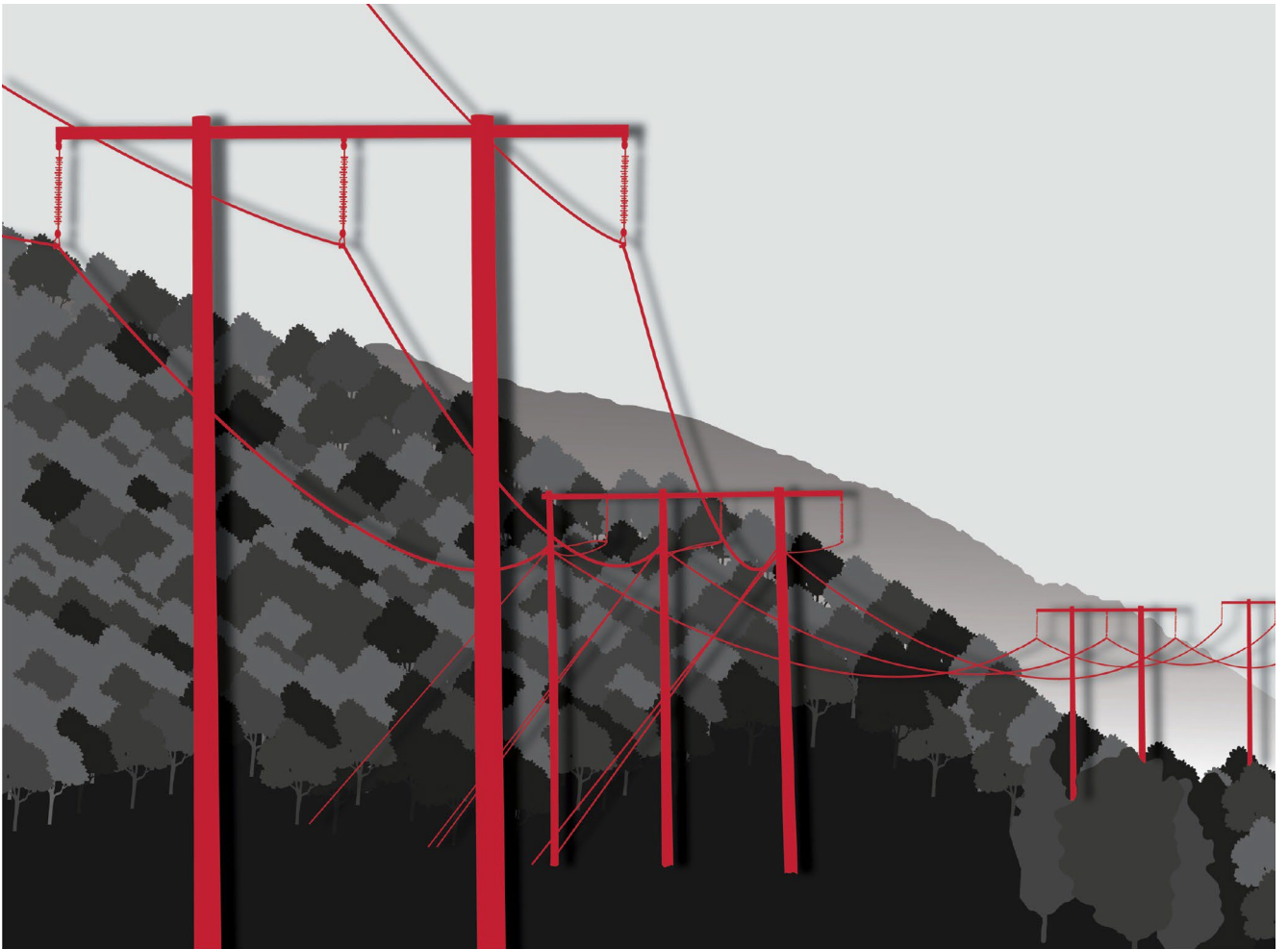


EL-tjeneste as

Norwegian quality and innovation



Norwegian-made quality products designed for harsh conditions

ALUMINUM

Environment and climate

March 2024

ALUMINUM IN THE ELECTRICAL POWER GRID

EL-tjeneste has supplied aluminum crossbars to the Norwegian power grid since 1996.

The operating experiences are very good.

Aluminum is today by far the most widely used material in crossbars in the norwegian power grid.

ALUMINUM'S IMPACT ON THE ENVIRONMENT

What makes a product sustainable?

