WA Cored Wires

Hardfacing

Cladding - Thermal Arc Spraying
Since its foundation in 1966, the Welding Alloys Group has become the global specialist in the development of high alloy content cored wires and programmable equipment for surfacing applications.

Using production machinery of our own design, Welding Alloys now designs and manufactures a range of welding wires unequalled in the global market. By responding to the needs of our customers, and maintaining a continuous and significant research investment, we are able to lead the market in cored welding wire technology.

Performance and quality criteria are becoming ever more stringent and require ever more complex materials. Shortages of raw materials are leading increasingly to the development of composite components, with surfacing provided by the hardfacing method, using sophisticated alloys. The Welding Alloys Group are proud to bring ground-breaking hardfacing technology to our customers.

WA Performance Guarantee means we will always recommend the product with the highest performance for our customers’ applications.
Definitions and Using this catalogue

Understanding wear phenomena and material attributes

<table>
<thead>
<tr>
<th>Wear Mechanism</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal/metal friction</td>
<td>Metal surfaces in relative motion forced into contact with or without lubricant. Degradation occurs from the formation of micro-welds between contacting surfaces.</td>
</tr>
<tr>
<td>Mineral abrasion</td>
<td>Wear by relative movement of mineral particles of suitable hardness, shape and texture to remove material from the metal surface.</td>
</tr>
<tr>
<td>Abrasion under pressure</td>
<td>Wear by relative movement under pressure of mineral particles of suitable hardness, shape and texture to remove material from the metal surface, leaving superficial deformation.</td>
</tr>
<tr>
<td>Hot abrasion</td>
<td>As above, but in a high-temperature environment, leading generally to softening of the metal or its constituents.</td>
</tr>
<tr>
<td>Erosion</td>
<td>Repeated high-speed impacts between mineral particles and a material surface, local destruction by tearing out of metallic grains.</td>
</tr>
<tr>
<td>Cavitator</td>
<td>Tearing out of grains from the metal surface by the formation and implosion of bubbles in a liquid in a rapid motion.</td>
</tr>
<tr>
<td>Impact</td>
<td>Impact between two materials, one of which provokes deformation or rupture of the other. This phenomenon is controlled by the toughness or ductility of the two materials.</td>
</tr>
<tr>
<td>Mechanical fatigue</td>
<td>Cyclic deformation not exceeding the elastic limit of the material. Degradation over time by localised stress concentrations.</td>
</tr>
<tr>
<td>Thermal fatigue</td>
<td>Cyclic exposure to high temperatures leading to permanent deformation by alternate expansion and contraction. Alteration of the structure and properties of the material.</td>
</tr>
<tr>
<td>Hot oxidation</td>
<td>Creasing of a poorly adhering oxide layer that reforms constantly. Degradation by loss of material thickness.</td>
</tr>
<tr>
<td>Corrosion</td>
<td>Degradation of the material by chemical reaction with its environment. Complex phenomenon involving numerous parameters.</td>
</tr>
</tbody>
</table>

Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rebuilding or cladding</td>
<td>Repair by reshaping to the original or specified dimensions, Application of a corrosion-resistant protective cladding.</td>
</tr>
<tr>
<td>Buffer layer or assembly</td>
<td>Layer of weld metal providing a good metallurgical transition between the base metal and the coating. For welded joints between similar or dissimilar materials.</td>
</tr>
<tr>
<td>Cutting ability</td>
<td>Ability of the material to resist impact, heat, friction and abrasion simultaneously for edge retention of cutting tool.</td>
</tr>
<tr>
<td>Work-hardening</td>
<td>Ability of a material to increase its surface hardness under the effect of impact or high pressure. In general, this increases wear resistance.</td>
</tr>
<tr>
<td>Machinability</td>
<td>Suitability for machining by removal of metal shavings, e.g. turning, milling or drilling.</td>
</tr>
</tbody>
</table>

Chemical Composition

Each alloy is composed of elements expressed as percentages by weight. The values of those elements essential to the physical, chemical and mechanical properties of the deposit are highlighted in the composition tables.

Example:

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Composition [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
</tr>
<tr>
<td>HARDFACE AP</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Cored Wires

Hard-facing by arc welding is a surfacing operation to extend the service life of industrial components, pre-emptively on new components, or as part of a maintenance programme.

The result of significant savings in machine down time and production costs has meant that this process has been adopted across many industries.

For each industrial application and wear phenomena, there is a Welding Alloys cored welding wire to provide wear resistance. Due to the unrivalled flexibility and ease of application, cored wires are used in many situations – in workshops, on site, for new parts or for repair. An alloy may be deposited by various welding methods;

- Open arc welding (O)
- Gas shielded welding MIG/MAG (G)
- Submerged arc welding (S)
- Thermal spraying (as shown by the symbol) □

Welding Alloys Quality Control teams are an integral part of the production process at all our production sites, to ensure our continued commitment to delivering high quality, standard-setting welding consumables.
Shielding Gas and Flux Recommendations

- **HARDFACE** (a cored wire with a seam) the recommended shielding gas is Argon + 5-25% CO₂ (M21)
  A neutral flux is required for submerged arc welding

- **ROBODUR** (a seamless cored wire) the recommended shielding gases are Argon + 2-25% CO₂ (M12-M21) and Argon + 2-3% Oxygen (M13)

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Composition [%] - Fe balance</th>
<th>Hardness - 3 layers</th>
<th>Description and applications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C Mn  Si Cr Ni as welded work hardened</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HARDFACE 19 G 6</td>
<td>0.10 6.00 0.50 19.0 9.00 180 HB 47 HRC</td>
<td></td>
<td>Highly resistant to cracking - austenitic structure that work-hardens strongly</td>
</tr>
<tr>
<td>HARDFACE AP</td>
<td>0.40 16.0 0.50 14.0 240 HB 48 HRC</td>
<td></td>
<td>Wide field of application: buffer layer before hardfacing, assembly of wear plates and armouring, and of manganese steels and dissimilar joints</td>
</tr>
<tr>
<td>HARDFACE NM14</td>
<td>1.00 14.0 0.50 200 HB 46 HRC</td>
<td></td>
<td>Highly resistant to cracking - austenitic structure that work-hardens strongly</td>
</tr>
</tbody>
</table>

