böhlerwelding
by voestalpine

Welding Consumables for Pipeline Construction

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

Lasting Connections

Creating lasting connections is the most important part of the welding process. Böhler Welding offers a globally unique product portfolio for all conventional arc welding processes and our best-in-class welding consumables ensure these lasting connections – even in the most challenging applications and industries.

These merits are equally valid for our extensive range of arc welding consumables for pipeline fabrication. The voestalpine Böhler Welding program answers the industry's general trend towards semi-and fully automatic welding processes, the use of high strength steels with reduced wall thickness, as well as application under demanding climatic conditions.

A wide selection of manual arc welding electrodes comprises types with cellulosic coating for highly efficient vertical-down welding and basic low-hydrogen types with vertical-down or vertical-up operability. A broad range of products for semi- and fully- mechanized welding features solid wires and rods, self- and gas-shielded cored wires and submerged arc wire/flux combinations for double jointing.

The range presented in this catalogue covers normal strength pipeline steel grades up to API X60/EN L415MB, high tensile grades up to API X100/ENL690MB, standard stainless steel grades, duplex and super duplex stainless steel, nickel base alloy 625 and CRA clad pipes alloy 316L, 625 and 825.

As part of the voestalpine Group – Austria's largest steel manufacturer and one of the world's leading suppliers of specialized steel products – we are part of a global network of metallurgy experts. Absolute customer focus is our guiding principle. You will benefit from:

- Comprehensive welding and steel know-how under one roof
- Co-ordinated complete solutions comprised of steel and welding filler materials
- A partner offering maximum economic stability and technological expertise

Overview of products

	Process	Product Name	AWS Classification	EN ISO Classification	Page
Cellulosic electrodes for vertical-down welding	SMAW	BÖHLER FOX CEL	A5.1: E6010	2560-A: E 38 3 C 2 1	10
		BÖHLER FOX CEL+	A5.1: E6010	2560-A: E 38 2 C 2 1	10
		BÖHLER FOX CEL-S	A5.1: E6010	2560-A: E 38 3 C 2 1	11
		Phoenix Cel 70	A5.1: E6010	2560-A: E 42 2 C 2 5	11
		BÖHLER FOX CEL Mo	A5.5: E7010-A1	2560-A: E 42 3 Mo C 2 5	12
		BÖHLER FOX CEL 70-P	A5.5: E7010-P1	2560-A: E 42 3 C 2 5	12
		BÖHLER FOX CEL 75	A5.5: E7010-P1	2560-A: E 42 3 C 2 5	13
		BÖHLER FOX CEL 75-G	A5.5: E7010-G		13
		Phoenix Cel 75	A5.5: E7010-P1	2560-A: E 42 2 C 2 5	<?>
		BÖHLER FOX CEL 80-P	A5.5: E8010-P1	2560-A: E 46 3 1Ni C 2 5	14
		BÖHLER FOX CEL 85	A5.5: E8010-P1	2560-A: E 46 4 1Ni C 2 5	15
		BÖHLER FOX CEL 85-G	A5.5: E8010-G		15
		Phoenix Cel 80	A5.5: E8010-P1	2560-A: E 46 3 C 2 5	<?>
		BÖHLER FOX CEL 90	A5.5: E9010-P1	2560-A: E 50 3 1Ni C 2 5	16
		Phoenix Cel 90	A5.5: E9010-G	2560-A: E 50 3 1Ni C 2 5	17
Basic electrodes for vertical-down welding		BÖHLER FOX BVD 85	A5.5: E8045-P2	2560-A: E 46 5 1Ni B 4 5	22
		BÖHLER FOX BVD 90	A5.5: E9045-P2 (mod.)	18275-A: E 55 5 Z2Ni B 4 5	22
		BÖHLER FOX BVD 100	A5.5: E10045-P2 (mod.)	18275-A: E 62 5 Z2Ni B 4 5	23
		BÖHLER FOX BVD 110	A5.5: E11018-G	18275-A: E 69 3 Mn2NiMo B 4 5	23
		BÖHLER FOX BVD 120	A5.5: E12018-G	18275-A: E 69 3 Mn2NiMo B 4 5	24
Basic electrodes for vertical-up welding		BÖHLER FOX EV PIPE	A5.1: E7016-1	2560-A: E 42 4 B 1 2	27
		BÖHLER FOX EV 50-W	A5.1: E7016-1H4R	2560-A: E 42 5 B 1 2 H5	27
		BÖHLER FOX EV 50	A5.1: E7018-1H4R	2560-A: E 42 5 B 4 2 H5	28
		Phoenix 120 K	A5.1: E7018-1	2560-A: E 42 5 B 3 2 H5	28
		BÖHLER FOX EV 60	A5.5: E8018-C3H4R	2560-A: E 46 6 1Ni B 4 2 H5	29
		BÖHLER FOX EV 60 PIPE	A5.5: E8016-GH4R	2560-A: E 50 4 1Ni B 1 2 H5	29
		BÖHLER FOX EV 65	A5.5: E8018-GH4R	18275-A: E 50 6 1NiMo B 4 2 H5	30
		Phoenix SH V 1	A5.5: E8018-G/E8018-C3 (mod.)	2560-A: E 50 6 Mn 1Ni B 4 2 H5	30
		BÖHLER FOX EV 70	A5.5: E9018-GH4R	18275-A: E 55 6 1NiMo B 4 2 H5	31
		BÖHLER FOX EV 70 PIPE	A5.5: E9016-GH4R	18275-A: E 55 4 ZMn2NiMo B 1 2 H5	31
		BÖHLER FOX EV 75	A5.5: E10018-GH4R	18275-A: E 62 6 MnNiCrMo B 4 2 H5	32
		BÖHLER FOX EV 85	A5.5: E11018-GH4R	18275-A: E 69 6 Mn2NiCrMo B 4 2 H5	32
Flux-cored wires for automatic and semiautomatic pipeline welding	FCAW	BÖHLER Ti 52-FD	A5.36: E71T1-M21A4-CS1-H8	17632-A: T 46 4 P M 1 H10/T 42 2 P C 1 H5	33
		BÖHLER Ti 60- FD	A5.36: E81T1-M21A8-Ni1-H4	17632-A: T 50 6 1Ni P M 1 H5	33
		BÖHLER Ti 70 Pipe-FD	A5.36: E91T1-M21A4-G	18276-A: T 55 4 Mn1Ni P M 1 H5	34
		BÖHLER Ti 80 Pipe-FD	A5.36: E111T1-M21A4-GH4	18276-A: T 69 4 Z P M 1 H5	34
Self shielded flux-cored wire for vertical-down welding		BÖHLER Pipeshield 71 T8-FD	A5.36: E71T8-A4-K6		36
		BÖHLER Pipeshield 71.1T8-FD	A5.36: E71T8-A4-Ni1		36
		BÖHLER Pipeshield 81 T8-FD	A5.36: E81T8-A4-Ni2		37
Solid wires for automatic pipeline welding	GMAW	BÖHLER SG3-P	A5.18: ER70S-G	14341-A: G 46 5 M21 Z/G 42 4 C1 Z	38
		Union K 52 S	A5.18: ER70S-6	14341-A: G 42 4 M21 3Si1/G 42 2 C1 3Si1	38
		Union K 56 S	A5.18: ER70S-6	14341-A: G 46 4 M21 4Si1/G 46 2 C1 4Si1	39
		Union K NOVA	A5.28: ER70S-G	14341-A: G 46 5 M21 Z/G 42 4 C1 Z	39
		BÖHLER SG8-P	A5.18: ER80S-G (ER80S-Ni1 mod.)	14341-A: G 50 6 M21 Z3Ni1/ G 46 4 C1 Z3Ni1	40
		Union K NOVA NI	A5.18: ER80S-G (ER80S-Ni1 mod.)	14341-A: G 50 6 M21 Z3Ni1/ G 46 4 C1 Z3Ni1	40
		BÖHLER NiMo 1-IG	A5.28: ER90S-G	16834-A: G 55 6 M Mn3 Ni1 Mo	41
		Union NiMo 80	A5.28: ER90S-G	16834-A: G 62 5 M21 Mn3Ni1Mo/G 55 4 C1 Mn3Ni1Mo	41
		Union Ni1MoCr	A5.28: ER100S-G	16834-A: G Z Mn3Ni0.9MoCr	42
		Union NiMoCr	A5.28: ER100S-G (ER100S-1 mod.)	16834-A: G 69 6 M21 Mn4Ni1.5CrMo	42

	Process	Product Name	AWS Classification	EN ISO Classification	Page
Rods for TIG welding	GTAW	BÖHLER ER 70 S-2	A5.18: ER70S-2		44
		BÖHLER EMK 6	A5.18: ER70S-6	636-A: W 42 5 W3Si1	44
		Union I 2	A5.18: ER70S-3	636-A: W 42 5 W2Si1	45
		Union I 52	A5.18: ER70S-6	636-A: W 42 5 W3Si1	45
		BÖHLER EML 5	A5.18: ER70S-3	636-A: W 46 5 W2Si1	46
		BÖHLER Ni 1-IG	A5.28: ER80S-G	636-A: W 46 5 W3Ni1	46
		BÖHLER NiMo1-IG	A5.28: ER90S-G	16834-A: W 55 6 1Mn3Ni1Mo	47
		BÖHLER NiCrMo2,5-IG	A5.28: ER110S-G	16834-A: W 69 6 1Mn3Ni2.5CrMo	47
Wires and flux for SAW welding	SAW	Union S 2	A5.17: EM12	756: S2	48
		Union S 3 Si	A5.17: EH12K	756: S3Si	48
		Union S 2 NiMo1	A5.23: ENi1	756: SZ2Ni1	49
		Union S 3 NiMo1	A5.23: EF3	756: S3Ni1Mo	49
		Union S 3 NiMoCr	A5.23: EG (EF6 mod.)	14295: SZ3Ni2.5CrMo	50
		UV 421 TT		760: SA FB 1 65 DC H5	48-50
Electrodes for corrosion resistant alloys (CRA)	SMAW	BÖHLER FOX EAS 4 M-A	A5.4: E316L-17	3581-A: E 19 12 3 L R 3 2	51
		BÖHLER FOX EAS 4 M	A5.4: E316L-15	3581-A: E 19 12 3 L B 2 2	51
		BÖHLER FOX CN 22/9 N	A5.4: E2209-17	3581-A: E 22 9 3 NL R 3 2	52
		BÖHLER FOX CN 22/9 N-B	A5.4: E2209-15	3581-A: E 22 9 3 NL B 2 2	52
		BÖHLER FOX CN 25/9 CuT	A5.4: E2595-15	3581-A: E 25 9 4 NL B 2 2	53
		Thermanit 625	A5.11: ENiCrMo-3	14172 E Ni 6625 (NiCr22Mo9Nb)	53
		Thermanit 686	A5.14: ERNiCrMo-14	18274: S Ni 6686 (NiCr21Mo16W4)	53
Flux cored wires for corrosion resistant alloys (CRA)	FCAW	BÖHLER EAS 4 PW-FD	A5.22: E316LT1-4/ E316LT1-1	17633-A: T 19 12 3 L P M21 1/ T 19 12 3 L P C1 1	55
		BÖHLER CN 22/9 PW-FD	A5.22: E2209T1-4/ E2209T1-1	17633-A: T 22 9 3 N L P M21 1/ T 22 9 3 N L P C1 1	55
		BÖHLER CN 25/9 PW-FD	A5.22: E2594T1-4/ E2594T1-1	17633-A: T 25 9 4 N L P M21 2/ T 25 9 4 N L P C1 2	56
		BÖHLER NIBAS 625 PW-FD	A5.34: ENiCrMo3T1-4	12153 T Ni 6625 P M21 2	56
Solid wires for corrosion resistant alloys (CRA)	GMAW	Thermanit GE-316L Si	A5.9: ER316LSi	14343-A: G 19 12 3 L Si	57
		Thermanit 22/09 LH	A5.9: ER2209	14343-A: G 22 9 3 N L	57
		Thermanit 25/09 CuT LH	A5.9: ER2594	14343-A: G 25 9 4 N L	57
		Thermanit 625	A5.14: ERNiCrMo-3	18274: S Ni 6625 (NiCr22Mo9Nb)	58
		Thermanit 686	A5.14: ERNiCrMo-14	18274: S Ni 6686 (NiCr21Mo16W4)	58
TIG rods for corrosion resistant alloys (CRA)	GTAW	Thermanit GE-316L	A5.9: ER316L	14343-A: W 19 12 3 L	59
		Thermanit 22/09	A5.9: ER2209	14343-A: W 22 9 3 NL	59
		Thermanit 25/09 CuT	A5.9: ER2594	14343-A: W 25 9 4 NL	60
		Thermanit 625	A5.14: ERNiCrMo-3	18274: S Ni 6625 (NiCr22Mo9Nb)	60
		Thermanit 686	A5.14: ERNiMo-14	18274: S Ni 6686 (NiCr21Mo16W4)	61
Wires and flux for corrosion resistant alloys (CRA)	SAW	Thermanit GE-316L	A5.9: ER316L	17633-A: S 19 12 3 L	62
		Thermanit 22/09	A5.9: ER2209	14343-A: S 22 9 3 N L	62
		Thermanit 625	A5.14: ERNiCrMo3	18274: S Ni 6625 (NiCr22Mo9Nb)	62
		Marathon 431		760: SA FB 2 64 DC	62
		Marathon 444		760: SA FB 2 AC	62

Selection guide

ISO 3183 pipe steel yield strength level		Welding process				
		MMA / SMAW			MAG / GMAW	
EN	API 5L	Cellulosic	Basic vertical-down	Basic vertical-up		
L175	A25	BÖHLER FOX CEL BÖHLER FOX CEL + BÖHLER FOX CEL-S Phoenix Cel 70	BÖHLER FOX BVD 85	BÖHLER FOX EV PIPE BÖHLER FOX EV 50-W BÖHLER FOX EV 50 Phoenix 120K	BÖHLER SG 3-P Union K 52 S	
L210	A	BÖHLER FOX CEL BÖHLER FOX CEL + BÖHLER FOX CEL-S Phoenix Cel 70	BÖHLER FOX BVD 85	BÖHLER FOX EV PIPE BÖHLER FOX EV 50-W BÖHLER FOX EV 50 Phoenix 120K	BÖHLER SG 3-P Union K 52 S	
L245	B	BÖHLER FOX CEL BÖHLER FOX CEL + BÖHLER FOX CEL-S Phoenix Cel 70	BÖHLER FOX BVD 85	BÖHLER FOX EV PIPE BÖHLER FOX EV 50-W BÖHLER FOX EV 50 Phoenix 120K	BÖHLER SG 3-P Union K 52 S	
L290	X42	BÖHLER FOX CEL BÖHLER FOX CEL + BÖHLER FOX CEL-S Phoenix Cel 70	BÖHLER FOX BVD 85	BÖHLER FOX EV PIPE BÖHLER FOX EV 50-W BÖHLER FOX EV 50 Phoenix 120K	Union K 52 S BÖHLER SG 3-P Union K 56 S Union K Nova	
L320	X46	BÖHLER FOX CEL BÖHLER FOX CEL + BÖHLER FOX CEL-S Phoenix Cel 70	BÖHLER FOX BVD 85	BÖHLER FOX EV PIPE BÖHLER FOX EV 50-W BÖHLER FOX EV 50 Phoenix 120K	Union K 52 S BÖHLER SG 3-P Union K 56 S Union K Nova	
L360	X52	BÖHLER FOX CEL BÖHLER FOX CEL + BÖHLER FOX CEL-S Phoenix Cel 70	BÖHLER FOX BVD 85	Böhler FOX EV PIPE Böhler FOX EV 50-W Böhler FOX EV 50 Phoenix 120K BÖHLER FOX EV 60 Phoenix SH V 1	Union K 52 S BÖHLER SG 3-P Union K 56 S Union K Nova	
L390	X56	BÖHLER FOX CEL BÖHLER FOX CEL + BÖHLER FOX CEL-S Phoenix Cel 70 BÖHLER FOX CEL Mo BÖHLER FOX CEL 70-P BÖHLER FOX CEL 75 BÖHLER FOX CEL 75-G Phoenix Cel 75	BÖHLER FOX BVD 85	Böhler FOX EV PIPE Böhler FOX EV 50-W Böhler FOX EV 50 Phoenix 120K BÖHLER FOX EV 60 Phoenix SH V 1	Union K 52 S BÖHLER SG 3-P Union K 56 S Union K Nova	
L415	X60	BÖHLER FOX CEL BÖHLER FOX CEL + BÖHLER FOX CEL-S Phoenix Cel 70 BÖHLER FOX CEL Mo BÖHLER FOX CEL 70-P BÖHLER FOX CEL 75 BÖHLER FOX CEL 75-G Phoenix Cel 75 BÖHLER FOX CEL 80-P BÖHLER FOX CEL 85	BÖHLER FOX BVD 85	FOX EV PIPE FOX EV 50-W FOX EV 50 Phoenix 120K BÖHLER FOX EV 60 Phoenix SH V 1 BÖHLER FOX EV 60 PIPE BÖHLER FOX EV 65	Union K 52 S BÖHLER SG 3-P Union K 56 S Union K Nova Union K Nova Ni	

	TIG / GTAW	FCAW	SAW
	BÖHLER ER 70 S-2 BÖHLER EMK 6 Union I 2 Union I 52 BÖHLER EML 5	BÖHLER Ti 52-FD BÖHLER Pipeshield 71 T 8-FD BÖHLER Pipeshield 71.1 T 8-FD	Union S 2 / UV 421 TT Union S 3 Si / UV 421 TT
	BÖHLER ER 70 S-2 BÖHLER EMK 6 Union I 2 Union I 52 BÖHLER EML 5	BÖHLER Ti 52-FD BÖHLER Pipeshield 71 T 8-FD BÖHLER Pipeshield 71.1 T 8-FD	Union S 2 / UV 421 TT Union S 3 Si / UV 421 TT
	BÖHLER ER 70 S-2 BÖHLER EMK 6 Union I 2 Union I 52 BÖHLER EML 5	BÖHLER Ti 52-FD BÖHLER Pipeshield 71 T 8-FD BÖHLER Pipeshield 71.1 T 8-FD	Union S 2 / UV 421 TT Union S 3 Si / UV 421 TT
	BÖHLER ER 70 S-2 BÖHLER EMK 6 Union I 2 Union I 52 BÖHLER EML 5	BÖHLER Ti 52-FD BÖHLER Pipeshield 71 T 8-FD BÖHLER Pipeshield 71.1 T 8-FD	Union S 2 / UV 421 TT Union S 3 Si / UV 421 TT
	BÖHLER ER 70 S-2 BÖHLER EMK 6 Union I 2 Union I 52 BÖHLER EML 5	BÖHLER Ti 52-FD BÖHLER Pipeshield 71 T 8-FD BÖHLER Pipeshield 71.1 T 8-FD	Union S 2 / UV 421 TT Union S 3 Si / UV 421 TT
	BÖHLER ER 70 S-2 BÖHLER EMK 6 Union I 2 Union I 52 BÖHLER EML 5 BÖHLER Ni 1-IG	BÖHLER Ti 52-FD BÖHLER Ti 60-FD BÖHLER Pipeshield 71 T 8-FD BÖHLER Pipeshield 71.1 T 8-FD	Union S 2 / UV 421 TT Union S 3 Si / UV 421 TT
	BÖHLER ER 70 S-2 BÖHLER EMK 6 Union I 2 Union I 52 BÖHLER EML 5 BÖHLER Ni 1-IG	BÖHLER Ti 52-FD BÖHLER Ti 60-FD BÖHLER Pipeshield 71 T 8-FD BÖHLER Pipeshield 71.1 T 8-FD	Union S 3 Si / UV 421 TT
	BÖHLER ER 70 S-2 BÖHLER EMK 6 Union I 2 Union I 52 BÖHLER EML 5 BÖHLER Ni 1-IG	BÖHLER Ti 52-FD BÖHLER Ti 60-FD BÖHLER Pipeshield 71 T 8-FD BÖHLER Pipeshield 71.1 T 8-FD	Union S 3 Si / UV 421 TT Union S 2 NiMo 1 / UV 421 TT

Legend:

Root pass only

FCAW Ti -X = Gas shielded flux cored wire for vertical-up and -down welding

FCAW Pipeshield -X = Self shielded flux cored wire for vertical-down welding

GMAW= solid wires for mechanized vertical-down welding

FOX EV PIPE and FOX EV 50-W are special designed for root pass welding

ISO 3183 pipe steel yield strength level		Welding process				
		MMA / SMAW			MAG / GMAW	
EN	API 5L	Cellulosic	Basic vertical-down	Basic vertical-up		
L415 (cont.)	X60 (cont.)	BÖHLER FOX CEL 85-G Phoenix Cel 80				
L450	X65	BÖHLER FOX CEL BÖHLER FOX CEL + BÖHLER FOX CEL-S Phoenix Cel 70 BÖHLER FOX CEL 80-P BÖHLER FOX CEL 85 BÖHLER FOX CEL 85-G Phoenix Cel 80	BÖHLER FOX BVD 85	BÖHLER FOX EV PIPE BÖHLER FOX EV 50-W BÖHLER FOX EV 60 Phoenix SH V 1 BÖHLER FOX EV 60 PIPE BÖHLER FOX EV 65	Union K 52 S BÖHLER SG 3-P Union K 56 S Union K Nova Union K Nova Ni BÖHLER SG 8-P	
L485	X70	BÖHLER FOX CEL BÖHLER FOX CEL + BÖHLER FOX CEL 70 Phoenix Cel-S BÖHLER FOX CEL 80-P BÖHLER FOX CEL 85 BÖHLER FOX CEL 85-G Phoenix Cel 80 BÖHLER FOX CEL 90 Phoenix Cel 90	BÖHLER FOX BVD 90	BÖHLER FOX EV PIPE BÖHLER FOX EV 50-W BÖHLER FOX EV 65 BÖHLER FOX EV 70 PIPE BÖHLER FOX EV 70	Union K 56 S Union K Nova Union K Nova Ni BÖHLER SG 8-P BÖHLER NiMo 1-IG	
L555	X80	BÖHLER FOX CEL BÖHLER FOX CEL + BÖHLER FOX CEL-S	BÖHLER FOX BVD 90 BÖHLER FOX BVD 100	BÖHLER FOX EV PIPE BÖHLER FOX EV 50-W BÖHLER FOX EV 70 PIPE BÖHLER FOX EV 75	Union K Nova Ni Union Ni Mo 80 BÖHLER NiMo 1-IG	
L625	X90		BÖHLER FOX BVD 100	BÖHLER FOX EV 85	BÖHLER NiMo 1-IG Union Ni1MoCr	
L690	X100		BÖHLER FOX BVD 110 BÖHLER FOX BVD 120	BÖHLER FOX EV 85	BÖHLER NiMo 1-IG Union Ni1MoCr	
L830	X120				Union NiMoCr	
Stainless Steel/ Cladded Pipes						
13% Cr		BÖHLER FOX CN 22/9 N BÖHLER FOX CN 22/9 N-B BÖHLER FOX CN 25/9 CuT			Thermanit 22/09 Thermanit 25/09 CuT	
316L		BÖHLER FOX EAS 4 M-A BÖHLER FOX EAS 4 M			Thermanit GE-316L Si	
22% Cr		BÖHLER FOX CN 22/9 N BÖHLER FOX CN 22/9 N-B			Thermanit 22/09	
25% Cr		BÖHLER FOX CN 25/9 CuT			Thermanit 25/09 CuT	
CRA 625/825		Thermanit 625 Thermanit 686			Thermanit 625 Thermanit 686	

