TUNGSTEN ELECTRODES
Alloy elements

Thorium oxides  Zirkonium oxides  Lanthan oxides  Cerium oxides

$\text{ThO}_2$  $\text{ZrO}_2$  $\text{La}_2\text{O}_3$  $\text{CeO}_2$

Rare materials ??????????????????????????????

Why Tungsten alloys?

• To improve the fusion point
• To improve ignition properties
• To improve arc control
• To avoid contamination of weld pool
Tungsten

Chemical designation = W
Density = 19.3 g/cm³
Fusion point = 3,380° C
Boiling point = 6,000° C

Unalloyed Tungsten (Pure Tungsten)

• Designation = W
• Colour code = Green

Advantages
• AC welding, fine arc control

Disadvantages
• DC welding. Very poor ignition properties and arc control
• Tendency towards dropping Tungsten particles into the weld pool in connection with ignition
Thorium alloy Tungsten

- Designation = WT 10 = 0.9 - 1.2 % thorium oxide
- Colour code = Yellow
- Designation = WT 20 = 1.8 - 2.2 % thorium oxide
- Colour code = Red
- Designation = WT 30 = 2.8 - 3.2 % thorium oxide
- Colour code = Lilac
- Designation = WT 40 = 3.8 - 4.2 % thorium oxide
- Colour code = Orange

Advantages

- DC welding
- When contents of Thorium oxide increase, electrical resistance will decline whereby the electron liberation will improve
- This improves ignition properties, lifetime and current load, at the same time the fusion point increases
- High fusion point (approx. 3,600° C for WT 20)

Disadvantages

- Poor ability to establish a shiny surface on the electrode point in traditional AC welding which means flickering arc. At the same time there is a tendency towards Tungsten particles in the weld pool
- Tendency towards slagging in DC welding
- Not environmentally friendly since Thorium gives off radio activity during grinding of electrodes
Zirconium alloy
Tungsten

- Designation = WZ 4 = 0.3 - 0.5 % zirconium oxide
- Colour code = Brown

- Designation = WZ 8 = 0.7 - 0.9 % zirconium oxide
- Colour code = White

Advantages
- AC welding
- No dropping of Tungsten particles into the weld pool

Disadvantages
- Poorer ignition properties than pure Tungsten electrodes (W = green).
Lanthan alloy Tungsten

- Designation = WL 10 = 0.9 - 1.2 % lanthan oxide
- Colour code = Black

- Designation = WL 20 = 1.8 - 2.2 % lanthan oxide
- Colour code = Blue

Advantages

- Both AC and DC welding
- No tendency towards slagging
- Longer lifetime than WT electrodes
- Produces a shiny surface in AC welding
- Higher fusion point than W-electrodes (3600°C for WL 10)
- No dropping Tungsten particles into the weld pool in connection with AC welding ignition.

Disadvantages

- WL 10 (Lanthanated) cannot be loaded as much as WC (Ceriated) electrodes as on ignition they start to drop Tungsten particles into the weld pool, since they have a lower fusion point than WC electrodes.
Cerium alloy Tungsten

- Designation = WC 10 = 0.8 - 1.2 % cerium oxide
- Colour code = Pink

- Designation = WC 20 = 1.8 - 2.2 % cerium oxide
- Colour code = Grey

Advantages
- Both AC and DC welding
- No tendency towards slagging
- Fine ignition properties

Disadvantages
- DC welding causes more wear on electrodes than WL 20 (blue)
Tungsten alloy with rare materials

- Designation = WS 2 = ? % rare materials
- Colour code = Turquoise

Advantages

- Both AC and DC welding
- Smaller tendency towards slagging than WT (Thoriated)
- AC welding produces a shiny surface on the electrode point

Disadvantages

- No details on chemical content
- DC welding causes more wear on electrodes than WL 20 (blue)
Grinding of Tungsten

Grinding grooves must always follow the longitudinal direction of the electrode.
Pointing angles

- A small pointing angle gives a wide weld pool
- A large pointing angle gives a narrow weld pool
- Only for machine welding with Argon shielding gas.

$D$ smaller than 2.5 mm

$D$ larger than 2.5 mm

Approx. 2D

Approx. 1.5D
Pointing angles

For machine welding it is an advantage to grind the electrode point in order to prolong the lifetime.
Handling of Tungsten electrodes

Breaking a Tungsten electrode by hand has always been forbidden. The electrode should always be cut or ground, a very slow and expensive process, however, which the welder has often turned his blind eye to. That is why suppliers of electrodes have tried to solve this problem.

