Welding consumables for dissimilar joints and special applications

Content

Stick electrodes

Product name	C	Si	Mn	Cr	Ni	Mo	N
BÖHLER FOX A 7	0.09	0.70	6.50	18.60	8.80		
BÖHLER FOX A 7-A	0.10	1.50	4.00	19.50	8.50	0.70	
BÖHLER FOX CN 19/9 M	0.04	0.70	0.80	20.20	10.30	3.20	
Thermanit 20/10 W 140 K	0.05	0.90	0.80	20.00	10.50	3.30	
BÖHLER FOX CN 23/12-A	0.02	0.70	0.80	23.20	12.50		
BÖHLER FOX CN 23/12 Mo-A	0.02	0.70	0.80	23.00	12.50	2.70	
Thermanit 30/10 W	0.10	1.10	0.80	29.00	9.00		0.10
BÖHLER FOX CN 29/9-A	0.11	0.90	0.70	28.80	9.50		

GTAW rods

Product name	C	Si	Mn	Cr	Ni	Mo
Thermanit X	0.08	0.80	7.00	19.00	9.00	
Thermanit 25/14 E-309L	0.02	0.50	1.70	23.50	13.20	
Thermanit 25/14 E-309L Si	0.02	0.80	1.80	23.50	13.50	
BÖHLER CN 23/12 Mo-IG	0.01	0.40	1.50	21.50	15.00	2.70

Solid wires

Product name	C	Si	Mn	Cr	Ni	Mo	FN
Thermanit X	0.08	0.80	7.00	19.00	9.00		
Thermanit 20/10	0.05	0.50	1.30	20.50	10.50	3.30	
Thermanit 25/14 E-309L	≤ 0.02	0.50	1.70	24.00	13.20		
Thermanit 25/14 E-309L Si (-)	0.03	0.90	2.00	24.00	13.00		
BÖHLER CN 23/12 Mo-IG	0.01	0.35	1.50	21.50	15.00	2.80	8
Thermanit 30/10	0.15	0.50	1.60	30.00	9.00		

SAW wire/flux combinations

Product name	C	Si	Mn	Cr	Ni	Mo	FN
BÖHLER A 7 CN-UP - BÖHLER BB 203	0.06	0.80	6.00	18.70	9.00		
Thermanit 25/14 E-309L - Marathon 213	0.01	0.70	1.30	23.50	13.50		
Thermanit 25/14 E-309L - Marathon 431	0.01	0.60	1.40	23.50	13.50		
Thermanit 25/14 E-309L - Avesta Flux 805	0.01	0.60	1.40	24.50	13.50		
Avesta P5 - Avesta Flux 805	0.01	0.50	1.10	22.00	14.80	2.60	15 FN (DeLong)
Avesta P7 - Avesta Flux 805	0.10	0.60	1.60	30.50	8.80		

Flux-cored and metal-cored wire

Product name	C	Si	Mn	Cr	Ni	Mo	FN
BÖHLER A 7-FD	0.10	0.80	6.80	18.80	9.00		2 – 4
BÖHLER A 7 PW-FD	0.10	0.80	6.80	18.80	9.00		2 – 4
BÖHLER A 7-MC	0.10	0.60	6.30	18.80	9.20		2 – 4
BÖHLER CN 23/12-FD	0.03	0.70	1.40	23.00	12.50		12 – 23
Avesta FCW-2D 309L	0.03	0.70	1.20	23.10	12.50		12 – 23
BÖHLER CN 23/12 PW-FD	0.03	0.70	1.40	23.00	12.50		12 – 23
Avesta FCW 309L-PW	0.03	0.70	1.40	23.00	12.50		12 – 23
BÖHLER CN 23/12-MC	0.03	0.60	1.40	23.00	12.50		12 – 23
BÖHLER CN 23/12 Mo-FD	0.03	0.60	1.40	23.00	12.50	2.70	27 – 42
BÖHLER CN 23/12 Mo PW-FD	0.03	0.70	1.40	23.00	12.50	2.70	23 – 36

BÖHLER FOX A 7

Stick electrode, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 3581-A
E 18 8 Mn B 2 2

AWS A5.4 / SFA-5.4
E307-15 (mod.)

Characteristics and typical fields of application

Basic coated, core wire alloyed austenitic electrode of E 18 8 Mn B / E307-15 type for welding and cladding in all positions except vertical down. Versatile electrode for numerous applications – welding of "hard-to-weld" steels, dissimilar welding as well as repair and maintenance. For tough buffer and intermediate layers for cladding of rails and switches, valve seats and in hydropower plants. The weld metal offers exceptionally high ductility and elongation together with outstanding crack resistance. Good resistance to embrittlement when operating at service temperatures from –100ºC up to 650ºC. The weld metal work hardens and offers good resistance to cavitation. The weld metal is resistant to scaling up to 850ºC, but at temperatures above 500ºC there is not sufficient resistance to sulfurous combustion gases. The weld deposit offers high ductility, elongation and resistance to hot cracking, also after high dilution of "hard-to-weld" steels.

Base materials

Dissimilar joints, tough buffer and intermediate layers prior to hardfacing, 14Mn-steels, 13 – 17% Cr and heat resistant Cr and austenitic steels up to 850ºC, armor plates, high carbon and quenched and tempered steels, surfacing of gears, valves, turbine blades, etc. For joint welding of unalloyed / low-alloyed or Cr steels with high-alloyed Cr and CrNi-steels. Welding of austenitic high manganese steels and with other steels.

Typical analysis of all-weld metal

	C	Si	Mn	Cr	Ni
wt.-%	0.09	0.7	6.5	18.6	8.8

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–110°C
u	440 (≥ 350)	600 (≥ 500)	35 (≥ 25)	90	34 (≥ 32)

u untreated, as-welded

Operating data

Polarity DC+

Electrode identification FOX A 7 / E 18 8 Mn B

Dimension mm	Current A
2.5 × 300	55 – 75
3.2 × 350	80 – 100
4.0 × 350	100 – 130
5.0 × 450	140 – 170

Preheat, interpass temperature and post-weld heat treatment as required by the base metal.

Approvals

TÜV (06786), DB (30.014.24), DNV GL, CE

BÖHLER FOX A 7-A

Stick electrode, high-alloyed, austenitc stainless, special applications

Classifications

EN ISO 3581-A
E Z 18 9 MnMo R 3 2

AWS A5.4 / SFA-5.4
E307-16 (mod.)

Characteristics and typical fields of application

Rutile basic coated austenitic electrode of E Z 18 9 MnMo R / E307-16 (mod.) type for welding and cladding in all positions except vertical down. Versatile electrode for numerous applications – welding of "hard-to-weld" steels, dissimilar welding as well as repair and maintenance. For tough buffer and intermediate layers for cladding of rails and switches, valve seats and in hydropower plants.

The weld metal offers exceptionally high ductility and elongation together with outstanding crack resistance. Good resistance to embrittlement when operating at service temperatures from –100ºC up to 650ºC. The weld metal work hardens and offers good resistance to cavitation. The weld metal is resistant to scaling up to 850ºC, but at temperatures above 500ºC there is not sufficient resistance to sulfurous combustion gases. The weld deposit offers high ductility, elongation and resistance to hot cracking, also after high dilution of "hard-to-weld" steels. Designed for first class weld seems and easy handling on AC or DC. Ferrite according to WRC 92 is 4 – 8 FN.

Base materials

Dissimilar joints, tough buffer and intermediate layers prior to hardfacing, 14Mn-steels, 13 – 17% Cr and heat resistant Cr and austenitic steels up to 850ºC, armor plates, high carbon and quenched and tempered steels, surfacing of gears, valves, turbine blades, etc. For joint welding of unalloyed / low-alloyed or Cr steels with high-alloyed Cr and CrNi-steels. Welding of austenitic high manganese steels and with other steels.

Typical analysis of all-weld metal

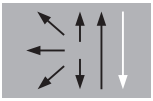
	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.10	1.5	4.0	19.5	8.5	0.7

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–20°C	–100°C
u	520 (≥ 350)	620 (≥ 500)	35 (≥ 25)	57	75	(≥ 32)

u untreated, as-welded

Operating data



Polarity DC+ / AC

Electrode identification FOX A 7-A / E Z 18 9 MnMo R

Dimension mm	Current A
2.5 × 300/350	60 – 80
3.2 × 300/350	80 – 110
4.0 × 350	110 – 140
5.0 × 450	140 – 170

Preheat, interpass temperature and post-weld heat treatment as required by the base metal.

Redrying at 120 – 200°C for min. 2 h if necessary.

Approvals

TÜV (09101), NAKS (Ø 3.2 mm), CE

BÖHLER FOX CN 19/9 M

Stick electrode, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 3581-A
E 20 10 3 R 3 2

AWS A5.4 / SFA-5.4
E308Mo-17 (mod.)

Characteristics and typical fields of application

Rutile coated, core wire alloyed electrode of E 20 10 3 R / E308Mo-17 type. Designed for dissimilar joints and weld cladding. BÖHLER FOX CN 19/9 M offers a lower chromium and ferrite content than an E309LMo weld deposit with the result that carbon diffusion and Cr-carbide formation is reduced after post-weld heat treatment and lower ferrite contents can be achieved in the second layer of 316L surfacing. Suitable for service temperatures from –80ºC to 300ºC. Excellent weldability in all positions except vertical down. Runs well also on AC.

Base materials

Welding and dissimilar joining of high-strength, mild steels and low-alloyed constructional steels; quench tempered steels, armour plates and austenitic manganese steels. Welding of non-alloyed as well as alloyed boiler or constructional steels to high-alloyed stainless Cr and CrNi-steels.

Typical analysis of all-weld metal

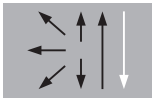
	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.04	0.7	0.8	20.2	10.3	3.2

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–80°C
u	500 (≥ 400)	700 (≥ 620)	28 (≥ 20)	70	42 (≥ 32)

u untreated, as-welded

Operating data



Polarity DC+ / AC

Electrode identification FOX CN 19 9 M / E 20 10 3 R

Dimension mm	Current A
2.5 × 250	50 – 85
3.2 × 350	75 – 115
4.0 × 350	110 – 160
5.0 × 450	160 – 200

Preheating and interpass temperature as required by the base metal.

Redrying if necessary at 250 – 300ºC for min. 2 h.

Approvals

TÜV (01086), DB (30.014.03), ABS, DNV GL, LR, CE

Thermanit 20/10 W 140 K

Stick electrode, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 3581-A
E 20 10 3 R 5 3

AWS A5.4 / SFA-5.4
E308Mo-17 (mod.)

Characteristics and typical fields of application

Rutile coated electrode of E 20 10 3 R / E308Mo-17 (mod.) type. For joining of stainless Cr and austenitic CrNiMo-steels/cast steel grades. Especially suited for dissimilar austenitic ferritic joints at a max. service temperature of 300°C. For tough joints on high manganese steel (steel castings), CrNiMn-steels and armor steels. For surfacing and repair welding on wear parts such as rotors and rails. Particularly for tough joints between unalloyed and low-alloyed steels or stainless and heat resistant Cr-steels to austenitic steels. Not recommended for buffer layers on weld claddings or clad plates. Max. application temperature 300°C.

Base materials

Combinations of austenitic steels with ferritic steels.

Typical analysis of all-weld metal

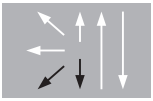
	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.05	0.9	0.8	20.0	10.5	3.3

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C
u	400	650	25	50

u untreated, as-welded

Operating data



Polarity DC+ / AC

Electrode identification Thermanit 20/10 W 140K E 20 10 3 R

Dimension mm	Current A
3.2 × 350	90 – 120
4.0 × 350	130 – 160

Suggested heat input is max.1.5 kJ/mm, interpass temperature max. 200°C. High manganese steels become brittle at 400 – 600°C so these should be welded as cold as possible.

Preheating only if required by the parent material.

Postweld heat treatment generally not needed. In special cases, solution annealing can be performed at 1050°C. Stress relieving only if allowed by the parent material.

Approvals

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BÖHLER FOX CN 23/12-A

Stick electrode, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 3581-A
E 23 12 L R 3 2

AWS A5.4 / SFA-5.4
E309L-17

Characteristics and typical fields of application

Rutile coated, core wire alloyed electrode of E 23 12 L / E309L-17 type providing increased delta ferrite contents (FN ~17) in the weld deposit for safe and crack resistant dissimilar joint welds and surfacing. Designed for first class weld seems and easy handling on AC or DC+. High current carrying capacity with minimum spatter formation. Self-releasing slag, smooth and clean weld profile. Safety against formation of porosity due to moisture resistant coating and its packaging into hermetically sealed tins. Operating temperature from –60ºC to 300ºC and for weld claddings up to 400ºC.

