, without micro fissuring and also has resistance to fatigue and impact. ESAB AGGLOWELD HFS can produce deposits of higher hardness with suitable wire.

TYPICAL APPLICATIONS

Suitable for overlaying of scraper blades, cane cutting knives, bucket body, chutes, guides, plough shear, cam rollers, gate valve seats, road graders, roll reclamation, crane wheels, earth moving equipment, crusher equipment etc. Suitable for building of machine components such as cams, gears, splines, sprockets, railway equalizer beams, sugar mill pinions, rims, tractor sprockets, gear teeth, wobblers, pump shafts, crane wheel, pulley brakes, cable drums skid wheels pulley brakes, track rollers, Crane wheels, ditcher rolls etc.

TYPICAL PROPERTIES - WRAS

Wire Composition (Wt.%)	
C	0.35
Si	0.40
Mn	0.90
Cr	1.00

PACKING: The wire is available in 4.00 mm dia having net weight of 25 Kg.Flux is available in plastic lined paper bag containing 25 Kg.

TYPICAL WELDMETAL PROPERTIES (After 3rd layer)

FLUX /	ESAB WRAS		OK AUTROD 12.40L		OK AUTROD 12.08L	
	VHN	RC	VHN	RC	VHN	RC
ESAB AGGLOWELD HFG	400-440	38-42	320-370	31-35	260-300	24-28
ESAB AGGLOWELD HFS	480-550	46-56	400-450	48-43	-	-
OK FLUX 10.71L	220-250	21-26	-	-	-	-

9% Ni STEELS FOR LNG TANK FABRICATION

DESCRIPTION

LNG Storage tanks are usually fabricated from 9% Ni steels to provide a combination of properties at a reasonable price. Quenched & tempered 9% Ni Steels has excellent low temperature properties and is not susceptible to under bead cracking or excessive hardening in the HAZ on account of its low carbon. Esab offers a complete range of proven consumables, which have been used in over 30 global installations.

Nickel Based Consumables

The tensile strength of the high nickel alloy weld metal is close to that of 9% nickel steels and has high resistance to brittle fracture, good impact strength at -196°C, lateral expansion, side bend test and yield strength properties. Special stainless steel consumables are also available for LNG transport tanks and associated piping. Please refer section on stainless steel consumables elsewhere in this book.

APPLICATIONS

The SMAW electrodes are designed to weld on AC, largely to eliminate the magnetic arc blow problem of 9% nickel steels. SAW is preferred for cicumferential welds and SMAW for the vertical welds. Smaller diameter wires (1.6mm) deliver better impact values. 9% nickel steels can be welded without pre and post weld treatment up to 60 mm, as per ASME code, OK 92.55 is Preferred, when higher impact values are specified.

TYPICAL WELDMETAL COMPOSTION (After 3rd Layer)

Material/ESAB Product	Chemical Composition (%)									
	C	Si	Mn	Cr	Ni	Mo	Nb	W	S&P	Fe
9% Ni Steels	0.13 Max	0.15 0.40	0.90 Max	-	8.5 9.5	-	-	-	0.005 Max	-
OK 92.45	≤0.05	0.5	≤0.5	21.5	64.0	9.0	3.3	-	-	≤5.0
OK 92.55	≤0.08	0.4	3.0	13.0	70.0	6.0	1.5	1.5	-	≤8.0
OK AUTROD 19.82/ OK FLUX 10.16	0.01	0.3	0.3	22.0	Bal	9.0	3.5*	-	-	1.5

*Including Tantalum

TYPICAL ALL WELDMETAL MECHANICIAL PROPERTIES

Material / ESAB Product	Classification	Mechanical Properties			
		YS	UTS	El	CVN Impact Values
9% Ni Steels	A553-82	(N/mm^2) 585	(N/mm^2) 690-825	(%) 20	(J at -196°C) 27
OK 92.45	ENiCrMo-3	500	780	35	50
OK 92.55	ENiCrMo-6	>430	>690	>35	>70
OK AUTROD 19.82/ OK FLUX 10.16	ERNiCrMo-3	420	700	40	80

Consumables for Ni Steels
SMAW

OK 92.26

Classification AWS A5.11 ENiCrFe-3

DESCRIPTION

A nickel - based electrode for welding nickel alloys such as inconel 600 and similar Inconel alloys, cryogenic steels, martensitic to austenitic steels, dissimilar steels, heat-resistant steels and castings with limited weldability.

