böhlerwelding
by voestalpine

Arc Welding Consumables

voestalpine Böhler Welding Middle East FZE
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

voestalpine Böhler Welding

We are a leading manufacturer and worldwide supplier of filler metals for industrial welding and brazing applications. With more than 100 years of experience, our company has decisively influenced the development of welding technology, setting the benchmark with innovative solutions. This solidity is also reflected in the confidence of our employees who, as co-owners of the enterprise, hold a substantial portion of the shares.

As a part of voestalpine, Austria's largest steel manufacturer and one of the world's leading suppliers of specialized steel products, we belong to a global network of metallurgy experts.

Our customers benefit from:

- Comprehensive welding and steel know-how under one roof
- Coordinated complete solutions for steel and welding filler metals
- A partner offering maximum economic stability and technological expertise

Three specialized and dedicated brands

böhlerwelding by voestalpine

Böhler Welding – More than 2,000 products for joint welding in all conventional arc welding processes are united in a product portfolio that is unique throughout the world.

utp maintenance by voestalpine

UTP Maintenance – Decades of industry experience and application know-how in the areas of repair and surface protection, combined with innovative and custom-tailored products.

fontargen brazing by voestalpine

Fontargen Brazing – The best brazing and soldering solutions based on proven products with German technology.

voestalpine Böhler Welding Middle East FZE

is a fully owned subsidiary of voestalpine Böhler Welding GmbH for the Middle East, with a history of more than 30 years in providing welding solutions to a great variety of industries in the region. We have our headquarters in Dubai and a network of distributors across the region. On a daily basis, our experienced engineers and application technologists support customers in important industrial segments such as oil & gas upstream, petrochemical and chemical processing, pipeline fabrication and maintenance & repair. We have a well-equipped demo centre available to support our customers with tests and training.

Demanding industries

voestalpine Böhler Welding is a strategic supplier of filler metals to demanding industries, serving them with best-in-class products and valuable application support. We have specialists for all target segments who understand your specific challenges and give support in finding optimum welding solutions.

Oil and gas

Our products can be found in every field of oil and gas production and processing. For the oil & gas upstream segment, we supply a complete range of filler materials for all applied welding processes covering the various strength levels, most of which are low-hydrogen falling in AWS class H4. Part of these is our vast range of seamless cored wires which offer the best possible protection against hydrogen induced or hydrogen assisted cracking. Relevant to both oil & gas upstream and downstream is our complete range of 1 % Ni-alloyed welding consumables with all-weld metal Ni-content kept below 1 % to ensure conformance with the NACE MR0175 requirement for SSC safe service in sour environments. In addition, our program features a vast range of filler metals all grades of duplex stainless steel and for Ni-base alloys, including CRA cladding solutions.

LNG

voestalpine Böhler Welding has been involved in the LNG industry from the very beginning with advanced products and welding procedures for the safe and efficient construction of typical LNG transport, storage and handling installations, such as:

- LNG carriers, tanker trucks and rail tank cars
- Regasification terminals and large cryogenic storage tanks
- Liquefaction trains and short LNG pipelines

Our range of LNG welding consumables covers all main arc welding processes and construction materials commonly used in the fabrication of LNG installations, such as non-alloyed CMn steel, 5 - 9% Ni low-temperature steel, austenitic stainless steel, dissimilar joints, nickel-base alloys and aluminium.

Pipeline construction

Material specifications play a crucial role in the success and integrity of on and offshore pipeline construction, especially in low-temperature and sour service applications. voestalpine Böhler Welding offers a full range of cellulosic, and basic vertical-down and vertical-up electrodes, as well as solid, flux and metal-cored wires for semi-automatic and fully mechanized welding, self-shielded flux-cored wires and submerged arc wires and fluxes for steel grades up to X100. Consumables for martensitic, austenitic, duplex and corrosion resistant alloys (CRA) are readily available. NACE and CTOD tests have been carried out with a wide range of our products. We cooperate with major pipeline constructors – both on and offshore – and supply dedicated consumables for their specific welding systems.

Quality & HSEE

Throughout our global organization, voestalpine Böhler Welding fully commits to the philosophies of quality, health & safety and environmental & energy management systems. Our Global Quality & HSEE function ensures the implementation and maintenance of a multi-site management system comprising ISO 9001, ISO 14001 and ISO 45001. In addition, voestalpine Böhler Welding is committed to implement ISO 50001 standards for all European manufacturing plants.

Content

The new Böhler welding DRY SYSTEM for stick electrodes: safe, easy and recyclable

Oven dry electrodes without re-drying

DRY SYSTEM Features	User Benefits
Oven dry electrodes upon opening the vacuum pack and up to nine hours thereafter	■ Guarantee of low-hydrogen weld metal – an important prerequisite in the prevention of hydrogen cracks
Strong vacuum packs that fully resist moisture reabsorption	■ Avoidance of costly climate controlled storage and handling and re-drying. Simple distribution to welders
Label for documenting date and time of opening	■ Possibility to check whether electrodes are within 9 hours of safe exposure
Several filling contents available	■ Content can be chosen to match fabricator or industry specific consumption. Fewer electrodes remaining to be re-dried or scrapped
Fully recyclable materials	■ Can be disposed with normal paper and metal waste

The Böhler Welding DRY SYSTEM ensures for the relevant basic covered non-alloy and low-alloy electrodes a diffusible hydrogen content of <5 ml/100 g weld metal according to EN ISO 3690 or <4 ml/100 g according to AWS A4.3-93 within a processing time of 9 hours after opening of the pack, provided the foil remains in place.

Maximize efficiency by reducing the number of handling steps

Conventional packaging (non vacuum)

1. Climate controlled storage in central stock
2. Re-drying as safety procedure
3. Climate controlled intermediate storage on site
4. Climate controlled storage in quivers before use
5. Welding
6. Re-drying or scrapping of remaining electrodes

With DRY SYSTEM

1. Storage in any dry place where packaging cannot get damaged
2. Welding
3. Re-drying or scrapping of remaining electrodes

Joining

Covered electrodes, unalloyed

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
BOHLER FOX S EV 50 AWS A 5.1: E7018 H4R EN ISO 2560-A: E42 3 B 32 H5	C: 0.08 Si: 0.5 Mn: 1.4	R_e: 490 MPa R_m: 560 MPa A: 30 % CVN impact: -45 °C: >120 J	2.5x350 3.2x350 4.0x450 5.0x450	ABS, BKI, DNV, LR, TOYO, HPCL	Basic covered electrode with excellent strength and toughness down to -45 °C. Metal recovery approx. 115 %. Diffusible hydrogen level H4. Crack free weld metal when welding high carbon steels.
BOHLER FOX S EV 50-1 AWS A 5.1: E7018-1H4R EN ISO 2560-A: E42 5 B 4 2 H5	C: 0.07 Si: 0.5 Mn: 1.4	R_e: 490 MPa R_m: 560 MPa A: 27 % CVN impact: -50°C: >100 J PWHT: 600 °C / 2 hrs R_e: 430 MPa R_m: 520 MPa A: 29 % CVN impact: -50°C: >140 J	2.5x350 3.2x350 4.0x450 5.0x450	ABS, BKI, DNV, LR, TOYO, HPCL	Basic covered electrode with excellent strength and toughness properties down to -50°C. Metal recovery approx. 110%. Diffusible hydrogen level H4. CTOD tested at -10°C. It can be used in sour gas applications (HIC-Test acc. NACE TM-02-84). Meeting AWS mechanical properties after extended PWHT of 12 hours.
BÖHLER FOX AWS E7018-1 AWS A5.1: E7018-1H4	C 0.07 Si 0.5 Mn 1.1	R_e: 470 MPa R_m: 540 MPa CVN impact: -50°C: 80 J	2.0x250 2.5x300 3.2x350 4.0x450 5.0x450 6.0x450	TÜV, ABS, DNV GL, BV, CWB	Basic covered electrode engineered for high-quality welds. Excellent strength and toughness properties. Also suitable for welding steels with low purity and high carbon content. Metal recovery >110 %. Good weldability in out-of-position work except for vertical-down. Suitable for welding in steel construction, boiler and container fabrication, vehicle construction, shipbuilding, and machine construction, as well as for buffer layers when building up on high carbon steels.
BOHLER FOX S EV Pipe-1 AWS A5.1: E7016-1H4R EN ISO 2560-A: E 42 4 B 12 H5	C: 0.06 Si: 0.6 Mn: 0.9	R_e: 510 MPa R_m: 580 MPa A: 30 % CVN impact: +20 °C: 170 J -46 °C: 45 J	2.5x350 3.25x350 4.0x450	ABS	BÖHLER FOX S EV PIPE-1 is a basic electrode with some additions of rutile and silicates. It is very suited for positional welding of root passes using DC negative polarity as well as for filler and cover passes of pipes, tubes and plates on DC positive polarity, or even AC. It is user friendly and provides a good gap bridging ability together with easy slag removal to ensure minimum grinding. Weld metal toughness is available down to -46 °C. Very low hydrogen content (HD <4ml / 100 g weld metal as per AWS). BÖHLER FOX S EV PIPE-1 offers considerable time savings against AWS E 7018 type electrodes when welding root passes due to increased travel speeds. Also the use of dia. 3.25 mm is possible for root passes in case of wall thicknesses of 8 mm and more.
BOHLER FOX N 6013 AWS A5.1: E 6013 IS 814: ER 4211	C: 0.06 Si: 0.3 Mn: 0.45 P: 0.02	R_e: 440 MPa R_m: 520 MPa A: 25 % CVN impact: +20 °C: 55 J Hardness: <180 BHN	2.5x350 3.15x350 4.0x450 5.0x450	IBR, LRS (applied for)	Excellent weldability in all position thus ease of manipulation & high welder appeal. Well suited for welding rusty & primered plates thus good penetration & no surface preparation required. Excellent re-striking and arc stability characteristics and usable on low OCV transformers (OCV~45) Good fluidity & excellent passage through joints thus helps easy & controlled flow of weld metal including bad fit-up joints & tank welding. Typical applications are tanks, ships, trawlers, dredgers, machinery construction, bridges & sheet metal works.

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
BÖHLER FOX OHV AWS A5.1: E6013 EN ISO 2560-A: E38 0 RC 1 1	C: 0.06 Si: 0.4 Mn: 0.45	R_e: 460 MPa (≥380) R_m: 490 MPa (470 – 600) A: 25 % (≥20) CVN impact: +20 °C: 75 J(≥47) +/-0 °C: 60 J(≥47) -10 °C: 47 J	2.0x250 2.5x250/350 3.2x350 4.0x350/450 5.0x450	TÜV, DB ABS, DNV, LR, LTSS, SEPROZ, CE	Rutile-cellulosic coated electrode with good weld ability in all positions including vertical-down. Most popular E 6013 type. For small welding machines, very good operating characteristics, flexible coating, good for tack welding. Versatile applications in structural welding, vehicle construction, boiler and tank welding, and in shipbuilding, also suitable for galvanised components.
BÖHLER FOX CEL AWS A5.1: E6010 EN ISO 2560-A: E 38 3 C 2 1	C: 0.12 Si: 0.14 Mn: 0.5	R_e: 450 MPa R_m: 550 MPa A: 26 % CVN impact: +20 °C: 100 J -30 °C: ≥47 J	2.5x250/300 3.2x350 4.0x350 5.0x350	TÜV, DNV GL, SEPROZ, CE, NAKS	Cellulose electrode for vertical-down welding of large diameter pipelines; suitable for root runs (vertical down and vertical up), hot passes, filler and cover layers. Especially recommended for root run welding. Highly economical compared with vertical-up welding. Apart from its excellent welding and gap bridging characteristics FOX CEL offers a weld deposit with outstanding impact strength values and thus offers the benefit of still more safety in field welding of pipelines. BÖHLER FOX CEL can be used in sour gas applications (HIC-Test acc. NACE TM-02-84). Test values for SSC-test are available too.
BÖHLER FOX CEL + AWS A5.1: E6010 EN ISO 2560-A: E 38 2 C 2 1	C: 0.17 Si: 0.15 Mn: 0.6	R_e: 450 MPa R_m: 520 MPa A: 26 % CVN impact: +20 °C: 105 J -20 °C: 65 J (≥47)	2.5x300 3.2x350 4.0x350	–	Cellulose electrode for vertical-down welding of large diameter pipelines. Especially recommended for root pass welding on D.C. positive polarity in the vertical-down and vertical-up welding positions. Apart from its good welding and gap bridging characteristics, BÖHLER FOX CEL+ provides a powerful arc that deposites well penetrated, smooth root passes with high travel speeds as well as high safety against the formation of piping or hollow bead and undercut. BÖHLER FOX CEL+ can be used in sour gas applications (HIC-Test acc. to NACE TM-02-84). Test values for SSC-test are available too.
BÖHLER FOX CEL 70-P AWS A5.5: E7010-P1 EN ISO 2560-A: E 42 3 C 25	C: 0.15 Si: 0.1 Mn: 0.45 Ni: 0.17	R_e: 460 MPa R_m: 550 MPa A: 23 % CVN impact: 23 (≥22) +20 °C: 100 J -30 °C: 65 J (≥47)	3.2x350 4.0x350 5.0x350	–	Cellulose electrode for vertical-down welding of high strength large diameter pipelines. Especially recommended for hot passes, filler and cover layers. Highly economical compared with conventional vertical-up welding. BÖHLER FOX CEL 70-P provides an intense arc and a fluid weld metal. It can be used in sour gas applications (HIC-Test acc. to NACE TM-02-84). Test values are SSC-test are available too.
BÖHLER FOX CEL 80-P AWS A5.5: E8010-P1 EN ISO 2560-A: E 46 3 1Ni C 2 5	C: 0.15 Si: 0.15 Mn: 0.7 Ni: 0.8	R_e: 490 MPa R_m: 580 MPa A: 23 % CVN impact: +20 °C: 90 J -30 °C: 60 J (≥47)	3.2x350 4.0x350 5.0x350	TÜV, CE	High-strength cellulosic covered electrode for vertical-down welding of large pipelines. BÖHLER FOX CEL 80-P provides an intense arc and a fluid weld metal. BÖHLER FOX CEL 80-P can also be used in sour gas applications (HIC-Test acc. to NACE TM-02-84). Test values for SSC-test are available too.
BÖHLER FOX CEL 90 AWS A5.5: E9010-P1 / E9010-G EN ISO 2560-A: E 50 3 1Ni C 2 5	C: 0.17 Si: 0.15 Mn: 0.9 Ni: 0.8	R_e: 580 MPa R_m: 650 MPa A: 21 % CVN impact: +20 °C: 100 J -30 °C: 65 J (≥47)	4.0x350 5.0x350	TÜV, SEPROZ, CE	High-strength cellulosic covered electrode for vertical down welding of large pipelines, especially X70 and X80 steels. Especially recommended for hot passes, filler and cover layers. BÖHLER FOX CEL 90 can be used in sour gas applications (HIC-Test acc. to NACE TM-02-84). Test values for SSC-test are available too.

Grades with higher strength are available on request

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
BÖHLER FOX BVD 85 AWS A5.5: E8045-P2 / E8018-G EN ISO 2560-A: E 46 5 1Ni B 4 5	C: 0.05 Si: 0.4 Mn: 1.1 Ni: 0.9	R_e: 510 MPa R_m: 560 MPa A: 27 % CVN impact: +20 °C: 170 J -50 °C: 65 J (≥47)	3.2 x 350 4.0 x 350 4.5 x 350	TÜV, SEPROZ, CE	Basic electrodes for vertical-down welds of large diameter pipelines and for structural work. Suitable for filler and cover pass welding in pipeline construction. Deposit is extremely crack resistant, and features high toughness and a very low hydrogen content. Deposition rate is 80 – 100 % higher than for vertical up welding. The weld deposit of BÖHLER FOX BVD 85 shows an ideal combination between high strength and cryogenic toughness down to -50 °C. Special design and development work has enabled this electrode to provide exceptional striking characteristics and the avoidance of start porosity on cover (cap) passes. Due to this and the good welding characteristics this special basic electrode offers easy handling even under field conditions. BÖHLER Fox BVD 85 can be used in sour gas applications (HIC-Test acc. to NACE TM-02-84). Test values for SSC-test are available too.

Flux and metal-cored wires, unalloyed

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
BOHLER Ti 71-T1C AWS A5.20: E71T-1C-DH8 AWS A5.36: E 71T1-C1A2-CS1-H8	C: ≤0.12 Si: ≤0.90 Mn: ≤1.75	Shielding gas: CO_2 R_e: ≥400 MPa R_m: 490-660 MPa A: ≥22 % CVN impact: -20 °C: ≥27 J	1.2 1.6	ABS, DNV, LR	BOHLER Ti 71-T1C is a rutile flux cored wire with fast freezing slag. Excellent welding characteristics in all positions. Very good mechanical properties, easy slag removability, low spatter level, smooth and well shaped beads with X-ray-quality. Applicable in out-of-position welding, with higher productivity and less time needed for postweld cleaning. Suitable for butt and fillet welding of hulls, storage tanks, mechanical and constructional steel structures and bridges. This wire is designed to deliver extremely consistent mechanical properties that meet the D1.8 seismic requirements.
BOHLER Ti 71-T1M AWS A5.36: E71T1-M21A0-CS1 EN ISO 17632-A: T42 2 P M 1 H10	C: ≤0.12 Si: ≤0.9 Mn: ≤1.75 P: ≤0.03 S: ≤0.03	Shielding gas: Ar + 15 – 25 % CO_2 R_e: ≥390 MPa R_m: 490 - 670 MPa A: 22 % CVN impact: -20 °C: >27 J	1.2 1.6	BV	BÖHLER Ti 71-T1M is a rutile flux cored wire with fast freezing slag. Excellent welding characteristics in all positions. Very good mechanical properties, easy slag removability, low spatter level, smooth and well shaped beads with X-ray quality. Applicable in out-of-position welding, with higher productivity and less time needed for postweld cleaning. Suitable for butt and fillet welding of hulls, storage tanks, mechanical and constructional steel structures and bridges.
BOHLER Ti 71-T9C AWS A5.20: E71T-9C-J AWS A5.36: E71T1-C1A4-CS1	C: <0.12 Mn: <1.75 Ni: <0.50	Shielding gas: CO_2 R_e: 420 MPa R_m: 490 - 670 MPa A: 22 % CVN impact: -40 °C: >100 J	1.2 1.6	–	BOHLER Ti 71-T9C is a rutile flux cored wire and designed for all-position welding with excellent CVN impact proerties in as weldeded condition at -40 °C. Excellent welding characteristics in all positions. Very good mechanical properties, easy slag removability, low spatter level, smooth and good weld beads with X-ray-quality. Applicable in ou-tof- position welding, with higher productivity and less time for postweld cleaning. Applicable for Single pass & multi passes weld. Suitable for Butt, fillet welding of 490 MPa class high strength steel and low temperature steel of structure such as ships, bridges, buildings and storage tanks etc.

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
BÖHLER Ti 46-FD AWS A5.36: E71T1-M21A0-CS1-H8 E71T1-C1A0-CS1-H4 EN ISO 17632-A: T 46 2 P M 1 H10 T 42 2 P C 1 H5	C: 0.05 Si: 0.5 Mn: 1.2 Ti: +	Shielding gas: Ar + 15 – 25 % CO_2 R_e: 500 MPa R_m: 580 MPa A: 26 % CVN impact: +20 °C: 160 J -20 °C: 90 J (≥ 47)	1.2	TÜV, DB, ABS, LR, DNV GL, BV, RINA, CE	All position rutile flux-cored wire with fast freezing slag system. User friendly welding characteristics in all positions with one parameter setting. Excellent mechanical properties, easy slag removal, low spatter loss, smooth, finely rippled bead surface, high X-ray safety. The product performs at the highest productivity level with significant time savings in positional welding.
BÖHLER Pipeshield 71 T8-FD AWS A5.36: E71T8-A4-K6 AWS A5.36M: E491T8-A4-K6	C: 0.045 Si: 0.14 Mn: 1.1 Al: 0.8 Ni: 0.7	R_e: 435 MPa R_m: 535 MPa A: 28 % CVN impact: +20 °C: 200 J -30 °C: 150 J -40 °C: 100 J	2.0	NAKS, GAZPROM	BÖHLER Pipeshield 71 T8-FD self-shielded flux cored wire, especially developed and recommended for pipe welding in vertical down (5G) position. It is also suitable for welding of unalloyed steel constructions. This wire offers a fast freezing, easy removable slag, excellent welding characteristics, is easy to operate for the welders and this product provides high productivity. BÖHLER Pipeshield 71 T8-FD is designed to provide good mechanical properties as well as high impact toughness at low temperatures. Basically outstanding benefits and advantages in vertical down position for (hot pass), fill and cap layers. Due to the fluoride-basic filling the interpass temperature can be arranged similar to that of basic electrodes, we recommend 80 – 200 °C. BÖHLER self-shielded flux cored wire provide an easy handling for the welder due to a very tolerant stick out length and loss tendency to porosity also when welding with a longer arc length as a result of higher voltage.
BÖHLER HL 46-MC AWS A5.36: E70T15-M21A0-CS1-H4 EN ISO 17632-A: T 46 2 M M 1 H5	C: 0.07 Si: 0.7 Mn: 1.5	Shielding gas: Ar + 15 – 25 % CO_2 R_e: 490 MPa (≥ 460) R_m: 590 MPa (550 – 740) A: 25 % (≥ 20) CVN impact: +20 °C: 110 J -20 °C: 50 J (≥ 47)	1.2 1.4 1.6	TÜV, DB, DNV GL, LR, BV, ABS, CE	Metal-cored high-efficiency wire for semi-automatic and fully automatic joint welding of unalloyed and fine-grained constructional steels and service temperatures from -20 °C to +450 °C. Very high metal recovery between 93 and 97 % and deposition rate up to 9 kg/hr. Steady spray arc-like droplet transfer with minimal spatter formation. Good penetration, high resistance to porosity, good wetting behaviour as well as low hydrogen contents (≤ 5 ml/100 g deposit) are further quality features of this flux cored wire. Ideal for horizontal and flat fillet welds. Compared to solid wires 20 % higher productivity can be achieved. This wire is designed for minimum oxide residues permit the welding of multi passes without the need for inter-run cleaning.
BÖHLER HL 51-FD AWS A5.18: E70C-6MH4	C: 0.07 Si: 0.7 Mn: 1.5	Shielding gas: Ar + 15 – 25 % CO_2 R_e: 490 MPa (≥ 460) R_m: 610 MPa (550 – 740) A: 27 % (≥ 20) CVN impact: +20 °C: 130 J -40 °C: 90 J	1.2 1.4 1.6	TÜV, DB, ABS, BV, DNV GL, LR, CE	Metal-cored high-efficiency wire for semi-automatic and fully automatic joint welding of unalloyed and fine-grained constructional steels and service temperatures from –40 °C to +450 °C. Very high metal recovery between 93 and 97 % and deposition rate up to 9 kg/hr. Steady spray arc-like droplet transfer with minimal spatter formation. Good penetration, high resistance to porosity, good wetting behaviour as well as low hydrogen contents (< 5 ml/100 g deposit) are further quality features of this metal cored wire. Minimum oxide residues permit the welding of multi passes without the need for inter-run cleaning. Ideal for horizontal and flat fillet welds. Compared to solid wires 20 % higher productivity can be achieved. This wire is especially suitable for automated and robotic applications and for root pass welding for piping and butt-joints. This wire is CTOD-tested.

Böhler seamless cored wires: convincing advantages that speak for themselves

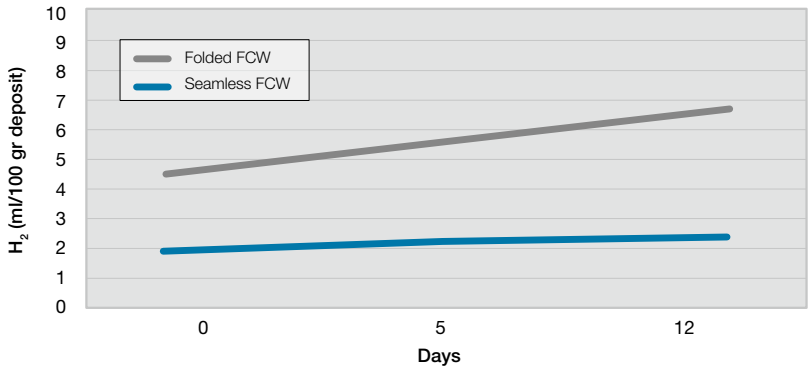
Optimal protection against hydrogen induced cracking

Within the field of flux-cored arc welding, the seamless design offers optimal protection against moisture reabsorption and thereby against hydrogen induced cracking / hydrogen assisted cracking (HIC, HAC, cold cracking). Because of the seamless design, moisture cannot penetrate into the filling, during storage and use of the wires. For all types, the initial hydrogen level is guaranteed to be in AWS hydrogen class H4 (typically 1-3 ml / 100 g weld metal). And they maintain this property until the moment of welding, regardless duration of storage and time of exposure at the work site. With Böhler seamless cored wires, you will always enjoy the best protection you can possibly get.

Superior welding productivity

Superior welding productivity is one of the unique features to be obtained with well-designed flux formulations. Böhler rutile cored wires with fast freezing slag, for instance, provide deposition rates in positional welding up to three times as high as obtainable with any other manual arc welding process. In the downhand position, Böhler metal-cored wires are a fast way to join steel plate. Arc stabilizers enable favorable spray arc welding from relatively low current levels, currents with associated superior productivity.

H_{DM}: Rutile folded FCW versus rutile seamless FCW



Welding Conditions: 25 V – 250 A – Stick-out: 17 mm – Gas: M21
Diffusible hydrogen content determined according to AWS A4.3-93, using the chromatography method.

Excellent weldability and weld quality

Ingredients in the core make sure that Böhler seamless cored wires have optimized weldability. They feature low spatter, deep weld penetration and smooth tie-in, making it easier to avoid weld defects such as insufficient penetration and lack of fusion.

Problem-free feeding

Whether you weld manually close to the power source or robotic with long liners – problem-free wire feeding is what you will get. The seamless, copper-coated wire design adds sufficient stiffness and glide to overcome friction in liners, welding guns and contact tips, while the copper-coating enhances current transfer between contact tip and wire resulting in a stable arc.

Seamless flux and metal-cored wires, unalloyed

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
BÖHLER Ti 52 T-FD AWS A5.36: E71T1-M21A4-CS1-DH4 E71T1-C1A2-CS1-DH4 EN ISO 17632-A: T 46 4 P M 1 H5 T46 2 P C 1 H5	C: 0.06 Si: 0.40 Mn: 1.45	Shielding gas: Ar + 15 – 25 % CO_2 R_e: 500 MPa (≥460) R_m: 570 MPa (550 – 660) A: 26 % (≥20) CVN impact: -20 °C: 130 J (≥47) -40 °C: 70 J (≥47)	1.0 1.2 1.4 1.6	TÜV, DB, DNV GL, ABS, LR, BV, RINA, RS, CE, D1.8 Seismic Supplement	Seamless rutile flux cored wire for single- or multilayer welding of carbon, carbon-manganese steels and similar types of steels including fine grain steels with Argon-CO_2 shielding gas or pure CO_2. D1.8 Seismic Supplement approved. Typical hydrogen value 2.5 – 3.5 ml/100 g weld metal.
BÖHLER Ti 52 T-FD (CO_2) AWS A5.36: E71T1-C1A2-CS1-H4 EN ISO 17632-A: T46 3 P C 1 H5	C: 0.065 Si: 0.45 Mn: 1.3	Shielding gas: C1 R_e: 520 MPa (≥460) R_m: 580 MPa (550 – 660) A: 25 % (≥20) CVN impact: +20 °C: 100 J -20 °C: 95 J -30 °C: 70 J (≥47)	1.0 1.2 1.4 1.6	TÜV, DB, DNV GL, ABS, LR, BV, RINA, RS, CE	Seamless rutile flux cored wire for single- or multilayer welding of Carbon, Carbon-Manganese steels and similar types of steels including fine grain steels with pure CO_2 shielding gas. Main features: excellent weldability in all positions especially vertical upward position, also with high parameters (300 A), very low spatter losses, fast freezing, easy to remove slag and smooth and bright bead. This wire is especially suitable for ship building where excellent performance and welding speed are needed.
BÖHLER Ti 52 T-FD SR (CO_2) AWS A5.36: E71T12-C1AP4-CS2-H4 EN ISO 17632-A: T42 4 P C 1 H5	C: 0.04 Si: 0.40 Mn: 1.3 Ni: 0.40	Shielding gas: CO_2 R_e: 500 MPa (≥420) R_m: 570 MPa (500 – 640) A: 24 % (≥20) CVN impact: -20 °C: 110 J -40 °C: 100 J (≥47) -60 °C: 60 J	1.0 1.2 1.4 1.6	ABS, DNV GL, BV, LR, CE	Seamless rutile flux cored wire for single- or multilayer welding of Carbon, Carbon-Manganese steels and similar types of steels including fine grain steels with pure CO_2 shielding gas. Main features: excellent weldability in all positions, good wetting beads, no spatter, fast freezing, easy to remove slag, smooth and bright bead and excellent toughness at low temperatures in as welded conditions and after post weld heat treatments. This wire is especially suitable for ship building, storage vessels, structure, bridge construction, earthmoving equipment and piping. The seamless technology guarantees extreme and constant low diffusible hydrogen in all situations of humidity and enviromental temperature.
BÖHLER HL 51 T-MC AWS A5.36: E70T15-M21A8-CS1-H4 E70T15-C1A6-CS1-H4 EN ISO 17632-A: T46 6 M M 1 H5 T42 5 M C 1 H5	M21 C: 0.06 Si: 0.80 Mn: 1.6 C1 C: 0.05 Si: 0.60 Mn: 1.50	Shielding gas: M21 R_e: 500 MPa (≥460) R_m: 600 MPa (550 – 660) A: 29 % (≥20) CVN impact: -40 °C: 90 J -60 °C: 60 J (≥47) Shielding gas: C1 R_e: 460 MPa (≥420) R_m: 560 MPa (500 – 640) A: 30 % (≥20) CVN impact: -40 °C: 80 J -50 °C: 60 J (≥47)	1.0 1.2 1.4 1.6	TÜV, DB, DNV GL, ABS, LR, BV, RINA, CWB, CE	Seamless metal cored wire for single- or multilayer welding of carbon, carbon-manganese and similar types of steels, including fine grain steels with Argon-CO_2 or pure CO_2 shielding gas. Features include: high yield strength, good weldability, excellent bead appearance, very low spatter losses and exceptional mechanical properties at low temperatures (-60 °C) in as welded conditions as well with post weld heat treatment. This wire is especially suitable for automated-robotized applications and for root pass welding for piping and butt-joints. This wire is CTOD-tested.

Solid GMAW wire, unalloyed

Product Name Classification AWS Classification EN	Chemical composition wire (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
BÖHLER SG 2 AWS A5.18: ER70S-6 EN ISO 14341-A: G 42 3 M21 3Si1 / G 42 3 C1 3Si1	C: 0.07 Si: 0.85 Mn: 1.5	Shielding gas: M21 R_e: ≥ 420 MPa R_m: 500-640 MPa A: ≥ 20 % CVN impact: -30 °C: ≥ 47 J Shielding gas: CO_2 R_e: ≥ 420 MPa R_m: 500-640 MPa A: ≥ 20 % CVN impact: -30 °C: ≥ 47 J	0.8 1.0 1.2 1.6	TÜV, DB, CE	GMAW solid wire electrode for for universal application in boiler and vessel fabrication and in structural steel engineering. Largely spatter-free metal transfer both when using gas mixtures and carbon dioxide. Thanks to its high current carrying capacity this filler metal is also optimally suited for welding thick-walled sheet and plate structures.
BÖHLER EMK 6 AWS A5.18: ER70S-6 EN ISO 14341-A: G 42 4 M21 3Si1 / G 42 4 C1 3Si1	C: 0.08 Si: 0.9 Mn: 1.45	Shielding gas: M21 R_e: 440 MPa R_m: 560 MPa A: 30 % CVN impact: +20 °C: 160 J -40 °C: 80 J (≥ 47)	0.8 1.0 1.2 1.6	TÜV, DB, ABS, DNV GL, LR, CE	Copper-coated solid wire with universal application in storage tanks, and for boiler and structural work. Practically spatter-free metal transfer using either gas mixtures or CO_2.
BÖHLER EMK 8 D AWS A5.18: ER70S-6 EN ISO 14341-A: G 46 4 M21 4Si1 / G 46 2 C1 4Si1	C: 0.1 Si: 1.0 Mn: 1.7	Shielding gas: M21 R_e: 480 MPa (≥ 460) R_m: 610 MPa (530-680) A: 26 % (≥ 20) CVN impact: +20 °C: 150 J -40 °C: 50 J (≥ 47) Shielding gas: CO_2 R_e: 470 MPa (≥ 460) R_m: 580 MPa (530 – 680) A: 27 % (≥ 20) CVN impact: +20 °C: 110 J -20 °C: 60 J (≥ 47)	0.8 1.0 1.2 1.6	TÜV, DB, GL, CE	Copper-coated solid wire suited for universal application in boiler and vessel fabrication and in structural steel engineering. Largely spatter-free metal transfer both when using gas mixtures and carbon dioxide. Thanks to its high current carrying capacity this filler metal is also optimally suited for welding thick-walled sheet and plate structures. The non copper coated version of the solid wire, BÖHLER EMK 8 D TOP, is designed for low spatter formation and excellent feeding properties.

GTAW rods, unalloyed

Product Name Classification AWS Classification EN	Chemical composition rod (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
BOHLER S ER 70 S2 AWS A5.18: ER70S-2 AWS A5.18M: ER48S-2	C: 0.05 Si: 0.5 Mn: 1.2 Ti: + Zr: + Al: +	R_e: ≥420 MPa R_m: ≥520 MPa A: ≥23 % CVN impact: +20 °C: 180 J -30 °C: 120 J -50 °C: 80 J	1.6 2.0 2.4	–	BÖHLER S ER 70 S2 is a copper-coated GTAW rod containing Al, Ti and Zr as strong deoxidents in addition to Mn and Sl and is often referred to as triple deoxidised. This has advantages when rimming or semi-killed mild steels are welded or where joint preparations are rusty or contaminated. BÖHLER S ER 70 S2 is primarily used for single pass welding. For applications involving single and multipass GTAW and/or low temperature toughness requirements down to -50 °C we recommend our GTAW rod BÖHLER EML 5 (AWS ER 70S-3).
BOHLER S EMK 6 AWS A5.18: ER70S-6 EN ISO 636-A: W 42 5 W3Si1	C: 0.08 Si: 0.9 Mn: 1.45	R_e: 450 MPa R_m: 560 MPa A: 28 % CVN impact: +20 °C: 180 J -40 °C: 80 J -50 °C: ≥47 J	1.6 2.0 2.4	–	GTAW rod with high silicon content. The welding rod is suited for joints in boiler and vessel fabrication as well as in structural steel engineering.
BOHLER S EML 5 AWS A5.18: ER70S-3 EN ISO 636-A: W 46 5 W2Si	C: 0.1 Si: 0.6 Mn: 1.2	R_e: 520 MPa R_m: 620 MPa A: 26 % CVN impact: +20 °C: 220 J -20 °C: 200 J -50 °C: 90 J	1.6 2.0 2.4 3.0	–	The GTAW welding rod is suitable for thin-walled plate and pipe as well as root pass welds. The low Si content makes this welding rod especially suitable for joint welds that are subjected to enamelling or galvanising.

SAW wire/flux combinations, unalloyed

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
Union S 2 Si / UV 306 AWS A5.17: F7A2-EM12K / F7P2-EM12K EN ISO 14171-A: S 42 3 AR S2Si	C: 0.06 Si: 0.75 Mn: 1.6	R_e: ≥420 MPa R_m: ≥540 MPa A: ≥22 % CVN impact: +20 °C: ≥70 J -20 °C: ≥47 J -30 °C: ≥47 J	2.5 3.0 4.0	–	Union S 2 Si / UV 306 is a wire-flux combination for submerged-arc welding of unalloyed steel grades. It is used in general purpose applications in structural steel and pipe. It can be used for single- and multi-wire welding with high welding speed using the two-run technique as well as for fillet welding. The flux is donating Mn and Si to the weld pool (desoxidation) and therefore it is less sensitive for porosity issues due to dirt and rust on the plate. Most suitable for single run or 2-run procedures. Multi-run procedures should be limited to weld thickness of max 20 mm. For higher wall thickness UV 400 or UV 418 TT to be preferred. Very good slag detachability and nice bead appearance.
Union S 2 Si / UV 400 AWS A5.17: F7A4-EM12K / F7P2-EM12K EN ISO 14171-A: S 42 3 AB S2Si	C: 0.06 Si: 0.45 Mn: 1.00	R_e: 440 MPa R_m: 540 MPa A: 22 % CVN impact: +20 °C: 120 J -20 °C: 100 J -30 °C: 47 J	2.5 3.0 4.0	–	UV 400 is an agglomerated welding flux of the aluminate basic type. It is suitable for single and multi-pass welding. Good slag removability by butt and fillet welding. General and fine grained structural steels, shipbuilding steels, pipe steels up to 420 MPa minimum yield strength.
Union S 2 Si / UV 418 TT AWS A5.17: F7A8-EM12K / F6P8-EM12K EN ISO 14171: S 42 5 FB S2Si	C: 0.07 Si: 0.33 Mn: 1.10	R_e: 420 MPa R_m: 530 MPa A: 22 % CVN impact: +20 °C: 150 J -40 °C: 80 J -60 °C: 40 J	2.5 3.0 4.0	–	UV 418 TT is an agglomerated fluoride-basic flux with high basicity and neutral metallurgical behaviour. It is suitable for single (AC and DC) and tandem (DC and AC or AC and AC) welding. Very good slag detachability also for narrow gap welding. Flux can especially be used for multipass butt welding of medium and high tensile steels. Very good impact toughness of weld metal at low temperatures.
Union S EM12K / UV C 418 TT-M AWS A5.17: F7A8-EM12K / F6P8-EM12K EN ISO 14171: S 42 6 FB S2Si	C: 0.08 Si: 0.31 Mn: 1.30	R_e: ≥420 MPa R_m: ≥500 MPa A: ≥22 % CVN impact: -60 °C: ≥47 J	2.4 3.2 4.0	ABS	Union S EM12K - UV C 418 TT-M is a wire flux combination universally applicable in shipbuilding, steel construction and in the fabrication of boilers and containers. A nice bead appearance and good wetting properties, together with good slag detachability and low hydrogen content in the weld metal (≤5 ml/100 g) characterize this wire/flux combination. It is particularly suitable for multi-pass welding of thick plates. Very good slag detachability also for narrow gap welding.
Union S 3 Si / UV 418 TT AWS A5.17: F7A8-EH12K EN ISO 14171: S 46 6 FB S3Si	C: 0.08 Si: 0.30 Mn: 1.55	R_e: 460 MPa R_m: 550 MPa A: 25 % CVN impact: +20°C: 160 J -40°C: 70 J -60°C: 47 J	2.5 3.0 4.0	TÜV, DB, DNV GL, LR, BV	General structural steels and fine grained steels up to 460 MPa yield strength. Especially for offshore steels together with flux UV 418 TT. In combination with Union S 3 Si wire electrode, the weld metal has high toughness properties up to -60 °C and very good CTOD values up to -30 °C, so that this combination is outstandingly suited for offshore constructions.
Union S EH12K / UV C 418 TT-M AWS A5.17: F7A8-EH12K / F7P8-EH12K EN ISO 14171: S 46 6 FB S3Si	C: 0.08 Si: 0.35 Mn: 1.7	R_e: ≥460 MPa R_m: ≥500 MPa A: ≥22 % CVN impact: -60 °C: ≥47 J	2.4 3.2 4.0	ABS	Union S EH12K / UV C 418 TT-M is a wire flux combination universally applicable in shipbuilding, steel construction and in the fabrication of boilers and containers. A nice bead appearance and good wetting properties, together with good slag detachability and low hydrogen content in the weld metal (≤5 ml/100 g) characterize this wire/flux combination. It is particularly suitable for multi-pass welding of thick plates. Very good slag detachability also for narrow gap welding.

SAW flux/unalloyed

Product Name Classification EN	Flux type	Main constituents: %	Grain size EN ISO 14174	Characteristics and applications
UV 306 EN ISO 14174: SA AR 1 77 AC H5	Agglomerated aluminate-rutile	SiO_2+TiO_2: 24 Al_2O_3+MnO: 50 CaF_2+CaO+MgO: 14	3 - 16	UV 306 is an agglomerated flux designed for joining applications on general-purpose structural and pipe steels. Suitable for use on DC and AC. For single- and multi-wire welding with high welding speed using the two-run technique as well as for fillet welding. Very good slag removal.
UV 400 EN ISO 14174: SA AB 1 67 AC H5	Agglomerated aluminate-basic	SiO_2+TiO_2: 20 CaO+MgO 30 Al_2O_3+MnO: 28 CaF_2: 16	3 – 20	UV 400 is an agglomerated aluminate-basic flux, designed for joining and surfacing applications with general-purpose structural steels, fine grained structural steels, boiler and pipe steels. The flux is characterized by its low silicon and moderate manganese pickup. It can be used on DC and AC.
UV 418 TT EN ISO 14174: SA FB 1 55 AC H5	Agglomerated fluoride-basic	SiO_2+TiO_2: 15 CaO+MgO 38 Al_2O_3+MnO: 20 CaF_2: 25	3 – 20	UV 418 TT is an agglomerated fluoride-basic flux for joining and surfacing and applications with dissimilar steels. Mainly for high strength and cryogenic fine grained structural steels. This flux is suited for many SAW wires on AC and DC current. Also suited for tandem and multiwire systems.
UV C 418 TT-M EN ISO 14174: SA FB 1 55 AC H5	Agglomerated fluoride-basic	SiO_2+TiO_2: 15 CaO+MgO 32 Al_2O_3+MnO: 20 CaF_2: 28	3 – 20	UV C 418 TT-M is an agglomerated flux of fluoride basic type for joining and surfacing applications. Mainly for high strength and cryogenic fine grained structural steels. Very good slag detachability. Excellent for narrow gap welding. The flux can be used for tandem and multi wire welding with DC+ and AC.

Covered electrodes, low- and medium alloyed creep resistant

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
BÖHLER FOX DMO Kb AWS A5.5: E7018-A1H4 EN ISO 3580-A: E Mo B 4 2 H5 EN ISO 2560-A: E 46 5 Mo B 4 2 H5	C: 0.08 Si: 0.35 Mn: 0.8 Mo: 0.45	$R_{p0.2}$: 510 MPa R_m: 590 MPa A: 24 % CVN impact: +20 °C: 170 J -50 °C: 60 J (≥ 47)	2.5 x 250/350 3.2 x 350 4.0 x 350/450 5.0 x 450	TÜV, DB, KTA, ABS, DNV GL, LTSS, SEPROZ, CE, NAKS, RS	Basic low-hydrogen electrode for 0.5 % Mo-alloyed boiler, plates, and tube steels. Approved for long term exposure up to +550 °C service temperature. For high quality welds of long term stressed components with reliable mechanical properties under high and low temperature conditions. Crack resistant, tough and ageing resistant. Very low hydrogen content (acc. to AWS class HD < 4 ml/100 g). Metal recovery approx. 115 %.
BÖHLER FOX DCMS Kb AWS A5.5: E8018-B2H4 EN ISO 3580-A: E CrMo1 B 4 2 H5	C: 0.08 Si: 0.25 Mn: 0.8 Cr: 1.1 Mo: 0.8	$R_{p0.2}$: 480 MPa R_m: 580 MPa A: 23 % CVN impact: +20 °C: 160 J (≥ 47)	2.5 x 250/350 3.2 x 350 4.0 x 350/450 5.0 x 450	TÜV, DB, ABS, DNV GL, LTSS, SEPROZ, CE, NAKS	Basic low hydrogen electrode for 1 % Cr 0.5 % Mo alloyed boiler, plate, and tube steels. Approved for long term exposure up to +570 °C service temperature. Fully alloyed core wire which will provide reliable creep rupture properties for the whole service life of a boiler plant. High ductility and crack resistance. The weld metal deposit is heat treatable. Very low hydrogen content (acc. AWS class HD < 4 ml/100 g). Metal recovery approx. 115 %. Suitable for step-cooling application. Bruscato ≤ 15ppm. Post weld tempering at 660 – 700 °C for at least ½ h followed by cooling in furnace down to 300 °C and still air.

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
BÖHLER FOX CM 2 Kb AWS A5.5: E9018-B3H4R EN ISO 3580-A: E CrMo2 B 4 2 H5	C: 0.08 Si: 0.3 Mn: 0.6 Cr: 2.2 Mo: 1.0	$R_{p0.2}$: 510 MPa R_m: 600 MPa A: 20 % CVN impact: +20 °C: 120 J (≥ 47)	2.5 x 250 3.0 x 350 4.0 x 350/450 5.0 x 450	TÜV, DB, ABS, DNV GL, SEPROZ, CE, NAKS	Basic electrode for 2.25 % Cr 1 % Mo alloyed boiler, plate and tube steels. Approved for long term exposure up to +600 °C service temperature. Core wire alloyed electrode which will provide reliable creep rupture properties for the whole service life of a boiler plant. Crack resistant and ductile deposit, high creep rupture strength, low hydrogen content (acc. AWS class HD < 4 ml/100 g). Good weldability in all positions except vertical down. Deposit is nitridable and heat treatable. Metal recovery approx. 115 %. For step cooling applications we can offer a special product program.
BÖHLER FOX CM 5 Kb AWS A5.5: E8018-B6H4R EN ISO 3580-A: ECrMo5 B 4 2 H5	C: 0.08 Si: 0.3 Mn: 0.8 Cr: 5.0 Mo: 0.6	PWHT: annealed 730 °C / 2hrs $R_{p0.2}$: 520 MPa R_m: 620 MPa A: 21 % CVN impact: +20°C: > 90 J (≥ 47)	2.5 x 250 3.2 x 350 4.0 x 350	TÜV, LTSS, SEPROZ, CE	Basic core wire alloyed electrode for creep resistant steels and steels for hot hydrogen service. Preferably used for X12CrMo5 (5 Cr 0.5 Mo) steels. Approved for long term exposure up to +650 °C service temperature. High crack resistance, very low hydrogen content (acc. AWS class HD < 4 ml/100 g). Good weldability in all positions except vertical down. The deposit is heat treatable. Metal recovery approx. 115 %.
BÖHLER FOX CM 9 Kb AWS A5.5: E8018-B8 EN ISO 3580-A: E CrMo9 B 4 2 H5	C: 0.08 Si: 0.25 Mn: 0.65 Cr: 9.0 Mo: 1.0	PWHT: 760 °C / 2h $R_{p0.2}$: 610 MPa R_m: 730 MPa A: 20 % CVN impact: +20 °C: > 70 J (≥ 34)	2.5 x 250 3.2 x 350 4.0 x 350	TÜV, SEPROZ, CE	Basic electrode with alloyed core wire for high temperature steels and steels for hot hydrogen service, particularly in the petrochemical industry. Preferably used for 9 % Cr 1 % Mo steels e.g. X12CrMo9-1 (P9). Approved in long-term condition up to +600 °C service temperature. The weld metal is heat treatable. Metal recovery approx. 115 %. Detailed information on welding technology available on request.
BÖHLER FOX C 9 MV AWS A5.5: E9015-B9 EN ISO 3580-A: E CrMo91 B 4 2 H5	C: 0.1 Si: 0.2 Mn: 0.6 Cr: 8.5 Ni: 0.5 Mo: 1.0 Nb: 0.06 V: 0.2 N: 0.04	PWHT: annealed 760 °C / 2h $R_{p0.2}$: 580 MPa R_m: 710 MPa A: 19 % CVN impact: +20 °C: 75 J (≥ 47)	2.5 x 250 3.2 x 350 4.0 x 350 5.0 x 450	TÜV, SEPROZ, CE	Basic electrode with alloyed core wire suited for high temperature martensitic 9 – 12 % chromium steels, in turbine and boiler fabrication and in the chemical industry. Especially for T 91 and P91 steels and operating temperatures up to +620 °C (approved up to +650 °C). High creep rupture strength and good toughness properties under long term stresses. Low hydrogen content. The electrode is suitable in all positions except vertical down. It features excellent striking and re-striking properties.
Phoenix Chromo 1 AWS A5.5: E8018-B2 EN ISO 3580-A: E CrMo1 B 4 2 H5	C: 0.06 Si: 0.25 Mn: 0.85 Cr: 1.20 Mo: 0.50	PWHT: stress relieved 690 °C / 10 h $R_{p0.2}$: 460 MPa R_m: 550 MPa A: 22 % CVN impact: +20 °C: > 120 J -20 °C: > 100 J -40 °C: > 60 J	2.5 x 300 3.2 x 350/450 4.0 x 350/450 5.0 x 450	TÜV, CE	Basic covered CrMo alloyed electrode. Cryogenic, suitable for quenching and tempering; resistant to caustic cracking; creep resistant in short time range up to 500 °C and in long time range up to 570 °C. Electrode for heavy-duty steam boiler and superheater tube fabrication; for quenched and tempered steels. Weld properties under step cooling conditions available on request.

Covered electrodes, low- and medium alloyed high strength

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
BÖHLER FOX EV 60 AWS A5.5: E8018-C3H4R EN ISO 2560-A: E 46 6 1Ni B 42 H5	C: 0.07 Si: 0.4 Mn: 1.15 Ni: 0.9	$R_{p0.2}$: 510 MPa R_m: 610 MPa A: 27 % CVN impact: +20 °C: 180 J -60 °C: 110 J (≥ 47)	2.5 x 350 3.2 x 350 4.0 x 450 5.0 x 450	TÜV, DNV GL, RMR, SEPROZ, CRS, CE, VG 95132	Ni-alloyed, basic covered electrode with excellent mechanical properties, most notably greater toughness and cracking resistance for high-strength, fine-grained constructional steels. Suitable for a temperature range of -60 °C to +350 °C. Very low hydrogen content (according AWS condition HD ≤ 4 ml/100 g). SSC test values are available on request.
BÖHLER FOX EV 65 AWS A5.5: E8018-GH4R / E8018-D1H4R (mod.) EN ISO 18275-A: E 55 6 1NiMo B 4 2 H5	C: 0.06 Si: 0.3 Mn: 1.2 Ni: 0.8 Mo: 0.35	$R_{p0.2}$: 600 MPa R_m: 650 MPa A: 25 % CVN impact: +20 °C: 180 J -60 °C: 80 J (≥ 47)	2.5 x 350 3.2 x 350 4.0 x 450 4.8 x 450 5.0 x 450	TÜV, SEPROZ, NAKS, VG 95132, BV, RMR, ABS, CE	Basic electrode with high ductility and crack resistance, for high- strength fine- grained steels. Ductile down to -60 °C. Resistant to ageing. Easy to handle in all positions, except vertical- down. Very low hydrogen content (acc. to AWS condition HD < 4 ml / 100 g weld metal). BÖHLER FOX EV 65 can be used in sour gas applications (HIC-Test acc. NACE TM-02-84). Test values for SSC-test are available on request.
BÖHLER FOX EV 70 AWS A5.5: E9018-GH4R / E9018-D1H4R (mod.) EN ISO 18275-A: E 55 6 1NiMo B 4 2 H5	C: 0.04 Si: 0.3 Mn: 1.2 Ni: 0.9 Mo: 0.4	$R_{p0.2}$: 650 MPa R_m: 700 MPa A: 24 % CVN impact: +20 °C: 160 J -60 °C: 70 J (≥ 47)	2.5 x 350 3.2 x 350 4.0 x 450 5.0 x 450	TÜV, SEPROZ, CE	Basic, Mo-Ni alloyed covered electrode exhibiting high ductility and crack resistance for applications on high-strength, fine-grained steels. Suitable for service temperatures between -60 °C and +350 °C. Metal recovery approx. 115 %. Easy to handle in all positions except vertical-down. Very low hydrogen content (acc. AWS class HD < 4 ml/100 g weld metal). Preheat and interpass temperatures, as well as post weld heat treatment as required by the base metal.
BÖHLER FOX 7018 G AWS A5.5: E7018-GH4R EN ISO 2560-A: E 46 6 1Ni B 4 2 H5	C: 0.07 Si: 0.3 Mn: 1.3 Ni: 0.9	$R_{p0.2}$: 490 MPa R_m: 580 MPa A: 28 % CVN impact: +20 °C: 170 J -60 °C: 100 J (≥ 47)	2.5 x 350 3.2 x 350 4.0 x 450 5.0 x 450	ABS, CE	Basic coated, Mn-Ni alloyed electrode with excellent quality, particularly high toughness and resistance to cracking. For higher-strength, fine-grained constructional steels. Suitable for service temperatures from -60 to +350 °C. Very good impact strength in aged condition. Metal recovery is about 115 %. Good weldability in all positions, except vertical-down. Deposits have very low hydrogen contents (HD ≤ 5 ml/100 g).
BÖHLER FOX NiCuCr AWS A5.5: E8018-W2H4R EN ISO 2560-A: E 46 4 Z1NiCrCu B 42 H5	C: 0.05 Si: 0.4 Mn: 0.7 Cr: 0.6 Cu: 0.45 Ni: 0.6	$R_{p0.2}$: 520 MPa R_m: 570 MPa A: 27 % CVN impact: +20 °C: 200 J -40 °C: 130 J (≥ 47)	2.5 x 350 3.2 x 350 4.0 x 450	RMR	NiCuCr alloyed basic electrode for welding weathering resistant constructional steels. Excellent mechanical properties, and high crack resistance even when subjected to restraint. Metal recovery approx. 115 %. Easily weldable in all positions except vertical-down. Very low hydrogen contents (acc. AWS condition HD < 4 ml / 100 g weld metal).

Flux and metal-cored wires, low- and medium alloyed

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
BÖHLER DMO Ti-FD AWS A5.36: E81T1-M21PY-A1H8 EN ISO 17634-A: T MoL P M 1 H10	C: 0.04 Si: 0.25 Mn: 0.75 Mo: 0.5	Shielding gas: M21 $R_{p0.2}$: 540 MPa (≥ 470) R_m: 600 MPa (550 - 690) A: 23 % (≥ 22) CVN impact: +20 °C: 120 J (≥ 47)	1.2	TÜV, CE	Rutile flux-cored wire which provides easy all-position weld ability, primarily designed for the welding of 0,5 % Mo alloyed base metals, that are used for the fabrication of vessels, high-pressure storage tanks, pipe systems as well as for structural steel applications. Due to the fast freezing slag system this flux-cored wire provides excellent positional welding characteristics and allows fast travel speeds to be used. It can be operated in spray arc mode in all positions and offers a controllable spatter free arc. Easy slag detachability with smooth, good profile, clean weld beads are further features of this wire.
BÖHLER CM 2 Ti-FD AWS A5.36: E91T1-M21PY-B3-H8 EN ISO 17634-A: T CrMo2 P M 1 H10	C: 0.08 Si: 0.25 Mn: 0.8 Cr: 2.25 Mo: 1.1	Shielding gas: M21 PWHT: annealed 720 °C / 2h $R_{p0.2}$: 600 MPa R_m: 700 MPa A: 19 % CVN impact: +20 °C: 70 J	1.2	TÜV, CE	The welding consumable BÖHLER CM 2 Ti-FD is a low alloyed, flux-cored wire with rutile filling, primarily designed for the welding of 2.25 % Cr and 1% Mo alloyed creep-resistant base metals (e.g. 10CrMo9-10), that are used for the fabrication of high-pressure vessels and pipe systems. Due to the fast freezing slag system this flux-cored wire provides excellent positional welding characteristics and allows fast travel speeds to be used.
BÖHLER Ti 60-FD AWS A5.36: E81T1-M21A8-Ni1-H4 EN ISO 17632-A: T 50 6 1Ni P M 1 H5	C: 0.06 Si: 0.45 Mn: 1.3 Ni: 0.9	Shielding gas Ar + 15 – 25 % CO_2 $R_{p0.2}$: 530 MPa R_m: 570 MPa A: 27 % CVN impact: +20 °C: 140 J -20 °C: 120 J -40 °C: 100 J -60 °C: 60 J	1.2	TÜV, DB, ABS, CE, DNV GL, LR, BV	Rutile flux cored wire with fast freezing slag for welding low-temperature steels. Outstanding welding properes in all positions. Exceponal mechanical strength and good slag detachability, low spatter losses, smooth, finely rippled seam surface, notch-free weld toes. Out-of-position welding can be carried out with increased welding current, and therefore very economically with increased deposition rate. For high-quality welding in shipbuilding, for offshore applications and steel structures with high strength requirements, as well as for low-temperature applications down to -60 °C. BÖHLER Ti 60-FD can be used in sour gas applications (HIC-Test acc. to NACE TM-02-84). Test values for SSC-test are available too. The wire is CTOD tested.
BÖHLER Ti 70 PIPE-FD AWS A5.36: E91T1-M21A4-G EN ISO 18276-A: T 55 4 Mn1Ni P M 1 H5	C: 0.07 Si: 0.5 Mn: 1.5 Ni: 0.95	Shielding gas: M21 $R_{p0.2}$: ≥ 550) R_m: 640-820 MPa A: 25 % (≥ 18) CVN impact: -40 °C: ≥ 47 J	1.2		Rutile micro alloyed flux cored wire for single or multipass welding of carbon-manganese steels and high strength steels with Ar-CO_2 shielding gas. Main features: excellent weldability in all positions, excellent bead appearance, no spatter; fast freezing and easy removeable slag. The exceptional mechanical properties of this wire even at the low temperature (-40 °C) as well as the low content of diffusible hydrogen make it especially suitable for pipeline applications. Further applications are in the offshore industry, shipbuilding and structures built with high strength steels.

Seamless flux and metal-cored wires, low- and medium alloyed

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
BÖHLER NiCu Ti T-FD AWS A5.36: E81T1-M21A4-GH4 EN ISO 17632-A: T46 4 Z P M 1 H5	C: 0.05 Si: 0.40 Mn: 1.20 Ni: 1.20 Cu: 0.40	Shielding gas: M21 R_e: 530 MPa (≥ 470) R_m: 620 MPa (550-680) A: 25 % (≥ 20) CVN impact: -40 °C: 70 J (≥ 47)	1.0 1.2 1.4 1.6	CE	Seamless rutile, nickel-copper-alloyed, flux-cored wire for single- or multilayer welding of atmospheric corrosion resistant steels with Ar-CO_2 shielding gas. Main features: excellent weldability, good bead appearance and easy slag removal.
BÖHLER Ti 60 T-FD AWS A5.36: E81T1-M21A8-Ni1-H4 EN ISO 17632-A: T50 6 1Ni P M 1 H5	C: 0.07 Si: 0.45 Mn: 1.3 Ni: 0.85	Shielding gas: M21 R_e: 550 MPa (≥ 500) R_m: 610 MPa (560-690) A: 25 % (≥ 18) CVN impact: -40 °C: 100 J -60 °C: 75 J (≥ 47) PWHT: stress relieved 620 °C/2h R_e: 520 MPa (≥ 500) R_m: 580 MPa (560-690) A: 29 % (≥ 18) CVN impact: -40 °C: 60 J	1.0 1.2 1.4 1.6	TÜV, DB, DNV GL, ABS, LR, BV, RINA, RS, CWB, CE	Seamless rutile, nickel alloyed, flux cored wire for single- or multilayer welding of carbon, carbon-manganese steels and high strength steels with Argon-CO_2. Main features: excellent weldability in all positions, excellent bead appearance, very low spatter losses, fast freezing and easy to remove slag. The exceptional mechanical properties of this wire even at low temperatures (-60 °C), also after post weld heat treatment make it especially suitable for offshore applications. The wire is CTOD tested.
BÖHLER Ti 60 T-FD (CO_2) AWS A5.36: E81T1-C1A4-Ni1-H4 EN ISO 17632-A: T46 4 1Ni P C 1 H5	C: 0.07 Si: 0.35 Mn: 1.1 Ni: 0.85	Shielding gas: C1 $R_{p0.2}$: 550 MPa (≥ 470) R_m: 620 MPa (550-680) A: 24 % (≥ 20) CVN impact: -20 °C: 110 J -40 °C: 80 J (≥ 47)	1.0 1.2 1.4 1.6	–	Seamless rutile, nickel alloyed, flux cored wire for single- or multilayer welding of carbon, carbon-manganese steels and high strength steels with pure CO_2 shielding gas. Main features: excellent weldability in all positions, excellent bead appearance, very low spatter losses and fast freezing and easy to remove slag. The exceptional mechanical properties of this wire even at low temperatures make it especially suitable for offshore applications.
BÖHLER Ti 60 K2 T-FD (CO_2) AWS A5.36: E81T1-C1A8-K2-H4 EN ISO 17632-A: T50 6 1,5Ni P C 1 H5	C: 0.07 Si: 0.3 Mn: 1.2 Ni: 1.5	Shielding gas: C1 $R_{p0.2}$: 580 MPa (≥ 500) R_m: 650 MPa (560-690) A: 22 % (≥ 18) CVN impact: -60 °C: 75 J (≥ 47)	1.2	–	High performance seamless rutile flux cored wire, for the welding of medium alloyed steel and for low temperature applications with pure CO_2 shielding gas. Main features: excellent weldability in all positions, fast freezing and easy removable slag, no spatter at low parameters. The good mechanical properties of this wire even at the low temperature (-60 °C) as well as the low content of diffusible hydrogen make it especially suitable for offshore applications.

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
BÖHLER 700 T-MC AWS A5.36: E110T15-M21A8-K4-H4 EN ISO 18276-A: T69 6 Mn2NiCrMo M M 1 H5	C: 0.07 Si: 0.40 Mn: 1.40 Cr: 0.50 Ni: 2.20 Mo: 0.40	Shielding gas: M21 $R_{p0.2}$: 720 MPa (≥ 690) R_m: 810 MPa (770-900) A: 17 % (≥ 17) CVN impact: -40 °C: 80 J -60 °C: 70 J (≥ 47) PWHT: stress relieved 580 °C/2h $R_{p0.2}$: 700 MPa (≥ 690) R_m: 790 MPa (770-900) A: 19 % (≥ 17) CVN impact: -40 °C: 70 J -40 °C: 60 J (≥ 47)	1.0 1.2 1.4 1.6	TÜV, DB, DNV, ABS, LR, CE	Seamless, nickel-chromium-molybdenum alloyed, metal cored wire for single- or multilayer welding of low alloyed and high strength steels with Ar-CO_2 shielding gas. Features include: high yield, good weldability, excellent bead appearance, low spatter losses and exceptional mechanical properties at low temperatures (-60 °C) and also after post weld heat treatment. This wire is especially suitable for crane constructions.
BÖHLER HL 75 T-MC AWS A5.36: E101T15-M21A4-G-H4 EN ISO 18276-A: T62 4 Z M M 1 H5	C: 0.10 Si: 0.50 Mn: 1,80 Ni: 0.90 Mo: 0.55	Shielding gas: M21 $R_{p0.2}$: 780 MPa (≥ 620) R_m: 820 MPa (700-830) A: 20 % (≥ 17) CVN impact: -40 °C: 70 J (≥ 47) PWHT: annealed 650 °C/4h $R_{p0.2}$: 670 MPa (≥ 620) R_m: 750 MPa (700-830) A: 22 % (≥ 17) CVN impact: -40 °C: 60 J (≥ 47)	1.2	ABS, DNV GL	Seamless, nickel-molybdenum alloyed, metal cored wire for single - or multilayer welding of high strength steels with pure Argon or Ar-CO_2 shielding gas. This wire is especially suitable for pipe welding of special base material like ASTM A519 Gr. 4130; it meets the NACE requirements. Features include: high yield, good weldability, excellent bead appearance, low spatter losses and exceptional mechanical properties at low temperatures.
BÖHLER Ti 80 T-FD AWS A5.36: E111T1-M21A8-GH4 EN ISO18276-A: T69 6 Z P M 1 H5	C: 0.07 Si: 0.40 Mn: 1.70 Ni: 2.00 Mo: 0.15	Shielding gas: M21 $R_{p0.2}$: 770 MPa (≥ 690) R_m: 800 MPa (770-900) A: 19 % (≥ 17) CVN impact: -40 °C: 75 J -60 °C: 60 J(≥ 47)	1.0 1.2 1.4 1.6	DNV GL, ABS, LR, BV, CE	Seamless rutile, nickel-molybdenum alloyed, flux cored wire for single or multilayer welding of high strengh steels with Argon-CO_2 shielding gas. Excellent weldability in all positions, excellent bead appearance, very low spatter losses, fast freezing and easy to remove slag. The good mechanical properties of this wire even at low temperatures (-60 °C) as well as the low content of diffusible hydrogen make it especially suitable for offshore, pipeline applications and crane applications.

Solid GMAW wire, low and medium-alloyed

Product Name Classification AWS Classification EN	Chemical composition wire (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
Union X 85 AWS A5.28: ER110S-G EN ISO16834-A: G 79 5 M21 M Mn4Ni1.5CrMo	C: 0.09 Si: 0.7 Mn: 1.7 Cr: 0.3 Mo: 0.6 Ni: 1.85	Shielding gas: CO_2 $R_{p0.2}$: 720 MPa R_m: 770 MPa A: 17 % CVN impact: +20 °C: > 80 J Shielding gas: M21 $R_{p0.2}$: 790 MPa R_m: 880 MPa A: 16 % CVN impact: +20 °C: > 90 J	1.0 1.2	DB, CE	Low-alloyed solid wire for shielded arc welding welding of quenched and tempered fine grained structural steels. Outstandingly tough weld metal at low temperature when deposited with gas mixture. Good deformability; outstanding mechanical properes even at higher electric heat input per unit length of weld. good resistance to cold cracking due to high purity of the wire surface. for use in crane and vehicle manufacturing.
Union X 69 AWS A5.28: ER100S-G EN ISO 16834-A: G 69 4 M21 Mn3Ni1CrMo	C: 0.09 Si: 0.55 Mn: 1.50 Cr: 0.35 Mo: 0.25 Ni: 1.40	Shielding gas: M21 $R_{p0.2}$: 700 MPa R_m: 780 MPa A: 17 % CVN impact: +20 °C: 80 J -40 °C: > 47 J	1.0 1.2	TÜV, DB, CE	Low-alloyed solid wire electrode for shielded arc welding of quenched and tempered and thermomechanically treated fine grained structural steels; for joint welding of wear resistant steels. For use in yellow goods, crane and vehicle manufacturing.
Union X 90 AWS A5.28: ER120S-G EN ISO 16834-A: G 89 6 M21 Mn4Ni2CrMo	C: 0.10 Si: 0.80 Mn: 1.80 Cr: 0.35 Mo: 0.60 Ni: 2.30	Shielding gas: M21 $R_{p0.2}$: 890 MPa R_m: 950 MPa A: 15 % CVN impact: +20 °C: 90 J -60 °C: > 47 J	1.0 1.2	TÜV, DB, CE	Low-alloyed solid wire electrode for shielded arc welding of quenched and tempered fine grained structural steels. Outstandingly tough weld metal at low temperatures when deposited with gas mixture. Good resistance to cold cracking due to high purity of the wire surface. Used in crane and vehicle manufacture.

GTAW rods, low and medium-alloyed

Product Name Classification AWS Classification EN	Chemical composition rod (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
BÖHLER DMO-IG AWS A5.28: ER70S-A1 (ER80S-G) EN ISO 21952-A: W MoSi EN ISO 636-A: W2Mo	C: 0.1 Si: 0.6 Mn: 1.1 Mo: 0.5	$R_{p0.2}$: 530 MPa R_m: 650 MPa A: 26 % CVN impact: +20 °C: 200 J -30 °C: 80 J	1.6 2.0 2.4 3.0	TÜV, DB, KTA, BV, DNV GL, CRS, CE, NAKS	GTAW welding rod, copper-coated, for welding in the construction of boilers, pressure tanks, pipelines, cranes and steel construction for steelwork. High-quality, very tough and crack-resistant weld metal, resistant to ageing. Approved for long-term use at operating temperatures from -30 °C to +550 °C.
BÖHLER DCMS-IG AWS A5.28: ER80S-G, ER80S-B2 (mod.) EN ISO 21952-A: W CrMo1Si	C: 0.1 Si: 0.6 Mn: 1.0 Cr: 1.2 Mo: 0.5	$R_{p0.2}$: 440 MPa R_m: 570 MPa A: 25 % CVN impact: +20 °C: 250 J	1.6 2.0 2.4 3.0	TÜV, SEPROZ, CE, NAKS	GTAW welding rod, copper-coated, for welding in the construction of boilers, pressure tanks, pipelines, as well as for welding work on quenched and tempered or case-hardened steels. Preferred for 13CrMo4-5. Approved for long-term use at operating temperatures to +570 °C. Suitable for step-cooling applications (Bruscato ≤ 15 ppm).
BÖHLER CM 2-IG AWS A5.28: ER90S-G, ER90S-B3 (mod.) EN ISO 21952-A: W CrMo2Si	C: 0.08 Si: 0.6 Mn: 0.9 Cr: 2.5 Mo: 1.0	$R_{p0.2}$: 470 MPa R_m: 600 MPa A: 23 % CVN impact: +20 °C: 190 J	1.6 2.0 2.4 3.0	TÜV, SEPROZ, CE, NAKS	GTAW welding rod, copper-coated, for welding in the construction of boiler, vessels and tube steels, as well as in the petroleum processing industry, e.g. in cracking plants. Preferred for 10CrMo9-10. Approved for long-term use at operating temperatures to +600 °C.
BÖHLER CM 5-IG AWS A5.28: ER80S-B6 EN ISO 21952-A: W CrMo5Si	C: 0.08 Si: 0.4 Mn: 0.5 Cr: 5.6 Mo: 0.6	$R_{p0.2}$: 510 MPa (≥ 470) R_m: 620 MPa (≥ 590) A: 20 % (≥ 17) CVN impact: +20 °C: 200 J (≥ 47)	1.6 2.0 2.4 3.0	TÜV, SEPROZ, CE	GTAW rod for 5% Cr 0.5% Mo steels and steels for hot hydrogen service, particularly for application in oil refineries and the base metals X12CrMo5 / P5. Approved in long-term condition up to +650 °C service temperature.
BÖHLER C 9 MV-IG AWS A5.28: ER90S-B9 EN ISO 21952-A: W CrMo91	C: 0.11 Si: 0.3 Mn: 0.5 Cr: 9.0 Ni: 0.5 Mo: 0.9 V: 0.2 Nb: 0.06	$R_{p0.2}$: 640 MPa (≥ 415) R_m: 760 MPa (≥ 620) A: 19 % (≥ 17) CVN impact: +20 °C: 150 J (≥ 47)	2.0 2.4	TÜV, CE, NAKS	GTAW rod for high temperature, creep resistant martensitic 9 – 12 % chromium steels in turbine and boiler fabrication and in the chemical industry. Especially designed for the ASTM steels T91 / P91. Approved in long-term condition up to +650 °C service temperature.
Thermanit MTS 3 AWS A5.28: ER90S-B9 EN ISO 21952-A: W CrMo91	C: 0.1 Si: 0.3 Mn: 0.5 Cr: 9.0 Mo: 1.0 Ni: 0.5 Nb: 0.06 V: 0.2	$R_{p0.2}$: 530 MPa R_m: 620 MPa A: 17 % CVN impact: +20 °C: 50 J	2.0 2.4 3.2	TÜV, CE	High temperature resistant, resistant to scaling up to 600 °C. Suited for joining and surfacing applications with quenched and tempered 9 % Cr steels, parcularly for matching high temperature resistant parent metal like T91 / P91 according to ASTM.

SAW wire/flux combinations, low and medium-alloyed

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
Union S 2 Mo + UV 420 TTR / UV 420 TTR-W AWS A 5.23: F8A4-EA2-A3 EN ISO 14171-A: S 46 4 FB S2Mo		$R_{p0.2}$: 470 MPa R_m: 550 MPa A: 25 % CVN impact: +20 °C: 140 J PWHT: N + A $R_{p0.2}$: 290 MPa R_m: 440 MPa A: 26 % CVN impact: +20 °C: 120 J	2.0 2.5 3.0 4.0	TÜV	Mo alloyed steels and boiler plates of 16Mo3, fine grained steels up to S460N, P460N and similar pipeline steels like StE 480 TM.
Union S 2 CrMo + UV 420 TTR / UV 420 TTR-W AWS A 5.23: F8P2-EB2R-B2 EN ISO 24589-A: S S CrMo 1 FB	C: 0.08 Si: 0.20 Mn: 1.0 Cr: 1.1 Mo: 0.45	Heat treatment: 690 °C / 2 h $R_{p0.2}$: 470 MPa R_m: 550 MPa A: ≥ 20 % CVN impact: +20 °C: 130 J -20 °C: 100 J -30 °C: 80 J	2.0 2.5 3.0 4.0	TÜV, CE	UV 420 TTR / UV 420 TTR-W is an agglomerated fluoride-basic flux with high basicity and neutral metallurgical behavior. It is characterized by a high degree of purity. The low P-pickup of 0.004 % max. makes it particularly suitable for use in reactor construction as well as for welding of hydrocrackers. When the combination Union S 2 CrMo - UV 420 TTR / UV 420 TTR-W is used for SAW of high-temperature resistant steels of the type 1 % Cr-0.5 % Mo, it is possible to meet the most stringent toughness requirements at low/subzero temperatures, even after step-cooling treatment. UV 420 TTR is suitable for single wire welding with direct current (DC) only while UV 420 TTR-W provides good weldability for single wire with alternating current (AC). Thereby it is possible to achieve higher toughness level than with the flux UV 420 TTR (DC-welding). UV 420 TTR-W is also applicable when using the tandem process with DC and AC or AC and AC.
Union S 1 CrMo 2 + UV 420 TTR-W AWS A 5.23: F9P2-EB3R-B3R EN ISO 24589-A: S S CrMo2 FB	C: 0.07 Si: 0.20 Mn: 0.75 Cr: 2.3 Mo: 1.0 X: < 12	Heat treatment: 690 °C / 2 h $R_{p0.2}$: 460 MPa R_m: 560 MPa A: 22 % CVN impact: +20 °C: 140 J	2.0 2.5 3.0 4.0	TÜV	Union S 1 CrMo 2 – UV 420 TTR-W is a wire-flux combination for submerged-arc welding of creep resistant steel grades with 2¼ % Cr – 1 % Mo. To prevent long term temper-embrittlement the weld metal is characterized by a high degree of purity, and meets the most stringent toughness requirements at low/subzero temperatures, also after step-cool heat treatment. After a PWHT of 5 hrs at 690 °C : TT(54)+2,5 ΔTT(54)sc < +10° C (typical < -10 °C). The very good welding behavior on AC and DC+ make it possible to weld with single wire (DC+ or AC) and tandem (DC+/AC or AC/AC) in narrow gap joint configurations without limitation in thickness. Highest toughness levels are achieved using AC current.
Union S 3 NiMo 1 + UV 420 TT AWS A 5.23: F9A8-EF3-F3-N / F9P8-EF3-F3-N EN ISO 14171-A: S 55 6 FB S3Ni1Mo	C: 0.08 Si: 0.25 Mn: 1.70 Ni: 0.90 Mo: 0.55	$R_{p0.2}$: 560 MPa R_m: 620 MPa A: 20 % CVN impact: +20 °C: 160 J Heat treatment: 690 °C / 2 hrs $R_{p0.2}$: 500 MPa R_m: 620 MPa A: 24 % CVN impact: +20 °C: 150 J	2.0 2.5 3.0 4.0	TÜV	Union S 3 NiMo 1 - UV 420 TTR is a wire flux combination for submerged arc welding of unalloyed and low alloyed steel grades. UV 420 TTR is an agglomerated fluoride-basic flux with high basicity with a neutral metallurgical behavior and is characterised by a high degree of purity. The wire / flux combination Union S 3 NiMo 1 – UV 420 TTR is extensively used for the manufacturing of nuclear pressure vessels and also used in oil and gas industry for the welding of high strength low alloy steel grades - such as 22NiMoCr37, 20 MnMo44, 20MnMoNi55, WB 36 - where good strength and toughness properties are required with controlled hardness levels. Excellent weldability, good slag detachability and side wall fusion and a nice bead appearance. It is mostly applied in single wire technique on DC+ polarity.

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
Union S 3 NiMoCr + UV 421 TT AWS A 5.23: F11A6-EF5-F5 EN ISO 26304-A: S 69 6 FB SZ3Ni2,5CrMo	C: 0.08 Si: 0.20 Mn: 1.60 Cr: 0.32 Ni: 2.00 Mo: 0.58	$R_{p0.2}$: 690 MPa R_m: 760 MPa A: 17 % CVN impact: +20 °C: 120 J -40 °C: 47 J -60 °C: 47 J	3.0 4.0	TÜV, DB, BV, WIWEB, LR, DNV GL, ABS, CE	UV 421 TT is an agglomerated fluoride-basic flux with high basicity and neutral metallurgical behavior. It is suitable for single (AC or DC) and tandem (DC and AC) welding. Very good slag detachability also for narrow gap welding. Flux can especially be used for multi-pass butt welding of medium and high tensile steels. Very good impact toughness of weld metal at low temperatures. Fine grained steels up to P690Q, S690QL1, S700MC.
BÖHLER SUBARC T85 UV 421 TT AWS A5.23: F11A10-EC-F5 / F11P6-EC-F5 EN ISO 26304-A: S 69 6 FB TZ H5	C: 0.06 Si: 0.3 Mn: 1.7 Cr: 0.5 Ni: 2.5 Mo: 0.5	$R_{p0.2}$: 790 MPa (≥ 690) R_m: 850 MPa (830-900) A: 20 % (≥ 17) CVN impact: +20 °C: 140 J -60 °C: 85 J (≥ 69) Heat treatment: 580 °C / 2 h $R_{p0.2}$: 750 MPa (≥ 690) R_m: 830 MPa (790-900) A: 20 % (≥ 17) CVN impact: +20 °C: 140 J -60 °C: 85 J (≥ 27)	2.4 3.2 4.0	ABS, DNV GL, LRS, CE	Basic flux cored wire-flux combination for joint welding of high-strength, quenched and tempered fine grained structural steels up to MSYS = 690 MPa. The combination is designed to be applied in applications with requirements concerning overmatching YS and TS. The flux UV 421 TT has a high basicity index and has been designed to be applied in unlimited maximum thickness for a low level of diffusible hydrogen (to decrease the risk of cold cracking). The flux features a neutral metallurgical behavior. The weld metal demonstrates good toughness properties at low temperatures (-60 °C), a fine bead appearance and good wetting properties, together with good slag detachability and low hydrogen content in the weld metal (≤ 5 ml/100g acc ISO 3690) characterize this wire/flux combination. The seamless coppered wire is not sensitive to moisture pick up, has a good resistance to deformation (wire feed rollers) and is very easy to straighten to ensure the best current transfer with low contact tip consumption.
Thermanit MTS 3 Marathon 543 AWS A5.23: F9PZ-EB91-B91 EN ISO 24598-A: S S CrMo 91 FB	C: 0.09 Si: 0.22 Mn: 0.70 Cr: 8.9 Ni: 0.40 Mo: 0.95 V: 0.18 Nb: 0.05 N: 0.04	Heat treatment: 760 °C / 4 h $R_{p0.2}$: 540 MPa R_m: 700 MPa A: 18 % CVN impact: +20 °C: ≥ 47 J	2.0 2.4 3.0 4.0	TÜV	Thermanit MTS 3 is a matching filler metal for welding high temperature and creep resistance 9% chromium steel such as X10CrMoVNb91, A213-T91, A335-P91. Marathon 543 is an agglomerated welding flux of the fluoride basic type with high basicity.

SAW flux/low and medium-alloyed

Product Name Classification EN	Flux type	Main constituents: %	Grain size EN ISO 14174	Characteristics and applications
UV 419 TT-W EN ISO 14174: SA FB 1 55 AC H5	Agglomerated fluoride-basic	SiO_2+TiO_2: 15 CaO+MgO: 35 Al_2O_3+MnO: 21 CaF_2: 26	3 – 20	UV 419 TT-W is an agglomerated fluoride-basic flux for submerged arc welding of unalloyed and low alloyed steel grades. The basic flux has a neutral metallurgical behaviour regarding to Mn and Si, and is mainly recommended for multi-run procedures for relative great wall thickness. Nice flat bead appearance with very good slag detachability, especially in narrow gap applications. Metallurgically, the flux has been optimised to provide excellent mechanical properties as well after extended PWHT-duration as also in as welded condition. The flux generates a low amount of diffusible hydrogen content HD < 5 ml/100 gr according to ISO 3690 in the weld metal.
UV 420 TTR / **UV 420 TTR-W** EN ISO 14174: SA FB 1 65 DC / SA FB 1 65 AC	Agglomerated fluoride-basic	SiO_2+TiO_2: 15 CaO+MgO: 35 Al_2O_3+MnO: 21 CaF_2 26	3 – 20	UV 420 TTR is an agglomerated fluoride-basic flux, mainly for joining and surfacing applications with creep resistant steels. It displays neutral metallurgical behaviour and is characterised by a high degree of purity. It is particularly suitable for welding hydrocrackers because of the low P pick-up of 0.004 % max. UV 420 TTR-W permits sound welding on AC, by this achieving a higher level of toughness when welding with CrMo-alloyed SAW wires.
UV 421 TT EN ISO 14174: SA FB 1 55 AC H5	Agglomerated fluoride-basic	SiO_2+TiO_2: 15 CaO+MgO: 38 Al_2O_3+MnO: 20 CaF_2 25	3 – 20	UV 421 TT is an agglomerated flux of fluoride basic type for joining and surfacing of high strength steels and cryogenic fine grained structural steels. The silicon and manganese pick-ups and burn-off rates are neutral because of its metallurgical behaviour. The cryogenic toughness of the weld metal is very good. It can be welded with nearly every wire electrode. The flux can be used for tandem and multi wire welding with DC and AC. Very good slag detachability.
Marathon 543 EN ISO 14174: SA FB 2	Agglomerated fluoride-basic	SiO_2+Al_2O_3: 35 CaF_2 +CaO+MgO: 60	3 – 20	Marathon 543 is an agglomerated fluoride-basic flux with a high basicity. For joining and surfacing applications of creep resistant CrMo steels such as e.g. 12CrMo 19-5, P 91/T 91, X10CrMoVNb9-1, X20CrMoWV12-1. In combintion with SAW wire Thermanit MTS 616 the flux is suited for welding steels of type P 92 and X11CrMoWVNb9-1-1, E 911.

Covered electrodes, stainless

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
BOHLER FOX S 308L-16 AWS A5.4: E308L-16	C: 0.02 Si: 0.7 Mn: 0.7 Cr: 19.5 Ni: 10.0 Mo: 0.03	$R_{p0.2}$: 425 MPa R_m: 575 MPa A: 48 % CVN impact: +20 °C: 67 J	2.5 x 300 3.25 x 350 4.0 x 350	ABS	Rutile electrode noted for its superior welding characteristics and metallurgy. Other characteristics include high current carrying capacity, minimum spatter formation, self releasing slag, smooth and clean weld profile, safety against formation of porosity due to moisture resistant coating and packaging into hermetically sealed tins. Resistant to intergranular corrosion (ASTM A262 Pracce E).
BOHLER FOX S 316L-16 AWS A5.4: E316L-16	C: 0.02 Si: 0.7 Mn: 0.8 Cr: 18.0 Ni: 13.0 Mo: 2.2	$R_{p0.2}$: 430 MPa R_m: 575 MPa A: 33 % CVN impact: +20 °C: 73 J -120 °C: 45 J	2.5 x 300 3.25 x 350 4.0 x 350	ABS	Rutile electrode noted for its superior welding characteristics and metallurgy. Other characteristics include high current carrying capacity, minimum spatter formation, self-releasing slag, smooth and clean weld profile, safety against formation of porosity due to moisture resistant coating and packaging into hermetically sealed tins. Resistant to intergranular corrosion (ASTM A262 Practice E).
BOHLER FOX S 309L-16 AWS A5.4: E309L-16	C: 0.02 Si: 0.7 Mn: 0.8 Cr: 23 Ni: 12 Mo: 0.02	$R_{p0.2}$: 445 MPa R_m: 555 MPa A: 37 % CVN impact: +20 °C: 52 J -60 °C: 39 J	2.5 x 300 3.25 x 350 4.0 x 350	ABS	Electrode designed for dissimilar welding between stainless steel and mild steel or low alloy steels.
BÖHLER AWS E308L-17 AWS A5.4: E308L-17 EN ISO 3581-A: E 19 9 L R 3 2	C: ≤ 0.03 Si: 0.8 Mn: 0.8 Cr: 19.8 Ni: 10.2	$R_{p0.2}$: 430 MPa R_m: 560 MPa A: 40 % CVN impact: +20 °C: 70 J -120 °C: ≥ 32 J	2.0 x 350 3.2 x 350 4.0 x 350	TÜV, ABS, DNV GL, CE	Low carbon, core wire alloyed austenitic electrode with rutile-basic coating for use in all industries where similar type steels including higher carbon grades as well as ferritic 13 % chromium steels are welded. This brand is noted for its outstanding welding characteristics, excellent weld ability on AC, and high hot cracking resistance of the weld metal. The main features of economic interest are excellent out-of-position weld ability, self-detaching slag with no residues, and moisture resistant coating. Resistant to intergranular corrosion up to 350 °C.
BÖHLER AWS E316L-17 AWS A5.4: E316L-17 EN ISO 3581-A: E 19 12 3 L R 3 2	C: ≤ 0,03 Si: 0.8 Mn: 0.8 Cr: 18.8 Ni: 11.5 Mo: 2.7	$R_{p0.2}$: 460 MPa R_m: 600 MPa A: 36 % CVN impact: +20 °C: 70 J -120 °C: ≥ 32 J	2.5 x 350 3.2 x 350 4.0 x 350	TÜV, ABS, DNV GL, LR, CE	Rutile electrode, core wire alloyed stainless steel. Preferably used for 1.4435 / 316L steel grades. BÖHLER AWS E316L-17 is an acknowledged world leader, noted for its superior welding characteristics and metallurgy. It can be used on AC or DC. Other advantages include high current capacity, minimum spatter formation, self-releasing slag, smooth and clean weld profile, safety against formation of porosity due to moisture resistant coating and packaging into hermetically sealed tins. The fully alloyed core wire ensures the most reliable corrosion resistance. Resistant to intergranular corrosion up to +400 °C.
BÖHLER AWS E309-L17 AWS A5.4: E309L-17 EN ISO 3581-A: E 23 12 L R 3 2	C: 0.02 Si: 0.7 Mn: 0.8 Cr: 23.2 Ni: 12.5	$R_{p0.2}$: 440 MPa R_m: 570 MPa A: 40 % CVN impact: +20 °C: 60 J -60 °C: ≥ 32 J	2.5 x 300 3.2 x 350 4.0 x 350	ABS	Rutile electrode of type E 23 12 L / 309L providing increased delta ferrite contents (FN ~17) in the weld deposit for safe and crack resistant dissimilar joint welds and surfacing. Operating temperature from -60 °C to +300 °C and for weld claddings up to +400 °C.

