OERLIKON

Offshore construction

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www.oerlikon-welding.com

AIR LIQUIDE WELDING

OERLIKON solutions for the offshore construction industry

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, enableling 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 offshore industry

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 it's 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.

OERLIKON

Demand the Welding Expertise

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.

MMA consumables for the offshore construction 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 <3.2 mm diameter are double coated using unique OERLIKON manufacturing technology to ensure arc stability, resulting in excellent operability particularly in the vertically up position.

Weldability

Exacting 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 <4 ml H_2 per 100 g 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 >690 MPa and high CVN toughness at -50 °C. Typical applications include rack to rack and chord to chord joints.

Cored wires for the offshore construction industry

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

FLUXOFIL and CITOFLUX 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 ~4 ml H_2 per 100 g 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.

CITOFLUX 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

CITOFLUX 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%CO_2. 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 CO_2 shielding gas.

• FLUXOFIL 41

Basic flux cored electrode filler wire for gas shielded welding with mixed gases, e.g.80%Ar/20%CO_2. FLUXOFIL 41 deposits high strength, high toughness 1.2%Ni-0.4%Mo weld metal, for the welding of higher strength steels, yield strength >550 MPa.

■ FLUXOFIL 42

Basic flux cored electrode filler wire for gas shielded welding with mixed gases, e.g.80%Ar/20%CO_2. 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 >690 MPa. Typical applications include rack and chord joints.

■ CITOFLUX R550

Rutile flux cored electrode filler wire for gas shielded welding in all positions with mixed gases, e.g.80%Ar/20%CO_2. CITOFLUX 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 550 MPa.

■ CITOFLUX R82

Rutile flux cored electrode filler wire for gas shielded welding in all positions with mixed gases, e.g.80%Ar/20%CO_2. CITOFLUX 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.

■ CITOFLUX R620 Ni2

Rutile flux cored electrode filler wire for gas shielded welding in all positions with mixed gases, e.g.80%Ar/20%CO_2. CITOFLUX R620 Ni2 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 construction industry

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<5 ml H_2 per 100 g 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 thoughness 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 0.25-0.35 mm 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 API 2Y Gr50, API 2Y Gr60

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

Key Products:

CVN at -30 to -60 °C CTOD at -10 °C	**MMA**	SUPERCITO TENACITO TENACITO 38R TENAX 56S TENAX 76S
	SAW	OP121TT/OE-SD3
	FCW	CITOFLUX R00C FLUXOFIL 19 HD CITOFLUX R00NiC

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 ABS FQ 70, A514 grade Q, A517 grade F, SUPERELSO 690 CR.

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

Key Products:

Yield Stress >690 MPa CVN at -40 °C to -60 °C	**MMA**	TENACITO 80CL
	SAW	FLUXOCORD 42/OP 121TT(W)
	FCW	FLUXOFIL 42 FLUXOFIL 29 HD

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 0.25-0.35 mm 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

ABS Grades of high strength Quenched and Tempered Steel from yield strength level 420MPa up to 690MPa

Key Products:

CVN at -40 to -60 °C CTOD at -10 °C	**MMA**	TENACITO 38R TENACITO 70 TENAX 88S TENAX 76S TENAX 88S HR
	SAW	OP121TT/OE-SD3 OP 121TT/OE-SD3 1Ni ¼Mo OP 121TT / FLUXOCORD 41 HD
	FCW	FLUXOFIL 20HD FLUXOFIL 21HD CITOFLUX R82 CITOFLUX R20C

Fabrication of higher strength grades

Yield Strength higher than 500MPa

Cv at -40 to -60 °C CTOD at -10 °C	**MMA**	TENACITO 65R TENAX 98M TENACITO 80 CL TENAX 118-M
	SAW	OP 121TT/OE SD3 1Ni ½Mo OP 121TT / FLUXOCORD 41 HD
	FCW	FLUXOFIL 41 CITOFLUX R550 CITOFLUX R620 Ni2 FLUXOFIL 29 HD

