

Offshore Oil & Gas





OERLIKON solutions for the offshore oil & gas industry

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Introduction



2008-758

Air Liquide group, with its headquarters in Paris, France, is one of Europe's larger multinational companies with a consolidated turnover of € 11.8 billion in 2007

Air Liquide Welding, with a sales turnover of ~ €700 million, is represented throughout the world by individual ALW companies. These are involved in many different areas of OERLIKON product design, development and application. The research and development centre, AL CTAS, is located in Paris and is the largest privately owned centre for welding R&D. This facilitates the rapid transfer and implementation of important innovations and advances in welding technology throughout the whole of the OERLIKON global network. Through utilising in this way the strengths and experience of the network, OERLIKON continues to maintain its position and international reputation for innovative leadership at the forefront of advanced welding technology in both welding consumables and processes.

With this background, OERLIKON has generated a proven history of supplying welding products on an ongoing basis for the most demanding and critical applications. Nowhere has this record of success been greater than in the offshore oil and gas industry. Right from its very beginning,

OERLIKON has been involved in the fabrication of almost all fixed and mobile structures for the extraction of offshore oil and gas in the cold waters of the European basin and now serves the industry globally.

Over this period, OERLIKON has continued to work closely with oil companies, construction contractors and fabricators in developing and supplying welding consumables, equipment and processes capable of meeting the stringent mechanical property specifications and increasingly the demands for enhanced welding productivity.

The results of this process of ongoing innovation and product development are demonstrated by the unrivalled range of OERLIKON welding consumables, specifically tailored for the offshore oil and gas construction industry. Welding consumables are accompanied by extensive ranges of welding and cutting equipment, manual through to fully automated installations, flame and workplace products.



OERLIKON and the offshore oil and gas industry



2008-764

A commitment to technical excellence supported by a dedication to quality is regarded as fundamental to OERLIKON's success in the offshore oil and gas industry

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 offshore oil and gas 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 performance on site.

A team of highly qualified engineers is ready to respond in collaboration with the fabricator, with the objective of providing technologically relevant and practical solutions.

A large information base is at the service of every customer to ensure the most cost effective selection of welding procedures 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, 24/7 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, detailed technical articles are available in the journal of OERLIKON's welding and cutting expertise, "Competence".

Track Record

OERLIKON has been a major supplier of welding products to the offshore industry for significant projects during the past three decades. A track record of highly successful products combining quality and technology with technical service has been firmly established.



2008-765



Demand the Welding Expertise

MMA consumables for the offshore industry



MMA welding

Oerlikon TENACITO manual metal arc electrodes are designed to optimise toughness and productivity in the fabrication of structural steels while retaining the excellent levels of operating characteristics required for positional welding during on-site construction

The TENACITO range is characterised by the following features:

Toughness

The TENACITO range of MMA electrodes for offshore applications are all fully basic electrodes of the EX018-H4 type with nominal 110% efficiency. They are the result of many years of systematic development and high Charpy values at -40 °C to -60 °C and Crack Tip Opening Displacement toughness at -10 °C are readily achieved at realistic arc energies. The TENACITO range of electrodes is made on high purity steel core wire, very low in residual and impurity elements to ensure weld deposit cleanliness and optimum mechanical properties. The smaller sizes <3.2mm diameter are double coated using unique OERLIKON manufacturing technology to ensure arc stability, resulting in excellent operability particularly in the vertically up position.

Weldability

Exact electrode design produces an excellent weld bead profile with smooth toe blending and a near mitre finish. In itself this is a significant factor in maintaining productivity as grinding, particularly of the weld toe is minimised. This feature is of vital importance as offshore failures to date have been via the fatigue rather than the toughness failure mode.

Hydrogen Potential

The TENACITO range is all Low Hydrogen Potential welding consumables and can be described as fully moisture resistant. A very low hydrogen potential of <4ml H₂ per 100g deposited weld metal is readily achieved in practise. ISO, EN, DIN, AWS

Key products

A selection of key products is shown below. A more complete view of the product range is shown on pages 10-11 or consult the OERLIKON Welding Consumables Product Data handbook for full details.

■ TENACITO R

An E7018-1H4 electrode depositing a nominal C-1.4%Mn weld metal. This ensures good toughness from the C-Mn system in both the as welded and stress relieved conditions.

■ TENACITO 38R

An E7018-GH4 electrode depositing a nominal C-1.2%Mn-0.9%Ni weld metal for high integrity applications while conforming to NACE requirements. This electrode is designed to ensure optimum toughness for structural steel joints in both the as welded and stress relieved conditions. TENACITO 38R has established a unique position in the construction of offshore oil and gas structures due to the consistent high fracture toughness, CTOD, of the weld metal deposited.

■ TENACITO 70

An E8018-GH4 electrode depositing a nominal C-1.6%mn-0.9%Ni weld metal conforming to NACE requirements. This electrode is designed for maximum as welded toughness in higher strength joints combined with good fracture toughness properties, particularly when welding higher strength steels for topside applications.

■ TENACITO 70B

An E8018-C1H4 electrode depositing a nominal C-0.8%Mn-2.5%Ni weld metal for high CVN toughness at -50 °C with increased arc energies. This electrode is especially relevant where lower reference temperature testing may be required.

■ TENACITO 80CL

A high strength E11018-GH4 electrode depositing a nominal C-1.4%Mn-2.2NiCrMo weld metal for the welding of HYSS, with a yield strength of >690MPa and high CVN toughness at -50 °C. Typical applications include rack to rack and chord to chord joints.

Cored wires for the offshore industry



2008-767

OERLIKON flux-cored wires for MAG welding comprise the FLUXOFIL and CITOFLEX high performance product ranges

FLUXOFIL and CITOFLEX wires are produced in ISO certified group manufacturing plants

FLUXOFIL cored wires are manufactured using a process similar to the production of a solid wire and results in a seamless flux-cored wire with a number of product advantages:

Low Hydrogen Potential

FLUXOFIL wires have a hydrogen potential of ~4ml H₂ per 100g deposited weld metal when used straight from the carton or store with no re-conditioning. This is very low and can be considered by the welding engineer to be an excellent safety factor. A reduction in pre-heat may also be possible meaning more cost effective fabrication.

Feeding Characteristics

The solid sheath provides uniform mechanical properties around the wire circumference and hence the wire feeding is smooth without kinking or spiralling. The production annealing ensures close control of the wire hardness and this in turn reduces wear of the wire feeder and cable hose assembly.

Stability in Welding

FLUXOFIL wires are coppered in exactly the same way as solid wire. Current transfer from the torch contact tube to the wire is thus improved.

CITOFLEX cored wires were recently introduced to the OERLIKON product range, manufactured using a folded strip technique. This range of wires includes, rutile, basic and metal cored wires, bringing another balance of operating characteristics, mechanical properties and deposition rate to the OERLIKON range of cored wires, to meet all fabrication requirements.

Deposition rate

CITOFLEX rutile cored wires feature enhanced filling of the flux core, which results in increased current carrying capacity, thus increasing welding speed and hence deposition rate.

Key products

A selection of key products is shown below. A more complete view of the product range is shown on pages 10-11 or consult the OERLIKON Welding Consumables Product Data handbook for full details.

■ FLUXOFIL 20HD

A rutile flux cored electrode filler wire for gas shielded welding with mixed gases, e.g.80%Ar/20%CO₂. The higher core filling ratio results in increased welding speeds and deposition rate. Used in all positions including vertically up and vertically down. FLUXOFIL 20HD deposits C-1.2%Mn-0.9%Ni steel weld metal with optimised operating characteristics and deposit toughness down to -40 °C, in both the as welded and stress relieved conditions and in conformance with NACE requirements. Typical applications include bracing, ring stiffener to can fillet welding and full thickness joints for high integrity applications.

■ FLUXOFIL 21HD

Rutile flux cored electrode filler wire, similar in all respects to FLUXOFIL 20HD, but used with CO₂ shielding gas.

● FLUXOFIL 41

Basic flux cored electrode filler wire for gas shielded welding with mixed gases, e.g.80%Ar/20%CO₂. FLUXOFIL 41 deposits high strength, high toughness 1.2%Ni-0.4%Mo weld metal, for the welding of higher strength steels, yield strength >550MPa.

■ FLUXOFIL 42 / 42LT

Basic flux cored electrode filler wire for gas shielded welding with mixed gases, e.g.80%Ar/20%CO₂. FLUXOFIL 42 is for use DC+ and 42LT DC- depositing high strength, high toughness 2.4%Ni-0.4%Cr-0.4%Mo weld metal, for the welding of HYSS, yield strength >690MPa. Typical applications include rack and chord joints.