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
BÖHLER FOX EAS 4 M AWS A5.4: E316L-15 EN ISO 3581-A: E 19 12 3 L B 2 2	C: 0.03 Si: 0.4 Mn: 1.2 Cr: 18.8 Ni: 11.8 Mo: 2.7	$R_{p0.2}$: 460 MPa R_m: 600 MPa A: 38 % CVN impact: +20 °C: 90 J -120 °C: ≥32 J -196 °C: ≥27 J	2.5 x 300 3.2 x 350 4.0 x 350	TÜV, DNV GL, SEPROZ, CE	Basic coated electrode with stainless steel core wire. Preferably used for 1.4435 / 316L steel grades. BÖHLER FOX EAS 4 M is designed to produce high quality weld deposits with reliable toughness values down to -196 °C. 100 % X-ray safety together with very good root pass and positional welding characteriscs. Good gap bridging ability, easy weld pool and slag control. Easy slag removal even in narrow preparaons result in clean bead surfaces with minimum post weld cleaning. Ideal electrode for welding on site. Electrodesare packed in hermecally sealed ns and have a moisture resistant coang. Resistant to intergranular corrosion up to +400 °C.
BÖHLER FOX EAS 4 M-A AWS A5.4: E316L-17 EN ISO 3581-A: E 19 12 3 L R 3 2	C: 0.03 Si: 0.8 Mn: 0.8 Cr: 18.8 Ni: 11.5	$R_{p0.2}$: 460 MPa R_m: 600 MPa A: 36 % CVN impact: +20 °C: 70 J -120 °C: ≥32 J	1.5 x 250 2.0 x 300 2.5 x 250/350 3.2 x 350 4.0 x 350/450	TÜV, DB, ABS, DNV GL, LR, VUZ, SEPROZ, CE, CWB, NAKS	Rutile covered electrode with stainless steel core wire. Preferably used for 1.4435 / 316L steel grades. BÖHLER FOX EAS 4 M-A is an acknowledged world leader, noted for its superior welding characteristics and metallurgy. It can be used on AC or DC. High current capacity, minimum spatter formation, self-releasing slag, smooth and clean weld profile, safety against formation of porosity due to moisture resistant coating and packaging into hermetically sealed tins. The fully alloyed core wire ensures the most reliable corrosion resistance. Resistant to intergranular corrosion up to +400 °C.
BÖHLER FOX EAS 2 AWS A5.4: E308L-15 EN ISO 3581-A: E 19 9 L B 2 2	C: 0.03 Si: 0.4 Mn: 1.3 Cr: 19.8 Ni: 9.6 FN: 4 – 10	$R_{p0.2}$: 420 MPa R_m: 590 MPa A: 38 % CVN impact: +20 °C: 110 J -196 °C: 50 J (≥34)	2.5 x 300 3.2 x 350 4.0 x 350	TÜV, DB, SEPROZ, CE	Basic coated stainless steel electrode. Designed to produce first class weld deposits with reliable CVN toughness values down to -196 °C, 100 % X-ray safety together with very good root pass and positional welding characteristics, good gap bridging ability, easy weld pool and slag control as well as easy slag removal even in narrow preparations resulting in clean bead surfaces and minimum post weld cleaning. An excellent electrode for welding on site! Resistant to intergranular corrosion up to +350 °C. Fully core wire alloyed and packed into hermetically sealed tins. This type of consumables is also available as a special low ferrite version.
BÖHLER FOX EAS 2-A AWS A5.4: E308L-17 EN ISO 3581-A: E 19 9 L R 3 2	C: 0.03 Si: 0.8 Mn: 0.8 Cr: 19.8 Ni: 10.2	$R_{p0.2}$: 430 MPa R_m: 560 MPa A: 40 % CVN impact: +20 °C: 70 J -120 °C: ≥32 J	1.5 x 250 2.0 x 300 2.5 x 250/350 3.2 x 350 4.0 x 350 5.0 x 450	TÜV, DB, ABS, DNV GL, VUZ, SEPROZ, CE, CWB, NAKS	Low carbon, core wire alloyed, austenitic, rutile covered electrode. Application in all industry branches where identical steel types are welded, including higher-carbon varieties, as well as ferritic 13 % chrome steels. The electrode offers particularly excellent welding characteristics. The very good positional weldability and the self-releasing slag are economically significant arguments that favour this electrode. Intergranular corrosion resistant up to +350 °C.
BÖHLER FOX EAS 2 (LF) AWS A5.4: E308L-15 EN ISO 3581-A: E 19 9 L B 2 2	C: 0.03 Si: 0.4 Mn: 1.3 Cr: 19.5 Ni: 10.5	$R_{p0.2}$: 410 MPa R_m: 560 MPa A: 40 % CVN impact: +20 °C: 125 J -196 °C: 60 J (≥34) Lateral expansion at -196 °C: ≥0.38 mm	2.5 x 300 3.2 x 350 4.0 x 350	TÜV-D (submitted), CE	Basic coated stainless steel electrode. Due to the specific alloying concept and a controlled ferrite content of 3-8FN (aimed 2-6FN) the weld metal provides excellent impact toughness down to -196 °C along with lateral expansion values of >0.38 mm which makes it especially suitable for LNG applications. X-ray safety together with good root pass and positional welding characteristics, good gap bridging ability, easy weld pool and slag control as well as easy slag removal resulting in clean bead surfaces and minimum post weld cleaning. An excellent electrode for welding on site. Resistant to intergranular corrosion up to +350 °C. Fully core wire alloyed and packed into hermetically sealed tins.

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
BÖHLER FOX CN 23/12-A AWS A5.4: E309L-17 EN ISO 3581-A: E 23 12 L R 3 2	C: 0.02 Si: 0.7 Mn: 0.8 Cr: 23.2 Ni: 12.5	$R_{p0.2}$: 460 MPa R_m: 570 MPa A: 40 % CVN impact: +20 °C: 55 J -60 °C: ≥ 32 J	2.5 x 350 3.2 x 350 4.0 x 350 5.0 x 450	TÜV, DB, ABS, BV, DNV GL, LR, SEPROZ, CE, CWB, NAKS, VUZ	Rutile coated electrode of type E 23 12 L / 309L providing increased delta ferrite contents (FN ~17) in the weld deposit for safe and crack resistant dissimilar welds and surfacing. BÖHLER FOX CN23/12-A is noted for its superior welding characteristics and metallurgy. It can be used on AC and DC. High current carrying capacity, minimum spatter formation, self releasing slag, smooth and clean weld profile, safety against formation of porosity due to the moisture resistant coating and its packaging into hermetically sealed tins. Operating temperature from –60 °C to +300 °C and for weld claddings up to +400 °C.
BÖHLER FOX CN 23/12 Mo-A EN ISO 3581-A: E 23 12 2 L R 3 2 AWS A 5.4: E309LMo-17	C: 0.02 Si: 0.7 Mn: 0.8 Cr: 23.0 Ni: 12.5 Mo: 2.7	$R_{p0.2}$: 580 MPa R_m: 720 MPa A: 27 % CVN impact: +20 °C: 55 J -20 °C: 45 J (≥ 32)	2.0 x 300 2.5 x 350 3.2 x 350 4.0 x 350 5.0 x 450	TÜV, ABS; RINA, LR, DNV GL, BV, LTSS, VUZ, SEPROX, CE, NAKS	Rutile coated electrode of the type E 23 12 2 L / 309MoL providing increased delta ferrite contents (FN ~20) in the weld deposit for safe and crack resistant dissimilar joint welds as well as claddings or root passes of clad steel. BÖHLER FOX CN 23/12 Mo-A is noted for its superior welding characteristics and metallurgy. It can be used on AC and DC. High current carrying capacity, minimum spatter formation, self releasing slag, smooth and clean weld profile, safety against formation of porosity due to the moisture resistant coating and its packaging into hermetically sealed tins. Operating temperature from –10 °C to +300 °C and for cladding (1st layer) up to +400 °C.
BÖHLER FOX SAS 2 AWS A5.4: E347-15 EN ISO 3581-A: E 19 9 Nb B 2 2	C: 0.03 Si: 0.4 Mn: 1.3 Cr: 19.8 Ni: 10.2 Nb: +	$R_{p0.2}$: 470 MPa R_m: 640 MPa A: 36 % CVN impact: +20 °C: 110 J -196 °C: ≥ 32 J	2.5 x 300 3.2 x 350 4.0 x 350	TÜV, DB, ABS, DNV GL, LTSS, SEPROZ, CE	Basic coated electrodewith core wire of stabilized austenitic stainless steel, mainly for Ti and Nb stabilised 1.4541 / 321 / 347 CrNi-steel grades. Designed to produce first class weld deposits with reliable CVN toughness values down to -196 °C, 100 % X-ray safety together with very good root pass and positional welding characteristics, good gap bridging ability, easy weld pool and slag control as well as easy slag removal even in narrow preparations resulting in clean bead surfaces and minimum post weld cleaning. An excellent electrode for welding on site and for heavy and rigid components. The product is resistant to intergranular corrosion up to +400 °C.
BÖHLER FOX SAS 2-A AWS A5.4: E347-17 EN ISO 3581-A: E 19 9 Nb R 3 2	C: 0.03 Si: 0.8 Mn: 0.8 Cr: 19.5 Ni: 10.0 Nb: +	$R_{p0.2}$: 470 MPa R_m: 620 MPa A: 35 % CVN impact: +20 °C: 70 J -120 °C: ≥ 32 J	2.0 x 300 2.5 x 250/350 3.2 x 350 4.0 x 350 5.0 x 450	TÜV, DB, ABS, DNV GL, LTSS, VUZ, SEPROZ, CE, NAKS	Rutile coated electrode, stabilised austenitic stainless steel. Preferably used for Ti or Nb stabilised 1.4541 / 1.4550 / 321 / 347 CrNi-steel grades. BÖHLER FOX SAS 2-A is noted for its superior welding characteristics and metallurgy. It can be used on AC or DC. Other advantages include high current carrying capacity, minimum spatter formation, self-releasing slag, smooth and clean weld profile, safety against formation of porosity due to moisture resistant coating and packaging into hermetically sealed tins. The fully alloyed core wire ensures the most reliable corrosion resistance. Resistant to intergranular corrosion up to +400 °C.

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
BÖHLER FOX A 7 AWS A5.4: E307-15 (mod.) EN ISO 3581-A: E 18 8 Mn B 2 2	C: 0.09 Si: 0.7 Mn: 6.5 Cr: 18.6 Ni: 8.8	$R_{p0.2}$: 460 MPa R_m: 660 MPa A: 35 % CVN impact: +20 °C: 90 J -110 °C: ≥32 J	2.5 x 300 3.2 x 350 4.0 x 350 5,0 x 450 6.0 x 450	TÜV, DB, DNV GL, LTSS, SEPROZ, VG, CE	Basic coated electrode for joint welding of dissimilar joints, problem steels and for repair and maintenance. Very popular electrode for numerous applications. The weld metal offers exceptionally high ductility and elongation together with outstanding crack resistance. There is no fear of embrittlement when operating down to service temperatures of -110 °C or above +500 °C. The scaling resistance goes up to +850 °C. When working at service temperatures above +650 °C please contact the supplier. The weld metal can be post weld heat treated without any problems. The deposit will work harden and offers good resistance against cavitation. Ductility is good even after high dilution when welding problem steels or when subjected to thermal shock or scaling. An excellent alloy providing cost effective performance.
BÖHLER FOX A 7-A AWS A5.4: E307-16 (mod.) EN ISO 3851-A: E Z18 9 MnMo R 3 2	C: 0.1 Si: 1.5 Mn: 4.0 Cr: 19.5 Ni: 8.5 Mo: 0.7	$R_{p0.2}$: 520 MPa R_m: 720 MPa A: 35 % CVN impact: +20 °C: 75 J -100 °C: ≥32 J	2.5 x 350 3.2 x 350 4.0 x 350 5.0 x 450	TÜV, SEPROZ, CE,	Rutile-basic electrode, for joint welding of dissimilar joints and/or difficult to weld materials. Very popular electrode for numerous applications. The weld metal offers exceptionally high ductility and elongation together with outstanding crack resistance. No embrittlement for service temperatures down to -100 °C or above +500 °C. The scaling resistance goes up to +850 °C. When working at service temperatures above +650 °C please contact BÖHLER Welding. The weld metal can be post weld heat treated without any problems. Good resistance against cavitation. BÖHLER FOX A 7-A is suitable for both AC and DC.
BÖHLER FOX ASN 5 AWS A5.4: E317L-15 (mod.) EN ISO 3581-A: E 18 16 5 N L B 2 2	C: ≤ 0.04 Si: 0.5 Mn: 2.5 Cr: 18.5 Ni: 17.0 Mo: 4.3 N: 0.17 FN: ≤ 0.5 PREN: ~36	$R_{p0.2}$: 460 MPa R_m: 660 MPa A: 35 % CVN impact: +20 °C: 100 J -110 °C: 42 J (≥32)	2.5 x 300 3.2 x 350 4.0 x 350	TÜV, DNV GL, SEPROZ, CE	Basic (with rutile contents) electrode, core wire alloyed, for corrosion resistant CrNi steels with increased Mo-contents like 1.4439 / 317L. Suited for difficult corrosion conditions encountered e.g. in the chemical industry, flue gas de-sulphurisation plants, sea water desalinisation plants and particularly in the paper, pulp and textile industries. It is characterised by an increased Mo content (4.5 %) to compensate for segregation in high molybdenum alloyed weld metals to meet equivalent corrosion properties as the relevant base metals with 3 – 4 % Mo guarantee. The weld metal features excellent chemical resistance to stress corrosion cracking as well as high pitting resistance. Intergranular corrosion resistance at operating temperatures up to +300 °C. Excellent cryogenic toughness down to -269 °C. The electrode provides easy slag removal with smooth and clean bead surfaces as well as good positional weldability.
Avesta 904L AWS A5.4: E385-17 EN ISO 3581-A: E 20 25 5 Cu N L R	C: 0.02 Si: 0.7 Mn: 1.2 Cr: 20.5 Ni: 25 Mo: 4.5 Cu: 1.5	$R_{p0.2}$: 420 MPa R_m: 600 MPa A: 34 % CVN impact: +20 °C: 70 J -40 °C: 60 J -196 °C: 50 J Hardness HB: 200	2.5 x 350 3.2 x 350 4.0 x 400 5.0 x 400	–	Avesta 904L is a high-alloy fully austenitic Cr-Ni-Mo-Cu electrode designed for welding 1.4539/ASTM 904L type steels. It can also be used for welding 1.4404/ASTM 316 components where a ferrite free weld is required, e.g. in cryogenic or non-magnetic applications. The weld metal has a very good impact toughness at low temperatures. Very good resistance to general corrosion in non-oxidising environments such as sulphuric acid and phosphoric acid. Very good resistance to pitting and crevice corrosion in chloride containing solutions. Meets the corrosion test requirements per ASTM G48 Methods A, B and E (40 °C).

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
Thermanit 22/09 AWS A5.4: E2209-15 EN ISO 3581-A: E 22 9 3 N L B 2 2	C: <0.04 Si: 0.5 Mn: 0.9 Cr: 22.5 Ni: 9.0 Mo: 3.0 N: 0.13	$R_{p0.2}$: 480 MPa R_m: 690 MPa A: 25 % CVN impact: +20 °C: 50 J	2.5 x 350 3.2 x 350 4.0 x 350	TÜV, CE	Basic coated electrode, core wire alloyed, for the welding of ferritic-austenitic duplex materials, e.g. 1.4462, UNS S31803. High tensile strength and a very good toughness behaviour down to -60 °C. Furthermore the high crack resistance of the weld metal and the particularly good resistance to stress corrosion cracking and pitting behaviour are significant features.
Avesta 2507/P100 rutile AWS A5.4: E2594-16 EN ISO 3581-A: E 25 9 4 N L R 4 2	C: 0.03 Si: 0.4 Mn: 1.0 Cr: 24.8 Ni: 9.3 Mo: 3.7 N: 0.23 FN: 45 PREN: >40	$R_{p0.2}$: 700 MPa R_m: 880 MPa A: 26 % CVN impact: +20 °C: 80 J -46 °C: 45 J Hardness HB: 250	2.5 x 300 3.2 x 350 4.0 x 350	CE	Covered electrode designed for welding of superduplex steel and equivalent steel grades such as EN 1.4410 / UNS S32570 and EN 1.4501 / UNS S32760. Superduplex steels are particularly popular for desalination, pulp & paper, flue gas desulphurization and sea water systems. Developed to satisfy severe requirements, such as those in NORSOK M-601 and similar standards. Properties of the weld metal match those of the parent metal, offering high tensile strength and toughness as well as an excellent resistance to stress corrosion cracking and localized corrosion in chloride containing environments. Meets the corrosion test requirements for ASTM G48 Methods A, B and E (40 °C). Over-alloyed in nickel to promote austenite formation. Designed for welding in all positions. The operating temperature range is -50 °C to 220 °C.

Flux and metal-cored wires, stainless

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
BÖHLER EAS 2-FD AWS A5.22: E308LT0-4(1) EN ISO 17633-A: T 19 9 L R M21 (C1) 3	C: 0.03 Si: 0.7 Mn: 1.5 Cr: 19.8 Ni: 10.5	$R_{p0.2}$: 360 MPa R_m: 530 MPa A: 40 % CVN impact: +20 °C: 60 J -196 °C: ≥35 J	0.9 1.2 1.6	TÜV, DB, CWB, GL, CE	Rutile flux-cored wire for the welding of austenitic CrNi steels, primarily in flat and horizontal welding positions. The ease of handling and high deposition rate results in greater productivity with excellent welding characteristics, self-releasing slag, low spatter formation and seam oxidation, smooth seam finish with good bead wetting and uniformly reliable penetration. The weld metal is suitable for temperatures down to -196 °C and intergranular corrosion resistant up to +350 °C.
BÖHLER EAS 4 M-FD AWS A5.22: E316LT0-4(1) EN ISO 17633-A: T 19 12 3 L R M21 (C1) 3	C: 0.03 Si: 0.7 Mn: 1.5 Cr: 19.0 Ni: 12.0 Mo: 2.7	$R_{p0.2}$: 410 MPa R_m: 560 MPa A: 34 % CVN impact: +20 °C: 55 J -120 °C: 35 J	0.9 1.2 1.6	TÜV, DB, CWB, LR, CE, DNV GL	Rutile flux-cored wire for the welding of austenitic CrNiMo steels (AISI 316L, 316, 316Ti, 316Cb, 316LN), primarily in flat and horizontal welding positions. The ease of handling and high deposition rate results in greater productivity with excellent welding characteristics, self-releasing slag, low spatter formation and seam oxidation, smooth seam finish with good bead wetting and uniformly reliable penetration. The weld metal is suitable for temperatures down to -120 °C and resistant to interganular corrosion up to +400 °C.
BÖHLER CN 23/12-FD AWS A5.22: E309LT0-4(1) EN ISO 17633-A: T 23 12 L R M21 (C1) 3	C: 0.03 Si: 0.7 Mn: 1.4 Cr: 23.0 Ni: 12.5	$R_{p0.2}$: 400 MPa R_m: 540 MPa A: 33 % CVN impact: +20 °C: 55 J -60 °C: 45 J	0.9 1.2 1.6	TÜV, DB, CWB, LR, CE, RINA, DNV GL, BV	Rutile flux-cored wire for the welding of dissimilar joints between high-alloy Cr and CrNi(Mo) steels with unalloyed or low-alloy steels as well as for weld cladding in primarily flat and horizontal welding positions. Suitable for service temperatures from -60 °C up to +300 °C.

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
BÖHLER EAS 2 PW-FD AWS A5.22: E308LT1-4(1) EN ISO 17633-A: T 19 9 L P M21 (C1) 1	C: 0.03 Si: 0.7 Mn: 1.5 Cr: 19.8 Ni: 10.5	$R_{p0.2}$: 380 MPa R_m: 535 MPa A: 39 % CVN impact: +20 °C: 70 J -196 °C: 40 J	0.9 1.2 1.6	TÜV, DB, CWB, GL, CE	Rutile flux-cored wire which is optimised especially for positional welding. The fast-freezing slag supports the weld pool and enables particularly economical welding in all positions. The chemical and mechanical properties correspond to those of BÖHLER EAS 2-FD.
BÖHLER EAS 4 PW-FD AWS A5.22: E316LT1-4(1) EN ISO 17633-A: T 19 12 3 L P M21 (C1) 1	C: 0.03 Si: 0.7 Mn: 1.5 Cr: 19.0 Ni: 12.0 Mo: 2.7	$R_{p0.2}$: 430 MPa R_m: 560 MPa A: 34 % CVN impact: +20 °C: 65 J -120 °C: 40 J	0.9 1.2 1.6	TÜV, DB, CWB, LR, CE, DNV GL, ABS	Rutile flux-cored wire which is optimised especially for positional welding. The fast-freezing slag supports the weld pool and enables particularly economical welding in all positions. The chemical and mechanical properties correspond to those of EAS 4 M-FD. Intergranular corrosion resistant up to +400 °C.
BÖHLER CN 23/12 PW-FD AWS A5.22: E309LT1-4(1) EN ISO 17633-A: T 23 12 L P M21 (C1) 1	C: 0.03 Si: 0.7 Mn: 1.4 Cr: 23.0 Ni: 12.5	$R_{p0.2}$: 420 MPa R_m: 540 MPa A: 36 % CVN impact: +20 °C: 65 J -60 °C: 50 J	0.9 1.2 1.6	TÜV, DB, ABS, LR, CWB, CE, DNV GL, RINA	BÖHLER CN 23/12 PW-FD is a rutile flux-cored wire for positional welding of dissimilar joints between high-alloy Cr and CrNi(Mo) steels and unalloyed or low-alloy steels. The supporting effect of the fast-freezing slag enables excellent positional welding characteristics. Suitable for service temperatures from -60 °C up to +300 °C.
BÖHLER CN 23/12 Mo-FD AWS A5.22: E309LMoT0-4(1) EN ISO 17633-A: T 23 12 2 L R M21 (C1) 3	C: 0.03 Si: 0.6 Mn: 1.4 Cr: 23.0 Ni: 12.5 Mo: 2.7	Shielding gas: Ar + 18 % CO_2 $R_{p0.2}$: 520 MPa R_m: 700 MPa A: 28 % CVN impact: +20 °C: 50 J -60 °C: 36 J	1.2 1.6	TÜV, DB, ABS, DNV GL, LR, RINA, CWB, CE	Rutile flux-cored welding wire of type T 23 12 2 L / E309LMoT0 for GMAW of dissimilar joints of Cr- and CrNi(Mo)-steels and un or low-alloy steels, as well as weld cladding of un or low alloyed base metals preferably in flat or horizontal position. The wire offers a high safety against hot cracking even in the case of high dilution. For Mo-alloyed claddings the product is necessary for the first layer.
BÖHLER CN 23/12 Mo PW-FD AWS A5.22: E309LMoT1-4/1 EN ISO 17633-A: T 23 12 2 L P M21/C1 1	C: 0.03 Si: 0.7 Mn: 1.4 Cr: 23.0 Ni: 12.5 Mo: 2.7 FN: 29-32	Shielding gas: Ar + 18 % CO_2 $R_{p0.2}$: 540 MPa (≥ 350) R_m: 705 MPa (≥ 550) A: 28 % (≥ 25) CVN impact: +20 °C: 65 J -20 °C: 44 J (≥ 32)	0.9 1.2	TÜV, BV, LR, DNV GL, CE	Austenitic stainless steel CrNiMo rutile flux-cored wire. The corrosion resistance is superior to E316L type fillers. Primarily designed for welding dissimilar joints between stainless steels and low-alloyed steels. It can also be used for overlay welding, providing an 18Cr-8Ni-2Mo deposit from the very first layer and for joining of various steels. The fast freezing slag offers excellent weldability and slag control in all positions. Provides high resistance to hot cracking even at high dilution. Alloying with molybdenum increases the corrosion resistance and weld metal strength. Suitable for service temperatures from -60 °C to 300 °C.
Avesta FCW-2D 2205 AWS A5.22: E2209T0-4/1 EN ISO 17633-A: T 22 9 3 N L R M21/C1 3	C: 0.027 Si: 0.7 Mn: 0.9 Cr: 22.9 Ni: 9.2 Mo: 3.2 N: 0.13 FN: 45-65 PREN: >35	Shielding gas: Ar + 18 % CO_2 $R_{p0.2}$: 620 MPa (≥ 450) R_m: 800 MPa (≥ 690) A: 27 % (≥ 20) CVN impact: +20 °C: 60 J -30 °C: 45 J	1.2	TÜV, BV, CWB, DNV GL, LR, RINA, DB, CE	Primarily designed for welding 22Cr duplex stainless steels used in offshore, shipyards, chemical tankers, chemical/petrochemical, pulp & paper, etc. Avesta FCW-2D 2205 provides excellent weldability in flat as well as horizontal-vertical position. The weld metal has very good resistance to pitting and stress corrosion cracking in chloride containing environments and meets the corrosion test requirements per ASTM G48 Methods A, B and E (22 °C), ASTM G36 and NACE TM 0177 Method A. Over-alloyed in nickel to promote austenite formation.

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
Avesta FCW 2205-PW AWS A5.22: E2209T1-4/1 EN ISO 17633-A: T 22 9 3 N L P M21/C1 1	C: 0.029 Si: 0.7 Mn: 1.0 Cr: 23.0 Ni: 9.1 Mo: 3.2 N: 0.13 FN: 45-65 PREN: > 35	Shielding gas: Ar + 18 % CO_2 $R_{p0.2}$: 600 MPa (≥ 450) R_m: 800 MPa (≥ 690) A: 27 % (≥ 20) CVN impact: +20 °C: 58 J -46 °C: 45 J Hardness HB: 240	1.2 1.6	TÜV, BV, CWB, DNV GL, LR, RINA, CE	Primarily designed for welding 22Cr duplex stainless steels used in offshore, shipyards, chemical tankers, chemical/petrochemical, pulp & paper, etc. It is designed for allround welding and can be used in all positions without changing the parameter settings. The weldability is excellent in the vertical-up and overhead welding positions. Very good resistance to pitting and stress corrosion cracking in chloride containing environments. Meets the corrosion test requirements per ASTM G48 Methods A, B and E (25 °C). Over-alloyed in nickel to promote austenite formation.
Avesta FCW 2507/P100-PW AWS A5.22: E2594T1-4/1 EN ISO 17633-A: T 25 9 4 N L P M21 (C1) 2	C: 0.03 Si: 0.7 Mn: 0.9 Cr: 25.3 Ni: 9.8 Mo: 3.7 N: 0.23 PREN > 41	$R_{p0.2}$: 690 MPa R_m: 890 MPa A: 27 % CVN impact: +20 °C: ≥ 60 J -40 °C: ≥ 38 J	1.2	CE	Avesta FCW 2507-PW is primarily designed for welding the super duplex stainless steel 2507, ASTM S32760, S32550 und S31260 and similar grades. Avesta 2507/P100-PW produces a ferritic-austenitic stainless all weld metal which combines the good characteristics of both types. Corrosion resistance: Very good resistance to pitting and stress corrosion cracking in nitric acid environments. The critical pitting temperature is higher than 40 °C.

Solid GMAW wire, stainless

Product Name Classification AWS Classification EN	Chemical composition wire (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
BÖHLER AWS 308LSI AWS A5.9: ER308LSi EN ISO 14343-A: G 19 9 L Si	C: ≤ 0.02 Si: 0.8 Mn: 1.7 Cr: 20.0 Ni: 10.2	Shielding gas: Ar + 2.5 % CO_2 $R_{p0.2}$: 350 MPa (≥ 320) R_m: 540 MPa (≥ 510) A: 38 % (≥ 35) CVN impact: +20 °C: 75 J -196 °C: ≥ 32 J	0.8 1.0 1.2	TÜV, DB, CE	Stainless solid GMAW wire designed for first class welding, wetting and feeding characteristics and excellent weld metal CVN values down to -196 °C. Resistance to intergranular corrosion up to +350 °C.
BÖHLER AWS 309LSI AWS A5.9: ER309LSi EN ISO 14343-A: G 23 12 L Si	C: 0.03 Si: 0.9 Mn: 2.0 Cr: 24.0 Ni: 13.0	Shielding gas: M12, M13 $R_{p0.2}$: 400 MPa R_m: 550 MPa A: 30 % CVN impact: +20 °C: 55 J	0.8 1.0 1.2 1.6	TÜV, CE	Stainless solid GMAW wire. Well suited for depositing intermediate layers when welding cladded materials. Favorably high Cr and Ni contents, low C content. For joining unalloyed/ low-alloy steels/cast steel grades or stainless heat resistant Cr steels / cast steel grades to austenitic steels / cast steel grades. For depositing intermediate layers when welding the side of plates clad with low-carbon – non stabilized or stabilized – austenitic CrNiMo(N) austenitic metals. Application temperature max. 300 °C .
BÖHLER AWS 316LSI AWS A5.9: ER316LSi EN ISO 14343-A: G 19 12 3 L Si	C: 0.02 Si: 0.8 Mn: 1.7 Cr: 18.4 Ni: 12.4 Mo: 2.8	Shielding gas: Ar + 2.5 % CO_2 $R_{p0.2}$: 420 MPa (≥ 320) R_m: 560 MPa (≥ 510) A: 35 % (≥ 25) CVN impact: +20 °C: 70 J -196 °C: ≥ 32 J	0.8 1.0 1.2	TÜV, DB, CE	Stainless solid GMAW wire designed for first class welding, good wetting and feeding characteristics as well as reliable corrosion resistance up to +400 °C. Low temperature service down to -196 °C.

Product Name Classification AWS Classification EN	Chemical composition wire (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
BÖHLER GMA 309L AWS A5.9: ER309L EN ISO 14343-A: G (23 12 L)	C: 0.02 Si: 0.55 Mn: 2.2 Cr: 23.5 Ni: 13.6	Shielding gas: Ar + 2.5 % CO_2 $R_{p0.2}$: 430 MPa (≥350) R_m: 580 MPa (≥520) A: 36 % (≥30) CVN impact: +20 °C: 130 J (≥47) -60 °C: ≥32 J	0.8 1.0 1.2 1.6	CE	GMAW solid wire of type G 23 12 L / ER309L. This is a standard alloy for welding dissimilar joints with average ferrite content 16 FN. It is designed for very good welding and wetting characteristics as well as good safety after dilution when welding dissimilar joints. Suitable for service temperatures between -80 °C and +300 °C.
BÖHLER GMA 316L AWS A5.9: ER316L EN ISO 14343-A: G (19 12 3 L)	C: 0,02 Si: 0.55 Mn: 1.7 Cr: 18.4 Ni: 12.2 Mo: 2.3	Shielding gas: Ar + 2.5 % CO_2 $R_{p0.2}$: 430 MPa (≥350) R_m: 570 MPa (≥510) A: 38 % (≥30) CVN impact: +20 °C: 100 J (≥47) -120 °C: 70 J (≥32)	0.8 1.0 1.2 1.6	CE	GMAW solid wire of type G 19 12 3 L / ER316L designed for first class welding, good wetting and feeding characteristics as well as reliable corrosion resistance up to +400 °C. Low temperature service down to -196 °C. General purpose wire used for joining 316L type stainless steels in both wrought iron and cast forms. Because of the molybdenum, this product has increased creep resistance at elevated temperatures, as well as pitting resistance in marine and industrial environments. This product has many applications in the chemical process industry.
Avesta LDX 2101 AWS A5.9: ER2307 EN ISO 14343-A: G 23 7 NL	C: 0.02 Si: 0.4 Mn: 0.5 Cr: 23.0 Ni: 7.0 Mo: <0.5 N: 0.14 FN: 40	Shielding gas: Ar / 30 % He + 2 % CO_2 $R_{p0.2}$: 520 MPa (≥450) R_m: 710 MPa (≥690) A: 30 % (≥20) CVN impact: +20 °C: 150 J (≥47) -20 °C: 110 J (≥47)	0.8 1.0 1.2	CE	Designed for welding of lean duplex stainless steel such as LDX 2101® and similar alloys. The wire is over-alloyed with nickel to promote weldmetal austenite formation. Typical applications are constructions, storage tanks and piping. LDX 2101® is used for instance in the desalination water treatment and pulp and paper industry. Welding with the GMAW process can be performed by using short and spray arc mode. However best results are obtained in pulsed arc process using Ar + 30 % He + 2 % CO_2 shielding gas. Corrosion resistance is equal to or better than ASTM 304. Structure: Austenite with 35 – 65 % ferrite. Scaling temperature: Approx. 850 °C (air).

GTAW rods, stainless

Product Name Classification AWS Classification EN	Chemical composition rod (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
BOHLER S EAS 2-IG AWS A5.9: ER308L EN ISO 14343-A: W 19 9 L EN ISO 14343-B: S S308L	C: 0.02 Si: 0.45 Mn: 2.00 Cr: 19.8 Ni: 10 Mo: 0.04	$R_{p0.2}$: 385 MPa R_m: 575 MPa A: 40 % CVN impact: +20 °C: 150 J -196 °C: 58 J	1.6 2.0 2.4 3.2	ABS	Good welding and wetting characteriscs as well as corrosion resistance up to +350 °C.
BOHLER S CN 23/12-IG AWS A5.9: ER309L EN ISO 14343-A: W 23 12 L EN ISO 14343-B: S S309L Material No.: 1.4332	C: 0.02 Si: 0.40 Mn: 1.80 Cr: 23.00 Ni: 13.60	$R_{p0.2}$: 450 MPa R_m: 590 MPa A: 38 % CVN impact: +20 °C: 200 J -40 °C: 120 J	1.6 2.0 2.4 3.2	ABS	This is a standard alloy for welding dissimilar joints and designed for very good welding and wetting characterisc as well as good safety after dilution when welding dissimilar joints.
BOHLER S EAS 4 M-IG AWS A5.9: ER316L EN ISO 14343-A: W 19 12 3 L	C: ≤0.02 Si: 0.5 Mn: 1.8 Cr: 18.5 Ni: 12.3 Mo: 2.8	$R_{p0.2}$: 470 MPa R_m: 610 MPa A: 38 % CVN impact: +20 °C: 140 J -196 °C: ≥32 J	1.6 2.0 2.4 3.0	–	GTAW rod of type W 19 12 3 L / ER316L engineered to a very precise analysis to create a weld deposit of high purity, superior hot cracking a corrosion resistance. Application in all industry branches where identical steel types are welded, including higher-carbon varieties, as well as ferritic 13 % chrome steels, e.g. in the construction of chemical apparatus and storage tanks, in the chemical and pharmaceutical industries, for the manufacturing of cellulose, artificial silk and textiles, among many other branches. CVN toughness down to -196 °C, resistant to intergranular corrosion up to +400 °C.
BÖHLER SAS 2-IG AWS A5.9: ER347 EN ISO 14343-A: W 19 9 Nb	C: 0.05 Si: 0.5 Mn: 1.8 Cr: 19.6 Ni: 9.5 Nb: +	$R_{p0.2}$: 490 MPa R_m: 660 MPa A: 35 % CVN impact: +20 °C: 140 J -196 °C: ≥32 J	1.6 2.0 2.4 3.0	TÜV, GL, LTSS, SEPROZ, CE, NAKS	GTAW rod of type W 19 9 Nb / ER 347 engineered to a very precise analysis to create a weld deposit of high purity, superior hot cracking a corrosion resistance. Application in all industry branches where identical steel types are welded, as well as ferritic 13 % chrome steels, e.g. in the construction of chemical apparatus and storage tanks, in textile and cellulose manufacturing, dyework factories, among many others. Low temperature service down to -196 °C and intergranular corrosion resistant up to +400 °C.
Avesta LDX 2101 AWS A5.9: ER2307 EN ISO 14343: W 23 7 NL	C: 0.02 Si: 0.4 Mn: 0.5 Cr: 23.0 Ni: 7.0 Mo: <0.5 N: 0.14	$R_{p0.2}$: 550 MPa (>450) R_m: 730 MPa (>690) A: 30 % (>20) CVN impact: +20 °C: 180 J (>47) -40 °C: 180 J (> 47)	1.6 2.0 2.4 3.2	–	Avesta LDX 2101 is designed for welding of lean duplex stainless steel such as LDX 2101® and similar alloys. The wire is over-alloyed with nickel to promote weldmetal austenite formation. Typical applications are constructions, storage tanks and piping. LDX 2101® is used for instance in the desalination water treatment and pulp and paper industry. Corrosion resistance is equal to or better than ASTM 304. Structure: Austenite with 35 – 65 % ferrite. Scaling temperature: Approx. 850 °C (air).
Thermanit 22/09 AWS A5.9: ER2209 EN ISO 14343-A: W 22 9 3 N L	C: 0.02 Si: 0.4 Mn: 1.7 Cr: 22.5 Mo: 3.2 Ni: 8.8 N: 0.15	$R_{p0.2}$: 600 MPa R_m: 720 MPa A: 25 % CVN impact: +20 °C: 100 J	1.6 2.0 2.4 3.2	TÜV, ABS, LR, DNV GL, CE	Duplex stainless steel; resistant to intercrystalline corrosion and wet corrosion up to 250 °C. Good resistance to stress corrosion cracking in chlorine - and hydrogen sulphide-bearing environment. High Crand Mo- contents provide resistance to pitting corrosion. For joining and surfacing work with matching and similar austenitic steels/ cast steel grades. Attention must be paid to embrilement susceptibility of the parent metal.

Product Name Classification AWS Classification EN	Chemical composition rod (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
Thermanit 25/09 CuT AWS A5.9: ER2594 EN ISO 14343-A: W 25 9 4 N L	C: 0.02 Si: 0.3 Mn: 0.8 Cr: 25.3 Mo: 3.7 Ni: 9.5 N: 0.2 Cu: 0.6 W: 0.6	$R_{p0.2}$: 600 MPa R_m: 750 MPa A: 25 % CVN impact: +20 °C: 80 J -40 °C: 50 J	1.6 2.0 2.4 3.2 Spools on request	–	Super duplex stainless steel; resistant to intercrystalline corrosion (Service temperature: -50 °C up to +220 °C). Very good resistance to pittng corrosion and stress corrosion cracking due to the high CrMo(N) content (pittng index ≥ 40). Well suited for conditions in offshore application, particularly for welding of supermartensitic stainless steels (13 % Cr); Extra low hydrogen in the filler material available on request.
Avesta P5 AWS A5.9: (ER309NMo)* EN ISO 14343: W 23 12 2 L	C: 0.02 Si: 0.35 Mn: 1.5 Cr: 21.5 Ni: 15.0 Mo: 2.7	$R_{p0.2}$: >470 MPa R_m: >640 MPa A: 30 % CVN impact: +20 °C: >90 J	1.6 2.0 2.4 3.2	–	Avesta P5 is a high-alloy low carbon wire of the 309L|l/lo type, primarily designed for surfacing low-alloy-steels and for welding dissimilar joints between stainless and mild or low-alloy steels. It is also suitable for welding steels like durostat® and alform®. When used for surfacing, a coniposition equivalent to that of 1.4401/ASTM 316 is obtained already in the first layer.

SAW wire/flux combinations, stainless

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
Thermanit JE 308L + Marathon 431 Wire: AWS A5.9: ER308L EN ISO 14343-A: S 19 9 L Flux: EN ISO 14343: SA FB 2	C: 0.01 Si: 0.60 Mn: 1.3 Cr: 10.5 Ni: 9.8	$R_{p0.2}$: 320 MPa R_m: 550 MPa A: 35 % CVN impact: +20 °C: 65 J	2.4 3.2 4.0	TÜV	Joining and surfacing applications on similar stabilized or non stabilized steels like 1.4301, 1.4306, 1.4311, AISI 304, 304L, 304LN.
Thermanit GE 316L + Marathon 431 Wire: AWS A5.9: ER316L EN ISO 14343-A: S 19 12 3 L Flux: EN ISO 14343: SA FB 2	C: 0.01 Si: 0.60 Mn: 1.2 Cr: 18.0 Ni: 12.2 Mo: 2.8	$R_{p0.2}$: 350 MPa R_m: 550 MPa A: 30 % CVN impact: +20 °C: 70 J	2.0 2.4 3.2 4.0	TÜV	Joining and surfacing applications on similar CrNiMo-steels like 1.4404, 1.4541, 1.4435, UNS S31653, AISI 316, 316L, 316Ti, 316Cb.
Thermanit 25/14 E-309L / Marathon 431 AWS A5.9: ER309L EN ISO 14343-A: S 23 12 L Flux: EN ISO 14174: S A FB 2	C: 0.015 Si: 0.6 Mn: 1.3 Cr: 23.5 Ni: 13.2	$R_{p0.2}$: >380 MPa R_m: >600 MPa A: 25 % CVN impact: +20 °C: 100 J	2.4 3.2 4.0		Thermanit 25/14 E-309L / Marathon 431 is a wire - flux combination for submerged arc welding. This is a standard combination for welding dissimilar joints, and the first layer in weld overlay (wire cladding). The average ferrite content is 16 FN. Suitable up to service temperatures of +300 °C. Marathon 431 is an agglomerated basic flux that ensures good welding properties with nice bead appearance and good slag detachability.For more information regarding this sub-arc welding flux see our detailed data sheet.
Thermanit A / Marathon 431 AWS A5.9: ER318 EN ISO 14343-A: S 19 12 3 Nb Flux: EN ISO 14174: SA FB 2	C: 0.038 Si: 0.60 Mn: 1.2 Cr: 19.0 Ni: 11.5 Mo: 2.8 Nb: 0.65	$R_{p0.2}$: >380 MPa R_m: >550 MPa A: >30 % CVN impact: +20 °C: >70 J -120 °C: >40 J	2.4 3.2 4.0	TÜV, CE	Thermanit A / Marathon 431 is a wire-flux-combination for submerged arc welding of stainless steel grades like 1.4571 / 316Ti. Applicable for service temperatures from –120 °C to +400 °C. Marathon 431 is an agglomerated basic flux that ensures good welding properties with nice bead appearance and good slag detachability.For more information regarding this sub-arc welding flux see our detailed data sheet.

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
Thermanit H 347 / Marathon 431 AWS A5.9: ER347 EN ISO 14343-A: S 19 9 Nb Flux: EN ISO 14174: SA FB 2	C: 0.038 Si: 0.60 Mn: 1.3 Cr: 19.0 Ni: 9.5 Nb: 0.55	$R_{p0.2}$: >380 MPa R_m: >550 MPa A: >30 % CVN impact: +20 °C: >65 J -120 °C: >40 J	2.4 3.2 4.0	TÜV, CE	Thermanit H 347 / Marathon 431 is a wire/ flux-combination for submerged arc welding of stainless steel grades like 1.4541 / 347. Marathon 431 is an agglomerated basic flux that ensures good welding properties with nice bead appearance and good slag detachability. For information regarding this sub-arc welding flux see our detailed data sheet.
Avesta 2205 / Flux 805 AWS A5.23: ER2209 EN ISO 14343-A: S 22 9 3 N L Flux: EN ISO 14174: SA AF 2	C: 0.013 Si: 0.50 Mn: 1.1 Cr: 22.5 Ni: 8.8 Mo: 3.2 N: 0.14 PREN: 35.0	$R_{p0.2}$: >450 MPa R_m: >550 MPa A: >20 % CVN impact: +20 °C: 140 J -120 °C: >32 J	2.4 3.0 3.2	–	Avesta 2205 is primarily designed for welding the duplex grade Outokumpu 2205 and similar but it can also be used for SAF 2304 type of steels. Avesta 2205 provides a ferritic-austenitic weldment that combines many of the good properties of both ferritic and austenitic stainless steels. Structure: Austenite with 45 – 55 % ferrite. Scaling temperature: Approx. 850 °C (air). Corrosion resistance: Very good resistance to pitting and stress corrosion cracking in chloride containing environments.
Thermanit 25/09 CuT / Marathon 431 AWS A5.9: ER2594 EN ISO 14343-A: S 25 9 4 N L Flux: EN ISO 14174: SA FB 2	C: 0.02 Si: 0.50 Mn: 0.8 Cr: 25.0 Ni: 9.5 Mo: 3.8 N: 0.22 Cu: 0.5 W: 0.6	$R_{p0.2}$: 650 MPa R_m: 870 MPa A: >20 % CVN impact: -46 °C: 45 J	2.0 2.4	ABS, DNV, BV	Thermanit 25/09 CuT / Marathon 431 is a wire/ flux combination for submerged arc welding of super duplex stainless steel grades like SAF 2507, ASTM S32760, S32550 and S31260. The weld metal shows excellent resistance to pitting- and crevice corrosion in chlorine containing media as well as to stress corrosion cracking especially in H2S containing media. Suitable for service temperatures from -40 °C to +220 °C. Marathon 431 is an agglomerated basic flux that ensures good welding properties with nice bead appearance and good slag detachability.For more information regarding this sub-arc welding flux see our detailed data sheet.

SAW flux, stainless

Product Name Classification EN	Flux type	Main constituents: %	Grain size EN ISO 14174	Characteristics and applications
Avesta Flux 805 EN ISO 14174: SA AF 2	Agglomerated aluminum-fluoride	SiO_2: 10 Al_2O_3: 36 CaF_2: 48 Cr: 2.5	4 – 14	Avesta Flux 805 is a basic, slightly chomium-compensated agglomerated flux. It is primalrily desinged for welding with high-alloyed stainless fillers such as Avesta P12, 904L and 2205. Standard Cr-Ni and Cr-Ni-Mo fillers can also be welded with excellent results.
Marathon 431 EN ISO 14343: SA FB 2	Agglomerated fluoride-basic	SiO_2: 10 Al_2O_3: 38 CaF_2: 50	4 – 16	Marathon 431 is an agglomerated basic welding flux for welding stainless high alloyed CrNi(Mo) steels. The weld seams are smooth and finely rippled without any slag residues. Besides the good slag detachability the flux also provides good fillet weld properties. The weld metals show high degree of purity and good mechanical properties.

Covered electrodes, nickel-base

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
Thermanit Nicro 182 AWS A5.11: ENiCrFe-3 EN ISO 14172: E Ni 6182 (NiCr15Fe6Mn)	C: 0.025 Si: 0.4 Mn: 6.0 Cr: 16.0 Ni: bal. Nb: 2.2 Fe: 6.0	$R_{p0.2}$: 400 MPa R_m: 670 MPa A: 35 % CVN impact: +20 °C: 120 J -196 °C: 80 J (≥ 32)	2.5 x 300 3.2 x 300 4.0 x 350 5.0 x 400	TÜV	Nickel base electrode, stainless; resistant to scaling up to 950 °C, creep resistant up to 800 °C. Cold toughness down to -196 °C. Well suited for austenitic ferritic joints. Well suited for tough joints and surfacing on heat resistant Cr- and CrNi steels/cast steel grades and Ni-base alloys. For welding work on cryogenic steels/cast steel grades including Ni steels suitable for quenching and tempering. For joining applications on steels with a low expansion coefficient (Dilavar, Invar).
Thermanit Nicro 82 AWS A5.11: ENiCrFe-3 (mod.) EN ISO 14172: E Ni 6082 (NiCr20Mn3Nb)	C: < 0.05 Si: < 0.4 Mn: 4.0 Cr: 19.5 Mo: 1.5 Ni: bal. Nb: 2.0 Fe: < 4.0	$R_{p0.2}$: 380 MPa R_m: 620 MPa A: 35 % CVN impact: +20 °C: 90 J -196 °C: 70 J -296 °C: 50 J	2.5 x 300 3.2 x 300 4.0 x 350 5.0 x 400	TÜV, DNV GL, CE	Nickel base electrode, stainless; heat resistant; creep resistant. Cold toughness down to -269 °C. Well suited for welding austenitic ferritic joints. Well suited for tough joints and surfacing on heat resistant Cr and CrNi steels/cast steel grades and Ni-base alloys. Temperature limits: 500 °C in sulphureous atmospheres, 800 °C max for fully stressed welds. Resistant to scaling up to 1,000 °C.
Thermanit 625 AWS A5.11: ENiCrMo-3 EN ISO 14172: E Ni 6625 (NiCr22Mo9Nb)	C: < 0.04 Si: < 0.7 Mn: < 1.0 Cr: 21.5 Mo: 9.0 Ni: bal. Nb: 3.3 Fe: < 2.0	$R_{p0.2}$: 420 MPa R_m: 760 MPa A: 30 % CVN impact: +20 °C: 75 J -196 °C: 60 J	2.5 x 250 3.2 x 300 4.0 x 350 5.0 x 400	TÜV, CE, DNV GL	Nickel base electrode, stainless; high resistance to corrosive environments. Resistant to stress corrosion cracking. Resistant to scaling up to 1,100 °C. Temperature limit: 500 °C max. in sulphureous atmospheres. Creep resistant up to 1,000 °C. Cold toughness down to -196 °C. For joining and surfacing work with matching/similar corrosion resistant materials as well as on matching and similar heat resistant, creep resistant steels and alloys. For joining and surfacing work with cryogenic austenitic CrNi(N) steels/cast steel grades and on cryogenic Ni steels suitable for quenching and tempering.
Thermanit 617 AWS A5.11: ENiCrCoMo-1 (mod.) EN ISO 14172: E Ni 6617 (NiCr22Co12Mo)	C: < 0.08 Si: 0.7 Mn: < 0.5 Cr: 21.0 Mo: 9.0 Ni: bal. Co: 11.0 Al: 1.2 Ti: 0.5 Fe: 1.0	$R_{p0.2}$: 400 MPa R_m: 700 MPa A: 30 % CVN impact: +20 °C: 100 J	2.5 x 250 3.2 x 300 4.0 x 350	TÜV, CE	Resistant to scaling up to 1,100 °C, creep resistant up to 1,000 °C. High resistance to hot gases in oxidizing resp. carburizing atmospheres. Suited for joining and surfacing applications with matching and similar heat resistant steels and alloys. Thermanit 617 can be welded in all positions except vertical-down. It has a stable arc. The seam is finely rippled and notch-free. Easy slag removal. Preheating temperature should be adjusted to the base material. Post weld heat treatments can be applied independently of the weld metal.

Flux and metal-cored wires, nickel-base

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
BÖHLER NIBAS 625 PW-FD AWS A5.34: ENiCrMo3T1-4 EN ISO 12153: T Ni 6625 P M21 2	C: 0.05 Si: 0.4 Mn: 0.4 Cr: 21.0 Ni: bal. Mo: 8.5 Nb: 3.3 Fe: < 1.0	$R_{p0.2}$: 460 MPa R_m: 740 MPa A: 40 % CVN impact: +20 °C: 90 J -196 °C: 80 J	1.2	TÜV, CE	Flux-cored wire for high-quality joint welds of high Mo-alloy, nickel-based alloys (e.g. alloy 625 and alloy 825) as well as CrNiMo steels with a high Mo-content (e.g. 6 % Mo steels). In addition, this type is also suitable for high temperature and creep-resistant steels, heat- and cold-resistant materials, dissimilar joints and low-alloy, difficult-to-weld steels. Suitable in pressure tank construction for -196 °C up to +550 °C, otherwise scaling resistant up to +1,200 °C (sulphur-free atmosphere).
BÖHLER NIBAS 70/20-FD AWS A5.34: ENiCr3T0-4 EN ISO 12153: T Ni 6082 R M21 3	C: 0.03 Si: 0.4 Mn: 3.2 Cr: 19.5 Ni: bal. Nb: 2.5 Fe: ≤ 2.5	$R_{p0.2}$: 385 MPa R_m: 650 MPa A: 39 % CVN impact: +20 °C: 130 J -196 °C: 120 J	1.2 1.6	TÜV, CE	Fully austenitic rutile flux-cored wire of Ni 6082 R / ENiCr3T0 type for welding a variety of creep-resistant steels and nickel-based alloys. Well-suited for dissimilar welding of stainless and nickel alloys to mild steels and some copper alloys. Can also be used as a buffer layer in many difficult-to-weld applications, where the high nickel content will minimize the carbon diffusion from the mild steel into the stainless material. The austenitic structure is very stable and the risk of solidification cracking is low. Suitable for pressure vessel fabrication in the service temperature range –196°C to 550°C, otherwise resistant to scaling up to 1200°C (in S-free atmosphere). Especially designed for flat and horizontal welding positions.

Solid GMAW wire, nickel-base

Product Name Classification AWS Classification EN	Chemical composition wire (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
Thermanit 625 AWS A5.14: ERNiCrMo-3 EN ISO 18274: S Ni 6625 (NiCr22Mo9Nb)	C: 0.03 Si: 0.25 Mn: 0.20 Cr: 22.0 Mo: 9.0 Ni: Bal. Nb: 3.6 Fe: < 0.5	$R_{p0.2}$: 460 MPa R_m: 740 MPa A: 30 % CVN impact: +20 °C: 60 J -196 °C: 40 J	0.8 1.0 1.2 1.6	TÜV, DB	Nickel based alloy; high resistance to corrosive environment. Resistant to stress corrosion cracking. Resistant to scaling up to 1,100 °C. Temperature limit: 500 °C max. in sulphureous atmospheres. High temperature resistant up to 900 °C. Cold toughness down to -196 °C. Suitable for joining of matching/similar corrosion resistant steels, heat or creep resistant steels and alloys. Also for joining of cryogenic austenitic CrNi(N) steels or cast steels.

GTAW rods, nickel-base

Product Name Classification AWS Classification EN	Chemical composition rod (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
Thermanit Nicro 82 AWS A5.14: ERNiCr-3 EN ISO 18274: S Ni 6082 (NiCr20Mn3Nb)	C: 0.02 Si: 0.1 Mn: 3.0 Cr: 20.0 Ni: >67.0 Nb: 2.5 Fe: <2	$R_{p0.2}$: 400 MPa R_m: 620 MPa A: 35 % CVN impact: +20 °C: 150 J	1.6 2.0 2.4 3.2	TÜV, DB, DNV GL, CE	Nickel base, stainless TIG rod; heat resistant and creep resistant. Cold toughness down to -269 °C. For welding of austenitic-ferritic joints as well as for joining or cladding of heat resistant Cr and CrNi steels and Nickel base alloys. Temperature limits: 500 °C in sulphureous atmospheres, 800 °C max. for fully stressed welds. Resistant to scaling up to 1,000 °C.
Thermanit 625 AWS A5.14: ERNiCrMo-3 EN ISO 18274: S Ni 6625 (NiCr22Mo9Nb)	C: 0.03 Si: 0.1 Mn: 0.1 Cr: 22.0 Mo: 9.0 Ni: Bal. Nb: 3.6 Fe: <0.5	$R_{p0.2}$: 460 MPa R_m: 740 MPa A: 35 % CVN impact: +20 °C: 120 J -196 °C: 100 J	1.6 2.0 2.4 3.2	TÜV, DB, DNV GL, CE	Nickel base, stainless TIG rod; high resistance to corrosive environments. Resistant to stress corrosion cracking. Resistant to scaling up to 1,000 °C. Temperature limit: 500 °C max. in sulphureous atmospheres. High temperature resistant up to 900 °C. Cold toughness down to -196 °C. Suitable for joining or cladding of matching/similar corrosion resistant steels, heat or creep resistant steels and alloys. Also for joining of cryogenic austenitic CrNi(N) steels or cast steels.
Thermanit 617 AWS A5.14: ERNiCrCoMo-1 EN ISO 18274: S Ni 6617 (NiCr22Co12Mo9)	C: 0.05 Si: 0.1 Mn: 0.1 Cr: 21.5 Mo: 9.0 Ni: Bal. Co: 11.0 Al: 1.3 Ti: 0.3 Fe: 0.5	$R_{p0.2}$: 450 MPa R_m: 700 MPa A: 30 % CVN impact: +20 °C: 60 J	2.0 2.4	TÜV, CE	Resistant to scaling up to 1,100 °C, high temperature resistant up to 1,000 °C. High resistance to hot gases in oxidizing resp. carburizing atmospheres. For joining and surfacing applications with matching and similar heat resistant steels and alloys.
THERMANIT NIMO C 276					
Thermanit NiMo C 24 AWS A5.14: ERNiCrMo-13 EN ISO 18274: S Ni 6059 (NiCr23Mo16)	C: 0.01 Si: <0.10 Mn: <0.5 Cr: 23.0 Mo: 16.0 Ni: Bal. Fe: <1.5	$R_{p0.2}$: 450 MPa R_m: 700 MPa A: 35 % CVN impact: +20 °C: 120 J	1.6 2.0 2.4 3.2	TÜV, DNV GL, CE	Nickel based alloy. High corrosion resistance in reducing and, above all, in oxidzing environments. For joining and surfacing with matching and similar alloys and cast alloys. For welding the cladded side of plates of matching and similar alloys.

SAW wire/flux combinations, nickel-base

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
Thermanit Nicro 82 / Marathon 104 AWS A5.14: ERNiCr-3 EN ISO 18274: S Ni 6082 (NiCr20Mn3Nb) Flux: EN ISO 14174: SA FB 2	C: 0.020 Si: 0.30 Mn: 3.0 Cr: 20.2 Ni: bal. Nb: 2.4 Fe: <2.0	$R_{p0.2}$: >380 MPa R_m: >600 MPa A: >35 % CVN impact: +20 °C: >100 J	2.4	–	Thermanit Nicro 82 / Marathon 104 is a wire-flux combination for submerged arc welding. It can be applied for a large scope of base metals, like stainless and heat resistant steel grades, creep resistant and cryogenic steel grades. Also suitable for dissimilar welding (austenitic to ferritic) The weld metal shows excellent mechanical properties with high hot cracking resistance. It is mainly applied for components in chemical and in petrochemical plants. 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 information regarding this sub-arc welding flux see our detailed data sheet.
Thermanit 625 / Marathon 444 AWS A5.14: ERNiCrMo-3 EN ISO 18274: S Ni 6625 (NiCr22Mo9Nb) Flux: EN ISO 14174: SA FB 2 AC	C: 0.010 Si: 0.16 Mn: 0.2 Cr: 21.8 Mo: 9.0 Ni: bal. Nb: 3.2 Fe: <1.0	$R_{p.02}$: 420 MPa R_m: 700 MPa A: 40 % CVN impact: +20 °C: 80 J -196 °C: 70 J	1.6 2.4	TÜV, CE, GL	Excellent corrosion resistance especially to pitting and crevice corrosion. Joining of the 6 % Mo super-austenitic grades S31254, equivalent NiCrMo-alloys, surfacing of low alloyed steels Marathon 444 is an agglomerated fluoride basic welding flux with high basic slag characteristics without Cr support. The weld metals show excellent mechanical properties with high hot cracking resistance.

SAW flux, nickel-base

Product Name Classification EN	Flux type	Main constituents: %	Grain size EN ISO 14174 / densitiy	Characteristics and applications
MARATHON 104 EN ISO 14174: SA FB 2	Agglomerated fluoride-basic	SiO_2+TiO_2: 15 CaO+MgO: 36 Al_2O_3+MnO: 20 CaF_2: 25	1 – 20	Marathon 104 is an agglomerated fluoride-basic flux for submerged arc welding of stainless and heat resistant steel grades. Combined with stainless wire grades the flux has neutral metallurgical behaviour and it provides a high degree of purity in the weld metal, with good mechanical properties and good corrosion resistance. The flux does not have a Cr support. The weld metal is characterized by high resistance to hot cracking and is recommended for the highest demanding applications.
MARATHON 444 EN ISO 14174: SA FB 2	Agglomerated fluoride-basic	SiO_2+TiO_2: 7 CaO+MgO: 40 Al_2O_3+MnO: 30 CaF_2: 20	3 – 16	Marathon 444 is a highly basic agglomerated welding flux, designed for welding and cladding of NiCr(Mo) alloys. Highly resistant against hot cracking thanks to its low level of Si pick up.

GMAW, Aluminium

Product Name Classification AWS Classification EN	Chemical composition wire (%) Typical values	Mechanical properties Typical values	Ø (mm)	Approvals	Characteristics and applications
Union Al 99.7 EN ISO 18273-A: S Al 1070 (Al99.7)	Al: ≥99.7 Si: <0.20 Fe: <0.25 Ti: <0.03	R_e: 20 MPa R_m: 65 MPa A: 35 %	0.8 1.0 1.2 1.6	–	Aluminium solid wire for GMAW welding of very pure aluminium materials according to EN ISO 18273 for applications in electro technical and mechanical construction, food and chemical industry.
Union AlMg 3 AWS A5.10: ER5754 EN ISO 18273: S Al 5754 (AlMg3)	Al: bal. Mg: 2.6-3.6	R_e: 80 MPa R_m: 190 MPa A: 20 %	0.8 1.0 1.2 1.6	–	Solid aluminium wire for GMAW of AlMg alloys containing up to 3 % Mg. Seawater resistant weld metal. Good colour matching with base metal after anodizing. Thorough cleaning of the workpiece bevels is necessary. Thicker plate materials require preheating to 150 °C.
Union AlMg 4,5 Mn Zr AWS A5.10: ER5183(mod.) EN ISO 18273-A: S Al 5087 (AlMg4,5MnZr)	Al: bal. Mg: 4.5-5.2 Mn: 0.75-1.0 Cr: 0.05-0.25 Zr: 0.1-0.2 Ti: <0.15	R_e: 125 MPa R_m: 275 MPa A: 16 %	0.8 1.0 1.2 1.6	DB, DNV GL, CE	Zirconium micro-alloyed aluminium wire. The weld metal is uncritical in terms of hot cracks. Suitable especially for complicated welding constructions with critical tensions. Base material should be cleaned near the seam. Pre-heating 150 °C for plates >15 mm.
Union AlMg 5 AWS A5.10: ER5356 EN ISO 18273: AlMg5Cr(A)	Al: bal. Mg: 4.5-5.5	R_e: 110 MPa R_m: 240 MPa A: 17 %	0.8 1.0 1.2 1.6	TÜV, DB	Solid aluminium wire for GMAW of AlMg alloys containing up to 5 % Mg. Seawater resistant weld metal. Good colour matching with base metal after anodizing. Thorough cleaning of the workpiece bevels is necessary. Thicker plate materials require preheating to 150 °C.
Union AlSi 5 AWS A5.10: ER4043 EN ISO 18273-A: S Al 4043 A (AlSi5(A))	Al: bal. Si: 4.7-6.0	R_e: 70 MPa R_m: 130 MPa A: 16 %	0.8 1.0 1.2 1.6	DB, CE	Solid aluminium wire fot GMAW of AlSi containing up to 5 % Si. Oxyacetylene welding respectively brazing with suitable fluxes possible. The weld metal is not suitable for anodizing for decorative purposes. Very fluid weld pool. Base material should be cleaned near the seam. Pre-heating 150 – 200 °C for plates >15 mm. Do not use for welding hardenable alloys is high stressed zones.
Union AlSi 12 AWS A5.10: ER4047 EN ISO 18273-A: S Al 4047A (AlSi12(A))	Al: bal. Si: 11.5-13.0 Mn: <0.3	R_e: 75 MPa R_m: 165 MPa A: 4-8 %	0.8 1.0 1.2 1.6	–	Solid aluminium wire for GMAW of AlSi containing more than 10 % Si. Very fluid weld pool. The weld metal is not suitable for anodizing for decorative purposes. Base material should be cleaned near the seam. Pre-heating 150 – 200 °C for plates >15 mm. Do not use for welding hardenable alloys is high stressed zones.

GTAW, Aluminium

Product Name Classification AWS Classification EN	Chemical composition rod (%) Typical values	Mechanical properties Typical values	Ø l (mm)	Approvals	Characteristics and applications
Union Al 99.7 EN ISO 18273-A: S Al 1070 (Al99.7)	Al: ≥99.7 Si: <0.20 Fe: <0.25 Ti: <0.03	R_e: 20 MPa R_m: 65 MPa A: 35 %	1.6 2.0 2.4 3.2 4.0	–	Aluminium rod for GTAW welding of very pure aluminium materials according to EN ISO 18273 for applications in electro technical and mechanical construction, food and chemical industry.
Union AlMg 3 AWS A5.10: ER5754 EN ISO 18273: S Al 5754 (AlMg3)	Al: bal. Mg: 2.6-3.6	R_e: 80 MPa R_m: 190 MPa A: 20 %	1.6 2.0 2.4 3.2 4.0		TIG welding rod for AlMg alloys containing up to 3 % Mg. Seawater resistant weld metal. Good colour matching with base metal after anodizing. Thorough cleaning of the workpiece bevels is necessary. Thicker plate materials require preheating to 150 °C.
Union AlMg 4,5 Mn Zr AWS A5.10: ER5183 (mod) EN ISO 18273-A: S Al 5087 (AlMg4,5MnZr)	Al: bal. Mg: 4.5-5.2 Mn: 0.75-1.0 Cr: 0.05-0.25 Zr: 0.1-0.2 Ti: <0.15	R_e: 125 MPa R_m: 275 MPa A: 16 %	1.6 2.0 2.4 3.2 4.0	DB, DNV GL, CE	Zirconium micro-alloyed aluminium GTAW rod. The weld metal is uncritical in terms of hot cracks. Suitable especially for complicated welding constructions with critical tensions. Base material should be cleaned near the seam. Pre-heating 150 °C for plates >15 mm.
Union AlMg 5 AWS A5.10: ER5356 EN ISO 18273: AlMg5Cr(A)	Al: bal. Mg: 4.5-5.5	R_e: 110 MPa R_m: 240 MPa A: 17 %	1.6 2.0 2.4 3.2 4.0	TÜV, DB	TIG welding rod for AlMg alloys containing up to 5 % Mg. Seawater resistant weld metal. Good colour matching with base metal after anodizing. Thorough cleaning of the workpiece bevels is necessary. Thicker plate materials require preheating to 150 °C.
Union AlSi 5 AWS A5.10: ER4043 EN ISO 18273-A: S Al 4043 A (AlSi5(A))	Al: bal. Si: 4.7-6.0	R_e: 70 MPa R_m: 130 MPa A: 16 %	1.6 2.0 2.4 3.2 4.0	DB, CE	Rods for GTAW of AlSi containing up to 5 % Si. Oxyacetylene welding respectively brazing with suitable fluxes possible. The weld metal is not suitable for anodizing for decorative purposes. Very fluid weld pool. Base material should be cleaned near the seam. Pre-heating 150 – 200 °C for plates >15 mm. Do not use for welding hardenable alloys is high stressed zones.
Union AlSi 12 AWS A5.10: ER4047 EN ISO 18273-A: S Al 4047A (AlSi12(A))	Al: bal. Si: 11.5-13.0 Mn: <0.3	R_e: 75 MPa R_m: 165 MPa A: 4-8 %	1.6 2.0 2.4 3.2 4.0		Rods for GTAW of AlSi containing more than 10 % Si. Very fluid weld pool. The weld metal is not suitable for anodizing for decorative purposes. Base material should be cleaned near the seam. Pre-heating 150 – 200 °C for plates >15 mm. Do not use for welding hardenable alloys is high stressed zones.

Maintenance, Repair and Cladding

Covered electrodes

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
UTP 6222 Mo AWS A5.11: E NiCrMo-3 EN ISO 14172: E Ni 6625 (NiCr22Mo9Nb)	C: 0.03 Si: 0.4 Mn: 0.6 Cr: 22.0 Mo: 9.0 Ni: bal. Nb: 3.3 Fe: <1	$R_{p0.2}$: >450 MPa R_m: >760 MPa A: >30 % CVN impact: -196 °C: 45 J	2.5x250 3.2x300 4.0x350 5.0 400	TÜV, DNV GL, ABS, BV	UTP 6222 Mo is particularly suited for joining and surfacing on nickel alloys, austenitic steels, low temperature nickel steels, austenitic-ferritic-joints and claddings of the same or similar nature, like 2.4856 (NiCr22Mo 9 Nb), 1.4876 (X30 NiCrAlTi 32 20), 1.4529 (X2 NiCrMoCu 25 20 5). The weld metal is heat resistant and suitable for operating temperatures up to 1000 °C. It must be noted that a slight decrease in ductility will occur if prolonged heat treatment is given within the temperature range 600 – 800 °C. Scale-resisting in low-sulphur atmosphere up to 1,100 °C. High creep strength.
UTP 65 EN ISO 3581-A: ~E29 9 R 32 EN 14700: E Z Fe11	C: 0.1 Si: 1.0 Mn: 1.0 Cr: 29.0 Ni: 9.0 Fe: bal.	$R_{p0.2}$: >620 MPa R_m: >800 MPa A: >22 %	1.6x250 2.0x250 2.5x250 3.2x350 4.0x350 5.0x350	DB	UTP 65 is particularly suitable for joinings on hardly weldable steels, when highest demands on the welding seam are made. High crack resistance when joining parent metals of difficult weldability, such as austenitic and ferritic steels, high-manganese steels with alloyed and non-alloyed steels, heat-treatable and tool steels. As cushion layer on these materials it is also ideally suited. UTP 65 finds a variety of applications in the repair and maintenance of machine and drive components as well as in tool repairing. UTP 65 is very easily weldable with a smooth and stable arc, homogeneous, finely rippled bead appearance and gives very good slag removal, self-lifting in parts. The austenitic-ferritic weld deposit has highest strength values and high crack resistance. Workhardening, creep resistant and stainless.
UTP 068 HH AWS A5.11: E NiCrFe-3 (mod.) EN ISO 14172: E Ni 6082 (NiCr20Mn3Nb)	C: 0.025 Si: 0.4 Mn: 5.0 Cr: 19.0 Mo: 1.5 Nb: 2.2 Ni: bal. Fe: 3.0	$R_{p0.2}$: 420 MPa R_m: 680 MPa A: 40 % CVN impact: -196 °C: 80 J 15 h 650 °C / air -196 °C : 70 J	2.0x250 2.5x300 3.2x300 4.0x350 5.0x400	TÜV, KTA, ABS, BV, DNV GL	UTP 068 HH is predominantly used for joining identical or similar heat-resistant Ni-base alloys, heat-resistant austenites, such as 2.4817 (LC NiCr15Fe), 1.4876 (X10 NiCrTiAl 32 20), 1.4941 (X8 CrNTi 18 10). Specially used for joining of high carbon containing 25/35 CrNi cast steel to 1.4859 or 1.4876 for petrochemical installations with working temperatures up to 900° C. Furthermore UTP 068 HH can be used for repair welding of hardly weldable steels such as heat-treatable steels or tool steels. Additionally mixed joints of austenitic and ferritic materials with elevated service temperatures can be welded. The welding deposit of UTP 068 HH is hot-cracking-resistant, does not tend to embrittlement and is scale-resistant at high temperatures.
UTP 83 FN AWS A5.15: E NiFe-CI EN ISO 1071: E C NiFe-11	C: 1.3 Ni: 52.0 Fe: bal.	Hardness HB: 190 HB	2.5x300 3.2x350 4.0x350	–	UTP 83 FN is suitable for surfacing and joining of all commercial cast iron grades, such as lamellar grey cast iron and nodular cast iron, malleable cast iron and for joining these materials to steel or cast steel. This stick electrode is particularly used where a high deposition rate is needed. UTP 83 FN has an excellent melting performance and the easily controllable transfer provides a spatterfree deposit of perfect appearance. The weld deposit is easily machinable with cutting tools, tough and crack-resistant.

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
UTP 80 M AWS A5.11 : E NiCu-7 EN ISO 14172 : E Ni 4060 (NiCu30Mn3Ti)	C: <0.05 Si: 0.7 Mn: 3.0 Cu: 29.0 Ti: 0.7 Al: 0.3 Fe: 1.0 Ni: bal.	$R_{p0.2}$: >300 MPa R_m: >480 MPa A: >30 % CVN impact: +20 °C: >80 J	2.5x300 3.2x350 4.0x350 5.0x400	TÜV, ABS, DNV GL	UTP 80 M is suitable for joining and surfacing of nickel-copper alloys and of nickel-copper-clad steels. Parcularly suited for the following materials: 2.4360 NiCu30Fe, 2.4375 NiCu30Al. UTP 80 M is also used for joining different materials, such as steel to copper and copper alloys, steel to nickel-copper alloys. These materials are employed in high-grade apparatus construction, primarily for the chemical and petrochemical industries. A special application field is the fabrication of seawater evaporation plants and marine equipment.
UTP 6170 Co AWS A5.11: ENiCrCoMo-1 (mod.) EN ISO 14172: E Ni 6117 (NiCr22Co12Mo)	C: 0.06 Si: 0.7 Mn: 0.1 Cr: 21.0 Mo: 9.0 Ni: bal. Co: 11.0 Fe: 1.0 Al: 0.7 Ti: 0.3	$R_{p0.2}$: >450 MPa R_m: >700 MPa A: >35 % CVN impact: +20 °C: >80 J	2.5x250 3.2x300 4.0x350	TÜV	UTP 6170 Co is suitable for joining high-temperature and similar nickel-base alloys, heat resistant austenitic and cast alloys, such as 2.4663 (NiCr23Co12Mo), 2.4851 (NiCr23Fe), 1.4876 (X10 NiCrAlTi 32 21),1.4859 (GX10 NiCrSiNb 32 20). The weld metal is resistant to hot-cracking and is used for service temperatures up to 1,100 °C. Scale-resistance up to 1,100 °C in oxidizing and carburized atmospheres, e. g. gasturbines, ethylene production plants. UTP 6170 Cocan be welded in all positions except vertical-down. It has a stable arc. The seam is finely rippled and notch-free. Easy slag removal. Preheating temperature should be adjusted to the base material. Post weld heat treatments can be applied independently of the weld metal.
UTP CELSIT 706 AWS A5.13: E CoCr-A EN 14700: E Z Co2	C: 1.1 Cr: 27.5 W: 4.5 Co: bal.	Hardness of the pure weld deposit 40 – 42 HRC Hardness at 500 °C approx. 30 HRC Hardness at 700 °C approx. 160 HB	3.2x350 4.0x350 5.0x350	–	UTP CELSIT 706 is used for hardfacing on parts subject to a combination of erosion, corrosion, cavitation, impact, pressure, abrasion and high temperatures up to 900 °C, such as tight surfaces on fittings, valve seats and cones for combustion engines, gliding surfaces metal-metal, highly stressed hot working tools without thermal shock, milling mixers and drilling tools. Excellent gliding characteristics, easy polishability, good toughness, nonmagnetic. Machining by grinding or with tungsten carbide cutting tools. UTP CELSIT 706 has excellent welding properties and a homogenenous, finely rippled seam due to spray arc. Very easy slag removal.
UTP 80 Ni AWS A5.11 : E Ni-1 EN ISO 14172 : E Ni 2061 (NiTi3)	C: <0.02 Si: 0.8 Mn: 0.25 Ti: 2.0 Al: 0.2 Fe: 0.1 Ni: bal.	$R_{p0.2}$: >300 MPa R_m: >450 MPa A: >30 % CVN impact: +20 °C: >160 J	2.5x300 3.2x300 4.0x350	TÜV	UTP 80 Ni is suited for joining and surfacing on commercial pure nickel grades, including LC nickel, nickel alloys and nickel-clad steels. These materials are employed primarily in the construction of pressure vessels and apparatus in the chemical industry, in the food industry and for power generation, where good behaviour under corrosion and temperature is demanded.
UTP DUR 600 EN 14700: E Fe8	C: 0.5 Si: 2.3 Mn: 0.4 Cr: 9.0 Fe: bal.	Hardness of the pure weld deposit 56 – 58 HRC After soft–annealing 780 – 820 °C / oven approx. 25 HRC After hardening 1000 – 1050 °C / oil approx. 60 HRC 1 layer on high Mn-steel approx. 22 HRC 2 layers on high Mn-steel approx. 40 HRC	2.5x300 3.2x350 4.0x450 5.0x450	DB	UTP DUR 600 is universally applicable for cladding on parts of steel, cast steel and high Mn-steel, subject simultaneously to abrasion, impact and compression. Typical application fields are the earth moving and stone treatment industry, e.g. excavator teeth, bucket knives, crusher jaws and cones, mill hammers etc., but also for cutting edges on cold cutting tools.

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
UTP DUR 650 KB EN 14700: E Fe8	C: 0.5 Si: 0.8 Mn: 1.3 Cr: 7.0 Mo: 1.3 Nb: 0.5 Fe: bal.	Hardness of the pure weld deposit 58 – 60 HRC 1 layer on high Mn-steel approx. 24 HRC 2 layers on high Mn-steel approx. 45 HRC	3.2 x 450 4.0 x 450 5.0 x 450	–	UTP DUR 650 Kb is suitable for cladding structural parts subject to abrasion combined with impact. The main applications are tools in the earth moving industry and crushing plants as well as cold and hot working tools. The deposit is only machinable by grinding. UTP DUR 650 Kb is a martensitic alloy. The stick electrode is suited in impact an pressure stress situations. Machining of the weld metal only by grinding.
UTP LEDURIT 61 AWS A5.13: ~ E FeCr-A 1 EN 14700: EZ Fe14	C: 3.2 Si: 1.3 Cr: 32.0 Fe: bal.	Hardness of the pure weld deposit approx. 60 HRC 1 layer on steel with C = 0,15 % approx. 55 HRC 1 layer on high Mn-steel approx. 52 HRC	2.5 x 350 3.2 x 350 4.0 x 450 5.0 x 450	–	UTP LEDURIT 61 is suited for highly wear resistant claddings on parts subject to strong grinding abrasion combined with medium impact, such as conveyor screws, scraper blades, digging teeth, mixer wings, sand pumps. Also as a final layer on crusher jaws. Welding properties UTP LEDURIT 61 has excellent welding characteristics and a very easy slag removal. The homogeneous and finely rippled seam surface does, for most applications, not require any finishing by grinding.
UTP LEDURIT 65 En 14700: E Fe16	C: 4.5 Cr: 23.5 Mo: 6.5 Nb: 5.5 V: 1.5 W: 2.2 Fe: bal.	Hardness of the pure weld deposit approx. 65 HRC 1 layer on steel with C = 0,15 % approx. 58 HRC 1 layer on high Mn-steel approx. 55 HRC	3.2 x 350 4.0 x 450 5.0 x 450		UTP LEDURIT 65 is suited for highly abrasion resistant claddings on parts subject to extreme sliding mineral abrasion, also at elevated temperatures up to 500 °C. The extremely high abrasion resistance is reached by the very high content of special carbides (Mo, V, W, Nb). Main application fields are surfacings on earth moving equipment, working parts in the cement and brick industry as well as in steel mills for radial breakers und revolving-bar screens of sintering plants. UTP LEDURIT 65 has an even droplet transfer in the spray arc. The smooth welding bead is without slag covering. In general there is no need for any finishing by grinding. Recovery approx. 265 %.

GMAW wire, nickel-base

Product Name Classification AWS Classification EN	Chemical compos-ition wire (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
UTP A 6222 Mo-3 AWS A5.14: ER NiCrMo-3 EN ISO 18274: S Ni 6625 (NiCr22Mo9Nb)	C: ≤0.02 Si: ≤0.2 Cr: 22.0 Mo: 9.0 Nb: 3.5 Fe: <1.0 Ni: bal.		0.9 1.0 1.2 1.6	–	UTP A 6222 Mo-3 has been developed for applications in the oil & gas industry, and is mainly used for cladding of unalloyed and high strength low alloyed steel (HSLA) components. Typical applications are internal cladding of tubes & pipes, risers, and subsea components such as manifolds, BOPs, Christmas trees, well heads, flanges, valve bodies, blocks etc. to improve corrosion resistance to surfaces exposed to hydrocarbon and hydrogen sulphide. Typical base metals for these applications are SAE 4130, SAE 8630, F 22, F 65. UTP A 6222 Mo-3 has excellent dissimilar materials welding character-istics and can be used for joining components produced from a variety of clad and base metal alloys such as austenitic, super austenitic, martensitic, Duplex and Super Duplex stainless steels. UTP A 6222 Mo-3 is manufactured to optimise wire-feed and weld pool delivery characteristics, via consistent metallurgical quality raw material and physical control of wire processing, pre-requisites for successful cold and hot wire GTAW/TIG applications where the highest quality standards have to be fulfilled. The wire can also be successfully applied using the GMAW/MIG process. UTP A 6222 Mo-3 can be welded with either cold- or hot wire automated TIG (GTAW) or MIG.

GTAW rods, nickel-base

Product Name Classification AWS Classification EN	Chemical composi-tion rod (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
UTP A 6222 Mo AWS A5.14 : ER NiCrMo-3 EN ISO 18274 : S Ni 6625(NiCr22Mo9Nb)	C: <0.02 Si: <0.2 Cr: 22.0 Mn: 9.0 Ni: Bal. Nb: 3.5 Fe: 1.0	$R_{p0.2}$: 460 MPa R_m: 740 MPa A: 30 % CVN impact: +20 °C: >100 J -196 °C: >85 J	1.6 2.0 2.4	TÜV, DNV GL, ABS	Rods and wires for high corrosion resistant NiCrMo-alloys. The special features of the weld metal of UTP A 6222 Mo include a good creep rupture strength, corrosion resistance, resistance to stress and hot cracking. It is highly resistant and tough even at working temperatures up to 1100 ° C. It has an extremelygood fague resistance due to the alloying elements Mo and Nb in the NiCr-matrix. The weld metal is highly resistant to oxidaon and is almost immune to stress corrosion cracking. It resists intergranular penetraon without having been heat-treated.

SAW wire/flux combinations

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
UTP UP 6222 Mo/ Record IND 24 AWS A5.14: ERNiCrMo-3 EN ISO 18274: S Ni 6625 (NiCr22Mo9Nb)	C: <0.02 Si: <0.2 Cr: 21.0 Mo: 9,0 Ni: bal. Nb: 3.3 Fe: 2.0	$R_{p0.2}$: 460 MPa R_m: 725 MPa A: 40 % CVN impact: +20 °C: >80 J -196 °C: 65 J	1.6 2.0 2.4 3.2		For high quality welding joints of 6 % Mo alloyed super-austenitic steels like S31254, N08926, N08367 and nickel-base alloy 625. Designed for highest corrosion requirements and an extremely high resistance against pitting and stress corrosion (PREN > 52).
UTP UP 80M/Record NiCuW AWS A 5.7: ER NiCu-7 EN ISO 18274: S Ni 4060 (NiCu30Mn3Ti)	C: 0.02 Si: 1.3 Mn: 3.4 Ti: 0.9 Fe: 3.8 Cu: 29.5 Ni: bal.	$R_{p0.2}$: >260 MPa R_m: >490 MPa A: 30 % CVN impact: +20 °C: >100 J	2.4 3.2		The SAW-wire-flux-combination of UTP UP 80 M + Record NiCuW is suited for welding of components in plants of chemical apparatus construction, seawater evaporation and offshore. Excellent resistance to stress corrosion cracking, esp. in halogenous environments. This wire-flux-combination is designed for joining and cladding of NiCu alloys, cladding of carbon steels and joint welding of matching or similar materials.
SK CrMo15-SA/Record SA ASME IIC SFA 5.23: F9P2-ECB2-B2 F10A10-ECB2-B2	C: 0.02 Mn: 0.8 Si: 0.6 Cr: 1.1 Mo: 0.4 Fe: bal.	Hardness as welded: 230 HB	2.0 2.4 3.2		Cored wire for joining and rebuilding of mild and low alloy steels. Can also be used as buffer layer prior to hardfacing. Microstructure: Ferritic. Machinability: Good with conventional tools. Oxy-acetylene cutting: Cannot be flame cut. Deposit thickness: Depends upon application and procedure used. Welding flux: Record SA
SK 410 NiMo-SA/Record SA DIN 8555: UP 5-GF-40-C	C: 0.05 Mn: 1.0 Si: 0.3 Cr: 12.5 Ni: 5.0 Mo: 0.9 Fe: bal.	Hardness as welded: 39 HRC	2.4 3.2		Alloy depositing a ferritic-martensitic steel containing 13 % Chromium, 5 % Nickel and 1 % Molybdenum designed to resist metal-to-metal wear, corrosion and thermal fatigue. Fire cracking. Microstructure: Martensite + 10 %. Ferrite Machinability: Good with carbide tipped tools. Oxy-acetylene cutting: Cannot be flame cut. Deposit thickness: Depends upon application and procedure used.

SAW flux

Product Name	Classification	General characteristics	Characteristics and applications
Record IND 24	DIN EN ISO 14174: SA FB 2	Current: DC (+/-) and AC - 900A max. Basicity index: 2.2 Grain size: 0.4 – 1.4 mm Apparent density: 1.0 Consumption: 0.65 (kg flux/ kg wire) Redrying: 1-2h at 350 +/- 50 °C	Record IND 24 is an agglomerated basic welding flux for welding stainless high alloyed Cr-Ni-(Mo) steels. The weld seams are smooth and finely rippled without any slag residues. Besides the good slag detachability the flux also provides good fillet weld properties. The weld metals show a high degree of purity and good mechanical properties.
RECORD NiCrW	DIN EN ISO 14174: SA FB 2	Current: DC (+/-) and AC - 800A max. Basicity index: 4.5 Grain size: 0.4 – 1.4 mm Apparent density: 1.0 Consumption: 1 (kg flux/ kg wire) Redrying: 1-2h at 350 +/- 50 °C	Record NiCrW os a high basic agglomerated flux designed for welding and cladding of NiCr(Mo) alloys. It has a high resistance against hot cracking thanks to its low silicon pick-up.
RECORD SA	DIN EN ISO 14174: SA FB 2	Current: DC (+/-) and AC - 1000A max. Basicity index: 3.4 Grain size: 0.4 – 1.4 mm Apparent density: 0.85 Consumption: 0.65 (kg flux/ kg wire) Redrying: 1-2h at 350 +/- 50 °C	Highly basic agglomerated flux designed for hardfacing with cored wires or solid wires. Very good slag removal even at high welding intensity levels.

Brazing

Solid wires / rods

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
FONTARGEN A 200 SM AWS A 5.7: ER Cu ISO 24373: S Cu 1898 (CuSn1)	Sn: 0.8 Mn: 0.3 Si: 0.3 Cu: Rem.	Melting range: 1020 – 1050 °C R_e: 120 MPa R_m: 200-240 MPa A: 30 % CVN impact: +20 °C: 75 J Hardness: 50-60 HB	0.8 1.0 1.2 1.6	–	Joint and build-up welding on oxygen-free copper and copper alloys of material numbers: 2.0040, 2.0060, 2.0070, 2.0080, 2.0090, 2.0100, 2.0120, 2.0150, 2.0170, 2.1202, 2.1322, 2.1325, 2.1491. Suitable for out-of posion welding. Clean base materials in the welding spheres and preheat if over 3 mm (per mm of plate thickness approx. 100 °C, but not more than 600 °C). Suitable for welding of galvanised steel (MIG-brazing).
FONTARGEN A 202 M AWS A5.7: ERCuSi-A ISO 24373: S Cu 6560 (CuSi3Mn1)	Si: 2.9 Sn: 0.1 Zn: 0.1 Mn: 1.2 Fe: -.2 Cu: bal.	Melting range: 965 – 1032 °C R_e: 120 MPa R_m: 350 MPa A: 40 % CVN impact: +20 °C: 60 J Hardness: 80 HB	0.8 1.0 1.2 1.6		MIG-brazing of zinc or aluminium plated and uncoated steel plates. Applications: Auto body, air condition and container building. The corrosion resistance of zinc plated surfaces remains unaffected . Little deformation of thin steel sheets.
FONTARGEN A 2115/8 M AWS A5.7: ERCuAl-A1 ISO 24373: S Cu 6100 (CuAl7)	Al: 8.0 Ni: 0.5 Mn: 0.2 Fe: 0.2 Cu: bal.	Melting range: 1030 – 1040 °C R_m: 380-450 MPa A: 45 % Hardness: 60-80 HB	0.8 1.0 1.2		MIG-brazing of aluminium plated and uncoated steel plates. Applications: Auto body, magnetic solenoids, air conditioning and container building. The corrosion resistance galvanized steel plates remain unaffected. Little deformation of thin steel sheets. Suitable for joining of aluminium-bronze, high-strength brass and steel. Range of applications: Car body, ship building, heating and cooling as well as container building.
FONTARGEN A 101 AWS A5.8: RBCuZn-D EN ISO 3677: B-Cu48ZnNi(Si)-890/920	Cu: 48 Ni: 9.5 Si: 0.25 Mn: <0.2 Sn: <0.2 Zn: bal.	Melting range: 890 – 920 °C R_m: 690 MPa A: 15 – 20 %	1.5 2.0 3.0		Nickel-bearing filler metal of high strength and good fluidity. Suitable for brazing of steel, cast iron, malleable cast iron, nickel and nickel alloys. Suitable for brazing and hardening in one production step. It is very often used in the steel furniture industry.
FONTARGEN A 210 AWS A 5.8 : RB Cu Zn – A EN ISO 3677 : B-Cu 60 Zn (Si) – 875/895	Cu: 60 Si: 0.3 Sn: <0.2 Zn: Rem.	Melting range: 875 – 895 °C R_m: >350 MPa A: >35 % Hardness: 110 HB	2.0 2.5 3.0 4.0		Brazing alloy with good flowing properties, hardly sensitive to over heating. Suitable for gap brazing and coating of steel, cast iron, malleable cast iron, nickel and nickel alloys, as well as copper and copper alloys with a solidus >900 °C.
FONTARGEN A 2003 AWS A 5.8: B Cu P - 2 EN ISO 3677: B-Cu 93 P - 710/820 Material No.: 2.1463	Cu: 93 P: 7	Melting Range: 710 – 820 °C R_m: 250 N / mm² A: 5 %	–	–	Filler metal with good flowing properties and capillarity. Suitable for gap brazing of copper and copper alloys. Joint-brazing at working temperatures between -20 °C and +150 °C. Do not use in sulphurous environment and on Fe-and Ni-alloys
FONTARGEN A 3002 EN ISO 3677: B-Cu92PAg-645/825	Ag: 2.0 Cu: 91.7 P: 6.3	Melting range: 645 – 825 °C R_m: 250 MPa A: 5 %	1.5 2.0 3.0	–	Copper-phosphorus alloy with low silver content. This alloy has good gap filling properties and is well suited to bridge wide gaps. Suitable for gap brazing of copper and copper alloys. Approved by DVGW-worksheet GW 2 for copper pipes. Joint-brazing at working temperatures between -60 °C and +150 °C. Do not use in sulphurous environment and on Fe- and Ni-alloys.

