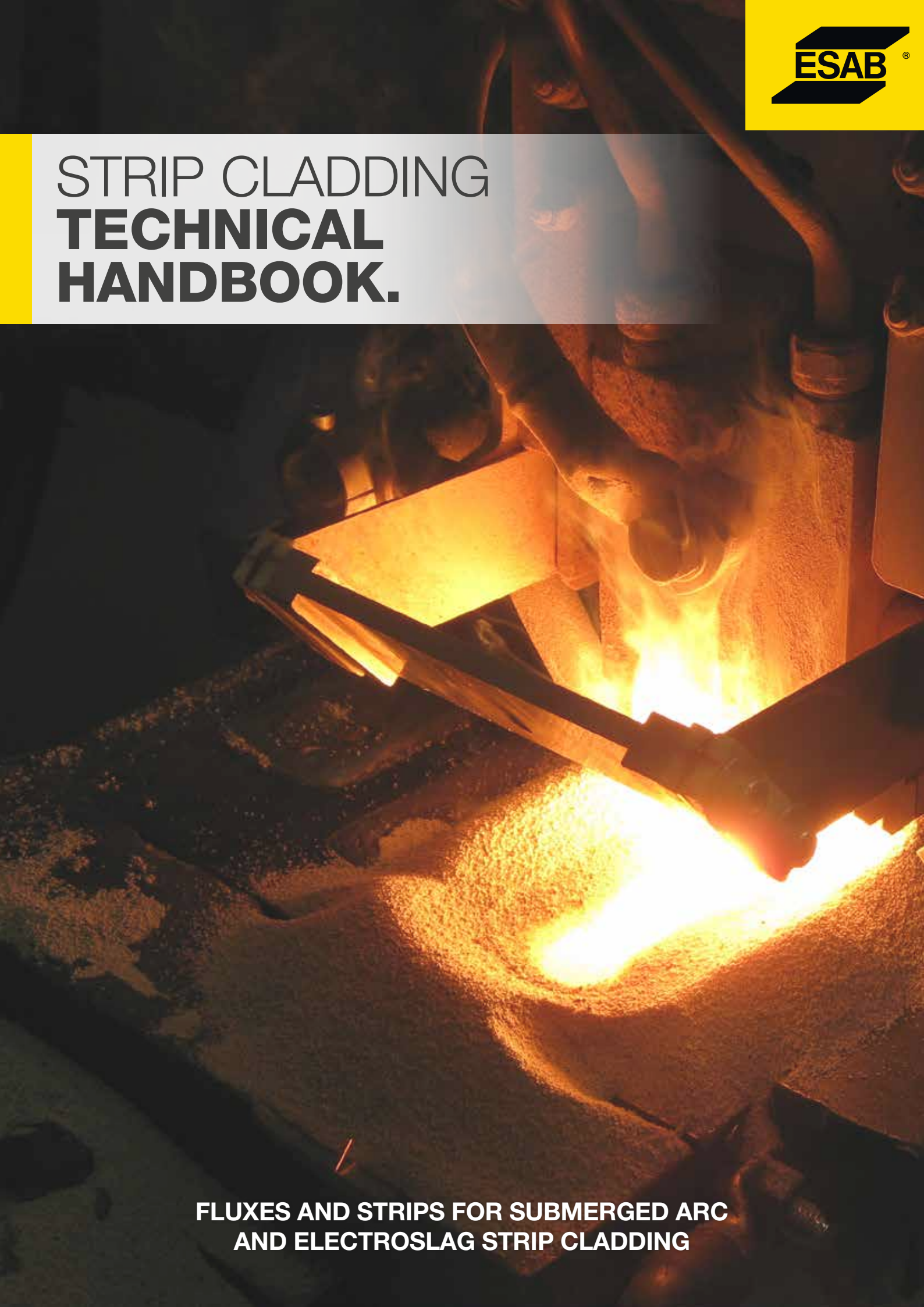
STRIP CLADDING **TECHNICAL HANDBOOK.**



FLUXES AND STRIPS FOR SUBMERGED ARC AND ELECTROSLAG STRIP CLADDING

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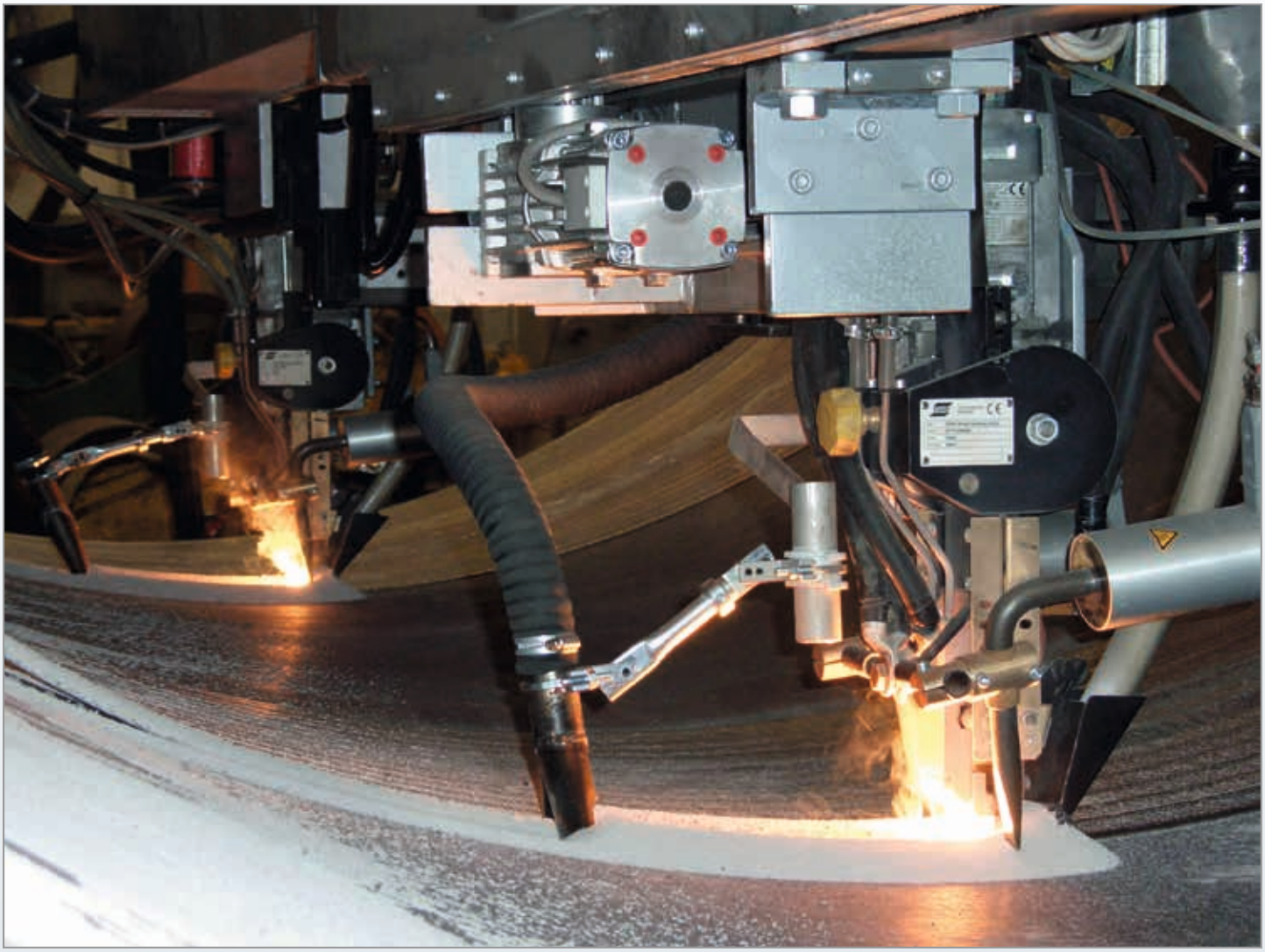


ESAB – ONE SOLUTION, ONE SUPPLIER.

