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Submerged Arc Wires and Fluxes

Submerged Arc Wires and Fluxes

WELDING
CONSUMABLES
GUIDE BOOK

Storage and handling
Recommendations for OK Flux

The ESAB OK Fluxes for SAW are generally manufactured from calcined minerals which have been heat treated at high temperatures(≈1500℃) which gives excellent storage properties. The OK Fluxes have, when delivered, a moisture content with a nominal level of max. 0.05% determined at 1000℃

It is of great importance for the quality of the weld metal that the moisture content is kept as low as possible. For this reason the OK Fluxes are delivered in moisture resistant steel cans or paper bags with an interior plastic bag. However, in the paper bags it is possible that the OK Fluxes may pick up moisture during unsuitable handling, storage or transport.
This is generally indicated by a porous slag and/or pores on the weld. ESAB has set guidelines for handling to avoid these incidents :

1. Unopened paper bags must be stored under warm and dry conditions. It is important that these conditions are maintained 24 hours a day, 7 days a week.
2. Unopened flux bags should not be exposed to direct moisture such as rain ro snow.
3. Remaining flux from opened cans/bags or flux hopper should be stored at a temperature of 150±25℃

If the fluxes have for some reason become wet, it is possible to return the fluxes to their original state by rebaking in a drying over as follows :
Agglomerated fluxes : 300±25℃ for about 2~4 hours.
Fused fluxes : 200±50℃ for about 2~4 hours.
Rebaked flux, not immediately used, must be kept at 150±25℃

General welding recommendations

1. 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 residues from gouging or grinding can adversely affect the quality of the weld metal. The more impurities in the weld area, the greater the risk of weld metal defects.

2. The arc voltage must be kept constant. Increased arc voltage gives increased flux consumption. If the flux contains alloying elements, the amount transferred to the weld metal will increase as the arc voltage increases.

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

NB. The chemical analyses given in this catalogue are for all weld metal deposits using the following welding parameters
DC+, 580A, 29V, 33m/h except for OK Flux 10.92, where
DC+, 420A, 27V, and 30m/h have been used. Wire Ø4mm.

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

Approvals in complicance with classification society rules

Welding materials are normally classified in accordance with a standard, e.g. AWS and are approved in compliance 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 by internal testing the correct classification of a product.

Approvals

Shipowners and partners in Off-Shore enterprises require that welding consumables are approved in accordance with the rules of the appropriate classification bodies. Approvals are also required by clients in accordance with national or international standards for Boiler and Pressure Vessels, e.g. SS-EN, CSA, DIN to be verified by an authorized

Approval Institution such as the Swedish National Testing and Research Institute(SP), the Canadian Welding Bureau(CWB) and TUV.
Approved welding products are entered into “List of Approved Welding Consumables” distributed annually by the Societies and other institutions.

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. 33YM) that the electrode is to be used in steel with a yield strength(ReH) of min 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 etc from the different strength steel categories, where the numbers 42... 69 symbolize a Yield strength in MPa indicating that the electrodes can be used together with extra high tensile steels.

Each steel category is divided into 3 to 5 toughness levels represented by the first digit in the Grade(1, 2, 3, 4 or 5)
-1 suitable for grades A steel
(impact tested at 20℃)
-2 suitable for grades A, B and D steel
(impact tested at 0℃)
-3 suitable for grades A, B, D and E steel
(impact tested at -20℃)
-4 suitable for grades A, B, D, E and F steel
(impact tested at -40℃)
-5 suitable for grades A, B, D, E and E steel
(impact tested at -60℃)

Other frequently used abbreviations

T two-sided welding(submerged are welded with one run from each side)
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 diffusible hydrogen level
DP deep penetration

Stainless steel and other high-alloy content 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 etc.

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.

Note :
The system described for grading the consumables in accordance with the rules of the Classification Bodies changes as new steels appear on the market and sometimes there are changes of the approval gradings which means that the Handbook may not currently be up-to-date. To ensure that the current information is used, please request the latest edition of the “List of Approved Consumables” and approval certificate from the most recent Annual Test.