■ CITOFLEX R550

Rutile flux cored electrode filler wire for gas shielded welding in all positions with mixed gases, e.g.80%Ar/20%CO₂.

CITOFLEX R550 deposits C-1.0%Mn-1.5%Ni steel weld metal with deposit toughness down to -50 °C, in both the as welded and stress relieved conditions for the welding of higher strength steels with a minimum yield stress of 550MPa.

■ CITOFLEX R82

Rutile flux cored electrode filler wire for gas shielded welding in all positions with mixed gases, e.g.80%Ar/20%CO₂. CITOFLEX R82 deposits C-1.4%Mn-0.8%Ni steel weld metal with optimised operating characteristics and deposit toughness in the range -40 °C to -50 °C, in both the as welded and stress relieved conditions and in conformance with NACE requirements.

■ CITOFLEX R26

Rutile flux cored electrode filler wire for gas shielded welding in all positions with mixed gases, e.g.80%Ar/20%CO₂. CITOFLEX R26 deposits C-1.3%Mn-2.2%Ni steel weld metal with deposit toughness in the range -50°C to -60 °C, in both the as welded and stress relieved conditions

Submerged arc wires and fluxes for the offshore industry



2008-760

OERLIKON's agglomerated submerged arc welding fluxes, in combination with the OERLIKON range of solid wires, have achieved worldwide recognition as the first choice for quality submerged arc welding

Toughness

Consistent CVN and CTOD even at deep sub-zero temperatures through the right combination of wire and flux.

Weldability

As well as the consistent ability to deliver the highest levels of mechanical properties, OERLIKON fluxes have stable arc running characteristics together with excellent slag detachability.

Technology

OERLIKON submerged arc wire specifications are designed to incorporate the state of the art technology and hence the highest levels of weld metal toughness are generated for the alloy type. In addition, as new steels and applications are developed so special wires are designed and introduced to the range.

Low Hydrogen Potential

OERLIKON fully basic fluxes and semi basic SAW fluxes are designed and manufactured to give a low hydrogen potential under the most demanding conditions. This minimises the risks of weld metal hydrogen (chevron) cracking in the welding of thick structural steel sections even after exposure of the flux to atmospheric moisture during recirculation. These flux characteristics are supported by the OERLIKON DryBag packaging system, which is particularly relevant for use in high humidity climates.

Reproducibility

Consolidating the metallurgical rationale for OERLIKON agglomerated fluxes, the grain size distribution and agglomerate strength ensure reliable recirculation characteristics and consistent chemistry. This is most important when submerged arc welding.

Productivity

OERLIKON can input into the optimum choices of the number of wires, head geometry and wire size for a given application, in order to optimise productivity in a given application. Improved deposition rates can be attained without sacrificing weld metal toughness, operability or bead profile.

Quality

All OERLIKON agglomerated fluxes are produced in ISO certified group manufacturing plants, under the most stringent quality control conditions.

Key products

A selection of key products is shown below. A more complete view of the product range is shown on pages 10-11 or consult the OERLIKON Welding Consumables Product Data handbook for full details.

Submerged Arc Fluxes

■ OP 121TT

OP 121TT has achieved worldwide recognition by the offshore oil and gas industry. It is an agglomerated flux with high basicity, B.I. =3 FB type, and is used for joints of high structural integrity where excellent sub-zero Crack Tip Opening Displacement (CTOD) fracture toughness is required.

OP 121TT is capable of generating such properties at high deposition rates using multi-wire welding, giving the potential for high levels of welding productivity.

OP 121TT is an excellent choice when narrow gap welding.

OP 121TT has a low hydrogen potential, HDM<5ml H₂ per 100g deposited weld metal, with excellent recirculation characteristics in automatic systems, where low hydrogen levels are readily achieved with regular yard practices.

■ OP 121TTW

OP 121TTW is an agglomerated flux with high basicity, B.I. =3, FB type, with a very low diffusible hydrogen potential, of <4 HDM. It is used for welding thicker sections of more hardenable steels. OP 121TTW is particularly suitable in combination with the OE FLUXOCORD range of cored wires for submerged arc welding.

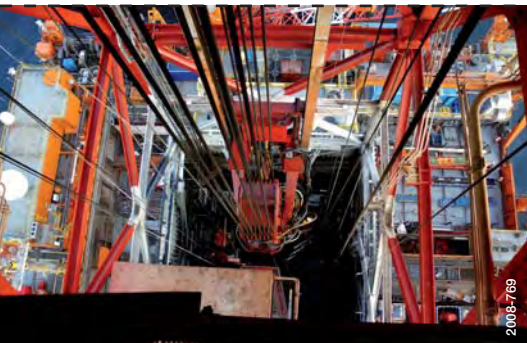
Submerged Arc Wires

The OERLIKON range of submerged arc wires contain low levels of impurity and residual elements and are optimised for joint toughness at the full range of strength levels.

■ **Solid wires** : OE-SD3, OE-S2 Ni1, OE-SD3 1Ni ¼Mo, OE-SD3 1Ni ½Mo, OE-TiBoR 33 for "punch through" joint completion.

■ **Flux cored wires** for SAW welding (FLUXOCORD range) to maximise productivity in combination with OP 121TT(W) flux : FLUXOCORD 31HD, 41HD & 42.

Jacket and jack up rig construction



Fabrication of cans, Tubulars, Nodes and Piling.
Fabrication of racks, Chords, Jackcasings, Cantilever.

Jacket construction

The current toughness specifications for jacket construction are nominally CV at -30 °C to -60 °C and a minimum of 0.25-0.35mm of CTOD at -10 °C, depending on location in the structure. OERLIKON consumable packages are available to reliably achieve these levels of toughness at a high level of productivity.

The steel grades include DIN StE 355 (St E 36), T St E 420 (TT St E 43) and EN S (P) 235-S (P) 500.

ABS mild steel Gr.A, B, D, E. ABS HT Gr.AH36, DH36, EH36

Key Products:

CVN at -40 to -60 °C CTOD at -10 °C	MMA	TENACITO 38R TENACITO 70 TENACITO 70B
	SAW	OP121TT/OE-SD3 OP 121TT/OE S2 Ni1 OP 121TT/OE TiBoR 33 (root)
	FCW	FLUXOFIL 20HD FLUXOFIL 21HD CITOFILUX R82 CITOFILUX R26



Jack up rig construction

The current toughness specifications for the high strength components of jack up rigs are nominally CVN at -40 °C to -60 °C, depending on location in the structure.

The high strength steel grades of particular importance for jack up rig construction are currently A514 grade Q, ALDUR 700QL1, A517 grade F.

Jackcase, cantilever and chord to rack, rack to rack and chord to chord applications:

Key Products:

Yield Stress >690MPa CVN at -40 °C to -60 °C	MMA	TENACITO 80CL
	SAW	FLUXOCORD 42/OP 121TT(W) OE SD3 2NiCrMo/OP 121TT(W)
	FCW	FLUXOFIL 42 FLUXOFIL 42LT



Topside construction



Fabrication of Modules, Support frames and Integrated decks

The current toughness specifications for topside construction are nominally Cv at -30 °C to -60 °C and a minimum of 0.25-0.35mm of CTOD at -10 °C, depending on location in the structure.

The steel grades of particular importance for topside construction are DIN StE 355 (St E 36), T St E 420 (TT St E 43) and EN S (P) 235-S (P) 500.

ABS mild steel Gr.A, B, D, E. ABS HT Gr.AH36, DH36, EH36

EN 10225: S460 G2+Q

Key Products:

CVN at -40 to -60 °C CTOD at -10 °C	MMA	TENACITO 38R TENACITO 70 TENACITO 70B
	SAW	OP121TT/OE-SD3 OP 121TT/OE S2 Ni1 OP 121TT/OE TiBoR 33 (root)
	FCW	FLUXOFIL 20HD FLUXOFIL 21HD CITOFILUX R82 CITOFILUX R26

Fabrication of higher strength grades

Cv at -40 to -60 °C CTOD at -10 °C	MMA	TENACITO 70
	SAW	OP 121TT/OE SD3 1Ni ¼Mo
	FCW	FLUXOFIL 41 CITOFILUX R550



Associated construction and special applications



Hook ups, Blow out preventors, Well heads and Process pipe work

A comprehensive range of MMA electrodes, flux cored wires, MIG and TIG wires and SAW wires and fluxes are available for all aspects of topside and hook up applications for C-Mn steels, low alloy steels, stainless steels, nickel base and cupro-nickel alloys

AISI 4130

Blow Out Preventers and Well Head Constructions are typically fabricated from AISI 4130, or similar low alloy steel, and matching strength properties are specified. These properties may on occasions have to be retained in the weld metal after a complex heat treatment.