Product Name Classification AWS Classification EN	Chemical composition (%) Typical values	Mechanical properties Typical values	Ø x l (mm)	Approvals	Characteristics and applications
FONTARGEN A 3005 AWS A5.8: BC uP-3 EN ISO 3677: B-Cu89PAg-645/815	Ag: 5 Cu: 89 P: 6	Melting range: 645 – 815°C R_m: 250 MPa A: 8 %	1.5 2.0 3.0		Copper-phosphorus alloy with low silver content, good flowing properties and high ductility. Suitable for gap brazing of copper and copper alloys. Jointbrazing at working temperatures between -60 °C and +150 °C. Do not use in sulphurous environment and on Fe- and Ni-alloys.
FONTARGEN A 3015 AWS A5.8: BC uP-5 EN ISO 3677: B-Cu80AgP-645/800	Ag: 15 Cu: 80 P: 5	Melting range: 645 – 800°C R_m: 250 MPa A: 10 %	2.0 3.0		Thin fluid copper-phosphorus alloy with high silver content and high ductility, even at low temperatures. Suitable for gap brazing of copper and copper alloys. Recommended for joints with strong thermal load and vibrations. Jointbrazing at working temperatures between -70 °C and +150 °C. Do not use in sulphurous environment and on Fe- and Ni-alloys.
FONTARGEN A 320 AWS A 5.8 : B Ag – 36 EN ISO 3677 : B-Ag 45 Cu Zn Sn – 640/680	Ag: 45 Cu: 27 Zn: 25.5 Sn: 2.5 Si: 0.15	Melting range: 640 – 680°C R_m: 350 – 430 MPa A: 12 %	2.0 2,5 3.0 4.0	DVGW, GW 2, VG 81245	Cadmium free brazing alloy for gap brazing of alloyed and unalloyed steel, nickel and nickel alloys, malleable cast iron, copper and copper alloys. Approval: Marine code VG 81245, secon 3. Also suitable for copper pipe installation according to DVGW work certificate GW 2. The silicon contained in the solder can reduce the mechanical property values of welded carbon steels. Joint-brazing at working temperatures of max 200 °C.
FONTARGEN A 330 AWS A5.8: BAg-20 EN ISO 3677: B-Cu38ZnAg-680/765	Ag: 30 Cu: 38 Zn: 32	Melting range: 680 – 765°C R_m: 380 – 430 MPa A: 25 %	1.5 2.0		Silver alloy, cadmium free, insensitive to overheating. Gap brazing of alloyed and unalloyed steel, nickel and nickel alloys, malleable cast iron, copper and copper alloys. Good colour match with brass. Joint-brazing at working temperatures of max. 300 °C.
FONTARGEN A 340 AWS A5.8: BAg-140 EN ISO 3677: B-Ag40CuZnSn-650/710	Ag: 40 Cu: 30 Zn: 28 Sn: 2 Si: 0.15	Melting range: 650 – 710°C R_m: 350 – 430 MPa A: 20 %	1.5 2.0 3.0	VG 81245	Silver alloy, cadmium free, insensitive to overheating. Gap brazing of alloyed and unalloyed steel, nickel and nickel alloys, malleable cast iron, copper and copper alloys and carbides. Seawater resistant, according to marine standard VG 82145, part 3. Silicon can reduce the mechanical properties of carbon steel. Joint-brazing at working temperatures of max. 200 °C.

Pickling & passivation

Product Name	Product type	Characteristics and applications
Avesta Pickling Paste 101	Paste	A universal pickling paste with good adhesion properties. Suitable for pickling of standard stainless steel grades such as 304 and 316, and for difficult surfaces such as “overhead” pickling
Avesta Pickling Gel 122	Gel	A universal pickling gel, with a more free-flowing consistency that facilitates the application and gives a high coverage. Suitable for pickling of standard stainless steel grades such as 304 and 316 and for use and storage in warmer climates.
Avesta BlueOne Pickling Paste 130	Paste	A unique world patented safer-to-use pickling paste. This low-fuming pickling paste reduces toxic nitric fumes by 80 %. Suitable for pickling of standard stainless steel grades such as 304 and 316.
Avesta RedOne Pickling Paste 140	Paste	A powerful world patented safer-to-use pickling paste. This low-fuming pickling paste reduces toxic nitric fumes by 50 %. Suitable for pickling of heavy-duty applications such as high-alloyed stainless steel grades like duplex and SMO, and for picking at lower temperatures.
Avesta Pickling Spray 204	Spray	A powerful pickling spray for heavy-duty applications such as high-alloyed stainless steel grades such like duplex and SMO, and pickling at lower temperatures.
Avesta RedOne Pickling Spray 240	Spray	A unique, safer-to-use pickling spray. This low-fuming pickling spray reduces toxic nitric fumes by 50 %. Suitable for pickling of standard stainless steel grades such as 304 and 316.
Avesta Pickling Bath 302	Liquid	A concentrated pickling bath which should be diluted with water depending on the stainless steel grade. Suitable for immersion pickling of objects or circulation pickling of pipe systems.
Avesta Cleaner 401	Spray	A heavy-duty stainless steel cleaner. Suitable for pre-cleaning and degreasing of stainless steel surfaces before pickling. Could also be used for maintenance cleaning to restore and brighten stainless steel surfaces and remove surface rust. The Cleaner 401 can be used for maintenance cleaning and surface restoration together with Passivator 630 to further improve the cleaning effect.
Avesta Neutraliser 502	Liquid	For simple neutralization of acidic rinse water resulting from pickling. This rinse water is acidic and contains dissolved metals including chromium and nickel. For environmental reason this water should be treated before discharge.
Avesta Passivator 601	Spray	A traditional nitric acid based well-proven passivator. The passivator can be used after mechanical cleaning of stainless steel surfaces to remove remaining grinding dust and iron particles. It can also be used after pickling to accelerate the rebuilding of the protective layer of chromium oxide.
Avesta FinishOne Passivator 630	Spray	An acid-free passivator, which creates no hazardous waste. The passivator can be used after mechanical cleaning of stainless steel surfaces to remove remaining grinding dust and iron particles. It can also be used after pickling to accelerate the rebuilding of the protective layer of chromium oxide.
Avesta Moly Test 960	Liquid	Easy identifying of stainless steel grades. The Moly-Drop test helps to differentiate 304 (EN 1.4301) grade stainless steel from 316 grade (EN 1.4436)
Avesta Spray Pump SP-25	Pump	A customized pump system for Finishing Chemicals. The pump is specially designed for the demanding spraying of cleaning solutions.

071/2016/EN/ME

voestalpine Böhler Welding

Welding know-how joins steel

Customers in over 150 countries join the expertise of voestalpine Böhler Welding. Focused on filler metals, voestalpine Böhler Welding offers extensive technical consultation and individual solutions for industrial welding and soldering applications. Customer proximity is guaranteed by 40 subsidiaries in 28 countries, with the support of 2,200 employees, and through more than 1,000 distribution partners worldwide. voestalpine Böhler Welding offers three specialized and dedicated brands to cater our customers' and partners' requirements.

böhler welding by voestalpine

Böhler Welding – More than 2,000 products for joint welding in all conventional arc welding processes are united in a product portfolio that is unique throughout the world. Creating lasting connections is the brand's philosophy in welding and between people.

utp maintenance by voestalpine

UTP Maintenance – Decades of industry experience and application know-how in the areas of repair as well as wear and surface protection, combined with innovative and custom-tailored products, guarantee customers an increase in the productivity and protection of their components.

fontargen brazing by voestalpine

Fontargen Brazing – Through deep insight into processing methods and ways of application, Fontargen Brazing provides the best brazing and soldering solutions based on proven products with German technology. The expertise of this brand's application engineers has been formulated over many years of experience from countless application cases.

forwarded by:

voestalpine Böhler Welding Middle East FZE
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

fontargen brazing
by voestalpine

Brazing Solutions for the HVAC Industry

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

voestalpine Böhler Welding

Metallurgical Expertise for Best Welding Results

voestalpine Böhler Welding (formerly Böhler Welding Group) is a leading manufacturer and worldwide supplier of filler materials for industrial welding and brazing applications.

As a part of the voestalpine Group, Austria's largest steel manufacturer and one of the world's leading suppliers of specialized steel products, we are a part of a global network of metallurgy experts.

Our customers benefit from:

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

Customer First

Absolute customer focus is our guiding principle. We see ourselves as a provider of solutions to challenging welding projects. We ensure that our customers get the right filler metals, use them correctly, and that all welding process parameters are adjusted for the best possible performance. We consider it as our responsibility to guarantee that we deliver to our customers, now and in the future, the best possible solutions. We also strive to develop new products, optimize existing products, and streamline processes so as to achieve very short turnaround times. We focus on technologically advanced industrial sectors and provide products that are geared to their specific requirements.

Three Competences – Three Brands

In our efforts to afford our customers the best possible support and promote development in line with specific targets, we have built our core competences within Joint Welding, Repair & Maintenance Welding and Soldering & Brazing.

This way we offer our customers the largest and most comprehensive product portfolio of filler materials within our three brands:

- Böhler Welding
- UTP Maintenance
- Fontargen Brazing

Join Expertise

Silver-containing brazing consumables to your requirements

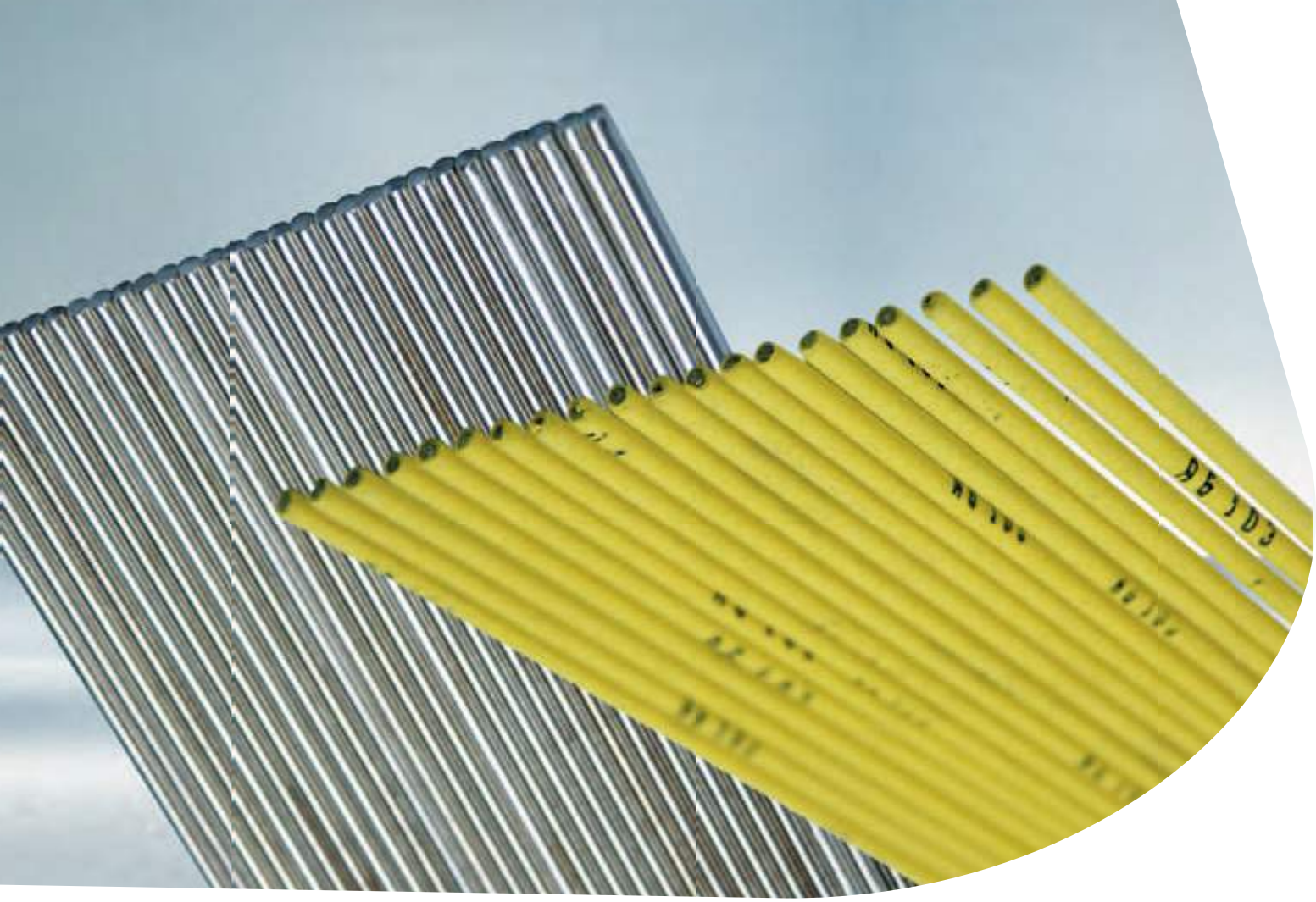
As one of the leading suppliers of silver-containing brazing consumables for the HVAC&R industry, voestalpine Böhler Welding offers customized brazing solutions for a demanding market.

China, Mexico, Middle East and Europe are the main markets for HVAC&R brazing. As a competent partner for brazing applications voestalpine Böhler Welding serves customers in refrigeration, HVAC systems and vehicle air-conditioning as well as in the heat pump technology. The industry trends are taken into account in product selection and product development:

- Ongoing expansion of fast food chains with new equipment needed at smaller locations for cooling large volumes of food.
- Market driven by the increase in frozen food consumption. Need to increase the cold chain quality in order to insure high hygiene standards.
- Avoid breakdown and loss of stocks and insure the concordance regarding all National legislations for food safety standards.
- Reduce production costs by optimizing brazing and post brazing processes.
- Air-conditioning of buildings, offices, cars, a.s.o. to be seen as standard.
- Use of aluminum as new base material for micro-channels heat exchangers (HX).

Rely on a strong Partnership

voestalpine Böhler Welding is involved in many global R&D projects, partnerships with HVAC&R manufacturers and networks. We provide the technical support for both developing the brazing process and choosing the appropriate alloys types and forms. We run technical process optimization with the customer and support him in its new projects.



Take advantage of technically proven and customized products

Applications

We supply products for:

- Heating: heat pumps; water heaters; room heating; towel dryers; induction heaters; thermostats; cookware
- Air conditioning: heat exchangers; chillers; roof top units; data center cooling; room air conditioning units
- HVAC DX systems: air-cooled and water cooled (split; build-up; windows unit; packaged unit; condenser water pump units; cooling towers)
- HVAC central systems: air-cooled chilled and water cooled chilled (condensers; chilled water pump units; chillers; cooling towers)
- Refrigerating: refrigerators; displays (island; multi-deck); reach-in coolers; walk-in coolers; blast freezers; freezers; transportation coolers
- HVAC vehicle: evaporator; compressor; condenser; radiator; car heater cores
- Compressors: rotary; reciprocating; scroll; screw and centrifugal

Product solutions

- Bare and coated silver rods and wires
- Fluxes
- Copper phosphorus rods and wires (square and round)
- Copper and aluminum wires
- Copper, tin, silver and nickel brazing paste
- Preforms
- Foils

Services

We provide additional value by offering:

- Process optimization with the customer
- Brazing process debugging
- Courses for the staff
- Expertise in brazing techniques
- Intensive customer support by our competent internal and external staff

Important benefits for customers

- Solution provider
- Global distribution and sales network
- Broad product range
- Fulfilling special demands
- Engineering support
- ISO 9001 / 14001 Approvals
- AEO Standard
- Deliveries just in time in all packing units
- Financial performance

	DIN EN 1044 (Brazing) EN 29453 (Soldering)	DIN 8513	Deep temperature resistance	Flux Type	Delivery										
					Rods bare	Square rods bare	Rods flux-coated	Rods flux-coated (thin)	Rods flux-coated (extra-thin)	Rods flux-coated (flexible)	Foil	Wire	Powder	Preforms	Paste
Copper - Copper[1] / Copper - Brass[2] **Brazing** Overlapping joint															
A 2004	CP 203	L-Cu P 6	-60 °C	- [1] / F 300[2]	•							•			•
A 3002 V	CP 105	L-Ag 2 P	-60 °C	- [1] / F 300[2]		•									
A 3005 V	CP 104	L-Ag 5 P	-60 °C	- [1] / F 300[2]		•						•			
A 3015 V	CP 102	L-Ag 15 P	-70 °C	- [1] / F 300[2]	•	•					•	•	•		•
A 319	AG 106	L-Ag 34 Sn	-200 °C	F 300	•		•	•	•	•	•	•	•	•	•
A 340	AG 105	L-Ag 40 Sn	-200 °C	F 300	•		•	•	•	•	•	•	•	•	•
A 320	AG 104	L-Ag 45 Sn	-200 °C	F 300	•		•	•	•	•	•	•	•	•	•
A 314	AG 103	L-Ag 55 Sn	-200 °C	F 300	•		•	•	•	•	•	•	•	•	•
Blunt joint															
A 311	AG 203	L-Ag 44	-200 °C	F 300	•		•	•	•		•	•	•	•	•
Soldering Overlapping joint															
A 611	S-Sn 96 Ag 4		-200 °C	F 600								•		•	•
A 627	S-Sn 95 Sb 5		-200 °C	F 600								•		•	
Brazing **Copper - Steel (austenitic)[3] / (ferritic)[4]** Overlapping joint															
A 319	AG 106	L-Ag 34 Sn	-200 °C[3] / -70 °C[4]	F 300	•		•	•	•	•	•	•	•	•	•
A 340	AG 105	L-Ag 40 Sn	-200 °C[3] / -70 °C[4]	F 300	•		•	•	•	•	•	•	•	•	•
A 320	AG 104	L-Ag 45 Sn	-200 °C[3] / -70 °C[4]	F 300	•		•	•	•	•	•	•	•	•	•
A 314	AG 103	L-Ag 55 Sn	-200 °C[3] / -70 °C[4]	F 300	•		•	•	•	•	•	•	•	•	•
Blunt joint															
A 311	AG 203	L-Ag 44	-200 °C[3] / -70 °C[4]	F 300	•		•	•	•		•	•	•	•	•
Soldering Overlapping joint															
A 611	S-Sn 96 Ag 4		-200 °C[3] / -70 °C[4]	F 600								•		•	•
Aluminium - Aluminium **Brazing**															
A 407 L	AL 104	L-Al Si 12	-200 °C	F 400 D2	•		•	•	•			•	•	•	•
				F 400 NHD[5]											
DIN EN 1045: FL 10: corrosive residues to be removed [5] DIN EN 1045: FL 20: Residues non-corrosive in general. Keep dry															
Soldering															
A 608	L-Pb Sn Cd 4		-70 °C	F 600 AL								•			•
A 633	L-Zn Al 4		-70 °C	F 600 Zn								•			•
Aluminium - Copper **Soldering**															
A 633	L-Zn Al 4		-70 °C	F 600 ZN								•			•

023/2015/EN/GL

voestalpine Böhler Welding

Welding know-how joins steel

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

Böhler Welding – More than 2,000 products for joint welding in all conventional arc welding processes are united in a product portfolio that is unique throughout the world. Creating lasting connections is the brand's philosophy in welding and between people.

UTP Maintenance – Decades of industry experience and application know-how in the areas of repair as well as wear and surface protection, combined with innovative and custom-tailored products, guarantee customers an increase in the productivity and protection of their components.

Fontargen Brazing – Through deep insight into processing methods and ways of application, Fontargen Brazing provides the best brazing and soldering solutions based on proven products with German technology. The expertise of this brand's application engineers has been formulated over many years of experience from countless application cases.

forwarded by:

Global Industry Segment Management
HVAC

T. +49 6351 401 0
brazing.hvac@voestalpine.com

voestalpine Böhler Welding Fontargen GmbH
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

New eyewear available – Get the perfect protection

- Unique design
- Eyewear fulfilling industrial standards (CE, EN 166F)
- Display spender box of 20 pcs.
- Supremely comfortable and extremely robust
- Branded micro-fiber pouches for storage and lens cleaning

Different lenses offered

Examples Böhler Welding		Art. no.	Product name
	**Clear** general industrial use	32457	Böhler Eyewear Clear
		32467	UTP Eyewear Clear
		32477	Fontargen Eyewear Clear
	**Amber** for low light conditions	32458	Böhler Eyewear Amber
		32468	UTP Eyewear Amber
		32484	Fontargen Eyewear Amber
	**Blue Mirror / Silver Mirror** for outdoor industrial use offering sunglare protection	32464	Böhler Eyewear Blue Mirror
		32469	UTP Eyewear Silver Mirror
		32486	Fontargen Eyewear Silver Mirror
	**UVIR5**	32466	Böhler Eyewear IR5
		32475	UTP Eyewear IR5
		32496	Fontargen Eyewear IR5

Minimum order quantity: 1 display spender box of 20 pcs.

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

utp maintenance
by voestalpine

Filler Metals for Repair, Anti-wear and Anti-corrosion

voestalpine Böhler Welding
www.voestalpine.com/welding

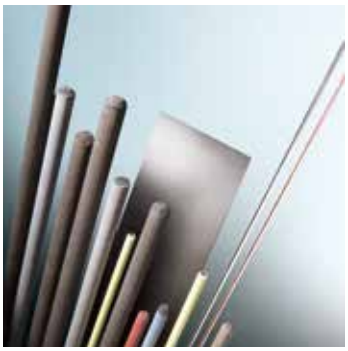
voestalpine
ONE STEP AHEAD.

UTP Maintenance

Tailor-Made Protectivity™

High-quality industrial-use welding filler metals for maintenance, repair, and overlay welding. By adding the UTP and Soudokay brands to the voestalpine Böhler Welding brand network, the UTP Maintenance can look back on a proud history spanning 60 years as an innovative supplier of welding technology products. UTP Maintenance is the global leader in the repair, maintenance, and overlay welding segment.

With roots both in Bad Krozingen (Germany) and Seneffe (Belgium), UTP Maintenance offers the world's most unique product portfolio for filler metals from its own production facilities. The Soudokay brand was established back in 1938, while the UTP brand began operations in 1953. Each of these brands therefore respectively look back on a long history of international dimension.



By merging into the UTP Maintenance brand, the collective know-how of both brands – gathered over decades in the fields of metallurgy, service, and applications engineering – is now united under one umbrella. As a result, a truly unique portfolio of solutions for welding applications has been created in the fields of repair, maintenance, and overlay welding.

Tailor-Made Protectivity™

Industry experience and applications know-how – combined with innovative and custom (tailor-made) products – guarantee that our customers obtain the ideal combination of productivity and protection, within the shortest operating times and up to the maximum performance capacity of their products. This explains UTP Maintenance's guiding principle – "Tailor-Made Protectivity™" – which puts the focus on the customer.

Research and Development for Customized Solutions

At UTP Maintenance, research and development, conducted in collaboration with customers, plays a crucial role. Because of our strong commitment to research and development, combined with our tremendous innovative capacity, we are constantly engineering new products, and improving existing ones on an ongoing basis.
The result is a vast number of innovative products for solving individual problems and complex matters.

Customized Products of Superior Quality

We continuously adapt our product portfolio of about 600 products to customer and industry specifications, while ensuring that we meet the highest quality specifications.

From its in-house production facilities, UTP Maintenance delivers innovative, tailor-made welding filler metals for: unalloyed and fine-grained structural steel, low-grade alloyed steels, rust-proof, acid-proof, and heat-proof steels, nickel-based alloys, cast iron, copper and copper alloys, manganese steels, tool steels, and cobalt steels.

The product portfolio comprises:

- Stick electrodes
- Solid wires and rods
- Flux cored wires
- Submerged arc wires and fluxes
- Submerged arc strips and fluxes
- Spraying- and PTA-powders

Solutions at Every Point on the Globe

UTP Maintenance provides products and services through the global branches of voestalpine Böhler Welding and its dealer network in more than 150 countries throughout the world. A team of welding engineers stand at the customer's side, providing advice and support in all matters related to the challenges of welding technology.

Business Product Lines

Maintenance		Cladding
Repair product line	Surfacing product line	Cladding product line
Repair of cracked material	Anti-wear applications	Anti-corrosion applications
■ Covered Electrodes ■ TIG Rods ■ Solid Wires ■ Metal Cored Wires ■ Gas Shielded Cored Wires ■ Open Arc Wires	■ Covered Electrodes ■ Solid Wires ■ Metal Cored Wires ■ Gas Shielded Cored Wires ■ Open Arc Wires ■ SAW-Wires ■ SAW-Flux ■ SAW-Cored Wires ■ Thermal Spraying Powders	■ Covered Electrodes ■ TIG Rods ■ Solid Wires ■ Gas Shielded Cored Wires ■ Open Arc Wires ■ SAW-Flux ■ SAW-Cored Wires ■ SAW-Strips ■ Cladding Equipment

Industry Focus

- Agriculture & Food
- Cement
- Earth Moving
- Energy & Power
- Glass
- Mining
- Oil & Gas
- Pulp & Paper
- Pumps, Valves & Fittings
- Railway Systems
- Recycling and Waste Management
- Shipyards
- Steel Structure
- Steel Works
- Sugar & Ethanol
- Tool Construction

Contents

Corresponding filler metals

Covered Electrode	TIG Rod	Solid wire	Gas shielded cored wire	Open Arc wire	SAW Cored wire
UTP 610	UTP A 118	UTP A 118			
UTP 611		UTP A 119			
UTP 614 KB		UTP A 119	UTP AF152	SK BU-C1	
UTP 63	UTP A 63	UTP A 63	SK 402-G / SK 307-G	SK 402-O	SK 402-S
UTP 68 LC	UTP A 68 LC	UTP A 68 LC	UTP AF 68 LC	SK 308L-O	
UTP 68 Mo	UTP A 68 Mo	UTP A 68 Mo			
UTP 68 MoLC	UTP A 68 MoLC	UTP A 68 MoLC		SK 316L-O	
UTP 6824 LC	UTP A 6824 LC	UTP A 6824 LC	UTP AF 6824 LC	SK 309L-O	
UTP 068 HH	UTP A 68 HH	UTP A 68 HH			
UTP 6222 Mo	UTP A 6222 Mo	UTP A 6222 Mo			
UTP 83 FN	UTP A 8051 Ti		SK FNM-G	SK FN-O	
UTP 86 FN	UTP A 8051 Ti		SK FNM-G	SK FN-O	
UTP 387	UTP A 387	UTP A 387			
UTP 34 N	UTP A 34 N	UTP A 34 N			
UTP 73 G 2	UTP A 73 G 2	UTP A 73 G 2	SK D 12-G / SK D 12S-G		
UTP 73 G 3	UTP A 73 G 3	UTP A 73 G 3			
UTP 73 G 4	UTP A 73 G 4	UTP A 73 G 4	SK 734-G	SK 734-O	
UTP 690			SK 20-G		
UTP 750			SK D35-G		SK D 35-S
UTP 7200				SK 313-O	
UTP BMC			SK AP-G	SK AP-O	SK AP-S
UTP CELSIT 706			SK STELKAY 6-G	SK STELKAY 6-O	
UTP CELSIT 721			SK STELKAY 21-G		
UTP DUR 250		UTP A DUR 250	SK D250-G / SK 250-G	SK BU-O	SK BU-S
UTP DUR 350		UTP A DUR 350	SK 350-G	SK 350-O	SK 350-S
UTP DUR 600		UTP A DUR 600	UTP AF DUR 600 T / SK 600-G	SK A12-O	
UTP LEDURIT 61				SK 460-O	
UTP LEDURIT 65				SK A45-O	SK A45-S

Covered electrodes for repair of cracked material

Unalloyed and low alloy steels

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP 610	AWS 5.1	Yield strength RP0,2	Tensile strength Rm	Rutile cellulose coated stick electrode with very good weldability in all positions, including vertical down. Universal electrode, particularly for small transformers. Bendable covering. Versatile application in steel, vehicle etc.
	E 6013	≥ 380	470-600	
	EN ISO 2560-A	Elongation A	Impact strength KV	
	E 38 0 RC 11	≥ 20	≥ 47	
UTP 611	AWS 5.1	Yield strength RP0,2	Tensile strength Rm	UTP 611 is a strongly coated stick electrode for repair of cracked material and surfacing on all kind of steel constructions. It is used in autobody- and wagon industry, boiler construction and shipbuilding.
	E 6013	>380	>510	
	EN ISO 2560-A	Elongation A	Impact strength KV	
	E 38 0 RR 12	> 22%	>47 J	
UTP 614 Kb	AWS 5.1	Yield strength RP0,2	Tensile strength Rm	UTP 614 Kb is a double coated stick electrode with a universally suited application field. It is used in industry, trade, as well as in production and repair welds for diverse base materials
	E 7018	> 420	> 510	
	EN ISO 2560-A	Elongation A	Impact strength KV	
	E 42 3 B32 H10	> 22	> 47 (-30°)	

Stainless Steels

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP 63	EN 14700	Yield strength RP0,2	Tensile strength Rm	With the fully austenitic UTP 63, non-alloy structural and heat-treatable steels can be welded, also in combination with austenitic CrNi steels.
	E Fe10	> 350	> 600	
	EN ISO 3581-A	Elongation A	Impact strength KV	
	E 18 8 Mn R 32	> 40	> 60	
UTP 65 D	EN 14700	Yield strength RP0,2	Tensile strength Rm	UTP 65 D has been developed to satisfy the highest requirements for repair and surfacing. It is extremely crack-resistant when joining steels of difficult weldability.
	E Z Fe11	> 640	> 800	
	EN ISO 3581-A	Elongation A		
	~ E 29 9 R 12	> 20		
UTP 68 H	AWS A5.4	Yield strength RP0,2	Tensile strength Rm	The rutile coated stick electrode UTP 68 H is suitable for repair and surfacing of heat resistant Cr-, CrSi-, CrAl-, CrNi-steels/cast steels.
	E 310-16	> 350	> 550	
	EN ISO 3581-A	Elongation A	Impact strength KV	
	E 25 20 R 32	> 30	> 47	
UTP 68 LC	AWS A5.4	Yield strength RP0,2	Tensile strength Rm	The rutile coated stick electrode UTP 68 LC, with a low carbon content, is used for repair and building up of identical low carbon, austenitic CrNi steels and CrNi cast steels.
	E 308 L - 17	> 350	> 520	
	EN ISO 3581-A	Elongation A	Impact strength KV	
	E 19 9 L R 3 2	> 35	> 47	
UTP 68 Mo	AWS A5.4	Yield strength RP0,2	Tensile strength Rm	The rutile coated stick electrode UTP 68 Mo is used for repair and surfacing of stabilized and non stabilized CrNiMo steels and CrNiMo cast steels.
	E 318 - 16	380	560	
	EN ISO 3581-A	Elongation A	Impact strength KV	
	E 19 12 3 Nb R 3 2	30	55	
UTP 68 MoLC	AWS A5.4	Yield strength RP0,2	Tensile strength Rm	The rutile coated stick electrode UTP 68 MoLC, with a low C content, is used for repair and surfacing of identical, low carbon, austenitic CrNiMo steels and CrNiMo cast steels.
	E 316 L-17	380	560	
	EN ISO 3581-A	Elongation A	Impact strength KV	
	E 19 12 3 L R 3 2	30	60	
UTP 6824 LC	AWS A5.4	Yield strength RP0,2	Tensile strength Rm	The rutile coated stick electrode UTP 6824 LC is used for repair and surfacing of stainless and heat resistant steels / cast steels as well as for dissimilar metal joints (heterogeneous joints) and for buffer layers on corrosion - or wear resistant claddings on C-steels.
	E 309 L-17	> 390	> 550	
	EN ISO 3581-A	Elongation A	Impact strength KV	
	E 23 12 L R 32	> 30	> 47	

Nickel Alloys

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP 80 M	AWS 5.11	Yield strength RP0,2	Tensile strength Rm	UTP 80 M is suitable for repair and surfacing of nickel-copper alloys and of nickel-copperclad steels.
	E NiCu-7	> 300	> 480	
	EN ISO 14172	Elongation A	Impact strength KV	
	E Ni 4060	> 30	> 80	
UTP 068 HH	AWS 5.11	Yield strength RP0,2	Tensile strength Rm	UTP 068 HH is predominantly used for repair identical or similar heat resistant Ni-base alloys, heat resistant austenites, cold tough Ni-steel, and for joining heat resistant austenitic-ferritic materials.
	E NiCrFe-3 (mod.)	420	680	
	EN ISO 14172	Elongation A	Impact strength KV	
	E Ni 6082	40	120	
UTP 6222 Mo	AWS 5.11	Yield strength RP0,2	Tensile strength Rm	UTP 6222 Mo is particularly suited for joining, repair and surfacing on nickel alloys, austenitic steels, low temperature nickel steels, austenitic-ferritic-joints and claddings.
	E NiCrMo-3	> 450	> 760	
	EN ISO 14172	Elongation A	Impact strength KV	
	E NI 6625	> 30	> 75	
UTP 7015	AWS 5.11	Yield strength RP0,2	Tensile strength Rm	UTP 7015 is employed for repair and surfacing of nickel-base materials. UTP 7015 is also recommended for welding different materials, such as austenitic to ferritic steels, as well as for weld claddings on unalloyed and low-alloyed steels, e.g. for reactor construction.
	E Ni 6182	400	670	
	EN ISO 14172	Elongation A	Impact strength KV	
	E NiCrFe-3	40	120	

Cast Iron

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP 8	AWS A5.15	Yield strength RP0,2	Hardness HB	UTP 8 is for cold welding of grey and malleable cast iron, cast steel and for repair these base metals to steel, copper and copper alloys, especially for repair and maintenance.
	E Ni-CI	approx. 220	approx. 180	
	EN ISO 1071			
	E C Ni-CI 1			
UTP 83 FN	AWS A5.15	Hardness HB		UTP 83 FN is suitable for surfacing and repair of all commercial cast iron grades, such as lamellar grey cast iron and nodular cast iron, malleable cast iron and for repair these materials to steel or cast steel.
	E NiFe-CI	approx. 190		
	EN ISO 1071			
	E C NiFe-11			
UTP 86 FN	AWS A5.15	Yield strength RP0,2	Hardness HB	UTP 86 FN is suitable for repair, joining and surfacing of lamellar grey cast iron EN GJL 100 - EN GJL 400, nodular cast iron (spheroidal cast iron) EN GJS 400 - EN GJS 700 and malleable cast iron grades EN GJMB 350 - EN GJMB 650 as well as for joining these materials with each other or with steel and cast steel.
	E NiFe-CI	approx. 340	approx. 220	
	EN ISO 1071			
	E C NIFE-13			

Copper alloys

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP 32	AWS A5.6	Yield strength RP0,2	Tensile strength Rm	UTP 32 is a basic-coated tin-bronze stick electrode for repair and surfacing on copper tin alloys with 6 – 8 % Sn, copper-tin alloys and for weld claddings on cast iron materials and on steel.
	E CuSn-C (mod.)	approx. 300	> 30	
	DIN 1733	Elongation A	Hardness HD	
	EL-CuSn7	approx. 7	approx. 100	
UTP 387	AWS A5.6	Yield strength RP0,2	Tensile strength Rm	The copper-nickel base stick electrode UTP 387 is used for repair and surfacing alloys of similar com-positions with up to 30 % nickel, as well as non-ferrous alloys and steels of different nature.
	E CuNi	> 240	> 390	
	DIN 1733	Elongation A	Impact strength KV	
	EL-CuNi30Mn	> 30	> 80	

Surfacing electrodes for anti-wear and anti-corrosion

Product Name	Abrasion	Corrosion	Erosion	Cavitation	Heat	Impact	Metal to Earth	Metal to Metal
UTP 34 N		•		•				•
UTP 73 G 2	•		•		•	•		•
UTP 73 G 3	•		•		•	•		•
UTP 73 G 4	•		•		•	•		•
UTP 673	•		•		•	•		•
UTP 690					•			•
UTP 750		•			•	•		•
UTP 7200						•		•
UTP BMC						•		•
UTP CELSIT 706	•	•	•	•	•	•		•
UTP CELSIT 721	•	•	•	•	•	•		•
UTP DUR 250								•
UTP DUR 350						•		•
UTP DUR 600	•		•			•	•	•
UTP LEDURIT 61	•		•				•	
UTP LEDURIT 65	•		•		•		•	

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP 34 N	AWS A5.13	Yield strength RP0,2	Tensile strength Rm	UTP 34 N is suitable for repair and surfacings on copper-aluminium alloys, specially with high Mn-content as well as for claddings on cast iron materials and steel.
	E CuMnNiAl	400	650	
	EN 14700	Elongation A	Hardness HB	
	E Cu1	15	220	
UTP 73 G 2	DIN 8555	Hardness HRC		UTP 73 G 2 is, due to its high hardness, toughness and heat resistance ideally suited for buildups on parts subject to severe friction, compression and moderate impact loads at elevated tempera-tures.
	E 3-UM-55-ST	55 - 58		
	EN 14700			
	E Fe8			
UTP 73 G 3	DIN 8555	Hardness HRC		UTP 73 G 3 is, due to its high strength, toughness and heat resistance ideally suited for buildups on parts subject to friction, compression and impact at elevated temperatures.
	E 3-UM-45-T	approx. 45-50		
	EN 14700			
	E Fe3			
UTP 73 G 4	DIN 8555	Hardness HRC		UTP 73 G 4 is, due to its toughness and heat resistance, ideally suited for surfacings on parts and tools subject to abrasion, compression and impact at elevated temperatures.
	E 3-UM-40-PT	approx. 38 - 42		
	EN 14700			
	E Z Fe3			
UTP 673	DIN 8555	Hardness HRC	Heat resistent	UTP 673 is used for wear resistant buildups on cold and hot working tools, particularly for cutting-edges on hot cutting tools, hot-shear blades, trimming tools and cold cutting knives.
	E 3-UM-40-PT	approx. 58	up to 550° C	
	EN 14700			
	E Z Fe3			

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP 690	AWS A5.13	Hardness HRC		UTP 690 is used for repair and production of cutting tools, particularly for building-up cutting edges and working surfaces. (soft annealed 800-840°C approx. 25 HRC)
	E Fe 5-B (mod.)	approx. 62		
	EN 14700			
	E Fe4			
UTP 750	DIN 8555	Hardness HRC		UTP 750 is suited for heat resistant buildups on hot working steels particularly exposed to metallic gliding wear and elevated thermal shock stress. (soft annealed 850 – 900 °C approx. 35 HRC)
	E 3-UM-50-CTZ	48 - 52		
	EN 14700			
	E Z Fe6			
UTP 7200	AWS A5.13	Hardness HB	Hardness HRC	UTP 7200 is predominantly suited for tough and crack resistant joinings, repairs and surfacings on parts of high Mn-steel subject to extreme impact, compression and shock.
	~ E FeMn-A	After welding	After workhardening	
	EN 14700	200 - 250	48 - 53	
	EZ Fe9			
UTP BMC	DIN 8555	Hardness HB	Hardness HRC	UTP BMC is suitable for claddings on parts subject to highest pressure and shock in combination with abrasion.
	E 7-UM-250-KPR	After welding	After workhardening	
	EN 14700	approx. 260	48 - 53	
	E Fe9			
UTP CELSIT 706	AWS A5.13	Hardness HRC		UTP CELSIT 706 is used for hardfacing on parts subject to a combination of erosion, corrosion, cavitation, impact, pressure, abrasion and high temperatures up to 900 °C.
	E CoCr-A	40 - 42		
	EN 14700			
	E Z Co2			
UTP CELSIT 721	AWS A5.13	Hardness HRC	Hardness HRC	UTP CELSIT 721 is used for crack resistant hard-facing on parts subject to a combination of impact, pressure, abrasion, corrosion and high tempera-tures up to 900 °C.
	E CoCr-E	After welding	After workhardening	
	EN 14700	31 - 37	45	
	E Co1			
UTP DUR 250	DIN 8555	Hardness HB		UTP DUR 250 is used for surfacing on parts, where a tough and easily machinable deposit is required.
	E 1-UM-250	approx. 270		
	EN 14700			
	E Fe1			
UTP DUR 350	DIN 8555	Hardness HB		UTP DUR 350 is particularly suited for wear resis-tant surfacings on Mn-Cr-V alloyed parts.
	E 1-UM-350	approx. 370		
	EN 14700			
	E Fe1			
UTP DUR 600	DIN 8555	Hardness HRC		UTP DUR 600 is universally applicable for cladding on parts of steel, cast steel and high Mn-steel, subject simultaneously to abrasion, impact and compression.
	E 6-UM-60	56 - 58		
	EN 14700			
	E Fe8			
UTP LEDURIT 61	AWS A5.13	Hardness HRC		UTP LEDURIT 61 is suited for highly wear resistant claddings on parts subject to strong grinding abra-sion combined with medium impact.
	~ E FeCr-A 1	approx. 60		
	EN 14700			
	EZ FE14			
UTP LEDURIT 65	DIN 8555	Hardness HRC		UTP LEDURIT 65 is suited for highly abrasion re-sistant claddings on parts subject to xtreme sliding mineral abrasion, also at elevated temperatures up to 500 °C.
	E 10-UM-65-GRZ	approx. 65		
	EN 14700			
	E Fe16			

TIG rods for repair of cracked material

Unalloyed and low alloy steels

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP A 118	AWS A5.18	Yield strength RP0,2	Tensile strength Rm	GTAW solid rod for the welding repair with argon. Typical fields of use: boiler, tank and pipeline constructions and apparatus engineering.
	ER70S-6	440	560	
	EN ISO 636-A	Elongation A	Impact strength KV	
	W 42 5 W3Si1	25	130	
UTP A 641	AWS A5.28	Yield strength RP0,2	Tensile strength Rm	Welding rod for the welding repair with argon. Suitable for repair creep resistant steels in boiler, tank, pipeline and nuclear reactor construction.
	ER80S-G	450	560	
	EN ISO 21952-A	Elongation A	Impact strength KV	
	W CrMo1Si	22	90	

Stainless Steels

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP A 63	AWS A5.9	Yield strength RP0,2	Tensile strength Rm	UTP A 63 is suitable for particularly crack resistant joining, repair and surfacing of high-strength ferritic and austenitic steels, hard manganese steels and cold-tough steels, as cushioning layer under hard alloys, dissimilar metal joints.
	ER 307 (mod.)	>370	>600	
	EN ISO 14343-A	Elongation A		
	W 18 8 Mn	>30		
UTP A 68 LC	AWS A5.9	Yield strength RP0,2	Tensile strength Rm	UTP A 68 LC is suitable for repair and surfacing in chem. apparatus and vessel construction for working temperatures of – 196 °C up to 350 °C.
	ER 308 L (Si)	400	600	
	EN ISO 14343-A	Elongation A	Impact strength KV	
	W 19 9 L (Si)	35	100	
UTP A 68 Mo	AWS A5.9	Yield strength RP0,2	Tensile strength Rm	UTP A 68 Mo is aplicable for repair and surfacings of stabilized, corrosion resistant CrNiMo steels of similar nature in the construction of chemical apparatus and vessels up to working temperatures of 120 °C up to 400 °C.
	ER 318 (Si)	460	680	
	EN ISO 14343-A	Elongation A	Impact strength KV	
	W 19 12 3 NB (Si)	35	100	
UTP A 68 MoLC	AWS A5.9	Yield strength RP0,2	Tensile strength Rm	UTP A 68 MoLC is used for repair and surfacing of low-carbon, corrosion resistant CrNiMo steels exposed to high corrosion for working temperatures up to + 350 °C.
	ER 316 L (Si)	420	600	
	EN ISO 14343-A	Elongation A	Impact strength KV	
	W 19 12 3 L (Si)	35	100	
UTP A 651	AWS A5.9	Yield strength RP0,2	Tensile strength Rm	UTP A 651 is suitable for joining, repair and surfacing of steels of difficult weldability, repair of hot and cold working steels, cushioning layers.
	ER 312	650	750	
	EN ISO 14343-A	Elongation A	Impact strength KV	
	W 29 9	25	27	
UTP A 6824 LC	AWS A5.9	Yield strength RP0,2	Tensile strength Rm	UTP A 6824 LC ist used for repair and surfacing in chem. apparatus and vessel construction for working temperatures up to + 300 °C. Weld cladding of non- and low-alloyed base materials. Dissimilar joints.
	ER 309 L (Si)	400	590	
	EN ISO 14343-A	Elongation A	Impact strength KV	
	W 23 12 L (Si)	30	140	

Nickel Alloys

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP A 80 M	AWS 5.14	Yield strength RP0,2	Tensile strength Rm	UTP A 80 M is suitable for repair and surfacing of nickel-copper alloys and of nickelcopper-clad steels. Particularly suited for the following materials: 2.4360 NiCu30Fe, 2.4375 NiCu30Al.
	ER NiCu-7	>300	>480	
	EN ISO 18274	Elongation A	Impact strength KV	
	S Ni 4060	>30	>80	
UTP A 068 HH	AWS 5.14	Yield strength RP0,2	Tensile strength Rm	UTP A 068 HH is predominantly used for repair identical or similar high heat resistant Ni-base alloys, heat resistant austenites, and for joining heat resistant austenitic-ferritic materials.
	ER NiCr-3	>380	>640	
	EN ISO 18274	Elongation A	Impact strength KV	
	S Ni 6082	>35	>160	
UTP A 6222 Mo	AWS 5.14	Yield strength RP0,2	Tensile strength Rm	UTP A 6222 Mo has a high nickel content and is suitable for repair high-strength and high-corrosion resistant nickel-base alloys.
	ER NiCrMo-3	>460	>740	
	EN ISO 18274	Elongation A	Impact strength KV	
	S NI 6625	>30	>100	

Cast Iron

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP A 8051 Ti	EN ISO 1071	Yield strength RP0,2	Tensile strength Rm	UTP A 8051 Ti is particularly suited for welding of ferritic and austenitic nodular cast iron as well as for joining it with unalloyed and high-alloyed steels, copper and nickel alloys. Build-up layers on grey cast iron qualities are also possible.
	S C NiFe-2	>300	>500	
		Elongation A	Hardness HB	
		>25	approx. 200	

Copper alloys

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP A 34 N	AWS A5.7	Yield strength RP0,2	Tensile strength Rm	UTP A 34 N is applied in TIG repair and surfacing on complex aluminium bronzes mainly on such materials with a high Mn content as well as on steel and cast steel by using a nodular iron rod.
	ER CuMnNiAl	400	650	
	EN ISO 24373	Elongation A	Hardness HB	
	S Cu 6338	15	220	
UTP A 38	AWS A5.7	Yield strength RP0,2	Tensile strength Rm	UTP A 38 is used for oxygen free copper types according to DIN 1787 OF-Cu, SE-Cu, SWCu, SF-Cu. The main applications are in the electrical industry e.g. for conductor rails or other applications where high electricity is required.
	ER Cu	80	200	
	EN ISO 24373	Elongation A	Hardness HB	
	S Cu 1897 (CuAg1)	20	60	
UTP A 381	AWS A5.7	Yield strength RP0,2	Tensile strength Rm	UTP A 381 is used for oxygen free copper types according to DIN 1787 OF-Cu, SE-Cu, SWCu, SF-Cu. The main applicational fields are in the apparatus- and pipeline repair.
	ER Cu	50	200	
	EN ISO 24373	Elongation A	Hardness HB	
	S CU 1898 (CuSn1)	30	approx. 60	
UTP A 387	AWS A5.7	Yield strength RP0,2	Tensile strength Rm	UTP A 387 is used for copper nickel alloys with up to 30 % nickel according to DIN 17664, such as CuNi20Fe (2.0878), CuNi30Fe (2.0882). Chemical industry, seawater desalination plants, ship building, offshore technique.
	ER CuNi	>200	>360	
	EN ISO 24373	Elongation A	Hardness HB	
	S Cu 7158	>30	120	

Solid wires for repair of cracked material

Unalloyed and low alloy steels

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP A 118	AWS A5.18	Yield strength RP0,2	Tensile strength Rm	GTAW solid wire for the welding repair with argon. Typical fields of use: boiler, tank and pipeline constructions and apparatus engineering.
	ER70S-6	440	560	
	EN ISO 636-A	Elongation A	Impact strength KV	
	G 42 2 C1 3Si1 /G 46 4 M21 3Si1	25	130	
UTP A 119	AWS A5.28	Yield strength RP0,2	Tensile strength Rm	Welding rod for the welding repair with argon. Suitable for repair creep resistant steels in boiler, tank, pipeline and nuclear reactor construction.
	ER80S-G	450	560	
	EN ISO 21952-A	Elongation A	Impact strength KV	
	G 46 2 C1 4Si1 / G 46 4 M21 4Si1	22	90	
UTP A 641	AWS A5.28	Yield strength RP0,2	Tensile strength Rm	Welding rod for the welding repair with argon. Suitable for repair creep resistant steels in boiler, tank, pipeline and nuclear reactor construction.
	ER80S-G	450	560	
	EN ISO 21952-A	Elongation A	Impact strength KV	
	G CrMo1Si	22	90	

Stainless Steels

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP A 63	AWS A5.9	Yield strength RP0,2	Tensile strength Rm	UTP A 63 is suitable for particularly crack resistant joining, repair and surfacing of high-strength ferritic and austenitic steels, hard manganese steels and cold-tough steels, as cushioning layer under hard alloys, dissimilar metal joints.
	ER 307 (mod.)	>370	>600	
	EN ISO 14343-A	Elongation A		
	G 18 8 Mn	>30		
UTP A 68 LC	AWS A5.9	Yield strength RP0,2	Tensile strength Rm	UTP A 68 LC is suitable for repair and surfacing in chem. apparatus and vessel construction for working temperatures of – 196 °C up to 350 °C.
	ER 308 L (Si)	400	600	
	EN ISO 14343-A	Elongation A	Impact strength KV	
	G 19 9 L (Si)	35	100	
UTP A 68 Mo	AWS A5.9	Yield strength RP0,2	Tensile strength Rm	UTP A 68 Mo is aplicable for repair and surfacings of stabilized, corrosion resistant CrNiMo steels of similar nature in the construction of chemical apparatus and vessels up to working temperatures of 120 °C up to 400 °C.
	ER 318 (Si)	460	680	
	EN ISO 14343-A	Elongation A	Impact strength KV	
	G 19 12 3 Nb (Si)	35	100	
UTP A 68 MoLC	AWS A5.9	Yield strength RP0,2	Tensile strength Rm	UTP A 68 MoLC is used for repair and surfacing of low-carbon, corrosion resistant CrNiMo steels exposed to high corrosion for working temperatures up to + 350 °C.
	ER 316 L (Si)	420	600	
	EN ISO 14343-A	Elongation A	Impact strength KV	
	G 19 12 3 L (Si)	35	100	
UTP A 651	AWS A5.9	Yield strength RP0,2	Tensile strength Rm	UTP A 651 is suitable for joining, repair and surfacing of steels of difficult weldability, repair of hot and cold working steels, cushioning layers.
	ER 312	650	750	
	EN ISO 14343-A	Elongation A	Impact strength KV	
	G 29 9	25	27	
UTP A 6824 LC	AWS A5.9	Yield strength RP0,2	Tensile strength Rm	UTP A 6824 LC ist used for repair and surfacing in chem. apparatus and vessel construction for working temperatures up to + 300 °C. Weld cladding of non- and low-alloyed base materials. Dissimilar joints.
	ER 309 L (Si)	400	590	
	EN ISO 14343-A	Elongation A	Impact strength KV	
	G23 12 L (Si)	30	140	

Nickel Alloys

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP A 80 M	AWS 5.14	Yield strength RP0,2	Tensile strength Rm	UTP A 80 M is suitable for repair and surfacing of nickel-copper alloys and of nickelcopper-clad steels. Particularly suited for the following materials: 2.4360 NiCu30Fe, 2.4375 NiCu30Al.
	ER NiCu-7	>300	>480	
	EN ISO 18274	Elongation A	Impact strength KV	
	S Ni 4060	>30	>80	
UTP A 068 HH	AWS 5.14	Yield strength RP0,2	Tensile strength Rm	UTP A 068 HH is predominantly used for repair identical or similar high heat resistant Ni-base alloys, heat resistant austenites, and for joining heat resistant austenitic-ferritic materials.
	ER NiCr-3	>380	>640	
	EN ISO 18274	Elongation A	Impact strength KV	
	S Ni 6082	>35	>160	
UTP A 6222 Mo	AWS 5.14	Yield strength RP0,2	Tensile strength Rm	UTP A 6222 Mo has a high nickel content and is suitable for repair high-strength and high-corrosion resistant nickel-base alloys.
	ER NiCrMo-3	>460	>740	
	EN ISO 18274	Elongation A	Impact strength KV	
	S Ni 6625	>30	>100	

Cast Iron

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP A 8051 Ti	EN ISO 1071	Yield strength RP0,2	Tensile strength Rm	UTP A 8051 Ti is particularly suited for welding of ferritic and austenitic nodular cast iron as well as for joining it with unalloyed and high-alloyed steels, copper and nickel alloys. Build-up layers on grey cast iron qualities are also possible.
	S C NiFe-2	>300	>500	
		Elongation A	Hardness HB	
		>25	approx. 200	

Copper alloys

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP A 34 N	AWS A5.7	Yield strength RP0,2	Tensile strength Rm	UTP A 34 N is applied in TIG repair and surfacing on complex aluminium bronzes mainly on such materials with a high Mn content as well as on steel and cast steel by using a nodular iron rod.
	ER CuMnNiAl	400	650	
	EN ISO 24373	Elongation A	Hardness HB	
	S Cu 6338	15	220	
UTP A 38	AWS A5.7	Yield strength RP0,2	Tensile strength Rm	UTP A 38 is used for oxygen free copper types according to DIN 1787 OF-Cu, SE-Cu, SWCu, SF-Cu. The main applications are in the electrical industry e.g. for conductor rails or other applications where high electricity is required.
	ER Cu	80	200	
	EN ISO 24373	Elongation A	Hardness HB	
	S Cu 1897 (CuAg1)	20	60	
UTP A 381	AWS A5.7	Yield strength RP0,2	Tensile strength Rm	UTP A 381 is used for oxygen free copper types according to DIN 1787 OF-Cu, SE-Cu, SWCu, SF-Cu. The main applicational fields are in the apparatus- and pipeline repair.
	ER Cu	50	200	
	EN ISO 24373	Elongation A	Hardness HB	
	S Cu 1898 (CuSn1)	30	approx. 60	
UTP A 387	AWS A5.7	Yield strength RP0,2	Tensile strength Rm	UTP A 387 is used for copper nickel alloys with up to 30 % nickel according to DIN 17664, such as CuNi20Fe (2.0878), CuNi30Fe (2.0882). Chemical industry, seawater desalination plants, ship building, offshore technique.
	ER CuNi	>200	>360	
	EN ISO 24373	Elongation A	Hardness HB	
	S Cu 7158	>30	120	

Surfacing solid wires for anti-wear and anti-corrosion

Product Name	Abrasion	Corrosion	Erosion	Cavitation	Heat	Impact	Metal to Earth	Metal to Metal
UTP A 34 N		•		•				•
UTP A 73 G 2	•		•		•	•		•
UTP A 73 G 3	•		•		•	•		•
UTP A 73 G 4	•		•		•	•		•
UTP A DUR 250								•
UTP A DUR 350						•		•
UTP A DUR 600	•		•			•	•	•
UTP A DUR 650	•		•		•	•	•	•

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP A 34 N	AWS A5.7	Yield strength RP0,2	Tensile strength Rm	UTP A 34 N is applied for repair and surfacing on complex aluminium bronzes mainly on such materials with a high Mn content as well as on steel and cast steel by using a nodular iron rod.
	ER CuMnNiAl	400	650	
	EN ISO 24373	Elongation A	Hardness HB	
	S Cu 6338	15	220	
UTP A 73 G 2	DIN 8555	Hardness HRC		UTP A 73 G 2 is used for highly wear resistant buildups on machine parts and tools, subject to heavy abrasion and compression combined with moderate impact at elevated temperatures.
	MSG 3-GZ-55-ST	55 - 58		
	EN 14700			
	S Fe8			
UTP A 73 G 3	DIN 8555	Hardness HRC		UTP A 73 G 3 is, due to the excellent hot wear resistance and toughness, used for highly stressed hot working tools, which are simultaneously subject to high mechanical, thermal and abrasive loads.
	MSG 3-GZ-45-T	approx. 45 - 50		
	EN 14700			
	S Z Fe3			
UTP A 73 G 4	DIN 8555	Hardness HRC		UTP A 73 G 4 is, due to its excellent hot wear resistance and toughness, used for buildups on hot working tools and structural parts subject to impact, compression and abrasion at elevated temperatures.
	MSG 3-GZ-40-T	approx. 38 - 42		
	EN 14700			
	S Z Fe3			
UTP A DUR 250	DIN 8555	Hardness HB		UTP A DUR 250 is used for MAG buildups on structural parts subject to rolling wear and where a good machinability is required.
	MSG 1-GZ-250	approx. 250		
	EN 14700			
	SZ Fe 1			
UTP A DUR 350	DIN 8555	Hardness HB		UTP A DUR 350 is suited for MAG buildups on structural parts subject to compression, impact and abrasion, such as caterpillar track components, machine and gear parts, stamps.
	MSG 2-GZ-400	approx. 450		
	EN 14700			
	SZ Fe 2			
UTP A DUR 600	DIN 8555	Hardness HRC		UTP A DUR 600 is universally applicable for MAG buildups on structural parts subject to high impact and medium abrasion.
	MSG 6-GZ-60-S	54 - 60		
	EN 14700			
	S Fe 8			
UTP A DUR 650	DIN 8555	Hardness HRC		UTP A DUR 650 is universally used for MAG buildups on structural parts subject to high impact and abrasion.
	MSG 3-GZ-60	55 - 60		
	EN 14700			
	S Fe 8			

Flux cored wires for repair of cracked material

Unalloyed and low alloy steels

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP AF 152	AWS A5.36	Yield strength RP0,2	Tensile strength Rm	Rutile flux cored wire with fast freezing slag. Outstanding repair welding properties in all positions. Excellent mechanical properties and good slag detachability, low spatter losses, smooth, finely rippled seam surface, high x-ray security, notch-free weld toes.
	E71T1-M21A4-CS1-H8 E71T1-C1A2-CS1-H4	500	580	
	EN ISO 17632-A	Elongation A	Impact strength KV	
	T 46 4 P M 1 H10 T 42 2 P C 1 H5	26	180	
UTP AF 155	AWS A5.18	Yield strength RP0,2	Tensile strength Rm	UTP AF 155 is a high-efficiency flux cored wire with metal powder filling, for all position repair welding with mixed gas M21 acc. to EN ISO 14175.
	E70C-6MH4	460	560	
	EN ISO 17632-A	Elongation A	Impact strength KV	
	T 46 4 M M 1 H5	22	130	
UTP AF 160	AWS A5.36	Yield strength RP0,2	Tensile strength Rm	Rutile flux cored wire with fast freezing slag for welding low-temperature steels. Outstanding welding properties in all positions.
	E81T1-M21A8-Ni1-H4	530	570	
	EN ISO 17632-A	Elongation A	Impact strength KV	
	T 50 6 1Ni P M 1 H5	27	140	

Stainless Steels

Name	Classification	Mechanical properties of the weld metal		Characteristics and field of use
UTP AF 68 LC	AWS A5.22	Yield strength RP0,2	Tensile strength Rm	UTP AF 68 LC is a low carbon, CrNi flux-cored wire with rutile slag used for joint-welding of alloyed CrNi-steels and cast steels.
	E 308 LT-0-1 E 308 LT-0-4	380	560	
	EN ISO 17633-A	Elongation A	Impact strength KV	
	T 19 9 L RM3 T 19 9 L RC3	35	70	
UTP AF 68 MoLC	AWS A5.22	Yield strength RP0,2	Tensile strength Rm	UTP AF 68 MoLC is a low carbon, CrNi flux-cored wire with rutile slag for joining and surfacing of CrNisteels and cast steel.
	E 316 LT0-1 E 316 LT0-4	400	560	
	EN ISO 17633-A	Elongation A	Impact strength KV	
	T 19 12 3 L RM3 T 19 12 3 L RC3	35	55	
UTP AF 6824 LC	ASME II C SFA 5.22	Yield strength RP0,2	Tensile strength Rm	UTP AF 6824 LC is a low-carbon flux-cored wire with rutile slag used for repair welding of alloyed CrNi steels among each other or with other unalloyed or low alloyed steels / cast steels.
	E 309 LT 0-1 E 309 LT 0-4	400	550	
	EN ISO 17633-A	Elongation A	Impact strength KV	
	T 23 12 L RM3 T 23 12 L RC3	35	60	
UTP AF 6222 MoPW	AWS A5.22	Yield strength RP0,2	Tensile strength Rm	The nickel-base-flux-cored wire (NiCrMo) UTP AF 6222 Mo PW is suitable for repair and surfacing on nickel-base materials of the same nature and on C- and CrNi-steels as well as for cladding on C-steels, furthermore in high temperature applications.
	ENiCrMo3 T1-4	490	750	
	EN ISO 17633-A	Elongation A	Impact strength KV	
	T Ni 6625 PM 2	30	70	

Gas shielded cored wires for repair, anti-wear and anti-corrosion

Product Name	Low stress abrasion	High stress abrasion	Erosion	Impact	Corrosion	Cavitation	Heat	Metal to metal wear
SK AP-G				•	•			•
SK 250-G				•				
SK 350-G				•				
SK 600-G	•			•				•
SK 650-G	•			•				•
SK A45-G		•						•
SK ABRA-MAX O/G		•	•					•
SK D8-G								•
SK D12-G								•
SK D20-G	•							•
SK D35-G					•	•	•	•
SK D250-G				•				•
SK STELKAY 6-G					•	•	•	•
SK STELKAY 21-G				•	•	•	•	•
SK STELKAY 25-G				•	•	•	•	•
SK 900 Ni-G		•			•		•	
SK FNM-G				•	•			
SK 356-G	•				•			•
SK 741-G					•			•
SK ANTINIT DUR 500					•	•	•	•

Manganese steels

Name	Classi-fication	Hardness		Composition (All weld metal)											Characteristics and field of use
		HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	
SK AP-G	DIN 8555 MF-7-GF-200 KP ISO 14700 T Fe9	185		0,9	14,5	0,3	12		0,5						Bal.	Austenitic alloy with Chromium designed for rebuilding 14 % Manganese steel parts where parent metal matching colour is a must.

Low alloy steels

Name	Classi-fication	Hardness		Composition (All weld metal)											Characteristics and field of use
		HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	
SK 250-G	DIN 8555 MF 1-GF-225-GP ISO 14700 TZ Fe1	225		0,09	1,2	0,5	0,4								Bal.	Metal-cored wire designed for building-up by welding in horizontal and vertical-up positions under gas shielding.
SK 350-G	DIN 8555 MF 1-GF-350-GP ISO 14700 T Z Fe1	330		0,35	1,5	0,4	1,4								Bal.	Rebuilding and hardfacing alloy for carbon steel parts.
SK 600-G	DIN 8555 MF 6-GF-60-GP ISO 14700 T Fe8		59	0,52	1,5	1,2	5,9		0,8		0,05				Bal.	Martensitic steel alloy designed for welding in horizontal and vertical-up positions under gas shielding. Its resistance to friction and low stress abrasive wear with moderate impact is excellent.
SK 650-G	DIN 8555 MF 3-GF-60-GT ISO 14700 T Fe8		58	0,45	0,9	0,6	5,5		1,4			1,6	0,5		Bal.	Martensitic steel alloy designed for welding in horizontal and vertical-up positions under gas shielding. Its resistance to friction and medium stress abrasive wear with moderate impact is excellent.

High alloyed steels

Name	Classi-fication	Hardness		Composition (All weld metal)											Characteristics and field of use
		HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	
SK A45-G	DIN 8555 MF 10-GF-65-GT ISO 14700 T Fe16		63	5,3	0,1	0,7	21		6,3	6		1,8	0,75		Bal.	Chromium-Niobium-Molybdenum alloy with addition of Tungsten and Vanadium designed to resist high stress grinding abrasion with low impact and solid erosion at service temperatures up to 650 °C.
SK ABRA-MAX O/G	DIN 8555 MF 6-GF-70-GT ISO 14700	HB	HRC		Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	Special hardfacing cored wire designed to give an extreme resistance against high stress grinding abrasion and erosion without impact.
		C +Cr + Mo + Nb + W + V + B (Bal Fe)														
			69 -70													

Tool steels

Name	Classi-fication	Hardness		Composition (All weld metal)											Characteristics and field of use
		HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	
SK D8-G	DIN 8555 MF 3-GF-40-T ISO 14700 T Z Fe3		38	0,1	1,1	0,4	2,4					3,8	0,6		Bal.	Special alloy designed for the repair and the hard surfacing of tools working at low and high temperatures.
SK D12-G	DIN 8555 MF 3-GF-55-T EN ISO 14700 T Z Fe3		55	0,35	1,2	0,3	7,5		1,7		0,3				Bal.	Metal cored wire designed for hardsurfacing of tool steel parts.
SK D20-G	DIN 8555 MF 4-GF-60-S EN ISO 14700 T Z Fe8		60	1,2	0,4	0,4	4,5		8			1,8	1,7		Bal.	Special alloy designed to deposit a molybdenum-alloyed high-speed steel. To avoid cracking, a minimum interpass temperature of 300 °C should be applied.
SK D35-G	DIN 8555 MF 6-GF-50-CT EN ISO 14700 T Z Fe3		50	0,16	0,1	0,7	13		2,4	14					Bal.	Special Iron-Chromium-Cobalt-Molybdenum alloy designed to resist metal-to-metal wear, fatigue, oxidation, cavitation and corrosion at high temperature. The typical hardness can be achieved in the first layer.
SK D250-G	DIN 8555 MF 1-GF-350 EN ISO 14700	330		0,09	0,8	0,3	2,9	2,4							Bal.	Special alloy suitable for repair of tool steel parts working at high temperatures. The deposit is particularly resistant against cracks propagation.

Cobalt steels

Name	Classi-fication	Hardness		Composition (All weld metal)												Characteristics and field of use
SK STELKAY 6-G	DIN 8555 MF 20-GF-40-CTZ ASME IIC SFA 5.21 ERC CoCr-A ISO 14700 T Co2	HB	HRC	C	Mn	Si	Cr	Co	Mo	Nb	Ti	W	V	B	Fe	Cobalt base alloy providing excellent resistance to metal-to-metal wear, oxidation, thermal cycling and impact in corrosive environments at high temperature.
			40	0,95	0,8	1,4	30	Bal.				4,2			3	
SK STELKAY 21-G	DIN 8555 MF 20-GF-300-CTZ ASME IIC SFA 5.21 ERC CoCr-E ISO 14700 T Co1	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Co	Ti	W	V	B	Fe	Cobalt base alloy providing excellent resis-tance to metal-to-metal wear, thermal shocks, oxidation in corrosive environments at high temperature.
			32	0,27	1	1,2	28	2,4	5	Bal.					3,5	
SK STELKAY 25-G	DIN 8555 MF 20-GF-200-STZ ISO 14700 T Co1	HB	HRC	C	Mn	Si	Cr	Ni	Co	Nb	Ti	W	V	B	Fe	Cobalt base alloy providing excellent resis-tance to metal-to-metal wear, thermal shocks, oxidation in corrosive environments at high temperature.
		195		0,01	0,8	0,4	20,2	10	Bal.			13			3,5	

Nickel alloys

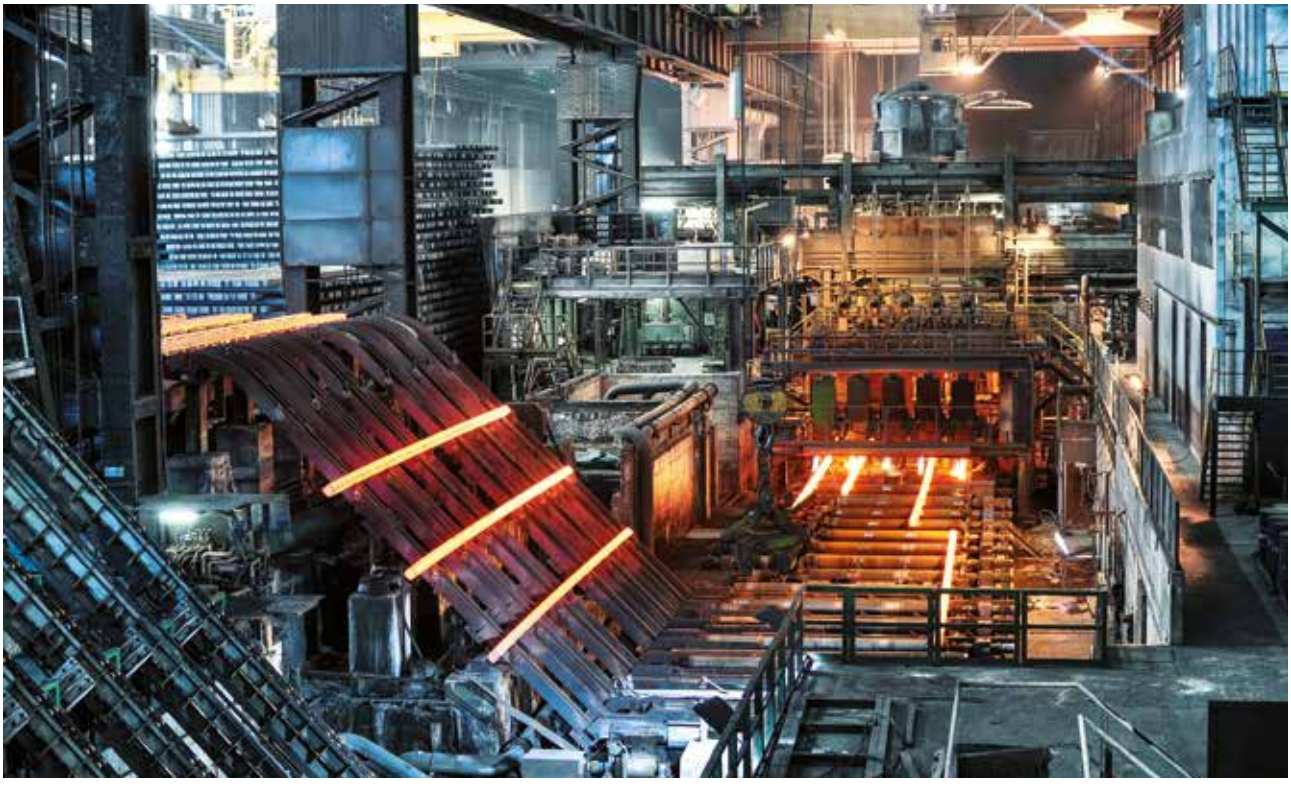
Name	Classi-fication	Hardness		Composition (All weld metal)												Characteristics and field of use
SK 900 Ni-G	DIN 8555 MF 22-GF-45-G ISO 14700 T Ni20	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	Hardfacing cored wire containing about 45 % Tungsten carbide particles incorporated in a NiB matrix.
			46	1,7	0,1	0,1		Bal.				41,5		0,8	1,1	
SK FNM-G	DIN 8555 MSG23-GF-200 ISO 14700	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	FeNi alloy with 12 % Manganese designed for joining and surfacing of cast iron pieces. Can also be used for dissimilar welding between cast iron and steel.
		145		0,2	12	0,4		Bal.							48	

Stainless Steel

Name	Classi-fication	Hardness		Composition (All weld metal)												Characteristics and field of use
SK 356-G	DIN 8555 MF 4-GF-50-ST ISO 14700 T Fe8	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	Special iron base alloy designed to rebuild parts in the rubber industry.
			47	0,7	1,2	0,9	12	0,7	3,8			0,9	2		Bal.	
SK 741-G	DIN 8555 MF 5-GF-40-C ISO 14700 T Fe7	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	Alloy depositing a ferritic-martensitic steel containing 13 % Chromium, 5 % Nickel and 1 % Molybdenum designed to resist metal-to-metal wear, corrosion and thermal fatigue fire cracking.
			41	0,06	0,5	0,6	13	5,5	0,8						Bal.	
SK ANTINIT DUR 500	DIN 8555 MF 9-GF-45-CT ISO 14700 T Fe10	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	For Hardfacing of or austenitic steels exposed to general corrosion, frictional wear, cavitation , or to high surface pressure. For use at tempera-tures up to 550 °C. Offers additionally enhanced resistance to pitting and intergranular corrosion. Preheating to 450 - 500 °C.
			43	0,07	4,3	4,5	17,5	8	5,4	1						

Open arc cored wires for repair, anti-wear and anti-corrosion

Product Name	Low stress abrasion	High stress abrasion	Erosion	Impact	Corrosion	Cavitation	Heat	Metal to metal wear
SK 218-O				•				
SK 624-O		•		•				
SK AP-O				•	•			
SK 258-O	•			•				
SK 258 TIC-O		•		•				
SK 400-O				•				•
SK 162-O		•	•					
SK 255-O		•	•					
SK 256-O		•	•					
SK 866-O		•	•					
SK 867-O		•	•					
SK 900-0		•	•					
SK A43-O		•	•					
SK A45-O		•	•					
SK 370-O					•		•	•
SK 402-O			•		•			•
SK 714 N-O					•			•



Manganese steels

Name	Classi-fication	Hardness		Composition (All weld metal)												Characteristics and field of use
SK 218-O	DIN 8555 MF 7-GF-200-KP ASME IIC SFA 5.21 ERC FeMn-G EN 14700 T Z Fe9	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	Self shielded flux cored wire depositing an austenitic alloy designed for rebuilding of 14 % Manganese steel parts.
		200		0,9	14	0,5	3,5	0,4							Bal.	
SK 624-O	DIN 8555 MF 7-GF-250-GKP EN 14700 T Fe9	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	High Manganese-Chromium alloy enriched with Niobium, designed to resist abrasion and solid erosion wear combined with heavy impact. High Managnese alloy resulting in a workhardnable deposit.
		240		1	17,2	0,3	8,2			2,5	0,12				Bal.	
SK AP-O	DIN 8555 MF 7-GF-200-KP ASME IIC SFA 5.21 FeMn-Cr EN 14700 T Z Fe9	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	Multi-purpose cored wire, mainly used for rebuilding and joining of Carbon and 14 % Manganese steels. Can also be used as buffer layer prior to hard overlay. Work-hardenable alloy.
		205		0,37	16	0,3	12,8								Bal.	

Low alloy steels

Name	Classification	Hardness		Composition (All weld metal)												Characteristics and field of use
SK 258-O	DIN 8555 MF 6-GF-55-GT EN 14700 T Fe8	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	Martensitic alloy designed to give an outstanding resistance to low stress abrasion with heavy impact and high compressive stresses. The deposit is heat treatable and forgeable.
			55	0,47	1,5	0,8	5,7		1,4			1,5			Bal.	
SK 258 TIC-O	DIN 8555 MF 6-GF-60-GP EN 14700 T Z Fe8	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	Martensitic Chromium-Titanium alloy designed to resist high stress abrasion with heavy impact. Deposits usually do not show stress relief cracks.
			58	1,8	0,9	0,2	6,1		1,4		5,5				Bal.	
SK 400-O	DIN 8555 MF 1-GF-40-P EN 14700 T Z Fe1	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	Open-arc wire designed for rebuilding and hardfacing of Carbon steel parts subjected to adhesive wear with impacts.
			40	0,13	0,7	0,6	2,4								Bal.	

High alloyed steels

Name	Classi-fication	Hardness		Composition (All weld metal)												Characteristics and field of use
		HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	
SK 162-O	DIN 8555 MF 10-GF-65-G EN 14700 T Fe15		63	5,4	0,2	1,3	27								Bal.	High Chromium alloy designed to resist high stress grinding abrasion with low impact. The deposit will show readily stress relief cracks.
SK 255-O	DIN 8555 MF 10-GF-60-G ASME IIC SFA 5.21 FeCr-A9 EN 14700 T Z Fe14	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	Open-arc metal cored wire designed to deposit a metal resistant to high stress grinding abrasion with low impact. The deposits will readily show stress relief cracks.
			60	5	0,6	1	27							0,5	Bal.	
SK 256-O	DIN 8555 MF 10-GF-65-G EN 14700 T Fe16	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	High Chromium carbide alloy designed to resist high stress grinding abrasion with low impact. The deposits will readily show stress relief cracks.
			63	5,5	1,1	1,2	25,7								Bal.	
SK 866-O	DIN 8555 MF 10-GF-60-G EN 14700 T Z Fe15	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	Alloy designed to resist high stress grinding abrasion with low impact. The deposits will readily show stress relief cracks.
			60	4,5	0,7	0,8	27							0,5	Bal.	
SK 867-O	DIN 8555 MF 10-GF-60-G EN 14700 T Fe16	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	Alloy designed to resist high stress grinding abrasion with low impact. The deposits will readily show stress relief cracks.
			60	4,5	0,7	0,8	27							0,5	Bal.	
SK 900-O	DIN 8555 MF 21-GF-65-G EN 14700 T Fe20	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	Cored wire containing about 60 % Tungsten carbide particles. The composition and particle size have been optimized to provide the best combination of toughness and wear resistance.
			63	2,9	0,4	0,4	5,8					42			Bal.	
SK A43-O	DIN 8555 MF 10-GF-65-G EN 14700 T Z Fe15	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	CrNb alloy designed to resist high stress grinding abrasion at service temperature not exceeding 450 °C. The deposit will readily show stress relief cracks.
			64	5,6	0,2	1,3	20,2			6,7					Bal.	
SK A45-O	DIN 8555 MF 10-GF-65-GT EN 14700 T Z Fe16	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	Chromium-Niobium-Molybdenum alloy with addition of Tungsten and Vanadium designed to resist high stress grinding abrasion with low impact and solid erosion at service temperatures up to 650 °C.
			63	5,3	0,2	0,7	27,2		6,3	6,1		1,9	1		Bal.	

Stainless Steel

Name	Classi-fication	Hardness		Composition (All weld metal)												Characteristics and field of use
		HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	
SK 370-O	DIN 8555 MF 5-GF-400-C EN 14700 T Fe7		42	0,03	0,5	0,6	15,5	5,2	0,5						Bal.	Self shielded cored wire depositing a ferrit-ic-martensitic steel designed to resist metal-to-metal wear, corrosion and thermal fatigue fire cracking.
SK 402-O	DIN 8555 MF 8-GF-150/400-KPZ EN 14700 T Z Fe10	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	Austenitic alloy type 18Cr8Ni7Mn recommended for build up and buffer layer prior to hardfacing. It can also be used for joining of dissimilar metals.
		160		0,09	6	0,9	18	7,8							Bal.	
SK 714 N-O	DIN 8555 MF 5-GF-45 EN 14700 T Fe7	HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	N	W	V	B	Fe	Alloy depositing a ferritic-martensitic steel with addition of nitrogen designed to resist metal-to-metal wear, corrosion and thermal fatigue.
			44	0,03	1	0,6	13	4,2	0,5		0,1				Bal.	

Submerged arc cored wires for anti-wear and anti-corrosion

Construction and low alloyed steel

Name	Classi-fication	Hardness		Composition (All weld metal)												Characteristics and field of use
		HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	
SK BU-S	DIN 8555 UP 1-GF-300-P ISO 14700 T Fe6	275		0,12	1,2	0,6	0,7		0,4						Bal.	Rebuilding alloy for Carbon steel parts.
SK CrMo15-SA	DIN 8555 UP 1-GF-250 ISO 14700 T Fe1	230		0,03	0,8	0,6	1,15		0,5						Bal.	Rebuilding alloy (1% Cr . 0.5% Mo) for not or slightly alloyed steels.

Stainless steels

Name	Classi-fication	Hardness		Composition (All weld metal)												Characteristics and field of use
		HB	HRC	C	Mn	Si	Cr	Ni	Mo	Nb	Ti	W	V	B	Fe	
SK 385-SA	DIN 8555 UP 6-GF-55-CG ISO 14700 T Fe8		54	0,3	1,3	0,4	16		0,5						Bal.	Martensitic alloy giving a very good resistance to metal-to-metal wear, corrosion and thermal fatigue.
SK 410 NiMo-SA	DIN 8555 UP 5-GF-40-C ISO 14700 T Fe7		39	0,04	1	0,3	12	5	0,9						Bal.	Alloy depositing a ferritic-martensitic steel containing 13% Chromium, 5% Nickel and 1% Molybdenum designed to resist metal-tometal wear, corrosion and thermal fatigue fire cracking.
SK 415-SA	DIN 8555 UP 5-GF-45-C ISO 14700 T Fe7		42	0,8	0,9	0,4	13,5	2,1	1,1	0,2			0,3		Bal.	Alloy depositing a ferritic-martensitic steel designed to resist metal-to-metal wear, corrosion and thermal fatigue.
SK 420-SA	DIN 8555 UP 6-GF-55-C ISO 14700		53	0,27	1,4	0,4	13,5								Bal.	Alloy depositing a martensitic steel containing 13% Chromium giving a good resistance to metal-to-metal wear and corrosion.
SK 430C-SA	DIN 8555 UP 5-GF-200-C ISO 14700	175		0,04	0,9	0,5	19,5								Bal.	Alloy depositing a ferritic steel containing 17% Chromium giving a good resistance to corrosion and also used as a buffer layer for Surfacing of CC Rollers.
SK 430 NiMo-SA	DIN 8555 UP 5-GF-300-C ISO 14700 T Fe7	220		0,05	0,9	0,7	17	5,6	1,3						Bal.	Flux cored wire for submerged arc welding specially designed to deposit an alloy of the 410 NiMo-type directly on the first layer.
SK 461C-SA	DIN 8555 UP 6-GF-50-C ISO 14700 T Fe8		54	0,26	0,9	0,5	12,2	0,4	1,4			0,9	1	1,8	Bal.	Alloy depositing a ferritic-martensitic steel designed to resist metal-to-metal wear, corrosion and thermal fatigue fire cracking.
SK 742N-SK	DIN 8555 UP 5-GF-45-C ISO 14700 T Fe7		44	0,05	1,2	0,4	13,5	3,3	1,3	0,1				0,1	Bal.	Alloy depositing a ferritic-martensitic steel with addition of Nitrogen designed to enhance the resistance to thermal fatigue and intergranular corrosion by reducing the formation of carbides at grain boundaries.

Hardness conversion table

R_m	HV	HB	HRC
200	63	60	–
210	65	62	–
220	69	66	–
225	70	67	–
230	72	68	–
240	75	71	–
250	79	75	–
255	80	76	–
260	82	78	–
270	85	81	–
280	88	84	–
285	90	86	–
290	91	87	–
300	94	89	–
305	95	90	–
310	97	92	–
320	100	95	–
330	103	98	–
335	105	100	–
340	107	102	–
350	110	105	–
360	113	107	–
370	115	109	–
380	119	113	–
385	120	114	–
390	122	116	–
400	125	119	–
410	128	122	–
415	130	124	–
420	132	125	–
430	135	128	–
440	138	131	–
450	140	133	–
460	143	136	–
465	145	138	–
470	147	140	–
480	150	143	–
490	153	145	–
495	155	147	–
500	157	149	–

R_m	HV	HB	HRC
545	170	162	–
550	172	163	–
560	175	166	–
570	178	169	–
575	180	171	–
580	181	172	–
590	184	175	–
595	185	176	–
600	187	178	–
610	190	181	–
620	193	184	–
625	195	185	–
630	197	187	–
640	200	190	–
650	203	193	–
660	205	195	–
670	208	198	–
675	210	199	–
680	212	201	–
690	215	204	–
700	219	208	–
705	220	209	–
710	222	211	–
720	225	214	–
730	228	216	–
740	230	219	–
750	233	221	–
755	235	223	–
760	237	225	–
770	240	228	–
780	243	231	21
785	245	233	
790	247	235	
800	250	238	22
810	253	240	
820	255	242	23
830	258	245	
835	260	247	24
840	262	249	
850	265	252	

R_m	HV	HB	HRC
890	278	264	
900	280	266	27
910	283	269	
915	285	271	
920	287	273	28
930	290	276	
940	293	278	29
950	295	280	
960	299	284	
965	300	285	
970	302	287	30
980	305	290	
990	308	293	
995	310	295	31
1000	311	296	
1010	314	299	
1020	317	301	32
1030	320	304	
1040	323	307	
1050	327	311	33
1060	330	314	
1070	333	316	
1080	336	319	34
1090	339	322	
1095	340	323	
1100	342	325	
1110	345	328	35
1120	349	332	
1125	350	333	
1130	352	334	
1140	355	337	36
1150	358	340	
1155	360	342	
1160	361	343	
1170	364	346	37
1180	367	349	
1190	370	352	
1200	373	354	38
1210	376	357	
1220	380	361	

R_m	HV	HB	HRC
510	160	152	–
520	163	155	–
530	165	157	–
540	168	160	–
1260	392	372	40
1270	394	374	
1280	397	377	
1290	400	380	
1300	403	383	41
1310	407	387	
1320	410	390	
1330	413	393	42
1340	417	396	
1350	420	399	
1360	423	402	43
1370	426	405	
1380	430	409	
1390	431	410	
1400	434	413	44
1410	437	415	
1420	440	418	
1430	443	421	45
1440	446	424	
1450	449	427	
1455	450	428	
1460	452	429	
1470	455	432	
1480	458	435	46
1485	460	437	
1490	461	438	
1500	464	441	
1510	467	444	
1520	470	447	
1530	473	449	47
1540	476	452	
1550	479	455	
1555	480	456	
1560	481		
1570	484		48
1580	486		
1590	489		
1595	490		
1600	491		
1610	494		

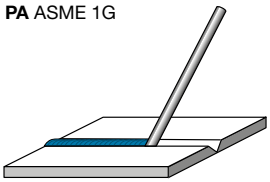
R_m	HV	HB	HRC
860	268	255	25
865	270	257	
870	272	258	26
880	275	261	
1620	497		49
1630	500		
1640	503		
1650	506		
1660	509		
1665	510		
1670	511		
1680	514		50
1690	517		
1700	520		
1710	522		
1720	525		
1730	527		51
1740	530		
1750	533		
1760	536		
1770	539		
1775	540		
1780	541		
1790	544		52
1800	547		
1810	550		
1820	553		
1830	556		
1840	559		
1845	560		53
1850	561		
1860	564		
1870	567		
1880	570		
1890	572		
1900	575		
1910	578		54
1920	580		
1930	583		
1940	586		
1950	589		
1955	590		
1960	591		
1970	594		

R_m	HV	HB	HRC
1230	382	363	39
1240	385	366	
1250	388	369	
1255	390	371	
1980	596		55
1990	599		
1995	600		
2000	602		
2010	605		
2020	607		
2030	610		
2040	613		
2050	615		56
2060	618		
2070	620		
2080	623		
2090	626		
2100	629		
2105	630		
2110	631		
2120	634		
2130	636		
2140	639		57
2145	640		
2150	641		
2160	644		
2170	647		
2180	650		
2190	653		
2200	655		58
	675		59
	698		60
	720		61
	745		62
	773		63
	800		64
	829		65
	864		66
	900		67
	940		68

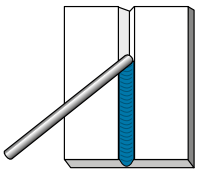
R_m = Tensile strength (MPa)
HV = Vickers hardness
HB = Brinell hardness
HRC = Rockwell hardness

Caution: Because of their approximate nature, conversion tables must be regarded as only an estimate of comparative values. It is recommended that hardness conversions be applied primarily to values such as specification limits, which are established by agreement or mandate, and that the conversion of test data be avoided whenever possible.

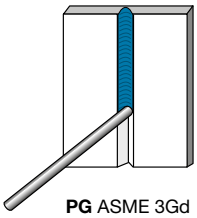
Welding positions according to EN ISO 6947 und ASME code, section IX



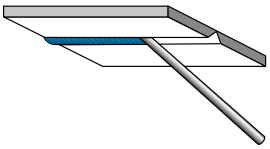
PA ASME 1G



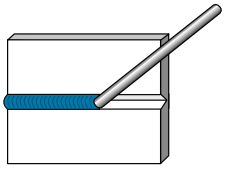
PF ASME 3Gu



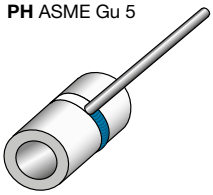
PG ASME 3Gd



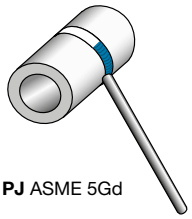
PE ASME 4G



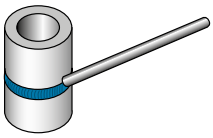
PC ASME 2G



PH ASME Gu 5

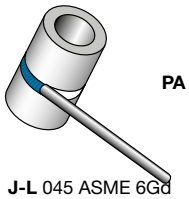


PJ ASME 5Gd

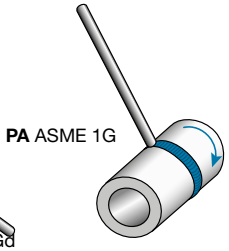


PC ASME 2G

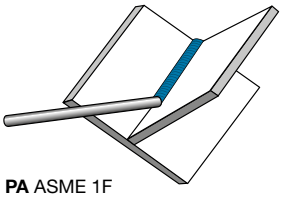
H-L 045 ASME 6Gu



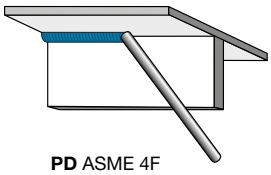
J-L 045 ASME 6Gd



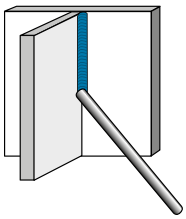
PA ASME 1G



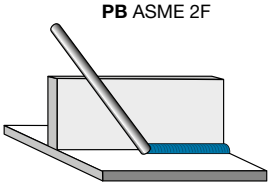
PA ASME 1F



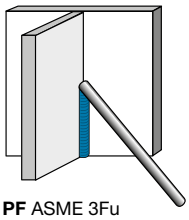
PD ASME 4F



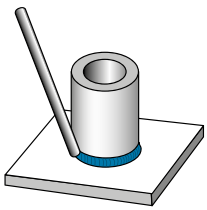
PG ASME 3Fd



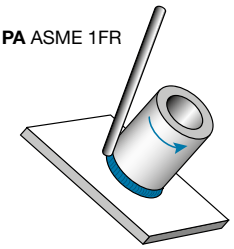
PB ASME 2F



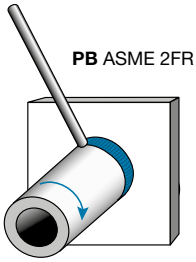
PF ASME 3Fu



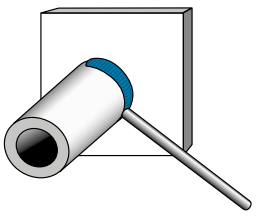
PB ASME 2F



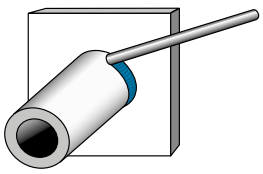
PA ASME 1FR



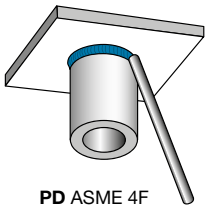
PB ASME 2FR



PJB ASME 4Fd



PH ASME 5Fu



PD ASME 4F

020/2017/EN/GL

voestalpine Böhler Welding

Welding know-how joins steel

With over 100 years of experience, voestalpine Böhler Welding is the global top address for the daily challenges in the areas of joint welding, wear and corrosion protection as well as brazing. Customer proximity is guaranteed by more than 40 subsidiaries in 25 countries, with the support of 2,200 employees, and through more than 1,000 distribution partners worldwide. With individual consultation by our application technicians and welding engineers, we make sure that our customers master the most demanding welding challenges. voestalpine Böhler Welding offers three specialized and dedicated brands to cater for our customers' and partners' requirements.

böhler welding by voestalpine

Lasting Connections – More than 2,000 products for joint welding in all conventional arc welding processes are united in a product portfolio that is unique throughout the world. Creating Lasting Connections is the brand's philosophy in welding and between people.

utp maintenance by voestalpine

Tailor-Made Protectivity™ – Decades of industry experience and application know-how in the areas of repair of cracked material, anti-wear and cladding, combined with innovative and custom-tailored products, guarantee customers an increase in the productivity and protection of their components.

fontargen brazing by voestalpine

In-Depth Know-How – Through deep insight into processing methods and ways of application, Fontargen Brazing provides the best brazing and soldering solutions based on proven products with German technology. The expertise of this brand's application engineers has been formulated over many years of experience from countless application cases.