	TIG / GTAW	FCAW	SAW
	BÖHLER Ni 1-IG BÖHLER NiMo 1-IG	BÖHLER Ti 52-FD BÖHLER Ti 60-FD BÖHLER Ti 70 Pipe-FD BÖHLER Pipeshield 81 T8-FD	Union S 3 Si / UV 421 TT Union S 2 NiMo 1 / UV 421 TT Union S 3 NiMo 1 / UV 421 TT
	BÖHLER NiMo 1-IG	BÖHLER Ti 60-FD BÖHLER Ti 70 Pipe-FD BÖHLER Ti 80 Pipe-FD BÖHLER Pipeshield 81 T8-FD	Union S 2 NiMo 1 / UV 421 TT Union S 3 NiMo 1 / UV 421 TT Union S 3 NiMoCr / UV 421 TT
	BÖHLER NiMo 1-IG	BÖHLER Ti 80 Pipe-FD	Union S 3 NiMoCr / UV 421 TT
	BÖHLER NiCrMo 2,5-IG		Union S 3 NiMoCr / UV 421 TT
	BÖHLER NiCrMo 2,5-IG		Union S 3 NiMoCr / UV 421 TT
	Thermanit 22/09 Thermanit 25/09 CuT	BÖHLER CN22/9 PW-FD BÖHLER CN 25/9 PW-FD	Thermanit 22/09 Marathon 431
	Thermanit GE-316L	BÖHLER EAS 4 PW-FD	Thermanit GE-316L Marathon 431
	Thermanit 22/09	BÖHLER CN22/9 PW-FD	Thermanit 22/09 Marathon 431
	Thermanit 25/09 CuT	BÖHLER CN 25/9 PW-FD	
	Thermanit 625 Thermanit 686	BÖHLER NIBAS 625 PW-FD	Thermanit 625 Marathon 444

Legend:

Root pass only

FCAW Ti -X = Gas shielded flux cored wire for vertical-up and -down welding

FCAW Pipeshield -X = Self shielded flux cored wire for vertical-down welding

GMAW= solid wires for mechanized vertical-down welding

FOX EV PIPE and FOX EV 50-W are special designed for root pass welding

Cellulosic electrodes for vertical-down welding

BÖHLER FOX CEL	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 38 3 C 2 1			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.1: E6010	%		MPa	MPa	%	°C	J	mm	A		
	C	0.12	450	550	26	+20	100	2.5	50-90	L210NB-L415NB	A
	Si	0.14	(≥ 380)	(470-600)	(≥ 22)	0	90	3.2	80-130	L290MB-L415MB	B
	Mn	0.50				-20	80	4.0	120-180		X42 -X56
						-30	50 (≥ 47)	5.0	160-210		
Root pass negative polarity			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
Re-drying not allowed			65	80	26	+68	74	3/32	50-90		
			(≥ 48)	(≥ 60)	(≥ 22)	+32	66	1/8	80-130		
For preheating, interpass temperature and welding procedure note our recommendations p. 18						-4	59	5/32	120-180		
						-22	37 (≥ 20)	3/16	160-210	Root pass up to L555NB, L555MB	X80

Characteristics and application

Cellulosic electrode for vertical-down welding of large diameter pipelines; suitable for root runs, hot passes, filler passes and capping. Especially recommended for root run welding. Highly economical compared with vertical-up welding. Apart from its excellent welding and gap bridging characteristics, FOX CEL offers a weld deposit with outstanding impact strength values and thus offers the benefit of still more safety in field welding of pipelines. It can be used in sour gas applications (HIC-Test acc. NACE TM-02-84). Test values for SSC test are available too.

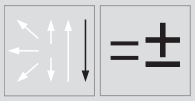
Approvals

TÜV (01281), DNV (3), Statoil, SEPROZ, CE, NAKS (ø3.2, 4.0 mm)

BÖHLER FOX CEL+	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 38 2 C 2 1			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.1: E6010	%		MPa	MPa	%	°C	J	mm	A		
	C	0.17	450	520	26	+20	105	2.5	50-90	L210NB-L415NB	A
	Si	0.15	(≥ 380)	(470-600)	(≥ 22)	0	95	3.2	80-130	L290MB-L415MB	B
	Mn	0.6				-20	65 (≥ 47)	4.0	120-180		X42 -X56
						-30	≥ 27				
Root pass positive polarity (negative polarity possible)			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
			65	75	26	+68	77	3/32	50-90		
Re-drying not allowed			(≥ 48)	(≥ 60)	(≥ 22)	+32	70	1/8	80-130		
						-4	48	5/32	120-180		
For preheating, interpass temperature and welding procedure note our recommendations p. 18						-22	≥ 20			Root pass up to L555NB, L555MB	X80

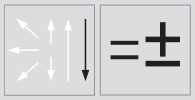
Characteristics and application

Cellulosic electrode for vertical-down welding of large diameter pipelines. Especially recommended for root pas welding on DC positive polarity in the vertical-down and vertical-up welding positions. Apart from its good weldability and gap bridging characteristics, Böhler FOX CEL+ provides a powerful arc that deposits well-penetrated, smooth root passes at high travel speed as well as high safety against the formation of piping or hollow bead and undercut. Böhler FOX CEL+ can be used in sour gas applications (HIC-Test acc. NACE TM-02-84). Test values for SSC test are available too.

BÖHLER FOX CEL-S	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 38 3 C 2 1			**Re**	**Rm**	**A5**	**CVN**		**ø**		**EN**	**API 5L**
AWS A5.1: E6010	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**	**A**		
	C	0.10	480	550	23	+20	110	2.5	50-90	L210NB-L415NB	A, B
	Si	0.20	(≥ 380)	(470-600)	(≥ 22)	-30	≥ 47	3.2	80-130	L290MB-L415NB	X42-X56
	Mn	0.50						4.0	110-170		
Root pass negative polarity			**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**			
			ksi	**ksi**	**%**	**°F**	**ft-lbf**	**inch**	**A**		
Re-drying not allowed			70	80	23	+68	81	3/32	50-90		Root pass up to X80
			(≥ 48)	(≥ 60)	(≥ 22)	-22	≥ 20	1/8	80-130		
For preheating, interpass temperature and welding procedure note our recommendations p. 18								5/32	110-170		

Characteristics and application

Cellulosic for the vertical-down welding of filler and cap layers on large diameter pipelines. Root passes with diameters 2.5 and 3.2 on negative polarity, vertically-up and down.

Phoenix Cel 70	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 42 2 C 2 5			**Re**	**Rm**	**A5**	**CVN**		**ø**		**EN**	**API 5L**
AWS A5.1: E6010	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**	**A**		
	C	0.14	440	540	24	+20	80	2.5	50 - 80	L210NB-L390NB	A
	Si	0.18	(≥ 420)	(500-640)	(≥ 20)	± 0	70	3.2	80 - 130	L290MB-L390MB	B
	Mn	0.55				-20	55 (≥ 47)	4.0	120 - 180		X42 - X56
						-40	28	5.0	160 - 220		
Root pass negative polarity			**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**			
			ksi	**ksi**	**%**	**°F**	**ft-lb**	**inch**	**A**		
Re-drying not allowed			64	78	24	+68	59	3/32	50 - 80		
			(≥ 48)	(≥ 60)	(≥ 22)	+32	51	1/8	80 - 130		
For preheating, interpass temperature and welding procedure note our recommendations p. 18						-4	37	5/32	120 - 180	Root pass up to L485NB, L485MB	X70
						-40	20	3/16	160 - 220		

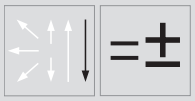
Characteristics and application

Cellulosic electrode for vertical down circumferential welds in pipeline constructions. Excellent weldability in root pass welding (DC ±); also in the vertical up position. CTOD, HIC and HSCC tested.

Approvals

TÜV (00247), DB (10.132.44), ABS, DNV, GL, LR, CE

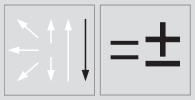
Cellulosic electrodes for vertical-down welding

BÖHLER FOX CEL Mo	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 42 3 Mo C 2 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E7010-A1	%		MPa	MPa	%	°C	J	mm	A		
	C	0.1	480	550	23	+ 20	100	3.2	80-130	L210 NB-L415NB	A
	Si	0.14	(≥ 420)	(500-640)	(≥ 20)	0	95	4.0	120-180	L290MB-L415MB	B
	Mn	0.4				-20	85	5.0	160-210		X42 -X60
	Mo	0.5				-30	50 (≥ 47)				
Root pass negative polarity						-40	42				
			YS	TS	E (L=4d)	CVN		ø			
Re-drying not allowed			ksi	ksi	%	°F	ft-lbf	inch	A		
			70	80	23	+ 68	74	1/8	80-130		
For preheating, interpass temperature and welding procedure note our recommendations p. 18			(≥ 57)	(≥ 70)	(≥ 22)	+ 32	70	5/32	120-180	Root pass up to L555MB	X80
						-4	63	3/16	160-210		
						-22	37 (≥ 20)				
Characteristics and application						-40	31				

Cellulosic electrode for vertical-down welding of high strength large diameter pipelines. Highly economical compared with conventional vertical-up welding. Especially recommended for hot passes, filler and cap layers. Besides the excellent weld metal toughness properties, it offers easy operation and a concentrated, intensive arc with deep penetration, in order to ensure sound joint welds with good X-ray quality. Böhler FOX CEL Mo can be used in sour gas applications (HIC-Test acc. NACE TM-02-84). Test values for SSC test are available too.

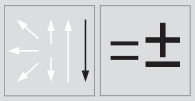
Approvals

TÜV (01325), ABS (E7010-A1), SEPROZ, CE

BÖHLER FOX CEL 70-P	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 42 3 C 2 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E7010-P1	%		MPa	MPa	%	°C	J	mm	A		
	C	0.15	460	550	23	+20	100	3.2	60-130	L210NB-L415NB	A
	Si	0.10	(≥ 420)	(500-640)	(≥ 22)	-20	80	4.0	100-180	L290MB-L415MB	B
	Mn	0.45				-30	65 (≥ 47)	5.0	140-210		X42 -X60
	Ni	0.17									
Root pass negative polarity			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
Re-drying not allowed			67	75	23	+ 68	74	1/8	60-130		
			(≥ 57)	(≥ 70)	(≥ 22)	-4	59	5/32	100-180		
For preheating, interpass temperature and welding procedure note our recommendations p. 18						-22	48 (≥ 20)	3/16	140-210	Root pass up to L480MB	X70

Characteristics and application

Cellulosic electrode for vertical-down welding of high strength large diameter pipelines. Especially recommended hot passes, filler and cap layers. Highly economical compared with conventional vertical-up welding. Böhler FOX CEL 70-P provides a more intensive arc and a more fluid weld metal compared with the well-known Böhler FOX CEL 75. Böhler FOX CEL 70-P can be used in sour gas applications (HIC-Test acc. NACE TM-02-84). Test values for SSC test are available too.

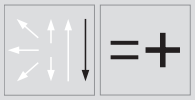
BÖHLER FOX CEL 75	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 42 3 C 2 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E7010-P1	%		MPa	MPa	%	°C	J	mm	A		
	C	0.14	480	550	23	+20	100	3.2	80-130	L210-L415NB	A
	Si	0.14	(≥ 420)	(500-640)	(≥ 22)	-20	65	4.0	120-180	L290MB-L415MB	B
	Mn	0.7				-30	55 (≥ 47)	5.0	160-210		X42 -X60
						-40	45				
Root pass negative polarity			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
Re-drying not allowed			70	80	23	+68	81	1/8	80-130		
			(≥ 57)	(≥ 70)	(≥ 22)	-4	70	5/32	120-180		
For preheating, interpass temperature and welding procedure note our recommendations p. 18						-22	48 (≥ 20)	3/16	160-210		
						-40	33			Root pass up to L480MB	X70

Characteristics and application

Cellulosic electrode for vertical-down welding of high strength large diameter pipelines. Especially recommended for hot passes, filler and cap layers. Highly economical compared with conventional vertical-up welding. The penetrating arc and the low slag formation allow good bead control and ensure best performance, even with larger diameter electrodes and high amperages. Böhler FOX CEL 75 can be used in sour gas applications (HIC-Test acc. NACE TM-02-84). Test values for SSC test are available too.

Approvals

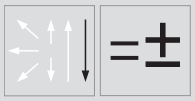
TÜV (533)

BÖHLER FOX CEL 75 G	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
AWS A5.5: E7010-G			Re	Rm	A5	CVN		ø		EN	API 5L
	%		MPa	MPa	%	°C	J	mm	A		
	C	0.17	450	560	23	+20	90	3.2	60-130	L415NB-L450NB	X56-X65
	Si	0.15	(≥ 390)	(≥ 490)	(≥ 22)	-20	75	4.0	100-180	L415MB-L450MB	
	Mn	0.55				-30	55	5.0	140-210		
	Ni	0.6									
Re-drying not allowed			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		Root pass up to X70
For preheating, interpass temperature and welding procedure note our recommendations p. 18			65	81	23	+68	66	1/8	60-130		
			(≥ 57)	(≥ 70)	(≥ 22)	-4	55	5/32	100-180		
						-22	40	3/16	140-210		

Characteristics and application

Cellulosic electrode for vertical-down welding of high strength large diameter pipelines. Especially recommended for hot passes, filler and cap layers. Highly economical compared with conventional vertical-up welding. The electrode has superior operating characteristics and consistently produces high quality welds with outstanding low-temperature impact toughness. Results from SSC testing are available.

Cellulosic electrodes for vertical-down welding

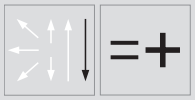
Phoenix Cel 75	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 42 2 C 2 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E7010-P1	%		MPa	MPa	%	°C	J	mm	A		
	C	0.15	440	540	24	+20	80	3.2	80 - 130	L210NB - L415NB	A
	Si	0.20	(≥ 420)	(500-640)	(≥ 20)	-20	55 (≥ 47)	4.0	120 - 180	L290MB - L415MB	B
	Mn	0.60				-40	28	5.0	160 - 220		X42 - X60
			YS	TS	E (L=4d)	CVN		ø			
Root pass negative polarity			ksi	ksi	%	°F	ft-lb	inch	A		
			64	78	24	+ 68	59	1/8	80 - 130		
Re-drying not allowed			(≥ 60)	(≥ 70)	(≥ 22)	-4	41	5/32	120 - 180		
						-40	20	3/16	160 - 220	Root pass up to L485NB, L485MB	X70
For preheating, interpass temperature and welding procedure note our recommendations p. 18											

Characteristics and application

Cellulosic electrode for vertical down circumferential welds in pipeline constructions. Excellent weldability in root and hot hot pass, filler and cap layers. Easy slag removal. Particularly suitable for root pass welding (DC ±); also in the vertical up position. CTOD, HIC and HSCC tested.

Approvals

TÜV (03199), LR, CE

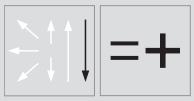
BÖHLER FOX CEL 80-P	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 46 3 1Ni C 2 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E8010-P1	%		MPa	MPa	%	°C	J	mm	A		
	C	0.15	490	580	23	+20	90	3.2	60-130	L415NB-L485NB	X56-X70
	Si	0.15	(≥ 460)	(550-680)	(≥ 20)	-20	80	4.0	100-180	L415MB-L485MB	
	Mn	0.7				-30	60 (≥ 47)	5.0	140-210		
	Ni	0.8									
Re-drying not allowed			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
For preheating, interpass temperature and welding procedure note our recommendations p. 18			71	84	23	+68	66	1/8	60-130		
			(≥ 67)	(≥ 80)	(≥ 19)	-4	59	5/32	100-180		
						-22	44 (≥ 20)	3/16	140-210		

Characteristics and application

Cellulosic electrode for vertical-down welding of high strength, large diameter pipelines. Highly economical compared with conventional vertical-up welding. Especially recommended for hot passes, filler and cap layers. Böhler FOX CEL 80-P provides a more intensive arc and a more fluid weld metal compared with the well-known Böhler FOX CEL 85. Böhler FOX CEL 80-P can be used in sour gas applications (HIC-Test acc. NACE TM-02-84). Test values for SSC test are available too.

Approvals

TÜV (11181), CE

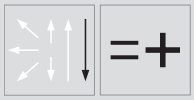
BÖHLER FOX CEL 85	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 46 4 1Ni C 2 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E8010-P1	%		MPa	MPa	%	°C	J	mm	A		
	C	0.14	490	570	23	+20	110	3.2	80-130	L415NB-L485NB	X56-X70
	Si	0.15	(≥ 460)	(550-680)	(≥ 20)	0	105	4.0	120-180	L415MB-L485MB	
	Mn	0.75				-20	100	5.0	160-210		
	Ni	0.7				-40	70 (≥ 47)				
Re-drying not allowed			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
For preheating, interpass temperature and welding procedure note our recommendations p. 18			71	83	23	+68	81	1/8	80-130		
			(≥ 67)	(≥ 80)	(≥ 19)	+32	77	5/32	120-180		
						-4	74	3/16	160-210		
						-22	≥ 20				
						-40	52				

Characteristics and application

Cellulosic electrode for vertical-down welding of high strength, large diameter pipelines. Highly economical compared with conventional vertical-up welding. Especially recommended for hot passes, filler and cap layers. Böhler FOX CEL 85 is the most popular cellulosic electrode, very well meeting all exacting demands of cross country pipeline field welding. It ensures highest joint weld quality down to -40 °C. Böhler FOX CEL 85 can be used in sour gas applications (HIC-Test acc. NACE TM-02-84). Test values for SSC test are available too.

Approvals

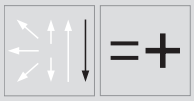
TÜV (01361), ABS (E8010-P1), SEPROZ, CE

BÖHLER FOX CEL 85 G	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
AWS A5.5: E8010-G			Re	Rm	A5	CVN		ø		EN	API 5L
	%		MPa	MPa	%	°C	J	mm	A		
	C	0.15	490	580	23	+20	90	3.2	60-130	L415NB-L485NB	X56-X70
	Si	0.15	(≥ 460)	(≥ 550)	(≥ 19)	0	85	4.0	100-180	L415MB-L485MB	
	Mn	0.7				-30	60	5.0	140-210		
	Ni	0.8									
Re-drying not allowed			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
For preheating, interpass temperature and welding procedure note our recommendations p. 18			71	84	23	+68	66	1/8	60-130		
			(≥ 67)	(≥ 80)	(≥ 19)	+32	63	5/32	100-180		
						-22	44	3/16	140-210		

Characteristics and application

Cellulosic electrode for vertical-down welding of high strength large diameter pipelines. Especially recommended for hot passes, filler and cap layers. Highly economical compared with conventional vertical-up welding. The electrode has superior operating characteristics and consistently produces high quality welds with outstanding low-temperature impact toughness.

Cellulosic electrodes for vertical-down welding

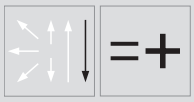
Phoenix Cel 80	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 46 3 C 2 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E8010-P1	%		MPa	MPa	%	°C	J	mm	A		
	C	0.16	490	580	23	-20	60	3.2	80 - 130	L415NB - L485NB	X56 - X70
	Si	0.20	(≥ 460)	(530-680)	(≥ 20)	-30	≥ 47	4.0	140 - 190	L415MB - L485MB	
	Mn	0.85						5.0	160 - 220		
	Ni	0.2									
Re-drying not allowed			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lb	inch	A		
For preheating, interpass temperature and welding procedure note our recommendations p. 18			71	84	23	-4	44	1/8	80 - 130		
			(≥ 67)	(≥ 80)	(≥ 19)	-22	35 (≥ 20)	5/32	140 - 190		
								3/16	160 - 220	Root pass up to L555MB, L555NB	X80

Characteristics and application

Cellulosic electrode for vertical-down circumferential welding of pipelines. Suitable for welding of root pass, hot pass, filler and cap layers. Welding of root pass with AC (+/–). CTOD values at –10 °C > 0,25 mm HIC and HSCC testet.

Approvals

TÜV (03199), ABS, LR, CE

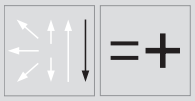
BÖHLER FOX CEL 90	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 50 3 1Ni C 2 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E9010-P1	%		MPa	MPa	%	°C	J	mm	A		
	C	0.17	580	650	21	+20	100	4.0	120-180	L450MB, L485MB	X65-X80
	Si	0.15	(≥ 530)	(620-720)	(≥ 18)	0	90	5.0	160-210		
	Mn	0.9				-20	75				
	Ni	0.8				-30	65 (≥ 47)				
						-40	40				
Re-drying not allowed			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
For preheating, interpass temperature and welding procedure note our recommendations p. 18			84	94	21	+68	74	5/32	120-180		
			(≥ 77)	(≥ 90)	(≥ 17)	+32	66	3/16	160-210		
						-4	55				
						-22	48 (≥ 20)				
						-40	30				

Characteristics and application

Cellulosic electrode for vertical down welding of large diameter, high strength pipelines. Highly economical compared with conventional vertical-up welding. Especially recommended for hot passes, filler and cap layers. The special design of coating and core guarantees the highest metallurgical quality and soundness of the weld deposit with excellent mechanical properties. The electrode allows good weld pool visability and easy manipulation, as well as high safety margins against porosity and slag inclusions. Böhler FOX CEL 90 can be used in sour gas applications (HIC-Test acc. NACE TM-02-84). Test values for SSC test are available too.

Approvals

TÜV (1324), Statoil, SEPROZ, CE

Phoenix Cel 90	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 50 3 1 Ni C 2 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E9010-G	%		MPa	MPa	%	°C	J	mm	A		
	C	0.18	570	640	20	+20	70	3.2	80 - 140	L415NB - L555NB	X60 - X80
	Si	0.20	(≥ 500)	(560-720)	(≥ 18)	-20	55	4.0	140 - 190	L415MB - L555MB	
	Mn	0.85				-30	≥ 47	5.0	160 - 220		
	Ni	0.75									
Re-drying not allowed			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lb	inch	A		
For preheating, interpass temperature and welding procedure note our recommendations p. 18			82	93	20	+68	52	1/8	80 - 140		
			(≥ 77)	(≥ 90)	(≥ 17)	-4	41	5/32	140 - 190		
						-22	35 (≥ 20)	3/16	160 - 220		

Characteristics and application

Cellulosic electrode for circumferential welds; developed for field welding of higher strength pipeline steels in the vertical-down position. Excellent weldability in root and hot hot pass, filler and cap layers.

