Manual Metal Arc Electrodes

Contents

Manual Metal Arc Welding Electrodes

OK 46.00
Type Rutile

SMAW
E6013

Description

OK 46.00 is the best, all-round, rutile electrode and it is relatively insensitive to rust or other surface impurities. It deposits smooth weld beads in all positions, including vertical down, and the slag is easy to remove. OK 46.00 is very easy to strike and restrike, making it ideal for short welds, root runs and tacking.

Recovery
95%

Welding current
AC,DC+ - OCV 50 V

Classifications

SFA/AWS A5.1	E6013
EN 499	E 38 0 RC 11
ISO 2560	E 43 3 R 11
CSN 05 5010	E 46.17

Typical all weld metal composition, %

C	Si	Mn
0.08	0.3	0.4

Typical mech. properties all weld metal

Yield stress, MPa	400
Tensile strength, MPa	510
Elongation, %	28

Charpy V

Test temps, °C	Impact values, J
0	70
-20	35

Approvals

ABS	2
BV	2
DB	10.039.05
DNV	2
DS	EN 499 E 38 0 RC 11
GL	2
LR	2
PRS	2
RS	2
Sepros	UNA 485154
SS	EN 499 E 38 0 RC 11
UDT	EN 499
Ü	10.039/1
VdTÜV	00623

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
1.6	300	30-60	20	0.63	263	0.38	36
2.0	300	50-70	21	0.60	172	0.55	38
2.5	350	60-100	22	0.65	86.0	0.8	50
3.2	350	80-150	22	0.65	53.0	1.3	57
4.0	350	100-200	22	0.60	39.0	1.6	65
5.0	350	150-290	24	0.60	24.0	2.3	87
5.0	450	170-220	24	0.60	31.0	2.3	114

OK 48.00
Type Lime-basic

SMAW
E7018

Description

A reliable, general purpose, LMA electrode for mild and low-alloy steels. OK 48.00 deposits a tough, crack-resistant weld metal. High welding speed in the vertical-up position. OK 48.00 is insensitive to the composition of the base material within fairly wide limits. The electrode can be used for welding structures where difficult stress conditions cannot be avoided.

Recovery
125%

Welding current
DC+(-)

Classifications

SFA/AWS A5.1	E7018
CSA W48	E4918
EN ISO 2560-A	E424 B42 H5

Typical all weld metal composition, %

C	Si	Mn
0.06	0.5	1.2

Typical mech. properties all weld metal

Yield stress, MPa	445
Tensile strength, MPa	540
Elongation, %	29

Charpy V

Test temps, °C	Impact values, J
-20	140
-40	70

Approvals

ABS	3H5, 3Y	LR	3,3Y H5
BV	3, 3Y H5	PRS	3YH10
CE	EN 13479	RINA	E 52 3 HH
CWB	CSA W48	RS	3YHH
DB	10.039.12	Sepros	
DNV	3Y H5	VdTÜV	00690
GL	3Y H5		

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
1.6	300	30-55	22				
2.0	300	50-80	24				
2.5	350	80-110	23	0.65	62.5	1.0	56
3.2	350	90-140	22	0.64	43	1.3	66
3.2	450	90-140	23	0.64	32.3	1.5	76
4.0	350	125-210	24	0.51	35.0	2.1	64
4.0	450	125-210	26	0.67	20.5	2.1	86
5.0	450	200-260	23	0.69	13.5	2.6	102
6.0	450	220-340	23	0.72	9.6	3.7	102
7.0	450	280-410	25	0.72	7.0	4.4	117

OK 48.04
Type Lime-basic

SMAW
E7018

Description

OK 48.04 is an AC/DC, general purpose, LMA electrode for welding mild and low-alloy steels. It has very good welding properties and deposits a high quality weld metal with very good mechanical properties. The electrode can be used for welding restrained structures where high welding stresses cannot be avoided.

Recovery
125%

Welding current
AC, DC+(-) OCV 65 V

Classifications

SFA/AWS A5.1	E7018
EN ISO 2560-A	E 42 4 B 32 H5

Typical all weld metal composition, %

C	Si	Mn
0.06	0.5	1.1

Typical mech. properties all weld metal

Yield stress, MPa	480
Tensile strength, MPa	560
Elongation, %	30

Charpy V

Test temps, °C	Impact values, J
-20	150
-20	100

Approvals

ABS	3H5, 3Y
BV	3YHH
DB	10.039.34
DNV	3 YH10
GL	3YH10
LR	3, 3YH15
PRS	3YH10
RS	3YHH
Sepros	UNA 409819
VdTÜV	00050
CE	EN 13479

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.0	300	50-80	23	0.61	125	0.67	44
2.5	350	70-110	23	0.64	67.0	1.0	59
3.2	350	110-150	22	0.63	42.3	1.37	62.4
3.2	450	110-150	25	0.67	30.0	1.5	92
4.0	450	150-200	26	0.68	20.0	2.0	101
5.0	450 1	90-260	26	0.72	13.0	2.8	106

OK 53.16 SPEZIAL
Type Basic

SMAW
E7016

Description

OK 53.16 is a double-coated electrode combining the running characteristics of a rutile electrode with the mechanical properties of a basic electrode. OK 53.16 welds on both AC and DC and the spatter loss is minimal.

Recovery
105%

Welding current
DC+, AC OCV 50 V

Classifications

SFA/AWS A5.1	E7016
ISO 2560-A	E 38 2 B 32 H10

Typical all weld metal composition, %

C	Si	Mn
0.07	0.6	0.9

Typical mech. properties all weld metal

Yield stress, MPa	450
Tensile strength, MPa	530
Elongation, %	28

Charpy V

Test temps, °C	Impact values, J
-20	120

Approvals

ABS	3, H10, 3Y
BV	3, 3YHH
CE	EN 13479
DB	10.039.29
DNV	3YH10
GL	3YH10
LR	3, 3YH10
VdTÜV	02762

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	350	50-90	26	0.63	77	0.86	54
3.2	350	90-150	25	0.65	46	1.4	57
4.0	450	120-190	26	0.64	24	1.9	79
5.0	450	160-230	26	0.63	15	2.4	99

OK Femax 33.80
Type Rutile

SMAW
E7024

Description

High-recovery rutile electrode for the high productivity welding of fillets in the horizontal-vertical position. Particularly suitable for welding thick plates and for long run-out lengths. Good bead appearance. Easy slag removal.

Recovery
180%

Welding current
AC, DC(+ -) OCV 50 V

Classifications

SFA/AWS	A5.1 E7024
ISO 2560-A	E 42 0 RR 73

Typical all weld metal composition, %

C	Si	Mn
<0.12	0.5	0.7

Typical mech. properties all weld metal

Yield stress, MPa	450
Tensile strength, MPa	550
Elongation, %	26

Charpy V

Test temps, °C	Impact values, J
0	50

Approvals

ABS	2
BV	2
DB	10.039.28
DNV	2
GL	2Y
LR	2, 2Y
PRS	2
RS	2
Sepros	UNA 485154
VdTÜV	00634
CE	EN 13479

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	350	85-125	27	0.64	53.0	1.6	43
3.2	450	130-170	28	0.68	21.0	2.5	69
4.0	450	180-230	30	0.68	13.5	3.8	69
4.5	700	180-230	30	0.69	6.8	3.7	141
5.0	450	250-340	30	0.67	9.1	5.8	68
5.0	700	210-260	31	0.69	5.6	4.4	146
5.6	700	250-300	35	0.69	4.7	4.5	171
6.0	450	300-430	35	0.68	6.4	7.1	79
6.0	700	280-400	34	0.72	4.0	6.9	131

OK Femax 38.65
Type Zirconium-basic

SMAW
E7028

Description

High-recovery zircon-basic electrode, especially developed for performing butt welds and fillet welds in the downhand position in ordinary and high tensile steels. Good slag removal.

Recovery
165%

Welding current
AC, DC+ OCV 65 V

Classifications

SFA/AWS A5.1	E7028
EN ISO 2560-A	E 42 4 B 73 H5

Typical all weld metal composition, %

C	Si	Mn
0.08	0.5	1.1

Typical mech. properties all weld metal

Yield stress, MPa	430
Tensile strength, MPa	540
Elongation, %	26

Charpy V

Test temps, °C	Impact values, J
-20	110
-30	95
-40	65
-60	50

Approvals

ABS	3H5, 3Y
BV	3Y HH
CE	EN 13479
DB	10. 039.15
DNV	3 YH10
GL	3YH10
LR	3, 3YH15
RINA	3Y H10
Sepros	UNA 409819
VdTÜV	00635

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
3.2	450	100-170	32	0.66	23.6	2.3	67
4.0	450	170-240	36	0.68	14.4	3.7	70
5.0	450	225-355	40	0.69	9.6	5.7	72
6.0	450	300-430	40	0.68	6.6	7.2	80
7.0	450	340-490	44	0.70	5.1	8.5	88

Pipeweld 6010 Plus

Type Cellulosic

SMAW
E 38 2 C 21

Description

Cellulosic-coated electrode designed for the welding of pipes and pipelines in all positions, using conventional and stovepipe techniques with AC or DC.

