böhler welding
by voestalpine

Lasting Connections

CRAFTING THE PERFECT WELD SEAM FOR PIPELINE CONSTRUCTION

voestalpine Böhler Welding
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ONE STEP AHEAD.

SOLUTIONS FOR THE PIPELINE INDUSTRY

The 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.

EDITORIAL

In today's world, the evolution of pipeline technology is more crucial than ever, particularly with the increasing demand for sustainable energy solutions. As we look to the future, the role of innovative welding solutions becomes paramount, particularly in the development of hydrogen and CO_2 pipelines. At the forefront of this transformative industry is voestalpine Böhler Welding, a pioneer in manufacturing high-quality welding consumables, which is setting new standards with its extensive product portfolio designed for joint welding on a global scale.

voestalpine Böhler Welding boasts over 2000 products, continuously adapted to meet the latest industry specifications and customer requirements. Our offerings are certified by respected institutes, ensuring approval for even the most demanding welding applications. The significance of our welding solutions is magnified in the context of hydrogen and CO_2 pipelines, both critical in the transition to cleaner energy sources. These systems pose unique challenges in terms of material compatibility, corrosion resistance, and welding integrity—areas where voestalpine Böhler Welding excels.

Our commitment to "The Perfect Weld Seam" not only exemplifies our brand philosophy, but it also reflects our dedication to excellence in both welding and customer relations. As a dependable partner for our customers, we offer a unique set of benefits:

- Comprehensive welding process expertise that addresses the industry's prevailing shift towards semi- and fully automatic welding processes.
- The best combination of all portfolio components tailored for high-strength steels with reduced wall thickness, which are increasingly being deployed in pipeline fabrication.
- Integration of our products into comprehensive welding solutions designed to function flawlessly, even in demanding climatic conditions.
- Unique metallurgical and application expertise that enhances the quality and longevity of welded joints across various pipeline materials.
- Value-selling skills to identify and engage potential customers effectively, ensuring they receive the most appropriate solutions for their specific needs.

Our comprehensive range of manual arc welding electrodes includes types with cellulosic coating designed for highly efficient vertical-down welding, as well as basic low-hydrogen types known for their vertical-down or vertical-up operability. For semi- and fully mechanized welding, we provide a diverse array of products including solid wires, rods, self-shielded and gas-shielded cored wires, and submerged arc wire/flux combinations specially designed for double jointing.

Moreover, our catalogue encompasses a wide spectrum of steel grades, ensuring that pipeline projects of all types have the specialized support they require:

- Normal strength pipeline steel grades up to API X60/EN L415MB,
- High tensile grades up to API X100/EN L690MB,
- Standard stainless-steel grades,
- Duplex and super duplex stainless steel,
- Nickel base Alloy 625,
- CRA clad pipes alloy 316L, 625, and 825.

As we forge ahead into a new era of energy transition, voestalpine Böhler Welding remains committed to providing cutting-edge solutions for the challenges of pipeline welding. Our innovative approach not only meets the demands of today's rigorous standards but also anticipates the future needs of the industry. Trust in our expertise and let us help you achieve "The Perfect Weld Seam" for a sustainable tomorrow

CONTENT

PIPELINE PORTFOLIO: CARBON STEEL MATERIAL (CS)

Carbon steel pipelines play a crucial role in various industries, providing essential infrastructure for the transportation of fluids, gases, and slurry materials. The construction of these pipelines requires attention to specific quality standards, rigorous welding techniques, and thorough inspections to ensure the integrity and longevity of the system. The unique characteristics of carbon steel, including its high strength, machinability, and cost-effectiveness, make it a favored choice for pipeline construction. However, specific precautions must be implemented during welding to avoid issues like hydrogen-induced cracking, especially when working with high strength grades or in challenging environments.

Welding carbon steel pipelines involves meticulous planning and execution to address the risks associated with differing heat inputs, interpass temperatures, and the use of filler metals. Proper preheating and post-weld heat treatment may be necessary for certain alloys to alleviate stress and enhance toughness. The presence of contaminants, such as moisture and oil, must also be controlled to avoid compromising the weld quality. Specific carbon steel grades may require tailored welding approaches, especially when subjected to sour service conditions where hydrogen sulfide exposure can lead to sulfide stress cracking.

In addition to these considerations, the laying methodologies for carbon steel pipelines significantly impact the welding procedures employed. For offshore applications, methods such as J-lay, S-lay, and reeling are often used, each having specific implications on the type of welded joints formed and the stress distributions involved. Onshore pipelines may follow conventional trenching techniques, but factors such as soil composition and environmental conditions must be assessed to determine the optimal concrete placement method. The chosen method also dictates the grades of pipe used, as certain approaches may better accommodate high-strength or sour-service materials. The versatile portfolio of voestalpine Böhler Welding (vaBW) offers numerous stick electrodes and other welding consumables that have earned a robust reputation in the pipeline industry for their reliability and quality, ensuring effective performance across various carbon steel applications.

As the industry evolves, the emergence of hydrogen, CO_2, and water pipelines is set to redefine traditional energy transportation methods. These alternative pipeline types are anticipated to gradually complement existing gas and crude oil lines as the global focus shifts towards sustainability and reducing carbon footprints. Each of these new applications demands specific considerations regarding material selection, welding techniques, and integrity assessments to ensure the successful transport of these critical resources. The voestalpine Böhler Welding portfolio adapts efficiently to meet the demands of these new pipeline materials, reflecting decades of expertise in delivering high-performance welding solutions suited for both current and future applications.

CELLULOSIC ELECTRODES

Cellulosic electrodes have a long-standing history and have been extensively employed in various welding applications, particularly in the context of large pipeline girth welds for pipe steels, including those adhering to the stringent API 5L X80 specification. These electrodes are favored not just for their efficiency but also for their economic benefits, making them a preferred choice in the pipeline construction industry. The effectiveness of cellulosic electrodes is particularly evident during the welding process, where they contribute significantly to root passes, filler layers, and cap passes alike.

It's important to note that re-drying of these electrodes is not permitted.

In practice, welders often utilize larger electrode diameters when working in the vertical down position, which accommodates high amperages and allows for faster travel speeds. This capability is essential for maintaining productivity on demanding projects while ensuring that the welds maintain their integrity even under challenging conditions.

Table 1: Cellulosic electrode selection

Pipe Grade API 5L	CELLULOSIC ELECTRODES				
	BÖHLER FOX CEL / FOX CEL+ E6010	**BÖHLER FOX CEL Mo** E7010-A1	**BÖHLER FOX CEL 70-P** E7010-P1	**BÖHLER FOX CEL 80-P** E8010-P1	**BÖHLER FOX CEL 90** E9010-G
A					
B					
X42					
X46					
X52					
X56					
X60					
X65					
X70					
X80					

For root pass welding only
For hot pass, filler passes and capping
For root and hot pass, filler passes and capping

voestalpine Böhler Welding cellulosic electrodes are meticulously engineered to produce welds with exceptional integrity and impressive impact strength. These attributes are crucial not only for meeting industry standards but also for ensuring the longevity and reliability of the welded structures. However, it is important to be aware that the high hydrogen content inherent in the weld deposit can impose certain limitations on the application of these electrodes. Specifically, this characteristic may affect the suitability of cellulosic electrodes in relation to pipe wall thickness and the desired impact properties of the finished welds, particularly in applications where weld soundness and toughness are critical.
Operational data and practical experience point toward the preferred use of negative polarity for root pass welding with cellulosic electrodes. This approach has been shown to enhance the welding performance significantly, resulting in a stable arc and minimizing defects. Additionally, cellulosic electrodes exhibit remarkable gap-bridging capabilities, allowing welders to effectively tackle joints with varying alignment and fit-up conditions. The versatility and adaptability of these electrodes make them a valuable tool in the welding arsenal, especially in situations that demand high performance and durability.
In summary, while cellulosic electrodes offer a plethora of advantages in terms of productivity and effectiveness, it remains vital for welders to be mindful of their specific characteristics and limitations. Proper selection and application can lead to outstanding welding results, ensuring that projects meet the rigorous demands of the industry while maintaining cost-efficiency. The balance of these factors makes cellulosic electrodes an enduring choice for welding professionals engaged in large-scale pipeline projects.

Table 2: Root pass cellulosic electrodes data

Product Name	Typical Analysis	Typical Mechanical properties	Diam. Ø	Amps A	Approvals	Characteristics and applications
BÖHLER FOX CEL ISO 2560-A : E 38 3 C 2 1 AWS A5.1: E6010	C. 0.12 Si. 0.14 MN. 0.5	Re. 450 (≥ 380) MPa Rm. 520 (470-540) Mpa A5. 26 (≥ 22) % Av +20°C: 100 J (≥ 70) ± 0°C: 90 J -20°C: 70 J -30°C: 55 J (≥ 47)	2.5 3.2 4.0 5.0	50 - 90 80 - 130 120 - 180 160 - 210	TÜV (01281), DNV, CE	BÖHLER FOX CEL deposits welds with remarkable impact strength, enhancing safety in field welding operations for pipelines. Moreover, it is suitable for use in sour gas applications, with test values available for SSC testing according to NACE TM-02-84 standards.
BÖHLER FOX CEL + ISO 2560-A : E 38 2 C 2 1 AWS A5.1: E6010	C: 0.17 Si: 0.15 Mn: 0.6	Re: 430 (≥ 380) MPa Rm: 520 (470-540) Mpa A5: 26 (≥ 22) % Av +20°C: 105 J ± 0°C: 95 J -20°C: 60 J (≥ 47) -30°C: 50 J (≥ 27)	2.5 3.2 4.0	50 - 90 80 - 130 120 - 180	TÜV (19380), CE	Specific emphasis on root pass welding. It is recommended for use on D.C. positive polarity in both vertical down and vertical up welding positions. BÖHLER FOX CEL+ features a powerful arc that produces well-penetrated and smooth root passes at high travel speeds. Moreover, it offers high safety against the formation of hollow bead, undercut and ensuring quality welds reducing the risk of defects.
BÖHLER FOX CEL Mo ISO 2560-A : E 42 3 Mo C 2 5 AWS A5.1: E7010-A1	C: 0.10 Si: 0.14 Mn: 0.4 Mo: 0.5	Re: 480 (≥ 420) MPa Rm: 550 (510-590) Mpa A5: 23 (≥ 22) % Av +20°C: 100 J (≥ 70) ± 0°C: 95 J -20°C: 85 J -30°C: 50 J (≥ 47) -40°C: 42 J	3.2 4.0 5.0	80 - 130 120 - 180 160 - 210	TÜV (01325), ABS, CE	This electrode is designed for ease of operation, featuring a concentrated and intensive arc that provides deep penetration for sound joint welds with high-quality X-ray results. Moreover, it is suitable for use in sour gas environments, with test values available for both HIC and SSC testing according to NACE standards.
BÖHLER FOX CEL 70-P ISO 2560-A : E 42 3 C 2 5 AWS A5.5: E7010-P1	C: 0.15 Si: 0.10 Mn: 0.45 Ni: 0.17	Re: 460 (≥ 420) MPa Rm: 560 (500-640) Mpa A5: 23 (≥ 22) % Av +20°C: 100 J -20°C: 80 J -30°C: 65 J (≥ 47)	3.2 4.0 4.8 5.0	60 - 130 100 - 180 130 - 200 140 - 210	TÜV (11180), CE	This electrode features a more intensive arc and a more fluid weld metal compared to the well-known BÖHLER FOX CEL 75, enhancing weld quality and efficiency. Moreover, it is suitable for use in sour gas environments, with test values available for both HIC and SSC testing according to NACE TM-02-84 standards.
BÖHLER FOX CEL 80-P ISO 2560- A : E 46 3 1Ni C 2 5 AWS A5.5: E8010-P1	C: 0.15 Si: 0.15 Mn: 0.7 Ni: 0.8	Re: 490 (≥ 460) MPa Rm: 580 (550-680) Mpa A5: 23 (≥ 20) % Av +20°C: 90 J -20°C: 80 J -30°C: 60 J (≥ 47)	3.2 4.0 4.8 5.0	60 - 130 100 - 180 130 - 200 140 - 210	TÜV (11181), CE	This electrode features a more intensive arc and a more fluid weld metal compared to the well-known BÖHLER FOX CEL 85, enhancing weld quality and efficiency. Moreover, it is suitable for use in sour gas environments, with test values available for both HIC and SSC testing according to NACE TM-02-84 standards.
BÖHLER FOX CEL 90 ISO 2560-A : E 50 3 1Ni C 2 5 AWS A5.1: E9010-G E9010-P1	C: 0.17 Si: 0.15 Mn: 0.9 Ni: 0.8	Re: 560 (≥ 530) MPa Rm: 650 (620-720) Mpa A5: 21 (≥ 18) % Av +20°C: 100 J ± 0°C: 90 J -20°C: 75 J -30°C: 65 J (≥ 47) -40°C: 40 J (≥ 27)	3.2 4.0 5.0	80 – 130 120 - 180 160 - 210	TÜV (01324), CE	They are particularly well-suited for hot passes, filler, and cover layers. The unique coating design and core wire construction ensure the highest metallurgical quality and integrity of the weld metal deposit, resulting in excellent mechanical properties. These electrodes provide good weld pool visibility and are easy to manipulate in all positions, offering high safety margins against porosity and slag inclusions.

BASIC VERTICAL DOWN ELECTRODES

In scenarios where exceptionally high toughness is critical, particularly in extreme climates or during the welding of heavy wall pipes (≥ 25 mm / ≥ 1 inch), such as at landfall sections or when working with top-tier strength pipe steels like X 70 to X 100, the utilization of low hydrogen vertical down electrodes becomes imperative. The BÖHLER FOX BVD series is specifically engineered to meet these stringent requirements.

These electrodes shall be re-dry if necessary is allowed at 300 – 350 °C for minimum 2 hours.

voestalpine Böhler Welding provides a selection of three distinct grades within this series, each designed to adhere to crucial operational standards while also addressing practical and economic considerations for field welding large diameter pipelines. These electrodes are recognized for their versatility and efficacy, making them particularly well-suited for the critical stages of hot passes, filler, and capping layers during the welding process.
One of the standout features of these electrodes is their exceptional crack resistance in the deposited welds, which is a vital attribute for ensuring long-lasting structural integrity in demanding applications. Furthermore, they exhibit remarkable toughness properties, showcasing a very low hydrogen content which significantly reduces the risk of hydrogen-induced cracking. This low hydrogen characteristic is essential for maintaining the mechanical properties of the weld, particularly in high-stress environment.

Table 3: Basic vertical down electrodes selection

Pipe Grade API 5L	BASIC VERTICAL DOWN ELECTRODES				
	-	**BÖHLER FOX BVD 85** E8018-G	**BÖHLER FOX BVD 90** E9018-G	**BÖHLER FOX BVD 100** E10018-G	-
A		■			
B		■			
X42		■			
X46		■			
X52		■			
X56		■			
X60		■			
X65		■			
X70			■		
X80			■	■	

■ For filler passes and capping

In comparison to the vertical up welding technique, the BÖHLER FOX BVD electrodes achieve substantially higher deposition rates, typically ranging between 80-100%. This increased efficiency not only enhances productivity but also contributes to the overall quality of the weld. The weld deposit maintains excellent toughness even at cryogenic temperatures down to -50°C, ensuring that the material performs reliably even in some of the harshest conditions.

