

Petrochemicals



Edition 2016



OERLIKON solutions for the Petrochemical Industry

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Introduction



Air Liquide SA, with its headquarters in Paris, France, is one of Europe's larger multinational companies. It had a consolidated turnover of € 16.4 billion in 2015, with 50 000 employees all over the world.

Air Liquide Welding is represented throughout the world with a brand portfolio optimized locally to the needs of all types of customers. OERLIKON brand is an important part of this portfolio and has a long and distinguished history of innovation in welding products.

Air Liquide Welding have 3 research and development centers located in Pont-Sainte-Maxence (*France*) for equipment & automation, in Due Carrare (*Italy*) and Eisenberg (*Germany*) for consumables.

This facilitates the rapid transfer and implementation of important innovations throughout the whole OERLIKON network, enabling to maintain the brand position and international reputation of innovative leadership in advanced welding technology.

OERLIKON has generated a proven history of supplying welding consumables for the most demanding and critical applications, particularly in the energy sector to industries such as offshore oil and gas and nuclear power generation. OERLIKON supplies customized solutions through performance and innovation, by developing and providing welding products and processes meeting the stringent mechanical property specifications and the increasing demands for enhanced welding productivity.

The results of this process are demonstrated by the range of automated installations, welding consumables and equipment specifically tailored for the high productivity requirements of wind turbine tower and foundation fabrication.



OERLIKON and the petrochemical industry



A commitment to technical excellence supported by a dedication to quality is regarded as fundamental to OERLIKON's success with fabricators world wide.

Quality

OERLIKON has a total commitment to quality. The product ranges are manufactured in group production facilities, all of which are ISO certified. Detailed certification for welding consumables is supplied as a matter of routine and customers' special quality requirements for increased frequency of batch testing or specialised certification are also readily accommodated. This ensures the reliability and reproducibility fabricators need in the petrochemical industry.

Technical Service

OERLIKON's involvement with its products does not stop at manufacture. OERLIKON provides a close and detailed participation with the application of products, right from the initial selection to welding characteristics on site. A team of highly qualified engineers is ready to respond, with the objective of providing technologically relevant and practical solutions. This is of particular relevance for activities such as refinery maintenance during a shut down when solutions must be identified under time pressure. A large information base is at the service of every customer to ensure the most cost effective selection of process and welding procedure to meet the needs of any application.

Flexibility

The OERLIKON product range is continuously developing in response to changing technological requirements. As new steel types are developed and used, as new more demanding applications are developed, so OERLIKON reacts to provide the right products, regularly meeting with engineering departments and major manufacturers at the design stage to ensure optimum welding solutions.



Information

All OERLIKON products are backed by a full technical information package, which is available in printed or electronic format, on the OERLIKON web sites. Product information is written to enable the professional welding engineer to select the correct OERLIKON product for the application. In order to elaborate the technology of the product range in more detail, technical articles are available in the journal of OERLIKON's welding and cutting expertise, "Competence".

Track Record

OERLIKON is a technological innovator and major supplier of welding products to large industries. A track record of highly successful products combining quality and technology with technical service has been firmly established.



Selected OERLIKON Consumables for Petrochemical Applications

All-Weld-Metal Properties, wt %

Type	Shielding gas	AWS	EN	C	Mn	Si	S	P	Cr
MMA									
CROMOCORD Kb	-	A5.5: E8018-B2-H4	1599: E CrMo 1 B 42 H5	0.07	0.7	0.3	<0.010	<0.012	1.1
OE-KV5L	-	A5.5: E7015-B2L	1599: E CrMo 1L B 22 H5	0.04	0.8	0.4	<0.015	<0.015	1.25
OE-KV5HR	-	A5.5: E8018-B2-H4R	1599: E CrMo 1 B 32 H5	0.08	0.8	0.25	<0.010	<0.010	1.25
OE-KV3L	-	A5.5: E8015-B3L-H4	1599: E CrMo 2L B 22 H5	0.04	0.7	0.35	<0.015	<0.020	2.25
OE-KV3HR	-	A5.5: E9018-B3-H4R	1599: E CrMo 2B 32 H5	0.1	0.75	0.3	<0.010	<0.010	2.25
CROMOCORD 2STC	-	A5.5: E9018-B3-H4R	1599: E CrMo 2B 42 H5	0.09	0.5	0.3	<0.010	<0.012	2.4
CROMO E225	-	A5.5: E9015-B3 H4	1599: E CrMo2 B 22 H5	0.1	0.7	0.25	<0.010	<0.010	2.3
CROMO E225V	-	A5.5: E9015-G	1599: E Z B 22 H5	0.09	0.6	0.2	<0.010	<0.010	2.3
CROMOCORD 5	-	A5.5: E8015-B6 H4	1599: E CrMo5 B 22 H5	0.07	0.8	0.3	<0.010	<0.012	5
SUPRANOX 308L	-	A5.4: E308L-17	1600: E 19 9L R 12	<0.03	0.8	0.9	<0.020	<0.025	19
SUPRANOX RS308L	-	A5.4: E308L-16	1600: E 19 9L R 12	0.02	0.9	0.8	<0.025	<0.025	19.8
SUPRANOX RS308H	-	A5.4: E308H-16	1600: E 19 9 R 12	0.05	0.9	0.8	<0.030	<0.030	20
SUPRANOX 309L	-	A5.4: E309L-17	1600: E 23 12L R 12	<0.03	0.7	0.9	<0.020	<0.025	24
SUPRANOX RS309L	-	A5.4: E309L-16	1600: E 23 12 L R 12	<0.03	0.9	0.8	<0.020	<0.025	23.5
BASINOX 309L	-	A5.4: E309L-15	1600: E 23 12 L B 12	0.025	1.4	0.35	<0.025	<0.030	22.5
SUPRANOX RS309Mo	-	A5.4: E309Mo-16	1600: E 23 12 2L R 12	0.03	0.9	0.9	<0.020	<0.020	22.7
BASINOX 309Nb	-	A5.4: E309Nb-15	1600: E 23 12 Nb B 12	<0.04	1.6	0.45	<0.025	<0.030	23.5
SUPRANOX RS316L	-	A5.4: E316L-16	1600: E 19 12 3L R12	0.03	0.85	0.8	<0.020	<0.025	19
SUPRANOX 316L	-	A5.4: E316L-17	1600: E 19 12 3L R12	<0.03	0.7	0.9	<0.020	<0.025	18.5
BASINOX 316L	-	A5.4: E316L-15	1600: E 19 12 3L B 42	<0.025	1	0.3	<0.020	<0.025	18.5
SUPRANOX 317	-	A5.4: E317-16	1600: E 19 13 4N L R12	0.025	0.9	0.8	<0.030	<0.030	20
SUPRANOX 347	-	A5.4: E347-16	1600: E 19 9 Nb R 12	<0.03	0.8	0.9	<0.020	<0.025	19
SUPRANOX RS347	-	A5.4: E347-16	1600: E 19 9 Nb R 12	0.05	0.8	0.6	<0.020	<0.025	19.5
BASINOX 347	-	A5.4: E347-15	1600: E 19 9 Nb B 42	<0.04	1.6	0.4	<0.020	<0.025	19
SUPRANOX RS22.9.3L	-	A5.4: E2209-16	1600: E 22 9 3 N L R 12	0.025	0.9	0.9	<0.030	<0.030	22.5
SUPRANOX E22.9.3N	-	-	1600: E 22 9 3 N L R 12	<0.03	1	1	<0.020	<0.025	22.5
BASINOX 22.9.3N	-	A5.4: E2209-15	1600: E 22 9 3 N L B 42	0.03	1.2	0.4	<0.020	<0.020	23.4
BASINOX EB25.10.4N	-	A5.4 : E25 9 4-15	1600: E 25 9 4 N L B 42	0.03	0.8	0.4	<0.025	<0.030	25
SUPRANEL 600	-	A5.11: ENiCrFe3	ISO 14172: E Ni 6182	0.03	8	0.3	<0.015	<0.020	16
SUPRANEL SR	-	A5.11: ENiCrFe2	ISO 14172: E Ni 6092	<0.05	2	0.2	<0.015	<0.020	16
SUPRANEL 625	-	A5.11: ENiCrMo3	ISO 14172: E Ni 6625	0.02	0.9	0.2	<0.015	<0.015	22
MIG									
CARBOFIL CrMo1	M21	A5.28: ER 80S-G	21952-A: G CrMo1Si	0.08	1.2	0.6	<0.020	<0.020	1.2
CARBOFIL KV5	M21	A5.28: ER 80S-B2	21952-B: G 55M 1 CM	0.1	0.55	0.55	<0.010	<0.010	1.3
CARBOFIL CrMo2	M21	A5.28: ER 90S-G	21952-A: G CrMo2Si	0.09	1.2	0.7	<0.020	<0.020	2.5
CARBOFIL KV3	M21	A5.28: ER 90S-B3	21952-B: G62 M 2 C1 M	0.1	0.55	0.55	<0.010	<0.010	2.5
CARBOFIL CrMo5	M21	A5.28: ER 80S-B6	21952-A: G CrMo5	0.07	0.5	0.5	<0.020	<0.020	5.7
INERTFIL 308L	M13	A5.9: ER 308L	14343-A: G 19 9 L	0.02	1.8	0.45	<0.020	<0.025	20
INERTFIL 308H	M13	A5.9: ER 308H	14343-A: G 19 9 H	0.06	1.9	0.5	<0.020	<0.020	20
INERTFIL 309L	M13	A5.9: ER 309L	14343-A: G 23 12 L	0.02	1.8	0.45	<0.020	<0.025	24
INERTFIL 309LMo	M13	A5.9: ≈ ER 309LMo	14343-A: G 23 12 2 L	0.02	1.6	0.45	<0.020	<0.025	24
INERTFIL 316L	M13	A5.9: ER 316L	14343-A: G 19 12 3 L	0.02	1.4	0.45	<0.020	<0.025	19
INERTFIL 347	M13	A5.9: ER 347	14343-A: G 19 9 Nb	0.04	1.6	0.45	<0.020	<0.025	19.5
INERTFIL 22 9 3	M12(He+)	A5.9: ER 2209	14343-A: G 22 9 3 N L	0.02	1.7	0.5	<0.020	<0.025	23
INERTFIL 25 10 4	M13	A5.9: ER 2594	14343-A: G 25 9 4 N L	0.01	0.6	0.5	<0.020	<0.020	25
NIFIL 600	I3	A5.14: ER NiCr-3	18274: S Ni 6082	0.05	3	0.3	<0.015	<0.020	20
NIFIL 625	I3	A5.14: ER NiCrMo-3	18274: S Ni 6625	0.025	0.4	0.3	<0.015	<0.020	21

Ni	Mo	Nb	V	Fe	PWHT	Tensile Strength MPa	Yield Strength MPa	A5d %	CVN		Type
									Joules	°C	
MMA											
-	0.55	-	-	-	690 °C / 2h	560-720	>490	>22	>120	20	CROMOCORD Kb
-	0.5	-	-	-	690 °C / 1h	520-650	>390	>20	>47	-40	OE-KV5L
-	0.5	-	-	-	690 °C / 1h	550-690	>460	>20	>47	-40	OE-KV5HR
-	1.0	-	-	-	700 °C / 1h	630-720	>460	>18	>47	-20	OE-KV3L
-	1.0	-	-	-	690 °C / 17h	550-650	>400	>22	>100	-30	OE-KV3HR
-	1.0	-	-	-	690 °C / 17h	550-650	>400	>22	>100	-30	CROMOCORD 2STC
-	1.1	-	-	-	690 °C / 8h	550-650	>400	>22	>80	-40	CROMO E225
-	1	0.02	0.25	-	710 °C / 8h	620-750	>420	>18	>54	-18	CROMO E225V
-	0.5	-	-	-	740 °C / 1h	600-700	>460	>19	>100	20	CROMOCORD 5
10	-	-	-	-	AW	>520	>350	>30	>50	20	SUPRANOX 308L
9.5	-	-	-	-	AW	>520	>320	>35	>60	20	SUPRANOX RS308L
9.5	-	-	-	-	AW	>550	>350	>35	>60	20	SUPRANOX RS308H
12.5	-	-	-	-	AW	>520	>320	>30	>50	20	SUPRANOX 309L
12.3	-	-	-	-	AW	>520	>320	>30	>50	20	SUPRANOX RS309L
13	-	-	-	-	AW	>520	>320	>30	>60	20	BASINOX 309L
12.5	3	-	-	-	AW	>550	>350	>30	>60	20	SUPRANOX RS309Mo
12.5	-	0.9	-	-	AW	>550	>350	>30	>60	20	BASINOX 309Nb
12	2.5	-	-	-	AW	>510	>350	>30	>47	20	SUPRANOX RS316L
12	2.7	-	-	-	AW	>520	>400	>30	>50	20	SUPRANOX 316L
11.5	2.7	-	-	-	AW	>520	>420	>30	>60	20	BASINOX 316L
13	3.4	-	-	-	AW	>550	>350	>30	>27	20	SUPRANOX 317
10	-	0.4	-	-	AW	>550	>350	>25	>50	20	SUPRANOX 347
10	-	0.4	-	-	AW	>550	>350	>30	>47	20	SUPRANOX RS347
10	-	0.5	-	-	AW	>600	>420	>25	>70	20	BASINOX 347
9.5	2.8	-	-	-	AW	>690	>450	>20	>47	20	SUPRANOX RS22.9.3L
9	3.2	-	-	-	AW	>800	>690	>24	>50	20	SUPRANOX E22.9.3N
9	2.8	-	-	-	AW	>690	>550	>25	>50	-50	BASINOX 22.9.3N
9.5	4	-	-	-	AW	>850	>650	>20	>32	-50	BASINOX EB25.10.4N
Rem	-	1.9	-	9	AW	>550	>360	>30	>60	-196	SUPRANEL 600
Rem	1	1.8	-	8.5	AW	>550	>360	>35	>60	-196	SUPRANEL SR
Rem	9	3.7	-	1	AW	>760	>420	>30	>50	-196	SUPRANEL 625
MIG											
-	0.6	-	-	-	690 °C / 1h	>550	>355	>20	>80	+20	CARBOFIL CrMo1
0.2	0.5	-	-	-	620 °C / 1h	>550	>470	>20	>70	-20	CARBOFIL KV5
-	1	-	-	-	690 °C / 1h	>620	>400	>18	>47	+20	CARBOFIL CrMo2
<0.2	1	-	-	-	620 °C / 1h	>620	>540	>20	>70	+20	CARBOFIL KV3
-	0.6	-	-	-	760 °C / 1h	>590	>470	>17	>47	+20	CARBOFIL CrMo5
10	-	-	-	-	AW	>520	>350	>35	>80 / >32	+20 / -120	INERTFIL 308L
10	-	-	-	-	AW	>550	>350	>35	>70 / >32	+20 / -10	INERTFIL 308H
13	-	-	-	-	AW	>520	>350	>30	>55 / >32	+20 / -80	INERTFIL 309L
13	2.7	-	-	-	AW	>550	>350	>30	>55	+20	INERTFIL 309LMo
12.5	2.6	-	-	-	AW	>510	>350	>30	>80 / >32	+20 / -120	INERTFIL 316L
10	-	0.5	-	-	AW	>550	>400	>30	>65 / >32	+20 / -120	INERTFIL 347
9	3	-	-	-	AW	>680	>480	>22	>50 / >32	+20 / -40	INERTFIL 22 9 3
9.5	4	-	-	-	AW	>800	>550	>25	>80 / >32	+20 / -40	INERTFIL 25 10 4
Rem	-	2	-	2	AW	>620	>380	>35	>100 / >55	+20 / -196	NIFIL 600
Rem	9	3.5	-	3	AW	>720	>460	>30	>100 / >40	+20 / -196	NIFIL 625

