WELDING FILLER METAL HANDBOOK

INDIA 2021

Covered (Stick) Electrodes (SMAW)

ESAB FERROSPEED

ESAB FERROSPEED is a rutile-coated general-purpose electrode for welding structures that are not subjected to heavy dynamic loading and is specially designed for higher tolerance to less cleaned plates and poor joint fit-ups. The electrode has high current carrying capacity and produces quality weld metal.

Classifications:	SFA/AWS A5.1:E6012, IS 814:ER4124
Approvals:	IRS 1

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+-
Alloy Type:	C-Mn
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	430 MPa	520 MPa	25 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	27 °C	85 J
As Welded	20 °C	70 J

Typical Weld Metal Analysis %

C	Mn	Si
0.08	0.35	0.20

Current Range

Diameter	Current
3.15 x 450 mm	95-140 A
4.0 x 450 mm	120-190 A
5.0 x 450 mm	170-260 A

ESAB FERROARC

ESAB FERROARC is a medium coated general purpose mild steel electrode, which operates on low OCV (50V) AC in all positions. It delivers smooth and stable welding arc with low spatter, excellent slag detachability and smooth weld bead appearance. The weld deposit is of radiographic quality.

Classifications:	SFA/AWS A5.1:E6013, IS 814:ER4211X
Approvals:	ABS 2, BV 2, IBR E6013, IRS 2, LR 2m

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+-
Alloy Type:	C-Mn
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	420 MPa	500 MPa	26 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	0 °C	80 J

Typical Weld Metal Analysis %

C	Mn	Si
0.08	0.35	0.20

Current Range

Diameter	Current
2.5 x 350 mm	50-80 A
3.15 x 350 mm	70-120 A
3.15 x 450 mm	70-120 A
4.0 x 450 mm	90-170 A
5.0 x 450 mm	150-260 A

ESAB FERROSPEED PLUS

ESAB FERROSPEED PLUS is a medium-heavy coated mild steel welding electrode for all positions, having good mechanical properties and arc characteristics. It operates on low open circuit voltage and its good running characteristics results in excellent weld finish of radiographic quality. It is also known for its superior V-down welding capabilities.

Classifications:	SFA/AWS A5.1:E6013, IS 814:ER4211X
Approvals:	ABS 2, BV 2, DNV 2, IBR E6013, IRS 2, LR 2m, PDIL E6013, M N Dastur E6013

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+-
Alloy Type:	C-Mn
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	400 MPa	500 MPa	27 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	0 °C	80 J

Typical Weld Metal Analysis %

C	Mn	Si
0.08	0.30	0.20

Current Range

Diameter	Current
2.5 x 350 mm	50-85 A
3.15 x 350 mm	70-120 A
3.15 x 450 mm	70-110 A
4.0 x 450 mm	90-180 A
5.0 x 450 mm	150-250 A

ESAB 28

ESAB 28 is a medium heavy rutile coated mild steel electrode designed for welding of unalloyed structural steels in all positions. The electrode gives smooth radiographic quality weld with low spatter and smoke. Slag is self detachable and the bead shape is uniform and finely rippled.

Classifications:	SFA/AWS A5.1:E6013, EN ISO 2560-A:E 38 0 RC 11, IS 814:ER4212X
Approvals:	ABS 2, BV 2, DNV 2, IBR E6013, IRS 2, LR 2m, PDIL E6013

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+-
Alloy Type:	C-Mn
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	420 MPa	510 MPa	28 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	0 °C	90 J

Typical Weld Metal Analysis %

C	Mn	Si
0.08	0.35	0.25

Current Range

Diameter	Current
2.5 x 350 mm	50-80 A
3.15 x 350 mm	70-120 A
3.15 x 450 mm	70-120 A
4.0 x 450 mm	100-170 A
5.0 x 450 mm	150-260 A

ESAB VORDIAN

ESAB VORDIAN is an all position medium heavy rutile coated mild steel welding electrode of outstanding quality permitting the use of low open circuit voltages. It is extremely suitable for flat and horizontal-vertical positions, as well as for vertical and overhead welding.

Classifications:	SFA/AWS A5.1:E6013, IS 814:ERR4221X
Approvals:	BV 2, IRS 2,

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+-
Alloy Type:	C-Mn
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	430 MPa	490 MPa	29 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	0 °C	90 J

Typical Weld Metal Analysis %

C	Mn	Si
0.07	0.35	0.20

Current Range

Diameter	Current
2.5 x 350 mm	50-80 A
3.15 x 450 mm	70-120 A
4.0 x 450 mm	100-170 A
5.0 x 450 mm	150-240 A

ESAB VORTIC

ESAB VORTIC is a medium coated general purpose mild steel electrode, especially designed for use in vertical and over head positions. This is a rutile coated electrode, with fast freezing slag and excellent slag detachability even in deep grooves.

Classifications:	SFA/AWS A5.1:E6013, IS 814:ER4224X

Welding Current:	AC, DC+-
Alloy Type:	C-Mn
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	430 MPa	470 MPa	25 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	0 °C	70 J

Typical Weld Metal Analysis %

C	Mn	Si
0.07	0.40	0.20

Current Range

Diameter	Current
2.5 x 350 mm	50-100 A
3.15 x 450 mm	100-130 A
4.0 x 450 mm	130-180 A
5.0 x 450 mm	150-260 A

ESAB FERROWELD 1

ESAB FERROWELD 1 is a basic coated, hydrogen controlled electrode for welding mild, medium tensile, low alloy, free cutting, difficult to weld steels and grey cast iron (non-machinable deposits) in all positions. The composition of coating ensures complete absence of porosity and cracking.

Classifications:	SFA/AWS A5.1:E7016, IS 814:EB5424H3X
Approvals:	IBR E7016

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+-
Diffusible Hydrogen:	<5.0 ml/100g
Alloy Type:	C-Mn
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	450 MPa	540 MPa	32 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	-20 °C	90 J
As Welded	-30 °C	60 J

Typical Weld Metal Analysis %

C	Mn	Si
0.06	1.00	0.70

Current Range

Diameter	Current
2.5 x 350 mm	60-90 A
3.15 x 450 mm	95-140 A
4.0 x 450 mm	130-190 A
5.0 x 450 mm	180-240 A

ESAB 36H

ESAB 36H is a basic coated, hydrogen controlled iron powder electrode designed for welding in all positions. It gives tough, crack resistant weld on mild and low alloy steels. It deposits good radiographic quality welds and is ideal for welding restraint structures where stresses can not be avoided.

Classifications:	SFA/AWS A5.1:E7018, EN ISO 2560-A:E 42 3 B 32 H5
Approvals:	ABS 3YH5, BV 3YHH, DNV 3YH10, IBR E7018, IRS 3YHH, LR 3YmH15, PDIL E7018, M N Dastur

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+
Diffusible Hydrogen:	< 5.0 ml/100g
Alloy Type:	C-Mn
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	470 MPa	550 MPa	28 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	-30 °C	100 J
As Welded	-40 °C	80 J

Typical Weld Metal Analysis %

C	Mn	Si
0.08	1.20	0.40

Current Range

Diameter	Current
2.5 x 350 mm	60-100 A
3.15 x 450 mm	80-130 A
4.0 x 450 mm	100-190 A
5.0 x 450 mm	180-260 A

ESAB 36H (SPL)

ESAB 36H (SPL) is a basic coated low hydrogen iron powder electrode for low temperature applications. It is an all positional electrode for welding medium tensile and fine grained carbon steels. The electrode exhibits very good mechanical properties after extended post weld heat treatment.

Classifications:	SFA/AWS A5.1:E7018-1
Approvals:	ABS E7018-1, IBR E7018-1, LR 4Y40mH15, PDIL E7018-1

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+
Diffusible Hydrogen:	< 5.0 ml/100g
Alloy Type:	C-Mn
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	500 MPa	570 MPa	32 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	-30 °C	135 J
As Welded	-40 °C	90 J
As Welded	-46 °C	75 J

Typical Weld Metal Analysis %

C	Mn	Si
0.07	1.30	0.30

Current Range

Diameter	Current
2.5 x 350 mm	60-100 A
3.15 x 450 mm	80-140 A
4.0 x 450 mm	100-190 A
5.0 x 450 mm	180-260 A

OK 55.00

OK 55.00 is a reliable, high-quality, LMA electrode, particularly suitable for welding high strength low-alloy steels. 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 also suitable for welding high strength ships steel, grades A, D and E.

Classifications:	SFA/AWS A5.1:E7018-1H4 R, CSA W48:E4918-1-H4, EN ISO 2560-A:E 46 5 B 32 H5
Approvals:	ABS 3Y H5, BV 3Y H5, CE EN 13479, CWB E4918-1-H4, DB 10.039.03, DNV-GL 3Y H5, LR 3Ym H5, NAKS/HAKC 2.5-4.0 mm, RS 3Y H5, VdTÜV 00632

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+
Diffusible Hydrogen:	< 4.0 ml/100g
Alloy Type:	Carbon Manganese
Coating Type:	Basic covering

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
ISO			
As Welded	500 MPa	590 MPa	28 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
ISO		
As Welded	-45 °C	105 J
As Welded	-50 °C	100 J

Typical Weld Metal Analysis %

C	Mn	Si
0.06	1.5	0.5

Other Properties

HIC test according to NACE TM0284	Satisfactory
SSC test according to NACE TM0177	Satisfactory

Current Range

Diameter	Current
2.5 x 350 mm	80-110 A
3.2 x 450 mm	110-140 A
4.0 x 450 mm	140-200 A
5.0 x 450 mm	200-270 A

ESAB PIPEWELD 6010R

ESAB PIPEWELD 6010R is a high cellulose coated electrode for welding of pipes. The electrode is designed to provide deep and complete penetration. The weld bead obtained is smooth with a thin, fast freezing and easily removable slag giving radiographic quality weld metal.

Classifications:	SFA/AWS A5.1:E6010, IS 814:EC4410X
Approvals:	PDIL E6010

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	DC+
Alloy Type:	C-Mn
Coating Type:	Cellulosic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	440 MPa	520 MPa	26 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	-30 °C	60 J

Typical Weld Metal Analysis %

C	Mn	Si
0.10	0.65	0.35

Current Range

Diameter	Current
2.5 x 350 mm	50-80 A
3.15 x 350 mm	80-120 A
4.0 x 350 mm	100-150 A

OK 73.08

OK 73.08 is a Ni-Cu alloyed low hydrogen electrode, which deposits a weld metal with good corrosion resistance to sea water and flue gases. The weld metal has excellent mechanical properties. It is used for the welding of weather proof steel and ship's hull structural steel and shell plating of ice-breakers.

Classifications:	SFA/AWS A5.5:E8018-G, IS 1395:E55BG129Fe

Welding Current:	AC, DC+
Diffusible Hydrogen:	< 5 ml/100g
Alloy Type:	Ni-Cu alloyed
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	500 MPa	580 MPa	28 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	-20 °C	120 J

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cu
0.07	1.20	0.40	0.45	0.45

Current Range

Diameter	Current
2.5 x 350 mm	75-100 A
3.15 x 450 mm	100-140 A
4.0 x 450 mm	140-200 A
5.0 x 450 mm	190-270 A

OK 74.46

OK 74.46 is a 0.5Mo alloyed low hydrogen electrode for welding of similar alloyed type creep resistant steels. The specially designed running characteristics make it suitable for welding joints in the inclined positions. It deposits a weld metal with good crack resistance and creep resistance up to a temperature of 525°C.

Classifications:	SFA/AWS A5.5:E7018-A1, IS 1395:E49BA126Fe
Approvals:	IBR E7018-A1, PDIL E7018-A1

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+
Diffusible Hydrogen:	< 4 ml/100g
Alloy Type:	Mo alloyed
Coating Type:	Lime Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
PWHT 620°C 1h	470 MPa	550 MPa	28 %

Typical Weld Metal Analysis %

C	Mn	Si	Mo
0.06	0.70	0.30	0.55

Current Range

Diameter	Current
2.5 x 350 mm	70-100 A
3.15 x 450 mm	90-150 A
4.0 x 450 mm	120-180 A
5.0 x 450 mm	160-250 A

OK 76.18

OK 76.18 is a basic coated, hydrogen controlled iron powder type electrode, for welding creep resistant steels of 1.25Cr-0.5Mo or similar type, used in high temperature components of power plants, boilers, oil refineries, petrochemical plants etc. The slag system is designed in such a way that the electrode welds with a stable arc and minimum spatter. It welds without short-circuiting and deposits a weld metal resistant to both cracking and porosity. The weld metal is resistant to scaling up to 575°C.

Classifications:	SFA/AWS A5.5:E8018-B2, IS 1395:E55BB224Fe
Approvals:	IBR E8018-B2, PDIL E8018-B2

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	DC+(-)
Diffusible Hydrogen:	< 4 ml/100g
Alloy Type:	Cr-Mo alloyed
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
PWHT 690°C 1h	500 MPa	600 MPa	26 %

Typical Weld Metal Analysis %

C	Mn	Si	Cr	Mo
0.06	0.70	0.40	1.40	0.60

Current Range

Diameter	Current
2.5 x 350 mm	70-100 A
3.15 x 450 mm	90-150 A
4.0 x 450 mm	140-180 A
5.0 x 450 mm	180-240 A

OK 76.16

Basic DC low hydrogen electrode for welding creep resisting steels of the type 1.25 % Cr 0.5 % Mo.

Classifications:	SFA/AWS A5.5:E8018-B2-H4R, EN ISO 3580-A:E CrMo1B 4 2 H5
Approvals:	CE EN 13479, NAKS/HAKC , VdTÜV 10731, Seproz UNA 272580

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	DC+(-)
Diffusible Hydrogen:	< 4.0 ml/100g
Alloy Type:	1.25 % Cr - 0.5 % Mo

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
PWHT 690°C 22h	520 MPa	600 MPa	28 %
ISO			
PWHT 690°C 2h	560 MPa	640 MPa	25 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
PWHT 690°C 22h	-20 °C	175 J
PWHT 690°C 22h	-30 °C	150 J
ISO		
PWHT 690°C 2h	20 °C	150 J
PWHT 690°C 2h	-20 °C	120 J
PWHT 690°C 2h	-30 °C	95 J

Typical Weld Metal Analysis %

C	Mn	Si	Cr	Mo
0.06	0.7	0.3	1.3	0.5

Current Range

Diameter	Current
2.5 x 350 mm	70-110 A
3.2 x 350 mm	95-150 A
4.0 x 350 mm	130-190 A
5.0 x 450 mm	150-260 A

OK 76.28

OK 76.28 is a basic coated hydrogen controlled iron powder type electrode, depositing a weld metal of the type 2.25Cr-1Mo, suitable for welding of similar Cr-Mo steels, used in high temperature components of power plants, boilers, oil-refineries, petrochemical plants etc. The slag system is designed in such a way that the electrode welds with a stable arc and minimum spatter. The weld metal provides scaling resistance up to 600°C.

Classifications:	SFA/AWS A5.5:E9018-B3, IS 1395:E63BB324Fe
Approvals:	IBR E9018-B3, PDIL E9018-B3

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+-
Diffusible Hydrogen:	< 5 ml/100g
Alloy Type:	Cr-Mo alloyed
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
PWHT 690°C 1h	590 MPa	680 MPa	23 %

Typical Weld Metal Analysis %

C	Mn	Si	Cr	Mo
0.06	0.75	0.35	2.35	1.00

Current Range

Diameter	Current
2.5 x 350 mm	60-90 A
3.15 x 450 mm	90-150 A
4.0 x 450 mm	120-180 A
5.0 x 450 mm	140-270 A

OK 76.26

Basic low-hydrogen electrode for the AC/DC welding of creep-resistant steels of the 2.3% Cr/1% Mo type, such as SA - 387 Grade 22/A 335 Grade P22 or similar. The weld metal has the extra-low impurity levels specified in step-cooling requirements.

Classifications:	SFA/AWS A5.5:E9018-B3, EN ISO 3580-A:E CrMo2 B 32 H5
Approvals:	CE EN 13479, NAKS/HAKC 2.5-5.0 mm, VdTÜV 10732, Seproz UNA 272580

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+
Diffusible Hydrogen:	< 5.0 ml/100g
Alloy Type:	Cr-Mo
Coating Type:	Lime Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
ISO			
PWHT 690°C 1h	650 MPa	740 MPa	19 %
PWHT 690°C 4h	520 MPa	610 MPa	21 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
ISO		
PWHT 690°C 1h	-20 °C	60 J
PWHT 690°C 4h	20 °C	170 J
PWHT 690°C 4h	-20 °C	140 J

Typical Weld Metal Analysis %

C	Mn	Si	Cr	Mo
0.07	0.69	0.23	2.17	1.10

Current Range

Diameter	Current
2.5 x 350 mm	60-85 A
3.2 x 350 mm	90-130 A
4.0 x 450 mm	130-190 A
5.0 x 450 mm	150-260 A

ESAB KV4

ESAB KV4 is a 5Cr-0.5Mo alloyed basic coated low hydrogen electrode, used for welding creep resistant Cr-Mo bearing steels. It deposits a weld metal that is highly resistant to heat and corrosion. The electrode is designed to provide a stable arc, minimum spatter and superior weld bead. ESAB KV4 finds extensive use in the oil refineries, chemical and petrochemical Industries where it has to resist corrosion and hydrogen attack at high temperatures.

Classifications:	SFA/AWS A5.5:E8018-B6, IS 1395:E55BB620

Welding Current:	DC+
Diffusible Hydrogen:	< 5 ml/100g
Alloy Type:	Cr-Mo alloyed
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
PWHT 740°C 1h	480 MPa	570 MPa	20 %

Typical Weld Metal Analysis %

C	Mn	Si	Cr	Mo
0.06	0.70	0.45	5.00	0.50

Current Range

Diameter	Current
2.5 x 350 mm	60-90 A
3.15 x 350 mm	90-130 A
4.0 x 350 mm	120-160 A
5.0 x 450 mm	160-240 A

ATOM ARC 9018-B91

Atom Arc 9018-B91 is designed to weld martensitic 9Cr-1Mo-V steels known by the designations T91, P91 or Grade 91. These steels are designed to provide improved creep strength, fatigue, oxidation and corrosion resistance at elevated temperatures. It also provides good weld metal ductility and high charpy values at room temperature. This product is optimized to meet the requirements for Mn + Ni contents <1.0 %.

Classifications:	SFA/AWS A5.5:E9018-B91 H4 R

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Reduction in Area	Elongation
PWHT 760°C 2h	593 MPa (86 ksi)	731 MPa (106 ksi)	62 %	25 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
PWHT 760°C 2h	21 °C (70 °F)	94 J (69 ft-lb)

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo	V	Cu	Mn+Ni	N	Nb	X-Factor
0.10	0.75	0.20	0.21	8.48	0.92	0.21	0.04	<1.0	0.043	0.04	<15 ppm

Current Range

Diameter	Current
2.4 mm (3/32 in.)	70-100 A
3.2 mm (1/8 in.)	90-160 A
4.0 mm (5/32 in.)	130-220 A
4.8 mm (3/16 in.)	200-300 A

ESAB FERROWELD W2

ESAB FERROWELD W2 is a Cr-Ni-Cu alloyed basic coated hydrogen controlled electrode, suitable for welding of weathering steels, steels having greater resistance to atmospheric corrosion as compared to normal steels and high tensile strength steels. The electrode is designed to provide excellent striking and re-striking properties, stable arc, easily detachable slag and smooth weld bead. It is specially recommended for weathering steels like COR-TEN A/B and their equivalents.

Classifications:	SFA/AWS A5.5:E8018-W2

Welding Current:	DC+
Diffusible Hydrogen:	< 5 ml/100g
Alloy Type:	Cr-Ni-Cu alloyed
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	560 MPa	650 MPa	27 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	-20 °C	80 J

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Cu
0.06	0.90	0.50	0.60	0.60	0.40

Current Range

Diameter	Current
2.5 x 350 mm	50-90 A
3.15 x 450 mm	75-140 A
4.0 x 450 mm	140-190 A
5.0 x 450 mm	190-240 A

ESAB 98

ESAB 98 is a Cr-Ni-Mo alloyed hydrogen controlled iron powder type electrode, for welding high tensile strength steels. The electrode deposits, tough and crack resistant welds. The optimum addition of iron powder permits the use of higher currents and results in improved arc characteristics coupled with higher metal recovery. The operational characteristics are excellent in all positions. ESAB 98 finds extensive use in pressure vessels, piping, penstock, earth moving equipment, machinery parts, automobile parts, chemical plants etc.

Classifications:	SFA/AWS A5.5:E9018M

Welding Current:	AC, DC+
Diffusible Hydrogen:	< 5 ml/100g
Alloy Type:	Cr-Ni-Mo alloyed
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	570 MPa	640 MPa	29 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	-50 °C	110 J

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo
0.05	1.00	0.40	1.60	0.10	0.25

Current Range

Diameter	Current
2.5 x 350 mm	50-90 A
3.15 x 450 mm	90-140 A
4.0 x 450 mm	140-190 A
5.0 x 450 mm	190-240 A

ESAB 118

ESAB 118 is a Cr-Ni-Mo alloyed low hydrogen electrode, for welding high strength low alloy steels including quenched and tempered steels. The electrode gives a tough weld metal without the risk of temper brittleness. The all position electrode has excellent arc and current carrying characteristics, with an easily removable slag and excellent bead finish contributing to its immense welder appeal. Used for components of penstock, earth moving equipment and other heavy steel fabrications made of high tensile strength steels.

Classifications:	SFA/AWS A5.5:E11018M

Welding Current:	AC, DC+
Diffusible Hydrogen:	< 5 ml/100g
Alloy Type:	Cr-Ni-Mo alloyed
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	690 MPa	780 MPa	25 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	-50 °C	50 J

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo
0.05	1.40	0.40	2.20	0.15	0.40

Current Range

Diameter	Current
2.5 x 350 mm	75-110 A
3.15 x 450 mm	90-140 A
4.0 x 450 mm	140-190 A
5.0 x 450 mm	160-240 A

ESAB 120

ESAB 120 is a Cr-Ni-Mo alloyed low hydrogen electrode, for welding ultra high strength low alloy steels. The electrode is designed to give a tough weld metal avoiding risk of temper brittleness. The operational characteristics are excellent in all positions.

Classifications:	SFA/AWS A5.5:E12018M

Welding Current:	AC, DC+
Diffusible Hydrogen:	< 5 ml/100g
Alloy Type:	Cr-Ni-Mo alloyed
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	790 MPa	860 MPa	20 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	-50 °C	70 J

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo
0.06	1.60	0.25	2.35	0.90	0.40

Current Range

Diameter	Current
3.15 x 450 mm	90-140 A
4.0 x 450 mm	140-190 A
5.0 x 450 mm	190-240 A

OK 61.67

OK 61.67 is an AC/DC rutile coated 20Cr-10Ni stainless steel electrode suitable for welding of types 304, 304H & similar alloys. The unique flux coating allows easy striking & restriking and is completely free from short circuiting during welding.

Classifications:	SFA/AWS A5.4:E308/E308H-16

Welding Current:	DC+, AC
Ferrite Content:	3-10 FN
Alloy Type:	Austenitic Cr-Ni
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	470 MPa	630 MPa	42 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr
0.05	0.75	0.80	9.10	20.50

Current Range

Diameter	Current
2.5 x 350 mm	60-100 A
3.15 x 350 mm	70-100 A
4.0 x 350 mm	120-170 A
5.0 x 350 mm	160-210 A

OK 61.63

OK 61.63 is a rutile based low carbon 20Cr-10Ni type stainless steel electrode with controlled ferrite that provides excellent resistance to corrosion, cracking and high temperature scaling up to 800°C.

Classifications:	SFA/AWS A5.4:E308L-16
Approvals:	PDIL E308L-16

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+
Ferrite Content:	3-10 FN
Alloy Type:	Austenitic Cr-Ni
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	470 MPa	610 MPa	42 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr
0.025	0.65	0.85	10.00	20.00

Current Range

Diameter	Current
2.5 x 350 mm	60-90 A
3.15 x 350 mm	80-120 A
4.0 x 350 mm	120-170 A
5.0 x 350 mm	160-210 A

ESAB 304B

ESAB 304B is a low carbon, basic coated 19Cr-10Ni stainless steel electrode with outstanding welding properties in the vertical and overhead positions. The weld metal is highly resistant to cracking & porosity and has good impact toughness at very low temperatures.