Moreover, the electrodes are designed with exceptional striking characteristics that facilitate an easy initiation of the welding process. This feature is crucial as it minimizes the risk of start porosity, a common issue that can compromise the integrity of welds. The design also includes special ergonomic features that ensure easy handling, even under challenging field conditions. This attention to usability means that welders can operate efficiently without compromising on safety or quality, even in the most demanding work environments.

In summary, the BÖHLER FOX BVD series represents a blend of advanced engineering and practical application, making it an ideal choice for professionals who require reliable, high-performance welding solutions that meet the toughest industry standards.

Table 4: Basic vertical down electrodes data

Product Name	Typical Analysis	Typical Mechanical properties	Diam. Ø	Amps A	Approvals	Characteristics and applications
BÖHLER FOX BVD 85 ISO 2560-A : E 46 5 1Ni B 4 5 H5 AWS A5.5: E8018-GH4R	C: 0.05 Si: 0.4 Mn: 1.1 Ni: 0.9	Re: 500 (≥ 460) MPa Rm: 560 (550-680) Mpa A5: 27 (≥ 20) % Av +20°C: 170 J -20°C: 140 J -30°C: 120 J -40°C: 100 J -50°C: 65 J (≥ 47)	3.2 4.0 4.5	110 - 160 180 - 210 200 - 240	TÜV (03531), CE	The BÖHLER FOX BVD 85 can be used in sour gas applications, and test values for SSC (Sulfide Stress Cracking) are also available. This electrode is a reliable choice for demanding welding tasks in pipeline construction and other structural applications.
BÖHLER FOX BVD 90 ISO 2560-A : E 55 5 Z2Ni B 4 5 H5 AWS A5.5: E9018-G H4R E9045-G H4R	C: 0.05 Si: 0.3 Mn: 1.2 Ni: 2.2	Re: 580 (≥ 550) MPa Rm: 650 (620-780) Mpa A5: 27 (≥ 18) % Av +20°C: 170 J -20°C: 130 J -30°C: 110 J -40°C: 90 J -50°C: 70J (≥ 47)	2.5 3.2 4.0 4.5	80 - 110 110 - 160 180 - 210 200 - 240	TÜV (03402), CE	BÖHLER FOX BVD 90 has very similar characteristics and utilization to FOX BVD 85. The higher Nickel (Ni) content in this product provides the same level of toughness but at a higher strength, making it suitable for welding high strength X70 and X80 pipes.
BÖHLER FOX BVD 100 ISO 2560-A : E 62 5 Z2Ni B 4 5 AWS A5.5: E10018-G E10045-G	C: 0.07 Si: 0.4 Mn: 1.2 Ni: 2.3	Re: 640 (≥ 620) MPa Rm: 720 (690-890) Mpa A5: 24 (≥ 18) % Av +20°C: 150 J -20°C: 120 J -30°C: 105 J -40°C: -50°C: 60 J (≥ 47)	3.2 4.0 4.5	110 - 160 180 - 210 200 - 240	TÜV (06333), CE	BÖHLER FOX BVD 100 offers the highest strength in our Basic Vertical Down range, making it particularly suitable for welding X80 pipeline steels

Combined Technology with Cellulosic and Basic Electrodes

Due to the high iron powder content of the basic coating and the capability to weld with high currents, 4 mm (5/32”) diameter low hydrogen vertical down electrodes offer a deposition rate comparable to that of 5.5 mm (7/32”) diameter cellulosic electrodes. Thus, the time required for welding filler and cover passes is similar when using either cellulosic or basic vertical down electrodes. However, there are cost disadvantages when welding the root pass with basic vertical down electrodes. Therefore, it’s commonly recommended and practiced welding root and hot passes with cellulosic electrodes, reserving filler and cover passes for basic vertical down electrodes. This approach combines high efficiency with good mechanical and technological properties in the joint weld.

This technology has been extensively employed with highly positive outcomes, and for further details, please reach out to our Technical Department.

ROOT PASS BASIC VERTICAL UP ELECTRODES

When evaluating the efficiencies of root pass welding, the distinction between using cellulosic vertical-down electrodes and basic vertical-up electrodes becomes quite pronounced. Welders often report up to a 60-70% decrease in welding speed when employing the latter method, which can significantly impact productivity on large-scale projects. In response to this challenge, voestalpine Böhler Welding has engineered the innovative FOX EV Pipe series, which is specifically designed to optimize welding speed without compromising the quality or integrity of the welds compared to standard basic coated electrodes.

These electrodes shall be re-dry if necessary is allowed at 300 – 350 °C for minimum 2 hours.

For successful execution of root passes, achieving the optimum gap width is essential, which should ideally fall between 2 – 3 mm, while the root face is recommended to be maintained within a range of 2 – 2.5 mm. These precise measurements are critical for ensuring proper penetration and bonding during the welding process. The FOX EV Pipe electrodes come pre-packaged in hermetically sealed DrySys packaging that is vacuumed to maintain their integrity and usability, allowing welders to start their work immediately without any preparation time or concerns about moisture contamination.

Table 5: Root pass basic vertical up electrodes selection

Pipe Grade API 5L	ROOT PASS BASIC VERTICAL UP ELECTRODES				
	-	**FOX EV Pipe** E7016-1	**FOX EV 50-W** E7016-1 H4R	**FOX EV 60 Pipe** E8016-G H4R	-
A					
B					
X42					
X46					
X52					
X56					
X60					
X65					
X70					
X80					

For root pass welding only
For root and hot pass, filler passes and capping

voestalpine Böhler Welding's Basic Root Pass coated electrodes possess a unique formulation that makes them exceptionally well-suited for the positional welding of pipeline root passes when used with D.C. negative polarity. In addition to their efficacy in root passes, these electrodes are versatile enough to be applied to filler and cap passes on pipes, tubes, and plates, permitting welding with D.C. positive polarity or even AC. This versatility means they can adapt to various welding scenarios, providing welders with a reliable tool for multiple applications.

User-friendliness is a hallmark of these electrodes, engineered to enhance the overall welding experience. Their excellent gap-bridging capability allows for effective welding over various joint configurations, even when faced with challenging geometries or misaligned pieces. Furthermore, the easy slag removal feature helps to minimize post-weld grinding and cleanup, streamlining the workflow and helping maintain a clean working environment.

Overall, the FOX EV Pipe series and Basic Root Pass coated electrodes represent a significant advancement in pipeline welding technology, offering enhanced speed, versatility, and ease of use while maintaining the performance standards necessary for high-quality welds in demanding environments.

Table 6: Root pass basic vertical up electrodes data

Product Name	Typical Analysis	Typical Mechanical properties	Diam. Ø	Amps A	Approvals	Characteristics and applications
BÖHLER FOX EV PIPE ISO 2560-A : E 42 4 B 1 2 H5 AWS A5.1: E7016-1	C: 0.06 Si: 0.60 Mn: 0.9	Re: 470 (≥ 420) MPa Rm: 560 (520-640) Mpa A5: 29 (≥ 22) % Av +20°C: 170 J -20°C: 120 J -40°C: 100 J (≥ 47) -45°C: 70 J (≥ 27)	2.0 2.5 3.2 4.0	30 – 60 40 - 90 60 - 130 110 - 180	TÜV (07620), DB (10.014.77) CE	BÖHLER FOX EV PIPE offers considerable time savings against AWS E7018 type electrodes when welding root passes due to increased travel speeds. Also, the use of dia. 3.2 mm is possible for root passes in case of wall thicknesses of 8 mm and more. BÖHLER FOX EV PIPE 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 EV 50-W ISO 2560-A : E 42 5 B 1 2 H5 AWS A5.1: E7016-1H4R	C: 0.07 Si: 0.5 Mn: 1.1	Re: 480 (≥ 420) MPa Rm: 570 (500-640) Mpa A5: 28 (≥ 20) % Av +20°C: 200 J -20°C: 150 J -50°C: 80 J (≥ 47)	2.5 3.2 4.0 5.0	55 – 85 80 - 140 110 - 180 180 - 230	TÜV (04180), CE	Smooth and slag-free welds. Crack resistant deposits of high toughness at sub-zero temperatures. Very low hydrogen contents in the weld deposit (acc. AWS condition HD < 4 ml/100 g weld metal). Especially suited for welding on AC.
BÖHLER FOX EV 60 PIPE ISO 2560-A : E 50 4 1Ni B 1 2 H5 AWS A5.5: E8016-G H4R	C: 0.07 Si: 0.6 Mn: 1.2 Ni: 0.9	Re: 540 (≥ 500) MPa Rm: 620 (560-720) Mpa A5: 26 (≥ 18) % Av +20°C: 170 J -20°C: 140 J -40°C: 110 J (≥ 47) -45°C: 60 J	2.5 3.2 4.0 5.0	40 - 90 60 - 130 110 – 180 180 - 230	BV, CE	Basic coated electrode excellent suited for positional welding for filler and cover passes for pipes, tubes, and plates. Good impact properties down to –40°C, low hydrogen content (HD < 4 ml/100 g).

BASIC VERTICAL UP ELECTRODES

Basic coated electrodes are meticulously engineered to deliver high-quality welds, showcasing remarkable strength and toughness properties that remain effective even in extremely low temperatures, withstanding conditions down to -50°C. This durability makes them an excellent choice for environments subject to severe thermal stress and is crucial for applications where safety and structural integrity are paramount.

These electrodes shall be re-dry if necessary is allowed at 300 – 350 °C for minimum 2 hours.

Their versatility extends far beyond pipeline welding; these electrodes are also highly effective for welding steels that exhibit low purity and high carbon content. This adaptability renders them suitable for a diverse array of applications, including but not limited to steel construction, boiler and tank manufacturing, vehicle construction, shipbuilding, and machine construction. In these varied fields, their consistent performance and reliability establish them as a staple choice for manufacturers and professionals alike.

Table 7: Basic vertical up electrodes selection

Pipe Grade API 5L	BASIC VERTICAL UP ELECTRODES					
	BÖHLER FOX EV 47 E7016-1 H4R	**BÖHLER FOX EV 50** E7018-1H4R	**BÖHLER FOX EV 60** E8018-C3 H4R	**BÖHLER FOX EV 62** E8018-G	**BÖHLER FOX EV 65** E8018-G H4R	**BÖHLER FOX EV 70** E9018-G H4R
A	■					
B	■	■				
X42	■	■	■			
X46	■	■	■	■		
X52	■	■	■	■	■	
X56		■	■	■	■	
X60			■	■	■	■
X65				■	■	■
X70					■	■
X80						■

■ For filler passes and capping

Furthermore, basic coated electrodes are capable of being employed for buffer layers on build-ups specifically designed for high carbon steels, making them particularly advantageous in offshore construction projects where resilience to harsh marine environments is required. While their use in the pipeline industry may not be a common prerequisite, the exceptional characteristics of voestalpine Böhler Welding (vaBW) electrodes make them an ideal solution for these critical applications.

For projects requiring higher yield strengths, voestalpine Böhler Welding offers the FOX EV Series, which includes options such as FOX EV 75, FOX EV 85, and FOX EV 105, boasting strengths of up to 890 MPa. This versatility allows you to select the most appropriate electrode for your specific operational demands and material challenges. Should you require further information or guidance in selecting the right electrode for your welding needs, do not hesitate to reach out to us. Our team is equipped to provide expert advice and recommendations tailored to your unique situations and project specifications.

Table 8: Basic vertical up electrodes data

Product Name	Typical Analysis	Typical Mechanical properties	Diam. Ø	Amps A	Approvals	Characteristics and applications
BÖHLER FOX EV 47 ISO 2560-A : E 38 4 B 4 2 H5 AWS A5.1: E7016-1H4R	C: 0.06 Si: 0.3 Mn: 0.9	Re: 440 (≥ 380) MPa Rm: 530 (470-600) Mpa A5: 27 (≥ 20) % Av +20°C: 200 J -20°C: 130 J -40°C: 100 J (≥ 47) -45°C: ≥ 47	2.5 3.2 4.0 5.0 6.0	80 – 110 100 - 140 130 - 180 180 - 230 240 – 280	TÜV (01098), DB (10.014.09) ABS BV DNV LR RINA CE	Basic coated stick electrode designed for steel constructions with lower strength but exceptionally high toughness. The weld metal is extremely ductile, crack-resistant, and aging-resistant, making it especially suited for rigid welds with heavy seam cross-sections
BÖHLER FOX EV 50 ISO 2560-A : E 42 5 B 4 2 H5 AWS A5.1: E7018-1H4R	C: 0.08 Si: 0.40 Mn: 1.2	Re: 460 (≥ 420) MPa Rm: 570 (500-640) Mpa A5: 30 (≥ 20) % Av +20°C: 190 J -20°C: 160 J -40°C: -50°C: 70 J (≥ 47)	2.0 2.5 3.2 4.0 5.0 6.0	50 – 70 80 - 110 100 - 140 130 - 180 180 – 230 240 - 290	TÜV (00426), DB (10.014.02) ABS, BV DNV, LR RINA CWB (Ø3.2 - 6.0) CE	Basic coated 7018-type stick electrode with excellent strength and toughness properties down to -50°C. Ideal for versatile steel constructions, boiler, and tank construction. This electrode produces high-quality welds, has been CTOD tested at -10°C, and meets NACE and SSC testing standards. It features very low hydrogen content and a moisture-resistant coating.
BÖHLER FOX EV 60 ISO 2560-A : E 46 6 1Ni B 4 2 H5 AWS A5.5: E8018-C3 H4R	C: 0.07 Si: 0.4 Mn: 1.15 Ni: 0.9	Re: 510 (≥ 460) MPa Rm: 600 (550-680) Mpa A5: 27 (≥ 20) % Av +20°C: 200 J -60°C: 120 J (≥ 47)	2.5 3.2 4.0 5.0	80 - 100 110 - 140 140 - 180 190 - 230	TÜV (01524), DNV VG 95132 ABS CE	A basic coated, Ni-alloyed electrode with excellent mechanical properties, high toughness, and crack resistance. Suitable for service temperatures ranging from -60°C to 350°C, ideal for welding higher strength fine-grained construction steels. It features very low hydrogen content and a moisture-resistant coating.
BÖHLER FOX EV 62 ISO 2560-A : E 50 6 Mn1Ni B 4 2 H5 AWS A5.5: E8018-G	C: 0.07 Si: 0.25 Mn: 1.5 Ni: 0.95	Re: 530 (≥ 500) MPa Rm: 620 (560-720) Mpa A5: ≥ 19 % Av +20°C: 140 J -60°C: 55 J (≥ 47)	3.2 4.0 5.0	100 - 150 140 - 180 170 - 250	TÜV (00531), DB (10.014.58) ABS, BV DNV, LR VG 95132-1 CE	Basic coated, MnNi alloyed electrode, for high strength fine grained steels, impact toughness down to -60°C. It ensures high radiographical soundness. Very low hydrogen content below 5 ml/100 g weld metal. Suited for welding of fine-grained structural steels, gas storage tanks.
BÖHLER FOX EV 65 ISO 2560-A : E 55 6 1NiMo B 4 2 H5 AWS A5.5: E8018-G H4R E8018-D1 H4R	C: 0.06 Si: 0.3 Mn: 1.2 Ni: 0.8 Mo: 0.35	Re: 590 (≥ 550) MPa Rm: 650 (610-780) Mpa A5: 25 (≥ 18) % Av +20°C: 190 J -60°C: 90 J (≥ 47)	2.5 3.2 4.0 5.0	80 – 100 100 - 140 140 - 180 190 - 230	TÜV (01802), ABS BV VG 95132 CE	A basic coated, MnNi alloyed electrode designed for high strength fine-grained steels with impact toughness down to-60°C. It ensures high radiographic soundness and is applicable for sour gas environments (HIC test acc. to NACE TM-02-84). It features very low hydrogen content combined with a moisture-resistant coating.
BÖHLER FOX EV 70 ISO 2560-A : E 55 6 1NiMo B 4 2 H5 AWS A5.5: E9018-G H4R	C: 0.04 Si: 0.3 Mn: 1.2 Ni: 0.9 Mo: 0.4	Re: 590 (≥ 550) MPa Rm: 670 (620-780) Mpa A5: 24 (≥ 18) % Av +20°C: 160 J -60°C: 70 J (≥ 47)	2.5 3.2 4.0 5.0	80 – 100 100 - 140 140 - 180 190 - 230	TÜV (00112), CE	A basic coated, MnNi alloyed electrode, engineered to deliver high toughness even at temperatures as low as -60°C. It ensures high radiographic soundness due to the low hydrogen content. It has undergone CTOD and NDT testing to ensure its reliability and performance. Very low hydrogen content combined with a moisture-resistant coating.


