Joining WA Cored Wires
The go-to provider of advanced welding consumables
This catalogue presents a selection of cored wires for joining applications. Welding Alloys standard products for hardfacing feature in a separate catalogue. We will gladly examine any special request. In fact, each year we receive hundreds of special requests, and as experts in our field we examine them all individually. Please do not hesitate to contact us.

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

A policy of continuous R&D, hand in hand with industrial development, enables us to offer the quality guarantees required by international codes of practice, such as those that exist in the nuclear, petrochemical, offshore, LNG and transport industries.

Though we are a global company, our engineers and technicians are available locally. Technical support and service is provided where it is needed, from international WA joining specialists.

Welding Alloys performance guarantee means we will always recommend the product and service best suited to our customers’ applications.

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Our commitment to quality

Our ISO-approved quality assurance system has been in place in the Group wire production units since 1993, and is a fundamental ingredient in achieving our quality objectives. Our employees’ commitment to high standards guarantees the quality of our products and services through:

- Production according to strict procedures, conforming to current standards and customer specifications
- Customer service from specialists, allowing the best technical and economic choices to be made
- Permanent commitment to customer satisfaction
- Team spirit driven by the pride of belonging to a dynamic and innovative group

Research and Development programmes

The success of Welding Alloys cored wires is due to their quality and performance. This is closely linked to our commitment to continuous improvement and to our substantial investment in R&D. As a true partner in progress, Welding Alloys collaborates closely with customers on specific projects.

The real value of Welding Alloys cored wires

Cost is not the only consideration when choosing a welding consumable. The decision must include other critical factors, such as production time, re-working, finishing costs, and associated consumable costs. Welding Alloys manufactures cored welding wires to the highest technological standards, offering constant quality and high productivity, a combination that gives the best overall value and cost control.

- Quality
  - Very clean fusion and impeccable bead appearance
  - Virtually no spatter
  - Low welding energy which limits deformation, while guaranteeing excellent mechanical and metallurgical properties

- Performance
  - High deposit rates (kg/h) around three times greater than with coated electrodes
  - Optimised arc time
  - High welding speed
  - The penetration characteristics allow for work with narrower chambers, thus reducing the quantity of necessary weld metal

- Flexibility
  - Various arc welding processes: open-arc, gas shielded, submerged arc
  - Usable with all types of power sources and with low cost standard gas mixtures
  - Wide range of welding parameters – all-position welding is much easier than with solid wires
  - Possibility of purchasing small quantities adapted to particular technical specifications

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## Self shielded welding

<table>
<thead>
<tr>
<th>Product name</th>
<th>Standard diameters (mm)</th>
<th>EN ISO ASME / AWS standards</th>
<th>Composition - Fe balance</th>
<th>Typical mechanical properties</th>
<th>Description and applications</th>
<th>Base materials</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mild steels</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPEEDARC T4</td>
<td>1.0 to 3.2</td>
<td>T38 Z W N3 ET10-4</td>
<td>C: 0.2 Mn: 0.55 Si: 0.2 Al: 1.3</td>
<td>610 450 - -</td>
<td>Horizontal welding at high deposition rates</td>
<td>S275 JR, S235J0G3, S235GH, P255NH, P295GH</td>
</tr>
<tr>
<td>ROBOFIL T4</td>
<td>1.2 to 2.4</td>
<td>T38 Z W N3 ET10-4</td>
<td>C: 0.2 Mn: 0.55 Si: 0.2 Al: 1.3</td>
<td>610 450 25 -</td>
<td>All-position welding under negative polarity DC -</td>
<td>S275JR, S235J0G3, S235GH, P255NH, P295GH, P235 T1&amp;T2, P355T1&amp;T2, ASTM: A26a - A53 all grades, A106 Gr A,B,C, A283 Gr.A,B,C,D</td>
</tr>
<tr>
<td>SPEEDARC T11</td>
<td>1.2 and 1.6</td>
<td>T38 Z Z N1 ET11-11</td>
<td>C: 0.1 Mn: 0.5 Si: 0.3 Al: 1.4</td>
<td>600 440 25 -</td>
<td>Excellent current transfer</td>
<td></td>
</tr>
</tbody>
</table>
# Welding of constructional steels