Formerly, welders were always provided with unannealed Tungsten electrodes, which are very soft (flexible). Unfortunately, there will be longitudinal cracks if the electrode is broken, which will result in a very unstable and flickering arc. In recent years it has been possible to buy annealed Tungsten electrodes which, however, are very brittle and will easily fly to pieces if you break them. The electrodes may even burst if you drop a storage cabinet with electrodes on a concrete floor or the like.

Annealed electrodes are the most frequently sold type of electrode in Europe, and unless you specifically order unannealed Tungsten electrodes, you will be supplied with annealed electrodes.
Test period: week 52, 1997

Participants:
Niels-Jørgen Christiansen, AMU Center, Randers
Stig Jensen, Migatronic

Tests were carried out to demonstrate whether there are any types of Tungsten electrodes available that can be used as alternatives to pure Tungsten electrodes for AC welding and Thorium alloy Tungsten electrodes for DC welding (the latter give off a little radioactivity during grinding).

We also hoped to find a type of electrode that would be suitable for both AC and DC welding which would allow welders to use just one type of electrodes instead of two or three types.

Tests were carried out with a view to demonstrating the difference between re-ignition properties and lifetimes (wear of electrodes) in the case of welding stainless steel and aluminium with Tungsten electrodes of different alloys (see table).

Tests were carried out on standard AC/DC machines. Please note that test results (such as current intensity, re-ignition properties (HF), (ACt-balance), (ACi-balance), (current frequency) and (electrode preheating) may be different if other welding machines and shielding gases are used.

All AC tests were carried out on a Migatronic Commander with the following settings:

- ACt-balance: 65%
- ACi-balance: 0 = neutral
- Frequency: 50 Hz
- Electrode preheating: 0 = neutral

This test method can be used by individual works for comparing two or more types of Tungsten electrodes by using the welding machines available and the current intensities and other settings used for the relevant welding operations.
# CURRENT LOAD OF TUNGSTEN ELECTRODES

<table>
<thead>
<tr>
<th>Welding current: DC⁺</th>
<th>Gas: Argon 10 l/min.</th>
<th>Electrode dia.: 1.6 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope up: 0</td>
<td>Slope down: 4 secs.</td>
<td>Electrode point: 20°</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of electrode</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green: WP</td>
<td>Pure Tungsten</td>
</tr>
<tr>
<td>Red: WT 20</td>
<td>2% Thorium oxide</td>
</tr>
<tr>
<td>Orange: WT 40</td>
<td>4% Thorium oxide</td>
</tr>
<tr>
<td>Grey: WC 20</td>
<td>2% Cerium oxide</td>
</tr>
<tr>
<td>Black: WL 10</td>
<td>1% Lanthan oxide</td>
</tr>
<tr>
<td>Blue: WL 20</td>
<td>2% Lanthan oxide</td>
</tr>
<tr>
<td>Turquoise: WS 2</td>
<td>?% Rare materials</td>
</tr>
</tbody>
</table>
Welding current: AC 50 Hz
Shielding gas: Argon
Parent material: AIMg 2.5

Blue: WL 20 2% Lanthan oxide. Load 240 A
Red: WT 20 2% Thorium oxide. Load 260 A
Green: WP Pure Tungsten. Load 200 A
Grey: WC 20 2% Cerium oxide. Load 280 A
Black: WL 10 1% Lanthan oxide. Load 280 A
Turquoise: WS 2 ?% Rare materials. Load 280 A
Orange: WT 40 4% Thorium oxide. Load 240 A

