OERLIKON Solutions
Strip Weld Overlay

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Air Liquide SA, with its headquarters in Paris, France, is one of Europe’s larger multinational companies. It had a consolidated turnover of €14.5 billion in 2011 with 46,200 employees all over the world.

Air Liquide Welding is represented throughout the world by individual ALW companies with a brand portfolio optimised 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. These ALW companies 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. The utilisation of the strengths and experience of this network enables OERLIKON to maintain its position and international reputation for innovative leadership at the forefront of advanced welding technology in both welding consumables and increasingly equipment and processes.

With this background, OERLIKON has generated a proven history of supplying welding consumables on an ongoing basis 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 has continued to work closely with owners, construction contractors and fabricators to supply customised solutions through performance and innovation by developing and supplying welding products 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 range of automated installations, welding consumables and equipment specifically tailored for the high productivity requirements of the fabrication industry.
OERLIKON and Strip Weld Overlay

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

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

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

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

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

Track Record
OERLIKON is a technological innovator and major supplier of welding products to large industries. A track record of highly successful products combining quality and technology with technical service has been firmly established.
As many industries require equipment to work at elevated temperatures, in corrosive media and under high pressure, the use of highly alloyed materials for the fabrication of complete components becomes financially unrealistic as their size increases. One solution for stainless steels and other highly alloyed materials, such as nickel base alloys, is to deposit a weld overlay on the surface of the equipment to resist corrosion attack.

Dual-material clad plate utilises a thin layer of the costly higher alloyed material which is in contact with the corrosive media, while the lower cost substrate is used to give the desired structural integrity. The application of the high alloyed layer can be accomplished by several methods including, dual rolling, explosive bonding and weld overlay. However the most flexible of these methods is weld overlay.

**Strip Weld Overlay Process**

The initial use of a strip instead of a wire with the submerged arc process, was patented in the US around 1922. Due to the development of the nuclear industry, this process became industrial, and is now considered as a mature process.

Several modifications of submerged-arc welding with strip have been developed mainly with a view to further increasing the deposition rate and to decrease the dilution. There are two strip processes: Submerged Arc Strip (SAW) and Electroslag Strip (ESW).

Among all the welding processes, submerged arc and electroslag strip weld overlay offer the highest deposition rate, the best bead characteristics and trouble free operation using standard SAW welding equipment.

The Submerged Arc Strip process (SAW Fig. 1) uses an arc that runs back and forth at high speed along the strip, melting the strip, the base metal and the flux to obtain the overlay onto the base material. Because this is an arc process, there is penetration into the base material resulting in dilution levels of ~20%. For a strip of 60 mm, deposition rates are in the region of 12-14 kg/hr.

The Electroslag Strip process (ESW) Fig. 2 ignites like the submerged arc process. When a sufficient amount of flux is melted, because the molten flux has a lower electrical resistance than the electric arc, the current flows through the shallow layer of conductive slag, and the arc is extinguished. The process produces sufficient heat to keep the process stable and to melt the strip into the liquid slag; which is transferred into molten metal deposited onto the base material.

The ESW process has significant advantages over its SAW counterpart:

1. As there is no arc present, there is limited dilution into the base material, typically 10% (compared with 20% for SAW using 60 x 0.5 mm strip). This leads to the ability to deposit single layer full chemistry with over alloyed strip, even when a low carbon grade is required.
2. Due to the smooth operation of this process, higher current levels can be used resulting in deposition rates up to 40 kg/hr for 60 mm strip.
3. Electroslag refining occurs when the molten metal passes through the slag bath, resulting in cleaner weld metal with a lower risk of hot cracks, even for fully austenitic deposits.
4. The electroslag process cannot be used with carbon steel strip, because of the higher electricity conductivity than stainless or nickel strip.

Weld overlay gives the designer and fabricator flexibility to choose a wide variety of load bearing materials as substrates, as well as a wide variety of wire/strip chemistries to deposit the required overlay. In general, the use of weld overlay to surface finish shaped components eliminates the eventual problems arising with cold or hot forming.

All the welding processes can be utilised, however due to constraints in the physical requirements, some are better suited than others.
General Considerations: Welding Parameters

Current and welding speed
In weld overlay, the requirement is to deposit an alloy which is quite different from the base metal. If the 2 main parameters which govern the dilution are the current and the welding speed, other parameters also need to be taken in consideration: voltage, stick-out, size of strip, and in the case of circumferential surfacing, the strip position related to the diameter of the work needs to be controlled.

For a stainless steel strip of 60 x 0.5 mm, all other parameters remaining constant, when the current increases, the thickness deposited increases and the dilution decreases.

Fig. 3, illustrates the influence of the current and the welding speed on the dilution and the thickness deposited.

Voltage
Generally the voltage should be set between 24 V and 25 V, as an excessive voltage generates spatter and too low a voltage induces current instability.

Stick out
Standard stick out is around 30-35 mm, a short stick out generates spatter, an increase of stick out from 30 mm to 50 mm will reduce the dilution level slightly (e.g. from 10% to 8%) but the smoothness of the surface deteriorates.

Size of strip
With the same current density, typically used in ESW: ~ 40 A/mm², as the width of the strip increases, the dilution level decreases: ~12% for a strip of 30 mm, ~10% for a strip of 60 mm and ~9% for a strip of 90 mm.

Number of layers
During the welding of the first layer, the deposit is generally quite different from the base material, but for the subsequent layers, the deposit is generally similar to the first layer. For the ESW process, when a first layer is welded with a strip type 309L, on a carbon steel plate, with typical parameters, the dilution is about 10%, the second layer, welded with same parameters, will have a dilution around 25%.

Magnetic steering device
Magnetic steering is used to reduce the risk of lack of fusion at the overlap, and to increase the flatness of the surface of the deposit.

Strip positioning
When working on a curved surface, the molten pool is relatively large, and the liquid slag and the liquid metal have the tendency to flow to the lowest point of the curved surface. Thus, the position of the strip will have a big influence on the dilution level and on the profile of the bead. This effect takes place when the diameter becomes smaller than 3 metres, the smaller the diameter, the bigger the influence.

For more information about these parameters, please contact OERLIKON Service.
General Requirements of the Overlay

Specifications generally require a ferrite level on the surface and chemical composition at a specified distance from the surface. The deposit will pass corrosion resistance and guided side-bend testing after post weld heat treatment. If the equipment is required to conform to ASME IX code, reference should be made to QW-214.

**Chemical analysis**
Generally, the specified chemical analysis is required to conform to the composition for the undiluted weld metal of the equivalent AWS grade MMA electrode. For applications in the petrochemical industry, the required analysis needs to be controlled at -3 or 3.2 mm below the surface of the deposit. For applications in the nuclear industry, the requirement is generally for the undiluted weld metal from the “strip-flux” combination.

