Böhler
WELDING

WELDING CONSUMABLES
FOR THE CHEMICAL AND PETROCHEMICAL PROCESS INDUSTRY

Editorial

BÖHLER WELDING is one of the premier suppliers of welding consumables for corrosion resistant alloys as well as high temperature and creep resistant steels, providing a full range of solutions for all joint welding applications and base metals. For this reason, key fabricators in a diverse range of process industries have preferred to use BÖHLER WELDING products and services worldwide since 1927.

The most demanding industries trust our experience and proven quality to reduce fabrication costs and to increase the service life of plant components.
Our experienced welding engineers will assist you in matching the optimum and most economic welding solutions suitable to your individual requirements.

BÖHLER WELDING customers are able to choose from an extensive range of high quality electrodes and wires manufactured to the latest industry specifications.
Specific customer and process requirements: i.e.: documentation, data sheets, certification, testing, packing and marking of products can be arranged upon request.

Contact us for more detailed information!

Our particular focus on high temperature and creep resisting products, as well as stainless steel and nickel base welding consumables, combined with our experience and solid history of almost 80 years has made BÖHLER WELDING a strong partner for the high quality demands of today's process industries.

BÖHLER WELDING consumables are available in moisture resistant and hermetically sealed packs.

For high demanding industries

Chemical and Petrochemical Plant Engineering
In excess of 180 first class BÖHLER WELDING products suported by years of R&D including first hand production knowledge provide users with the confidence to be assured that BÖHLER WELDING products have the ability to perform to advanced product standards, consistent product quality and best operating characteristics for reliable corrosion / heat resistance to guarantee safe operating conditions and extend the life of today's modern plant operations.

Chemical Tankers
Apart from 316L and 317L stainless steel, the application of Duplex stainless steel is being introduced more widely for the construction of tanks for bulk storage. BÖHLER WELDING products lead the way with a comprehensive range of flux cored wires, sub arc wires and flux and of course the full range of covered electrodes, GMAW solid wires and GTAW rods.

Pharmaceutical Industry
Particularly high demands of quality and purity of all medium exposed surfaces require top quality base and filler metals, including extremely smooth and even electro-polished stainless steel pipes and weld surfaces. BÖHLER WELDING recognises the importance of these specialist applications and as such has undertaken investigation of their filler metals and weld behaviour to ensure that optimum results are achieved when undertaking these specialist applications.

Food and Beverage
Whatever the application, storage tanks, pressure vessels, heat exchangers or process pipe work, you can be assured that BÖHLER WELDING filler metals are being referred to by thousands of welding engineers and used by welders throughout the world on a daily basis. There are many single product features available in the food and beverage industry.

Pulp and Paper
Mo alloyed stainless steel – Duplex and Super duplex stainless steel alternatively Nickel base alloys or even Titanium welding consumables are necessary to resist the severe effects of corrosive environments. The metallurgical concept of BÖHLER WELDING consumables guarantees the highest homogeneity and reliability of the chemical composition of weld metals and their corrosion resistance, crack resistance and mechanical properties.

Seawater Desalination
Adequate supplies of fresh water throughout the world are an essential part of everyday life, in several regions seawater desalination plants are needed to cover the demand. BÖHLER WELDING is aware of the extreme requirements demanded in this industry sector and a broad range of filler metals has been engineered without compromise to resist pitting, crevice and stress corrosion, and the cracking of weld metals.

Flue Gas Desulphurisation
Although allied to the power generation industry, FGD wet scrubbing systems are a perfect example to choose extremely corrosion resistant nickel base alloys. Alloy BÖHLER WELDING consumables offer maximum corrosion resistance e.g. in the absorber towers.

References

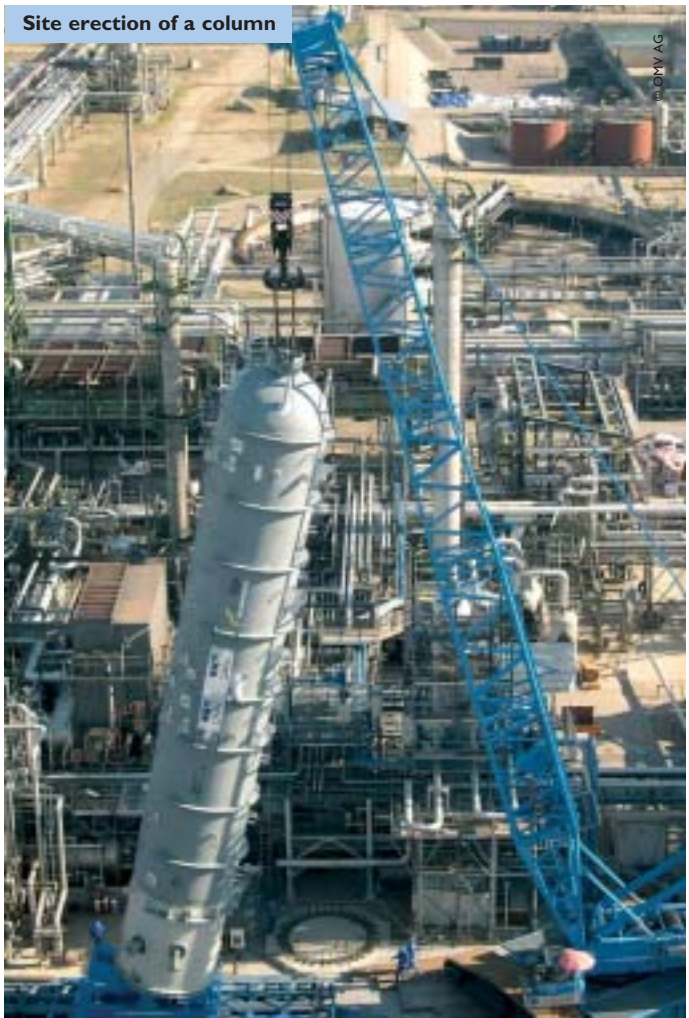
Leuna Refinery

Ammonia synthesis

Methanol plant

Flue gas desulphurization

Site erection of a column



Selection guide

	Base metals AISI/UNS/ASTM	Welding processes SMAW	FCAW	GTAW	GMAW	SAW	Page
High temperature and creep resistant steels							
0,5Mo	P/T1	FOX DMO Ti, Kb		DMO-IG	DMO-IG	EMS 2Mo+BB 24	8
1Cr 0,5Mo	P/T11	FOX DCMS Ti, Kb		DCMS-IG	DCMS-IG	EMS 2CrMo+BB 24	8, 9
0,5Cr 1Mo +V	–	FOX DMV 83Kb		DMV 83-IG	DMV 83-IG		9
$2^1/_4$Cr 1Mo	P/T22	FOX CM 2Kb		CM 2-IG	CM 2-IG	CM 2-UP+BB 24	9
$2^1/_4$Cr 1Mo (mod.)	P/T23	FOX P 23		P 23-IG		P 23-UP+BB 430	10
	P/T24	FOX P 24		P 24-IG		P 24-UP+BB 430	10
5Cr 0,5Mo	P/T5	FOX CM 5 Kb		CM 5-IG	CM 5-IG	CM 5-UP+BB 24	11
9Cr 1Mo	P/T9	FOX CM 9 Kb		CM 9-IG			11
9Cr 1Mo +V(W)	P/T91	FOX C 9 MV		C 9 MV-IG	C 9 MV-IG	C 9 MV-UP+BB 910	11, 12
	P/T911	FOX C 9 MVW		C 9 MVW-IG			12
	P/T92	FOX P 92		P 92-IG		P 92-UP+BB 910	13
12Cr 1Mo +VW	–	FOX 20 MVW		20 MVW-IG		20 MVW-UP+BB 24	13, 14
18Cr 11Ni	304H	FOX CN 18/11		CN 18/11-IG	CN 18/11-IG	CN 18/11-UP+BB 202	14
	321H	FOX E 308 H	E 308 H-FD	ER 308 H-IG			15
			E 308 H PW-FD				15
18Cr 10Ni +Nb	347H	FOX E 347 H					15
Stainless steels **Austenitic**							
19Cr 9Ni L	304L	FOX EAS 2	EAS 2-FD	EAS 2-IG	EAS 2-IG (Si)	EAS 2-UP+BB 202	16
		FOX EAS 2-A	EAS 2 PW-FD				16
		FOX EAS 2-VD					16
19Cr 9Ni 3Mo L	316L	FOX EAS 4 M	EAS 4 M-FD	EAS 4 M-IG	EAS 4 M-IG (Si)	EAS 4 M-UP+BB 202	17, 18
		FOX EAS 4 M-A	EAS 4 PW-FD				17
		FOX EAS 4 M-VD					17
		FOX EAS 4 M-TS					17
19Cr 13Ni 4Mo L	317L	FOX E 317L	E 317L-FD			ASN 5 SY-UP+BB 202	18
			E 317L PW-FD				18
18Cr 16Ni 5Mo NL	317LN	FOX ASN 5		ASN 5-IG	ASN 5-IG (Si)	ASN 5-UP+BB 203	19
		FOX ASN 5-A					19
22Cr 18Ni 4Mo L	–	FOX AM 400		AM 400-IG	AM 400-IG		19
19Cr 12Ni 3Mo Nb	316Ti	FOX SAS 4	SAS 4-FD	SAS 4-IG	SAS 4-IG (Si)	SAS 4-UP+BB 202	21
		FOX SAS 4-A	SAS 4 PW-FD				21
19Cr 9Ni Nb	347	FOX SAS 2	SAS 2-FD	SAS 2-IG	SAS 2-IG (Si)	SAS 2-UP+BB 202	20
		FOX SAS 2-A	SAS 2 PW-FD				20
20Cr 25Ni 5Mo CuNL	904L	FOX CN 20/25 M		CN 20/25 M-IG	CN 20/25 M-IG (Si)		22
		FOX CN 20/25 M-A					22
							22
Ferritic / Martensitic							
13Cr NbL	409				KW 5 Nb-IG		23
13Cr	410	FOX KW 10			KW 10-IG		23
17Cr	431	FOX SKWA			SKWA-IG, KWA-IG		23
17Cr Mo	–	FOX SKWAM			SKWAM-IG	SKWAM-UP+BB 203	24
18Cr NbL	430Cb				CAT 430 L Cb-IG		24
Soft martensitic							
13Cr 4Ni	CA6NM	FOX CN 13/4 SUPRA		CN 13/4-IG	CN 13/4-MC	CN 13/4-UP+BB 203	25
	S41500	FOX CN 13/4			CN 13/4-IG		25
16Cr 6Ni Mo	–	FOX CN 16/6 M-HD					25
							26
Precipitation hardening							
17Cr 4Ni Cu	–	FOX CN 17/4 PH					
Duplex / Superduplex							
22Cr	S31803	FOX CN 22/9 N-B	CN 22/9 N-FD	CN 22/9 N-IG	CN 22/9 N-IG	CN 22/9N-UP+BB 202	26, 27
		FOX CN 22/9 N	CN 22/9 PW-FD				26, 27
25Cr	S32750	FOX CN 25/9 CuT		CN 25/9 CuT-IG	CN 25/9 CuT-IG		27

	Base metal AISI/UNS/ASTM	Welding processes					
		SMAW	FCAW	GTAW	GMAW	SAW	Page
Special applications							
18Cr 8Ni Mn		FOX A 7	A 7-FD	A 7 CN-IG	A 7-IG	A 7 CN-UP+BB 203	28
		FOX A 7-A	A 7 PW-FD				28
20Cr 10Ni 3Mo	Dissimilar joints,	FOX CN 19/9 M		CN 19/9 M-IG	CN 19/9 M-IG		28, 29
23Cr 12Ni L	corrosion	FOX CN 23/12-A	CN 23/12-FD	CN 23/12-IG	CN 23/12-IG	CN 23/12-UP+BB 202	29
	resistant claddings		CN 23/12 PW-FD				29
23Cr 12Ni 2Mo L		FOX CN 23/12 Mo-A	CN 23/12 Mo-FD				30
			CN 23/12 Mo PW-FD				30
24Cr 13Ni L	Buffer layers	FOX CN 24/13					30
24Cr 13Ni NbL		FOX CN 24/13 Nb					30
29Cr 9Ni	Problem steels	FOX CN 29/9					30
		FOX CN 29/9-A					30
19Cr 14Ni Si	Against nitric acid	FOX EAS 2 Si		EASN 2 Si-IG			31
25Cr 22Ni 2Mo NL	UREA plant engineering	FOX EASN 25 M		EASN 25 M-IG			31
Low temperature							
2.5Ni	A633 Gr. E	FOX 2.5 Ni		2.5 Ni-IG	2.5 Ni-IG	Ni 2-UP+BB 24	32
19Cr 9Ni L	304L	FOX EAS 2	EAS 2-FD	EAS 2-IG	EAS 2-IG (Si)	EAS 2-UP+BB 202	33
			EAS 2 PW-FD				33
			EAS 2 PW-FD (LF)				33
9Ni	K81340	FOX NIBAS 60/15	NIBAS 625-FD	NIBAS 625-IG	NIBAS 625-IG	NIBAS 625-UP+BB 444	34
Heat resistant							
25Cr 4Ni	327	FOX FA		FA-IG	FA-IG		35
22Cr 12Ni	309	FOX FF		FF-IG	FF-IG		35
		FOX FF-A					35
25Cr 20Ni	310	FOX FFB		FFB-IG	FFB-IG		35, 36
		FOX FFB-A					35
21Cr 33Ni Mn	N08810 / 800H	FOX CN 21/33 Mn		CN 21/33 Mn-IG	CN 21/33 Mn-IG		36
25Cr 35Ni Nb	–	FOX CN 25/35 Nb		CN 25/35 Nb-IG	CN 25/35 Nb-IG		36
35Cr 45Ni Nb	–	FOX CN 35/45 Nb		CN 35/45 Nb-IG	CN 35/45 Nb-IG		36
Nickel base alloys							
Alloy 600	N06600	FOX NIBAS 70/15					37
Alloy 600	N06600	FOX NIBAS 70/20	NIBAS 70/20-FD	NIBAS 70/20-IG	NIBAS 70/20-IG	NIBAS 70/20-UP+BB 444	37, 38
Alloy 625	N06625	FOX NIBAS 625	NIBAS 625-FD	NIBAS 625-IG	NIBAS 625-IG	NIBAS 625-UP+BB 444	38
Alloy C 276	N10276	FOX NIBAS C 276		NIBAS C 276-IG	NIBAS C 276-IG	NIBAS C 276-UP+BB 444	39
Alloy 59	N06059	FOX NIBAS C 24		NIBAS C 24-IG	NIBAS C 24-IG	NIBAS C 24-UP+BB 444	39
Alloy 400	N04400	FOX NIBAS 400		NIBAS 400-IG	NIBAS 400-IG		40
Alloy 617	N06617	FOX NIBAS 617		NIBAS 617-IG	NIBAS 617-IG	NIBAS 617-UP+BB 444	40
Non-ferrous alloys							
Cu-Ni 90-10	C70600	FOX CuNi 30Fe		CuNi 30Fe-IG			41
Cu-Ni 90-30	C71500	FOX CuNi 30Fe		CuNi 30Fe-IG			41
Ti grade 2	R50400			ER Ti 2-IG	ER Ti 2-IG		41

High temperature and creep resistant steels

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX DMO Ti E Mo R 12 –	SMAW	C 0.06 Si 0.3 Mn 0.6 Mo 0.5	Re 500 N/mm² Rm 570 N/mm² A5 23 % Av 90 J	2.0 2.5 3.2 4.0	TÜV-D, Ü, TÜV-A, CL, DNV, BV, DB, UDT, Statoil, RMR, ÖBB, VUZ	Rutile coated electrode for 0.5 % Mo alloyed boiler and tube steels up to +550 °C service temperature. It offers excellent striking and restriking characteristics, easy slag removal, smooth beads, AC/DC weldability and produces first class X-ray quality welds in all positions.	S355J2G3, E295, P255G1TH, L320-L415NB, 16Mo3, L320MB-L415MB,16Mo3, S255N, P235GH-P310GH, P255-P355N, P255NH-P355NH **ASTM e. g.** A335 Gr. P 1, A161-94 Gr. T 1 A182M Gr. F 1, A250M Gr. T 1
FOX DMO Kb E Mo B 42 H5 E7018-A1H4R	SMAW	C 0.08 Si 0.4 Mn 0.8 Mo 0.5	Re 550 N/mm² Rm 600 N/mm² A5 25 % Av 200 J ≥32 J…-50 °C	2.5 3.2 4.0 5.0	TÜV-D, Ü, TÜV-A, FI, ÖBB, DB, ABS, DNV, GL, RMR, Statoil, CL, LTSS, UDT, KTA 1408.1 ITI, VUZ, SEPROZ	Basic coated low hydrogen electrode for 0.5 % Mo alloyed boiler and tube steels up to +550 °C service temperature. For high quality welds of long term stressed components with reliable mechanical properties under high and low service temperatures conditions. HD ≤ 4 ml/100 g acc. AWS condition. Low temperature toughness proven down to -50 °C.	S355J2G3, L320-L415NB, L320 MB-L415MB, P255G1TH, P235GH-P310GH, P255NH, 16Mo3, 17MnMoV6-4, 22NiMoCr4-7, 20MnMoNi5-5, 15NiCuMoNb5, 20MnMoNi4-5, GE240-GE300, 22Mo4, S255N-S460N, P255NH-P460NH, ageing resistant and resistant to caustic cracking **ASTM e. g.** A335 Gr. P1 A217 Gr. WC1 A182M Gr. F1 A250M Gr. T1
DMO-IG W Mo Si (GTAW) G Mo Si (GMAW) ER70S-A1	GTAW	C 0.1 Si 0.6 Mn 1.2 Mo 0.5	Re 520 N/mm² Rm 630 N/mm² A5 27 % Av 200 J ≥47 J…-30 °C	1.6 2.0 2.4 3.0 3.2	TÜV-D, Ü, TÜV-A, FI, DB, BV, CL, UDT, DNV, KTA 1408.1 ÖBB, LRS	GTAW rod and GMAW wire for 0.5 % Mo alloyed boiler and tube steels as well as in pressure vessel and structural steel engineering. Recommended for service in the temperature range -30 °C (GTAW) or -40 °C (GMAW) up to +550 °C.	
	GMAW	C 0.1 Si 0.6 Mn 1.2 Mo 0.5	Re 500 N/mm² Rm 620 N/mm² A5 25 % Av 150 J ≥47 J…-40 °C	0.8 1.0 1.2	TÜV-D, Ü, TÜV-A, CL, FI, UDT, SEPROZ, DB, ÖBB	The GMAW wire shows excellent welding, wetting and feeding characteristics.	
Wire: EMS 2 Mo S2 Mo EA2 **Flux: BB 24** SA FB 1 65 DC H5	SAW	C 0.08 Si 0.25 Mn 1.15 Mo 0.45	Re ≥470 N/mm² Rm ≥550 N/mm² A5 ≥24 % Av ≥140 J ≥47 J…-40 °C	2.0 2.5 3.0 4.0	TÜV-D, UDT **Wire:** TÜV-D, TÜV-A, Ü, DB, ÖBB, KTA 1408.1 SEPROZ	SAW wire/flux combination. Mainly for high temperature 0.5 % Mo alloyed steels up to service temperatures of +550 °C* but also for low temperature conditions due to good toughness behaviour of the weld metal. BÖHLER BB 24 is metallurgically Mn-neutral and produces very good low temperature impact properties. Low hydrogen contents (HD < 5 ml/100 g). The combination is ideally suited for multi pass welding of thick plates.	16 Mo3, P275T1-P355T1, WB25 P315NH-P420NH, P310 G-H **ASTM e. g.** A335 Gr. P1 API X52-X65
FOX DCMS Ti ECrMo 1 R 12 E8013-G	SMAW	C 0.06 Si 0.4 Mn 0.6 Cr 1.1 Mo 0.5	PWHT a 680 °C/2h Re 510 N/mm² Rm 610 N/mm² A5 21 % Av 100 J	2.5 3.2 4.0	TÜV-D, Ü, TÜV-A, ÖBB, DB, DNV, GL, ABS, CL, SEPROZ, UDT	Rutile coated electrode for 1 % Cr 0.5 % Mo alloyed boiler plate and tube steels up to +570 °C service temperature. Easy to operate. Fully alloyed core wire. Specifically prefered for thin walled welds and root pass welding in all positions and first class X-ray quality.	13CrMo4-5, 15CrMo5, 16CrMoV4 **ASTM e. g.** A335 Gr. P11 A335 Gr. P12 A193 Gr. B7
FOX DCMS Kb E CrMo 1 B 42 H5 E8018-B2H4R	SMAW	C 0.07 Si 0.4 Mn 0.8 Cr 1.1 Mo 0.5 P ≤0.010 As ≤0.005 Sb ≤0.005 Sn ≤0.005	PWHT a 680 °C/2h Re 530 N/mm² Rm 630 N/mm² A5 23 % Av 160 J	2.5 3.2 4.0 5.0	TÜV-D, Ü, TÜV-A, FI, ÖBB, DB, DNV, GL, CL, LTSS, UDT, ABS, VUZ, SEPROZ	Basic coated low hydrogen electrode for 1 % Cr 0.5 % Mo alloyed boiler and tube steels up to +570 °C service temerature. For high quality welds, suitable for Step-Cooling treatments, fully alloyed core wire which will provide reliable creep rupture properties for the whole service life of a boiler plant. HD ≤ 4 ml/100 g acc. AWS condition.	13CrMo4-5, 15CrMo5, 16CrMoV4, G17CrMo5-5, G22CrMo5-4 Furthermore: Steels resistant to caustic cracking, quenched and tempered steels up to 780 N/mm² tensile strength, case hardening and nitriding steels. **ASTM e. g.** A335 Gr. P11 A335 Gr. P12 A193 Gr. B7 A217 Gr. WC6
DCMS-IG W Cr Mo 1 Si (GTAW) G Cr Mo 1 Si (GMAW) ER80S-G	GTAW	C 0.11 Si 0.6 Mn 1.0 Cr 1.2 Mo 0.5 P ≤0.012 As ≤0.010	PWHT a 680 °C/2h Re 490 N/mm² Rm 590 N/mm² A5 25 % Av 250 J	1.6 2.0 2.4 3.0	TÜV-D, TÜV-A, FI, UDT, SEPROZ	GTAW rod and GMAW wire for 1 % Cr 0.5 % Mo-alloyed boiler and tube steels up to +570 °C service temperature. Suitable for Step-Cooling treatments (GTAW). The weld metal meets all prerequisites for reliable long term creep properties without embrittlement due to very low content of trace elements.	
	GMAW	Sb ≤0.005 Sn ≤0.006	Re 460 N/mm² Rm 570 N/mm² A5 23 % Av 150 J	0.8 1.0 1.2 1.6	TÜV-D, Ü, TÜV-A, DB, CL, FI, ÖBB, UDT, SEPROZ		

