Welding consumables for heat and creep resistant stainless steels

Content

Stick electrodes

Product name	C	Si	Mn	Cr	Ni	Nb	N	Ti	FN
Avesta 253 MA	0.08	1.50	0.70	22.00	10.50		0.18		
BÖHLER FOX CN 18/11	0.05	0.30	1.30	19.40	10.40				3 – 8
BÖHLER FOX CN 16/13	0.14	0.50	3.80	16.00	13.00	1.50			
BÖHLER FOX E 347 H	0.05	0.30	1.30	19.00	10.20	≥ 8 × C			3 – 8
BÖHLER FOX E 308 H	0.05	0.60	0.80	19.80	10.20				
BÖHLER FOX FA	0.10	0.50	1.20	25.00	5.40				
Avesta 309 AC/DC	0.06	0.80	1.10	24.30	13.30				14
BÖHLER FOX FFB	0.12	0.60	3.20	25.00	20.50				
BÖHLER FOX FFB-A	0.12	0.50	2.20	26.00	21.00				
Avesta 310	0.11	0.70	2.00	26.00	21.40				
Thermanit 21/33 So	0.15	0.50	4.50	22.00	33.00	1.30			
Thermanit 25/35 R	0.40	1.00	1.80	25.00	35.00	1.30		0.10	

GTAW rods

Product name	C	Si	Mn	Cr	Ni	Mo	Nb	N	Cu
Thermanit ATS 4	0.05	0.40	1.80	18.80	9.30				
Thermanit 304 H Cu	0.10	0.40	3.20	18.00	16.00	0.80	0.40	0.20	3.00
BÖHLER FA-IG	0.07	0.80	1.20	25.70	4.50				
BÖHLER FF-IG	0.10	1.10	1.60	22.50	11.50				
Thermanit 310	0.12	0.40	1.80	25.80	21.00				
BÖHLER FFB-IG	0.13	0.90	3.20	24.60	20.50				
Thermanit CR	0.45	0.90	1.50	26.00	21.50				
BÖHLER CN 21/33 Mn-IG	0.12	0.20	4.80	21.80	32.50		1.20		
Thermanit 25/35 R	0.42	1.00	1.80	26.00	35.00		1.30		
Thermanit 35/45 Nb	0.42	1.50	1.00	35.00	45.50		0.80		

Solid wires

Product name	C	Si	Mn	Cr	Ni	Nb
Thermanit ATS 4	0.05	0.30	1.80	18.80	9.30	
BÖHLER FA-IG	0.07	0.80	1.20	25.70	4.50	
BÖHLER FF-IG	0.10	1.10	1.60	22.50	11.50	
Thermanit 310	0.13	0.40	1.80	25.80	20.80	
BÖHLER FFB-IG	0.13	0.90	3.20	24.60	20.50	
BÖHLER CN 21/33 Mn-IG	0.12	0.20	4.80	21.80	32.50	1.20
Thermanit 25/35 R	0.42	1.20	1.80	26.00	35.00	1.30

SAW wire/flux combinations

Product name	C	Si	Mn	Cr	Ni	N
Thermanit ATS 4 - Marathon 104	0.05	0.50	1.30	18.50	9.30	
Avesta 253 MA - Avesta Flux 805	0.07	1.70	0.30	21.50	9.50	0.15
Thermanit D - Marathon 104	0.10	1.00	1.20	22.20	11.50	

Flux-cored and metal-cored wire

Product name	C	Si	Mn	Cr	Ni	Nb	FN
BÖHLER E 308 H-FD	0.05	0.60	1.20	19.40	10.10		2 – 8
BÖHLER E 308 H PW-FD	0.05	0.60	1.20	19.40	10.10		2 – 8
BÖHLER E 309L H-FD	0.03	0.60	1.30	23.00	12.20		10 – 19
BÖHLER E 309L H PW-FD	0.04	0.70	1.30	23.00	12.50		10 – 23
BÖHLER E 347L H-FD	0.03	0.60	1.30	18.50	10.50	0.45	2 – 7
BÖHLER E 347 H PW-FD	0.05	0.60	1.30	18.50	10.50	0.45	2 – 7
BÖHLER FF-MC	0.07	0.60	0.60	20.20	10.60		5 – 9

Avesta 253 MA

Stick electrode, high-alloyed, austenitic stainless, creep resistant

Classifications

EN ISO 3581-A
E 21 10 N R

Characteristics and typical fields of application

Rutile coated electrode of E 21 10 N R type. Designed for welding the high temperature stainless steel 253 MA® (1.4835 / UNS S30815), used for furnaces, combustion chambers and burners. Both the steel and filler metal offers excellent resistance to oxidation up to 1100ºC. The chemical composition of Avesta 253 MA has a balanced ferrite content of max. 6 FN to give a crack resistant weld metal. Excellent resistance to high temperature corrosion. Not intended for applications exposed to wet corrosion.

Base materials

1.4835 X9CrNiSiNCe21-11-2, 1.4818 X6CrNiSiNCe19-10

UNS S30815, S30415

253 MA®, 153 MA™

Typical analysis of all-weld metal

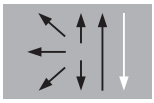
	C	Si	Mn	Cr	Ni	N
wt.-%	0.08	1.5	0.7	22.0	10.5	0.18

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
u	535	725	37	60	215

u untreated, as-welded

Operating data



Polarity DC+ / AC

Electrode identification 253 MA

Dimension mm	Current A
2.0 × 300	45 – 65
2.5 × 350	45 – 80
3.2 × 350	70 – 120
4.0 × 400	90 – 160
5.0 × 400	150 – 200

Suggested heat input is max. 1.5 kJ/mm, interpass temperature max. 150ºC

Metal recovery approximately 110%.

Approvals

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BÖHLER FOX CN 18/11

Stick electrode, high-alloyed, austenitic stainless, creep resistant

Classifications

EN ISO 3581-A
E 19 9 B 4 2

AWS A5.4 / SFA-5.4
E308-15

Characteristics and typical fields of application

Basic coated, core wire alloyed electrode of E 19 9 N / E308-15 type. Controlled delta ferrite content (3 – 8 FN) for heat and creep resistant austenitic CrNi-steels with increased carbon contents (e.g. 1.4948 / 304H), for boiler, reactor and turbine fabrication. Approved in long-term condition up to 700ºC service temperature (300ºC in the case of wet corrosion). High resistance to hot cracking. Excellent weldability in all positions except vertical down. Also suitable for 1.4550 / 347 and 1.4541 / 321, which are approved for temperatures up to 550ºC.

Base materials

Similar alloyed creep and heat resistant steels

1.4878 X8CrNiTi18-10, 1.4912 X7CrNiNb18-10, 1.4940 X7CrNiTi18-10, 1.4948 X6CrNi18-10, 1.4949 X3CrNiN18-11

UNS S30409, S32100

AISI 304H, 321

Typical analysis of all-weld metal

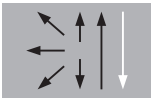
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.05	0.3	1.3	19.4	10.4	3 – 8

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	420 (≥ 350)	580 (≥ 550)	40 (≥ 30)	85	57 (≥ 32)

u untreated, as-welded

Operating data



Polarity DC+

Electrode identification FOX CN 18/11 308-15 E 19 9 B

Dimension mm	Current A
2.5 × 250	50 – 80
3.2 × 350	80 – 100
4.0 × 350	110 – 140

Preheating is only necessary in case of wall thickness above 25 mm preheat up to 150ºC.

Low heat input, max. 1.5 kJ/mm is recommended. Interpass temperatures should not exceed 150ºC.

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

Approvals

TÜV (00138), KTA 1408.1 (08067), LTSS, CE

BÖHLER FOX CN 16/13

Stick electrode, high-alloyed, austenitic stainless, creep resistant

Classifications

EN ISO 3581-A
E Z 16 13 Nb B 4 2

Characteristics and typical fields of application

Basic coated, core wire alloyed electrode of E Z 16 13 Nb B type for welding of heat and creep resistant CrNi-alloyed austenitic stainless steels in high efficiency boilers and turbine components. Approved in long-term condition up to 800ºC. Fully austenitic weld deposit. Resistant to embrittlement and hot cracking. Excellent weldability in all positions except vertical down.

