ESAB Filler materials

ESAB
Welding Handbook

Fifth edition

Filler materials for manual and automatic welding

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Member of The Esab Group

Submerged Arc Fluxes and Wires

MIG/MAG/TIG Wires and Rods

Flux and Metal Cored Wires

Spool Types

Handwelding Electrodes

Gas Welding Rods

Storage and Handling

Quick Guide for selection of Filler Materials

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Contents

AUTOMATIC, SEMI-AUTOMATIC AND TIG WELDING

MANUAL ARC WELDING

Standard and Classification Codes for Automatic, Semiautomatic and TIG welding

In this catalogue the approvals applicable to different electrodes and electrode/flux combinations are given for the different Classification Societies.
The classification references usually consist of a number, which refers to the grade and one or more letters, which state the welding process or welding technique for which the approval applies.

T = approved for two-run techniques, i.e. a butt weld consisting of one run from each side.
M = approved for multi-run welding of butt welds in which the weld is deposited in more than two runs.
TM = approved for both two-run and multirun welding.
SA = semi-automatic welding, (American Bureau of Shipping, Bureau Veritas).
S = semi-automatic welding (Germanischer Lloyd).
MS = before a figure means ordinary mild steel (Lloyd's Register of Shipping).
H = before a figure means high strength.
HT = high tensile (ship) steel.
A = automatic welding (Bureau Veritas only).

The figures included in the classifications can have different meanings in different connections. H, after a figure = hydrogen controlled.
In the next column, a summary is given showing which steel grades can be welded with the different grades of filler materials according to the Classification Societies:

American Bureau of Shipping	ABS
American Welding Society	AWS
Det norske Veritas	DnV
Bureau Veritas	BV
Lloyd's Register of Shipping	LR
Germanischer Lloyd	GL

Approved grades of filler material for welding different grades of steel
In principle, the following applies to both manual metal arc welding electrodes and filler materials for automatic welding when welding ordinary strength ship steel 400–490 N/mm² (41–50 kp/mm²).

Grade 1 – for welding steel of Grade A to A, D and E steels.
Grade 2 – for welding steels of Grades A and D to A, D and E steels.
Grade 3 – for welding all combinations of steel in the above strength grades.
For welding high tensile (HT) ship steels corresponding rules are applied by the Classification Societies.

Note 1
Steels having a nominal yield stress of minimum 270 N/mm² are regarded as high tensile steels according to the rules of the Classification Societies.

Note 2
When manual metal arc welding joints, which include high tensile steel, the risk of hydrogen embrittlement should always be taken into account. As a safety precaution, electrodes having a guaranteed low hydrogen content should be used, i.e. basic electrodes class 3H, 3YH, 3YHH or III H.

Table 1 **Classification of filler materials for automatic and semi-automatic welding**

ESAB OK		AWS	BS no.	Designation	DIN	Designation
Flux	10.16				32522:	BFB 6 6723 DC 8B 1–16 FMS 1 88 AC 8 M
Flux	10.40	F6A0-EL12 F7A0-EM12				
Flux	10.61	F6A2-EM12 F7A8-EM12K F7A6-EH14 F8A8-EA4-A4 F9A8-EA3-A3				BFB 1 65 DC 7 M 2–16
Flux	10.62	F6A4-EM12 F7A8-EM12K F7A6-EH14 F8A4-EA4-A4 F9A8-EA3-A3				BFB 1 55 AC 8 M HP 5 2–16
Flux	10.70	F7A4-EL12 F7A4-EM12				BAB 1 79 AC 8 SM 2–16
Flux	10.71	F6A4-EL12 F7A4-EM12 F7A5-EM12K F8A2-EH14 F8A4-EA4-A4 F9A4-EA3-A3				BAB 1 67 AC 8 M HP 5 2–16
Flux	10.80	F7A2, EL12, F7A2-EM12				BCS 1 89 AC 8 M 2–16
Flux	10.81	F7AZ-EL12, F7A0-EM12 F7A0-EM12K				BAR 1 97 AC 8 SMK
Flux	10.92					BCS 5 71645 DC 8 MB 2–16
Autrod	12.10	EL12			8557:	S 1
	12.20	EM12				S 2
	12.22	EM12K				S 2 Si
	12.24	E A2				S 2 Mo
	12.32	EH12K				S 3
	12.34	EA4				S 3 Mo
	12.40	EH14				S 4
	12.51	ER70 S-6	2901:	A15	8559:	SG 2
Autrod	12.64	ER70 S-6				SG 3
and	13.09	ER80 S-G		(2901 A 31)	8575:	SG Mo
Tigrod	13.12	ER80 S-G		(2901 A 32)		SG Cr Mo 1
	13.13	ER100 S-G				
Autrod	13.27	EN2				
Tigrod	13.91				8555:	MSG-6-G2-C-60G
Tubrod	14.00	E71 T-G				
	14.01	E70 T-G			8559:	SG B 1 Fülldraht
	14.02	E81 TG-A1				SG R 1 Fülldraht
	14.03	E111 TG-K3				SG R 1 Fülldraht
	14.04	E87 TG-Ni2				SG R 1 Fülldraht
	14.05	E71 TG-Ni1				
	14.17	E71 T-7				
	14.18	E70 T-4				
	14.30	E308 LT-1				
	14.31	E316 LT-1				
	14.32	E309 LT-1				
	15.00	E70 T-5 E71 T-5				
	15.12	E70 T-1				
	15.15	E71 T-1				
	15.17	E81 T1-Ni1				
	15.18	E70 T-1 E71 T-1				
	15.19	E81 T1-Ni1				
	15.20	E81 T5-B2				
	15.22	E91 T5-B3				
	15.25	E71 T5-Ni2				
Tubrod	15.30	E308 LT-2				
	15.31	E316 LT-2				
	15.32	E309 T-2				
	15.33	E308 MoT-2				
	15.34	E307 T-2				
	15.35	E309 LT-2				
Tubrodur	14.70					
	14.71				8559	SG 10– 55 Fülldraht
	15.40				8555	SG 8–200 Fülldraht
	15.42					SG 1–350 Fülldraht
	15.52					SG 1–400 Fülldraht
	15.60					SG 6–500 Fülldraht
	15.70	ER 410				UP 6–500, UP 6–55
	15.73	ER 420				SG 7– Fülldraht
						UP 5– Fülldraht
						SG 6– 50 Fülldraht
						UP 6– 50 Fülldraht
Autrod	16.10	ER 308 L	2901:	308 S 92	1.4316	X2 Cr Ni 19 9
and	16.11	ER 347 Si		(347 S 96)	1.4551	X5 Cr Ni Nb 19 9
Tigrod	16.12	ER 308 L Si		308 S 93	1.4316	X2 Cr Ni 19 9
	16.30	ER 316 L		316 S 92	1.4430	X2 Cr Ni Mo 19 12
	16.31	"ER 318 Si"		(318 S 96)	1.4576	X5 Cr Ni Mo Nb 19 12
	16.32	ER 316 L Si		316 S 93	1.4430	X2 Cr Ni Mo 19 12
	16.52	ER 309 Si		(309 S 94)	1.4829	X8 Cr Ni 24 12
	16.53	ER 309 L		309 S 92	1.4332	X2 Cr Ni 24 12
	16.86				(1.4462)	
	16.95	(ER 307)			1.4370	X15 Cr Ni Mn 18 8
Autrod	18.01	(ER 1100)		1050A	17.32:	S-Al 99.5
and	18.04	ER 4043		4043A		S-Al Si 5
Tigrod	18.11					S-Al 99.5 Ti
	18.15	ER 5356		5056A		S-Al Mg 5
	18.16	ER 5183		5183		S-Al Mg 4.5 Mn
	19.12	ER Cu		(C7)	1733:	S-Cu Sn
	19.40	ER Cu Al-A1		(C13)		S-Cu Al 8
	19.82	ER Ni Cr Mo-3			1736:	SG Ni Cr 21 Mo 9 Nb
	19.85	ER Ni Cr-3				SG Ni Cr 20 Nb

Table 2 Submerged arc welding of ship hull structural steel OK Flux/OK Autrod. Approved combinations for the different steel grades by the Classification Societeies

Filler material combination OK Flux/Autrod	American Bureau of Shipping	Bureau Veritas	Det norske Veritas	Germanischer Lloyd	Lloyd's Register of Shipping
10.40/12.10	A, B, D, DS	A, D	A, A-27, D, D-27, A-32, A-36	A, D, (B)	A, D
10.40/12.20 10.61/12.24 10.62/12.22 10.62/12.24 10.62/12.32[1] 10.70/12.10 10.70/12.20 10.71/12.10 10.71/12.20 10.71/12.22 10.71/12.24 10.71/12.34	A, B, D, DS, AH DN, CS, DH E, EH	A, A-32, A-36 D, D-32, D-36 E, E-32, E-36	A, A-27, A-32, A-36, A-40 D, D-27, D-32, D-36, D-40 E, E-27, E-32, E-36, E-40	A, A-32. A-36 D, D-32, D-36 E, E-32, E-36	A, AH D, DH E, EH
10.70/12.10+ OK Grain 21.80+ OK Backing 21.22	A, AH B, D, DS, DH	A, A-32, A-36 D, D-32, D-36	A, A-27, A-32, A-36 D, D-27	A, A-32. A-36 D, D-32, D-36	A, AH D, DH
10.80/12.10+	A, AH B, D, DS, DH	A, A-32, A-36 D, D-32, D-36	A, A-27, A-32, A-36, A-40 D, D-27, D-32, D-36, D-40	A, A-32. A-36 D, D-32, D-36	A, AH D, DH
10.80/12.20	A B, D, DS	A for two run B for multi run	The same as for 10.40/12.20	A for two run B for multirun	A,AH D, DH
10.81/12.10+	A, AH B, D, DS, DH	A, A-32, A-36 D, D-32, D-36	A, A-27, A-32, A-36, A-40 D, D-27, D-32, D-36, D-40	A, A-32. A-36 D, D-32, D-36	A, AH D, DH
10.81/12.20+	A, AH B, D, DS, DH	A, A-32, A-36 D, D-32, D-36	A, A-27, A-32, A-36, A-40 D, D-27, D-32, D-36, D-40 E, E-27, E-32, E-36, E-40	A, A-32. A-36 D, D-32, D-36	A, AH D, DH

[1] 10.62/12.32 also for Det norske Veritas NV4-4

Table 3 Approvals filler materials for submerged arc welding

Filler material combination OK Flux/OK Autrod	ABS	BV	Dnv	GL	LRS	RS
10.40/12.10	2 TM	A2 TM	II TM	2 TM	2 TM	2 TM
10.40/12.20	2 T, 3 M, 3 YM	A2T, A3 YM	II T, III YM	2T, 3 YM	2 T, 3 M, 3 YM	3 TM
10.61/12.24	3 TM, 3 YTM	A3, 3 YTM	III YTM	3 YTM	3 TM, 3 YTM	3 YTM
10.62/12.22	3 M, 3 YM	A3, 3 YM	III YM	3 YM	3 M, 3 YM	3 YM
10.62/12.24	3 M, 3 YM	A3, 3 YM	III TM, III YM	3 YM	3 YM	–
10.62/12.32	3 M, 3 YM	A3, 3 YM	III YM, NV 4-4	3 YM	3 M. 3 YM	3 YM
10.62/12.34	3 M, 3 YM	A3, 3 YM	III YM	3 YM	3 M, 3 YM	3 YM
10.62/13.27			III YM, NV 4-4			
10.62/13.43						
10.70/12.10	3 TM. 3 YTM	A3, 3 YTM	III YTM	3 YTM	QT steel	QT steel
10.70/12.20	2 T, 3 M, 3 YM	A3 M 2T, 3 YM	III M, IIT, III YM	2T, 3 YM	3 TM, 3 YTM	3 YTM
10.71/12.10	3 M	A3 M	III M	3 M	2T, 3 M, 3 YM	3 YTM
10.71/12.20	3 M, 3 YM	A3, 3 YM	III M, III YM	3 YM	3 M	3 M
10.71/12.22	3 M, 3 YM	A3, 3 YM	III YM	3 YM	3 M, 3 YM	–
10.71/12.24	3 TM, 3 YTM	A3, 3 YTM	III YTM	3 YTM	3 M, 3 YM	–
10.71/12.34	3 TM, 3 YM	UP (M-40°C)	III YTM (M-40°C)	–	3 TM, 3 YTM	3 YTM
					3 TM, 3 YM	K6 TM (M-40°C)
10.80/12.10	2 TM, 2 YTM	A2, 2 YTM	II YTM	2 YTM	C-Mn LT 40	
10.80/12.20	1 T 2 M	A1T, A2 M	I YT, II YM	1 T, 2M	2 TM, 2 YTM	K 5 TM
10.81/12.10	1 T 2 M, 1 YT, 2 YM	A 1 YT, A2 YM	I YT, II YM	1 YT, 2 YM	1 T2M, 1 YT, 2YM	–
10.81/12.20	2 TM, 2 YTM	A2, 2 YTM	II YTM	2 YTM	1 T 2M, IYT, 2 YM	K4 T5M
10.91/16.30	–	UP	LTM 316 for NV 25	Stainless steel	2 TM, 2 YTM	–
10.92/16.30	–	–	LTM 316 for NV 25	–	–	–
10.92/16.34	–	UP	TM for NV 25	–	–	–
					–	–

Table 4 Approvals filler materials for gas shielded metal arc welding

Electrode shielding gas combination	American Bureau of Shipping	Bureau Veritas	Det norske Veritas	Lloyd's Register	Others Controlas
OK Autrod 12.51 – 80 Ar/20CO_2	3SA, 3YSA	SA3YM	IIIYMS	3S, 3YS	TÜV
– 95 Ar/ 5CO_2				3S, 3YS	TÜV
– CO_2	3SA, 3YSA	SA3YM	IIIYMS		TÜV
OK Autrod 12.64 – 80 Ar/20CO_2	3SA, 3YSA	SA3YM			TÜV
– CO_2	3SA, 3YSA	SA3YM			TÜV
OK Autrod 13.09 – 80 Ar/20CO_2			IIIYMS		TÜV
– CO_2			IIIYMS		TÜV
OK Tigrod 13.09 – Ar			IIIYMS		TÜV
OK Tigrod 16.10 – Ar			308LMS		TÜV
OK Tigrod 16.11 – Ar					–SA TÜV
OK Autrod 16.12 – Ar/102			308LMS		TÜV
OK Tigrod 16.30 – Ar			316LMS		TÜV
OK Tigrod 16.31 – Ar					–SA TÜV
OK Autrod 16.32 – Ar/102			316LMS		TÜV
OK Tubrod 14.00 – Ar/20CO_2	2SA, 2YSA	SA2YMH	IIYMS (HH)	2S, 2YSH	TÜV, Controlas, GL
– Ar/ 5CO_2	1SA	SA1MH	IYMS (HH)	1S, 1YSH	
OK Tubrod 14.01 – Ar/20CO_2					BSC for Corten
OK Tubrod 14.02 – Ar/20CO_2					TÜV (on going)
OK Tubrod 14.03 – Ar/20CO_2					TÜV, USSR
OK Tubrod 14.04 – Ar/20CO_2	3SA, 3YSA	UPHH	IIIYMS (HH)	3S, 3YSH	TÜV, USSR
OK Tubrod 14.05 – Ar/20CO_2	3SA, 3YSA H	UPHH	IIIYMS (HH)	3S, 3YSH	MOD
OK Tubrod 14.30 – CO_2 Ar/CO_2					TÜV
OK Tubrod 14.31 – CO_2 Ar/CO_2					TÜV
OK Tubrod 14.32 – CO_2 Ar/CO_2					TÜV
OK Tubrod 15.00 – Ar/20CO_2			IIIYMS	3S, 3YSH	TÜV, Controlas, GL
OK Tubrod 15.00 – CO_2	3SA, 3YSA	SA, 3MH	IIIYMS	3S, 3YSH	TÜV, Controlas, GL, USSR
OK Tubrod 15.12 – CO_2	2SA	SA2, 2YM	IIYMS	2S, 2YS	TÜV, Controlas, GL
OK Tubrod 15.15 – CO_2 Ar/20CO_2	3SA, 3YSA	SA3 3YM	IIIYMS	3S, 3YS	TÜV, Controlas, GL, USSR
OK Tubrod 15.17 – Ar/20CO_2	3SA, 3YSA	SA 3YM	IIIYMS (HH)	3S, 3YSH	TÜV, USSR
OK Tubrod 15.17 – CO_2	3SA, 3YSA			3S, 3YSH	
OK Tubrod 15.18 – CO_2 Ar/20CO_2		SA 2YMH	IIYMS	2S, 2YSH	TÜV,(on going)
OK Tubrod 15.25 – Ar/20CO_2			IIIYMS(HH)	3S, 3YSH	TÜV, Controlas
OK Tubrod 15.30 – Ar/2 O_2			–196°C		TÜV, Controlas
OK Tubrod 15.31 – Ar/5 O_2			–196°C		TÜV, Controlas
OK Tubrod 15.32 – Ar/5 O_2			Grade 309		Controlas
OK Tubrod 15.34 – Ar/2 O_2					TÜV
OK Tubrod 15.35 – Ar/2 O_2					Controlas

The following types are also TÜV approved

OK Autrod 13.12, 13.29, 16.95, 18.11, 18.13, 18.15, 18.16
OK Tigrod 13.12, 16.95, 18.11, 18.13, 18.15, 18.16

Submerged Arc Fluxes and Wires

List of products

Filler materials for submerged arc welding

Fluxes for submerged arc welding

OK Flux	Type	Chemistry	Alloying	Remarks	Page
10.16	Agglomerated	Basic	Non-alloying	Strip cladding	20
10.40	Fused	Acid	Mn-alloying		21
10.50	Fused	Basic	Non-alloying		22
10.61	Agglomerated	High basic	Non-alloying		23
10.62	Agglomerated	High basic	Non-alloying		24
10.70	Agglomerated	Basic	Mn-alloying		26
10.71	Agglomerated	Basic	Non-alloying		27
10.80	Agglomerated	Neutral	Mn-alloying		29
10.81	Agglomerated	Acid	Mn-alloying		30
10.92	Agglomerated	Neutral	Cr-alloying		31
10.96	Agglomerated	Acid	Cr-alloying	Hardfacing	32

Solid wire for mild, medium and high tensile steels

OK	Alloy type	DIN	AWS[1)]	Welding process	Page
Autrod 12.10	Unalloyed	S 1	A5.17:EL12	Sub arc	33
Autrod 12.20	1 % Mn	S 2	A5.17:	Sub arc	34
Autrod 12.22	Mn-Si	S 2 Si	A5.17:EM12K	Sub arc	35
Autrod 12.24	Mn-Mo-alloyed	S 2 Mo	A5.23:EA2	Sub arc	36
Autrod 12.32	1,5 Mn	S 3	A5.17:EM12K	Sub arc	37
Autrod 12.34	1,5 Mn-Mo	S 3 Mo	A5.23:EA4	Sub arc	38
Autrod 12.40	2 Mn	S4	A5.17:EH14	Sub arc	39
Autrod 13.27	2,3 Ni		A5.23-ENi2	Sub arc	40
Autrod 13.36	Cu-Ni weathering steel			Sub arc	41
Autrod 13.43	Cr-Ni-Mo			Sub arc	42

Solid wire for welding stainless steel

Autrod 16.10	20 Cr 10 Ni		ER308L	Sub arc	43
Autrod 16.30	18 Cr 12 Ni 2,7 Mo		ER316L	Sub arc	44
Autrod 16.53	24 Cr 13 Ni		ER309L	Sub arc	45

General Recommendations for Submerged Arc Welding

1. **The flux must be dry.** Agglomerated fluxes must be protected against moisture pick-up.
   In the tropical humid area redrying of agglomerated fluxes at 250–350 C before use is recommended. Remaining flux in the container of the welding machine should be removed and stored in a drykeeping cabinet and thus not be left in the open container during the night.
   During transport of fluxes maximum two pallets should be stapled to prevent cruching to the grains.
2. The fusion faces and the plate in the vicinity of the joint should be clean and dry. The cleaner the joint, the better the chanses of obtaining a satisfactory weld. Rust, mill scale, paint, oil and residues from arc-air gouging or grinding can adversely affect the quality of the weld metal. The more impurities on the fusion faces, the greater the risk of weld metal defects.
3. The arc voltage must be kept constant. Increased arc voltage gives increased flux consumption. If the flux contains alloying elements, the amount transferred to the weld metal will increase as the arc voltage increases.
4. Multi-run deposits made at moderate welding currents have, as a general rule,better mechanical properties than one or two layer deposits made at high currents in similar plate thicknesses.

NOTE. The chemical analyses given in this catalogue are for allweld metal deposits made according to DIN 32522, i.e. with DC+, 580 A, 29V, 33 m/h except for OK Flux 10.91 and OK Flux 10.92, where DC+, 420 A, 27 V and 30 m/h have been used. Wire ø 4 mm.
The mechanical properties are obtained according to welding conditions given in DIN 8557. (That means the same welding data as given in DIN 32522)
Other welding conditions may give weld metal analyses and mechanical properties which differ from those given in the catalogue.

Welding Data and Joint Preparation

Table 5 Typical welding data and recommended joint preparation for submerged arc welding mild steel and carbon-manganese structural steels with OK Flux 10.40, OK Flux 10.70, OK Flux 10.71, OK Flux 10.80 and OK Flux 10.81.

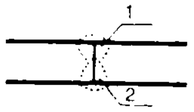
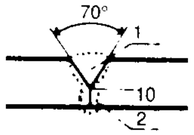
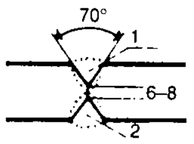
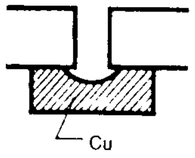
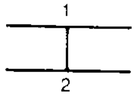
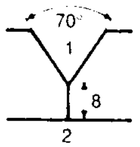
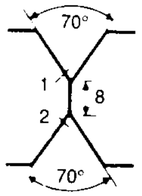
Type of joint	Plate thickness mm	Wire ø mm	Run No.	Arc voltage V	Welding current A	Welding speed m/h
	6	4	1	35	300	50
			2	35	350	
	8	4	1	35	450	46
			2	35	500	
	10	4	1	35	500	42
			2	35	550	
	12	5	1	35	600	38
			2	35	700	
	14	5	1	35	650	35
			2	35	750	
	16	5	1	35	700	35
			2	36	800	
	18	6	1	36	850	30
			2	38	850	
	20	6	1	36	925	27
			2	38	850	
	18	6	1	36	700	30
			2	36	850	
	20	6	1	36	800	25
			2	36	850	
	25	6	1	36	850	20
			2	36	950	
	30	6	1	36	900	15
			2	36	1000	
	2	2	1	28	325	75
	4	2.5	1	30	450	40
	6	3	1	31	510	30
	8	3	1	32	525	26
	10	3	1	33	600	23
	12	3	1	33	625	20

Table 6 Typical welding data for submerged arc fillet welding mild steel and carbon-manganese structural steels with OK Flux 10.40, OK Flu 10.70, OK Flux 10.71, OK Flux 10.80 and OK Flux 10.81.

Type of joint	Plate thickness mm	Wire diam mm	Throat thickness mm	Arc voltage V	Welding current A	Welding speed m/h
	Single welding head					
	≥ 6	3	3	30–32	450	45
	≥ 8	4	4	30–32	575	42
	≥10	4	5	30–32	650	36
	≥ 8	5	4	32–34	800	50
	≥12	5	4	32–34	850	35
	≥15	6	7	33–35	875	25
	≥15	5	–	36	825	27
	≥20	5	–	36	850	22
	Twin wire					
	–	2x2.5	4	34	800	65
	–	2x2.5	5	34	800	45
	Two welding heads + ~					
	–	4	4	+32 ~38	800 700	85
	–	4	4	+32 ~38	800 700	75
	–	5	4	+32 ~35	600 500	65
	–	5	5	+32 ~35	600 600	42

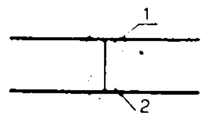
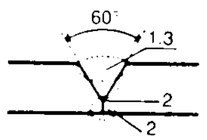
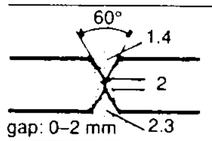
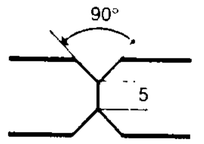
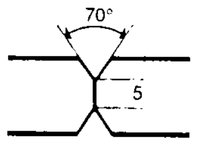
Table 7 Typical welding data for different types of joint OK Flux 10.61 and 10.62

Type of joint	Plate thickness mm	Wire diam mm	Run No.	Arc voltage V	Welding current A	Welding speed m/h
	6	3	1	29	350	40
		3	2	30	425	40
	8	3	1	31	450	40
		3	2	31	500	40
	10	4	1	30	500	40
		4	2	30	575	40
	12	5	1	30	600	40
		5	2	30	650	40
	16	5	1	32	750	35
		5	2	32	800	35
	20	6	1	31	950	23
		6	2	32	950	23
	25	6	1	31	1000	21
		6	2	31	1000	21
	30	6	1	31	1000	20
		6	2	30	1050	20
	35	6	S.1:1*	30	1050	23
		6	2	32	900	30
		6	S. 2: 1**	30	1100	25
		6	2	32	900	30

* First side
** Second side

	Throat thickness (a) a-mm	Wire diam mm	Arc voltage V	Welding current A	Welding speed m/h
	6.0	5	32	800	30
	6.5	5	31	850	30
	7.0	5	30	900	30
	3.5	4	29	650	60
	4.5	4	29	650	50
	5.5	4	29	650	40

Table 8 Submerged arc welding "18/8" stainless steel. Joint preparation and typical welding data for filler materials OK Autrod 16.10 + OK Flux 10.91, 10.92 and similar OK-combinations.

Type of joint	Plate thickness mm	Wire ø mm	Run No.	Arc voltage V	Welding current A	Welding speed m/h
	6	3	1	34	400	80
			2		500	60
	8	4	1	34	500	80
			2		600	60
	Manual welded root bead					
 gap: 0–2 mm	10	4	1	34	600	40
			2		600	60
	12	4	1	34	600	35
			2		600	50
	20	4	1	34	600	35
			2		600	30
			3		600	40
 gap: 0–2 mm	25	4	1	34	600	40
			2		600	35
			3		600	35
			4	34	600	40
	8	4	1	34	450	55
			2	34	550	50
	10	4	1	34	500	40
			2	34	600	50
	12	4	1	34	500	35
			2	34	600	40
	14	4	1	34	550	35
			2	34	600	35

OK Flux 10.16

ESAB

An agglomerated high basic all mineral, non alloying flux for submerged arc welding.

Classification
DIN 32522: BFB6 6723 DC 8B 1–16

Description and applications
OK Flux 10.16 is specially designed for butt welding with nickel-based alloy wire, and cladding with nickel based alloy strips. The well balanced flux composition minimizes silicone transfer from the flux to the welding metal, and thus minimizes risk of hot cracking when welding with nickel based alloys. OK Flux 10.16 gives a good bead shape and surface finish with easy slag removal. OK Flux 10.16 can only be used on DC when butt welding with nickel-based alloy wires, reverse polarity (DC–) is preferably used in order to minimize the dilution from the base material and the risk of hot cracking in the weld metal.

Approvals
Vd TÜV: In combination with OK Band 11.95 according to the latest edition Vd TÜV 1000.

Typical weld metal composition %

OK Flux 10.16/ OK Autrod	C	Si	Mn	Cr	Ni	Mo	Fe	Nb
19.82	0.01	0.35	0.3	20	>60	9	1.5	3.0
19.85	0.01	0.35	3.0	19	>67	1	1.5	2.0

OK Band 11.95	C	Si	Mn	Cr	Ni	Mo	Fe	Nb
1:st layer	0.025	0.25	3.0	17.5	66	–	10	2.1
2:nd layer	0.006	0.32	3.3	18.3	72	–	3	2.3
3:rd layer	0.004	0.33	3.4	18.7	73	–	2	2.4

Typical mechanical properties. All weld metal

OK Flux 10.16/ OK Autrod	Yield stress N/mm²	Tensile strength N/mm²	Charpy V –196°C
19.82	425	700	80J
19.85	360	600	100J

Flux consumption as kg flux per kg strip/wire
Flux consumption is almost directly proportional to the arc voltage according to table below.

Strip/wire	Amp	V	kg flux/ kg strip or wire
Strip DC+	750	26–28	0.75
Wire DC+	580	26	0.4
		30	0.6
		34	0.7
		38	1.0
Wire DC–	580	26	0.3
		30	0.4
		34	0.5
		38	0.6

Storage and handling
Recommendations for storage and handling see page 265.

Packing data
OK Flux 10.16 delivered in plastic lined paper bags containing 25 kgs.

OK Flux 10.40

ESAB

A fused acid Si and Mn alloying flux for submerged arc welding.
Density 1.5 kg/dm³ approx.
Basicity index 0.7.

Classification
AWS A5 17–89: F6A0–F6P0–EL12
F7A0–F6P0–EM 12
DIN 32522: FMS 188 AC 8M 2–16

Applications
OK Flux 10.40 is specially designed for welding in combination with a mild steel electrode of type OK Autrod 12.10 or OK Autrod 12.20 in single and multiwire systems. OK Flux 10.40 is to be used for single and multipass butt welding of mild and medium tensile steels with impact requirements down to a minimum of –20° OK Flux 10.40 is of manganese silicate type which allows a high current carrying capacity on both AC and DC.

Typical weld metal composition %

OK Flux 10.40/ OK Autrod	C	Si	Mn
12.10	0.05	0.6	1.2
12.20	0.05	0.6	1.5

Flux consumption as kg flux/kg wire
Flux consumption is almost directly proportional to the arc voltage according to table below.

Voltage	AC	DC+
26	0.7	0.7
30	1.0	1.0
34	1.3	1.3
38	1.8	1.8

Typical mechanical properties. All weld metal

OK Flux 10.40/ OK Autrod	Yield stress N/mm²	Tensile strength N/mm²	Impact values J	Charpy V °C
12.10	370	470	60	–20
12.20	410	510	50	–20

Approvals

OK Flux 10.40/ OK Autrod	ABS	LR	DnV	BV	GL	RS
12.10	2 TM	2TM	IITM	A2TM	2TM	2TM
12.20	2T ,3M	2T, 3M	IIT	A2T	2T	3TM
	3YM	3 YM	IIIYM	A3YM	3YM	

Vd TÜV: In combination with OK Autrod 12.10, 12.20 and 12.32 according to the latest edition Vd TÜV 1000.

Storage and handling
Recommendations for storage and handling see page 265.

Packing data
OK Flux 10.40 is supplies in plastic-lined paper bags containing 25 kgs.

OK Flux 10.50

A fused basic non alloying flux for electroslag welding.
Density: 1.5 kg/dm³ approx
Basicity index: 2.0

Description and applications
OK Flux 10.50 is specially designed for electroslag welding as no alloying take place from the flux the required mechanical properties can be reached by using suitable alloyed wire.

Typical weld metal composition %

OK Flux 10.50/ OK Autrod	C	Si	Mn	Mo
12.20	0.1	0.2	1.1	–

Typical mechanical properties. All weld metal

OK Flux 10.50/ OK Autrod	Yield stress N/mm²	Tensile strength N/mm²	Impact values J	Charpy V °C
12.20	380	480	50	0

Approvals
Vd TÜV: In combination with OK Autrod 12.20, 12.32, 12.34 and 12.40 according to the latest edition Vd TÜV 1000.

Storage and handling
Recommendations for storage and handling see page 265.

Packing data
OK Flux 10.50 is delivered in paper bags containting 25 kgs.

OK Flux 10.61

An agglomerated high basic non alloying flux for submerged arc welding.
Density: 1.1 kg/dm³
Basicity index: 2.8

Classification
AWS A5.17–89 F6A2–F6P2–EM12
F7A8–F7P8–EM12K
F7A6–F7P8–EH14
AWS A5.23–90 F8A8–F8P6–EA4–A4
F9A8–F9P6–EA3–A3
DIN 32522: BFB 1 65 DC 7 M 2–16

Applications
OK Flux 10.61 is designed for single wire multirun butt welding of mild, medium and high tensile steels with impact strength requirements down to –40°C/–60°C.
Due to the non alloying effect OK Flux 10.61 is to be used with a suitable alloying wire OK Flux 10.61 can only be used on DC.

Typical weld metal composition %

OK Flux 10.61/ OK Autrod	C	Si	Mn	Mo
12.22	0.08	0.3	1.0	–
12.24	0.08	0.25	1.0	0.4
12.32	0.1	0.3	1.5	–
12.34	0.1	0.2	1.4	0.4

Flux consumption as kg/flux/kg wire
Flux consumption is almost directly proportional to the arc voltage according to table below

Voltage	DC+
26	0.6
30	0.9
34	1.1
38	1.4

Typical mechanical properties. All weld metal

OK Flux 10.61/ OK Autrod	Yield stress N/mm²	Tensile strength N/mm²	Charpy V –40°C J	Charpy V –60°C
12.22	450	520	90	60
12.24	520	640	50	–
12.32	470	550	90	40
12.34	550	660	50	40

Approvals

OK Flux 10.61/ OK Autrod	ABS	LR	DnV	BV	GL	RS	Controlas
12.24	3TM, 3YTM	3TM, 3YTM	IIIYTM	A3, 3YTM	3YTM	3YTM	3YTM

Vd TÜV: In combination with OK Autrod 12.10, 12.20, 12.24, 12.32, 13.10, 13.29, 13.39 according to the latest edition Vd TÜV 1000.

Storage and handling
Recommendations for storage and handling see page 265.

Packing data
OK Flux 10.61 is delivered in plastic-lined paper bags containing 25 kgs.

OK Flux 10.62

An agglomerated all mineral high basic non alloying flux for submerged arc welding.
Density: 1.1 kg/dm³
Basicity index: 3.4

Classification
AWS A5.17–89: F6A4–F6P5–EM12
F7A8–F6P8–EM12K
F7A6–F7P5–EH14
AWS A5.23–90: F8A8–F8P6–EA4–A4
F9A8–F9P8–EA3–A3
F7A6–F7P8–ENi1–Ni1
F8A10–F8P10–ENi2–Ni2
DIN 32522: BFB 155 AC 8M HP5 2–16

Applications

OK Flux 10.62 is all mineral non alloying, and the weld metal can be fully controlled independently of the welding parameters through suitable choice of wires. This makes OK Flux 10.62 suitable for multi-run welding of thick materials using single wire as well as multible wire technique. OK Flux 10.62 is designed for multi-pass butt welding of mild, medium and high tensile steels, as well as low-alloyed steels, with impact strength down to –40/–60°C. For being a flux of high basic type, OK Flux 10.62 allows high current carrying capacity both on AC and DC. In order to increase the productivity with maintained mechanical properties OK Flux 10.62 can preferably be used together with iron powder addition. OK Flux 10.62 is specially well suited for narrow gap welding due to the good slag detachability and smooth blending with the side walls. Pressure vessels for nuclear applications and offshore constructions where good CTOD values are required are some areas where OK Flux 10.62 are succesfully used. OK Flux 10.62 operates better at the lower end of the voltage range.
OK Flux 10.62 gives the weld metal a low oxygen content (approx 300 ppm) and low hydrogen content in deposit weld metal (lower than 5 ml/100g).

Typical weld metal composition %

OK Flux 10.62/ OK Autrod	C	Si	Mn	Cr	Ni	Mo
12.22	0.1	0.3	1.0	–	–	–
12.24	0.1	0.2	1.0	–	–	0.4
12.32	0.1	0.3	1.5	–	–	–
12.34	0.1	0.2	1.4	–	–	0.4
13.10	0.1	0.2	0.7	1.0	–	0.5
13.20	0.08	0.3	0.7	2.3	–	0.9
13.21	0.08	0.3	1.0	–	1.0	–
13.27	0.08	0.3	1.0	–	2.1	–
13.40	0.09	0.3	1.5	–	0.9	0.4
13.43	0.1	0.3	1.3	0.6	2.2	0.5

Flux consumption as kg flux/kg wire

The flux consumption is almost directly proportional to the arc voltage according to table below.

Voltage	AC	DC+
26	0.6	0.7
30	0.8	0.9
34	1.0	1.2

Typical mechanical properties. All weld metal

OK Flux 10.62/ OK Autrod	Yield stress N/mm²	Tensile strength N/mm²	Charpy V +20°C J	Charpy V –40°C J	Charpy V –60°C J
12.22	420	510	–	100	50
12.24	520	600	–	50	–
12.32	480	580	–	100	80
12.34	580	660	–	100	60
13.10	430	560	100	–	–
13.20	450	590	100	–	–
13.21	470	560	–	120	60
13.27	500	570	–	120	80
13.40	630	700	–	60	40
13.43	710	800	–	70	50

OK Flux 10.62

Approvals

OK Flux 10.62/ OK Autrod	ABS	LR	DnV	BV	GL	RS	Controlas
12.22	3M, 3YM	3M, 3YM	IIIYM	A3, 3YM	3YM	3YM	3YM
12.24	3M, 3YM	3YM	IIITM IIIYM	A3 3YM	3YM	–	–
12.32	3M, 3YM	3M, 3YM	IIIYM NV 4–4	A3, 3YM	3YM	3YM	HRS 3YM
12.34	3M, 3YM	3M, 3YM	IIIYM	A3, 3YM	3YM	3YM	HRS 3YM
13.27	–	–	IIIYM NV 4–4	–	–	–	
13.43	–	QT steel	–	–	–	QT steel –60 CM	

Vd TÜV: In combination with OK Autrod 12.20, 12.22, 12.32, 13.10, 13.27, 13.40 according to the latest edition of Vd TÜV 1000.

Storage and handling

Recommendations for storage and handling see page 265.

Packing data

OK Flux 10.62 is delivered in plastic-lined paper bags containing 25 kgs.

OK Flux 10.70

An agglomerated basic Si and Mn alloying flux for submerged arc welding.
Density: 1.1 kg/dm³ approx
Basicity index: 1.7

Classification
AWS A5.17–89: F7A4–F7P4–EL12
F7A2–F7P2–EM12
DIN 32522: BAB 1 79 AC 8 SM 2–16

Applications

OK Flux 10.70 is specially designed for welding with OK Autrod 12.10 and OK Autrod 12.20 in butt and fillet welding of mild, medium and high tensile steels, with impact requirements down to –20°C. OK Flux 10.70 is of aluminate basic type and has for this slagsystem very high current carrying capacity on both AC and DC. Being an alloying flux with significant Si and Mn pick-up it is most suitable for applications where dilution of base material is high, which means in fillet welding and butt welding with a small number of passes in single or multiwire systems.

Typical weld metal composition %

OK Flux 10.70/ OK Autrod	C	Si	Mn
12.10	0.07	0.5	1.7
12.20	0.08	0.5	1.9

Flux consumption as kg flux/kg wire

Flux consumption is almost directly proportional to the arc voltage according to table below.

Voltage	AC	DC+
26	0.6	0.5
30	0.9	0.8
34	1.6	1.0
38	1.4	1.2

Typical mechanical properties. All weld metal

OK Flux 10.70/ OK Autrod	Yield stress N/mm²	Tensile strength N/mm²	Impact values J	Charpy V °C
12.10	440	520	70	–20
12.20	480	580	60	–20

Approvals

OK Flux 10.70/ OK Autrod	ABS	LR	DnV	BV	GL	RS
12.10	3TM, 3YTM	3TM, 3YTM	IIIYTM	A3, 3YTM	3YTM	3YTM
12.20	2T, 3M 3YM	2T, 3M 3YM	IIT IIIYM	A3, M2T 3YM	2T, 3YM	3YTM

Vd TÜV: In combination with OK Autrod 12.10, 12.20 and 12.32 according to the latest edition Vd TÜV 1000.

Storage and handling

Recommendations for storage and handling see page 265.

Packing data

OK Flux 10.70 is delivered in paper bags containing 25 kgs.

OK Flux 10.71

An agglomerated basic slightly Si and Mn alloying flux for submerged arc welding.
Density: 1.2 kg/dm³ approx
Basicity index: 1.6

Classification
AWS A5.17–89: F6A4–F6P5–EL12
F7A4–F6P4–EM12
F7A5–F6P5–EM12K
F7A2–F7P2–EH14
AWS A5.23–90: F8A4–F8P2–EA4–A4
F9A4–F9P4–EA3–A3
DIN 32522: BAB 167 AC 8M HP5 2–16

Applications

OK Flux 10.71 is specially designed for fillet welding and for single and multipass but welding of mild, medium and high tensile steels. OK Flux 10.71 is of aluminate basic type and has for this slag system very high current carrying capacity on both AC and DC and has for a basic slag system very good operability characteristics both in single and multiwire systems. OK Flux 10.71 produces a low oxygen content in the weld metal and gives excellent impact strength down to –40°C. It is possible to achives the required strength level of the weld metal by selection of suitable alloyed wires since the alloying effect mainly devices from the wire. OK Flux 10.71 can be used to particular advantage for narrow-gap welding due to the excellent slag detachability and smooth blending of the weld bead with the joint side walls.

Typical weld metal composition %

OK Flux 10.71/ OK Autrod	C	Si	Mn	Mo
12.10	0.08	0.2	0.9	–
12.20	0.08	0.2	1.3	–
12.22	0.08	0.4	1.3	–
12.24	0.08	0.3	1.3	0.4
12.32	0.09	0.4	1.6	–
12.34	0.10	0.3	1.6	0.4

Flux consumption as kg flux/kg wire

Flux consumption is almost directly proportional to the arc voltage according to table below.

Voltage	AC	DC+
26	0.6	0.5
30	0.8	0.7
34	1.2	0.9
38	1.4	1.1

Typical mechanical properties. All weld metal

OK Flux 10.71/ OK Autrod	Yield stress N/mm²	Tensile strength N/mm²	Impact values J	Charpy V °C
12.10	360	460	60	–40
12.20	420	520	60	–40
12.22	430	530	80	–40
12.24	520	590	30	–40
12.32	480	580	70	–40
12.34	550	640	50	–40

OK Flux 10.71

Approvals

OK Flux 10.71/ OK Autrod	ABS	LR	DnV	BV	GL	RS	Controlas
12.10	3M	3M	IIIM	A3M	3M	3M	3M
12.20	3M, 3YM	3M, 3YM	IIIM,IIIYM	A3, 3YM	3YM	–	HRS 3YM
12.22	3M, 3YM	3M, 3YM	IIIYM	A3, 3YM	3YM	–	HRS
12.24	3TM, 3YTM	3TM, 3YTM	IIIYTM	A3, 3YTM	3YTM	3YTM	3/3YM CS–P 3YTM
12.32	–	–	–	–	–	–	HRS 3YM
13.34	3TM, 3YM M–40°C	CMn LT40 3TM, 3YM	IIIYTM M–40°C	UP M–40°C	–	3YTM	–

Vd TÜV: In combination with OK Autrod 12.10, 12.20, 12,22, 12.24, 12.32 and 13.27 according to the latest edition of Vd TÜV 1000.

Storage and handling
Recommendations for storage and handling see page 265.

Packing data
OK Flux 10.71 is delivered in plastic-lined paper bags containing 25 kgs.

OK Flux 10.80

An agglomerated neutral Si and Mn alloying flux for submerged arc welding.
Density: 1.1 kg/dm³ approx
Basicity index: 1.1

Classification
AWS A5.17–89: F7A2–F6P0–EL12
F7A2–F6P0–EM12
DIN 32522: BCS 189 AC 8 M 2–16

Applications
OK Flux 10.80 is to be used for single and multi-pass butt welding of mild and medium tensile steels where moderate impact strengths arc required. OK Flux 10.80 is of calcium-silicate type which allows very high current carrying capacity even at low welding speeds both an AC and DC.
OK Flux 10.80 is excellent for butt welding of materials from 10 up to 40 m/m and is used e.g. in the ship building industry.
OK Flux 10.80 is especially designed for welding in combination with OK Autrod 12.10 or OK Autrod 12.20 in single or multi-wire systems.

Typical weld metal composition %

OK Flux 10.80/ OK Autrod	C	Si	Mn
12.10	0.09	0.6	1.4
12.20	0.10	0.6	1.7

Flux consumption as kg flux/kg wire
Flux consumption is almost directly proportional to the arc voltage according to table below.

Voltage	AC	DC+
26	0.4	0.5
30	0.6	0.7
34	0.9	1.0
38	1.1	1.2

Typical mechanical properties. All weld metal

OK Flux 10.80/ OK Autrod	Yield stress N/mm²	Tensile strength N/mm²	Impact values J	Charpy V °C
12.10	420	530	60	–20
12.20	450	560	50	–20

Approvals

OK Flux 10.80/ OK Autrod	ABS	LR	DnV	BV	GL	RS	Controlas
12.10	2TM, 2YTM	2TM, 2YTM	IIYTM	A2, 2YTM	2YTM	2YTM	CS–P 2TM
12.20	1T2M	1T2M1YT 2YM	IYT IIYM	A1T A2M	1T2M	–	–

Vd TÜV: In combination with OK Autrod 12.10, 12.20 and 12.32 according to the latest edition Vd TÜV 1000.

Storage and handling
Recommendations for storage and handling see page 265.

Packing data
OK Flux 10.80 is delivered in plastic-lined paper bags containing 25 kgs.

OK Flux 10.81

An agglomerated acid Si and Mn alloying flux for submerged arc welding.
Density: 1.25 kg/dm³ approx
Basicity index: 0.6

Classification
AWS A5.17–89: F7AZ–F7PZ–EL12
F7A0–F7PZ–EM12
F7A0–EM12K
DIN 32522: BAR 197 AC 8 SMK 2–16

Applications

OK Flux 10.81 is excellent for all types of general applications in low and medium tensile steels, in combination with a mild steel electrode of type OK Autrod 12.10 or OK Autrod 12.20 and impact requirements down to ±0°C. Beeing an alloying flux with significant Si and Mn pick-up, it is most suitable for applications where dilution of base metal is high e.g. in fillet welding and butt welding of thin and medium thick plates with a small number of passes. The excellent welding properties associated with the acid slag system of OK Flux 10.81 allow high travel speeds in butt welding i.e. spiral welding of thin walled pipes and fillet welding where good bead shape excellent slag removal and very good surface finish are essential.

Typical weld metal composition %

OK Flux 10.81/ OK Autrod	C	Si	Mn
12.10	0.07	0.7	1.2
12.20	0.08	0.7	1.4

Flux consumption as kg flux/kg wire

Flux consumption is almost directly proportional to the arc voltage according to table below.

Voltage	AC	DC+
26	0.5	0.6
30	0.7	0.8
34	0.9	1.1
38	1.2	1.4

Typical mechanical properties. All weld metal

OK Flux 10.81/ OK Autrod	Yield stress N/mm²	Tensile strength N/mm²	Impact values J	Charpy V °C
12.10	460	530	50	0
12.20	490	580	40	–20

Approvals

OK Flux 10.81/ OK Autrod	ABS	LR	DnV	BV	GL	RS	Controlas
12.10	1T2M	1T2M	IYTIIYM	A1YT	IYT	K4T5M	CS–P 1TM
12.20	1YT, 2YM 2TM 2YTM	1YT, 2YM 2TM 2YTM	IIYTM	A2YM A2 A2YTM	2YM 2YTM	K4T5M –	1YT, YM 2YTM

Vd TÜV: In combination with OK Autrod 12.10, 12.20 and 12.32 according to the latest edition Vd TÜV 1000.

Storage and handling

Recommendations for storage and handling see page 265.

Packing data

OK Flux 10.81 is delivered in plastic-lined paper bags containing 25 kgs.

OK Flux 10.92

An agglomerated neutral chromium alloying flux for welding of stainless steel.
Density: 1.0 kg/dm³
Basicity index: 1.0

Classification
DIN 32522: BCS5 71645 DC 8 MB 2–16

Applications

OK Flux 10.92 is specially designed for butt welding of stainless steels OK Flux 10.92 is also excellent for strip cladding with stainless strips. The chromium alloying effect from OK Flux 10.92 compensates for the chromium losses in the arc during welding. Strip cladding can be carried out with strips up to 100 mm in width. The strip cladding process is stable over a wide range of currents and speeds. Smooth overlapping between adjacent beads. Direct current and positive polarity give maximum flexibility when choosing welding parameters and is normally used with OK Flux 10.92.

Chemical composition of the weld metal

Due to the chromium compensating effect of the flux, the typical chemical composition of the weld metal is close to the chemical composition of the wire used.

Flux consumption as kg flux per kg strip/ wire

Strip/wire	Amp	Voltage	Kg flux/ kg strip, wire
Strip DC+	750	26–28	0.7
Wire DC+	580	26	0.4
		30	0.5
		34	0.7
		38	0.9

Typical mechanical properties. All weld metal

OK Flux 10.92/ OK Autrod	Yield stress Rp 0.2	Tensile strength N/mm²	Impact values J	Charpy V °C
16.10	365	580	50	–196
16.30	385	590	55	– 70

Approvals

Vd TÜV: In combination with OK Autrod 16.10, 16.11 and 16.30, according to the latest edition of Vd TÜV 1000.

Storage and handling

Recommendations for storage and handling see page 265.

Packing data

OK Flux 10.92 is delivered in plastic-lined paper bags containing 25 kgs.

OK Flux 10.96

A neutral Cr-alloying agglomerated flux for hardfacing.
Density: 1.1 kg/dm³
Basicity index: 0.9

Applications
OK Flux 10.96 is intended for hardfacing with hardness up to 40 H_{RC} in combination with mild steel electrodes. OK Flux 10.96 is specially designed for hardfacing in combination with OK Autrod 12.10 which gives a weld metal hardness of 35–40 H_{RC}.
The flux consumption and the chromium content of the deposit in the weld metal increase with increasing arc voltage. Thus the hardness and the hardenability of the weld metal also increase as the arc voltage increases. Wheel beds for cranes loading wagons, shafts, caterpillar tracks and links are typical areas of applikation. Hardfacing with OK Flux 10.96 can be done on AC or DC. DC positive polarity gives higher heat input to the base material and somewhat higher flux consumption and lower deposition rate than negative polarity. Since the flux contains chromium and the chromium content of the deposite varies with the arc voltage, the latter should be kept as constant as possible.

Flux consumption as kg flux/kg wire
Flux consumption is almost directly proportional to the arc voltage, according to the table below.

Voltage	AC	DC–	DC+
30	0.6	0.5	0.7
34	0.8	0.6	0.9
38	1.0	0.8	1.2

Welding current range

OK Flux 10.96/ OK Autrod 12.10	Current A	Arc voltage V
ø 3 mm	300–400	30–38
ø 4 mm	400–500	30–38
ø 5 mm	500–600	30–38
ø 6 mm	600–700	30–38

Storage and handling
Recommendations for storage and handling see page 265.

Packing data
OK Flux 10.96 is delivered in plastic-lined paper bags containing 25 kgs.

OK Autrod 12.10

Copper coated mild steel wire for submerged arc welding.

Classification
AWS A5.17–80:EL 12
DIN 8557: S 1

Typical wire composition %

C	Si	Mn
0.08	0.02	0.5

Typical weld metal composition % with different fluxes

OK Autrod 12.10/OK Flux	10.40	10.70	10.71	10.80	10.81
Carbon	0.05	0.07	0.08	0.09	0.07
Silicon	0.6	0.5	0.2	0.6	0.7
Manganese	1.2	1.7	0.9	1.4	1.2

Typical mechanical properties. All weld metal specimens
Combination

OK Autrod 12.10 OK Flux	Yield stress N/mm²	Tensile strength N/mm²	Charpy V impact values J	Charpy V impact values temp °C
10.40	370	470	60	–20
10.70	440	520	70	–20
10.71	360	460	60	–40
10.80	420	530	60	–20
10.81	460	530	50	0

Approvals
For approvals by the Classification Societies refer to the OK Flux being used or see table 3, page 9.

Packing data

Diameter mm	Spool	Weight of electrode kg
1.6	07–0	30
2.0	07–0	30
2.5	07–0	30
3.0	08–0	30
4.0	08–0	30
5.0	08–0	30
6.0	08–0	30

Other spooltypes available on request

OK Autrod 12.20

Copper coated semi-killed electrode for submerged arc and electroslag welding of medium and high strength structural steel.

Classification
AWS A5.17-80: EM 12
DIN 8557: S2

Typical wire composition %

C	Si	Mn
0.10	0.1	1.0

Typical weld metal composition %

OK Autrod 12.20/ OK Flux	10.40	10.50*	10.70	10.71	10.80	10.81
Carbon	0.05	0.1	0.08	0.08	0.10	0.08
Silicon	0.6	0.2	0.5	0.2	0.6	0.7
Manganese	1.5	1.1	1.9	1.3	1.7	1.4

* Electroslag welding in 35 mm. Si-killed steel SIS 1411.

Typical mechanical properties. All weld metal specimens

OK Autrod 12.20 OK Flux	Yield stress N/mm²	Tensile strength N/mm²	Charpy V impact values J	Charpy V impact values temp °C
10.40	410	510	50	–20
10.50*	380	480	50	0
10.70	480	580	60	–20
10.71	420	520	60	–40
10.80	460	560	50	–20
10.81	490	580	40	–20

* Electroslag welding

Approvals
For approvals by the Classification Societies refer to the OK Flux being used or see table 3, page 9.

Packing data

Diameter mm	Spool	Weight of electrode kg
2.0	07–0	30
3.0	08–0	30
4.0	08–0	30
5.0	08–0	30

Other spool types available on request

OK Autrod 12.22

A medium manganese alloyed copper coated steel electrode for submerged arc welding and electroslag welding medium and high tensile steel. Contributes to exceptional high impact values of submerged arc welds, when combined with OK flux 10.62.

Classification
AWS A5. 17-80: EM 12 K
DIN 8557:S2 Si

Typical wire composition %

C	Si	Mn
0.10	0.20	1.0

Typical weld metal composition %

OK Autrod 12.22/ OK Flux	10.61	10.62	10.71
Carbon	0.08	0.1	0.08
Silicon	0.3	0.3	0.4
Manganese	1.0	1.0	1.3

*Electroslag welding in 35 mm. Si-killed mild steel.

Typical mechanical properties. All weld metal specimens

OK Autrod 12.22 OK Flux	Yield stress N/mm²	Tensile strength N/mm²	Charpy V impact values J	Charpy V impact values temp °C
10.61	450	520	60	–60
10.62	420	510	50	–60
10.71	430	530	80	–40

* Electroslag welding

Approvals
For approvals by the Classification Societies refer to the OK Flux being used or see table 3, page 9.

Packing data

Diameter mm	Spool	Weight of electrode kg
2.0	07–0	30
2.5	07–0	30
3.0	08–0	30
4.0	08–0	30
5.0	08–0	30

Other spool types available on request

OK Autrod 12.24

A copper coated molybdenum alloyed electrode for submerged arc and electroslag welding of unalloyed and low alloy steels with impact strength requirements higher than those obtainable with mild steel filler wires. Specially suited for the two run technic.

Classification
AWS A5.23-80: EA 2
DIN 8557: S 2 Mo

Typical wire composition %

C	Si	Mn	Mo
0.10	0.1	1.0	0.5

Typical weld metal composition %

OK Autrod 12.24/ OK Flux	10.61	10.62	10.71
Carbon	0.08	0.1	0.08
Silicon	0.25	0.2	0.3
Manganese	1.0	1.0	1.3
Molybdenum	0.4	0.4	0.4

Typical mechanical properties. All weld metal specimens

OK Autrod 12.24 OK Flux	Yield stress N/mm²	Tensile strength N/mm²	Charpy V impact values J	temp °C
10.61	520	640	50	–40
10.62	520	600	50	–40
10.71	520	590	30	–40

Approvals
For approvals by the Classification Societies refer to the OK Flux being used or see table 3, page 9.

Packing data

Diameter mm	Spool	Weight of electrode kg
2.0	07–0	30
2.5	07–0	30
3.0	08–0	30
4.0	08–0	30
5.0	08–0	30
6.0	08–0	30

Other spool types available on request

OK Autrod 12.32

A manganese alloyed copper coated electrode for submerged arc welding of medium and high tensile steel. Preferably combined with OK Flux 10.62 or OK Flux 10.71.

Description and application
OK Autrod 12.32 should be used preferably together with nonalloying or slightly alloying fluxes when high weld metal quality requirements must be fulfiled.

Typical wire composition

C	Si	Mn
0.12	0.2	1.5

Typical weld metal composition %

OK Autrod 12.32 OK Flux	10.62	10.71	10.61
Carbon	0.1	0.09	0.1
Silicon	0.3	0.4	0.3
Manganese	1.5	1.6	1.5

Typical mechanical properties. All weld metal specimens

OK Autrod 12.32 OK Flux	Yield stress N/mm²	Tensile strength N/mm²	Charpy V impact values J	temp °C
10.62	480	580	100	–40
10.71	480	580	70	–40
10.61	470	550	90	–40

Approvals
For approvals by the Classification Societies refer to the OK Flux being used or see table 3, page 9.

Packing data

Diameter mm	Spool	Weight of electrode kg
3	08–0	30
4	08–0	30
5	08–0	30

Other spool types available on request

OK Autrod 12.34

A manganese-molybdenum alloyed copper coated electrode for submerged arc welding and electroslag welding of high tensile steel and steel for low temperature work.

Classification
AWS A5.23:-80 EA 4
DIN 8557: S3 Mo

Typical weld metal composition %

OK Autrod 12.34 OK Flux	10.62	10.71	10.61
Carbon	0.1	0.1	0.1
Silocon	0.2	0.3	0.2
Manganese	1.4	1.6	1.4
Molybdenum	0.4	0.4	0.4

Typical wire composition %

C	Sl	Mn	Mo
0.12	0.2	1.5	0.5

Typical mechanical properties. All weld metal specimens
Combination

OK Autrod 12.34 OK Flux	Yield stress N/mm²	Tensile strength N/mm²	Charpy V impact values J	 temp °C
10.62	580	660	100	–40
10.71	550	640	50	–40
10.61	550	660	50	–40

Approvals
For approvals by the Classification Societies refer to the OK Flux being used or see table 3, page 9.

Packing data

Diameter mm	Spool	Weight of electrode kg
3.0	08–0	30
4.0	08–0	30
5.0	08–0	30

Other spool types available on request

OK Autrod 12.40

A copper coated manganese-alloyed semi-killed electrode for submerged arc

Classification
AWS A5.17-80: EH14
DIN 8557: S 4

Typical weld metal composition %
Combination

OK Autrod 12.40/ OK Flux	10.62
Carbon	0.1
Silicon	0.2
Manganese	1.9

Typical wire composition %

C	Si	Mn
0.12	0.1	2.0

Typical mechanical properties. All weld metal specimens
Combination

OK Autrod 12.40 OK Flux	Yield stress N/mm²	Tensile strength N/mm²	Charpy V impact values J	 temp °C
10.62	540	630	50	–40

Packing data

Diameter mm	Spool	Weight of electrode kg
3.0	08–0	30
4.0	08–0	30

Other spool types avaliable on request

OK Autrod 13.27

A NI-alloyed electrode for submerged arc welding

Classification
AWS A5.23-80: ENi2

Applications
OK Autrod 13.27 is intended for submerged arc welding in combination with OK Flux 10.62 This combination gives excellent welding properties with good slag removal even in narrow joints.

Typical wire composition %

C	Si	Mn	Ni
0.08	0.2	1.0	2.3

Typical weld metal composition %

OK Flux	C	Si	Mn	Ni
10.62	0.08	0.3	1.0	2.1

Typical mechanical properties
All weld metal speciments.

Yield stress	500 N/mm²
Tensile strength	570 N/mm²
Elongation	27 %

Charpy V impact values

–20°C	160 J
–40°C	120 J
–60°C	80 J

Packing data

Diameter mm	Spool	Weight of wire kg
3.0	08–0	30
4.0	08–0	30

OK Autrod 13.36

A Cu-Ni-alloyed electrode for submerged arc welding of weathering steel type USS CORTEN A, B and C and other weldable low alloy high tensile steel.

Applications
OK Autrod 13.36 is intended for submerged arc welding in combination with OK Flux 10.71 or OK Flux 10.81.
The highest weld metal impact strength is obtained in combination with OK Flux 10.71. Both fluxes have very good welding properties but OK flux 10.81 is the best suited for high speed welding of plate thinner than about 6–8 mm.