**Ferrite level**
Ferrite level is generally indicated in FN (Ferrite Number) and is calculated using the WRC 92 diagram or measured on the surface of the deposit, in the as welded condition, with a calibrated instrument. For petrochemical industry applications, a minimum ferrite number is specified, FN 3 to 5, to avoid hot cracking, and a maximum ferrite number is specified, FN 8 to 10, to avoid a continuous band of delta ferrite, where sigma phase can be formed during PWHT. In case of specific corrosive environments such as urea specifications, ferrite should be minimised, FN <0.6. In the case of duplex weld overlay, FN is recommended to be in the range 35 - 75.

**Guide side-bend test**
This is a test generally conducted after post weld heat treatment, which indicates possible lack of fusion between beads, inclusions and/or porosity.

**Corrosion tests**
The aim of corrosion testing is to evaluate the effect of the manufacturing process. Standard stainless steel grades are generally required to satisfy an accelerated corrosion test such as ASTM A 262 Practice C (HUEY test), to control the corrosion rate, or Practice E (Strauss test), for carbide formation. Nickel base alloys are mainly tested to ASTM G 28A for corrosion rate and corrosion penetration or ASTM G 48A to analyse the resistance to pitting corrosion. For specific applications, the specification may request particular testing such as: stress-corrosion or corrosion in a specific media.

**Disbonding test**
Conducted following ASTM G 146, this test is mainly required for petrochemical reactor applications, when there is a partial hydrogen pressure. This test is used to evaluate the bonding integrity between the weld overlay alloy and the base material, after a live simulation of the component.

For more information about the tests, please contact OERLIKON Service.
AST and ELT fluxes

Similar to other welding processes, the most sophisticated components are the coating of an MMA electrode and the flux for the submerged arc process, which determine the quality of the weld deposit. Welding fluxes are characterized by their basicity, granulometry and composition. The most important characteristics of the liquid slag which is formed during the process are: viscosity, solidification temperature range, surface tension and interaction with the chemistry of the deposit.

For many years, the extensive R&D commitment of OERLIKON has continued to contribute to the knowledge of raw materials and experience in flux formulation used in both the submerged arc and electroslag processes.

Generally, submerged arc fluxes contain small quantities of alloying elements, mainly Cr, to compensate burn-out due to the electrical arc. In the electroslag process, there is no arc, the burn out of Cr is hence reduced. No alloying elements are required and these fluxes are neutral. In some cases, when specific strip compositions are not available, compensated fluxes are required to reach specific analyses.

The main characteristics for electro slag fluxes are a large quantity of fluoride and very low silicon oxide content. Due to the large quantity of fluoride, these fluxes are able to form a shallow layer of electrically conductive molten flux. Due to the very low silicon oxide content, the deposited metal contains an extremely low oxygen concentration and a high degree of purity in terms of levels and size of non metallic inclusions. This is important for obtaining a good resistance to pitting corrosion.

OERLIKON DRYBAG and METAL DRUMS packaging are completely moisture proof requiring no controlled climatic conditions and as such can be used for welding without any reconditioning or re-baking. Before use, the packaging integrity should be checked. If the bags or drums show signs of puncture then the contents must be re-dried or discarded.

Fluxes for the Submerged Arc Process

<table>
<thead>
<tr>
<th>Designation</th>
<th>Classification</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST 100 B</td>
<td>ISO 14174 - S A CS 3</td>
<td>Agglomerated and alloyed flux (nickel and molybdenum) for strip weld overlay applications using the submerged arc process. It has been designed to produce a weld metal deposit with a martensitic structure in conjunction with SUPRASTRIP 430 stainless strip. Excellent slag removal and good wettability, producing a smooth weld surface.</td>
</tr>
<tr>
<td>AST 300</td>
<td>ISO 14174 - S A CS 2B</td>
<td>Agglomerated and chromium compensated flux for strip weld overlay applications using the submerged arc process. Highly basic agglomerated flux specially designed for use with stainless steel welding strips. Excellent slag removal and good wettability, producing a smooth weld surface.</td>
</tr>
<tr>
<td>AST 600</td>
<td>ISO 14174 - S A AB 2B</td>
<td>Neutral agglomerated flux for strip weld overlay applications using the submerged arc process. Highly basic agglomerated flux specially designed for use with nickel base welding strips. Excellent slag removal and good wettability, producing a smooth weld surface.</td>
</tr>
</tbody>
</table>
## Fluxes for the Electroslag Process

<table>
<thead>
<tr>
<th>Designation</th>
<th>Classification</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELT 300</td>
<td>ISO 14174 - ES A FB 2B</td>
<td>Neutral agglomerated flux for strip weld overlay applications using the electroslag process. Highly basic agglomerated flux specially designed for welding with stainless steel strips. Due to the very high hot cracking resistance, this flux can be used to deposit fully austenitic weld metals. Excellent slag removal and good wettability, producing a smooth weld surface.</td>
</tr>
<tr>
<td>ELT 300 S</td>
<td>ISO 14174 - ES A FB 2B</td>
<td>Neutral agglomerated flux for strip weld overlay applications using the electroslag process; this revised formulation is used from low to high speeds, from 10 to 50 cm/min. Highly basic agglomerated flux specially designed for use with stainless steel welding strips. Due to the very high hot cracking resistance, this flux can be used to deposit fully austenitic weld metals. Excellent slag removal and good wettability, producing a smooth weld surface.</td>
</tr>
<tr>
<td>ELT 308-1</td>
<td>ISO 14174 - ES A FB 2B</td>
<td>Compensated agglomerated flux for strip weld overlay applications using the electroslag process. Highly basic agglomerated flux specially designed for single layer deposit, with SUPRASTRIP 19 9 L to attain ASME 5.4 E 308L.</td>
</tr>
<tr>
<td>ELT 316-1</td>
<td>ISO 14174 - ES A FB 2B</td>
<td>Compensated agglomerated flux for strip weld overlay applications using the electroslag process. Highly basic agglomerated flux specially designed for use with SUPRASTRIP 19 12 3 L to deposit an ASME 5.4 E 316L classification in one layer. This flux is used when &gt;2.5% Mo is required in the deposit.</td>
</tr>
<tr>
<td>ELT 347-1</td>
<td>ISO 14174 - ES A FB 2B</td>
<td>Compensated agglomerated flux for strip weld overlay applications using the electroslag process. Highly basic agglomerated flux specially designed for use with SUPRASTRIP 19 9 LNb to deposit an ASME 5.4 E 347 classification in one layer.</td>
</tr>
<tr>
<td>ELT 317-1</td>
<td>ISO 14174 - ES A FB 2B</td>
<td>Compensated agglomerated flux for strip weld overlay applications using the electroslag process. Highly basic agglomerated flux specially designed for use with SUPRASTRIP 19 13 4 L stainless steel strip to deposit an ASME 5.4 E 317L classification in one layer.</td>
</tr>
<tr>
<td>ELT 600</td>
<td>ISO 14174 - ES A FB 2B</td>
<td>Neutral agglomerated flux for strip weld overlay applications using the electroslag process. Highly basic agglomerated flux specially designed for use with nickel base welding strips. Excellent slag removal and good wettability, producing a smooth weld surface.</td>
</tr>
<tr>
<td>ELT 600 S</td>
<td>ISO 14174 - ES A FB 2B</td>
<td>Neutral agglomerated flux for strip weld overlay applications using the electroslag process at high speed. Highly basic agglomerated flux specially designed for use with nickel base welding strips. Due to the very high resistance to hot cracking, this flux can be used to deposit fully austenitic weld metals. Excellent slag removal and good wettability, producing a smooth weld surface.</td>
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<tr>
<td>ELT 625-1</td>
<td>ISO 14174 - ES A FB 2B</td>
<td>Compensated agglomerated flux for strip weld overlay applications using the electroslag process. Highly basic agglomerated flux specially designed for use with SUPRASTRIP 625 to deposit an ASME 5.11: E NiCrFe3 classification in one layer, with Fe &lt;7%.</td>
</tr>
<tr>
<td>ELT 825-1</td>
<td>ISO 14174 - ES A FB 2B</td>
<td>Compensated agglomerated flux for strip weld overlay applications using the electroslag process. Highly basic agglomerated flux specially designed for use with SUPRASTRIP 825 to deposit an alloy UNS N° 8825 in one layer.</td>
</tr>
</tbody>
</table>
OERLIKON SUPRASTRIP are solid strips used for weld overlay. In the past, some sintered strips and some flux cored strips have been used.