Illustration no. 1
**CURRENT LOAD OF TUNGSTEN ELECTRODES**

**Welding current:** AC 50 Hz  **Gas:** Argon 12 l/min.  **Parent mat.:** AlMg 2.5

<table>
<thead>
<tr>
<th>Slope up: 0</th>
<th>Slope down: 4 secs.</th>
<th>Electrode point: 70°</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACt: 65% -</td>
<td>Electrode dia.: 2.4 mm</td>
<td>Elec. dist. to workpiece: 3 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of electrode</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue: WL 20</td>
<td>2% Lanthan oxide</td>
</tr>
<tr>
<td></td>
<td>The point forms a small, shiny ball at 150 amp. A ball with dia. like elec. is formed at 180 amp. Drops Tungsten at 220 amp. Arc becomes unstable at 240 amp.</td>
</tr>
<tr>
<td>Red: WT 20</td>
<td>2% Thorium oxide</td>
</tr>
<tr>
<td></td>
<td>The point gets a coarse structure at 100 amp. Drops Tungsten at 220 amp. Arc becomes unstable at 260 amp.</td>
</tr>
<tr>
<td>Green: WP</td>
<td>Pure Tungsten</td>
</tr>
<tr>
<td></td>
<td>The point forms a small, shiny ball at 50 amp. A ball with dia. like elec. is formed at 80 amp. The ball gets a larger dia. than elec. at 140 amp. Drops Tungsten at 200 amp. Arc becomes unstable at 200 amp.</td>
</tr>
<tr>
<td>Grey: WC 20</td>
<td>2% Cerium oxide</td>
</tr>
<tr>
<td></td>
<td>The point forms a small, shiny ball at 100 amp. A ball with dia. like elec. is formed at 180 amp. Drops Tungsten at 260 amp. Arc becomes unstable at 280 amp.</td>
</tr>
<tr>
<td>Black: WL 10</td>
<td>1% Lanthan oxide</td>
</tr>
<tr>
<td></td>
<td>The point forms a small, shiny ball at 100 amp. A ball with dia. like elec. is formed at 200 amp. Drops Tungsten at 260 amp. Arc becomes unstable at 280 amp.</td>
</tr>
<tr>
<td>Turquoise: WS 2</td>
<td>7% Rare materials</td>
</tr>
<tr>
<td></td>
<td>The point forms a small, shiny ball at 100 amp. A ball with dia. like elec. is formed at 160 amp. Drops Tungsten at 260 amp. Arc becomes unstable at 280 amp.</td>
</tr>
<tr>
<td>Orange: WT 40</td>
<td>4% Thorium oxide</td>
</tr>
<tr>
<td></td>
<td>The point forms a small, shiny ball at 100 amp. The point gets a coarse structure at 140 amp. Drops Tungsten at 200 amp. Arc becomes unstable at 240 amp.</td>
</tr>
<tr>
<td>Lilac: WT 30</td>
<td>3% Thorium oxide</td>
</tr>
<tr>
<td></td>
<td>(not illustrated)</td>
</tr>
<tr>
<td></td>
<td>The point forms a small, shiny ball at 100 amp. A ball with dia. like elec. is formed at 160 amp. Drops Tungsten at 260 amp. Arc becomes unstable at 260 amp.</td>
</tr>
</tbody>
</table>

*See illustration no. 1*
Welding current: AC 50 Hz
Shielding gas: Ar/He 70/30
Parent material: AlMg 2.5

Red: WT 20 2% Thorium oxide. Load 260 A
Green: WP Pure Tungsten. Load 180 A
Grey: WC 20 2% Cerium oxide. Load 240 A
Black: WL 10 1% Lanthan oxide. Load 220 A
Turquoise: WS 2 ?% Rare material. Load 220 A
Orange: WT 40 4% Thorium oxide. Load 260 A

Illustration no. 2
### CURRENT LOAD OF TUNGSTEN ELECTRODES

**Welding current:** AC 50 Hz  
**Gas:** Ar/He 70/30 12 l/min.  
**Parent mat.:** AlMg 2.5

<table>
<thead>
<tr>
<th>Type of electrode</th>
<th>Comments</th>
</tr>
</thead>
</table>
| **Red: WT 20**   | 2% Thorium oxide  
The point gets a coarse structure at 80 amp.  
A ball with dia. like elec. is formed at 140 amp.  
Burns down on one side at 200 amp.  
Drops Tungsten at 260 amp.  
Arc becomes unstable at 260 amp. |
| **Green: WP**    | Pure Tungsten  
The point forms a small ball at 30 amp.  
A ball with dia. like elec. is formed at 60 amp.  
The ball gets a larger dia. than elec. at 100 amp.  
Drops Tungsten at 180 amp.  
Arc becomes unstable at 180 amp. |
| **Grey: WC 20**  | 2% Cerium oxide  
The point forms a small ball at 90 amp.  
A ball with dia. like elec. is formed at 160 amp.  
The ball does not get a larger dia. than elec.  
Drops Tungsten at 220 amp.  
Arc becomes unstable at 240 amp. |
| **Black: WL 10** | 1% Lanthan oxide  
The point forms a small ball at 80 amp.  
A ball with dia. like elec. is formed at 160 amp.  
The ball does not get a larger dia. than elec.  
Drops Tungsten at 220 amp.  
Arc becomes unstable at 220 amp. |
| **Turquoise: WS 2** | 2% Rare materials  
The point forms a small ball at 80 amp.  
A ball with dia. like elec. is formed at 160 amp.  
The ball does not get a larger dia. than elec.  
Drops Tungsten at 220 amp.  
Arc becomes unstable at 220 amp. |
| **Orange: WT 40** | 4% Thorium oxide  
The point gets a coarse structure at 80 amp.  
A ball with dia. like elec. is formed at 140 amp.  
Burns down on one side at 220 amp.  
Drops Tungsten at 260 amp.  
Arc becomes unstable at 260 amp. |
| **Blue: WL 20**  | 2% Lanthan oxide  
(not illustrated)  
The point forms a small ball at 70 amp.  
A ball with dia. like elec. is formed at 130 amp.  
The ball does not get a larger dia. than elec.  
Drops Tungsten at 200 amp.  
Arc becomes unstable at 240 amp. |