- Made from material with a low climate footprint from production compared to the global average.
 - Products from EL-tjeneste are produced from aluminum with emissions of 4-7kg CO² equivalent per kg aluminum, compared to the world average of 16.7kg CO² equivalent.
- Affects nature and the environment as little as possible during the building period.
- Low net weight
 - Creates good opportunities for simpler, safer and more environmentally friendly assembly methods.
 - Provides a lower climate footprint during transport.
- Affects the environment and nature as little as possible during the lifetime of the system.
- 80-100 year lifetime
 - Total climate footprint distributed over lifetime will be low.
 - Allows for re-use.
- Modular system
 - Parts with the highest wear and tear can be easily replaced when needed, without having to replace the entire product.
 - Easy to sort different materials when recycling.
- Low maintenance
- Made from 100% recyclable material
 - Aluminum does not lose any of its mechanical properties when it is remelted, which means that aluminum can be recycled indefinitely. In addition, the energy saving by recycling is approx. 95% compared to virgin material.

THE ENVIRONMENTS IMPACT ON ALUMINUM

Anodized aluminum crossbars as standard

EL-tjeneste delivers all its crossbars anodized in dark brown as the standard color. This is done primarily for the aesthetic appearance, but also to improve corrosion resistance. Brown is a natural color and works very well as camouflage.

Anodizing

Aluminum is one of the most corrosion-resistant construction materials available, as long as a consideration is given to what materials are combined with the metal.

Aluminum naturally forms a protective layer of aluminum oxide as long as oxygen is present.

When aluminum is cut or drilled into, aluminum oxide will immediately form on the processed surface.

The anodizing process itself is a post-treatment of finished aluminum profiles to obtain a different color and increase the corrosion resistance of the products.

An anodizing process strengthens the natural oxide layer of aluminum, making it thicker and thus better protecting the material. Since the oxide layer is an integrated part of the metal, anodized aluminum can withstand greater stress and can be used in most places without the metal corroding. EL-tjeneste has set a minimum requirement of 15 µm on its profiles.

Use in corrosive environments

When used in a corrosive environment, special precautions must be taken
Grease can be used to prevent moisture from settling between materials at connection points
See a separate document on corrosion on our website under the "BROCHURES" tab

Aluminum and low temperatures

The yield and tensile strengths for our aluminum products are provided at 20°C, but a common trait for all aluminum alloys is that they only become stronger at lower temperatures.

Refer to tables from Hydro aluminium:

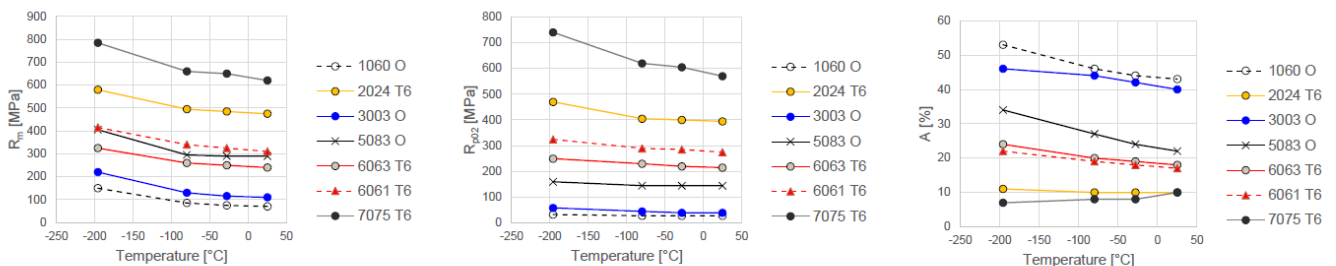
Low-temperature behavior of aluminium alloys



It seems that all aluminium alloys respond to tensile testing at subzero-temperatures in the same manner;

- The yield strength and tensile strength increases with decreasing temperature
- The elongation to fracture generally increases as well (exception for age hardened 7xxx)

The figures below show handbook data^[3] for a selection of alloys.



[3] J. Gilbert Kaufman: Properties of Aluminum Alloys, ASM International, 1999

Source: Hydro aluminium:

The numbers to the right of the tables denote different aluminum alloys

EL-tjeneste mostly utilizes four different variants of alloys in its products.

All of the alloys belong to the AlMgSi 6000 series, which is a series of alloys best suited for our usage, boasting the finest qualities in terms of extrusion, corrosion resistance, brittleness, and strength.

It features an alloy mixture in a specific ratio of Aluminum - Magnesium - Silicon:

6061-T6, 6063-T6, 6005A-T6, 6082-T6.

For crossbars, we use two alloys: 6005A-T6 and 6082-T6.

6082-T6 has the highest strength in the 6000 series and is therefore used for the most heavily loaded crossbars.

T6, which appears at the end, denotes that the material is hardened to T6 after extrusion to achieve the correct strength.

As the table shows, the strength of all aluminum alloys increases at lower temperatures.



Norwegian quality and innovation

**Sales and product development,
Trondheim**

Østre Rosten 84G
7075 Tiller
Tel: +47 976 74 000
www.el-tjeneste.no/en
Mail: info@eltjeneste.no

**Factory and warehouse,
Steinkjer**

Jæktsmedgata 4
7725 Steinkjer
Tel: +47 976 74 000
Mail: info@eltjeneste.no