■ MMA

TENAX 118D2 is a C-1.9%Mn-0.4%Mo welding electrode depositing tough manganese molybdenum weld metal with a minimum UTS of 690 MPa in full conformance to NACE. TENAX 118D2 is used for the welding of AISI 4130 in the stress relieved condition.

■ SAW

OE-SD3 1Ni½Mo/OP 121TT(W) is used for depositing high strength, crack resistant weld metal suitable for the welding of AISI 4130 in the stress relieved condition.

STAINLESS STEELS

■ MMA

The SUPRANOX range of rutile coated manual metal arc welding electrodes is designed to enable the diversity of stainless steels – plates, pipes, tubes, castings and forgings – to be welded both to themselves and to each other. Smooth operation in all positions with minimal spatter and near self releasing slag for excellent weld bead appearance and profile. The SUPRANOX range also has a proven resistance to both weld start and weld bead porosity giving high radiographic integrity. This makes these electrodes particularly suitable for the most critical applications.

The SUPRANOX range of MMA welding electrodes is as follows: 308L, 308LP, RS308L, RS308H, 347, RS347, 347-P, 316L, 316LP, RS316L, 317, 318, 309L, RS309L, 309L-P, 309MoL, RS309Mo, 310, RS310 & 904L.

The range of applications is as diverse as the comprehensive range of electrodes.

■ MIG/TIG

A comprehensive range of OERLIKON INERTFIL and INERTROD wires for all applications, e.g. 308L, 347, 316L, 309L & 312.

■ FCW

A comprehensive range of FLUXINOX stainless cored wires for applications in the primarily down hand, e.g. FLUXINOX 316L and positional e.g. FLUXINOX 316L-PF applications. Including alloys 308L, 308H, 347, 307, 316L, 318, 309L, 309MoL, 22.9.3L, 310, and 625.

■ SAW

OP 33 is a special semi-basic agglomerated flux with a basicity index of 1.8. It is used for the welding of stainless and heat resisting steels. In respect to the carbon content of the weld metal, OP 33 is neutral. Typically used with AWS A5.9 grade 300 series wires, e.g. OE-316L, OE-308L, OE-309LMO.

DUPLEX STAINLESS STEELS

Duplex stainless steel (e.g. W.No. 1.4462) is used for pipe lines, vessels and module pipe work. Matching consumables are available:

■ MMA

SUPRANOX RS22.9.3L is an MMA electrode depositing Cr-Ni-Mo-N duplex stainless steel weld metal, highly resistant to intergranular pitting and stress corrosion in the presence of hydrogen containing aqueous solution or wet gases.

■ MIG/TIG

INERTFIL/INERTROD 22.9.3 are solid wires depositing duplex stainless steel weld metal.

■ FCW

FLUXINOX 22.9.3L is optimised for down hand fillet welding and FLUXINOX 22.9.3L-PF for positional welding of duplex stainless steels.

■ SAW

OE-S22 09/OP 33 is used for the high deposition rate welding of duplex stainless steels.

CUPRO-NICKEL ALLOYS

Cupro-nickel alloys are used for process and anti-fouling pipe work.

■ MMA

SUPRANEL NiCu7 is used for the manual welding of cupro-nickel alloys

■ MIG/TIG

NIFIL/NIROD NiCu7 are cupro-nickel MIG and TIG wires used for the welding of 70/30, 80/20 and 90/10 cupro-nickel alloys.

Welding consumables product summary

Construction Steels CVN to -30 °C / -60 °C As welded condition

Type	AWS	EN	C	Mn	Si	S	P
MMA							
SUPERCITO	E7018-1-H4	E 42 5 B 32 H5	0.06	1.5	0.3	<0.025	<0.025
TENAX 56S	E7016-1-H4	E 42 5 B 12 H5	0.08	1.2	0.5	<0.015	<0.020
TENACITO R	E 7018-1-H4	E 42 6 B 42 H5	0.06	1.5	0.3	<0.012	<0.015
TENACITO 38 R	E7018-G-H4	E46 6 1 Ni B 42 H5	0.06	1.2	0.3	<0.012	<0.015
TENAX 88S	E8016-G-H4	E 50 6 Mn1 Ni B 12 H 5	0.06	1.6	0.3	<0.015	<0.015
TENACITO 70	E8018-G-H4	E 50 6 Mn1 Ni B 42 H 5	0.06	1.6	0.5	<0.015	<0.020
TENACITO 70B	E8018-C1-H4	E 46 6 2Ni 42 H5	0.05	1.1	0.3	<0.015	<0.020
TENACITO 65 R	E9018-G-H4	E 55 6 Mn 1 NiMo B T 42 H5	0.05	1.4	0.3	<0.008	<0.012
TENAX 118D2	E10016-D2-H4	E 62 4 MnMo B32 H5	0.09	1.9	0.5	<0.020	<0.025
TENACITO 80	E11018-G-H4	E 69 6 Mn2 NiCrMo B 42 H 5	0.06	1.8	0.5	<0.012	<0.020
TENACITO 80 (CL)	E11018-G-H4	E 69 6 Mn2 NiCrMo B 42 H 5	0.06	1.4	0.5	<0.012	<0.020
SAW (wire / flux)							
OE-SD3 / OP 121 TT	F7A8-EH12K	S 42 6 FB S3Si	0.07	1.6	0.3	<0.015	<0.020
OE-TIBOR 33 / OP 121 TT	F7A6-EG-G	S 46 5 FB Sz	0.07	1.2	0.3	<0.015	<0.015
OE-SD3 1Ni ½Mo / OP 121 TT	F8A10EG-G	S 50 6 FB Sz	0.07	1.3	0.3	<0.015	<0.020
OE-SD3 1Ni ½Mo / OP 121 TT	F9A6-EG-G	S62 4 FB S3 Ni1Mo	0.08	1.4	0.3	<0.015	<0.020
OE-S2 Ni2 / OP 121TT	F7P10ENi2-Ni2	S 62 6 FB S2 Ni2	0.07	0.9	0.3	<0.015	<0.020
FLUXOCORD 31 HD / OP 121 TT(W)	F7AP8-EC1	S35 6 FB T3	0.06	1.7	0.4	<0.015	<0.020
FLUXOCORD 41 HD/OP 121 TT(W)	F9A8-EC-F3	S 55 4 FB TZ	0.05	1.3	0.2	<0.015	<0.020
FLUXOCORD 42/OP 121 TT(W)	F11A4-EC-F5	S 69 6 FB TZ	0.05	1.4	0.2	<0.015	<0.020
GMAW							
CARBOFIL 1A	ER70S-6	G46 3 M G4 Si1	0.06	1.7	0.9	<0.030	<0.020
CARBOFIL 1A Gold	ER70S-6	G46 4 M G4 Si1	0.06	1.7	0.9	<0.030	<0.020
CARBOFIL Ni1	ER80S-Ni1	G 46 6 M G3 Ni1	0.08	1.0	0.6	<0.020	<0.020
CARBOFIL NiMo 1	ER100S-G	G62 4 M Mn3Ni1Mo	0.08	1.8	0.6	<0.015	<0.018
FCAW - Rutile							
CITOFILUX R 00 Ni	E81T1-GH4	T 46 4 1Ni PC 1 H5	0.06	1.2	0.4	<0.015	<0.015
CITOFILUX R 20C	E81T1-Ni1H8	T 46 5 1Ni P C 1 H10	0.06	1.3	0.5	<0.020	<0.020
FLUXOFIL 20 HD	E81T1-Ni1MJH4	T 46 4 1Ni P M 1 H5	0.05	1.2	0.5	<0.020	<0.020
FLUXOFIL 21 HD	E81T1-Ni1JH4	T 46 4 1Ni P C 1 H5	0.05	1.2	0.5	<0.020	<0.020
CITOFILUX R 82	E81T1-Ni1MH4	T 46 5 1Ni PM 1 H5	0.07	1.4	0.4	<0.015	<0.015
CITOFILUX R 550	E91T1-GMH4	T 55 5M 1.5Ni P M 1 H5	0.06	1.0	0.3	<0.015	<0.015
CITOFILUX R 26	E101T1-GMH4	T 62 5 Mn 2.5NiP1 H5	0.08	1.3	0.4	<0.015	<0.015
FCAW - Basic							
FLUXOFIL 31	E70T5-MJH4	T 42 4 B M 3 H5	0.05	1.4	0.4	<0.020	<0.020
CITOFILUX B 00	E71T5-MJH4	T 42 5 B M 1 H5	0.06	1.5	0.6	<0.025	<0.025
FLUXOFIL 44	E70T5-GMJH4	T 42 6 2Ni B M 3 H5	0.05	0.9	0.3	<0.015	<0.020
FLUXOFIL 40	E80T5-GMH4	T 46 6 1Ni B M 3 H5	0.05	1.4	0.4	<0.020	<0.020
FLUXOFIL 41	E90T5-GMH4	T 55 6 1 NiMo B C 3 H5	0.05	1.4	0.4	<0.020	<0.020
FLUXOFIL 42LT	E111T5-GH4	T 69 6 Mn2NiCrMo B M 3 H5	0.08	1.6	0.4	<0.015	<0.015
FCAW - Metal Cored							
FLUXOFIL M 10	E70C-6MH4	T 46 4 M M 1 H5	0.06	1.3	0.6	<0.020	<0.020
FLUXOFIL M 10 S	E70C-6MH4	T 42 6 MM 1 H5	0.05	1.3	0.4	<0.015	<0.020
CITOFILUX M 00	E70C-6MH4	T 46 4 M M 1 H5	0.04	1.7	0.5	<0.020	<0.020
CITOFILUX M 20	E81T5-GH4	T 46 6 Mn 1Ni 1 M M H5	0.04	1.7	0.5	<0.020	<0.020
FLUXOFIL M 41	E91T1-GH4	T 55 Z M M 1 H5	0.08	1.8	0.6	<0.015	<0.015
GTAW							
CARBOROD 1A	ER70S-6	W 42 4 W3 Si1	0.08	1.5	0.9	<0.025	<0.025
CARBOROD Ni1	ER80S-Ni1	W 46 6 W3 Ni1	0.08	1.0	0.6	<0.020	<0.020
CARBOROD Ni2	ER80S-Ni2	W 46 6 W2 Ni2	0.08	1.1	0.5	<0.020	<0.020
CARBOROD NiMo 1	ER90S-G	W Mn3 Ni 1 Mo	0.08	1.8	0.6	<0.018	<0.015