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	P	S
MMA							
SUPERCITO	E 7018-1-H4	E 42 5 B 32 H5	0.05-0.08	1.0-1.5	<0.55	<0.020	<0.020
TENAX 56S	E 7016-1 H4	E42 5 B 12 H5	0.06	1.2	0.5	<0.02	<0.02
TENACITO R	E 7018-1 H4	E 42 6 B 42 H5	0.06	1.45	0.3	<0.012	<0.012
TENACITO 38R	E 7018-G H4	E 46 6 1Ni B 42 H5	0.06	1.3	0.4	<0.012	<0.015
TENAX 76S	E 7018-G H4	E 46 6 1Ni B 32 H5	0.07	1.4	0.3	<0.02	<0.01
TENAX 88S	E 8016-G	E 50 6 Mn1Ni B 12 H5	0.06	1.7	0.4	<0.02	<0.02
TENAX 88S HR	E 8018-G H4	E 50 6 Mn1Ni B 32 H5	0.06	1.5	0.3	<0.015	<0.015
TENACITO 70	E 8018-G H4	E 50 6 Mn1 Ni B 42 H5	0.06	1.6	0.3	<0.020	<0.015
TENACITO 65R	E 9018-G H4	E 55 6 Mn1NiMo B T 42 H5	0.05	1.6	0.3	<0.012	<0.012
TENAX 98M	E 9018-M H4	E 55 5 Z B 32 H5	0.07	1.2	0.4	<0.02	<0.02
TENAX 118-M	E 11018-M H4	E 69 5 Z B 32 H5	0.07	1.6	0.3	<0.02	<0.02
TENACITO 80 CL	E11018-G H4	E 69 6 Mn2 NiCrMo B 42 H5	0.06	1.4	0.5	<0.020	<0.012
SAW							
OE-SD3 / OP 121 TT	F7A8-EH12K	S 46 6 FB S3Si	0.07	1.6	0.3	<0.020	<0.015
OE-SD3 1Ni ¼Mo / OP 121 TT	F8A10EG-G	S 50 6 FB S3Ni1Mo0.2	0.07	1.3	0.3	<0.020	<0.015
OE-SD3 1Ni ½Mo / OP 121 TT	F9A8-EF3/EG-F3	S 62 6 FB S3Ni1Mo	0.07	1.5	0.3	<0.020	<0.015
FLUXOCORD 31 HD / OP 121 TT(W)	F7A8-EC1	S 42 6 FB T3	0.06	1.7	0.4	<0.020	<0.015
FLUXOCORD 41 HD / OP 121 TT(W)	F9A8-EC-F3	S 55 5 FB T2Ni1Mo	0.05	1.3	0.2	<0.020	<0.015
FLUXOCORD 42 / OP 121 TT(W)	F11A8-EC-F5	S 69 6 FB TZ	0.05	1.4	0.2	<0.020	<0.015
GMAW							
CARBOFIL 1A	ER 70S-6	G46 4 M G4Si1	0.08	1.3	0.7	<0.025	<0.025
CARBOFIL 1A GOLD	ER 70S-6	G46 4 M G4Si1	0.08	1.3	0.7	<0.025	<0.025
CARBOFIL Ni1	ER 80S-Ni1	G 46 6 M G3Ni1	0.07	0.8	0.4	<0.020	<0.020
CARBOFIL NiMo1	ER 100S-G	G 62 4 M Mn3Ni1Mo	0.07	1.5	0.4	<0.015	<0.018
CARBOFIL NiMoCr	ER 110S-G	G 69 4 M Mn3Ni1CrMo	0.08	1.2	0.3	<0.015	<0.018
FCAW - Rutile							
CITOFLUX R00C	E71T-1C-JH4	T 42 3 P C 1 H5	0.05	1.2	0.35	<0.020	<0.025
FLUXOFIL 19 HD	E71T-1C-JH4	T 46 3 P C 1 H5	0.05	1.3	0.5	<0.010	<0.010
CITOFLUX R00NiC	E71T-1C-JH4	T 46 4 P C 1 H5	0.06	1.2	0.4	<0.015	<0.015
CITOFLUX R20C	E 81T1-Ni1C-H4	T 46 5 1Ni P C 1 H5	0.05	1.3	0.4	<0.010	<0.010
FLUXOFIL 20 HD	E81T1-Ni1M-JH4	T 46 4 1Ni P M 1 H5	0.06	1.3	0.4	<0.010	<0.010
FLUXOFIL 21 HD	E81T1-Ni1C-JH4	T 46 4 1Ni P C 1 H5	0.07	1.4	0.4	<0.010	<0.010
CITOFLUX R82	E81T1-Ni1M-H4	T 46 5 1Ni P M 1 H5	0.05	1.3	0.4	<0.010	<0.010
CITOFLUX R550	E91T1-GM-H4	T 55 5 Mn1.5Ni P M 1 H5	0.07	1.3	0.4	<0.015	<0.015
CITOFLUX R620 Ni2	E101T1-GM-H4	T 62 5 Mn2.5Ni P M 1 H5	0.08	1.35	0.35	<0.015	<0.015
FLUXOFIL 29 HD	E111T1-GM-JH4	T 69 4 Z P M 1 H5	0.06	1.4	0.4	<0.010	<0.010
FCAW - Basic							
FLUXOFIL 31	E70T-5M-JH4	T 42 4 B M 2 H5	0.05	1.2	0.3	<0.010	<0.010
CITOFLUX B 00	E70T-5M-JH4	T 42 5 B M 2 H5	0.06	1.5	0.6	<0.020	<0.020
FLUXOFIL 40	E80T5-GM-H4	T 46 6 1Ni B M 2 H5	0.05	1.1	0.2	<0.010	<0.010
FLUXOFIL 41	E90T5-GM-H4	T 55 6 1 NiMo B C 2 H5	0.07	1.3	0.4	<0.01	<0.01
FLUXOFIL 42	E110T5-K4M-H4	T 69 6 Mn2NiCrMo B M 2 H5	0.06	1.5	0.3	<0.01	<0.01
FCAW - Metal Cored							
FLUXOFIL M 10	E70C-6M-H4	T 46 4 M M 1 H5	0.08	1.5	0.4	<0.010	<0.010
CITOFLUX M00	E 70C-6M-H4	T 46 5 M M 1 H5	0.04	1.7	0.5	<0.02	<0.02
CITOFLUX M20	E70C-GM-H4	T 46 6 Mn1Ni M M 1 H5	0.05	1.45	0.9	<0.010	<0.010
FLUXOFIL M 41	E90C-GM-H4	T 55 5 Z M M 1 H5	0.06	1.7	0.6	<0.015	<0.015
GTAW							
CARBOROD 1A	ER 70S-6	W 46 5 W4Si1	0.08	1.7	0.9	<0.020	<0.020
CARBOROD Ni1	ER80S-Ni1	W 46 6 W3Ni1	0.08	1.1	0.6	<0.020	<0.020
CARBOROD NiMo1	ER 100S-G	W Mn3Ni1Mo	0.08	1.8	0.6	<0.015	<0.018
CARBOROD NiMoCr	ER 110S-G	W Mn3Ni1CrMo	0.08	1.2	0.3	<0.015	<0.018