Welding current
AC, DC+

Classifications

EN 499	E 38 2 C 21
SFA/AWS A5.1	E6010

Typical all weld metal composition, %

C	Si	Mn
0.08	0.15	0.4

Typical mech. properties all weld metal

Yield stress, MPa	410
Tensile strength, MPa	495
Elongation, %	26

Charpy V

Test temps, °C	Impact values, J
-20	60
-29	40

Approvals

ABS	3
LR	3

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	350	50-70	31.5	0.69	91	0.71	55
3.2	350	65-120	29	0.71	54	0.9	76
4.0	350	90-180	28	0.72	36	1.3	78
5.0	350	150-240	29	0.71	23	1.58	98

OK 73.08
Type Lime-basic

SMAW
E8018-G

Description

OK 73.08 is a NiCu-alloyed LMA electrode, which deposits a weld metal with good corrosion resistance to sea-water and flue gases, for the welding of weatherproof steel and for ship's hull structural steel. The weld metal has excellent mechanical properties. 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.

Recovery
125%

Welding current
AC, DC(+) OCV 65 V

Classifications

SFA/AWS A5.5	E8018-G
EN ISO 2560-A	E 46 5 Z B 32

Typical all weld metal composition, %

C	Si	Mn	Ni	Cu
0.06	0.4	1.0	0.7	0.4

Typical mech. properties all weld metal

Yield stress, MPa	500
Tensile strength, MPa	590
Elongation, %	27

Charpy V

Test temps, °C	Impact values, J
-20	160
-40	130
-50	27

Approvals

ABS	3H5, 3Y
BV	3Y HH
DB	10.039.20
DNV	3 YH10
GL	3YH15
LR	3, 3Y H15
RS	3YHH
Sepros	UNA 485154
VdTÜV	02115
CE	EN 13479

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.0	300	60-90	20	0.62	113.0	0.7	42
2.5	350	80-115	21	0.62	66.0	0.9	59
3.2	350	100-150	23	0.62	43	1.2	68
3.2	450	100-150	22	0.66	30.5	1.3	90
4.0	450	130-200	23	0.68	20.0	1.8	100
5.0	450	190-280	27	0.70	13.5	2.6	106
6.0	450	240-370	28	0.68	9.5	3.3	115

OK 74.78
Type Lime-basic

SMAW
E9018-D1

Description

OK 74.78 is an LMA electrode suitable for welding high tensile steels used in low-temperature applications. Good notch toughness down to -40°C. Very suitable for both the enclosed welding and cladding of rails, when a hardness of about 250 HV is required. The moisture content of the coating is very low, which makes OK 74.78 suitable when preheating cannot be applied.

Recovery
125%

Welding current
AC, DC+ OCV 65 V

Classifications

SFA/AWS A5.5	E9018-D1
EN 757	E 55 4 MnMo B 32 H5

Typical all weld metal composition, %

C	Si	Mn	Mo
0.06	0.4	1.5	0.4

Typical mech. properties all weld metal

Yield stress, MPa	600
Tensile strength, MPa	650
Elongation, %	24

Charpy V

Test temps, °C	Impact values, J
0	100
-20	90
-51	60

Approvals

ABS	3H5, 3Y
BV	3Y HH
DB	10.039.17
DB	20.039.02
DNV	3 YH10
LR	3, 3Y H15
Sepros	UNA 481555
VdTÜV	01027
CE	EN 13479

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.0	300	55-80	22	0.62	136.0	0.7	38
2.5	350	75-100	22	0.62	73.0	0.9	55
3.2	450	105-140	23	0.65	32.0	1.3	86
4.0	450	140-190	23	0.65	20.5	1.8	97
5.0	450	190-260	24	0.68	14.0	2.6	100
6.0	450	240-340	24	0.69	10.0	3.6	103

OK 74.86 Tensitrode

Type Basic

SMAW
E10018-D2

Description

A basic coated electrode for steels and castings with U.T.S. of min. 690 MPa.

Recovery
120%

Welding current
DC+, AC OCV 70 V

Classifications

SFA/AWS A5.5	E10018-D2
BS 2493 (1985)	2Mn Mo BH

Typical all weld metal composition, %

C	Si	Mn	Ni	Mo
0.07	0.6	1.8	0.7	0.4

Typical mech. properties all weld metal

Yield stress, MPa	>610
Tensile strength, MPa	>690
Elongation, %	>16

Charpy V

Test temps, °C	Impact values, J
-51	>30

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	350	75-100	22	0.61	69.4	0.86	60.1
3.2	450	110-140	22	0.62	33.0	1.3	84.0
4.0	450	150-190	23	0.62	22.4	1.72	93.4
5.0	450	190-260	23	0.68	14.3	2.72	92.6

OK 75.75
Type Lime-basic

SMAW
E11018-G

Description

OK 75.75 is an LMA electrode dried to a very low moisture content and suitable for the welding of high-strength, low-alloyed steels, at room temperature or with moderate preheating.

Recovery
125%

Welding current
DC+

Classifications

SFA/AWS A5.5	E11018-G
EN 757	E 69 4 Mn2NiCrMoB 42 H5

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo
0.06	0.3	1.7	0.4	2.2	0.4

Typical mech. properties all weld metal

Yield stress, MPa	755
Tensile strength, MPa	820
Elongation, %	20

Charpy V

Test temps, °C	Impact values, J
+20	115
-20	85
-40	70
-51	55
-60	45

Approvals

ABS	E11018-G
DB	10.039.19
RS	4Y62HH
Sepros	UNA 485155
VdTÜV	01028
CE	EN 13479

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	350	70-110	22	0.67	66.0	1.0	54
3.2	450	100-150	23	0.67	31.5	1.4	80
4.0	450	135-200	24	0.65	21.0	1.9	92
5.0	450	180-260	25	0.63	12.0	2.5	105

OK 76.18
Type

SMAW
E8018-B2

Description

OK 76.18 is a basic flux covered low hydrogen manual metal arc welding electrode which deposits nominally 11/4% chromium, 1/2% molybdenum, low alloy ferritic steel weld metal.

Welding current
DC+-

Classifications

EN 1599	ECrMo1B 42 H5
SFA/AWS A5.5	E 8018-B2

Typical all weld metal composition, %

C	Mn	Si	S	P	Cr	Mo
0.06	0.70	0.35	0.01	0.015	1.30	0.6

Typical mech. properties all weld metal

Stress relieved		
Tensile strength		610 MPa
0.2% PS		520 MPa
Elongation	(l=4d)	24%
Typical impact value	+20ºC	120J
	-40ºC	50J

Approvals

ABS	
BV	UP
DNV	H10 for NV 1Cr0.5Mo
VdTÜV	01387

Welding parameters

Diameter, mm	Length, mm	Minimum current, A	Maximum, current, A
2.5	350	70	110
3.2	450	90	140
4.0	450	130	190
5.0	450	150	260
6.0	450	200	350

OK 76.28
Type

SMAW
E9018-B3

Description

OK 76.28 is a basic flux covered low hydrogen manual metal arc welding electrode which deposits 2¼% chromium,1% molybdenum, low alloy ferritic steel weld metal.

Recovery
110%

Welding current
DC+-

Classifications

EN 1599	ECr Mo 2 B42 H5
SFA/AWS A5.5	E 9018-B3

Typical all weld metal composition, %

C	Mn	Si	S	P	Cr	Mo
0.08	0.8	0.3	0.01	0.015	2.25	1.0

Typical mech. properties all weld metal

Tensile strength		min. 620 MPa
Yield strength		min. 530 MPa
Elongation	(l=4d)	min. 18%

Approvals

ABS	SR
BV	UP
Sepros	UNA 485155
VdTÜV	00971

Welding parameters

Diameter, mm	Length, mm	Minimum current, A	Maximum, current, A
2.5	350	70	100
3.2	450	95	140
4.0	450	130	190
5.0	450	150	260
6.0	450	200	350

OK 61.25
Type Basic

SMAW
E308H-15

Description

OK 61.25 is a basic coated, stainless-steel electrode of the 308H type. The electrode is designed for high-temperature applications in petrochemical and chemical process plants.

Welding current
DC+

Classifications

EN 1600	E 19 9 H B 2 2
SFA/AWS A5.4	E308H-15

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Cu
0.07	0.5	1.5	19.0	10.0	<0.5	<0.5

Typical mech. properties all weld metal

	As Welded	720ºC/1000h:
Yield stress, MPa	430	300
Tensile strength, MPa	600	570
Elongation A4, %	45	45

Charpy V

Test temps, °C	Impact values, J	
+20	96	100
Ferrite content	FN 2-5	

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	300	55-85	23	0.62	93	0.9	47
3.2	350	75-110	23	0.59	49	1.2	66
4.0	350	100-155	24	0.61	32	1.8	68

OK 61.30
Type Acid-rutile

SMAW
E308L-17

Description

OK 61.30 is an extra-low carbon, AC/DC, LMA electrode for welding steel of the 19Cr10Ni type. It is also suitable for welding stabilised stainless steels of similar composition, except when the full creep resistance of the base material is to be met. OK 61.30 is very easy to strike and restrike and produces weld beads with an excellent appearance and self-releasing slag.