The most common thickness for welding strip is 0.5 mm, except in some Asian countries where the thickness is 0.4 mm. The standard widths are 30, 60, 90 and 120 mm. On request, OERLIKON can provide SUPRASTRIP from <10 mm up to <180 mm width, with up to 450 kg coil depending on the width of the strip. SUPRASTRIP products are delivered in the cold rolled condition, with a cleanliness of ~28 mN/m. OERLIKON supply SUPRASTRIP within a very narrow range of chemical composition in order to attain fully consistent deposit analyses from batch to batch with the same parameters.

### OERLIKON stainless steel SUPRASTRIP

<table>
<thead>
<tr>
<th>Stainless strip</th>
<th>AWS Classification</th>
<th>ISO Classification</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Ni</th>
<th>Mo</th>
<th>N</th>
<th>Fe</th>
<th>Other Elements</th>
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<tr>
<td>SUPRASTRIP 19 9 L</td>
<td>EQ 308 L</td>
<td>B 19 9 L</td>
<td>0.014</td>
<td>1.9</td>
<td>0.3</td>
<td>20.1</td>
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<tr>
<td>SUPRASTRIP 19 9 Lnb</td>
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<td>B 19 9 Nb</td>
<td>0.015</td>
<td>1.8</td>
<td>0.4</td>
<td>19.8</td>
<td>10.6</td>
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<td>0.045</td>
<td>bal.</td>
<td>Nb : 0.5</td>
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<tr>
<td>SUPRASTRIP 19 12 3 L</td>
<td>EQ 316 L</td>
<td>B 19 12 3 L</td>
<td>0.015</td>
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<td>0.4</td>
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<td>3.4</td>
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<td>SUPRASTRIP 20 25 5 LCu</td>
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<td>1.8</td>
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<tr>
<td>SUPRASTRIP 22 9 3 L</td>
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<tr>
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<td>~ EQ 309 L</td>
<td>B 22 11 L</td>
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<td>0.3</td>
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<td>0.035</td>
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<tr>
<td>SUPRASTRIP 24 13 L</td>
<td>EQ 309 L</td>
<td>B 23 13 L</td>
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<td>13.1</td>
<td>0.1</td>
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<tr>
<td>SUPRASTRIP 24 13 Lnb</td>
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<td>B 23 12 Nb</td>
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<td>2.0</td>
<td>0.4</td>
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<td>0.045</td>
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<td>EQ 430</td>
<td>B 17</td>
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<td>16.2</td>
<td>-</td>
<td>-</td>
<td>0.040</td>
<td>bal.</td>
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</table>

### OERLIKON nickel base SUPRASTRIP

<table>
<thead>
<tr>
<th>Stainless strip</th>
<th>AWS Classification</th>
<th>ISO Classification</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Mo</th>
<th>Cu</th>
<th>Fe</th>
<th>Nb</th>
<th>Ni</th>
<th>Other Elements</th>
</tr>
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<tbody>
<tr>
<td>SUPRASTRIP 825</td>
<td>EQ NiFeCr 1</td>
<td>B Ni 8065</td>
<td>0.010</td>
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<td>22.4</td>
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<td>2.3</td>
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<td>-</td>
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<td>0.80 Ti</td>
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<tr>
<td>SUPRASTRIP 625</td>
<td>EQ NiMo 3</td>
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<td>0.1</td>
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<td>-</td>
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<td>3.7</td>
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<td>SUPRASTRIP 600</td>
<td>EQ NiCr 3</td>
<td>B Ni 6082</td>
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<td>0.15</td>
<td>20.1</td>
<td>-</td>
<td>-</td>
<td>1.1</td>
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<td>0.30 Ti</td>
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<tr>
<td>SUPRASTRIP 690</td>
<td>~ EQ NiCrFe 7(A)</td>
<td>B Ni Z</td>
<td>0.017</td>
<td>2.8</td>
<td>0.2</td>
<td>30.5</td>
<td>0.1</td>
<td>-</td>
<td>8.8</td>
<td>1.8</td>
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<td>0.35 Ti</td>
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<tr>
<td>SUPRASTRIP N6022</td>
<td>EQ NiMo 10</td>
<td>B Ni 6022</td>
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<td>0.03</td>
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<td>13.6</td>
<td>-</td>
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<td>-</td>
<td>bal.</td>
<td>2.9 W</td>
</tr>
<tr>
<td>SUPRASTRIP N6059</td>
<td>EQ NiMo 13</td>
<td>B Ni 6059</td>
<td>0.005</td>
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<td>15.2</td>
<td>-</td>
<td>0.8</td>
<td>-</td>
<td>bal.</td>
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<td>0.1</td>
<td>5.4</td>
<td>-</td>
<td>bal.</td>
<td>3.6 W</td>
</tr>
</tbody>
</table>
Recommended combinations and parameters

Typical OERLIKON solutions for Alloy 308L

Welding Process SAW double layers

**Welding consumables**
- First layer:
  - Electrode: SUPRASTRIP 24 13 L 60 x 0.5 mm
  - Flux: AST 300
- Second layer:
  - Electrode: SUPRASTRIP 19 9 L 60 x 0.5 mm
  - Flux: AST 300

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Chemical analysis (typical values):**

- Base material
  - C: 0.18, Mn: 1.2, Si: 0.4, Cr: 0.2, Ni: 0.01, Mo: -
  - N, FN:

