



Welding  
Alloys  
Group



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# WA Electrodes

## Hardfacing - Joining



This catalogue presents a selection of standard covered electrodes for hardfacing and joining applications. We will gladly examine any special request. Please do not hesitate to consult with us.

# Cored welding wires and covered electrodes - The Global Solution



Since its foundation in 1966, the Welding Alloys Group, an independent group, has specialised in the manufacture of cored welding wires for surfacing applications – **100% produced in our modern factories – 100% our own technology.**

This catalogue presents the Manual Welding Electrode program completing the Welding Alloys Flux Cored Wire range, offering a global product range of welding consumables to suit customers' changing needs. Our wide range of non-alloyed, low-alloyed and high-alloyed coated electrodes meets or exceeds the most stringent standards for hardfacing, cladding and joining applications.

Our policy of continuous R&D along with industrial development, enables us to offer the quality guarantees required by international codes of practice, which exist in the nuclear, petrochemical, offshore, LNG and transport industries.

As a global company, our engineers and technicians are available locally. Technical support and service are provided where needed, from international WA welding specialists.

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# Hardfacing - Electrodes



Product name	Composition [%] - Fe balance						Hardness - 3 layers	
	C	Mn	Si	Cr	Mo	Co	As welded	Work hardened
HARDFACE AP-E	0.60	16.0	0.30	14.0			260 HB	48 HRC
HARDFACE 250	0.25	1.00	0.50	1.00			250 HB	
HARDFACE 400	0.30	1.00	0.50	1.50			400 HB	39-42 HRC
HARDFACE L-E	0.50	0.60	2.00	9.50			58 HRC	
HARDFACE 40-E	0.15	0.70	0.50	6.50	3.50		38-42 HRC	
HARDFACE 48-E	0.30	0.60	0.50	5.20	4.00		45-50 HRC	
HARDFACE 58-E	0.40	1.20	0.50	7.00	2.50		53-58 HRC	
HARDFACE DCO-E	0.15	0.60	0.60	14.0	2.30	13.0	47 HRC	55 HRC
HARDFACE AR-E	0.80	0.50	0.50	5.00	10.0		60-63 HRC	

Product name	Standard diameters and length [mm]	Standards EN 14700	Polarity	Metal/metal friction	Mineral abrasion	Abrasion under pressure	Hot abrasion	Erosion	Cavitation	Impact	Mechanical fatigue	Thermal fatigue	Hot oxidation	Corrosion	Rebuilding or cladding	Buffer-layer or assembly	Cutting ability	Work-hardening	Machinability	Description and applications
<b>Work-hardening Manganese Alloys</b>																				
HARDFACE AP-E	2.5 x 350 3.2 x 350 4.0 x 450	E Fe9	= + ~ 65V	••					•	••						••		••	•	<ul style="list-style-type: none"> <li>High recovery (140%), basic electrode</li> <li><b>High rate of work-hardening</b> – Non magnetic deposit strongly resistant to impact and high pressures</li> <li>Rebuilding, buffer layers and assembly of manganese steels. Buffer layer before hardfacing with chromium cast irons</li> <li>Applications: repair work on railway frogs and crossings. Hammers, bars, cones and jaws for crushers</li> <li>Complements Welding Alloys cored wire HARDFACE AP</li> </ul>
<b>Low and Medium Alloyed</b>																				
HARDFACE 250	2.5 x 350 3.2 x 450 4.0 x 450	E Fe1	= - ~ 45V	•							••								••	<ul style="list-style-type: none"> <li>Rutile coated electrode for surfacing of equipment parts, constructions and tools, resistant to medium friction and compression</li> <li>Good resistance to cavitation, highly resistant to shocks.</li> <li>Sound, crack free deposit, machinable with standard tools.</li> <li>General applications: Surfacing of rails and switches, roller guides, slideways, build up before hardfacing.</li> </ul>