Classifications:	SFA/AWS A5.4:E308L-15

Welding Current:	DC+
Ferrite Content:	2-8 FN
Alloy Type:	Austenitic Cr-Ni
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	450 MPa	570 MPa	40 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	-196 °C	30 J

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr
0.03	1.50	0.40	10.50	19.00

Current Range

Diameter	Current
2.5 x 350 mm	60-100 A
3.15 x 350 mm	80-120 A
4.0 x 350 mm	120-170 A

OK 61.80

OK 61.80 is a rutile type low carbon 19Cr-10Ni stabilized stainless steel electrode. Niobium minimizes the chromium carbide precipitation and thereby improves resistance to intergranular corrosion.

Classifications:	SFA/AWS A5.4:E347-16
Approvals:	IBR E347-16

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+
Ferrite Content:	3-10 FN
Alloy Type:	Austenitic Cr-Ni
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	500 MPa	630 MPa	35 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Nb
0.03	0.65	0.90	9.80	19.80	0.65

Current Range

Diameter	Current
2.5 x 350 mm	60-100 A
3.15 x 350 mm	80-120 A
4.0 x 350 mm	120-170 A

OK 63.67

OK 63.67 is a rutile based stainless steel electrode suitable for welding of types 316, 316H & similar alloys used in applications involving high temperature service. Molybdenum provides creep resistance and ductility at elevated temperatures.

Classifications:	SFA/AWS A5.4:E316/E316H-16

Welding Current:	AC, DC+
Ferrite Content:	5-10 FN
Alloy Type:	Austenitic Cr-Ni-Mo
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	500 MPa	600 MPa	40 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo
0.05	0.75	0.70	12.00	19.50	2.10

Current Range

Diameter	Current
2.5 x 350 mm	60-100 A
3.15 x 350 mm	70-100 A
4.0 x 350 mm	120-170 A

OK 63.63

OK 63.63 is a low carbon, rutile based electrode depositing a weld metal of the type 18Cr-12Ni-2.5Mo. It has good corrosion resistance, particularly in acid and chlorinated environments.

Classifications:	SFA/AWS A5.4:E316L-16
Approvals:	PDIL E316L-16

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+
Ferrite Content:	5-10 FN
Alloy Type:	Austenitic Cr-Ni-Mo
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	500 MPa	580 MPa	40 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo
0.03	0.60	0.85	12.00	18.30	2.30

Current Range

Diameter	Current
2.5 x 350 mm	60-100 A
3.15 x 350 mm	80-120 A
4.0 x 350 mm	120-170 A
5.0 x 350 mm	160-210 A

OK 67.67

OK 67.67 is a rutile based, all positional electrode depositing a weld metal of the type 23Cr-13Ni. The weld deposit provides excellent resistance to corrosion and oxidation at very high temperatures, up to 1100°C.

Classifications:	SFA/AWS A5.4:E309/E309H-16

Welding Current:	AC, DC+
Ferrite Content:	5-15 FN
Alloy Type:	Austenitic Cr-Ni
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	480 MPa	590 MPa	35 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr
0.05	0.70	0.75	13.20	23.50

Current Range

Diameter	Current
2.5 x 350 mm	60-100 A
3.15 x 350 mm	80-120 A
4.0 x 350 mm	120-170 A

OK 67.63

OK 67.63 is a rutile based, low carbon all positional electrode of 23Cr-13Ni type for joining of stainless steels to unalloyed or low alloyed steels. Also suitable for transition layers when surfacing mild or low alloyed steels with stainless steel weld metal.

Classifications:	SFA/AWS A5.4:E309L-16
Approvals:	PDIL E309L-16

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+
Ferrite Content:	5-15 FN
Alloy Type:	Austenitic Cr-Ni
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	490 MPa	600 MPa	40 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr
0.025	0.85	0.75	13.60	23.00

Current Range

Diameter	Current
2.5 x 350 mm	60-100 A
3.15 x 350 mm	80-120 A
4.0 x 350 mm	120-170 A
5.0 x 350 mm	160-210 A

ESAB 309LC

ESAB 309LC is a low carbon all positional basic coated electrode giving austenitic weld deposit of 23Cr-13Ni type. It is suitable for welding heat resistant Cr-Ni alloyed steels and stainless steels to unalloyed or low alloyed steels, where better toughness is required.

Classifications:	SFA/AWS A5.4:E309/E309L-15

Welding Current:	DC+
Ferrite Content:	10-18 FN
Alloy Type:	Austenitic Cr-Ni
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	470 MPa	590 MPa	32 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
As Welded	-50 °C	60 J

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr
0.03	1.00	0.75	13.70	23.50

Current Range

Diameter	Current
2.5 x 350 mm	60-100 A
3.15 x 350 mm	80-120 A
4.0 x 350 mm	120-170 A

OK 67.70

OK 67.70 is a rutile based, over alloyed stainless steel electrode giving a weld deposit of 23Cr-13Ni-2.5Mo type, for welding stainless steels to other types of steels and for use as a buffer layer in welding acid resisting clad steels.

Classifications:	SFA/AWS A5.4:E309Mo-16
Approvals:	PDIL E309Mo-16

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+
Ferrite Content:	15-24 FN
Alloy Type:	Austenitic Cr-Ni-Mo
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	520 MPa	650 MPa	32 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo
0.06	0.60	0.80	13.50	24.00	2.60

Current Range

Diameter	Current
2.5 x 350 mm	60-100 A
3.15 x 350 mm	80-120 A
4.0 x 350 mm	120-170 A

ESAB 309Mo

ESAB 309Mo is a basic coated, over-alloyed stainless steel electrode giving a weld deposit of 23Cr-13Ni-2.5Mo type, for welding stainless steels to other types of steels, where better toughness is required.

Classifications:	SFA/AWS A5.4:E309Mo-15

Welding Current:	DC+
Ferrite Content:	15-24 FN
Alloy Type:	Austenitic Cr-Ni-Mo
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	520 MPa	620 MPa	32 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo
0.06	0.80	0.80	13.00	24.00	2.50

Current Range

Diameter	Current
2.5 x 350 mm	60-100 A
3.15 x 350 mm	80-120 A
4.0 x 350 mm	120-170 A

ESAB 309LMo

ESAB 309LMo is a low carbon basic coated all positional stainless steel electrode, giving an austenitic weld deposit of 23Cr-13Ni-2.5Mo type for welding stainless steels to unalloyed and low alloyed steels. The weld metal has excellent resistance to corrosion and oxidation at elevated temperatures up to 1100°C.

Classifications:	SFA/AWS A5.4:E309LMo-15

Welding Current:	DC+
Ferrite Content:	15-22 FN
Alloy Type:	Austenitic Cr-Ni-Mo
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	500 MPa	600 MPa	34 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo
0.025	0.70	0.85	13.30	23.00	2.30

Current Range

Diameter	Current
2.5 x 350 mm	60-90 A
3.15 x 350 mm	80-120 A
4.0 x 350 mm	100-170 A

OK 67.13

OK 67.13 is an austenitic stainless steel electrode depositing a 25Cr-20Ni type weld deposit, which has excellent stability and oxidation resistance in continuous service up to 1100°C.

Classifications:	SFA/AWS A5.4:E310-16

Welding Current:	AC, DC+
Ferrite Content:	0 FN
Alloy Type:	Austenitic Cr-Ni
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	430 MPa	600 MPa	34 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr
0.10	1.70	0.60	21.00	26.50

Current Range

Diameter	Current
2.5 x 350 mm	60-100 A
3.15 x 350 mm	70-100 A
4.0 x 350 mm	120-170 A

OK 67.45

OK 67.45 is an austenitic stainless steel electrode giving a weld metal of the 20Cr-10Ni-5Mn type. The tough weld metal imparts excellent crack resistance, when welding steels of even poor weldability.

Classifications:	SFA/AWS A5.4:E307-16 (Nearest)

Welding Current:	AC, DC+
Alloy Type:	Austenitic Cr-Ni-Mn
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	450 MPa	610 MPa	45 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo
0.04	5.10	0.60	10.50	20.50	0.60

Current Range

Diameter	Current
2.5 x 300 mm	60-100 A
3.15 x 350 mm	70-100 A
4.0 x 350 mm	120-170 A
5.0 x 350 mm	160-210 A

ESAB ARMOID 1

ESAB ARMOID 1 is a stainless steel electrode designed for welding of armour plates and crack sensitive steels.

Welding Current:	AC, DC+
Alloy Type:	Austenitic Cr-Ni-Mo
Coating Type:	Rutile

Typical Tensile Properties

Condition	Tensile Strength	Elongation
AWS		
As Welded	730 MPa	35 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo
0.08	1.40	0.50	8.50	19.50	2.80

Current Range

Diameter	Current
3.15 x 350 mm	80-120 A
4.0 x 350 mm	120-170 A

ESAB RSW

ESAB RSW is a rutile coated all positional electrode for welding of complex dissimilar alloys and high strength steels with low heat input, giving sound joints free from any cracks and fissures. It is a specially designed high alloy electrode for joining steels of unknown composition. The weld metal has high strength combined with excellent resistance against impact, heat (excellent scaling resistance up to 1150°C) and corrosion.

Classifications:	SFA/AWS A5.4:E312-16

Welding Current:	AC, DC+
Ferrite Content:	30-45 FN
Alloy Type:	Stainless Duplex
Coating Type:	Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
As Welded	600 MPa	790 MPa	23 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr
0.09	1.80	0.50	10.00	30.00

Current Range

Diameter	Current
2.5 x 350 mm	60-100 A
3.15 x 350 mm	80-120 A
4.0 x 350 mm	120-170 A
5.0 x 350 mm	160-210 A

OK 68.15

OK 68.15 is a stainless-steel electrode which deposits a ferritic 13Cr weld metal. OK 68.15 is designed for welding steels of similar composition, when CrNi-alloyed austenitic stainless steel electrodes cannot be used, e.g. when the structure is going to be exposed to aggressive sulphuric gases. Depending on the welding parameters, the structure and consequently the mechanical properties of untreated weld metal can vary within fairly large limits.

Classifications:	EN 14700:E Fe7, EN ISO 3581-A:E 13 B 4 2, SFA/AWS A5.4:E410-15, Werkstoffnummer :1.4009
Approvals:	Seproz UNA 272580

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	DC+
Alloy Type:	13% Cr
Coating Type:	Lime Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS			
PWHT 750°C 1h	370 MPa	520 MPa	25 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS		
PWHT 750°C 6h	20 °C	55 J
PWHT 750°C 6h	0 °C	35 J
PWHT 750°C 6h	-20 °C	20 J

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr
0.04	0.3	0.4	0.1	12.9

Current Range

Diameter	Current
2.5 x 350 mm	65-115 A
3.2 x 450 mm	90-160 A
4.0 x 450 mm	120-220 A

OK 68.00

OK 68.00 is a rutile coated stainless steel electrode for the welding of stainless steel castings of the 13Cr4NiMo type.

Classifications:	SFA/AWS A5.4:E410NiMo-26

Welding Current:	AC, DC+
Alloy Type:	Martensitic 12Cr-4.5Ni-0.5Mo
Coating Type:	Rutile

Typical Tensile Properties

Condition	Tensile Strength	Elongation
AWS		
PWHT 610°C 1h	800 MPa	16 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo
0.05	0.55	0.40	4.75	12.00	0.55

Current Range

Diameter	Current
3.15 x 350 mm	90-120 A
4.0 x 350 mm	120-170 A

OK 67.50

OK 67.50 is an acid rutile coated type for welding of austenitic-ferritic stainless steels of CrNiMoN 22 5 3 - and CrNiN 23 4-types. The duplex all weld metal offers a high strength level combined with good ductility. The pitting corrosion resistance is good and the all weld metal is not sensitive for stress corrosion cracking.

Classifications:	EN ISO 3581-A:E 22 9 3 N L R 3 2, SFA/AWS A5.4:E2209-17, CSA W48:E2209-17, Werkstoffnummer: 1.4462
Approvals:	ABS Stainless, BV 2209, CE EN 13479, CWB CSA W48: E2209-17, DNV-GL Duplex, RINA 2209, Seproz UNA 272580, VdTÜV 04368

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	AC, DC+
Ferrite Content:	35-50 FN
Alloy Type:	Duplex CrNiMoN
Coating Type:	Acid Rutile

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
ISO			
As Welded	691 MPa	857 MPa	25 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
ISO		
As Welded	20 °C	50 J
As Welded	-30 °C	41 J

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo	N	Ferrite FN
0.03	0.8	0.8	8.8	23.2	3.2	0.16	42

Current Range

Diameter	Current
2.0 x 300 mm	30-65 A
2.5 x 300 mm	50-90 A
3.2 x 350 mm	80-120 A
4.0 x 350 mm	90-160 A
5.0 x 350 mm	150-220 A

OK 68.55

OK 68.55 is a basic coated electrode for welding austenitc-ferritic steels of the Super Duplex type, e. g. SAF 2507 and Zeron 100. OK 68.55 deposits a weld metal with high ductility.

Classifications:	EN ISO 3581-A:E 25 9 4 N L B 4 2, SFA/AWS A5.4:E2594-15, Werkstoffnummer :(1.4410)
Approvals:	DNV-GL Duplex

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	DC+
Ferrite Content:	35-50 FN
Alloy Type:	Austenitic CrNiMo
Coating Type:	Basic

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
ISO			
As Welded	700 MPa	900 MPa	28 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
ISO		
As Welded	20 °C	90 J
As Welded	-20 °C	70 J
As Welded	-40 °C	55 J
As Welded	-60 °C	45 J

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo	N	Ferrite FN
0.03	0.9	0.6	10.4	25.2	4.3	0.23	45

Current Range

Diameter	Current
2.5 x 300 mm	50-80 A
3.2 x 350 mm	60-100 A
4.0 x 350 mm	100-140 A

MIG/MAG Wires (GMAW)

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ESAB MW1

ESAB MW1 is a copper coated, Mn-Si alloyed solid wire for MIG/MAG welding of non alloyed steels, used in automotive, general construction, ship building etc. The wire has a carefully controlled wire chemistry and an unique surface technology that provides superior weld metal quality at high wire feed speeds.

Classifications Weld Metal:	EN ISO 14341-A:G 42 3 C1 3Si1, EN ISO 14341-A:G 42 3 M21 3Si1
Classifications Wire Electrode:	EN ISO 14341-A:G 3Si1, SFA/AWS A5.18:ER70S-6
Approvals:	DNV III MS/IIIT, IBR ER70S6, IRS 2M, 1T, LR 1T, 3S, RDSO Class I

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Mn-Si alloyed

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
C1 Shielding gas			
As Welded	430 MPa	530 MPa	26 %
M21 Shielding gas			
As Welded	450 MPa	560 MPa	23 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
C1 Shielding gas		
As Welded	-30 °C	70 J
M21 Shielding gas		
As Welded	-30 °C	80 J

Typical Wire Composition %

C	Mn	Si
0.075	1.45	0.85

Current Range

Diameter	Current	Voltage
0.8 mm	60-200 A	17-24 V
1.2 mm	120-330 A	18-30 V
1.6 mm	225-440 A	28-36 V
2.0 mm	300-550 A	32-41 V

OK AristoRod 12.50

OK Aristorod 12.50 is a non copper coated Mn-Si-alloyed G3Si1/ER70S-6 solid wire for the GMAW of non-alloyed steels, as used in general construction, automotive components, pressure vessel fabrication and shipbuilding.
OK Aristorod 12.50 is treated with ESAB's unique Advanced Surface Characteristics (ASC) technology, taking MAG welding operations to new levels of performance and all-round efficiency, especially in robotic and mechanised welding. Characteristic features include excellent start properties; trouble-free feeding at high wire speeds and lengthy feed distances; a very stable arc at high welding currents; extremely low levels of spatter; low fume emission; reduced contact tip wear and improved protection against corrosion of the wire.

Classifications Weld Metal:	EN ISO 14341-A:G 38 3 C1 3Si1, EN ISO 14341-A:G 42 4 M20 3Si1, EN ISO 14341-A:G 42 4 M21 3Si1
Classifications Wire Electrode:	EN ISO 14341-A:G 3Si1, SFA/AWS A5.18:ER70S-6, CSA W48:B-G 49A 3 C1 S6, JIS Z 3312:YGW 12 (C1)
Approvals:	ABS 3Y SA, BV SA3YM, CE EN 13479, CWB B-G 49A 3 C1 S6 (B-G 49A 3 C G6), DB 42.039.29, DNV-GL III YMS, JIS YGW12 (C1), LR 3YS H15, NAKS/HAKC 1.2-1.6 mm, PRS 3YS, RINA 3Y S, RS 3Y40MS, VdTÜV 10052

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Mn-Si alloyed

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
EN 80Ar/20CO2 (M21)			
As Welded	470 MPa	560 MPa	26 %
PWHT 620°C 15h	370 MPa	495 MPa	28 %
EN CO2 (C1)			
As Welded	440 MPa	540 MPa	25 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
EN 80Ar/20CO2 (M21)		
As Welded	-20 °C	120 J
As Welded	-30 °C	100 J
As Welded	-40 °C	90 J
As Welded	-50 °C	70 J
PWHT 620°C 15h	-20 °C	90 J
EN CO2 (C1)		
As Welded	-30 °C	75 J

Typical Wire Composition %

C	Mn	Si
0.08	1.46	0.85

OK AristoRod 12.50

Current Range		
Diameter	**Current**	**Voltage**
0.8 mm	60-200 A	18-24 V
0.9 mm	70-250 A	18-26 V
1.0 mm	80-300 A	18-32 V
1.2 mm	120-380 A	18-35 V
1.4 mm	150-420 A	22-36 V
1.6 mm	225-550 A	28-38 V
2.0 mm	300-650 A	32-44 V

OK AristoRod 12.63

OK AristoRod 12.63 is a non copper coated Mn-Si-alloyed G4Si1/ER70S-6 solid wire for the GMAW of non-alloyed steels, as used in general construction, automotive components, pressure vessel fabrication and shipbuilding. It has a slightly higher manganese and silicon content than OK AristoRod 12.50 to increase the weld metal strength. This also promotes a low sensitivity to surface impurities and contributes to smooth and sound welds. OK AristoRod 12.63 is treated with ESAB's unique Advanced Surface Characteristics (ASC) technology, taking MAG welding operations to new levels of performance and all-round efficiency, especially in robotic and mechanised welding. Characteristic features include excellent start properties; trouble-free feeding at high wire speeds and lengthy feed distances; a very stable arc at high welding currents; extremely low levels of spatter; low fume emission; reduced contact tip wear and improved protection against corrosion of the wire.

Classifications Weld Metal:	EN ISO 14341-A:G 42 3 C1 4Si1, EN ISO 14341-A:G 46 4 M21 4Si1, EN ISO 14341-B:G 55A 5 M21 S6
Classifications Wire Electrode:	EN ISO 14341-A:G 4Si1, EN ISO 14341-B:G S6, SFA/AWS A5.18:ER70S-6, CAN/CSA-ISO 14341:B-G 49A 3 C1 S6
Approvals:	ABS 3YSA (C1 & M21), BV SA3YM (C1 & M21), CE EN 13479, CWB B-G 49A 3 C1 S6 (B-G 49A 3 C G6), DB 42.039.30, DNV-GL III YMS (C1 & M21), LR 3YS H15 (C1 & M21), NAKS/HAKC 1.2MM, VdTÜV 10051

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Mn-Si alloyed

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
EN 80Ar/20CO2 (M21)			
As Welded	490 MPa	590 MPa	29 %
PWHT 650°C 15h	385 MPa	520 MPa	28 %
EN CO2 (C1)			
As Welded	460 MPa	570 MPa	28 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
EN 80Ar/20CO2 (M21)		
As Welded	-20 °C	120 J
As Welded	-30 °C	100 J
As Welded	-40 °C	90 J
As Welded	-50 °C	80 J
PWHT 650°C 15h	-20 °C	90 J
EN CO2 (C1)		
As Welded	-30 °C	75 J

Typical Wire Composition %

C	Mn	Si
0.074	1.68	0.95

OK AristoRod 12.63

Current Range		
Diameter	**Current**	**Voltage**
0.8 mm	60-185 A	18-24 V
0.9 mm	70-250 A	18-26 V
1.0 mm	80-300 A	18-32 V
1.2 mm	120-380 A	18-35 V
1.4 mm	150-420 A	22-36 V
1.6 mm	225-550 A	28-38 V

ESAB MW2

ESAB MW2 is a low alloy (0.5% Mo) solid wire for Gas Metal Arc Welding of high strength steels. The wire can be welded with mixture of Ar-CO2 or with CO2 as the shielding gas. The wire is suitable for welding of high strength structural materials such as automobile components.

Classifications Wire Electrode:	SFA/AWS A5.28:ER80S-G

Alloy Type:	Low Alloy (0.5% Mo)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
C1 Sheilding gas			
As Welded	560 MPa	650 MPa	25 %
M21 Sheilding gas			
As Welded	570 MPa	690 MPa	22 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
C1 Sheilding gas		
As Welded	-30 °C	45 J
M21 Sheilding gas		
As Welded	-30 °C	65 J

Typical Wire Composition %

C	Mn	Si	Mo
0.10	1.90	0.55	0.43

Current Range

Diameter	Current	Voltage
1.2 mm	120-280 A	20-28 V

OK Autrod 13.14

OK Autrod 13.14 is a copper coated low alloyed wire for GMAW of HSLA steels. It is used for fabrication of tractor cylinder, automobile components and wagons. The wire is designed to produce excellent beads of radiographic quality in all positions. One of the major applications of OK Autrod 13.14 is for welding 'CONCOR' wagons of the Indian Railways.

Classifications Wire Electrode:	SFA/AWS A5.28:ER90S-D2
Approvals:	RDSO Class III

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Low Alloyed (0.5% Mo)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
C1 Shielding gas			
As Welded	570 MPa	650 MPa	26 %
M21 Shielding gas			
As Welded	590 MPa	690 MPa	23 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
C1 Shielding gas		
As Welded	-30 °C	45 J
M21 Shielding gas		
As Welded	-30 °C	60 J

Typical Wire Composition %

C	Mn	Si	Mo
0.11	2.00	0.60	0.42

Current Range

Diameter	Current	Voltage
1.2 mm	120-280 A	20-28 V
1.6 mm	225-360 A	26-34 V

OK AristoRod 13.09

OK AristoRod 13.09 is a 0.5Mo-alloyed, non copper coated solid wire for the GMAW of creep-resistant steels of the same composition, like those used for pipes in pressure vessels and boilers with a service temperature of up to 500°C. OK AristoRod 13.09 is treated with ESAB's unique Advanced Surface Characteristics (ASC) technology, taking MAG welding operations to new levels of performance and all-round efficiency, especially in robotic and mechanised welding. Characteristic features include excellent start properties; trouble-free feeding at high wire speeds and lengthy feed distances; a very stable arc at high welding currents; extremely low levels of spatter; low fume emission; reduced contact tip wear and improved protection against corrosion of the wire.