Welding data and joint preparation

Table 1. Typical welding data and recommended joint preparation for submerged arc welding mild steel and carbon-manganese structural steels with OK Flux 10.40 and OK Flux 10.71

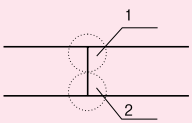
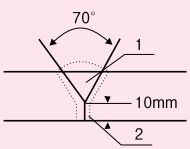
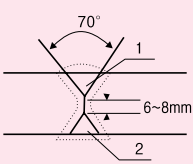
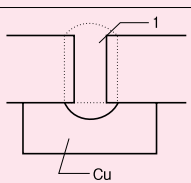
Type of joint	Plate thickness mm	Wire diam mm	Run No.	Arc voltage V	Welding current A	Welding speed m/h
	6	4	1	35	300	50
			2	35	350	
	8	4	1	35	450	46
			2	35	500	
	10	4	1	35	500	42
			2	35	550	
	12	5	1	35	600	38
			2	35	700	
	14	5	1	35	650	35
			2	35	750	
	16	5	1	35	700	35
			2	36	800	
	18	6	1	36	850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

Table 2. Typical welding data for submerged arc fillet welding mild steel and carbon-manganese structural steels with OK Flux 10.40 and OK Flux 10.71

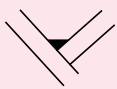
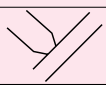
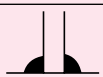
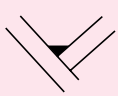
Type of joint	Plate thickness mm	Wire diam mm	Run No.	Arc voltage V	Welding current A	Welding speed m/h
	Single welding head					
	≥6	3	3	30-32	450	45
	≥8	4	4	30-32	575	42
	≥10	4	4	30-32	650	36
	≥8	5	4	32-34	800	50
	≥12	5	4	32-34	850	35
	≥15	6	7	33-35	875	25
	≥15	5	-	36	825	27
	≥20	5	-	36	850	22
	Twin wire					
	-	2×2.5	4	34	800	65
	-	2×2.5	5	34	800	45
	Two welding heads+ ~					
	-	4	4	+32	800	85
				~38	700	
	-	4	4	+32	800	75
				~38	700	
	-	5	4	+32	600	65
				~35	500	
	-	5	5	+32	600	42
				~35	600	

Table 3. Typical welding data for different types of joint OK Flux 10.62

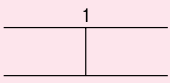
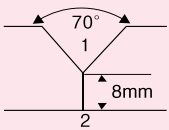
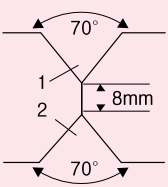
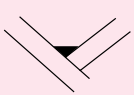
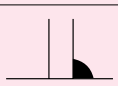
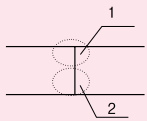
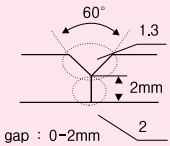
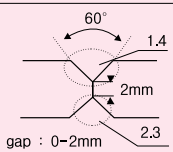
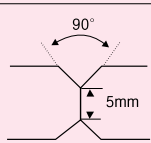
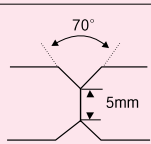
Type of joint	Plate thickness mm	Wire diam mm	Run No.	Arc voltage V	Welding current A	Welding speed m/h
	6	3	1	29	350	40
		3	2	30	425	40
	8	3	1	31	450	40
		3	2	31	500	40
	10	4	1	30	500	40
		4	2	30	575	40
	12	5	1	30	600	40
		5	2	30	650	40
	16	5	1	32	750	35
		5	2	32	800	35
	20	6	1	31	950	23
		6	2	32	950	23
 *First side **Second side	25	6	1	31	1000	21
		6	2	31	1000	21
	30	6	1	31	1000	20
		6	2	30	1050	20
	35	6	1:1*	30	1050	23
		6	2*	32	900	30
		6	2:1*	30	1100	25
		6	2**	32	900	30
Type of joint		Wire diam mm	Throat thickness (a)a-mm	Arc voltage V	Welding current A	Welding speed m/h
	-	5	6.0	32	800	30
		5	6.5	31	850	30
		5	7.0	30	900	30
	-	4	3.5	29	650	60
		4	4.5	29	650	50
		4	5.5	29	650	40

Table 4. Submerged arc welding 18/8 stainless steel. Joint preparation and typical welding data for filler materials ER 308L +OK Flux 10.92.