## Gas shielded welding

<table>
<thead>
<tr>
<th>Product name</th>
<th>Standard diameters (mm)</th>
<th>EN ISO ASME / AWS standards</th>
<th>Composition - Fe balance</th>
<th>Typical mechanical properties</th>
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<tr>
<td><strong>Mild steels</strong></td>
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<td></td>
</tr>
<tr>
<td>ROBOFIL R 71 +</td>
<td>1.2 and 1.6</td>
<td>T 46 4 P M 1 H5</td>
<td>C: 0.04 Mn: 1.2 Si: 0.4</td>
<td>570 510 25 -40°C 70</td>
<td>▪ Rutile-type wire usable in all-positions with one single parameter setting</td>
<td>S235J2G3 to S355K2G3, P235GH to P355GH, S420NL, P275NH to P460 NH, P275NL1 to P460NL1, L210 to L290, L360MB to L415, X42 to X60 (API-5L)</td>
</tr>
<tr>
<td>ROBOFIL KX 71T1 +</td>
<td>1.2 and 1.6</td>
<td>T 46 2 P C 1 H5</td>
<td>C: 0.04 Mn: 1.3 Si: 0.5</td>
<td>570 500 25 -30°C 80</td>
<td>▪ Rutile-type wire usable in all-positions except vertical-down</td>
<td>S235J2G3 to S355K2G3, P235GH to P355GH, S420NL, P275NH to P460 NH, P275NL1 to P460NL1, L210 to L290, L360MB to L415, X42 to X60 (API-5L)</td>
</tr>
<tr>
<td>ROBOFIL M 70</td>
<td>1.2 and 1.6</td>
<td>T 46 2 M 1 H5</td>
<td>C: 0.05 Mn: 1.5 Si: 0.65</td>
<td>570 500 26 -30°C 80</td>
<td>▪ Metal-cored wire</td>
<td>S235J2G3 to S355K2G3, P235GH to P355GH, S420NL, P275NH to P460 NH, P275NL1 to 460NL1, L210 to L290, L360MB to L415, X42 (API-5L)</td>
</tr>
<tr>
<td>ROBOFIL M 71</td>
<td>1.2 and 1.6</td>
<td>T 46 6 M M 1 H5</td>
<td>C: 0.07 Mn: 1.4 Si: 0.5</td>
<td>580 510 26 -60°C 80</td>
<td>▪ Metal-cored wire</td>
<td>S235JR to S355GR, P235GH, P265GH, S275S355N, P295GH, P275NH-P355NH, P275NL1-P355NL1, X42 to X70 (API-5L)</td>
</tr>
<tr>
<td>ROBOFIL B 71</td>
<td>1.2 and 1.6</td>
<td>T 46 6 B M 3 H5</td>
<td>C: 0.06 Mn: 1.4 Si: 0.4</td>
<td>580 480 28 -60°C 100</td>
<td>▪ Strongly basic slag</td>
<td>S235JR to S355GR, P235GH, P265GH, S275S355N, P295GH, P275NH-P355NH, P275NL1-P355NL1, X42 to X70 (API-5L)</td>
</tr>
<tr>
<td><strong>Galvanised non-alloyed steels</strong></td>
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<tr>
<td>ROBOFIL M 71Zn</td>
<td>1.2 and 1.6</td>
<td>T 46 2 Z M M 1 H5</td>
<td>C: 0.1 Mn: 1.6 Si: 0.6</td>
<td>580 510 22 +20°C 60</td>
<td>▪ Seamlessly coated metal-cored tubular wire for semi-automatic gas shielded arc welding</td>
<td>S12, Sl13, Sl14m ZSE 260 to ZSE 420 SIE 250-22 to SIE 305-3Z</td>
</tr>
<tr>
<td><strong>Weathering steels</strong></td>
<td></td>
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<tr>
<td>ROBOFIL M 71Cu</td>
<td>1.2 and 1.6</td>
<td>T 46 2 Z M M 1 H5</td>
<td>C: 0.06 Mn: 1.1 Si: 0.5 Cu: 0.4</td>
<td>570 510 24 -30°C 80</td>
<td>▪ Weld deposit with the same colour as that of weathered steel</td>
<td>S235J2W, S355K2W, S355J2G3Cu, CORTEN-A, PATINAX 37, ASTM: A36, A28G Gr B/C</td>
</tr>
<tr>
<td><strong>Cold tough steels</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>ROBOFIL R Ni1 +</td>
<td>1.2 and 1.6</td>
<td>T 50 4 N P M 1 / T 46 4 N P C 1 H5</td>
<td>C: 0.07 Mn: 1.3 Si: 0.5 Ni: 0.9</td>
<td>610* 550* 25* -40°C 90*</td>
<td>▪ 1% Ni alloyed wire for welding fine-grained steels with toughness required down to -60°C</td>
<td>L450NB, L245MB-L450MB, P355NL1-P460NL1, P355NL2-P460NL2, S460N, P355NH-P460NH, S380NL-S460NL, S380NL1-S460NL1, ASTM: A516 Gr65, A572 Gr55,60,65, A633 Gr E, A618 Gr, A537 Gr-1</td>
</tr>
<tr>
<td>ROBOFIL R Ni1SR</td>
<td>1.2 and 1.6</td>
<td>T 50 5 E N P M 1 H5</td>
<td>C: 0.06 Mn: 1.2 Ni: 0.9</td>
<td>620 550 24 -60°C 90</td>
<td>▪ High resistance to initiation and propagation of cracks on account of its particularly low diffusible hydrogen content (&lt;4 ml/100g)</td>
<td>Metal-cored wire for single or multi-pass welding and for automatic welding</td>
</tr>
<tr>
<td>ROBOFIL M Ni1</td>
<td>1.2 and 1.6</td>
<td>T 50 5 E N M 1 H5</td>
<td>C: 0.05 Mn: 1.3 Si: 0.6 Ni: 0.9</td>
<td>610 540 27 -60°C 47</td>
<td>▪ Metal-cored wire specially developed for welding 3.5% nickel steels</td>
<td>S235J2G3 to S355K2G3, P235GH to P355GH, S420NL, P275NH to P460 NH, P275NL1 to P460NL1, L210 to L290, L360MB to L415, X42 to X60 (API-5L)</td>
</tr>
<tr>
<td>ROBOFIL B Ni1</td>
<td>1.2 and 1.6</td>
<td>T 46 6 E N B 3 H5</td>
<td>C: 0.06 Mn: 1.4 Ni: 1.1</td>
<td>600 520 24 -60°C 80</td>
<td>▪ Excellent toughness down to -100°C after heat treatment at 620°C for 1 hour</td>
<td>12Ni14-10Ni14, ASTM: A350 Gr LF3</td>
</tr>
<tr>
<td>ROBOFIL M Ni3</td>
<td>1.2 and 1.6</td>
<td>T 46 10 3 N B 3 H5</td>
<td>C: 0.04 Mn: 0.7 Si: 0.5 Ni: 3.3</td>
<td>580 480 29</td>
<td>▪ Strongly basic wire satisfying very tough high strength requirements</td>
<td>12Ni14-10Ni14, ASTM: A350 Gr LF3</td>
</tr>
</tbody>
</table>

**Under M21 gas shielding**

**S.R: 600°C / 2h**

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**Typical mechanical properties**

- **Rm:** Yield strength (MPa)
- **Rp:** Transverse yield strength (MPa)
- **AS:** Toughness (KJ/m²)
- **CVN:** Charpy V-notch impact (J)

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**Description and applications**

- **Rutile-type wire usable in all-positions with one single parameter setting**
- **Protection:** mixed gas and pure CO₂

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**Base materials**

- **S235J2G3 to S355K2G3, P235GH to P355GH, S420NL, P275NH to P460 NH, P275NL1 to P460NL1, L210 to L290, L360MB to L415, X42 to X60 (API-5L)**
## Robofil - Speedarc: Description, shielding gas and welding positions - see page 6

### Gas Shielded Welding

#### Typical Mechanical Properties

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<tr>
<td>Metal-cored wire for single or multi-pass welding and for automatic welding</td>
<td>P235GH, P265GH, P295GH, 16Mo3, S225N, P310GH, ASTM: A335GrP1, A169-94 GrT1A, A182M GrF1, A204M GrA,B,C, A250 GrT1, A217 GrWC1</td>
</tr>
<tr>
<td>Creep resistant 1.25% Cr - 0.5% Mo weld deposit</td>
<td>(1.7335) 13CrMo4-5, (1.7225) 42CrMo, (1.7128) 25CrMo4-4, (1.7258) 24CrMo5; ASTM: A193 GrB7, A335 GrP11, A217 GrWC6</td>
</tr>
<tr>
<td>Creep resistant 2.25% Cr - 1.0% Mo weld deposit</td>
<td>(1.7380) 10CrMo910, (1.7379) G17CrMo910; ASTM: A335 GrP22, A217 Gr WC9</td>
</tr>
<tr>
<td>Very good toughness properties</td>
<td>(1.4903) X10CrMoVNb 9-1; ASTM: A199 GrT91, A335 GrP91, A213/213M GrT91</td>
</tr>
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### High Strength Steels