Classifications Weld Metal:	EN ISO 14341-A:G 38 0 C1 2Mo, EN ISO 14341-A:G 46 2 M21 2Mo
Classifications Wire Electrode:	EN ISO 14341-A:G 2Mo, EN ISO 21952-A:G MoSi, EN ISO 21952-B:G 1M3, SFA/AWS A5.28:ER70S-A1 (ER80S-G)
Approvals:	CE EN 13479, DB 42.039.31, DNV-GL III YMS (M21), NAKS/HAKC 1.2MM, VdTÜV 10088

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Low alloyed (0.5 % Mo)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
80Ar/20CO2			
As Welded	515 MPa	630 MPa	26 %
PWHT 620°C 15h	430 MPa	545 MPa	26 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
80Ar/20CO2		
As Welded	-20 °C	75 J
As Welded	-40 °C	57 J
PWHT 620°C 15h	-20 °C	95 J
PWHT 620°C 15h	-40 °C	90 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo
0.094	1.09	0.61	0.04	0.07	0.45

Current Range

Diameter	Current	Voltage
0.8 mm	40-170 A	16-22 V
1.0 mm	80-280 A	18-28 V
1.2 mm	120-350 A	20-33 V
1.6 mm	225-480 A	26-38 V

OK AristoRod 13.16

OK AristoRod 13.16 is a low-alloyed, chromium-molybdenum (1,3% Cr, 0,5% Mo) ER80S-B2, solid wire for GMAW of creep resistant steels like SA-387 Grade 11, A335 Grade P11 or similar materials. OK AristoRod 13.16 is a high purity wire with a guaranteed Bruscato factor X < 15. It is treated with ESAB's unique Advanced Surface Characteristics (ASC) technology, taking MAG welding operations to new levels of performance and all-round efficiency, especially in robotic and mechanised welding. Characteristics features include excellent start properties; trouble free feeding at high wire speeds and lengthy feed distances; a very stable arc at high welding currents; extremely low levels of spatter; low fume emission; reduced contact tip wear and improved protection against corrosion of the wire.

Classifications Wire Electrode:	EN ISO 21952-A:Z CrMo1Si, EN ISO 21952-B:G 55A 1CM, SFA/AWS A5.28:ER80S-B2
Approvals:	CE EN 13479

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Low alloyed (1.3Cr-0.5Mo)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
Ar / 1-3% O2 (M13) AWS			
PWHT 620°C 1h	540 MPa	640 MPa	26 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
Ar / 1-3% O2 (M13) AWS		
PWHT 620°C 1h	20 °C	163 J
PWHT 620°C 1h	-20 °C	100 J
PWHT 620°C 1h	-40 °C	>47 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo
0.1	0.4	0.5	0.1	1.3	0.5

Current Range

Diameter	Current	Voltage
1.0 mm	80-280 A	18-28 V
1.2 mm	120-350 A	20-33 V

OK AristoRod 69

The non-copper-coated OK AristoRod 69 is a low-alloyed, chromium-nickel-molybdenum (0,3% Cr, 1,4% Ni, 0,25% Mo), solid wire for GMAW of high tensile strength steels requiring tough weld metal for critical applications. Also suitable when high impact strength at lower temperatures is required. The AristoRod wires are suitable for operating at high currents with maintained disturbance free wire feeding giving a stable arc with a low amount of spatter. OK AristoRod 69 delivered in the unique ESAB Marathon Pac is excellent in mechanised welding applications.

Classifications Weld Metal:	EN ISO 16834-A:G 69 4 M Mn3Ni1CrMo
Classifications Wire Electrode:	EN ISO 16834-A:G Mn3Ni1CrMo, SFA/AWS A5.28:ER110S-G
Approvals:	ABS ER110S-G (M21), CE EN 13479, DB 42.039.33, DNV-GL IV Y69MS (M21), NAKS/HAKC 1.2MM, VdTÜV 11837

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Low alloyed (1.4 % Ni, 0.3 % Cr, 0.3 % Mo)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
EN 80Ar/20CO2 (M21)			
As Welded	730 MPa	800 MPa	19 %
PWHT 620°C 15h	690 MPa	750 MPa	20 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
EN 80Ar/20CO2 (M21)		
As Welded	20 °C	100 J
As Welded	-40 °C	73 J
PWHT 620°C 15h	20 °C	130 J
PWHT 620°C 15h	-20 °C	60 J
PWHT 620°C 15h	-30 °C	60 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo
0.089	1.54	0.53	1.23	0.26	0.24

Current Range

Diameter	Current	Voltage
0.8 mm	80-280 A	18-28 V
0.9 mm	80-280 A	18-28 V
1.0 mm	80-280 A	18-28 V
1.2 mm	120-350 A	20-33 V
1.6 mm	225-480 A	26-38 V

OK Autrod 16.10

A corrosion resistant, chromium-nickel alloyed solid wire for welding austenitic stainless alloys of 18Cr-8Ni type. OK Autrod 16.10 has good general corrosion resistance. The alloy has a low carbon content which makes it particularly suitable to the applications, where there is a risk of intergranular corrosion. The alloy is widely used in the chemical and food-processing industries, as well as for pipes, tubes and boilers.

Classifications Wire Electrode:	SFA/AWS A5.9:ER308L

Alloy Type:	Austenitic Cr-Ni

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	420 MPa	590 MPa	36 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	-110 °C	50 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr
0.025	1.70	0.40	9.50	19.80

Current Range

Diameter	Current	Voltage
0.8 mm	55-160 A	15-24 V
1.2 mm	100-280 A	19-28 V

OK Autrod 16.30

A corrosion resistant, chromium-nickel-molybdenum alloyed solid wire for welding austenitic stainless alloys of the 18Cr-12Ni-2.5Mo type. The alloy has very good resistance to corrosion in acid and chlorinated environments. The alloy has a low carbon content which makes it particularly suitable to the applications, where there is a risk of intergranular corrosion. The alloy is widely used in the chemical and food-processing industries, as well as in shipbuilding and various types of architectural structures.

Classifications Wire Electrode:	SFA/AWS A5.9:ER316L

Alloy Type:	Austenitic Cr-Ni-Mo

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	430 MPa	620 MPa	35 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	-110 °C	50 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo
0.02	1.70	0.40	11.30	18.50	2.20

Current Range

Diameter	Current	Voltage
0.8 mm	55-160 A	15-24 V
1.2 mm	100-280 A	15-28 V

OK Autrod 16.53

A corrosion resistant, chromium-nickel alloyed solid wire for joining stainless steels to non-alloy or low-alloy steels and for welding austenitic stainless alloys of the 24Cr-13Ni types. The alloy is also used for welding buffer layers on C-Mn/low-alloy steels.

Classifications Wire Electrode:	SFA/AWS A5.9:ER309L

Alloy Type:	Austenitic Cr-Ni

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	420 MPa	600 MPa	35 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	-60 °C	80 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr
0.02	1.70	0.40	12.30	23.50

Current Range

Diameter	Current	Voltage
0.8 mm	55-160 A	15-24 V
1.2 mm	100-280 A	15-28 V

OK Autrod 16.95

A continuous solid, corrosion resisting chromium-nickel-manganese wire for welding of austenitic stainless alloys of 18% Cr, 8% Ni, 7% Mn types. OK Autrod 16.95 has a general corrosion resistance similar to that of the corresponding parent metal. The higher silicon content improves the welding properties, such as wetting. The product is a modified variant of ER307, basically with a higher Mn content to make the weld less sensitive to hot cracking. When used for joining dissimilar materials the corrosion resistance is of secondary importance. The alloy is used in a wide range of applications across the industry such as the joining of austenitic, manganese, work hardenable steels as well as armour plates and heat resistant steels.

Classifications Wire Electrode:	EN ISO 14343-A:G 18 8 Mn, SFA/AWS A5.9:ER307 mod, Werkstoffnummer :~1.4370
Approvals:	CE EN 13479, DB 43.039.10, NAKS/HAKC 1.2MM, VdTÜV 05420

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Austenitic (18 % Cr - 8 % Ni - 7 % Mn)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	450 MPa	640 MPa	41 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	20 °C	130 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo
0.08	7.0	0.9	8.1	18.7	0.20

Current Range

Diameter	Current	Voltage
0.8 mm	55-160 A	15-24 V
0.9 mm	65-220 A	15-28 V
1.0 mm	80-240 A	15-28 V
1.2 mm	100-300 A	15-29 V
1.6 mm	230-375 A	23-31 V

OK Autrod 410NiMo

A continuous, solid welding wire of the 12% Cr, 4.5% Ni, 0.5% Mo type. OK Autrod 410NiMo is used for welding similar martentsitic and martensitic-ferritic steels in different applications, such as hydro turbines.

Classifications Wire Electrode:	EN ISO 14343-A:G 13 4

Alloy Type:	Martensitic-ferritic (12 % Cr - 4.5 % Ni - 0.5 % Mo)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	860 MPa	1050 MPa	13 %
PWHT 600°C 2h	850 MPa	900 MPa	17 %
PWHT 600°C 8h	750 MPa	850 MPa	20 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	0 °C	35 J
As Welded	-20 °C	30 J
PWHT 600°C 2h	0 °C	70 J
PWHT 600°C 2h	-20 °C	55 J
PWHT 600°C 8h	0 °C	75 J
PWHT 600°C 8h	-20 °C	75 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo
0.02	0.5	0.4	4.2	12.4	0.6

Current Range

Diameter	Current	Voltage
0.8 mm	50-140 A	16-22 V
1.0 mm	80-190 A	16-24 V
1.2 mm	180-280 A	20-28 V

OK Autrod 1100

OK Autrod 1100 is highly resistant to chemical attack and weathering. It is a relatively soft alloy that is very formable and is used extensively in thin gauge and foil products. It has good welding characteristics. A desirable characteristic of the alloy is the bright finish obtained by anodising. Non-heat treatable.

Classifications Wire Electrode:	SFA/AWS A5.10:ER1100, EN ISO 18273:S Al 1100 (Al99,0Cu)
Approvals:	CWB AWS A5.10/A5.10M: ER1100

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Al

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	30 MPa	75 MPa	35 %

Typical Wire Composition %

Cu	Si+Fe	Zn
0.07	0.55	0.01

Current Range

Diameter	Current	Voltage
1.0 mm	140-260 A	20-29 V
1.2 mm	140-260 A	20-29 V
1.6 mm	190-350 A	25-30 V

OK Autrod 4043

OK Autrod 4043 is one of the most widely used welding and brazing alloys and can be classed as a general purpose filler alloy. The silicon addition result in improved fluidity (wetting action) to make the alloy a preferred choice by welders. The alloy is not sensitive to weld cracking and produces bright and almost smut free welds. Not recommended for anodizing. Non-heat treatable.

Classifications Wire Electrode:	SFA/AWS A5.10:ER4043, EN ISO 18273:S Al 4043 (AlSi5), JIS Z 3232:A4043
Approvals:	CE EN 13479, CWB AWS A5.10/A5.10M: ER4043, DB 61.039.05, JIS Z 3232, VdTÜV 12187

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	AlSi

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	55 MPa	124 MPa	18 %

Typical Wire Composition %

Mn	Si	Al	Cu	Fe	Ti	Zn
0.01	5.00	Rem	0.02	0.14	0.01	0.01

Current Range

Diameter	Current	Voltage
0.8 mm	60-170 A	13-24 V
0.9 mm	60-170 A	13-24 V
1.0 mm	90-210 A	15-26 V
1.2 mm	140-260 A	20-29 V
1.6 mm	190-350 A	25-30 V
2.0 mm	280-400 A	26-31 V
2.4 mm	280-400 A	26-31 V

OK Autrod 5183

OK Autrod 5183 was developed to provide the highest strengths possible in the as welded condition of alloy AA 5083 and other similar high magnesium alloys. The more common OK Autrod 5356 will typically fail to meet the as-welded tensile requirements of AA 5083. The alloy is typically utilised in marine and structural applications where high strengths, high fracture toughness for impact resistance and exposure to corrosive elements are important. The alloy is not recommended for elevated temperature applications due to its susceptibility to stress corrosion cracking. The alloy is non-heat treatable.

Classifications Wire Electrode:	SFA/AWS A5.10:ER5183, EN ISO 18273:S Al 5183 (AlMg4,5Mn0,7(A)), JIS Z 3232:A5183
Approvals:	ABS ER5183, BV WC, CE EN 13479, ClassNK KAl5RCG(I-1)(I-4), CWB AWS A5.10/A5.10M: ER5183, DB 61.039.03, DNV-GL 5183, JIS Z 3232, LR WC1/I-1, NAKS/HAKC 1.2-1.6 mm, RINA WC, VdTÜV 04666

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	AlMgMn

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	140 MPa	290 MPa	25 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	20 °C	90 J

Typical Wire Composition %

Mn	Si	Cr	Al	Cu	Fe	Mg	Ti	Zn
0.65	0.04	0.08	94.20	0.01	0.13	4.90	0.10	0.01

Current Range

Diameter	Current	Voltage
1.0 mm	90-210 A	15-26 V
1.2 mm	140-260 A	20-29 V
1.6 mm	190-350 A	25-30 V

OK Autrod 5356

OK Autrod 5356 is the most widely used welding alloy and can be classified as a general purpose type filler alloy. OK Autrod 5356 is typically chosen because of its relatively high shear strength. The 5XXX alloy base material, welded with OK Autrod 5356, with a weld pool chemistry greater than 3 % Mg and service temperatures in excess of 65°C are susceptible to stress corrosion cracking. The alloy is non-heat treatable.

Classifications Wire Electrode:	SFA/AWS A5.10:ER5356, EN ISO 18273:S Al 5356 (AlMg5Cr(A)), JIS Z 3232:A53556
Approvals:	ABS ER5356, BV WB, CE EN 13479, CWB AWS A5.10/A5.10M: ER5356, DB 61.039.01, DNV-GL 5356, JIS Z 3232, LR WB/I1, RINA WC, VdTÜV 04664

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	AlMg5

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	120 MPa	265 MPa	26 %

Typical Wire Composition %

Mn	Si	Cr	Al	Cu	Fe	Mg	Zn
0.13	0.05	0.12	94.56	0.01	0.13	4.90	0.01

Current Range

Diameter	Current	Voltage
0.8 mm	60-170 A	13-24 V
0.9 mm	60-170 A	13-24 V
1.0 mm	90-210 A	15-26 V
1.2 mm	140-260 A	20-29 V
1.6 mm	190-350 A	25-30 V
2.4 mm	280-400 A	26-31 V

OK Autrod 5556A

A continuous solid wire suitable for welding aluminium alloys with up to approx. 5% Mg that are not age hardenable and alloys where a higher tensile strength is required. The corrosion resistance in a marine atmosphere is high.

Classifications Wire Electrode:	SFA/AWS A5.10:ER5556A, EN ISO 18273:S Al 5556A (AlMg5Mn)
Approvals:	CE EN 13479, VdTÜV 05794

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	AlMgMn

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	145 MPa	295 MPa	25 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	20 °C	24 J

Typical Wire Composition %

Mn	Si	Cr	Cu	Fe	Mg	Ti
0.68	0.05	0.10	0.01	0.12	5.20	0.08

Current Range

Diameter	Current	Voltage
1.0 mm	90-210 A	15-26 V
1.2 mm	140-260 A	20-29 V
1.6 mm	190-350 A	25-30 V
2.4 mm	280-400 A	26-31 V

TIG Rods (GTAW)

OK Tigrod S2

OK Tigrod S2 is a copper coated Mn-Si alloyed solid rod for TIG welding of non-alloyed steels, used in general construction, pressure vessel fabrication and shipbuilding. It is especially suitable for welding of light gauge non-alloyed steels in all positions and for a variety of applications, including root run for pipes & tubes.

Classifications Weld Metal:	EN ISO 636-A:W 38 3 W2Ti
Classifications Wire Electrode:	EN ISO 636-A:W2Ti, SFA/AWS A5.18:ER70S-2
Approvals:	IBR ER70S-2, PDIL ER70S-2

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	C-Mn

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	460 MPa	550 MPa	28 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	-30 °C	120 J

Typical Wire Composition %

C	Mn	Si
0.05	1.10	0.55

OK Tigrod S2 (Spl)

OK Tigrod S2 (Spl) is a copper coated Mn-Si alloyed solid rod for the GTAW of non-alloyed and micro alloyed steels, used in general construction, pressure vessel fabrication and shipbuilding. OK Tigrod S2 (Spl) contains optimized manganese and silicon to provide good strength and impact toughness at sub-zero temperatures. The alloy meets NACE requirements.

Classifications Weld Metal:	EN ISO 636-A:W 46 4 W2Ti
Classifications Wire Electrode:	EN ISO 636-A:W2Ti, SFA/AWS A5.18:ER70S-2

Alloy Type:	Carbon-Manganese

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	500 MPa	570 MPa	27 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	-30 °C	110 J
As Welded	-40 °C	50 J
As Welded	-46 °C	35 J

Typical Wire Composition %

C	Mn	Si
0.05	1.10	0.55

Other Properties

HIC test according to NACE TM0284	Satisfactory
SSC test according to NACE TM0177	Satisfactory

OK Tigrod 12.64

OK Tigrod 12.64 is a copper-coated Mn-Si-alloyed W4Si1/ER70S-6 solid rod for the GTAW of non-alloyed steels, as used in general construction, pressure vessel fabrication and shipbuilding. It has a slightly higher manganese and silicon content than OK Tigrod 12.61 to increase the weld metal strength. This also promotes low sensitivity to surface impurities and contributes to smooth & sound welds.

Classifications Weld Metal:	EN ISO 636-A:W 46 4 4Si1
Classifications Wire Electrode:	EN ISO 636-A:W4Si1, SFA/AWS A5.18:ER70S-6
Approvals:	ABS 3Y (I1), BV 3YM (I1), CE EN 13479, DNV-GL III YM (I1), LR 3Ym H15 (I1), NAKS/HAKC 1.6MM-2.4MM, VdTÜV 05260

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Carbon-Manganese

Typical Tensile Properties			
Condition	**Yield Strength**	**Tensile Strength**	**Elongation**
Ar (I1) EN			
As Welded	525 MPa	595 MPa	26 %

Typical Charpy V-Notch Properties		
Condition	**Testing Temperature**	**Impact Value**
Ar (I1) EN		
As Welded	-40 °C	150 J

Typical Wire Composition %		
C	**Mn**	**Si**
0.074	1.68	0.95

OK Tigrod 13.09

OK Tigrod 13.09 is a 0.5Mo-alloyed, copper-coated rod for the GTAW of creep-resistant steels of the same type, such as pipes in pressure vessels and boilers with a working temperature of up to about 500°C.

Classifications Weld Metal:	EN ISO 636-A:W 46 2 W2Mo
Classifications Wire Electrode:	EN ISO 636-A:W2Mo, EN ISO 21952-A:W MoSi, EN ISO 21952-B:W 52 1M3, SFA/AWS A5.28:ER70S-A1 (ER80S-G)
Approvals:	CE EN 13479, DB 42.039.08, DNV-GL III YMS (I1), NAKS/HAKC 2.0MM-3.2MM, VdTÜV 04950

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Low alloyed steel (0.5 % Mo)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
AWS Ar (I1)			
As Welded	520 MPa	620 MPa	27 %
PWHT 620°C 1h	510 MPa	610 MPa	28 %
EN Ar (I1)			
As Welded	490 MPa	600 MPa	30 %
PWHT 620°C 1h	450 MPa	550 MPa	31 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
AWS Ar (I1)		
As Welded	-29 °C	150 J
As Welded	-46 °C	130 J
PWHT 620°C 1h	-20 °C	220 J
EN Ar (I1)		
As Welded	-20 °C	160 J
As Welded	-40 °C	90 J
PWHT 620°C 1h	-20 °C	170 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo
0.094	1.09	0.61	0.05	0.05	0.45

OK Tigrod 13.16

OK Tigrod 13.16 is a 1.3Cr-0.5Mo-alloyed (ER80S-B2), copper-coated rod for the GTAW of creep-resistant steels like SA-387 Grade 11, A335 Grade P11 or similar materials. The rod has a high purity chemistry with a guaranteed Bruscato factor X < 15.

Classifications Wire Electrode:	EN ISO 21952-A:Z CrMo1Si, EN ISO 21952-B:W 55 1CM, SFA/AWS A5.28:ER80S-B2
Approvals:	CE EN 13479, NAKS/HAKC 2.0MM-2.4MM

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Low alloyed steel (1.3%Cr, 0.5%Mo)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
Ar (I1) AWS			
PWHT 620°C 1h	640 MPa	730 MPa	24 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
Ar (I1) AWS		
PWHT 620°C 1h	-40 °C	>47 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo
0.08	0.5	0.5	0.08	1.3	0.5

OK Tigrod 13.17

OK Tigrod 13.17 is a 2.5Cr-1.1Mo-alloyed (ER90S-B3), copper-coated rod for the GTAW of creep-resistant steels like SA-387 Grade 22, A335 Grade P22 or similar materials. The rod has a high purity chemistry with a guaranteed Bruscato factor X < 15.

Classifications Wire Electrode:	EN ISO 21952-A:Z CrMo2Si, EN ISO 21952-B:W 62 2C1M, SFA/AWS A5.28:ER90S-B3
Approvals:	CE EN 13479, NAKS/HAKC 2.0-2.4MM

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Low alloyed steel (2.5%Cr, 1%Mo)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
PWHT 690°C 1h	620 MPa	730 MPa	22 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
PWHT 690°C 1h	-40 °C	>47 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo
0.08	0.5	0.5	0.05	2.4	1.0

OK Tigrod 13.32

OK Tigrod 13.32 is a 5Cr-0.5Mo-alloyed (ER80S-B6), copper-coated rod for the GTAW of creep-resistant steels of similar composition. The rod is also suitable for welding high strength steels with a minimum yield strength of up to 730 MPa. AWS has changed the classification for this product. The previous classification was A5.9 ER502.

Classifications Wire Electrode:	EN ISO 21952-A:W CrMo5Si, EN ISO 21952-B:W 55 5CM, SFA/AWS A5.28:ER80S-B6

Alloy Type:	Low alloyed steel (5 % Cr - 0.5 % Mo)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
Ar (I1) AWS			
As Welded	730 MPa	900 MPa	22 %
PWHT 745°C 1h	580 MPa	680 MPa	22 %
Ar (I1) EN			
PWHT 730-760°C 1h	550 MPa	640 MPa	23 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
Ar (I1) AWS		
As Welded	-20 °C	80 J
As Welded	-29 °C	50 J
PWHT 745°C 1h	-20 °C	200 J
PWHT 745°C 1h	-29 °C	200 J
Ar (I1) EN		
PWHT 730-760°C 1h	20 °C	250 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo
0.07	0.48	0.44	0.06	5.73	0.58

OK Tigrod 13.37

OK Tigrod 13.37 is a 9Cr-1Mo-alloyed, copper-coated rod for the GTAW of high temperature steels and steels for hot hydrogen service, especially in oil refineries.

Classifications Wire Electrode:	EN ISO 21952-A:W CrMo9, EN ISO 21952-B:W 55 9C1M, SFA/AWS A5.28:ER80S-B8

Alloy Type:	Alloyed steel (9 % Cr - 1 % Mo)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
Ar (I1) EN			
PWHT 760°C 2h	540 MPa	660 MPa	26 %
PWHT 735°C 4h	560 MPa	680 MPa	22 %
Tested at 450°C			
PWHT 760°C 2h	430 MPa	500 MPa	17 %
Tested at 482°C			
PWHT 760°C 2h	410 MPa	480 MPa	18 %
Tested at 560°C			
PWHT 760°C 2h	350 MPa	390 MPa	22 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
Ar (I1) EN		
PWHT 760°C 2h	-20 °C	140 J
PWHT 760°C 2h	-40 °C	120 J
PWHT 760°C 2h	-60 °C	90 J
PWHT 735°C 4h	-20 °C	150 J
PWHT 735°C 4h	-40 °C	130 J
PWHT 735°C 4h	-60 °C	50 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo
0.06	0.52	0.45	0.23	8.66	1.00

OK Tigrod 13.38

OK Tigrod 13.38 is a non-copper coated, low alloyed, 9CrMoVN rod for the GTAW of high-temperature steels and steels for hot hydrogen service, especially in oil refineries. It should preferably be used for 9% Cr steels, such as P91/T91 steels. The alloy is modified in terms of the limits for impurity elements and is extremely "clean". This produces improved strength levels both at room temperature and at higher temperatures. AWS has changed the classification for this product. The previous classification was A5.9 ER505.