Approvals

TÜV (00105), CE

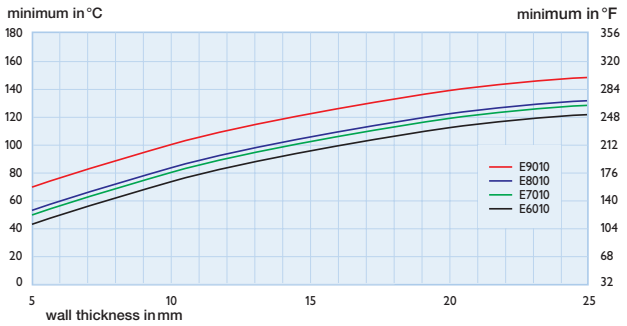
Welding Techniques Cellulosic Electrodes

Preheating and interpass temperature

In order to prevent hydrogen induced cracking, it is neccessary to preheat pipes before starting to weld and to maintain an interpass temperature during the welding of individual beads.

In respect of the quite often difficult site conditions, preheating at 150 °C (300 °F) is recommended in general. This covers all wall thicknesses up to 25 mm (1") and weld metals up to class E9010 (FOX CEL 90). Be aware that lower preheat and interpass temperatures are valid, when welding thin-walled pipes.

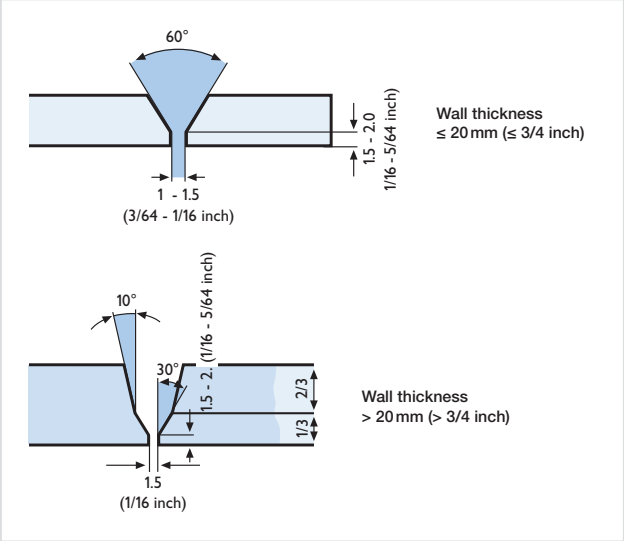
The diagram below shows minimum required preheat temperatures, in dependence of wall thickness and type of electrode. This is related to both preheating and interpass.



Welding machines

Cellulosic electrodes can only be operated on direct current. Welding machines must have a dropping characteristic and high open circuit voltage.

Recommended joint preparation



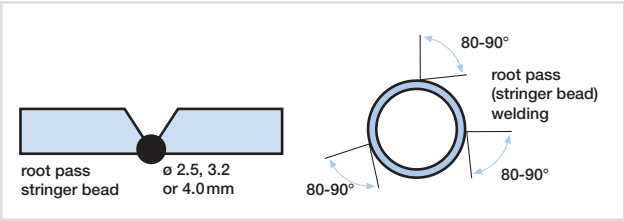
Welding technique
Stringer bead or root pass

The root pass is a critical part of any pipe weld, requiring perfect penetration. Electrode diameter, travel speed and amperage must be selected to match pipe diameter and wall thickness. For pipe diameters up to about 250 mm (10") and wall thickness up to 8 mm (5/16"), we recommend to use 3.2 mm (1/8") diameter electrodes, for larger sizes, 4 mm (5/32") diameter electrodes.

Welding is performed in vertical-down direction, with the electrode in good contact with both beveled plate edges.

Electrode diameter:		
2.5 mm	(3/32")	50 - 80 A
3.2 mm	(1/8")	80 - 100 A
4.0 mm	(5/32")	120 - 150 A

Line-up clamps should be removed only after completing the root pass over the full circumference and, when welding larger diameter pipe, only after completing the hot pass. While making the hot pass, do not move pipes in order to avoid the risk of crack formation.



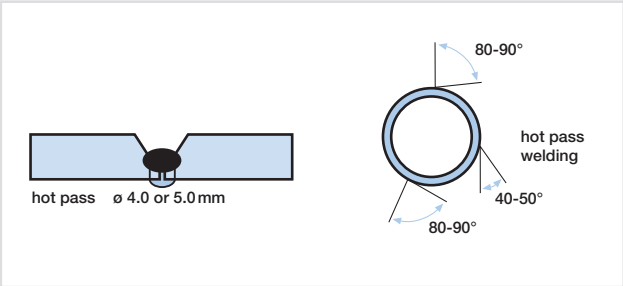
Hot pass

In order to prevent lateral slag inclusions (showing up as „waggon tracks“ in weld radiographs), slight grinding of the stringer bead is essential.

Electrode sizes commonly used are:

Electrode diameter:		
3.2 mm	(1/8“)	80 - 130 A
4.0 mm	(5/32“)	150 - 180 A
5.0 mm	(3/16“)	170 - 210 A

Use of a relatively high welding current is favourable, because it gives a good penetration making any remaining slag inclusions re-melt and float to the surface, while ensuring that the root pass is annealed thoroughly. The hot pass should be welded immediately after deposition of the stringer bead, but in no case more than 10 minutes later. This is of special importance for high strength line pipe grades to avoid underbead cracking in the base material.



Filler layers

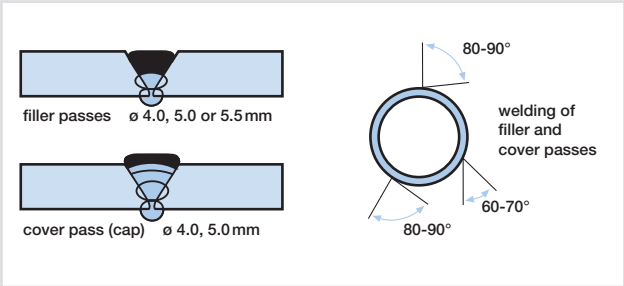
Beads will be sufficiently flat and free from undercut and slag inclusions, if the electrode is applied with a slight circular or stepping motion, especially in positions 12 to 2 o‘clock, 12 to 10 o‘clock, 4 to 6 o‘clock and 8 to 6 o’clock. Weaving of max. 2xØ is recommended for all other positions.

Electrode sizes and amperages recommended for filler pass welding on positive (+) polarity:

Electrode diameter:		
3.2 mm	(1/8“)	80 - 130 A
4.0 mm	(5/32“)	100 - 180 A
5.0 mm	(3/16“)	140 - 210 A

Cover pass (cap)

The cover pass is executed with a slight weaving of the electrode. The weld should not overlap the groove edge by more than 1.5 mm (1/16“). If the cover pass is applied correctly, weld reinforcement is about 1 to 2 mm (1/16“).

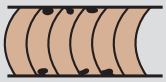
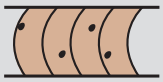
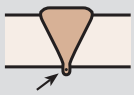
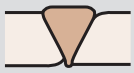
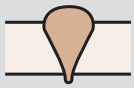
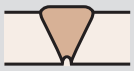
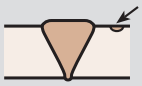


Storage of cellulosic electrodes

The coating of cellulosic electrodes has a relatively high content of moisture which is necessary for welding characteristics and metallurgical properties of the deposit.

Electrodes must be stored in a closed area, away from solar radiation and excessive variations in temperature. Once a can has been opened, the electrodes must be used as soon as possible. Rebaking of cellulosic electrodes is not permitted.

Trouble shooting

Trouble shooting	Defects	Causes	How to avoid defects
	**Porosity** visible on the surface	■ excessive and uncontrolled weaving ■ base metal overheated (increased risk in thin wall pipe) ■ moisture content of electrode coating too low	■ weaving not to exceed 2 x electrode dia. ■ choose electrode dia. and amperage as a function of pipe wall thickness ■ keep electrodes in closed containers
	**Pinholes** not visible on the surface	■ delayed deoxidation process in weld deposit ■ moisture content in electrode coating too low or too high	■ avoid excessive upsetting of metal deposited ■ see chapter „storage“
	**Piping or hollow beat** almost exclusively in the reinforcement of stringer bead - therefore, practically no reduction of cross section	■ root gap too narrow: degassing hindered by excessive dilution ■ chemical composition of base metal: high Al levels usually favour piping formation	■ root gap width not less than 1 mm ■ the optimum root gap width of 1.5 mm should be observed for 0.040% Al steels in particular. If trouble continues, use smaller electrode dia.
	Slag inclusions generally occuring in groove faces and in stringer bead area (waggon tracks)	■ insufficient cleaning in between passes ■ stringer bead poorly ground ■ incorrect electrode manipulation ■ amperage too low	■ clean each layer with rotary wire brush ■ grind stringer bead sufficiently before applying hot pass ■ improve electrode manipulation ■ increase amperage
	Lack of fusion (cold laps)	■ insufficient melting of groove faces ■ amperage too low ■ groove faces contaminated and/or oxidized	■ choose amperage to match electrode dia. and welding position ■ clean groove faces properly
	Underbead cracks almost exclusively in the hardened HAZ	■ combined action of hydrogen, stresses, hardened structure	■ preheat pipe material to favour hydrogen effusion, increase of heat input is also advantageous ■ avoid moving pipe string ■ considerable hardening is to be expected during welding of the stringer bead, therefore the hot pass must be applied immediately after its completion
	Cracks caused by mechanical stresses usually in the stringer bead region	■ moving of pipes during welding of stringer bead and/or before applying hot pass ■ edge offset too large, resulting in reduced root cross section and incrceased risk of crack formation	■ avoid moving pipe particularly during welding of stringer bead ■ refer to relevant standards and specifications for maximum offset which, however, should be kept to a minimum
	**Undercut** in the region of stringer bead and cover passes	■ amperage too high ■ incorrect manipulation	■ selection of correct amperage to match electrode size
	**Excess reinforcement**	■ Incorrect manipulation	■ select amperage to match joint width ■ allowance for desired cap layer weld reinforcement is to be made already when applying last filler pass (e.g. by additional layers or grinding of filler layers that are too high)
	**Sagging stringer bead**	■ amperage too high ■ poor joint preparation, root gap too large	■ select correct amperage to match joint preparation for stringer bead
	**Striking marks**	■ striking right or left of the joint causes local hardening – risk of hardening cracks	■ strike arc in the groove

Basic electrodes for vertical-down welding

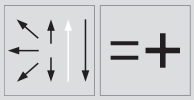
BÖHLER FOX BVD 85	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 46 5 1Ni B 4 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E8045-P2	%		MPa	MPa	%	°C	J	mm	A		
	C	0.05	510	560	27	+20	170	3.2	110-160	L290NB-L450NB	A
	Si	0.4	(≥ 460)	(550-680)	(≥ 20)	0	150	4.0	180-210	L290MB-L450MB	B
	Mn	1.1				-20	120	4.5	200-240		X42 -X65
	Ni	0.9				-40	85				
						-50	65 (≥ 47)				
Re-drying if necessary: 300-350 °C (570-660 °F) / min. 2h			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
Recommended interpass temperature > 80 °C (176 °F)			74	81	26	+68	125	1/8	110-160		
			(≥ 67)	(≥ 80)	(≥ 19)	+32	110	5/32	180-210		
						-4	89	11/16	200-240		
						-22	≥ 20				
						-40	63				
						-58	48				

Characteristics and application

Basic electrode for vertical-down welding of large diameter, high strength pipelines and for structural work. Suitable for filler and cap layers in pipe welds. The deposit is extremely crack resistant and features a high toughness and very low hydrogen content. The deposition rate is 80-100% higher than obtainable in vertical-up welding. The weld deposit of Böhler FOX BVD 85 shows the ideal combination of high strength and cryogenic toughness down to -50 °C (-58 °F). Due to the specially designed electrode tip, the arc striking is improved and start porosity can be avoided. Good additional welding characteristics make this special basic electrode very suited for convenient field welding. Böhler FOX BVD 85 can be used in sour gas applications (HIC-Test acc. NACE TM-02-84). Test values for SSC test are available too.

Approvals

TÜV (03531), SEPROZ, CE

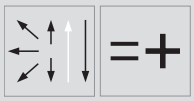
BÖHLER FOX BVD 90	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 18275-A: E 55 5 Z2Ni B 4 5											
AWS A5.5: E9018-G / E9045-P2 (mod.)	%		Re MPa	Rm MPa	A5 %	CVN °C	J	ø mm	A	EN	API 5L
	C	0.05	600	650	27	+20	170	3.2	110-160	L458MB, L555MB	X70, X80
	Si	0.3	(≥ 550)	(620-780)	(≥ 18)	0	145	4.0	180-210		
	Mn	1.2				-20	130	4.5	200-240		
	Ni	2.2				-40	110				
						-50	80 (≥ 47)				
Re-drying if necessary: 300-350 °C (570-660 °F) / min. 2h			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
Recommended interpass temperature > 90 °C (194 °F)			87	94	26	+68	125	1/8	110-160		
			(≥ 77)	(≥ 90)	(≥ 17)	+32	107	5/32	180-210		
						-4	96	11/16	200-240		
						-22	≥ 20				
						-40	81				
						-58	59				

Characteristics and application

Basic electrode for vertical-down welding of large diameter, high strength pipelines and for structural work. Suitable for filler and cap layers in pipe welds. The deposit is extremely crack resistant and features a high toughness and very low hydrogen content. The deposition rate is 80-100% higher than obtainable in vertical-up welding. Due to the specially designed electrode tip, the arc striking is improved and start porosity can be avoided. Good additional welding characteristics make this special basic electrode very suited for convenient field welding.

Approvals

TÜV (03402), Staoil, SEPROZ, CE, GAZPROM (ø 3.2, 4.0, 4.5 mm)

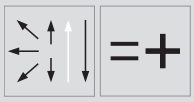
BÖHLER FOX BVD 100	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 18275-A: E 62 5 Z2Ni B 4 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E10018-G /E10045-P2 (mod.)	%		MPa	MPa	%	°C	J	mm	A		
	C	0.07	670	730	24	+20	150	4.0	180-210	L555MB	X80
	Si	0.4	(≥ 620)	(690-890)	(≥ 18)	0	125	4.5	200-240		
	Mn	1.2				-20	120				
	Ni	2.3				-50	70 (≥ 47)				
Re-drying if necessary: 300-350 °C (570-660 °F) / min. 2h			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
			97	106	26	+68	110	5/32	180-210		
Recommended interpass temperature > 100 °C (212 °F)			(≥ 87)	(≥ 100)	(≥ 16)	+32	92	11/64	200-240		
						-4	89				
						-22	≥ 20				
						-58	52				

Characteristics and application

Basic electrode for vertical-down welding of large diameter, high strength pipelines and for structural work. Suitable for filler and cap layers in pipe welds. The deposit is extremely crack resistant and features a high toughness and very low hydrogen content. The deposition rate is 80-100% higher than obtainable in vertical-up welding. Due to the specially designed electrode tip, the arc striking is improved and start porosity can be avoided. Good additional welding characteristics make this special basic electrode very suited for convenient field welding.

Approvals

TÜV (06333), SEPROZ, CE

BÖHLER FOX BVD 110	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 18275-A: E 69 3 Mn2NiMo B 4 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E11018-G	%		MPa	MPa	%	°C	J	mm	A		
	C	0.07	720	810	20	+20	90	4.0	180-210	L690	X100
	Si	0.4	(≥ 690)	(760-960)	(≥ 17)	-20	70	4.5	200-240		
	Mn	1.5				-30	50 (≥ 47)				
	Ni	2.2									
Re-drying if necessary: 300-350 °C (570-660 °F) / min. 2h	Mo	0.4	YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
			104	117	20	+68	66	5/32	180-210		
Recommended interpass temperature > 110 °C (230 °F)			(≥ 97)	(≥ 110)	(≥ 15)	-4	52	11/64	200-240		
						-22	37				

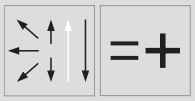
Characteristics and application

Basic electrode for vertical-down welding of large diameter, high strength pipelines and for structural work. Suitable for filler and cap layers in pipe welds. The deposit is extremely crack resistant and features a high toughness and very low hydrogen content. The deposition rate is 80-100% higher than obtainable in vertical-up welding. Due to the specially designed electrode tip, the arc striking is improved and start porosity can be avoided. Good general welding characteristics make this special basic electrode suited for convenient welding, also under difficult conditions.

Approvals

SEPROZ

Basic electrodes for vertical-down welding

BÖHLER FOX BVD 120	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 18275-A: E 69 3 Mn2NiMo B 4 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E12018-G	%		MPa	MPa	%	°C	J	mm	A		
	C	0.07	815	870	18	+20	80	3.2	110-160	L690	X100
	Si	0.4	(≥ 740)	(≥ 830)	(≥ 17)	-20	60	4.0	180-220		
	Mn	1.85				-30	50 (≥ 47)				
	Ni	2.25									
Re-drying if necessary: 300-350 °C (570-660 °F) / min. 2h	Mo	0.35	YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
			118	126	18	+68	59	1/8	110-160		
Recommended interpass temperature > 120 °C (248 °F)			(≥ 107)	(≥ 120)	(≥ 14)	-4	44	5/32	180-220		
						-22	37				

Characteristics and application

Basic electrode for vertical-down welding of large diameter, high strength pipelines and for structural work. Suitable for filler and cap layers in pipe welds. The deposit is extremely crack resistant and features a high toughness and very low hydrogen content. The deposition rate is 80-100% higher than obtainable in vertical-up welding. Due to the specially designed electrode tip, the arc striking is improved and start porosity can be avoided. Good general welding characteristics make this special basic electrode suited for convenient welding, also under difficult conditions.

Welding Techniques Basic Electrodes for Vertical-down Welding

Combined technology with cellulosic and basic electrodes

In combination with basic vertical-down electrodes (BVD) root passes can either be welded with cellulosic or basic vertical-up electrodes.

When root passes are welded with cellulosic electrodes in the vertical-down position, hot passes shall preferably be welded with cellulosic electrodes as well.

Preheating and interpass temperature

The interpass temperature influences the metallurgical processes that take place in the deposit during solidification and cooling and thus influences to a certain extent also the mechanical properties of the basic vertical-down weld metal.

It is generally recommended that the interpass temperature shall be maintained in the range of 100 °C - 200 °C (210 °F - 392 °F) throughout welding.

Joint preperation, preheating and interpass for cellulosic electrodes shall be according to the recommendation on page 18.

Welding machines

Basic vertical-down electrodes can only be operated on direct current. Welding machines must have a dropping characteristic and high open circuit voltage.

Welding Techniques Basic Electrodes for Vertical-down Welding

Filler passes

These passes are executed with 3.2 mm, 4.0 mm and 4.5 mm dia electrodes, depending upon pipe thickness.

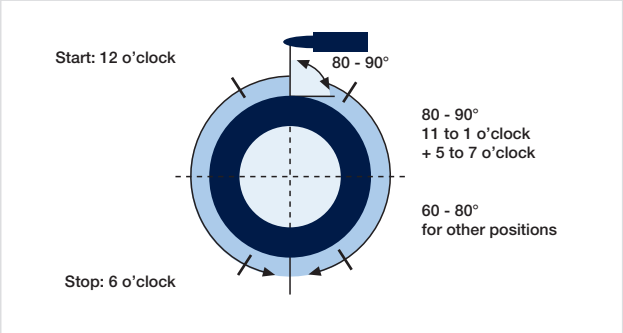
Electrode diameter:		
3.2 mm	(1/8")	110 - 160 A
4.0 mm	(5/32")	180 - 210 A
4.5 mm	(3/16")	200 - 240 A

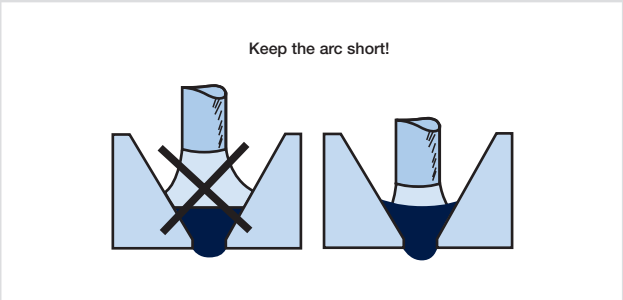
The high amperage ensures sufficient penetration and satisfactory economy of the process.

Slight weaving is always recommended as this prevents short-circuiting the arc.

For welding heavy wall pipe, we recommend to deposit two to three beads side by side, removing all slag before applying the next bead.

Keep the arc as short as possible.



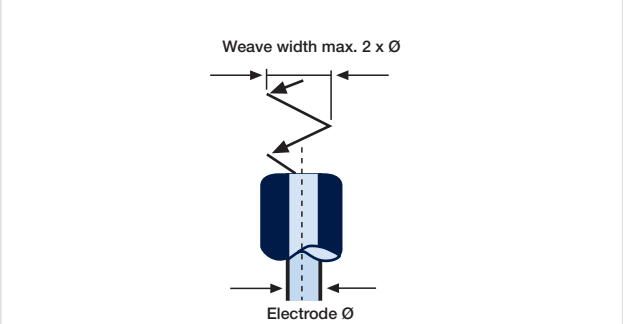


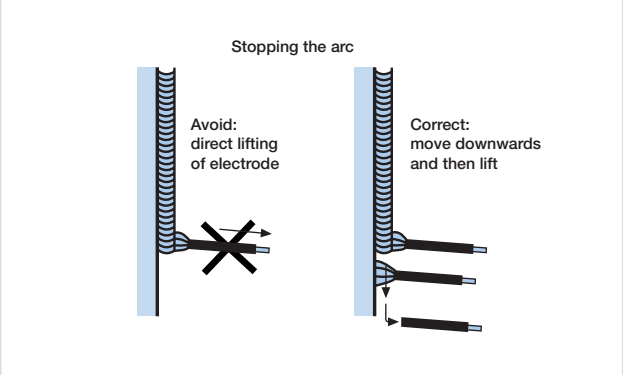
Cap

The cap is deposited with a slight weaving technique, with a maximum weave of twice the electrode diameter.

Recommended amperages:

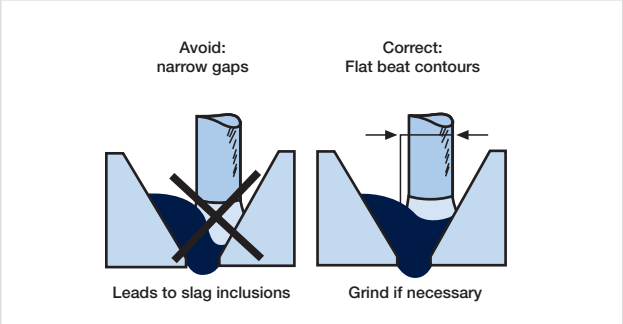
Electrode diameter:		
3.2 mm	(1/8")	110 - 160 A
4.0 mm	(5/32")	180 - 210 A





Storage of basic electrodes

Basic electrodes which have been stored in sealed cans do not need to be rebaked. Once a can has been opened, the electrodes can be used up to 8 hours. Basic electrodes which are taken from unsealed, damaged cans or those which have been kept in open storage for more than 8 hours, should be rebaked at 300 - 350 °C (570 - 660 °F) for two hours minimum and ten hours maximum. In the event of a relative air humidity of more than 70% it is recommended to use heated quivers maintaining a temperature of 120 - 200 °C (248 - 400 °F) prior to use.