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<tr>
<td>ROBOFIL M NiMo</td>
<td>1.2 and 1.6</td>
<td>T 69 4 Mn2NiCrMo M M 1 H5 E901C-G H4</td>
<td>C: 0.05 Mn: 1.6 Si: 0.4 Ni: 1.6 Mo: 0.3</td>
<td>Rm 720 Rp-0.2% 610 AS 24 CVN 19</td>
<td>1.5% Ni weld deposit for service temperature down to -60°C Welding of fine-grained steels with low temperature toughness Especially low diffusible hydrogen content Metal-cored wire for single pass or multi-pass welding and for automatic welding</td>
</tr>
<tr>
<td>ROBOFIL B NiMo</td>
<td>1.2 and 1.6</td>
<td>T 69 5 Mn2NiCrMo B M 3 H5 E907S-G H4</td>
<td>C: 0.05 Mn: 1.4 Si: 0.4 Ni: 2.5 Mo: 0.4</td>
<td>Rm 680 Rp-0.2% 600 AS 24 CVN 19</td>
<td>Steel with low temperature toughness Strong basic wire satisfying very high toughness requirements</td>
</tr>
<tr>
<td>ROBOFIL R 690</td>
<td>1.2 and 1.6</td>
<td>T69 6 2 P M 1 H5 E111T1-GM-JH4 E111T1-M2TA-G H4</td>
<td>C: 0.05 Mn: 1.8 Si: 0.3 Cr: 2.2 Ni: 0.2 Mo: 0.15</td>
<td>Rm 780 Rp-0.2% 740 AS 19</td>
<td>Very high strength steel Ni-Mo alloyed weld deposit Metal cored wire for single or multi-pass welding and for automatic welding</td>
</tr>
<tr>
<td>ROBOFIL R 690 +</td>
<td>1.2 and 1.6</td>
<td>T 69 4 Mn2Mo NiMo P M 1 H5 E111T1-K3M-JH4</td>
<td>C: 0.05 Mn: 1.85 Si: 0.2 Ni: 2.2 Mo: 0.35</td>
<td>Rm 800 Rp-0.2% 740 AS 19</td>
<td>Very high strength nickel-chromium-molybdenum alloyed weld deposit Strong basic wire satisfying very high toughness requirements Very good sound deposit</td>
</tr>
<tr>
<td>ROBOFIL M 700</td>
<td>1.2 and 1.6</td>
<td>T 69 4 Mn2CrMo Mo M M 1 H5 E1110C-K4 H4</td>
<td>C: 0.05 Mn: 1.6 Si: 0.5 Cr: 0.5 Ni: 2.5 Mo: 0.5</td>
<td>Rm 820 Rp-0.2% 760 AS 17</td>
<td>Creep resistant 2.25% Cr - 1.0% Mo weld deposit Strong basic wire satisfying very high toughness requirements</td>
</tr>
<tr>
<td>ROBOFIL B 700</td>
<td>1.2 and 1.6</td>
<td>T 69 5 Mn2CrMo NiMo B M 3 H5 E110TS-K4M-JH4</td>
<td>C: 0.05 Mn: 1.4 Si: 0.4 Cr: 3.0 Ni: 2.4 Mo: 0.5</td>
<td>Rm 850 Rp-0.2% 760 AS 20</td>
<td>Creep resistant 1.25% Cr - 0.5% Mo weld deposit Strong basic wire satisfying very high toughness requirements Metal cored wire for single or multi-pass welding and for automatic welding</td>
</tr>
</tbody>
</table>

### Creep Resistant Steels

<table>
<thead>
<tr>
<th>Product name</th>
<th>Standard diameters (mm)</th>
<th>EN ISO ASME / AWS standards</th>
<th>Composition - Fe balance</th>
<th>Typical mechanical properties</th>
<th>Description and applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROBOFIL M Mo</td>
<td>1.2 and 1.6</td>
<td>T 69 4 CrMo M M 1 H5 E901C-G H4</td>
<td>C: 0.06 Mn: 1.2 Si: 0.4 Mo: 0.5</td>
<td>Rm 600 Rp-0.2% 510 AS 25</td>
<td>Metal-cored wire for service temperature from -50°C to +500°C Safety-critical applications on very thick mild steels and on steels with moderately high yield points</td>
</tr>
<tr>
<td>ROBOFIL M CrMo1</td>
<td>1.2 and 1.6</td>
<td>T 69 4 CrMo1 M M 1 H5 E901C-G H4</td>
<td>C: 0.06 Mn: 0.8 Si: 0.3 Cr: 1.2 Mo: 0.5</td>
<td>Rm 630 Rp-0.2% 530 AS 22</td>
<td>Creep resistant 1.25% Cr - 0.5% Mo weld deposit Creep resistant 2.25% Cr - 1.0% Mo weld deposit Metal-cored wire for single or multi-pass welding and for automatic welding Strong basic wire Tough sound deposit highly resistant to initiation and propagation of cracks at high and low temperatures</td>
</tr>
<tr>
<td>ROBOFIL B CrMo1</td>
<td>1.2 and 1.6</td>
<td>T 69 4 CrMo1 M M 3 H5 E81T5-B2 H4</td>
<td>C: 0.06 Mn: 1.1 Si: 0.4 Cr: 1.2 Mo: 0.5</td>
<td>Rm 650 Rp-0.2% 580 AS 23</td>
<td>Creep resistant 1.25% Cr - 0.5% Mo weld deposit Creep resistant 2.25% Cr - 1.0% Mo weld deposit Metal-cored wire for single or multi-pass welding and for automatic welding Strong basic wire Tough sound deposit highly resistant to initiation and propagation of cracks at high and low temperatures</td>
</tr>
<tr>
<td>ROBOFIL M CrMo2</td>
<td>1.2 and 1.6</td>
<td>T 69 4 CrMo2 M M 1 H5 E901C-G H4</td>
<td>C: 0.06 Mn: 0.8 Si: 0.3 Cr: 2.3 Mo: 1.0</td>
<td>Rm 680 Rp-0.2% 580 AS 21</td>
<td>Creep resistant 1.25% Cr - 0.5% Mo weld deposit Creep resistant 2.25% Cr - 1.0% Mo weld deposit Metal-cored wire for single or multi-pass welding and for automatic welding Strong basic wire Tough sound deposit highly resistant to initiation and propagation of cracks at high and low temperatures</td>
</tr>
<tr>
<td>ROBOFIL B CrMo2</td>
<td>1.2 and 1.6</td>
<td>T 69 4 CrMo2 M M 3 H5 E81T5-B2 H4</td>
<td>C: 0.06 Mn: 0.8 Si: 0.3 Cr: 3.3 Mo: 1.0</td>
<td>Rm 650 Rp-0.2% 580 AS 22</td>
<td>Creep resistant 1.25% Cr - 0.5% Mo weld deposit Creep resistant 2.25% Cr - 1.0% Mo weld deposit Metal-cored wire for single or multi-pass welding and for automatic welding Strong basic wire Tough sound deposit highly resistant to initiation and propagation of cracks at high and low temperatures</td>
</tr>
<tr>
<td>ROBOFIL B P91</td>
<td>1.2 and 1.6</td>
<td>T697S-0G-01Cr1M2H5 E901TS-M2P1-Y-B1-H4</td>
<td>C: 0.12 Mn: 0.3 Si: 0.3 Cr: 10 Ni: 0.3 Mo: 1 Nb: 0.08 Cu: 0.06 Cu: 0.05</td>
<td>Rm 750 Rp-0.2% 600 AS 19</td>
<td>9% Cr -1% Mo weld deposit modified by Nb, V and N additions (P91/T91) Very good toughness properties</td>
</tr>
</tbody>
</table>

**Stress relieved**

**PWHT 1h / 620°C**

**EN ISO**

C: Carbon, Ni: Nickel, Cr: Chromium, Mo: Molybdenum, Si: Silicon, Cu: Copper, Mn: Manganese, Nb: Niobium, V: Vanadium, N: Nitrogen
### Welding of highly alloyed steels