Welding current
DC+, AC OCV 50 V

Classifications

EN 1600	E 19 9 L R 1 2
SFA/AWS A5.4	E308L-17
Werkstoff Nr.	1.4316
CSA W48	E 308L-17

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Cu
<0.03	0.7	0.9	19.5	10.0	<0.5	<0.5

Typical mech. properties all weld metal

Yield stress, MPa	430
Tensile strength, MPa	560
Elongation A5, %	43

Charpy V

Test temps, °C	Impact values, J
+20	70

Ferrite content	FN 3-10

Approvals

ABS	Stainless
CE	EN 13479
CWB	CSA W48
DB	30.039.02
DNV	308L
Sepros	UNA 409820
VdTÜV	00792

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
1.6	300	35-50	27	0.55	240	0.6	24
2.0	300	45-65	29	0.55	160	0.8	29
2.5	300	60-90	31	0.55	99	1.1	36
3.2	350	80-120	31	0.60	49	1.4	54
4.0	350	120-170	32	0.60	33	2.0	60
5.0	350	150-240	33	0.60	20	3.0	60

OK 61.35
Type Basic

SMAW
E308L-15

Description

OK 61.35 is a basic, low-carbon, stainless electrode of the E308L type with very good welding properties in the vertical and overhead positions. The high impact toughness at cryogenic temperature (-196°C) makes OK 61.35 excellent in LNG applications.

Welding current
DC+

Classifications

EN 1600	E 19 9 L B 2 2
SFA/AWS A5.4	E308L-15
Werkstoff Nr.	1.4316

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Cu
<0.04	0.5	1.7	19.0	10.0	<0.3	<0.3

Typical mech. properties all weld metal

Yield stress, MPa	460
Tensile strength, MPa	610
Elongation A4, %	40

Charpy V

Test temps, °C	Impact values, J
+20	100
-120	70
-196	40

Ferrite content FN 2-7

Approvals

Sepros	UNA 409820
VdTÜV	04811

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	300	55-85	22	0.61	92	0.9	37
3.2	350	75-110	25	0.61	50	1.3	54
4.0	350	110-155	27	0.61	33	1.9	58
5.0	350	160-210	26	0.51	25	2.2	66

OK 61.80
Type Acid-rutile

SMAW
E347-17

Description

OK 61.80 is a niobium-stabilised, stainless-steel, LMA electrode with low carbon content for welding stainless types 321 and 347. It is resistant to intergranular corrosion up to 400°C.

Welding current
DC+, AC OCV 50 V

Classifications

EN 1600	E 19 9 Nb R 1 2
SFA/AWS A5.4	E347-17
Werkstoff Nr.	1.4551

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Nb	Cu
<0.03	0.7	0.9	20.0	10.0	<0.3	<0.6	<0.3

Typical mech. properties all weld metal

Yield stress, MPa	480
Tensile strength, MPa	620
Elongation A5, %	40

Charpy V

Test temps, °C	Impact values, J
+20	60
-80	40

Ferrite content FN 6-12

Approvals

GL	4550
VdTÜV	00638
CE	EN 13479

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	300	60-90	26	0.56	97	1.0	38
3.2	350	80-120	28	0.56	50	1.4	53
4.0	350	120-170	30	0.56	33	2.0	55
5.0	350	150-240	31	0.56	21	2.9	60

OK 63.20
Type Acid-rutile

SMAW
E316L-16

Description

OK 63.20 is a rutile electrode with an extra-low carbon content for welding stainless steel of the 316L, 18Cr12Ni3Mo type. The electrode is specially designed for the positional welding of thinwalled pipes. OK 63.20 is very easy to strike and restrike.

Welding current
DC+, AC OCV 50 V

Classifications

EN 1600	E 19 12 3 L R 1 1
SFA/AWS A5.4	E316L-16
Werkstoff Nr	1.4430
CSA W48	E316L-16

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Cu
<0.03	<0.9	0.9	18.3	12.0	2.8	<0.3

Typical mech. properties all weld metal

Yield stress, MPa	460
Tensile strength, MPa	590
Elongation A5, %	41

Charpy V

Test temps, °C	Impact values, J
+20	56
-60	46

Ferrite content FN 3-10

Approvals

CWB	CSA W48
Sepros	UNA 409820
VdTÜV	09716
CE	EN 13479

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
1.6	265	15-40	23	0.55	294	0.4	30
1.6	300	15-40	23	0.63	227	0.3	53
2.0	265	18-60	22	0.65	167	0.6	44
2.0	300	18-60	25	0.62	152	0.5	49
2.5	300	25-80	22	0.63	96	0.8	54
3.2	350	55-110	26	0.60	52	1.2	65

OK 63.30
Type Acid-rutile

SMAW
E316L-17

Description

OK 63.30 is an extra-low carbon, LMA electrode of the 18Cr12Ni2.8Mo type. It is also suitable for welding stabilised steels of similar composition, except when the full creep resistance of the base material has to be met. OK 63.30 is very easy to strike and restrike and produces weld beads with an excellent appearance and self-releasing slag.

Welding current
DC+, AC OCV 50 V

Classifications

EN 1600	E 19 12 3 L R 1 2
SFA/AWS A5.4	E316L-17
Werkstoff Nr.	1.4430
CSA W48	E316L-17

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Cu
<0.03	<0.9	0.9	18.0	12.0	2.8	<0.2

Typical mech. properties all weld metal

Yield stress, MPa	460
Tensile strength, MPa	570
Elongation A5, %	40

Charpy V

Test temps, °C	Impact values, J
+20	60
-20	55
-60	43

Ferrite content	FN 3-10

Approvals

ABS	E316L-17
BV	316L
CE	EN 13479
CWB	CSA W48
DB	30.039.06
DNV	316L
GL	4571
LR	316L
Sepros	UNA 409820
VdTÜV	00262

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
1.6	300	35-50	29	0.56	250	0.4	37
2.0	300	45-65	29	0.60	147	0.6	39
2.5	300	60-90	29	0.55	96	0.9	45
2.5	350	60-90	30	0.56	83	1.1	41
3.2	350	80-125	30	0.55	52	1.4	57
4.0	350	120-170	32	0.56	34	2.0	57
5.0	350	150-240	32	0.56	21	3.0	63

OK 63.34
Type Acid-rutile

SMAW
E316L-16

Description

OK 63.34 is a stainless electrode of the 19Cr12Ni2.8Mo type, designed for the vertical down welding of steels of similar composition. OK 63.34 produces beads with a very good finish and a smooth transition to the joint edges. The slag volume is fairly small and is easy to manipulate and easy to remove.

Welding current
DC+, AC OCV 60 V

Classifications

EN 1600	E 19 12 3 L R 1 1
SFA/AWS A5.4	E316L-16
Werkstoff Nr.	1.4430
CSA W48	E316L-16

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Cu
<0.03	0.7	0.9	18.0	12.0	2.8	<0.3

Typical mech. properties all weld metal

Yield stress, MPa	440
Tensile strength, MPa	600
Elongation A5, %	40

Charpy V

Test temps, °C	Impact values, J
+20	65
-120	38

Ferrite content FN 3-8

Approvals

CWB	CSA W48
VdTÜV	03816

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	300	70-90	22	0.7	94	1.0	39
3.2	300	110-130	25	0.7	59	1.6	39

OK 63.35
Type Basic

SMAW
E316L-15

Description

OK 63.35 is a low-carbon, basic, stainless electrode designed for welding steel of the 18Cr12Ni3Mo type. The high impact toughness at cryogenic temperatures (-196°C) makes OK 63.35 excellent in LNG applications. The weld metal is very resistant to cracking and porosity. OK 63.35 has outstanding welding properties in the vertical and overhead positions.

Welding current
DC+

Classifications

EN 1600	E 19 12 3 L B 2 2
SFA/AWS A5.4	E316L-15
Werkstoff Nr.	1.4430

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Cu
<0.04	0.5	1.7	18.5	12.0	2.8	<0.3

Typical mech. properties all weld metal

Yield stress, MPa	430
Tensile strength, MPa	560
Elongation A4, %	40

Charpy V

Test temps, °C	Impact values, J
+20	95
-60	75
-120	60
-196	35

Ferrite content FN 3-8

Approvals

ABS	Stainless
DNV	316L
VdTÜV	04812
CE	EN 13479

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	300	55-85	24	0.63	91	0.9	42
3.2	350	75-110	24	0.63	47	1.3	58
4.0	350	110-150	24	0.62	32	1.8	63

OK 63.80
Type Acid-rutile

SMAW
E318-17

Description

OK 63.80 is a stainless LMA electrode for welding Nb- or Ti-stabilised stainless steels of the 18Cr12Ni2-3Mo type. OK 63.80 is specially designed for welding Nb- and Ti-stabilised stainless steel corresponding to DIN Werkstoff Nr: 4573 and 4583.

Welding current
DC+, AC OCV 50 V

Classifications

EN 1600	E 19 12 3 Nb R 3 2
SFA/AWS A5.4	E318-17
Werkstoff Nr.	1.4576

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Nb	Cu
<0.03	0.7	0.9	18.0	12.0	2.8	<0.6	<0.3

Typical mech. properties all weld metal

Yield stress, MPa	507
Tensile strength, MPa	614
Elongation A5, %	38

Charpy V

Test temps, °C	Impact values, J
+20	55

Ferrite content FN 6-12

Approvals

VdTÜV	00639
CE	EN 13479

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.0	300	45-65	29	0.56	155	0.8	29
2.5	300	60-90	30	0.56	97	1.1	35
3.2	350	80-120	32	0.61	48	1.4	54
4.0	350	120-170	33	0.61	32	2.1	55

OK 67.15
Type Lime-basic

SMAW
E310-15

Description

OK 67.15 is a stainless-steel electrode for welding 25Cr20Ni steels. It is also suitable for welding armour steel, austenitic-manganese steel and for joining dissimilar steels. OK 67.15 deposits a very crack-resistant weld metal.