Basic electrodes for vertical-up welding

BÖHLER FOX EV PIPE	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 42 4 B 1 2			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E7016-1	%		MPa	MPa	%	°C	J	mm	A		
	C	0.06	470	560	29	+20	170	2.0	30-60	L290NB-L360NB	A
	Si	0.60	(≥ 420)	(500-640)	(≥ 20)	-20	100	2.5	40-90	L290MB-L415MB	B
	Mn	0.9				-40	60 (≥ 47)	3.2	60-130	L450 MB1-555MB1	X42-X60
						-45	55 (≥ 27)	4.0	110-180		X65[1]-X80[1]
Root pass negative polarity			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A	[1] Only for root pass	
Re-drying if necessary: 300 - 350 °C (570 - 660 °F) / min. 2h			68	81	29	+68	125	5/64	30-60		
			(≥ 58)	(≥ 70)	(≥ 22)	-4	74	3/32	40-90		
						-40	44	1/8	60-130		
Preheat and interpass temperature as required by the base material. The optimum gap width for root passes is 2-3 mm, the root face should be in the range 2-2.5 mm.						-50	41 (≥ 27)	5/32	110-180		

Characteristics and application

Basic electrode with some additions of rutile and silicates. Excellent suited for positional welding of root passes using DC- negative polarity. Also for filler and cap layers in pipes, tubes and plates using DC+ positive polarity, or even AC. User-friendly electrode with good gap bridging capability and with easy slag removal ensuring minimum grinding. Good weld metal impact toughness down to -45 °C (-50 °F). Böhler FOX EV PIPE offers considerable time savings in root pass welding compared with AWS E7018 type electrodes, due to increased travel speed. Use of diameter 3.2 mm electrodes is possible as from 8 mm wall thickness. Böhler FOX EV PIPE can be used in sour gas applications (HIC-Test acc. NACE TM-02-84). Test values for SSC test are available too.

Approvals

TÜV (7620), DB (10.014.77), LTSS, SEPROZ, CE, NAKS (ø 2.5-4.0 mm), GAZPROM (ø 2.5-4.0 mm)

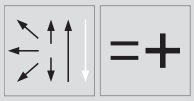
BÖHLER FOX EV 50-W	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 42 5 B 12 H5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.1: E7016-1H4R	%		MPa	MPa	%	°C	J	mm	A		
	C	0.07	460	560	28	+20	200	2.5	55-85	L245NB-L415NB	A, B
	Si	0.5	(≥ 420)	(500-640)	(≥ 20)	-20	150	3.2	80-140	L245MB-L415MB	X42-X60
	Mn	1.1				-50	≥ 47	4.0	110-180		
								5.0	180-230		
Root pass negative polarity			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
Re-drying if necessary: 300 - 350 °C (570 - 660 °F) / min. 2h			67	81	28	+68	148	3/32	55-85		
			(≥ 58)	(≥ 70)	(≥ 22)	-4	111	1/8	80-140		
						-50	≥ 20	5/32	110-180		
Preheat and interpass temperature as required by the base material.								3/16	180-230		

Characteristics and application

Basic electrode for high quality joint welds. Especially suited for root pass welding. Excellent weldability in all positions, except vertical-down. Smooth and slag-free welds. Crack resistant deposits of high toughness at ambient and sub-zero temperatures. Very low diffusible hydrogen content - AWS class H4/ HDM < 4 ml/100g weld metal. Especially suited for welding on AC. DC negative polarity recommended for root passes.

Approvals

TÜV (4180), GL (3YH5), LTSS, SEPROZ

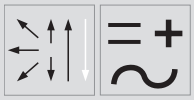
BÖHLER FOX EV 50	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 42 5 B 4 2 H5			**Re**	**Rm**	**A5**	**CVN**		**ø**		**EN**	**API 5L**
AWS A5.1: E7018-1H4R	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**	**A**		
	C	0.08	460	560	27	+20	190	2.0	50-70	L245NB-L415NB	A,B
	Si	0.4	(≥ 420)	(500-640)	(≥ 20)	-20	160	2.5	80-110	L245MB-L415MB	X42-X60
	Mn	1.2				-50	70 (≥ 47)	3.2	100-140		
								4.0	130-180		
Re-drying if necessary: 300 - 350 °C (570 - 660 °F) / min. 2h								5.0	180-230		
			YS	**TS**	**E (L=4d)**	**CVN**		**ø**			
			ksi	**ksi**	**%**	**°F**	**ft-lbf**	**inch**	**A**		
Preheat and interpass temperature as required by the base material.			67	81	27	+68	140	5/64	50-70		
			(≥ 58)	(≥ 70)	(≥ 22)	-4	118	3/32	80-110		
						-50	52 (≥ 20)	1/8	100-140		
								5/32	130-180		
								3/16	180-230		

Characteristics and application

Basic electrode designed for high-quality welds. Excellent strength and toughness properties down to -50 °C (-58 °F). Metal recovery approx. 110%. Good weldability in all positions, except vertical-down. Very low diffusible hydrogen weld metal- AWS class H4 / HDM < 4ml/100g weld metal. Suitable for welding low-purity steels with a high carbon content. Used in steel contruction, boiler and tank manufacture, vehicle construction, shipbuilding and machine construction, as well as for buffer layers on high carbon steels. Especially suited for offshore construction. CTOD tested at -10 °C (14 °F). Böhler FOX EV 50 can be used in sour gas applications (HIC-Test acc. NACE TM-02-84). Results from SSC testing are available too.

Approvals

TÜV (0426), DB (10.014.02), ABS (3H5, 4Y), BV (3YHHH), DNV (3YH10), GL (4Y40H15), LR (3, 3YH5), RMR (3YHH), RINA (4YH5/4H5), LTTS, VUZ, SEPROZ, PDO, CRS (3YH5), CE. NAKS

Phoenix 120 K	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 42 5 B 3 2 H5			**Re**	**Rm**	**A5**	**CVN**		**ø**		**EN**	**API 5L**
AWS A5.1: E7018-1	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**	**A**		
	C	0.07	440	530	30	+20	190	2.0	45 - 65	L245NB - L415NB	A,B
	Si	0.35	(≥ 420)	(500-640)	(≥ 20)	-50	100	2.5	65 - 110	L245MB - L415MB	X42 - X60
	Mn	1.20						3.2	100 - 145		
								4.0	135 - 200		
Re-drying if necessary: 300 - 350 °C (570 - 660 °F) / min. 2h								5.0	180 - 280		
			YS	**TS**	**E (L=4d)**	**CVN**		**ø**			
			ksi	**ksi**	**%**	**°F**	**ft-lbf**	**inch**	**A**		
Preheat and interpass temperature as required by the base material.			64	77	30	+68	140	5/64	45 - 65		
			(≥ 58)	(≥ 70)	(≥ 22)	-50	(≥ 20)	3/32	65 - 110		
						-58	74	1/8	100 - 145		
								5/32	135 - 200		
								3/16	180 - 280		

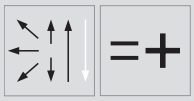
Characteristics and application

Basic covered electrode. Excellent welding characteristics including out of position work, except vertical-down. 120 % weld metal recovery. H_2-content in the weld metal ≤ 5 ml / 100 g. Very pure cryogenic weld metal at temperatures as low as –50 °C (–58 °F); CTOD tested up to –10 °C (14 °F).

Approvals

TÜV (00348), DB (10.132.17), ABS, BV, DNV, GL, LR, CE

Basic electrodes for vertical-up welding

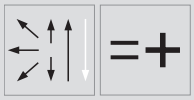
BÖHLER FOX EV 60	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 46 6 1Ni B 4 2 H5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E8018-C3H4R	%		MPa	MPa	%	°C	J	mm	A		
	C	0.07	510	610	27	+20	180	2.5	80-100	L360NB, L415NB	X52-X65
	Si	0.4	(≥ 460)	(580-740)	(≥ 20)	-60	110 (≥ 47)	3.2	110-140	L360MB-L450MB	
	Mn	1.15						4.0	140-180		
	Ni	0.9						5.0	190-230		
Re-drying if necessary: 300 - 350 °C (570 - 660 °F) / min. 2h			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
			74	88	27	+68	133	3/32	80-100		
Preheat and interpass temperature as required by the base material.			(68-80)	(≥ 80)	(≥ 24)	-76	81	1/8	110-140		
						-40	≥ 20	5/32	140-180		
								3/16	190-230		

Characteristics and application

Basic <1% Ni-alloyed electrode with excellent mechanical properties, particularly low-temperature toughness and crack resistance. Suitable for service temperatures from 350 °C (662 °F) down to -60 °C (-76 °F). Very good impact toughness in aged condition. Metal recovery about 115%. Good weldability in all positions, except vertical-down. Very low diffusible hydrogen content - AWS class H4 / HDM < 4ml/100g weld metal. CTOD tested at -40 °C (-40 °F). Results from SSC testing available.

Approvals

TÜV (1524), DNV (3YHH), RMR (3YHH), Statoil, LTSS, SEPROZ, CRS (3YH5), VG 95132, CE, ABS

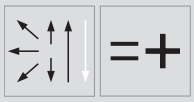
BÖHLER FOX EV 60 PIPE	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 50 4 1Ni B 1 2 H5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E8016-GH4R	%		MPa	MPa	%	°C	J	mm	A		
	C	0.07	550	590	29	+20	170	2.5	40-90	L210NB-L450NB	X42-X65
	Si	0.60	(≥ 500)	(560-720)	(≥ 18)	0	150	3.2	60-130	L210MB-L450MB	
	Mn	1.2				-20	140	4.0	110-180		
	Ni	0.9				-40	110 (≥ 47)	5.0	180-230		
						-45	60				
Re-drying if necessary: 300 - 350 °C (570 - 660 °F) / min. 2h			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
			80	85	29	+68	125	3/32	40-90		
Preheat and interpass temperature as required by the base material.			(≥ 67)	(≥ 80)	(≥ 19)	+32	110	1/8	60-130		
						-4	103	5/32	110-180		
						-40	81	3/16	180-230		
						-50	44				

Characteristics and application

Basic coated electrode for positional welding of filler and cap layers in tubes and plates. Good impact toughness down to -40 °C (-40 °F) and low hydrogen content (HDM < 5ml/100g). Packed in hermetically sealed tins.

Approvals

NAKS (ø 3.2 mm), GAZPROM (ø 3.2 mm)

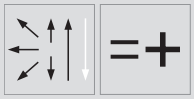
BÖHLER FOX EV 65	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 18275-A: E 55 1NiMo B 4 2 H5											
AWS A5.5: E8018-GH4R / E8018-D1H4R	**%**		**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**	**ø mm**	**A**	**EN**	**API 5L**
	C	0.06	600	650	25	+20	180	2.5	80-100	L415NB	X60-X70
	Si	0.3	(≥ 550)	(620-780)	(≥ 18)	-60	80 (≥ 47)	3.2	100-140	L415MB, L485MB	
	Mn	1.2						4.0	140-180		
	Ni	0.8						4.8	180-220		
Re-drying if necessary: 300 - 350 °C (570 - 660 °F) / min. 2h	Mo	0.35						5.0	190-230		
			YS ksi	**TS ksi**	**E (L=4d) %**	**CVN °F**	**ft-lbf**	**ø inch**	**A**		
Preheat and interpass temperature as required by the base material.			87	94	25	+68	132	3/32	80-100		
			(≥ 67)	(≥ 80)	(≥ 19)	-76	59	1/8	100-140		
						-60	≥ 20	5/32	140-180		
								-	180-220		
								3/16	190-230		

Characteristics and application

Basic electrode providing a high ductily, crack resistant weld deposit for service temperatures down to -60 °C (-76 °F). Resistant to ageing. Good weldability in position, except vertical-down. Very low diffusible hydrogen weld content - AWS class H4 / HDM < 4ml/100g weld metal.

Approvals

TÜV (1802), SEPROZ, NAKS, VG 95132, BV, RMR, ABS, CE

Phoenix SH V 1	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 50 6 Mn1Ni B 4 2 H5											
AWS A5.1: E8018-G (E8018-C3 mod.)	**%**		**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**	**ø mm**	**A**	**EN**	**API 5L**
	C	0.07	540	630	28	+20	180	3.2	100 - 150	L360NB - L485NB	X52 - X70
	Si	0.25	(≥ 500)	(560-720)	(≥ 18)	-60	80 (≥ 47)	4.0	140 - 200		
	Mn	1.50						5.0	170 - 250	L360MB - L485MB	
	Ni	0.95									
Re-drying if necessary: 300 - 350 °C (570 - 660 °F) / min. 2h			**YS ksi**	**TS ksi**	**E (L=4d) %**	**CVN °F**	**ft-lbf**	**ø inch**	**A**		
Preheat and interpass temperature as required by the base material.			78	91	28	+68	133	1/8	100 - 150		
			(≥ 67)	(≥ 80)	(≥ 19)	-76	59	5/32	140 - 200		
								3/16	170 - 250		

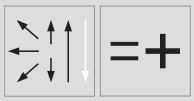
Characteristics and application

Basic covered MnNi-alloyed electrode. High toughness at temperatures as low as –60 °C (–76 °F). High radio-graphical soundness. H_2-content ≤ 5 m l/ 100 g (HD). CTOD- and NDT tested.

Approvals

TÜV (00531), DB (10.132.37), ABS, BV, DNV, GL, LR, VG 95132-1, CE

Basic electrodes for vertical-up welding

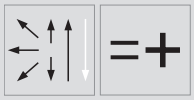
BÖHLER FOX EV 70	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 18275-A: E 55 6 1NiMo B 4 2 H5											
AWS A5.5: E9018-GH4R / E9018-D1H4R (mod.)	%		Re MPa	Rm MPa	A5 %	CVN °C	J	ø mm	A	EN	API 5L
	C	0.04	650	700	24	+20	160	2.5	80-100	L415MB, L485MB	X60-X70
	Si	0.3	(≥ 550)	(620-780)	(≥ 18)	-60	70 (≥ 47)	3.2	100-140		
	Mn	1.2						4.0	140-180		
	Ni	0.9						5.0	190-230		
Re-drying if necessary: 300 - 350 °C (570 - 660 °F) / min. 2h	Mo	0.4	YS ksi	TS ksi	E (L=4d) %	CVN °F	ft-lbf	ø inch	A		
			94	101	24	+68	118	3/32	80-100		
Preheat and interpass temperature as required by the base material.			(≥ 77)	(≥ 90)	(≥ 17)	-76	52	1/8	100-140		
						-60	≥ 20	5/32	140-180		
								3/16	190-230		

Characteristics and application

Basic Mo-Ni-alloyed electrode depositing a high ductility, crack resistant weld, for welding high strength, fine-grained steels. Suitable for service temperatures from +350 °C (662 °F)down to -60 °C (-76 °F). Metal recovery of approximately 115%. Good weldability in all positions, except vertical-down. Very low diffusible hydrogen content - AWS class H4 / HDM < 4ml/100g weld metal.

Approvals

TÜV (0112), SEPROZ, CE

BÖHLER FOX EV 70 PIPE	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 18275-A: E 55 4 ZMn2NiMo B 1 2 H5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E9016-GH4R	%		MPa	MPa	%	°C	J	mm	A		
	C	0.06	620	680	20	+20	140	2.5	40-90	L450MB - L555MB	X65-X80
	Si	0.5	(≥ 550)	(620-780)	(≥ 18)	-20	80	3.2	60-130		
	Mn	1.7				-40	70 (≥ 47)	4.0	110-180		
	Ni	2.2				-45	55				
Re-drying if necessary: 300 - 350 °C (570 - 660 °F) / min. 2h	Mo	0.3	YS ksi	TS ksi	E (L=4d) %	CVN °F	ft-lbf	ø inch	A		
			90	98	20	+68	103	3/32	40-90		
Preheat and interpass temperature as required by the base material.			(≥ 77)	(≥ 90)	(≥ 17)	-4	59	1/8	60-130		
						-40	52	5/32	110-180		
						-50	48				

Characteristics and application

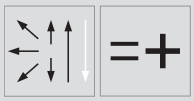
Böhler FOX EV 70 PIPE is a high strength, basic electrode for positional welding of filler and cap layers in tubes, pipes and plate using DC+ positive polarity. It is user-friendly, has good gap bridging ability and easy slag removal to ensure minimal grinding. Good impact toughness down to -40 °C (-40 °F) and low hydrogen content (HDM < 5ml/100g). Packed in hermetically sealed tins.

Approvals

TÜV (12809), CE

BÖHLER FOX EV 75

EN ISO 18275-A: E 62 6 Mn2NiCrMo B 4 2 H5
AWS A5.5: E10018-GH4R / E10018MH4R (mod.)



Re-drying if necessary:
300 - 350 °C (570 - 660 °F) / min. 2h

Preheat and interpass temperature as required by the base material.

Typical analyses all weld metal	
%	
C	0.05
Si	0.4
Mn	1.6
Cr	0.4
Ni	2.0
Mo	0.4

Typical mechanical properties all weld metal					
Re MPa	Rm MPa	A5 %	CVN °C	J	
700	750	23	+20	140	
(≥ 620)	(690-980)	(≥ 18)	-60	≥ 47	
YS ksi	TS ksi	E (L=4d) %	CVN °F	ft-lbf	
101	109	23	+68	103	
(≥ 87)	(≥ 100)	(≥ 16)	-60	≥ 20	

Diameter and welding current	
ø mm	A
2.5	80-100
3.2	100-140
4.0	140-180
5.0	190-230
ø inch	A
3/32	80-100
1/8	100-140
5/32	140-180
3/16	190-230

Pipeline steel grades	
EN	API 5L
L555MB	X80

Characteristics and application

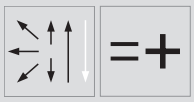
Basic Cr-Ni-Mo-alloyed electrode depositing a high ductility, crack resistant weld, for welding high strength, fine-grained steels. Suitable for service temperatures from +400 °C (752 °F°) down to -60 °C (-76 °F). Metal recovery of approximately 120%. Good weldability in all positions, except vertical-down. Very low diffusible hydrogen content - AWS class H4 / HDM 4ml/100g weld metal.

Approvals

SEPROZ

BÖHLER FOX EV 85

EN ISO 18275-A: E 69 6 Mn2NiCrMo B 4 2 H5
AWS A5.5: E11018-GH4R / E11018-MH4R (mod.)



Re-drying if necessary:
300 - 350 °C (570 - 660 °F) / min. 2h

Preheat and interpass temperature as required by the base material.

Typical analyses all weld metal	
%	
C	0.05
Si	0.4
Mn	1.7
Cr	0.4
Ni	2.1
Mo	0.5

Typical mechanical properties all weld metal					
Re MPa	Rm MPa	A5 %	CVN °C	J	
780	840	20	+20	110	
(≥ 690)	(760-960	(≥ 17)	-60	60 (≥ 47)	
YS ksi	TS ksi	E (L=4d) %	CVN °F	ft-lbf	
113	122	20	+68	81	
(≥ 97)	(≥ 110)	(≥ 15)	-60	≥ 20	

Diameter and welding current	
ø mm	A
2.5	70-100
3.2	100-140
4.0	140-180
5.0	190-230
ø inch	A
3/32	70-100
1/8	100-140
5/32	140-180
3/16	190-230

Pipeline steel grades	
EN	API 5L
L625, L690	X90, X100

Characteristics and application

Basic Cr-Ni-Mo-alloyed electrode depositing a high ductility, crack resistant weld, for welding high strength, fine-grained steels. Suitable for service temperatures down to -60 °C (-76 °F). Good weldability in all positions, except vertical-down. Very low diffusible hydrogen content - AWS class H4 / HDM < 4ml/100g weld metal.

Approvals

TÜV (4313), DB (10.014.22), SEPROZ, BV, CE

Flux-cored wires for automatic and semi-automatic pipeline welding

BÖHLER Ti 52-FD	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades	
EN ISO 17632-A: T 46 4 P M 1 H10 / T 42 2 P C 1 H5 AWS A5.36: E71T1-M21A4-CS1-H8 E71T1-C1A2-CS1-H4	%			Re MPa	Rm MPa	A5 %	CVN °C	J	ø mm	EN	API 5L
=+	C	0.06	M21	500	580	26	+20	180	1.2	L245NB-L415NB	A,B
	Si	0.5		(≥ 460)	(550-740)	(≥ 20)	-20	130	1.6	L450QB	X42-X65
	Mn	1.2					-40	90 (≥47)		L245MB-L450MB	
	Ti	0.05	C1	480	550	25	+20	160			
				(≥ 420)	(500-670)	(≥ 20)	-20	110 (≥47)			
				YS ksi	TS ksi	E (L=4d) %	CVN °F	ft-lbf	ø inch		
			M21	72	84	26	+68	133	0.045		
				(≥ 58)	(70-95)	(≥ 22)	-4	96	1/16		
							-40	66 (≥ 20)			
			C1	70	80	25	+68	118			
				(≥ 58)	(70-95)	(≥ 22)	-20	81 (≥ 20)			

Shielding gas:
M21: Ar + 15-25% CO_2
C1: 100% CO_2

Preheating and interpass temperature as required by base metal

Re-drying possible at 150 °C (300 °F) / 24h, but generally not needed

Characteristics and application

All-positional rutile flux-cored wire with fast freezing slag system. Welder-friendly characteristics. The diameter 1.2 mm size can be used in all welding positions with the same parameter setting. Low spatter losses, easy slag removal, finely rippled bead surface. High X-ray quality welds with excellent mechanical properties. The most productive consumable for manual positional welding with deposition rates up to three times as high as with SMAW / mmA. Can be used with conventional non-pulse power sources.

Approvals

TÜV (11164), DB (42.014.35), ABS, GL, LR, DNV, BV, CRS, CE

BÖHLER Ti 60-FD	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades	
EN ISO 17632-A: T 50 6 1Ni P M 1 H5 AWS A5.36: E81T1-M21A8-Ni1-H4	%			Re MPa	Rm MPa	A5 %	CVN °C	J	ø mm	EN	API 5L
=+	C	0.06	M21	530	570	27	+20	140	1.2	L245NB-L415NB	B
	Si	0.45		(≥ 500)	(560-720)	(≥ 18)	-20	120		L245MB-L485MB	X42-X70
	Mn	1.3					-40	100			
	Ni	0.9					-60	60 (≥47)			
				YS ksi	TS ksi	E (L=4d) %	CVN °F	ft-lbf	ø inch		
			M21	77	83	27	+68	103	0.045		
				(≥ 68)	(80-100)	(≥ 19)	-4	86			
							-40	74			
							-80	44 (≥ 20)			

Shielding gas:
M21: Ar + 15-25% CO_2

Preheating and interpass temperature as required by base metal

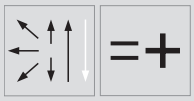
Re-drying possible at 150 °C (300 °F) / 24h, but generally not needed

Characteristics and application

All-positional rutile flux-cored wire with fast freezing slag system for welding low-temperature steels.Outstanding welding characteristics in all positions. Low spatter losses, good slag detachability, finely rippled smooth beads and notch-free toes. Exceptionally good low-temperature impact toughness down to -60 °C (-80 °F). The wire is CTOD tested. The most productive consumable for manual positional welding with deposition rates up to three times as high as with SMAW / mmA. Can be used with conventional non-pulse power sources. BÖHLER Ti 60-FD can be used for sour gas applications (HIC test acc. to NACE TM 02-84). Test results from SSC testing available too.