Typical wire composition %

C	Si	Mn	Ni	Cu
0.10	0.3	1.0	0.8	0.5

Typical weld metal composition %

Flux	C	Si	Mn	Ni	Cu
10.71	0.08	0.5	1.3	0.7	0.5
10.81	0.07	0.9	1.4	0.7	0.5

Typical mechanical properties
All weld metal specimens

OK Flux	10.71	10.81
Yield stress N/mm²	490	580
Tensile strength N/mm²	580	680
Elongation %	27	23
Charpy V impact values		
+20°C	120 J	50 J
–20°C	70 J	30 J

Packing data

Diameter mm	Spool	Weight of wire kg
2.4	08–0	30
3.0	08–0	30
4.0	08–0	30

OK Autrod 13.43

A Cr-Ni-Mo alloyed electrode for submerged arc welding of extra high tensile steels e.g. 0X 812, SSS 100.

Applications
OK Autrod 13.43 is intended for submerged arc welding in combination with OK Flux 10.62.
This combination gives excellent welding properties with good slag removal even in narrow joints.

Typical wire composition %

C	Si	Mn	Cr	Ni	Mo
0.11	0.2	1.4	0.7	2.4	0.5

Typical weld metal composition %

Flux	C	Si	Mn	Cr	Ni	Mo
10.62	0.1	0.3	1.3	0.6	2.2	0.5

Typical mechanical properties
All weld metal speciments.

Yield stress	710 N/mm²
Tensile strength	800 N/mm²
Elongation	20 %

Charpy V impact values

–20°C	100 J
–40°C	70 J
–60°C	50 J

Packing data

Diameter mm	Spool	Weight of wire kg
3.0	08–0	30
4.0	08–0	30

OK Autrod 16.10

OK Autrod 16.10 is an extra low carbon stainless wire designed for use in combination with OK Flux 10.91 or OK Flux 10.92 for submerged arc welding corrosion resisting steel of the 19 % Cr, 10 % Ni type.

Classification
AWS A5.9-81:ER 308 L
DIN 8556:X2 Cr Ni 19 9
Werkstoff Nr 1.4316

Applications
The welding of austenitic corrosion resisting steels such as AISI 1301, 304, 304L and equivalent types as given in Table 5.

Recommendations for welding
OK Autrod 16.10 is deposited on direct current using either positive or negative polarity. On negative polarity, lower penetration and lower heat transfer into the base material are obtained compared with the same welding parameters used on positive polarity. The choice of polarity does not affect the quality of the weld metal, except insofar as the latter is affected by dilution from the parent plate. Too much heat into the parent plate can decrease the corrosion resistance of the heat-affected zone. Negative polarity is therefore particularly appropriate when welding stainless steels which are not extra low carbon qualities. For any particular wire diameter, the welding current is limited to a lower maximum value than that applied in the submerged arc welding of mild and low alloy steels.

Recommended welding data

Wire diameter mm	Welding current A	Arc voltage V
2.4	250–350	30
3.0	300–500	34

Typical wire composition %

Wire C	Si	Mn	Cr	Ni
≤0.025	0.4	1.8	20	10

Weld metal: OK Flux 10.92

C	Si	Mn	Cr	Ni
≤0.03	≤0.90	1.2	20	10

Typical mechanical properties
All weld metal specimens

Yield stress (0.2 %)	365 N/mm²
Tensile strength	580 N/mm²

Charpy V impact value

–196°C	50 J

Packing data

Diameter mm	Spool	Weight of electrode kg
2.4	25–2	10
3.0	09–0	15

OK Autrod 16.30

OK Autrod 16.30 is an extra low carbon stainless wire used in combination with OK Flux 10.91 or OK Flux 10.92 for submerged arc welding acid resisting steels of the 18 % Cr, 12 % Ni, 3 % Mo type.

Classification
AWS A5.9-81: ER 316 L
DIN 8556: X 2 Cr Ni Mo 19 12
Werkstoff Nr 1.4330

Applications
The welding of austenitic corrosion resisting and acid resisting steels of the AISI 316 and 316L or somewhat lower alloyed types. For equivalent types in other standards refer to table 5.

Recommendations for welding
OK Autrod 16.30 is deposited on direct current. Either straight or reverse polarity can be used. On straight polarity (i.e. electrode negative) lower penetration and lower heating of the base material are obtained compared with reverse polarity (electrode positive) at the same current and voltage.
The choice of polarity does not affect the quality of the weld metal, except in so far as the latter is affected by dilution from the parent plate. Too much heat into the parent plate can decrease the corrosion resistance of the heat-affected zone so that negative polarity is particularly appropriate when welding stainless steels which are not extra low carbon qualities. For any particular wire diameter, the welding current is limited to a lower maximum value than that used in the submerged arc welding of mild and low alloy steels.

Welding data

Wire diameter mm	Welding current A	Arc voltage V
2.4	250–350	30
3.0	300–500	34
4.0	400–600	34

Approvals
OK Autrod 16.30/OK Flux 10.91 is approved by Det norske Veritas for welding austenitic stainless steel, grade NV 25.

Typical wire composition %

Wire C	Si	Mn	Cr	Ni	Mo
≤0.025	0.4	1.8	1.8	12	2.7

Weld metal: OK Flux 10.92

C	Si	Mn	Cr	Ni	Mo
≤0.03	≤0.90	1.2	18	12	2.7

Typical mechanical properties
All weld specimens

Yield stress (0.2 %)	385 N/mm²
Tensile strength	590 N/mm²
Charpy V impact value	
–70°C	55 J

Packing data
OK Autrod 16.30

Diameter mm	Spool	Weight of electrode kg
2.4	25–2	10
3.0	09–0	15
4.0	09–0	15

OK Autrod 16.53

OK Autrod 16.53 is an extra low carbon 24 % Cr 13 % Ni stainless welding wire for submerged arc welding and cladding combined with OK Flux 10.91 and OK Flux 10.92.

Classification
AWS A5.9-81: ER 309 L
DIN 8556: X 2 Cr Ni 24 12

Applications
OK Autrod 16.53 is used for welding similar alloys in wrought or cast forms. OK Autrod 16.53 is also suitable for welding of "18–8" steel when severe corrosion conditions exist which require higher alloy content weld metal.
OK Autrod 16.53 is especially recommended for joining dissimilar steels such as "18–8" to mild steel and for stainless surfacing of mild steel, carbon steel and low alloy steel.

Recommendations for welding
DC-straight polarity is normally used in combination with OK Flux 10.91. With OK Flux 10.92, DC-straight or AC.
Electrode positive gives a higher heat input to the base material and a lower deposition rate.

Welding data

Wire diameter mm	Welding current A	Arc voltage V
3.0	300–500	34
4.0	400–600	34

Typical wire composition %

C	Si	Mn	Cr	Ni
≤0.025	0.4	1.8	24	13

Typical mechanical properties
All weld metal specimens

Yield stress (0.2 %)	440 N/mm²
Tensile strength	64 N/mm²

Packing data OK Autrod 16.53

Wire diameter mm	Spool	Weight of electrode kg
0.8	24–3	12
1.0	24–3	12
1.2	24–3	12
1.6	24–3	12
3.0	71–0, 09–0	20, 15
4.0	71–0, 09–0	20, 15

MIG/MAG/TIG Wires and Rods

List of products

Filler materials for gas shielded arc welding

Solid wire and rods for welding mild and medium tensile steels

OK	Alloy type	DIN 8559/EN 440	AWS	Welding process	Page
Autrod 12.51	Mn-Si	EN G3Si1	A5.18: ER70S-6	MAG-CO_2 or 80 % Ar+20 % CO_2	51
Tigrod 12.64	Mn-Si	DIN SG 3	A5.18: ER70S-6	TIG welding	52
Autrod 12.64	Mn-Si	EN G4Si1	A5.18: ER70S-6	MAG CO_2 or 80 % Ar+20 % CO_2	

Solid wire and rods for welding high tensile steels

OK	Alloy type	DIN 8559	EN 440	Welding process	Page
Autrod 13.09	Mn-Mo-Si	SG Mo	G2 Mo	MAG 80 % Ar+20 % CO_2	53
Tigrod 13.09	Mn-Mo-Si	SG Mo	–	TIG welding	
Autrod 13.12	Cr-Mo	SGCrMo 1		MAG 80 % Ar+20 % CO_2	54
Tigrod 13.12	Cr-Mo	SGCrMo 1		TIG welding	
Autrod 13.13	Cr-Mo-Ni			MAG 80 % Ar+20 % CO_2	55
Tigrod 13.13	Cr-Mo-Ni			TIG welding	
Autrod 13.26	Cu-Ni, weathering steel			MAG CO_2 or 80 % Ar+20 % CO_2	56

Solid wire for hardfacing

OK	Alloy type	DIN	Welding process	Page
Autrod 13.91	9 Cr	MSG-6-GZ-C-60G	MAG CO_2 or Ar+	57

Solid wires and rods for welding stainless steel

OK	Alloy type	AWS	Welding process	Page
Tigrod 16.10	20 Cr 10 Ni	ER308L	TIG	58
Autrod 16.11	19 Cr 9 Ni, Nb	ER347Si	MIG	59
Tigrod 16.11	19 Cr 9 Ni, Nb	ER347Si	TIG	
Autrod 16.12	20 Cr 10 Ni	ER308L Si	MIG	60
Tigrod 16.30	18 Cr, 12 Ni, 2.7 Mo	ER316L	TIG	61
Autrod 16.31	19 Cr, 11 Ni, 2.7 Mo, Nb	ER318Si	MIG	62
Tigrod 16.31	19 Cr, 11 Ni, 2.7 Mo, Nb	ER318Si	TIG	
Autrod 16.32	18 Cr, 12 Ni, 2.7 Mo	ER316L Si	MIG	63
Autrod 16.52	24 Cr, 13 Ni	ER309Si	MIG	64
Autrod 16.53	24 Cr, 13 Ni	ER309L	TIG and MIG	65
Tigrod 16.53	Cr 24 Ni 13	ER309L		
Autrod 16.86	23 Cr, 9 Ni, 3 Mo		MIG	66
Tigrod 16.86	23 Cr, 9 Ni, 3 Mo		TIG	
Autrod 16.95	18 Cr, 8 Ni, 6 Mn	–	MIG and TIG	67
Tigrod 16.95	18 Cr, 8 Ni, 6 Mn			

Solid wire and rods for welding non-ferrous alloys

OK	Alloy type	AWS	Welding process	Page
Autrod 18.01, 18.11	Al 99.5, Al 99.5 Ti	ER 1100	MIG	68
Tigrod 18.01, 18.11	Al 99.5, Al 99.5 Ti	ER 1100	TIG	
Autrod 18.04	Al Si 5	ER 4043	MIG	69
Tigrod 18.04	Al Si 5	ER 4043	TIG	
Autrod 18.15	Al Mg 5	ER 5356	MIG	70
Tigrod 18.15	Al Mg 5	ER 5356	TIG	
Autrod 18.16	Al Mg 4.5 Mn	ER 5183	MIG	71
Tigrod 18.16	Al Mg 4.5 Mn	ER 5183	TIG	
Autrod 19.12	Tin-bronze	ER Cu	MIG	72
Autrod 19.40	Al-bronze	ER Cu Al-A1	MIG	73
Autrod 19.82	60 Ni 22 Cr 9 Mo	ER Ni Cr Mo-3	MIG	74
Tigrod 19.82	60 Ni 22 Cr 9 Mo	ER Ni Cr Mo-3	TIG	
Autrod 19.85	67 Ni 20 Cr	ER Ni Cr-3	MIG	75
Tigrod 19.85	67 Ni 20 Cr	ER Ni Cr-3	TIG	

General Recommendations for Gas Shielded Metal Arc Welding

The electrodes and joint faces should be clean. This is particularly important when welding aluminium and aluminium alloys. The shielding gases used must be of a purity suitable for welding. Moisture in the gas can give porous welds.

Shielding gas for mild and low alloy steels
Carbon dioxide, CO_2, is the cheapest and most commonly used gas and, in most cases, gives satisfactory welds in both mild and low alloy steel.
Mixed gas, of which the most commonly used consists of 80 % Ar + 20 % CO_2, is dearer than pure CO_2 but gives a softer arc, quieter welding, better bead appearance and less spatter. It is therefore often used, in spite of its higher price, for the welding of sheet steel 0.8–1.5 mm thick which is more difficult to weld with pure CO_2. A further advantage of mixed gas is the higher quality, in particular notch toughness, compared with CO_2. For this reason, mixed gas is often recommended for welding low alloy steels, e.g. creep-resistant steels, even in thicknesses greater than 1.5 mm. Mixed gas of the 80/20 type is also available in which the argon is of a lower purity. Such gases are cheaper than those based on pure argon and can often be used with equally good results.
A drawback of Argon/CO_2 mixtures is that they lead to increased ozone formation compared with pure CO_2 when used as a shielding gas in arc welding.
Another drawback with using the mixture is that the current load capacity of the welding gun is reduced with about 30 % compared with welding with CO_2.

Shielding gas for stainless and heat resisting steels
Argon containing 1 % oxygen is normally used for welding stainless and heat resisting steels, but Argon containing 2 % O_2 or 5 % O_2 is also available. The latter gives a more fluid weld pool. A shielding gas which consists of 98 % Argon + 2 % CO_2 has gained favour for MIG welding stainless steels, It can often replace Argon/Helium mixtures, which are used to help fusion when welding thick stainless steel, and can very often replace Argon/Oxygen mixtures.

Choice of welding process:
Short arc or spray arc
The electrodes for gas metal arc welding listed in these pages are suitable for short arc welding in the smallest diameters and for spray arc welding in diameters 1.2–2.4 mm. Short arc welding (welding with short circuiting droplet transfer) can be carried out in all positions and is the best process for welding sheet material approximately 0.8–3 mm thick and for making the root run in prepared butt joints.
Spray arc welding (welding with finely divided free flight drop transfer) is carried out at higher currents and voltages than short arc welding and, in general, is therefore quicker and more economical than short arc welding for plate thicknesses exceeding 2–3 mm. It is only used for welding in the horizontal or horizontal/vertical positions. The gas consumption for short arc welding is 6–10 litres/min. and for spray arc welding 12–20 litres/min. The higher the welding current, the greater the gas flow required.

Welding technique
The welding gun is normally held in the right hand, which means that the weld is made from the right to the left with the gun directed away from the deposited weld at an angle of 75–80° between the electrode and the workpiece thus giving the operator a good view of the weld pool and the joint. This gives a smoother weld bead than if the gun is directed towards the finished weld.

Abbreviations
MIG welding = Metal Inert Gas welding = metal arc welding in an atmosphere consisting mainly of an inert gas such as.Argon.
MAG welding = Metal Active Gas welding = metal arc welding in an atmosphere consisting of an active gas, usually carbon dioxide. Gas mixtures containing 20 % or more CO_2 are usually classified as active.

OK Autrod 12.51

ESAB

A copper coated manganese-silicon bearing electrode for gas metal arc welding using CO_2 or 80 % Ar –20 % CO_2 mixtures as the gas shield.

Classification
AWS A 5.18: ER 70 S-6
(DIN 8559: SG 2)
(BS 2901: A18)
(SS14 34 23)
(AS 2717.1: ES6-GC-W503H)
EN 440 G3Si1

Applications
Designed for welding of unalloyed steels, e.g. general structural steels and pressure vessel steels with a minimum tensile strength of max. 530 N/mm² as well as for fine-grained carbon-manganese steels for the same purpose with a yield strength of min. 420 N/mm².

Welding data
DC positive polarity
Recovery: 96 % approx.

Dimensions ø mm	H	Arc Voltage V	Wire feed m/min	Current A
0.8	0.8–2.5	18–24	3.2–10	60–185
1.0	1.0–5.5	18–32	2.7–15	80–300
1.2	1.2–8.0	18–35	2.3–15	120–380
1.6	3.0–9.5	28–40	3.2–10	225–480

H) Deposit rate, kg weld metal/hour.

Approvals

ABS	3SA,3YSA
DnV	III YMS
LR	3S, 3YS
GL	3YS
BV	SA3, 3YM
Controlas	
RS	K6SM
DB	42.039.06/QS
TÜV	Yes

Typical wire composition %

C	Si	Mn
0.1	0.85	1.5

Typical weld metal composition % (Ar/20 CO_2)

C	Si	Mn
0.10	0.8	1.2

Typical mechanical properties. (Ar/20 CO_2)
All weld metal specimen—as welded

Yield stress	470 N/mm²
Tensile strength	570 N/mm²
Elongation	25 %

Charpy V impact value

Test temp.	Joule
–20°C	80

Packing data

For all wire diameters	Spool	Net weight of wire (kg)
0.8–1.0–1.2–1.6	25–0	15
	46–0	5
	76–1	18
	77–1	18 layer wound

OK Autrod 12.64
OK Tigrod 12.64

A copper coated electrode for gas metal arc welding. Slightly higher silicon and manganese alloyed than OK 12.51.

Classification
AWS A 5.18: ER 70 S-6
(DIN 8559: SG 3)
(SS 14 34 26)
EN 440 G4Si1

Description
OK Autrod 12.64 should be used when a higher silicon and manganese content is required or desired compared to OK Autrod 12.51.
The higher contents of silicon and manganese increase the yield stress and the tensile strenght of the weld metal (20–50 N/mm² compared with OK Autrod 12.51). The high silicon content promotes a low sensitivity to surface impurities and contributes to smooth, sound welds.

Welding data
(See OK Autrod 12.51)
With CO_2 as shielding gas use 1–2 voltage more than with Ar/20 CO_2 for the same current.

Approvals OK Autrod 12.64

ABS	3SA, 3YSA
DnV	III YMS
LR	3S, 3YS
GL	3YS
BV	SA3, 3YM
Controlas	
DB	42.039.11/QS
RS	6
TÜV	Yes

Typical wire composition %

C	Si	Mn
0.1	1.0	1.7

Typical weld metal [1] composition %

C	Si	Mn
0.1	0.6	1.1

[1] Shielding gas CO_2

Typical mechanical properties. (CO_2)
All weld metal specimens—As welded

Yield stress	470 N/mm²
Tensile strength	590 N/mm²
Elongation	25 %

Charpy V impact value

Test temp.	Joule
–20°C	80

Packing data OK Autrod 12.64

For all wire diameters	Spool	Net weight of wire (kg)
0.8–1.0–1.2–1.6	25–0 76–1 77–1	15 18 18 layer wound

Packing OK Tigrod 12.64
ø 1.6, 2.0 and 2.4 mm.
Length 1000 mm
Packing: tubes 5 kg

OK Autrod 13.09
OK Tigrod 13.09

OK Autrod 13.09 is a wire for gas metal arc welding of low alloy high tensile steel and creep resistant steel of the 0.5 % Mo-type. OK Tigrod 13.09 is for TIG welding.

Classification
(DIN 8575: SG Mo)
(Werkstoff Nr. 1.5424)
AWS A5.28: ER 80S-G
EN 440 G2Mo

Applications
OK Autrod 13.09 is recommended for welding creep resistant steels of similar composition used in e.g. pipes in pressure vessels and boilers with a working temperature up to about 500°C. Also for welding of high tensile steels.

Recommendation for welding
OK Autrod 13.09 is usually welded with mixed gas consisting of 80 % Ar +20 % CO_2.

Welding data MIG

Wire diameter mm	Welding current A (DC+)	Arc voltage V
0.8	40–170	16–22
1.0	80–280	18–28
1.2	120–350	20–33
1.6	225–480	26–38

Approvals OK Autrod 13.09

Dnv	III YMS
DB	42.039.09/QS
TÜV	

Typical wire composition %

C	Si	Mn	Mo
0.1	0.6	1.1	0.5

Typical mechanical properties
All weld metal specimens

Yield stress	500 N/mm²
Tensile strength	600 N/mm²
Elongation	25 %

Charpy V impact values

Test temp.	Impact values
–20°C	50 J

Packing data OK Autrod 13-09

Diameter mm	Spool	Weight of electrode kg
0.8	77–1	18
1.0	77–1	18
1.2	77–1	18
1.6	77–1	18

Packing OK Tigrod 13.09
ø 1.6, 2.0 and 2.4 mm.
Length 1000 mm.
Packing: plastic tubes 5 kg.

OK Autrod 13.12
OK Tigrod 13.12

A copper coated chromium/molybdenum alloyed electrode for gas metal arc welding of low alloy creep resistant steels of the 1 % Cr, 0.5 % Mo type.
OK Tigrod 13.12 for TIG welding.

Classification
DIN 8575: SG Cr Mo1
Werkstoff Nr. 1.7339
AWS A5.28: ER 80S-G

Applications
Welding of Cr-Mo steels of the ASTM 387 B type, and also other high strength low alloy steels, such as Oxelösund OX 600/602, OX 702 and OX 800/802 and USS T1 steel.

Recommendations for welding
For plate thicknesses greater than 8–10 mm, a working temperature of 150–220°C should be maintained to decrease the risk of cracking.
Steels such as OX 600 and OX 800 can often be welded without preheat with OK Autrod 13.12, but when several runs are necessary to fill the joint, preheat is advisable.
Whenever high strength steels are welded, the work should be arranged so that the applied restraint is as low as possible in order to keep residual stresses to a minimum.
In order to prevent the workpiece cooling to room temperature before the weld is finished the joints should be completely welded, without intrerruptions, if possible. The risk of cracking during cooling is less once the joint has been filled.
OK Autrod 13.12 is usually welded with mixed gas consisting of 80 % Ar +20 % CO_2.

Welding data MIG

Wire diameter mm	Welding current A (DC+)	Arc voltage V
0.8	40–170	16–22
1.0	80–280	18–28
1.2	120–350	20–33

Typical wire composition %

C	Si	Mn	Cr	Mo
0.1	0.6	1.0	1.1	0.5

Typical mechanical properties
All weld metal specimens

Treatment	as welded	heat treated[1]
Yield stress (0.2 %) N/mm²	670	480
Tensile strength N/mm²	785	600
Elongation %	18	23
Charpy V impact values		
Test temp. +20°C	40	55

Approvals OK Autrod 13.12
TÜV

[1] Annealed 1/2 h at 700°C.

Packing data OK Autrod 13.12

Diameter mm	Spool	Weight of electrode kg
0.8	77–1	18
1.0	77–1	18
1.2	77–1	18

Packing data OK Tigrod 13.12
ø 1.6, 2.0 and 2.4 mm. Length 1000 mm.
Packing: plastic tubes 5 kg.

OK Autrod 13.13
OK Tigrod 13.13

OK Autrod 13.13 is a low alloy electrode for gas metal arc welding of high tensile strength steels.
OK Tigrod 13.13 are rods for TIG-welding.

Classification
AWS A5. 28: ER 100 S-G

Applications
OK Autrod 13.13 is used for welding of high tensile strength steels with a minimum yield strength (0.2 %) of 610 N/mm² and a minimum tensile strength of 710 N/mm². Also for welding of steels where a good impact strength at lower temperatures is required.

Recommendations for welding
OK Autrod 13.13 is usually welded with shielding gas 80 % Ar +20 % CO_2.
Work and preheat temperature of 150–200°C is often recommended to reduce the risk of cracking especially for plate thicknesses greater than 8–10 mm.
The instructions for the steel to be welded should be followed.

Welding data MIG

Diameter mm	Welding current A (DC+)	Arc voltage V
0.8	40–170	16–22
1.0	80–280	18–28
1.2	120–350	20–33

Typical wire composition %

C	Si	Mn	Cr	Mo	Ni
0.08	0.5	1.1	0.6	0.3	0.5

Typical mechanical properties
All weld metal

	AW	PWHT[1]
Yield stress (0.2 %)	690	660 N/mm²
Tensile strength	770	750 N/mm²
Elongation	20	24 %
Charpy V impact values		
–20°C	75	70J
–40°C	60	50J

[1] Stress relieving 620°C, 1 h.

Packing data
OK Autrod 13.13

Diameter mm	Spool	Weight of electrode kg
0.8	77–1	18
1.0	77–1	18
1.2	77–1	18

OK Tigrod 13.13
ø 1.6, 2.0 and 2.4 m.
Length 1000 mm.
Packing: plastic tubes 5 kg.

OK Autrod 13.26

A Cu-Ni-alloyed electrode for gas metal arc welding weathering steel type USS CORTEN, A, B and C.

AWS A5.28: ER 80S-G

Applications

OK Autrod 13.26 can be welded with CO_2 or 80 % Ar –20 % CO_2 mixture. Argon-Mixture gives the weld higher yield and tensile strength without decreasing the elongation.
The weld metal composition and mechanical properties make OK Autrod 13.26 suitable also for welding high tensile cold tough steel.

Welding data MIG

Wire diameter mm	Welding current A (DC+)	Arc voltage V
0.8	40–170	16–22
1.0	80–280	18–28
1.2	120–350	20–33

Typical wire composition %

C	Si	Mn	Ni	Cu
0.1	0.8	1.4	0.8	0.4

Typical mechanical properties

All weld metal specimens

Shielding gas	Ar/CO_2	CO_2
Yield stress	550	500 N/mm²
Tensile strength	650	625 N/mm²
Elongation	26	25 %
Charpy V impact values		
–20°C	100	60J
0°C	110	80J
+20°C	120	100J

Approvals

DnV	III YMS (DC+, CO_2)
DB	42.039.04/QS

Packing data

Diameter mm	Spool	Weight of electrode kg
0.8	77–1	18
1.0	77–1	18
1.2	77–1	18

OK Autrod 13.91

OK Autrod 13.91 is a wire for gas metal arc hardfacing.

Classification
DIN 8555: MSG-6-GZ-C-6OG

Applications

OK Autrod 13.91 is used for hard facing and gives a highly wear resistant weld metal. Due to the high Cr-content, about 9 %, the weld metal shows relative good resistance to general corrosion.
The weld metal is resistant to softening up to about 550°C.
The wire is used for hardfacing of e.g:
loading machines, road machines, mixers, shovel teeth, different tools and wear parts.

Recomendations for welding

MIG-welding is performed with DC reverse polarity . As shielding gas both CO_2 and Ar + CO_2 mixtures can be used.
Preheating to 200–300°C is recommended if welding on crack sensitive material.

Welding data

Welding process	Wire diameter mm	Welding current A (DC+)
MAG	1.0	100–210
	1.2	150–270

Typical wire composition %

C	Si	Mn	Cr
0.45	3	0.45	9

Weld metal hardness

50–60 HRC

The weld metal can only be worked by grinding.

Packing data

Wire diameter mm	Spool	Weight of electrode kg
1.0	25–1	12.5
1.2	25–1	12.5

OK Tigrod 16.10

OK Tigrod 16.10 are extra low carbon stainless bare rods for TIG welding of corrosion resisting steels containing about 19 % Cr and 10 % Ni.

Classification
AWS A5.9: ER 308L
DIN 8556: X2 Cr Ni 19.9
Werkstoff Nr: 1.4316
BS 2901: 308 S 92
AS 1167.2: R 308L

Applications
The welding of austenitic corrosion resisting steels such as AISI 301, 304, 304L and equivalent types.

Typical wire composition %

C	Si	Mn	Cr	Ni
≤0.025	0.4	1.8	20	10

Typical mechanical properties
All weld metal specimens

Yield stress (0.2 %)	450 N/mm²
Yield stress (1.0 %)	510 N/mm²
Tensile strength	645 N/mm²
Elongation	36 %

Charpy V impact strength

Temp	Impact value
+20°C	140J
–196°C	70J

Approvals
DnV 308 LMS
TÜV

Packing data
ø 1.2, 1.6, 2.0, 2.4, 3.2 and 4.0 mm.
Length 1000 mm.
Packing: plastic tubes 5 kg.

OK Autrod 16.11
OK Tigrod 16.11

OK Autrod 16.11 is a niobium stabilized 20 Cr 10 Ni wire for metal inert gas welding (MIG).
OK Tigrod 16.11 are bare rods for TIG welding.

Classification
AWS A5.9: ER 347 Si
DIN 8556: X 5 Cr Ni Nb 19 9
Werkstoff Nr: 1.4551
AS 1167.2: R 347 (Tigrod)

Applications
OK Autrod 16.11 is intended for MIG welding stainless steel corresponding to AISI 347 and AISI 321. Shielding gas:
Ar + 1–3 % O_2 or Ar + 2 % CO_2.
OK Tigrod 16.11 is intended for TIG welding.

Welding data MIG

Wire diameter mm	Welding current A (DC+)	Arc voltage V
0.8	50–140	16–22
1.0	80–190	16–24
1.2	180–280	20–28
1.6	230–350	24–28

Typical wire composition %

C	Si	Mn	Cr	Ni	Nb
≤0.07	0.8	1.8	20	10	0.7

Typical mechanical properties
All weld metal specimens

Yield stress (0.2 %)	440 N/mm²
Tensile strength	650 N/mm²
Elongation	37 %

Charpy V impact value

Temp	Impact value
–60°C	80J

Approvals OK Autrod 16.11
TÜV

Packing data

Diameter mm	Spool	Weight of electrode kg
0.8	77–0	15
1.0	77–0	15
1.2	77–0	15
1.6	77–0	15

OK Tigrod 16.11
ø 1.6, 2.0, 2.4 and 3.2
Length 1000 mm
Packing: Plastic tubes 5 kg.

OK Autrod 16.12

An extra low carbon stainless wire for metal inert gas welding (MIG) and mechanized TIG welding of corrosion resisting steels containing about 19 % Cr and 10 % Ni.

Classification
AWS A5.9: ER 308 L Si
DIN 8556: X 2 Cr Ni 19 9
Werkstoff Nr: 1.4316
BS 2901: 308 S 93

Applications
The welding of austenitic corrosion resisting steels such as AISI 304, 304L and equivalent types.

Recommendations for welding
For plate thicknesses less than 3 mm, short arc welding is easier to apply than spray arc welding. The root run in prepared joints is also easier to deposit by short arc welding, but the remaining runs can be put down quicker with spray arc welding.
As shielding gas, argon containing 1–3 % oxygen is used.

Welding data MIG

Wire diameter mm	Welding current A (DC+)	Arc voltage V
0.6	40– 60	14–20
0.8	50–140	16–22
1.0	80–190	16–24
1.2	180–280	20–28
1.6	230–350	24–28

Typical wire composition %

C	Si	Mn	Cr	Ni
≤0.025	0.85	1.8	20	10

Typical mechanical properties
All weld metal specimens

Yield stress (0.2 %)	470 N/mm²
Yield stress (1.0 %)	510 N/mm²
Tensile strength	620 N/mm²
Elongation	36 %

Charpy V impact value

Temp.	Impact value
–60°C	90J

Approvals
DnV: 308 L Si Ms
DB: 43.039.01/QS
TÜV

Packing data

Diameter mm	Spool	Weight of electrode kg
0.6	46–0	5
0.8	77-0/46–0	15/5
1.0	77–0	15
1.2	77–0	15
1.6	77–0	15

OK Tigrod 16.30

OK Tigrod 16.30 are extra low carbon stainless bare rods for TIG welding of corrosion resisting steels containing about 18 % Cr, 12 % Ni and 3 % Mo.

Classification
AWS A5.9: ER 316 L
DIN 8556: X2 Cr Ni Mo 19 12
Werkstoff Nr: 1.4430
BS 2901: 316 S 92
AS 1167.2: R 316 L

Applications
The welding of austenitic corrosion resisting and acid resisting steels of the AISI 316 and 316L or somewhat lower alloyed types.

Typical wire composition %

C	Si	Mn	Cr	Ni	Mo
≤0.025	0.4	1.8	18.5	12	2.7

Typical mechanical properties
All weld specimens

Yield stress (0.2 %)	470 N/mm²
Yield stress (1.0 %)	510 N/mm²
Tensile strength	650 N/mm²
Elongation	32 %

Charpy V impact value

Temp.	Impact value
–60°C	120J

Approvals
DnV: 316 LMS
Controlas: sheet no 061693
TÜV

Packing data
ø 1.2, 1.6, 2.0, 2.4, 3.2 and 4.0 mm
Length 1000 mm
Packing: Plastic tubes 5 kg.

OK Autrod 16.31
OK Tigrod 16.31

OK Autrod 16.31 is a niobium stabilized 19 Cr 12 Ni 3 Mo wire for metal inert gas welding (MIG).
OK Tigrod 16.31 are rods for TIG welding.

Classification
AWS A5.9: ER 318 Si
DIN 8556: X 5 Cr Ni Mo Nb 19 12
Werkstoff Nr: 1.4576

Applications
OK Autrod 16.31 is intended for MIG welding of Ti and Nb stabilized stainless steels of 18 Cr 12 Ni 3 Mo type.

Welding data MIG

Wire diameter mm	Welding current A (DC+)	Arc voltage V
0.8	50–140	16–22
1.0	80–190	16–24
1.2	180–280	20–28
1.6	230–350	24–28

Typical wire composition %

C	Si	Mn	Cr	Ni	Mo	Nb
≤0.07	0.8	1.8	19	12	2.6	0.7

Typical mechanical properties
All weld metal specimens

Yield stress (0.2 %)	460 N/mm²
Yield stress (1.0 %)	480 N/mm²
Tensile strength	615 N/mm²
Elongation	35 %

Charpy V impact value

Temp.	Impact value
–60°C	70J

Approvals OK Autrod 16.31
DB: 52.039.11/QS
TÜV

Packing data

Wire diameter mm	Spool	Weight of electrode kg
0.8	77–0	15
1.0	77–0	15
1.2	77–0	15
1.6	77–0	15

OK Tigrod 16.31
ø1.6, 2.0, 2.4 and 3.2 mm.
Length 1000 mm.
Packing: plastic tubes 5 kg

OK Autrod 16.32

An extra low carbon stainless wire for metal inert gas welding (MIG) and mechanized TIG welding of corrosion resisting steels containing about 18 % Cr, 12 % Ni and 3 % Mo.

Classification
AWS A5.9: ER 316 L Si
DIN 8556: X 2 Cr Ni Mo 19 12
Werkstoff Nr. 1.4430
BS 2901: 316 S93

Applications
The welding of austenitic corrosion resisting and acid resisting steels of the AISI 316 and 316L or somewhat lower alloyed types.

Recommendations for welding
For plate thickneses less than 3 mm, short arc welding is easier to apply than spray arc welding. The root run in bevelled joints is also easier to deposit by the short arc process, but the remainder of the joint can be filled quicker by spray arc welding.
As shielding gas, argon containing 1–3 % oxygen is used.

Welding data MIG

Wire diameter mm	Welding current A (DC+)	Arc voltage V
0.6	40– 60	14–20
0.8	50–140	16–22
1.0	80–190	16–24
1.2	180–280	20–28
1.6	230–350	24–28

Typical wire composition %

C	Si	Mn	Cr	Ni	Mo
≤0.025	0.85	1.8	18.5	12	2.7

Typical mechanical properties
All weld metal specimens

Yield stress (0.2 %)	440 N/mm²
Yield stress (1.0 %)	480 N/mm²
Tensile strength	620 N/mm²
Elongation	37 %

Charpy V impact value

Temp.	Impact value
–60°C	100J

Approvals
DnV: 316 LSIMS
DB: 43.039.05/QS
TÜV

Packing data

Wire diameter mm	Spool	Weight of electrode kg
0.6	46–0	5
0.8	77–0/46–0	15/5
1.0	77–0	15
1.2	77–0	15
1.6	77–0	15

OK Autrod 16.52

A 24 % Cr 13 % Ni stainless steel wire for metal inert gas welding (MIG). Shielding gas Ar + 1–3 % O_2 or Ar + 2 % CO_2.

Classification
AWS A5.9: ER 309 Si

Applications
OK Autrod 16.52 is used for welding stainless steel of similar type used in heat treatment equipment, furnace parts, heat exchangers and pump parts but also for steels which are difficult to weld as ferritic and martensitic 13 % chromium steel.
OK Autrod 16.52 is also recommended for joining dissimilar steels such as "18–8" to mild steel and stainless sheet linings to mild steel shells.

Welding data MIG

Wire diameter mm	Welding current A (DC+)	Arc voltage V
0.8	50–140	16–22
1.0	80–190	16–24
1.2	180–280	20–28
1.6	230–350	24–28

Typical wire composition %

C	Si	Mn	Cr	Ni
≤0.08	0.8	1.8	23.5	13.5

Typical mechanical properties
All weld metal specimens

Yield stress (0.2 %)	440 N/mm²
Tensile strength	640 N/mm²
Elongation	35 %
Hardness	180 HB

Charpy V impact value

Temp.	Impact value
–60°C	80J
+20°C	100J

Packing data

Wire mm	Spool	Weight of electrode kg
0.8	77–0	15
1.0	77–0	15
1.2	77–0	15
1.6	77–0	15

OK Autrod 16.53
OK Tigrod 16.53

OK Autrod 16.53 is an extra low carbon 24 % Cr 13 % Ni stainless welding wire for metal inert gas welding (MIG).
OK Tigrod 16.53 are bare rods for TIG-welding.

Classification
AWS A5.9: ER 309 L
DIN 8556: X 2 Cr Ni 24 12
Werkstoff Nr: 1.4332
BS 2901: 309 S 92
AS 1167.2: R 309 L (Tigrod)

Applications
OK Autrod 16.53 is used for welding similar alloys in wrought or cast forms. OK Autrod 16.53 is also suitable for welding of "18–8" steel when severe corrosion conditions exist which require higher alloy content weld metal.
OK Autrod 16.53 is especially recommended for joining dissimilar steels such as "18–8" to mild steel and for stainless surfacing of mild steel, carbon steel and low alloy steel.

Recommendations for welding
MIG-welding is performed with DC-reverse polarity. As shielding gas argon with 1–3 % oxygen is used.

Welding data

Welding process	Wire diameter mm	Welding current A (DC+)	Arc voltage V
MIG	0.8	50–140	16–22
	1.0	80–190	16–24
	1.2	180–280	20–28
	1.6	230–350	24–28

Typical wire composition %

C	Si	Mn	Cr	Ni
≤0.025	0.4	1.8	24	13

Typical mechanical properties
All weld metal specimens

Yield stress (0.2 %)	440 N/mm²
Tensile strength	600 N/mm²
Elongation	41 %

Charpy V impact value

Temp.	Impact value
–60°C	130J
+20°C	160J

Packing data OK Autrod 16.53

Wire diameter mm	Spool	Weight of electrode kg
0.8	77–0	15
1.0	77–0	15
1.2	77–0	15
1.6	77–0	15

OK Tigrod 16.53
ø 1.6, 2.0, 2.4 and 3.2 mm
Length 1000 mm
Packing: plastic tubes 5 kg.

OK Autrod 16.86
OK Tigrod 16.86

OK Autrod 16.86 is a corrosion-resisting wire for MIG-welding of austenitic-ferritic, "Duplex", stainless steels.
OK Tigrod 16.86 are bare rods for TIG-welding.

Classification
AWS A5.9: ER 2209
BS 2901: 22.83 S 92

Applications
OK Autrod/Tigrod 16.86 is used for welding of "Duplex" stainless steels like: Werkstoff Nr 1.4462, SAF 2205, Avesta 2205 and SS 2377.
The weld metal has a high resistance to general corrosion, intergranular and pitting corrosion and especially to stress corrosion in chloride containing media and media containing hydrogen sulphide.

Recommendations for welding
MIG-welding is perfomed with DC-reverse polarity.
As shielding gas, argon with 1–3 % oxygen is used.

Welding data

Welding process	Wire diameter mm	Welding current A (DC+)	Arc voltage V
MIG	0.8	50–140	16–22
	1.0	80–190	16–24
	1.2	180–280	20–28
	1.6	230–350	24–28

Typical wire composition %

C	Si	Mn	Cr	Ni	Mo	N
≤0.020	0.5	1.5	23	9	3	0.15

Typical mechanical properties
All weld metal specimens

Yield stress (0.2 %)	600 N/mm²
Tensile strength	765 N/mm²
Elongation	28 %

Charpy V impact value

Temp.	Impact value
–60°C	60J
–20°C	85J
+20°C	100J

Packing data OK Autrod 16.86

Wire diameter mm	Spool	Weight of electrode kg
0.8	77–0	15
1.0	77–0	15
1.2	77–0	15
1.6	77–0	15

OK Tigrod 16.86
ø1.6, 2.0, 2.4 and 3.2 mm
Length 1000 mm
Packing: plastic tubes 5 kg

OK Autrod 16.95
OK Tigrod 16.95

An austenitic stainless welding wire with a high manganese content. Especially designed for joining dissimilar types of steel and for joining steel difficult to weld, using metal inert gas welding (MIG).
OK Tigrod are bare rods for TIG-welding.

Classification
AWS A5.9: (ER 307)
DIN 8556: SG X 15 Cr Ni Mn 18 8
Werkstoff Nr: 1.4370

Applications
OK Autrod 16.95 is designed for MIG welding with Ar + 2–3 % O_2 or Ar + 2 % CO_2 as shielding gas.
OK Autrod 16.95 is used mainly for joining 18–8 steel to carbon steel and low alloy steel and other cases of joining quite dissimilar types of steel.
The weld metal remains austenitic and tough also in diluted condition. The tough weld metal is able to absorb high welding stresses, which is important particulary when welding rigid structures.

Welding data MIG

Wire diameter mm	Welding current A (DC+)	Arc voltage V
0.8	50–140	16–22
1.0	80–190	16–24
1.2	180–280	20–28
1.6	230–350	24–28

Typical wire composition %

C	Si	Mn	Cr	Ni
≤0.20	0.4	7	18	8

Typical mechanical properties
All weld metal specimens

Yield stress (0.2 %)	450 N/mm²
Tensile strength	640 N/mm²
Elongation	42 %

Charpy V impact value

Temp.	Impact value
+20°C	130J

Approvals OK Autrod 16.95
DB: 43.039.10/QS
TÜV

Packing data OK Autrod 16.95

Wire diameter mm	Spool	Weight of electrode kg
0.8	77–0	15
1.0	77–0	15
1.2	77–0	15
1.6	77–0	15

OK Tigrod 16.95
ø 1.6, 2.0, 2.4 and 3.2 mm
Length 1000 mm
Packing: plastic tubes 5 kg.

OK Autrod 18.01 and 18.11
OK Tigrod 18.01 and 18.11

Pure aluminium electrodes (99.5 % Al) for inert gas metal arc welding (MIG) of unalloyed aluminium.
OK Autrod 18.11 has a small addition of titanium which improves the weldability.
OK Tigrod 18.01 and 18.11 are bare rods for TIG welding.

Classification 18.01
(AWS A5.10: ER 1100)
DIN 1732: S-Al 99.5
SS 144017
BS 2901: 1050A
Classification 18.11
DIN 1732: S-Al 99.5 Ti
SS 144067
AS 2717.2: E 1100

Applications
OK Autrod 18.01 and 18.11 are intended for automatic and semi-automatic gas metal arc welding of unalloyed aluminium corresponding to SS aluminium 4005, 4007, 4008 and 4010.
For equivalent specifications see table 9, page 282.

Recommendations for welding
The joint faces and the electrode must be as clean as possible, since even small amounts of grease, moisture or aluminium oxide can give rise to defects in the welds. When making butt welds a copper or aluminium backing bar can be used to quicken solidification of the melt and prevent burnthrough. When an aluminium backing bar is used, it should be thicker than the plate being welded. Pure argon is normally used as shielding gas. The gas consumption for short arc welding is 6–10 litres/min. and for spray arc welding 12–22 litres/min. The higher the welding current, the larger the quantity of gas required

Typical wire composition %

Al	Zn	Fe
99.5 min.	<0.07	<0.40

18.11 has additionally 0.10–0.20 % Ti

Typical weld metal tensile strength

18.01	75 N/mm²
18.11	90 N/mm²

Approvals
OK Autrod/Tigrod 18.11
TÜV

Typical welding data MIG

Wire diameter mm	Welding current A (DC+)	Arc voltage V
0.8	60–120	20–24
1.0	90–180	22–26
1.2	120–200	22–28
1.6	150–280	24–30
2.4	250–370	26–32

Packing data
OK Autrod 18.01 and 18.11

Wire diameter mm	Spool type	Weight of electrode kg
0.8	24*–5	6
1.0	24 –5	6
1.2	24 –5	6
1.6	24 –5	6
2.4	24*–5	6

Packing data
OK Tigrod 18.01 and 18.11

Diameter mm	Length mm	Plastic tubes Weight of rod kg
1.6	1000	2.5
2.4	1000	2.5
3.2	1000	2.5
5.0*	1000	2.5

* Not normally kept in stock.

OK Autrod 18.04
OK Tigrod 18.04

An aluminium-5 % silicon electrode for metal inert gas (MIG) welding and mechanized tungsten inert gas (TIG) welding of Al-Si-alloys and Al-Mg-Si-alloys containing up to 7 % silicon.
OK Tigrod 18.04 are bare rods for TIG welding.

Classification
AWS A5.10: ER 4043
DIN 1732: S-Al Si 5
SS 144225
BS 2901: 4043 A
AS 2717.2: E 4043

Applications
OK Autrod 18.04 is for automatic and semi automatic gas metal arc welding. It is recommended for welding SS-aluminium alloys: 4104, 4212, 4244, 4251, 4253 and equivalent alloys according to other standards. For equivalent specifications please refer to table 9, page 282.

Recommendations for welding
The joint faces and the electrode must be as clean as possible, since even small amounts of grease, moisture or aluminium oxide can give rise to defects in the welds. When making butt welds, a copper or aluminium backing bar can be used to speed up solidification of the molten metal and prevent burn-through. When an aluminium backing bar is used, it should be thicker than the plate being welded. Pure argon is normally used as shielding gas.
The gas consumption for short arc welding is 6–10 litres/min. and for spray arc welding 12–22 litres/min. The higher the welding current, the larger the quantity of gas required.

Typical wire and rod composition %

Si	Mn	Fe	Zn	Al
5	<0.05	<0.4	<0.1	rest

Typical weld metal tensile strength
165 N/mm²

Approvals OK Autrod 18.04
DB: 61.039.05/QS

Typical welding data MIG

Wire diameter mm	Welding current A (DC+)	Arc voltage V
0.8	80–120	20–24
1.0	90–180	22–26
1.2	130–220	22–28
1.6	190–320	24–30
2.4	270–380	26–32

Packing data
OK Autrod 18.04

Wire diameter mm	Spool	Weight of electrode kg
0.8	24*–5	6
1.0	24 –5	6
1.2	24 –5	6
1.6	24 –5	6
2.4	24*–5	6

Packing data
OK Tigrod 18.04

Diameter mm	Length mm	Plastic tubes weight of rod kg
1.6	1000	2.5
2.4	1000	2.5
3.2	1000	2.5
5.0*	1000	2.5

* Not normally kept in stock.

OK Autrod 18.15
OK Tigrod 18.15

A magnesium alloyed wire containing 5 % Mg for the metal inert gas (MIG) welding and mechanized TIG welding of sea water corrosion-resistant Al-Mg alloys. More crack resistant than Al-Mg alloys having a lower Mg content.

Classification
AWS A5.10: ER 5356
DIN 1732: S-Al Mg 5
SS 144146
BS 2901: 5356
AS 2717.2: E 5356

Applications
OK Autrod 18.15 is for automatic and semi-automatic gas metal arc welding of aluminium-magnesium alloys having a magnesium content of up to 5 %. For equivalent specifications please refer to table 9, page 282.

Recommendations for welding
The joint faces and the electrode must be as clean as possible, since even small amounts of grease, moisture or aluminium oxide can give rise to defects in the welds. When making butt welds, a copper or aluminum backing bar can be used to speed up solidification of the molten metal and prevent burn-through. When an aluminium backing bar is used, it should be thicker than the plate being welded. Pure argon is normally used as shielding gas. The gas consumption for short arc welding is 6–10 litres/min. and for spray arc welding 12–22 litres/min. The higher the welding current, the larger the quantity of gas required.

Typical wire composition %

Mg	Fe	Si	Mn	Al
5	<0.4	<0.25	<0.2	rest

Typical weld metal tensile strength
265 N/mm²

Approvals
DnV: Al Mg 5 (5056)
DB: 61.039.01/QS
TÜV

Typical welding data MIG

Wire diameter mm	Welding current A (DC+)	Arc voltage V
0.8	80–120	20–24
1.0	90–180	22–26
1.2	130–200	22–28
1.6	170–300	24–30
2.4	270–380	26–32

Packing data
OK Autrod 18.15

Wire diameter mm	Spool	Weight of electrode kg
0.8	24*–5	6
1.0	24 –5	6
1.2	24 –5	6
1.6	24 –5	6
2.4	24*–5	6

Packing data
OK Tigrod 18.15

Diameter mm	Length mm	Plastic tubes weight of rod kg
1.6	1000	2.5
2.4	1000	2.5
3.2	1000	2.5
5.0*	1000	2.5

* Not normally kept in stock.

OK Autrod 18.16
OK Tigrod 18.16

OK Autrod 18.16 is a magnesium-manganese alloyed aluminium electrode, type Al Mg 4.5 Mn, for metal inert gas (MIG) welding of alloys with the same composition.
OK Tigrod 18.16 are bare rods for TIG-welding.

Classification
AWS A5.10: ER 5183
DIN 1732: S-Al Mg 4.5 Mn
BS 2901: 5183
AS 2712.2: E 5183

Applications
OK Autrod 18.16 is intended for automatic and semi-automatic gas metal arc welding. It is recommended for welding of SS aluminium 4140 and equivalent specifications according to other standards. Please refer to table 9, page 282.

Recommendations for welding
The joint faces and the electrode must be as clean as possible, since even small amounts of grease, moisture or aluminium oxide can give rise to defects in the welds. When making butt welds, a copper or aluminium backing bar can be used to speed up solidification of the molten metal and prevent burn-through. When an aluminium backing bar is used, it should be thicker than the plate being welded. Pure argon is normally used as shielding gas. The gas consumption for short arc welding is 6–10 litres/min. and for spray arc welding 12–22 litres/min. The higher the welding current, the larger the quantity of gas required.

Typical welding data MIG

Wire diameter mm	Welding current A (DC+)	Arc voltage V
0.8	60–120	20–24
1.0	90–180	22–26
1.2	120–200	22–28
1.6	150–280	24–30
2.4	250–370	26–32

Typical wire composition %

Mg	Mn	Fe	Si	Al
4.8	0.7	<0.4	<0.25	rest

Typical weld metal tensile strength
285 Nmm²

Approvals
DnV: Al Mg 4.5 Mn (5083)
DB: 61.039.03/QS
TÜV

Packing data
OK Autrod 18.16

Wire diameter mm	Spool	Weight of electrode kg
0.8	24*–5	6
1.0	24 –5	6
1.2	24 –5	6
1.6	24 –5	6
2.4	24*–5	6

OK Tigrod 18.16
ø 1.6, 2.4, 3.2 and 5.0* mm
Length 1000 mm
Packing: plastic tubes 2.5 kg

* Not normally kept in stock.

OK Autrod 19.12

A copper wire for metal inert gas (MIG) and mechanized tungsten inert gas (TIG) welding of pure and low alloy copper.

Classification
AWS A5.7:ER Cu
DIN 1733: S-Cu Sn
Werkstoff Nr: 2.1006

Applications
OK Autrod 19.12 is intended for spray arc welding of pure and low alloy copper using pure argon as the shielding gas. It can be used for welding the following qualities:
Electrolytic tough pitch copper.
Oxygen-free copper
Phosphorous deoxidized copper.

Recommendations for welding
Normally the welding of copper is only carried out in the flat position. Butt joints in copper should be welded from both sides.
One-side welding in thicknesses from 5–6 mm and upwards should be bevelled 35–60° for complete penetration. Preheat, 200–600°C is usually necessary for plate thicknesses greater than 5 mm.
The greater the plate thickness, the higher the preheat and interpass temperature required.

Typical wire composition %

Mn	Si	Sn	Cu
0.25	0.25	0.7	min 98

Typical mechanical properties
All weld metal specimens

Tensile strength	170–200 N/mm²
Elongation	25–30 %
Hardness	50 HV approx

Typical welding data

Diameter mm	Current A (DC+)	Arc voltage V
1.2	150–300	27–28
1.6	250–400	29–30

Packing data

Diameter mm	Spool	Weight of electrode kg
1.2	24–3	12
1.6	24–3	12

OK Autrod 19.40

An aluminium bronze wire for metal inert gas (MIG) welding and mechanized tungsten inert gas (TIG) welding.

Classification
(AWS A5.7:ER Cu Al A1)
DIN 1733: S-Cu Al 8
Werkstoff Nr: 2.0921

Applications
OK Autrod 19.40 is intended for welding and cladding rolled and cast aluminium bronze alloys by spray arc welding in pure argon. This type of alloy is noted for its high strength, good wear resistance and very good corrosion resistance, particularly in salt water. It is therefore used extensively for welding and repairing of ships screws.
OK Autrod 19.40 can also be used for cladding steel surfaces, e.g. shafts and axles, where local improvement in corrosion resistance is required, and for butt welding steel to weldable copper alloys.

Recommendations for welding
When welding bronze in butt joints, the plates should be bevelled if their thickness exceeds 5–6 mm. In certain cases, vertical-up welding is possible.
As a rule, preheat is not necessary when welding aluminium bronze.

Typical wire composition %

Al	Fe	Mn	Cu
8	<0.5	<1.8	rest

Typical mechanical properties
All weld metal specimens

Tensile strength	440–490 N/mm²
Elongation	25 %
Hardness	130–150 HV

Typical welding data

Diameter mm	Welding current A (DC+)	Arc voltage V
1.2	150–300	27–28
1.6	250–400	29–30

Packing data

Diameter mm	Spool	Weight of electrode kg
1.0	24*-3	12
1.2	24 -3	12
1.6	24 -3	12

* Not normally kept in stock.

OK Autrod 19.82
OK Tigrod 19.82

OK Autrod 19.82 is a corrosion and heat resisting nickel-chromium wire for welding of high-alloyed materials.
OK Tigrod 19.82 are bare rods for TIG-welding.

Classification
AWS A5.14: ER Ni Cr Mo-3
DIN 1736: SG Ni Cr 21 Mo 9 Nb
Werkstoff Nr: 2.4831

Applications
OK Autrod 19.82 is used for welding of high alloyed heat-resisting and corrosion resisting materials, 9 %-Ni-steels and similar steels with high notch toughness at low temperatures. Also for joining of dissimilar metals of the types mentioned. The weld metal has very good mechanical properties at high as well as low temperatures. Good resistance to pitting and stress corrosion.

Recommendations for welding
MIG-welding is performed with DC reverse polarity.
As shielding gas an inert gas, like pure argon, is used.

Welding data

Welding process	Wire diameter mm	Welding current A (DC+)
MIG	0.8	70–190
	1.0	100–200
	1.2	160–280
	1.6	200–350

Typical wire composition %

Ni	Cr	Mo	Nb
min 60	22	9	3.5

Typical mechanical properties
All weld metal specimens

Yield stress (0.2 %)	500 N/mm²
Tensile strength	800 N/mm²
Elongation	38 %

ISO V impact value

Temp.	Impact value
–196°C	110J/cm²
–105°C	120J/cm²
+ 20°C	130J/cm²

Approvals OK Autrod 19.82
TÜV

Packing data
OK Autrod 19.82

Wire diameter mm	Spool	Weight of electrode kg
0.8	77–0	15
1.0	77–0	15
1.2	77–0	15
1.6	77–0	15

OK Tigrod 19.82
ø 1.6, 2.0, 2.4 and 3.2 mm
Length 1000 mm
Packing: plastic tubes 5 kg

OK Autrod 19.85
OK Tigrod 19.85

OK Autrod 19.85 is a corrosion and heat resisting nickel-chromium wire for welding of high-alloyed materials.
OK Tigrod 19.85 are bare rods for TIG-welding.

Classification
AWS A5.14: ER Ni Cr-3
DIN 1736: SG Ni Cr 20 Nb
Werkstoff Nr: 2.4806

Applications
OK Autrod 19.85 is used for welding of high alloyed heat resisting and corrosion resisting materials, 9 %-Ni-steels and similar steels with high notch toughness at low temperatures. Also for joining of dissimilar metals of the types mentioned. The weld metal has very good mechanical properties at high as well as low temperatures. Good resistance to stress corrosion.

Recommendations for welding
MIG welding is performed with DC reverse polarity.
As shielding gas an inert gas like pure argon is used.

Welding data

Welding process	Wire diameter mm	Welding current A (DC+)
MIG	0.8	70–190
	1.0	100–200
	1.2	160–280
	1.6	200–350

Typical wire composition %

Ni	Cr	Nb	Mn
min 67	20	2.5	3

Typical mechanical properties
All weld metal specimens

Yield stress	425 N/mm²
Tensile strength	700 N/mm²
Elongation	44 %

ISO V impact values

Temp.	Impact value
–196°C	145J/cm²
+ 20°C	150J/cm²

Approvals
TÜV

Packing data

Wire diameter mm	Spool	Weight of electrode kg
0.8	77–0	15
1.0	77–0	15
1.2	77–0	15
1.6	77–0	15

OK Tigrod 19.85
ø 1.6, 2.0, 2.4 and 3.2 mm
Length 1000 mm
Packing: plastic tubes 5 kg

Flux and Metal Cored Wires

List of products

OK Tubrod 14.00

OK Tubrod 14.00 is metal cored tubular wire for welding mild and medium tensile steels with a nominal tensile strength of 510 N/mm². It is depositing low hydrogen, typically 5 ml/100 g weld metal.
Shielding gas Ar + 20 % CO_2.
Polarity DC+ or DC–.
The wire burns with a deep penetrating arc giving good penetration in the root of fillet welds and the side walls of butt welds, reducing the chance of lack of fusion defects associated with MIG/MAG welding using solid wire. The 1.0 mm, 1.2 mm and 1.4 mm sizes permit all positional welding including overhead.

Slag levels are comparable with solid wire often allowing multipass welding without inter-pass deslagging.

Classification
AWS A5.18–93
E7OC–6M

Applications
Applications are for the welding of carbon-manganese steels greater than 5 mm thick used extensively in general fabrication e.g. the fabrication of beams, trailers, boilers and steel framed structures. OK Tubrod 14.00 produces a very low level of slag, similar in volume to that produced when using a solid wire, and hence inter-run deslagging is not necessary. This combined with the deep penetrating arc makes the wire ideally suited to use on welding robots.

Welding data DC– and DC+

Diameter mm	Welding position	Current amps	Volts
1.0	F.H.V.O.	110–280	14–33
1.2	F.H.V.O.	120–350	14–35
1.4	F.H.V.O.	140–380	14–36
1.6	F.H.	150–400	18–36
2.0	F.H.	300–450	30–36
2.4	F.H.	350–550	30–38

Typical weld metal composition %

C	Si	Mn
0.06	0.8	1.2

Typical mechanical properties
All weld metal

Yield stress	460 N/mm²
Tensile strength	540 N/mm²
Elongation	28 %

Charpy V

Test. temp	Impact values
0°C	60J

Approvals

ABS	2SA, 2YSA
BV	SA2YMH
DnV	IIYMS (HH)
LR	2S, 2YS, H 15
GL	2YHHS
CO	CDS 0115
FORCE	E51 2M (H)
RS	3YMS HH
DB	42.039.10
TÜV	4311

Packing data

Diameter mm	Spool	Weight (kg)
1.0, 1.2	46–0	5
1.0, 1.2, 1.4, 1.6, 2.0, 2.4	25–0	15
2.4	07–3	25

OK Tubrod 14.01

OK Tubrod 14.01 is a metal cored tubular wire containing copper especially for the welding of Corten A & B and similar weathering steels or other high tensile structural steels with a tensile strength up to 510 N/mm².
Shielding gas Ar + 20 % CO_2
polarity DC–
Slag levels are comparable with solid wire often allowing multipass welding without inter-pass deslagging.

Classification
Nearest AWS A5.29–80
E70T–G

Applications
Bridge and general structural steelwork, ships and chimneys.

Welding data
DC electrode negative

Diameter mm	Welding position	Current amps	Volts
1.6	F.H.	150–400	18–36

Typical weld metal composition %

C	Si	Mn	Cu
0.06	0.8	1.2	0.4

Typical mechanical properties
All weld metal

Yield stress	490 N/mm²
Tensile strength	580 N/mm²
Elongation	27 %

Charpy V

Test. temp	Impact values
0°C	60J

Approvals
BSC for Corten A & B
BS 4360 weathering steels
FORCE E51 3M (H)

Packing data

Diameter mm	Spool	Weight kg
1.6	25–0	15

OK Tubrod 14.02

OK Tubrod 14.02 is a metal cored tubular wire similar to 14.00 with an addition of Mo for use on high tensile and quenched and tempered steels with tensile strengths up to 550 N/mm².
Shielding gas Ar + 20 % CO_2
Polarity DC–
Slag levels are comparable with solid wire often allowing multipass welding without inter-pass deslagging.

Classification
Nearest AWS A5.29–80
E81TG–A1

Applications
Marine structures, heavy machinery and high strength applications requiring good notch ductility.