Base materials

Primarily used for surfacing (buffer layer) unalloyed or low-alloyed steels and when joining non-molybdenum-alloyed stainless and carbon steels. Joints and mixed joints between austenitic steels such as

1.4301 X5CrNi18-10, 1.4306 X2CrNi19-11, 1.4308 GX5CrNi19-10, 1.4401 X5CrNiMo17-12-2, 1.4404 X2CrNiMo17-12-2, 1.4408 GX5CrNiMo19-11-2, 1.4435 X2CrNiMo18-14-3, 1.4436 X3CrNiMo17-12-3, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4552 GX5CrNiNb19-11, 1.4571 X6CrNiMoTi17-12-2, 1.4580 X6CrNiMoNb17-12-2, 1.4581 GX5CrNiMoNb19-11-2, 1.4583 X10CrNiMoNb18-12, 1.4948 X6CrNi18-10

UNS S30400, S30403, S30809, S31600, S31603, S31635, S32100, S34700, S31640

AISI 304, 304L, 316, 316L, 316Ti, 321, 347

or mixed joints between austenitic and heat resistant steels such as

1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18, 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12, 1.4832 GX25CrNiSi20-14, 1.4837 GX40CrNiSi25-12

with ferritic steels to pressure boiler steels P295GH and fine grained structural steels to P355N, ship building steel grades A – E, AH 32 – EH 36, A40 – F40, etc.

Typical analysis of all-weld metal

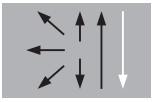
	C	Si	Mn	Cr	Ni
wt.-%	0.02	0.7	0.8	23.2	12.5

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–60°C
u	450 (≥ 320)	570 (≥ 520)	37 (≥ 25)	55	42 (≥ 32)

u untreated, as-welded

Operating data



Polarity DC+ / AC

Electrode identification FOX CN 23/12-A / 309L-17 E 23 12 L R

Dimension mm	Current A
2.5 × 300/350	60 – 80
3.2 × 300/350	80 – 110
4.0 × 350/450	110 – 140
5.0 × 450	140 – 180

Preheating and interpass temperature as required by the base metal.

Redrying at 120 – 200°C for min. 2 h if necessary.

Approvals

TÜV (01771), DB (30.014.08), ABS, BV, LR, DNV GL, CWB, NAKS (Ø 3.2 mm, Ø 4.0 mm), CE

BÖHLER FOX CN 23/12 Mo-A

Stick electrode, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 3581-A
E 23 12 2 L R 3 2

AWS A5.4 / SFA-5.4
E309LMo-17

Characteristics and typical fields of application

Rutile coated electrode of E 23 12 2 L / E309LMo-17 type. Provides increased delta ferrite content (FN ~20) in the weld metal for safe and crack resistant dissimilar joints as well as for cladding or root passes of clad steel. Designed for first class weld seems and easy handling on AC or DC+. High current carrying capacity with minimum spatter formation. Self-releasing slag, smooth and clean weld profile. Safety against formation of porosity due to moisture resistant coating and its packaging into hermetically sealed tins. Operating temperature from –10ºC to 300ºC and for weld surfacing (1st layer) up to 400ºC.

Base materials

Joints and mixed joints between austenitic stainless steels such as

1.4301 X5CrNi18-10, 1.4306 X2CrNi19-11, 1.4308 GX5CrNi19-10, 1.4401 X5CrNiMo17-12-2, 1.4404 X2CrNiMo17-12-2, 1.4408 GX5CrNiMo19-11-2, 1.4435 X2CrNiMo18-14-3, 1.4436 X3CrNiMo17-12-3, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4552 GX5CrNiNb19-11, 1.4571 X6CrNiMoTi17-12-2, 1.4580 X6CrNiMoNb17-12-2, 1.4581 GX5CrNiMoNb19-11-2, 1.4583 X10CrNiMoNb18-12, 1.4948 X6CrNi18-10

UNS S30400, S30403, S30809, S31600, S31603, S31635, S32100, S34700, S31640, S31653

AISI 304, 304L, 304LN, 302, 321, 347, 316, 316L, 316Ti, 316Cb

or duplex stainless steels such as

1.4162 X2CrNiMoN21-5-1, 1.4362 X2CrNiN23-4, 1.4462 X2CrNiMoN22-5-3

UNS S32101, S32304, S31803, S32205

LDX 2101®, SAF 2304, SAF 2205

or mixed joints between austenitic and heat resistant steels

1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18, 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12, 1.4832 GX25CrNiSi20-14, 1.4837 GX40CrNiSi25-12

with ferritic steels to pressure boiler steels P295GH and also fine grained structural steels to P355N, shipbuilding steels grade A – E, AH 32 – EH 36, A40 – F40, etc.

Dissimilar joint welds – overlay welding the first corrosion resistant surface layer on P235GH, P265GH, S255N, P295GH, S355N – S500N and high-temperature quenched and tempered fine-grained steels.

Typical analysis of all-weld metal

	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.02	0.7	0.8	23.0	12.5	2.7

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_o=5d_o) %	Impact values ISO-V KV J 20°C	–60°C
u	550 (≥ 350)	700 (≥ 550)	27 (≥ 25)	50	40 (≥ 32)

u untreated, as-welded

Operating data

Polarity DC+ / AC

Electrode identification FOX CN 23/12 Mo-A / E 23 12 2 L R

Dimension mm	Current A
2.0 × 300	45 – 60
2.5 × 250/350	60 – 80
3.2 × 350	80 – 120
4.0 × 350/450	100 – 160
5.0 × 450	140 – 220

Preheating and interpass temperature as required by the base metal.
Redrying at 250 – 300°C for min. 2 h if necessary.

Approvals

TÜV (01362), ABS, RINA, DNV GL, BV, LR, NAKS (Ø 2.5 mm), CE

Thermanit 30/10 W

Stick electrode, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 3581-A
E 29 9 R 1 2

AWS A5.4 / SFA-5.4
E312-16 (mod.)

Characteristics and typical fields of application

Rutile coated electrode of E 29 9 R / E312-16 type. Wet corrosion up to 300ºC. High resistance to hot cracking and good toughness at high yield strength. For joining and surfacing applications with matching and similar steel grades. For fabricating tough joints on unalloyed and low-alloyed structural steels of higher strength, on high manganese and CrNiMn-steels, between dissimilar metals e.g. between stainless or heat resistant and unalloyed or low-alloyed steels and cast steel grades.

Base materials

For welding of unalloyed steels with limited weldability and low-alloyed steels of higher strength. Used as stress-relieved buffer layer when cladding cold and warm machine tools. For joining of high manganese and CrNiMn-steels, as well as for combinations on steels of different chemical composition or strength.

1.3401 X120Mn12, 1.4006 X10Cr13, 1.4339 GX32CrNi28-10, 1.4340 GX49CrNi27-4, 1.4347 GX8CrCrNiN26-7 1.4460 X3CrNiMoN27-5-2 UNS S41000 AISI 329, 410. S235, E295

Typical analysis of all-weld metal

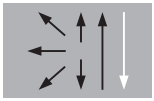
	C	Si	Mn	Cr	Ni	N
wt.-%	0.10	1.1	0.8	29.0	9.0	0.1

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A ($L_0=5d_0$) %	Impact values ISO-V KV J 20°C
u	> 550	> 700	> 18	25

u untreated, as-welded

Operating data



Polarity DC+ / AC

Electrode identification Thermanit 30/10 W E 29 9 R

Dimension mm	Current A
2.0 × 250	45 – 60
2.5 × 300	50 – 80
3.2 × 350	60 – 110
4.0 × 350	90 – 150
5.0 × 450	150 – 210

Suggested heat input max. 2.0 kJ/mm and interpass temperature max. 150ºC.

Preheating and interpass temperature as required by the base metal.

Weld with a short arc, use stringer beads or slight weaving, as applicable.

Redrying at 120 – 200ºC for min. 2h if necessary.

Approvals

CE

BÖHLER FOX CN 29/9-A

Stick electrode, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 3581-A
E 29 9 R 3 2

AWS A5.4 / SFA-5.4
E312-17

Characteristics and typical fields of application

Rutile coated, core wire alloyed electrode of E 29 9 R / E312-17 type. Highly alloyed electrode with high ferrite content to offer high tensile strength and excellent resistance to cracking. Primarily intended for dissimilar welding between stainless steel, high strength steel, tool steel; spring steel and 14Mn-steel as well as other difficult-to-weld combinations. The weld metal work hardens making it suitable for wear resisting build-ups on clutches, gear wheels, shafts, etc. Also suitable for repair and maintenance; for instance welding of tools. Designed for first class weld seems and easy handling on AC or DC+. Very good corrosion resistance in wet sulfuric environments, such as in sulfate digesters used by the pulp & paper industry.

Base materials

For steels with higher strength and difficult welding characteristics, joining of dissimilar materials, tool steels, heat treatable or quenched and tempered steels, spring steels, high carbon steels etc.

1.4339 GX32CrNi28-10, 1.4347 GX8CrCrNiN26-7, 1.4340 GX49CrNi27-4, 1.4460 X3CrNiMoN27-5-2

Typical analysis of all-weld metal

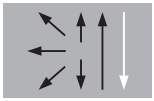
	C	Si	Mn	Cr	Ni
wt.-%	0.11	0.9	0.7	28.8	9.5

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A ($L_0=5d_0$) %	Impact values ISO-V KV J 20°C
u	650 (≥ 450)	790 (≥ 660)	24 (≥ 15)	30

u untreated, as-welded

Operating data



Polarity DC+ / AC

Electrode identification FOX CN 29/9-A E 29 9 R

Dimension mm	Current A
2.5 × 300	60 – 80
3.2 × 350	80 – 110
4.0 × 350	110 – 140
5.0 × 450	140 – 180

Recommended heat input max. 2.0 kJ/mm and interpass temperature max. 150°C.

Preheating and interpass temperature as required by the base metal.

Redrying at 250 – 300°C for min. 2 h if necessary.

Approvals

DB (30.014.16, 20.014.07), CE

Thermanit X

TIG rod, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 14343-A
W 18 8 Mn

AWS A5.9 / SFA-5.9
ER307 (mod.)

Characteristics and typical fields of application

TIG rod of W 18 8 Mn / ER307 (mod.) type for joining and surfacing applications with heat resistant Cr-steels and heat resistant austenitic steels. Max. service temperature 850ºC. Well-suited for fabricating dissimilar austenitic-ferritic joints for a max. application temperature of 300ºC. For joining unalloyed, low-alloyed or Cr-steels to austenitic steels. Low heat input required in order to avoid brittle martensitic transition zones. Inadequate resistance against sulfurous combustion gases at temperatures above 500ºC.

Base materials

Dissimilar joints, tough buffer and intermediate layers prior to hardfacing, 14Mn-steels, 13 – 17% Cr and heat resistant Cr and austenitic steels up to 850ºC, armor plates, high carbon and quenched and tempered steels, surfacing of gears, valves, turbine blades, etc. For joint welding of unalloyed / low-alloyed or Cr steels with high-alloyed Cr and CrNi-steels. Welding of austenitic high manganese steels and with other steels.

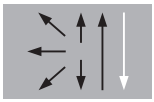
Typical analysis of the wire rod

	C	Si	Mn	Cr	Ni
wt.-%	0.08	0.8	7.0	19	9.0

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A ($L_0=5d_0$) %	Impact values ISO-V KV J 20°C
u	450 (≥ 350)	620 (≥ 500)	35 (≥ 25)	100

Operating data



Rod marking W 18 8 Mn / 1.4370

Dimension mm	Current A	Voltage V
1.0 × 1000	50 – 70	9 – 11
1.6 × 1000	80 – 120	10 – 13
2.0 × 1000	100 – 130	14 – 16
2.4 × 1000	130 – 160	16 – 18
3.2 × 1000	160 – 200	17 – 20

Preheat, interpass temperature and post-weld heat treatment as required by the base metal. Thicker heat resistant Cr-steels can be preheated to 150 – 300ºC. In case of post weld heat treatment of dissimilar joints, attention must be paid to resistance to intercrystalline corrosion and to susceptibility of the austenitic metal side to embrittlement. For dissimilar joining with unalloyed or low-alloy steels, no post weld heat treatment should be performed above 300ºC due to the risk of carbide precipitation in the weld fusion zone causing loss of toughness.

Shielding gas: 100% Ar. Gas flow: 8 – 12 l/min.