Classifications Wire Electrode:	EN ISO 21952-A:W CrMo91, EN ISO 21952-B:W 62 9C1MV, SFA/AWS A5.28:ER90S-B9
Approvals:	VdTÜV 07686

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Alloyed steel (9 % Cr - 1 % Mo - V - N) "9CrMoVN"

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
Ar (I1) EN			
PWHT 760°C 2h	690 MPa	785 MPa	20 %
PWHT 735°C 4h	670 MPa	760 MPa	20 %
Tested at 450°C			
PWHT 760°C 2h	510 MPa	580 MPa	14 %
Tested at 482°C			
PWHT 760°C 2h	500 MPa	560 MPa	16 %
Tested at 560°C			
PWHT 760°C 2h	420 MPa	450 MPa	22 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
Ar (I1) EN		
PWHT 760°C 2h	0 °C	180 J
PWHT 760°C 2h	-20 °C	150 J
PWHT 760°C 2h	-40 °C	90 J
PWHT 760°C 2h	-60 °C	70 J
PWHT 735°C 4h	0 °C	190 J
PWHT 735°C 4h	-20 °C	130 J
PWHT 735°C 4h	-40 °C	60 J
PWHT 735°C 4h	-60 °C	30 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo	V	N	Nb
0.1	0.5	0.3	0.5	8.7	0.9	0.2	0.05	0.06

OK Tigrod 13.23

OK Tigrod 13.23 is a 0.9Ni-alloyed (ER80S-Ni1), copper-coated rod for the GTAW of low-temperature, fine-grained steels. The wire provides good impact toughness down to -50°C and is especially suitable for use in the offshore industry.

Classifications Wire Electrode:	SFA/AWS A5.28:ER80S-Ni1
Approvals:	DNV-GL IV Y40M (I1), NAKS/HAKC 2.0MM-2.4MM

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Low alloyed steel (1 % Ni)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
Ar (I1) AWS			
As Welded	500 MPa	600 MPa	25 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
Ar (I1) AWS		
As Welded	0 °C	230 J
As Welded	-20 °C	200 J
As Welded	-46 °C	140 J
As Welded	-60 °C	90 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo
0.07	1.11	0.57	0.90	0.07	0.29

OK Tigrod 16.10

OK Tigrod 16.10 is a corrosion resistant, chromium-nickel alloyed solid rod for welding austenitic chromium-nickel alloys of 18Cr-8Ni type. OK Tigrod 16.10 has good general corrosion resistance. The alloy has a low carbon content which makes it particularly suitable to the applications, where there is a risk of intergranular corrosion. The alloy is widely used in the chemical and food-processing industries, as well as for pipes, tubes and boilers.

Classifications Wire Electrode:	SFA/AWS A5.9:ER308L
Approvals:	PDIL ER308L

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Austenitic Cr-Ni

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	400 MPa	580 MPa	55 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	-65 °C	100 J
As Welded	-80 °C	80 J
As Welded	-196 °C	60 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr
0.02	1.75	0.40	9.60	19.80

OK Tigrod 16.11

OK Tigrod 16.11 is a corrosion-resistant, chromium-nickel-niobium alloyed solid rod for welding stabilized austenitic chromium-nickel alloys of 18Cr-8Ni type. OK Tigrod 16.11 has good general corrosion resistance. The alloy is stabilized with niobium to improve resistance to the intergranular corrosion of the weld metal. Due to the niobium content, this alloy is recommended for use at higher temperatures.

Classifications Wire Electrode:	SFA/AWS A5.9:ER347

Alloy Type:	Austenitic Cr-Ni -Nb

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	430 MPa	620 MPa	35 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	20 °C	100 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Nb
0.04	1.50	0.40	9.50	19.50	0.50

OK Tigrod 16.30

OK Tigrod 16.30 is a corrosion resistant, chromium-nickel-molybdenum alloyed solid rod for welding austenitic stainless alloys of the 18Cr-12Ni-2.5Mo type. The alloy has very good resistance to corrosion in acid and chlorinated environments. OK Tigrod 16.30 has a low carbon content which makes it particularly suitable to the applications, where there is a risk of intergranular corrosion. The alloy is widely used in the chemical and food-processing industries, as well as in shipbuilding and various types of architectural structures.

Classifications Wire Electrode:	SFA/AWS A5.9:ER316L
Approvals:	PDIL ER316L

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Austenitic Cr-Ni-Mo

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	420 MPa	570 MPa	40 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	-60 °C	130 J
As Welded	-110 °C	100 J
As Welded	-196 °C	75 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo
0.02	1.70	0.40	11.50	18.50	2.30

OK Tigrod 16.53

OK Tigrod 16.53 is a corrosion resistant, chromium-nickel alloyed solid rod for joining stainless steels to non-alloy or low-alloy steels and for welding austenitic stainless alloys of the 24Cr-13Ni types. The alloy is also used for welding buffer layers on C-Mn/low-alloyed steels.

Classifications Wire Electrode:	SFA/AWS A5.9:ER309L
Approvals:	PDIL ER309L

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Austenitic Cr-Ni

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	410 MPa	580 MPa	35 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	-60 °C	100 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr
0.02	1.75	0.45	12.20	23.50

OK Tigrod 16.54

OK Tigrod 16.54 is a corrosion resistant, chromium-nickel-molybdenum alloyed solid rod for welding dissimilar steels, such as 316L to unalloyed and low-alloyed steels and for overlay welding of unalloyed and low-alloyed steels when Mo is essential.

Classifications Wire Electrode:	SFA/AWS A5.9:ER309LMo (Nearest)

Alloy Type:	Austenitic Cr-Ni-Mo

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	400 MPa	600 MPa	34 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	20 °C	100 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo
0.02	1.50	0.45	14.50	21.50	2.50

OK Tigrod 16.13

OK Tigrod 16.13 is a corrosion-resistant, chromium-nickel alloyed solid rod for welding heat-resistant austenitic stainless steels of 25Cr-20Ni type. OK Tigrod 16.13 has good general oxidation resistance, especially at high temperatures, due to its high Cr content. Common applications include industrial furnaces, boiler parts and heat exchangers.

Classifications Wire Electrode:	SFA/AWS A5.9:ER310

Alloy Type:	Fully Austenitic Cr-Ni

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	370 MPa	570 MPa	32 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	20 °C	120 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr
0.10	1.65	0.40	20.30	26.00

OK Tigrod 2209

Bare, corrosion-resistant, duplex welding rod for welding austenitic-ferritic stainless alloys of the 22% Cr, 5% Ni, 3% Mo types. OK Tigrod 2209 has high general corrosion resistance. In media containing chloride and hydrogen sulphide, the alloy has high resistance to intergranular corrosion, pitting and especially to stress corrosion. The alloy is used in a variety of applications across all industrial segments.

Classifications Wire Electrode:	EN ISO 14343-A:W 22 9 3 N L, SFA/AWS A5.9:ER2209
Approvals:	CE EN 13479, DB 43.039.19, NAKS/HAKC 2.0MM-3.2MM, VdTÜV

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Austenitic-ferritic (22.5 % Cr - 8 % Ni - 3 % Mo - Low C)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	600 MPa	765 MPa	28 %
SHT 1050°C 0.5h	450 MPa	730 MPa	34 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	20 °C	100 J
As Welded	-20 °C	85 J
As Welded	-60 °C	60 J
SHT 1050°C 0.5h	20 °C	130 J
SHT 1050°C 0.5h	-20 °C	110 J
SHT 1050°C 0.5h	-60 °C	90 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo	N
0.01	1.5	0.5	8.5	22.7	3.2	0.17

OK Tigrod 2509

Bare, corrosion-resistant, “Super Duplex” rod for welding austenitic-ferritic stainless alloys of the 25% Cr, 7% Ni, 4% Mo, low C types. OK Tigrod 2509 has high intergranular-corrosion, pitting and stress-corrosion resistance. The alloy is widely used in applications where corrosion resistance is of the utmost importance. The pulp & paper industry, offshore and gas industry are areas of interest.

Classifications:	EN ISO 14343-A:W 25 9 4 N L, SFA/AWS A5.9:ER2594

Alloy Type:	Austenitic-ferritic (25 % Cr - 10 % Ni - 4 % Mo - Low C)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	660 MPa	835 MPa	37 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	-20 °C	200 J
As Welded	-50 °C	180 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo	N
0.01	0.4	0.4	9.4	25.2	3.9	0.24

OK Tigrod 1100

OK Tigrod 1100 is highly resistant to chemical attack and weathering. It is a relatively soft alloy that is very formable and it is used extensively in thin-gauge and foil products. It has good welding characteristics. One desirable characteristic of the alloy is the bright finish obtained by anodising. Non-heat treatable.

Classifications Wire Electrode:	SFA/AWS A5.10:R1100, EN ISO 18273:S Al 1100 (Al99,0Cu)
Approvals:	CWB AWS A5.10/A5.10M: ER1100

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Al

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	30 MPa	75 MPa	35 %

Typical Wire Composition %

Cu	Si+Fe	Zn
0.07	0.55	0.01

OK Tigrod 4043

OK Tigrod 4043 is one of the most widely used welding alloys. The alloy is used for welding AlMgSi - types and AlSi - alloys with up to 7% Silicon. Not recommended for anodizing. Non-heat treatable.

Classifications Wire Electrode:	SFA/AWS A5.10:R4043, EN ISO 18273:S Al 4043 (AlSi5), JIS Z 3232:A4043
Approvals:	CE EN 13479, CWB AWS A5.10/A5.10M: ER4043, DB 61.039.06, JIS Z 3232

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	AlSi

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	55 MPa	124 MPa	18 %

Typical Wire Composition %

Mn	Si	Al	Cu	Fe	Ti	Zn
0.01	5.00	Rem	0.02	0.14	0.01	0.01

OK Tigrod 5183

OK Tigrod 5183 was developed to provide the highest strengths possible in the as welded condition of alloy AA 5083 and other similar high magnesium alloys. The more common OK Tigrod 5356 will typically fail to meet the as-welded tensile requirements of AA 5083. The alloy is typically utilised in marine and structural applications where high strengths, high fracture toughness for impact resistance and exposure to corrosive elements are important. The alloy is not recommended for elevated temperature applications due to its susceptibility to stress corrosion cracking. The alloy is non-heat treatable.

Classifications Wire Electrode:	SFA/AWS A5.10:R5183, EN ISO 18273:S Al 5183 (AlMg4,5Mn0,7(A)), JIS Z 3232:A5183
Approvals:	ABS R5183, CE EN 13479, CWB AWS A5.10/A5.10M: ER5183, DB 61.039.04, JIS Z 3232, VdTÜV 04667

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	AlMgMn

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	140 MPa	290 MPa	25 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	20 °C	90 J

Typical Wire Composition %

Mn	Si	Cr	Al	Cu	Fe	Mg	Ti	Zn
0.65	0.04	0.08	94.20	0.01	0.13	4.90	0.10	0.01

OK Tigrod 5356

OK Tigrod 5356 is the most widely used welding alloy and can be classified as a general purpose type filler alloy. OK Tigrod 5356 is typically chosen because of its relatively high shear strength. The 5XXX alloy base material, welded with OK Tigrod 5356, with a weld pool chemistry greater than 3 % Mg and service temperatures in excess of 65°C are susceptible to stress corrosion cracking. The alloy is non-heat treatable.

Classifications Wire Electrode:	SFA/AWS A5.10:R5356, EN ISO 18273:S Al 5356 (AlMg5Cr(A)), JIS Z 3232:A5356
Approvals:	ABS R5356, CE EN 13479, CWB A5.10/A5.10M: ER5356, DB 61.039.02, JIS Z 3232, VdTÜV 04665

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	AlMg5

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	120 MPa	265 MPa	26 %

Typical Wire Composition %

Mn	Si	Cr	Al	Cu	Fe	Mg	Zn
0.13	0.05	0.12	94.56	0.01	0.13	4.90	0.01

OK Tigrod 5556A

Bare welding rod suitable for welding aluminium alloys with up to approx. 5% Mg that are not age hardenable and alloys where a higher tensile strength is required. The corrosion resistance in a marine atmosphere is very good.

Classifications Wire Electrode:	SFA/AWS A5.10:R5556A, EN ISO 18273:S Al 5556A (AlMg5Mn)
Approvals:	VdTÜV 05795

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	AlMgMn

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As Welded	145 MPa	295 MPa	25 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As Welded	20 °C	24 J

Typical Wire Composition %

Mn	Si	Cr	Cu	Fe	Mg	Ti
0.68	0.05	0.10	0.01	0.12	5.20	0.08

Cored Wire (FCAW) (MCAW)

ESAB 71T1

ESAB 71T1 is an all position rutile flux cored wire designed for optimum performance with 100% CO2 shielding gas. It produces a slag with good coverage that is easily removable as well as a weld metal that is consistently free of slag inclusions and porosity.

Classifications Weld Metal:	SFA/AWS A5.20:E71T1-C1A0-CS2, EN ISO 17632-A:T 42 0 P C 1 H10
Approvals:	ABS 2Y400, BV 2Y40, IRS 2Y40SM, LR 2Y

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	DC+
Alloy Type:	C-Mn

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
C1 shielding gas			
As Welded	500 MPa	550 MPa	28 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
C1 shielding gas		
As Welded	0 °C	95 J
As Welded	-20 °C	40 J

Typical Weld Metal Analysis %

C	Mn	Si
C1 shielding gas		
0.05	1.10	0.45

Current Range

Diameter	Current	Voltage
1.2 mm	140-300 A	21-32 V
1.6 mm	160-410 A	22-34 V

Weld 71T-1

A multi-purpose all positional rutile cored wire for use with CO2 shielding gas. It performs well over steels with moderate rust and mill scale. It produces a slag with good coverage that is easily removable as well as a weld metal that is consistently free of slag inclusions and porosity.

Classifications Weld Metal:	SFA/AWS A5.20:E71T1-C1A2-CS1-H8, EN ISO 17632-A:T 46 2 P C1 1 H10, JIS Z 3313:T49J0T1-1CA-U
Approvals:	ABS 3YSA H10, BKI 3YH10SM, BV S3YM H10, CCS 3YSH10, CE EN 13479, DNV-GL III YMS(H10), FBTS E71T-1C, LR 3YS H10, NAKS/HAKC 1.2MM, RS 3Y40MS H10

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	DC+
Alloy Type:	C-Mn

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
C1 shielding gas			
As Welded	490 MPa	556 MPa	28 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
C1 shielding gas		
As Welded	-20 °C	100 J
As Welded	-29 °C	>27 J

Typical Weld Metal Analysis %

C	Mn	Si
C1 shielding gas		
0.05	1.36	0.45

Current Range

Diameter	Current	Voltage
1.2 mm	140-300 A	21-30 V
1.6 mm	160-410 A	22-34 V

Dual Shield 7100 LH

Dual Shield 7100 LH is a multi-purpose all positional rutile, low hydrogen cored wire for use with CO2 or Ar/CO2 shielding gas. The wire is suitable for all mild and medium tensile steels. The running characteristics are exceptional with a stable arc, low spatter and flat welds.

Classifications Weld Metal:	SFA/AWS A5.20:E71T-1C, SFA/AWS A5.20:E71T-1M

Welding Current:	DC+
Alloy Type:	C-Mn

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
C1 shielding gas			
As Welded	500 MPa	570 MPa	31 %
M21 shielding gas			
As Welded	550 MPa	600 MPa	30 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
C1 shielding gas		
As Welded	-20 °C	61 J
M21 shielding gas		
As Welded	-20 °C	72 J

Typical Weld Metal Analysis %

C	Mn	Si
0.055	1.20	0.50

Current Range

Diameter	Current	Voltage
1.2 mm	150-350 A	23-35 V

OK Tubrod 15.14A

OK Tubrod 15.14A is a multipurpose all position flux cored wire for use with CO2 or Ar/CO2 shielding gas. The wire is suitable for all mild and medium tensile steels. The smooth metal transfer facilitates easy deposition even in positional welding. Weld metal is radiographically sound and provides good impact toughness down to -30°C.

Classifications Weld Metal:	SFA/AWS A5.20:E71T-1C/E71T-9C/E71T-1M/E71T-9M

Welding Current:	DC+
Alloy Type:	C-Mn

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
C1 shielding gas			
As Welded	490 MPa	550 MPa	28 %
M21 shielding gas			
As Welded	530 MPa	580 MPa	26 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
C1 shielding gas		
As Welded	-20 °C	80 J
As Welded	-30 °C	50 J
M21 shielding gas		
As Welded	-20 °C	90 J
As Welded	-30 °C	55 J

Typical Weld Metal Analysis %

C	Mn	Si
0.04	1.30	0.50

Other Properties

HIC test according to NACE TM0284	Satisfactory
SSC test according to NACE TM0177	Satisfactory

Current Range

Diameter	Current	Voltage
1.2 mm	140-300 A	21-30 V
1.6 mm	160-410 A	22-34 V

Dual Shield 7100SR

Dual Shield 7100SR is an all-position gas shielded flux cored wire with an unique balanced formulation to produce superior mechanical properties and excellent operator appeal. The flux cored wire is designed for both as-welded and post-weld heat treatment applications. The wire is formulated to provide excellent impact toughness down to -46°C and has extremely low weld metal diffusible hydrogen levels of less than 4.0 ml/100g. Excellent wet-in action of a weld puddle produces flatter to a slight convex weld bead profile for easy slag detachment.

Classifications Weld Metal:	SFA/AWS A5.20:E71T-1C/9C/12C-J
Approvals:	ABS 4YSA H5 , BV SA4YM H5, CCS 4YSH5, ClassNK KSW54G(C)H5, DNV-GL IV YMS(H5) , KR 4YSG (C) H5, LR 4YS H5

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	DC+
Alloy Type:	C-Mn-Ni

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
C1 shielding gas			
As Welded	451 MPa	541 MPa	31 %
PWHT 630°C 8h	435 MPa	520 MPa	31 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
C1 shielding gas		
As Welded	-30 °C	152 J
As Welded	-40 °C	123 J
As Welded	-46 °C	88 J
PWHT 630°C 8h	-30 °C	128 J
PWHT 630°C 8h	-40 °C	85 J
PWHT 630°C 8h	-46 °C	75 J

Typical Weld Metal Analysis %

C	Mn	Si	Ni
C1 shielding gas			
0.047	1.40	0.55	0.44

Current Range

Diameter	Current	Voltage
1.2 mm	140-330 A	22-34 V
1.6 mm	160-460 A	24-36 V

Dual Shield 7000-A1

Dual Shield 7000-A1 is an all-position flux cored wire recommended for 0.5% Mo steels. It is used in the fabrication & erection of boilers, pressure piping & tubing and other pressure vessel applications.

Classifications Weld Metal:	SFA/AWS A5.29:E81T1-A1C

Welding Current:	DC+
Alloy Type:	Low alloyed (0.5 % Mo)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
C1 shielding gas			
PWHT 620°C 1h	540 MPa	610 MPa	26 %

Typical Weld Metal Analysis %

C	Mn	Si	Mo
C1 shielding gas			
0.05	1.02	0.57	0.51

Current Range

Diameter	Current	Voltage
1.2 mm	140-330 A	22-34 V
1.6 mm	160-430 A	24-36 V

Dual Shield 8000-B2

Dual Shield 8000-B2 is an all-position 1.25Cr-0.5Mo flux cored wire for welding creep resistant steels of type 0.5Cr-0.5Mo, 1Cr-0.5Mo and 1.25Cr-0.5Mo.

Classifications:	SFA/AWS A5.29:E81T1-B2C

Welding Current:	DC+
Alloy Type:	Cr-Mo alloyed

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
C1 shielding gas			
PWHT 690°C 1h	520 MPa	610 MPa	24 %

Typical Weld Metal Analysis %

C	Mn	Si	Cr	Mo
C1 shielding gas				
0.058	0.65	0.58	1.30	0.55

Current Range

Diameter	Current	Voltage
1.2 mm	140-330 A	22-34 V
1.6 mm	160-430 A	24-36 V

Dual Shield 9000-B3

Dual Shield 9000-B3 is an all-position 2.25Cr-1Mo flux cored wire for welding creep resistant steels of similar composition.

Classifications:	SFA/AWS A5.29:E91T1-B3C

Welding Current:	DC+
Alloy Type:	Cr-Mo alloyed

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
C1 shielding gas			
PWHT 690°C 1h	590 MPa	660 MPa	20 %

Typical Weld Metal Analysis %

C	Mn	Si	Cr	Mo
C1 shielding gas				
0.06	0.70	0.40	2.21	1.04

Current Range

Diameter	Current	Voltage
1.2 mm	140-330 A	22-34 V
1.6 mm	160-430 A	24-36 V

Dual Shield B9

Dual Shield B9 is an all-position flux cored wire designed for the welding of modified 9% chromium - 1% molybdenum creep resisting steels, such as ASTM A335 Grade P91 or ASTM A213 T91. This product is formulated with a combined Mn & Ni < 1.20% to meet stringent customer specifications.

Classifications:	SFA/AWS A5.29:E91T1-B9M

Welding Current:	DC+
Alloy Type:	Alloyed steel (9 % Cr - 1 % Mo - V - Nb - N)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
M21 shielding gas			
PWHT 760°C 2h	600 MPa	738 MPa	21 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo	V	N	Nb	X-Factor
M21 shielding gas									
0.10	0.96	0.18	0.15	9.25	1.00	0.22	0.04	0.04	< 15 ppm

Current Range

Diameter	Current	Voltage
1.2 mm	150-330 A	22-34 V
1.6 mm	170-430 A	24-36 V

Dual Shield II 110

Dual Shield II 110 is an all-position flux cored wire designed to join high strength steel such as HY-100 and T-1 in the as welded or stress relieved condition. It is well suited for joining high tensile steels that will be used in low temperatures. It provides smooth spray type transfer, low spatter levels and easy slag removal.

Classifications:	SFA/AWS A5.29:E111T1-K3C/M
Approvals:	ABS AWS A5.29: E111T1-K3M

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	DC+
Alloy Type:	Low alloyed (Ni-Mo)

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
C1 shielding gas			
As Welded	735 MPa	830 MPa	21 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
C1 shielding gas		
As Welded	-20 °C	54 J
As Welded	-30 °C	49 J

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo
C1 shielding gas					
0.05	1.63	0.30	1.66	0.02	0.35

Current Range

Diameter	Current	Voltage
1.2 mm	140-330 A	22-34 V
1.6 mm	160-430 A	24-36 V

Shield-Bright 308L

Shield-Bright 308L was developed for welding type 304L stainless steel and can also be used for welding types 301, 302 and 304. It may also be used for welding types 321 and 347 if the service conditions do not exceed an approximate of 750°F (399°C).

Classifications Weld Metal:	SFA/AWS A5.22:E308LT1-1, SFA/AWS A5.22:E308LT1-4, EN ISO 17633-A:T 19 9 L P C1 2 , EN ISO 17633-A:T 19 9 L P M21 2, JIS Z 3323:TS308L-FB1, KS D 3612:YF308LC
Approvals:	ABS E308LT1-1 (C1), ABS E308LT1-4 (M21), BV 308L (C1), CCS 308L (C1), CE EN 13479, ClassNK KW308LG(C) (C1), CWB E308LT1-1 (C1), CWB E308LT1-4 (M21), DNV-GL VL 308L (C1), DNV-GL VL 308L (M21), KR RW308LG (C) (C1), LR 304L (C1), LR 304L (M21), NAKS/HAKC 1.2 mm, VdTÜV 04832 (M20, M21)

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	DC+
Alloy Type:	Austenitic Cr-Ni

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
C1 shielding gas			
As Welded	372 MPa	568 MPa	61 %
M21 shielding gas			
As Welded	410 MPa	580 MPa	44 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
C1 shielding gas		
As Welded	-29 °C	60 J

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr
C1 shielding gas				
0.025	1.10	0.70	10.00	19.10
M21 shielding Gas				
0.030	1.20	0.90	10.10	19.30

Current Range

Diameter	Current	Voltage
1.2 mm	130-220 A	24-29 V
1.6 mm	160-320 A	24-33 V

Shield-Bright 316L

Shield-Bright 316L was developed for the welding of type 316L stainless steel but can be used for other stainless steels including types 316 and 304L. In a few cases, e.g. nitric acid service, Shield-Bright 316L should not be used to weld 304L. It contains molybdenum which resists pitting corrosion induced by sulphuric and sulphurous acids, chlorides and cellulose solutions. Used widely in the rayon, dye and paper making industries.