Welding data
DC electrode negative

Diameter mm	Welding position	Current amps	Volts
1.2	F.H.V.O.	120–350	14–35
1.6	F.H.	150–400	18–36

Typical weld metal composition %

C	Si	Mn	Mo
0.06	0.5	1.5	0.5

Typical mechanical properties
All weld metal

Yield stress	580 N/mm²
Tensile strength	640 N/mm²
Elongation	20 %

Charpy V

Test. temp	Impact values
–30°C	50J

Packing data

Diameter mm	Spool	Weight kg
1.6	25–0	15
1.2	25–0	15

OK Tubrod 14.03

OK Tubrod 14.03 is a metal cored tubular wire alloyed with nickel and molybdenum to provide extra high strength with good notch ductibility down to –50°C. The 1.2 mm and 1.4 mm sizes are available to cater for out of position welding.
Shielding gas Ar +20 % CO_2
Polarity DC–
Slag levels are comparable with solid wire often allowing multipass welding without inter-pass deslagging.

Classification
Nearest AWS A5.29–80
E111TG–K3

Applications
Typical applications for the electrode would be the welding of offshore jack-up structures and general structural fabrication of high tensile steels for low temperature service, examples of which are the quenched and tempered steels, RQT 701, USS T1A and B, HY80 and Q1N.

Welding data
DC electrode negative

Diameter mm	Welding position	Current amps	Volts
1.2	F.H.V.O.	120–350	14–35
1.4	F.H.V.O.	140–380	14–36
1.6	F.H.	150–400	18–36

Typical weld metal composition %

C	Si	Mn	Ni	Mo
0.06	0.4	1.4	2.0	0.5

Typical mechanical properties
All weld metal

Yield stress	710 N/mm²
Tensile strength	780 N/mm²
Elongation	20 %

Charpy V

Test. temp	Impact values
–50°C	60J

Approvals

RS	5YMSHH (–50)
DB	42.039.23
TÜV	4143

Packing data

Diameter mm	Spool	Weight kg
1.4	25–0	15
1.6	25–0	15
1.2	25–0	15

OK Tubrod 14.04

OK Tubrod 14.04 is a metal cored tubular wire containing nickel for applications that require –60°C impact properties, e.g. offshore.
Shielding gas Ar + 20 % CO_2
Polarity DC–
The 1.2 mm and 1.4 mm diameter wires are suitable for all positional welding using the dip transfer mode whilst the larger diameter wire used in the spray transfer mode permits high deposition rate welding in the downhand and horizontal-vertical positions.
Slag levels are comparable with solid wire often allowing multipass welding without inter-pass deslagging.

Classification
Nearest AWS A5.29–80
E71TG–Ni2

Applications
All general fabrication and structural steelwork including offshore equipment where sub-zero impact properties are of prime importance.

Welding data
DC electrode negative

Diameter mm	Welding position	Current amps	Volts
1.2	F.H.V.O.	100–260	17–25
1.4	F.H.V.O.	120–330	18–28
1.6	F.H.	150–400	18–36

Typical weld metal composition %

C	Si	Mn	Ni
0.05	0.3	1.0	2.2

Typical mechanical properties
All weld metal

Yield stress	480 N/mm²
Tensile strength	540 N/mm²
Elongation	24%

Charpy V

Test. temp –60°C	Impact values 70J

Approvals

ABS	3SA, 3YSA
LR	3S, 5Y40S H15 CMn LT 60
DnV	III YMS (HH), NV 2–4, NV 4–4
BV	UPHH KV–60
GL	7YHHS (–70)
RS	5YMSHH (–60)
FORCE	E51 5M (H)
TÜV	4298

Packing data

Diameter mm	Spool	Weight kg
1.2	25–0	15
1.4	25–0	15
1.6	25–0	15

OK Tubrod 14.05

OK Tubrod 14.05 is a metal cored tubular wire containing 1 % nickel for toughness properites down to –40°C.
Available in a wide range of sizes including 1.0 mm which is ideal for root passes when used for one sided welding.
Shielding gas Ar + 20 % CO_2
Polarity DC–
Slag levels are comparable with solid wire often allowing multipass welding without inter-pass deslagging.

Classification
Nearest AWS A5.29–80
E71TG–Ni1

Applications
All general fabrication and structural steelwork including offshore equipment where sub-zero impact properties down to –40°C are of prime importance.
The 1.0 mm, 1.2 mm and 1.4 mm sizes permit all positional welding including overhead.

Welding data
DC electrode negative

Diameter mm	Welding position	Current amps	Volts
1.0	F.H.V.O.	110–280	14–33
1.2	F.H.V.O.	120–350	14–35
1.4	F.H.V.O.	140–380	14–36
1.6	F.H.	150–400	18–36

Typical weld metal composition %

C	Si	Mn	Ni
0.05	0.4	1.0	0.9

Typical mechanical properties
All weld metal

Yield stress	460 N/mm²
Tensile strength	530 N/mm²
Elongation	26 %

Charpy V

Test. temp –40°C	Impact values 70J

Approvals

ABS	3SA, 3YSA
DnV	III YMS HH
BV	SA3YM HH KV-40
LR	3S 4Y40S H15
FORCE	E51 5M (H)

Packing data

Diameter mm	Spool	Weight kg
1.2	25–0	15
1.4	25–0	15
1.6	25–0	15

OK Tubrod 14.17

OK Tubrod 14.17 is a self-shielded flux cored wire for all-positional welding of mild and medium tensile steels not exceeding 510 N/mm². It can be used for single or multi-pass welding and is equally suitable for flat and drooping characteristic power sources.
Polarity DC–

Classification
AWS A5.20–79
E71T–7
AS 2203: ETP-Nn-W500H

Applications
On site general fabrication and structural work requiring no impact properties.

Welding data
DC electrode negative

Diameter mm	Welding position	Current amps	Volts
1.2	F.H.V.O.	100–280	24–26
1.6	F.H.V.O.	110–350	22–28
2.0	F.H.V.O.	220–400	25–29

Typical weld metal composition %

C	Si	Mn
0.13	0.1	0.8

Typical mechanical properties
All weld metal

Yield stress	450 N/mm²
Tensile strength	555 N/mm²
Elongation	25 %

Packing data

Diameter mm	Spool	Weight (kg)
1.2	25–0	15
1.6	25–0	15
2.0	25–0	15

OK Tubrod 14.18

OK Tubrod 14.18 is a self--shielded flux cored wire for the single and multi-pass welding of mild and medium tensile steels not exceeding 510 N/mm² in the flat and HV positions. Capable of high deposition rates, it is ideal for welding on site where no impact properties are required.
Polarity DC+

Classification
AWS A5.20–79
E70 T–4
AS 2203: ETD-Nn-W500H

Applications
Site welding of general and structural steel work as well as field equipment maintenance and repair.

Welding data
DC electrode negative

Diameter mm	Welding position	Current amps	Volts
1.6	F.H.	200–400	25–32
2.4	F.H.	350–450	27–32

Typical weld metal composition %

C	Si	Mn
0.2	0.4	0.5

Typical mechanical properties
All weld metal

Yield stress	440 N/mm²
Tensile strength	620 N/mm²
Elongation	23 %

Packing data

Diameter mm	Spool	Weight kg
1.6	25–0	15
2.4	25–0	15
2.4	07–3	25

OK Tubrod 14.30

A rutile flux cored tubular wire designed for welding stainless steels containing 18–20% Cr and 8–12 % Ni in all positions. As well as the low carbon 304 and 308 varieties Tubrod 14.30 is also suitable for welding the stabilised 321 and 347 types.
The slag detachability is effortless and self releasing in most cases, leaving a bright finish to a weld deposit of exceptional finely rippled appearance. Due to the extremely stable DC+ arc spatter levels are virtually non existent.

Classification
AWS: E308 LT–1

Shielding gas
CO_2, Ar/CO_2

Welding data: DC+

Diameter mm	Current Amps	Volt	Deposition kg/h
1.2	250	30	5.0
1.6	300	32	6.0

Typical weld metal composition

C	Si	Mn	Cr	Ni	Ferrite
0.03 (Ar/CO_2) 0.04 (CO_2)	0.6	1.6	19	10	approx 10 %

Typical mechanical properties
All weld metal specimens

Yield stress	380 N/mm²
Tensile strength	535 N/mm²
Elongation	42 %

Charpy V impact values

Test. temp	
+ 0°C	57J
–196°C	32J

Approvals

LR	304L (C/*)
TÜV	5145

Packing data

Diameter (mm)	Spool	Weight (kg)
1.2	24–8	12.5
1.6	24–8	12.5

OK Tubrod 14.31

A rutile flux cored tubular wire used for the joining of the 316 low carbon type 18–20 % Cr/10–14 % Ni/2–3 % Mo steels. The composition also ensures that the stabilised types may be welded with equal success.
Capable of welding in all positions using the spray transfer mode, very high deposition rates are assured. The weld appearance is characterised by a bright, fine and evenly rippled surface finish with minimal spatter. The profile is flat with reduced reinforcement which allows mitre fillets to be produced with ease.

Classification
AWS: E316LT–1

Shielding gas
CO_2, Ar/CO_2

Welding data: DC+

Diameter mm	Current Amps	Volt	Deposition kg/h
1.2	250	30	5.0
1.6	300	32	6.0

Typical weld metal composition

C	Si	Mn	Cr	Ni	Mo	Ferrite
0.03 (Ar/CO_2) 0.04 (CO_2)	0.6	1.7	19.5	12.5	2.5	approx 10–15 %

Approvals

LR	316L (C/*)
TÜV	5147

Typical mechanical properties
All weld metal specimens

Yield stress	410 N/mm²
Tensile strength	535 N/mm²
Elongation	42 %

Charpy V impact values

Test. temp	
+ 20°C	57J
–100°C	46J

Packing data

Diameter (mm)	Spool	Weight (kg)
1.2	24–8	12.5
1.6	24–8	12.5

OK Tubrod 14.32

A rutile flux cored tubular wire depositing weld metal of the 309 type 22–25 % Cr and 12–14 % Ni composition. Apart from joining these steels the weld metal analysis and controlled ferrite content ensures that Tubrod 14.32 is eminently suitable for a wide variety of dissimilar applications involving ferritic and austenitic stainless steels, as well as joining difficult-to-weld steels such as the ferritic martensitic 410 and 430 steels. It is also ideal for buffer layers when fabricating clad steels.
The running characteristics and physical appearance of the weld deposits are similar in all respectes to other wires in the stainless flux cored range which promote a high degree of operator appeal.

Classification
AWS: E309 LT–1

Shielding gas
CO_2, Ar/CO_2

Welding data: DC+

Diameter mm	Current Amps	Volt	Deposition kg/h
1.2	250	30	5.0
1.6	300	32	6.0

Typical weld metal composition

C	Si	Mn	Cr	Ni	Ferrite
0.03 (Ar/CO_2) 0.04 (CO_2)	0.6	1.7	24	13	approx 20 %

Typical mechanical properties
All weld metal specimens

Yield stress	440 N/mm²
Tensile strength	600 N/mm²
Elongation	42 %

Charpy V impact values

Test. temp	
+20°C	50J

Approvals

LR	SS–CMn (C)
TÜV	5149

Packing data

Diameter (mm)	Spool	Weight (kg)
1.2	24–8	12.5
1.6	24–8	12.5

OK Tubrod 15.00

OK Tubrod 15.00 is a fully basic flux cored wire producing very low hydrogen quality weld metal with a high resistance to cracking in joints under restraint. Diameter 1.0 and 1.2 mm size are available for positional welding and the 1.6 mm, 2.0 mm and 2.4 mm sizes give high deposition rates in the flat and HV positions. The slag cover is thin and easily remelted.
Shielding gas CO_2 or Ar + 20 % CO_2
Polarity DC–

Classification
AWS A5.20–79
E71T–5 for ø 1.0, 1.2 mm
E70T–5 for ø 2.16 mm
AS 2203: ETP-Cn-W504H

Applications
All general fabrication work involving the multi pass welding of heavy sections in tensile strength up to 530 N/mm².
Bridges, pressure vessels and offshore structures.

Typical weld metal composition %

C	Si	Mn
0.06	0.6	1.2

Welding data
DC electrode negative

Diameter mm	Welding position	Current amps	Volts
1.0	F.H.V.O.	100–230	18–25
1.2	F.H.V.O.	100–250	18–26
1.6	F.H.	140–400	18–32
2.0	F.H.	200–450	28–34
2.4	F.H.	300–525	28–34

Typical mechanical properties
All weld metal

Yield stress	470 N/mm²
Tensile strength	540 N/mm²
Elongation	25 %

Charpy V

Test. temp	Impact values
–30°C	80J

Approvals

ABS	3SA, 3YSA	(CO_2)
DnV	III YMS	(CO_2, Ar/20 CO_2)
BV	SA, 3MH	(CO_2)
LR	3S, 3YSH15	(CO_2, Ar/20 CO_2)
CO	CDS 0485	(CO_2, Ar/20 CO_2)
GL	3YHHS	(CO_2, Ar/20 CO_2)
RS	3YMSHH	(CO_2)
FORCE	E15 3B(H)	(CO_2, Ar/20 CO_2)
DB	42.039.12	(CO_2, Ar/20 CO_2)
TÜV	2181	

Packing data

Diameter mm	Spool	Weight kg
1.0	25–0	15
1.2	25–0	15
1.6	25–0	15
2.0	25–0	15
2.4	25–0	15
2.4	07–3	25

OK Tubrod 15.12

OK Tubrod 15.12 is a rutile flux cored tubular wire designed especially for heavy deposition in the flat and horizontal positions on mild and medium tensile steels up to 510 N/mm² tensile strength. Slag removal is easy and generally selfreleasing. The weld appearance is exceptional and spatter level minimal.
Shielding gas CO_2
Polarity DC+

Classification
AWS A5.20–79
E70T–1
A5 2203: ETD-Cp-W502H

Applications
Mass production situations demanding heavy deposition such as contractors plant, bed plates and pit-props in steel thicknesses of 9 mm upwards.

Welding data
DC electrode positive

Diameter mm	Welding position	Current amps	Volts
1.2	F.M.V.O	130–300	24–34
1.6	F.H.	200–400	28–36
2.0	F.H:	230–500	28–38
2.4	F.H.	250–600	28–40

Typical weld metal composition %

C	Si	Mn
0.06	0.7	1.6

Typical mechanical properties
All weld metal

Yield stress	530 N/mm²
Tensile strength	610 N/mm²
Elongation	23 %

Charpy V

Test temp.	Impact values
0°C	60J

Approvals

ABS	2SA
LR	2S 2YS
DnV	II YMS
BV	SA 2,2YM
CO	CDS 0880
CWB	E4802T–9–CH
GL	2YS
FORCE	E51 2R (H)
DB	42.039.13
TÜV	4211

Packing data

Diameter mm	Spool	Weight kg
1.6	25–0	15
2.0	25–0	15
2.0	07–3	25
2.4	25–0	15
2.4	07–3	25

OK Tubrod 15.15

OK Tubrod 15.15 is a rutile flux cored tubular wire designed as a truly all-positional general purpose wire for welding mild and medium tensile steels up to 510 N/mm² tensile strength. Using either type of shielding gas the 1.2 and 1.4 mm sizes can be used in the vertical position on spray transfer providing for maximum deposition and time savings. Weld pool control is easy both vertically up and downwards and slag removal is rapid.
Shielding gas Ar+ 20 % CO_2 or CO_2
Polarity DC+

Classification
AWS A5.20–79
E71T–1
AS 2203: ETP-Cp-W503H

Applications
General purpose welding of large fabrications in site. Ideal in situations where manipulation of the work is practical.

Welding data
DC electrode positive

Diameter mm	Welding position	Current Amps	Volts
1.2	F.H.V.O.	130–300	20–30
1.4	F.H:V:O:	140–330	22–30
1.6	F.H.V.O.	150–360	24–32

Typical weld metal composition %

C	Si	Mn
0.06	0.4	1.4

Typical mechanical properties
All weld metal

	Ar + 20 % CO_2	CO_2
Yield stress	540 N/mm²	520 N/mm²
Tensile strength	570 N/mm²	560 N/mm²
Elongation	26 %	26 %

Charpy V

Test temp.	Impact values
–20°C	70J

Approvals

ABS	3SA 3YSA	(CO_2, Ar/20 CO_2)
LR	3S 3YS H15	(CO_2, Ar/20 CO_2)
DnV	IIIYMS	(CO_2, Ar/20 CO_2)
BV	SA3 3YM	(CO_2, Ar/20 CO_2)
GL	3YHHS	(CO_2, Ar/20 CO_2)
CO	CDS 0390	(CO_2, Ar/20 CO_2)
RS	3YMSHH	(CO_2, Ar/20 CO_2)
FORCE	E51 3R(H)	(CO_2, Ar/20 CO_2)
DB	42.039.14	(CO_2, Ar/20 CO_2)
TÜV	4314	

Packing data

Diameter mm	Spool	Weight kg
1.2	46–0	5
1.2	25–0	15
1.4	25–0	15
1.6	25–0	15

OK Tubrod 15.17

OK Tubrod is an all-positional rutile flux cored wire for the welding of structured steels with a nominal tensile strength of 550 N/mm², particularly where good toughness is required down to –40°C.
The wire contains 1 % nickel and has exceptional operating characteristics in all positions with high deposition rates being achieved using spray transfer.
Very suitable for open butt joints using non fusible (eg ceramic) backing material.
Shielding gas Ar + 20 % CO_2
Polarity DC+

Classification
AWS A5.29–80
E81T1–Ni1

Applications
Applications include the all positional welding of carbon manganese and low alloy steels intended for use at sub-zero temperatures e.g. offshore fabrications, vessels and structural steelwork.

Welding data
DC electrode positive

Diameter mm	Welding position	Current Amps	Volts
1.2	F.H.V.O.	130–300	20–30
1.6	F.H.V.O.	150–360	24–32

Typical weld metal composition %

C	Si	Mn	Ni
0.05	0.3	1.1	1.0

Typical mechanical properties
All weld metal

Yield stress	560 N/mm²
Tensile strength	600 N/mm²
Elongation	25 %

Charpy V

Test temp.	Impact values
–40°C	100J

Approvals

ABS	3SA, 3YSA
LR	3S, 4Y40S H15 CMn LT40
DnV	IIIYMS HH (–40)
BV	SA3YM
RS	4YMSH (–40)
FORCE	E51 5RH
TÜV	5198

Packing data

Diameter mm	Spool	Weight kg
1.2	46–0	5
1.2	25–0	15
1.6	25–0	15

OK Tubrod 15.18

OK Tubrod 15.18 is a rutile flux cored tubular wire designed for high deposition welding in the flat and HV positions. It is characterised by an exceptional weld finish with minimal spatter and self releasing slag using either Argon rich or CO_2 shielding gases. Manufactured in four sizes for maximum versatility, this wire is capable of single and multi-pass welding of fillet and butt joints on mild and medium tensile steels with a tensile strength of 510 N/mm².
Shielding gas Ar + 20 % CO_2 or CO_2
Polarity DC+

Classification
AWS A5.20–79
E70T–1 for ø≥1.4 mm
E71T–1 for ø 1.2 mm
AS 2203: ETD-Cp-W502H

Applications
All general fabrication of medium to heavy sections where weld appearance and high weld metal integrity is important. This will include bogie frames for railway rolling stock, contractors plant, bedplates, structural steelwork, bridges and shipbuilding.

Welding data
DC electrode positive

Diameter mm	Welding positions	Current amps	Volts
1.2	F.H.V.O.	130–300	24–34
1.4	F.H.	140–350	24–36
1.6	F.H.	200–400	26–38
2.0	F.H.	230–500	26–38
2.4	F.H.	250–600	26–40

Typical weld metal composition %

C	Si	Mn
0.06	0.5	1.1

Typical mechanical properties
All weld metal

Yield stress	500 N/mm²
Tensile strength	560 N/mm²
Elongation	25 %

Charpy V

Temp.	Impact value
0°C	70J

Approvals

ABS	2SA, 2YSA	(CO_2, Ar/20 CO_2)
DnV	II YMSH	(CO_2, Ar/20 CO_2)
BV	SA 2YMH	(CO_2, Ar/20 CO_2)
LR	2S, 2YSH	(CO_2, Ar/20 CO_2)

Packing data

Diameter mm	Spool	Weight kg
1.2	25–0	15
1.4	25–0	15
1.6	25–0	15
2.0	25–0	15
2.4	25–0	15
2.4	07–3	25

OK Tubrod 15.19

OK Tubrod 15.19 is an all-positional rutile flux cored wire specially developed to give high yield strength (min 550 N/mm²) and good toughness down to –50°C with high deposition spray transfer welding. Also suitable for open butt joints using non fusible (eg ceramic) backing material.
Shielding gas Ar + 20 % CO_2
Polarity DC+

Classification
Nearest AWS A5.29–80
E81T1–Ni1

Applications
Ideal for welding quenched and tempered steels of the HY80 type.

Welding data
DC electrode positive

Diameter mm	Welding position	Current Amps	Volts
1.2	F.H.V.O.	130–300	20–30
1.6	F.H.V.O.	150–360	24–32

Typical weld metal composition %

C	Si	Mn	Ni
0.05	0.4	1.3	1.0

Typical mechanical properties
All weld metal specimens

Yield stress	620 N/mm²
Tensile strength	650 N/mm²
Elongation	24 %

Charpy V

Test temp.	Impact values
–40°C	85J
–50°C	65J

Packing data

Diameter mm	Spool	Weight kg
1.2	25–0	15
1.6	25–0	15

OK Tubrod 15.20

OK Tubrod 15.20 is a fully basic low hydrogen flux cored wire containing 1.25 % Cr and 0.5 % Mo designed for welding creep-resisting steels of similar composition. It is also suitable for welding high tensile steels with a tensile strength of 700 N/mm² in the gas-weld condition.
Shielding gas CO_2 or Ar + 20 % CO_2
Polarity DC–

Classification
AWS A5.29–80
E81T5–B2

Applications
Typical applications include fabrication and repair in the power industry.

Welding data
DC electrode negative

Diameter mm	Welding position	Current amps	Volts
1.2	F.H.V.O.	100–250	18–26
1.6	F.H.	140–400	18–32

Typical weld metal composition %

C	Si	Mn	Cr	Mo	S	P
0.06	0.5	1.1	1.25	0.5	0.02	0.01

Typical mechanical properties
All weld metal

	As Welded	Stress Relieved (650°C)
Yield stress	680 N/mm²	540 N/mm²
Tensile strength	740 N/mm²	630 N/mm²
Elongation	21 %:	20 %

Packing data

Diameter mm	Spool	Weight kg
1.2	25–0	15
1.6	25–0	15

OK Tubrod 15.22

OK Tubrod 15.22 is a basic low hydrogen flux-cored wire containing 2.25 % Cr and 1.0 % Mo for welding creep-resisting steels of similar composition and intended for service at around 600°C.
Shielding gas CO_2 or Ar + 20 % CO_2
Polarity DC–

Classification
AWS A5.29–80
E91T5–B3

Applications
Typical applications include fabrication and repair in the power generation field.

Welding data
DC electrode negative

Diameter mm	Welding position	Current amps	Volts
1.2	F.H.V.O.	100–250	18–26
1.6	F.H.	140–400	18–32

Typical weld metal composition %

C	Si	Mn	Cr	Mo	S	P
0.08	0.6	1.2	2.25	1.0	0.02	0.01

Typical mechanical properties
All weld metal

	Stress Relieved (690°C)
Yield stress	630 N/mm²
Tensile strength	730 N/mm²
Elongation	17 %

Packing data

Diameter mm	Spool	Weight kg
1.2	25–0	15
1.6	25–0	15

OK Tubrod 15.25

OK Tubrod 15.25 is a 2 1/2 % nickel alloyed fully basic tubular welding wire which deposits low hydrogen, typically <5mls/100 g weld metal. The wire operates under CO_2 or Ar/CO_2 gas shield, is all positional in the 1.2 mm diameter and deposits tough, crack resistant weld metal capable of charpy fracture toughness properties at temperatures down to –60°C.
Shielding gas CO_2 or Ar + 20 % CO_2
Polarity DC–

Classification
Nearest AWS A5.29–80
E71T5–Ni2

Applications
Applications for OK Tubrod 15.25 are for the multipass welding of medium to heavy section fabrications demanding tough crack resistant welds at sub-zero temperatures down to –60°C.

Welding data
DC electrode negative

Diameter mm	Welding position	Current amps	Volts
1.2	F.H.V.O.	100–250	18–26
1.6	F.H.	140–400	18–32

Typical weld metal composition %

C	Si	Mn	Ni
0.06	0.4	0.7	2.2

Typical mechanical properties
All weld metal

Yield stress	460 N/mm²
Tensile strength	550 N/mm²
Elongation	25 %

Charpy V

Test. temp –60°C	Impact values 70J

Approvals

DnV	IIIYMS(HH), NV2–4, NV4–4
LR	3S 5Y40 H15
CO	CDS 0551
TÜV	4299

Packing data

Diameter mm	Spool	Weight kg
1.2	46–0	5
1.2	25–0	15
1.6	25–0	15

OK Tubrod 15.30

A metal cored tubular wire for welding stainless steels containing 18–20 % Cr and 8–12 % Ni in the flat and HV positions. It is also suitable for the stabilised variants of the 18 Cr/10 Ni steels.

Classification
AWS: E308 LT–2

Shielding gas
Ar/O_2, He/Ar, (Ar/CO_2)

Welding data: DC+

Diameter mm	Current Amps	Volt	Deposition kg/h
1.2	250	30	4.0
1.6	300	33	7.0

Typical weld metal composition

C	Si	Mn	Cr	Ni	Ferrite
0.06 (Ar/CO_2) 0.03 (CO_2)	0.7	1.2	20	10	approx 10 %

Typical mechanical properties
All weld metal specimens

Yield stress	360 N/mm²
Tensile strength	550 N/mm²
Elongation	40 %

Charpy V impact values

Test. temp	
+ 20°C	80J
–196°C	35J

Approvals
TÜV 4402
Controlas

Packing data

Diameter (mm)	Spool	Weight (kg)
1.2	25–0	15
1.6	25–0	15

OK Tubrod 15.31

A metal cored tubular wire for welding low carbon stainless steels containing 18–20 % Cr/10–14 % Ni 2–3 % Mo at high deposition rates in the flat and HV positions. This wire may also be used with confidence on the stabilised type 316 and 318 steels.

Classification
AWS: E316 LT–2

Shielding gas
Ar/O_2, He/Ar, (Ar/CO_2)

Welding data: DC+

Diameter mm	Current Amps	Volt	Deposition kg/h
1.2	250	30	4.0
1.6	350	33	7.0

Typical weld metal composition

C	Si	Mn	Cr	Ni	Mo	Ferrite
0.06 (Ar/CO_2) 0.03 (Ar/CO_2)	0.7	1.2	19	12	3.0	approx 10 %

Typical mechanical properties
All weld metal specimens

Yield stress	380 N/mm²
Tensile strength	550 N/mm²
Elongation	40 %

Charpy V impact values

Test. temp	
+ 20°C	70J
–196°C	35J

Approvals
TÜV 4403
DnV
Controlas

Packing data

Diameter (mm)	Spool	Weight (kg)
1.2	25–0	15
1.6	25–0	15

OK Tubrod 15.32

A metal cored tubular wire for welding of the 22–25 % Cr/12–14 % Ni stainless steels. The austenitic type 309 weld metal is also suitable for joining the ferritic and martensitic 410 and 430 steels as well as the widest possible range of dissimilar applications. In conjuction with clad steels it can also be used for buffer layers.

Classification
AWS: E309 T–2

Shielding gas
Ar/O_2, He/Ar, Ar/CO_2

Weldingdata: DC+

Diameter mm	Current Amps	Volt	Deposition kg/h
1.6	350	33	7.0

Typical weld metal composition

C	Si	Mn	Cr	Ni	Ferrite
0.08 (Ar/O_2)	0.6	1.2	25	14	approx 10–15 %

Typical mechanical properties
All weld metal specimens

Yield stress	380 N/mm²
Tensile strength	550 N/mm²
Elongation	35 %

Charpy V impact values

Test. temp	
+ 20°C	80J
–196°C	30J

Approvals
DnV
Controlas

Packing data

Diameter (mm)	Spool	Weight (kg)
1.6	25–0	15

OK Tubrod 15.33

A metal cored tubular wire especially designed for the welding of armour plate and those steels with limited weldability. Having a highly austenitic weld metal it is also capable of dissimilar welding.

Classification
AWS: E308 MoT–2
(Nearest)

Shielding gas
Ar/CO_2

Welding data: DC+

Diameter mm	Current Amps	Volt	Deposition kg/h
1.6	350	33	7.0

Typical weld metal composition

C	Si	Mn	Cr	Ni	Mo	Ferrite
0.07	0.7	1.8	20	9	3	less than 10 %

Typical mechanical properties
All weld metal specimens

Yield stress	450 N/mm²
Tensile strength	650 N/mm²
Elongation	35 %

Charpy V impact values

Test. temp	
+20°C	47J
–40°C	40J

Packing data

Diameter (mm)	Spool	Weight (kg)
1.6	25–0	15

OK Tubrod 15.34

A metal cored tubular wire having a highly alloyed 17–20 % Cr, 7–9 % Ni, 6–7 % Mn type weld metal and is particularly useful for buffer layers, armour plate and dissimilar welding. It has high wear and corrosion resistance.

Classification
AWS: E307 T–2
(Nearest)

Shielding gas
Ar/O_2, Ar/CO_2

Welding data: DC+

Diameter mm	Current Amps	Volt	Deposition kg/h
1.6	350	33	7.0

Typical weld metal composition

C	Si	Mn	Cr	Ni
0.15	0.7	6.5	19.0	8.0

Typical mechanical properties
All weld metal specimens

Yield stress	410 N/mm²
Tensile strength	620 N/mm²
Elongation	37 %

Charpy V impact values

Test. temp	
+20°C	60J
–40°C	40J

Approvals
TÜV 4404

Packing data

Diameter (mm)	Spool	Weight (kg)
1.6	25–0	15

OK Tubrod 15.35

A metal cored tubular wire for welding low carbon 22–25 % Cr and 12–14 % Ni 309 type stainless steels and also the 410 and 430 ferritic and martensitic plain chrome steels. The weld metal composition is also suitable for a wide variety of dissimilar steel applications including buffer layers for clad steels

Classification
AWS: E309 LT–2

Shielding gas
Ar/O_2, He/Ar, (Ar/CO_2)

Welding data: DC+

Diameter mm	Current Amps	Volt	Deposition kg/h
1.6	350	33	7.0

Typical weld metal composition

C	Si	Mn	Cr	Ni	Ferrite
0.03	0.6	1.2	25	14	approx 10–15 %

Typical mechanical properties
All weld metal specimens

Yield stress	300 N/mm²
Tensile strength	515 N/mm²
Elongation	32 %

Charpy V impact values

Test. temp	
+20°C	60J

Approvals
Controlas

Packing data

Diameter (mm)	Spool	Weight (kg)
1.6	25–0	15

OK Tubrodur 15.41

A tubular self shielded electrode giving a chromium manganese alloyed weld metal for semi-automatic hardfacing at a hardness of 28–36 Rockwell C.

Applications
OK Tubrodur 15.41 being self shielded is ideal for on site rebuilding of rollers, shafts, wheels and worn parts of C/Mn railway tracks, point frogs etc, where resistance to compressive loads is of prime importance. It is also useful as a buffer layer of intermediate hardness build up prior to use of harder material.

Welding data: DC+

Diameter mm	Current Amps	Volts
1.6	320	26
2.4	360	26

Typical weld metal composition

C	Si	Mn	Cr
0.15	0.5	1.5	3.5

Typical weld metal hardness
28–36 Rockwell C

Packing data

Diameter (mm)	Spool	Weight (kg)
1.6	25–0	15
2.4	25–0	15
2.4	07–3	25

OK Tubrodur 14.70

Selfshielded flux-cored electrode for semi-automatic abrasion-resistant hardfacing. Alloy type ledeburitic chromium steel.

Classification
DIN 8559:
SG 10–55 Fülldraht

Description and application
The chromium-carbide rich weld metal is extremely resistant to abrasive wear by gritty fine grain materials such as earth, ore, clay, etc.
Good wear resistance is retained to temperatures over 500°C and the deposit does not soften after soaking at high temperature.
The weld metal is pretty corrosion resistant.
OK Tubrodur 14.70 is recommended for hardfacing of bucket lips, auger points, mining and earthmoving equipment, scraper blades etc.

Recommendations for welding
Maximum 2–3 layers should be deposited. Building up of heavily worn parts is better made with OK Tubrodur 14.71 or OK Selectrode 67.52 on 13 % manganese steel. On carbon steel a lower alloyed electrode can be used for the filling up prior to the hardfacing.

Welding data
400 amps, 30 volts
Electrode extension (stick-out) 30–40 mm

Typical weld metal composition %

C	Si	Mn	Cr	Mo	V
3.5	0.4	0.8	21	3.5	0.4

Weld metal hardness
50–60 HRC

Other properties of the weld deposit
The weld metal is annealing and scaling resistant to about 1000°C.

Packing data

Diameter mm	Spool	Weight kg
2.4	25–3	12
2.4	07–2	20

OK Tubrodur 14.71

A stainless "18.8.6–Mn" tubular electrode for open arc welding. For cladding and joining of 13 % manganese steel and other steels, which are difficult to weld with unalloyed and low alloyed electrodes.

Classification
DIN 8555: SG 8–200 Fülldraht

Description and application
OK Tubrodur 14.71 is of an old and reliable alloy type for electrodes for steels having a limited weldability such as 13 % manganese steel and high carbon steel. The weld metal is extremely tough and able to absorb high stresses.
OK Tubrodur 14.71 should be used for welding and building up on 13 % manganese steel.
Welding of 13 % manganese steel to carbon and low alloy steel. Welding of hardenable steel.
Stainless cladding on carbon steel and low alloy steel.
Buffer-layer before hardfacing.

Welding recommendations
Avoid large molten pools and high penetration.

Welding data
Electrode ø 2.4 mm 400 Amps, 30 V.

Typical weld metal composition %

C	Si	Mn	Cr	Ni
0.07	0.5	6	19	8

Typical mechanical properties
All weld metal

0.2 % proof stress	400 N/mm²
Tensile strength	640 N/mm²
Elongation 5xD	35 %

Charpy V impact values

Test. temp	Impact values
+20°C	70 J, 7 kpm
–20°C	60 J, 6 kpm
–60°C	40 J, 4 kpm

Weld metal hardness
as welded ab. 200 HV
cold worked up to 400 HV

Packing data

Diameter mm	Spool	Weight kg
2.4	25–3	12
2.4	07–2	20

OK Tubrodur 15.40

Tubular electrode for hardfacing depositing a manganese, chromium molybdenum alloyed weld metal having a hardness of 32–36 Rockwell C.
ø 1.6 mm and 2.4 mm are for gas metal arc welding using CO_2 shielding gas.
ø 3.0 mm and 4.0 mm are for use with the submerged arc process in conjunction with OK 10.71.

Classification
DIN 8555: SG 1–350–Fülldraht
UP1–400

Applications
Surfacing of wheel runners, track links, wheels and rollers for conveyor belts, wheels for mine trucks, rolls and shafts, where a hardness within the range 32–40 Rockwell C is desired.

Welding instructions
OK Tubrodur 15.40 is to be used on DC, negative or positive polarity. With negative polarity, less heat input to the base material, less dilution of the weld metal and a higher deposition rate are obtained.
In most cases, surfacing with OK Tubrodur 15.40 can be done without preheat. The need for preheat and increased interpass temperature is decided by the weldability of the actual parent material and the form and dimensions of the workpiece. Surfaced axles and similar objects, which are exposed to a bending stress during rotation, should, if possible, always be stress-relieved at 500–600°C.

Typical weld metal composition %

	C	Si	Mn	Cr
CO_2-welded	0.2	0.8	1.4	1.4
Sub arc with OK Flux 10.71	0.12	0.5	1.3	3.2

Weld metal hardness HRC and tempering resistance

	As welded	After temp. 24 h at 500°C
CO_2-welded	32–40	About 25 HRC
Sub arc welded with OK Flux 10.71	35–44	About 25 HRC

Welding data recommended

Diameter mm	Method	Amps	Current Polarity	Volt	Deposition rate kg/hour
1.6	CO_2	300	DC+	30	3.8
2.4	CO_2	360	DC+	28	4.8
3.0	SAW	400	DC±	28	2.5
4.0	SAW	550	DC±	32	6.0

Packing data

Diameter mm	Spool	Weight kg	Diameter mm	Spool	Weight kg
1.6	25–0	15	3	07–3	25
2.4	25–0	15	4	07–3	28
2.4	07–3	25	4	51–0	75

OK Tubrodur 15.42

Tubular electrode for hardfacing, giving a chromium, manganese, molybdenum alloy deposit with an as welded hardness of 35–44 Rockwell C.
ø 1.6 mm and 2.4 mm are for gas metal arc welding, with or without CO_2 shielding gas.
ø 3.0 mm and 4.0 mm are designed for the submerged arc process and should be used with OK 10.71 flux.

Classification
DIN 8555: SG 1–400 Fülldraht

Applications
Surfacing of wheel runners, track links, billet rolls, wheels and rollers for conveyor belts, wheels for mine trucks, rolls and shafts, where a hardness of 40–45 Rockwell C is desired.

Welding instructions for submerged arc welding
OK Tubrodur 15.42 should be deposited on DC, negative or positive polarity. On negative polarity there is less heat input to the base material, less dilution of the weld metal, and a higher deposition rate is obtained, Preheat and interpass temperature is chosen to suit the composition of the base material and the form and dimensions of the workpiece.
Surfacing with only a single layer of weld metal can often be successfully carried out without preheat. When multi-layer surfacing, the interpass temperature should not fall below 100°C

Typical weld metal composition %

Method	C	Si	Mn	Cr	Ni	Mo
Self-shielded/ CO_2	0.15	0.5	1.5	4.5	0.5	0.5
SAW OK 10.71	0.12	0.5	1.3	3.0	–	0.75

Weld metal hardness and tempering resistance

Hardness as welded:	35–45 Rockwell C
Hardness after tempering:	
15 h at 500°C	40 Rockwell C
24 h at 500°C	38 Rockwell C
36 h at 500°C	32–36 Rockwell C
36 h at 500°C	about 30 Rockwell C

Welding data recommended

Diameter mm	Method	Amps	Current Polarity	Volt	Deposition rate kg/hour
1.6	CO_2	300	DC+	30	3.8
2.4	CO_2	360	DC+	28	4.8
3.0	SAW	400	DC±	25	4.5
4.0	SAW	550	DC±	30	5.0

Packing data

Diameter mm	Spool	Weight of electrode kg
1.6	25–0	15
2.4	25–1	15
2.4	07–3	25
3.0	07–3	25
4.0	07–3	25

OK Tubrodur 15.52

Tubular electrode for hardfacing producing manganese, chromium and molybdenum alloy weld metal with a hardness of 55–60 Rockwell C.
ø 1.6 mm and 2.4 mm are for use with gas metal arc with or without CO_2 shielding gas.
ø 3.0 mm and 4.0 mm are for submerged arc welding and should be used in conjunction with OK 10.71.

Classification
DIN 8555: SG 6–500 Fülldraht
UP 6–500
UP 6–55

Applications
Hardfacing of feed screws, mixer blades and vessels, ring grooves on diesel motor pistons.

Recommendations for submerged arc welding
OK Tubrodur 15.52 should be deposited on DC, negative or positive polarity. On negative polarity there is less heat input of the base material, less dilution of the weld metal, and a higher deposition rate is obtained. Preheat is usually necessary even when only a single layer of weld metal is to be deposited.
The preheat and interpass temperature must be at least 200°C. When surfacing complicated workpieces with differences in the thickness of the material being surfaced, the interpass temperature should preferably be 300–400°C, followed by slow cooling. If the workpiece is subsequently to be machined, tempering at 650–700°C followed by slow cooling is recommended.

Machining and heat treatment
Weld metal OK Tubrodur 15.52/OK Flux 10.71 has very poor machinability in the gas-welded condition.
Tempering at 650–700°C makes machining with ordinary cutting tools possible. Tempered weld metal can be rehardened to the original hardness.
Hardening temperature: 950–1000°C.
Cooling in air or quenching in oil.
This type of alloy is suitable for flame hardening.

Typical weld metal composition %

Method	C	Si	Mn	Cr	Mo
"CO_2" SAW OK 10.71	0.4	0.3	1.3	5	1.2
	0.4	0.7	1.5	5.0	1.2

Welding data
DC, positive pole. Sub arc DC±.

Diameter mm	Current Amps	Volt	Deposition rate kg/h
1.6	300	30	3.8
2.4	360	28	4.8
3.0	400	28	4.5
4.0	550	32	5.0

Weld metal hardness HRC and tempering resistance

Combination	As welded	Tempered 24 h 500°C	Tempered 24 h 600°C
CO_2 and OK Flux 10.71	55–60	45–50	40–45

Packing data

Diameter mm	Spool	Electrode kg
1.6	25–0	15
2.4	25–0	15
2.4	07–3	25
3	07–3	25
4	07–3	25

OK Tubrodur 15.60

A self shielded tubular electrode of the austenitic manganese type for use with the semi-automatic process. Intended for re-building of 13 % manganese steels.

Classification
DIN 8555:
SG 7-Fülldraht

Applications
The work hardening characteristics and extremely tough crack resistant weld metal ensure that OK Tubrodur 15.60 is the ideal solution for rebuilding 13 % manganese steels. Such materials are normally found in crusher jaws, swing hammers and numerous parts of earth moving, mining and quarrying equipment where resistance to heavy impact is important.

Typical weld metal composition %

C	Si	Mn	Ni
0.9	0.4	12.5	3.0

Typical weld hardness

As welded	22 HRC
Work hardened	50 HRC

Welding data

Diameter mm	Amps	Volts
1.6	250/350	30
2.4	300/400	28

Packing data

Diameter mm	Spool	Weight of electrode kg
1.6	25–0	15
2.4	25–0	15

OK Tubrodur 15.65

A tubular electrode for self or gas shielding, producing a martensitic-austenitic work hardening deposit which has universal wear resistance and is not sensitive to hot cracking.

Applications
OK Tubrodur 15.65 can be used for rebuilding of mild, low alloy and 13 % manganese steels. The weld metal combines excellent abrasion and impact resistance and is suitable for such applications as crusher jaws and hammers, railway point frogs, ripper teeth, wear plates and general surfaces subject to rubbing wear.

Typical weld metal composition

C	Si	Mn	Cr	Ni	Mo	V
0.3	0.5	14.0	17.0	1.8	0.9	0.7

Typical weld metal hardness

As welded	24 Rockwell C
Work hardened	52 Rockwell C

Welding data: DC+

Diameter mm	Current Amps	Volts
2.8	400	32

Packing data

Diameter (mm)	Spool	Weight (kg)
2.8	07–2	20

OK Tubrodur 15.70

A tubular hardfacing electrode for use with the submerged arc process in combination with OK 10.91 flux. The weld metal produced is a ferritic 13 % chromium with excellent surface finish together with high resistance to cracking and porosity. The slag is self releasing even under red heat conditions and machineability is good.

Classification
AWS A.5.9–81: ER 410
DIN 8555: UP 5 Fülldraht

Applications
OK Tubrod 15.70/OK Flux 10.91 or OK Flux 10.92 is recommended for surfacing on the top of diesel motor pistons and machine parts which are working in a corrosive environment or at elevated temperature.
The weld metal is machinable and has a good resistance to wearing in corrosive environment.

Recommendations for welding
DC should preferably be used.
The electrode negative yields the highest deposition rate and the lowest dilution with the base material.

Welding data

Diameter mm	Current Amps	Volt	Deposition rate kg/h
3.0	400	28	4.5
4.0	500	30	5.2

Typical weld metal composition %

C	Si	Mn	Cr
0.05	0.8	0.5	13

Typical weld metal properties
Hardness about 30– 40 HRC

Scaling resistance in air to about 800°C
The weld metal resistance to hydrogen sulphide is higher than that of the austenitic stainless "18/8" steel.

Packing data

Diameter mm	Spool	Weight electrode kg
3.0	07–3	25
4.0	07–3	25

OK Tubrodur 15.73

A versatile tubular hardfacing electrode producing a martensitic 13 % chromium alloy steel deposit, which is especially suitable for applications involving wear at elevated temperatures.
ø 1.6 mm, 2.0 mm and 2.4 mm are for gas metal arc welding using either CO_2 or Argon + 20 % CO_2 gas mixtures.
ø 3.0 mm and 4.0 mm are for the submerged arc process and should be used with OK 10.61 flux.

Classification
AWS A5.9–81: ER 420
DIN 8555: SG6–50
Fülldraht, UP6–50 Fülldraht

Typical weld metal composition %

	C	Si	Mn	Cr	Ni	Mo	V	Nb
CO_2 shielded and SAW with OK.61	0.14	0.3	1.2	13	2.5	1.5	0.25	0.25

Applications
Hard facing of different kinds of shafts, valve seats, rolls and other parts subjected to wear, where submerged arc welding of gas metal arc welding can be applied.
Gas mix 80 % Ar+20 % CO_2 is recommended for FCAW.

Recommendations for submerged arc welding
OK Tubrodur 15.73 should be deposited on DC, negative or positive polarity[1]). Negative polarity gives a higher deposition rate and less fusion of the base material and is recommended when the minimum possible dilution of the weld metal is desired.
Except at the start, preheat is not required when hardfacing the surfaces of solid carbon steel shafts having diameter of up to about 200 mm. When multi-run welding, the interpass temperature should preferably not fall below 300°C.
The crack resistance when submerged arc welding with OK Tubrodur 15.73/OK Flux 10.91 is better than when handwelding with the corresponding manual electrode, due to the higher, more even heat input.
Weld metal of OK Tubrodur 15.73 can be machined with sintered carbide cutting tools before it has cooled below about 100°C. After cooling to room temperature the machinability is considerably less. Reheating to 100°C after cooling does not significantly improve the machinability.
[1]) Always positive for FCAW.

Weld metal hardness
40–50 HRC

Welding data

Diameter mm	Current Amps	Volt	Deposition rate kg/h
1.6	260	29	2.5
2.0	300	27	3.9
2.4	360	28	4.8
3.0	400	28	4.5
4.0	500	30	5.2

Packing data

Diameter mm	Spool	Weight of electrode kg
1.6	25–0	15
2.0	25–0	15
2.4	25–0	15
3.0	07–3	25
4.0	07–3	25

OK Tubrodur 15.76

This tubular electrode produces ferritic—martensitic weld metal which has an excellent combination of wear and corrosion resistance of a much higher level than low alloy steels of similar hardness. Using either semi automatic MIG/MAG or submerged arc with OK 10.61 flux crack resistance is good provided controlled pre-heat and interpass temperatures are employed. Bead shape and slag removal are exceptional even at elevated temperatures.
Ø 1.6 mm and 2.4 mm are for gas metal arc welding using CO_2 or Argon +20 % CO_2 gas mixtures.
Ø 3.0 mm and 4.0 mm are designed for use with the submerged arc process in conjunction with OK 10.61 flux.

Applications
Eminently suitable for steel mill continuous casting rolls, axles, shafts and marine engine piston ring grooves where good wear resistance is required particularly under corrosive conditions at elevated temperatures.

Welding data: DC+

Diameter mm	Current Amps	Volt	Deposition kg/h
1.6	260	29	2.5
2.4	360	27	4.8
3.0	400	28	4.5
4.0	500	30	5.2

Typical weld metal composition

C	Si	Mn	Cr	Ni	Mo
0.14	0.3	1.0	12.5	2.2	1.3

Ar/20 % CO_2 shielded and SAW with OK Flux 10.61

Typical weld metal hardness
35–48 Rockwell C

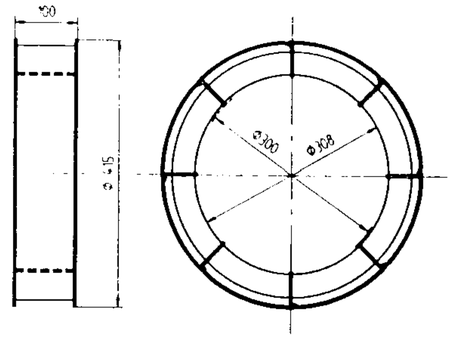
Packing data

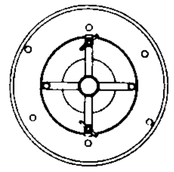
Diameter (mm)	Spool type	Weight (kg)
1.6	25–0	15
2.4	25–0	15
2.4	07–3	25
3.0	07–3	25
3.0	51–0	75
4.0	07–3	25
4.0	51–0	75

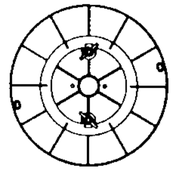
Spool types

Spool 03
03-0 25 kg
03-2 30 kg

Wire basket spool to be fitted to ESAB's 0416 492-880 or 0153 872-880 coil holders. This spool is also suitable for coil holders with crossed arms.

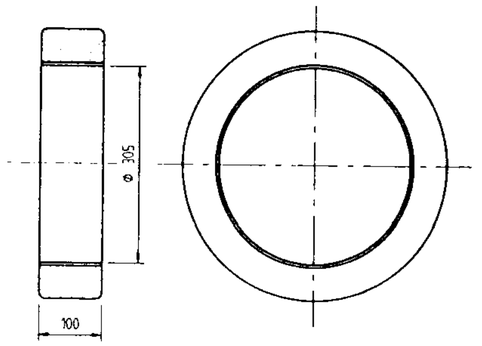


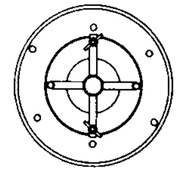

0416 492-880 holder steel

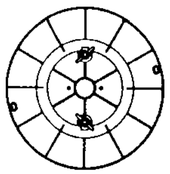

0153 872-880 holder plastic

Spool 07
07-0 30 kg
07-2 25 kg

This spool can be fitted to ESAB's 0416 492-880 or 0153 872-880 coil holders. This spool is also suitable for coil holders with crossed arms.

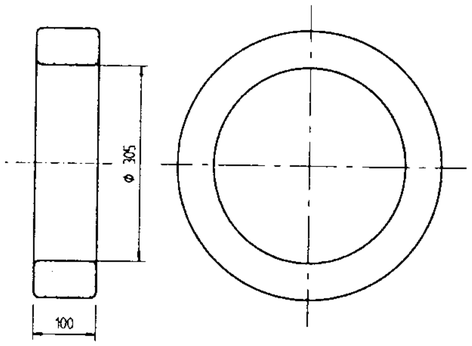


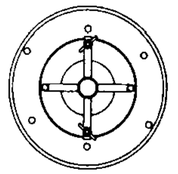

0416 492-880 holder steel

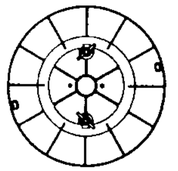

0153 872-880 holder plastic

Spool 08
08-0 30 kg

This spool can be fitted to ESAB's 0416 492-880 or 0153 872-880 coil holders. This spool is not suitable for coil holders with crossed arms.



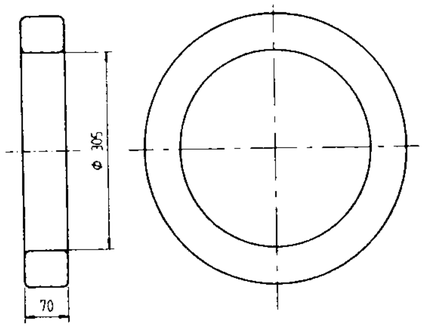

0416 492-880 holder steel

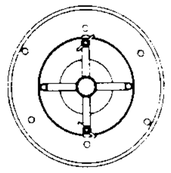

0153 872-880 holder plastic

Spool 09

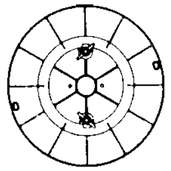
09-0 15 kg

This spool can be fitted to ESAB's 0416 492-880 or 0153 872-880 coil holders. This spool is not suitable for coil holders with crossed arms.





0416 492-880 holder steel

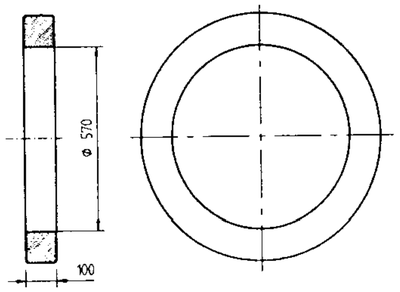


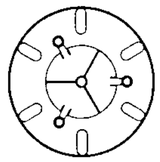
0153 872-880 holder plastic

Spool 16

16-0 100 kg

This spool can be fitted to ESAB's 06711 554-80 coil holder.





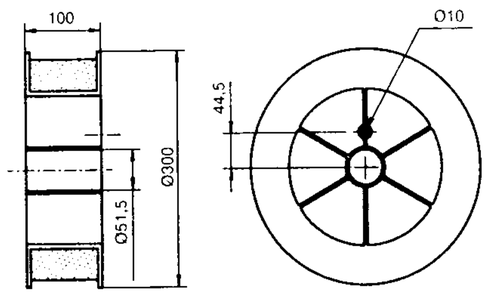
6711 554-80, holder

Spool 24

Plastic spool. Layer wound.
DIN 8559: D 300

24-0	*5 kg*
24-1	*10 kg*
24-3	*12 kg*
24-5	*6 kg*
24-8	*12.5 kg*

This spool can be fitted to ESAB's MIG/MAG welding machines, as well as machines of other makes with a hub diameter of 51 mm.

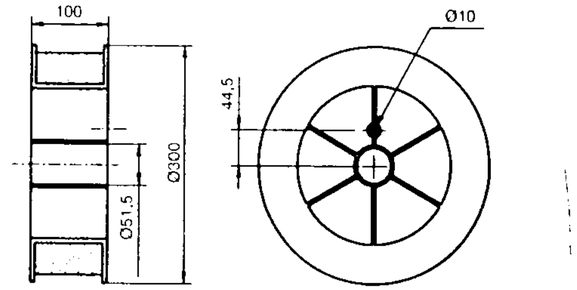


Spool 25

Plastic spool. Random wound.
DIN 8559: D 300

25-0	*15 kg*
25-1	*13 kg*
25-2	*10 kg*
25-3	*12 kg*
25-4	*11.3 kg*

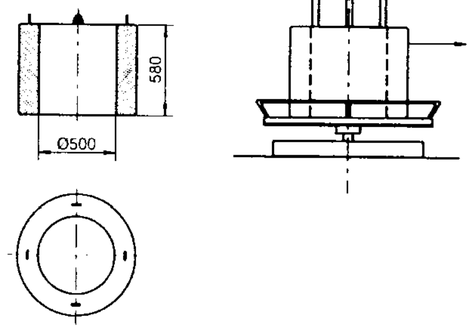
This spool can be fitted to ESAB's MIG/MAG welding machines, as well as machines of other makes with a hub diameter of 51 mm.



Spool 30

30-0	*catch weight*
30-1	*700 kg*
30-2	*1,000 kg*

Random-wound spool with cardboard former. Four lifting eyelets. Decoiling stand needed.

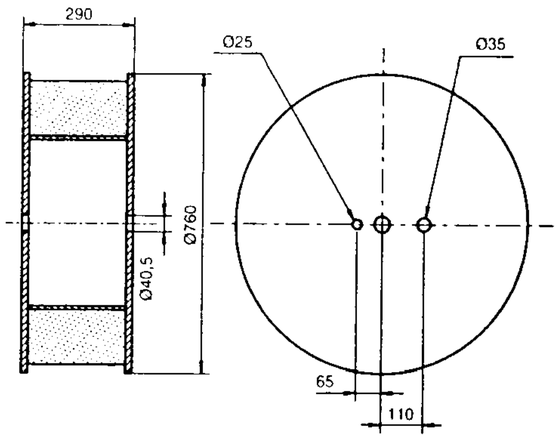


Spool 34

DIN 8559: D 760

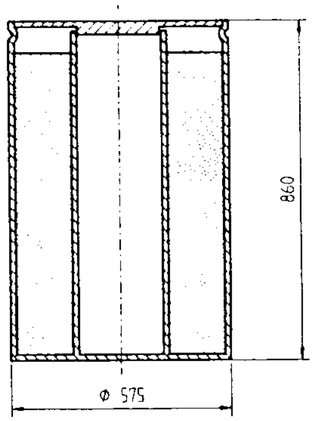
34-0	*300 kg*
34-1	*270 kg*

This spool is made of wood. Non-returnable. Decoiling stand needed.



Spool 40

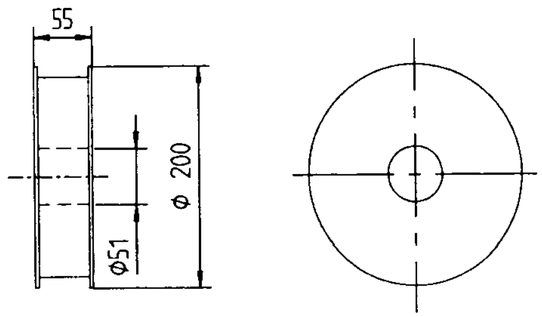
40-1 *250 kg*
40-X *catch weight*



Spool 46

Plastic spool. Random wound.
DIN 8559: D 200

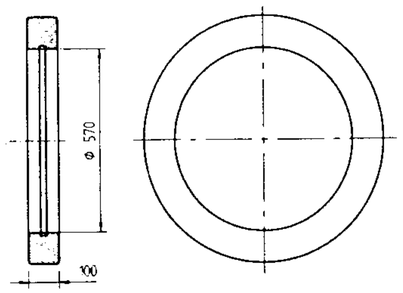
46-0	*5 kg*
46-2	*2 kg*
46-3	*4.5 kg*
46-D	*3 spools, 4.7 kg*

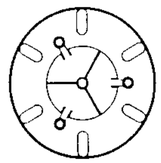


Spool 51

51-0 *75 kg*

This wire is coiled on a sheet metal former. This spool can de fitted to ESAB's spool holder 06711 554-80.

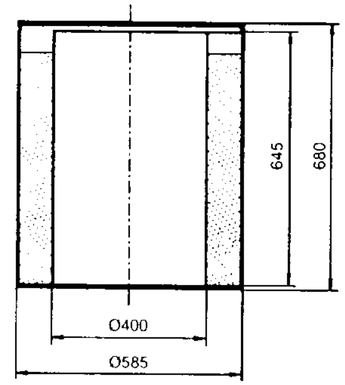




06711 554-80, holder

Spool 58

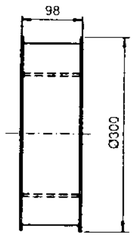
58-X *catch weight*

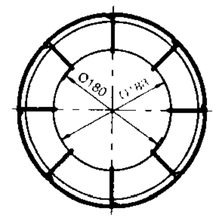


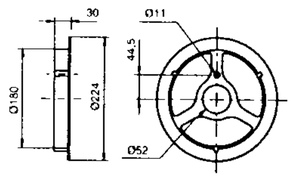
Spool 76

Wire basket. Random wound.
DIN 8559: K 300

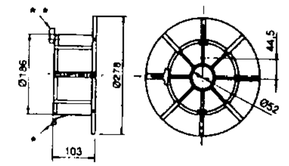
76-0	*15 kg*
76-1	*18 kg*
76-3	*16 kg*
76-4	*13 kg*







Adapter. XD 42010000. two adapters needed

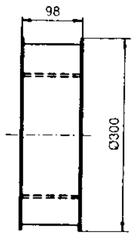


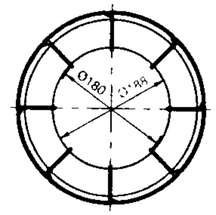
*Adapter with one locking device: 0000004200
**Adapter with an extra locking device: 2155400000

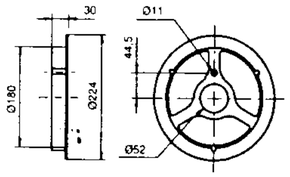
Spool 77

Wire basket. Layer wound.
DIN 8559: K 300

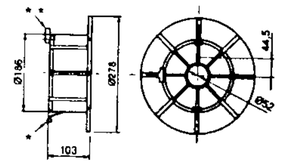
77-0	*15 kg*
77-1	*18 kg*







Adapter. XD 42010000. two adapters needed



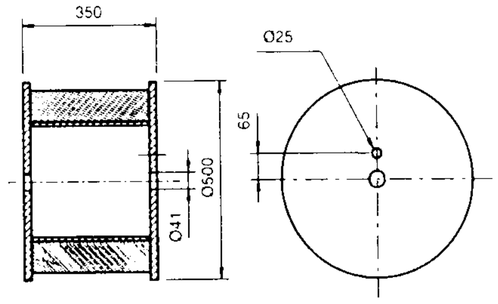
*Adapter with one locking device: 0000004200
**Adapter with an extra locking device: 2155400000

Spool 86

DIN 8559: D 500

86-0 *150 kg*

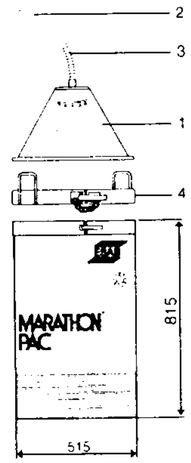
The spool is made of wood. Non-returnable. Decoiling stand needed.



