Welding Alloys

Joining Welding Consumables

Cored wires for joining, cladding & repair applications

For Welding **Professionals**

Contents

Our company

Welding Alloys has been a global leader in the production of advanced welding consumables for more than 50 years. We provide innovative solutions for even the most challenging service conditions, in a range of industries.

Complementary to our welding consumables, we manufacture a range of automated equipment for hardfacing, joining and cladding. We also offer engineered wear services in our workshops, or in situ, as well as a wide range of wear plates, pipes and components.

Since 1966, the Welding Alloys name has been synonymous with excellence in research and development (R&D), resulting in a steady stream of innovative products and advanced technical solutions and services.

Welding Alloys is a participating member of the United Nations Global Compact and supports all principles relating to the environment, labour, human rights, and anti-corruption. Reflecting this, we have developed welding wires that emit less harmful fumes, and we manufacture a range of our wires using processes that produce less harmful waste for the environment. We continue to improve our products and processes in order to reduce the negative impact on both the welder and the environment.

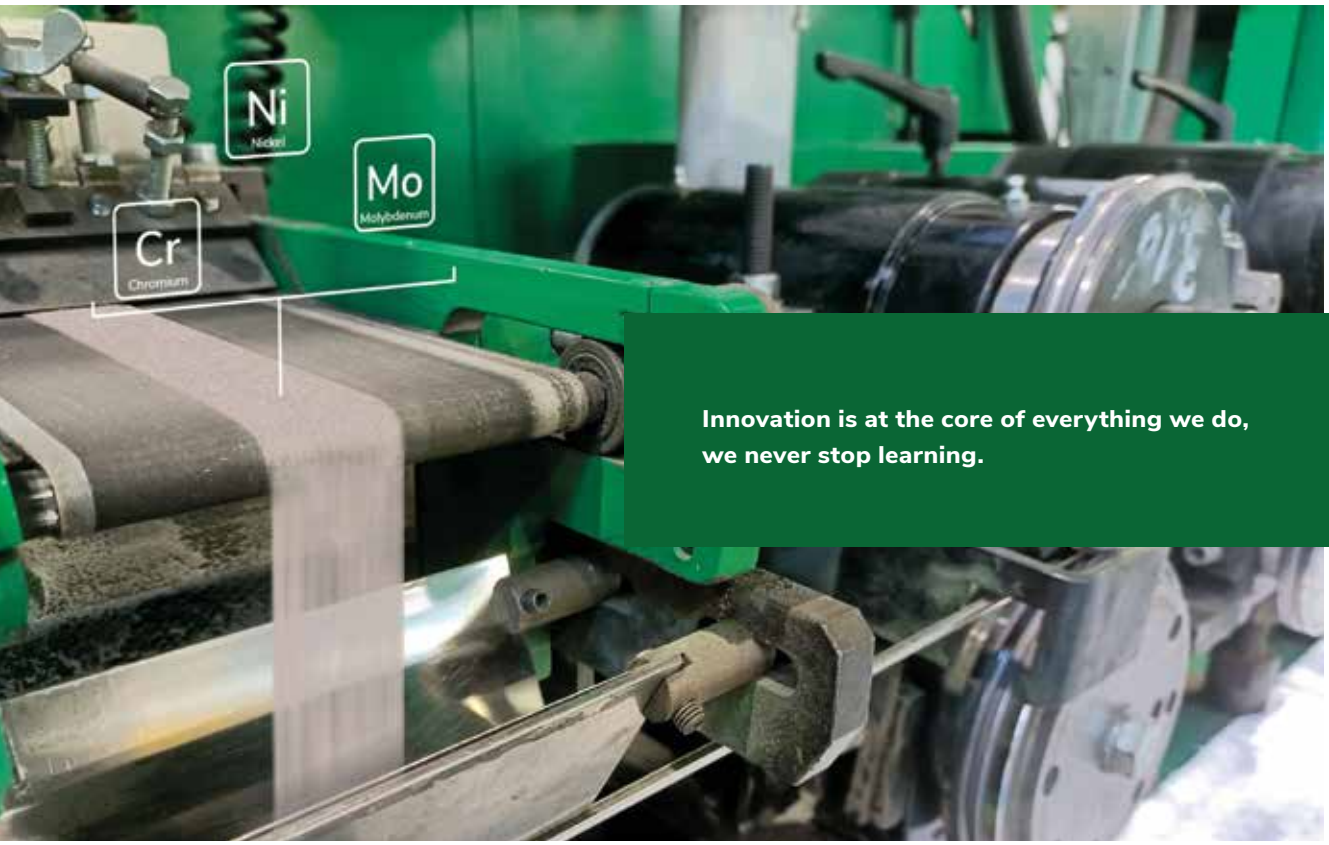
Quality & innovation

Since inception in 1966, innovation has always played a key role at Welding Alloys. We have globally located R&D teams capable of designing a large range of joining, cladding and hardfacing cored wires, based on a culture of continuous development and innovation.

We take pride in our ability to maintain flexibility and agility in the development of cored wires. One of our key strengths lies in our capability to collaborate closely with our customers, thoroughly assessing their unique challenges. This approach enables us to tailor solutions that precisely align with their requirements.

We have total control over design, development and production. Our wires are produced using our own manufacturing equipment, which is installed in our production plants worldwide. Our commitment to maintaining strict quality control is evident through our consistent implementation of laboratory tests and quality checks at different stages of the manufacturing process.

Welding Alloys backs its products and services with teams of technical experts active in 150 countries across the world who work closely with customers to deliver best-in-class solutions to every major industrial sector.



Innovation is at the core of everything we do, we never stop learning.

Industry solutions

Welding Alloys offers a large range of joining and cladding cored wires.

Our solutions are customer-based with a focus on quality and high productivity. This is achieved by taking the time to understand our customers' operational requirements, needs and expectations, and delivering bespoke solutions focused on improving productivity and reducing total cost of ownership.

Welding Alloys provides solutions in a range of different industries, including but not limited to:

- Construction
- Naval
- Petrochemical, Oil & Gas
- Hydropower
- Agriculture & Food
- Pulp & Paper
- Steel Making
- Railways
- Recycling & Waste
- Power
- Cement
- Sugar
- Mining, Quarries & Earthmoving

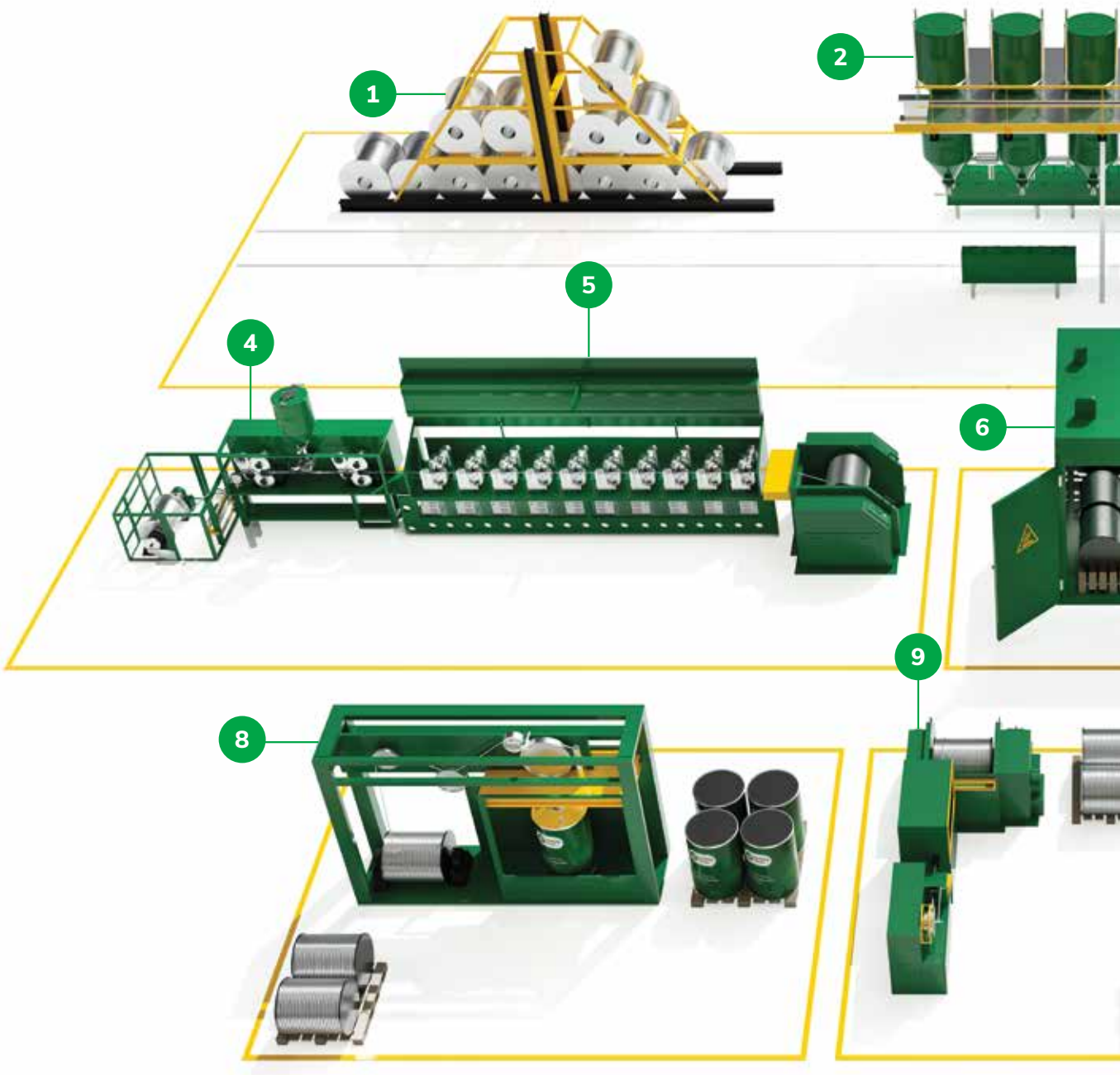
ROBOFIL M 700, pipe butt welding root to cap