- Specific TIG versions available in diameter 1.2 mm and 1.6 mm.
- Colour and structure of the deposit similar to Hadfield type manganese steel.
- Applications: rubber kneaders
- Highest hardness of the cobalt base alloy range, offering excellent resistance to abrasion and corrosion
- Applications: wood and paper industries, extrusion screws for filled plastic
- Good resistance to abrasion by minerals on account of its high hardness
- Applications: small valves and valve gates, extrusion dies
- Allows the required hardness to be obtained on low alloy steels from the first layer
- Equivalent alloy to STELLOY 6 with higher carbon
- Pump sleeves and shafts
- Recomended for buffering on large parts or for thick deposits
- Easier machining and reduced cracking tendency
- Equivalent alloy to STELLOY 6 with lower carbon
- Deposit of intermediate hardness with good machinability
- Highly resistant to metal-to-metal abrasion
- Highly resistant to high temperature wear and metal-to-metal abrasion
- Applications: straightening guides, vertical mill rolls and foot rolls in continuous casting
- Maintains a good level of hardness at high temperatures
- Resists corrosion and cavitation
- Ideal choice for resisting multiple combinations of stresses
- Applications: for retouching of casting imperfections
- Highly resistant to cracking - austenitic structure that work-hardens strongly
- Applications: repair work on railway frogs and crossings. Hammers, bars, cones and jaws for crushers
- High rate of work-hardening. Non-magnetic deposit strongly resistant to impact and high pressure
- Rebuilding, buffer layers and assembly of manganese steels. Buffer layer before hardfacing with chromium cast iron
- Applications: for retouching of casting imperfections
### Hardfacing - Low and Medium Alloived

#### Shielding Gas and Flux Recommendations
- A. Shielding Gas and Flux Recommendations
  - The recommended shielding gases are 100% Argon (I1) and Argon + 1-3% CO2 (M12)

#### Product List
- **Product Name**
- **Composition [%] - Fe balance**
- **Hardness**

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Composition [%] - Fe balance</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>HARDFACE B</td>
<td>0.10 1.50 0.40 1.00</td>
<td>200 HB</td>
</tr>
<tr>
<td>HARDFACE T</td>
<td>0.15 1.50 0.80 1.50</td>
<td>360 HB</td>
</tr>
<tr>
<td>HARDFACE P</td>
<td>0.20 2.00 0.80 3.00</td>
<td>400 HB</td>
</tr>
<tr>
<td>HARDFACE L</td>
<td>0.50 1.50 2.50 8.50</td>
<td>650 HB</td>
</tr>
<tr>
<td>ROBODUR K 250</td>
<td>0.10 1.50 0.70 1.50 0.20</td>
<td>250 HB</td>
</tr>
<tr>
<td>ROBODUR K 350</td>
<td>0.15 1.50 0.70 2.00 0.20</td>
<td>350 HB</td>
</tr>
<tr>
<td>ROBODUR K 450</td>
<td>0.40 1.50 0.70 2.50 0.50</td>
<td>450 HB</td>
</tr>
<tr>
<td>ROBODUR K 600</td>
<td>0.50 1.20 0.70 6.00 0.70</td>
<td>600 HB</td>
</tr>
</tbody>
</table>

### Hardfacing
- **Hardfacing - Cladding - Thermal Arc Spraying**
  - **Description and applications**
    - Crack-resistant deposit
    - Repair, rebuilding and buffering of castings
    - Automated welding of large parts, semi-automated welding for outdoor use
    - Applications: shafts, rollers, wheels, etc, in the mining and civil engineering industries
    - Self-tempering deposit for hardfacing
    - Seamless copper coated tubular wires for gas-shielded welding
    - Excellent weldability
    - Rebuilding and buffering of forged or rolled mechanical components: transmission shafts, rolls or chocks for steel making, roller bearing seats, rollers for gantry cranes, gear teeth, forging tools and dies
    - Seamless copper coated tubular wires for gas-shielded welding
    - Retains a high hardness level to 400°C
    - Excellent weldability
    - Hardfacing applications for all industries: seats, cams, raceways, press and transport screws

### Process
- **Process**
  - O: open-arc
  - S: sub-arc
  - G: gas-shielded

### Standard diameters
- **Standard diameters [mm]**
  - 1.2 to 2.8
  - 2.4 to 3.2

### EN ISO standard
- **EN ISO standard**
  - 14700 standard

### Applications
- **Applications**
  - Pumps and valves for the chemical and petrochemical industries
  - Tube extrusion dies, extrusion tooling and forging die
  - Superalloy offering extreme resistance to prolonged high temperature stress
  - Repair, rebuilding and buffering of castings
  - Excellent weldability
  - High temperature stress
  - Corrosion
  - Cutting ability
  - Work-hardening
  - Machinability

### Suitability
- **Suitability**
  - Suitable
  - Highly suitable

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<table>
<thead>
<tr>
<th>Product Name</th>
<th>Process</th>
<th>Standard diameters [mm]</th>
<th>EN 14700 standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>HARDFACE B</td>
<td>O</td>
<td>1.2 to 2.8</td>
<td>T Fe1</td>
</tr>
<tr>
<td>HARDFACE T</td>
<td>O</td>
<td>1.2 to 2.8</td>
<td>T Fe1</td>
</tr>
<tr>
<td>HARDFACE P</td>
<td>O</td>
<td>1.2 to 2.8</td>
<td>T Fe1</td>
</tr>
<tr>
<td>HARDFACE L</td>
<td>O</td>
<td>1.2 to 2.8</td>
<td>T Fe8</td>
</tr>
<tr>
<td>ROBODUR K 250</td>
<td>G</td>
<td>1.0 to 1.6</td>
<td>T Fe1</td>
</tr>
<tr>
<td>ROBODUR K 350</td>
<td>G</td>
<td>1.0 to 1.6</td>
<td>T Fe1</td>
</tr>
<tr>
<td>ROBODUR K 450</td>
<td>G</td>
<td>1.0 to 1.6</td>
<td>T Fe2</td>
</tr>
<tr>
<td>ROBODUR K 600</td>
<td>G</td>
<td>1.0 to 1.6</td>
<td>T Fe2</td>
</tr>
</tbody>
</table>
### Hardfacing - Heat Treated Steels for Tooling