Base materials

Similar alloyed heat and creep resistant steels

1.4878 X8CrNiTi18-10, 1.4910 X3CrNiMoBN17-13-3, 1.4919 X6CrNiMoB17-12-2, 1.4981 X8CrNiMoNb16-6, 1.4988 (G) X8CrNiMoVNb16-13

UNS S31635, S32100

AISI 316H, 321

Typical analysis of all-weld metal

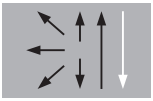
	C	Si	Mn	Cr	Ni	Nb
wt.-%	0.14	0.5	3.8	16.0	13.0	1.5

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	450 (≥ 390)	600 (≥ 550)	31 (≥ 30)	55 (≥ 32)

u untreated, as-welded

Operating data



Polarity DC+

Electrode identification FOX CN 16/13 E Z16 13 Nb B

Dimension mm	Current A
2.5 × 250	60 – 80
3.2 × 350	80 – 110

Preheating is only necessary in case of wall thickness above 25 mm preheat up to 150ºC.

Low heat input, max. 1.5 kJ/mm is recommended.

Interpass temperature should not exceed 150ºC.

Re-drying at 250 – 300ºC for min. 2 h if necessary.

Approvals

TÜV (00550), CE

BÖHLER FOX E 347 H

Stick electrode, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 3581-A
E 19 9 Nb B

AWS A5.4 / SFA-5.4
E347-15

Characteristics and typical fields of application

Basic coated electrode of E 19 9 Nb B / E347-15 type for welding of heat and creep resistant CrNi-alloyed austenitic stainless steels such as 1.4541 / 347H for service temperatures exceeding 400ºC. Controlled ferrite content of 3 – 8 FN. The deposit is less susceptible to embrittlement and is scaling resistant. Excellent weldability in all positions except vertical down.

Base materials

1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4878 X8CrNiTi18-10, 1.4912 X7CrNiNb18-10, 1.4940 X7CrNiTi18-10

UNS S32100, S32109, S34700, S34709

AISI 321, 321H, 347, 347H

Typical analysis of all-weld metal

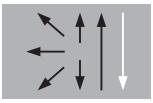
	C	Si	Mn	Cr	Ni	Nb	FN
wt.-%	0.05	0.3	1.3	19.0	10.2	≥ 8 × C	3 – 8

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	470 (≥ 350)	630 (≥ 550)	36 (≥ 25)	95 (≥ 32)

u untreated, as-welded

Operating data



Polarity DC+

Electrode identification FOX E 347 H-15 E 19 9 Nb B

Dimension mm	Current A
2.5 × 300	50 – 80
3.2 × 350	75 – 110
4.0 × 350	110 – 145

Preheating is not required; only in case of wall thickness above 25 mm preheat up to 150ºC.

Interpass temperature should not exceed 200ºC.

Approvals

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BÖHLER FOX E 308 H

Stick electrode, high-alloyed, austenitic stainless, creep resistant

Classifications

EN ISO 3581-A
E 19 9 H R 4 2

AWS A5.4 / SFA-5.4
E308H-16

Characteristics and typical fields of application

Rutile-basic coated electrode of E 19 9 H R / E308H-16 type for welding of creep resistant CrNi-alloyed austenitic stainless steels such as 1.4948 / 304H. Controlled ferrite content of 3 – 8 FN. The deposit is resistant to embrittlement and scaling. Excellent weldability in all position except vertical down. Service temperatures up to 700ºC.

Base materials

1.4301 X5CrNi18-10, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4878 X8CrNiTi18-10, 1.4948 X7CrNi18-9

UNS S30400, S30409, S32100, S34700

AISI 304, 304H, 321, 321H, 347, 347H

Typical analysis of all-weld metal

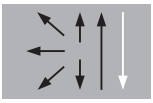
	C	Si	Mn	Cr	Ni
wt.-%	0.05	0.6	0.8	19.8	10.2

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
u	420 (≥ 350)	580 (≥ 550)	40 (≥ 30)	70 (≥ 32)

u untreated, as-welded

Operating data



Polarity DC+ / AC

Electrode identification FOX E 308 H-16 E 19 9 H R

Dimension mm	Current A
2.5 × 300	45 – 75
3.2 × 350	70 – 110
4.0 × 350	110 – 145

Preheating is not required; only in case of wall thickness above 25 mm preheat up to 150ºC.

Interpass temperature should not exceed 200ºC.

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

Approvals

TÜV (11178), CE

BÖHLER FOX FA

Stick electrode, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 3581-A
E 25 4 B 2 2

Characteristics and typical fields of application

Basic coated, cored wire alloyed electrode of E 25 4 B type for welding heat resistant steels. For furnaces requiring elevated resistance to reducing and oxidizing sulfurous gases as well as for final passes of weld joints in heat resistant, ferritic CrSiAl-steels. Scaling resistant up to 1100ºC.

Base materials

1.4347 GX8CrCrNiN26-7, 1.4340 GX49CrNi27-4, 1.4745 GX40CrSi23, 1.4746 X8CrTi25, 1.4762 X10CrAlSi25, 1.4776 GX40CrSi29, 1.4821 X15CrNiSi25-4, 1.4822 GX40CrNi24-5, 1.4823 GX40CrNiSi27-4

AISI 327, ASTM 297 HC

Typical analysis of all-weld metal

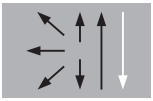
	C	Si	Mn	Cr	Ni
wt.-%	0.10	0.5	1.2	25.0	5.4

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
u	520 (≥ 400)	680 (≥ 600)	22 (≥ 15)	45

u untreated, as-welded

Operating data



Polarity DC+

Electrode identification FOX FA E 25 4 B

Dimension mm	Current A
2.5 × 300	50 – 75
3.2 × 350	80 – 105
4.0 × 350	100 – 130

Preheating and interpass temperatures 200 – 400ºC, depending on the relevant base metal and material thickness.

Approvals

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Avesta 309 AC/DC

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

Classifications

EN ISO 3581-A
E 22 12 R

AWS A5.4 / SFA-5.4
E309-17

Characteristics and typical fields of application

Rutile coated high-carbon electrode of E Z 22 12 R / E309-17 type for welding heat resistant steels such as 1.4833 / 309S. The weld metal is suitable for high temperature applications up to 1000ºC. Can also be used for dissimilar welding between stainless and mild or low-alloyed steels and surfacing on unalloyed steels. Designed for first class weld seems and easy handling on AC or DC. Resulting all weld metal microstructure: austenite with approximately 10 – 15% ferrite. Scaling temperature approximately 1000ºC in air.

Base materials

Over-alloyed electrode primarily used for welding of high temperature steels such as 1.4833 / 309S, but it may also be used for surfacing unalloyed steel, joint welding stainless steel to unalloyed steel and welding cladded material.

Typical analysis of all-weld metal

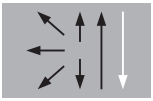
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.055	0.8	1.1	24.3	13.3	14

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 (≥ 320)	570 (≥ 550)	30 (≥ 25)	40

u untreated, as-welded

Operating data



Polarity DC+ / AC

Electrode identification 309-17

Dimension mm	Current A
2.5 × 300	50 – 80
3.2 × 350	80 – 120
4.0 × 350	100 – 160

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

Metal recovery approximately 110%.

Approvals

Certified by CWB to CSA W48, CE

BÖHLER FOX FFB

Stick electrode, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 3581-A
E 25 20 B 2 2

AWS A5.4 / SFA-5.4
E310-15 (mod.)

Characteristics and typical fields of application

Basic coated, cored wire alloyed electrode of E 25 20 B / E310-15 (mod.) type for welding heat resistant rolled and forged steels as well as cast steels e.g. in annealing plants, hardening plants, steam boiler construction, the crude oil industry and the ceramic industry. Heat resistant CrSiAl-steels exposed to sulfurous gases should be welded with a final layer of FOX FA after joining. Cryogenic resistance down to –196ºC. Avoid the service temperature range between 650ºC and 900ºC due to the risk of embrittlement. Scaling resistant up to 1200ºC.