TETRA S 316L-G, flange joining on a pressure vessel

TETRA S 309LNb-G & TETRA S 347L-G, blind cladding

CHROMECORE B 13 4-G, repair of hydro Pelton bucket

World class cored wire manufacturing



1. Strip raw material
Different strip material and dimensions are used depending on the type of wire being manufactured.

2. Powder mix preparation
Welding Alloys blend management software provides a list, with quantities of each powder to obtain the required weld metal composition.

3. Powder mixing
The powders are mixed to produce a homogeneous blend throughout the batch. Some powders are mixed with binders to prevent segregation and improve weldability. Different mixers are used depending on the wire being produced to prevent cross contamination of elements.

4. Strip forming and powder feeding
The strip is formed into a U-shape ready to receive the powder. The strip powder ratio is continuously controlled; the right combination of the strip and the powder is what allows us to obtain the required chemical composition of the weld metal.

5. Wire rolling
The wire is closed to form an O-shape (our seamless cored wires are laser butt welded). The wire then goes through the rolling process to reduce the diameter and compact the powder.

6. Heat treatment
Certain wires are baked to remove moisture and oil from them before the final finishing and packing. Some wires require special baking in atmosphere controlled ovens.

7. Wire drawing
Wire drawing uses calibrated dies to produce a round wire with excellent control of the diameter. The addition of lubricants and rust protectors improves the feedability and storage life of the wires.

8. Drum packing
Different options are available: rotary, static or twist free, depending on the wire dimensions and customers' requirements.

9. Spooling
The wires are precision layer wound to control cast and helix in order to improve feedability.

10. Packaging
A range of packaging options are available depending on the customer's needs. Carefully chosen packaging material prevents moisture pickup during transport and storage.

Back side welding of a V-groove joint using ROBOFIL M 71.

Low alloyed steels

This section presents our ROBOFIL range of seamless cored wires, which are hermetically sealed by laser welding to prevent hydrogen absorption and reduce the risk of cold cracking. These cored wires offer a very low amount of diffusible hydrogen (<4ml/100g) for single or multipass welding of general engineering and structural parts.

Part of the ROBOFIL range is made up of metal cored wires (M).

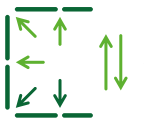
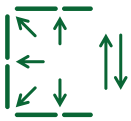
- Metal cored wires have similar welding characteristics to those of solid wires, and can be used right from the root pass through to the filling passes. Metal cored wires provide more flexibility in terms of the parameter range and offer higher productivity thanks to faster travel speeds and higher deposition rates.

Additionally, the ROBOFIL family is made up of flux cored wires producing either a rutile slag (R) or basic slag (B).

- Rutile flux cored wires are renowned for their excellent weldability, with low spatter and a soft arc. ROBOFIL R products have a fast freezing slag, making them well-suited for out of position welding. The slag releases from the weld independently. However, rutile slag wires have limitations in terms of mechanical properties performance, such as impact test results.

- Basic flux cored wires are ideal when high mechanical properties are required. These wires consist of special minerals, which reduce the weld metal oxygen content and enhance the weld metal performance. However, they have a slow freezing slag, making them suitable only for flat welding positions.

In both cases, the slag serves to shield the weld from oxidation and atmospheric contamination, resulting in a superior final weld.

Product	ROBOFIL M	ROBOFIL R	ROBOFIL B	SPEEDARC / ROBOFIL
Welding process	GMAW	FCAW-G	FCAW-G	FCAW-S
Wire type	Metal cored	Flux cored	Flux cored	Flux cored
Slag	No slag	Fast freezing rutile slag	Basic slag	Basic slag
Shielding gas	M21: Ar + 15 - 25% CO_2	M21: Ar + 15 - 25% CO_2	M21: Ar + 15 - 25% CO_2	No gas
Welding positions	 *			 **

*Out of position welding also possible using short circuit or pulsed arc modes of transfer
**Speedarc T11 can be also welded in vertical down position under negative polarity DC-

Low alloyed steels - GMAW & FCAW-G

Product	Standard diameters [mm]	Slag	EN ISO ASME / AWS standards	Typical chemical composition (%)				
				C	Mn	Si	Cr	Ni
MILD STEELS								
ROBOFIL R 71+	1.2 - 1.6	Fast freezing rutile slag	ISO 17632-A T 46 4 P M21 1 H5 AWS A5.20 E71T-1M-H4	0.04	1.2	0.4	-	-
ROBOFIL M 70	1.2 - 1.6	No slag	ISO 17632-A T 46 2 M M21 1 H5 AWS A5.18 E70C-6M H4	0.05	1.5	0.6	-	-
ROBOFIL M 71	1.2 - 1.6	No slag	ISO 17632-A T 46 6 M M21 1 H5 AWS A5.18 E70C-6M H4	0.07	1.4	0.5	-	-
ROBOFIL B 71	1.2 - 1.6	Basic slag	ISO 17632-A T 46 6 B M21 3 H5 AWS A5.20 E70T-5M-JH4	0.06	1.4	0.4	-	-
ROBOFIL M Ni1	1.2 - 1.6	No slag	ISO 17632-A T 50 6 1Ni M M21 1 H5 AWS A5.28 E80C-Ni1 H4	0.05	1.3	0.6	-	0.9
ROBOFIL B Ni1	1.2 - 1.6	Basic slag	ISO 17632-A T 46 6 1Ni B M21 3 H5 AWS A5.29 E80T5-GM-JH4	0.06	1.4	0.4	-	1.1
HIGH STRENGTH STEELS								
ROBOFIL M NiMo	1.2 - 1.6	No slag	ISO 18276-A T 55 5 1.5NiMo M M21 1 H5 AWS A5.28 E90C-G H4	0.05	1.6	0.4	-	1.6
ROBOFIL B NiMo	1.2 - 1.6	Basic slag	ISO 18276-A T 55 6 1.5NiMo B M21 3 H5 AWS A5.29 E90T5-G-H4	0.05	1.4	0.4	-	1.2
ROBOFIL M 700	1.2 - 1.6	No slag	ISO 18276-A T69 4 Mn2NiCrMo M M21 1 H5 AWS A5.28 E110C-K4 H4	0.06	1.5	0.5	0.5	2.5
ROBOFIL B 700	1.2 - 1.6	Basic slag	ISO 18276-A T69 5 Mn2NiCrMo B M21 3 H5 AWS A5.29 E110T5-K4M-JH4	0.05	1.4	0.4	0.3	2.4

Other	Typical mechanical properties				Description and applications
	Rp0.2% [Mpa]	Rm [Mpa]	A5 [%]	CVN [J]	
-	510	570	25	-40 °C: 70	Joining of base metal S235 to S355, P235 to P355, X42 to X60. Dedicated for use in construction, boiler plates, pipes, shipbuilding.
-	500	570	26	-20 °C: 80	Joining of base metal S235 to S355, P235 to P355, X42 to X60. Dedicated for use in construction, boiler plates, pipes, shipbuilding, casting parts made of carbon manganese steel.
-	510	580	26	-60 °C: 80	Recommended for welding of heavily worked or restrained joints with toughness required down to -60 °C. Joining of base metal S235 to S355, P235 to P355, X42 to X65. Dedicated for use in construction, boiler plates, pipes, shipbuilding, casting parts made of carbon manganese steel.
-	480	580	28	-60 °C: 100	Welding of thick joints and safety-critical joining applications on high carbon, high sulphur or high phosphorus steels, under heavy static or dynamic stresses down to -60 °C. Joining of base metal S235 to S355, P235 to P355, X42 to X65. Dedicated to construction, boiler plates, pipes, shipbuilding, casting parts made of carbon manganese steel.
-	540	610	27	-60 °C: 80	Deposition of cold tough steel alloyed with 1% nickel to improve toughness down to -60 °C. High resistance to cracking, thanks to a low amount of diffusible hydrogen guaranteed (<4 ml/100 g). Joining of base metal S275 to S460, P235 to P460, X42 to X65. Dedicated for use in construction, boiler plates, pipes, shipbuilding.
-	520	600	24	-60 °C: 80	
Mo: 0.3	610	720	24	-50 °C: 80	Deposition of steel alloyed with nickel and molybdenum to improve yield strength and toughness. Joining of base metal S355 to S550, P460, X60 to X70. Ideally suited for use in construction, oil and gas, shipbuilding.
Mo: 0.4	600	680	24	-60 °C: 55	
Mo: 0.5	760	820	17	-40 °C: 60	Deposition of steel alloyed with nickel and molybdenum to improve yield strength and toughness. Joining of base metal S500 to S690, P500 to P590, X70 to X80. Ideally suited for use in construction, oil and gas, shipbuilding.
Mo: 0.5	760	850	20	-50 °C: 60	