Selected OERLIKON Consumables for Petrochemical Applications

All-Weld-Metal Properties, wt %

Type	Shielding gas	AWS	EN	C	Mn	Si	S	P	Cr
TIG									
CARBOROD CrMo1	I1	A5.28: ER 80S-G	21952-A: W CrMo1Si	0.08	1.2	0.6	<0.020	<0.020	1.2
CARBOROD KV5	I1	A5.28: ER 80S-B2	21952-B: W 55M 1CM	0.1	0.08	0.56	<0.020	<0.020	1.25
CARBOROD CrMo2	I1	A5.28: ER 90S-G	21952-A: W CrMo2Si	0.09	1.1	0.7	<0.020	<0.020	2.5
CARBOROD KV3	I1	A5.28: ER 90S-B3	21952-B: W 62M 2C1M	0.08	0.60	0.55	<0.020	<0.020	2.4
CARBOROD W 225 V	I1	A5.28: ER 90S-G	-	0.13	<1.0	<0.2	-	-	2.50
CARBOROD CrMo5	I1	A5.28: ER 80S-B6	21952-A: W CrMo5Si	0.07	0.5	0.5	<0.020	<0.020	5.7
INERTROD 308L	I1	A5.9: ER 308L	14343-A: W 19 9 L	0.02	1.8	0.45	<0.020	<0.025	20
INERTROD 308H	I1	A5.9: ER 308H	14343-A: W 19 9 H	0.06	1.9	0.5	<0.020	<0.020	20
INERTROD 309L	I1	A5.9: ER 309L	14343-A: W 23 12 L	0.02	1.8	0.45	<0.020	<0.025	24
INERTROD 309LMo	I1	A5.9: ER 309LMo	14343-A: W 23 12 2 L	0.02	1.6	0.45	<0.020	<0.025	22
INERTROD 316L	I1	A5.9: ER 316L	14343-A: W 19 12 3 L	0.02	1.4	0.45	<0.020	<0.025	19
INERTROD 347	I1	A5.9: ER 347	14343-A: W 19 9 Nb	0.04	1.6	0.45	<0.020	<0.025	19.5
INERTROD 22 9 3	I1	A5.9: ER 2209	14343-A: W 22 9 3 N L	0.02	1.7	0.5	<0.020	<0.025	23
INERTROD 25 10 4	I1	A5.9: ER 2594	14343-A: W 25 9 4 N L	0.03	1	0.5	<0.020	<0.020	25
NIROD 600	I1	A5.14: ER NiCr-3	18274: S Ni 6082	0.050	3	0.3	<0.015	<0.020	20
NIROD 625	I1	A5.14: ER NiCrMo-3	18274: S Ni 6625	0.025	0.4	0.3	<0.015	<0.020	21
CORED WIRE									
FLUXINOX 308L	M21	A5.22: E308LT0-4	12073: T 19 9 L R M3	<0.04	1.4	0.6	-	-	20
FLUXINOX 308L PF	M21	A5.22: E308LT1-4	12073: T 19 9 L P M1	<0.04	1.4	0.6	-	-	20
FLUXINOX 308H	M21	A5.22: E308HT0-4/-1	-	0.06	1.4	0.6	-	-	20
FLUXINOX 309L	M21	A5.22: E309LT0-4	12073: T 23 12 L R M3	<0.04	1.5	0.6	-	-	24
FLUXINOX 309LPPF	M21	A5.22: E309LT1-4	12073: T 23 12 L P M1	<0.04	1.5	0.6	-	-	24
FLUXINOX 309MoL	M21	A5.22: E309LMoT0-4	12073: T23 12 2 L R M3	<0.04	1.5	0.7	-	-	24
FLUXINOX 309MoLPPF	M21	A5.22: E309LMoLT1-4	12073: T23 12 2 L P M1	<0.04	1.5	0.7	-	-	24
FLUXINOX 316L	M21	A5.22: E316LT0-4	12073: T 19 12 3 L R M3	<0.04	1.5	0.6	-	-	19
FLUXINOX 316LPPF	M21	A5.22: E316LT1-4	12073: T 19 12 3 L P M3	<0.04	1.5	0.6	-	-	19
FLUXINOX 347	M21	A5.22: E347T0-1	12073: T 19 9 Nb R M3	<0.04	1.5	0.9	-	-	20
FLUXINOX 347PPF	M21	A5.22: E347T1-4	12073: T19 9 Nb P M1	<0.04	1.5	0.9	-	-	20
FLUXINOX 22.9.3L	M21	A5.22: E2209T0-4	12073: T 22 9 3 N L R M3	<0.04	1.2	0.7	-	-	22
FLUXINOX 22.9.3LPPF	M21	A5.22: E2209T1-4	12073: T 22 9 3 N L P M1	<0.04	1.2	0.7	-	-	22
FLUXINOX 625	M21	A5.11: ENiCrMo-3	-	0.03	0.8	0.6	<0.015	<0.015	21
SUBMERGED ARC									
OP121TT(WH) / OE-S2CrMo1	-	A5.23: F8P4 EB2-B2	-	0.07	0.9	0.3	<0.025	<0.025	1
OP121TT(W) / OE-S1CrMo2	-	A5.23: F8P2 EB3-B3	-	0.08	0.6	0.3	<0.025	<0.025	2.2
OP F537 / OE CROMO S225	-	A5.23: F9P2-EB3R-B3R	-	<0.12	<1	<0.25	<0.025	<0.025	2.2
OP F537 / OE CROMO S225V	-	A5.23: F9P2-EGR-GR	-	<0.12	<1	<0.25	<0.025	<0.025	2.2
OP F537 / OE-S1CrMo5	-	A5.23: F8P0-EB6-B6	-	<0.12	<1	<0.5	<0.025	<0.025	5
OP F500 / OE-308L	-	-	-	0.03	2	0.8	<0.025	<0.025	18
OP 33 / OE-308L	-	-	-	0.03	2	0.8	<0.025	<0.025	18
OP F500 / OE-309L	-	-	-	0.03	<2	0.5	<0.025	<0.025	22
OP F500 / OE-309LMo	-	-	-	0.03	2	0.8	<0.025	<0.025	21
OP 33 / OE-309LMo	-	-	-	<0.03	2	0.8	<0.025	<0.025	21
OP F500 / OE-316L	-	-	-	0.03	2	0.8	<0.025	<0.025	18
OP 33 / OE-316L	-	-	-	0.03	2	0.8	<0.025	<0.025	18
OP F500 / OE-347	-	-	-	0.07	2	0.8	<0.025	<0.025	18
OP 33 / OE-347	-	-	-	0.07	2	0.8	<0.025	<0.025	18
OP F500 / OE-S2209	-	-	-	0.03	1.5	0.8	<0.025	<0.025	21.5
OP 33 / OE-S2209	-	-	-	<0.03	1.5	0.8	<0.025	<0.025	23
OP 76 / OE-S2510	-	-	-	0.04	0.5	0.9	<0.025	<0.025	25
OP76 / Nifil 600	-	-	-	0.03	0.3	0.9	<0.025	<0.025	22
OP76 / Nifil 625	-	-	-	0.03	0.3	0.4	<0.025	<0.025	23

Ni	Mo	Nb	V	Fe	PWHT	Tensile Strength MPa	Yield Strength MPa	A5d %	CVN		Type
									Joules	°C	
TIG											
-	0.6	-	-	-	690 °C / 1h	>550	>355	>22	>100 / >70	+20 / -30	CARBOROD CrMo1
-	0.5	-	-	-	620 °C / 1h	>550	>470	>20	>47	-29	CARBOROD KV5
-	1	-	-	-	690 °C / 1h	>620	>400	>22	>120 / >70	+20 / -30	CARBOROD CrMo2
-	1.0	-	-	-	620 °C / 1h	>620	>540	>18	>47	-29	CARBOROD KV3
-	1	0.02	0.25	-	710 °C / 8h	>680	>500	>18	>100	-29	CARBOROD W 225 V
-	0.6	-	-	-	760 °C / 1h	>590	>470	>20	>100 / >60	+20 / -30	CARBOROD CrMo5
10	-	-	-	-	AW	>520	>350	>35	>80 / >40	+20 / -120	INERTROD 308L
10	-	-	-	-	AW	>550	>350	>35	>70 / >32	+20 / -10	INERTROD 308H
13	-	-	-	-	AW	>520	>350	>30	>47 / >32	+20 / -80	INERTROD 309L
15	2.7	-	-	-	AW	>550	>350	>30	>55	+20	INERTROD 309LMo
12.5	2.6	-	-	-	AW	>510	>350	>30	>80 / >32	+20 / -120	INERTROD 316L
10	-	0.5	-	-	AW	>550	>400	>30	>65 / >32	+20 / -120	INERTROD 347
9	3	-	-	-	AW	>680	>480	>22	>50 / >32	+20 / -40	INERTROD 22 9 3
9.5	4	-	-	-	AW	>800	>550	>25	>80 / >32	+20 / -40	INERTROD 25 10 4
Rem	-	2.5	-	2	AW	>620	>380	>35	>100 / >55	+20 / -196	NIROD 600
Rem	9	3.5	-	3	AW	>720	>460	>30	>120 / >40	+20 / -196	NIROD 625
CORED WIRE											
10	-	-	-	-	AW	>520	>350	>35	>32	-196	FLUXINOX 308L
10	-	-	-	-	AW	>520	>320	>35	>32	-196	FLUXINOX 308L PF
10	-	-	-	-	AW	>550	>350	>35	>40	20	FLUXINOX 308H
13	-	-	-	-	AW	>520	>320	>30	>32	-60	FLUXINOX 309L
13	-	-	-	-	AW	>520	>320	>30	>32	-60	FLUXINOX 309L PF
13	2.5	-	-	-	AW	>550	>350	>25	>40	20	FLUXINOX 309MoL
13	2.5	-	-	-	AW	>550	>350	>28	>40	20	FLUXINOX 309MoL PF
12	2.8	-	-	-	AW	>510	>320	>30	>32	-110	FLUXINOX 316L
12	2.8	-	-	-	AW	>510	>320	>30	>32	-110	FLUXINOX 316L PF
10	-	0.4	-	-	AW	>550	>350	>30	>32	-196	FLUXINOX 347
10	-	0.4	-	-	AW	>550	>350	>30	>32	-196	FLUXINOX 347 PF
9	3	-	-	-	AW	>690	>450	>20	>32	-60	FLUXINOX 22.9.3L
9	3	-	-	-	AW	>690	>450	>20	>32	-60	FLUXINOX 22.9.3L PF
Rem	9	4	-	3	AW	>750	>440	>35	>50	-196	FLUXINOX 625
SUBMERGED ARC											
-	0.5	-	-	-	680 °C / 2h	530-630	>380	>24	>180	0	OP121TT(WH) / OE-S2CrMo1
-	1	-	-	-	720 °C / 8h	550-650	>450	>22	>100	0	OP121TT(W) / OE-S1CrMo2
-	1	-	-	-	690 °C / 8h	620-750	>540	>18	>100	-20	OP F537 / OE CROMO S225
-	1	0.01	-	-	710 °C / 8h	620-750	>540	>18	>27	-20	OP F537 / OE CROMO S225V
-	0.5	-	-	-	760 °C / 2h	550-700	>470	>20	>27	0	OP F537 / OE-S1CrMo5
9	-	-	-	-	AW	>500	>350	>35	>75	20	OP F500 / OE-308L
9	-	-	-	-	AW	>500	>350	>35	>75	20	OP 33 / OE-308L
13	-	-	-	-	AW	>550	>350	>35	>60	20	OP F500 / OE-309L
15	3	-	-	-	AW	>600	>370	>25	>65	20	OP F500 / OE-309LMo
15	3	-	-	-	AW	>600	>420	>25	>80	20	OP 33 / OE-309LMo
10	2.5	-	-	-	AW	>525	>350	>30	>75	20	OP F500 / OE-316L
10	2.5	-	-	-	AW	>525	>350	>30	>75	20	OP 33 / OE-316L
9	-	1	-	-	AW	>575	>500	>30	>70	-60	OP F500 / OE-347
9	-	-	-	-	AW	>575	>370	>30	>65	20	OP 33 / OE-347
8	3	-	-	-	AW	>690	>400	>25	>70	-60	OP F500 / OE-S2209
9	3	-	-	-	AW	>750	>550	>35	>70	-60	OP 33 / OE-S2209
10	4	0.02	-	-	AW	>650	>550	>20	>50	-40	OP 76 / OE-S2510
74	-	2.5	-	-	AW	>590	>390	>35	>70	-196	OP76 / Nifil 600
60	10	3.5	-	3	AW	>700	>450	>35	>70	-196	OP76 / Nifil 625