Cr	Ni	Mo	Other	Yield-strength MPa	Tensile strength MPa	A5d %	CVN (Joules)	Type
								MMA
				>430	510-640	>24	>47 @ -50°C	SUPERCITO
				>420	500-640	>22	>110 @ -50°C	TENAX 56S
				>420	500-640	>25	>90 @ -60°C	TENACITO R
	0.95			>460	530-650	>25	>110 @ -60°C	TENACITO 38R
	0.9			>460	530-680	>22	>60 @ -60°C	TENAX 76S
	0.8			>500	560-720	>24	>60 @ -60°C	TENAX 88S
	0.9	0.2		>500	560-720	>24	>60 @ -60°C	TENAX 88S HR
	0.75			>510	590-680	>24	>80 @ -60°C	TENACITO 70
	0.9	0.35		>560	630-750	>20	>47 @ -60°C	TENACITO 65R
	1.6	0.3		>550	610-780	>24	>47 @ -50°C	TENAX 98M
	2.3	0.4		>690	760-960	>20	>70 @ -60°C	TENAX 118-M
0.4	2.2	0.4		>720	760-900	>17	>60 @ -60°C	TENACITO 80 CL
								SAW
				>450	530-630	>25	>70 @ -60°C	OE-SD3 / OP 121 TT
	0.9	0.2		>500	560-680	>22	>70 @ -60°C	OE-SD3 1Ni ¼Mo / OP 121 TT
	0.95	0.5		>540	630-730	>20	>70 @ -60°C	OE-SD3 1Ni ½Mo / OP 121 TT
				>420	500-640	>20	>80 @ -60°C	FLUXOCORD 31 HD / OP 121 TT(W)
	0.9	0.5		>550	620-720	>18	>47 @ -50°C	FLUXOCORD 41 HD / OP 121 TT(W)
0.6	2.5	0.4		>690	750-830	>16	>69 @ -60°C	FLUXOCORD 42 / OP 121 TT(W)
								GMAW
				>460	530-680	>24	>70 @ -40°C	CARBOFIL 1A
				>460	530-680	>24	>70 @ -40°C	CARBOFIL 1A GOLD
	0.9			>480	550-680	>24	>47 @ -60°C	CARBOFIL Ni1
	1	0.4	Ti 0.1	>620	700-890	>18	>60 @ -40°C	CARBOFIL NiMo1
0.25	1.5	0.25		>690	770-890	>17	>47 @ -40°C	CARBOFIL NiMoCr
								FCAW - Rutile
				>420	530-680	>20	>47 @ -30°C	CITOFLUX R00C
				>460	550-650	>24	>50 @ -30°C	FLUXOFIL 19 HD
	0.4			>460	510-610	>24	>80 @ -40°C	CITOFLUX R00NiC
	0.85			> 460	550-690	>22	>60 @ -50°C	CITOFLUX R20C
	<0.9			>480	570-670	>24	>80 @ -40°C	FLUXOFIL 20 HD
	0.9			>490	570-670	>22	>70 @ -40°C	FLUXOFIL 21 HD
	0.85			>460	550-690	>22	>60 @ -50°C	CITOFLUX R82
	1.5			>550	620-760	>22	>47 @ -50°C	CITOFLUX R550
	2.2			>620	700-890	>18	>47 @ -50°C	CITOFLUX R620 Ni2
	2.9	0.35		>690	770-940	>17	>50 @ -40°C	FLUXOFIL 29 HD
								FCAW - Basic
				>420	500-640	>25	>80 @ -40°C	FLUXOFIL 31
				>420	500-640	>26	>60 @ -50°C	CITOFLUX B 00
	1			>470	550-650	>24	>60 @ -60°C	FLUXOFIL 40
	1	0.4		>550	640-760	>23	>60 @ -40°C	FLUXOFIL 41
0.4	2.3	0.4		>690	780-890	>15	>60 @ -60 °C	FLUXOFIL 42
								FCAW - Metal Cored
				>460	550-680	>24	>60 @ -40°C	FLUXOFIL M 10
				>460	530-680	>24	>75 @ -50°C	CITOFLUX M00
	0.8			>460	530-680	>26	>80 @ -60°C	CITOFLUX M20
	0.6	0.3		>550	640-820	>22	>47 @ -50°C	FLUXOFIL M 41
								GTAW
				>460	550-680	>24	>60 @ -50°C	CARBOROD 1A
	0.9	-		>480	550-680	>24	>47 @ -60°C	CARBOROD Ni1
	1	0.4		>620	700-890	>20	>80 @ -40°C	CARBOROD NiMo1
0.25	0.5	0.25		>690	770-890	>17	>47 @ -40°C	CARBOROD NiMoCr

Classification Society Approvals

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

Name	Shielding GAS	TUV	DB	ABS	BV
SUPERCITO		00287.	10.098.02	3YH5	3YHHH
TENACITO 38R		03160./08027.	10.098.14	3Y	5Y
TENACITO 65R		00769./08028.	10.098.26	E9018G	
TENACITO 70		00807.	10.098.21	3YH10	
TENACITO 80 CL				E 11018-G	
TENACITO R		00369.	10.098.13/81.098.01	4YH5/3H10,3Y	3YHH
TENAX 118-M				E11018-M H4	
TENAX 56S		04944.	10.098.24	4YH5	3YHHH
TENAX 76S				3YH5	3YHHH
TENAX 88S				3YH5	
OE-SD3 / OP 121 TT		03768	51.098.09	3YM	A3YM
OE-SD3 1Ni ¼Mo / OP 121 TT		09895		4 YQ 460 M	
OE-SD3 1Ni ½Mo / OP 121 TT			52.098.29	5 YQ 550 M	
FLUXOCORD 31 HD / OP 121 TT(W)		10377	52.098.28	4YM	
FLUXOCORD 41 HD / OP 121 TT(W)		11075			
FLUXOCORD 42 / OP 121 TT(W)			51.098.09	5YQ690M	
CITOFLUX B00	C1			4Y400SAH5	SA3YMH5
CITOFLUX B00	M21			4Y400SAH5	SA3YMH5
CITOFLUX M00	M21		42.098.40		SA3YMH5
CITOFLUX M20	M21				
CITOFLUX R00	C1	11092.00	42.098.43	3YSAH5	SA3YMH5
CITOFLUX R00	M21	11012.04	42.098.43	3YSAH5	SA3YMH5
CITOFLUX R00 C	C1	10344.02	42.098.44	3YSAH5	SA3YMH5
CITOFLUX R82	M21			4Y400SA H4	
FLUXOFIL 19HD	C1	10389.02	42.098.29	3Y40SAH5	SA-3Y40MHHH
FLUXOFIL 20HD	M21	09857.05	42.098.20	4Y46SA H5	SA4Y46MHHH (UPKV-40)
FLUXOFIL 21HD	C1			4Y46SAH5	SA4Y46HHH (UPKV-40)
FLUXOFIL 29HD				2Y69 H5	
FLUXOFIL 31	C1	06450.04	42.098.04	3YSA H5	SA3-3YM HHH
FLUXOFIL 31	M21	06451.04	42.098.04	3YSA H5	
FLUXOFIL 40	C1	00283.08	42.098.08		
FLUXOFIL 40	M21	07206.04	42.098.08		
FLUXOFIL 41	M21		42.098.09		
FLUXOFIL 42	M21	00285.09		4Y 690 SA H5	4Y 69 MS H5
FLUXOFIL M10	M21	05959.06	42.098.23	4YSA H5	SA4YMHHH
CITOFLUX R620 Ni2	M21			UP	
CITOFLUX R550	M21				
CARBOFIL 1A	C1	00266.10	42.098.01	2 Y SA	SA3YM
CARBOFIL 1A	M21	00266.10	42.098.01	3 Y SA	SA3YM
CARBOFIL 1A GOLD	C1	11041.00	42.098.17	2 Y SA	SA3YM
CARBOFIL 1A GOLD	M21	11041.00	42.098.17	3 Y SA	SA3YM
CARBOFIL Ni1	M21				
CARBOFIL NiMo1	M21	09848.03	42.098.27		
CARBOFIL NiMoCr	M21	03231.05	42.098.12		
CARBOROD 1A	I1				
CARBOROD Ni1	I1	03286.08		ER80S-Ni1	
CARBOROD NiMo1	I1				
CARBOROD NiMoCr	I1				