See illustration no. 2
Welding current: AC 200 A 50 Hz
Shielding gas: Argon
Parent material: AIMg 2,5
Load: 50 re-ignitions at 200 A

Illustration no. 3
### Tungsten re-ignition properties

#### MIGATRONIC COMMANDER 320 AC/DC

<table>
<thead>
<tr>
<th>Type of electrode</th>
<th>After 10 ignitions</th>
<th>After 20 ignitions</th>
<th>After 30 ignitions</th>
<th>After 40 ignitions</th>
<th>After 50 ignitions</th>
<th>Total evaluation</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue: WL 20 2% Lanthan</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F+</td>
<td>Very fine ignition, produces a shiny ball with the same dia. as the electrode diameter. Electrode was tested at 180 amp, because the peak load is lower than for other electrodes.</td>
</tr>
<tr>
<td>Red: WT 20 2% Thorium</td>
<td>FI</td>
<td>FI/DT</td>
<td></td>
<td></td>
<td></td>
<td>F</td>
<td>Stops after 20 ignitions, since large quantities of Tungsten are dropped into the weld pool. Very coarse structure of the point after a few stitch weldings.</td>
</tr>
<tr>
<td>Green: WP Pure Tungsten</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F+</td>
<td>Very fine ignition, but produces a shiny and vibrating ball much larger than the electrode diameter. The reason may be the almost maximum load of the electrode.</td>
</tr>
<tr>
<td>Grey: WC 20 2% Cerium</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F</td>
<td>Fine ignition, produces a shiny ball which is a little larger than the electrode diameter, but a little asymmetric.</td>
</tr>
<tr>
<td>Black: WL 10 1% Lanthan</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F</td>
<td>Fine ignition, produces a shiny ball which is a little larger than the electrode diameter, but a little asymmetric.</td>
</tr>
<tr>
<td>Turquoise: WS 2 7% Rare materials</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F</td>
<td>Fine ignition, produces a shiny ball which is a little larger than the electrode diameter, but a little asymmetric.</td>
</tr>
<tr>
<td>Orange: WT 40 4% Thorium</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F</td>
<td>Fine ignition, but after a few stitch weldings the structure of the point becomes extremely coarse, causing an unstable arc.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Shielding gas: Ar</td>
<td>Gas quantity: 10 l/min.</td>
<td>Elect.dist. to workpiece: 3 mm</td>
<td>Electrode diameter: 2.4 mm</td>
<td>Electrode point: 90°</td>
</tr>
</tbody>
</table>

FI = Fine Ignition  
PI = Poor Ignition  
UA = Unstable Arc  
T = Tungsten  
NP = No Point  
S = Slag  
DT = Drops Tungsten  
P = Poor  M = Mean  F = Fine

See illustration no. 3
Welding current: DC+  
Shielding gas: Argon  
Parent material: Stainless steel AISI  
Load: 50 re-ignitions at 100 A  