High temperature and creep resistant steels

BÖHLER Standard EN AWS	**Welding process**	**Typical analysis** %	**Typical mechanical properties**	**Sizes** mm	**Approvals**	**Characteristics and applications**	**Base metals**
Wire: EMS 2 CrMo S Cr Mo 1 EB2 **Flux: BB 24** SA FB 1 65 DC H5	SAW	C 0.08 Si 0.25 Mn 1.0 Cr 1.0 Mo 0.45 P ≤ 0.012 As ≤0.005 Sb ≤0.005 Sn ≤0.005	PWHT a 680 °C/2h Re ≥460 N/mm² Rm ≥550 N/mm² A5 ≥22% Av ≥47 J	2.5 3.0 4.0	TÜV-D, UDT **Wire:** TÜV-D, TÜV-A, SEPROZ	SAW wire/flux combination for 1%Cr 0.5% Mo alloyed boiler and tube steels up to +570 °C* service temperature. Suitable for Step-Cooling treatments. The weld metal meets all pre-requisites for reliable long term creep properties without embrittlement due to very low content of trace elements. BÖHLER BB 24 is metallurgically Mn-neutral and produces very good low temperature impact properties. Low hydrogen contents (HD < 5 ml/100 g). The combination is ideally suited for multi pass welding of thick plates.	13CrMo4-5 (1.7335) Steels resistant to caustic cracking ASTM A335 Gr. P11 A335 Gr. P12 A193 Gr. B7
FOX DMV 83 Kb E MoV B 4 2 H5 E9018-G	SMAW	C 0.05 Si 0.4 Mn 1.1 Cr 0.4 Mo 0.9 V 0.5	PWHT a 720 °C/2h Re 510 N/mm² Rm 660 N/mm² A5 22% Av 200 J	2.5 3.2 4.0	TÜV-D, TÜV-A, UDT, SEPROZ	Basic coated core wire alloyed stick electrode with special suitability for 1/2 Cr 1 Mo-steels. Approved in longterm condition up to 580 °C service temperature. Crack resistant and ductile deposit, low hydrogen content. Good weldability in all positions except vertical down. Metal recovery approx. 115 %. Preheating and nterpass temperature 200-300 °C. PWHT at 700-720 °C min. 2 hs, cooling in furnace down to 300 °C and still air.	High temperature steels and similar alloyed cast steels 1.7715 14MoV6-3, 1.7733 24CrMoV5-5, 1.7709 21CrMoV5-7, 1.8070 21CrMoV5-11, 1.7706 G17CrMoV5-10 ASTM A389 Gr. C23 a. C24 A405 Gr. P24 UNS I21610
DMV 83-IG W MoV Si (GTAW) G MoV Si (GMAW) ER80S-G	GTAW	C 0.08 Si 0.6 Mn 0.9 Cr 0.45 Mo 0.85 V 0.35	PWHT a 700 °C/2h Re 520 N/mm² Rm 670 N/mm² A5 24% Av 220 J	2.4	TÜV-D, TÜV-A, UDT, LTSS, SEPROZ	GTAW rod and GMAW wire for boiler, plate and tube steels. Designed specially for 14MoV6-3 (1/2 Cr 1/2 Mo 1/4 V). Approved in long-term condition up to +560 °C service temperature. Tough, cracking resistant deposit with good creep rupture strength. The wire shows very good feeding characteristics, resulting in smooth welding and wetting behaviour. Preheating and interpass temperatures 200-300 °C. PWHT at 700-720 °C for at least 2 hrs followed by cooling in furnace down to 300 °C and still air.	
	GMAW	C 0.08 Si 0.6 Mn 0.9 Cr 0.45 Mo 0.85 V 0.35	Re 610 N/mm² Rm 710 N/mm² A5 20% Av 80 J	1.2	TÜV-D, TÜV-A UDT, SEPROZ		
FOX CM 2 Kb E CrMo 2B 42 H5 E9018-B3H4R	SMAW	C 0.07 Si 0.3 Mn 0.8 Cr 2.3 Mo 1.0 P ≤0.010 As ≤0.005 Sb ≤0.005 Sn ≤0.005	PWHT a 720 °C/2h Re 510 N/mm² Rm 640 N/mm² A5 22% Av 180 J	2.5 3.2 4.0 5.0	TÜV-D, Ü, TÜV-A, FI, DB, DNV, CL, UDT, ABS, GL, ÖBB, SEPROZ, VUZ	Basic coated electrode for 2,25 %Cr 1 % Mo alloyed boiler and tube steels up to +600 °C service temperature. For high quality welds suitable for Step-Cooling treatments, fully alloyed core wire which will provide reliable creep rupture properties for the whole service life of a boiler plant. HD ≤ 4 ml/100 g acc. AWS codition. Preheating and interpass temperature 200-350 °C. PWHT at 700-750 °C min. 2 hs, cooling in furnace down to 300 °C and still air.	10CrMo9-10, 10CrSiMoV7, G-17CrMo9-10, (W.-Nr. 1.7379). High temperature steels and similar alloyed cast steels, similar alloyed case hardening steels, nitriding steels. **ASTM e. g.** A335 Gr. P22 A217 Gr. WC9
CM 2-IG W Cr Mo 2 Si (GTAW) G Cr Mo 2 Si (GMAW) ER90S-G	GTAW	C 0.06 Si 0.7 Mn 1.1 Cr 2.6 Mo 1.0 P ≤0.010 As ≤0.010 Sb ≤0.005 Sn ≤0.006	PWHT a 720 °C/2h Re 470 N/mm² Rm 600 N/mm² A5 23% Av 190 J	1.6 2.0 2.4 3.0	TÜV-D, TÜV-A, CL, UDT, SEPROZ, FI	GTAW rod and GMAW wire for 2,25 %Cr 1 % Mo alloyed boiler and tube steels up to +600 °C* service temperature. BÖHLER CM 2-IG (GTAW) meets the requirements for Step-Cooling. The weld metal meets all prerequisites for reliable long term creep properties without embrittlement due to very low content of trace elements. Preheating and interpass temperatures 200-350 °C. PWHT at 700-750 °C for at least 2 hrs followed by cooling in furnace down to 300 °C and still air.	
	GMAW		Re 440 N/mm² Rm 580 N/mm² A5 23% Av 170 J	0.8 1.0 1.2	TÜV-D, TÜV-A, FI, UDT, SEPROZ		
Wire: CM 2-UP S Cr Mo 2 EB3 **Flux: BB 24** SA FB 1 65 DC H5	SAW	C 0.07 Si 0.25 Mn 0.80 Cr 2.30 Mo 0.95 P ≤ 0.012 As ≤0.015 Sb ≤0.005 Sn ≤0.01	PWHT a 720 °C/2h Re ≥460 N/mm² Rm ≥530 N/mm² A5 ≥22% Av ≥47 J	2.5 3.0 4.0	TÜV-D, UDT **Wire:** TÜV-D, TÜV-A KTA 1408.1 SEPROZ	SAW wire/flux combination for 2,25 % Cr 1 % Mo alloyed boiler and tube steels up to +600 °C* service temperature. Particularly for cracking plants in the crude oil industry. Suitable for Step-Cooling treatments, Bruscato ≤15 ppm. The weld metal meets all pre-requisites for reliable long term creep properties without embrittlement due to very low content of trace elements. BÖHLER BB 24 is metallurgically Mn-neutral. Preheat, interpass and PWHT temperature are determined by the base material.	10CrMo9-10 (1.7380) **ASTM e. g.** A335 Gr.P22

High temperature and creep resistant steels

BÖHLER Standard EN AWS	**Welding process**	**Typical analysis** %	**Typical mechanical properties**	**Sizes** mm	**Approvals**	**Characteristics and applications**	**Base metals**
FOX P 23 E ZCrWV 21,5 B42 H5 E9018-G	SMAW	C 0.06 Si 0.2 Mn 0.5 Cr 2.3 W 1.5 V 0.22 Nb 0.04 N 0.01	PWHT a 740 °C/2h Re 520 N/mm² Rm 620 N/mm² A5 19% Av 130 J	2.5 3.2 4.0	TÜV	Basic coated core wire alloyed stick electrode for welding bainitic steels such as P23/T23 (ASTM A 213, code case 2199), pipe material. For high quality welds, which will provide reliable creep rupture properties for the whole service life of a boiler plant. Preheat and interpass temperature depends on wall thickness. PWHT at 740°C for 2 hrs.	HCM2S, P/T23 (ASTM A 213 code case 2199)
P 23-IG W ZCrWV 2 ER90S-G	GTAW	C 0.07 Si 0.3 Mn 0.5 Cr 2.2 W 1.7 V 0.22 Nb 0.05 N 0.01	PWHT a 740 °C/2h Re 450 N/mm² Rm 585 N/mm² A5 17% Av 120 J	1.0 1.2 1.6 2.0 2.4 3.2	TÜV	For manual or automatic GTAW-welding of creep resistant steels such as HCM2S (P23/T23 acc. to ASTM A 213 code case 2199), pipe or tube material. Preheat and interpass temperature depends on wall thickness. PWHT at 740 °C for 2 hrs.	
Wire: P 23-UP S ZCrWV2 **Flux: BB 430** SA FB 1 55 AC	SAW	C 0.05 Si 0.27 Mn 0.9 Cr 2.05 W 1.6 V 0.20 Nb 0.04 N 0.01	PWHT a 740 °C/2h Re ≥450 N/mm² Rm ≥600 N/mm² A5 ≥15% Av ≥100 J	2.0 2.5 3.0	TÜV	SAW wire/flux combination for welding high temperature and creep resistant steels such as HCM2S (P23/T23 acc. to ASTM A213 code case 2199), pipe or tube material. Preheat and interpass temperature: 200-300 °C. Heat input ≤ 2.0 kJ/mm. BB 430 is an agglomerated welding flux of the fluoride-basic type with high basicity (2.9).	
FOX P 24 EZ CrMoVNbB 21 B42 H5 E9018-G	SMAW	C 0.08 Si 0.4 Mn 0.5 Cr 2.4 Mo 1.0 V 0.22 Ti 0.04 B 0.003	PWHT a 740 °C/2h Re 560 N/mm² Rm 660 N/mm² A5 18% Av 100 J	2.5 3.2 4.0	TÜV	Basic coated core wire alloyed stick electrode for welding bainitic steels like 7CrMoVTiB10-10. For high quality welds, which will provide reliable creep rupture properties for the whole service life of a boiler plant. Preheat and interpass temperature depends on wall thickness. PWHT at 740 °C for 2 hrs.	7CrMoVTiB10-10, P/T24 acc. to ASTM A213 Draft
P 24-IG W Z CrMoV 2 –	GTAW	C 0.05 Si 0.3 Mn 0.5 Cr 2.2 Mo 1.0 V 0.22 Ti 0.05 B 0.003	PWHT a 740 °C/2h Re 540 N/mm² Rm 620 N/mm² A5 15% Av 120 J	1.0 1.2 1.6 2.0 2.4 3.2	TÜV	For manual or automatic GTAW-welding of creep resistant steels such as 7CrMoVTiB10-10 (P24/T24 acc. to ASTM A 213 Draft), pipe or tube material. Preheat and interpass temperature depends on wall thickness. PWHT at 740°C for 2 hrs.	
Wire: P 24-UP S Z CrWV2 – **Flux: BB 430** SA FB 1 55 AC	SAW	C 0.06 Si 0.2 Mn 0.7 Cr 2.2 Mo 1.0 V 0.22 Ti 0.027 B 0.003	PWHT a 740 °C/2h Re 500 N/mm² Rm 620 N/mm² A5 15% Av 100 J	2.0 2.5 3.0	TÜV	SAW wire/flux combination for welding high temperature and creep resistant steels such as 7CrMoVTiB (P24/T24 acc. to ASTM A213). Böhler B 430 is an agglomerated welding flux of the fluoride-basic type with high basicity. Grain size: EN 760: 3-16 (0.3-1.6 mm). Preheating and interpass temperature: 200-300 °C. Heat input ≤ 2.0 kJ/mm.	

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FOX CM 5 Kb E CrMo 5 B 42 H5 E8018-B6H4R	SMAW	C 0.07 Si 0.4 Mn 0.8 Cr 5.0 Mo 0.5	PWHT a 730 °C/2h Re 520 N/mm² Rm 620 N/mm² A5 21% Av 90 J	2.5 3.2 4.0	TÜV-D, TÜV-A, CL, UDT, LTSS, VUZ, SEPROZ	Basic coated core wire alloyed stick electrode, preferably used for X12CrMo5 (5 Cr 1/2 Mo) steels. Approved in long-term condition up to +650 °C service temperature. High crack resistance, very low hydrogen content (acc. AWS condition HD < 4 ml/100 g). Good weldability in all positions except vertical down. The deposit is heat treatable. Metal recovery approx. 115 %. Preheat and interpass temperatures 300-350 °C. PWHT at 730-760 °C for at least 1 hour followed by cooling in furnace down to 300 °C and still air.	High temperature steels and similar alloyed cast steels 1.7362 X12CrMo5, 1.7363 GX12CrMo5 **ASTM e. g.** A213 Gr.T5 A217 Gr.C5 A335 Gr.P5
CM 5-IG W Cr Mo 5 Si (GTAW) G Cr Mo 5 Si (GMAW) ER80S-B6	GTAW GMAW	C 0.08 Si 0.4 Mn 0.5 Cr 5.8 Mo 0.6 C 0.08 Si 0.4 Mn 0.5 Cr 5.8 Mo 0.6	PWHT a 730 °C/2h Re 510 N/mm² Rm 620 N/mm² A5 20% Av 200 J Re 520 N/mm² Rm 620 N/mm² A5 20% Av 200 J	1.6 2.0 2.4 3.0 1.2	TÜV-D, TÜV-A, UDT, SEPROZ –	GTAW rod and GMAW wire for 5 % Cr 1/2 % Mo steels and steels for hot hydrogen service, particularly for application in oil refineries and the base metals X12CrMo5 / P5. Approved in long-term condition up to +660 °C service temperature. The GMAW wire shows very good feeding characteristics, resulting in smooth welding and flow behaviour. Uniform copper bonding with low total copper content. Preheating and interpass temperatures 300-350 °C. Tempering at 730-760 °C at least 1 hr followed by cooling in furnace down to 300 °C and still air.	
Wire: CM 5-UP S CrMo5 EB6 **Flux: BB 24** SA FB 1 65 DC H5	SAW	C 0.05 Si 0.5 Mn 0.75 Cr 5.5 Mo 0.55	PWHT a 740 °C/2h Re ≥450 N/mm² Rm ≥590 N/mm² A5 ≥18% Av ≥47 J	4.0	UDT **Wire:** TÜV-D TÜV-A SEPROZ	SAW wire /flux combination suited for 5 % Cr 0.5 % Mo alloyed steels, particularly for hot hydrogen service. High temperature strength at service temperatures up to +600 °C. The weld deposit exhibits good mechanical properties. Easy slag detachability and smooth bead surface are additional quality features. Preheating, interpass temperature and PWHT are determined by the base metal.	
FOX CM 9 Kb E CrMo 9 B 42 H5 E8018-B8	SMAW	C 0.07 Si 0.4 Mn 0.7 Cr 9.0 Mo 1.0	PWHT a 760 °C/2h Re 610 N/mm² Rm 730 N/mm² A5 20% Av 70 J	2.5 3.2 4.0	TÜV-D, TÜV-A, UDT, VUZ, SEPROZ	Basic coated core wire alloyed electrode for high temperature steels and steels for hot hydrogen service, particularly in the petrochemical industry. Preferably used for 9 % Cr 1 % Mo steels (e.g. X12CrMo9-1 Approved in long-term condition up to +650 °C service temperature. The weld metal is heat treatable. Metal recovery approx. 115 %. Preheating and interpass temperatures 250-350 °C. PWHT at 710-760 °C for at least 1 hr followed by cooling in furnace down to 300 °C and still air.	Similar alloyed creep resistant steels 1.7386 X12CrMo9-1, 1.7388 X7CrMo9-1, 1.7389 GX12CrMo10 ASTM A217 Gr.C12 A234 Gr.WP9 A335 Gr.P9
CM 9-IG W CrMo9 Si ER80S-B8	GTAW	C 0.07 Si 0.5 Mn 0.5 Cr 9.0 Mo 1.0	PWHT a 760 °C/2h Re 530 N/mm² Rm 670 N/mm² A5 24% Av 250 J	1.6 2.0 2.4	TÜV-D, TÜV-A, SEPROZ	GTAW rod for 9 % Cr 1 % Mo high temperature steels and steels for hot hydrogen service, particularly for application in oil refineries and the base metals X12CrMo9-1 (P9). Approved in long-term condition up to +600 °C service temperature. Preheating and interpass temperature 250-350 °C. Tempering at 710-760 °C for at least 1 hr followed by cooling in furnace down to 300 °C/air.	
FOX C 9 MV E CrMo 9 1 B 42 H5 E9015-B9	SMAW	C 0.09 Si 0.3 Mn 0.5 Cr 9.0 Mo 0.9 Ni 0.9 V 0.2 Nb 0.05	PWHT a 760 °C/2h Re 500 N/mm² Rm 720 N/mm² A5 19% Av 60 J	2.5 3.2 4.0 5.0	TÜV-D, CL, UDT, SEPROZ	Basic coated core wire alloyed electrode, for creep resisting, heat treatable 9 Cr steels especially for T/P91 acc. ASTM A 335 in turbine and boiler construction as well as in the chemical industry. Service temperatures up to +650 °C. High creep rupture strength and very good toughness under long term stress. Low hydrogen content (< 4 ml/100 g acc. AWS condition). Preheating and interpass temperatures 200-300 °C. After welding the joint should be cooled down below 80 °C to finish martensite formation. PWHT at 760 °C for at least 2 hrs, max. 10 hrs. Heating ang cooling rates up tp 550 °C max. 150 °C/h, above 550 °C max. 80 °C. For optimised toughness values a welding technology should be applied which produces thin welding layers (approx. 2 mm).	X10CrMoVNb9-1 (W.-Nr. 1.4903) **ASTM e. g.** A335 Gr.P91 A213 Gr.T91 A199 Gr.T91

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BÖHLER Standard EN AWS	**Welding process**	**Typical analysis** %	**Typical mechanical properties**	**Sizes** mm	**Approvals**	**Characteristics and applications**	**Base metals**
C 9 MV-IG W CrMo 91 G CrMo 91 ER90S-B9	GTAW GMAW	C 0.09 Si 0.3 Mn 0.5 Cr 9.0 Mo 0.9 Ni 0.9 V 0.2 Nb 0.05	PWHT a 760 °C/2h Re 660 N/mm² Rm 760 N/mm² A5 17% Av 55 J	2.0 2.4 3.0 1.0 1.2	TÜV-D, CL, UDT –	GTAW rod and GMAW wire for high temperature, creep resistant martensitic 9 % chromium steels. Especially designed for the ASTM steels T/P91. Approved in long-term condition up to +650 °C service temperature. Preheating and interpass temperature 200-300 °C. After welding, the weld joint should cool down below 80 °C to finish the martensite transformation. In case of greater wall thickness or complex components the possibility of residual stresses must be considered. The following post weld heat treatment is recommended: annealing 760 °C/min. 2 hrs, max. 10 hrs, heating and cooling rates below 550 °C max. 150 °C/hr, above 550 °C max. 80 °C/hr. For optimised toughness values a welding technology should be applied which produces thin welding layers (approx. 2 mm).	X10CrMoVNb9-1 (W.-Nr. 1.4903) **ASTM e. g.** A335 Gr. P91 A213 Gr. T91 A199 Gr. T91
Wire: C 9 MV-UP S CrMo91 EB9 **Flux: BB 910** SA FB 2 55 DC H5	SAW	C 0.11 Si 0.3 Mn 0.6 Cr 9.0 Mo 0.8 Ni 0.7 V 0.2 Nb 0.05	PWHT a 760 °C/2h Re 610 N/mm² Rm 740 N/mm² A5 20% Av 40 J	2.5 3.0	TÜV-D, UDT, CL, SEPROZ	SAW wire/flux combination suited for creep resistant 9 % Cr steels, especially for T/P91 acc. ASTM A335. Approved in long-term condition up to +650 °C service temperature. The wire and flux are precisely balanced to consistently meet the highest technical requirements. Preheating and interpass temperature 200-300 °C. After welding the joint should cool down below 80 °C in order to finish the martensitic transformation. Pipe welds with wall thickness up to 45 mm can be cooled down to room temperature For heavier wall thicknesses or stressed components, unfavourable possible stress condition must be considered. The recommended post weld heat treatment is annealing after welding at 760 °C/min. 2 hrs, max. 10 hrs, heating/cooling-rates below 550 °C max. 150 °C/hr, above 550 °C max 80 °C/hr. For optimised toughness properties a technology which ensures thin welding layers is recommended.	
FOX C 9 MVW E Z CrMoWV 911 B 42 H5 E9015-B9(mod.)	SMAW	C 0.1 Si 0.25 Mn 0.7 Cr 8.5 Mo 1.0 Ni 0.7 W 1.0 V 0.2 N 0.05 Nb 0.05	PWHT a 760 °C/2h Re 560 N/mm² Rm 720 N/mm² A5 15% Av 40 J	3.2 4.0 5.0	TÜV-D, UDT, SEPROZ	Basic coated core wire alloyed Cr-Mo-Ni-V-W-Nb-electrode for the welding of high temperature martensitic steels like e.g. X11CrMoWVNb9-1-1 (P/T911). Approved in long-term condition up to +650 °C service temperature. Good welding properties in all positions except vertical down. Preheating and interpass temperature 200-300 °C. After welding the joint should be cooled down below 80 °C to finish the martensite transformation. In case of greater wall thickness or complex components the possibility of residual stresses must be considered. The following post weld heat treatment is recommended: annealing 760 °C/ min. 2hrs, max. 10 hrs, heating and cooling rates up to 550 °C max. 150 °C/h, above 550 °C max. 80 °C/h. For optimised toughness values a welding technology should be applied which produces thin welding layers (app. 2 mm).	Similar alloyed creep resistant steels 1.4905 X11CrMoWVNb9-1-1 ASTM A335 Gr. P911 A213 Gr. T911
C 9 MVW-IG W Z CrMoWVNb 911 ER90S-B9(mod.)	GTAW	C 0.11 Si 0.35 Mn 0.45 Cr 9.0 Mo 1.0 Ni 0.75 W 1.05 V 0.2 N 0.07 Nb 0.06	PWHT a 760 °C/2h Re 660 N/mm² Rm 790 N/mm² A5 16% Av 50 J	2.0 2.4	TÜV-D, UDT	GTAW-rod for high temperature, creep resistant martensitic 9 % chromium steels, especially designed for the steel T/P911 according to ASTM A335. Approved in long-term condition up to +650 °C service temperature. Preheating and interpass temperature 200-300 °C. After welding the joint should be cooled down below 80 °C to finish the martensite transformation. In case of greater wall thickness or complex components the possibility of residual stresses must be considered. The following post weld heat treatment is recommended: annealing 760 °C/ min. 2 hrs, max. 10 hrs, heating and cooling rates below 550 °C max. 150 °C/h, above 550 °C max. 80 °C/hr. For optimised toughness values a welding technology should be applied which produces thin welding layers (app. 2 mm).	