Polarity: DC-

Approvals

TÜV (01234), DB (43.132.26), DNV GL, CE

Thermanit 25/14 E-309L

TIG rod, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 14343-A
W 23 12 L

AWS A5.9 / SFA-5.9
ER309L

Characteristics and typical fields of application

TIG rod of W 23 12 L / ER309L type for welding dissimilar joints. Well-suited for depositing intermediate layers when welding of cladded materials. Designed for very good welding and wetting characteristics as well as good safety after dilution when welding dissimilar joints. Due to the high ferrite content, 16 FN, the weld metal is less susceptible to hot cracking. Suitable for service temperatures between –80ºC and 300ºC.

Base materials

Primarily used for surfacing (buffer layer) unalloyed or low-alloyed steels and when joining non-molybdenum-alloyed stainless and carbon steels.

Joints and mixed joints between austenitic steels such as

1.4301 X5CrNi18-10, 1.4306 X2CrNi19-11, 1.4308 GX5CrNi19-10, 1.4401 X5CrNiMo17-12-2, 1.4404 X2CrNiMo17-12-2, 1.4408 GX5CrNiMo19-11-2, 1.4435 X2CrNiMo18-14-3, 1.4436 X3CrNiMo17-12-3, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4552 GX5CrNiNb19-11, 1.4571 X6CrNiMoTi17-12-2, 1.4580 X6CrNiMoNb17-12-2, 1.4581 GX5CrNiMoNb19-11-2, 1.4583 X10CrNiMoNb18-12, 1.4948 X6CrNi18-10

UNS S30400, S30403, S30809, S31600, S31603, S31635, S32100, S34700, S31640

AISI 304, 304L, 316, 316L, 316Ti, 321, 347

or mixed joints between austenitic and heat resistant steels such as

1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18, 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12, 1.4832 GX25CrNiSi20-14, 1.4837 GX40CrNiSi25-12

with ferritic steels to pressure boiler steels P295GH and fine grained structural steels to P355N, ship building steel grades A – E, AH 32 – EH 36, A40 – F40, etc.

Typical analysis of the wire rod

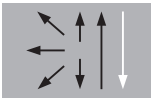
	C	Si	Mn	Cr	Ni
wt.-%	0.02	0.5	1.7	23.5	13.2

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–120°C
u	440 (≥ 320)	580 (≥ 520)	34 (≥ 25)	150	(≥ 32)

u untreated, as-welded – shielding gas Ar

Operating data



Rod marking

W 23 12 L
ER 309 L

Dimension mm	Current A	Voltage V
2.0 × 1000	100 – 130	14 – 16
2.4 × 1000	130 – 160	16 – 18

Heat input max. 1,5 kJ/mm, interpass temperature max. 100ºC.

Preheating and interpass temperature as required by the base metal. In case of post weld heat treatment of dissimilar joints, attention must be paid to resistance to intercrystalline corrosion and to susceptibility of the austenitic metal side to embrittlement. For dissimilar joining with unalloyed or low-alloyed steels, no post-weld heat treatment should be performed above 300ºC due to the risk of carbide precipitation in the weld fusion zone causing loss of toughness.

Shielding gas: Ar. Gas flow: 8 – 12 l/min.

Polarity: DC-

Approvals

TÜV (02661), DNV GL, ABS, BV, NAKS, CE

Thermanit 25/14 E-309L Si

TIG rod, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 14343-A
23 12 L Si

AWS A5.9 / SFA-5.9
ER309LSi

Characteristics and typical fields of application

TIG rod of W 23 12 L Si / ER309LSi for joining and surfacing applications. Designed for dissimilar welding between mild steel and stainless steels and surfacing of low-alloy steels, offering a ductile and crack resistant weldment. The chemical composition when surfacing is equivalent to that of base material 1.4301 / 304 from the first run. One or two layers of 309L are usually combined with a final layer of 308L, 316L or 347. The resulting microstructure is austenite with 5 – 10% ferrite. The corrosion resistance is superior to type 308L already in the first clad layer.

Base materials

1.4301 X5CrNi18-10, 1.4306 X2CrNi19-11, 1.4308 GX5CrNi19-10, 1.4401 X5CrNiMo17-12-2, 1.4404 X2CrNiMo17-12-2, 1.4408 GX5CrNiMo19-11-2, 1.4435 X2CrNiMo18-14-3, 1.4436 X3CrNiMo17-12-3, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4552 GX5CrNiNb19-11, 1.4571 X6CrNiMoTi17-12-2, 1.4580 X6CrNiMoNb17-12-2, 1.4581 GX5CrNiMoNb19-11-2, 1.4583 X10CrNiMoNb18-12, 1.4948 X6CrNi18-10

UNS S30400, S30403, S30809, S31600, S31603, S31635, S32100, S34700, S31640

AISI 304, 304L, 316, 316L, 316Ti, 321, 347

or mixed joints between austenitic and heat resistant steels such as

1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18, 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12, 1.4832 GX25CrNiSi20-14, 1.4837 GX40CrNiSi25-12

with ferritic steels to pressure boiler steels P295GH and fine grained structural steels to P355N, ship building steel grades A – E, AH 32 – EH 36, A40 – F40, etc.

Typical analysis of the wire rod

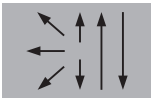
	C	Si	Mn	Cr	Ni
wt.-%	0.02	0.8	1.8	23.5	13.5

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A ($L_0=5d_0$) %	Impact values ISO-V KV J 20°C
u	470	650	28	100

u untreated, as-welded – shielding gas Ar + 30% He

Operating data



Polarity DC-

Dimension mm
0.8

Heat input max. 2.0 kJ/mm, interpass temperature max. 150ºC. Post-weld heat treatment generally not needed. For constructions that include low-alloyed steels in mixed joints, a stress-relieving annealing stage may be advisable. This type of alloy may be susceptible to embrittlement-inducing precipitation in the temperature range 550 – 950ºC. .

Shielding gas: 100% Ar or Ar + 20 – 30% He, Ar + 1 – 5% H_2. The addition of helium and hydrogen increases the energy of the arc. Gas flow: 8 – 12 l/min (somewhat higher with helium).

Approvals

TÜV (02661), DNV GL, ABS, BV, NAKS, CE

BÖHLER CN 23/12 Mo-IG

TIG rod, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 14343-A
W 23 12 2 L

AWS A5.9 / SFA-5.9
ER309LMo

Characteristics and typical fields of application

TIG rod of W 23 12 2 L / ER309LMo type for welding dissimilar joints between duplex and stainless steels with low-alloyed steels and surfacing low-alloyed steels. Very good wetting characteristics and high resistance against cracking. When used for surfacing the composition is more or less equal to that of base material 1.4401/316 from the first run. Suitable for service temperatures between -40ºC and 300ºC. The corrosion resistance is superior to that of 316L even in the first layer of cladding.

Base materials

Joints and mixed joints between austenitic stainless steels such as

1.4301 X5CrNi18-10, 1.4306 X2CrNi19-11, 1.4308 GX5CrNi19-10, 1.4401 X5CrNiMo17-12-2, 1.4404 X2CrNiMo17-12-2, 1.4408 GX5CrNiMo19-11-2, 1.4435 X2CrNiMo18-14-3, 1.4436 X3CrNiMo17-12-3, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4552 GX5CrNiNb19-11, 1.4571 X6CrNiMoTi17-12-2, 1.4580 X6CrNiMoNb17-12-2, 1.4581 GX5CrNiMoNb19-11-2, 1.4583 X10CrNiMoNb18-12, 1.4948 X6CrNi18-10

UNS S30400, S30403, S30809, S31600, S31603, S31635, S32100, S34700, S31640, S31653

AISI 304, 304L, 304LN, 302, 321, 347, 316, 316L, 316Ti, 316Cb

or duplex stainless steels such as

1.4162 X2CrNiMoN21-5-1, 1.4362 X2CrNiN23-4, 1.4462 X2CrNiMoN22-5-3

UNS S32101, S32304, S31803, S32205

LDX 2101®, SAF 2304, SAF 2205 or mixed joints between austenitic and heat resistant steels

1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18, 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12, 1.4832 GX25CrNiSi20-14, 1.4837 GX40CrNiSi25-12 with ferritic steels to pressure boiler steels P295GH and also fine grained structural steels to P355N, shipbuilding steels grade A – E, AH 32 – EH 36, A40 – F40, etc.

Dissimilar joint welds – overlay welding the first corrosion resistant surface layer on P235GH, P265GH, S255N, P295GH, S355N – S500N and high-temperature quenched and tempered fine-grained steels.

Typical analysis of the wire rod

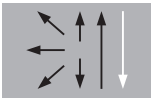
	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.014	0.4	1.5	21.5	15.0	2.7

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–40°C
u	470 (≥ 350)	640 (≥ 550)	34 (≥ 25)	140 (≥ 47)	90 (≥ 32)

u untreated, as-welded – shielding gas Ar

Operating data



Rod marking 1.4459

Dimension mm	Current A	Voltage V
2.0 × 1000	100 – 130	14 – 16
2.4 × 1000	130 – 160	16 – 18

Preheating and interpass temperature as required by the base metal, max. 150ºC.

Suggested heat input is max. 2.0 kJ/mm.

For constructions that include low-alloyed steels in mixed joints, a stress-relieving annealing stage may be advisable. However, this type of alloy may be susceptible to embrittlement-inducing precipitation in the temperature range 550 – 950ºC.

Shielding gas: Ar or Ar + 20 – 30% He. The addition of helium and hydrogen increases the energy of the arc. Gas flow: 8 – 12 l/min (somewhat higher with helium).

Polarity: DC-

Approvals

TÜV (10990), CE

Thermanit X

Solid wire, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 14343-A
G 18 8 Mn

AWS A5.9 / SFA-5.9
ER307 (mod.)

Characteristics and typical fields of application

Solid wire of G 18 8 Mn / ER307 (mod.) type for joining and surfacing applications with heat resistant Cr-steels and heat resistant austenitic steels. Well-suited for fabricating dissimilar austenitic-ferritic joints for a max. application temperature of 300ºC. For joining unalloyed / low-alloyed or Cr-steels to austenitic steels. Low heat input required in order to avoid brittle martensitic transition zones. Max. service temperature 850ºC.

Base materials

Dissimilar joints, tough buffer and intermediate layers prior to hardfacing, 14Mn-steels, 13 – 17% Cr and heat resistant Cr and austenitic steels up to 850ºC, armor plates, high carbon and quenched and tempered steels, surfacing of gears, valves, turbine blades, etc. For joint welding of unalloyed / low-alloyed or Cr steels with high-alloyed Cr and CrNi-steels. Welding of austenitic high manganese steels and with other steels.

Typical analysis of the solid wire

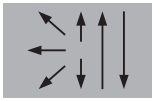
	C	Si	Mn	Cr	Ni
wt.-%	0.08	0.8	7.0	19	9.0

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A ($L_0=5d_0$) %	Impact values ISO-V KV J 20°C
u	370	600	35	100

u untreated, as-welded – shielding gas Ar + 2.5% CO_2

Operating data



Dimension mm	Current A	Voltage V
0.8 short arc	90 – 120	18 – 22
1.0 short arc	110 – 140	19 – 22
1.0 spray arc	160 – 220	25 – 29
1.2 spray arc	200 – 270	26 – 30
1.6 spray arc	250 – 330	27 – 32

Preheat, interpass temperature and post-weld heat treatment as required by the base metal. Thicker heat resistant Cr-steels can be preheated to 150 – 300ºC. In case of post weld heat treatment of dissimilar joints, attention must be paid to resistance to intercrystalline corrosion and to susceptibility of the austenitic metal side to embrittlement. For dissimilar joining with unalloyed or low-alloy steels, no post weld heat treatment should be performed above 300ºC due to the risk of carbide precipitation in the weld fusion zone causing loss of toughness.

Shielding gas: Ar + 2 – 3% CO_2 (M12) or Ar + 1 – 2% O_2 (M13). Gas flow: 15 – 20 l/min.

Polarity: DC+

Approvals

TÜV (05651), DB (43.132.01), DNV GL, VG 95132-1, CE

Thermanit 20/10

Solid wire, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 14343-A
G 20 10 3

AWS A5.9 / SFA-5.9
ER308Mo (mod.)

Characteristics and typical fields of application

Solid wire of G 20 10 3 / ER308Mo (mod.) type for joining of stainless Cr and similar austenitic CrNiMo-steels and cast steel grades. For joining of dissimilar materials. For tough joints on high manganese steel (steel castings), CrNiMn-steels and cast steel grades and armor steels. For surfacing and repair welding on wear-exposed parts such as rotors and rails. Especially suited for dissimilar austenitic-ferritic joints at maximum application temperature of 300ºC. Particularly for tough joints of unalloyed / low-alloyed steels and cast steel grades or stainless heat resistant Cr-steels and cast steel grades with austenitic steels and cast steel grades. Application temperature max. 300ºC.