DNV	GL	LRS	RINA	RMS	Name
3YH5	3YH5	3YmH5		3YHH	**SUPERCITO**
5YH5	6Y42H5	5Y42mH5		5Y46HHH	**TENACITO 38R**
				5Y50HHH	**TENACITO 65R**
4Y50H5	3YH5	5Y42mH10		5Y50HHH	**TENACITO 70**
					TENACITO 80 CL
5YH10/None	3YH5	3YmH15			**TENACITO R**
4Y69H5					**TENAX 118-M**
4YH5	3YH10	4YmH5	4YH5		**TENAX 56S**
5YH5	6YH10	5Y42mH5	4YH5		**TENAX 76S**
5YH10		5Y42mH5			**TENAX 88S**
IV Y42M(H5)	5Y40M	4Y40M H5			**OE-SD3 / OP 121 TT**
		5Y50M H5			**OE-SD3 1Ni ¼Mo / OP 121 TT**
		3Y50M H5			**OE-SD3 1Ni ½Mo / OP 121 TT**
V YM					**FLUXOCORD 31 HD / OP 121 TT(W)**
					FLUXOCORD 41 HD / OP 121 TT(W)
IV Y69M / V Y69M	6Y69M	5Y69M H5			**FLUXOCORD 42 / OP 121 TT(W)**
IV Y40MS(H5)	4YH5S	4Y40 H5			**CITOFLUX B00**
IV Y40MS(H5)	4YH5S	4Y40 H5	3YS H5		**CITOFLUX B00**
IV Y42MS(H5)		4Y40 H5	3YS H5		**CITOFLUX M00**
VYMS H5					**CITOFLUX M20**
III Y40MS(H5)	3YH5S	3Y40 H5	2YS H5	3Y40S HHH	**CITOFLUX R00**
III Y40MS(H5)	3YH5S	3Y40 H5 (+TA3)	3YS H5	3Y40S HHH	**CITOFLUX R00**
III Y40MS(H5)	3YH5S	3Y40 H5	2YS H5	3Y40S HHH	**CITOFLUX R00 C**
V Y46MS (H5)		4Y40 H5			**CITOFLUX R82**
IIIY40MSH5	3Y40H5S	3Y40SH5	3Y40SH5	3Y/3Y40SH5	**FLUXOFIL 19HD**
4Y46MSH5	4Y46H5S	4Y46SH5		4Y46SH5	**FLUXOFIL 20HD**
4Y46MSH5	4Y46H5S	4Y46SH5			**FLUXOFIL 21HD**
					FLUXOFIL 29HD
IIIY40MS H5	3YH5S	3YSH5			**FLUXOFIL 31**
	3YH5S	3YSH5			**FLUXOFIL 31**
VYMS H5					**FLUXOFIL 40**
					FLUXOFIL 40
				5Y50H5	**FLUXOFIL 41**
4Y 69 MS H5					**FLUXOFIL 42**
IV Y40MS H5	4YH5S	4Y40 SH5			**FLUXOFIL M10**
IVY55MS H5		4Y62S H5			**CITOFLUX R620 Ni2**
IVY55MS H5		4Y62S H5			**CITOFLUX R550**
III YMS	3YS	2YS	3Y S		**CARBOFIL 1A**
III YMS	3YS	3YS	4Y40 S		**CARBOFIL 1A**
	3YS	2YS			**CARBOFIL 1A GOLD**
	3YS	3YS			**CARBOFIL 1A GOLD**
					CARBOFIL Ni1
					CARBOFIL NiMo1
					CARBOFIL NiMoCr
					CARBOROD 1A
					CARBOROD Ni1
					CARBOROD NiMo1
					CARBOROD NiMoCr

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 unecessary, 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.

Product Packaging
Welding Consumables


2008-677


2662-05


2662-31

MIG/MAG wires (solid and FCW)

Drums (ROUNDPAC)

Heavy duty cardboard drums

- 300 kg format
- 100% recyclable
- Reliable rapid pay off at high wire feed speeds
- Fitted sling points for handling safety

2010-269

Spools

- B 300
- 100% recyclable


2006-200

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

DRYBAG

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
- No re-conditioning required before use
- Protection during extended transport and storage
- Supply: 1 tonne (40 x 25 kg DRYBAG) per pallet

2007-474

MMA

Standard Packaging

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


2006-937

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
2009-012

DRY

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

VPMD

- Pack contents ~3 kg

TIG

Rods

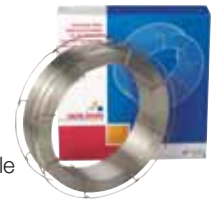
- 1.6, 2.0 & 2.4 mm diameter in 1 m lengths
- Full range of compositions
- Alloy grades are coin stamped
- Bright finished
- Fully certificated


2008-181
2006-940_r

SAW Wires

Spools

- B 450 (25 kg)
- B 570 (90 kg)
- 100% recyclable


2006-936

Drums

- 300 kg
- 700 kg

2010-269

Variants of packing solutions are available on request to suit specific requirements.

MIG/MAG manual equipment


2008-075


2191-01


2006-788

WARRANTY 3 YEARS

CITOMIG 500 XP

Optimised performance and advanced functionality:

With the CITOMIG range OERLIKON welding sets utilise highly developed and carefully applied technology. This robust and reliable range will always meet the challenge, even under heavy duty conditions.
CITOMIG sets are available in air or water, compact or separate versions, meeting every need and offering the following advantages.