Low alloyed steels - FCAW-S

Product	Standard diameters [mm]	Slag	EN ISO ASME / AWS standards	Typical chemical composition (%)				
				C	Mn	Si	Cr	Ni
MILD STEELS								
SPEEDARC T4	1.0	Basic slag	ISO 17632-A T 38 Z W NO 3 AWS A5.20 E70T-4	0.20	0.5	0.2	-	-
ROBOFIL T4	1.2 - 1.6	Basic slag	ISO 17632-A T 38 Z W NO 3 AWS A5.20 E70T-4	0.20	0.5	0.2	-	-
SPEEDARC T11	1.2 - 1.6	Basic slag	ISO 17632-A T 38 Z Z NO 1 AWS A5.20 E71T-11	0.10	0.5	0.3	-	-

	Typical mechanical properties				Description and applications
Other	Rp0.2% [Mpa]	Rm [Mpa]	A5 [%]	CVN [J]	
-	450	610	-	-	Addition of aluminium in flux to deoxidise the weld deposit. Joining of base metal S235 to S295, and P235 to P295. Easy arc striking and restriking, simplified tack welding. Well suited to welding of poorly fitted joints. Horizontal welding with high deposition rate. Dedicated to general fabrication applications.
-	450	610	-	-	
-	440	600	-	-	Addition of aluminium in flux to deoxidise the weld deposit. Joining of base metal S235 to S295, and P235 to P295. Wide range of welding parameters possible. Particularly recommended for tack welding or fillet and lap joints, welding of thin sheets. Dedicated to general fabrication applications.

Joining of a reinforcing pad using our TETRA wire range.

Stainless steels

The corrosion resistance, mechanical properties and weldability of our cored wires are dependent on the stainless steel microstructure, which we break down into the following six sub-categories: ferritic and martensitic stainless steels (see Hardfacing Welding Consumables brochure), soft martensitic stainless steels, austenitic and super-austenitic stainless steels, austenitic-ferritic stainless steels (duplex), heat resistant stainless steels, repair and maintenance austenitic stainless steels.

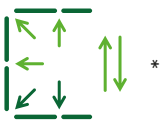
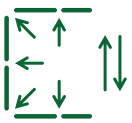
Our stainless steel cored wires provide operational flexibility and precise control over the chemical analysis and mechanical properties. This includes the ability to regulate ferrite levels.

When using a metal cored wire, the heat input is reduced, leading to minimised distortion and lower susceptibility to intergranular corrosion on austenitic stainless steels (addressing the issue of chromium depletion at the grain boundaries). Therefore, using these wires for manufacturing 3D parts (Directed Energy Deposition - WAAM) could be highly advantageous.

Flux cored wires have the capability to produce different types of slag, offering versatility to cater to specific requirements. Depending on the application needs, it is possible for the wire to have either a fast freezing slag (designated as V), which is best suited for out of position welding, or a slow freezing slag (designated as S), providing excellent protection for the welding bead, resulting in optimal weld quality.

For critical applications that are sensitive to hot cracking, like welding 310 stainless steels, an option with a basic slag (designated as SB) is available.

Additionally, Welding Alloys has developed a range of flux cored TIG rods known as WAROD, a cost-effective solution for manual TIG welding purposes. WAROD is specifically engineered for root pass welding, particularly in situations where gas purging is not feasible.

Product	TUBE S / CHROMECORE M	TETRA S	TETRA V / CHROMECORE V	TETRA S B / CHROMECORE B	TRI S
Welding process	GMAW SAW	FCAW-G	FCAW-G	FCAW-G	FCAW-S
Wire type	Metal cored	Flux cored	Flux cored	Flux cored	Flux cored
Slag	No slag	Slow freezing rutile slag	Fast freezing rutile slag	Basic slag	Basic slag
Shielding gas	M12: Ar + 0.5 - 5% CO_2 Neutral flux	M21: Ar + 15 - 25% CO_2 C1: 100% CO_2	M21: Ar + 15 - 25% CO_2 C1: 100% CO_2	M12: Ar + 0.5 - 5% CO_2 M21: Ar + 15 - 25% CO_2	No gas
Welding positions	 *				

*Out of position welding also possible using short circuit or pulsed arc modes of transfer

Stainless steels - GMAW & FCAW-G *(1 of 4)*

Product	Standard diameters [mm]	Slag	EN ISO ASME / AWS standards	Typical chemical composition (%)				
				C	Mn	Si	Cr	Ni
SOFT MARTENSITIC STAINLESS STEELS								
CHROMECORE M 410NiMo-G	1.0 - 1.6	No slag	ISO 17633-A T 13 4 M M12 1 AWS A5.22 EC410NiMo*	0.02	0.9	0.7	12.5	4.5
CHROMECORE V 410NiMo-G	1.2 - 1.6	Fast freezing rutile slag	ISO 17633-A T 13 4 P M21 1 AWS A5.22 E410NiMoT1-4	0.03	0.4	0.3	12.0	4.5
CHROMECORE B 13 4-G	1.0 - 1.6	Basic slag	ISO 17633-A T 13 4 B M12 2 AWS A5.22 EC410NiMo*	0.02	0.5	0.3	12.0	4.5
CHROMECORE B 16 5 1-G	1.0 - 1.6	Basic slag	ISO 17633-A T Z 16 5 1 B M12 1 AWS A5.22 *	0.03	1.0	0.4	15.5	4.5
CHROMECORE M 17 6-G	1.0 - 1.6	No slag	ISO 17633-A T Z 17 6 M M12 1 AWS A5.22 *	0.02	0.6	0.4	17.0	5.5
AUSTENITIC STAINLESS STEELS								
TETRA S 308L-G	1.2 - 1.6	Slow freezing rutile slag	ISO 17633-A T 19 9 L R M21 3 AWS A5.22 E308LT0-4	0.03	1.4	0.7	19.5	10.5
TETRA V 308L-G	1.2 - 1.6	Fast freezing rutile slag	ISO 17633-A T 19 9 L P M21 1 AWS A5.22 E308LT1-4	0.03	1.4	0.7	20.0	10.5
TUBE S 308L-G	1.0 - 1.6	No slag	ISO 17633-A T 19 9 L M M12 1 AWS A5.22 EC308L	0.02	1.4	0.5	20.5	10.5
TETRA S 347L-G	1.2 - 1.6	Slow freezing rutile slag	ISO 17633-A T 19 9 Nb R M21 3 AWS A5.22 E347T0-4	0.03	1.4	0.7	19.0	10.5
TETRA V 347L-G Bi FREE	1.2 - 1.6	Fast freezing rutile slag	ISO 17633-A T 19 9 Nb P M21 1 AWS A5.22 E347T1-4	0.03	1.4	0.7	19.0	10.5
TUBE S 347L-G	1.0 - 1.6	No slag	ISO 17633-A T 19 9 Nb M M12 1 AWS A5.22 EC347	0.02	1.5	0.5	20.0	10.5

Bi FREE Bismuth free (<0.002%)

Other	Typical mechanical properties				Description and applications
	Rp0.2% [Mpa]	Rm [Mpa]	A5 [%]	CVN [J]	
	After PWHT 580 °C - 8 h				
Mo: 0.5	720	860	18	-20 °C: 55	Soft martensitic deposit of CrNi steel, type 410NiMo. Good ductility, toughness, excellent resistance to cavitation and to stress corrosion cracking. Low amount of diffusible hydrogen guaranteed (<4 ml/100 g). A post-weld heat treatment at 580 °C to 620 °C is recommended to obtain a soft martensite structure. Joining and rebuilding of stainless martensitic and martensitic-ferritic steel base metals. For use in hydropower, thermal power, forging, casting of parts made of homogeneous base metal (e.g. F6NM, CA6NM). *Classified EC410: Out of AWS standard regarding Mn > 0.6 and Si > 0.5.
Mo: 0.5	730	850	18	-20 °C: 40	
Mo: 0.5	690	830	18	-20 °C: 110	
Mo: 0.9	670	860	17	-20 °C: 60	Soft martensitic deposit CrNiMo, type 16 5 1 / 17 6. Good ductility, toughness, excellent resistance to cavitation and to stress corrosion cracking. Low amount of diffusible hydrogen guaranteed (<4 ml/100 g). Better pitting corrosion resistance compared to 410NiMo. A post-weld heat treatment at 580 °C to 620 °C is recommended to obtain a soft martensite structure. Joining and rebuilding of stainless martensitic and martensitic-ferritic steel base metals. Dedicated to applications in hydropower, thermal power, forging, casting of parts made of homogeneous base metal. Classified Z: 16 5 1 / 17 6 are not referenced in ISO standard. *Not referenced in AWS standard.
Mo: 0.9	650	850	15	+20 °C: 30	
-	400	560	40	-196 °C: 32	Austenitic deposit of CrNi steel, type 308L. Service temperatures range from -196 °C to +400 °C. We also manufacture TETRA V 308XL-G, which is the variation of this wire that is dedicated to cryogenic applications with process temperatures down to -196 °C: 40 J thanks to the controlled ferrite. Welding of stainless steel base metals with similar compositions, type 301, 302, 303, 304L. For cladding applications, use 309L for the buffer layer. Ideally suited for applications in the food industry, pharmaceutical, nuclear and fabrication.
-	460	620	40	-196 °C: 35	
-	430	600	40	-196 °C: 35	
Nb: 0.5	470	650	35	-196 °C: 34	Austenitic deposit of CrNi steel stabilised with Nb, type 347. Nb improves intergranular corrosion resistance and mechanical properties at high temperatures. Service temperatures range from -196 °C to +400 °C. Welding of titanium or niobium stabilised stainless steel base metals with similar compositions, type 321, 347 or 304L. For cladding applications use 309LNb for the buffer layer. Ideally suited for applications in the food industry, pharmaceutical, nuclear and fabrication.
Nb: 0.5	470	660	35	-196 °C: 35	
Nb: 0.5	430	620	35	-105 °C: 45	