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BÖHLER Standard EN AWS	**Welding process**	**Typical analysis** %	**Typical mechanical properties**	**Sizes** mm	**Approvals**	**Characteristics and applications**	**Base metals**
FOX P 92 E Z CrMoWVNb 9 0.5 2 B 42 H5 E9015-B9(mod.)	SMAW	C 0.10 Si 0.3 Mn 0.7 Cr 9.1 Mo 0.55 Ni 0.7 W 1.7 V 0.2 N 0.045 Nb 0.05	PWHT a 760 °C/2h Re 690 N/mm² Rm 810 N/mm² A5 19% Av 55 J	3.2 4.0	TÜV-D, UDT, SEPROZ	Basic coated Cr-Mo-Ni-V-W-Nb alloyed electrode suited for welding of high temperature steel 9 % Cr - 1.5 % W-Mo-Nb-N / T/P92. Approved in long-term condition up to +650 °C service temperature. The stick electrode features a stable arc, good striking and re-striking properties, low spatter loss and an easy removable slag. Preheating and interpass temperature 200-300 °C. After welding the joint should cool down below 80 °C, to finish the martensite transformation. The following postweld heat treatment is recommended: Annealing 760 °C/min. 2 hours, max. 10 hours, heating/cooling rate up to 550 °C max. 150 °C/h, above 550 °C max. 80 °C/h. In case of heat treatments less than 2 hours the requirements have to be proved by a procedure test. For optimised toughness values a welding technology should be applied which produces thin welding layers (approx. 2 mm).	Similar alloyed creep resistant steels NF 616 ASTM A335 Gr.P 92(T92) A213/213M Gr.T92
P 92-IG W Z CrMoWVNb 9 0.5 2 ER90S-B9(mod.)	GTAW	C 0.10 Si 0.4 Mn 0.4 Cr 8.6 Mo 0.4 Ni 0.6 W 1.5 V 0.2 N 0.05 Nb 0.05	PWHT a 760 °C/2h Re 710 N/mm² Rm 820 N/mm² A5 19% Av 77 J PWHT a 760 °C/6h Re 650 N/mm² Rm 770 N/mm² A5 20% Av 70 J	2.0 2.4	TÜV-D, UDT	GTAW rod especially designed for the welding of a 9 % Cr 1.5 % W Mo-Nb-N / T/P92, NF616-steels. Approved in long-term condition up to +650 °C service temperature. Preheating and interpass temperature 200-300 °C. After welding the joint should cool down below 80 °C to finish the martensite transformation. In case of greater wall thickness or complex components the possibility of residual stresses must be considered. The following postweld heat treatment is recommended: annealing 760 °C/min. 2 hours, max. 10 hours, heating/cooling rate below 550 °C max. 150 °C/h, above 550 °C max. 80 °C/h. In case of heat treatments less than 2 hours the requirements have to be proved by a procedure test. For optimised toughness values a welding technology should be applied which produces thin welding layers (approx. 2 mm).	
Wire: P 92-UP S Z CrMoWVNb9 0.5 1.5 EB9(mod.) **Flux: BB 910** SA FB 2 55 DC H5	SAW	C 0.09 Si 0.45 Mn 0.4 Cr 8.6 Mo 0.35 Ni 0.6 W 1.5 V 0.2 Nb 0.04	PWHT a 760°C/2h Re 660 N/mm² Rm 780 N/mm² A5 20% Av 60 J	3.0	TÜV-D, UDT	SAW wire/flux combination designed for 9 % Cr creep resistant steel, especially for T/P92/NF616. Approved in long-term condition up to +650 °C service temperature. Preheating and interpass temperature 200-300 °C. After welding the joint should cool down below 80 °C in order to finish the martensite transformation. Pipe welds with wall thickness up to 45 mm can be cooled down to room temperature. For heavier wall thicknesses or stressed components, unfavourable possible stress condition must be considered. The recommended post weld heat treatment is annealing at 760°C/min. 2 hrs, max. 10 hrs, heating/cooling rates below 550 °C max. 150 °C/hr, above 550 °C max. 80 °C/h. For optimised toughness properties a technology which ensures thin welding layers is recommended.	
FOX 20 MVW E CrMoWV12 B 42 H5 –	SMAW	C 0.18 Si 0.3 Mn 0.6 Cr 11.0 Mo 1.0 Ni 0.6 W 0.5 V 0.3	PWHT a 760 °C/4h Re 610 N/mm² Rm 800 N/mm² A5 18% Av 45 J	2.5 3.2 4.0 5.0	TÜV-D, TÜV-A, CL, DB, Ü, LTSS, UDT, KTA 1408.1, SEPROZ, ÖBB	Basic coated, core wire alloyed electrode for high temperature, heat treatable 12 % chromium steels in turbine and boiler construction as well as in the chemical industry. Preferably used for X20CrMoV12-1. Approved in long-term condition up to +650 °C service temperature. High creep rupture strength and excellent toughness under long term stresses. Optimum chemical composition ensures a high quality weld metal. Low hydrogen content (HD < 5 ml/100 g). Good weldability in all positions except vertical down. The weld metal deposit is heat treatable. Metal recovery approx. 115 %. Preheating and interpass temperatures 400-450 °C (austenitic welding) or 250-300 °C (martensitic welding). Root passes should principally be welded in the martensitic range. Lower preheat and interpass temperatures are possible, yet must be approved by practical welding tests and process qualification tests. After welding cooling down to 90±10 °C, followed by tempering at 720-760 °C for three minutes/mm wall thickness (at least for 2 hours). Tempering, if specified, at 1050 °C for 1/2 hour/oil and annealing at 760 °C for 2 hours.	X20CrMoV12-1 (W.-Nr. 1.4922) X20Cr MoWV12-1 (W.-Nr. 1.4935) X22CrMoV12-1 (W.-Nr. 1.4923) X19CrMoVNb11-1 (W.-Nr. 1.4913) G-X22CrMoV12-1 (W.-Nr. 1.4931)

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20 MVW-IG W CrMoWV12Si –	GTAW	C 0.21 Si 0.4 Mn 0.6 Cr 11.3 Mo 1.0 W 0.45 V 0.3	PWHT a 760 °C/2h Re 610 N/mm² Rm 780 N/mm² A5 18% Av 60 J	2.0 2.4	TÜV-D, TÜV-A, DB, Ü, CL, UDT, KTA 1408.1 SEPROZ, ÖBB	GTAW rod for creep resistant, quenched and tempered 12 % Cr steels in turbine and boiler fabrication and in the chemical industry. Preferably used for the base metal X20CrMoV12-1. Approved in long-term condition up to +650 °C service temperature. The deposit exhibits high creep rupture strength and good toughness properties under long term stresses. Preheating and interpass temperatures 400-450 °C (austenitic welding) or 250-300 °C (martensitic welding). Root passes should principally be welded in the martensitic range. Lower preheat and interpass temperatures are possible, yet must be approved by practical welding tests and process qualification tests. After welding cooling down to 90±10 °C, followed by tempering at 720-760 °C for three minutes/mm wall thickness (at least for 2 hours). Tempering, if specified, at 1050 °C for 1/2 hour/oil and annealing at 760 °C for 2 hours.	X20CrMoV12-1 (W.-Nr. 1.4922) X20Cr MoWV12-1 (W.-Nr. 1.4935) X22CrMoV12-1 (W.-Nr. 1.4923) X19CrMoVNb11-1 (W.-Nr. 1.4913) G-X22CrMoV12-1 (W.-Nr. 1.4931)
Wire: 20 MVW-UP S CrMoWV12 **Flux: BB24** SA FB 2 65 DC H5	SAW	C 0.16 Si 0.3 Mn 0.8 Cr 10.3 Mo 0.85 Ni 0.4 W 0.45 V 0.25	PWHT a 760 °C/2h Re ≥550 N/mm² Rm ≥660 N/mm² A5 ≥15% Av ≥47 J	3.0	TÜV-D (07813.), KTA 1408.1 (8060.01), TÜV-A (393), SEPROZ	SAW wire/flux combination suited for analogous and similar creep resistant steels in turbine and steam boiler construction as well as in the chemical industry. Approved in long-term condition up to +650 °C service temperature. Preheating and interpass temperature 400-450 °C (austenitic welding) or 250-300 °C (martensitic welding). Root passes should principally be welded in the martensitic range. Lower preheat and interpass temperatures are possible, yet must be approved by practical welding tests and process qualification tests. After welding cooling to 90±10 °C, followed by tempering at 760 °C for three minutes/mm wall thickness at least for 2 hours. Tempering, if specified, at 1050 °C for 1/2 hour/oil and annealing at 760 °C for 2 hours. Further details on the welding technology available on request.	
FOX CN 18/11 E 19 9 B 4 2 H5 E308-15	SMAW	C 0.05 Si 0.3 Mn 1.3 Cr 19.0 Ni 1 0.3	Re 420 N/mm² Rm 580 N/mm² A5 40% Av 85 J	2.5 3.2 4.0	TÜV-D, TÜV-A, KTA 1408.1 UDT, LTSS, CL, SEPROZ	Basic coated, core wire alloyed electrode with controlled delta ferrite content (3-8 FN) for austenitic CrNi steels with increased carbon contents (e.g. 1.4948/304H), in the boiler, reactor and turbine fabrication. Approved in long-term condition up to +700 °C service temperature (300 °C in the case of wet corrosion). Resistant to hot cracking, scaling and corrosion. Excellent weldability in all positions except vertical down. Preheating is not required, only in case of wall thickness above 25 mm preheat up to 150 °C. Interpass temperature should not exceed 200 °C. Also suitable for German material no. 1.4550 and Nr. 1.4551, which are approved for temperatures up to 550 °C.	X6CrNi18-11 (W.-Nr. 1.4948) X3CrNiN18-11 (W.-Nr. 1.4949) AISI 304H (321H) (347H)
CN 18/11-IG W 19 9 H (GTAW) G 19 9 H (GMAW) ER19-10H	GTAW	C 0.05 Si 0.4 Mn 1.6 Cr 18.8 Ni 9.3	Re 420 N/mm² Rm 620 N/mm² A5 40% Av 150 J ≥32J…-10 °C	2.0 2.4 3.0	TÜV-D, TÜV-A, KTA 1408.1 CL, UDT	GTAW rod and GMAW wire with controlled ferrite content (3-8 FN). For austenitic CrNi steels with increased carbon contents (e.g. 1.4948/304H), in the boiler, reactor and turbine fabrication. Approved in long-term condition up to +700 °C service temperature (300 °C in the case of wet corrosion). Preheating is not required, only in case of wall thickness above 25 mm preheat up to 150 °C. Interpass temperature should not exceed 200 °C. Steels to German material no. 1.4550 and 1.4551 which are approved for the high temperature range up to 550 °C, can also be welded.	
	GMAW	C 0.05 Si 0.4 Mn 1.6 Cr 18.8 Ni 9.3	Re 400 N/mm² Rm 580 N/mm² A5 38% Av 120 J ≥32J…-10 °C	1.2	TÜV-D, CL, UDT, SEPROZ		
Wire: CN 18/11-UP S 19 9 H ER19-10H **Flux: BB 202** SA FB 2 DC	SAW	C 0.05 Si 0.55 Mn 1.2 Cr 18.4 Ni 9.3	PWHT a 760°C/2h Re ≥320 N/mm² Rm ≥550 N/mm² A5 ≥35% Av ≥80 J	3.0	UDT	SAW wire/flux combination for high quality joint weld on high temperature austenitic CrNi-steels at service temperature up to 700 °C (300 °C in the case of wet corrosion). The controlled ferrite content (3-8FN) ensures hot cracking resistance. The deposit is insusceptible to sigma phase embrittlement. Preheating is not required, only in case of wall thickness above 25 mm preheat up to 150 °C. The interpass temperature should not exceed 200 °C. Steels to German material no. 1.4550 and 1.4551 which are approved for the high temperature range up to 550 °C, can also be welded.	

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BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX E 308 H E 19 9 H R 42 H5 E308H-16	SMAW	C 0.05 Si 0.6 Mn 0.7 Cr 19.4 Ni 10.4	Re 420 N/mm² Rm 580 N/mm² A5 40% Av 75 J	2.5 3.2 4.0	UDT, SEPROZ	Rutile-basic coated, core wire alloyed electrode for the use of high temperature CrNi austenitic steel for service temperatures up to 700 °C. Specially designed for the base metal AISI 304H (W. no. 1.4948). Controlled ferrite content of 3-8 FN. The deposit is less susceptible to embrittlement and is scaling resistant. Excellent weldability in all position except vertical down. Preheating is not required, only in case of wall thickness above 25 mm preheat up to 150 °C. Interpass temperature should not exceed 200 °C.	Similar alloyed creep resistant steels 1.4948 X6CrNi18-11, 1.4878 X12CrNiTi18-9 AISI 304 304H (321H) (347H)
ER 308 H-IG W 19 9 H ER308H	GTAW	C 0.06 Si 0.4 Mn 1.7 Cr 20.0 Ni 9.5 Mo 0.2	Re ≥350 N/mm² Rm ≥550 N/mm² A5 ≥35% Av ≥70 J	1.6 2.0 2.4	–	GTAW rod for high quality joints for the use of high temperature CrNi austenitic steel for service temperatures up to 700 °C. Specially designed for the base metal AISI 304H (W. No. 1.4948). Controlled ferrite content of 3-8 FN. The deposit is less susceptible to embrittlement and is scaling resistant.	
E 308 H-FD T Z 19 9 H R M (C) 3 E308HT0-4/-1	FCAW	C 0.06 Si 0.5 Mn 1.1 Cr 19.4 Ni 10.1	Re ≥390 N/mm² Rm ≥585 N/mm² A5 ≥42% Av ≥80 J	1.2	UDT	Flux cored wire with rutile slag characteristic for GMAW of austenitic CrNi steels like 1.4948 / AISI 304H. This wire is designed mainly for downhand and horizontal welding positions. The weld metal is suitable for service temperatures up to approx. 700 °C. This product achieves high productivity and is easy to operate achieving excellent welding characteristics, almost no spatter formation and temper discoloration, smooth weld finish and safe penetration. Increased travel speeds as well as little demand for cleaning and pickling provide considerable savings in time and money. The weld deposit is scaling resistant and because of the controlled low delta ferrite content (3-8 FN) less susceptible to embrittlement. E 308 H PW-FD is a rutile flux cored welding wire with fast freezing slag providing excellent positional welding characteristics and fast travel speeds.	
E 308 H PW-FD T Z 19 9 H P M (C) 1 E308HT1-4/-1	FCAW	C 0.06 Si 0.5 Mn 1.1 Cr 19.4 Ni 10.1	Re ≥390 N/mm² Rm ≥585 N/mm² A5 ≥42% Av ≥90 J	1.2	–		
FOX E 347 H E 19 9 Nb B E347-15	SMAW	C 0.05 Si 0.3 Mn 1.3 Cr 19.0 Ni 10.0 Nb ≥8xC	Re 440 N/mm² Rm 620 N/mm² A5 35% Av 85 J	2.5 3.2 4.0	–	Basic coated, core wire alloyed electrode for the use of high temperature CrNi austenitic steel for service temperatures exceeding 400 °C. Specially designed for the base metal AISI 347H. Controlled ferrite content of 3-8 FN. The deposit is less susceptible to embrittlement and is scaling resistant.	X 1 2 CrNiTi18-9 AISI 321H 347H

Stainless steels – Austenitic

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX EAS 2 E 19 9 L B 22 E308L-15	SMAW	C 0.03 Si 0.4 Mn 1.3 Cr 19.5 Ni 10.5	Re 430 N/mm² Rm 580 N/mm² A5 42% Av 100 J ≥34J…-196°C	2.5 3.2 4.0	TÜV-D, Ü, TÜV-A, ÖBB, DB, CL, UDT, Statoil, SEPROZ	Basic coated stainless steel electrode. Designed to produce first class weld deposits with reliable CVN toughness values down to -196 °C, 100 % X-Ray safety together with very good root pass and positional welding characteristics, good gap bridging ability, easy weld pool and slag control as well as easy slag removal even in narrow preparations resulting in clean bead surfaces and minimum post weld cleaning. An excellent electrode for welding on site! Resistant to intergranular corrosion up to +350 °C. Fully core wire alloyed and packed into hermetically sealed tins.	1.4306 X2CrNi19-11 1.4301 X5CrNi18-10 1.4541 X6CrNiTi18-10 1.4550 X6CrNiNb18-10 1.4311 X2CrNiN18-10 1.4546 X5CrNiNb18-10 1.4312 G-X10CrNi18-8
FOX EAS 2-A E 19 9 L R 32 E308L-17	SMAW	C 0.03 Si 0.8 Mn 0.8 Cr 19.8 Ni 10.2	Re 430 N/mm² Rm 560 N/mm² A5 40% Av 70 J ≥32J…-120°C	1.5 2.0 2.5 3.2 4.0 5.0	TÜV-D, Ü, TÜV-A, ÖBB, DB, ABS, CL, GL, UDT, Statoil, SEPROZ, VUZ	Rutile coated stainless steel electrode. An acknowledged world leader, noted for its superior welding characteristics and metallurgy. Can be used on AC or DC. Other advantages Include high current carrying capacity, minimum spatter formation, self releasing slag, smooth and clean weld profile, safety against formation of porosity due to moisture resistant coating and packaging into hermetically sealed tins. Resistant to intergranular corrosion up to +350 °C.	AISI 304L 304 321 347 304LN A320 Gr. B8 C a. D 302
FOX EAS 2-VD E 19 9 L R 15 E308L-17	SMAW	C 0.02 Si 0.7 Mn 0.7 Cr 19.5 Ni 10.5	Re 470 N/mm² Rm 600 N/mm² A5 36% Av 55 J ≥32J…-120°C	2.5 3.2	UDT, SEPROZ	Rutile-basic coated stainless steel electrode for vertical down welding. Ideal for welding thin sheet in the vertical down position. Extremely low heat input and little distortion due to the fast welding speed. An ideal product to save time and money in sheet metal fabrication. Resistant to intergranular corrosion up to +350 °C.	
EAS 2-IG W 19 9 L ER308L	GTAW	C 0.02 Si 0.5 Mn 1.7 Cr 20.0 Ni 10.0	Re 450 N/mm² Rm 620 N/mm² A5 38% Av 150 J ≥32J…-269°C	1.6 2.0 2.4 3.0	TÜV-D, Ü, TÜV-A, ÖBB, DB, GL, DNV, CL, UDT, SEPROZ	GTAW rod, suitable not only for standard welding jobs but also for cryogenic applications down to -269 °C. As well as the good welding and wetting characteristics of EAS 2-IG corrosion resistance up to +350 °C is achieved.	
EAS 2-IG (Si) G 19 9 L Si ER308L(Si)	GMAW	C 0.02 Si 0.8 Mn 1.7 Cr 20.0 Ni 10.2	Re 420 N/mm² Rm 630 N/mm² A5 38% Av 110 J ≥32J…-196°C	0.8 1.0 1.2	TÜV-D, Ü, TÜV-A, ÖBB, CL, DB, DNV, GL, UDT, SEPROZ	GMAW wire designed for first class welding, wetting and feeding characteristics and excellent weld metal CVN values down to -196 °C. Resistant to intergranular corrosion up to +350 °C.	
EAS 2-FD T 19 9 L R M (C) 3 E308LT0-4(1) Ø 0.9 mm T 19 9 L P M (C) 1 E308LT1-4(1)	FCAW	C 0.03 Si 0.7 Mn 1.5 Cr 19.8 Ni 10.2	Re 380 N/mm² Rm 560 N/mm² A5 40% Av 60 J ≥32J…-196°C	0.9 1.2 1.6	TÜV-D, Ü, TÜV-A, CL, UDT, DB, CWB, SEPROZ, GL, ÖBB	Rutile flux cored welding wire. This product achieves high productivity and is easy to operate achieving excellent welding characteristics, self releasing slag, almost no spatter formation and temper discoloration, smooth weld finish and safe penetration. Increased travel speeds as well as little demand for cleaning and pickling provide considerable savings in time and money. Suitable for service temperatures from -196 °C to +350 °C.	
EAS 2 PW-FD T 19 9 L P M (C) 1 E308LT1-4(1)	FCAW	C 0.03 Si 0.7 Mn 1.5 Cr 19.8 Ni 10.2	Re 380 N/mm² Rm 560 N/mm² A5 40% Av 70 J ≥32J…-196°C	1.2 1.6	TÜV-D, CL, UDT, CWB, SEPROZ, DB, ÖBB	Rutile flux cored welding wire with fast freezing slag providing excellent positional welding characteristics and fast travel speeds.	
Wire: EAS 2-UP S 19 9 L ER308L **Flux: BB 202** SA FB 2 DC	SAW	C 0.02 Si 0.6 Mn 1.3 Cr 19.8 Ni 9.8	Re ≥350 N/mm² Rm ≥550 N/mm² A5 ≥35% Av ≥80 J ≥35J…-196°C	3.0	TÜV-D, UDT **Wire:** TÜV-D, TÜV-A, KTA 1408.1 SEPROZ	SAW-wire/flux combination. Smooth beads, easy slag removal without any slag residues and good welding characteristics even for fillet welds are very much appreciated by users. Suitable for service temperatures from -196 °C to +350 °C. BB 202 is a fluoride-basic, agglomerated flux, providing a low flux consumption. Basicity 2.3. Density 1.0 kg/dm³.	

Stainless steels – Austenitic

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX EAS 4 M E 19 12 3 L B 22 E316L-15	SMAW	C 0.03 Si 0.4 Mn 1.2 Cr 18.8 Mo 2.7 Ni 11.5	Re 460 N/mm² Rm 600 N/mm² A5 38% Av 90 J ≥32J…-120°C ≥27J…-196°C	2.5 3.2 4.0	TÜV-D, TÜV-A, ÖBB, UDT, CL, DNV, Statoil, SEPROZ,	Basic coated stainless steel electrode. Designed to produce first class weld deposits. Provides 100 % X-ray safety together with very good root pass and positional welding characteristics. Good gap bridging ability, easy weld pool and slag control. An excellent product for welding on site! Fully core wire alloyed and packed into hermetically sealed tins. Resistant to intergranular corrosion up to +400 °C.	1.4583 X10CrNiMoNb18-12 1.4435 X2CrNiMo18-14-3 1.4436 X3CrNiMo17-13-3 1.4404 X2CrNiMo17-12-2 1.4401 X5CrNiMo17-12-2 1.4571 X6CrNiMoTi 17-12-2 1.4580 X6CrNiMoNb17-12-2 1.4409 G-X2CrNiMo19-11-2 AISI 316Cb 316L 316 316Ti UNS S31653
FOX EAS 4 M-A E 19 12 3 L R 32 E316L-17	SMAW	C 0.03 Si 0.8 Mn 0.8 Cr 18.8 Mo 2.7 Ni 11.7	Re 460 N/mm² Rm 600 N/mm² A5 36% Av 70 J ≥32J…-120°C	1.5 2.0 2.5 3.2 4.0 5.0	TÜV-D, Ü, TÜV-A, ÖBB, DB, DNV, GL, ABS, CL, LR, UDT, Statoil, SEPROZ, VUZ	Rutile coated stainless steel electrode. An acknowledged world leader, noted for its superior welding characteristics. Fully core wire alloyed ensures the most reliable corrosion resistance. Other advantages include high current carrying capacity, minimum spatter formation, self releasing slag, smooth and clean weld profile, safety against formation of porosity due to moisture resistant coating and packaging into hermetically sealed tins and VAC-packs. Resistant to intergranular corrosion up to +400 °C.	
FOX EAS 4 M-VD E 19 12 3 L R 15 E316L-17	SMAW	C 0.03 Si 0.7 Mn 0.7 Cr 19.0 Mo 2.7 Ni 12.0	Re 470 N/mm² Rm 600 N/mm² A5 35% Av 55 J ≥32J…-120°C	2.5 3.2	TÜV-D, DNV, GL, UDT, CL, SEPROZ, LTSS	Rutile-basic coated stainless steel electrode for vertical down welding. Ideal for welding thin sheet in the vertical down position. Extremely low heat input and little distortion due to the fast welding speed. An ideal product to save time and money in sheet metal fabrication. Resistant to intergranular corrosion up to +400 °C.	
FOX EAS 4 M-TS E 19 12 3 L R 1 2 E316L-16(mod.)	SMAW	C 0.03 Si 0.8 Mn 0.7 Cr 19.0 Mo 2.7 Ni 11.5	Re 510 N/mm² Rm 630 N/mm² A5 35% Av 60 J ≥32J…-120°C	2.0 2.5 3.2	TÜV-D, TÜV-A, UDT, SEPROZ	Special type low carbon rutile-basic coated stainless steel electrode particululary designed for site welding of thin walled tubes and sheets. The very stable arc produces an excellent root penetration, bead configuration and gap bridging ability. A good economical alternative to GTA welding on difficult accessible on-site welding applications. High safety against formation of porosity by moisture resistant coating and packaging into hermetically sealed tin. Resistant to intergranular corrosion up to +400 °C.	
EAS 4 M-IG W 19 12 3 L ER316L	GTAW	C 0.02 Si 0.5 Mn 1.7 Cr 18.5 Mo 2.6 Ni 12.3	Re 470 N/mm² Rm 650 N/mm² A5 38% Av 140 J ≥32J…-196°C	1.6 2.0 2.4 3.0	TÜV-D, Ü, TÜV-A, CL, DNV, GL, UDT, DB, ÖBB, SEPROZ	GTAW rod designed to a very precise analysis to create a weld deposit of high purity, superior hot cracking and corrosion resistance. CVN toughness down to -196 °C. Resistant to intergranular corrosion up to +400 °C.	
EAS 4 M-IG (Si) G 19 12 3 L Si ER316LSi	GMAW	C 0.02 Si 0.8 Mn 1.7 Cr 18.4 Mo 2.8 Ni 11.8	Re 450 N/mm² Rm 630 N/mm² A5 38% Av 120 J ≥32J…-196°C	0.8 1.0 1.2	TÜV-D, Ü, TÜV-A, Statoil, GL, DB, CL, ÖBB, DNV, UDT, SEPROZ	GMAW wire designed for first class welding, wetting and feeding characteristics as well as reliable corrosion resistance up to +400 °C and low temperature service down to -196 °C.	
EAS 4 M-FD T 19 12 3 L R M (C) 3 E316LT0-4(1) ø 0.9 mm T 19 12 3 L P M (C) 1 E316LT1-4(1)	FCAW	C 0.03 Si 0.7 Mn 1.5 Cr 19.0 Mo 2.7 Ni 12.0	Re 400 N/mm² Rm 560 N/mm² A5 38% Av 55 J ≥32J…-120°C	0.9 1.2 1.6	TÜV-D, Ü, TÜV-A, CL, UDT, GL, DB, CWB, ÖBB, LR, SEPROZ	Rutile flux cored welding wire for downhand welding. This products achieve high productivity and are easy to operate. Self releasing slag, almost no spatter formation and temper discoloration. Smooth weld finish and safe penetration. Suitable for service temperatures from -120 °C to +400 °C.	
EAS 4 PW-FD T 19 12 3 L P M (C) 1 E316LT1-4(1)	FCAW	C 0.03 Si 0.7 Mn 1.5 Cr 19.0 Mo 2.7 Ni 12.0	Re 400 N/mm² Rm 560 N/mm² A5 38% Av 65 J ≥32J…-120°C	1.2 1.6	TÜV-D, UDT, GL, CWB, SEPROZ, DB, ÖBB, LR	Rutile flux cored welding wire with fast freezing slag providing excellent positional welding characteristics and fast travel speeds.	