Product features and advantages:

- Three-phase, dual-voltage power supply allowing connection to any type of three-phase power supply,
- Digital parameter display (plate thickness / current / wire speed),
- 4 feed-rollers unit with speed regulation system providing constant wire feed,
- “Assisted adjustment” mode taking into account the thickness to be welded,
- “Spatter reduction” system based on coil saturation after the striking phase,
- 2T/4T/spot/intermittent welding modes for an optimised operating procedure,
- Ventilation automatically operates when required,
- 2 coil positions,
- Plug-in harnesses on generator side,
- Fully sheathed and shielded harness for greater robustness,
- Ultra-compact wire-feed unit designed for restricted access,
- Wire-feed unit delivered with the possibility of


2010-901

WARRANTY 3 YEARS

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
  - 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 sheet)
  - MIG brazing
  - 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

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-rollers feeder unit with drive rollers as

CITOWAVE MXW

Product features and advantages:

Same as the CITOPULS range with in addition:

- 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,
- Control of aluminium welding (Spray Modal™): special welding transfer which provides reduced porosity and increases the penetration,
- More controls: parameters monitoring, indication of defects, parameter blocking on several levels, printing, 99 programs, calibration…

Technical specifications:	CITOMIG 500 XP	CITOPULS II 420	CITOWAVE 400	CITOWAVE 500
Technology	Thyristor	Inverter		
Primary power supply (3 phase)	230/240/380/400 V	400 V		
Primary consumption @ I max	50 A (400 V)	35 A	35 A	45 A
Welding current	16 A - 480 A	20 A - 420 A	20 A - 400 A	20 A - 500 A
Duty cycle 10 min. cycle (at 40°C)	480 A @ 50%	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 in response to the needs of the Cranes and Heavy Lifting Equipment industry.

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.	■ 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.	■ 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.	■ Effective on thin sheets ■ Reduces distortion ■ Easy operating technique ■ TIG appearance weld bead	CITOPULS II CITOWAVE

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 1800HPF

- Very light and portable unit for maintenance,
- Ultra flexible for light duty and flexible finishing applications.

CITOARC 1900 EXPERT

- More performance 160 @ 50% at 40 °C,
- With 16 A shuko plug,
- Suitable for welding with cellulosic electrodes,
- VRD (Voltage Reduction Device) for increased safety when welding on site,
- Inverter technology.

CITOARC 3500i

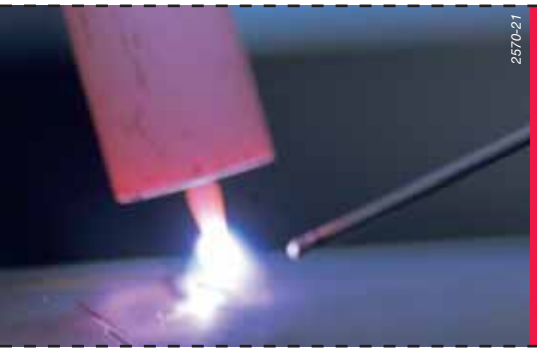
- Multi-process (MMA, Gouging, TIG DC, MIG) inverter unit,
- Welding MMA electrodes up to Ø 6.3 mm,
- MIG welding with the DV 4004 wire feeder option,
- CC/CV 3 phase unit,
- Weighing only 29 kg.

CITOROD 6500 XT

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

Technical specifications:		CITOARC 1800 HPF	CITOARC 1900 EXPERT	CITOARC 3500i	CITOROD 6500 XT
Primary					
Power supply		230 V single-phase	230 V single-phase	400 V three phase	230 - 400 V +/- 15% 50/60 Hz three phase
Effective consumption		15 A	16 A	28.5 A	61.5 - 35.4 A
Secondary					
Open circuit voltage		44 V	67 V (14 V rest voltage)	91 V	68 - 75 V
Welding current		10 - 180 A	5 -160 A	5 - 350 A	10 - 630 A
Duty cycle 10 min. cycle (at 40 °C)		180 A at 20%	160 A at 40%	350 A at 35%	630 A at 35%
Diam. Electrode	**MMA**	1.6 to 4.0 mm	1.6 to 4.0 mm	1.6 to 6.0 mm	1.6 to 6.0 mm
	Gouging	-	-	Up to 6.3 mm	Up to 10 mm
Dimensions (L x W x H)		170 x 320 x 395 mm	205 x 345 x 450 mm	525 x 300 x 390 mm	1000 x 600 x 600 mm
Net weight		6.6 kg	9 kg	29 kg	176 kg

TIG equipment



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.

WARRANTY 3 YEARS

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.

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.

Technical specifications:	DC welding		
	CITOTIG 200 DC	CITOTIG 300 DC (W)	CITOTIG 400 DC W
Primary			
Power supply	230 V single-phase	400 V three-phase	
Consumption	15 A	6.6 A	11 A
Secondary			
Open circuit voltage	80 V	80 V	80 V
Welding current	5 - 200 A	5 - 300 A	5 - 400 A
Duty cycle 10 min. cycle (at 40°C)	200 A at 30%	230 A at 60%	285 A at 60%
Diam. Electrode	1.6 to 4.0 mm	1.6 to 5.0 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
Net weight	15 kg	22 kg / 32 kg in W version	33 kg
Cooling unit	No	Yes in W version	Yes

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.

WARRANTY 3 YEARS

From the CITOCUT 10KT, a single phase portable unit with integrated compressor, a highly portable unit that cuts up to 10 mm, to the NERTAJET 50, a high performance chopper, multi gas machine that cuts up to 50 mm of steel.

CITOCUT 40i


2007-118

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.

CITOCUT 40C

- High cutting capcity: 40 mm with 120 A,
- 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, start set of wear parts.


2010-260

NERTAJET 50


2007-280

Work of high quality and precision with contact cutting.

- Multi-voltage three-phase,
- Intensive work (100% duty cycle),
- Well suited for stainless steels and light alloys with Ar/H_2 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.