HARDFACE 400	2.5 x 350 3.2 x 450 4.0 x 450	E Fe1	= - ~ 45V	•							••								••	<ul style="list-style-type: none"> <li>Rutile coated electrode for surfacing of machine and construction parts, as well as of tools made of lowalloyed and cast steels which are mainly stressed by pressure and shock. Electrodes are easy to weld even on small welding equipment with low open arc voltage.</li> <li>Soft flow, almost no spatters, self releasing slag, nice aspect of the weld beads.</li> <li>Sound, crack free deposit, machinable with carbide cutting tools.</li> <li>General applications: Surfacing of rollers, gear teeth, stamps, hammers, guide rails etc.</li> </ul>
HARDFACE L-E	2.5 x 350 3.2 x 350 4.0 x 450	T Fe8	= + ~ 70V	•	•					•							•			<ul style="list-style-type: none"> <li>Basic electrode with 120% recovery</li> <li><b>Quenching deposit for hardfacing</b></li> <li>Wide field of application in the mining and civil engineering industries : bucket teeth and blades, slides, conveyor screws, etc</li> <li>Complements Welding Alloys cored wire HARDFACE L</li> </ul>
<b>Steels for tooling</b>																				
HARDFACE 40-E	2.5 x 300 3.2 x 350 4.0 x 450	E Fe3	= + ~ 70V	•							•	•	•		••		••		•	<ul style="list-style-type: none"> <li>The weld deposit distinguishes itself by its toughness and heat resistance: the electrode is used for overlay and build up of machinery parts and tools subject to impact, compression and wear used at operating temperatures up to 550° C.</li> <li>It is widely used for building up dies, rollers, hot shear blades, etc. ...</li> </ul>
HARDFACE 48-E	2.5 x 300 3.2 x 350 4.0 x 450	~ E Fe3	= + ~ 70V	•							•	•	•		••		••		•	<ul style="list-style-type: none"> <li>The weld deposit distinguishes itself by its toughness and heat resistance: the electrode is used for overlay and build up of machinery parts and tools subject to impact, compression and wear used at operating temperatures up to 550° C.</li> <li>It is widely used for building up hammers, dies, swages, hot shear blades, rollers, etc ...</li> </ul>
HARDFACE 58-E	2.5 x 300 3.2 x 350 4.0 x 450	E Fe3	= + ~ 70V	•						•	•	•	•		••		••		•	<ul style="list-style-type: none"> <li>The weld deposit distinguishes itself by its high hardness, toughness and heat resistance: the electrode is used for overlay and build up of machinery parts and tools subject to impact, compression and wear used at operating temperatures up to 550° C.</li> <li>It is widely used for building up hammers, dies, swages, hot shear blades, rollers, extrusion press pistons, valves, etc ...</li> </ul>
HARDFACE DCO-E	2.5 x 300 3.2 x 350 4.0 x 450	E ZFe3	= + ~ 60V	••			•	•	•			••	••	•			••	•	•	<ul style="list-style-type: none"> <li>Rutile-basic electrode</li> <li><b>Superalloy offering similar performance to cobalt based alloys</b></li> <li>High cracking resistance little affected by dilution, highly resistant to thermal shock, may be polished and keeps its properties to 550° C</li> <li>Applications: traction rollers in continuous casting installations, valves for diesel engines, steam valves, deburring stamps and dies, moulds for ceramic tiles, screws for filled plastic</li> <li>Complements Welding Alloys cored wire HARDFACE DCO</li> </ul>
HARDFACE AR-E	2.5 x 300 3.2 x 350 4.0 x 450	E Fe4	= + ~ 50V	••			•			••		••					••			<ul style="list-style-type: none"> <li>Rutile-basic coated electrode destined to surface all kinds of cutting tools such as lathe and plane tools.</li> <li>The sharpness obtained has an exceptional quality. C-Cr-Mo-W martensitic deposit, resistant up to 500° C.</li> <li>Also used for surfacing of pieces subject to metal/metal wear: withstands moderate shock.</li> <li>In the as welded condition only machinable by grinding.</li> <li>For machining by tools, carry out a soft annealing heat treatment at 850° C during 2 hours followed by slow cooling (approx. 3° C/min) in an oven. To re-obtain the hardness, temper the deposit: 1200° C/ 1h , cooling in oil or with compressed air and annealing 2x500° C.</li> <li>Special applications: Hardfacing of machining tools, cutting tools made of steel, punches, drills, shear blades.</li> </ul>