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Composition [%] - Fe balance</th>
<th>Hardness 3 layers as welded</th>
</tr>
</thead>
<tbody>
<tr>
<td>HARDFACE WLC</td>
<td>C 0.25, Mn 2.00, Si 0.80, Cr 0.50, Mo 1.50, V 0.60, W 1.50</td>
<td>44 HRC</td>
</tr>
<tr>
<td>HARDFACE W</td>
<td>C 0.50, Mn 2.00, Si 0.80, Cr 0.50, Mo 1.50, V 0.60, W 1.50, Ni 1.80</td>
<td>55 HRC</td>
</tr>
<tr>
<td>HARDFACE VMOLC</td>
<td>C 0.08, Mn 1.00, Si 0.90, Cr 10.0, Mo 2.40, V 0.60, W 0.40, Ni 0.80</td>
<td>36 HRC</td>
</tr>
<tr>
<td>HARDFACE WM</td>
<td>C 0.30, Mn 0.30, Si 0.40, Cr 0.40, Mo 2.00, V 0.60, W 1.00, Ni 0.20</td>
<td>45 HRC</td>
</tr>
<tr>
<td>HARDFACE WMOLC</td>
<td>C 0.30, Mn 0.80, Si 0.60, Cr 0.50, Mo 0.80, V 0.60, W 0.20, Ni 0.40, Mn 0.40</td>
<td>52 HRC</td>
</tr>
<tr>
<td>HARDFACE R40</td>
<td>C 0.12, Mn 0.60, Si 0.50, Cr 0.20, Mo 0.80, V 0.40, W 1.00, Ti 0.30</td>
<td>40 HRC</td>
</tr>
<tr>
<td>HARDFACE R46</td>
<td>C 0.22, Mn 1.00, Si 0.50, Cr 0.50, Mo 6.80, V 0.30, W 2.00, Ti 0.30</td>
<td>55 HRC</td>
</tr>
<tr>
<td>HARDFACE RS8</td>
<td>C 0.35, Mn 1.20, Si 0.50, Cr 0.50, Mo 6.80, V 0.30, W 2.00, Ti 0.30</td>
<td>45 HRC</td>
</tr>
<tr>
<td>HARDFACE AR</td>
<td>C 1.10, Mn 0.40, Si 0.25, Cr 0.00, Mo 5.00, V 7.60, W 1.10, Ni 0.50, Co 12.5</td>
<td>60 HRC</td>
</tr>
<tr>
<td>HARDFACE DCO</td>
<td>C 0.15, Mn 0.40, Si 0.70, Cr 0.00, Mo 14.0, V 2.50, W 0.50, Ni 0.50, Co 12.5</td>
<td>47 HRC</td>
</tr>
</tbody>
</table>

**Description and applications**

- **Low cracking sensitivity**
- **Specially developed for rebuilding and buffering on very large components and alloyed steels**
- **Applications:** mill rolls, bell hoppers, seats in blast furnaces, mouds for light alloys, forging tools, etc.

- **Hard deposit (55 HRC) that keeps its properties over long periods of exposure up to 500°C**
- **Heat treatable self-hardening deposits**
- **Range of products designed for the construction and repair of hot working tooling:** forging, stamping and deburring dies

- **Resists thermal fatigue and high pressure**
- **Deposits can be polished**
- **Applications:** mouds for moulded glass or for pressure casting of light alloys and impact forging tools

- **Medium hardness deposit (46 HRC) offering exceptional oxidation resistance and hot toughness up to 600°C**
- **Applications:** as-welded hardness may be increased by tempering

- **Hard deposit (52 HRC) offering exceptional oxidation resistance and hot toughness up to 600°C**
- **A suitable heat treatment enables hardnesses up to 57 HRC to be reached**
- **Applications:** press tooling

- **Tough deposits with increasing hardness for touching up and repair of hot and cold working tooling**
- **Applications:** press tooling

- **Can be heat treated by oil quenching and tempering (40, 46 and 58 HRC)**
- **Applications:** plastic injection screws and mouds for polymers

- **Seamless copper coated tubular wire giving a tough high speed steel deposit**
- **Superalloy offering similar performance to cobalt based alloys**
- **High hardness deposit (65 HRC) that keeps its properties over 550°C**
- **Applications:** traction rollers in continuous casting installations, valves for diesel engines, steam valves, deburring stamps and dies, mouds for ceramic tiles, screws for filled plastic

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**HARDFACE – ROBODUR:** for a description of shielding gas and flux recommendations – see page 6

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**Hardfacing - Cladding - Thermal Arc Spraying**

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**SUITED TO THERMAL ARC SPRAYING**