Blue: WL 20 2% Lanthan oxide  
Red: WT 20 2% Thorium oxide  
Green: WP Pure Tungsten  
Grey: WC 20 2% Cerium oxide  
Black: WL 10 1% Lanthan oxide  
Turquoise: WS 2 ?% Rare materials  
Orange: WT 40 4% Thorium oxide
<table>
<thead>
<tr>
<th>Type of electrode</th>
<th>After 10 ignitions</th>
<th>After 20 ignitions</th>
<th>After 30 ignitions</th>
<th>After 40 ignitions</th>
<th>After 50 ignitions</th>
<th>Total evaluation</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue: WL 20 2% Lanthan</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F</td>
<td>Stable arc. The point remains intact.</td>
</tr>
<tr>
<td>Red: WT 20 2% Thorium</td>
<td>FI</td>
<td>A little S</td>
<td>FI</td>
<td>A little S</td>
<td>FI</td>
<td>S</td>
<td>FI</td>
</tr>
<tr>
<td>Green: WP Pure Tungsten</td>
<td>MI UA</td>
<td>MI UA</td>
<td>MI UA</td>
<td>MI UA</td>
<td>MI UA</td>
<td>M</td>
<td>After a few ignitions the point was dropped. Ignoites up in the gas nozzle. Very unstable arc.</td>
</tr>
<tr>
<td>Grey: WC 20 2% Cerium</td>
<td>FI</td>
<td>A little S</td>
<td>FI</td>
<td>A little S</td>
<td>FI</td>
<td>S</td>
<td>FI</td>
</tr>
<tr>
<td>Black: WL 10 1% Lanthan</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F</td>
<td>Stable arc. The point remains intact.</td>
</tr>
<tr>
<td>Turquoise: WS 2 2% Rare materials</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>A little S</td>
<td>FI</td>
<td>A little S</td>
<td>FI</td>
</tr>
<tr>
<td>Orange: WT 40 4% Thorium</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>A little S</td>
<td>FI</td>
<td>S</td>
<td>FI</td>
</tr>
</tbody>
</table>

Welding time: 10 secs.  
Idle period: 10 secs.  
Welding current: 100 amp DC+  
AC t. balance:  
Frequency:  
Gas pre flow: 1 sec.  
Slope up: 0 sec.  
Slope down: 2 secs.  
Gas post flow: 10 secs.  
Gas nozzle: no. 8 with gas lens  
Shielding gas: Ar.  
Gas quantity: 10 l/min.  
Elect. distance to workpiece: 3 mm  
Electrode diameter: 1.6 mm  
Electrode point: 20°  

Fl = Fine Ignition  
MI = Mean Ignition  
PI = Poor Ignition  
UA = Unstable Arc  
NP = No Point  
S = Slag  
DT = Drops Tungsten  
P = Poor  M = Mean  F = Fine
Welding current: DC+ 80 A
Shielding gas: Ar/H₂ 97.3
Parent material: Stainless steel AISI 304
Load: 6 x 5 min. at 80 A

Blue: WL 20 2% Lanthan oxide

Red: WT 20 2% Thorium oxide

Green: WP Pure Tungsten

Grey: WC 20 2% Cerium oxide

Black: WL 10 1% Lanthan oxide

Turquoise: WS 2 ?% Rare materials

Orange: WT 40 4% Thorium oxide

Illustration no. 5
# Lifetime of Tungsten Electrodes

<table>
<thead>
<tr>
<th>Welding current: DC÷ 80 A</th>
<th>Shielding gas: Ar/H₂ 97/3</th>
<th>Parent mat.: Stainless steel AISI 304</th>
</tr>
</thead>
<tbody>
<tr>
<td>FI = Fine Ignition</td>
<td>PI = Poor Ignition</td>
<td>UA = Unstable Arc</td>
</tr>
<tr>
<td>NP = No Point</td>
<td>S = Slag</td>
<td>T = Tungsten</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of electrode</th>
<th>5 min.</th>
<th>10 min.</th>
<th>15 min.</th>
<th>20 min.</th>
<th>25 min.</th>
<th>30 min.</th>
<th>Total evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue: WL 20</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F+</td>
</tr>
<tr>
<td>Red: WT 20</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>DT</td>
<td>FI</td>
<td>FI</td>
<td>M</td>
</tr>
<tr>
<td>Green: WP</td>
<td>PI</td>
<td>PI/NP</td>
<td>PI/NP</td>
<td>PI/NP</td>
<td>PI/NP</td>
<td>PI/NP</td>
<td>P</td>
</tr>
<tr>
<td>Grey: WC20</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>PI</td>
<td>PI</td>
<td>F-</td>
</tr>
<tr>
<td>Black: WL10</td>
<td>FI</td>
<td>FI-</td>
<td>FI-</td>
<td>FI-</td>
<td>FI-</td>
<td>FI-</td>
<td>M+</td>
</tr>
<tr>
<td>Turquoise: WS 2</td>
<td>FI</td>
<td>PI</td>
<td>PI/NP</td>
<td>DT/NP</td>
<td>DT/NP</td>
<td>DT/NP</td>
<td>P</td>
</tr>
<tr>
<td>Orange: WT 40</td>
<td>FI</td>
<td>FI</td>
<td>FI/S</td>
<td>FI/S</td>
<td>FI/S</td>
<td>FI/S</td>
<td>P</td>
</tr>
</tbody>
</table>