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

böhler welding
by voestalpine

Schweißzusätze für Aluminium

Welding filler metals for aluminium

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

Drahtelektroden und Schweißstäbe für Alu
Bare electrodes and welding rods for alum

Markenname Product name EN ISO 18273 AWS A5.10	Grundwerkstoffe Base materials DIN 1725		EN 573/753/1706	Richtanalyse Typical Composition %	
Union Al 99.5 S Al 1450 (Al99.5Ti)	Al99.5 Al99.7 Al99.8	3.0255 3.0275 3.0285		Al Si Fe Ti	min. 99.5 <0.25 <0.4 0.15
Union Al Mg 3 S Al 5754 (AlMg3) ER5754	AlMg 3 AlMg 2 Mn 0.3 AlMg AlMgSi 0.5 AlMg 2.7 Mn G-AlMg 3 G-AlMg 3 Si	3.3535 3.3525 3.3315 3.3206 3.3537 3.3541 3.3241	EN AW-5754 [AlMg 3] EN AW-5251 [AlMg 2] EN AW-500SA [AlMg 1(C)] EN AW-6060 [AlMgSi] EN AW-5454 [AlMg 3 Mn] EN AC-51100 -	Al Mg Cr Mn Ti Fe Si Zn Cu	Rest/Ballanced 2.6 - 3.6 < 0.3 < 0.5 < 0.15 < 0.4 < 0.4 < 0.2 < 0.1
Union AlMg 4.5 Mn Zr S Al 5087 (AlMg4.5MnZr) ER5087	AlMg 4.5 Mn AlMg 4 Mn AlMg 5 AlMgSi 0.5 AlMgSi 0.7 AlMgSi 1 AlMg 1 SiCu AlZn 4.5 Mg 1 G-AlMg 5 G-AlMg 5 Si	3.3547 3.3545 3.3555 3.3206 3.3210 3.2315 3.3211 3.4335 3.3561 3.3261	EN AW-5083 [AlMg 4.5 Mn 0.7] EN AW-5086 [AlMg 4] EN AW-5019 [AlMg 5] EN AW-6060 [AlMgSi] EN AW-6005A [AlSiMg(A)] EN AW-6082 [AlSi 1 MgMn] EN AW-6061 [AlMg 1 SiCu] EN AW-7020 [AlZn 4.5 Mg 1] EN AC-51300 EN AC-51400	Al Mn Cr Mg Zr Ti Fe Si Zn	Rest / Balanced 0.7 - 1.1 0.05 - 0.25 4.5 - 5.2 0.1 - 0.2 <0.15 <0.4 <0.25 <0.25
Union AlMg 4.5 Mn S Al 5183 (AlMg4.5Mn0.7(A)) ER5183	AlMg 4.5 Mn AlMg 4 Mn AlMg 5 AlMgSi 0.5 AlMgSi 0.7 AlMgSi 1 AlMg 1 SiCu AlZn 4.5 Mg G-AlMg 5 G-AlMg 5 Si	3.3547 3.3545 3.3555 3.3206 3.3210 3.2315 3.3211 3.4335 3.3561 3.3261	EN AW-5083 [AlMg 4.5 Mn 0.7] EN AW-5086 [AlMg 4] EN AW-5019 [AlMg 5] EN AW-6060 [AlMgSi] EN AW-6005A [AlSiMg(A)] EN AW-6082 [AlSi 1 MgMn] EN AW-6061 [AlMg 1 SiCu] EN AW-7020 [AlZn 4.5 Mg 1] EN AC-51300 EN AC-51400	Al Mn Cr Mg Ti Si Zn Cu	Rest / Balanced 0.5 - 1.0 0.05 - 0.25 4.3 - 5.2 <0.15 <0.4 <0.25 <0.1
Union AlMg 5 S Al 5356 (AlMg5Cr(A)) ER5356	AlMg 5 AlMg 3 AlMg 4 Mn AlMgSi 0.5 AlMgSi 0.7 AlMgSi 1 AlMg 1 SiCu AlZn 4.5 Mg 1 AlMg 2.7 Mn G-AlMg 5 G-AlMg 5 Si G-AlMg 3 G-AlMg 3 Si	3.3555 3.3535 3.3545 3.3206 3.3210 3.2315 3.3211 3.4335 3.3537 3.3561 3.3261 3.3541 3.3241	EN AW-5019 [AlMg 5] EN AW-5754 [AlMg 3] EN AW-5086 [AlMg 4] EN AW-6060 [AlMgSi] EN AW-6005A [AlSiMg(A)] EN AW-6082 [AlSi 1 MgMn] EN AW-6061 [AlMg 1 SiCu] EN AW-7020 [AlZn 4.5 Mg 1] EN AW-5454 [AlMg 3 Mn] EN AC-51300 EN AC-51400 EN AC-51100 -	Al Mn Cr Mg Ti Fe Si Zn Cu	Rest / Balanced 0.05 - 0.2 0.05 - 0.2 4.5 - 5.5 0.06 - 0.2 <0.4 <0.25 <0.1 <0.1
Union AlSi 5 S Al 4043A (AlSi5(A)) ER4043	AlMgSi 0.5 AlMgSi 0.7 AlMgSi 1 AlMg 1 SiCu G-AlSi 6 Cu 4	3.3206 3.3210 3.2315 3.3211 3.2151	EN AW-6060 [AlMgSi] EN AW-6005A [AlSiMg(A)] EN AW-6082 [AlSi 1 MgMn] EN AW-6061 [AlMg 1 SiCu] EN AC-45000	Al Si Fe Cu Mg Ti Mn Zn	Rest / Balanced 4.5 - 6.0 <0.6 <0.3 <0.2 <0.15 <0.15 <0.1
Union AlMg2.7 Mn 0.8 S Al 5554 (AlMg 2.7Mn) ER5554	AlMg 3 AlMm 1 Mg 1 AlMg 2.7 Mn AlMg 2 Mn 0.3 AlMg 1 G-AlMg 3 G-AlMg 3 Si	3.3535 3.0526 3.3537 3.3525 3.2315 3.3541 3.3241	EN AW-5754 [AlMg 3] EN AW-3004A [AlMn 1 Mg 1] EN AW-5454 [Al Mg 3 Mn] EN AW-5251 [AlMg 2] EN AW-5005A [AlMg 1 (C)] EN AC-51100 –	Al Mn Cr Mg Ti Fe Si Zn Cu	Rest / Balanced 0.5 - 1.0 0.05 - 0.2 2.4 - 3.0 0.2 <0.4 <0.25 <0.25 <0.1

minium und Aluminiumlegierungen
inium and aluminium alloys

Mechanische Gütewerte des reinen Schweißgutes Mechanical properties of all weld metal	Abmessungen * Dimensions * mm B300 Spule B300 Spool	 WIG Stäbe TIG rods	Zulassungen Approvals GTAW	 GMAW	Schutzgase Shielding gases GTAW	 GMAW
$R_{p0.2}$ 20 MPa R_m 65 MPa A (L_0=5d_0) 35%	1.2	2.0 2.4 3.2	–	–	EN ISO 14175: I1	EN ISO 14175: I1, I3
$R_{p0.2}$ 80 MPa R_m 190 MPa A (L_0=5d_0) 20%	1.0 1.2 1.6	1.6 2.0 2.4 3.2 4.0	–	–	EN ISO 14175: I1	EN ISO 14175: I1, I3
$R_{p0.2}$ 125 MPa R_m 275 MPa A (L_0=5d_0) 17%	1.0 1.2 1.6	2.0 2.4 3.2	DB (61.132.04) WIWEB	DB (61.132.04) GL WIWEB	EN ISO 14175: I1	EN ISO 14175: I1, I3
$R_{p0.2}$ 125 MPa R_m 275 MPa A (L_0=5d_0) 17%	1.0 1.2 1.6	1.6 2.0 2.4 3.2 4.0	TÜV (2196) DB (61.132.03) WIWEB	TÜV (2195) DB (61.132.03) GL LR DNV WIWEB BV	EN ISO 14175: I1	EN ISO 14175: I1, I3
$R_{p0.2}$ 110 MPa R_m 240 MPa A (L_0=5d_0) 17%	1.0 1.2 1.6	1.6 2.0 2.4 3.2	TÜV (2198) DB (61.132.01)	TÜV (2197) DB (61.132.01) GL LR	EN ISO 14175: I1	EN ISO 14175: I1, I3
$R_{p0.2}$ 40 MPa R_m 120 MPa A (L_0=5d_0) 8%	1.0 1.2 1.6	1.6 2.0 2.4 3.2 4.0	DB (61.132.02)	DB (61.132.02)	EN ISO 14175: I1	EN ISO 14175: I1, I3
$R_{p0.2}$ 100 MPa R_m 215 MPa A (L_0=5d_0) 17%	1.2 1.6	2.4	–	–	EN ISO 14175: I1	EN ISO 14175: I1, I3

$R_{p0.2}$	Dehngrenze Yield strength	R_m	Zugfestigkeit Tensile strength	A (L_0=5d_0)	Dehnung Elongation	Polarität: Polarity:		Schweißpositionen: Welding positions:	

* weitere Abmessungen auf Anfrage
other dimensions on request

Eigenschaften und typische Anwendungsgebiete
Characteristics and typical field of application

Reinaluminiumdraht zum Verbindungs- und Auftragsschweißen an Aluminiumwerkstoffen nach EN ISO 18273.
Der Schweißzusatz enthält Ti zur Kornverfeinerung und ist in allen Positionen verschweißbar.

Is a pure aluminium welding wire for joining and surfacing of aluminium materials according to EN ISO 18273.
It is a welding consumable with Ti for grain refinement and weldable in all positions.

Schweißstäbe und Drahtelektroden zum WIG- und MIG-Schweißen von AlMg-Legierungen bis 3% Mg. Das Schweißgut ist seewasserbeständig.
Für annähernd farbgleiche Schweißverbindungen an anodisch oxidierbaren Werkstoffen. Werkstückflanken gründlich reinigen.
Dicke Bleche auf 150°C vorwärmen.

Solid wires and rods for GTAW and GMAW of AlMg alloys containing up to 3% Mg. Seawater resistant weld metal. Good colour matching with base metal after anodizing. Thorough cleaning of the workpiece bevels is necessary. Thicker plate materials require preheating to 150°C (302°F).

Zirkon-mikrolegierte Schweißstäbe und Drahtelektroden. Das Schweißgut ist heißrissunempfindlich. Besonders vorteilhaft bei komplizierten Schweißkonstruktionen mit ungünstigen Einspannverhältnissen. Werkstückflanken gründlich reinigen. Dicke Bleche auf 150°C vorwärmen.

Zirconium micro alloyed welding rods and bare wire electrodes. The weld metal is not susceptible to hot cracking.
Particularly advantageous for complicated weldments involving damp conditions.
Thorough cleaning of the workpiece bevels is necessary. Thicker plate materials require preheating to 150°C (302°F).

Schweißstäbe und Drahtelektroden zum WIG- und MIG-Schweißen von AlMg-Legierungen. Das Schweißgut ist seewasserbeständig.
Werkstückflanken gründlich reinigen. Dicke Bleche auf 150°C vorwärmen.

Solid wires and rods for GTAW and GMAW of AlMg alloys. Seawater resistant weld metal.
Thorough cleaning of the workpiece bevels is necessary. Thicker plate materials require preheating to 150°C (302°F).

Schweißstäbe und Drahtelektroden zum WIG- und MIG-Schweißen von AlMg-Legierungen bis 5% Mg.
Das Schweißgut ist seewasserbeständig.
Werkstückflanken gründlich reinigen. Dicke Bleche auf 150°C vorwärmen.

Solid wires and rods for GTAW and GMAW of AlMg alloys containing up to 5% Mg.
Seawater resistant weld metal. Good colour matching with base metal after anodizing.
Thorough cleaning of the workpiece bevels is necessary. Thicker plate materials require preheating to 150°C (302°F).

Schweißstäbe und Drahtelektroden zum WIG- und MIG-Schweißen. Gasschweißen bzw. Hartlöten mit geeigneten Flussmitteln möglich.
Das Schweißgut ist nicht dekorativ anodisch oxydierbar. Sehr flüssiges Schweißbad. Dicke Bleche und Gusstücke auf 150 - 200°C vorwärmen.
Die Schweißnähte an Werkstücken aus aushärtbaren Legierungen in nicht höchstbeanspruchte Zonen legen.

Solid wires and rods for GTAW and GMAW. Oxyacetylene welding respectively brazing with suitable fluxes possible.
The weld metal is not suitable for anodizing for decorative purposes. Very fluid weld pool. Thicker plate materials and castings require preheating to 150 - 200°C (302 - 392°F). Do not use for welding hardenable alloys is high stressed zones.

Schweißstäbe und Drahtelektroden zum WIG- und MIG-Schweißen von AlMg-Legierungen.
Zur Erzielung ausreichender IK-Beständigkeit ist der Mg-Gehalt auf 3% begrenzt.
Das Schweißgut ist seewasserbeständig. Für annähernd farbgleiche Schweißverbindungen an anodisch oxidierten Werkstoffen.

Solid wires and rods for GTAW and GMAW of AlMg alloys.
Mg-content max. 3% to obtain intergranular corrosion resistance.
Seawater resistant weld metal. For obtaining near matching coloured joints where anodizing is required.

Die Angaben zur Art und Anwendung unserer Produkte dienen lediglich der Information des Anwenders. Die Daten zu den mechanischen Eigenschaften beziehen sich immer auf das reine Schweißgut unter Beachtung der geltenden Normen. In der Schweißverbindung werden die Schweißguteigenschaften u.a. vom Grundwerkstoff, der Schweißposition und den Schweißparametern beeinflusst. Eine Garantie für die Eignung für eine bestimmte Art der Anwendung erfordert in jedem einzelnen Fall eine ausdrückliche schriftliche Vereinbarung.

Änderungen vorbehalten.

The specifications in regard to the type and application of our products are only for the user's information. The data specified for the mechanical properties always refer to the weld metal alone under observance of the applicable standards. In the weld joint, the weld metal properties are influenced, among other factors, by the parent metal, the welding position and the welding parameters. A guarantee of suitability for a certain type of application requires an explicit written agreement in each individual case.

Subject to change without notice.

004/2016/GL

Böhler Welding
Global Brand Management
bohler.welding@voestalpine.com
www.boehler-welding.com

voestalpine
ONE STEP AHEAD.

Filler Metals for Pipelines

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

Joining 1/2

	Process	Product Name	AWS Classification	EN ISO Norm
Unalloyed steels	SMAW	BÖHLER FOX CEL	A5.1 E6010	2560-A E 38 3 C 2 1
		BÖHLER FOX CEL+	A5.1 E6010	2560-A E 38 2 C 2 1
		BÖHLER FOX CEL-S	A5.1 E6010	2560-A E 38 3 C 2 1
		Phoenix Cel 70	A5.1 E6010	2560-A E 42 2 C 2 5
		BÖHLER FOX CEL 75	A5.5 E7010-P1	2560-A E 42 3 C 2 5
		Phoenix Cel 75	A5.5 E7010-P1	2560-A E 42 2 C 2 5
		Phoenix K 50 R	A 5.1 E7016	2560-A E 42 3 B 3 2
		BÖHLER FOX EV PIPE	A 5.1 E7016-1H4R	2560-A E 42 4 B 1 2 H5
		Phoenix 120 K	A5.1 E7018-1	2560-A E 42 5 B 3 2 H5
		BÖHLER FOX EV 50	A5.1 E7018-1H4R	2560-A E 42 5 B 4 2 H5
	GTAW	BÖHLER ER 70 S-2	A5.18 ER70S-2	
		BÖHLER EML 5	A5.18 ER70S-3	636-A W 46 5 W2Si1
		Union I 2	A5.18 ER70S-3	636-A W 42 5 W2Si1
		BÖHLER EMK 6	A5.18 ER70S-6	636-A W 42 5 W3Si1
		Union I 52	A5.18 ER70S-6	636-A W 42 5 W3Si1
	FCAW	BÖHLER HL 46-MC	A5.18 E70C-6MH4	17632-A T46 3 M M 1 H5
		BÖHLER TI 52-FD	A5.20 E71T-1MJH8	17632-A T 46 4 P M 1 H10/T 42 2 P C 1 H5
	GMAW	BÖHLER EMK 8	A5.18 ER70S-6	14341-A G 46 4 M G4Si1/G 46 4 C G4Si1
		BÖHLER SG 3-P	A5.18 ER70S-G	14341-A G 46 5 M G3Si1/G 42 4 C G3Si1
		Union K 52 S	A5.18 ER70S-6	14341-A G 42 4 M21 3Si1
		Union K 56	A5.18 ER70S-6	14341-A G 46 4 M G4Si1/G 42 2 C G4Si1
		Union K 56 S	A5.18 ER70S-6	14341-A G 46 2 C G4 Si1/G 46 4 M G6 Si1
		Union K Nova	A5.18 ER70S-G	14341-A G 46 5 M G3Si1/G 42 4 C G3Si1
	SAW	UV 418 TT		14174 SA FB 1 55 AC H5
		UV 421 TT		14174 SA FB 1 55 AC H5
		Union S 2	A5.17 EM12	756 S2
		Union S 3 Si	A5.17 EH12K	756 S3Si
Medium alloyed steels	SMAW	BÖHLER FOX CEL 70-P	A5.5 E7010-P1	2560-A E42 3 C 2 5
		BÖHLER FOX CEL Mo	A5.5 E7010-A1	2560-A E 42 3 Mo C 2 5
		BÖHLER FOX CEL 80-P	A5.5 E8010-P1	2560-A E 46 3 1Ni C 2 5
		Phoenix Cel 80	A5.5 E8010-P1	2560-A E 46 3 C 2 5
		BÖHLER FOX CEL 85	A5.5 E8010-P1	2560-A E 46 4 1Ni C 2 5
		Phoenix Cel 90	A5.5 E9010-G	2560-A E 50 3 1Ni C 2 5
		BÖHLER FOX CEL 90	A5.5 E9010-P1	2560-A E 50 3 1Ni C 2 5
		BÖHLER FOX EV 60 PIPE	A5.5 E8016-GH4R	2560-A E 50 4 1Ni B 1 2 H5
		BÖHLER FOX EV 60	A5.5 E8018-C3H4R	2560-A E 46 6 1Ni B 4 2 H5
		Phoenix SH V 1	A5.5 E8018-G/E8018-C3 (mod.)	2560-A E 50 6 Mn 1Ni B 42 H5
		BÖHLER FOX EV 65	A5.5 E8018-GH4R	E 55 6 1NiMo B 4 2 H5
		BÖHLER FOX EV 70 PIPE	A5.5 E9016-GH4R	18275-A E 55 4 ZMn2NiMo B 1 2 H5
		BÖHLER FOX EV 70	A5.5 E9018-GH4R	18275-A E 55 6 1NiMo B 4 2 H5
		Phoenix SH Ni 2 K 100	A5.5 E11018G/E11018-M (mod.)	18275-A E 69 5 Mn 2 NiCrMo B 4 2 H5
		BÖHLER FOX EV 85	A5.5 E11018-GH4R	18275-A E 69 6 Mn2NiCrMo B 4 2 H5
		BÖHLER FOX BVD 85	A5.5 E8045-P2	2560-A E 46 5 1Ni B 4 5
		BÖHLER FOX BVD 90	A5.5 E9045-P2 (mod.)	18275-A E 55 5 Z2Ni B 4 5
		BÖHLER FOX BVD 100	A5.5 E10045-P2 (mod.)	18275-A E 62 5 Z2Ni B 4 5
		BÖHLER FOX BVD 110	A5.5 E11018-G	18275-A E 69 3 Mn2NiMo B 4 5
		BÖHLER FOX BVD 120	A5.5 E12018-G	18275-A E 69 3 Mn2NiMo B 4 5
	GTAW	BÖHLER Ni 1-IG	A5.28 ER80S-Ni1 (mod.)	636-A W3Ni1
		Union I 1,2 Ni	A5.28 ER80S-G	636-A W 46 6 W3Ni1
		Union I Ni1MoCr	A5.28 ER100S-G	16834-A W 55 6 ZMn3Ni0,9MoCr
	FCAW	Union RV 71	A5.20 E71T-1MJH4/E71T-1CH4	17632-A T 42 2 P M 1 H5/T 42 2 P C 1 H5
		BÖHLER PIPESHIELD 71 T8-FD	A5.29 E71T8-K6	
		BÖHLER PIPESHIELD 71.1 T8-FD	A5.29 E71T8-Ni1	
		BÖHLER PIPESHIELD 81 T8-FD	A5.29 E81T8-N2	
		Union MV Ni1	A5.28 E80C-Ni1H4	17632-A T 50 6 1 Ni MM 1 H5
		Union RV Ni1	A5.29 E81T1-Ni1MJH4	T 50 6 1Ni P M 1 H5
		BÖHLER TI 60-FD	A5.29 E81T1-Ni1	17632-A T 50 6 1Ni P M 1 H5
		BÖHLER TI 70 PIPE-FD	A5.29 E91T1-GM	18276-A T 55 4 Mn1Ni P M 1 H5
		BÖHLER TI 80 PIPE-FD	A5.29 E111T1-GMH4	18276-A T 69 4 Z P M 1 H5

Joining 2/2

	Process	Product Name	AWS Classification	EN ISO Norm
Medium alloyed steels	GMAW	BÖHLER SG 8-P	A5.28 ER80S-G	14341-A G 42 5 M G3Ni1
		Union K Nova Ni	A5.28 ER80S-G	14341-A G 50 6 M Z3Ni1/G 46 4 C Z3Ni1
		Union NiMo 80	A5.28 ER90S-G	16834-A G 62 5 M21 Mn3Ni1Mo/ G 55 4 C1 Mn3Ni1Mo
		BÖHLER NiMo 1-IG	A5.28 ER90S-G	16834-A G 55 6 M Mn3 Ni1 Mo
		Union I Ni 1 MoCr	A5.28 ER100S-G	16834-A G Z Mn3Ni0,9MoCr
	SAW	Union S 2 NiMo 1	A5.23 ENi1	756 SZ2Ni1
		Union S 3 NiMo 1	A5.23 EF3 mod.	756 S3Ni1Mo
		Union S 3 NiMoCr	A5.23 EF6 mod.	756 SZ3Ni2,5CrMo
		Union S 3 Ti B	A5.23 EG	14171 SZ
		Union S 3 Mo Ti B	A5.23 EA2TiB	14171 SZ
Stainless steels	SMAW	BÖHLER FOX EAS 4 M	A5.4 E316L-15	3581-A E 19 12 3 L B 2 2
		BÖHLER FOX EAS 4 M-A	A5.4 E316L-17	3581-A E 19 12 3 L R 3 2
		BÖHLER FOX CN 22/9 N-B	A5.4 E2209-15	3581-A E 22 9 3 NL B 2 2
		BÖHLER FOX CN 22/9 N	A5.4 E2209-17	3581-A E 22 9 3 NL R 3 2
		BÖHLER FOX CN 25/9 Cu T	A5.4 E2595-15	3581-A E 25 9 4 NL B 2 2
	GTAW	BÖHLER EAS 4 M-IG	A5.9 ER316L	14343-A W 19 12 3 L
		BÖHLER CN 22/9 N-IG	A5.9 ER2209	14343-A W 22 9 3 NL
		Thermanit 22/09	A5.9 ER2209	14343-A W 22 9 3 NL
		BÖHLER CN 25/9 Cu T-IG	A5.9 ER2594	14343-A W 25 9 4 NL
		Thermanit 25/09 CuT	A5.9 ER2594	14343-A W 25 9 4 NL
	FCAW	BÖHLER EAS 4 PW-FD	A5.22 E316LT1-4(1)	17633-A T 19 12 3 L P M(C) 1
		BÖHLER CN 22/9 PW-FD	A5.22 E2209T1-4(1)	17633-A T 22 9 3 NL P M(C) 1
		BÖHLER CN 25/9 PW-FD	A5.22 E2594T1-4(1)	17633-A T 25 9 4 N L P M21 (C1) 2
	GMAW	BÖHLER EAS 4 M-IG (SI)	A5.9 ER316LSi	14343-A W 19 12 3 LSi
		BÖHLER CN 22/9 N-IG	A5.9 ER2209	14343-A G 22 9 3 NL
		Thermanit 22/09	A5.9 ER2209	14343-A G 22 9 3 NL
		BÖHLER CN 25/9 Cu T-IG	A5.9 ER2594	14343-A G 25 9 4 NL
		Thermanit 25/09 CuT	A5.9 ER2594	14343-A G 25 9 4 NL
	SAW	Marathon 431		14174 SA FB 2 DC
		BÖHLER BB 202		14174 SA FB 2 DC
		Thermanit GE-316L	A5.9 ER316L	14343-A S 19 12 3 L
		BÖHLER EAS 4 M-UP	A5.9 ER316L	14343-A S 19 12 3 L
		Thermanit 22/09	A5.9 ER2209	14343-A S 22 9 3 NL
		BÖHLER CN 22/9 N-UP	A5.9 ER2209	14343-A S 22 9 3 NL
Nickel base	SMAW	UTP 6222 Mo	A5.11 ENiCrMo-3	14172 ENi 6625
	GTAW	Thermanit 625	A5.14 ERNiCrMo-3	18274 S Ni 6625
		UTP A 6222 Mo-3	A5.14 ERNiCrMo-3	18274 S Ni 6625
	FCAW	UTP AF 6222 MoPW	A5.34 ENiCrMo-3 T1-4	12153 T Ni 6625 P M21 2
	GMAW	Thermanit 625	A5.14 ERNiCrMo-3	18274 S Ni 6625
		UTP A 6222 Mo-3	A5.14 ERNiCrMo-3	18274 S Ni 6625
	SAW	UTP UP FX 504		14174 SA AB 2 AC
		Thermanit 625	A5.14 ERNiCrMo-3	18274 S Ni 6625
		UTP A 6222 Mo-3	A5.14 ERNiCrMo-3	18274 S Ni 6625

Productfolder-066/2015/EN/GL

voestalpine Böhler Welding

Welding know-how joins steel

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

Böhler Welding – More than 2,000 products for joint welding in all conventional arc welding processes are united in a product portfolio that is unique throughout the world. Creating lasting connections is the brand's philosophy in welding and between people.

UTP Maintenance – Decades of industry experience and application know-how in the areas of repair as well as wear and surface protection, combined with innovative and custom-tailored products, guarantee customers an increase in the productivity and protection of their components.

Fontargen Brazing – Through deep insight into processing methods and ways of application, Fontargen Brazing provides the best brazing and soldering solutions based on proven products with German technology. The expertise of this brand's application engineers has been formulated over many years of experience from countless application cases.

forwarded by:

Global Industry Segment Management
Pipelines

T. +43 3862 301 28257
F. +43 3862 301 95257
E. welding.pipeline@voestalpine.com

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

utp maintenance
by voestalpine

Cast iron electrodes for highest demands

UTP 8 | UTP 83 FN | UTP 86 FN

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

UTP Maintenance

Tailor-Made Protectivity™

High-quality industrial-use welding filler metals for maintenance, repair, and overlay welding. By adding the UTP and Soudokay brands to the voestalpine Böhler Welding brand network, the UTP Maintenance can look back on a proud history spanning 60 years as an innovative supplier of welding technology products. UTP Maintenance is the global leader in the repair, maintenance, and overlay welding segment.

With roots both in Bad Krozingen (Germany) and Seneffe (Belgium), UTP Maintenance offers the world's most unique product portfolio for filler metals from its own production facilities. The Soudokay brand was established back in 1938, while the UTP brand began operations in 1953. Each of these brands therefore respectively look back on a long history of international dimension.

By merging into the UTP Maintenance brand, the collective know-how of both brands – gathered over decades in the fields of metallurgy, service, and applications engineering – is now united under one umbrella. As a result, a truly unique portfolio of solutions for welding applications has been created in the fields of repair, maintenance, and overlay welding.

Tailor-Made Protectivity™

Industry experience and applications know-how – combined with innovative and custom (tailor-made) products – guarantee that our customers obtain the ideal combination of productivity and protection, within the shortest operating times and up to the maximum performance capacity of their products. This explains UTP Maintenance's guiding principle – "Tailor-Made Protectivity™" – which puts the focus on the customer.

Research and Development for Customized Solutions

At UTP Maintenance, research and development, conducted in collaboration with customers, plays a crucial role. Because of our strong commitment to research and development, combined with our tremendous innovative capacity, we are constantly engineering new products, and improving existing ones on an ongoing basis.
The result is a vast number of innovative products for solving individual problems and complex matters.

Customized Products of Superior Quality

We continuously adapt our product portfolio of about 600 products to customer and industry specifications, while ensuring that we meet the highest quality specifications.

From its in-house production facilities, UTP Maintenance delivers innovative, tailor-made welding filler metals for: unalloyed and fine-grained structural steel, low-grade alloyed steels, stainless and heat-resistant steels, nickel-based alloys, cast iron, copper and copper alloys, manganese steels, tool steels, and cobalt steels. The product portfolio comprises:

- Stick electrodes
- Solid wires and rods
- Flux cored wires
- Submerged arc wires and fluxes
- Submerged arc strips and fluxes
- Spraying- and PTA-powders

Solutions at Every Point on the Globe

UTP Maintenance provides products and services through the global branches of voestalpine Böhler Welding and its dealer network in more than 150 countries throughout the world. A team of welding engineers stands at the customer's side, providing advice and support in all matters related to the challenges of welding technology.

Welding of cast iron materials

This brochure provides an overview of the different types of cast iron and the UTP Maintenance welding consumables for production, repair and construction.

Cast iron is an iron-carbon alloy with a carbon content of more than 2.06 %. The metallurgical composition of cast iron is adjusted according to the application. In general, cast iron parts exhibit high compression strength, absorb vibration well and can be machined. Because of this properties cast materials are often used for large housings or machine beds. On the other hand, cast iron has relatively low tensile strength and toughness, which has an influence on the welding properties. By oversizing the components, these properties can be mitigated with modest economic consequences, making cast iron suitable as a building material.

UTP Maintenance Special Electrodes for Cast Iron Welding

Pure nickel stick electrode

Pure nickel electrodes are suitable for cold welding of grey cast iron, malleable cast iron and cast steel as well as for joining these materials to steel, copper and copper alloys. Due to its high nickel content, the soft and tough weld metal is especially suitable for welding cast iron which is brittle or old. The electrodes have excellent welding properties and can be used in any position (except vertical down) with no spattering or undercuts. Slag can be removed easily. To eliminate stresses, the weld metal should be hammered whilst it is warm (see page 12).

UTP 8

graphite-basic coated stick electrode

Standard designation		Typical weld metal composition (%)			Hardness	Welding position	Dimensions	Current	Current type
EN ISO 1071	AWS A5.15	C	Ni	Fe	HB		mm	A	
E C Ni-CI 1	E Ni-CI	1,2	Rest	1,0	ca. 180	PA / PB / PC PE / PF	2,0 x 300 2,5 x 300 3,2 x 350 4,0 x 350	45 – 60 60 – 80 80 – 100 110 – 140	= – ~

Nickel-Iron stick electrode

Nickel-iron electrodes are suitable for joining and hardfacing of grey cast iron, nodular cast iron (spheroidal graphite cast iron) and malleable cast iron as well as for joining with steel. The welding electrodes are universally applicable for cold welding in repair, production or construction. They have excellent mechanical and welding properties, do not cause spattering or undercuts and the slag can easily be removed. The use of bimetallic core wires (e.g. UTP 86FN) provides good current carrying capacity and melting characteristics, since the electrical resistance is less than for alloyed core wires (UTP 83 FN).

UTP 83 FN

graphite-basic coated stick electrode

Standard designation		Typical weld metal composition (%)			Hardness	Welding position	Dimensions	Current	Current type
EN ISO 1071	AWS A5.15	C	Ni	Fe	HB		mm	A	
E C NiFe-1 1	E NiFe-CI	1,3	52,0	Rest	ca. 190	PA / PB	2,5 x 300 3,2 x 350 4,0 x 350	50 – 70 70 – 100 100 – 130	= + ~

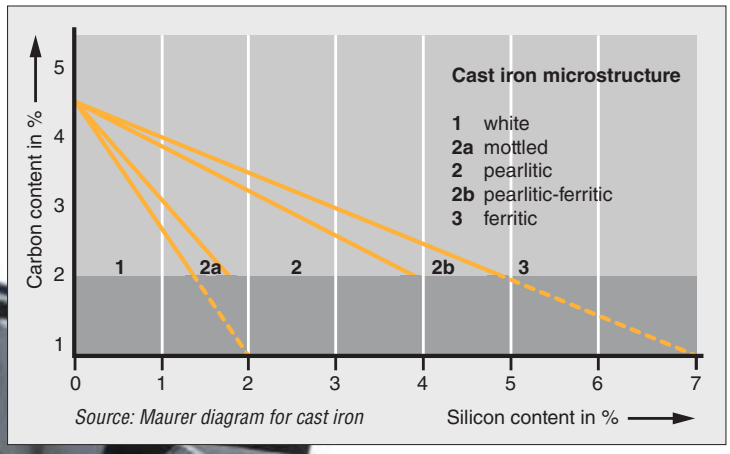
UTP 86 FN

graphite-basic coated stick electrode

Standard designation		Typical weld metal composition (%)			Hardness	Welding position	Dimensions	Current	Current type
EN ISO 1071	AWS A5.15	C	Ni	Fe	HB		mm	A	
E C NiFe-1 3	E NiFe-CI	1,2	Rest	45,0	ca. 220	PA / PB / PC PE / PF	2,5 x 300 3,2 x 350 4,0 x 350	60 – 90 90 – 140 100 – 170	= – ~

Cast Iron

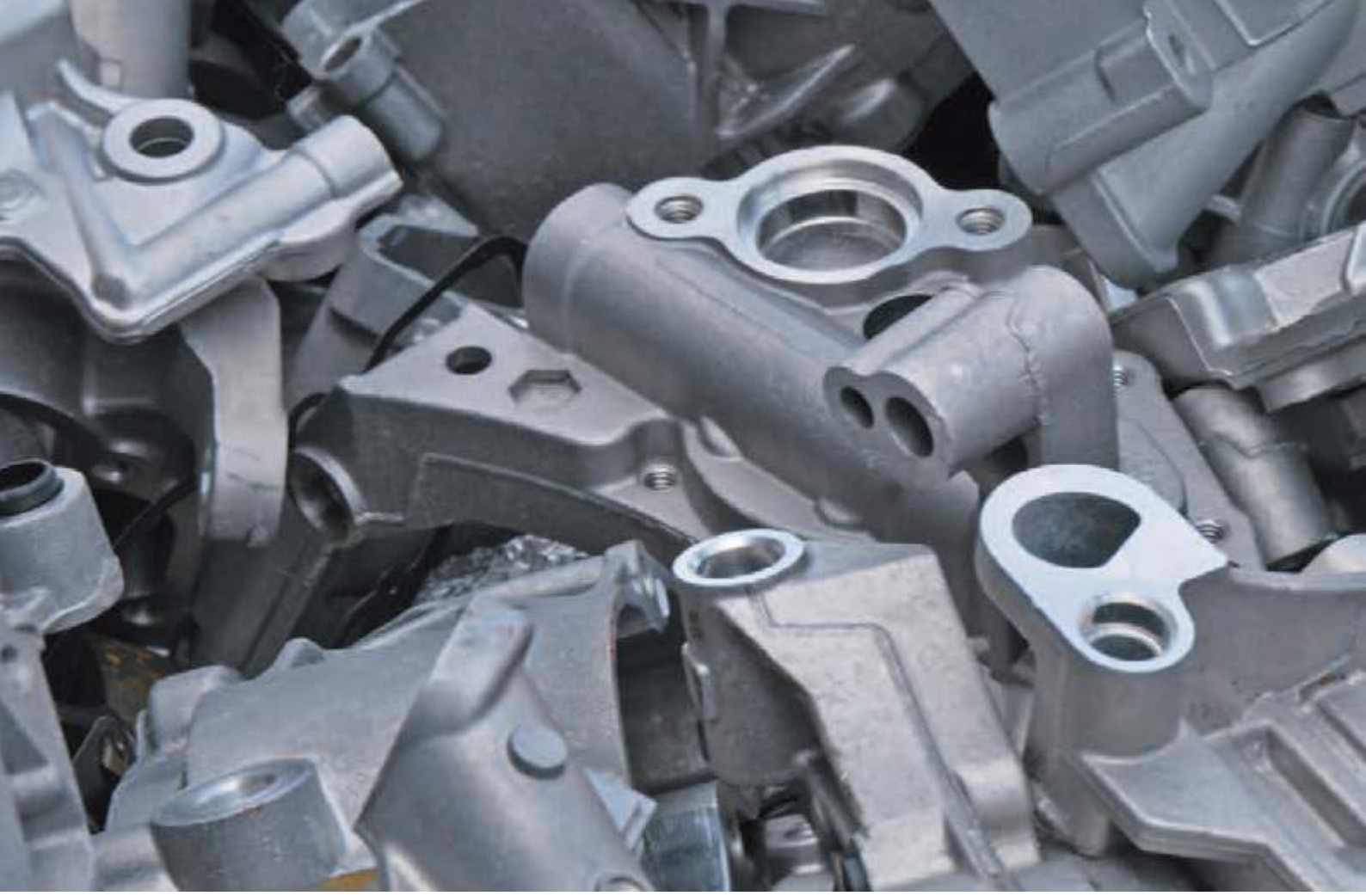
Most cast iron grades have a carbon content between 2 to 5 percent. Depending on the other alloying elements, cooling conditions and heat treatment, carbon can precipitate into different shapes, which determine the properties of the cast iron. Compared to steel, cast iron has a lower melting point of around 1.150 °C for near-eutectic alloys (C-content approx. 3.5 %) and very low viscosity. As a result, it has excellent "form filling" properties. It can therefore be used to produce complex geometries and thin-walled parts.



Source: Maurer diagram for cast iron

Cast iron is generally classified according to how the carbon is present in the microstructure after solidification. Carbon in white cast iron is bound as iron carbide (cementite). Depending on the heat treatment, or tempering, this malleable iron can be used to make white (GJMW) or black (GJMB) malleable cast iron. Unlike malleable iron, the carbon in grey cast iron is precipitated directly as graphite in a ferritic or pearlitic matrix. A distinction is made between the different forms of graphite. There are three forms: lamellar (GJL), spheroidical (GJS) and vermicular (GJV). The graphite form is the main determinate of the properties of the cast iron.

Cast iron				
White cast iron (malleable cast iron)		Grey cast iron		
"White" mottled cast iron **DIN EN 1562** **GJMW**	Black mottled cast iron **DIN EN 1562** **GJMB**	Nodular cast iron (spheroidal cast iron) **DIN EN 1563** **GJS**	Lamellar graphite cast iron (grey cast iron) **DIN EN 1561** **GJL**	Vermicular graphite cast iron **DIN EN 16079** **GJV**



Cast Iron Welding Applications

Repair Welding

During repair welding, cracks, breakage and surface wear are welded so that the lifetime of these cast parts can be prolonged.

Production Welding

Production welding is the process when cast parts are welded during the casting process to ensure that mechanical properties and surface appearance meet the required quality levels. Typical production welding jobs are e. g. to repair casting defects, to correct undersized parts, weld cladding-, or hardfacing layers.

Construction Welding

During construction welding, several cast parts are welded together with other parts made of the same or dissimilar nature. Cast iron with nodular graphite (GJS), vermicular graphite (GJV) or malleable iron are usually used for construction welding. UTP 86 FN, for example, can be used to join cast iron or steel pipes with cast iron flanges.

Weld Preparation

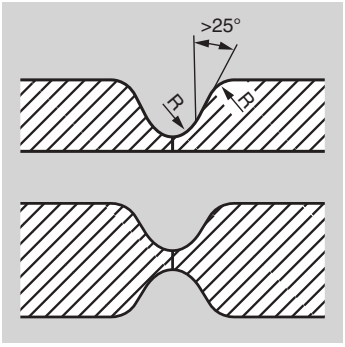
Remove the cast skin in the entire welding area.

Use dye penetrant testing to localize cracks in the material. At both ends, cracks should be drilled-out to prevent them from spreading into undamaged material.

Drill-out the crack or cracks to an open tulip shape. Round off the edges. Use a double U shape for thick walled components if they can be reached from both sides.

Before welding, remove the residues from the dye penetrant test and any other contamination e. g. oil, grease, dust or paint so that the welding area is metallically bright.

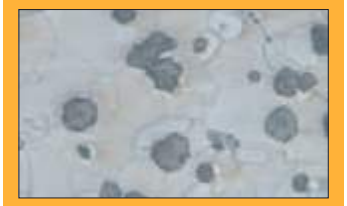
If the component is old and oiled, then an oxygen-acetylene flame can be used to remove the oil to prevent the formation of pores in the weld metal. Singe the part to burn off the oil or grease, but do not exceed a temperature of 150 °C. Before welding, cool the area down to 60 °C or less and make sure it is metallically bright.



Cast Iron Types

Nodular Cast Iron

Nodular cast iron (spheroidal graphite cast iron/GJS) is a cast iron material in which the carbon is present in nodular form. This is achieved by adding small amounts of Magnesium as a spherodising agent to the molten cast iron. The nodular graphite minimises the notch effect, giving GJS the best strength and ductility properties within the group of cast iron materials. Due to its excellent mechanical properties, GJS can be used in a wide variety of automotive, machine and pipeline construction applications.



Spheroidal Graphite Cast Iron
(Nodular Cast Iron)
Standard (DIN EN 1563): GJS

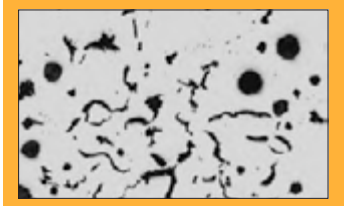
Lamellar Cast Iron

Lamellar graphite cast (GJL), commonly known as grey cast iron, has been successfully used in machinery construction for decades. The carbon in these alloys is present in the form of graphite flakes in a ferritic or perlitic matrix. Since graphite cannot bear stresses and due to its lamellar form, it acts as a severe inner notch, GJL has low tensile strength and practically no ductility. Grey cast iron has good damping properties and can easily be cast. GJL is the preferred material for manufacturing machine beds and machine bases.

Lamellar Cast Iron
Standard (DIN EN 1561): GJL

Vermicular Graphite Cast Iron

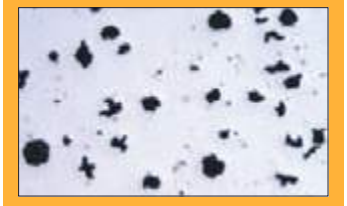
In vermicular graphite cast iron (GJV), the precipitated graphite has a vermicular (worm-shaped) form, though in general it can consist of up to 20 % nodular graphite. However, it cannot contain lamellar graphite. The properties of GJV lie between those of GJL and GJS. Vermicular graphite cast iron has better strength properties and higher ductility than GJL. Compared with GJS, it responds better to high temperatures and temperature changes and has a better castability. Due to these properties, it is predominantly used for engine construction applications, where, for example, GJV is used to pour crankcases and exhaust manifolds. Other industries such as mold manufacturing also benefit from this material.



Vermicular Graphite Cast Iron
Standard (DIN EN 16079): GJV

Malleable Cast Iron

There are two types of malleable cast iron: white (GJMW) and black (GJMB). White malleable cast iron has a carbon content of 2.8 to 3.4 % and black malleable cast iron a carbon content of 2.3 to 2.6 %. In the “as-cast” condition, carbon is chemically bound as iron carbide. By a subsequent heat treatment (or tempering) the iron – carbide precipitates into tempered carbon (graphite). The microstructure of GJMW changes with the wall thickness – from a ferrite edge zone to a ferritic-pearlitic transition area to a pearlitic core zone with tempered carbon in the transition area and part in the core zone. The microstructure of GJMB remains practically identical as the wall thickness changes. Malleable cast iron is used, for instance, in automobile construction, e.g. for the vehicle axis.



Malleable Cast Iron
(graphite flakes)
Standard (DIN EN 1562):
GJMW / GJMB

Welding of Cast Iron Materials

Most cast iron grades are not considered to be suitable for welding, but it is possible with the correct welding technology. This is the case for grey cast iron with lamellar graphite (GJL), nodular graphite (GJS) or vermicular graphite and for mealleable cast iron (GJMW, GJMB).

The weldability of a part depends on the weldability of the base material, the facilities of the welding shop and the construction of the component. Weldability mainly depends on the material's chemical- and mechanical properties. Other influencing facts are the microstructure, the level of contamination resulting from e.g. sulfur or oxides and the exposure from service (age, temperature, chemical media, etc.)

Suitable for welding

- Cast steel
- Spheroidal nodular cast iron
- Vermicular cast iron

Limited weldability

- Lamellar graphite cast iron
- Malleable cast iron

Difficult to weld or not suitable for welding

- Special cast iron

Cold Welding of Cast Iron

Nickel and iron-nickel stick electrodes are generally used for cold welding of cast iron. Temperature control is vital. Do not preheat before welding unless dampness and condensation needs to be removed from the surface of the part. To keep the thermal stress low while welding, the smallest possible electrode diameter should be used and the arc should be kept as short as possible. Always keep the welding beads short (max. 30 mm) and hammer the beads while the weld metal is warm. Use a hammer with a rounded head. The hammering introduces compressive stresses, which counteracts the shrinkage stresses of the cooling weld metal. The interpass temperature should not exceed 60 °C. When repairing large areas, change the welding location often to prevent heat accumulation.

Short stringer bead before slag is removed

Hammering

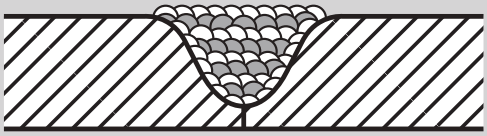
Short stringer bead after slag is removed

The most important rules for cold welding

- Weld with stringer beads only (max. 1 to 3 cm).
- Weld with the lowest possible heat input.
- Hammer off the beads whilst they are warm. This introduces compressive stresses, which counteract the shrinkage stresses.
- Avoid heat accumulation.
- If possible, start on already welded beads to avoid hardness peaks in the heat affected zone.

Observe the following when welding cast iron:

- If pores appear in the first layer, e.g. when welding old, oiled cast iron, then this first layer has to be removed and welded again to ensure a defect-free weld metal.
- If old cast iron needs to be welded, UTP 81 can be used for the first layer to get sufficient bondage to the base metal.
- When joining difficult-to-weld cast materials, first clad the edges with the UTP 8 and then use UTP 86 FN to weld the joint.
- The mechanical properties can be improved by welding with UTP 8 pure nickel electrode (as an intermediate layer) and then using UTP 86 FN nickel-iron electrode.
- Start welding with the smallest possible electrode diameter to keep the heat input low.
- Keep the arc as short as possible.
- The weld seam should not be longer than ten times the electrode diameter and not wider than twice the diameter of the core wire.
- Use a (jack) hammer with a rounded head to immediately hammer off each stringer bead whilst these are still warm.



Drawing of a combination weld on grey cast iron that was welded using UTP 8 ◠ pure nickel electrode and UTP 86 FN ◠ nickel-iron electrode.

- Remove the slag residue with a wire brush.
- Restriking should be performed on previously welded beads and not on the base material.
- Choose a welding sequence that best prevents stresses due to distortion.
- Always weld open cracks from the inside to the outside.

Rounded hammer head

Hammered out weld metal

UTP Maintenance Special Electrodes for Cast Iron Welding

UTP 8 ■ graphite-basic coated stick electrode for cold welding cast iron

UTP 8 is suitable for cold welding of grey and malleable cast iron, cast steel and for joining these base metals to steel, copper and copper alloys.

UTP 8 has excellent welding properties. The easily controllable flow permits spatterfree welding in all positions with minimal amperage. The weld deposit and the transition zones are can be filled. No undercutting. Ideally suited for the combined welding with the ferro-nickel type UTP 86 FN (buttering with UTP 8 and build-up with UTP 86 FN).

EN ISO 1071: E C Ni-CI 1
AWS A5.15: E Ni-CI

UTP 83 FN ■ graphite-basic coated nickel-iron stick electrode with high melting rate and 115 % weld metal recovery

UTP 83 FN is suitable for cold-welding many commercial cast iron grades, such as lamellar or and nodular cast iron, malleable cast iron and for joining these materials to steel or cast steel. This stick electrode is particularly used if a high deposition rate is needed.

UTP 83 FN has excellent welding properties and the easily controllable transfer provides a spatter-free deposit of perfect appearance. The weld deposit is easily machinable with cutting tools. The weld metal is tough and crack-resistant.

EN ISO 1071: E C NiFe-1 1
AWS A5.15: E NiFe-CI

UTP 86 FN ■ graphite-basic coated nickel-iron stick electrode with bimetallic core wire for excellent mechanical properties for repair and construction

UTP 86 FN is suitable for joining and surfacing of lamellar grey cast iron EN GJL 100 - EN GJL 400, nodular cast iron (spheroidal cast iron) EN GJS 400 - EN GJS 700 and malleable cast iron grades EN GJMB 350 - EN GJMB 650 as well as for joining these materials with each other or with steel or cast steel. Universally applicable for repair, construction and production welding.

UTP 86 FN has excellent wetting characteristics on cast iron. The stick electrode has a stable arc and produces a flat bead without undercutting.

Particularly for fillet welds, an optimal bead structure is achieved (e.g. welding GJS-flanges or sockets to GJS-tubes). Due to the bimetallic core wire, the current carrying capacity and the deposition rate are excellent. The bead appearance is smooth. The weld deposit is highly crack resistant and easily machinable with cutting tools.

EN ISO 1071:	E C NiFe-1 3
AWS A5.15:	E NiFe-CI

004/2015/EN/GL

voestalpine Böhler Welding

Welding know-how joins steel

Customers in over 150 countries join the expertise of voestalpine Böhler Welding. Focused on filler metals, voestalpine Böhler Welding offers extensive technical consultation and individual solutions for industrial welding and soldering applications. Customer proximity is guaranteed by 40 subsidiaries in 28 countries, with the support of 2,200 employees, and through more than 1,000 distribution partners worldwide. voestalpine Böhler Welding offers three specialized and dedicated brands to cater our customers' and partners' requirements.

böhler welding
by voestalpine

Böhler Welding – More than 2,000 products for joint welding in all conventional arc welding processes are united in a product portfolio that is unique throughout the world. Creating lasting connections is the brand's philosophy in welding and between people.

utp maintenance
by voestalpine

UTP Maintenance – Decades of industry experience and application know-how in the areas of repair as well as wear and surface protection, combined with innovative and custom-tailored products, guarantee customers an increase in the productivity and protection of their components.

fontargen brazing
by voestalpine

Fontargen Brazing – Through deep insight into processing methods and ways of application, Fontargen Brazing provides the best brazing and soldering solutions based on proven products with German technology. The expertise of this brand's application engineers has been formulated over many years of experience from countless application cases.

forwarded by:

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

utp maintenance
by voestalpine

Productive Consumables and Equipment Solution for the Rebuilding of Sugar Cane Mill Crusher Rolls

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

Worldwide there are over 3000 sugar cane mills. Many of them are looking for a mechanized process to clad the rollers more efficiently and less demanding for welders, replacing commonly applied SMAW.
A state-of-the-art system is now available from voestalpine Böhler Welding and Fronius.

UTP Maintenance

Tailor-Made Protectivity™

UTP Maintenance stands for decades of industry experience and application know-how in the areas of repair as well as wear and surface protection. Innovative and customer-tailored products guarantee customers increased productivity and protection of their components.

Our range of flux- and metal-cored wires for the rebuilding of worn sugar cane crusher rolls continues this tradition. Developed in close co-operation with specialized repair companies and mill maintenance departments – they feature welding characteristics that are fully dedicated to the rebuilding and protection of crusher rolls.

Complete solution

voestalpine Böhler Welding can supply welding consumables only to increase productivity with existing equipment, but also a total solution developed for the mechanized hardfacing of sugar cane crusher rolls. This dedicated package of equipment and consumables was developed by Fronius GmbH in Austria, in close co-operation with voestalpine Böhler Welding Soldas do Brazil Ltda. Extensive field-testing was performed by a major specialized repair and maintenance company - in the repair shop with rolls taken out of production, but also on rolls in operation in sugar cane mills. The heavy duty and user-friendly equipment enables the mechanized welding of all steps in the rebuilding of rolls, including the arcing of the flanges of the teeth. It significantly improves work conditions for welders, while meeting labour laws that prohibit workers to stay near crushers in operation.

Specialized Consumables Designed to bring Productivity and Protection

Sugar cane is acidic with a pH of around 5 and carries up to 5 % soil which is harvested with the cane. As a result, the mill rolls are exposed to a combination of abrasive and corrosive wear and require hardfacing to repair them periodically. The hardfacing alloy must provide good wear characteristics and add to the good grip on the sugar cane and bagasse (the fibrous by-product) provided by a special roller profile.

The repair of crusher rolls can take the form of a complete overhaul in a repair workshop – often performed off season or on a stock of spare rollers – or on rolls in operation in the actual crushing of sugar cane in mills. In the latter case, arcing is a commonly applied technique to increase the grip of the rollers on the bagasse, consisting of the deposition of a great number of droplets onto the flanges of the teeth. The arcing operation with stick electrodes requires welders to be near rotating rollers – a work situation which is potentially dangerous and therefore increasingly subjected to restrictive labour laws.

A full overhaul involves a four-step rebuilding procedure, see figure on page 3, for which voestalpine Böhler Welding developed a set of three dedicated hard surfacing cored wires and procedures for mechanized welding described in the table below. In step 1, the laterals, are deposited to strengthen and protect the sides of the teeth against abrasion, using UTP AF DUR 600-MP in diameter 1.2 mm.

Sugar cane mill repair of rollers

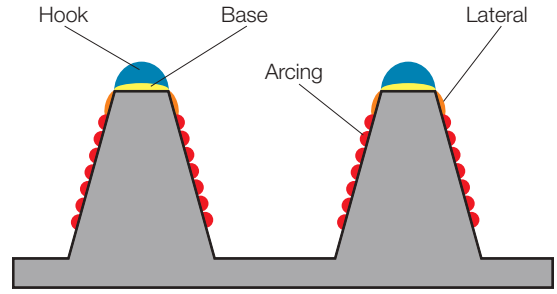
Sugar mill application and function			Consumables & typical welding parameters	
Step 1	**Lateral** ■ Strengthen and protect the sides of the teeth ■ Providing a wider underground for step nr. 2 – the base weld		**UTP AF DUR 600-MP**	**Ø 1.2 mm**
			Position	Vertical-down
			Current (A)	150-170
			Voltage (V)	25-28
			Stickout length (mm)	18
			Travel speed (cm/min)	36
			Weaving width (mm)	12-20
			Number of torches	1 or 2
Step 2	**Base** ■ Sealing top of teeth ■ Preparing underground for hook weld		**UTP AF DUR 600-MP**	**Ø 1.6 mm**
			Position	Downhand
			Current (A)	160-220
			Voltage (V)	25-28
			Stickout length (mm)	20
			Travel speed (cm/min)	64
			Weaving width (mm)	0
			Number of torches	1
Step 3	**Hook** ■ Protection of top of teeth ■ Providing firm grip on bagasse ■ Higher crushing efficiency		**UTP AF LEDURIT 60**	**Ø 1.6 mm**
			Position	Downhand
			Current (A)	150-180
			Voltage (V)	25-28
			Stickout length (mm)	20
			Travel speed (cm/min)	54
			Weaving width (mm)	0
			Number of torches	1
Step 4	**Arcing** ■ Providing further improved grip on bagasse ■ Protection of teeth profile ■ Enabling repair while crushing		**UTP AF VANADIUM 500**	**Ø 2.8 mm**
			Position	Vertical down
			Current (A)	250-350
			Voltage (V)	28-36
			Stickout length (mm)	40-60
			Travel speed (rounds/min)	4-6
			Weaving width (mm)	0
			Number of torches	1 or 2

This cored wire gives a very hard weld metal. The same wire, in diameter 1.6 mm, is used in step 2 to seal the top of the teeth and provide a firm underground for the next step. In step 3 the hook is deposited with UTP AF Ledurit 60 diameter 1.6 mm giving a weld metal with resistance to very high abrasion. This part of the teeth catches the sugar cane and bagasse and largely determines the output of a sugar mill in terms of tonnage of sugar cane processed or juice and bagasse produced.

Step 4 involves the arcing with UTP AF Vanadium diameter 2.8 mm. This special, large diameter cored wire operates in the spray arc mode at relatively low currents depositing a high amount of weld metal droplets of exact size. It is used with a relatively long stick-out length and produces a very powerful arc, which also enables the welding of the rolls in the presence of large quantities of juice and bagasse, while in operation during the harvesting season.

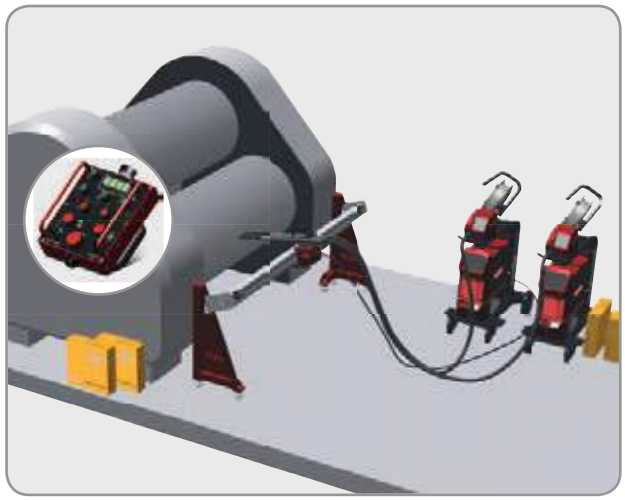
The use of UTP cored wires makes the whole repair procedure much more efficient. Deposition rates and duty cycles are much higher than in procedures with stick electrode welding. Also when compared to mechanized welding with solid wires, repair times can be significantly shorter.

Operation Modus "Hook"

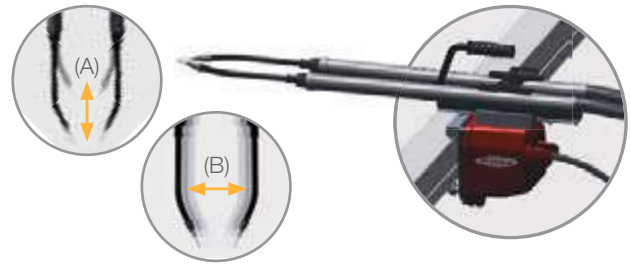


Consumable product data	Consumable description
Classification: DIN 8555: MF 6-GF-60 Polarity: DC+ Shielding gas: Ar/CO_2: M21, M22 / CO_2: C1 Weld hardness: 55-60 HRC Typical chemical composition all weld metal (%) C 0.6 · Si 0.6 · Mn 0.8 · Cr 7.0 · Mo 1.0	Metal-cored wire for the hardfacing of components subjected to a combination of compression, friction and impact. The weld metal is machinable by grinding. Alternative SMAW/MMA: UTP 670
	Alternative SMAW/MMA: UTP 670
Classification: DIN 8555: MF 6-GF-60/ MF 10-GF-60-GR Polarity: DC+ Shielding gas: self-shielded Weld hardness: 57-62 HRC Typical chemical composition all weld metal (%) C 4.4 · Si 0.3 · Mn 0.3 · Cr 27.0 · Ni · Mo	Metal-cored wire for the hardfacing of components subjected to high abrasion combined with moderate impact and compression. High chromium and carbon alloying gives a structure rich in chromium-carbides. Alternatives SMAW/MMA: UTP 7100, UTP Ledurit 68, UTP 713
Classification: – Polarity: DC+ or AC Shielding gas: self-shielded Weld hardness: 60-66 HRC Typical chemical composition all weld metal (%) C 2.0 · Si 1.8 · Mn 1.2 · Cr 7.0 · V 0.5	Metal-cored wire specially developed for the arcing of sugar cane mill rolls. With a diameter of 2.8 mm, it operates in the spray arc mode at relatively low currents providing weld metal droplets of exact size. The powerful arc enables welding of the rolls submerged in sugar cane juice and in the presence bagasse, while in operation during the harvesting season. A high amount of chromium-vanadium carbides in the micro structure gives the arcing surface an excellent resistance against abrasion. An alternative cored wire for increased droplet size is UTP AF Vanadium SG. Alternative SMAW/MMA: UTP Vanadium 500, UTP Vanadium SG

User-friendly Equipment for Heavy Duty Work



The Fronius Arcing system is special developed for the mechanized hard facing of teeth of sugar mill rolls in the sugar & ethanol industry. Due to its lightweight and mobile design, it can be used for repair task in workshops as well as on-site during crushing. The use of latest Fronius technology guarantees highest quality standards and best welding.

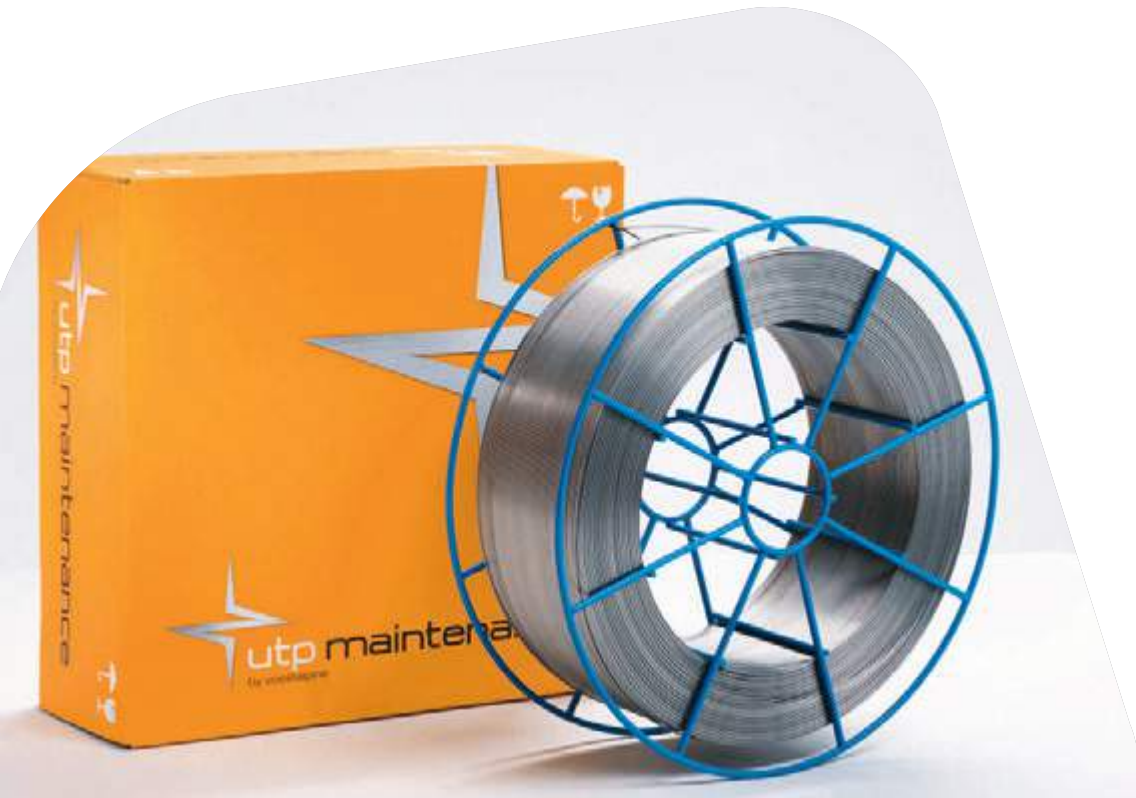


Fronius Arcing System benefits

- Specially designed for heavy duty sugar mill applications
- Lightweight yet sturdy, mobile design
- Servo motor driven torch carriage for secure positioning
- Cross beam angle adjustable for optimal torch positioning
- Latest Fronius TPS/i power source technology
- Excellent arc ignition
- Synergic lines for UTP cored wires
- Parameter sets pre-programmable
- All functions available on remote control

The heart of the Fronius equipment solution is the tandem MAG welding torch that allows simultaneous welding of both flanges of the tooth. It can handle wires with diameters from 1.2 up to 2.8 mm and can easily be adjusted for tooth width.

Fromius TPS/i power source with arcing controller.



019/2015/EN/GL

voestalpine Böhler Welding

Welding know-how joins steel

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

Böhler Welding – More than 2,000 products for joint welding in all conventional arc welding processes are united in a product portfolio that is unique throughout the world. Creating lasting connections is the brand's philosophy in welding and between people.

UTP Maintenance – Decades of industry experience and application know-how in the areas of repair as well as wear and surface protection, combined with innovative and custom-tailored products, guarantee customers an increase in the productivity and protection of their components.

Fontargen Brazing – Through deep insight into processing methods and ways of application, Fontargen Brazing provides the best brazing and soldering solutions based on proven products with German technology. The expertise of this brand's application engineers has been formulated over many years of experience from countless application cases.

forwarded by:

Global Industry Segment Management
Sugar Industry

T. +32 64 432631
M. +32 496 508 250

E. welding.maintenance@voestalpine.com

Fronius International GmbH

Froniusplatz 1
4600 Wels / Österreich

T. +43 7242 241-0
F. +43 7242 241-953940

E. sales@fronius.com
www.fronius.com

utp maintenance
by voestalpine

Tailor-Made Protectivity™

Repair and Maintenance Weld Overlay Solutions for Steel Mills

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.


utp maintenance

UTP Maintenance

Tailor-Made Protectivity™

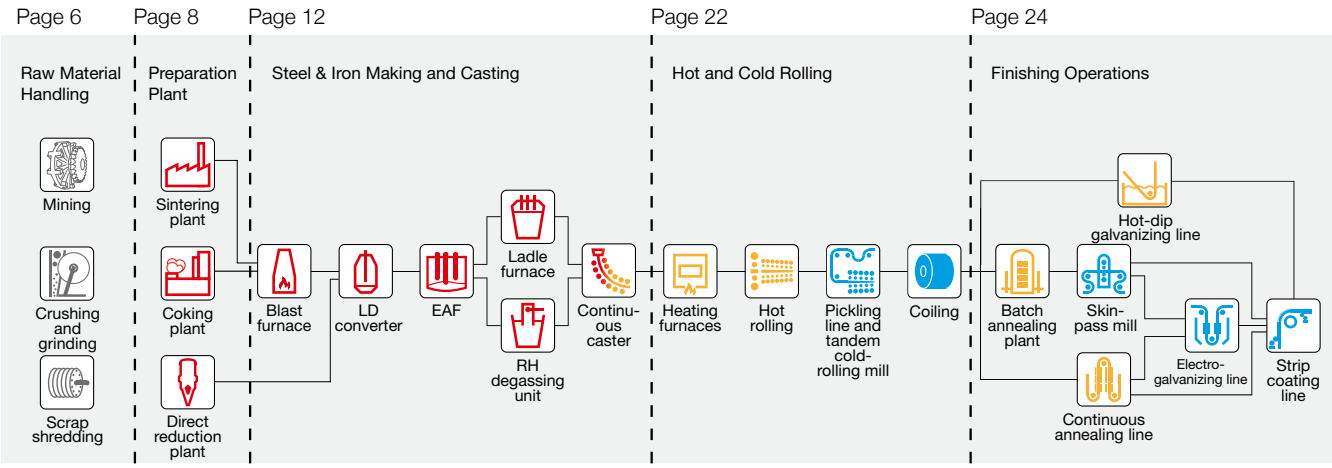
UTP Maintenance guarantees its customers the ideal combination of productivity and protection via innovative and tailor-made products – anywhere in the world. This central theme of Tailor-Made Productivity puts the customer and partner in the center of all activities in order to always optimally fulfill even the most special requirements.

UTP Maintenance offers the best repair, anti-wear and cladding product solutions for the local and global challenges of their customers. UTP Maintenance operates with local specialists and they are closely linked to our global industry managers and application engineers.

With the largest number of application engineers, with the deepest metallurgical and repair, anti-wear and cladding process know-how, UTP Maintenance ensures that the branded products are used to the fullest satisfaction of their customers. All UTP Maintenance branded products are constantly controlled by the voestalpine Böhler Welding certified laboratories.

UTP Maintenance focuses exclusively on its core areas repair, anti-wear and cladding. Thus, the customer application is always in the center of UTP Maintenance activities. UTP Maintenance focuses on the customers, service partners and distributors needs.

voestalpine blast furnace, Linz, Austria



We are at Home in Steel Mills

As a division of specialty steel maker voestalpine, we feel at home when it comes to steel production and the typical wear systems steel mill equipment is subjected to. At voestalpine Böhler Welding, we overlook the full steel manufacturing process – from raw material handling up to continuous casting and finishing operations – and offer tested maintenance and repair solutions for every individual piece of equipment with its own typical wear mechanism.

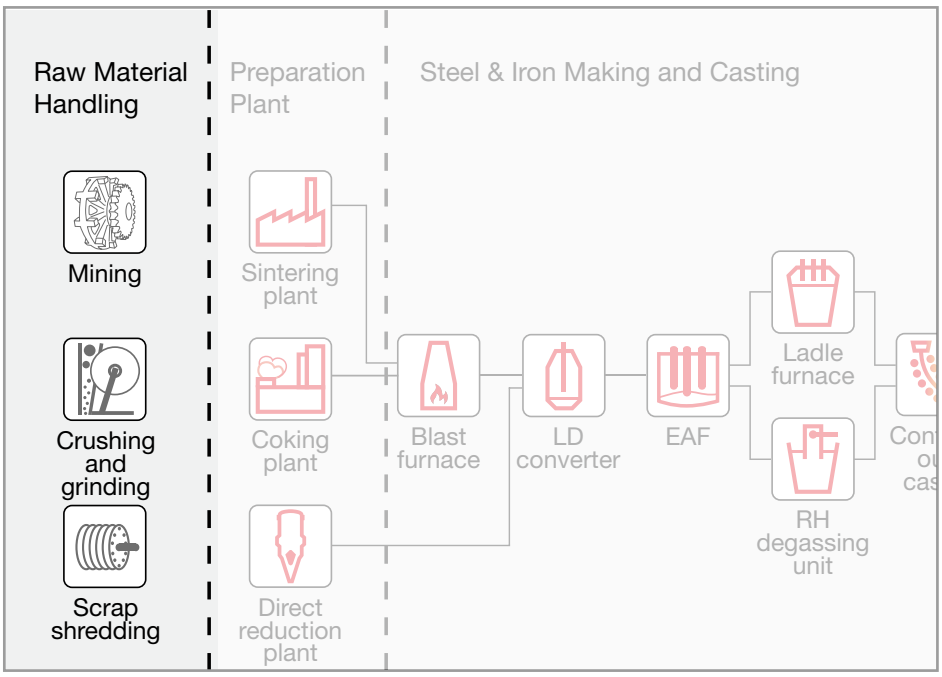
Our solutions for steel mills are based on European technology and are fully developed by our two specialized units in Seneffe, Belgium and Bad Krozingen, Germany, where we have well equipped test centers and chemical and metallurgical laboratories at our disposal. Our products, all marketed under the UTP brand name, are developed and tested in close co-operation with voestalpine and other steel mills across the globe and cover all commonly applied welding processes used in the maintenance and repair of steel mill equipment.

We offer one, two and three layer solutions for the repair of continuous casting rollers with properties optimized for the various wear systems occurring along the line. Next to the steel mills themselves, we co-operate with manufacturers of continuous casting lines and with technical universities.

We are at home in steel mills. Our specialized engineers and technicians share their expertise and support you on site with the selection and implementation of tailor-made and productive repair and maintenance solutions and train your staff to apply them in the most effective way.

UTP Maintenance
Tailor-Made Protectivity™

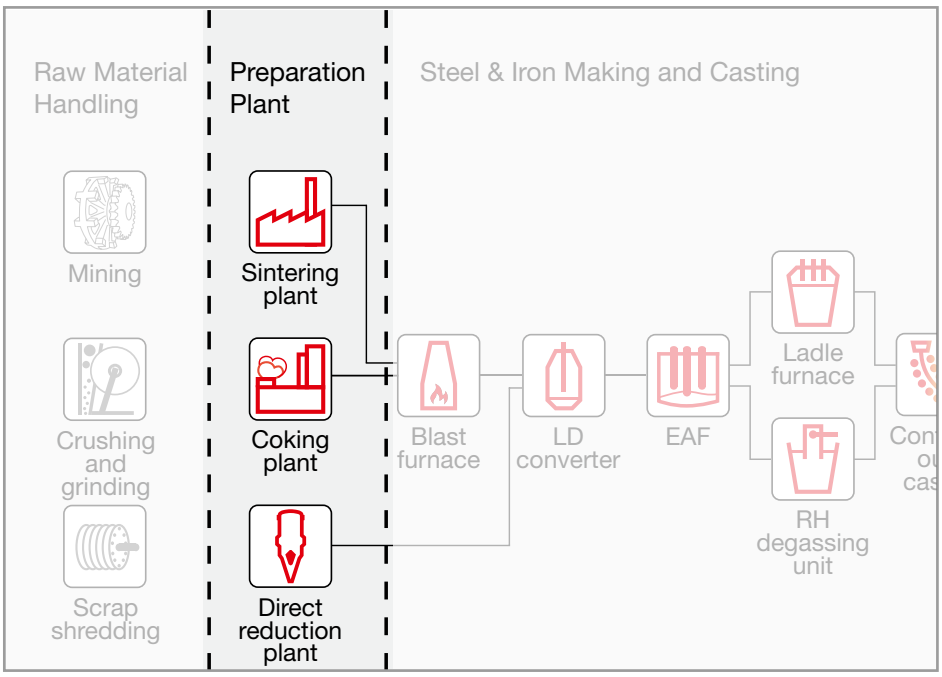
Raw Material Handling



Component	Predominant wear modes	Intensity	Recommended consumables*	Hardness	Microstructure
Wear plates	Abrasion		**Cored wires**		
	High temperatures		SK 162-O	63 HRC	Austenitic matrix with Cr carbides
	Impact		SK 867 WP-O	62 HRC	Austenitic matrix with Cr carbides
	Corrosion		SK A43-O	64 HRC	Austenitic matrix with Cr and Nb carbides
	Metal to metal		SK A45-O	63 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
Scrap shredders	Abrasion		**Cored wires**		
	High temperatures		SK AP-O	205HB/50HRC**	Austenite
	Impact		SK A43-O	64 HRC	Austenitic matrix with Cr and Nb carbides
	Corrosion		**Stick electrodes**		
	Metal to metal		UTP BMC	260HB/50HRC**	Austenite
			UTP LEDURIT 65	65 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides

* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.
** After work hardening

Preparation Plant



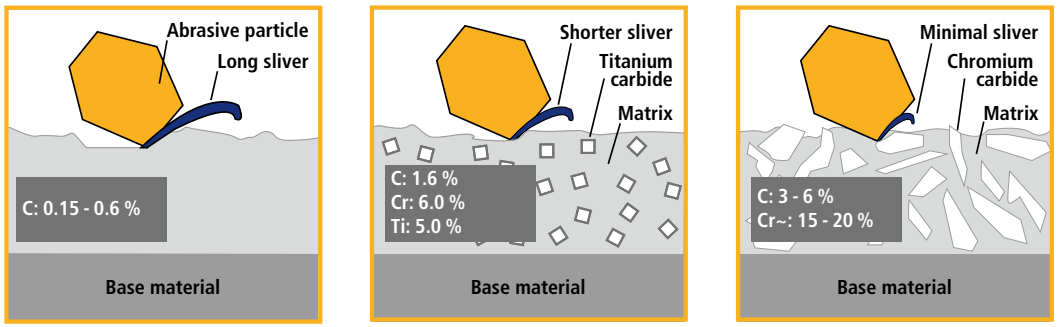
Iron ore and coal handling

Component	Predominant wear modes	Intensity	Recommended consumables*	Hardness	Microstructure
Raw material mixing	Abrasion		**Cored wires** SK 900 Ni RTC-O/G	Matrix: 50 / 44 HRC W-carbides: 3000 HV	Austenitic NiBSi matrix with tungsten carbides.
	High temperature				
	Impact				
	Corrosion		SK ABRA-MAX O/G	70 HRC	Homogeneously dispersed complex carbo-borides and borides
	Metal to metal				
Sinter breaker	Abrasion		**Cored wires** SK A45-O	63 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
	High temperature				
	Impact		SK A83-OSP	62 HRC	Austenitic cast iron with complex carbides
	Corrosion		**Stick electrodes** UTP LEDURIT 65	65 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
	Metal to metal				
Sinter bars	Abrasion		**Cored wires** SK A45-O SK A83-OSP	63 HRC 62 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides Austenitic cast iron with complex carbides
	High temperature				
	Impact		**Stick electrodes** UTP LEDURIT 65	65 HRC	Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
	Corrosion				
	Metal to metal				
Exhaust fans	Abrasion		**Cored wires** SK 402-O SK A 43-O SK A 45-O	200 HB 64 HRC 63 HRC	Austenite Austenitic cast iron with Cr and Nb carbides Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
	High temperature				
	Impact		SK ABRA-MAX O/G	70 HRC	Homogeneously dispersed complex carbo-borides and borides
	Corrosion		SK A 43-OB	65 HRC	Austenitic cast iron with Cr and Nb carbides
	Metal to metal		**Stick electrodes** UTP 63 UTP Abrasodur 43+ UTP LEDURIT 65	180 HB 63 HRC 65 HRC	Austenite Austenitic cast iron with Cr and Nb carbides Austenitic matrix with Cr, Nb, Mo, W and V complex carbides

* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.

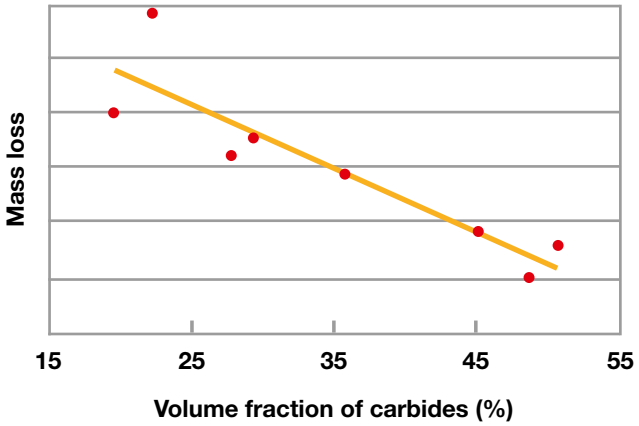
Component	Predominant wear modes	Intensity	Recommended consumables*	Hardness	Microstructure
Sinter grinding	Abrasion		**Cored wires** SK 900 Ni RTC-O/G	Matrix: 50 / 44 HRC W-carbides: 3000 HV	Austenitic NiCrBSi matrix with tungsten carbides.
	High temperature				
	Impact				
	Corrosion				
	Metal to metal				
Sinter wagon	Abrasion		**Cored wires** SK FNM4-G	140 HB	Austenitic FeNi alloy
	High temperature		**Solid wire** UTP A 8051 Ti	200 HB	Ferritic & austenitic nodular cast iron
	Impact		**Stick electrodes** UTP 86 FN	220 HB	Austenitic FeNi alloy
	Corrosion				
	Metal to metal				
Direct reduction of iron	Abrasion		**Cored wires** UTP AF 068 HH SK A 45-O	180 HB 63 HRC	Austenitic NiCr alloy Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
	High temperature				
	Impact		**Stick electrodes** UTP 068 HH UTP LEDURIT 65	180 HB 65 HRC	Austenitic NiCr alloy Austenitic matrix with Cr, Nb, Mo, W and V complex carbides
	Corrosion				
	Metal to metal				

Abrasion Resistance Requires Presence of Carbides



Increasing quantities of carbide formers : C, Cr, Ti, Nb, Mo, V, W

Abrasion resistance not only depends on the overall hardness level, but also on shape, size and volume fraction (density) of carbides. As carbides are harder than the matrix, they slow down wear of the matrix by abrasive particles. The higher the volume fraction of carbides, the better the abrasion resistance.



Single layer solution for hardfacing

SK 900 Ni RTC-G is a unique gas shielded cored wire for the hardfacing of components which are subjected to extreme abrasive wear in combination with wet corrosion. Already in the first layer, the weld metal generates sufficient amounts of carbides in the matrix to achieve good abrasion resistance for many practical applications. The nickel base matrix also provides excellent corrosion resistance in wet environments. The diagram compares abrasion wear resistance according to the ASTM G65 method with a traditional gas-shielded cored wire, SK 900 Ni-G. For both wires, Ar + 2 % O_2 shielding gas was used in the standard MIG process and the Cold Metal Transfer MIG process. Lowest weight loss with a single layer is obtained, using SK 900 Ni RTC-G with the CMT process.

In general, the single layer solution provides substantial savings in overlay time and welding consumables.

SK 900 Ni RTC-G : abrasion with Al_2O_3, metal losses in gr. according to ASTM G65.

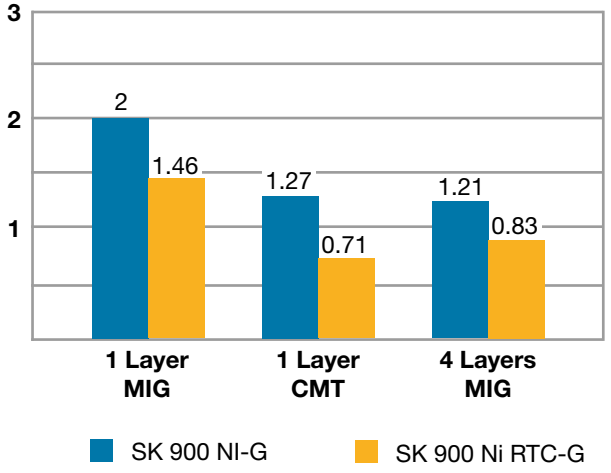
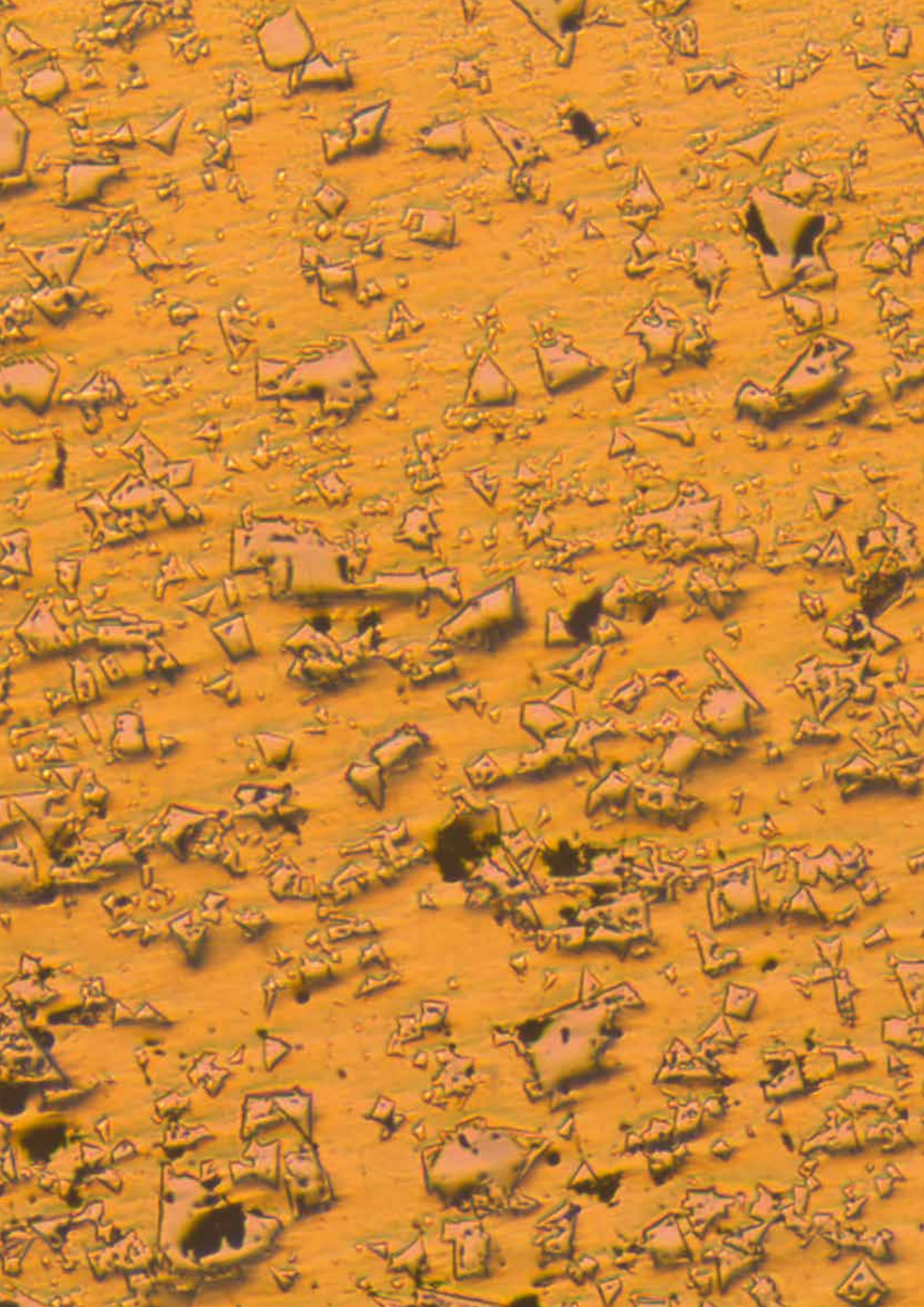
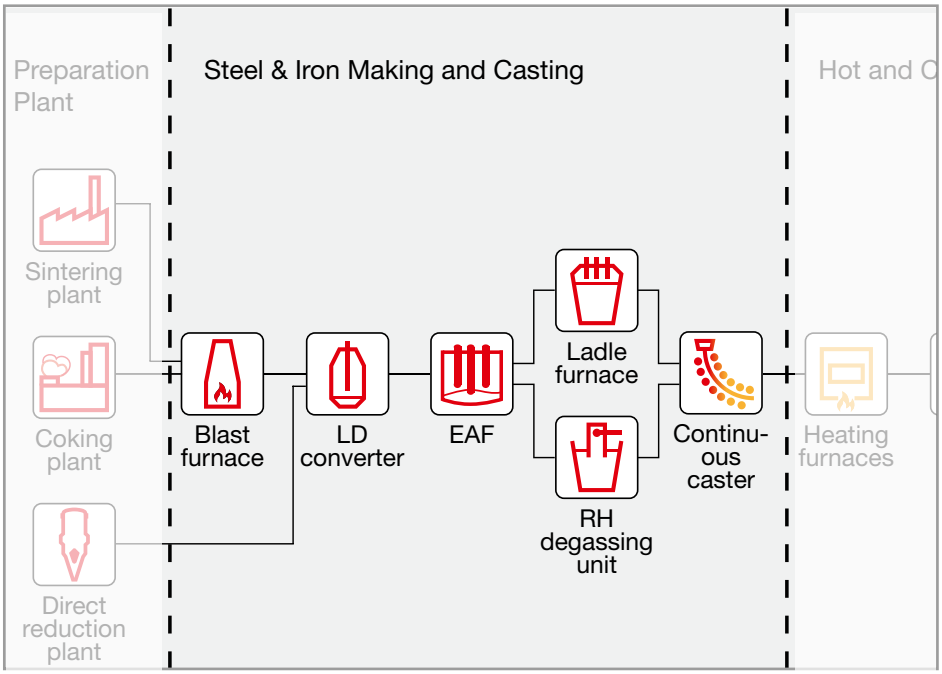


Photo right hand page: Tungsten carbides in NiCrSiB matrix



Steel & Iron Making



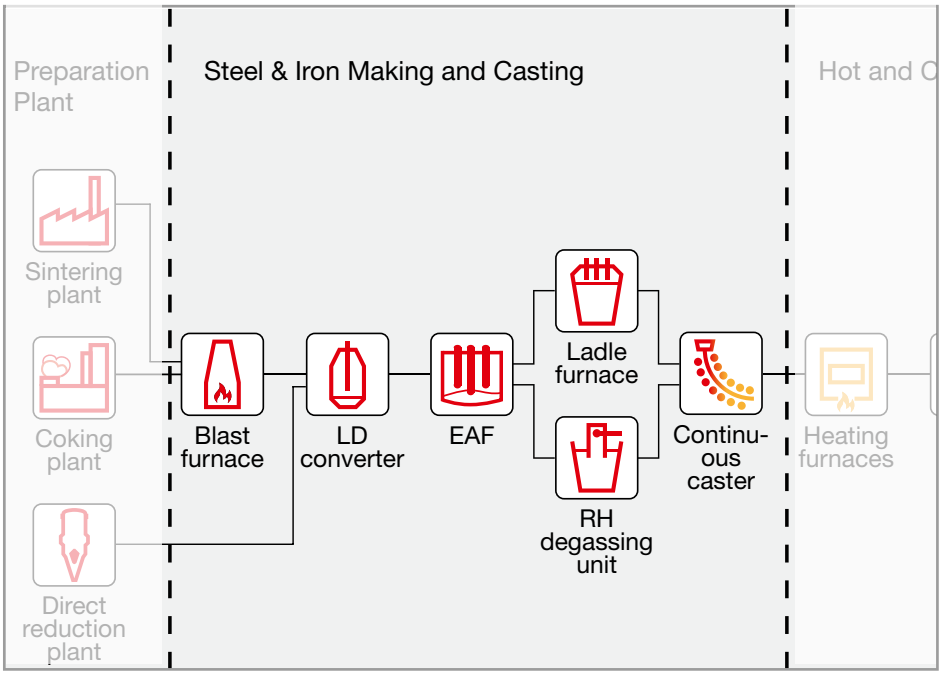
Component	Predominant wear modes	Intensity	Recommended consumables*	Hardness	Microstructure
Blast furnace bell	Abrasion		**Cored wires** SK 309L-O SK 258L-O/SA SK A43-O/S	 170 HB 44 HRC 64 HRC	 Austenite + Ferrite Martensite Austenitic matrix with Cr and Nb carbides
	High temperature				
	Impact				
	Corrosion				
	Metal to metal				
Rotating chutes	Abrasion		**Cored wires** SK A45-O SK A83-OSP	 63 HRC 62 HRC	 Austenitic matrix with Cr, Nb, Mo, W and V complex carbides Austenite + Co + complex carbides
	High temperature				
	Impact				
	Corrosion				
	Metal to metal				
Hot air blowing nozzles	Abrasion		**Cored wires** SK 089-O SK GS-O **Solid wire** UTP A 38 **Stick electrodes** UTP 39 UTP 5D	 50 HRC 220 HB 60 HB 60 HB 220HB	 Lamellar grey cast iron Spheroidal graphite cast iron Pure copper Pure copper Spheroidal graphite cast iron
	High temperature				
	Impact				
	Corrosion				
	Metal to metal				
Ladle transportation	Abrasion		**Cored wires** SK 350-G SK 450-G SK 258L-SA SK 242-S UTP A ROBOTIC 352 UTP AF ROBOTIC 405 **Stick electrodes** UTP DUR 350	 330 HB 47 HRC 44 HRC 40 HRC 350 HB 48 HRC 370 HB	 Bainite Martensite Martensite Martensite Martensite Martensite Bainite
	High temperature				
	Impact				
	Corrosion				
	Metal to metal				
Slag pots	Abrasion		**Cored wires** SK Soudocore S8-O	 190 HB	 Ferrite
	High temperature				
	Impact				
	Corrosion				
	Metal to metal				

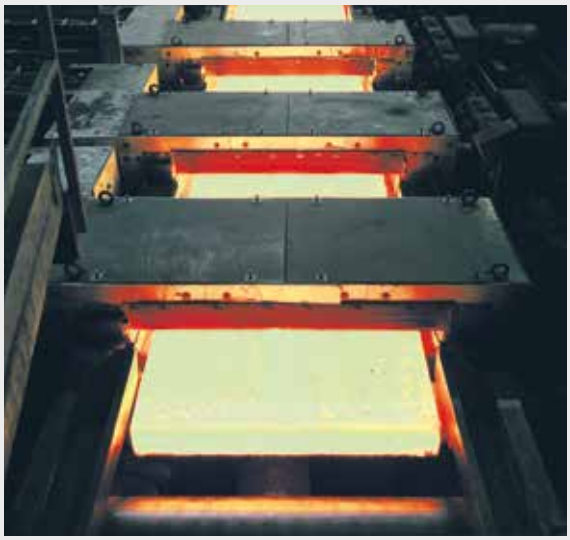
* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.