Base materials

1.4586 X5NiCrMoCuNb22-18, 1.4710 GX30CrSi6, 1.4713 X10CrAl7, 1.4724 X10CrAl13, 1.4740 GX40CrSi17, 1.4742 X10CrAl18, 1.4762 X10CrAl 25, 1.4826 GX40CrNiSi22-9, 1.4840 GX15CrNi25-20, 1.4841 X15CrNiSi25-20, 1.4845 X12CrNi25-21, 1.4828 X15CrNiSi20-12, 1.4837 GX40CrNiSi25-12, 1.4840 GX15CrNi25-20, 1.4846 GX40CrNi25-21

UNS S31000, S31400, S44600

AISI 305, 310, 314, 446

Typical analysis of all-weld metal

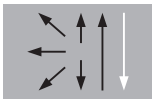
	C	Si	Mn	Cr	Ni
wt.-%	0.12	0.6	3.2	25.0	20.5

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	–196°C
u	420 (≥ 350)	570 (≥ 550)	39 (≥ 30)	100	≥ 32

u untreated, as-welded

Operating data



Polarity DC+

Electrode identification FOX FFB E 25 20 B

Dimension mm	Current A
2.5 × 300	50 – 75
3.2 × 350	80 – 110
4.0 × 350	110 – 140
5.0 × 450	140 – 180

Preheating and interpass temperatures for ferritic steels 200 – 300ºC.

Approvals

TÜV (00143), CE

BÖHLER FOX FFB-A

Stick electrode, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 3581-A
E 25 20 R 3 2

AWS A5.4 / SFA-5.4
E310-16

Characteristics and typical fields of application

Rutile coated electrode of E 25 20 R / E310-16 type for welding heat resistant rolled steels e.g. in annealing plants, hardening plants, steam boiler construction, the crude oil industry and the ceramic industry. Heat resistant CrSiAl-steels exposed to sulfurous gases should be weld with a final layer of BÖHLER FOX FA after joining. For thick-walled components the basic coated BÖHLER FOX FFB is recommended. Avoid the service temperature range between 650ºC and 900ºC due to the risk of embrittlement. Scaling resistant up to 1200ºC.

Base materials

1.4586 X5NiCrMoCuNb22-18, 1.4710 GX30CrSi6,1.4713 X10CrAl7, 1.4724 X10CrAl13, 1.4740 GX40CrSi17, 1.4742 X10CrAl18 1.4762 X10CrAl25, 1.4826 GX40CrNiSi22-9, 1.4840 GX15CrNi25-20, 1.4841 X15CrNiSi25-20, 1.4845 X12CrNi25-21, 1.4828 X15CrNiSi20-12, 1.4837 GX40CrNiSi25-12, 1.4840 GX15CrNi25-20, 1.4846 GX40CrNi25-21

UNS S31000, S31400, S44600

AISI 305, 310, 314, 446

Typical analysis of all-weld metal

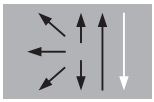
	C	Si	Mn	Cr	Ni
wt.-%	0.12	0.5	2.2	26.0	21.0

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 (≥ 350)	580 (≥ 550)	35 (≥ 30)	80 (≥ 47)

u untreated, as-welded

Operating data



Polarity DC+ / AC

Electrode identification FOX FFB-A 310-16 E 25 20 R

Dimension mm	Current A
2.0 × 300	40 – 60
2.5 × 300	50 – 80
3.2 × 300/350	80 - 110
3.2 × 350	80 – 110
4.0 × 350	110 – 140

Preheating and interpass temperatures for ferritic steels 200 – 300ºC.

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

Approvals

Equinor

Avesta 310

Stick electrode, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 3581-A
E 25 20 R 3 2

AWS A5.4 / SFA-5.4
E310-17

Characteristics and typical fields of application

Rutile coated fully austenitic electrode of E 25 20 R / E310-17 type designed for welding of high temperature stainless steel such as 1.4845 / 310S and similar grades. To minimize the risk of hot cracking when welding fully austenitic steels, the heat input and interpass temperature must be kept low and there must be as little dilution as possible from the parent metal. Primary intended for constructions running at high temperatures. Wet corrosion properties are moderate. Scaling temperature approximately 1150ºC in air.

Base materials

1.4841 X15CrNiSi25-21, 1.4845 X8CrNi25-21, 1.4846 X40CrNi25-21

UNS S31000, S31400

AISI 310, 310S, 314

Typical analysis of all-weld metal

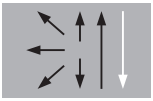
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.11	0.7	2.0	26.0	21.4	0

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	Impact values ISO-V KV J –196°C	Hardness HB
u	420 (≥ 350)	560 (≥ 550)	25 (≥ 20)	65	45	170

u untreated, as-welded

Operating data



Polarity DC+ / AC

Electrode identification 310-17

Dimension mm	Current A
2.5 × 300	45 – 80
3.2 × 350	70 – 120
4.0 × 350	100 – 150

Suggested heat input is max. 1.0 kJ/mm, interpass temperature max. 100ºC.

Preheating and post-weld heat-treatment not necessary.

Metal recovery approximately 115%.

Approvals

-

Thermanit 21/33 So

Stick electrode, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 3581-A
E Z 21 33 B 4 2

Characteristics and typical fields of application

Basic coated electrode of E Z 21 33 B 4 2 type. Heat resistant up to 1050ºC. Good resistance to carburizing atmospheres. For joining and surfacing applications with matching / similar heat resistant steels and cast steel grades.

Max. service temperature	Sulfur-free	Max. 2 g S/Nm^3
Air and oxidizing combustion gases	1050ºC	1000ºC
Reducing combustion gases	1000ºC	950ºC

Base materials

1.4847 X8CrNiAlTi20-20, 1.4849 GX40NiCrSiNb38-18, 1.4958 X5NiCrAlTi31-20, 1.4859 GX10NiCrNb32-20 / GX10NiCrNb38-18, 1.4861 X10NiCr32-20, 1.4864 X12NiCrSi36-16 / X12NiCrSi 35-16, 1.4865 GX40NiCrSi38-18, 1.4876 X10NiCrAlTi32-20 / X10NiCrAlTi32-21

UNS N08810

AISI 330, 334

Alloy 800, 800H, 800HT

Typical analysis of all-weld metal

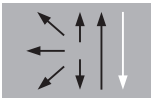
	C	Si	Mn	Cr	Ni	Nb
wt.-%	0.15	0.5	4.5	22.0	33.0	1.3

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	> 410	> 600	> 25	> 50

u untreated, as-welded

Operating data



Polarity	DC+
Electrode identification	Thermanit 21/33 So

Dimension mm	Current A
2.5 × 300	50 – 75
3.2 × 350	70 – 110

Suggested heat input is max.1.5 kJ/mm, interpass temperature max. 150ºC.

Welding with stringer bead technique or limited weaving motion advisable.

Creep rupture properties according to matching heat resistant parent metals.

Post-weld heat treatment generally not needed. If required 875ºC for 3 h followed by air cooling.

Approvals

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Thermanit 25/35 R

Stick electrode, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 3581-A
E Z 23 35 Nb B 2 2

Characteristics and typical fields of application

Thermanit 25/35 R is suitable for joining and surfacing of heat resistant CrNi-cast steels (centrifugal and mould cast parts) of the same or of similar nature. Resistant to scaling up to 1050ºC

Base materials

1.4840 GX15CrNi25-20, 1.4849 GX40NiCrSiNb38-18, 1.4852 GX40NiCrSiNb35-25, 1.4857 GX40NiCrSi35-25, 1.4865 GX40NiCrSi38-18

Typical analysis of all-weld metal

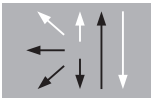
	C	Si	Mn	Cr	Ni	Nb	Ti	Fe
wt.-%	0.40	1.0	1.8	25.0	35.0	1.3	0.1	Bal.

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

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A ($L_0=5d_0$) %
u	500	700	15

u untreated, as-welded

Operating data



Polarity DC+

Electrode identification Thermanit 25/35 R

Dimension mm	Current A
2.5 × 300	50 – 70
3.2 × 350	70 – 120
4.0 × 350	90 – 135

Suggested heat input is max. 1.5 kJ/mm and interpass temperature max. 100ºC.
No preheating or post-weld heat treatment required.

Approvals

-

Thermanit ATS 4

TIG rod, high-alloyed, austenitic stainless, creep resistant

Classifications

EN ISO 14343-A
W 19 9 H

AWS A5.9 / SFA-5.9
ER19-10H

Characteristics and typical fields of application

TIG rod of W 19 9 H / ER19-10H type for joining and surfacing applications on matching and similar creep resistant steel and cast steel grades. Creep resistant up to 700°C. Controlled microstructure with max. 5% ferrite.