- Suitable
- Highly suitable
### Hardfacing - Anti-abrasion

#### HARDFACE – ROBODUR : for a description of shielding gas and flux recommendations – see page 6

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Composition [%] - Fe balance</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
<td>Mn</td>
</tr>
<tr>
<td>HARDFACE BN</td>
<td>0.50</td>
<td>1.80</td>
</tr>
<tr>
<td>HARDFACE BNC</td>
<td>2.50</td>
<td>2.00</td>
</tr>
<tr>
<td>HARDFACE FC</td>
<td>5.00</td>
<td>1.00</td>
</tr>
<tr>
<td>HARDFACE HC</td>
<td>5.00</td>
<td>1.30</td>
</tr>
<tr>
<td>HARDFACE HC333</td>
<td>3.50</td>
<td>0.20</td>
</tr>
<tr>
<td>HARDFACE CN</td>
<td>5.00</td>
<td>0.50</td>
</tr>
<tr>
<td>HARDFACE CV</td>
<td>5.50</td>
<td>0.50</td>
</tr>
<tr>
<td>HARDFACE CNV</td>
<td>5.50</td>
<td>0.50</td>
</tr>
</tbody>
</table>

#### Description and applications

- **Ultra-hard single layer deposit designed to resist pure abrasion.** For welding on to unalloyed steels with C < 0.5%.
- **Applications:** equipment used in agriculture, quarrying, mining and civil engineering. Examples: screw conveyors, hoppers, stamper cutters, etc.

- **Ultra-hard deposit offering extremely high resistance to abrasion under high stresses and moderate impacts.**
- **Applications:** contains boron carbides of extreme hardness.
- **Applications:** screw conveyors, riddles for hot materials, fans, crushers, etc.

- **Chromium cast iron offering a good compromise in applications involving combined abrasion and impact.**
- **Examples:** crushers for soft materials, shredders, chemical and food processing industries.

- **Highly abrasion resistant chromium carbide deposit.**
- **Applications:** design of high performance composite parts such as wear plates, mineral conveying equipment, dredger pumps, mixers and riddle plates.

- **Highly alloyed chromium carbide deposit designed for single-layer hardfacing.**
- **Applications:** thin components or weight-limited parts such as continuous screws, fans, skips, buckets and mixer blades.

- **High concentration of niobium and chromium carbides.**
- **Very good wear resistance to fine abrasive particles of high hardness.**
- **Applications:** vertical cutters, armoring of conveyors for coal, striker and glass.

- **Highly alloyed chromium carbide based deposit with a high concentration of complex carbides.**
- **Resistant to combined abrasion and impacts at high temperatures.**
- **Applications:** thick deposits for sinter processing in steelmaking. Examples: drop zones, sinter stars, sinter bars, thermal treatment of metal areas.

- **Highly-alloyed chromium cast iron with a high concentration of complex carbides.**
- **Resists combined abrasion and impacts at high temperatures.**
- **Applications:** riddling, blast furnace hoppers, extractor fans.
Hardfacing - Anti-abrasion (continued)

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Composition [%] - Fe balance</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C  Mn  Si  Cr  V  Others 3 layers as welded</td>
<td>Hard phases [micro-hardness HV]</td>
</tr>
<tr>
<td>HARDFACE STEELCARBW</td>
<td>Composite deposit containing tungsten carbide particles in a steel matrix</td>
<td>WC : 50 to 60 according to Ø</td>
</tr>
<tr>
<td>HARDFACE NICARBW</td>
<td>Composite deposit containing tungsten carbide particles in a nickel-boron-silicon matrix</td>
<td>WC : 50 to 60 according to Ø</td>
</tr>
<tr>
<td>HARDFACE VN</td>
<td>5.00  0.50  1.20  22.5  10.0  Nb : 6.50</td>
<td>63 HRC</td>
</tr>
<tr>
<td>HARDFACE VNB</td>
<td>5.50  0.50  1.30  16.0  6.00  B : 1.00  Nb : 8.5  Ti : 5.00</td>
<td>66 HRC</td>
</tr>
<tr>
<td>HARDFACE TIC</td>
<td>1.80  1.20  0.80  6.50  0.20  Mo : 1.1  Ti : 5.00  Nb : 8.5  Ti : 0.2</td>
<td>57 HRC</td>
</tr>
<tr>
<td>HARDFACE 168NB</td>
<td>1.3  1.00  1.00  6.00</td>
<td>58 HRC</td>
</tr>
</tbody>
</table>

* Hardness Matrix

Moderate Impact (continued)

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Process O : open-arc  G : gas-shielded  S : sub-arc</th>
<th>Standard diameters [mm]</th>
<th>EN 14700 standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>HARDFACE STEELCARBW</td>
<td>O</td>
<td>1.6 to 2.8</td>
<td>T Fe20</td>
</tr>
<tr>
<td>HARDFACE NICARBW</td>
<td>G</td>
<td>1.6 to 2.8</td>
<td>T Ni20</td>
</tr>
<tr>
<td>HARDFACE VN</td>
<td>O</td>
<td>1.6 to 2.8</td>
<td>T Fe16</td>
</tr>
<tr>
<td>HARDFACE VNB</td>
<td>O</td>
<td>1.6 to 3.2</td>
<td>T Fe16</td>
</tr>
<tr>
<td>HARDFACE TIC</td>
<td>O/G</td>
<td>1.2 to 2.8</td>
<td>T Fe8</td>
</tr>
<tr>
<td>HARDFACE 168NB</td>
<td>O</td>
<td>1.6 to 2.8</td>
<td>T Fe8</td>
</tr>
</tbody>
</table>

**Suitable**  **Highly suitable**

**Description and applications**

- **HARDFACE STEELCARBW**
  - Composite wire filled with carbide particles
  - Fine tungsten carbide grains embedded in a martensitic matrix
  - Extreme resistance to abrasives, especially fine-grained. Examples: dust extractor fans in the mining, cement and steel industries, scraper blades, components for agriculture, etc

- **HARDFACE NICARBW**
  - Composite wire filled with carbide particles
  - Fine tungsten carbide grains embedded in a corrosion resistant nickel-based matrix
  - The surface roughens slightly under the effects of wear, which protects the deposit from attack by coarser particles
  - Applications: drilling, food processing, chemical, fertilizer and rubber industries

- **HARDFACE VN**
  - Chromium carbide type matrix with vanadium carbide particles dispersed uniformly throughout the deposit thickness
  - For improving abrasion resistance: Ideal complement to conventional chromium carbide deposits at the final pass or for local reinforcement
  - Applications: mixer blades, crusher component armouring, tile and brick making equipment

