Welding consumables for martensitic stainless steels

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Stick electrodes

Product name	C	Si	Mn	Cr	Ni	Mo	Nb	Cu
BÖHLER FOX CN 13/4	0.04	0.30	0.50	12.20	4.50	0.50		
BÖHLER FOX CN 13/4 SUPRA	0.03	0.30	0.60	12.20	4.50	0.50		
BÖHLER FOX CN 16/6 M-HD	0.03	0.30	0.60	15.50	5.80	1.20		
BÖHLER FOX CN 17/4 PH	0.03	0.30	0.60	16.00	5.10	0.40	0.20	3.20

GTAW rods

Product name	C	Si	Mn	Cr	Ni	Mo
BÖHLER CN 13/4-IG	0.01	0.70	0.70	12.30	4.70	0.50

Solid wires

Product name	C	Si	Mn	Cr	Ni	Mo
BÖHLER KW 10-IG	0.06	0.07	0.60	13.60		
BÖHLER CN 13/4-IG	0.01	0.65	0.70	12.20	4.80	0.50

SAW wire/flux combinations

Product name	C	Si	Mn	Cr	Ni	Mo
BÖHLER CN 13/4-UP - BÖHLER BB 203	0.01	0.80	0.70	12.00	4.70	0.50
Avesta 248 SV - Avesta Flux 805	0.02	0.60	1.00	16.50	5.00	1.00

Flux-cored and metal-cored wire

Product name	C	Si	Mn	Cr	Ni	Mo
BÖHLER CN 13/4 PW-FD	0.03	0.70	0.90	12.00	5.00	0.50
BÖHLER CN 13/4-MC	0.02	0.70	0.90	12.00	4.60	0.60
BÖHLER CN 13/4-MC (F)	0.02	0.70	0.90	12.20	4.60	0.60
BÖHLER CN 13/4-MC HI	0.01	0.30	0.60	12.00	4.70	0.50

BÖHLER FOX CN 13/4

Stick electrode, high-alloyed, soft-martensitic stainless

Classifications

EN ISO 3581-A
E 13 4 B 6 2

AWS A5.4 / SFA-5.4
E410NiMo-15

Characteristics and typical fields of application

Basic coated low-hydrogen electrode of E 13 4 B / E410NiMo-15 type for welding soft-martensitic and martensitic-ferritic rolled, forged, and cast steels. Mainly used in the construction of hydro turbines and compressors. Corrosion resistance similar to matching 13Cr(Ni)-steels. Thanks to an optimum balance of alloying components, the weld deposit yields very good ductility and toughness and cracking resistance despite of its high strength. Excellent operating characteristics with easy slag removal, smooth bead appearance and low hydrogen weld metal (HD < 5 ml/100 g). The Ø 2.5 and 3.2 mm electrodes can be used for welding in all positions apart from vertical down. Higher recovery rate and better restriking properties than BÖHLER FOX CN 13/4 SUPRA.

Base materials

1.4313 X3CrNiMo13-4, 1.4317 GX4CrNi13-4, 1.4407 GX5CrNiMo13-4, 1.4414 GX4CrNiMo13-4

ACI Grade CA 6 NM

UNS S41500, J91540

Typical analysis of all-weld metal

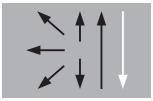
	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.035	0.3	0.5	12.2	4.5	0.5

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	–20°C	–60°C	Hardness HV_{10}
u	890	1090	12	33			401
a	680 (≥ 500)	910 (≥ 760)	17 (≥ 15)	66	55	50	301
a1	670 (≥ 500)	850 (≥ 760)	18 (≥ 15)	95			

u untreated, as-welded
a annealed, 600°C for 2 h / cooling in air
a1 quenched + tempered, 950°C for 0.5 h / cooling in air + 600°C for 2 h / cooling in air

Operating data



Polarity DC+

Electrode identification FOX CN 13/4 410NiMo-15 E 13 4 B

Dimension mm	Current A
2.5 × 350	60 – 90
3.2 × 450	90 – 130
4.0 × 450	120 – 170
5.0 × 450	160 – 220

Preheating and interpass temperatures of heavy-wall components 100 – 130ºC.

Maximum heat input 1.5 kJ/mm. Post-weld heat treatment at 580 – 620ºC.

Re-drying at 300 – 350ºC for min. 2 h if necessary.

Metal recovery approximately 130%.

Approvals

TÜV (03232), CE

BÖHLER FOX CN 13/4 SUPRA

Stick electrode, high-alloyed, soft-martensitic stainless

Classifications

EN ISO 3581-A
E 13 4 B 4 2

AWS A5.4 / SFA-5.4
E410NiMo-15

Characteristics and typical fields of application

Basic coated, cored wire alloyed low-hydrogen electrode of E 13 4 B / E410NiMo-15 type for welding soft-martensitic and martensitic-ferritic rolled, forged, and cast steels. Mainly used in the construction of hydro turbines and compressors. Corrosion resistance similar to matching 13Cr(Ni)-steels. Thanks to an optimum balance of alloying components the weld deposit yields very good ductility and toughness and cracking resistance despite of its high strength. Excellent slag removability, smooth bead appearance and low hydrogen weld metal (HD < 5 ml/100 g).

Base materials

1.4313 X3CrNiMo13-4, 1.4317 GX4CrNi13-4, 1.4407 GX5CrNiMo13-4, 1.4414 GX4CrNiMo13-4

ACI Grade CA 6 NM UNS S41500

Typical analysis of all-weld metal

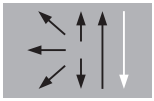
	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.03	0.3	0.6	12.2	4.5	0.5

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	–20°C	–60°C	Hardness HV_{10}
u	800	950	16	35			370
a	680 (≥ 500)	910 (≥ 760)	18 (≥ 15)	70	60	55	270
a1	670 (≥ 500)	850 (≥ 760)	18 (≥ 15)	105			315

u untreated, as-welded
a annealed, 600°C for 2 h / cooling in air
a1 quenched + tempered, 950°C for 0.5 h / cooling in air + 600°C for 2 h / cooling in air

Operating data



Polarity DC+

Electrode identification FOX CN 13/4 SUPRA 410NiMo-15
E 13 4 B

Dimension mm	Current A
2.5 × 300	55 – 80
3.2 × 350	90 – 110
4.0 × 350/450	120 – 145
5.0 × 350/450	140 – 200

Preheating and interpass temperatures of heavy-wall components 100 – 130ºC.

Maximum heat input 1.5 kJ/mm.

Re-drying at 300 – 350ºC for min. 2 h if necessary.

Post-weld heat treatment at 580 – 620ºC. Metal recovery approximately 103%.