**Welding parameters**
- Current: 750 A, Voltage: 27 V
- Welding speed: 12 cm/min

**Physical properties (typical indicative values):**
- Thickness of the deposit: 9.0 mm
- Deposition rate: 14 kg/h

---

Welding Process ESW single layer

**Welding consumables**
- Electrode: SUPRASTRIP 19 9 L 60 x 0.5 mm
- Flux: ELT 308-1

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Chemical analysis (typical values):**

- Base material
  - C: 0.18, Mn: 1.2, Si: 0.4, Cr: 0.2, Ni: 0.01, Mo: -
  - N, FN:

**Welding parameters**
- Current: 1250 A, Voltage: 24 V
- Welding speed: 18 cm/min

**Physical properties (typical indicative values):**
- Thickness of the deposit: 4.7 mm
- Deposition rate: 23 kg/h

---

Welding Process ESW double layers

**Welding consumables**
- First layer:
  - Electrode: SUPRASTRIP 24 13 L 60 x 0.5 mm
  - Flux: ELT 300 S
- Second First layer:
  - Electrode: SUPRASTRIP 19 9 L 60 x 0.5 mm
  - Flux: ELT 300 S

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Chemical analysis (typical values):**

- Base material
  - C: 0.18, Mn: 1.2, Si: 0.4, Cr: 0.2, Ni: 0.01, Mo: -
  - N, FN:

**Welding parameters**
- Current: 1250 A, Voltage: 24 V
- Welding speed: 18 cm/min

**Physical properties (typical indicative values):**
- Thickness of the deposit: 4.7 mm
- Deposition rate: 23 kg/h

---

Welding Process ESW double layers

**Welding consumables**
- Electrode: SUPRASTRIP 22 11 L 60 x 0.5 mm
- Flux: ELT 300 or ELT 300S

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Chemical analysis (typical values):**

- Base material
  - C: 0.18, Mn: 1.2, Si: 0.4, Cr: 0.2, Ni: 0.01, Mo: -
  - N, FN:

**Welding parameters**
- Current: 1250 A, Voltage: 24 V
- Welding speed: 18 cm/min

**Physical properties (indicative values):**
- Thickness of the deposit: 4.7 mm
- Deposition rate: 23 kg/h

---

**Analysis**: Chemical analysis results for different materials and layers.
Typical OERLIKON solutions for Alloy 316L

**Welding Process SAW double layers**

**Welding consumables**
- First layer:
  - Electrode: SUPRASTRIP 21 13 3 L 60 x 0.5 mm
  - Flux: AST 300
- Second layer:
  - Electrode: SUPRASTRIP 19 12 3 L 60 x 0.5 mm
  - Flux: AST 300

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding parameters**
- Current: 750 A - Voltage: 27 V
- Welding speed: 12 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 9.0 mm
- Deposition rate: 14 kg/h

**Chemical analysis (typical values):**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
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<tr>
<td>Base material</td>
<td>0.18</td>
<td>1.2</td>
<td>0.4</td>
<td>0.2</td>
<td>0.01</td>
<td>-</td>
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</tr>
<tr>
<td>SUPRASTRIP 21 13 3 L</td>
<td>0.015</td>
<td>1.9</td>
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<td>0.045</td>
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</tr>
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<td>SUPRASTRIP 19 12 3 L</td>
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<td>0.045</td>
<td>-</td>
</tr>
<tr>
<td>Surface - 3.0 mm</td>
<td>0.025</td>
<td>1.6</td>
<td>0.9</td>
<td>18.0</td>
<td>12.3</td>
<td>2.5</td>
<td>0.045</td>
<td>5</td>
</tr>
</tbody>
</table>

**Welding Process SAW double layers**

**Welding consumables**
- First layer:
  - Electrode: SUPRASTRIP 24 13 L 60 x 0.5 mm
  - Flux: AST 300
- Second layer:
  - Electrode: SUPRASTRIP 19 12 3 L 60 x 0.5 mm
  - Flux: AST 300

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding parameters**
- Current: 750 A - Voltage: 27 V
- Welding speed: 12 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 9.0 mm
- Deposition rate: 14 kg/h

**Chemical analysis (typical values):**

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</tr>
<tr>
<td>SUPRASTRIP 24 13 L</td>
<td>0.015</td>
<td>1.9</td>
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<td>0</td>
<td>0.045</td>
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<td>2.2</td>
<td>0.045</td>
<td>6</td>
</tr>
</tbody>
</table>

**Welding Process ESW single layer**

**Welding consumables**
- Electrode: SUPRASTRIP 19 12 3 L 60 x 0.5 mm
- Flux: ELT 316-1

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding parameters**
- Current: 1250 A - Voltage: 24 V
- Welding speed: 18 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 4.7 mm
- Deposition rate: 23 kg/h

**Chemical analysis (typical values):**

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<tr>
<th>Analysis</th>
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<td>0.045</td>
<td>6</td>
</tr>
</tbody>
</table>

**Welding Process ESW single layer**

**Welding consumables**
- Electrode: SUPRASTRIP 21 13 3 L 60 x 0.5 mm
- Flux: ELT 300 or ELT 300S

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding parameters**
- Current: 1250 A - Voltage: 24 V
- Welding speed: 18 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 4.7 mm
- Deposition rate: 23 kg/h

**Chemical analysis (typical values):**

<table>
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<tr>
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<th>C</th>
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<td>5</td>
</tr>
</tbody>
</table>

**Chemical analysis (typical values):**

- Type P1 according to ASME IX, thickness: 40 mm
- Preheat: Room temperature
- Interpass temperature: 150 °C
Recommended combinations and parameters

Typical OERLIKON solutions for Alloy 316L

Welding Process ESW double layers

**Welding consumables**
- First layer:
  - Electrode: SUPRASTRIP 21 13 3 L 60 x 0.5 mm
  - Flux: ELT 300 S
- Second layer:
  - Electrode: SUPRASTRIP 19 12 3 L 60 x 0.5 mm
  - Flux: ELT 300 S

**Base material**
- Type P1 according to ASME IX,
  thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 1500 A - Voltage: 24 V
- Welding speed: 32 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 7.0 mm
- Deposition rate: 28 kg/h

**Chemical analysis** (typical values):

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
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<td>12.3</td>
<td>2.5</td>
<td>0.045</td>
<td>5</td>
</tr>
</tbody>
</table>

Welding Process ESW double layers

**Welding consumables**
- First layer:
  - Electrode: SUPRASTRIP 24 13 L 60 x 0.5 mm
  - Flux: ELT 300 S
- Second layer:
  - Electrode: SUPRASTRIP 19 12 3 L 60 x 0.5 mm
  - Flux: ELT 300 S

**Base material**
- Type P1 according to ASME IX,
  thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 1500 A - Voltage: 24 V
- Welding speed: 32 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 7.0 mm
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**Chemical analysis** (typical values):