• Suitable •• Highly suitable



# Hardfacing - Electrodes



Product Name	Composition [%]							Hardness			
	C	Mn	Si	Cr	W	Fe	Others	As welded - 3 layers	Work hardened	Hardfacing [micro-hardness HV]	
HARDFACE HC-E	5.00	0.50	1.00	35.0		Balance		61 HRC		950 - 1450	
HARDFACE CN-E	5.00		1.50	24.0		Balance	Nb: 7.00	64 HRC		950 - 2000	
HARDFACE CNV-E	5.00		1.50	22.0	2.00	Balance	Mo: 7.00 Nb: 7.00 V: 1.00	65 HRC		950 - 2900	
HARDFACE STEELCABW-E	Deposit containing tungsten carbide particles in a steel matrix						WC/W2C: 65		60 HRC matrix		950 - 2000
STELLOY 25-E	0.10	1.00	0.80	20.0	15.0	2.00	Ni: 10.00 Co: Balance	220 HB			
STELLOY 21-E	0.30	0.50	0.80	28.0		2.00	Mo: 5.00 Ni: 2.50 Co: Balance	35 HRC			
STELLOY 6-E	1.10		1.00	28.0	4.50	3.00	Co: Balance	44 HRC			

Product name	Standard diameters and length [mm]	Standards EN 14700 AWS	Polarity	Metal/metal friction	Mineral abrasion	Abrasion / impact pressure	Hot abrasion	Erosion	Cavitation	Impact	Mechanical fatigue	Thermal fatigue	Hot oxidation	Corrosion	Rebuilding or cladding	Buffer-layer or assembly	Cutting ability	Work-hardening	Machinability	Description and applications
<b>Anti-abrasion</b>																				
HARDFACE HC-E	3.2 x 350 4.0 x 350 5.0 x 450	E Fe15 -	= + ~ 50V		••	••		•		•										<ul style="list-style-type: none"> <li>Very high recovery basic electrode (190%)</li> <li><b>Highly abrasion resistant chromium carbide deposit</b></li> <li>Combination of primary and eutectic chromium carbides in a tough matrix.</li> <li>Final weld pass when joining Integra™ and Hardlite™ wear plates</li> <li>Applications: components for crushing and mineral conveying equipment, dredger pumps, mixers and riddle plates</li> <li>Complements Welding Alloys cored wire HARDFACE HC-O</li> </ul>
HARDFACE CN-E	3.2 x 350 4.0 x 450 5.0 x 450	E Fe15 -	= + ~ 50V		••	••	•	•		•										<ul style="list-style-type: none"> <li>Very high recovery basic electrode (190%) with very pleasing arc characteristics and a slag-free deposit</li> <li>High concentration of niobium and chromium carbides</li> <li><b>Very good wear resistance to fine abrasive particles of high hardness</b></li> <li>Applications: vertical crushers, armouring of conveyors for coal, clinker and glass</li> <li>Complements Welding Alloys cored wire HARDFACE CN-O</li> </ul>
HARDFACE CNV-E	3.2 x 350 4.0 x 450 5.0 x 450	E Fe16 -	= + ~ 50V		••	••	••	••		•										<ul style="list-style-type: none"> <li>Very high recovery rutile electrode (200%)</li> <li><b>Highly-alloyed chromium cast iron with a high concentration of complex carbides</b></li> <li>Excellent weldability, very soft spatter-free fusion, no slag</li> <li>Resists combined abrasion and impacts at high temperatures. The properties are reached in only three layers</li> <li>Applications: riddling, blast furnace hoppers, extractor fans</li> <li>Complements Welding Alloys cored wire HARDFACE CNV-O</li> </ul>
HARDFACE STEELCABW-E	4.0 x 350 5.0 x 350	- -	= + ~ 45V		••			•												<ul style="list-style-type: none"> <li>Tubular electrode filled with carbide particles</li> <li><b>Extreme resistance to abrasives, especially fine-grained</b></li> <li>Applications: dust extractor fans in the mining, cement and steel industries, scraper blades, components for agriculture, etc.</li> <li>Complements Welding Alloys cored wire HARDFACE STEELCABW-O</li> </ul>
<b>Cobalt base</b>																				
STELLOY 25-E	3.2 x 350 4.0 x 350	E Z Co 1 -	= + ~ 70V	•					•	••	••	••	••	••	••	•		•	••	<ul style="list-style-type: none"> <li>Rutile basic coated electrode</li> <li>Highly resistant to high temperature wear and metal-to-metal abrasion</li> <li><b>Particular ease of application due to its low cracking tendency</b></li> <li>Maintains a good level of hardness at high temperatures. Work-hardenable.</li> <li>Applications: straightening guides, vertical mill rolls and foot rolls in continuous casting</li> <li>Complements Welding Alloys cored wire STELLOY 25-G</li> </ul>
STELLOY 21-E	2.5 x 300 3.2 x 350 4.0 x 350	E Co1 E CoCr-E	= + ~ 70V	••					••	••	•	••	••	••	••		••	•	••	<ul style="list-style-type: none"> <li>Rutile basic coated electrode</li> <li><b>Ideal choice for resisting multiple combinations of stresses</b></li> <li>Resists corrosion and cavitation</li> <li>Maintains a good level of hardness at high temperatures</li> <li>Work-hardenable, can be polished, low coefficient of friction</li> <li>Applications: industrial valve work, forging dies and hot shearing blades</li> <li>Complements Welding Alloys cored wire STELLOY 21-G</li> </ul>
STELLOY 6-E	2.5 x 300 3.2 x 350 4.0 x 350 5.0 x 350	E Co2 E CoCr-A	= + ~ 70V	•			•	•					••	••	••		••		•	<ul style="list-style-type: none"> <li>Rutile basic coated electrode</li> <li><b>Combines all the outstanding properties of the cobalt base alloys, including abrasion and erosion resistance</b></li> <li>Deposit of intermediate hardness with good machinability</li> <li>Wide field of applications: hot shearing tools, petrochemical and industrial valves, valves and valve seats of marine engines, pump sleeves and shafts</li> <li>Complements Welding Alloys cored wire STELLOY 6-G</li> </ul>

• Suitable •• Highly suitable



# Electrodes for joining



Product name	Composition [%] - Fe balance					
	C	Mn	Si	Cr	Ni	Mo
SPEEDARC 6013-E	< 0.10	0.45	0.40			
SPEEDARC 7018-1-E	< 0.10	1.10	0.40			
SPEEDARC 7016-E	< 0.10	0.90	0.70			
SPEEDARC Ni1-E	< 0.12	1.10	0.50		1.00	
SPEEDARC HLE 550-E	< 0.10	1.10	0.50	0.10	0.80	0.30
SPEEDARC HLE 620-E	< 0.10	1.40	0.50	0.30	1.50	0.30
SPEEDARC HLE 700-E	< 0.10	1.50	0.40	0.40	2.10	0.50