Base materials

Welding and dissimilar joining of high-strength, mild steels and low-alloyed constructional steels; quench tempered steels, armour plates and austenitic manganese steels. Welding of unalloyed as well as alloyed boiler or constructional steels to high-alloyed stainless Cr and CrNi-steels.

Typical analysis of the solid wire

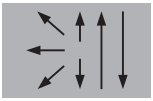
	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.05	0.5	1.3	20.5	10.5	3.3

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A ($L_0=5d_0$) %	Impact values ISO-V KV J 20°C
u	470 (≥ 400)	670 (≥ 620)	25 (≥ 20)	50

u untreated, as-welded – shielding gas Ar + 2.5% CO_2

Operating data



Dimension mm	Current A	Voltage V
1.2 spray arc	200 – 270	26 – 30
1.6 spray arc	250 – 330	27 – 32

Suggested heat input is max.1.5 kJ/mm, interpass temperature max. 200ºC. High manganese steels become brittle at 400 – 600ºC so these should be welded as cold as possible.

Preheating only if required by the parent material.

Post-weld heat treatment generally not needed. In special cases, solution annealing can be performed at 1050ºC. Stress relieving only if allowed by the parent material.

Shielding gas: Ar + 1 – 2% O_2 or Ar + 2 – 3% CO_2. Gas flow: 15 – 20 l/min. Polarity: DC+

Approvals

TÜV (01773), CE

Thermanit 25/14 E-309L

Solid wire, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 14343-A
G 23 12 L Si

AWS A5.9 / SFA-5.9
ER309LSi

Characteristics and typical fields of application

GMAW solid wire of type 309L / 23 12 L for welding dissimilar joints with an average ferrite content 16 FN. Well suited for depositing intermediate layers when welding cladded materials. Due to the high ferrite content, the weld metal is less susceptible to hot cracking. Suitable for service temperatures between -80°C and 300°C.

Base materials

Dissimilar Joints of and between high-strength, mild steels and low-alloyed QT-steels, stainless, ferritic Cr and austenitic Cr-Ni-steels, high manganese steels

Surfacing: for the first layer of corrosion resistant weld surfacing on ferritic-perlitic steels in boiler and pressure vessel parts up to fine-grained steel S500N, as well as of high temperature steels.

Typical analysis of the solid wire

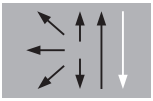
	C	Si	Mn	Cr	Ni
wt.-%	≤ 0.02	0.5	1.7	24.0	13.2

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–80°C
u	420 (≥ 320)	570 (≥ 520)	32 (≥ 25)	90	(≥ 32)

u untreated, as-welded – shielding gas Ar + 2.5% CO_2

Operating data



Dimension mm	Current A	Voltage V
0.8 short arc	60 – 100	18 – 20
1.0 short arc	110 – 140	20 – 22
1.0 spray arc	160 – 220	25 – 29
1.2 spray arc	200 – 260	27 – 30
1.6 spray arc	250 – 330	29 – 32

Post-weld heat treatment generally not needed. For constructions that include low-alloyed steels in mixed joints, a stress-relieving annealing stage may be advisable. However, this type of alloy may be susceptible to embrittlement-inducing precipitation in the temperature range 550 – 950°C. Always consult the supplier of the parent metal or seek other expert advice to ensure that the correct heat treatment process is carried out. Heat input max. 2.0 kJ/mm, interpass temperature max. 150°C.

Shielding gas: Ar + 2 – 3% CO_2 or Ar + 1 – 2% O_2. Gas flow: 15 – 20 l/min.

Polarity: DC+

Approvals

TÜV (09362), DNV GL, ABS, BV, CE

Thermanit 25/14 E-309L Si

Solid wire, high-alloyed, austenitic stainless, special applications

Classifications

EN 12072
G 23 12 L Si

AWS A5.9 / SFA-5.9
ER309LSi

Characteristics and typical fields of application

Solid wire of G 23 12 L Si / ER309LSi type for joining unalloyed and low-alloyed steels and cast steel grades or stainless heat resistant Cr-steels to austenitic steels. Well-suited for depositing intermediate layers when welding cladded materials. Favorably high Cr and Ni contents, low C content. For depositing intermediate layers when welding the side of plates clad with low-carbon unstabilized or stabilized austenitic CrNiMo(N) austenitic metals. Application temperature max. 300ºC.

Base materials

Primarily used for surfacing (buffer layer) unalloyed or low-alloyed steels and when joining non-molybdenum-alloyed stainless and carbon steels. Joints and mixed joints between austenitic steels such as

1.4301 X5CrNi18-10, 1.4306 X2CrNi19-11, 1.4308 GX5CrNi19-10, 1.4401 X5CrNiMo17-12-2, 1.4404 X2CrNiMo17-12-2, 1.4408 GX5CrNiMo19-11-2, 1.4435 X2CrNiMo18-14-3, 1.4436 X3CrNiMo17-12-3, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4552 GX5CrNiNb19-11, 1.4571 X6CrNiMoTi17-12-2, 1.4580 X6CrNiMoNb17-12-2, 1.4581 GX5CrNiMoNb19-11-2 1.4583 X10CrNiMoNb18-12, 1.4948 X6CrNi18-10

UNS S30400, S30403, S30809, S31600, S31603, S31635, S32100, S34700, S31640

AISI 304, 304L, 316, 316L, 316Ti, 321, 347

or mixed joints between austenitic and heat resistant steels such as

1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18, 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12 1.4832 GX25CrNiSi20-14, 1.4837 GX40CrNiSi25-12

with ferritic steels to pressure boiler steels P295GH and fine grained structural steels to P355N, ship building steel grades A – E, AH 32 – EH 36, A40 – F40, etc.

Typical analysis of the solid wire

	C	Si	Mn	Cr	Ni
wt.-%	0.03	0.9	2.0	24	13.0

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A ($L_0=5d_0$) %	Impact values ISO-V KV J 20°C
u	400	550	30	55

u untreated, as-welded – shielding gas Ar + 2.5% CO_2

Operating data

Dimension mm

0.8
1.0
1.2
1.6

Preheating and interpass temperature as required by the base metal.

Shielding gas: Ar + 2 – 3% CO_2 or Ar + 1 – 2% O_2. Gas flow: 15 – 20 l/min.

Polarity: DC+

Approvals

TÜV (12312), DNV GL, NAKS, CE

GMAW

BÖHLER CN 23/12 Mo-IG

Solid wire, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 14343-A
G 23 12 2 L

AWS A5.9 / SFA-5.9
ER309LMo

Characteristics and typical fields of application

Solid wire of G 23 12 L Mo / ER309LMo type for surfacing low-alloyed steels and welding dissimilar joints between duplex and austenitic stainless steels with low-alloyed steels. When used for surfacing the composition is more or less equal to that of ER316 from the first run. Designed for very good welding and wetting characteristics and ensuring a high resistance against cracking. Suitable for service temperatures between -40ºC and 300ºC. The corrosion resistance is superior to that of 316L even in the first layer of cladding.

Base materials

Joints and mixed joints between austenitic stainless steels such as

1.4301 X5CrNi18-10, 1.4306 X2CrNi19-11, 1.4308 GX5CrNi19-10, 1.4401 X5CrNiMo17-12-2, 1.4404 X2CrNiMo17-12-2, 1.4408 GX5CrNiMo19-11-2, 1.4435 X2CrNiMo18-14-3, 1.4436 X3CrNiMo17-12-3, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4552 GX5CrNiNb19-11, 1.4571 X6CrNiMoTi17-12-2, 1.4580 X6CrNiMoNb17-12-2, 1.4581 GX5CrNiMoNb19-11-2 1.4583 X10CrNiMoNb18-12, 1.4948 X6CrNi18-10

UNS S30400, S30403, S30809, S31600, S31603, S31635, S32100, S34700, S31640, S31653

AISI 304, 304L, 304LN, 302, 321, 347, 316, 316L, 316Ti, 316Cb

with duplex stainless steels such as

1.4162 X2CrNiMoN21-5-1, 1.4362 X2CrNiN23-4, 1.4462 X2CrNiMoN22-5-3

UNS S32101, S32304, S31803, S32205

LDX 2101®, SAF 2304, SAF 2205

or mixed joints between austenitic and heat resistant steels

1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18, 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12 1.4832 GX25CrNiSi20-14, 1.4837 GX40CrNiSi25-12

with ferritic steels to pressure boiler steels P295GH and also fine grained structural steels to P355N, shipbuilding steels grade A – E, AH 32 – EH 36, A40 – F40, etc.

Dissimilar joint welds – overlay welding the first corrosion resistant surface layer on P235GH, P265GH, S255N, P295GH, S355N – S500N and high-temperature quenched and tempered fine-grained steels.

Typical analysis of the solid wire

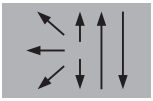
	C	Si	Mn	Cr	Ni	Mo	FN
wt.-%	0.014	0.35	1.5	21.5	15.0	2.8	8

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–40°C
u	470 (≥ 350)	640 (≥ 550)	34 (≥ 25)	140 (≥ 47)	90 (≥ 32)

u untreated, as-welded – shielding gas Ar + 2.5% CO_2

Operating data



Dimension mm	Current A	Voltage V
1.2 spray arc	200 – 260	26 – 30

Preheating and interpass temperature as required by the base metal and should not exceed 150ºC. Suggested heat input is max. 2.0 kJ/mm.

For constructions that include low-alloyed steels in mixed joints, a stress-relieving annealing stage may be advisable. However, this type of alloy may be susceptible to embrittlement in the temperature range 550 – 950ºC.

Shielding gas: Ar + 2 – 3% CO_2 or Ar + 1 – 2% O_2. Gas flow: 15 – 20 l/min.

Polarity: DC+

Approvals

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Thermanit 30/10

Solid wire, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 14343-A	AWS A5.9 / SFA-5.9
G 29 9	ER312

Characteristics and typical fields of application

Solid wire of G 29 9 / ER312 type for joining and surfacing applications with matching / similar steels and cast steel grades. For fabricating tough joints (one layer) on unalloyed / low-alloyed structural steels of higher strength on high manganese steel and CrNiMn steels. High resistance to hot cracking, good toughness and strength properties. The weld metal also work hardens making it suitable for wear resisting build-ups on clutches, gear wheels, shafts, etc. It is also suitable for repair welding of tools. Application temperature max. 300ºC.

Base materials

For welding of unalloyed steels with limited weldability and low-alloyed steels of higher strength. Used as stress-relieved buffer layer when cladding cold and warm machine tools. For joining of high manganese and CrNiMn-steels and combinations of steels of different chemical composition or strength.

1.3401 X120Mn12, 1.4006 X10Cr13, 1.4339 GX32CrNi28-10, 1.4340 GX49CrNi27-4, 1.4347 GX8CrCrNiN26-7, 1.4460 X3CrNiMoN27-5-2

UNS S41000, AISI 329, 410, S235, E295

Typical analysis of the solid wire

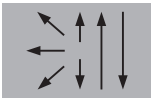
	C	Si	Mn	Cr	Ni
wt.-%	0.15	0.5	1.6	30	9.0

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A ($L_0=5d_0$) %	Impact values ISO-V KV J 20°C
u	500	750	20	27

u untreated, as-welded – shielding gas Ar + 2.5% CO_2

Operating data



Dimension mm	Current A	Voltage V
1.0 spray arc	170 – 210	24 – 28
1.2 spray arc	200 – 240	25 – 29

Suggested heat input max. 2.0 kJ/mm and interpass temperature max. 150ºC.

Preheating and interpass temperature as required by the base metal.

Shielding gas: Ar + 2 – 3% CO_2 (M12) or Ar + 1 – 2% O_2 (M13). Gas flow: 15 – 20 l/min.

Polarity: DC+

Approvals

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BÖHLER A 7 CN-UP - BÖHLER BB 203

SAW wire/flux combination, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 14343-A	AWS A5.9 / SFA-5.9	EN ISO 14174
S 18 8 Mn	ER307 (mod.)	S A FB 2 DC

Characteristics and typical fields of application

BÖHLER A 7 CN-UP - BB 203 is as wire/flux combination for submerged arc welding for multiple applications.

Solid wire of S 18 8 Mn / ER307 (mod.) type for joining and surfacing applications with heat resistant Cr-steels and heat resistant austenitic steels. Well-suited for fabricating dissimilar austenitic-ferritic joints at a max. application temperature of 300ºC. For joining unalloyed / low-alloyed or Cr-steels to austenitic steels. The weld deposit offers exceptionally high ductility and elongation together with outstanding crack resistance. There is low risk for embrittlement when operating temperatures cool down to –100ºC or rise till 500ºC. The deposit work hardens and offers good resistance against cavitation. Ductility remains good even after high dilution or when subjected to thermal shock or scaling. Resistant to scaling up to 850ºC. Inadequate resistance against sulfurous combustion gases at temperatures above 500ºC.