TERRA MP 350 RC
böhler welding

INTRODUCTION TERRA MP 350

Introducing the TERRA MP 350 RC, a powerful and dependable three-phase power source meticulously designed for TIG DC Lift and electrode welding, making it the perfect companion for pipeline jobsites. This compact yet robust unit is driven by cutting-edge inverter technology, ensuring it delivers exceptional performance and durability even in the most demanding environments.

The TERRA MP 350 RC is characterized by its lightweight and portable design, allowing users to transport it easily to various job locations. A standout feature of this model is its user-friendly RC 100 MP remote control, which significantly enhances functionality and operational efficiency in the field.
Users will appreciate the RC 100 MP robust metallic rollbar that provides anti-shock protection. Furthermore, a dedicated rear magnet ensures that the unit is securely and stably positioned over pipes during welding tasks. Designed for versatility, the TERRA MP 350 RC boasts special electronics that remain operational in extremely low temperatures, making it adaptable to a wide range of working conditions.

Performance and Power:

This powerful equipment boasts high output at a 100% duty cycle, making it suitable for heavy-duty applications, while also performing excellently with long power supply extension cables of up to 30 meters. Inverter modulation allows for easy striking of cellulosic stick electrodes regardless of open circuit voltage, and it is compatible with diesel engine generators. The TERRA MP 350 RC supports multiple welding processes, including MMA and TIG Lift, achieving a rating of 350A at 40% duty cycle even at 40°C.

Durability and Protection:

The unit's high-temperature, shockproof, and abrasion-resistant plastic casing ensures durability, while its air flow ducting and fully encapsulated PC board protect against dust contamination. With an IP23S rating, it provides a high level of safety for outdoor use in adverse weather conditions.

Control and Usability:

Control and usability are enhanced with built-in adjustable arc control features, a comprehensive digital display, and easy adjustments. The remote control is specifically designed for pipeline jobsites, allowing for manual operations and voltage control. As the technology evolves, software-based controls can be upgraded to integrate new features, supported by a CAN fieldbus digital communication system that ensures high-speed and reliable connectivity.

Design and Construction:

Weighing only 16.5 kg, the compact design of the TERRA MP 350 RC operates on a three-phase 3x400V system, while minimizing electromagnetic interference during lift-start TIG welding. Its current socket accommodates 50/70 mm^2 connections.

Special Features:

This exceptionally rugged and easy-to-use system excels at stick welding with a variety of popular electrodes and boasts a long service life even under heavy-duty and challenging environmental conditions. The TERRA MP 350 RC is engineered to fulfill the demanding requirements of pipeline welding, ensuring superior arc dynamics and outstanding overall welding performance for achieving flawless weld seams in tough conditions.

The TERRA MP 350 RC is expertly designed to meet the rigorous demands of pipeline welding, ensuring optimal arc dynamics and exceptional welding performance. With its rugged design and advanced features, it is the ultimate choice for achieving flawless weld seams, even in the most challenging conditions. Whether on a remote job site or in extreme climates, the TERRA MP 350 RC rises to the occasion, showcasing reliability and efficiency at every turn
Böhler Welding machines are covered by a five-year warranty (requires registration), giving customers the peace of mind of knowing that they have purchased a high-quality power source.
Robust, reliable design and regular maintenance - guarantees a long product life cycle.

SOLID WIRES (GMAW)

Table 9: Solid wires for mechanized welding selection

Pipe Grade API 5L	SOLID WIRES FOR MECHANIZED WELDING				
	Pipeshield X 56 ER70S-3	**Pipeshield X 60** ER70S-6	**Pipeshield X 70** ER70S-6	**Pipeshield X 80** ER80S-Ni5	**Pipeshield X 90** ER90S-G
A	■				
B	■				
X42	■				
X46	■	■			
X52	■	■			
X56		■	■		
X60			■	■	
X65			■	■	
X70				■	■
X80					■

■ For root pass, hot pass, filler passes and capping

The Pipeshield X series of solid wires for Gas Metal Arc Welding (GMAW) are meticulously crafted for fully mechanized circumferential, all-position pipe welding.

Pipeshield X integrates engineered wire surfaces and precisely controlled chemical compositions, resulting in excellent impact values even at low temperatures.

The consistent wire geometry enhances wire feeding and ensures stable arc performance throughout the welding process.

Table 10: Solid wires for mechanized welding data

Product Name	Typical Analysis	Typical Mechanical properties	Diam. Ø	Approvals	Shielding Gas	Characteristics and applications
Pipeshield X 56 EN ISO 14341-A : G 42 5 M21 2Si AWS A5.18: ER70S-3	C: 0.08 Si: 0.60 Mn: 1.15	Re: (≥ 420) MPa Rm: (≥ 530) Mpa A5: (≥ 22) % Av +20°C: (≥ 200) -50°C: (≥ 120)	1.0	-	Ar + 15 – 25 % CO_2	Pipeshield X 56 is designed to accommodate pipe steel grades up to API X56, with a softer macrostructure. It is frequently utilized for root pass welding, particularly with limited hardness requirements, ensuring reliable performance in critical welding applications. Also suitable for H2 pipeline transportation.
Pipeshield X 60 EN ISO 14341-A : G 42 4 M21 3Si1 AWS A5.18: ER70S-6	C: 0.08 Si: 0.85 Mn: 1.50	Re: 450 (≥ 420) MPa Rm: 560 (≥ 500 - 640) Mpa A5 25 (≥ 20) % Av -20°C: - -40°C: 70 J (≥ 47)	1.0 1.2	-	Ar + 15 – 25 % CO_2	Pipeshield X60 is designed to accommodate pipe steel grades up to API X60, providing commendable impact toughness even at low temperatures down to -40 °C. It is frequently utilized for root pass welding, particularly with higher tensile pipe grades, ensuring reliable performance in critical welding applications.
Pipeshield X 70 EN ISO 14341-A : G 46 4 M21 4Si1 AWS A5.18: ER70S-6	C: 0.069 Si: 0.95 Mn: 1.65	Re: 530 (≥ 480) MPa Rm: 615 (≥ 580) Mpa A5: 24 (≥ 18) % Av -20°C: 140 J (≥ 75) -40°C: 115 J (≥ 47)	1.0 1.02 1.2	TÜV (19421), CE	Ar + 15 – 25 % CO_2	Pipeshield X70 is designed to cover pipe steel grades up to API X70, providing excellent impact toughness even at low temperatures down to -40 °C and CTOD values at -10 °C. Moreover, this product is suitable for sour gas applications, having been tested for Hydrogen-Induced Cracking (HIC) according to NACE TM-0284 standards.
Pipeshield X 80 EN ISO 14341-A : G 50 6 M21 Z3Ni1 AWS A5.28: ER80S-Ni5	C: 0.065 Si: 0.69 Mn:1.55 Ni: 0.9 Ti +	Re: 520 (≥ 500) MPa Rm: 630 (≥ 600) Mpa A5: 26 (≥ 24) % Av -40°C: 180 J (≥ 80) -60°C: 100 J (≥ 60)	0.9 1.0 1.02 1.2	TÜV (19421), ABS, DNV, CE	Ar + 15 – 25 % CO_2	The 1%Ni-alloyed Pipeshield X80 is designed to cover pipe steel grades up to API X80, providing excellent impact toughness even at low temperatures down to -60 °C and CTOD values at -10 °C. Moreover, this product is suitable for sour gas applications, having been tested for Hydrogen-Induced Cracking (HIC) according to NACE TM-0284 standards.
Pipeshield X 90 EN ISO 14341-A : G 55 6 M21 Mn3Ni1Mo AWS A5.28: ER90S-G	C: 0.08 Si: 0.60 Mn:1.8 Ni: 0.9 Mo: 0.3 Ti +	Re: 620 (≥ 550) MPa Rm: 700 (≥ 640) Mpa A5 23 (≥ 18) % Av -40°C: 110 J (≥ 70) -60°C: 160 J (≥ 47)	1.0	-	Ar + 15 – 25 % CO_2	Pipeshield X 90 is tailored to cover pipe steel grades up to API X80Q and is engineered for welding in all positions. It offers excellent cryogenic impact energy down to -60°C and maintains low hydrogen contents in the deposit, ensuring high-quality welds even in demanding conditions.

SOLID WIRES (GTAW)

In the realm of gas tungsten arc welding (GTAW) for pipeline applications, the selection of the right filler materials is paramount for achieving high-quality, durable welds. The voestalpine Böhler Welding portfolio offers a range of TIG rods and wires specifically designed for high integrity welds, ensuring that the finished joints meet stringent industry standards. These filler metals are suitable for diverse applications, particularly where low-temperature toughness, crack resistance, and impact performance are essential.

Table 11: Solid wires for GTAW welding selection

Pipe Grade API 5L	**Solid Wires for manual & mechanized TIG welding**				
	Union I2 ER70S-3	**Union I52** ER70S-6	**BÖHLER ER80S-Ni1** ER80S-Ni1	**Union I Ni 1 MoCr** ER100S-G	**BÖHLER NiCrMo 2,5-IG** ER100S-G
A	■				
B	■				
X42	■				
X46	■				
X52	■	■			
X56	■	■	■		
X60		■	■		
X65			■	■	■
X70				■	■
X80				■	■

■ For root pass, hot pass, filler passes and capping

A hallmark of the voestalpine Böhler Welding portfolio is its focus on low silicon content in the filler metals, which enhances their suitability for joint welds subjected to processes like enameling and galvanizing. This characteristic makes them particularly valuable in environments requiring exceptional weld integrity, such as offshore pipework and marine engineering. The rods are engineered to perform reliably under extreme conditions, with demonstrated impact properties down to -60°C, ensuring the structural integrity of welded joints in harsh climates.

Furthermore, the inclusion of micro alloying elements in some of the rods contributes to excellent ductility and resilience against cracking, even under challenging service conditions. These features are crucial for applications in sectors like pressure vessel and boiler construction, where high strength and low hydrogen content in the weld deposit can significantly influence long-term performance and safety.

The voestalpine Böhler Welding portfolio emphasizes quality over productivity, recognizing that in critical applications like pipeline construction, the reliability and toughness of welds are of utmost importance. The solid rods and wires provided are not only ideal for structural steel engineering but also exemplify the commitment to producing welds that maintain their high impact values even after post-weld heat treatment. As industries continue to demand materials that withstand extreme challenges, the voestalpine Böhler Welding GTAW product line stands out for its ability to deliver superior welding solutions characterized by exceptional quality and integrity.

Table 12: Solid wires for GTAW welding Data with I2 shielding gas

Product Name	Typical Analysis	Typical Mechanical properties	Diam. Ø	Approvals	Characteristics and applications
Union I 2 EN ISO 636- A : W 42 5 W2Si AWS A5.18: ER70S-3	C: 0.08 Si: 0.60 Mn: 1.15	Re: 420 MPa Rm: 530 Mpa A5: 22 % Av -20°C: 150 J (≥ 75) J -40°C:≥ 47 J	2.0 2.4 3.0	TÜV (09482), CE	Thanks to its exceptional purity, the resulting weld metal achieves impressive impact values even in frigid conditions, reaching down to -50 °C (-58 °F). Furthermore, these high values remain consistent even after undergoing stress-relieving Post Weld Heat Treatment (PWHT).
Union I 52 EN ISO 636- A : W 42 5 W3Si1 AWS A5.18: ER70S-6	C: 0.08 Si: 0.85 Mn: 1.50	Re: 440 MPa Rm: 560 Mpa A5: 25 % Av -20°C: 130 J -40°C: 50 J	2.0 2.4 3.2	TÜV (01656), DB (42.132.119), DNV, CE	
BÖHLER ER80S-Ni1 EN ISO 636- A : W Z2Ni1Mo AWS A5.28: ER80S-Ni1	C: 0.09 Si: 0.6 Mn: 1.1 Ni: 0.95 Mo: 0.25	Re: 500 (≥ 470) MPa Rm: 600 (550 – 680) Mpa A5: 25 (≥ 20) % Av -20°C: 150 J -40°C:≥ 47 J	Spool 1.0 1.2 Rod 2.4 3.2	TÜV (09482), CE	TIG rods of type ER80S-Ni1 are specifically designed for welding offshore pipe work and similar high integrity applications. They possess exceptional impact properties, maintaining high performance even in extremely low temperatures down to -50°C.
Union I Ni 1 MoCr EN ISO 16834-A : W 55 6 ZMn3Ni 0,9 MoCr AWS A5.28: ER100S-G	C: 0.08 Si: 0.50 Mn:1.60 Ni: 0.90 Mo: 0.40 Cr: 0.27	Re: 600 (≥ 550) MPa Rm: 710 (≥ 640) Mpa A5: 19 (≥ 18) % Av +20°C: 160 (≥ 100) J -20°C: 90 (≥ 55) J -60°C: 55 (≥ 47) J	Spool 1.0 1.2 Rod 2.4	-	They exhibit outstanding weld metal toughness at low temperatures and fulfill sour gas requirements. These rods and wires find applications in crane manufacturing, the automotive industry, and for components of offshore equipment.
BÖHLER NiCrMo 2,5-IG EN ISO 16834-A W 69 6 I1 Mn3Ni2.5CrMo AWS A5.28: ER110S-G	C: 0.08 Si: 0.6 Mn: 1.4 Ni: 2.5 Mo: 0.4 Cr: 0.3	Re: 750 (≥ 690) MPa Rm: 830 (≥ 770 – 960) Mpa A5: 22 (≥ 17) % Av +20°C: 160 (≥ 80) J -40°C: 80 (≥ 47) J -60°C:≥ 47 J	1.6 2.0 2.4 3.0	TÜV (09482), CE	GTAW rods designed for joint welding of high-strength fine-grained constructional steels with strict requirements on low-temperature toughness down to -60°C are utilized, for instance, in marine engineering for the fabrication of LPG tankers.