Product name	Standard diameters and length [mm]	Standards AWS EN ISO	Polarity	Mechanical properties				Description and applications	Base material
				Rm [MPa]	Rp 0.2% [MPa]	A5 [%]	KCV [J]		
<b>Constructional steels</b>									
SPEEDARC 6013-E	2.5 x 350 3.2 x 350 3.2 x 450 4.0 x 450 5.0 x 450	AWS A5.1: E6013 E 42 0 RC 11	= + ~ 40V	510 - 580	> 420	> 22	+20°C: > 65	<ul style="list-style-type: none"> <li>Universal Rutile Coated Electrode for all-position welding of common carbon-steel</li> </ul>	S185-S355, P 235-P355, ASTM A 285 grade C, A442 grade 55,60.
SPEEDARC 7018-1-E	2.5 x 350 3.2 x 350 3.2 x 450 4.0 x 450 5.0 x 450	AWS A5.1: E 7018-1 E 42 4 B 32 H 5	= + ~ 70V	510 - 610	> 420	> 22	+20°C: > 120 -20°C: > 70 -50°C: > 40	<ul style="list-style-type: none"> <li>Electrode with a thick basic coating for all position welding with high level mechanical properties</li> <li><b>Welding of high carbon, sulphur and phosphore content steels subjected to high static or dynamic stresses with guaranteed high toughness even at low temperatures</b></li> <li>Excellent usability in all positions, stable arc, soft fusion, very high quality deposit which resists cracking and aging</li> <li>Baking before use: 2 hours at 300/350°C</li> </ul>	S235JR to S355GR, P235GH, P265GH, S275S355N, P295GH, P275NH-P355NH, P275NL1-P355NL1, X42 to X70 (API-5L)
SPEEDARC 7016-E	2.5 x 350 3.2 x 350 3.2 x 450 4.0 x 450 5.0 x 450	AWS A5.1: E 7016 E 38 2 B 12 H 10	= + ~ 70V	> 520	> 400	> 27	+20°C: > 100 -20°C: > 60 -30°C: > 50	<ul style="list-style-type: none"> <li><b>Basic electrode with exceptional weldability thanks to its double coating</b></li> <li>Particularly stable arc in all positions, recommended for root passes on poorly-fitting joints</li> <li>Very good deposit appearance, with concave fillet free of undercut</li> </ul>	S235J2G3 to S355K2G3, P235GH to P355GH, S420NL, P275NH to P460NH, P275NL1 to 460NL1, L210 to L290, L360MB to L415, X42 (API-5L)
<b>Low temperature steels</b>									
SPEEDARC Ni1-E	2.5 x 350 3.2 x 350 4.0 x 450 5.0 x 450	AWS A5.5: E 8018-C3 E 46 5 1 Ni B 42	= + ~ 70V	> 550	> 470	> 24	-40°C: > 70	<ul style="list-style-type: none"> <li>Basic coated electrode giving a 1% Ni type steel deposit for service temperatures from -60°C to +400°C</li> <li><b>High resistance to initiation and propagation of cracks on account of its particularly low diffusible hydrogen content (&lt; 5 ml/ 100g)</b></li> <li>Excellent low temperature toughness down to -60°C, both as welded and stress relieved, pleasing arc characteristics, good bead appearance</li> <li>Baking before use: 2 hours at 300/350°C</li> <li>Complements Welding Alloys cored wires ROBOFIL M Ni1 and ROBOFIL B Ni1, R Ni1</li> </ul>	L450NB, L245MB-L450MB, P355NL1-P460NL1, P355NL2- P460NL2, S460N, P355NH-P460NH, S380NL-S460NL, S380NL1-S460NL1. ASTM: A516 Gr 65, A572 Gr 55, 60, 65, A633 Gr E, A618 Gr I, A537 Gr 1-3
<b>High strength steels</b>									
SPEEDARC HLE 550-E	2.5 x 350 3.2 x 350 4.0 x 450 5.0 x 450	AWS A5.5: E 9018-G E 55 5 1 Ni Mo B 42	= + ~ 70V	> 620	530	> 20	+20°C: > 150 -50°C: > 50 -60°C: > 28	<ul style="list-style-type: none"> <li><b>Basic coated electrode for welding fine grained low alloy steels with higher strength steels</b></li> <li>Combines excellent low temperature toughness down to -50°C with very high radiographic quality and hot strength up to +450°C.</li> <li>Baking before use: 2 hours at 300/350° C.</li> <li>Complements Welding Alloys cored wires ROBOFIL M Ni Mo, B Ni Mo, R Ni Mo</li> </ul>	P 355 NL1-P 460 NL1- P 355 NL 2- P 460 NL 2- S380N- S500N, S500NL, S380NL1-S500NL1- 20 MnMoNi5-5-17MnMoV6-4-15NiCrMo10-6, N-AXTRA55-N-AXTRA60, X65, X70
SPEEDARC HLE 620-E	2.5 x 350 3.2 x 350 4.0 x 450 5.0 x 450	AWS A5.5: E 10018-G E 62 5 1.5 Ni Mo B 42	= + ~ 70V	720 - 820	> 620	> 22	+20°C: > 130 -20°C: > 90 -50°C: > 50	<ul style="list-style-type: none"> <li><b>Basic coated electrode giving a 1.5% NiMo type steel deposit for service temperatures from -50°C to +400°C</b></li> <li>Welding of fine grained high strength steels up to 650 MPa.</li> <li>Excellent low temperature toughness down to -50°C both as welded and stress relieved</li> <li>Preheat according to the type and thickness of the steel to be welded and to the degree of joint restraint</li> <li>Baking before use: 2 hours at 300/350°C</li> <li>Complements Welding Alloys cored wire ROBOFIL M Ni Mo, B Ni Mo, R Ni Mo</li> </ul>	S355N, S500NL, S500NL1, P460NL1, P460NL2, S500 QL, 15Mn Ni3, API 5L X60, X65, X70
SPEEDARC HLE 700-E	2.5 x 350 3.2 x 350 4.0 x 450 5.0 x 450	AWS A5.5: E 11018-M E 69 4 Mn 2Ni Cr Mo B 42	= + ~ 70V	> 760	> 690	> 20	+20°C: > 120 -40°C: > 60	<ul style="list-style-type: none"> <li><b>Basic coated electrode giving a 2% Mn 2% Ni Cr Mo type steel deposit for service temperatures from -40°C to +450°C</b></li> <li>Welding of fine grained very high strength steels up to 700 MPa and in root pass up to 900 MPa</li> <li>Welding of wear plates, buffer layers before hardfacing on type 55 NCDV 7 tool steels for cold working</li> <li>Excellent low temperature toughness down to -40°C both as welded and stress relieved</li> <li>Baking before use: 2 hours at 300/350°C</li> <li>Complements Welding Alloys cored wires ROBOFIL B 700 and ROBOFIL M 700</li> </ul>	S620QL,S690QL1, N'AXTRA56-63-70, ASTM: A225 Gr C, A514 and 517 Gr A, B, C, E, F, H, J, K, M, P, A656, A678 Gr C (K4)