Welding current
DC+

Classifications

EN 1600	E 25 20 B 2 2
SFA/AWS A5.4	E310-15
Werkstoff Nr.	1.4842

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Cu
0.12	0.5	2.2	26.0	21.0	<0.5	<0.5

Typical mech. properties all weld metal

Yield stress, MPa	410
Tensile strength, MPa	590
Elongation A5, %	35

Charpy V

Test temps, °C	Impact values, J
+20	100

Ferrite content FN 0

Approvals

DB	30.039.01
Sepros	UNA 409820
VdTÜV	01025
CE	EN 13479

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.0	300	35-55	24	0.62	162	0.6	36
2.5	300	55-85	25	0.61	96	0.9	40
3.2	350	70-110	25	0.59	50	1.2	60
4.0	350	110-150	26	0.59	28	1.8	62
5.0	350	150-200	26	0.60	22	2.5	65

OK 67.45
Type Lime-basic

SMAW
(E307-15)

Description

Austenitic stainless steel electrode producing a weld metal with less than 5% ferrite. The tough weld metal has excellent crack resistance, even when welding steels with very poor weldability. Suitable for joining 12-14% manganese steel to itself or other steels. It is also suitable for buffer layers before hardfacing.

Welding current
DC+

Classifications

EN 1600	E 18 8 Mn B 4 2

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Cu
0.11	0.5	6.0	18.5	8.5	<0.5	<0.5

Typical mech. properties all weld metal

Yield stress, MPa	470
Tensile strength, MPa	605
Elongation A5, %	35

Charpy V

Test temps, °C	Impact values, J
+20	85

Ferrite content	FN <5

Approvals

ABS	Stainless
Sepros	UNA 409820
VdTÜV	01580

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	300	50-80	23	0.58	102	0.7	50
3.2	350	70-100	24	0.60	51	1.1	71
4.0	350	100-140	24	0.60	33	1.5	73
5.0	350	150-200	25	0.60	22	2.2	80

OK 67.55
Type Basic

SMAW
E2209-15

Description

OK 67.55 is a basic coated electrode specially designed for the welding of duplex stainless steel, e.g. UNS S31803. The deposited weld metal gives very high ductility down to -50°C/-60°C. Particularly suitable for welding duplex pipes in offshore applications.

Welding current
DC+

Classifications

EN 1600	E 22 9 3 N L B 2 2
SFA/AWS A5.4	E2209-15
Werkstoff Nr.	1.4462

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	N
<0.04	0.5	0.9	22.5	9.3	3.0	0.15

Typical mech. properties all weld metal

Yield stress, MPa	650
Tensile strength, MPa	800
Elongation A5, %	28

Charpy V

Test temps, °C	Impact values, J
+20	100
-20	85
-40	75
-60	65

Ferrite content	FN 35-50

Approvals

DNV	For duplex SS
Sepros	UNA 409820
VdTÜV	06774

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	300	50-80	21	0.58	98	0.8	46
3.2	350	60-100	21	0.58	50	1.0	71
4.0	350	100-140	21	0.58	32	1.5	74

OK 67.60
Type Acid-rutile

SMAW
E309L-17

Description

OK 67.60 is an over-alloyed, stainless electrode for welding stainless to mild steel and low-alloy steel, for surfacing mild steel and for welding the root runs in clad steel. The electrode has excellent weldability in all positions except vertical down, on both AC and DC.

Welding current
DC+, AC OCV 55 V

Classifications

EN 1600	E 23 12 L R 3 2
SFA/AWS A5.4	E309L-17
Werkstoff Nr.	1.4332
CSA W48	E309L-17

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Cu
<0.03	0.7	0.9	24.0	13.0	<0.3	<0.3

Typical mech. properties all weld metal

Yield stress, MPa	470
Tensile strength, MPa	580
Elongation A5, %	32

Charpy V

Test temps, °C	Impact values, J
+20	50
-10	40

Ferrite content FN 10-22

Approvals

CE	EN 13479
CWB	CSA W48
Sepros	UNA 409820
VdTÜV	00898

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.0	300	30-60	27	0.60	136	0.7	38
2.5	300	50-90	28	0.60	85	1.1	38
3.2	350	90-120	29	0.60	45	1.6	51
4.0	350	130-180	31	0.60	29	2.5	51
4.0	450	130-180	31	0.60	23	2.5	65
5.0	350	160-240	32	0.60	19	3.3	58

OK 67.70
Type Acid-rutile

SMAW
E309MoL-17

Description

OK 67.70 is an over-alloyed, stainless-steel electrode for use as a buffer layer when welding acid resistant clad steels and stainless steels to other types of steel. OK 67.70 has outstanding welding properties on both AC and DC. The electrode can be used in all positions apart from vertical down.

Welding current
DC+, AC OCV 55 V

Classifications

EN 1600	E 23 12 2 L R 3 2
SFA/AWS A5.4	E309MoL-17
Werkstoff Nr.	1.4459
CSA W48	E309LMo-17

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Cu
<0.03	0.7	0.9	23.0	13.0	2.8	<0.3

Typical mech. properties all weld metal

Yield stress, MPa	510
Tensile strength, MPa	610
Elongation A5, %	32

Charpy V

Test temps, °C	Impact values, J
+20	50
-20	35

Ferrite content FN 12-22

Approvals

ABS	SS to C&C/Mn steels
CE	EN 13479
CWB	CSA W48
DB	30.039.05
DNV	309 Mo
LR	SS/CMn
RINA	E 309Mo
Sepros	UNA 409820
VdTÜV	02424

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.0	300	30-60	26	0.58	147	0.6	48
2.5	300	50-90	29	0.57	94	0.9	45
3.2	350	90-120	27	0.59	47	1.4	61
4.0	350	130-180	31	0.61	32	2.0	56
5.0	350	160-240	30	0.59	20	2.7	64
5.0	450	160-240	30	0.57	15	2.7	85

OK 67.75
Type Basic

SMAW
E309L-15

Description

OK 67.75 is a basic coated, stainless electrode for welding steels of the 24Cr13Ni type, for welding transition layers when surfacing mild steel with stainless, for joining dissimilar steels and welding root runs in the stainless side of clad steels.

Welding current
DC+

Classifications

EN 1600	E 23 12 L B 4 2
SFA/AWS A5.4	E309L-15
Werkstoff Nr.	1.4332

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Cu
<0.04	0.5	2.2	24.0	13.0	<0.5	<0.3

Typical mech. properties all weld metal

Yield stress, MPa	470
Tensile strength, MPa	600
Elongation A5, %	35

Charpy V

Test temps, °C	Impact values, J
+20	75
-80	55

Ferrite content	FN 12-22

Approvals

ABS	Stainless
DNV	309
LR	SS to C/Mn Steels
Sepros	UNA 409820
VdTÜV	00633

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	300	50-80	22	0.73	78.0	1.1	42
3.2	350	80-110	24	0.73	39.0	1.5	60
4.0	350	100-150	26	0.73	25.0	2.3	62
5.0	350	160-220	27	0.73	16.5	3.4	65

OK 68.81
Type Acid-rutile

SMAW
E312-17

Description

OK 68.81 is a high-alloyed electrode which deposits a ferritic-austenitic duplex weld metal with approx. 40% ferrite. It is resistant to stress corrosion and is highly insensitive to dilution. Good scaling resistance up to 1150°C. OK 68.81 is used for joining dissimilar steels, steels with reduced weldability and buffer layers prior to hardfacing. Applications: rolls, forging dies, hotwork tools, dies for plastics and so on.

Welding current
DC+, AC OCV 60 V

Classifications

EN 1600	E 29 9 R 3 2
SFA/AWS A5.4	E312-17
Werkstoff Nr.	1.4337
EN 14700	EFe 11

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Cu
0.12	0.7	0.8	29.0	9.8	<0.5	<0.3

Typical mech. properties all weld metal

Yield stress, MPa	610
Tensile strength, MPa	790
Elongation A5, %	22

Charpy V

Test temps, °C	Impact values, J
+20	30

Ferrite content FN 35-65

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.0	300	35-60	22	0.64	123.0	0.7	41
2.5	300	50-85	24	0.64	78.0	0.9	48
3.2	350	80-125	25	0.62	42.0	1.3	65
4.0	350	110-175	26	0.62	26.0	2.0	66
5.0	350	150-240	28	0.65	16.5	3.2	68

OK 69.33
Type Basic-rutile

SMAW
E385-16

Description

OK 69.33 is a stainless-steel electrode which deposits a fully austenitic weld metal with increased resistance to sulphuric acid. The weld metal of OK 69.33 also has good resistance to intergranular and pitting corrosion.

Welding current
AC, DC+ OCV 65 V

Classifications

EN 1600	E 20 25 5 Cu N L R 3 2
SFA/AWS A5.4	E385-16
Werkstoff Nr.	1.4519

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Cu
<0.03	0.5	1.3	20.5	25.5	4.8	1.6

Typical mech. properties all weld metal

Yield stress, MPa	400
Tensile strength, MPa	575
Elongation A5, %	35

Charpy V

Test temps, °C	Impact values, J
+20	80
-140	45

Ferrite content	FN 0

Approvals

Sepros	UNA 409820
VdTÜV	02723

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.0	300	40-60	23	0.58	125	0.7	40
2.5	300	60-85	24	0.60	91	0.9	44
3.2	350	85-130	27	0.58	41	1.5	60
4.0	350	120-180	29	0.51	30	1.9	64
5.0	350	160-240	31	0.51	19	2.5	78

OK 92.15
Type Basic

SMAW
ENiCrFe-2

Description

OK 92.15 is a nickel-based electrode for welding Inconel 600 and similar alloys, cryogenic steels (e.g. 9Ni and 5Ni steels), martensitic to austenitic steels, dissimilar steels, heat-resistant steel castings with limited weldability and so on. The weldability is good in all positions, even in the overhead position.