Approvals

TÜV (11544), DB (42.014.42), GL (6Y46H5S), ABS, DNV, LR, BV, CE

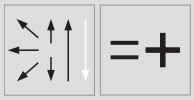
BÖHLER Ti 70 Pipe-FD	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
EN ISO 18276-A: T 55 4 Mn1Ni P M 1 H5			**Re**	**Rm**	**A5**	**CVN**		**ø**	**EN**	**API 5L**
AWS A5.36: E91T1-M21A4-G	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**		
	C	0.07	≥ 550	640-820	≥ 18	-40	≥47	1.2	L450MB-L485MB	X65-X70
	Si	0.50							(L555MB)	(X80)
	Mn	1.50								
	Ni	0.95	**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**		
Shielding gas: M21: Ar + 15-25% CO_2			**ksi**	**ksi**	**%**	**°F**	**ft-lbf**	**inch**		
			≥ 78	90-110	≥ 17	-40	≥ 20	0.045		
Re-drying possible at 150 °C (300 °F) / 24h, but generally not needed										
Preheating and interpass temperature as required by base metal										

Characteristics and application

Rutile micro alloyed flux-cored wire for single or multipass welding of carbon-manganese steels and high strength steels with Ar-CO_2 shielding gas. Main features: excellent weldability in all positions, excellent bead appearance, no spatter; fast freezing and easily removable slag. The exceptional mechanical properties of this wire even at the low temperature (-40 °C) (-40 °F), as well as the low content of diffusible hydrogen make it especially suitable for pipeline applications. Further applications are found in the offshore industry, shipbuilding and structures built with high strength steels. Spray arc operation with all parameters allows the used of standard, non-pulse power sources.

Approvals

TÜV (12279),CE, GAZPROM

BÖHLER Ti 80 Pipe-FD	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
EN ISO 18276-A: T 69 4 Z P M 1 H5			**Re**	**Rm**	**A5**	**CVN**		**ø**	**EN**	**API 5L**
AWS A5.36: E111T1-M21A4-GH4	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**		
	C	0.07	790	850	18	-40	65 (≥ 47)		L485MB, L555MB	X70, X80
	Si	0.3	(≥ 690)	(770-940)	(≥ 17)					
	Mn	1.8								
	Ni	2.1	**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**		
Shielding gas: M21: Ar + 15-25% CO_2			**ksi**	**ksi**	**%**	**°F**	**ft-lbf**	**inch**		
			114	123	18	-40	48 (≥ 20)	0.045		
Re-drying possible at 150 °C (300 °F) / 24h, but generally not needed			(≥ 98)	(110-130)	(≥ 15)					
Preheating and interpass temperature as required by base metal										

Characteristics and application

Seamless rutile Ni-Mo alloyed flux-cored wire for single- or multi-pass welding of high strength steels, using Ar-CO_2 shielding gas. It features excellent weldability in all positions, excellent bead appearance, no spatter and a fast freezing slag that is easily removed. Its very low hydrogen weld metal and good impact toughness down to -40 °C (-40 °F) make the wire especially suited for pipeline applications. Further use is found in offshore fabrication, shipbuilding and in high strength steel structures. Spray arc operation with all parameters allows the use of standard, non-pulse power sources.

Self-shielded flux-cored wires for semi-automatic pipeline welding

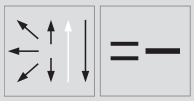
BÖHLER Pipeshield 71 T8-FD	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
AWS A5.36: E71T8-A4-K6			Re	Rm	A5	CVN		ø	EN	API 5L
	%		MPa	MPa	%	°C	J	mm		
	C	0.045	435	535	28	+20	200	2.0		A. B
	Si	0.14	(≥ 400)	(490-660)	(≥ 22)	-30	150			X42-X60
	Mn	1.1				-40	100 (≥27)			
	Al	0.8	YS	TS	E (L=4d)	CVN		ø		
Self-shielded	Ni	0.7	ksi	ksi	%	°F	ft-lbf	inch		
			63	77	28	+68	148	5/64		
Recommended stick-out: 10-25 mm (0.4-1 “)			(≥ 58)	(70-95)	(≥ 22)	-22	111			
						-40	74 (≥ 20)			

Characteristics and application

BÖHLER Pipeshield 71 T8-FD is a self-shielded flux-cored wire especially developed for semi-automatic pipe welding in vertical-down (5G) position. It is also suitable for welding unalloyed steel constructions. This wire has a fast freezing, easily removable slag, excellent welding characteristics, is welder-friendly and provides high productivity. BÖHLER Pipeshield 71 T8-FD is designed to provide good mechanical properties as well as high impact toughness at low temperatures. Outstanding characteristics for vertical-down welding of hot pass, fill and cap layers. Due to the fluoride-basic filling, a similar interpass temperatures as with basic electrodes can be applied (we recommend 80 - 200 °C (176-392 °F). This self-shielded flux cored wire is easy to handle by welders, due to a very tolerant stick-out length and low tendency to porosity also when welding with a high arc length as a result of higher voltage.

Approvals

NAKS, GAZPROM

BÖHLER Pipeshield 71.1 T8-FD	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
AWS A5.36: E71T8-A4-Ni1			Re	Rm	A5	CVN		ø	EN	API 5L
	%		MPa	MPa	%	°C	J	mm		
	C	0.045	435	535	28	+20	200	2.0		A, B
	Si	0.14	(≥ 400)	(490-660)	(≥ 22)	-30	150			X42-X60
	Mn	1.1				-40	120 (≥27)			
	Al	0.8	YS	TS	E (L=4d)	CVN		ø		
Self-shielded	Ni	0.95	ksi	ksi	%	°F	ft-lbf	inch		
			63	77	28	+68	148	5/64		
Recommended stick-out: 10-25 mm (0.4-1 “)			(≥ 58)	(70-95)	(≥ 22)	-22	111			
						-40	89 (≥ 20)			

Characteristics and application

BÖHLER Pipeshield 71.1 T8-FD is a self-shielded flux-cored wire especially developed for semi-automatic pipe welding in vertical-down (5G) position. It is also suitable for welding unalloyed steel constructions. This wire has a fast freezing, easily removable slag, excellent welding characteristics, is welder-friendly and provides high productivity. BÖHLER Pipeshield 71.1 T8-FD is designed to provide good mechanical properties as well as high impact toughness at low temperatures. Outstanding characteristics for vertical-down welding of hot pass, fill and cap layers. Due to the fluoride-basic filling, a similar interpass temperatures as with basic electrodes can be applied (we recommend 80 - 200 °C (176-392 °F). This self-shielded flux cored wire is easy to handle by welders, due to a very tolerant stick-out length and low tendency to porosity also when welding with a high arc length as a result of higher voltage.

BÖHLER Pipeshield 81 T8-FD	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
AWS A5.36: E81T8-A4-Ni2			Re	Rm	A5	CVN		ø	EN	API 5L
	%		MPa	MPa	%	°C	J	mm		
	C	0.05	500	600	25	+20	170	2.0		X65, X70
	Si	0.15	(≥ 470)	(550-690)	(≥ 19)	-30	120			
	Mn	1.4				-40	90 (≥27)			
	Al	0.8	YS	TS	E (L=4d)	CVN		ø		
Self-shielded	Ni	1.95	ksi	ksi	%	°F	ft-lbf	inch		
			72	87	25	+68	125	5/64		
Recommended stick-out: 10-25 mm (0.4-1 “)			(≥ 68)	(80-100)	(≥ 19)	-22	89			
						-40	66 (≥ 20)			

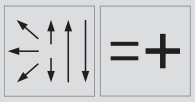
Characteristics and application

BÖHLER Pipeshield 81 T8-FD is a self-shielded flux-cored wire especially developed for semi-automatic pipe welding in vertical-down (5G) position. It is also suitable for welding low-alloyed steel constructions. This wire has a fast freezing, easily removable slag, excellent welding characteristics, is welder-friendly and provides high productivity. BÖHLER Pipeshield 81 T8-FD is designed to provide good mechanical properties as well as high impact toughness at low temperatures. Outstanding characteristics for vertical-down welding of hot pass, fill and cap layers. Due to the fluoride-basic filling, similar interpass temperatures as with basic electrodes can be applied (we recommend 80 - 200 °C (176-392 °F). This self-shielded flux cored wire is easy to handle by welders, due to a high tolerance for stick-out length and low tendency to porosity also when welding with a high arc length as a result of higher voltage.

Approvals

NAKS, GAZPROM

Solid wires for automatic pipeline welding

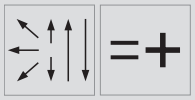
BÖHLER SG 3-P	Typical analyses all weld metal		Typical field results in X70 obtained with various automatic processes						Diameter	Pipeline steel grades	
EN ISO 14341-A: G 46 5 M21 Z / G 42 4 C1 Z				Re	Rm	A5	CVN		ø	EN	API 5L
AWS A5.18: ER70S-G	%			MPa	MPa	%	°C	J	mm		
	C	0.06	M21	670	720	29	+20	100	0.9	L290MB-L485MB	X42-X70
	Si	0.75		(≥ 460)	(530-680)	(≥ 20)	-40	75	1.0		
	Mn	1.55					-50	55 (≥ 47)	1.2		
	Ti	+	C1	630	690	30	+20	195			
Shielding gas: M21: Ar + 15-25 % CO_2 C1: 100 % CO_2				(≥ 420)	(500-640)	(≥ 20)	-40	50 (≥ 47)			
				YS	TS	E (L=4d)	CVN		ø		
				ksi	ksi	%	°F	ft-lbf	inch		
			M21	97	105	29	+68	74	0.035		
Preheating and interpass temperature as required by the base metal				(≥ 58)	(≥ 70)	(≥ 22)	-40	65	0.040		
									0.045		
			C1	91	100	30	+68	70			
				(≥ 40)	(≥ 70)	(≥ 22)	-40	37			

Characteristics and application

BÖHLER SG 3-P is a micro alloyed GMAW solid wire designed for high quality automatic welding of pipelines. An optimally balanced alloying concept ensures good weld metal properties to fulfil the high requirements in the on- and offshore pipeline industry. Deposit is extremely crack resistant with good weld metal toughness down to -50 °C. Good wire feeding properties are promoted due to close control of important quality aspects during production, such as cast and helix, copper coating, narrow diameter tolerance and precision layer wound spooling. BÖHLER SG 3-P can be used in sour gas applications (HIC-test acc. to NACE TM 02-84). Test values for SSC-test available too.

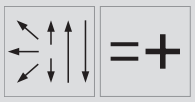
Approvals

TÜV (07682), CE, NAKS

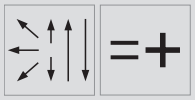
Union K 52 S	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades	
EN ISO 14341-A: G 42 4 M31 3Si1				Re	Rm	A5	CVN		ø	EN	API 5L
AWS A5.18: ER70S-6	%			MPa	MPa	%	°C	J	mm		
	C	0.07	M31	490	590	27	+20	155	0.9	L290MB - L450MB	A, B, X42 - X65
	Si	0.85		(≥ 420)	(500-640)	(≥ 22)	-30	105	1.0		
	Mn	1.50					-40	95 (≥ 47)	1.2		
Shielding gas: M31: Ar + 40 % CO_2				YS	TS	E (L=4d)	CVN		ø		
				ksi	ksi	%	°F	ft-lbf	inch		
			M31	71	86	27	+68	114	0.035		
Preheating and interpass temperature as required by the base metal				(≥ 65)	(≥ 78)	(≥ 24)	-22	(≥ 20)	0.040		
							-30	78	0.045		
							-40	69			

Characteristics and application

Mn, Si-alloyed solid wire electrode with a highly purified weld metal. Very low trace element content. Low spatter development in short and spray arc.
For fully automatic vertical-down and vertical-up welding of pipe steels up to X70.

Union K 56 S	Typical analyses all weld metal		Typical mechanical properties all weld metal							Diameter	Pipeline steel grades	
EN ISO 14341-A: G 46 4 M21 4Si1 / G 46 2 C1 4Si1				Re	Rm	A5	CVN			ø	EN	API 5L
AWS A5.18: ER70S-6	%			MPa	MPa	%	°C	J		mm		
	C	0.08	M21	520	620	25	+20	170		1.0	L290MB - L485MB	X42 - X70
	Si	1.05		(≥ 460)	(530-680)	(≥ 20)	-20	160		1.2		
	Mn	1.65					-40	100 (≥ 47)				
			C1	470	580	30	+20	130				
Shielding gas: M21: Ar + 15-25 % CO_2 C1: 100 % CO_2				(≥ 460)	(530-680)	(≥ 20)	-20	95 (≥ 47)				
							-40	60				
				YS	TS	E (L=4d)	CVN			ø		
				ksi	ksi	%	°F	ft-lbf		inch		
Preheating and interpass temperature as required by the base metal			M21	75	90	25	+68	125		0.040		
				(≥ 58)	(≥ 70)	(≥ 22)	-4	118		0.045		
							-22	≥20				
							-40	73				
			C1	68	84	30	+68	103				
				(≥ 58)	(≥ 70)	(≥ 22)	-4	89				
							-22	≥20				
Characteristics and application							-40	44				

All-purpose Mn-, Si-alloyed solid wire electrode for use with C1 and Ar/CO_2 mixed gas. Low-spatter metal transfer in short and spray arc mode. For fully automatic vertical-down and vertical-up welding on steel pipes.

Union K Nova	Typical analyses all weld metal		Typical field results in X70 obtained with various automatic processes							Diameter	Pipeline steel grades	
EN ISO 14341-A: G 46 5 M21 Z / G 42 4 C1 Z				Re	Rm	A5	CVN			ø	EN	API 5L
AWS A5.18: ER70S-G	%			MPa	MPa	%	°C	J		mm		
	C	0.06	M21	670	720	29	+20	100		0.9	L290MB - L485MB	X42 - X70
	Si	0.75		(≥ 460)	(530-680)	(≥ 20)	-40	65		1.0		
	Mn	1.55					-50	≥ 47		1.2		
	Ti	+	C1	630	690	30	+20	95				
				(≥ 420)	(500-640)	(≥ 20)	-40	50 (≥ 47)				
Shielding gas: M21: Ar + 15-25 % CO_2 C1: 100 % CO_2				YS	TS	E (L=4d)	CVN			ø		
				ksi	ksi	%	°F	ft-lbf		inch		
			M21	97	105	29	+68	74		0.035		
				(≥ 58)	(≥ 70)	(≥ 22)	-40	65		0.040		
Preheating and interpass temperature as required by the base metal										0.045		
			C1	91	100	30	+68	70				
				(≥ 40)	(≥ 70)	(≥ 22)	-40	37				

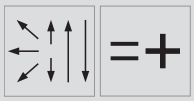
Characteristics and application

Union K Nova is a GMAW solid wire for automatic circumferential pipe welding. All quality characteristics regarding chemical composition, arc stability and feeding behaviours are optimised to meet the special quality requirements. CTOD values up to –5° C (– 21° F).
Fulfils strength-overmatching of X70 pipe steel.

Approvals

TÜV (05926), CE

Solid wires for automatic pipeline welding

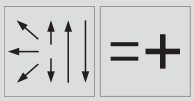
BÖHLER SG 8-P	Typical analyses all weld metal		Typical field results in X70 obtained with various automatic processes						Diameter	Pipeline steel grades	
EN ISO 14341-A: G 50 6 M21 Z3Ni1 / G 46 4 C1 Z3Ni1 AWS A5.18: ER80S-G (ER80S-Ni1(mod.))	%			Re MPa	Rm MPa	A5 %	CVN °C	J	ø mm	EN	API 5L
	C	< 0.09	M21	590	670	26	+20	200	0.9	L290MB-L555MB	X42-X80
	Si	0.75		(≥ 500)	(560-720)	(≥ 18)	-60	100 (≥47)	1.0		
	Mn	1.60	C1	560	630	25	+20	110	1.2		
	Ni	0.9		(≥ 460)	(530-680)	(≥ 20)	-40	95 (≥ 47)			
Shielding gas: M21: Ar + 15-25 % CO_2 C1: 100 % CO_2	Ti	+		YS ksi	TS ksi	E (L=4d) %	CVN °F	ft-lbf	ø inch		
			M21	85	91	26	+68	148	0.035		
Preheating and interpass temperature as required by the base metal				(≥ 68)	(≥ 80)	(≥ 24)	-76	74	0.040		
			C1	91	100	25	+68	81	0.045		
				(≥ 68)	(≥ 80)	(≥ 24)	-40	70			

Characteristics and application

BÖHLER SG 8-P is a micro alloyed GMAW solid wire designed for high quality automatic welding of pipelines. An optimally balanced alloying concept ensures good weld metal properties to fulfil the high requirements in the on- and offshore pipeline industry. Deposit is extremely crack resistant with good weld metal toughness down to -50 °C (-58 °F).

Approvals

DNV (IV Y46 MS)

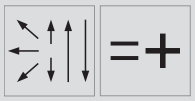
Union K Nova Ni	Typical analyses all weld metal		Typical field results in X70 obtained with various automatic processes						Diameter	Pipeline steel grades	
EN ISO 14341-A: G 50 6 M21 Z3Ni1 / G 46 4 C1 Z3Ni1 AWS A5.18: ER80S-G (ER80S-Ni1(mod.))	%			Re MPa	Rm MPa	A5 %	CVN °C	J	ø mm	EN	API 5L
	C	< 0.09	M21	590	670	26	+20	200	0.9	L290MB - L555MB	X42 - X80
	Si	0.75		(≥ 500)	(≥ 560-720)	(≥ 18)	-60	100 (≥ 47)	1.0		
	Mn	1.60							1.2		
	Ni	0.9	C1	560	630	25	+20	110			
	Ti	+		(≥ 460)	(530-680)	(≥ 20)	-40	95 (≥ 47)			
Shielding gas: M21: Ar + 15-25 % CO_2 C1: 100 % CO_2				YS ksi	TS ksi	E (L=4d) %	CVN °F	ft-lbf	ø inch		
			M21	85	91	26	+68	148	0.035		
				(≥ 68)	(≥ 80)	(≥ 24)	-76	74	0.040		
Preheating and interpass temperature as required by the base metal									0.045		
			C1	91	100	25	+68	81			
				(≥ 68)	(≥ 80)	(≥ 24)	-40	70			

Characteristics and application

Union K Nova Ni is a GMAW solid wire electrode for fully automatic circumferential vertical-down and vertical-up pipe welding with especially good impact toughness even at low temperatures.

Approvals

TÜV (11542), DNV, CE

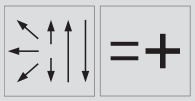
BÖHLER NiMo 1-IG	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades	
EN ISO 14341-A: G 55 6 M21 Mn3NiMo G 55 4 C1 Mn3Ni1Mo AWS A5.18: ER90S-G	**%**			**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**	**ø mm**	**EN**	**API 5L**
	C	0.08	M21	620	700	23	+20	140	0.9	L415MB- L555MB	X60-X80
	Si	0.6		(≥ 550)	(640-820)	(≥ 18)	-40	110	1.0		X60Q- X80Q
	Mn	1.8					-60	≥ 47	1.2	L515QB- L555QB	
	Mo	0.3	C1	590	680	22	+20	140			
Shielding gas: M21: Ar + 15-25 % CO_2 C1: 100 % CO_2	Ni	0.9		(≥ 550)	(620-770)	(≥ 20)	-40	≥ 47			
				YS ksi	**TS ksi**	**E (L=4d) %**	**CVN °F**	**ft-lbf**	**ø inch**		
			M21	90	101	23	+68	103	0.035		
Preheating and interpass temperature as required by the base metal					(≥ 90)		-40	81	0.040		
									0.045		
			C1	85	98	22	+68	103			
					(≥ 90)						

Characteristics and application

Copper-coated GMAW wire for high strength, quenched and tempered, fine-grained construction steels. The wire is used for joint welding in boiler, pressure vessel, pipeline, and crane construction, as well as in structural steel engineering. The typical composition of the wire satisfies the requirements of the NORSOK7 regulation for water injection systems. Due to precise addition of micro alloying elements and low weld metal hydrogen, NiMo 1-IG wire features excellent ductility and crack resistance, in spite of its high strength. Good low-temperature impact energy down to-60 °C (-76 °F). Good wire feeding properties.

Approvals

TÜV (11763), DB (42.014.06), GL (4Y55S), SEPROZ, NAKS (1.2 mm), GAZPROM (1.2 mm), CE, VG 95132.

Union NiMo 80	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades	
EN ISO 16834-A: G 62 5 M21 Mn3Ni1Mo AWS A5.28: ER90S-G	**%**			**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**	**ø mm**	**EN**	**API 5L**
	C	0.09	M21	680	760	22	+20	190	0.9	L485MB - L555MB	X70 - X80
	Si	0.65		(≥ 620)	(700-890)	(≥ 18)	-50	90 (≥ 47)	1.0		
	Mn	1.55							1.14		
	Ni	1.10	C1	620	705	21	+20	110			
	Mo	0.40					-40	75			
Shielding gas: M21: Ar + 15-25 % CO_2 C1: 100 % CO_2	Ti	+		**YS ksi**	**TS ksi**	**E (L=4d) %**	**CVN °F**	**ft-lbf**	**ø inch**		
			M21	98	110	22	+68	140	0.035		
							-58	66	0.040		
Preheating and interpass temperature as required by the base metal									0.045		
			C1	90	102	21	+68	81			
							-40	55			

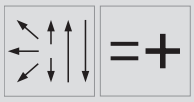
Characteristics and application

Union NiMo 80 is a GMAW solid wire for automatic girth welding. All quality characteristics regarding chemical composition, arc stability and feeding behaviour are optimised to meet the special quality requirements. Fulfils strength-overmatching of X80 pipe steel.

Approvals

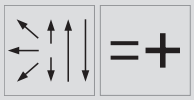
TÜV (06525), CE

Solid wires for automatic pipeline welding

Union Ni1MoCr	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades	
EN ISO 16834-A: **G Z Mn3Ni0.9MoCr** **AWS A5.28: ER100S-G**	**%**			**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**	**ø mm**	**EN**	**API 5L**
	C	0.08	M21	630	720	22	+20	135	1.0	L625M - L690MB	X90 - X100
	Si	0.50					-40	95	1.2		
	Mn	1.60					-60	80			
	Ni	0.9									
	Mo	0.40		**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**		
Shielding gas: M21: Ar + 15-25 % CO_2	Cr	0.27		**ksi**	**ksi**	**%**	**°F**	**ft-lbf**	**inch**		
			M21	91	104	22	+68	100	0.040		
				(≥ 88)	(≥ 100)	(≥ 16)	-40	70	0.045		
							-76	59			
Preheating and interpass temperature as required by the base metal											

Characteristics and application

Union Ni1MoCr is a copper coated, medium-alloy wire electrode for quenched and tempered and thermomechanically rolled fine-grained structural steels. Excellent weld metal toughness at low temperatures when deposited in combination with gas mixtures. Application in components of offshore equipment like pipework and tubes.