Welding time: 5 min.  
Idle period: 15 secs.  
Welding current: 80 amp DC÷  
Gas pre flow: 1 sec.  
Gas post flow: 4 secs.  
Slope down: 4 secs.  
Slope up: 2 secs.  
Gas nozzle: no. 8 with gas lens  
Shielding gas: Ar/H₂ 97/3  
Shielding gas quantity: 10 l/min.  
Electrode dist. to workpiece: 4 mm  
Electrode diameter: 1.6 mm  
Electrode point: 20°  
Parent material: AISI 304  

See illustration no. 5
Welding current: DC+ 100 A
Shielding gas: Argon
Parent material: Stainless steel AISI 304
Load: 6 x 5 min. at 80 A

Blue: WL 20 2% Lanthan oxide
Red: WT 20 2% Thorium oxide
Green: WP Pure Tungsten
Grey: WC 20 2% Cerium oxide
Black: WL 10 1% Lanthan oxide
Turquoise: WS 2 ?% Rare materials
Orange: WT 40 4% Thorium oxide

Illustration no. 6
# Lifetime of Tungsten electrodes

<table>
<thead>
<tr>
<th>Type of electrode</th>
<th>5 min.</th>
<th>10 min.</th>
<th>15 min.</th>
<th>20 min.</th>
<th>25 min.</th>
<th>30 min.</th>
<th>Total evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue: WL 20</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F+</td>
</tr>
<tr>
<td>Blue: WL 20</td>
<td>2% Lanthan oxide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red: WT 20</td>
<td>FI</td>
<td>PI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>M</td>
</tr>
<tr>
<td>Red: WT 20</td>
<td>2% Thorium oxide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green: WP</td>
<td>FI</td>
<td>PI</td>
<td>PI</td>
<td>PI</td>
<td>PI/NP UA</td>
<td>PI/NP UA</td>
<td>P</td>
</tr>
<tr>
<td>Green: WP</td>
<td>Pure Tungsten</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grey: WC20</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F</td>
</tr>
<tr>
<td>Grey: WC20</td>
<td>2% Cerium oxide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black: WL10</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F+</td>
</tr>
<tr>
<td>Black: WL10</td>
<td>1% Lanthan oxide</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Turquoise: WS 2</td>
<td>FI</td>
<td>PI</td>
<td>FI</td>
<td>PI</td>
<td>PI</td>
<td>PI</td>
<td>M</td>
</tr>
<tr>
<td>Turquoise: WS 2</td>
<td>2% Rare materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orange: WT 40</td>
<td>FI/S</td>
<td>FI/S</td>
<td>FI/S</td>
<td>FI/S</td>
<td>FI/S</td>
<td>FI/S</td>
<td>P</td>
</tr>
<tr>
<td>Orange: WT 40</td>
<td>4% Thorium oxide</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Welding time: 5 min.  Idle period: 15 secs.
Welding current: 100 amp DC÷  Pre-gas flow: 1 sec.  Post-gas flow: 10 secs.
Slope down: 4 secs.  Slope up: 2 secs.  Gas nozzle: no. 8 with gas lens
Shielding gas: Ar.  Shielding gas quantity: 10 l/min.  Electro. dist. to workpiece: 4 mm
Electrode diameter: 1.6 mm  Electrode point: 20°  Parent material: AISI 304

See illustration no. 6
Welding current: AC 170 A
Shielding gas: Ar/He 70/30
Parent material: AIMgSi 0.3
Load: 6 x 5 min. at 170 A
# Lifetime of Tungsten Electrodes