Stainless steels - GMAW & FCAW-G (2 of 4)

Product	Standard diameters [mm]	Slag	EN ISO ASME / AWS standards	Typical chemical composition (%)				
				C	Mn	Si	Cr	Ni
TETRA S 316L-G	1.2 - 1.6	Slow freezing rutile slag	ISO 17633-A T 19 12 3 L R M21 3 AWS A5.22 E316LT0-4	0.03	1.4	0.8	19.0	12.0
TETRA V 316L-G	1.2 - 1.6	Fast freezing rutile slag	ISO 17633-A T 19 12 3 L P M21 1 AWS A5.22 E316LT1-4	0.03	1.4	0.8	19.0	12.0
TUBE S 316L-G	1.0 - 1.6	No slag	ISO 17633-A T 19 12 3 L M M12 1 AWS A5.22 EC316L	0.02	1.4	0.6	19.5	12.0
TETRA S 904L-G	1.2 - 1.6	Slow freezing rutile slag	ISO 17633-A T Z 20 25 5 Cu L R M21 3 AWS A5.22 E385T0-4*	0.03	3.0	0.5	21.0	25.5
TETRA V 904L-G	1.2 - 1.6	Fast freezing rutile slag	ISO 17633-A T Z 20 25 5 Cu L P M21 1 AWS A5.22 E385T1-4*	0.03	3.2	0.5	20.0	26.0
TUBE S 904L-G	1.2 - 1.6	No slag	ISO 17633-A T Z 20 25 5 Cu L M I1 1 AWS A5.22 EC385*	0.02	3.5	0.4	21.0	25.0
DUPLEX & SUPER DUPLEX STAINLESS STEELS								
TETRA S 22 9 3L-G	1.2 - 1.6	Slow freezing rutile slag	ISO 17633-A T 22 9 3 N L R M21 3 AWS A5.22 E2209T0-4	0.03	1.2	0.8	23.0	9.0
TETRA V 22 9 3L-G	1.2 - 1.6	Fast freezing rutile slag	ISO 17633-A T 22 9 3 N L P M21 1 AWS A5.22 E2209T1-4	0.03	0.9	0.5	23.0	9.0
TUBE S 22 9 3L-G	1.0 - 1.6	No slag	ISO 17633-A T 22 9 3 N L M M12 1 AWS A5.22 EC2209	0.02	1.4	0.6	23.0	9.5
TETRA S D57L-G	1.2 - 1.6	Slow freezing rutile slag	ISO 17633-A T 25 9 4 Cu N L R M21 3 AWS A5.22 E2594T0-4	0.03	1.0	0.5	25.5	9.0
TETRA V D57L-G	1.2 - 1.6	Fast freezing rutile slag	ISO 17633-A T 25 9 4 Cu N L P M21 1 AWS A5.22 E2594T1-4	0.03	1.4	0.6	25.0	9.4
TUBE S D57L-G	1.2 - 1.6	No slag	ISO 17633-A T 25 9 4 Cu N L M I1 1 AWS A5.22 EC2594	0.02	1.7	0.5	25.0	9.5

Bi FREE Bismuth free (<0.002%)

	Typical mechanical properties				Description and applications
Other	Rp0.2% [Mpa]	Rm [Mpa]	A5 [%]	CVN [J]	
Mo: 2.8	420	560	37	-60 °C: 40	Austenitic deposit of CrNi steel with addition of Mo, type 316L. Mo improves intergranular corrosion resistance in humid conditions. Service temperatures range from -196 °C to +400 °C. We also manufacture TETRA V 316XL-G, the variation of this wire that is dedicated to cryogenic applications with process temperatures down to -196 °C: 32 J thanks to the controlled ferrite. Welding of stainless steel base metals with similar compositions or stabilised with titanium and niobium. For cladding applications, use 309LMo for the buffer layer. Ideally suited for applications in the food industry, chemical, refineries, nuclear and fabrication.
Mo: 2.9	490	600	35	-60 °C: 50	
Mo: 2.8	450	610	35	-60 °C: 40	
Mo: 4.9 Cu: 1.6	430	640	32	-196 °C: 35	Fully austenitic deposit of CrNi steel with addition of Mo and Cu, type 385. Alloys improve corrosion resistance in concentrated acids and also yield strength. Service temperatures range from -110 °C to +400 °C. Welding of copper-free and overmatching leaner alloy stainless steels, such as 317L. For use in phosphoric, sulphuric and acetic acid plants, or salt and seawater environments. Classified Z: Out of ISO standard regarding no N addition. *Classified E385: Not referenced in AWS as flux cored wire - Innovative wire *Classified EC385: Out of AWS standard regarding Mn > 2.5 to prevent from hot cracking.
Mo: 5.0 Cu: 1.6	430	640	32	-196 °C: 35	
Mo: 5.0 Cu: 1.5	410	640	35	-196 °C: 40	
Mo: 3.1 N: 0.1	650	830	26	-50 °C: 27	Austenitic-ferritic deposit of CrNi steel with addition of Mo, type 2209. Mo improves intergranular corrosion resistance in humid conditions. Outstanding corrosion resistance: PREN = Cr + 3.3 Mo + 16 N ≥ 35 and Critical Pitting Temperature = 25 °C. Welding of duplex stainless steel base metals and dissimilar joints. Suited for use in forging and/or casting parts, chemical, oil and gas plants.
Mo: 3.1 N: 0.1	630	820	27	-60 °C: 40	
Mo: 3.3 N: 0.1	610	800	28	-40 °C: 35	
Mo: 3.8 Cu: 1.1 N: 0.2	730	920	22	-20 °C: 35	Austenitic-ferritic deposit of CrNi steel with addition of Cu and Mo, type 2507. Mo and Cu improve corrosion resistance in sulphuric acid environments. Outstanding corrosion resistance: PREN = Cr + 3.3 Mo + 16 N ≥ 40 and Critical Pitting Temperature = 40 °C. Welding of super duplex stainless steel base metals and dissimilar joints. Ideally suited for use in forging and/or casting parts, chemical, oil and gas plants.
Mo: 3.8 Cu: 1.4 N: 0.2	710	890	24	-20 °C: 35	
Mo: 3.8 Cu: 1.5 N: 0.2	680	880	22	-45 °C: 35	

Stainless steels - GMAW & FCAW-G (3 of 4)

Product	Standard diameters [mm]	Slag	EN ISO ASME / AWS standards	Typical chemical composition (%)				
				C	Mn	Si	Cr	Ni
HEAT RESISTANT STAINLESS STEELS								
TETRA S 308H-G	1.2 - 1.6	Slow freezing rutile slag	ISO 17633-A T Z 19 9 H R M21 3 AWS A5.22 E308HT0-4	0.06	1.4	0.8	20.5	10.5
TETRA V 308H-G	1.2 - 1.6	Fast freezing rutile slag	ISO 17633-A T Z 19 9 H P M21 1 AWS A5.22 E308HT1-4	0.06	1.4	0.8	20.5	10.5
TUBE S 308H-G	1.0 - 1.6	No slag	ISO 17633-A T Z 19 9 H M M12 1 AWS A5.22 EC308H	0.06	1.4	0.6	20.5	10.5
TETRA S 347H-G	1.2 - 1.6	Slow freezing rutile slag	ISO 17633-A T 19 9 Nb R M21 3 AWS A5.22 E347HT0-4	0.06	1.4	0.9	19.5	10.5
TETRA V 347H-G	1.2 - 1.6	Fast freezing rutile slag	ISO 17633-A T 19 9 Nb P M21 1 AWS A5.22 E347HT1-4	0.06	1.4	0.9	19.5	10.5
TUBE S 347H-G	1.0 - 1.6	No slag	ISO 17633-A T 19 9 Nb M M12 1 AWS A5.22 EC347	0.06	1.4	0.6	19.5	10.5
TETRA S B 310-G	1.2	Slow freezing rutile slag	ISO 17633-A T 25 20 B M21 3 AWS A5.22 E310T0-4	0.10	2.3	0.5	25.5	21.0
TETRA V 310-G	1.2 - 1.6	Fast freezing rutile slag	ISO 17633-A T 25 20 P M21 1 AWS A5.22 E310T1-4	0.10	2.3	0.5	25.0	20.0
TUBE S 310-G	1.2 - 1.6	No slag	ISO 17633-A T 25 20 M M12 1 AWS A5.22 EC310*	0.15	3.0	0.3	26.0	21.0
TETRA S 309HT-G	1.2 - 1.6	Slow freezing rutile slag	ISO 17633-A T Z 22 10 N H R M21 3 AWS A5.22 *	0.06	1.0	1.4	22.0	10.0
TETRA V 309HT-G	1.2 - 1.6	Fast freezing rutile slag	ISO 17633-A T Z 22 10 N H P M21 1 AWS A5.22 *	0.06	1.0	1.4	22.0	10.0