Union NiMoCr	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades	
EN ISO 16834-A: **G 69 6 M21 Mn4Ni1.5CrMo** **AWS A5.28: ER100S-G (ER100S-1(mod.)**	**%**			**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**	**ø mm**	**EN**	**API 5L**
	C	0.08	M21	750	830	21	+20	135	0.8	L830M	X120
	Si	0.60		(≥ 690)	(770-940)	(≥ 17)	-60	70 (≥ 47)	1.0		
	Mn	1.70							1.2		
	Ni	1.50	C1	680	740	18	+20	80			
	Mo	0.50					-40	47			
Shielding gas: M21: Ar + 15-25 % CO_2 C1: 100 % CO_2	Cr	0.20		**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**		
				ksi	**ksi**	**%**	**°F**	**ft-lbf**	**inch**		
			M21	108	120	21	+68	99	0.032		
							-76	51	0.040		
Preheating and interpass temperature as required by the base metal									0.045		
			C1	99	107	18	+68	59			
				(≥ 88)	(≥ 100)	(≥ 16)	-40	35			

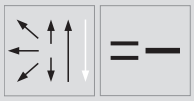
Characteristics and application

Union NiMoCr is low-alloyed solid wire electrode for shielded arc welding of quenched and tempered and thermomechanically treated fine grained structural steels. For use with CO_2 and Ar/CO_2 mixed gas. Outstanding toughnesss of the weld metal at low temperatures.

Approvals

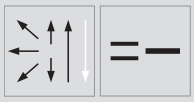
TÜV (02760), DB (42.132.08), ABS, BV, DNV, GL, LR, VG 95132-1, CE

Rods for TIG-welding

BÖHLER ER 70 S-2	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
			Re	Rm	A5	CVN		ø	EN	API 5L
AWS A5.18: ER70S-2	%		MPa	MPa	%	°C	J	mm		
	C	0.05	420	520	23	+20	180	1.6	L245NB-L415NB	A, B
	Si	0.5	(≥ 400)	(≥ 480)	(≥ 22)	-30	120 (≥ 27)	2.0	L245MB-L415MB	X42-X60
	Mn	1.2				-50	80	2.4		
			YS	TS	E (L=4d)	CVN		ø		
Shielding gas: I1: 100 % Ar			ksi	ksi	%	°F	ft-lbf	inch		
			61	75	23	+68	133	1/16		
Preheating and interpass temperature as required by base metal			(≥ 58)	(≥ 70)	(≥ 22)	-22	89	5/64		
						-58	59	3/32		
						-20	(≥ 20)			

Characteristics and application

Copper-coated GTAW rod containing Al, Ti and Zr as strong deoxidizers in addition to Mn and Si - often referred to as triple deoxidized. This has advantages when rimming or semi-killed steels are welded or where joint preparations are rusty or contaminated. BÖHLER ER 70 S-2 is primarily used for single pass welding. For applications involving single and multi pass GTAW - and/or low-temperature toughness demands down to -50 °C (-58 °F) - we recommend our GTAW rod BÖHLER EML 5 (ER70S-3). BÖHLER ER 70 S-2 can be used in sour gas applications (HIC-test acc. to NACE TM-02-84).

BÖHLER EMK 6	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
EN ISO 636-A: W 42 5 W3Si1			Re	Rm	A5	CVN		ø	EN	API 5L
AWS A5.18: ER70S-6	%		MPa	MPa	%	°C	J	mm		
	C	0.08	450	560	28	+20	180	1.6	L245NB-L415NB	A, B
	Si	0.9	(≥ 420)	(500-640)	(≥ 20)	-40	80	2.0	L245MB-L415MB	X42-X60
	Mn	1.45				-50	≥47			
			YS	TS	E (L=4d)	CVN		ø		
Shielding gas: I1: 100 % Ar			ksi	ksi	%	°F	ft-lbf	inch		
			65	81	28	+68	132	1/16		
Preheating and interpass temperature as required by base metal			(≥ 58)	(≥ 70)	(≥ 22)	-40	59	5/64		
						-20	(≥ 20)	3/32		

Characteristics and application

GTAW rod with high silicon content, suited for joints in boiler and vessel fabrication, as well as in structural engineering. BÖHLER EMK 6 can be used in sour gas applications (HIC-test acc. to NACE TM-02-84). Results from SSC testing are available too.

Approvals

TÜV (09717), LTSS, SEPROZ, CE

Union I 2	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
EN ISO 636-A: W 42 5 W2Si			**Re**	**Rm**	**A5**	**CVN**		**ø**	**EN**	**API 5L**
AWS A5.18: ER70S-3	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**		
	C	0.08	435	520	28	+20	220	1.6	L245NB - L415NB	A, B
	Si	0.60	(≥ 420)	(500-640)	(≥ 20)	-50	200 (≥ 47)	2.0	L245MB - L415MB	X42 - X60
	Mn	1.15						2.4		
								3.0		
Shielding gas:			**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**		
I1: 100 % Ar			**ksi**	**ksi**	**%**	**°F**	**ft-lbf**	**inch**		
			63	75	28	+68	162	1/16		
Preheating and interpass temperature as required by base metal			(≥ 58)	(≥ 70)	(≥ 22)	-4	(≥ 20)	5/64		
						-58	148	3/32		
								-		

Characteristics and application

Copper coated, unalloyed GTAW rod for TIG welding of unalloyed structural steels. Due to its high purity the weld metal obtains high impact values down to -50 °C (-58 °F). Suited for root pass welding.

Approvals

TÜV (09482), CE

Union I 52	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
EN ISO 636-A: W 42 5 W3Si1			**Re**	**Rm**	**A5**	**CVN**		**ø**	**EN**	**API 5L**
AWS A5.18: ER70S-6	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**		
	C	0.08	450	580	27	+20	210	1.6	L245NB - L415NB	A, B
	Si	0.60	(≥ 420)	500-640	(≥ 20)	-50	90 (≥ 47)	2.0	L245MB - L415MB	X42 - X60
	Mn	1.15						2.4		
								3.0		
Shielding gas:			**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**		
I1: 100 % Ar			**ksi**	**ksi**	**%**	**°F**	**ft-lbf**	**inch**		
			65	84	27	+68	155	1/16		
Preheating and interpass temperature as required by base metal			(≥ 58)	(≥ 70)	(≥ 22)	-22	(≥ 20)	5/64		
						-58	66	3/32		
								-		

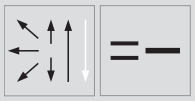
Characteristics and application

Copper coated, GTAW rod for TIG welding. Suited for root pass welding. Can be used in sour gas applications (HIC-test acc. to NACE TM-02-84).

Approvals

TÜV (09482), CE

Rods for TIG-welding

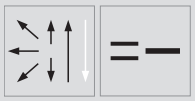
BÖHLER EML 5	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
EN ISO 636-A: W 46 5 W2Si			**Re**	**Rm**	**A5**	**CVN**		**ø**	**EN**	**API 5L**
AWS A5.18: ER70S-3	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**		
	C	0.1	520	620	26	+20	220	1.6	L245NB-L415NB	A, B
	Si	0.6	(≥ 460)	(530-680)	(≥ 23)	-20	200	2.0	L245MB-L415MB	X42-X60
	Mn	1.2				-50	90 (≥47)	2.4		
								3.0		
Shielding gas: I1: 100 % Ar			**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**		
			ksi	**ksi**	**%**	**°F**	**ft-lbf**	**inch**		
			75	90	26	+68	162	1/16		
Preheating and interpass temperature as required by base metal			(≥ 58)	(≥ 70)	(≥ 22)	-4	148 (≥ 20)	5/64		
						-58	66	3/32		

Characteristics and application

GTAW rod for high integrity welds. The low S-content makes this filler metal particularly suited for joint welds that are subjected to enamelling or galvanizing. Especially suited for root pass welding (approved at -50 °C) (-58 °F). BÖHLER EML 5 can be used in sour gas applications (HIC-test acc. to NACE TM-02-84). Results from SSC testing are available too.

Approvals

TÜV (1096) DB (42.014.02), Statoil, CE

BÖHLER Ni 1-IG	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
EN ISO 636-A: W 46 5 W3Ni1			**Re**	**Rm**	**A5**	**CVN**		**ø**	**EN**	**API 5L**
AWS A5.28: ER80S-Ni1 (mod.)	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**		
	C	0.07	500	600	25	-20	150	2.0	L360NB-L415NB	X52-X65
	Si	0.7	(≥ 460)	(550-740)	(≥ 20)	-50	≥ 47	2.4	L360MB-L450MB	
	Mn	1.4								
	Ni	0.9	**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**		
Shielding gas: I1: 100 % Ar			**ksi**	**ksi**	**%**	**°F**	**ft-lbf**	**inch**		
			72	87	25	+68	162	5/64		
Preheating and interpass temperature as required by base metal			(≥ 68)	(≥ 80)	(≥ 24)	-50	(≥ 20)	3/32		

Characteristics and application

Ni-alloyed GTAW rod for the welding of offshore pipework and similar high integrity applications. Good impact toughnesss down to -50 °C (-58 °F). Results from SSC testing are available too.

Approvals

TÜV (12808), CE

BÖHLER NiMo 1-IG	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
EN ISO 16834-A: W 55 6 1Mn3Ni1Mo **AWS A5.28: ER90S-G**	**%**		**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**	**ø mm**	**EN**	**API 5L**
	C	0.08	620	700	23	+20	140	2.4	L450MB-L555MB	X65-X80
	Si	0.6	(≥ 550)	(640-820)	(≥ 18)	-40	110			
	Mn	1.8				-60	≥ 47			
	Mo	0.3								
	Ni	0.9	**YS ksi**	**TS ksi**	**E (L=4d) %**	**CVN °F**	**ft-lbf**	**ø inch**		
Shielding gas: I1: 100 % Ar			90	101	23	+68	103	3/32		
Preheating and interpass temperature as required by base metal				(≥ 90)		-40	81			

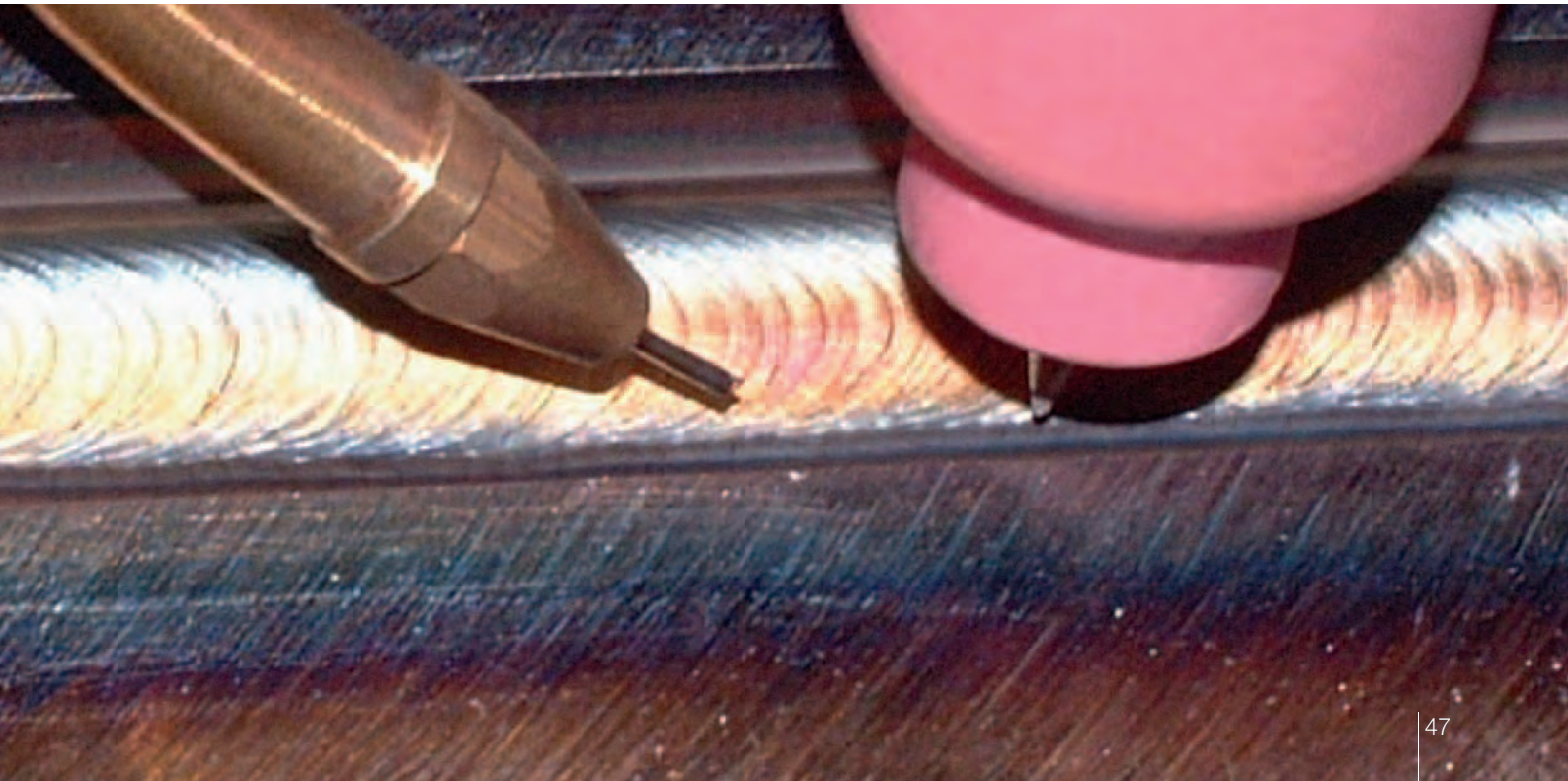
Characteristics and application

GTAW rod for welding high strength, quenched & tempered, fine-grained construction steels. The rod is suited for joint welding in boiler, pipeline and crane construction, as well as in structural steel engineering. BÖHLER NiMo 1-IG features excellent ductility and crack resistance in spite of its high strength, due to precise addition of micro-alloying elements. Very low-hydrogen weld deposit and good impact toughness down to -60 °C (-76 °F).

BÖHLER NiCrMo 2.5-IG	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
EN ISO 16834-A: **W 69 6 1Mn3Ni2.5CrMo** **AWS A5.28: ER110S-G**	**%**		**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**	**ø mm**	**EN**	**API 5L**
	C	0.08	750	830	22	+20	160	2.4	L625, L690	X90, X100
	Si	0.6	(≥ 690)	(770-960)	(≥ 17)	-40	80			
	Mn	1.4				-60	≥ 47			
	Cr	0.3	**YS ksi**	**TS ksi**	**E (L=4d) %**	**CVN °F**	**ft-lbf**	**ø inch**		
Shielding gas: I1: 100 % Ar	Ni	2.5								
	Mo	0.4	109	120	26	+68	118	3/32		
				(≥ 110)		-40	59			

Characteristics and application

GTAW rod for welding high strength, fine-grained constructional steels with stringent requirements on low-temperature impact toughness down to -60 °C (-76 °F) e.g. in the construction of LPG tankers.



Wires and flux for SAW welding

Union S 2 UV 421 TT	Typical analyses			Typical mechanical properties all weld metal					Dia-meter	Pipeline steel grades	
			Weld	Re	Rm	A5	CVN		ø	EN	API 5L
	%	Wire	metal	MPa	MPa	%	°C	J	mm		
Classification flux	C	0.10	0.07	420	515	29	+20	200	2.0	L175(P)	A25
EN ISO 14174: SA FB 1 55 AC H5	Si	0.10	0.10				-20	170	2.5	L210	A
Classification wire	Mn	1.00	1.00				-40	140	3.0	L245 (R)	B
EN ISO 14171-A: S2									4.0	L290M-L360M	X42 - X52
AWS A5.17: EM12				YS	TS	E (L=4d)	CVN		ø		
Classification weld metal				ksi	ksi	%	°F	ft-lbf	inch		
EN ISO 14171-A: S 35 4 FB S2				61	74	29	+68	147	5/64		
AWS A5.17: F7A6-EM12 / F6P6-EM12							-4	125	3/32		
Polarity: DC+/AC							-40	103	1/8		
Flux has to be redried before use for approx. 2h at 300 - 350 °C (570 - 660 °F) Preheating and interpass temperature as required by base metal: 150 – 200 °C (300-400 °F)									5/32		

Characteristics and application

Flux UV 421 TT is a high basicity, fluoride-basic agglomerated flux combining good weldability with excellent CVN toughness properties down to -60 °C. It has a neutral metallurgical behaviour and has been designed to promote a homogeneous weld chemistry and consistent mechanical properties in multi-layer welds, such as in double- and triple-jointing. This wire/flux combination features good wetting properties along with good slag detachability and a nice bead appreance. It is welded on DC+ polarity. The flux yields a low-hydrogen weld deposit (≤ 5 ml/100g acc ISO 3690).

Approvals

TÜV (05497), DB (51.132.06), LR, CE

Union S 3 Si UV 421 TT	Typical analyses			Typical mechanical properties all weld metal					Dia-meter	Pipeline steel grades	
			Weld	Re	Rm	A5	CVN		ø	EN	API 5L
Classification flux	%	Wire	metal	MPa	MPa	%	°C	J	mm		
EN ISO 14174: SA FB 1 55 AC H5	C	0.10	0.07	465	560	24	+20	160	2.5	L175(P)	A25
Classification wire	Si	0.30	0.30				-40	90	3.0	L210	A
EN ISO 14171-A: S3Si	Mn	1.70	1.55				-60	50	4.0	L245 (R)	B
AWS A5.17: EH12K										L290M-L450M	X42 - X65
Classification weld metal											
EN ISO 14171-A: S 46 6 FB S3Si				YS	TS	E (L=4d)	CVN		ø		
AWS A5.17 :				ksi	ksi	%	°F	ft-lbf	inch		
F7A8-EH12K / F6P10-EH12K				67	81	24	+68	118	3/32		
Polarity: DC+/AC							-40	66	1/8		
Flux has to be redried before use for approx. 2h at 300 - 350 °C (570 - 660 °F) Preheating and interpass temperature as required by base metal: 150 – 200 °C (300-400 °F)							-76	37	5/32		

Characteristics and application

Flux UV 421 TT is a high basicity, fluoride-basic agglomerated flux combining good weldability with excellent CVN toughness properties down to -60 °C. It has a neutral metallurgical behaviour and has been designed to promote a homogeneous weld chemistry and consistent mechanical properties in multi-layer welds, such as in double- and triple-jointing. This wire/flux combination features good wetting properties along with good slag detachability and a nice bead appreance. It is welded on DC+ polarity. The flux yields a low-hydrogen weld deposit (≤ 5 ml/100g acc ISO 3690).

Approvals

TÜV (10424), DNV, LR, CE

Union S 2 NiMo 1 UV 421 TT	Typical analyses			Typical mechanical properties all weld metal					Dia-meter	Pipeline steel grades	
			Weld	Re	Rm	A5	CVN		ø	EN	API 5L
Classification flux	%	Wire	metal	MPa	MPa	%	°C	J	mm		
EN ISO 14174: SA FB 1 55 AC H5	C	0.10	0.06	505	590	26	+20	180	2.5	L415M-L485M	X60-X70
Classification wire	Si	0.10	0.20				-40	120	3.0		
EN ISO 14174-A: SZ	Mn	1.10	1.10				-60	70	4.0		
AWS A5.23: ENi1	Ni	0.90	0.90								
Classification weld metal	Mo	0.25	0.25								
EN ISO 14171-A: S 50 6 FB SZ				YS	TS	E (L=4d)	CVN		ø		
AWS A5.23: F8A10-ENi-Ni1 / F8P10-ENi-1-Ni				ksi	ksi	%	°F	ft-lbf	inch		
				73	85	26	+68	133	3/32		
Polarity: DC+/AC							-40	88	1/8		
Flux has to be redried before use for approx. 2h at 300 - 350 °C (570 - 660 °F) Preheating and interpass temperature as required by base metal: 150 – 200 °C (300-400 °F)							-76	52	5/32		

Characteristics and application

Flux UV 421 TT is a high basicity, fluoride-basic agglomerated flux combining good weldability with excellent CVN toughness properties down to -60 °C. It has a neutral metallurgical behaviour and has been designed to promote a homogeneous weld chemistry and consistent mechanical properties in multi-layer welds, such as in double- and triple-jointing. This wire/flux combination features good wetting properties along with good slag detachability and a nice bead appreance. It is welded on DC+ polarity. The flux yields a low-hydrogen weld deposit (≤ 5 ml/100g acc ISO 3690).

Approvals

TÜV (10425), DNV, LR, CE

Union S 3 NiMo 1 UV 421 TT	Typical analyses			Typical mechanical properties all weld metal					Dia-meter	Pipeline steel grades	
			Weld	Re	Rm	A5	CVN		ø	EN	API 5L
Classification flux	%	Wire	metal	MPa	MPa	%	°C	J	mm		
EN ISO 14174: SA FB 1 55 AC H5	C	0.12	0.08	589	670	24	+20	180	1.6	L450M-L485M	X65 - X70
Classification wire	Si	0.10	0.20				-20	160	2.0		
EN ISO 14171-A S3Ni1Mo	Mn	1.60	1.55				-40	100	2.5		
AWS A5.23: EF3	Mo	0.60	0.55				-60	55	3.0		
Classification weld metal	Ni	0.95	0.90						4.0		
EN ISO 14295: S 55 6 FB S3Ni1Mo				YS	TS	E (L=4d)	CVN		ø		
AWS A5.23: F9A8-EF3-F3				ksi	ksi	%	°F	ft-lbf	inch		
Polarity: DC+/AC				84	97	24	+68	133	1/16		
Flux has to be redried before use for approx. 2h at 300 - 350 °C (570 - 660 °F) Preheating and interpass temperature as required by base metal: 150 – 200 °C (300-400 °F)							32	89	5/64		
							-4	118	3/32		
							-40	74	1/8		
							-76	40	5/32		

Characteristics and application

Flux UV 421 TT is a high basicity, fluoride-basic agglomerated flux combining good weldability with excellent CVN toughness properties down to -60 °C. It has a neutral metallurgical behaviour and has been designed to promote a homogeneous weld chemistry and consistent mechanical properties in multi-layer welds, such as in double- and triple-jointing. This wire/flux combination features good wetting properties along with good slag detachability and a nice bead appreance. It is welded on DC+ polarity. The flux yields a low-hydrogen weld deposit (≤ 5 ml/100g acc ISO 3690).