Classification Society Approvals

Selected OERLIKON Products for the Petrochemical Industry

Type	GAS	AWS	EN	TÜV	DB	ABS	BV	DNV	GL	LRS	RINA
MMA											
CROMOCORD Kb	-	A5.5: E8018-B2-H4	1599: E CrMo 1 B 42 H5	X	10.098.31	-	-	-	-	-	-
OE-KV5L	-	A5.5: E7015-B2L-H4	1599: E CrMo 1L B 22 H5	-	-	-	-	-	-	-	-
OE-KV5HR	-	A5.5: E8018-B2-H4R	1599: E CrMo 1 B 32 H5	-	-	-	-	-	-	-	-
OE-KV3L	-	A5.5: E8015-B3L-H4	1599: E CrMo 2L B 22 H5	-	-	-	-	-	-	-	-
OE-KV3HR	-	A5.5: E9018-B3-H4R	1599: E CrMo 2B 32 H5	-	-	-	-	-	-	-	-
CROMOCORD 2STC	-	A5.5: E9018-B3-H4R	1599: E CrMo 2B 42 H5	-	-	-	-	-	-	-	-
CROMO E225	-	A5.5: E9015-B3 H4	1599: E CrMo2 B 22 H5	-	-	-	-	-	-	-	-
CROMO E225V	-	A5.5: E9015-G	1599: E Z B 22 H5	-	-	E9015-G	-	-	-	-	-
CROMOCORD 5	-	A5.5: E8015-B6	1599: E CrMo5 B 22 H5	-	-	-	-	-	-	-	-
SUPRANOX 308L	-	A5.4: E308L-17	1600: E 19 9L R 12	TÜV	DB	308L	UP	308L	4550	308L	-
SUPRANOX RS308L	-	A5.4: E308L-16	1600: E 19 9L R 12	4479.00	-	E308L-16	-	-	-	-	-
SUPRANOX RS308H	-	A5.4: E308H-16	1600: E 19 9 R 12	-	-	-	-	-	-	-	-
SUPRANOX 309L	-	A5.4: E309L-17	1600: E 23 12L R 12	TÜV	DB	309L	UP	309L	4332	SS/CMn	-
SUPRANOX RS309L	-	A5.4: E309L-16	1600: E 23 12 L R 12	4946.00	-	-	-	-	-	-	-
BASINOX 309L	-	A5.4: E309L-15	1600: E 23 12 L B 12	-	-	-	-	-	-	-	-
SUPRANOX RS309Mo	-	A5.4: E309Mo-16	1600: E 23 12 2L R 12	-	-	-	-	-	-	-	309Mo
BASINOX RS309Nb	-	A5.4: E309Cb-15	1600: E 23 12 Nb B 12	9532.00	-	-	-	-	-	-	-
SUPRANOX RS316L	-	A5.4: E316L-16	1600: E 19 12 3L R12	-	-	-	-	-	-	-	-
SUPRANOX 316L	-	A5.4: E316L-17	1600: E 19 12 3L R12	TÜV	DB	316L	UP	316L	4571	316L	-
BASINOX 316L	-	A5.4: E316L-15	1600: E 19 12 3L B 42	06.339	30.098.09	-	-	-	-	-	-
SUPRANOX 317	-	A5.4: E347-16	1600: E 19 9 Nb R 12	-	-	-	-	-	-	-	-
SUPRANOX 347	-	A5.4: E347-16	1600: E 19 9 Nb R 12	TÜV	DB	-	-	-	-	-	-
SUPRANOX RS347	-	A5.4: E347-16	1600: E 19 9 Nb R 12	4482.00	-	-	-	-	-	-	-
BASINOX 347	-	A5.4: E347-15	1600: E 19 9 Nb B 42	06.257	30.098.05	-	-	-	-	-	-
SUPRANOX RS22.9.3L	-	A5.4: E2209-16	1600: E 22 9 3 N L R 12	-	-	-	2209	DNV	-	-	2209
SUPRANOX E22.9.3N	-	-	1600: E 22 9 3 N L R 12	-	-	E2209	UP	DUPLEX	4462	S31803	-
BASINOX 22.9.3N	-	A5.4: E2209-15	1600: E 22 9 3 N L B 12	-	-	-	-	-	-	-	-
BASINOX EB25.10.4N	-	-	1600: E 25 9 4 N L B 42	-	-	-	-	-	-	-	-
SUPRANEL 600	-	A5.11: ENiCrFe3	ISO 14172: E Ni 6182	X	-	-	-	-	-	-	-
SUPRANEL SR	-	A5.11: ENiCrFe2	ISO 14172: E Ni 6062	-	-	-	-	-	-	-	-
SUPRANEL 625	-	A5.11: ENiCrMo3	ISO 14172: E Ni 6625	X	-	-	-	-	-	-	-
MIG											
CARBOFIL CrMo1	M21	A5.28: ER 80S-G	21952: G CrMo 1Si	00267	42.098.28	-	-	-	-	-	-
CARBOFIL KV5	M21	A5.28: ER 80S-B2	21952: G 55M 1CM	-	-	-	-	-	-	-	-
CARBOFIL CrMo2	M21	A5.28: ER 90S-G	21952: G CrMo 2Si	00799	-	-	-	-	-	-	-
CARBOFIL KV3	M21	A5.28: ER 90S-B3	21952: G 62M 2C1M	-	-	-	-	-	-	-	-
CARBOFIL CrMo5	M21	A5.28: ER 80S-B6	21952: G CrMo 5	-	-	-	-	-	-	-	-
INERTFIL 308L	M13	A5.9: ER 308L	14343-A: G 19 9 L	1150	43.098.06	-	-	-	-	-	-
INERTFIL 308H	M13	A5.9: ER 308H	14343-A: G 19 9 H	-	-	-	-	-	-	-	-
INERTFIL 309L	M13	A5.9: ER 309L	14343-A: G 23 12 L	12022	-	-	-	-	-	-	-
INERTFIL 309LMo	M13	A5.9: ER 309LMo	14343-A: G 23 12 2 L	-	-	-	-	-	-	-	-
INERTFIL 316L	M13	A5.9: ER 316 L	14343-A: G 19 12 3L	02429	43.098.07	-	-	-	-	-	-
INERTFIL 347	M13	A5.9: ER 347	14343-A: G 19 9 Nb	02404	43.098.01	-	-	-	-	-	-
INERTFIL 22.9.3	M12	A5.9: ER 2209	14343-A: G 22 9 3 N L	-	-	-	-	-	-	-	-
INERTFIL 25.10.4	M13	A5.9: ER 2594	14343-A: G 25 9 4 N L	-	-	-	-	-	-	-	-
NIFIL 600	I3	A5.14: ER NiCr-3	18274: S Ni 6082	-	-	-	-	-	-	-	-
NIFIL 625	I3	A5.14: ER NiCrMo-3	18274: S Ni 6625	-	-	-	-	-	-	-	-
TIG											
CARBOROD CrMo1	I1	A5.28: ER 80S-G	21952-A: W CrMo1Si	-	-	-	-	-	-	-	-
CARBOROD KV5	I1	A5.28: ER 80S-B2	21952-B: W 55M 1CM	-	-	-	-	-	-	-	-
CARBOROD CrMo2	I1	A5.28: ER 90S-G	21952-A: W CrMo2Si	-	-	-	-	-	-	-	-
CARBOROD KV3	I1	A5.28: ER 90S-B3	21952-B: W 62M 2C1M	-	-	-	-	-	-	-	-
CARBOROD W225V	I1	A5.28: ER 90S-G	-	-	-	-	-	-	-	-	-
CARBOROD CrMo5	I1	A5.28: ER 80S-B6	21952-A: W CrMo5Si	-	-	-	-	-	-	-	-
INERTROD 308L	I1	A5.9: ER 308L	14343-A: W 19 9 L	01151	43.098.14	-	-	-	-	-	-
INERTROD 308H	I1	A5.9: ER 308H	14343-A: W 19 9 H	-	-	-	-	-	-	-	-
INERTROD 309L	I1	A5.9: ER 309L	14343-A: W 23 12 L	-	-	-	-	-	-	-	-
INERTROD 309LMo	I1	A5.9: ER 309LMo	14343-A: W 23 12 2 L	-	-	-	-	-	-	-	-
INERTROD 316L	I1	A5.9: ER 316L	14343-A: W 19 12 3 L	02430	43.098.17	-	-	-	-	-	-
INERTROD 347	I1	A5.9: ER 347	14343-A: W 19 9 Nb	02405	43.098.10	-	-	-	-	-	-
INERTROD 22.9.3	I1	A5.9: ER 2209	14343-A: W 22 9 3 N L	-	-	-	-	-	-	-	-
INERTROD 25.10.4	I1	A5.9: -ER 2509	14343-A: W 25 9 4 N L	-	-	-	-	-	-	-	-
NIROD 600	I1	A5.14: ER NiCr-3	18274: S Ni 6082	-	-	-	-	-	-	-	-
NIROD 625	I1	A5.14: ER NiCrMo-3	18274: S Ni 6625	-	-	-	-	-	-	-	-

Type	GAS	AWS	EN	TÜV	DB	ABS	BV	DNV	GL	LRS	RINA
CORED WIRE											
FLUXINOX 308L	M21	A5.22: E308LT0-4	12073: T 19 9 L R M3	TÜV	DB	-	-	308L	4550S	304LS	-
FLUXINOX 308L PF	M21	A5.22: E308LT1-4	12073: T 19 9 L P M1	TÜV	-	-	-	308L	-	304LS	-
FLUXINOX 308H	M21	A5.22: E308HTO-4/-1	-	-	-	-	-	-	-	-	-
FLUXINOX 309L	M21	A5.22: E309LT0-4	12073: T 23 12 L R M3	TÜV	DB	-	-	309L	4332S	SS/CMn	-
FLUXINOX 309L PF	M21	A5.22: E309LT1-4	12073: T 23 12 L P M1	TÜV	-	-	-	309L	4332S	SS/CMn	-
FLUXINOX 309MoL	M21	A5.22: E309LMoT0-4	12073: T23 12 2 L R M3	-	-	-	-	-	-	-	-
FLUXINOX 309MoL PF	M21	A5.22: E309LMoLT1-4	12073: T23 12 2 L P M1	-	-	-	-	-	-	-	-
FLUXINOX 316L	M21	A5.22: E316LT0-4	12073: T 19 12 3 L R M3	TÜV	DB	-	316L	316L	4571S	316L S	-
FLUXINOX 316L PF	M21	A5.22: E316LT1-4	12073: T 19 12 3 L P M3	TÜV	-	-	316L	316L	-	316L S	-
FLUXINOX 347	M21	A5.22: E347T0-1	12073: T 19 9 Nb R M3	TÜV	-	-	-	-	-	-	-
FLUXINOX 347 PF	M21	A5.22: E347T1-4	12073: T19 9 Nb P M1	-	-	-	-	-	-	-	-
FLUXINOX 22.9.3L	M21	A5.22: E2209T0-4	12073: T 22 9 3 N L R M3	-	-	-	-	DUPLEX	4462	S31803S	-
FLUXINOX 22.9.3L PF	M21	A5.22: E2209T1-4	12073: T 22 9 3 N L P M1	TÜV	-	-	-	DUPLEX	4462	S31803S	-
FLUXINOX 625	M21	A5.11: ENICrMo-3	-	-	-	-	-	-	-	-	-
SUBMERGED ARC											
OP 121TT / OE-S2CrMo1	-	A5.23: F7P4 EB2-B2	-	03967	-	-	-	-	-	-	-
OP 121TT(W) / OE-S1CrMo2	-	A5.23: F8P2 EB3-B3	-	04152	-	-	-	-	-	-	-
OP F537 / OE CROMO S225	-	A5.23: F9P2-EB3R-B3R	-	09503	-	-	-	-	-	-	-
OP F537 / OE CROMO S225V	-	A5.23: F9P2-Egr-GR	-	-	-	-	-	-	-	-	-
OP F537 / OE-S1CrMo5	-	A5.23: F8P0-EB6-B6	-	07892	-	-	-	-	-	-	-
OP 33 / OE-308L	-	-	-	TÜV	51.098.15	-	-	-	-	-	-
OP F500 / OE-309L	-	-	-	-	-	-	-	309L	4332	-	-
OP 33 / OE-309L Mo	-	-	-	-	-	-	-	-	-	-	309Mo M
OP 33 / OE-316L	-	-	-	TÜV	51.098.15	-	-	-	-	-	-
OP 33 / OE-347	-	-	-	-	TÜV	-	-	-	-	-	-
OP 76 / NIFIL 625	-	-	-	03961	-	-	-	-	-	-	-

INITIALS	AWS	EN	TÜV	DB	ABS	BV	DNV	GL	LRS	PRS	RMRS	RINA
DESCRIPTION	American Welding Society	European Normalization	Technischer Überwachungs Verein	Die Bahn	American Bureau of Shipping	Bureau Veritas	Det Norske Veritas	Germanischer Lloyd	Lloyd's Register of Shipping	Polski Rejestr Statkow	Russian Maritime Register of Shipping	Registro Italiano Navale