APPROVALS: ABS, SEPROS, UDT.

WELDING CURRENT: DC+

TYPICAL WELDMETAL PROPERTIES

Weldmetal Composition (%)		Typical Mechanical properties of all Weldmetal	
C	≤0.10	YS	410 N/mm²
Si	0.5	UTS	640 N/mm²
Mn	7.0	EL	40%
Cr	15.0	Impact Values +20°C	100J
Ni	67.0	-196°C	80J
Nb	1.7		
Cu	<0.5		
Ti	<0.5		
Ta	<0.3		
Fe	7.0		

CURRENT DATA

Diameter (mm)	Length mm	Welding Current, A	Arc voltage, V
2.5	300	50-70	22
3.2	350	65-105	23
4.0	350	75-150	24
5.0	350	120-170	25

OK 92.86

Classification AWS A5.11 ENiCu-7

DESCRIPTION

A nickel-copper electrode for welding NiCu alloys to themselves and to steels and for corrosion resistant surfacing. The weld metal of OK 92.86 is crack resistant and ductile and meets rigorous requirements relating to corrosion resistance in sea water and in reducing and oxidising acids. OK 92.86 is used for welding corrosion - resistant monel alloys within the petroleum and ammoniun sulphate industry and in power plants.

WELDING CURRENT: DC+

TYPICAL WELDMETAL PROPERTIES

Weldmetal Composition (%)		Typical Mechanical properties of all Weldmetal	
C	≤0.10	YS	410 N/mm²
Si	0.5	UTS	640 N/mm²
Mn	2.5	EL	40%
Ni	66.0	Impact Values +20°C	100J
Nb	<0.3	-196°C	80J
Cu	30.0		
Al	<0.5		
Ti	0.2		
Fe	1.5		

CURRENT DATA

Diameter (mm)	Length mm	Welding Current, A	Arc voltage, V
2.5	300	50-70	22
3.2	350	70-120	26
4.0	350	120-140	28

OK 92.59

Classification AWS A5.11 ENiCrMo-13

DESCRIPTION

OK 92.59 is designed for welding alloy 59, C-276 and 625 Ni-based materials. It is also suitable for welding superaustenitic steels like AISI/ASTM S31254 and S32654.

WELDING CURRENT: DC+

TYPICAL WELDMETAL PROPERTIES

Weldmetal Composition (%)		Typical Mechanical properties of all Weldmetal	
C	<0.02	YS	430 N/mm²
Si	<0.2	UTS	770 N/mm²
Mn	<0.2	EL	40%
Cr	23.0	Impact Values +20°C	70J
Ni	62.0	-196°C	60J
Mo	15.5		
Fe	<1.0		

CURRENT DATA

Diameter (mm)	Length mm	Welding Current, A	Arc voltage, V
2.5	300	50-70	20
3.2	350	60-90	21
4.0	350	80-120	22

Consumables for Ni Steels
GMAW

OK AUTROD 19.81

Classification AWS A5.14 ERNiCrMo-13

DESCRIPTION

A continous, solid, Ni-Cr-Mo electrode for welding high-alloyed materials of the 20Cr-25Ni type with 4-6% Mo and Ni-based alloys of a similar type. It can also be welded in combination with carbon steels. The weld metal has very good corrosion resistance over a wide range of applications in oxidising and reducing media.