This brochure presents an overview of ESAB's product range of strip cladding consumables. ESAB can offer a complete technical solution including power sources, equipment, strips and fluxes as well as process and metallurgical know-how for strip cladding.

We supply strip electrodes and suitable fluxes for almost all demanding applications, for example for the chemical, petrochemical, nuclear and pulp and paper industries and also repair and maintenance.

Two Cladding Processes.

ESAB can offer the two most productive systems for surfacing large components which are subjected to corrosion or wear. These are submerged arc and electroslag cladding, using a strip electrode.

Both processes are characterised by a high deposition rate and low dilution. They are suitable for surfacing flat and curved objects such as heat exchangers, tubes, tube sheets and various pressure vessels.

Submerged arc welding (SAW) is the more frequently used, but if higher productivity and restricted dilution rates are required, then electroslag welding (ESW) is recommended.

STRIP CLADDING PROCESSES.

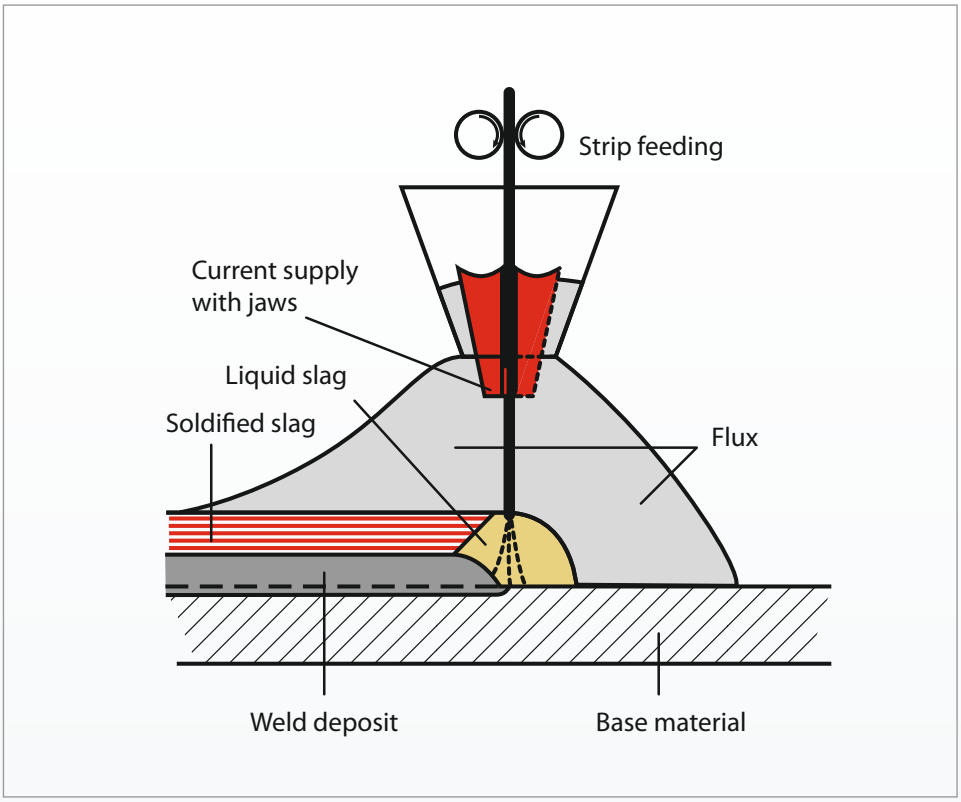


Figure 2: Submerged arc strip cladding

SAW Strip Cladding.

The well-known SAW method has been widely used with strip electrodes since the mid-1960s. A strip electrode, normally measuring 60 x 0.5 mm or 90 x 0.5 mm, is used as the (usually positive) electrode and an electric arc is formed between the strip and the workpiece. Flux is used to form a molten slag to protect the weld pool from the atmosphere and helps to form a smooth weld bead surface.

ESW Strip Cladding.

Electroslag strip cladding is a development of submerged arc strip cladding which has quickly established itself as a reliable high deposition rate process. ESW strip cladding relates to the resistance welding processes and is based on the ohmic resistance
heating of a molten electrically conductive slag. There is no arc between the strip electrode and the parent material. The heat generated by the molten slag melts the surface of the base material, and the edge of the strip electrode is submerged in the slag and flux.

The penetration achieved with ESW is less than that with for SAW because the molten slag pool is used to melt the strip and some of the parent material. The temperature of the slag pool is about 2300°C, making it necessary to water-cool the contact jaws.

ESW uses higher welding currents than SAW strip cladding so the welding heads used are more heavy duty. The following shows the features of ESW compared with the strip cladding process.

- Increased deposition rate of 60% to 80%.
- Only half of the dilution (10%–15%) from the base material due to less penetration.
- Lower arc voltage (24–26 V).