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</tr>
</tbody>
</table>
Typical OERLIKON solutions for Alloy 317L

Welding Process SAW double layers

Welding consumables
- First layer:
  - Electrode: SUPRASTRIP 21 13 3 L 60 x 0.5 mm
  - Flux: AST 300
- Second layer:
  - Electrode: SUPRASTRIP 19 13 4 L 60 x 0.5 mm
  - Flux: AST 300

Base material
- Type P1 according to ASME IX,
  thickness: 40 mm

Welding conditions
- Preheat: Room temperature
- Interpass temperature: 150 °C

Chemical analysis (typical values):

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<td>3.6</td>
<td>0.045</td>
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</tr>
<tr>
<td>Surface - 3.0 mm</td>
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<td>1.6</td>
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<td>18.3</td>
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<td>3.2</td>
<td>0.045</td>
<td>6</td>
</tr>
</tbody>
</table>

Welding Process ESW single layer

Welding consumables
- Electrode: SUPRASTRIP 19 13 4 L 60 x 0.5 mm
- Flux: ELT 317-1

Base material
- Type P1 according to ASME IX,
  thickness: 40 mm

Welding conditions
- Preheat: Room temperature
- Interpass temperature: 150 °C

Chemical analysis (typical values):

<table>
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<tr>
<th>Analysis</th>
<th>C</th>
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</tbody>
</table>

Welding Process ESW double layers

Welding consumables
- First layer:
  - Electrode: SUPRASTRIP 21 13 3 L 60 x 0.5 mm
  - Flux: ELT 300 S
- Second layer:
  - Electrode: SUPRASTRIP 19 13 4 L 60 x 0.5 mm
  - Flux: ELT 300 S

Base material
- Type P1 according to ASME IX,
  thickness: 40 mm

Welding conditions
- Preheat: Room temperature
- Interpass temperature: 150 °C

Chemical analysis (typical values):

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Typical OERLIKON solutions for Alloy 347

**Welding Process SAW double layers**

**Welding consumables**
- First layer:
  - Electrode: SUPRASTRIP 24 13 L Nb 60 x 0.5 mm
  - Flux: AST 300
- Second layer:
  - Electrode: SUPRASTRIP 19 9 L Nb 60 x 0.5 mm
  - Flux: AST 300

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 750 A - Voltage: 27 V
- Welding speed: 12 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 9.0 mm
- Deposition rate: 14 kg/h

**Chemical analysis (typical values):**

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<td>SUPRASTRIP 24 13 L Nb</td>
<td>0.020</td>
<td>2.1</td>
<td>0.4</td>
<td>23.9</td>
<td>12.9</td>
<td>0.1</td>
<td>0.7</td>
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</tr>
<tr>
<td>SUPRASTRIP 19 9 L Nb</td>
<td>0.015</td>
<td>1.7</td>
<td>0.4</td>
<td>19.8</td>
<td>10.6</td>
<td>0.1</td>
<td>0.5</td>
<td>0.040</td>
<td>-</td>
</tr>
<tr>
<td>Surface - 3.0 mm</td>
<td>0.025</td>
<td>1.7</td>
<td>0.6</td>
<td>19.5</td>
<td>10.5</td>
<td>0.1</td>
<td>0.45</td>
<td>0.045</td>
<td>6</td>
</tr>
</tbody>
</table>

**Welding Process SAW double layers**

**Welding consumables**
- First layer:
  - Electrode: SUPRASTRIP 24 13 L 60 x 0.5 mm
  - Flux: AST 300
- Second layer:
  - Electrode: SUPRASTRIP 19 9 L Nb 60 x 0.5 mm
  - Flux: AST 300

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 750 A - Voltage: 27 V
- Welding speed: 12 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 9.0 mm
- Deposition rate: 14 kg/h

**Chemical analysis (typical values):**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Ni</th>
<th>Mo</th>
<th>Nb</th>
<th>N</th>
<th>FN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base material</td>
<td>0.18</td>
<td>1.2</td>
<td>0.4</td>
<td>0.21</td>
<td>-</td>
<td>0.01</td>
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<tr>
<td>SUPRASTRIP 24 13 LNb</td>
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<td>12.9</td>
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<tr>
<td>SUPRASTRIP 19 9 L Nb</td>
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<td>10.6</td>
<td>0.1</td>
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<tr>
<td>Surface - 3.0 mm</td>
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<td>1.7</td>
<td>0.6</td>
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<td>10.5</td>
<td>0.1</td>
<td>0.33</td>
<td>0.045</td>
<td>7</td>
</tr>
</tbody>
</table>

**Welding Process ESW single layer**

**Welding consumables**
- Electrode: SUPRASTRIP 19 9 L Nb 60 x 0.5 mm
- Flux: ELT 347-1

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 1250 A - Voltage: 24 V
- Welding speed: 18 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 4.7 mm
- Deposition rate: 23 kg/h

**Chemical analysis (typical values):**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Ni</th>
<th>Mo</th>
<th>Nb</th>
<th>N</th>
<th>FN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base material</td>
<td>0.18</td>
<td>1.2</td>
<td>0.4</td>
<td>0.21</td>
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<td>0.01</td>
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<tr>
<td>SUPRASTRIP 19 9 L Nb</td>
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<td>1.7</td>
<td>0.4</td>
<td>19.8</td>
<td>10.6</td>
<td>0.1</td>
<td>0.45</td>
<td>0.045</td>
<td>7</td>
</tr>
<tr>
<td>Surface - 3.0 mm</td>
<td>0.025</td>
<td>1.7</td>
<td>0.6</td>
<td>19.5</td>
<td>10.5</td>
<td>0.1</td>
<td>0.33</td>
<td>0.045</td>
<td>7</td>
</tr>
</tbody>
</table>

**Welding Process ESW single layer**

**Welding consumables**
- Electrode: SUPRASTRIP 21 11 L Nb 60 x 0.5 mm
- Flux: ELT 300 or ELT 300S

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 1250 A - Voltage: 24 V
- Welding speed: 18 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 4.7 mm
- Deposition rate: 23 kg/h

**Chemical analysis (typical values):**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Ni</th>
<th>Mo</th>
<th>Nb</th>
<th>N</th>
<th>FN</th>
</tr>
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<tbody>
<tr>
<td>Base material</td>
<td>0.18</td>
<td>1.2</td>
<td>0.4</td>
<td>0.21</td>
<td>-</td>
<td>0.01</td>
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<td>SUPRASTRIP 21 11 L Nb</td>
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</tr>
<tr>
<td>Surface - 3.0 mm</td>
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<td>0.6</td>
<td>19.3</td>
<td>10.2</td>
<td>0.1</td>
<td>0.4</td>
<td>0.045</td>
<td>7</td>
</tr>
</tbody>
</table>
Typical OERLIKON solutions for Alloy 347