- **HARDFACE VNB**
  - Chromium cast iron containing complex niobium, vanadium and chromium carbides
  - Highest resistance to abrasion by scratching, even at high temperature
  - Applications: rotating excavator bucket, finge crushers-fans, homogenisers for coal or coke, equipment for the electro-metallurgical industry

- **HARDFACE TIC**
  - Tubular wire contains extremely hard finely dispersed titanium carbides
  - For improving abrasion resistance: Combination of abrasion, high pressure and impact
  - Exceptional weldability and ease of application
  - Applications: crushing of hard materials, shredders, asphalt kneaders, vertical shaft impact crusher rotors, roller pressers

- **HARDFACE 168NB**
  - Tubular wire for self-shielded metal arc welding, designed for hardfacing of items subjected to impact, gouging and abrasion under high stresses
  - Gives a highly abrasion-resistant crack-free deposit which may be machined despite its high hardness
  - Suitable for multi-layer deposits
  - Applications: crushing hammers and roller press, leading edges, teeth of excavator buckets and bulldozer blades, crusher cones

**Notes**

- Tubular wire contains extremely hard finely dispersed titanium carbides
- For improving abrasion resistance: Combination of abrasion, high pressure and impact
- Exceptional weldability and ease of application
- Applications: crushing of hard materials, shredders, asphalt kneaders, vertical shaft impact crusher rotors, roller pressers
- Tubular wire for self-shielded metal arc welding, designed for hardfacing of items subjected to impact, gouging and abrasion under high stresses
- Gives a highly abrasion-resistant crack-free deposit which may be machined despite its high hardness
- Suitable for multi-layer deposits
- Applications: crushing hammers and roller press, leading edges, teeth of excavator buckets and bulldozer blades, crusher cones

**Suitable**  **Highly suitable**

**Hardfacing - Cladding - Thermal Arc Spraying**
Shielding Gas and Flux Recommendations

**CHROMECORE**
- The recommended shielding gas are Argon + 2-18% CO₂ (M12-M21) and Argon + 2-3% Oxygen (M13)
- A neutral flux is required for submerged arc welding

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Composition [%] - Fe balance</th>
<th>Hardness</th>
<th>Description and applications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C Mn Si Cr Ni Mo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHROMECORE 430</td>
<td>0.08 0.90 0.70 17.5</td>
<td>220 HB</td>
<td></td>
</tr>
<tr>
<td>CHROMECORE 410</td>
<td>0.08 1.20 0.80 12.5</td>
<td>42 HRC</td>
<td></td>
</tr>
<tr>
<td>CHROMECORE 414</td>
<td>0.08 1.00 0.60 13.5 4.00 0.50</td>
<td>38 HRC</td>
<td></td>
</tr>
<tr>
<td>CHROMECORE 420</td>
<td>0.30 1.00 1.00 13.0</td>
<td>50 HRC</td>
<td></td>
</tr>
</tbody>
</table>

**Product Name**
- **CHROMECORE 430**
  - Process: open-arc
  - Composition: 0.08 C, 0.90 Mn, 0.70 Si, 17.5 Cr
  - Hardness: 220 HB
  - Description and applications: Suitable for hardfacing of continuous casting rolls, pulleys and rolls for port and waterway installations, hydraulic rams

**Product Name**
- **CHROMECORE 410**
  - Process: gas-shielded
  - Composition: 1.2 to 2.4 Fe, 1.2 to 2.4 Cr
  - Hardness: 42 HRC
  - Description and applications: Suitable for applications in mining and civil engineering

**Product Name**
- **CHROMECORE 414**
  - Process: open-arc
  - Composition: 1.00 C, 1.00 Si, 13.0 Cr
  - Hardness: 38 HRC
  - Description and applications: Suitable for applications in mining and civil engineering

**Product Name**
- **CHROMECORE 420**
  - Process: sub-arc
  - Composition: 1.2 to 2.4 Fe, 1.2 to 2.4 Cr
  - Hardness: 50 HRC
  - Description and applications: Suitable for applications in mining and civil engineering
## Hardfacing - Cupro-aluminium

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Process</th>
<th>Standard diameters [mm]</th>
<th>EN 14700 standard</th>
<th>Hardness 3 layers as welded</th>
<th>Description and applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>HARDFACE R40</td>
<td>G</td>
<td>1.2 and 1.6 T Cu1</td>
<td>•</td>
<td>150 HB</td>
<td>Low hardness, easily machined</td>
</tr>
<tr>
<td>HARDFACE W</td>
<td>G</td>
<td>1.2 and 1.6 T Cu1</td>
<td>•</td>
<td>210 HB</td>
<td>Usable over a wide temperature range</td>
</tr>
<tr>
<td>HARDFACE WMOLC</td>
<td>G</td>
<td>1.2 and 1.6 T Cu1</td>
<td>•</td>
<td>320 HB</td>
<td>Good resistant to hot friction</td>
</tr>
<tr>
<td>HARDFACE R46</td>
<td>G</td>
<td>1.2 and 1.6 T Cu1</td>
<td>•</td>
<td>40 HRC</td>
<td>Best combination of weldability and corrosion resistance for multi-layer deposits</td>
</tr>
<tr>
<td>CORBRONZE</td>
<td>G</td>
<td>1.2 and 1.6 T Cu1</td>
<td>•</td>
<td>55 HRC</td>
<td>Combines high hardness with resistance to marine corrosion</td>
</tr>
<tr>
<td>CORBRONZE</td>
<td>G</td>
<td>1.2 and 1.6 T Cu1</td>
<td>•</td>
<td>60 HRC</td>
<td>For parts undergoing friction under low pressure</td>
</tr>
<tr>
<td>CORBRONZE</td>
<td>G</td>
<td>1.2 and 1.6 T Cu1</td>
<td>•</td>
<td></td>
<td>For parts undergoing friction under medium pressure</td>
</tr>
<tr>
<td>CORBRONZE</td>
<td>G</td>
<td>1.2 and 1.6 T Cu1</td>
<td>•</td>
<td></td>
<td>For parts undergoing friction under high pressure</td>
</tr>
<tr>
<td>CORBRONZE CMA1</td>
<td>G</td>
<td>1.2 and 1.6 T Cu1</td>
<td>•</td>
<td></td>
<td>Best combination for resisting erosion, cavitation and corrosion</td>
</tr>
</tbody>
</table>