Approvals

TÜV (09081), CE

BÖHLER FOX CN 16/6 M-HD

Stick electrode, high-alloyed, soft-martensitic stainless

Classifications

EN ISO 3581-A
E Z 16 6 Mo B 6 2 H5

Characteristics and typical fields of application

Basic coated high efficiency electrode of E Z 16 6 Mo B type for welding of soft-martensitic forged and cast steels. The high chromium content enhances the corrosion resistance in water, steam and seawater atmosphere. Main applications are found in turbines, pumps and compressor parts. Popular in hydro turbine engineering.

The electrode shows very good features in regard to arc stability, weld puddle control, slag detachability and seam cleanliness. The Ø 2.5 and 3.2 mm electrodes can be used for welding in all positions apart from vertical down. Low hydrogen is an essential and necessary prerequisite of this product.

Base materials

Soft-martensitic forged steels and cast steels

1.4405 GX4CrNiMo16-5-1, 1.4313 X3CrNiMo13-4, 1.4317 GX4CrNi13-4, 1.4418 X4CrNiMo16-5-1

ACI Grade CA 6 NM / UNS J91540

248 SV

Typical analysis of all-weld metal

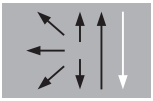
	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.03	0.3	0.6	15.5	5.8	1.2

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	–60°C	Hardness HV_{10}
u	520	1050	13	28	21	370
a	650	920	15	42	31	340
a1	640	920	16	48	30	330
a2	680	880	24	75	50	295

u untreated, as-welded
a annealed, 580°C for 4 h / cooling in air
a1 annealed, 590°C for 8 h / cooling in furnace down to 300°C then cooling in air
a2 solution annealed, 1030°C for 1 h / cooling in air + 590°C for 8 h / cooling in furnace down to 300°C then cooling in air

Operating data



Polarity DC+

Electrode identification FOX CN 16/6 M-HD EZ16 6 Mo B

Dimension mm	Current A
2.5 × 350	70 – 95
3.2 × 450	110 – 140
4.0 × 450	140 – 180
5.0 × 450	180 – 230

The interpass temperature should preferably be kept between 70ºC and 120ºC for joint welding. Low interpass temperature minimizes distortion and risk of cracks. Preheating normally not necessary. Post-weld heat treatment depends on the base material requirements. It is common to perform an annealing at 540 – 590ºC for 6 h / after the weld has cooled down to room temperature. To lower the hydrogen content, soaking can be performed at 250ºC for 2 h. This treatment should be started immediately after welding. A low cooling rate is necessary.

Re-drying at 300 – 350ºC for min. 2 h if necessary.

Metal recovery approximately 135%.

Approvals

TÜV (19071), CE

BÖHLER FOX CN 17/4 PH

Stick electrode, high-alloyed, precipitation hardening stainless

Classifications

EN ISO 3581-A
E Z 17 4 Cu B 4 3 H5

AWS A5.4 / SFA-5.4
E630-15 (mod.)

Characteristics and typical fields of application

Basic coated electrode of E Z 17 4 Cu B / E630-15 (mod.) type with strength properties for joint and fabrication welding of similar precipitation hardening CrNiCu-alloyed rolled, forged and cast steels. Popular for components in the paper industry, rotors of compressors, fan blades, press plates in the plastic processing industry and for the aerospace industry. The electrode shows very good features in regard to arc stability and weld puddle control as well as slag detachability and seam cleanliness. Low hydrogen content in the deposit is a prerequisite (HD < 5 ml/100 g). Suitable for welding in all positions except vertical down. With the use of the proper PWHT (solution annealing + precipitation hardening impact values down to –50ºC are achievable.

Base materials

Precipitation hardening forged steels and cast steels

1.4405 GX4CrNiMo16-5-1, 1.4418 X4CrNiMo16-5-1, 1.4525 GX5CrNiCu16-4, 1.4532 X8CrNiMoAl15-7-2, 1.4540 X4CrNiCuNb16-4, 1.4542 X5CrNiCuNb16-4, 1.4548 X5CrNiCu17-4

UNS S15700, S15500, S17400, S17480; AISI 630, 632

17-4 PH, 248 SV, XM12

Typical analysis of all-weld metal

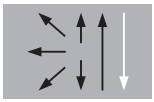
	C	Si	Mn	Cr	Ni	Mo	Nb	Cu
wt.-%	0.03	0.3	0.6	16.0	5.1	0.4	0.2	3.2

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	–50°C	Hardness HRC
u						32 – 39
a1	940	1030	10	20		37 – 40
a2	830	1110	8	15		
a3	630	940	15	24 – 30		29 – 31
a4	920	1030	15	60 – 66		
a5	550	880	18	69 – 75	55	27 – 29

u untreated, as-welded
a 540°C for 3 h / cooling in air
a1 480°C for 1 h / cooling in air
a2 760°C for 2 h / cooling in air + 620°C for 4 h / cooling in air
a3 solution annealed 1040°C for 0.5 h / cooling in air + 580°C for 4 h / cooling in air
a4 solution annealed 1040°C for 0.5 h / cooling in air + 620°C for 4 h / cooling in air

Operating data



Polarity DC+

Electrode identification FOX CN 17/4 PH E Z 17 4 Cu B

Dimension mm	Current A
2.5 × 300	65 – 85
3.2 × 350	90 – 110
4.0 × 350	120 – 140
5.0 × 450	140 – 180

The interpass temperature has to be kept very low (max. 80ºC).
Re-drying at 300 – 350ºC for min. 2 h if necessary.

Approvals

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BÖHLER CN 13/4-IG

TIG rod, high-alloyed, soft-martensitic stainless

Classifications

EN ISO 14343-A
W 13 4

AWS A5.9 / SFA-5.9
ER410NiMo (mod.)

Characteristics and typical fields of application

TIG rod of W 13 4 / ER410NiMo (mod.) type. Low-carbon rod suited for soft-martensitic steels such as 1.4313 / UNS S41500. Corrosion resistance similar to matching 13Cr(Ni)-steels and cast steel grades. High resistance to corrosion fatigue. Designed with precisely tuned alloying composition creating a weld deposit featuring very good ductility and crack resistance despite high strength. Typical applications are within hydro and steam turbines.

Base materials

1.4313 X3CrNiMo13-4, 1.4317 GX4CrNi13-4, 1.4407 GX5CrNiMo13-4, 1.4414 GX4CrNiMo13-4

ACI Grade CA 6 NM UNS S41500, J91540

Typical analysis of the wire rod

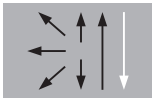
	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.01	0.7	0.7	12.3	4.7	0.5

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	840	960	19	180
a	780	870	23	200

u untreated, as-welded – shielding gas Ar
a annealed, 600°C for 8 h / furnace down to 300°C followed by air cooling

Operating data



Rod marking W 13 4

Dimension mm	Current A	Voltage V
1.2 × 1000	60 – 80	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

Maximum heat input 1.5 kJ/mm. Preheating and interpass temperatures in case of thick-walled sections 100 – 160°C.

Tempering at 580 – 620°C.