**Welding Process ESW single layer High speed**

**Welding consumables**
- Electrode: SUPRASTRIP 24 13 L Nb 60 x 0.5 mm
- Flux: ELT 300 S

**Base material**
- Type 2.25Cr 1Mo, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 1500 A - Voltage: 24 V
- Welding speed: 45 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 7.0 mm
- Deposition rate: 28 kg/h

**Chemical analysis (typical values):**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Ni</th>
<th>Mo</th>
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<td>12.9</td>
<td>0.1</td>
<td>0.7</td>
<td>0.040</td>
<td>-</td>
</tr>
<tr>
<td>Surface - 3.0 mm</td>
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<td>19.5</td>
<td>10.4</td>
<td>0.22</td>
<td>0.54</td>
<td>0.045</td>
<td>6</td>
</tr>
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</table>

**Welding Process SAW double layers**

**Welding consumables**
- First layer:
  - Electrode: SUPRASTRIP 24 13 L 60 x 0.5 mm
  - Flux: ELT 300 S
- Second layer:
  - Electrode: SUPRASTRIP 19 9 L Nb 60 x 0.5 mm
  - Flux: ELT 300 S

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 1500 A - Voltage: 24 V
- Welding speed: 32 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 7.0 mm
- Deposition rate: 28 kg/h

**Chemical analysis (typical values):**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Ni</th>
<th>Mo</th>
<th>Nb</th>
<th>N</th>
<th>FN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base material</td>
<td>0.18</td>
<td>1.2</td>
<td>0.4</td>
<td>0.21</td>
<td>-</td>
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</tr>
<tr>
<td>SUPRASTRIP 24 13 L</td>
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<td>12.9</td>
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<tr>
<td>SUPRASTRIP 19 9 L Nb</td>
<td>0.015</td>
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<td>10.6</td>
<td>0.1</td>
<td>0.5</td>
<td>0.040</td>
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</tr>
<tr>
<td>Surface - 3.0 mm</td>
<td>0.025</td>
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<td>10.4</td>
<td>0.1</td>
<td>0.30</td>
<td>0.045</td>
<td>7</td>
</tr>
</tbody>
</table>

**Welding Process ESW double layers**

**Welding consumables**
- First layer:
  - Electrode: SUPRASTRIP 24 13 L Nb 60 x 0.5 mm
  - Flux: ELT 300 S
- Second layer:
  - Electrode: SUPRASTRIP 19 9 L Nb 60 x 0.5 mm
  - Flux: ELT 300 S

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 1500 A - Voltage: 24 V
- Welding speed: 32 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 7.0 mm
- Deposition rate: 28 kg/h

**Chemical analysis (typical values):**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Ni</th>
<th>Mo</th>
<th>Nb</th>
<th>N</th>
<th>FN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base material</td>
<td>0.18</td>
<td>1.2</td>
<td>0.4</td>
<td>0.21</td>
<td>-</td>
<td>0.01</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SUPRASTRIP 24 13 L Nb</td>
<td>0.020</td>
<td>2.1</td>
<td>0.4</td>
<td>23.9</td>
<td>12.9</td>
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<td>0.7</td>
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</tr>
<tr>
<td>SUPRASTRIP 19 9 L Nb</td>
<td>0.015</td>
<td>1.7</td>
<td>0.4</td>
<td>19.8</td>
<td>10.6</td>
<td>0.1</td>
<td>0.5</td>
<td>0.040</td>
<td>-</td>
</tr>
<tr>
<td>Surface - 3.0 mm</td>
<td>0.025</td>
<td>1.7</td>
<td>0.6</td>
<td>19.6</td>
<td>10.4</td>
<td>0.1</td>
<td>0.45</td>
<td>0.045</td>
<td>7</td>
</tr>
</tbody>
</table>
### Recommended combinations and parameters

#### Typical OERLIKON solutions for Duplex stainless steel

**Welding Process SAW double layers**

**Welding consumables**
- First layer:
  - Electrode: SUPRASTRIP 24 13 L 60 x 0.5 mm
  - Flux: AST 300
- Second layer:
  - Electrode: SUPRASTRIP 22 9 3 L 60 x 0.5 mm
  - Flux: AST 300

**Welding Process ESW double layers**

**Welding consumables**
- First layer:
  - Electrode: SUPRASTRIP 20 25 5 LCu 60 x 0.5 mm
  - Flux: AST 300
- Second layer:
  - Electrode: SUPRASTRIP 20 25 5 LCu 60 x 0.5 mm
  - Flux: AST 300

**Typical OERLIKON solutions for Alloy 385L**

**Welding Process SAW double layers**

**Welding consumables**
- First layer:
  - Electrode: SUPRASTRIP 24 13 L 60 x 0.5 mm
  - Flux: AST 300
- Second layer:
  - Electrode: SUPRASTRIP 22 9 3 L 60 x 0.5 mm
  - Flux: AST 300

**Welding Process ESW double layers**

**Welding consumables**
- First layer:
  - Electrode: SUPRASTRIP 20 25 5 LCu 60 x 0.5 mm
  - Flux: AST 300
- Second layer:
  - Electrode: SUPRASTRIP 20 25 5 LCu 60 x 0.5 mm
  - Flux: AST 300

### Chemical analysis (typical values):

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Ni</th>
<th>Mo</th>
<th>Cu</th>
<th>N</th>
<th>FN*</th>
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<tbody>
<tr>
<td>Base material</td>
<td>0.18</td>
<td>1.2</td>
<td>0.4</td>
<td>0.2</td>
<td>0.01</td>
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</tr>
<tr>
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<td>0.3</td>
<td>20.5</td>
<td>24.8</td>
<td>4.3</td>
<td>1.5</td>
<td>3</td>
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</tr>
<tr>
<td>Surface - 3.0 mm</td>
<td>0.015</td>
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<td>0.6</td>
<td>19.5</td>
<td>24.0</td>
<td>4.1</td>
<td>1.3</td>
<td>3</td>
<td>0.045</td>
</tr>
</tbody>
</table>

* FN (FERITSCOPE) (%)

### Welding Process SAW Single layers

**Welding consumables**
- Electrode: SUPRASTRIP 24 13 L 60 x 0.5 mm
- Flux: AST 300

**Welding Process ESW Single layers**

**Welding consumables**
- Electrode: SUPRASTRIP 24 13 L 60 x 0.5 mm
- Flux: AST 300

### Chemical analysis (typical values):

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Ni</th>
<th>Mo</th>
<th>Cu</th>
<th>N</th>
<th>FN*</th>
</tr>
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<tbody>
<tr>
<td>Base material</td>
<td>0.18</td>
<td>1.2</td>
<td>0.4</td>
<td>0.2</td>
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<tr>
<td>SUPRASTRIP 20 25 5 LCu</td>
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<td>1.6</td>
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<td>24.8</td>
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<td>1.5</td>
<td>3</td>
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</tr>
<tr>
<td>Surface - 3.0 mm</td>
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<td>0.6</td>
<td>19.5</td>
<td>24.0</td>
<td>4.1</td>
<td>1.3</td>
<td>3</td>
<td>0.045</td>
</tr>
</tbody>
</table>