BÖHLER BB 203 is a fluoride-basic, agglomerated flux providing good operating characteristics, smooth beads and a low hydrogen weld metal. For more information regarding this sub-arc welding flux, see the separate datasheet.

Base materials

14Mn-steels, 13 – 17% Cr and heat resistant Cr and austenitic steels up to 850ºC, armor plates, high carbon and quenched and tempered steels, surfacing of gears, valves, turbine blades, etc.

Typical analysis of the weld metal

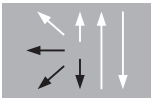
wt.-%	C	Si	Mn	Cr	Ni
wire	0.08	0.90	7.0	19.0	9.0
all-weld metal	0.06	0.80	6.0	18.7	9.0

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength R_e MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J –100°C
u	(≥ 350)	(≥ 500)	(≥ 25)	(≥ 40)

u untreated, as-welded

Operating data



Dimension mm	Current A	Voltage V
2.4	300 – 400	29 – 33
3.0	320 – 450	29 – 33

Preheat, interpass temperature and post-weld heat treatment as required by the base metal. Polarity: DC+. Thicker heat resistant Cr-steels can be preheated to 150 – 300ºC. In case of post weld heat treatment of dissimilar joints, attention must be paid to resistance to intercrystalline corrosion and to susceptibility of the austenitic metal side to embrittlement. For dissimilar joining with unalloyed or low-alloy steels, no postweld heat treatment should be performed above 300ºC due to the risk of carbide precipitation in the weld fusion zone causing loss of toughness.

Approvals

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Thermanit 25/14 E-309L - Marathon 213

SAW wire/flux combination, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 14343-A	AWS A5.9 / SFA-5.9	EN ISO 14174
S 23 12 L	ER309L	S F CS 2 DC

Characteristics and typical fields of application

Thermanit 25/14 E-309L - Marathon 213 is a wire/flux combination for submerged arc welding. This is a standard combination for welding dissimilar joints, and the first layer in weld overlay (wire cladding). The average ferrite content is 16 FN.

Solid wire of S 23 12 L / ER309L type for joining unalloyed/low-alloyed steels and cast steel grades or stainless heat resistant Cr-steels to austenitic steels. For depositing intermediate layers when welding the side of plates clad with low-carbon unstabilized and stabilized austenitic CrNi(MoN)-alloys. Favorably high chromium and nickel contents, low carbon content. Max. service temperature 350ºC. Well-suited for depositing intermediate layers when welding cladded materials.

Marathon 213 is an fused flux with good welding properties with nice bead appearance and good slag detachability. For more information regarding this sub-arc welding flux, see the separate datasheet.

Base materials

Dissimilar joint welds: Of and between high-strength, mild steels and low-alloyed QT-steels, stainless, ferritic Cr and austenitic CrNi-steels, manganese steels.

Surfacing: For the first layer of corrosion resistant weld surfacing on ferritic-pearlitic steels in boiler and pressure vessel parts up to fine-grained steel S500N, as well as of high temperature steels such as 1.6310 20MnMoNi5-5, 1.6755 22NiMoCr4-7 and 1.6759 GS-18NiMoCr3-7.

SAW

Typical analysis of the weld metal

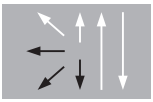
wt.-%	C	Si	Mn	Cr	Ni
wire	0.01	0.50	1.8	24.0	13.5
all-weld metal	0.01	0.70	1.3	23.5	13.5

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A ($L_0=5d_0$) %	Impact values ISO-V KV J 20°C
u	≥ 380	≥ 580	≥ 30	≥ 80

u untreated, as-welded

Operating data



Dimension mm	Current A	Voltage V
2.4	300 – 400	29 – 33
3.2	350 – 500	29 – 33
4.0	425 – 575	30 – 34

Preheating and interpass temperature as required by the base metal. Polarity: DC+.

In case of post weld heat treatment of dissimilar joints, attention must be paid to resistance to intercrystalline corrosion and to susceptibility of the austenitic metal side to embrittlement. For dissimilar joining with unalloyed or low-alloyed steels, no postweld heat treatment should be performed above 300ºC due to the risk of carbide precipitation in the weld fusion zone causing loss of toughness.

Approvals

TÜV (09617), CE

Thermanit 25/14 E-309L - Marathon 431

SAW wire/flux combination, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 14343-A	AWS A5.9 / SFA-5.9	EN ISO 14174
S 23 12 L	ER309L	S A FB 2 DC

Characteristics and typical fields of application

Thermanit 25/14 E-309L - Marathon 431 is a wire/flux combination for submerged arc welding. This is a standard combination for welding dissimilar joints, and the first layer in weld overlay (wire cladding).

Solid wire of S 23 12 L / ER309L type for joining unalloyed/low-alloyed steels and cast steel grades or stainless heat resistant Cr-steels to austenitic steels. For depositing intermediate layers when welding the side of plates clad with low-carbon unstabilised and stabilised austenitic CrNi(MoN)-alloys. Favorably high chromium and nickel contents, low carbon content. Max. service temperature 350ºC. Well-suited for depositing intermediate layers when welding cladded materials.

Marathon 431 is an agglomerated basic flux that ensures good welding properties with nice bead appearance and good slag detachability. For more information regarding this sub-arc welding flux, see the separate datasheet.

Base materials

Dissimilar joint welds: Of and between high-strength, mild steels and low-alloyed QT-steels, stainless, ferritic Cr and austenitic CrNi-steels, manganese steels.

Surfacing: For the first layer of corrosion resistant weld surfacing on ferritic-pearlitic steels in boiler and pressure vessel parts up to fine-grained steel S500N, as well as of high temperature steels such as 1.6310 20MnMoNi5-5, 1.6755 22NiMoCr4-7 and 1.6759 GS-18NiMoCr3-7.

Typical analysis of the weld metal

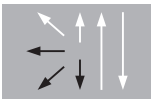
wt.-%	C	Si	Mn	Cr	Ni
wire	0.01	0.50	1.8	24.0	13.5
all-weld metal	0.01	0.60	1.4	23.5	13.5

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A ($L_0=5d_0$) %	Impact values ISO-V KV J 20°C
u	≥ 380	≥ 600	≥ 25	≥ 100

u untreated, as-welded

Operating data



Dimension mm	Current A	Voltage V
2.4	300 – 400	29 – 33
3.2	350 – 500	29 – 33
4.0	425 – 575	30 – 34

Preheating and interpass temperature as required by the base metal. Polarity: DC+.

In case of post-weld heat treatment of dissimilar joints, attention must be paid to resistance to intercrystalline corrosion and to susceptibility of the austenitic metal side to embrittlement. For dissimilar joining with unalloyed or low-alloyed steels, no post weld heat treatment should be performed above 300ºC due to the risk of carbide precipitation in the weld fusion zone causing loss of toughness.

Approvals

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Thermanit 25/14 E-309L - Avesta Flux 805

SAW wire/flux combination, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 14343-A	AWS A5.9 / SFA-5.9	EN ISO 14174
S 23 12 L	ER309L	S A AF 2 DC

Characteristics and typical fields of application

Thermanit 25/14 E-309L - Avesta Flux 805 is a wire/flux combination for submerged arc welding. This is a standard combination for welding dissimilar joints, and the first layer in weld overlay (wire cladding).

Solid wire of S 23 12 L / ER309L type for joining unalloyed/low-alloyed steels or stainless heat resistant Cr-steels to austenitic steels. For depositing intermediate layers when welding the side of plates clad with low-carbon unstabilised and stabilised austenitic CrNi(MoN)-alloys. Favorably high chromium and nickel contents, low carbon content. Max. service temperature 350ºC. Well-suited for depositing intermediate layers when welding cladded materials.

Avesta Flux 805 is an agglomerated basic flux that ensures good welding properties with nice bead appearance and good slag detachability. The flux avoids excessive Cr-burn-out (Cr-support). For more information regarding this sub-arc welding flux, see the separate datasheet.

Base materials

Dissimilar joint welds: Of and between high-strength, mild steels and low-alloyed QT-steels, stainless, ferritic Cr and austenitic CrNi-steels, manganese steels.

Surfacing: For the first layer of corrosion resistant weld surfacing on ferritic-pearlitic steels in boiler and pressure vessel parts up to fine-grained steel S500N, as well as of high temperature steels such as 1.6310 20MnMoNi5-5, 1.6755 22NiMoCr4-7 and 1.6759 GS-18NiMoCr3-7.

Typical analysis of the weld metal

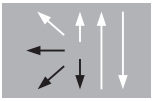
wt.-%	C	Si	Mn	Cr	Ni
wire	0.01	0.50	1.8	24.0	13.5
all-weld metal	0.01	0.60	1.4	24.5	13.5

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C
u	400	550	36 (≥ 30)	100

u untreated, as-welded

Operating data



Dimension mm	Current A	Voltage V
2.4	300 – 400	29 – 33
3.2	350 – 500	29 – 33
4.0	425 – 575	30 – 34

Preheating and interpass temperature as required by the base metal. Polarity: DC+.

In case of post-weld heat treatment of dissimilar joints, attention must be paid to resistance to intercrystalline corrosion and to susceptibility of the austenitic metal side to embrittlement. For dissimilar joining with unalloyed or low-alloyed steels, no post-weld heat treatment should be performed above 300ºC due to the risk of carbide precipitation in the weld fusion zone causing loss of toughness.

Approvals

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Avesta P5 - Avesta Flux 805

SAW wire/flux combination, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 14343-A	AWS A5.9 / SFA-5.9	EN ISO 14174
S 23 12 2 L	ER309LMo (mod.)	S A AF 2 DC

Characteristics and typical fields of application

Avesta P5 - Avesta Flux 805 is a wire/flux combination for submerged arc welding. Solid wire of S 23 12 2 L / ER309LMo (mod.) type for surfacing low-alloyed steels and welding dissimilar joints between duplex and stainless steels with unalloyed and low-alloyed steels. The all-weld metal is austenitic - ferrite. When used for surfacing the composition is more or less equal to that of the base material 1.4401/316 from the first run. Designed for very good welding and wetting characteristics and ensuring a high resistance against cracking. Suitable for service temperatures between –40ºC and 300ºC. The corrosion resistance is superior to that of 1.4404/316L even in the first layer of cladding. Scaling temperature approximately 950ºC in air.

Avesta Flux 805 is an agglomerated basic flux that ensures good welding properties with nice bead appearance and good slag detachability. The flux avoids excessive Cr-burn-out (Cr-support). For more information regarding this sub-arc welding flux, see the separate datasheet.

Base materials

Suitable for dissimilar joints of unalloyed or low-alloyed steels with stainless steels as well as for cladding on low-alloyed steels.

Typical analysis of the weld metal

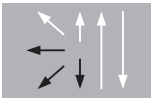
wt.-%	C	Si	Mn	Cr	Ni	Mo	FN
wire	0.02	0.35	1.5	21.5	15.0	2.7	
all-weld metal	0.01	0.50	1.1	22.0	14.8	2.6	15 FN (DeLong)

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C
u	420 (≥ 380)	600 (≥ 550)	30 (≥ 24)	≥ 70

u untreated, as-welded

Operating data



Dimension mm	Current A	Voltage V
2.4	300 – 400	29 – 33
3.2	350 – 500	29 – 33
4.0	425 – 575	30 – 34

Preheating and interpass temperature as required by the base metal and should not exceed 150ºC. Suggested heat input is max. 2.0 kJ/mm. Polarity: DC+.

For constructions that include low-alloyed steels in mixed joints, a stress-relieving annealing stage may be advisable. However, this type of alloy may be susceptible to embrittlement-inducing precipitation in the temperature range 550 – 950ºC. Always consult the supplier of the parent metal or seek other expert advice to ensure that the correct heat treatment process is carried out.

Approvals

DNV GL

Avesta P7 - Avesta Flux 805

SAW wire/flux combination, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 14343-A	AWS A5.9 / SFA-5.9	EN ISO 14174
S 29 9	ER312	S A AF 2 DC

Characteristics and typical fields of application

Avesta P7 - Avesta Flux 805 is a wire/flux combination for submerged arc welding.

Solid wire of S 29 9 / ER312 type for joining and surfacing applications with matching / similar steels and cast steel grades. For fabricating tough joints (one layer) on unalloyed / low-alloyed structural steels of higher strength on high manganese steel and CrNiMn-steels. The all-weld metal is has as high ferrite content as 40 – 60% ferrite. In high dilution applications with unalloyed or low-alloyed steel grades, Avesta P7 can, for this reason, be advantageous over an ER309L wire. Suitable also for "difficult-to-weld steels".
High resistance to hot cracking, good toughness and strength properties. Scaling temperature 850ºC in air. Application temperature max. 300ºC.