Type of joint	Plate thickness mm	Wire dia mm	Run No.	Arc voltage V	Welding current A	Welding speed m/h
	6	3	1	34	400	80
			2		500	60
	8	4	1	34	500	80
			2		600	60
	Manual welded root bead					
	10	4	1	34	600	40
			2		600	60
	12	4	1	34	600	35
			2		600	50
	20	4	1	34	600	35
			2		600	30
			3		600	40
	25	4	1	34	600	40
			2		600	35
			3		600	35
			4	24	600	40
	8	4	1	34	450	55
			2	34	550	50
	10	4	1	34	500	40
			2	34	600	50
	12	4	1	34	500	35
			2	34	600	40
	14	4	1	34	550	35
			2	34	600	35

Submerged Arc Flux Products

The following section outlines the various submerged arc products from ESAB. You will find weld metal data for various base materials. ESAB SeAH's Research & Development laboratory is equipped to simulate most submerged arc welding applications and/or conditions. These wire and flux products were developed to help you achieve the best results at the lowest possible cost.

Selection Requirements

There are two kinds of requirements for most submerged arc welding jobs : service requirements of the weld metal and productivity requirements. Both influence selection of flux/wire combinations. The objective is to produce a weldment that meets all service requirements.

The most common requirements are usually described as follows :

- Ultimate Tensile Strength - psi (Mpa)
- % Elongation
- Charpy V-Notch Toughness - ft.-lbs.(J)
- Corrosion Resistance

Each application requires knowledge of the service requirements prior to selecting wire and flux.

The productivity requirements are likewise specific to the application. A thorough understanding of type of weld joint, base metal condition, available equipment and general shop proficiencies must also be considered.

Choosing The Right Submerged Arc Flux

ESAB Produces Two Types of Submerged Arc Fluxes-Fused and Bonded (agglomerated)

Fused Fluxes

Fused fluxes are produced by mixing the ingredients, then melting them together in an electric furnace to form a chemically homogeneous product. The cooled melt is ground to flux particle size.

Consistent performance and mechanical properties, inch after inch, weld after weld, day after day!

Because the ingredients are completely reacted in manufacture, you get smooth, stable performance with welding currents up to 2000 amps. And weld metal properties are consistent because flux particles are identical in chemical composition.

Additional protection against hydrogen cracking

Fused fluxes contain no chemically combined water. Total moisture removal is possible simply by drying the flux at low temperature.

Microphotograph of fused flux shows uniformity of particles.

Bonded Fluxes

Bonded fluxes are made by dry mixing the ingredients, then bonding them together with a low melting point compound such as sodium silicate.

Highly effective over rust and mill scale

Most bonded fluxes contain metallic deoxidizers which prevent weld porosity - this is especially important in fillet welds.

Good performance, in most applications, with one mesh size

Fine ingredients are mechanically bonded into larger particles.

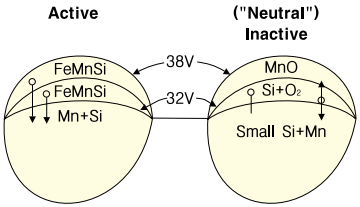
Microphotograph of flux shows mesh size uniformity of bonded, large particles.

Active Fluxes

All fluxes interact with the weld metal and affect its composition and mechanical properties. It is common practice, however, to refer to fluxes as “active” if they add manganese and silicon to the weld. Active fluxes add manganese and silicon in proportion to the arc voltage and to the amount of flux used during welding. Their use is usually limited to single or restricted multipass welds and welding voltages below 36V.

Neutral Fluxes

With neutral fluxes, manganese or silicon transfer from flux to weld metal is relatively unaffected by the arc voltage or the amount of flux used. Neutral fluxes are usually recommended for multipass welding and for welding low alloy, high strength steels.



Transfer of manganese and silicon into weld metal depends on amount of flux used.
Use the lowest voltage that gives satisfactory bead shape and appearance.

Transfer of manganese and silicon is minimal and not significantly affected by the amount of flux used.