1909-12

Technical specifications:	CITOCUT 40i	CITOCUT 40C	NERTAJET 50
Technology	Inverter	Transformer	Chopper
Maximum thickness	40 mm	40 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

Personal Protection Equipment, PPE and Workplace Products


2009-471

Air Liquide Welding through WELDLINE brand offers a wide range of tools and accessories dedicated for welding applications (cables, earth clamps, torches, brushes and hammers, sprays…) as well as personal protective equipment for the welder (gloves, clothing, goggles, mask…) and for the workshop (strips, curtains etc.).

Tungsten electrodes

For TIG welding, the WELDLINE range includes a full range of non consumable tungsten electrodes.

This range includes pure tungsten electrodes and several grades of alloyed electrodes.

Pure Tungsten for AC welding of aluminum
Tungsten + thorium for DC welding
Tungsten + cerium for DC welding
Tungsten + lanthanum for both DC and AC welding
Tungsten + rare earths for both DC and AC welding


2009-462

Cables and connectors

Primary and secondary cables, solid copper meeting the international standards requirements.


2000-174


2007-814

Ovens


2008-574
2008-579

A full range of portable quivers, holding and re-baking ovens for MMA electrodes and hopper ovens for SAW flux.

Sprays

Anti-spatter (SPRAYMIG), crack detection products (SKINCRIC), leak detection (BUBBLE).


2007-394


2007-794


2006-238
2006-239
2006-240

SPRAYMIG *BUBBLE* *SKINCRIC*

Welder Protection

A complete range of helmets, leather and cotton clothing, glasses, gloves and shoes.

The ZEPHYR helmet ensures comfort and protection with a new high performance liquid crystal cell, extra-wide vision and extreme reliability. The ZEPHYR is equipped with a forced air flow system preventing welding fume from infiltrating into the welder's helmet. The filter and protection screen are easy to extract, with pressure on the push button. Adjustable head gear (4 positions) with an optimised design to ensure good protection of the head, and light weight for comfort.


2008-247

Flame and Plasma cutting machines


1881-41

OXYTOME / PLASMATOME RS & TWIN RS - CYBERTOME open the way to all oxycutting and plasma arc cutting operations that require the use of machines capable of cutting very wide plates and implementing more complex options.

OXYTOME RS


2006-298

PLASMATOME TWIN RS


2007-361

Reinforced structure for OXYTOME / PLASMATOME (RS)
For plates wider than 4 m or for certain equipment, a reinforced structure is used to ensure movement stability and precision.

TWIN RS structure for OXYTOME / PLASMATOME
The TWIN RS structure is designed as a double transversal beam equipped with liner guides and bearing, located in a safety position away from heat radiation. This machine is specially suitable for bevelling head applications requiring a transversal cutting stroke over 4 m or tool holder of 800 mm. Finally, the accuracy of this machine is particulary suitable for HP plasma applications.

CYBERTOME

Designed as a “machine tool” concept, stated in terms of accuracy and repeatability according to current standards. This design can be modified to accomodate special requirements, and allows sheet metal cutting of 8 m width and more.

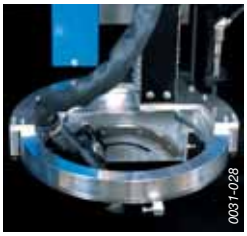

2003-342

Bevelling system


0031-055

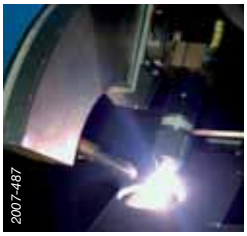
Plasma longitudinal

This system allows the operator to manually tilt the torch in order to work plasma bevels along the longitudinal axis.


0031-028

Plasma straight

This system is used to work bevels along the axes using a plasma torch. For further details on this option, please contact OERLIKON service.


2007-487

Plasma bevelling head

System rotation and tilting are entirely servo-controlled by the HPC digital process controller which makes it possible to program a bevel angle change during a run. This light but rugged system guarantees excellent cutting results.


2008-470

V X K Straight line bevelling unit

For bevelling along the machine axes with mechanical sensing.


1065-001

V X K endless rotation bevelling unit

Can be fitted on Cybertome Numerical control programs the blowtorches positions. It can work V, X, or K type bevels from 0 to 45° for plates up to 60 mm thick (other possibilities on request).

AZURMATIC cutting tables

3 models of table adapted to the process of cutting

Extraction table for dry cutting

The AZURMATIC table with air extraction offers unrivalled efficiency in terms of fume extraction due to its unique system of transverse extraction ducts.
Robustly designed in one-piece or modular form, the table is divided over its length into 1 metre sections, extraction taking place across the full width of the table on the module in operation only. Mechanical grills actuated by the displacement of the machine provide suction under the sheet at the place of cutting only.
This principle of operation guarantees optimum extraction, irrespective of the size of the sheet being cut, while maintaining a modest extraction air-flow rate.

Technical characteristics:
- Transverse duct extraction system,
- Division into 1 metre sections over the length of the table (500 and 750 mm sections on demand for intensive use),
- Removable slag boxes,
- Removable workpiece supporting frame with flat irons (section 100 x 6 mm) and wire mesh grid (50 x 50 x 5 mm),
- Maximum capacity: sheet up to 300 mm thick.

Constant water level extraction table

Various processes, especially plasma cutting with non-immersed water vortex, require a cutting table with water recovery and fume extraction.

This table provides both possibilities. This process (which is patented) avoids the need for filtering equipment upstream of fume extraction.

Technical characteristics:
- One-piece design divided into 630 mm sections,
- Standard lengths of 3 to 12 m,
- Standard widths: 1.5 - 2 - 2.5 and 3 m,
- Height: 700, 800 or 920 mm
- Maximum capacity: sheet thickness 50 mm.

Variable water level tables

Variable water level tables are specifically intended for immersed plasma cutting.
This procedure limits pollution by solid or gaseous matter and gives protection against audible and visual stress.
It improves accuracy of cutting while limiting distortion caused by heating of the workpiece.

Technical characteristics:
- Modular construction in lengths of 1.5, 1.75 and 2 m,
- Widths to demand,
- Pivoting workpiece support frame for easier, faster cleaning.