3,5%Ni-steels CVN to -85 °C/-101 °C As welded condition

Type	AWS	EN	C	Mn	Si	S	P
MMA							
FREEZAL E Ni 3	E8018-C2-H4	E46 6 3Ni B 32	0.05	0.6	0.2	<0.015	<0.020
SAW (wire / flux)							
OE S2 Ni3 / OP 121 TT(W)	F8A15-F7P15 ENi3-Ni3	SA FB 1 55 AC H5	0.06	0.6	0.3	<0.015	<0.020

Cr	Ni	Mo	Tensile strength MPa	Yield strength MPa	A5d %	CVN (Joules)	Type
MMA							
--	--	--	490-550	>430	>24	>47 @ -50 °C	SUPERCITO
--	--	--	500-640	>420	>22	>110 @ -50 °C	TENAX 56S
--	--	--	500-640	>420	>25	>90 @ -60 °C	TENACITO R
--	0.9	--	500-650	>460	>25	>110 @ -60 °C	TENACITO 38 R
--	0.8	--	560-720	>500	>24	>60 @ -60 °C	TENAX 88S
--	0.9	--	590-680	>510	>24	>80 @ -60 °C	TENACITO 70
--	2.4	--	550-700	>480	>22	>110 @ -60 °C	TENACITO 70B
--	0.9	0.4	630-750	>560	>20	>75 @ -60 °C	TENACITO 65 R
--	--	0.4	690-890	>620	>22	>50 @ -40 °C	TENAX 118D2
0.4	2.2	0.4	850-960	>800	>16	>60 @ -60 °C	TENACITO 80
0.4	2.2	0.4	760-900	>720	>17	>60 @ -60 °C	TENACITO 80 (CL)
SAW (wire / flux)							
--	--	--	530-630	>450	>25	>50 @ -50 °C	OE-SD3 / OP 121 TT
--	--	0.5	540-640	>460	>20	>80 @ -50 °C	OE-TIBOR 33 / OP 121 TT
--	0.8	0.2	600-650	>530	>24	>120 @ -60 °C	OE-SD3 1Ni ¼Mo / OP 121 TT
--	0.9	0.5	650-750	>540	>20	>70 @ -40 °C	OE-SD3 1Ni ½Mo / OP 121 TT
--	2	--	550-600	>450	>24	>70 @ -60 °C	OE-S2 Ni2 / OP 121TT
--	--	--	500-640	>420	>20	>80 @ -40 °C	FLUXOCORD 31 HD / OP 121 TT(W)
--	0.9	0.5	620-720	>550	>18	>50 @ -40 °C	FLUXOCORD 41 HD/OP 121 TT(W)
0.6	2.5	0.4	750-830	>680	>16	>50 @ -40 °C	FLUXOCORD 42/OP 121 TT(W)
GMAW							
--	--	--	550-630	>460	>24	>47 @ -30 °C	CARBOFIL 1A
--	--	--	530-680	>460	>24	>47 @ -30 °C	CARBOFIL 1A Gold
--	1	0.1	550-680	>470	>20	>47 @ -60 °C	CARBOFIL Ni1
--	1	0.4	700-890	>620	>18	>47 @ -40 °C	CARBOFIL NiMo 1
FCAW - Rutile							
--	0.7	--	530-680	>460	>20	>80 @ -40 °C	CITOFLEX R 00 Ni
--	0.9	--	530 - 680	> 460	> 20	>47 @ -50 °C	CITOFLEX R 20C
--	0.9	--	570-670	>490	>22	>60 @ -40 °C	FLUXOFIL 20 HD
--	0.9	--	570-670	>490	>22	>60 @ -40 °C	FLUXOFIL 21 HD
--	0.8	--	530-680	>460	>20	>80 @ -50 °C	CITOFLEX R 82
--	1.5	--	620-760	>550	>20	>47 @ -50 °C	CITOFLEX R 550
--	2.2	--	700-890	>620	>18	>47 @ -50 °C	CITOFLEX R 26
FCAW - Basic							
--	--	--	510-610	>420	>22	>47 @ -40 °C	FLUXOFIL 31
--	--	--	500-640	>420	>20	>60 @ -50 °C	CITOFLEX B 00
--	2.5	--	520-620	>440	>26	>47 @ -80 °C	FLUXOFIL 44
--	1.2	--	540-640	>470	>24	>47 @ -60 °C	FLUXOFIL 40
--	1.2	0.4	650-750	>560	>20	>80 @ -40 °C	FLUXOFIL 41
0.3	2.4	0.5	760-900	>690	>17	>47 @ -50 °C	FLUXOFIL 42LT
FCAW - Metal Cored							
--	--	--	550-660	>460	>24	>47 @ -40 °C	FLUXOFIL M 10
--	--	--	510-560	>420	>26	>70 @ -60 °C	FLUXOFIL M 10 S
--	--	--	530-680	>460	>22	>80 @ -40 °C	CITOFLEX M 00
--	0.9	--	530-680	>460	>20	>80 @ -60 °C	CITOFLEX M 20
--	0.6	0.4	640-820	>550	>18	>47 @ -60 °C	FLUXOFIL M 41
GTAW							
--	--	--	500-640	>420	>20	>47 @ -50 °C	CARBOROD 1A
--	1.0	0.1	550-680	>470	>20	>47 @ -60 °C	CARBOROD Ni1
--	2.5	--	550-680	>470	>20	>47 @ -60 °C	CARBOROD Ni2
--	1.0	0.4	700-890	>620	>18	>47 @ -40 °C	CARBOROD NiMo 1

Cr	Ni	Mo	Tensile strength MPa	Yield strength MPa	A5d %	CVN (Joules)	Type
MMA							
--	3.3	--	540-600	>450	>25	>40 @ -101 °C	FREEZAL E Ni 3
SAW (wire / flux)							
--	3.5	0.15	565-645	>460	>24	>50 @ -85 °C	OE S2 Ni3 / OP 121 TT(W)