APPROVALS: VdTÜV

WELDING CURRENT: DC+

TYPICAL WELDMETAL PROPERTIES

Wire Composition (%)		Typical Mechanical properties of all Weldmetal	
C	<0.01	YS	550 N/mm²
Si	<0.1	UTS	750 N/mm²
Mn	<0.5	EL	40%
Cr	23.0	Impact Values -110°C	120J
Ni	>56.0		
Mo	15.5		
Fe	<1.5		

CURRENT DATA

Diameter (mm)	Welding Current, A	Arc voltage, V
0.8	70-190	20-27
1.0	100-200	21-27
1.2	160-280	24-30
1.6	200-350	25-32

PACKING: The wire can be supplied in plastic or wire basket spool packed in a cardboard box weighing 15kg.

OK AUTROD 19.82

Classification AWS A5.14 ERNiCrMo-3

DESCRIPTION

A continous, solid, corrosion and heat - resistant, Ni-Cr electrode for welding high-alloyed heat-resistant and corrosion - resistant materials, 9% Ni steels and similar steels with high notch toughness at low temperatures. It is also suitable for joining dissimilar metals of the types mentioned above. The weld metal has very good mechanical properties at high and low temperatures. Good resistance to pitting and stress corosion.

APPROVALS: UDT, VdTÜV

WELDING CURRENT: DC+

TYPICAL WELDMETAL PROPERTIES

Wire Composition (%)		Typical Mechanical properties of all Weldmetal	
C	<0.10	YS	500 N/mm²
Si	<0.5	UTS	780 N/mm²
Mn	<0.5	EL	45%
Cr	21.5	Impact Values +20°C	130J
Ni	>60.0	-105°C	120J
Mo	9.0	-196°C	110J
Cu	<0.5		
Al	<0.4		
Ti	<0.4		
Fe	<2.0		

CURRENT DATA

Diameter (mm)	Welding Current, A	Arc voltage, V
1.0	100-200	21-27
1.2	160-280	24-30
1.6	200-350	25-32

PACKING: The wire can be supplied in plastic or wire basket spool packed in a cardboard box weighing 15kg.

OK TIGROD 19.81

Classification SFA/AWS A5.14 ERNiCrMo-13

DESCRIPTION

Bare Ni-Cr-Mo rod for welding high - alloyed materials of the 20Cr-25Ni typewith 4-6% Mo and Ni based alloys of a similar type. It can also be welded in combination with carbon steels. The weld metal has very good corrosion resistance over a wide range of applications in oxidising and reducing media.

APPROVALS: VdTÜV

WELDING CURRENT: DC-

TYPICAL WELDMETAL PROPERTIES

Wire Composition (%)		Typical Mechanical properties of all Weldmetal	
C	<0.01	YS	550 N/mm²
Si	<0.1	UTS	800 N/mm²
Mn	<0.5	EL	45%
Cr	23.0	Impact Values -110°C	120J
Ni	>56.0		
Mo	15.5		
Fe	<1.5		

PACKING DATA

Diameter (mm)	Length mm	Packing (5 Kg)
1.6	1000	✓
2.0	1000	✓
2.4	1000	✓

OK TIGROD 19.82

Classification AWS A5.14 ERNiCrMo-3

DESCRIPTION

A nickel-based, corrosion - and heat - resistant, 22% Cr, 9% Mo, 3.5% Nb rod for the GTAW of high - alloyed steel, heat - resistant steel, corrosion - resistant steel, 9% Ni steels and similar steel with high notch toughness at low temperatures. It is also suitale for joining dissimilar metals of the types mentioned above. OK TIGROD 19.82 is normally welded with pure Ar as the shielding gas.