* FN (FERITSCOPE) (%)

### Welding Process SAW double layers

**Welding consumables**
- Electrode: SUPRASTRIP 24 13 L 60 x 0.5 mm
- Flux: AST 300

**Welding Process ESW double layers**

**Welding consumables**
- Electrode: SUPRASTRIP 20 25 5 LCu 60 x 0.5 mm
- Flux: AST 300

### Chemical analysis (typical values):

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Ni</th>
<th>Mo</th>
<th>Cu</th>
<th>N</th>
<th>FN*</th>
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<tr>
<td>Base material</td>
<td>0.18</td>
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<td>0.4</td>
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<tr>
<td>Surface - 3.0 mm</td>
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<td>0.6</td>
<td>19.5</td>
<td>24.0</td>
<td>4.1</td>
<td>1.3</td>
<td>3</td>
<td>0.045</td>
</tr>
</tbody>
</table>

* FN (FERITSCOPE) (%)

### Physical properties (indicative values)
- Thickness of the deposit: 9.0 mm
- Deposition rate: 14 kg/h
Typical OERLIKON solution for Alloy 410S

**Welding consumables**
- Electrode: SUPRASTRIP 430 60 x 0.5 mm
- Flux: ELT 300S

**Base material**
- Type P1 according to ASME IX, thickness: 40mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 1250A, Voltage: 24V
- Welding speed: 18 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 4.2 mm
- Deposition rate: 23 kg/h

**Chemical analysis (typical values):**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Ni</th>
<th>Mo</th>
<th>N</th>
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<td>12.9</td>
<td>0.1</td>
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<td>0.045</td>
</tr>
</tbody>
</table>

Typical OERLIKON solution for Alloy 410 Ni Mo

**Welding consumables**
- Electrode: SUPRASTRIP 430 60 x 0.5 mm
- Flux: AST 100 B

**Base material**
- Type 42CrMo4, thickness: 40 mm

**Welding conditions**
- Preheat: 200 °C
- Interpass temperature: 250 °C

**Welding parameters**
- Current: 750 A, Voltage: 27 V
- Welding speed: 19 cm/min

**Physical properties (indicative values)**
- 4 layers thickness of the deposit: 12 mm
- Deposition rate: 14 kg/h

**Chemical analysis (typical values):**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
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<th>Cr</th>
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<th>Mo</th>
<th>N</th>
<th>Hardness</th>
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<td>SUPRASTRIP 430</td>
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<td>16.4</td>
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<td>Fourth layer</td>
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<td>0.6</td>
<td>0.9</td>
<td>14.0</td>
<td>4.0</td>
<td>1.0</td>
<td>0.04</td>
<td>39 HRC</td>
</tr>
</tbody>
</table>
Recommended combinations and parameters

Typical OERLIKON solutions for Alloy 600

Welding Process SAW double layers

**Welding consumables**
- First and second layers:
  - Electrode: SUPRASTRIP 600 60 x 0.5 mm
  - Flux: AST 600

**Base material**
- Type P1 according to ASME IX,
  thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Chemical analysis** (typical values):

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Nb</th>
<th>Fe</th>
<th>Ni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base material</td>
<td>0.18</td>
<td>1.2</td>
<td>0.4</td>
<td>0.21</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SUPRASTRIP 600</td>
<td>0.015</td>
<td>3.1</td>
<td>0.3</td>
<td>20.4</td>
<td>3.7</td>
<td>0.25</td>
<td>bal.</td>
</tr>
<tr>
<td>Surface - 3.0 mm</td>
<td>0.026</td>
<td>3.5</td>
<td>0.8</td>
<td>19.8</td>
<td>2.0</td>
<td>4.9</td>
<td>bal.</td>
</tr>
</tbody>
</table>

Welding Process ESW double layers

**Welding consumables**
- First and second layers:
  - Electrode: SUPRASTRIP 600 60 x 0.5 mm
  - Flux: ELT 600 or ELT 600S

**Base material**
- Type P1 according to ASME IX,
  thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Chemical analysis** (typical values):

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Nb</th>
<th>Fe</th>
<th>Ni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base material</td>
<td>0.18</td>
<td>1.2</td>
<td>0.4</td>
<td>0.21</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SUPRASTRIP 600</td>
<td>0.015</td>
<td>3.1</td>
<td>0.3</td>
<td>20.4</td>
<td>2.7</td>
<td>0.25</td>
<td>bal.</td>
</tr>
<tr>
<td>Surface - 3.0 mm</td>
<td>0.026</td>
<td>2.8</td>
<td>0.5</td>
<td>19.5</td>
<td>2.4</td>
<td>4.3</td>
<td>bal.</td>
</tr>
</tbody>
</table>
Typical OERLIKON solutions for Alloy 625

Welding Process SAW double layers

**Welding consumables**
- First and second layers:
  - Electrode: SUPRASTRIP 625 60 x 0.5 mm
  - Flux: ELT 625-1

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 750 A - Voltage: 27 V
- Welding speed: 12 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 8.6 mm
- Deposition rate: 14 kg/h

**Chemical analysis (typical values):**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Mo</th>
<th>Nb</th>
<th>Ti</th>
<th>Fe</th>
<th>Ni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base material</td>
<td>0.18</td>
<td>1.2</td>
<td>0.4</td>
<td>0.21</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SUPRASTRIP 625</td>
<td>0.015</td>
<td>0.1</td>
<td>0.1</td>
<td>22.0</td>
<td>9.0</td>
<td>3.6</td>
<td>0.2</td>
<td>0.25</td>
<td>bal.</td>
</tr>
<tr>
<td>Surface - 3.0 mm</td>
<td>0.020</td>
<td>0.1</td>
<td>0.5</td>
<td>21.0</td>
<td>8.1</td>
<td>3.2</td>
<td>0.07</td>
<td>4.4</td>
<td>bal.</td>
</tr>
</tbody>
</table>

Welding Process ESW single layer

**Welding consumables**
- Electrode: SUPRASTRIP 625 60 x 0.5 mm
- Flux: ELT 625-1

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 1250 A - Voltage: 25 V
- Welding speed: 18 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 4.7 mm
- Deposition rate: 23 kg/h