<table>
<thead>
<tr>
<th>Product name</th>
<th>Process</th>
<th>Standard diameters (mm)</th>
<th>Composition + Fe balance</th>
<th>Typical mechanical properties</th>
<th>Description and applications</th>
<th>Base materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean duplex stainless steel</td>
<td>TETRA S</td>
<td>LD62</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T Z 24 8 N L M21 3 (C1 3)</td>
<td>C: 0.03 Mn: 1.4 Si: 0.8 Cr: 24 Ni: 8.5 Mo: 0.2 Cu: 0.3 N: 0.2</td>
</tr>
<tr>
<td></td>
<td>TETRA V</td>
<td>LD62</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T Z 24 8 N L M21 1 (C1 1)</td>
<td>C: 0.03 Mn: 1.4 Si: 0.8 Cr: 24 Ni: 8.5 Mo: 0.2 Cu: 0.3 N: 0.2</td>
</tr>
<tr>
<td></td>
<td>TUBE S</td>
<td>LD62</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T Z 24 8 N L M12 1</td>
<td>C: 0.03 Mn: 1.4 Si: 0.8 Cr: 24 Ni: 8.5 Mo: 0.2 Cu: 0.3 N: 0.2</td>
</tr>
<tr>
<td></td>
<td>TUBE S</td>
<td>LD62</td>
<td>S</td>
<td>2.4 and 3.2</td>
<td>T Z 24 8 N L N M 12</td>
<td>C: 0.03 Mn: 1.4 Si: 0.8 Cr: 24 Ni: 8.5 Mo: 0.2 Cu: 0.3 N: 0.2</td>
</tr>
<tr>
<td></td>
<td>TUBE S</td>
<td>LD62</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T Z 2 4 6 N L N M L 1 2</td>
<td>C: 0.03 Mn: 1.4 Si: 0.8 Cr: 24 Ni: 8.5 Mo: 0.2 Cu: 0.3 N: 0.2</td>
</tr>
<tr>
<td>Duplex stainless steels</td>
<td>TETRA S</td>
<td>22 9 3L</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T 2 2 9 3 4 N L R M21 3 (C1 3)</td>
<td>C: 0.03 Mn: 1.2 Si: 0.8 Cr: 23 Ni: 9 Mo: 3.1 Cu: 0.14</td>
</tr>
<tr>
<td></td>
<td>TETRA V</td>
<td>22 9 3L</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T 2 2 9 3 4 N L P M21 1 (C1 1)</td>
<td>C: 0.03 Mn: 1.2 Si: 0.8 Cr: 23 Ni: 9 Mo: 3.1 Cu: 0.14</td>
</tr>
<tr>
<td></td>
<td>TUBE S</td>
<td>22 9 3L</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T 2 2 9 3 N L M M21 1</td>
<td>C: 0.03 Mn: 1.2 Si: 0.8 Cr: 23 Ni: 9 Mo: 3.1 Cu: 0.14</td>
</tr>
<tr>
<td></td>
<td>TUBE S</td>
<td>22 9 3L</td>
<td>S</td>
<td>2.4 and 3.2</td>
<td>T 2 2 9 3 N L N M O 3</td>
<td>C: 0.03 Mn: 1.2 Si: 0.8 Cr: 23 Ni: 9 Mo: 3.1 Cu: 0.14</td>
</tr>
<tr>
<td>Super duplex stainless steels</td>
<td>TETRA S</td>
<td>D57L</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T 2 5 9 4 Cu N L R M21 3</td>
<td>C: 0.03 Mn: 0.5 Cr: 25 Ni: 9 Mo: 3.80 Cu: 1.10 N: 0.24</td>
</tr>
<tr>
<td></td>
<td>TETRA V</td>
<td>D57L</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T 2 5 9 4 Cu N L M21 1</td>
<td>C: 0.03 Mn: 0.5 Cr: 25 Ni: 9 Mo: 3.80 Cu: 1.10 N: 0.24</td>
</tr>
<tr>
<td></td>
<td>TUBE S</td>
<td>D57L</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T 2 5 9 4 Cu N L M 1 2</td>
<td>C: 0.03 Mn: 0.5 Cr: 25 Ni: 9 Mo: 3.80 Cu: 1.10 N: 0.24</td>
</tr>
<tr>
<td></td>
<td>TUBE S</td>
<td>D57L</td>
<td>S</td>
<td>2.4 and 3.2</td>
<td>T 2 5 9 4 Cu N L N M 3</td>
<td>C: 0.03 Mn: 0.5 Cr: 25 Ni: 9 Mo: 3.80 Cu: 1.10 N: 0.24</td>
</tr>
</tbody>
</table>

- **Austenitic-ferritic deposit in CrNi steel - type 2304**
- **Joining of lean duplex stainless steels and dissimilar assemblies**
- **Corrosion resistance is comparable to the standard austenitic grades like 4301 and 4404**

Welding Alloys Group has developed TETRA V stainless steel cored wires with controlled Bismuth content (<20ppm), we have also developed Basic stainless steel cored wires (TETRA S B) for several chemical analyses, if you would like more information on these products, please ask our experts.

Welding of highly alloyed steels

<table>
<thead>
<tr>
<th>Welding process</th>
<th>TETRA S</th>
<th>TETRA S B</th>
<th>TETRA V</th>
<th>TUBE S</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS type</td>
<td>FCAW</td>
<td>FCAW</td>
<td>GMAW or SAW</td>
<td></td>
</tr>
<tr>
<td>Slag</td>
<td>Rutile slow freezing</td>
<td>Basic</td>
<td>Rutile fast freezing</td>
<td>No slag (metal powder)</td>
</tr>
<tr>
<td>Shielding gas (G)</td>
<td>M21: Ar + 15 - 25% CO₂, M20: Ar + 5 - 15% CO₂, C1: 100% CO₂</td>
<td>M21: Ar + 15 - 25% CO₂, M20: Ar + 5 - 15% CO₂, C1: 100% CO₂</td>
<td>M12: Ar + 0.5 - 5% CO₂, M12: Ar + 0.5 - 3% O₂</td>
<td></td>
</tr>
<tr>
<td>Flux for submerged arc welding (S)</td>
<td>--</td>
<td>--</td>
<td>Neutral Flux</td>
<td></td>
</tr>
<tr>
<td>Welding positions</td>
<td>Optimised bead appearance and productivity in flat and downhand positions</td>
<td>Ultimate impact toughness and crack resistance</td>
<td>Ideal for out-of-position welding</td>
<td>X-ray quality on heavy sections</td>
</tr>
<tr>
<td>Features</td>
<td><em>Position welding possible using pulsed arc modes of transfer (similar to solid wire)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Detailed operating conditions see page 26
## Austenitic Stainless Steels