Equipment for submerged arc welding


1881-064


2007-386

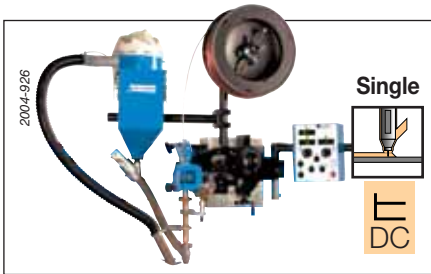
WELDING HEAD

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.

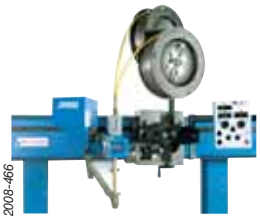
For the most demanding applications, SUBARC 5 is a compact welding and hard surfacing installation. It allows accurate pre-setting and pre-selection of the actual welding current and voltage parameters for excellent arc striking every time:

- **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.


2004-926

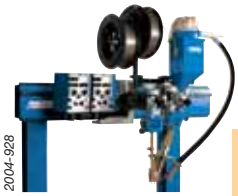
Single

DC


2008-466

Twin

DC


2004-928

Tandem

DC AC

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.


2006-781


2000-357

	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.*

SAW self propelled tractor.

A practical, efficient and cost effective solution.

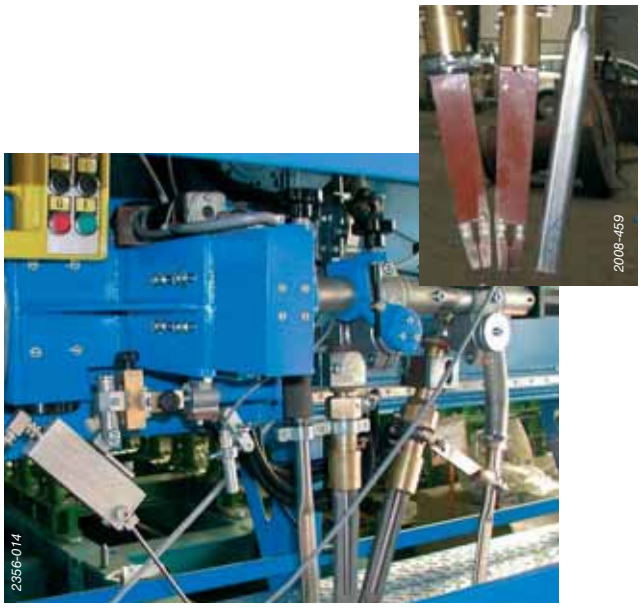
MEGATRAC 6 SUBARC 3C

- 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.



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.

Temperature Conversion Table

°C		°F
- 156.6	**- 250**	- 418
- 128.8	**- 200**	- 328
- 101.1	**- 150**	- 238
- 73.3	**- 100**	- 148
- 45.5	**- 50**	- 58
- 45.0	**- 49**	- 56.2
- 44.4	**- 48**	- 54.4
- 43.8	**- 47**	- 52.6
- 43.3	**- 46**	- 50.8
- 42.7	**- 45**	- 49
- 42.2	**- 44**	- 47.2
- 41.6	**- 43**	- 45.4
- 41.1	**- 42**	- 43.6
- 40.5	**- 41**	- 41.8
- 40.0	**- 40**	- 40.0
- 39.4	**- 39**	- 38.2
- 38.8	**- 38**	- 36.4
- 38.3	**- 37**	- 34.6
- 37.7	**- 36**	- 32.8
- 37.2	**- 35**	- 31

°C		°F
- 36.6	**- 34**	- 29.2
- 36.1	**- 33**	- 27.4
- 35.5	**- 32**	- 25.6
- 35.0	**- 31**	- 23.8
- 34.4	**- 30**	- 22.0
- 33.8	**- 29**	- 20.2
- 33.3	**- 28**	- 18.4
- 32.7	**- 27**	- 16.6
- 32.2	**- 26**	- 14.8
- 31.6	**- 25**	- 13.0
- 31.1	**- 24**	- 11.2
- 30.5	**- 23**	- 9.4
- 30.0	**- 22**	- 7.6
- 29.4	**- 21**	- 5.8
- 28.8	**- 20**	- 4.0
- 28.3	**- 19**	- 2.2
- 27.7	**- 18**	- 0.4
- 27.2	**- 17**	1.4
- 26.6	**- 16**	3.2
- 26.1	**- 15**	5.0

°C		°F
- 25.5	**- 14**	6.8
- 25.0	**- 13**	8.6
- 24.4	**- 12**	10.4
- 23.8	**- 11**	12.2
- 23.3	**- 10**	14.0
- 22.7	**- 9**	15.8
- 22.2	**- 8**	17.6
- 21.6	**- 7**	19.4
- 21.1	**- 6**	21.2
- 20.5	**- 5**	23.0
- 20.0	**- 4**	24.8
- 19.4	**- 3**	26.6
- 18.8	**- 2**	28.4
- 18.3	**- 1**	30.2
- 17.8	**0**	32.0
- 17.2	**1**	33.8
- 16.7	**2**	35.6
- 16.1	**3**	37.4
- 15.6	**4**	39.2
- 15.0	**5**	41.0

°C		°F
- 14.4	**6**	42.8
- 13.9	**7**	44.6
- 13.3	**8**	46.4
- 12.8	**9**	48.2
- 12.2	**10**	50.0
- 11.7	**11**	51.8
- 11.1	**12**	53.6
- 10.6	**13**	55.4
- 10.0	**14**	57.2
- 9.44	**15**	59.0
- 8.89	**16**	61.8
- 8.33	**17**	63.6
- 7.78	**18**	65.4
- 7.22	**19**	67.2
- 6.67	**20**	68.0
- 6.11	**21**	69.8
- 5.56	**22**	71.6
- 5.0	**23**	73.4
- 4.44	**24**	75.2
- 3.89	**25**	77.0

°C		°F
- 33.3	**26**	78.8
- 2.78	**27**	80.6
- 2.22	**28**	82.4
- 1.67	**29**	84.2
- 1.11	**30**	86.0
- 0.56	**31**	87.8
0.00	**32**	89.6
0.56	**33**	91.4
1.11	**34**	93.2
1.67	**35**	95.0
2.22	**36**	96.8
2.78	**37**	98.6
3.33	**38**	100.4
3.89	**39**	102.2
4.44	**40**	104.0
5.00	**41**	105.8
5.56	**42**	107.6
6.11	**43**	109.4
6.67	**44**	111.2
7.22	**45**	113.0