Component	Predominant wear modes	Intensity	Recommended consumables*	Hardness	Microstructure
Electric arc furnace	Abrasion		**Cored wires**		
	High temperature		UTP AF 6222 Mo PW-FD UTP AF 068 HH-FD	220 HB 180 HB	Austenitic NiCrMo alloy Austenitic NiCr alloy
	Impact		**Stick electrodes**		
	Corrosion		UTP 6222Mo UTP 068 HH	220 HB 180 HB	Austenitic NiCrMo alloy Austenitic NiCr alloy
	Metal to metal				
Basic oxygen convertor	Abrasion		**Cored wires**		
	High temperature		SK 350-G SK 450-G SK 258L-SA SK 242-O/S SK 252-O/S SK AP-O/S UTP A ROBOTIC 352 UTP AF ROBOTIC 405	330 HB 47 HRC 44 HRC 40 HRC 44-46 HRC 205HB/50HRC 350 HB 48 HRC	Bainite Martensite Martensite Martensite Martensite Austenite Martensite Martensite
	Impact				
	Corrosion				
	Metal to metal				
BOF scrap charging chute	Abrasion		**Cored wires**		
	High temperature		SK 258 TiC-O SK 650-G SK 255-O	58 HRC 58 HRC 60 HRC	Martensitic + Ti carbides Martensite Austenitic matrix + Cr carbides
	Impact				
	Corrosion				
	Metal to metal				
Fume exhaust pipes	Abrasion		**Cored wires**		
	High temperature		SK 256-O SK OXY-M	63 HRC –	Austenitic matrix + Cr carbides Cermets
	Impact				
	Corrosion				
	Metal to metal				
Converter chimney	Abrasion		**Cored wires**		
	High temperature		SK 830-MF SK 840-MF SK OXY-M	– – –	Ni-Si-B multiphasic microstructure Ni-Cr-Si-B multiphasic microstructure Cermets
	Impact				
	Corrosion				
	Particle erosion				

* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.

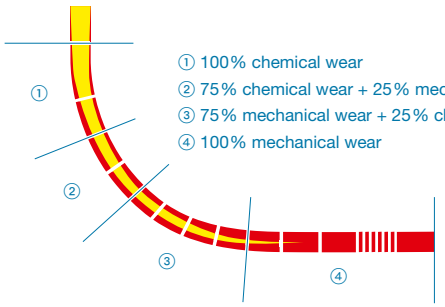
Continuous Casting



Component	CC zone	Recommended consumables*	Hard-ness	Microstructure
Continuous casting		**Cored wires**		
	1	SK 768-G/S SK 741-O/G SK 410 NiMo-SA SK 370-O	35 HRC 41 HRC 39 HRC 42 HRC	Supermartensitic Martensite + 10% Ferrite Martensite + 10% Ferrite Martensite + 10% Ferrite
	2	SK 415-SA SK 714N-O SK 742N-SK SK 743N SK	42 HRC 44 HRC 44 HRC 45 HRC	Martensite + 10% Ferrite Martensite + Ferrite Martensite + 10% Ferrite Martensite + 5-10% Ferrite
	3	SK 420-SA SK 461C-SA SK 258-SA	53 HRC 54 HRC 57 HRC	Martensite Martensite + Ferrite Martensite
	4	SK 258-O SK 258-SA	55 HRC 57 HRC	Martensite Martensite
	Buffering	SK 430 C-SA SK BU-S SK 20CrMo-SA	175 HB 225 HB 250 HB	Ferrite + Martensite Bainite Ferrite
		Strip-flux combinations		
	1	SOUDOTAPE 430L + RT 168 SOUDOTAPE 430 + RT 152 SOUDOTAPE 430 + EST 453	35 HRC 41 HRC 40 HRC	Supermartensitic Martensite + 10% Ferrite Martensite + 10% Ferrite
	2	SOUDOTAPE 430 + RT 742 SOUDOTAPE 410L + RT 157	40 HRC 45 HRC	Martensite + 10% Ferrite Martensite + Ferrite
	3	SOUDOTAPE 420 + RT 159 SOUDOTAPE 420 + EST 426 SOUDOTAPE 258 + EST 122	55 HRC 50 HRC 55 HRC	Martensite Martensite Martensite
	4	SOUDOTAPE 258 + EST 122 SOUDOTAPE 258 + RT157	55 HRC 50 HRC	Martensite Martensite
	Buffering	SOUDOTAPE A + RT 146 SOUDOTAPE A + SMoTW SOUDOTAPE 430 + RT 179 SOUDOTAPE 430 + EST 127	150 HB 165 HB 200 HB 200 HB	Ferrite Ferrite Ferrite Ferrite

* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.

Identification of wear modes along a CC line

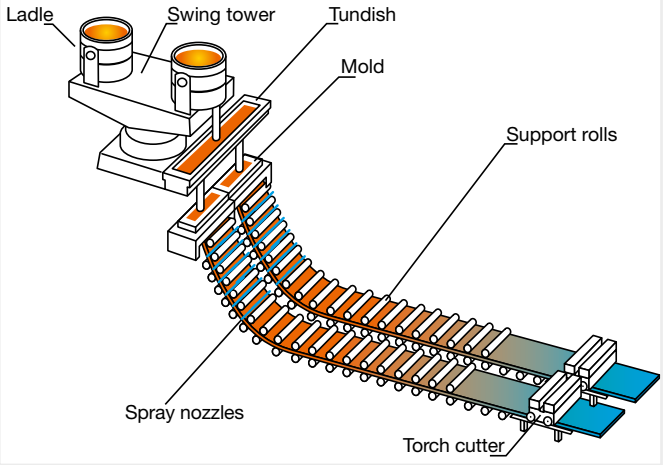


Recommended alloys for overlay

① 13Cr+4Ni+Mo-LC ② 13Cr+Ni+Mo+C
③ 12Cr+Mo+C ④ 5Cr+Mo, W, V

Continuous Casting Rollers

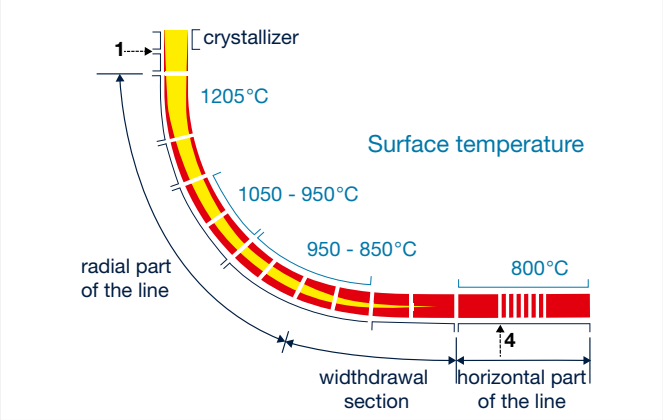
Wear & repair

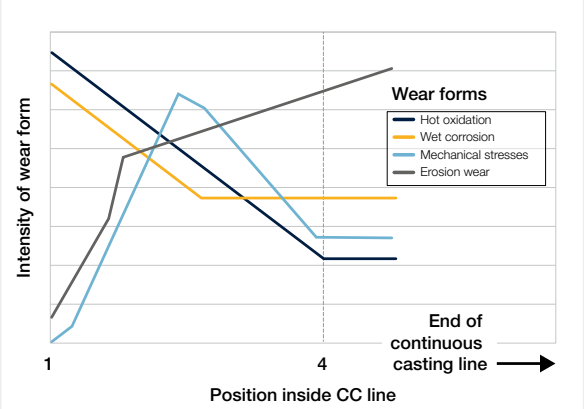


In the continuous slab casting process, caster rollers are utilized for solidification containment, strand support, slab bending and unbending, driving and conveying of the solidifying slab. Dimensional tolerances, mechanical stability and surface condition of the caster rollers affect both the internal and surface quality of the steel slab. A typical continuous casting installation contains 350-700 caster rollers. Common base materials used for the rollers are 42CrMo4, 25CrMo4, 16CrMo44 and 21CrMoV5.11.

To substantially extend the service life of the rollers, their surface is covered with a wear resistant overlay, typically with martensitic stainless steel alloys.

Wear types along the continuous casting line

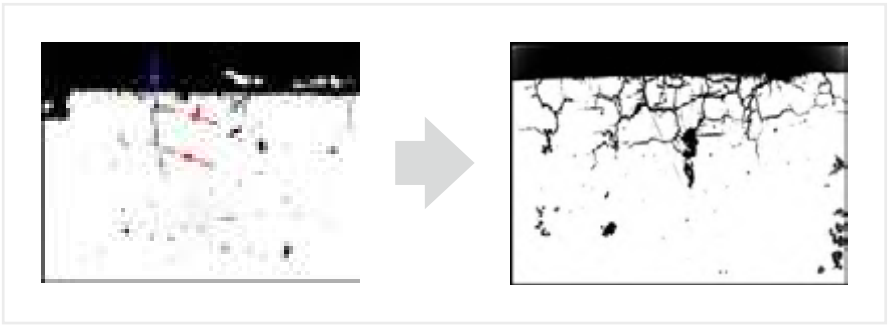




Continuous casting rollers are subjected to varying combinations of rather complex individual wear mechanisms. This leads to rapid deterioration of the rollers when their surface is not properly protected. The type of wear and its intensity depend on the position of the rollers in the continuous casting line as the slab temperature drops and the gravitational force acting on the rollers increases. At the upper part of the line, wet corrosion, thermal shock and resulting fire cracking are predominant. At the lower part of the line, mechanical stresses and metal-to-metal wear progressively play a more significant role.

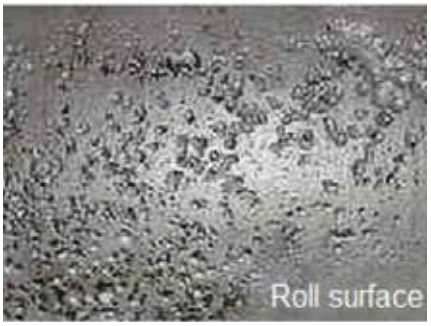
Fire cracking

Fire cracking is the combined result of several degradation processes such as thermal fatigue, hot oxidation, erosion and cyclic bending. Fire cracks have the appearance of shallow surface cracks. Stresses from corrosion, steam erosion, cyclic heat and alternating mechanical loads concentrate at the crack tips and lead to further extension of the network of cracks.

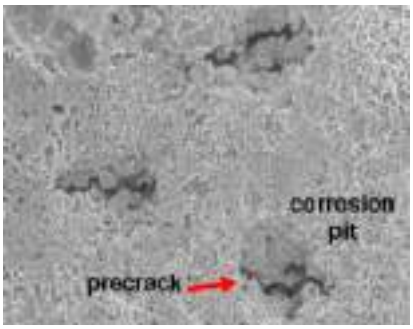


Wet corrosion

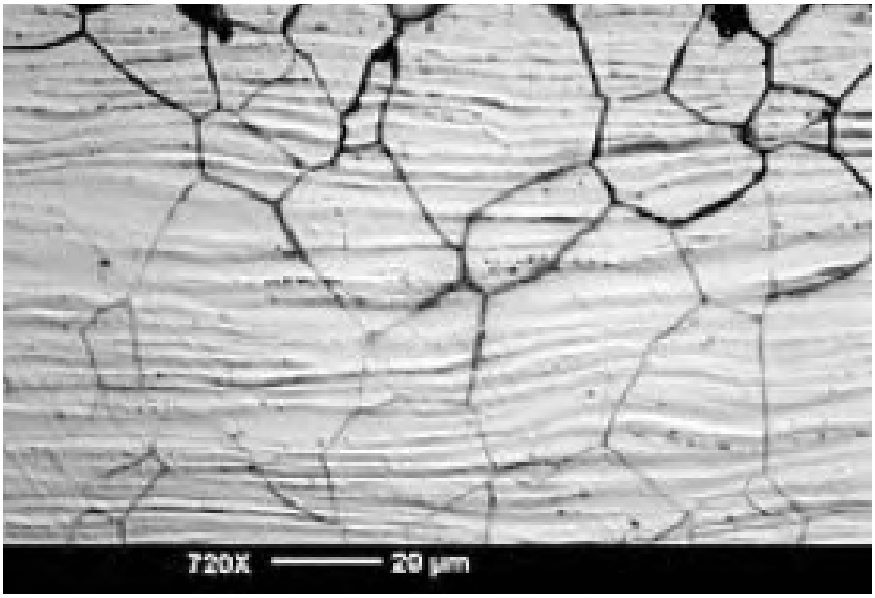
Wet corrosion from cooling water can be caused by a high mineral content in water from local sources or by re-circulated water contaminated with fluorides from ladle insulation powders, tundish cover refractories or from casting powders. The cooling water becomes an aggressive pitting medium, leading to a combination of three main corrosion mechanisms; pitting, intergranular and stress corrosion cracking.



Pitting corrosion on roll surface



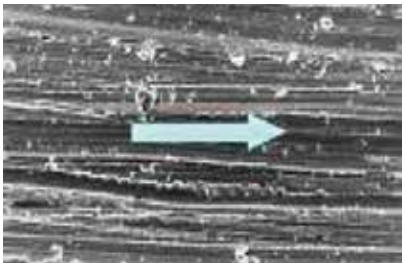
Stress corrosion cracks originating at corrosion pits.

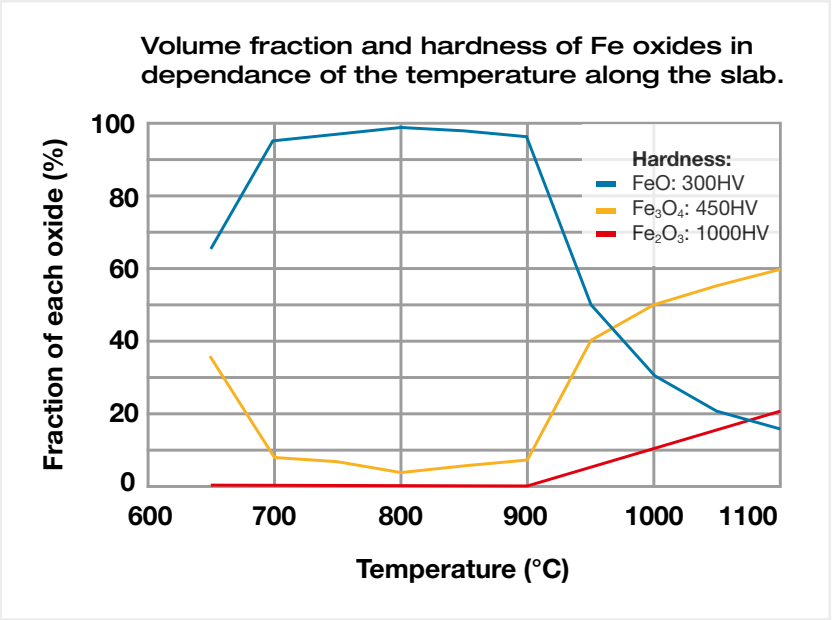


Intergranular corrosion due to chromium carbide precipitation at the grain boundaries

Erosion wear

Surfaces of extremely hot steel oxidize rapidly in air, forming abrasive iron oxides that wear off the surfaces of continuous casting rollers. The exit temperature of the cast slab is in the range where hard and abrasive FeO, Fe_2O_3 and Fe_3O_4 are formed on its surface. The rollers are subjected to abrasive wear by these oxides and by the resulting debris. The intensity of this wear depends on the overall oxides hardness and, therefore, on the volume fraction and individual hardness of the oxide types shown in the diagram below.





Another form of erosive wear is erosion caused by steam formation combined with chloride induced corrosion. Cooling water trapped in surface pits and oxides forms steam bubbles whose pressure breaks off particles from the roll surface.

Overlay of Continuous Casting Rollers

Cladding processes

In most cases, the SAW process with cored wires and mechanized welding with self-shielded cored wires are used for the overlay of continuous casting rollers. Weaving is applied to minimize the number of overlaps between runs, as these may be more sensitive to corrosion. Submerged arc or electroslag strip cladding are also regularly used. These processes feature lower dilution with the base material, wider beads with fewer overlaps and significantly increased deposition rate.

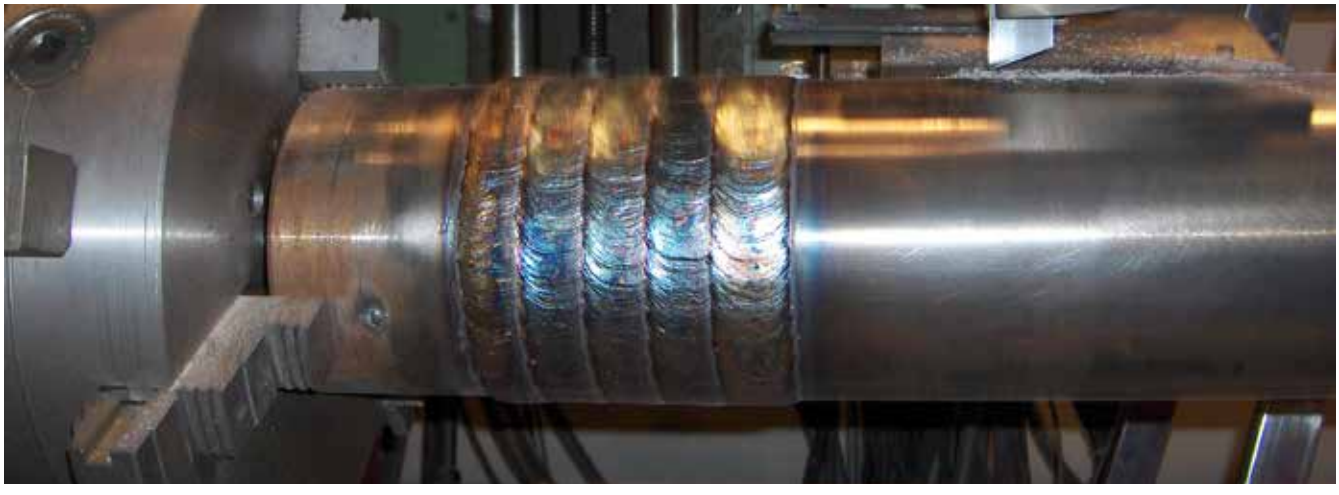
Overlay materials

The most suitable alloys with a good resistance against a combination of wear and corrosion are found in the martensitic stainless steel family. By an appropriate balance between the addition of carbide formers and heat treatment, weld overlays with hardness values between 35 HRC and 55 HRC can be obtained, which have shown a satisfactory behavior in service. The addition of alloying elements has to be carefully controlled to obtain a minimum delta-Ferrite content of 5% to minimize stress corrosion and max. 10 % delta-Ferrite for fatigue strength resistance. Different martensitic stainless steels have been investigated. Alloy type 420 became very popular during the 80-s and 90-s, but nowadays Alloy type 410NiMoNbV is the preferred choice, providing a significant increase in service life of the rollers. Also soft martensitic stainless steels are applied.
UTP Maintenance overlay consumables for continuous casting rollers on page 14 are categorized in the same manner.

Family	Alloy type	Chemical composition, wt %								Hardness
		C	Mn	Si	Cr	Ni	Mo	Nb	V	HRC
Martensitic	410NiMoNbV	0.09	0.25	0.9	13.5	2.4	1	0.15	0.15	54
Soft martensitic	13Cr4Ni1Mo	0.06	0.4	0.9	14	4	0.9	–	–	40 - 45
Super martensitic	12Cr6Ni2Mo	0.017	0.22	1.1	12.9	5.2	2.6	–	–	35

Typical all weld metal chemical compositions of the different martensitic stainless steel types.

A completely new solution for the overlay welding of continuous casting foot rollers is with supermartensitic stainless steel. It is used for the topmost part of the line where thermal shock, corrosion and hot oxidation are most severe, but with still low mechanical wear.



NEW SOLUTION: Supermartensitic weld overlays

At the topmost part of the continuous casting line, thermal shock, corrosion and hot oxidation are most severe, while mechanical wear is still low. For this reason, it is accepted to apply overlay materials with a lower hardness, but with increased corrosion resistance. Supermartensitic stainless steel has a much better corrosion resistance than classic martensitic types combined with acceptable wear behaviour.

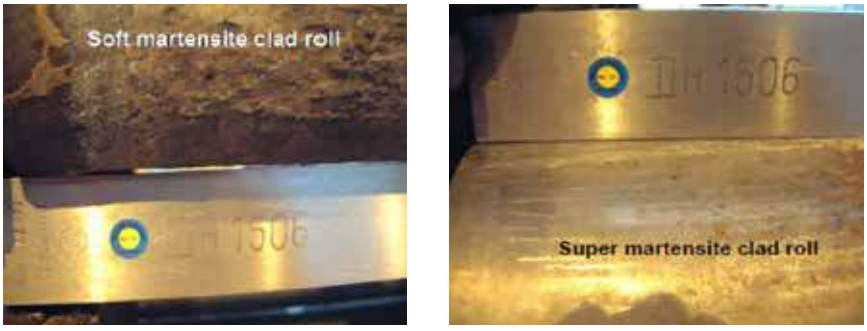
UTP Maintenance has developed two types of overlay materials for the first series of rollers in the vertical section, directly after the mould of the continuous casting process:

- SK 768 G and SK 768 S cored wires of the 12.5Cr-5Ni-2.5Mo type for respectively gas-shielded and submerged arc overlay welding
- SOUDOTAPE 430L / RECORD RT 168 strip / flux combination of the 12.5Cr-5Ni-2.5Mo type for submerged arc strip cladding.

One of the severest corrosion mechanisms taking place here is due to accumulation of fluorine and alkaline casting powders in the cooling water, the so called mould-flux-induced-corrosion. In this area, soft martensitic stainless steel overlays are a commonly applied solution and therefore formed the benchmark in development. The new strip / flux combination was extensively tested at the Dillinger Hütte steel works, in Germany.

Following targets were specified for the properties of the new solution:
- Improved wear resistance in primary roller section.
- Martensite starting temperature far above room temperature to facilitate full transformation
- No influence of dilution with base material in the third layer
- Delta Ferrite content below 10% (point counting method)
- Suitability for small roll diameters, typically 150-300 mm
- Good slag release at temperatures of 300-350°C

Results of laboratory and field tests summarized are:
- The supermartensitic overlay with RECORD RT 168 / SOUDOTAPE 430L doubled the lifetime of the overlaid rollers in the first segment of a continuous casting line.
- The delta Ferrite content in the supermartensitic structure of the third layer can be established below 10%, by applying a fourth "post heating layer".
- Slag self-releasing after only half a turn of 150-160 mm diameter rollers.
- Laboratory and field tests were in full allignment



Comparison of soft and supermartensitic overlaid rollers after long term testing in continuous casting practice.

Universal **single layer** solution for the repair of continuous casting rollers

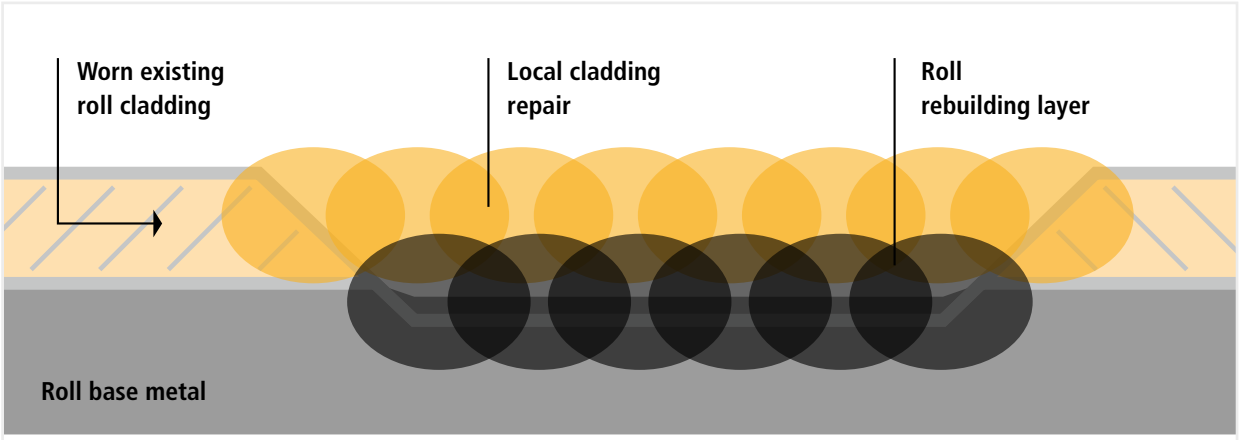
SK 743N-SK / RECORD SK

For steel mills requiring a universal single-layer solution for the repair of rollers over the full length of the continuous casting line, the submerged arc cored wire / flux overlay combination SK 743N-SK / RECORD SK and the open arc cored wire SK 743N-O form a compromise for using several product combinations. The innovative aspect of this combination is that the targeted chemical composition is reached in one single layer when overlaying onto commonly applied creep resistant steel roller materials such as 42CrMo4, 25CrMo4, 16CrMo44 and 21CrMoV5.

This product combination gives a weld metal with a martensitic matrix with 5-10 % Ferrite and a hardness of ~45 HRC after PWHT of 6 hours at 500 °C. Nitrogen is added to enhance resistance to thermal fatigue and intergranular corrosion by reducing the formation of carbides at the grain boundaries.

	C	Mn	Si	Cr	Ni	Mo	Nb	V	N	Fe
All Weld	0.035	0.53	0.6	15.0	2.4	1.0	0.9	0.15	0.1	Bal.

When needed due to excessive wear, rollers can be re-built with the wire / flux combination SK 20CrMo-SA / RECORD SK prior to hard facing with SK 743N-O.



Repair solution with straight beads. Weaved beads also possible.

Universal **multi-layer** solution for the repair of continuous casting rollers

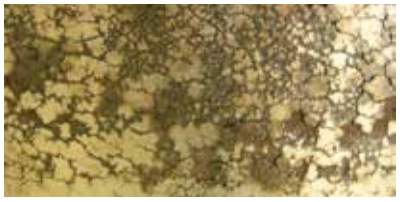
SK 742N-SK / RECORD SK

For steel mills requiring a universal multi-layer solution for the repair of rollers over the full length of the continuous casting line, the submerged arc cored wire / flux overlay combination SK 742N-SK / RECORD SK forms a compromise for using several product combinations. The wire gives a martensitic microstructure and the chemical elements are balanced to provide optimum average resistance to the common wear mechanisms occurring along the line. A minimum of three layers is recommended to reach the desired weld composition in the top layer.

- Hot oxidation (thermal fatigue)
- Wet corrosion from aggressive cooling water contaminant
- Erosive wear caused by steam formation
- Erosive wear caused by oxides formation on the surface of the slab
- Plastic deformation due to mechanical stresses

	C	Mn	Si	Cr	Ni	Mo	Nb	Fe	N
All Weld	0.05	1.2	0.4	13.50	3.30	1.3	0.10	Bal.	0.1

SK 742N-SK /RECORD SK - all weld metal typical chemical composition to be reached in three layers with a total thickness of 10-12 mm.



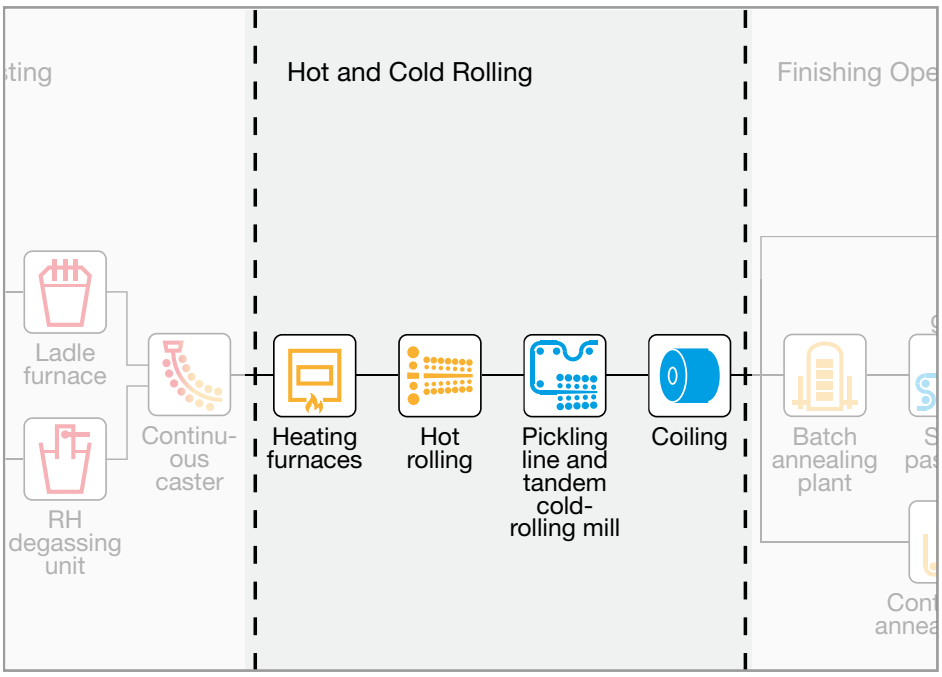
Hot oxidation

Thermal fatigue

Wet corrosion

The combination SK 742N-SK / RECORD SK features excellent weldability with flat beads with smooth overlaps and excellent slag release. It offers the advantage of a repeatable, uniform repair procedure, all along the continuous casting line. The combination is successfully used by major steel works worldwide for many years, with expected life time of reclaimed rollers above 3.5 million tons production output.To increase the deposition rate use our alternative strip / flux combination SOUDOTAPE 430 / RECORD RT 742.

Hot and cold rolling



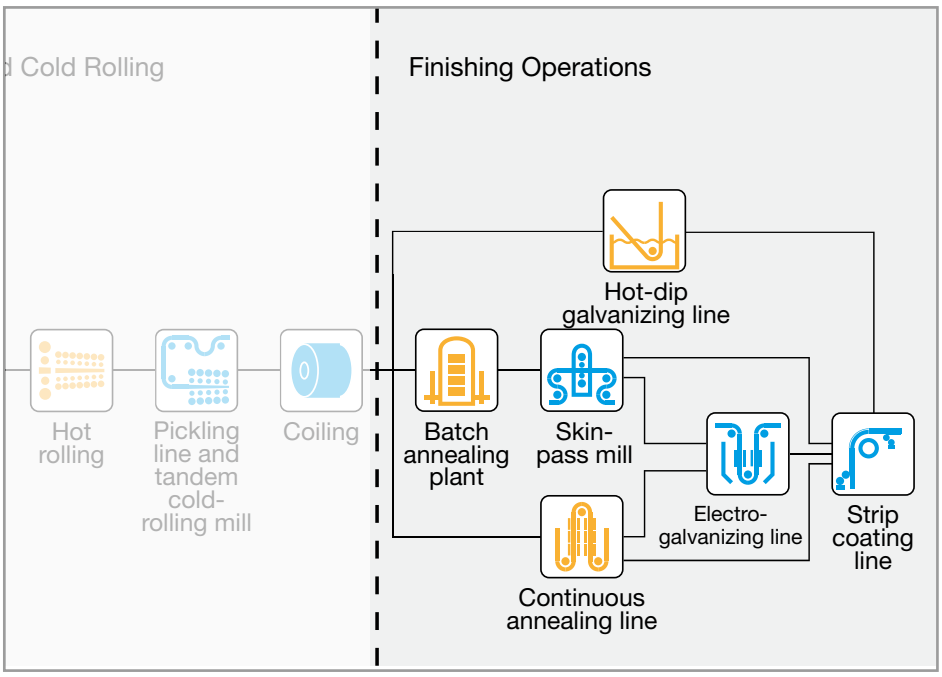
Component	Predominant wear modes	Intensity	Recommended consumables*	Hard-ness	Microstructure
Slab tongs	Abrasion		**Cored wires**		
	High temperature		SK Tool Alloy C-G	~200 HB	Austenite with solid strengthening precipitates
	Impact		SK Tool Alloy Co-G	230 HB	Austenite with solid strengthening precipitates
	Corrosion		SK Stelkay 21-G	32 HRC	Austenite with dispersed Cr and Mo precipitates
	Metal to metal		SK U520 Co-G	190 HB	Austenite with solid strengthening precipitates
			Stick electrodes		
			UTP Celsit 721	37 HRC	Austenite with dispersed Cr and Mo precipitates
Slab scale scraper	Abrasion		**Cored wires**		
	High temperature		SK D12-G	56 HRC	Martensite
	Impact		SK D35-G	50 HRC	Martensite
	Corrosion				
	Metal to metal				
Scale breaker	Abrasion		**Cored wires**		
	High temperature		SK 385-SA	54 HRC	Chromium carbides in a martensitic matrix with residual austenite
	Impact		SK 740-SA	46 HRC	Martensite + 10% Ferrite
	Corrosion		SK 461C-SA	54 HRC	Martensite + max 20% Ferrite
	Metal to metal				
Conveying rolls	Abrasion		**Cored wires**		
	High temperature		SK 650-G	58 HRC	Martensite
	Impact		SK 258-O	55 HRC	Martensite
	Corrosion		SK 258-SA	57 HRC	Martensite
	Metal to metal		SK 385-SA	54 HRC	Chromium carbides in a martensitic matrix with residual austenite
			Strip & flux		
			SOUDOTAPE 420 / RECORD EST 423	54 HRC	Martensite
Hot rolling mills	Abrasion		**Cored wires**		
	High temperature		SK 740-SA	46 HRC	Martensite + 10% Ferrite
	Impact		SK 263-SA	50 HRC	Martensite
	Corrosion		SK 258L-SA	44 HRC	Martensite
	Metal to metal		SK 258 NbC-SA	58 HRC	Martensite + Nb carbides
			SK 461 C-SA	54 HRC	Martensite + max 20% Ferrite

* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.

Component	Predominant wear modes	Intensity	Recommended consumables*	Hard-ness	Microstructure
Hot rolling mills					
Back-up rolls 	Abrasion High temperature Impact Corrosion Metal to metal		**Cored wire** SK 258NbC-SA	57 HRC	Martensite + Nb and W carbides
Bearing chock 	Abrasion High temperature Impact Corrosion Metal to metal		**Strip-flux combi-nation** SOUDOTAPE 430 / RECORD RT 159	230 HB	Martensite + Ferrite
Working rolls 	Abrasion High temperature Impact Corrosion Metal to metal		**Strip-flux combi-nation** SOUDOTAPE 430 / RECORD EST 423	52 HRC	Martensite
Edger rolls 	Abrasion High temperature Impact Corrosion Metal to metal		**Cored wires** SK 263-SA SK 461C-SK	50 HRC 54 HRC	Martensite
Coiling					
Pinch rolls 	Abrasion High temperature Impact Corrosion Metal to metal		**Cored wires** SK 742N-SK **Strip-flux combi-nation** SOUDOTAPE 430 / RECORD RT 742	44 HRC 40 HRC	Martensite + 10 % Ferrite
Pinch rolls 	Abrasion High temperature Impact Corrosion Metal to metal		**Cored wire** SK 258-SA **Strip-flux combi-nation** SOUDOTAPE 258 / RECORD EST 122	57 HRC 55 HRC	Martensite + carbides
Coiler 	Abrasion High temperature Impact Corrosion Metal to metal		**Cored wires** SK 461C-SA SK 385-SA	54 HRC 54 HRC	Martensite + max. 20% Ferrite

* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.

Finishing operations



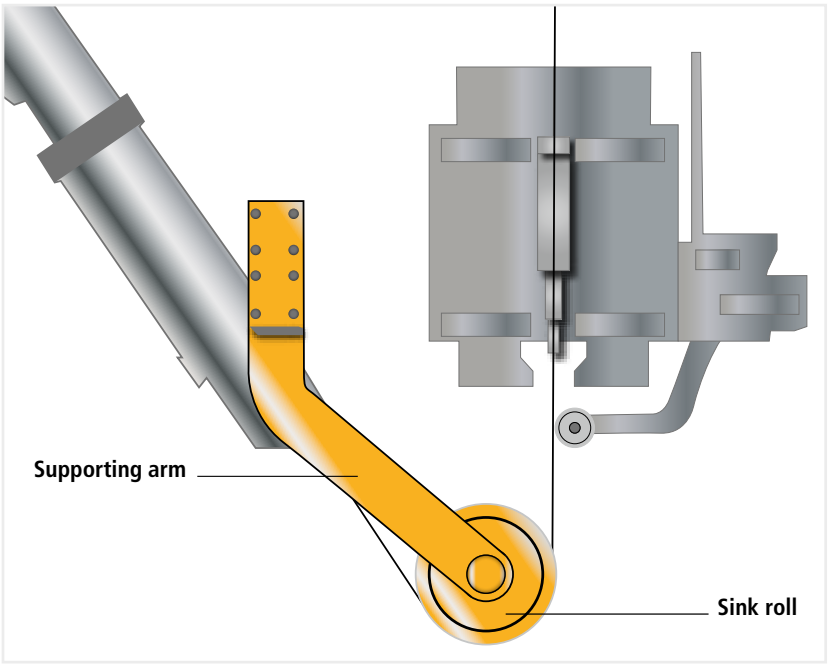
Component	Predominant wear modes	Intensity	Recommended consumables*	EN 14700	Hardness	Microstructure
Gear roll driving shaft	Abrasion		**Cored wires** SK 228-G SK 258L-G SK 350-G		315 HB 45 HRC 330 HB	Martensite Martensite Bainite
	High temperature					
	Impact					
	Corrosion					
	Metal to metal					
Tension levelers	Abrasion		**Cored wires** SK 263-SA SK 253NbC-S		50 HRC 51 HRC	Martensite Martensite, little residual austenite and dispersed NbC carbides
	High temperature					
	Impact					
	Corrosion					
	Metal to metal					
Hot dip galvanizing rollers	Abrasion		**Cored wires** SK ZIP-O		170 HB	Fully austenitic
	High temperature					
	Impact					
	Corrosion					
	Metal to metal					

* For more detailed information, see our Product Data Sheets at http://www.voestalpine.com/welding or contact your local UTP Maintenance office.

SK ZIP-O for cladding sink roll journals

The hot dip galvanizing process may involve several baths whose aggressiveness depends on chemical composition, bath temperature and other production related factors. Commonly applied bath compositions are pure molten Zn at a working temperature of 420-500 °C or AlZn molten alloys at a working temperature of 660 °C. The service life of sink roll journals and kettle walls depends on the above mentioned production factors, but also on the material of the journal. In the case of commonly used 316L material, repair may already be needed after 2-3 days of service.

Overlay welding with SK ZIP-O self-shielded cored wire substantially improves the service life of the journals.



In a comparative test with 316L material, after 7 days of immersion in molten Al-Zn, a substantially lower diameter reduction is observed as well as a more regular wear pattern, causing less ovality of the roll supporting arms.

128/2017/EN/GL

voestalpine Böhler Welding

Welding know-how joins steel

With over 100 years of experience, voestalpine Böhler Welding is the global top company for the daily challenges in the areas of joint welding, repair, hardfacing and cladding as well as brazing. Customer proximity is guaranteed by more than 40 subsidiaries in 25 countries, with the support of 2,200 employees, and through more than 1,000 distribution partners worldwide. With individual consultation by our application technicians and welding engineers, we make sure that our customers master the most demanding welding challenges.voestalpine Böhler Welding offers three specialized and dedicated brands to cater our customers' and partners' requirements.

Lasting Connections – As a pioneer in innovative welding consumables, Böhler Welding offers a unique product portfolio for joint welding worldwide. More than 2000 products are adapted continuously to the current industry specifications and customer requirements, certified by well-respected institutes and thus approved for the most emanding welding applications. As a reliable partner for customers, „lasting connections" are the brand's philosophy in terms of both welding and people.

Tailor-Made Protectivity™ – UTP Maintenance ensures an optimum combination of protection and productivity with innovative and tailor-made solutions. Everything revolves around the customer and their individual requirements. That is expressed in the central performance promise: Tailor-Made Protectivity™.

In-Depth Know-How – As a leading manufacturer of soldering and brazing consumables, Fontargen Brazing offers proven solutions based on 50 years of industrial experience, tried and tested processes and methods. This In-Depth Know-How has made Fontargen Brazing an internationally preferred partner for every soldering and brazing task.

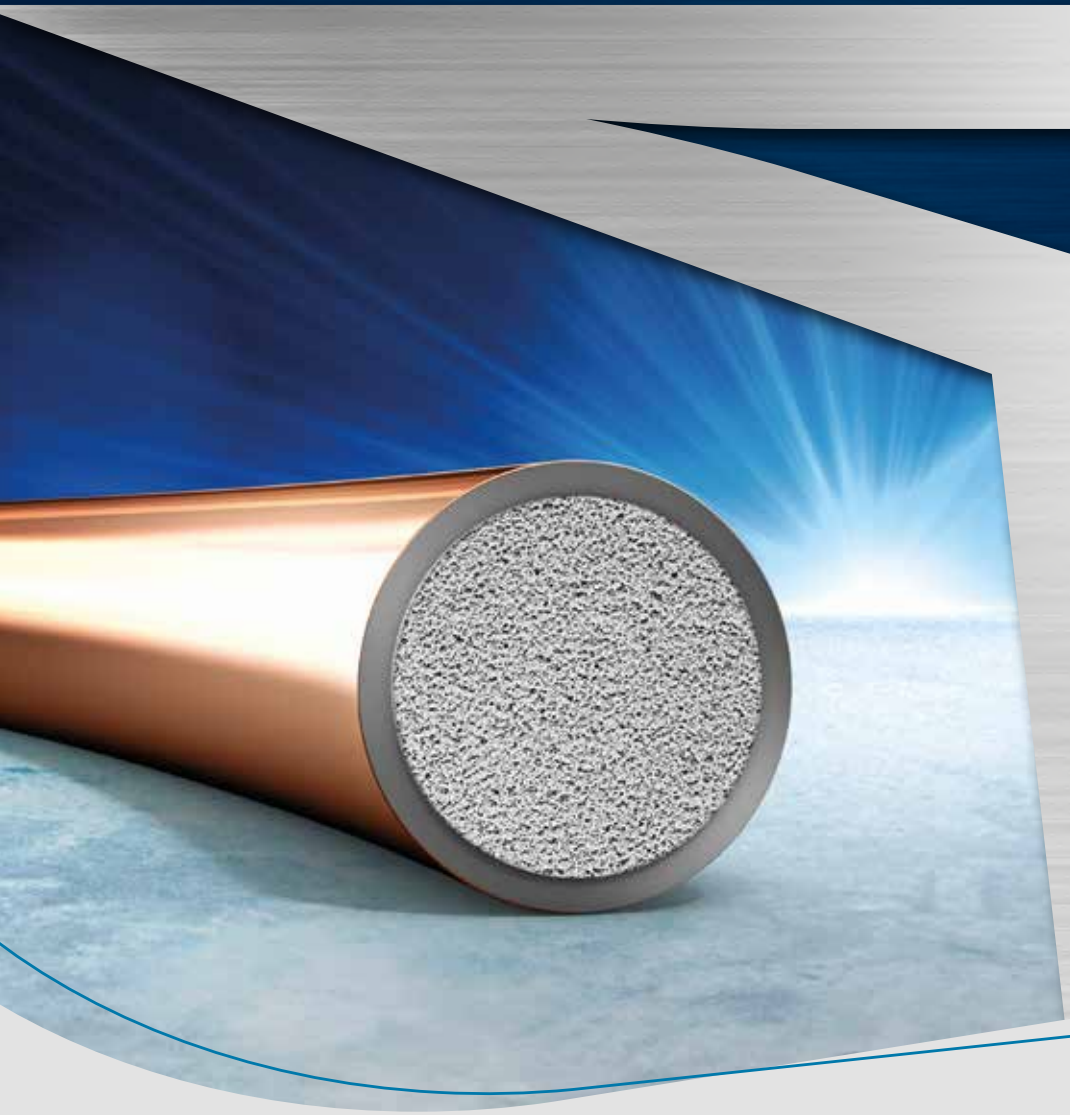
voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

böhler welding
by voestalpine

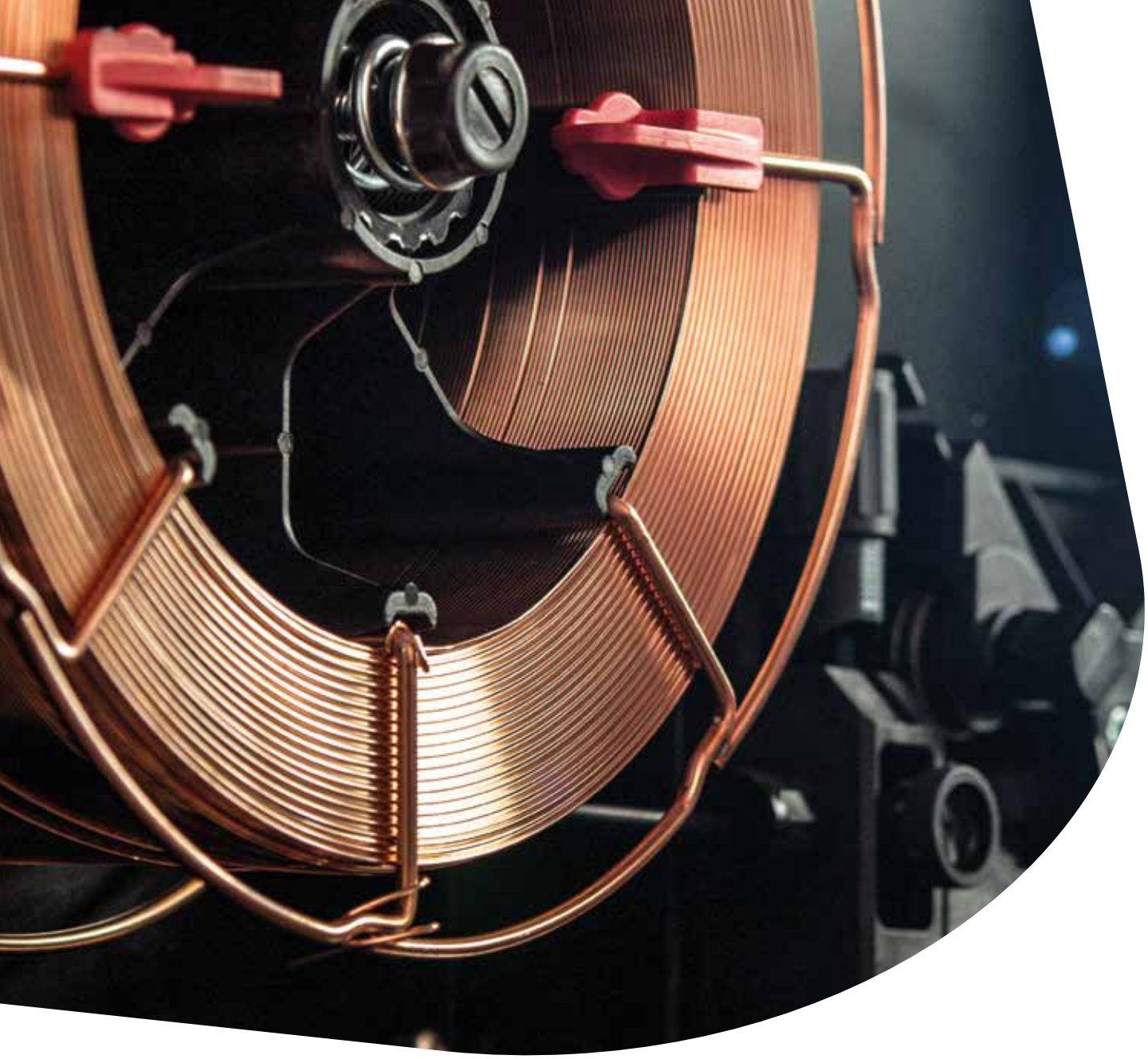
I am the Number One Seamless Cored Wire

Engineered by the Leading Welding Consumables Developers



voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.



Benefit from the Specialist in Seamless Cored wires

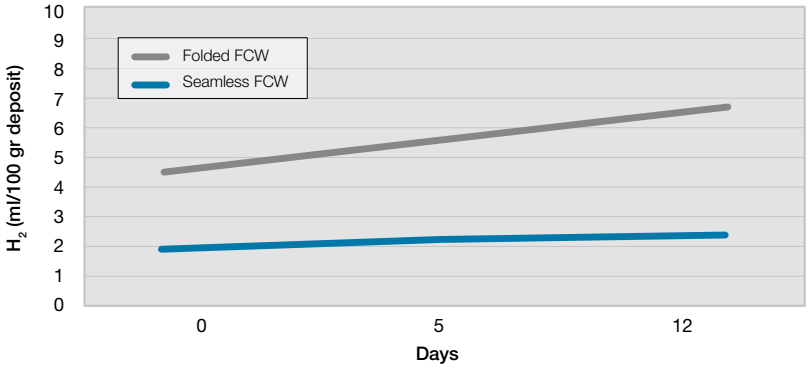
Strong European quality traditions, deep application knowledge and best-in-class welding consumables. This is the essence of all of which voestalpine Böhler Welding stands for. These merits are equally valid for our comprehensive range of seamless, copper-coated flux- and metal-cored welding wires, brought together under the renowned Böhler Welding brand name. Packed with decades of application experience, they are designed to bring you productivity, weld quality and – above all – security.

Convincing Advantages that Speak for Themselves

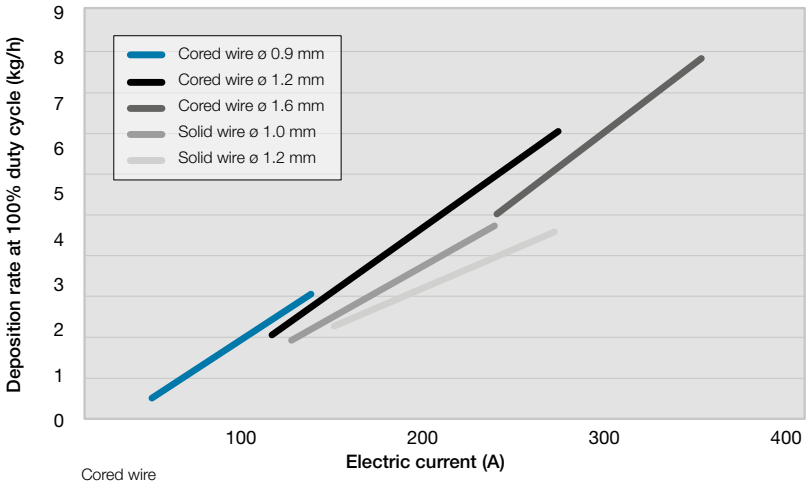
Optimal protection against hydrogen induced cracking

Within the field of flux-cored arc welding, the seamless design offers optimal protection against moisture reabsorption and thereby against hydrogen induced cracking / hydrogen assisted cracking (HIC, HAC, cold cracking). For the simple reason that there is no butt- or overlap-closed seam running over the wire length, moisture cannot penetrate into the filling, during storage and use of the wires. Böhler seamless cored wires are produced with extremely low levels of diffusible hydrogen – typically 2-3 ml/100g weld metal for rutile types and even lower for metal-cored and basic wires. For all types, the initial hydrogen level is guaranteed to be in AWS hydrogen class H4. And they maintain this property until the moment of welding, regardless duration of storage and time of exposure at the work site. With Böhler seamless cored wires, you will always enjoy the best protection you can possibly get in flux-cored arc welding.
Easy and secure. As an additional advantage, the copper-coating counteracts the formation of rust on the wire surface.

H_{DM}: Rutile folded FCW versus rutile seamless FCW



Welding Conditions: 25 V – 250 A – Stick-out: 17 mm – Gas: M21
Diffusible hydrogen content determined according to AWS A4.3-93, using the chromatography method.



Cored wire		
ø 0.9 mm	Argon + 18 % CO_2	Stickout length 15 mm
ø 1.2 / 1.6 mm	Argon + 18 % CO_2	Stickout length 20 mm
Solid wire	Argon + 2 % CO_2	Stickout length 12 mm

Superior welding productivity

Böhler seamless cored wires carry all general productivity advantages brought along by the cored wire product design, when compared with solid wires. At equal wire diameters, the current conducting cross section of cored wires is smaller and, therefore, resistance heating in the sheath (I^2R effect) is higher at the same welding current. This translates into a higher wire melt-off rate and – depending on cored wire type (flux- or metal-cored) – in higher deposition rates than with solid wires.

On top of this basic productivity advantage, cored wires offer a powerful option to very precisely influence welding characteristics by adding specific ingredients to the core, such as slag formers, arc stabilizers and alloying elements. Superior welding productivity is one of the unique features to be obtained with well-designed flux formulations. Böhler rutile cored wires with fast freezing slag, for instance, provide deposition rates in positional welding up to three times as high as obtainable with any other manual arc welding process.
In the downhand position, Böhler metal-cored wires are the fastest way to join steel plate.
Arc stabilizers make favorable spray arc welding start at welding currents where solid wires of the same diameter operate in the short or globular arc mode, with associated superior productivity and virtual absence of spatter.

Excellent weldability and weld quality

Ingredients in the core also make sure that Böhler seamless cored wires have optimized weldability. Low spatter is one aspect. The level of spatter depends on flux formulation and arc type, but results are generally better than with solid wires, over a wider range of parameters. Tie-in (wetting) is usually smoother and weld penetration rounder and deeper, making it easier to avoid weld defects such as insufficient penetration and lack of fusion.

Problem-free feeding

Whether you are using 16 kg basket spools or 250 kg Eco Drums, whether you weld manually close to the power source or robotic with long liners – problem-free wire feeding is what you will get.
The seamless, copper-coated wire design adds sufficient stiffness and glide to overcome friction in liners, welding guns and contact tips. The copper-coating enhances current transfer between contact tip and wire resulting in a stable arc. Controlled wire cast and helix largely avoids “dog tailing”, promoting straight, well positioned welds.

Full range for non- and low-alloyed steels

The Böhler range comprises a broad range of seamless, low-hydrogen cored wires covering the non-and low alloyed steel categories: high strength, low-temperature, weathering and creep resistant. They are available in all commonly used diameter sizes. Most types are tested according EN and AWS classification standards and approved by relevant approval societies. There is a choice between types for use with CO_2 or with mixed shielding gas. The majority of industries will find excellent wires for their specific cored wire welding needs.

Böhler Seamless Cored Wires Quick Guide

Rutile, all positional wires	Basic, downhand wires	Metal-cored, all-positional wires
These give exceptional productivity in positional welding, due to a fast freezing slag that supports the weld metal, while allowing high welding currents. A single current/voltage setting can be applied for all welding positions. The wires are characterized by a smooth spray arc droplet transfer with very low spatter losses. Slag is easily removed and welds have a nice appearance. Root runs are welded economically on ceramic weld metal support.	These give good weldability and productivity in the flat and horizontal-vertical positions. They yield very clean welds with high elongation and impact toughness and good crack resistance, and are therefore often used for constructions with a high restraint and for root passes. Very low spatter losses. Slag release is acceptable and welds have a nice appearance. Use of ceramic weld metal support is an option for more productive welding of root runs.	These have highest weld metal recovery, because they produce hardly any slag. Multi-run welds can be performed without removing the few silicate islands present on the surface of beads. They are therefore often used for mechanized or robotized welding, but also for manual operations when removal of slag is not desirable. They are often applied for root pass welding. Use of ceramic weld metal support is an option.
Suited for single- and multi-pass welds. Diffusible hydrogen class EN H5 and AWS class H4 - typically 2-3 ml/100g weld metal, in mixed gas (1-2 ml/100g weld metal in 100% CO_2).	Suited for single- and multi-pass welds. Diffusible hydrogen class EN H5 and AWS class H4 - typically 1-3 ml/100g weld metal.	Suited for single- and multi-pass welds. Diffusible hydrogen class EN H5 and AWS class H4 - typically 1-3 ml/100g weld metal.

Wires for normal strength steel

Product	Information
BÖHLER Ti 52 T-FD Rutile, all-positional Mixed gas and CO_2	Multi-purpose wire for steel with up to 460 MPa YS. Good CVN impact toughness down to -40°C. General fabrication, shipbuilding.
BÖHLER Ti 52 T-FD (HP) Rutile, all-positional Mixed gas and CO_2	Multi-purpose wire for steel with up to 460 MPa YS. Excellent CVN impact toughness down to -40°C for applications with highest toughness demands e.g. in offshore and shipbuilding.
BÖHLER Ti 52 T-FD (CO_2) Rutile, all-positional CO_2	Multi-purpose wire for steel with up to 460 MPa YS. Excellent productivity, especially in vertical-up welding. Single and multi-pass welds. Good CVN impact toughness down to -30°C. For excellent performance in shipbuilding.
BÖHLER Ti 52 T-FD SR (CO_2) Rutile, all-positional CO_2	Multi-purpose wire for steel with up to 460 MPa YS under stress relieve conditions. . Excellent productivity, especially in vertical-up welding. Single and multi-pass welds. Good CVN impact toughness down to -40°C. For excellent performance in shipbuilding, storage vessels and heavy wall steel constructions. (CTOD pending)
BÖHLER Kb 46 T-FD Basic, downhand CO_2	For C- and C-Mn steels up to 420 MPa YS, including fine grain steels. Excellent weldability in flat and horizontal position. Excellent CVN impact toughness down to -60°C.
BÖHLER Kb 52 T-FD Basic, downhand Mixed gas and CO_2	For steel up to 460 MPa YS. Very tough weld metal with high crack resistance for steels with high CE and constructions with high restraint. Unlimited wall thickness. Outstanding CVN impact toughness down to -60°C with mixed gas.
BÖHLER HL 51 T-MC Metal-cored, all-positional Mixed gas and CO_2	Multi-purpose wire for steel up to 460 MPa YS. Excellent CVN impact toughness down to -60°C. General fabrication.

Wires for weather resistant steel

Product	Information
BÖHLER NiCu1 Ti T-FD Rutile, all-positional Mixed gas	For weathering steels such as CORTEN and PATINAX. Good CVN impact toughness down to -40°C. Buildings, bridges.
BÖHLER NiCu1 T-MC Metal-cored, all-positional Mixed gas	For weathering steels such as CORTEN and PATINAX. Excellent CVN impact toughness down to -60°C. Buildings, bridges.
BÖHLER Kb NiCu1 T-FD Basic, downhand	For weathering steel such as CORTEN and PATINAX. Excellent CVN impact toughness down to -60°C. Buildings, bridges.

Wires for low temperature steel

Product	Information
BÖHLER Ti 60 T-FD Rutile, all-positional Mixed gas	For low-temperature steels up to 500 MPa YS and impact requirements down to -60°C. Alloyed with < 1% Ni to meet NACE offshore requirement. Offshore, upstream oil and gas exploration. CTOD tested.
BÖHLER Ti 60 T-FD (CO_2) Rutile, all-positional CO_2	For low-temperature steels up to 500 MPa YS and impact requirements down to -40°C. Alloyed with < 1% Ni to meet NACE offshore requirement. Offshore, upstream oil and gas exploration. (CTOD pending).
BÖHLER Ti 60 T-FD SR Rutile, all-positional Mixed gas	For low-temperature steels with impact requirements down to -60°C. As welded and stress relieved. Alloyed with < 1% Ni to meet NACE offshore requirement. Offshore, upstream oil and gas exploration. (CTOD pending).
BÖHLER Ti 2 Ni T-FD Rutile, all-positional Mixed gas	For low-temperature steels with impact requirements down to -60°C. Alloyed with 2% Ni for superior CVN impact properties. Offshore, upstream oil and gas exploration. CTOD tested.
BÖHLER Kb 60 T-FD Basic, downhand Mixed gas	For low-temperature steels with impact requirements down to -60°C. Alloyed with < 1% Ni to meet NACE offshore requirement. Offshore, upstream oil and gas exploration.
BÖHLER HL 46 GS T-MC Metal-cored, all-positional Mixed gas	Developed to weld galvanized steel plates. Well suited for thin plate applications. Single layer technology.
BÖHLER HL 53 T-MC Metal-cored, all-positional Mixed gas	For low-temperature steels with impact requirements down to -60°C. Alloyed with < 1% Ni to meet NACE offshore requirement. Exceptional mechanical properties down to -60°C, both as welded and stress relieved. This wire is especially suitable for rootpass welding in offshore and pipeline applications. CTOD pending.

Wires for high strength steel

Product	Information
BÖHLER Ti 75 T-FD Rutile, all-positional Mixed gas	Ni-Mo-alloyed wire for high strength steels up to 620 MPa YS. Excellent CVN impact toughness down to -40°C. The exceptional mechanical properties of this wire even at low temperatures as well as the low content of diffusible hydrogen make it especially suitable for off-shore applications.
BÖHLER Ti 80 T-FD Rutile, all-positional Mixed gas	Ni-Mo-alloyed wire for high strength steels up to 690 MPa YS. Excellent CVN impact toughness down to -60°C as well as the low diffusible hydrogen content make it especially suitable for offshore, pipeline and crane applications.
BÖHLER Kb 63 T-FD Basic, downhand Mixed gas	Cr-Ni-Mo-alloyed wire for high strength steels up to 550 MPa YS. Excellent CVN impact toughness down to -40°C. Multiple steel constructions.
BÖHLER Kb 65 T-FD Basic, downhand Mixed gas	Ni-Mo-alloyed wire for high strength steels up to 550 MPa YS. Excellent CVN impact toughness down to -40°C.
BÖHLER Kb 85 T-FD Basic, downhand Mixed gas	Ni-Mo-alloyed wire for high strength steels up to 690 MPa YS. Excellent CVN impact toughness down to -60°C.
BÖHLER Kb 90 T-FD Basic, downhand Mixed gas	Ni-Mo-alloyed wire for high strength steels up to 890 MPa YS, such as S890QL, S960QL and SQL 1100. Excellent CVN impact toughness down to -40°C.
BÖHLER HL 65 T-MC Metal-cored, all-positional Mixed gas	Ni-Mo-alloyed wire for high strength steels up to 550 MPa YS. Excellent CVN impact toughness down to -50°C. Especially suited for root pass welding in offshore and pipelines.
BÖHLER HL75 T-MC Metal-cored, all-positional Mixed gas	Ni-Mo- alloyed wire for single - or multilayer welding of high strength steels. This wire is especially suitable for the pipe welding of special base material like ASTM A519 Gr. 4130. It meets the NACE requirements. Excellent CVN impact toughness down to -40°C.
BÖHLER 700 T-MC Metal-cored, all positional Mixed gas	Ni-Mo-alloyed wire for high strength steels up to 690 MPa YS. Excellent CVN impact toughness down to -60°C. Applied in crane construction.
BÖHLER 900 T-MC Metal-cored, all-positional Mixed gas	Ni-Mo-alloyed wire for high strength steels up to 890 MPa YS. Excellent CVN impact toughness down to -60°C. Applied in crane construction and offshore fabrication.

Wires for pipes

Product	Information
BÖHLER Ti 70 Pipe T-FD Rutile, all-positional Mixed gas	Developed for pipe welding of API 5L grades up to X70. Well suited for mechanized (orbital) welding. Good CVN impact toughness down to -50°C.
BÖHLER HL 60 Pipe T-MC Metal-cored, all-positional Mixed gas	For automatic (orbital) welding applications for pipeline construction. Matches the minimum stregth requirements of X70 base material. Excellent CVN impact toughness down to -60°C. CTOD tested at -10°C.

Wires for creep resistant steel

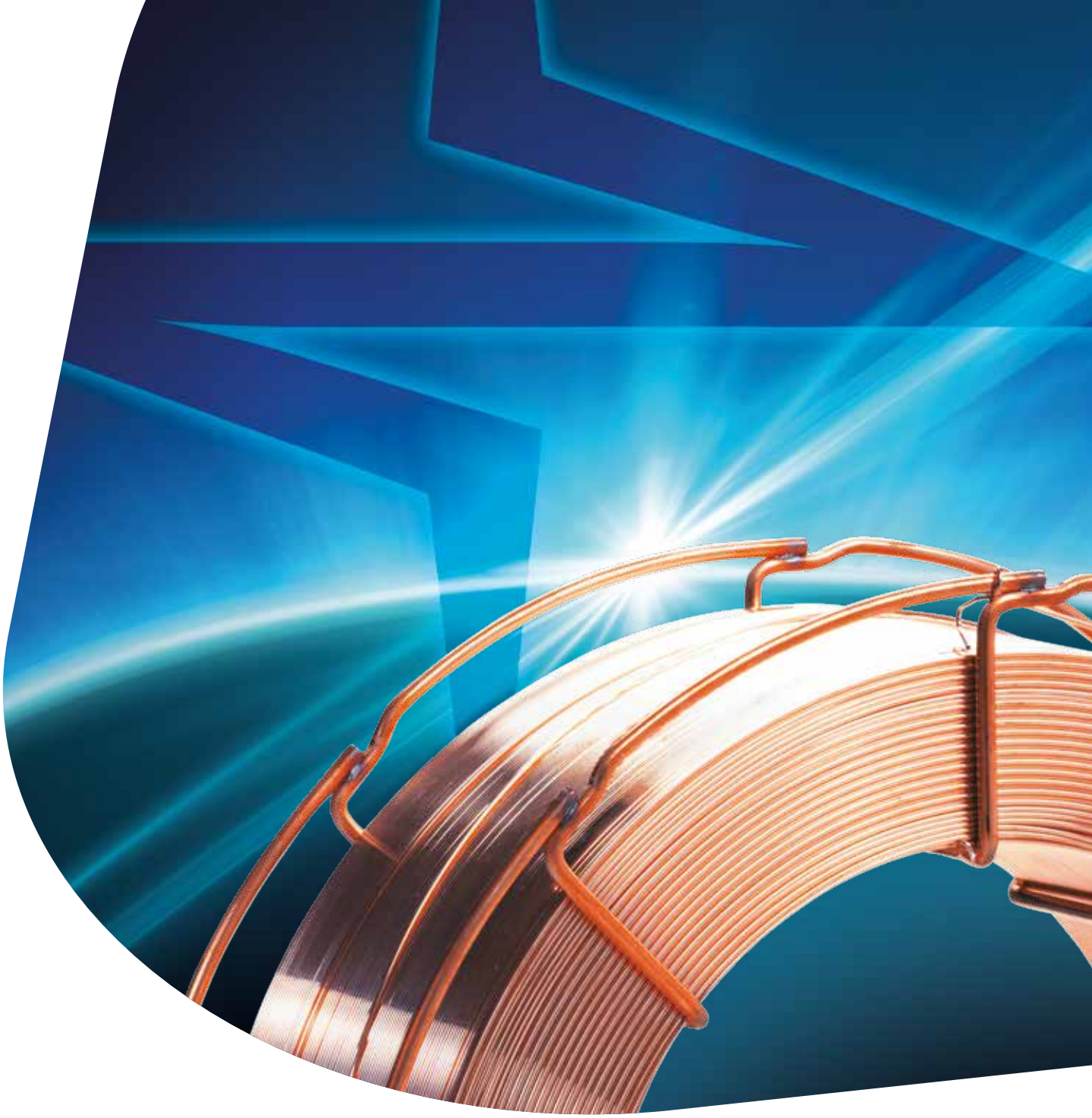
Product	Information
BÖHLER DMO Kb T-FD Basic, downhand Mixed gas	For 0.5% Mo type creep resistant steels for service temperatures up to 500°C. Excellent CVN impact toughness down to -60°C, as welded and post weld heat treated.
BÖHLER DCMS Kb T-FD Basic, downhand Mixed gas	For 1% Cr-0.5% Mo type creep resistant steels for service temperatures up to 500°C.
BÖHLER CM2 Kb T-FD Basic, downhand Mixed gas	For 2.25% Cr-0.5% Mo type creep resistant steels for service temperatures up to 600°C
BÖHLER DCMV Kb T-FD Basic, downhand Mixed gas	For Cr-Mo-V- alloyed steels resistant to creep up to 550°C. This wire is especially suitable for welding steel G17CrMoV5-10 with post weld heat treatment.
BÖHLER CM5 Kb T-FD	Basic cored wire for use in downhand positions with mixed gas. For 5% Cr-0.5% Mo type creep resistant steels.
BÖHLER DMO T-MC Metal-cored, all-positional Mixed gas	For 0.5% Mo type creep resistant steels for service temperatures up to 500°C.
BÖHLER DCMS T-MC Metal-cored, all-positional Mixed gas	For 1% Cr-0.5% Mo type creep resistant steels for service temperatures up to 500°C
BÖHLER CM2 T-MC Metal-cored, all-positional Mixed gas	For 2.25% Cr-0.5% Mo type creep resistant steels for service temperatures up to 600°C.

Böhler Seamless Cored Wires

Classifications and low-temperature performance

Shielding GAS M21 acc. EN ISO 14175

Alloy group	Product name	EN ISO	Product Classification	AWS A5.36	Product Classification	ISO V Test Values						
						20°C	-20°C	-30°C	-40°C	-50°C	-60°C	CTOD
Unalloyed steel grades	BÖHLER Ti 52 T-FD	17632-A	T46 4 P M 1 H5	A5.36	E71T1-M21A4-CS1-H4	110			60			
		17632-B	T555T1-1MA-H5	A5.36M	E491T1-M21A4-CS1-H4							
	BÖHLER Ti 52 T-FD (HP)	17632-A	T46 4 P M 1 H5	A5.36	E71T1-M21A4-CS1-H4	120	110		90	≥47		
		17632-B	T554T1-1MA-H5	A5.36M	E491T1-M21A4-CS1-H4							
	BÖHLER Kb 52 T-FD	17632-A	T46 4 B M 3 H5	A5.36	E70T5-M21A4-CS1-H4	160			100		80	
		17632-B	T556T5 0MA H5	A5.36M	E490T5-M21A4-CS1-H4							
	BÖHLER HL 51 T-MC	17632-A	T 46 6 M M 1 H5	A5.36	E70T15-M21A8-CS1-H4				90		60	
		17632-B	T 556T15-1MA H5	A5.36M	E490T15-M21A6-CS1-H4							
	BÖHLER HL 46 GS T-MC	17632-A	T46 Z M M 1 H5	A5.36	E70T15-M21AZ-CS1-H4							
		17632-B	T55ZT15-1MA H5	A5.36M	E490T15-M21AZ-CS1-H4							
Low- and medium alloyed steel grades	BÖHLER NiCu1 Ti T-FD	17632-A	T46 4 Z P M 1 H5	A5.36	E81T1-M21A4-GH4				70			
		17632-B	T554T1-1MA-G-H5	A5.36M	E551T1-M21A4-GH4							
	BÖHLER Ti 60 T-FD	17632-A	T 50 6 1Ni P M 1 H5	A5.36	E81T1-M21A8-Ni1-H4	110			90 (60)	70	65	-10°C
		17632-B	T556T1-1MA-N2-UH5	A5.36M	E551T1-M21A6-Ni1-H4							
	BÖHLER Ti 60 T-FD SR	17632-A	T50 6 1Ni P M 1 H5	A5.36	E81T1-M21AP8-Ni1-H4				120 (60)		90 (50)	-10°C
		17632-B	T556T1-1MAP-N2-H5	A5.36M	E551T1-M21AP6-Ni1-H4							
	BÖHLER Ti 2 Ni T-FD	17632-A	T50 6 2Ni P M 1 H5	A5.36	E81T1-M21A8-Ni2-H4						80	-40°C
		17632-B	T576T1-1MA-N5-H5	A5.36M	E551T1-M21A6- Ni2-H4							
	BÖHLER Ti 75 T-FD	18276-A	T62 4 Mn1.5Ni P M 1H5	A5.36	E101T1-M21A4-K2-H4				90			
		18276-B	T694T1-1MA-N3M1-UH5	A5.36M	E691T1-M21A4-K2-H4							
	BÖHLER Ti 80 T-FD	18276-A	T69 6 Z P M 1 H5	A5.36	E111T1-M21A8-GH4				75		60	
		18276-B	T766T1-1MA-G-UH5	A5.36M	E761T1-M21A6-GH4							
	BÖHLER Kb NiCu1 T-FD	17632-A	T46 6 1Ni B M 3 H5	A5.36	E80T5-M21A8-GH4						130	
		17632-B	T55 6 T5-0MA-G-H5	A5.36M	E550T5-M21A6-GH4							
	BÖHLER Kb 60 T-FD	17632-A	T 46 6 1Ni B M 3 H5	A5.36	E80T5-M21P8-Ni1-H4				100		80	
		17632-B	T556T5-0MA-N2-UH5	A5.36M	E550T5-M21P6-Ni1-H4							
	BÖHLER Kb 63 T-FD	18276-A	T55 4 Z B M 3 H5	A5.36	E90T5-M21A4-GH4				80			
		18276-B	T624T5-0MA-G-UH5	A5.36M	E620T5-M21A4-GH4							
	BÖHLER Kb 65 T-FD	18276-A	T55 4 1NiMo B M 3 H5	A5.36	E90T5-M21A4-GH4				100			
		18276-B	T62 4 T5-0MA-N2M2-UH5	A5.36M	E620T5-M21A4-GH4							
	BÖHLER Kb 85 T-FD	18276-A	T 69 6 Mn2NiCrMo B M 3 H5	A5.36	E110T5-M21A8-K4-H4						80	
		18276-B	T766T5-0MA-N4C1M2-H5	A5.36M	E760T5-M21A6-K4-H4							
	BÖHLER Kb 90 T-FD	18276-A	T89 4 Mn2Ni1CrMo B M 3 H5	A5.36	E120T5-M21A4-GH4				75			
		18276-B	T83 4 T5-0MA-N4C2M2-UH5	A5.36M	E830T5-M21A4-GH4							
	BÖHLER NiCu1 T-MC	18276-A	T46 6 Z M M 1 H5	A5.36	E80T15-M21A8-GH4				100		70	
		18276-B	T55 6 T15-1MA-G-H5	A5.36M	E550T15-M21A6-GH4							



Shielding GAS M21 acc. EN ISO 14175

Alloy group	Product name	EN ISO	Product Classification	AWS A5.36	Product Classification	ISO V Test Values						
						20°C	-20°C	-30°C	-40°C	-50°C	-60°C	CTOD
Low- and medium alloyed steel grades	BÖHLER HL 53 T-MC	17632-A	T50 6 1Ni M M 1 H5	A5.36	E80T15-M21A8-Ni1-H4						90 (90)	(-40°C)
		17632-B	T576T15-1MA-N2-UH5	A5.36M	E550T15-M21A6-Ni1-H4							
	BÖHLER HL 65 T-MC	18276-A	T55 4 1NiMo M M 1 H5	A5.36	E90T15-M21A4-K3-H4					70		
		18276-B	T62 5 T15-1MA-N2M2-UH5	A5.36M	E620T15-M21A4-K3-H4							
	BÖHLER HL75 T-MC	18276-A	T62 4 Mn1NiMo M M 2 H5	A5.36	E101T15-M21A4-G-H4				70 (60)			
		18276-B	T 694T15-1MA-N2M2-UH5	A5.36M	E691T15-M21A4-G-H4							
	BÖHLER 700 T-MC	18276-A	T69 6 Mn2NiCrMo M M 1 H5	A5.36	E110T15-M21A8-K4-H4				80 (70)		70 (60)	
		18276-B	T766T15-1MA-N4C1M2-UH5	A5.36M	E760T15-M21A6-K4-H4							
	BÖHLER 900 T-MC	18276-A	T89 6 Mn2NiCrMo M M 2 H5	A5.36	E120T15-M21A8-GH4				58		55	
		18276-B	T836T15-1MA-N4C1M2-UH5	A5.36M	E830T15-M21A6-GH4							

( ) Values after post weld heat treatment. For PWHT conditions please check the individual data sheets on our website

Shielding GAS M21 acc. EN ISO 14175

Alloy group	Product name	EN ISO	Product Classification	AWS A5.36	Product Classification	ISO V Test Values						
						20°C	-20°C	-30°C	-40°C	-50°C	-60°C	CTOD
Creep resistant	BÖHLER DMO Kb T-FD	17632-A	T46 6 Mo B M 3 H5	A5.36	E80T5-M21P8-A1-H4	210 (140)			150 (140)		130 (120)	
		17632-B	T556T5-0M-2M3-H5	A5.36M	E550T5-M21P6-A1-H4							
		17634-A	T Mo B M 3 H5									
		17634-B	T55T5-0M-2M3-H5									
	BÖHLER DCMS Kb T-FD	17634-A	T CrMo1 B M 3 H5	A5.36	E80T5-M21PY-B2-H4	(100)						
		17634-B	T55T5-0M-1CM-H5	A5.36M	E550T5-M21PY-B2-H4							
	BÖHLER CM2 Kb T-FD	17634-A	T CrMo2 B M 4 H5	A5.36	E90T5-M21PY-B3-H4	(100)						
		17634-B	T62T5-0M-2C1M	A5.36M	E620T5-M21PY-B3-H4							
	BÖHLER DCMV Kb T-FD	17634-A	T Z B M 3 H5	A5.36	E90T5-M21PY-GH4	100						
		17634-B	T62T5-0M-G-H5	A5.36M	E620T5-M21PY-GH4							
	BÖHLER CM5 Kb T-FD	17634-A	T CrMo5 B M 4 H5	A5.36	E80T5-M21PY-B6-H4	100						
		17634-B		A5.36M	E550T5-M21PY-B6-H4							
	BÖHLER DMO T-MC	17632-A	T46 2 Mo M M 1 H5	A5.36	E80T15-M21P0-A1-H4		(90)					
		17632-B	T552T15-1M-2M3-H5	A5.36M	E550T15-M21P2-A1-H4							
		17634-A	T MoL M M 1 H5									
	BÖHLER DCMS T-MC	17634-A	T CrMo1 M M 1 H5	A5.36	E80T15-M21PY-B2-H4	(110)	(80)					
		17634-B	T55T15-1M-1CM-H5	A5.36M	E550T15-M21PY-B2-H4							
	BÖHLER CM2 T-MC	17634-A	T CrMo2 M M 1 H5	A5.36	E90T15-M21PY-B3-H4	(110)						
		17634-B	T62T15-1M-2C1M-H5	A5.36M	E620T15-M21PY-B3-H4							
Pipe steel grades	BÖHLER Ti 70 Pipe T-FD	18276-A	T55 5 Mn1Ni P M 1 H5	A5.36	E91T1-M21A6-K2-H4				90	80		
		18276-B	T625T1-1MA-N3M1-UH5	A5.36M	E621T1-M21A5-K2-H4							
	BÖHLER HL 60 Pipe T-MC	17632-A	T46 6 Z M M 1 H5	A5.36	E80T15-M21A8-K6-H4				160		140	(-10°C)
		17632-B	E556T15-1MA-N1-H5	A5.36M	E550T15-M21A6-K6-H4							

( ) Values after post weld heat treatment. For PWHT conditions please check the individual data sheets on our website

Shielding GAS C1 acc. EN ISO 14175

Alloy group	Product name	EN ISO	Product Classification	AWS A5.36	Product Classification	ISO V Test Values						
						20°C	-20°C	-30°C	-40°C	-50°C	-60°C	CTOD
Unalloyed steel grades	BÖHLER Ti 52 T-FD	17632-A	T46 2 P C 1 H5	A5.36	E71T1-C1A2-CS1-H4	55						
		17632-B	T553T1-1CA-H5	A5.36M	E491T1-C1A3-CS1-H4							
	BÖHLER Ti 52 T-FD (CO_2)	17632-A	T46 3 P C 1 H5	A5.36	E71T1-C1A2-CS1-H4	100	95	70				
		17632-B	T553T1-1CA-H5	A5.36M	E491T1-C1A3-CS1-H4							
	BÖHLER Ti 52 T-FD (HP)	17632-A	T 42 2 P C 1H5	A5.36	E71T1-C1A0-CS1-H4	110	100					
		17632-B	T492T1-1CA-H5	A5.36M	E491T1-C1A2-CS1-H4							
	BÖHLER Ti 52 T-FD SR (CO_2)	17632-A	T42 4 P C 1 H5	A5.36	E71T12-C1AP4-CS1-H4		110 (90)		85 (70)			(-10°C)
		17632-B	T494T12-1CAP-H5	A5.36M	E491T12-C1AP4-CS1-H4							
	BÖHLER Kb 46 T-FD	17632-A	T 42 4 B C 1 H5	A5.36	E70T5-C1A4-CS1-H4				90		80	
		17632-B	T496T5-1CA-H5	A5.36M	E490T5-C1A4-CS1-H4							
	BÖHLER Kb 52 T-FD	17632-A	T42 4 B C 3 H5	A5.36	E70T5-C1A4-CS1-H4	140			80			
		17632-B	T496T5 - 0CA H5	A5.36M	E490T5-C1A4-CS1-H4							
	BÖHLER HL 51 T-MC	17632-A	T42 5 M C 1 H5	A5.36	E70T15-C1A6-CS1-H4				80	60		
		17632-B	T495T15-1CA-H5	A5.36M	E490T15-C1A5-CS1-H4							
Low-and medium alloyed	BÖHLER Ti 60 T-FD (CO_2)	17632-A	T46 4 1Ni P C 1 H5	A5.36	E81T1-C1A4-Ni1-H4		110		80			(-10°C)
		17632-B	T554T1-1CA-N2-H5	A5.36M	E551T1-C1A4-Ni1-H4							
	BÖHLER Ti 60 K2 T-FD (CO_2)	17632-A	T46 6 1.5Ni P C 1 H5	A5.36	E81T1-C1A8-K2-H4				80	70	60	
		17632-B	T556T1-1CA-N3-H5	A5.36M	E551T1-M21A6-K2-H4							
	BÖHLER Kb 85 T-FD (CO_2)	18276-A	T69 4 Mn2NiCrMo B C 3 H5	A5.36	E110T5-C1A4-K4-H4				80			
		18276-B	T764T5-0CA-N4C1M2-UH5	A5.36M	E760T5-C1A4-K4-H4							

( ) Values after post weld heat treatment. For PWHT conditions please check the individual data sheets on our website

Certificates and Approvals

Metal-cored types	CE	TÜV	GL	DNV	DB	ABS	LR	BV	RINA	CWB	RS
HL 46 GS T-MC											
HL 53 T-MC	■	■	■	■	■	■					
HL 75 T-MC				■		■					
HL 65 T-MC	■										
HL-60 Pipe T-MC											
HL 51 T-MC	■	■	■	■	■	■	■	■	■	■	
NiCu1 T-MC	■										
900 T-MC	■	■			■						
700 T-MC	■	■		■	■	■	■			■	
CM2 T-MC	■	■									
DCMS T-MC	■	■			■						
DMO T-MC	■	■			■						

Basic types	CE	TÜV	GL	DNV	DB	ABS	LR	BV	RINA	CWB	RS
Kb 46 T-FD	■	■									
Kb 52 T-FD	■	■	■	■	■	■	■	■	■		
Kb 90 T-FD	■										
Kb 85 T-FD	■	■		■		■	■				
Kb 85 T-FD (CO_2)											
Kb 65 T-FD											
Kb 60 T-FD	■										
Kb NiCu1 T-FD	■										
CM5 Kb T-FD											
CM2 Kb T-FD											
DMO Kb T-FD	■	■									
DCMV Kb T-FD	■	■									
DCMS Kb T-FD											

Rutile types	CE	TÜV	GL	DNV	DB	ABS	LR	BV	RINA	CWB	RS
Ti 52 T-FD	■	■	■	■	■	■	■	■	■	■	■
Ti 52 T-FD SR (CO_2)	■			■		■	■				
Ti 52 T-FD (HP)	■			■			■		■	■	
Ti 52 T FD (CO_2)	■	■	■	■	■	■	■	■	■		■
NiCu1 Ti T-FD	■										
Ti 60 T-FD	■	■	■	■	■	■	■	■	■	■	■
Ti 60 T-FD SR	■			■		■	■				
Ti 60 T-FD (CO_2)	■			■		■	■				
Ti 60 K2 T-FD (CO_2)	■										
Ti 70 Pipe T-FD	■	■									
Ti 75 T-FD	■										
Ti 80 T-FD	■		■	■		■	■	■			
Ti 2Ni T-FD	■			■		■	■				■

Spool Types

D200 	Plastic spool D200 Precision layer wound Dimensions: Ø external 200mm Ø internal 52mm width 47mm Available packaging: M5=5kg	Available diameters: 1.0mm 1.2mm 1.6mm
K200 	Wire basket K200 Precision layer wound Dimensions: Ø external 200mm Ø internal 100mm width 47mm Available packaging: K8=5kg	Available diameters: 1.0mm 1.2mm 1.6mm
K300 	Wire basket K300 Precision layer wound Dimensions: Ø external 300mm Ø internal 180mm width 100mm Available packaging: K0=12.5kg K1=15kg K2=18kg K3=16kg	Available diameters: 1.0mm 1.2mm 1.6mm

BS300 	Wire basket Precision layer wound Dimensions: Ø external 300mm Ø internal 180mm width 100mm Available packaging: S1=15kg S2=18kg S3=16kg	Available diameters: 1.0mm 1.2mm 1.6mm
D300 	Plastic spool D300 Precision layer wound Dimensions: Ø external 300mm Ø internal 52mm width 100mm Available packaging: P0=12.5kg P1=15kg P3=16kg	Available diameters: 1.0mm 1.2mm 1.6mm
Eco Drum 	Robot drum Weight: app. 230kg flux cored wire Dimensions: h 780mm Ø 510mm	Available diameters: 1.0mm 1.2mm 1.6mm

Photo courtesy Welcon A/S Denmark

Rely on the Expertise of Böhler Welding

voestalpine Böhler Welding is a leading manufacturer and worldwide supplier of filler metals for industrial welding and brazing applications.