OK Flux 10.62

AWS A5.17 F7A8-EM12K / F7A6-EH14 / A5.23 F8A6-EA2-A2 / F8A8-EA4-A4 / F8A10-ENi2-Ni2

HIGH-BASIC

Description

• OK Flux 10.62 is a high-basic agglomerated, all-mineral, non-alloying flux for submerged arc welding. OK Flux 10.62 is also particularly well-suited to narrow gap welding as a result of its good slag detachability and smooth blending with the side walls. OK Flux 10.62 is designed for multirun butt welding and allows high current capacity on both AC and DC.

Typical Mechanical Properties of All Weld Metal(DC(+))

Wire (AWS Class)	Yield Point N/mm²{kgf/mm²}	Tensile Strength N/mm²{kgf/mm²}	Impact Value ℃	J{kgf · m}
F7A8-EM12K	410 {42}	500 {51}	-40	100 {10}
			-50	65 {6.6}
F7A6-EH14	540 {55}	630 {64}	-20	80 {8}
			-60	40 {4}
F8A6-EA2-A2	520 {53}	600 {61}	20	140 {14}
			-20	80 {8}
			-40	50 {5}
			-50	40 {4}
F8A8-EA4-A4	580 {59}	660 {67}	-60	60 {6}
F8A10-ENi2-Ni2	500 {51}	570 {58}	-20	160 {16}
			-60	80 {8}

Typical All Weld Metal Composition %

Wire (AWS Class)	C	Mn	Si	Cr	Ni	Mo
F7A8-EM12K	0.07	1.0	0.30	-	-	-
F7A6-EH14	0.08	1.9	0.20	-	-	-
F8A6-EA2-A2	0.10	1.0	0.20	-	-	0.4
F8A8-EA4-A4	0.10	1.4	0.20	-	-	0.4
F8A10-ENi2-Ni2	0.08	1.0	0.30	-	2.1	-

Flux Consumption as kg flux / kg wire

Voltage	DC	AC
26	0.7	0.6
30	0.9	1.75
34	1.2	1.0
38	1.5	1.25

• Density ≈ 1.1kg/dm³

• Basicity index 3.4

OK Flux 10.71

BASIC

Description

• OK Flux 10.71 is a basic agglomerated, slightly Si and Mn-alloying for submerged arc welding, specially designed for fillet welding and for single and multipass butt welding of mild, medium and high tensile steels.
OK Flux 10.71 is of aluminate basic type and has for this slag system very high current-carrying capacity on both AC and DC, with very good operability characteristics both in single and multiwire systems. OK Flux 10.71 can be used to particular advantage for narrow gap welding due to the excellent slag detachability and smooth blending of the weld bead with the joint side walls. OK Flux 10.71 is a good choice for most general purpose welding applications.

Typical Mechanical Properties of All Weld Metal(DC(+))

Wire (AWS Class)	Yield Point N/mm²{kgf/mm²}	Tensile Strength N/mm²{kgf/mm²}	Impact Value ℃	J{kgf · m}
F7A5-EM12K	440 {45}	530 {54}	-40	80 {8.2}
F8A4-EA2-A2	520 {53}	590 {60}	0	100 {10}
F8A4-EA4-A4	550 {56}	640 {65}	-20 -40 0	60 {6} 30 {3} 105 {11}
			-40	50 {5.1}

Typical All Weld Metal Composition %

Wire (AWS Class)	C	Mn	Si	Cr	Ni	Mo
F7A5-EM12K	0.08	1.3	0.4	-	-	-
F8A4-EA2-A4	0.08	1.3	0.4	-	-	0.4
F8A4-EA4-A3	0.10	1.3	0.3	-	-	0.4

Flux Consumption as kg flux / kg wire

Voltage	DC(+)	AC
26	0.6	0.5
30	0.85	0.7
34	1.15	0.95
38	1.35	1.15

• Density ≈ 1.5kg/dm³
• Basicity index 1.6

OK Flux 80

Description

• OK Flux 80 is a general purpose, neutral fused flux for multipass, heavy plate welding application. This specially formulated flux is not sensitive to changes in welding parameters, and plates of unlimited thickness may be welded without fear of excessive strength build-up. Superior mechanical properties are achieved on clean plate, in both the as-welded and stress relieved condition. The use of AC or DC power provides for a wider range of parameters. The non-hygroscopic nature of this flux helps reduce the handling and storage costs.