Classifications Weld Metal:	SFA/AWS A5.22:E316LT1-1, SFA/AWS A5.22:E316LT1-4, EN ISO 17633-A:T 19 12 3 L P C1 2, EN ISO 17633-A:T 19 12 3 L P M21 2, JIS Z 3323:TS316L-FB1, KS D 3612:YF316LC
Approvals:	ABS E316LT1-1 (C1), ABS E316LT1-4 (M21), BV 316L (C1), CE EN 13479, ClassNK KW316LG(C) (C1), CWB E316LT1-1 (C1), CWB E316LT1-4 (M21), DNV-GL VL 316L (C1), DNV-GL VL 316L (M21), KR RW316LG(C) (C1), LR 316L (C1), LR 316L (M21), NAKS/HAKC 1.2 mm, RS A-6(xCrNiMo 19 11 3) (C1), VdTÜV 04834 (M20, M21)

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	DC+
Alloy Type:	Austenitic Cr-Ni-Mo

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
C1 shielding gas			
As Welded	442 MPa	570 MPa	53 %
M21 shielding gas			
As Welded	450 MPa	580 MPa	40 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
C1 shielding gas		
As Welded	-29 °C	60 J

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo
C1 shielding gas					
0.028	1.10	0.80	11.80	18.50	2.60
M21 shielding Gas					
0.030	1.20	0.90	12.00	18.50	2.70

Current Range

Diameter	Current	Voltage
1.2 mm	130-220 A	24-29 V
1.6 mm	160-320 A	24-33 V

Shield-Bright 309L

Shield-Bright 309L is a rutile cored wire designed for the all-positional welding (except vertical down) of stainless steels to carbon or low alloy steels and for the first layer cladding of carbon and low alloy steels with Ar/15-25%CO2 or CO2 shielding gas.

Classifications Weld Metal:	SFA/AWS A5.22:E309LT1-1, SFA/AWS A5.22:E309LT1-4, EN ISO 17633-A:T 23 12 L P C1 2 , EN ISO 17633-A:T 23 12 L P M21 2, JIS Z 3323:TS309L-FB1, KS D 3612:YF309LC
Approvals:	ABS E309LT1-1 (C1), ABS E309LT1-4 (M21), BV 309L (C1), CCS 309L (C1), CE EN 13479, ClassNK KW309LG(C) (C1), CWB E309LT1-1 (C1), CWB E309LT1-4 (M21), DNV-GL VL 309L (C1), DNV-GL VL 309L (M21), KR RW309LG(C) (C1), LR SS/CMn (C1), LR SS/CMn (M21), NAKS/HAKC 1.2 mm, RS A-9sp(x8CrNi 24 14) (C1), VdTÜV 04833 (M20, M21)

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current:	DC+
Alloy Type:	Austenitic Cr-Ni

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
C1 shielding gas			
As Welded	392 MPa	539 MPa	51 %
M21 shielding gas			
As Welded	480 MPa	600 MPa	35 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
C1 shielding gas		
As Welded	-29 °C	55 J

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr
C1 shielding gas				
0.029	1.10	0.80	12.40	23.10
M21 shielding Gas				
0.030	1.30	0.90	12.50	23.50

Current Range

Diameter	Current	Voltage
1.2 mm	130-220 A	24-29 V
1.6 mm	160-320 A	24-33 V

Submerged Arc Wires and Fluxes (SAW)

OK Autrod 12.08L

OK Autrod 12.08L is a copper coated, mild steel solid wire for submerged arc welding of mild and medium tensile steels. It is suitable for use in combination with various fluxes, depending on the application requirements.

Classifications Wire Electrode:	SFA/AWS A5.17:EL8/EL12, EN ISO 14171-A:S1

Alloy Type:	C-Mn

Typical Wire Composition %		
C	**Mn**	**Si**
0.06	0.50	0.02

OK Autrod 12.22L

OK Autrod 12.22L is a copper coated, medium manganese alloyed killed solid wire for submerged arc welding of medium and high strength steels. It can be used in combination with various fluxes, depending on the application requirements.

Classifications Wire Electrode:	SFA/AWS A5.17:EM12K, EN ISO 14171-B:SU21

Alloy Type:	Carbon-Manganese

Typical Wire Composition %		
C	**Mn**	**Si**
0.10	1.00	0.20

ESAB SA10K

ESAB SA10K is a copper coated, high manganese alloyed killed solid wire for submerged arc welding of medium and high strength steels. It can be used in combination with OK Flux 10.62 or OK Flux 10.71L, depending on the application requirements.

Classifications Wire Electrode:	SFA/AWS A5.17:EH10K

Alloy Type:	Carbon-Manganese

Typical Wire Composition %		
C	**Mn**	**Si**
0.11	1.55	0.20

OK Autrod 12.32

Copper-coated, unalloyed solid wire for Submerged Arc Welding of structural steels, ship building steels, pressure vessel steels, fine grained steels, off-shore constructions etc. It provides excellent toughness values in combination with OK Flux 10.62.

Classifications Wire Electrode:	SFA/AWS A5.17:EH12K, EN ISO 14171-A:S3Si
Approvals:	CE EN 13479, DB 52.039.12, NAKS/HAKC 2.0, 3.0, 4.0, 5.0 mm, VdTÜV 12103

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	C-Mn

Typical Wire Composition %		
C	**Mn**	**Si**
0.13	1.77	0.30

OK Autrod 12.40L

OK Autrod 12.40L is a copper coated, high manganese alloyed semi-killed solid wire for submerged arc welding of medium and high tensile steels. It can be used in combination with OK Flux 10.62 or OK Flux 10.71L, depending on the application requirements.

Classifications Wire Electrode:	SFA/AWS A5.17:EH14

Alloy Type:	C-Mn

Typical Wire Composition %		
C	**Mn**	**Si**
0.12	1.85	0.05

OK Autrod 12.24L

OK Autrod 12.24L is a copper coated, molybdenum alloyed solid wire for the submerged arc welding of non alloyed and low alloyed steels. It can be used in combination with OK Flux 10.62 or OK Flux 10.71L, depending on the application requirements.

Classifications Wire Electrode:	SFA/AWS A5.23:EA2, IS 7280:AS-2 Mo (Nearest)
Approvals:	RDSO W4

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Mo alloyed

Typical Wire Composition %			
C	**Mn**	**Si**	**Mo**
0.10	1.20	0.15	0.50

OK Autrod 12.33L

OK Autrod 12.33L is a copper coated, manganese-molybdenum alloyed solid wire for the submerged arc welding of high tensile steels. It can be used in combination with OK Flux 10.62 or OK Flux 10.71L, depending on the application requirements.

Classifications Wire Electrode:	SFA/AWS A5.23:EA3K

Alloy Type:	Mn-Mo

Typical Wire Composition %			
C	**Mn**	**Si**	**Mo**
0.08	1.80	0.55	0.42

OK Autrod 13.10 SC

Cr-Mo-alloyed, copper-coated solid wire for Submerged Arc Welding of creep resistant steels (1,25% Cr, 0,5% Mo). OK Autrod 13.10 SC has a very low level of impurities with X-factor (Bruscato) maximum 10.

Classifications Wire Electrode:	SFA/AWS A5.23:EB2R, EN ISO 24598-A:S S CrMo1
Approvals:	CE EN 13479, DB 52.039.09, NAKS/HAKC 2.0-4.0 mm, VdTÜV 12104

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Cr-Mo alloyed

Typical Wire Composition %				
C	**Mn**	**Si**	**Cr**	**Mo**
0.10	0.83	0.12	1.21	0.49

OK Autrod 13.20 SC

OK Autrod 13.20 SC is a Cr-Mo-alloyed, copper-coated solid wire for Submerged Arc Welding of creep resistant steels (2,25% Cr, 1% Mo). It has a very low level of impurities with X-factor (Bruscato) maximum 11.

Classifications Wire Electrode:	SFA/AWS A5.23:EB3R, EN ISO 24598-A:S S CrMo2
Approvals:	CE EN 13479, NAKS/HAKC 3.0-4.0 mm, VdTÜV 12104

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Cr-Mo alloyed

Typical Wire Composition %				
C	**Mn**	**Si**	**Cr**	**Mo**
0.11	0.66	0.15	2.33	0.95

OK Autrod 13.35

A non copper-coated solid wire for Submerged Arc Welding of creep resistant steels (9% Cr, 1% Mo V Nb N).

Classifications Wire Electrode:	SFA/AWS A5.23:EB91, EN ISO 24598-A:S S CrMo91
Approvals:	VdTÜV 12104

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	9Cr-1Mo-V-Nb-N

Typical Wire Composition %								
C	**Mn**	**Si**	**Ni**	**Cr**	**Mo**	**V**	**N**	**Nb**
0.10	0.52	0.22	0.67	8.82	0.92	0.20	0.05	0.07

OK Autrod 13.40

Ni-Mo-alloyed, copper-coated solid wire for Submerged Arc Welding of high strength steels with minimum yield strengths up to 620 MPa, low temperature steels, fine grained steels etc. It can be used in combination with OK Flux 10.62.

Classifications Wire Electrode:	SFA/AWS A5.23:EG, EN ISO 14171-A:S3Ni1Mo, EN ISO 26304-A:S3Ni1Mo, EN ISO 26304-B:(SUN2M2)
Approvals:	CE EN 13479, NAKS/HAKC 3.2-4.0 mm, VdTÜV 12103

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Ni-Mo alloyed

Typical Wire Composition %				
C	**Mn**	**Si**	**Ni**	**Mo**
0.11	1.63	0.16	0.86	0.51

OK Autrod 13.43

Ni-Cr-Mo-alloyed, copper-coated solid wire for Submerged Arc Welding of high strength steels with minimum yield strengths up to 690 MPa, low temperature steels, fine grained steels etc. It can be used in combination with OK Flux 10.62.

Classifications Wire Electrode:	SFA/AWS A5.23:EG, EN ISO 26304-A:S3Ni2,5CrMo, EN ISO 26304-B:(SUN4C1M3)
Approvals:	CE EN 13479, VdTÜV 12104

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Ni-Cr-Mo alloyed

Typical Wire Composition %					
C	**Mn**	**Si**	**Ni**	**Cr**	**Mo**
0.12	1.55	0.19	2.29	0.67	0.47

OK Autrod 16.10

A corrosion resistant, chromium-nickel alloyed solid wire for welding austenitic stainless alloys of 18Cr-8Ni type. OK Autrod 16.10 can be used in combination with OK Flux 10.93.

Classifications:	SFA/AWS A5.9:ER308L

Alloy Type:	Austenitic Cr-Ni

Typical Wire Composition %

C	Mn	Si	Ni	Cr
0.02	1.80	0.50	9.20	19.80

OK Autrod 16.11

A corrosion-resistant, chromium-nickel-niobium alloyed solid wire for welding stabilized austenitic chromium-nickel alloys of 18Cr-8Ni type. OK Autrod 16.11 can be used in combination with OK Flux 10.93.

Classifications Wire Electrode:	SFA/AWS A5.9:ER347

Alloy Type:	Austenitic 19% Cr - 9% Ni - Nb

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Nb
0.02	1.70	0.40	9.15	19.50	0.35

OK Autrod 16.30

A corrosion resistant, chromium-nickel-molybdenum alloyed solid wire for welding austenitic stainless alloys of the 18Cr-12Ni-2.5Mo types. OK Autrod 16.30 can be used in combination with OK Flux 10.93.

Classifications Wire Electrode:	SFA/AWS A5.9:ER316L

Alloy Type:	Austenitic Cr-Ni-Mo

Typical Wire Composition %					
C	**Mn**	**Si**	**Ni**	**Cr**	**Mo**
0.02	1.70	0.40	11.20	18.40	2.10

OK Autrod 16.53

A corrosion resistant, chromium-nickel alloyed solid wire for joining stainless steels to non-alloy or low-alloy steels and for welding austenitic stainless alloys of the 24Cr-13Ni types. The alloy is also used for welding buffer layers on C-Mn/low-alloy steels. OK Autrod 16.53 can be used in combination with OK Flux 10.93.

Classifications Wire Electrode:	SFA/AWS A5.9:ER309L

Alloy Type:	Austenitic Cr-Ni

Typical Wire Composition %				
C	**Mn**	**Si**	**Ni**	**Cr**
0.02	1.70	0.40	12.30	23.50

OK Flux 10.81L

OK Flux 10.81L is an agglomerated Si and Mn alloying flux for submerged arc welding. It provides exceptional welding characteristics with a slag system that allows higher welding speeds. OK Flux 10.81L gives good surface finish and excellent slag detachability. Due to high Mn & Si alloying, this is intended for limited number of passes and plate thickness up to about 20 mm.

Classifications:	EN ISO 14174:S A AR 1 87 DC

Slag Type:	Aluminate-rutile
Alloy Transfer:	Silicon and Manganese alloying
Basicity Index:	nom: 0.8
Grain Size (met):	0.2-1.6 mm

Classifications	Wire	Weld Metal		
Wire	**AWS/EN ISO**	**AWS - As Welded**	**AWS - PWHT**	**EN ISO - As Welded**
OK Autrod 12.08L	A5.17: EL8/EL12 / 14171-A: S1	A5.17: F7AZ-EL8/EL12	A5.17: F7PZ-EL8/EL12	14171-A: S 42 Z AR S1
OK Autrod 12.22L	A5.17: EM12K / 14171-B: SU21	A5.17: F7AZ-EM12K	A5.17: F7PZ-EM12K	-

Approvals				
Wire	**BV**	**IRS**	**LR**	**M N Dastur**
OK Autrod 12.08L	•	•	•	•

*Selected production units only. Please contact ESAB for more information. Visit esab.com to download specific flux/wire combination fact sheets for more details.

Typical Mechanical Properties				
Wire	**Condition**	**Yield Strength**	**Tensile Strength**	**Elongation**
OK Autrod 12.08L	As Welded AWS DC+	500 MPa	590 MPa	25 %
	PWHT 620°C 1h AWS DC+	450 MPa	540 MPa	26 %
OK Autrod 12.22L	As Welded AWS DC+	540 MPa	600 MPa	25 %
	PWHT 620°C 1h AWS DC+	500 MPa	560 MPa	26 %

Typical Weld Metal Analysis %		
C	**Mn**	**Si**
OK Autrod 12.08L DC+, 550A, 29V		
0.06	1.15	0.70
OK Autrod 12.22L DC+, 550A, 29V		
0.08	1.40	0.80

OK Flux 10.81LS

OK Flux 10.81LS is an agglomerated Si and Mn alloying flux for submerged arc welding. Most suitable for applications where the dilution of base metal is high, e.g. in fillet welding and butt welding of thin and medium thick plates with a limited number of passes. The superior welding properties associated with the acid slag system of OK Flux 10.81LS permit high travel speeds in butt and fillet welding. It offers superior bead shape, slag removal and surface finish. It can be easily used over rust and primer without running into the risk of porosity.

Slag Type:	Aluminate-rutile
Alloy Transfer:	Silicon and Manganese alloying
Basicity Index:	nom: 0.7
Grain Size (met):	0.2-1.6 mm

Classifications	Wire	Weld Metal	
Wire	**AWS/EN ISO**	**AWS - As Welded**	**AWS - PWHT**
OK Autrod 12.08L	A5.17: EL8/EL12 / 14171-A: S1	A5.17: F7AZ-EL8/EL12	A5.17: F7PZ-EL8/EL12
OK Autrod 12.22L	A5.17: EM12K / 14171-B: SU21	A5.17: F7AZ-EM12K	A5.17: F7PZ-EM12K

Typical Mechanical Properties

Wire	Condition	Yield Strength	Tensile Strength	Elongation
OK Autrod 12.08L	As Welded AWS DC+	530 MPa	580 MPa	26 %
	PWHT 620°C 1h AWS DC+	470 MPa	550 MPa	28 %
OK Autrod 12.22L	As Welded AWS DC+	550 MPa	620 MPa	24 %
	PWHT 620°C 1h AWS DC+	510 MPa	580 MPa	25 %

Typical Weld Metal Analysis %

C	Mn	Si
OK Autrod 12.08L DC+, 550A, 29V		
0.07	1.10	0.70
OK Autrod 12.22L DC+, 550A, 29V		
0.09	1.45	0.85

OK Flux 10.81LHS

Agglomerated aluminate-basic flux for Submerged Arc Welding. It is specially designed for fillet welding applications at high speeds primarily with single & twin wire systems. Major applications include beams fabrication, general construction etc. Due to high Mn & Si alloying, this is intended for limited number of passes and plate thickness up to about 25 mm.

Slag Type:	Aluminate-basic
Alloy Transfer:	Silicon and Manganese alloying
Basicity Index:	nom: 1.0
Grain Size (met):	0.2-1.2 mm

Classifications	Wire	Weld Metal	
Wire	**AWS/EN ISO**	**AWS - As Welded**	**AWS - PWHT**
OK Autrod 12.22L	A5.17: EM12K / 14171-B: SU21	A5.17: F7AZ-EM12K	A5.17: F7PZ-EM12K

Typical Mechanical Properties

Wire	Condition	Yield Strength	Tensile Strength	Elongation
OK Autrod 12.22L	As Welded AWS DC+	460 MPa	540 MPa	30 %
	PWHT 620°C 1h AWS DC+	420 MPa	510 MPa	30 %

Typical Weld Metal Analysis %

C	Mn	Si
OK Autrod 12.22L DC+ 550A, 29V		
0.06	1.90	0.70

OK Flux 10.71L

OK Flux 10.71L is an agglomerated, basic flux for submerged arc welding. It is used for single and multi-run welding of all plate thicknesses. It can be combined with a wide range of wires and thus it is suitable for all kinds of steels. OK Flux 10.71L combines good toughness values with excellent weldability. It is used for single & multi-wire procedures such as tandem, twin-arc, tandem-twin welding and many more, for butt, overlap and fillet welds. It works equally well on DC and AC current. The good slag detachability and limited alloying of Si and Mn makes it well suited for multi-pass thick section welding.

In general construction, OK Flux 10.71L is one of the most used SAW fluxes. Not just for structural steels and fine-grained steels, but also for weather resistant steels e.g. for bridges. Pressure vessels are welded with this flux, because it can be used for a wide range of steels including low temperature steels. This reduces the number of different fluxes a customer needs to have in stock. Wind tower production with plate thicknesses of greater than 50 mm require not only excellent slag detachability particularly in the first run, high deposition rates in all following runs and also excellent toughness values. Since OK Flux 10.71L offers all this it is well established in this market segment. Other applications are in shipbuilding or in the production of pipes with steels up to X70 strength level.

Classifications:	EN ISO 14174:S A AB 1 67 AC H5

Diffusible Hydrogen:	max 5 ml/100g weld metal (Redried flux)
Slag Type:	Aluminate-basic
Alloy Transfer:	Slightly Silicon and moderately Manganese alloying
Basicity Index:	nom: 1.5
Grain Size (met):	0.2-1.6 mm (10x65 mesh)

Classifications	Wire	Weld Metal	
Wire	**AWS/EN ISO**	**AWS - As Welded**	**AWS - PWHT**
OK Autrod 12.08L	A5.17: EL8/EL12 / 14171-A: S1	A5.17: F6A2-EL8/EL12	-
OK Autrod 12.22L	A5.17: EM12K / 14171-B: SU21	A5.17: F7A4-EM12K	A5.17: F6P5-EM12K
ESAB SA10K	A5.17: EH10K	A5.17: F7A4-EH10K	A5.17: F7P6-EH10K
OK Autrod 12.40L	A5.17: EH14	A5.17: F7A4-EH14	A5.17: F7P5-EH14
OK Autrod 12.24L	A5.23: EA2	A5.23: F8A2-EA2-A4	A5.23: F7P0-EA2-A4
OK Autrod 12.33L	A5.23: EA3K	A5.23: F9A0-EA3K-G	A5.23: F8P0-EA3K-G

Approvals					
Wire	**ABS**	**IBR**	**IRS**	**LR**	**M N Dastur**
OK Autrod 12.08L	•	-	•	-	-
OK Autrod 12.22L	-	-	-	•	-
OK Autrod 12.40L	-	•	•	•	•

*Selected production units only. Please contact ESAB for more information. Visit esab.com to download specific flux/wire combination fact sheets for more details.

OK Flux 10.71L

Typical Mechanical Properties

Wire	Condition	Yield Strength	Tensile Strength	Elongation	Charpy V-Notch
OK Autrod 12.08L	As Welded AWS DC+	390 MPa	450 MPa	25 %	100 J @ -18°C 70 J @ -29°C
OK Autrod 12.22L	As Welded AWS DC+	450 MPa	540 MPa	29 %	45 J @ -29°C 30 J @ -40°C
	PWHT 620°C 1h AWS DC+	390 MPa	490 MPa	32 %	65 J @ -29°C 30 J @ -46°C
ESAB SA10K	As Welded AWS DC+	490 MPa	580 MPa	26 %	45 J @ -29°C 30 J @ -40°C
	PWHT 620°C 1h AWS DC+	430 MPa	530 MPa	32 %	100 J @ -29°C 40 J @ -51°C
OK Autrod 12.40L	As Welded AWS DC+	490 MPa	580 MPa	27 %	60 J @ -29°C 40 J @ -40°C
	PWHT 620°C 1h AWS DC+	440 MPa	530 MPa	29 %	80 J @ -29°C 45 J @ -46°C
OK Autrod 12.24L	As Welded AWS DC+	550 MPa	610 MPa	23 %	65 J @ -18°C 40 J @ -29°C
	PWHT 620°C 1h AWS DC+	480 MPa	560 MPa	26 %	80 J @ 0°C 50 J @ -18°C
OK Autrod 12.33L	As Welded AWS DC+	630 MPa	700 MPa	25 %	65 J @ 0°C 35 J @ -18°C
	PWHT 620°C 1h AWS DC+	550 MPa	650 MPa	30 %	70 J @ 0°C 40 J @ -18°C

Typical Weld Metal Analysis %

C	Mn	Si	Mo
OK Autrod 12.08L DC+ 550A, 29V			
0.06	0.90	0.20	-
OK Autrod 12.22L DC+ 550A, 29V			
0.08	1.35	0.40	-
ESAB SA10K DC+ 550A, 29V			
0.07	1.75	0.50	-
OK Autrod 12.40L DC+ 550A, 29V			
0.07	1.95	0.40	-
OK Autrod 12.24L DC+ 550A, 29V			
0.08	1.35	0.40	0.45
OK Autrod 12.33L DC+ 550A, 29V			
0.06	1.95	0.75	0.40

OK Flux 10.62

Agglomerated fluoride-basic flux for Submerged Arc Welding. It is used for multi-run welding of thick section materials. OK Flux 10.62 with advanced slag detachability creates soft transitions to side walls, concave weld bead profiles and very smooth weld beads. The strong grains allow multiple recycling cycles and prolonged flux hopper refilling intervals. The original grain size distribution is maintained which increases product consistency and thus contributes to high quality of the welding joints.

OK Flux 10.62 can be used with high parameters and all SAW process variants such as Tandem, Twin, ICE, 3 or 4 wire process in every multi pass joint including narrow gap. It is suitable for highest demands on impact properties, low temperature toughness, strength and CTOD-values. It is used in the offshore constructions, pressure vessels, power generation, ship building, pipe mills, civil constructions, transport industries, etc. Produces weld metal with hydrogen contents maximum 4 ml/100g, in BlockPac (moisture protection).

Classifications:	EN ISO 14174:S A FB 1 55 AC H4 (only BlockPac/moisture protection)
Approvals:	CE EN 13479, DB 51.039.07, NAKS/HAKC RD 03-613-03

Approvals are based on factory location. Please contact ESAB for more information.