WF NX 4000 SMART
URANOS NX 4000 GSM

INTRODUCING THE NX WELDING SOLUTIONS

In the demanding world of pipeline construction and maintenance, the need for reliable, high-quality welding solutions is paramount. At Böhler Welding, we understand that welding professionals require more than just equipment; they need a partner that truly supports their mission. The NX welding equipment are engineered specifically to meet the rigorous demands of the pipeline industry, providing you with the technological edge you need to ensure the integrity of your work.

Unmatched Performance and Precision

The URANOS NX 5000 GSM stands out as a powerful source of welding excellence, designed to navigate the unique challenges presented by pipeline environments. With cutting-edge digital control technology, it allows for high-quality welding that meets the exacting standards required for pipeline integrity. The equipment supports various welding processes, including MIG/MAG and TIG, and offers a vast library of 600 Böhler Arc welding programs, along with 240 customizable job parameters. This adaptability ensures that you can tailor your welding processes for each specific job, delivering optimal results on the first attempt.

Advanced Features for Maximum Efficiency

In the pipeline industry, efficiency and connectivity can significantly enhance productivity. The NX systems feature a full-color display with an intuitive user interface, enabling quick adjustments and real-time monitoring. With enhanced connectivity through WeldNet, your NX equipment seamlessly integrates into a network that allows for data tracking and economic reporting, ensuring that you stay informed and in control throughout the welding process.

Innovative greenWave® Technology

At the heart of the NX welding experience is Böhler Welding's groundbreaking greenWave® technology. This patented inverter system not only complies with the strictest energy efficiency standards (EN61000-3-12) but also revolutionizes the way power is consumed during welding operations. greenWave® provides complete protection against unstable mains supplies, adapting automatically to varying input voltages to maintain optimal performance. Not only does it enhance the overall reliability of the welding operation, but it also significantly reduces installation power requirements and cuts energy costs. By minimizing reactive energy consumption by between 70% and 100%, and reducing joule effect losses by over 50%, greenWave® not only boosts your operational efficiency but also contributes to sustainability by lowering CO_2 emissions. This commitment to energy efficiency is essential for pipeline operations where environmental responsibility meets economic vitality.

Customized Solutions for Your Specific Needs

The NX approach allows you to enter an era of personalized welding. Tailor your NX welding equipment to suit your specific pipeline operations with options for inverter technology, diverse welding processes, and a variety of power specifications. From carbon steel to aluminum and specialty applications, Böhler Welding has you covered. Equip your NX with essential accessories, including welding torches, wire feeders, cooling units, and remote controls to enhance your welding setup further.

Rely on Our Expertise

With Böhler Welding, you receive more than just equipment; you gain a true ally in the field. Our offerings include up to a 5-year warranty, trial uploads of welding programs, a welding validation program, compliance with EN1090 standards, and access to the WeldNet platform. Our goal is to ensure that you have all the support and resources you need to succeed in the challenging pipeline landscape.
Choose the NX welding solutions for unparalleled performance, precision, and innovation—because your pipeline projects deserve the best. Let Böhler Welding be the partner that propels your operations into a new era of excellence.

Böhler Welding machines are covered by a five-year warranty (requires registration), giving customers the peace of mind of knowing that they have purchased a high-quality power source.
Robust, reliable design and regular maintenance - guarantees a long product life cycle.

FLUX CORED WIRES (GSFCAW)

Table 13: Gas shielded flux cored wires selection

Pipe Grade API 5L	FCAW for manual & mechanized welding				
	diamondspark X52 RC	diamondspark X60 RC-Pipe	diamondspark X70 RC-Pipe diamondspark X70 RC-Pipe (HP)	diamondspark 550 RC	diamondspark X80 RC-Pipe
A	■				
B	■				
X42	■				
X46	■				
X52	■				
X56	■	■			
X60	■	■	■		
X65		■	■	■	
X70			■	■	■
X80				■	■

■ For root pass, hot pass, filler passes and capping

These seamless rutile flux-cored wires are designed for single or multilayer welding of Carbon, Carbon-Manganese steels, and similar types of steels, including fine grain steels, using Argon-CO_2 shielding gas.
Their main features include excellent weldability in all positions, high-performance welding speed, very low spatter losses, good bead appearance, fast freezing, and easy removal of slag. Additionally, they typically have a hydrogen value ranging from 2.5 to 3.5 ml/100g weld metal.

Table 14: Gas shielded flux cored wires data (Sour service) / Packaging available : 5 kg &15 kg plastic spools / 16 kg BS300 spools

Product Name	Typical Analysis	Typical Mechanical properties	Diam. Ø	Approvals	Characteristics and applications
diamondspark X52 RC EN ISO 17632-A: T 46 4 P M21 1 H5 AWS A5.20: E71T-1M/ T-9M/T-12M JDH4	C: 0.06 Si: 0.40 Mn:1.45	Re: 500 (≥ 460) MPa Rm: 590 (530–620) Mpa A5: 22 % Av -20°C: 100 (≥ 47) J -40°C: 70 (≥ 47) J -50°C: 45 (≥ 27)	1.0 1.2 1.4 1.6	TÜV (06219), DB (42.052.03), DNV, ABS, CWB, LR, BV, RINA CE	The wire is especially suitable for ship-building, structural steel work, or any application requiring a good bead appearance. It is D1.8 Seismic Supplement approved and CTOD tested at -10°C (14°F). Additionally, this product can be used in sour gas applications.
diamondspark X60 RC-Pipe EN ISO 17632-A: T 50 6 1Ni P M21 1 H5 AWS A5.20: E81T1-Ni1M-JH4	C: 0.05 Si: 0.40 Mn: 1.3 Ni: 0.85	Re: 550 (≥ 500) Rm: 610 (560–690) A5: 25 (≥ 18) Av -40°C: 100 J -60°C: 75 (≥ 47) J	1.2	TÜV (019491), CE	This nickel-manganese alloyed seamless flux-cored wire shows outstanding mechanical properties even at low (-60°C) temperatures. The wire is CTOD tested at -10°C (14°F), and it can be used in sour gas applications.
diamondspark 550 RC EN ISO 18276-A : T 55 6 Z P M21 1 H5 AWS A5.29: E91T1-GM-JH4	C: 0.05 Si: 0.35 Mn: 1.6 Ni: 0.85	Re: 610 (≥ 550) MPa Rm: 680 (640–760) Mpa A5: 22 (≥ 18) % Av -40°C: 100 J -60°C: 80 (≥ 47) J	1.2	CE	This wire is specifically designed for sour gas applications and meets NACE requirements. It is ideal for pressure vessels and pipeline applications and performs reliably in both as welded and post-welded conditions. Tested for Hydrogen-Induced Cracking (HIC) per NACE TM-0284 standards, with Sulfide Stress Cracking (SSC) test results available upon request.

Table 15: Gas shielded flux cored wires data (Ni> 1%) / Packaging available : 5 kg &15 kg plastic spools / 16 kg BS300 spools

Product Name	Typical Analysis	Typical Mechanical properties	Diam. Ø	Approvals	Characteristics and applications
diamondpsark X70 RC-Pipe EN ISO 18276-A: T 55 5 Mn1.5Ni P M21 1 H5 AWS A5.29: E91T1-K2M-JH4	C: 0.06 Si: 0.4 Mn:1.45 Ni: 1.45	Re: 630 (≥ 550) MPa Rm: 700 (640–760) Mpa A5: 22 (≥ 18) % Av -40°C: 70 J -50°C: 60 (≥ 47) J	1.2	TÜV (19765), DB (42.052.27), CE	This nickel-manganese alloyed seamless flux-cored wire shows outstanding mechanical properties even at low (-50°C) temperatures.
diamondspark X70 RC-Pipe (HP) EN ISO 18276-A : AWS A5.29:	C: 0.06 Si: 0.4 Mn:1.45 Ni	Re: 600 (≥ 550) MPa Rm: 710 (≥ 640) Mpa A5: 22 (≥ 18) % Av +20°C: 160 (≥ 100) J -20°C: 90 (≥ 55) J -60°C: 55 (≥ 47) J	1.2		This nickel-manganese alloyed seamless flux-cored wire exhibits outstanding toughness at -60°C and excellent CTOD performance at -10°C.
diamondspark X80 RC-Pipe EN ISO 18276-A: T 62 4 Mn1.5Ni P M21 1 H5 AWS A5.29: E101T1-K2M-JH4	C: 0.04 Si: 0.45 Mn:1.45 Ni: 1.6 Mo: 0.15	Re: 680 (≥ 620) MPa Rm: 720 (700–760) Mpa A5: 22 (≥ 18) % Av -40°C: 80 (≥ 47) J	1.2	CE	The wire is specifically engineered for semi- and fully automatic welding in pipeline applications, particularly for high-strength steels X80-X90 base materials.


böhler welding

REVOLUTIONIZE YOUR PIPELINE WELDING WITH PIPERUNNER®

Introducing the pipeRunner®, the ultimate solution for achieving perfect girth welds in pipeline and piping welding. When combined with Böhler Welding flux cored wires, the pipeRunner® ensures excellent material properties and the highest quality welds, significantly reducing NDT indications and repair rates.

Precision and Ease of Use

The pipeRunner® is designed for precision and ease of use. Digitally controlled with programmable parameters, it guarantees the highest precision in movement. Its intuitive setup and maintenance, along with easy positioning on bands, make it a user-friendly choice for any welding project.

Key Features

- DC Brushless Electric Motors: Ensures perfect movement control and maximum precision.
- On-board 5 kg Wire Spool: Minimizes the distance between the wire feeder and torch, ensuring smooth and precise wire feedability.
- Integrated Intelligence: All electronics, software, and PCBs are integrated on-board, minimizing communication signal errors.
- Modular Concept: Allows for quick replacement of assemblies and easy upgrades.
- Full control in one hand: The remote control of pipeRunner allows the welding operator to position the pipeRunner, control the movements, test functions, and execute welding programs.

Robust and Reliable

The pipeRunner® uses the TERRA 400 PRM welding generator inverter, known for its robustness and reliability. Key features include:

- High Power at 100% Duty Cycle: Ideal for heavy-duty services.
- Shockproof and Abrasion-Resistant Case: Ensures durability in harsh conditions.
- Dust Contamination Protection: Fully encapsulated PC board and air flow ducting.
- IP23S Protection: Highest safety level for outdoor use, even in bad weather.
- Extreme Temperature Resistance: Special electronics designed to withstand extreme temperatures.
- Diesel Engine Generator Compatibility: Excellent performance with long power supply extension cables (20 m).

Superior Positioning Bands

The pipeRunner® bands are crafted from stainless steel, offering an optimal combination of hardness, toughness, and flexibility. They feature spring-loaded stand-offs which make them less sensitive to ovality and easier to assemble (max precision and ovality partly recovered). These bands are designed to be harder than the pipeRunner® gear pinion, significantly extending their lifespan and reducing downtime and costs.

Versatile Welding Capabilities

The pipeRunner® excels in various girth weld joint configurations, including V-bevel, compound bevel, and U narrow gap, in both uphill and downhill progressions. Its hybrid technique allows for efficient execution of fills and caps with flux cored wires, saving time and materials.

High-Alloy and Clad Pipeline Applications

The pipeRunner® is also ideal for high-alloyed pipework and clad pipes. It has successfully welded Alloy 625 Clad pipes and stainless steel 304L pipes using Böhler flux cored wires, ensuring perfect results every time.

This content highlights the key features and benefits of the pipeRunner® system, making it an attractive option for newcomers within pipeline industry.

SUBMERGED ARC WELDING

Table 17: SAW combination selection

Pipe Grade API 5L	Submerged Arc Welding			
	Union S 3 Si UV 418 TT	Union S 2 NiMo 1 UV 418 TT	Union S 3 NiMo 1 UV 418 TT	Union S 3 NiMo 1 UV 420 TTR-C
A	■			
B	■			
X42	■			
X46	■			
X52	■			
X56	■			
X60	■	■		
X65		■	■	
X70			■	■
X80				■

■ For all passes

Due to its high basicity and neutral metallurgical behavior, UV 418 TT and UV 420 TTR-C are a specially designed agglomerated fluoride basic flux ideal for submerged arc welding of unalloyed and low alloyed steel grades with medium and high strength. Even in challenging conditions, such as at -60°C, the combination wire / UV 418 TT mentioned in the table above, exhibits remarkable toughness properties, along with commendable CTOD values at -30°C, whether in its original as-welded state or following post-weld heat treatment. What sets it apart further is its ability to yield visually appealing bead appearances, with exceptional slag release capabilities, even in narrow gap scenarios. These wire/flux combinations excel in multi-pass butt welding applications, offering unmatched impact toughness throughout the process. Moreover, its versatility shines through as it seamlessly adapts to various welding configurations, including single wire, twin-arc, and tandem welding setups.

Table 18: Flux Properties

Flux Properties	UV 418 TT	UV 420 TTR-C
Polarity	DC / AC	DC / AC
Basicity index (Boniszewski)	2.7	3.4
Grain size (EN ISO 14174)	3 – 20 (0.3 – 2.0 mm)	3 – 20 (0.3 – 2.0 mm)
Flux consumption	1.0 kg flux per kg wire	0.9 - 1.1 kg flux per kg wire
Redrying	300 – 350°C (572-662°F), min 2 hrs.	
Diffusible hydrogen (ISO 3690)	≤ 5 ml / 100gr (as produced / re-dried)	-
Packaging	BIGBAG DRY SYSTEM: 500 kg / 1000 kg Bag: 1000 kg Drum: 200 kg DRY SYSTEM: 25 kg	Metal drum: 30 kg PE-BAG: 25 kg

The combination Union S 3 NiMo 1 / UV 420 TTR-C is ideal for welding the forging parts in F22, AISI 8630, and AISI 4130, as well as for welding API 5L – X75 and X80

Table 19: SAW combination data

Product Name	Typical Analysis	Typical Mechanical properties	Diam. Ø	Approvals	Characteristics and applications
Union S 3 Si - UV 418 TT EN ISO 14171-A: S 46 6 FB S3Si H5 AWS A5.17 : F7A8-EH12K / F7P8-EH12K DC +	C: 0.08 Si: 0.30 Mn:1.55	Re: 475 (≥ 460) MPa Rm: 560 (530-650) Mpa A5: 28 (≥ 25) % Av +20°C: -10°C: 170 (≥ 70) J -60°C: 150 (≥ 47) J	2.0 2.4 2.5 3.0 3.2 4.0	TÜV (07276), DB (51.132.05), DNV GL, LR, BV, ABS, CE	This wire-flux combination tailored for welding of very wide unalloyed steel grades,
Union S 2 NiMo 1 - UV 418 TT EN ISO 14171-A: S 50 6 FB SZ2Ni1Mo0,3 H5 AWS A5.17 : F 8A10-ENi1-Ni1 - F8P10-ENi1-Ni1 DC +	C: 0.06 Si: 0.20 Mn: 1.20 Ni: 0.93 Mo: 0.25	Re: ≥ 500 MPa Rm: ≥ 570 Mpa A5: ≥ 25 % Av +20°C: ≥ 180 J -40°C: ≥ 120 J -60°C: ≥ 70 J	2.0 2.4 2.5 3.0 3.2 4.0	LRS 5Y46M, DNV-GL, VY46M, ABS 5YQ460M	This wire-flux combination designed for applications involving non- and low-alloyed steel grades, commonly found in sour service applications.
Union S 3 NiMo 1 - UV 418 TT EN ISO 26304-A : S 55 6 FB S3Ni1Mo H5 AWS A5.23 : F9A8-EF3-F3 / F9A8-EF3-F3 DC +	C: 0.08 Si: 0.20 Mn:1.55 Ni: 0.90 Mo: 0.55	Re: ≥ 560 MPa Rm: ≥ 640 Mpa A5: ≥ 20 % Av +20°C: ≥ 140 J -40°C: ≥ 70 J -60°C: ≥ 47 J	2.0 2.4 2.5 3.0 3.2 4.0	TÜV (11578), CE	This wire-flux combination tailored for welding of non-alloyed and low-alloyed steel grades with high strength, commonly found in sour service applications.
Union S 3 NiMo 1 - UV 420 TTR-C EN ISO 26304-A : S 62 4 FB S3Ni1Mo H4 AWS A5.23 : F10A6-EF3-F3-H4 / F9P6-EF3-F3-H4 DC +	C: 0.10 Si: 0.30 Mn:1.75 Ni: 0.95 Mo: 0.55	Re: ≥ 620 MPa Rm: ≥ 690 Mpa A5: ≥ 18 % Av -20°C: ≥ 100 J -40°C: ≥ 47 J -51°C: ≥ 27 J	2.0 2.4 2.5 3.0 3.2 4.0	-	This wire-flux combination tailored for welding of low-alloyed steel grades with yield strength over 555Mpa in AC current, suitable for sour service applications.