<table>
<thead>
<tr>
<th>Product name</th>
<th>Grade</th>
<th>Process O: open arc G: gas shielded S: sub arc</th>
<th>Standard diameters (mm)</th>
<th>EN ISO ASME / AWS standards</th>
<th>Composition - Fe balance</th>
<th>Typical mechanical properties</th>
<th>Description and applications</th>
<th>Base materials</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TETRA S</strong></td>
<td>308L</td>
<td>G</td>
<td>1.2 and 1.6 T 19 9 L R M2 1 (C1 3) E308LT1-5/4</td>
<td>C: 0.03 Mn: 1.4 Si: 0.7 Cr: 19.5 Ni: 10.5</td>
<td>560 400 40 -196°C: 32</td>
<td>• Austenitic deposit in CrNi steel - type 308L</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TETRA V</strong></td>
<td>308L</td>
<td>G</td>
<td>1.2 and 1.6 T 19 9 L P M2 1 (C1 1) E309LT1-5/4</td>
<td>C: 0.03 Mn: 1.4 Si: 0.7 Cr: 19.5 Ni: 10.5</td>
<td>620 460 40 -196°C: 35</td>
<td>• Joining of similar compositions, resistant to corrosion</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TUBE S</strong></td>
<td>308L</td>
<td>G</td>
<td>1.2 and 1.6 T 19 9 L M M12 1 E1Cr18Ni9</td>
<td>C: 0.03 Mn: 1.4 Si: 0.7 Cr: 19.5 Ni: 10.5</td>
<td>600 430 40 -196°C: 35</td>
<td>• Service temperatures from -196°C to +400°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TUBE S</strong></td>
<td>308L</td>
<td>S</td>
<td>2.4 and 3.2 T 19 L M NO 3 E308L</td>
<td>C: 0.03 Mn: 1.4 Si: 0.7 Cr: 19.5 Ni: 10.5</td>
<td>600 450 40 -196°C: 35</td>
<td>• TETRA V 308XL-G is specifically dedicated for cryogenic applications with process temperature down to -196°C: 40J (thanks to the controlled ferrite)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TETRA S</strong></td>
<td>347L</td>
<td>G</td>
<td>1.2 and 1.6 T 19 9 Nb R M2 1 (C1 3) E357LT1-5/4</td>
<td>C: 0.03 Mn: 1.4 Si: 0.8 Cr: 19 N: 10.5</td>
<td>650 470 35 -196°C: 34</td>
<td>• Austenitic deposit in CrNiNb steel - type 347</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TETRA V</strong></td>
<td>347L</td>
<td>G</td>
<td>1.2 and 1.6 T 19 9 Nb P M2 1 (C1 1) E357T1-5</td>
<td>C: 0.03 Mn: 1.4 Si: 0.8 Cr: 19 N: 10.5</td>
<td>660 470 35 -196°C: 35</td>
<td>• Joining of Ti or Nb stabilised steels of similar composition, resistant to corrosion</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TUBE S</strong></td>
<td>347L</td>
<td>G</td>
<td>1.2 and 1.6 T 19 9 Nb M M12 1 E347</td>
<td>C: 0.03 Mn: 1.4 Si: 0.8 Cr: 19 N: 10.5</td>
<td>620 430 35 -196°C: 45</td>
<td>• Weld overlaying of clad plates of the same or similar compositions</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TUBE S</strong></td>
<td>347L</td>
<td>S</td>
<td>2.4 and 3.2 T 19 9 Nb M NO 3 E347L</td>
<td>C: 0.03 Mn: 1.4 Si: 0.8 Cr: 19 N: 10.5</td>
<td>600 430 35 -196°C: 35</td>
<td>• Service temperatures from -196°C to +400°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TETRA S</strong></td>
<td>317L</td>
<td>G</td>
<td>1.2 and 1.6 T 19 12 3 L M R M2 1 (C1 3) E317LT0-1/4</td>
<td>C: 0.03 Mn: 1.4 Si: 0.8 Cr: 19.5 Ni: 13 Mo: 2.8</td>
<td>580 440 30 -60°C: 35</td>
<td>• Austenitic deposit in CrNiMo steel - type 316L - resistant to intercrystalline corrosion under humid conditions up to 400°C.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TETRA V</strong></td>
<td>317L</td>
<td>G</td>
<td>1.2 and 1.6 T 19 12 3 L P M2 1 (C1 1) E317T1-5</td>
<td>C: 0.03 Mn: 1.4 Si: 0.8 Cr: 19.5 Ni: 13 Mo: 2.8</td>
<td>620 490 30 -60°C: 30</td>
<td>• Joining of low-carbon or stabilised steels with similar compositions</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TUBE S</strong></td>
<td>317L</td>
<td>G</td>
<td>1.2 and 1.6 T 19 12 3 L M M12 1 E1Cr18Ni10.5</td>
<td>C: 0.03 Mn: 1.4 Si: 0.8 Cr: 19.5 Ni: 13 Mo: 2.8</td>
<td>610 450 35 -60°C: 40</td>
<td>• Weld overlaying of clad plates of the same or similar compositions</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TUBE S</strong></td>
<td>317L</td>
<td>S</td>
<td>2.4 and 3.2 T 19 12 3 L M NO 3 E1Cr18Ni10.5</td>
<td>C: 0.03 Mn: 1.4 Si: 0.8 Cr: 19.5 Ni: 13 Mo: 2.8</td>
<td>610 450 35 -105°C: 50</td>
<td>• Service temperatures up to +400°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TETRA S</strong></td>
<td>318L</td>
<td>G</td>
<td>1.2 and 1.6 T 19 12 3 Nb R M2 1 (C3 3) E318LT0-1/4</td>
<td>C: 0.03 Mn: 1.5 Si: 0.9 Cr: 19.5 Ni: 12 Mo: 2.9 Nb: 0.45</td>
<td>580 440 30 -60°C: 30</td>
<td>• Austenitic deposit in CrNiMoNb steel - type 318</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TETRA V</strong></td>
<td>318L</td>
<td>G</td>
<td>1.2 and 1.6 T 19 12 3 Nb P M2 1 (C1 1) E318T1-5</td>
<td>C: 0.03 Mn: 1.5 Si: 0.9 Cr: 19.5 Ni: 12 Mo: 2.9 Nb: 0.45</td>
<td>620 480 34 +20°C: 60</td>
<td>• Joining and cladding of Ti or Nb stabilised steels of similar compositions</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TUBE S</strong></td>
<td>318L</td>
<td>S</td>
<td>2.4 and 3.2 T 19 12 3 Nb M M12 1 E1Cr18Ni10.5</td>
<td>C: 0.03 Mn: 1.5 Si: 0.9 Cr: 19.5 Ni: 12 Mo: 2.9 Nb: 0.45</td>
<td>620 480 34 +20°C: 60</td>
<td>• Service temperatures up to +400°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TETRA S</strong></td>
<td>304L</td>
<td>G</td>
<td>1.2 and 1.6 T 20 25 5 Cu L M2 1 (C3 3) E338LT0-1/4</td>
<td>C: 0.03 Mn: 1.3 Si: 0.5 Cr: 19.5 Ni: 25.5 Mo: 4.9 Cu: 1.6</td>
<td>640 430 32 -196°C: 35</td>
<td>• Austenitic deposit in CrNiMoCu steel - type 385</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TETRA V</strong></td>
<td>304L</td>
<td>G</td>
<td>1.2 and 1.6 T 20 25 5 Cu L P M2 1 E338T1-5</td>
<td>C: 0.03 Mn: 1.3 Si: 0.5 Cr: 19.5 Ni: 25.5 Mo: 4.9 Cu: 1.6</td>
<td>640 430 32 -196°C: 35</td>
<td>• Great flexibility of use: unique rutile type slag in the TETRA version</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TUBE S</strong></td>
<td>304L</td>
<td>G</td>
<td>1.2 and 1.6 T 20 25 5 Cu L M L11 E388</td>
<td>C: 0.03 Mn: 1.3 Si: 0.5 Cr: 19.5 Ni: 25.5 Mo: 4.9 Cu: 1.6</td>
<td>640 410 35 196°C: 40</td>
<td>• Specially developed for the phosphate industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TUBE S</strong></td>
<td>304L</td>
<td>S</td>
<td>2.4 and 3.2 T 20 25 5 Cu L M NO 3 E388</td>
<td>C: 0.03 Mn: 1.3 Si: 0.5 Cr: 19.5 Ni: 25.5 Mo: 4.9 Cu: 1.6</td>
<td>640 410 35 -196°C: 45</td>
<td>• Service temperatures from -110°C to +400°C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: [UNS N08904, S31726 (1.4539) X2CrNiMoCu25-20-5, (1.4537) X1CrNiMoCu25-25-5, (1.4505) X4CrNiMoCu25-20-18-2 UNS N08914, S31726]
### Welding of highly alloyed steels