Base materials

1.4878 X8CrNiTi18-10, 1.4912 X7CrNiNb18-10, 1.4940 X7CrNiTi18-10, 1.4948 X6CrNi18-10

AISI 304H, 321H, 347H

Typical analysis of the wire rod

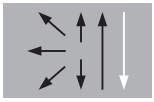
	C	Si	Mn	Cr	Ni
wt.-%	0.05	0.4	1.8	18.8	9.3

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	600	30	100

u untreated, as-welded – shielding gas Ar

Operating data



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

Heat input max. 2.0 kJ/mm, interpass temperature max. 150°C.

Creep rupture properties according to matching high temperature steels / alloys.

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

Polarity: DC-

Approvals

TÜV (01616), CE

Thermanit 304 H Cu

TIG rod, high-alloyed, austenitic stainless, creep resistant

Classifications

EN ISO 14343-A
W Z 18 16 1 Cu H

AWS A5.9 / SFA-5.9
ER308H (mod.)

Characteristics and typical fields of application

TIG rod of W Z 18 16 1 Cu H / ER308H (mod.) type for joining and surfacing on matching austenitic creep resistant steels and cast steel grades. Good high temperature corrosion resistance.

Base materials

1.4907 X10CrNiCuNb18-9-3 and similar creep resistant austenitic steels such as Super 304 H and DMV 304 HCu

18Cr-9Ni-3Cu-Nb-N ASME SA-213; code case 2328-1

Typical analysis of the wire rod

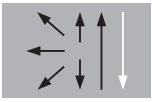
	C	Si	Mn	Cr	Ni	Mo	Nb	N	Cu
wt.-%	0.1	0.4	3.2	18	16.0	0.8	0.4	0.2	3.0

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	350	590	25	47

u untreated, as-welded – shielding gas Ar

Operating data



Dimension mm	Current A	Voltage V
1.6 × 1000	80 – 120	10 – 13
2.0 × 1000	100 – 130	14 – 16
2.4 × 1000	130 – 160	16 – 18

Heat input is max. 2.0 kJ/mm, interpass temperature max. 150°C. Preheating and post-weld heat-treatment not necessary.

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

Polarity: DC-

Approvals

TÜV (11219), CE

BÖHLER FA-IG

TIG rod, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 14343-A
W 25 4

Characteristics and typical fields of application

TIG rod of W 25 4 type for welding of heat resisting, matching or similar Mo-free 25Cr(Ni)-steels and cast steel grades. The low Ni-content renders this filler metal especially recommendable for applications involving the attack of sulfurous oxidizing or reducing combustion gases.

Base materials

1.4347 GX8CrCrNiN26-7, 1.4340 GX49CrNi27-4, 1.4745 GX40CrSi23, 1.4746 X8CrTi25, 1.4762 X10CrAlSi25, 1.4776 GX40CrSi29, 1.4821 X15CrNiSi25-4, 1.4822 GX40CrNi24-5, 1.4823 GX40CrNiSi27-4

AISI 327

Typical analysis of the wire rod

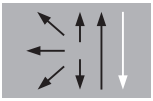
	C	Si	Mn	Cr	Ni
wt.-%	0.07	0.8	1.2	25.7	4.5

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	540 (≥ 450)	710 (≥ 650)	22 (≥ 15)	70

u untreated, as-welded – shielding gas Ar

Operating data



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

Preheating and interpass temperature as required by the base metal. For parent metals susceptible to embrittlement, interpass temperature must not be allowed to exceed 300°C.

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

Polarity: DC-

Approvals

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BÖHLER FF-IG

TIG rod, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 14343-A
W 22 12 H

AWS A5.9 / SFA-5.9
ER309 (mod.)

Characteristics and typical fields of application

TIG rod of W 22 12 H / ER309 (mod.) type for analogous, heat resisting rolled, forged and cast steels as well as for heat resisting, ferritic CrSiAl-steels, e.g. in annealing shops, hardening shops, steam boiler construction, the crude oil industry and the ceramics industry. Austenitic deposited with a ferrite content of approximately 8%. Preferably used for applications involving the attack of oxidizing gases.

The final layer of joint welds in CrSiAl-steels exposed to sulfurous gases must be deposited by means of BöHLER FOX FA or BöHLER FOX FA-IG. Scaling resistance up to 1000°C.

Base materials

Austenitic 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12, 1.4833 X12CrNi23-13

Ferritic-pearlitic 1.4710 GX30CrSi7, 1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4740 GX40CrSi17, 1.4742 X10CrAlSi18

AISI 305

Typical analysis of the wire rod

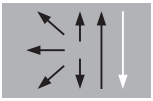
	C	Si	Mn	Cr	Ni
wt.-%	0.1	1.1	1.6	22.5	11.5

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	500 (≥ 350)	630 (≥ 550)	32 (≥ 25)	115

u untreated, as-welded – shielding gas Ar

Operating data



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

Heat input, max. 2.0 kJ/mm, interpass temperature max. 150°C.

Preheating and interpass temperatures for ferrite steels 200 – 300°C. Creep rupture properties according to matching high temperature steels / alloys

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

Polarity: DC-

Approvals

TÜV (00020), CE

Thermanit 310

TIG rod, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 14343-A
W 25 20

AWS A5.9 / SFA-5.9
ER310

Characteristics and typical fields of application

GTAW rod of W 25 20 / ER310 type for joining and surfacing of matching / similar heat resistant steels and cast steel grades. For tough fill layers beneath cap passes made with BöHLER FA-IG / FOX FA when welding thicker cross-sections of Cr-steels grades to permit use of such steels in sulfurous atmospheres.

	Sulfur-free	Max. 2 g S/Nm^3
Max. service temperature		
Air and oxidizing combustion gases	1150°C	1100°C
Reducing combustion gases	1080°C	1040°C

Base materials

1.4586 X5NiCrMoCuNb22-18, 1.4710 G-X30CrSi6, 1.4713 X10CrAl7, 1.4724 X10CrAl13, 1.4740 G-X40CrSi17, 1.4742 X10CrAl18, 1.4762 X10CrAl25, 1.4826 GX40CrNiSi22-9, 1.4840 G-X15CrNi25-20, 1.4841 X15CrNiSi25-20, 1.4845 X12CrNi25-21, 1.4828 X15CrNiSi20-12, 1.4837 GX40CrNiSi25-12, 1.4840 GX15CrNi25-20, 1.4846 G-X40CrNi25-21

UNS S31000, S31400, S44600

AISI 305, 310, 314, 446

Typical analysis of the wire rod

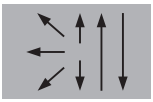
	C	Si	Mn	Cr	Ni
wt.-%	0.12	0.4	1.8	25.8	21.0

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) %
u	420 (≥ 350)	610 (≥ 550)	33 (≥ 20)

u untreated, as welded – Shielding gas Ar

Operating data



Dimension mm	Current A	Voltage V
1.6 × 1000	80 – 120	10 – 13
2.0 × 1000	100 – 130	14 – 16
2.4 × 1000	130 – 160	16 – 18

Preheating and post-weld heat-treatment not necessary.

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

Polarity: DC-

Approvals

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BÖHLER FFB-IG

TIG rod, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 14343-A
W 25 20 Mn

AWS A5.9 / SFA-5.9
ER310 (mod.)

Characteristics and typical fields of application

TIG rod of W 25 20 Mn / ER310 (mod.) type for analogous, heat resisting, rolled, forged and cast steels, e.g. in annealing shops, hardening shops, steam boiler construction, the crude oil industry and the ceramics industry. Fully austenitic deposit. Preferably employed for applications involving the attack of oxidizing, nitrogen-containing or low-oxygen gases. In sulfurous atmospheres cap passes should be made with BöHLER FA-IG / BöHLER FOX FA. The temperature range between 650°C and 900°C should be avoided owing to the risk of embrittlement.

Base materials

1.4586 X5NiCrMoCuNb22-18, 1.4710 GX30CrSi6, 1.4713 X10CrAl7, 1.4724 X10CrAl13, 1.4740 G-X40CrSi17,1.4742 X10CrAl18, 1.4762 X10CrAl 25, 1.4826 GX40CrNiSi22-9, 1.4840 GX15CrNi25-20, 1.4841 X15CrNiSi25-20, 1.4845 X12CrNi25-21, 1.4828 X15CrNiSi20-12, 1.4837 GX40CrNiSi25-12, 1.4840 GX15CrNi25-20, 1.4846 GX40CrNi25-21

UNS S31000, S31400, S44600

AISI 305, 310, 314, 446

Typical analysis of the wire rod

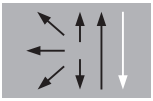
	C	Si	Mn	Cr	Ni
wt.-%	0.13	0.9	3.2	24.6	20.5

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 –40°C
u	420 (≥ 350)	630 (≥ 550)	33 (≥ 20)	128 (≥ 32)

u untreated, as-welded – shielding gas Ar

Operating data



Dimension mm	Current A	Voltage V
1.6 × 1000	80 – 120	10 – 13
2.0 × 1000	100 – 130	14 – 16
2.4 × 1000	130 – 160	16 – 18

Preheating and interpass temperatures for ferritic steels 200 – 300°C.

