Hot Conductors and Black Conductors
Hot conductors (TAL/ACS-conductors) are composed of mono-metallic TAL-wires and composite conductors (ACS-wires)

Most essential benefit of these conductors is the higher current carrying capacity compared with standard ACSR-conductors

Up to 50% higher current carrying capacity is possible
Hot Conductors

- Surface: shiny
- Outer Layer: TAL-wires
- Core: ACS-wires

TAL / ACS-conductor
Black conductors are a further development of the hot conductors, they are blackened with a permanent layer of colour on their surface (BTAL/ACS-conductors). A higher heat radiation means that the current carrying capacity can be increased compared with the hot conductors at the same temperature.

More than 50% higher current carrying capacity is possible.
Black Conductors

Surface: black coated

Outer Layer: TAL-wires

Core: ACS-wires

BTAL / ACS-conductor
TAL (= thermal resistant aluminium) is an alloy of aluminium.

Starting from high grade aluminium (99.7% purity) an alloy containing, among other elements, small amounts of zirconium

Zirconium retains its mechanical properties even after operation at higher temperatures up to 150°C over long periods

Standard aluminium can be used only for temperatures up to 80°C

With the exception of the higher thermal rating and the conductivity all other properties/qualities are completely identical
Comparison of different material characteristics

<table>
<thead>
<tr>
<th></th>
<th>Conductivity</th>
<th>Tensile strength</th>
<th>Modulus of elasticity</th>
<th>Coeff. of linear expansion</th>
<th>max. cont. working</th>
<th>working short time &lt;30 Min.</th>
<th>temp. short circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIT</td>
<td>% IACS</td>
<td>daN/mm²</td>
<td>daN/mm²</td>
<td>1/ °C</td>
<td>°C</td>
<td>°C</td>
<td>°C</td>
</tr>
<tr>
<td>TAL</td>
<td>% IACS</td>
<td>16 - 19</td>
<td>6000</td>
<td>2,3 x10-5</td>
<td>150</td>
<td>180</td>
<td>260</td>
</tr>
<tr>
<td></td>
<td>S.m/mm²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>34,8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-AL</td>
<td>61</td>
<td>16 - 19</td>
<td>6000</td>
<td>2,3 x10-5</td>
<td>80</td>
<td>(80)</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>35,38</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ACS (= aluminium clad steel) is a high strength steel wire with a thick aluminium coating.
Advantages of ACS

- Corrosion resistance and long service life in industrial atmospheres
- Higher short current capacity
- Higher mechanical tensile strength
- Higher continuous tensile strength
- Higher conductivity
- Reduction of performance losses
- Less weight
- Less sag
- Less tower load at the same sag
Mixed configuration in composite conductors with TAL/ACS

The use of ACS-wires allows a mixed configuration in composite conductors

Examples of the construction of the TAL/ACS-conductors:

Thus a far reaching project-oriented optimization of the conductor for mechanical and electrical conditions is possible
Typical Applications and Economic Benefits

Typical applications for the use of TAL/ACS-conductors - economic benefits

- Refitting of older transmission lines for a higher current carrying capacity
- Elimination of critical bottleneck standard conductors in overhead lines instead of a replacement with larger standard conductors or higher voltage level
- Increasement of the current carrying capacity in a changing market
- Redundant (n-1)-application or to cover power peaks
An economic analysis should contain the following points:

- The costs for a new line with a larger conductor diameter
- A higher price for TAL and for a black coating
- Due to the increased sags, maybe a heightening of the towers is necessary
- Costs for an increase of the losses
Additional benefits of a conductor coating with black colour

- Immediate capacity with nominal current under all weather conditions
- Reduction of the transmission losses
- Reduction of necessary tower reorganizations
- Less corona losses and decreasing of the corona noise
- Highest corrosion protection
- Higher current carrying capacity
Specification of the Coating

Specification of the coating process and the material
- Temperature- and UV-resistance of the coating material
- As-thin-as-possible coating with a low isolation effect
- Maximum adherence of the material and easy to remove in the fitting area
- Elastic and robust coating
- Metallic contact between each layer of the conductor
Nominal Current at Different Conductor Temperatures

Nominal current [A] at different conductor temperatures [°C]

- ACSR 300/50 standard conductor
- TAL/ACS 300/50 shiny
- BTAL/ACS 300/50 black coated
## Nominal Current at Different Conductor Temperatures

Nominal current at different conductor temperatures

<table>
<thead>
<tr>
<th>conductor temp. [°C]</th>
<th>60</th>
<th>80</th>
<th>100</th>
<th>120</th>
<th>135</th>
<th>150</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACSR 300/50 standard conductor</td>
<td>540</td>
<td>740</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAL/ACS 300/50 shiny</td>
<td>546</td>
<td>754</td>
<td>905</td>
<td>1026</td>
<td>1105</td>
<td>1175</td>
</tr>
<tr>
<td>BTAL/ACS 300/50 black coated</td>
<td>547</td>
<td>785</td>
<td>957</td>
<td>1096</td>
<td>1188</td>
<td>1270</td>
</tr>
</tbody>
</table>

= max. values
Temperature of Fittings with a 150°C Hot Conductor

<table>
<thead>
<tr>
<th>Fitting</th>
<th>Temperature in °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>conductor TAL/ACS 380/ 50</td>
<td>150</td>
</tr>
<tr>
<td>tension clamp</td>
<td>71</td>
</tr>
<tr>
<td>full tension compression joint</td>
<td>107</td>
</tr>
<tr>
<td>suspension clamp</td>
<td>94</td>
</tr>
<tr>
<td>current carrying clamp</td>
<td>93</td>
</tr>
</tbody>
</table>

In addition to the coating of the overhead conductors, also every kind of fittings could be blackened to use the effect of temperature radiation.