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

Polarity: DC-

Approvals

TÜV (04110), CE

BÖHLER KW 10-IG

Solid wire, high-alloyed, stainless

Classifications

EN ISO 14343-A
G Z 13

AWS A5.9 / SFA-5.9
ER410 (mod.)

Characteristics and typical fields of application

Solid wire of G Z 13 / ER410 (mod.) type for joining and surfacing applications with matching or similar 13Cr-steels and cast steel grades. Predominantly used for surfacing sealing faces of water, steam and gas valves and accessories made of unalloyed and low-alloy steels for service temperatures up to 450°C. The machinability of the weld metal depends largely on the kind of base metal and degree of dilution. Joint welding of similar 13Cr-steels shows matching color of the weld metal.

Base materials

Welding of corrosion resistant Cr-steels as well as other matching a C-content < 0.20% (repair welding).

Heat resistant Cr-steels of similar chemical composition.

1.4006 X12Cr13, 1.4021 X20Cr13

AISI 410, 420

Corrosion resistant weld surfacing of most weldable unalloyed and low-alloyed steels.

GMAW

Typical analysis of the solid wire

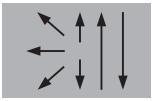
	C	Si	Mn	Cr
wt.-%	0.06	0.07	0.6	13.6

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) %	Hardness HB
u				320
a	(≥ 450)	(≥ 650)	(≥ 15)	200

u untreated, as-welded – shielding gas Ar + 8% CO_2
a annealed – shielding gas Ar + 8% CO_2, 750°C for 2 h / cooling in furnace

Operating data



Dimension mm	Current A	Voltage V
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

Suggested preheating and interpass temperature 200 – 300°C. Post weld heat treatment at 700 – 750°C depending on base material and requirements.

The hardness of the deposit is increasing with the dilution with the base metal (depending on the relevant welding conditions) and by its chemical composition. Gas mixtures containing more CO_2 result in higher deposit hardness.

Shielding gas: Ar + 8 – 10% CO_2 or 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 CN 13/4-IG

Solid wire, high-alloyed, soft-martensitic stainless

Classifications

EN ISO 14343-A
G 13 4

AWS A5.9 / SFA-5.9
ER410NiMo (mod.)

Characteristics and typical fields of application

Solid wire of G 13 4 / ER410NiMo (mod.) type. Low-carbon wire suited for soft-martensitic steels such as 1.4313 / UNS S41500. Corrosion resistance similar to matching 13Cr(Ni)-steels and cast steel grades. High resistance to corrosion fatigue cracking. Designed with precisely tuned alloying composition creating a weld deposit featuring very good ductility and crack resistance despite high strength. For applications like hydro and steam turbines.

Base materials

1.4313 X3CrNiMo13-4, 1.4317 GX4CrNi13-4, 1.4407 GX5CrNiMo13-4, 1.4414 GX4CrNiMo13-4

ACI Grade CA 6 NM UNS S41500, J91540

Typical analysis of the solid wire

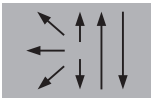
	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.01	0.65	0.7	12.2	4.8	0.5

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	–20°C
u	950 (≥ 750)	1210 (≥ 950)	12 (≥ 10)	36 (≥ 30)	
a	705 (≥ 680)	880 (≥ 800)	21 (≥ 15)	80 (≥ 50)	58

u untreated, as-welded – shielding gas Ar + 8% CO_2
a annealed – shielding gas Ar + 8% CO_2, 600°C for 8 h / cooling in furnace to 300°C followed by air cooling
a1 annealed – shielding gas Ar + 2.5% CO_2, 600°C for 8 h / cooling in furnace to 300°C followed by air cooling
Preheating to 100°C; interpass temperature 150°C

Operating data



Dimension mm	Current A	Voltage V
1.0 short arc	110 – 140	19 – 22
1.0 spray arc	160 – 220	25 – 29
1.2 spray arc	200 – 270	26 – 30

Preheating and interpass temperatures of heavy-wall components 100 – 160°C.

Maximum heat input 1.5 kJ/mm. Post-weld heat treatment at 580 – 620°C.

Shielding gas: Ar + 2 – 3% CO_2 or Ar + 8 - 10% CO_2. Gas flow: 15 – 20 l/min.

Polarity: DC+

Approvals

CE

BÖHLER CN 13/4-UP - BÖHLER BB 203

SAW wire/flux combination, high-alloyed, soft-martensitic stainless

Classifications

EN ISO 14343-A	AWS A5.9 / SFA-5.9	EN ISO 14174
S 13 4	ER410NiMo (mod.)	S A FB 2 DC

Characteristics and typical fields of application

BÖHLER CN 13/4-UP - BB 203 is a wire/flux combination for submerged arc welding of soft-martensitic steels such as 1.4313 / UNS S41500.

Solid wire of S 13 4 / ER410NiMo (mod.) type. Corrosion resistance similar to matching 13Cr(Ni)-steels and cast steel grades. High resistance to corrosion fatigue cracking. The weld deposit shows a relative high ductility and CVN toughness with high crack resistance. Especially suitable for applications in hydro and steam turbines.

BÖHLER BB 203 is a fluoride-basic, agglomerated flux providing good operating characteristics, smooth beads and a low hydrogen weld metal (HD < 5 ml/100 g). For more information regarding this sub-arc welding flux, see the separate datasheet.

Base materials

1.4313 X3CrNiMo13-4, 1.4317 GX4CrNi13-4, 1.4407 GX5CrNiMo13-4, 1.4414 GX4CrNiMo13-4

ACI Grade CA 6 NM UNS S41500

Typical analysis of the weld metal

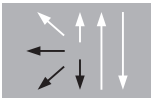
wt.-%	C	Si	Mn	Cr	Ni	Mo
wire	0.01	0.7	0.7	12.3	4.8	0.5
all-weld metal	0.01	0.8	0.7	12.0	4.7	0.5

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
a1	730 (≥ 650)	850 (≥ 750)	19 (≥15)	50 (≥27)
a2	785	845	22	80 (≥27)
u	880	1000	<10	27

a1 600°C for 8 h
a2 960°C for 1 h + 580°C for 8 h
u untreated, as-welded

Operating data



Dimension mm	Current A	Voltage V
2.0	250 – 350	28 – 32
2.4	300 – 400	29 – 33
3.0	320 – 450	29 – 33

Preheating and interpass temperatures of heavy-wall components 100 – 160ºC.

Maximum heat input 1.5 kJ/mm. Post-weld heat treatment (tempering) at 580 – 620ºC.

Polarity: DC+

Approvals

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SAW

Avesta 248 SV - Avesta Flux 805

SAW wire/flux combination, high-alloyed, soft-martensitic stainless

Classifications

EN ISO 14343-A	AWS A5.9 / SFA-5.9	EN ISO 14174
S 16 5 1	EG	S A AF 2 DC

Characteristics and typical fields of application

Avesta 248 SV - Avesta Flux 805 is a wire/flux combination for submerged arc welding with an austenitic-ferritic-martensitic weld metal deposit.