**Shielding Gas Recommendation**

**CORBRONZE**

- The recommended shielding gases are 100% Argon (11) and Argon + 10-50% Helium (13)

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Composition [%] - Cu balance</th>
<th>Hardness 3 layers as welded</th>
</tr>
</thead>
<tbody>
<tr>
<td>CORBRONZE 100</td>
<td>8.00 0.50 0.50 0.40</td>
<td>150 HB</td>
</tr>
<tr>
<td>CORBRONZE 201</td>
<td>9.00 0.50 3.50 0.40</td>
<td>210 HB</td>
</tr>
<tr>
<td>CORBRONZE 301</td>
<td>11.5 0.50 3.50 0.40</td>
<td>320 HB</td>
</tr>
<tr>
<td>CORBRONZE 202</td>
<td>9.00 1.00 2.00 4.80</td>
<td>210 HB</td>
</tr>
<tr>
<td>CORBRONZE 302</td>
<td>11.5 1.00 2.00 4.80</td>
<td>320 HB</td>
</tr>
<tr>
<td>CORBRONZE 204</td>
<td>9.00 4.00</td>
<td>210 HB</td>
</tr>
<tr>
<td>CORBRONZE 304</td>
<td>11.5 4.00</td>
<td>320 HB</td>
</tr>
<tr>
<td>CORBRONZE 404</td>
<td>13.5 4.00</td>
<td>420 HB</td>
</tr>
<tr>
<td>CORBRONZE CMA1</td>
<td>8.00 11.5 3.00 2.00</td>
<td>210 HB</td>
</tr>
</tbody>
</table>

**Composition [%]**

- Cu balance
- Ni : 0.20
- Ti : 0.25
- Mn : 0.50
- Fe : 0.50
- Co : 12.5
- Al : 8.00
- Ni : 1.80
- W : 1.50
- Mo : 8.00
- Cr : 9.00
- Si : 6.50
- Mn : 5.00
- Cu : 9.00
- Ni : 1.00
- Mn : 2.00
- Fe : 1.80
- Cr : 1.60
- Si : 1.00
- Mn : 1.50
- Cr : 0.50
- Ni : 0.30

**Product selection depending on the deposit**

- Range of products designed for the construction and repair of hot working tooling: forging, cutting, workpieces, heat treatable self-hardening deposits

**Heat treatable self-hardening deposits**

- Suitable heat treatment enables hardnesses up to 58 HRC to be reached
- Resistance and hot toughness up to 600°C

**Applications**

- Sealing seats, guides
- Suitable for cryogenic applications, valve shafts and seats, slideways
- Exceptional wear resistance in cold cutting operations
- Specially developed for rebuilding and buffering on very large components and alloyed steels
- Resists corrosion by oxidising acids and sea water
- Toughness may be increased by a suitable thermal treatment
- For parts undergoing friction under low pressure
- Applications: shafts, bushes
- For parts undergoing friction under medium pressure
- Applications: slideways, guide plates and rings, mandrel slides, collar flanges
- For parts undergoing friction under high pressure
- Applications: cold forming tools, punches and dies for stainless steel
- Best combination for resisting erosion, cavitation and corrosion
- Applications: ship propellers, mixer blades, pump rotors

**Suitable thermal treatment**

- Coarse grained structures
- High hardness
- High cracking resistance little affected by dillution
- Highly resistant to thermal shock
- May be polished and keeps its properties to 550°C
- Superalloy offering similar performance to cobalt based alloys
- Exceptional wear resistance in cold cutting operations
- Seamless copper coated tubular wire giving a tough high speed steel deposit

**Hardfacing - Cladding - Thermal Arc Spraying**

---

*- Suitable * Highly suitable
Joining Wires

Complementary nickel base wires for joining are presented in the joining catalogue.

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Composition [%] - Ni balance</th>
<th>Hardness - 3 layers</th>
</tr>
</thead>
<tbody>
<tr>
<td>STELLOY C 0.05</td>
<td>0.05 0.60 0.50 16.0 5.00 16.0 4.50</td>
<td>Co : 2.30 190 HB</td>
</tr>
<tr>
<td>STELLOY CCO 0.05</td>
<td>0.05 1.00 0.60 15.5 3.00 16.0 4.40</td>
<td>Co : 11.5 220 HB</td>
</tr>
<tr>
<td>STELLOY Ni 520</td>
<td>0.06 0.20 0.20 13.0 2.20 6.00 0.80</td>
<td>Co : 3.00 200 HB</td>
</tr>
<tr>
<td>STELLOY C 0.06</td>
<td>0.20 0.20 13.0 2.20 6.00 0.80</td>
<td>Co : 3.00 200 HB</td>
</tr>
<tr>
<td>STELLOY CCO 0.06</td>
<td>0.05 1.00 0.60 15.5 3.00 16.0 4.40</td>
<td>Co : 11.5 220 HB</td>
</tr>
<tr>
<td>STELLOY Ni 520</td>
<td>0.06 0.20 0.20 13.0 2.20 6.00 0.80</td>
<td>Co : 3.00 200 HB</td>
</tr>
</tbody>
</table>

Shielding Gas and Flux Recommendations

STELLOY (Nickel base)
- The recommended shielding gases are 100% Argon (I1) and Argon + 1-3% CO₂ (M12)
- A neutral flux is required for submerged arc welding