Classification Society Approvals

Construction Steels CVN to -30 °C / -60 °C As welded condition

Type	GAS	AWS	EN	TÜV	DB	ABS
MMA						
SUPERCITO	-	E7018-1-H4	E 42 5 B 32 H5	00287.07		
TENAX 56S	-	E7016-1-H4	E 42 5 B 12 H5	4944.01	10.035.02	4H5-4Y
TENACITO R	-	E 7018-1-H4	E 42 6 B 42 H5	TÜV	DB	4H5-4Y
TENACITO 38 R	-	E7018-G-H4	E46 6 1 Ni B 42 H5	08027.04	10.098.14	3Y
TENAX 88S	-	E8016-G-H4	E 50 6 Mn1 Ni B 12 H 5			3YH5
TENACITO 70	-	E8018-G-H4	E 50 6 Mn1 Ni B 42 H5	TÜV	DB	3H5-3Y
TENACITO 70B	-	E8018-C1-H4	E 46 6 2Ni 42 H5	TÜV		
TENACITO 65 R	-	E9018-G-H4	E 55 6 Mn 1 NiMo B T 42 H5	TÜV	DB	E9018-G
TENAX 118D2	-	E10016-D2H4	E 62 4 MnMo B 32 H5			
TENACITO 80	-	E11018-G-H4	E 69 6 Mn2 NiCrMo B 42 H5	TÜV		E11018-G
TENACITO 80 (CL)	-	E11018-G-H4	E 69 6 Mn2 NiCrMo B 42 H5			E11018-G
FREEZAL E Ni 3	-	E8018-C2-H4	E46 6 3Ni B 32			
SAW (wire / flux)						
OE-SD3 / OP 121 TT	-	F7A8-EH12K	S 42 6 FB S3Si	03768	51.098.09	3YM (-40 °C)
OE-TIBOR 33 / OP 121 TT	-	F7A6-EG-G	S 46 5 FB Sz			
OE-SD3 1Ni ¼Mo / OP 121 TT	-	F8A10EG-G	S 50 6 FB Sz	09895		
OE-SD3 1Ni ½Mo / OP 121 TT	-	F9A6-EG-G	S 62 4 FB S3Ni1Mo			
OE-S2 Ni2 / OP 121 TT	-	F7P10 ENi2-Ni2	S 62 6 FB S2Ni2	03766		
FLUXOCORD 31 HD / OP 121 TT	-	F7AP8-EC1	S 35 6 FB T3			4YM
FLUXOCORD 41 HD/OP 121 TT	-	F9A8 EC-F3	S 55 4 FB TZ			
FLUXOCORD 42/OP 121 TT	-	F11A8 EC-F5	S 69 6 FB TZ			5YQ690M
OE S2 Ni3 / OP 121 TT	-	F8A15-F7P15 ENi3-Ni3	SA FB 1 55 AC H5	10343		
GMAW						
CARBOFIL 1A	C1	ER 70S-6	G46 3 M G4 Si1	00266.10	42.098.01	2YSA F,V
	M21	ER 70S-6	G46 3 M G4 Si1	00266.10	42.098.01	3YSA F,V
CARBOPIL 1A Gold	C1-M21	ER 70S-6	G46 4 M G4 Si1	11041.00	42.098.17	
CARBOPIL Ni1	M21	ER 80S-Ni1	G 46 6 M G3Ni1			ER80S-Ni1
CARBOPIL NiMo 1	M21-C1	ER 90S-G	G62 4 M Mn3Ni1Mo	09848	42.098.27	
FCAW - Rutile						
CITOFILUX R 00 Ni	C1	E81T1-GH4	T 46 4 1Ni PC 1 H5			
CITOFILUX R 20C	C1	E81T1-Ni1 H8	T 46 5 1Ni P C 1 H10			
FLUXOFIL 20 HD	M21	E81T1-Ni1 MJH4	T 46 4 1Ni P M 1 H5	TÜV	DB	4Y46SA H5
	C1	E81T1-Ni1 CJH4	T 46 4 1Ni P C 1 H5			4Y46SA H5
FLUXOFIL 21 HD	C1	E81T1-Ni1 JH4	T 46 4 1Ni P C 1 H5			4Y46SA H5
CITOFILUX R 82	M21	E81T1-Ni1 MH4	T 46 5 1Ni P M 1 H5			4Y400SA H5
CITOFILUX R 55	M21	E91T1-GMH4	T 55 5M 1.5Ni P M 1 H5			
CITOFILUX R 26	M21	E101T1-G-MH4	T 62 5 Mn 2,5Ni P 1 H5			UP
FCAW - Basic						
FLUXOFIL 31	C1	E70T-5JH4	T 42 4 B C 3 H5	TÜV	DB	3YSA H5
	M21	E70T5-MJH4	T 42 4 B M 3 H5	TÜV	DB	3YSA H5
CITOFILUX B 00	M21	E71T5-MJH4	T 42 5 B M 1 H5	TÜV	DB	3YSA H5 (P)
	C1	E71T5-JH4	T 42 5 B C 1 H5			3YSA H5 (P)
FLUXOFIL 44	M21	E70T5-GMJH4	T 42 6 2Ni B M 3 H5			
FLUXOFIL 40	C1	E80T5-GH4	T 46 6 1Ni B C 3 H5	TÜV	DB	
	M21	E80T5-GMH4	T 46 6 1Ni B M 3 H5	TÜV		
FLUXOFIL 41	C1	E90T5-GH4	T 55 6 1 NiMo B C 3 H5	TÜV	DB	
	M21	E90T5-GMH4	T 55 4 1 NiMo B M 3 H5			
FLUXOFIL 42LT	M21	E111T5-GMH4	T 69 6 Mn2NiCrMo B M 3 H5			
FCAW - Metal Cored						
FLUXOFIL M 10	M21	E70C-6MH4	T 46 4 M M 1 H5	TÜV	DB	4YSA H5
FLUXOFIL M 10 S	M21	E70C-6MH4	T 42 6 M M 1 H5		DB	4YSA H5
CITOFILUX M 00	M21	E70C-6MH4	T 46 4 M M 1 H5			3YSA H5 (P)
CITOFILUX M 20	M21	E81T5-GH4	T 46 6 Mn 1Ni 1 M M H5			
FLUXOFIL M 41	M21	E91T1-GH4	T 55 Z M M 1 H5			
GTAW						
CARBOROD 1A	I1	ER 70S-6	W 42 4 W3Si1			
CARBOROD Ni1	I1	ER 80S-Ni1	W 46 6 W3Ni1			ER 80S-Ni1
CARBOROD Ni2	I1	ER 80S-Ni2	W 46 6 W2Ni 2			
CARBOROD NiMo 1	I1	ER 90S-G	W Mn3 Ni1 Mo			

INITIALS	AWS	EN	TÜV	DB	ABS	BV	DNV	GL	LRS	PRS	RMRS	RINA
DESCRIPTION	American Welding Society	European Normalization	Technischer Überwachungs Verein	Deutsche 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