Application

• Multipass welding on heavy wall pressure vessel and boilers of carbon and low alloy steels, including Cr-Mo, where weld chemistry integrity is important.
Fabrication of large diameter valves and fittings.
Heavy structural components and machine tool bases.
Weld build-up on large diameter steel mill rolls where

Typical Welding Parameters : (a)

Weld Type	Plate Thickness (in.)	Electrode Dia. (in.)	Current (A)	Voltage (V)	Travel Speed (ipm)	Comments
Multipass Butt	1	5/32	500-550	28-32	23-26	Single wire
Multipass Butt	1	5/32	600-700	30-34	12-15	Single wire AC recommended
Multipass DBL V-Groove	13-3/4	1/8	300 800	33 39	12 18	Root passes-AC Fill passes-AC

Typical Mechanical Properties of All Weld Metal : (b)

Wire (AWS Class)	Yield Point N/mm²{kgf/mm²}	Tensile Strength N/mm²{kgf/mm²}	Impact Value J{kgf · m}	
			-20℃	-30℃
F7A2-EM12K	440 {44.9}	515 {52.5}	-	60 {6.1}
F7A0-EA2-A2	470 {47.9}	560 {57.1}	40 {4.1}	-

Typical All Weld Matal Composition

Wire (AWS Class)	C	Mn	Si	O
F7A2-EM12K	0.07	1.20	0.45	0
F7A2-EA2-A2	0.08	1.10	0.39	0.46

OK Flux 10.16

FLOURIDE BASIC

Description

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

Typical Mechanical Properties of All Weld Metal

Wire (AWS Class)	Yield Point N/mm²{kgf/mm²}	Tensile Strength N/mm²{kgf/mm²}	Impact Value	
			℃	J{kgf · m}
ERNiCrMo-3	425	700	+20	100
			−196	80
ERNiCr-3	360	600	+20	140
			−196	100

Typical All Weld Metal Composition(%)

Wire (AWS Class)	C	Si	Mn	Cr	Ni	Mo
ERNiCrMo-3	0.01	0.35	0.3	21.0	bal.	9.0
ERNiCr-3	0.01	0.3	3.2	19.0	bal.	0.5

Flux Consumption as kg flux / kg wire

Voltage	DC(+)
26	0.75
28	0.75
30	0.55
34	0.7
38	1.0

• Density = 1.2kg/dm³
• Basicity index 2.4

OK Flux 10.90

AWS A5.14 ERNiCrMo-3 / ERNiCrMo-13

FLOURIDE BASIC

Description

- OK Flux 10.90 is an agglomerated fluoride basic flux for welding 9% Ni steels and other highalloyed steels. The flux adds manganese , which reduces the risk of hot cracking. Good slag detachability and attractive bead appearance.

Typical Mechanical Properties of All Weld Metal

Wire (AWS Class)	Yield Point N/mm²{kgf/mm²}	Tensile Strength N/mm²{kgf/mm²}	Impact Value	
			℃	J{kgf · m}
ERNiCrMo-13	470	675	-196	70
ERNiCrMo-3	440	720	-196	90

Typical All Weld Metal Composition(%)

Wire (AWS Class)	C	Si	Mn	Cr	Ni	Mo
ERNiCrMo-13	0.001	0.2	3.0	22.0	bal.	14.0
ERNiCrMo-3	0.01	0.2	1.5	21.0	bal.	8.5

Flux Consumption as kg flux / kg wire

Voltage	DC(+)
26	0.75
28	0.75
30	0.55
34	0.7
38	1.0

- Density = 1.0kg/dm³
- Basicity index 1.7

OK Flux 10.92

AWS A5.9 ER 308L(Wire) / ER 309L(Wire) / ER 316L(Wire)

NEUTRAL

Description

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

Typical Mechanical Properties of All Weld Metal(DC(+))

Wire (AWS Class)	Yield Point N/mm^2{kgf/mm²}	Tensile Strength N/mm^2{kgf/mm²}	Impact Value ℃	Impact Value J{kgf · m}
ER 308(L)	365 {37}	580 {59}	-60	60 {6}
			-196	50 {5}
ER 309(L)	410 {42}	575 {58}	-20	50 {5}
ER 316(L)	385 {39}	590 {60}	-70	55 {5.6}