As a part of the voestalpine Group, a worldwide operating steel-based technology group and one of the world's leading suppliers of specialized steel products, we are a part of a global network of metallurgy experts.

Our customers benefit from:

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

Customer first

Absolute customer focus is our guiding principle. We see ourselves as a provider of solutions to challenging welding projects. We ensure that our customers get the right filler metals, use them correctly, and that all welding process parameters are adjusted for the best possible performance. We consider it as our responsibility to guarantee that we deliver to our customers, now and in the future, the best possible solutions. We also strive to develop new products, optimize existing products, and streamline processes so as to achieve very short turnaround times. We focus on technologically advanced industrial sectors and provide products that are geared to their specific requirements.

Three competences – three brands

In our efforts to afford our customers the best possible support and promote development in line with specific targets, we have built our core competences within Joint Welding, Repair & Maintenance Welding and Soldering & Brazing.

This way we offer our customers the largest and most comprehensive product portfolio of filler metals within our three brands:

- Böhler Welding
- UTP Maintenance
- Fontargen Brazing

001/2016/EN/GL

voestalpine Böhler Welding

Welding know-how joins steel

With over 100 years of experience, voestalpine Böhler Welding is the global top address for the daily challenges in the areas of joint welding, wear and corrosion protection as well as brazing. Customer proximity is guaranteed by more than 40 subsidiaries in 25 countries, with the support of 2,200 employees, and through more than 1,000 distribution partners worldwide. And with individual consultation by our application technicians and welding engineers, we make sure that our customers master the most demanding welding challenges. voestalpine Böhler Welding offers three specialized and dedicated brands to cater our customers' and partners' requirements.

Lasting connections – More than 2,000 products for joint welding in all conventional arc welding processes are united in a product portfolio that is unique throughout the world. Creating lasting connections is the brand's philosophy in welding and between people.

Tailor-made Protectivity™ – Decades of industry experience and application know-how in the areas of repair of cracked material, anti-wear and cladding, combined with innovative and custom-tailored products, guarantee customers an increase in the productivity and protection of their components.

In-depth know-how – Through deep insight into processing methods and ways of application, Fontargen Brazing provides the best brazing and soldering solutions based on proven products with German technology. The expertise of this brand's application engineers has been formulated over many years of experience from countless application cases.

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

utp maintenance
by voestalpine

Thermal Spraying Powders and Arc Spraying Cored Wires

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

voestalpine Böhler Welding

Metallurgical Expertise for Best Welding Results

voestalpine Böhler Welding (formerly Böhler Welding Group) is a leading manufacturer and worldwide supplier of filler materials for industrial welding and brazing applications.

As a part of the voestalpine Group, Austria's largest steel manufacturer and one of the world's leading suppliers of specialized steel products, we are a part of a global network of metallurgy experts.

Our customers benefit from:

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

Customer First

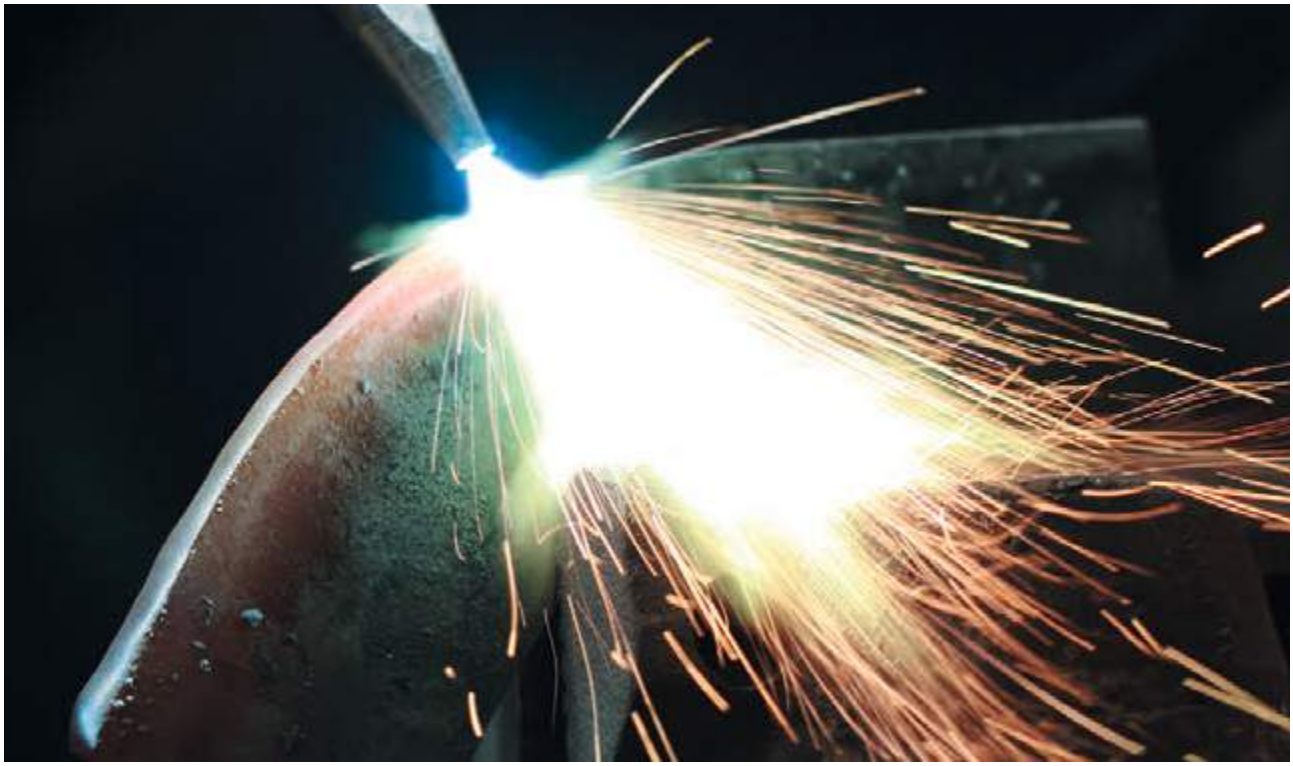
Absolute customer focus is our guiding principle. We see ourselves as a provider of solutions to challenging welding projects. We ensure that our customers get the right filler metals, use them correctly, and that all welding process parameters are adjusted for the best possible performance. We consider it as our responsibility to guarantee that we deliver to our customers, now and in the future, the best possible solutions. We also strive to develop new products, optimize existing products, and streamline processes so as to achieve very short turnaround times. We focus on technologically advanced industrial sectors and provide products that are geared to their specific requirements.

Three Competences – Three Brands

In our efforts to afford our customers the best possible support and promote development in line with specific targets, we have built our core competences within Joint Welding, Repair & Maintenance Welding and Soldering & Brazing.

This way we offer our customers the largest and most comprehensive product portfolio of filler materials within our three brands:

- Böhler Welding
- UTP Maintenance
- Fontargen Brazing



Tailor-made Protectivity™

UTP Maintenance – provides lasting “protection” and “productivity” of the plant. “Protectivity” is the result of supporting our customers with maximum performance. Decades of industry experience and application know-how in the areas of repair as well as wear and surface protection, combined with innovative and tailored products, guarantee the customers increased productivity and in addition protection and the highest performance of their components under the UTP Maintenance brand.

Solutions for demanding industries

Products of UTP Maintenance are focused on industries with high technical requirements and specialized applications.

Metallurgical know-how for research & development

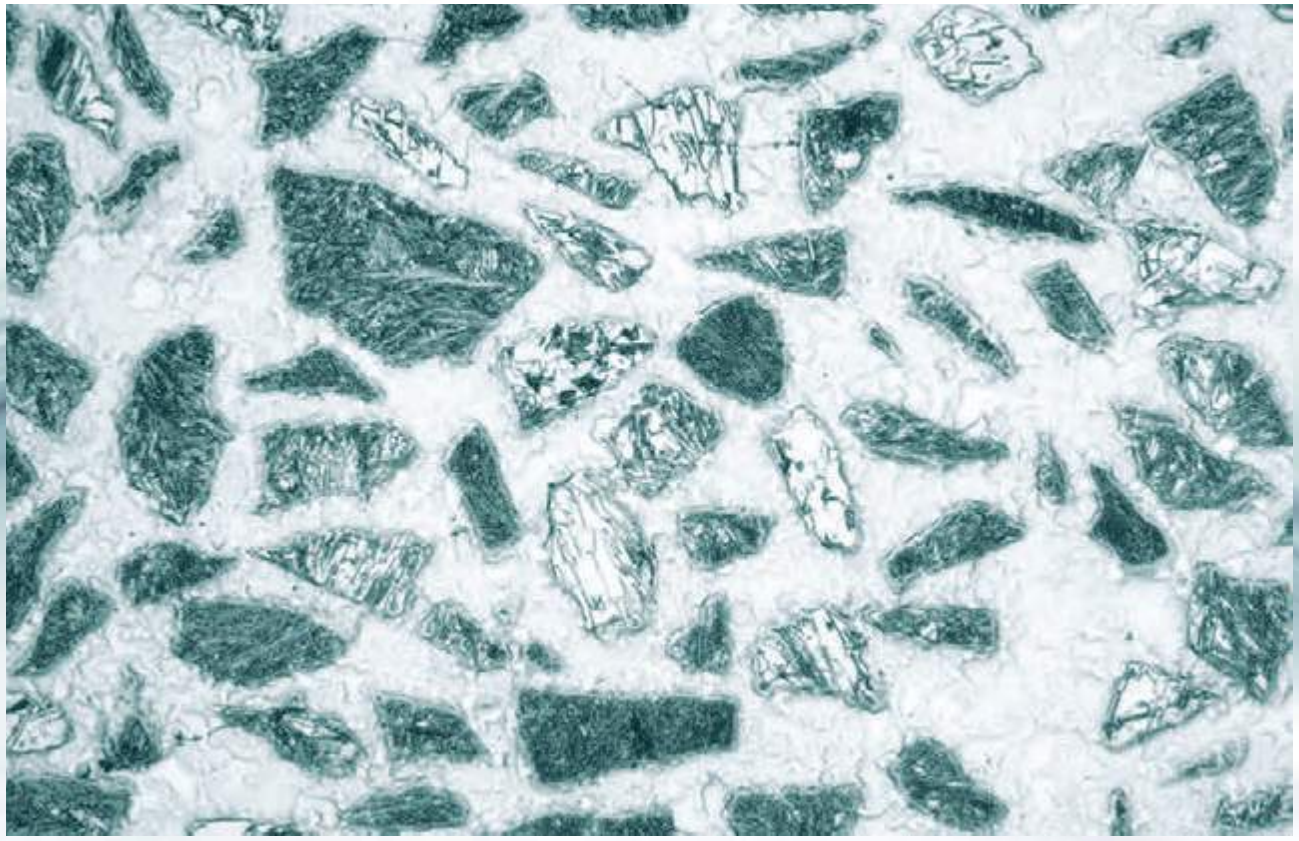
International customers and distributors are supported by experienced welding engineers by voestalpine Böhler Welding. In addition our ambition to be best in class motivates constant evolution through our total dedication to research and development and guarantees our customers are using the most technically advanced welding products available today. The product portfolio of UTP Maintenance comprises of innovative and tailored welding consumables from own production facilities as follows:

- Stick electrodes
- Solid wires and rods
- Flux cored wires
- Submerged arc wires and flux
- Welding strips and powders
- Spraying- and PTA powder

Our product range is comprehensive and covers the following steel alloys: Unalloyed and fine-grained steels, Low-alloy steels, Stainless and heat-resistant steels, Nickel-base alloys, Cast-iron, Copper and Copper-base alloys, Manganese steels, Tool steels and Cobalt steels.

Powder flame spraying

Flame spraying is one of a number of thermal coating processes. In powder flame spraying, the spray material, in powder form, is melted with an oxy-fuel gas flame, accelerated towards a component by the combustion gases and sprayed on to the surface of the component.



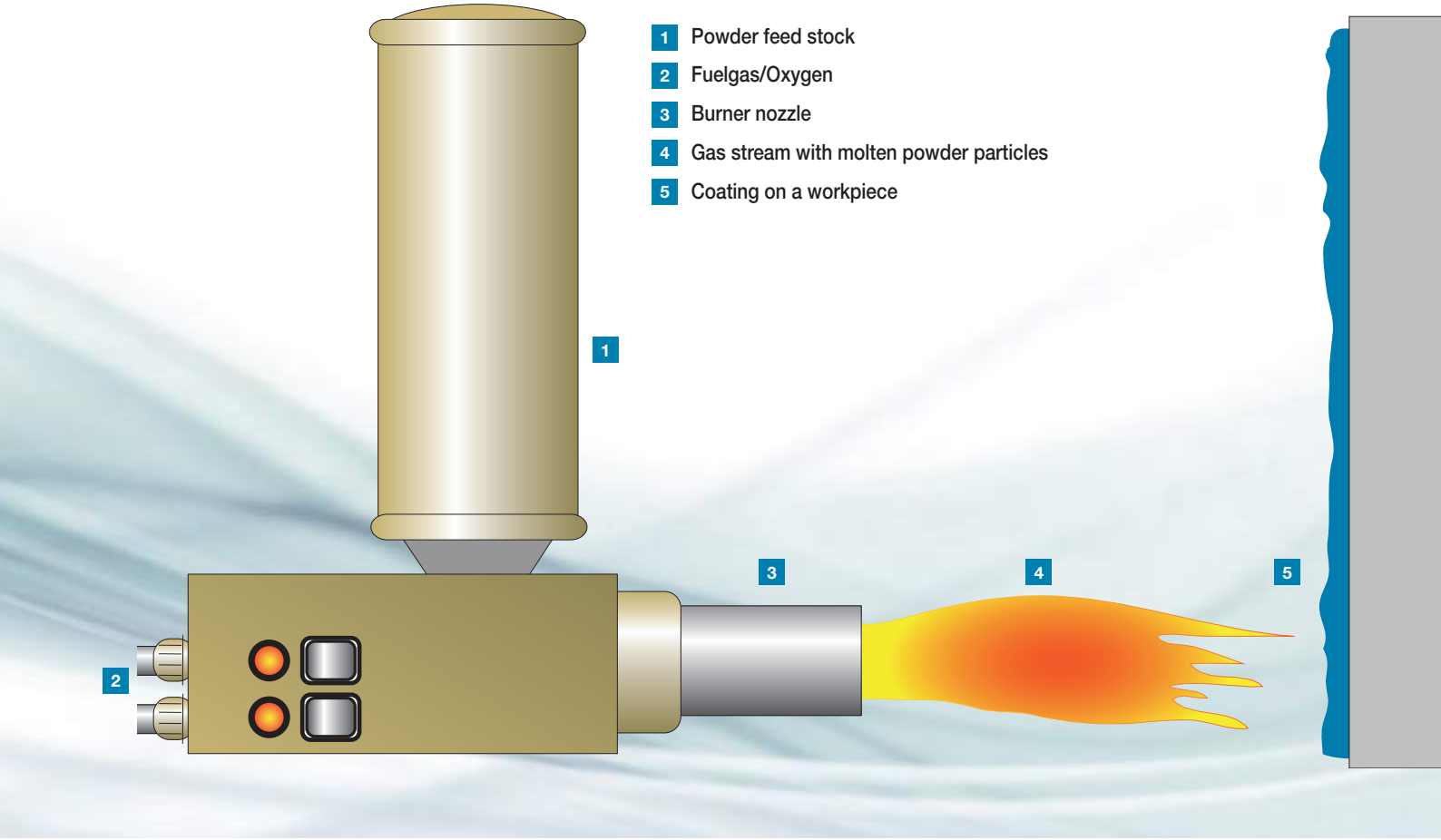
Sprayed on and melted down – micrograph of UTP SIMmelt™ NiBasW35

Metallic, oxide ceramic, carbide and plastic powders can be processed using spray guns specifically designed for those materials. Spray guns that frequently take the form of manual torches, preferably using acetylene as a fuel gas because of its high flame temperature, are chosen for metallic alloys based on nickel, iron or cobalt. The powder particles, which are partially melted by the flame, deform on impact with the surface of the component and are deposited there to form a spray coating with a lamellar structure. The main areas of application for thermal coatings are corrosion protection and wear protection.

Power flame spraying may be subdivided into cold and hot processes. In cold processes, the powders are only applied by the spray gun, and the spray coating is not subjected to any subsequent thermal treatment.
UTP Maintenance has, accordingly, designated these powders as COLDmelt™; these coatings typically have a porosity of between about 5 and 15%, depending on the process used. In hot processes, metal powders of materials known as self-fluxing alloys, based on Ni-B-Si, are employed.

The layer that has been sprayed on is melted down by an additional subsequent thermal treatment; this thermal compaction makes it possible to obtain coatings that are virtually free of pores.

Depending on the application, two processes have emerged for this: simultaneous and subsequent melting.



UTP Maintenance has designated these powders according to the process used:

Simultaneous Melting	SIMmelt™
Subsequent Melting	SUBmelt™

Rotationally symmetrical parts are frequently coated using a two-stage process (subsequent melting), while a single-stage process (simultaneous melting) is often used for surfaces and edges.

SIMmelt™

Powders for simultaneous meltdown

Powder description

- Powders for flame spraying with simultaneous melting
- Self-fluxing alloys
- Powder types based on NiBSi C+Cr+Co+Cu + tungsten carbides

Powder characterization

- Alloyed metal powder (some with hard additives)
- Round grains (matrix)
- Smooth surface
- Gas atomized (except hard material additives)
- Typical grain size: -106 +20 micron, adjusted to the torch
- Spraying layer hardness ~ 150 HV up to > 60 HRC

Spray and fuse process from cast repair with UTP SIMmelt™ NiBas25

Description	Grain Size	Chemical Composition	Hardness	Properties and applications
SIMmelt™ NiBas22	-106 +20 µm	NiCuBSi	170-240 HV	Surfacing of grey cast iron, resistance to changes temperature and excellent sea-water resistance
SIMmelt™ NiBas25	-106 +20 µm	NiBSi	205-260 HV	Repair surfacing, high impact resistance, press moulds, bearings, pump vanes
SIMmelt™ NiBas25F	-53 + 20 µm	NiBSi	190-260 HV	Good wettability and smooth surfaces; surfacing on cast parts, moulds in the glass industry
SIMmelt™ NiBas30	-106 + 20 µm	NiBSi	260-310 HV	Anti-oxidation protection and bond coat in case of hard finishing passes, easy to machine cut; valve cones, gearwheels, bearings, moulds in the glass industry
SIMmelt™ NiBas40	-106 + 20 µm	NiCrBSiFe	40 HRC	Good resistance to corrosion and wear even at high operating temperatures; drawing dies, forging dies, tools in the plastics industry, ejector pins
SIMmelt™ NiBas50	-106 + 20 µm	NiCrBSiFe	50 HRC	Good resistance to corrosion and wear even at high operating temperatures; hard surfacing for valves, valve seats, impellers, guide rollers, pressure rollers
SIMmelt™ NiBas60	-106 + 20 µm	NiCrBSiFe	60 HRC	Good resistance to corrosion and wear even at high operating temperatures; pump rings, friction bearing surfaces, knife edges, press moulds, camshafts
SIMmelt™ Cobalt45	-106 + 20 µm	CoCrNiWFeSiB	400-460 HV	Resistant to changes in temperature, impact and corrosion; valve seats, knife edges, shears and scissor blades, friction bearings, hot punching tools
SIMmelt™ NiBasW35	-106 + 20 µm	NiCrBSiFe+WSC	Matrix 60 HRC	High level of protection against abrasive wear; slicing machine blades, conveyor chains, kneader parts
SIMmelt™ NiBasW55	-106 + 20 µm	NiCrCoBSiFe+WSC	Matrix 60 HRC	Highest abrasion resistance; mixer-settler parts and kneaders in the ceramics industry, die drawing tools, chopping blades, scrapers
SIMmelt™ NiBasW60	-106 + 20 µm	NiCrBSiFe+WSC	Matrix 60 HRC	Highest abrasion resistance; well suitable for automated spraying processes; separator screws, mixing shovels

SUBmelt™

Powders for subsequent melting

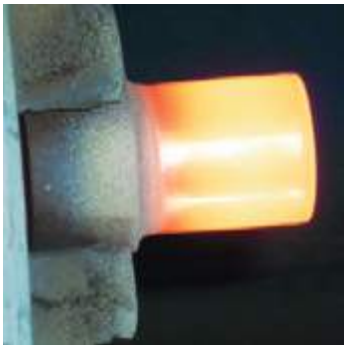
Powder description

- Powders for flame spraying and subsequent melting
- Self fluxing alloys
- Powders types based NiBSi (+Cr +Co + tungsten carbide)

Powder characterization

- Alloyed metal powders (some with hard additives)
- Round grains (matrix)
- Smooth surface
- Gas atomized (except hard material additives)
- Typical grain size: -125 +45 microns
- Spray coating hardness ~200 HV to >60 HRC

Melting pattern with UTP SUBmelt™ NiBas60



Melting pattern with UTP SUBmelt™ NiBas40

Description	Grain Size	Chemical Composition	Hardness	Properties and applications
SUBmelt™ NiBas40	-125 + 36 µm	NiCrBSiFe	40 HRC	Good resistance to corrosion and wear even at high operating temperatures; valve discs, conveyour chains, mixer parts, friction bearings, moulds in the glass industry, feed screws
SUBmelt™ NiBas50	-125 + 45 µm	NiCrBSiFe	50 HRC	Good resistance to corrosion and wear even at high operating temperatures; gauges, cogs, bearing surfaces, cylinders, guide mechanisms, mixer blades, continuously cast rollers, valve discs, glass industry
SUBmelt™ NiBas56	-125 + 45 µm	NiCrBSiFeCuMo	56 HRC	Toughened coatings; valve stems, mixer and stirrer shafts, bearing seats, wearing rings, pump shafts, impellers
SUBmelt™ NiBas60	-125 + 45 µm	NiCrBSiFe	60 HRC	Excellent resistance to wear and corrosion, high level of hardness with moderate dynamic compression stress; feed screws, running and sealing surfaces in valves, fittings and bearing seats
SUBmelt™ NiBasW35	-125 + 45 µm	NiCrBSiFe+WSC	Matrix 60 HRC	High abrasion resistance; stirrers, mixer blades, mould edges, extruder screws
SUBmelt™ NiBasW50	-125 + 45 µm	NiCrBSiFe+WSC	Matrix 60 HRC	Highest abrasion resistance; stirrer, mixing shovels, screw shafts
SUBmelt™ NiBasW60	-125 + 45 µm	NiCrBSiFe+WSC	Matrix 60 HRC	Highest abrasion resistance; stirrer, mixing shovels, screw shafts, for automatic spray processes

COLDmelt™

Powders without melting (cold process)

Cold Spray process with
UTP COLDmelt™ stainless 18

Powder description

- Powder for thermal spraying without melting (cold process)
- Metal alloys, hard alloys, hard material additives, usually with bond layer

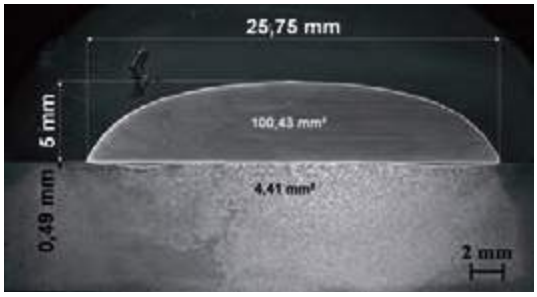
Powder characterization

- Metal or Metal alloyed (some with hard additives)
- Round grains (gas atomized)
- Smooth surface
- Spattered grain, uniform grain structure, water atomized (except for hard material additives)
- Typical grain size: -125 +36 microns
- Spray coating hardness ~23 JHB to >60 HRC

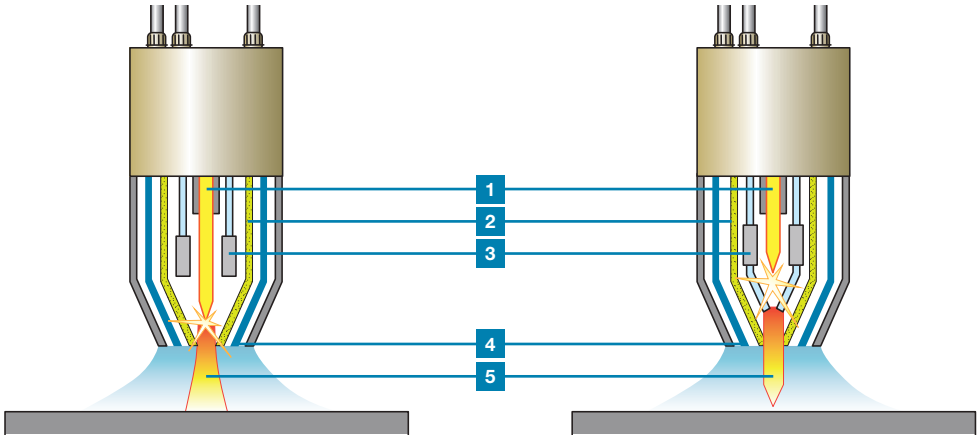
Description	Grain Size	Chemical Composition	Hardness	Properties and applications
COLDmelt™ Base 17	-106 + 36 µm	NiAl	150-190 HV	Bond coat, base powder for initial layer under further coats of wear resistant CrNi- and Cu-alloys
COLDmelt™ Base 20	-106 + 45 µm	NiAlMo	170-240 HV	Bond coat, base powder on iron-, copper- and aluminium materials, also “one-step-powder”, possible to apply thick layers, good sliding behavior
COLDmelt™ Zn	-125 µm	Zn	23 HB	Active corrosion protection on steel under atmospheric stresses
COLDmelt™ Ni37	-106 + 36 µm	NiCrBSiFeAl	350-380 HV	Oxidation stability at moderate temperatures, high wear resistance; camshafts, bearings of rollings, cylinder liners, valve stems, hydraulic pistons, sliding ways etc
COLDmelt™ CuAl	-120 + 36 µm	CuAl	130 HV	Good sliding and emergency running properties; rollers, bearing journals, slideways
COLDmelt™ NiW15	-125 + 20 µm	NiCrBSiFeAl+WSC	Matrix 400 HV	Abrasion resistance for micro-particle surfacings, good oxidation stability; ventilator blades
COLDmelt™ Stainless 18	-106 + 36 µm	FeCrNiMo	180 HV	Corrosion resistant coatings; pump sleeves, shafts and parts requiring the characteristics of stainless steel in the chemical and petrochemical industry. Special applications where coats like 18/8, AWS 316 L, 1.4436 are necessary
COLDmelt™ Fe31	-125 + 45 µm	FeCrNi	260-350 HV	Chromium steel alloy with high oxidation stability, good machinability; coating on bearing journals, shafts, piston rods
COLDmelt™ OneStep 16	-106 + 45 µm	NiCrAlMoFe	170 HV	“One-step powder”, also bond coat, repair and prophylactic protective coating, resistant to high temperatures; flue boilers, finned tube walls

Plasma powder surfacing (PPS/PTA)

Plasma powder surfacing (PPS), also known as the plasma transferred arc (PTA) process, is a thermal coating process. In contrast to the spraying processes, this method is a welding process and so involves metallurgical bonding of the applied material to the base material.



Cross section of PTA surfacing with PLASweld™ Ledurit 60



1 Wolfram-Electrode
2 Powder
3 Water cool unit
4 Shielding gas
5 Arc

Schematic diagram of PTA process

However, if the parameters are set optimally, the degree to which it blends with the base material can be reduced to a minimum. The PTA process is employed primarily for surfacing of wear resistant and corrosion resistant coatings on to a base material. The process is characterized by the use of two separately controllable electric arcs. One of these is the (non-transferred) pilot arc; this arc is formed between the non-melting (tungsten) electrode and the plasma nozzle. It accelerates the plasma gas and enables ignition of the (transferred) main arc. This arc burns with a high energy density between the electrode and the workpiece. With the aid of the electric arc, both the base material and the metal powder that serves as the welding consumable are fused together, which then gives rise to the deposited protective coating. Ar, H2, He, or mixtures of gas are employed as a processing gas. This serves, firstly, as a plasma gas and, secondly, as a shielding gas and as a carrier gas for the powder. Because of its high degree of automation, the PTA process is clearly most suitable for series parts and offers advantages here with regard to:

- High reproducibility
- Low degree of dilution with base material
- Small concentrated heat-affected zone
- High surfacing rates possible
- Alloy multiplicity in powder form
- Material combinations with hard substances

UTP Maintenance offers these PTA powders as nickel-based, cobalt-based and iron-based alloys. The powders are designated PLASweld™ in keeping with the process for which they are intended. The grain sizes should be chosen according to the type of system; powder grain sizes between 150 and 210 µm are selected for the standard range of PTA.

Another method of using metal powder as a welding consumable is provided by laser powder surfacing. Here, a laser serves as the source of heat for partially melting the surface of the workpiece and fusing the welding consumable in powder form. The high-energy focus of the laser allows precisely targeted surfacing, which makes it possible to provide wear protection at specific places without negatively affecting (e.g. through a high heat input) the properties of the rest of the component. Because the coating thicknesses are usually small and the processing times short for laser powder surfacing, PLASweld™ powder of a finer grain size, typically 45-106 µm, can be used here.

PLASweld™

Powders for hard facing

Powder description

- Alloyed metal powder (some with hard additives)
- Round grain, smooth surface, gas atomized (except hard material additives)
- Typical particle size: -150 +50 microns or -200 +63 microns
- Surface hardening of about 180 HV (buffer layers) up to 60 HRC

	Description	Grain Size	Chemical Composition	Hardness	Properties and applications
Cobalt-Base	PLASweld™ Celsit 706	-150 + 50 µm*	CoCrWC	41 HRC	Qualities to protect against adhesive and abrasive wear, high-temperature resistant; hardsurfacing of running and sealing surfaces in valves carrying gas, water and acid, hot-working tools subject to high stresses, valve seats, valve collets for combustion engines, grinding, mixing, carrying and drilling tools, dies and press moulds
	PLASweld™ Celsit 706HC	-150 + 50 µm*	CoCrWC	43 HRC	
	PLASweld™ Celsit 708	-150 +50 µm*	CoCrNiWC	45 HRC	
	PLASweld™ Celsit 712	-150 +50 µm*	CoCrWC	48 HRC	
	PLASweld™ Celsit 712HC	-150 +50 µm*	CoCrWC	49 HRC	
	PLASweld™ Celsit 721	-150 + 50 µm*	CoCrMoNiC	32 HRC	High corrosion resistance and resistance to adhesive (metal-to-metal) wear, buffer material for hard stellite qualities; medical engineering
Ferrum-Base	PLASweld™ Ledurit 60	-150 + 50 µm*	FeCrC	57 HRC	Highly wear-resistant, preferred for protection against mineral wear with low impact; feed screws, excavator teeth
	PLASweld™ Ledurit 68	-150 + 50 µm*	FeCrCBV	62 HRC	Hardfacing on parts with extremely high rubbing wear; grinding rolls, screw conveyor, excavator parts
	PLASweld™ Ferro55	-150 + 50 µm*	FeCrMo	55 HRC	Ferreous based alloy combining high strength, toughness and temperature resistance up to 550°C. Applicable on hot and cold work steels. Cutting tools, forging tools, roller, mandrel. Powder also available for laser welding with finer grain size (e.g. 45-106 µm)
	PLASweld™ Ferro45	-150 + 50 µm*	FeCrMo	45 HRC	
	PLASweld™ Ferro39	-150 + 50 µm*	FeCrMo	39 HRC	
	PLASweld™ FerroV10	-150 + 50 µm*	FeCrV	60 HRC	Ferreous based powder with vanadium carbides, well balanced combination of abrasion resistance and toughness; industry knives, tools
	PLASweld™ FerroV12	-150 + 50 µm*	FeCrV	61 HRC	Ferreous alloy with finely distributed Vanadium carbides in a martensitic matrix. High resistance against abrasion. Hardfacing on highly loaded edges
	PLASweld™ FerroV15	-150 + 50 µm*	FeCrV	61 HRC	Martensitic alloy with high Vanadium and Chromium content against a combination of wear and corrosion. Cutting tools, scraper
Nickel-Base	PLASweld™ NiBasW60	-150 + 50 µm*	NiBSi+WSC	Matrix 60 HRC	Specially developed nickel base matrix for highest abrasion stresses, rolling and mineralic wear, sliding abrasion, impact demand applications. For excavator parts, drilling tools, screws in the plastic industry and mining
	PLASweld™ NiBas 776	-150 +5 0 µm*	NiCrMoW	170 HV	Corrosion and high-temperature resistant coatings, forging hammers, saddles, continuous cast rollers/ buffer layer, mixer blades
	PLASweld™ NiBas 068HH	-150 + 50 µm*	NiCrFeNb	170 HV	Buffer layer preferred for stellite qualities, corrosion-resistant; pressure vessel construction, petrochemical industry, power plants
	PLASweld™ NiBas 6222Mo	-150 + 50 µm*	NiCrMoNb	200 HV	Nickel base powder for cladding, similar corrosion and temperature resistant alloys and for surfacing on mild steels. Chemical and petrochemical industries and for repair purposes (valve cladding in ship engines)

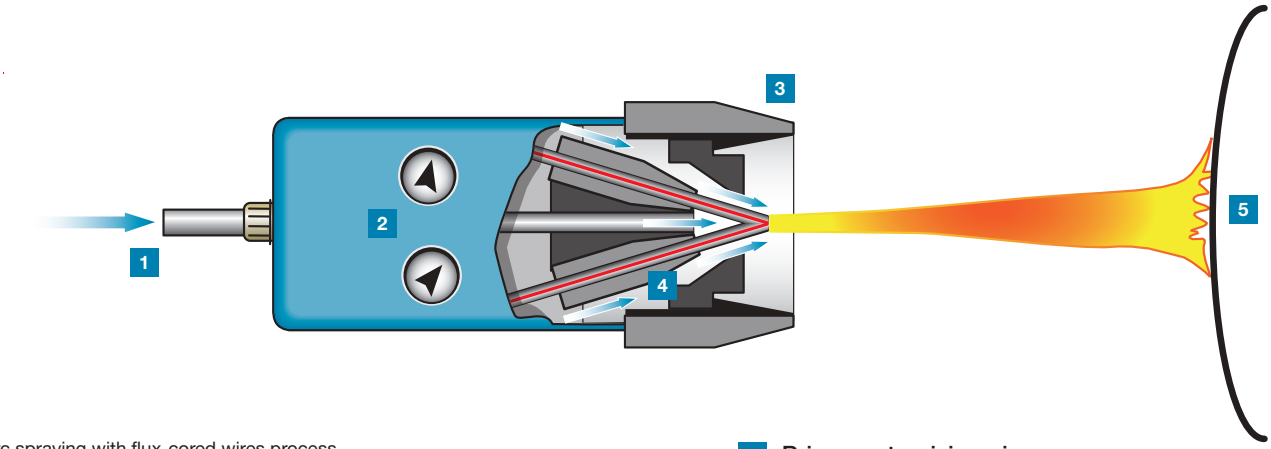
* Also available in grain size -200 +63 µm or according to customers requirements

Cored wires

Arc spraying with flux-cored wires process

Arc Spraying is the highest productivity thermal spraying process. A DC electric arc is struck between two continuous consumable wire electrodes that form the spray material.

Compressed gas (usually air) atomizes the molten spray material into fine droplets and propels them towards the substrate.
The process is simple to operate and can be used either manually or in an automated manner.



Arc spraying with flux-cored wires process

1. Primary atomizing air
2. Constant wire feeding
3. Torch
4. Electrically conductive wire
5. Work-piece

Product name	Alloy Type	Low stress abrasion	High stress abrasion	Corrosion	Heat
SK 235-M	High alloyed steels		•	•	
SK 255-M	High alloyed steels		•		
SK 420-M	High alloyed steels			•	
SK 848-M	High alloyed steels			•	•
SK 825-M	Nickel alloys			•	•
SK 830-MF	Nickel alloys	•		•	•
SK 840-MF	Nickel alloys			•	
SK 850-MF	Nickel alloys			•	•
SK 858-M	Nickel alloys			•	•
SK 860-MF	Nickel alloys		•	•	•
SK 868-M	Nickel alloys			•	•
SK 900-MF	Nickel alloys		•	•	•

075/2016/EN/GL

voestalpine Böhler Welding

Welding know-how joins steel

With over 100 years of experience, voestalpine Böhler Welding is the global top address for the daily challenges in the areas of joint welding, wear and corrosion protection as well as brazing. Customer proximity is guaranteed by more than 40 subsidiaries in 25 countries, with the support of 2,200 employees, and through more than 1,000 distribution partners worldwide. With individual consultation by our application technicians and welding engineers, we make sure that our customers master the most demanding welding challenges. voestalpine Böhler Welding offers three specialized and dedicated brands to cater for our customers' and partners' requirements.

böhler welding by voestalpine

Lasting connections – More than 2,000 products for joint welding in all conventional arc welding processes are united in a product portfolio that is unique throughout the world. Creating lasting connections is the brand's philosophy in welding and between people.

utp maintenance by voestalpine

Tailor-made Protectivity ™ – Decades of industry experience and application know-how in the areas of repair of cracked material, anti-wear and cladding, combined with innovative and custom-tailored products, guarantee customers an increase in the productivity and protection of their components.

fontargen brazing by voestalpine

In-depth know-how – Through deep insight into processing methods and ways of application, Fontargen Brazing provides the best brazing and soldering solutions based on proven products with German technology. The expertise of this brand's application engineers has been formulated over many years of experience from countless application cases.

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

böhler welding
by voestalpine

Welding consumables for Joint Welding

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

Böhler Welding
Lasting Connections
To make High Quality Contacts

Böhler Welding, a merger of the product brands **„Böhler“, „T-PUT“, „Avesta“** and **„UTP“** in the brand network of voestalpine Böhler Welding, is for over 85 years renown as an innovative producer of welding consumables for joint welding in all major arc welding processes. Böhler Welding has a leading position globally in regards to medium- to high-alloyed grades, where we continuously set our focus.

Böhler Welding offers a globally unique and complete product portfolio of welding consumables from own production. The extensive range of approximately 2.000 products is constantly aligned to the up-to-date specifications of the most demanding industries and is adjusted, if necessary, to the market requirements under observance of the highest quality standards.

The product brands comprising Böhler Welding look back at a longstanding and proven international market history and are in their respective specialized areas permanently on the leading edge of innovation. The merger into **„Böhler Welding“** bundles the metallurgical, service and technical know-how we have accumulated globally over decades for the maximum benefit of our customers and partners.

Our maxim **„lasting connections“** is basis of our actions. On one hand this reflected in our high quality products, services and solutions, which are being applied successfully globally, but even more so in the lasting relationships we have built with customers and partners globally.

With our international network of 34 sales companies and 11 production units around the globe, we are in close proximity to our customers and can offer our support for daily operational welding challenges. Our experienced welding engineers go, if necessary, into the deepest details of welding technology and are only satisfied once the optimum and most economical solution is found for the customer. This customer focus is also manifested in our research and development activities, which are clearly driven at Böhler Welding by specific industry- or customer-requirements. Cooperations with leading companies of various industries, universities and research institutes, as well as our parent company voestalpine of course, ensure that we continuously push the edge of innovation and this will allow us to guarantee the already expected lasting connections of highest quality well into the future.

For high demanding industries

Automotive

Welding consumables of Böhler Welding are used in numerous demanding areas of the automobile industry, e.g. in auto body construction, production of axles and in the manufacture of exhaust systems. Our new generation of metal cored wires has already been successfully applied by notable branch leaders and enables the highest process reliability while at the same time minimising scrap rates and rectification costs.

Chemical and petrochemical processing industry

Top quality high-alloyed welding consumables made by Böhler Welding are available for plant construction. Decades of first-hand experience in development, manufacture and applications provides users with the assurance of the highest metallurgical standards, consistently high product quality and excellent welding characteristics. Reliable resistance to corrosion and ageing ensures safe and enduring operation of the plants.

Pipeline

The laying of pipelines through varying climatic zones and terrain demands a high level of engineering ingenuity. Böhler Welding faces this task in close collaboration with the leading pipelaying companies and offers a unique product portfolio for the pipeline industry. The toughness of the weld metal, which is decisive for safety, is of primary concern. Over 100,000 km of pipeline successfully laid worldwide with welding consumables made by Böhler Welding confirm the trust placed in our products.

Steel construction and special designs

For metallurgically demanding structures in bridges and steel construction as well as in the field of fine-grained steels for crane and vehicle manufacture, the proven quality of Böhler Welding is akey to reducing manufacturing costs and ensuring structural safety. The excellent welding characteristics are valued by welders all over the world.

Thermal power

The demands for higher efficiency with improved economy and a simultaneously reduced environmental impact continually spurs the development of new materials for thermal power plants. Böhler Welding develops these high temperature and creep resistant filler metals working closely with leading steel producers and power station operators worldwide.

Hydropower

For the construction of Francis, Kaplan and Pelton turbines, Böhler Welding offers high-quality, specialised welding consumables, which are optimally suited for type 316L stainless steel as well as for 13%Cr-4%Ni alloys. For the associated pressure pipelines we also offer a wide product range which meets the strictest safety requirements while also ensuring excellent mechanical properties.

Selection guide

	Welding process											
	SMAW	Page	FCAW	Page	GTAW (GW)	Page	GMAW	Page	SAW	Page
Unalloyed steels										
$R_e \leq 355$ MPa	BÖHLER FOX OHV	6	BÖHLER Ti 46-FD	11	BÖHLER EML 5	16	BÖHLER EMK 6	19	BÖHLER EMS 2 + BB 24	24
	BÖHLER AWS E6013	6	BÖHLER Ti 52-FD	11	Union I 52	16	BÖHLER EMK 8	19	BÖHLER EMS 3 + BB 24	24
	BÖHLER FOX EV 50	6	Union TG 55 M	11	Union 37	16	BÖHLER HL 46-MC	19	Union S 2 + UV 420 TT	24
	BÖHLER AWS E7018-1	6					Union K 56	19	Union S 3 + UV 420 TT	24
	Phoenix Blau	6					BÖHLER SG 2	19	Union S 3 Si + UV 418 TT	24
	Phoenix Spezial D	6					Union MV 70	19		
High strength steels										
$R_e \leq 460$ Mpa	BÖHLER FOX EV 60	6	Union RV Ni 1	11	BÖHLER Ni 1-IG	16			BÖHLER Ni 2-UP + UV 421 TT	24
	BÖHLER FOX 2.5 Ni	6			Union I 1.2 Ni	16			Union S 2 Ni 2,5 + UV 421 TT	24
$R_e \leq 500$ Mpa	BÖHLER FOX EV 63	6			BÖHLER 2.5 Ni-IG	16	BÖHLER NiCu 1-IG	19	Union S 2 Ni 3,5 + UV 421 TT	24
$R_e \leq 550$ Mpa	BÖHLER FOX EV 70	7	BÖHLER Ti 60-FD	11					Union S 3 NiMo + UV 420 TTR	25
			Union TG 55 Ni	11					Union S 3 NiMo 1 + UV 420 TT	25
$R_e \leq 690$ Mpa	BÖHLER FOX alform® 700	7	BÖHLER Ti 80 T-FD	12			BÖHLER alform® 700-IG	20	Union S 3 NiMoCr + UV 421 TT	25
	BÖHLER FOX EV 85	7					BÖHLER X 70-IG	20		
							Union NiMoCr	20		
$R_e \leq 890$ Mpa							BÖHLER alform® 900-IG	20		
							Union X 90	20		
Creep resistant steels										
0.5 Mo	BÖHLER FOX DMO KB	7	BÖHLER DMO Ti-FD	12	BÖHLER DMO-IG (DMO)	16	BÖHLER DMO-IG	20	Union S 2 Mo + UV 420 TTR	25
									Union S 3 Mo + UV 420 TT	25
1Cr 0.5Mo	BÖHLER FOX DCMS KB	7	BÖHLER DCMS Ti-FD	12	BÖHLER DCMS-IG	16	BÖHLER DCMS-IG	20	Union S 1 CrMo 2 + UV 420 TTR	26
2 1/4Cr 1Mo	BÖHLER FOX CM 2 KB	7	BÖHLER CM 2 Ti-FD	12	BÖHLER CM 2-IG	16	BÖHLER CM 2-IG	20	Union S 2 CrMo + UV 420 TTR	26
	Phoenix SH CHROMO 2 KS	7							Union S P 24 + UV P24	26
9Cr 1Mo +V(W)	BÖHLER FOX C 9 MV	8	BÖHLER C 9 MV Ti-FD	13	BÖHLER C 9 MV-IG	17	BÖHLER C 9 MV-IG	21		
	Thermanit CHROMO 9 V	8					BÖHLER C 9 MV-MC	21		
	Thermanit MTS 3	8	Thermanit MTS 3 PW	13	Thermanit MTS 3	17	Thermanit MTS 3	21	Thermanit MTS 3 + Marathon 543	26
	Thermanit MTS 616	8			Thermanit MTS 616	17			Thermanit MTS 616 + Marathon 543	26
Stainless steels										
							BÖHLER CAT 430L CB-IG	21		
							BÖHLER CAT 430L CbTi-IG	21		
304L	BÖHLER FOX EAS 2-A	8	BÖHLER EAS 2-FD	13	BÖHLER EAS 2-IG	17	Thermanit JE 308L Si	21	Thermanit JE 308L + Marathon 431	26
	Avesta 308L/MVR	8	BÖHLER EAS 2 PW-FD	13						
	BÖHLER AWS E308L-17	8								
316L	BÖHLER FOX EAS 4 M-A	8	BÖHLER EAS 4 M-FD	13	BÖHLER EAS 4 M-IG	17	Thermanit GE 316L Si	21	Thermanit GE 316L + Marathon 431	27
	Avesta 316L/SKR	9	BÖHLER EAS 4 PW-FD	13						
	BÖHLER AWS E316L-17	9								
347	BÖHLER FOX SAS 2-A	9	BÖHLER SAS 2 PW-FD	13	BÖHLER SAS 2-IG	17	BÖHLER SAS 2-IG (Si)	21		
	Avesta 347/MVNb	9								
316 Ti	BÖHLER FOX SAS 4-A	9	BÖHLER SAS 4 PW-FD	13	BÖHLER SAS 4-IG	17	BÖHLER SAS 4-IG (Si)	22	Thermanit H-347 + Marathon 431	27
13Cr/4Ni	BÖHLER FOX CN 13/4	9					BÖHLER CN 13/4-IG	22	BÖHLER CN 13/4-UP + BB 203	27
							BÖHLER CN 13/4-MC	22		
904L	Avesta 904L	9								
Duplex	BÖHLER FOX CN 22/9 N	9	BÖHLER CN 22/9 PW-FD	14	BÖHLER CN 22/9 N-IG	17	BÖHLER CN 22/9 N-IG	22	Thermanit 22/09 + Marathon 431	27
Super Duplex			Avesta FCW 2507/P100-PW	14	Avesta 2507/P100	17	Avesta 2507/P100	22	Avesta 2507/P100 $^{CU/W}$ + Flux 805	27
Lean Duplex							Avesta LDX 2101	22		
	Avesta 253MA	9			Avesta 253MA	18	Avesta 253MA	22		
Special application										
	BÖHLER FOX A 7-A	10	BÖHLER A 7-FD	14	BÖHLER A 7 CN-IG	18	BÖHLER A 7 CN-IG	22	BÖHLER A 7 CN-UP + BB 203	27
	BÖHLER FOX CN 23/12-A	10	BÖHLER CN 23/12-FD	14	BÖHLER CN 23/12-IG	18	Thermanit 25/14 E-309L Si	23		
	BÖHLER AWS E309L-17	10	BÖHLER CN 23/12 PW-FD	14			BÖHLER CN 23/12-MC	23		
			BÖHLER CN 23/12 Mo-FD	14						
Heat resistant steels										
							BÖHLER CN 21/33 Mn-IG	23		
	BÖHLER FOX FFB	10			BÖHLER FFB-IG	18	BÖHLER FFB-IG	23		
	BÖHLER FOX FFB-A	10			BÖHLER FA-IG	18				
					Thermanit 35/45 Nb	18				
Nickel base										
	Thermanit Nicro 182	10								
			BÖHLER NIBAS 70/20-FD	14						
	Thermanit Nicro 82	10	Thermanit TG Nicro 82	15	Thermanit Nicro 82	18	Thermanit Nicro 82	23	Thermanit Nicro 82 + Marathon 444	27
	Thermanit 625	10	BÖHLER NIBAS 625 PW-FD	15	Thermanit 625	18	Thermanit 625	23	Thermanit 625 + Marathon 444	27
	Thermanit 617				Thermanit 617	18				
					Thermanit NiMo C 24	18	Thermanit NiMo C 24	23		
SAW Flux										
	For un- and low-alloyed wires						**For high alloyed wires**			
	BÖHLER BB 24	28	UV 306	28	UV 420 TTR	28	BÖHLER BB 203	29	Marathon 431	29
	UV 400	28	UV 418 TT	28	UV 420 TTRC	28	Avesta FLUX 801	29	Marathon 543	29
	UV 305	28	UV 420 TT	28	UV 421 TT	28	Avesta FLUX 805	29		

Our complete product range of welding consumables can be found in our handbook or at www.boehler-welding.com

Selection guide Pipeline

Steel types API EN	SMAW						GMAW		FCAW	
	CEL	Page	BVD	Page	Pipe	Page		Page		Page
Lower strenght pipeline steels										
API										
A, B	BÖHLER FOX CEL	29	BÖHLER FOX BVD 85	29	BÖHLER FOX EV PIPE	31				
X42 - X52	BÖHLER FOX CEL	29	BÖHLER FOX BVD 85	29	BÖHLER FOX EV PIPE	30	BÖHLER SG 3-P	30	BÖHLER Pipeshield 71 T8-FD	31
					BÖHLER FOX EV 60 PIPE	30	BÖHLER SG 8-P	31		
X56 - X60	BÖHLER FOX CEL	29	BÖHLER FOX BVD 85	29	BÖHLER FOX EV PIPE	30	BÖHLER SG 3-P	30	BÖHLER Pipeshield 71 T8-FD	31
	Phoenix CEL 70	30			BÖHLER FOX EV 60 PIPE	30	BÖHLER SG 8-P	31		
	BÖHLER FOX CEL 75	30								
	BÖHLER FOX CEL 80-P	30								
	BÖHLER FOX CEL 85	30								
EN										
L210	BÖHLER FOX CEL	29	BÖHLER FOX BVD 85	29	BÖHLER FOX EV PIPE	30				
L290MB-L360MB	BÖHLER FOX CEL	29	BÖHLER FOX BVD 85	29	BÖHLER FOX EV PIPE	30	BÖHLER SG 3-P	30	BÖHLER Pipeshield 71 T8-FD	31
					BÖHLER FOX EV 60 PIPE	30	BÖHLER SG 8-P	31		
L385M-L415MB	BÖHLER FOX CEL	29	BÖHLER FOX BVD 85	29	BÖHLER FOX EV PIPE	30	BÖHLER SG 3-P	30	BÖHLER Pipeshield 71 T8-FD	31
	Phoenix CEL 70	30			BÖHLER FOX EV 60 PIPE	30	BÖHLER SG 8-P	31		
	BÖHLER FOX CEL 75	30								
	BÖHLER FOX CEL 80-P	30								
	BÖHLER FOX CEL 85	30								
High strength pipeline steels										
API										
X65	BÖHLER FOX CEL	29	BÖHLER FOX BVD 85	29	BÖHLER FOX EV 60 PIPE	30	BÖHLER SG 3-P	30	BÖHLER Ti 70 PIPE-FD	31
	BÖHLER FOX CEL 80-P	30					BÖHLER SG 8-P	31	BÖHLER Pipeshield 71 T8-FD	31
	BÖHLER FOX CEL 85	30								
X70	BÖHLER FOX CEL	29	BÖHLER FOX BVD 90	29	BÖHLER FOX EV 70 PIPE	30	BÖHLER SG 8-P	31	BÖHLER Ti 70 PIPE-FD	31
	BÖHLER FOX CEL 80-P	30					BÖHLER NiMo 1-IG	31	BÖHLER Pipeshield 81 T8-FD	31
	BÖHLER FOX CEL 85	30								
	BÖHLER FOX CEL 90	30								
X80	BÖHLER FOX CEL	29	BÖHLER FOX BVD 90	29	BÖHLER FOX EV 70 PIPE	30	BÖHLER NiMo 1-IG	31		
	BÖHLER FOX CEL 90	30								
EN										
L450MB	BÖHLER FOX CEL	29	BÖHLER FOX BVD 85	29	BÖHLER FOX EV 60 PIPE	30	BÖHLER SG 3-P	30	BÖHLER Pipeshield 71 T8-FD	31
	BÖHLER FOX CEL 80-P	30					BÖHLER SG 8-P	31		
	BÖHLER FOX CEL 85	30								
L485MB	BÖHLER FOX CEL	29	BÖHLER FOX BVD 90	29	BÖHLER FOX EV 70 PIPE	30	BÖHLER SG 8-P	31	BÖHLER Pipeshield 81 T8-FD	31
	BÖHLER FOX CEL 80-P	30					BÖHLER NiMo 1-IG	31		
	BÖHLER FOX CEL 85	30								
	BÖHLER FOX CEL 90	30								
L555MB	BÖHLER FOX CEL	29	BÖHLER FOX BVD 90	29	BÖHLER FOX EV 70 PIPE	30	BÖHLER NiMo 1-IG	31		
	BÖHLER FOX CEL 90	30								

Covered electrodes, unalloyed and low-alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER FOX OHV EN ISO 2560-A: E 38 0 RC 11 AWS A5.1: E6013	Heat treatment: untreated, as welded R_e 460 MPa R_m 490 MPa A_5 25% A_v 75 J	2.0 2.5 3.2 4.0 5.0	TÜV (5687.), DB (10.014.12), ABS, DNV, LR, LTSS, SEPROZ, CE	Rutile-cellulosic covered electrode with very good weldability in all positions, including vertical down. Universal electrode, especially suitable for small transformers. Flexible coating, very stable arc. Multi-purpose application in steel construction, boiler and tank fabrication, vehicle manufacture and shipbuilding.
BÖHLER AWS E6013 EN ISO 2560-A: E 42 0 RC 11 AWS A5.1: E6013	Heat treatment: untreated, as welded R_e 440 MPa R_m 540 MPa A_5 22% A_v 80 J 55 J…0°C	2.0 2.5 3.2 4.0 5.0	TÜV (12680.), ABS, DNV, CE	Rutile-cellulosic electrode with good weld ability in all positions including vertical down. Excellent gap-bridging and arc-striking ability. For tack welding and load fit ups. General purpose for industry and trade, assembly and shop welding
BÖHLER FOX EV 50 EN ISO 2560-A: E 42 5 B 42 H5 AWS A5.1: E7018-1H4R	Heat treatment: untreated, as welded R_e 460 MPa R_m 560 MPa A_5 27% A_v 190 J 70 J…-50°C	2.0 2.5 3.2 4.0 5.0 6.0	TÜV (0426.), DB (10.014.02), CE, LR, ABS, BV, DNV, GL, RMR, RINA, LTSS, SEPROZ, CRS, NAKS	Basic covered electrode for high-quality welds. Excellent strength and toughness properties down to -50°C. Weld metal recovery approx. 110%. Good weldability in all positions except vertical down. Very low hydrogen content in the weld metal (according AWS conditions HD ≤4 ml/100 g).
BÖHLER AWS E7018-1 EN ISO 2560-A: E 42 5 B 42 H5 AWS A5.1: E7018-1H4	Heat treatment: untreated, as welded R_e 470 MPa R_m 540 MPa A_5 26% A_v 160 J 130 J…-20°C	2.0 2.5 3.2 4.0 5.0	TÜV (12451.), ABS, BV, DNV, GL, CE	Basic coated electrode engineered for high-quality welds. Excellent strength and toughness properties. Also suitable for welding steels with low purity and high carbon content. Metal recovery > 110%. Good weldability in out-of-position work except for vertical-down. Suitable for welding in steel construction, boiler and container fabrication, vehicle construction, shipbuilding, and machine construction as well as for buffer layers when building up on high carbon steels.
Phoenix Blau EN ISO 2560-A: E 42 0 RC 11 AWS A5.1-04: E6013	Heat treatment: untreated, as welded R_e 420 MPa R_m 510 MPa A_5 22% A_v 50 J	2.0 2.5 3.2 4.0 5.0	TÜV (00425.), DB (10.132.19), ABS, BV, LR, GL (2Y), DNV	Rutile-Cellulose covered electrode. General purpose; useable in all positions; excellent gap-bridging and arc-striking ability; for tack-welding and bad fit-ups. Well suited for welding rusty and primered plates (roughly 40 µm); excellent vertical down characteristics. Useable on small transformers (42 V, open circuit).
Phoenix Spezial D EN ISO 2560-A: E 42 3 B 12 H10 AWS A5.1: E7016	Heat treatment: untreated, as welded R_e 440 MPa R_m 550 MPa A_5 22% A_v 80 J 50 J…-30°C	2.5 3.2 4.0 5.0	TÜV (03282.), DB (10.132.42), ABS, BV, DNV, GL, LR	Double coated basic electrode. Outstanding welding characteristics on AC and DC in all positions except vertical down. Stable arc, good radiographic soundness. Useable in handicraft and industry for field and workshop application.
BÖHLER FOX EV 60 EN ISO 2560-A: E 46 6 1Ni B 42 H5 AWS A5.5: E8018-C3H4R	Heat treatment: untreated, as welded $R_{p0.2}$ 510 MPa R_m 610 MPa A_5 27% A_v 180 J 110 J…-60°C	2.5 3.2 4.0 5.0	TÜV (1524.), DNV, RMR, Statoil, LTSS, SEPROZ, CRS, CE, VG 95132	Ni-alloyed, basic covered electrode with excellent mechanical properties, most notably greater toughness and cracking resistance for high-strength, fine-grained constructional steels. Suitable for a temperature range of -60°C to +350°C. Very low hydrogen content (according AWS condition HD ≤ 4 ml/100 g).
BÖHLER FOX 2.5 Ni EN ISO 2560-A: E 46 8 2Ni B 42 H5 AWS A5.5: E8018-C1H4R	Heat treatment: untreated, as welded $R_{p0.2}$ 490 MPa R_m 570 MPa A_5 30% A_v 180 J 110 J…-80°C	2.5 3.2 4.0 5.0	TÜV (00147.), DB (10.014.16), ABS, BV, WIWEB, DNV, GL, LR, RINA, Statoil, SEPROZ, CE	Ni-alloyed, basic covered electrode for unalloyed and Ni-alloyed fine-grained constructional steels. Tough, crack-resistant weld metal. Low temperature toughness down to -80°C. Very low hydrogen content in the weld metal (HD ≤ 4 ml/100 g).
BÖHLER FOX EV 63 EN ISO 2560-A: E 50 4 B 42 H5 AWS A5.5: E8018-GH4R	Heat treatment: untreated, as welded $R_{p0.2}$ 580 MPa R_m 630 MPa A_5 26% A_v 170 J 90 J…-40°C	2.5 3.2 4.0 5.0	TÜV (0730.), DB (10.014.07 / 81.014.01), RMR, SEPROZ, CE	Basic covered electrode for unalloyed and low-alloy steels of higher strength and a carbon content of up to 0.6%. Also suitable for rail joint welding. Very low hydrogen content in the weld metal (HD ≤ 4 ml/100 g).

Covered electrodes, unalloyed and low-alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER FOX EV 70 EN ISO 18275-A: E 55 6 1NiMo B 4 2 H5 AWS A5.5: E9018-GH4R E9018-D1H4R (mod.)	Heat treatment: untreated, as welded $R_{p0.2}$ 650 MPa R_m 700 MPa A_5 24% A_v 160 J 70 J…-60°C	2.5 3.2 4.0 5.0	TÜV (0112.), SEPROZ, CE	MoNi-alloyed, basic covered electrode with a high degree of toughness and cracking resistance for high-strength, fine-grained constructional steels. Suitable for the temperature range of -60°C to +350°C. Very low hydrogen content in the weld metal (HD ≤ 4 ml/100 g).
BÖHLER FOX alform® 700 EN ISO 18275-A: E 69 6 Mn2NiCrMo B 4 2 H5 AWS A5.5: E11018-GH4R E11018MH4R (mod.)	Heat treatment: untreated, as welded $R_{p0.2}$ 780 MPa R_m 840 MPa A_5 20% A_v 110 J 60 J…-60°C	2.5 3.2 4.0 5.0	NAKS	Mn-Ni-Mo-alloyed, basic covered electrode with a high degree of toughness and cracking resistance for high-strength, fine-grained constructional steels. Very low hydrogen content in the weld metal (HD ≤ 4 ml/100 g).
BÖHLER FOX EV 85 EN ISO 18275-A: E 69 6 Mn2NiCrMo B 4 2 H5 AWS A5.5: E11018-GH4R E11018MH4R (mod.)	Heat treatment: untreated, as welded $R_{p0.2}$ 780 MPa R_m 840 MPa A_5 20% A_v 110 J 60 J…-60°C	2.5 3.2 4.0 5.0	TÜV (4313.), DB (10.014.22), SEPROZ, CE, BV	Mn-Ni-Mo-alloyed, basic covered electrode with a high degree of toughness and cracking resistance for high-strength, fine-grained constructional steels. Very low hydrogen content in the weld metal (HD ≤ 4 ml/100 g).
BÖHLER FOX DMO Kb EN ISO 3580-A: E Mo B 4 2 H5 EN ISO 2560-A: E 46 5 Mo B 4 2 H5 AWS A5.5: E7018-A1H4R	Heat treatment: untreated, as welded R_e 510 MPa R_m 590 MPa A_5 24% A_v 170 J 60 J…-50°C	2.5 3.2 4.0 5.0	TÜV (0019.), DB (10.014.14), KTA 1408.1, ABS, DNV, GL, Statoil, LTSS, SEPROZ, CRS, CE, NAKS, RS	Basic covered electrodes for high-quality welds on high temperature boiler and pipe steels, preferred for 16Mo3. Approved for long-term use at operating temperatures to +550°C. Very low hydrogen content (according to AWS conditions, HD ≤ 4 ml/100 g)
BÖHLER FOX DCMS Kb EN ISO 3580-A: E CrMo1 B 4 2 H5 AWS A5.5: E8018-B2H4R	Heat treatment: annealed 680°C/2h $R_{p0.2}$ 480 MPa R_m 580 MPa A_5 23% A_v 160 J	2.5 3.2 4.0 5.0	TÜV (0728.), DB (10.014.32), ABS, DNV, GL, LTSS, SEPROZ, CE, NAKS	Basic covered electrode, core wire alloyed, for high-quality welds on boiler and pipe steels or steels of similar quality. Preferred for 13CrMo4-5. Approved for long-term use at operating temperatures to +570°C. Suitable for step-cooling applications (Bruscato ≤ 15 ppm).
BÖHLER FOX CM 2 Kb EN ISO 3580-A: E CrMo2 B 4 2 H5 AWS A5.5: E9018-B3H4R	Heat treatment: annealed 720°C/2h $R_{p0.2}$ 510 MPa R_m 600 MPa A_5 20% A_v 120 J	2.5 3.2 4.0 5.0	TÜV (0722.), DB (10.014.30), ABS, DNV, GL, SEPROZ, CE, NAKS	Basic covered electrode, core wire alloyed, for components subject to high temperatures in the construction of boilers, apparatus and tube steels, as well as in the petroleum industry, e.g. in cracking plants. Preferred for 10CrMo9-10. Approved for long-term use at operating temperatures to +600°C.
Phoenix **SH CHROMO 2 KS** EN ISO 3580-A: E CrMo2 B 4 2 H5 AWS A5.5: E9015-B3	Heat treatment: stress relieved $R_{p0.2}$ 440 MPa R_m 550 MPa A_5 22% A_v 130 J 90 J…-30°C 80 J…-40°C	2.5 3.2 4.0 5.0	TÜV (01823.)	Basic covered CrMo alloyed electrode. Extra low content of trace elements; step-cooling tested; not sensitive to long term embrittlement. Manufacture of chemical apparatus, hydrocrackers; for welding work on heavy-duty boilers, superheaters, superheater lines; for welding of CrMo and CrMoV alloyed steels for the petrochemnical industry.

Covered electrodes, high alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER FOX C 9 MV EN ISO 3580-A: E CrMo91 B 4 2 H5 AWS A5.5: E9015-B9	Heat treatment: annealed 760°C/2h $R_{p0.2}$ 580 MPa R_m 710 MPa A_5 19% A_v 75 J	2.5 3.2 4.0 5.0	TÜV (6762.), SEPROZ, CE	Basic covered electrode, core wire alloyed, for creep-resistant, quenched and tempered 9-12% chrome steels, especially T91 and P91 steels in turbine and boiler fabrication as well as in the chemical industry. Approved for long-term use at operating temperatures to +650°C.
Thermanit CHROMO 9 V EN ISO 3580-A: E CrMo91 B 4 2 H5 AWS A5.5: E9015-B9	Heat treatment: annealed 760°C/2h $R_{p0.2}$ 550 MPa R_m 680 MPa A_5 17% A_v 47 J	2.5 3.2 4.0 5.0	TÜV (06173.)	Basic covered CrMoVNb alloyed electrode. Good welding characteristics in out of position work; high temperature resistant weld metal. For quenched and tempered 9% chromium steels, in particular P 91 / T 91 according to ASTM.
Thermanit MTS 3 EN ISO 3580-A: E CrMo 9 1 B 4 2 H5 AWS A5.5: E9015-B9	Heat treatment: annealed 760°C/2h $R_{p0.2}$ 550 MPa R_m 680 MPa A_5 17% A_v 47 J	2.5 3.2 4.0 5.0	TÜV (09168.)	High temperature creep resistant, resistant to scaling up to 600°C. Suited for joining and surfacing applications with quenched and tempered 9% Cr steels, particularly for matching high temperature resistant parent metal T91 / P91 according to ASTM.
Thermanit MTS 616 EN ISO 3580-A: E ZCrMoWVNb9 0.5 2 B 4 2 H5 AWS A5.5: E9015-G (E9015 B9 mod.)	Heat treatment: annealed 760°C/≥2h $R_{p0.2}$ 560 MPa R_m 720 MPa A_5 15% A_v 41 J	2.5 3.2 4.0	TÜV (09289.)	Basic covered CrMoNiVWNb alloyed electrode. Good welding characteristics in out of position work; high temperature resistant matching weld metal. For the welding of high temperature martensitic steels in particular P 92 according to ASTM A 355.
BÖHLER FOX EAS 2-A EN ISO 3581-A: E 19 9 L R 3 2 AWS A5.4: E308L-17	Heat treatment: untreated, as welded $R_{p0.2}$ 430 MPa R_m 560 MPa A_5 40% A_v 70 J	1.5 2.0 2.5 3.2 4.0 5.0	TÜV (1095.), DB (30.014.15), ABS, GL, Statoil, VUZ, SEPROZ, CE, CWB, NAKS	Low carbon, core wire alloyed, austenitic, rutile covered electrode. Application in all industry branches where identical steel types are welded, including higher-carbon varieties, as well as ferritic 13% chrome steels. The electrode offers particularly excellent welding characteristics. The very good positional weldability and the self-releasing slag are economically significant arguments that favour this electrode. Intergranular corrosion resistant up to +350°C.
Avesta 308L/MVR EN ISO 3581-A: E 19 9 L R AWS A5.4: E308L-17	Heat treatment: untreated, as welded $R_{p0.2}$ 440 MPa R_m 570 MPa A_5 37% A_v 60 J 40 J…-40°C	2.5 3.25 4.0 5.0	TÜV (1058.), DB (30.007.01), DNV	Avesta 308L/MVR is a Cr-Ni electrode for all position welding of 1.4301/ASTM 304 type stainless steels. Corrosion resistance: Very good under fairly severe conditions, e.g. in oxidising acids and cold or dilute reducing acids.
BÖHLER AWS E308L-17 EN ISO 3581-A: E 19 9 L R 3 2 AWS A5.4: E308L-17	Heat treatment: untreated, as welded R_e 430 MPa R_m 560 MPa A_5 40% A_v 70 J	2.0 3.2 4.0	TÜV (10647.), ABS, GL, CE	Low carbon, core wire alloyed austenitic electrode with rutile-basic coating for use in all industries where similar type steels including higher carbon grades as well as ferritic 13% chromium steels are welded. This brand is noted for its outstanding welding characteristics, excellent weld ability on AC, and high hot cracking resistance of the weld metal. The main features of economic interest are excellent out-of-position weld ability, self-detaching slag with no residues, and moisture resistant coating. Resistant to intergranular corrosion up to 350°C.
BÖHLER FOX EAS 4 M-A EN ISO 3581-A: E 19 12 3 L R 3 2 AWS A5.4: E316L-17	Heat treatment: untreated, as welded $R_{p0.2}$ 460 MPa R_m 600 MPa A_5 36% A_v 70 J	1.5 2.0 2.5 3.2 4.0 5.0	TÜV (0773.), DB (30.014.14), ABS, DNV, GL, LR, Statoil, VUZ, SEPROZ, CE, CWB, NAKS	Low carbon, core wire alloyed, austenitic, rutile covered electrode. Application in all industry branches where identical steel types are welded, including higher-carbon varieties, as well as ferritic 13% chrome steels. The electrode offers particularly excellent welding characteristics. The very good positional weldability and the self-releasing slag are economically significant arguments that favour this electrode. Intergranular corrosion resistant up to +400°C.

Covered electrodes, high alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
Avesta 316L/SKR EN ISO 3581-A: E 19 12 3 L R AWS A5.4: E316L-17	Heat treatment: untreated, as welded $R_{p0.2}$ 460 MPa R_m 590 MPa A_5 36% A_v 60 J 55 J…-40°C	2.5 3.25 4.0 5.0	TÜV (1073.), DB (30.007.10), DNV	Avesta 316L/SKR is a Cr-Ni-Mo electrode for all position welding of 1.4436/ASTM 316 type stainless steels. Corrosion resistance: Excellent resistance to general, pitting and intergranular corrosion in chloride containing environments. Intended for severe conditions, e.g. in dilute hot acids.
BÖHLER AWS E316L-17 EN ISO 3581-A: E 19 12 3 L R 3 2 AWS A5.4: E316L-17	Heat treatment: untreated, as welded R_e 460 MPa R_m 600 MPa A_5 36% A_v 70 J	2.5 3.2 4.0	TÜV (10648.), ABS, GL, LR, CE	Rutile electrode, core wire alloyed stainless steel. Preferably used for 1.4435 / 316L steel grades. BÖHLER AWS E316L-17 is an acknowledged world leader, noted for its superior welding characteristics and metallurgy. It can be used on AC or DC. Other advantages include high current capacity, minimum spatter formation, self-releasing slag, smooth and clean weld profile, safety against formation of porosity due to moisture resistant coating and packaging into hermetically sealed tins. The fully alloyed core wire ensures the most reliable corrosion resistance. Resistant to intergranular corrosion up to +400°C.
BÖHLER FOX SAS 2-A EN ISO 3581-A: E 19 9 Nb R 3 2 AWS A5.4: E347-17	Heat treatment: untreated, as welded $R_{p0.2}$ 470 MPa R_m 620 MPa A_5 35% A_v 70 J	2.0 2.5 3.2 4.0 5.0	TÜV (1105.), DB (30.014.06), ABS, GL, LTSS, VUZ, SEPROZ, CE, NAKS	Stabilised, core wire alloyed, austenitic, rutile covered electrode. Application in all industry branches where identical steel types are welded, as well as ferritic 13% chrome steels. The electrode offers particularly excellent welding characteristics. The very good positional weldability and the self-releasing slag are economically significant arguments that favour this electrode. Intergranular corrosion resistant up to +400°C.
Avesta 347/MVNb EN ISO 3581-A: E 19 9 Nb R AWS A5.4: E347-17	Heat treatment: untreated, as welded $R_{p0.2}$ 470 MPa R_m 620 MPa A_5 35% A_v 60 J 45 J…-40°C	2.0 2.5 3.2 4.0 5.0	TÜV (1062.), DB (30.007.08), DNV, CWB	Avesta 347/MVNb is a Nb-stabilised Cr-Ni electrode for welding steels that are stabilised with titanium or niobium, such as 1.4541/ASTM 321. A stabilised weldment has improved high temperature properties, e.g. creep resistance, compared to low-carbon non-stabilised grades. Avesta 347/MVNb can also be used for the second layer (first layer 309 type) when cladding mild steel. Corrosion resistance: Avesta 347/MVNb is primarily intended for high temperature service oder applications that should be heat treated. However, the corrosion resistance corresponds to that of 308H, i.e. good resistance to general corrosion.
BÖHLER FOX SAS 4-A EN ISO 3581-A: E 19 12 3 Nb R 3 2 AWS A5.4: E318-17	Heat treatment: untreated, as welded $R_{p0.2}$ 490 MPa R_m 640 MPa A_5 32% A_v 60 J	2.0 2.5 3.2 4.0 5.0	TÜV (0777.), DB (30.014.07), LTSS, SEPROZ, CE, NAKS	Stabilised, core wire alloyed, austenitic, rutile covered electrode. Application in all industry branches where identical steel types are welded, as well as ferritic 13% chrome steels. The electrode offers particularly excellent welding characteristics. The very good positional weldability and the self-releasing slag are economically significant arguments that favour this electrode.
BÖHLER FOX CN 13/4 EN ISO 3581-A: E 13 4 B 6 2 AWS A5.4: E410NiMo-15	Heat treatment: untreated, as welded $R_{p0.2}$ 890 MPa R_m 1090 MPa A_5 12% A_v 32 J	2.5 3.2 4.0 5.0	TÜV (3232.), LTSS, SEPROZ, CE	Basic covered electrode for corrosion-resistant, martensitic and martensitic-ferritic rolled, forged and cast steels of identical type. Application in the construction of hydro turbines, compressors and steam power stations. Resistant to water vapour, steam and sea water atmospheres. Low hydrogen content of HD ≤ 5 ml/100 g in the weld metal.
Avesta 904L EN ISO 3581-A: E 20 25 5 Cu N L R AWS A5.4: E385-17	Heat treatment: untreated, as welded $R_{p0.2}$ 420 MPa R_m 600 MPa A_5 34% A_v 70 J 60 J…-40°C 50 J…-196°C	2.5 3.25 4.0 5.0	TÜV (03496.), DB (30.007.09)	Avesta 904L is a high-alloy fully austenitic Cr-Ni-Mo-Cu electrode designed for welding 1.4539/ASTM 904L type steels. It can also be used for welding 1.4404/ASTM 316 components where a ferrite free weld is required, e.g. in cryogenic or non-magnetic applications. The weld metal has a very good impact toughness at low temperatures. Corrosion resistance: Very good resistance to general corrosion in non-oxidising environments such as sulphuric acid and phosphoric acid. Very good resistance to pitting and crevice corrosion in chloride containing solutions. Meets the corrosion test requirements per ASTM G48 Methods A, B and E (40°C).
BÖHLER FOX CN 22/9 N EN ISO 3581-A: E 22 9 3 N L R 3 2 AWS A5.4: E2209-17	Heat treatment: untreated, as welded $R_{p0.2}$ 650 MPa R_m 820 MPa A_5 25% A_v 55 J 50 J…-10°C	2.5 3.2 4.0 5.0	TÜV (3636.), ABS, DNV, GL, LR, RINA, Statoil, SEPROZ, CE	Core wire alloyed, rutile covered electrode for welding of ferritic-austenitic duplex steels, e.g. 1.4462, UNS 31803. Areas of application primarily in offshore technology and the chemical industry. In addition to increased strength and toughness, the high proportion of ferrite in the weld metal also makes it highly resistant to stress corrosion cracking.
Avesta 253MA EN ISO 3581-A: E 21 10 R	Heat treatment: untreated, as welded $R_{p0.2}$ 535 MPa R_m 725 MPa A_5 37% A_v 60 J	2.0 2.5 3.25 4.0 5.0	–	Avesta 253 MA is primarily designed for welding the high temperature stainless steel Outokumpu 253 MA, used for furnaces, combustion chambers and burners. Both the steel and filler metal offers excellent resistance to oxidation up to 1,100°C. The chemical composition of Avesta 253 MA is balanced to give a crack resistant weld metal. Corrosion resistance: Excellent resistance to high temperature corrosion. Not intended for applications exposed to wet corrosion.

Covered electrodes, high alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER FOX A7-A EN ISO 3851-A: E Z18 9 MnMo R 3 2 AWS A5.4: E307-16 (mod.)	Heat treatment: untreated, as welded $R_{p0.2}$ 520 MPa R_m 720 MPa A_5 35% A_v 75 J ≥32 J…-100°C	2.5 3.2 4.0 5.0	TÜV (09101.), SEPROZ, CE, NAKS	Rutile basic electrode, for joint welding of dissimilar joints and/or difficult to weld materials. Very popular electrode for numerous applications. The weld metal offers exceptionally high ductility and elongation together with outstanding crack resistance. No embrittlement for service temperatures down to -100°C or above +500°C. The scaling resistance goes up to +850°C. When working at service temperatures above +650°C please contact Böhler Welding. The weld metal can be post weld heat treated without any problems. Good resistance against cavitation. BÖHLER FOX A 7-A is suitable for both AC and DC.
BÖHLER FOX CN 23/12-A EN ISO 3581-A: E 23 12 L R 3 2 AWS A5.4: E309L-17	Heat treatment: untreated, as welded $R_{p0.2}$ 460 MPa R_m 570 MPa A_5 40% A_v 55 J ≥32 J…-60°C	2.5 3.2 4.0 5.0	TÜV (1771.), DB (30.014.08), ABS, BV, DNV, GL, LR, SEPROZ, CE, CWB, NAKS	Core wire alloyed, low carbon, austenitic, rutile covered electrode. Increased ferrite content (FN~17) in the weld deposit for safe and crack resistant dissimilar joints. Suitable for service temperatures from -60°C up to +300°C.
BÖHLER AWS E309-L17 EN ISO 3581-A: E 23 12 L R 3 2 AWS A5.4: E309L-17	Heat treatment: untreated, as welded R_e 440 MPa R_m 570 MPa A_5 40% A_v 60 J ≥32 J…-60°C	2.5 3.2 4.0 5.0	ABS	Rutile electrode of type E 23 12 L / 309L providing increased delta ferrite contents (FN ~17) in the weld deposit for safe and crack resistant dissimilar joint welds and surfacing. Operating temperature from -60°C to +300°C and for weld claddings up to +400°C.
BÖHLER FOX FFB EN 3581-A: E 25 20 B 2 2 AWS A5.4: E310-15 (mod.)	Heat treatment: untreated, as welded $R_{p0.2}$ 420 MPa R_m 600 MPa A_5 36% A_v 100 J ≥32 J…-196°C	2.5 3.2 4.0 5.0	TÜV (0143.), Statoil, SEPROZ, CE	Core wire alloyed, basic covered electrode for heat-resistant rolled, forged and cast steels of identical type, e.g. in annealing and hardening shops, in steam boiler construction, in the petroleum and ceramic industries. Joint welds on heat-resistant CrSiAl steels subject to sulphurous gases must be welded with BÖHLER FOX FA as the final pass. Scaling resistant up to +1,200°C.
BÖHLER FOX FFB-A EN ISO 3581-A: E 25 20 R 3 2 AWS A5.4: E310-16	Heat treatment: untreated, as welded $R_{p0.2}$ 430 MPa R_m 620 MPa A_5 35% A_v 75 J	2.0 2.5 3.2 4.0	Statoil, SEPROZ, CE	Core wire alloyed, rutile covered electrode for heat-resistant rolled steels of identical type, e.g. in annealing and hardening shops, in steam boiler construction, in the petroleum and ceramic industries. Scaling resistant up to +1,200°C.
Thermanit Nicro 182 EN ISO 14172: E Ni 6182 (NiCr15Fe6Mn) AWS A5.11: ENiCrFe-3	Heat treatment: untreated $R_{p0.2}$ 350 MPa R_m 620 MPa A_5 35% A_v 90 J 70 J…-196°C	2.5 3.2 4.0 5.0	TÜV (02073.), TÜV (KTA) (08109)	Nickel base electrode, stainless; resistant to scaling up to 950°C, creep resistant up to 800°C. Cold toughness down to -196°C. Well suited for austenitic ferritic joints. Well suited for tough joints and surfacing on heat resistant Cr- and CrNi steels/cast steel grades and Ni-base alloys. For welding work on cryogenic steels/cast steel grades including Ni steels suitable for quenching and tempering. For joining applications on steels with a low expansion coefficient (Dilavar, Invar).
Thermanit Nicro 82 EN ISO 14172: E Ni 6082 (NiCr20Mn3Nb) AWS A5.11: ENiCrFe-3 (mod.)	Heat treatment: untreated $R_{p0.2}$ 380 MPa R_m 620 MPa A_5 35% A_v 90 J 70 J…-196°C 50 J…-296°C	2.5 3.2 4.0 5.0	TÜV (01775.), TÜV (KTA), GL	Nickel base electrode, stainless; heat resistant; creep resistant. Cold toughness down to -269°C. Well suited for welding austenitic ferritic joints. Well suited for tough joints and surfacing on heat resistant Cr and CrNi steels/cast steel grades and Ni-base alloys. Temperature limits: 500°C in sulphureous atmospheres, 800°C max for fully stressed welds. Resistant to scaling up to 1,000°C.
Thermanit 625 EN ISO 14172: E Ni 6625 (NiCr22Mo9Nb) AWS A5.11: ENiCrMo-3	Heat treatment: untreated $R_{p0.2}$ 420 MPa R_m 760 MPa A_5 30% A_v 75 J 60 J…-196°C	2.5 3.2 4.0 5.0	TÜV (03463.), ABS, DNV, GL	Nickel base electrode, stainless; high resistance to corrosive environments. Resistant to stress corrosion cracking. Resistant to scaling up to 1,100°C. Temperature limit: 500°C max. in sulphureous atmospheres. Creep resistant up to 1,000°C. Cold toughness down to -196°C. For joining and surfacing work with matching/similar corrosion resistant materials as well as on matching and similar heat resistant, creep resistant steels and alloys. For joining and surfacing work with cryogenic austenitic CrNi(N) steels/cast steel grades and on cryogenic Ni steels suitable for quenching and tempering.
Thermanit 617 EN ISO 14172: E Ni 6617 (NiCr22Co12Mo) AWS A5.11: ENiCrCoMo-1 (mod.)	Heat treatment: untreated $R_{p0.2}$ 400 MPa R_m 700 MPa A_5 30% A_v 100 J	2.5 3.2 4.0	TÜV (06844.)	Resistant to scaling up to 1,100°C, creep resistant up to 1,000°C. High resistance to hot gases in oxidizing resp. carburizing atmospheres. Suited for joining and surfacing applications with matching and similar heat resistant steels and alloys.

Flux cored wires, unalloyed and low-alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER Ti 46-FD EN ISO 17632-A: T 46 2 P M 1 H10 T 42 2 P C 1 H5 AWS A5.36: E71T1-M21A0-CS1-H8 E71T1-C1A0-CS1-H4	Heat treatment: untreated, as welded Shielding gas: Ar + 15-25% CO_2 R_e 500 MPa R_m 580 MPa A_5 26% A_v 160 J 90 J…-20°C	1.2	TÜV (12522.), DB (42.014.41), ABS, GL, LR, DNV, BV, RINA (3Y S, C1), CE	All position rutile flux-cored wire with fast freezing slag system. User friendly welding characteristics in all positions with one parameter setting. Excellent mechanical properties, easy slag removal, low spatter loss, smooth, finely rippled bead surface, high X-ray safety. The product performs to the highest productivity with significant savings in time and economical aspects when used for positional welding.
BÖHLER Ti 52-FD EN ISO 17632-A: T 46 4 P M 1 H10 T 42 2 P C 1 H5 AWS A5.36: E71T1-M21A4-CS1-H8 E71T1-C1A2-CS1-H4	Heat treatment: untreated, as welded Shielding gas: Ar + 15-25% CO_2 R_e 500 MPa R_m 580 MPa A_5 26% A_v 180 J 130 J…-20°C 90 J…-40°C	1.2 1.6	TÜV (11164.), DB (42.014.35), ABS, GL, LR, DNV, BV, CRS, CE	Rutile flux-cored wire with fast-freezing slag system. Excellent welding properties in all positions. Excellent mechanical properties, easy slag removability and low spatter loss. Highest productivity with significant savings in time and economical aspects when used for positional welding.
Union TG 55 M EN ISO 17632-A: T 46 4 P M 1 H10 T 42 2 P C 1 H5 AWS A5.20: E71T-1MJH8 / E71T-1CH8	Heat treatment: untreated, as welded Shielding gas: M21 R_e 460 MPa R_m 560 MPa A_5 24% A_v 140 J 47 J…-40°C Heat treatment: untreated, as welded Shielding gas: C1 $R_{p0.2}$ 420 MPa R_m 520 MPa A_5 24% A_v 130 J	1.0 1.2 1.4 1.6	TÜV (11194.), DB (42.132.47), ABS, DNV, LR, BV, GL	Union TG 55 M is an all position flux cored wire that displays exceptional high impact properties in the as welded as well as in the stress relieved condition with mixed gas M21 acc. to EN ISO 14175. This “welder friendly” wire with its soft, spatterfree arc always operates in the spray arc mode. It is possible to weld in all positions with one diameter (1.2 mm from 160 A to 250 A), so ideal for fit-up work. Deposition rates in vertical-up welding can reach 2.2 - 5.5 kg/h, making it one of the most productive consumables available. The slag is easily to detach. Good bead appearance with smooth tie-in.
Union RV Ni 1 EN ISO 17632-A: T 50 6 1Ni P M 1 H5/ T 46 5 1Ni P C 1 H5 AWS A5.29: E81T1-Ni1MJH4 E81T1-Ni1CJH4	Heat treatment: untreated, as welded Shielding gas: M21 $R_{p0.2}$ 500 MPa R_m 560 MPa A_5 22% A_v 120 J 90 J… 0°C 70 J…-20°C 47 J…-60°C	1.2 1.4 1.6	TÜV (11079.), DB (42.132.40), GL, LR, ABS, DNV	Union RV Ni 1 is a seamless copper coated rutile basic flux cored wire for the welding of cryogenic steels in all positions with mixed gas M21 and C1 acc. to EN ISO 14175. The wire is characterised by a low spatter affinity, a fine bead appearance, a good slag detachability and x-ray proof joints. The weld metal furthermore disposes of excellent mechanical properties as welded and annealed. The Ni-alloyed weld metal (acc. to stickelectrode E8018-C3) allows the application at petrochemical constructions and offshore technics. The fast solidifying slag permits the manual and mechanized position welding with increased welding current. The welding of root passes in all positions with ceramic backing strips is proven.
BÖHLER Ti 60-FD EN ISO 17632-A: T 50 6 1Ni P M 1 H5 AWS A5.36: E81T1-M21A8-Ni1-H4	Heat treatment: untreated, as welded Shielding gas: Ar + 15-25% CO_2 $R_{p0.2}$ 530 MPa R_m 570 MPa A_5 27% A_v 140 J 120 J…-20°C 100 J…-40°C 60 J…-60°C	1.2	TÜV (12544.), DB (42.014.42), GL, ABS, CE, DNV, LR, BV	Rutile flux cored wire with fast freezing slag for welding low-temperature steels. Outstanding welding properties in all positions. Exceptional mechanical strength and good slag detachability, low spatter losses, smooth, finely rippled seam surface, notch-free weld toes. Out-of-position welding can be carried out with increased welding current, and therefore very economically with increased deposition rate. For high-quality welding in shipbuilding, for offshore applications and steel structures with high strength requirements, as well as for low-temperature applications down to –60 °C. BÖHLER Ti 60-FD is also suitable for sour gas application. Results for HIC-test acc. to NACE TM0248 and SSC test are available.
Union TG 55 Ni EN ISO 17632-A: T 50 6 1 Ni P M 1 H5 AWS A5.29: E81T1-Ni1M-JH4	Heat treatment: untreated, as welded Shielding gas: M21 $R_{p0.2}$ 500 MPa R_m 560 MPa A_5 20% A_v 120 J 47 J…-60°C	1.2 1.6	LR	Union TG 55 Ni is a rutile basic flux cored wire with fast freezing slag characteristic. It is suitable for GMAW welding with mixed gas M21 acc. to EN ISO 14175 for welding of structural steels with a nominal tensile strength of 560 MPa in all positions. The wire displays exceptional high impact properties in the as welded as well as in the stress relieved condition. This “welder friendly” wire with its soft, spatter-free arc, always operates in spray arc mode. It is possible to weld in any position with one Diameter (1.2 mm from 160 A to 250 A), so ideal for fit-up work. Single sided root runs are made economically on ceramic backing strips. The nickel alloyed weld metal – corresponding to the stick electrode E8018-C3 – is usable in petrochemical plants and in offshore technology. Areas of application are primarily in the offshore, structural steel and shipbuilding industries.