Solid wire of S 16 5 1 type for welding and repair of propellers, pumps, valves and shafts in 248 SV / 420 and similar types of steels and castings where it provides a relative low crack sensitivity compared to many other martensitic weld metals. The properties of the weld are largely the same as those of the parent metal. The general and pitting corrosion resistance corresponds to that of the base material 1.4301 / 304.

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

1.4028 X30Cr13, 1.4405 GX4CrNiMo16-5-1, 1.4418 X4CrNiMo16-5-1

AISI 420

248 SV

Typical analysis of the weld metal

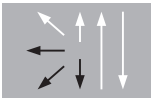
wt.-%	C	Si	Mn	Cr	Ni	Mo
wire	0.02	0.35	1.3	16.0	5.5	1.0
all-weld metal	0.02	0.60	1.0	16.5	5.0	1.0

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	Hardness
a1	550 (≥ 400)	880 (≥ 600)	16	40	260

a1 590°C for 4 h

Operating data



Dimension mm	Current A	Voltage V
3.2	350-500	29-33

Suggested heat input is max. 2.0 kJ/mm and interpass temperature max. 150ºC. Polarity: DC+

Preheating is normally not necessary, but when welding thick materials where high stresses can be expected, preheating to 75 – 100ºC is recommended.

To stabilize structure and reduce brittle martensite, post-weld heat treatment for 4 h at 590ºC, followed by air cooling is recommended.

Approvals

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BÖHLER CN 13/4 PW-FD

Flux-cored wire, high-alloyed, soft-martensitic stainless

Classifications

EN ISO 17633-A
T 13 4 P M21 (C1) 1 (H5)

AWS A5.22 / SFA-5.22
E410NiMoT1-4(1)

Characteristics and typical fields of application

Rutile flux-cored wire of T 13 4 P / E410NiMoT1 type for welding of 13Cr-4Ni soft-martensitic stainless steels such as 1.4313 / UNS S41500. Applications are for instance turbine components in the hydropower industry. Results in very low weld metal hydrogen content (HD of 1 – 3 ml/100 g) and high weld metal impact toughness after post-weld heat treatment. 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. The wide arc ensures even penetration and side-wall fusion to prevent lack of fusion.

Base materials

1.4313 X3CrNiMo13-4, 1.4317 GX4CrNi13-4, 1.4407 GX5CrNiMo13-4, 1.4414 GX4CrNiMo13-4

ACI Grade CA 6 NM UNS S41500, J91540

Typical analysis of the wire

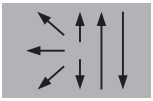
	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.03	0.7	0.9	12.0	5.0	0.5

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	–20°C	–50°C
u	800	1100	11	30	28	25
a	790 (≥ 500)	920 (≥ 760)	17 (≥ 15)	50	45	40
a1	760 (≥ 500)	900 (≥ 760)	16 (≥ 15)	45	40	35

u untreated, as-welded – shielding gas Ar + 18% CO_2
a annealed, 600°C for 2 h / cooling in air – shielding gas Ar + 18% CO_2
a1 annealed, 600°C for 2 h / cooling in air – shielding gas 100% CO_2

Operating data



Dimension mm	Arc length mm	Current A	Voltage V	Wire feed m/min
1.6	~ 3	160 – 330	22 – 30	4 – 11

Welding with standard GMAW power source with DC+ polarity. No pulsing needed. Backhand (drag) technique preferred with a work angle of appr. 80°. Ar + 15 – 25% CO_2 as shielding gas offers the best weldability. 100% CO_2 can also be used, but the voltage should be increased by 2 V. The gas flow should be 15 – 20 l/min. Recommended stick out 18 – 20 mm, 100 – 150°C preheating and 150°C interpass temperature. The heat input should not exceed 1.5 kJ/mm. Annealing performed at 590 – 620°C.

Approvals

TÜV (18993), CE

BÖHLER CN 13/4-MC

Metal-cored wire, high-alloyed, soft-martensitic stainless

Classifications

EN ISO 17633-A
T 13 4 M M12 2

AWS A5.22 / SFA-5.22
EC410NiMo (mod.)

Characteristics and typical fields of application

Metal-cored wire of T 13 4 M / EC410NiMo type for welding of 13Cr-4Ni soft martensitic stainless steels such as 1.4313 / UNS S41500. Applications are for instance turbine components in the hydropower industry. 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. It is easy operate in all welding positions. Additionally, precise alloy adjustment ensures very good weld metal impact toughness after heat treatment. The diffusible hydrogen content is extra low with maximum 3 ml / 100 g to prevent cold cracking.

Base materials

1.4313 X3CrNiMo13-4, 1.4317 GX4CrNi13-4, 1.4407 GX5CrNiMo13-4, 1.4414 GX4CrNiMo13-4

ACI Grade CA 6 NM UNS S41500, J91540

Typical analysis of the wire

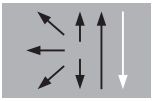
	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.022	0.7	0.9	12.0	4.6	0.6

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	0°C	–20°C
a	760 (≥ 500)	900 (≥ 760)	16 (≥ 15)	65		60 (≥ 47)
a1	730	860	17	68		62 (≥ 47)
a2	635	850	23		80	

a annealed, 600°C for 2 h / furnace cooling to 300°C followed by air cooling – shielding gas Ar + 2.5% CO_2
a1 annealed, 580°C for 8 h / furnace cooling to 300°C followed by air cooling – shielding gas Ar + 2.5% CO_2
a2 annealed, 620°C for 6 h / furnace cooling to 300°C followed by air cooling – 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
1.6	max. 3	110 – 380	20 – 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. 80°. Ar + 2 – 3% 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. Recommended preheating and interpass temperatures in case of heavy wall thickness are 100 – 160°C. The heat input should not exceed 1.5 kJ/mm. Tempering performed at 590 – 620°C.

Approvals

TÜV (12880), LR (M21, supplementary list), CE

BÖHLER CN 13/4-MC (F)

Metal-cored wire, high-alloyed, soft-martensitic stainless

Classifications

EN ISO 17633-A
T 13 4 M M12 2

AWS A5.22 / SFA-5.22
EC410NiMo (mod.)

Characteristics and typical fields of application

Metal-cored wire of T 13 4 M / EC410NiMo type for welding and repair welding of cast 13Cr-4Ni soft-martensitic stainless steels such as 1.4407. Applications are for instance turbine components in the hydropower industry. 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. It is easy operate in all welding positions. Additionally, precise alloy adjustment ensures very good weld metal impact toughness after heat treatment. The diffusible hydrogen content is extra low with maximum 3 ml / 100 g to prevent cold cracking. Significant gains in productivity can be realized by higher deposition rates and reduced post weld grinding as compared to GMAW using solid wires.