BV	DNV	GL	LRS	PRS	RMRS	RINA	GAS	Type
MMA								
3-3YHHH	3YH5	3Y H5	3m 3Ym H5		3YHHH		-	SUPERCITO
3-3YHHH	4YH5	3Y H5	DXVuO-BF-3m-4Ym-H5			4YH5	-	TENAX 56S
3Y HH	5Y H5	4Y H5	4m 4Ym H5				-	TENACITO R
5YH5	5Y H5 (P)	6Y42 H5	5Y40m H5 (P)				-	TENACITO 38 R
	5Y H5		DXVuO-BF-5Y40m-H5				-	TENAX 88S
3YHHH	4Y50 H5	3Y H5	3m 5Y40m H5		3YHHH		-	TENACITO 70
							-	TENACITO 70B
					5Y50HHH		-	TENACITO 65 R
							-	TENAX 118D2
		3Y69 H5			3Y69HHH		-	TENACITO 80
							-	TENACITO 80 (CL)
							-	FREEZAL E Ni 3
SAW (wire / flux)								
3YM	IVY42M H5	5Y40M	4Y40M		5Y40M HHH		-	OE-SD3 / OP 121 TT
							-	OE-TIBOR 33 / OP 121 TT
							-	OE-SD3 1Ni ¼Mo / OP 121 TT
			3Y50M				-	OE-SD3 1Ni ½Mo / OP 121 TT
	V YM H5/(III YT(H5))	in Progress					-	OE-S2 Ni2 / OP 121 TT
							-	FLUXOCORD 31 HD / OP 121 TT
							-	FLUXOCORD 41 HD/OP 121 TT
	IV Y69M						-	FLUXOCORD 42/OP 121 TT
							-	OE S2 Ni3 / OP 121 TT
GMAW								
SA3YM PA,PF,PC SA3YM PA. PF, PE	III YMS F,V III YMS AP	2YSA F, V 3YSA F,V	DVu BF 2YS H15 DXVdO BF 3YS H15				C1 M21	CARBOFIL 1A
							C1-M21	CARBOFIL 1A Gold
							M21	CARBOFIL Ni1
							M21-C1	CARBOFIL NiMo 1
FCAW - Rutile								
						MR (P)	C1	CITOFLUX R 00 Ni
							C1	CITOFLUX R 20C
SA4Y46M H5	IVY46MS H5	4Y46H5S	4Y46S H5		4Y46S H5		M21	FLUXOFIL 20 HD
SA4Y46M H5		4Y46H5S	4Y46S H5		4Y46S H5		C1	
SA4Y46M H5	IVY46MS H5	4Y46H5S	4Y46S H5				C1	FLUXOFIL 21 HD
	IVY46MS H5		4Y40S H5				M21	CITOFLUX R 82
	V Y55 H5						M21	CITOFLUX R 550
	IVY55MS H5		4Y62S H5				M21	CITOFLUX R 26
FCAW - Basic								
SA3-3YM H5	IIY40MS H5	3YH5S	3S-3YS-H5	3S-3YS H5			C1	FLUXOFIL 31
		3YH5S	3S-3YS-H5					
SA3YM H5 (P)	IVY40MS H5 (P)	4YH5S (P)	4Y40S H5 (P)			MR (P)	M21	CITOFLUX B 00
SA3YM H5 (P)	IVY40MS H5 (P)	4YH5S (P)	4Y40S H5 (P)			MR (P)	C1	FLUXOFIL 44
	VJMS						M21	FLUXOFIL 40
							C1	
					5Y50 H5		M21	FLUXOFIL 41
		BWB					C1	FLUXOFIL 41
							M21	FLUXOFIL 42LT
FCAW - Metal Cored								
SA3Y M H5 KV40	IVY40MS H5	4YH5S	4Y40S H5				M21	FLUXOFIL M 10
SA3Y M H5 KV40	IVY40MS H5	4YH5S	4Y40S H5				M21	FLUXOFIL M 10 S
SA3YM H5 (P)	IVY42MS H5 (P)		4Y40S H5 (P)				M21	CITOFLUX M 00
	VYMS						M21	CITOFLUX M 20
							M21	FLUXOFIL M 41
GTAW								
							I1	CARBOROD 1A
							I1	CARBOROD Ni1
							I1	CARBOROD Ni2
							I1	CARBOROD NiMo 1

DRYBAG



Absolute watertight control for submerged arc fluxes. DRYBAG an innovative packaging system from Oerlikon reduces costs, time and energy

The needs of industry

The fabrication specifications of oil companies and power suppliers usually require a guaranteed very low level of SAW flux moisture in order to attain a diffusible hydrogen level of less than 5 ml/100 g in the deposited weld metal. These specifications clearly stipulate the conditions required to guarantee compliance with this requirement.

DRYBAG : a packaging solution from our R&D teams

The research and development and the production departments of the Air Liquide Welding group, have developed an innovative new packaging system for Oerlikon submerged arc welding fluxes: DRYBAG a fully moisture proof packaging system making any requirement for flux conditioning unnecessary, resulting in high-quality welds even in the most hostile ambient conditions.

DRYBAG is made of an advanced composite foil, specially developed for vacuum packaging applications. For enhanced security, a partial vacuum is produced in the DRYBAG during the packaging of the welding flux. The low-pressure serves as an indicator for the security of the packaging. Oerlikon DRYBAG offers similar levels of security as packaging in metal drums, but is more cost effective. DRYBAG is available in 25 kg or larger, 800 or 1000 kg formats. The 25 kg-DRYBAG can be stored, transported and palletised in the same way as regular 25 kg bags and the larger formats have an integral pallet.



Advantages

- No risk of moisture ingress, even during transcontinental or maritime transport and following long-term storage in adverse conditions.
- No risk from ambient humidity, even in extreme climatic conditions.
- No need to re-condition the flux before use.
- This new packaging solution enables fabricators to reduce the risk of hydrogen induced cracking.
- No requirement for detailed control of temperature or humidity during storage, thereby saving time and energy costs.
- Improved, simplified handling and storage compared to existing solutions using metal drums, again reducing costs.

Oerlikon : Satisfied customers are our primary objective

Allseas choose Oerlikon DRYBAG OP 121TT submerged arc flux



**Allseas' dynamically positioned
pipelay vessel Solitaire**

The Swiss-based Allseas Group S.A. is one of the major offshore pipelay and subsea construction companies in the world, operating specialised vessels – which are designed in-house. The largest pipelay vessel in the world, Solitaire, has set new standards in the pipelay industry. The S-lay capacity with a holding force of 1050 tons, enables her to lay the heaviest pipelines. Welding processes SAW (rotating pipe) and MAG welding (fixed pipe) are used on board. For storage of the submerged arc flux at sea DRYBAG packaging is the chosen solution to avoid moisture pick up. Also for the SAW-wire, special packing in aluminium foil has been developed to avoid corrosion. Using these solutions, Allseas is assured of low hydrogen welding consumables during welding.

Arc equipment for large fabrication sites and yard applications

MIG/MAG welding equipment

OERLIKON CITOMIG 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.



Conventional switch based MIG-MAG installations

CITOMIG

Two power sources for intensive industrial applications in workshop conditions. These machines are easy to use via an intuitive parameter adjustment system which provides optimised welding parameters for the highest quality results.

Product features:

- Digital parameter display
- 4 roller feeder with speed regulation
- Assistant adjustment mode
- Complete welding cycle
- Compact wire feeder
- Protected harness (5m or 10m)
- 30 step adjustment
- 220/400V three phase

CITOMIG 400W XP 380 A at 40%

CITOMIG 500W XP 480 A at 50%



Digital technology for advanced welding installations

CITOPULS

Efficient and advanced MIG/MAG machines for all applications. Equipped with a tough separate wire feeder for improved reach.

These innovative OERLIKON CITOPULS machines have been recognised with an internationally prestigious Janus de l'Industrie design award.

Features for improved quality and productivity:

- Digital current regulation and control, totally managing the current wave form and exact parameter reproduction.
- A more powerful current/voltage characteristic, increasing arc stiffness and joint penetration.
- SSA (Speed Short Arc), which provides an increase in welding speed while reducing distortion, an advantage when welding thinner sheets.
- CDP (Cold Double Pulse) enabling very high quality beads to be obtained on thinner sheet material without distortion. The CDP™ gives the same

bead appearance as a TIG weld, and delivers optimum results on very thin aluminium or stainless steel, < 2 mm, with increased molten pool control even on poor edge preparations.

- MIG Brazing, or MIG braze welding, an extremely effective process which accommodates large joint tolerances.
- An unequalled number of welding programmes with more than 150 synergic curves as standard and a memory capacity for over 100 welding procedures.
- Increased control: Warning system for parameter variations, parameter print-outs, power source networking, correction and calibration of the values displayed, etc.

Product features:

- Digital parameter display
- Harness 5 m to 25 m
- 400 V three-phase
- MMA welding
- Gouging with CITOPULS MXW 520



DMY 4000 WKS

New rugged wire feeder for heavy duty applications



CITOPULS MXW 420
420 A at 45%

CITOPULS MXW 520
500 A at 60%

Arc equipment for large fabrication sites and yard

TIG welding installations OERLIKON

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



CITOTIG DC

(welding current range, 5A to 400A)

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.

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.



Technical specifications:	CITOTIG 200 DC	CITOTIG 300 DC	CITOTIG 300 W DC	CITOTIG 400 W DC
Power supply	230 V ($\pm 10\%$) 50-60 Hz single-phase	400 V (+20% -15%) 50-60 Hz three-phase	400 V (+20% -15%) 50-60 Hz three-phase	400 V (+20% -15%) 50-60 Hz three-phase
Effective consumption	15 A	6.6 A	6.6 A	10.9 A
Open circuit voltage	80 V (40 V)	80 V	80 V	80 V
Welding current	5 - 200 A	5 - 300 A	5 - 300 A	5 - 400 A
Duty cycle 10 min. cycle (at 40°C)	at 100%	130 A	200 A	220 A
	at 60%	150 A	230 A	285 A
	at 30%	200 A	300 A	400 A
Electrode diameter max.	4.0 mm	5.0 mm	5.0 mm	6.0 mm
Dimensions (L x W x H)	410 x 180 x 390 mm	500 x 180 x 390 mm	499 x 180 x 650 mm	500 x 180 x 650 mm
Net weight	15 kg	22 kg	32 kg	33 kg

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 6mm, to the NERTAJET 50, a high performance chopper, multi gas machine that cuts up to 50mm of steel.