Welding current
DC+

Classifications

SFA/AWS A5.11	ENiCrFe-2
EN ISO 14172	E Ni 6133 (NiCr16Fe12NbMo)

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Nb	Cu	Fe
<0.1	<0.75	2.3	15.5	70	1.5	2.0	<0.5	9.0

Typical mech. properties all weld metal

Yield stress, MPa	420
Tensile strength, MPa	660
Elongation A4, %	45

Charpy V

Test temps, °C	Impact values, J
+20	110
-196	90

Approvals

ABS

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	300	50-80	22	0.63	91	0.9	45
3.2	350	70-105	23	0.62	57	1.3	57
4.0	350	95-140	24	0.65	31	2.1	58

OK 92.26
Type Basic

SMAW
ENiCrFe-3

Description

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

Welding current
DC+

Classifications

SFA/AWS A5.11	ENiCrFe-3
EN ISO 14172	E Ni 6182 (NiCr15Fe6Mn)

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Nb	Cu	Ti	Ta	Fe
0.03	0.5	6.6	15.8	67	1.7	<0.5	<0.5	<0.3	8.8

Typical mech. properties all weld metal

Yield stress, MPa	410
Tensile strength, MPa	640
Elongation A4, %	40

Charpy V

Test temps, °C	Impact values, J
+20	100
-196	80

Approvals

ABS	ENiCrFe-3
Sepros	UNA 409820

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	300	45-70	22	0.63	88	0.9	50
3.2	350	70-105	23	0.62	57	1.2	60
4.0	350	90-130	24	0.64	31	2.0	60
5.0	350	120-170	25	0.64	20	2.7	68

OK 92.45
Type Basic

SMAW
ENiCrMo-3

Description

OK 92.45 is a NiCrMoNb-based electrode for welding nickel alloys of the same or similar type, like Inconel 625, and for welding 5Ni and 9Ni steel. OK 92.45 is also suitable for welding UNS S31254 steel.

Welding current
DC+

Classifications

SFA/AWS A5.11	ENiCrMo-3
EN ISO 14172	E Ni 6625 (NiCr22Mo9Nb)

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	Nb	Cu	Al	Fe
0.03	0.4	0.2	21.7	63	9.3	3.3	<0.3	<0.4	2.0

Typical mech. properties all weld metal

Yield stress, MPa	500
Tensile strength, MPa	780
Elongation A5, %	35

Charpy V

Test temps, °C	Impact values, J
+20	70
-196	50

Approvals

VdTÜV	06833

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	300	50-80	23	0.6	100	0.9	40
3.2	350	70-110	25	0.6	49	1.4	52
4.0	350	100-140	27	0.6	33	1.9	57
5.0	350	120-170	24	0.6	21	2.1	72

OK 92.55
Type Basic

SMAW
ENiCrMo-6

Description

OK 92.55 is an all-positional, basic coated electrode which deposits a NiCr-based alloy with additions of Mo, W and Nb. The electrode is specifically designed for welding 9%Ni steels for cryogenic applications down to -196°C.

Welding current
AC, DC+ - OCV 55 V

Classifications

SFA/AWS A5.11	ENiCrMo-6
EN ISO 14172	E Ni 6620 (NiCr14Mo7Fe)

Typical all weld metal composition, %

C	Si	Mn	Cr	Ni	Mo	W	Nb	Cu	Fe
0.05	0.3	3.0	13.0	69	6.2	1.6	1.3	<0.3	5.0

Typical mech. properties all weld metal

Yield stress, MPa	>430
Tensile strength, MPa	>690
Elongation A4, %	>35

Charpy V

Test temps, °C	Impact values, J
-196	>70

Approvals

ABS	ENiCrMo-6
BV	N50, N90
DNV	for welding NV 1.5Ni to NV 9Ni

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	350	65-115	22	0.66	34	1.5	68
3.2	350	70-150	22	0.66	34	1.5	68
4.0	350	120-200	22	0.67	23	1.9	82
5.0	350	150-240	23	0.68	14	2.8	91

OK 94.25
Type Basic

SMAW
EL-CuSn7

Description

Electrode for welding copper and bronzes, especially tin bronzes. It is also suitable for cladding steels and for small-scale repair work in weldable cast irons.

Applications:
For the repair and construction of parts in casting such as:
- valves
- pumps
- housings
- bearing surfaces

Welding current
DC+

Classifications

DIN 1733	EL-CuSn7

Typical all weld metal composition, %

Mn	P	Cu	Sn	Fe
<0.5	<0.1	92.5	7.0	<0.2

Typical mech. properties all weld metal

Yield stress, MPa	235
Tensile strength, MPa	330-390
Elongation A5, %	25
Hardness(HB):	95

(Preheat and interpass temp. 300°C)

Charpy V

Test temps, °C	Impact values, J
+20	25
0	20

Approvals

Sepros	UNA 409820

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	350	60-90	22	0.71	77.0	1.2	39
3.2	350	90-125	24	0.72	46.0	1.9	40
4.0	350	125-170	25	0.74	30.5	2.9	41

OK 92.18

Type Basic special, high graphite

SMAW
ENi-CI

Description

A nickel-cored electrode for welding normal grades of cast iron. The weld metal is soft and easily machinable. Deposition is performed on cold or slightly preheated material. The electrode is suitable for joining cast iron for the rectification of casting and the repair of broken parts.

Welding current
AC, DC+ OCV 50 V

Classifications

SFA/AWS A5.15	ENi-CI
EN ISO 1071	E C Ni-CI 3

Typical all weld metal composition, %

C	Si	Mn	Ni	Fe
0.9	0.7	0.4	>92.0	3.5

Typical mech. properties all weld metal

Tensile strength, MPa	300
Hardness:	150 HB

Approvals

Sepros	UNA 409820

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	300	55-110	20	0.71	83.3	0.9	46
3.2	350	80-140	20	0.68	44.8	1.2	66
4.0	350	100-190	20	0.70	29.4	1.7	71

OK 92.58

Type Basic special, high graphite

SMAW
ENiFe-CI-A

Description

A nickel-iron-cored electrode for joining normal grades of cast iron, such as grey, ductile and malleable irons. It is also suitable for the rectification and repair of these grades and for joining them to steel. Deposition is performed on cold or slightly preheated cast iron. The weld metal is stronger and more resistant to impurities than the nickel-cored type.

Welding current
AC, DC+ - OCV 50 V

Classifications

SFA/AWS A5.15	ENiFe-CI-A
EN ISO 1071	E C NiFe-CI-A 1

Typical all weld metal composition, %

C	Si	Mn	Ni	Al	Fe
1.5	0.7	0.8	51	1.4	46

Typical mech. properties all weld metal

Tensile strength, MPa	375
Hardness (HB):	180

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	300	55-75	21	0.70	90	0.6	70
3.2	350	75-100	23	0.70	45	0.9	90
4.0	350	85-160	24	0.70	30	1.8	70

OK 92.78
Type Basic-special

SMAW
E C NiCu 1

Description

OK 92.78 is a nickel-copper electrode of the monel-alloy type for welding all types of cast iron with or without low preheat. The weld metal is easily machinable and produces a colour very similar to that of cast iron.

Welding current
AC, DC+ - OCV 45 V

Classifications

EN ISO 1071	E C NiCu 1

Typical all weld metal composition, %

C	Si	Mn	Ni	Cu	Fe
0.7	<0.2	0.9	64	32	3

Typical mech. properties all weld metal

Tensile strength, MPa	300-350
Elongation A5, %	15
Hardness (HB):	150

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	300	50-100	18	0.60	96	0.6	66
3.2	350	60-125	18	0.65	49	0.8	97
4.0	350	90-140	18	0.65	32	0.9	130

OK 83.28
Type Lime-basic

SMAW
EZ Fe1

Description

OK 83.28 is a chromium-alloyed electrode for hardfacing and cladding tracks, shafts, rolls, rails and rail-crossing sections, as well as components in rolling mills, such as grooved rollers and clutches and large cog wheels made of cast steel.

Welding current
AC, DC+ OCV 70 V

Classifications

EN 14700	EZ Fe1

Typical all weld metal composition, %

C	Si	Mn	Cr
0.1	<0.7	0.7	3.2

Typical mech. properties all weld metal

Weld metal hardness, a w (no preheat, interpass temperature <90°C)	≈30 HRC
Machinability	Good
Impact resistance	Very good
Metal-to-metal wear resistance	Very good

Tempering resistance

Temp°C	HRC(1h)	HRC(24h)
100	33	33
300	33	33
400	34	34
500	35	28
600	27	17
700	18	

Approvals

DB	20.039.01
Sepros	UNA 485155

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	350	60-90	20	0.64	69.0	0.7	75
3.2	450	100-140	21	0.66	34.0	1.2	88
4.0	450	140-190	22	0.66	23.0	1.7	92
5.0	450	190-260	23	0.68	15.0	2.8	86
6.0	450	230-320	23	0.68	10.5	3.7	92

OK 83.50
Type Acid-rutile

SMAW
EZ Fe2

Description

OK 83.50 is a hardfacing electrode for the repair welding of worn parts on agricultural equipment, forestry tools, loading machines and so on. Transformers with low open-circuit voltage can be used (> 45 volt).