Avesta Flux 805 is an agglomerated basic flux that ensures good welding properties with nice bead appearance and good slag detachability. The flux avoids excessive Cr-burn-out (Cr-support). For more information regarding this sub-arc welding flux see the detailed data sheet.

Base materials

Suitable for dissimilar joints of unalloyed or low-alloyed steels with stainless steels as well as for cladding on low-alloyed steels. Difficult-to-weld steels.

SAW

Typical analysis of the weld metal

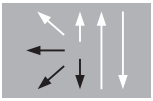
wt.-%	C	Si	Mn	Cr	Ni
wire	0.10	0.40	1.9	30.0	9.0
all-weld metal	0.10	0.60	1.6	30.5	8.8

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C
u	(≥ 640)	(≥ 770)	(≥ 22)	(≥ 35)

u untreated, as-welded

Operating data



Dimension mm	Current A	Voltage V
2.4	300 – 400	29 – 33

Preheating and interpass temperature as required by the base metal and should not exceed 150ºC. Suggested heat input is max. 2.0 kJ/mm. Polarity: DC+.

For constructions that include low-alloyed steels in mixed joints, a stress-relieving annealing stage may be advisable. However, this type of alloy may be susceptible to embrittlement-inducing precipitation in the temperature range 550 – 950ºC. Always consult the supplier of the parent metal or seek other expert advice to ensure that the correct heat treatment process is carried out.

Approvals

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BÖHLER A 7-FD

Flux-cored wire, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 17633-A
T 18 8 Mn R M21 (C1) 3

AWS A5.22 / SFA-5.22
E307T0-G

Characteristics and typical fields of application

Austenitic rutile flux-cored wire of T 18 8 Mn R / E307LT0 type for welding and cladding in flat and horizontal position. One of the most universal alloys and for some applications a cost-efficient alternative to T 29 9 / E312 or T 23 12 L / E309L. For tough buffer and intermediate layers for cladding of rails and switches, valve seats and in hydropower plants. Good resistance to embrittlement when operating at service temperatures from –60ºC up to 650ºC. Easy handling and high deposition rate result in high productivity with excellent welding performance and very low spatter formation. Increased travel speeds as well as self-releasing slag with little demand for cleaning and pickling provide considerable savings in time and money. The wire shows good wetting behavior and results in a finely rippled surface pattern. The wide arc ensures even penetration and side-wall fusion to prevent lack of fusion. Used for fabrication, repair and maintenance. The weld deposit offers high ductility and elongation, also after high dilution of "hard-to-weld" steels. The weld metal work hardens and offers good resistance to cavitation. The weld metal is resistant to scaling up to 850ºC, but at temperatures above 500ºC there is not sufficient resistance to sulfurous combustion gases. Ferrite measured with FeritScope FMP30 2 – 7 FN. For welding in vertical-up and overhead positions, BÖHLER A 7 PW-FD should be preferred.

Base materials

Dissimilar joints, tough buffer and intermediate layers prior to hardfacing, 14Mn-steels, 13 – 17% Cr and heat resistant Cr and austenitic steels up to 850ºC, armor plates, high carbon and quenched and tempered steels, surfacing of gears, valves, turbine blades, etc. For joint welding of unalloyed, low-alloyed or Cr steels with high-alloyed Cr and CrNi-steels. Welding of austenitic high manganese steels and with other steels.

Typical analysis of the wire

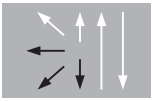
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.10	0.8	6.8	18.8	9.0	2 – 4

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	Impact values ISO-V KV J –60°C	Hardness HB	Stress hardened HV
u	395 (≥ 350)	595 (≥ 590)	40 (≥ 30)	60	36 (≥ 32)	~ 200	≤ 400

u untreated, as-welded – shielding gas Ar + 18% CO_2

Operating data



Dimension mm	Arc length mm	Current A	Voltage V	Wire feed m/min
1.2	~ 3	130 – 280	22 – 30	5.0 – 15.0
1.6	~ 3	200 – 350	25 – 30	4.5 – 9.5

Welding with standard GMAW power source with DC+ polarity. No pulsing needed. Backhand (drag) technique preferred with a work angle of appr. 80º. Ar + 15 – 25% CO_2 as shielding gas offers the best weldability. 100% CO_2 can be also used, but the voltage should be increased by 2 V. The gas flow should be 15 – 20 l/min. The wire stick-out should be 15 – 20 mm and the heat input not exceed 2.0 kJ/mm. Preheating and interpass temperature as required by the base metal.

Approvals

TÜV (11101), CE

BÖHLER A 7 PW-FD

Flux-cored wire, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 17633-A
T 18 8 Mn P M21 (C1) 2

AWS A5.22 / SFA-5.22
E307T1-G

Characteristics and typical fields of application

Austenitic rutile flux-cored wire of T 18 8 Mn P / E307LT1 type for welding and cladding in all positions. One of the most universal alloys and for some applications a cost-efficient alternative to T 29 9 / E312 or T 23 12 L / E309L. For tough buffer and intermediate layers for cladding of rails and switches, valve seats and in hydropower plants. Good resistance to embrittlement when operating at service temperatures from –100ºC up to 650ºC. The fast freezing slag offers excellent weldability and slag control in all positions. Easy handling and high deposition rate result in high productivity with excellent welding performance and very low spatter formation. Increased travel speeds as well as self-releasing slag with little demand for cleaning and pickling provide considerable savings in time and money. The wide arc ensures even penetration and side-wall fusion to prevent lack of fusion. The weld deposit offers high ductility, elongation and resistance to hot cracking, also after high dilution of "hard-to-weld" steels. The weld metal work hardens and offers good resistance to cavitation. The weld metal is resistant to scaling up to 850ºC, but at temperatures above 500ºC there is not sufficient resistance to sulfurous combustion gases. Ferrite measured with FeritScope FMP30 2 – 7 FN. For flat and horizontal welding positions, BÖHLER A 7-FD may be preferred.

Base materials

Dissimilar joints, tough buffer and intermediate layers prior to hardfacing, 14Mn-steels, 13 – 17% Cr and heat resistant Cr and austenitic steels up to 850ºC, armor plates, high carbon and quenched and tempered steels, surfacing of gears, valves, turbine blades, etc. For joint welding of unalloyed, low-alloyed or Cr-steels with high-alloyed Cr and CrNi-steels. Welding of austenitic high manganese steels and with other steels.

Typical analysis of the wire

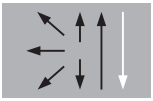
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.10	0.8	6.8	18.8	9.0	2 – 4

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–60°C	Hardness HB	Stress hardened HV
u	400 (≥ 350)	610 (≥ 590)	38 (≥ 30)	51	40 (≥ 32)	~ 200	≤ 400

u untreated, as-welded – shielding gas Ar + 18% CO_2

Operating data



Dimension mm	Arc length mm	Current A	Voltage V	Wire feed m/min
1.2	~ 3	150 – 230	22 – 29	6.0 – 13.0
1.6	~ 3	200 – 360	23 – 28	4.5 – 9.5

Welding with standard GMAW power source with DC+ polarity. No pulsing needed. Backhand (drag) technique preferred with a work angle of appr. 80º. Ar + 15 – 25% CO_2 as shielding gas offers the best weldability. 100% CO_2 can be also used, but the voltage should be increased by 2 V. The gas flow should be 15 – 20 l/min. The wire stick-out should be 15 – 20 mm and the heat input not exceed 2.0 kJ/mm. Preheating and interpass temperature as required by the base metal.

Approvals

TÜV (11102), CE

BÖHLER A 7-MC

Metal-cored wire, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 17633-A
T 18 8 Mn M M12 1

AWS A5.22 / SFA-5.22
EC307 (mod.)

Characteristics and typical fields of application

Austenitic metal-cored wire of T 18 8 Mn / EC307 type for numerous applications. The corrosion resistance is on par with T 19 9 L R / E308LT0. The easy handling and high deposition rate result in high productivity with excellent welding performance and very low spatter formation. The wire shows good wetting behavior and results in a smooth surface. The wide arc ensures even penetration and side-wall fusion to prevent lack of fusion. This makes the metal-cored wire less sensitive to edge misalignment and variation in gap width as compared to solid wires. This is for instance utilized for robotic welding of exhaust systems in the automotive industry.

Used for fabrication, repair and maintenance. The weld deposit offers exceptionally high ductility and elongation, also after high dilution of "hard-to-weld" steels. The resistance to cracking is excellent also when subject to thermal shock. The weld metal work hardens and offers good resistance to cavitation. Good resistance to embrittlement when operating at service temperatures from –110ºC up to 650ºC. The weld metal is resistant to scaling up to 850ºC, but at temperatures above 500ºC there is not sufficient resistance to sulfurous combustion gases. Ferrite measured with FeritScope FMP30 2 – 7 FN.

Base materials

Dissimilar joints, tough buffer and intermediate layers prior to hardfacing, 14Mn-steels, 13 – 17% Cr and heat resistant Cr and austenitic steels up to 850ºC, armor plates, high carbon and quenched and tempered steels, surfacing of gears, valves, turbine blades, etc. For joint welding of unalloyed / low-alloyed or Cr steels with high-alloyed Cr and CrNi-steels. Welding of austenitic high manganese steels and with other steels.

Typical analysis of the wire

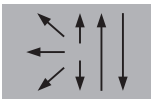
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.10	0.6	6.3	18.8	9.2	2 – 4

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–60°C
u	408 (≥ 350)	608 (≥ 590)	40 (≥ 30)	55	40 (≥ 32)

u untreated, as-welded – shielding gas Ar + 2.5% CO_2

Operating data



Dimension mm	Arc length mm	Current A	Voltage V	Wire feed m/min
1.2	~ 3	100 – 280	10 – 27	3.5 – 13.0
1.6	~ 3	110 – 380	10 – 27	1.5 – 8.0

Welding with conventional or pulsed power sources using DC+ polarity, but pulsed arc may be advantageous and especially when welding out of position. Forehand (pushing) technique preferred with a work angle of appr. 80º. Ar + 2.5% CO_2 as shielding gas offers the best weldability. The gas flow should be 15 – 20 l/min and the wire stick-out 15 – 20 mm. Preheating and interpass temperature as required by the base metal.

Approvals

TÜV (10871), DB (43.014.27), CE

BÖHLER CN 23/12-FD

Flux-cored wire, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 17633-A
T 23 12 L R M21 (C1) 3

AWS A5.22 / SFA-5.22
E309LT0-4(1)

Characteristics and typical fields of application

Rutile flux-cored wire of T 23 12 L R / E309LT0 type for welding of dissimilar joints of Cr and CrNi(Mo)-steels and unalloyed or low-alloyed steels, as well as weld cladding of unalloyed or low-alloyed base metals preferably in flat or horizontal position. Ferrite measured with FeritScope FMP30 14 – 22 FN. Easy handling and high deposition rate result in high productivity with excellent welding performance and very low spatter formation. Increased travel speeds as well as self-releasing slag with little demand for cleaning and pickling provide considerable savings in time and money. The wire shows good wetting behavior and results in a finely rippled surface pattern. The wide arc ensures even penetration and side-wall fusion to prevent lack of fusion. Suitable for service temperatures from –60ºC to 300ºC. For welding in vertical-up and overhead positions, BÖHLER CN 23/12 PW-FD should be preferred.

Base materials

Primarily used for surfacing (buffer layer) unalloyed or low-alloyed steels and when joining non-molybdenum-alloyed stainless and carbon steels.

Joints and mixed joints between austenitic steels such as

1.4301 X5CrNi18-10, 1.4306 X2CrNi19-11, 1.4308 GX5CrNi19-10, 1.4401 X5CrNiMo17-12-2, 1.4404 X2CrNiMo17-12-2, 1.4408 GX5CrNiMo19-11-2, 1.4435 X2CrNiMo18-14-3, 1.4436 X3CrNiMo17-12-3, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4552 GX5CrNiNb19-11, 1.4571 X6CrNiMoTi17-12-2, 1.4580 X6CrNiMoNb17-12-2, 1.4581 GX5CrNiMoNb19-11-2 1.4583 X10CrNiMoNb18-12, 1.4948 X6CrNi18-10

UNS S30400, S30403, S30809, S31600, S31603, S31635, S32100, S34700, S31640

AISI 304, 304L, 316, 316L, 316Ti, 321, 347

or mixed joints between austenitic and heat resistant steels such as

1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18, 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12, 1.4832 GX25CrNiSi20-14, 1.4837 GX40CrNiSi25-12

with ferritic steels to pressure boiler steels P295GH and fine grained structural steels to P355N, ship building steel grades A – E, AH 32 – EH 36, A40 – F40, etc.