Diffusible Hydrogen:	max 4 ml/100g in BlockPac (moisture protection)
Slag Type:	Fluoride-basic
Alloy Transfer:	No Silicon or Manganese alloying
Basicity Index:	nom: 3.2
Grain Size (met):	0.2-1.6 mm (10x65 mesh)

Classifications	Wire	Weld Metal		
Wire	**AWS/EN ISO**	**AWS - As Welded**	**AWS - PWHT**	**EN ISO - As Welded**
ESAB SA10K	A5.17: EH10K	A5.17: F7A6-EH10K	A5.17: F7P8-EH10K	-
OK Autrod 12.32	A5.17: EH12K / 14171-A: S3Si	A5.17: F7A8-EH12K	A5.17: F7P8-EH12K	14171-A: S 46 6 FB S3Si
OK Autrod 12.40L	A5.17: EH14	A5.17: F7A6-EH14	A5.17: F7P6-EH14	-
OK Autrod 12.24L	A5.23: EA2	A5.23: F8A4-EA2-A2	A5.23: F8P4-EA2-A2	-
OK Autrod 12.33L	A5.23: EA3K	A5.23: F10A4-EA3K-G	A5.23: F9P4-EA3K-G	-
OK Autrod 13.40	A5.23: EG / 14171-A: S3Ni1Mo / 26304-A: S3Ni1Mo / 26304-B: (SUN2M2)	A5.23: F9A8-EG-F3	A5.23: F9P8-EG-F3	26304-A: S 55 6 FB S3Ni1Mo
OK Autrod 13.43	A5.23: EG / 26304-A: S3Ni2,5CrMo / 26304-B: (SUN4C1M3)	A5.23: F11A8-EG-G	A5.23: F11P8-EG-G	26304-A: S 69 6 FB S3Ni2,5CrMo

Approvals									
Wire	**ABS**	**BV**	**CE**	**DB**	**DNV-GL**	**LR**	**RINA**	**RS**	**VdTÜV**
OK Autrod 12.32	•	•	•	•	•	•	•	•	•
OK Autrod 13.40	•	•	•	-	•	•	-	•	•
OK Autrod 13.43	•	•	•	-	•	•	-	-	-

*Selected production units only. Please contact ESAB for more information. Visit esab.com to download specific flux/wire combination fact sheets for more details.

OK Flux 10.62

Typical Mechanical Properties

Wire	Condition	Yield Strength	Tensile Strength	Elongation	Charpy V-Notch
ESAB SA10K	As Welded AWS DC+	490 MPa	570 MPa	28 %	55 J @ -40°C 40 J @ -51°C
	PWHT 620°C 1h AWS DC+	450 MPa	540 MPa	30 %	80 J @ -40°C 30 J @ -62°C
OK Autrod 12.32	As Welded AWS DC+	475 MPa	560 MPa	28 %	110 J @ -40°C 70 J @ -62°C
	PWHT 620°C 1h AWS DC+	410 MPa	510 MPa	28 %	110 J @ -40°C 60 J @ -62°C
OK Autrod 12.40L	As Welded AWS DC+	520 MPa	610 MPa	26 %	85 J @ -40°C 40 J @ -51°C
	PWHT 620°C 1h AWS DC+	450 MPa	550 MPa	28 %	90 J @ -40°C 50 J @ -51°C
OK Autrod 12.24L	As Welded AWS DC+	550 MPa	620 MPa	25 %	40 J @ -29°C 30 J @ -40°C
	PWHT 620°C 1h AWS DC+	530 MPa	590 MPa	27 %	35 J @ -29°C 30 J @ -40°C
OK Autrod 12.33L	As Welded AWS DC+	660 MPa	740 MPa	25 %	45 J @ -29°C 30 J @ -40°C
	PWHT 620°C 1h AWS DC+	620 MPa	690 MPa	26 %	50 J @ -29°C 30 J @ -40°C
OK Autrod 13.40	As Welded AWS DC+	610 MPa	690 MPa	24 %	90 J @ -40°C 50 J @ -62°C
	PWHT 620°C 1h AWS DC+	600 MPa	680 MPa	26 %	60 J @ -40°C 45 J @ -62°C
OK Autrod 13.43	As Welded AWS DC+	700 MPa	800 MPa	21 %	75 J @ -40°C 50 J @ -62°C
	PWHT 565°C 1h AWS DC+	695 MPa	790 MPa	21 %	60 J @ -40°C 40 J @ -62°C

OK Flux 10.62

Typical Weld Metal Analysis %					
C	**Mn**	**Si**	**Ni**	**Cr**	**Mo**
ESAB SA10K DC+, 550A, 29V					
0.08	1.45	0.25	-	-	-
OK Autrod 12.32 DC+, 580A, 29V					
0.10	1.60	0.35	-	-	-
OK Autrod 12.40L DC+, 550A, 29V					
0.09	1.75	0.15	-	-	-
OK Autrod 12.24L DC+, 550A, 29V					
0.07	1.10	0.25	-	-	0.45
OK Autrod 12.33L DC+, 550A, 29V					
0.06	1.70	0.75	-	-	0.40
OK Autrod 13.40 DC+, 580A, 29 V					
0.07	1.50	0.26	0.90	-	0.50
OK Autrod 13.43 DC+, 580A, 29 V					
0.11	1.50	0.25	2.20	0.60	0.50

Other Properties		
Wire	**Property**	
ESAB SA10K	HIC test according to NACE TM0284	Satisfactory
	SSC test according to NACE TM0177	Satisfactory

OK Flux 10.63

OK Flux 10.63 is an agglomerated, high-basic flux for submerged arc welding. It is used for multi-run welding of creep resistant Cr-Mo-alloyed steels when high toughness values are required, even after step cooling heat treatment. It can be used for single and multi-wire procedures, for butt and fillet welds and works equally well on DC and AC current. The flux is neutral in terms of Si and Mn alloying and thus it is perfect for multi-layer welding of unlimited plate thicknesses.
It is well suited for narrow gap welding, due to good slag detachability and smooth sidewall blending. The optimum voltage is at the lower end of the voltage range. The weld metal produced has a very low level of impurities with well controlled X-factors. It has a low oxygen content, approx. 300ppm and hydrogen levels lower than 5ml/100g.
OK Flux 10.63 is used in the petrochemical, chemical, power generation, pressure vessels industries etc.

Classifications:	EN ISO 14174:S A FB 1 55 AC H5
Approvals:	NAKS/HAKC RD 03-613-03

Approvals are based on factory location. Please contact ESAB for more information.

Diffusible Hydrogen:	max 5 ml/100g weld metal (Redried flux)
Slag Type:	Fluoride-basic
Alloy Transfer:	No Silicon or Manganese alloying
Basicity Index:	nom: 3.0
Grain Size (met):	0.2-1.6 mm (10x65 mesh)

Classifications	Wire	Weld Metal	
Wire	**AWS/EN ISO**	**AWS - PWHT**	**EN ISO - PWHT**
OK Autrod 13.10 SC	A5.23 :EB2R / 24598-A: S S CrMo1	A5.23: F8P4-EB2R-B2R	24598-A: S S CrMo1 FB
OK Autrod 13.20 SC	A5.23: EB3R / 24598-A: S S CrMo2	A5.23: F8P8-EB3R-B3R	24598-A: S S CrMo2 FB

Typical Mechanical Properties					
Wire	**Condition**	**Yield Strength**	**Tensile Strength**	**Elongation**	**Charpy V-Notch**
OK Autrod 13.10 SC	PWHT 690°C 1h AWS DC+	500 MPa	600 MPa	27 %	200 J @ -20°C 150 J @ -29°C 140 J @ -40°C
OK Autrod 13.20 SC	PWHT 690°C 1h AWS DC+	530 MPa	630 MPa	25 %	150 J @ -20°C 110 J @ -40°C 50 J @ -62°C

Typical Weld Metal Analysis %					
C	**Mn**	**Si**	**Cr**	**Mo**	**X-Factor**
OK Autrod 13.10 SC DC+, 485A, 30V					
0.075	0.80	0.25	1.10	0.50	≤ 12 ppm
OK Autrod 13.20 SC DC+, 580A, 29V					
0.07	0.60	0.20	2.10	1.00	≤ 15 ppm

OK Flux 10.64

Agglomerated fluoride-basic flux for Submerged Arc Welding. Designed for multi-run welding with EB91 wire for joining of T/P91 base materials. The flux is C and Cr compensating so that the weld metal fully complies with B91 weld metal chemistry according to AWS. Mainly for power generation and pressure vessel production. Very good slag detachability. Suitable for DC only. Single layer and multi layer welding of unlimited plate thickness.

Classifications:	EN ISO 14174:S A FB 1 54 DC H5

Diffusible Hydrogen:	max 5 ml/100g weld metal (Redried flux)
Slag Type:	Fluoride-basic
Alloy Transfer:	No Silicon alloying and Manganese slightly burning off
Basicity Index:	nom: 2.6
Grain Size (met):	0.2-1.6 mm (10x65 mesh)

Classifications	Wire	Weld Metal
Wire	**AWS/EN ISO**	**AWS - PWHT**
OK Autrod 13.35	A5.23: EB91 / 24598-A: S S CrMo91	A5.23: F10PZ-EB91-B91

Typical Mechanical Properties

Wire	Condition	Yield Strength	Tensile Strength	Elongation
OK Autrod 13.35	PWHT 760°C 2h AWS DC+	670 MPa	780 MPa	20 %

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo	V	N	Nb
OK Autrod 13.35 DC+, 400A, 28V								
0.11	0.65	0.25	0.55	8.80	0.90	0.17	0.05	0.05

OK Flux 10.93

OK Flux 10.93 is an agglomerated, basic flux for submerged arc welding of stainless steels. It is used for single and multi-run welding of all plate thicknesses. It can be combined with a wide range of stainless steel wires and is commonly used for butt & fillet welding of all standard austenitic and higher alloyed stainless steels. It provides a very good slag detachability, a smooth surface finish and an excellent bead appearance.

Classifications:	EN ISO 14174:S A AF 2 56 54 DC
Approvals:	CE EN 13479, DB 51.039.10, NAKS/HAKC RD 03-613-03

Approvals are based on factory location. Please contact ESAB for more information.

Slag Type:	CaF2-Al2O3-SiO2
Alloy Transfer:	Non alloying
Basicity Index:	nom: 1.9

Classifications	Wire
Wire	**AWS/EN**
OK Autrod 16.10	A5.9: ER308L
OK Autrod 16.11	A5.9: ER347
OK Autrod 16.30	A5.9: ER316L
OK Autrod 16.53	A5.9: ER309L

Typical Mechanical Properties

Wire	Condition	Yield Strength	Tensile Strength	Elongation	Charpy V-Notch
OK Autrod 16.10	As Welded DC+	410 MPa	570 MPa	38 %	60 J @ -110°C 45 J @ -196°C
OK Autrod 16.11	As Welded DC+	420 MPa	590 MPa	36 %	60 J @ -60°C 45 J @ -110°C
OK Autrod 16.30	As Welded DC+	400 MPa	530 MPa	35 %	65 J @ -110°C 40 J @ -196°C
OK Autrod 16.53	As Welded DC+	430 MPa	570 MPa	35 %	65 J @ -60°C 55 J @ -110°C

Typical Weld Metal Analysis %

C	Mn	Si	Ni	Cr	Mo	Nb
OK Autrod 16.10 DC+						
0.02	1.40	0.60	8.60	18.80	-	-
OK Autrod 16.11 DC+						
0.05	1.20	0.55	8.50	18.30	-	0.50
OK Autrod 16.30 DC+						
0.02	1.40	0.50	10.60	17.50	2.00	-
OK Autrod 16.53 DC+						
0.02	1.40	0.50	11.60	22.10	-	-

Recommendations for the storage, re-drying and handling of ESAB 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 storeroom 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 dehumidification.

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 re-dried 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. Re-drying the electrodes will restore their usability.

Mild steel rutile and acid electrodes normally require no re-drying.

Cellulose electrodes must not be re-dried.

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

Re-Drying Conditions

Re-drying temperatures and holding times are specified on the label and in the product specification.The re-drying temperature is the temperature in the bulk of the electrodes. The re-drying time is measured from the point at which the re-drying temperature has been reached. Do not stack more than four layers of electrodes in the re-drying oven. It is recommended not to re-dry covered electrodes more than three times.

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 re-dried
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 storeroom 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 re-drying before use, provided the package is undamaged. This is indicated by the 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 9 hours.

Storage and Handling Recommendations for Cored Wires

Cored wire should be stored in conditions which prevent the accelerated deterioration of products or packaging. All cored wires should avoid direct contact with water or moisture. This could take the form of rain or the condensation of moisture on a cold wire.

Cored wires must be stored in dry conditions. The relative humidity and temperature should be monitored and the temperature should not fall below the dew point.

To avoid condensation, the wire should be kept in the original packaging and, if necessary, left to warm up to at least the ambient temperature before opening the package.

Other hydrogen-containing substances, such as oil, grease and corrosion, or substances that could absorb moisture must also be avoided on the wire surface.

Products must be stored in such a way as to avoid damage during storage.

Easy and Efficient Storage and Handling of Fluxes

ESAB agglomerated fluxes have a guaranteed as-manufactured moisture content from production. This moisture content is controlled by internal ESAB specifications. Before transport, each pallet is shrinked or wrapped in plastic foil. This precautionary action is done in order to maintain the as-manufactured moisture content for as long as possible. Flux should never be exposed to wet conditions, such as rain or snow.

Storage

- Unopened flux bags must be stored in maintained storage conditions as follows:

  Temperature: 20 +/- 10°C
  Relative humidity: As low as possible, not exceeding 60%.
- Fluxes delivered in aluminium lined 25 kg bags (BlockPac™) or BigBags can be stored under more severe climatic conditions, because the packaging protects the flux reliably from moisture pick-up, as long as it is unopened and undamaged.
- Fluxes shall not be stored longer than 3 years (exept BlockPac).
- Fluxes in BlockPac have unlimited shelf life as long as the foil is not damaged.
- The content of unprotected flux hoppers must, after an 8 hours shift, be placed in a drying cabinet or heated flux hopper at a temperature of 150 +/- 25°C.
- Remaining flux from opened bags must be placed at a temperature of 150 +/- 25°C.

Recycling

- Moisture and oil must be removed from the compressed air used in the re-cycling system.
- Addition of new flux must be done with the proportion of at least one part new flux to three parts re-cycled flux.
- Foreign material, such as millscale and slag, must be removed by a suitable system, such as sieving.

Re-drying

- When handled and stored as above, the ESAB fluxes can normally be used straight away.
- In severe applications, stipulated by the applicable material specification or if the flux has somehow picked up moisture, re-drying of the flux is recommended.
- Re-drying shall be performed as follows:

  300 +/- 25°C for about 2-4 hours.
- Redrying must be done either in equipment that turns the flux so that the moisture can evaporate easily or in an oven on shallow plates with a flux height not exceeding 5 cm.
- Re-dried flux, not immediately used, must be kept at 150 +/- 25°C before use.

Disposal

- Discard any product, residue, disposable container or liner in an environmentally acceptable manner, in full compliance with federal and local regulations.
- Please address your local disposal company for prescribed disposal.
- Information on product and residues are given in the Safety Data Sheets available through www.esab.com.

Hand Welding 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 6 mm 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 EN 1011-2 (2011). 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.

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, 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/min for 6 mm 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, rutile-basic 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 electrodes. 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 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 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 zircon-basic, 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.

General Recommendations GMAW

GMAW – Gas Metal Arc Welding

The electrodes and joint faces should be clean. This is particularly important when welding aluminium and aluminium alloys. The shielding gases which are used must be of a purity suitable for welding. Moisture in the gas can produce 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, it produces 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 more expensive than pure CO_2, but produces a softer arc, quieter welding, better bead appearance and less spatter. It is therefore often used, in spite of its higher price, for welding 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, such as creep-resistant steels, even in thicknesses greater than 1.5 mm. Mixed gas of the 80/20 type, in which the argon is of a lower purity, is also available. These gases are less expensive than those based on pure argon and can often be used with equally good results.

One drawback of Ar/CO_2 mixtures is that they lead to increased ozone formation, compared with pure CO_2, when used as shielding gas in arc welding.

Another drawback when using the mixture is that the current load capacity of the welding gun is reduced by about 30% compared with welding with CO_2.

Shielding Gas for Stainless and Heat-Resistant Steels

Argon containing 1% oxygen is normally used for welding stainless and heat-resistant steels, but argon containing 2% O_2 or 5% O_2 is also available. The latter produces 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 is, therefore generally faster 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 is 6-10 litres/min for short arc welding and 12-20 litres/min for spray arc welding. The higher the welding current, the higher the gas flow required.

Welding Technique

The welding gun is normally held in the right hand, which means that the weld is made from right to left with the gun directed away from the deposited weld at an angle of 75-80° between the electrode and the workpiece, thereby giving the operator a good view of the weld pool and the joint. This produces 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.

General Recommendations for Submerged Arc Welding

1. **The flux must be dry**. Agglomerated fluxes must be protected from moisture pick-up.

   In tropical, humid areas, re-drying agglomerated fluxes at 250-350°C before use is recommended. The remaining flux in the welding machine container should be removed and stored in a dry cabinet and should therefore not be left in the open container during the night.

   During the transport of fluxes, a maximum of two pallets should be stacked to prevent the grains being crushed.

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 chances of obtaining a satisfactory weld. Rust, mill scale, paint, oil and residue 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 results in higher flux consumption. If the flux contains alloying elements, the amount transferred to the weld metal will increase as the arc voltage increases.

4. As a general rule, multi-run deposits made at moderate welding currents have better mechanical properties than one- or two-layer deposits made at high currents in similar plate thicknesses.

The mechanical properties are obtained according to the welding conditions given in applicable standards such as EN ISO or AWS.

Other welding conditions may produce weld metal analyses and mechanical properties which differ from those given in the handbook.

Approval in Accordance with Classification Society Rules

Welding materials are normally classified by ESAB in accordance with a standard, e.g. AWS and EN ISO. To verify mechanical properties they are also approved in accordance with the rules of the classification societies.

Classification

The classification of welding products refers to standards and, when a welding product is classified, its type, properties and field of application are given. The manufacturer verifies the correct classification of a product by internal testing and/or by witness of an outside organisation.

Approval

Ship owners and partners in offshore enterprises require welding consumables to be approved in accordance with the rules of the classification societies. Approval is also required by clients in accordance with national or international standards for boiler and pressure vessels as well as other standards to be verified by an authorized approval institute.

Approved welding products are entered on the “List of Approved Welding Consumables” distributed annually by the societies and other institutes.

The ESAB Welding Handbook provides information about the welding position, current/polarity, low hydrogen and grading.

Non-Alloyed and Low-Alloyed Steels

Consumables are divided into three categories based on their tensile strength level:

Normal strength steel: indicated by the numbers 1, 2 or 3 (e.g. 3 3M) that the electrode is to be used in steel with a minimum yield strength (ReH) of 305 and a tensile strength of 400-560 MPa.

High strength steel: indicated by 2Y, 3Y, 4Y, 5Y (ReH min 375 and Rm 490-660 MPa) and 2Y40, 3Y40, 4Y40 (ReH min 400 and Rm 510-690 MPa).

Extra high strength steel: indicated by 3Y42, 4Y42, 5Y42 up to 5Y69 and so on for the different strength steel categories, where the numbers 42...69 symbolize a yield strength in MPa indicating that the electrodes can be used for extra high tensile steels.

Toughness Level

Each steel category is divided into three to five toughness levels represented by the first digit in the grade (1, 2, 3, 4 or 5)

-1 suitable for grade A steel (impact tested at 20°C)

-2 suitable for grade A, B and C steels (impact tested at 0°C)

-3 suitable for grade A, B, D and E steels (impact tested at -20°C)

-4 suitable for grade A, B, D, E and F steels (impact tested at -40°C)

-5 suitable for grades A, B, D, E and F steels (impact tested at -60°C)

Other Frequently Used Abbreviations

T two-run welding (submerged arc welded with one run from eachside)

M multi-run welding (submerged arc or automatic gas-shielded arc welding)

S semi-automatic, gas-shielded and flux-cored arc welding

H5, H10, H15 low-hydrogen welding consumables

DP deep penetration

Stainless Steel and Other High-Content Alloyed Steels

Grades of stainless steel for which the welding consumable is approved are indicated with respect to one or more of the types of stainless steels: 304L, 304LN, 316LN and so on.

The abbreviation SS/CMn indicates approval for joining any of the austenitic types of stainless steel to any of the normal strength or higher tensile ship steels. Dup/CMn indicates approval for joining any of the duplex types of stainless steel to any of the normal strength or higher tensile ship steels.

The system described for grading the consumables in accordance with the rules of the classification societies changes as new steels appear on the market and sometimes there are changes to the approval ratings which might mean that the handbook may not be currently up-to-date. To ensure that valid information is used, please request the latest issued Product Data Sheet for the filler material or please look into the list of product type approvals of the marine society you need the approval from.

EN ISO 2560-A: for covered electrodes for manual arc welding of non-alloyed and fine grain steels

E 46 3 1Ni B 5 4 H5

Symbol for strength and elongation

Symbol	Min. Yield Strength[1], MPa	Tensile Strength, MPa	Min. Elongation[2], %
35	355	440-570	22
38	380	470-600	20
42	420	500-640	20
46	460	530-680	20
50	500	560-720	18

1 - For the yield strength the lower yield (R_{eL}) shall be used when yielding occurs, otherwise the 0.2% proof stress ($R_{p0.2}$) shall be used. 2 - $L_0 = 5d$

Symbol for impact properties

Symbol	Min. average impact energy 32 J °C
Z	no requirements
A	+20
0	0
2	-20
3	-30
4	-40
5	-50
6	-60

Symbol for chemical composition of all weld metal

Alloy Symbol	Chemical Composition[123] %		
	Mn	Mo	Ni
no symbol	2.0	-	-
Mo	1.4	0.3-0.6	-
MnMo	1.4-2.0	0.3-0.6	-
1Ni	1.4	-	0.6-1.2
2Ni	1.4	-	1.8-2.6
3Ni	1.4	-	2.6-3.8
Mn1Ni	1.4-2.0	-	0.6-1.2
Mn2Ni	1.4-2.0	1.2-2.6	1.2-2.6
1NiMo	1.4	0.3-0.6	0.6-1.2
Z	any other agreed composition		

1 - If not specified: Mo <0.2, Ni <0.3, Cr <0.2,V <0.05, Nb <0.05, Cu <0.3(electrodes without gas shield only)
2 - Single values shown in the table mean maximum values
3 - The results shall be rounded to the same number of significant figures as in the specified value using the rules according to ISO 31-0, annex B Rule A.

Symbol for diffusible hydrogen

Symbol	Max. hydrogen content, ml/100g deposited weld metal
H 5	5
H 10	10
H 15	15

Symbol for the welding position

Welding positions in accordance with ISO 6947.
1: all positions
2: all positions,except vertical down
3: flat butt weld, flat fillet weld, horizontal/vertical weld
4: flat butt weld, flat fillet weld
5: as 3 and recommended vertical down welding

Symbol for recovery and type of current

Symbol	Weld metal recovery %	Type of current[1,2]
1	≤105	AC + DC
2	≤105	DC
3	>105 ≤125	AC + DC
4	>105 ≤125	DC
5	>125 ≤160	AC + DC
6	>125 ≤160	DC
7	>160	AC + DC
8	>160	DC

1 - In order to demonstrate operability on ac, tests shall be carried out with no load voltage not higher than 65V.
2 - AC = alternation current DC = direct current

Symbol for the type of electrode covering

A	Acid
C	Cellulosic
R	Rutile
RC	Rutile-cellulosic
RA	Rutile-acid
RB	Rutile-basic
RR	Rutile-thick
B	Basic

EN ISO 18275 – A: for covered electrodes for manual metal arc welding of high-strengths steels.