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BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
Wire: EAS 4M-UP S 19 12 3 L ER316L **Flux: BB 202** SA FB 2 DC	SAW	C 0.02 Si 0.6 Mn 1.3 Cr 18.3 Mo 2.7 Ni 12.2	Re ≥350 N/mm² Rm ≥560 N/mm² A5 ≥35 % Av ≥80 J ≥32J…-120°C	3.0	TÜV-D, UDT **Wire:** TÜV-D, KTA 1408.1 DB, ÜZ, ÖBB, TÜV-A SEPROZ	SAW-wire/flux combination of type 316L for multi-pass welding. Smooth beads, easy slag removal without any slag residues and good welding characteristics are very much appreciated by users. BB 202 is a basic, agglomerated flux, providing a low flux consumption. Basicity 2.3 acc. to Boniczewski.	1.4583 X10CrNiMoNb18-12 1.4435 X2CrNiMo18-14-3 1.4436 X3CrNiMo17-13-3 1.4404 X2CrNiMo17-12-2 1.4401 X5CrNiMo17-12-2 1.4571 X6CrNiMoTi 17-12-2 1.4580 X6CrNiMoNb17-12-2 1.4409 G-X2CrNiMo19-11-2 AISI 316Cb 316L 316 316Ti S31653
FOX E 317L – E 317L-17	SMAW	C 0.03 Si 0.8 Mn 0.8 Cr 19.0 Mo 3.6 Ni 13.0 N + FN 4-12	Re 460 N/mm² Rm 610 N/mm² A5 35 % Av 65 J 47J…-60°C	2.5 3.2 4.0	BV	Rutile coated core wire alloyed electrode suited for corrosion resistant, CrNiMoN-steels. It satisfies the high demands of offshore fabricators, shipyards building chemical tankers as well as the chemical / petrochemical, pulp and paper industries. Suitable for service temperatures from -60 °C to +300 °C. The weld metal exhibits resistance against pitting corrosion and intergranular corrosion resistance up to +300 °C (ASTM A 262 / Practice E). Good operating characteristics on AC and DC, minimum spatter formation, self releasing slag with smooth and clean bead surface. Recommended for wall thicknesses up to 30 mm. Preheating and post weld heat treatment is not required by the weld deposit. The interpass temperature should be kept below 150 °C.	CrNiMo-steels with increased Mo-content like grade AISI 316LN/317LN or corrosion resistant claddings on mild steels 1.4434 X2CrNiMoN18-12-4, 1.4438 X2CrNiMo18-15-4, 1.4429 X2CrNiMoN17-13-3, AISI 316L 316LN 317L 317LN
E 317L-FD T Z 19 13 4 L R M (C) 3 E317LT0-4(1)	FCAW	C 0.035 Si 0.7 Mn 1.3 Cr 18.5 Mo 3.4 Ni 13.3	Re 420 N/mm² Rm 570 N/mm² A5 32 % Av 50 J 32J…-60°C	1.2 1.6	UDT	Rutile flux cored welding wire. This product achieves high productivity and is easy to operate achieving excellent welding characteristics, self releasing slag, almost no spatter formation and temper discoloration, smooth weld finish and safe penetration. Increased travel speeds as well as little demand for cleaning and pickling provide considerable savings in time and money.	
E 317L PW-FD T Z 19 13 4 L P M (C) 1 E317LT1-4	FCAW	C ≤0.035 Si 0.7 Mn 1.3 Cr 18.5 Mo 3.4 Ni 13.3	Re 380 N/mm² Rm 560 N/mm² A5 39 % Av 58 J ≥32J…-60°C	1.2	BV, LR	Rutile flux cored welding wire with fast freezing slag providing excellent positional welding characteristics and fast travel speeds. It is designed for welding of corrosion resistant CrNiMo-steels and satisfies the high demands of offshore fabricators, shipyards building chemical tankers as well as the chemical/petrochemical, pulp and paper industries. Suitable for service temperatures from -60 °C to +300 °C. The weld metal exhibits resistance against pitting corrosion and intergranular corrosion resistance (ASTM A 262 / Practise E) up to +300 °C. For corrosion resistant single claddings the wire should be used under mixture gas (Argon + 15-25 % CO_2).	
Wire: ASN 5 SY-UP ER 317L **Flux: BB 202** SA FB 2 DC	SAW	C 0.03 Si 0.50 Mn 1.6 Cr 19.0 Mo 3.6 Ni 13.5	Re 410 N/mm² Rm 590 N/mm² A5 29 % Av 58 J ≥32J…-60°C	3.0 4.0	LR, BV with flux BB 203 SY	SAW wire/flux combination for CrNiMo steels. It satisfies the high demands of offshore fabricators, shipyards building chemical tankers as well as the chemical/petrochemical, pulp and paper industries. Suitable for service temperatures from -60 °C to +300 °C. The weld metal exhibits resistance against pitting corrosion and intergranular corrosion resistance (ASTM A 262 / Practice E) up to +300 °C The fluoride-basic agglomerated flux provides a low flux consumption. Preheating and post weld heat treatment is not required by the weld deposit. The interpass temperature should be kept below 150 °C.	

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX ASN 5 E 18 16 5 N L B 22 E317LN-15(mod.)	SMAW	C ≤0.04 Si 0.5 Mn 2.5 Cr 18.5 Mo 4.3 Ni 17.0 N 0.15 PREN 36.3 FN ≤0.5	Re 460 N/mm² Rm 660 N/mm² A5 35 % Av 100 J ≥32J…-269°C	2.5 3.2 4.0	TÜV-D, TÜV-A, GL, UDT, DNV, SEPROZ	Basic coated electrode. Its weld metal shows a stable austenitic micro structure with good pitting resistance (PREN >35) and crevice corrosion resistance as well as an excellent toughness behaviour down to -269 °C. BÖHLER FOX ASN 5-A is a rutile-basic coated electrode providing good operating characteristics on DC and AC, easy slag removal, smooth and clean bead surfaces. Recommeded for wall thicknesses <15 mm. Both electrodes are characterized by an increased Mo content (4.3 %) to compensate for segregation in high molybdenum alloyed weld metals to meet equivalent corrosion properties as the relevant base metals with 3-4 % Mo guarantee.	1.4439 X2 CrNiMoN17-13-5 1.4436 X3 CrNiMo17-13-3 1.4429 X2 CrNiMoN17-13-3 1.4583 X10 CrNiMoNb18-12 1.4438 X2 CrNiMo18-15-4 AISI 317LN 316L 316Cb 316LN UNS 31726
FOX ASN 5-A E 18 16 5 N L R 32 E317LN-17(mod.)	SMAW	C ≤ 0.035 Si 0.7 Mn 1.1 Cr 18.0 Ni 16.0 Mo 4.5 N 0.13 PREN 36 FN ≤0.5	Re 460 N/mm² Rm 660 N/mm² A5 32 % Av 70 J ≥32J…-120°C	2.5 3.2 4.0	TÜV-D, UDT		
ASN 5-IG W Z 18 16 5 N L ER317LN(mod.)	GTAW	C ≤0.02 Si 0.2 Mn 5.0 Cr 19.0 Mo 4.1 Ni 16.5 N 0.16 PREN 38 FN ≤0.5	Re 440 N/mm² Rm 650 N/mm² A5 35 % Av 120 J ≥32J…-269°C	1.6 2.0 2.4	TÜV-D, TÜV-A, UDT, DNV, SEPROZ	GTAW rod and GMAW for 3-4 % Mo alloyed CrNi-steels. The weld metal shows a stable austenitic micro structure with good pitting resistance (PREN >35) and crevice corrosion resistance as well as excellent CVN toughness behaviour. Both MIG and TIG wires have an increased Mo content (4.3 %) to compensate for segregation when welding high molybdenum alloyed steels, thus producing equivalent corrosion resistance to the relevant base metals offering a 3-4 % Mo guarantee.	
ASN 5-IG (Si) G Z 18 16 5 N L ER317LN(mod.)	GMAW	C ≤0.03 Si 0.7 Mn 7.0 Cr 19.0 Mo 4.3 Ni 17.5 N 0.16 PREN 37.1 FN≥0.5	Re 430 N/mm² Rm 650 N/mm² A5 35 % Av 110 J ≥32J…-196°C	1.0 1.2	TÜV-D, GL, UDT, DNV		
Wire: ASN 5-UP S 18 16 5 N L ER317LN(mod.) **Flux: BB 203** SA FB 2 DC	SAW	C ≤0.02 Si 0.2 Mn 4.5 Cr 18.5 Mo 4.0 Ni 16.3 N 0.14 PREN 33.9	Re ≥420 N/mm² Rm ≥630 N/mm² A5 ≥35 % Av ≥120 J ≥40J…-196°C	3.0	UDT	SAW-wire/flux combination of type 317 L modified. For CrNiMo-steels with 3-4 % Mo. The weld metal shows a stable austenitic micro structure with good pitting resistance and crevice corrosion resistance as well as an excellent toughness behaviour down to -196 °C. The fluoride-basic, agglomerated flux provides good operating characteristics, smooth beads and a low hydrogen weld metal. Basicity 2.7. Density 1.0 kg/dm³.	
FOX AM 400 E Z 22 18 4 L B 2 2 –	SMAW	C ≤0.04 Si 0.8 Mn 7.5 Cr 21.8 Mo 3.7 Ni 18.3 N 0.2 PREN 37.2	Re 470 N/mm² Rm ≥700 N/mm² A5 35 % Av 80J ≥32J…-196°C	2.5 3.2 4.0	WIWEB, GL, UDT SEPROZ	Basic coated core wire alloyed electrode for corrosion resistant nonmagnetizable CrNiMo steels, preferably used for the steels to Werkstoff Nr. 1.3952 and Nr. 1.3964 in the special shipbuilding sector. Excellent weldability in all positions except vertical-down. Fully austenitic weld metal, nonmagnetic, excellent resistance to pitting, crevice corrosion and stress corrosion cracking, excellent subzero toughness, suited for service temperatures up to 350 °C (or up to 400 °C in media that do not induce intergranular corrosion). Further applications are sea water desalinization plants, centrifuges, bleaching plants and the welding of cryogenic steels. Preheating not required, interpass temperatures must not exceed 150 °C.	1.3948 X4CrNiMnMoN19-13-8 1.3951 X2CrNiMoN22-15 1.3952 X2CrNiMoN18-14-3 1.3964 X2CrNiMnMoNNb21-16-5-3 1.4439 X2CrNiMoN17-13-5
AM 400-IG W Z 22 17 8 4 N L (GTAW) G Z 22 17 8 4 N L (GMAW)	GTAW GMAW	C ≤0.03 Si 0.7 Mn 7.5 Cr 21.5 Mo 3.6 Ni 17.5 N 0.22 PREN 37	Re 480 N/mm² Rm 700 N/mm² A5 35 % Av 170 ≥32J…-196°C Re 440 N/mm² Rm 680 N/mm² A5 35 % Av 120 ≥32J…-196°C	2.0 1.0 1.2	WIWEB GL, UDT WIWEB GL UDT	GTAW rod and GMAW wire N-alloyed, fully austenitic and nonmagnetic. Distinguished by its especially high resistance to pitting, crevice corrosion and stress corrosion cracking. Excellent cryogenic toughness. Suitable for service temperatures up to +350 °C, and up to +400 °C in media that do not induce intergranular corrosion. Used for sea water desalinisation plants, centrifuges, bleaching plants and in special shipbuilding.	

Stainless steels – Austenitic

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX SAS 2 E 19 9 Nb B 22 E347-15	SMAW	C 0.03 Si 0.4 Mn 1.3 Cr 19.8 Ni 10.5 Nb +	Re 470 N/mm² Rm 640 N/mm² A5 36 % Av 110 J ≥32J…-196°C	2.5 3.2 4.0	TÜV-D, ÜZ, TÜV-A, ÖBB, DB, ABS, GL, UDT, LTSS, SEPROZ	Basic coated core wire alloyed electrode. Preferably used for Ti or Nb stabilised 1.4541 / 1.4550 / 321 / 347 CrNi-steel grades. Designed to produce first class weld deposits with reliable CVN toughness values down to -196 °C, 100 % X-ray safety together with very good root pass and positional welding characteristics, good gap bridging ability, easy weld pool and slag control as well as easy slag removal even in narrow preparations resulting in clean bead surfaces and minimum post weld cleaning. An excellent electrode for welding on site! The product is resistant to intergranular corrosion up to +400 °C.	1.4550 X6CrNiNb18-10 1.4541 X6CrNiTi18-10 1.4552 G-X5CrNiNb19-11 1.4301 X5CrNi18-10 1.4312 G-X10 CrNi18-8 1.4311 X2CrNiN18-10 AISI/ASTM 347 321 A296 CF8c A157 Gr. C 9 321 A320 Gr. B8 C a. D 304LN 304L 302
FOX SAS 2-A E 19 9 Nb R 32 E347-17	SMAW	C ≤0.03 Si 0.8 Mn 0.8 Cr 19.5 Ni 10.0 Nb +	Re 470 N/mm² Rm 640 N/mm² A5 35 % Av 70 J ≥32J…-120°C	2.0 2.5 3.2 4.0 5.0	TÜV-D, ÜZ, TÜV-A, ÖBB, DB, ABS, CL, UDT, LTSS, VUZ, GL, SEPROZ	Rutile coated core wire alloyed electrode. Preferably used for Ti or Nb stabilised 1.4541 / 1.4550 / 321 / 347 CrNi-steel grades. An acknowledged world leader, noted for its superior welding characteristics and metallurgy. Can be used on AC or DC. Other advantages include high current carrying capacity, minimum spatter Formation, self releasing slag, smooth and clean weld profile, safety against formation of porosity due to moisture resistant coating and packaging into hermetically sealed tins. Fully alloyed core wire ensures the most reliable corrosion resistance. The product is resistant to intergranular corrosion up to +400 °C.	
SAS 2-IG W 19 9 Nb ER347	GTAW	C 0.05 Si 0.5 Mn 1.8 Cr 19.5 Ni 9.5 Nb +	Re 490 N/mm² Rm 660 N/mm² A5 35 % Av 140 J ≥32J…-196°C	1.6 2.0 2.4 3.0	TÜV-D, TÜV-A, CL, GL, UDT, LTSS, SEPROZ	GTAW rod engineered to a very precise analysis to create a weld deposit of high purity, superior hot cracking and corrosion resistance. CVN toughness down to -196 °C, resistant to intergranular corrosion up to +400 °C.	
SAS 2-IG (Si) G 19 9 Nb Si ER347Si	GMAW	C 0.03 Si 0.9 Mn 1.3 Cr 19.4 Ni 9.7 Nb +	Re 460 N/mm² Rm 630 N/mm² A5 33 % Av 110 J ≥32J…-196°C	0.8 1.0 1.2	TÜV-D, TÜV-A, UDT, GL LTSS, SEPROZ	GMAW wire designed for first class welding, wetting and feeding characteristics as well as reliable corrosion resistance up to +400 °C and low temperature service down to -196 °C.	
SAS 2-FD T 19 9 Nb R M (C) 3 E347T0-4(1)	FCAW	C 0.03 Si 0.7 Mn 1.4 Cr 19.0 Ni 10.4 Nb +	Re 420 N/mm² Rm 600 N/mm² A5 35 % Av 75 J ≥32J…-120°C	1.2 1.6	TÜV-D, SEPROZ	Rutile flux cored welding wire. This product achieves high productivity and is easy to operate achieving excellent welding characteristics, self releasing slag, almost no spatter formation and temper discoloration, smooth weld finish and safe penetration. Increased travel speeds as well as little demand for cleaning and pickling provide considerable savings in time and money. Suitable for service temperatures from -196 °C to +400 °C.	
SAS 2 PW-FD T 19 9 Nb P M (C) 1 E347T1-4(1)	FCAW	C 0.03 Si 0.7 Mn 1.4 Cr 19.0 Ni 10.4 Nb +	Re 420 N/mm² Rm 600 N/mm² A5 35 % Av 75 J 35J…-196°C	1.2	TÜV-D, SEPROZ	Rutile flux cored welding wire with fast freezing slag providing excellent positional welding characteristics and fast travel speeds.	
Wire: SAS 2-UP S 19 9 Nb ER347 **Flux: BB 202** SA FB 2 DC	SAW	C 0.045 Si 0.65 Mn 1.3 Cr 19.3 Ni 9.5 Nb 0.5	Re ≥420 N/mm² Rm ≥600 N/mm² A5 ≥30 % Av ≥90 J ≥35J…-196°C	3.0	TÜV-D, UDT, TÜV-A, **Wire:** TÜV-D, UZ, TÜV-A, ÖBB, DB, KTA 1408.1 SEPROZ	SAW-wire/flux combination, smooth beads, easy slag removal without any slag residues and good welding characteristics even for fillet welds are very much appreciated by users. Suitable for service temperatures from -196 °C to +400 °C. The fluoride-basic, agglomerated flux, provides a low flux consumption. Basicity 2.3, Density 1.0 kg/dm³.	

Stainless steels – Austenitic

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX SAS 4 E 19 12 3 Nb B 22 E318-15	SMAW	C 0.03 Si 0.4 Mn 1.3 Cr 18.8 Mo 2.7 Ni 11.5 Nb +	Re 490 N/mm² Rm 660 N/mm² A5 31% Av 120 J ≥32J…-90°C	2.5 3.2 4.0	TÜV-D, ÜZ, TÜV-A, ÖBB, DB, ABS, GL, UDT, SEPROZ	Basic coated core wire alloyed electrode for austenitic CrNiMo (Ti/Cb/Nb) alloyed stainless steels. Designed to produce first class weld deposits with reliable CVN toughness values down to -90 °C, 100 % X-ray safety together with very good root pass and positional welding characteristics, good gap bridging ability, easy weld pool and slag control as well as easy slag removal even in narrow preparations resulting in clean bead surfaces and minimum post weld cleaning. An excellent electrode for welding on site and for heavy and rigid components. The product is resistant to intergranular corrosion up to +400 °C.	1.4583 X10 CrNiMoNb 18-12 1.4435 X2 CrNiMo 18-14-3 1.4436 X3 CrNiMo 17-13-3 1.4404 X2 CrNiMo 17-12-2 1.4401 X5 CrNiMo 17-12-2 1.4571 X6 CrNiMoTi 17-12-2 1.4580 X6 CrNiMoNb 17-12-2 AISI 316Cb 316L 316 316Ti UNS S31653
FOX SAS 4-A E 19 12 3 Nb R 32 E 318-17	SMAW	C 0.03 Si 0.8 Mn 0.8 Cr 19.0 Mo 2.7 Ni 11.5 Nb +	Re 490 N/mm² Rm 640 N/mm² A5 32% Av 60 J ≥32J…-60°C	2.0 2.5 3.2 4.0 5.0	TÜV-D, ÜZ, TÜV-A, CL, ÖBB, DB, UDT, LTSS, SEPROZ, VUZ	Rutile coated core wire alloyed electrode for austenitic CrNiMo (Ti/Cb/Nb) alloyed stainless steels. An acknowledged world leader, noted for its superior welding characteristics and metallurgy. Can be used on AC or DC. Other advantages include high current carrying capacity, minimum spatter formation, self releasing slag, smooth and clean weld profile, safety against formation of porosity due to moisture resistant coating and packaging into hermetically sealed tins. The product is resistant to intergranular corrosion up to +400 °C.	
SAS 4-IG W 19 12 3 Nb ER318	GTAW	C 0.04 Si 0.4 Mn 1.7 Cr 19.5 Mo 2.7 Ni 11.5 Nb +	Re 520 N/mm² Rm 700 N/mm² A5 35% Av 120 J ≥32J…-120°C	1.0 1.2 1.6 2.0 2.4 3.0	TÜV-D, ÜZ, TÜV-A, GL, ÖBB, DB, CL, UDT, KTA 1408.1 SEPROZ	GTAW rod for austenitic CrNiMo (Ti/Cb/Nb) alloyed stainless steels. Engineered to a very precise analysis to create a weld deposit of high purity, superior hot cracking and corrosion resistance. CVN toughness down to -120 °C, resistant to intergranular corrosion up to +400 °C.	
SAS 4-IG (Si) G 19 12 3 Nb Si ER318(mod.)	GMAW	C 0.035 Si 0.8 Mn 1.4 Cr 19.0 Mo 2.8 Ni 11.5 Nb +	Re 490 N/mm² Rm 670 N/mm² A5 33% Av 100 J ≥32J…-120°C	0.8 1.0 1.2	TÜV-D, TÜV-A, UDT, SEPROZ, LTSS, DB, ÖBB, UZ	GMAW wire for austenitic CrNiMo (Ti/Cb/Nb) alloyed stainless steels, designed for first class welding, wetting and feeding characteristics as well as reliable corrosion resistance up to +400 °C and low temperature service down to -120 °C.	
SAS 4-FD T 19 12 3 Nb R M (C) 3 E318T0-4(1)	FCAW	C 0.03 Si 0.6 Mn 1.3 Cr 18.8 Mo 2.6 Ni 12.2 Nb +	Re 430 N/mm² Rm 570 N/mm² A5 35% Av 65 J 35J…-120°C	1.2 1.6		Rutile, flux cored welding wire for austenitic CrNiMo (Ti/Cb/Nb) alloyed stainless steels. This product provides high productivity and is easy to operate achieving excellent welding characteristics, self releasing slag, almost no spatter formation and temper discoloration, smooth weld finish and safe penetration. Increased travel speeds as well as little demand for cleaning and pickling provide considerable savings in time and money. Suitable for service temperatures down to -120 °C. Resists to intergranular corrosion up to +400 °C.	
SAS 4 PW-FD T 19 12 3 Nb P M (C) 1 E318T1-4(1)	FCAW	C 0.03 Si 0.6 Mn 1.3 Cr 18.8 Mo 2.6 Ni 12.2 Nb +	Re 430 N/mm² Rm 570 N/mm² A5 35% Av 65 J 40J…-120°C	1.2		Rutile flux cored welding wire with fast freezing slag providing excellent positional welding characteristics and fast travel speeds.	
Wire: SAS 4-UP S 19 12 3 Nb ER318 **Flux: BB 202** SA FB 2 DC	SAW	C 0.025 Si 0.65 Mn 1.3 Cr 18.8 Mo 2.7 Ni 11.4 Nb +	Re ≥430 N/mm² Rm ≥600 N/mm² A5 ≥30% Av ≥80 J 32J…-120°C	3.0	TÜV-D, TÜV-A, UDT **Wire:** TÜV-D, UZ, TÜV-A, KTA 1408.1 DB, ÖBB, SEPROZ	SAW-wire/flux combination for austenitic CrNiMo (Ti/Cb/Nb) alloyed stainless steels. Smooth beads, easy slag removal without any slag residues and good welding characteristics even for fillet welds are very much appreciated by users. Suitable for service temperatures from -120 °C to +400 °C. THE fluoride-basic, agglomerated flux, provides a low flux consumption. Basicity 2.3, Density 1.0 kg/dm³.	