<table>
<thead>
<tr>
<th>Product name</th>
<th>Process</th>
<th>Standard diameters (mm)</th>
<th>EN ISO ASME / AWS standards</th>
<th>Composition - Fe balance</th>
<th>Typical mechanical properties</th>
<th>Description and applications</th>
<th>Base materials</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heat-resistant steels</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TETRA V 16 8 2</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T / Z 16 8 2 P M21 1 (C1 1) E16-8-2 Ti-1.5-4**</td>
<td>C: 0.06  Mn: 1.4  Si: 0.5  Cr: 19.8  Ni: 9.3  Mo: 1.2</td>
<td>Rm 620  Rp 0.2% 460  A5 40  CVN 320°C 70</td>
<td>▪ Heat resistant austenitic deposit for applications up to 850°C  ▪ Unique resistance to hot cracking</td>
<td>(1.4848) X6CrNi18-11, (1.4841) X8CrNiTi18-10, (1.4861) X8CrNiMo17-13</td>
</tr>
<tr>
<td>TETRA S 308H</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T / Z 19 9 H R M21 3 (C1 1) E308HT-1/-4</td>
<td>C: 0.06  Mn: 1.4  Si: 0.8  Cr: 20.5  Ni: 10.5</td>
<td>Rm 820  Rp 0.2% 470  A5 40  CVN 320°C 80</td>
<td>▪ Austenitic deposit in CrNi steel - type 308H with controlled ferrite level, heat resistant up to 650°C and oxidation resistant up to 800°C  ▪ Joining and cladding of stabilised or non stabilise creep-resistant austenitic steels with similar compositions</td>
<td>(1.4848) X6 CrNi18-11, (1.4850) X6CrNiNb18-10, (1.4878) X12CrNiTi18-9 AISI 304H-321H-347H</td>
</tr>
<tr>
<td>TUBE S 308H</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T / Z 19 9 H M M12 EC309H</td>
<td>C: 0.06  Mn: 1.4  Si: 0.8  Cr: 23  Ni: 12.8</td>
<td>Rm 820  Rp 0.2% 470  A5 40  CVN 320°C 80</td>
<td>▪ Heat resistant austenitic deposit in CrNi steel - type 308H with controlled ferrite level, heat resistant up to 650°C and oxidation resistant up to 800°C  ▪ Joining of steel forgings and castings with similar compositions</td>
<td>(1.4828) X15CrNi20-12, (1.4826) X6CrNiNb18-10, (1.4833) XCrNiTi23-14, AISI 304HF-321HF-347H</td>
</tr>
<tr>
<td>TUBE S 309H</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T / Z 22 12 H M31 1 (C1 1) E317LT-1/-4</td>
<td>C: 0.04  Mn: 1.4  Si: 0.8  Cr: 22  Ni: 10</td>
<td>Rm 820  Rp 0.2% 460  A5 30  CVN 320°C 80</td>
<td>▪ Austenitic deposit in CrNi steel – modified type 309, with additions of nitrogen and rare earths  ▪ Joining of steels with similar compositions resisting oxidation up to 1000°C  ▪ Good resistance to fatigue and to deformation linked to rapid and repeated temperature variations</td>
<td>(1.4835) X9CrNiSiC21-11-2, UNS S30815, S30415 253MA</td>
</tr>
<tr>
<td>TUBE S 309HT</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T / Z 22 10 H M21 3</td>
<td>-</td>
<td>C: 0.06  Mn: 1.4  Si: 0.8  Cr: 22  Ni: 10  N: 0.1 (+ Ce)</td>
<td>Rm 720  Rp 0.2% 530  A5 33  CVN 320°C 50</td>
<td>▪ Heat resistant austenitic deposit in CrNi steel – modified type 309, with additions of nitrogen and rare earths  ▪ Joining of steels with similar compositions resisting oxidation up to 1000°C  ▪ Good resistance to fatigue and to deformation linked to rapid and repeated temperature variations</td>
</tr>
<tr>
<td>TUBE S 310</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T / Z 25 20 H M31 1 (C1 1) E310T-1/-4</td>
<td>C: 0.1  Mn: 2.5  Si: 0.8  Cr: 25.5  Ni: 21</td>
<td>Rm 820  Rp 0.2% 410  A5 35  CVN 320°C 70</td>
<td>▪ Heat resistant austenitic deposit in CrNi steel - type 310, resistant to oxidation up to 1150°C  ▪ Joining of stainless steels with similar compositions  ▪ Good resistance to hot cracking during welding</td>
<td>(1.4837 ) GX40CrNiSi 25-12, (1.4840) GX15CrNi25-20, (1.4841) X15CrNiSi25-20 ASTM: A297HF</td>
</tr>
<tr>
<td>TUBE S 347H</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T / Z 19 9 Nb M31 1 (C1 1) E347HT-1/-4</td>
<td>C: 0.06  Mn: 1.4  Si: 0.9  Cr: 19.5  Ni: 10.5  Nb: 0.7</td>
<td>Rm 820  Rp 0.2% 470  A5 35  CVN 320°C 70</td>
<td>▪ Austenitic deposit in CrNiNb steel - type 347 with controlled ferrite level, creep resistant  ▪ Heat resistant up to 700°C  ▪ Joining and cladding of steels with similar compositions</td>
<td>(1.4850) X6CrNiNb 18-10, (1.4878), X12CrNiTi18-9 AISI 321H-347H</td>
</tr>
</tbody>
</table>

*Nearest  **No AWS specification is available

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**Detailed operating conditions see page 26**
### Welding of highly alloyed steels

<table>
<thead>
<tr>
<th>Product name</th>
<th>Process</th>
<th>Standard diameters (mm)</th>
<th>EN ISO ASME / AWS standards</th>
<th>Composition - Fe balance</th>
<th>Typical mechanical properties</th>
<th>Description and applications</th>
</tr>
</thead>
</table>
| TETRA S 312 | G       | 1.2 and 1.6             | T 29 P M21 3 (C1 3) E312T7-5/4 | C: 0.1 Mn: 1.5 Si: 0.8 Cr: 29 Ni: 8.6 Mo: 0.3 | 860 650 22 +20°C: 40 | • Austeno-ferritic deposit in CrNi steel - type 312, offering exceptional cracking resistance  
   • Joining of unknown or hard-to-weld steels  
   • Dissimilar joints, including those to steels with high carbon equivalents: high speed steels, tool steels, Mn steels, high strength constructional steels, abrasion-resistant steel plates |
| TUBE S 312  | S       | 2.4 and 3.2             | T 29 M NO 3 E312           | 750 650 22 +20°C: 40   | • Work-hardening austenitic deposit in CrNiMn steel - modified type 307  
   • Dissimilar joints, welding of steels of unknown types, armouring steels, buffering  
   • Joining of 14% Mn austenitic steels  
   • Service temperatures from -120°C to +300°C |
| TETRA S 307 | G       | 1.2 and 1.6             | T 18 Mn R M21 3 (C1 3) E307T7-5/4 | C: 0.06 Mn: 0.6 Si: 0.8 Cr: 19 Ni: 9.5 | 630 480 40 +20°C: 50 | • Austenitic deposit in CrNiMo steel - modified type 308Mo, offering high mechanical strength  
   • Fabrication of armoured vehicles, joining of steels with high yield points and limited weldability, dissimilar joints  
   • High resistance to hot cracking  
   • Service temperatures from -60°C to +300°C |
| TUBE S 307  | S       | 2.4 and 3.2             | T 18 M Mn M21 3 E307T6 | 850 450 35 +20°C: 70   | • Austenite-ferrite deposit in over-alloyed CrNi steel - type 309L, with optimised ferrite content for jointing dissimilar metals  
   • Joining of steels with similar compositions and joining carbon steels to stainless steels.  
   • Buffering before cladding  
   • Service temperatures from -60°C to +350°C |
| TETRA S 209 | G       | 1.2 and 1.6             | T 20 10 3 R M21 3 (C1 3) E309/308MnT6-6-6 | 710 530 30 -20°C: 45 | 710 530 30 -20°C: 45  
   • Austenite-ferrite deposit in over-alloyed CrNiMnMo steel - type 309LMo, for joining dissimilar metals  
   • Joining of stainless steels to mild or low-alloyed steels at high dilution levels  
   • Buffering before cladding  
   • Service temperatures from -60°C to +350°C |
| TUBE S 209  | S       | 2.4 and 3.2             | T 20 10 3 M NO 3 E309/308MnT6-6-6 | 850 450 35 +20°C: 70   | 710 530 30 -20°C: 45  
   • Austenite-ferrite deposit in over-alloyed CrNiMo steel - type 309LMo, for joining dissimilar metals  
   • Joining of stainless steels to mild or low-alloyed steels at high dilution levels  
   • Buffering before cladding  
   • Service temperatures from -60°C to +350°C |