Guide to OERLIKON welding consumable product designations and fluxes

Range	Key Features	Main Applications
MMA		
CROMOCORD	Basic, -15/-18, double coated <3.2 mm, full CrMo range.	CrMo steels.
KV	Basic, -15 coated, optimised positional operability.	CrMo steels, pipe welding.
KVHR	Basic, -18 coated, X & J factor controlled.	CrMo steels, filling. Step cooling applications.
CROMO	Basic coated, matching core wire, very clean CrMo weld metal X & J factor controlled.	CrMo steels. Step cooling applications.
SUPRANOX	Rutile (16/17) coating stainless steels. Fine spray arc metal transfer, easy slag release.	Stainless and heat resistant steels, e.g 300 series. Widest range of stainless applications.
SUPRANOX RS	-16 type thin rutile coating, ferrite controlled.	Positional stainless pipe work and assembly.
BASINOX	Basic (15) coated, low hydrogen, low oxygen weld metal Full range, ferrite controlled. Root penetration.	Stainless and heat resistant steels, e.g 300 series. Thick sections, positional pipework.
DRY Packaging	Vacuum packaging systems for MMA electrodes, eliminating the need for re-conditioning prior to use.	Contains ~1 kg higher alloy, site applications
VPM Packaging		Contains ~3 kg low hydrogen and alloy, site applications
MIG/MAG		
CARBOFIL	C-Mn & low alloy ferritic steel wires, copper coated, all formats.	Wide range of C-Mn, structural and low alloy steels.
INERTFIL	Solid stainless steel alloy wires, bright finished.	Stainless and heat resistant steels, e.g 300 series.
NIFIL	Solid high nickel series alloy wires.	High nickel base alloys, e.g. 625.
TIG		
CARBOROD	C-Mn & low alloy ferritic steel rods.	Wide range of C-Mn, structural and low alloy steels.
INERTROD	Solid stainless steel alloy rods, bright finished. Coin stamped with alloy grade.	Stainless and heat resistant steels, e.g 300 series.
NIROD	Solid high nickel series alloy rods. Coin stamped with alloy grade.	High nickel base alloys, e.g. 625.
Cored Wires		
FLUXOFIL	Flux cored wires, mixed shielding gases & CO ₂ . Seamless, coppered, very low hydrogen characteristic. Precision layer wound on baskets.	Wide range of C-Mn, structural and low alloy steels. Excellent for hardenable steels. Semi and fully automatic applications.
FLUXINOX	Flux cored wires, mixed shielding gases, ferrite controlled.	Joining 300 series, buffer layers and cladding.
FLUXINOX PF	For positional applications in stainless steel.	300 series pipe work and assembly.



for the petrochemical industry

Range	Key Features	Main Applications
Submerged Arc Fluxes		
OP 121TT	Agglomerated fluoride basic flux. B.I. 3.1. Low Hydrogen controlled. Multi-wire, AC/DC.	Wide range of C-Mn, structural and low alloy steels. High toughness, CVN & CTOD tested. High productivity.
OP 121TTW	Agglomerated fluoride basic flux. B.I. 3.1. Multi-wire, AC/DC. Very low hydrogen controlled, very low impurity/residual elements.	Thick section, hardenable ferritic steels, e.g. CrMoV. High toughness, CVN & CTOD tested. High productivity.
OP CROMO F537	Agglomerated fluoride basic flux. B.I. 2.6. Hydrogen controlled. Characteristic: Very low silicon pick up, manganese neutral.	Heat resistant CrMo & CrMoV steels, step cooling. High joint toughness CVN & CTOD tested. X & J factor requirements.
OP F500	Agglomerated, semi basic flux. B.I. 2.2.	Stainless and heat resistant steels, e.g 300 series.
OP 33	Agglomerated, semi basic flux. B.I. 1.8. Carbon neutral.	Stainless and heat resistant steels, e.g 300 series.
OP 76	Agglomerated fluoride basic flux. B.I. 2.7. Hydrogen controlled.	High nickel base alloys, e.g 625 & 825.
DRYBAG	Vacuum packaging system for OERLIKON SAW fluxes. Variety of formats: 25, 500 & 800kg.	Eliminates flux re-conditioning prior to use even following extended transport or use in high humidity regions.
Strips for Weld Overlay		
SUPRASTRIP	Wide range of austenitic steel and nickel base alloy steel strips 30, 60 & 90 mm thicknesses.	308L, 309L, 309LNb, 309LMo, 316L, 347, 600, 625, 825 alloys. High productivity weld overlay.
Fluxes for Submerged Arc Weld Overlay		
AST 300	Agglomerated flux.	Weld overlay 300 series alloys.
AST 600	Agglomerated basic flux.	Weld overlay 600, 625 alloys.
Fluxes for Electro-Slag Weld Overlay		
ELT 300	High productivity.	Weld overlay 300 series alloys.
ELT 300S	Very high speed, 35 cm/min, high productivity.	Weld overlay 300 series alloys.
ELT 316-1	Agglomerated, highly basic flux.	Single layer 316L weld overlay with Suprastrip 19 12 3L.
ELT 347-1	Agglomerated, highly basic flux.	Single layer 347 weld overlay with Suprastrip 19 9LNb.
ELT 600	High productivity.	Weld overlay 600, 625 alloys.
ELT 600S	Very high speed, 35 cm/min, high productivity.	Weld overlay 600, 625 alloys.



Petrochemical applications

Material Grade

Process	1¼Cr½Mo	2¼Cr1Mo	2¼Cr1MoV	5Cr1Mo	304	304H	316L
MMA							
	CROMOCORD Kb	CROMOCORD 2STC	CROMO E225V	CROMOCORD 5	SUPRANOX RS308L	SUPRANOX RS308H	SUPRANOX RS316L
	OE KV5L	CROMO E225	-	-	SUPRANOX 308L	BASINOX 308H	SUPRANOX 316L
	OE KV5HR	OE KV3L	-	-	BASINOX 308L	-	BASINOX 316L
	-	OE KV3HR	-	-	-	-	-
GTAW							
	CARBOROD CrMo1	CARBOROD CrMo2	CARBOROD W225V	CARBOROD CrMo5	INERTROD 308L	INERTROD 308H	INERTROD 316L
	CARBOROD KV5L	CARBOROD KV3L	-	-	-	-	-
	-	CARBOROD W225	-	-	-	-	-
GMAW							
	CARBOFIL CrMo1	CARBOFIL CrMo2	-	CARBOFIL CrMo5	INERTFIL 308L	INERTFIL 308H	INERTFIL 316L
	CARBOFIL KV5L	CARBOFIL KV3L	-	-	-	-	-
FCAW							
	FLUXOFIL 36	FLUXOFIL 37	-	-	FLUXINOX 308L	FLUXINOX 308H	FLUXINOX 316L
	-	-	-	-	-	-	FLUXINOX 316LPP
SAW Flux							
	OP121TT(W)	OP121TT(W)*	OP F537	OP F537	OP F500	OP F500	OP F500
	-	OP F537**	-	OP76	OP 33	OP 33	OP 33
	-	-	-	-	-	-	-
SAW Wire							
	OE-S2CrMo1	OE-S1CrMo2*	OE-CROMO S225V	OE-S1CrMo5	OE-308L	OE-308H	OE-316L
	-	OE-CROMOS225**	-	-	-	-	-
SAW Overlay							
Flux	-	-	-	-	AST 300	-	AST 300
Strip	Multi Pass Layer 1	-	-	-	SUPRASTRIP 24 13L	-	SUPRASTRIP 24 13L
	Layer 2	-	-	-	SUPRASTRIP 19 9L	-	SUPRASTRIP 19 12 3L
ESW Overlay							
Flux - normal speed	-	-	-	-	ELT 300	-	ELT 300
Strip Single layer	-	-	-	-	SUPRASTRIP 21.11L	-	SUPRASTRIP 21.13.3L
Flux - high speed	-	-	-	-	ELT 300S	-	ELT 300S
Strip Single layer	-	-	-	-	SUPRASTRIP 24 13L	-	-
Strip Two layers	Layer 1	-	-	-	SUPRASTRIP 24 13L	-	SUPRASTRIP 24 13 L
	Layer 2	-	-	-	SUPRASTRIP 19.9L	-	SUPRASTRIP 19 12 3L



317	321 & 347	Dissimilar Joining & Buffer Layers			Duplex	Super Duplex	Inconel 600	Inconel 625
		309L	309LMo	309LNb				
SUPRANOX 317	SUPRANOX RS347	SUPRANOX RS309L	SUPRANOX RS309MoL	BASINOX 309LNb	SUPRANOX RS22.9.3L	BASINOX EB25.10.4N	SUPRANEL 600	SUPRANEL 625
-	BASINOX 347	SUPRANOX 309L	SUPRANOX 309MoL	-	SUPRANOX E22.9.3N	-	SUPRANEL RS	-
-	-	BASINOX 309L	BASINOX 309MoL	-	BASINOX 22.9.3N	-	-	-
-	-	-	-	-	-	-	-	-
INERTROD 317	INERTROD 347	INERTROD 309L	INERTROD 309LMo	INERTROD 309LNb	INERTROD 22.9.3	INERTROD 25.10.4	NIROD 600	NIROD 625
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	INERTFIL 347	INERTFIL 309L	INERTFIL 309LMo	-	INERTFIL 22.9.3	INERTFIL 25.10.4	NIFIL 600	NIFIL 625
-	-	-	-	-	-	-	-	-
-	FLUXINOX 347	FLUXINOX 309L	FLUXINOX 309MoL	-	FLUXINOX 22.9.3L	FLUXINOX 347	-	FLUXINOX 625
-	FLUXINOX 347PF	FLUXINOX 309LPF	FLUXINOX 309MoLPF	-	FLUXINOX 22.9.3LPF	FLUXINOX 347PF	-	-
-	OP F500	OP F500	OP F500	-	OP F500	OP F500	OP 76	OP 76
-	OP 33	OP 33	OP 33	-	OP 33	OP 76	-	-
-	-	-	-	-	OP76	-	-	-
-	OE-347	OE-309L	OE-309LMo	-	OE-S2209	OE-S2510	OE-S600	OE-S625
-	-	-	-	-	-	-	-	-
-	AST 300	AST 300	AST 300	AST 300	-	-	AST 600	AST 600
-	SUPRASTRIP 24 13L	SUPRASTRIP 24 13L	SUPRASTRIP 24 13 3L	SUPRASTRIP 24 13LNb	-	-	SUPRASTRIP 600	SUPRASTRIP 625
-	SUPRASTRIP 19 9 LNb	-	-	-	-	-	SUPRASTRIP 600	SUPRASTRIP 625
-	ELT 300	-	-	-	ELT 300	-	ELT 600	ELT 600
-	SUPRASTRIP 21.11LNb	-	-	-	-	-	-	SUPRASTRIP 625
-	ELT 300S	-	-	-	-	-	ELT 600S	ELT 600S
-	SUPRASTRIP 24.13LNb	-	-	-	-	-	-	-
-	SUPRASTRIP 24 13L	-	-	-	SUPRASTRIP 24.13L	-	SUPRASTRIP 600	SUPRASTRIP 625
-	SUPRASTRIP 19 9LNb	-	-	-	SUPRASTRIP 21.8.3L	-	SUPRASTRIP 600	SUPRASTRIP 625



Special considerations for welding consumables for the petrochemical industry



Temper Embrittlement

Low alloy steels containing Cr, Mo and perhaps V, are used to accommodate the high working stress levels at elevated temperatures, e.g. 300-600 °C, and can resist corrosion by sulphurous-acid environments. They can also resist hydrogen attack at elevated temperatures and pressures. However these CrMo low alloy steels are susceptible to temper embrittlement, or the decrease in notch toughness when heated or cooled through the temperature range of ~400-600 °C.

The main embrittling elements are the mobile impurities, antimony, phosphorus, tin and arsenic.

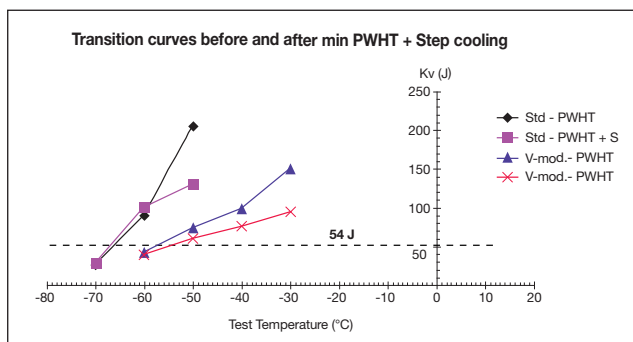
Two compositional parameters are usually used to assess the propensity to temper embrittlement of weld metals, the Watanabe or "J" factor and the Bruscato or "X" factor.

$$J = (Mn+Si)(P+Sn) \times 10^4 \text{ (in weight \%)}$$

$$X = (10P + 5Sb + 4Sn + As) / 100 \text{ (in ppm)}$$

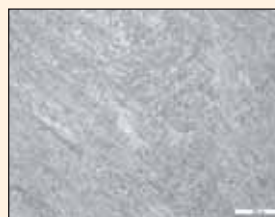
OERLIKON consumables for these applications can be supplied certificated to levels of these factors indicating low risk of temper embrittlement: $J < 150 - X < 15$.

Special heat treatment cycles have been developed, "Step Cooling", to reveal susceptibility to temper embrittlement and data are available for a range of OERLIKON consumables. Typical Step cooling tests results of the 2 $\frac{1}{4}$ Cr1Mo standard and 2 $\frac{1}{4}$ Cr1MoV modified weld metal are shown in the diagram.