CITOCUT 40i

Heavy duty portable cutting unit inverter technology.



- 400V 50/60 Hz three phase.
- Heavy duty cycle, 120 A at 60% at 40 °C.
- Quality cut, up to 40 mm.
- Contact cut, distance cut, plasma gouging.
- Blow back start, no HF interference.
- Grid cutting capability.

CITOCUT 40

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 6m torch, air hose, primary cable, earth cable, starting set of wear parts.
- Input voltage three phases : 220/230/380/400 V - 50/60 Hz



MMA electrode power sources

OERLIKON has a wide range of equipment for MMA welding on site in all conditions.

From small, portable, high performance machines which can be carried by the welder to the location, such as the CITOARC 1900i, to rugged thyristor controlled units, such as the CITOROD 6500TH designed for heavy duty site applications, with rack fitting, remote parameter control and use with very long cables

CITOARC 1900i

Single phase inverter, portable machine.

- MMA / TIG Lift / MMA Cellulosic.
- 230V 50/60Hz single phase.
- Motor generator compatible.
- Duty cycle 160A at 60%.
- Light and portable 40 x 18 x 30 cm - 11kg.
- Digital display.
- Remote control.
- 2 years warranty



CITOROD 6500 TH

Thyristor controlled multiprocess power source.

- MMA, TIG Lift, MMA cellulosic, gouging.
- Double characteristic, CC/CV.
- Options: TIG, TIG - HF / MIG.
- 230/400/440V 50/60Hz three phase.
- Heavy duty cycle, 630A at 35%.
- 82 x 51 x 57 cm - 185 kg.
- Hot start and arc force adjustment.
- Remote control.
- Hoisting ring standard, suitable for rack fitting.



Equipment for submerged arc welding



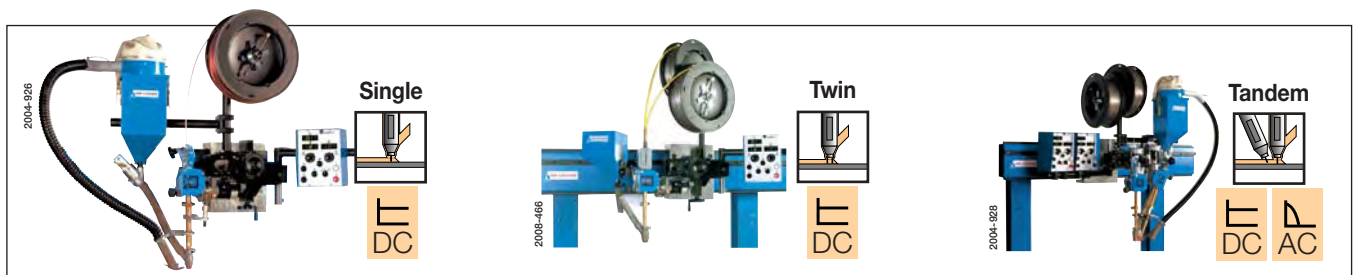
WELDING HEAD

SUBARC 5 standard welding heads

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



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 alternative current (AC).
 - 3 - SAW gouging arc.



	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	64.6 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.



2004-6892

SAW self propelled tractor.

A practical, efficient and cost effective solution.

MEGATRAC 6 SUBARC 3C

- Modular S.A. carriage which can be adapted to various applications.
- Flat and angle assembly of plates in all grades and thicknesses.
- Wheel diameter: 150 mm.
- Crabbing arms

Submerged arc special welding heads.

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.



2356-014



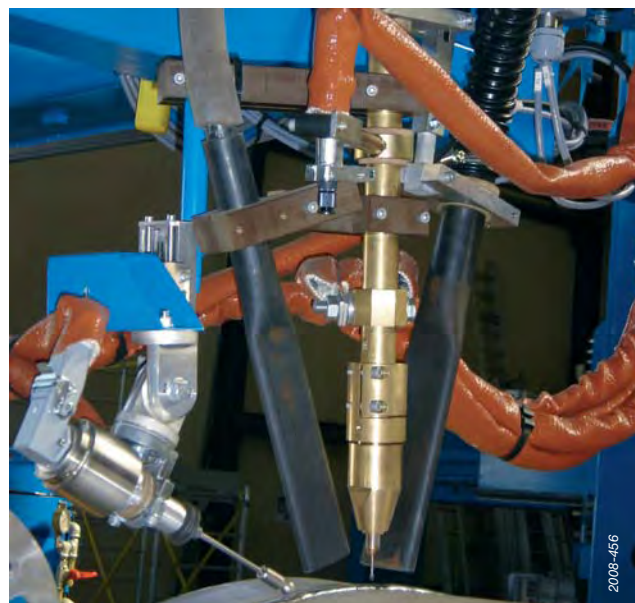
2008-459



2008-337

Single or twin heavy duty torch.

- Thicknesses up to 70 mm.
- Kit to retrofit on SUBARC installations.
- Adjustable nozzle.
- 2.4 mm to 5.0 mm single wire diameter.
- 2 x 1.6 mm - 2 x 2.4 mm twin wire diameter.



2008-466

Equipment for submerged arc welding

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

- Centralized console
- Mobile plug & play system
- User friendly-interface

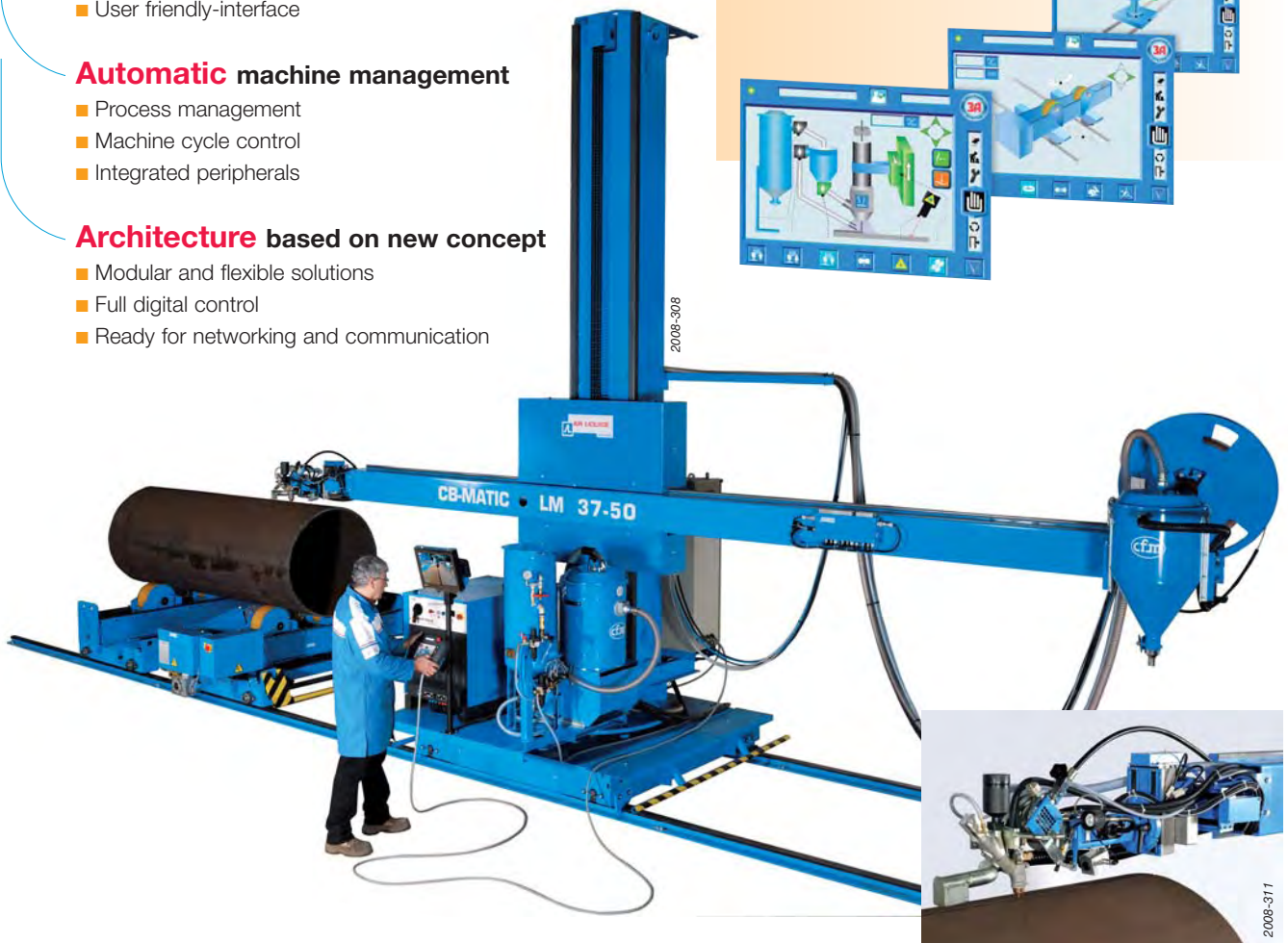
Automatic machine management

- Process management
- Machine cycle control
- Integrated peripherals

Architecture based on new concept

- Modular and flexible solutions
- Full digital control
- Ready for networking and communication

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



3A welding system is particularly suited for Submerged Arc Welding industrial applications.