Bi FREE Bismuth free (<0.002%)

	Typical mechanical properties				Description and applications
Other	Rp0.2% [Mpa]	Rm% [Mpa]	A5 [%]	CVN [J]	
-	470	620	40	+20 °C: 60	Austenitic deposit of CrNi steel, type 308H. Heat resistance up to 750 °C. Welding of stainless steel base metals, stabilised or non stabilised creep-resistant steel base metals with similar compositions, such as 304H. TETRA V 16 8 2 equivalent wire is available with low quantities of Cr and Mo, dedicated to thick sections to avoid in-service HAZ failure. Suited for use in petrochemical and chemical plants. Classified Z: Out of ISO standard regarding Mn > 1.0 and Si < 1.0.
-	470	625	40	+20 °C: 60	
-	430	600	35	+20 °C: 80	
Nb: 0.7	470	620	35	+20 °C: 60	Austenitic deposit of CrNi steel stabilised with Nb, type 347. Nb improves intergranular corrosion resistance and mechanical properties at high temperatures. Creep and heat resistance up to 700 °C. Welding of stainless steel base metals with similar compositions. We also offer TETRA V 16 8 2, which is available with low quantities of Cr and Mo, dedicated to thick sections to avoid in-service HAZ failure. Suited for use in petrochemical, chemical and power generation plants.
Nb: 0.7	470	620	35	+20 °C: 60	
Nb: 0.7	450	640	35	+20 °C: 70	
-	400	590	30	+20 °C: 80	Fully austenitic deposit of high alloyed CrNi steel with addition of Mn, type 310. Heat resistance up to 1150 °C. The basic slag type is particularly advised to avoid hot cracking problems. Welding of stainless steel base metals with similar compositions. Ideal for applications in chemical plants, petrochemical plants, cement plants and steel plants. *Classified EC310: Out of AWS standard regarding Mn > 2.5 to prevent from hot cracking.
-	410	600	35	+20 °C: 60	
-	420	630	35	+20 °C: 70	
N: 0.1	530	720	33	+20 °C: 50	Austenitic deposit of CrNi steel with addition of nitrogen and rare earth elements, modified type 309. Alloys compensate for the dilution after welding and improve the resistance to fatigue and deformation linked to rapid and repeated temperature variations. Heat resistance up to 1000 °C. Welding of steels with similar compositions to 253MA®. Dedicated for use on parts such as furnaces and flues. Classified Z: 22 10 N is not referenced in ISO standard. *Not referenced in AWS standard - Innovative development.
N: 0.1	540	730	32	+20 °C: 55	

Stainless steels - GMAW & FCAW-G (4 of 4)

Product	Standard diameters [mm]	Slag	EN ISO ASME / AWS standards	Typical chemical composition (%)				
				C	Mn	Si	Cr	Ni
DISSIMILAR STAINLESS STEELS								
TETRA S 309L-G	1.2 - 1.6	Slow freezing rutile slag	ISO 17633-A T 23 12 L R M21 3 AWS A5.22 E309LT0-4	0.03	1.4	0.7	23.5	13.0
TETRA V 309L-G Bi FREE	1.2 - 1.6	Fast freezing rutile slag	ISO 17633-A T 23 12 L P M21 1 AWS A5.22 E309LT1-4	0.03	1.4	0.7	23.5	13.0
TUBE S 309L-G	1.0 - 1.6	No slag	ISO 17633-A T 23 12 L M M12 1 AWS A5.22 EC309L	0.02	1.4	0.6	24.0	13.0
TETRA S 312-G	1.2 - 1.6	Slow freezing rutile slag	ISO 17633-A T 29 9 R M21 3 AWS A5.22 E312T0-4	0.10	1.3	0.8	29.0	8.5
TETRA V 312-G	1.2 - 1.6	Fast freezing rutile slag	ISO 17633-A T 29 9 P M21 1 AWS A5.22 E312T1-4	0.10	1.3	0.8	29.0	8.5
TUBE S 312-G	1.2 - 1.6	No slag	ISO 17633-A T 29 9 M M12 1 AWS A5.22 EC312	0.03	1.5	0.6	28.5	9.0
TETRA S 307-G	1.2 - 1.6	Slow freezing rutile slag	ISO 17633-A T 18 8 Mn R M21 3 AWS A5.22 E307T0-4*	0.10	6.0	0.9	19.0	9.5
TETRA V 307-G	1.2 - 1.6	Fast freezing rutile slag	ISO 17633-A T 18 8 Mn P M21 1 AWS A5.22 E307T1-4*	0.11	6.0	0.8	19.0	9.5
TUBE S 307-G	1.0 - 1.6	No slag	ISO 17633-A T 18 8 Mn M M12 1 AWS A5.22 EC307*	0.10	6.0	0.6	19.5	8.5
TETRA S 20 9 3-G	1.2 - 1.6	Slow freezing rutile slag	ISO 17633-A T 20 10 3 R M21 3 AWS A5.22 E308MoT0-4*	0.05	1.5	0.8	20.5	9.5
TETRA V 20 9 3-G	1.2 - 1.6	Fast freezing rutile slag	ISO 17633-A T 20 10 3 P M21 1 AWS A5.22 E308MoT1-4*	0.05	1.2	0.6	20.0	9.5
TUBE S 20 9 3-G	1.0 - 1.6	No slag	ISO 17633-A T 20 10 3 M M12 1 AWS A5.22 EC308Mo*	0.05	1.5	0.8	20.5	9.5

Bi FREE Bismuth free (<0.002%)

Other	Typical mechanical properties				Description and applications
	Rp0.2% [Mpa]	Rm [Mpa]	A5 [%]	CVN [J]	
-	460	580	32	-60 °C: 40	Austenitic deposit of highly alloyed CrNi steel, type 309L. Service temperatures range from -60 °C to +350 °C. Joining of steels with similar and dissimilar base metal compositions. To be used as a buffer layer if cladding with 308L. We also offer 309LNb, which can be used as a buffer layer when cladding 347, and 309Mo for cladding 316L. Dedicated for applications in the food industry, chemical plants, pipes, nuclear plants and fabrication.
-	460	580	35	-60 °C: 40	
-	470	580	35	+20 °C: 65	
Mo: 0.3	650	860	22	+20 °C: 40	Austenitic-ferritic deposit of CrNi steel with high percentage of Cr, type 312. Cr ensures a high ferrite ratio, offering exceptional resistance to cracking. Good wear and friction resistance. Welding of dissimilar joints, high carbon equivalent or unknown steel base metals. Suitable for maintenance applications, gear teeth, tool steels.
Mo: 0.3	650	860	22	+20 °C: 40	
Mo: 0.3	610	800	25	+20 °C: 40	
-	480	630	40	+20 °C: 50	Work hardening austenitic deposit of CrNi steel with addition of Mn, modified type 307. Service temperatures range from -120 °C to +400 °C. Joining of 14% Mn austenitic steel base metals and dissimilar joints for high temperatures. For repair jobs where high strength and toughness combined with work hardening is required. Suitable for rail applications and the defence industry. *Classified E307 and EC307: Out of AWS standard regarding Mo < 0.5 and Mn > 4.75 to prevent from hot cracking.
-	480	650	32	+20 °C: 60	
-	450	650	40	+20 °C: 70	
Mo: 2.9	530	710	30	-20 °C: 45	Austenitic deposit of CrNi steel with addition of Mo, modified type 308Mo. Service temperatures range from -60 °C to +300 °C. High mechanical strength and good resistance to hot cracking. Joining of high tensile steel with limited weldability base metals, and dissimilar joints. Suitable for maintenance applications, defence industry applications, tool steels. *Classified 308Mo: Out of AWS standard regarding Mn > 3 to prevent from hot cracking.
Mo: 3.2	570	730	32	-40 °C: 45	
Mo: 3.2	600	780	35	+20 °C: 60	