Typical All Weld Metal Composition %

Wire (AWS Class)	C	Mn	Si	Cr	Ni	Mo
ER 308(L)	0.03	1.0	0.9	20	10.0	-
ER 309(L)	0.02	1.1	0.8	24	13.0	-
ER 316(L)	0.02	1.0	0.8	19	12.0	2.7

Flux Consumption as kg flux / kg wire

Voltage	DC(+)
26	0.4
30	0.55
34	0.7
38	0.9

- Density $\approx$ 1.0kg/dm^3
- Basicity index 1.0

OK Flux 10.93

AWS A5.9 ERNiCrMo-3 / ERNiCrMo-13

FLOURIDE BASIC

Description

- OK Flux 10.93 is a basic non-alloying agglomerated flux for the submerged arc welding of stainless steels and high-alloyed CrNiMo steels such as duplex stainless steels.

Typical Mechanical Properties of All Weld Metal

Wire (AWS Class)	Yield Point N/mm²{kgf/mm²}	Tensile Strength N/mm²{kgf/mm²}	Impact Value	
			℃	J{kgf · m}
ER 308(L)	400	560	-40	75
			-60	65
			-110	55
			-196	40
ER 309(L)	430	570	-60	70
			-110	60
			-196	35
ER 316(L)	390	565	-40	95
			-60	90
			-110	75
			-196	40
ER 2209	630	780	-20	125
			-40	110
			-60	80

Typical All Weld Metal Composition(%)

Wire (AWS Class)	C	Si	Mn	Cr	Ni	Mo
OK Autrod 19.81	0.03	0.6	1.4	20.0	10.0	-
OK Autrod 19.82	0.03	0.6	1.5	24.0	12.5	-
OK Autrod 19.81	0.1	0.5	1.5	29.0	9.5	-
OK Autrod 19.82	0.03	0.6	1.4	18.5	11.5	2.7
OK Autrod 19.81	0.04	0.6	1.2	18.5	12.0	2.6
OK Autrod 19.82	0.03	0.5	1.1	19.2	9.6	-
OK Autrod 19.81	0.03	0.6	1.6	19.0	25.0	4.0
OK Autrod 19.82	0.06	1.2	6.3	18.0	8.0	-
OK Autrod 19.81	0.02	0.8	1.3	22.0	9.0	-

- Density = 1.0kg/dm^3
- Basicity index 1.7

Chemical composition of SAW wires(1)

Wire	Classification	
	EN ISO	SFA/AWS
OK Autrod 12.10	EN 756: S1	A5.17: EL12
OK Autrod 12.20	EN 756: S2	A5.17: EM12
OK Autrod 12.22	EN 756: S2Si	A5.17: EM12K
OK Autrod 12.24	EN 756: S2Mo	A5.23: EA2
	EN 12070: S Mo	
OK Autrod 12.30	EN 756: S3	
OK Autrod 12.32	EN 756: S3Si	A5.17: EH12K
OK Autrod 12.34	EN 756: S3Mo	
	EN 12070: S MnMo	A5.23: EA4
OK Autrod 12.40	EN 756: S4	A5.17: EH14
OK Autrod 12.44	EN 756: S4Mo	A5.23: EA3
OK Autrod 13.10 SC	EN 12070: S CrMo1	A5.23: EB2R
OK Autrod 13.20 SC	EN 12070: S CrMo2	A5.23: EB3R
OK Autrod 13.21	EN 756: S2Ni1	A5.23: ENi1
OK Autrod 13.24	EN 756: SZ	A5.23: EG
OK Autrod 13.27	EN 756: S2Ni2	A5.23: ENi2
OK Autrod 13.33	EN 12070: S CrMo5	A5.23: EB6
OK Autrod 13.34	EN 12070: S CrMo9	A5.23: EB8
OK Autrod 13.35	EN 12070: S CrMo91	A5.23: EB9
OK Autrod 13.36	EN 756: S2Ni1Cu	A5.23: EG
OK Autrod 13.40	EN 756: S3Ni1Mo	
	EN 14295: S3Ni1Mo	A5.23: EG
OK Autrod 13.43	EN 14295: S3Ni2,5CrMo	A5.23: EG
OK Autrod 13.44	EN 14295: S3Ni1,5CrMo	A5.23: EG
OK Autrod 13.45	EN 12070: S Z	A5.23: EG
OK Autrod 13.49	EN 756: S2Ni3	A5.23: ENi3
OK Autrod 13.64	EN 756: SZ	A5.23: EG
OK Tubrod 14.00S		
OK Tubrod 14.07S		
OK Tubrod 15.00S		
OK Tubrod 15.24S		
OK Tubrod 15.25S		