Temperature Conversion Table

°C	°F	°C	°F	°C	°F	°C	°F				
-156.6	-250	-418	-36.6	-34	-29.2	-25.5	-14	6.8	-14.4	6	42.8
-128.8	-200	-328	-36.1	-33	-27.4	-25.0	-13	8.6	-13.9	7	44.6
-101.1	-150	-238	-35.5	-32	-25.6	-24.4	-12	10.4	-13.3	8	46.4
-73.3	-100	-148	-35.0	-31	-23.8	-23.8	-11	12.2	-12.8	9	48.2
-45.5	-50	-58	-34.4	-30	-22.0	-23.3	-10	14.0	-12.2	10	50.0
-45.0	-49	-56.2	-33.8	-29	-20.2	-22.7	-9	15.8	-11.7	11	51.8
-44.4	-48	-54.4	-33.3	-28	-18.4	-22.2	-8	17.6	-11.1	12	53.6
-43.8	-47	-52.6	-32.7	-27	-16.6	-21.6	-7	19.4	-10.6	13	55.4
-43.3	-46	-50.8	-32.2	-26	-14.8	-21.1	-6	21.2	-10.0	14	57.2
-42.7	-45	-49	-31.6	-25	-13.0	-20.5	-5	23.0	-9.44	15	59.0
-42.2	-44	-47.2	-31.1	-24	-11.2	-20.0	-4	24.8	-8.89	16	61.8
-41.6	-43	-45.4	-30.5	-23	-9.4	-19.4	-3	26.6	-8.33	17	63.6
-41.1	-42	-43.6	-30.0	-22	-7.6	-18.8	-2	28.4	-7.78	18	65.4
-40.5	-41	-41.8	-29.4	-21	-5.8	-18.3	-1	30.2	-7.22	19	67.2
-40.0	-40	-40.0	-28.8	-20	-4.0	-17.8	0	32.0	-6.67	20	68.0
-39.4	-39	-38.2	-28.3	-19	-2.2	-17.2	1	33.8	-6.11	21	69.8
-38.8	-38	-36.4	-27.7	-18	-0.4	-16.7	2	35.6	-5.56	22	71.6
-38.3	-37	-34.6	-27.2	-17	1.4	-16.1	3	37.4	-5.0	23	73.4
-37.7	-36	-32.8	-26.6	-16	3.2	-15.6	4	39.2	-4.44	24	75.2
-37.2	-35	-31	-26.1	-15	5.0	-15.0	5	41.0	-3.89	25	77.0
-33.3	26	78.8	7.78	46	114.8	18.9	66	150.8	30.0	86	186.8
-2.78	27	80.6	8.33	47	116.6	19.4	67	152.6	30.6	87	188.6
-2.22	28	82.4	8.89	48	118.4	20.2	68	154.4	31.1	88	190.4
-1.67	29	84.2	9.44	49	120.2	20.6	69	156.2	31.7	89	192.2
-1.11	30	86.0	10.0	50	122.0	21.1	70	158.0	32.2	90	194.0
-0.56	31	87.8	10.6	51	123.8	21.7	71	159.8	32.8	91	195.8
0.00	32	89.6	11.1	52	125.6	22.2	72	161.6	33.3	92	197.6
0.56	33	91.4	11.7	53	127.4	22.8	73	163.4	33.9	93	199.4
1.11	34	93.2	12.2	54	129.2	23.3	74	165.2	34.4	94	201.2
1.67	35	95.0	12.8	55	131.0	23.9	75	167.0	35.0	95	203.0
2.22	36	96.8	13.3	56	132.8	24.4	76	168.8	35.6	96	204.8
2.78	37	98.6	13.9	57	134.6	25.0	77	170.6	36.1	97	206.6
3.33	38	100.4	14.4	58	136.4	25.6	78	172.4	36.7	98	208.4
3.89	39	102.2	15.0	59	138.2	26.1	79	174.2	37.2	99	210.2
4.44	40	104.0	15.6	60	140.0	26.7	80	176.0	38	100	212.0
5.00	41	105.8	16.1	61	141.8	27.2	81	177.8	43	110	230
5.56	42	107.6	16.7	62	143.6	27.8	82	179.6	49	120	248
6.11	43	109.4	17.2	63	145.4	28.3	83	181.4	54	130	266
6.67	44	111.2	17.8	64	147.2	28.9	84	183.2	60	140	284
7.22	45	113.0	18.3	65	149.0	29.4	85	185.0	66	150	302
71	160	320	177	350	662	621	1150	2102	1177	2150	3902
77	170	338	182	360	680	649	1200	2192	1204	2200	3992
82	180	356	188	370	698	677	1250	2282	1232	2250	4082
88	190	374	193	380	716	704	1300	2372	1260	2300	4172
93	200	392	199	390	734	732	1350	2462	1288	2350	4262
99	210	410	204	400	752	760	1400	2552	1316	2400	4352
100	212	413	232	450	842	788	1450	2642	1343	2450	4442
104	220	428	260	500	932	816	1500	2732	1371	2500	4532
110	230	446	288	550	1022	843	1550	2822	1399	2550	4622
116	240	464	316	600	1112	871	1600	2912	1427	2600	4712
121	250	482	343	650	1202	899	1650	3002	1454	2650	4802
127	260	500	371	700	1292	927	1700	3092	1482	2700	4892
132	270	518	399	750	1382	954	1750	3182	1510	2750	4982
138	280	536	427	800	1472	982	1800	3272	1538	2800	5072
143	290	554	454	850	1562	1010	1850	3362	1566	2850	5162
149	300	572	482	900	1652	1038	1900	3452	1593	2900	5252
154	310	590	510	950	1742	1066	1950	3542	1621	2950	5342
160	320	608	538	1000	1832	1093	2000	3632	1649	3000	5432
166	330	626	566	1050	1922	1121	2050	3722			
171	340	644	593	1100	2012	1149	2100	3812			

Note: the numbers in bold type refer to the temperature, either in Celsius or Fahrenheit, which is desired to convert into the other scale. If converting from Fahrenheit degrees to Celsius degrees, the equivalent temperature will be found in the left column, while converting from Celsius degrees to Fahrenheit degrees the answer will be found in the column on the right.

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

Product Literature

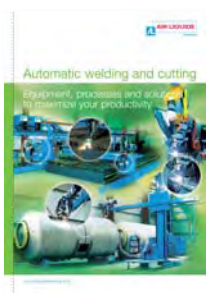


Oerlikon consumables Catalogue

All data sheets of welding consumables of the Oerlikon range. 500 pages in A5 format (available also on CD and on line www.oerlikon-welding.com)

Oerlikon Manual Arc Equipment

- MMA range 1
- TIG range 2
- Plasma cutting range 3
- CITOMIG range 4
- CITOWAVE - CITOPULS range 5



Automation Catalogue,

this catalogue describes a complete range of equipment for the automatic oxy and plasma cutting processes, as well as for the welding processes (MIG/MAG, TIG, plasma...). Positioning equipment is also presented, with rotators, positioners, column and booms, turntables etc...

“Competence”, a journal from Oerlikon containing technical articles on some of the latest developments in welding technology. Each issue contains technical articles designed to illustrate recent technological developments from Oerlikon, their background and the consequent fabrication opportunities.





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