Stainless steels - SAW *(1 of 2)*

Product	Standard diameters [mm]	EN ISO ASME / AWS standards	Typical chemical composition (%)					
			C	Mn	Si	Cr	Ni	Other
AUSTENITIC STAINLESS STEELS								
TUBE S 308L-S	2.4 - 3.2	ISO 17633-A T 19 9 L M NO 3 AWS A5.22 EC308L	0.03	1.5	0.4	21.0	10.0	-
TUBE S 347L-S	2.4 - 3.2	ISO 17633-A T 19 9 Nb M NO 3 AWS A5.22 EC347	0.02	1.5	0.5	20.0	10.5	Nb: 0.5
TUBE S 316L-S	2.4 - 3.2	ISO 17633-A T 19 12 3 L M NO 3 AWS A5.22 EC316L	0.02	1.4	0.6	19.5	12.0	Mo: 2.8
TUBE S 904L-S	2.4 - 3.2	ISO 17633-A T Z 20 25 5 Cu L M NO 3 AWS A5.22 EC385*	0.02	2.3	0.5	21.0	26.0	Mo: 5.0 Cu: 1.6
DUPLEX & SUPER DUPLEX STAINLESS STEELS								
TUBE S 22 9 3L-S	2.4 - 3.2	ISO 17633-A T 22 9 3 N L M NO 3 AWS A5.22 EC2209	0.03	1.3	0.5	23.0	9.0	Mo: 3.2 N: 0.1
TUBE S D57L-S	2.4 - 3.2	ISO 17633-A T 25 9 4 Cu N L M NO 3 AWS A5.22 EC2594	0.02	1.4	0.6	25.5	9.5	Mo: 3.8 Cu: 1.0 N: 0.2

Typical mechanical properties				Description and applications
Rp0.2% [Mpa]	Rm [Mpa]	A5 [%]	CVN [J]	
450	600	40	-196 °C: 50	Austenitic deposit of CrNi steel, type 308L. Service temperatures range from -196 °C to +400 °C. Welding of stainless steel base metals with similar compositions, type 301, 302, 303, 304L. When cladding, use 309L for the buffer layer. For use in the food, pharmaceutical, nuclear and fabrication industries.
430	600	35	+20 °C: 80	Austenitic deposit of CrNi steel stabilised with Nb, type 347. Nb improves intergranular corrosion resistance and mechanical properties at high temperatures. Service temperatures range from -196 °C to +400 °C. Welding of titanium or niobium stabilised stainless steel base metals with similar compositions, type 321, 347 or 304L. When cladding, use 309LNb for the buffer layer. Suited for applications in the food, pharmaceutical, nuclear and fabrication industries.
450	610	35	-100 °C: 50	Austenitic deposit of CrNi steel with addition of Mo, type 316L. Mo improves intergranular corrosion resistance in humid conditions. Service temperatures range from -196 °C to +400 °C. Welding of stainless steel base metals with similar compositions or stabilised with titanium and niobium. When cladding, use 309LMo for the buffer layer. For applications in the food, chemical, oil and gas, nuclear and fabrication industries.
410	640	35	-196 °C: 45	Fully austenitic deposit of CrNi steel with addition of Mo and Cu, type 385. Alloys improve corrosion resistance in concentrated acids and also yield strength. Service temperatures range from -110 °C to +400 °C. Welding of copper-free and overmatching leaner alloy stainless steels, such as 317L. Ideal for applications in phosphoric, sulphuric and acetic acid plants, salt and seawater environments. Classified Z: Out of ISO standard regarding no N addition. *Classified EC385: Out of AWS standard regarding Mn > 2.5.
630	800	28	-50 °C: 55	Austenitic-ferritic deposit of CrNi steel with addition of Mo, type 2209. Mo improves intergranular corrosion resistance in humid conditions. Outstanding corrosion resistance: PREN = Cr + 3.3 Mo + 16 N ≥ 35 and Critical Pitting Temperature = 25 °C. Welding of duplex stainless steel base metals and dissimilar joints. For applications in forging and/or casting parts, chemical, oil and gas plants.
630	800	23	-20 °C: 50	Austenitic-ferritic deposit of CrNi steel with addition of Cu and Mo, type 2553. Mo and Cu improve corrosion resistance in sulphuric acid environments. Outstanding corrosion resistance: PREN = Cr + 3.3 Mo + 16 N ≥ 40 and Critical Pitting Temperature = 40 °C. Welding of super duplex stainless steel base metals and dissimilar joints. For applications in forging and/or casting parts, chemical, oil and gas plants.

Stainless steels - SAW (2 of 2)

Product	Standard diameters [mm]	EN ISO ASME / AWS standards	Typical chemical composition (%)					
			C	Mn	Si	Cr	Ni	Other
HEAT RESISTANT STAINLESS STEELS								
TUBE S 308H-S	2.4 - 3.2	ISO 17633-A T Z 19 9 H M NO 3 AWS A5.22 EC308H	0.06	1.4	0.6	20.5	10.5	-
TUBE S 347H-S	2.4 - 3.2	ISO 17633-A T 19 9 Nb M NO 3 AWS A5.22 EC347	0.06	1.4	0.6	19.5	10.5	Nb: 0.7
TUBE S 310-S	1.6	ISO 17633-A T 25 20 M NO 3 AWS A5.22 EC310*	0.15	3.0	0.7	26.0	21.0	-
DISSIMILAR STAINLESS STEELS								
TUBE S 309L-S	2.4 - 3.2	ISO 17633-A T 23 12 L M NO 3 AWS A5.22 EC309L	0.02	1.4	0.6	24.0	13.0	-
TUBE S 312-S	2.4 - 3.2	ISO 17633-A T 29 9 M NO 3 AWS A5.22 EC312	0.05	1.5	0.6	29.0	9.5	Mo: 0.3
TUBE S 307-S	2.4 - 3.2	ISO 17633-A T 18 8 Mn M NO 3 AWS A5.22 EC307*	0.07	7.0	0.8	19.0	8.0	-
TUBE S 20 9 3-S	2.4 - 3.2	ISO 17633-A T 20 10 3 M NO 3 AWS A5.22 EC308Mo*	0.05	1.5	0.8	20.5	9.5	Mo: 3.2

Typical mechanical properties				Description and applications
Rp0.2% [Mpa]	Rm [Mpa]	A5 [%]	CVN [J]	
430	600	35	+20 °C: 80	Austenitic deposit of CrNi steel, type 308H. Heat resistance up to 750 °C. Welding of stainless steels stabilised or non stabilised, creep-resistant steel base metals with similar compositions, such as 304H. Ideally suited to applications in petrochemical and chemical plants. Classified Z: Out of ISO standard regarding Mn > 1.0 and Si < 1.0.
450	640	35	+20 °C: 70	Austenitic deposit of CrNi steel stabilised with Nb, type 347. Nb improves intergranular corrosion and mechanical properties at high temperatures. Creep and heat resistance up to 700 °C. Welding of stainless steel base metals with similar compositions. Ideal for petrochemical, chemical and power generation plant applications.
420	630	30	+20 °C: 80	Fully austenitic deposit of highly alloyed CrNi steel with addition of Mn, type 310. Heat resistance up to 1150 °C. Welding of stainless steel base metals with similar compositions. Suited for use in chemical plants, petrochemical plants, cement plants and steel plants. *Classified EC310: Out of AWS standard regarding Mn > 2.5 to prevent from hot cracking.
470	580	35	+20 °C: 65	Austenitic deposit of highly alloyed CrNi steel, type 309L. Service temperatures range from -60 °C to +350 °C. Joining of steels with similar and dissimilar base metal compositions. To be used as a buffer layer when cladding with 308L. We also offer 309LNb, which can be used as a buffer layer when cladding 347, and 309Mo for cladding 316L. For applications in the food, chemical, pipe, nuclear and fabrication industries.
600	750	25	+20 °C: 40	Austenitic-ferritic deposit of CrNi steel with a high percentage of Cr, type 312. Cr ensures a high ferrite ratio to offer exceptional cracking resistance. Good wear and friction resistance. Welding of dissimilar joints, high carbon equivalent or unknown steel base metals. For use in maintenance applications, gear teeth, tool steels.
450	650	35	+20 °C: 70	Work hardening austenitic deposit of CrNi steel with addition of Mn, modified type 307. Service temperatures range from -120 °C to +400 °C. Joining of 14% Mn austenitic steel base metals and dissimilar joints for high temperatures. Repair jobs where high strength and toughness combined with work hardening are required. Suitable for rail applications and the defence industry. *Classified EC307: Out of AWS standard regarding Mo < 0.5 and Mn > 4.75 to prevent from hot cracking.
600	780	35	+20 °C: 60	Austenitic deposit of CrNi steel with addition of Mo, modified type 308Mo. Service temperatures range from -60 °C to +300 °C. Offers high mechanical strength and high resistance to hot cracking. Joining of high tensile steels and limited weldability base metals, and dissimilar joints. Ideal for maintenance, defence industry applications, tool steels. *Classified 308Mo: Out of AWS standard regarding Mn > 3 to prevent from hot cracking.