E 55 4 MnMo B 3 2 H5

Symbol for strength and elongation

Symbol	Min. Yield Strength[1], MPa	Tensile Strength, MPa	Min. Elongation[2], %
55	550	610-780	18
62	620	690-890	18
69	690	760-960	17
79	790	880-1080	16
89	890	980-1180	15

1 - For the yield strength the lower yield (R_{eL}) shall be used when yielding occurs, otherwise the 0.2% proof stress ($R_{p0.2}$) shall be used.
2 - The guage length is equal to five times the test specimen diameter

Symbol for impact properties

Symbol	Min. average impact energy 32 J °C
Z	no requirements
A	+20
0	0
2	-20
3	-30
4	-40
5	-50
6	-60
7	-70
8	-80

Symbol for chemical composition of all weld metal

Alloy Symbol	Chemical Composition[1,2] %			
	Mn	Ni	Cr	Mo
MnMo	1.4-2.0	-	-	0.3-0.6
Mn1Ni	1.4-2.0	0.6-1.2	-	-
1NiMo	1.4	0.6-1.2	-	0.3-0.6
1.5NiMo	1.4	1.2-1.8	-	0.3-0.6
2NiMo	1.4	1.8-2.6	-	0.3-0.6
Mn1NiMo	1.4-2.0	0.6-1.2	-	0.3-0.6
Mn2NiMo	1.4-2.0	1.8-2.6	-	0.3-0.6
Mn2NiCrMo	1.4-2.0	1.8-2.6	0.3-0.6	0.3-0.6
Mn2Ni1CrMo	1.4-2.0	1.8-2.6	0.6-1.0	0.3-0.6
Z[3]	any other agreed composition			

1 - If not specified: Mo <0.2, Ni <0.3, Cr <0.2,V <0.05, Nb <0.05, Cu <0.3, C ≤ 0.10, P < 0.025, S < 0.020, Si < 0.80
2 - Single values shown in the table mean maximum values
3 - Consumables for which the chemical composition is not listed shall be symbolized similarily and prefixed by the letter Z. The chemical composition ranges are not specified and it is possible that two electrodes with the same Z classification are not interchangeable.

Symbol for diffusible hydrogen

Symbol	Max. hydrogen content, ml/100g deposited weld metal
H 5	5
H 10	10
H 15	15

Symbol for the welding position

Welding positions in accordance with ISO 6947.
1: all positions
2: all positions,except vertical down
3: flat butt weld, flat fillet weld, horizontal/vertical weld
4: flat butt weld, flat fillet weld
5: as 3 and recommended vertical down welding

Symbol for recovery and type of current

Symbol	Weld metal recovery %	Type of current[1,2]
1	≤105	AC + DC
2	≤105	DC
3	>105 ≤125	AC + DC
4	>105 ≤125	DC
5	>125 ≤160	AC + DC
6	>125 ≤160	DC
7	>160	AC + DC
8	>160	DC

1 - In order to demonstrate operability on ac, tests shall be carried out with no load voltage not higher than 65V.
2 - AC = alternation current DC = direct current

Symbol for the type of electrode covering

B	Basic

For other electrodes covering, consult ISO 2560-A.

The letter T indicates that strength, elongation and impact properties in the classification of the deposited weld metal are obtained after a post-weld heat treatment between 560 °C and 600 °C for 1 h. The test piece shall be left in the furnace to cool down to 300 °C.

EN ISO 14171-A: for flux/wire combinations

S 38 5 AB S2Si

S	Submerged arc welding

Symbol for tensile properties

Grade Designation	Min. Yield Strength[1], MPa	Tensile Strength, MPa	Elongation[2], %
35	355	440-570	22
38	380	470-600	20
42	420	500-640	20
46	460	530-680	20
50	500	560-720	18

Symbol	Minimum parent material yield strength, MPa	Minimum tensile strength of the welded joint, MPa
2T	275	370
3T	355	470
4T	420	520
5T	500	600

All-weld chemical compositionof FCAW

Symbol	Chemical Composition %			
	Mn	Ni	Mo	Cu
T3	1.4-2.0	-	-	0.3
T3Ni1	1.4-2.0	0.6-1.2	-	0.3

Chemical composition of flux

Symbol	Type of flux
MS	Manganese-silicate
CS	Calcium-silicate
ZS	Zirconium-silicate
RS	Rutile-silicate
AR	Aluminate-rutile
AB	Aluminate-basic
AS	Aluminate-silicate
AF	Aluminate-fluoride-basic
FB	Fluoride-basic
GS	Magnesium-silicate
Z	Any other composition

Symbol for impact properties

Grade Designation	Charpy-V Impact J (min)	Temp °C
Z	No requirements	-
A	47	20
0	47	0
2	47	-20
3	47	-30
4	47	-40
5	47	-50
6	47	-60
7	47	-70
8	47	-80

Type of wire according to EN ISO 14171-A and chemical composition of wire electrode

Grade Designation	C	Si	Mn	Ni	Mo	Cr	Other Elements
SZ	Any other agreed analysis						
S1	0.05-0.15	-0.15	0.35-0.60	-0.15	-0.15	-0.15	*
S2	0.07-0.15	-0.15	0.80-1.30	-0.15	-0.15	-0.15	*
S3	0.07-0.15	-0.15	1.30-1.75	-0.15	-0.15	-0.15	*
S4	0.07-0.15	-0.15	1.75-2.25	-0.15	-0.15	-0.15	*
S1Si	0.07-0.15	0.15-0.40	0.35-0.60	-0.15	-0.15	-0.15	*
S2Si	0.07-0.15	0.15-0.40	0.80-1.30	-0.15	-0.15	-0.15	*
S2Si2	0.07-0.15	0.40-0.60	0.80-1.20	-0.15	-0.15	-0.15	*
S3Si	0.07-0.15	0.15-0.40	1.30-1.85	-0.15	-0.15	-0.15	*
S4Si	0.07-0.15	0.15-0.40	1.85-2.25	-0.15	-0.15	-0.15	*
S1Mo	0.05-0.15	0.05-0.25	0.35-0.60	-0.15	0.45-0.65	-0.15	*
S2Mo	0.07-0.15	0.05-0.25	0.80-1.30	-0.15	0.45-0.65	-0.15	*
S2MoTiB	0.05-0.15	0.15-0.35	1.00-1.35	-	0.40-0.65	-	**
S3Mo	0.07-0.15	0.05-0.25	1.30-1.75	-0.15	0.45-0.65	-0.15	*
S4Mo	0.07-0.15	0.05-0.25	1.75-2.25	-0.15	0.45-0.65	-0.15	*
S2Ni1	0.07-0.15	0.05-0.25	0.80-1.30	0.80-1.20	-0.15	-0.15	*
S2Ni1.5	0.07-0.15	0.05-0.25	0.80-1.30	1.20-1.80	-0.15	-0.15	*
S2Ni2	0.07-0.15	0.05-0.25	0.80-1.30	1.80-2.40	-0.15	-0.15	*
S2Ni3	0.07-0.15	0.05-0.25	0.80-1.30	2.80-3.70	-0.15	-0.15	*
S2Ni1Mo	0.07-0.15	0.05-0.25	0.80-1.30	0.80-1.20	0.45-0.65	-0.20	*
S3Ni1.5	0.07-0.15	0.05-0.25	1.30-1.70	1.20-1.80	-0.15	-0.20	*
S3Ni1Mo	0.07-0.15	0.05-0.25	1.30-1.80	0.80-1.20	0.45-0.65	-0.20	*
S3Ni1Mo0,2	0.07-0.15	0.10-0.35	1.20-1.60	0.80-1.20	0.15-0.30	-0.15	P, S: -0.015
S3Ni1.5Mo	0.07-0.15	0.05-0.25	1.20-1.80	1.20-1.80	0.30-0.50	-0.20	*
S2Ni1Cu	0.06-0.12	0.15-0.35	0.70-1.20	0.65-0.90	0.15	-0.40	Cu: 0.40-0.65
S3Ni1Cu	0.05-0.15	0.15-0.40	1.20-1.70	0.60-1.20	0.15	-0.15	Cu: 0.30-0.60

** Cu: -0.30 P, S: 0.025 or 0.020 Al: -0.030 ** Ti: 0.10-0.20 B: 0.005-0.020*

EN ISO 17632: for Cored Wires

T 46 3 1Ni B M 4 H5

Symbol for strength and elongation

Symbol	Min. Yield Strength[1], MPa	Tensile Strength, MPa	Min. Elongation[2], %
35	355	440-570	22
38	380	470-600	20
42	420	500-640	20
46	460	530-680	20
50	500	560-720	18

1 - For the yield strength the lower yield (R_{eL}) shall be used when yielding occurs, otherwise the 0.2% proof stress ($R_{p0.2}$) shall be used. 2 - $L_o = 5d$

Symbol for impact properties

Symbol	Min. average impact energy 47J °C
Z	no requirements
A	+20
0	0
2	-20
3	-30
4	-40
5	-50
6	-60

Symbol for chemical composition of all weld metal

Alloy Symbol	Chemical Composition[1][2][3] %		
	Mn	Mo	Ni
no symbol	2.0	-	-
Mo	1.4	0.3-0.6	-
MnMo	> 1.4-2.0	0.3-0.6	-
1Ni	1.4	-	0.6-1.2
2Ni	1.4	-	1.8-2.6
3Ni	1.4	-	> 2.6-3.8
Mn1Ni	> 1.4-2.0	-	0.6-1.2
1NiMo	1.4	0.3-0.6	0.6-1.2
Z	any other agreed composition		

1 - If not specified: Mo <0.2, Ni <0.3, Cr <0.2,V <0.05, Nb <0.05, Cu <0.3(electrodes without gas shield only)
2 - Single values shown in the table mean maximum values
3 - The results shall be rounded to the same number of significant figures as in the specified value using the rules according to ISO 31-0, annex B Rule A.

Symbol for diffusible hydrogen

Symbol	Max. hydrogen content, ml/100g deposited weld metal
H 5	5
H 10	10
H 15	15

Symbol for the welding position

The welding positions are symbolised by a digit designating the positions for which the electrode is tested according to prEN-3 (00121205)
1: all positions
2: all positions,except vertical down
3: flat butt weld, flat fillet weld, horizontal/vertical weld
4: flat butt weld, flat fillet weld
5: as 3 and recommended vertical down welding

Shielding gas

EN 758 symbol	
M	Argon mixture
C	CO_2
N	No shielding gas

Description of core

Gas-Shielded	
R	Rutile base, slow freezing slag
P	Rutile base, fast freezing slag
B	Basic slag
M	Metal powder core
Self-Shielded	
U	
V	Rutile of basic/fluoride
W	Basic/fluoride, slow freezing slag
X	
Y	Basic/fluoride, fast freezing slag
Z	Other types
S	

EN ISO 14174: for fluxes

S A AB 1 67 AC H5

S	Submerged arc welding
ES	Electroslag welding

Method of manufacture

Symbol	
F	Fused flux
A	Agglomerated flux
M	Mixed flux

Chemical composition of flux

Symbol	Type of flux
MS	Manganese-silicate
CS	Calcium-silicate
ZS	Zirconium-silicate
RS	Rutile-silicate
AR	Aluminate-rutile
AB	Aluminate-basic
AS	Aluminate-silicate
AF	Aluminate-fluoride-basic
FB	Fluoride-basic
GS	Magnesium-silicate
Z	Any other composition

Application

Class	
1	SA welding of non alloy and low alloy steels
2 and 2B	Fluxes for joining and surfacing of/with stainless and heat resisting Cr and Cr-Ni steels and/or Ni and Ni-based alloys. 2B for fluxes especially for strip cladding.
3	Fluxes for hardfacing overlay welding which alloy elements such as C, Cr or Mo to the weld metal.
4	Other fluxes which do not fit in class 1 to 3, e.g. fluxes for backing in one-side welding applications.

Hydrogen content of deposited metal

Symbol	Max. hydrogen content, ml/100g deposited weld metal
H 2	2
H 4	4
H 5	5
H 10	10

Type of current

Symbol	
DC	Direct current only
AC	Alternating and direct current

Metallurgical behaviour, flux class 1

Symbol	Metallurgical behaviour	Contribution from flux
1	Burn-out	>0.7
2	Burn-out	0.5-0.7
3	Burn-out	0.3-.05
4	Burn-out	0.1-0.3
5	Neutral	0.0-0.1
6	Pick-up	0.1-0.3
7	Pick-up	0.3-0.5
8	Pick-up	0.5-.07
9	Pick-up	>0.7
Sequence	Si, then Mn	

Metallurgical behaviour, flux class 2 and class 2B

Symbol	Metallurgical Behaviour	Chemical Composition[123] %			
		C	Si	Cr	Nb
1	Burn-out	>0.020	>0.7	>2.0	>0.20
2	Burn-out	-	0.5-0.7	1.5-2.0	0.15-1.20
3	Burn-out	0.010-0.020	0.3-0.5	1.0-1.5	0.10-0.15
4	Burn-out	-	0.1-0.3	0.5-1.0	0.05-0.10
5	Neutral	0.000-0.010	0.0-0.1	0.0-0.5	0.00-0.05
6	Pick-up	-	0.1-0.3	0.5-1.0	0.05-0.10
7	Pick-up	0.010-0.020	0.3-0.5	1.0-1.5	0.10-0.15
8	Pick-up	-	0.5-0.7	1.5-2.0	0.15-0.20
9	Pick-up	>0.020	>0.7	>2.0	>2.0
Sequence	C, Si, then Cr, Nb (then other elements if applicable)				

Metallurgical behaviour, flux class 3 and class 4

Class 3	Stating chemical symbols of alloying elements (e.g. C, Cr, Mo) and approximate amount (without the % symbol).
Class 4	Stating chemical symbols of alloying elements

SFA/AWS A5.17: specification for carbon steel electrodes and fluxes for submerged arc welding

F 7 A 5 - EM12K

F	Submerged arc welding flux

Symbol for strength and elongation

Symbol	Min. Yield Strength, MPa	Tensile Strength, MPa	Min. Elongation, %
6	330	415 - 550	22
7	400	480 - 650	22

Symbol for heat treatment

Symbol	
A	As Welded
P	Postweld heat treated (PWHT); 620°C / 1h

Symbol for impact properties

Symbol	Min. average impact energy 27J °C
0	-18
2	-29
4	-40
5	-46
6	-51
8	-62
Z	no requirements

Symbol for chemical composition of wire electrodes

Symbol	Chemical Composition %					
	C	Mn	Si	S	P	Cu (including Cu-coating)
EL12	0.04-0.14	0.25-0.60	0.10	0.030	0.030	0.35
EM12	0.06-0.15	0.80-1.25	0.10	0.030	0.030	0.35
EM12K	0.05-0.15	0.80-1.25	0.10-0.35	0.030	0.030	0.35
EH12K	0.06-0.15	1.50-2.00	0.25-0.65	0.025	0.025	0.35
EH14	0.10-0.20	1.70-2.20	0.10	0.030	0.030	0.35
Single values are maximum.						

Symbol for chemical composition for composite electrode weld metal

Symbol	Chemical Composition %					
	C	Mn	Si	S	P	Cu
EC1	0.15	1.80	0.90	0.035	0.035	0.35
ECG	Not specified					
Single values are maximum.						

EN ISO 24598-A: welding consumables - solid wire electrodes, tubular cored electrodes and electrode/flux combinations for submerged arc welding of creep-resisting steels

S	Submerged arc welding

Type of wire

S	Solid Wire
T	Tubular Wire

Type of flux

FB	Flouride-basic

Chemical composition of solid wire electrodes for submerged arc welding (extract of table)

Symbol	Chemical Composition[123] %										
	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	V	Other
Mo	0.08-0.15	0.05-0.25	0.80-1.20	0.025	0.025	0.2	0.3	0.45-0.65	0.030	0.3	Nb: 0.01
MnMo	0.08-0.15	0.05-0.25	1.30-1.70	0.025	0.025	0.2	0.3	0.45-0.65	0.030	0.3	Nb: 0.01
CrMo1	0.08-0.15	0.05-0.25	0.60-1.00	0.020	0.020	0.90-1.30	0.3	0.40-0.65	0.030	0.3	Nb: 0.01
CrMo2	0.08-0.15	0.05-0.25	0.30-0.70	0.020	0.020	2.2-2.8	0.3	0.90-1.15	0.025	0.3	Nb: 0.01
CrMo5	0.03-0.10	0.20-0.50	0.40-0.75	0.020	0.020	5.5-6.5	0.3	0.50-0.80	0.030	0.3	Nb: 0.01
CrMo91	0.07-0.15	0.60	0.4-1.5	0.020	0.020	8.0-10.5	0.4-1.0	0.80-1.20	0.025	0.15-0.30	Nb: 0.03-0.10 N: 0.02-0.07
Z	Any other agreed composition.										
Single values shown in the table are maximum values.											

Chemical composition for all weld metal deposits (extract of table)

Symbol	Chemical Composition[123] %										
	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	V	Other
Mo	0.15	0.80	1.4	0.030	0.030	0.2	0.3	0.45-0.65	0.35	0.3	Nb: 0.01
MnMo	0.15	0.80	2.0	0.030	0.030	0.2	0.3	0.45-0.65	0.35	0.3	Nb: 0.01
CrMo1	0.15	0.80	1.20	0.030	0.030	0.80-1.30	0.25	0.35-0.65	0.40	0.3	Nb: 0.01
CrMo2	0.15	0.80	1.20	0.030	0.030	2.2-2.8	0.3	0.80-1.15	0.35	0.3	Nb: 0.01
CrMo5	0.10	0.80	1.20	0.030	0.030	4.5-6.5	0.3	0.45-0.80	0.35	0.3	Nb: 0.01
CrMo91	0.15	0.80	1.80	0.030	0.030	8.0-10.5	1.0	0.70-1.20	0.35	0.10-0.30	Nb: 0.02-0.10 N: 0.02-0.07
Z	Any other agreed composition.										
Single values shown in the table are maximum values.											

Mechanical properties of all weld metal deposits (Extract of table)

Symbol	Min. Yield Strength[1], MPa	Min. Tensile Strength, MPa	Min. Elongation[2], %	Min. Toughness at 20°C		Heat Treatment		
				Average of 3, J	Single Value, J	Preheat interpass, °C	PWHT Temp °C	PWHT Time, minutes
Mo	355	510	22	47	38	<200	-	-
MnMo	355	510	22	47	38	<200	-	-
CrMo1	355	510	20	47	38	150-250	660-700	60
CrMo2	400	500	18	47	38	200-300	690-750	60
CrMo5	400	590	17	47	38	200-300	730-760	60
CrMo91	415	585	17	47	38	250-350	750-760	180
Z	Any other agreed composition.							

SFA/AWS A5.23: specification for low-alloy steel electrodes and fluxes for submerged arc welding - two-run classification system

F 8T A 6 - EA2TiB

S	Submerged arc welding flux

Symbol for strength and elongation, two-run (T)

Symbol	Yield Strength[1], MPa	Tensile Strength, MPa	Min. Elongation[2], %
6T	340	410	22
7T	410	480	22
8T	480	550	20
9T	550	620	17
10T	620	690	16
11T	690	760	15
12T	760	830	14
13T	830	900	14

All values are minimum requirements.

Symbol for heat treatment

Symbol	
A	As Welded
P	Postweld heat treated (PWHT); depending on alloy, 620°C, 690°C and other temp. / 1h

Symbol for impact properties

Symbol	Min. average impact energy 27J °C
0	-18
2	-29
4	-40
5	-46
6	-51
8	-62
10	-73
15	-101
Z	no requirements

Chemical composition of solid wire electrodes for submerged arc welding (extract of table)

Symbol	Chemical Composition[123] %									
	C	Mn	Si	S	P	Cr	Ni	Mo	Cu (incl Cu-coating)	Other
EA2	0.05-0.17	0.95-1.35	0.20	0.025	0.025	-	-	0.45-0.65	0.35	-
EA2TiB	0.05-0.17	0.95-1.35	0.35	0.025	0.025	-	-	0.45-0.65	0.35	see 1
EA4	0.05-0.17	1.20-1.70	0.20	0.025	0.025	-	-	0.45-0.65	0.35	-
EB2R	0.07-0.15	0.45-1.00	0.05-0.30	0.010	0.010	1.00-1.75	-	0.45-0.65	0.15	see 2
EB3R	0.05-0.15	0.40-0.80	0.05-0.30	0.010	0.010	2.25-3.00	-	0.90-1.00	0.15	see 2
EB6	0.10	0.35-0.70	0.05-0.50	0.025	0.025	4.50-6.50	-	0.45-0.70	0.35	-
EB91	0.07-0.13	1.25	0.50	0.010	0.010	8.50-10.50	1.00	0.85-1.15	0.10	see 3
ENi1	0.12	0.75-1.25	0.05-0.30	0.020	0.020	0.15	0.75-1.25	0.30	0.35	-
ENi2	0.12	0.75-12.5	0.05-0.30	0.020	0.020	-	2.10-2.90	-	0.35	-
ENi3	0.13	0.60-1.20	0.05-0.30	0.020	0.020	0.15	3.10-3.80	-	0.35	-
ENi6	0.07-0.15	1.20-1.60	0.05-0.30	0.020	0.020	-	0.75-1.25	0.10-0.30	0.35	-
EG	not specified									
(EC)	(composite electrode)									

Single values are maximum.
1.) Ti: 0.05-0.30; B: 0.005 - 0.030 2) As: 0.005; Sn: 0.005; Sb: 0.005 3) V: 0.15-0.25; Nb: 0.02-0.10; N: 0.03-0.07; Al: 0.04

SFA/AWS A5.23: specification for low-alloy steel electrodes and fluxes for submerged arc welding - multiple pass classification system

F 8 A 10 - ENi6 - Ni6

S	Submerged arc welding flux

Symbol for strength and elongation

Symbol	Min. Yield Strength[1], MPa	Tensile Strength, MPa	Min. Elongation[2], %
7	400	480-650	22
8	470	550-690	20
9	540	620-760	17
10	610	690-830	16
11	680	760-900	15
12	740	830-870	14
13	810	900-1030	14

Symbol for impact properties

Symbol	Min. average impact energy 27J °C
0	-18
2	-29
4	-40
5	-46
6	-51
8	-62
10	-73
15	-101
Z	no requirements

Symbol for heat treatment

Symbol	
A	As Welded
P	Postweld heat treated (PWHT); depending on alloy, 620°C, 690°C and other temp. / 1h (B91: 2h)

Chemical composition of solid wire electrodes for submerged arc welding (extract of table)

Symbol	Chemical Composition[123] %									
	C	Mn	Si	S	P	Cr	Ni	Mo	Cu (incl Cu-coating)	Other
EA2	0.05-0.17	0.95-1.35	0.20	0.025	0.025	-	-	0.45-0.65	0.35	-
EA2TiB	0.05-0.17	0.95-1.35	0.35	0.025	0.025	-	-	0.45-0.65	0.35	see 1
EA4	0.05-0.17	1.20-1.70	0.20	0.025	0.025	-	-	0.45-0.65	0.35	-
EB2R	0.07-0.15	0.45-1.00	0.05-0.30	0.010	0.010	1.00-1.75	-	0.45-0.65	0.15	see 2
EB3R	0.05-0.15	0.40-0.80	0.05-0.30	0.010	0.010	2.25-3.00	-	0.90-1.00	0.15	see 2
EB6	0.10	0.35-0.70	0.05-0.50	0.025	0.025	4.50-6.50	-	0.45-0.70	0.35	-
EB91	0.07-0.13	1.25	0.50	0.010	0.010	8.50-10.50	1.00	0.85-1.15	0.10	see 3
ENi1	0.12	0.75-1.25	0.05-0.30	0.020	0.020	0.15	0.75-1.25	0.30	0.35	-
ENi2	0.12	0.75-12.5	0.05-0.30	0.020	0.020	-	2.10-2.90	-	0.35	-
ENi3	0.13	0.60-1.20	0.05-0.30	0.020	0.020	0.15	3.10-3.80	-	0.35	-
ENi6	0.07-0.15	1.20-1.60	0.05-0.30	0.020	0.020	-	0.75-1.25	0.10-0.30	0.35	-
EG	not specified									
(EC)	(composite electrode)									

Single values shown in the table are maximum values.
1) Ti: 0.05-0.30; B: 0.005-0.030 2) As: 0.005; Sn: 0.005; Sb: 0.005 3) V: 0.15 - 0.25; Nb: 0.02 - 0.10; N: 0.03 - 0.07; Al: 0.04

Chemical composition of weld metal (extract of complete table)