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

Polarity: DC-

Approvals

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Thermanit CR

TIG rod, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 14343-A
W Z 25 20 H

AWS A5.9 / SFA-5.9
ER310 (mod.)

Characteristics and typical fields of application

TIG rod of W Z 25 20 H / ER310 (mod.) type for surfacing and joining applications on matching heat resistant cast steel grades. Service temperature max. 1000°C.

Base materials

1.4848 GX40CrNiSi25-20, 1.4826 GX40CrNiSi22-9, 1.4837 GX40CrNiSi25-12

Typical analysis of the wire rod

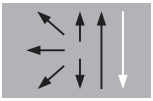
	C	Si	Mn	Cr	Ni
wt.-%	0.45	0.9	1.5	26	21.5

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) %
u	500	700	10

u untreated, as-welded – shielding gas Ar

Operating data



Dimension mm	Current A	Voltage V
2.4 × 1000	130 – 160	16 – 18
3.2 × 1000	160 – 200	17 – 20

Suggested heat input is max. 1.0 kJ/mm and interpass temperature max. 100°C.

Creep rupture properties according to matching high temperature steels / alloys.

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

Polarity: DC-

Approvals

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BÖHLER CN 21/33 Mn-IG

TIG rod, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 14343-A
W Z 21 33 Mn Nb

Characteristics and typical fields of application

TIG rod of W Z 21 33 Mn Nb type for joining and surfacing applications with matching / similar heat resistant steels and cast steel grades. Good resistance to carburizing atmospheres.

Max. application temperature	Sulfur-free	Max. 2 g S/Nm^3
Air and oxidizing combustion gases	1050ºC	1000ºC
Reducing combustion gases	1000ºC	950ºC

Base materials

1.4847 X8CrNiAlTi20-20, 1.4849 GX40NiCrSiNb38-18, 1.4958 X5NiCrAlTi31-20, 1.4859 GX10NiCrNb32-20 / GX10NiCrNb38-18, 1.4861 X10NiCr32-20, 1.4864 X12NiCrSi36-16 / X12NiCrSi 35-16, 1.4865 GX40NiCrSi38-18, 1.4876 X10NiCrAlTi32-20 / X10NiCrAlTi32-21

UNS N08810

AISI 330, 334

Alloy 800, 800H, 800HT

Typical analysis of the wire rod

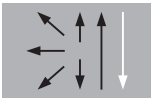
	C	Si	Mn	Cr	Ni	Nb
wt.-%	0.12	0.2	4.8	21.8	32.5	1.2

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
u	400	600	17	50

u untreated, as-welded - Shielding gas Ar

Operating data



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. 150ºC.

Welding with stringer bead technique or limited weaving motion advisable.

Creep rupture properties according to matching heat resistant parent metals.

If needed, a stabilizing heat treatment can be performed at 875ºC for 3 h followed by air cooling.

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

Polarity: DC-

Approvals

TÜV (11217), CE

Thermanit 25/35 R

TIG rod, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 14343-A
W Z 25 35

Characteristics and typical fields of application

TIG rod of W Z 25 35 type for joining and surfacing work with matching / similar heat resistant cast steel grades. Typical application is welding of pyrolysis furnace tubes. Service temperature max. 1050°C.

Base materials

1.4840 GX15CrNi25-20, 1.4849 GX40NiCrSiNb38-18, 1.4852 GX40NiCrSiNb35-25, 1.4857 GX40NiCrSi35-25, 1.4865 GX40NiCrSi38-18

Typical analysis of the wire rod

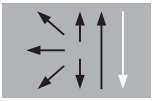
	C	Si	Mn	Cr	Ni	Nb
wt.-%	0.42	1.0	1.8	26	35.0	1.3

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

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation A ($L_0=5d_0$) %
u	450	650	8

u untreated, as-welded – shielding gas Ar

Operating data



Dimension mm	Current A	Voltage V
1.2 × 1000	60–80	9–11

Heat input max. 1.0 kJ/mm, interpass temperature max. 100°C.

Preheating and post-weld heat-treatment not necessary.

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

Polarity: DC-

Approvals

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Thermanit 35/45 Nb

TIG rod, high-alloyed, nickel-base, heat resistant

Classifications

EN ISO 18274
S Ni Z (NiCr36Fe15Nb0.8)

Characteristics and typical fields of application

Nickel-base TIG rod of W Ni Z (NiCr36Fe15Nb0.6) type for joining and surfacing of heat resistant steels and cast steels of the same or similar chemical composition. Resistant to scaling up to 1180°C. Typical alloy for welding of pyrolysis furnace tubes.

Base materials

GX45NiCrNbSiTi45-35

Typical analysis of the wire rod

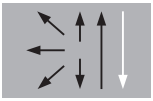
	C	Si	Mn	Cr	Ni	Nb
wt.-%	0.42	1.5	1.0	35	45.5	0.8

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

Condition	Yield strength $R_{p0.2}$ MPa	Tensile strength R_m MPa
u	450	550

u untreated, as-welded – shielding gas Ar

Operating data



Dimension mm	Current A	Voltage V
2.0 × 1000	100 – 130	14 – 16
2.4 × 1000	130 – 160	16 – 18
3.2 × 1000	160 – 200	17 – 20

Heat input max. 1.0 kJ/mm, interpass temperature max. 150°C.

Preheating and post-weld heat treatment not necessary. Service temperature max. 1050°C.

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

Polarity: DC-

Approvals

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Thermanit ATS 4

Solid wire, high-alloyed, austenitic stainless, creep resistant

Classifications

EN ISO 14343-A	AWS A5.9 / SFA-5.9
G 19 9 H	ER19-10H

Characteristics and typical fields of application

Solid wire of G 19 9 H / ER19-10H type for joining and surfacing applications on matching and similar creep resistant steel and cast steel grades. Creep resistant up to 700ºC. Controlled microstructure with approximately 5% ferrite.

Base materials

1.4436 X3CrNiMo17-13-3, 1.4439 X2CrNiMoN17-13-5, 1.4429 X2CrNiMoN17-13-3, 1.4438 X2CrNiMo18-15-4, 1.4583 X10CrNiMoNb18-12

AISI 316Cb, 316LN, 317LN, 317L

UNS S31726

GMAW

Typical analysis of the solid wire

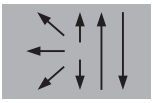
	C	Si	Mn	Cr	Ni
wt.-%	0.05	0.3	1.8	18.8	9.3

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	350	550	35	70

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

Up to 25 mm wall thickness no preheating or post weld heat treatment. Over 25 mm wall thickness preheating to max. 200ºC and stress relieving treatment at 1050ºC followed by air cooling.

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

Creep rupture properties according to matching high temperature steels / alloys.

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

Polarity: DC+

Approvals

TÜV (06522), CE

BÖHLER FA-IG

Solid wire, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 14343-A
G 25 4

Characteristics and typical fields of application

Solid wire of G 25 4 type for welding of heat resistant, matching or similar Mo-free 25Cr(Ni)-steels and cast steel grades. For parent metals susceptible to embrittlement, interpass temperature must not be allowed to exceed 300ºC. The low Ni-content renders this filler metal especially suitable for applications involving of sulfurous oxidizing or reducing combustion gases. Scaling resistant up to 1100ºC.

Base materials

1.4347 GX8CrCrNiN26-7, 1.4340 GX49CrNi27-4, 1.4745 GX40CrSi23, 1.4746 X8CrTi25, 1.4762 X10CrAlSi25, 1.4776 GX40CrSi29, 1.4821 X15CrNiSi25-4, 1.4822 GX40CrNi24-5, 1.4823 GX40CrNiSi27-4

AISI 327, ASTM A297 HC

Typical analysis of the solid wire

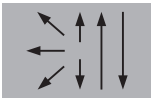
	C	Si	Mn	Cr	Ni
wt.-%	0.07	0.8	1.2	25.7	4.5

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	520 (≥ 450)	690 (≥ 650)	20 (≥ 15)	50

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

Operating data



Dimension mm	Current A	Voltage V
1.0 spray arc	180 – 240	25 – 29
1.2 spray arc	190 – 250	26 – 30
1.6 spray arc	250 – 330	29 – 32

Preheating and interpass temperature as required by the base metal.