ADDITIONAL PRODUCTS

In this section, we present a selection of additional products commonly utilized for pipeline applications. This assortment includes items that customers have grown accustomed to over time, as well as those that may simply serve the purpose of extra classification based on industry habits and preferences. Despite evolving technologies and methodologies, these products continue to play a significant role in pipeline construction due to their reliability and proven track record. Their ongoing popularity among professionals in the field underscores their effectiveness and contribution to successful pipeline projects.

Table 20: Other stick electrodes for pipeline welding

Product Name	Welding Process	Typical Analysis	Typical Mechanical properties	Diam. Ø	Characteristics and applications
BÖHLER FOX CEL S ISO 2560-A : E 38 3 C 2 1 AWS A5.1: E6010	SMAW	C: 0.1 Si: 0.2 Mn: 0.5	Re: 480 (≥ 390) MPa Rm: 550 (≥ 470-540) Mpa A5: 23 (≥ 22) % Av +20°C: 110 J -30°C: ≥ 47	2.5 3.2 4.0 5.0	Cellulose-coated electrode is intended for root pass welding in the vertical-up position and for filler and cap layers in the vertical-down welding of large diameter pipelines. Specifically, the 2.5 mm and 3.2 mm diameters are tailored for welding the root pass on negative polarity.
BÖHLER FOX CEL 75 ISO 2560-A : E 42 3 C 2 5 AWS A5.1: E7010-P1	SMAW	C: 0.14 Si: 0.14 Mn: 0.7	Re: 460 (≥ 420) MPa Rm: 550 (≥ 500-640) Mpa A5: 23 (≥ 22) % Av +20°C: 100 J -30°C: 60 J (≥ 47)	3.2 4.0 5.0	The BÖHLER FOX CEL 75 s characterized by its penetrating arc and low slag formation, which allow for excellent bead control and optimal performance even at high amperages. the BÖHLER FOX CEL 75 is suitable for sour gas applications, meeting the requirements of HIC-Test standards according to NACE TM-02-84.
BÖHLER FOX CEL 85 ISO 2560-A : E 42 3 C 2 5 AWS A5.1: E8010-P1	SMAW	C: 0.14 Si: 0.15 Mn: 0.75 Ni: 0.7	Re: 490 (≥ 420) MPa Rm: 580 (≥ 550-680) Mpa A5: 23 (≥ 20) % Av +20°C: 110 J (≥ 70) -30°C: 70 J (≥ 47)	3.2 4.0 5.0	The BÖHLER FOX CEL 85 is a cellulose electrode designed for vertical-down welding of high-strength, large diameter pipelines. Additionally, the BÖHLER FOX CEL 85 is suitable for sour gas applications, complying with HIC-Test standards according to NACE TM-02-84.
BÖHLER FOX EV 55 ISO 2560-A : E 46 5 B 4 2 H5 AWS A5.5: E7018-1H4R	SMAW	C: 0.07 Si: 0.35 Mn: 1.4	Re: 500 (≥ 460) MPa Rm: 550 (≥ 530-680) Mpa A5: 30 (≥ 20) % Av +20°C: 220 J -20°C: 170 J -50°C: 90 J (≥ 47)	2.5 3.2 4.0 5.0	It offers a metal recovery rate of approximately 110%. It boasts very low hydrogen content (according to AWS condition HD < 4 ml/100g weld metal) and features a coating resistant to moisture. Re-drying if necessary is allowed at 300 – 350 °C for minimum 2 hours.

Table 21: Other solid wires for pipeline welding

Product Name	Welding Process	Typical Analysis	Typical Mechanical properties	Shielding Gas	Diam. Ø	Characteristics and applications
Pipeshield X65 EN ISO 14341-A: G 46 5 M21 Z3Si1 AWS A5.18: ER70S-G	GMAW	C: 0.05 Si: 0.75 Mn:1.55 Ti +	Re: 510 (≥ 460) MPa Rm: 640 (≥ 530 - 680) Mpa A5: 25 (≥ 20) % Av -40°C: 75 J -50°C: 55 J (≥ 47)	Ar + 15 – 25 % CO_2	0.9 1.0 1.2	The micro-alloyed Pipeshield X65 is engineered to cover pipe steel grades up to API X65, providing excellent impact toughness even at low temperatures down to -50 °C. Additionally, it is suitable for sour gas applications, having undergone testing for Hydrogen-Induced Cracking (HIC) according to NACE TM-02-84 standards.
Union Ni 1 MoCr EN ISO 14341-A: G 55 6 ZMn3Ni 0,9 MoCr AWS A5.18: ER100S-G	GMAW	C: 0.08 Si: 0.50 Mn: 1.60 Ni: 0.9 Mo: 0.40 Cr: 0.27	Re: 650 (≥ 600) MPa Rm: 730 (≥ 710) Mpa A5: 20 (≥ 18) % Av +20°C: 150 (≥ 80) J -40°C: 80 J (≥ 47) J -50°C: 70 J (≥ 47) J	Ar + 15 – 25 % CO_2	1.2 1.6	
BÖHLER EML 5 EN ISO 636- A : W 46 5 2Si AWS A5.28: ER70S-3	GTAW	C: 0.1 Si: 0.6 Mn: 1.2 Ti +	Re: 520 (≥ 460) MPa Rm: 620 (≥ 530 - 680) Mpa A5: 26 (≥ 23) % Av +20°C: 220 J -20°C: 200 J -50°C: 90 (≥ 47)J	100% Ar (I2)	Rod 1.2 1.6 2.0 2.4 3.0	The TIG rod is engineered for high integrity welds. Its low silicon content makes this filler metal especially suitable for joint welds subjected to enameling or galvanizing processes. It is particularly well-suited for root pass welding and has been approved for use at -50°C. Moreover, it can be utilized in sour gas applications, having undergone HIC testing according to NACE TM-02-84 standards. TÜV (01096), DB (42.132.84), Equinor, CE approvals
BÖHLER Ni 1-IG EN ISO 636- A : W Z3Ni1 AWS A5.28: ER80S-G	GTAW	C: 0.07 Si: 0.7 Mn: 1.4 Ni: 0.9 Ti +	Re: 500 (≥ 460) MPa Rm: 600 (550 – 680) Mpa A5: 25 (≥ 20) % Av +20°C: 150 (≥ 80) J -50°C: ≥ 47 J	100% Ar (I2)	Spool 0.8 1.2 Rod 1.6 2.0 2.4 3.2	A nickel-alloyed rod is employed for welding offshore pipe work and similar high-integrity applications. It offers exceptional impact properties, maintaining high performance even in extreme temperatures down to –50 °C. Test values for SSC-tests are readily available, ensuring reliability and quality assurance. TÜV (12808), CE approvals
BÖHLER NiMo 1-IG EN ISO 636- A : W 55 6 I1 Mn3Ni1Mo AWS A5.28: ER90S-G	GTAW	C: 0.08 Si: 0.6 Mn: 1.8 Ni : 0.9 Mo: 0.3 Ti +	Re: 620 (≥ 550) MPa Rm: 700 (640 – 820) Mpa A5: 23 (≥18) % Av +20°C: 140 J -40°C: 110 J -60°C: ≥ 47 J	100% Ar (I2)	Rod 2.4	Thanks to the precise addition of micro-alloying elements like NiMo 1, the rod exhibits excellent ductility and crack resistance despite its high strength. Additionally, it boasts good cryogenic impact energy down to –60°C and maintains low hydrogen contents in the deposit, providing further advantages for welding applications.

PIPELINE PORTFOLIO: CORROSION RESISTANCE ALLOY (CRA)

Corrosion-resistant alloy (CRA) pipeline construction has become increasingly vital in industries where harsh environments pose significant challenges to material integrity and longevity. These applications involve the transportation of aggressive fluids, which can lead to rapid deterioration of conventional materials. As such, specialized welding techniques and materials are required to ensure the structural and functional performance of CRA pipelines. The use of filler metals and equipment designed specifically for CRA applications is essential for achieving high-quality welds that can withstand extreme conditions.

When welding CRA materials, it's imperative to monitor various parameters, including heat input and interpass temperature, to prevent issues such as embrittlement and cracking. Precautions must be taken to maintain cleanliness in the weld zone, as contamination can undermine the corrosion resistance properties intrinsic to these advanced alloys. Additionally, the choice of filler metals plays a critical role; using products designed for CRA applications, such as those from voestalpine Böhler Welding (vaBW), ensures optimal performance, enhanced resistance to pitting and stress corrosion cracking, and overall weld integrity.

The benefits of using vaBW filler metals and equipment extend beyond merely meeting technical specifications. They are engineered to provide superior ease of use, reliability, and high deposition rates while effectively minimizing welding defects. This results in increased productivity and long-term durability of the welded joints, particularly crucial in demanding pipeline environments. As the industry evolves, having access to high-performance solutions tailored for CRA applications becomes indispensable for maintaining operational efficiency and safety.

In the realm of CRA pipelines, various materials such as 13% Cr stainless steel, duplex, super duplex stainless steels, and clad materials are prevalent. 13% Cr stainless steel, known for its excellent tensile strength and resistance to corrosion, is often utilized in sour service conditions. Duplex and super duplex stainless steels combine the benefits of both austenitic and ferritic structures, providing exceptional resistance to stress corrosion cracking while maintaining high strength. Clad pipelines consist of a layer of corrosion-resistant material bonded to a substrate of lower-cost steel, creating a composite that delivers both mechanical strength and enhanced corrosion resistance. Common alloy materials used in clad pipeline applications include Alloy 825, Alloy 625 and other nickel-based alloys tailored for specific environmental challenges. By understanding the properties and applications of these different CRAs, engineers and welders can select appropriate materials and processes to ensure successful pipeline construction.

PIPELINE CRA PORTFOLIO: 316L STAINLESS STEEL

Welding alloy 316 stainless steel involves its own set of considerations and best practices to ensure quality welds while preserving material integrity. Below is an expanded overview of common practices tailored to achieve optimal results with this versatile alloy.

Preheating
Preheating is generally not required for welding alloy 316 stainless steel, which simplifies the preparation process and reduces overall cycle time.

Interpass Temperature Control
Controlling the interpass temperature during welding is essential. It is recommended to keep the interpass temperature under 100°C to prevent the risk of cracking and to maintain the mechanical properties of the weld. Adhering to this guideline significantly enhances the reliability of the final weld.

Heat Input Management
Maintaining low heat input is crucial to minimize overheating and to avoid the formation of harmful microstructural phases in the weld metal. A typical heat input range for alloy 316 is between 0.5 and 1.5 kJ/mm. This allows for flexibility, depending on specific welding requirements and conditions.

Post-Weld Heat Treatment (PWHT)
Post-weld heat treatment (PWHT) is typically unnecessary but may be warranted in specific situations to improve microstructural properties. If required, PWHT should be conducted at temperatures between 1000°C and 1100°C, followed by rapid cooling to maintain corrosion resistance.

Shielding Gas Composition
Utilizing the appropriate shielding gas is vital for successful welding. For Gas Metal Arc Welding (GMAW) of alloy 316, an argon-based shielding gas with up to 1% carbon dioxide is recommended to reduce pore formation and ensure cleaner welds with fewer defects.

This filler metal of W 19 12 3 L / ER316L type is designed for joining and surfacing applications with matching and similar unstabilized austenitic CrNi(N) and CrNiMo(N) steels and cast steel grades, it offers corrosion resistance comparable to low-carbon and stabilized austenitic 17Cr-12Ni-2Mo steels and cast steel grades. It is ideal for welding titanium or niobium-stabilized steels (e.g., 1.4571 / 316Ti). The weld metal shows excellent toughness down to –196°C, with a maximum service temperature of 400°C. For higher temperatures, a niobium-stabilized consumable is necessary.