	Typical chemical composition									
	C	Si	Mn	P	S	Cr	Ni	Mo	Other	Remark
	0.06	0.08	0.51	0.010	0.012	0.04	0.03	0.01		
	0.10	0.08	1.01	0.013	0.012	0.05	0.03	0.01		
	0.10	0.19	1.01	0.013	0.010	0.03	0.03	0.01		
	0.10	0.15	1.06	0.013	0.010	0.04	0.02	0.50		
	0.12	0.13	1.52	0.015	0.009	0.04	0.07	0.01		
	0.13	0.33	1.76	0.013	0.007	0.03	0.03	0.01		
	0.13	0.13	1.45	0.009	0.007	0.07	0.08	0.48		
	0.13	0.07	1.97	0.011	0.012	0.08	0.08	0.02		
	0.12	0.09	1.84	0.009	0.009	0.05	0.06	0.50		
	0.10	0.16	0.73	0.005	0.004	1.25	0.04	0.53		X≤12
	0.11	0.16	0.63	0.004	0.004	2.39	0.05	1.01		X≤12
	0.11	0.18	0.96	0.004	0.007	0.03	0.95	0.01		
	0.11	0.21	1.45	0.010	0.009	0.06	0.84	0.22		
	0.10	0.19	0.99	0.007	0.005	0.04	2.14	0.01		
	0.06	0.40	0.52	0.005	0.011	5.66	0.07	0.54		
	0.07	0.40	0.50	0.009	0.007	8.90	0.22	0.96		
	0.10	0.24	0.52	0.005	0.003	8.64	0.65	0.94	Nb: 0.07: V: 0.20: N: 0.05	
	0.10	0.22	0.93	0.007	0.006	0.29	0.72	0.02	Cu: 0.43	
	0.11	0.15	1.65	0.009	0.006	0.07	0.93	0.53		
	0.12	0.16	1.45	0.011	0.010	0.60	2.25	0.49		
	0.10	0.09	1.42	0.011	0.014	0.25	1.60	0.47		
	0.10	0.16	0.66	0.007	0.003	2.46	0.08	1.05	Nb: 0.02: V: 0.27	X≤12
	0.09	0.18	1.05	0.007	0.007	0.03	3.12	0.01		
	0.07	0.28	1.23	0.010	0.003	0.03	0.02	0.51	Ti: 0.15: B: 0.12	
	0.06	0.47	1.52	0.013	0.011	0.03	0.03	0.01		weld metal with 10.71
	0.07	0.45	1.05	0.015	0.010	1.18	0.03	0.51		weld metal with 10.71
	0.07	0.59	1.61	0.015	0.010	0.03	0.03	0.01		weld metal with 10.71
	0.08	0.24	1.61	0.013	0.007	0.03	0.65	0.13		weld metal with 10.47
	0.05	0.35	1.26	0.012	0.006	0.03	2.26	0.01		weld metal with 10.62

Chemical composition of SAW wires(2)