Flux cored wires, unalloyed and low-alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER Ti 80 T-FD EN ISO 18276-A: T69 6 Z P M 1 H5 AWS A5.36: E111T1-M21A8-GH4	Heat treatment: untreated, as welded Shielding gas: M21 $R_{p0.2}$ 770 MPa R_m 800 MPa A_5 19% A_v 75 J 60 J…-60°C	1.0 1.2 1.4 1.6	GL, DNV, ABS, LR, BV, CE	Seamless rutile, Nickel-Molybdenum alloyed, flux cored wire for single- or multilayer welding of high strength steels with Argon-CO_2 shielding gas. Main features: excellent weldability in all positions, excellent bead appearance, very low spatter losses, fast freezing and easy to remove slag. The good mechanical properties of this wire even at low temperatures (–60°C) as well as the low content of diffusible Hydrogen make it especially suitable for off-shore, pipeline applications and crane applications.
BÖHLER DMO Ti-FD EN ISO 17634-A: T MoL P M 1 H10 AWS A5.36: E81T1-M21PY-A1H8	Heat treatment: untreated, as welded $R_{p0.2}$ 540 MPa R_m 600 MPa A_5 23% A_v 120 J	1.2	TÜV (11120.), CE	BÖHLER DMO Ti-FD is a flux-cored wire for welding in the construction of boilers, pressure tanks, pipelines and for steel construction, preferably for high temperature steel grades with 0.5% Mo. Due to the fast freezing slag, the flux-cored wire is especially suitable for positional welding.
BÖHLER DCMS Ti-FD EN ISO 17634-A: T CrMo1 P M 1 H10 AWS A5.36: E81T1-M21PY-B2H8	Heat treatment: annealed 690°C/1h $R_{p0.2}$ ≥460 MPa R_m 550-740 MPa A_5 ≥20% A_v ≥47 J	1.2	TÜV (11162.), CE	BÖHLER DCMS Ti-FD is a low-alloy, slag-forming flux-cored wire with rutile filling for welding in the construction of boilers, vessels and pipe systems, preferably for creep resistant steels with 1% chrome- and 0.5% molybdenum-alloy. Due to the fast-freezing slag, the flux-cored wire is especially suitable for positional welding.
BÖHLER CM 2 Ti-FD EN ISO 17634-A: T CrMo2 P M 1 H10 AWS A5.36: E91T1-M21PY-B3-H8	Heat treatment: annealed 720°C/2h $R_{p0.2}$ 600 MPa R_m 700 MPa A_5 19% A_v 70 J	1.2	TÜV (11812.), CE	BÖHLER CM 2 Ti-FD filler metal is a low-alloy, slag-forming flux-cored wire with rutile filling for welding in the construction of boilers, vessels and tube steels, preferably for creep resistant steels with 2.25% chrome- and 1% molybdenum-alloy (e.g. 10CrMo9 10). Due to the fast-freezing slag, the flux-cored wire is especially suitable for positional welding.

Flux cored wires, high alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER C 9 MV Ti-FD EN ISO 17634-A: T ZCrMo9VNb P M 1 AWS A5.36: E91T1-M21PY-B91	Heat treatment: annealed 760°C/3h $R_{p0.2}$ 580 MPa R_m 720 MPa A_5 17% A_v 35 J	1.2	–	BÖHLER C 9 MV Ti-FD is a slag-forming, flux-cored wire with rutile-basic filling for welding creep-resistant, quenched and tempered 9-12% chrome steels, especially T91 and P91 steels in turbine, boiler and tube steels as well as in foundry engineering. Due to a fast-freezing slag, also suitable for positional welding.
Thermanit MTS 3 PW EN ISO 17634-A: T ZCrMo9VNb P M 1 AWS A5.29-05 E91T1-B9M	Heat treatment: annealed 760°C/3h Shielding gas: M21 $R_{p0.2}$ 580 MPa R_m 720 MPa A_5 17% A_v 27 J	1.2	–	Thermanit MTS 3 PW is a rutile- basic flux cored wire for welding creep resistant, tempered 9 – 12% chromium steels in turbine-, boiler- and pipeline construction as well as in the foundry technology. The wire is especially designed for the ASTM steels T91 / P91. This flux cored wire is developed for welding with conventional power sources on DC + under mixture gas (Ar + 15 – 25% CO_2). It is also suitable for positional welding.
BÖHLER EAS 2-FD EN ISO 17633-A: T 19 9 L R M21 (C1) 3 T 19 9 L P M21 (C1) 1 (for ø 0.9 mm) AWS A5.22: E308LT0-4, E308LT0-1 E308LT1-4/-1 (for ø 0.9 mm)	Heat treatment: untreated, as welded $R_{p0.2}$ 380 MPa R_m 560 MPa A_5 40% A_v 60 J ≥32 J…-196°C	0.9 1.2 1.6	TÜV (5348.), DB (43.014.14), CWB, GL, SEPROZ, CE	Strip-alloyed, flux-cored wire with rutile-containing filling for welding of austenitic CrNi steels, primarily in flat and horizontal welding positions. The ease of handling and high deposition rate of BÖHLER EAS 2-FD means greater productivity with excellent welding characteristics, self-releasing slag, low spatter formation and seam oxidation, smooth seam finish with good bead wetting and uniformly reliable penetration. The weld metal is suitable for temperatures down to -196°C and intergranular corrosion resistant up to +350°C.
BÖHLER EAS 2 PW-FD EN ISO 17633-A: T 19 9 L P M21 1 T 19 9 L P C1 1 AWS A5.22: E308LT1-4 E308LT1-1	Heat treatment: untreated, as welded $R_{p0.2}$ 380 MPa R_m 560 MPa A_5 40% A_v 70 J 40 J…-196°C	1.2 1.6	TÜV (09117.), DB (43.014.23), CWB, GL, SEPROZ, CE	BÖHLER EAS 2 PW-FD is optimised especially for positional welding. The fast-freezing slag supports the weld pool and enables particularly economical welding in all positions. The chemical and mechanical properties correspond to those of BÖHLER EAS 2-FD.
BÖHLER EAS 4 M-FD EN ISO 17633-A: T 19 12 3 L R M21 (C1) 3 T 19 12 3 L P M21 (C1) 1 (for ø 0.9 mm) AWS A5.22: E316LT0-4, E316LT0-1 E316LT1-4/-1 (for ø 0.9 mm)	Heat treatment: untreated, as welded $R_{p0.2}$ 400 MPa R_m 560 MPa A_5 38% A_v 55 J 35 J…-120°C	0.9 1.2 1.6	TÜV (5349.), DB (43.014.15), CWB, GL, LR, SEPROZ, CE, DNV	Strip-alloyed, flux-cored wire electrode with rutile-containing filling for welding of austenitic CrNiMo steels, primarily in flat and horizontal welding positions. The ease of handling and high deposition rate of BÖHLER EAS 4 M-FD means greater productivity with excellent welding characteristics, self-releasing slag, low spatter formation and seam oxidation, smooth seam finish with good bead wetting and uniformly reliable penetration. The weld metal is suitable for temperatures down to -120°C and intergranular corrosion resistant up to +400°C.
BÖHLER EAS 4 PW-FD EN ISO 17633-A: T 19 12 3 L P M21 1 T 19 12 3 L P C1 1 AWS A5.22: E316LT1-4 E316LT1-1	Heat treatment: untreated, as welded $R_{p0.2}$ 400 MPa R_m 560 MPa A_5 38% A_v 65 J 45 J…-120°C	1.2 1.6	TÜV (09118.), DB (43.014.24), CWB, LR, GL, SEPROZ, CE, DNV, ABS	BÖHLER EAS 4 PW-FD is optimised especially for positional welding. The fast-freezing slag supports the weld pool and enables particularly economical welding in all positions. The chemical and mechanical properties correspond to those of EAS 4 M-FD. Intergranular corrosion resistant up to +400°C.
BÖHLER SAS 2 PW-FD EN ISO 17633-A: T 19 9 Nb P M21 1 T 19 9 Nb P C1 1 AWS A5.22: E347T1-4 E347T1-1	Heat treatment: untreated, as welded $R_{p0.2}$ 420 MPa R_m 600 MPa A_5 35% A_v 75 J 38 J…-120°C	1.2	TÜV (10059.), SEPROZ, CE	BÖHLER SAS 2 PW-FD is optimised especially for positional welding. The supporting effect of the fast-freezing slag enables positional welding with high amperage at high welding speeds. The areas of application, as well as the chemical and mechanical properties, correspond to those of BÖHLER SAS 2-FD. For service temperatures down to -120°C and intergranular corrosion resistant up to +400°C.
BÖHLER SAS 4 PW-FD EN ISO 17633-A: T 19 12 3 Nb P M21 1 T 19 12 3 Nb P C1 1	Heat treatment: untreated, as welded $R_{p0.2}$ 430 MPa R_m 570 MPa A_5 35% A_v 65 J 40 J…-120°C	1.2	–	The BÖHLER SAS 4 PW-FD is optimised especially for positional welding. The supporting effect of the fast-freezing slag enables positional welding with high amperage at high welding speeds. The areas of application, as well as the chemical and mechanical properties, correspond to those of BÖHLER SAS 4-FD. Intergranular corrosion resistant up to +400°C.

Flux cored wires, high alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER CN 22/9 PW-FD EN ISO 17633-A: T 22 9 3 N L P M21 1 T 22 9 3 N L P C1 1 AWS A5.22: E2209T1-4 E2209T1-1	Heat treatment: untreated, as welded $R_{p0.2}$ 600 MPa R_m 800 MPa A_5 27% A_v 80 J 65 J…-20°C 55 J…-40°C 45 J…-46°C	1.2	TÜV (07666.), ABS, CWB, DNV, GL, LR, RINA, SEPROZ, CE	BÖHLER CN 22/9 PW-FD is a strip alloyed, flux-cored wire electrode with a rutile-containing filling for positional welding on duplex steels for chemical apparatus and plant construction, in the chemical industry, for storage tanks as well as for tanker ships for transporting chemicals and in the offshore industry. Positional welding for this duplex quality also yields excellent deposition rates. The supporting effect of the slag enables positional welding with high amperage at high welding speeds.
Avesta **FCW 2507/P100-PW** EN ISO 17633-A: T 25 9 4 N L P M21 (C1) 2 AWS A5.22: E2594T1-4/1	Heat treatment: untreated, as welded $R_{p0.2}$ 670 MPa R_m 880 MPa A_5 27% A_v ≥50 J ≥32 J…-40°C	1.2	–	Avesta FCW 2507-PW is primarily designed for welding the super duplex stainless steel 2507, ASTM S32760, S32550 und S31260 and similar grades. Avesta 2507/P100-PW produces a ferritic-austenitic stainless all weld metal which combines the good characteristics of both types. Corrosion resistance: Very good resistance to pitting and stress corrosion cracking in nitric acid environments. The critical pitting temperature is higher than 40°C.
BÖHLER A 7-FD EN ISO 17633-A: T 18 8 Mn R M21 3 T 18 8 Mn R C1 3 AWS A5.22: E307T0-G (mod.)	Heat treatment: untreated, as welded $R_{p0.2}$ 420 MPa R_m 630 MPa A_5 39% A_v 60 J ≥32 J…-100°C	1.2 1.6	TÜV (11101.), CE	Flux-cored wire with rutile-containing filling for primarily flat and horizontal welding positions. Very universally applicable flux-cored wire. Characteristics of weld metal: Cold-work hardening ability, very good resistance to cavity formation, crack resistant, thermal shock resistant, scaling resistant up to 850°C, impervious to sigma-phase embrittlement above 500°C, service temperature down to -100°C.
BÖHLER CN 23/12-FD EN ISO 17633-A: T 23 12 L R M21 (C1) 3 T 23 12 L P M21 (C1) 1 (for ø 0.9 mm) AWS A5.22: E309LT0-4(1) E309LT1-4/-1 (for ø 0.9 mm)	Heat treatment: untreated, as welded $R_{p0.2}$ 400 MPa R_m 540 MPa A_5 33% A_v 60 J 45 J…-60°C	0.9 1.2 1.6	TÜV (5350.), DB (43.014.16), CWB, GL, LR, SEPROZ, CE, RINA, DNV	Strip alloyed, flux-cored wire with rutile-containing filling for welding of dissimilar joints between high-alloy Cr and CrNi(Mo) steels with unalloyed or low-alloy steels as well as for weld claddings in primarily flat and horizontal welding positions. Suitable for service temperatures from -60°C up to +300°C.
BÖHLER **CN 23/12 PW-FD** EN ISO 17633-A: T 23 12 L P M21 1 T 23 12 L P C1 1 AWS A5.22: E309LT1-4 E309LT1-1	Heat treatment: untreated, as welded $R_{p0.2}$ 400 MPa R_m 540 MPa A_5 35% A_v 65 J 50 J…-60°C	1.2 1.6	TÜV (09115.), DB (43.014.22), ABS, LR, GL, CWB, SEPROZ, CE, DNV, RINA	BÖHLER CN 23/12 PW-FD is a strip alloyed, flux-cored wire with rutile slag characteristics for positional welding of dissimilar joints between high-alloy Cr and CrNi(Mo) steels and unalloyed or low-alloy steels. The supporting effect of the fast-freezing slag enables excellent positional welding characteristics. Suitable for service temperatures from -60°C up to +300°C.
BÖHLER **CN 23/12 Mo-FD** EN ISO 17633-A: T 23 12 2 L R M21 (C1) 3 T 23 12 2 L P M21 (C1) 1 (for ø 0.9 mm) AWS A5.22: E309LMoT0-4/1 E309LMoT1-4/-1 (for ø 0.9 mm)	Heat treatment: untreated, as welded $R_{p0.2}$ 500 MPa R_m 700 MPa A_5 30% A_v 55 J 37 J…-60°C	0.9 1.2 1.6	TÜV (05351.), DB (43.014.17), ABS, DNV, GL, LR, RINA, SE- PROZ, CWB, CE	Rutile flux-cored welding wire of type T 23 12 2 L / E309LMoT0 for GMAW of dissimilar joints of Cr- and CrNi(Mo)-steels and non- or low-alloy steels, as well as weld cladding of un- or low alloyed base metals preferably in flat or horizontal position. The wire offers a high safety against hot cracking even in the case of high dilution. For Mo-alloyed claddings the product is necessary for the 1. layer. Beside the major savings in time and cost BÖHLER offers a high production quality level together with lowest probabilities for welding errors. Increased travel speeds as well as little demand for cleaning and pickling provide considerable savings in time and money. Wire ø 0,9 mm is designed for positional welding, wire ø 1.2 mm and 1.6 mm are recommended mainly for downhand and horizontal welding positions, horizontal/vertical position as well as slightly vertical down position (1 o'clock).
BÖHLER **NIBAS 70/20-FD** EN ISO 12153: T Ni 6082 R M21 3 AWS A5.34: ENiCr3T0-4	Heat treatment: untreated, as welded $R_{p0.2}$ 400 MPa R_m 650 MPa A_5 39% A_v 135 J 110 J…-196°C	1.2 1.6	TÜV (10298.), CE	Nickel base flux-cored wire containing a filling with rutile and basic content for primarily flat and horizontal welding positions. The ease of handling and high deposition rate means greater productivity with excellent welding characteristics, self-releasing slag, low spatter formation and seam oxidation, smooth seam finish with good wetting and safe penetration. Suitable for high-quality joint welding of nickel-based alloys, high temperature and creep-resistant materials, heat- and cold-resistant materials, as well as low-alloy, difficult-to-weld steels and dissimilar joints. Also for ferrite-austenite connections at operating temperatures ≥ +300°C or where post weld heat treatments are required. Suitable in pressure tank construction for -196°C up to +550°C, otherwise scaling resistant up to +1,200°C (sulphur-free atmospheres).

Flux cored wires, high alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
Thermanit TG Nicro 82 EN ISO 12153: T Ni 6082 R M 3 AWS A5.34: ENiCr3T0-4	Heat treatment: untreated, as welded $R_{p0.2}$ 360 MPa R_m 600 MPa A_5 30% A_v 110 J 80 J…-196°C	1.2 1.6	–	Nickel base rutile/basic flux cored wire mainly designed for flat and horizontal welding position. Easy handling and high deposition rate of this wire are leading to high productivity with brilliant welding properties. It produces self detaching slag, almost spatter and weld oxidation-free welding, fine bead appearance with good sidewall wetting and secure penetration. Suitable for high-quality welds of nickel-base alloys, high temperature and creep resistant steels, heat-resistant, cryogenic materials, difficult-to-weld steels and mixed structures. Furthermore it is useable for ferrite austenite joint welding at service temperatures above 300°C or with post weld heat treatment. This wire is designed for applications in pressure vessel constructions for temperatures from -196°C up to 550°C. It is resistant to scaling up to 1,200°C (sulfur free atmosphere).
BÖHLER NIBAS 625 PW-FD EN ISO 12153: T Ni 6625 P M21 2 AWS A5.34: ENiCrMo3T1-4	Heat treatment: untreated, as welded $R_{p0.2}$ 500 MPa R_m 740 MPa A_5 40% A_v 90 J 80 J…-196°C	1.2	TÜV (11223.), CE	Flux-cored wire for high-quality joint welds of high Mo-alloy, nickel-based alloys (e.g. alloy 625 and alloy 825) as well as CrNiMo steels with a high Mo content (e.g. 6% Mo steels). In addition, this type is also suitable for high temperature and creep-resistant steels, heat- and cold-resistant materials, dissimilar joints and low-alloy, difficult-to-weld steels. Suitable in pressure tank construction for -196°C up to +550°C, otherwise scaling resistant up to +1,200°C (sulphur-free atmosphere).

TIG rods, unalloyed and low-alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER EML 5 EN ISO 636-A: W 46 5 W2Si AWS A5.18: ER70S-3	Heat treatment: untreated, as welded R_e 520 MPa R_m 620 MPa A_5 26% A_v 220 J 200 J…-20°C 90 J…-50°C	1.6 2.0 2.4 3.0	TÜV (1096.), DB (42.014.02), Statoil, CE	The GTAW welding rod is suitable for thin-walled plate and pipe as well as root pass welds. The low Si content makes this welding rod especially suitable for joint welds that are subjected to enamelling or galvanising. BÖHLER EML 5 can be used in sour gas applications (HIC-Test acc. NACE TM-02-84) as well.
Union I 52 EN ISO 636-A: W 42 5 W3Si1 AWS A5.18: ER70S-6	Heat treatment: untreated, as welded Shielding gas: I1 R_e 440 MPa R_m 560 MPa A_5 25% A_v 130 J 50 J…-50°C	1.6 2.0 2.4 3.0	TÜV (1656.), DB (42.132.11), DNV	GTAW solid rod and wire for the welding with argon. Typical fields of use: boiler, tank and pipeline constructions and apparatus engineering.
Union 37 EN 12536: O I AWS A5.3: R45	–	1.5 2.0 2.5 3.0 4.0 5.0 6.0 8.0	DB (70.132.01)	Gas welding rod for unalloyed structual steels up to a yield strength of 235 MPa. Liquide weld pool.
BÖHLER Ni 1-IG EN ISO 636-A: W3Ni1 W 46 5 W3Ni1 AWS A5.28: ER80S-Ni1 (mod.)	Heat treatment: untreated, as welded $R_{p0.2}$ 500 MPa R_m 600 MPa A_5 25% A_v 150 J ≥47 J…-50°C	2.0 2.4	–	Ni-alloyed GTAW rod for welding of offshore pipe work and similar high integrity applications. High impact properties down to -50°C.
Union I 1.2 Ni EN ISO 636-A: W 46 6 W3Ni1 AWS A5.28: ER80S-G	Heat treatment: untreated, as welded Shielding gas: I1 R_e 470 MPa R_m 600 MPa A_5 25% A_v 150 J 47 J…-60°C	2.0 2.5 3.0	TÜV (0513.), DB (42.132.49) KTA 1408.1 (8012), DNV	Ni alloyed welding rod / wire. Good flow characteristics in out of position welding. Very good impact toughness of weld metal at low temperatures. Tested according to KTA 1408.
BÖHLER 2.5 Ni-IG EN ISO 636-A: W2Ni2 W 46 8 W2Ni2 AWS A5.28: ER80S-Ni2	Heat treatment: untreated, as welded R_e 510 MPa R_m 600 MPa A_5 26% A_v 280 J 80 J…-60°C ≥47 J…-80°C	2.0 2.4 3.0	TÜV (01081.), BV, GL, Statoil, SEPROZ, CE	A 2.5% Ni-alloyed GTAW welding rod, copper-coated, for welding of cold-resistant, fine-grained constructional steels and alloyed steels. Low temperature toughness down to -80°C.
BÖHLER DMO-IG EN ISO 21952-A: W MoSi EN ISO 636-A: W2Mo (for rod) AWS A5.28: ER70S-A1 (ER80S-G)	Heat treatment: untreated, as welded R_e 530 MPa R_m 650 MPa A_5 26% A_v 200 J 80 J…-30°C	1.6 2.0 2.4 3.0	TÜV (0020.), DB (42.014.09), KTA 1408.1, BV, DNV, CRS, CE, NAKS	GTAW welding rod, copper-coated, for welding in the construction of boilers, pressure tanks, pipelines, cranes and steel construction for steelwork. High-quality, very tough and crack-resistant weld metal, resistant to ageing. Approved for long-term use at operating temperatures from -30°C to +550°C.
BÖHLER DCMS-IG EN ISO 21952-A: W CrMo1Si AWS A5.28: ER80S-G, ER80S-B2 (mod.)	Heat treatment: annealed 680°C/2h R_e 440 MPa R_m 570 MPa A_5 25% A_v 250 J	1.6 2.0 2.4 3.0	TÜV (0727.), SEPROZ, CE, NAKS	GTAW welding rod, copper-coated, for welding in the construction of boilers, pressure tanks, pipelines, as well as for welding work on quenched and tempered or case-hardened steels. Preferred for 13CrMo4-5. Approved for long-term use at operating temperatures to +570°C. Suitable for step-cooling applications (Bruscato ≤ 15 ppm).
BÖHLER CM 2-IG EN ISO 21952-A: W CrMo2Si AWS A5.28: ER90S-G, ER90S-B3 (mod.)	Heat treatment: annealed 720°C/2h R_e 470 MPa R_m 600 MPa A_5 23% A_v 190 J	1.6 2.0 2.4 3.0	TÜV (1564.), SEPROZ, CE	GTAW welding rod, copper-coated, for welding in the construction of boiler, vessels and tube steels, as well as in the petroleum processing industry, e.g. in cracking plants. Preferred for 10CrMo9-10. Approved for long-term use at operating temperatures to +600°C.

TIG rods, high alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER C 9 MV-IG EN ISO 21952-A: W CrMo91 AWS A5.28: ER90S-B9	Heat treatment: annealed 760°C/2h $R_{p0.2}$ 640 MPa R_m 760 MPa A_5 19% A_v 150 J	2.0 2.4 3.0	TÜV (07106.), CE, NAKS	GTAW welding rod for creep-resistant, quenched and tempered 9-12% chrome steels, especially T91 and P91 steels in turbine and boiler fabrication as well as in the chemical industry. Approved for long-term use at operating temperatures to +650°C.
Thermanit MTS 3 EN ISO 21952-A: W CrMo91 AWS A5.28: ER90S-B9	Heat treatment: annealed 760°C/2h $R_{p0.2}$ 530 MPa R_m 620 MPa A_5 17% A_v 50 J	1.6 2.0 2.4 3.2	TÜV (6166.)	Creep resistant TIG rod, resistant to scaling up to 600°C. Suited for applications with quenched and tempered 9% Cr steels, particularly for matching creep resistant base metal T91 / P91 according to ASTM.
Thermanit MTS 616 EN ISO 21952-A: WZ CrMoWVNb 9 0.5 1.5 AWS A5.28: ER90S-G [ER90S-B9(mod.)]	Heat treatment: annealed 760°C/≥2h $R_{p0.2}$ 560 MPa R_m 720 MPa A_5 15% A_v 41 J	1.6 2.0 2.4 3.2	TÜV (9290.)	Creep resistant. Suited for joining and surfacing applications with matching creep resistant resistant base metal P92 according to ASTM A 335.
BÖHLER EAS 2-IG EN ISO 14343-A: W 19 9 L AWS A5.9: ER308L	Heat treatment: untreated, as welded $R_{p0.2}$ 400 MPa R_m 550 MPa A_5 38% A_v 150 J 75 J…-269°C	1.6 2.0 2.4 3.0	TÜV (00145), DB (43.014.08), DNV, GL, SEPROZ, CE, NAKS	Application in all industry branches where identical steel types are welded, including higher-carbon varieties, as well as ferritic 13% chrome steels, e.g. in the construction of chemical apparatus and storage tanks, in the chemical, pharmaceutical and cellulose industries, among many others. Suitable for cryogenic applications down to -269°C.
BÖHLER EAS 4 M-IG EN ISO 14343-A: W 19 12 3 L AWS A5.9: ER316L	Heat treatment: untreated, as welded $R_{p0.2}$ 470 MPa R_m 610 MPa A_5 38% A_v 140 J ≥32 J…-196°C	1.6 2.0 2.4 3.0	TÜV (00149.), DB (43.014.12), DNV, GL, SEPROZ, CE, NAKS	Application in all industry branches where identical steel types are welded, including higher-carbon varieties, as well as ferritic 13% chrome steels, e.g. in the construction of chemical apparatus and storage tanks, in the chemical and pharmaceutical industries, for the manufacturing of cellulose, artificial silk and textiles, among many other branches. Low temperature service down to -196°C.
BÖHLER SAS 2-IG EN ISO 14343-A: W 19 9 Nb AWS A5.9: ER347	Heat treatment: untreated, as welded $R_{p0.2}$ 490 MPa R_m 660 MPa A_5 35% A_v 140 J ≥32 J…-196°C	1.6 2.0 2.4 3.0	TÜV (00142.), GL, LTSS, SEPROZ, CE, NAKS	Application in all industry branches where identical steel types are welded, as well as ferritic 13% chrome steels, e.g. in the construction of chemical apparatus and storage tanks, in textile and cellulose manufacturing, dyework factories, among many others. Low temperature service down to -196°C and intergranular corrosion resistant up to +400°C.
BÖHLER SAS 4-IG EN ISO 14343-A: W 19 12 3 Nb AWS A5.9: ER318	Heat treatment: untreated, as welded $R_{p0.2}$ 520 MPa R_m 700 MPa A_5 35% A_v 120 J ≥32 J…-120°C	1.0 1.2 1.6 2.0 2.4 3.0	TÜV (00236.), KTA 1408.1, DB (43.014.03), GL, SEPROZ, CE, NAKS	Application in all industry branches where identical steel types are welded, as well as ferritic 13% chrome steels. Also used in the construction of chemical apparatus and storage tanks, textile and cellulose manufacturing, dyework factories, food and beverage production, synthetic resin plants, among many others.
BÖHLER CN 22/9 N-IG EN ISO 14343-A: W 22 9 3 N L AWS A5.9: ER2209	Heat treatment: untreated, as welded $R_{p0.2}$ 600 MPa R_m 800 MPa A_5 33% A_v 150 J	1.6 2.0 2.4 3.2	TÜV (04484.), ABS, DNV, GL, LR, Statoil, CE	GTAW welding rod for welding ferritic-austenitic duplex steels. In addition to improved strength and toughness characteristics, a purposeful adjustment of the composition also gives the weld metal excellent resistance to stress corrosion cracking and pitting.
Avesta 2507/P100 EN ISO 14343: W 25 9 4 N L AWS A5.9: ER2594	Heat treatment: untreated, as welded $R_{p0.2}$ 700 MPa R_m 900 MPa A_5 26% A_v 80 J 45 J…-46°C	1.2 1.6 2.0 2.4 3.2	–	Avesta 2507/P100 rutile is designed for welding super duplex steels such as 2507/1.4410. The weldability of duplex and super duplex steels is excellent but the welding should be adapted to the base material, considering fluidity, joint design, heat input etc. Corrosion resistance: Very good resistance to pitting and stress corrosion cracking in chloride containing environments. PRE_N >40. Meets the corrosion test requirements per ASTM G48 Methods A, B, E (40°C).

TIG rods, high alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
Avesta 253MA EN ISO 14343-A: G 21 10 N	Heat treatment: untreated, as welded $R_{p0.2}$ 535 MPa R_m 725 MPa A_5 37% A_v 60 J Hardness 210 Brinell	1.2 1.6 2.0 2.4 3.2	–	Avesta 253 MA is primarily designed for welding the high temperature stainless steel Outokumpu 253 MA, used for furnaces, combustion chambers and burners. Both the steel and filler metal offers excellent resistance to oxidation up to 1,100°C. The chemical composition of Avesta 253 MA is balanced to give a crack resistant weld metal. The steel often forms a rather thick oxide in welding or hot rolling and oxidized plates and welds must be brushed or ground clean before welding.
BÖHLER A 7 CN-IG EN ISO 14343-A: W 18 8 Mn AWS A5.9: ER307 (mod.)	Heat treatment: untreated, as welded $R_{p0.2}$ 460 MPa R_m 650 MPa A_5 38% A_v 120 J ≥32 J…-110°C	1.6 2.0 2.4	TÜV (00023.), DNV, GL, DB (43.014.28), CE, NAKS, VG 95132	GTAW welding rod for welding of dissimilar joints or difficult-to-weld steels and 14%-Mn steels. Characteristics of weld metal: Cold-work hardening ability, very good resistance to cavity formation, crack resistant, thermal shock resistant, scaling resistant up to 850°C, impervious to sigma-phase embrittlement above +500°C. Service temperatures down to -110°C.
BÖHLER CN 23/12-IG EN ISO 14343-A: W 23 12 L AWS A5.9: ER309L	Heat treatment: untreated, as welded $R_{p0.2}$ 440 MPa R_m 580 MPa A_5 34% A_v 150 J ≥32 J…-120°C	1.6 2.0 2.4 3.2	TÜV (4699.), GL, SEPROZ, DB (43.014.29), CE	GTAW welding rod with increased ferrite content (FN~16) in the weld metal. High cracking resistance for difficult-to-weld materials, as well as for welding of dissimilar joints. Suitable for service temperatures from -120°C up to +300°C.
BÖHLER FFB-IG EN ISO 14343-A: W 25 20 Mn AWS A5.9: ER310 (mod.)	Heat treatment: untreated, as welded $R_{p0.2}$ 420 MPa R_m 630 MPa A_5 33% A_v 85 J ≥32 J…-196°C	1.6 2.0 2.4	SEPROZ	GTAW welding rod for heat-resistant rolled, forged and cast steels of identical type, e.g. in annealing and hardening shops, in steam boiler construction, in the petroleum and ceramic industries. Fully austenitic weld metal. Preferred in the case of aggressive oxidizing, nitrogen-containing or low-oxygen gases. Scaling resistant up to +1,200°C.
BÖHLER FA-IG EN ISO 14343-A: W 25 4 –	Heat treatment: untreated, as welded $R_{p0.2}$ 540 MPa R_m 710 MPa A_5 22% A_v 70 J	2.4	–	GTAW rod for gas-shielded welding of heat resisting, analogous or similar steels. Ferritic- austenitic deposit. The low Ni-content renders this filler metal especially recommendable for applications involving the attack of sulphurous oxidizing or reducing combustion gases. Scaling resistance up to + 1,100°C.
Thermanit 35/45 NB EN ISO 18274: S Ni Z (NiCr36Fe15Nb0.8)	Heat treatment: untreated $R_{p0.2}$ 450 MPa R_m 550 MPa A_5 – A_v –	2.0 2.4 3.2	–	Resistant to scaling up to 1,180°C. For joining and surfacing work on matching/similar heat resistant cast steel grades
Thermanit Nicro 82 EN ISO 18274: S Ni 6082 (NiCr20Mn3Nb) AWS A5.14: ERNiCr-3	Heat treatment: untreated, as welded $R_{p0.2}$ 400 MPa R_m 620 MPa A_5 35% A_v 150 J	1.6 2.0 2.4 3.2	TÜV (1703.), DB (43.132.11)	Nickel base, stainless TIG rod; heat resistant and creep resistant. Cold toughness down to -269°C. For welding of austenitic-ferritic joints as well as for joining or cladding of heat resistant Cr and CrNi steels and Nickel base alloys. Temperature limits: 500°C in sulphureous atmospheres, 800°C max. for fully stressed welds. Resistant to scaling up to 1,000°C.
Thermanit 625 EN ISO 18274: S Ni 6625 (NiCr22Mo9Nb) AWS A5.14: ERNiCrMo-3	Heat treatment: untreated, as welded $R_{p0.2}$ 460 MPa R_m 740 MPa A_5 35% A_v 120 J 100 J…-196°C	1.6 2.0 2.4 3.2	TÜV (3464.), DB (43.132.25), DNV	Nickel base, stainless TIG rod; high resistance to corrosive environments. Resistant to stress corrosion cracking. Resistant to scaling up to 1,100°C. Temperature limit: 500°C max. in sulphureous atmospheres. High temperature resistant up to 1,000°C. Cold toughness down to -196°C. Suitable for joining or cladding of matching/similar corrosion resistant steels, heat or creep resistant steels and alloys. Also for joining of cryogenic austenitic CrNi(N) steels or cast steels.
Thermanit 617 EN ISO 18274: S Ni 6617 (NiCr22Co12Mo9) AWS A5.14: ERNiCrCoMo-1	Heat treatment: untreated $R_{p0.2}$ 450 MPa R_m 700 MPa A_5 30% A_v 60 J	2.0 2.4	TÜV (06845.)	Resistant to scaling up to 1,100°C, high temperature resistant up to 1,000°C. High resistance to hot gases in oxidizing resp. carburizing atmospheres. For joining and surfacing applications with matching and similar heat resistant steels and alloys.
Thermanit NiMo C 24 EN ISO 18274: S Ni 6059 (NiCr23Mo16) AWS A5.14: ERNiCrMo-13	Heat treatment: untreated $R_{p0.2}$ 450 MPa R_m 700 MPa A_5 35% A_v 120 J	1.6 2.0 2.4 3.2	TÜV (6462.), GL (NiCr23Mo16)	Nickel based alloy. High corrosion resistance in reducing and, above all, in oxidzing environments. For joining and surfacing with matching and similar alloys and cast alloys. For welding the cladded side of plates of matching and similar alloys.

Solid wire, unalloyed and low-alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER EMK 6 EN ISO 14341-A: G 42 4 M21 3Si1 G 42 4 C1 3Si1 AWS A5.18: ER70S-6	Heat treatment: untreated, as welded Shielding gas: M21 R_e 440 MPa R_m 560 MPa A_5 30% A_v 160 J ≥47 J…-40°C	0.8 1.0 1.2 1.6	TÜV (3036.), DB (42.014.11), ABS, CWB, DNV, GL, LR, LTSS, SEPROZ, CE	Universally applicable copper-coated solid wire with a practically spatter-free metal transfer for either CO_2 or gas mixtures.
BÖHLER EMK 8 EN ISO 14341-A: G 46 4 M21 4Si1 G 46 4 C1 4Si1 AWS A5.18: ER70S-6	Heat treatment: untreated, as welded Shielding gas: M21 R_e 480 MPa R_m 620 MPa A_5 26% A_v 150 J ≥47 J…-40°C	0.8 1.0 1.2	TÜV (3038.), DB (42.014.05), ABS, DNV, GL, LR, SEPROZ, CE, NAKS	Copper-coated solid wire with universal application in storage tanks, and for boiler and structural work. Practically spatter-free metal transfer using either gas mixtures or CO_2.
BÖHLER HL 46-MC EN ISO 17632-A: T 46 2 M M 1 H5 AWS A5.18: E70C-6MH4	Heat treatment: untreated, as welded R_e 490 MPa R_m 590 MPa A_5 25% A_v 110 J 50 J…-20°C		TÜV (12542.), DB (42.014.43), DNV, GL, LR, BV, CE	Metal-cored high-efficiency wire for semi-automatic and fully automatic joint welding of unalloyed and fine-grained constructional steels and service temperatures from -20°C to +450°C. Very high metal recovery between 93 and 97% and deposition rate up to 9 kg/hr. Steady spray arc-like droplet transfer with minimal spatter formation. Good penetration, high resistance to porosity, good wetting behaviour as well as low hydrogen contents (≤ 5 ml/100 g deposit) are further quality features of this flux cored wire. Ideal for horizontal and flat fillet welds. Compared to solid wires 20% higher productivity can be achieved. This wire is designed for minimum oxide residues permit the welding of multi passes without the need for inter-run cleaning.
Union K 56 EN ISO 14341-A: G 46 2 C1 4Si1 / G 46 4 M21 4Si1 AWS A5.18: ER70S-6	Heat treatment: untreated, as welded Shielding gas: CO_2 R_e 450 MPa R_m 550 MPa A_5 25% A_v 90 J 47 J…-20°C Shielding gas: M21 R_e 480 MPa R_m 580 MPa A_5 24% A_v 95 J 65 J…-20°C 47 J…-40°C	0.8 1.0 1.2 1.6	TÜV (0376.), DB (42.132.01), ABS, BV, GL, LR, DNV	GMAW solid wire electrode for welding unalloyed and low alloy steels with CO_2 or gas mixture. Low spatter transfer in short and spray arc range. High arc stability also at high welding current amperage. Large application range; specially suited for steels of higher strength in boiler and pipeline construction, shipbuilding, vehicle manufacturing and structural engineering.
BÖHLER SG 2 EN ISO 14341-A: G 38 2 C1 3Si1 / G 42 3 M21 3Si1 AWS A5.18: ER70S-6	Heat treatment: untreated, as welded Shielding gas: M21 R_e 420 MPa R_m 500-640 MPa A_5 20% A_v 120 J 47 J…-20°C Shielding gas: CO_2 R_e 380 MPa R_m 470-600 MPa A_5 20% A_v 47 J	0.8 1.0 1.2 1.6	TÜV (3640.), DB (42.132.15), GL	GMAW solid wire electrode for welding unalloyed and low alloy steels with gas mixtures (M1 – M3). Low spatter transfer in the short and spray arc range. Used in boiler construction, shipbuilding, structural engineering and vehicle manufacturing.
Union MV 70 EN ISO 17632-A: T 46 6 M M 1 H5 / T 42 5 M C 1 H5 AWS A5.18: E70C-6MH4 / E70C-6CH4	Heat treatment: untreated, as welded Shielding gas: M21 $R_{p0.2}$ 460 MPa R_m 560 MPa A_5 24% A_v 140 J 80 J…-20°C 47 J…-60°C	1.2 1.6	TÜV (11076.), DB (42.132.33), ABS, DNV, GL, LR, BV	Union MV 70 is a high-efficiency seamless copper coated wire, with metal powder filling for all position welding with mixed gas M21, M31 and C1 according to EN ISO 14175.
BÖHLER NiCu 1-IG EN ISO 14341-A: G 42 4 M21 Z3Ni1Cu G 42 4 C1 Z3Ni1Cu AWS A5.28: ER80S-G	Heat treatment: untreated, as welded $R_{p0.2}$ 500 MPa R_m 580 MPa A_5 26% A_v 130 J ≥47 J…-40°C	1.0 1.2	DB (42.014.08), CE	Ni-Cu alloyed wire, copper-coated, for metal/gas-shielded arc welding on weather-resistant steels, constructional steels and special steels. Due to the copper alloying, the weld metal features higher resistance to atmospheric corrosion.

Solid wire, unalloyed and low-alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER alform® 700-IG EN ISO 16834-A: G 79 5 M21 Mn4Ni1.5CrMo AWS A5.28: ER110S-G	Heat treatment: untreated, as welded $R_{p0.2}$ 790 MPa R_m 880 MPa A_5 ≥16% A_V ≥90 J ≥47 J…-50°C	1.0 1.2	NAKS	Medium alloyed solid wire for gas metal arc welding of quenched and tempered fine grained steels. Optimized and proofed welding results can be expected with the appropriate steel alform® 700 M.
BÖHLER X 70-IG EN ISO 16834-A: G Mn3Ni1CrMo G 69 5 M21 Mn3Ni1CrMo AWS A5.28: ER110S-G	Heat treatment: untreated, as welded $R_{p0.2}$ 800 MPa R_m 900 MPa A_5 19% A_V 190 J ≥47 J…-50°C	1.0 1.2	TÜV (5547.), DB (42.014.19), GL, SEPROZ, CE, ABS, BV, DNV, LR, RMR	Copper-coated solid wire for welding of high-strength, quenched and tempered fine-grained constructional steels with a minimum yield strength of 690 MPa. Good low temperature impact strength down to -50°C.
Union NiMoCr EN ISO 16834-A: G 69 6 M21 Mn4Ni1.5CrMo AWS A5.28: ER100S-G	Heat treatment: untreated, as welded Shielding gas: CO_2 $R_{p0.2}$ 680 MPa R_m 740 MPa A_5 18% A_V 80 J 47 J…-40°C Shielding gas: M21 $R_{p0.2}$ 720 MPa R_m 780 MPa A_5 16% A_V 100 J 47 J…-60°C	0.8 1.0 1.2	TÜV (2760.), DB (42.132.08), ABS, DNV, BV, GL, LR	Medium alloy solid wire electrode for shielded arc welding of quenched and tempered and thermomechanically treated fine grained structural steels; for joint welding of wear resistant steels. For use with CO_2 and gas mixture. Outstanding toughnesss of the weld metal at low temperatures. For use in crane and vehicle manufacturing.
BÖHLER alform® 900-IG EN ISO 16834-A G 89 6 M21 Mn4Ni2CrMo AWS A5.28: ER120S-G	Heat treatment: untreated, as welded $R_{p0.2}$ 890 MPa R_m 950 MPa A_5 ≥15% A_V ≥47 J…-60°C	1.0 1.2	–	Medium alloyed solid wire for gas metal arc welding of quenched and tempered fine grained steels. Optimized and proofed welding results can be expected with the appropriate steel alform® 900 M x-treme.
Union X 90 EN ISO 16834-A: G 89 6 M21 Mn4Ni2CrMo AWS A5.28: ER120S-G	Heat treatment: untreated, as welded $R_{p0.2}$ 890 MPa R_m 950 MPa A_5 15% A_V 90 J 47 J…-60°C	1.0 1.2	TÜV (7675.), DB (42.132.12)	Medium alloy solid wire electrode for shielded arc welding of quenched and tempered fine grained structural steels. Outstandingly tough weld metal at low temperatures when deposited with gas mixture. Good resistance to cold cracking due to high purity of the wire surface. Used in crane and vehicle manufacture.
BÖHLER DMO-IG EN ISO 21952-A: G MoSi AWS A5.28: ER70S-A1 (ER80S-G)	Heat treatment: untreated, as welded $R_{p0.2}$ 500 MPa R_m 600 MPa A_5 25% A_V 150 J ≥47 J…-40°C	0.8 1.0 1.2	TÜV (0021.), DB (42.014.09), SEPROZ, CE, NAKS	Solid wire, copper-coated, for welding in the construction of boilers, pressure tanks, pipelines, cranes and steel construction. High-quality, very tough and crack-resistant weld metal, resistant to ageing. Low temperature toughness down to -40°C. Approved for long-term use at operating temperatures to +550°C.
BÖHLER DCMS-IG EN ISO 21952-A: G CrMo1Si AWS A5.28: ER80S-G ER80S-B2 (mod.)	Heat treatment: annealed 680°C/2h $R_{p0.2}$ 440 MPa R_m 570 MPa A_5 23% A_V 150 J	0.8 1.0 1.2 1.6	TÜV (1091.), DB (42.014.15), SEPROZ, CE	Solid wire, copper-coated, for welding in the construction of boilers, pressure tanks, pipelines, as well as for welding work on quenched and tempered or case-hardened steels. Preferred for 13CrMo4-5. Approved for long-term use at operating temperatures to +570°C.
BÖHLER CM 2-IG EN ISO 21952-A: G CrMo2Si AWS A5.28: ER90S-G ER90S-B3 (mod.)	Heat treatment: annealed 720°C/2h $R_{p0.2}$ 440 MPa R_m 580 MPa A_5 23% A_V 170 J	0.8 1.0 1.2	TÜV (1085.), DB (42.014.39), SEPROZ, CE	Solid wire, copper-coated, for welding in the construction of boilers, vessels plates and tube steels, as well as in the petroleum processing industry, e.g. in cracking plants. Preferred for 10CrMo9-10. Approved for long-term use at operating temperatures to +600°C.

Solid wire, high alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER C 9 MV-IG EN ISO 21952-A: G CrMo91 AWS A5.28: ER90S-B9	Heat treatment: annealed 760°C/2h $R_{p0.2}$ 620 MPa R_m 760 MPa A_5 18% A_v 80 J	1.0 1.2	–	Solid wire electrode for creep-resistant, quenched and tempered 9-12% chrome steels, especially T91 and P91 steels in turbine and boiler fabrication as well as in the chemical industry. Approved for long-term use at operating temperatures to +650°C.
BÖHLER C 9 MV-MC EN ISO 17634-B: TS 69T15-1G-9C1MV AWS A5.28: E90C-B9	Heat treatment: annealed 760°C/3h $R_{p0.2}$ 650 MPa R_m 760 MPa A_5 18% A_v 55 J	1.2	–	Metal cored wire for creep-resistant, quenched and tempered 9-12% chrome steels, especially T91 and P91 steels in turbine and boiler construction as well as in the chemical industry.
Thermanit MTS 3 EN ISO 21952-A: G CrMo91 AWS A5.28: ER90S-B9	Heat treatment: annealed 760°C/2h $R_{p0.2}$ 520 MPa R_m 620 MPa A_5 16% A_v 50 J	1.0 1.2	–	Creep resistant GMAW wire, resistant to scaling up to 600°C. Suited for joining and surfacinig applications with quenched and tempered 9% Cr steels, particularly for matching creep resistant base metal T91 / P91 according to ASTM.
BÖHLER CAT 430L Cb-IG EN ISO 14343-A: G Z18 L Nb AWS A5.9: ER430 (mod.)	Brinell-Hardness HB: untreated, as welded* 150 annealed** 130 * untreated, as welded, shielding gas Ar + 8-10% CO_2 ** annealed, 760°C/2h, shielding gas Ar + 8-10% CO_2	1.0	–	Special GMAW solid wire for catalytic converters as well as exhaust silencers, mufflers, manifolds, and manifold elbows of analogous or similar materials. Resists scaling up to +900°C. Outstanding feeding characteristics. Very good welding and flow characteristics.
BÖHLER CAT 430L CbTi-IG EN ISO 14343-A: G ZCr 18 NbTi L AWS A5.9: ER430Nb (mod.)	Brinell-Hardness HB: untreated, as welded* 150 annealed** 130 * untreated, as welded, shielding gas Ar + 0.5-5% CO_2 ** annealed, 760°C/2h, shielding gas Ar + 0.5-5% CO_2	1.0 1.2	–	Special GMAW solid wire for joint welding and surfacing of exhaust systems. For analogous or similar materials. Double stabilized (Nb + Ti) with minimum affection to grain growth. Resists scaling up to +900°C. Outstanding feeding characteristics. Very good welding and flow characteristics.
Thermanit JE 308L Si EN ISO 14343-A: G 19 9 L Si AWS A5.9: ER308LSi	Heat treatment: untreated, as welded $R_{p0.2}$ 350 MPa R_m 570 MPa A_5 35% A_v 75 J 35 J…-196°C	1.0 1.2 1.6	TÜV (0555.), DB(43.132.08), DVN	Stainless; resistant to intercrystalline corrosion and wet corrosion up to 350°C. Corrosion-resistance similar to matching low-carbon and stabilized austenitic 18/8 CrNi(N) steels/cast steel grades. Cold toughness down to -196°C. For joining and surfacing applications with matching and similar - stabilized and non-stabilized - austenitic CrNi(N) and CrNiMo(N) steels/cast steel grades. For joining and surfacing work on cryogenic matching/similar austentic CrNi(N) steels/cast steels grades.
Thermanit GE 316L Si EN ISO 14343-A: G 19 12 3 L Si AWS A5.9: ER316LSi	Heat treatment: untreated, as welded $R_{p0.2}$ 380 MPa R_m 560 MPa A_5 35% A_v 70 J	0.8 1.0 1.2 1.6	TÜV (0489.), DB (43.132.10), LR, CWB, GL, DNV	Stainless; resistant to intercrystalline corrosion and wet corrosion up to 400°C. Corrosion-resistance similar to matching low-carbon and stabilized austenitic 18/8 CrNiMo steels/cast steel grades. For joining and surfacing application with matching and similar – non-stabilized – austenitic CrNi(N) and CrNiMo(N) steels and cast steel grades.
BÖHLER SAS 2-IG (Si) EN ISO 14343-A: G 19 9 Nb Si AWS A5.9: ER347Si	Heat treatment: untreated, as welded $R_{p0.2}$ 460 MPa R_m 630 MPa A_5 33% A_v 110 J ≥32 J…-196°C	0.8 1.0 1.2	TÜV (00025.), GL, LTSS, SEPROZ, CE, NAKS	Application in all industry branches where identical steel types are welded, including higher-carbon varieties, as well as ferritic 13% chrome steels, e.g. in the construction of chemical apparatus and storage tanks, in the chemical, pharmaceutical and cellulose industries, among many others. Excellent gliding ability and feed characteristics. Low temperature service down to -196°C and intergranular corrosion resistant up to +400°C.

Solid wire, high alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER SAS 4-IG (Si) EN ISO 14343-A: G 19 12 3 Nb Si AWS A5.9: ER318 (mod.)	Heat treatment: untreated, as welded $R_{p0.2}$ 490 MPa R_m 670 MPa A_5 33% A_V 100 J ≥32 J…-120°C	0.8 1.0 1.2	TÜV (03492.), DB (43.014.04), SEPROZ, CE, NAKS	Solid wire for use in all industry branches where identical steel types are welded, including higher-carbon varieties, as well as ferritic 13% chrome steels. Areas of application: Construction of chemical apparatus and storage tanks, textile and cellulose manufacturing, dyework factories, food and beverage production, synthetic resin plants, among many others.
BÖHLER CN 13/4-IG EN ISO 14343-A: G 13 4 AWS A5.9: ER410NiMo (mod.)	Heat treatment: untreated, as welded $R_{p0.2}$ 950 MPa R_m 1210 MPa A_5 12% A_V 36 J	1.2	TÜV (04110.), SEPROZ, CE	Solid wire for corrosion-resistant, martensitic and martensitic-ferritic rolled, forged and cast steels of identical type. Application in the construction of hydro turbines, compressors and steam power stations. Resistant to water vapour, steam and sea water atmospheres.
BÖHLER CN 13/4-MC EN ISO 17633-A: T 13 4 M M12 2 AWS A5.9: EC410NiMo (mod.)	Heat treatment: annealed 600°C/2h $R_{p0.2}$ 760 MPa R_m 900 MPa A_5 16% A_V 65 J 60 J…-20°C	1.2 1.6	SEPROZ	Metal cored wire for corrosion-resistant, soft martensitic and martensitic-ferritic rolled, forged and cast steels of identical type. Application in the construction of hydro turbines and compressors. BÖHLER CN 13/4-MC exhibits very good toughness properties of the heat-treated weld metal, as well as a very low hydrogen content in the weld metal (under AWS conditions HD max. 4 ml/100 g) and excellent feeding characteristics.
BÖHLER CN 22/9 N-IG EN ISO 14343-A: G 2 9 3 N L AWS A5.9: ER2209	Heat treatment: untreated, as welded $R_{p0.2}$ 660 MPa R_m 830 MPa A_5 28% A_V 85 J ≥32 J…-40°C	1.0 1.2	TÜV (04483.), DB (43.014.26), DNV, GL, Statoil, SEPROZ, CE	Solid wire for welding ferritic-austenitic duplex steels. In addition to improved strength and toughness characteristics, a purposeful adjustment of the composition also gives the weld metal excellent resistance to stress corrosion cracking and pitting.
Avesta 2507/P100 EN ISO 14343-A: G 25 9 4 N L AWS A5.9: ER2594	Heat treatment: untreated, as welded $R_{p0.2}$ 600 MPa R_m 830 MPa A_5 27% A_V 140 J 100 J…-50°C	0.8 1.0 1.2 1.6	–	Avesta 2507/P100 is designed for welding super duplex steels such as 2507, ASTM S32760, S32550 und S31260. 2507/P100 GMAW solid wire shows its best characteristics when using impuls arc welding. Corrosion resistance: Very good resistance to pitting and stress corrosion cracking in chloride containing environments. $PREN$ >40. Meets the corrosion test requirements per ASTM G48 Methods A, B, E (40°C).
Avesta LDX 2101 EN ISO 14343-A: G 23 7 N L	Heat treatment: untreated, as welded $R_{p0.2}$ 520 MPa R_m 710 MPa A_5 32% A_V 150 J 110 J…-40°C	0.8 1.0 1.2 1.6	–	Avesta LDX 2101 is designed for welding the duplex stainless steel Outokumpu LDX 2101®. LDX 2101 is a “lean duplex” steel with excellent strength and medium corrosion resistance. The steel is used in many various applications such as bridges, process equipment in desalination, pressure vessel in the pulp/paper industry and transport and storage tanks for chemicals. To ensure the right ferrite balance in the weld metal, Avesta LDX 2101 is over-alloyed with respect to nickel. Welding is possible as well under short arc, spray arc or impuls arc. Using impuls arc, welding results both in flat and horizontal as well as in vertical position are good. Corrosion resistance: Good resistance to general corrosion. Better resistance to pitting, crevice corrosion and stress corrosion cracking than 1.4301/AISI 304.
Avesta 253MA	Heat treatment: untreated, as welded $R_{p0.2}$ 440 MPa R_m 680 MPa A_5 36% A_V 130 J Hardness 210 Brinell	0.8 1.0 1.2	–	Avesta 253 MA is primarily designed for welding the high temperature stainless steel Outokumpu 253 MA, used for furnaces, combustion chambers and burners. Both the steel and filler metal offers excellent resistance to oxidation up to 1100°C. The chemical composition of Avesta 253 MA is balanced to give a crack resistant weld metal. The steel often forms a rather thick oxide in welding or hot rolling and oxidized plates and welds must be brushed or ground clean before welding. Corrosion resistance: Excellent resistance to high temperature corrosion. Not intended for applications exposed to wet corrosion.
BÖHLER A 7 CN-IG EN ISO 14343-A: G 18 8 Mn AWS A5.9: ER307 (mod.)	Heat treatment: untreated, as welded $R_{p0.2}$ 430 MPa R_m 640 MPa A_5 36% A_V 110 J ≥32 J…-110°C	0.8 1.0 1.2 1.6	TÜV (00024.), DB (43.017.07), CE, GL, DNV	Special solid wire for welding of dissimilar joints or difficult-to-weld steels and 14%-Mn steels. All-purpose filler metal with many uses. Characteristics of weld metal: Cold-work hardening ability, very good resistance to cavity formation, crack resistant, thermal shock resistant, scaling resistant up to 850°C, impervious to sigma-phase embrittlement above +500°C. Service temperatures down to -110°C.

Solid wire, high alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
Thermanit 25/14 E-309L Si EN ISO 14343-A: G 23 12 L Si AWS A5.9: ER309LSi	Heat treatment: untreated, as welded $R_{p0.2}$ 400 MPa R_m 550 MPa A_5 30% A_v 55 J	0.8 1.0 1.2	GL, TÜV (12312.)	Stainless; (wet corrosion up to 350°C. Well suited for depositing intermediate layers when welding cladded materials. Favourably high Cr and Ni contents, low C content. For joining unalloyed/low-alloy steels/cast steel grades or stainless heat resistant Cr steels/cast steel grades to austenitic steels/cast steel grades. For depositing intermediate layers when welding the side of plates clad with low-carbon – non stabilized or stabilized – austenitic CrNiMo(N) austenitic metals.
BÖHLER CN 23/12-MC EN ISO 17633-A: T 23 12 L M M12 1 AWS A5.9: EC309L	Heat treatment: untreated, as welded $R_{p0.2}$ 400 MPa R_m 540 MPa A_5 32% A_v 90 J 70 J…-120°C	1.2 1.6	–	Metal cored wire for welding of dissimilar joints between high-alloy Cr and CrNi(Mo) steels and unalloyed or low-alloy steels. BÖHLER CN 23/12-MC features very good welding, wetting and wire-feed characteristics, as well as high metallurgical reliability after mixing of different materials. Suitable for service temperatures from -120°C up to +300°C.
BÖHLER CN 21/33 Mn-IG EN ISO 14343-A: G Z21 33 MnNb –	Heat treatment: untreated, as welded $R_{p0.2}$ ≥400 MPa R_m ≥600 MPa A_5 ≥17% A_v ≥50 J	1.0 1.2	–	Solid wire for joint welding and cladding of identical or similar type heat-resistant steels and steel casting grades. Typical alloys for the welding of pyrolysis furnance tubes in the petrochemical industry.
BÖHLER FFB-IG EN ISO 14343-A: G 25 20 Mn AWS A5.9: ER310 (mod.)	Heat treatment: untreated, as welded $R_{p0.2}$ 400 MPa R_m 620 MPa A_5 38% A_v 95 J	0.8 1.0 1.2	SEPROZ	Solid wire for heat-resistant rolled, forged and cast steels of identical type, e.g. in annealing and hardening shops, in steam boiler construction, in the petroleum and ceramic industries. Fully austenitic weld metal. Preferred in the case of aggressive oxidizing, nitrogen-containing or low-oxygen gases. Scaling resistant up to +1,200°C.
Thermanit Nicro 82 EN ISO 18274: S Ni 6082 (NiCr20Mn3Nb) AWS A5.14: ERNiCr-3	Heat treatment: untreated, as welded $R_{p0.2}$ 380 MPa R_m 620 MPa A_5 35% A_v 90 J 80 J…-196°C	0.8 1.0 1.2 1.6	TÜV (3089.), DNV (NV 5 Ni), GL (NiCr20Nb)	Nickel based alloy; heat and creep resistant. Cold toughness down to -269°C. Good for welding austenitic-ferritic joints. For welding of austenitic-ferritic joints as well as for joining or cladding of heat resistant Cr and CrNi steels and Nickel base alloys. Temperature limits: 500°C in sulphureous atmospheres, 800°C max. for fully stressed welds. Resistant to scaling up to 1,000°C.
Thermanit 625 EN ISO 18274: S Ni 6625 (NiCr22Mo9Nb) AWS A5.14: ERNiCrMo-3	Heat treatment: untreated $R_{p0.2}$ 460 MPa R_m 740 MPa A_5 30% A_v 60 J 40 J…-196°C	0.8 1.0 1.2 1.6	TÜV (3462.), DB (43.132.25)	Nickel based alloy; high resistance to corrosive environment. Resistant to stress corrosion cracking. Resistant to scaling up to 1,100°C. Temperature limit: 500°C max. in sulphureous atmospheres. High temperature resistant up to 1,000°C. Cold toughness down to -196°C. Suitable for joining or cladding of matching/similar corrosion resistant steels, heat or creep resistant steels and alloys. Also for joining of cryogenic austenitic CrNi(N) steels or cast steels.
Thermanit NiMo C 24 EN ISO 18274: S Ni 6059 (NiCr23Mo16) AWS A5.14: ERNiCrMo-13	Heat treatment: untreated, as welded $R_{p0.2}$ 420 MPa R_m 700 MPa A_5 40% A_v 60 J	1.0 1.2 1.6	TÜV (6461.)	Nickel based alloy. High corrosion resistance in reducing and, above all, in oxidizing environments. For joining and surfacing with matching and similar alloys and cast alloys. For welding the cladded side of plates of matching and similar alloys.

Wire/flux combination, un- and low-alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER EMS 2 + BB 24 Wire/flux combination: EN ISO 14171-A: S 38 6 FB S2 AWS A 5.17: F7A8-EM12K F6P6-EM12K	Heat treatment: untreated, as welded R_e 440 MPa R_m 520 MPa A_5 30% A_v 185 J 90 J…-60°C	2.0 2.5 3.0 4.0	TÜV (7808.) Wire: TÜV (02603.), KTA 1408.1, DB (52.014.03), SEPROZ	The SAW wire BÖHLER EMS 2 is universally applicable in shipbuilding, steel construction as well as for boiler and storage tanks. It is also suitable for joint welds of standard and fine-grained constructional steels.
BÖHLER EMS 3 + BB 24 Wire/flux combination: EN ISO 14171-A: S 42 4 FB S3 AWS A 5.17: F7A4-EH10K F7P6-EH10K	Heat treatment: untreated, as welded $R_{p0.2}$ 455 MPa R_m 550 MPa A_5 28% A_v 180 J 70 J…-40°C	3.0 4.0	TÜV (7811.) Wire: TÜV (02603.), KTA 1408.1, DB (52.014.04), SEPROZ	The solid SAW wire BÖHLER EMS 3 is universally applicable in shipbuilding, steel construction as well as for boiler and storage tanks. It is also suitable for joint welds of standard and fine-grained constructional steels.
Union S 2 + UV 420 TT Wire/flux combination: EN ISO 14171-A: S 35 4 FB S2 AWS A 5.17: F7A4-EM12 F6P6-EM12	Heat treatment: untreated, as welded $R_{p0.2}$ 400 MPa R_m 510 MPa A_5 26% A_v 160 J 100 J…-20°C 47 J…-60°C	2.0 2.5 3.0 4.0	TÜV (3358.), DB (51.132.02)	General structural steels up to S355JR, boiler plates up to P295GH, shipbuilding steels, pipe steels up to L360 and unalloyed boiler tubes, fine grained structural steels up to P355N, S355N.
Union S 3 + UV 420 TT Wire/flux combination: EN ISO 14171-A: S 38 4 FB S3 AWS A 5.17: F7A4-EH10K	Heat treatment: untreated, as welded $R_{p0.2}$ 400 MPa R_m 510 MPa A_5 26% A_v 160 J 100 J…-20°C 47 J…-60°C	3.0 4.0 5.0	TÜV (1795.)	General structural steels up to S355JR, boiler plates up to P355GH shipbuilding steels, pipe steels up to L360 and unalloyed boiler tubes, fine grained structural steels up to P355N, S355N.
Union S 3 Si + UV 418 TT Wire/flux combination: EN ISO 14171-A: S 46 6 FB S3Si AWS A 5.17: F7A8-EH12K	Heat treatment: untreated, as welded $R_{p0.2}$ 460 MPa R_m 550 MPa A_5 26% A_v 160 J 120 J…-20°C 47 J…-60°C	2.5 3.0 4.0	TÜV (7276.), DB (51.132.05), DNV, GL, LR, BV	General structural steels and fine grained steels up to S460N, P460N. Especially for offshore steels together with flux UV 418 TT.
BÖHLER Ni 2-UP + UV 421 TT Wire/flux combination: EN ISO 14171-A: S 46 8 FB S2Ni2 AWS A 5.23: F8A10-ENi2-Ni2	Heat treatment: untreated, as welded $R_{p0.2}$ 480 MPa R_m 580 MPa A_5 22% A_v 160 J 47 J…-80°C	2.5 3.0	TÜV (11914.) Wire: TÜV (2603.), DB (52.014.10), KTA, SEPROZ	Wire/flux combination for joint welding of cryogenic and ageing resistance fine grained and Ni-alloyed steels. The flux react metallurgical neutral. Excellent slag detachability, smooth beads, good wetting and low hydrogen contents (≤ 5 ml/100 g) are further important features.
Union S 2 Ni 2,5 + UV 421 TT Wire/flux combination: EN ISO 14171-A: S 46 8 FB S2Ni2 AWS A 5.23: F8A10-ENi2-Ni2	Heat treatment: untreated, as welded $R_{p0.2}$ 460 MPa R_m 560 MPa A_5 24% A_v 160 J 120 J…-20°C 60 J…-60°C	2.5 3.0 4.0	TÜV (2213.), DB (51.132.06) ABS, BV, GL, LR, DNV	Cryogenic fine grained steels up to S460NL, P460NL and special structual steels e.g. 12Ni14G1.
Union S 2 Ni 3,5 + UV 421 TT Wire/flux combination: EN ISO 14171-A: S 46 8 FB S2Ni3 AWS A 5.23: F8A15-ENi3-Ni3	Heat treatment: untreated, as welded $R_{p0.2}$ 460 MPa R_m 560 MPa A_5 25% A_v 160 J 120 J…-20°C 47 J…-60°C	3.0 4.0	–	For welding of cryogenic steels e.g. 10Ni14, SA350G.LF3, SA 203 Gr. D.

N normalized, 920°C/air
SR stress relieved, 580-620°C
All values at test temperature +20°C

SR* 750°C/4h, SR** 760°C/4h
A annealed, 580-620°C/air

A* annealed, 670-720°C
SO 60h 550°C + 40h 620°C/air

Wire/flux combination, un- and low-alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
Union S 3 NiMo + UV 420 TTR / UV 420 TTR-W Wire/flux combination: EN ISO 14171-A: S 50 6 FB S3Ni1,5Mo AWS A 5.23: F9A8-EG-F1	Heat treatment: untreated, as welded $R_{p0.2}$ 560 MPa R_m 620 MPa A_5 22% A_v 160 J Heat treatment: N+A $R_{p0.2}$ 420 MPa R_m 540 MPa A_5 24% A_v 120 J	3.0 4.0	TÜV (1797.)	Creep resistant fine grained steels.
Union S 3 NiMo 1 + UV 420 TT Wire/flux combination: EN ISO 14171-A: S 50 6 FB S3Ni1Mo AWS A 5.23: F9A8-EF3-F3	Heat treatment: untreated, as welded $R_{p0.2}$ 560 MPa R_m 620 MPa A_5 20% A_v 160 J Heat treatment: SO $R_{p0.2}$ 500 MPa R_m 620 MPa A_5 24% A_v 150 J	2.0 2.5 3.0 4.0	TÜV (3020.)	For welding of reactor fine grained steels e.g. 22NiMoCr37, 20 MnMo44, 20MnMoNi55, WB 36.
Union S 3 NiMoCr + UV 421 TT Wire/flux combination: EN ISO 26304-A: S 69 6 FB SZ3Ni2,5CrMo AWS A 5.23: F11A8-EG-F6	Heat treatment: untreated, as welded $R_{p0.2}$ 690 MPa R_m 780 MPa A_5 17% A_v 120 J 60 J…-40°C 47 J…-60°C Heat treatment: SR at 580°C $R_{p0.2}$ 690 MPa R_m 780 MPa A_5 18% A_v 100 J 60 J…-20°C 47 J…-40°C	2.0 2.4 3.0 4.0	TÜV (5063.), DB (51.132.06), BV, WIWEB, GL, LR, DNV, ABS	Fine grained steels up to P690Q, S690QL1, S700MC.
Union S 2 Mo + UV 420 TTR / UV 420 TTR-W Wire/flux combination: EN ISO 14171-A: S 46 4 FB S2Mo AWS A 5.23: F8A4-EA2-A3	Heat treatment: untreated, as welded $R_{p0.2}$ 470 MPa R_m 550 MPa A_5 25% A_v 140 J Heat treatment: N+A $R_{p0.2}$ 290 MPa R_m 440 MPa A_5 26% A_v 120 J	2.0 2.5 3.0 4.0	TÜV (3438.)	Mo alloyed steels and boiler plates of 16Mo3, fine grained steels up to S460N, P460N and similar pipeline steels like StE 480 TM.
Union S 3 Mo + UV 420 TT Wire/flux combination: EN ISO 14171-A: S 46 4 FB S3Mo AWS A 5.23: F8A4-EA4-A4	Heat treatment: untreated, as welded $R_{p0.2}$ 470 MPa R_m 550 MPa A_5 24% A_v 140 J Heat treatment: N+A $R_{p0.2}$ 320 MPa R_m 510 MPa A_5 26% A_v 130 J	2.4 3.0 4.0	TÜV (1796.)	Mo alloyed steels and boiler plates of 16Mo3, fine grained steels up to S460N, P460N.

N normalized, 920°C/air
SR stress relieved, 580-620°C
SR* 750°C/4h, SR** 760°C/4h
A annealed, 580-620°C/air
A* annealed, 670-720°C
SO 60h 550°C + 40h 620°C/air
All values at test temperature +20°C

Wire/flux combination, un- and low-alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
Union S 1 CrMo 2 + UV 420 TTR / UV 420 TTR-W Wire/flux combination: EN ISO 24589-A: S S CrMo2 FB AWS A 5.23: F9P2-EB3R-B3R	Heat treatment: A* $R_{p0.2}$ 460 MPa R_m 560 MPa A_5 22% A_v 140 J	2.0 2.5 3.0 4.0	–	Creep resistant boiler steels e.g. 10CrMo9-10 or 12CrMo9-10
Union S 2 CrMo + UV 420 TTR / UV 420 TTR-W Wire/flux combination: EN ISO 24589-A: S S CrMo 1 FB AWS A 5.23: F8P2-EB2R-B2	Heat treatment: A* $R_{p0.2}$ 470 MPa R_m 550 MPa A_5 24% A_v 140 J Heat treatment: N+A $R_{p0.2}$ 330 MPa R_m 480 MPa A_5 26% A_v 120 J	2.0 2.5 3.0 4.0	TÜV (3439.)	CrMo alloyed boiler tubes and plates of 13CrMo4-5 and similar steels.
Union S P 24 + UV P24 Wire/flux combination: EN ISO 24598-A: S S Z CrMo2VNb AWS A5.23: EG	Heat treatment: 740°C/4h $R_{p0.2}$ 450 MPa R_m 590 MPa A_5 15% A_v ≥47 J	2.0 2.4	–	7CrMoVTiB10-10, T/P 24, P 23

Wire/flux combination, high alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
Thermanit MTS 3 + Marathon 543 Wire: EN ISO 24598-A: S S CrMo91 AWS A5.23: EB9 Flux: EN 14174: SA FB 2 55 DC H5	Heat treatment: SR* $R_{p0.2}$ 540 MPa R_m 700 MPa A_5 18% A_v ≥47 J	2.0 2.4 3.0 4.0	TÜV (6527.),	Creep resistant 9% Cr-steel like X10CrMoVNb91, A213-T91, A335-P91.
Thermanit MTS 616 + Marathon 543 Wire: EN ISO 24598-A: S S Z CrMoWVNb9 0,5 1,5 AWS A5.23: EG [EB9 (mod.)] Flux: EN 14174: SA FB 2 55 DC H5	Heat treatment: 760°C/4h $R_{p0.2}$ 560 MPa R_m 700 MPa A_5 18% A_v ≥41 J	2.0 2.5 3.0	TÜV (9391.)	Creep resistant matensitic steel of type P 92 acc. to ASTM A335, Gr.P92 (T92).
Thermanit JE 308L + Marathon 431 Wire: EN ISO 14343-A: S 19 9 L AWS A5.9: ER308L Flux: EN ISO 14343: SA FB 2 64 DC	Heat treatment: untreated, as welded $R_{p0.2}$ 320 MPa R_m 550 MPa A_5 35% A_v 65 J	2.4 3.2 4.0	TÜV (6114.)	Joining and surfacing applications on similar stabilized or non stabilized steels like 1.4301, 1.4306, 1.4311, AISI 304, 304L, 304LN.

N normalized, 920°C/air
SR stress relieved, 580-620°C
SR* 750°C/4h, SR** 760°C/4h
A annealed, 580-620°C/air
A* annealed, 670-720°C
SO 60h 550°C + 40h 620°C/air
All values at test temperature +20°C

Wire/flux combination, high alloyed

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
Thermanit GE 316L + Marathon 431 Wire: EN ISO 14343-A: S 19 12 3 L AWS A5.9: ER316L Flux: EN ISO 14343: SA FB 2 64 DC	Heat treatment: untreated, as welded $R_{p0.2}$ 350 MPa R_m 550 MPa A_5 30% A_v 70 J	2.0 2.4 3.2 4.0	TÜV (6113.)	Joining and surfacing applications on similar CrNiMo-steels like 1.4404, 1.4541, 1.4435, UNS S31653, AISI 316, 316L, 316Ti, 316Cb.
Thermanit H-347 + Marathon 431 Wire: EN ISO 14343-A: S 19 9 Nb AWS A5.9: ER347 Flux: EN ISO 14343: SA FB 2 64 DC	Heat treatment: untreated, as welded $R_{p0.2}$ 380 MPa R_m 550 MPa A_5 30% A_v 65 J	2.4 3.2 4.0	TÜV (6479.)	Joining and surfacing applications on similar stabilized or non stabilized austenitic steels like 1.4301, 1.4541, AISI 347, 321, 304, 304L, 304LN.
BÖHLER CN 13/4-UP + BB 203 Wire: EN ISO 14343-A: S 13 4 AWS A5.9: ER410NiMo (mod.) Flux: EN ISO 14174: SA FB 2 DC	Heat treatment: annealed 600°C/2h $R_{p0.2}$ ≥500 MPa R_m ≥750 MPa A_5 ≥15% A_v ≥50 J	3.0	SEPROZ Wire: SEPROZ	Wire/flux combination for corrosion-resistant, martensitic and martensitic-ferritic rolled, forged and cast steels of identical type. Application in the construction of hydro turbines, compressors and steam power stations. Resistant to water vapour, steam and sea water atmospheres. Low hydrogen content of HD ≤ 5 ml/100 g in the weld metal.
Thermanit 22/09 + Marathon 431 Wire: EN ISO 14343-A: S 22 9 3 N L AWS A5.9: ER2209 Flux: EN ISO 14343: SA FB 2 64 DC	Heat treatment: untreated, as welded $R_{p0.2}$ 480 MPa R_m 690 MPa A_5 25% A_v 80 J	2.0 2.5 3.0	TÜV (6112.), DNV, GL, LR, ABS	Joining of similar dupex steels like 1.4462, UNS S31803, S32205.
Avesta 2507/P100 CU/W + Flux 805 Wire: EN ISO 14343-A: S 25 9 4 N L AWS A5.9: ER2594 Flux: EN ISO 14174: SA AF 2 Cr DC	Heat treatment: untreated, as welded $R_{p0.2}$ 670 MPa R_m 850 MPa A_5 26% A_v 80 J 60 J…-46°C	2.4 3.2	–	Avesta 2507/P100 CU/W for welding of super duplex steels e.g. type 2507, ASTM S32760, S32550 und S31260. If high corrosion resistance is requiered Avesta 2507/P100 CU/W can also be used for welding standard duplex 2205.
BÖHLER A 7 CN-UP + BB203 Wire: EN ISO 14343-A: S 18 8 Mn AWS A5.9: ER307 (mod.) Flux: EN ISO 14174: SA FB 2 DC	$R_{p0.2}$ ≥350 MPa R_m ≥500 MPa A_5 ≥25% A_v ≥95 J ≥40 J…-100°C	2.4 3.0	Wire: TÜV (02604.)	For joint welds between CrNi steels and unalloyed steels, cladding of surfaces on mountings and cladding on cogging, billet and profiled rolls. Characteristics of weld metal: Cold-work hardening ability, very good resistance to cavity formation, crack resistant, thermal shock resistant, scaling resistant to +850°C, impervious to sigma-phase embrittlement above +500°C. Service temperature down to -100°C.
Thermanit Nicro 82 + Marathon 444 Wire: EN ISO 18274: S Ni 6082 (NiCr20Mn3Nb) AWS A5.14: ERNiCr-3 Flux: EN ISO 14343: SA FB 2 AC	Heat treatment: untreated, as welded $R_{p0.2}$ ≥380 MPa R_m ≥580 MPa A_5 ≥35% A_v ≥80 J 80 J…-196°C	2.0 2.4 3.2	TÜV (7767.)	For high quality welding joints of nickel base alloys, creep resistant steels, heat resistant and cryogenic steels. Also suitable for joining of ferritic with austenitic steels at service temperatures above 300°C or for pressure vessels up to 550°C or down to -196°C.
Thermanit 625 + Marathon 444 Wire: EN ISO 18274: S Ni 6625 (NiCr22Mo9Nb) AWS A5.14: ERNiCrMo-3 Flux: EN ISO 14343: SA FB 2 AC	Heat treatment: untreated, as welded $R_{p0.2}$ ≥420 MPa R_m ≥700 MPa A_5 40% A_v ≥80 J 70 J…-196°C	1.6 2.0 2.4	TÜV (10173.), GL	For high quality welding joints of 6% Mo alloyed super-austenitic steels like S31254, N08926, N08367 and nickel base alloy 625. Designed for highest corrosion requirements and an extremely high resistance against pitting and stress corrosion (PRE_N > 52).

N normalized, 920°C/air
SR stress relieved, 580-620°C
All values at test temperature +20°C

SR* 750°C/4h, SR** 760°C/4h
A annealed, 580-620°C/air

A* annealed, 670-720°C
SO 60h 550°C + 40h 620°C/air

SAW-flux for un- and low-alloyed wires

Brand Standard EN ISO Standard AWS	**Main constituent:** %				**Grain size / density**	**Characteristics and applications**
BÖHLER BB 24 EN ISO 14174: SA FB 1 65 DC H5	SiO_2+TiO_2 15	CaO+MgO 35	Al_2O_3+MnO 21	CaF_2 26	Grain size acc. EN ISO 14174: 3 - 25	BÖHLER BB 24 is agglomerated fluoride-basic welding flux. It is characterised by its neutral metallurgical behaviour. When used in combination with suitable wire electrodes the weld metal displays high toughness properties at low/ subzero temperatures. The flux is designed for joining and surfacing applications on general-purpose structural steels, fine-grained high strength and low temperature steels, and high-temperature steel grades. BÖHLER BB 24 is a hydrogen-controlled welding flux with hydrogen contents of maximum 5 ml/100 g weld deposit.
UV 400 EN ISO 14174: SA AB 1 67 AC H5	SiO_2+TiO_2 20	CaO+MgO 30	Al_2O_3+MnO 28	CaF_2 16	Grain size acc. EN ISO 14174: 3 - 20	UV 400 is an agglomerated aluminate basic flux, designed for joining and surfacing applications with general-purpose structural steels, fine grained structural steels, boiler and pipe steels. The flux is characterized by its low silicon and moderate manganese pickup. It can be used on DC and AC.
UV 305 EN ISO 14174: SA AR 1 76 AC H5	SiO_2+TiO_2 30	Al_2O_3+MnO 55	CaF_2+CaO+MgO 8		Grain size acc. EN ISO 14174: 4 - 14	UV 305 is an agglomerated aluminate-rutile flux for joining and surface welding. Suited for direct and alternating current. The flux is suited for butt welding in two-run technique and for sheet thickness up to 10 mm for fillet welding. It is especially suited for welding tube walls.
UV 306 EN ISO 14174: SA AR 1 77 AC H5	SiO_2+TiO_2 24	Al_2O_3+MnO 50	CaF_2+CaO+MgO 14		Grain size acc. EN ISO 14174: 3 - 16	UV 306 is an agglomerated flux designed for joining applications on general-purpose structural and pipe steels. Suitable for use on DC and AC. For single- and multi-wire welding with high welding speed using the two-run technique as well as for fillet welding. Very good slag removal.
UV 418 TT EN ISO 14174: SA FB 1 55 AC H5	SiO_2+TiO_2 15	CaO+MgO 38	Al_2O_3+MnO 20	CaF_2 25	Grain size acc. EN ISO 14174: 3 - 20	UV 418 TT is an agglomerated fluoride-basic flux for joining and surfacing and applications with dissimilar steels. Mainly for high strength and cryogenic fine grained structural steels. This chameleonic flux is suited for many SAW wires on AC and DC current. Also suited for Tandem and multi-wire systems.
UV 420 TT EN ISO 14174: SA FB 1 65 DC / SA FB 1 65 DC H5	SiO_2+TiO_2 15	CaO+MgO 35	Al_2O_3+MnO 21	CaF_2 26	Grain size acc. EN ISO 14174: 3 - 20	UV 420 TT is an agglomerated fluoride-basic flux for joining and surfacing applications with general purpose structural steels, fine grained structural steels and creep resistant steels. It is characterized by its neutral metallurgical behaviour. When used in combination with suitable wire electrodes the weld metal has high toughness properties at subzero temperatures. It is suited for single wire and tandem welding.
UV 420 TTR / **UV 420 TTR-W** EN ISO 14174: SA FB 1 65 DC / SA FB 1 65 AC	SiO_2+TiO_2 15	CaO+MgO 35	Al_2O_3+MnO 21	CaF_2 26	Grain size acc. EN ISO 14174: 3 - 20	UV 420 TTR is an agglomerated fluoride-basic flux, mainly for joining and surfacing applications with creep resistant steels. It displays neutral metallurgical behaviour and is characterised by a high degree of purity. It is particularly suitable for welding hydrocrackers because of the low P pick-up of 0.004% max. UV 420 TTR-W permits sound welding on AC, by this achieving a higher level of toughness when welding with CrMo-alloyed SAW wires.
UV 420 TTRC EN ISO 14174: SA FB 1 65 DC	SiO_2+TiO_2 15	CaO+MgO 35	Al_2O_3+MnO 21	CaF_2 26	Grain size acc. EN ISO 14174: 3 - 20	This special variant of flux UV 420 TTR supports the C-content of the wire electrode when DC-welding. In comparison with UV 420 TTR the C-content in the all weld metal is about 0.03 - 0.04% higher. It is suitable for multipass welding, for single- and tandem-wire systems. UV420 TTRC has prime importance for SAW of the high-temperature resistant steel, for joining and surfacing applications.
UV 421 TT EN ISO 14174: SA FB 1 55 AC H5	SiO_2+TiO_2 16	CaO+MgO 34	Al_2O_3+MnO 21	CaF_2 26	Grain size acc. EN ISO 14174: 3 - 20	UV 421 TT is an agglomerated fluoride-basic flux for welding of high strength and cryogenic fine-grained steels. It has a neutral metalurgical behaviour acc. to burn-off or pickup of Si and Mn.

SAW-flux for high alloyed wires

Brand Standard EN ISO Standard AWS	Main constituent: %	Grain size / density	Characteristics and applications
BÖHLER BB 203 EN ISO 14174: SA FB 2 DC	SiO_2+TiO_2 20 CaO+MgO 26 Al_2O_3 18 CaF_2 32	Grain size acc. EN ISO 14174: 2 - 12	BÖHLER BB 203 is an agglomerated fluoride-basic flux with high basicity for joint welding of soft martensitic CrNi-steels and austenitic CrNi(Mo)-steels. BÖHLER BB 203 produces well contoured and smooth welding beads. Beside good slag detachability the flux features good fillet weld capabilities. The weld deposits show high purity and good mechanical properties.
Avesta Flux 801 EN ISO 14174: SA CS 2 Cr DC	SiO_2 30 Al_2O_3 15 CaF_2+MgO 40 Cr 5.6	Density: 0.8 kg/dm³	Avesta Flux 801 is a neutral chromium compensated agglomerated flux. It is a general-purpose flux designed for both joint welding stainless steel and for cladding onto unalloyed or low-alloyed steel. Flux 801 can be used in combination with all types of stabilised and non-stabilised Cr-Ni and Cr-Ni-Mo fillers.
Avesta Flux 805 EN ISO 14174: SA AF 2 Cr DC	SiO_2 10 Al_2O_3 36 CaF_2 48 Cr 2.5	Density: 1.0 kg/dm³	Avesta Flux 805 is a basic, slightly chomium-compensated agglomerated flux. It is primalrily desinged for welding with high-alloyed stainless fillers such as Avesta P12, 904L and 2205. Standard Cr-Ni and Cr-Ni-Mo fillers can also be welded with excellent results.
Marathon 431 EN ISO 14343: SA FB 2 64 DC	SiO_2 10 Al_2O_3 38 CaF_2 50	Grain size acc. EN ISO 14174: 4 - 14	Marathon 431 is an agglomerated basic welding flux for welding stainless high alloyed CrNi(Mo) steels. The weld seams are smooth and finely rippled without any slag residues. Besides the good slag detachability the flux also provides good fillet weld properties. The weld metals show high degree of purity and good mechanical properties.
Marathon 543 EN ISO 14174: SA FB 2 55 DC H5	SiO_2+Al_2O_3 35 CaF_2+CaO+MgO 60	Grain size acc. EN ISO 14174: 3 - 20	Marathon 543 is an agglomerated fluoride-basic flux with a high basicity. For joining and surfacing applications of creep resistant CrMo steels such as e.g. 12CrMo 19-5, P 91/T 91, X10CrMoVNb9-1, X20CrMoWV12-1. In combintion with SAW wire Thermanit MTS 616 the flux is suited for welding steels of type P 92 and X11CrMoWVNb9-1-1, E 911.

Pipeline

Brand Standard EN ISO Standard AWS	Mechanical Properties Typical values	Ø mm	Approvals	Characteristics and applications
BÖHLER FOX BVD 85 EN ISO 2560-A: E 46 5 1Ni B 4 5 AWS A5.5: E8045-P2 E8018-G	Heat treatment: untreated, as welded R_e 510 MPa R_m 560 MPa A_5 27% A_v 170 J 65 J…-50°C	3.2 4.0 4.5	TÜV (03531.), SEPROZ, CE	Basic covered vertical down electrode for high-quality weld joints on large pipelines as well as in structural work. In pipeline construction, suitable for filler and cap welding. Vertical down welding enables an as much as 100% higher deposition rate as compared to vertical up welding. This applies to all BÖHLER BVD electrodes!
BÖHLER FOX BVD 90 EN 757: E 55 5 Z2Ni B 4 5 AWS A5.5: E9018-G E9045-P2 (mod.)	Heat treatment: untreated, as welded R_e 600 MPa R_m 650 MPa A_5 27% A_v 170 J 80 J…-50°C	3.2 4.0 4.5	TÜV (03402.), Statoil, SEPROZ, CE, GAZPROM	Basic covered vertical down electrode for high-quality weld joints on large pipelines as well as in structural work. In pipeline construction, suitable for filler and cap welding. Especially crack-resistant weld metal with excellent toughness.
BÖHLER FOX CEL EN ISO 2560-A: E 38 3 C 2 1 AWS A5.1: E6010	Heat treatment: untreated, as welded R_e 450 MPa R_m 520 MPa A_5 26% A_v 100 J ≥47 J…-30°C	2.5 3.2 4.0 4.5	TÜV (1281.), DNV, Statoil, SEPROZ, CE, NAKS	Cellulosic covered electrode for vertical down welding of the root, hot passes, filler and cap passes on large pipelines. Great economy as compared to vertical up welding, also in combination with basic vertical down electrodes. Particularly suitable for welding of root passes on minus polarity.