Stainless steels – Austenitic

BÖHLER Standard EN AWS	**Welding process**	**Typical analysis** %	**Typical mechanical properties**	**Sizes** mm	**Approvals**	**Characteristics and applications**	**Base metals**
FOX CN 20/25M E 20 25 5 Cu N L B 22 E385-15(mod.)	SMAW	C ≤0.04 Si 0.4 Mn 4.0 Cr 20.0 Mo 6.5 Ni 25.0 Cu 1.4 N 0.14 PREN ≥45	Re 440 N/mm² Rm 650 N/mm² A5 35 % Av 75 J ≥32J…-269°C	2.5 3.2 4.0	TÜV-D, TÜV-A, UDT, Statoil, SEPROZ,	Basic (with rutile contents) coated core wire alloyed electrode for corrosion resisting high-molybdenum CrNi steels like 1.4539 / N08904. Recommended for highly corrosive environments encountered e.g. in the chemical industry, in flue gas desulphurisation and sea water desalinisation plants, as well as in cooling and power plants using brackish or sea water. Particularly recommended for steels containing up to 5 % molybdenum. The above average molybdenum content (6.5 %) is characteristic to FOX CN 20/25 M, thus compensating for segregation in high molybdenum alloyed weld metals. The fully austenitic weld metal possess a marked resistance towards pitting and crevice corrosion in chloride containing media. Highly resistant against Sulphur-, Phosphorus-, Acetic- and Formic acid, as well as sea-and brackish water. Caused from the low C-content of the weld metal, the risk of intergranular corrosion can be avoided. The high Ni-content in comparison to standard CrNi-weld metals leads to high resistance against stress corrosion cracking. It is advisable to grind out the end craters of root passes. For root pass welding it is expedient to apply the GTAW process using CN 20/25 M-IG. FOX CN 20/25 M-A is a rutile-basic coated electrode and should be preferably used up to wall thicknesses of 14 mm. It is designed for excellent operating characteristics on DC/AC.	1.4539 X1NiCrMoCu25-20-5 1.4439 X2CrNiMoN17-13-5 1.4537 X1CrNiMoCuN25-25-5 Similar type CrNi steels with Mo content up to 5 % **UNS** N08904 S31726
FOX CN 20/25M-A E 20 25 5 Cu N L R 32 E385-17(mod.)	SMAW	C ≤0.03 Si 0.7 Mn 2.0 Cr 20.5 Mo 6.2 Ni 25.0 Cu 1.6 N 0.17 PREN ≥45	Re 410 N/mm² Rm 640 N/mm² A5 34 % Av 70 J ≥32J…-196°C	2.5 3.2 4.0	TÜV-D, UDT, SEPROZ		
CN 20/25M-IG W Z 20 25 5 Cu N L ER385(mod.)	GTAW	C 0.02 Si 0.7 Mn 4.7 Cr 20.0 Mo 6.2 Ni 25.4 Cu 1.5 N 0.12 PREN ≥45	Re 440 N/mm² Rm 670 N/mm² A5 42 % Av 115 J ≥32J…-269°C	1.6 2.0 2.4	TÜV-D, TÜV-A, UDT, Statoil	GTAW rod and GMAW wire for 4-5 % Mo alloyed CrNisteels like N 08904. The weld metal shows a stable austenitic micro structure with excellent pitting resistance (PREN >45) and crevice corrosion resistance as well as resistance to stress corrosion cracking. Both rod and wire have an increased Mo content (6.2 %) to compensate for segregation in high Mo alloyed weld metals, thus producing equivalent corrosion resistance to the relevant base metals offering 4-5 % Mo.	
CN 20/25M-IG (Si) G Z20 25 5 Cu N L ER385(mod.)	GMAW	C 0.02 Si 0.7 Mn 4.7 Cr 20.0 Mo 6.2 Ni 25.4 Cu 1.5 N 0.12 PREN ≥45	Re 410 N/mm² Rm 650 N/mm² A5 39 % Av 100 J ≥32J…-196°C	0.8 1.0 1.2	TÜV-D, TÜV-A, UDT, Statoil, SEPROZ	Shielding gases for GMAW Ar + 20-30 % He + max. 2% CO_2 or Ar + 2% He + 0.5 % CO_2.	

Stainless steels – Ferritic / Martensitic

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX KW 10 E 13 B 2 2 E410-15(mod.)	SMAW	C 0.08 Si 0.7 Mn 0.8 Cr 13.5	PWHT a 750 °C/2h Re 530 N/mm² Rm 700 N/mm² A5 17% HB 210	2.5 3.2 4.0	UDT, SEPROZ	Basic coated core wire alloyed low-hydrogen electrode with good operating characteristics in all positions except vertical-down. Mainly used for surfacing on sealing faces of gas, water and steam valves to meet stainless and wear resistant overlays for instance. In the machined condition, at least a two layer build up should remain. Joint welding of similar, stainless and heat resistant chromium steels provides matching colour of weld metal with very good ability to polishing. Retention of hardness up to +450 °C, scaling resistant up to +900 °C. Preheating and interpass temperature 200-300 °C, post weld heat treatment at 700-750 °C depending on the weld job.	Surfacings: all weldable backing materials, unalloyed and low-alloyed Joint welds: corrosion resistant Cr-steels as well as other similar-alloyed steels with C-contents 0.20 % (repair welding); heat resistant Cr-steels of similar chemical composition. Be careful with dilution and welding technology.
KW 10-IG W Z 13 (GTAW) G Z 13 (GMAW) ER410(mod.)	GTAW GMAW	C 0.08 Si 1.1 Mn 0.6 Cr 14.5	PWHT a 720 °C/2h Re ≥450 N/mm² Rm ≥650 N/mm² A5 ≥15% HB 200 HB 320 (as welded)	2.0 1.2 1.6	SEPROZ, UDT SEPROZ, UDT	GTAW rod and GMAW wire predominantly used for surfacing of sealing faces of valves for gas, water, and steam piping systems at service temperatures up to +450 °C. The machinability of the weld metal depends largely upon the kind of base metal and degree of dilution. Joint welding of similar 13 % chromium steels shows matching colour of the weld metal and very good ability to polishing. For joint welding preheating to 200-300 °C is recommended. Tempering at 700-750 °C to increase toughness.	1.4006 X12Cr13, 1.4021 X20Cr13 AISI 410 420
KW 5 Nb-IG G Z 13 Nb L ER409Cb	GMAW	C 0.05 Si 0.6 Mn 0.6 Cr 11.5 Nb +	PWHT a 750 °C/2h HB 130	1.0	SEPROZ, UDT	Special GMAW welding wire for catalytic converters as well as exhaust silencers, mufflers, manifolds, and manifold elbows of analogous or similar materials. Also used for repair welding and surfacing of sealing faces of gas, water, and steam turbines with service temperatures of up to 450 °C. Resists scaling up to 900 °C. Machinability depends largely on the degree of base metal dilution. Outstanding feeding, very good welding and flow characteristics.	1.4512 X2CrTi12, 1.4006 X10Cr13 1.4024 X15Cr13 1.4021 X20Cr13 AISI 409 410 420
FOX SKWA E 17 B 2 2 E430-15	SMAW	C 0.08 Si 0.3 Mn 0.3 Cr 17.0	PWHT a 750°C/2h Re 370 N/mm² Rm 560 N/mm² A5 23% HB 200	2.5 3.2 4.0 5.0	KTA 1408.1, SEPROZ, UDT	Basic coated core wire alloyed electrode with good weldability in all positions except vertical-down. Mainly used for hard-surfacing, corrosion resistant, wear resistant. Preferably employed for sealing faces of gas, water and steam valves. In the machined condition, at least a two-layer buildup should remain on the surface. Joint welding (of equal colour): similar, corrosion resistant and heat resistant chromium steels. Scaling resistance up to 900 °C, preheat and interpass temperatures 200-300 °C, annealing at 700-750 °C. Hydrogen content in weld deposit < 5 ml/100 g.	Surfacings: all weldable backing materials, unalloyed and low-alloy. Dilution and heat input must be observed. Joint welding: corrosion resisting, Cr-steels and other similar materials with carbon contents < 0,20 %. Heat resisting Cr-steels of similar chemical composition.
SKWA-IG G Z 17 Ti ER430(mod.)	GMAW	C 0.07 Si 0.6 Mn 0.6 Cr 17.5 Ti +	PWHT a 750 °C/2h Re ≥300 N/mm² Rm ≥500 N/mm² A5 ≥20% HB 130	1.0 1.2 1.6	DB, ÖBB, UDT, SEPROZ	GMAW solid wire for build up on sealing faces of gas, water and steam valves and fittings made from unalloyed or low-alloy steels, for service temperatures up to 500 °C.The wire exhibits good feeding properties with excellent welding and flow characteristics. The weld deposit allows machining. Sea water resistant and scaling resistant up to 900 °C. SKWA-IG wire is also suited for joint welding of stainless ferritic steels containing 12-18 % chromium. Furthermore for applications where colour match of the base metal and weld seam is required. Preheat to 250-450 °C for joint welding. Annealing at 650-750 °C for improved toughness.	1.4510 X3CrTi17 AISI 430Ti 431
KWA-IG G 17 ER430(mod.)	GMAW	C 0.06 Si 0.6 Mn 0.6 Cr 17.5	PWHT a 800 °C/2h Re ≥340 N/mm² Rm ≥550 N/mm² A5 ≥20% HB 150	1.2	SEPROZ, UDT	GMAW wire of type G 17/ER430 suitable for surfacing of sealing faces of gas, water and steam valves and fittings. Service temperatures up to +450 °C. Scaling resistant up to +950 °C. Also in sulphur containing combustion gas at high temperature. This wire is also suited for joint welding of stainless ferritic steels containing 12-17 % chromium, and by the request of colour matching weld deposit/base metal. For thick-walled components it is recommendable to use A 7-IG wire for the filler passes in order to improve the ductility behaviour of the joint weld, KWA-IG wire for the cover pass especially in case of sulphur containing combustion gases. Excellent feeding, welding and wetting behaviour of the wire and weld metal are important economical features. For joint welding preheating up to 200-300 °C is recommended. Annealing at 730-800 °C improves the toughness of the weld deposit.	Surfacings: all weldable backing materials, unalloyed and low-alloyed. Joint welds: corrosion resistant Cr-steels as well as other similar-alloyed steels with C-contents up to 0.20 % (repair welding). Be careful with dilution and welding technology. 1.4510 X3CrTi17 AISI 430 431

Stainless steels – Ferritic / Martensitic

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX SKWAM E Z 17 Mo B 2 2 –	SMAW	C 0.22 Si 0.4 Mn 0.4 Cr 17.0 Mo 1.3	PWHT a 700 °C/2h HB 250	2.5 3.2 4.0 5.0	KTA 1408.1, DB, UZ, ÖBB, UDT, SEPROZ	Basic coated core wire alloyed low-hydrogen electrode with good operating characteristics in all positions except vertical-down. Mainly used for surfacing on sealing faces of gas, water and steam valves to meet stainless and wear resistant overlays for instance. In the machined condition, at least a two layer build up should remain. Joint welding of similar, stainless and heat resistant chromium steels provides matching colour of weld metal with very good ability to polishing. Hydrogen content in weld deposit < 5 ml/100 g. Weld metal retention of hardness up to +500 °C. Scaling resistant up to 900 °C. Preheating as required by the base metal, with temperatures between 100 °C and 200 °C being generally sufficient (for joint welding operations 250-400 °C). Annealing at 650-750 °C may be carried out to improve the toughness values in the weld metal and in the transition zone of the base metal.	Surfacings: all weldable backing materials, unalloyed and low-alloyed. Joint welds: corrosion resistant Cr-steels as well as other similar-alloyed steels with C-contents up to 0.20 % (repair welding). Be careful with dilution and welding technology
SKWAM-IG G Z 17 Mo H –	GMAW	C 0.20 Si 0.7 Mn 0.7 Cr 17.0 Mo 1.1	PWHT a 720 °C/2 h Re ≥500 N/mm² Rm ≥700 N/mm² A5 ≥15% HB 200	1.2 1.6	KTA 1408.1, DB, ÖBB, SEPROZ, UDT	GMAW solid wire of type 17 % Cr 1 % Mo for surfacing on sealing faces of gas, water and steam valves and fittings made from unalloyed or low-alloy steels, for service temperatures up to 450 °C. Excellent anti-friction properties. The weld deposit is still machinable. Scaling resistant up to 900 °C. SKWAM-IG wire is also suited for joint welding of stainless ferritic steels containing 13-18 % chromium, above all for applications where uniform colour of the base metal and weld seam is required. For thick-walled components it is recommendable to use A 7-IG wire for the filler passes in order to improve the ductility behaviour of the joint weld. Preheating to 250-450 °C for joint welding operations. Annealing at 650-750 °C improves the toughness of the weld deposit.	
Wire: SKWAM-UP S Z 17Mo H Flux: BB 203	SAW	C 0.16 Si 0.6 Mn 0.7 Cr 17.0 Mo 1.1	PWHT a 720 °C/2 h HB 200 As welded HB 320-420	3.2	TÜV-D	SAW wire/flux combination of type 17 % Cr 1 % Mo for surfacing on sealing faces of gas, water and steam valves and fittings made from unalloyed or low-alloy steels, for service temperatures up to 450 °C. Excellent anti-friction properties. The weld deposit is still machinable. Scaling resistant up to 900 °C	
CAT 430 L Cb-IG G Z 18 Nb L ER430(mod.)	GMAW	C ≥0.02 Si 0.5 Mn 0.5 Cr 18.0 Nb >12xC	PWHT a 760 °C/2 h HB 130 HB 150 (as welded)	1.0	–	Special GMAW welding wire for catalytic converters as well as exhaust sinencers, mufflers, manifolds and manifold elbows of analogous or similar materials. Resists scaling up to 900 °C. Outstanding feeding characteristics. Very good welding and flow characteristics.	1.4511 1.4016 AISI 430

Stainless steels – Soft martensitic

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX CN 13/4 E 13 4 B 6 2 E410NiMo-25	SMAW	C 0.035 Si 0.3 Mn 0.5 Cr 12.2 Mo 0.5 Ni 4.5	PWHT a 600 °C/2 h Re 680 N/mm² Rm 910 N/mm² A5 17 % Av 66 J 50 J…-60°C	2.5 3.2 4.0 5.0	TÜV-D, UDT, LTSS, SEPROZ	Basic coated low-hydrogen electrode suited for similar soft martensitic and martensitic-ferritic rolled, forged, and cast steels. Mainly used in the construction of hydro turbines, compressors. Resistant to corrosion from water, steam, and sea water atmosphere. Thanks to an optimum balance of alloying components the weld deposit yields very good ductility and toughness & cracking resistance despite of its high strength. Excellent operating characteristics, easy slag removal, and smooth bead appearance. Metal recovery approx. 130 %. Positional weldability is offered up to ø 3.2 mm electrodes. FOX CN 13/4 as well as the GTAW-rod CN 13/4-IG and the analogous GMAW wire are very popular in the construction of hydro turbines.Preheating and interpass temperatures of heavy-wall components 100-160 °C.	1.4317 G-X4CrNi13-4, 1.4313 X3CrNiMo13-4, 1.4351 X3CrNi13-4, 1.4414 G-X4CrNiMo13-4 AISI/UNS ACI Gr. CA6NM S41500
FOX CN 13/4 SUPRA E 13 4 B 4 2 E410NiMo-15	SMAW	C 0.03 Si 0.3 Mn 0.6 Cr 12.5 Mo 0.5 Ni 4.5	PWHT a 600 °C/2 h Re 680 N/mm² Rm 930 N/mm² A5 18 % Av 70 J 55 J…-60°C	3.2 4.0	TÜV-D UDT, SEPROZ	Basic coated core wire alloyed electrode for welding of similar alloyed soft martensitic steels. Due to an optimum balanced alloying concept the weld deposit offers very good ductility and cracking resistance despite of its high strength. Out of position weldable except vertical down. Preheating and interpass temperatures of heavy-wall components 100-160 °C. Maximum heat input 15 kJ/cm. Post weld heat treatment at 580-620 °C.	
CN 13/4-IG W 13 4 (GTAW) G 13 4 (GMAW) ER410NiMo(mod.)	GTAW	C ≤0.02 Si 0.7 Mn 0.6 Cr 12.3 Mo 0.5 Ni 4.7	PWHT 600 °C/8h Re 750 N/mm² Rm 830 N/mm² A5 21% Av 150 J >32 J…-60°C	2.0 2.4	TÜV-D, UDT, SEPROZ	GTAW rod and GMAW wire for welding of similar alloyed soft martensitic steels, with precisely tuned alloying composition for ductile weld metal with best CVN toughness and crack resistance. The preferred gas for MAG welding is Argon +8-10 % CO_2.	
	GMAW	C ≤0.02 Si 0.7 Mn 0.6 Cr 12.3 Mo 0.5 Ni 4.7	PWHT 580 °C/8h Re 760 N/mm² Rm 890 N/mm² A5 17% Av 80 J >47 J…-20°C	1.2	UDT, SEPROZ		
CN 13/4-MC T 13 4 MM 2 EC410NiMo(mod.)	FCAW	C ≤0.025 Si 0.7 Mn 0.9 Cr 12.0 Mo 0.6 Ni 4.6	PWHT 580 °C/8h Re 760 N/mm² Rm 890 N/mm² A5 16% Av 65 J ≥47 J…-20°C	1.2 1.6	SEPROZ	Metal cored wire for welding of similar alloyed soft martensitic steels and cast steels. CN 13/4-MC offers favourable spray or puls arc characteristics, minimum spatter formation, flat and smooth bead profiles, an excellent wetting behaviour and safe penetration as well as best productivity. Best impact values and extra low hydrogen contents (< 4 ml/100 g acc. to AWS 4.3-93). Recommended preheating and interpass temperatures in case of heavy wall thicknesses are 100-160 °C. Maximum heat input 15 kJ/cm. Tempering at 580-620 °C.	
Wire: CN 13/4-UP S 13 4 ER410NiMo(mod.) **Flux: BB 203** SA FB 2 DC	SAW	C 0.025 Si 0.20 Mn 0.6 Cr 12.1 Ni 4.7 Mo 0.5	PWHT 600 °C/2h Re ≥600 N/mm² Rm ≥800 N/mm² A5 15% Av 50 J	3.0	SEPROZ, UDT	Sub-arc wire/flux combination for welding similar soft-martensitic steels. The weld deposit featuring very good ductility and CVN toughness as well as high crack resistance. The fluoride-basic, agglomerated flux provides good operating characteristics, smooth beads and a low hydrogen weld metal (HD > 5 ml/100g). Recommended preheating and interpass temperatures in case of heavy wall thicknesses are 100-160 °C. Maximum heat input 15 kJ/cm. Tempering at 580-620 °C.	
FOX CN 16/6M-HD E Z 16 6 Mo B 6 2 H5 –	SMAW	C 0.03 Si 0.3 Mn 0.6 Cr 15.5 Ni 5.8 Mo 1.1	PWHT 580 °C/4h/air Re 650 N/mm² Rm 920 N/mm² A5 15% Av 42 J HB 340 PWHT 590 °C/8h Re 640 N/mm² Rm 920 N/mm² A5 16% Av 48 J HB 330	2.5 3.2 4.0 5.0	UDT, SEPROZ	Basic coated, high efficiency electrode for welding of soft martensitic forged and cast steels. The high chromium content enhances the corrosion resistance in water, steam and sea atmosphere. Main applications are found in turbines, pumps- and combustion building. Popular in hydro turbine engineering. The electrode shows very good features in regard to arc stability, weld puddle control, slag detachability and seam cleanliness. Suitable for all positions except vertical down (positional welding up to ø 3.2 mm). Metal recovery approx. 135 %. Low hydrogen (HD > 5 ml/100g) is a essential and necessary prerequisite of this product. The maximum interpass temperature should not exceed 120 °C.	Soft-martensitic forge steels and cast steels, same-alloyed 1.4505 G-X5CrNiMo16-5, 1.4418 X4CrNiMo16-5

Stainless steels – Precipitation hardening

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX CN 17/4 PH E Z 17 4 Cu B 4 3 H5 E630-15(mod.)	SMAW	C 0.04 Si 0.3 Mn 0.6 Cr 16.0 Mo 0.4 Ni 4.9 Nb 0.2 Cu 3.2	PWHT 540 °C/3h Re 940 N/mm² Rm 1030 N/mm² A5 10% Av 20 J HRC 37-40	3.2 4.0	UDT, SEPROZ	Basic coated electrode with strength properties for joint and fabrication welding of analogous precipitation hardening Cr-Ni-Cu alloyed rolled-, forged- and cast steels. Popular for components in the paper industry, rotors of compressors, fan blades, press plates in the plastic processing industry and for the aerospace industry. The electrode shows very good features in regard to arc stability, weld puddle control, slag detachability and seam cleanliness. Lowest hydrogen content in the deposit is a prerequisite (HD < 5 ml/100 g). The electrode is suitable for welding in all positions except vertical down. The interpass temperature has to be kept very low (maximum 80 °C). With the use of the proper PWHT (solution annealing + precipitation hardening impact values down to -50 °C are still achievable.	Precipitation hardening forged steels and cast steels, same-alloyed 1.4540 X4CrNiCuNb16-4, 1.4540 GX4CrNiCuNb16-4, 1.4542 X5CrNiCuNb16-4, 1.4548 X5CrNiCuNb17-4-4 UNS J92180 Gr. CB Cu-1 S17400 Type 630 SAE J467 17-4PH

Stainless steels – Duplex / Superduplex

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX CN 22/9 N E 22 9 3 N L R 3 2 E2209-17	SMAW	C ≤0.03 Si 0.9 Mn 0.8 Cr 23.0 Mo 3.2 Ni 9.0 N 0.17 PREN ≥35	Re 650 N/mm² Rm 820 N/mm² A5 25 % Av 55 J ≥32 J…-20°C	2.5 3.2 4.0 5.0	TÜV-D, TÜV-A, DNV, CL, ABS, LR Statoil, UDT, FI, GL, RINA, SEPROZ	FOX CN 22/9 N is a rutile-basic coated electrode which offers excellent positional weldability and thus is perfectly suited for pipe welding of grade UNS S31803. Good wetting characteristics and slag removability. Resistant to porosity, reliable CVN toughness down to -20 °C. It is designed with a fully alloyed core wire providing best corrosion resistance and a very homogeneous micro structure with specified ferrite content of 30 - 60 FN (WRC).	1.4462 X2CrNiMoN22-5-3 1.4462 X2CrNiMoN22-5-3 with 1.4583 X10CrNiMoNb18-12 1.4462 X2CrNiMoN22-5-3 Dissimilar joints
FOX CN 22/9 N-B E 22 9 3 N L B 2 2 E2209-15	SMAW	C ≤0.03 Si 0.3 Mn 1.1 Cr 23.0 Mo 3.2 Ni 8.8 N 0.16 PREN ≥35	Re 630 N/mm² Rm 830 N/mm² A5 27 % Av 105 J 40J…-60°C	2.5 3.2 4.0 5.0	TÜV-D, CL, UDT	The basic coated electrode FOX CN 22/9 N-B is recommended for wall thicknesses > 25 mm or impact requirements down to -60 °C	UNS S31803 S32205
CN 22/9 N-IG W 22 9 3 N L (GTAW) G 22 9 3 N L (GMAW) ER2209	GTAW GMAW	C ≤0.015 Si 0.4 Mn 1.7 Cr 22.6 Mo 3.2 Ni 8.8 N 0.15 PREN ≥35	Re 600 N/mm² Rm 800 N/mm² A5 33 % Av 150 J ≥32J…-60°C Re 660 N/mm² Rm 830 N/mm² A5 28 % Av 85 J ≥32J…-40°C	1.6 2.0 2.4 3.2 1.0 1.2	TÜV-D, CL, TÜV-A, LR, DNV, UDT, GL, ABS, Statoil TÜV-D, CL, TÜV-A, DNV, GL, Statoil, UDT, SEPROZ	GTAW rod and GMAW wire of type ER 2209 for standard duplex stainless steels. Designed for first class welding, wetting and feeding characteristics as well as reliable resistance to stress corrosion cracking and pitting. Ferrite content 30-60 FN (WRC). Shielding gas for GMAW: Argon +20-30 % He + max. 2 % CO_2 or Argon +20-30 % He + max. 1 % O_2	

Stainless steels – Duplex / Superduplex

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
CN 22/9 N-FD T 22 9 3 N L R M (C) 3 E2209T0-4(1)	FCAW	C ≤0.03 Si 0.8 Mn 0.9 Cr 22.7 Mo 3.2 Ni 9.0 N 0.13 PREN ≥35	Re 600 N/mm² Rm 800 N/mm² A5 27 % Av 60 J ≥32J…-46°C Ar +18% CO_2	1.2	TÜV-D, UDT, CL, RINA, GL, DNV, ABS, LR, CWB, SEPROZ	CN 22/9 N-FD is a rutile flux cored wire for downhand welding. Self releasing slag, almost no spatter formation and temper discoloration, smooth weld finish and safe penetration. Ferrite 30-50FN, CPT 22 °C acc. to ASTM G48/A or A 923 method C.	1.4462 X2CrNiMoN22-5-3 1.4462 X2CrNiMoN22-5-3 with 1.4583 X10CrNiMoNb18-12 1.4462 X2CrNiMoN22-5-3 Dissimilar joints UNS S31803 S32205
CN 22/9 PW-FD T 22 9 3 N L P M (C) 1 E2209T1-4(1)	FCAW	C ≤0.03 Si 0.8 Mn 0.9 Cr 22.7 Mo 3.2 Ni 9.0 N 0.13 PREN ≥35	Re 600 N/mm² Rm 800 N/mm² A5 27 % Av 80 J 45J…-46°C Ar +18% CO_2	1.2	TÜV-D, DNV, CL, ABS, LR, UDT, GL, RINA, CWB	Rutile flux cored welding wire with fast freezing slag providing excellent positional welding characteristics and fast travel speeds.	
Wire: CN 22/9 N-UP S 22 9 3 N L ER2209 **Flux: BB 203** SA FB 2 DC	SAW	C ≤0.015 Si 0.55 Mn 1.3 Cr 22.5 Mo 3.1 Ni 8.9 N 0.14 PREN ≥35	Re ≥550 N/mm² Rm ≥750 N/mm² A5 ≥27% Av ≥100 J ≥32 J…-40°C	3.0	TÜV-D, DNV, CL, ABS, LR, UDT, GL, RINA, CWB	SAW-wire/flux combination of type 2209 duplex stainless steel for multi-pass welding. Smooth beads, easy slag removal without any slag residues and good welding characteristics are very much appreciated by the users. BB 203 is a basic, agglomerated flux, providing a low flux consumption. Basicity 2.3 acc. to Boniczewski.	
FOX CN 25/9 CuT E 25 9 4 N L B 2 2 E2553-15(mod.)	SMAW	C <0.03 Si 0.5 Mn 1.1 Cr 25.0 Ni 9.3 Mo 3.7 N 0.22 Cu 0.7 T 0.7 PREN ≥40	Re >600 N/mm² Rm >750 N/mm² A5 >22% Av >70 J 50 J…-50°C	2.5 3.2 4.0	–	Basic coated electrode for welding of Superduplex stainless steels. Excellent resistance to stress corrosion cracking and pitting corrosion. The operating temperature is -50 °C up to +250 °C.	25 % Cr-Superduplex steels e.g. 1.4501 X2CrNiMoCuWN 25-7-4 UNS S32750 S32760 S32550 ZERON 100, SAF 25/07, FALC 100
CN 25/9 CuT-IG W 25 9 4 N L (GTAW) G 25 9 4 N L (GMAW) ER2553(mod.)	GTAW	C 0.02 Si 0.3 Mn 1.5 Cr 25.5 Ni 9.5 Mo 3.7 N 0.22 Cu 0.8 T 0.6 PREN ≥40	Re >600 N/mm² Rm >750 N/mm² A5 >25% Av >80 J 50 J…-50°C	2.0 2.4	–	GTAW rod and GMAW wire for welding of Superduplex stainless steels. Excellent resistance to stress corrosion cracking and pitting corrosion. The operating temperature is -50 °C up to +250 °C.	
	GMAW	C 0.02 Si 0.3 Mn 1.5 Cr 25.5 Ni 9.5 Mo 3.7 N 0.22 Cu 0.8 T 0.6 PREN ≥40	Re >650 N/mm² Rm >800 N/mm² A5 >20% Av >80 J 50 J…-50°C	1.0 1.2	–	Shielding gases for GMAW Ar + 20-30 % He + max. 2 % CO_2 or Ar + 20-30 % He + max. 1 % O_2. For applications requiring low hydrogen, we offer the product CN 25/9 CuT-IG-LH with hydrogen content guaranteed less than 3 ppm.	