The weld metal is required to satisfy high tensile strength at room and elevated temperatures and excellent ISO-V impact properties at temperatures* below 0 °C after minimum post weld heat treatment. A fully bainitic microstructure is required to satisfy the mechanical requirements.

Oerlikon consumables for welding 1 $\frac{1}{4}$ Cr1 $\frac{1}{2}$ Mo - 2 $\frac{1}{4}$ Cr1Mo-2 $\frac{1}{4}$ Cr1MoV base materials satisfy the more stringent technical requirements for the step cooling test. Consult OERLIKON technical literature or call OERLIKON Service for full details.



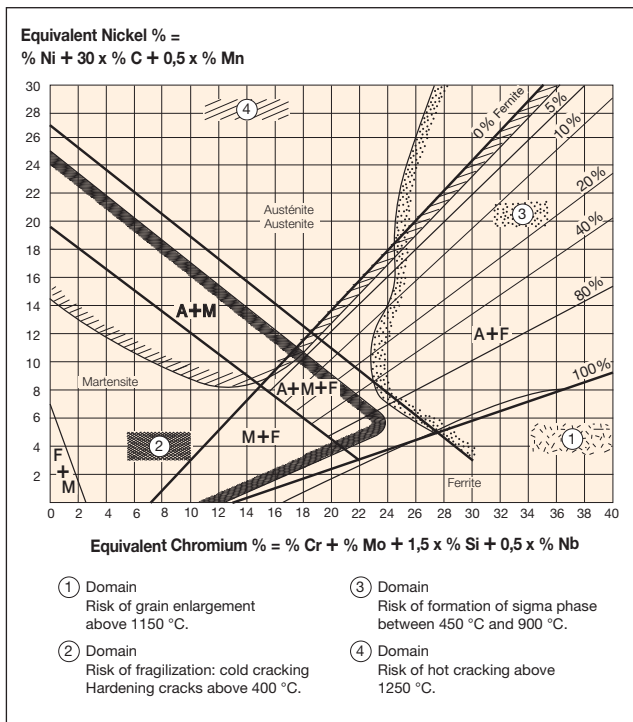
* -18 °C 1 $\frac{1}{4}$ Cr1 $\frac{1}{2}$ Mo / -29 °C 2 $\frac{1}{4}$ Cr1Mo / -29 °C 2 $\frac{1}{4}$ Cr1MoV

Ferrite control in stainless steels


Austenitic stainless steels are straightforward to weld because hydrogen cannot cause cracking. Therefore there is no need to pre-heat, indeed it is preferable to keep the work piece cool to avoid metallurgical problems and distortion. The main potential problem when welding CrNi austenitic stainless steels is hot cracking which is a combination of solidification cracking and low ductility at around 1,000 °C. This hot cracking can appear in craters, along the weld bead centre line, form herringbone extensions from the centre line crack or be very fine in the form of microscopic fissures. This cracking is suppressed by having a small amount of ferrite in the austenitic matrix.

A widely used tool for assessing the relationship between chemical composition and microstructure, and hence the ferrite content, is the Schaeffler diagram, developed in the 1940s. The diagram is used as a practical engineering tool to predict weld metal microstructures in stainless steels and to avoid weld metal compositions which will be prone to cracking.


Schaeffler diagram



Macrostructure:
Ferrite in Duplex weld metal



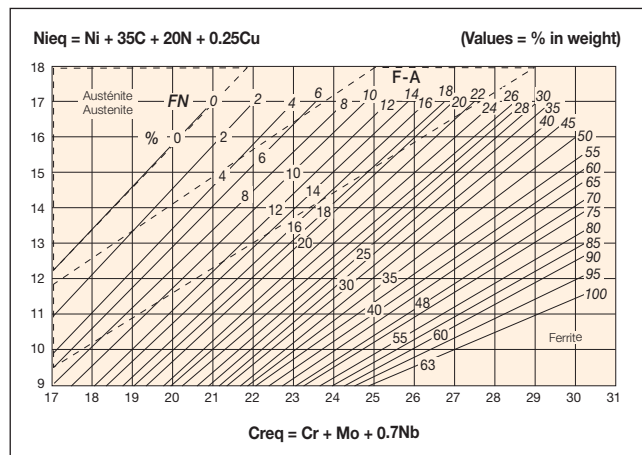
Microstructure:
Ferrite in 347 weld metal



Ferrite control is required to reduce susceptibility to hot cracking and to ensure the mechanical properties and corrosion resistance of the weld metal, with or without post weld heat treatment. Whatever the application, there is an appropriate OERLIKON welding consumable, which can be supplied with full certification.

The Schaeffler diagram does not predict duplex microstructures, as there is no allowance for nitrogen. In this respect the DeLong diagram was developed which has been largely replaced by the WRC diagram.

WRC Diagram



Ferrite content is measured or evaluated by the following methods:

- Chemical analysis using a predictive diagram, e.g. WRC diagram
- Metallographic measurement, e.g. point counting
- Magnetic probe, e.g. Feritscope by Fischer

Chemical analysis determines a percentage of ferrite or a ferrite number, the magnetic probe method a ferrite number and the metallographic method a percentage of ferrite. The percentage of ferrite evaluated with the chemical analysis method may be slightly different from the percentage obtained with the metallographic method, and the ferrite number does not correspond precisely to a percentage of ferrite. As a consequence, the ferrite content determined in the weld metal depends upon the method used for the evaluation. In case of dispute, when the measured or calculated value of the ferrite content is very close to the limit of the acceptable range, the metallographic method is usually selected as the reference method.

Weld Overlay



0109-25

Equipment manufactured for the petrochemical industry must be designed to produce excellent resistance to corrosion and/or hydrogen attack. C-Mn, microalloyed and low alloy steels are used to fabricate components such as barrels, heads and nozzles, the material choice being a function of the operating conditions, environment, temperature and pressure.

The use of highly alloyed material for fabrication of the whole component is financially unrealistic for large components. One solution for stainless steels and other highly alloyed materials, such as nickel base alloys, is to deposit a weld overlay on the inner surface of the equipment to resist corrosion and hydrogen attack. The clad plate utilises a thin layer of the costly higher alloyed material which is in contact with the corrosive media, while the lower cost substrate is used to give the desired structural integrity. The application of the high alloyed layer can be accomplished by several methods including, dual rolling, explosive bonding and weld overlay.

Weld overlay gives the designer and fabricator:

- Flexibility to choose a wide variety of load bearing materials as substrates.
- Wide variety of wire/strip chemistries to deposit the correct deposit chemistry to resist the different corrosive media and operating conditions.
- Ability to meet the complex design shapes of finished components.

In refinery and petrochemical equipment, hydrogen is present at high pressure and high temperatures. Hydrogen in contact with the carbon of the base material forms methane, CH₄, which causes decarburization, which may subsequently result in cracking. During shut down periods and cooling to ambient temperature, hydrogen can remain trapped at the interface between the base material and the weld overlay.

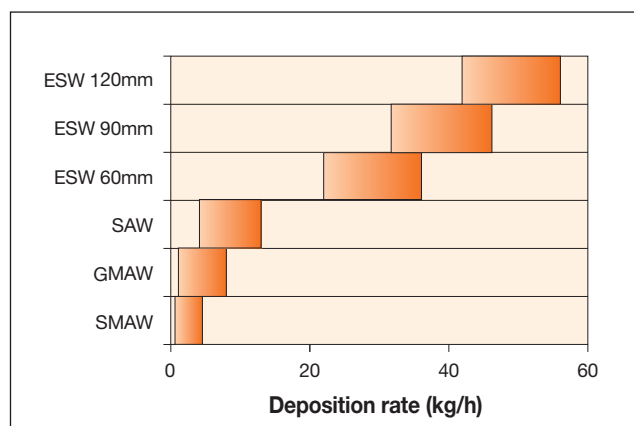
Locally the hydrogen pressure can become very high, so high that the weld overlay can separate from the base material, resulting in disbonding. In practice, defects are detected using UT and if the percentage defect area exceeds 5-10% of the total area of sample, then the welding procedure will be rejected. OERLIKON weld overlay consumables are designed to resist disbonding and these products are tested to the requirements of ASTM G 146.

The two processes most used for weld overlay are submerged arc, SAW, and electro-slag, ESW.

The final chemical analysis required, e.g.347, 316L, 625, 825 must be achieved, typically at 3 mm from the surface of the weld overlay. Minimising

dilution from the parent plate during weld overlay is an important factor, as is the penetration of the welding process, which plays a major role in obtaining the target chemical analysis. The electroslag weld overlay process has a significantly higher deposition rate than weld overlay using the submerged arc process and the dilution is significantly lower with the electroslag process. Lower dilution is a strong process advantage of electroslag weld overlay compared to submerged arc weld overlay as the desired composition can be achieved in a single layer, for example with 300 series compositions. There is the potential to save one layer in 600 series overlay applications, with the number of layers depending on the maximum iron content required.

Process	MMA	MIG	Submerged Arc SAW		Electro Slag ESW		
			Single, 4 mm	60 mm strip	60 mm strip	90 mm strip	120 mm strip
Deposition Rate Typical kg/hr	2	4	7	20	30	40	50
Dilution Typical %	20-40	20-45	40-70	15-30	7-18		





A selection from the OERLIKON weld overlay consumables range is given below. Initially for submerged arc welding fluxes in combination with OE-Suprastrips and then for electro slag fluxes in combination with OE-Suprastrips.

SUPRASTRIP is supplied in three widths, 30, 60 & 90 mm by 0.5 mm thickness:

SUPRASTRIP	Conformance	Chemical Composition, typical wt %							
		C	Mn	Si	Cr	Ni	Mo	Nb	Others
SUPRASTRIP 19 9L	AWS SFA 5.9: EQ 308L	<0.015	1.9	0.3	20	10.5	-	-	-
SUPRASTRIP 19 9LNb	AWS SFA 5.9: EQ 347	<0.020	1.9	0.3	19.7	10.7	-	0.5	-
SUPRASTRIP 19 12 3L	AWS SFA 5.9: EQ 316L	<0.020	1.9	0.3	18.5	12.6	2.7	-	-
SUPRASTRIP 21 11L	AWS SFA 5.9: EQ ~309L	<0.015	1.9	0.3	21	11.5	-	-	-
SUPRASTRIP 21 11LNb	AWS SFA 5.9: EQ ~347	<0.020	1.9	0.2	21	11	-	0.7	-
SUPRASTRIP 21 13 3L	AWS SFA 5.9: EQ ~309LMo	<0.015	1.9	0.2	20.5	13.7	2.8	-	-
SUPRASTRIP 24 13L	AWS SFA 5.9: EQ 309L	<0.015	2	0.3	23.5	13.3	-	-	-
SUPRASTRIP 24 13LNb	AWS SFA 5.9: "EQ 309LNb"	<0.020	2	0.2	24	12.7	-	0.8	-
SUPRASTRIP 600	AWS SFA 5.14: EQ NiCr-3	<0.03	3	0.2	20	>65	-	2.5	Fe < 1
SUPRASTRIP 625	AWS SFA 5.14: EQ NiCrMo-3	<0.05	0.3	0.1	22	>58	9	3.8	Fe < 0.5
SUPRASTRIP 20 25 5LCu	AWS SFA 5.9: EQ 385	<0.025	1.8	0.4	20.5	25	4.5	-	Cu 1.5
SUPRASTRIP 22 8 3L	AWS SFA 5.9: EQ 2209	<0.02	1.5	0.5	23	9	3	-	N

There are two Oerlikon AST submerged arc fluxes for weld overlay, used in combination with OE Suprastrips. These OE-AST fluxes are designed for the flat position and circumferential weld overlay applications, as follows:

Flux Designation	Conformance	Description
AST 300	EN 760: S A CS 2Cr	Agglomerated flux for weld overlay with stainless alloy strips Cr-Ni, Cr-Ni-Mo and Cr-Ni-Nb stabilised. Good wettability and excellent slag release
AST 600	EN 760: S A AB 2	Agglomerated basic flux for weld overlay with nickel base alloy strips, e.g. 625 as well as fully austenitic strip. High resistance to hot cracking. Excellent welding characteristics and slag release.

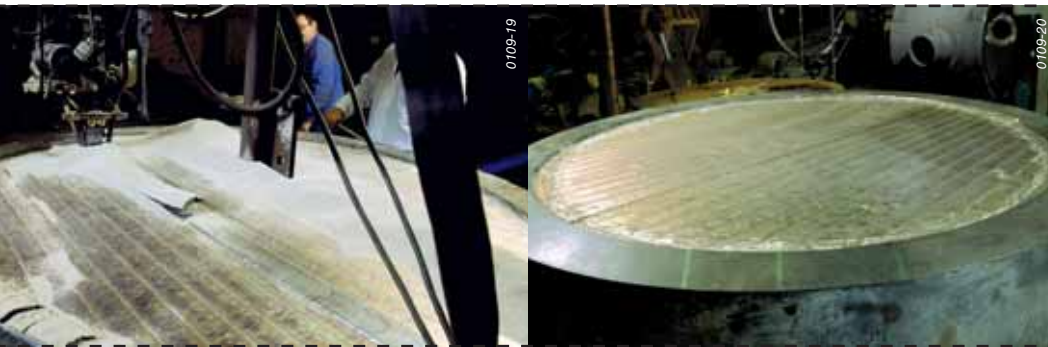
The Oerlikon ELT fluxes are for electroslag weld overlay and are used in combination with OE Suprastrips. These OE-ELT fluxes are designed for the flat position and circumferential weld overlay applications, as follows:

Flux Designation	Conformance	Description
ELT 300	EN 760: S A FB2	General purpose agglomerated basic flux for weld overlay with austenitic as well as duplex and fully austenitic Cr-Ni-Mo grades. Good wetting and slag release.
ELT 300S	EN 760: S A FB2	High speed agglomerated basic flux for weld overlay with stainless alloy Cr-Ni, Cr-Ni-Mo and Cr-Ni-Nb stabilised strips. Very good wetting and excellent slag release.
ELT 316-1	EN 760: S A FB 2 Cr Ni Mo	Agglomerated highly basic flux for single layer weld overlay with Suprastrip 19 12 3 L. Excellent welding characteristics and slag release.
ELT 347-1	EN 760: S A FB 2 Cr Ni	Agglomerated highly basic flux for single layer weld overlay with Suprastrip 19 9 LNb. Excellent welding characteristics and slag release.
ELT 600	EN 760: S A FB2	Agglomerated highly basic flux for weld overlay with nickel base alloy strips.
ELT 600S	EN 760: S A FB2	High speed agglomerated basic flux for weld overlay with nickel base alloy strips. Excellent slag removal, good wettability and low flux consumption.