**Note:** Nearest
### Welding of highly alloyed steels

#### CHROMECORE B
- **Welding process:** FCAW
- **AWS type:** Td-4
- **Slag:** Basic
- **Shielding gas (G):** M12: Ar + 0.5 - 5% CO₂, M20: Ar + 5 - 15% CO₂
- **Flux for submerged arc welding (S):** Neutral flux
- **Welding positions:** All positions
- **Features:** Ultimate impact toughness

#### CHROMECORE V
- **Welding process:** FCAW
- **AWS type:** T1-1/4
- **Slag:** Rutile tube-freezing
- **Shielding gas (G):** M21: Ar + 15 - 25% CO₂
- **Flux for submerged arc welding (S):** All positions
- **Welding positions:** Ideal for out-of-position welding
- **Features:** Ultimate impact toughness and crack resistance

#### CHROMECORE M
- **Welding process:** GMAW
- **AWS type:** ECXXX
- **Slag:** No slag (metal powder)
- **Shielding gas (G):** M12: Ar + 0.5 - 5% CO₂
- **Flux for submerged arc welding (S):** All positions
- **Welding positions:** All positions
- **Features:** X-Ray quality on heavy section

<table>
<thead>
<tr>
<th>Product name</th>
<th>Process</th>
<th>Standard diameters (mm)</th>
<th>EN ISO ASME / AWS standards</th>
<th>Composition - Fe balance</th>
<th>Typical mechanical properties**</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHROMECORE M 410NiMo</td>
<td>G/S</td>
<td>1.2 and 1.6</td>
<td>T 13 4 M M12 1 EC410NiMo*</td>
<td>C: 0.02 Mn: 0.9 Si: 0.7 Cr: 12.5 Ni: 4.7 Mo: 0.55</td>
<td>860 720 18 +20°C: 65 -30°C: 55</td>
</tr>
<tr>
<td>CHROMECORE V 410NiMo</td>
<td>G</td>
<td>1.6</td>
<td>T 13 4 P M21 1 E410NiMoT1-4</td>
<td>C: 0.03 Mn: 0.40 Si: 0.5 Cr: 12 Ni: 4.5 Mo: 0.5</td>
<td>860 720 18 +20°C: 50 -20°C: 43</td>
</tr>
<tr>
<td>CHROMECORE B 13 4</td>
<td>G</td>
<td>1.2 and 1.6</td>
<td>T 13 4 M M12 2 EC410NiMo</td>
<td>C: 0.02 Mn: 0.5 Si: 0.25 Cr: 12 Ni: 4.5 Mo: 0.5</td>
<td>860 720 18 +20°C: 110 -20°C: 100</td>
</tr>
</tbody>
</table>

**Nearest**

**After PWHT 580°C - 8 hours**

### Description and applications
- Soft martensitic stainless steel – type 13Cr- 4Ni
- Joining and rebuilding of turbines in the hydro power industry
- A post-weld heat treatment at 580°C - 620°C is advised to obtain a tempered martensite that combines ductility, corrosion resistance and cavitation resistance
- CHROMECORE B 16 S 1-G soft martensitic deposit is also available and provides better pitting corrosion resistance
### Welding of nickel alloys and special applications

| Product name | Process | Standard diameters (mm) | EN ISO ASME / AWS standards | Composition - Ni balance | Typical mechanical properties | Description and applications | Base materials |
|--------------|---------|-------------------------|-----------------------------|--------------------------|-------------------------------|-----------------------------|----------------|----------------|
| GAMMA 182    | G       | 1.2 and 1.6             | T N 6182 B M21 3            | C: 0.01                  | Rm 610 380 40                | -196°C: 90                  | (2.4816) NiCr15Fe, 600 alloys, 600L, 800H |
| GAMMA 182    | G       | 1.2 and 1.6             | T N 6182 B M21 3            | Mn: 6                     | -196°C: 90                  | (2.4856) NiCr22Mo9Nb, NiCr21Mo, NiCrMo17-12Ni19ASTM A |
| GAMMA 4648   | G       | 1.2 and 1.6             | T N 6083 B M21 3            | Cr: 17                    | -196°C: 90                  | (1.5662) X8 Ni 9          |
| GAMMA V 625  | G       | 1.2 and 1.6             | T N 6025 B M21 3            | Nb: 2.4                   | -196°C: 90                  | (1.5637) 10Ni14, X12Ni14, X8Ni18Ni12Cr20Mo, NiCrMo19-11-1ASTM A |
| GAMMA V 625  | G       | 1.2 and 1.6             | T N 6025 B M21 3            | Fe: 2.4                   | -196°C: 90                  | (2.4858) X10NiCrAlTi, X11NiCrAlTi, X5NiAl, 625 alloys, 800H |
| GAMMA 276    | G       | 1.2 and 1.6             | T N 6027 B M21 3            | Mn: 16                    | -196°C: 90                  | (1.5662) X8 Ni 9          |
| GAMMA V 276  | G       | 1.2 and 1.6             | T N 6027 B M21 3            | W: 4                      | -196°C: 90                  | (2.4819) NiMo16Cr15W, NiMo16Cr15W, NiCr15Fe, 600 alloys, 600L, 800H |
| GAMMA 400    | G       | 1.2 and 1.6             | T Z N 6040 B M21 3          | Ti: 2                     | -196°C: 90                  | (1.5640) NiCrMo19-11-1ASTM A |
| GAMMA V CRYO | G       | 1.2 and 1.6             | T Z N 6082 B M21 3          | Cr: 16                    | -196°C: 90                  | (1.5662) X8Ni18Ni12Cr20Mo, NiCrMo19-11-1ASTM A |