Table 22 : 316L product data

Product Name		Welding Process	Typical Analysis	Typical Mechanical properties	Diam. Ø	Characteristics and applications
BÖHLER FOX EAS 4 M-A EN ISO 3581-A : E 19 12 3 L R 3 2 AWS A5.4: E316L-17	Re-drying : 250 - 300°C / 2 - 3 h	SMAW	Cr: 18.8 Ni: 11.5 Mo: 2.7	Rp0.2: 460 (≥ 320) Mpa Rm: 590 (≥ 510) Mpa A5: 41 (≥ 25) % Av +20°C: 64 J -120°C: 50 (≥ 32) J	2.5 3.2 4.0 5.0	This rutile-coated, core wire alloyed electrode is designed for top-quality weld seams and easy handling on both AC and DC. It offers high current carrying capacity with minimal spatter, self-releasing slag, and a smooth, clean weld profile. It also provides good resistance to general and pitting corrosion.
BÖHLER FOX EAS 4 M EN ISO 3581-A : E 19 12 3 L B 2 2 AWS A5.4: E316L-15	Re-drying : 250 - 300°C / 2 - 3 h	SMAW	Cr: 18.8 Ni: 11.8 Mo: 2.7	Rp0.2: 450 (≥ 320) Mpa Rm: 590 (≥ 510) Mpa A5: 42 (≥ 25) % Av +20°C: 130 J -50°C: 62 J -196°C: 38 (≥ 27) J	2.5 3.2 4.0 5.0	It provides good welding characteristics in all positions except vertical-down, with easy weld pool and slag control, good gap bridging ability. It also allows for easy slag removal, even in narrow joint preparations, resulting in clean bead surfaces with minimal post-weld cleaning.
FOXcore 316-T1* EN ISO 17633-A T 19 12 3 L P M21 (C1) 1 AWS A5.22 : E316LT1-4(1)	Shielding Gas : M21 (Ar + 18% CO_2) Can also be welded with C1	FCAW	Cr: 19. Ni: 12.0 Mo: 2.7 FN 4 - 13	Rp0.2: 410 (≥ 320) MPa Rm: 550 (≥ 510) Mpa A5 34 (≥ 30) % Av +20°C: 65 J -20°C: 55 J -120°C: 40 (≥ 32) J Hardness : 210 HB	1.2 1.6	Designed for versatile welding, it can be used in all positions without changing settings. It features very good slag detachability and minimal spatter. The fast-freezing rutile slag ensures excellent weldability, even in vertical-up and overhead positions. The wide arc provides even penetration and side-wall fusion, preventing lack of fusion.
Thermanit GE-316L Si EN ISO 14343-A : G 19 12 3 L Si AWS A5.19: ER316LSi	Shielding Gas : Ar + 2.5% CO 2	GMAW	Cr: 18.4 Ni: 12.4 Mo: 2.8 Si: 0.8	Rp0.2: 430 (≥ 320) MPa Rm: 580 (≥ 510) Mpa A5: 38 (≥ 25) % Av +20°C: 120 (≥ 47) J -196°C: 45 (≥ 32) J	0.9 1.0 1.2	
Thermanit GE-316L EN ISO 14343-A : W 19 12 3 L AWS A5.19: ER316L	Shielding Gas : 100% Ar (I2)	GTAW	Cr: 22.5 Ni: 8.8 Mo: 3.2 Si: 0.5	Rp0.2: 470 (≥ 320) MPa Rm: 610 (≥ 510) Mpa A5: 38 (≥ 25) % Av +20°C:: 140 (≥ 60) J -20°C:130 (≥ 47) J -196°C:58 (≥ 32) J	Rod 2.0 2.4 3.2	
Thermanit GE-316L / Marathon 431 EN ISO 14174 : S A FB 2 DC		SAW	Cr: 18.0 Ni: 12.2 Mo: 2.7 Si: 0.55	Rp0.2: (≥ 350) MPa Rm: (≥ 550) Mpa A5: (≥ 30) % Av +20°C: (≥ 70) J -120°C: (≥ 60) J		Thermanit GE-316L - Marathon 431 is a wire-flux-combination for welding of stainless-steel grades such as 1.4435 / 316L with good welding properties, with nice bead appearance and good slag detachability.

* For flat and horizontal welding positions, FOXcore 316L-T0 DG may be preferred

PIPELINE CRA PORTFOLIO: SUPER DUPLEX/DUPLEX

Welding super duplex and duplex stainless steel presents unique challenges and requires specific consideration across various welding processes. Below is an expanded overview of common practices tailored to ensure optimal results while maintaining the integrity of these materials.

Preheating
Typically, preheating is not a necessary step when welding duplex and super duplex stainless steels. This is beneficial as it simplifies the preparation process and reduces overall cycle time.

Interpass Temperature Control
It is crucial to control the interpass temperature during welding. Exceeding limits typically recommended in the range of 100°C to 120°C can lead to cracking and adversely affect the mechanical properties of the weld. By adhering to these guidelines, welders can significantly increase the reliability of the final weld.

Heat Input Management
Maintaining a low heat input is essential to minimize overheating and prevent the formation of detrimental microstructural phases in the weld metal. A recommended range for heat input is between 0.3 and 1.5 kJ/mm. However, duplex steels can tolerate slightly elevated ratios, extending this range to 0.5-2.5 kJ/mm, allowing for flexibility depending on the specific requirements of the task at hand.

Post-Weld Heat Treatment (PWHT)
In most cases, post-weld heat treatment (PWHT) is not necessary for duplex and super duplex stainless steels. Nevertheless, there may be specific circumstances where solution annealing at temperatures between 1100°C and 1150°C, followed by water quenching, is warranted to optimize the microstructure, and enhance corrosion resistance.

Shielding Gas Composition
To mitigate pore formation during the Gas Metal Arc Welding (GMAW) process, it is advisable to utilize a shielding gas mixture consisting of argon and helium, with a maximum of 0.5% carbon dioxide. This careful selection of shielding gas aids in achieving cleaner welds with fewer defects.

Avoiding Autogenous TIG Welding
It is highly recommended to avoid autogenous TIG welding, which involves welding without the addition of filler metal. This technique can lead to a drastic increase in ferrite content within the weld, negatively impacting both mechanical properties and corrosion resistance. Welders should always opt for the appropriate filler materials to maintain the integrity of the weld.

Table 23: Duplex product data

Product Name		Welding Process	Typical Analysis	Typical Mechanical properties	Diam. Ø	Characteristics and applications
BÖHLER FOX CN 22/9 N EN ISO 3581-A : E 22 9 3 N L R 3 2 AWS A5.4: E2209-17	Re-drying : 250 - 300°C / 2 - 3 h	SMAW	Cr: 22.6 Ni: 9.0 Mo: 3.1 N: 0.17 PREN ≥ 35 FN 30-60	Rp0.2: 650 (≥ 450) Mpa Rm: 850 (≥ 690) Mpa A5: 27 (≥ 20) % Av +20°C: 50 J -40°C: 35 (≥ 32) J	2.5 3.2 4.0 5.0	Excellent weldability in all positions and outstanding resistance to pitting and stress corrosion cracking in chloride environments. Features good wetting, easy slag detachment, and high porosity resistance. For wall thickness over 20 mm or impact requirements down to -60°C, the BÖHLER FOX CN 22/9 N-B basic electrode is recommended.
BÖHLER FOX CN 22/9 N-B EN ISO 3581-A : E 22 9 3 N L B 2 2 AWS A5.4: E2209-15	Re-drying : 250 - 300°C / 2 - 3 h	SMAW	Cr: 22.6 Ni: 8.8 Mo: 3.1 N: 0.16 PREN ≥ 35	Rp0.2: 630 (≥ 450) Mpa Rm: 830 (≥ 690) Mpa A5: 30 (≥ 20) % Av +20°C: 100 J -50°C: 65 (≥ 32) J	2.5 3.2 4.0 5.0	The weld metal meets ASTM G48 corrosion test requirements (Methods A, B, and E, at 25°C) and exhibits excellent resistance to stress corrosion cracking. The electrode is user-friendly in all positions except vertical down, providing good slag removability and weld bead appearance. It also offers high safety against porosity formation.
FOXcore 2209-T1* EN ISO 17633-A : T 22 9 3 N L P M21 (C1) 1 AWS A5.22 : E2209T1-4(1)	Shielding Gas : M21 (Ar + 18% CO_2) Can also be welded with C1	FCAW	Cr: 23.0 Ni: 9.0 Mo: 3.2 N :0.14 PREN ≥ 35 FN 40 -60	Rp0.2: 600 (≥ 450) MPa Rm: 800 (≥ 690) Mpa A5: 27 (≥ 20) % Av +20°C: 58 J -45°C: 45 (≥ 32) J Hardness : 260	1.2	Excellent resistance to pitting, intergranular corrosion, and stress corrosion cracking in chloride environments, meeting ASTM G48 corrosion test requirements (Methods A, B, and E, at 25°C). This versatile electrode performs well in all positions without altering parameters, demonstrating superior weldability in vertical-up and overhead settings. Its wide arc ensures uniform penetration and sidewall fusion, while the nickel over-alloying promotes austenite formation.
Thermanit 22/09 EN ISO 14343-A : G 22 9 3 N L AWS A5.19: ER 2209	Shielding Gas : Ar + 2% CO_2	GMAW	Cr: 22.8 Ni: 8.5 Mo: 3.1 N: 0.17 PREN > 35 FN 50	Rp0.2: 560 (≥ 450) MPa Rm: 780 (≥ 550) Mpa A5:30 (≥ 20) % Av +20°C: 150 (≥ 47) J -50°C: 100 (≥ 47) J	0.8 0.9 1.0 1.2 1.6	Welding can be conducted using short, spray, or pulsed arc techniques, with pulsed arc yielding excellent results in horizontal and vertical-up positions. The recommended heat input ranges from 0.5 to 2.5 kJ/mm, and the maximum interpass temperature is 150°C. The alloy is over-alloyed in nickel to encourage austenite formation, resulting in a microstructure comprising 45-55% ferrite.
Thermanit 22/09 EN ISO 14343-A : W 22 9 3 N L AWS A5.19: ER 2209	Shielding Gas : 100% Ar (I2)	GTAW	Cr: 22.5 Ni: 8.8 Mo: 3.2 N: 0.15	Rp0.2: 600 (≥ 450) MPa Rm: 720 (≥ 550) Mpa A5: 33 (≥ 20) % Av +20°C: 100 (≥ 47) J -40°C: ≥ 47 J	Rod 0.8 1.2 1.6 2.0 2.4 3.2	TIG rod and wire suitable for both manual and automatic welding with recommended heat input is between 0.5 – 1.5 kJ/mm, with a maximum interpass temperature of 150°C. Consider the embrittlement susceptibility of the parent metal, and use nitrogen-based backing gas to enhance root side corrosion resistance.
Thermanit 22/09 / Marathon 431 EN ISO 14174 : SA FB 2 DC		SAW	Cr: 25.0 Ni: 9.5 Mo: 3.8 N: 0.22 W: 0.6	Rp0.2: 650 MPa Rm: 870 Mpa A5: >20 % Av +20°C: -45°C: >45 J	2.0 2.5 3.2	Suggested heat input is max. 2.0 kJ/mm and interpass temperature max. 150°C. Polarity: DC+. No preheating.

* For flat and horizontal welding positions (1G, 1F and 2F) please select the FOXcore 2209-T0

SUBMERGED ARC WELDING WITH MARATHON 431 FLUX

For submerged arc welding (SAW), Marathon 431 flux stands out as an optimal choice for stainless steels, particularly for those within the chromium-nickel family, including duplex stainless steels. This flux is formulated with a combination of fluoride and basic ingredients and features agglomerated particles to enhance usability

Key Benefits of Marathon 431:

- Versatility: Compatible with both single-pass and multi-pass welding applications, making it adaptable to various project needs.
- Excellent Weld Quality: Produces aesthetically pleasing weld seams with minimal slag residue. The thin, fluid nature of the slag allows for self-release upon solidification, reducing post-weld cleaning time.
- High-Performance Welds: The high purity of the weld metal ensures good mechanical properties and strong corrosion resistance, further validating the use of Marathon 431 in critical applications.
- No Chromium Loss Compensation: Unlike some other fluxes, Marathon 431 is specifically formulated to avoid adding chromium to the weld metal, thereby preserving the qualities that define duplex and super duplex stainless steels.

Summary of Flux Properties for Marathon 431:

- Polarity: Direct Current Positive (DC+)
- Basicity Index (Boniszewski): 2.2 (wt%); 2.4 (mol)
- Grain Size (EN ISO 14174): Ranges from 3 – 16 (0.3 – 1.6 mm); 4 – 14 (0.4 – 1.4 mm)
- Redrying Requirements: Recommended at temperatures of 300°C to 350°C for a minimum of 2 hours to ensure optimal performance.

Packaging Options:

Marathon 431 is available in various packaging formats to accommodate the needs of different users:

- Dry System: 25 kg
- Metal Bucket: 30 kg
- PE-Bag: 25 kg

In conclusion, the integration of these practices and materials, particularly the use of Marathon 431 flux, enhances the capabilities of welding duplex and super duplex stainless steels, ensuring that the highest standards of quality and performance are met across diverse welding applications. For further inquiries or tailored solutions, do not hesitate to reach out for more information.

Table 24 : Super duplex product data

Product Name		Welding Process	Typical Analysis	Typical Mechanical properties	Diam. Ø	Characteristics and applications
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 : 250 - 300°C / 2 - 3 h	SMAW	Cr: 25.0 Ni: 9.5 Mo: 3.7 W: 0.7 N: 0.22 Cu: 0.7 PREN ≥ 40	Rp0.2: 650 (≥ 550) Mpa Rm: 850 (≥ 760) Mpa A5: 28 (≥ 18) % Av +20°C: 80 J -50°C: 40 (≥ 32) J	2.5 3.2 4.0	Use a “thick layer” technique for the root pass followed by thin layers with minimal heat input for subsequent passes.
FOXcore 2594-T1 EN ISO 17633-A: T 25 9 4 N L P M21 (C1) 2 AWS A5.22 : E2594T1-4 (1)	Shielding Gas : M21 (Ar + 18% CO_2) Can also be welded with C1	FCAW	Cr: 25.02 Ni: 9.4 Mo: 3.7 W: 0.7 N: 0.24 Cu: 0.7 PREN > 41 FN 35 -55	Rp0.2: 690 (≥ 550) MPa Rm: 890 (≥ 760) Mpa A5: 27 (≥ 18) % Av +20°C: 60 (≥50) J -40°C:38 (≥ 32) J Hardness : 270	1.2	Use standard GMAW power source with DC+ polarity and no pulsing. It is designed for all-round welding and can be used in all positions without changing the parameter settings. Use backhand (drag) technique with an 80° work angle. Maintain low heat input (0.5-1.5 kJ/mm) and interpass temperature (max 120°C). Wire stick-out: 15-20 mm.
Thermanit 25/09 CuT EN ISO 14343-A : G 25 9 4 N L AWS A5.19: ER2594	Shielding Gas : Ar + 30% He + 0,25% CO_2	GMAW	Cr: 25.5 Ni: 9.5 Mo: 3.8 W: 0.6 N: 0.22 Cu: 0.5 PREN > 41.5 FN 45	Rp0.2: 600 (≥ 550) MPa Rm: 830 (≥ 620) Mpa A5: 27 (≥ 18) % Av +20°C: 140 (≥ 80) J -50°C: 100 (≥ 47) J Hardness : 280 HB	0.9 1.0 1.2	The properties of the weld metal match those of the parent metal, offering excellent resistance to stress corrosion cracking and localized corrosion in chloride containing environments. Pitting resistance is in accordance with ASTM G48A Methods A, B and E (> 40°C).
Thermanit 25/09 CuT EN ISO 14343-A : w 25 9 4 N L AWS A5.19: ER2594	Shielding Gas : 100% Ar (I2)	GTAW	Cr: 25.02 Ni: 9.4 Mo: 3.7 W: 0.6 N: 0.22 Cu. 0.5 PREN > 41 FN 35 -55	Rp0.2: 630 (≥ 600) MPa Rm: 780 (≥ 760) Mpa A5: 28 (≥ 25) % Av +20°C: 100 (≥ 80) J -50°C: 60 (≥ 47) J	Rod 1.2 1.6 2.0 2.4 3.2	Aim for 70-80% heat input in the second layer compared to the root pass. Consider using nitrogen-based backing gas to improve root corrosion resistance.
Thermanit 25/09 CuT / Marathon 431 EN ISO 14174 : SA FB 2 DC		SAW	Cr: 25.0 Ni: 9.5 Mo: 3.8 N: 0.22 W: 0.6	Rp0.2: 650 MPa Rm: 870 Mpa A5: >20 % Av +20°C: -45°C: >45 J	2.0 2.4 3.2	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.