Special applications

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX A 7 E 18 8 Mn B 22 E307-15(mod.)	SMAW	C 0.1 Si 0.7 Mn 6.5 Cr 18.8 Ni 8.8	Re 460 N/mm² Rm 660 N/mm² A5 38% Av 90 J ≥32 J…-110 °C	2.5 3.2 4.0 5.0 6.0	TÜV-D, DNV, GL, UDT, LTSS, PRS, VUZ SEPROZ	Basic resp. rutile basic coated stainless steel electrodes. Very popular for numerous applications. The weld deposit offers exceptionally high ductility and elongation together with crack resistance. There is no fear of embrittlement when operating between -110 °C and +850 °C and can be PWHT without any problems. The deposit will work harden and offers good resistance against cavitation. Ductility is good even after high dilution when welding problem steels or when subjected to thermal shock or scaling. An excellent alloy providing cost effective performance. FOX A 7-A is suitable for both AC and DC.	**For fabrication, -repair and maintenance!** Dissimilar joints, tough buffer and intermediate layers prior to hardfacing, 14 % manganese steels, 13-17 % Cr heat resistant steels, armour plates, high carbon and quenched & tempered steels, surfacing of gears, valves, turbine blades etc. .
FOX A 7-A EZ 18 9 Mn Mo R 32 E307-16(mod.)	SMAW	C 0.1 Si 1.2 Mn 4.2 Cr 19.5 Mo 0.7 Ni 8.5	Re 520 N/mm² Rm 720 N/mm² A5 35% Av 75 J ≥32 J…-100 °C	2.5 3.2 4.0 5.0	TÜV-D UDT, SEPROZ		
A 7 CN-IG W 18 8 Mn ER307(mod.)	GTAW	C 0.08 Si 0.9 Mn 7.0 Cr 19.2 Ni 9.0	Re 460 N/mm² Rm 660 N/mm² A5 38% Av 120 J ≥32 J…-110 °C	1.6 2.0 2.4 3.0	TÜV-D, DNV, GL, UDT	GTAW rod and GMAW wire. Very popular stainless steel wires for numerous applications. The weld deposit offers exceptionally high ductility and elongation together with crack resistance. There is no fear of embrittlement when operating between -110 °C and +850 °C and can be PWHT without any problems. The deposit will work harden and offers good resistance against cavitation. Ductility is good even after high dilusion when welding problem steels or when subjected to thermal shock or scaling. An excellent alloy providing cost effective performance.	
A 7-IG G 18 8 Mn ER307(mod.)	GMAW	C 0.08 Si 0.9 Mn 7.0 Cr 19.2 Ni 9.0	Re 430 N/mm² Rm 640 N/mm² A5 36% Av 110 J ≥32 J…-110 °C	0.8 1.0 1.2 1.6	TÜV-D, DB, UDT, Ü, ÖBB, SEPROZ		
A 7-FD T 18 8 Mn R M (C) 3 E307T0-G	FCAW	C 0.1 Si 0.8 Mn 6.8 Cr 19.0 Ni 9.0	Re 420 N/mm² Rm 630 N/mm² A5 39% Av 60 J ≥32 J…-100 °C	1.2 1.6	–	Rutile flux cored welding wire. These products achieve high productivity and are easy to operate achieving excellent welding characteristics, self releasing slag, almost no spatter formation and temper discolouration, smooth weld finish and safe penetration. The weld deposit offers exceptionally high ductility and elongation together with crack resistance. There is no fear of embrittlement when operating between -100 °C and +850 °C and can be PWHT without any problems. A7 PW-FD is a rutile flux cored welding wire with fast freezing slag providing positional welding characteristics and fast travel speeds.	
A 7 PW-FD T 18 8 Mn P M (C) 2 E307T1-G	FCAW	C 0.1 Si 0.8 Mn 6.8 Cr 19.0 Ni 9.0	Re 420 N/mm² Rm 630 N/mm² A5 39% Av 60 J ≥32 J…-100 °C	1.2			
Wire: A 7 CN-UP S 18 8 Mn ER307(mod.) **Flux: BB 203** SA FB 2 DC	SAW	C 0.08 Si 0.9 Mn 6.8 Cr 18.5 Ni 8.8	Re ≥390 N/mm² Rm ≥620 N/mm² A5 ≥36% Av 95 J ≥40 J…-100 °C	3.0	UDT **Wire:** TÜV-D	SAW wire/flux combination for numerous applications. A 7 CN-UP / BB 203 yields a weld deposit offering exceptionally high ductility and elongation together with outstanding crack resistance. There is no fear of embrittlement when operating down to service temperatures of -110 °C or above 500 °C. The scaling resistance goes up to 850 °C. When working at service temperatures above 650 °C please contact the supplier. The weld metal can be post weld heat treated without any problems. The deposit will work harden and offers good resistance against cavitation. Ductility is good even after high dilution when welding problem steels or when subjected to thermal shock or scaling. An excellent alloy providing cost effective performance. Preheating and post weld heat treatment as required by the base metal. The fluoride-basic, agglomerated flux provides good operating characteristics, smooth beads and a low hydrogen weld metal.	
FOX CN 19/9 M E 20 10 3 R 32 E308Mo-17(mod.)	SMAW	C 0.04 Si 0.8 Mn 1.0 Cr 20.2 Mo 3.2 Ni 10.3 N 0.09	Re 520 N/mm² Rm 700 N/mm² A5 30 % Av 70 J ≥32 J…-80 °C	2.5 3.2 4.0 5.0	TÜV-D, Ü, DB, GL, ABS, LR, ÖBB, UDT	Rutile coated electrode designed for dissimilar joints and weld cladding. It offers a lower Cr and ferrite content than a 309 Mo L weld deposit with the result that carbon diffusion and Cr-carbide formation is reduced after PWHT and lower ferrite contents can be achieved in the second layer of 316 L weld claddings. Suitable for service temperatures from -80 °C to +300 °C. Safety against formation of porosity due to the moisture resistant coating	High-strength, mild steels and low-alloyed constructional steels, QT-steels and armour plates among themselves or among each other; non-alloy as well as alloyed boiler or constructional steels with highalloy stainless Cr- and Cr-Ni-steels; austenitic manganese steels and dissimilar joints.

Special applications

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
CN 19/9 M-IG W 20 10 3 (GTAW) G 20 10 3 (GMAW) ER308Mo(mod.)	GTAW	C 0.06 Si 0.7 Mn 1.3 Cr 20.0 Mo 3.3 Ni 10.0	Re 550 N/mm² Rm 750 N/mm² A5 35% Av 150 J ≥32 J…-80 °C	1.6 2.0 2.4	TÜV-D, DNV	GTAW rod and GMAW wire designed for dissimilar joints and weld cladding. It offers a lower Cr and ferrite content than a 309 Mo L weld deposit with the result that carbon diffusion and Cr-carbide formation is reduced after PWHT and lower ferrite contents can be met in the second layer of 316 L weld claddings.	High-strength, mild steels and low-alloyed constructional steels, QT-steels and armour plates among themselves or among each other; non-alloy as well as alloyed boiler or constructional steels with highalloy stainless Cr- and Cr-Ni-steels; austenitic manganese steels and dissimilar joints.
	GMAW	C 0.06 Si 0.7 Mn 1.3 Cr 20.0 Mo 3.3 Ni 10.0	Re 520 N/mm² Rm 720 N/mm² A5 32% Av 140 J ≥32 J…-60 °C	1.0 1.2	TÜV-D, UZ, DNV, DB, ÖBB	For GMAW shielding gas Ar + max. 2,5 % CO_2 or Ar + max. 1 % O_2 is recommended.	
FOX CN 23/12-A E 23 12 L R 32 E309L-17	SMAW	C 0.02 Si 0.7 Mn 0.7 Cr 23.0 Ni 12.5	Re 440 N/mm² Rm 570 N/mm² A5 40% Av 60 J ≥32 J…-60 °C	2.5 3.2 4.0 5.0	TÜV-D, DB, UDT, ABS, TÜV-A, UZ, GL, DNV, SEPROZ, BV, LR, CL, VUZ, ÖBB	Rutile coated stainless steel electrodes. Superior welding characteristics. Can be used on AC or DC. Other advantages include high current carrying capacity, minimum spatter formation, self releasing slag, smooth and clean weld profile, safety against formation of porosity due to the moisture resistant coating and its packaging into hermetically sealed tins or VAC-packs. Suitable for service temperatures from -60 °C up to +300 °C.	For welding stainless to mild steel and low alloy steel, for surfacing of mild steel and for root pass welding of clad steel and the first layer of corrosion resistant claddings on mild and low alloyed steels.
CN 23/12-IG W 23 12 L (GTAW) G 23 12 L (GMAW) ER309L	GTAW	C ≤0.02 Si 0.5 Mn 1.7 Cr 24.0 Ni 13.2	Re 440 N/mm² Rm 590 N/mm² A5 34% Av 150 J ≥32 J…-120 °C	1.6 2.0 2.4	TÜV-D, TÜV-A, CL, UDT, GL, SEPROZ	GTAW rod and GMAW wire designed for good welding, wetting and feeding characteristics as well as good safety after dilution when welding dissimilar joints. Suitable for service temperatures between -120 °C (GTAW) and -80 °C (GMAW) up to +300 °C.	
	GMAW		Re 420 N/mm² Rm 570 N/mm² A5 32% Av 130 J ≥32 J…-80 °C	0.8 1.0 1.2	TÜV-D, DB, TÜV-A, CL, ÖBB, UDT, UZ, GL, DNV, SEPROZ	For GMAW shielding gas Ar + max. 2,5 % CO_2 or Ar + max. 1 % O_2 is recommended.	
CN 23/12-FD T 23 12 L R M (C) 3 E309LT0-4(1) ø 0.9 mm T 23 12 L P M (C) 1 E309LT1-4(1)	FCAW	C ≤0.03 Si 0.7 Mn 1.4 Cr 22.8 Ni 12.5	Re 400 N/mm² Rm 540 N/mm² A5 35% Av 60 J 45 J…-60 °C	0.9 1.2 1.6	TÜV-D, ÜZ, TÜV-A, GL, CL, DB, UDT, CWB, ÖBB, LR, SEPROZ	Rutile flux cored welding wires. These products achieve high productivity and are easy to operate achieving excellent welding characteristics, self releasing slag, almost no spatter formation and temper discolouration, smooth weld finish and safe penetration. Increased travel speeds as well as little demand for cleaning and pickling provide considerable savings in time and money. Suitable for service temperatures from -60 °C up to +300 °C.	
CN 23/12 PW-FD T 23 12 L P M (C) 1 E309LT1-4(1)	FCAW	C ≤0.03 Si 0.7 Mn 1.4 Cr 22.8 Ni 12.5	Re 400 N/mm² Rm 540 N/mm² A5 35% Av 65 J 50 J…-60 °C Ar + 18% CO_2	1.2 1.6	TÜV-D, LR, UDT, ABS, SEPROZ, CWB, CL, DB, ÖBB UZ	Rutile flux cored welding wire with fast freezing slag providing excellent positional welding characteristics and fast travel speeds.	
Wire: CN 23/12-UP S 23 12 L ER309L **Flux: BB 202** SA FB 2 DC	SAW	C 0.015 Si 0.65 Mn 1.3 Cr 23.4 Ni 13.1	Re >320 N/mm² Rm >520 N/mm² A5 >30% Av >70 J	3.0	DNV, UDT **Wire:** TÜV-D	SAW wire/flux combination for welding dissimilar joints, Steels with poor weldability and weld claddings for multi-pass welding. Smooth beads, easy slag release without any slag residues and good welding characteristics. The average ferrite content is 16 FN. Suitable for service temperatures up to +300 °C. BB 202 is a basic, agglomerated flux, providing a low flux consumption. Basicity 2.3 acc. to Boniczewski.	

Special applications

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX CN 23/12Mo-A E 23 12 2 L R 32 E309MoL-17(mod.)	SMAW	C 0.02 Si 0.7 Mn 0.8 Cr 23.0 Mo 2.7 Ni 12.5	Re 580 N/mm² Rm 720 N/mm² A5 27% Av 55 J 45 J…-20 °C	2.0 2.5 3.2 4.0 5.0	TÜV-D, TÜV-A, CL, UDT, LTSS, DNV, RINA, ABS, VUZ, SEPROZ, LR	Rutile coated stainless steel electrodes. Superior welding characteristics. Can be used on AC or DC. Other advantages include high current carrying capacity, minimum spatter formation, self releasing slag, smooth and clean weld profile, safety against formation of porosity due to the moisture resistant coating and its packaging into hermetically sealed tins or VAC-packs. Operating temperature up to +300 °C and for weld claddings up to +400 °C.	For welding stainless to mild steel and low alloy steel, for surfacing of mild steel and for root pass welding of clad steel and the first layer of corrosion resistant claddings on mild and low alloyed steels.
CN 23/12 Mo-FD T 23 12 2 L R M (C) 3 E309LMoT0-4(1) ø 0.9 mm T 23 12 2 L P M (C) 1 E309LMoT1-4(1)	FCAW	C ≤0.03 Si 0.6 Mn 1.4 Cr 22.7 Mo 2.7 Ni 12.3	Re 500 N/mm² Rm 700 N/mm² A5 30% Av 55 J 37 J…-60 °C	0.9 1.2 1.6	TÜV-D, Ü, TÜV-A, CL, ÖBB, DB, UDT, GL, DNV, LR, ABS, RINA, SEPROZ	Rutile flux cored welding wires. These products achieve high productivity and are easy to operate achieving excellent welding characteristics, self releasing slag, almost no spatter formation and temper discolouration, smooth weld finish and safe penetration. Increased travel speeds as well as little demand for cleaning and pickling provide considerable savings in time and money. Suitable for service temperatures from -60 °C up to +300 °C. It can also be used for 316 L weld cladding of un- or low alloyed base metals with very economic results.	
CN 23/12 Mo PW-FD T 23 12 2 L P M (C) 1 E309LMoT1-4(1)	FCAW	C ≤0.03 Si 0.7 Mn 1.4 Cr 22.7 Mo 2.7 Ni 12.3	Re 530 N/mm² Rm 720 N/mm² A5 32% Av 65 J 50 J…-60 °C Ar + 18% CO_2	1.2	TÜV-D, UDT, SEPROZ BV, LR	Rutile flux cored welding wire with fast freezing slag providing excellent positional welding characteristics and fast travel speeds.	
FOX CN 24/13 – E309L-15	SMAW	C 0.03 Si 0.3 Mn 1.3 Cr 24.0 Ni 13.0	Re 430 N/mm² Rm 570 N/mm² A5 35% Av 70 J	3.2 4.0	–	Special basic coated electrode with controlled alloying elements to meet the metallurgical requirements of buffer layers. Stringer bead technique is recommended. Normally used in combination with different corrosion resistant claddings. For service temperatures up to 400 °C. Preheating and interpass temperature acc. the base materials, but not higher than 200 °C.	**For buffer layers** on weldable unalloyed, high tensile, high temperature or alloyed base metals.
FOX CN 24/13 Nb E 23 12 Nb B 2 2 E309Cb-15	SMAW	C 0.03 Si 0.4 Mn 1.0 Cr 24.5 Ni 12.5 Nb 0.85	Re 505 N/mm² Rm 690 N/mm² A5 25% Av 95 J 85 J…-10 °C	3.2 4.0	TÜV-D	Special basic coated electrode with controlled alloying elements to meet the metallurgical requirements of buffer layers. Excellent welding properties, stable arc, well detaching slag without residuals. Stringer bead technique is recommended. Normally used in combination with different corrosion resistant claddings, usually with an additional PWHT. For service temperatures up to 400°C. Preheating and interpass temperature acc. the base materials, but not higher than 200°C.	
FOX CN 29/9 E 29 9 R 12 E312-16(mod.)	SMAW	C 0.11 Si 1.0 Mn 0.7 Cr 29.0 Ni 10.2	Re 620 N/mm² Rm 770 N/mm² A5 25% Av 30 J	2.5 3.2 4.0	ÖBB, DB, UDT, UZ, SEPROZ	Rutile-basic resp. rutile coated (FOX CN 29/9-A) stainless steel electrode for repair & maintenance. These electrodes offers outstanding operating characteristics and weld metals of high strength combined with high crack resistance when welding problem steels or dissimilar joints.	**For problem steels** with high strength. Joining of dissimilar materials, tool steels, heat treatable or quenched and tempered steels, spring steels, high carbon steels etc.
FOX CN 29/9-A E 29 9 R 32 E312-17(mod.)	SMAW	C 0.11 Si 0.9 Mn 0.7 Cr 28.5 Ni 9.5	Re 650 N/mm² Rm 810 N/mm² A5 24% Av 30 J	2.5 3.2 4.0 5.0	DB, UDT, UZ, ÖBB, SEPROZ	The weld metal also work hardens making it suitable for wear resisting build-ups on clutches, gear wheels, shafts, etc. Also suitable for repair welding of tools. Preheating and interpass temperature as required by the base metal.	

Special applications

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX EAS 2 Si E Z 19 14 Si B 22 –	SMAW	C <0.025 Si 4.5 Mn 1.2 Cr 19.0 Ni 14.8	Re 500 N/mm² Rm 720 N/mm² A5 35% Av 75 J ≥32 J…-50 °C	2.5 3.2	TÜV-D, UDT, SEPROZ	Special basic coated core wire alloyed electrode for joint welding of the special steel X2CrNiSi1815, 1.4361 (BÖHLER A 610), which resists the attack of highly concentrated nitric acid as well as of nitric acid which additionally contains strong deoxidants. Also recommended for weld cladding of analogous type steels. Operating temperatures up to +350 °C.	**Nitric acid resistant** 1.4361 X1CrNiSi18-15-4 UNS S30600
EASN 2 Si-IG W Z 19 13 Si NL –	GTAW	C ≤0.015 Si 4.6 Mn 0.7 Cr 19.5 Ni 13.4 N 0.12	Re 520 N/mm² Rm 750 N/mm² A5 35% Av 100 J ≥32 J…-50 °C	1.6 2.0 2.4	TÜV-D, UDT	GTAW rod designed for joint welding of the special stainless steel grade X2CrNiSi18-15, mat-no. 1.4361 (BÖHLER A 610), which is resistant to the attack of highly concentrated nitric acid and of nitric acid additionally containing strong deoxidants. Also suited for cladding applications on analogous materials. Operating temperatures up to +350 °C.	
FOX EASN 25 M EZ 25 22 2 NL B 2 2 –	SMAW	C <0.035 Si 0.4 Mn 5.5 Cr 25.0 Mo 2.2 Ni 22.0 N 0.14	Re 405 N/mm² Rm 615 N/mm² A5 35% Av 110 J	2.5 3.2 4.0	TÜV-D, TÜV-A, UDT, SEPROZ	Basic coated core wire alloyed for Cr-Ni-Mo electrode. Characterised by a low C-content, a limited Mo-content (for better Huey-test-resistance), a well-defined N-alloying as well as a high Ni-content to assure a fully austenitic structure (ferrite contents < 0.5 %). The corrosion rates in the Huey-test are 0.08 g/m²h (4 mils/year). The stick electrode is suited for urea plant components exposed to extremely severe corrosion at high pressures and temperatures. The weld deposit will exhibit superior resistance to boiling concentrated nitric acid (optimum condition: 60-80 % HNO_3) when made to join components of the highest Huey test quality. It is also recommendable for weldments wetted by strong chloride solutions at high temperatures. The chromium and molybdenum percentages create good resistance to pitting from solutions containing chlorine ions. Further applications involve severe corrosive service in such industries as dyeing (leaching and dyeing baths), textiles, paper, leather, chemicals, pharmaceuticals, and rayon. During welding an interpass temperature of 150 °C and a weaving above two times core wire diameter should be avoided. The arc should be kept short. Grind out root pass end craters and use intermediate current settings.	**UREA plant engineering** X2CrNiMoN25-22-2 (1.4466) and in combination with X1CrNiMoN25-25-2 (1.4465), X2CrNiMo18-14-3 (1.4435)
EASN 25 M-IG W 25 22 2 L ER310(mod.)	GTAW	C 0.025 Si 0.20 Mn 6.0 Cr 25.0 Mo 2.2 Ni 22.5 N 0.13	Re 400 N/mm² Rm 600 N/mm² A5 30% Av 80 J	1.6 2.0 2.4	TÜV-D	GTAW rod for joining and surfacing applications on matching/similar steels. For weld cladding on high temperature steels and for fabrication joints on claddings. Resistant to intercrystalline corrosion and wet corrosion up to +350 °C (662 °F). Good resistance to Cl-bearing environment, pitting corrosion and nitric acid. Huey test acc. to ASTM A262: max. 1.5 µm/48 h (0.25 g/m²h), selective attack max. 100 µm. Particularly suited for corrosion conditions in urea synthesis plants.	