# Electrodes for joining



Product name	Composition [%] - Fe balance						
	C	Mn	Si	Cr	Ni	Mo	Cu
TETRA 308L-E	< 0.03	0.70	0.80	19.0	9.50		
TETRA 316L-E	< 0.03	0.70	0.80	18.5	12.0	2.70	
TETRA 904L-E	< 0.03	1.40	0.80	20.5	25.0	4.50	1.50
TETRA 307-E	0.10	4.50	1.20	18.0	8.00		
TETRA 309L-E	< 0.03	0.70	0.80	22.5	12.5		
TETRA 309LMo-E	< 0.03	0.70	0.80	22.5	12.5	2.30	
TETRA 312-E	0.10	0.60	1.00	29.0	9.50	0.50	

Product name	Standard diameters and length [mm]	Standards ASME EN ISO	Polarity	Mechanical properties				Description and applications	Base material
				Rm [MPa]	Rp 0.2% [MPa]	A5 [%]	KCV [J]		
<b>Austenitic steels</b>									
TETRA 308L-E	2.5 x 300 3.2 x 350 4.0 x 350 5.0 x 450	AWS A5.4: E 308L-16 EN 1600: E 19 9L R 3 2	= + ~ 70V	> 540	> 360	> 35	+20°C: > 70	<ul style="list-style-type: none"> <li>Rutile basic coated electrode</li> <li>Austenitic deposit in CrNi steel - type 308L</li> <li><b>Joining of low carbon steels and/or stabilised steels with similar compositions, resistant to corrosion</b></li> <li>Service temperatures from -196°C to +350°C</li> <li>Complements Welding Alloys cored wires TETRA S 308L and TETRA V 308L</li> </ul>	(1.4306) X2CrNi19-11, (1.4301) X5CrNi18.10, (1.4311) X2 CrNi18-10, (1.4312) GX10CrNi18-8. AISI 304-304L-304LN-302-321-347, ASTM : A157 Gr C9, A320 Gr B8C or D
TETRA 316L-E	2.0 x 300 2.5 x 300 3.2 x 350 4.0 x 450	AWS A5.4: E 316L-17 EN 1600: E 19 12 3 L R 3 2	= + ~ 70V	> 560	> 400	> 35	+20°C: > 70 -120°C: > 40	<ul style="list-style-type: none"> <li>Rutile basic coated electrode</li> <li>Austenitic deposit in CrNiMo steel – type 316L – resistant to intercrystalline corrosion under humid conditions up to 400°C</li> <li><b>Joining of low-carbon or stabilised steels with similar compositions</b></li> <li>Cladding of coated plates of the same or similar compositions</li> <li>Service temperatures from -110°C to +400°C</li> <li>Complements Welding Alloys cored wires TETRA S 316L and TETRA V 316L</li> </ul>	(1.4401) X5CrNiMo17-12-2, (1.4404) X2CrNiMo17-12-2, (1.4435) X2CrNiMo18-14-3, (1.4436) X3CrNiMo17-13-3, (1.4571) X6CrNiMoTi17-12-2, (1.4580) X6CrNiMoNb17-12-2, (1.4583) X10CrNiMoNb18-12, (1.4409) GX2CrNiMo19-11-2 UNS S 31603, 31600, 31653, AISI316L, 316Ti, 316Cb
TETRA 904L-E	2.5 x 300 3.2 x 350 4.0 x 350	AWS A5.4: E 385-16 EN 1600: E 20 25 5 Cu N L R 1 2	= + ~ 70V	> 570	> 370	> 35	+20°C: > 70	<ul style="list-style-type: none"> <li>Rutile basic coated electrode</li> <li>Fully austenitic deposit in CrNiMoCu steel – type 385</li> <li>Specially developed for the phosphate industry</li> <li><b>Welding of matching steel 1.4539 (UB6), 904L</b></li> <li>Service temperatures from -110°C to +350°C</li> <li>Complements Welding Alloys cored wires TETRA S 904L and TETRA V 904L</li> </ul>	(1.4539) X1NiCrMoCu 25-20-5, (1.4537) X1 CrNiMoCuN 25-25-5, (1.4505) X4NiCrMoCuNb 20-18-2 UNS N08904, S31726
<b>Dissimilar assemblies and repairs</b>									
TETRA 307-E	2.5 x 300 3.2 x 350 4.0 x 350 5.0 x 350	AWS A5.4: ~ E 307-16 E 18 8 Mn R 3 2	= + ~ 70V	> 600	> 400	> 30	+20°C: > 70	<ul style="list-style-type: none"> <li>Rutile coated electrode</li> <li><b>Work-hardening austenitic deposit in CrNiMn steel – modified type 307</b></li> <li>Dissimilar joints, welding of steels of unknown types, armouring steels, buffering</li> <li>Joining of 14% Mn austenitic steels</li> <li>Service temperatures from -120°C to +300°C</li> <li>Complements Welding Alloys cored wires TETRA S 307 and TETRA V 307</li> </ul>	
TETRA 309L-E	2.5 x 300 3.2 x 350 4.0 x 350 5.0 x 450	AWS A5.4: E 309L-16 E 23 12 L R 3 2	= + ~ 70V	> 560	> 400	> 35	+20°C: > 60	<ul style="list-style-type: none"> <li>Rutile basic coated electrode</li> <li><b>Austeno-ferritic deposit in over-alloyed CrNi steel - type 309L, with optimised ferrite content for joining dissimilar metals</b></li> <li>Joining of steels with similar compositions and joining carbon steels to stainless steels</li> <li>Buffering before cladding</li> <li>Service temperatures from -60°C to +350°C</li> <li>Complements Welding Alloys cored wire TETRA S 309L and TETRA V 309L</li> </ul>	
TETRA 309LMo-E	2.5 x 300 3.2 x 350 4.0 x 350 5.0 x 450	AWS A5.4: E 309 Mo L-17 E 23 12 2 L R 3 2	= + ~ 70V	> 650	> 450	> 25	+20°C: > 55 -40°C: > 45	<ul style="list-style-type: none"> <li>Rutile basic coated electrode</li> <li><b>Austeno-ferritic deposit in over-alloyed CrNiMo steel - type 309LMo, for joining dissimilar metals</b></li> <li>Joining of stainless steels to mild or low-alloyed steels at high dilution levels</li> <li>Buffering before cladding</li> <li>Service temperatures from -60°C to +350°C</li> <li>Complements Welding Alloys cored wire TETRA S 309LMo and TETRA V 309LMo</li> </ul>	
TETRA 312-E	2.5 x 300 3.2 x 350 4.0 x 350 5.0 x 450	AWS A5.4: ~ E 312-16 E 29 9 R 3 2	= + ~ 50V	700 - 820	> 500	> 20	-	<ul style="list-style-type: none"> <li>Rutile basic coated electrode</li> <li><b>Austeno-ferritic deposit in CrNi steel - type 312, offering exceptional cracking resistance</b></li> <li>Joining of unknown or hard-to-weld steels</li> <li>Dissimilar joints, including those to steels with high carbon equivalents: high speed steels, tool steels, Mn steels, high strength constructional steels, wear plates</li> <li>Complements Welding Alloys cored wires TETRA S 312 and TETRA V 312</li> </ul>	