Base materials

1.4313 X3CrNiMo13-4, 1.4317 GX4CrNi13-4, 1.4407 GX5CrNiMo13-4, 1.4414 GX4CrNiMo13-4

ACI Grade CA 6 NM UNS S41500, J91500

Typical analysis of the wire

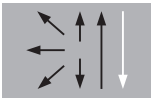
	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.023	0.7	0.9	12.2	4.6	0.6

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
a	745 (≥ 500)	900 (≥ 760)	16 (≥ 15)	55 (≥ 50)	50 (≥ 47)
a1	715	840	18		50

a annealed/tempered, 600°C for 2 h / furnace cooling to 300°C followed by air cooling - shielding gas Ar + 2.5% CO_2
a1 annealed/tempered, 580°C for 12 h / furnace cooling to 300°C followed by air cooling - 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
1.6	Max. 3	110 – 380	20 – 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. 80°. Ar + 2 – 3% CO_2 as shielding gas offers the best weldability. The gas flow should be 15 – 20 l/min and the wire stick-out 18 – 20 mm. When welding out of position, the metal-cored wires are similar to solid wires and pulsed arc welding is recommended. Recommended preheating and interpass temperatures in case of heavy wall thickness are 100 – 180°C. The heat input should not exceed 1.5 kJ/mm. Tempering performed at 580 – 620°C.

Approvals

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BÖHLER CN 13/4-MC HI

Metal-cored wire, high-alloyed, soft-martensitic stainless

Classifications

EN ISO 17633-A
T 13 4 M M12 2

AWS A5.22 / SFA-5.22
EC410NiMo (mod.)

Characteristics and typical fields of application

Metal-cored wire of T 13 4 M / EC410NiMo type for welding of 13Cr-4Ni soft-martensitic stainless steels such as 1.4313 / UNS S41500. Applications are for instance turbine components in the hydropower industry. 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. It is easy operate in all welding positions. BÖHLER CN 13/4-MC HI offers extra high impact values for heat treated weld metal and a very low hydrogen content with maximum 4 ml / 100 g to prevent cold cracking.

Base materials

1.4313 X3CrNiMo13-4, 1.4317 GX4CrNi13-4, 1.4407 GX5CrNiMo13-4, 1.4414 GX4CrNiMo13-4

ACI Grade CA 6 NM UNS S41500, J91540

Typical analysis of the wire

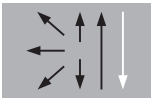
	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.014	0.3	0.6	12.0	4.7	0.5

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	0°C	–20°C
u	800	950	11	50	45	45
a	685 (≥ 500)	770 (≥ 760)	21 (≥ 15)	90	85	75 (≥ 47)
a1	665 (≥ 500)	785 (≥ 760)	21 (≥ 15)	80	75	70 (≥ 47)

u untreated, as-welded – shielding gas Ar + 2.5% CO_2
a annealed, 580°C for 8 h / furnace cooling to 300°C followed by air cooling – shielding gas Ar + 2.5% CO_2
a1 annealed, 600°C for 2 h / furnace cooling to 300°C followed by air cooling – 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 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. 80°. Ar + 2 – 3% 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. Recommended preheating and interpass temperatures in case of heavy wall thickness are 100 – 160ºC. The heat input should not exceed 1.5 kJ/mm. Tempering performed at 580 – 620ºC.

Approvals

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Welding consumables for ferritic stainless steels

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FLUX-CORED AND METAL-CORED WIRE 326

Stick electrodes

Product name	C	Si	Mn	Cr	Mo
BÖHLER FOX SKWA	0.08	0.40	0.30	17.00	
BÖHLER FOX SKWAM	0.22	0.30	0.40	17.00	1.30

Solid wires

Product name	C	Si	Mn	Cr	Ni	Mo	Nb	Ti
BÖHLER CAT 409 Cb-IG	≤ 0.05	0.60	0.60	11.50			≥ 10 × C	
BÖHLER CAT 430L Cb-IG	0.02	0.50	0.50	18.00			0.46 (≥ 12 × C)	
BÖHLER CAT 430L CbTi-IG	0.02	0.50	0.50	18.00			≥ 12xC	0.40
BÖHLER CAT 439L Ti-IG	0.02	0.80	0.80	18.00				0.35 (≥ 12 × C)
BÖHLER SKWA-IG	0.07	0.80	0.60	17.50				0.30
BÖHLER SKWAM-IG	0.20	0.65	0.55	17.00	0.40	1.10		

SAW wire/flux combinations

Product name	C	Si	Mn	Cr	Ni	Mo
BÖHLER SKWAM-UP - BÖHLER BB 203	0.15	0.70	0.55	17.00	0.40	1.10

Flux-cored and metal-cored wire

Product name	C	Si	Mn	Cr	Nb	Ti
BÖHLER CAT 430L Cb-MC	0.02	0.50	0.70	18.50	0.65	0.12
BÖHLER CAT 430L CbTi-MC	0.02	0.50	0.70	18.50	0.55	0.35
BÖHLER CAT 439L Ti-MC	0.02	0.50	0.70	18.50		0.85

BÖHLER FOX SKWA

Stick electrode, high-alloyed, ferritic stainless

Classifications

EN ISO 3581-A
E 17 B 2 2

AWS A5.4 / SFA-5.4
E430-15

Characteristics and typical fields of application

Basic coated, cored wire alloyed electrode of E 17 B / E430-15 type. Good welding characteristics in all positions except vertical-down. Mainly used for surfacing on sealing faces of gas, water and steam valves to meet stainless and wear resistant overlays. Be careful with dilution, at least two layers build up should remain after machining. Joint welding of similar, stainless and heat resistant chromium steels provides a very good ability to polishing. Hydrogen content in weld deposit < 5 ml/100 g. Scaling resistance up to 900ºC.

Base materials

Surfacing can be performed on all weldable base materials, unalloyed and low-alloyed.

Welding of corrosion resistant chromium steels as well as other similar-alloyed steels with C-contents up to 0.20% (repair welding).

1.4001 X7Cr14, 1.4006 X12Cr13, 1.4057 X17CrNi16-2, 1.4000 X6Cr13, 1.4002 X6CrAl13, 1.4016 X6Cr17, 1.4059 X17CrNi16-2 1.4509 X2CrTiNb18, 1.4510 X3CrTi17, 1.4511 X3CrNb17, 1.4512 X2CrTi12, 1.4520 X2CrTi17, 1.4712 X10CrSi6, 1.4713 X10CrAlSi7 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18

AISI 403, 405, 409, 410, 429, 430, 430Cb, 430Ti, 439, 431, 442

UNS S40300, S40500, S40900, S41000, S42900, S43000, S43035, S43036, S43100, S44200

Typical analysis of all-weld metal

	C	Si	Mn	Cr
wt.-%	0.08	0.4	0.3	17.0

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) %	Hardness HB
u				250
a	370 (≥ 300)	560 (≥ 450)	23 (≥ 15)	200

u untreated, as-welded
a annealed, 750°C for 2 h / cooling in furnace

Operating data

Polarity DC+

Electrode identification FOX SKWA 430-15 E 17 B

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

The hardness of the deposit is greatly influenced by the degree of dilution with the base metal (depending on the relevant welding conditions) and by its chemical composition. As a general rule it can be observed that the higher the degree of dilution and the C-content of the base metal, the higher the deposit hardness.