Stainless steels - FCAW-S

Product	Standard diameters [mm]	EN ISO ASME / AWS standards	Typical chemical composition (%)					
			C	Mn	Si	Cr	Ni	Other
AUSTENITIC STAINLESS STEELS								
TRI S 308L-O	1.2 - 2.4	ISO 17633-A T 19 9 L U NO 3 AWS A5.22 E308LT0-3	0.02	1.8	0.8	20.5	10.0	-
TRI S 347L-O	1.6 - 2.4	ISO 17633-A T 19 9 Nb U NO 3 AWS A5.22 E347T0-3	0.03	1.5	0.9	20.5	10.0	Nb: 0.5
TRI S 316L-O	1.2 - 2.4	ISO 17633-A T 19 12 3 L U NO 3 AWS A5.22 E316LT0-3	0.03	1.4	0.8	19.0	12.0	Mo: 2.9
DISSIMILAR STAINLESS STEELS								
TRI S 312-O	1.2 - 2.8	ISO 17633-A T 29 9 U NO 3 AWS A5.22 E312T0-3	0.10	1.3	0.8	29.0	9.5	Mo: 0.4
TRI S 307-O	1.2 - 2.4	ISO 17633-A T 18 8 Mn U NO 3 AWS A5.22 E307T0-3*	0.03	6.5	0.8	19.0	8.0	-
TRI S 309L-O	1.2 - 2.4	ISO 17633-A T 23 12 L U NO 3 AWS A5.22 E309LT0-3	0.03	1.7	0.8	24.5	13.0	-

Typical mechanical properties				Description and applications
Rp0.2% [Mpa]	Rm [Mpa]	A5 [%]	CVN [J]	
490	690	40	+20 °C: 60	Austenitic deposit of CrNi steel, type 308L. Service temperatures range from -196 °C to +400 °C. Welding of stainless steel base metals with similar compositions, type 301, 302, 303, 304L. When cladding, use 309L for the buffer layer. Suitable for applications in the food, pharmaceutical, nuclear and fabrication industries.
530	710	40	+20 °C: 60	Austenitic deposit of CrNi steel stabilised with Nb, type 347. Nb improves intergranular corrosion and mechanical properties at high temperatures. Service temperatures range from -196 °C to +400 °C. Welding of titanium or niobium stabilised stainless steel base metals with similar compositions, type 321 and 347 or 304L. When cladding, use 309LNb for the buffer layer. Suited to applications in the food, pharmaceutical, nuclear and fabrication industries.
500	700	35	+20 °C: 55	Austenitic deposit of CrNi steel with addition of Mo, type 316L. Molybdenum improves intergranular corrosion resistance in humid conditions. Service temperatures range from -196 °C to +400 °C. Welding of stainless steel base metals with similar compositions or stabilised with titanium and niobium. When cladding, use 309LMo for the buffer layer. Ideal for applications in the food, chemical, oil and gas, nuclear and fabrication industries.
670	800	22	+20 °C: 35	Austenitic-ferritic deposit of CrNi steel with a high percentage of Cr, type 312. Chromium ensures a high ferrite ratio for exceptional resistance to cracking. Good wear and friction resistance. Welding of dissimilar joints, high carbon equivalent or unknown steel base metals. Suited to maintenance applications, gear teeth, tool steels.
490	670	40	+20 °C: 80	Work hardening austenitic deposit of CrNi steel with addition of Mn, modified type 307. Service temperatures range from -120 °C to +400 °C. Joining of 14% Mn austenitic steel base metal and dissimilar joints for high temperatures. Repair jobs where high strength and toughness combined with work hardening are required. Suitable for rail applications and the defence industry. TRI V 19 9 6-O is the equivalent wire that can be used for out of position welding. *Classified EC307: Out of AWS standard regarding Mo < 0.5 and Mn > 4.75 to prevent from hot cracking.
560	680	35	+20 °C: 45	Austenitic deposit of highly alloyed CrNi steel, type 309L. Service temperatures range from -60 °C to +350 °C. Joining of steels with similar and dissimilar composition base metals. To be used as a buffer layer when cladding with 308L. Suited to applications in the food, chemical, pipe, nuclear and fabrication industries.

Stainless steels - GTAW

Product	Standard diameters [mm]	EN ISO ASME / AWS standards	Typical chemical composition (%)					
			C	Mn	Si	Cr	Ni	Other
AUSTENITIC STAINLESS STEELS								
WAROD 308L	2.2	AWS A5.22 R308LT1-5	0.03	0.9	0.6	19.5	10.0	-
WAROD 347	2.2	AWS A5.22 R347T1-5	0.04	1.4	0.7	19.0	10.5	Nb: 0.5
WAROD 316L	2.2	AWS A5.22 R316LT1-5	0.03	0.9	0.5	18.5	12.0	Mo: 2.8
DISSIMILAR STAINLESS STEELS								
WAROD 309L	2.2	AWS A5.22 R309LT-5	0.03	1.5	0.8	24.5	13.0	-

Typical mechanical properties				Description and applications
Rp0.2% [Mpa]	Rm [Mpa]	A5 [%]	CVN [J]	
460	620	45	-196 °C: 60 +20 °C: 140	Austenitic deposit of CrNi steel, type 308L. Service temperatures range from -196 °C to +400 °C. Welding of stainless steel base metals with similar compositions, type 301, 302, 303, 304L. Suitable for applications involving the root pass joining of stainless steel pipes where the use of backing gas is impossible.
460	620	45	+20 °C: 140	Austenitic deposit of CrNi steel stabilised with Nb, type 347. Nb improves intergranular corrosion and mechanical properties at high temperatures. Service temperatures range from -196 °C to +400 °C. Welding of titanium or niobium stabilised stainless steel base metals with similar compositions, type 321, 347 or 304L. Suited to applications in the food, pharmaceutical, nuclear and fabrication industries.
510	630	32	-196 °C: 50 +20 °C: 140	Austenitic deposit of CrNi steel with the addition of Mo, type 316L. Molybdenum improves intergranular corrosion resistance in humid conditions. Service temperatures range from -196 °C to +400 °C. Welding of stainless steel base metals with similar composition or stabilised with titanium and niobium. Ideal for applications in the food, chemical, oil and gas, nuclear and fabrication industries.
460	580	35	+20 °C: 70	Austenitic deposit of highly alloyed CrNi steel, type 309L. Service temperatures range from -60 °C to +350 °C. Joining of steels with similar and dissimilar composition base metals. Suited to applications in the food, chemical, pipe, nuclear and fabrication industries.

Fabrication of a fan using GAMMA 276.

Nickel based alloys

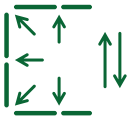
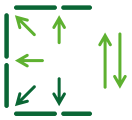
Nickel based alloys are widely used for joining, cladding, and repair operations due to their exceptional performance. They provide an ideal solution for corrosion resistance, high strength at both ambient and extreme temperatures, as well as ductility and toughness at low temperatures. Additionally, these alloys share a similar distortion tendency with carbon-manganese steels, due to their comparable thermal expansion characteristics.

In terms of operability, nickel based alloys offer two main advantages:

- Ease of use - these alloys require welding procedures similar to stainless steels, usually eliminating the need for preheating before welding. However, depending on the type of base metal and thickness, preheating, post-heating, and even PWHT (Post Weld Heat Treatment) may be necessary to prevent a brittle heat-affected zone, for example, during cladding operations on 1.25% Cr-0.5% Mo.
- Versatility - they can be used for both homogeneous and heterogeneous welding, with the ability to be diluted on different parent metals while maintaining high mechanical properties.
  Our GAMMA 182 wire is a particularly versatile solution as it can also be used for both gas shielded and self shielded arc welding.

To achieve a high deposition rate, a common practice is to weld with a high heat input (current and voltage), leading to a high puddle temperature and increased risk of hot cracking. However, when using flux cored wires with a basic slag (our GAMMA range), there are significant advantages compared to using those with a rutile slag (our GAMMA V range), thanks to deoxidising elements that drastically reduce this risk.

For out of position welding jobs, the use of our GAMMA V range of products is necessary, whereas when working in the flat position, our GAMMA range of products are the ideal choice.

Product	GAMMA	GAMMA V	CAST	CAST
Welding process	FCAW-G	FCAW-G	GMAW	FCAW-S
Wire type	Flux cored	Flux cored	Metal cored	Flux cored
Slag	Basic slag	Fast freezing rutile slag	No slag	Basic slag
Shielding gas	M21: Ar + 15 - 25% CO_2	M21: Ar + 15 - 25% CO_2	M21: Ar + 15 - 25% CO_2	No gas
Welding positions			 *	

*Out of position welding also possible using short circuit or pulsed arc modes of transfer