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

Approvals

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BÖHLER FF-IG

Solid wire, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 14343-A
G 22 12 H

AWS A5.9 / SFA-5.9
ER309 (mod.)

Characteristics and typical fields of application

Solid wire of G 22 12 H / ER309 (mod.) type for similar, heat resisting rolled, forged and cast steels as well as for heat resisting, ferritic CrSiAl-steels, e.g. in annealing shops, hardening shops, steam boiler construction, the crude oil industry and the ceramics industry. Scaling resistance up to 950°C. Results in an austenitic microstructure deposited with a ferrite content of approximately 8%. Preferably used for applications involving the attack of oxidizing gases.

The final layer of joint welds in CrSiAl-steels exposed to sulfurous gases must be deposited by means of BöHLER FOX FA or BöHLER FOX FA-IG.

Base materials

Austenitic 1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12, 1.4833 X12CrNi23-13

Ferritic-pearlitic 1.4710 GX30CrSi7, 1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4740 GX40CrSi17, 1.4742 X10CrAlSi18

AISI 305, ASTM A297 HF

Typical analysis of the solid wire

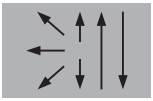
	C	Si	Mn	Cr	Ni
wt.-%	0.1	1.1	1.6	22.5	11.5

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	480 (≥ 350)	620 (≥ 550)	34 (≥ 25)	110

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

Suggested heat input is max. 2.0 kJ/mm, interpass temperature max. 150°C.

Preheating and interpass temperatures for ferrite steels 200 – 300°C. Creep rupture properties according to matching high temperature steels / alloys.

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

Polarity: DC+

Approvals

TÜV, CE

Thermanit 310

Solid wire, high-alloyed, stainless, heat resistant

Classifications

EN ISO 14343-A
G 25 20

AWS A5.9 / SFA-5.9
ER310

Characteristics and typical fields of application

Solid wire of G 25 20 / ER310 type for joining and surfacing of matching / similar heat resistant steels / cast steel grades. For tough fill layers beneath cap passes made with BöHLER FA-IG / FOX FA when welding thicker cross-sections of Cr-steels and cast steel grades to permit use of such steels in sulfurous atmospheres.

	Sulfur-free	Max. 2 g S/Nm^3
Max. application temperature		
Air and oxidizing combustion gases	1150°C	1100°C
Reducing combustion gases	1080°C	1040°C

Base materials

1.4841 X15CrNiSi25-21, 1.4845 X8CrNi25-21, 1.4846 X40CrNi25-21

UNS S31000, S31400

AISI 310, 310S, 314

Typical analysis of the solid wire

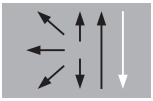
	C	Si	Mn	Cr	Ni
wt.-%	0.13	0.4	1.8	25.8	20.8

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	350	550	25	80

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

Operating data



Dimension mm	Current A	Voltage V
1.0 spray arc	180 – 240	25 – 29
1.2 spray arc	19 – 250	26 – 30

Suggested heat input is max. 1.0 kJ/mm, interpass temperature max. 100°C.

Preheating and post-weld heat treatment not necessary.

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

Polarity: DC+

Approvals

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BÖHLER FFB-IG

Solid wire, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 14343-A
G 25 20 Mn

AWS A5.9 / SFA-5.9
ER310 (mod.)

Characteristics and typical fields of application

Solid wire of G 25 20 Mn / ER310 (mod.) type for joining and surfacing of matching / similar heat resisting, rolled, forged and cast steels, e.g. in annealing shops, hardening shops, steam boiler construction, crude oil industry and the ceramics industry. In sulfurous atmospheres cap passes should be made with BöHLER FA-IG / BöHLER FOX FA. The temperature range between 650 – 900ºC should be avoided due to the risk of embrittlement.

Base materials

1.4586 X5NiCrMoCuNb22-18, 1.4710 GX30CrSi6, 1.4713 X10CrAl7, 1.4724 X10CrAl13, 1.4740 GX40CrSi17, 1.4742 X10CrAl18 1.4762 X10CrAl25, 1.4826 GX40CrNiSi22-9, 1.4840 GX15CrNi25-20, 1.4841 X15CrNiSi25-20, 1.4845 X12CrNi25-21, 1.4828 X15CrNiSi20-12, 1.4837 GX40CrNiSi25-12, 1.4840 GX15CrNi25-20, 1.4846 GX40CrNi25-21

UNS S31000, S31400, S44600

AISI 305, 310, 314, 446

Typical analysis of the solid wire

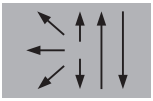
	C	Si	Mn	Cr	Ni
wt.-%	0.13	0.9	3.2	24.6	20.5

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	–196°C
u	400 (≥ 350)	620 (≥ 550)	38 (≥ 20)	95	(≥ 32)

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

Operating data



Dimension mm	Current A	Voltage V
1.0 short arc	60 – 100	20 – 22
1.0 spray arc	180 – 240	25 – 29
1.2 spray arc	190 – 250	26 – 30

Preheating and interpass temperatures for ferritic steels 200 – 300ºC.

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

Polarity: DC+

Approvals

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BÖHLER CN 21/33 Mn-IG

Solid wire, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 14343-A
G Z 21 33 Mn Nb

Characteristics and typical fields of application

Solid wire of G Z 21 33 Mn Nb type for joining and surfacing applications with matching / similar heat resistant steels and cast steel grades. Good resistance to carburizing atmospheres. Typical alloy for welding of pyrolysis furnace tubes.

Base materials

1.4847 X8CrNiAlTi20-20, 1.4849 GX40NiCrSiNb38-18, 1.4958 X5NiCrAlTi31-20, 1.4859 – GX10NiCrNb32-20 / GX10NiCrNb38-18, 1.4861 X10NiCr32-20, 1.4864 X12NiCrSi36-16 / X12NiCrSi 35-16, 1.4865 GX40NiCrSi38-18, 1.4876 – X10NiCrAlTi32-20 / X10NiCrAlTi32-21

UNS N08810

AISI 330, 334

Alloy 800, 800H, 800HT

Typical analysis of the solid wire

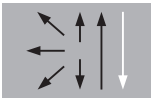
	C	Si	Mn	Cr	Ni	Nb
wt.-%	0.12	0.2	4.8	21.8	32.5	1.2

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
u	≥ 400	≥ 600	≥ 17	≥ 50

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

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 – 260	26 – 30

Suggested heat input is max.1.5 kJ/mm, interpass temperature max. 150°C.

Welding with stringer bead technique or limited weaving motion advisable.

Creep rupture properties according to matching heat resistant parent metals.

If needed, a stabilizing heat treatment can be performed at 875°C for 3 h followed by air cooling.

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

Polarity: DC+

Approvals

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Thermanit 25/35 R

Solid wire, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 14343-A
G 25 35

Characteristics and typical fields of application

For joining and surfacing work on matching / similar heat resistant cast steel grades. Resistant to scaling up to 1050ºC.

Base materials

1.4852 GX40NiCrSiNb35-25

Typical analysis of the solid wire

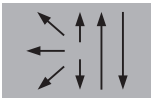
	C	Si	Mn	Cr	Ni	Nb
wt.-%	0.42	1.2	1.8	26.0	35.0	1.3

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) %
u	400	600	8

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

Operating data



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

Suggested heat input is max. 1.5 kJ/mm and interpass temperature max. 100ºC.

Preheating and post-weld heat treatment generally not needed.

Shielding gas: Ar + 8 – 10% CO_2, 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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Thermanit ATS 4 - Marathon 104

SAW wire/flux combination, high-alloyed, austenitic stainless, heat and creep resistant

Classifications

EN ISO 14343-A	AWS A5.9 / SFA-5.9	EN ISO 14174
S 19 9 H	ER19-10H	S A FB 2 AC

Characteristics and typical fields of application

Thermanit ATS 4 - Marathon 104 is a wire/flux combination for submerged arc welding of matching/similar high temperature resistant steels and cast steel grades.

Solid wire of S 19 9 H / ER19-10H type for joining and surfacing applications. Creep resistant up to 700ºC. Resistant to scaling up to 800ºC.