APPROVALS: UDT, VdTÜV

WELDING CURRENT: DC-

TYPICAL WELDMETAL PROPERTIES

Wire Composition (%)		Typical Mechanical properties of all Weldmetal	
C	<0.1	YS	550 N/mm²
Si	<0.5	UTS	780 N/mm²
Mn	<0.5	EL	40%
Cr	21.5	Impact Values -196°C	130J
Ni	>60.0		
Mo	9.0		
Cu	<0.5		
Al	<0.4		
Ti	<0.4		
Fe	<2.0		

PACKING DATA

Diameter (mm)	Length mm	Packing (5 Kg)
1.6	1000	✓
2.0	1000	✓
2.4	1000	✓
3.2	1000	✓

OK TIGROD 19.85

Classification SFA/AWS A5.14 ERNiCr-3

DESCRIPTION

A nickel-based, corrosion - and heat - resistant, 20% Cr, 3% Mn, 2.5% Nb rod for the GTAW of high - alloyed steel, heat - resistant steel, corrosion - resistant steel, 9% Ni steels and similar steels with high notch toughness at low temperatures. It is also suitable for joining dissimilar metals of the types mentioned above. OK TIGROD 19.85 is usually welded with pure Ar as the shielding gas.

APPROVALS: UDT, VdTÜV

WELDING CURRENT: DC-

TYPICAL WELDMETAL PROPERTIES

Wire Composition (%)		Typical Mechanical properties of all Weldmetal	
C	<0.1	YS	440 N/mm²
Si	<0.5	UTS	670 N/mm²
Mn	3.0	EL	40%
Cr	20.0	Impact Values +20°C	150J
Ni	>67.0	-196°C	100J
Cu	<0.5		
Ti	<0.7		
Fe	<3.0		

PACKING DATA

Diameter (mm)	Length mm	Packing (5 Kg)
1.6	1000	✓
2.0	1000	✓
2.4	1000	✓

OK TIGROD 19.93

Classification AWS A5.14 ERNiCu-7

DESCRIPTION

A nickel-based, rod alloyed with about 30% Cu, 2% Ti and 1% Fe for the GTAW of base materials of the same type. It can also be used for joining these alloys to steels. OK TIGROD 19.93 is normally welded with pure Ar as the shielding gas.

APPROVALS: UDT, VdTÜV

WELDING CURRENT: DC-

TYPICAL WELDMETAL PROPERTIES

Wire Composition (%)		Typical Mechanical properties of all Weldmetal	
C	<0.15	YS	300 N/mm²
Si	<1.0	UTS	530 N/mm²
Mn	3.0	EL	45%
Ni	65.0	Impact Values +20°C	130J
Nb	<0.5	0°C	140J
Cu	30.0	-20°C	150
Ti	2.3		
Fe	1.5		

PACKING DATA

Diameter (mm)	Length mm	Packing (5 Kg)
1.6	1000	✓
2.0	1000	✓
2.4	1000	✓

OK FLUX 10.16

BASICITY INDEX: 2.4

DESCRIPTION

OK FLUX 10.16 is an agglomerated, non-alloying flux for submerged arc welding. OK FLUX 10.16 is specially designed for butt welding with nickel based alloyed wire and cladding with nickel based alloy strips. The well - balanced flux composition minimises silicon transfer from the flux to the welding metal, thereby minimising the risk of hot cracking when welding with nickel - based alloys. OK FLUX 10.16 can only be used on DC when butt welding with nickel-based alloy wires. Reverse polarity (DC-) should preferably be used in order to minimise the dilution for the base material and the risk of hot cracking in the weld metal.

TYPICAL WELDMETAL PROPERTIES

	Chemical Composition (%)						Mechanical Properties			
OK FLUX 10.16 / OK AUTROD	C	Si	Mn	Cr	Ni	Mo	YS N/mm^2	UTS N/mm^2	Impacts values Charpy V Notch	
									J	Temp (^{O}C)
19.82	0.01	0.3	0.3	21.0	bal.	9.0	420	700	80	-196
19.85	0.01	0.3	3.2	19.0	bal.	<2.0	360	600	100	-196

PACKING: OK FLUX 10.16 is packed in paper bag containing 25 Kg.