Preheating and interpass temperature 200 – 300ºC, post-weld heat treatment at 730 – 800ºC.

Re-drying if necessary at 120 – 200ºC for min. 2 h.

Approvals

KTA 1408.1 (08098.00), CE

BÖHLER FOX SKWAM

Stick electrode, high-alloyed, ferritic stainless

Classifications

EN ISO 3581-A
E Z 17 Mo B 2 2

Characteristics and typical fields of application

Basic coated, cored wire alloyed electrode of E Z 17 Mo B type. Good welding characteristics in all positions except vertical-down. Mainly used for surfacing on sealing faces of gas, water and steam valves to meet stainless and wear resistant overlays. Be careful with dilution, at least two layers build up should remain after machining. Joint welding of similar, stainless and heat resistant chromium steels provides a very good ability to polishing. Hydrogen content in weld deposit < 5 ml/100 g. Weld metal retention of hardness up to 500ºC. Scaling resistant up to 900ºC.

Base materials

Surfacing can be performed on all weldable base materials, unalloyed and low-alloyed.

Welding of corrosion resistant chromium steels as well as other similar-alloyed steels with C-contents up to 0.20% (repair welding).

1.4122 X39CrMo17-1, 1.4113 X6CrMo17-1, 1.4513 X2CrMoTi17-1

UNS S S43400, 43600

AISI 440C, 434, 436

Typical analysis of all-weld metal

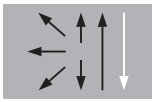
	C	Si	Mn	Cr	Mo
wt.-%	0.22	0.3	0.4	17.0	1.3

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

Condition	Hardness HB
u	400
a	250

u untreated, as-welded
a annealed, 750°C for 2 h / cooling in furnace

Operating data



Polarity DC+

Electrode identification FOX SKWAM E Z 17 Mo B

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

Preheating as required by the base metal, with temperatures between 100ºC and 200ºC being generally sufficient (for joint welding operations 250 – 400ºC). Annealing at 650 – 750ºC may be carried out to improve the toughness values in the weld metal and in the transition zone of the base metal. The hardness of the deposit is greatly influenced by the degree of dilution with the base metal (depending on the relevant welding conditions) and by its chemical composition. As a general rule it can be observed that the higher the degree of dilution and the C-content of the base metal, the higher the hardness of the deposit.

Re-drying if necessary at 120 – 200ºC for min. 2 h.

Approvals

KTA 1408.1 (08043.03), DB, CE

BÖHLER CAT 409 Cb-IG

Solid wire, high-alloyed, ferritic stainless, stabilized

Classifications

EN ISO 14343-A
G Z 13 Nb L

AWS A5.9 / SFA-5.9
ER409Nb

Characteristics and typical fields of application

Solid wire of Z 13 Nb L / 409Nb type especially for joint welding of exhaust systems. For matching or similar materials. Resistant to scaling up to 900ºC. Outstanding feeding characteristics and very good welding and flow characteristics.

Base materials

1.4006 X12Cr13, 1.4021 X20Cr13, 1.4024 X15Cr13, 1.4512 X2CrTi12 / X6CrTi12

AISI 409

Typical analysis of the solid wire

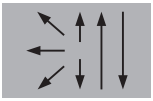
	C	Si	Mn	Cr	Nb
wt.-%	≤ 0.05	0.6	0.6	11.5	≥ 10 × C

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

Condition	Hardness
u	~150
a	~130

u untreated, as-welded – shielding gas Ar + 2% CO_2
a annealed – shielding gas Ar + 2% CO_2, 750°C for 2 h

Operating data



Dimension mm	Current A	Voltage V
1.0 short arc	110 – 140	19 – 22
1.0 spray arc	160 – 220	25 – 29
1.2 spray arc	200 – 270	26 – 30

Preheating 200 – 300ºC.

Post-weld heat treatment can be performed at 700 – 750ºC.

Shielding gas: Ar + 2 – 3% CO_2 (M12), Ar + 8 – 10% CO_2 oder 1 – 2% O_2 (M13). Gas flow: 15 – 20 l/min.

Polarity: DC+

Approvals

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BÖHLER CAT 430L Cb-IG

Solid wire, high-alloyed, ferritic stainless, stabilized

Classifications

EN ISO 14343-A
G Z 18 L Nb

AWS A5.9 / SFA-5.9
ER430 (mod.)

Characteristics and typical fields of application

Solid wire of G Z 18 Nb L / ER430 (mod.) type especially for joint welding of exhaust systems. For matching or similar materials. Stabilized with Nb to reduce tendency to grain growth. Resistant to scaling up to 900ºC. Outstanding feeding characteristics and very good welding and flow characteristics.

Base materials

1.4016 X6Cr17, 1.4511 X3CrNb17

UNS S43000

AISI 430

Typical analysis of the solid wire

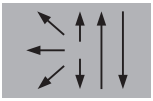
	C	Si	Mn	Cr	Nb
wt.-%	0.02	0.5	0.5	18	0.46 (≥ 12 × C)

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

Condition	Hardness
u	150
a	130

u untreated, as-welded – shielding gas Ar + 2% CO_2
a annealed – shielding gas Ar + 2% CO_2, 760°C for 2 h

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

Preheating as required by the base metal. Thicker matching ferritic steels can be preheated to 200 – 300ºC and post weld heat treated at 700 – 750ºC.

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 CAT 430L CbTi-IG

Solid wire, high-alloyed, ferritic stainless, stabilized

Classifications

EN ISO 14343-A
G Z 18 L NbTi

AWS A5.9 / SFA-5.9
ER430 (mod.)

Characteristics and typical fields of application

Solid wire of G Z 18 NbTi L / ER430 (mod.) for exhaust manifolds, catalytic converters, silencers and diesel particle filters of matching or similar materials. Double stabilized (Nb + Ti) to reduce tendency to grain growth. Resistant to scaling up to 900ºC. Outstanding feeding characteristics and very good welding and flow characteristics.