**Description and applications**

- Superalloy offering extreme resistance to high temperature stress and thermal shock
  - Recommended with buffer layer of STELLOY C
  - Applications: high speed forging tools, tube extrusion mandrels
- Superalloy offering extreme resistance to prolonged high temperature stress
  - Good resistance to corrosion, wear and high temperature oxidation
  - Applications: tube extrusion dies, extrusion tooling and forging dies
- Repair assembly, buffering, cladding and friction wear resistant coating
  - Suits for use between -190°C and +1050°C
  - Resistant to stress corrosion cracking in the presence of hydrogen sulphide
  - Recommended for buffering before cladding with STELLOY Ni520
  - Applications: pumps and valves for the chemical and petrochemical industries
Shielding Gas Recommendation

STELLOY (Cobalt base)
- The recommended shielding gas is 100% Argon (I1)
- Specific TIG versions available in diameter 1.2 mm and 1.6 mm.

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Composition [%] - Co balance</th>
<th>Hardness - 3 layers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
<td>Mn</td>
</tr>
<tr>
<td>STELLOY 25</td>
<td>0.15</td>
<td>1.50</td>
</tr>
<tr>
<td>STELLOY 21</td>
<td>0.25</td>
<td>1.50</td>
</tr>
<tr>
<td>STELLOY 6 BC</td>
<td>0.90</td>
<td>1.00</td>
</tr>
<tr>
<td>STELLOY 6 HC</td>
<td>1.20</td>
<td>1.00</td>
</tr>
<tr>
<td>STELLOY 12</td>
<td>1.50</td>
<td>1.00</td>
</tr>
<tr>
<td>STELLOY 1</td>
<td>2.30</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Description and applications

- Highly resistant to high temperature wear and metal-to-metal abrasion
- Particular ease of application due to its low cracking tendency
- Maintains a good level of hardness at high temperatures
- Applications: straightening guides, vertical mill rolls and foot rolls in continuous casting

- Ideal choice for resisting multiple combinations of stresses
- Resists corrosion and cavitation
- Maintains a good level of hardness at high temperatures
- Work-hardenable, can be polished, low coefficient of friction
- Applications: industrial valve work, forging dies and hot shearing blades

- Equivalent alloy to STELLOY 6 with lower carbon
- Easier machining and reduced cracking tendency
- Recommended for buffeting on large parts or for thick deposits

- Combines all the outstanding properties of the cobalt base alloys, including abrasion and erosion resistance
- Wide field of applications: hot shearing tools, petrochemical and industrial valves, valves and valve seats of marine engines, pump sleeves and shafts

- Equivalent alloy to STELLOY 6 with higher carbon
- Allows the required hardness to be obtained on low alloy steels from the first layer
- Applications: small valves and valve gates, extrusion dies

- Good resistance to abrasion by minerals on account of its high hardness
- Particularly suited to the production of cutting tools
- Applications: wood and paper industries, extrusion screws for filled plastic

- Highest hardness of the cobalt base alloy range, offering excellent resistance to abrasion and corrosion
- Self-polishing, promotes scratch free sliding of abrasive materials
- Applications: rubber kneaders

Product Name: STELLOY 25
- Process: O: open-arc, G: gas-shielded
- Standard diameters: 1.2 to 2.4
- EN 14700 standard: T Co

Product Name: STELLOY 21
- Process: O: open-arc, G: gas-shielded
- Standard diameters: 1.2 to 2.4
- EN 14700 standard: T Co1

Product Name: STELLOY 6 BC
- Process: G: gas-shielded
- Standard diameters: 1.2 to 2.4
- EN 14700 standard: T Co2

Product Name: STELLOY 6 HC
- Process: G: gas-shielded
- Standard diameters: 1.2 to 2.4
- EN 14700 standard: T Co2

Product Name: STELLOY 12
- Process: G: gas-shielded
- Standard diameters: 1.2 to 2.4
- EN 14700 standard: T Co2

Product Name: STELLOY 1
- Process: G: gas-shielded
- Standard diameters: 1.2 to 2.4
- EN 14700 standard: T Co3
## Cladding

### Product Name

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Process</th>
<th>Standard diameters [mm]</th>
<th>Standards</th>
<th>Mechanical Fatigue</th>
<th>Corrosion</th>
<th>Machinability</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRI S 307</td>
<td>G</td>
<td>1.2 to 3.2</td>
<td>EN ISO 17633-A</td>
<td>• • • • • • • • • • •</td>
<td>• • • • • • • • • • •</td>
<td>• • • • • • • • • • •</td>
</tr>
<tr>
<td>TRI S 312</td>
<td>G</td>
<td>1.6 to 2.4</td>
<td>EN 14700</td>
<td>• • • • • • • • • • •</td>
<td>• • • • • • • • • • •</td>
<td>• • • • • • • • • • •</td>
</tr>
<tr>
<td>TRI S 309L</td>
<td>G</td>
<td>1.2 to 2.4</td>
<td>EN 17633-A</td>
<td>• • • • • • • • • • •</td>
<td>• • • • • • • • • • •</td>
<td>• • • • • • • • • • •</td>
</tr>
<tr>
<td>TRI S 308L</td>
<td>G</td>
<td>1.2 to 2.4</td>
<td>EN 17633-A</td>
<td>• • • • • • • • • • •</td>
<td>• • • • • • • • • • •</td>
<td>• • • • • • • • • • •</td>
</tr>
<tr>
<td>TRI S 347L</td>
<td>G</td>
<td>1.6 to 2.4</td>
<td>EN 14700</td>
<td>• • • • • • • • • • •</td>
<td>• • • • • • • • • • •</td>
<td>• • • • • • • • • • •</td>
</tr>
<tr>
<td>TRI S 309LMo</td>
<td>G</td>
<td>1.6 to 2.4</td>
<td>EN 14700</td>
<td>• • • • • • • • • • •</td>
<td>• • • • • • • • • • •</td>
<td>• • • • • • • • • • •</td>
</tr>
<tr>
<td>TRI S 316L</td>
<td>G</td>
<td>1.2 to 2.4</td>
<td>EN 14700</td>
<td>• • • • • • • • • • •</td>
<td>• • • • • • • • • • •</td>
<td>• • • • • • • • • • •</td>
</tr>
</tbody>
</table>