For information on the complete range of products for weld overlay, consult OERLIKON technical literature or www.oerlikon-welding.com.

Weld Overlay



The key applications by final composition required are tabulated below for the OERLIKON submerged arc and electro-slag fluxes used with OE Suprastrips. It is assumed that the substrate is structural steel in all cases. The solutions illustrated below include two layer solutions for submerged arc overlay and for

electro-slag overlay there are both single layer and two layer procedures with regular speed and high speed electro-slag fluxes. Please consult OERLIKON service to discuss the most cost effective procedure for the application.

Application	Process	Flux	Number of Layers	Layer 1	Layer 2	Typical parameters SUPRASTRIP: 60 mm x 0.5 mm	Deposition Rate kg/hr
347	SAW	AST 300	2	SUPRASTRIP 24 13L	SUPRASTRIP19 9LNb	900 A / 28 V / 15 cm/min	17
	ESW	ELT 300	1	SUPRASTRIP 21 11LNb	-	1200 A / 24 V / 17 cm/min	25
		ELT 300	2	SUPRASTRIP 24 13L	SUPRASTRIP19 9LNb	1200 A / 24 V / 20 cm/min	25
	ESW HP*	ELT 300S	1	SUPRASTRIP 24 13LNb	-	1600 A / 24 V / 35 cm/min	35
		ELT 300S	2	SUPRASTRIP 24 13L	SUPRASTRIP 19 9LNb	1500 A / 24 V / 35 cm/min	32
ESW SL**	ELT 347-1	1	SUPRASTRIP19 9LNb	-	1200 A / 24 V / 17 cm/min	25	
304L	SAW	AST300	2	SUPRASTRIP 24 13L	SUPRASTRIP 19 9L	900 A / 28 V / 15 cm/min	17
	ESW	ELT 300	1	SUPRASTRIP 21 11L	-	1200 A / 24 V / 17 cm/min	25
		ELT 300	2	SUPRASTRIP 24 13L	SUPRASTRIP 19 9L	1200 A / 24 V / 20 cm/min	25
	ESW HP*	ELT 300S	1	SUPRASTRIP 24 13L	-	1600 A / 24 V / 35 cm/min	35
		ELT 300S	2	SUPRASTRIP 24 13L	SUPRASTRIP 19 9L	1500 A / 24 V / 35 cm/min	32
316L	SAW	AST 300	2	SUPRASTRIP 24 13L	SUPRASTRIP 19 12 3L	900 A / 28 V / 15 cm/min	17
	ESW	ELT 300	1	SUPRASTRIP 21 13 3L	-	1200 A / 24 V / 17 cm/min	25
		ELT 300	2	SUPRASTRIP 24 13L	SUPRASTRIP 19 12 3L	1200 A / 24 V / 20 cm/min	25
	ESW HP*	ELT300S	2	SUPRASTRIP 24 13L	SUPRASTRIP 19 12 3L	1500 A / 24 V / 35 cm/min	32
	ESW SL**	ELT 316-1	1	SUPRASTRIP 19 12 3L	-	1200 A / 24 V / 17 cm/min	25
904L	ESW	ELT 300	2	SUPRASTRIP 20 25 5LCu	SUPRASTRIP 20 25 5LCu	900 A / 24 V / 18 cm/min	18
Duplex 2209	ESW	ELT 300	2	SUPRASTRIP 24 13L	SUPRASTRIP 21 8 3L	900 A / 24 V / 18 cm/min	18
600	SAW	AST 600	2	SUPRASTRIP 600	SUPRASTRIP 600	800 A / 26 V / 12 cm/min (Fe < 4%)	17
	ESW	ELT 600	2	SUPRASTRIP 600	SUPRASTRIP 600	1100 A / 24 V / 17 cm/min (Fe < 3%)	20
	ESW HP*	ELT 600 S	2	SUPRASTRIP 600	SUPRASTRIP 600	1500 A / 24 V / 35 cm/min (Fe < 5%)	32
625	SAW	AST 600	2	SUPRASTRIP 625	SUPRASTRIP 625	800 A / 26 V / 12 cm/min (Fe < 3%)	17
	ESW	ELT 600	1	SUPRASTRIP 625	-	1200 A / 24 V / 17 cm/min (Fe < 7%)	25
	ESW	ELT 600	2	SUPRASTRIP 625	SUPRASTRIP 625	1100 A / 24 V / 15 cm/min (Fe < 2%)	20
	ESW HP*	ELT 600 S	2	SUPRASTRIP 625	SUPRASTRIP 625	1500 A / 24 V / 35 cm/min (Fe < 5%)	32

* HP=High Productivity **SL=Single Layer



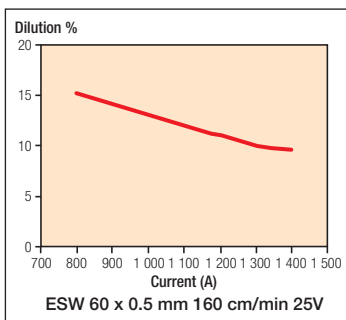
Weld overlay using the submerged arc and electroslag processes



Dilution

Dilution plays a major role when weld overlaying and determines the chemical composition of the deposit. The degree of dilution is the amount of parent metal melted and mixed in with the filler metal, in this process the strip electrode, which is vitally important.

Excessive dilution is responsible for inadequate physical-chemical properties of weld overlays. Dilution is strongly dependant on the current intensity and to reduce the impact of dilution, it is necessary to increase the heat input.



To achieve a weld overlay with the required composition in an industrial application, it is mandatory to control thoroughly all the process variables: current, voltage, speed and interpass temperature.

Current intensity and overlaying speed have a strong impact on layer geometry. An increase in the overlaying speed results in a decrease in the layer thickness and an increase in the dilution. An increase in the current intensity at a constant overlaying speed decreases dilution.

The Influence of strip "stick-out"

The current intensity and the "stick-out" determine the heating of the strip electrode. When the stick-out increases, the strip

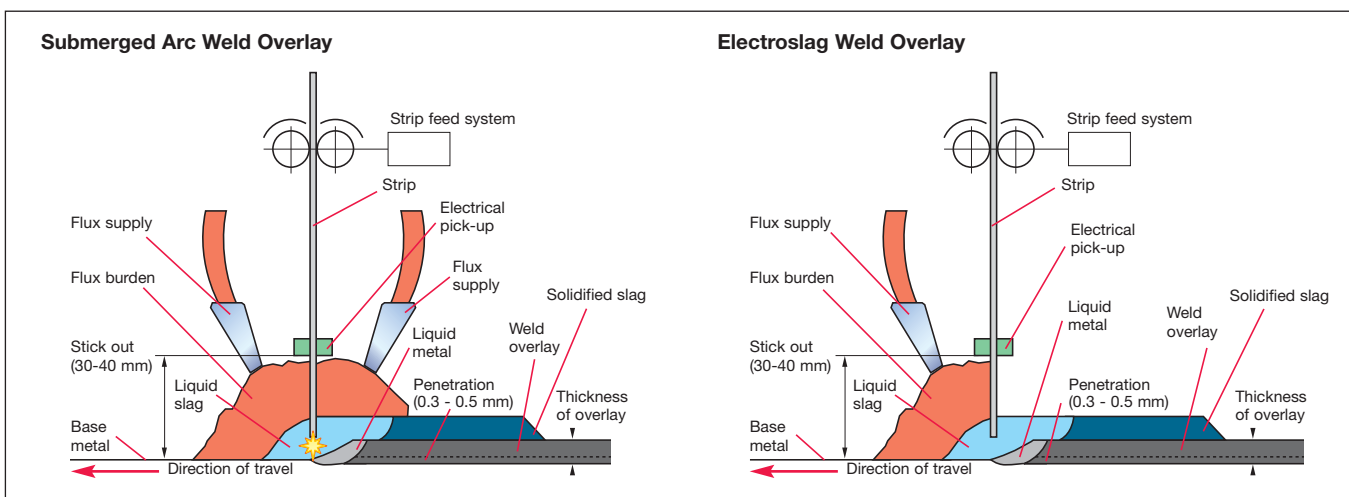
electrode melting rate increases with a resulting tendency to increase the layer thickness and decrease penetration and dilution. The stick-out generally ranges from 20 to 40 mm. Stick out has a strong influence on the extent of dilution of the deposit from the base plate.

Bead overlap

The bead overlap is the distance between the edge of the strip and the toe of the previous weld bead. In order to obtain a smooth tie-in between two beads and to obtain a smooth weld surface, the overlap between two beads requires careful control and adjustment. The overlap needs to be adjusted between 5 and 10 mm depending on the fluidity of the deposited metal, flux type and thickness of the bead. The general principle is that the thicker the bead, the smaller the overlap. In practice, with the electroslag process, for bead thicknesses around 4.5 mm, the overlap is between 8 and 10 mm. Additional magnetic steering devices also contribute to a smooth overlap with a minimum of height mismatch between beads.

Flux burden

The depth of the flux burden is adjusted by the positioning of the flux hopper. The normal flux burden is about 5 mm higher than the stick-out of the strip electrode. A higher flux burden will result in increased flux consumption and this extra quantity of flux impedes degassing with the risk of marks on the weld bead surface. When circumferential cladding and for wide strips, a high flux burden may be used to reduce spatter and improve molten slag control.



Product packaging Welding consumables



Flux cored wire

Drums (ROUNDPACK)

Heavy duty cardboard drums

- 320 kg & 600 kg formats,
- 100% recyclable,
- Reliable rapid pay off at high wire feed speeds,
- Fitted sling points for handling safety,



Spool

- B 300
- 100% recyclable

SAW

Fluxes

Sacks

- Weld sealed
- 100% recyclable ("4")
- Easy to handle
- Effective flux protection from the environment
- Supply: 1 tonne (40 sacks x 25 kg) per pallet



2006-943



2007-474

DRY BAG

This new packaging solution has been developed by the Air Liquide Welding research teams for OERLIKON submerged arc welding fluxes. DRYBAG packaging system features:

- Triple layer composite technology system
- Fully moisture proof
- Low vacuum
- Protection from atmospheric humidity
- Designed for the most hostile ambient conditions
- Protection during extended transport and storage
- Supply: 1 tonne (40 sacks x 25 kg DRYBAG) per pallet

TIG

Rods

- 1.6, 2.0 & 2.4 mm diameter in 1 m lengths
- Full range of compositions
- Alloy grades are coin stamped
- Bright finished
- Fully certificated



2008-187

2006-940

MMA

Standard Packaging

- Reliable protective packaging for most applications
- 3 packets per outer carton
- Packet weight ~5 kg



2006-987

Vacuum Packaging

- No re-conditioning required before use
- No quivers or holding ovens are required
- Ideal for on site applications
- Simplified QA procedures



2006-939

DRY

- Pack contents ~1 kg
- Supplied in outer cartons ~15 kg



2009-012

VPMD

- Pack contents ~3 kg
- Supplied in outer cartons ~15 kg

Wires

- Spool B450
- 100% recyclable
- Supply: 1 tonne (40 coils x 25 kg) per pallet



2006-936

Weld overlay

Flux drums

- Hermetically sealed steel drums
- Containing 30 kg flux
- No flux reconditioning required from sealed drum



0109-33

Strip

Full range of stainless and high nickel alloys.

- 30 x 0.5 mm, 25 kg coils, 300 mm internal diameter, 475 mm overall diameter
- 60 x 0.5 mm, 50 kg coils, 300 mm internal diameter, 475 mm overall diameter
- 90 x 0.5 mm, 50 kg coils, 300 mm internal diameter, 425 mm overall diameter
- Bright finished
- Fully certificated



0109-32

Arc equipment

MMA electrode power sources



MMA electrode power sources

OERLIKON propose a wide range of equipment for MMA welding. This is a selection of units for on site applications in all conditions.



CITOARC 1800 HPF

- Very light and portable unit for maintenance
- Ultra flexible for light duty and flexible finishing applications
- Possibility to weld with very long primary cable (up to 70 m)



2009-092

CITOARC 3500i

- Multi-process (MMA, Gouging, TIG DC, MIG) inverter unit
- Welding MMA electrodes up to Ø 6.3 mm
- MIG welding with the DV 4004 wire feeder option
- CC/CV 3phase unit
- Weighing only 29 kg



2006-762

CITOARC 2200i VRD

- Portable 3 phase unit for heavy applications and maintenance operations

- Generator compatible
- Built-in Voltage Reduction Device for higher security, for welding all types of MMA electrodes, including cellulosic
- Inverter technology



2009-055

CITOROD 6500 XT

- For the heaviest duty applications including arc air gouging
- Thyristor technology
- Multiprocess (MMA, Gouging, TIG DC, MIG) - 3 phase unit,
- Possibility of MIG/MAG welding using DEVIDARC an autonomous wire-feeder.

