

Copper in comparison with aluminium as material of LV/MV cable conductors

Wim Boone
DNV-GL, The Netherlands

Christiaan Sonderen
DNV-GL, The Netherlands

Introduction

On request of the ECI, DNV GL investigated per international questionnaire:

- Material properties of copper/versus aluminium
- Failure mechanisms in which the conductor material plays a part
- Decision model how utilities select copper or aluminium as material for LV/MV cable conductors

Material properties

Material Properties	Comparative Values	
	Copper	Aluminium
Electrical resistivity	100	164
Density	100	30
Weight/unit resistance	100	53
Diameter/unit resistance	100	129
Elastic modulus	100	55
Hardness	100	44
Ultimate tensile stress	100	35
Melting point	100	61
Stress fatigue endurance limit	100	62
Thermal resistivity	100	158
Corrosiveness	1)	2)
Thermal expansion	100	135

- 1) Copper is resistant to most organic chemicals
2) Aluminium corrodes quickly

Failure mechanisms

- Chemical reaction between water and aluminium
- Corrosion of aluminium
- Thermo-mechanical failure of aluminium

Decision model

Selection criteria:

1. Price per meter of cable
2. Radial size
3. Weight per meter of cable
4. Mechanical properties
5. Ease of accessory installation
6. Ease of repair
7. Cost of corrective maintenance (repair after failure)
8. Company standard or company procedures
9. Compatibility with existing cables in network
10. Environmental concern (losses)
11. Expected problems with connectors
12. Any other factor.

Results

High scores Copper/Aluminium:

- ✓ Mechanical/Price
- ✓ Connector/Company standard

Low scores Copper/Aluminium

- ✓ Price/Repair
- ✓ Weight/ Radial size



Conclusions

- Copper is better than aluminium with a view to material properties
- *Almost the only unsatisfactory feature of copper is the way the price fluctuates*
- *Aluminium has become a replacement solely on the basis of price*
- Copper should be promoted for the situations where it is superior, in terms of practical use and operational reliability