Product name	Composition [%]								
	C	Mn	Si	Cr	Ni	Mo	Fe	Nb	Others
GAMMA 182-E	< 0.04	6.00	0.40	16.5	Balance	0.20	6.00	2.00	
GAMMA 625-E	< 0.04	0.60	0.40	22.0	Balance	9.00	3.00	3.40	
GAMMA 276-E	< 0.02	0.60	0.20	16.5	Balance	16.0	5.00		W: 4.00
FONTE NI-E	0.60	0.20	0.50		Balance		6.00		Cu: 0.60
FONTE BI-NIFE-E	1.30	0.30	0.80		55.0		Balance		

Product name	Standard diameters and length [mm]	Standards AWS EN ISO	Polarity	Mechanical properties				Description and applications	Base material
				Rm [MPa]	Rp 0.2% [MPa]	A5 [%]	KCV [J]		
<b>Nickel base</b>									
GAMMA 182-E	2.5 x 300 3.2 x 350 4.0 x 350	AWS A5.11: E NiCr Fe-3 EN 14172: E-Ni 6182	= +	> 620	> 380	> 35	+20°C: > 80 -196°C: > 65	<ul style="list-style-type: none"> <li>Basic coated electrode giving a NiCrFe alloy deposit</li> <li>Joining and cladding of corrosion and heat resisting type 600 nickel alloys</li> <li>Dissimilar joints between stainless steels and CrMo steels</li> <li>Joining of heat resisting steels</li> <li>Joining and repair of steels with limited weldability</li> <li>Service temperatures from -196°C to +900°C</li> <li>Complements Welding Alloys cored wire GAMMA 182</li> </ul>	(1.4816) NiCr 15Fe, 600 alloys, 600L, 800H
GAMMA 625-E	2.5 x 300 3.2 x 350 4.0 x 350	AWS A5.11: E NiCr Mo-3 EN 14172: E-Ni 6625	= +	> 760	> 450	> 30	+20°C: > 70	<ul style="list-style-type: none"> <li>Basic coated electrode giving a 625 type alloy deposit</li> <li>Joining and cladding of Ni base alloys of corresponding types</li> <li>Joining of steels exposed to low temperatures : CrNi (Mo,N) austenitic steels and 5-9% Ni steels</li> <li>Dissimilar joints between Ni base alloys or to low alloy or stainless steels</li> <li>Joining of super-austenitic stainless steels</li> <li>Service temperatures from -196°C to +1100°C</li> <li>Complements Welding Alloys cored wire GAMMA 625 and Gamma V625</li> </ul>	(2.4856) NiCr22Mo9Nb, (2.4858) NiCr21Mo, (1.4876) X10 NiCrAlTi 32-20H, (1.4876) X10 NiCrAlTi 32-21, X8 Ni9; ASTM A 533 Gr1, 625 alloys, 800H
GAMMA 276-E	2.5 x 300 3.2 x 350 4.0 x 350	AWS A5.11: E NiCr Mo-4 EN 14172: E-Ni 6276	= +	> 720	> 450	> 30	+20°C: > 70	<ul style="list-style-type: none"> <li>Basic coated electrode giving a fully austenitic NiCrMoW deposit, highly resistant to corrosion in reducing and oxidising media</li> <li>Exceptional resistant to hot cracking</li> <li>Wide range of application including joints between mild or low alloyed steels and nickel alloys, hardfacing on wrought alloys, and hardfacing or repair of hot working tooling</li> <li>Service temperatures from -196°C to 900°C</li> <li>Complements Welding Alloys cored wire GAMMA 276 and Gamma V276</li> </ul>	2.4819 NiMo 16 Cr 15 W
<b>Cast iron</b>									
FONTE NI-E	2.5 x 300 3.2 x 350 4.0 x 350	AWS A5.15: ENi-CI E Ni BG 13	= - ~ 40V	> 300				<ul style="list-style-type: none"> <li>Graphite-containing basic electrode with nickel core giving a machinable deposit for welding of cast iron</li> <li>Particularly suited to welding from cold of old and new grey and malleable cast irons, even when impregnated with oil</li> <li>Very soft fusion, good bead appearance free of undercut</li> <li>Low hardness deposit and heat affected zone, easily machinable</li> <li>Particularly suited to repairing holes and cracks</li> <li>Peening recommended immediately after each pass for efficient elimination of internal contraction stresses</li> </ul>	GG 10 to GG 40, GTS35 to GTS 60, GTW35 to GTW 60, GGG 40 to GGG70, GGGL to 170 N/ mm <sup>2</sup> GGG Ni to 375 N/ mm <sup>2</sup>
FONTE BI-NIFE-E	2.5 x 350 3.2 x 350 4.0 x 350	AWS A5.15: ENiFe-CI ENiFe	= - ~ 50V	500 - 600	> 300	> 15		<ul style="list-style-type: none"> <li>Graphite-containing basic electrode with NiFe bimetal core for joining heavy-gauge ductile and spheroidal cast irons and for heavily restrained joints</li> <li>Reduced heat affected zone</li> <li>Easily machinable deposit</li> <li>Excellent weldability and good mechanical properties</li> <li>Complements Welding Alloys cored wire CAST NIFE</li> </ul>	GG 10, GG40, GGG 40, GGG 70, GTS 35, GTS 65