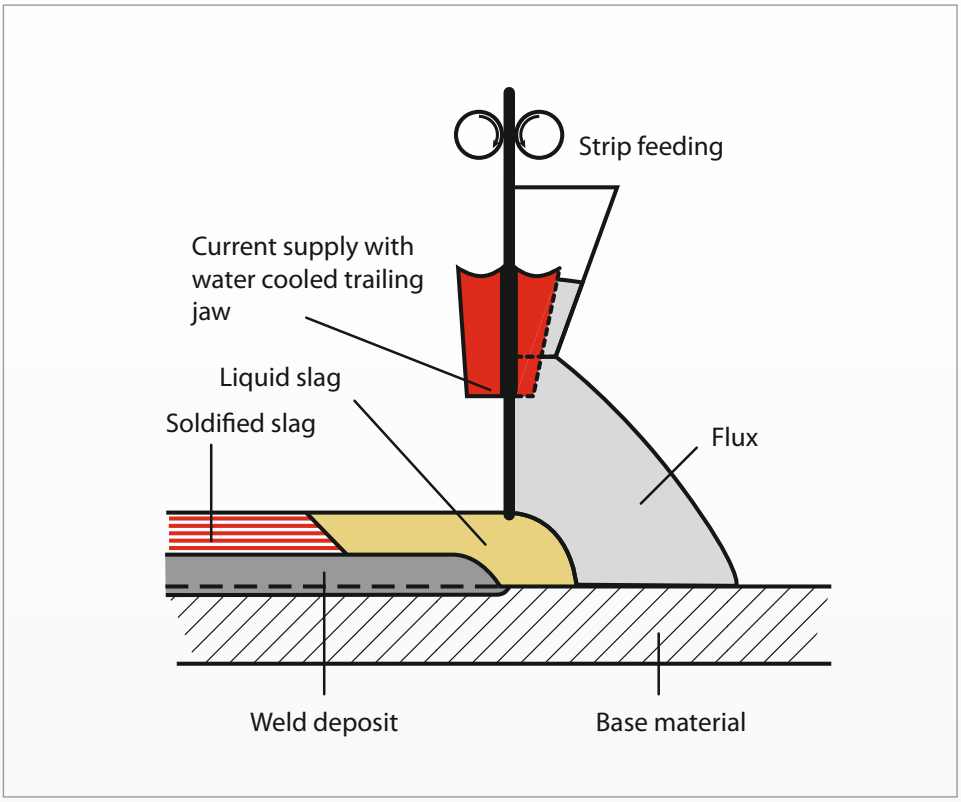


Figure 3: Electro slag strip cladding

- Higher amperage and current density (About 1000–1250 A with strips of 60 mm width, corresponding to 33–42 A/mm^2). Specially developed fluxes for high productivity purposes can be welded with amperage in excess of 2000 A which
  corresponds to a current density about 70 A/mm^2.
- Increased welding speed (50%–200%), resulting in a higher area coverage in m^2/h.
- Comparable heat input.
- Lower flux consumption (about 0.5 kg/kg strip).
- The solidification rate of the ESW weld metal is lower, aids de-gassing and increases resistance to porosity. Oxides can rise easier out of the molten pool to the surface; resulting in a metallurgically cleaner weld metal which is less sensitive to hot cracking and corrosion.

Fluxes for EWS.

The ESW-process requires a slag pool with an ohmic resistance behaviour. In
comparison to SAW cladding the electrical conductance must be higher to avoid arc flash, which is a disturbance of the process. The composition of the welding flux influences the conductivity, the solidification range and the viscosity of the molten slag.
To increase the cladding speed at corresponding high welding currents, it is necessary to use fluxes with high electrical conductivity and low viscosity.

DEPOSITION RATE OF ELECTROSLAG STRIP CLADDING.

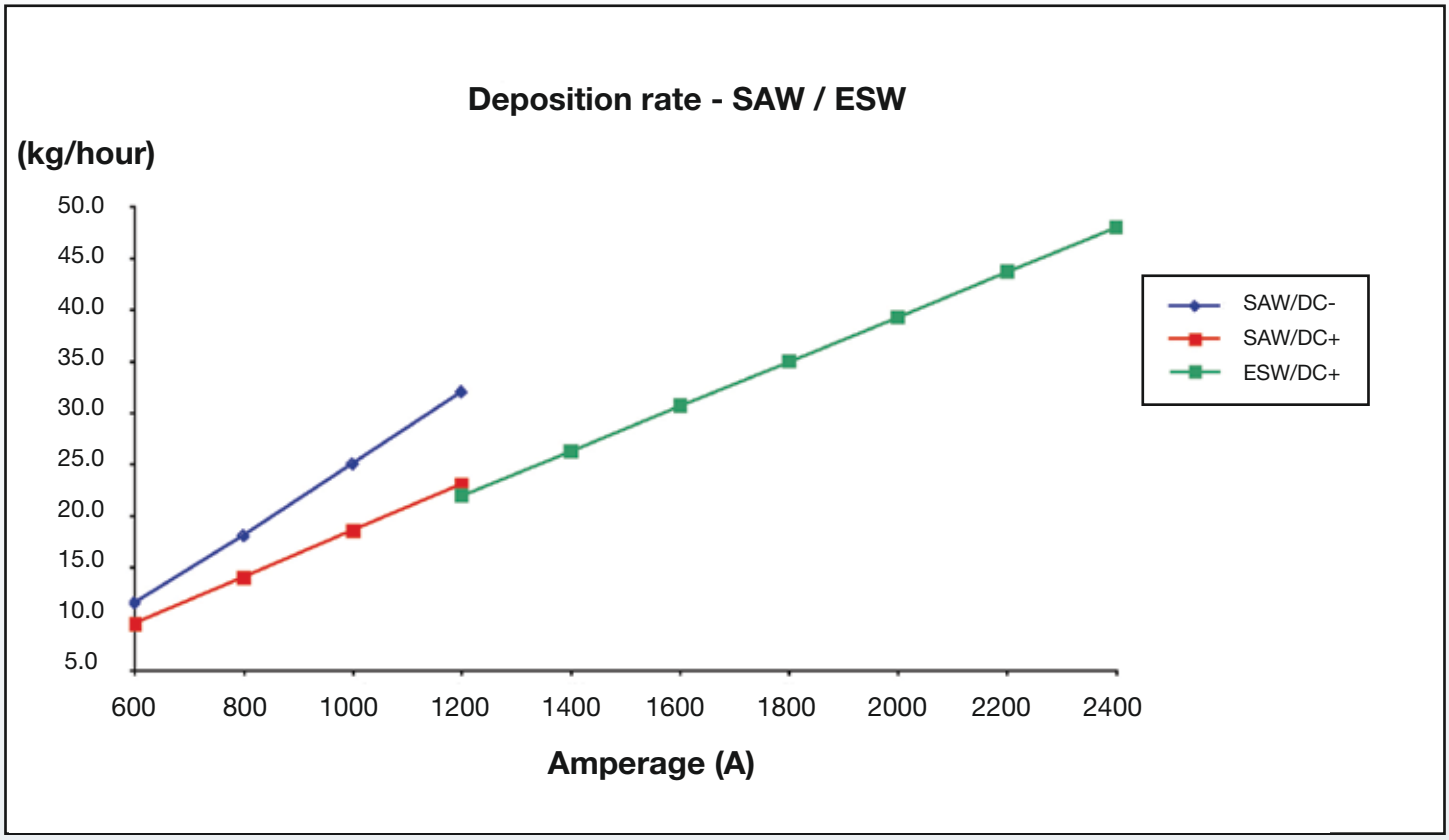
The electroslag strip cladding method was developed in the early seventies to increase productivity by increasing the deposition rate and decreasing the dilution compared with the SAW process.

Due to the properties of ESW often only one layer is needed to fulfill the cladding requirements and further the consumption of consumables is significantly reduced.

ESW can be advantageously used for the productive cladding of a second layer, when the two layer technology is demanded. The first layer, usually a buffer layer, can be deposited with either SAW or ESW.

The unique ESAB OK Flux 10.14 is a high basicity flux used with the electroslag process, designed for single-layer or multi-layer cladding in combination with austenitic strips at very high deposition rates using high power intensity (up to 45 cm/min with 60 x 0.5mm strip).

With the 60 x 0,5 mm strip, the most common size, welding currents up to 2300 A can be used. The difference in deposition rate between the methods is illustrated in the diagram below.



Deposition Rate Table			
Combination	**OK Flux 10.05/ OK Band 347 SAW**	**OK Flux 10.10/ OK Band 309LNb ESW**	**OK Flux 10.14/ OK Band 309LNb High speed ESW**
Strip [mm]	60 x 0.5	60 x 0.5	60 x 0.5
Welding process	SAW	ESW	ESW
Current [A]	750	1250	2100
Voltage [V]	26	24	25
Travel speed [cm/min]	10	18	40
Current density [A/mm2]	25	42	70
Arc	yes	no	no
Heat input [kJ/mm]	11.7	11.25	8.6
Bead height [mm]	4.5	4.5	4.5
Bead width [mm]	65	68	65
Dilution [%]	18	9	18
Number of layers	2 (Buffer OK Band 309L)	1	1
Deposition rate [kg/hour]	14	22	51
Flux consumption [kg/kg strip]	0.8	0.6	0.6

CLADDING EQUIPMENT FOR AUTOMATION.