FCW

Typical analysis of the wire

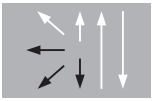
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.03	0.7	1.4	23.0	12.5	12 – 23

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–60°C
u	400 (≥ 320)	540 (≥ 520)	33 (≥ 30)	55	45 (≥ 32)

u untreated, as-welded – shielding gas Ar + 18% CO_2

Operating data



Dimension mm	Arc length mm	Current A	Voltage V	Wire feed m/min
1.2	~ 3	130 – 280	22 – 30	5.0 – 15.0
1.6	~ 3	200 – 350	25 – 30	4.5 – 9.5

Welding with standard GMAW power source with DC+ polarity. No pulsing needed. Backhand (drag) technique preferred with a work angle of appr. 80º. Ar + 15 – 25% CO_2 as shielding gas offers the best weldability. 100% CO_2 can be also used, but the voltage should be increased by 2 V. The gas flow should be 15 – 20 l/min. The wire stick-out should be 15 – 20 mm and the heat input not exceed 2.0 kJ/mm. For dissimilar welding, slight weaving is recommended for all welding positions. The scaling temperature is approx. 1000ºC in air. Post-weld heat treatment generally not needed. Preheat and interpass temperatures as required by the base material.

Approvals

TÜV (05350), DB (43.014.16), DNV GL, LR, CE, RINA, BV (C1 + Ø 1.2 mm), ABS (M21), CE

Avesta FCW-2D 309L

Flux-cored wire, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 17633-A
T 23 12 L R M21 (C1) 3

AWS A5.22 / SFA-5.22
E309LT0-4(1)

Characteristics and typical fields of application

Rutile flux-cored wire of T 23 12 L R / E309T0 type. Primarily intended for surfacing low-alloyed steels and for dissimilar welds between mild steel and stainless steels. Ferrite measured with FeritScope FMP30 14 – 22 FN. Corrosion resistance superior to T 19 9 L / E308L type fillers. When used for overlay welding on mild steel a corrosion resistance equivalent to that of base metal 1.4301 / 304 is obtained already in the first layer.

Avesta FCW-2D 309L provides excellent weldability in flat as well as horizontal-vertical position. Great slag detachability and almost no spatter formation. Optimized to result in a shiny weld metal surface; also when welding with 100% CO_2. Due to the slow freezing rutile slag, the weld metal shows very smooth bead appearance and low temper discoloration, which makes post-weld cleaning easier. Welding in vertical-up and overhead positions is preferably done using Avesta FCW 309L-PW. Maximum service temperature 300ºC. The scaling temperature is approximately 1000ºC in air.

Base materials

Primarily used for surfacing (buffer layer) unalloyed or low-alloyed steels and when joining non-molybdenum- alloyed stainless and carbon steels.

Joints and mixed joints between austenitic steels such as

1.4301 X5CrNi18-10, 1.4306 X2CrNi19-11, 1.4308 GX5CrNi19-10, 1.4401 X5CrNiMo17-12-2, 1.4404 X2CrNiMo17-12-2 1.4408 GX5CrNiMo19-11-2, 1.4435 X2CrNiMo18-14-3, 1.4436 X3CrNiMo17-12-3, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4552 GX5CrNiNb19-11, 1.4571 X6CrNiMoTi17-12-2, 1.4580 X6CrNiMoNb17-12-2, 1.4581 GX5CrNiMoNb19-11-2, 1.4583 X10CrNiMoNb18-12, 1.4948 X6CrNi18-10

UNS S30400, S30403, S30809, S31600, S31603, S31635, S32100, S34700, S31640 304, 304L, 316, 316L, 316Ti, 321, 347,

or mixed joints between austenitic and heat resistant steels such as

1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18, 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12 1.4832 GX25CrNiSi20-14, 1.4837 GX40CrNiSi25-12

with ferritic steels to pressure boiler steels P295GH and also fine grained structural steels to P355N, ship building steels grade A – E, AH 32 – EH 36, A40 – F40, etc.

Typical analysis of the wire

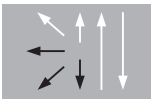
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.03	0.7	1.2	23.1	12.5	12 – 23

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–60°C	Hardness HB
u	390 (≥ 320)	560 (≥ 520)	35 (≥ 30)	49	48 (≥ 32)	210

u untreated, as-welded – shielding gas Ar + 18% CO_2

Operating data



Dimension mm	Arc length mm	Current A	Voltage V	Wire feed m/min
1.2	~ 3	130 – 280	22 – 30	5.0 – 15.0
1.6	~ 3	200 – 350	25 – 30	4.5 – 9.5

Welding with standard GMAW power source with DC+ polarity. No pulsing needed. Backhand (drag) technique preferred with a work angle of appr. 80º. Ar + 15 – 25% CO_2 offers the best weldability. 100% CO_2 can be also used, but the voltage should be increased by 2 V. Suitable gas flow rate for welding outdoors is 18 – 25 l/min. Suggested heat input is max. 2.0 kJ/mm and wire stick-out 15 – 20 mm. For dissimilar welding, slight weaving is recommended for all welding positions. Post-weld heat treatment generally not needed. For constructions that include dissimilar welding of low-alloyed steels, a stress-relieving annealing stage may be advisable. Always consult the supplier of the parent material or seek other expert advice to ensure that the correct heat treatment process is carried out. Preheat and interpass temperatures as required by the base metal.

Approvals

TÜV (10747), CWB, DB (43.014.41), DNV GL, RINA (M21), BV (C1 + Ø 1.2 mm), ABS, CE

BÖHLER CN 23/12 PW-FD

Flux-cored wire, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 17633-A
T 23 12 L P M21 (C1) 1

AWS A5.22 / SFA-5.22
E309LT1-4(1)

Characteristics and typical fields of application

Rutile flux-cored wire of T 23 12 L P / E309LT1 type for welding of dissimilar joints of Cr and CrNi(Mo)-steels and unalloyed or low-alloyed steels, as well as weld cladding of unalloyed or low-alloyed base metals. Ferrite measured with FeritScope FMP30 14 – 22 FN. The fast freezing slag offers excellent weldability and slag control in all positions. Easy handling and high deposition rate result in high productivity with excellent welding performance and very low spatter formation. Increased travel speeds as well as self-releasing slag with little demand for cleaning and pickling provide considerable savings in time and money. The wide arc ensures even penetration and side-wall fusion to prevent lack of fusion. Suitable for service temperatures from –60ºC to 300ºC. For flat and horizontal welding positions, BÖHLER CN 23/12-FD may be preferred.

Base materials

Primarily used for surfacing (buffer layer) unalloyed or low-alloyed steels and when joining non-molybdenum-alloyed stainless and carbon steels. Joints and mixed joints between austenitic steels such as

1.4301 X5CrNi18-10, 1.4306 X2CrNi19-11, 1.4308 GX5CrNi19-10, 1.4401 X5CrNiMo17-12-2, 1.4404 X2CrNiMo17-12-2 1.4408 GX5CrNiMo19-11-2, 1.4435 X2CrNiMo18-14-3, 1.4436 X3CrNiMo17-12-3, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4552 GX5CrNiNb19-11, 1.4571 X6CrNiMoTi17-12-2, 1.4580 X6CrNiMoNb17-12-2, 1.4581 GX5CrNiMoNb19-11-2, 1.4583 X10CrNiMoNb18-12, 1.4948 X6CrNi18-10

UNS S30400, S30403, S30809, S31600, S31603, S31635, S32100, S34700, S31640

AISI 304, 304L, 316, 316L, 316Ti, 321, 347

or mixed joints between austenitic and heat resistant steels such as

1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18, 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12 1.4832 GX25CrNiSi20-14, 1.4837 GX40CrNiSi25-12

with ferritic steels to pressure boiler steels P295GH and fine grained structural steels to P355N, ship building steel grades A – E, AH 32 – EH 36, A40 – F40, etc.

FCW

Typical analysis of the wire

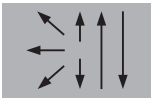
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.03	0.7	1.4	23.0	12.5	12 – 23

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–60°C
u	420 (≥ 320)	540 (≥ 520)	36 (≥ 30)	65	50 (≥ 32)

u untreated, as-welded – shielding gas Ar + 18% CO_2

Operating data



Dimension mm	Arc length mm	Current A	Voltage V	Wire feed m/min
0.9	~ 3	100 – 160	20 – 31	8.0 – 15.0
1.2	~ 3	150 – 280	21 – 29	6.0 – 15.0
1.6	~ 3	200 – 360	21 – 29	4.5 – 9.5

Welding with standard GMAW power source with DC+ polarity. No pulsing needed. Backhand (drag) technique preferred with a work angle of appr. 80º. Ar + 15 – 25% CO_2 as shielding gas offers the best weldability. 100% CO_2 can be also used, but the voltage should be increased by 2 V. The gas flow should be 15 – 20 l/min. The wire stick-out should be 15 – 20 mm and the heat input not exceed 2.0 kJ/mm. For dissimilar welding, slight weaving is recommended for all welding positions. Post-weld heat treatment generally not needed, but depends on the base material being used. Preheat and interpass temperatures as required by the base material.

Approvals

TÜV (09115), DB (43.014.22), DNV GL, LR, RINA (M21), BV (Ø 1.2 mm), ABS (M21), CE

Avesta FCW 309L-PW

Flux-cored wire, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 17633-A
T 23 12 L P M21 (C1) 1

AWS A5.22 / SFA-5.22
E309LT1-4(1)

Characteristics and typical fields of application

Austenitic stainless steel flux-cored wire of T 23 12 L P / E309LT1 type, primarily intended for surfacing low-alloyed steels and for dissimilar welds between mild steel and stainless steels. Ferrite measured with FeritScope FMP30 14 – 22 FN. Corrosion resistance superior to T 19 9 L / E308L fillers. When used for overlay welding on mild steel a corrosion resistance equivalent to that of 1.4301 / 304 is obtained already in the first layer. Avesta FCW 309L-PW has a stronger arc and a faster freezing slag compared Avesta FCW-2D 309L. It is designed for all-round welding and can be used in all positions without changing the parameter settings. Very good slag detachability and almost no spatter formation. Due to the fast freezing rutile slag, the weldability is excellent also in the vertical-up and overhead positions. Maximum application temperature 300ºC. The scaling temperature is approx. 1000ºC in air.

Base materials

Primarily used for surfacing (buffer layer) unalloyed or low-alloyed steels and when joining non-molybdenum- alloyed stainless and carbon steels. Joints and mixed joints between austenitic steels such as 1.4301 X5CrNi18-10, 1.4306 X2CrNi19-11, 1.4308 GX5CrNi19-10, 1.4401 X5CrNiMo17-12-2, 1.4404 X2CrNiMo17-12-2, 1.4408 GX5CrNiMo19-11-2, 1.4435 X2CrNiMo18-14-3 1.4436 X3CrNiMo17-12-3, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4552 GX5CrNiNb19-11 1.4571 X6CrNiMoTi17-12-2, 1.4580 X6CrNiMoNb17-12-2, 1.4581 GX5CrNiMoNb19-11-2, 1.4583 X10CrNiMoNb18-12 1.4948 X6CrNi18-10

UNS S30400, S30403, S30809, S31600, S31603, S31635, S32100, S34700, S31640

AISI 304, 304L, 316, 316L, 316Ti, 321, 347

or mixed joints between austenitic and heat resistant steels such as 1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18, 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12, 1.4832 GX25CrNiSi20-14, 1.4837 GX40CrNiSi25-12 with ferritic steels to pressure boiler steels P295GH and also fine grained structural steels to P355N, ship building steels grade A – E, AH 32 – EH 36, A40 – F40, etc.

Typical analysis of the wire

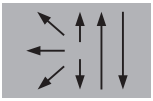
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.03	0.7	1.4	23.0	12.5	12 – 23

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–20°C	–60°C	Hardness HB
u	420 (≥ 320)	540 (≥ 520)	36 (≥ 30)	65	55	50 (≥ 32)	210

u untreated, as-welded – shielding gas Ar + 18% CO_2

Operating data



Dimension mm	Arc length mm	Current A	Voltage V	Wire feed m/min
0.9	~ 3	100 – 160	22 – 27	8.0 – 15.0
1.2	~ 3	150 – 280	22 – 30	6.0 – 15.0
1.6	~ 3	200 – 360	23 – 28	4.5 – 9.5

Welding with standard GMAW power source with DC+ polarity. No pulsing needed. Backhand (drag) technique preferred with a work angle of appr. 80º. Ar + 15 – 25% CO_2 offers the best weldability. 100% CO_2 can be also used, but the voltage should be increased by 2 V. Suitable gas flow rate for welding outdoors is 18 – 25 l/min. Suggested heat input is max. 2.0 kJ/mm, interpass temperature max. 150ºC and wire stick-out 15 – 20 mm. Post-weld heat treatment generally not needed. In special cases, solution annealing can be performed at 1050ºC followed by water quenching.