# Hardfacing Electrodes



## Understanding wear phenomena and material attributes

Wear Mechanism	Description
Metal/metal friction	Metal surfaces in relative motion forced into contact with or without lubricant. Degradation by the formation of micro-welds between the contacting surfaces.
Mineral abrasion	Wear by relative movement of mineral particles of suitable hardness, shape and texture to remove material from the metal surface.
Abrasion under pressure	Wear by relative movement under pressure of mineral particles of suitable hardness, shape and texture to remove material from the metal surface, leaving superficial deformation.
Hot abrasion	As above but in a high-temperature environment, leading generally to softening of the metal or its constituents.
Erosion	Repeated high-speed impacts between mineral particles and a material surface. Local destruction by tearing out of metallic grains.
Cavitation	Tearing out of grains from the metal surface by the formation and implosion of bubbles in a liquid in rapid motion.
Impact	Impact between two materials, one of which provokes deformation or rupture of the surface of the other. This phenomenon is controlled by the toughness or ductility of the two materials.
Mechanical fatigue	Cyclic deformation not exceeding the elastic limit of the material. Degradation over time by localised stress concentrations.
Thermal fatigue	Cyclic exposure to high temperatures leading to permanent deformation by alternate expansion and contraction. Alteration of the structure and properties of the material.
Hot oxidation	Creation of a poorly adhering oxide layer that reforms constantly. Degradation by loss of material thickness.
Corrosion	Degradation of the material by chemical reaction with its environment. Complex phenomenon involving numerous parameters.

Attributes	Description
Rebuilding or cladding	Repair by resurfacing to the original or specified dimensions. Application of a corrosion-resistant protective cladding.
Buffer layer or assembly	Layer of weld metal providing a good metallurgical transition between the base metal and the coating. For welded joints between similar or dissimilar materials.
Cutting ability	Ability of the material to resist impact, heat, friction and abrasion simultaneously for edge retention of cutting tools.
Work-hardening	Ability of a material to increase its surface hardness under the effect of impact or high pressure. In general, this increases wear resistance.
Machinability	Suitability for machining by removal of metal shavings, e.g. turning, milling or drilling.

### Chemical Composition

Each alloy is composed of elements expressed as percentages by weight. The values of those elements essential to the physical, chemical and mechanical properties of the deposit are **highlighted** in the composition tables.

### Example:

Product Name	Composition [%]			
	C	Mn	Si	Cr
HARDFACE AP	0.60	<b>16.0</b>	0.30	<b>14.0</b>