Welding current
AC, DC+ OCV 45 V

Classifications

EN 14700	EZ Fe2

Typical all weld metal composition, %

C	Si	Mn	Cr	Mo
0.4	<0.6	<1.0	6.0	0.6

Typical mech. properties all weld metal

Weld metal hardness, a w (preheat and interpass temperature approx. 250°C)	50-60 HRC
Machinability	Grinding only
Abrasion resistance	Very good

Tempering resistance

Temp°C/1h	HRC
200	56
300	54
400	53
500	52
550	51
600	44
650	41
700	34

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	350	60-120	28	0.46	88.0	0.8	49
3.2	350	90-160	30	0.46	52.0	1.2	59
4.0	450	125-210	33	0.48	25.5	1.7	82
5.0	450	160-260	37	0.48	16.0	2.6	86

OK 84.58
Type Lime-basic

SMAW
EZ Fe6

Description

OK 84.58 is a hardfacing electrode depositing a semi-corrosion-resistant martensitic steel. Full hardness is obtained even in the first bead, irrespective of the cooling rate. Suitable for hardfacing parts exposed to abrasive and impact wear, such as farm equipment, forestry tools, loading machines and mixers.

Welding current
AC, DC+ OCV 65 V

Classifications

EN 14700	EZ Fe6

Typical all weld metal composition, %

C	Si	Mn	Cr
0.7	0.6	0.7	10.0

Typical mech. properties all weld metal

Weld metal hardness, a w deposited on mild steel, no preheat, interpass temperature 250°C)	53-59 HRC
1st layer	52-59 HRC
2nd layer	52-59 HRC
3rd layer	53-59 HRC
Machinability	Grinding only
Abrasion resistance	Very good
High temp. wear resistance	Good
Corrosion resistance	Good

Tempering resistance

Temp°C/1h	HRC
100	55
200	55
300	52
400	50
500	54
600	46
700	31

Annealing and hardening of weld metal:

Soft annealing:	840-860°C
Rehardening procedure:	
Hardening temperature, °C:	950- 1000
Quenching medium:	compressed air or oil

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	350	75-110	23	0.67	58.0	1.0	62
3.2	450	110-150	23	0.67	27.0	1.4	95
4.0	450	145-200	24	0.67	17.5	1.9	107
5.0	450	190-270	26	0.66	11.5	2.8	110

OK 84.78
Type Rutile-basic

SMAW
EZ Fe14

Description

Electrode producing a weld metal with coarse chromium carbides in an austenitic matrix. Suitable for surfacing worn parts exposed to abrasion and wear by coal, ore or other minerals. Typical applications include earth-moving machines, mixers, feeder screws, dust exhausters and crushers. It can also be used on components operating in corrosive environments and/or at elevated temperatures.

Welding current
AC, DC+ OCV 50 V

Classifications

EN 14700	EZ Fe14

Typical all weld metal composition, %

C	Si	Mn	Cr
4.5	0.8	<1.6	33

Typical mech. properties all weld metal

Weld metal hardness, a w No preheat and interpass temperature 100°C:	59-63 HRC
3rd layer:	59-63 HRC
Preheat and interpass temperature 500°C:	
3rd layer:	55-61 HRC
Machinability	Grinding only
Abrasion resistance	Excellent
High temp. wear resistance	Good
Corrosion resistance	Excellent

Tempering resistance

Temp°C/1h	HRC
100	58
300	59
400	57
490	59
600	57
700	58

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	350	90-120	24	0.62	48.0	1.2	60
3.2	350	115-170	24	0.62	26.0	1.6	85
4.0	450	130-210	26	0.64	13.5	2.0	135
5.0	450	150-300	26	0.64	9.0	2.9	140

OK 84.84
Type Basic

SMAW
E10-UM-60-GP

Description

OK 84.84 is a hardfacing electrode depositing a weld metal with a high volume fraction of fine carbides in a martensitic matrix. It is designed for the protection of components subjected to severe abrasive wear. Typical applications: earth-drilling equipment, hammers, scrapers and knives, shovel buckets and shovel teeth.

Recommendation:
Preheating is normally not required, except for heavier sections where preheating to 200°C may be beneficial. Stringer beads are recommended. Optimum hardness is obtained in the first layer due to low dilution with the parent material.

Welding current
AC, DC+ - OCV 45 V

Classifications

DIN 8555	E10-UM-60-GP

Typical all weld metal composition, %

C	Si	Cr	V	Ti
3.0	2.0	6.3	5.0	4.8

Typical mech. properties all weld metal

Weld metal hardness, a w (deposited on mild steel, no preheat):	60-62 HRC
1st layer:	62 HRC
Machinability	Grinding only
Impact resistance	Very good
Abrasion resistance	Excellent

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	350	70-100	17	0.63	71	0.5	105
3.2	350	100-150	17	0.60	44	0.7	110
4.0	350	115-200	17	0.64	27	1.0	120

OK 85.65
Type Lime-basic

SMAW
E Fe4

Description

OK 85.65 deposits a molybdenum-alloyed, highspeed steel. Suitable for metal cutting tools, punching tools, drills and stamping machines. Welded cutting edges can be put into use without tempering. For shaping machine tools and large cutting tools, untempered weld metal is recommended. To avoid cracking, the welding temperature should be at least 300°C and preferably 400-500°C.

Welding current
AC, DC+ OCV 70 V

Classifications

EN 14700	E Fe4

Typical all weld metal composition, %

C	Si	Mn	Cr	Mo	W	V
0.9	1.5	1.3	4.5	7.5	1.8	1.5

Typical mech. properties all weld metal

Weld metal hardness (top of a three-layer deposit on mild steel, preheat and interpass temperature 450ºC)	59-61 HRC
As welded:	59-61 HRC
Tempered:	65-67 HRC
Soft annealed:	37-40 HRC
Machinability	Grinding only
Abrasion resistance	Very good
High temp. wear resistance	Very good

Tempering resistance

Temp°C	HRC(1h)	HRC(2x1h)
20	60	60
100	60	60
300	60	60
400	58	58
550	62	66
700	40	40

Heat treatment data

Hardening. Temperature, °C:	1230-1250
Cooling:	In air
Tempering. Temperature, °C:	525
Holding time, h:	2 x 1h
Cooling:	In air
Soft annealing. Temperature, °C:	750-775
Holding time, h:	2-3
Cooling:	In air

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
2.5	350	80-110	23	0.55	67.0	0.8	67
3.2	350	100-150	23	0.57	40.0	1.1	82
4.0	350	120-190	25	0.58	26.5	1.4	97

OK 86.08
Type Lime-basic

SMAW
E Fe9

Description

OK 86.08 deposits an austenitic-manganese steel alloy which work-hardens under impact and compressive stresses. The electrode is primarily used for surfacing and building up manganese steel components such as crusher jaws and hammers. The interpass temperature should be kept as low as possible.

Welding current
AC, DC+ OCV 70 V

Classifications

EN 14700	EZ Fe9

Typical all weld metal composition, %

C	Si	Mn
1.1	0.8	13.0

Typical mech. properties all weld metal

Weld metal hardness, a w (No preheat, interpass temperature 100-150°C)	180-200 HB
Weld metal hardness, w h (approx. 25% reduction)	44-48 HRC
Machinability	Grinding
Impact resistance	Excellent
Metal-to-metal wear resistance	Very good

Welding parameters

Diameter, mm	Length, mm	Welding current, A	Arc voltage, V	N. Kg weld metal/kg electrodes	B. No. of electrodes/ kg weld metal	H. Kg weld metal/hour arc time	T. Burn-off time, s/ electrode
3.2	450	95-135	23	0.60	35.5	1.1	95
4.0	450	130-180	23	0.60	24.0	1.4	109
5.0	450	170-230	25	0.60	15.0	1.8	132

OK 21.03
Type

SMAW

Description

OK 21.03 is designed for gouging, cutting and piercing mild and alloyed steel, cast iron and non-ferrous metals, with the exception of pure copper, using standard welding equipment. The electrode can be used in a wide variety of applications, such as bevelling, the preparation of cracked areas before welding and the back-gouging of root runs.

Welding current
AC, DC- OCV 70 V

Classifications

The arc is struck with the electrode perpendicular to the workpiece, after which 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 with increased carbon content is obtained and it should be removed by grinding.

When using OK 21.03 indoors, it is necessary to have very good ventilation or fume extraction.

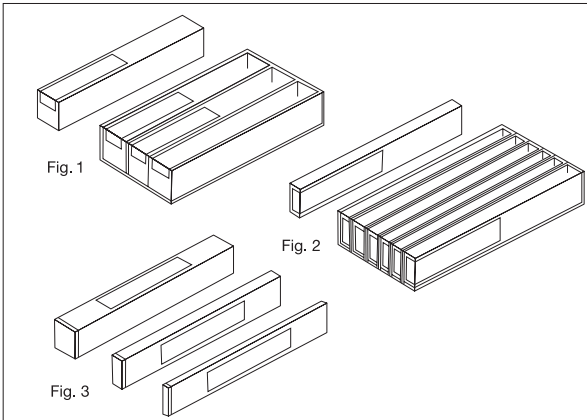
Welding parameters

Diameter, mm	Length, mm	Minimum current, A	Maximum, current, A
2.5	350	100-120	43
3,2	350	130-180	43
4.0	350	170-230	48
5.0	450	230-300	48

Packaging

Stick electrodes
Rutile and low-hydrogen electrodes are packed in cardboard packs with polyethylene shrink wrapping. They are supplied in units of three or six in outer boxes made of corrugated board (Figures 1 & 2).