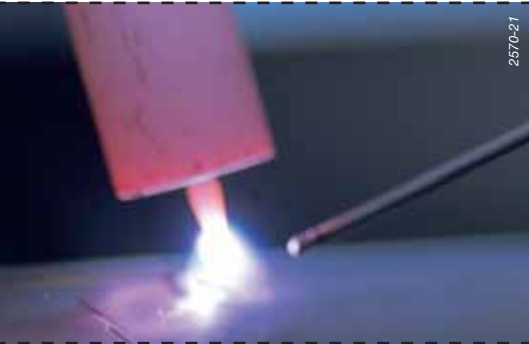


2008-800

Technical specifications:	CITOARC 1800 HPF	CITOARC 2200i VRD	CITOARC 3500i	CITOROD 6500 XT
Primary				
Power supply	230 V single-phase	400 V three-phase	400 V three-phase	230 - 400 V three-phase
Effective consumption	15 A	9 A	28.5 A	102 - 60 A
Secondary				
Open circuit voltage	44 V	105 V (14 V rest voltage)	91 V	75 V
Welding current	10 - 180 A	5 - 220 A	5 - 350 A	10 - 630 A
Duty cycle 10 min. cycle (at 40 °C)	180 A at 20%	220 A at 35%	350 A at 35%	630 A at 35%
Diam. Electrode	MMA	1.6 to 4.0 mm	1.6 to 6.0 mm	1.6 to 6.3 mm
	Gouging	-	-	Up to 10 mm
Dimensions (L x W x H)	170 x 320 x 395 mm	250 x 470 x 450 mm	525 x 300 x 390 mm	1000 x 600 x 600 mm
Net weight	6.6 kg	19 kg	29 kg	176 kg

Arc equipment

TIG welding installations



2570-21

TIG welding installations

OERLIKON high-performance TIG machines, are designed for on-site durability and premium quality results. This inverter range equips welders for a wide diversity of activities in both regular and high-tech applications.



CITOTIG

Optimised performance and advanced functionality:

- CITOSTEP double current level function, allows the power input to be changed without interruption when welding
- Synergic pulse function, for ease of setting the pulsed current parameters
- Storage facility for welding parameters
- Reliability designed in with an efficient isolated cooling system which prevents dust and small metal particles from penetrating the machine interior
- Optional low voltage OCV with Voltage Reduction Device available
- Generator compatible (except CITIG)

The DC sets are used for TIG welding stainless and structural steels and have the flexibility to weld with all types of MMA welding electrodes, with excellent arc characteristics, in addition the AC/DC installations can be used for welding light alloys.



Technical specifications:	DC welding			AC/DC welding	
	CITOTIG II 200 DC	CITOTIG II 300 DC (W)	CITOTIG II 400 DC W	CITOTIG 240 AC/DC (W)	CITOTIG 310 AC/DC (W)
Primary					
Power supply	230 V single-phase	400 V three-phase		230 V single-phase	400 V three-phase
Consumption	15 A	6.6 A	11 A	23 A	11 A
Secondary					
Open circuit voltage	80 V	80 V	80 V	58 V	63 V
Welding current	5 - 200 A	5 - 300 A	5 - 400 A	3 - 230 A	3 - 300 A
Duty cycle 10 min. cycle (at 40 °C)	200 A at 30%	230 A at 60%	285 A at 60%	200 A at 60%	230 A at 60%
Diam. Electrode	1.6 to 4.0 mm	1.6 to 5.0 mm	1.6 to 6.0 mm	1.6 to 3.2 mm	1.6 to 6.0 mm
Other					
Dimensions (L x W x H)	410 x 180 x 390 mm	500 x 180 x 390 mm 500 x 180 x 650 mm in W version	500 x 180 x 650 mm	475 x 200 x 405 mm	505 x 195 x 440 mm
Net weight	15 kg	22 kg / 32 kg in W version	33 kg	17 kg	74 kg
Cooling unit	No	Yes in W version	Yes	Yes in W version	Yes in W version

Automatic balance for AC welding with CITOTIG 310 AC/DC

The balance values change automatically according to current settings and the form of electrode adopted.

- Optimised balance value,
- Same electrode diameter throughout the whole current spectrum,
- Same type of electrode for DC or AC current,
- Reduces electrode changes and wear part consumption.

The CITOSTEP function in the CITOTIG range

With the CITOSTEP function, two current levels can be chosen, the welding current and the basic current. This facilitates the change from one to the other by rapidly pressing the torch trigger. The CITOSTEP function can be used to adjust heat input momentarily, to change welding positions or to replenish the filler metal supply without having to stop welding.

Accessories

This very high-tech range of TIG equipment has all the product features required by the most skilled welders for the widest range of demanding applications. For maximum functionality, there is a full range of accessories, such as hand- or foot-operated remote control units and trolleys.

Plasma cutting



1909-01

Plasma cutting installations

OERLIKON has a complete Manual Plasma cutting range for all applications.



From the CITOCUT K, a single phase unit with integrated compressor, a highly portable unit that cuts up to 6 mm, to the NERTAJET 50, a high performance chopper, multi gas machine that cuts up to 50 mm of steel.

CITOCUT 40i

Heavy duty portable cutting unit inverter technology.

- Quality cut, up to 40 mm,
- Contact cut, distance cut, plasma gouging,
- Blow back start, no HF interference,
- Grid cutting capability.



2007-117

CITOCUT 40C

Product features:

- High cutting capacity: 40 mm with 120 A
- High duty cycle: 50% at 40 °C
- 4 steps for setting the current according to the thickness to cut
- IP 23 for indoor and outdoor applications
- High quality cut with drag cutting nozzles
- Delivered ready to use with 6 m torch, air hose, primary cable, earth cable, starting set of wear parts
- Input voltage three-phase: 220/230/380/400 V - 50/60 Hz
- Torch with central connector



2010-260

NERTAJET 50

Work of high quality and precision with contact cutting.

Product features and advantages:

- Multi-voltage three-phase,
- Intensive work (100% duty cycle),
- Well suited for stainless steels and light alloys with Ar/H₂ up to 50 mm,
- Plasma gouging,
- Manual or automatic applications,
- Assistance gas use possible to improve quality cutting in large thickness,
- Water cooled torches,
- Chopper (secondary power transitions) technology.



2007-280

Technical specifications:	CITOCUT 40i	CITOCUT 40C	NERTAJET 50
Technology	Inverter	Transformer	Chopper
Maximum thickness	40 mm	35 mm	50 mm
Primary power supply (3 phase)	400 V	220/230/380/400 V	230/400/415/440 V
Maximum consumption	40 A	40 A (400 V)	60 A (415 V)
Cutting intensity	Up to 120 A	Up to 120 A	Up to 150 A
Dimensions (L x W x H)	720 x 310 x 430 mm	500 x 855 x 705 mm	1170 x 710 x 1200 mm
Weight	35 kg	125 kg	260 kg



1909-12

Arc equipment

MIG/MAG manual installations

MIG/MAG welding equipment

OERLIKON CITOMAG and CITOPULS ranges of heavy-duty MIG/MAG machines have a comprehensive array of features focused on the requirements of major fabricators. Durable design is combined with easy-to-use control panels and a variety of synergic programmes, combining improved productivity with high quality results.



CITOMAG

Thyristor technology for heavy duty applications

CITOMAG range is a thyristor based soft current MIG-MAG welding installation, with a separate four roll wire feeder unit, to weld unalloyed steel, stainless steel and light alloys, using solid wire and cored wire. OERLIKON expertise is automatically available to the welders and therefore the installations are straight forward to us:

- Maximum power at 60 % duty cycle (40 °C)

- Rapid access to the correct welding parameters
- Complete welding cycle with Hot Start and crater filler
- Optional water cooled configuration
- Easy to use with fast parameter changes using the CITO system



2008-042

CITOPULS II

Digital technology for advanced welding installations

CITOPULS II is the only product on the MIG/MAG welding market offering superior quality welding and advanced welding processes with a simple interface at the price of standard welding equipment. Moreover DIGIPULS II is designed in a modular system for a better fit with the users' requirements.

- Superior quality welding and advanced processes and features
- Fully digitally controlled inverter: for process repeatability and consequently higher welding quality and simpler regulation
- In Synergic mode, more than 100 synergies are available
- Soft switching inverter (increased efficiency of the power source)
- Full range of processes:
 - Standard MIG/MAG
 - Pulsed MIG/MAG
 - MIG brazing
 - Speed Short Arc™ (for high quality thin sheet welding & root pass)
 - Spray Modal™ (special for high quality welding of aluminium)
 - Cold Double Pulse (producing very high quality welds on thin material)
 - MMA coated electrodes
- Powerful installation up to 420 A at 60%
- Storage of 100 welding programs (with expert wire feeder DVU P500 or advanced remote control RC JOB)
- Parameter locking with a digit code (with expert wire feeder DVU P500 or advanced remote control RC JOB). When this function is activated, the welder can still fine-tune the parameters in a +/- 20% range
- A user interface (Power source and wire feeder) designed for a really easy to use front panel



2010-901

Specify and build your installation:

- Power sources
- Wire feeders
- Cooling unit
- Harnesses (up to 50 m for on site applications)
- Trolleys for the installation and the wire-feeder
- Remote control
- Torches (standard, with potentiometer, push-pull, automatic..)
- More benefits for the user
- Small machine for easier access
- Light installation (37 kg for the power source)
- Compatible with motor generator
- A powerful 4-wheel feeder unit with **drive rollers** as standard



1877-48



2006-026

CITOWAVE MXW

Product features and advantages:

Same as the CITOPULS range with in addition:

- Control of aluminium welding (Spray Modal™): special welding transfer which provides reduced porosity and increases the penetration
- Advanced torch "DIGITAL": a range of ergonomic torches with the possibility on the handle to - select the program number - adjust the wire feed speed - adjust the arc length
- More processes: Soft current, Pulsed, SSA, SSP, SM, CDP, MIG brazing, MMA, and PR Spray
- More memory: 153 welding programs on CITOWAVE MXW for all welding applications. The power sources also allow memorisation of 100 programs, selectable from the wire feeder, remote control and CITORCH M E family

- More controls: parameters monitoring, indication of defects, parameter blocking on several levels, printing, 99 programs, calibration...

Technical specifications:	CITOMAG 500W	CITOPULS II 420	CITOWAVE 400	CITOWAVE 500
Technology	Thyristor		Inverter	
Primary power supply (3 phase)	220/230/240/380/400/415/440 V		400 V	
Primary consumption @ I max	45 A (400 V)	35 A	35 A	45 A
Welding current	40 A - 520 A	20 A - 420 A	20 A - 400 A	20 A - 500 A
Duty cycle 10 min. cycle (at 40 °C)	520 A @ 60%	400 A @ 60%	400 A @ 60%	500 A @ 60%
Suitable wire diameter	0.8 to 1.6 mm			

Process advantages for a perfect assembly:

This new generation of power sources provides new welding methods able to meet quality and productivity levels to answer the needs of fabrication for cryogenic applications.

Process	Definition	Customer advantages	Power source
Speed Short Arc™ (SSA)	The Speed Short Arc™ allows a high travel speed due to a rigid arc and a cold regime. It is very effective for welding thin steel plates, working in position and in closed angle and filling bevels. The SSA™ is used for short circuit welding though the normal globular regime travel speed domain.	<ul style="list-style-type: none"> ■ Increase in travel speed ■ Reduced distortion (thin steel sheets) ■ Suited to welding in position ■ Tolerance and usability 	CITOWAVE CITOPULS II
Soft Silence Pulse™ (SSP)	The Soft Silence Pulse™ is a quieter pulsed mode mainly intended for stainless steel welding applications. The SSP™ produces a softer but very stable arc with good wetting of the weld bead. This waveform significantly reduces spatter and gives a very fine appearance to the weld bead.	<ul style="list-style-type: none"> ■ Reduction of noise ■ Good wetting of the weld bead ■ Reduction of spatter ■ Good weld bead appearance 	CITOWAVE
Cold Double Pulse™ (CDP)	The Cold Double Pulse™ produces very high quality welds on thin material while avoiding distortion. CDP™ gives a TIG appearance to the weld and is very effective on very thin aluminium or stainless steel sheet (< 2 mm). The operating technique is made easier due to good control of the weld pool even on badly-prepared sheets. This sequencer mode automatically chains hot arc and cold arc regimes together.	<ul style="list-style-type: none"> ■ Effective on thin sheets ■ Reduces distortion ■ Easy operating technique ■ TIG appearance weld bead 	CITOPULS II CITOWAVE

Equipment for submerged arc welding



Welding head

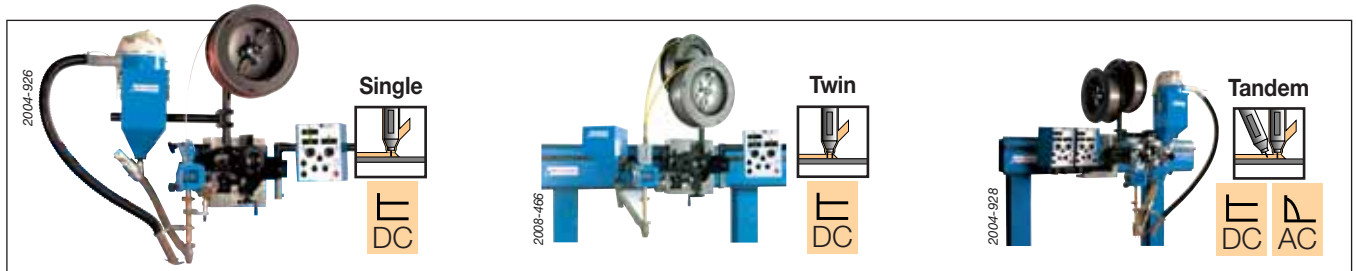
Standard applications SUBARC 5

A complete range of high-performance equipment using microprocessor technology to combine performance, flexibility of use and guaranteed high reliability in welding cycle management.