Wire	Classification	
	EN ISO	SFA/AWS
OK Autrod 16.38	EN ISO 14343: S 20 16 3 Mn L	A5.9:
OK Autrod 16.97	EN ISO 14343: S 18 8 Mn	A5.9:(ER307)
OK Autrod 19.81	EN ISO 18274: S Ni6059 (NiCr23Mo16)	A5.14: ERNiCrMo-13
OK Autrod 19.82	EN ISO 18274: S Ni6625 (NiCr22MopNb)	A5.14: ERNiCrMo-3
OK Autrod 19.83	EN ISO 18274: S Ni6276 (NiCr15Mo16Fe6W4)	A5.14: ERNiCrMo-4
OK Autrod 19.85	EN ISO 18274: S Ni6082 (NiCr20Mn3Nb)	A5.14: ERNiCr-3
OK Autrod 308H	EN ISO 14343: S 19 9 H	A5.9: ER308H
OK Autrod 308L	EN ISO 14343: S 19 9 L	A5.9: ER308L
OK Autrod 309L	EN ISO 14343: S 23 12 L	A5.9: ER309L
OK Autrod 309MoL	EN ISO 14343: S 23 12 L	A5.9: (ER309MoL)
OK Autrod 310	EN ISO 14343: S 25 20	A5.9: ER310
OK Autrod 310MoL	EN ISO 14343: S 25 22 2 N L	A5.9: (ER310MoL)
OK Autrod 312	EN ISO 14343: S 29 9	A5.9: ER312
OK Autrod 316H	EN ISO 14343: S 19 12 3 H	A5.9: ER316H
OK Autrod 316L	EN ISO 14343: S 19 12 3 L	A5.9: ER316L
OK Autrod 317L	EN ISO 14343: S 18 15 3 L	A5.9: ER317L
OK Autrod 318	EN ISO 14343: S 19 12 3 Nb	A5.9: ER318
OK Autrod 347	EN ISO 14343: S 19 9 Nb	A5.9: ER347
OK Autrod 385	EN ISO 14343: S 20 25 5 Cu L	A5.9: ER385
OK Autrod 2209	EN ISO 14343: S 22 9 3 N L	A5.9: ER2209
OK Autrod 2509	EN ISO 14343: S 25 9 4 N L	A5.9:
OK Autrod 410NiMo	EN ISO 14343: S 13 4	A5.9:

	Typical chemical composition										
	C	Si	Mn	P	S	Cr	Ni	Mo	N	FN	Other
	0.01	0.4	6.9	0.015	0.010	19.9	16.5	3.0	0.18		
	0.07	0.5	6.5	0.013	0.010	18.5	8.2	0.1			
	0.01	0.1	0.2	0.010	0.003	23.0	Bal.	16.0			Al: 0.3, Fe: 1.0
	0.05	0.2	0.2	0.015	0.010	22.0	Bal.	9.0			Nb: 3.5, Fe: 1.0
	0.01	0.05	0.8	0.015	0.010	15.5	Bal.	15.5			W: 4.0, Co: 2.0, Fe: 5.0
	0.05	0.3	3.0	0.015	0.010	20.0	Bal.	0.1			Nb: 2.6, Fe: 10
	0.05	0.5	1.7	0.010	0.010	21.0	10.0	0.2	0.04		
	0.02	0.4	1.8	0.015	0.010	20.0	10.0	0.2	0.05		
	0.01	0.4	1.7	0.015	0.010	23.4	13.4	0.1	0.05		
	0.01	0.4	1.4	0.020	0.010	21.4	15.0	2.7	0.05		
	0.11	0.4	1.7	0.010	0.005	25.9	20.8	0.1	0.04		
	0.01	0.1	4.5	0.013	0.002	25.0	21.9	2.0	0.14		
	0.10	0.4	1.8	0.020	0.005	30.3	9.3	0.2	0.04		
	0.05	0.4	1.7	0.010	0.010	19.3	12.5	2.6	0.04		
	0.01	0.4	1.7	0.015	0.010	18.5	12.2	2.7	0.05		
	0.01	0.4	1.7	0.015	0.010	19.0	13.5	3.6	0.05		
	0.04	0.4	1.7	0.015	0.010	18.5	11.5	2.5	0.08		Nb: 0.8
	0.04	0.4	1.7	0.015	0.010	19.3	10.0	0.1	0.08		Nb: 0.8
	0.01	0.4	1.7	0.010	0.005	20.0	25.0	4.4	0.04		Cu: 1.5
	0.01	0.5	1.6	0.015	0.002	23.0	8.6	3.2	0.16		
	0.01	0.4	0.4	0.015	0.020	25.0	9.5	3.9	0.25		
	0.05	0.3	0.7	0.025	0.020	12.5	4.5	0.8			