Low temperature

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX 2,5 Ni E 46 8 2 Ni B 4 2 H5 E8018-C1H4R	SMAW	C 0.04 Si 0.3 Mn 0.8 Ni 2.4	Re 490 N/mm² Rm 570 N/mm² A5 30% Av 180 J 110 J…-80 °C	2.5 3.2 4.0 5.0	TÜV-D, ÜZ, ÖBB, DB, ABS, BV, DNV, GL, LR, UDT, CL, Statoil, WIWEB, SEPROZ, RINA	Basic coated low hydrogen electrode containing 2.5 % Ni for low temperature service down to -80 °C. Very low hydrogen content (acc. AWS condition HD < 4 ml/100 g). Preheat 100-150°C on wall thickness >15 mm, interpass temperature max. 150 °C. Post weld heat treatment if necessary only as required by the base metal.	Cryogenic constructional steels and Ni-steels. S235NL2, S255NL2, 14Ni6, 12Ni14, X12Ni5, S255NL-S460NL, S255NL1-S460NL1 **ASTM e. g.** A633 Gr. E A572 Gr. 65 A203 Gr. D A333 A 334 Gr. 3 A350 Gr. LF3
2.5 Ni-IG W 2 Ni 2 (GTAW) G 2 Ni 2 (GMAW) ER80S-Ni2	GTAW	C 0.1 Si 0.6 Mn 1.1 Ni 2.5	Re 510 N/mm² Rm 600 N/mm² A5 26% Av 280 J ≥47 J…-80 °C	2.0 2.4 3.0	TÜV-D, GL, TÜV-A, CL, UDT, BV, Statoil, SEPROZ	GTAW rod and GMAW wire, 2.5 % Ni alloyed for high quality welds in the construction of storage tanks and piping systems for cryogenic applications. The weld deposit is noted for its particularly good low temperature and non-ageing properties down to -80 °C. 2.5 Ni-IG (GMAW) is noted for their first class feeding and welding characteristics providing consistent high productivity and can be used for robotic welding as well.	
	GMAW	C 0.1 Si 0.6 Mn 1.1 Ni 2.5	Re 510 N/mm² Rm 600 N/mm² A5 22% Av 170 J ≥47 J…-80 °C	1.0 1.2	TÜV-D, TÜV-A, ÜZ, ÖBB, LR, ABS, DB, DNV, GL, UDT, BV, SEPROZ		
Wire: Ni 2-UP S2Ni2 ENi2 **Flux: BB 24** SA FB 1 65 DC H5	SAW	C 0.07 Si 0.25 Mn 1.05 Ni 2.2	Re ≥480 N/mm² Rm ≥580 N/mm² A5 ≥24% Av ≥130 J ≥47 J…-60 °C	3.0	UDT **Wire:** TÜV-D, KTA 1408.1 DB, ÜZ, ÖBB, TÜV-A, SEPROZ	SAW wire/flux combination (as welded and stress relieved condition) is distinguished by excellent welding characteristic, cryogenic toughness and ageing resistance with low hydrogen content in the deposit. (≤5 ml/100 g). The sub-arc wire/flux combination produces very good low temperature impact properties down to -60 °C. Excellent slag detachability, smooth beads and good wetting are further important features. The combination is ideally suited for multipass welding of thick plates. The flux reacts metallurgically Mn-neutral.	

Low temperature – Stainless steels

BÖHLER Standard EN AWS	**Welding process**	**Typical analysis** %	**Typical mechanical properties**	**Sizes** mm	**Approvals**	**Characteristics and applications**	**Base metals**
FOX EAS 2 E 19 9 L B 22 E308L-15	SMAW	C 0.03 Si 0.4 Mn 1.3 Cr 19.5 Ni 10.5	Re 430 N/mm² Rm 580 N/mm² A5 42% Av 100 J ≥34 J…-196 °C	2.5 3.2 4.0	TÜV-D, Ü, TÜV-A, ÖBB, DB, CL, UDT, Statoil, SEPROZ	Basic coated stainless steel electrode. Designed to produce first class weld deposits with reliable CVN toughness values down to -196 °C, 100 % X-Ray safety together with very good root pass and positional welding characteristics, good gap bridging ability, easy weld pool and slag control as well as easy slag removal even in narrow preparations resulting in clean bead surfaces and minimum post weld cleaning. An excellent electrode for welding on site! Resistant to intergranular corrosion up to +350 °C Fully alloyed core wire and packed into hermetically sealed tins.	1.4306 X2CrNi19-11 1.4301 X5CrNi18-10 1.4541 X6CrNiTi18-10 1.4550 X6CrNiNb18-10 1.4311 X2CrNiN18-10 1.4546 X5CrNiNb18-10 1.4312 G-X10CrNi18-8 AISI 304 L 304 321 347 304 LN A320 Gr. B 8 C a. D 302
EAS 2-IG W 19 9 L ER308L	GTAW	C ≤0.02 Si 0.5 Mn 1.7 Cr 20.0 Ni 10.0	Re 450 N/mm² Rm 620 N/mm² A5 38% Av 150 J ≥32 J…-269 °C	1.6 2.0 2.4 3.0	TÜV-D, Ü, TÜV-A, ÖBB, DB, GL, DNV, CL, UDT, SEPROZ	GTAW rod, suitable not only for standard welding jobs but also for cryogenic applications down to -269 °C. As well as the good welding and wetting characteristics of EAS 2-IG corrosion resistance up to +350 °C is achieved.	
EAS 2-IG (Si) G 19 9 L Si ER308L(Si)	GMAW	C ≤0.02 Si 0.8 Mn 1.7 Cr 20.0 Ni 10.2	Re 420 N/mm² Rm 630 N/mm² A5 38% Av 110 J ≥32J…-196°C	0.8 1.0 1.2	TÜV-D, Ü, TÜV-A, ÖBB, CL, DB, DNV, GL, UDT, SEPROZ	GMAW wire designed for first class welding, wetting and feeding characteristics and excellent weld metal CVN values down to -196 °C. Resistant to intergranular corrosion up to +350 °C.	
EAS 2-FD T 19 9 L R M (C) 3 E308LT0-4(1) Ø 0.9 mm T 19 9 L P M (C) 1 E308LT1-4(1)	FCAW	C ≤0.03 Si 0.7 Mn 1.5 Cr 19.8 Ni 10.2	Re 380 N/mm² Rm 560 N/mm² A5 40% Av 60 J ≥32 J…-196 °C	0.9 1.2 1.6	TÜV-D, Ü, TÜV-A, CL, UDT, DB, CWB, SEPROZ, GL, ÖBB	Rutile flux cored welding wire. This product achieves high productivity and is easy to operate achieving excellent welding characteristics, self releasing slag, almost no spatter formation and temper discoloration, smooth weld finish and safe penetration. Increased travel speeds as well as little demand for cleaning and pickling provide considerable savings in time and money. Suitable for service temperatures from -196 °C to +350 °C.	
EAS 2 PW-FD T 19 9 L P M (C) 1 E308LT1-4(1)	FCAW	C ≤0.03 Si 0.7 Mn 1.5 Cr 19.8 Ni 10.2	Re 380 N/mm² Rm 560 N/mm² A5 40% Av 70 J ≥32 J…-196 °C	1.2 1.6	TÜV-D, CL, UDT, CWB, SEPROZ, DB, ÖBB	Rutile flux cored welding wire with fast freezing slag providing excellent positional welding characteristics and fast travel speeds.	
EAS 2 PW-FD (LF) T 19 9 L P M (C) 1 E308LT1-4(1)	FCAW	C ≤0.03 Si 0.6 Mn 1.4 Cr 19.3 Ni 10.9 FN 3-6	Re 380 N/mm² Rm 560 N/mm² A5 40% Av 78 J 45 J…-196 °C	1.2	–	Rutile flux cored welding wire, with controlled weld metal ferrite content (FN 3-6), particularly for good cryogenic toughness and lateral expansion down to -196 °C like specified for LNG applications. The slag system of the wire provides excellent positional welding characteristics and fast travel speeds.	
Wire: EAS 2-UP S 19 9 L ER308L **Flux: BB 202** SA FB 2 DC	SAW	C 0.02 Si 0.6 Mn 1.3 Cr 19.8 Ni 9.8	Re ≥350 N/mm² Rm ≥550 N/mm² A5 ≥35% Av ≥80 J ≥35 J…-196 °C	3.0	TÜV-D, UDT **Wire:** TÜV-D, TÜV-A, KTA 1408.1 SEPROZ	SAW-wire/flux combination. Smooth beads, easy slag removal without any slag residues and good welding characteristics even for fillet welds are very much appreciated by users. Suitable for service temperatures from -196 °C to +350 °C. The fluoride-basic, agglomerated flux, provides a low flux consumption. Basicity 2.3. Density 1.0 kg/dm³.	

Low temperature – Nickel base alloys

BÖHLER Standard EN AWS	**Welding process**	**Typical analysis** %	**Typical mechanical properties**	**Sizes** mm	**Approvals**	**Characteristics and applications**	**Base metals**
FOX NIBAS 60/15 E Ni 6620 (NiCr14Mo7Fe) ENiCrMo-6	SMAW	C <0.1 Si <0.6 Mn 2.5-3.5 Cr 12-16 Mo 5.0-8.0 Ni bal. Nb 0.5-1.5 Fe <10.0 W 1.0-1.5	Re ≥420 N/mm² Rm ≥690 N/mm² A5 ≥35% Av ≥60 J…-196 °C	2.5 3.2 4.0	–	The high-nickel electrode NIBAS 60/15 is especially suited for welding cold-tough nickel steels, such as X8Ni9. The electrode is designated for welding with ac, in order to avoid the magnetic arc blow effects which occur when welding cold-tough nickel steels with dc. It is weldable in flat, horizontal and vertical-up position. Stable arc, easy slag removal. The weld zone must be bare and properly degreased. Prior to welding, the electrodes must be predried for 2-3 hours at 250-300 °C. The electrode is welded with a slight tilt, short arc and sufficient high amperage adjustment. To avoid end crater cracks the crater must be filled properly and the arc drawn away to the side.	9 % nickel steel base metal: X 8 Ni 9 ASTM A333 A334 A353 A522 A553 K81340
NIBAS 625-IG S Ni6625 (Ni Cr22 Mo 9 Nb) ERNiCrMo-3	GTAW	C ≤0.02 Si ≤0.2 Mn ≤0.3 Cr 21.5 Mo 9.0 Ni ≥60 Nb 3.6 Fe ≤2.0 PREN >52	Re 540 N/mm² Rm 800 N/mm² A5 38% Av 160 J 130 J…-196 °C	1.6 2.0 2.4	TÜV-D, TÜV-A, Statoil, SEPROZ	GTAW rod and GMAW wire of type AWS ER NiCrMo-3 suitable for welding of the 6 % Mo superaustenitic grades S31254, N 08926, N 08367 and the matching alloy 625. Rod, wire and weld metal meet highest quality and corrosion requirements. Extremely resistant to stress corrosion cracking and pitting. Due to the weld metal embrittlement between 650-850°C, this temperature range should be avoided. The pitting resistance equivalent is >52. Highly resistant to hot cracking. For GMAW shielding gas to EN 439 I1 Argon or I3 Ar + He isrecommended.	2.4856 NiCr 22 Mo 9 Nb, 2.4858 NiCr 21 Mo, 2.4816 NiCr 15 Fe, 1.4583 X10CrNiMoNb18-12, 1.4876 X 10 NiCrAlTi 32 20 H, 1.4876 X 10 NiCrAlTi 32 20, 1.4529 X1NiCrMoCuN25-20-7, X 2 CrNiMoCuN 20 18 6, 2.4641 NiCr 21 Mo 6 Cu Joint welds of listed materials with non alloy and low alloy steels, e.g, P285NH P295GH 16Mo3, S355N X8Ni9 ASTM A553 Gr.1 B443 B446 UNS N06625 Inconel 600 Inconel 625 Incoloy 800 9 % Ni-steels
	GMAW		Re 510 N/mm² Rm 780 N/mm² A5 40% Av 130 J 80 J…-196 °C	1.0 1.2	TÜV-D, TÜV-A, Statoil, SEPROZ, UDT		
Wire: NIBAS 625-UP S Ni 6625 (NiCr22Mo9Nb) ERNiCrMo-3 **Flux: BB 444** SA-FB 2 AC	SAW	C 0.012 Si 0.16 Mn 0.2 Cr 21.8 Mo 9.0 Ni ≥60 Nb 3.2 Fe 1.5 PREN >52	Re 420 N/mm² Rm 700 N/mm² A5 40% Av 130 J 80 J…-196 °C	2.4	TÜV-D	For SAW wire and flux combination, suitable for welding of the 6 % Mo superaustenitic grades S31254, N 08926, N 08367 and the matching alloy 625. Weld metal meet highest quality and corrosion requirements. Extremely resistant to stress corrosion cracking and pitting. The pitting resistance equivalent is >52.	
NIBAS 625-FD NiCr 22 Mo 9 Nb ENiCrMo-3	FCAW	C 0.05 Si 0.4 Mn 0.4 Cr 22.0 Mo 8.5 Ni ≥60 Nb 3.3	Re 480 N/mm² Rm 750 N/mm² A5 30% Av 60 J	1.2	–	Rutil FCAW wire of type E NiCrMo-3 suitable for welding of the 6 % Mo superaustenitic grades S31254, N08926, N08367 and the matching alloy 625. The wire can be used in all positions except vertical down. Extremely resistant to stress corrosion cracking and pitting. Shielding gases Ar + 15-25 % CO_2.	

Heat resistant

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX FA E 25 4 B 22 –	SMAW	C 0.1 Si 0.5 Mn 1.2 Cr 25.0 Ni 5.4	Re 520 N/mm² Rm 680 N/mm² A5 22% Av 45 J	2.5 3.2 4.0	UDT, SEPROZ	Basic coated core wire alloyed electrode for heat resistant steels and service temperatures up to +1100 °C. An excellent product when increased resistance against reducing and oxidizing, sulphur containing gases is required. Can also be used for the capping of joint welds which have been carried out with higher nickel alloyed filler metals (e.g. FOX FF-A, FOX FFB) where better joint toughness is required. Preheating and interpass temperatures 200-400 °C, depending on the relevant base metal and material thickness.	**Ferritic-austenitic** 1.4821 X20CrNiSi 25 4 3271.4823*) G-X40CrNiSi 27 4 A297HC **Ferritic-perlitic** 1.4713 X10CrAl7 1.4724 X10CrAl13 1.4742 X10CrAl18 1.4762 X10CrAl25 1.4710*) X30CrSi6 1.4740*) G-X40CrSi17 *) limited weldability
FA-IG W 25 4 (GTAW) G 25 4 (GMAW) –	GTAW	C 0.08 Si 0.8 Mn 1.2 Cr 25.7 Ni 4.5	Re 540 N/mm² Rm 710 N/mm² A5 22% Av 70 J	2.4	UDT	GTAW rod and GMAW wire for heat resistant steels and service temperatures up to +1100 °C. An excellent product when increased resistance against reducing and oxidizing, sulphur containing gases is required. Also for the capping of joints which have been welded with higher nickel alloyed filler metals (e.g. FF-IG, FFB-IG) where better joint toughness is required. Preheating and interpass temperatures 200-400 °C, depending on the relevant base metal and material thickness.	
	GMAW	C 0.08 Si 0.8 Mn 1.2 Cr 25.7 Ni 4.5	Re 520 N/mm² Rm 690 N/mm² A5 20% Av 50 J	1.0 1.2	UDT		
FOX FF E 22 12 B 22 E309-15(mod.)	SMAW	C 0.1 Si 1.0 Mn 1.1 Cr 22.5 Ni 11.5	Re 440 N/mm² Rm 600 N/mm² A5 35% Av 80 J	2.5 3.2 4.0	TÜV-D, TUV-A UDT, SEPROZ	Basic coated resp. rutile coated (FOX FF-A) core wire alloyed electrodes for welding analogous, heat resistant rolled, forged and cast steels as well as heat resistant ferritic CrSiAl steels, e.g. in annealing plants, hardening plants, steam boiler construction, the crude oil industry and the ceramics industry. For weld joints exposed to reducing, sulphurous gases, the final layer has to be deposited by means of FOX FA, or FA-IG. Scaling resistant up to +1000 °C. Preheating and interpass temperatures for ferritic steels 200-300 °C.	Austenitic 1.4828 X15CrNiSi20-12, 1.4826 G-X40CrNiSi22-9, 1.4833 X7 CrNi23 14 Ferritic-perlitic 1.4713 X10CrAl7, 1.4724 X10CrAl13, 1.4742 X10CrAl18, 1.4710 GX30CrSi6, 1.4740 G-X40CrSi17 AISI 305 ASTM A297HF
FOX FF-A E 22 12 R 32 E309-17	SMAW	C 0.1 Si 0.8 Mn 1.0 Cr 22.5 Ni 12.5	Re 460 N/mm² Rm 610 N/mm² A5 37% Av 60 J	2.5 3.2 4.0	TÜV-D, UDT, ABS SEPROZ		
FF-IG W 22 12 H (GTAW) G 22 12 H (GMAW) ER309(mod.)	GTAW	C 0.08 Si 1.1 Mn 1.6 Cr 23.0 Ni 12.5	Re 500 N/mm² Rm 630 N/mm² A5 32% Av 115 J	1.6 2.0 2.4	TÜV-A, UDT, SEPROZ	GTAW rod and GMAW wire for analogous, heat resisting rolled, forged and cast steels as well as for heat resisting, ferritic CrSiAl steels, e.g. in annealing shops, hardening shops, steam boiler construction, the crude oil industry and the ceramics industry. Austenitic deposited with a ferrite content of approx. 8 %. Preferably used for applications involving the attack of oxidizing gases. The final layer of joint welds in CrSiAl steels exposed to sulphurous gases must be deposited by means of FOX FA or FA-IG. Scaling resistance up to +1000 °C. Preheating and interpass temperatures for ferritic steels 200-300 °C.	
	GMAW	C 0.08 Si 1.1 Mn 1.6 Cr 23.0 Ni 12.5	Re 480 N/mm² Rm 620 N/mm² A5 34% Av 110 J	1.0 1.2	TÜV-A, UDT, SEPROZ		
FOX FFB E 25 20 B 22 E310-15(mod.)	SMAW	C 0.11 Si 0.6 Mn 3.5 Cr 26.0 Ni 20.5	Re 420 N/mm² Rm 600 N/mm² A5 36% Av 100 J	2.5 3.2 4.0 5.0	TÜV-D, UDT, Statoil, SEPROZ	Basic coated resp. rutile coated (FOX FFB-A) core wire alloyed electrode for analogous, heat resisting rolled, forged and cast steels e.g. in annealing plants, hardening plants, steam boiler construction, the crude oil industry and the ceramics industry. Joint welds in heat resisting CrSiAl steels exposed to sulphurous gases should be given a final layer deposited by means of FOX FA. Scaling resistant up to +1200 °C. Cryogenic resistance down to -196 °C. The service temperature range between +650 °C and +900 °C should be avoided owing to the risk of embrittlement. Preheating and interpass temperatures for ferritic steels 200-300 °C.	**Austenitic** 1.4841 X15CrNiSi25-20 1.4845 X12CrNi25-21 1.4828 X15CrNiSi20-12 1.4840 G-X15 CrNi25-20 1.4846 G-X40 CrNi25-21 1.4826 G-X40 CrNiSi22-9 **Ferritic-perlitic** 1.4713 X10CrAl7 1.4724 X10CrAl13 1.4742 X10CrAl18 1.4762 X10CrAl25 1.4710 X30CrSi6 1.4740 G-X40CrSi17 AISI 314 310 305 ASTM A287HJ A297HF
FOX FFB-A E 25 20 R 32 E310-16	SMAW	C 0.12 Si 0.5 Mn 2.2 Cr 26.0 Ni 20.5	Re 430 N/mm² Rm 620 N/mm² A5 35% Av 75 J	2.0 2.5 3.2 4.0	Statoil, UDT, SEPROZ, VUZ		

Heat resistant

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FFB-IG G (W) 25 20 Mn ER310(mod.)	GTAW	C 0.12 Si 0.9 Mn 3.2 Cr 25.0 Ni 20.5	Re 420 N/mm² Rm 630 N/mm² A5 33% Av 85 J	1.6 2.0 2.4	UDT, SEPROZ	GTAW rod and GMAW wire for analogous, heat resisting, rolled, forged and cast steels, e.g. in annealing shops, hardening shops, steam boiler construction, the crude oil industry and the ceramics industry. Fully austenitic deposit. Preferably employed for applications involving the attack of oxidizing, nitrogen-containing or low-oxygen gases. The final layer of joint welds in heat resisting CrSiAl steels exposed to sulphurous gases must be deposited by means of FOX FA or FA-IG. Scaling resistance up to +1200 °C. Cryogenic toughness down to -196 °C. Preheating and interpass temperatures for ferritic steels 200-300 °C. The Mn-content is above the maximum limit of AWS ER 310 to provide much better hot cracking resistance of the fully austenitic weld metal than a similar AWS corresponding type	**Austenitic** 1.4841 X15CrNiSi25-20 1.4845 X12CrNi25-21 1.4828 X15CrNiSi20-12 1.4840 G-X15 CrNi25-20 1.4846 G-X40 CrNi25-21 1.4826 G-X40 CrNiSi22-9 **Ferritic-perlitic** 1.4713 X10CrAl7 1.4724 X10CrAl13 1.4742 X10CrAl18 1.4762 X10CrAl25 1.4710 X30CrSi6 1.4740 G-X40CrSi17 AISI 314, 310, 305 A287HJ A297HF
	GMAW	C 0.12 Si 0.9 Mn 3.2 Cr 25.0 Ni 20.5	Re 400 N/mm² Rm 620 N/mm² A5 38% Av 95 J	0.8 1.0 1.2	UDT, SEPROZ		
FOX CN 21/33 Mn EZ 21 33 B 4 2 –	SMAW	C 0.14 Si 0.3 Mn 4.5 Cr 21.0 Ni 33.0 Nb 1.3 Fe bal.	Re >410 N/mm² Rm >600 N/mm² A5 >25% Av 70 J	2.5 3.2 4.0	TÜV-D, TÜV-A, CL	Basic coated electrode for joining and surfacing of heat resistant steels and cast steels of the same or similar chemical composition. Suitable for operating temperatures up to 1050 °C in carburized low-sulphur gas. Typical alloy for welding of pyrolysis furnace tubes.	X10NiCrAlTi32-20 (1.4876) GX10NiCrNb32-20 (1.4859) X5NiCrAlTi31-20 (1.4958) X8NiCrAlTi31-21 (1.4959) Alloy 800 H / 800 UNS N08800 N08810 N08811
CN 21/33 Mn-IG W Z 21 33Nb (GTAW) G Z 21 33 Nb (GMAW) –	GTAW	C 0.2 Si 0.2 Mn 2.3 Cr 22.0 Ni 33.0 Nb 1.7 Fe bal.	Re 430 N/mm² Rm 620 N/mm² A5 17% Av 50 J	2.0 2.4 3.2	TÜV-D	GTAW rod and GMAW wire are also best suited to meet all before mentioned characteristics. For GMAW shielding gas Ar + 2.5% CO_2.	
	GMAW		Re 400 N/mm² Rm 600 N/mm² A5 25% Av 50 J	1.0 1.2			
FOX CN 25/35 Nb EZ 25 35 Nb B 6 2 –	SMAW	C 0.40 Si 1.0 Mn 1.5 Cr 25.0 Ni 35.0 Nb 1.2 Fe bal.	Re 480 N/mm² Rm 700 N/mm² A5 >8%	2.5 3.2 4.0 5.0	TÜV-D, TÜV-A, Controlas	Basic coated electrode for joining and surfacing of heat resistant steels and cast steels of the same or similar chemical composition Resistant to scaling up to 1150 °C. Typical alloy for welding of pyrolysis furnace tubes.	GX40NiCrSiNb35-25 (1.4852) G-X40NiCrSi35-25 (1.4857
CN 25/35 Nb-IG W Z25 35 Nb (GTAW) G Z25 35 Nb (GMAW) –	GTAW	C 0.42 Si 1.2 Mn 1.8 Cr 26.0 Ni 35.0 Nb 1.3	Re >400 N/mm² Rm >600 N/mm² A5 >8%	2.0 2.4 3.2	TÜV-D, TÜV-A, Controlas	GTAW rod and GMAW wire are also best suited to meet all before mentioned characteristics. For GMAW shielding gas Ar + 2.5% CO_2.	
	GMAW		Re >400 N/mm² Rm >600 N/mm² A5 >8%	1.2	Controlas		
FOX CN 35/45 Nb EZ 35 45 Nb B 6 2 –	SMAW	C 0.45 Si 1.0 Mn 0.8 Cr 35.0 Ni 45.5 Nb 0.9 Fe bal.	Re >450 N/mm² Rm >600 N/mm² A5 >8%	2.5 3.2 4.0	–	Basic coated electrode for joining and surfacing of heat resistant steels and cast steels of the same or similar chemical composition Resistant to scaling up to 1180 °C. Typical alloy for welding of pyrolysis furnace tubes.	GX45NiCrNbSiTi45-35
CN 35/45 Nb-IG WZ 35 45 Nb H (GTAW) GZ 35 45 Nb H (GMAW) –	GTAW	C 0.42 Si 1.5 Mn 1.0 Cr 35.0 Ni 45.5 Nb 0.8	Re >450 N/mm² Rm >550 N/mm²	2.0 2.4 3.2	–	GTAW rod and GMAW wire are also best suited to meet all before mentioned characteristics. For GMAW shielding gas Ar + 2.5% CO_2.	
	GMAW		Re >240 N/mm² Rm >450 N/mm² A5 >6%	1.2			