Base materials

1.4509 X5CrTiNb 18, 1.4016 X6Cr17, 1.4511 X3CrNb17

UNS S43940, S43000

AISI 430, 441

Typical analysis of the solid wire

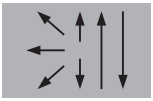
	C	Si	Mn	Cr	Nb	Ti
wt.-%	0.02	0.5	0.5	18	≥ 12xC	0.40

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

Condition	Hardness HB
u	150
a	130

u untreated, as-welded – shielding gas Ar + 2% CO_2
a annealed – shielding gas Ar + 2% CO_2, 760°C for 2 h

Operating data



Dimension mm	Current A	Voltage V
1.0 short arc	110 – 140	19 – 22
1.0 spray arc	160 – 220	25 – 29

Preheating as required by the base metal. Thicker matching ferritic steels can be preheated to 200 – 300ºC. Post weld heat treated at 700 – 750ºC.

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 CAT 439L Ti-IG

Solid wire, high-alloyed, ferritic stainless, stabilized

Classifications

EN ISO 14343-A	AWS A5.9 / SFA-5.9
G Z 18 L Ti	ER439

Characteristics and typical fields of application

Solid wire of G Z 18 Ti L / ER439 type for exhaust manifolds, catalytic converters, silencers and diesel particle filters of matching or similar materials. Stabilized with Ti to reduce tendency to grain growth. Resistant to scaling up to 900ºC. Outstanding feeding characteristics and very good welding and flow characteristics.

Base materials

1.4510 X3CrTi17, 1.4016 X6Cr17, 1.4502 X8CrTi18

AISI 430, 439

Typical analysis of the solid wire

	C	Si	Mn	Cr	Ti
wt.-%	0.02	0.8	0.8	18	0.35 (≥ 12 × C)

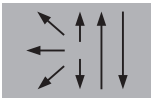
Mechanical properties of all-weld metal - typical values (min. values)

Condition	Hardness HB
u	150
a	130

u untreated, as-welded – shielding gas Ar + 2% CO_2

a annealed – shielding gas Ar + 2% CO_2, 800°C for 1 h

Operating data



Dimension mm	Current A	Voltage V
1.0 short arc	110 – 140	19 – 22
1.0 spray arc	160 – 220	25 – 29

Preheating as required by the base metal. Thicker matching ferritic steels can be preheated to 200 – 300ºC. Stress relieving heat treatment at 800ºC. Air cooling is recommended when multi-layer welding.

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 SKWA-IG

Solid wire, high-alloyed, ferritic stainless, stabilized

Classifications

EN ISO 14343-A
G Z 17 Ti

AWS A5.9 / SFA-5.9
ER430 (mod.)

Characteristics and typical fields of application

Solid wire of G Z 17 Ti / ER430 (mod.) type for joining and surfacing work on matching ferritic and similar Cr-steels and cast steel grades, suitable for quenching and tempering. Corrosion resistance similar to matching 17 Cr steels in seawater, diluted organic and inorganic acids. Service temperatures up to 500ºC. Lowest possible heat input is required, as ferritic 17Cr steels are susceptible to embrittlement due to grain growth. Resistant to scaling up to 900ºC.

Base materials

Surfacing can be performed on all weldable base materials, unalloyed and low-alloyed.

Welding of corrosion resistant chromium steels as well as other similar-alloyed steels with C-contents up to 0.20% (repair welding).

1.4001 X7Cr14, 1.4006 X12Cr13, 1.4057 X17CrNi16-2, 1.4000 X6Cr13, 1.4002 X6CrAl13, 1.4016 X6Cr17, 1.4059 X17CrNi16-2/1.4509 X2CrTiNb18, 1.4510 X3CrTi17, 1.4511 X3CrNb17, 1.4512 X2CrTi12, 1.4520 X2CrTi17, 1.4712 X10CrSi6, 1.4713 X10CrAlSi7/1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18

AISI 403, 405, 409, 410, 429, 430, 430Cb, 430Ti, 439, 431, 442

UNS S40300, S40500, S40900, S41000, S42900, S43000, S43035, S43036, S43100, S44200

Typical analysis of the solid wire

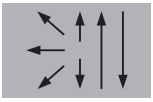
	C	Si	Mn	Cr	Ti
wt.-%	0.07	0.8	0.6	17.5	0.3

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

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A ($L_0=5d_0$) %	Hardness HB
u				150 – 170
u – 1st layer				300 – 400
u – 2nd layer				200 – 300
u – 3rd layer				170 – 220
a	(≥ 300)	(≥ 500)	(≥ 20)	130

u untreated, as-welded – shielding gas Ar + 8% CO_2
a annealed – shielding gas Ar + 8% CO_2, 750°C for 2 h

Operating data



Dimension mm	Current A	Voltage V
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

Depending on steel grade preheating to 200 – 400ºC.

After air cooling, annealing can be performed at 650 – 800ºC to improve the toughness of the weld deposit and to improve the resistance to intercrystalline corrosion.

Matching grades suitable for quenching and tempering can after air cooling to 120ºC be subject to a temper or quench and temper operation in accordance with the recommendation for the base material.

The hardness of the deposit is increasing with the dilution with the base metal. Gas mixtures containing CO_2 promotes higher hardness.

Shielding gas: Ar + 8 – 10% CO_2 or Ar + 2 – 3% CO_2 (M12) or Ar + 1 – 2% O_2 (M13). Gas flow: 15 – 20 l/min.

Polarity: DC+

Approvals

DB (20.132.22), ÖBB, CE

BÖHLER SKWAM-IG

Solid wire, high-alloyed, ferritic stainless

Classifications

EN ISO 14343-A
G Z 17 Mo H

Characteristics and typical fields of application

Solid wire of G Z 17 Mo type for surfacing on sealing faces of gas, water and steam valves and fittings made from unalloyed or low-alloyed steels, for service temperatures up to 450ºC. The weld deposit is normally machinable. Scaling resistant up to 900ºC. Also suited for joint welding of stainless ferritic steels containing 13 – 18% chromium, above all for applications where uniform color of the base metal and weld seam is required. For thick-walled components it is recommended to use Thermanit X wire for the filler passes in order to improve the ductility behavior of the joint weld.

Base materials

Surfacing can be performed on all weldable base materials, unalloyed and low-alloyed.

Welding of corrosion resistant chromium steels as well as other similar-alloyed steels with C-contents up to 0.20% (repair welding).

1.4122 X39CrMo17-1, 1.4113 X6CrMo17-1, 1.4513 X2CrMoTi17-1

UNS SS43400, S43600

AISI 440C, 434, 436

Typical analysis of the solid wire

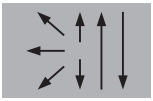
	C	Si	Mn	Cr	Ni	Mo
wt.-%	0.20	0.65	0.55	17	0.4	1.1

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

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A ($L_0=5d_0$) %	Hardness HB
a	(≥ 500)	(≥ 700)	(≥ 15)	200
u				350
u – 1st layer				400 – 500
u – 2nd layer				380 – 450
u – 3rd layer				330 – 400

u untreated, as-welded – shielding gas Ar + 8% CO_2
a annealed – shielding gas Ar + 8% CO_2, 720°C for 2 h

Operating data



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

Preheating to 100 – 150ºC for materials up to 10 mm wall thickness. Preheating to 150 – 200ºC for materials over 10 mm wall thickness. Tempering or quenching and tempering according to the parent metal.