ESAB supplies various options for strip cladding operations:

- CaB 300/460/600 as carrier.
- Welding control by PEK and PLC or only sequence control by PLC for step and spiral cladding.
- Strip cladding heads for SAW and ESW.
- Compact heads for small ID objects.
- Feed motors air cooled or water cooled.
- Holders for heads providing easy set-up and adjustment for circumferential or longitudinal cladding.
- Manual or automatic height and side control (joint tracking).

ESW STRIP CLADDING OF VALVES FOR PETROCHEMICAL PLANTS.

Wherever chemical or petrochemical plants exist, pipes and valves are needed to transport fluids or gas and control flows. Over the last decade, the use of noble materials for the entire valve has shifted to the cladding of a forged or cast CMn steel load-bearing bodies with a resistant alloy. The quality of the facing varies with the valve application. In the case of valves for transporting gas, the final layer is grade 316L stainless steel, as it is only subject to corrosion, whereas a final layer of Inconel 625 is a common choice when crude oil mixed with sand is involved, causing both chemical attack and abrasion.

Consumables.

The flux/wire combinations used for ESW strip cladding with 316L composition are:

- Single layer: OK Flux 10.10/OK Band OK Band 309LMo ESW.
- Double layers: OK Flux 10.10/OK Band 309LMo ESW for the first pass and OK Flux 10.10/OK Band 316L for the second pass.

The flux/wire combination used for ESW strip cladding with final Inconel 625 composition is:

- OK Flux 10.11/ OK Band NiCrMo3. This combination ensures optimum results in terms of analysis and surface appearance for both single and double layers.

ESW INCONEL STRIP CLADDING.

SAW and ESW strip cladding are two options for cladding vessels with a protective Inconel 625 layer. In the application described here, the client's specification stipulated a minimum of two layers and an Fe content of 5% maximum at the weld overlay surface and 7% maximum at 2 mm sub surface (the highest requirement within the petrochemical industry, covering both heat and corrosion). Since no overlay thickness was specified, there was the freedom to reach the final composition in the most economic way.

Both methods were trial tested for consumable selection and choice of parameters. The trial tests clearly indicated that it was not possible to meet the Fe requirements with SAW strip cladding in two layers. A third layer would have been needed, involving an extra, time-consuming fabrication step and more expensive weld metal. With ESW cladding, however, parameters could be found to fulfill the chemical requirements in two layers due to less dilution with the parent material. Welding parameters were fine-tuned and a welding procedure for the weld overlay of SA516 Gr. 70 (P1 Gr.2) was established and qualified according to ASME Sec. IX and client specification.

ESW cladding with OK Flux 10.11 / OK Band NiCrMo3			
Trial	**Layer**	**Thickness**	**% Fe surface**
1	1st	4.9mm	9.05%
2	1st	4.3mm	10.41%
3	1st	4.0mm	11.91%
	1st & 2nd	8.0mm	3.28%
4	1st	3.1mm	11.93%
	1st & 2nd	6.2mm	5.15%

Chemical analyses of the ESW weld overlay (%). Inconel 625 chemistry met at 3.5mm from the fusion line, so 2.5mm sub surface.

C	Ni	Cr	Mo	Fe
0.02	59	22	8.5	4.0

Right: ESW cladding of an Inconel 625 protective layer onto a SA 516 Gr. 70 vessel for the desalination industry. Welding parameters: 1050-1180A, 24-25V, 19.8-21.9cm/min. Strip dimensions OK Band NiCrMo3: 60 x 0.5mm.

COMBINATIONS FOR
SAW AND ESW STRIP CLADDING.

Alloy	Process	Layers	Flux	Strip	Strip	Welding parameters [1]		
		Nr.		Layer 1[2]	Layer 2	A	V	cm/min
Low alloy	SAW	1	OK Flux 10.31	OK Band 7018		750	28	12
	SAW	2	OK Flux 10.31	OK Band 7018	OK Band 7018	750	28	12
308 L	SAW	2	OK Flux 10.05	OK Band 309L	OK Band 308L	750	28	13
	ESW	1	OK Flux 10.10	OK Band 309L ESW	-	1250	24	16
	ESW	2	OK Flux 10.10	OK Band 309L ESW	OK Band 309L ESW	1250	24	16
	SAW/ESW[3]	2	OK Flux 10.05/10.10	OK Band 309L	OK Band 308L	1250	24	32
	SAW/ESW[3]	2	OK Flux 10.05/10.14	OK Band 309L	OK Band 308L	1250	24	32
316 L	SAW	2	OK Flux 10.05	OK Band 309L	OK Band 316L	750	28	13
	ESW	1	OK Flux 10.10	OK Band 309LMo ESW	-	1250	25	16
	ESW	2	OK Flux 10.10	OK Band 309LMo ESW	OK Band 309LMo ESW	1250	25	16
	SAW/ESW[5]	2	OK Flux 10.05/10.10	OK Band 309L	OK Band 316L	1250	24	32
	SAW/ESW[3]	2	OK Flux 10.05/10.14	OK Band 309L	OK Band 316L	2000	26	35
347	SAW	2	OK Flux 10.05	OK Band 309L	OK Band 347	750	28	13
	SAW	1	OK Flux 10.05	OK Band 309LNb	-	750	28	12
	ESW	1	OK Flux 10.10	OK Band 309LNb ESW	-	1250	25	16
	ESW	2	OK Flux 10.10	OK Band 309LNb ESW	OK Band 309LNb ESW	1250	24	16
	ESW	1	OK Flux 10.14	OK Band 309LNb	-	2300	24	40
	ESW	1	OK Flux 10.14	OK Band 309LNb[4]	-	2300	24	30
	SAW/ESW[5]	2	OK Flux 10.05/10.10	OK Band 309L	OK Band 347	1250	24	18
	SAW/ESW[5]	2	OK Flux 10.05/10.14	OK Band 309L	OK Band 347	2000	26	35
2209	SAW	2	OK Flux 10.05	OK Band 2209	OK Band 2209	750	28	12
904L	SAW	3	OK Flux 10.05	OK Band 385	OK Band 385	750	28	12
	ESW	1	OK Flux 10.11	OK Band 385		1250	24	18
	ESW	2	OK Flux 10.11	OK Band 385	OK Band 385	1250	24	18
310 MoL	ESW		OK Flux 10.10	OK Band 310MoL	OK Band 310MoL	1250	25	18
410 NiMo	SAW	3	OK Flux 10.07	OK Band 430	OK Band 430[6]	770	25	22
Alloy 82	SAW	2	OK Flux 10.16/10.17	OK Band NiCr3	OK Band NiCr3	750	28	12
	ESW	2	OK Flux 10.11	OK Band NiCr3	OK Band NiCr3	1200	24	25
Alloy 625	SAW	2	OK Flux 10.16/10.17	OK Band NiCrMo3	OK Band NiCrMo3	750	27	13
	SAW	3	OK Flux 10.16/10.17	OK Band NiCrMo3	OK Band NiCrMo3[6]	750	27	13
	ESW	2	OK Flux 10.11	OK Band NiCrMo3	OK Band NiCrMo3	1200	24	25
Monel	SAW	2	OK Flux 10.18	OK Band NiCu7	OK Band NiCu7	750	29	14
	SAW	3	OK Flux 10.18	OK Band NiCu7	OK Band NiCu7[6]	750	29	14