Approvals

TÜV (10425), DNV, LR, CE

Wires and flux for SAW welding

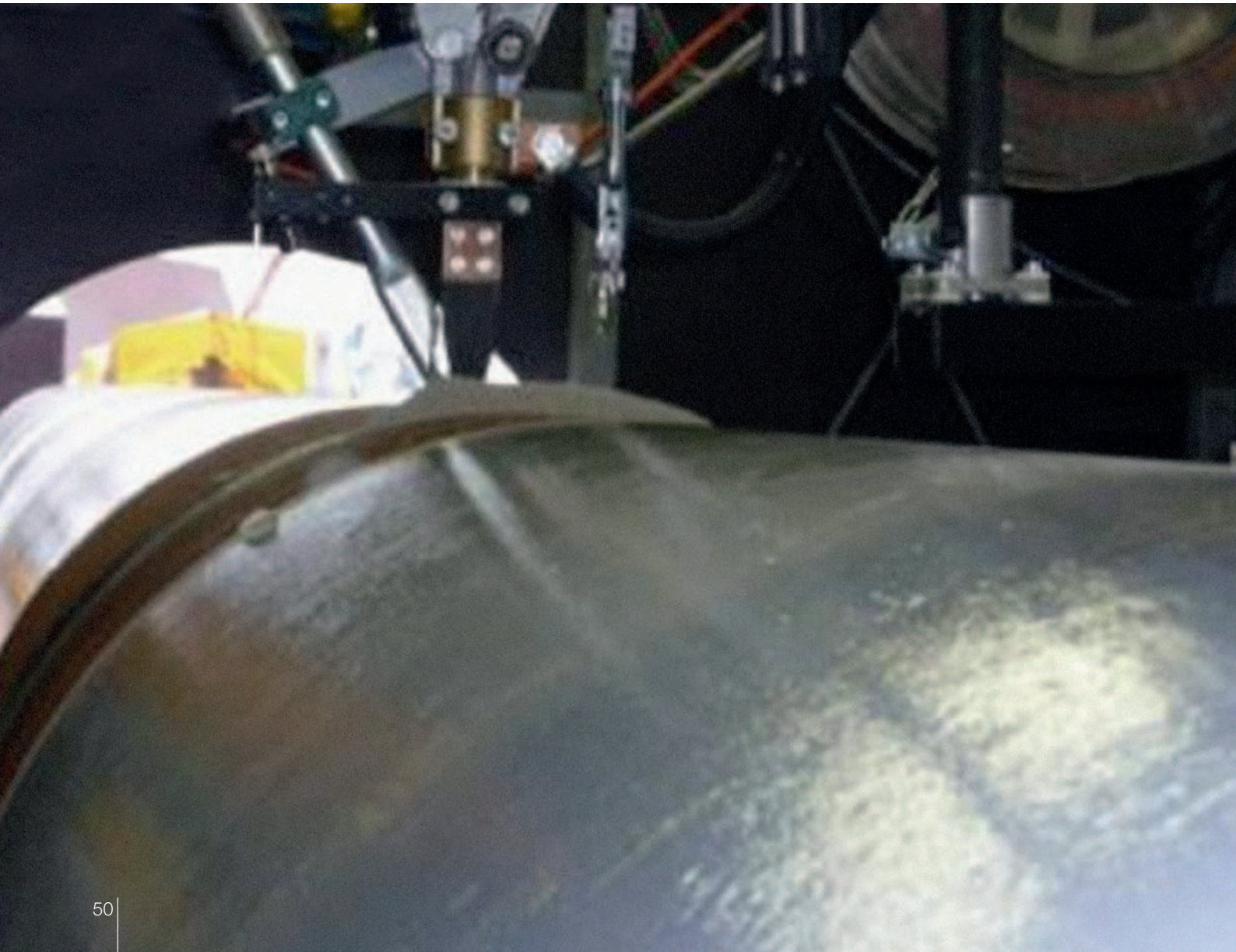
Union S 3 NiMoCr UV 421 TT	Typical analyses			Typical mechanical properties all weld metal					Dia-meter	Pipeline steel grades	
			Weld	Re	Rm	A5	CVN		ø	EN	API 5L
Classification flux	%	Wire	metal	MPa	MPa	%	°C	J	mm		
EN ISO 14174: SA FB 1 55 AC H5	C	0.14	0.08	730	805	21	+20	145	2.0	L485M-L690M	X70 - X100
Classification wire	Si	0.10	0.20				+0	100	2.4		
EN ISO 26304-A: SZ3Ni2,5CrMo	Mn	1.75	1.60				-20	120	3.0		
AWS A5.23: (EG) EF 6 mod.	Cr	0.35	0.32				-40	110	4.0		
Classification weld metal	Mo	0.60	0.58				-60	55			
EN ISO 26304-A: S 69 6 FB SZ3Ni2,5CrMo	Ni	2.10	2.00								
AWS A5.23: F11A8-EG-F6				**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**		
Polarity: DC+/AC				**ksi**	**ksi**	**%**	**°F**	**ft-lbf**	**inch**		
Flux has to be redried before use for approx. 2h at 300 - 350 °C (570 - 660 °F) Preheating and interpass temperature as required by base metal: 150 – 200 °C (300-400 °F)				105	116	21	+68	107	5/64		
							32	74	3/32		
							-4	88	1/8		
							-40	81	5/32		
							-76	40			

Characteristics and application

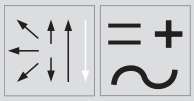
Flux UV 421 TT is a high basicity, fluoride-basic agglomerated flux combining good weldability with excellent CVN toughness properties down to -60 °C. It has a neutral metallurgical behaviour and has been designed to promote a homogeneous weld chemistry and consistent mechanical properties in multi-layer welds, such as in double- and triple-jointing. This wire/flux combination features good wetting properties along with good slag detachability and a nice bead appreance. It is welded on DC+ polarity. The flux yields a low-hydrogen weld deposit (≤ 5 ml/100g acc ISO 3690).

Approvals

TÜV (05063), DB (51.132.06), ABS, BV, DNV, GL, LR, CE



Electrodes for corrosion resistant alloys (CRA)

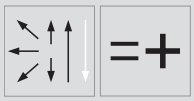
BÖHLER FOX EAS 4 M-A	Typical analyses all weld metal		Typical mechanical properties all weld metal					Dia-meter		Pipeline steel grades	
EN ISO 3581-A: E 19 12 3 L R 3 2			Re	Rm	A5	CVN		ø		EN	UNS/
AWS A5.4: E316L-17	%		MPa	MPa	%	°C	J	mm	A		AISI
	C	0.03	460	600	36	+20	70	1.5	25-40	1.4404	S31603
	Si	0.8	(≥ 320)	(≥ 510)	(≥ 25)	-120	≥ 32	2.0	40-60	X2CrNiMo 17-12-2	316L
	Mn	0.8						2.5	50-90	1.4435	
	Cr	18.8						3.2	80-120	X2CrNiMo 18-14-3	
	Ni	11.5						4.0	120-160		
Re-drying if necessary:	Mo	2.7						5.0	140-200		
120-200 °C (250-400 °F) / min. 2h			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
			66	87	36	+68	51	3/50	25-40		
				(≥ 70)	(≥ 30)	-184	≥ 23	5/64	40-60		
								3/32	50-90		
								1/8	80-120		
								5/32	120-160		
								3/16	140-200		

Characteristics and application

Stainless steel, rutile electrode, preferably used for 1.4435 / 316L steel grades. The fully alloyed core wire ensures most reliable corrosion resistance.

Approvals

TÜV (0773), DB (30.014.14), ABS (E316L-17), DNV (316L), GL (4571), LR (316Lm). Statoil, VUZ, SEPROZ, CE, CWB, NAKS (ø 3.2 mm; ø 4.0 mm)

BÖHLER FOX EAS 4 M	Typical analyses all weld metal		Typical mechanical properties all weld metal					Dia-meter		Pipeline steel grades	
EN ISO 3581-A: E 19 12 3 L B 2 2			Re	Rm	A5	CVN		ø		EN	UNS/
AWS A5.4: E316L-15	%		MPa	MPa	%	°C	J	mm	A		AISI
	C	0.03	460	600	38	+20	90	2.5	50-80	1.4404	S31603
	Si	0.4	(≥ 320)	(≥ 510)	(≥ 25)	-120	≥ 32	3.2	80-110	X2CrNiMo 17-12-2	316L
	Mn	1.2				-196	≥ 27	4.0	110-140	1.4435	
	Cr	18.8								X2CrNiMo 18-14-3	
	Ni	11.8	YS	TS	E (L=4d)	CVN		ø			
	Mo	2.7	ksi	ksi	%	°F	ft-lbf	inch	A		
			66	87	38	+68	66	3/32	50-80		
				(≥ 70)	(≥ 30)	-184	≥ 24	1/8	80-110		
						-320	≥ 20	5/32	110-140		

Characteristics and application

Stainless steel,basic electrode, preferably used for 1.4435 / 316L steel grades. Designed to provide high quality weld deposits with reliable impact toughness values down to -196 °C (-320 °F). The fully alloyed core wire ensures most reliable corrosion resistance.

Approvals

TÜV (0772), DNV (316), Statoil, SEPPROZ, CE

BÖHLER FOX CN 22/9 N	Typical analyses all weld metal		Typical mechanical properties all weld metal					Dia-meter		Pipeline steel grades	
EN ISO 3581-A: E 22 9 3 N L R 3 2			Re	Rm	A5	CVN		ø		EN	UNS
AWS A5.4: E2209-17	%		MPa	MPa	%	°C	J	mm	A		
	C	0.03	650	820	25	+20	55	2.5	40-75	1.4462	S31803
	Si	0.8	(≥ 450)	(≥ 690)	(≥ 20)	-10	50	3.2	70-120	X2CrNiMoN 22-5-3	S32205
	Mn	0.9				-20	≥ 32	4.0	110-150		
	Cr	22.6						5.0	150-200		
Re-drying if necessary:	Ni	9.0	YS	TS	E (L=4d)	CVN		ø			
250-300 °C (480-570 °F) / min. 2h	Mo	3.1	ksi	ksi	%	°F	ft-lbf	inch	A		
			94	118	25	+68	40	3/32	40-75		
Preheating and interpass temperature				(≥ 100)	(≥ 22)	+14	37	1/8	70-120		
max. 150 °C (302 °F)						-4	≥ 23	5/32	110-150		
								3/16	150-200		

Characteristics and application

Rutile stainless steel electrode designed for the welding of ferritic-austenitic duplex stainless steels such as 1.4462 and UNS 31803. BÖHLER FOX CN 22/9 N offers excellent positional weldability, making it perfectly suited for pipe welding. Pitting resistance equivalent (PREN) of > 35.

Approvals

TÜV (3636), ABS (E 22 09-17), DNV (Duplex), GL (4462), LR (X), RINA (2209), Statoil, SEPROZ, CE

BÖHLER FOX CN 22/9 N-B	Typical analyses all weld metal		Typical mechanical properties all weld metal					Dia-meter		Pipeline steel grades	
EN ISO 3581-A: E 22 9 3 N L B 2 2			Re	Rm	A5	CVN		ø		EN	UNS
AWS A5.4: E2209-15	%		MPa	MPa	%	°C	J	mm	A		
	C	0.03	630	830	27	+20	110	2.5	50-75	1.4462	S31803
	Si	0.3	(≥ 450)	(≥ 690)	(≥ 20)	-20	90	3.2	80-110	X2CrNiMoN 22-5-3	S32205
	Mn	1.1				-40	75	4.0	100-145		
	Cr	22.6				-60	40 (≥ 32)	5.0	140-180		
Re-drying if necessary:	Ni	8.8	YS	TS	E (L=4d)	CVN		ø			
250-300 °C / min. 2h	Mo	3.1	ksi	ksi	%	°F	ft-lbf	inch	A		
	Ni	0.16	91	120	27	+68	81	3/32	50-75		
Re-drying if necessary:				(≥ 100)	(≥ 22)	-4	66	1/8	80-110		
250-300 °C (480-570 °F) / min. 2h						-40	55	5/32	100-145		
						-76	29 (≥ 23)	3/16	140-180		

Characteristics and application

Basic stainless steel electrode designed for the welding of ferritic-austenitic duplex stainless steels such as 1.4462 and UNS 31803.Very good impact toughness down to -60 °C (-76 °F). Pitting resistance equivalent (PREN) of > 35.

Approvals

TÜV (7084), CE

Electrodes for corrosion resistant alloys (CRA)

BÖHLER FOX CN 25/9 CuT	Typical analyses all weld metal		Typical mechanical properties all weld metal					Dia-meter		Pipeline steel grades	
EN ISO 3581-A: E 25 9 4 N L B 2 2			Re	Rm	A5	CVN		ø		EN	UNS
AWS A5.4: E2595-15	%		MPa	MPa	%	°C	J	mm	A		
=+	C	0.03	650	850	25	+20	75	2.5	55-85	1.4501	S32750
	Si	0.5	(≥ 550)	(≥ 760)	(≥ 18)	-50	50 (≥ 32)	3.2	80-105	X2CrNiMoCuWN 25-7-4	S32760
	Mn	1.0						4.0	90-140		
	Cr	25.0									
Re-drying if necessary: 250-300 °C (480-570 °F) / min. 2h	Ni	9.5	YS	TS	E (L=4d)	CVN		ø		ZERON 100	
	Mo	3.7	ksi	ksi	%	°F	ft-lbf	inch	A	SAF 25/07	
	N	0.22	94	123	25	+68	55	3/32	55-85	FALC 100	
	Cu	0.7		(≥ 110)	(≥ 15)	-58	37 (≥ 23)	1/8	80-105		
	W	0.7						5/32	90-140		

Characteristics and application

Basic stainless steel electrode designed for the welding of ferritic-austenitic duplex stainless steels. Excellent reistance to pitting corrosion and stress corrosion cracking. Suited for service temperatures from -50 (-58 °F) up to +250 °C (482 °F). Well suited for conditions in offshore oil and gas exploration.

Thermanit 625	Typical analyses all weld metal		Typical mechanical properties all weld metal					Dia-meter		Pipeline steel grades
EN ISO 14172: E Ni 6625 (NiCr22Mo9Nb)			Re	Rm	A5	CVN		ø		CRA clad pipes
AWS A5.11: ENiCrMo-3	%		MPa	MPa	%	°C	J	mm	A	
=+	C	< 0.04	470	760	40	+20	90	2.5	45-70	Alloy 316L
	Si	< 0.7	(≥ 420)	(≥ 760)	(≥ 27)	-196	70 (≥ 32)	3.2	65-105	Alloy 625
	Mn	< 1.0						4.0	85-130	Alloy 825
	Cr	21.5						5.0	130-160	
Re-drying if necessary: 250-300 °C (480-570 °F) / min. 2h	Ni	Bal.	YS	TS	E (L=4d)	CVN		ø		
	Mo	9.0	ksi	ksi	%	°F	ft-lbf	inch	A	
	Nb	3.3	68	110	40	+68	66	3/32	45-70	
	Fe	< 2.0		(≥ 110)	(≥ 30)	-320	52	1/8	65-105	
								5/32	85-130	
								3/16	130-160	

Characteristics and application

Basic stick electrode with alloyed core wire for high quality welding of corrosion resistant alloyed (CRA) clad steel - Alloy 316L, 625 and 825.

Approvals

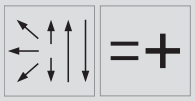
TÜV (03463), ABS, GL, CE

Thermanit 686	Typical analyses all weld metal		Typical mechanical properties all weld metal					Dia-meter		Pipeline steel grades
EN ISO 14172: E Ni 6686 (NiCr21Mo14W4)			Re	Rm	A5	CVN		ø		CRA clad pipes
AWS A5.11: ENiCrMo-14	%		MPa	MPa	%	°C	J	mm	A	
=+	C	0.02	480	770	38	+20	60	2.5	50-70	Alloy 316L
	Si	< 0.2	(≥ 350)	(≥ 690)	(≥ 27)			3.2	70-105	Alloy 625
	Mn	< 0.5						4.0	90-120	Alloy 825
	Cr	21.0								
Re-drying if necessary: 250-300 °C (480-570 °F) / min. 2h	Ni	Bal.	YS	TS	E (L=4d)	CVN		ø		
	Mo	16.0	ksi	ksi	%	°F	ft-lbf	inch	A	
	W	3.5	69	111	38	+68	44	3/32	50-70	
	Fe	< 1.0		(≥ 100)	(≥ 30)			1/8	70-105	
								5/32	90-120	

Characteristics and application

Basic stick electrode with alloyed core wire for high quality welding of corrosion resistant alloyed (CRA) clad steel - Alloy 316L, 625 and 825.

Flux-cored wires for corrosion resistant alloys (CRA)

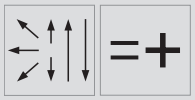
BÖHLER EAS 4 PW-FD	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades	
EN ISO 17633-A: **T 19 12 3 L P M21 1 /** **T 19 12 3 L P C1 1** **AWS A5.22:** **E316LT1-4 / E316LT1-1**	**%**			**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**	**ø mm**	**EN**	**UNS/ AISI**
	C	0.03	M21	400	560	38	+20	65	1.2	1.4404	S31603
	Si	0.7		(≥ 320)	(≥ 510)	(≥ 30)	-120	45 (≥ 32)	1.6	X2CrNiMo 17-12-2	316L
	Mn	1.5								1.4435	
	Cr	19.0								X2CrNiMo 19-14-3	
	Ni	12.0									
Shielding gas:	Mo	2.7		**YS ksi**	**TS ksi**	**E (L=4d) %**	**CVN °F**	**ft-lbf**	**ø inch**		
M1-M3			M21	58	81	38	+68	48	0.045		
C1					(≥ 70)	(≥ 30)	-184	33 (≥ 23)	1/16		
Re-drying possible at 150 °C (300 °F) / 24h, but generally not needed											

Characteristics and application

BÖHLER EAS 4 PW-FD is an all-positional rutile flux-cored wire with fast freezing slag. It has excellent welding characteristics in all welding positions and allows high travel speed and deposition rate. Welds are well suited for service temperatures from -120 (-184 °F) up to + 400 °C (752 °F).

Approvals

TÜV (09118), DB (43.014.24), CWB (E316LT-1(4)), LR (DXVu.O, BF 316LS), GL (4571S (C1, M21), SEPROZ, CE, DNV, ABS

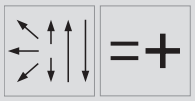
BÖHLER CN 22/9 PW-FD	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades	
EN ISO 17633-A: **T 22 9 3 N L P M21 1 /** **T 22 9 3 N L P C1 1** **AWS A5.22:** **E2209T1-4 / E2209T1-1**	**%**			**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**	**ø mm**	**EN**	**UNS/ AISI**
	C	< 0.03	M21	600	800	27	+20	80	1.2	1.4462	S31803
	Si	0.8		(≥ 450)	(≥ 690	(≥ 20)	-20	65		X2CrNiMoN 22-5-3	S32205
	Mn	0.9					-40	55			
	Cr	22.7					-46	45 (≥ 32)			
	Ni	9.0									
Shielding gas:	Mo	3.2		**YS ksi**	**TS ksi**	**E (L=4d) %**	**CVN °F**	**ft-lbf**	**ø inch**		
M1-M3	N	0.13									
C1	FN	30-50	M21	87	116	27	+68	59	0.045		
					(≥ 100)	(≥ 20)	-4	48			
Re-drying possible at 150 °C (300 °F) / 24h, but generally not needed							-40	40			
							-50	33 (≥ 23)			

Characteristics and application

BÖHLER CN 22/9 PW-FD is an all-positional rutile flux-cored wire with fast freezing slag, for welding duplex stainless steel grades 1.4462 / S31803. Weld metal features good pitting corrosion resistance (CP ASTM G48/method A / 24h up to 25 °C, +77 °F) (PREN ≥ 35) and resistance to stress corrosion cracking in chloride-containing fluids e.g. sea water. Welds are well suited for service temperatures from -46 (-50 °F) up to +250 °C (482 °F).

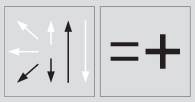
Approvals

TÜV (07666), ABS (E 22 09 T1-4(1)), CWB (E2209T1-1(4)), DNV (-(M21, C1) ø 1.2 mm), GL (4462S (M21)), LR (X (M21, C1)), RINA (2209S), SEPROZ, CE

BÖHLER CN 25/9 PW-FD	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades	
EN ISO 17633-A: T 25 9 4 N L P M21 2 / T 25 9 4 N L P C1 2 **AWS A5.22: E2594T1-4 / E2594T1-1**	**%**			**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**	**ø mm**	**EN**	**UNS/ AISI**
	C	< 0.03	M21	670	880	27	+20	≥ 50	1.2	1.4410	SAF 2507
	Si	0.7		(≥ 550)	(≥ 760)	(≥ 18)	-40	≥ 32		X2CrNiMoN 25-7-4	S32750
	Mn	0.9								1.4501	S32760
	Cr	25.3								X2CrNiMoCu W N 2507-4	
	Ni	9.8									
Shielding gas: M1-M3 C1	Mo	3.7		**YS ksi**	**TS ksi**	**E (L=4d) %**	**CVN °F**	**ft-lbf**	**ø inch**		
	N	0.23									
Interpass temperature max. 120 °C (+248 °F). Heat input 0.5-1.5 kJ/mm	FN	> 35	M21	97	127	27	+68	≥ 37	0.045		
					(≥ 110)	(≥ 15)	-40	≥ 23			
Re-drying possible at 150 °C (300 °F) / 24h, but generally not needed											

Characteristics and application

BÖHLER CN 25/9 PW-FD is an all-positional rutile flux-cored wire with fast freezing slag, for welding super duplex and equivalent stainless steel grades, such as UNS S32760 and EN 1.4501. Weld metal features excellent reistance to stress corrosion and localized corrosion (PREN > 41) and is suited for service temperatures from -50 (-58 °F) up to +240 °C (464 °F).