**Chemical analysis (typical values):**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Mo</th>
<th>Nb</th>
<th>Ti</th>
<th>Fe</th>
<th>Ni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base material</td>
<td>0.18</td>
<td>1.2</td>
<td>0.4</td>
<td>0.21</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SUPRASTRIP 625</td>
<td>0.015</td>
<td>0.1</td>
<td>0.1</td>
<td>22.0</td>
<td>9.0</td>
<td>3.6</td>
<td>0.2</td>
<td>0.25</td>
<td>bal.</td>
</tr>
<tr>
<td>Surface - 3.0 mm</td>
<td>0.020</td>
<td>0.15</td>
<td>0.20</td>
<td>21.5</td>
<td>8.5</td>
<td>3.3</td>
<td>0.07</td>
<td>7.2</td>
<td>bal.</td>
</tr>
</tbody>
</table>

Welding Process ESW double layers

**Welding consumables**
- First and second layers:
  - Electrode: SUPRASTRIP 625 60 x 0.5 mm
  - Flux: ELT 600 S

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 1400 A - Voltage: 24 V
- Welding speed: 20 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 7.8 mm
- Deposition rate: 24 kg/h

**Chemical analysis (typical values):**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Mo</th>
<th>Nb</th>
<th>Ti</th>
<th>Fe</th>
<th>Ni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base material</td>
<td>0.18</td>
<td>1.2</td>
<td>0.4</td>
<td>0.21</td>
<td>-</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>SUPRASTRIP 625</td>
<td>0.015</td>
<td>0.1</td>
<td>0.1</td>
<td>22.0</td>
<td>9.0</td>
<td>3.6</td>
<td>0.2</td>
<td>0.25</td>
<td>bal.</td>
</tr>
<tr>
<td>Surface - 3.0 mm</td>
<td>0.020</td>
<td>0.15</td>
<td>0.20</td>
<td>21.5</td>
<td>8.2</td>
<td>3.3</td>
<td>0.07</td>
<td>4.2</td>
<td>bal.</td>
</tr>
</tbody>
</table>
### Recommended combinations and parameters

**Typical OERLIKON solutions for Alloy 825**

**Welding Process SAW double layers**

**Welding consumables**
- First and second layers:
  - Electrode: SUPRASTRIP 825 60 x 0.5 mm
  - Flux: AST 600

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 750 A - Voltage: 27 V
- Welding speed: 12 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 8.6 mm
- Deposition rate: 14 kg/h

**Chemical analysis (typical values):**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Mo</th>
<th>Cu</th>
<th>Fe</th>
<th>Ni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base material</td>
<td>0.18</td>
<td>1.2</td>
<td>0.4</td>
<td>0.21</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SUPRASTRIP 825</td>
<td>0.013</td>
<td>0.8</td>
<td>0.3</td>
<td>22.0</td>
<td>3.0</td>
<td>2.0</td>
<td>32</td>
<td>bal.</td>
</tr>
<tr>
<td>Surface - 3.0 mm</td>
<td>0.023</td>
<td>0.9</td>
<td>0.8</td>
<td>20.1</td>
<td>2.74</td>
<td>1.6</td>
<td>37</td>
<td>bal.</td>
</tr>
</tbody>
</table>

**Welding Process ESW single layer**

**Welding consumables**
- Electrode: SUPRASTRIP 825 60 x 0.5 mm
- Flux: ELT 825-1

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 1250 A - Voltage: 25 V
- Welding speed: 18 cm/min

**Physical properties (indicative values)**
- Thickness of the deposit: 4.7 mm
- Deposition rate: 23 kg/h

**Chemical analysis (typical values):**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Mo</th>
<th>Cu</th>
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<tr>
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<td>0.4</td>
<td>0.21</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>SUPRASTRIP 825</td>
<td>0.013</td>
<td>0.8</td>
<td>0.3</td>
<td>22.0</td>
<td>3.0</td>
<td>2.0</td>
<td>32</td>
<td>bal.</td>
</tr>
<tr>
<td>Surface - 3.0 mm</td>
<td>0.023</td>
<td>0.7</td>
<td>0.7</td>
<td>20.0</td>
<td>2.87</td>
<td>1.6</td>
<td>32</td>
<td>bal.</td>
</tr>
</tbody>
</table>

**Welding Process ESW double layers**

**Welding consumables**
- First and second layers:
  - Electrode: SUPRASTRIP 825 60 x 0.5 mm
  - Flux: ELT 600 S

**Base material**
- Type P1 according to ASME IX, thickness: 40 mm

**Welding conditions**
- Preheat: Room temperature
- Interpass temperature: 150 °C

**Welding parameters**
- Current: 1400 A - Voltage: 24 V
- Welding speed: 32 cm/min

**Physical properties (indicative values)**
- Thickness of the 7.0 mm
- Deposition rate: 28 kg/h

**Chemical analysis (typical values):**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Mo</th>
<th>Cu</th>
<th>Fe</th>
<th>Ni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base material</td>
<td>0.18</td>
<td>1.2</td>
<td>0.4</td>
<td>0.21</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SUPRASTRIP 825</td>
<td>0.013</td>
<td>0.8</td>
<td>0.3</td>
<td>22.0</td>
<td>3.0</td>
<td>2.0</td>
<td>32</td>
<td>bal.</td>
</tr>
<tr>
<td>Surface - 3.0 mm</td>
<td>0.023</td>
<td>0.7</td>
<td>0.6</td>
<td>21.0</td>
<td>2.85</td>
<td>1.7</td>
<td>33</td>
<td>bal.</td>
</tr>
</tbody>
</table>

For alloys Ni6022, Ni6059, Ni60276, please contact OERLIKON service.
Equipment for weld overlay applications

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

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

<table>
<thead>
<tr>
<th>STARMATIC 1303 DC</th>
<th>STARMATIC 1003 AC/DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duty cycle at 100%</td>
<td>1 300 A - 44 V</td>
</tr>
<tr>
<td>Welding range</td>
<td>2 DC</td>
</tr>
<tr>
<td>Primary power supply</td>
<td>400-440 V 50/60 Hz²</td>
</tr>
<tr>
<td>Technology</td>
<td>Thyristors</td>
</tr>
<tr>
<td>Power at 100% duty cycle</td>
<td>99 kVA</td>
</tr>
<tr>
<td>External-static characteristics - flat - drooping</td>
<td>AC - DC</td>
</tr>
<tr>
<td>Net weight</td>
<td>483 kg</td>
</tr>
<tr>
<td></td>
<td>540 kg</td>
</tr>
</tbody>
</table>

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

**Positioning equipment**
Oerlikon provides a full range of seamers, column and booms, rotators, positioners, turntables and mechanisation equipment for every application.

**3A WELDING SYSTEM**
A new generation of mobile console control device
The 3A Welding System plug & play Mobile Console gives the operator complete mobility and permits the management of both machine and process. This new generation user-friendly interface is easy to use and operators are rapidly able to program the machine efficiently.

The multipurpose 3A welding system concept is designed for all arc welding processes, and the equipment remains upgradable with the open architecture.

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

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

**Automatic machine management**
- Process management
- Machine cycle control
- Integrated peripherals

**Architecture based on new concept**
- Modular and flexible solutions
- Full digital control