Spool 90 – Marathon Pac®

90-0 *200 kg*
90-2 *250 kg*
90-X *catch weight*

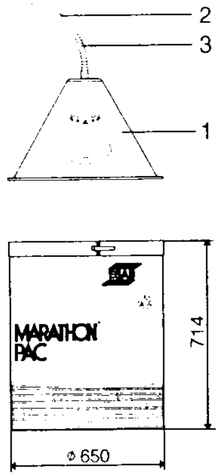
Accessories:
1. Plastic hood 0441 196-001
2. Wire conduit (please quote length) 0442 827-001
3. Adapter kit 0442 828-880
4. Steel ring with handles 2155 9010 00



Spool 92 – Marathon Pac®

92-0 *350 kg*
92-X *catch weight*

Accessories:
1. Plastic hood 0441 196-002
2. Wire conduit (please quote length) 0442 827-001
3. Adapter kit 0442 828-880



Handwelding Electrodes

List of Products

Electrodes for Manual Metal Arc Welding

Electrodes for welding mild and medium tensile steels.

	Classification AWS A5.1	Designation DIN 1913	Page
Cellulosic electrodes			
Pipeweld 6010	E 6010	E 4332 C4	149
Pipeweld 7010	E 7010-G	E 5143 C4	150
Pipeweld 85	E 7010-A1	E 5143 C4	151
Pipeweld 8010	E 8010-G	E 5132 C4	152
Rutile electrodes			
OK 43.32	E 6013	E 51 21 RR 6	163
OK 46.00	E 6013	E 43 32 R (C) 3	164
OK 46.16	E 7014	E 43 32 RR (C) 6	165
Basic electrodes			
OK 48.00	E 7018	E 51 53 B 10	166
OK 48.04	E 7018	E 51 53 B 10	167
OK 48.08	E 7018-G	E 51 55 B 10	168
OK 48.15	E 7018	E 51 43 B (R) 10	169
OK 48.68	E 7018-1	E 51 54 B 10	170
OK 50.10	E 6013 (6020)	E 43 42 AR 7	171
OK 50.40	E 6013	E 51 42 RR (B) 7	172
OK 53.04	E 7016	E 51 44 B 10	173
OK 53.35	E 7048	E 51 43 B (R) 9	174
OK 53.68	E 7016-1	E 51 55 B 10	175
OK 55.00	E 7018-1	EY 46 66 Mn B DIN 8529	176
Acid electrodes			
OK 50.10	E 6013	E 43 42 A 5	171
OK 50.40	E 6013	E 43 42 AR 7	172
Rutile high recovery electrodes			
OK Femax 33.60	E 7024	E 51 22 RR 11 170	154
OK Femax 33.80	E 7024	E 51 32 RR 11 180	155
Basic high recovery electrodes			
OK Femax 38.48	E 7028	E 51 43 B (R) 12 150	157
OK Femax 38.65	E 7028	E 51 43 B (R) 12 160	158
OK Femax 38.85	E 7028	E 51 43 B (R) 12 220	159
OK Femax 38.95	E 7028	E 51 54 B (R) 12 240	161
Deep penetration electrodes			
OK Rapid 23.50	E 6020		153

Root gouging of a vertical butt joint with OK Selectrode 21.03

Long electrodes for gravity welding

	Classification AWS A5. 1	Designation DIN 1913	Page
OK Femax 33.80 Fematic	E 7024	E 51 32 RR 11 180	156
OK Femax 38.85 Fematic	E 7028	E 51 43 B (R) 12 220	160
OK Femax 39.50 Fematic	E 6027	E 51 53 AR 11 160	162

Electrodes for welding stainless and heat resisting steels

Electrode	Alloy type	Classification AWS A5. 4	Designation DIN 8556	Page
OK 61.10	19 Cr 10 Ni	E 308 L-16	E 19 9 LR 23	177
OK 61.30	19 Cr 10 Ni ELC	E 308 L-16	E 19 LR 23	178
OK 61.33 NAG	19 Cr 10 Ni ELC	E 308 L-16	E 19 9 LB 20+	179
OK 61.34	19 Cr 10 Ni	E 308 L-16	E 19 9 LR 23	180
OK 61.35	19 Cr 10 Ni	E 308 L-15	E 19 9 LB 20+	181
OK 61.41	19 Cr 10 Ni ELC	E 308 L-15	E 19 9 LR 23 150	182
OK 61.80	20 Cr 10 Ni Nb	E 347-16	E 19 9 Nb R 23	183
OK 61.81	19 Cr 9 Ni 0.8 Nb	E 347-16	E 19 9 Nb R 23 110	184
OK 63.10	18 Cr 12 Ni 2.8 Mo	E 316 L-16	E 19 12 3 LR 23	185
OK 63.20	18 Cr 12 Ni 2.8 Mo	E 316 L-16	E 19 12 3 R 13	186
OK 63.30	18 Cr 12 Ni 2.8 Mo ELC	E 316 L-16	E 19 12 3 LR 23	187
OK 63.32	19 Cr 10 Ni 2.8 Mo	E 308 Mo L-16	E 19 12 3 L MPR 23 175	188
OK 63.34	18 Cr 12 Ni 2.8 Mo	E 316 L-16	E 19 12 3 LR 16	189
OK 63.35	18 Cr 12 Ni 2.8 Mo	E 316 L-15	E 19 12 3 LB 20+	190
OK 63.41	18 Cr 12 Ni 2.8 Mo ELC	E 316 L-16	E 19 12 3 LR 23 150	191
OK 63.80	18 Cr 12 Ni 2.8 Mo 0.6 Nb		E 19 12 3 Nb R 23	192
OK 64.30	19 Cr 13 Ni 3.5 Mo ELC	E 317 L-16	E 18 13 4 L R 23	193
OK 64.63	18 Cr 17 Ni 4.7 Mo 2.7 Mn		E 18 16 5 LR 26	194
OK 67.13	25 Cr 20 Ni	E 310-16	E 25 20 B 20+	195
OK 67.15	25 Cr 20 Ni	E 310-15	E 25 20 B 20+	196
OK 67.50	22 Cr 9 Ni 3 Mo		E 22 9 3 L R 23	197
OK 67.60	24 Cr 13 Ni	E 309 L-16	E 23 12 L R 23	198
OK 67.62	24 Cr 12 Ni	E 309-16	E 23 12 MPR 36 170	199
OK 67.70	22 Cr 12 Ni 2.5 Mo 0.03 C	E 309 Mo-16	E 22 12 3 LR 23	200
OK 67.71	23 Cr 13 Ni 3 Mo	E 309 Mo-16	E 22 12 3 LR 26 150	201
OK 67.72	23 Cr 13 Ni 2.8 Mo	E 309 Mo-16	E 23 13 3 MPR 36 190	202
OK 67.75	22 Cr 12 Ni ≤0.5 Mo	E 309 L-15	E 23 12 LB 20+	203
OK 67.83	25 Cr 21 Ni 2.3 Mo 4.2 Mn			204
OK 68.15	13 Cr	E 410-15	E 13 MPB 20+ 120	205
OK 68.17	12 Cr 4.3 Ni 0.5 Mo 0.7 Mn	E 410 Ni Mo-16	E 13 4 MPR 23 120	206
OK 68.53	25 Cr 9 Ni 4 Mo 0.7 Mo			207
OK 68.60	26 Cr 5 Ni 1.5 Mo		E 25 Mo R 26 110	208

Fully austenitic

OK 69.21	18 Cr 16 Ni 2.5 Mo 6 Mn			209
OK 69.33	20 Cr 25 Ni 4.5 Mo ELC		E 20 25 5 L Cu R	210
OK 69.63	20 Cr 25 Ni 6.5 Mo 2.8 Mn		E 20 25 6 L Cu R 23	211

Electrodes for welding high tensile steels

Electrode	Alloy type	Designed for welding	Classification AWS A5.5:	Page
OK 73.08	0.6 Ni 0.4 Cu	Weathering steel	E 8018-G	212
OK 73.68	2.4 Ni	Cold ductile steel	E 8018-C1	213
OK 74.78	1.3 Mn. 0.4 Mo	High tensile. cold ductile steel	E 9018-D1	214
OK 75.75	1.4 Mn, 0.35 Cr, 1.8 Ni,	High tensile steel	E 11018-G	215
OK 76.18	1.2 Cr 0.5 Mo (Basic)	Corresponding steel	E 8018-B2 L	216
OK 76.28	0.05 C 2.3 Cr 1 Mo	Corresponding steel	E 9018-B3 L	217
OK 76.35	5 Cr 0.5 Mo	Corresponding steel	E 502-15	218
OK 76.96	9 Cr 1 Mo	Corresponding steel	E 505-15	219
OK 78.04	1.7 Mn, 1Ni:	High tensile steel	E 9016-G	220
OK 78.08	1.7 Mn, 2.5 Ni 0.2 Mo	High tensile steel	E 11018-G	221
OK 78.10	1.7 Mn, 1.8 Ni, 0.4 Mo	High tensile steel	E 10018-M	222
OK 78.12	1.7 Mn, 2 Ni 0.4 Mo	High tensile steel	E 11018-M	223
OK 78.16	0.8 Mn 1 Cr 0.2 Mo	Hign tensile steel	E 9018-G	224

Electrodes for Repair & Maintenance, Special Electrodes for

1. "Difficult to weld steels"
2. Joining metals of quite different composition and high alloy to low alloy steel
3. Crack-free welds in cast iron
4. Hardfacing and corrosion resistant cladding
5. Steels for low temperature service
6. Nickel alloys, nickel-copper
7. Copper and copper alloys
8. Aluminium alloys
9. Cutting and charmfering of steel, cast iron and nonferrous alloys. Joint preparation.

	Alloy type	Hardness	OK	Page
Electrodes for difficult to weld steels and for joining metals of different composition	19 Cr, 9 Ni, 6 Mn	190 HV	67.45	226
	19 Cr, 9 Ni, 6 Mn	190 HV	67.52	227
	29 Cr, 9 Ni	240 HV	68.81	228
	29 Cr, 9 Ni	240 HV	68.82	229
Electrodes for hardfacing and cladding steels: Non hardenable deposit	3.5 Cr, 0.1 C	33 HRC	83.28	230
	3.5 Cr, 0.1 C	33 HRC	83.29	231
Air hardening deposits	6 Cr, 0.6 Mo, 0.4 C	55 HRC	83.50	232
	4 Si, 2 Cr, 0.7 C	60 HRC	83.65	233
	13 Cr, 0.1 C	45 HRC	84.42	234
	13 Cr, 0.25 C	55 HRC	84.52	235
	10.5 Cr, 0.7 C	57 HRC	84.58	236
Air hardening "tempering resistant" deposit	33 Cr, 4.5 C	60 HRC	84.78	237
	Hot forming steel	50 HRC	85.58	238
	High speed cutting steel	65 HRC	85.65	239
	23 Cr, 7 Mo, 7 Nb, 2W	63 HRC	84.80	242
Heat resistant deposits	Hastelloy C	220–400 Hv	92.35	245
	Co-base	40–45 HRC	93.01–12	254,255, 256,257
Work hardening deposits	13 Mn, 1 C	≤450 HV$_1$)	86.08	240
	14 Mn, 3.5 Ni, 0.7 C	≤450 HV$_1$)	86.28	241
	Hastelloy C	≤450 HV$_1$)	92.35	245
	29 Cr, 9 Ni	≤450 HV$_1$)	68.81	228
	29 Cr, 9 Ni		68.82	229
	Co-base		93.07	256
Electrodes for welding of cast iron	Nickel	160 HB	92.18	243
			92.45	246
	Nickel-iron	170 HV	92.58	247
Electrodes for welding of nonferrous metals and for cladding of nonferrous weld metal on steel	Inconel		92.26	244
	Hastelloy C	220 HV	92.35	245
	Monel metal	150 HV	92.86	248
	Tin bronze	100 HV	94.25	249
	Silicon bronze	150 HV	94.55	250
	Unalloyed aluminium		96.10	251
	Al-Mn		96.20	252
	Silumin		96.50	253
	Cobalt-based		Cobal 50	259
Electrodes for cutting and joint preparation	For joint preparing		21.03	225
	For cutting and deep penetration welding			

1) In cold worked condition

Note. ESAB also has a range of special electrodes which are supplied to order.

General

Official approvals
Over and above the official approvals given in this catalogue, there are many OK electrodes approved by foreign authorities, railway boards, private companies etc. Information on these approvals is available on request.

Tensile properties
Tensile properties, unless otherwise stated, refer to all weld metal test pieces prepared according to the rules of the Classification Societies using 4 and 6 mm diam. electrodes.

Welding current
Maximum and minimum values are given. The most suitable welding current depends largely on the size of the workpiece, the welding position and the type of joint.
Small workpieces need a lower current, larger workpieces a higher current depending on the dissipation of heat from the joint. When preheat is used, reduce the recommended current values by 15–30 %.

Storage of electrodes. Refers also to the chapter on the care of electrodes, page 169 Electrodes, which are not packed in air-tight containers, should be stored in a dry place, the temperature of which does not fall below +10°C. For basic electrodes, the minimum temperature should be at least +15°C and the relative humidity less than about 60 %.

Drying instructions
Slightly damp electrodes can, in most cases, be made usable again in the following way:

Heat the electrodes in a suitable oven up to 200–250°C and keep them there for 3 hours. (Organic rutile electrodes, e.g. OK 46.00, OK 46.16 and OK 46.64 should be redried at 70–90°C for 1 hour). Note that the electrodes should not be tightly packed in a closed oven during drying since the moisture released must be allowed to escape.

Note
Electrodes seriously damaged by moisture can normally not be redried with first class result. Such electrodes should be scrapped.

Marking
The electrode type is clearly marked on the coating of each electrode near the grip end, e.g. OK 48.00.

Choice of suitable Electrode

The OK electrodes in this catalogue are placed in numerical order and divided into groups according to the type of alloy deposited. Within each group of electrodes for welding mild, low alloy and stainless steels, there are, in several cases, many electrodes which are intended for welding the same type of steel. Therefore, for each steel quality there are often a large number of electrode types to choose from, giving similar weld metal compositions but having different coverings, welding properties, welding speeds and weld metal quality. This large choice makes it possible to choose the electrode which gives the right weld metal quality at the lowest cost.
When choosing an electrode, the first rule is to select one which gives a weld metal quality equal to or better than that of the base material and when necessary approved for the material in question. Welding position and type of joint are other factors which influence the choice of electrode since different electrodes have different properties in different welding positions and types of joint.

General information on the influence of the electrode coating type on welding properties, welding speed and weld metal quality.

Rutile electrodes giving about 100 % weld metal recovery are easy to strike and use and are particularly suitable for short welds in mild steel, for fillet welds, for welding sheet steels and for bridging large joint gaps. The welds have a fine finish and spatter losses are negligible. The welding speed is moderate.
Unalloyed rutile electrodes are not normally recommended for welding steel having a nominal tensile strength exceeding 440 N/mm² (45 kp/mm²). Rutile electrodes are relatively insensitive to moisture.

High efficiency rutile electrodes generally give a higher welding speed, which increases as the weld metal recovery increases up to a max. of about 140 g/min. for 6 mm diam. OK Femax 33.80.
All are easy to use, give excellent slag detachability, fine bead appearance and are particularly suitable for welding horizontal/vertical fillets. The weld metal has tensile properties, which are as high as, or somewhat higher than weld metal from unalloyed basic electrodes but have lower elongation and notch toughness. The evenness of the weld and the smooth transition to the base material make joints carried out with rutile electrodes at least as good as unmachined joints made with basic electrodes as regards fatique strength. Unalloyed rutile electrodes, irrespective of their efficiency, can be recommeded for welding mild steel having a nominal tensile strength of 440 N/mm² (45 kp/mm²). As regards the tensile strength of the deposit, rutile electrodes can also be used for welding steels having a higher nominal tensile strength than 440 N/mm² (45 kp/mm²), but as a general rule only electrodes giving a low hydrogen content weld metal, e.g. basic, rutile-basic or zircon-basic electrodes should be used for welding these steels.

Acid electrodes without iron powder in the covering are easier to strike than basic electrodes but more difficult to strike and re-strike than rutile electrodes. The welding speed is moderate. The weld beads are smooth and shiny. The slag is inflated and easy to remove. The weld metal has a lower yield stress and tensile strength compared with those from rutile electrodes but has higher elongation and impact strength.
This type of electrode, which completely dominated the market a few decades ago, has gradually been replaced by rutile electrodes for welding in the flat position and basic electrodes for positional welding. Unalloyed acid electrodes are suitable for welding steels having a nominal tensile strength of up to 440 N/mm² (45 kp/mm²).

High efficiency acid electrodes have considerably higher welding speed than the normal electrodes, up to a maximum of about 120 g/min. for 6 mm diam. OK Femax 39.50. The beads are smooth and shiny. The slag is inflated and easy to remove. High efficiency acid electrodes are particularly suitable for making butt joints and fillet weld in the flat position. OK Femax 39.50 in long lengths is suitable for gravity welding with the Short-Neck equipment.
The weld metal has the same strength as that from normal acid electrodes, and the application range is therefore similar, i.e. they are suitable for welding mild steels having a nominal tensile strength not exceeding 440 N/mm² (45 kp/mm²).

Unalloyed basic electrodes have moderate welding speed in the flat position but are faster than other types when welding vertically upwards. The reason for this is that basic electrodes can be deposited at a higher current in the vertical position than other types of electrode. In addition, the amount of weld metal deposited per electrode is greater than for other electrodes which can be used in this position. This means a smaller number of electrode changes. Thus, the result is normally a higher fusion rate and higher arc-time factor when welding vertically upwards with basic electrodes compared with other types.
The slag is normally not quite as easy to remove as the slag from acid or rutile electrodes, but even so, it can be classed as easily detachable. The slag from basic electrodes has a lower melting point than that from rutile or acid electrodes. The risk of slag inclusions during normal production welding is therefore unusually small when basic electrodes are used, even if the slag is not completely removed between beads during multi-run welding.
The weld metal from basic electrodes has a low hydrogen content and usually good toughness even at low temperatures. Basic electrodes are less likely to give either hot cracks or cold cracks compared with other types of electrode. The superiority of basic electrodes from this point of view appears when welding manganese-alloyed structural steels, pressure vessel steels and ship plate having a nominal tensile strength of 490–530 N/mm² (50–54 kp/mm²) and a yield stress of 290–390 N/mm² (30–40 kp/mm²). The higher the hardenability of the steel to be welded, the greater the necessity to use basic electrodes, and the greater is the need for low covering moisture contents.
Unalloyed basic electrodes are suitable for steels having a minimal tensile strength of 530 N/mm² (54 kp/mm²) and a yield stress of 390 N/mm² (40 kp/mm²), some electrodes can also be recommended for steels having a yield stress 440 N/mm² (45 kp/mm²) and often for steels with even higher strength, if this high strength is not necessary in the welded joint. For good corrosion resistance in sea water, and in corrosive atmosphere, OK 73.08 is recommended.

Zircon-basic high efficiency electrodes are the fastest of all and are preferably deposited in the flat position. OK Femax 38.95 deposits 250 g/min. max. with 6 mm diam. electrodes. Zircon-basic high efficiency electrodes can be used for welding the same steels as the unalloyd basic electrodes. OK Femax 38.65 is suitable for welding butt joints and fillet joints in the horizontal vertical and flat positions. OK Femax 38.95 is recommended for welding butt joints and fillet joints in the flat position only.

Rutile-basic high efficiency electrodes combine the good welding properties of rutile electrodes with the high weld metal quality of basic electrodes. They are therefore the best electrodes for making horizontal-vertical fillet welds in high strength steels, where ordinary rutile high efficiency electrodes are not permitted. They can be used for welding the same steels as ordinary unalloyed basic electrodes or unalloyed zircon-basic high efficiency electrodes.
OK Femax 38.85 is the fastest low hydrogen electrode for horizontal fillet welds.

Cellulosic electrodes They are easy to use in all welding positions and particularly good for vertical and overhead welding. Cellulosic electrodes are recommended for all position welding where the mechanical properties of the deposit is of greatest importance and radiographic requirements must be met. Vertical and overhead welding require often one size larger electrode in comparison to electrodes with other types of coating. Cellulose electrodes are extremely good for vertical down welding.
Mild steel can be welded without preheating. Higher tensile steel require preheating and higher interpass temperature than when the welding is done with low hydrogen electrodes.

Standards and Codes

Guide to the ISO coding

Mechanical properties

Electrode designation	Tensile strength[1]	Minimum elongation on L=5 d	Temperature for minimum impact value of 28 J[2]
	N/mm²	%	C
E 43 0	430 to 510	–	–
E 43 1	430 to 510	20	+20
E 43 2	430 to 510	22	0
E 43 3	430 to 510	24	–20
E 43 4	430 to 510	24	–30
E 43 5	430 to 510	24	–40
E 51 0	510 to 610	–	–
E 51 1	510 to 610	18	+20
E 51 2	510 to 610	18	0
E 51 3	510 to 610	20	–20
E 51 4	510 to 610	20	–30
E 51 5	510 to 610	20	–40

[1]) Upper limit tolerance: +40 N/mm²
[2]) 1J = 0.102 kgf.m

Type of coating

A = Acid (iron oxide)
AR = Acid (rutile)
B = Basic
C = Cellulosic
O = Oxidizing
R = Rutile (medium coated)
RR = Rutile (heavy coated)
S = Other types

COMPULSORY

Example: E 51 3 B 160 20 H

% Metal recovery for not less than 110 % recovery

Low hydrogen electrode

Welding positions

1 all positions;
2 all positions, except vertical downward;
3 flat butt weld, flat fillet weld, horizontal/vertical fillet weld;
4 flat butt weld, flat fillet weld;
5 as 3 and recommended for vertical downward.

Current conditions

Symbol	Direct current Recommended polarity	Alternating current Minimum open–circuit voltage V
0[1])	+	
1	+ or –	50
2	–	50
3	+	50
4	+ or –	70
5	–	70
6	+	70
7	+ or –	90
8	–	90
9	+	90

[1]) Symbol reserved for electrodes used exclusively on direct current

OPTIONAL

Note: In the example given above, it will be seen that E 51 3 B is compulsory, the remainder optional.

Table 9 OK-electrodes: Classification according to AWS, DIN and ISO standards (Stainless electrodes to British Standard)

Electrode	AWS	DIN	ISO
Mild and Low Alloy Steel			
Pipeweld 6010	E 6010	E 43 32 C 4	E 43 3 C 14
Pipeweld 7010	E 7010–G	E 51 43 C 4	E 51 4 C 10
Pipeweld 85	E 7010–A1	E 51 43 C 4	E 51 4 C 10
Pipeweld 8010	E 8010–G	E 51 32 C 4	E 51 3 C 10
OK Femax 33.60	E 7024	E 51 22 RR 11 170	E 51 2 RR 170 31
OK Femax 33.80	E 7024	E 51 32 RR 11 180	E 51 2 RR 180 31
OK Femax 38.48	E 7028	E 51 43 B(R) 12 150	E 51 4 B 150 36 H
OK Femax 38.65	E 7028	E 51 43 B(R) 12 160	E 51 4 B 170 36 H
OK Femax 38.85	E 7028	E 51 43 B(R) 12 220	E 51 4 B 220 36 H
OK Femax 38.95	E 7028	E 51 54 B(R) 12 240	E 51 5 B 240 46 H
OK Femax 39.50	E 6027	E 51 53 AR 11 160	E 51 5 AR 160 25
OK 43.32	E 6013	E 51 21 RR 6	E 51 2 RR 32
OK 46.00	E 6013	E 43 32 R(C) 3	E 43 3 R 11
OK 46.16	E 7014	E 43 32 RR(C) 6	E 43 3 RR 11
OK 48.00	E 7018	E 51 53 B 10	E 51 5 B 120 20 H
OK 48.04	E 7018	E 51 53 B 10	E 51 5 B 120 26 H
OK 48.08	E 7018–G	E 51 55 B 10	E 51 6 B 120 24 (H)
OK 48.15	E 7018	E 51 43 B(R) 10	E 51 4 B 120 26 H
OK 48.68	E 7018–1	E 51 54 B 10	E 51 5 B 120 24 H
OK 50.10	E 6013	E 43 42 AR 5	E 43 4 AR 24
OK 50.40	E 6013	E 51 43 RR(B) 7	E 51 4 RR 24
OK 53.04	E 7016	E 51 44 B 10	E 51 4 B 24
OK 53.35	E 7048	E 51 43 B(R) 9	E 51 4 B 56 H
OK 53.68	E 7016–1	E 51 55 B 10	E 51 5 B 24 H
OK 55.00	E 7018–1	EY 4666 Mn B	E 51 B 120 26 H
Stainless steel			**BS 2926**
OK 61.10	E 308 L–16	E 19 9 LR 23	19.9 LR
OK 61.30	E 308 L–16	E 19 9 LR 23	19.9 LAR
OK 61.33 NAG	E 308 L–16	E 19 9 LB 20+	19.9 LR
OK 61.34	E 308 L–16	E 19 9 LR 23	19.9 LAR
OK 61.35	E 308 L–15	E 19 9 LB 20+	19.9 LB
OK 61.41	E 308 L–16	E 19 9 LR 23 150	19.9 LAR
OK 61.80	E 347–16	E 19 9 Nb R 23	19.9 Nb AR
OK 61.81	E 347–16	E 19 9 Nb R 23 110	19.9 Nb R
OK 63.10	E 316 L–16	E 19 12 3 LR 23	19.12.3 LR
OK 63.20	E 316 L–16	E 19 12 3 R 13	19.12.3 LR
OK 63.30	E 316 L–16	E 19 12 3 LR 23	19.12.3 LAR
OK 63.32	E 308 Mo–16	E 20 10 3 L MPR 23 175	
OK 63.34	E 316 L–16	E 19 12 3 LR 16	19 12.3 LAR
OK 63.35	E 316 L–15	E 19 12 3 LB 20+	19 12.3 LB
OK 63.41	E 316 L–16	E 19 12 3 LR 23 150	19.12.3 LR
OK 63.80		E 19 12 3 Nb R 23	19 12 3 Nb AR
OK 64.30	E 317 L–16	E 18 13 4 LR 23	
OK 64.63		E 18 16 5 LR 26	
OK 67.13	E 310–16	E 25 20 B 20+	
OK 67.15	E 310–15	E 25 20 B 20+	25 20 B
OK 67.50		E 22 9 3 LR 23	
OK 67.60	E 309L–16	E 23 12 LR 23	E 23.12 LR
OK 67.62	E 309–16	E 22 12 MPR 36 160	23 12 R MP
OK 67.70	E 309 Mo–16	E 22 12 3 LR 23	23 12.2 AR
OK 67.71	E 309 Mo–16	E 22 12 3 LR 26 150	
OK 67.72	E 309 Mo–16	E 23 13 3 MPR 36 190	
OK 67.75	E 309–15	E 23 12 LB 20+	23.12 LB
OK 68.15	E 410–15	E 13 MPB 20+120	
OK 68.17	E 410 Ni Mo–16	E 134 MPR 23 120	
OK 69.33		E 20 25 5 L CuR	
OK 69.63		E 20 25 6 L CuR 23	

Table 9 OK-electrodes: Classification according to AWS, DIN and ISO standards (Stainless electrodes to British Standard)

Electrode	AWS	DIN	ISO
Low Alloy Steel			
OK 73.08	E 8018–G	–	E 51 5 B 120 26 H
OK 73.68	E 8018–C1	–	–
OK 74.78	E 9018–D1	–	–
OK 75.75	E 11018–G	–	–
OK 76.18	E 8018–B2 L	E Kb, Cr Mo 1 26	–
OK 76.28	E 9018–B3L	E Kb, Cr Mo 2 26	–
OK 76.35	E 502–15	E Cr Mo 5820+	E 5 Cr Mo LB 20
OK 76.96	E 505–15	E Cr Mo 9 B 20+	E 9 Cr Mo B 20
OK 78.04	E 9016–G	–	–
OK 78.08	E 11018–G	–	–
OK 78.10	E 10018–M	EY 55 66 Mn 2Ni Mo BH5 120	
OK 78.12	E 11018–M	EY 69 66 Mn 2Ni Mo BH5 26 120	
OK 78.16	E 9018–G		

Table 10 OK-electrode: Approvals by the Classification Societies and other approvals

Electrode OK	American Bureau of Shipping	Bureau Veritas	Det norske Veritas	Germa-nischer Lloyd	Lloyd's Register of Shipping	Sovjet USSR	Others
Pipeweld 6010	3		3		3		Controlas 3YP, GdF
Pipeweld 7010	3, 3Y		3, 3Y		3, 3Y		Controlas 3 YP
Pipeweld 85	3		3		3		Controlas 3 YP
Pipeweld 8010	3		For pipe line welding 3, 3Y		3		Controlas grade 3 YP, GdF
OK Rapid 23.50	1 DP	1 DP	1 DP		1		
OK Femax 33.60	2	2	2	2	2		TÜV*
OK Femax 33.80	2	2	2	2	2		Polands PRS grade 2, TÜV
OK Femax 38.48	3H, 3Y	3, 3Y HH	3Y HH	3Y HH	3H, 3Y H	6 HH	TÜV
OK Femax 38.65	3H, 3Y	3, 3Y HH	3Y HH	3Y HH	3H, 3Y H		TÜV
OK Femax 38.85	3H, 3Y	3, 3Y HH	3Y HH		3 3Y H	6 HH	Poland PRS grade 3 Y HH
OK Femax 38.95	3H, 3Y	3, 3Y HH	3Y HH		3 3Y H	K 6 HH-40	
OK Femax 39.50	3	3	3	3	3	3	Poland PRS grade 3
OK 43.32	1	1	1	1	1		TÜV
OK 46.00	2	2	2		2		Poland PRS grade 2
OK 46.16	2	2	2	2	2		Poland PRS grade 2, DSRK
OK 48.00	3H, 3Y	3, 3Y HH	3Y HH	3Y HH	3H, 3Y H	6 HH-40	Poland PRS 3Y HH DSRK, TÜV
OK 48.04	3H, 3Y	3, 3Y HH	3Y HH	3Y HH	3, 3Y H		Poland PRS 3Y HH
OK 48.08	3H, 3Y-40		3Y HH-40		3YH, C Mn LT 40		
OK 48.15	3H, 3Y	3, 3Y HH	3Y HH	3Y HH	3, 3Y H	KIV, 6	Poland PRS 3Y HH DSRK, TÜV
OK 48.68	3H, 3Y	3, 3Y HH	3Y HH		3H, 3Y H		
OK 50.10	3	3	3	3	3		
OK 50.40	2	2	2	2	2		TÜV
OK 53.04	3H, 3Y	3, 3Y HH	3Y HH	3Y HH	3H, 3Y H		
OK 53.35	3H, 3Y	3, 3Y HH	3Y HH	3Y HH	3H, 3Y H	6	Poland PRS grade 3 Y HH TÜV
OK 53.68	3H, 3Y	3, 3Y HH	3Y HH	3Y HH	3, 3Y, C Mn LT 40		Poland PRS grade 3 Y HH
OK 55.00	3H, 3Y	3, 3Y HH	3Y HH		3, 3Y H	K6-40	and for low temperature, TÜV

Table 10 OK-electrode: Approvals by the Classification Societies and other approvals

Electrode OK	American Bureau of Shipping	Bureau Veritas	Det norske Veritas	Germa-nischer Lloyd	Lloyd's Register of Shipping	Sovjet USSR	Others
Low alloy							
OK 73.08	3H, 3Y	3, 3Y HH	3Y HH	3Y H	3, 3Y H		TÜV
OK 73.68	3H, 3Y	UP, Low temp	3Y HH, NV4-4		3, 3Y H, C Mn LT 60		Controlas, TÜV PRS: 3Y HH
OK 74.78	3H, 3Y	3, 3Y HH	3Y HH		3, 3Y H		TÜV
OK 75.75	E 11018-M		High strength				TÜV
OK 76.18	SR	UP	HH for NV7-2		yes		Controlas, TÜV
OK 76.28	SR	UP	HH for NV7-3		yes		Controlas, TÜV
OK 76.35							Controlas: X TÜV
OK 76.96							Controlas: X
OK 78.04							NES769, Q1(N), HY80
OK 78.08							NES769, HY100, Q2(N)
OK 78.12	E11018-M, –51°C		HH –51°C				Controlas X, –51°C

* TÜV means TÜV: Eignungsgeprüft

Table 11 Approvals for the different grades of ship's steel

ESAB	American Bureau of Shipping	Bureau Veritas	Det norske Veritas	Germanischer Lloyd	Lloyd's Register of Shipping
OK Rapid 23.50	A	A	A, A-27	A	A
OK Femax 33.60	A, B, D, DS	A, D	A, A-27, A-32, B (W), C, D	A, AD	A, D
OK Femax 33.80	A, B, D, DS	A, D		A, AD	A, D
OK Femax 38.48	A, AH	A, A-32, A-36	A, A-27, A-32, A-36, A-40	A, A-32, A-36	
OK Femax 38.65	B, CS	D, D-32, D-36	B (W) C		
	D, DN, DS, DH		D, D-27, D-32, D-36, D-40	D, D-32, D-36	A, AH, D, DH, E, EH
OK Femax 38.85	E, EH	E, E-32, E-36	E, E-27, E-32, E-36, E-40	E, E-32, E-36	
OK Femax 38.95					
OK Femax 39.50	A, B, CS D, DS, DN, E	A, D, E	A, A-27, A-32, B (W) C,	A, D, E	A, D, E
		A, D, G	D, D-27, D-32, (E)[1]	A, AD, E	A, D, E
OK 43.32	A ≤12.5 mm	A	A, A-27	A	A
OK 46.00	A, B, D, DS	A, D	A, A-27, A-32, B (W), C	A, D	A, D
OK 46.16	A, B, D, DS	A, D	D, D-27, D-32, (E)[1]	A, D	A, D
OK 48.00	A, AH	A, A-32, A-36	A, A-27, A-32, A-36, A-40	A, D, E	
OK 48.04	B, CS	D, D-32, D-36		A, A-32, A-36	A, AH
OK 48.08	3H, 3Y		3YHH, service temp –40°		3YH, C Mn Lt 40
OK 48.15	D, DN, DS, DH	E, E-32, E-36	D, D-27, D-32, D-36, D-40	D, D-32, D-36	D, DH
OK 48.68	E, EH		E, E-27, E-32, E-36, E-40	E, E-32, E-36	E, EH
OK 50.10	A, B, CS, D, DS, DN, E	A, D, E	A, A-27, D, D-27, B, C (E)[3] (E-27)[1]	A, D, E	A, D, E
		A, AH	A, A-32, A-36	A, A-27, A-32, A-36, A-40	
OK 53.35	D, DS, DN, DH	D, D-32, D-36	D, D-27, D-32, D-36, D-40	D, D-32, D-36	A, AH, D, DH, E, EH
OK 53.68	E, EH	E, E-32, E-36	E, E-27, E-32, E-36, E-40	E, E-32, E-36	
OK 55.00					

[1] For A, W (B), C or D to E steel.

Table 12 OK Electrodes for welding AISI stainless steels

AISI No.	Steel type	Weldability	OK Electrodes
201	C 0.15 17 Cr–4.5 Ni–6.5 Mn	good	OK 63.35 OK 67.75
202	C 0.15 18 Cr–5 Ni–8.5 Mn	good	OK 63.35 OK 67.75
301	C 0.15 17 Cr–7 Ni	good	OK 61.30 OK 61.33 OK 61.41
302	C 0.15 18 Cr–9 Ni	good	OK 61.30 OK 61.33 OK 61.41
302 B	C 0.15 18 Cr–9 Ni 2–3 Si	good	OK 61.30 OK 61.33 OK 61.41
303	C 0.15 18 Cr–9 Ni S 0.15	poor	OK 61.30 OK 61.33 OK 61.41
303 Se	C 0.15 18 Cr–9 Ni Se 0.15	poor	OK 61.30 OK 61.41
304	C 0.08 max. 19 Cr–10 Ni	good	OK 61.30 OK 61.41 OK 61.33
304 L	C 0.03 max. 19 Cr–10 Ni	good	OK 61.30 OK 61.41 OK 61.33
305	C 0.12 18 Cr–11.5 Ni	good	OK 61.30 OK 61.41 OK 61.33
308	C 0.08 20 Cr–11 Ni	good	OK 61.30 OK 61.41 OK 61.33
308 L	C 0.03 20 Cr–11 Ni	good	OK 61.30 OK 61.41 OK 61.33
309	C 0.2 23 Cr–13 Ni	good	OK 67.70 OK 67.62 OK 67.75
309 S	C 0.08 23 Cr–13 Ni	good	OK 67.70 OK 67.62 OK 67.75
310	C 0.25 25 Cr-20 Ni	good	OK 67.13 OK 67.15
310 S	C 0.8 25 Cr-20 Ni	good	OK 67.13
314	C 0.25 24 Cr–20 Ni 1.5/3.0 Si	good	OK 67.15
316	C 0.08 17 Cr–12 Ni–2.5 Mo	good	OK 63.30, 63.34, 63.35, 63.41
316 L	C 0.03 17 Cr–12 Ni–2.5 Mo	good	OK 63.30, 63.34, 63.41
317	C 0.08 19 Cr–13 Ni–3.5 Mo	good	OK 64.30
321	C 0.08 18 Cr–10 Ni Ti 5xC	good	OK 61.30 OK 61.81
347	C 0.08 18 Cr–10 Ni Nb 10xC	good	OK 61.30 OK 61.81
403	C 0.15 12 Cr 0.5 Si max.	fair	OK 63.35 OK 84.42
405	C 0.08 13 Cr 1.0 Si max.	fairly good	OK 63.30 OK 63.35
410	C 0.15 12.5 Cr 1.0 Si max.	fair	OK 84.42 OK 63.35

In all cases the temperature of the workpiece should be kept as low as possible when welding austenitic steel.
Steel corresponding to AISI No 403, 405 and 410 should preferably be welded at elevated temperature 200–300°C.

Calculation of Electrode Consumption

In the tables, joint cross section, theoretical joint volume and kg weld metal per metre length of welded joint are given. The electrode consumption per metre of welded joint is obtained by dividing the number of kg of weld metal by N, where N is the kg of weld metal per kg of electrode and is given for each electrode in the following section under the heading "Deposition data at max. welding current".

Square butt joints: Joint volumes and weld metal weights

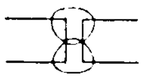
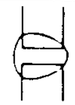
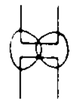
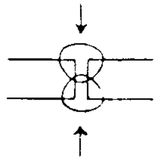
Position	Plate thickness mm	Gap mm	Volume/length cm³/m	Weight/length weld metal kg/m
 Flat	1	0	2	0.02
	1.5	0.5	3	0.02
	2	1	4	0.03
	3	1.5	7	0.05
 Flat	4	2	17	0.13
	5	2	21	0.16
	6	2.5	27	0.21
	7	3	36	0.28
 Horizontal-Vertical	1	0	2.5	0.02
	1.5	0.5	4	0.03
	2	1	5	0.04
	3	1.5	9.5	0.07
 Horizontal-Vertical	4	2	22	0.17
	5	2.5	25	0.20
	6	3	32	0.25
	7	3	42	0.33
 Overhead	4	2	9	0.07
	5	2	10.5	0.08
	6	2	13	0.10
	7	2.5	16	0.13
	4	3	10.5	0.08
	5	3	16	0.13
	6	2.5	18	0.14
	7	3	21	0.16

Plate thickness mm	Gap mm	70° Vertical 1	70° Vertical 2	70° Vertical 3	80° Overhead 1	80° Overhead 2	80° Overhead 3	60° Horizontal-Vertical 1	60° Horizontal-Vertical 2	60° Horizontal-Vertical 3
4	1	15	16.5	0.13	17.5	18	0.14	13	14.5	0.11
5	1	22.5	24.5	0.19	26	28	0.22	19.5	21	0.16
6	1	31	37	0.29	36	38.5	0.30	27	30	0.24
7	1.5	45	49	0.38	51.5	56	0.44	39	42	0.33
8	1.5	57	59.5	0.47	65.5	70	0.55	49	56	0.44
9	1.5	70	75.5	0.59	81.5	87.5	0.69	60.5	65	0.51
10	2	90	96.5	0.76	104	109	0.86	77.5	81	0.64
11	2	107	113	0.89	124	130	1.02	92	96.5	0.76
12	2	125	134	1.05	145	157	1.23	107	113	0.89
14	2	165	171	1.34	193	204	1.60	141	159	1.17
15	2	188	197	1.55	219	231	1.81	160	171	1.34
16	2	211	223	1.75	247	257	2.02	180	186	1.46
18	2	263	276	2.17	308	320	2.51	223	233	1.83
20	2	320	334	2.62	376	396	3.11	271	281	2.21
25	2	488	510	4.00	577	606	4.76	411	425	3.34

Single V-joints: volumes and weld metal weights

Plate thickness mm	Gap mm	50° Flat 1	50° Flat 2	50° Flat 3	60° Flat 1	60° Flat 2	60° Flat 3
4	1	11.5	11	0.09	13	12.5	0.10
5	1	16.5	16	0.13	19.5	19	0.15
6	1	23	21.5	0.17	27	25.5	0.20
7	1.5	33.5	32.5	0.26	39	38	0.30
8	1.5	42	40	0.31	49	46.5	0.37
9	1.5	51	48	0.38	60.5	56	0.44
10	2	66.5	62	0.49	77.5	72	0.57
11	2	78.5	71.5	0.56	92	83.5	0.66
12	2	91	83	0.65	107	97.5	0.77
14	2	120	110	0.86	141	130	1.02
15	2	135	123	0.97	160	146	1.15
16	2	151	132	1.04	180	157	1.23
18	2	189	170	1.33	223	204	1.60
20	2	227	208	1.63	271	247	1.94
25	2	341	313	2.46	411	375	2.94

1 Theoretical volume cm³/m
2 Actual joint volume cm³/m (taking account of transverse shrinkage)
3 Deposited weld metal kg/m

The first run and backing run V-joints: Weld metal weights

Position	Plate thickness mm	Weight/length kg/m	Electrode diam mm
Flat	6–12	0.10	3.25
Flat	> 12	0.15	4
Vertical	> 8	0.15	3.25
Horizontal-Vertical	> 8	0.15	3.25
Overhead	> 10	0.10	3.25

Corner welds: Joint volumes and weld metal weights

Plate thickness	Section size								
mm	mm²	cm³/m	kg/m	cm³/m	kg/m	cm³/m	kg/m	cm³/m	kg/m
2	2	3.5	0.03	3	0.02	3.5	0.03	3.5	0.03
3	4.5	7	0.05	7	0.05	7	0.05	7.5	0.06
4	8	9	0.07	9	0.07	9.5	0.07	10.5	0.08
5	12.5	13	0.10	13.5	0.11	14.5	0.11	16	0.13
6	18	18.5	0.15	19.5	0.15	21	0.16	22	0.17
7	24.5	25.5	0.20	26.5	0.21	27.5	0.22	31.5	0.25
8	32	33	0.26	34.5	0.27	36	0.28	40.5	0.32
9	40.5	41.5	0.33	43	0.34	45.5	0.36	51	0.40
10	50	51.5	0.40	53.5	0.42	56	0.44	64	0.50
11	60.5	63	0.49	67	0.53	72	0.57	78.5	0.62
12	72	74.5	0.58	79	0.62	84.5	0.66	93	0.73
15	113	116	0.91	123	0.97	132	1.04	141	1.11
18	162	167	0.31	174	1.37	190	1.49	204	1.60
20	200	206	1.62	206	1.62	227	1.78	252	1.98
22	242	248	1.95	255	2.00	275	2.16	204	2.39
25	323	329	2.58	331	2.60	370	2.90	405	3.18

Fillet welds: Joint volumes and weld metal weights

Plate thickness	Section size								
mm	mm³	cm³/m	kg/m	cm³/m	kg/m	cm³/m	kg/m	cm³/m	kg/m
2	4	5	0.04	6	0.05	5.5	0.04	5.5	0.04
2.5	6.5	7.5	0.06	8.5	0.07	8	0.06	8.5	0.07
3	9	10.5	0.08	12.5	0.10	11	0.09	12	0.09
3.5	12.5	14	0.11	16	0.13	15	0.12	16.5	0.13
4	16	18	0.14	21	0.16	19.5	0.15	22	0.17
4.5	20.5	22.5	0.18	26	0.20	24.5	0.19	26.5	0.21
5	25	27.5	0.22	31.5	0.25	30.5	0.24	33	0.26
5.5	30.5	33.5	0.26	37	0.29	36	0.28	40.5	0.32
6	36	40	0.31	42	0.33	43	0.34	47.5	0.37
6.5	42.5	46.5	0.37	49.5	0.39	51	0.40	56	0.44
7	49	54.5	0.43	57	0.45	56	0.44	65	0.51
7.5	56.5	60.5	0.47	65	0.51	64	0.50	73.5	0.58
8	64	70	0.55	73.5	0.58	76.5	0.60	82.5	0.65
9	81	88	0.69	94	0.74	95	0.75	109	0.86
10	100	018	0.85	114	0.89	116	0.91	130	1.02
11	121	131	1.03	138	1.08	143	1.12	157	1.23
12	144	155	1.22	162	1.27	169	1.33	188	1.48
13	169	179	1.41	190	1.49	195	1.53	220	1.73
14	196	207	1.62	224	1.76	227	1.78	257	2.02
15	225	237	1.86	248	1.95	264	2.07	294	2.31

Choose the proper OK Electrodes, Wires and Fluxes for Hardfacing and Maintenance

Recommendations for the right choice of electrodes for joining dissimilar materials can be found in the figs 1 and 2.
The conditions to be considered when choosing the proper electrode, wire and flux for hardfacing and maintenance are compiled in the following summary sketch.
A grading of the weld metal resistance to different kinds of working conditions are compiled in table No 13.
The working conditions for an object to be repaired are often known. The table gives information about suitable electrodes and regards which must be taken to the different kinds of attacks which can occur.
Recommended OK-electrodes, wires and fluxes for some of the most common objects for hardfacing and maintenance by welding are compiled in table No 14.

Short Rules for the choice of the proper Type of Weld Metal Alloy for Hardfacing and Cladding

With regard to:
1. Type of Wearing
2. Working Conditions
3. Machineability Requirements

Useful knowledge when choosing the proper type of alloy

1. The composition of the material to be welded when deciding
   a) Which types of welding alloys are usable and suitable.
   b) If preheating is favourable.
   c) If welding of a buffer layer is necessary.

2. Conditions for the welding
   a) Is preheating possible or not?
      If not possible: hardenable welding alloys can be used only to a very limited extent for steel and cast iron weldments: austenitic or non-ferrous alloys should be preferred:
      OK 67.45, OK 67.75- austenitic
      OK 68.81 and 68.82- austenitic-ferritic
      OK 92.18, 92.58, 92.35- non-ferrous.
      The welding position
   b) Can submerged-arc welding or gas metal
   c) arc welding be applied?
      For which of the applicable welding pro-
   d) cesses is suitable filler material available?

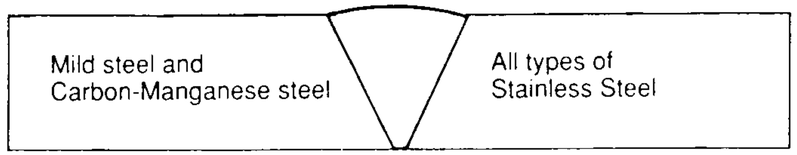
3. Working Conditions for the Repaired Work Piece
   a) Type of wearing: abrasive, erosive or caviation
      For *resisting abrasive wear* by sharp-edged blast stone and ore a hard surface or a work hardening surface is required or desired.
      Recommended:
      OK 84.78 and 84.80
      OK 84.58
      OK 83.65
      OK 86.28
      OK 86.08
      For resisting erosive wear a hard surface and a fine grained microstructure of the weld metal is required.
      Recommended:
      OK 84.80
      OK 84.78
      OK 85.65, 84.58
      OK 83.65
      OK 84.52
      Cavitation attacks in water turbines are usually met by cladding with austenitic electrodes:
      OK 63.35 is the most used electrode for this purpose, but the following are also suitable.
      OK 63.32
      OK 67.70
      OK 67.75
      OK 68.81

4. Environment
   a) Corrosive or non-corrosive?
   b) The temperature, high or low
   c) For resisting wearing in a corrosive environment the weld metal must be resistant to both corrosion and wearing. Thus, depending on the degree of the severity of the corrosion attacks a more or less corrosion resistant alloy is required.

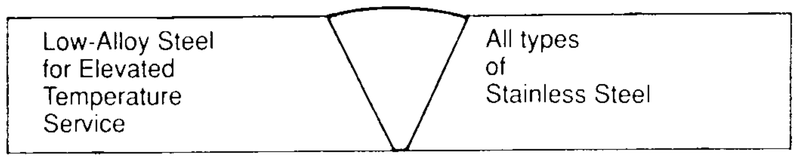
Choose the right OK Electrodes for Joining-Dissimilar Materials

Fig 1.

1. OK 67.70, OK 67.75
2. OK 67.15, OK 67.45, OK 68.81
3. OK 63.35, OK 63.30



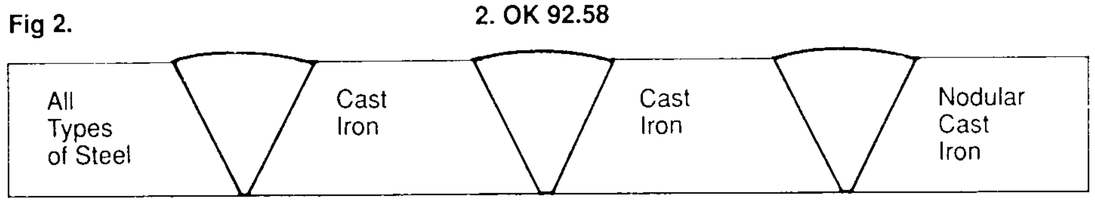
1. OK 92.26
2. OK 67.70, OK 67.75, OK 67.45
3. OK 63.30, OK 63.35



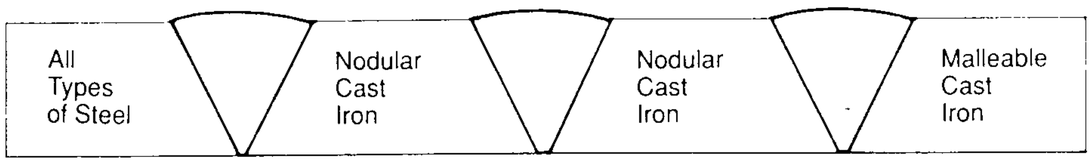
Never use unalloyed electrodes for these joints.

Fig 2.

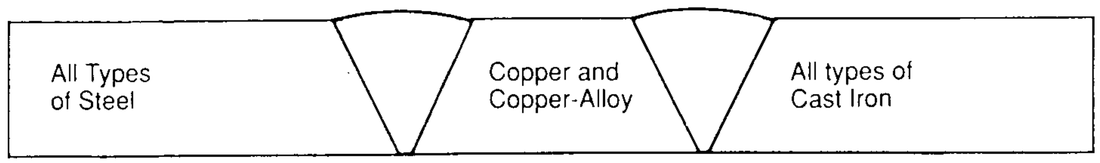
1. OK 92.18
2. OK 92.58



1. OK 92.58
2. OK 92.18



OK 94.25



1. First Hand Choice
2. Second Hand Choice
3. Third Hand Choice

Table 13 Hardfacing and Cladding
Choose the Right Electrode for Different Working Conditions

ENVIRONMENT	Resistance-Suitability 5. Superior 3. Good 1. Limited usability
Corrosive environment Requirements: Corrosion Resistance	5. 92.26, 92.35, 92.86, 94.25, 94.55, 93.01–12 4. 68.81, 67.45, 67.52 3. 84.80, 84.78, 84.42, 84.52 2. 84.58, 83.50 1. 83.28, 83.29, 83.65, 85.38, 85.58, 85.65, 86.08, 86.28
HIGH TEMPERATURE **Oxidizing** Requirements: Scaling Resistance	5. 92.26, 92.35, 93.01–12 4. 68.81, 84.78, 67.45, 67.52, 83.65, 84.80 3. 84.42, 84.52, 84.58, 85.58, 85.65 2. 83.50, 92.86 1. 83.28, 83.29, 85.38, 86.08, 86.28
Annealing, Softening Requirements: Hardness at High Temperature, Annealing Resistance	5. 92.35, 93.01–12 4. 84.78, 85.58, 85.65 3. 85.38, 84.42, 84.52, 84.58, 83.50, 83.65 2. 83.28, 83.29, 86.08, 86.28, 68.81 1. 67.45, 67.52
Low temperature Requirements: Cold Toughness	5. 92.26, 92.35, 92.86, 67.45, 94.25, 94.55 4. 67.52, 86.28, 86.08 3. 83.28, 83.29, 68.81 2. 83.50, 84.42, 84.52 1. 83.65, 84.58, 84.78, 85.38, 85.58, 85.65, 93.01–12, 84.80
TYPE OF WEAR	
Impact, high surface pressure Requirements: Impact-Resistance and Resistance to Crushing	5. 92.35, 86.08, 86.28, 83.28, 83.29, 68.81, Cobal 7 4. 67.45, 67.52 3. 92.25, 93.06 2. 84.42, 84.52, 85.38, 85.58, 85.65, 93.12 1. 83.50, 83.65, 84.58, 84.78, 94.25, 94.55, 93.01
Wear by blast stone and ore Requirements: High surface-Hardness or Cold-Work Hardening weld metal	5. 84.78, 84.80, 93.01 4. 86.08, 86.28, 83.65, 85.65, 93.12 3. 83.50, 85.38, 84.58, 84.42, 84.52, 93.06 2. 85.58, 68.81, 67.45, 67.52, 93.07 1. 83.28, 83.29
Wear by fine grained materials Sand and clay Requirements: High surface hardness	5. 84.78, 84.80, 93.01 4. 83.65, 85.65, 93.12 3. 84.58, 83.50, 93.06 2. 84.42, 84.52, 68.81, 85.38, 85.58 1. 67.45, 67.52, 83.28, 83.29, 86.08, 86.28, 93.07
Cavitation Requirements: Cavitation Resistance	5. 68.81, 63.35, 67.75, 93.06–07 4. 67.45, 67.52, 94.55, 94.25 3. 84.42 2. 84.52, 84.58, 93.01–12 1. 83.28, 83.29

Quite unfitted electrodes and electrodes of more expensive composition than necessary with regards to the work conditions are omitted.

Table 14 Application Range, Electrodes, wires and Fluxes for Hardfacing and Maintenance.
*Superior, OA = Open Arc = No shielding gas is required.

Object	Required weld hardness	Electrodes for MMA	Consumables for MAG, MIG, submerged-arc, hard-facing and building up	Recommended post weld treatment
Shafts Note! Stress relief is recommended for shafts subject to fatigue	<250 HV	OK 48.xx, OK 55.00	OK Autrod 12.40+ OK Flux 10.40, 10.70 10.71	Stress relief
	200–300 HV 30–35 HRC	OK 74.78, OK 74.79 OK 83.28, OK 83.29	OK Autrod 12.10+ OK Flux 10.96	Stress relief Stress relief
	35–40 HRC		OK Tubrodur 15.40+ OK Flux 10.40, 10.71 OK Autrod 12.40+ OK Flux 10.96	Stress relief Stress relief Stress relief
	44–49 HRC 50–56 HRC	OK 84.42 OK 84.52	OK Tubrodur 15.73+ OK Flux 10.61	
Caterpillar tracks Links	30–35 HRC	OK 83.28, OK 83.29	OK Autrod 12.10+ OK Flux 10.96	
	35–40 HRC		OK Autrod 12.40+ OK Flux 10.96 OK Tubrodur 15.40+ OK Flux 10.71	
Plates and rollers	31–35 HRC 45–50 HRC	OK 83.28, OK 83.29 OK 86.28 Workhardening	OK Tubrodur 15.65 OK Tubrodur 15.60	
Brake shoes	30–35 HRC 45–50 HRC	OK 83.28, OK 83.29 OK 86.28 Workhardening after welding		
Mixer arms etc.	50–56 HRC	OK 84.52 OK 84.58	OK Tubrodur 15.73	
	55–63 HRC >62 HRC	OK 84.78* OK 84.80	OK Tubrodur 14.70* OA	

* Chromium Carbide~1500 HV

Object	Required weld hardness	Electrodes for MMA,	Consumables for MAG MIG, submerged-arc, hard-facing and building up	Recommended post weld treatment
Impellers for mills and crushers	55–58 HRC 58–63 HRC	OK 84.58 OK 83.65, OK 84.78*, OK 84.80	OK Tubrodur 15.52 OK Tubrodur 14.70	
Excavator teeth, forged: Joining		OK 48.xx, OK 55.00 OK Femax 38.65	OK Autrod 12.51	
Hardfacing	55–58 HRC 58–63 HRC	OK 48.xx+OK 84.58 OK 48.xx+OK 83.65 OK 84.78*, OK 84.80	OK Tubrodur 15.41+15.52 OK Tubrodur 14.70	
Excavator teeth, 13 % Manganese steel: Joining		OK 63.35, OK 67.45 OK 67.52	OK Tubrodur 14.71	
Hardfacing	50 HRC 55–58 HRC 58–63 HRC	OK 48.xx OK 48.xx+OK 84.58 OK 48.xx+OK 83.65 OK 84.78*, OK 84.80	OK Tubrodur 15.41+15.52 OK Tubrodur 14.70	
Excavator buckets, 13 % Manganese steel: Joining		OK 63.35, OK 67.45, OK 67.52, OK 67.75	OK Tubrodur 14.71	
Hardfacing	55–58 HRC 58–63 HRC	OK 48.xx+OK 84.58 OK 84.78, OK 84.80 48.xx = all electrodes of the OK 48-series	OK Tubrodur 15.52 OK Tubrodur 14.70	

* Chromium Carbide~1500 HV

Object	Required weld hardness	Electrodes for MMA	Consumables for MAG, MIG, submerged-arc, hard-facing and building up	Recommended post weld treatment
Wheel beds for cranes, lorries and loading wagons	<250 HV	OK 48.xx	OK Autrod 12.40+ OK Flux 10.40, 10.71	Stress relief
	200–300 HV 30–35 HRC	OK 74.78 OK 83.28, OK 83.29	OK Autrod 12.10+ OK Flux 10.96 OK Tubrod 15.40+ OK Flux 10.71	Stress relief
	40–45 HRC	OK 86.28	OK Tubrodur 15.60	
Guillotine blades	50–56 HRC	OK 84.52	OK Tubrodur 15.73	
Cold die and cutting tools	60–65 HRC	OK 85.65		
Cog wheels and bars	<250 HV	OK 48.xx	OK Autrod 12.51 For MIG-welding OK Autrod 13.12 For SAW OK Tubrodur 15.40/ OK Flux 10.71	
	200–300 HV	OK 74.78		
	30–35 HRC	OK 83.28, OK 83.29		
	44–49 HRC 51–56 HRC	OK 84.42 OK 84.52		
	55–58 HRC	OK 84.58	OK Tubrodur 15.73+OK Autrod 13.91 For Sub Arc welding OK Tubrodur 15.52+OK Flux 10.71	
Feed gears	50–56 HRC 55–63 HRC 30–40 HRC	OK 84.52 OK 84.58, OK 84.78*, OK 84.80 OK 63.32	OK Tubrodur 15.52 OK Tubrodur 14.70* OK Tubrodur 14.71	Hammering
		48.xx = all of the OK 48-serie		

* Chromium Carbide~1500 HV

Consumables for hardfacing, building up, gas metal arc and submerged arc welding

Object	Required weld hardness	Electrodes for MMA	Consumables for MAG, MIG, submerged-arc, hard-facing and building up	Post weld treatment
Dredger Buckets 13 % Mn Steel	200–230 HV 30–50 HRC	OK 86.28, OK 63.32 Work-hardening OK 86.28, OK 63.32 Work-hardening	OK Tubrodur 15.65 OK Tubrodur 14.71	
	50 HRC 55–58 HRC	OK 48.xx OK 48.xx+OK 84.58 OK 84.78*, OK 84.80	OK Tubrodur 15.52, OK Autrod 13.91 OK Tubrodur 14.70	
Links and pins 13 % Mn steel		See buckets, Mn steel		
Buckets, links and pins of carbon steel or low-alloyed steel	<250 HV	OK 48.xx	For MAG-welding OK Autrod 12.51 For MIG-welding OK Autrod 13.12 OK Tubrodur 14.71 OK Tubrodur 15.41 OK Tubrodur 15.42, 15.65	
	200–300 HV	OK 74.78		
	200–230 HV 31–35 HRC 44–50 HRC	OK 63.32 OK 83.28, OK 83.29 OK 84.42, OK 86.28		
Chequer-net wearing plates	50–58 HRC 58–63 HRC >62 HRC	OK 84.58 OK 83.65, OK 84.78*, 84.79 OK 84.80	OK Tubrodur 15.52 OK Tubrodur 14.70*	
Unalloyed and low-alloyed C steel	<250 HV	OK 48.xx	OK Autrod 12.40+ OK Flux 10.40, 10.71	
	250–300 HV 31–35 HRC	OK 74.78, OK 74.79 OK 83.28, OK 83.29	OK Autrod 12.10+ OK Flux 10.96 OK Tubrodur 15.65 OK Tubrod 15.52+ OK Flux or OK Flux 10.71 OK Autrod 13.91	
	45–50 HRC 50–58 HRC	OK 86.28 Workhardening OK 84.58		

* Chromium Carbide 1500 HV

Object	Required weld hardness	Electrodes for MMA	Consumables for MAG, MIG, submerged-arc, hard-facing and building up	Post weld treatment (desired)
13 % Mn steel	200–230 HV 400 HV *	OK 86.28, OK 63.32, OK 67.45, OK 67.52	OK Tubrodur 14.71 OK Tubrodur 15.65	
Forging tools	31–35 HRC 40 HRC * 45 HRC 40–52 HRC	OK 83.28, OK 93.07 OK 92.35 OK 84.42 OK 93.01, –06, –12	OK Tubrodur 15.41 OK Tubrodur 15.73 and OK Tubrodur 15.52	Tempering 550°C
Stone and ore crushers Plates 13 % Mn steel Cones 13 % Mn steel Spindles 13 % Mn steel Casings 13 % Mn steel Rollers etc.	200–230 HV 45–50 HRC 55–58 HRC 58–63 HRC	OK 86.28 OK 86.28 OK 48.xx+OK 84.58 OK 48.xx+83.65 OK 84.78, 84.79	OK Tubrodur 15.65 OK Tubrodur 15.52 OK Tubrodur 14.70	
High speed tools	60–65 HRC	OK 85.65	—	Tempering 625°C
Hot bar shears steel	45 HRC * 50–56 HRC	OK 93.07 OK 85.58	—	Tempering 625°C
Hot rollers, C steel and low-alloyed steel	250–300 HV 30–35 HRC 40–50 HRC	OK 74.78, OK 74.79 OK 83.28, OK 83.29 OK 93.07, OK 92.35 OK 84.42 OK 93.01, –06, –12	OK Tubrodur 15.41 OK Tubrodur 15.42+ OK Flux 10.71 OK Autrod 12.40+ OK Flux 10.96 OK Tubrodur 15.73+ OK Flux 10.61	Stress relief 500°C Stress relief 500°C Stress relief 500°C

* work-hardened

Pipeweld 6010

A cellulosic coated manual arc welding electrode.