1) Strip dimension 60x0.5 if no other information is given.
2) Buffer layer if more than one layer is welded.
3) Results for second layer (Buffer layer cladded by SAW 750A, 28V, 20 cm/min)
4) Strip dimension 90x0.5 mm
5) Results for second layer (Buffer layer cladded by SAW 750A, 28V, 14 cm/min)
6) Second and third layer
7) For each layer

	Chemical composition (%)									FN			Deposition rate	
	C	Mn	Si	Cr	Ni	Mo	Nb+Ta	N	Other	WRC 92	Overlay thickness (mm)	Typical base material	(kg/h)	(m^2/h) [7]
	0.07	0.15	0.4	0.04	0.06	0.5	-	-	Cu=0.02		3.9	CMn	14	0.43
	0.07	0.09	0.34	0.04	0.06	0.6	-	-	Cu=0.02		7.0	CMn	14	0.43
	0.02	1.0	0.6	19.0	10.5	-	-	0.03	-	~6	8.5	2.25Cr1Mo	14	0.43
	0.03	1.2	0.4	19.0	10.0	-	-	0.05	-	~4	4.5	2.25Cr1Mo	23	0.6
	0.02	1.2	0.5	20.0	11.0	-	-	0.05	-	~7	8.6	CMn	23	0.6
	0.02	1.2	0.5	19.5	9.9	-	-	0.04		~6	6.5	CMn		
	0.02	1.3	0.5	19.2	9.9	-	-	0.05	-	~6	6.5	CMn		
	0.02	1.1	0.7	18.0	13.0	2.5	-	0.02	-	~7	8.5	CMn	14	0.43
	0.02	1.1	0.4	18.0	12.5	2.8	-	0.04	-	~6	4.5	2.25Cr1Mo	23	0.6
	0.02	1.3	0.5	19.0	13.0	3.0	-	0.04	-	~8	8.6	2.25Cr1Mo	23	0.6
	0.025	1.3	0.6	18.0	12.0	2.0	-	0.04	-	~3	7.5	CMn		
	0.025	1.3	0.5	18.0	11.9	2.0	-	0.04	-	~3	7.0	CMn		
	0.02	1.1	0.7	19.0	10.5	-	0.4	0.03	-	~8	8.2	2.25Cr1Mo	14	0.43
	0.03	1.1	0.6	19.0	10.0	-	0.4	0.04	-	~9	4.5	CMn	14	0.43
	0.03	1.3	0.5	19.0	10.0	-	0.4	0.05	-	~4	4.5	2.25Cr1Mo	23	0.6
	0.02	1.3	0.5	20.5	11.0	-	0.4	0.05	-	~9	8.6	2.25Cr1Mo	23	0.6
	0.06	1.6	0.5	19.0	10.0	-	0.6	0.02	-	~5	5.0	CMn	31	1.3
	0.04	1.7	0.4	20.0	11.0	-	0.6	0.02	-	~9	5.2	CMn	51	1.8
	0.015	1.3	0.4	19.0	11.0	-	0.5	0.04	-	~6	9.0	2.25Cr1Mo		
	0.01	1.3	0.4	19.0	10.5	-	0.4	0.05	-	~7	8.0	2.25Cr1Mo		
	0.02	1.1	0.8	22.0	8.0	3.0	-	0.15	-	~35	8.2	CMn	13	0.38
	0.02	1.1	0.6	19.0	24.0	4.6	-	0.06	Cu=1.3	-	12.0	CMn	14	0.43
	0.02	1.4	0.5	19.0	24.0	4.3	-	0.06	Cu=1.3	-	4.5	CMn	22	0.65
	0.02	1.4	0.5	20.0	25.0	4.5	-	0.06	Cu=1.4	-	8.6	CMn	22	0.65
	0.02	2.8	0.4	24.0	22.0	2.0	-	0.14	-	-	8.6	CMn	22	0.61
	0.05	0.15	0.6	13.0	4.0	1.0	-	-	HB=410	-	12.0	CMn	12	0.35
	0.02	3.0	0.5	20.0	Balance	-	2.5	-	Fe=3.0	-	9.0	CMn	17	0.47
	0.02	2.8	0.5	21.0	Balance	-	3.2	0.01	Fe=4.0		7.0	CMn	23	0.7
	0.01	1.1	0.2	21.0	Balance	8.0	2.8	-	Fe=4.0	-	9.0	CMn	17	0.47
	0.01	1.2	0.2	21.0	Balance	8.4	2.8	-	Fe=1.7		11.5	CMn	17	0.47
	0.02	0.10	0.3	21.0	Balance	8.0	3.2	-	Fe=4.0	-	7.0	CMn	23	0.7
	0.015	3.2	1.1	-	Balance	-	-	-	Cu=26.0Fe=6.5Ti=0.3		8.0	CMn	14	0.44
	0.013	3.5	1.1	-	Balance	-	-	-	Cu=28.0Fe=2.4Ti=0.31		11.5	CMn	14	0.44

FLUXES AND STRIPS
FOR SAW AND ESW STRIP CLADDING.

FLUX		
	EN ISO 14174	**Description**
SAW		
OK Flux 10.05	S A AAS 2B 56 34 DC	Standard flux for strip cladding with austenitic strips.
OK Flux 10.07	S A GS 3 Ni4 Mo1 DC	For cladding with 17Cr-strip producing 14Cr 4Ni 1Mo overlay.
OK Flux 10.16	S A FB 2 55 43 DC	For strip cladding and joining with Ni-base materials
OK Flux 10.17	S A FB 2B 57 24 DC	For strip cladding with with Ni-base materials.
OK Flux 10.18	S A CS 2B 58 13 DC	For strip cladding with Monel type of strips primarily with NiCu7-strip.
OK Flux 10.31	S A CS 3 Mo1 DC	For strip cladding with unalloyed CMn-steel strips.
OK Flux 10.92	S A CS 2 57 53 DC	For strip cladding and joining of stainless steels.
ESW		
OK Flux 10.10	ES A FB 2B 56 44 DC	Standard ES cladding flux for austenitic stainless strips. Suitable for ferritic strips also.
OK Flux 10.11	ES A FB 2B 56 44 DC	For ES high speed cladding with stainless and Ni-base strips.
OK Flux 10.14	ES A FB 2B 56 44 DC	For very high speed ES cladding with austenitic stainless strips.
OK Flux 10.26	ES A FB 2B 54 91 NiMo DC	For ES cladding with 316L strip giving 316L material in one layer.
OK Flux 10.27	ES A FB 2B 54 62 NiMo DC	For ES cladding with 309LMo ESW strip giving 317L material in one layer.