Pipeline

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER FOX CEL 75 EN ISO 2560-A: E 42 3 C 2 5 AWS A5.5: E7010-P1	Heat treatment: untreated, as welded R_e 480 MPa R_m 550 MPa A_5 23% A_v 100 J 45 J…-40°C	3.2 4.0 5.0	TÜV-A (533.)	High-strength cellulosic covered electrode for vertical down welding of large pipelines. Great economy as compared to vertical up welding. BÖHLER cellulosic covered electrodes are used first and foremost for hot pass, filler and cap welding.
Phoenix CEL 70 EN ISO 2560-A: E 42 2 C 2 5 AWS A5.1: E6010	Heat treatment: untreated, as welded $R_{p0.2}$ 420 MPa R_m 510 MPa A_5 22% A_v 80 J 28 J…-40°C	2.5 3.2 4.0 5.0	TÜV (00247.), DB (10.132.44), ABS, GL, LR, DNV, VNIIST	Cellulose covered electrode for vertical down circumferential welds in pipeline constructions. Excellent weldability in root pass welding; also in the vertical up position. CTOD, HIC and HSCC tested.
BÖHLER FOX CEL 85 EN ISO 2560-A: E 46 4 1Ni C 2 5 AWS A5.5: E8010-P1	Heat treatment: untreated, as welded R_e 490 MPa R_m 570 MPa A_5 23% A_v 110 J ≥47 J…-40°C	3.2 4.0 5.0	TÜV (1361.), ABS, SEPROZ, CE	High-strength cellulosic covered electrode for vertical down welding of large pipelines. BÖHLER cellulosic covered electrodes offer excellent economy compared to vertical up welding.
BÖHLER FOX CEL 80-P EN ISO 2560-A: E 46 3 1Ni C 2 5 AWS A5.5: E8010-P1	Heat treatment: untreated, as welded R_e 490 MPa R_m 570 MPa A_5 23% A_v 90 J ≥47 J…-30°C	3.2 4.0 5.0	TÜV (11181.), CE	High-strength cellulosic covered electrode for vertical-down welding of large pipelines. BÖHLER FOX CEL 80-P provides a more intensive arc and a more fluid weld metal compared to BÖHLER FOX CEL 85.
BÖHLER FOX CEL 90 EN ISO 2560-A: E 50 3 1Ni C 2 5 AWS A5.5: E9010-P1 E9010-G	Heat treatment: untreated, as welded R_e 580 MPa R_m 650 MPa A_5 21% A_v 100 J ≥47 J…-30°C	4.0 5.0	TÜV (1324.), Statoil, SEPROZ, CE	High-strength cellulosic covered electrode for vertical down welding of large pipelines, especially X70 and X80 steels.
BÖHLER FOX EV PIPE EN ISO 2560-A: E 42 4 B 12 H5 AWS A5.1: E7016-1H4R	Heat treatment: untreated, as welded R_e 470 MPa R_m 560 MPa A_5 29% A_v 170 J 55 J…-40°C	2.0 2.5 3.2 4.0	TÜV (7620.), DB (10.014.77), LTSS, SEPROZ, VNIIGAZ, CE, NAKS	BÖHLER FOX EV PIPE is a basic covered electrode which has excellent welding characteristics for pipe vertical up welds of root passes with negative polarity as well as filler and cap passes with positive polarity, or even AC. BÖHLER FOX EV PIPE offers considerable time savings against AWS E 7018 type electrodes when welding root passes due to increased travel speeds.
BÖHLER FOX EV 60 PIPE EN ISO 2560-A: E 50 4 1Ni B 12 H5 AWS A5.5: E8016-GH4R	Heat treatment: untreated, as welded R_e 550 MPa R_m 590 MPa A_5 29% A_v 170 J 110 J…-40°C	2.5 3.2 4.0 5.0	NAKS, GAZPROM	BÖHLER FOX EV 60 PIPE is a basic covered electrode which has excellent welding characteristics for pipe vertical up welds of root passes with negative polarity as well as filler and cap passes with positive polarity, or even AC. BÖHLER FOX EV 60 PIPE offers considerable time savings against AWS E 8018 type electrodes when welding root passes due to increased travel speeds.
BÖHLER FOX EV 70 PIPE EN 757: E 55 4 Z Mn2NiMo B 12 H5 AWS A5.5: E9016-GH4R	Heat treatment: untreated, as welded R_e 620 MPa R_m 680 MPa A_5 20% A_v 140 J 55 J…-46°C	2.5 3.2 4.0	–	BÖHLER FOX EV 70 PIPE is a basic covered electrode which has excellent welding characteristics for pipe vertical up welds of root passes with negative polarity as well as filler and cap passes with positive polarity, or even AC. BÖHLER FOX EV 70 PIPE offers considerable time savings against AWS E 9018 type electrodes when welding root passes due to increased travel speeds.
BÖHLER SG 3-P EN ISO 14341-A: G3Si1 G 46 5 M21 3Si1 G 42 4 C1 3Si1 AWS A5.18: ER70S-G	Heat treatment: untreated, as welded R_e 510 MPa R_m 640 MPa A_5 25% A_v 120 J 55 J…-50°C	0.9 1.0 1.2	TÜV (07682.), CE, NAKS, GAZPROM	BÖHLER SG 3-P is a micro-alloyed solid wire designed for the automated gas-shielded arc welding of pipelines. Due to the precise addition of micro-alloying elements it offers very good low temperature impact strength to -50°C, as well as excellent ductility and cracking resistance.

Pipeline

Brand Standard EN ISO Standard AWS	**Mechanical Properties** Typical values	**Ø** mm	**Approvals**	**Characteristics and applications**
BÖHLER SG 8-P EN ISO 14341-A: G3Ni1 G 42 5 M21 3Ni AWS A5.28: ER80S-G	Heat treatment: untreated, as welded R_e 500 MPa R_m 590 MPa A_5 24% A_v 150 J 80 J…-50C	0.9 1.0 1.2	DNV	BÖHLER SG 8-P is a micro-alloyed wire designed for the automated gas-shielded arc welding of pipelines. The precise addition of micro-alloying elements results in a weld metal with excellent low temperature impact strength to -50°C as well as excellent ductility and cracking resistance.
BÖHLER NiMo 1-IG EN ISO 16834-A: G 55 6 M21 Mn3Ni1Mo G 55 4 C1 Mn3Ni1Mo AWS A5.28: ER90S-G	Heat treatment: untreated, as welded R_e 620 MPa R_m 700 MPa A_5 23% A_v 140 J ≥47 J…-60°C	1.0 1.2	TÜV (11763.), DB (42.014.06), GL, SEPROZ, CE, NAKS, GAZPROM	Copper-coated wire for the gas-shielded arc welding of high-strength, quenched and tempered fine-grained constructional steels. Due to the precise addition of micro-alloying elements, very good low temperature impact strength to -60°C, as well as excellent ductility and cracking resistance, can also be obtained when using BÖHLER NiMo1-IG.
BÖHLER Ti 70 PIPE-FD EN ISO 18276-A: T 55 4 Mn1Ni P M 1 H5 AWS A5.29: E91T1-M21A4-G	Heat treatment: untreated, as welded R_e ≥550 MPa R_m 640-820 MPa A_5 ≥18% A_v ≥47 J…-40C	1.2	TÜV (12279.), GAZPROM, CE	Micro-alloyed rutile flux-cored wire for single- and multi-pass welding of carbon-manganese steels and high-strength steels using Ar-CO_2 shielding gas.
BÖHLER Pipeshield 71 T8-FD AWS A5.29: E71T8-A4-K6	Heat treatment: untreated, as welded R_e 435 MPa R_m 535 MPa A_5 28% A_v 200 J 150 J…-30°C ≥27 J…-40°C	2.0	NAKS, GAZPROM	Böhler Pipeshield 71 T8-FD is a self shielded flux-cored wire designed for semiautomatic vertical-down welding of pipelines and low-alloyed steel constructions.
BÖHLER Pipeshield 81 T8-FD AWS A5.29: E81T8-A4-Ni2 E81T8-A4-G	Heat treatment: untreated, as welded R_e 500 MPa R_m 600 MPa A_5 25% A_v 170 J 120 J…-30°C ≥27 J…-40°C	2.0	NAKS, GAZPROM	Böhler Pipeshield 81 T8-FD is a self shielded flux-cored wire designed for semiautomatic vertical-down welding of pipelines and low-alloyed steel constructions.

The specifications in regard to the type and application of our products are only for the user's information. The data specified for the mechanical properties always refer to the weld metal alone under observance of the applicable standards. In the weld joint, the weld metal properties are influenced, among other factors, by the parent metal, the welding position and the welding parameters. A guarantee of suitability for a certain type of application requires an explicit written agreement in each individual case.

Subject to modifications.

008/2016/EN/GL

voestalpine Böhler Welding

Welding know-how joins steel

With over 100 years of experience, voestalpine Böhler Welding is the global innovator for the daily welding challenges in joining, wear and corrosion protection as well as brazing. Customer proximity is guaranteed by more than 40 subsidiaries in 25 countries, with the support of 2,200 employees, and through more than 1,000 distribution partners worldwide. And with individual consultation by our application technicians and welding engineers, we make sure that our customers master the most demanding welding challenges. voestalpine Böhler Welding offers three specialized and dedicated brands to cater our customers' and partners' requirements.

böhler welding by voestalpine

Lasting Connections – More than 2,000 products for joint welding in all conventional arc welding processes are united in a product portfolio that is unique throughout the world. Creating Lasting Connections is the brand's philosophy in welding and between people.

utp maintenance by voestalpine

Tailor-Made Protectivity™ – Decades of industry experience and application know-how in the areas of repair of cracked material, anti-wear and cladding, combined with innovative and custom-tailored products, guarantee customers an increase in the productivity and protection of their components.

fontargen brazing by voestalpine

In-Depth Know-How – Through deep insight into processing methods and ways of application, Fontargen Brazing provides the best brazing and soldering solutions based on proven products with German technology. The expertise of this brand's application engineers has been formulated over many years of experience from countless application cases.

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

böhlerwelding
by voestalpine

Welding Consumables for Pipeline Construction

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

Lasting Connections

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

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

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

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

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

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

Overview of products

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

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

Selection guide

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

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

Legend:

Root pass only

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

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

GMAW= solid wires for mechanized vertical-down welding

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

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

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

Legend:

Root pass only

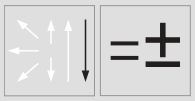
FCAW Ti -X = Gas shielded flux cored wire for vertical-up and -down welding

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

GMAW= solid wires for mechanized vertical-down welding

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

Cellulosic electrodes for vertical-down welding

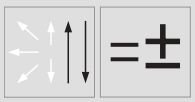
BÖHLER FOX CEL	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 38 3 C 2 1			**Re**	**Rm**	**A5**	**CVN**		**ø**		**EN**	**API 5L**
AWS A5.1: E6010	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**	**A**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

Characteristics and application

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

Approvals

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

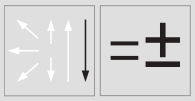
BÖHLER FOX CEL+	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 38 2 C 2 1			**Re**	**Rm**	**A5**	**CVN**		**ø**		**EN**	**API 5L**
AWS A5.1: E6010	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**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

Characteristics and application

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

BÖHLER FOX CEL-S

Typical analyses all weld metal			Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 38 3 C 2 1			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.1: E6010	%		MPa	MPa	%	°C	J	mm	A		
	C	0.10	480	550	23	+20	110	2.5	50-90	L210NB-L415NB	A, B
	Si	0.20	(≥ 380)	(470-600)	(≥ 22)	-30	≥ 47	3.2	80-130	L290MB-L415NB	X42-X56
	Mn	0.50						4.0	110-170		
			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
			70	80	23	+68	81	3/32	50-90		Root pass up to X80
			(≥ 48)	(≥ 60)	(≥ 22)	-22	≥ 20	1/8	80-130		
								5/32	110-170		



Root pass negative polarity

Re-drying not allowed

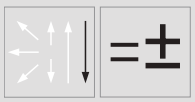
For preheating, interpass temperature and welding procedure note our recommendations p. 18

Characteristics and application

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

Phoenix Cel 70

Typical analyses all weld metal			Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 42 2 C 2 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.1: E6010	%		MPa	MPa	%	°C	J	mm	A		
	C	0.14	440	540	24	+20	80	2.5	50 - 80	L210NB-L390NB	A
	Si	0.18	(≥ 420)	(500-640)	(≥ 20)	± 0	70	3.2	80 - 130	L290MB-L390MB	B
	Mn	0.55				-20	55 (≥ 47)	4.0	120 - 180		X42 - X56
						-40	28	5.0	160 - 220		
			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lb	inch	A		
			64	78	24	+68	59	3/32	50 - 80		
			(≥ 48)	(≥ 60)	(≥ 22)	+32	51	1/8	80 - 130		
						-4	37	5/32	120 - 180	Root pass up to L485NB, L485MB	X70
						-40	20	3/16	160 - 220		



Root pass negative polarity

Re-drying not allowed

For preheating, interpass temperature and welding procedure note our recommendations p. 18

Characteristics and application

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

Approvals

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

Cellulosic electrodes for vertical-down welding

BÖHLER FOX CEL Mo

Typical analyses all weld metal

	%	
C		0.1
Si		0.14
Mn		0.4
Mo		0.5

Typical mechanical properties all weld metal

Re	Rm	A5	CVN	
MPa	MPa	%	°C	J
480	550	23	+ 20	100
(≥ 420)	(500-640)	(≥ 20)	0	95
			-20	85
			-30	50 (≥ 47)
			-40	42

YS	TS	E (L=4d)	CVN	
ksi	ksi	%	°F	ft-lbf
70	80	23	+ 68	74
(≥ 57)	(≥ 70)	(≥ 22)	+ 32	70
			-4	63
			-22	37 (≥ 20)
			-40	31

Diameter and welding current

ø	
mm	A
3.2	80-130
4.0	120-180
5.0	160-210

ø	
inch	A
1/8	80-130
5/32	120-180
3/16	160-210

Pipeline steel grades

EN	API 5L
L210 NB-L415NB	A
L290MB-L415MB	B
	X42 -X60
Root pass up to L555MB	X80

Root pass negative polarity

Re-drying not allowed

For preheating, interpass temperature and welding procedure note our recommendations p. 18

Characteristics and application

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

Approvals

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

BÖHLER FOX CEL 70-P

Typical analyses all weld metal

	%	
C		0.15
Si		0.10
Mn		0.45
Ni		0.17

Typical mechanical properties all weld metal

Re	Rm	A5	CVN	
MPa	MPa	%	°C	J
460	550	23	+20	100
(≥ 420)	(500-640)	(≥ 22)	-20	80
			-30	65 (≥ 47)

YS	TS	E (L=4d)	CVN	
ksi	ksi	%	°F	ft-lbf
67	75	23	+ 68	74
(≥ 57)	(≥ 70)	(≥ 22)	-4	59
			-22	48 (≥ 20)

Diameter and welding current

ø	
mm	A
3.2	60-130
4.0	100-180
5.0	140-210

ø	
inch	A
1/8	60-130
5/32	100-180
3/16	140-210

Pipeline steel grades

EN	API 5L
L210NB-L415NB	A
L290MB-L415MB	B
	X42 -X60
Root pass up to L480MB	X70

Root pass negative polarity

Re-drying not allowed

For preheating, interpass temperature and welding procedure note our recommendations p. 18

Characteristics and application

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

BÖHLER FOX CEL 75

Typical analyses all weld metal

	%	
C		0.14
Si		0.14
Mn		0.7

Typical mechanical properties all weld metal

	Re	Rm	A5	CVN					
EN ISO 2560-A: E 42 3 C 2 5						ø		EN	API 5L
AWS A5.5: E7010-P1	MPa	MPa	%	°C	J	mm	A		
	480	550	23	+20	100	3.2	80-130	L210-L415NB	A
	(≥ 420)	(500-640)	(≥ 22)	-20	65	4.0	120-180	L290MB-L415MB	B
				-30	55 (≥ 47)	5.0	160-210		X42 -X60
				-40	45				
	YS	TS	E (L=4d)	CVN		ø			
	ksi	ksi	%	°F	ft-lbf	inch	A		
	70	80	23	+68	81	1/8	80-130		
	(≥ 57)	(≥ 70)	(≥ 22)	-4	70	5/32	120-180		
				-22	48 (≥ 20)	3/16	160-210		
				-40	33			Root pass up to L480MB	X70

Root pass negative polarity

Re-drying not allowed

For preheating, interpass temperature and welding procedure note our recommendations p. 18

Characteristics and application

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

Approvals

TÜV (533)

BÖHLER FOX CEL 75 G

Typical analyses all weld metal

	%	
C		0.17
Si		0.15
Mn		0.55
Ni		0.6

Typical mechanical properties all weld metal

	Re	Rm	A5	CVN					
AWS A5.5: E7010-G						ø		EN	API 5L
	MPa	MPa	%	°C	J	mm	A		
	450	560	23	+20	90	3.2	60-130	L415NB-L450NB	X56-X65
	(≥ 390)	(≥ 490)	(≥ 22)	-20	75	4.0	100-180	L415MB-L450MB	
				-30	55	5.0	140-210		
	YS	TS	E (L=4d)	CVN		ø			
	ksi	ksi	%	°F	ft-lbf	inch	A		
	65	81	23	+68	66	1/8	60-130		Root pass up to X70
	(≥ 57)	(≥ 70)	(≥ 22)	-4	55	5/32	100-180		
				-22	40	3/16	140-210		

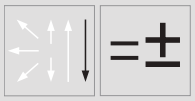
Re-drying not allowed

For preheating, interpass temperature and welding procedure note our recommendations p. 18

Characteristics and application

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

Cellulosic electrodes for vertical-down welding

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

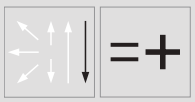
For preheating, interpass temperature and welding procedure note our recommendations p. 18

Characteristics and application

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

Approvals

TÜV (03199), LR, CE

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

Characteristics and application

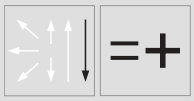
Cellulosic electrode for vertical-down welding of high strength, large diameter pipelines. Highly economical compared with conventional vertical-up welding. Especially recommended for hot passes, filler and cap layers. Böhler FOX CEL 80-P provides a more intensive arc and a more fluid weld metal compared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

Approvals

TÜV (11181), CE

BÖHLER FOX CEL 85

Typical analyses all weld metal			Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 46 4 1Ni C 2 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E8010-P1	%		MPa	MPa	%	°C	J	mm	A		
	C	0.14	490	570	23	+20	110	3.2	80-130	L415NB-L485NB	X56-X70
	Si	0.15	(≥ 460)	(550-680)	(≥ 20)	0	105	4.0	120-180	L415MB-L485MB	
	Mn	0.75				-20	100	5.0	160-210		
	Ni	0.7				-40	70 (≥ 47)				
			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
			71	83	23	+68	81	1/8	80-130		
			(≥ 67)	(≥ 80)	(≥ 19)	+32	77	5/32	120-180		
						-4	74	3/16	160-210		
						-22	≥ 20				
						-40	52				



Re-drying not allowed

For preheating, interpass temperature and welding procedure note our recommendations p. 18

Characteristics and application

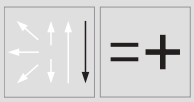
Cellulosic electrode for vertical-down welding of high strength, large diameter pipelines. Highly economical compared with conventional vertical-up welding. Especially recommended for hot passes, filler and cap layers. Böhler FOX CEL 85 is the most popular cellulosic electrode, very well meeting all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

Approvals

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

BÖHLER FOX CEL 85 G

Typical analyses all weld metal			Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
AWS A5.5: E8010-G			Re	Rm	A5	CVN		ø		EN	API 5L
	%		MPa	MPa	%	°C	J	mm	A		
	C	0.15	490	580	23	+20	90	3.2	60-130	L415NB-L485NB	X56-X70
	Si	0.15	(≥ 460)	(≥ 550)	(≥ 19)	0	85	4.0	100-180	L415MB-L485MB	
	Mn	0.7				-30	60	5.0	140-210		
	Ni	0.8									
			YS	TS	E (L=4d)	CVN		ø			
			ksi	ksi	%	°F	ft-lbf	inch	A		
			71	84	23	+68	66	1/8	60-130		
			(≥ 67)	(≥ 80)	(≥ 19)	+32	63	5/32	100-180		
						-22	44	3/16	140-210		



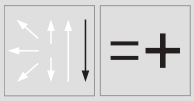
Re-drying not allowed

For preheating, interpass temperature and welding procedure note our recommendations p. 18

Characteristics and application

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

Cellulosic electrodes for vertical-down welding

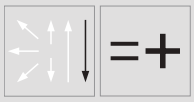
Phoenix Cel 80	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 46 3 C 2 5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E8010-P1	%		MPa	MPa	%	°C	J	mm	A		
	C	0.16	490	580	23	-20	60	3.2	80 - 130	L415NB - L485NB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

Characteristics and application

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

Approvals

TÜV (03199), ABS, LR, CE

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

Characteristics and application

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

Approvals

TÜV (1324), Statoil, SEPROZ, CE

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

Characteristics and application

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

Approvals

TÜV (00105), CE

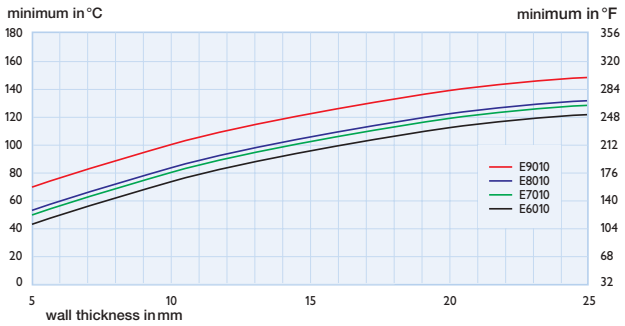
Welding Techniques Cellulosic Electrodes

Preheating and interpass temperature

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

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

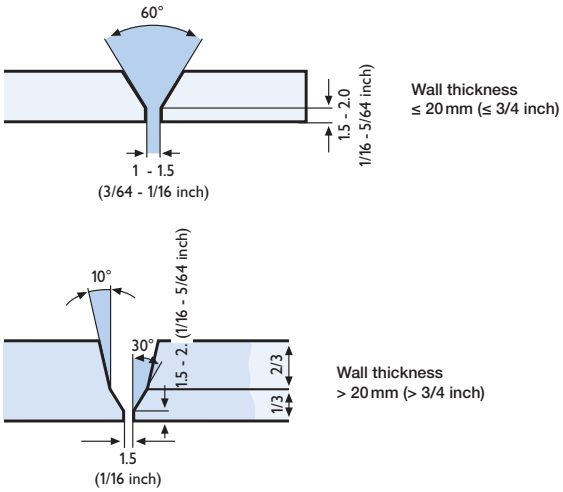
The diagram below shows minimum required preheat temperatures, in dependence of wall thickness and type of electrode. This is related to both preheating and interpass.



Welding machines

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

Recommended joint preparation



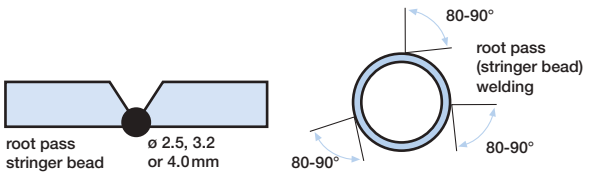
Welding technique
Stringer bead or root pass

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

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

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

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



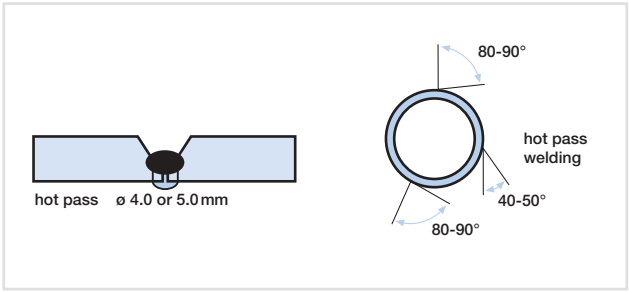
Hot pass

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

Electrode sizes commonly used are:

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

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



Filler layers

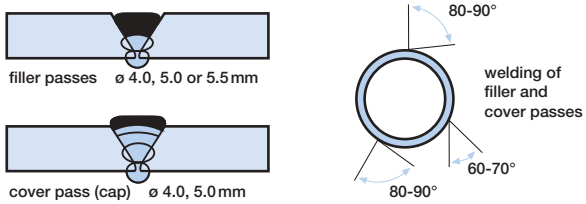
Beads will be sufficiently flat and free from undercut and slag inclusions, if the electrode is applied with a slight circular or stepping motion, especially in positions 12 to 2 o‘clock, 12 to 10 o‘clock, 4 to 6 o‘clock and 8 to 6 o‘clock. Weaving of max. 2xØ is recommended for all other positions.

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

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

Cover pass (cap)

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

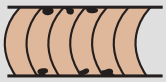
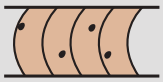
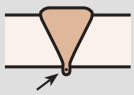
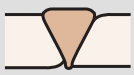
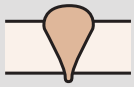
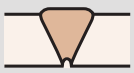
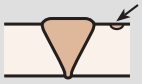


Storage of cellulosic electrodes

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

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

Trouble shooting

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

Basic electrodes for vertical-down welding

BÖHLER FOX BVD 85

Typical analyses all weld metal

	%	
C	0.05	
Si	0.4	
Mn	1.1	
Ni	0.9	

Typical mechanical properties all weld metal

Re MPa	Rm MPa	A5 %	CVN °C	CVN J
510	560	27	+20	170
(≥ 460)	(550-680)	(≥ 20)	0	150
			-20	120
			-40	85
			-50	65 (≥ 47)

YS ksi	TS ksi	E (L=4d) %	CVN °F	CVN ft-lbf
74	81	26	+68	125
(≥ 67)	(≥ 80)	(≥ 19)	+32	110
			-4	89
			-22	≥ 20
			-40	63
			-58	48

Diameter and welding current

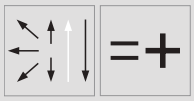
ø mm	A
3.2	110-160
4.0	180-210
4.5	200-240

ø inch	A
1/8	110-160
5/32	180-210
11/16	200-240

Pipeline steel grades

EN	API 5L
L290NB-L450NB	A
L290MB-L450MB	B X42 -X65

EN ISO 2560-A: E 46 5 1Ni B 4 5
AWS A5.5: E8045-P2



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

Recommended interpass
temperature > 80 °C (176 °F)

Characteristics and application

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

Approvals

TÜV (03531), SEPROZ, CE

BÖHLER FOX BVD 90

Typical analyses all weld metal

	%	
C	0.05	
Si	0.3	
Mn	1.2	
Ni	2.2	

Typical mechanical properties all weld metal

Re MPa	Rm MPa	A5 %	CVN °C	CVN J
600	650	27	+20	170
(≥ 550)	(620-780)	(≥ 18)	0	145
			-20	130
			-40	110
			-50	80 (≥ 47)

YS ksi	TS ksi	E (L=4d) %	CVN °F	CVN ft-lbf
87	94	26	+68	125
(≥ 77)	(≥ 90)	(≥ 17)	+32	107
			-4	96
			-22	≥ 20
			-40	81
			-58	59

Diameter and welding current

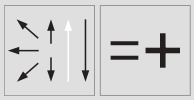
ø mm	A
3.2	110-160
4.0	180-210
4.5	200-240

ø inch	A
1/8	110-160
5/32	180-210
11/16	200-240

Pipeline steel grades

EN	API 5L
L458MB, L555MB	X70, X80

EN ISO 18275-A: E 55 5 Z2Ni B 4 5
AWS A5.5: E9018-G / E9045-P2 (mod.)



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

Recommended interpass
temperature > 90 °C (194 °F)

Characteristics and application

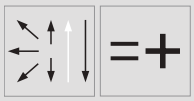
Basic electrode for vertical-down welding of large diameter, high strength pipelines and for structural work. Suitable for filler and cap layers in pipe welds. The deposit is extremely crack resistant and features a high toughness and very low hydrogen content. The deposition rate is 80-100% higher than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

Approvals

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

BÖHLER FOX BVD 100

EN ISO 18275-A: E 62 5 Z2Ni B 4 5
AWS A5.5: E10018-G /E10045-P2 (mod.)



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

Recommended interpass temperature >
100 °C (212 °F)

Typical analyses all weld metal

	%
C	0.07
Si	0.4
Mn	1.2
Ni	2.3

Typical mechanical properties all weld metal

Re MPa	Rm MPa	A5 %	CVN °C	CVN J
670	730	24	+20	150
(≥ 620)	(690-890)	(≥ 18)	0	125
			-20	120
			-50	70 (≥ 47)

YS ksi	TS ksi	E (L=4d) %	CVN °F	CVN ft-lbf
97	106	26	+68	110
(≥ 87)	(≥ 100)	(≥ 16)	+32	92
			-4	89
			-22	≥ 20
			-58	52

Diameter and welding current

ø mm	A
4.0	180-210
4.5	200-240

ø inch	A
5/32	180-210
11/64	200-240

Pipeline steel grades

EN	API 5L
L555MB	X80

Characteristics and application

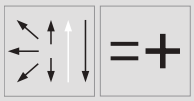
Basic electrode for vertical-down welding of large diameter, high strength pipelines and for structural work. Suitable for filler and cap layers in pipe welds. The deposit is extremely crack resistant and features a high toughness and very low hydrogen content. The deposition rate is 80-100% higher than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

Approvals

TÜV (06333), SEPROZ, CE

BÖHLER FOX BVD 110

EN ISO 18275-A: E 69 3 Mn2NiMo B 4 5
AWS A5.5: E11018-G



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

Recommended interpass temperature >
110 °C (230 °F)

Typical analyses all weld metal

	%
C	0.07
Si	0.4
Mn	1.5
Ni	2.2
Mo	0.4

Typical mechanical properties all weld metal

Re MPa	Rm MPa	A5 %	CVN °C	CVN J
720	810	20	+20	90
(≥ 690)	(760-960)	(≥ 17)	-20	70
			-30	50 (≥ 47)

YS ksi	TS ksi	E (L=4d) %	CVN °F	CVN ft-lbf
104	117	20	+68	66
(≥ 97)	(≥ 110)	(≥ 15)	-4	52
			-22	37

Diameter and welding current

ø mm	A
4.0	180-210
4.5	200-240

ø inch	A
5/32	180-210
11/64	200-240

Pipeline steel grades

EN	API 5L
L690	X100

Characteristics and application

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

Approvals

SEPROZ

Basic electrodes for vertical-down welding

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

Characteristics and application

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

Welding Techniques Basic Electrodes for Vertical-down Welding

Combined technology with cellulosic and basic electrodes

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

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

Preheating and interpass temperature

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

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

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

Welding machines

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

Welding Techniques Basic Electrodes for Vertical-down Welding

Filler passes

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

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

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

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

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

Keep the arc as short as possible.

Cap

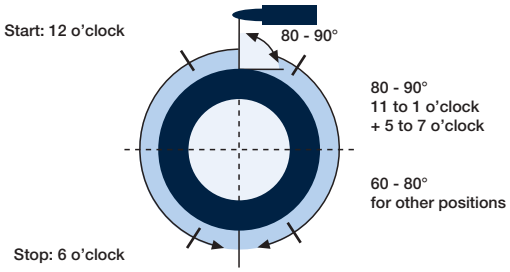
The cap is deposited with a slight weaving technique, with a maximum weave of twice the electrode diameter.

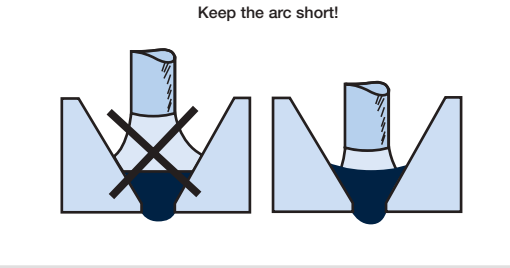
Recommended amperages:

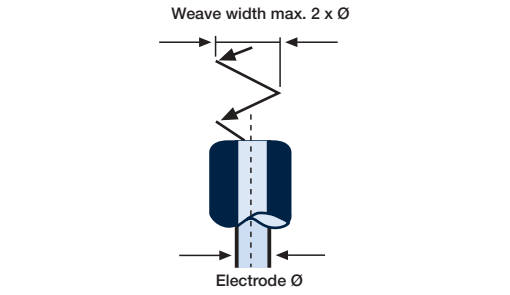
Electrode diameter:		
3.2 mm	(1/8")	110 - 160 A
4.0 mm	(5/32")	180 - 210 A

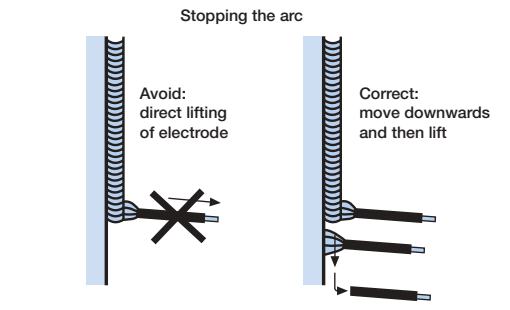
Storage of basic electrodes

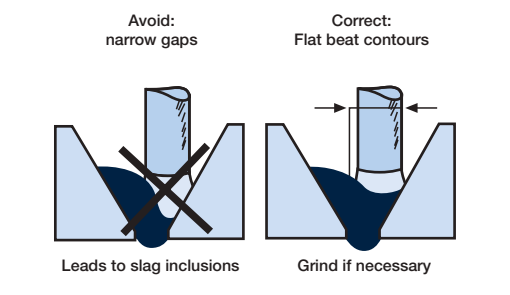
Basic electrodes which have been stored in sealed cans do not need to be rebaked. Once a can has been opened, the electrodes can be used up to 8 hours. Basic electrodes which are taken from unsealed, damaged cans or those which have been kept in open storage for more than 8 hours, should be rebaked at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



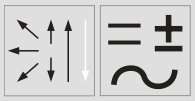








Basic electrodes for vertical-up welding

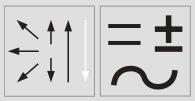
BÖHLER FOX EV PIPE	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 42 4 B 1 2			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E7016-1	%		MPa	MPa	%	°C	J	mm	A		
	C	0.06	470	560	29	+20	170	2.0	30-60	L290NB-L360NB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

Characteristics and application

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

Approvals

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

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

Characteristics and application

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

Approvals

TÜV (4180), GL (3YH5), LTSS, SEPROZ

BÖHLER FOX EV 50

Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
		Re	Rm	A5	CVN		ø		EN	API 5L
%		MPa	MPa	%	°C	J	mm	A		
C	0.08	460	560	27	+20	190	2.0	50-70	L245NB-L415NB	A,B
Si	0.4	(≥ 420)	(500-640)	(≥ 20)	-20	160	2.5	80-110	L245MB-L415MB	X42-X60
Mn	1.2				-50	70 (≥ 47)	3.2	100-140		
							4.0	130-180		
							5.0	180-230		
		YS	TS	E (L=4d)	CVN		ø			
		ksi	ksi	%	°F	ft-lbf	inch	A		
		67	81	27	+68	140	5/64	50-70		
		(≥ 58)	(≥ 70)	(≥ 22)	-4	118	3/32	80-110		
					-50	52 (≥ 20)	1/8	100-140		
							5/32	130-180		
							3/16	180-230		

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

Preheat and interpass temperature as required by the base material.

Characteristics and application

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

Approvals

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

Phoenix 120 K

Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
		Re	Rm	A5	CVN		ø		EN	API 5L
%		MPa	MPa	%	°C	J	mm	A		
C	0.07	440	530	30	+20	190	2.0	45 - 65	L245NB - L415NB	A,B
Si	0.35	(≥ 420)	(500-640)	(≥ 20)	-50	100	2.5	65 - 110	L245MB - L415MB	X42 - X60
Mn	1.20						3.2	100 - 145		
							4.0	135 - 200		
							5.0	180 - 280		
		YS	TS	E (L=4d)	CVN		ø			
		ksi	ksi	%	°F	ft-lbf	inch	A		
		64	77	30	+68	140	5/64	45 - 65		
		(≥ 58)	(≥ 70)	(≥ 22)	-50	(≥ 20)	3/32	65 - 110		
					-58	74	1/8	100 - 145		
							5/32	135 - 200		
							3/16	180 - 280		

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

Preheat and interpass temperature as required by the base material.

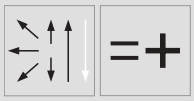
Characteristics and application

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

Approvals

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

Basic electrodes for vertical-up welding

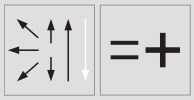
BÖHLER FOX EV 60	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 2560-A: E 46 6 1Ni B 4 2 H5			Re	Rm	A5	CVN		ø		EN	API 5L
AWS A5.5: E8018-C3H4R	%		MPa	MPa	%	°C	J	mm	A		
	C	0.07	510	610	27	+20	180	2.5	80-100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

Characteristics and application

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

Approvals

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

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

Characteristics and application

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

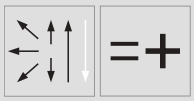
Approvals

NAKS (ø 3.2 mm), GAZPROM (ø 3.2 mm)

BÖHLER FOX EV 65

EN ISO 18275-A: E 55 1NiMo B 4 2 H5

AWS A5.5: E8018-GH4R / E8018-D1H4R



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

Preheat and interpass temperature as required by the base material.

Typical analyses all weld metal

%	
C	0.06
Si	0.3
Mn	1.2
Ni	0.8
Mo	0.35

Typical mechanical properties all weld metal

Re MPa	Rm MPa	A5 %	CVN °C	CVN J
600	650	25	+20	180
(≥ 550)	(620-780)	(≥ 18)	-60	80 (≥ 47)

YS ksi	TS ksi	E (L=4d) %	CVN °F	CVN ft-lbf
87	94	25	+68	132
(≥ 67)	(≥ 80)	(≥ 19)	-76	59
			-60	≥ 20

Diameter and welding current

ø mm	A
2.5	80-100
3.2	100-140
4.0	140-180
4.8	180-220
5.0	190-230

ø inch	A
3/32	80-100
1/8	100-140
5/32	140-180
-	180-220
3/16	190-230

Pipeline steel grades

EN	API 5L
L415NB	X60-X70
L415MB, L485MB	

Characteristics and application

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

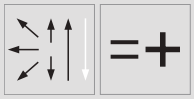
Approvals

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

Phoenix SH V 1

EN ISO 2560-A: E 50 6 Mn1Ni B 4 2 H5

AWS A5.1: E8018-G (E8018-C3 mod.)



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

Preheat and interpass temperature as required by the base material.

Typical analyses all weld metal

%	
C	0.07
Si	0.25
Mn	1.50
Ni	0.95

Typical mechanical properties all weld metal

Re MPa	Rm MPa	A5 %	CVN °C	CVN J
540	630	28	+20	180
(≥ 500)	(560-720)	(≥ 18)	-60	80 (≥ 47)

YS ksi	TS ksi	E (L=4d) %	CVN °F	CVN ft-lbf
78	91	28	+68	133
(≥ 67)	(≥ 80)	(≥ 19)	-76	59

Diameter and welding current

ø mm	A
3.2	100 - 150
4.0	140 - 200
5.0	170 - 250

ø inch	A
1/8	100 - 150
5/32	140 - 200
3/16	170 - 250

Pipeline steel grades

EN	API 5L
L360NB - L485NB	X52 - X70
L360MB - L485MB	

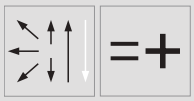
Characteristics and application

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

Approvals

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

Basic electrodes for vertical-up welding

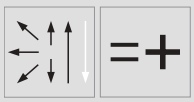
BÖHLER FOX EV 70	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter and welding current		Pipeline steel grades	
EN ISO 18275-A: E 55 6 1NiMo B 4 2 H5											
AWS A5.5: E9018-GH4R / E9018-D1H4R (mod.)	**%**		**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**	**ø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

Characteristics and application

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

Approvals

TÜV (0112), SEPROZ, CE

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

Characteristics and application

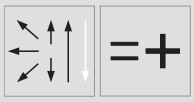
Böhler FOX EV 70 PIPE is a high strength, basic electrode for positional welding of filler and cap layers in tubes, pipes and plate using DC+ positive polarity. It is user-friendly, has good gap bridging ability and easy slag removal to ensure minimal grinding. Good impact toughness down to -40 °C (-40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

Approvals

TÜV (12809), CE

BÖHLER FOX EV 75

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



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

Preheat and interpass temperature as required by the base material.

Typical analyses all weld metal

%	
C	0.05
Si	0.4
Mn	1.6
Cr	0.4
Ni	2.0
Mo	0.4

Typical mechanical properties all weld metal

Re MPa	Rm MPa	A5 %	CVN °C	J
700	750	23	+20	140
(≥ 620)	(690-980)	(≥ 18)	-60	≥ 47

YS ksi	TS ksi	E (L=4d) %	CVN °F	ft-lbf
101	109	23	+68	103
(≥ 87)	(≥ 100)	(≥ 16)	-60	≥ 20

Diameter and welding current

ø mm	A
2.5	80-100
3.2	100-140
4.0	140-180
5.0	190-230

ø inch	A
3/32	80-100
1/8	100-140
5/32	140-180
3/16	190-230

Pipeline steel grades

EN	API 5L
L555MB	X80

Characteristics and application

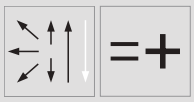
Basic Cr-Ni-Mo-alloyed electrode depositing a high ductility, crack resistant weld, for welding high strength, fine-grained steels. Suitable for service temperatures from +400 °C (752 °F°) down to -60 °C (-76 °F). Metal recovery of approximately 120%. Good weldability in all positions, except vertical-down.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

Approvals

SEPROZ

BÖHLER FOX EV 85

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



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

Preheat and interpass temperature as required by the base material.

Typical analyses all weld metal

%	
C	0.05
Si	0.4
Mn	1.7
Cr	0.4
Ni	2.1
Mo	0.5

Typical mechanical properties all weld metal

Re MPa	Rm MPa	A5 %	CVN °C	J
780	840	20	+20	110
(≥ 690)	(760-960	(≥ 17)	-60	60 (≥ 47)

YS ksi	TS ksi	E (L=4d) %	CVN °F	ft-lbf
113	122	20	+68	81
(≥ 97)	(≥ 110)	(≥ 15)	-60	≥ 20

Diameter and welding current

ø mm	A
2.5	70-100
3.2	100-140
4.0	140-180
5.0	190-230

ø inch	A
3/32	70-100
1/8	100-140
5/32	140-180
3/16	190-230

Pipeline steel grades

EN	API 5L
L625, L690	X90, X100

Characteristics and application

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

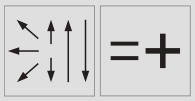
Approvals

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

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

BÖHLER Ti 52-FD

EN ISO 17632-A:
T 46 4 P M 1 H10 / T 42 2 P C 1 H5
AWS A5.36:
E71T1-M21A4-CS1-H8
E71T1-C1A2-CS1-H4



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

Preheating and interpass temperature as required by base metal

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

Typical analyses all weld metal

	%
C	0.06
Si	0.5
Mn	1.2
Ti	0.05

Typical mechanical properties all weld metal

	Re MPa	Rm MPa	A5 %	CVN °C	J
M21	500	580	26	+20	180
	(≥ 460)	(550-740)	(≥ 20)	-20	130
				-40	90 (≥47)
C1	480	550	25	+20	160
	(≥ 420)	(500-670)	(≥ 20)	-20	110 (≥47)
	YS ksi	**TS ksi**	**E (L=4d) %**	**CVN °F**	**ft-lbf**
M21	72	84	26	+68	133
	(≥ 58)	(70-95)	(≥ 22)	-4	96
				-40	66 (≥ 20)
C1	70	80	25	+68	118
	(≥ 58)	(70-95)	(≥ 22)	-20	81 (≥ 20)

Diameter

ø mm	ø inch
1.2	0.045
1.6	1/16

Pipeline steel grades

EN	API 5L
L245NB-L415NB	A,B
L450QB	X42-X65
L245MB-L450MB	

Characteristics and application

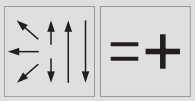
All-positional rutile flux-cored wire with fast freezing slag system. Welder-friendly characteristics. The diameter 1.2 mm size can be used in all welding positions with the same parameter setting. Low spatter losses, easy slag removal, finely rippled bead surface. High X-ray quality welds with excellent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

Approvals

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

BÖHLER Ti 60-FD

EN ISO 17632-A:
T 50 6 1Ni P M 1 H5
AWS A5.36: E81T1-M21A8-Ni1-H4



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

Preheating and interpass temperature as required by base metal

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

Typical analyses all weld metal

	%
C	0.06
Si	0.45
Mn	1.3
Ni	0.9

Typical mechanical properties all weld metal

	Re MPa	Rm MPa	A5 %	CVN °C	J
M21	530	570	27	+20	140
	(≥ 500)	(560-720)	(≥ 18)	-20	120
				-40	100
				-60	60 (≥47)
	YS ksi	**TS ksi**	**E (L=4d) %**	**CVN °F**	**ft-lbf**
M21	77	83	27	+68	103
	(≥ 68)	(80-100)	(≥ 19)	-4	86
				-40	74
				-80	44 (≥ 20)

Diameter

ø mm	ø inch
1.2	0.045

Pipeline steel grades

EN	API 5L
L245NB-L415NB	B
L245MB-L485MB	X42-X70

Characteristics and application

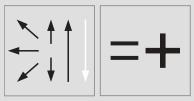
All-positional rutile flux-cored wire with fast freezing slag system for welding low-temperature steels.Outstanding welding characteristics in all positions. Low spatter losses, good slag detachability, finely rippled smooth beads and notch-free toes. Exceptionally good low-temperature impact toughness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

Approvals

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

BÖHLER Ti 70 Pipe-FD

Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
EN ISO 18276-A: T 55 4 Mn1Ni P M 1 H5		**Re**	**Rm**	**A5**	**CVN**		**ø**	**EN**	**API 5L**
AWS A5.36: E91T1-M21A4-G	**%**	**MPa**	**MPa**	**%**	**°C**	**J**	**mm**		
C	0.07	≥ 550	640-820	≥ 18	-40	≥47	1.2	L450MB-L485MB (L555MB)	X65-X70 (X80)
Si	0.50								
Mn	1.50								
Ni	0.95	**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**		
		ksi	**ksi**	**%**	**°F**	**ft-lbf**	**inch**		
		≥ 78	90-110	≥ 17	-40	≥ 20	0.045		



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

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

Preheating and interpass temperature as required by base metal

Characteristics and application

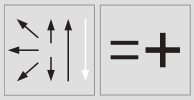
Rutile micro alloyed flux-cored wire for single or multipass welding of carbon-manganese steels and high strength steels with Ar-CO_2 shielding gas. Main features: excellent weldability in all positions, excellent bead appearance, no spatter; fast freezing and easily removable slag. The exceptional mechanical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

Approvals

TÜV (12279),CE, GAZPROM

BÖHLER Ti 80 Pipe-FD

Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
EN ISO 18276-A: T 69 4 Z P M 1 H5		**Re**	**Rm**	**A5**	**CVN**		**ø**	**EN**	**API 5L**
AWS A5.36: E111T1-M21A4-GH4	**%**	**MPa**	**MPa**	**%**	**°C**	**J**	**mm**		
C	0.07	790	850	18	-40	65 (≥ 47)		L485MB, L555MB	X70, X80
Si	0.3	(≥ 690)	(770-940)	(≥ 17)					
Mn	1.8								
Ni	2.1	**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**		
		ksi	**ksi**	**%**	**°F**	**ft-lbf**	**inch**		
		114	123	18	-40	48 (≥ 20)	0.045		
		(≥ 98)	(110-130)	(≥ 15)					



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

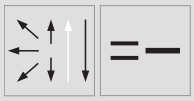
Re-drying possible at 150 °C (300 °F) / 24h, but generally not needed

Preheating and interpass temperature as required by base metal

Characteristics and application

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

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

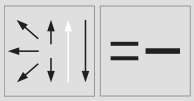
BÖHLER Pipeshield 71 T8-FD	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
AWS A5.36: E71T8-A4-K6			**Re**	**Rm**	**A5**	**CVN**		**ø**	**EN**	**API 5L**
	%		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**		
	C	0.045	435	535	28	+20	200	2.0	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

Characteristics and application

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

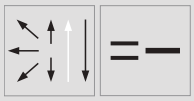
Approvals

NAKS, GAZPROM

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

Characteristics and application

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

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

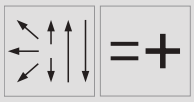
Characteristics and application

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

Approvals

NAKS, GAZPROM

Solid wires for automatic pipeline welding

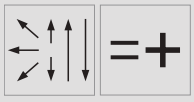
BÖHLER SG 3-P	Typical analyses all weld metal		Typical field results in X70 obtained with various automatic processes						Diameter	Pipeline steel grades	
EN ISO 14341-A: G 46 5 M21 Z / G 42 4 C1 Z				Re	Rm	A5	CVN		ø	EN	API 5L
AWS A5.18: ER70S-G	%			MPa	MPa	%	°C	J	mm		
	C	0.06	M21	670	720	29	+20	100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

Characteristics and application

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

Approvals

TÜV (07682), CE, NAKS

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

Characteristics and application

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

Union K 56 S

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

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

Preheating and interpass temperature as required by the base metal

Characteristics and application

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

Union K Nova

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

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

Preheating and interpass temperature as required by the base metal

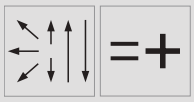
Characteristics and application

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

Approvals

TÜV (05926), CE

Solid wires for automatic pipeline welding

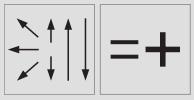
BÖHLER SG 8-P	Typical analyses all weld metal		Typical field results in X70 obtained with various automatic processes						Diameter	Pipeline steel grades	
EN ISO 14341-A: G 50 6 M21 Z3Ni1 / G 46 4 C1 Z3Ni1											
AWS A5.18: ER80S-G (ER80S-Ni1(mod.))	**%**			**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**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

Characteristics and application

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

Approvals

DNV (IV Y46 MS)

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

Characteristics and application

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

Approvals

TÜV (11542), DNV, CE

BÖHLER NiMo 1-IG

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

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

Preheating and interpass temperature as required by the base metal

Characteristics and application

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

Approvals

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

Union NiMo 80

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

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

Preheating and interpass temperature as required by the base metal

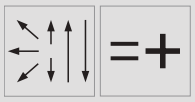
Characteristics and application

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

Approvals

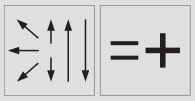
TÜV (06525), CE

Solid wires for automatic pipeline welding

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

Characteristics and application

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

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

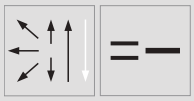
Characteristics and application

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

Approvals

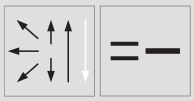
TÜV (02760), DB (42.132.08), ABS, BV, DNV, GL, LR, VG 95132-1, CE

Rods for TIG-welding

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

Characteristics and application

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

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

Characteristics and application

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

Approvals

TÜV (09717), LTSS, SEPROZ, CE

Union I 2

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

Shielding gas:
I1: 100 % Ar

Preheating and interpass temperature as required by base metal

Characteristics and application

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

Approvals

TÜV (09482), CE

Union I 52

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

Shielding gas:
I1: 100 % Ar

Preheating and interpass temperature as required by base metal

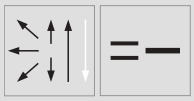
Characteristics and application

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

Approvals

TÜV (09482), CE

Rods for TIG-welding

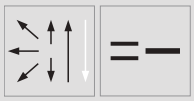
BÖHLER EML 5	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
EN ISO 636-A: W 46 5 W2Si			Re	Rm	A5	CVN		ø	EN	API 5L
AWS A5.18: ER70S-3	%		MPa	MPa	%	°C	J	mm		
	C	0.1	520	620	26	+20	220	1.6	L245NB-L415NB	A, B
	Si	0.6	(≥ 460)	(530-680)	(≥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

Characteristics and application

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

Approvals

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

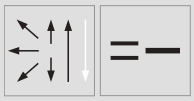
BÖHLER Ni 1-IG	Typical analyses all weld metal		Typical mechanical properties all weld metal					Diameter	Pipeline steel grades	
EN ISO 636-A: W 46 5 W3Ni1			Re	Rm	A5	CVN		ø	EN	API 5L
AWS A5.28: ER80S-Ni1 (mod.)	%		MPa	MPa	%	°C	J	mm		
	C	0.07	500	600	25	-20	150	2.0	L360NB-L415NB	X52-X65
	Si	0.7	(≥ 460)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

Characteristics and application

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

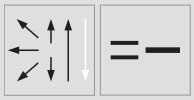
Approvals

TÜV (12808), CE

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

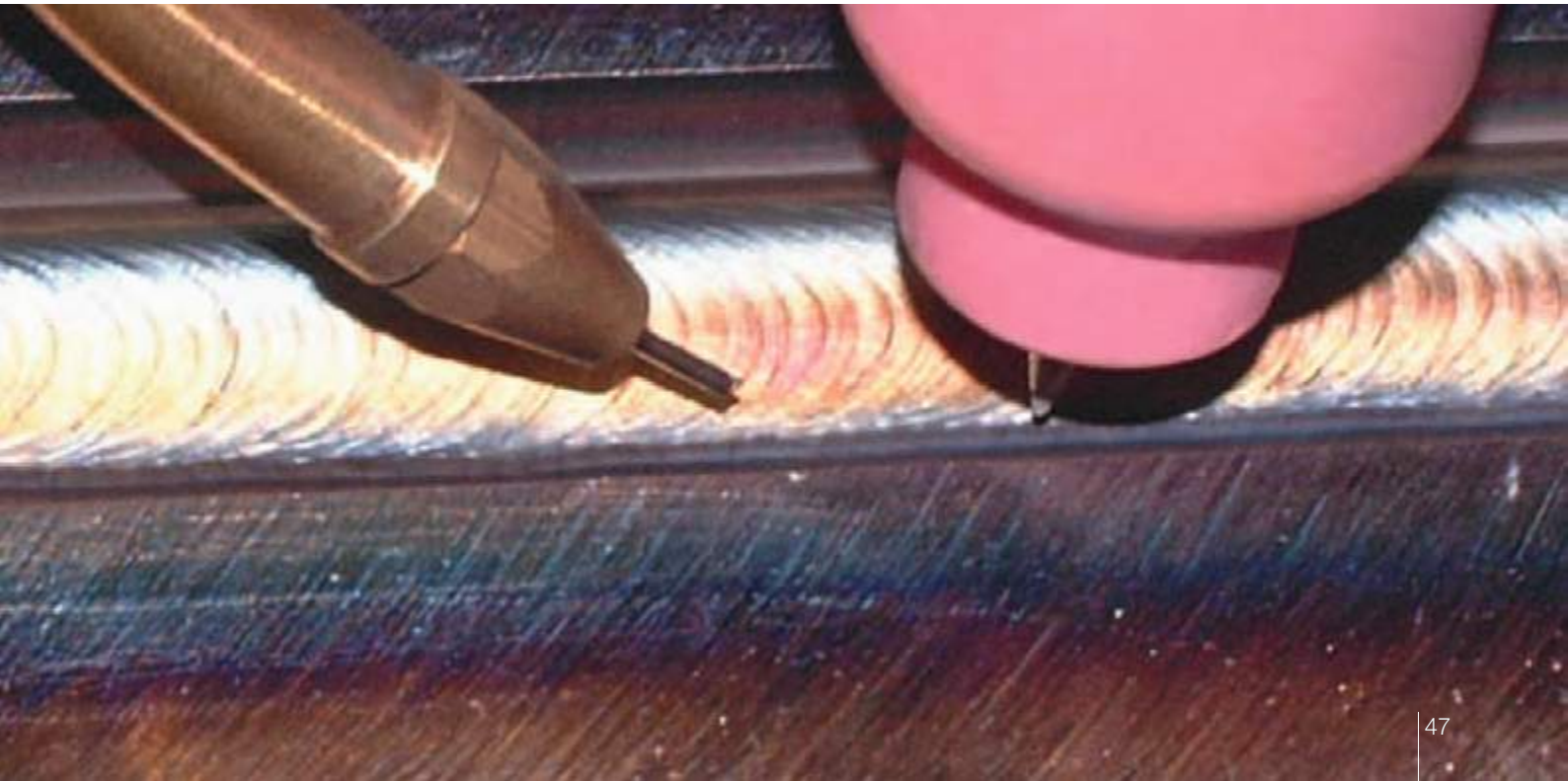
Characteristics and application

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

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

Characteristics and application

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



Wires and flux for SAW welding

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

Characteristics and application

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

Approvals

TÜV (05497), DB (51.132.06), LR, CE

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

Characteristics and application

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

Approvals

TÜV (10424), DNV, LR, CE

Union S 2 NiMo 1 UV 421 TT

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

Characteristics and application

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

Approvals

TÜV (10425), DNV, LR, CE

Union S 3 NiMo 1 UV 421 TT

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

Characteristics and application

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

Approvals

TÜV (10425), DNV, LR, CE

Wires and flux for SAW welding

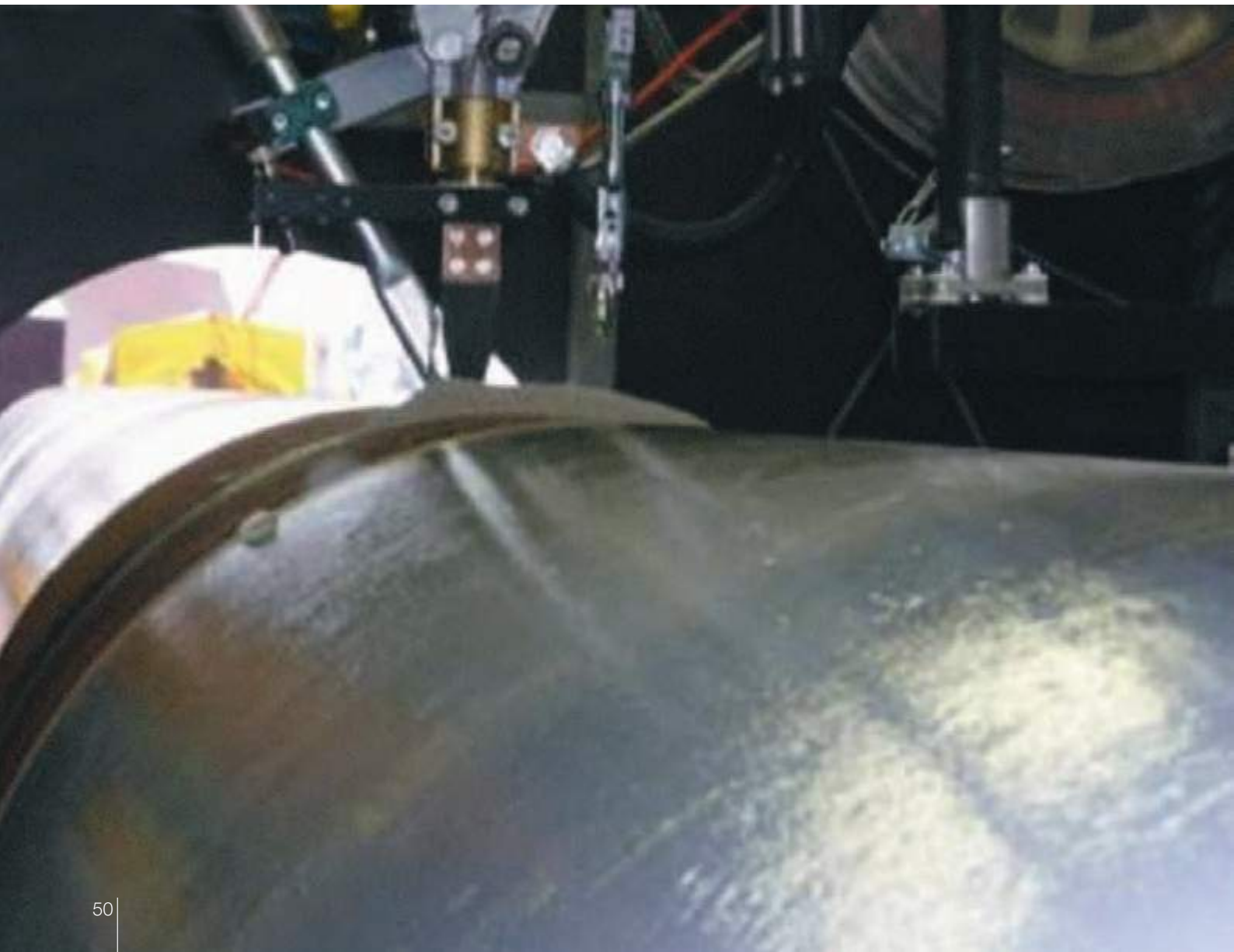
Union S 3 NiMoCr UV 421 TT	Typical analyses			Typical mechanical properties all weld metal					Dia-meter	Pipeline steel grades	
			Weld	Re	Rm	A5	CVN		ø	EN	API 5L
Classification flux	**%**	**Wire**	**metal**	**MPa**	**MPa**	**%**	**°C**	**J**	**mm**		
EN ISO 14174: SA FB 1 55 AC H5	C	0.14	0.08	730	805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

Characteristics and application

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

Approvals

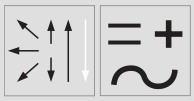
TÜV (05063), DB (51.132.06), ABS, BV, DNV, GL, LR, CE



Electrodes for corrosion resistant alloys (CRA)

BÖHLER FOX EAS 4 M-A

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



Re-drying if necessary:
120-200 °C (250-400 °F) / min. 2h

Characteristics and application

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

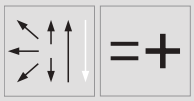
Approvals

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

EN ISO 3581-A: E 19 12 3 L R 3 2
AWS A5.4: E316L-17

BÖHLER FOX EAS 4 M

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



Characteristics and application

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

Approvals

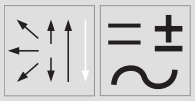
TÜV (0772), DNV (316), Statoil, SEPPROZ, CE

EN ISO 3581-A: E 19 12 3 L B 2 2
AWS A5.4: E316L-15

BÖHLER FOX CN 22/9 N

Typical analyses all weld metal		Typical mechanical properties all weld metal					Dia-meter		Pipeline steel grades	
		Re	Rm	A5	CVN		ø		EN	UNS
		MPa	MPa	%	°C	J	mm	A		
C	0.03	650	820	25	+20	55	2.5	40-75	1.4462	S31803
Si	0.8	(≥ 450)	(≥ 690)	(≥ 20)	-10	50	3.2	70-120	X2CrNiMoN 22-5-3	S32205
Mn	0.9				-20	≥ 32	4.0	110-150		
Cr	22.6						5.0	150-200		
Ni	9.0	YS	TS	E (L=4d)	CVN		ø			
Mo	3.1	ksi	ksi	%	°F	ft-lbf	inch	A		
		94	118	25	+68	40	3/32	40-75		
			(≥ 100)	(≥ 22)	+14	37	1/8	70-120		
					-4	≥ 23	5/32	110-150		
							3/16	150-200		

EN ISO 3581-A: E 22 9 3 N L R 3 2
AWS A5.4: E2209-17



Re-drying if necessary:
250-300 °C (480-570 °F) / min. 2h

Preheating and interpass temperature
max. 150 °C (302 °F)

Characteristics and application

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

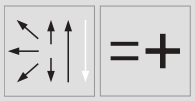
Approvals

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

BÖHLER FOX CN 22/9 N-B

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

EN ISO 3581-A: E 22 9 3 N L B 2 2
AWS A5.4: E2209-15



Re-drying if necessary:
250-300 °C / min. 2h

Re-drying if necessary:
250-300 °C (480-570 °F) / min. 2h

Characteristics and application

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

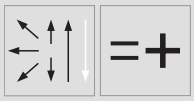
Approvals

TÜV (7084), CE

Electrodes for corrosion resistant alloys (CRA)

BÖHLER FOX CN 25/9 CuT

EN ISO 3581-A: E 25 9 4 N L B 2 2
AWS A5.4: E2595-15



Re-drying if necessary:
250-300 °C (480-570 °F) / min. 2h

Typical analyses all weld metal	
%	
C	0.03
Si	0.5
Mn	1.0
Cr	25.0
Ni	9.5
Mo	3.7
N	0.22
Cu	0.7
W	0.7

Typical mechanical properties all weld metal				
Re	Rm	A5	CVN	
MPa	MPa	%	°C	J
650	850	25	+20	75
(≥ 550)	(≥ 760)	(≥ 18)	-50	50 (≥ 32)
YS	TS	E (L=4d)	CVN	
ksi	ksi	%	°F	ft-lbf
94	123	25	+68	55
	(≥ 110)	(≥ 15)	-58	37 (≥ 23)

Dia-meter	
ø	
mm	A
2.5	55-85
3.2	80-105
4.0	90-140
ø	
inch	A
3/32	55-85
1/8	80-105
5/32	90-140

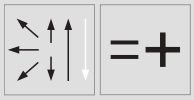
Pipeline steel grades	
EN	UNS
1.4501	S32750
X2CrNiMoCuWN 25-7-4	S32760
ZERON 100	
SAF 25/07	
FALC 100	

Characteristics and application

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

Thermanit 625

EN ISO 14172:
E Ni 6625 (NiCr22Mo9Nb)
AWS A5.11: ENiCrMo-3



Re-drying if necessary:
250-300 °C (480-570 °F) / min. 2h

Typical analyses all weld metal	
%	
C	< 0.04
Si	< 0.7
Mn	< 1.0
Cr	21.5
Ni	Bal.
Mo	9.0
Nb	3.3
Fe	< 2.0

Typical mechanical properties all weld metal				
Re	Rm	A5	CVN	
MPa	MPa	%	°C	J
470	760	40	+20	90
(≥ 420)	(≥ 760)	(≥ 27)	-196	70 (≥ 32)
YS	TS	E (L=4d)	CVN	
ksi	ksi	%	°F	ft-lbf
68	110	40	+68	66
	(≥ 110)	(≥ 30)	-320	52

Dia-meter	
ø	
mm	A
2.5	45-70
3.2	65-105
4.0	85-130
5.0	130-160
ø	
inch	A
3/32	45-70
1/8	65-105
5/32	85-130
3/16	130-160

Pipeline steel grades
CRA clad pipes
Alloy 316L
Alloy 625
Alloy 825

Characteristics and application

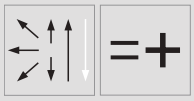
Basic stick electrode with alloyed core wire for high quality welding of corrosion resistant alloyed (CRA) clad steel - Alloy 316L, 625 and 825.

Approvals

TÜV (03463), ABS, GL, CE

Thermanit 686

EN ISO 14172:
E Ni 6686 (NiCr21Mo14W4)
AWS A5.11: ENiCrMo-14



Re-drying if necessary:
250-300 °C (480-570 °F) / min. 2h

Typical analyses all weld metal	
%	
C	0.02
Si	< 0.2
Mn	< 0.5
Cr	21.0
Ni	Bal.
Mo	16.0
W	3.5
Fe	< 1.0

Typical mechanical properties all weld metal				
Re	Rm	A5	CVN	
MPa	MPa	%	°C	J
480	770	38	+20	60
(≥ 350)	(≥ 690)	(≥ 27)		
YS	TS	E (L=4d)	CVN	
ksi	ksi	%	°F	ft-lbf
69	111	38	+68	44
	(≥ 100)	(≥ 30)		

Dia-meter	
ø	
mm	A
2.5	50-70
3.2	70-105
4.0	90-120
ø	
inch	A
3/32	50-70
1/8	70-105
5/32	90-120

Pipeline steel grades
CRA clad pipes
Alloy 316L
Alloy 625
Alloy 825

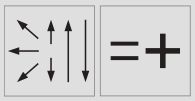
Characteristics and application

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

Flux-cored wires for corrosion resistant alloys (CRA)

BÖHLER EAS 4 PW-FD

EN ISO 17633-A:
T 19 12 3 L P M21 1 /
T 19 12 3 L P C1 1
AWS A5.22:
E316LT1-4 / E316LT1-1



Shielding gas:
M1-M3
C1

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

Typical analyses all weld metal

	%
C	0.03
Si	0.7
Mn	1.5
Cr	19.0
Ni	12.0
Mo	2.7

Typical mechanical properties all weld metal

	Re MPa	Rm MPa	A5 %	CVN °C	J
M21	400 (≥ 320)	560 (≥ 510)	38 (≥ 30)	+20	65
				-120	45 (≥ 32)

	YS ksi	TS ksi	E (L=4d) %	CVN °F	ft-lbf
M21	58	81 (≥ 70)	38 (≥ 30)	+68	48
				-184	33 (≥ 23)

Diameter

ø mm	ø inch
1.2	
1.6	
	0.045
	1/16

Pipeline steel grades

EN	UNS/ AISI
1.4404	S31603
X2CrNiMo 17-12-2	316L
1.4435	
X2CrNiMo 19-14-3	

Characteristics and application

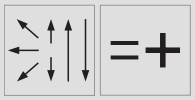
BÖHLER EAS 4 PW-FD is an all-positional rutile flux-cored wire with fast freezing slag. It has excellent welding characteristics in all welding positions and allows high travel speed and deposition rate. Welds are well suited for service temperatures from -120 (-184 °F) up to + 400 °C (752 °F).

Approvals

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

BÖHLER CN 22/9 PW-FD

EN ISO 17633-A:
T 22 9 3 N L P M21 1 /
T 22 9 3 N L P C1 1
AWS A5.22:
E2209T1-4 / E2209T1-1



Shielding gas:
M1-M3
C1

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

Typical analyses all weld metal

	%
C	< 0.03
Si	0.8
Mn	0.9
Cr	22.7
Ni	9.0
Mo	3.2
N	0.13
FN	30-50

Typical mechanical properties all weld metal

	Re MPa	Rm MPa	A5 %	CVN °C	J
M21	600 (≥ 450)	800 (≥ 690	27 (≥ 20)	+20	80
				-20	65
				-40	55
				-46	45 (≥ 32)

	YS ksi	TS ksi	E (L=4d) %	CVN °F	ft-lbf
M21	87	116 (≥ 100)	27 (≥ 20)	+68	59
				-4	48
				-40	40
				-50	33 (≥ 23)

Diameter

ø mm	ø inch
1.2	
	0.045

Pipeline steel grades

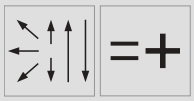
EN	UNS/ AISI
1.4462	S31803
X2CrNiMoN 22-5-3	S32205

Characteristics and application

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

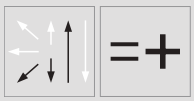
Approvals

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

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

Characteristics and application

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

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

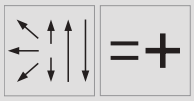
Characteristics and application

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

Approvals

TÜV (11223), CE

Solid wires for corrosion resistant alloys (CRA)

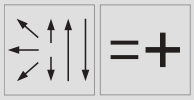
Thermanit GE - 316L Si	Typical analyses all weld metal		Typical mechanical properties all weld metal							Diameter	Pipeline steel grades	
EN ISO 14343-A: G 19 12 3 L Si **AWS A5.9: ER316LSi**	**%**			**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**		**ø mm**	**EN**	**UNS/ AISI**
	C	0.02	M21	430	600	38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

Characteristics and application

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

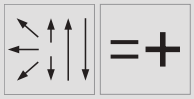
Approvals

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

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

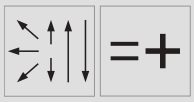
Characteristics and application

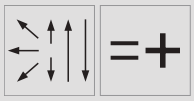
GMAW solid wire for welding ferritic-austenitic duplex stainless steel. Excellent resistance to stress corrosion cracking and pitting (PREN > 35). For service temperatures from -40 up to 250 °C. Specifically designed for welding super martensitic stainless steel in offshore applications. Very low weld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

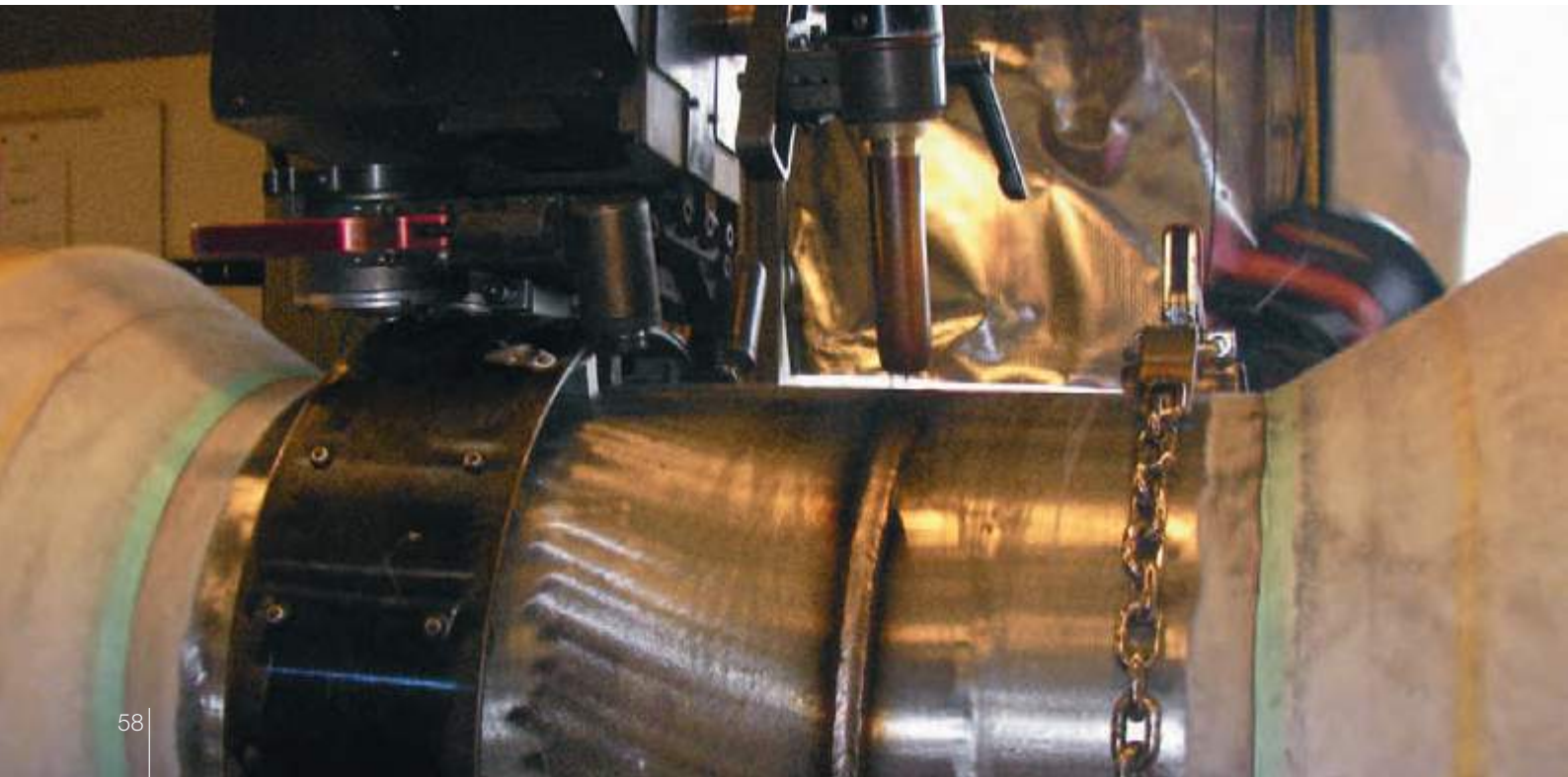
Thermanit 25/09 CuT LH	Typical analyses all weld metal		Typical mechanical properties all weld metal							Diameter	Pipeline steel grades	
EN ISO 14343-A: G 25 9 4 N L **AWS A5.9: ER2594**	**%**			**Re MPa**	**Rm MPa**	**A5 %**	**CVN °C**	**J**		**ø mm**	**EN**	**UNS/ AISI**
	C	0.02	M12	720	850	27	+20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

Characteristics and application

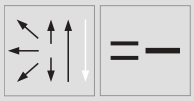
GMAW solid wire for welding ferritic-austenitic super duplex stainless steel. Excellent resistance to stress corrosion cracking and pitting (PREN > 40). For service temperatures from -50 (-58 °F) up to 250 °C (482 °F). Specifically designed for welding super martensitic stainless steel in offshore applications.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

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

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



TIG rods for corrosion resistant alloys (CRA)

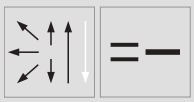
Thermanit GE-316L	Typical analyses all weld metal		Typical mechanical properties all weld metal					Dia-meter	Pipeline steel grades	
EN ISO 14343-A: W 19 12 3 L			**Re**	**Rm**	**A5**	**CVN**		**ø**	**EN**	**UNS/**
AWS A5.9: ER316L	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**		**AISI**
	C	0.02	480	620	37	+20	140	0.8	1.4404	S31603
	Si	0.5	(≥ 320)	(≥ 510)	(≥ 25)			1.6	X2CrNiMoN 17-12-2	316L
	Mn	1.7						2.0		
	Cr	18.5						2.4		
Shielding gas:	Ni	12.3						4.0		
I1: 100% Ar	Mo	2.6	**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**		
			ksi	**ksi**	**%**	**°F**	**ft-lbf**	**inch**		
Rod marking			69	90	37	+68	103	0.030		
Front: W 19 12 3 L, Back: ER316L				(≥ 70)	(≥ 30)			1/16		
								5/64		
Preheating and interpass temperature								3/32		
as required by base metal								5/32		

Characteristics and application

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

Approvals

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

Thermanit 22/09	Typical analyses all weld metal		Typical mechanical properties all weld metal					Dia-meter	Pipeline steel grades	
EN ISO 14343-A: W 22 9 3 N L			**Re**	**Rm**	**A5**	**CVN**		**ø**	**EN**	**UNS**
AWS A5.9: ER2209	**%**		**MPa**	**MPa**	**%**	**°C**	**J**	**mm**		
	C	0.02	620	800	32	+20	220	1.6	1.4462	S31803
	Si	0.4	(≥ 450)	(≥ 550)	(≥ 20)	-60	90 (≥ 32)	2.0	X2CrNiMoN 22-5-3	S32205
	Mn	1.7						2.4		
	Cr	22.5						3.2		
Shielding gas:	Ni	8.8								
I1: 100% Ar	Mo	3.2	**YS**	**TS**	**E (L=4d)**	**CVN**		**ø**		
Ar + 1-2% N_2	N	0.15	**ksi**	**ksi**	**%**	**°F**	**ft-lbf**	**inch**		
Rod marking			90	116	32	+68	162	1/16		
Front: W 22 9 3 NL, Back: ER2209				(≥ 100)	(≥ 20)	-76	66 (≥ 23)	5/64		
								3/32		
Preheating and interpass temperature								1/8		
as required by base metal										

Characteristics and application

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

Approvals

TÜV (03343), ABS, DNV, GL, LR, CE

Thermanit 25/09 CuT

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

Shielding gas:
I1: 100 % Ar
Ar + 2-3 % N2

Rod marking
Front: W 25 9 4 NL

Preheating and interpass temperature
as required by base metal

Characteristics and application

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

Thermanit 625

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

Shielding gas:
I1: 100 % Ar

Rod marking
Front: Ni6625, Back: ERNiCrMo-3

Preheating and interpass temperature
as required by base metal

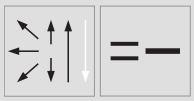
Characteristics and application

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

Approvals

TÜV (03464), DB (43.132.33), DNV, CE

TIG rods for corrosion resistant alloys (CRA)

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

Characteristics and application

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

Wire /flux combinations for corrosion resistant alloys (CRA)

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

Approvals
TÜV (06113), CE

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

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

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

Approvals
TÜV (10173), GL, CE


böhler
by voestalpine
böhlerwelding

009/2015/EN/GL

voestalpine Böhler Welding

Welding know-how joins steel

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

Böhler Welding – More than 2,000 products for joint welding in all conventional arc welding processes are united in a product portfolio that is unique throughout the world. Creating lasting connections is the brand's philosophy in welding and between people.

UTP Maintenance – Decades of industry experience and application know-how in the areas of repair as well as wear and surface protection, combined with innovative and custom-tailored products, guarantee customers an increase in the productivity and protection of their components.

Fontargen Brazing – Through deep insight into processing methods and ways of application, Fontargen Brazing provides the best brazing and soldering solutions based on proven products with German technology. The expertise of this brand's application engineers has been formulated over many years of experience from countless application cases.

forwarded by:

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

New welding helmets from Böhler Welding available – get the perfect all-round protection

Guardian^{50}

Designed for a wide range of
Welding and Grinding Applications

- High Impact Nylon Shell
- Comfort-Headgear with Longitudinal and angular adjustments, smooth ratcjet
- The ADF: Shade 4, 9-13, 50 x 100 Viewing area
- True Colour
- 4 Arc Sensors
- CE Classification 1/1/1/2
- Grind mode via External switch
- 2 years Warranty

Order now at our S&S 2017 Distributor Shop!

Guardian^{62}

The experts choice (Best-In-Class ADF Clarity, Light Weight and True Colour)

- High Impact Nylon Shell
- Comfort-Headgear with Longitudinal and angular adjustments, smooth ratcjet
- The ADF: Shade 4, 5-9/9-13, 62 x 98 Viewing area, Best-In-Class-Clarity
- True Colour
- 4 Arc Sensors
- CE Classification 1/1/1/2
- Grind mode via External switch
- Light weight at 490 gram
- 3 years Warranty

Guardian^{62F}

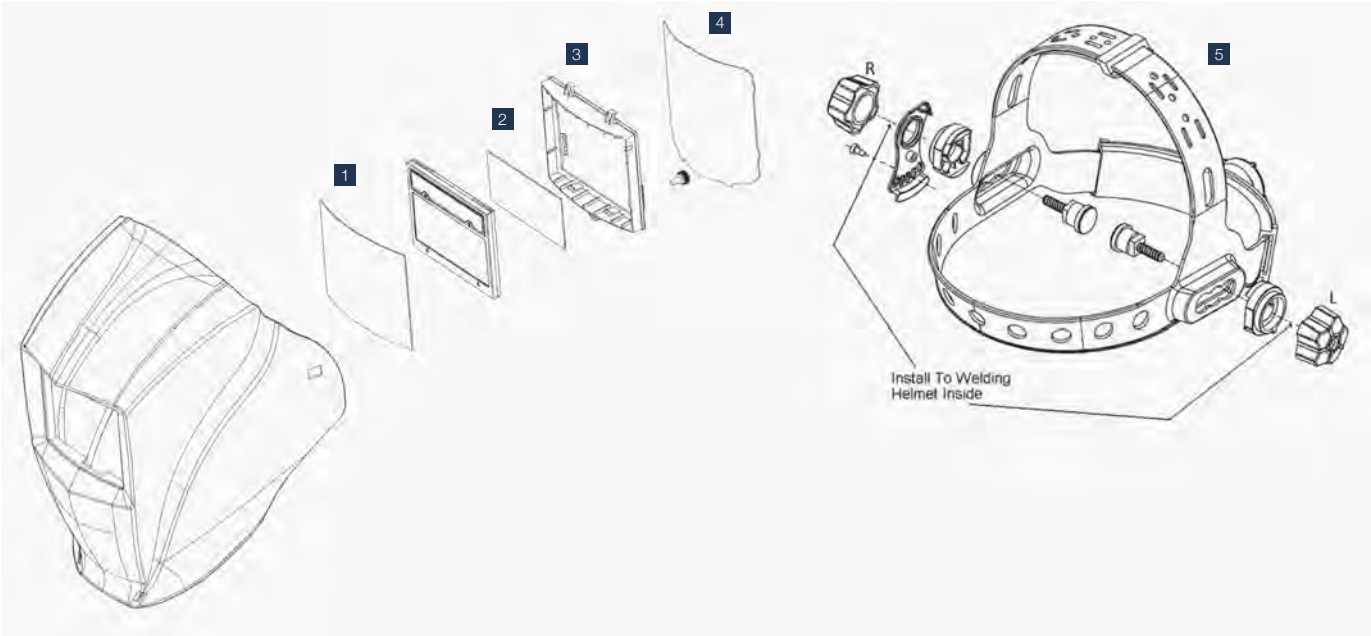
The All-in-One Solution
Protection and Clear View

- High Impact Nylon Shell
- Comfort-Headgear with Longitudinal and angular adjustments, smooth ratcjet
- The ADF: Shade 4, 5-9/9-13, 62 x 98 Viewing area, Best-In-Class-Clarity
- True Colour
- 4 Arc Sensors
- CE Classification 1/1/1/2
- Grind mode via External switch
- 3 years Warranty

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

Part List and Assembly Böhler Welding Helmet



Part List

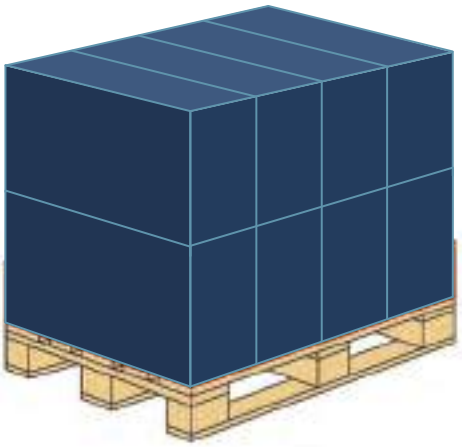
Item	Description	Part No.
1	front cover lens	32423
2	inner lens Guardian[50]	32425
2	inner lens Guardian[62], [62F]	32433
3	ADF retainer and screw Guardian[62], [62F]	32442
3	ADF retainer and screw Guardian[50]	32443
4	grinding visor Guardian[62F]	32437
5	headgear Böhler Welding	32406
*	sweatband (2pcs. front and rear)	32416
*	diopter 1.0	32444
*	diopter 1.5	32445
*	diopter 2.0	32452
*	diopter 2.5	32456
*	Battery ADF CR2450	32517

* not in Illustration

Packaging & Shipment

Packaging units	Product name	Part No.
6 Helmets in 1 carton unmixed (Minimum Order Quantity)	Böhler Guardian[50]	32371
	Böhler Guardian[62]	32373
	Böhler Guardian[62F]	32374
	Böhler The Legend 1927	32378

8 Cartons on 1 EURO-Pallet (48 helmets)



utp maintenance by voestalpine

Tailor-Made Protectivity™

New welding helmets from UTP Maintenance available – get the perfect all-round protection

Guardian^{50}

Designed for a wide range of
Welding and Grinding Applications

- High Impact Nylon Shell
- Comfort-Headgear with Longitudinal and angular adjustments, smooth ratcjet
- The ADF: Shade 4, 9-13, 50 x 100 Viewing area
- True Colour
- 4 Arc Sensors
- CE Classification 1/1/1/2
- Grind mode via External switch
- 2 years Warranty

Order now at our S&S 2017 Distributor Shop!

Guardian^{62}

The experts choice (Best-In-Class ADF
Clarity, Light Weight and True Colour)

- High Impact Nylon Shell
- Comfort-Headgear with Longitudinal and angular adjustments, smooth ratcjet
- The ADF: Shade 4, 5-9/9-13, 62 x 98 Viewing area, Best-In-Class-Clarity
- True Colour
- 4 Arc Sensors
- CE Classification 1/1/1/2
- Grind mode via External switch
- Light weight at 490 gram
- 3 years Warranty

Guardian^{62F}

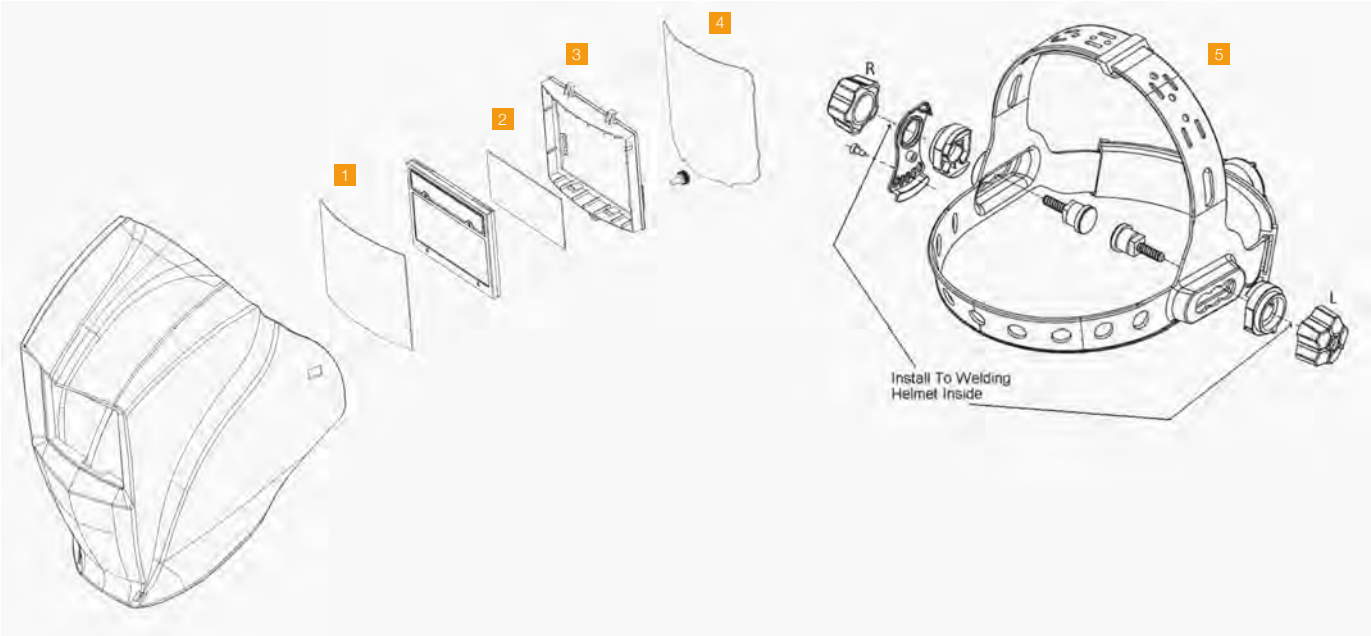
The All-in-One Solution
Protection and Clear View

- High Impact Nylon Shell
- Comfort-Headgear with Longitudinal and angular adjustments, smooth ratcjet
- The ADF: Shade 4, 5-9/9-13, 62 x 98 Viewing area, Best-In-Class-Clarity
- True Colour
- 4 Arc Sensors
- CE Classification 1/1/1/2
- Grind mode via External switch
- 3 years Warranty

voestalpine Böhler Welding
www.voestalpine.com/welding

voestalpine
ONE STEP AHEAD.

Part List and Assembly UTP Maintenance Helmet



Part List

Item	Description	Part No.
1	front cover lens	32423
2	inner lens Guardian[50]	32425
2	inner lens Guardian[62], [62F]	32433
3	ADF retainer and screw Guardian[62], [62F]	32442
3	ADF retainer and screw Guardian[50]	32443
4	grinding visor Guardian[62F]	32437
5	headgear UTP Maintenance	32415
*	sweatband (2pcs. front and rear)	32416
*	diopter 1.0	32444
*	diopter 1.5	32445
*	diopter 2.0	32452
*	diopter 2.5	32456
*	Battery ADF CR2450	32517

* not in Illustration

Packaging & Shipment

Packaging units	Product name	Part No.
6 Helmets in 1 carton unmixed (Minimum Order Quantity)	UTP Guardian[50]	32387
	UTP Guardian[62]	32391
	UTP Guardian[62F]	32401

8 Cartons on 1 EURO-Pallet (48 helmets)