Stainless electrodes are packed in polyethylene boxes with a re-sealable lid (Figure 3).



VacPac™

No re-baking – no quivers – no holding ovens
VacPac vacuum packaging eliminates the costly re-baking and handling routines normally associated with the storage of electrodes, by preventing airborne moisture absorption. VacPac is simple and convenient to use, ensuring that the electrodes keep their 'factory fresh', low-moisture condition until the sealed vacuum is released and the electrodes are used. When stored under conditions in which the sealed VacPac electrodes are not damaged, their shelf life is virtually unlimited.

Quality control is simple. The date and time of issue from the warehouse are written on the foil to monitor safe usage within the time limits prescribed for the various electrode types after opening the VacPac. The foil, showing all the necessary product information, is left in place after opening.

The VacPac sizing options make it possible to match the number of electrodes to the expected production rate and the electrodes are available as full, half and quarter packs, containing approximately 4, 2.5 and 1kg of electrodes.

Recommendations for the storage, re-drying and handling of covered electrodes

General information
All covered electrodes are sensitive to moisture re-absorption to a greater or lesser degree. Care must be taken during storage and handling to prevent moisture being re-absorbed.

Storage
Covered electrodes of any type will pick up moisture only very slowly if they are stored in the following climatic conditions:

Temperature	Relative humidity
5-15°C	< 60%
15-25°C	< 50%
above 25°C	< 40%

During the winter, it is possible to have low relative humidity by keeping the temperature in the store room at least 10°C above the outdoor temperature. During certain periods in the summer and in a tropical climate, sufficiently low relative humidity can be maintained by air de-humidification.

If the electrodes have been stored in a cold place, allow them to reach ambient temperature before breaking the package.

Re-drying
Low-hydrogen basic electrodes should be redried before use whenever there are application requirements relating to weld metal hydrogen content and/or radiographic soundness (not needed for VacPac™.)

Acid rutile stainless electrodes and all types of basic electrode may produce pores in the weld if they have not been stored in sufficiently dry conditions. Redrying the electrodes will restore their usability.

Mild steel rutile and acid electrodes normally need no redrying.

Cellulose electrodes must not be redried.

Electrodes which are seriously damaged by moisture can normally not be redried with first class results. These electrodes should be scrapped.

Redrying conditions
Redrying temperatures and holding times are specified on the label and in the product specification. The redrying temperature is the temperature in the bulk of the electrodes.

The redrying time is measured from the point at which the redrying temperature has been reached.

Do not stack more than four layers of electrodes in the redrying oven.

It is recommended not to redry covered electrodes more than three times.

Storage and handling

Holding oven
The holding oven is used for intermediate storage to avoid moisture pick-up in the coating of low-hydrogen electrodes and acid rutile stainless electrodes. The electrodes which should be stored in the holding oven are:

1. Electrodes that have been redried.
2. Electrodes that have been removed from their hermetically-sealed container.
3. Electrodes that are considered to be in good condition and are transferred directly from the store room after unpacking.

Holding oven temperature: 120-150°C.

Precautions on site
Keep the electrodes in electrically-heated quivers at a minimum temperature of 70°C.

After work, return the remaining electrodes to the holding oven.

Discoloration in the coating
If the colour of the electrodes changes during storage, they should be scrapped or the electrode manufacturer should be contacted.

Damaged coating
Mechanically damaged electrodes on which parts of the coating are missing will not perform correctly and should be scrapped.

VacPac™
Electrodes in VacPac™ will not pick up any moisture during storage. They require no redrying before use, provided the package is undamaged. This is indicated by a vacuum in the package.

Handling VacPac™ electrodes
Protect VacPac™ from damage at all times.

The outer board packaging offers extra protection from mechanical damage to the metal foil. Handle the single inner, metal foil, VacPac™ with special care.

Do not use a knife or any other sharp object to open the outer board packaging.

Before using VacPac™ electrodes
Check if the protective foil still contains a vacuum. If the vacuum has been lost, re-dry the electrodes before use.

Cut open the protective foil at one end.

Do not take out more than one electrode at a time, thereby ensuring that the remaining electrodes are still protected inside the package. Put the top back on the plastic capsule.

Discard or re-dry electrodes that have been exposed to the atmosphere in an opened Vac-Pac™ for more than 12 hours.

Handwelding electrodes

Official approval
In addition to the official approval given in this catalogue, many OK electrodes are approved by foreign authorities, railway boards, private companies and so on. Information about the different types of approval is available on request.

Tensile properties
Unless otherwise stated, tensile properties refer to all weld metal test pieces prepared according to the rules of the classification societies using 4 and 6mm diameter 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 require a lower current, larger workpieces a higher current, depending on the dissipation of heat from the joint.

Cold cracking
Cold cracking will only occur if the following three factors are present at the same time:

1. Hard phases in the weld, preferably martensite
2. Sufficient stress
3. Hydrogen dissolved 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 dissolve in the weld metal and make it brittle. The following formula describes this process in the case of standard carbon-manganese steel.

$$E_C = \%C + \frac{\%Mn}{6} + \frac{\%(Cr+Mo+V)}{5} + \frac{\%(Ni+Cu)}{15}$$

Steels with E_C=0.35 and below are usually weldable without any problems at normal steel sizes. For the more highly alloyed steels and steels with thicker dimensions, an elevated working temperature is necessary in order to reduce the cooling rate.

The elevated temperature also allows the hydrogen to diffuse.

To determine elevated working temperatures, please consult BS 5135: 1984 or SS 064025. If the E_C dimension of the plates and heat input are known, these standards will state whether heating is necessary and the level at which it should take place.

Tension cannot be avoided when welding, as steel expands when heated, although correct planning and heat treatment can reduce tension considerably.

Hydrogen forms from water in the surroundings and from the electrode coating. The water is divided into oxygen and hydrogen in the arc and the hydrogen in particular has a strong tendency to dissolve in the weld metal and initiate cold cracking.

Conclusion: Dry basic electrodes when there is risk of cold cracking.

Labelling
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 into groups according to the type of alloy deposited. Within each group of electrodes for welding mild, low-alloy and stainless steels, there are several cases in which many different electrodes are designed for welding the same type of steel. So, for each steel grade, there are often a large number of electrode types to choose from, all of which produce similar weld metal compositions but have different coatings, welding properties, welding speeds and weld metal quality. This large choice makes it possible to choose the electrode which produces the right weld metal quality at the lowest cost.

When selecting an electrode, the first rule is to select one which produces a weld metal quality equal to or better than that of the base material and, when necessary, is approved for the material in question. Welding position and type of joint are other factors which influence the choice of electrode, as different electrodes have different properties in different welding positions and types of joint.

General information about the influence of 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 electrodes
Unalloyed rutile electrodes are not normally recommended for welding steel with a nominal tensile strength exceeding 440 MPa (45 kp/mm^2). Rutile electrodes are relatively insensitive to moisture.

High-efficiency rutile electrodes
High-efficiency rutile electrodes generally produce a higher welding speed, which increases as the weld metal recovery increases, up to a maximum of about 140 g/minute for 6mm diameter OK Femax 33.80.

They are all easy to use, produce 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, those of the weld metal from unalloyed basic electrodes but have lower elongation and impact strength.

The evenness of the weld and the smooth transition of the base material make joints produced with rutile electrodes at least as good in terms of fatigue strength as unmachined joints produced using basic electrodes. Unalloyed rutile electrodes, irrespective of their efficiency, can be recommended for welding mild steel with a nominal tensile strength of 440 MPa (45 kp/mm^2). When it comes to the tensile strength of the deposit, rutile electrodes can also be used for welding steels with a nominal tensile strength of more than 440 MPa (45 kp/mm^2), but, as a general rule, only electrodes producing a weld metal with a low hydrogen content, e.g. basic, rutilebasic or zircon-basic electrodes, should be used to weld these steels.

Acid electrodes
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 that produced by rutile electrodes, but it 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 with a nominal tensile strength of up to 440 MPa (45 kp/mm^2).

High-efficiency acid electrodes
High-efficiency acid electrodes have a considerably higher welding speed than normal electrodes, up to a maximum of about 120 g/min for 6 mm diameter 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 welds in the flat position. OK Femax 39.50 in long lengths is suitable for gravity welding with short-neck equipment.

The weld metal has the same strength as that produced by normal acid electrodes and the range of applications is therefore similar, i.e. they are suitable for welding mild steels with a nominal tensile strength of no more than 440 MPa (45 kg/mm^2).

Unalloyed basic electrodes
Unalloyed basic electrodes give 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 that of other electrodes which can be used in this position. This results in a smaller number of electrode changes. The normal result is therefore a higher fusion rate and higher arctime 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, in spite of this, 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 has good toughness even at low temperatures. Basic electrodes are less likely to produce 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's plate with a nominal tensile strength of 490-530 MPa (50-54 kp/mm^2). The higher the hardenability of the steel to be welded, the greater the necessity to use basic electrodes and the greater the need for low moisture content in the coating.

Zircon-basic, high-efficiency electrodes
Zircon-basic, high-efficiency electrodes are the fastest of all and are preferably deposited in the flat position. OK Femax 38.95 deposits a maximum of 250 g/min. with 6 mm diameter electrodes. Zircon-basic, high-efficiency electrodes can be used for welding the same steels as unalloyed 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.