Approvals

TÜV (10739), CWB, DB (43.014.42), DNV GL, LR, RINA (M21), BV (Ø 1.2 mm), ABS, CCS, CE

BÖHLER CN 23/12-MC

Metal-cored wire, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 17633-A
T 23 12 L M M12 2

AWS A5.22 / SFA-5.22
EC309L

Characteristics and typical fields of application

Austenitic metal-cored wire of T 23 12 L / EC309L type for welding dissimilar joints between high-alloyed Cr and corrosion resistant austenitic CrNi(Mo) steels and mild or low-alloyed steels. The easy handling and high deposition rate result in high productivity with excellent welding performance and very low spatter formation. The wire shows good wetting behavior and results in a smooth surface. The wide arc ensures even penetration and side-wall fusion to prevent lack of fusion. This makes the metal-cored wire less sensitive to edge misalignment and variation in gap width as compared to solid wires. Suitable for service temperatures from –120ºC to 300ºC.

Base materials

Primarily used for surfacing (buffer layer) unalloyed or low-alloyed steels and when joining non-molybdenum-alloyed stainless and carbon steels. Joints and mixed joints between austenitic steels such as 1.4301 X5CrNi18-10, 1.4306 X2CrNi19-11, 1.4308 GX5CrNi19-10, 1.4401 X5CrNiMo17-12-2, 1.4404 X2CrNiMo17-12-2, 1.4408 GX5CrNiMo19-11-2, 1.4435 X2CrNiMo18-14-3, 1.4436 X3CrNiMo17-12-3, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4552 GX5CrNiNb19-11, 1.4571 X6CrNiMoTi17-12-2, 1.4580 X6CrNiMoNb17-12-2, 1.4581 GX5CrNiMoNb19-11-2, 1.4583 X10CrNiMoNb18-12, 1.4948 X6CrNi18-10 UNS S30400, S30403, S30809, S31600, S31603, S31635, S32100, S34700, S31640

AISI 304, 304L, 316, 316L, 316Ti, 321, 347 or mixed joints between austenitic and heat resistant steels such as 1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18, 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12, 1.4832 GX25CrNiSi20-14, 1.4837 GX40CrNiSi25-12 with ferritic steels to pressure boiler steels P295GH and fine grained structural steels to P355N, ship building steel grades A – E, AH 32 – EH 36, A40 – F40, etc.

Typical analysis of the wire

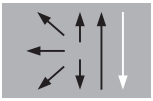
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.025	0.6	1.4	23.0	12.5	12 – 23

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–120°C
u	400 (≥ 320)	550 (≥ 520)	33 (≥ 32)	75	51 (≥ 32)

u untreated, as-welded – shielding gas Ar + 2.5% CO_2

Operating data



Dimension mm	Arc length mm	Current A	Voltage V	Wire feed m/min
1.2	Max. 3	100 – 280	10 – 27	3.5 – 13.0

Welding with conventional or pulsed power sources, but pulsed arc may be advantageous and especially when welding out of position. Forehand (pushing) technique preferred with a work angle of appr. 80º. Ar + 2.5% CO_2 as shielding gas offers the best weldability. The gas flow should be 15 – 20 l/min and the wire stick-out 15 – 20 mm. When welding out of position, the metal-cored wires are similar to solid wires and pulsed arc welding is recommended.

Approvals

CWB, CE

BÖHLER CN 23/12 Mo-FD

Flux-cored wire, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 17633-A
T 23 12 2 L R M21 (C1) 3

AWS A5.22 / SFA-5.22
E309LMoT0-4(1)

Characteristics and typical fields of application

Austenitic stainless rutile flux-cored wire of T 23 12 2 L R / E309LMoT0 type for welding and cladding preferably in flat and horizontal position. The corrosion resistance is superior to T 19 12 3 L / E316L type fillers. Primarily designed for welding dissimilar joints between stainless steels and low-alloyed steels. It can also be used for overlay welding, providing an 18Cr-8Ni-2Mo deposit from the very first layer. The wire offers high safety against hot cracking even at high dilution. Alloying with molybdenum increases the corrosion resistance and weld metal strength. Easy handling and high deposition rate result in high productivity with excellent welding performance, very low spatter formation and a smooth surface. Increased travel speeds as well as self-releasing slag with little demand for cleaning and pickling provide considerable savings in time and money. The wide arc ensures even penetration and side-wall fusion to prevent lack of fusion. Suitable for service temperatures from –60ºC to 300ºC. For welding in vertical-up and overhead positions, BÖHLER CN 23/12 Mo PW-FD should be preferred. Ferrite measured with FeritScope FMP30 15 – 23 FN.

Base materials

Joints and mixed joints between austenitic stainless steels such as
1.4301 X5CrNi18-10, 1.4306 X2CrNi19-11, 1.4308 GX5CrNi19-10, 1.4401 X5CrNiMo17-12-2, 1.4404 X2CrNiMo17-12-2, 1.4408 GX5CrNiMo19-11-2, 1.4435 X2CrNiMo18-14-3, 1.4436 X3CrNiMo17-12-3, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4552 GX5CrNiNb19-11, 1.4571 X6CrNiMoTi17-12-2, 1.4580 X6CrNiMoNb17-12-2, 1.4581 GX5CrNiMoNb19-11-2 1.4583 X10CrNiMoNb18-12, 1.4948 X6CrNi18-10
UNS S30400, S30403, S30809, S31600, S31603, S31635, S32100, S34700, S31640, S31653
AISI 304, 304L, 304LN, 302, 321, 347, 316, 316L, 316Ti, 316Cb
with duplex stainless steels such as
1.4162 X2CrNiMoN21-5-1, 1.4362 X2CrNiN23-4, 1.4462 X2CrNiMoN22-5-3
UNS S32101, S32304, S31803, S32205
LDX 2101®, SAF 2304, SAF 2205
or mixed joints between austenitic and heat resistant steels
1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18, 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12, 1.4832 GX25CrNiSi20-14, 1.4837 GX40CrNiSi25-12
with ferritic steels to pressure boiler steels P295GH and also fine grained structural steels to P355N, shipbuilding steels grade A – E, AH 32 – EH 36, A40 – F40, etc.
Dissimilar joint welds – overlay welding the first corrosion resistant surface layer on P235GH, P265GH, S255N, P295GH, S355N – S500N and high-temperature quenched and tempered fine-grained steels.

Typical analysis of the wire

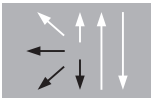
	C	Si	Mn	Cr	Ni	Mo	FN
wt.-%	0.03	0.6	1.4	23.0	12.5	2.7	27 – 42

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–60°C
u	520 (≥ 350)	700 (≥ 550)	28 (≥ 25)	50	36 (≥ 32)

u untreated, as-welded - shielding gas Ar + 18% CO_2

Operating data



Dimension mm	Arc length mm	Current A	Voltage V	Wire feed m/min
1.2	~ 3	130 – 280	22 – 30	5.0 – 15.0
1.6	~ 3	200 – 350	25 – 30	4.5 – 9.5

Welding with standard GMAW power source with DC+ polarity. No pulsing needed. Backhand (drag) technique preferred with a work angle of appr. 80º. Ar + 15 – 25% CO_2 as shielding gas offers the best weldability. 100% CO_2 can be also used, but the voltage should be increased by 2 V. The gas flow should be 15 – 20 l/min and the wire stick-out 15 – 20 mm. The heat input should not exceed 2.0 kJ/mm. For dissimilar welding, slight weaving is recommended for all welding positions. Preheat and interpass temperatures as required by the base metal. Post-weld heat treatment generally not needed. For constructions that include dissimilar welding of low-alloyed steels, a stress-relieving annealing stage may be advisable. Always consult the supplier of the parent material or seek other expert advice to ensure that the correct heat treatment process is carried out.

Approvals

TÜV (05351), DB (43.014.17), ABS (M21), DNV GL, LR (M21), RINA (M21), CWB, CE

BÖHLER CN 23/12 Mo PW-FD

Flux-cored wire, high-alloyed, austenitic stainless, special applications

Classifications

EN ISO 17633-A
T 23 12 2 L P M21 (C1) 1

AWS A5.22 / SFA-5.22
E309LMoT1-4(1)

Characteristics and typical fields of application

Austenitic stainless rutile flux-cored wire of T 23 12 2 L P / E309LMoT1 type. The corrosion resistance is superior to T 19 12 3 L / E316L type fillers. Primarily designed for welding dissimilar joints between stainless steels and low-alloyed steels. It can also be used for overlay welding, providing an 18Cr-8Ni-2Mo deposit from the very first layer. The fast freezing slag offers excellent weldability and slag control in all positions. Easy handling and high deposition rate result in high productivity with excellent welding performance and very low spatter formation. Increased travel speeds as well as self-releasing slag with little demand for cleaning and pickling provide considerable savings in time and money. The wide arc ensures even penetration and side-wall fusion to prevent lack of fusion. Provides high resistance to hot cracking even at high dilution. Alloying with molybdenum increases the corrosion resistance and weld metal strength. Suitable for service temperatures from –60ºC to 300ºC. For flat and horizontal welding positions, BÖHLER CN 23/12 Mo-FD may be preferred. Ferrite measured with FeritScope FMP30 15 – 23 FN.

Base materials

Joints and mixed joints between austenitic stainless steels such as
1.4301 X5CrNi18-10, 1.4306 X2CrNi19-11, 1.4308 GX5CrNi19-10, 1.4401 X5CrNiMo17-12-2, 1.4404 X2CrNiMo17-12-2, 1.4408 GX5CrNiMo19-11-2, 1.4435 X2CrNiMo18-14-3, 1.4436 X3CrNiMo17-12-3, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4552 GX5CrNiNb19-11, 1.4571 X6CrNiMoTi17-12-2, 1.4580 X6CrNiMoNb17-12-2, 1.4581 GX5CrNiMoNb19-11-2 1.4583 X10CrNiMoNb18-12, 1.4948 X6CrNi18-10
UNS S30400, S30403, S30809, S31600, S31603, S31635, S32100, S34700, S31640, S31653
AISI 304, 304L, 304LN, 302, 321, 347, 316, 316L, 316Ti, 316Cb
with duplex stainless steels such as
1.4162 X2CrNiMoN21-5-1, 1.4362 X2CrNiN23-4, 1.4462 X2CrNiMoN22-5-3
UNS S32101, S32304, S31803, S32205
LDX 2101®, SAF 2304, SAF 2205
or mixed joints between austenitic and heat resistant steels
1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18, 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12, 1.4832 GX25CrNiSi20-14, 1.4837 GX40CrNiSi25-12
with ferritic steels to pressure boiler steels P295GH and also fine grained structural steels to P355N, shipbuilding steels grade A – E, AH 32 – EH 36, A40 – F40, etc.
Dissimilar joint welds – overlay welding the first corrosion resistant surface layer on P235GH, P265GH, S255N, P295GH, S355N – S500N and high-temperature quenched and tempered fine-grained steels.

Typical analysis of the wire

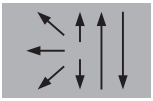
	C	Si	Mn	Cr	Ni	Mo	FN
wt.-%	0.03	0.7	1.4	23.0	12.5	2.7	23 – 36

Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A (L_0=5d_0) %	Impact values ISO-V KV J 20°C	–60°C
u	540 (≥ 350)	705 (≥ 550)	28 (≥ 25)	65	44 (≥ 32)

u untreated, as-welded - shielding gas Ar + 18% CO_2

Operating data



Dimension mm	Arc length mm	Current A	Voltage V	Wire feed m/min
0.9	~ 3	100 – 160	22 – 27	8.0 – 15.0
1.2	~ 3	150 – 200	22 – 29	6.0 – 13.0

Welding with standard GMAW power source with DC+ polarity. No pulsing needed. Backhand (drag) technique preferred with a work angle of appr. 80º. Ar + 15 – 25% CO_2 as shielding gas offers the best weldability. 100% CO_2 can be also used, but the voltage should be increased by 2 V. The gas flow should be 15 – 20 l/min. The heat input should not exceed 2.0 kJ/mm and the wire stick-out 15 – 20 mm. For dissimilar welding, slight weaving is recommended for all welding positions. Preheat and interpass temperatures as required by the base metal. Post-weld heat treatment generally not needed. For constructions that include dissimilar welding of low-alloyed steels, a stress-relieving annealing stage may be advisable. Always consult the supplier of the parent material or seek other expert advice to ensure that the correct heat treatment process is carried out.

Approvals

TÜV (09116), BV (C1 + Ø 1.2 mm), LR (C1) , DNV GL, CWB, ABS (M21), CE