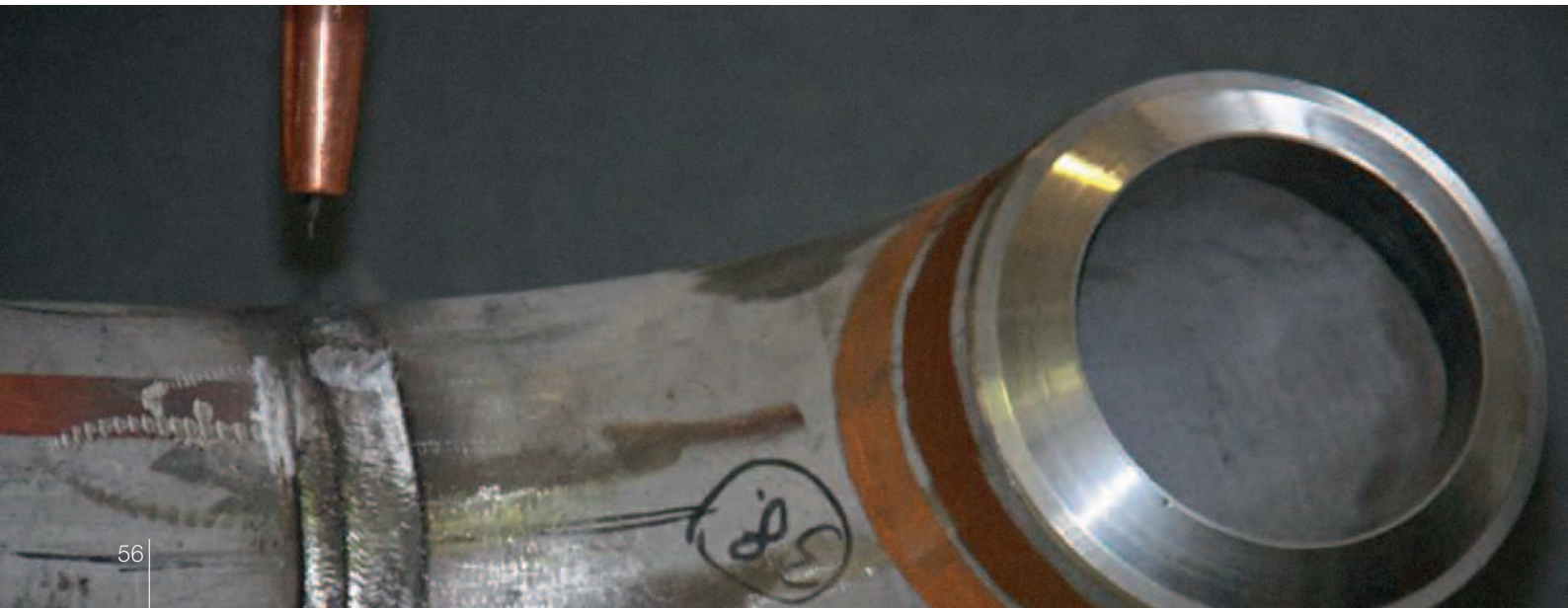
BÖHLER NIBAS 625 PW-FD	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades
EN ISO 12153: T Ni 6625 P M21 2 **AWS A5.34M: Tni 6625-14**	**%**			**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**	**ø mm**	**CRA clad pipes**
	C	0.05	M21	500	740	40	-20	90	1.2	Alloy 316L
	Si	0.4		(≥ 420)	(≥ 690)	(≥ 25)	-196	80 (≥ 32)		Alloy 625
	Mn	0.4								Alloy 825
	Cr	21.0								
	Ni	bal.								
Shielding gas: M1-M3	Mo	8.5		**YS ksi**	**TS ksi**	**E (L=4d) %**	**CVN °F**	**ft-lbf**	**ø inch**	
	Nb	3.3								
Re-drying possible at 150 °C (300 °F) / 24h, but generally not needed	Fe	< 1.0	M21	72	107	40	+68	66	0.045	
					(≥ 100)	(≥ 25)	-320	59 (≥ 23)		

Characteristics and application

Rutile flux-cored wire for high quality joint welding of corrosion resistant alloy (CRA) clad pipes, -alloys 316L, 625 and 825.

Approvals

TÜV (11223), CE



Solid wires for corrosion resistant alloys (CRA)

Thermanit GE - 316L Si	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades	
EN ISO 14343-A: G 19 12 3 L Si AWS A5.9: ER316LSi	%			Re MPa	Rm MPa	A5 %	CVN °C	J	ø mm	EN	UNS/ AISI
=+	C	0.02	M21	430	600	38	+20	130	0.8	1.4404	S31603, 316L
	Si	0.8		(≥ 320)	(≥ 510)	(≥ 25)			1.0		
	Mn	1.7							1.2		
	Cr	18.8									
	Ni	12.5									
Shielding gas: M12	Mo	2.8		YS ksi	TS ksi	E (L=4d) %	CVN °F	ft-lbf	ø inch		
			M21	62	87	38	+68	96	0.030		
				(≥ 88)	(≥ 70)	(≥ 30)			0.040		
									0.045		

Characteristics and application

ER316LSi type GMAW solid wire. Good wire feeding properties, excellent weldability, nice wetting and reliable corrosion resistance up to 400 °C (752 °F). For service temperatures down to -196 °C (-320 °F).

Approvals

TÜV (00489), DB (132.10), DNV, GL, LR, CE

Thermanit 22/09 LH	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades	
EN ISO 14343-A: G 22 9 3 N L AWS A5.9: ER2209	%			Re MPa	Rm MPa	A5 %	CVN °C	J	ø mm	EN	UNS/ AISI
=+	C	0.025	M12	615	790	30	+20	120	1.0	1.44062	S31803
	Si	0.5		(≥ 450)	(≥ 550)	(≥20)	-40	90	1.2	X2CrNiMoN 22-5-3	S32205
	Mn	1.6									
	Cr	23.0		YS ksi	TS ksi	E (L=4d) %	CVN °F	ft-lbf	ø inch		
Shielding gas: M12, M13	Ni	9.0									
	Mo	3.0	M12	89	114	30	+68	88	0.040		
	N	0.14			(≥ 100)	(≥ 20)	-40	66	0.045		
	FN	30-60									

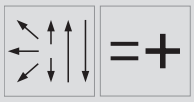
Characteristics and application

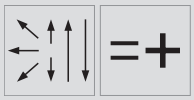
GMAW solid wire for welding ferritic-austenitic duplex stainless steel. Excellent resistance to stress corrosion cracking and pitting (PREN > 35). For service temperatures from -40 up to 250 °C. Specifically designed for welding super martensitic stainless steel in offshore applications. Very low weld metal hydrogen content. (H_2 < 3 ppm.)

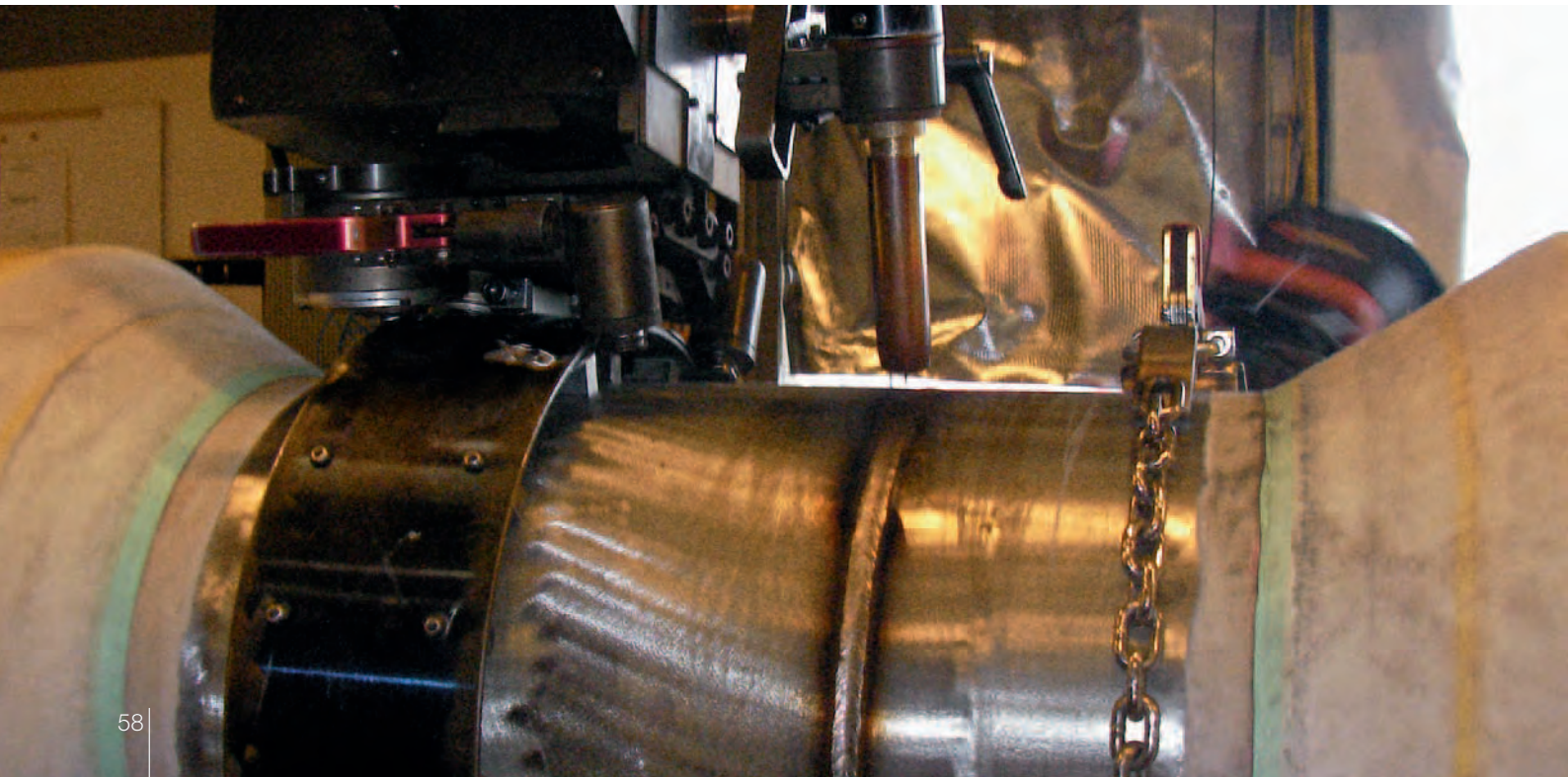
Thermanit 25/09 CuT LH	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades	
EN ISO 14343-A: G 25 9 4 N L AWS A5.9: ER2594	%			Re MPa	Rm MPa	A5 %	CVN °C	J	ø mm	EN	UNS/ AISI
=+	C	0.02	M12	720	850	27	+20	135	1.0	1.4501	S32750
	Si	0.3		(≥ 550)	(≥ 620)	(≥ 18)	-46	90		X2CrNiMoCuWN 25-7-4	S32760
	Mn	1.5									
	Cr	25.5									
Shielding gas: M12, M13	Ni	9.5		YS ksi	TS ksi	E (L=4d) %	CVN °F	ft-lbf	ø inch	ZERON 100	
	Mo	3.7								SAF 25/07	
	N	0.22	M12	104	123	27	+68	99	0.040	FALC 100	
	Cu	0.8			(≥ 110)	(≥ 15)	-76	66			
	W	0.6									

Characteristics and application

GMAW solid wire for welding ferritic-austenitic super duplex stainless steel. Excellent resistance to stress corrosion cracking and pitting (PREN > 40). For service temperatures from -50 (-58 °F) up to 250 °C (482 °F). Specifically designed for welding super martensitic stainless steel in offshore applications. Very low weld metal hydrogen content (H_2 < 3 ppm).

Thermanit 625	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades
EN ISO 18274: **S Ni 6625 (NiCr22Mo9Nb)** **AWS A5.14: ERNiMo-3**	**%**			**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**	**ø mm**	**CRA clad pipes**
	C	0.03	M12	480	760	42	+20	160	0.8	Alloy 316L
	Si	0.25		(≥ 460)	(≥ 760)	(≥ 25)	-196	130	1.0	Alloy 625
	Mn	0.20							1.2	Alloy 825
	Cr	22.0							1.6	
Shielding gas:	Ni	bal.		**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**	
I1	Mo	9.0		**ksi**	**ksi**	**%**	**°F**	**ft-lbf**	**inch**	
M12 (Argon + 30% He + 0.5% CO_2)	Nb	3.6	M12	69	110	42	+68	118	0.030	
	Fe	< 0.5			(≥ 100)	(≥ 25)	-320	96	0.040	
									0.045	
Characteristics and application									1/16	
GMAW solid wire for high quality joint welding of corrosion resistant alloyed (CRA) clad pipes.										
Approvals										
TÜV (03462), DB (43.132.25), CE										

Thermanit 686	Typical analyses all weld metal		Typical mechanical properties all weld metal						Diameter	Pipeline steel grades
EN ISO 18274: **S Ni 6686 (NiCr21Mo16W4)** **AWS A5.14: ERNiMo-14**	**%**			**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**	**ø mm**	**CRA clad pipes**
	C	0.01	M12	550	790	30	+20	55	1.2	Alloy 316L
	Si	0.8		(≥ 460)	(≥ 760)	(≥ 25)				Alloy 625
	Mn	< 0.5								Alloy 825
	Cr	22.8								
Shielding gas:	Ni	bal.		**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**	
I1	Mo	16.0		**ksi**	**ksi**	**%**	**°F**	**ft-lbf**	**inch**	
Ar + 30He + 2% H_2 + ~0.1% CO_2	W	3.8	M12	79	114	30	+68	41	0.045	
	Fe	< 1.0			(≥ 100)	(≥ 30)				
	Al	0.3								
Characteristics and application										
GMAW solid wire for high quality joint welding of corrosion resistant alloyed (CRA) clad pipes - alloy 316L, 625 and 825.										



TIG rods for corrosion resistant alloys (CRA)

Thermanit GE-316L	Typical analyses all weld metal		Typical mechanical properties all weld metal					Dia-meter	Pipeline steel grades	
EN ISO 14343-A: W 19 12 3 L			Re	Rm	A5	CVN		ø	EN	UNS/
AWS A5.9: ER316L	%		MPa	MPa	%	°C	J	mm		AISI
	C	0.02	480	620	37	+20	140	0.8	1.4404	S31603
	Si	0.5	(≥ 320)	(≥ 510)	(≥ 25)			1.6	X2CrNiMoN 17-12-2	316L
	Mn	1.7						2.0		
	Cr	18.5						2.4		
	Ni	12.3						4.0		
	Mo	2.6	YS	TS	E (L=4d)	CVN		ø		
			ksi	ksi	%	°F	ft-lbf	inch		
			69	90	37	+68	103	0.030		
				(≥ 70)	(≥ 30)			1/16		
								5/64		
								3/32		
								5/32		

Shielding gas:
I1: 100% Ar

Rod marking
Front: W 19 12 3 L, Back: ER316L

Preheating and interpass temperature
as required by base metal

Characteristics and application

E316L type GTAW rod. Alloyed with great precision to create a high purity weld deposit with superior hot cracking resistance. Good CVN impact toughness down to -196 °C (-320 °F). resistant to intergranular corrosion up to 400 °C (752 °F).

Approvals

TÜV (09500), DB (43.132.20), DNV, GL, CE

Thermanit 22/09	Typical analyses all weld metal		Typical mechanical properties all weld metal					Dia-meter	Pipeline steel grades	
EN ISO 14343-A: W 22 9 3 N L			Re	Rm	A5	CVN		ø	EN	UNS
AWS A5.9: ER2209	%		MPa	MPa	%	°C	J	mm		
	C	0.02	620	800	32	+20	220	1.6	1.4462	S31803
	Si	0.4	(≥ 450)	(≥ 550)	(≥ 20)	-60	90 (≥ 32)	2.0	X2CrNiMoN 22-5-3	S32205
	Mn	1.7						2.4		
	Cr	22.5						3.2		
	Ni	8.8								
	Mo	3.2	YS	TS	E (L=4d)	CVN		ø		
	N	0.15	ksi	ksi	%	°F	ft-lbf	inch		
			90	116	32	+68	162	1/16		
				(≥ 100)	(≥ 20)	-76	66 (≥ 23)	5/64		
								3/32		
								1/8		

Shielding gas:
I1: 100% Ar
Ar + 1-2% N_2

Rod marking
Front: W 22 9 3 NL, Back: ER2209

Preheating and interpass temperature
as required by base metal

Characteristics and application

GTAW rod of the ER2209/W 22 9 3 N L type for the welding of ferritic-austenitc duplex stainless steel. Excellent resistance to stress corrosion cracking and pitting (PREN > 35). Weld metal is suited for service temperatures from -60 °C (-76 °F) up to +250 °C (482 °F). Especially designed for the welding of super martensitic stainless steel in offshore fabrication.

Approvals

TÜV (03343), ABS, DNV, GL, LR, CE

Thermanit 25/09 CuT	Typical analyses all weld metal		Typical mechanical properties all weld metal					Dia-meter	Pipeline steel grades	
EN ISO 14343-A: W 25 9 4 N L			**Re**	**Rm**	**A5**	**CVN**		**ø**	**EN**	**UNS**
AWS A5.9: ER2594	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**		
	C	0.02	710	860	28	+20	220	1.6	1.4501	S32750
	Si	0.3	(≥ 550)	(≥ 620)	(≥ 18)	-50	160	2.0	X2CrNiMoCuWN	S32760
	Mn	0.7						2.4		
	Cr	25.2						3.2		
Shielding gas:	Ni	9.2								
I1: 100 % Ar	Mo	3.6	**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**	ZERON 100	
Ar + 2-3 % N2	N	0.22	**ksi**	**ksi**	**%**	**°F**	**ft-lbf**	**inch**	SAF 25/07	
Rod marking	Cu	0.6	103	124	28	+68	162	1/16	FALC 100	
Front: W 25 9 4 NL	W	0.62		(≥ 110)	(≥ 15)	-58	118	5/64		
								3/32		
Preheating and interpass temperature as required by base metal								1/8		

Characteristics and application

GTAW rod for the welding of ferritic-austenitc super duplex stainless steel. Excellent resistance to stress corrosion cracking and pitting (PREN > 40). Weld metal is suited for service temperatures from -50 °C (-58 °F) up to +250 °C (482 °F). Especially designed for the welding of super martensitic stainless steel in offshore fabrication.

Thermanit 625	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades
EN ISO 18274: S Ni 6625 (NiCr22Mo9Nb)			**Re**	**Rm**	**A5**	**CVN**		**ø**	**CRA clad pipes**
AWS A5.14: ERNiCrMo-3	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**	
	C	0.03	490	775	40	+20	140	1.6	Alloy 316L
	Si	0.1	(≥ 460)	(≥ 760)	(≥35)	-196	120	2.0	Alloy 625
	Mn	0.1						2.4	Alloy 825
	Cr	22.0						3.2	
Shielding gas:	Ni	Bal.							
I1: 100 % Ar	Mo	9.0	**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**	
	Nb	3.6	**ksi**	**ksi**	**%**	**°F**	**ft-lbf**	**inch**	
Rod marking	Fe	< 0.05	71	112	40	+68	103	1/16	
Front: Ni6625, Back: ERNiCrMo-3				(≥ 100)	(≥ 25)	-320	88	5/64	
								3/32	
Preheating and interpass temperature as required by base metal								1/8	

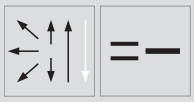
Characteristics and application

GTAW rod for high quality joint welding of corrosion resistant alloyed (CRA) clad pipes - alloy 316L, 625 and 825.

Approvals

TÜV (03464), DB (43.132.33), DNV, CE

TIG rods for corrosion resistant alloys (CRA)

Thermanit 686	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades
EN ISO 18274: **S Ni 6686 (NiCr21Mo16W4)** **AWS A5.14: ERNiCrMo-14**			**Re**	**Rm**	**A5**	**CVN**		**ø**	**CRA clad pipes**
	%		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**	
	C	≤ 0.01	540	800	30	+20	55	1.6	Alloy 316L
	Si	0.08	(≥ 460)	(≥ 760)	(≥ 25)			2.0	Alloy 625
	Mn	< 0.5						2.4	Alloy 825
	Cr	22.8							
Shielding gas: I1: 100 % Ar R1: Ar + 2 % He	Ni	Bal.							
	Mo	16.0	**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**	
	W	3.8	**ksi**	**ksi**	**%**	**°F**	**ft-lbf**	**inch**	
Rod marking Front: Ni6686, Back: ERNiCrMo-14	Al	0.3	78	116	30	+68	40	1/16	
	Fe	< 1.0		(≥ 100)	(≥30)			5/64	
								3/32	
Preheating and interpass temperature as required by base metal									

Characteristics and application

GTAW rod for high quality joint welding of corrosion resistant alloyed (CRA) clad pipes - alloy 316L, 625 and 825.

Wire /flux combinations for corrosion resistant alloys (CRA)

Thermanit GE-316L Marathon 431	Typical analyses			Typical mechanical properties all weld metal					Dia-meter	Pipeline steel grades	
			Weld	Re	Rm	A5	CVN		ø	UNS	AISI
Classification flux	%	Wire	metal	MPa	MPa	%	°C	J	mm		
EN ISO 14174: SA FB 2 DC	C	0.01	0.01	350	550	30	+20	70	2.0	S31603, S31653;	316L, 316Ti, 316Cb
Classification wire	Si	0.5	0.6				-120	60	2.4		
EN ISO 14343-A: S 19 12 3 L	Mn	1.7	1.2						3.2		
AWS A5.9: ER316L	Cr	18.5	18.0						4.0		
	Mo	2.8	2.8	YS	TS	E (L=4d)	CVN		ø		
Flux has to be redried before use for approx. 2h at 300 - 350 °C (570 - 660 °F)	Ni	12.2	12.2	ksi	ksi	%	°F	ft-lbf	inch		
				51	80	30	68	52	5/64		
							-184	44	3/32		
Polarity: DC+									1/8		

Approvals
TÜV (06113), CE

Thermanit 22/09 Marathon 431	Typical analyses			Typical mechanical properties all weld metal					Dia-meter	Pipeline steel grades
			Weld	Re	Rm	A5	CVN		ø	UNS
Classification flux	%	Wire	metal	MPa	MPa	%	°C	J	mm	
EN ISO 14174: SA FB 2 DC	C	0.01	0.02	450	690	20	+20	80	2.0	S31803, S32205
Classification wire	Si	0.40	0.50				-40	40	2.5	
EN ISO 14343-A: S 22 9 3 N L	Mn	1.6	1.4						3.0	
AWS A5.9: ER2209	Cr	22.5	22.2	YS	TS	E (L=4d)	CVN		ø	
	Mo	3.0	3.1	ksi	ksi	%	°F	ft-lbf	inch	
Flux has to be redried before use for approx. 2h at 300 - 350 °C (570 - 660 °F)	Ni	8.8	8.3	65	100		68	59	5/64	
	N	0.15	0.14				-40	29.5	3/32	
									1/8	
Polarity: DC+										

Approvals
TÜV (06112), ABS, DNV, GL, LR, CE

Thermanit 625 Marathon 444	Typical analyses			Typical mechanical properties all weld metal					Dia-meter	Pipeline steel grades
			Weld	Re	Rm	A5	CVN		ø	UNS
Classification flux	%	Wire	metal	MPa	MPa	%	°C	J	mm	
EN ISO 14174: SA FB 2 AC	C	0.01	0.01	420	700	40	+20	80	1.6	N06625
Classification wire	Si	0.10	0.16				-196	70	2.0	N 08926, N08367, Alloy 600
EN ISO 18274: S Ni 6625 (NiCr22Mo9Nb)	Mn	0.2	0.2						2.4	
AWS A5.14: ERNiCrMo-3	Cr	22.0	21.8	YS	TS	E (L=4d)	CVN		ø	
	Mo	9.0	9.0	ksi	ksi	%	°F	ft-lbf	inch	Alloy 625, Alloy 800,
Flux has to be redried before use for approx. 2h at 300 - 350 °C (570 - 660 °F)	Ni	Rest	Rest	60.9	101.5		68	59	1/16	
	Nb	3.6	3.2				-321	52	5/64	Alloy 825, 9 % Ni-steels
	Fe	< 1.0	< 1.0						3/32	
Polarity: DC+/AC										

Approvals
TÜV (10173), GL, CE

böhler welding
by voestalpine

009/2015/EN/GL

voestalpine Böhler Welding

Welding know-how joins steel

Customers in over 120 countries join the expertise of voestalpine Böhler Welding. Focused on filler metals, voestalpine Böhler Welding offers extensive technical consultation and individual solutions for industrial welding and soldering applications. Customer proximity is guaranteed by 40 subsidiaries in 28 countries, with the support of 2,200 employees, and through more than 1,000 distribution partners worldwide. voestalpine Böhler Welding offers three specialized and dedicated brands to cater our customers' and partners' requirements.

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