Symbol	Chemical Composition[123] %									
	C	Mn	Si	S	P	Cr	Ni	Mo	Cu (incl Cu-coating)	Other
A2	0.12	1.40	0.80	0.030	0.030	-	-	0.40-0.65	0.35	-
A3	0.15	2.10	0.80	0.030	0.030	-	-	0.40-0.65	0.35	-
A4	0.15	1.60	0.80	0.030	0.030	-	-	0.40-0.65	0.35	-
B2	0.05-0.15	1.20	0.80	0.030	0.030	1.00-1.50	-	0.40-0.65	0.35	-
B2R	0.05-0.15	1.20	0.80	0.010	0.010	1.00-1.50	-	0.40-0.65	0.15	see 1
B3	0.05-0.15	1.20	0.80	0.030	0.030	2.00-2.50	-	0.90-1.20	0.35	-
B3R	0.05-0.15	1.20	0.80	0.010	0.010	2.00-2.50	-	0.90-1.20	0.15	see 1
B91	0.08-0.13	1.20	0.80	0.010	0.010	8.0-10.5	0.80	0.85-1.20	0.25	see 2
Ni1	0.12	1.60	0.80	0.025	0.030	0.15	0.75-1.10	0.24	0.35	see 3
Ni2	0.12	1.60	0.80	0.025	0.030	-	2.00-2.90	-	0.35	-
Ni3	0.12	1.60	0.80	0.025	0.030	0.15	2.80-3.80	-	0.35	-
Ni6	0.14	1.60	0.80	0.025	0.030	-	0.70-1.10	0.10-0.35	0.35	-
F3	0.17	1.25-2.25	0.80	0.030	0.030	-	0.70-1.10	0.40-0.65	0.35	-
G	as agreed between supplier and purchaser									
(EC)	(composite electrode)									

Single values are maximum.
Weld metals generated with a composite electrode have the prefix "EC" before the appropriate electrode description.
1) As: 0.005; Sn: 0.005; Sb: 0.005 2) Mn+Ni = 1.40 max; Nb: 0.02 - 0.10; N: 0.02-0.07; V: 0.15-0.25; Al: 0.04 3) Ti+V+Zr: 0.05

EN ISO 26304-A: welding consumables – solid wire electrodes, tubular cored electrodes and electrode-flux-combinations for saw of high strength steels

S 55 6 FB - S3Ni1Mo

S	Submerged arc welding flux

Symbol for strength and elongation, two-run (T)

Symbol	Min. Yield Strength[1], MPa	Tensile Strength, MPa	Min. Elongation[2], %
55	550	640-820	18
62	620	700-890	18
69	690	770-940	17
79	790	880-1080	16
89	890	940-1180	15

Symbol for impact properties

Symbol	Min. average impact energy 47J °C
A	20
0	0
2	-20
3	-30
4	-40
5	-50
6	-60
Z	no requirements

Chemical composition of flux

Symbol	Type of flux
MS	Manganese-silicate
CS	Calcium-silicate
ZS	Zirconium-silicate
RS	Rutile-silicate
AR	Aluminate-rutile
AB	Aluminate-basic
AS	Aluminate-silicate
AF	Aluminate-fluoride-basic
FB	Fluoride-basic
GS	Magnesium-silicate
Z	Any other composition

Chemical composition of solid wire electrodes for submerged arc welding (extract of table)

Symbol	Chemical Composition[123] %									
	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	Other
S2Ni1Mo	0.07-0.15	0.05-0.25	0.80-1.30	0.020	0.020	0.20	0.80-1.20	0.45-0.65	0.30	0.50
S3Ni1Mo	0.07-0.15	0.05-0.35	1.30-1.80	0.020	0.020	0.20	0.80-1.20	0.45-0.65	0.30	0.50
S2Ni2Mo	0.05-0.09	0.15	1.10-1.40	0.015	0.015	0.15	2.00-2.50	0.45-0.60	0.30	0.50
S2Ni3Mo	0.08-0.12	0.10-0.25	0.80-1.20	0.020	0.020	0.15	2.80-3.20	0.10-0.25	0.30	0.50
S1Ni2, 5CrMo	0.07-0.15	0.10-0.25	0.45-0.75	0.020	0.020	0.50-0.85	2.10-2.60	0.40-0.70	0.30	0.50
S3Ni2, 5CrMo	0.07-0.15	0.10-0.25	1.20-1.80	0.020	0.020	0.30-0.85	2.00-2.60	0.40-0.70	0.30	0.50
S3Ni1, 5CrMo	0.07-0.14	0.05-0.15	1.30-1.50	0.020	0.020	0.15-0.35	1.50-1.70	0.30-0.50	0.30	0.50
S3Ni1, 5Mo	0.07-0.15	0.05-0.25	1.20-1.80	0.020	0.020	0.20	1.20-1.80	0.30-0.50	0.30	0.50
S4Ni2CrMo	0.08-0.11	0.30-0.40	1.80-2.00	0.015	0.015	0.85-1.00	2.10-2.60	0.55-0.70	0.30	0.50
SZ	any other agreed composition									
(EC)	(composite electrode)									

1) Al, Sn, As and Sb <= 0.02% each and Ti, Pb and N <=0.01%
2) Cu: Including the cu-coating
3) Single vales shown in the table are maximum values.

EN ISO 14343-A: welding consumables - wire electrodes, strip electrodes, wires and rods for arc welding of stainless and heat-resisting steels (extract)

G	Gas metal arc welding
W	Gas tungsten arc welding
P	Plasma arc welding
S	Submerged arc welding
B	Strip cladding
L	Laser beam welding

The nominal chemical composition of wire or rod

Chemical composition of alloy type

Nominal composition	Alloy Type	Chemical Composition in %										
		C	Si	Mn	P	S	Cr	Ni	Mo	N	Cu	Other
19 9 L		0.03	0.65	1.0-2.5	0.03	0.02	19.0-21.0	9.0-11.0	0.5	-	0.5	-
	308L	0.03	0.65	1.0-2.5	0.03	0.03	19.5-22.0	9.0-11.0	0.75	-	0.75	-
19 9 H		0.04-0.08	1.0	1.0-2.5	0.03	0.02	18.0-21.0	9.0-11.0	0.5	-	0.5	-
	308H	0.04-0.08	0.65	1.0-2.5	0.03	0.03	19.5-22.0	9.0-11.0	0.5	-	0.75	-
18 8 Mn		0.20	1.2	5.0-8.0	0.03	0.03	17.0-20.0	7.0-10.0	0.5		0.5	-
23 12 L		0.03	0.65	1.0-2.5	0.03	0.02	22.0-25.0	11.0-14.0	0.5	-	0.5	-
	309L	0.03	0.65	1.0-2.5	0.03	0.03	23.0-25.0	12.0-14.0	0.75	-	0.75	-
23 12 2 L		0.03	1.0	1.0-2.5	0.03	0.02	21.0-25.0	11.0-15.5	2.0-3.5	-	0.5	-
	309LMo	0.03	0.65	1.0-2.5	0.03	0.03	23.0-25.0	12.0-14.0	2.0-3.0	-	0.75	-
25 20		0.08-0.15	2.0	1.0-2.5	0.03	0.02	24.0-27.0	18.0-22.0	0.5	-	0.5	-
	310	0.08-0.15	0.65	1.0-2.5	0.03	0.03	25.0-28.0	20.0-22.5	0.75	-	0.75	-
29 9		0.15	1.0	1.0-2.5	0.03	0.02	28.0-32.0	8.0-12.0	0.5	-	0.5	-
	312	0.15	0.65	1.0-2.5	0.03	0.03	28.0-32.0	8.0-10.5	0.75	-	0.75	-
19 12 3 L		0.03	0.65	1.0-2.5	0.03	0.02	18.0-20.0	11.0-14.0	2.5-3.0	-	0.5	-
	316L	0.03	0.65	1.0-2.5	0.03	0.03	18.0-20.0	11.0-14.0	2.0-3.0	-	0.75	-
19 12 3 H		0.04-0.08	1.0	1.0-2.5	0.03	0.02	18.0-20.0	11.0-14.0	2.0-3.0	-	0.5	-
	316H	0.04-0.08	0.65	1.0-2.5	0.03	0.03	18.0-20.0	11.0-14.0	2.0-3.0	-	0.75	-
18 15 3 L		0.03	1.0	1.0-4.0	0.03	0.02	17.0-20.0	13.0-16.0	2.5-4.0	-	0.5	-
	317L	0.03	0.65	1.0-2.5	0.03	0.03	18.5-20.5	13.0-15.0	3.0-4.0	-	0.75	-
19 12 3 Nb		0.08	0.65	1.0-2.5	0.03	0.02	18.0-20.0	11.0-14.0	2.5-3.0	-	0.5	Nb=10xC to 1.0
	318	0.08	0.65	1.0-2.5	0.03	0.03	18.0-20.0	11.0-14.0	2.0-3.0	-	0.75	Nb=8xC to 1.0
19 9 Nb		0.08	0.65	1.0-2.5	0.03	0.02	19.0-21.0	9.0-11.0	0.5	-	0.5	Nb=10xC to 1.0
	347	0.08	0.65	1.0-2.5	0.03	0.03	19.0-21.5	9.0-11.0	0.75	-	0.75	Nb=10xC to 1.0
25 9 4 N L		0.03	1.0	2.5	0.03	0.02	24.0-27.0	8.0-10.5	2.5-4.5	0.2-0.3	1.5	W 1.0
20 25 5 Cu L		0.03	1.0	1.0-4.0	0.03	0.02	19.0-22.0	24.0-27.0	4.0-6.0	-	1.0-2.0	-
	385	0.025	0.5	1.0-2.5	0.02	0.03	19.5-21.5	24.0-26.0	4.2-5.2	-	1.2-2.0	-
20 16 3 Mn L		0.03	1.0	5.0-9.0	0.03	0.02	19.0-22.0	15.0-18.0	2.5-4.5	-	0.5	-
25 22 2 N L		0.03	1.0	3.5-6.5	0.03	0.02	24.0-27.0	21.0-24.0	1.5-3.0	0.1-0.2	0.5	-
22 9 3 N L		0.03	1.0	2.5	0.03	0.02	21.0-24.0	7.0-10.0	2.5-4.0	0.1-0.2	0.5	-
	2209	0.03	0.90	0.5-2.0	0.03	0.03	21.5-23.5	7.5-9.5	2.5-3.5	0.08-0.2	0.75	-
23 7 N L		0.03	1.0	2.5	0.03	0.02	22.5-25.5	6.5-9.5	0.8	0.10-0.20	0.5	-
25 9 4 N L	2594	0.03	1.0	2.5	0.03	0.02	24.0-27.0	8.0-10.5	2.5-4.5	0.20-0.30	1.5	W 1.0
	410NiMo	0.03	0.5	0.6	0.03	0.03	12.0-14.0	0.75	0.75	-	0.75	-

EN ISO 18274: welding consumables - wire and strip electrodes, wires and rods for arc welding of nickel and nickel alloys (extract)

S Ni6625 (NiCr22Mo9Nb)

S	Solid wire (electrode), solid rod
B	Solid strip electrode

Symbol for the chemical composition of strip, wire or rod.

Chemical composition of alloy type

Symbol	Chemical Composition in %									
	C	Si	Mn	Cr	Ni	Mo	Nb	Cu	Fe	Other
Ni6082 (NiCr20Mn3Nb)	0.1	0.5	2.5-3.5	18.0-22.0	Min. 67.0	-	2.0-3.0	0.5	3.0	Ti: 0.7 P: 0.03
Ni6625 (NiCr22Mo9Nb)	0.1	0.5	0.5	20.0-23.0	Min. 58.0	8.0-10.0	3.2-4.1	0.5	5.0	Ti: 0.4 Al: 0.4
Ni6276 (NiCr15Mo16Fe6W4)	0.02	0.08	1.0	14.5-16.5	Min. 50.0	15.0-17.0	-	0.5	4.0-7.0	Co: 2.5 W: 3.0-4.5
Ni6059 (NiCr23Mo16)	0.01	0.1	0.5	22.0-24.0	Min. 56.0	15.0-16.5	-	0.5	2.0-5.0	Ti: 0.5 Al: 0.1-0.4

SFA/AWS A5.4: specification for stainless steel electrodes for shielded metal arc welding (extract)

Nominal chemical composition of the filler metal

Symbol	Chemical Composition in %										
	C	Si	Mn	P	S	Cr	Ni	Mo	N	Cu	Other
E307	0.04-0.14	1.0	3.30-4.75	0.04	0.03	18.0-21.5	9.0-10.7	0.50-1.5	-	0.75	-
E308L	0.04	1.0	0.5-2.5	0.04	0.03	18.0-21.0	9.0-11.0	0.75	-	0.75	-
E308H	0.04-0.08	1.0	0.5-2.5	0.04	0.03	18.0-21.0	9.0-11.0	0.75	-	0.75	-
E309L	0.04	1.0	0.5-2.5	0.04	0.03	22.0-25.0	12.0-14.0	0.75	-	0.75	-
E309LMo	0.04	1.0	0.5-2.5	0.04	0.03	22.0-25.0	12.0-14.0	2.0-3.0	-	0.75	-
E310	0.08-0.20	0.75	1.0-2.5	0.03	0.03	25.0-28.0	20.0-22.5	0.75	-	0.75	-
E312	0.15	1.0	0.5-2.5	0.04	0.03	28.0-32.0	8.0-10.5	0.75	-	0.75	-
E316L	0.04	1.0	0.5-2.5	0.04	0.03	17.0-20.0	11.0-14.0	2.0-3.0	-	0.75	-
E316H	0.04-0.08	1.0	0.5-2.5	0.04	0.03	17.0-20.0	11.0-14.0	2.0-3.0	-	0.75	-
E317L	0.04	1.0	0.5-2.5	0.04	0.03	18.0-21.0	12.0-14.0	3.0-4.0	-	0.75	-
E318	0.08	1.0	0.5-2.5	0.04	0.03	17.0-20.0	11.0-14.0	2.0-3.0	-	0.75	Nb=6xCmin/1.0max
E347	0.08	1.0	0.5-2.5	0.04	0.03	18.0-21.0	9.0-11.0	0.75	-	0.75	Nb=8xCmin/1.0max
E385	0.03	0.9	1.0-2.5	0.03	0.02	19.5-21.5	24.0-26.0	4.2-5.2	-	1.2-2.0	
E2209	0.04	1.0	0.5-2.0	0.04	0.03	21.5-23.5	8.5-10.5	2.5-3.5	0.08-0.20	0.75	-
E2594	0.04	1.0	0.5-2.0	0.04	0.03	24.0-27.0	8.0-10.5	3.5-4.5	0.20-0.30	0.75	-

SFA/AWS A5.9: bare stainless steel welding electrodes and rods (extract)

ER	Solid wires (electrodes or rods
EC	Cored wires
EQ	Strip electrodes

Nominal chemical composition of the filler metal

AWS Classification	Chemical Composition in %										
	C	Si	Mn	P	S	Cr	Ni	Mo	N	Cu	Other
ER307	0.04-0.14	0.30-0.65	3.3-4.75	0.03	0.03	19.5-22.0	8.0-10.7	0.50-1.5	-	0.75	-
ER308L	0.03	0.30-0.65	1.0-2.5	0.03	0.03	19.5-22.0	9.0-11.0	0.75	-	0.75	-
ER308H	0.04-0.08	0.30-0.65	1.0-2.5	0.03	0.03	19.5-22.0	9.0-11.0	0.50	-	0.75	-
ER309L	0.03	0.30-0.65	1.0-2.5	0.03	0.03	23.0-25.0	12.0-14.0	0.75	-	0.75	-
ER309LMo	0.03	0.30-0.65	1.0-2.5	0.03	0.03	23.0-25.0	12.0-14.0	2.0-3.0	-	0.75	-
ER310	0.08-0.15	0.30-0.65	1.0-2.5	0.03	0.03	25.0-28.0	20.0-22.5	0.75	-	0.75	-
ER312	0.15	0.30-0.65	1.0-2.5	0.03	0.03	28.0-32.0	8.0-10.5	0.75	-	0.75	-
ER316L	0.03	0.30-0.65	1.0-2.5	0.03	0.03	18.0-20.0	11.0-14.0	2.0-3.0	-	0.75	-
ER316H	0.04-0.08	0.30-0.65	1.0-2.5	0.03	0.03	18.0-20.0	11.0-14.0	2.0-3.0	-	0.75	-
ER317L	0.03	0.30-0.65	1.0-2.5	0.03	0.03	18.5-20.5	13.0-15.0	3.0-4.0	-	0.75	-
ER318	0.08	0.30-0.65	1.0-2.5	0.03	0.03	18.0-20.0	11.0-14.0	2.0-3.0	-	0.75	Nb=8xCmin/1.0max
ER347	0.08	0.30-0.65	1.0-2.5	0.03	0.03	19.0-21.5	9.0-11.0	0.75	-	0.75	Nb=10xCmin/1.0max
ER385	0.025	0.50	1.0-2.5	0.02	0.03	19.5-21.5	24.0-26.0	4.2-5.2	-	1.2-2.0	
ER2209	0.03	0.90	0.50-2.0	0.03	0.03	21.5-23.5	7.5-9.5	2.5-3.5	0.08-0.20	0.75	-
ER2594	0.03	1.0	2.5	0.03	0.02	24.0-27.0	8.0-10.5	2.5-4.5	0.20-0.30	1.5	W: 1.0
ER410NiMo	0.06	0.5	0.6	0.03	0.03	11.0-12.50	4.0-5.0	0.4-0.7	-	0.75	-

SFA/AWS A5.14: specification for nickel and nickel alloy bare welding electrodes and rods (extract)

ER	Solid wires (electrodes or rods
EQ	Strip electrodes

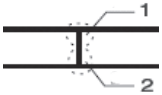
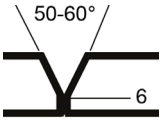
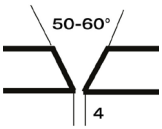
Nominal chemical composition of the filler metal

AWS Classification	Chemical Composition in %										
	C	Si	Mn	P	S	Cr	Ni	Mo	Nb	Cu	Fe
ERNiCr-3	0.1	0.5	2.5-3.5	0.03	0.015	18.0-22.0	min. 67.0	-	2.0-3.0	0.5	3.0
ERNiCrMo-3	0.1	0.5	0.5	0.02	0.015	20.0-23.0	min. 58.0	8.0-10.0	3.15-4.15	0.5	5.0
ERNiCrMo-4	0.02	0.08	1.0	0.04	0.03	14.5-16.5	Bal.	15.0-17.0	-	0.5	4.0-7.0
ERNiCrMo-13	0.01	0.1	0.5	0.015	0.010	22.0-24.0	Bal.	15.0-16.5	-	0.5	1.5

Submerged Arc Welding Joint Preparations

Typical welding data and recommended joint preparations for submerged arc welding.

Non and low-alloyed steels

Type of joint	Plate thickness mm	Wire diameter mm	Run no	Welding current A	Arc voltage V	Welding speed cm/min
	6	3.0	1	320	32	80
		3.0	2	350	32	
	8	4.0	1	450	32	75
		4.0	2	500	32	
	10	4.0	1	550	33	70
		4.0	2	600	33	
	12	4.0	1	600	33	60
		4.0	2	650	33	
	14	4.0	1	700	34	55
		4.0	2	750	34	
	For all procedures: 1 run from back side:					
		4.0	1	680	32	50
	14	4.0	1	650	26	50
	16	4.0	1	580	26	60
		4.0	2	750	34	60
	18	4.0	1	580	26	60
		4.0	2	750	34	50
Gap: as small as possible; in locations where gap > 1 mm: MMA or MAG root run.	20	4.0	1	580	26	60
		4.0	2	750	30	60
		4.0	3	750	34	60
	25	4.0	1	580	26	60
		4.0	2	750	30	60
		4.0	3	750	30	60
		4.0	4 - 5	750	32	50
	30	4.0	1	580	26	60
		4.0	2	750	30	60
		4.0	3	750	30	60
		4.0	4 - 5	750	32	50
		4.0	6 - 8	750	32	50
	Alternative parameters for first run (all thicknesses):					
		4.0	1	450	25	45
	14		1	MAG or MMA		
		4.0	2	550	26	50
		4.0	3	600	30	50
		4.0	4	680	32	50
	16		1	MAG or MMA		
		4.0	2	550	26	50
		4.0	3	650	32	50
		4.0	4 - 5	680	32	50
Welded from 1 side root run: MMA or MAG. Thickness of root run ≥ 5 mm.	18		1	MAG or MMA		
		4.0	2	550	26	50
		4.0	3 - 4	650	30	50
		4.0	5 - 6	680	32	50
	20		1	MAG or MMA		
		4.0	2	550	26	50
		4.0	3 - 4	650	30	50
		4.0	5 - 6	750	32	50
		4.0	7	680	32	50

Submerged Arc Welding Joint Preparations

Typical welding data and recommended joint preparations for submerged arc welding.

Non and low-alloyed steels

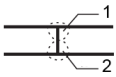
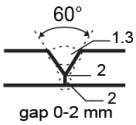
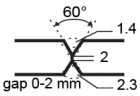
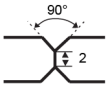
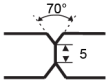
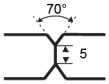
Type of joint	Throat thickness mm	Wire diameter mm	Run no	Welding current A	Arc voltage V	Welding speed cm/min
	3	1 x 3.0	1	500	28	80
	4	1 x 3.0	1	500	28	60
	5	1 x 4.0	1	650	30	60
	7	1 x 3.0	1	500	29	50
		1 x 3.0	2	620	32	60
	4	1 x 3.0	1	600	32	100
	5	1 x 3.0	1	600	32	60
	6	1 x 3.0	1	650	32	55
	7	1 x 3.0	1	750	32	45
	Twin Arc					
	4	2 x 1.6	1	750	32	115
	5	2 x 2.0	1	800	32	100
	Cored wire					
	5	2 x 2.4	1	800	30	120
	Tandem DC+, AC					
	4	4.0	1 (DC+)	800	32	140
		4.0	1 (AC)	700	36	
	Tandem DC+, AC					
	4	4.0	1 (DC+)	800	32	140
		4.0	1 (AC)	700	36	
	5	4.0	1 (DC+)	800	32	90
		4.0	1 (AC)	700	36	

Note: If a cored wire is used, an extra 2 volts are required in the high current range (>600A) to spread the extra weld metal (25-30%).

Submerged Arc Welding Joint Preparations

Typical welding data and recommended joint preparations for submerged arc welding.

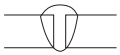
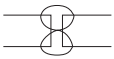
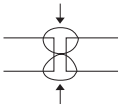
Stainless Steel

Type of joint	Plate thickness mm	Wire diameter mm	Run No.	Welding current A	Arc voltage V	Welding speed cm/min
	6	2.4	1	300	33	40
		2.4	2	400	34	40
		3.2	1	400	34	100
		3.2	2	500	34	130
	8	2.4	1	350	33	40
		2.4	2	450	34	40
		3.2	1	450	34	55
		3.2	2	550	34	55
		4	1	450	34	100
		4	2	550	34	130
	10	2.4	1	420	30	45
		2.4	2	420	32	40
		2.4	3	420	32	40
		3.2	1	500	30	55
		3.2	2	500	32	55
		4	1	550	31	65
		4	2	550	34	100
	12	4	1	600	32	60
		4	2	600	34	80
	20	4	1	575	31	60
		4	2	600	32	60
		4	3-5	600	34	65
	25	4	1	550	32	60
		4	2	600	34	50
		4	3	600	34	50
		4	4-8	600	34	60
	6	2	1-n	300	31	60
	10	3.2	1-n	380	32	65
	16	3.2	1-n	450	34	70
	8	4	1	450	32	90
		4	2	550	34	85
	10	4	1	500	32	65
		4	2	600	34	85
	12	4	1	500	32	60
		4	2	600	34	70
	14	4	1	550	32	60
		4	2	600	34	60

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

Calculation of Electrode Consumption

Square V-joints: volumes and weld metal weights

Plate Thickness	Gap	50° Flat			60° Flat			70° Vertical			80° Overhead			60° Horizontal-Vertical		
mm	mm	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 cm3/m

2 - Actual joint volume cm3/m (taking account of transverse shrinkage)

3 - Deposited weld metal kg/m

Position	Plate Thickness, mm	Weight/Length, kg/m	Electrode Diameter, mm
Flat	6-12	0.10	3.25
Flat	>2	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	 Flat		 Flat		 Vertical		 Overhead	
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	0.5	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	 Flat		 Flat		 Vertical		 Overhead	
mm	mm²	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	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

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