STRIPS													
OK Band	EN ISO		AWS/ SFA		C	Si	Mn	Cr	Ni	Mo	N	others	FN(WRC 92)
7018		Low alloy			0.1	0.1	0.5						
308L	14343-A	B 19 9 L	A5.9:	EQ308L	0.015	0.3	1.8	20.0	10.5		0.06		12
347	14343-A	B 19 9 Nb	A5.9:	EQ347	0.02	0.4	1.8	19.5	10.0		0.06	Nb=0.5	11
316L	14343-A	B 19 12 3 L	A5.9:	EQ316L	0.02	0.4	1.8	18.5	13.0	2.9	0.06		8
2209	14343-A	B 22 9 3 N L	A5.9:	EQ2209	0.015	0.4	1.5	23.0	9.0	3.2	0.15		50
309L	14343-A	B 23 12 L	A5.9:	EQ309L	0.015	0.4	1.8	23.5	13.5		0.06		13
309LNb	14343-A	B 23 12 L Nb	A5.9:		0.02	0.3	2.1	24.0	12.5		0.06	Nb=0.8	22
310MoL	14343-A	B 25 22 2 N L	A5.9:	(EQ310MoL)	0.02	0.2	4.5	25.0	22.0	2.1	0.13		0
309L ESW	14343-A	B 21 11 L	A5.9:		0.015	0.2	1.8	21.0	11.5		0.06		11
309LNb ESW	14343-A	B 22 12 L Nb	A5.9:		0.015	0.2	1.8	21.0	11.0		0.06	Nb=0.6	15
309LMo ESW	14343-A	B 21 13 3 L	A5.9:		0.015	0.2	1.8	20.5	13.5	2.9	0.06		13
430	14343-A	B 17	A5.9:		0.04	0.4	0.7	17.0			0.06		
NiCr3	18274	B Ni6082 (NiCr20Mn3Nb)	A5.14:	EQNiCr-3	< 0.1	0.2	3.0	20.0	≥67.0		0.05	Nb=2.5, Fe≤3.0	
NiCrMo3	18274	B Ni6625 (NiCr22Mo9Nb)	A5.14:	EQNiCr-Mo-3	< 0.1	0.1	0.3	22.0	≥58.0	9.0	0.05	Nb=4.0, Fe≤2.0	
NiCrMo7	18274	B Ni6455 (NiCr16Mo16Ti)	A5.14:	EQNiCr-Mo-7	≤ 0.01	≤0.08	≤1.0	16.0	≥56.0	16.0		Ti≤0.7,Fe≤3.0	
NiCu7	18274	B Ni4060 (NiCu30Mn3Ti)	A5.14:	EQNiCu-7	< 0.1	1.0	3.0		67.0			Cu=29,Ti=2.5, Fe≤2.0	

FLUXES FOR SAW STRIP CLADDING.

OK Flux 10.05

Basicity index
1.1

Density
~ 0.7 kg/dm³

Grain size
0.25-1.6mm

Slag type
Slightly Basic

Polarity
DC+

Alloy transfer
none

Classifications & approvals	Typical chemical composition all weld metal (%)								
	C	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**FN**	**Others**
EN ISO 14174 S A AAS 2B 56 34 DC									
With OK Band 309L									
EN ISO 14343-A: B 23 12 L AWS/SFA 5.9: EQ309L									
TÜV									
With OK Band 308L*	*2nd layer. First layer welded with OK Band 309L								
EN ISO 14343-A: B 19 9 L AWS/SFA 5.9: EQ308L	0.02	0.6	1.0	19.0	10.5	-	0.03	6	
With OK Band 347*	*2nd layer. First layer welded with OK Band 309L								
EN ISO 14343-A: B 19 9 Nb AWS/SFA 5.9: EQ347	0.02	0.7	1.1	19.0	10.5	-	0.03	8	Nb=0.35
With OK Band 316L*	*2nd layer. First layer welded with OK Band 309L								
EN ISO 14343-A: B 19 12 3 L AWS/SFA 5.9: EQ316L	0.02	0.7	1.1	18.0	13.0	2.5	0.02	7	

Aluminate basic, agglomerated flux designed for submerged strip cladding with Cr, CrNi, CrNiMo stabilised stainless strips of the AWS EQ300 type and duplex. OK Flux 10.05 is ESAB standard flux for internal overlay welding on mild or low alloyed steel. It has good welding characteristics and gives a smooth bead appearance and easy slag removal.

OK Flux 10.07

Basicity index
1.0

Density
~ 1.0 kg/dm³

Grain size
0.25-1.4mm

Slag type
Neutral

Polarity
DC+

Alloy transfer
Ni and Mo-alloying

Classifications & approvals	Typical chemical composition all weld metal (%)								
	C	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**FN**	**Others**
EN ISO 14174: S A GS 3 Ni4 Mo1 DC									
With OK Band 430*	*3rd layer cladded with OK Band 430 0.5x60 mm.								
EN ISO 14343-A: B 17	0.05	0.6	0.15	13.0	4.0	1.0			HB=410

Neutral Ni and Mo-alloying agglomerated flux designed for submerged strip cladding with an AWS EQ430 strip producing an overlay weld metal of 14Cr-4Ni-1Mo and a hardness of 370-420 HB . Especially suitable for cladding on continuous cast rolls. It produces a ferritic weld metal with an enhanced toughness and cracking resistance during service.

OK Flux 10.16

Basicity index
2.4

Density
~ 1.2 kg/dm³

Grain size
0.25-1.4mm

Slag type
Very High Basic

Polarity
DC+

Alloy transfer
Moderately manganese and silicon alloying

Classifications & approvals	Typical chemical composition all weld metal (%)								
	C	Si	Mn	Cr	Ni	Mo	N	FN	Others
EN ISO 14174: S A FB 2 55 43 DC TÜV									
With OK Band NiCrMo3*	*2nd layer on mild steel								
EN ISO 18274: B Ni6625 (NiCr22Mo9Nb) AWS/SFA 5.14: EQNiCrMo-3	0.01	0.2	1.1	21	Bal.	8	0.026		Nb+Ta=2.8 Fe=4.0
With OK Band NiCr3*	*2nd layer on mild steel								
EN ISO 18274: B Ni6082 (NiCr20Mn3Nb) AWS/SFA 5.14: EQNiCr-3	0.02	0.5	3.0	20	Bal.				Nb=2.5 Fe=3.0

OK Flux 10.16 is an agglomerated, non-alloying flux for submerged arc welding - specially designed for welding and cladding with Ni-base alloyed wires and strips. The well balanced flux composition minimises silicon transfer from the flux to the weld metal, reducing the risk of hot cracking. OK Flux 10.16 is suitable for submerged arc strip cladding with all grades of Ni-based strips. For chemical and petrochemical plants, offshore construction, marine equipment, pressure vessels, storage tanks, etc.

OK Flux 10.17

Basicity index
2.5

Density
~ 1.1 kg/dm³

Grain size
0.2-1.4mm

Slag type
Basic

Polarity
DC+

Alloy transfer
Moderately silicon alloying

Classifications & approvals	Typical weld metal chemical composition (%), DC+*								
	C	Si	Mn	Cr	Ni	Mo	N	FN	Others
EN ISO 14174: S A FB 2B 57 24 DC									
With OK Band NiCrMo3*	*2nd layer on mild steel								
EN 18274 : B Ni6625 (NiCr22Mo9Nb) AWS/SFA 5.14: EQNiCrMo-3	0.03	0.6	0.06	20.0	Bal.	8.0	0.04		Nb+Ta = 2.3 Fe = 3.5

OK Flux 10.17 is a high basic, agglomerated flux designed for submerged arc strip cladding with all grades of Ni-based strips. OK Flux 10.17 is new ESAB flux for internal overlay welding on mild or low alloyed steel. It has very good welding characteristics gives a smooth bead appearance and easy slag removal. For chemical and petrochemical plants, offshore constructions, marine equipments, pressure vessels, storage tanks, etc

OK Flux 10.18

Basicity index
1.0

Density
~ 1.2 kg/dm³

Grain size
0.25-1.6 mm

Slag type
Neutral

Polarity
DC+

Alloy transfer
Moderately silicon alloying

Classifications & approvals	Typical chemical composition all weld metal (%)								
	C	Si	Mn	Cu	Ni	Ti	Fe	FN	Others
EN ISO 14174: S A CS 2B 58 13 DC									
With OK NiCu7	*3rd layer on mild steel								
EN ISO 18274: B Ni4060 (NiCu30Mn3Ti) AWS/SFA 5.14: EQNiCu-7	0.013	1.1	3.5	28.0	Bal.	0.31	2.4		

OK Flux 10.18 is a neutral moderately silicon alloying agglomerated flux designed for strip cladding with Monel type of strips. The flux is primarily suitable for strip cladding with OK Band NiCu7 or with CuNi30 strip uses OK Band NiCu7 as buffer layer. This flux either 60mm or 90mm x 0.5mm strips gives good welding characteristics, a smooth bead appearance and easy slag removal. For desalinaiton plants, chemical processing industry, petrochemical industry, pressure vessels and other applications.