Classification
AWS A5.1: E 6011
BS 639: E43 32C 14
ISO 2560: E43 3C 14
DIN 1913: E43 32C 4

General Description
Designed for site-welding of pipe and pipelines in all positions, using conventional and 'stove-pipe' techniques particularly for the root bead. Easily controlled arc with low tensile deposit. Penetrating arc with low volume, fast-freezing easily-removable slag.

Typical Applications
Normally used DC. On pipe steels up to and including 5LX46. Ideal for root beads on higher tensile material. Suitable for use with misaligned and poor fit-up joints.

Approvals

ABS:	3
Controlas	
DnV:	3
LR:	3

Typical All-Weld Chemical Composition (Wt.%)

C	Si	Mn	P	S
0.12	0.2	0.45	<0.02	<0.02

Welding Current
DC (+) or (–) OCV: 70V min.

Typical All-Weld Mechanical Properties

Yield stress	Ultimate Tensile Strength	Elongation
380 N/mm²	470 N/mm²	30 %

Charpy V Impact Values

Test temp	Impact values
0°C	80J
–30°C	45J

Current Ranges

Size (mm)	2.5	3.25	4.0	5.0
Minimum Current (A)	40	75	110	130
Maximum Current (A)	80	125	200	230

Positional Welding
Recommended

Packaging Information

Diameter (mm)	2.5	3.25	4.0	5.0
Length (mm)	350	350	350	350
Box Weight (Kg)	15	16	16	16
Approx. No of Electrodes per Box	922	603	403	287

All electrodes supplied in sealed metal containers.

Pipeweld 7010

A cellulosic coated manual arc welding electrode.

Classification
AWS A5.5: E 7010–G
BS 639: E51 43C 10
ISO: E51 4C 10
DIN 1913: E51 43C 4

General Description
One of the new generation of Pipe-welding electrodes which show an increase in deposition rate, with both 'stovepipe' and conventional techniques. Features of Pipeweld 7010 are excellent molten-pool control, good penetration, low spatter, smooth arc-characteristics with a fast-freezing, low-volume, easily-removable slag.

Typical Applications
For welding high-strength pipelines and pipe steel. Suitable for use in root, capping and filling runs in 5LX52 to 5LX56 grade line pipe.

Approvals

ABS:	3,3Y
Controlas	
DnV:	3,3Y

Typical All-Weld Chemical Composition (Wt.%)

C	Si	Mn	P	S	Ni	Mo
0.12	0.15	0.70	<0.02	<0.02	0.20	0.25

Welding Current
DC + or (–) OCV: 70V min.

Typical All-Weld Mechanical Properties

Yield stress	Ultimate Tensile Strength	Elongation
460 N/mm²	540 N/mm²	24 %

Charpy V

Test temp	Impact values
0°C	80J
–20°C	45J
–30°C	45J

Current Ranges

Size (mm)	3.25	4.0	5.0	5.5
Minimum Current (A)	75	110	130	165
Maximum Current (A)	125	200	230	270

Positional Welding
Recommended

Packaging Information

Diameter (mm)	3.25	4.0	5.0	5.5
Length (mm)	350	350	350	350
Box Weight (Kg)	16	16	16	16
Approx. No of Electrodes per Box	602	390	255	203

All electrodes supplied in sealed metal containers.

Pipeweld 85

A cellulosic coated manual arc welding electrode.

Classification
AWS A5.5: E 7010–A1
BS 639: E51 43C 10
ISO 2560: E51 4C 10
DIN 1913: E51 43C 4

General Description
Designed specially for site-welding of higher-strength pipe and pipelines in all positions, using conventional and 'stovepipe' techniques. Penetrating arc with low volume, fast-freezing easily-removable slag.

Typical Applications
Used on pipe-steels in the 5LX52 to 5LX56 range. Higher-strength deposit, 525–555 N/mm² tensile strength with a manganese/molybdenum deposit, widely used for filling and capping on line pipe.

Approvals

ABS:	3
Controlas	
DnV:	3
LR:	3

Typical All-Weld Chemical Composition (Wt.%)

C	Si	Mn	P	S	Mo
0.12	0.15	0.35	<0.02	<0.02	0.50

Welding Current
DC+ or (–) OCV: 70V min.

Typical All-Weld Mechanical Properties

Yield stress	Ultimate Tensile Strength	Elongation
460 N/mm²	540 N/mm²	24 %

Charpy V Impact Values

Test temp	Impact values
0°C	80J

Current Ranges

Size (mm)	3.25	4.0	5.0
Minimum Current (A)	75	110	130
Maximum Current (A)	125	200	230

Positional Welding
Recommended

Packaging Information

Diameter (mm)	3.25	4.0	5.0
Length (mm)	350	350	350
Box Weight (Kg)	16	16	16
Approx. No of Electrodes per Box	605	402	257

All electrodes supplied in sealed metal containers.

Pipeweld 8010

A new cellulosic coated manual metal arc welding electrode.

Classification
AWS A5.5: E 8010–G
BS 639: E51 32C 10
ISO 2560: E51 3C 10
DIN 1913: E51 32C 4

General Description
The first of a new generation of pipe-welding electrodes which show an increase in deposition rates, with both 'stovepipe' and conventional techniques. Features of Pipeweld 8010 are excellent molten-pool control, good penetration, low spatter, smooth arc-characteristics with a fast-freezing, low-volume, easily-removable slag.

Typical Applications
For welding high-strength pipelines and pipe steel in the 570–620 N/mm² tensile-strength range. Can be used for root, filling and capping run in 5LX60 to 5LX70 grade line pipe.

Approvals

ABS:	3
Controlas	
DnV:	3
LR:	3,3Y

Typical All-Weld Chemical Composition (Wt.%)

C	Si	Mn	P	S	Ni	Mo
0.12	0.15	0.70	0.020	0.020	0.20	0.45

Welding Current
DC + or (–) OCV: 70V min.

Typical All-Weld Mechanical Properties

Yield stress	Ultimate Tensile Strength	Elongation
515 N/mm²	595 N/mm²	24 %

Charpy V Impact Values

Test temp	Impact values
0°C	65J
–20°C	45J

Current Ranges

Size (mm)	3.25	4.0	5.0	5.5
Minimum Current (A)	75	110	130	165
Maximum Current (A)	125	200	230	270

Positional Welding
Recommended

Packaging Information

Diameter (mm)	3.25	4.0	5.0	5.5
Length (mm)	350	350	350	350
Box Weight (Kg)	16	16	16	16
Approx. No of Electrodes per Box	602	398	251	203

All electrodes supplied in sealed metal containers.

OK Rapid 23.50

A deep penetration rutile covered electrode for welding square edged butt joints in the flat position and for making the sealing run on the root side of V-joints without prior chipping out.

Classification
AWS A5.1 E 6020
ISO 2560: E 4x2 R 45xP

Applications
OK Rapid 23.50 is intended for the welding of mild general purpose structural steels, pressure vessel steels and A-quality ship's plate.

Welding data
Arc voltage: 40–50 V
Type of current: AC or DC negative (positive).
Minimum open circuit voltage on AC: 60 volts.
Welding position: flat

Diameter mm	Length mm	Current Amps	Arc volts approx.
3.25	350	130–180	40
4	450	170–230	45
5	450	230–320	50

Typical weld metal composition %

C	Si	Mn
0.10	0.4	0.5

Typical mechanical properties
All weld metal specimens

Yield stress:	450 N/mm²
Tensile strength	520 N/mm²
Elongation 5xD	31 %

Charpy V impact values

Test. temp	Impact values
+20°C	about 70J

Approvals
Lloyd's Register of Shipping, grade 1
Bureau Veritas, grade 1 DP
Det norske Veritas, grade 1 DP
American Bureau of Shipping, grade 1 DP
Controlas

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T Burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
4	450	0.48	28	2.3	56	36	4.5
5	450	0.50	17	3.6	58	58	4.6

OK Femax 33.60

A high recovery rutile iron powder electrode giving a metal recovery of about 160 %. Particularly suitable for fillet welds in thick and medium thick plate.

Classification
AWS/SFA A5.1: E 7024
DIN 1913: E 51 32 RR 11 160
ISO 2560: E 51 2 RR 160 31
NFA 81.309: E24 3/2 RR 160 31
UNE 14.003: E5132 RR 160 31

Applications
OK Femax 33.60 is particularly recommended for welding horizontal-vertical fillets. The weld metal goes well up the vertical plate and gives a good transition to the base material without undercutting even at high welding current.

Welding current: AC ≥50 Volts, DC positive (or negative)

Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	350	80–115	27
3.2	450	130–170	30
4	450	150–230	33
4	450	170–240	35
5	450	200–350	35
6	450	280–450	36

Typical weld metal composition %

C	Si	Mn
0.07	0.4	0.7

Typical mechanical properties
All weld metal specimens

Yield stress:	450 N/mm²
Tensile strength	550 N/mm²
Elongation 5xD	28 %

Charpy V impact values

Test. temp	Impact values
0°C	approx. 55J
–20°C	28J

Approvals
Lloyd's Register of Shipping, grade 2
Bureau Veritas, grade 2
Det norske Veritas, grade 2
American Bureau of Shipping, grade 2
Germanischer Lloyd, grade 2
TÜV–Eignungsgeprüft, Kennblatt Nr 1031.01
DS E 512 RR
SS 143203
DB 10.039.11/QS

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T Burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
2.5	350	0.64	53	1.6	43	19	2.2
3.2	450	0.68	23	2.2	71	43	2.3
4	450	0.68	15	3.1	77	65	2.3
5	450	0.68	9.5	4.9	78	105	2.3
6	450	0.68	6.4	4	83	156	2.4

OK Femax 33.80

A very fast high efficiency rutile iron powder electrode giving a metal recovery of approx. 180 %. Particularly suitable for fillet welds. On alternating current an open circuit voltage of ≥50 V is necessary.
For mild steel of minimum tensile strength ≤440 N/mm², 45 kp/mm² and ordinary ship's plate A and D quality.

Classification
AWS/SFA A5.1: E 7024
DIN 1913: E 51 32 RR 11 180
ISO 2560: E 51 2 RR 180 31
NFA 81.309: E51 3/2 RR 190 31
AS 1553.1: E 4824

Welding data for horizontal fillets

Throat thickness a=mm	Electrode diam. mm	Current Amps	Travel speed m/h	Run length per electrode cm
3	4	200	31	71
3.5	4	220	26	55
	5	270	33	83
4	4	220	20	42
	5	310	29	66
4.5	5	320	26	56
	5.6	370	29	68
	6	380	30	77
5	5	320	20	44
	5.6	390	24	53
	6	410	26	61
5.5	5.6	400	21	46
	6	410	22	52
6	6	410	20	46

Typical weld metal composition %

C	Si	Mn
0.10	0.4	0.7

Typical mechanical properties
All weld metal specimens

Yield stress:	480 N/mm²
Tensile strength	555 N/mm²
Elongation 5xD	26 %

Charpy V impact values

Test. temp	Impact values
0°C	about 50J

Approvals
Lloyd's Register of Shipping, grade 2, 2Y
Bureau Veritas, grade 2Y
Det norske Veritas, grade 2
American Bureau of Shipping, grade 2
Poland PRS, grade 2
Germanischer Lloyd, grade 2
DSRK 44, 2
TÜV–Eignungsgeprüft, Kennblatt Nr 0634
Controlas
DB: 10.039.28/QS
DS: E 512 RR
RINA: E 42 2
RS: 2
SFS: E 5122 HX 3
SS: 143203

Welding current

Diameter mm	Current Amps	Arc volts approx.
3.25	130–170	28
4	180–230	30
5	250–340	32
5.6	280–400	33
6	300–430	34

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal electrode g	Power consumption per kg weld metal kWh
3.25	450	0.68	21	2.5	69	46	2.0
4	450	0.68	14	3.8	69	71	2.0
5	450	0.69	10	5.6	67	111	2.0
5.6	450	0.69	7.6	7.3	64	137	2.0
6	450	0.69	6.8	7.8	70	154	2.0

OK Fematic 33.80

Fematic

A fast high efficiency rutile iron powder electrode for gravity welding on mild steels using Fematic Long Neck electrode feeders. Same mechanical properties as OK Femax 33.80

Classification
AWS/SFA A5.1: E 7024
DIN 1913: E 51 32 RR 11 180
ISO 2560: E 51 2 RR 180 31
Swedish Standard: 3203
AS 1553.1: E 4824

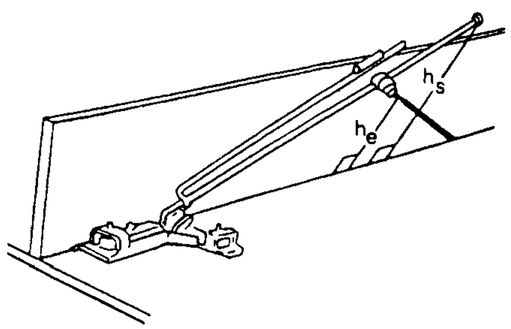
Description
OK electrodes for use in Gravity Feeders are called Fematic electrodes. The composition, strength and approvals are the same as for standard length OK Femax 33.80.

Recommendations for welding
Gravity welding with Fematic electrodes is carried out on AC, DC can give rise to arc blow. The throat thickness of the weld can be controlled partly by the choice of electrode diameter and partly by chaning the bead length. The bead length can be varied between 800 and 1100 mm by raising or lowering the guide bar of the gravity welder. The lower the guide bar, the longer the bead length (low h-value, see below). Note that the economy of the method increases as the bead length increases. Therefore, for a given throat thickness, the largest possible electrode and hence the longest bed length should be chosen.
The following table gives normal values. The information applies to cut plate edges without a gap. Gaps and round joint edges give smaller throat thicknesses.
Long electrodes cannot tolerate the same welding current as 450 mm electrodes, but the current values listed in the table can be somewhat exceeded. The easiest way to check the current is to measure the fusion time. (See table.)

Welding data

Throat thickness mm	Electrode dimensions Diam. mm	Length mm	Current Amps	Fusion time sec.	Feeder settings hs mm[1]	he mm[2]	Run length mm	Kg electrode per 100 mm weld
3.5	4.5	700	220	160	800	550	1000	22
4	5	700	250	165	800	550	1000	26
4.5	5.6	700	290	165	800	550	1000	29
5	6	700	315	165	800	550	1000	36
5.5	6	700	315	165	900	600	850	42

[1]) hs = The perpendicular distance from the joint to the highest point of the unit. (See drawing below.)
[2]) he = The perpendicular distance from the joint to the edge of the electrode screw. (See drawing below.)



Approvals
Lloyd's Register of Shipping, grade 2
Det norske Veritas, grade 2
Swedish Standard: 13 3202
ABS: 2,2Y
BV: 2,2Y
DSRK: 44,2

Typical weld metal composition %

C	Si	Mn
0.10	0.40	0.70

OK Femax 38.48

A low hydrogen AC/DC high recovery rutile basic iron powder electrode, 150 % recovery. Gives extremely smooth fillets of equal leg length and a very low emission of fume and spatter. Best on AC.

Classification
AWS/SFA A5.1: E 7028
DIN 1913: E 51 43 B (R) 12 150
ISO 2560: E 51 4 B 150 36 H
Swedish Standard: 3210 H10

Description and application
OK Femax 38.48 is for being a low hydrogen electrode unusual easy to weld and is especially well fitted for horizontal fillets with a leg length of 4–6.4 mm. The electrode is as easy to use as a rutile electrode but the weld metal quality corresponds to that of the basic electrodes. The slag is easy to remove.

Welding data for horizontal fillets

Size[1]) of weld mm	Electrode ø mm	Welding current Ampere	Welding speed cm/min.	Run length cm/electr.
5	4	210	27	40
6.4	5	260	25	40
6.4	5.6	300	25	44

[1]) Leg length of fillet

Typical weld metal composition %

C	Si	Mn
0.07	0.45	1.05

Typical mechanical properties
All weld metal specimens

Yield stress:	460 N/mm²
Tensile strength	545 N/mm²
Elongation 5xD	27 %

Charpy V impact values

Test. temp	Impact values
–20°C	90J
–30°C	50J
–40°C	36J

Approvals
American Bureau of Shipping: 3HH and 3Y
Bureau Veritas: grade 3, 3Y HH
Det norske Veritas: grade 3 Y HH
Lloyd's Register of Shipping: 3 and 3Y H
Germanischer Lloyd: grade 3YHH
TÜV: Eignungsgeprüft, Kennblatt 3004
RS: 3YHH
Controlas
DS: E 51 4B (H)
SFS: E 5140 H 103
SS: 1432 10-H 10
DB: 10.039.27/QS

Deposition data at max welding current

Electrode Diam. mm	Length mm	Current Amps	Kg weld metal per hour arc time	Kg weld metal kg electrodes	Number of electrodes per kg weld metal	Melting time per electrode, secs	Weight of weld metal per electrode g	Power consumption per kg weld metal kWh
4	450	216	2.5	0.58	18	88	56	2.6
5	450	300	4.2	0.60	11	84	91	2.6
5.6	450	320	4.4	0.62	9	96	114	2.5

OK Femax 38.65

A zircon-basic electrode with 165 % recovery. A very fast electrode which gives the weld metal quality expected from a basic electrode. On alternating current an open circuit voltage ≥65 V is necessary.

Classification
AWS/SFA A5.1: E 7028
DIN 1913: E 51 43 B (R) 12 160
ISO 2560: E 51 4 B 170 36 H

Applications
The welding of ordinary and high strength ships plate A, D and E qualities.

Welding data for horizontal fillets

Throat thickness a=mm	Electrode diam. mm	Welding current Amps	Travel speed m/h	Run length per electrode cm
4	4	210	17	36
4.5	4	210	14	31
	5	280	20	48
5	5	300	17	37
5.5	5	300	14	32
	6	360	20	47
6	6	360	17	40

Welding current: AC or DC negative

Diam mm	Current Amps	Arc volts approx.
3.25	100–190	37
4	170–240	36
5	225–355	40
6	300–430	40
7	340–490	40

Typical weld metal composition %

C	Si	Mn
0.07	0.45	1.1

Typical mechanical properties
All weld metal specimens

Yield stress:	430 N/mm²
Tensile strength	540 N/mm²
Elongation 5xD	30 %

Charpy V impact values

Test. temp	Impact values
–20°C	approx. 110J
–30°C	95J
–40°C	65J
–60°C	50J

Approvals
Lloyd's Register of Shipping
Bureau Veritas, grade 3, 3Y HH
Det norske Veritas, grade 3Y HH
American Bureau of Shipping, grade 3HH, 3Y
Germanischer Lloyd, grade 3Y HH
PRS: 3Y HH
TÜV: Eignungsgeprüft, Kennblatt 0635
Controlas
DS: E 51 4B (H)
SS: 143211-H 10
SFS: E 5150 H 10 3
DB: 10.039.15/QS

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.67	23	2.7	57	43	1.9
4	450	0.68	14.4	3.7	70	69	2.3
5	450	0.69	9.6	5.7	72	104	2.4
6	450	0.68	6.6	7.2	80	150	2.3
7	450	0.70	5.1	8.5	88	195	2.3

OK Femax 38.85

A fast rutile basic iron powder electrode having very high recovery (220 %) for welding mild and low alloy steels. It operates best on alternating current, minimum open circuit voltage 55 V.

Classification
AWS/SFA A5.1: E 7028
DIN 1913: E 51 43 B (R) 12 220
ISO 2560: E 51 4 B 220 36 H

Description and applications
OK Femax 38.85 is our best electrode for welding horizontal-vertical fillets in high tensile structural steels and ship's plate where the use of rutile electrodes is not permitted.

Welding current: AC (or DC positive)

Diameter mm	Current Amps	Arc volts approx.
5	200–350	40
5.6	250–440	42
6	300–500	44

Typical weld metal composition %

C	Si	Mn
0.07	0.60	1.1

Typical mechanical properties
All weld metal specimens

Yield stress:	480 N/mm²
Tensile strength	560 N/mm²
Elongation 5xD	29 %

Charpy V impact value. Butt weld test

Test. temp	Impact values
–20°C	100J
–30°C	80J

Approvals
American Bureau of Shipping 3HH, 3Y
Lloyd's Register of Shipping, 3, 3Y H
Bureau Veritas, grade 3, 3Y HH
Det norske Veritas, grade 3Y HH
Poland PRS, grade 3 Y HH

DSRK:	52.3 HH	SFS:	E 5130 H 103
GL:	3YHH	SS:	143209-H 10
RS:	3YHH		

Data for welding horixontal fillet joints with 450 mm OK Femax 38.85

Throat thickness	Diam. mm	Current Amps.	Welding speed m/h	Arc time secs.	Bead length cm/electrode
5.0	5	290	18	101	51
5.5	5	300	16	98	45
5.5	5.6	330	18	115	56
6.0	5.6	340	15	113	47

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal electrode g	Power consumption per kg weld metal kWh
5	450	0.7	7.0	6.0	84	140	2.3
5.6	450	0.7	5.9	8.0	75	170	2.3
6	450	0.7	5.2	9.2	73	190	2.3

OK Femax 38.85
Fematic

A fast high efficiency rutile basic iron powder electrode for gravity welding on mild and manganese alloyed structural steels using Fematic Long Neck electrode feeders.
Same mechanical properties as OK Femax 38.85

Classification
AWS/SFA A5.1: E 7028
ISO 2560: E 51 4B 220 36 (H)
DIN 1913: E 51 43 B (CR) 12 220
Swedish Standard: 3209 H10

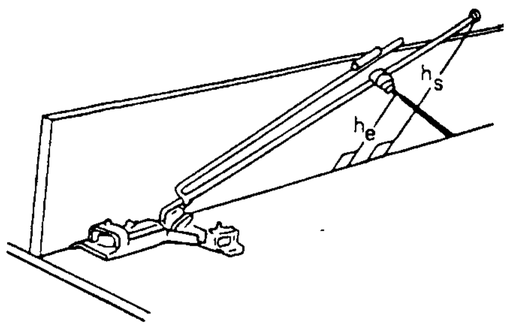
Description and application
OK electrodes intended for use in Fematic or other gravity feeders are called Fematic electrodes.
OK Femax 38.85 Fematic electrodes are only made in 700 mm lengths and are delivered in containers holding 375 to 400 kg.
OK Femax 38.85 Fematic has the same approvals and the same quality as the 450 mm long OK Femax 38.85 electrode.

Recommendations for welding
Gravity welding with Fematic electrodes carried out on AC/DC can give rise to arc blow. The throat thickness of the weld can be controlled partly by the choice of electrode size and partly by changing the bead length. The bead length can be varied by raising or lowering the guide bar of the gravity welder. The lower the guide bar, the longer the bead length (low h-value, see below). Note that the economy of the method increases as the bead length increases. For a given throat thickness, the largest possible electrode diameter, and hence the longest bead length, should therefore be chosen.
The table below gives normal values. The information applies to cut plate edges without a gap. Gaps and round joint edges give smaller throat thicknesses.
Long electrodes cannot tolerate the same welding current as 450 mm electrodes, but the current values listed in the table can be somewhat exceeded. The easiest way to check the current is to measure the fusion time. (See table)

Approvals
Lloyd's Register of Shipping, 3, 3Y H
Det norske Veritas, 3Y HH
USSR: 6 HH

Typical weld metal composition %

C	Si	Mn
0.07	0.60	1.1



Welding data

Throat thickness mm	Electrode dimensions Diam. mm	Length mm	Current Amps	Fusion time sec.	Feeder settings hs mm[1]	he mm[2]	Run length mm	Kg electrode per 100 mm weld
4	5	700	220	180	900	650	800	40
4.5	5.6	700	275	180	900	650	800	48
5	6	700	300	180	900	650	800	55

[1] hs = The perpendicular distance from the joint to the highest point of the unit. (See drawing.)
[2] he = The perpendicular distance from the joint to the edge of the electrode screw. (See drawing.)

OK Femax 38.95

A zircon-basic iron powder AC/DC electrode about 240 % recovery: It gives a welding speed comparable with submerged arc welding: up to 240 g weld metal per minute with a 6 mm diam. electrode.

Classification
AWS/SFA A5.1: E 7028
DIN 1913: E 51 54 B (R) 12 240
ISO 2560: E 51 5 B 240 46 H

Description
OK Femax 38.95 is a high efficiency electrode with a zircon-basic covering.

Applications
OK Femax 38.95 is primarily intended for welding prepared butt joints and fillets in the flat position where it gives a smooth transition to the base material.
Recommended for the welding of ordinary and high strength ship's plate A, D and E qualities.

Welding current: AC (DC positive)

Diameter mm	Current Amps	Arc volts approx.
4	170–240	35
4.5	220–300	35
5	330–400	45
5.6	370–460	50
6	400–520	50

OK Femax 39.95 must be deposited with a very short arc.

Typical weld metal composition %

C	Si	Mn
0.07	0.45	1.1

Typical mechanical properties
All weld metal specimens

Yield stress:	400 N/mm²
Tensile strength	500 N/mm²
Elongation 5xD	30 %

Charpy V impact value. Butt weld test

Test. temp	Impact values
–20°C	110J
–40°C	90J

Approvals
SS 143206- H10
Lloyd's Register of Shipping, grade 3 and 3Y H
Bureau Veritas, grade 3, 3Y HH
Det norske Veritas, grade 3Y HH
American Bureau of Shipping 3HH, 3Y
DS: E51 5B (H)
RS: 3YHH
SFS: E 5155 H 104

Deposition data at max welding current

Size Diam. mm	Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
4	450	0.68	14.9	3.6	67	69	2.3
4.5	450	0.71	9.0	6.0	68	110	2.0
5	450	0.70	6.6	9.0	63	155	2.0
5.6	450	0.70	5.2	11.0	65	190	2.1
6	450	0.71	4.2	13.3	65	240	1.7

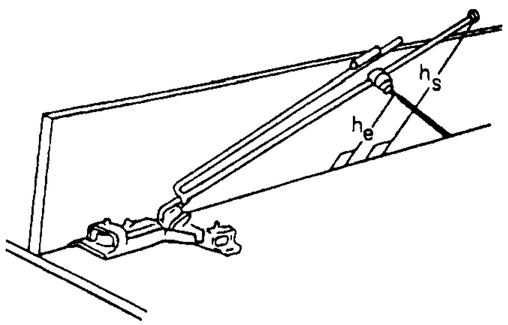
OK Femax 39.50
Fematic

A fast high efficency acid iron powder electrode for gravity welding mild steel using Long Neck or Short Neck gravity feeders. Fematic welding is carried out on DC-/AC. Minimum open circuit voltage 70 V.

Classification
AWS/SFA A5.1: E 6027
DIN 1913: E 51 53 AR 11 160
ISO 2560: E 51 5 AR 160 25
Swedish Standard: 3201
AS 1553.1: E 4827

Description
OK electrodes, which are supplied in 700 or 600 mm lengths for use in gravity feeders, are called Fematic electrodes.

Recommendations for welding
OK Femax 39.50 Fematic is a fast, easy to use electrode which because of the exceptionally good slag cover can be deposited with a very sharp angle between the electrode and the workpiece, which is the case when gravity welding in a short neck electrode holder. The good slag cover makes this electrode particularly suitable for fillet welding with a small throat thickness and a relatively long bead length per electrode.
OK Femax 39.50 Fematic is approved and recommended for welding ordinary strength ship's plate of A, D and E quality.



Typical weld metal composition %

C	Si	Mn
0.07	0.2	0.5

Typical mechanical properties
All weld metal specimens

Yield stress:	390 N/mm²
Tensile strength	510 N/mm²
Elongation 5xD	27 %

Charpy V impact value. Butt weld test

Test. temp	Impact values
–20°C	70J

Approvals
Lloyd's Register, grade 3, DnV grade 3
Note.
OK Femax 39.50 length 450 mm has the following approvals:

ABS:	grade 3 Y
BV:	grade 3 Y
DnV:	grade 3
GL:	grade 3 Y
LR:	grade 3 Y
PRS:	grade 3
RS:	grade 3

Welding data for gravity welding in Long Neck feeders

Throat thickness mm	Electrode dimensions Diam. mm	Length mm	Current Amps	Fusion time sec.	Feeder settings hs mm[1]	he mm[2]	Run length mm	Kg electrode per 100 mm weld
4	5	700	240	155	980	610	700	31
4.5	5.6	700	285	170	800	500	1000	31
5	5.6	700	285	170	950	500	800	39
5.5	5.6	700	285	170	1050	500	600	52

[1]) hs = The perpendicular distance from the joint to the highest point of the unit.
[2]) he = The perpendicular distance from the joint to the edge of the electrode screw.

OK 43.32

A very easy to use AC/DC rutile electrode which gives excellent bead appearance. Particularly suitable for welding sheet steel. Recovery about 94 %. Can be used with transformers having an open circuit voltage of only 50 V.

Classification
AWS/SFA A5.1: E 6013
DIN 1913: E 51 31 RR 6
ISO 2560: E 51 21 RR

Description
OK 43.32 is a heavily coated universal rutile electrode. It can be used in all positions on AC or DC. It is an easy to use electrode so that even an inexperienced welder produces very good results.
The arc is stable even at very low currents, a necessary condition for the successful welding of sheet steels. The excellent flow of the metal means that both butt welds and fillet welds made with OK 43.32 have a good, smooth appearance. Outside corner joints are also easy to weld with OK 43.32.
OK 43.32 is suitable for welding mild structural steel and pressure vessel steel having a tensile strength of up to 490 N/mm² (50 kp/mm²) and A-quality ship's plate.

Welding current: AC or DC

Diameter mm	Length mm	Current Amps	Arc volts approx.
1.6	300	30– 60	24
2	300	40– 80	24
2.5	350	50–110	23
3.25	450	80–150	27
4	450	120–210	27

Typical weld metal composition %

C	Si	Mn
0.07	0.4	0.5

Typical mechanical properties
All weld metal specimens

Yield stress:	460 N/mm²
Tensile strength	550 N/mm²
Elongation 5xD	26 %

Charpy V impact value. Butt weld test

Test. temp	Impact values
+20°C	65J

Approvals
Lloyd's Register of Shipping, grade 1
Bureau Veritas, grade 1
Det norske Veritas, grade 1
American Bureau of Shipping, grade 1
Germanischer Lloyd, grade 1
TÜV: Eignungsgeprüft, Kennblatt Nr 621

SS:	143203
SFS:	E 5120 HX 3
DS:	E 51 2 RR
DB:	80.039.02/QS

Deposition data at max welding current

Size Diam. mm	Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.54	41	1.3	74	26	3.0
4	450	0.54	27	1.9	76	37	3.0

OK 46.00

An easy to use rutile electrode having about 90 % recovery. It is very easy to strike and is ideal for short welds and root runs. On AC it only needs 50 V open circuit voltage.

Classification
AWS/SFA A5.1: E 6013
DIN 1913: E 43 32 R (C) 3
ISO 2560: E 43 3 R 11
NFA 81–309: E 43 3/2 R11

Description and applications

OK 46.00 is an easy to use electrode giving good quality weld metal. It is recommended for welding structures in thin and medium thick plate with different types of joint and welding positions OK 46.00 gives smooth weld beads in all positions, and the slag is easy to remove. OK 46.00 is easy to strike and re-strike and is therefore and ideal electrode for tacking. It welds relatively cold and can therefore be used for bridging over the large gaps, which can occur in site welding. OK 46.00 is one of the most suitable types of electrode for welding galvanized plate and is relatively insensitive to rust or other surface impurities.
It is recommended for welding ordinary ship steel and structural steel of similar strength and quality.

Welding current: AC 50V
DC positive or negative

Diameter mm	Length mm	Current Amps	Arc volts approx.
2	300	50– 70	21
2.5	350	60–100	22
3.25	350	80–150	22
4	350	100–200	22

Typical weld metal composition %

C	Si	Mn
0.08	0.3	0.4

Typical mechanical properties
All weld metal specimens

Yield stress:	380 N/mm²
Tensile strength	470 N/mm²
Elongation 5xD	28 %

Charpy V impact value. Butt weld test

Test. temp	Impact values
0°C	approx. 70J
–20°C	35J

Approvals

Lloyd's Register of Shipping, grade 2
Bureau Veritas, grade 2
Det norske Veritas, grade 2
American Bureau of Shipping 2
Poland, PRS, grade 2
TÜV: Eignungsgeprüft, Kennblatt Nr 0623
DS: E 43 3R
GL: 2
RS: 2
SS: 143201
SFS: E 43 22 HX1
DB: 10.039.05/QS
GDF:

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	350	0.65	53	1.3	57	17	2.3
4	350	0.60	39	1.6	65	26	2.4

OK 46.16

An easy to use general purpose rutile electrode for welding mild steel. Recovery approx. 100 %. On AC it needs only 50 V open circuit voltage.

Classification
AWS/SFA A5.1: E 7014
DIN 1913: E 43 32 RR (C) 6
ISO 2560: E 43 3 RR 11

Description and applications

OK 46.16 is easy to use and gives good weld metal quality. It is very easy to strike and re-strike and its welding characteristics are good in the different positions, including vertical down. OK 46.16 welds relatively cold and can therefore be used for bridging over fairly large gaps.
OK 46.16 gives less spatter than most other rutile electrodes. The slag is easy to remove and the weld bead is smooth and even. Resistance to cracking is good. Galvanized, rusty or otherwise dirty plate can as a rule be welded with OK 46.16.
OK 46.16 is recommended for depositing the root run in prepared joints, for tack welding and for general site welding.
It is suitable for welding ordinary ship's plate of A-, and D-quality.

Welding current: AC 50V
DC positive

Diameter mm	Length mm	Current Amps	Arc volts approx.
2	300	50– 70	22
2.5	350	60–100	22
3.25	350	80–150	23
4	350	100–200	24

Typical weld metal composition %

C	Si	Mn
0.09	0.4	0.5

Typical mechanical properties
All weld metal specimens

Yield stress:	440 N/mm²
Tensile strength	505 N/mm²
Elongation 5xD	28 %

Charpy V impact value. Butt weld test

Test. temp	Impact values
0°C	approx. 70J
–20°C	40J

Approvals

Lloyd's Register of Shipping, grade 2
Bureau Veritas, grade 2
Det norske Veritas, grade 2
American Bureau of Shipping, grade 2
Germanischer Lloyd, grade 2
Poland, PRS, grade 2,
DSRK: 44.2
DS: E 43 3 RR
DB: 80.039.03/QS
TÜV

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	350	0.58	52	1.3	59	19	2.9
4	350	0.59	34	1.8	65	29	2.9

OK 48.00

A reliable general purpose basic electrode for mild and low alloy steels. It gives a tough, crack resistant weld metal. Recovery about 125 %. High welding speed in the vertical-up position.

Classification
AWS/SFA A5.1: E 7018
DIN 1913: E 51 53 B 10
ISO 2560: E 51 5B 120 20H
NFA 81–309: E 51 5/4 B120 20 BH

Description and applications
OK 48.00 is insensitive to the composition of the base material within rather wide limits. The electrode can be used for welding structures where difficult stress conditions cannot be avoided.
OK 48.00 is suitable for welding ordinary and high tensile ship's plate of A-, D- and E- quality. It is also very suitable for welding galvanized plate.

Welding current: DC positive (negative)
AC OCV min 90 V

Diameter mm	Length mm	Current Amps	Arc volts approx.
1.6	300	30– 55	22
2	300	50– 80	22
2.5	350	80–110	22
3.25	450	110–150	23
4	450	140–200	24
5	450	200–260	25
6	450	220–340	25
7	450	280–410	25

Typical weld metal composition %

C	Si	Mn
0.07	0.5	1.1

Typical mechanical properties
All weld metal specimens

Yield stress:	445 N/mm²
Tensile strength	540 N/mm²
Elongation 5xD	29 %

Charpy V impact value. Butt weld test

Test. temp	Impact values
–20°C	160J
–40°C	80J

Approvals
Lloyd's Register of Shipping, grade 3, 3YH
Bureau Veritas, grade 3, 3Y HH
Det norske Veritas, grade 3Y HH
American Bureau of Shipping 3HH, 3Y
Germanischer Lloyd, grade 3Y HH
RS: 3 YHH
PRS: 3Y HH
TÜV: Eignungsgeprüft, Kennblatt Nr 0690
DB: 10.039.12/QS
DS: E 51 5B (H)
DSRK: 52.3 HH
GDF:
SS: 143211-H 102
SFS: E 5153 H102

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.70	30	1.4	87	33	2.5
4	450	0.71	20	1.9	96	50	2.5
5	450	0.73	13	2.6	110	77	2.4
6	450	0.74	9	3.7	105	105	2.3
7	450	0.72	7	4.4	117	140	2.3

OK 48.04

A realiable basic AC/DC electrode. It gives a tough crack resistant weld on mild and low alloy steels and can be used on both AC and DC.

Classification
AWS/SFA 5.1: E 7018
DIN 1913: E 51 53 B 10
ISO 2560: E 51 5B 120 26H
AS 1553.1: 4818
NFA 81–309: E51 5/4 B 120 26 BH

Description and applications
OK 48.04 is a basic AC/DC electrode with very good welding properties. It gives very high quality weld metal.
The electrode can be used for welding rigidly restrained structures where large welding stresses cannot be avoided. It welds well in all positions, particularly vertical and overhead. In the small diameters, OK 48.04 is also suitable for welding thin plate.
OK 48.04 can be used for welding ordinary and high tensile ship's plate of A-, D- and E-quality.

Welding current: DC positive
AC OCV min 70 V

Diameter mm	Length mm	Current Amps	Arc volts approx.
2	300	50– 80	23
2.5	350	70–110	24
3.25	450	110–150	25
4	450	150–200	26
5	450	190–260	26
6	450	220–360	26

Typical weld metal composition %

C	Si	Mn
0.06	0.5	1.2

Typical mechanical properties
All weld metal specimens

Yield stress:	480 N/mm²
Tensile strength	560 N/mm²
Elongation 5xD	30 %

Charpy V impact value. Butt weld test

Test. temp	Impact values
–40°C	about 80J
–20°C	110J
+20°C	190J

Approvals
Lloyd's Register of Shipping, grade 3, 3Y, H
Det norske Veritas, grade 3Y HH
Bureau Veritas, grade 3, 3Y HH
American Bureau of Shipping, grade 3HH, 3Y
Germanischer Lloyd, grade 3Y HH
PRS: 3Y HH
DS: E 51 5 B (H)
SS: 143211-H10
RS: 3YHH
TÜV

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.67	30	1.5	92	33	2.5
4	450	0.68	20	2.0	101	50	2.6
5	450	0.72	13	2.8	106	77	2.4
6	450	0.73	9	3.8	113	110	2.5

OK 48.08

An universal low hydrogen electrode with very good welding characteristics. This AC/DC electrode is especially made for offshore applications. The weld metal contains approx. 1 % Ni for extra good impact values down to –40°C

Classification
AWS/SFAA 5.5: E 7018-G
DIN 8529: E SY 4676 1NI BH5
ISO 2560: E 51 6B 120 24 (H)
CSA 48.3 M1982: E 4 801 8-G

Description and applications
OK 48.08 is especially designed for the offshore industry. The coating is of the Low Moisture Absorbtion type for optimum security against porosity and hydrogen cracking. The 1 % Ni in the weld metal in combination with the good running characteristic, especially on AC, makes this electrode suitable for demanding applications. OK 48.08 is CTOD tested.

Welding current: DC positive or negative or AC OCV min. 70 V

Diameter mm	Length mm	Current Amps	Arc volts approx.
2.0	300	55– 80	22
2.5	350	75–110	22
3.2	350	110–150	22
3.2	450	110–150	22
4.0	450	150–200	22
5.0	450	190–275	23
6.0	450	220–360	23

Typical weld metal composition %

C	Si	Mn	Ni	P	S
0.06	0.35	1.20	0.90	<0.015	<0.015

Typical mechanical properties
All weld metal specimens

Yield stress:	540 N/mm²
Tensile strength	600 N/mm²
Elongation 5xD	26 %

Charpy V impact values

Test. temp	Impact values
–20°C	150J
–40°C	120J
–60°C	50J

Approvals
American Bureau of Shipping: 3HH, 3Y
Det norske Veritas: 3Y HH
Lloyd's Register of Shipping: 3, 3YH, C Mn LT 40

SS:	143212-H10
GL:	5YHH
RS:	3YHH
SFS:	E 5160 H102

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs
2.5	350	0.55	77	0.9	56
3.2	350	0.62	42	1.3	66
3.2	450	0.66	30	1.4	85
4.0	450	0.69	20	2.0	90
5.0	450	0.69	14	3.0	85
6.0	450	0.66	10	3.8	95

OK 48.15

A basic AC/DC electrode for mild and low alloy steels. Unusually good welding properties in the vertical-up position. The same good weld metal quality as OK 48.00.

Classification
AWS/SFA A5.1: E 7018
DIN 1913: E 51 53 B 10
ISO 2560: E 51 5B 120 26 H
Swedish Standard: 3210 H10

Description and applications
OK 48.15 is a basic coated general purpose electrode with excellent welding properties. The good mechanical properties of the weld metal make the electrode suitable for welding structures in which high stresses cannot be avoided. It can be used on AC and DC and welds with a quiet, stable arc.
OK 48.15 can be used for welding ordinary and high strength ship's plate of A-, D-, and E-quality. It is also suitable for welding galvanized plate.

Welding current: AC 65 V DC positive or negative

Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	350	65–110	22
3.25	450	100–140	23
4	450	140–200	24
5	450	190–280	25
6	450	220–360	26

Typical weld metal composition %

C	Si	Mn
0.06	0.50	1.0

Typical mechanical properties
All weld metal specimens

Yield stress:	490 N/mm²
Tensile strength	575 N/mm²
Elongation 5xD	30 %

Charpy V impact value. Butt weld test

Test. temp	Impact value
–20°C	130J
–30°C	100J

Approvals
Lloyd's Register of Shipping, grade 3, 3YH
Bureau Veritas, grade 3, 3Y HH
Det norske Veritas, grade 3Y HH
American Bureau of Shipping grade 3HH, 3Y
Germanischer Lloyd, grade 3Y HH
PRS, grade 3Y HH
TÜV: Eignungsgeprüft, Kennblatt Nr 0625

DS:	E 51 4B (H)
DSRK:	52.3 HH
SS:	143210-H10
SFS:	E 51 40 H H102
RS:	3YHH
DB:	10.039.06/QS

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.66	30	1.5	80	33	2.7
4	450	0.68	20	2.1	84	60	2.2
5	450	0.66	15	3.0	87	69	2.3
6	450	0.67	11	4.4	87	95	2.2

OK 48.68

A basic AC/DC electrode with extra low moisture content and good resistance to moisture pickup. Suitable for welding high tensile steels sensitive to hydrogen embrittlement.

Classification
AWS/SFA A5.1: E 7018–1
DIN 1913: E 51 55 B 10
ISO 2560: E 51 5B 120 24 H

Description and applications
OK 48.68 is very suitable for welding hardenable low alloy structural steel and carbon steel, particularly when preheating cannot be used or when the moisture content of the coating is critical. It is also suitable for welding high tensile ship's plate of A-, D- and E-quality.

Welding current: DC positive or negative or AC min. 60–70 V

Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	350	75–110	22
3.25	450	105–150	22
4	450	150–200	22
5	450	180–260	22

Typical weld metal composition %

C	Si	Mn
0.07	0.5	1.2

Typical mechanical properties
All weld metal specimens

Yield stress:	470 N/mm²
Tensile strength	560 N/mm²
Elongation 5xD	28 %
Charpy V –20°C	150J
Charpy V –40°C	130J
Charpy V –50°C	90J

Approvals
Lloyd's Register of Shipping, grade 3, 3Y H
Bureau Veritas, grade 3, 3Y HH
Det norske Veritas, grade 3Y HH
American Bureau of Shipping, grade 3HH, 3Y
DS: E51 5B (H)
SS: 143212-H10

Deposition data at max welding current

Size Diam. mm	Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
3.25	450	0.64	34	1.4	81	30
4	450	0.65	22	1.9	88	45
5	450	0.68	15	2.9	90	68

OK 50.10

An easy to use AC/DC rutile acid electrode for welding mild steel. Good welding characteristics in all positions, but best in standing fillets. Good bead shape, good surface finish and easy slag removal.

Classification
AWS/SFA A5.1: E 6013
DIN 1913: E 43 42 AR 7
ISO 2560: E 43 4 AR 24

Description and applications
OK 50.10 for welding of general purpose mild steels and pressure vessel steels having a nominal tensile strength not exceeding 440 N/mm², and impact requirements down to –20°C. It can also be used for welding ship's steels A-, D- and E-qualities having strengths of 400–490 N/mm².

Welding current: AC OCV min 70 V DC positive

Diameter mm	Current Amps	Voltage V
2.5 x350	75–110	24
3.25x450	90–150	25
4 x450	140–190	26
5 x450	170–250	27

Typical weld metal composition %

C	Si	Mn
0.07	0.2	0.5

Typical mechanical properties
All weld metal specimens

Yield stress:	430 N/mm²
Tensile strength	500 N/mm²
Elongation 5xD	25 %

Charpy V impact value. Butt weld test

Test. temp	Impact value
–20°C	60J

Approvals
Det norske Veritas, grade 3
Lloyd's Register of Shipping, grade 3
American Bureau of Shipping, grade 3
Bureau Veritas, grade 3
Germanischer Lloyd, grade 3
DS: E 43 3 AR
SS: 143201

Deposition data at max welding current

Size Diam. mm	Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.60	37	1.5	65	27	2.5
4	450	0.64	24	2.1	71	42	2.3
5	450	0.63	16	3.3	69	62	2.0

OK 50.40

ESAB

An AC/DC rutile-basic electrode particularly good for welding in the vertical upwards position and for welding root beads.
AC OCV min 70 V.

Classification
AWS/SFA A5.1: E 6013
DIN 1913: E 51 43 RR (B) 7
ISO 2560: E 51 4 RR 24

Description and applications
OK 50.40 is an allround electrode for welding mild steel. Well suited also for pipe welding.

Welding current: AC or DC – (+)

Diameter mm	Length mm	Current Amps
2.5	350	50–100
3.25	450	80–150
4	450	130–190
5	450	170–280

Typical weld metal composition %

C	Si	Mn
0.07	0.2	0.5

Typical mechanical properties
All weld metal specimens

Yield stress:	450 N/mm²
Tensile strength	520 N/mm²
Elongation 5xD	30 %

Charpy V impact value. Butt weld test

Test. temp	Impact value
0°C	80J
–20°C	50J

Approvals
Det norske Veritas, grade 2
Germanischer Lloyd, grade 2
Lloyd's Register of Shipping, grade 2
TÜV: Eignungsgeprüft, Kennblatt Nr 0629
USSR: 2
DB:

OK 53.04

ESAB

A low hydrogen electrode for welding in all positions. Very good welding characteristics, little spatter and a thin easily removable slag.

Classification
AWS A/SFA A5.1: E 7016-1
DIN 1913: E 51 44 B 10
ISO 2560: E 51 4B 24
AS 1553.1: E 4816

Description and applications
OK 53.04 is a single-coated electrode intended for welding of C-, C MN-steels. In the vertical position OK 53.04 welds excellent on AC for diameters between 2.5–5 mm. The electrode is also characterized by good arc stability at low amperage. For root runs in single V-joints welding on DC- is recommended because of the cooler weld pool. OK 53.04 has a moisture resisting coating, LMA properties, which gives extra security against porosity and hydrogen cracking.

Welding current: DC+ (–)
or AC OCV min. 70 V

Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	350	70–110	23
3.25	350	90–140	23
4	350	120–190	23
5	450	150–240	23

Typical weld metal composition %

C	Si	Mn
0.06	0.5	1.1

Typical mechanical properties
All weld metal specimens

Yield stress:	500 N/mm²
Tensile strength	590 N/mm²
Elongation 5xD	27 %

Charpy V impact values

Test. temp	Impact values
–20°C	170J
–30°C	120J
–40°C	100J

Approvals
American Bureau of Shipping: 3HH, 3Y
Bureau Veritas: 3, 3Y HH
Det norske Veritas 3Y HH
Germanischer Lloyd 3Y HH
Lloyd's Register of Shipping: 3H, 3Y H

Deposition data at max welding current

Size Diam. mm	Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs
2.5	350	0.56	81.1	0.9	50
3.25	350	0.60	48.4	1.2	62
4	350	0.61	32.6	1.7	66
5	450	0.63	15.9	2.4	98

OK 53.35

The fastest electrode for vertical welding. It is a basic AC/DC electrode. Especially designed for welding vertically downwards.

Classification
AWS/SFA A5.1: E 7048
DIN 1913: E 51 54 B9
ISO 2560: E 51 5B 56 H

Description and applications

Welding vertically downwards with OK 53.25 is done with a relatively large diameter electrode and a high current, thus giving a high welding speed. See the table below for welding data for vertical fillets.
OK 53.35 is recommended for the welding of ordinary and high strength ship's steels A-, D- and E-quality and structural and low alloy steels of similar strength.
Welding current: AC ≥70V
DC positive polarity

Approvals

Lloyd's Register of Shipping, grade 3, 3YH
Bureau Veritas, grade 3, 3Y HH
Det norske Veritas, grade 3Y HH
ABS, grade 3HH, 3Y
Germanischer Lloyd, grade 3Y HH
PRS, grade 3Y HH
TÜV: Eignungsgeprüft, Kennblatt Nr 0631
DS: E 51 4B (H) SS: 143210-H10
SFS: E 5140 H105 RS: 3YHH

Typical weld metal composition %

C	Si	Mn
0.08	0.5	0.9

Typical mechanical properties
All weld metal specimens

Yield stress:	460 N/mm²
Tensile strength	560 N/mm²
Elongation 5xD	30 %

Charpy V impact value. Butt weld test

Test. temp	Impact values	Welding position
–20°C	90J	flat
–20°C	90J	vertical down
–30°C	70J	flat

Welding data for fillet welds in the vertical down position

Throat thickness a=mm	Electrode Diam. mm	Welding current A	Burn-off rate per electrode sec.	Rate of travel m/h	Effective length of the run per electrode cm
2.5	4	190	70	24	47
3	4	185	70	17	33
3	5	260	80	26	59
4	5	240	86	14	34
4.5	5	240	90	13	32
5	5	240	90	11	26

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
4	450	0.70	25	2.2	69	40	2.1
5	450	0.68	16	2.9	77	61	2.5
5.6	450	0.68	16	3.5	77	75	2.9

OK 53.68

An extra high quality basic low hydrogen AC/DC electrode. Particularly suitable for on site welding (CTOD-tested). Very high quality weld metal. Extra low content of impurities.

Classification
AWS/SFA A5.1: E 7016–1
DIN 1913: E 51 55 B10
ISO 2560: E 51 5B 24 H

Description and applications

OK 53.68 is first of all a high quality electrode, which is easy to weld and which yields a homogenous high quality weld metal.
OK 53.68 is recommended for welding of fixed offshore constructions and other structrures where good impact toughness at –30 or –40°C is required.
OK 53.68 is suitable for medium and high tensile steels with guaranteed yield strength up to 430 N/mm². OK 53.68 works in all positions, operates well on AC as well as DC positive and negative.
For full penetration root beads, ø 2.5 or 3.25 mm electrode is the right choice. DC-negative is preferred giving a small easily controlled weld pool, minimizing the risk of burn through or undercutting.

Welding current: AC or DC

Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	350	70–110	22
3.25	450	80–140	22
4	450	90–190	23
5	450	110–240	24

Typical weld metal composition %

C	Si	Mn	P	S
0.07	0.50	1.1	<0.02	<0.015

Typical mechanical properties
All weld metal specimens

Yield stress:	460 N/mm²
Tensile strength	550 N/mm²
Elongation 5xD	30 %

Charpy V impact value. Butt weld test

Temp°C	Welding conditions Flat J	V.H.H.1[2] J	V.L.H.1 J
0	240	140	180
–20	240	100	160
–40	180	30	100
–60	120	10	60

[2] Vertical upwards high heat input
[3] Vertical upwards low heat input

Approvals

American Bureau of Shipping, grade 3HH, 3Y (–40°C)
Bureau Veritas, grade 3, 3Y HH
Det norske Veritas, grade 3Y HH (–40°C)
Germanischer Lloyd, grade 4Y HH
Lloyd's Register of Shipping, grade 3, 3YH and CMN LT40
Poland, PRS, grade 3Y HH and for low temp. application
DS: E 51 5B (H) SS: 143212-H10
SFS: E 5150 H102

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.62	39	1.3	71	26	2.4
4	450	0.63	26	1.8	77	38	2.4
5	450	0.60	17	2.1	100	59	2.7

OK 55.00

A well known high quality basic electrode, particularly suitable for welding high strength low alloy steels.
Note! This electrode is now an AC/DC type.

Classification
AWS/SFA A5.1: E 7018–1
DIN 8529: EY 46 66 Mn B
ISO 2560: E 51 5B 120 26 H
NFA 81–390: E 51 5/5 B 120 26 BH

Description and applications

The good, low temperature impact strength of the weld metal should be noted. The weld metal is also very resistant to hot cracking. The electrode is recommended for welding high strength low alloy steels, particularly when good impact strength at low temperatures is required. The electrode is also suitable for welding high strength ship's steel A-, D- and E-quality.

Welding current: DC positive polarity AC OCV min 65 V

Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	350	80–110	22
3.25	450	110–140	24
4	450	140–200	24
5	450	200–270	24
6	450	215–360	25

Typical weld metal composition %

C	Si	Mn
0.07	0.5	1.5

Typical mechanical properties
All weld metal specimens

Yield stress:	480 N/mm²
Tensile strength	590 N/mm²
Elongation 5xD	30 %

Charpy V impact value. Butt weld test

Test. temp	Impact value
–20°C	115J
–40°C	60J
–50°C	50J

Approvals

Lloyd's Register of Shipping, grade 3, 3Y H
Bureau Veritas, grade 3, 3Y HH
Det norske Veritas, grade 3Y HH (–40°C)
American Bureau of Shipping, grade 3HH, 3Y
TÜV: Eignungsgeprüft, Kennblatt Nr 0632
DB: 10.039.03/QS
DS: E 51 5B (H)
RS: 3YHH
SFS: E 5153 H102
DSS: 143212-H10

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.69	30	1.4	88	33	2.4
4	450	0.70	19	2.0	94	52	2.4
5	450	0.72	13	3.0	94	77	2.2
6	450	0.72	9	4.0	98	110	2.3

OK 61.10

Rutile coated stainless electrode especially designed for pipe welding and positional welding in general.

Classification
AWS/SFA 5.4–92: E 308L–16
BS 2926: 19.9 LR
DIN 8556: E 19.9 LR 23
ISO 3581: E 19.9 LR
NF A 81–343: EZ 19.9 LR 23

Description and applications

OK 61.10 is a rutile electrode designed especially for positional welding such as pipes as the weld pool is very easy to control. It can be used in all positions except vertical down.
OK 61.10 is intended for welding austenitic steels type A131 304L, 304, 308L, 308 or Werkstoff Nr: 1.4301, 1.4306, 1.4541.

Welding current: AC >50V, DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
1.6	300	20– 46	24–26
2.0	300	30– 55	24–26
2.5	300	50– 75	24–26
3.25	350	75–110	24–26
4	350	90–140	24–26

Typical weld metal composition %

C	Si	Mn	Cr	Ni
≤0.030	0.8	0.8	19.5	10.5

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	min 340 N/mm²
Tensile strength	570 N/mm²
Elongation 4xD	40 %

Charpy V impact values

Test. temp	
+20°C	70J

Ferrite number 3–8

Approvals

TÜV
Controlas

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
1.6	300	0.61	217	0.5	33	5
2.0	300	0.62	151	0.6	38	7
2.5	300	0.60	100	0.8	43	10
3.25	350	0.60	52	1.3	54	19
4	350	0.61	33	1.7	63	30

OK 61.30

An extra low carbon AC/DC stainless electrode of the 19 % Cr and 10 % Ni type with a rutile covering. Good for vertical and overhead welding. Gives good fillet welds.

Classification
AWS A/SFA 5.4–92: E 308L–17
BS 2926: 19.9 L AR
DIN 8556: E 19 9 LR 23
ISO 3581: E 19.9 LR
NF A 81–343: EZ 19.9 LR 23
NEN–ISO 3581: E 19.9 LR

Description and applications
OK 61.30 is very easy to strike and restrike and is completely free from short circuiting during welding.
In most cases OK 61.30 gives fully acceptable results on niobium or titanium stabilized austenitic stainless steels. The smallest diameters, up to and including 3.25 mm, can be deposited in all positions, whereas 4 mm and 5 mm should in general only be used in the flat position.

Materials
OK 61.30 is intended for welding austenitic stainless steels corresponding to AISI 304L, 304,308L, 308
Werkstoff Nr: 4306, 4301, 4541
Swedish steel SS 2352, 2333

Welding current: AC ≥50V or DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts Approx
1.6	300	35– 50	27
2	300	45– 65	28
2.5	300	60– 90	29
3.25	350	80–120	30
4	350	120–170	30
5	350	150–240	32
5	450	150–240	

Typical weld metal composition %

C	Si	Mn	Cr	Ni
≤0.030	0.8	0.8	19.5	10

Typical mechanical properties
All weld metal specimens

0.2 % Proof stress:	420 N/mm²
Tensile strength	570 N/mm²
Elongation 4xD	45 %

Charpy V impact values

Test. temp	Impact values
+20°C	about 70J

Ferrite number 3–10

Approvals
Technischer Überwachungsverein (TÜV) eignungsgeprüft
DnV
SFS 3656: E 19.9 L
American Bureau of Shipping
Canadian Welding Bureau
Swedish Standard: 14 33 02

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal electrode g
2	300	0.55	160	0.8	29	6
2.5	300	0.55	99	1.1	36	10
3.25	350	0.60	49	1.4	54	17
4	350	0.60	33	2.0	60	31
5	350	0.60	20	3.0	60	48

Redrying at 250–350°C, 2h

OK 61.33 NAG

An extra low carbon AC/DC stainless electrode of the 19 % Cr and 10 % Ni type with a basic covering. Designed for BNFL (British Nuclear Fuels Ltd.) Nitric Acid Grade. Good for vertical and overhead welding. Gives good fillet welds. Low silicon content of the weld metal.