Rutile-basic, high-efficiency electrodes
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 performing 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 standard unalloyed basic electrodes or unalloyed zirconbasic, high-efficiency electrodes.

OK Femax 38.85 is the fastest low-hydrogen electrode for horizontal fillet welds.

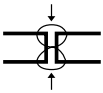
Cellulose electrodes
Cellulose electrodes are easy to use in all welding positions and are particularly good for vertical and overhead welding. Cellulose electrodes are recommended for all-positional welding where the mechanical properties of the deposit are of the greatest importance and radiographic requirements must be met. Vertical and overhead welding often require an electrode one size larger in comparison to electrodes with other types of coating. Cellulose electrodes are extremely good for vertical-down welding.

Higher tensile steel requires preheating and higher interpass temperatures than when the welding is done with low-hydrogen electrodes.

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 on their respective pages.

Square butt joints: Joint volumes and weld metal weights

Position	Plate thickness mm	Gap mm	Volume/length cm^3/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	2.5	13	0.10
	7	3	16	0.13
	4	2	10.5	0.08
	5	2	16	0.13
	6	2.5	18	0.14
	7	3	21	0.16

Calculation of electrode consumption

Single V-joints: volumes and weld metal weights

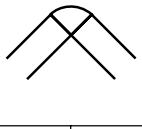
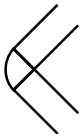
Plate thickness mm	Gap mm	50° Flat			60° Flat			70° Vertical			80° Overhead			60° Horizontal-Vertical		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
4	1	11.5	11	0.09	13	12.5	0.10	15	16.5	0.13	17.5	18	0.14	13	14.5	0.11
5	1	16.5	16	0.13	19.5	19	0.15	22.5	24.5	0.19	26	28	0.22	19.5	21	0.16
6	1	23	21.5	0.17	27	25.5	0.20	31	37	0.29	36	38.5	0.30	27	30	0.24
7	1.5	33.5	32.5	0.26	39	38	0.30	45	49	0.38	51.5	56	0.44	39	42	0.33
8	1.5	42	40	0.31	49	46.5	0.37	57	59.5	0.47	65.5	70	0.55	49	56	0.44
9	1.5	51	48	0.38	60.5	56	0.44	70	75.5	0.59	81.5	87.5	0.69	60.5	65	0.51
10	2	66.5	62	0.49	77.5	72	0.57	90	96.5	0.76	104	109	0.86	77.5	81	0.64
11	2	78.5	71.5	0.56	92	83.5	0.66	107	113	0.89	124	130	1.02	92	96.5	0.76
12	2	91	83	0.65	107	97.5	0.77	125	134	1.05	145	157	1.23	107	113	0.89
14	2	120	110	0.86	141	130	1.02	165	171	1.34	193	204	1.60	141	159	1.17
15	2	135	123	0.97	160	146	1.15	188	197	1.55	219	231	1.81	160	171	1.34
16	2	151	132	1.04	180	157	1.23	211	223	1.75	247	257	2.02	180	186	1.46
18	2	189	170	1.33	223	204	1.60	263	276	2.17	308	320	2.51	223	233	1.83
20	2	227	208	1.63	271	247	1.94	320	334	2.62	376	396	3.11	271	281	2.21
25	2	341	313	2.46	411	375	2.94	488	510	4.00	577	606	4.76	411	425	3.34

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

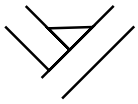
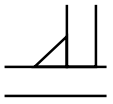
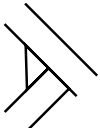
The first run and backing run V-joints: Weld metal weights

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

Calculation of electrode consumption
Corner welds: Actual joint volumes and weld metal weights

Plate thickness	Section size								
mm	mm^2	cm^3/m	kg/m	cm^3/m	kg/m	cm^3/m	kg/m	cm^3/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: Actual joint volumes and weld metal weights

Throat thickness	Section size								
mm	mm^2	cm^3/m	kg/m	cm^3/m	kg/m	cm^3/m	kg/m	cm^3/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	108	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

Hardness Scales

STATIC INDENTATION METHODS

Vickers or Diamond Pyramid Hardness HV,	Rockwell C Scale HRC, Rc	Hardness B Scale HRB, R_B	Brinell HB, HBr Steel Ball	Hardness BHN Tungsten Carbide Ball
1000	69	-	-	-
950	68	-	-	-
900	67	-	-	-
850	66	-	-	-
800	64	-	-	722
750	62	-	-	691
700	60	-	-	656
650	58	-	-	611
600	55	-	-	564
580	54	-	-	545
560	53	-	-	525
540	52	-	496	507
520	51	-	480	488
500	49	-	465	471
480	48	-	448	452
460	46	-	433	433
440	45	-	415	415
420	43	-	397	397
400	41	-	379	379
380	39	-	360	360
360	37	-	341	341
340	34	-	322	322
320	32	-	303	303
300	30	-	284	284
280	27	-	265	265
260	24	-	247	247
240	20	98	228	228
220	-	95	209	209
200	-	92	190	190
180	-	87	171	171
160	-	82	152	152
140	-	75	133	133
120	-	67	114	114
100	-	56	95	95

This table must be regarded as giving no more than a general indication of the hardness relationships for steels.

General information

Conversions and Information

ELECTRODE SIZE EQUIVALENTS

Diameters

mm	SWG	in
1.6	16	1/16
2	14	5/64
2.5	12	3/32
3.25	10	1/8
4	8	5/32
5	6	3/16
6	4	1/4
8	-	5/16

Lengths

mm	in
250	10
300	12
350	14
400	16
450	18
600	24
700	28

APPROXIMATE METAL DENSITIES

	(g/cm3 at +20°C)
Steel, 0.06% /0.4% Mn	7.87
Steel, 0.1% C/5% Cr	7.81
Steel - 0. 1 5% C/1 3% Cr	7.74
Steel: 0.2% C/26% C,	7.66
Stainless Steel 19% Cr/10% Ni/0.03% C	7.93
Stainless Steel 25% Cr/20% Ni/0.2% C	7.9
Aluminium, commercial Purity	2.7
Al/1.3% Mn	2.74
Al/11% Si	2.65
Copper, O.F.H.C	8.94
Cu/7.5% Sn/0.2% P	8.9

SYMBOLS FOR CHEMICAL ELEMENTS

Al	Aluminium	Nb	Niobium
C	Carbon	Ni	Nickel
Cb (Niobium)	Columbium	O	Oxygen
Co	Cobalt	P	Phosphorus
Cr	Chromium	Pb	Lead
Cu	Copper	S	Sulphur
H	Hydrogen	Sn	Tin
Fe	Iron	Ta	Tantalum
Mg	Magnesium	Ti	Titanium
Mn	Manganese	V	Vanadium
Mo	Molybdenum	W	Tungsten
N	Nitrogen	Zn	Zinc

General information

Conversions and Information

BASIC CONVERSION FACTORS

To Convert	Into	Multiply by:
(NB Factors ending in 0 are exact)		
in	mm	25.40
mm	in	0.0393701
ft	m	0.3048
m	ft	3.2808398
lb	kg	0.453592370
kg	lb	2.20462
ton (long)	tonne	1.01605
tonne	kg	1000.0
gallon (imp)	l (litre)	4.54596
l	ml	1000.0
ml	cm^3	1.000028
cu ft	l	28.3161

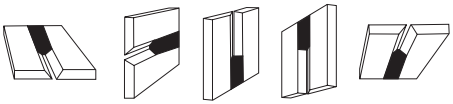
COMPOUND CONVERSION FACTORS

$tonf/in^2$	$N/m\ M^2$	15.444 3
lbf/in^2	$N/m\ M^2$	0.006 894 777
N/mm^2	$tonf/in^2$	0.064 749
N/mm^2	lbf/in^2	145.03776
ft lbf	J (joules)	1.35582
kgf m	J	9.806650
kgf m	ft lbf	7.23301
ft lbf	kgf m	0.138255
J	ft lbf	0.737562
in/min	m/hr	1.5240
m/hr	in/min	0.656168
cu ft/hr	l/min	0.47195
l/min	cu ft/hr	2.118936
lb/cu ft	g/cm^3	0.01602
g/cm^3	lb/cu ft	62.43

General information

Welding Positions in accordance with ASME IX / BS EN ISO 6947

Basic Welding Positions



Flat or downhand (1G)

Horizontal/ Vertical (2G)

Vertical up (3G)

Vertical down (3G)

Overhead (4G)

World leader in welding and cutting technology and systems.

World leader in welding and cutting technology and systems
ESAB operates at the forefront of welding and cutting technology. Over one hundred years of continuous improvement in products and processes enables us to meet the challenges of technological advance in every sector in which ESAB operates.

Quality and environment standards
Quality and the environment are two key areas of focus. ESAB is one of few international companies to have achieved the new ISO 14001 standard in Environmental Management Systems across all our global manufacturing facilities.

At ESAB, quality is an ongoing process that is at the heart of all our production processes and facilities worldwide.

Multinational manufacturing, local representation and an international network of independent distributors brings the benefits of ESAB quality and unrivalled expertise in materials and processes within reach of all our customers, wherever they are located.

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ESAB Limited
Hanover House, Queensgate, Britannia Road,
Waltham Cross, Hertfordshire,
EN8 7TF England
Telephone: 01992 760698 Fax: 01992 719191
Email: info@esab.co.uk Website www.esab.co.uk

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