Nickel base alloys

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX NIBAS 70/15 E Ni 6182 (NiCr15Fe6Mn) ENiCrFe-3	SMAW	C 0.025 Si 0.4 Mn 6.0 Cr 16.0 Ni≥67.0 Nb 2.2 Fe 6.0 Co ≤0.08 Ta ≤0.08 Ti +	Re 400 N/mm² Rm 670 N/mm² A5 40% Av 120 J 80 J…-196 °C	2.5 3.2 4.0	TÜV-D, UDT	Basic coated core wire alloyed electrode for high quality welding of nickel base alloys, high temperature and creep resisting steels, heat resisting and cryogenic materials, dissimilar joints and low alloy problem steels. Suitable in pressure vessel fabrication for -196 °C to +650 °C, scaling resistance temperature of +1200 °C (S-free atmosphere). Electrode and weld metal meet highest quality requirements.	NiCr 15 Fe (Inconel 600) UNS N06600, ASTM B168, as well as Ni-alloys of similar or same chemical composition; non alloy and low alloy steels for elevated temperatures, e.g. P235GH, P265GH, S255NB, P235GH-P355GH, 16Mo3, high temperature steels as well as constructional steels with comparable tensile strength; creep resistant austenitic steels, e.g. X8CrNiNb16-13, X8CrNiMoNb16-16, X8CrNiMoVNb16-13, Ni-steels containing 1.5 % up to and including 5 % Ni; low alloyed constructional and pressure vessel steels, also X20CrMoV12-1 and X20CrMoWV12-1 on stainless and creep resistant austenitic steels; also suitable for Incoloy 800.
FOX NIBAS 70/20 E Ni 6082 (NiCr20Mn 3 Nb) ENiCrFe-3(mod.)	SMAW	C 0.025 Si 0.4 Mn 5.0 Cr 19.0 Mo ≤1.2 Ni≥67.0 Nb 2.2 Fe 3.0 Co≤0.08 Ti +	Re 420 N/mm² Rm 680 N/mm² A5 40% Av 120 J 80 J…-196 °C	2.5 3.2 4.0 5.0	TÜV-D, UDT, VUZ, TÜV-A, SEPROZ Statoil, LTSS, Kotlandzor	Basic coated core wire alloyed electrode corresponding to DIN EL-NiCr 19 Nb for high-grade welding of nickel-base alloys, high-temperature and creep resisting steels, heat resisting and cryogenic materials, low-alloyed problem steels and dissimilar joints. Ferritic-austenitic joints for service temperatures above +300 °C or for applications where a post weld heat treatment is required. Suitable in pressure vessel fabrication for -196 °C to +650 °C, otherwise up to the scaling resistance temperature of +1200 °C (S-free atmosphere). Insusceptible to embrittlement, highly resistant to hot cracking, furthermore, C-diffusion at high temperature or during heat treatment of dissimilar joints is largely reduced. Thermal shock resistant, stainless, fully austenitic, low coefficient of thermal expansion between the coefficient values of C-steel and austenitic CrNi (Mo)-steel. Excellent welding characteristics in all positions except vertical-down, easy slag removal, high resistance to porosity, absence of undercuts, high degree of purity. Electrode and weld metal meet highest quality requirements.	2.4816 Ni Cr 15 Fe, 2.4817 LC-NiCr 15 Fe, Inconel 600, Inconel 600 L, UNS N06600 ASTM B168 Nickel and nickel alloys, low-temperature steels up to 5 % Ni steels, unalloyed and alloyed, high-temperature, creep resisting, high-alloy Cr- and CrNiMo-steels particularly for joint welding of dissimilar steels, and nickel to steel combinations; also recommended for Incoloy 800.
NIBAS 70/20-IG S Ni 6082 (NiCr 20 Mn 3 Nb) ERNiCr-3	GTAW	C ≤0.03 Si ≤0.3 Mn 3.0 Cr 20.0 Ni≥67.0 Nb 2.5 Fe ≤1.7 Ti +	Re 440 N/mm² Rm 680 N/mm² A5 42% Av 190 J 100 J…-196 °C	1.6 2.0 2.4	TÜV-D, TÜV-A, Statoil, SEPROZ	GTAW rod and GMAW wire for welding of nickel-base alloys, high-temperature and creep resisting steels, heat resisting and cryogenic materials, low-alloyed problem steels and dissimilar joints. Ferritic-austenitic joints for service temperatures above +300 °C or for applications where a post weld heat treatment is required. Suitable in pressure vessel fabrication from -196 °C to +550 °C, otherwise resistant to scaling up to +1200 °C (S-free atmosphere). Not susceptible to embrittlement, C-diffusion at elevated temperatures largely inhibited. Resistant to thermal shocks, corrosion resistant, fully austenitic, low coefficient of thermal expansion. between the coefficient values of C-steel and austenitic CrNi (Mo)-steel.	
	GMAW		Re 420 N/mm² Rm 680 N/mm² A5 40% Av 160 J 80 J…-196 °C	0.8 1.0 1.2	TÜV-D, TÜV-A, Statoil, UDT SEPROZ		
NIBAS 70/20-FD Type Ni 6082 (NiCr20Mn3Nb) ENiCr-3T0-4	FCAW	C 0.03 Si 0.4 Mn 3.2 Cr 20.0 Ni≥67.0 Nb 2.5 Fe 2.0	Re 400 N/mm² Rm 650 N/mm² A5 39% Av 135 J 110 J…-196 °C	1.2 1.6	TÜV-D	Rutile/basic flux cored welding wire for downhand and horizontal welding positions. It provides very good operating characteristics, good side wall wetting, safe penetration and a smooth weld finish. The shielding gas should be Argon +15-25 % CO_2.	

Nickel base alloys

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
Wire: NIBAS 70/20-UP S Ni 6082 (NiCr 20 Mn 3 Nb) ERNiCr-3 **Flux: BB 444** SA-FB 2 AC	SAW	C 0.010 Si 0.15 Mn 3.2 Cr 20.5 Ni bal. Nb 2.6 Fe <2.0	Re 350 N/mm² Rm 600 N/mm² A5 35% Av 80 J	1.6 2.0 2.4	TÜV-D	For SAW wire flux combination welding of Ni base alloy metals and special metals if the use of wire electrodes with high Ni content is requested. The weld metals show excellent mechanical properties with high hot cracking resistance. It is applicable for chemical apparatus construction on high temperature metals as well as in low temperature sections up to -196 °C. BB 444 is an agglomerated fluoride basic welding flux with high basic slag characteristics.	2.4816 Ni Cr 15 Fe, 2.4817 LC-NiCr 15 Fe, Inconel 600, Inconel 600 L, UNS N06600 ASTM B168 Nickel and nickel alloys, low-temperature steels up to 5 % Ni steels, unalloyed and alloyed, high-temperature, creep resisting, high-alloy Cr- and CrNiMo-steels particularly for joint welding of dissimilar steels, and nickel to steel combinations; also recommended for Incoloy 800.
FOX NIBAS 625 E Ni6625 (NiCr 22 Mo 9 Nb) ENiCrMo-3	SMAW	C 0.025 Si 0.4 Mn 0.7 Cr 22.0 Mo 9.0 Ni >60.0 Nb 3.3 Fe 0.5 Co ≤0.05 Al ≤0.4 PREN >52	Re 530 N/mm² Rm 800 N/mm² A5 40% Av 80 J 45 J…-196 °C	2.5 3.2 4.0	TÜV-D, TÜV-A, Statoil, UDT, LTSS, SEPROZ	Basic coated electrode suitable for welding of 6 % Mo superaustenitic grades S 31254, N 08926, N 08367 and the matching alloy 625. Electrode and weld metal meet highest quality and corrosion requirements. Extremely resistant to stress corrosion cracking and pitting. The pitting resistance equivalent is >52. Highly resistant to hot cracking. Due to the weld metal embrittlement between 650-850°C, this temperature range should be avoided.	2.4856 NiCr 22 Mo 9 Nb, 2.4858 NiCr 21 Mo, 2.4816 NiCr 15 Fe, 1.4583 X10CrNiMoNb18-12, 1.4876 X 10 NiCrAlTi 32 20 H, 1.4876 X 10 NiCrAlTi 32 20, 1.4529 X1NiCrMoCuN25-20-7, X 2 CrNiMoCuN 20 18 6, 2.4641 NiCr 21 Mo 6 Cu Joint welds of listed materials with non alloy and low alloy steels, e.g P265GH, P285NH, P295GH, 16Mo3, S355N, X8Ni9, ASTM A 553 Gr.1, B443,B446, UNS N06625, Inconel 600, Inconel 625, Incoloy 800, 9 % Ni-steels.
NIBAS 625-IG S Ni6625 (NiCr 22 Mo 9 Nb) ERNiCrMo-3	GTAW	C ≤0.02 Si ≤0.2 Mn≤0.3 Cr 21.5 Mo 9.0 Ni≥60.0 Nb 3.6 Fe ≤2.0 PREN >52	Re 540 N/mm² Rm 800 N/mm² A5 38% Av 160 J 130 J…-196 °C	1.6 2.0 2.4	TÜV-D, TÜV-A, Statoil, SEPROZ	GTAW rod and GMAW wire of type AWS ER NiCrMo-3 suitable for welding of the 6 % Mo superaustenitic grades S31254, N 08926, N 08367 and the matching alloy 625. Rod, wire and weld metal meet highest quality and corrosion requirements. Extremely resistant to stress corrosion cracking and pitting. Due to the weld metal embrittlement between 650-850°C, this temperature range should be avoided. The pitting resistance equivalent is >52. Highly resistant to hot cracking. For GMAW shielding gas to EN 439 I1 Argon or I3 Ar + He is recommended.	
	GMAW		Re 510 N/mm² Rm 780 N/mm² A5 40% Av 130 J 80 J…-196 °C	1.0 1.2	TÜV-D, TÜV-A, Statoil, SEPROZ, UDT		
NIBAS 625-FD Type Ni 6625 (NiCr 22 Mo 9 Nb) ENiCrMo-3T0-4	FCAW	C 0.05 Si 0.4 Mn 0.4 Cr 22.0 Mo 8.5 Ni≥60.0 Nb 3.3 Fe <5.0	Re 480 N/mm² Rm 750 N/mm² A5 30% Av 60 J	1.2	–	Rutil FCAW wire of type E NiCrMo-3 suitable for welding of the 6 % Mo superaustenitic grades S31254, N08926, N08367 and the matching alloy 625. The wire can be used in all positions except vertical down. Extremely resistant to stress corrosion cracking and pitting. Shielding gases Ar +15-25 % CO_2.	
Wire: NIBAS 625-UP S Ni 6625 (NiCr 22 Mo 9 Nb) ERNiCrMo-3 **Flux: BB 444** SA-FB 2 AC	SAW	C 0.012 Si 0.16 Mn 0.2 Cr 21.8 Mo 9.0 Ni≥60.0 Nb 3.2 Fe 1.5 PREN >52	Re 420 N/mm² Rm 700 N/mm² A5 40% Av 130 J 80 J…-196 °C	2.4	TÜV-D	For SAW wire and flux combination, suitable for welding of the 6 % Mo superaustenitic grades S31254, N 08926, N 08367 and the matching alloy 625. Weld metal meet highest quality and corrosion requirements. Extremely resistant to stress corrosion cracking and pitting. The pitting resistance equivalent is >52.	

Nickel base alloys

BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX NIBAS C 276 E Ni 6276 (NiCr 15 Mo 15 Fe 6 W4) ENiCrMo-4	SMAW	C <0.02 Si <0.2 Mn 0.6 Cr 16.5 Mo 16.5 Ni bal. Fe 5.0 T 4.0	Re >450 N/mm² Rm >720 N/mm² A5 >30% Av 70 J	2.5 3.2 4.0	TÜV-D, CL	Basic coated nickel base electrode for welding of similar alloyed Ni base steel grades, e.g. N10276, 2.4819 as well as for joining these grades with low alloyed and stainless steels. Excellent resistance to chlorine contaminated and chloride containing medias. Resistant against strong oxidisers such as ferric and cupric chlorides.	NiMo16Cr15W (2.4819) UNS N10276 Alloy C-276
NIBAS C 276-IG S Ni 6276 (NiCr 15 Mo 16 Fe 6 W4) ERNiCrMo-4	GTAW GMAW	C <0.01 Si 0.1 Cr 16.0 Mo 16.0 Ni bal. Fe 6.0 V 0.2 T 3.5	Re >450 N/mm² Rm >720 N/mm² A5 >30% Av >90 J Re >450 N/mm² Rm >720 N/mm² A5 >30% Av >90 J	1.6 2.0 2.4 1.0 1.2	TÜV-D, CL	GTAW rod and GMAW wire of type AWS ER NiCrMo-4 are also best suited to meet all before mentioned characteristics. For GMAW shielding gas acc. to EN 439 I1 Argon or M11 + 28 % He is recommended.	
Wire: **NIBAS C 276-UP** S Ni 6276 (NiCr 15 Mo 16 Fe 6 W4) ERNiCrMo-4 **Flux: BB 444** SA-FB 2 AC	SAW	C <0.015 Si 0.25 Mn <0.6 Cr 14.5 Mo 16.0 Ni bal. Fe 7.0 T 3.6	Re >400 N/mm² Rm >660 N/mm² A5 >35% Av >80 J	2.4	–	Nickel base wire/flux combination for welding of similar alloyed Ni base steel grades, e.g. N10276, 2.4819 as well as for joining these grades with low alloyed and stainless steels. Excellent resistance to chlorine contaminated and chloride containing medias. Resistant against strong oxidisers such as ferric and cupric chlorides.	
FOX NIBAS C 24 E Ni 6059 (NiCr 23 Mo 16) ENiCrMo-13	SMAW	C <0.02 Si <0.2 Mn 0.5 Cr 22.5 Mo 15.5 Ni bal. Fe 1	Re >450 N/mm² Rm >720 N/mm² A5 >30% Av >75 J	2.5 3.2 4.0	TÜV-D, CL	Basic coated NiCrMo electrode for highest corrosion requirements and welding of the Ni-base steel grades, e.g. UNS N06059, N06022, 2.4605, 2.4602 as well as for joining these grades with low alloyed and stainless steels. Excellent resistance against pitting and crevice corrosion and chloride-induced stress corrosion cracking. The special composition of the coating prevents the precipitation of intermetallic phases.	NiCr21Mo14W (2.4602) NiMo16Cr16Ti (2.4610) NiMo16Cr15W (2.4819) NiCr23Mo16Al (2.4605) X2CrNiMnMoNbN25-18-5-4 UNS N06059 N06022 ASTM B 575 B 626 Alloy 59
NIBAS C 24-IG S Ni 6059 (NiCr 23 Mo 16) ERNiCrMo-13	GTAW GMAW	C 0.01 Si 0.1 Mn <0.5 Cr 23.0 Mo 16.0 Ni bal. Fe <1.5	Re >450 N/mm² Rm >720 N/mm² A5 >35% Av >100 J Re >450 N/mm² Rm >720 N/mm² A5 >35% Av >100 J	1.6 2.0 2.4 1.0 1.2	TÜV-D	GTAW rod and GMAW wire of type AWS ER NiCrMo-13 are also best suited to meet all before mentioned characteristics. For GMAW shielding gas acc. to EN 439 I1 Argon or M11 + 28 % He is recommended.	
Wire: **NIBAS C 24-UP** S Ni 6059 (NiCr 23 Mo 16) ERNiCrMo-13 **Flux: BB 444** SA-FB 2 AC	SAW	C 0.015 Si 0.25 Mn <0.6 Cr 22.0 Mo 15.5 Ni bal. Fe <1.5	Re >480 N/mm² Rm >660 N/mm² A5 >30% Av >60 J	2.0	–	Nickel base wire/flux combination for welding of similar alloyed Ni base steel grades, e.g. UNS N06059, N06022, 2.4602 as well as for joining these grades with low alloyed and stainless steels. Excellent resistance against pitting and crevice corrosion and chloride induced stress corrosion cracking.	

Nickel base alloys

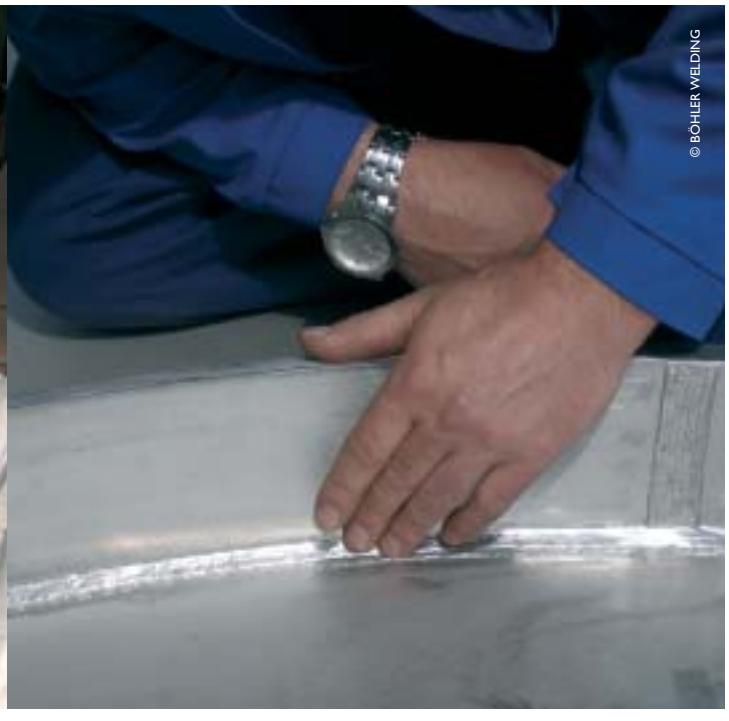
BÖHLER Standard EN AWS	Welding process	Typical analysis %	Typical mechanical properties	Sizes mm	Approvals	Characteristics and applications	Base metals
FOX NIBAS 400 E Ni 4060 (NiCu 30 Mn 3 Ti) ENiCu-7	SMAW	C <0.05 Si 0.7 Mn 3.0 Ni bal. Cu 29.0 Fe 1.0 Ti 0.7 Al 0.3	Re >300 N/mm² Rm >450 N/mm² A5 >30% Av >80 J	2.5 3.2 4.0 5.0	TÜV-D, ABS, GL, CI	Basic coated NiCu electrode for joining and surfacing of nickel copper alloys, e.g. alloy 400, N04400, 2.4360, 2.4375 as well as for cladded nickel copper steels and joining dissimilar materials such as steel to copper and copper alloys. Excellent corrosion resistance to chloride induced stress corrosion cracking and a wide range of marine and chemical requirements.	Nickel copper alloys, NiCu30Fe (2.4360), NiCu30Al (2.4375) UNS N04400 N05500 ASTM B127 B165 Alloy 400
NIBAS 400-IG S Ni 4060 (NiCu 30 Mn 3 Ti) ERNiCu-7	GTAW GMAW	C <0.02 Si 0.3 Mn 3.2 Ni bal. Cu 29.0 Fe 1.0 Ti 2.4	Re >300 N/mm² Rm >500 N/mm² A5 >35% Av >150 J Re >300 N/mm² Rm >500 N/mm² A5 >35% Av >150 J	1.6 2.0 2.4 1.0 1.2	TÜV-D, ABS, GL, CI	GTAW rod and GMAW wire of type AWS ER NiCu-7 are also best suited to meet all before mentioned characteristics. For GMAW shielding gas acc. to EN 439 I1 Argon or M11 + 28 % He is recommended.	
FOX NIBAS 617 E Ni 6617 (NiCr 21 Co 12 Mo) ENiCrCoMo-1(mod.)	SMAW	C ≤0.06 Si 0.7 Mn 0.1 Cr 21.0 Mo 9.0 Ni bal. Co 11.0 Al 0.7 Ti 0.3 Fe 1	Re >450 N/mm² Rm >700 N/mm² A5 >35% Av >100 J	2.5 3.2 4.0	TÜV-D	Basic coated NiCrCoMo electrode suitable for joining and surfacing applications on matching and similar nickel base alloys, heat resistant austenitic and cast alloys, e.g. alloy 617, N06007, 2.4663. Resistant to scaling up to 1100 °C high temperature resistant up to 1000 °C High resistance to hot gases in oxidizing resp. carburizing atmospheres.	X10NiCrAlTi32-20 (1.4876) NiCr23Fe (2.4851) GX10NiCrNb32-20 (1.4859) NiCr23Co12Mo (2.4663) UNS N06007 ASTM B582 B622 Alloy 617
NIBAS 617-IG S Ni 6617 (NiCr 22 Co 12 Mo 9) ERNiCrCoMo-1	GTAW GMAW	C 0.05 Si 0.1 Mn 0.1 Cr 21.5 Mo 9.0 Ni bal. Co 11.0 Al 1.0 Ti 0.5 Fe 1.0	Re 450 N/mm² Rm 700 N/mm² A5 30% Av 60 J Re 400 N/mm² Rm 700 N/mm² A5 40% Av 100 J	2.0 2.4 1.0 1.2	TÜV-D	GTAW rod and GMAW wire of type AWS ER NiCrCoMo-1 are also best suited to meet all before mentioned characteristics. For GMAW shielding gas acc. to EN 439 I1 Argon or M11 + 28 % He is recommended.	
Wire: NIBAS 617-UP S Ni 6617 (NiCr 22 Co 12 Mo 9) ERNiCrCoMo-1 **Flux: BB 444** SA-FB 2 AC	SAW	C <0.06 Si <0.4 Mn<0.3 Cr 20.0 Mo 8.8 Ni bal. Co 10.0 Al 0.8 Ti 0.25 Fe <1.0	Re >420 N/mm² Rm >700 N/mm² A5 >35% Av >80 J	2.0	–	Nickel base wire/flux combination for welding of similar Ni base alloys, heat resistant austenitic and cast alloys, e.g. alloys 617, N06007, 2.4643. High resistance to hot gases in oxidizing resp. carburizing atmospheres.	

BÖHLER Standard EN AWS	**Welding process**	**Typical analysis** %	**Typical mechanical properties**	**Sizes** mm	**Approvals**	**Characteristics and applications**	**Base metals**
FOX CuNi 30Fe EL-CuNi30Mn ECuNi	SMAW	C 0.03 Si 0.3 Mn 1.2 Ni 30.0 Fe 0.6 Cu bal.	Re >240 N/mm² Rm >390 N/mm² A5 >30% Av >80 J	2.5 3.2 4.0	TÜV-D, GL, CL	CuNi base electrode for joining and surfacing of similar alloyed base metals with up to 30 % Nickel, as well as for non ferrous alloys and steels of different nature. Due to the excellent resistance to sea water the electrode is best suitable for offshore applications and seawater desalination plants, ship building and also for chemical industry. The electrode can be operated in all positions except vertical down.	Copper nickel alloys with up to 30 % nickel CuNi 10 Fe 1 Mn (2.0872), CuNi20Fe (2.0878), CuNi30Fe (2.0882) UNS C71500, C70600
CuNi 30Fe-IG SG-CuNi 30 Fe ERCuNi	GTAW	C <0.05 Mn 0.8 Ni 30.0 Fe 0.6 Ti <0.5 Cu bal.	Re >200 N/mm² Rm >360 N/mm² A5 >30% HB 120	1.6 2.0 2.4	TÜV-D, GL, CL	GTAW rod for joining and surfacing of similar alloyed base metals with up to 30 % Nickel, as well as for non ferrous alloys and steels of different nature. Due to the excellent resistance to sea water, the wire is best suitable for offshore applications and seawater desalination plants, ship building and also for chemical industry.	
ER Ti 2-IG – ERTi2	GTAW	C 0.03 Fe 0.2 O <0.1 H <0.008 N 0.02 Ti bal.	Re 295 N/mm² Rm 500 N/mm² A5 42% Z 76%	1.6 2.0 2.4		GTAW rod for welding of pure Titan and Titan alloys with similar chemical composition. Titanium can be tungsten arc welded employing techniques similar to those used for welding of stainless steel. However, Titanium requires a greater cleanliness and the use of auxiliary gas shielding to protect the molten puddle and cooling weld zone from atmospheric contamination.	Pure Titan and Titan alloys with a similar composition. ASTM Grade 1-4 UNS R50400

References

Synthesis gas and oxoalcohol plant

Cooling tubes, welded with **BÖHLER WELDING** flux cored wire



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