PIPELINE CRA PORTFOLIO: ALLOY 625

Alloy 625 is a remarkably tough alloy known for its excellent mechanical properties, even in cold temperatures, making it a versatile choice for a wide array of welding applications.
This alloy excels at joining and surfacing various metals, including nickel alloys, austenitic steels, and even cryogenic steels like 9Ni. It also performs well for cladding on both regular and high-strength steels.

The welds created with Alloy 625 are exceptionally strong, making them suitable for harsh environments.
They exhibit remarkable resistance against general corrosion, pitting, and cracking that might occur due to stress or exposure to chlorides. One of the standout features of Alloy 625 is its ability to function effectively across an extensive temperature spectrum—from the extreme cold of -196°C (-325°F) to elevated temperatures reaching 550°C (1022°F).
Furthermore, in environments devoid of sulfur, these welds can withstand scaling at even higher temperatures of up to 1100°C (2012°F). However, it's important to note that this alloy is particularly sensitive to embrittlement within the temperature range of 600°C to 800°C.

To ensure optimal welding results with Alloy 625, meticulous attention to cleanliness in the welding area is essential. The work surface must be free from contaminants such as oil, paint, or grease, as Alloy 625 is highly susceptible to contamination, which can adversely affect weld quality.
Minimizing heat input is also critical during the welding process. Excessive heat can lead to grain growth, negatively impacting both the strength and corrosion resistance of the weld. It is advisable to keep the overall heat input below 12 kJ/cm (1.71 kJ/in), as this helps control the heat-affected zone and reduces the risk of weld cracking.
Additionally, maintaining interpass temperatures below 150°C (302°F) during welding is crucial, since higher temperatures can promote grain growth and increase the risk of hot cracking, further jeopardizing the integrity of the weld.
Use an opening angle of approximately 70° and a root gap of about 2 mm.
By adhering to these guidelines, welders can fully leverage the impressive capabilities of Alloy 625 in various challenging environments.

Table 27 : Alloy 625 / Cladding 625/825 products data

Product Name		Welding Process	Typical Analysis	Typical Mechanical properties	Diam. Ø	Characteristics and applications
Pipeshield X625 EN ISO 18274: S Ni 6625 (NiCr22Mo9Nb) AWS A5.14: ERNiCrMo-3	Shielding Gas : Ar+30% He+2% H2+0,05 %CO_2	GMAW	Cr: 22.0 Ni: Bal. Mo: 9.0 Nb: 3.6 Fe: <0.5	Rp0.2: 510 (≥ 460) MPa Rm: 640 (≥ 530 - 680) Mpa A5: 25 (≥ 20) % Av -40°C: 75 J -50°C: 55 J (≥ 47)	1.0 1.2	Pipeshield X625 is manufactured to optimize wire-feed and weld pool delivery characteristics, via consistent metallurgical quality raw material and physical control of wire processing.

Product Name		Welding Process	Typical Analysis	Typical Mechanical properties	Diam. Ø	Characteristics and applications
UTP 6222 Mo EN ISO 14172 : E Ni 6625 (NiCr22Mo9Nb) AWS A5.11: ENiCrMo-3	Re-drying : 250 - 300°C / 2 - 3 h	SMAW	Cr: 22.0 Ni: Bal. Mo: 9.0 Nb: 3.3 Fe: <1	Rp0.2: >450 MPa Rm: >760 Mpa A5: >30 % Av +20°C: 110 J -196°C: >45 J	2.5 3.2 4.0 5.0	Weld at a slight angle with a short arc, and use stringer beads. Avoid exceeding a maximum weaving of 2.5 x diameter of the stick electrode core wire.
FOXcore 625-T1 EN ISO 12153 : T Z Ni 6625 P M21 2 AWS A5.34 : ENiCrMo3T1-4	Shielding Gas : M21 (Ar + 18% CO_2) Can also be welded with C1	FCAW	Cr: 20.7 Ni: Bal. Mo: 8.5 Nb: 3.3 Fe: <1.0	Rp0.2: 475 (≥ 420) MPa Rm: 750 (≥ 690) Mpa A5: 42 (≥ 25) % Av +20°C: 83 J -196°C: 72 (≥ 47) J Lat. Exp : 1.07 (≥ 0.38)	1.2	Utilize standard GMAW power source on DC+ for welding, AC can be used for higher toughness values, especially with materials like 9Ni steels (Pulsing is not necessary). Prefer the backhand (drag) technique with a work angle of approximately 80°. Optimal shielding gas: Ar + 18 – 25% CO_2 with maintaining gas flow rate at 15 – 18 l/min. Limit interpass temperature to a maximum of 100°C. Keep wire stick-out at 15 – 20 mm with slight weaving recommended for all welding positions.
UTP A 6222 Mo – 3 EN ISO 18274: S Ni 6625 (NiCr22Mo9Nb) AWS A5.14: ERNiCrMo-3	Shielding Gas : I2	GTAW	Cr: 22.0 Ni: Bal. Mo: 9.0 Nb: 3.5 Fe: <1	Rp0.2: > 460 MPa Rm: > 740 Mpa A5: > 30 % Av +20°C: > 100 J -196°C: > 85J	Rod 1.6 2.0 2.4 3.2	TIG rod is engineered for high integrity welds
UTP UP 6222 Mo / Marathon 504 EN ISO 14174 : S A BA 2 AC Basicity index (Bonisze-wski) 2.8 (wt%)		SAW	Cr: 21.7 Ni: Bal. Mo: 8.7 Nb: 3.3 Fe: 1.2	Rp0.2: 490 (≥ 460) MPa Rm: 760 (≥ 720) Mpa A5: 45 (≥ 35)% Av +20°C: 80 (≥ 47) J -196°C: 65 (≥ 47) J	1.6 2.0 2.4	Marathon 504, an agglomerated welding flux, designed for welding and cladding of nickel-alloys. Additionally, it offers excellent slag detachability and produces a pleasing bead appearance under both direct and alternating current.
UTP UP 6222 Mo / Marathon 444 EN ISO 14174 : S A FB 2 AC Basicity index (Bonisze-wski) 2.9 (wt.%)		SAW	Cr: 21.8 Ni: Bal. Mo: 9.0 Nb: 3.2 Fe: < 1.0	Rp0.2: ≥ 420 MPa Rm: ≥ 700 Mpa A5: ≥ 40 % Av +20°C: ≥ 80 J -196°C: ≥ 70 J	1.6 2.0 2.4	Marathon 444 is a highly basic agglomerated welding flux, designed for welding and cladding of nickel-alloys. The weld metals show excellent mechanical properties with high hot cracking resistance.

INTRODUCING PERSONAL PROTECTIVE EQUIPMENT (PPE)

In the pipeline industry, personal safety at work is of paramount importance, particularly due to the inherent risks associated with tasks such as welding and grinding. Adhering to evolving health and safety regulations set forth by authorities is crucial to ensure effective protection for both employers and employees. Personal protective equipment (PPE) acts as a critical last line of defense against potential injuries, and its use is governed by legal requirements aimed at prioritizing health and safety on the job.

Eye, Ear, and Body Protection

Welding operations in pipeline construction pose significant hazards, including exposure to harmful UV and IR rays produced by the welding arc. To mitigate these risks, automatic welding helmets equipped with advanced auto-darkening filters that block nearly all UV and IR rays are essential. The use of true color technology enhances visibility, reducing eye fatigue during prolonged tasks, which is vital for maintaining efficiency and accuracy.

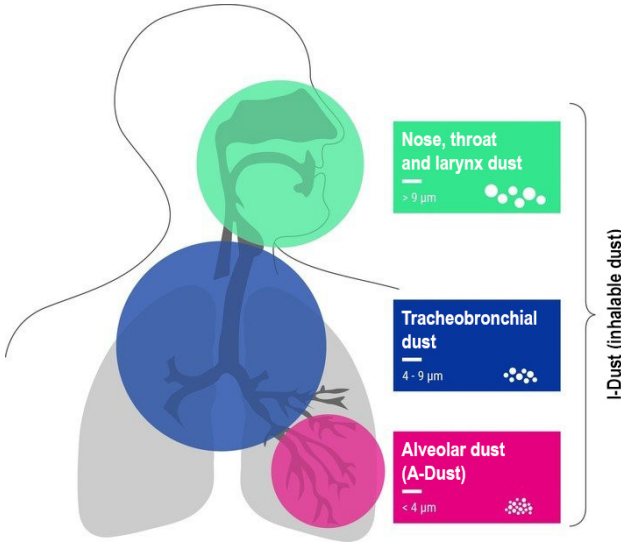
The threat of cuts, burns, and electrical hazards necessitates the use of specialized gloves designed for durability and temperature resistance. Our selection of welding gloves, crafted from tough materials and backed by stringent safety regulations, ensures that workers remain protected against common workplace injuries.

Protective clothing is equally vital, as it shields against hot particles and sparks generated during welding and grinding processes. Clothing made from a combination of leather and flame-retardant materials ensures maximum safety, comfort, and compliance with high ISO standards, helping workers perform tasks in challenging environments with peace of mind.

Protecting Respiratory Health

The fumes and gases produced during welding can cause serious long-term health repercussions, often unnoticed until years later. Protecting the respiratory tract is therefore of crucial importance. This can be achieved by using fresh air systems such as a PAPR system. This is a power air-purifying respiratory device that is worn on a waist belt and supplies the welder with filtered fresh air.

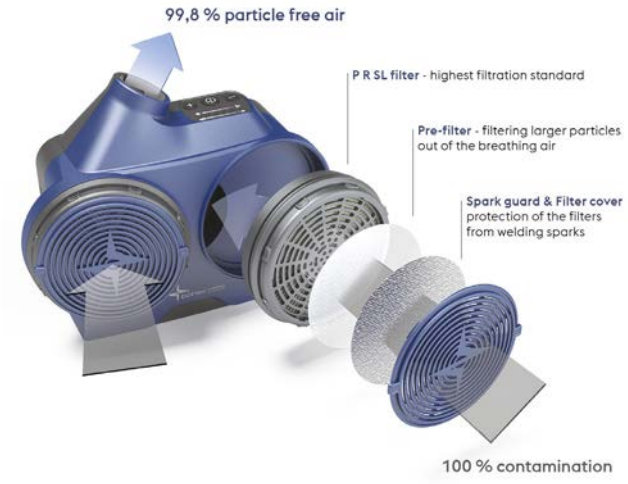
All Böhler PAPR systems have particle filters which, together with Böhler welding helmets, offer the highest certified protection factor. Some applications, such as high-amp welding, where various toxic gases are released, may require additional protection. This is why the Evolution Air can be fitted with optional gas filters, which makes a significant contribution to the long-term health protection of employees.

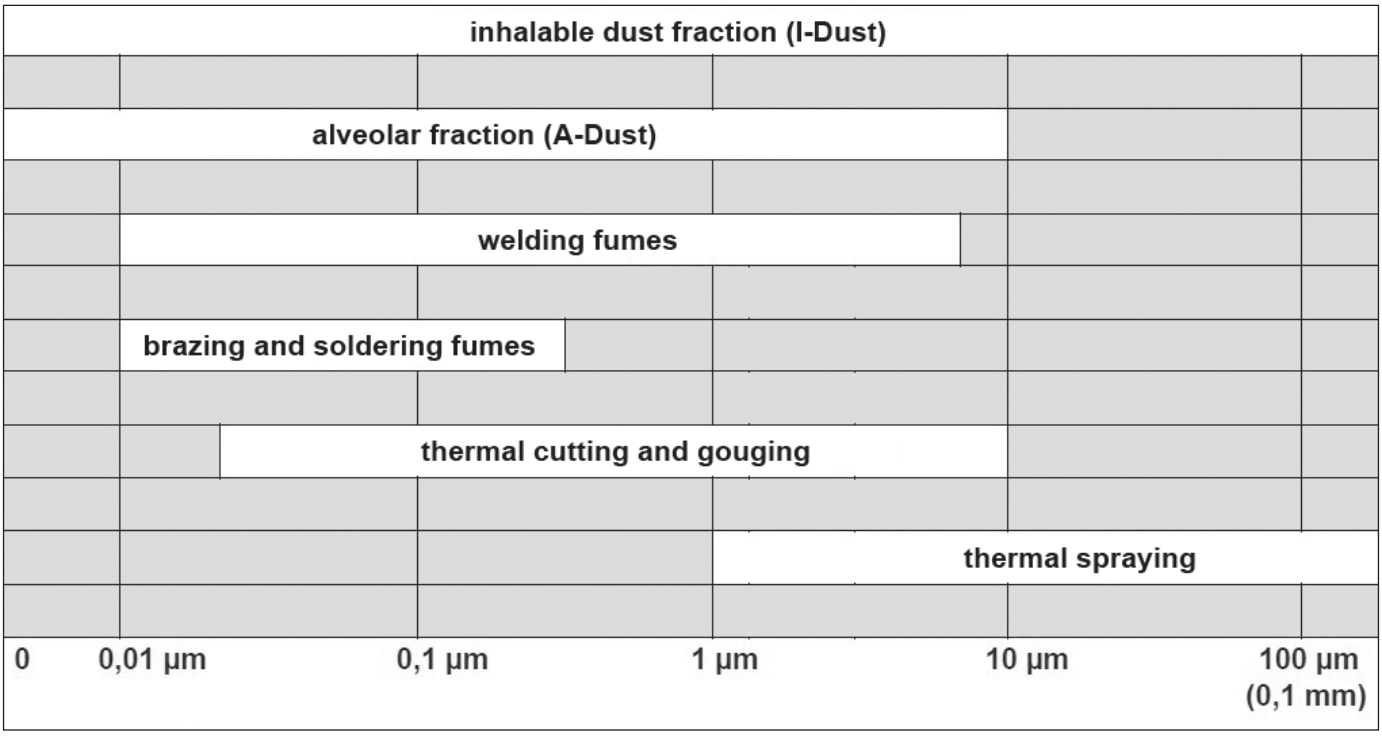


Comprehensive protection is essential during the preparation and post-processing of the weld seam.

Personal Protective Equipment (PPE) is a “must have” for a welder’s daily tasks. Yet, the significance of PPE during the preparation and post-processing stages of welding is often overlooked. Removing or lifting the welding helmet too quickly can result in the inhalation of residual fumes, particles, and gases from the work environment.

Grinding is one of these processing steps that requires face and eye protection from flying particles but also the protection of the respiratory system. A full-face visor, such as the Big Vision Air used in conjunction with a PAPR system, provides all these benefits along with an unobstructed view of the work area. By integrating these latest protective measures and equipment specifically designed for the unique hazards of the pipeline industry, we can prioritize health and safety, ensuring workers remain protected while performing their essential roles.






böhler welding
BOSCH

TECHNICAL SUPPORT

In the pipeline segment, the demand for high-quality welding services has never been greater. The scarcity of skilled welders, combined with the need for advanced technology and specialized knowledge, emphasizes the significance of tailored solutions. At voBW, our Welding Academy, WeldTech application services, and dedicated Application Technology Centers provide customized support specifically for pipeline industry. Our unwavering focus on high-quality filler metals ensures compliance with stringent requirements, including extreme sour service, stress-based design, high pipe grades, and the transportation of hydrogen and CO_2. These comprehensive services guarantee superior performance and reliability in this demanding field of application.

weldTECH Application Services : Experience the excellence!