Classification
AWS A/SFA 5.4–92: E 308L–16
BS 2926: 19.9 L BR
DIN 8556: E 19 9 L B 20+
NF A 81–343: EZ 19.9 LR 26
BNFL, NF 0086/1 issue No 2: NAG 19.9 LR
NEN–ISO 3581: E19.9 LR

Description and applications
OK 61.33 is very easy to strike and restrike and is completely free from short circuiting during welding.
The smallest diameters, up to and including 3.25 mm, can be deposited in all positions, whereas 4 mm should in general be used in the flat position.

Materials
OK 61.33 is intended for welding austenitic stainless steels such as AISI 304L, 308L
Werkstoff Nr: 1.4306.
Swedish SS-steel 2352, 2333
OK 61.33 also gives fully acceplable results on niobium or titanium stabilized austenitic stainless steels.

Welding current: AC ≥60V or DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.0	300	40– 65	22
2.5	300	50– 85	22
3.25	350	75–115	21
4	350	105–160	21

Typical weld metal composition %

C	Si	Mn	Cr	Ni
≤0.025	0.5	1.2	19.5	10.5

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	410 N/mm²
Tensile strength	570 N/mm²
Elongation 4xD	45 %

Charpy V impact values

Test. temp	Impact values
+20°C	about 85J
–196°C	min 32J

Approvals
BNFL

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2	300	0.57	145	0.7	38	7
2.5	300	0.57	96	0.9	42	10
3.25	350	0.59	52	1.2	59	17
4	350	0.60	34	1.6	66	30

OK 61.34

An AC/DC 19.9L electrode designed for vertical down welding. Excellent also for root runs of V-joints in all positions.

Classification
AWS A/SFA 5.4: E 308L–16
BS 2926: 19.9 L.AR
DIN 8556: E 19 9 LR 23
ISO 3581: E 19.9 LR
NF A 81–343: EZ 19.9 LR 23

Description and applications
OK 61.34 can be used in all positions but is principally for vertical down welding of sheet material. Due to the higher welding speed, heat input is less for vertical down welding than for vertical up welding.
OK 61.34 is also very suitable for single or multirun V-joints, fillets and lap joints on sheet and their plate materials. Slag detaches easily leaving a smooth weld bead.

Welding current: AC ≥60V, DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.5	300	50– 90	22–25
3.25	300	80–130	22–25

Typical weld metal composition %

C	Si	Mn	Cr	Ni
<0.030	0.8	0.8	19.5	10

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	420 N/mm²
Tensile strength	560 N/mm²
Elongation 4x0	45 %

Charpy V impact values

Test. temp	
+20°C	80J

Ferrite number 3–8

Approvals
TÜV eignungsgeprüft

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.5	300	0.70	94	1.0	39	11
3.25	300	0.70	59	1.6	39	17

Redrying: 250°C, 2h

OK 61.35

A low carbon basic covered stainless electrode with outstanding welding properties in the vertical and overhead position. It is very resistant to cracking and porosity and has high impact toughness at very low temperatures.

Classification
AWS A/SFA 5.4: E 308L–15
BS 2926: 19.9 LB
DIN 8556: E 19 9 LB 20+
ISO 3581: E 19.9 LB
NF A 81–343: EZ 19.9 LB 20
NEN–ISO 3581: E 19.9 LB

Description and applications
OK 61.35 is mainly used for welding of stainless steels having a corresponding analysis especially when high ductility and high impact values are required at low temperatures as in cryogenic application at –196°C working temperatures.
It is especially suitable for welding positional welding because of its fast freezing slag.

Welding current: DC positive

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.0	300	35– 55	
2.5	300	55– 85	22
3.25	350	75–110	23
4	350	110–155	24
5	350	160–210	

Typical weld metal composition %

C	Si	Mn	Cr	Ni
≤0.04	0.4	1.7	19.5	10.5

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	440 N/mm²
Tensile strength	580 N/mm²
Elongation 4xD	45 %

Charpy V impact values

Test. temp	
+ 20°C	100J
–120°C	70J
–196°C	35J

Lateral expansion –196°C ≥0.5

Ferrite number 2–7

Approvals
TÜV eignungsgeprüft

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.5	300	0.61	92	0.9	37	11
3.25	350	0.61	50	1.3	54	20
4	350	0.61	33	1.9	58	30

Redrying: 200°C 2h

OK 61.41

An extra low carbon, stainless steel, high deposition rutile electrode.
Alloy type 19 % CR, 10 % Ni corresponding to AISI 304L.
ESAB's fastest electrode of this type.

Classification
AWS A/SFA 5.4–92: E 308L–17
DIN 8556: E 19 9 LR 23 150
ISO 3581: E 19.9 LR
NF A 81–343: EZ 19.9 LR 150 23
BS 2926: 19.9 L AR
NEN–ISO 3581: E 19.9 LR

Description and applications
OK 61.41 has a stainless steel core wire and a new rutile-type covering.
OK 61.41 is intended for use in the flat position and welds very quietly with unusually little spatter. The slag is easy to remove. The weld surface is even and shiny. Fillet welds with a slightly concave profile are easily obtained.

Materials
OK 61.41 is intended for the welding of austenitic stainless steels corresponding to AISI 304L, 308L 304 and 3098.
Werkstoff Nr: 1.4306, 1.4301, 1.4541, 1.4550
Swedish Standard SS-steel 2352, 2333.

Welding current: AC ≥55V or DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts Approx
1.6	300	35– 55	29
2	300	45– 65	30
2.5	300	60–100	29
3.25	350	80–130	29
4	450	110–170	32
5	450	170–230	33

Typical weld metal composition %

C	Si	Mn	Cr	Ni
≤0.030	0.7	0.8	19.5	10

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	410 N/mm²
Tensile strength	580 N/mm²
Elongation 4xD	45 %

Charpy V impact values

Test. temp	Impact values
+20°C	65J

Ferrite number 3–10

Approvals
Controlas:
Canadian Welding Bureau
Technischer Überwachungsverein, (TÜV) eignungsgeprüft
SS 14 33 02

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
1.6	300	0.61	155	0.7	33	10
2	300	0.61	100	1.0	36	10
2.5	300	0.61	67	1.5	37	15
3.25	350	0.65	35	2.0	52	30
4	450	0.65	17.9	2.8	71	59
5	450	0.65	11.2	3.9	82	92

Redrying: 250°–350°C, 2h

OK 61.80

Niobium stabilized stainless steel electrode for welding of niobium or titanium stabilized steels of the 19 Cr 10 Ni type.

Classification
AWS A/SFA 5.4: E 347–17
BS 2926: 19.9 Nb AR
DIN 8556: E 19 9 Nb R 23
ISO 3581: E 19.9 Nb R
NF A 81–343: EZ 19.9 Nb R 23
NEN–ISO 3581: E 19.9 Nb R

Description and applications
OK 61.80 is used for welding of stabilized steels when stabilized weld metal is required.
OK 61.80 gives low carbon weld metal and is also stabilized with niobium.
It is used for stabilized steels AISI 321/347 or Werkstoff Nr: 1.4541, 1.4543, 1.4550, 1.4552.

Welding current: AC >50V, DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.0	300	45– 65	24–31
2.5	300	60– 90	24–31
3.25	350	80–120	24–31
4.0	350	120–170	24–31
5	350	150–240	24–31

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Nb
≤0.030	0.8	0.7	20	10	0.4

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	520 N/mm²
Tensile strength	660 N/mm²
Elongation 4xD	35 %

Charpy V impact values

Test. temp	
+20°C	55J

Ferrite number 6–12

Approvals
TÜV eignungsgeprüft
Controlas

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.0	300	0.56	150	0.7	35	7
2.5	300	0.56	97	1.0	38	10
3.25	350	0.56	50	1.4	53	20
4.0	350	0.56	33	2.0	55	30
5.0	350	0.56	21	2.9	60	48

Redrying: 250°–350°C, 2h

OK 61.81

A niobium-bearing, easy to use rutile electrode for Ti- and Nb-stabilized "18–8" steel. Particularly suitable for high temperature applications.

Classification
AWS A/SFA 5.4–92: E 347–16
BS 2926: 19.9 Nb R
DIN 8556: E 19 9 Nb R 23 110
ISO 3581: E 19.9. Nb R

Description and applications
The main application of OK 61.81 is for welding titanium or niobium stabilized 18–8–steels. As a rule OK 61.81 must only be chosen in cases where the structure will have to work at high temperatures. In other cases OK 61.30 will be quite satisfactory to use for stabilized 18–8–steels.

Materials
OK 61.81 is intended for welding stabilized stainless steels corresponding to:
SS-steels 2337, 2338
USA Standard AISI 321, 347
DIN Werkstoff 4541, 4550
British Standard 321 S 12, 347 S 17.

Welding current: AC ≥55V
DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts Approx
1.6	300	25– 40	20
2	300	40– 60	21
2.5	300	50– 80	21
3.25	350	75–115	22
4	350	110–160	22
5	350	140–210	23

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Nb
0.06	0.7	1.5	20	10	0.8

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	610 N/mm²
Tensile strength	680 N/mm²
Elongation 4xD	35 %

Charpy V impact values

Test. temp	Impact values
+20°C	70J

Ferrite number 6–12

Approvals
Controlas: E 347 for AISI 347–321
Swedish Standard: 143303
SFS 3656: E 19.9 Nb
Canadian Welding Bureau

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
1.6	300	0.63	210	0.4	40	5
2	300	0.63	140	0.7	40	7
2.5	300	0.63	88	0.9	47	11
3.25	350	0.63	44	1.2	66	19
4	350	0.60	32	1.7	66	31
5	350	0.60	20	2.3	78	48

Redrying: 250°C 2h

OK 63.10

Rutile coated stainless electrode especially designed for pipe welding and positional welding in general.

Classification
AWS/SFA 5.4–92: E 316L–16
BS 2926: 19.12.3 LR
DIN 8556: E 19 12 3 LR 23
ISO 3581: E 19.12.3 LR
NF A 81–343: EZ 19.12.3 LR 23

Description and applications
OK 63.10 is a rutile electrode designed especially for positional welding such as pipes as the weld pool and penetration is very easy to control. It can be welded in all positions except vertical down.
OK 63.10 is intended for welding austenitic steels such as AISI 316 and 316L or Werkstoff Nr: 1.4404, 1.44035, 1.4406, 1.4429, 1.4401, 1.4436, 1.4437, 1.4410 and 1.4408.

Welding current: AC ≥50V, DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
1.6	300	20– 40	23–26
2.0	300	30– 55	23–26
2.5	300	50– 75	23–26
3.25	350	75–110	23–26
4	350	90–140	23–26

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
≤0.030	0.8	0.8	18	12	2.8

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	min 340 N/mm²
Tensile strength	580 N/mm²
Elongation 4x0	40 %

Charpy V impact values

Test. temp	
+20°C	70J

Ferrite number 3–8

Approvals
TÜV
Controlas

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
1.6	300	0.58	203	0.5	33	5
2.0	300	0.59	151	0.7	36	7
2.5	300	0.62	94	0.9	42	11
3.25	350	0.62	48	1.4	52	21
4.0	350	0.61	32	1.7	66	31

Redrying: 250°C 2h

OK 63.20

Stainless rutile electrode especially suitable for welding thin walled tubes with "drop-welding" technique. Can be used in all positions also vertical down.

Classification
AWS A/SFA 5.4: E 316L–16
BS 2926: 19.12.3 LR
DIN 8556: E 19.12.3 R 13
ISO 3581: E 19.12.3 LR

Description and applications

OK 63.20 is used for steel types 304L/316L and can be used also for stabilized steels 321/347. It can be used in all positions and is extremely easy to restrike and lend itself to be used with the "drop-welding technique" i.e. intermittently striking and interupting the arc to control weld pool and facilitate welding of thin sheet material.

Welding current: AC ≥50V, DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
1.6	265	30–50	22–25
2	265	30–65	22–25
2	300	30–80	22–25
2.5	300	50–80	22–25
3.25	350	70–110	24–26

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
≤0.030	0.7	0.8	18	12	2.8

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	420 N/mm²
Tensile strength	520 N/mm²
Elongation 4xD	>30 %

Charpy V impact values

Test. temp	
+ 20°C	65J
–120°C	30J

Ferrite number 3–10

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
1.6	250	0.68	230	0.5	36	4
2	300	0.67	143	0.6	40	6
2.5	300	0.67	91	0.9	45	11

Redrying:

OK 63.30

An extra low carbon easy-to-use, stainless electrode with a rutile covering giving a deposit of the 18 % Cr, 12 % Ni and 2.8 % Mo type. Suitable for welding in the vertical and overhead positions. It gives fillet welds of good appearance.

Classification: NEN–ISO 3581: E 19.12.3 L–R
AWS A/SFA 5.4–92: E 316L–17
BS 2926: 19.12.3 L. AR
DIN 8556: E 19 12 3 LR 23
NF A 81–343: EZ 19.12.3 LR 23
ISO 3581: E 19.12.3 LR

Description and applications

OK 63.30 is a rutile covered electrode having outstanding welding characteristics on both alternativ and direct current. OK 63.30 is very easy to strike and re-strike and is completely free from short circuiting during welding.
The smaller sizes, up to and including 3.25 mm diam. can easily be used in all positions, but the 4 and 5 mm diam. should, in general, be used in the flat or nearly flat position only.

Materials

OK 63.30 is intended for welding austenitic stainless and acid resisting steels such as: AISI 316 and 316L.
OK 63.30 is also suitable for welding titanium and niobium stabilized 18–12 steels of the type SS 2344 and 2345, except when the corrosive conditions are very severe.
For the corresponding designations of other standard stainless steels, refer to table 8, page 23.

Welding current: AC ≥55V
DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts Approx
1.6	300	35– 50	23
2	300	45– 65	29
2.5	300	60– 90	30
3.25	350	80–125	30
4	350	120–175	31
5	350	150–240	32

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
≤0.030	0.8	0.8	18.5	12	2.8

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	435 N/mm²
Tensile strength	580 N/mm²
Elongation 4xD	40 %

Charpy V impact values

Test. temp	
+ 20°C	60J

Ferrite number 3–8

Approvals
Det norske Veritas: 316 L for NV-25
Technischer Übervachungsverein (TÜV) eignungsgeprüft
Canadian Welding Bureau
Controlas
SFS 3656: E 19.12.3.L
SS: 14 33 05
Lloyd's Register of Shipping 316 L

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
1.6	300	0.56	230	0.6	26	4
2	300	0.56	155	0.8	29	7
2.5	300	0.56	97	1.1	35	11
3.25	350	0.61	48	1.4	54	18
4	350	0.61	32	2.1	55	32
5	350	0.61	20	3.1	58	50

Redrying: 250°–350°C, 2h

OK 63.32

A fast high efficiency rutile electrode for welding mild and low alloy steels to stainless steel or austenitic manganese steel. It can also be used for stainless cladding.

Classification
AWS A/SFA 5.4: E 308 Mo –26
DIN 8556: E 19 12 3 L MPR 23 175

Description and applications
Because its high recovery, (175 %), and short fusion time, OK 63.32 has a very high deposition rate. This has been made possible by the use of an unalloyed core wire, all the alloying being done via the covering. This means that the electrode can tolerate a higher current than electrodes with a stainless core wire and thus can be deposited in a shorter time.

Materials
OK 63.32 is primarily recommended for joining mild and low alloy steels to either austenitic stainless steel or austenitic manganese steel, for welding austenitic manganese steel and for stainless cladding on carbon steel and manganese steel.

Welding current: AC ≥55V
DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
1.6	300	30– 50	24
2.0	300	40– 80	25
2.5	350	70–120	26
3.25	350	110–170	
3.25	450	110–170	28
4	450	140–220	29
5	450	220–320	30

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
≤0.05	0.8	0.7	19.8	10	2.8

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	530 N/mm²
Tensile strength	640 N/mm²
Elongation 4xD	35 %

Charpy V impact values

Test. temp	
+20°C	55J

Ferrite number 10–20

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
1.6	300	0.59		0.6	42	
2.0	300	0.60	97	0.9	52	10
2.5	350	0.60	51	1.4	55	20
3.25	450	0.63	22	2.2	73	46
4	450	0.63	14	3.2	77	72
5	450	0.63	9	4.7	84	112

Redrying: 350°C, 2 h

OK 63.34

An AC/DC Stainless 19.12.3.L-electrode, designed for welding vertical down. Excellent also for root runs of V-joints in all positions.

Classification
AWS A/SFA 5.4–92: E 316L–16
BS 2926: 19.12.3.L.AR
DIN 8556: E 19 12 3 LR 16
NF A 81–343: EZ 19.12.3 LR 16
ISO 3581: E 19.12.3 L R 16
NEN–ISO 3581: E 19.12.3 L R 16

Description
OK 63.34 can be welded in a wider current range than the mostly used types of stainless electrodes. The slag volume is fairly small. The slag is easy to manipulate and easy to remove.
Vertical down welding with OK 63.34 yields concave beads of very good finish and a smooth transition to the joint edges. Vertical down welding specially of thin walled material yields a very much higher rate than welding upwards.
The heat input to the base is less for vertical down than for vertical up welding.
OK 63.34 can be used in all poitions.

OK 63.34 is specially suitable for:
1 Vertical down single run welding of butt joints, fillets and lap joints in thin walled stainless steel structures.
2 Root runs in V-joints.
3 Vertical down multirun welding of stainless steel up to 6–8 mm wall thickness.

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
≤0.030	0.7	0.7	18	12	2.8

Typical mechanical properties
All weld metal specimens

0.2 % Proof stress:	440 N/mm²
Tensile strength	600 N/mm²
Elongation 5xD	40 %

Charpy V impact values

Test. temp	Impact values
+ 20°C	65J

Ferrite number 3–8

Approvals
SFS 3656: E 19.12.3 L
TÜV eignungsgeprüft

Welding current: DC + or AC ≥60V

Dimension mm	Current Amps	Volt
2.5 x300	50– 90	22–25
3.25x300	80–130	22–25

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.5	300	0.70	94	1.0	39	11
3.25	300	0.70	59	1.6	39	17

Redrying: 250°C 2h

OK 63.35

A low carbon basic covered stainless electrode of the 19 % Cr, 12 % Ni, 2.8 % Mo type. It is very resistant to cracking and porosity, and has outstanding welding properties in the vertical and overhead positions.

Classification
AWS A/SFA 5.4–92: E 316L–15
BS 2926: 19.12.3 LB
DIN 8556: E 19 12 3 LB 20+
ISO 3581: E 19.12.3.LB
NF A 81–343: EZ 19.12.3 LB 120 20
NEN–ISO 3581: E 19.12.3 L B

Description and applications

OK 63.35 is mainly used for welding stainless steels having a corresponding analysis, but it can also be used for welding certain airhardening steels, e.g. armour plate, and for butt welding stainless steel to unalloyed or low alloyed carbon steels.
Its good welding properties are particularly marked during vertical welding.

Materials

OK 63.35 is intended for welding acid resisting austenitic steels corresponding to AISI 316 and similiar steels. For the standard designations of corresponding steels please refer to table 8 on page 23.

Welding current: DC positive

Diameter mm	Length mm	Current Amps	Arc volts Approx
2	300	40– 65	21
2.5	300	55– 85	22
3.25	350	75–110	23
4	350	110–155	24
5	350	150–210	25

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
≤0.04	0.5	1.7	18.5	12	2.8

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	435 N/mm²
Tensile strength	580 N/mm²
Elongation 4xD	40 %

Charpy V impact values

Test. temp	
+ 20°C	95J
– 60°C	75J
–120°C	60

Ferrite number 3–8

Approvals

Det norske Veritas
American Bureau of Shipping
Swedish Standard 14 33 05
Controlas
SFS 3656: E19.12.3 L
TÜV eignungsgeprüft

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.0	300	0.67	135	0.7	38	7
2.5	300	0.67	81	1.0	45	12
3.25	350	0.66	40	1.4	65	20
4	350	0.66	28	2.0	69	36
5	350	0.65	18	2.7	75	55

Redrying: 200°C 2h

OK 63.41

An extra low carbon acid-resisting high deposition rutile electrode of the 18.5 % Cr, 12.5 % Ni, 2.8 % Mo type. ESAB's fastest core-wire alloyed electrode of this type.

Classification
AWS A/SFA 5.4: E 316L–17
BS 2926: 19.12.3 L AR
DIN 8556: E 19 12 3 LR 23 150
ISO 3581: E 19.12.3.LR
NF A 81–343: EZ 19.12.3 LR 150 23
NEN–ISO 3581: E 19.12.3 LR

Description and applications

OK 63.41 weld with a quiet arc and an unusually small amount of spatter. The electrode is intended for use in the flat position and gives smooth, shiny beads. Fillet welds have a slightly concave cross section.
OK 63.41 has the same application range as OK 63.30 but has a 50 % higher deposition rate and gives about 65 % more weld metal per electrode in the 5 and 6 mm diam. sizes.

Materials

OK 63.41 is intended for welding acid-resisting austenitic steels corresponding to SS steels 2343 and 2353. (It can also be used for SS steel 2341 and AISI 316 and 316L).
The designations of other standard steels are given in table 10 on page 25.

Welding current: AC ≥55V DC positive

Diameter mm	Length mm	Current Amps	Arc volts Approx
1.6	300	35– 55	30
2	300	45– 65	32
2.5	300	60–100	32
3.25	350	80–130	35
4	450	110–170	38
5	450	170–230	40

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
≤0.030	0.7	0.8	18	12	2.8

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	430 N/mm²
Tensile strength	570 N/mm²
Elongation 4xD	45 %

Charpy V impact values. All weld test

Test. temp	Impact values
+20°C	60J

Ferrite number 3–8

Approvals

Det norske Veritas, grade 316 for NV-25
Technischer Überwachungsverein TÜV eignungsgeprüft
Controlas
Canadian Welding Bureau
Swedish Standard 14 33 05
SFS 3656: E 19.12.3 L

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
1.6	300	0.60	160	0.7	33	6
2	300	0.61	103	1.0	36	10
2.5	300	0.61	65	1.6	35	15
3.25	350	0.58	35	2.2	50	29
4	450	0.60	17	2.9	70	59
5	450	0.61	11	4.0	82	92

Redrying: 250°–350°C, 2h

OK 63.80

A rutile Nb-bearing stainless 19.12.3-electrode for welding Ti-and Nb-stabilized stainless steels with similar base composition.

Classification
AWS A/SFA 5.4: E 318–17
BS 2926: 19.12.3.Nb AR
DIN 8556: E 19 12 3 Nb R 23
ISO 3581: E 19.12.3.Nb R
NF A 81–343: EZ 19.12.3 Nb R 110 23
NEN–ISO 3581: E 19.12.3 Nb R

Description and applications
OK 63.80 is especially designed for welding Nb- and Ti-stabilized stainless steel corresponding to DIN Werkstoff Nr: 4573 and 4583.

Welding current: AC ≥50V or DC positive

Diameter mm	Length mm	Current Amps	Arc volts Approx
1.6	300	35– 50	20
2	300	45– 65	20
2.5	300	60– 90	20
3.25	350	80–120	21
4	350	120–170	22
5	350	150–240	23

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo	Nb
≤0.030	0.8	0.8	18	12	2.8	0.4

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	490 N/mm²
Tensile strength	620 N/mm²
Elongation 4xD	35 %

Charpy V impact values

Test. temp	
+20°C	65J
–70°C	50J

Ferrite number 6–12

Approvals
TÜV eignungsgeprüft
SFS 3656: E 19.12.3 Nb
Swedish Standard 14 33 06

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
1.6	300	0.56	230	0.6	26	4
2	300	0.56	155	0.8	29	8
2.5	300	0.56	97	1.1	35	12
3.25	350	0.61	48	1.4	54	21
4	350	0.61	32	2.1	55	37
5	350	0.61	20	3.1	58	56

Redrying: 250 –350 C, 2h

OK 64.30

An extra low carbon AC/DC stainless 19.13.3.5 electrode for welding alloys of similar composition.

Classification
AWS A/SFA 5.4: E 317L–17
DIN 8556: E 18 13 4 LR 23
ISO 3581: E 19.13.4 LR
NEN–ISO 3581: E 19.13.4 L R

Description and applications
OK 64.30 is easy to weld in all positions and yields smooth runs both on AC and DC.
OK 64.30 is designed for welding stainless steel corresponding to
AISI 317, 317L
DIN W nr: 4438
British Standard: 317 S 12
Swedish Standard: SS-steel 2367

Welding current: AC ≥55V or DC positive

Diameter mm	Length mm	Current Amps	Arc volts Approx
1.6	300	25– 35	24
2	300	40– 55	26
2.5	300	50– 80	28
3.25	350	70–120	30
4	350	100–170	32
5	350	130–240	34

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
≤0.030	0.7	0.7	19	13	3.7

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	450 N/mm²
Tensile strength	600 N/mm²
Elongation 4xD	40 %

Charpy V impact values

Test. temp	
+20°C	55J

Ferrite number 5–10

Approvals
Bureau Veritas
Det norske Veritas
Canadian Welding Bureau
TÜV eignungsgeprüft

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
1.6	300	0.70	190	0.5	36	5
2.0	300	0.70	122	0.8	38	8
2.5	300	0.68	80	0.9	50	12
3.25	350	0.68	47	1.5	51	19
4	450	0.62	30	2.3	52	33
5	450	0.62	19	3.4	56	52

Redrying: 250°–350°C, 2h

OK 64.63

Stainless basic-rutile coated electrode giving a fully austenitic (non-magnetic) weld metal of the Cr Ni Mo type with very good corrosion resistance.

Classification
DIN 8556: E 18 16 5 LR 26

Description and applications
OK 64.63 gives a fully austenitic weld metal which has high resistance against pitting and stress corrosion because of high nickel and molybdeom content.
OK 64.63 is used for welding similar steels as Werkstoff Nr: 1.4406, 1.4429, 1.4435, 1.4438, 1.4439, 1.4446, 1.448, 1.4449 and stabilized steels as 1.4573, 1.4580 and 1.4583.
It has excellent welding characteristics in all positions.

Welding current: AC ≥60V, DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.5	300	60– 90	22
3.25	350	80–110	22
4	350	110–150	22

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo	N
≤0.040	0.5	2.7	18	17	4.7	0.13

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	450 N/mm²
Tensile strength	640 N/mm²
Elongation 4x0	40 %

Charpy V impact values

Test. temp	
+ 20°C	80J
–140°C	45J

Ferrite number 0

Approvals
Controlas

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.5	300	0.62	82	1.1	41	12
3.25	350	0.60	45	1.3	62	22
4	350	0.60	30	1.8	69	33

Redrying: 250°C 2h

OK 67.13

Austenitic stainless steel electrode for welding 25 Cr/20 Ni steels. Weld metal resists scaling up to 1100–1150°C.

Classification
AWS A/SFA 5.4: E 310–16
BS 2926: 25.20 BR
DIN 8556: E 25 20 B20+

Description and applications
OK 67.13 is a basic rutile electrode for welding of heat resisting steels of 25 Cr/20 Ni type such as AISI 310 and DIN werkst. nr. 1.4828, 1.4841, 1.4845.
OK 67.13 can also be used for welding certain air hardening steels such as armour plate and for welding stainless to unalloyed steel.

Welding current: AC ≥65V
DC positive

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.0	300	40– 70	
2.5	350	60– 85	21
3.25	350	80–120	22
4	350	105–160	23
5	350	150–220	24

Typical weld metal composition %

C	Si	Mn	Cr	Ni
0.1	0.5	1.7	26	21

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	560 N/mm²
Tensile strength	600 N/mm²
Elongation 4xD	35 %

Charpy V impact values

Test. temp	Impact values
+20°C	60J

Ferrite number 0

Approvals
Canadian Welding Bureau

Deposition data at max welding current

Size Diam mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs
2.5	300	0.51	101	0.8	42
3.25	350	0.51	53	1.2	58
4	350	0.51	34	1.7	61
5	350	0.54	20.5	2.6	67

Redrying: 250°C, 2h

OK 67.15

Gives heat-resistant weld metal of the 25 % Cr, 20 % Ni type having a scaling temperature of 1100–1150°C and good strength at high temperatures.

Classification
AWS A/SFA 5.4–92: E 310–15
BS 2926: 25.20 B
DIN 8556: E 25 20 B 20+
ISO 3581: E 25.20 B
NF A 81–343: EZ 25.20 B 20
NEN–ISO 3581: E 25.20 B

Description and applications
OK 67.15 is primarily recommended for welding heat resisting steels of a similar type such as AISI 309 and 310. OK 67.15 can also be used for welding certain air hardening steels such as armour plate, and for welding stainless to unalloyed steel. When welding plain carbon or low alloy steel to stainless steel, OK 67.15 gives a softer more machineable weld than 18–8 electrodes.

Materials
Ok 67.15 is for heat resistant steel corresponding to AISI-steel 310. The designations of other standard steels are given in table 10 on page 25.

Welding current: DC positive

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.0	300	35– 55	21
2.5	300	55– 85	22
3.25	350	85–125	23
4	350	110–160	24
5	350	150–220	26

Typical weld metal composition %

C	Si	Mn	Cr	Ni
0.1	0.3	1.5	26	21

Typical mechanical propertie
All weld metal specimens

0.2 % proof stress:	410 N/mm²
Tensile strength	610 N/mm²
Elongation 4xD	40 %

Charpy V impact values

Test. temp	Notch toughness
+20°C	65J

Ferrite number 0

Approvals
Controlas
TÜV eignungsgeprüft
SFS 3656: E 25.20
Swedish Standard 14 33 18

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.0	300	0.67	125	0.7	41	8
2.5	300	0.65	79	1.1	42	12
3.25	350	0.65	43	1.2	70	20
4	350	0.62	28	1.7	76	35
5	350	0.62	18.5	2.4	82	55

Redrying: 200°C 2h

OK 67.50

Electrode for welding of ferritic-austenitic stainless steels with high resistance to stress corrosion. ("Duplex steels")

Classification
AWS A/SFA 5.4: E 2209–17
DIN 8556: E 22 9 3 LR 23

Description and applications
OK 67.50 is an acid-rutile electrode specially designed for welding of the following types of steel.

1.4460	(329)
1.4417	S31500
1.4462	S31803

The composition of weldmetal is designed to give mechanical and corrosion properties to comply fully with these grades. e.g. high resistance to stress corrosion and high yield strength.
OK 67.50 can also be used for joining of Duplex steels to mild steels.
Welding of duplex steels should be made with low heat-input.

Welding current: AC ≥60V or DC positive

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.0	300	30– 65	
2.5	300	50– 90	27
3.25	350	80–120	28
4	350	100–160	29
5	350	150–220	30

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo	N
≤0.030	0.8	0.8	22	9	3	0.15

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	630 N/mm²
Tensile strength	780 N/mm²
Elongation 4xD	25 %

Charpy V impact values

Test. temp	Impact values
+20°C	50J

Ferrite number 30–45

Approvals
Controlas
TÜV eignungsgeprüft

Deposition data at max welding current

Size Diam mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs
2.5	300	0.58	91	1.0	38
3.25	350	0.58	47	1.4	55
4	350	0.58	32	1.9	59
5	350	0.58	20	2.8	64

Redrying: 250°–350°C, 2h

OK 67.60

Stainless steel electrode for joining of stainless to mild steel and for surfacing of mild steel.

Classification
AWS A/SFA 5.4: E 309L–17
BS 2926: 23.12 L A R
DIN 8556: E 23 12 LR 23
ISO 3581: E 23.12 LR
NEN–ISO 3581: E 23.12 L R

Description and applications
OK 67.60 is an acid-rutile electrode for welding heat resistant Cr and Cr-Ni alloyed steels for working temperatures up to 1000°C if sulphurous attack does not occur.
It is especially suitable for joining stainless to mild steel and for welding the root runs in clad steel.
The elecrrode has excellent weldability in all positions both on AC and DC.

Welding current: AC ≥55V or DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.0	300	30– 60	27
2.5	300	50– 90	28
3.25	350	90–120	28
4	350	130–180	31
4	450	130–180	
5	350	160–240	31
5	450	160–240	

Typical weld metal composition %

C	Si	Mn	Cr	Ni
≤0.030	0.8	0.8	24	13

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	470 N/mm²
Tensile strength	590 N/mm²
Elongation 4xD	40 %

Charpy V impact values

Test. temp	
+20°C	60J
–80°C	40J

Ferrite number 12–22

Approvals
TÜV eignungsgeprüft
Controlas
SFS 3656: E 23.12.L

Deposition data at max welding current

Size Diam mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs
2	300	0.6	136	0.7	38
2.5	300	0.6	85	1.1	38
3.25	350	0.6	45	1.6	51
4	350	0.6	29	2.5	51
5	350	0.6	19	3.3	58

Redrying: 250°–350°C, 2h

OK 67.62

A stainless high efficiency rutile electrode of the 24 Cr, 11 % Ni type for welding stainless steel to unalloyed steel.

Classification
AWS A/SFA 5.4–92: E 309–26
BS 2926: 23.12 R.MP
DIN 8556: E 23 12 MPR 36 170

Description and applications
OK 67.62 has a mild steel core wire. The alloying elements enter the weld metal from the covering. The mild steel core wire gives good current tolerance which results in a high deposition rate.
The composition is balanced to give good crack resistance when welding stainless steel to mild steel. The bead appearance is outstanding in both butt welds and fillet welds.

Welding current: AC ≥55V
DC positive

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.5	350	70–120	28
3.25	450	110–165	30
4	450	150–230	32
5	450	200–310	34
5	700	200–250	(gravity welding)

Typical weld metal composition %

C	Si	Mn	Cr	Ni
≤0.07	0.8	0.6	24	12.5

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	520 N/mm²
Tensile strength	680 N/mm²
Elongation 4xD	35 %

Charpy V impact values

Test. temp	Impact values
+20°C	60J
–60°C	45J

Ferrite number 12–22

Approvals
Det norske Veritas
Germanischer Lloyd
Lloyd's Register of Shipping
Canadian Welding Bureau
TÜV eignungsgeprüft

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.5	350	0.64	49	1.2	60	20
3.25	450	0.64	21	2.0	82	47
4	450	0.67	15	3.1	82	70
5	450	0.66	10	4.5	86	108

Redrying: 350°C, 2 h

OK 67.70

An "over-alloyed" stainless electrode for use as a buffer layer in welding acid resisting clad steels and stainless steels to other types of steel. It is an AC/DC rutile electrode.
OK 67.70 is also well suited fo ferritic ELI-steel. (Extra Low Interstitial stainless steel), type 18 % Cr, 2–2.5 % Mo.

Classification
AWS A/SFA 5.4: E 309 MoL–17
BS 2926: 23.12.2 AR
DIN 8556: E 22 12 3L R 23
ISO 3581: E 23.12.2.R
NEN–ISO 3581: E 23.12.2 R

Description and applications
OK 67.70 is "over-alloyed" and very suitable for welding the root runs in the transition between the stainless layer in a clad steel and the unalloyed base material. In spite of the dilution, the weld metal composition matches very well the composition of the stainless clad layer. OK 67.70 has outstanding welding properties on both AC and DC. The electrode can be used in all positions but is best in the flat position.

Recommendations for welding
When welding stainless clad plate, only basic electrodes with an extra low moisture, max 0,3 % by weight, should be used for the unalloyed side of the joint since the hydrogen content that may be present in the weld metal from ordinary basic electrodes is sufficiently high to cause hydrogen cracking in the mixed zone between the stainless and unalloyed weld metal.

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
≤0.030	0.8	0.8	23	13	2.7

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	500 N/mm²
Tensile strength	620 N/mm²
Elongation 4xD	35 %

Charpy V impact values

Test. temp	
+20°C	60J

Ferrite number 12–22

Approvals
Det norske Veritas
Controlas: E
Technischer Überwachungsverein (TÜV) eignungsgeprüft
Canadian Welding Bureau
SFS 3656: E 23.12.2
Swedish Standard: 14 33 17

Welding current: AC ≥55V
DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts Approx
1.6	300	20– 50	
2.0	300	30– 60	
2.5	300	50– 90	28
3.25	350	90–120	28
4	350/450	130–180	29
5	350/450	160–240	30

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.0		0.63	125	0.8	34	
2.5	300	0.63	81	1.2	36	12
3.25	350	0.61	28	1.7	53	19
4	350	0.61	33	2.5	56	37
5	350	0.61	18	3.3	62	57

Redrying: 250°–350°C, 2h

OK 67.71

High deposition stainless steel electrode for joining stainless to mild steel and for surfacing.

Classification
AWS A/SFA 5.4: E 309 MoL–17
DIN 8556: E 22 12 3 LR 26 150

Description and applications
OK 67.71 is an acid rutile high deposition rate electrode for joining mild and low alloyed steels to stainless steels. The ferritic-austenitic weld metal is very crack-resistant.
It has the same applications as OK 67.70 but the deposition rate is about 50 % higher. The metal recovery is about 150 %.
OK 67.71 is especially suitable for welding of fillet welds but is also very suitable for butt-joints and for surfacing of mild steel with stainless.

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
≤0.04	0.8	0.8	23	13	2.8

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	520 N/mm²
Tensile strength	640 N/mm²
Elongation 4xD	35 %

Charpy V impact values

Test. temp	
+20°C	55J

Ferrite number 12–22

Approvals
SFS 3656: E 23.13.2
TÜV eignungsgeprüft

Welding current: DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.0	300	45– 65	
2.5	300	60– 90	30
3.25	350	80–130	32
4	450	110–170	34
5	450	170–230	36

Deposition data at max welding current

Size Diam mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs
2.0	300	0.61	102	1.0	35
2.5	300	0.61	67	1.2	39
3.25	350	0.61	35	2.2	47
4	450	0.61	17.5	3.0	71
5	450	0.63	11	4.3	79

Redrying: 250°–350°C, 2h

OK 67.72

High recovery stainless electrode with mild steel core wire for welding stainless to mild on low alloyed steels also with gravity welding.

Classification
AWS A/SFA 5.4: E 309 Mo–26
BS 2926: 23.12.2 R MP
DIN 8556: E 23 13 3 MPR 36 190

Description and applications

OK 67.72 has a mild steel core wire which allows high currents to be used and the electrode can be used in 700 mm length for gravity welding.
This electrode is mainly used for joining stainless steels to mild and low alloyed steels as in construction of chemical tankers and similar applications. The composition is designed to give maximum crack resistance and the bead appearance is outstanding.

Welding current: AC >55V, DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
4	450	200–230	34
5	450	280–310	37
5	700	200–250 (gravity welding)	36

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
≤0.05	0.8	0.6	23	12.5	2.8

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	520 N/mm²
Tensile strength	680 N/mm²
Elongation 4xD	30 %

Charpy V impact values

Test. temp	
+20°C	60J

Ferrite number 12–22

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
4	450	0.63	13.3	3.4	79	75
5	450	0.64	8.3	5.3	81	120
5	700	0.66	5.2	4.1	171	192

Redrying: 350°C, 2h

OK 67.75

An "over-alloyed" stainless electrode for depositing the buffer-layer in acid resisting clad steel and for welding stainless steel to other types of steel. It is a basic DC electrode.

Classification
AWS A/SFA 5.: E 309L–15
BS 2926: 23.12 LB
DIN 8556: E 23 12 L B20+
ISO 3581: E 23.12 LB
NF A 81–343: EZ 23.12 LB 20
NEN–ISO 3581: E 23.12 LB

Description and applications

OK 67.75 is an "over-alloyed" stainless electrode primarily intended for welding the root runs in the acid resisting part of clad steel. For filling up the joint on the stainless side, an electrode should be chosen which gives a weld metal having a similiar composition to that of the stainless steel.
Note! When welding stainless clad steels only basic electrodes with extra low moisture in the covering should be used, H_2O max 0,3 % by weight, since the hydrogen content in weld metal from ordinary basic electrodes can be high enough to cause hydrogen cracking in the mixed zone between the stainless layer and the unalloyed layer. Because of the weld metal's high strength and good crack resistance, OK 67.75 is also suitable for welding austenitic- martensitic steels of the 13 % Cr, 6 % Ni type.

Welding current: DC positive

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.5	300	50– 80	22
3.25	350	80–110	23
4	350	100–150	25
5	350	160–220	25

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
≤0.04	0.5	2	24	13	0.3

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	470 N/mm²
Tensile strength	600 N/mm²
Elongation 4xD	35 %

Charpy V impact values

Test. temp	
+20°C	75J
–80°C	55J

Ferrite number 12–22

Approvals
Det norske Veritas
American Bureau of Shipping
TÜV eignungsgeprüft
SFS: 3656 E 23.12 L

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.5	300	0.73	78	1.1	42	13
3.25	350	0.73	39	1.5	60	22
4	350	0.73	25	2.3	62	39
5	350	0.73	16.5	3.4	65	62

Redrying: 200°C 2h

OK 67.83

Basic-rutile electrode giving a fully austenitic very corrosion resistant weld metal especially designed for welding steel in urea process applications.

Description and applications
OK 67.83 is designed for joining of steels in urea process applications of 25 % Cr 22 Ni 2 Mo type.
The weld metal has an excellent resistance to agressive media such as nitric-acid and is very insensitive to hot cracking.
OK 67.83 us also suitable for cladding to achieve av corrosion resistant surface.

Welding current: DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.5	300	55– 70	21–25
3.25	350	70–100	21–25
4	350	100–140	23–29
5	350	130–190	23–29

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo	N
≤0.040	0.4	4.2	25	21	2.3	0.13

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	min 350 N/mm²
Tensile strength	610 N/mm²
Elongation 4xD	45 %

Charpy V impact values

Test. temp	
+20°C	40J

Ferrite number 0

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.5	300	0.5	97	0.8	47	10
3.25	350	0.5	55	1.2	55	18
4	350	0.48	33	1.6	68	30
5	350	0.48	21	2.2	78	48

Redrying: 250°C, 2h

OK 68.15

Stainless steel electrode giving a ferritic weld metal of the 13 % Cr type for welding steels of similar composition.

Classification
AWS A/SFA 5.4: E 410–15
BS 2926: 13 BMP
DIN 8556: E 13 MPB 20+120

Description and applications
OK 68.15 gives a ferritic weld metal of the 13 % Cr type and is used for ferritic steels of similar composition when the construction will be exposed to aggressive sulphuric gases.

Welding current: DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.0	300	30– 75	
2.5	350	65–115	25
3.25	450	90–160	25
4	450	120–220	30
5	450	170–270	
6	450	220–330	

Typical weld metal composition %

C	Si	Mn	Cr
0.06	0.5	0.5	13

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	370 N/mm² PWHT
Tensile strength	520 N/mm² 1h 750°C
Elongation 4xD	25 %

Charpy V impact values

Test. temp	
+20°C	75J

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.5	350	0.62	73	1.0	48	14
3.25	450	0.63	33	1.5	71	30
4	450	0.57	24	2.0	73	42

Redrying: 200°C 2h

OK 68.17

Rutile basic stainless steel electrode for welding of martensitic steels and casting of 13 Cr 4 Ni Mo types.

Classification
AWS A/SFA 5.4: E 410 Ni Mo–16
BS 2926: 13.4.Mo.RMP
DIN 8556: E 13 4 MPR 23 120

Description and applications
OK 68.17 gives a martensitic weld metal and is used for welding of corrossion steels and castings. Thick materials are preheated to 100–120°C and stressrelieving is made at 650°C.
OK 68.17 can be welded in all positions except vertical down.

Welding current: AC ≥55V, DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.5	350	65–100	
3.25	350	90–130	
4	450	120–190	
5	450	165–240	
6	450	220–300	

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
0.05	0.5	0.7	12	4.3	0.5

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	710 N/mm²
Tensile strength	850 N/mm²
Elongation 4xD	>15 %

Charpy V impact values

Test. temp	
+20°C	45J
–10°C	45J
–40°C	40J

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.5	350	0.55	77	0.7	63	13
3.25	350	0.61	44	1.2	70	23
4	450	0.63	22	1.8	95	45
5	450	0.59	15	2.2	115	67

Redrying: 350°C 2h

OK 68.53

Stainless basic-rutile electrode for welding austenitic-ferritic steels of "Super Duplex" types.

Description and applications
This electrode is designed for the new range of Super Duplex steels as SAF 2507, Zeron 100, Ferralium 255 UR 47 N, DP3 and similar steels.
The weld metal has very high resistance to pitting and crevice corrosion and to stress corrosion.
OK 68.53 has good welding characteristics in all positions and the slag is easy detachable.

Welding current: AC ≥60V, DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.5	300	55– 85	21–25
3.25	350	70–110	21–25
4	350	110–150	21–25

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo	N
≤0.030	0.5	0.7	25.5	9.5	4.0	0.25

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	650 N/mm²
Tensile strength	850 N/mm²
Elongation 4xD	30 %

Charpy V impact values

Test. temp	
+20°C	50J
–40°C	35J

Ferrite Number 30–40

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.5	300	0.6	94	0.9	43	11
3.25	350	0.6	47	1.2	62	21
4	350	0.6	32	1.7	67	31

Redrying: 250°C 2h

OK 68.60

A heat and acid resistant rutile electrode giving a ferritic-austenic deposit. Very good resistance to sulphureous attack. Type: 26 % Cr, 5 % Ni, 1.5 % Mo.

Description and applications

OK 68.60 is intended for the welding of heat resistant and acid resistant steel, corresponding to DIN Werkstoff Nr: 1.5560, and AISI steel type 329, i.e. stainless steel having the same composition as the weld metal in those cases where it is necessary to match the plate composition. In other cases austenitic stainless electrodes which give tougher weld metal, e.g. OK 63.35, are preferable, provided that the lower resistance to oxidation and sulphurous attack of the latter can be tolerated. OK 68.60 is very suitable for welding ferritic chromium steels containing 17 and 24 % Cr respectively in all cases where severe sulphureous attack does not occur. (Hydrogen sulphide at high temperatures.)

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
0.1	0.8	0.8	26	5	1.5

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	620 N/mm²
Tensile strength	680 N/mm²
Elongation 4xD	6 %

Charpy V impact values
at +20°C 30J

Ferrite Number 60–80

Welding current: AC ≥60V
DC positive

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.0	300	40– 60	23
2.5	300	60– 85	24
3.25	350	80–120	25
4	350	100–160	26
5	350	150–220	27

Deposition Data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.0	300	0.58	136	0.7	45	7
2.5	300	0.58	90	0.8	50	17
3.25	350	0.61	46	1.3	63	22
4	350	0.62	30	1.8	69	33
5	350	0.66	20	2.4	73	50

Redrying: 250–350°C, 2h

OK 69.21

A stainless electrode giving fully austenitic weld metal with better corrosion resistance to hydrochloric acid, nitric acid and sulphuric acid than weld metals of the AISI 316L type which contain a certain percentage of ferrite. A rutile-basic AC/DC coating. Good resistance to hot cracking.

Classification
BS 2926: 18.15.3.L.Mn.R

Description and applications

OK 69.21 is a rutile-basic electrode giving a fully austenitic weld metal having exceptionally good corrosion resistance.

Materials

Fully austenitic stainless steel, e.g. Werkstoff Nr: 4438, 2 Cr Ni Mo 18 16, for urea reactors, stainless steel used in pickling plants where the pickling takes place in hydrochloric acid or sulphuric acid, and other cases where the ordinary austenitic stainless weld metals give less corrosion resistance than austenitic stainless steels of the AISI 316 and 316L types.

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
0.040	0.5	6	18	15	2.5

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	400 N/mm²
Tensile strength	550 N/mm²
Elongation 5xD	37 %

Charpy V impact values. Butt weld test

Test. temp	
at –160°C	57J
–196°C	47J

Ferrite Number 0

Welding current: DC positive or AC ≥70V

Diameter mm	Length mm	Current Amps	Arc volts Approx
2	300	45– 60	21
2.5	300	55– 80	22
3.25	350	80–115	23
4	350	110–150	23
5	350	150–210	24

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2	300	0.68	118	0.8	40	8
2.5	300	0.68	75	1.1	44	11
3.25	350	0.66	39	1.6	58	20
4	350	0.66	26	2.2	61	30
5	350	0.66	17	3.1	70	46

Redrying: 250°C 2h

OK 69.33

A fully austenitic, rutile-basic 20.25.4,5 weld metal with better corrosion resistance to sulphuric acid than lower alloyed weld metals of the AISI 316L and 317L-type.

Classification
DIN 8556: E 20 25 5 L Cu R

Description and applications
OK 69.33 is designed for welding of stainless steel with corresponding composition. This type of steel has better resistance to sulphuric acids than lower alloyed stainless steels. OK 69.33 is recommended for Swedish Standard steel SS 2562, Avesta 254 SLX UHB 904L, Sandvik 2 RK 65, 2R N65.

Welding current: DC positive or AC ≥65V

Diameter mm	Length mm	Current Amps	Arc volts Approx
1.6	300	30– 55	23
2	300	40– 60	24
2.5	300	60– 90	25
3.25	350	85–130	26
4	350	120–180	28
5	350	160–240	28

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo	Cu
≤0.030	0.5	1	20.5	25	5	1.5

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	400 N/mm²
Tensile strength	575 N/mm²
Elongation 4xD	35 %

Charpy V impact values. Butt weld test

Test. temp	
+ 20°C	80J
–140°C	45J

Ferrite Number 0

Approvals
TÜV eignungsgeprüft

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.0	300	0.58	125	0.7	40	8
2.5	300	0.58	80	1.0	45	13
3.25	350	0.58	41	1.5	52	21
4	350	0.51	30	1.9	64	34

Redrying: 250C 2h

OK 69.63

Stainless basic-rutile electrode giving a fully austenitic (non-magnetic) weld metal of the Cr Ni Mo-type with very high corrosion resistance.

Classification
DIN 8556: E 20 25 6 L Cu R 23

Description and applications
OK 69.63 is designed for welding of steels with corresponding composition as Werkstoff Nr: 1.4500, 1.4505, 1.4506, 1.4531, 1.4536, 1.4539, 1.4585, 1.4586.
The metal gives excellent pitting and crevice corrosion resistance and the high nickel content makes it very stress corrosion resistant.

Welding current: AC ≥60V, DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.0	300	30– 70	22
2.5	300	60– 90	22
3.25	350	80–110	22
4	350	110–150	22

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo	Cu	N
0.04	0.4	2.8	20	25	6.5	1.2	0.15

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	460 N/mm²
Tensile strength	680 N/mm²
Elongation 4xD	40 %

Charpy V impact values

Test. temp	
+ 20°C	80J
–140°C	50J

Ferrite Number 0

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
2.5	300	0.62	82	1.1	41	12
3.25	350	0.60	45	1.3	62	22
4	350	0.60	30	1.8	69	33

Redrying: 250°C 2h

OK 73.08

A Ni-Cu-alloyed basic AC/DC electrode. It gives a weld metal which has good corrosion resistance to sea water and flue gases. OK 73.08 is recommended for welding of weathering steel, and for ship hull construction steel. Excellent mechanical properties

Classification
AWS/SFA A5.5: E 8018–G
Swedish Standard: 143212–H10
AS 1553.2: E 5518–G
ISO 2560: E 51 5B 120 26 H

Description and applications

OK 73.08 welds with a quiet, stable arc and gives very little spatter. The electrode can be used for all types of joints and in all welding positions. It is particularly suitable for welding the shell plating of ice breakers and other ships, which work under conditions where the protective paint coating wears off, bridges, boilers, slow corrosion steels of the CORTEN type and ordinary and high tensile ship's steels A-, D- and E-quality.

Welding current: AC OCV min 65 V
DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	350	80–115	23
3.25	450	100–150	24
4	450	130–200	25
5	450	190–280	25

Typical weld metal composition %

C	Si	Mn	Ni	Cu
0.06	0.4	1.0	0.6	0.4

Typical mechanical properties
All weld metal specimens

Yield stress:	500 N/mm²
Tensile strength	590 N/mm²
Elongation 5xD	27 %

Charpy V impact values

Test. temp	Impact value
+20°C	160J
–20°C	130J

Approvals

Lloyd's Register of Shipping, grade 3, 3Y H
Bureau Veritas, grade 3, 3 YHH
Det norske Veritas, grade 3 Y HH
American Bureau of Shipping, grade 3HH, 3 Y
Germanischer Lloyd: 3 Y H
TÜV: Eignungsgeprüft, Kennblatt 2115.00
RS: 6 HH

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.7	30	1.3	90	33	2.6
4	450	0.7	20	1.8	100	50	2.8
5	450	0.7	14	2.6	106	77	2.8

OK 73.68

A nickel alloyed basic AC/DC electrode for welding low alloy steels with impact requirements down to –60°C.

Classification
AWS/SFA A5.5: E 8018–C1
AS 1553.2: E 5518–C1
DIN 8529: E Y 4687 2 Ni B

Description and applications

OK 73.68 is primarily intended for welding structures in low alloy steels, which must have good resistance to brittle fracture at temperatures down to –60°C.
The composition of the weld metal is such that good, low temperature impact properties are obtained, even when welding vertically up. OK 73.68 has the same good welding characteristics in all positions and types of joint as other basic AC/DC electrodes which ESAB makes. This particular alloy type is also noted for its good corrosion resistance to sea water and sulphuric acid fumes.

Welding current: AC OCV min 70 V
DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	350	70–110	23
3.25	450	105–150	24
4	450	145–190	25
5	450	190–270	27

Typical weld metal composition %

C	Si	Mn	P	S	Ni
0.06	0.35	0.9	<0.02	<0.02	2.4

Typical mechanical properties
All weld metal specimens

Yield stress:	520 N/mm²
Tensile strength	610 N/mm²
Elongation 5xD	26 %

Charpy V impact values

Test. temp	Impact value
+20°C	180J
–20°C	145J
–40°C	125J
–46°C	120J
–54°C	110J
–60°C	105J
–80°C	75J

Approvals

American Bureau of Shipping grade 3HH, 3Y
Bureau Veritas, grade UP low temp steel
Det norske Veritas, grade 3Y HH, NV 4–4
Lloyd's Register of Shipping, grade 3, 3YH and C Mn LT 60
Controlas, HRS
TÜV: Eignungsgeprüft, Kennblatt 1529.01
RS: 6 HH

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.62	33	1.3	83	30	2.7
4	450	0.65	21	1.8	98	48	2.7
5	450	0.65	14	2.5	104	74	2.8

OK 74.78

A basic AC/DC electrode for welding high tensile steels. Good notch toughness down to –60°C. Very suitable for enclosed joint welding of rail and for cladding on rail when a hardness of about 250 HV is desired.

Classification
AWS/SFA A5.5: E 9018–D1
Swedish Standard: EV 17–H
AS 1553.2: E 6218–D1
DIN 8529: E Y 5543 MnMoB

Description and applications
The weld metal has good notch toughness down to about –60°C. OK 74.78 is therefore suitable for welding mild and low alloy steels for structures working at low temperatures, e.g. holders for liquid petroleum gas (LPG). The moisture content of the cating is very low, which makes OK 74.78 suitable for welding low alloy high tensile steel when preheating cannot be applied. The risk of grain boundary cracking is very low when welding with OK 74.78.

Materials
OK 74.78 is suitable for welding the following high tensile steels: Domex 400TE, Domex 450 and Domex 480, FAMA 35, OX 540 E, OX 542 E, OX 602, OX 702, OX 802 and USS–T1 steel.

Welding current: AC OCV min 70 V DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts approx.
2.0	300	55–80	22
2.5	350	75–100	22
3.25	450	105–140	23
4	450	140–190	24
5	450	190–260	25
6	450	240–340	26

Typical weld metal composition %

C	Si	Mn	Mo
0.06	0.35	1.5	0.35

Typical mechanical properties
All weld metal specimens

Yield stress:	610 N/mm²
Tensile strength	670 N/mm²
Elongation 5xD	24 %

Charpy V impact values

Test. temp	Impact value
+20°C	170J
–20°C	95J
–40°C	70J
–52°C	50J
–60°C	40J

Approvals
American Bureau of Shipping, grade 3HH, 3Y
Det norske Veritas, grade 3Y HH
Bureau Veritas, grade 3, 3Y HH
Lloyd's Register of Shipping, grade 3, 3 Y H
TÜV: Eignungsgeprüft, Kennblatt 1027.01

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.65	32	1.3	86	31	2.5
4	450	0.65	21	1.8	97	47	2.5
5	450	0.68	14	2.6	100	71	2.5
6	450	0.68	10	3.5	105	103	2.6

OK 75.75

A low alloy basic DC electrode for welding high tensile, low alloy, tensile structural steels with none or moderate preheat.

Classification
AWS/SFAA 5.5: E 11018–G
AS 1553.2: E 7618–M
DIN 8529: E Y 6963 Mn2NiCrMoB

Description and applications
OK 75.75 is dried to a very high degree and is intended for welding low alloy, high strength weldable structural steels at room temperature or with moderate preheat.
It is recommended for welding steels of the type:
OX 700B, –C, –D and –E.
OX 800B, –C, –D and –E.
OX AR 1, –AR 2 and –AR 3.
HO AG N-A-XTRA 65 and –70.
USS T 1, SSS 100, Superelso, Superelso 700.

Recommendations for welding
1. If possible, each joint should be welded without a stop, except when changing the electrode and removing the slag.
2. When multi-run welding, maintain the inter-pass temperature at 100–150°C.
3. Use only dry electrodes, preferably directly from a heated electrode holder or from VacPac.

Welding current: DC positive polarity AC OCV min 70 V

Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	350	70–110	21
3.25	450	100–150	21
4	450	150–200	22
5	450	180–260	23

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo
0.06	0.3	1.5	0.35	1.8	0.4

Typical mechanical properties
All weld metal specimens

Yield stress:	760 N/mm²
Tensile strength	820 N/mm²
Elongation 5xD	20 %

Charpy V impact value. Butt weld test

Test. temp	Impact value
+20°C	115J
–20°C	85J
–40°C	70J
–50°C	55J
–60°C	45J

Approvals
American Bureau of Shipping: E 11018 G
Det norske Veritas: HH for high strength low alloy steel –40°C.
TÜV: Eignungsgeprüft, Kennblatt 1028.00

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.67	32	1.4	80	32	2.3
4	450	0.65	21	1.9	92	48	2.4
5	450	0.63	14	2.5	105	73	2.4

OK 76.18

A basic AC/DC electrode for welding creep resisting steels of the 1 % Cr, 0.5 % Mo type.

Classification
AWS/SFA A5.5: E 8018-B2 L
BS 2943: 1 Cr Mo B
DIN 8575: E Kb, Cr Mo 1 26
Swedish Standard: 143272-H
AS 1553,2: E 5518–B2 L

Description and applications

OK 76.18 can be used for all types of joints and welds in all positions.
The electrode welds with a quiet, stable arc and gives a minimum amount of spatter.
OK 76.18 welds without short circuiting and deposits a weld metal resistant to both cracking and porosity. Root runs can therefore be made with OK 76.18. The weld beads are smooth and even. The scaling temperature of the weld metal is about 575°C.

Approvals

Bureau Veritas UP
Lloyd's Register of Shipping Low alloy creep resistant steel
Det norske Veritas HH for NV Cr 0.5 Mo
American Bureau of Shipping SR
Controlas E8018 B2 L
TÜV: Eignungsgeprüft, Kennblatt Nr 1387.00

Typical weld metal composition %

C	Si	Mn	Cr	Mo
<0.05	0.3	0.6	1.4	0.5

Welding current: DC positive or negative polarity, AC OCV min 65 V

For root runs in butt joints DC negative polarity is often preferred.

Diameter mm	Length mm	Current Amps	Arc volts approx.
2	300	55– 80	23
2.5	300	70–110	23
3.25	350	90–140	24
4	450	130–190	24
5	450	150–260	25
6	450	200–350	27

Typical mechanical properties. All weld metal specimens

After annealing at 700°C for 2 hours

Test temp. °C	0.2 % Proof stress N/mm²	0.2 % Proof stress kp/mm²	Tensile strength N/mm²	Tensile strength kp/mm²	Elongation % on 5xD
+ 20	520	51	610	62	24
+100	480	49	565	57	23
+200	465	47	550	56	21
+300	450	46	540	55	21
+400	420	43	520	53	22

As-welded all weld metal specimens: preheat and interpass temp. about 250°C

+ 20	530	54	620	63	25

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal electrode g	Power consumption per kg weld metal kWh
3.25	350	0.59	37	1.2	82	27	2.8
4	450	0.64	23	1.7	90	44	2.6
5	450	0.64	15	2.7	95	69	2.6
6	450	0.64	11	3.7	93	95	2.6

OK 76.28

A basic AC/DC electrode for welding creep resisting steels containing approx. 2.25 % Cr and 1.0 % Mo.