<table>
<thead>
<tr>
<th>Type of Electrode</th>
<th>5 min.</th>
<th>10 min.</th>
<th>15 min.</th>
<th>20 min.</th>
<th>25 min.</th>
<th>30 min.</th>
<th>Total Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blue: WL 20</strong></td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F+</td>
</tr>
<tr>
<td>2% Lanthan oxide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Red: WT 20</strong></td>
<td>FI / S</td>
<td>FI / S</td>
<td>FI / S</td>
<td>FI / S</td>
<td>FI / S</td>
<td>FI / S</td>
<td>P</td>
</tr>
<tr>
<td>2% Thorium oxide</td>
<td>DT</td>
<td>DT</td>
<td>DT</td>
<td>DT</td>
<td>DT</td>
<td>DT</td>
<td></td>
</tr>
<tr>
<td><strong>Green: WP</strong></td>
<td>FI</td>
<td>FI</td>
<td>FI UA</td>
<td>FI UA</td>
<td>FI UA</td>
<td>FI UA</td>
<td>F-</td>
</tr>
<tr>
<td>Pure Tungsten</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grey: WC 20</strong></td>
<td>FI</td>
<td>a little S</td>
<td>a little S</td>
<td>a little S</td>
<td>a little S</td>
<td>a little S</td>
<td>F+</td>
</tr>
<tr>
<td>2% Cerium oxide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Black: WL 10</strong></td>
<td>FI a little S</td>
<td>FI a little S</td>
<td>FI a little S</td>
<td>FI a little S</td>
<td>FI a little S</td>
<td>FI a little S</td>
<td>F+</td>
</tr>
<tr>
<td>1% Lanthan oxide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Turquoise: WS 2</strong></td>
<td>FI</td>
<td>FI UA</td>
<td>FI/UA a little S</td>
<td>FI/UA a little S</td>
<td>FI/UA a little S</td>
<td>FI/UA a little S</td>
<td>M</td>
</tr>
<tr>
<td>??% Rare materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Orange: WT 40</strong></td>
<td>FI / S</td>
<td>FI / S</td>
<td>FI / S</td>
<td>FI / S</td>
<td>FI / S</td>
<td>FI / S</td>
<td>P</td>
</tr>
<tr>
<td>4% Thorium oxide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Welding time: 5 min.  
Idle period: 15 secs.  
Welding current: 170 amp AC  
Gas pre flow: 1 sec.  
Gas post flow: 10 secs.  
Slope down: 5 secs.  
Slope up: 2 secs.  
Gas nozzle: no. 8 with gas lens  
Shielding gas: Ar/He 70/30  
Shielding gas quantity: 12 l/min.  
Electrode dist. to workpiece: 3 mm  
Electrode diameter: 2.4 mm  
Electrode point: 70°  
Parent material: AlMgSi 0.3

See illustration no. 7
<table>
<thead>
<tr>
<th>Color</th>
<th>Code</th>
<th>Weight</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>WL</td>
<td>2%</td>
<td>Lanthan oxide</td>
</tr>
<tr>
<td>Red</td>
<td>WT</td>
<td>2%</td>
<td>Thorium oxide</td>
</tr>
<tr>
<td>Green</td>
<td>WP</td>
<td>Pure Tungsten</td>
<td></td>
</tr>
<tr>
<td>Grey</td>
<td>WC</td>
<td>2%</td>
<td>Cerium oxide</td>
</tr>
<tr>
<td>Black</td>
<td>WL</td>
<td>1%</td>
<td>Lanthan oxide</td>
</tr>
<tr>
<td>Turquoise</td>
<td>WS</td>
<td>2%</td>
<td>Rare materials</td>
</tr>
<tr>
<td>Orange</td>
<td>WT</td>
<td>4%</td>
<td>Thorium oxide</td>
</tr>
</tbody>
</table>

**Welding current:** AC 190 A  
**Shielding gas:** Argon  
**Parent material:** AIMgSi 0.3  
**Load:** 6 x 5 min. at 190 A

*Illustration no. 8*
# Lifetime of Tungsten electrodes

<table>
<thead>
<tr>
<th>Type of electrode</th>
<th>5 min.</th>
<th>10 min.</th>
<th>15 min.</th>
<th>20 min.</th>
<th>25 min.</th>
<th>30 min.</th>
<th>Total evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue: WL 20 2% Lanthan oxide</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F+</td>
<td></td>
</tr>
<tr>
<td>Red: WT 20 2% Thorium oxide</td>
<td>FI/UA</td>
<td>FI/UA</td>
<td>DT</td>
<td>FI/UA</td>
<td>DT/S</td>
<td>FI/UA</td>
<td>DT/S</td>
</tr>
<tr>
<td>Green: WP Pure Tungsten</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Grey: WC 20 2% Cerium oxide</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>Black: WL 10 1% Lanthan oxide</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F+</td>
<td></td>
</tr>
<tr>
<td>Turquoise: WS2 5% Rare materials</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>Orange: WT40 4% Thorium oxide</td>
<td>FI/S</td>
<td>FI/S</td>
<td>DT</td>
<td>FI/S</td>
<td>DT</td>
<td>FI/S</td>
<td>DT</td>
</tr>
<tr>
<td>Light blue: Multistrike (not illustrated)</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>FI</td>
<td>F</td>
<td></td>
</tr>
</tbody>
</table>