Marathon 104 is an agglomerated fluoride-basic flux for submerged arc welding of stainless and heat resistant steel grades. The weld metal is characterized by high resistance to hot cracking and is recommended for the highest demanding applications. For more information regarding this sub-arc welding flux, see the separate datasheet.

Base materials

1.4550 X6CrNiNb18-10, 1.4878 X12CrNiTi18-9, 1.4948 X6CrNi18-1

AISI 304H, 321H, 347H

Typical analysis of the weld metal

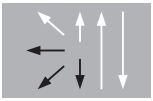
wt.-%	C	Si	Mn	Cr	Ni
wire	0.05	0.40	1.6	18.8	9.3
all-weld metal	0.05	0.50	1.3	18.5	9.3

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	(≥ 320)	(≥ 550)	(≥ 35)	(≥ 80)

u untreated, as-welded

Operating data



Dimension mm	Current A	Voltage V
2.4	300 – 400	29 – 33
3.0	320 – 470	29 – 33

No preheating.

Suggested heat input max. 1.5 kJ/mm and interpass temperature max. 150ºC. Polarity: DC+

Post-weld heat treatment generally not needed. In special cases, solution annealing can be perfiormed at 1050ºC followed by air cooling.

Approvals

TÜV (11232), CE

Avesta 253 MA - Avesta Flux 805

SAW wire/flux combination, high-alloyed, austenitic stainless, heat and creep resistant

Classifications

EN ISO 14343-A	AWS A5.9 / SFA-5.9	EN ISO 14174
S Z 21 10 N	EG	S A AF 2 DC

Characteristics and typical fields of application

Avesta 253 MA - Avesta Flux 805 is a wire/flux combination for submerged arc welding of matching/similar high temperature resistant steels/cast steel grades.

Solid wire of S Z 21 10 N type designed for welding the high temperature steel 253 MA® (1.4835 / UNS S30815), used for example in furnaces, combustion chambers, burners, etc. Both the steel and the consumable provide excellent properties at temperatures 850 – 1100ºC. The composition of the consumable is balanced to ensure crack resistant weld metal. The resulting microstructure is austenite with 2 – 8% ferrite. Scaling resistance up to 1150ºC in air. Excellence resistance to high temperature corrosion. Not intended for applications exposed to wet corrosion. 253 MA® has a tendency to give a thick oxide layer during welding and hot rolling. Black plates and previous weld beads should be carefully brushed or ground prior to welding.

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

1.4835 X9CrNiSiNCe21-11-2, 1.4818 X6CrNiSiNCe19-10

UNS S30815, S30415

253 MA®, 153 MA™

Typical analysis of the weld metal

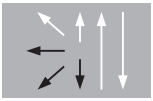
wt.-%	C	Si	Mn	Cr	Ni	N
wire	0.07	1.6	0.50	21.0	10.0	0.15
all-weld metal	0.07	1.7	0.30	21.5	9.5	0.15

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	690	39	90

u untreated, as-welded

Operating data



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

SAW – single wire process with Ø 2.4 mm wire. Suggested heat input is max. 1.5 kJ/mm, interpass temperature max. 150ºC.

Preheating and heat treatment are generally not necessary. Polarity: DC+

Approvals

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Thermanit D - Marathon 104

SAW wire/flux combination, high-alloyed, austenitic stainless, creep and heat resistant

Classifications

EN ISO 14343-A	AWS A5.9 / SFA-5.9	EN ISO 14174
S 22 12 H	ER309 (mod.)	S A FB 2 AC

Characteristics and typical fields of application

Thermanit D - Marathon 104 is a wire/flux combination for submerged arc welding for joining and surfacing applications with matching/similar heat resistant steels and cast steel grades. Solid wire of S 22 12 H / ER309 (mod.) type.

Max. application temperature	Sulfur-free	Max. 2 g S/Nm^3	> 2 g S/Nm^3
Air and oxidizing combustion gases	950ºC	930ºC	850ºC
Reducing combustion gases	900ºC	850ºC	

Marathon 104 is an agglomerated fluoride-basic welding flux without Cr-support and neutral metallurgical behavior. For more information regarding this sub-arc welding flux, see the separate datasheet.

Base materials

1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12, 1.4833 X12CrNi23-13

AISI 305, ASTM A297 HF

Typical analysis of the weld metal

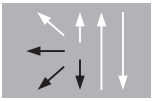
wt.-%	C	Si	Mn	Cr	Ni
wire	0.10	0.90	1.5	22.5	11.5
all-weld metal	0.10	1.0	1.2	22.2	11.5

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	(≥ 350)	(≥ 550)	(≥ 30)	(≥ 70)

u untreated, as-welded

Operating data



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

No preheating. Suggested heat input is max. 2.0 kJ/mm, interpass temperature max. 150ºC. Polarity: DC+

Annealing of heat resistant Cr-steels and cast steel grades not necessary if the service temperature is the same or higher.

Approvals

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SAW

BÖHLER E 308 H-FD

Flux-cored wire, high-alloyed, austenitic stainless, creep resistant

Classifications

EN ISO 17633-A
T Z19 9 H R M21 (C1) 3

AWS A5.22 / SFA-5.22
E308HT0-4(1)

Characteristics and typical fields of application

Rutile flux-cored wire of T Z 19 9 H R / E308HT0 type for welding of austenitic CrNi-steels such as 1.4948 / 304H for elevated service temperatures. The higher carbon content as compared to T 19 9 L R / E308LT1, provides improved creep resistance properties, which is advantageous at temperatures above 400ºC. Max. temperature according to the TÜV approval is 700ºC. The scaling temperature is approximately 850ºC in air. The corrosion resistance is corresponding to the base material 1.4301 / 304, i.e. good resistance to general corrosion. The enhanced carbon content, compared to 308L, makes it slightly more sensitive to intergranular corrosion. 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 controlled ferrite content of 3 – 8 FN (measured with FeritScope FMP30) offers good resistance to hot cracking and sigma phase embrittlement. The very low bismuth content of < 10 ppm results in excellent elongation and impact toughness also after service at elevated temperatures. For welding in vertical-up and overhead positions, BÖHLER E 308 H PW-FD should be preferred.

Base materials

1.4301 X5CrNi18-10, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4878 X8CrNiTi18-10, 1.4948 X7CrNi18-9

UNS S30400, S30409, S32100, S34700

AISI 304, 304H, 321, 321H, 347, 347H

Typical analysis of the wire

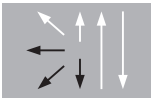
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.05	0.6	1.2	19.4	10.1	2 – 8

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	360 (≥ 350)	570 (≥ 550)	45 (≥ 30)	85 (≥ 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 – 250	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 heat input should not exceed 2.0 kJ/mm, the interpass temperature be limited to max. 150ºC and the 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 (11179), CE

BÖHLER E 308 H PW-FD

Flux-cored wire, high-alloyed, austenitic stainless, creep resistant

Classifications

EN ISO 17633-A
T Z19 9 H P M21 (C1) 1

AWS A5.22 / SFA-5.22
E308HT1-4(1)

Characteristics and typical fields of application

Rutile flux-cored wire of T Z 19 9 H P / E308HT1 type for welding of CrNi austenitic stainless steels such as 1.4948 / 304H for elevated service temperatures. The higher carbon content as compared to T 19 9 L P / E308LT1, provides improved creep resistance properties, which is advantageous at temperatures above 400ºC. Max. temperature according to the TÜV approval is 700ºC. The scaling temperature is approximately 850ºC in air. The corrosion resistance is corresponding to 1.4301 / 304, i.e. good resistance to general corrosion. The enhanced carbon content, compared to 308L, makes it slightly more sensitive to intergranular corrosion. 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 very low bismuth content of < 10 ppm results in excellent elongation and impact toughness also after service at elevated temperatures. The controlled ferrite content of 3 – 8 FN (measured with FeritScope FMP30) offers good resistance to hot cracking and sigma phase embrittlement. For flat and horizontal welding positions, BÖHLER E 308 H-FD may be preferred.