Classification
AWS/SFA A5.5: E 9018-B3 L
BS 2943: 2 Cr Mo B
DIN 8575: E Kb, Cr Mo 2 26
Swedish Standard: 143273-H
AS 1553,2: E 6218–B3 L

Description and applications

OK 76.28 can be used for all types of joints and welds in all positions in corresponding steel. The electrode runs with a quiet, stable arc and gives a minimum amount of spatter.
OK 76.28 deposits a weld metal with good crack resistance. The beads are smooth and even. The scaling temperature of the weld metal is about 625°C.

Approvals

Bureau Veritas UP
Lloyd's Register of Shipping Low alloy creep resistant steel
Det norske Veritas HH for NV 2.25 Cr 1Mo
American Bureau of Shipping SR
Controlas E9018 B3 L
TÜV: Eignungsgeprüft, Kennblatt Nr 0971.00

Typical weld metal composition %

C	Si	Mn	Cr	Mo
<0.05	0.3	0.7	2.3	1.0

Welding current: DC positive or negative polarity, AC OCV min 65 V

For making root runs in butt joints negative polarity is often preferred.

Diameter mm	Length mm	Current Amps	Arc volts approx.
2	300	55– 80	23
2.5	300	70–110	24
3.25	350	95–150	24
4	450	130–190	25
5	450	150–260	26

Typical mechanical properties. All weld metal specimens

Annealed for 1 hour at 750°C

Test temp. °C	0.2 % Proof stress N/mm²	Tensile strength N/mm²	Elongation % 5xD
+ 20	540	650	22
+100	520	610	20
+200	490	570	18
+300	480	560	17
+400	480	530	15
+500	445	520	17

As-welded all weld specimens: preheat and interpass temp. about 250°C

+ 20	550	650	20

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal electrode g	Power consumption per kg weld metal kWh
3.25	350	0.59	37	1.2	82	27	2.8
4	450	0.64	23	1.8	88	44	2.7
5	450	0.64	15	2.7	92	69	2.6

OK 76.35

ESAB

OK 76.35 has been redesigned to meet new demands from the industry. Weld metal purity has been improved as well as the mechanical properties.

Classification
AWS A5.4: E 502-15
BS 2496: E 5 Cr MoB
DIN 8575: E Cr Mo 5820+
ISO 3580: E 5 Cr Mo LB 20

Typical weld metal composition %

C	Mn	Si	Cr	Mo	P	S
0.07	0.70	0.50	5.0	0.5	<0.015	<0.015

Description
OK 76.35 is a low-hydrogen electrode for welding of creep resistant steels.
The electrode has an efficiency of 110 %.
Preheat and interpass temperature 150°C-260°C is normally required.

Typical applications
OK 76.35 is intended for welding of steels with simular composition. These steels are often found within the oil industry for high temperature/pressure parts.

Typical mechanical properties
All weld metal properties after heat treatment 2 h at 840–870°C

Tensile strength	Rm min 420 N/mm²
Elongation	A4 min 20 %
Impact Charpy-V	at –20°C min 75

Storage and drying
Rebake at 350°C for 2 hours. Do not rebake more than 5 times. Keep electrodes dry.

Welding current

Diameter mm	Length mm	Current Amps
2.0	300	55– 80
2.5	300	65– 95
3.25	350	90–130
4	350	125–165
5	450	190–220

Deposition data and packing info

Diam. mm	Length mm	Welding current A	Fusion time s	Deposition rate g/min	Deposition rate kg/h	Deposit/ electrode g	Nett weight 1000 el. kg	Content per pack no.	Packs/ box no.	Nett weight per box kg (approx)
2.5	300	65– 95	63	12	0.7	13	23.5	92	6	13.2
3.25	350	90–130	70	17	1.0	20	36.6	134	3	14.7
4	350	125–165	81	22	1.3	30	52.4	94	3	14.7
5	450	190–220	98	36	2.2	59	101.7	65	3	19.8

OK 76.96

ESAB

OK 76.96 has been redesigned to meet new demands from the industry. High purity electrode with low hydrogen potential.

Classification
AWS A5.4: E 505–15
BS 2493: E 9 Cr Mo B
DIN 8575: E Cr Mo 9 B 20+
ISO 3580: E 9 Cr Mo B 20

Typical weld metal composition %

C	Mn	Si	Cr	Mo	P	S
0.07	0.70	0.50 max	9.0	1.0	<0.015	<0.015

Description
OK 76.96 is a low-hydrogen electrode for welding of creep resistant steels.
The electrode has an efficiency of 120 %.
Preheat and interpass temperature 150°C-260°C is normally required.

Typical applications
OK 76.96 is intended for welding of steels with simiular composition. These steels are often found withing the oil index shy for high temperature/pressure parts.

Typical mechanical properties
All weld metal properties after heat treatment 2 h at 840–870°C

Tensile strength	Rm min 420 N/mm²
Elongation	A4 min 20 %
Impact Charpy-V	at +20°C min 80

Approvals
Controlas: X

Storage and drying
Rebake at 350°C for 2 hours.
Do not rebake more than 3 times.
Keep electrodes dry.

Welding current

Diameter mm	Length mm	Current Amps
2.5	300	65– 95
3.25	350	90–130

Deposition data and packing info

Diam. mm	Length mm	Welding current A	Fusion time s	Deposition rate g/min	Deposition rate kg/h	Deposit/ electrode g	Nett weight 1000 el. kg	Content per pack no.	Packs/ box no.	Nett weight per box kg (approx)
2.5	300	65– 95	66	13	0.8	14	24.4	92	6	13.5
3.25	350	90–130	74	19	1.1	23	37.8	134	3	15.3

OK 78.04

Ni-Mo alloyed basic electrode for welding of high tensile steels as N-A-XTRA 70, HY 80, Q1(N).

Classification
AWS/SFA A5.5: E 9016-G

Description and applications
OK 78.04 is a low hydrogen thinly coated electrode designed for HY80 steels. The electrode deposits a very clean metal of excellent impact properties at low temperature. The thin coating gives good access and operates well in all positions. This electrode should be used when a combination of high strength and very good toughness are required.

Welding current: AC OCV min 70V
DC negative polarity

Diameter mm	Length mm	Current Amps	Arc voltage approx.
3.2	450	70–140	22
4.0	450	110–180	23
5.0	450	160–250	24

Typical weld metal composition %

C	Mn	Si	Ni	Mo	S	P
0.05	1.6	0.4	0.8	0.3	0.010	0.010

Typical mechanical properties
All weld metal specimens

Yield stress	625 N/mm²
Tensile strength	670 N/mm²
Elongation 5xD	24 %

Charpy V impact values

Test. temp	Impact values
–20°C	170J
–50°C	115J

Approvals
NES 769 for Q1 (N) and HY 80.

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs
3.2	450	0.6	40	1.0	85
4.0	450	0.6	26	1.3	90
5.0	450	0.6	16	1.9	97

OK 78.08

Ni-Mo alloyed basic electrode for welding of high tensile steels as N-A-XTRA 70, HY 100, Q2 (N).

Classification
AWS/SFA A5.5: E 11016-G

Description and applications
OK 78.08 is a low hydrogen thinly coated electrode designed for HY100 steel. The electrode deposits a very clean metal of excellent toughness at low temperature. This thinly coated electrode for all positions deposits little hydrogen and gives excellent radiographic quality. The electrode is suitable for all critical applications in high strength steels, such as offshore and bridge structures.

Welding current: AC OCV min 70V
DC negative polarity

Diameter mm	Length mm	Current Amps	Arc voltage approx.
3.2	450	70–140	22
4.0	450	110–180	23
5.0	450	160–250	24

Typical weld metal composition %

C	Mn	Si	Ni	Mo	S	P
0.05	1.6	0.4	2.4	0.2	0.010	0.010

Typical mechanical properties
All weld metal specimens

Yield stress	720 N/mm²
Tensile strength	760 N/mm²
Elongation 5xD	22 %

Charpy V impact values

Test. temp	Impact values
–20°C	150J
–50°C	110J

Approvals
NES 769 for HY 100 and Q2(N).

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs
3.2	450	0.6	40	1.0	85
4.0	450	0.6	26	1.3	90
5.0	450	0.6	16	1.9	97

OK 78.10

ESAB

Ni-Mo alloyed basic electrode for welding of high tensile steels as N-A-XTRA 70, HY 80, TI.

Classification
AWS/SFA A5.5: E 10018-M
DIN 8529: E Y5566Mn2NiMoBH5120

Description and applications
OK 78.10 is a low hydrogen electrode for welding of high tensile steels with a yield point up to 690 N/mm². The electrode gives a low level of hydrogen, less than 5 ml/100 g weld metal and has very good welding characteristics in all positions. Use short arc length for optimum mechanical results.

Welding current: AC OCV min 70V
DC positive polarity

Diameter mm	Length mm	Current Amps	Arc voltage approx.
3.2	350	90–140	24
4.0	450	110–180	25
5.0	450	170–240	26

Typical weld metal composition %

C	Mn	Si	Ni	Mo	S	P
0.06	1.4	0.35	1.8	0.4	<0.020	<0.020

Typical mechanical properties
All weld metal specimens

Yield stress	610–690 N/mm²
Tensile strength	690–780 N/mm²
Elongation 4xD	min 24 %

Charpy V impact values

Test. temp	Impact values
–50°C	60J

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs
3.2	350	0.65	45	1.2	66
4.0	450	0.65	20	1.9	96
5.0	450	0.65	15	2.3	108

OK 78.12

ESAB

OK 78.12 is new low-hydrogen low-alloyed electrode for high tensile steels in ESAB electrode range.

Classification
AWS A5.5: E 11018–M
BS 2493: E 2 Ni Mo B
DIN 8529: EY6966Mn2NiMoBH526120

Typical weld metal composition %

C	Mn	Si	Ni	Mo	P	S
0.04–0.08	1.30–1.80	0.20 0.50	1.80–2.50	0.30–0.50	0.020	0.020

Description
OK 78.12 is a low-hydrogen electrode with an efficiency of approx 120 %. The electrode has the good welders apppeal typical for ESAB electrodes. This electrode is a first class alternative to the well known OK 75.75

Typical applications
OK 78.12 is intended for general welding of high tensile steels having a tensile strength of 750–850 N/mm² e.g. N-A-XTRA 70, TI, HY 80 and HY 100.

Welding current: AC ≥70V
DC + (–)

Diameter mm	Length mm	Amps A
2.5	350	55–105
3.25	350	90–140
4	450	110–180
5	450	170–240

For welding of root run use DC–

Typical mechanical properties
All weld metal in the as welded condition

Yield point	Re 680–760 N/mm²
Tensile strength	Rm 760 N/mm² min
Elongation	A4 min 20 %
Impact Charpy-V	at –51°C min 47J

Approvals

ABS:	E11018-M, –51°C
Controlas:	X, –51°C
DnV:	HH –51°C
MoD(N):	X

Storage and drying
Rebake at 350°C for 2 hours
Do not rebake more than 3 times
Keep electrodes dry!

Deposition data and packing info

Diam. mm	Length mm	Welding current A	Fusion time s	Deposition rate g/min	Deposition rate kg/h	Deposit/ electrode g	Nett weight 1000 el. kg	Content per tin no.	Tins/ box no.	Nett weight per box kg (approx)
2.5	350	55–105	46	14	0.8	11	20.0	310	2	12.4
3.25	350	90–140	66	20	1.2	22	45.3	150	2	13.6
4	450	110–180	83	31	1.8	43	73.7	110	2	16.2
5	450	170–240	108	38	2.3	68	113.3	70	2	15.9

OK 78.16

A basic DC electrode for welding low alloy, high strength hardenable steels.

Classification
AWS A5.5–81: E 9018–G

Description and applications
OK 78.16 is a basic covered Cr-Mo-alloyed electrode intended for welding Cr-Mo alloyed steel for hardening and tempering of the type C 0.25 %, Cr 1.0 %, Mo 0.2 %.
The heat treatment requirements for the weld metal are the same as those for the parent plate. The weld metal of OK 78.16 is also suitable for flame hardening.
Recommended for welding steels such as DIN Werkstoff Nr 1.7218 and similar steels having a tensile strength of 790–890 N/mm², 80–90 kp/mm².

Welding current: DC positive polarity AC ≥ 65V

Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	350	75–100	22
3.25	450	110–140	23
4	450	150–190	24
5	450	190–260	24
6	450	240–340	24

Recommendations for welding
The welding of high strength steel with OK 78.16 should be carried out at a temperature of minimum 150–200°C.

Typical weld metal composition %

C	Si	Mn	Cr	Mo
0.18	0.4	0.8	1.0	0.2

Typical mechanical properties All weld metal specimens

Condition	Yield stress N/mm²	Tensile strength N/mm²	Elongation 5xD %
As-welded	850	900	15–20
Tempered	800	850	15–20

Charpy V impact value. Butt weld test

Test. temp	Impact values
+20°C	ab. 50J both for as-welded, quenched and tempered condition

Heat treatment data

Normalizing	840–860°C
Quenching in water	840–860°C
Quenching in oil	850–870°C

Usual heat treatment after quenching consists of tempering at 500–580°C.
Annealing temp.: 725°C

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.66	33	1.4	78	30	2.3
4	450	0.66	23	1.9	83	44	2.4
5	450	0.68	15	2.8	86	60	2.2
6	450	0.70	10	3.6	98	91	2.2

OK 21.03

OK 21.03–an AC/DC electrode for gouging and joint preparing, all types of steel, cast iron and nonferrous metals.

Description
OK 21.03 has a thick, especially developed coating, which produces a strong gasjet, which blows away the melted material.
OK 21.03 is used for gouging in all metals, steel, stainless steel, cast iron and nonferrous metals. The electrode can be used in all positions, flat, horizontal-vertical, vertical down and overhead, but not vertical upwards.
The grooves are very even and smooth and welding can follow without further preparation.

Applications
OK 21.03 is used for bevelling, for weld preparation of cracks and for backgouging of root runs.
The electrode is particularly suitable for backgouging of welds when welding on site of steel structures, storage tanks etc., where equipment for carbon arc gouging is impractical.
For intermittent gouging of short welds the work is simplified considerably, since the same equipment can be used and only the electrode need to be changed.
OK 21.03 is indispensable for all kinds of repair and maintenance welding.

Procedure
Use DC negative pole or AC.
The arc is struck with the electrode perpendicular to the work piece, whereafter the electrode is pointed in the direction of travel at an angle of about 15–20°C and pushed forward. Gouging speed 100–150 cm/minute depending on the depth of the groove. Deep grooves can be made by repeated gouging. Welding can follow without further preparation, but when gouging in stainless steel a thin layer having increased carbon content is obtained, which should be removed by grinding.
When using OK 21.03 indoors it is necessary to have a very good ventilation or fume extraction.

Operating data

Diameter mm	Length mm	Current A	Arc voltage V
3.25	350	160–180	45–50
4	350	220–270	45–50
5	450	240–320	45–50

Gouging speed
100–150 cm/min.

Note
OK 21.03 is not designed for giving a weld metal.

OK 67.45

The most crack resistant electrode for welding steels with very poor weldability. It is a basic DC electrode giving a deposit containing 18 % Cr, 9 % Ni and 6 % Mn.

Classification
DIN 8555: E 8–200 CKZ
DIN 8556: E 18 8 Mn 6B 20+ 110
ISO 3581: E 18.8 Mn B

Description and applications
OK 67.45 is a special basic electrode for welding steels having limited weldability, such as manganese steel, hardenable steels and others.
The tough weld metal is able to absorb high welding stresses which is very important for achieving crack-free welds, particularly when welding rigid structures.

Recommendations for welding
Avoid a large molten metal pool. When welding thick, very hardenable materials, preheat up to 200–300°C is recommended. But normally, OK 67.45 is used without preheating.

Welding current: DC positive

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.5	300	50– 80	23
3.25	350	80–110	24
4	350	110–150	24
5	350	150–210	25

Typical weld metal composition %

C	Si	Mn	Cr	Ni
0.1	0.5	6	18	8.5

Typical mechanical properties
All weld metal specimens

0.2 Proof stress:	430 N/mm²
Tensile strength	620 N/mm²
Elongation 5xD	40 %

Charpy V impact values. Butt weld test

Test. temp	Impact values
+ 20°C	100J
–120°C	40J

Hardness Brinell
as-welded 190 approx.
cold worked 350–400

Approvals
American Bureau of Shipping for welding stainless steel to unalloyed steel.
TÜV for welding pressure vessel steel H1–H3 and 17 Mn 4 to W. No. 4301, 4401, 4541, 4550, 4571, 4580.

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
2.5	300	0.67	82	1.1	40	12	1.5
3.25	350	0.67	43	1.6	51	23	1.5
4	350	0.67	29	2.0	62	34	1.8
5	350	0.67	20	2.8	67	48	2.0

OK 67.52

A zircon-basic high recovery electrode for welding austenitic manganese steel, hardenable steels and for stainless cladding. Recovery approx. 180 %. The weld metal is a manganese alloyed stainless steel of the 18 Cr, 9 Ni, 6 Mn type.

Classification
DIN 8555: E 8–200 CKZ
DIN 8556: E 18 8 Mn B36 160
ISO 3581: E 18.8 Mn BX

Description
The weld metal of OK 67.52 is similar to that deposited by OK 67.45.
The unalloyed core wire and the zirconbasic coating give the electrode high current tolerance and maximum deposition rate. The latter is about 50 % higher than with OK 67.45.

Applications
1. Welding and repairing 13 % manganese steel.
2. Cladding worn parts in 13 % manganese steel, e.g. details in bulldozers, rail crossings, dredgers.
3. Joining austenitic manganese steel to carbon steel or to more or less hardenable steels.
4. Welding very hardenable steels without preheat.
5. Stainless cladding carbon steel and low alloy steel, e.g. rail surfaces, contact layer.
6. For welding parts onto excavating machines, e.g. tips on dredger teeth.

Typical weld metal composition %

C	Si	Mn	Cr	Ni
0.1	1	6	18	9

Typical mechanical properties
All weld metal specimens

0.2 Proof stress:	420 N/mm²
Tensile strength	630 N/mm²
Elongation 5xD	45 %

Charpy V impact values. Butt weld test

Test. temp	Impact values
+ 20°C	80J
–120°C	40J

Welding current: AC ≥65V

Diameter mm	Length mm	Current Amps	Arc volts Approx
3.25	450	120–165	34
4	450	150–240	40
5	450	200–340	48

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.68	21	2.3	76	49	2.2
4	450	0.68	14	3.7	72	75	2.3
5	450	0.65	9	6.0	66	109	2.2

OK 68.81

A high alloy, acid-rutile AC/DC universal electrode for difficult-to-weld steels and for surfacing of dies and hot working tools.

Classification
AWS A/SFA 5.4: E 312–17
DIN 8555: E 9-200 CZT
DIN 8556: E 29 9 R 23
BS 2926: 29.9.R
ISO 3581: E 29.9 R

Description and applications

The duplex structure stainless weld metal is highly tolerant of dilution from medium and high carbon steels and free-cutting steels, and it is free from hot cracking.
OK 68.81 is recommended for welding of medium and high carbon hardenable steels: machine components, tools, dies, springs, which are often of unknown compositions.
OK 68.81 is also recommended for welding joints between dissimilar steels:

1. Stainless steels to carbon steels and low alloy steels.
2. Austenitic manganese steel to carbon steels and low alloy steels.

The high scaling temperature of the weld metal makes it usable for work at high temperatures.

Welding data AC ≥60V or DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
2	300	35– 60	22
2.5	300	50– 85	23
3.25	350	80–120	25
4	350	100–170	26
5	350	160–235	28

Typical weld metal composition %

C	Si	Mn	Cr	Ni
0.1	0.8	1.5	28.5	10

Typical mechanical properties
All weld metal specimens

0.2 Proof stress:	610 N/mm²
Tensile strength	790 N/mm²
Elongation 5xD	25 %

Charpy V impact value. Butt weld test

Test. temp	Impact value
+20°C	~50J

Weld metal hardness
As welded about 230 HV
Cold worked up to 450 HV

Scaling temperature
about 1150°C

Approvals
Canadian Welding Bureau

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	350	0.62	42	1.3	56	21	2.4
4	350	0.65	26	2.0	66	39	2.1
5	350	0.65	17	3.2	68	60	2.1

OK 68.82

A high alloy, rutile-basic AC/DC universal electrode for difficult-to-weld steels and for surfacing of dies and hot working tools. Extremely good running properties.

Classification
DIN 8555: E 9–200 CZT
DIN 8556: E 29 9 R 23
ISO 3581: E 29.9 R
BS 2926: 29.9 R

Description and applications

The duplex structure stainless weld metal is highly tolerant of dilution from medium and high carbon steels and free-cutting steels, and it is free from hot cracking.
OK 68.82 is recommended for welding of medium and high carbon hardenable steels: machine components, tools, dies, springs which are often of unknown composition.
OK 68.82 is also recommended for welding joints between dissimilar steels:

1. Stainless steels to carbon steels and low alloy steels.
2. Austenitic manganese steels to carbon steels and low alloy steels.

The high scaling temperature of the weld metal makes it usable for work at high temperatures.

Welding data: AC ≥55V or DC+

Diameter mm	Length mm	Current Amps	Arc voltage
2	300	55– 75	22
2.5	300	75– 90	23
3.25	350	90–140	24
4	350	110–170	25
5	350	140–230	26

Typical weld metal composition %

C	Si	Mn	Cr	Ni
0.1	0.8	1.2	28.5	10

Typical mechanical properties
All weld metal specimens

0.2 Proof stress:	600 N/mm²
Tensile strength	770 N/mm²
Elongation 5xD	25 %

Charpy V impact value. Butt weld test

Test. temp	Impact value
+20°C	~50J, 5 kpm

Weld metal hardness
As welded about 230 HV
Cold worked up to 450 HV

Scaling temperature
about 1150°C

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	350	0.52	46	1.3	49	18	2.4
4	350	0.59	32	1.9	60	32	2.3
5	350	0.59	20	2.5	71	50	2.4

OK 83.28

A chromium alloyed basic AC/DC electrode for hardfacing and cladding tracks, shaft, rolls, rails and rail crossing sections. Weld metal hardness about 34 HRC.

Classification
DIN 8555: E 1–350

Description and applications
The electrode deposits smooth, even weld beads which can with advantage be weaved to a width of 50–60 mm.
Hardfacing of details in rolling mills, e.g. grooved rollers and clutches, rails, brake shoes, track links and rollers, big cog wheels of cast steel and so on, where a hardness of 31–38 HRC is required. Another application is the joining of hardenable steels when a high tensile strength of 80–90 kp/mm² in the weld metal is required.

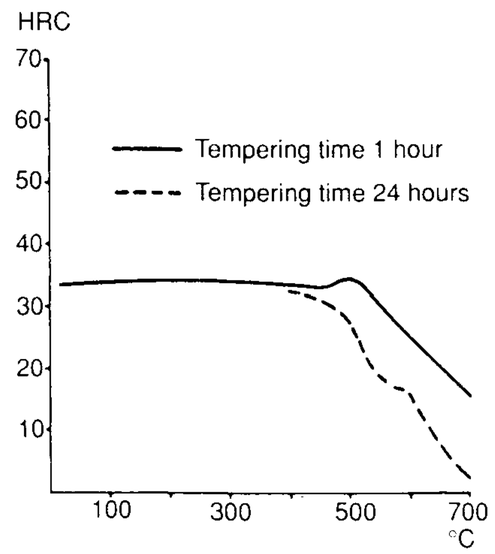
Welding current: DC positive polarity or AC ≥70V

Diameter mm	Length mm	Current Amps	Arc voltage
2.5	350	55– 85	22
3.25	450	110–140	23
4	450	150–190	24
5	450	190–260	23

Typical weld metal composition %

C	Si	Mn	Cr
0.1	0.5	0.7	3.2

Typical weld metal hardness and resistance to tempering
Hardness 34 HRC relatively independent of cooling rate.



Tempering curves

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.66	34	1.2	88	29	2.7
4	450	0.66	23	1.7	92	45	2.7
5	450	0.68	15	2.8	86	67	2.1

OK 83.29

A zircon-basic high recovery AC/DC hardfacing electrode for cladding and hardfacing rolls, points, crossings, wheel conveyors etc. Weld metal hardness about 34 HRC.

Classification
DIN 8555: E 1–350

Description
OK 83.29 is a zircon-basic high recovery electrode for the same applications as OK 83.28. The electrode gives smooth, even weld beads. These can be widened 8 to 10 times the electrode diameter. The welding properties are similar to those of OK Femax 38.65.

Applications
Hardfacing of parts in rolling mills, such as grooved rolls and clutch details, rails, rail ends, worn rail crossings, brake shoes, large cast steel gear wheels, wheels on overhead cranes, links and rollers for tractors etc and welding low alloy steel castings where a hardness of 31–38 HRC is required.

Welding current: DC or positive polarity or AC ≥70V

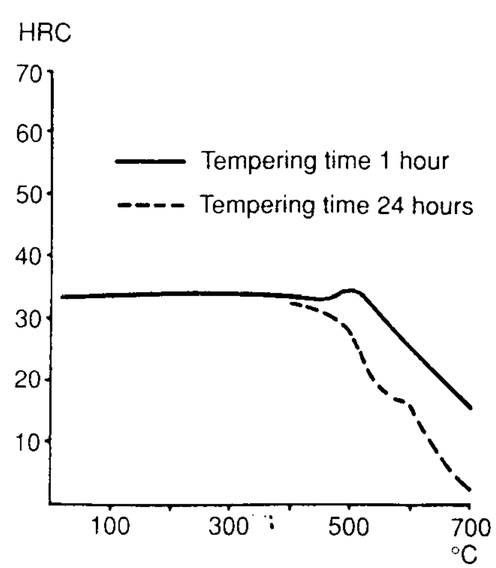
Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	350	70–120	
3.25	450	110–180	30
4.5	450	200–290	35
5	450	230–330	40
5.6	450	270–380	40

Approvals
Approved by the Swedish State Railway for hardfacing rail ends and crossings.

Typical weld metal composition %

C	Si	Mn	Cr
0.1	0.5	07	3.2

Typical weld metal hardness and resistance to tempering
Hardness abt 34 HRC relatively independent of cooling rate.



Tempering curves

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.67	23	2.4	66	43	2.3
4.5	450	0.67	12.4	4.1	71	83	2.4
5.6	450	0.68	8	5.9	77	125	2.6

OK 83.50

A general purpose hardfacing rutile electrode for use also with small transformers having a low open circuit voltage. AC min: 40 volts.

Classification
DIN 8555: E 6–55

Description
OK 83.50 is a rutile covered hardfacing electrode having good welding properties even when used with transformers having a relatively low open circuit voltage, e.g. TBH 140 Bantam, but can also be deposited on DC positive.
The electrode is very easy to use and gives a very smooth weld surface. The weld metal is very versatile and its resistance to cracking is good.

Applications
OK 83.50 is suitable for hardfacing worn parts on farm equipment, forestry tools, and loading machines.

Welding current: AC ≥40V
or DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts approx.
2	300	40– 90	24
2.5	350	60–120	28
3.25	350	90–160	30
4	450	125–210	33
5	450	160–260	37

Typical weld metal composition %

C	Si	Mn	Cr	Mo
0.4	0.4	0.5	6	0.6

Typical weld metal hardness and resistance to tempering
Hardness of single layer and multi-layer welds 50–60 HRC.
Good resistance to tempering up to approx. 500°C.

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	350	0.46	52	1.2	59	19	3.7
4	450	0.48	26	1.7	82	39	3.8
5	450	0.48	16	2.6	86	62	3.4

OK 83.65

Inexpensive basic AC/DC hardfacing electrode. Wear-resistant weld metal (58–63HRC) with good resistance to oxidization. For repairing worn parts of dredging machines and similar applications.

Classification
DIN 8555: E 2–60

Description
OK 83.65 is a basic electrode giving a hard wear-resistant weld metal which is also oxidation resistant up to about 875°C.
The electrode is used for surfacing machine parts exposed to wear by stone, coal, sand, soil etc. Work temperatures over 300°C should be avoided.

Applications
Chequer-net hardfacing on loading buckets, tractor parts, loading machines etc.
Hardfacing of details which are exposed to high temperatures and for which oxidization resistance is more important than hardness and resistance to tempering. Examples of details are arms, feed screws in furnaces etc.

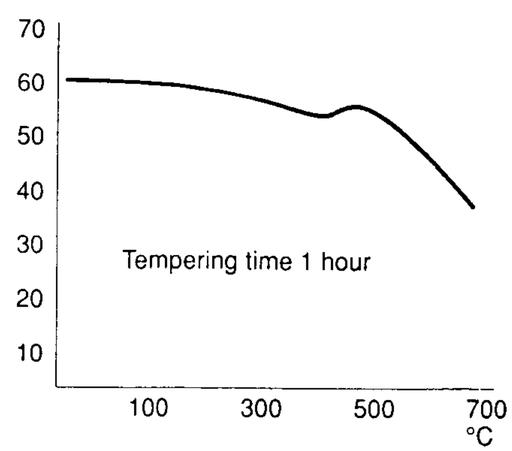
Welding current: AC ≥70V
DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts approx.
3.25	450	100–140	23
4	450	150–190	25
5	450	190–260	26
6	450	250–370	27

Typical weld metal composition %

C	Si	Mn	Cr
0.7	4	0.4	2

Typical weld metal hardness and resistance to tempering
Hardness measured on a three-layer bead 58–63 HRC.
Hardness measured on a three-layer bead, preheated to 300°C.
50–60 HRC on thick workpieces.



Tempering curve

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.68	34	1.2	87	29	2.6
4	450	0.68	22	1.8	90	45	2.5
5	450	0.70	15	2.6	94	68	2.5
6	450	0.70	11	3.4	105	98	2.9

OK 84.42

A versatile rutile AC/DC hardfacing electrode. Corrosion and wear resistant ferritic-martensitic weld metal with a hardness of 42–46 HRC.

Classification
DIN 8555: E 5–45–R

Description
OK 84.42 is a rutile electrode depositing weld metal containing 0.1 % C and 13 % Cr. This material is a stainless, ferritic-martensitic steel, which is air hardening, and within wide limits, insensitive to cooling rate. The electrode is suitable for all kinds of hardfacing where a wear-resistant surface of 42–46 HRC is required. The weld metal can be soft annealed at 780–800°C and rehardened by quenching in compressed air or oil from 980–1000°C.

Applications
General purpose hardfacing electrode suitable for alloyed and unalloyed shafts, rail points, wheel conveyors, racks and pinions, links and pins, valve seats of cast steel and so on. OK 84.42 can also be used for making joints in low carbon 13 % Cr steel.

Preheat and interpass temperature: 200°C min.

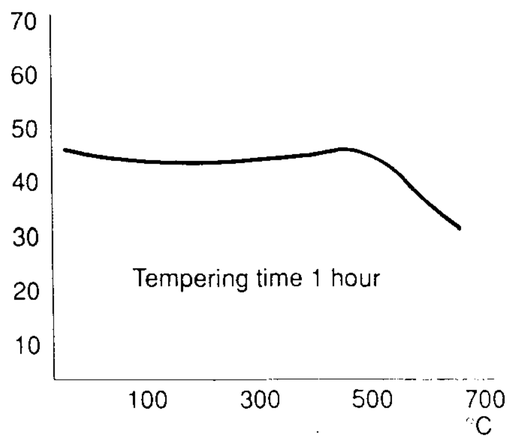
Welding current: AC ≥70V
DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	350	70–110	22
3.25	450	100–160	24
4	450	140–220	25
5	450	220–310	31

Typical weld metal composition %

C	Si	Mn	Cr
0.1	0.5	0.3	13

Typical weld metal hardness and resistance to tempering
Hardness 39–45 HRC
Good tempering resistance up to 475°C.



Tempering curves

Deposition data at max welding current

Size Diam. mm	Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs
3.25	450	0.57	34	1.5	69
4	450	0.57	22.5	2.1	78
5	450	0.61	14	3.2	80

OK 84.52

A versatile rutile AC/DC hardfacing electrode. Corrosion resistant, wear resistant weld metal of the martensitic 13 % chromium type. Hardness 51–56 HRC.

Classification
DIN 8555: E 6–55–R

Description
OK 84.52 gives a fully martensitic weld metal having a hardness of 51–56 HRC. This hardness is obtained even under slow cooling so that the weld metal is strongly air hardening. If it is necessary to machine the weld metal, it is recommended that this be done immediately after completion of the welding, preferably before the weld metal has cooled below 200°C. It is then possible to machine the weld with a hard metal cutting tool. Since the weld is stainless, the wear resistance is good even under certain corrosive conditions.

Applications
A general purpose electrode for hardfacing. It is suitable for hardfacing alloyed and unalloyed shafts, racks and pinions, link pins, valve seats of cast steel, mixer arms, feed gears, knives, loading buckets, track rollers etc.

Welding current: AC ≥70V
DC positive polarity

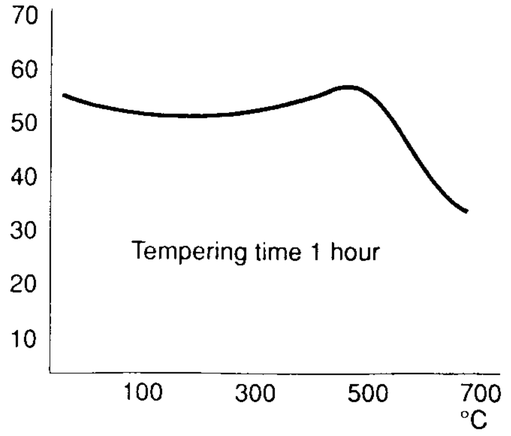
Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	350	70–110	22
3.25	450	100–160	24
4	450	140–220	25
5	450	220–310	31

Preheat and interpass temp: at least 200°C.

Typical weld metal composition %

C	Si	Mn	Cr
0.25	0.5	0.3	13

Typical weld metal hardness and resistance to tempering
Hardness 49–55 HRC
Good tempering resistance up to about 500°C.



Tempering curves

Heat treatment data
Hardening 950–1000°C for cooling in compressed air or oil.
Soft annealing at 830°C.

Deposition data at max welding current

Size Diam. mm	Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs
3.25	450	0.57	35	1.4	70
4	450	0.57	23	2.0	80
5	450	0.61	14.5	3.0	80

The coefficient of friction is low, which further contributes to the wear resistance.

OK 84.58

A basic AC/DC hardfacing electrode giving a wear resistant weld metal having good corrosion resistance. Hardness 55–58 HRC. Full hardness from the first bead on mild steel.

Classification
DIN 8555: E 6–55–R

Description
OK 84.58 is a basic hardfacing electrode giving a hard wear-resistant C-Cr-alloyed weld metal. OK 84.58 has good welding properties on both AC and DC.
The weld metal composition is such that the full hardness of 55–58 HRC is obtained even in the first bead when welding on low alloy and unalloyed steels, irrespective of the cooling rate. The weld metal is resistant to softening up to about 500°C. The fairly high Cr-content, about 10 %, makes the weld metal resistant to the simpler forms of corrosive attack.

Applications
Hardfacing of parts for loading machines, road machines, mixers etc where high wear resistance is required.

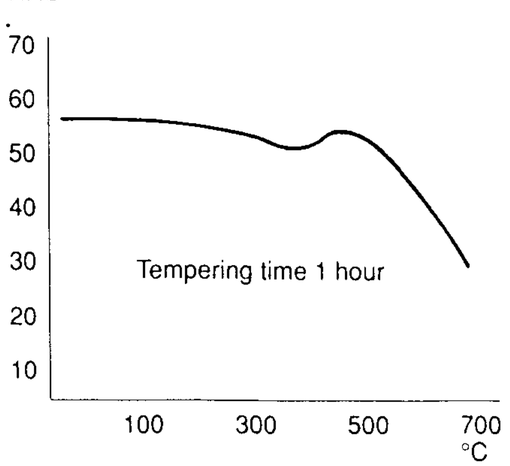
Welding current: AC ≥65V
DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	350	75–110	20
3.25	450	110–140	22
4	450	150–200	24
5	450	180–270	26
6	450	250–370	28

Typical weld metal composition %

C	Si	Mn	Cr
0.7	0.6	0.7	10

Typical weld metal hardness and resistance to tempering
Hardness measured on single or multi-run beads 53–58 HRC.
Resistance to softening up to about 500°C.



Tempering curves

Heat treatment data
Hardening in oil or compressed air from 950–1000°C.

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.67	27	1.4	95	37	2.2
4	450	0.67	18	1.9	107	57	2.5
5	450	0.66	12	2.8	110	87	2.4
6	450	0.65	9	4.0	110	122	2.5

OK 84.78

An AC/DC high chromium-carbide electrode. Extremely high resistance to wear by coarse and hard minerals. Also resistant to corrosion and oxidization. Weld metal hardness 60–62 HRC.

Classification
DIN 8555: E 10–60–Z

Description and applications
This alloy type 4.5 % carbon and 33 % chromium has owing to the high percentage of chromium carbide an extremely high resistance to wear by coarse sand and hard minerals.
The high chromium content yields the weld metal good corrosion and heat resistance. It can withstand temperatures up to about 1000°C.
OK 84.78 is ideal for hardfacing details in mining and mineral industry, earth moving parts, mixer blades, screw conveyors, excavator blades, crushing mills, edge runners and chutes.
OK 84.78 is also suitable for final layer on work-hardening deposits to ensure initial hardness.

Procedure
Use AC or DC positive, keep short arc and hold the electrode at right angles to the workpiece.
Deposition should be limited to three layers. For thicker deposits a build up with OK 67.45 or 68.81 is envisaged.

Typical weld metal composition %

C	Cr
4.5	33

Typical weld metal hardness
60 HRC

Chromium carbide [1]) 1400–1550 HV
[1]) about 50 % of the structure

Welding current: AC ≥50V
DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts approx.
3.25	350	115–170	22
4	450	120–200	23
5	450	150–300	25

Deposition data at max welding current

Size Diam mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs
3.25	350	0.68	26	1.6	85
4	450	0.67	13.5	2.0	135
5	450	0.67	9	2.9	140

OK 85.58

A basic AC/DC hardfacing electrode giving a deposit of the hot working steel type. For forging tools, hot-trimming machines, hot bar shears and similar tools.

Classification
DIN 8555: E 3–50–ST

Description and applications

OK 85.58 is a basic-coated electrode, depositing weld metal corresponding to steels used for hot-working tools, forging tools etc. These steels must possess high hardness, abrasion resistance, toughness and, in particular, a very good resistance to softening.
As-weld metal of 43–50 HRC may be hardened to 53–57 HRC by tempering for 1 hour at 550°C.

Preheat and interpass temp.: at least 300°C, preferably 500°C.

Welding current: AC ≥70V
DC positive polarity

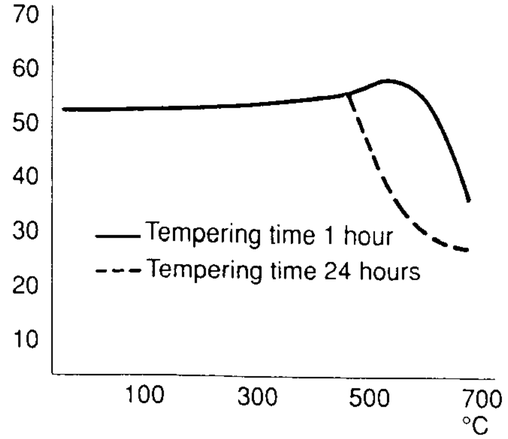
Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	350	70–110	22
3.25	350	100–150	23
4	350	130–190	24
5	350	180–250	25

Typical weld metal composition %

C	Cr	W	Nb	Co
≤0.35	1.8	8	0.8	2

Typical weld metal hardness and resistance to tempering

Hardness 42–50 HRC
After tempering 53–57 HRC
Good resistance to softening up to about 600°C.



Tempering curves

Heat treatment data

Hardening 1100–1150°C in oil
Tempering 550°C 1 hour
Soft annealing 850°C.

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	350	0.63	45	1.3	62	22	2.7
4	350	0.63	30	1.7	75	33	2.8
5	350	0.66	18	2.2	88	55	2.8

OK 85.65

A basic AC/DC high speed steel electrode. The hardness of the weld metal is 60–65 HRC. Suitable for metal cutting tools and punching tools.

Classification
DIN 8555: E 4–60–S

Description and applications

OK 85.65 is a basic covered electrode depositing a molybdenum alloyed high speed steel. The hardness after welding is about 60 HRC but after double tempering this can increase to about 65 HRC.
Welded cutting edges can be used without subsequent tempering, i.e. straight after welding and grinding, but the service life will be longer if tempering is carried out. However, for shaping machine tools and large cutting tools, untempered weld metal is recommended.
The maximum secondary hardness is obtained with OK 85.65 after tempering at 525°C for one hour, followed by air cooling and repeating the tempering once more. The weld metal is resistant to softening up to about 550°C.

Working temperature: min. 300°C, preferably 400–500°C.

Welding current: AC ≥70V
DC positive polarity

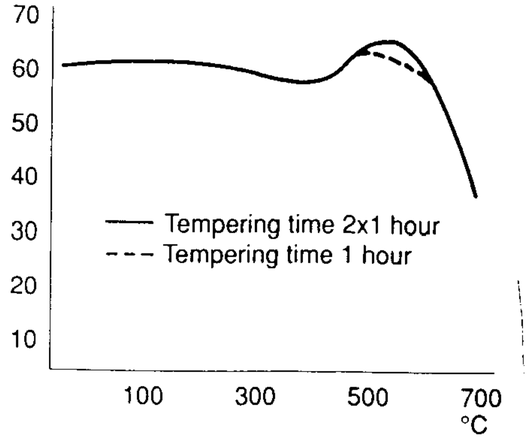
Diameter mm	Length mm	Current Amps	Arc volts approx
2.5	350	80–110	22
3.25	350	100–150	24
4	350	120–190	26

Typical weld metal composition %

C	Cr	Mo	W	V
0.9	4.5	7.5	1.8	1.5

Typical weld metal hardness and resistance to tempering

Weld metal hardness, preheated 400–500°C, 60 HRC approx.



Tempering curves

Heat treatment data

Hardening 1230–1250°C
The weld metal becomes machineable after tempering at 750–775°C for 2–4 hours.

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	350	0.57	40	1.1	81	25	3.3
4	350	0.57	27	1.4	97	38	3.6

OK 86.08

A basic AC/DC austenitic manganese steel electrode. Tough, wear resistant, work hardening weld metal. For hardfacing crusher plates, dredger teeth etc.

Classification
DIN 8555: E 7–200–K

Description
OK 86.08 is a basic-coated electrode depositing austenitic manganese steel weld metal. The steel is very useful as a wear-resisting material when subjected to heavy cold working and gritty abrasion.

Applications
Hardfacing of corresponding steels or parts of carbon steel which are required to be wear resistant when cold worked, for instance digging teeth, crusher plates of stone and ore crushers, links and rollers for strip coilers, slings for hammer mills etc.

Welding current: AC ≥70V
DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts approx.
3.25	450	95–135	22
4	450	130–180	24
5	450	170–230	26

Typical weld metal composition %

C	Si	Mn
1.1	0.8	13

Typical weld metal hardness
Hardness and wear resistance increase with the degree of cold working.
Hardness as-welded about 190 HB
The max. hardness on heavy cold working can in practise reach about 450 HB (approx. 45 HRC).

Recommendations for welding
The working temperature should be kept as low as possible and overheating of the weld metal should be avoided. When multi-layer welding, peening is recommended in order to decrease contraction stresses.

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.60	36	1.1	95	29	2.8
4	450	0.60	24	1.4	109	42	3.1
5	450	0.60	15	1.8	132	67	3.3

OK 86.28

A high recovery zirkonia-basic AC/DC electrode for hardfacing. It gives a tough nickel alloyed austenitic manganese steel, which work hardens during cold working.

Classification
AWS A5.13: E FeMn–A
DIN 8555: E 7–200–K

Description
OK 86.28 has a much higher deposition rate than OK 86.08. OK 86.28 gives a tougher weld metal with better crack arresting properties than OK 86.08.
The hardness increase during cold working is about the same for both types.

Applications
OK 86.28 is primarily intended for reclaiming worn parts made from austenitic manganese steel (Mn 12–14 %). E.g. cast manganese steel rail crossings, dredger buckets, bulldozer teeth etc. OK 86.28 really comes into its own when a weld metal is required which will be exposed to wear under high surface pressure.

Welding current: AC ≥70V
DC positive polarity

Diameter mm	Length mm	Current Amps	Arc volts approx.
3.25	450	100–150	28
4	450	150–205	32
5	450	205–270	35

Typical weld metal composition %

C	Mn	P	S	Ni
0.75	14	0.02	0.01	3.5

Typical weld metal hardness

Treatment	*Hardness*
as-welded	160–180 HB
cold worked	42– 46 HRC

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	440 N/mm²
Tensile strength	690 N/mm²
Elongation 5xD	30 %
Reduction of area	35 %

Charpy V impact values

Test. temp	Impact values
+ 20°C	100J
– 40°C	80J
– 80°C	40J
–120°C	25J

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	450	0.58	25	1.7	86	41	2.5
4	450	0.57	17	2.5	89	60	2.6
5	450	0.57	11	3.7	92	95	2.6

OK 84.80

A high recovery hardfacing electrode for extra high resistance to abrasive wear even at high temperatures.

Description
OK 84.80 deposits a high density of wear resisting carbides in an austenitic matrix. Resists extreme abrasive wear up to around 700°C.

Typical applications
Exhaust fans, ash ploughs, conveyor screws, sinter crushers, screens, blast furnace bells, scrapers in zinc industry.

Welding current: AC ≥65V, DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
3.25	450	90–120	19–21
4.0	450	110–220	21–23
5.0	450	190–290	23–25

Typical weld metal composition %

C	Si	Cr	Mo	Nb	W	V
5	1.5	23	7	7	2	1

Mechanical properties

Hardness
*Typical as welded**
Top of deposit on mild steel
57–61 HRC–1 layer
61–65 HRC–2 layers
62–66 HRC–3 layers

* No preheat. Interp temp ca 100°C

Deposition Data

Size Diam. mm	Size Length mm	η Efficiency %, g weld metal x 100/g core wire	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	W Weight of weld metal/electrode g
3.25	450	230	0.70	17	0.8	260	59
4.0	450	245	0.75	10	2.1	180	100
5.0	450	245	0.75	7	3.0	180	143

OK 92.18

An AC/DC nickel electrode for welding cast iron with a minimum of preheat. The weld metal is very soft and easy machineable.

Classification
AWS A/SFA 5.15: ENi-CI
DIN 8573: E Ni-B6-11

Description and applications
OK 92.18 has a coating which gives a negligible amount of slag. OK 92.18 is deposited at a relatively low current, compared with steel electrodes, but in spite of this, it has good welding properties. The heat affected zones are narrow.

Recommended
OK 92.18 can be deposited on cold or slightly heated cast iron and gives outstanding results if small diameter electrodes are used. The welding should proceed step by step so that the workpiece is not heated more than necessary. When welding thick cast iron, preheating up to 150–300°C is recommended. Light peening is recommended to minimize the risk of cracking resulting from shrinkage stresses.

Welding data and current range
Type of current: DC positive or negative polarity or AC ≥40V.

Diameter mm	Length mm	Current Amps	Voltage Volts.
2.5	300	55–110	16–22
3.25	350	80–140	16–22
4	350	100–190	16–22
5	350	150–260	16–22

Typical weld metal composition %

C	Ni
1	Bal

Typical mechanical properties
All weld metal specimens

0.2 % Proof stress:	270 N/mm²
Tensile strength	280 N/mm²
Elongation 5xD	8 %
Reduction of area	10 %

Charpy V impact value.

Test. temp +20°C	Impact value approx. 30J
Hardness (HB)	about 160

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g	Power consumption per kg weld metal kWh
3.25	350	0.71	45	1.0	80	23	2.6
4	350	0.71	30	1.4	90	34	2.9
5	350	0.68	20	1.8	102	59	2.9

OK 92.26

A nickel-base electrode for welding of nickel alloys and nickel alloyed steel for low temperature work. Also for welding of austenitic stainless steel to low alloy.

Classification
AWS A5.11: ENiCrFe-3
DIN 1736: EL-NiCr15FeMn

Description
OK 92.26 deposits a very crack proof weld metal. It is relatively tolerant to dilution. Good impact strength down to –200°C, good tensile strength up to 800°C. Also the corrosion resistance is good.

Applications
For welding of nickel alloys such as Inconel 600, Incoloy 800, Nimonic 75, NiCr 8070–W.Nr. 2.4869, NiCr 6015–W.Nr. 2.4867, NiCr 15 Fe–W.Nr. 2.4640. OK Selectrode 92.26 can also be used for welding low temperature steels such as 5 % and 9 % nickel steel (NiLo) and for joining dissimilar steels, e.g. ferritic or martensitic steel to austenitic steels, low alloy steels to high-nickel alloys or surfacing unalloyed steels with a layer of a nickel-chromium alloy. Often the electrode can be used to advantage for welding of high temperature resistant cast steels of limited weldability.

Procedure
Use DC with the electrode connected to the positive pole.
The electrode welds in all positions except vertically downwards.
The joint faces must be perfectly clean. Brushing of the surfaces with a stainless steel brush followed by degreasing is recommended. When welding dissimilar metals keep fusion of the parent materials as low as possible.

Welding data

Diameter mm	Length mm	Current mm	Arc voltage
2.5	300	50– 80	21–28
3.25	350	90–130	21–28
4	350	120–150	21–28
5	350	150–200	21–28

Typical weld metal composition %

C	Si	Mn	Cr	Nb	Fe	Ni
≤0.1	0.4	8	15	1.8	<10	Bal

Typical mechanical properties
All weld metal specimens

Temp. °C	0.2 proof stress kp/mm² about	N/mm²
+ 20	43	420
+200	39	380
400	37	365
600	34	335
800	19	185
1000	3.5	35

Tensile strength at +20°C about 640 N/mm²

Elongation 5xD about 25 %

Charpy V impact values.

Test. temp	Impact values
+ 20°C	100J
–196°C	80J

The weld metal is resistant to oxidization in sulphur free reducing atmosphere up to 1150°C.
Up to 800°C in a sulphur dioxide
Up to 550°C in a hydrogen sulphide

Other properties
The coefficient of expansion between 0°C and –196°C is 10.3×10^{-6}

Kg weld metal per kg of electrodes 0.58–0.62.
Number of electrodes per kg of weld metal:
ø 2.5 mm 81
ø 3.25 mm 50
ø 4 mm 30
ø 5 mm 20

OK 92.35

OK 92.35 is a nickel-base "super alloy" electrode of NiCr MoW-Type.

Classification
AWS A5.11: ENiCrMo-5
DIN 8555: E 23–250 CKT

Description and applications
OK 92.35 gives an extremely tough work hardening weld metal. Resistant to attacks by the most used acids. The weld metal is also resistant to high temperature.
The tensile strength of the weld metal at 800°C is about ten times higher than that of mild steel.
OK 92.35 yields very good results within widely different applications.

OK 92.35 is recommended for
Hardfacing of:
hot forging dies
hot working tools and
hot shear blades
Joining of:
Nimonic and Inconel alloys and these alloys to carbon steel and to alloy steel.
Corrosion resistant cladding on:
valves and pump components when wear and corrosion resistant surface is required.

Procedure recommendations
The joint surfaces should be clean. Impurities decreases the weld quality and may cause porosity. Brushing of the surfaces with a stainless steelbrush followed by degreasing is recommended. When joining dissimilar metals keep dilution from the base materials as low as possible.

Typical weld metal composition %

C	Cr	Mo	W	Ni	Fe
≤0.1	16	16	4	Bal	≥5

Typical mechanical properties
All weld metal specimens

Temp. °C	Rp 0.2 N/mm²	T.S. N/mm²
+20	580	750
200	530	670
400	480	610
500	460	560
600	445	630
700	410	560
800	360	515
850	330	415

Hardness: Typical values
As welded 240–260 HV
work hardened 40–45 HRC
Thermal expansion, coefficient 20–870°C:
$14.8\ 10^{-6}$

Welding data: DC positive or AC ≤65V

Diameter mm	Length mm	Current Amps
2.5	300	50– 90
3.25	350	110–150
4	350	160–200
5	350	190–250

Deposition data at max welding current

Size Diam. mm	Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time
3.25	350	0.63	28	1.5
4	350	0.63	19	2.1
5	350	0.63	11	3.1

OK 92.45

ESAB

A basic Ni-Cr-Mo-Nb electrode for welding of "NiCrMo" alloys and Super Stainless steels.

Classification
AWS: A 5.11.E NiCrMo–3
DIN 1736: EL-NiCr20Mo9 Nb

Descriptions and applications
OK 92.45 is suitable for nickelbase alloys type Inconel 600, 625, 800 and for super stainless steels UNS S31254 and W.nr 14529 as AVESTA 254SMo and outokumpu Polarit 77.
OK 92.45 can also be used for welding of nickelbased materials to mild steel, low alloyed steels and stainless steels.

Welding current: AC ≥65V, DC+

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.5	250	50– 80	23
3.25	350	70–110	25
4	350	100–140	27

Typical weld metal composition %

C	Si	Mn	Cr	Ni	Mo	Nb	Fe
<0.030	0.5	0.5	21	>60	9.5	3.3	3.0

Typical mechanical properties
All weld metal specimens

0.2 % proof stress:	480 N/mm²
Tensile strength	800 N/mm²
Elongation 4xD	40 %

Charpy V impact values

Test. temp	
+ 20°C	70J
–196°C	50J

Deposition Data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal electrode g
2.5	250	0.55	119	0.4	35	8
3.25	350	0.56	49	1.4	52	20
4	350	0.58	33	1.4	57	30

Redrying: 200°C, 2h

OK 92.58

ESAB

A nickel alloy AC/DC electrode for welding cast iron and nodular cast iron, either cold or with moderate preheat. The weld metal is very soft and machineable.

Classification
AWS A 5.15: E NiFe-Cl
DIN 8573: E NiFe-1-BG11

Description and applications
OK 92.58 gives a weld metal whose colour after machining closely matches that of the cast iron. The electrode has very good welding properties and gives a very small amount of slag. This, together with the toughness of the weld metal, makes the electrode very suitable for filling up cavities in castings.

Recommendations for welding
OK 92.58 is connected to direct current positive polarity of alternation current. When welding cast iron without preheat, the smallest possible electrode diameter and the lowest possible welding current should be used in order to limit the width of the heat-affected zone. Weld in stages since this helps to limit heating of the base material.
When welding thick sections and malleable irons, preheating to about 300°C is advisable to minimize shrinkage stresses and cracking. During welding, the joint can be lightly peened, and on completion, the workpiece should be allowed to cool slowly.

Welding data and current range
Arc voltage: 20–24 V
Type of current: DC positive or AC 50 V
Recovery: about 100 %
Welding positions: flat and vertical up

Size Diameter mm	Size Length mm	Current Amps
2.5	300	45– 80
3.25	350	60–105
4	350	90–135
5	350	110–170

Typical weld metal composition %

C	Ni	Fe
1	Bal	43

Tensile strength about 350 N/mm²
Elongation about 10 %

Hardness: Typical value 160–200 HB

Deposition data at max welding current

Diam. mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time
3.25	0.72	45	0.8
4	0.75	31	1.2
5	0.75	21	1.6

OK 92.86

A nickel-copper electrode for welding NiCu-alloys, and similar alloys to themselves and to steels and for corrosion resistant surfacing.

Classification
AWS A 5.11: E NiCu-7
DIN 1736: EL–NiCu30Mn

Description and applications
The weld metal of OK 92.86 is crack resistant and ductile and meets rigid requirements on corrosion resistance in sea water and in reducing and oxidizing acids. OK 92.86 is used for the welding of corrosion resistant monel alloys within the petroleum and ammonium sulphate industry and in power plants. OK 92.86 is suitable for material ASTM B127 and B164, and the German Werkstoff Nr. 2.4360.

Welding recommendations
Welding should be done only on clean metal surfaces. Impurities cause easily porosity. The base metal should not be pre-heated. Use DC with the electrode positive and keep the arc short. Use stringer beads or narrow weave beads and remove all slag thoroughly after each pass. Avoid large molten pools and keep the smelting of dissimilar base material as low as possible.

Typical weld metal composition %

C	Mn	Cu	Nb	Ti	Ni
0.05	4.5	Bal	2	0.3	≥60

Typical mechanical properties
All weld metal specimens

Tensile strength about	540 N/mm²
0.2 % Proof stress about	350 N/mm²

Charpy V impact values.

Test. temp	Impact values
+20°C	80J
–196°C	70J

Welding data and current range
DC positive

Diameter mm	Length mm	Current Amps	Arc volts approx.
2.5	300	50– 80	22–26
3.25	350	70–115	22–26
4	350	90–160	23–28

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
3.25	350	0.63	42	1.6	52	23
4	350	0.63	28	2.4	54	35

OK 94.25

An electrode for welding copper and copper alloys preferably tin-bronzes.

Classification
DIN 1733: EL-CuSn7

Description and applications
OK 94.25 gives a weld metal of the tin-bronze type and is intended for welding bronze and red brass.
OK 94.25 can be used for welding copper, for joining copper or bronze to steel, for welding cast iron without pre-heat when machining after welding is unnecessary. It is also suitable for cladding.

Recommendations for welding
When welding copper or bronze, the workpiece should be preheated to about 300°C, in order to obtain better joint fusion. When welding large objects, a continuous heat supply is necessary. A wider vee groove should be used. The angle between electrode and welding direction should be 90°C. The arc should be kept short.

Attention! Avoid working temperature range 400 to 600°C because of the risk of hot shortness.

Typical weld metal composition %

Mn	Cu	Sn	P
0.5	92	7	0.15

Typical weld metal

Tensile strength	330–390 N/mm²
Elongation	25– 35 %

Charpy V impact value

Test. temp	
+20°C	50J

Hardness
95 HB

Welding data and current range
Type of current: DC positive
Welding positions: flat, vertical up

Diameter mm	Length mm	Current Amps	Voltage V
2.5	350	60– 90	23
3.25	350	90–125	24
4	350	125–170	25
5	350	170–230	26

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
3.25	350	0.72	46	1.9	39	22
4	350	0.74	31	2.9	40	33
5	350	0.75	20	4.4	41	50

OK 94.55

A copper-silicon (silicon-bronze) electrode. For corrosion and wear resistant cladding on steel and bronze and for welding copper and copper alloys.

Description
The silicon-bronze deposit has corrosion resistance better than copper. Thermal and electrical conductivity is less than for OK 94.25.

Applications
OK 94.55 is suitable for welding of ordinary bronzes, red brass castings, bell metal, phosphor bronze, silicon-bronze and copper and for joining cast iron and steel to bronze.
OK 94.55 is used for repair and construction of parts in bar, sheet, castings, like valves, pump-parts, propellers and housings. It is also used for bearing surfaces and corrosion resistant surfaces on steel.

Recommendations for welding
Use DC positive pole and keep short arc with electrode perpendicular to workpiece. The weld metal should be deposited in string beads. When welding thin sections no preheat is necessary but thicker material of copper and bronze should be preheated to about 300°C. Great care must be taken to remove all slag after each run.

Typical weld metal composition %

Si	Mn	Cu	Fe
3	1.5	93	2

Typical mechanical properties
All weld metal specimens

Tensile strength	400 N/mm²
Elongation 5xD	35–40 %

Hardness: about 120 HB

Charpy V impact value
About 40J at +20°C

Welding data electrode positive

Diameter mm	Length mm	Current Amps	Voltage V
2.5	350	55– 90	25–30
3.25	350	85–130	25–30
4	350	110–165	25–30
5	350	150–220	25–30

Deposition data at max welding current

Size Diam. mm	Size Length mm	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	Weight of weld metal/ electrode g
3.25	350	0.67	47	1.7	45	21
4	350	0.67	32	2.3	49	31
5	350	0.68	20	3.2	55	50

OK 96.10

A pure aluminium electrode for manual metal arc welding commercially pure aluminium.

Classification
AWS A5.3–80: E 1100
DIN 1732: EL-Al 99.5

Description
OK 96.10 is recommended for welding commercially pure aluminium when a pure aluminium electrode should be used.