Welding current: AC 190 A  
Gas: Argon  
Parent mat.: AlMgSi 0.3

- Fl = Fine Ignition  
- Pi = Poor Ignition  
- UA = Unstable Arc  
- DT = Drops Tungsten  
- P = Tungsten  
- M = Mean  
- F = Fine

Welding time: 5 min.  
Idle period: 15 secs.  
Welding current: 190 amp AC  
Gas pre flow: 1 sec.  
Gas post flow: 10 secs.  
Slope down: 5 secs.  
Slope up: 2 secs.  
Gas nozzle: no. 8 with gas lens  
Shielding gas: Argon  
Shielding gas quantity: 12 l/min.  
Electrode dist. to workpiece: 3 mm  
Electrode diameter: 2.4 mm  
Electrode point: 70°  
Parent material: AlMgSi 0.3

See illustration no. 8
Migatronic has the following item numbers in stock:

<table>
<thead>
<tr>
<th>Diameter Standard length</th>
<th>Red 2% TH Order no.</th>
<th>Green Pure Order no.</th>
<th>Black 1% La Order no.</th>
<th>Grey 2% Ce Order no.</th>
<th>Orange 4% Th Order no.</th>
<th>Turquoise WS 2 Order no.</th>
<th>Blue 2% La Order no.</th>
<th>Gold 1,5% La Order no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,0 x 175 mm</td>
<td>80360001</td>
<td>80360021</td>
<td>80360041</td>
<td>80360051</td>
<td>80360061</td>
<td>80360091</td>
<td>80361191</td>
<td></td>
</tr>
<tr>
<td>1,2 x 175 mm</td>
<td>80360005</td>
<td>80360025</td>
<td>80360046</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1,6 x 175 mm</td>
<td>80360002</td>
<td>80360022</td>
<td>80360042</td>
<td>80360052</td>
<td>80360062</td>
<td>80360070</td>
<td>80360092</td>
<td>80361192</td>
</tr>
<tr>
<td>2,0 x 175 mm</td>
<td>80360003</td>
<td>803600xx</td>
<td>803600xx</td>
<td>80360053</td>
<td></td>
<td></td>
<td>80360071</td>
<td>80360093</td>
</tr>
<tr>
<td>2,4 x 175 mm</td>
<td>80360004</td>
<td>80360024</td>
<td>80360043</td>
<td>80360054</td>
<td>80360064</td>
<td>80360072</td>
<td>80360094</td>
<td>80361194</td>
</tr>
<tr>
<td>3,2 x 175 mm</td>
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<td>80360026</td>
<td>80360044</td>
<td>80360055</td>
<td>80360066</td>
<td>80360073</td>
<td>80360095</td>
<td>80361195</td>
</tr>
<tr>
<td>4,0 x 175 mm</td>
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<td>80360027</td>
<td>80360045</td>
<td>80360056</td>
<td>80360067</td>
<td>80360074</td>
<td>80360096</td>
<td>80361196</td>
</tr>
<tr>
<td>4,8 x 175 mm</td>
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<td>80360028</td>
<td>80360047</td>
<td></td>
<td>80360068</td>
<td>80360075</td>
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</tr>
<tr>
<td>6,4 x 175 mm</td>
<td>80360009</td>
<td>80360029</td>
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<tr>
<td>1,6 x 150 mm</td>
<td>80360102</td>
<td>80360122</td>
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<tr>
<td>2,4 x 150 mm</td>
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<td>2,4 x 75 mm</td>
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</tr>
</tbody>
</table>

If you do not find a Tungsten electrode that suits your requirements, please contact Migatronic. Delivery time for special length electrodes is 3 to 5 weeks.

Trouble-free TIG welding requires a correctly-ground Tungsten electrode. Grind the electrode with a fine-grained diamond disc which is designed for grinding Tungsten electrodes. Grinding method and angle will depend on individual preferences.

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Service department: (+44) 01509/211492

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DK-9690 Fjerritslev, Denmark
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Telefax: (+45) 96 500 601
Homepage: www.migatronic.com

Subsidiary companies in: United Kingdom, Norway, Sweden, Finland, Germany, France, Hungary, Czech Republic, Italy, Holland and