For the most demanding applications, SUBARC 5 is a compact welding and hard surfacing installation. It allows accurate

pre-setting and pre-selection of the actual welding current and voltage parameters for excellent arc striking every time:

- **Submerged arc welding:**
 - direct current: flat or drooping power source characteristic.
 - alternating current: drooping power source characteristic.
- **MIG/MAG (spray-arc transfer).**
- **Single, twin and tandem options** with flux recycling system.



Special applications

Single or tandem narrow-gap torch.

- Narrow-gap torch/holding device up to 250 mm wall thicknesses,
- Changeable head (standard heads up to 180 mm available),
- Self-centring head on floating bearing,
- Ceramic coating.



Single or twin heavy duty torch.

- Thicknesses
- Adjustable nozzle,
- 2.4 mm to 5.0 mm single wire diameter,
- 2 x 1.6 mm - 2 x 2.0 mm twin wire diameter.



Strip welding head for overlay applications.

- This head is designed for electroslag and submerged arc weld overlay with strip sizes of 30 mm, 60 mm, 90 mm and 120 mm,
- The minimum internal diameter necessary with this head is 700 mm for circumferential seams and 550 mm for longitudinal seams.



STARMATIC power sources

- Rugged, reliable, suitable for aggressive industrial surroundings,
- Fan-cooled, fitted with thermal cut-out, easy to move using crane or forklift,
- Quick connection to the core of the installation by simple and accessible connectors,
- Remote control system,
- Function type:
 - 1 - SAW direct current (DC)
 - 2 - SAW alternating current (AC)
 - 3 - Arc gouging.

	STARMATIC 1303 DC	STARMATIC 1003 AC/DC
Duty cycle at 100%	1 300 A - 44 V	1 000 A - 44 V
Welding range	2 DC	1 AC - 1 DC
Primary power supply	400-440 V 50/60 Hz* three-phase	380/400/415 V 50/60 Hz* three-phase
Technology	Thyristors	Thyristors
Power at 100% duty cycle	99 kVA	98 kVA
External-static characteristics		AC DC
- flat	■	■
- drooping	■	■
Net weight	483 kg	540 kg

* For other primary power supply three-phase, consult Air Liquide Welding.

3A WELDING SYSTEM a new generation of mobile console control device

The 3A Welding System plug & play Mobile Console gives the operator complete mobility and permits the management of both machine and process. This new generation user-friendly interface is easy to use and operators are rapidly able to program the machine efficiently. The multipurpose 3A welding system concept is designed for all arc welding processes, and the equipment remains upgradable with the open architecture.



Advanced mobile console

- Centralised console
- Mobile plug (multi point onto the machine)
- User friendly-interface

Automatic machine management

- Process management
- Machine cycle control
- Integrated peripherals

Architecture based on new concept

- Modular and flexible solutions
- Full digital control

Mobile console: browsing on the screens with a graphic representation of the machine.



Plasma Welding and positioning equipment



2003-208



2003-670

Plasma Welding

NERTAMATIC 450 / SP7 / HPW

An automatic welding process for high quality results.

Main features:

- Welding of carbon steel, stainless steel, inconel, titanium...
- Up to 8 mm thickness butt welding without bevels,
- Total penetration,
- **Even higher productivity with the plasma + TIG process,**
- Very flexible process.



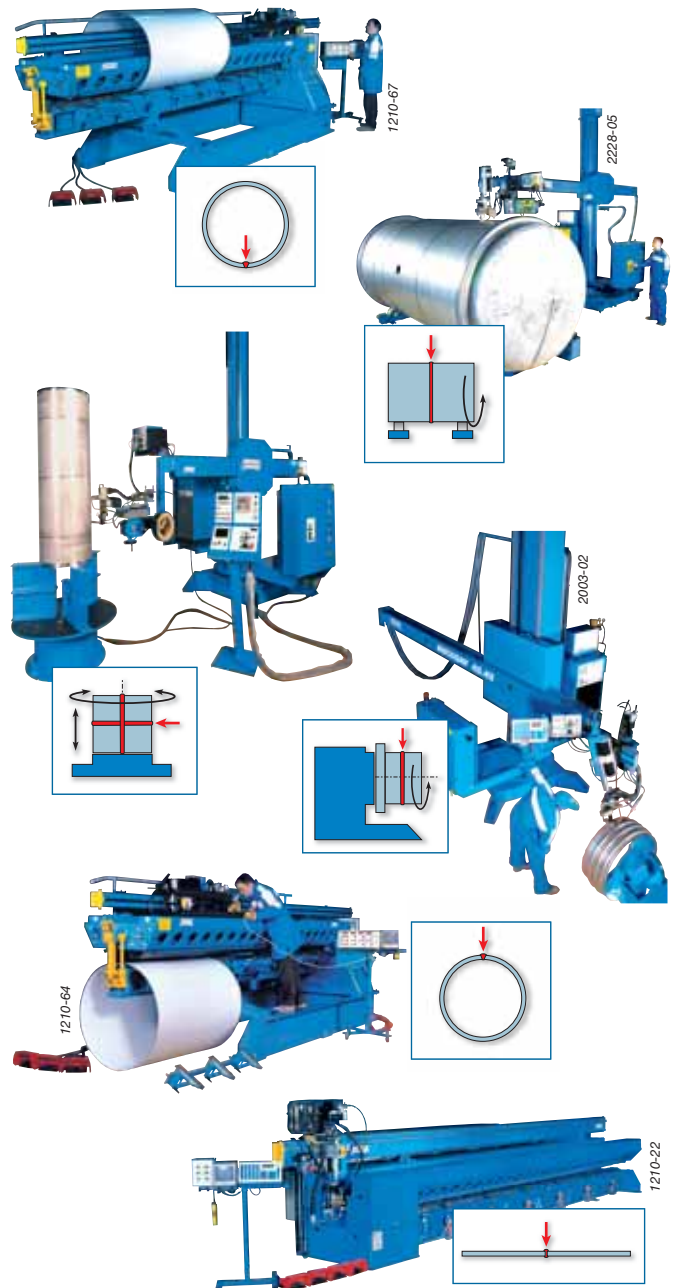
0725-010

Benefits:

- Speed of operation and low deformation to avoid or reduce re-work as well as low build-up to eliminate polishing procedures with respect to the chemical composition of the base material to avoid problems of corrosion.
- Excellent visual appearance which is a quality factor as more and more welds are visible, with repeatability of the quality obtained and a reduction in the preparation times for assemblies by eliminating bevelling for thicknesses up to 8 mm.
- 4- or even 5- fold reduction in welding times in comparison with manual welding, with assurance of complete and regular penetration by virtue of the traversing jet technique (key-hole) on butt joints.
- High quality proof against stringent inspections with excellent reproducibility.
- Produces a faultless weld bead overlap due to precise control of the relevant parameters.

Positioning equipment

A full range of seamers, column and booms, rotators, positioners, turntables and mechanisation equipment for every application (manual or automatic).



1210-67

2228-05

2003-02

1210-64

1210-22

Impact Toughness Conversion Table

J	ft.lb.	J	ft.lb.	J	ft.lb.	J	ft.lb.
20	14.7	48	35.4	76	56.0	104	76.7
22	16.2	50	36.8	78	57.5	106	78.1
24	17.7	52	38.3	80	59.0	108	79.6
26	19.1	54	39.8	82	60.4	110	81.1
28	20.6	56	41.3	84	61.9	112	82.6
30	22.1	58	42.7	86	63.4	114	84.0
32	23.6	60	44.2	88	64.9	116	85.5
34	25.0	62	45.7	90	66.3	118	87.0
36	26.5	64	47.2	92	67.8	120	88.5
38	28.0	66	48.6	94	69.3	122	89.9
40	29.5	68	50.1	96	70.8	124	91.4
42	30.9	70	51.6	98	72.2	126	92.9
44	32.4	72	53.1	100	73.7	128	94.4
46	33.9	74	54.5	102	75.2	130	95.8

J	ft.lb.	J	ft.lb.	J	ft.lb.
132	97.3	160	118.9	188	138.5
134	98.8	162	119.4	190	140.0
136	100.3	164	120.8	192	141.5
138	101.7	166	122.3	194	142.9
140	103.2	168	123.8	196	144.4
142	104.7	170	125.3	198	145.9
144	106.2	172	126.7	200	147.4
146	107.6	174	128.2		
148	109.1	176	129.7		
150	110.6	178	131.2		
152	112.1	180	132.6		
154	113.5	182	134.1		
156	115.0	184	135.6		
158	116.5	186	137.1		

Conversion factors: 1 Joule = 0.73756 ft.lb.
1 ft.lb. = 1.35582 J

Stress Conversion Table

N/mm ²	ksi	psi	MPa	N/mm ²	ksi	psi	MPa	N/mm ²	ksi	psi	MPa
150	21.8	21800	150	350	50.8	50800	350	550	79.8	79800	550
160	23.2	23200	160	360	52.2	52200	360	560	81.2	81200	560
170	24.7	24700	170	370	53.7	53700	370	570	82.7	82700	570
180	26.1	26100	180	380	55.1	55100	380	580	84.1	84100	580
190	27.6	27600	190	390	56.6	56600	390	590	85.6	85600	590
200	29.0	29000	200	400	58.0	58000	400	600	87.0	87000	600
210	30.5	30500	210	410	59.5	59500	410	610	88.5	88500	610
220	31.9	31900	220	420	60.9	60900	420	620	89.9	89900	620
230	33.4	33400	230	430	62.4	62400	430	630	91.4	91400	630
240	34.8	34800	240	440	63.8	63800	440	640	92.8	92800	640
250	36.3	36300	250	450	65.3	65300	450	650	94.3	94300	650
260	37.7	37700	260	460	66.7	66700	460	660	95.7	95700	660
270	39.2	39200	270	470	68.2	68200	470	670	97.2	97200	670
280	40.6	40600	280	480	69.6	69600	480	680	98.6	98600	680
290	42.1	42100	290	490	71.1	71100	490	690	100.1	100100	690
300	43.5	43500	300	500	72.5	72500	500	700	101.5	101500	700
310	45.0	45000	310	510	74.0	74000	510	710	103.0	103000	710
320	46.4	46400	320	520	75.4	75400	520	720	104.4	104400	720
330	47.9	47900	330	530	76.9	76900	530	730	105.9	105900	730
340	49.3	49300	340	540	78.3	78300	540	740	107.3	107300	740

N/mm ²	ksi	psi	MPa	N/mm ²	ksi	psi	MPa	N/mm ²	ksi	psi	MPa
750	108.8	108800	750	950	137.8	137800	950	1150	166.8	166800	1150
760	110.2	110200	760	960	139.2	139200	960	1160	168.2	168200	1160
770	111.7	111700	770	970	140.7	140700	970	1170	169.7	169700	1170
780	113.1	113100	780	980	142.1	142100	980	1180	171.1	171100	1180
790	114.6	114600	790	990	143.6	143600	990	1190	172.6	172600	1190
800	116.0	116000	800	1000	145.0	145000	1000	1200	174.0	174000	1200
810	117.5	117500	810	1010	146.5	146500	1010				
820	118.9	118900	820	1020	147.9	147900	1020				
830	120.4	120400	830	1030	149.4	149400	1030				
840	121.8	121800	840	1040	150.8	150800	1040				
850	123.3	123300	850	1050	152.3	152300	1050				
860	124.7	124700	860	1060	153.7	153700	1060				
870	126.2	126200	870	1070	155.2	155200	1070				
880	127.8	127800	880	1080	156.6	156600	1080				
890	129.1	129100	890	1090	158.1	158100	1090				
900	130.5	130500	900	1100	159.5	159500	1100				
910	132.0	132000	910	1110	161.0	161000	1110				
920	133.4	133400	920	1120	162.4	162400	1120				
930	134.9	134900	930	1130	163.9	163900	1130				
940	136.3	136300	940	1140	165.3	165300	1140				

Conversion factors: 1 N/mm² = 145.038 psi
 1 N/mm² = 0.145038 ksi
 1 MPa = 145.038 psi
 1 MPa = 0.145038 ksi

Note: psi values have been rounded off to the nearest fourth digit.

Welding Units Comparison Tables

Deposition rates

lbs/hr	kg/hr
1	0.45
2	0.9
3	1.36
4	1.81
5	2.26
6	2.72
7	3.17
8	3.68
9	4.08
10	4.53
11	4.98
12	5.44
13	5.89
14	6.35
15	6.80
16	7.25
17	7.71
18	8.16
19	8.61
20	9.07
21	9.52
22	9.97
23	10.43
24	10.88
25	11.33

Wire feed speed

ins/min	m/min
25	0.6
50	1.3
75	1.9
100	2.5
125	3.1
150	3.8
175	4.4
200	5.1
225	5.7
250	6.3
275	6.9
300	7.6
325	8.2
350	8.9
375	9.5
400	10.2
425	10.8
450	11.4
475	12.0
500	12.7
525	13.3
550	14.0
575	14.6
600	15.2
625	15.8
650	16.5
675	17.1
700	17.8

Consumable weight

lbs	kgs
2.2	1
4.4	2
6.6	3
8.8	4
11.0	5
13.2	6
15.4	7
17.6	8
19.8	9
22.0	10
33.0	15
44.0	20
55.0	25
66.0	30
77.0	35
88.0	40
99.0	45
110.0	50

Electrode and wire diameter

inches	mm
0.024	0.6
0.030	0.8
0.035	0.9
0.045	1.0
0.052	1.2
1/16	1.6
5/64	2.0
3/32	2.4
7/64	3.0
1/8	3.2
5/32	4.0
3/16	5.0
1/4	6.0

Electrode length

inches	mm
10	250
12	300
13	330
14	350
18	450



Contacts

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