°C		°F
7.78	**46**	114.8
8.33	**47**	116.6
8.89	**48**	118.4
9.44	**49**	120.2
10.0	**50**	122.0
10.6	**51**	123.8
11.1	**52**	125.6
11.7	**53**	127.4
12.2	**54**	129.2
12.8	**55**	131.0
13.3	**56**	132.8
13.9	**57**	134.6
14.4	**58**	136.4
15.0	**59**	138.2
15.6	**60**	140.0
16.1	**61**	141.8
16.7	**62**	143.6
17.2	**63**	145.4
17.8	**64**	147.2
18.3	**65**	149.0

°C		°F
18.9	**66**	150.8
19.4	**67**	152.6
20.2	**68**	154.4
20.6	**69**	156.2
21.1	**70**	158.0
21.7	**71**	159.8
22.2	**72**	161.6
22.8	**73**	163.4
23.3	**74**	165.2
23.9	**75**	167.0
24.4	**76**	168.8
25.0	**77**	170.6
25.6	**78**	172.4
26.1	**79**	174.2
26.7	**80**	176.0
27.2	**81**	177.8
27.8	**82**	179.6
28.3	**83**	181.4
28.9	**84**	183.2
29.4	**85**	185.0

°C		°F
30.0	**86**	186.8
30.6	**87**	188.6
31.1	**88**	190.4
31.7	**89**	192.2
32.2	**90**	194.0
32.8	**91**	195.8
33.3	**92**	197.6
33.9	**93**	199.4
34.4	**94**	201.2
35.0	**95**	203.0
35.6	**96**	204.8
36.1	**97**	206.6
36.7	**98**	208.4
37.2	**99**	210.2
38	**100**	212.0
43	**110**	230
49	**120**	248
54	**130**	266
60	**140**	284
66	**150**	302

°C		°F
71	**160**	320
77	**170**	338
82	**180**	356
88	**190**	374
93	**200**	392
99	**210**	410
100	**212**	413
104	**220**	428
110	**230**	446
116	**240**	464
121	**250**	482
127	**260**	500
132	**270**	518
138	**280**	536
143	**290**	554
149	**300**	572
154	**310**	590
160	**320**	608
166	**330**	626
171	**340**	644

°C		°F
177	**350**	662
182	**360**	680
188	**370**	698
193	**380**	716
199	**390**	734
204	**400**	752
232	**450**	842
260	**500**	932
288	**550**	1022
316	**600**	1112
343	**650**	1202
371	**700**	1292
399	**750**	1382
427	**800**	1472
454	**850**	1562
482	**900**	1652
510	**950**	1742
538	**1000**	1832
566	**1050**	1922
593	**1100**	2012

°C		°F
621	**1150**	2102
649	**1200**	2192
677	**1250**	2282
704	**1300**	2372
732	**1350**	2462
760	**1400**	2552
788	**1450**	2642
816	**1500**	2732
843	**1550**	2822
871	**1600**	2912
899	**1650**	3002
927	**1700**	3092
954	**1750**	3182
982	**1800**	3272
1010	**1850**	3362
1038	**1900**	3452
1066	**1950**	3542
1093	**2000**	3632
1121	**2050**	3722
1149	**2100**	3812

°C		°F
1177	**2150**	3902
1204	**2200**	3992
1232	**2250**	4082
1260	**2300**	4172
1288	**2350**	4262
1316	**2400**	4352
1343	**2450**	4442
1371	**2500**	4532
1399	**2550**	4622
1427	**2600**	4712
1454	**2650**	4802
1482	**2700**	4892
1510	**2750**	4982
1538	**2800**	5072
1566	**2850**	5162
1593	**2900**	5252
1621	**2950**	5342
1649	**3000**	5432

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

J	ft.lb.	J	ft.lb.	J	ft.lb.	J	ft.lb.
116	85.5	140	103.2	164	120.8	188	138.5
118	87.0	142	104.7	166	122.3	190	140.0
120	88.5	144	106.2	168	123.8	192	141.5
122	89.9	146	107.6	170	125.3	194	142.9
124	91.4	148	109.1	172	126.7	196	144.4
126	92.9	150	110.6	174	128.2	198	145.9
128	94.4	152	112.1	176	129.7	200	147.4
130	95.8	154	113.5	178	131.2		
132	97.3	156	115.0	180	132.6		
134	98.8	158	116.5	182	134.1		
136	100.3	160	118.9	184	135.6		
138	101.7	162	119.4	186	137.1		

Conversion factors:

1 Joule = 0.73756 ft.lb.
1 ft.lb. = 1.35582 J

Stress Conversion Table

N/mm²	ksi	psi	MPa	N/mm²	ksi	psi	MPa	N/mm²	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/mm²	ksi	psi	MPa	N/mm²	ksi	psi	MPa	N/mm²	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 positions **according to DIN EN ISO 6947:1997-05**

Butt welds

PA **1G** Horizontal flat position

PC **2G** Transverse position

PE **4G** Overhead position

PG **3Gd** Vertical down position

PF **3Gu** Vertical up position

Fillet welds

PA **1F** Horizontal flat position

PB **2F** Horizontal downhand position

PD **4F** Horizontal overhead position

PG **3F** Vertical down position

PF **3Fu** Vertical up position

Pipe welds

PA **1G** Pipe: rotated
Axis: horizontal
ASME: 1G

PG **5Gd** Pipe: fixed
Axis: horizontal
ASME: 5Gd

PF **5Gu** Pipe: fixed
Axis: horizontal
ASME: 5Gu

PC **2G** Pipe: fixed
Axis: vertical
ASME: 2G

H-LO45 **6G** Pipe: fixed
Axis: e.g. 45°
ASME: 6G

Pipe welds

PB **2F** Pipe: rotated
Axis: horizontal
ASME: 2F

PG **5Fd** Pipe: fixed
Axis: horizontal
ASME: 5Fd

PF **5Fu** Pipe: fixed
Axis: horizontal
ASME: 5Fu

PB **2F** Pipe: fixed
Axis: vertical
ASME: 2F

PD **4F** Pipe: fixed
Axis: vertical
ASME: 4F

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