OK Flux 10.31

Basicity index
1.0

Density
~ 1.0 kg/dm³

Grain size
0.25-1.6 mm

Slag type
Neutral

Polarity
DC+

Alloy transfer
Mo-alloying

Classifications & approvals: EN ISO 14174: S A CS 3 Mo1 DC

Typical chemical composition all weld metal (%)

	C	Si	Mn	Cr	Ni	Mo	N	FN	Others
With OK Band 7018*									
	0.07	0.4	0.15	0.05	0.06	0.5			H=2.7 ml/100 g HB=150

*1st layer on non alloy plate. The weld metal analysis performed under various welding conditions and up to 3 layers does not significantly change the deposit analysis.

OK Flux 10.31 is a neutral, agglomerated, slighltly molybdenium alloyed flux for strip cladding with unalloyed CMn-steel strips. Weld metal in one layer on non-alloyed plate shows that the flux adds nominally about 0,4% Mo. Maximum hydrogen content is 3.0 ml/100 g of weld metal. The flux gives very good weldability and excellent slag detachability with no slag residuals. For repair and maitenance of shafts, pistons, repairing of production mistakes, buffer layers, storage tanks and others.

OK Flux 10.92

Basicity index
1.0

Density
~ 1.0 kg/dm³

Grain size
0.25-1.6mm

Slag type
Neutral

Polarity
DC+

Alloy transfer
Cr compensating

Classifications & approvals: EN ISO 14174: S A CS 2 57 53 DC

TÜV

Typical chemical composition all weld metal (%)

	C	Si	Mn	Cr	Ni	Mo	N	FN	Others
With OK Band 308L*									
EN ISO 14343-A: B 19 9 L AWS/SFA 5.9: EQ308L	0.02	1.0	0.7	20.6	9.8			12	
With OK Band 347*									
EN ISO 14343-A: B 19 9 Nb AWS/SFA 5.9: EQ347	0.02	1.3	0.7	20.6	9.5			15	Nb=0.5
With OK Band 316L*									
EN ISO 14343-A: B 19 12 3 L AWS/SFA 5.9: EQ316L	0.02	0.9	0.7	18.5	12.3	2.8		8	

*Third layer on 2.5Cr1Mo steel

OK Flux 10.92 is a neutral, agglomerated, Cr-compensating flux designed for strip cladding, butt and fillet welding of stainless and corrosion resistant steel types with AWS ER300 types of wire. Works well on DC current for single layer and multi layer welding of unlimited plate thickness. Good welding characteristics and easy slag removal. When used for strip cladding with austenitic stainless welding strips, OK Flux 10.92 gives a smooth bead appearance. For chemical and petrochemical plants, offshore construction, pressure vessels, storage tanks, chemical tankers, power generation, nuclear, pulp and paper, civil construction, transport industries etc.

FLUXES FOR ESW STRIP CLADDING.

OK Flux 10.10

Basicity index
4.0

Density
~ 1.0 kg/dm³

Grain size
0.15-1.0mm

Slag type
Very High Basic

Polarity
DC+

Alloy transfer
Moderately silicon alloying

Classifications & approvals	Typical chemical composition all weld metal (%)								
	C	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**FN**	**Others**
EN ISO 14174: ES A FB 2B 56 44 DC									
TÜV									
With OK Band 309L ESW* (* 1st layer, welded on 2.25Cr1Mo steel)									
EN ISO 14343-A: B 21 11 L	0.03	0.4	1.2	19.0	10.0		0.05	4	
With OK Band 309LNb ESW* (* 1st layer, welded on 2.25Cr1Mo steel)									
EN ISO 14343-A: B 22 12 L Nb	0.03	0.5	1.3	19.0	10.0		0.05	4	Nb=0.4
With OK Band 309LMo ESW* (* 1st layer, welded on 2.25Cr1Mo steel)									
EN ISO 14343-A: B 21 13 3 L	0.02	0.4	1.1	18.0	12.5	2.8	0.04	6	

High basic, agglomerated flux designed for electroslag strip cladding with the austenitic stainless strips especially produced for electroslag process e.g. OK Band 309L ESW. It is flux for high productive strip cladding. Can be used for single or multi layer cladding. However, require special welding head and a power source of at least 1200 A.

OK Flux 10.11

Basicity index
5.4

Density
~ 1.0 kg/dm³

Grain size
0.2-1.0mm

Slag type
Very High Basic

Polarity
DC+

Alloy transfer
Moderately silicon alloying

Classifications & approvals	Typical chemical composition all weld metal (%)								
	C	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**FN**	**Others**
EN ISO 14174: ES A FB 2B 56 44 DC									
OK Band NiCrMo3* (*1st layer on mild steel)									
EN ISO 18274: B Ni6625 (NiCr22Mo9Nb) AWS/SFA 5.14: EQNiCrMo-3	0.03	0.5	0.20	19.5	Bal.	8.0			Nb+Ta=3.2, Fe=9.0
OK Band NiCrMo3** (**2nd layer on mild steel)									
EN ISO 18274: B Ni6625 (NiCr22Mo9Nb) AWS/SFA 5.14: EQNiCrMo-3	0.02	0.3	0.10	21.0	Bal.	8.1			Nb+Ta=3.2, Fe=4

High basic, agglomerated flux designed for electroslag strip cladding with the stainless, fully austenitic and Ni-based strips.
Can be used for single or multi layer cladding with higher welding speed.

OK Flux 10.14

Basicity index
4.4

Density
~ 1.0 kg/dm³

Grain size
0.2-1.0mm

Slag type
Very High Basic

Polarity
DC+

Alloy transfer
Moderately silicon alloying

Classifications & approvals	Typical chemical composition all weld metal (%)								
	C	**Si**	**Mn**	**Cr**	**Ni**	**Mo**	**N**	**FN**	**Others**
EN ISO 14174: ES A FB 2B 56 44 DC									
With OK Band 309LNb * (* 1st layer, welded on mild steel.)									
EN ISO 14343-A: B 23 12 L Nb	0.06	0.5	1.6	19.0	10.0		0.02	5	Nb=0.6

High basic, agglomerated flux designed for electroslag strip cladding with the austenitic stainless strips especially strip OK Band 309LNb.
It is flux for very high productive strip cladding, up to about 35 cm/min. Can be used for single or multi layer cladding. However, require water cooled welding head and a power source of at least 2400 A.