Nickel based alloys - FCAW-G

Product	Standard diameters [mm]	Slag	EN ISO ASME / AWS standards	Typical chemical composition (%)				
				C	Mn	Si	Cr	Ni
GAMMA 182	1.2 - 1.6	Basic slag	ISO 12153 T Ni 6182 B M21 3 AWS A5.34 ENiCrFe3T0-4	0.01	6.0	0.3	17.0	Bal.
GAMMA 4648	1.2 - 1.6	Basic slag	ISO 12153 T Ni 6083 B M21 3 AWS A5.34 ENiCr3T0-4*	0.02	5.5	0.2	20.0	Bal.
GAMMA V 4648	1.2 - 1.6	Fast freezing rutile slag	ISO 12153 T Ni 6083 P M21 1 AWS A5.34 ENiCr3T1-4*	0.02	5.5	0.2	20.0	Bal.
GAMMA 625	1.2 - 1.6	Basic slag	ISO 12153 T Ni 6625 B M21 3 AWS A5.34 ENiCrMo3T0-4	0.02	0.03	0.3	21.0	Bal.
GAMMA V 625	1.2 - 1.6	Fast freezing rutile slag	ISO 12153 T Ni 6625 P M21 1 AWS A5.34 ENiCrMo3T1-4	0.02	0.02	0.4	22.0	Bal.
GAMMA 276	1.2 - 1.6	Basic slag	ISO 12153 T Ni 6276 B M21 3 AWS A5.34 ENiCrMo4T0-4	0.02	0.4	0.2	16.0	Bal.
GAMMA V 276	1.2 - 1.6	Fast freezing rutile slag	ISO 12153 T Ni 6276 P M21 1 AWS A5.34 ENiCrMo4T1-4	0.02	0.6	0.1	16.0	Bal.
GAMMA 400	1.2 - 1.6	Basic slag	ISO 12153 T Z Ni 4060 B M21 3 AWS A5.34 ENiCu7T0-4*	0.05	3.5	0.4	-	Bal.
GAMMA 254	1.2 - 1.6	Basic slag	ISO 12153 T Z Ni 6012 B M21 3 AWS A5.34 *	0.03	0.1	0.25	21.0	Bal.
GAMMA V CRYO	1.2 - 1.6	Fast freezing rutile slag	ISO 12153 T Z Ni 6620 P M21 1 AWS A5.34 ENiCrMo6T1-4*	0.01	2.5	0.4	16.0	Bal.

	Typical mechanical properties				Description and applications
Other	Rp0.2% [Mpa]	Rm [Mpa]	A5 [%]	CVN [J]	
Nb: 1.7 Fe: 6.0	380	610	40	-196 °C: 90	Ni based alloy deposit, meets ENiCrFe-3 requirements. Service temperatures range from -196 °C to +900 °C. This wire is suitable for gas shielded and self shielded arc welding. Joining and cladding of corrosion and heat resistant type 600 nickel alloys. Similar or dissimilar joining between heat resistant, stainless or alloyed steels. Welding and repair of steels with limited weldability. For use on furnace equipment, petrochemical applications, power generation plants, pipe, cryogenic applications.
Mo: 1.3 Nb: 2.4 Fe: 2.4	400	650	30	-196 °C: 80	Ni based alloy deposit with reduced Fe and the addition of Cr, Mo and Nb to prevent from hot cracking. Service temperatures range from -269 °C to +1000 °C. Less sensitive to hot cracking than GAMMA 182. Joining and cladding of corrosion and heat resistant type 600 nickel alloys. Similar or dissimilar joining between heat resistant, stainless or alloyed steels. Welding and repair of steels with limited weldability. Ideal for furnace equipment, petrochemical applications, power generation plants, pipe, cryogenic applications. *Classified ENiCr3: Out of AWS standard regarding Mn > 3.5.
Mo: 1.3 Nb: 2.4 Fe: 2.4	400	650	40	-196 °C: 80	
Mo: 9.0 Nb: 3.4 Fe: 0.4	500	780	40	-196 °C: 70	Ni based alloy deposit, meets ENiCrMo-3 requirements, Cr-Mo-Nb composition for high strength, pitting, crevice and stress corrosion cracking resistance. Service temperatures range from -196 °C to +1000 °C. Joining and cladding of nickel based alloy base metals of similar types. Joining of steels exposed to low temperatures: CrNi (Mo, V) austenitic steels and 5% or 9% Ni steels. Dissimilar joints between nickel based alloys or stainless steels. Joining of super-austenitic stainless steels. Suited for furnace equipment, petrochemical applications, power generation plants, pipes, cryogenic applications.
Mo: 8.8 Nb: 3.4 Fe: < 1.0	500	760	40	-196 °C: 70	
Mo: 16.0 Fe: 5.0 W: 4.0	500	740	30	-196 °C: 60	Ni based alloy deposit, meets ENiCrMo-4 requirements, Cr-Mo-W-Fe composition with low C and Si to minimise carbide and intermetallic phase precipitates. Excellent resistance to pitting, crevice and stress corrosion cracking resistance, superior to alloy 625. Joining and cladding of nickel based alloy base metals of similar types. Dissimilar joints between nickel based alloys or stainless steels, 5% or 9% Ni steels. Suitable for applications in chemical process plants, flues, oil and gas plants.
Mo: 16.0 Fe: 5.0 W: 4.0	500	740	30	-196 °C: 60	
Cu: 30.0 Ti: 2.0 Fe: 1.0 Al: 0.07	330	520	35	+20 °C: 75	N04400 type alloy deposit (65% Ni - 30% Cu). Deoxidation system (Mn + Ti) designed to eliminate porosity and hot cracking. A full NiCu-7 composition is achieved in two layers. Joining and cladding of nickel copper alloy base metals of similar composition and dissimilar welding between alloy 400 and other alloy steels. For applications in marine, chemical, petrochemical, power industries. Classified Z: Out of ISO standard regarding Ti > 1.0 to prevent porosity. *Classified NiCu7: Not referenced as flux cored wire in AWS standard - Innovative product.
Mo: 9.5 Nb: 1.5 Fe: 2.0	450	670	35	-196 °C: 75	Ni based alloy deposit, meets AWS A.11 ENiCrMo-12 requirements for SMAW, more Mo and less Nb compared to 625. Similar alloying elements to 254SMo®, but with a nickel base for improved crack resistance. Joining of Cr-Ni-Mo super austenitic steel base metals to themselves, such as 254SMo®, or in dissimilar configuration with duplex stainless steels or Ni-Cr-Mo alloys. *Not referenced as flux cored wire in AWS standard.
Mo: 6.0 Nb: 2.0 Fe: 2.0 W: 1.5	470	720	40	-196 °C: 100	Ni based alloy deposit, meets AWS A.11 ENiCrMo-6 requirements for SMAW. Specially designed for welding 9% Ni steel base metals, and also used for joining low alloyed steels for cryogenic applications. Classified Z: Ni6620 is not referenced in ISO standard. *Classified NiCrMo6: Not referenced as flux cored wire in AWS standard.

Welding of cast irons - GMAW

Product	Standard diameters [mm]	Slag	EN ISO ASME / AWS standards	Typical chemical composition (%)				
				C	Mn	Si	Cr	Ni
CAST NICI-G	1.2 - 2.4	No slag	ISO 1071 T C NiFeT3-CI M21 AWS A5.15 ENiFeT3-CI*	0.6	4.0	0.6	-	45
CAST NIFE-G	1.2 - 2.4	No slag	ISO 1071 T C NiFeT3-CI M21 AWS A5.15 ENiFeT3-CI*	0.5	2.5	0.5	-	60

Welding of cast irons - FCAW-S

Product	Standard diameters [mm]	Slag	EN ISO ASME / AWS standards	Typical chemical composition (%)				
				C	Mn	Si	Cr	Ni
CAST NICI-O	1.2 - 2.4	Basic slag	ISO 1071 T C NiFeT3-CI NO AWS A5.15 ENiFeT3-CI	1.4	4.5	0.7	-	47

	Typical mechanical properties				Description and applications
Other	Rp0.2% [Mpa]	Rm [Mpa]	A5 [%]	Hardness [HB]	
Fe: Bal.	340	550	16	160 - 200	NiFe deposit for rebuilding ductile or spheroidal cast iron and joining cast irons to each other. Dissimilar joints between cast iron and steel. Welding of base metal GG10 to GG40, GTS35 to GTS70, GTW35 to GTW70, GGG40 to GGG80. *Classified ENiFeT3-CI: Out of AWS standard regarding gas shielding requirement.
Fe: Bal.	350	470	15	180 - 200	NiFe deposit for joining of thick ductile and spheroidal cast iron and for restrained joints. Easily machinable deposit Welding of GG10 to GG40, GTS35 to GTS70, GTW35 to GTW70, GGG40 to GGG80. *Classified ENiFeT3-CI: Out of AWS standard regarding gas shielding requirement.

	Typical mechanical properties				Description and applications
Other	Rp0.2% [Mpa]	Rm [Mpa]	A5 [%]	Hardness [HB]	
Fe: Bal.	400	560	15	140 - 160	NiFe deposit for rebuilding ductile or spheroidal cast iron and joining cast irons to each other. Dissimilar joints between cast iron and steel. Welding of base metal GG10 to GG40, GTS35 to GTS70, GTW35 to GTW70, GGG40 to GGG80.

Packaging

Welding Alloys cored wires are available in various packaging types, to suit your specific welding needs.

The table below presents our standard packaging options. For any alternative packaging requirements, please contact your local Welding Alloys subsidiary.

Type*	Weight	EN ISO 544 standard
Metal Basket Spool	25 kg 15 kg 5 kg	B 450 BS 300
Plastic Spool	15 kg 5 kg	S 300 S 200
Drum	Up to 330 kg	

**Packaging options may vary by region, consult your local Welding Alloys subsidiary.*

Our
global footprint

Our specialists and industry experts are active in 150 countries across the world and have an in-depth understanding of the operating conditions and customer requirements across a wide range of sectors.

Find your nearest subsidiary

Notes

Welding Alloys

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