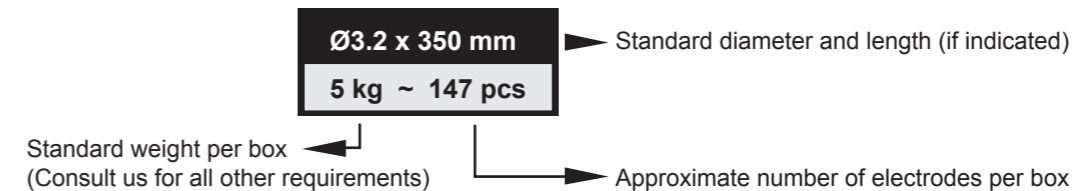
## Alphabetical Index

## Packaging

Ø2.5 x 300mm	Ø2.5 x 350mm	Ø3.2 x 350mm	Ø3.2 x 450mm	Ø4.0 x 350mm	Ø4.0 x 450mm	Product Name	Page
5 kg ~ 245 pcs		5 kg ~ 147 pcs		5 kg ~ 98 pcs		CAST NI-E	12
5 kg ~ 250 pcs		5 kg ~ 147 pcs		5 kg ~ 104 pcs		CAST BI-NIFE-E	12
4 kg ~ 214 pcs		5 kg ~ 139 pcs		5 kg ~ 94 pcs		GAMMA 182-E	12
4 kg ~ 216 pcs		5 kg ~ 143 pcs		5 kg ~ 91 pcs		GAMMA 625-E	12
4 kg ~ 233 pcs		5 kg ~ 152 pcs			5 kg ~ 102 pcs	GAMMA 276-E	12
4 kg ~ 214 pcs		5 kg ~ 139 pcs			6.5 kg ~ 92 pcs	HARDFACE 40-E	4
4 kg ~ 214 pcs		5 kg ~ 139 pcs			6.5 kg ~ 92 pcs	HARDFACE 48-E	4
4 kg ~ 214 pcs		5 kg ~ 139 pcs			6.5 kg ~ 92 pcs	HARDFACE 58-E	4
	5 kg ~ 251 pcs		6.5 kg ~ 167 pcs		6.5 kg ~ 102 pcs	HARDFACE 250-E	4
	5 kg ~ 267 pcs		6.5 kg ~ 163 pcs		6.5 kg ~ 104 pcs	HARDFACE 400-E	4
	4.5 kg ~ 176 pcs	5 kg ~ 122 pcs			6.5 kg ~ 77 pcs	HARDFACE AP-E	4
	4.5 kg ~ 176 pcs	5 kg ~ 122 pcs			6.5 kg ~ 77 pcs	HARDFACE AR-E	4
		4.5 kg ~ 71 pcs			6 kg ~ 48 pcs	HARDFACE CN-E	6
		4.5 kg ~ 64 pcs			6 kg ~ 41 pcs	HARDFACE CNV-E	6
4 kg ~ 195 pcs		5 kg ~ 125 pcs		5 kg	6.5 kg ~ 80 pcs	HARDFACE DCO-E	4
		5 kg ~ 98 pcs			5 kg ~ 68 pcs	HARDFACE HC-E	6
	5 kg ~ 250 pcs	5 kg ~ 152 pcs			6.5 kg ~ 96 pcs	HARDFACE L-E	4
						HARDFACE STEELCARBW-E	6
4 kg ~ 374 pcs	5 kg ~ 281 pcs	5 kg ~ 172 pcs	6.5 kg ~ 176 pcs	5 kg ~ 114 pcs	6.5 kg ~ 112 pcs	SPEEDARC 6013-E	8
	5 kg ~ 231 pcs	5 kg ~ 147 pcs	6.5 kg ~ 147 pcs		6.5 kg ~ 91 pcs	SPEEDARC 7018-1-E	8
	5 kg ~ 250 pcs	5 kg ~ 152 pcs	6 kg ~ 140 pcs		6 kg ~ 92 pcs	SPEEDARC 7016-E	8
	5 kg ~ 244 pcs	5 kg ~ 143 pcs			6.5 kg ~ 96 pcs	SPEEDARC HLE 550-E	8
	5 kg ~ 238 pcs	5 kg ~ 143 pcs			6.5 kg ~ 100 pcs	SPEEDARC HLE 620-E	8
	5 kg ~ 244 pcs	5 kg ~ 143 pcs			6.5 kg ~ 96 pcs	SPEEDARC HLE 700-E	8
	5 kg ~ 244 pcs	5 kg ~ 143 pcs			6.5 kg ~ 96 pcs	SPEEDARC Ni1-E	8
4 kg		5 kg		5 kg		STELLOY 6-E	6
4 kg		5 kg		5 kg		STELLOY 21-E	6
		5 kg		5 kg		STELLOY 25-E	6
4 kg ~ 215 pcs		5 kg ~ 143 pcs		5 kg ~ 94 pcs		TETRA 308L-E	10
5 kg ~ 246 pcs		5 kg ~ 143 pcs		4 kg ~ 94 pcs		TETRA 316L-E	10
4 kg ~ 242 pcs		5 kg ~ 156 pcs		5 kg ~ 106 pcs		TETRA 904L-E	10
4 kg ~ 233 pcs		5 kg ~ 147 pcs		5 kg ~ 93 pcs		TETRA 307-E	10
4 kg ~ 217 pcs		5 kg ~ 143 pcs		5 kg ~ 96 pcs		TETRA 309L-E	10
4 kg ~ 217 pcs		5 kg ~ 139 pcs		5 kg ~ 93 pcs		TETRA 309LMo-E	10
4 kg ~ 216 pcs		5 kg ~ 147 pcs		5 kg ~ 96 pcs		TETRA 312-E	10

### Standard packaging: explanation of the information in the above table

3 boxes per carton (except for 1 kg boxes)



### Technical Information

- All chemical compositions given are for all weld metal deposits. All mechanical properties are typical values
- Technical data sheets and safety data sheets are available for all products



Cored welding wires and covered electrodes

# The Global Solution



Welding products and techniques evolve constantly. All descriptions, illustrations and properties given in this catalogue are subject to change and can only be considered as general guidance.

## A perfectly controlled technology



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Design and manufacture  
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welding wires



### **WA MultiSurfacer™**

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