Base materials

1.4301 X5CrNi18-10, 1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4878 X8CrNiTi18-10, 1.4948 X7CrNi18-9

UNS S30400, S30409, S32100, S34700

AISI 304, 304H, 321, 321H, 347, 347H

Typical analysis of the wire

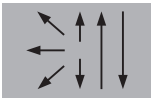
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.05	0.6	1.2	19.4	10.1	2 – 8

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	370 (≥ 350)	560 (≥ 550)	45 (≥ 30)	90 (≥ 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	150 – 230	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, the interpass temperature be limited to max. 150ºC and the 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 (11151), CE

BÖHLER E 309L H-FD

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

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 austenitic flux-cored wire of T 23 12 L R / E309LT0 type for welding of dissimilar joints of high-alloyed Cr and CrNi(Mo)-steels with unalloyed or low-alloyed steels in flat or horizontal position, as well as the first cladding layer on unalloyed and low-alloyed steels. Especially designed for welding in all positions with Ar + 15 – 25% CO_2 as shielding gas. 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 down to –60ºC. The bismuth-free weld deposit (Bi < 10 ppm) and controlled ferrite content of 12 – 18 FN (measured with FeritScope FMP30) meet the recommendations of API RP582 and AWS A5.22 for high temperature service or post-weld heat treatment. For welding in vertical-up and overhead positions, BÖHLER E 309 H 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 or mixed joints between austenitic and heat resistant steels with ferritic steels to pressure boiler steels and fine grained structural steels, ship building steels, etc.

Typical analysis of the wire

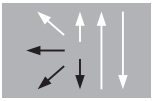
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.030	0.6	1.3	23.0	12.2	10 – 19

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	390 (≥ 350)	530 (≥ 520)	45 (≥ 30)	70 (≥ 47)	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
1.2	~ 3	130 – 250	22 – 30	5.0 – 15.0

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 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. 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

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BÖHLER E 309L H PW-FD

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

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 austenitic flux-cored wire of T 23 12 L P / E309LT1 type for welding of dissimilar joints of high-alloyed Cr and CrNi(Mo)-steels with unalloyed or low-alloyed steels, as well as the first cladding layer on unalloyed and low-alloyed steels. Especially designed for welding in all positions with Ar + 15 – 25% CO_2 as shielding gas. The fast freezing slag offers excellent weldability and slag control in all positions. Easy handling and high deposi-tion 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 down to –60ºC. The bismuth-free weld deposit (Bi < 10 ppm) and controlled ferrite content of 12 – 18 FN (measured with FeritScope FMP30) meet the recommendations of API RP582 and AWS A5.22 for high temperature service or post-weld heat treatment. For flat and horizontal welding positions, BÖHLER E 309L H-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 or mixed joints between austenitic and heat resistant steels with ferritic steels to pressure boiler steels and fine grained structural steels, ship building steels, etc.

Typical analysis of the wire

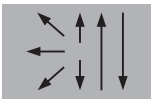
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.035	0.7	1.3	23.0	12.5	10 – 23

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	390 (≥ 350)	530 (≥ 520)	35 (≥ 30)	80 (≥ 47)	60 (≥ 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	150 – 230	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 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. 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

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BÖHLER E 347L H-FD

Flux-cored wire, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 17633-A
T 19 9 Nb R M21 (C1) 3

AWS A5.22 / SFA-5.22
E347T0-4(1)

Characteristics and typical fields of application

Rutile flux-cored wire of T 19 9 Nb R / E347T0 type for welding of creep resistant austenitic CrNi-steels such as 1.4912 / 347H suitable for service temperatures above 400ºC. Especially designed for welding in flat and horizontal position with Ar + 15 – 25% CO_2 as shielding gas. Application examples are heat exchangers, hot separators, hydrocracking and hydrodesulphurization in refineries. The corrosion resistance is corresponding to the base material 1.4301 / 304, i.e. good resistance to general corrosion. 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 bismuth-free weld deposit (Bi < 10 ppm) and controlled ferrite content of 5 – 9 FN (measured with FeritScope FMP30) meet the recommendations of API RP582 and AWS A5.22 for high temperature service or post-weld heat treatment. For welding in vertical-up and overhead positions, BÖHLER E 347 H PW-FD should be preferred.

Base materials

1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4878 X8CrNiTi18-10, 1.4912 X7CrNiNb18-10, 1.4940 X7CrNiTi18-10

UNS S32100, S32109, S34700, S34709

AISI 321, 321H, 347, 347H

Typical analysis of the wire

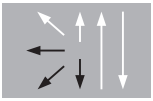
	C	Si	Mn	Cr	Ni	Nb	FN
wt.-%	0.030	0.6	1.3	18.5	10.5	0.45	2 – 7

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	–120°C	–196°C
u	420 (≥ 350)	580 (≥ 550)	35 (≥ 30)	90 (≥ 32)	50 (≥ 32)	37

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 – 250	22 – 30	5.0 – 15.0

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, the interpass temperature be limited to max. 150ºC and the wire stick-out 15 – 20 mm.

Approvals

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FCW

BÖHLER E 347 H PW-FD

Flux-cored wire, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 17633-A
T 19 9 Nb P M21 (C1) 1

AWS A5.22 / SFA-5.22
E347HT1-4(1)

Characteristics and typical fields of application

Rutile flux-cored wire of T 19 9 Nb P / E347HT1 type for welding of creep resistant austenitic CrNi-steels such as 1.4912 / 347H suitable for service temperatures above 400ºC. Especially designed for welding in all positions with Ar + 15 – 25% CO_2 as shielding gas. Application examples are heat exchangers, hot separators, hydrocracking and hydrodesulphurization in refineries. 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 bismuth-free weld deposit (Bi < 10 ppm) and controlled ferrite content of 4 – 8 FN (measured with FeritScope FMP30) meet the recommendations of API RP582 and AWS A5.22 for high temperature service or post-weld heat treatment. Also fulfils AWS A5.22 E347T1-4(1). For flat and horizontal welding positions, BÖHLER E 347L H-FD may be preferred.

Base materials

1.4541 X6CrNiTi18-10, 1.4550 X6CrNiNb18-10, 1.4878 X8CrNiTi18-10, 1.4912 X7CrNiNb18-10, 1.4940 X7CrNiTi18-10

UNS S32100, S32109, S34700, S34709

AISI 321, 321H, 347, 347H

Typical analysis of the wire

	C	Si	Mn	Cr	Ni	Nb	FN
wt.-%	0.045	0.6	1.3	18.5	10.5	0.45	2 – 7

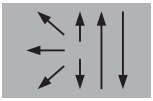
Mechanical properties of all-weld metal - typical values (min. values)

Condition	Yield strength $R_{p0.2}$	Tensile strength R_m	Elongation A (L_0=5d_0)	Impact values ISO-V KV J		
	MPa	MPa	%	20°C	–120°C	–196°C
u	370 (≥ 350)	560 (≥ 550)	45 (≥ 30)	95 (≥ 32)	55 (≥ 32)	38
a	375	570	44	90	35	28

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

a post-weld heat treatment at 600°C for 36 h – 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

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, the interpass temperature be limited to max. 150ºC and the wire stick-out 15 – 20 mm.

Approvals

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BÖHLER FF-MC

Metal-cored wire, high-alloyed, austenitic stainless, heat resistant

Classifications

EN ISO 17633-A
T 22 12 H M M13 1

AWS A5.22 / SFA-5.22
EC308H (mod.)

Characteristics and typical fields of application

Austenitic metal-cored wire of T 22 12 H / EC309H type for joint welding of heat resistant austenitic stainless steels such as 1.4828 and 1.4833. The main application area is robotic welding of exhaust systems in the automotive industry. The weld deposit is more stable to hot cracking than when using solid wire and resistant to scaling up to 1000ºC. Easy handling and high deposition rate result in high productivity with excellent welding performance. The wire shows good wetting behavior and results in a smooth surface with minimum spatter formation. 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.

Base materials

Stainless austenitic heat resisting steels such as

1.4826 GX40CrNiSi22-10, 1.4828 X15CrNiSi20-12 and 1.4833 X12CrNi23-13

Stainless ferritic high temperature steels such as

1.4713 X10CrAlSi7, 1.4724 X10CrAlSi13, 1.4742 X10CrAlSi18, 1.4710 GX30CrSi7, 1.4740 GX40CrSi17

AISI 305, ASTM A297HF

Typical analysis of the wire

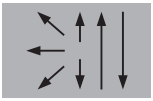
	C	Si	Mn	Cr	Ni	FN
wt.-%	0.07	0.6	0.6	20.2	10.6	5 – 9

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 (≥ 350)	560 (≥ 550)	43 (≥ 25)	74

u untreated, as-welded – shielding gas Ar + 2% O_2

Operating data



Dimension mm	Arc length mm	Current A	Voltage V	Wire feed m/min
1.2	Max. 3	140 – 280	15 – 26	4.0 – 12.0

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 + 1 – 2 % O_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. Then 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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