### Description and applications

- **High elongation, work-hardenability and resistant to high temperatures**
- **Buffer layer before hardfacing on 12-14% manganese steel**
- **Buffer layer before cladding with 308L or 347**
- **Transition layer on 308L-clad steel**

- **Cladding of mild and low alloy steels**
- **Resists wear by friction and oxidation**
- **Applications: repair of gear teeth, sprockets, chain links**

- **Heat resistant cladding in 347 for the petrochemical industry**
- **Cladding of mild and low alloy steels**
- **Buffering before cladding with 316L and similar alloys**
- **Transition layer on 316L-clad steel**

- **Cladding of 308L in the chemical and petrochemical industries**
- **Buffering before cladding with 308L or 347**

### Product Name

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Composition [%] - Fe balance</th>
<th>Machinability</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRI S 307</td>
<td>0.100 6.50 0.80 19.0 8.20</td>
<td>• • • • • • • • • • •</td>
</tr>
<tr>
<td>TRI S 312</td>
<td>0.100 1.30 0.80 29.0 9.50 0.30</td>
<td>• • • • • • • • • • •</td>
</tr>
<tr>
<td>TRI S 309L</td>
<td>0.030 1.75 0.80 24.5 13.0</td>
<td>• • • • • • • • • • •</td>
</tr>
<tr>
<td>TRI S 308L</td>
<td>0.030 1.80 0.80 20.5 10.0</td>
<td>• • • • • • • • • • •</td>
</tr>
<tr>
<td>TRI S 347L</td>
<td>0.080 1.50 0.90 20.5 10.0 0.50</td>
<td>• • • • • • • • • • •</td>
</tr>
<tr>
<td>TRI S 309LMo</td>
<td>0.030 1.80 0.80 24.0 13.0 2.80</td>
<td>• • • • • • • • • • •</td>
</tr>
<tr>
<td>TRI S 316L</td>
<td>0.030 1.40 0.80 19.0 12.0 2.50</td>
<td>• • • • • • • • • • •</td>
</tr>
</tbody>
</table>
Our customers’ applications.

Welding Alloys is proud to bring ground-breaking hardfacing technology to our customers. By responding to the needs of our customers, and maintaining the quality and performance of our products, we ensure that we provide the best solution for their applications.

Since its foundation in 1966, the Welding Alloys Group has become the global specialist in the development and production of hardfacing, cladding and thermal arc spraying products. We design and manufacture a range of high performance cored wires and programmers for surfacing applications.

Shortages of raw materials are leading increasingly to the development of composite components, with performance and quality criteria becoming ever more stringent and requiring ever more complex materials. Using production machinery of our own design, Welding Alloys now designs and manufactures a range of high alloy content cored wires and programmers for surfacing applications.

Cored wires: The winning technology

Cored wires are the ideal solution for aspects such as thin layer anti-wear protection, for the bonding layer and rebuilding, or for the alloy with exothermic reaction. They were the first solution to offer welders the flexibility to vary the composition of the arc and to achieve excellent results with a consistent and higher degree of control.

Definitions and Using this catalogue

This catalogue presents a selection of standard products for hardfacing, cladding and thermal arc spraying applications. A selection of these products is identified in this catalogue by the thermal arc spraying symbol.

Wire Type

ALCORE – a composite metallic wire

HARDSPRAY – a metal cored wire

Packaging

Technical Information

- Suitable shielding gases (according to the standard EN 439) are recommended in decreasing order of preference
- Welding Alloys recommends fluxes suited for use with its submerged arc wires
- 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 international standard ISO 11014-1

Welding products and techniques evolve constantly. All descriptions, illustrations and properties given in this catalogue are subject to change and can only be considered as general guidance.
A perfectly controlled technology

WA Cored Wires™
Design and manufacture of all types of cored welding wires

WA MultiSurfacer™
Design and manufacture of automated welding equipment for hardfacing and rebuilding applications

WA Integra™ Services
Innovative hardfacing and rebuilding solutions by welding

A worldwide presence

United Kingdom
(Head office)
Welding Alloys Ltd

Argentina
Welding Alloys Argentina S.A.

Australia (Trading Partner)
Specialised Welding Products Pty Ltd

Brazil
Welding Alloys Brasil Ltda

China
Welding Alloys China Ltd

Egypt
Welding Alloys Egypt

Finland
Welding Alloys Finland Oy

France
Welding Alloys France SAS

Germany
Welding Alloys Deutschland GmbH

Greece
Welding Alloys Hellas EPE

India
Welding Alloys South Asia Pvt Ltd

Italy
Welding Alloys Italiana s.r.l.

Japan
Welding Alloys Japan

Malaysia
Welding Alloys (Far East) Sdn. Bhd.

Mexico
Welding Alloys Panamericana S.A. de C.V.

Morocco
Welding Alloys Maroc Sàrl

Poland
Welding Alloys Polska Sp. z o.o.

Russia
ZAO Welding Alloys

South Africa
WASA (PTY) Ltd

South Korea
Welding Alloys Korea Ltd

Spain
Welding Alloys España

Sweden
Welding Alloys Sweden

Taiwan
Welding Alloys Taiwan Co.

Thailand
Welding Alloys (Thailand) Co. Ltd

Turkey
Welding Alloys Limited Şirketi

Ukraine
Welding Alloys Ukraine

United Arab Emirates
Welding Alloys Middle East FZC

USA
Welding Alloys (USA) Inc.

Vietnam
Welding Alloys Vietnam Co. Ltd.

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