*Nearest**

**No AWS specification is available
# Welding of Cast Irons

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Process</th>
<th>Slag</th>
<th>Shielding Gas</th>
<th>Welding Process</th>
<th>Slag Type</th>
<th>Slag Gas</th>
<th>Shielding Gas</th>
<th>Features</th>
<th>Description and Applications</th>
<th>Base Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAST NiCI</td>
<td>O</td>
<td>Basic</td>
<td>M13: Ar + 0.5 - 3% O₂, M12: Ar + 0.5 - 5% CO₂, M21: Ar + 15 - 25% CO₂</td>
<td>FCAW</td>
<td>Basic</td>
<td>Basic</td>
<td>No gas</td>
<td>Ultimate impact toughness and crack resistance</td>
<td>- FeNi deposit for rebuilding ductile or spheroidal cast iron and for joining cast irons to each other</td>
<td>GG10 to GG40, GTS35 to GTS 70, GTW35 to GTW 70, GGG40 to GGG80</td>
</tr>
<tr>
<td>CAST NiCI</td>
<td>G</td>
<td>Basic</td>
<td>No gas</td>
<td>FCAW</td>
<td>Basic</td>
<td>Basic</td>
<td>No gas</td>
<td>Ultimate impact toughness and crack resistance</td>
<td>- Reduced heat affected zone (HAZ)</td>
<td>GG10 to GG40, GTS35 to GTS 70, GTW35 to GTW 70, GGG40 to GGG80</td>
</tr>
<tr>
<td>CAST NiFe</td>
<td>G</td>
<td>Basic</td>
<td>No gas</td>
<td>FCAW</td>
<td>Basic</td>
<td>Basic</td>
<td>No gas</td>
<td>Ultimate impact toughness and crack resistance</td>
<td>- Dissimilar joints between cast irons and steels</td>
<td>GG10 to GG40, GTS35 to GTS 70, GTW35 to GTW 70, GGG40 to GGG80</td>
</tr>
</tbody>
</table>

| | | | | | | | | Ideal for outdoor welding jobs | | |

| | | | | | | | | Easily machined deposit | | |

## Welding of Cast Irons

- **CAST (-G)**
  - O: open arc
  - G: gas shielded

- **CAST (-O)**
  - O: open arc
  - G: gas shielded

## Standard Diameters

- **(mm)**
  - CAST NiCI: T C NiFeT3-Ci NO: 1.6 to 2.4
  - CAST NiCI: T C NiFeT3-Ci M21: 1.2 and 1.6
  - CAST NiFe: T C Z NiFe-1 M: 1.2 and 1.6

## Composition - Fe balance

- C: 1.2
- Mn: 4
- Si: 0.9
- Ni: 45

## Typical Mechanical Properties

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rm</td>
<td>Rp 0.2%</td>
<td>AS %</td>
<td>CVN</td>
<td></td>
</tr>
<tr>
<td>MPa</td>
<td>MPa</td>
<td></td>
<td>[J]</td>
<td></td>
</tr>
<tr>
<td>560</td>
<td>400</td>
<td>15</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>550</td>
<td>340</td>
<td>16</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>470</td>
<td>350</td>
<td>15</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

## Description and Applications

- **FeNi deposit for rebuilding ductile or spheroidal cast iron and for joining cast irons to each other**
- **Reduced heat affected zone (HAZ)**
- **Dissimilar joints between cast irons and steels**
- **NiFe deposit for joining heavy thicknesses of ductile and spheroidal cast iron and for restrained joints**
- **Reduced heat affected zone (HAZ)**
- **Easily machined deposit**

## Base Materials

- GG10 to GG40, GTS35 to GTS 70, GTW35 to GTW 70, GGG40 to GGG80
Optimum parameters vary according to the welding power source used

**Shielding gas**
See table page 12
When using a 100% CO₂ gas shield, 1 to 2 volts extra is recommended

**Gas flow rate**
12 - 20 m³/min
10 - 20 mm for wire diameters 0.9 - 1.0 mm
10 - 25 mm for wire diameters 1.2 - 1.6 mm

**Stick out**
10 - 20 mm for diameters 0.9 - 1.0 mm
10 - 25 mm for diameters 1.2 - 1.6 mm

**Lightly weaved beads**

**Optimum parameters vary according to the welding power source used**

**Downhand and horizontal fillet welding - TETRA S and TETRA V wires**

<table>
<thead>
<tr>
<th>Welding positions</th>
<th>Type of joint</th>
<th>Plate thickness [mm]</th>
<th>Wire diameter [mm]</th>
<th>Intensity [A]</th>
<th>Voltage [V]</th>
<th>Wire feed speed [m/min]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1G - 1F</td>
<td>Lap joint</td>
<td>1.5 - 15</td>
<td>0.9 - 1.0</td>
<td>100 - 160</td>
<td>22 - 28</td>
<td>8 - 15</td>
</tr>
<tr>
<td></td>
<td>J joint</td>
<td>3 - 5</td>
<td>1.2</td>
<td>130 - 150</td>
<td>23 - 24</td>
<td>4.5 - 6</td>
</tr>
<tr>
<td></td>
<td>V - Root pass</td>
<td>5 - 15</td>
<td>1.2</td>
<td>100 - 150</td>
<td>22 - 24</td>
<td>3.5 - 6</td>
</tr>
<tr>
<td></td>
<td>V - Filling passes</td>
<td>5 - 15</td>
<td>1.2</td>
<td>200 - 280</td>
<td>26 - 30</td>
<td>8.5 - 14.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 - 20</td>
<td>1.6</td>
<td>200 - 250</td>
<td>33 - 35</td>
<td>4.5 - 9.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.5 - 5</td>
<td>0.9 - 1.0</td>
<td>100 - 160</td>
<td>23 - 28</td>
<td>8 - 15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 - 7</td>
<td>1.2</td>
<td>130 - 220</td>
<td>22 - 28</td>
<td>4.5 - 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7 - 15</td>
<td>1.2</td>
<td>200 - 120</td>
<td>26 - 28</td>
<td>8.5 - 14.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 - 20</td>
<td>1.6</td>
<td>200 - 350</td>
<td>25 - 33</td>
<td>4.5 - 9.5</td>
</tr>
<tr>
<td>Fillet weld</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**V - Root pass**
1.2            140 - 170   24 - 28   6.5 - 9
V - Filling passes | 1.2          | 180 - 200            | 26 - 29     | 9 - 11   |
| Fillet weld      | 1.2          | 180 - 200            | 26 - 29     | 9 - 11   |
| V - Root pass    | 1.2          | 140 - 150            | 23 - 25     | 4.5 - 7  |
V - Filling passes | 1.2          | 170 - 190            | 26 - 28     | 8 - 10   |

**V - Filling passes**
1.2            170 - 190   26 - 28   8 - 10

**10 - 25 mm for wire diameters 1.2 - 1.6 mm**

**Welding Alloys recommends fluxes suited for weld metal deposits**

**Technical Information**

- All weld metal compositions and mechanical properties given are typical average values. All chemical compositions given are for all weld metal deposits.

- Use of the correct gun angle will give good control of the weld pool, good tie-in and optimum penetration.

- Joining

- All welds are done in accordance with the EC directives 91/155/CEE and 93/112/CE and to the international standard ISO 15014-1.

- Technical data sheets and safety data sheets are available for all products in accordance with EC-directives 91/155/CEE and 93/112/CE and to the international standard ISO 15014-1.

- Technical data sheets and safety data sheets are available for all products in accordance with EC-directives 91/155/CEE and 93/112/CE and to the international standard ISO 15014-1.

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