OK Flux 10.26

Basicity index
3.0

Density
~ 1.2 kg/dm³

Grain size
0.2-1.0 mm

Slag type
Fluoride basic

Polarity
DC+

Alloy transfer
Cr, Ni and Mo-alloying

Classifications & approvals

EN ISO 14174: ES A FB 2B 54 91 NiMo DC

With OK Band 316L *

EN ISO 14343-A: B 19 12 3 L
AWS SFA: 5.9 EQ 316L

Typical chemical composition all weld metal (%), DC+*

*1st layer, weld on mild steel

C	Si	Mn	Cr	Ni	Mo	N	FN	Others
0.03	0.2	1.2	19.0	12.8	2.7	0.06	8	Cu=0.05

OK Flux 10.26 is high basic, agglomerated Ni-, Cr- and Mo-adding flux designed for electroslag strip cladding with ESAB OK Band 316L strips gives 316L overlay in first layer. The flux has very good welding characteristics gives a smooth bead appearance and easy slag removal. For chemical industry, marine applications, paper industry digesters, evaporators & handling equipments, petroleum refining equipment, duct works, water tubes and heat exchangers.

OK Flux 10.27

Basicity index
3.1

Density
~ 1.2 kg/dm³

Grain size
0.2-1.0mm

Slag type
Fluoride Basic

Polarity
DC+

Alloy transfer
Cr, Ni and Mo-alloying

Classifications & approvals

EN ISO 14174: ES A FB 2B 54 62 NiMo DC

With OK Band 309LMo ESW *

EN ISO 14343-A: B 21 13 3 L

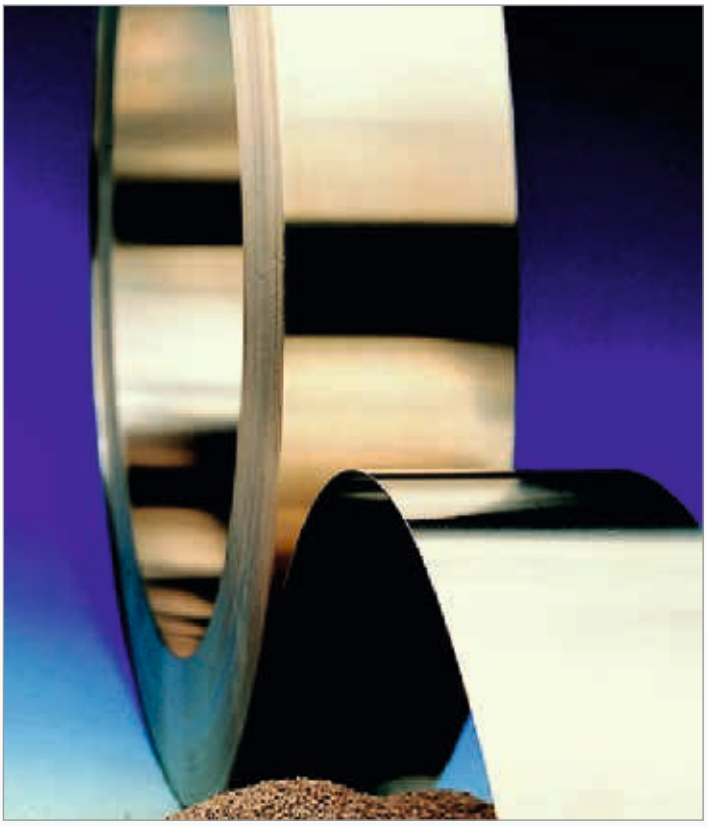
Typical weld metal chemical composition (%), DC+*

* 1st layer, welded on mild steel.

C	Si	Mn	Cr	Ni	Mo	N	FN	Others
0.03	0.2	1.0	18.8	13.2	3.4	0.04	8	Cu=0.08

OK Flux 10.27 is an high basic, agglomerated Ni-, Cr- and Mo-adding flux designed for electroslag strip cladding with ESAB 309LMo ESW strips gives 317L overlay in first layer. It has a smooth bead appearance, very good welding properties and easy slag removal. Suitable for special applications like flue gas desulfurization scrubber systems chemical and petro-chemical processing equipments and pulp and paper plants, etc.

FLUX AND STRIP PACKAGES.



ESAB strip electrodes are delivered in a cold rolled condition on 25 kg or 50 kg and 100 – 200 kg coils with an inner diameter of 300 mm. The standard thickness is 0.5 mm and widths normally 30, 60 or 90 mm. Other coil weight or strip dimensions are available on request.

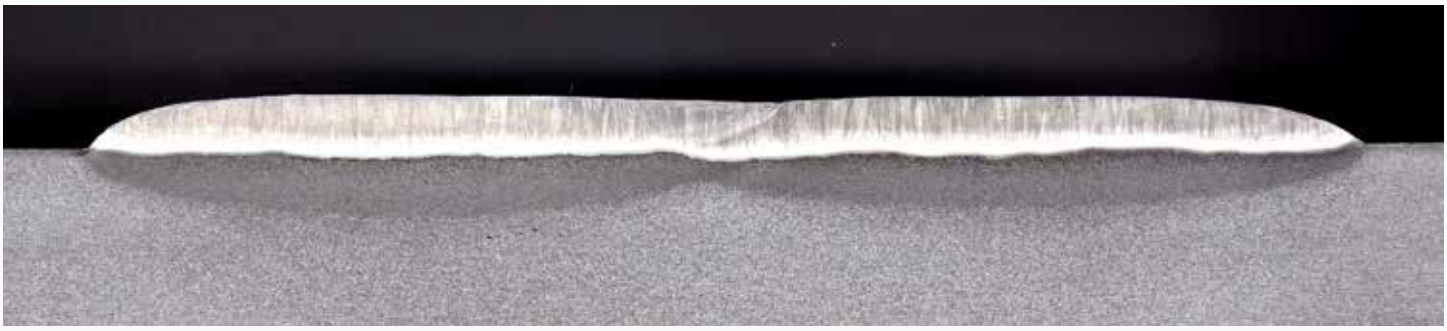
ESAB delivers fluxes in 25 kg bags, but some types are available in 20 kg bags. Each bag has a polyethylene inlay to prevent the flux from moisture pick-up from the surrounding atmosphere. The palettes used to transport the flux bags are also protected against moisture by wrapping with shrink foil.

For a more robust package ESAB can supply fluxes in steel buckets containing 20 or 25 kg. These have a soft rubber band in the lid which makes them moisture tight.

The coils and bags are labelled with all information according to EN and AWS norms.

STRIP CLADDING HEADS.

ESAB is a traditional supplier of strip cladding heads for submerged arc and electroslag strip cladding with strip widths between 30 and 100 mm. We have customized heads for internal cladding in diameters from Ø300 mm and up. Please contact ESAB for more information about our range of cladding equipment.



A6 SAW STRIP CLADDING KIT.

- Used in combination with standard A6S Arc Master welding head.
- Provides an economical solution for surfacing with high alloyed materials such as stainless steel or nickel-based alloys.
- Choose a wider variety of parent materials and consumables.
- Stainless steel cladding is widely used in production of components where additional strength or corrosion resistance is required.
- Welding head can be fitted with electrode strips as wide as 30-100 mm (1.2-4.0 inch) and as thick as 0.5 mm (0.02 inch).

UNRIVALED SERVICE AND SUPPORT.

All ESAB products are backed by our commitment to superior customer service and support. Our skilled customer service department is prepared to quickly answer any questions, address problems, and help with the maintenance and upgrading of your machines. And our products are backed with the most comprehensive warranty in the business.

With ESAB, you can be sure you purchased a product that will meet your needs today and in the future. Product and process training is also available. Ask your ESAB sales representative or distributor for a complete ESAB solution.

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