Product & Application Consulting: Our experts provide comprehensive consulting on the optimal welding filler metals for your base materials, ensuring they meet technical specifications, and offer solutions for converting classification standards into Böhler Welding products, verifying technical and economic feasibility, and developing full welding solutions.

Developing full welding solutions: We support process optimization by analyzing the entire welding process and related steps, aiming for cost savings and quality assurance, through simulation of customer applications and integration of testing laboratories, aiding in preparation and qualification of welding solutions.

Training and seminars: At our Welding Academy, we offer tailored training and seminars to enhance the skills of welding professionals, ensuring the best results with available equipment, through individual and product-specific courses both at our centers and on-site at customer locations.

Support in Welding Procedure Qualification (EN ISO 15614-1): Our experts assist with the preparation, execution, and documentation required for the qualification of welding procedures in accordance with EN ISO 15614-1, providing comprehensive support from initial tasks to the final drafting of the Welding Process Qualification Record (WPQR).

Prototype Production (Process Development): We partner with customers on innovative project developments, offering technical support for new welding solutions, conducting test welds, analyzing results, and recommending efficient production techniques to enhance competitiveness.

Application Technology Centers

Global Support: voestalpine Böhler Welding operates Application Technology Centers worldwide, providing local technical assistance. These centers offer pre-sales and post-sales support, simulate customer jobs, and develop welding procedures. The latest center in India is ISO 9001:2008 certified, and another will open in Dubai in 2014 to serve the Middle East region.

Cutting-Edge Facilities: Our well-equipped centers handle complex operations, including gas metal and gas tungsten arc welding, submerged arc welding, and strip cladding. Application engineers participate in seminars and workshops, sharing insights across various industry segments.

ANNEXE

Table 28: Comparison table for pipe grade

Pipe Grade		SMYS		SMTS		Elongation
ISO 3183	API 5L	ksi	Mpa	ksi	Mpa	%
L210		30.0	207	48.0	331	28
	A	30.4	210	46.4	320	26
L245		35.0	241	60.0	413	23
	B	35.5	245	60.2	415	22
L290		42.0	290	60.2	415	21
	X42	42.0	289	60.0	313	23
L320		46.4	320	66.7	460	21
	X46	46.0	317	63.0	434	22
L360		52.2	360	66.7	460	20
	X52	52.0	358	66.0	455	21
L390		55.8	385	76.9	530	19
	X56	56.0	386	71.0	489	20
L415		60.2	415	75.4	520	18
	X60	60.0	413	75.0	517	19
L450		65.3	450	77.6	535	18
	X65	65.0	448	77.0	530	18
L485		70.3	485	82.7	570	18
	X70	70.0	482	82.0	565	18
L555		79.8	550	100.1	690	18
	X80	80.0	550	90	620	18

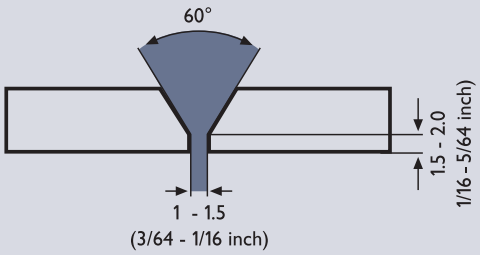
Table 28: Comparison table for pipe grade

Wall thickness [inch; mm]		**0.25 inch 6.35 mm**	**0.312 inch 7.92 mm**	**0.432 inch 10.97 mm**	**0.5 inch 12.7 mm**	**0.562 inch 14.27 mm**	
Ø Pipe	Ø Electr. [mm]	Weight [kg]					
10 3/4” 273 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0	9.5* 8.9* 25*	9.1 8.8 42.6	8.9 8.5 86.3	8.8 8.4 114.4	8.7 8.3 147.6	
12 3/4” 323.8 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0	11* 10.6* 28.3*	11 10.5 51.2	10.7 10.3 103.6	10.6 10.2 138.5	10.5 10.1 175.2	
14” 355.6 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0	12.5* 11.7* 31.3*	12.1 11.6 55.8	11.9 11.4 113.5	11.7 11.2 153.6	11.6 11.1 193.8	
16” 406.4 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0	14.3* 13.4* 36.3*	13.9 13.3 62.6	13.7 13.1 129	13.5 13 174.3	13.4 12.9 221.4	
18'' 457.2 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0	16.2* 15.1* 39.8*	15.7 15 71.2	15.5 14.8 146.3	15.4 14.7 196.8	15.2 14.6 249	
20” 508 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0	18* 16.9* 44.8*	17.5 16.8 78.1	17.3 16.5 161.7	17.2 16.4 219.2	17 16.3 276.7	
22” 558.8 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0	19.9* 18.6* 49.9*	19.3 18.5 86.6	19.1 18.3 179	19 18.2 241.7	18.9 18.1 306.1	
24” 609.6 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0	21.7* 20.3* 53.3*	21.1 20.2 95.1	20.9 20 194.4	20.8 19.9 264.1	20.7 19.8 333.7	
26” 660.9 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0	23.6* 22.1* 58.3*	22.9 22 102	22.7 21.8 211.7	22.6 21.6 284.8	22.5 21.5 361.3	
28'' 711.2 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0	25.4* 23.8* 61.7*	24.7 23.7 110.5	24.5 23.5 227.2	24.4 23.3 307.2	24.3 23.2 388.9	
30” 7 62 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0	27.3* 25.5* 68.6*	26.5 25.4 117.3	26.3 25.2 242.7	26.2 25.1 329.7	26.1 25 418.3	
32” 812.8 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0	29.1* 27.2* 71.9*	28.3 27.1 125.9	29.1 26.9 259.9	28 26.8 352.1	27.9 26.7 446	
34” 863.6 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0	31* 29* 75.2*	30.1 28.9 134.5	29.9 28.7 275.4	29.8 28.5 374.6	29.7 28.4 473.7	
36” 914.4 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0	32.8* 30.7* 80.3*	32 30.6 141.3	31.7 30.4 292.6	31.6 30.3 395.3	31.5 30.2 501.3	
38” 965.2 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0		33.8 32.3 149.9	33.5 32.1 308.1	33.4 32 417.7	33.3 31.9 527.2	
40” 1016 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0		35.6 34 1 56.7	35.3 33.8 325.4	35.2 33.7 440.1	35.1 33.6 558.3	
42” 1066.8 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0		37.4 35.8 165.2	37.2 35.6 340.8	37 35.5 462.6	36.9 35.3 585.9	

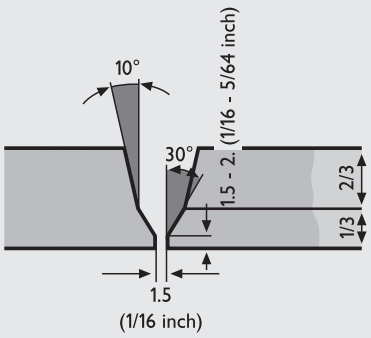
	0.625 inch 15.88 mm	0.719 inch 18.26 mm	0.812 inch 20.62 mm	0.938 inch 23.83 mm	1.0 inch 25.4 mm	1.062 inch 26.97 mm	1.188 inch 30.15 mm
	Weight [kg]						
	8.6 8.2 182.5	8.4 8.1 240.1	8.3 7.9 171	8 7.7 230.5	7.9 7.6 258.5	7.8 7.5 289.8	7.6 7.2 354.5
	10.4 9.9 217.1	10.2 9.8 284.7	10.1 9.6 210.8	9.8 9.4 350	9.7 9.3 391.8	9.6 9.2 438.9	9.4 9 538.3
	11.5 11 239.1	11.3 10.9 314	11.2 10.7 232.8	10.9 10.5 386	10.5 10 418.6	10.7 10.3 483.6	10.2 9.7 586.9
	13.3 12.8 273.6	13.2 12.6 360.4	13 12.5 267.4	12.8 12.2 443.1	12.2 11.7 480.5	12.5 12 556.3	11.9 11.4 675.6
	15.1 14.5 308.3	15 14.3 405.8	14.8 14.2 291.6	14.6 13.9 500.2	14 13.4 544.1	14.3 13.7 629	13.6 13.1 747.6
	16.9 16.2 342.8	16.8 16.1 452.4	16.8 15.9 324.3	16.4 15.7 557.4	15.7 15 606.1	16.1 15.5 701.8	15.4 14.7 834.8
	18.7 17.9 377.4	18.6 17.8 497.5	18.4 17.6 357.2	17.6 16.8 594	17.5 1 6.7 669.7	18 17.2 774.6	17.1 16.4 921.9
	20.5 19.7 412	20.4 19.5 544.2	20.2 19.4 391.8	20 19.1 671.6	19.2 18.4 731.6	19.9 18.9 847.3	18.9 18.1 1003.3
	22.4 21.4 448.2	22.2 21.3 589.1	22.1 21.1 424.6	21.8 20.9 730.4	21 20.1 795.2	21.6 20.7 919.9	20.6 19.8 1096.1
	24.2 23.1 482	24 23 635.9	23.8 22.8 457.5	23.6 22.6 785.8	22.7 21.7 857.1	23.4 22.4 991.1	22.4 21.4 1181.5
	26 24.9 517.5	25.8 24.7 680.8	25.7 24.6 490.4	25.4 24.3 843	24.4 23.4 919.1	25.2 24.1 1063.8	24.1 23.1 1269.9
	27.8 26.6 552.1	27.6 26.4 727.6	27.5 26.3 524.9	27.2 26 901.9	26.2 25.1 981.1	27 25.8 1136.6	25.9 24.8 1347.9
	29.6 28.3 586.6	29.4 28.2 772.6	29.3 28 557.8	29 27.8 959	27.9 26.7 1044.7	28.8 27.6 1209.3	27.6 26.4 1434.4
	31.4 30 621.2	31.2 29.9 819.3	31.1 29.7 590.6	30.8 29.5 1016.1	29.7 28.4 1106.6	30.6 29.3 1282	29.4 28.1 1519.8
	33.2 31.8 655.8	33 31.6 864.3	32.9 31.5 623.5	32.6 31.2 1073.3	31.4 30.1 1170.2	32.4 31 1354.8	31.1 29.8 1606.8
	35 33.5 690.4	34.8 33.3 911	34.7 3 3.2 656.3	34.4 33 1130.4	33.2 31.8 1232.1	34.2 32.8 1427.5	32.8 31.5 1692.3
	36.8 35.2 725	36.6 35.1 956	36.5 34.9 690.8	36.2 34.7 1187.5	34.9 33.4 1294	36 34.5 1500.3	34.6 33.1 1779.3

Wall thickness [inch; mm]		0.25 inch 6.35 mm	0.312 inch 7.92 mm	0.432 inch 10.97 mm	0.5 inch 12.7 mm	0.562 inch 14.27 mm	
Ø Pipe	Ø Electr. [mm]	Weight [kg]					
44” 1117.6 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0		39.2 37.5 172	39 37.3 356.3	38.8 37.2 483.3	38.7 37.1 613.6	
46” 1168.4 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0		41 39.2 180.6	40.8 39 372.6	40.6 38.9 505.7	40.5 38.8 641.2	
48” 1219.2 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0		42.8 41 189.1	42.6 40.8 389.1	42.4 40.6 528.1	42.3 40.5 670.6	
50” 1270 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0		44.6 42.7 196	44.4 42.5 406.3	44.3 42.4 550.6	44.1 42.3 698.3	
56” 1422.4 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0		50 47.9 219.9	49.8 47.7 454.5	49.7 47.6 616.1	49.6 47.5 781.1	
60” 1524 mm	Root pass 4.0 Hot pass 4.0 Filler Cap 5.0		53.6 51.3 221.4	53.4 51.1 471.7	53.3 51 643.7	53.2 50.9 817.4	
*** Exception:**	Root pass 3.2 Hot pass 4.0 Filler+Cap 4.0						

Electrode consumption in kg
Electrode weight for cellulosic electrodes. Calculation for 100 joints without wastage.
Stub end loss 50 mm (2 inches).



	0.625 inch 15.88 mm	0.719 inch 18.26 mm	0.812 inch 20.62 mm	0.938 inch 23.83 mm	1.0 inch 25.4 mm	1.062 inch 26.97 mm	1.188 inch 30.15 mm
	Weight [kg]						
	38.6 37 759.5	38.4 36.8 1002.8	37 35.4 723.2	38 36.4 1244.7	37.9 36.3 1404.5	37.8 36.2 1572.9	37.6 36 1939.5
	40.4 38.7 794.1	40.2 38.5 1047.7	10.1 38.4 756.6	39.9 38.2 1301.9	38.4 36.8 1419.6	39.6 37.9 1591.8	38.1 36.5 1962
	42.2 40.4 830.4	42.1 40.3 1094.5	41.9 40.1 1001.1	41.7 39.9 1359	41.5 39.8 1532.7	41.4 39.7 1718.5	41.2 39.5 2119.7
	44 42.2 865.1	43.9 42 1141.1	43.7 41.9 1042.6	43.5 41.6 1417.8	43.4 41.5 1598.4	43.2 41.4 1789.5	43 41.2 2209.8
	49.4 47.3 968.8	49.3 47.2 1277.9	49.1 47 1168.9	48.9 46.8 1589.2	48.8 46.7 1792.4	48.7 46.6 2007.8	48.4 46.4 2478.4
	53.1 50.8 1015.3	52.9 50.6 1341.8	52.7 50.5 1229.4	52.5 50.3 1674	52.4 50.2 1887.6	52.3 50 2115.1	52 49.8 2613.5



JOIN! We connect Metals and People

As a leader in the world of welding and part of the voestalpine steel and technology group, we are close to you with more than 100 years of experience, 50 subsidiaries and 4,000 sales partners worldwide. Thanks to our comprehensive product portfolio, welding expertise and global orientation, we know your needs and, as a total solution provider, ensure the best results for your most demanding challenges. Perfectly interlinked and as unique as your business.

Lasting Connections – Perfect alignment of welding machines, consumables and technologies combined with our renowned application and process know-how provide the best result for your requirements: A true and proven connection between people, products and technologies. The result is what we promise: The Perfect Weld Seam for Lasting Connections.

Tailor-Made Protectivity™ – Proven under the toughest conditions: Our products protect metal surfaces from wear and corrosion. With over 70 years of experience and the broadest product portfolio in the industry, we are your preferred partner for Surface Protection solutions. We deliver what we promise: Surface Protection tailored to your needs.

In-Depth Know-How – As a manufacturer of soldering and brazing consumables, we offer proven solutions based on 60 years of industrial experience, tested processes and methods, made-in-Germany. This in-depth know-how makes us the internationally preferred partner to meet your soldering and brazing challenge through innovative solutions. The result is what we promise: Innovation based on in-depth know-how.

The Management System of voestalpine Böhler Welding Group GmbH, Peter-Mueller-Strasse 14-14a, 40469 Duesseldorf, Germany has been approved by Lloyd's Register Quality Assurance to: ISO 9001:2015, ISO 14001:2015, OHSAS 18001:2007, applicable to: Development, Manufacturing and Supply of Welding and Brazing Consumables.
More information: www.voestalpine.com/welding

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