Applications
Welding aluminium corresponding to American Aluminium: Association AA 1095, 1100.
British Standard BS 1470–77, 1490: 1B, 1C
German, DIN 1725: A1 99.5 A1 99.
French Standard: A5NF57–601, A4NF57–601
Swedish Standard: SS aluminum 4007, 4010.

Recommendations for welding
Preheating of the start point to 150–300°C may be necessary. As the burn-off rate of the aluminium electrode is about three times higher than that of steel electrodes, the travel speed of OK 96.10 is considerably more rapid.

Typical weld metal composition %

Al	Fe	Si
≥99.5	≤0.3	≤0.2

Typical mechanical properties
All weld metal specimens

Tensile strength	60–80 N/mm²
Elongation 5xD	25–30 %

Welding data DC, electrode positive

Diameter mm	Length mm	Current A	Voltage V
2.5	350	60– 90	23–25
3.25	350	80–115	23–25
4	350	110–150	23–25

OK 96.20

An easy to use general purpose electrode for welding rolled weldable aluminium alloys.

Classification
DIN 1732: EL-AlMn1

Description and applications
OK 96.20 is intended for welding non-hardenable rolled aluminium alloys of the type used for containers in the dairy and brewery industries, and above all for super structures, funnels, and masts etc on ships. In general, these alloys have high strength and good weldability, but somewhat worse corrosion resistance than pure aluminium. The resistance to salt water corrosion is, however, very good.

Recommendations for welding
OK 96.20 is used on DC positive pole and a normal welding generator of rectifier can be used, provided it has an open circuit voltage of at least 70 V.
The burn-off rate of the aluminium electrode is at least three times higher than that of steel electrode.
Due to the relatively high thermal conductivity of aluminium and its alloys, it is recommended that the workpiece or at least the start of the joint to be preheated. The slag is readily soluble in water. It is important to remove the slag completely since it is corrosive.
The covering of OK 96.20 is quite sensitive to humidity. Damp electrodes cause porosity. Weld only with dry electrodes. The electrodes should be stored in dry areas and the packets should not be left open for long periods.

Typical weld metal composition %

Si	Mn	Fe	Al
0.2	1	0.5	Bal

Typical mechanical properties
All weld metal specimens

Tensile strength	100 N/mm²
Elongation 5xD	30 %
Reduction of area	25 %

Charpy V impact value

Test. temp	Impact value
+20°C	20J/cm².2.1 kpm/cm²

Welding data and current range
Arc voltage: 23–25 V
Type of current: DC positive polarity (open circuit voltage 70 V min.)
Welding positions: All

Diameter mm	Length mm	Current Amps
2.5	350	60– 90
3.25	350	80–115
4	350	110–150

OK 96.50

An easy to use general purpose electrode for welding cast or rolled weldable aluminium alloys.

Classification
DIN 1732: EL-AlSi12

Description and applications
OK 96.50 is intended for welding cast silumin alloys (12 % Si). Such alloys are used in the manufacture of petrol engines, decorative fittings, window frames and stairs. The alloys are easy to weld, and the strength of the weld metal is usually better than that of the cast material.

Materials
Welding of cast aluminium alloys, mainly of the half-silumin and silumintype, e.g. SS 4224, 4244, 4253, 4255, 4260 and 4261. With some precautions, the electrode can be used for welding other cast aluminium alloys and, in some cases, also rolled alloys.

Recommendations for welding
OK 96.50 is used on DC positive pole. The burn-off rate of the aluminum electrode is at least three times higher than that of steel electrodes.
Due to the relatively high thermal conductivity of aluminium and its alloys, it is recommended that the workpiece, or at least the start of the joint, be preheated to 250–300°C. Check suitable temperature by striking a stick of wood on the surface. The temperature for start of welding is correct when the stick leaves a brown trace on the surface. The slag is readily soluble in water. It is important to remove the slag completely since it is corrosive.
The covering of the OK 96.50 is quite sensitive to humidity. Damp electrodes can cause porosity. Weld only with dry electrodes. The electrodes should be stored in dry areas and the packets should no be left open for long periods.

Typical weld metal composition %

Si	Fe	Al
12	0.5	Bal

Typical mechanical properties
All weld metal specimens

Tensile strength	160 N/mm²
Elongation 5xD	13 %
Reduction of area	15 %

Welding data and current range
Arc voltage: 23–25 V
Type of current: DC positive polarity (open circuit voltage 70 V min.)
Welding positions: All

Diameter mm	Length mm	Current Amps
2.5	350	60– 90
3.25	350	80–115
4	350	110–150

OK 93.01

A high recovery Cobalt-based electrode for surfacing.

Classifications
AWS A 5.13: ECoCr-c
DIN 8555: E 20-55-CTZ

Description
OK 93.01 deposits a Co-Cr-W alloy with a high carbon content. The weld metal provides excellent resistance to combinations of heat, abrasion, corrosion and erosion. High hardness even at very high temperatures. The weld metal can only be shaped by grinding!

Typical applications

Iron & steel
Hot rolls, Hot rolling guides, Draving blocks

Food & Chem
Kneading rolls, Screw presses

Engineering
Hot shear blades, Glas cutters, Hot scrapers, Guides, Pump- and press casings, burner nozzles

Procedure
Preheat to around 200–400°C. OK 67.70 may be used for bufferlayer.

Weld metal composition %

C	Cr	W	Fe	Co
2.2	30	12.5	3.6	Bal

Mechanical properties

Hardness

	+20°C	+600°C	+800°C
as welded	55 HRC	44 HRC	34 HRC

Storage and drying
350 C 2h

Welding current: AC ≥65V, DC +

Diameter mm	Length mm	Current Amps	Arc volts Approx
3.25	350	90–130	28
4.0	350	120–170	28
5.0	350	150–200	28

Deposition Data

Size Diam. mm	Size Length mm	η Efficiency %, g weld metal x 100/g core wire	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs
3.25	350	160	0.65	21	1.3	132
4.0	350	160	0.65	14	1.9	136
5.0	350	160	0.65	9	2.0	198

Equivalent wires: None

OK 93.06

A high recovery Cobalt-based electrode for surfacing.

Classification
AWS A 5.13: E CoCr–A
DIN 8555: E 20–40–CTZ

Description
OK 93.06 deposits a Co-Cr-W alloy with high hot hardness together with good corrosion-, erosion-, impact- and thermal shock resistance. Excellent sliding properties and resistance to "fretting".

Typical applications

Iron & steel
Hot shear blades, Guide rolls.

Food & Chem
Kneading equipment, steam nozzles, mech sealings, bushings.

Engineering
Blanking dies, Press mandrels, Trimming dies, Exhaust valves, Tight fittings.

Weld metal compoisition %

C	Cr	W	Fe	Co
1.1	31	5	3	Bal

Mechanical properties

Hardness

	+20°C	+300°C	+650°C
as welded	42 HRC	35 HRC	29 HRC

Storage and drying
350 C 2h

Welding current: AC≥65V, DC+ or–

Diameter mm	Length mm	Current Amps	Arc volts Approx
2.5	350	60– 80	24
3.25	350	90–130	28
4.0	350	120–170	28
5.0	350	150–200	28

Deposition Data

Size Diam. mm	Size Length mm	η Efficiency %, g weld metal x 100/g core wire	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T burn off time per electrode secs	W Weight of weld metal/electrode g
2.5	350	140	0.63	54	0.9	72	19
3.25	350	140	0.63	26	1.3	102	38
4.0	350	140	0.63	16	1.7	126	63
5.0	350	140	0.63	11	2.0	150	91

Equivalent wires: OK Tubrodur 15.86

OK 93.07

A high recovery Cobalt-based electrode for surfacing.

Description
OK 93.07 deposits a Co-Cr-Ni-Mo alloy with low carbon content. Good resistance especially to thermal shock, fatigue and impact, but also to corrosion and erosion. Work-hardening even at elevated temperatures with good sliding properties.

Typical applications

Iron & steel
Watercooled hot shear blades, mandrels, Ingot gripper teeth.

Engineering
Blanking dies, Valves for hot steam and combustion engines, Slipping and sealing surfaces.

General
Crack-proof surface layers, Buffer layers under the OK 93.01, –6 or –12

Typical weld metal composition %

C	Cr	Ni	Mo	Fe	Co
0.3	28	3.0	5.5	2	Bal

Storage & drying
350 C 2h

Mechanical properties
Hardness

As welded

	+20°C	+300°C
HRC HB	30	 280

Work-hardened
+20°C
HRC 45

Welding current: AC≥65V, DC+ or–

Diameter mm	Length mm	Current Amps	Arc volts Approx
3.25	350	90–130	30
4.0	350	120–170	30
5.0	350	150–200	31

Deposition Data

Size Diam. mm	Size Length mm	η Efficiency %, g weld metal x 100/g core wire	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T Burn off time per electrode secs	W Weight of weld metal/electrode g
3.25	350	150	0.63	26	1.3	102	38
4.0	350	150	0.63	16	1.7	126	63
5.0	350	150	0.63	11	2.2	150	91

OK 93.12

A high recovery Cobalt based electrode for surfacing.

Classification
AWS A 5.13: E CoCr–B
DIN 8555: E 20–50–CTZ

Description
OK 93.12 deposits a Co–Cr–W alloy with fairly high carbon content. Good resistance to abrasion, erosion and corrosion, even at very high temperatures. Impact resistance is better than for OK 93.01. Good sliding properties.

Typical applications
Same as OK 93.01, for better crack resistance.

Engineering
Pistons, Sliding guides, Glas cutters, Cotton and Pulp cutters, Amatures for oil, Mixers, feeder screws, Extruders for plastics.
Preheat to 200–400 C. OK 67.70 may be used for bufferlayer.

Typical weld metal composition %

C	Cr	W	Fe	Co
1.4	28	8.5	3.0	bal

Storage & drying
350 C 2h

Mechanical properties.

	+20°C	+300°C	+600°C
HRC	46	37	32

Welding current: AC≥65V, DC+ or–

Diameter mm	Length mm	Current Amps	Arc volts Approx
3.25	350	90–130	30
4.0	350	120–170	30
5.0	350	150–200	31

Deposition Data

Size Diam. mm	Size Length mm	η Efficiency %, g weld metal x 100/g core wire	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T Burn off time per electrode secs	W Weight of weld metal/electrode g
3.25	350	150	0.63	24	1.2	102	42
4.0	350	150	0.67	15	1.6	138	67
5.0	350	150	0.67	10	2.1	168	100

OK Cobal 25

A high recovery Cobalt based electrode for joining of Cobalt alloys and for surfacing.

Description
OK Cobal 25 deposits a Co-Cr-Ni-W alloy with very low carbon content. Excellent high temperature prioperties regarding oxidation and corrosion. Resistant to chloric acid and its salts, and to erosion by gases. The good ductility also enables crackmending and joining of cobalt alloys.

Typical applications

General
Welding of jet and missile parts, Gas and steam turbines, combustion chamb... Furnace parts (muffles and liners)... Chlorine refining plants.

Engineering
Reclamation of forging dies, ... working to... Slipping guides, etc.

Welding current: AC ...V, DC+

Diameter mm	Leng... mm	...rent ...mp	Arc volts Approx
2.5		100	22
3....	4...	90–140	24
4.0	45	130–190	24
5.0		170–240	26

Typical weld metal composition %

C	Cr	Ni	...	Co
0.05	20	10	...	bal

Storage ... fin...
350 C 2h

M...nical p...es
Ha...s
200 ...

Typical as welded

R_p 0.2 N/mm²	R_m N/mm²	A_5 %
500	750	15

Deposition Data

Size Diam. mm	Size Length mm	η Efficiency %, g weld metal x 100/g core wire	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T Burn off time per electrode secs	W Weight of weld metal/electrode g
2.5	350	180	0.63	45	1.0	85	22
3.25	450	180	0.63	21	1.6	114	48
4.0	450	180	0.63	13	2.3	120	77
5.0	450	180	0.63	8	2.9	190	125

OK Cobal 50

A high recovery Cobalt based electrode for joining of Cobalt alloys and for surfacing.

Description
OK Cobal 50 deposits a Co-Cr alloy with low carbon content. Very resistant to oxidation and corrosion at high temperatures. Also good resistance to thermal shock and impact.

Typical applications

Iron and steel
Furnace grates, Trays and rolls. Skids and rails in heat treating furnaces. Slag-notch rings and tundishes.

Engineering
Drop forging dies and mandrels, F... ce plates (Doors, tightning surfaces).
Joining of UMCo 50 (Haynes alloy 15... alloy 75, Illium H, MO-RE 5) and UMCo 5...

Welding current: AC ≥65V, ...or –

Diameter mm	Length mm	...urrent A...s	...ts ...prox
2.5	350	0–1...	22
3.25		...0	24
4.0		190	24
5	4...	170–240	26

Typical weld metal composition %

C	Cr	...	Co
0.04	27	19	Bal

Mechani... ...ro...es
Hard...s

	+...	+300°C	+600°C
H...	ca 180	ca 195	ca 120

Deposition Data

Size Diam. mm	Size Length mm	η Efficiency %, g weld metal x 100/g core wire	N kg weld metal per kg electrodes	B number of electrodes per kg weld metal	H kg weld metal per hour arc time	T Burn off time per electrode secs	W Weight of weld metal/electrode g
2.5	350	180	0.63	46	1.0	72	22
3.25	450	180	0.63	22	1.6	108	45
4.0	450	180	0.63	14	2.2	114	71
5.0	450	180	0.63	9	2.8	186	111

Equivalent wires: None

Gas Welding Rods

OK Gasrod 98.70

OK Gasrod 98.70 are bare rods designed for gaswelding of unalloyed steels.

Classification
AWS A5.2: R 60
DIN 8554: G II

Applications
OK Gasrod 98.70 is designed for gaswelding of unalloyed steels with a minimum tensile strength of maximum 430 N/mm².

Typical wire composition %

C	Si	Mn
0.1	0.15	0.9

Typical mechanical properties

Yield stress (0.2 %)	320 N/mm²
Tensile strength	480 N/mm²
Elongation	30 %

Packing data

Diameter mm	Length mm	Weight kg
1.2	1000	5
1.6	1000	5
2.0	1000	5
2.5	1000	5
3.0	1000	5
4.0	1000	5
5.0	1000	5

OK Gasrod 98.76

OK Gasrod 98.76 are bare rods designed for gaswelding of unalloyed and low alloyed steels.

Classification
AWS A5.2: R 60
DIN 8554; G IV

Applications
OK Gasrod 98.76 is designed for gaswelding of unalloyed and low alloyed high temperature resistant steels in e.g. pipes, boilers and pressure vessels.

Typical wire composition %

C	Si	Mn	Mo
0.1	0.15	1.1	0.5

Typical mechanical properties

Yield stress (0.2 %)	430 N/mm²
Tensile strength	590 N/mm²
Elongation	25 %

ISO V impact value

Temp.	Impact value
+20°C	90J

Approvals
TÜV

Packing data

Diameter mm	Length mm	Weight kg
3.0	1000	5
4.0	1000	5

Storage and Handling

Storage and Handling of Electrodes

Manufacturing
MMA electrodes are manufactured by extruding alloying agents, slag formers, extrusion agents and silicates on a core wire.
The electrodes are dried at different temperatures depending on kind of electrode. Analysis of weld metal, moisture content, mechanical properties and welding performances are checked.

Standard packages
Standard packing for unalloyed electrodes is a paper box put in shrink plastics.
Plastic boxes are mostly used for alloyed electrodes.
Tin cans are used for cellulosic electrodes.
Tin capsules are used for basic electrodes in the tropics. Vacuum packages are used for extremely low hydrogen values for stick electrodes.

Different types of electrodes
When manufacturing electrodes a binder that consists mainly of water is used. Minerals used also contains water.
An electrode directly after extrusion before drying contains approximately 10 % water.
Acid, rutile and cellulosic electrodes are dried to a water content of 0.3–5 % dependent on kind of electrode.
Basic electrodes are dried much harder and the final moisture content can be as low as 0.05 %. Because of the risk of cold cracking it would have been good to entirely remove the water but this is not possible because the high temperatures that would be necessary would ruin the binding properties of the binder, oxidize the alloying elements and destroy the welding properties.
Dried electrodes are hydroscopic and have to be protected against damp surroundings. Acid, rutile and cellulosic electrodes are not as sensitive as basic but they will all pick up moisture if left unprotected.

Relative humidity

Relative humidity % RH is a measure of actual amount of water in air compared to maximal amount of water that can occur in air at a certain temperature. At 100 % RH water will condensate at a drop in temperature. The same mechanism that gives fog.
Relative humidity is strongly dependent on temperature and if the temperature drops the % RH will increase and vice versa.
This is the reason for using heating quivers and cabinets. At elevated temperature and constant amount of water in the air the relative humidity decreases and the moisture absorption of the electrodes decreases.

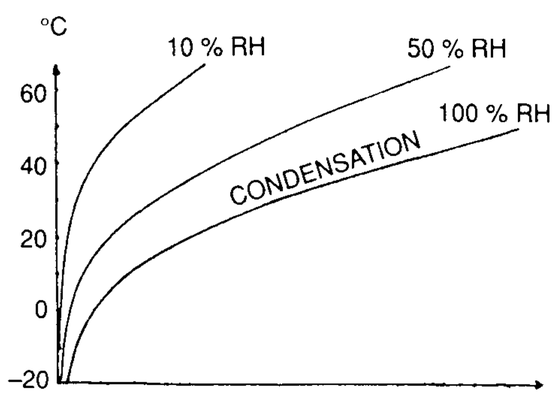


Fig 1.

Porosity
When acid, rutile or cellulosic electrodes give pores the coating moisture can be either too low or too high. When having too much moisture acid and rutiles shall be redried according to conditions given at the package. Cellulosic electrodes shall never be redried.
If the % RH is very low the acid rutile and cellulosic electrodes can be too dry and give pores. Remoistureing can in these cases help.
Before the introduction of LMA in the basic electrodes porosity was a much greater problem. If a basic electrode gives pores the most probable reason is moisture in the coating and redrying according to instructions at the package shall be performed.

Protection of Basic electrodes
The plastic wrappings protect the electrodes from the surroundings but when it is broken the electrodes ought to be put into a heated cabinet at 40–50°C.
In climate of 25°C, 70 % RH electrodes with LMA properties can stand for up to 8h after the package has been broken without the moisture content in the coating reaches dangerous levels.

Basic electrodes ought to be stored in storehouse in climate of minimum 15°C and max RH 60 %. Acid, rutile and cellulosic electrodes also ought to be stored inside but the demands of the climate are not as tough as for basic electrodes.

The demands for low hydrogen are high due to cold cracking risks. Recommended procedure for redrying is printed at the electrode packages.
The electrodes shall be redried at a maximum temperature between 350–450°C for 1–2h. Then they are stored in a heating cabinet. The welder uses a storage bucket that has a temperature around 100°C. In this the electrodes can be stored for 8h. If this time limit is exceeded the electrodes shall be redried in oven. It is not recommended to redry the same electrodes more than 3 times because the alloying elements will oxidize and analysis and welding properties will be influenced.
Electrodes in small packages of aluminum-laminate are dry if the package is unbroken when it is opened.

LMA
LMA stands for low moisture absorbtion and is developed for basic low alloyed and alloyed electrodes in order to have low initial moisture content in the coating and to slow up the absorbtion rate of the coating. (Fig 2).

Moisture absorbtion

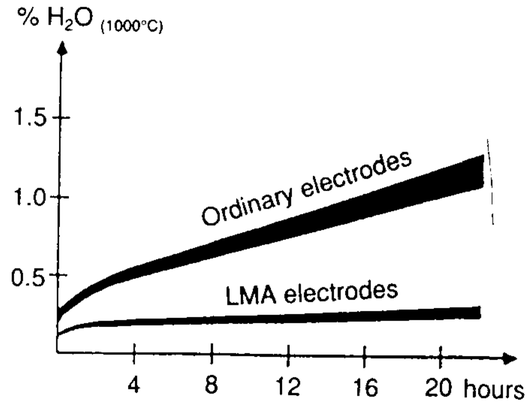


Fig 2.

Cold storing
If electrodes are stored in a place where it is colder than at the place where the welding takes place water will condensate at the electrodes if it has a lower temperature than the surroundings (the same phenomena as dew.) This problem especially occurs during winter and especially if the electrodes are stored outside. Electrodes ought to be taken from the cold store into the welding shop and allowed to get the same temperature as the surroundings, before opening the package.

Standards

Det norske veritas prescribes for storing and treatment of consumables for welding of off-shore constructions.
Basic low alloyed electrodes corresponding to AWS 5.5 must be redried 1h between 370–430°C if they are not taken directly from an airtight package. All electrodes redried or taken directly from a fresh package must be stored at 120°C if not used immediately. Damp electrodes are not allowed to be used.

Another standards: AWS A5.1–78

AWS gives the following directions according to AWS A5.1-78

Desirable storage and redrying procedure for covered electrodes

AWS-norms	Drying procedure		
	Standard	Drying cabinet	Drying*
E6010, E6011	Surrounding	Not recommended	Not recommended
E6012, E6013 E6020, E6022 E6027, E7014, E7024	80±20°F (30±10°C) 50 % max. rel humanity	20°F (11°C) to 40°F (22°C) Above surrounding temperature	275±25°F (135±15°C) Under 1 h
E7015, E7016, E7018, E7028, E7048	80±20°F (30±10°C) 50 % max. rel humanity	50°F (28°C) to 250°F (139°C) Above surrounding temperature	475±25°F (245±15°C) Under 2 hs

* Manufacturer to be consulted

Alloyed electrodes
Alloyed electrodes, both basic and rutile, shall be taken care of in the same way as basic unalloyed electrodes.

Acid, rutile and cellulosic unalloyed electrodes
Acid, rutile and cellulosic electrodes from newly opened packages have correct moisture content if the electrodes have been stored correctly.
If the package is broken acid and rutile electrodes have correct moisture content for rather long time.
For cellulosic electrodes there is a great risk of drying up in an opened package.

Cold cracking
Cold cracking will occur only if the following three factors are present:
1. Hard phases in the weld preferably martensite
2. Tensions
3. Hydrogen solved in the weld metal

Hard phases form when the weld is cooled rapidly from melting temperature to room temperature. Alloying elements mostly carbon are forced to solve in the weld metal and makes it brittle. The following formula describes this for ordinary carbon-manganese steel.

$$C_E = \%C + \frac{\%Mn}{6} + \frac{\%(Cr+Mo+V)}{5} + \frac{\%(Ni+Cu)}{15}$$

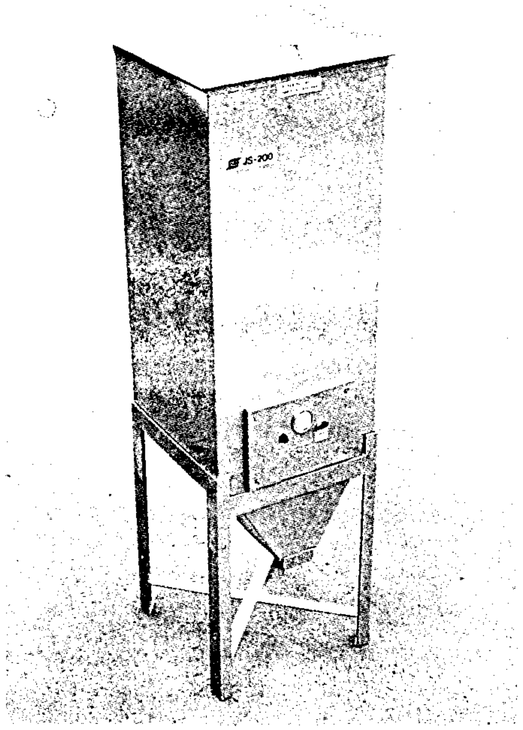
Steels with C_E=0.35 and below are usually weldable without any problems at normal sizes of the steel. For the more alloyed steels and steels of thicker dimensions elevated working temperature has to be used in order to decrease the cooling rate.
The elevated temperature also allows diffusion of the hydrogen.
For determination of elevated working temperatures look at BS 5135:1974 or SS 064020. If C_E dimension of the plates and heat input are known, these standards will tell if heating is necessary and at which level it should be.
Tensions cannot be avoided when welding due to the fact that steel expands when heated although correct planning and heat treatment can reduce the tensions considerably.

Hydrogen forms from water, from the surroundings and from the electrode coating. The water is divided into oxygen and hydrogen in the arc and escpecially the latter has a strong tendency to solve in the weld metal and initiate cold cracking.
Conclusion. Dry basic electrodes when there is risk for cold cracking.

Damaged coatings
Mechanically damaged electrodes with bits of the coating lacking will not perform correctly and shall be scrapped.

Discolouring of the coating
If the colour of the electrodes changes while storing they should be scrapped or contact shall be taken with the electrode manufacturer.

Storage and Handling Recommendations for Flux



Storage and Handling Recommendations

The ESAB Fluxes for SAW are generally manufactured from calcined minerals which have been heat treated at high temperatures (≈1500°C) which gives excellent storage properties. OK Fluxes have, when delivered a moisture content with a nominal level of max. 0.05 % determined at 1000°C.

It is of great importance for the quality of the weld metal that the moisture content is kept as low as possible. For this reason the OK Fluxes are delivered in a moisture resistant paper bag and an interior plastic bag. However it is possible that the OK Fluxes may pick up moisture during unsuitable handling, storage or transport. This is generally indicated by a porous slag and/or pores on the weld. ESAB has set guidelines for handling to avoid these incidents:

1. Unopened flux bags must be kept under properly maintained storage conditions as follows:
   – Temperature 20±10°C.
   – Relative humidity as low as possible exceeding 70 %.
2. Unopened flux bags should not be exposed to direct moisture like rain or snow.
3. Remaining flux from opened bags or flux hopper must be placed at a temperature of 150±25°C.

For perfect storage of OK Flux – use ESAB's heated flux hopper JS-200

OK Flux should be kept dry to obtain a perfect welding result. To obtain this, and to reduce waste, OK Flux is preferably stored in a JS-200 flux hopper, where the temperature can be regulated between 0–300 C.
Storage temperature: 150 C.
Redrying temperature: 300°C for 2–4 hours.

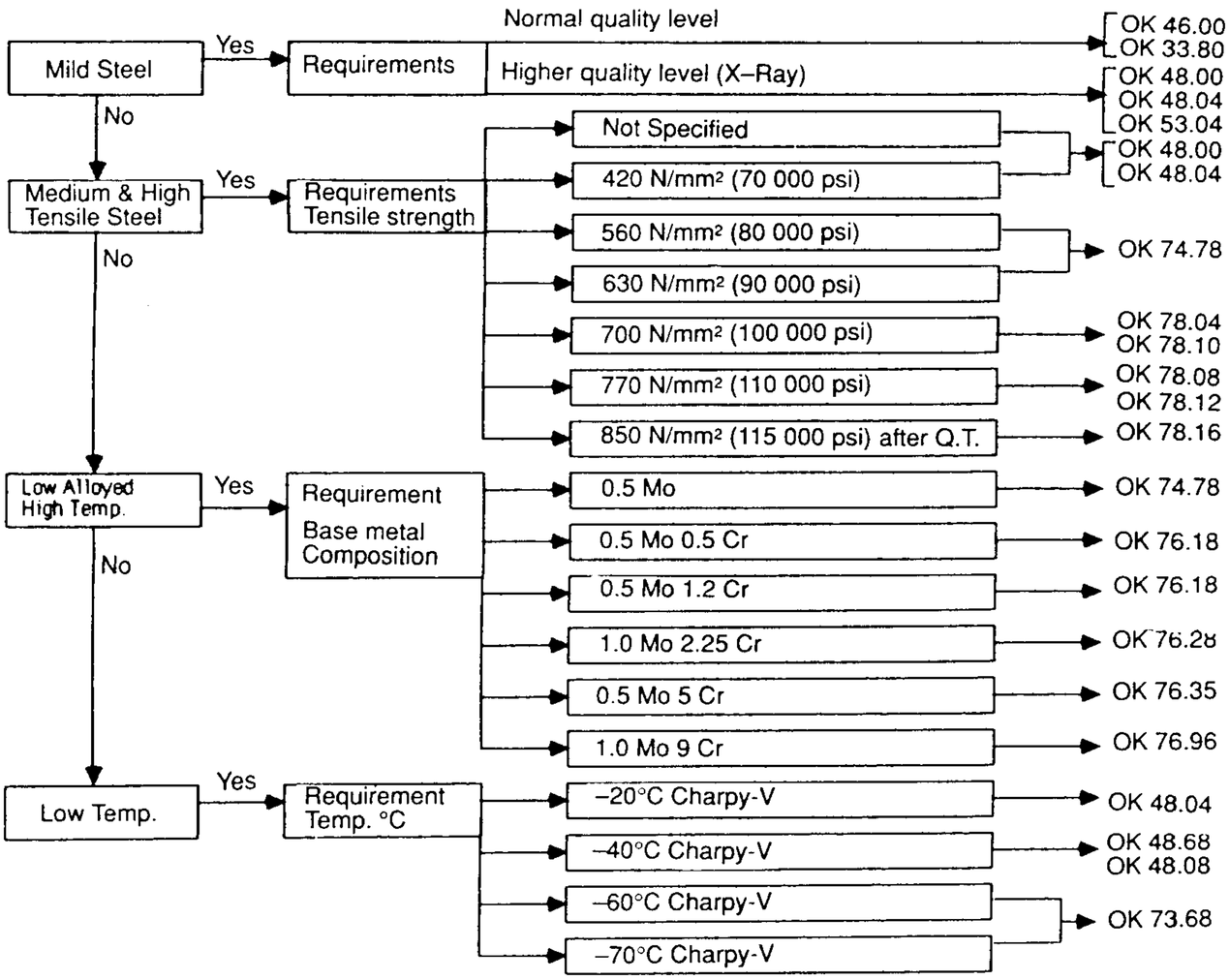
Storage volume: 200 l	Flux hopper size:
Heating effect: 2 kW	500x500x1700 mm
Mains supply: 220 V	Weight 115 kg (empty)

If the fluxes have for some reason become wet it is possible to return the fluxes to their original state by re-baking in a drying unit as follows: 300±25°C for about 2 hours. Rebaking must be done on shallow plates with a flux height not exceeding 50 mm. Rebaked flux, not immediately used must be kept at 150±25°C.

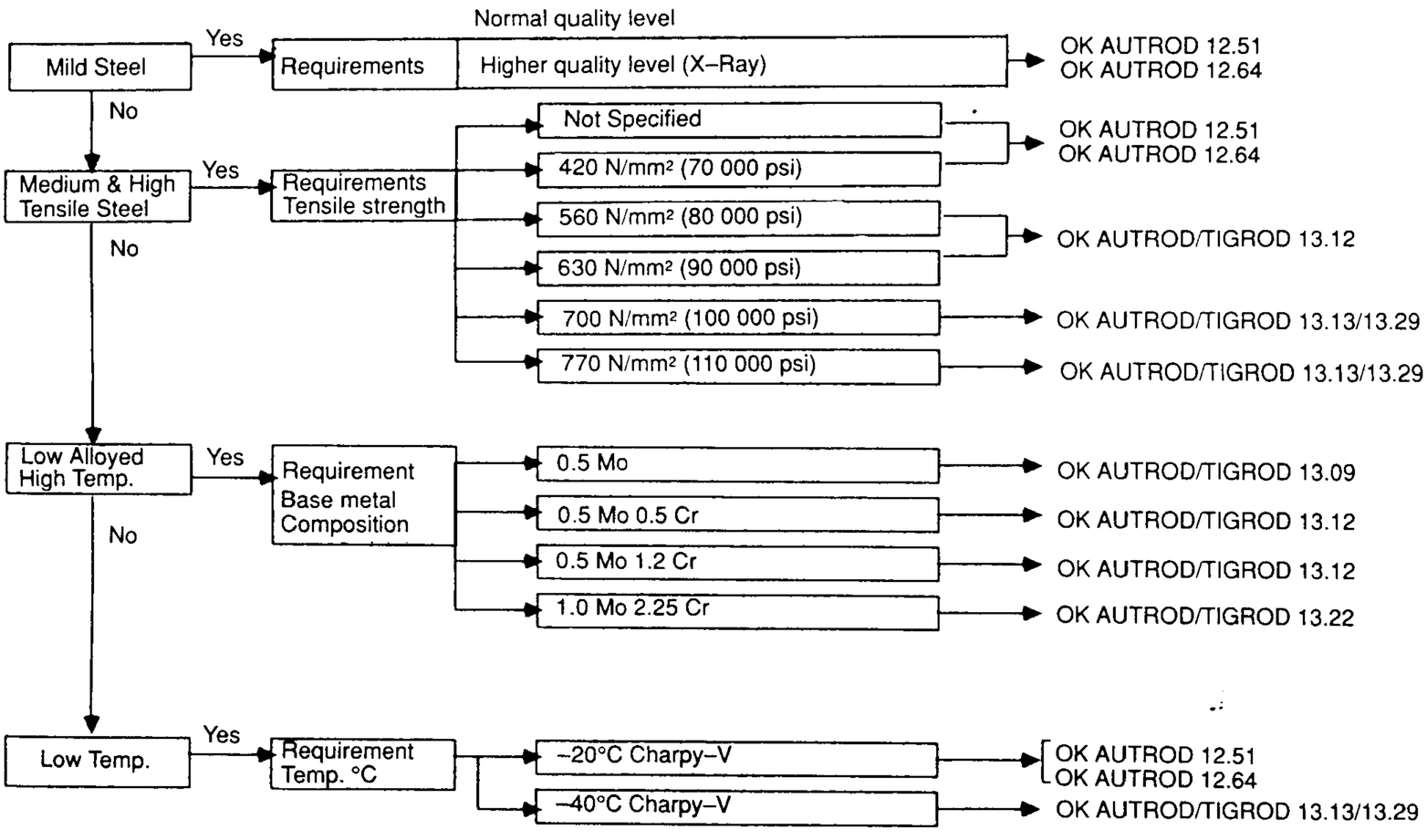
Quick guide for selection of Filler Materials

1. MMA electrodes for mild and low alloyed steels
2. Solid wires
3. Cored wires
4. Fluxes and Submerged Arc Wires
5. MMA electrodes for stainless steels
6. Wires for stainless steels
7. Fluxes and Submerged Arc Wires for stainless steels
8. Comparison table for stainless steels
9. MIG and TIG wires for aluminium

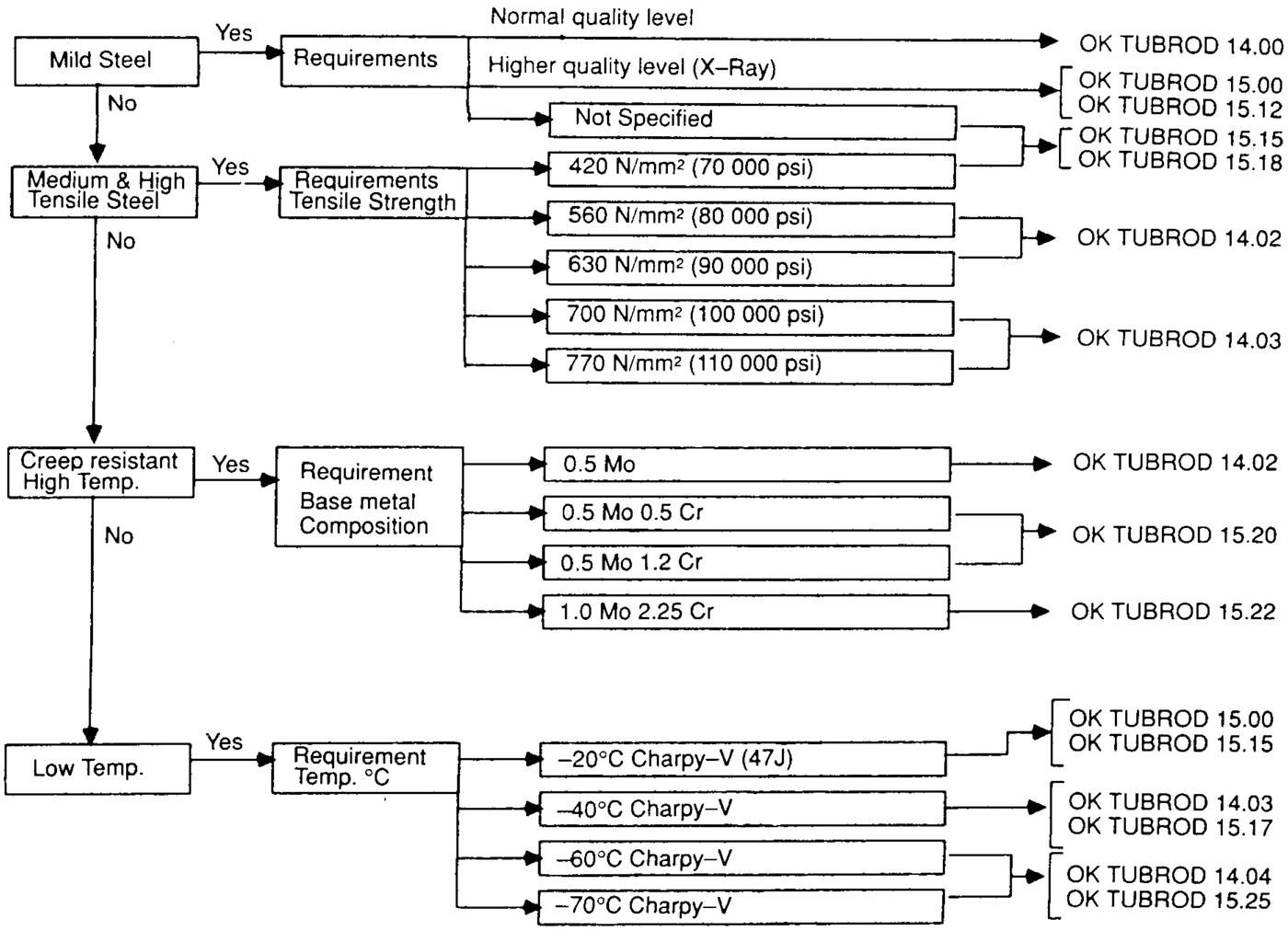
1. MMA Electrodes for mild and low alloyed steels



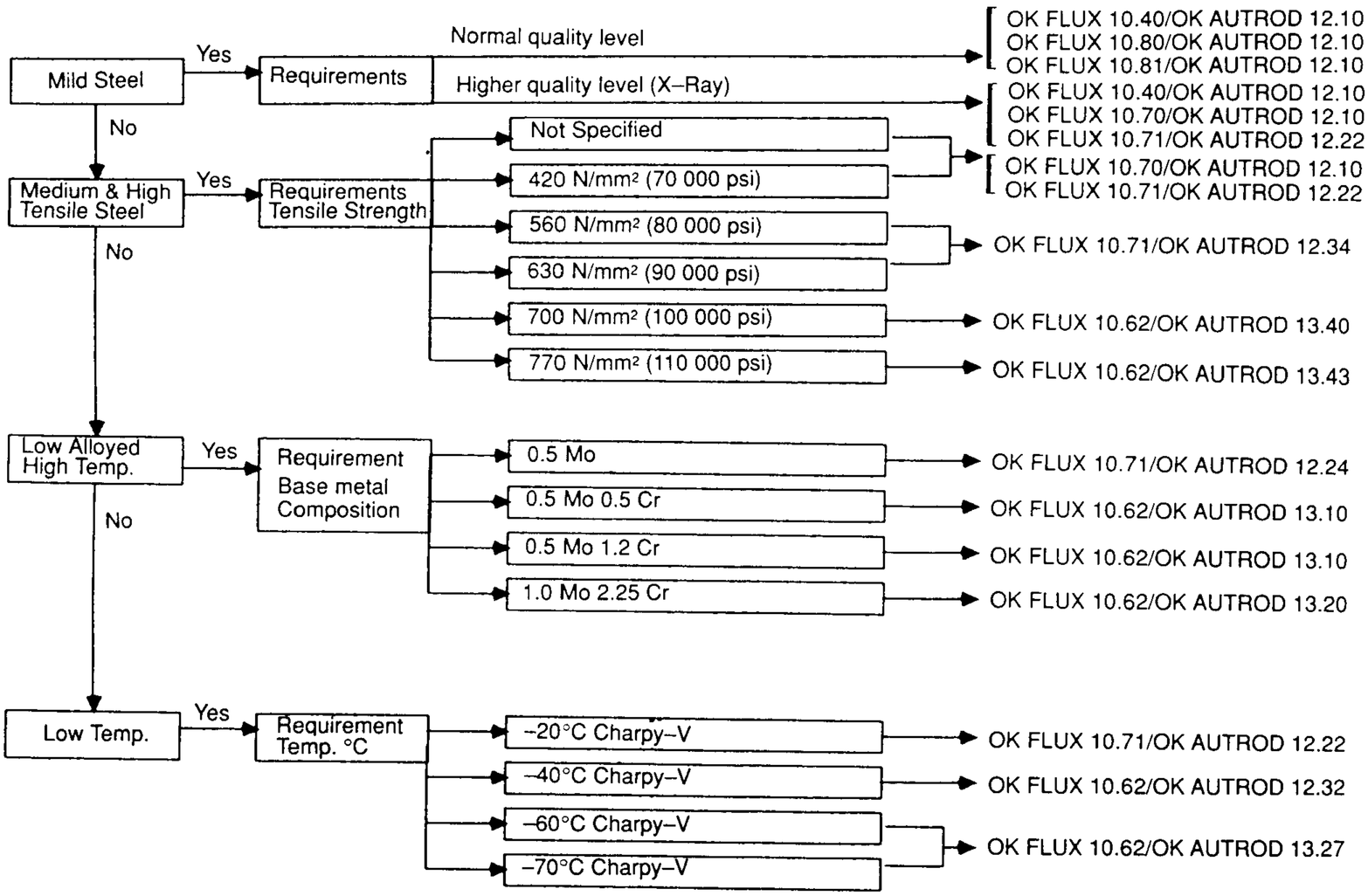
2. Solid wires



3. Cored wires



4. Fluxes and Submerged Arc Wires



5. MMA electrodes for stainless steels

FN Approx.	AWS Type	Basic DC	Acid-Rutile "Spray Arc" AC/DC	Acid-Rutile "Pipeweld" AC/DC	Basic-Rutile AC/DC	High Deposition Stainl Core AC/DC	High Deposition Steel Core AC/DC	Vertical Down AC/DC	'Drop Welding' AC/DC
0	(E 307)	OK 67.45							
6	E 308 L	OK 61.35	OK 61.30	OK 61.10			OK 67.42		
15	E 308 MO					OK 61.41		OK 61.34	
15	E 309 L	OK 67.75	OK 67.60				OK 63.32		
15	E 309 MO		OK 67.70				OK 67.62=E309		
0	E310	OK 67.15				OK 67.71	OK 67.72		
6	E 316 L	OK 63.35	OK 63.30	OK 63.10					
8	E 317 L		OK 64.30			OK 63.41		OK 63.34	OK 63.20
9	E 318	OK 63.85	OK 63.80						
9	E 347	OK 61.85	OK 61.80	OK 61.81					
32	E 312 (E 312)		OK 68.81 OK 68.82						
Ferritic	E 410	OK 68.15	OK 68.12						
Martensit	13.4 MO	OK 68.17							
32	22.9.3 "DUPLEX"		OK 67.50						
60	25.5.2 "DUPLEX"		OK 68.60						
0	20.25.5 LCU				OK 69.33				
0	20.25.6 L				OK 69.63				
0	18.12.5 L				OK 64.63				
0	17.12.4W CRYO	OK 69.46							
0	18.15.3 L "UREA"		OK 69.21						

NICKELBASED ELECTRODES

ENICRFE–2	OK 92.15
ENICRFE–3	OK 92.26
ENICRMO–3	OK 92.45
ENICRMO–6	OK 92.55

6. Wires for stainless steels

Selection by wire classification

AWS A5.9	DIN 8556	Werkst.no.	BS2901 Pt2	NF 35-583	ESAB-designation
ER 308L	X2CrNi 19 9	1.4316	308S92	Z 2 CN 20.10	OK Tigrod 16.10
ER 347Si	X5CrNiNb 19 9	1.4551	(347S96)	(Z 6 CNNb 20.10)	OK Autrod 16.11 OK Tigrod 16.11
ER 308LSi	X2CrNi 19 9	1.4316	308S93	Z 2 CNS 20.10	OK Autrod 16.12
ER 316L	X2CrNiMo 19 12	1.4430	316S92	Z 2 CND 19.13	OK Tigrod 16.30
ER 318Si	X5CrNiMoNb 19 12	1.4576	(318S96)	(Z 6 CNDNb 19.13)	OK Autrod 16.31 OK Tigrod 16.31
ER 316LSI	X2CrNiMo 19 12	1.4430	316S93	Z 2 CNDS 19.13	OK Autrod 16.32
ER 309Si	–	–	(309S94)	Z 10 CNS 24.13	OK Autrod 16.52
ER 309L	X2CrNi 24 12	1.4332	309S92	Z 2 CN 24.13	OK Autrod 16.53 OK Tigrod 16.53
ER 310	X12CrNi 25 20	1.4842	310S94	Z 12 CN 25.20	OK Autrod 16.70 OK Tigrod 16.70
ER 312	–	–	312S94	–	OK Autrod 16.75
(ER 307)	X15CrNiMn 18 8	1.4370	–	Z 15 CNM 19.8	OK Autrod 16.95 OK Tigrod 16.95

Selection by workpiece material.

Type of alloy		Steel designations SS	AISI	Werk-stoff nr	DIN	BS	AFNOR	Recommended filler material OK Autrod	OK Tigrod
13Cr	FM	2301	(405)	1.4000	X7Cr13	403S17	Z6C13	16.12	16.10
	FM	2302	410	1.4006	X10Cr13	410S21	Z12C13	16.12	16.10
	M	2303	(420)	1.4021	X20Cr13	420S37	Z20C13	*)	*)
	M	2304	(420)	(1.4034)	–	420S45	Z30C13	*)	*)
	M	2380	416	(1.4005)	X12CrS13	416S21	Z12CF13	*)	*)
17Cr	F	2320	(430)	1.4016	X8Cr17	430S15	Z8C17	16.12	16.10
	F	2325	–	(1.4113)	(X6CrMo17)	–	Z8CD17.01	16.12	16.10
	F	2326	–	–	–	–	–	16.12	16.10
	M	2321	431	1.4057	X22CrNi17	431S29	Z15CN16.02	*)	*)
	FM	2383	(430F)	1.4104	X12CrMoS17	441S29	Z10CF17	*)	*)
26Cr	F	2322	(446)	–	–	–	(Z10C24)	(16.12) 16.70	(16.10) 16.70
	FA	2324	(329)	1.4460	X8CrNiMo27 5	–	–	16.32, 16.70	16.30
18Cr8Ni	A	2331	(302)	–	–	302S25	Z10CN18.09	16.12	16.10
	A	2332	(304)	1.4301	X5CrNi18 9	301S21	Z6CN18.09	16.12	16.10
	A	2333	(304)	(1.4301)	(X5CrNi18 9)	(304S15)	Z6CN18.09	16.12	16.10
+Ti	A	2337	321	1.4541	X10CrNiTi18 9	321S12	Z6CNT18.10	16.11 (16.12)	(16.10) 16.11
+Nb	A	2338	347	1.4550	X10CrNiNb18 9	347S17	Z6CNN618.10	16.11(16.12)	(16.10) 16.11
	A	2346	303	1.4305	X12CrNiS18 8	303S21	Z10CNF18.09	(16.75)	
	A	2352	304L	1.4306	X2CrNi18 8	304S12	Z2CN18.10	16.12	16.10
	A	2370	(304N)	–	–	(304S65)	–	16.12	16.10
	A	2371	–	1.4311	X2CrNiN18 10	304S62	Z2CN18.10	16.12	16.10
	A	–	301	1.4310	–	–	–	16.12	16.10

A=Austenitic F=Ferritic M=Martensitic *) Not intended for welding

Type of alloy		Steel designations SS	AISI	Werk-stoff nr	DIN	BS	AFNOR	Recommended filler material OK Autrod	OK Tigrod
18Cr8Ni+Mo	A	2340	–	(1.4420)	(X5CrNiMo18 11)	(345S16)	–	16.32	16.30
	A	2343	(316)	(1.4436)	(X5CrNiMo18 12)	(316S16)	Z6CND17.12	16.32 (16.70)	16.30 (16.70)
	A	2347	(316)	(1.4401)	X5CrNiMo18 10	(316S16)	(Z6CND17.11)	16.32 (16.70)	16.30 (16.70)
LC	A	2348	316L	1.4404	X2CrNiMo18 10	(316S12)	Z2CND17.12	16.32 (16.70)	16.30 (16.70)
LC	A	2353	(316L)	1.4435	X2CrNiMo18 12	(316S12)	Z2CND17.13	16.32 (16.70)	16.30 (16.70)
+Ti	A	2350	316Ti	1.4571	X10CrNiMoTi18 10	(320S17)	Z6CNDT17.12	16.31 (16.70)	16.31 (16.70)
+N	A	2374	316N	–	–	(316S66)	–	16.32 (16.70)	16.30 (16.70)
+N, LC	A	2375	–	1.4429	X2CrNiMoN18 13	316S62	Z2CND17.13	16.32 (16.70)	16.30 (16.70)
25Cr20Ni	A	2361	310S	1.4845	X12CrNi25 21	310S24	Z12CN25.20	16.70	16.70
23Cr12Ni	A	–	309	1.4828	–	–	–	16.52	16.70
18Cr5Ni7Mn	A	–	202	–	–	–	–	(16.12) 16.95	(16.10) 16.95

A=Austenitic F=Ferritic M=Martensitic *) Not intended for welding

7. Fluxes and Submerged Arc Wires for stainless steels

SS steel No.	Type of steel	Submerged arc OK Flux + OK Autrod	Other standards nearest equivalent to the SIS standards in this table			
			AFNOR	AISI	BS 1449	DIN
2301	13 % ferritic-martensitic	10.91 or 10.92+16.30[1]	Z 6C 13	(405)	(403 S 17)	1.4000
2302	13 % ferritic-martensitic	10.91 or 10.92+16.30[1]	Z 12 C 13	410	410 S 21	1.4006
2303	13 % Cr martensitic		Z 20 C 13	(420)	420 S 37	1.4021
2320	17 % Cr ferritic	10.91 or 10.92+16.30[1]	Z 8 C 17	(430)	430 S 15	1.4016
2332	19 Cr-10 Ni austenitic	10.91 or 10.92+16.10	Z 6 CN 18–09	(304)	301 S 21	1.4301
2333	19 Cr-10 Ni austenitic	10.91 or 10.92+16.10	(Z 6 CN 18–09)	(304)	(304 S 15)	(1.4301)
2337	18 Cr-11 Ni austenitic Ti stabilized	10.91 or 10.92+16.11	Z 6 CNT 18–10	321	321 S 12	1.4541
2338	18 Cr-11 Ni austenitic Nb stabilized	10.91 or 10.92+16.11	Z 6 CNNb 18–10	347	347 S 17	1.4550
2343	18 Cr-12 Ni 2.8 Mo austenitic	10.91 or 10.92+16.30	(Z 6 CND 17–12)	(316)	(316 S 16)	(1.4436)
2347	18 Cr-12 Ni 2.3 Mo	10.91 or 10.92+16.30	Z 6 CND 17–11	(316)	(316 S 16)	(1.4401)
2352	19 Cr-11 Ni ELC	10.91 or 10.92+16.10	Z 2 CN 18–10	304 L	304 S 12	1.4306
2353	18 Cr-13 Ni 2.8 Mo ELC	10.91 or 10.92+16.30	Z 2 CND 17–13	(316 L)	316 S 12	1.4435
2361	25 Cr-20 Ni		Z 12 CN 25–20	310 S	310 S 24	1.4845
2366	19 Cr-13 Ni 3.5 Mo	10.91 or 10.92+16.34		(317)	(317 S 16)	
2367	19 Cr-13 Ni 3.5 Mo L	10.91 or 10.92+16.34	Z 2 CND 19 15	317 L	317 S 12	1.4438
2371	19 Cr-10 Ni 0.2 N	10.91 or 10.92+16.10	Z 2 CN 18 10		304 S 62	1.4311
2375	18 Cr-12 Ni 2.8 Mo 0.2 N	10.91 or 10.92+16.30	Z2 CND 17 13		316 S 62	1.4429

*) Not normally kept in stock
1) Not corresponding type of alloy

8. Comparison table for stainless steels

SS steel No	ISO 683/ XIII (ISO 4955)	German DIN 17440 etc. Designation	Werk-stoff Nr.	England BS 970;1 =Part 1 BS 1449;2 =Part 2	Old desig-nation	France AFNOR NF A35-572 to NF A35-578	USA AISI	Japan JIS G 4303-4318 SUS	Sovjet Union GOST 5632-1972	Italy UNI 6900-71	Norway NS
2301	1	X 7 Cr 13	1.4000	403 S 17	–	Z 6 C13	403	403	08Ch 13 3–2	X 6 Cr 13	–
2302	3	X 10 Cr 13	1.4006	410 S 21	En 56A	Z 12 C 13	410	410	12Ch 13 2–4	X 10 Cr 13	14 001
2303	4	X 20 Cr 13	1.4021	420 S 37	En 56C	Z 20 C 13	420	420 J1	20Ch 13 1–12	X 20 Cr 13	14 210
2304	5	X 30 Gr 13	1.4028	420 S 45	En 56D	Z30 C 13	–	420 J2	30Ch 13 1–13	X 38 Cr 13	–
2320	8	X 6 Cr 17	1.4016	430 S 17	En 60	Z 8 C 17	430	430	12Ch 17 3–3	X 8 Cr 17	–
2321	9b	X 20 Cr Ni 17 2	1.4057	431 S 29	–	Z 15 CN 16.02	431	431	20Ch 17 N2 2–5	X 16 Cr Nr 16	14 230
2322	H7	–	1.4749[1]	–	–	Z 10 C 24	446	–	–	X 16 Cr 26	–
2324	–	X 8 Cr Ni Mo 27 5 2[1]	1.4460[1]	–	–	–	329	329 J1	–	–	14 310
2331	12	–	–	302 S 31	En 58A	Z 10 CN 18.09	302	302	10Ch 18 N 10 6–25	–	–
2332	–	X 5 Cr Ni 18 10	1.4301	304 S 31	(En 58E)	Z 6 CN 18.09	304	304	08Ch 18 N 10 6–29	X 5 Cr Ni 18 10	–
2333	(11)	(X 5 Cr Ni 18 10)	(1.4301)	(304 S 15)	(En 58E)	(Z 6 CN 18.09)	(304)	(304)	(08Ch 18 N 10 6–29)	(X 5 Cr Ni 18 10)	14 350
2337	15	X 6 Cr Ni Ti 18 10	1.4541	321 S 31	En 58B	Z 6 CNT 18.10	321	321	09Ch 18 N 10 T 6–30	X 6 Cr Ni Ti-18 11	14 355
2338	16	X 10 Cr Ni Nb 18 10	1.4550	347 S 31	En 58F	Z 6 CNNb 18.10	347	347	08Ch 18 N 12 B 6–38	X 8 Cr Ni Nb 1811	–
2343	(20a)	(X 5 Cr Ni Mo 17 13 3)	(1.4436)	(316 S 33)	(En 58J)	(Z 6CND 17.12)	(316)	(316)	(SW-04 Ch 19 N 11 M 3)	(X 5 Cr Ni Mo 17 13)	14 450
2346	17	X 10 Cr Ni S 18 9	1.4305	303 S 31	En 58M	Z 10 CNF 18.09	303	303	–	X 10 Cr Ni 18 09	14 330
2347	(20)	(X 5 Cr Ni Mo 17 12 2	(1.4401)	(316 S 31)	(En 58J)	(Z 6 CND 17.11)	(316)	(316)	(SW-04 Ch 19N 11 M3)	X 5 Cr Ni Mo 17 12	–
2348	19	X 2 Cr Ni Mo 17 13 2	1.4404	316 S 11	–	Z 2 CND 17.12	316 L	316 L	–	X 2 Cr Ni Mo 17 2	14 455
2350	21	X 6 Cr Ni Mo Ti 17 12 2	1.4571	320 S 31	(En 58J)	Z 6 CNDT 17.12	316 Ti	–	10Ch 17 N 13 M 2 T 6–21	X 6 Cr Ni Mo Ti 17 12	–
2352	10	X 2 Cr Ni 18 10	1.4306	304 S 11	–	Z 2 CN 18.10	304 L	304 L	–	X 2 Cr Ni 18 11	14 360
2353	19a	X 2 Cr Ni Mo 18 14 3	1.4435	316 S 3	–	Z 2 CND 17.13	316 L	316 L	–	X 2 Cr Ni Mo 17 13	14 460
2361	H15	X 12 Cr Ni 25 21[1]	1.4845[1]	(310 S 24)	–	(Z 12 CN 25-20)	310 S	310 S	–	X 6 Cr Ni 2520	14 480
2367	24	X 2 Cr Ni Mo 18 16 4	1.4438	–	–	Z 2 CND 19.15	317 L	317 L	–	X 2 Cr Ni Mo 18 16	–
2371	10N	X 2 Cr Ni N 18 10	1.4311	–	–	Z 2 CN 18.10 Az	304 LN	304 LN	–	X 2 Cr Ni N 18 11	–
2375	19aN	X 2 Cr Ni Mo N 17 13 3	1.4429	–	–	Z 2 CND 18.10 Az	316 LN	316 LN	–	X 2 Cr Ni Mo N 17 13	–
2380	7	X 12 Cr S 13 8[1]	1.4005[1]	416 S 21	(En 56A)	Z 12 CF 13.4 M	416	416	–	X 12 Cr S 13	–
2383	–	X 12 Cr MoS 17	1.4104	–	–	Z 10 CF 17	430 F	430 F	–	X 10 Cr S 17	–

1) not standard

9. MIG and TIG wires for aluminium

SIS-aluminium	Alloy type	OK Autrod/Tigrod	British Standard BS 1470, 1490		Other designations for the parent material: American Aluminium Association	German DIN 1712	Werk-stoff Nr DIN 1712	French NF 57-312 NF 57-601 NF 57-602
4005	Al 99.7	18.01, 18.11			AA 1070A	Al 99.7	3.0275	A7
4007	Al 99.5	18.01, 18.11	(1B)	AA	1050A	Al 99.5	3.0255	A5
4010	Al 99.0	18.01, 18.11	(1C)	1200	AA 1200	Al 99	3.0205	A4
4054	Al Mn 1	18.01, 18.11	(N3)	3103	AA 3103	Al Mn	3.0515	(AM)
4103	Al Mg Si	18.04, 18.15			AA 6060	Al Mg Si 0.5	3.3206	AGS
4104	Al Mg 0.5 Si	18.04, 18.15	(H 9)	6063	AA 6063			
4106	Al Mg 1	18.15	(N 41)	5005	AA 5005			AG 0.6
4120	Al Mg 2.5	18.15	(N 4)	5251	AA 5052	Al Mg 2.5	3.3523	AG 2.5 C
4140	Al Mg 4.5 Mn	18.16	N 8	1470	AA 5083	Al Mg 4.5 Mn	3.3547	
4163	Al Mg 5 Si 1	18.04, 18.15				Al Mg 5 Si 1		
4212	Al Si Mg Mn	18.04, 18.15	(H 30)	6082	AA 6082	Al Mg Si 1	3.2315	ASG M 0.7
4230	Al Si 6 Cu 4	18.04	LM 21		AA 319	Al Si 6 Cu 4		
4231	Al Si 5 Cu 3	18.04	LM 4,	LM22				AS 5 U
4244	Al Si 7 Mg	18.04	2L99,	LM25	AA 356	Al Si Mg	3.2371	AS7 G, AS 7 G0.3
4247	Al Si 9	not weldable		AA 408				
4251	Al Si 7 Cu 3	18.04	LM 27					
4252	Al Si 9 Cu 3 Fe	not weldable	LM 24		AA 380	Al Si 8 Cu 3	3.2161	AS 9 U 3
4253	Al Si 10 Mg	18.04	LM 9					
4254	Al Si 9 Cu 3 Zn 2	not weldable						
4255	Al Si 10	18.04	LM 6		AA 4045			
4260	Al Si 12 (Cu)	18.04	LM 20		AA (4032)			
4261	Al Si 12	18.04	LM 6		AA A 13			
4335	Al Cu 4 Mg Pb	not weldable			AA 2030	Al Cu Mg P 6	3.1645	AU4 P6
4338	Al Cu 4 Si Mg	not weldable	(H 15)	2014A	AA 2014	Al Cu Si Mn	3.1255	AU4 SG
4425	Al Zn 4.5 Mg 1	18.04, 18.15	(H 17)	7020	AA 7020			A Z5G
4438	Al Zn 5 Mn	18.04, 18.15			AA D712			A Z5G

Notes