Shielding gas: Ar + 1 – 2% O_2 (M13), Ar + 8 – 10 % CO_2 or Ar + 2 – 3 % CO_2 (M12). Gas flow: 15 – 20 l/min.

Polarity: DC+

Approvals

TÜV (08044), DB (20.132.23), NAKS, ÖBB, CE

BÖHLER SKWAM-UP - BÖHLER BB 203

SAW wire/flux combination, high-alloyed, ferritic stainless

Classifications

EN ISO 14343-A	AWS A5.9 / SFA-5.9	EN ISO 14174
S Z 17 Mo H	ER430 (mod.)	S A FB 2 DC

Characteristics and typical fields of application

BÖHLER SKWAM-UP - BB 203 is a wire/flux combination for submerged arc welding of matching ferritic and similar quenchable and temperable Cr-steels and cast steel grades.

Solid wire of S Z 17 Mo H / ER430 (mod.) type for surfacing on sealing faces of gas, water and steam valves and fittings made from unalloyed or low-alloy steels, for service temperatures up to 450ºC. Corrosion resistance similar to matching 17 Cr steels in seawater, diluted organic and inorganic acids. Excellent anti-friction properties. The weld deposit is still machinable. Scaling resistant up to 900ºC.

BÖHLER BB 203 is a fluoride-basic, agglomerate 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

Surfacings: All weldable materials, unalloyed, low-alloyed

Joint welds: Corrosion resistant Cr-steels as well as other similar-alloyed steels with C-contents up to 0.20% (repair welding).

Typical analysis of the weld metal

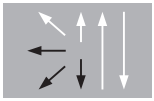
wt.-%	C	Si	Mn	Cr	Ni	Mo
wire	0.20	0.60	0.60	17.5	0.40	1.1
all-weld metal	0.15	0.70	0.55	17.0	0.40	1.1

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

Condition	Hardness HB
u	320 – 420
a1	200

u untreated, as-welded
a1 720°C for 2 h

Operating data



Dimension mm	Current A	Voltage V
2.4	300 – 400	29 – 33
3.2	350 – 500	29 – 33

Polarity: DC+. Preheating as required by the base metal. Thicker matching ferritic steels can be preheated to 150 – 300ºC.

Surfacing of thicker unalloyed, low-alloyed or high strength steels may require preheating to 100 – 250ºC.

For the reduction of stresses induced by welding, matching ferritic steels can be annealed at 800ºC followed by air cooling.

Lowest possible heat input is required as ferritic 17Cr steels are susceptible to embrittlement due to coarse grain growth.

Approvals

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BÖHLER CAT 430L Cb-MC

Metal-cored wire, high-alloyed, ferritic stainless, stabilized

Classifications

EN ISO 17633-A
T Z 17 Nb M M12 1

AWS A5.22 / SFA-5.22
EC439Nb

Characteristics and typical fields of application

Metal-cored wire of T Z 17 Nb / EC439Nb type for catalyzers, silencers, exhaust mufflers and inlet manifolds with same-type or of similar composition. Stabilized with niobium to reduce tendency to grain coarsening. The wire is resistant to scaling up to 900ºC. 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 finely rippled surface pattern. The wide arc ensures even penetration and side-wall fusion to prevent lack of fusion. The focus application is robotic welding of exhaust systems for the automotive industry, especially for thin sheet one-layer joints with a high travel speed.

Base materials

1.4016 X6Cr17, 1.4511 X3CrNb17

UNS S43000

AISI 430

Typical analysis of the wire

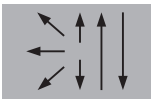
	C	Si	Mn	Cr	Nb	Ti
wt.-%	0.02	0.5	0.7	18.5	0.65	0.12

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

Condition	Hardness HB
u	180

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	60 – 280	13 – 30	3.5 – 13.0

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. The preferred shielding gas is Ar + 2 – 3% CO_2. 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. Preheating and interpass temperature as required by the base metal.

Approvals

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BÖHLER CAT 430L CbTi-MC

Metal-cored wire, high-alloyed, ferritic stainless, stabilized

Classifications

EN ISO 17633-A
T Z 17 Nb Ti L M M12 1

AWS A5.22 / SFA-5.22
EC430G, EC439Nb

Characteristics and typical fields of application

Metal-cored wire of T Z 17 Nb Ti L / EC439Nb type for joints in exhaust systems with similar or dissimilar materials. Double-stabilized (niobium and titanium) formula and a low carbon content with reduced tendency for grain coarsening. Resistant to scaling up to 900ºC. 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 finely rippled surface pattern. The wide arc ensures even penetration and side-wall fusion to prevent lack of fusion. The focus application is robotic welding of exhaust systems for the automotive industry, especially for thin sheet one-layer joints with a high travel speed.

Base materials

1.4016 X6Cr17, 1.4509 X2CrTiNb18, 1.4511 X3CrNb17

UNS S43000, S43940

AISI 430, 441

Typical analysis of the wire

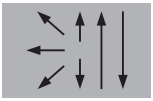
	C	Si	Mn	Cr	Nb	Ti
wt.-%	0.02	0.5	0.7	18.5	0.55	0.35

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

Condition	Hardness HB
u	180

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	60 – 280	13 – 30	3.5 – 13.0

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 – 3% CO_2 or Ar + 1 – 2% O_2 can be used as shielding gas. 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. Preheating and interpass temperature as required by the base metal.

Approvals

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BÖHLER CAT 439L Ti-MC

Metal-cored wire, high-alloyed, ferritic stainless, stabilized

Classifications

EN ISO 17633-A
T Z 17 Ti L M M12 1

AWS A5.22 / SFA-5.22
EC439

Characteristics and typical fields of application

Metal-cored wire of T Z 17 Ti L / EC439 type for catalyzers, silencers, exhaust mufflers and inlet manifolds of similar or matching composition. Stabilized with titanium to reduce tendency to grain coarsening. The wire is resistant to scaling up to 900ºC. 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 finely rippled surface pattern. The wide arc ensures even penetration and side-wall fusion to prevent lack of fusion. The focus application is robotic welding of exhaust systems for the automotive industry, especially for thin sheet one-layer joints with a high travel speed.

Base materials

1.4016 X6Cr17, 1.4510 X3CrTi17

UNS S43000, S43035

AISI 430, 439

Typical analysis of the wire

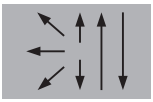
	C	Si	Mn	Cr	Ti
wt.-%	0.02	0.5	0.7	18.5	0.85

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

Condition	Hardness HB
u	180

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	60 – 280	13 – 30	3.5 – 13.0

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 – 3% CO_2 or Ar + 1 – 2% O_2 can be used as shielding gas. 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. Preheating and interpass temperature as required by the base metal.

Approvals

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