

CURRENT RATING FOR XLPE LAND CABLE SYSTEMS

Rating factors

Rating factors for cross section area of the metal screen of single core cables.

The rating factor is applicable to single-core cables in flat and trefoil formation with the screens bonded at both ends.

→ The rating factor does not apply to single-point bonding or cross-bonded systems.

Table 5 45-66 kV 35 mm² screen

| Rating factor for tables 1 and 2 | | | | | | | |
|----------------------------------|------|----|------|------|------|------|------|
| Conductor mm ² | | | | | | | |
| Al | Cu | 35 | 50 | 95 | 150 | 240 | 300 |
| 300 | | 1 | 0.99 | 0.98 | 0.97 | 0.96 | 0.95 |
| 500 | 300 | 1 | 0.99 | 0.97 | 0.95 | 0.93 | 0.93 |
| 800 | 500 | 1 | 0.99 | 0.96 | 0.93 | 0.90 | 0.90 |
| 1200 | 630 | 1 | 0.99 | 0.95 | 0.92 | 0.89 | 0.88 |
| 2000 | 800 | 1 | 0.98 | 0.94 | 0.91 | 0.87 | 0.86 |
| | 1200 | 1 | 0.97 | 0.91 | 0.85 | 0.81 | 0.80 |
| | 2000 | 1 | 0.96 | 0.88 | 0.82 | 0.77 | 0.76 |

Table 6 110-500 kV 95 mm² screen

| Rating factor for tables 3 and 4 | | | | | | |
|----------------------------------|------|------|----|------|------|------|
| Conductor mm ² | | | | | | |
| Al | Cu | 50 | 95 | 150 | 240 | 300 |
| 300 | | 1.01 | 1 | 0.99 | 0.98 | 0.97 |
| 500 | 300 | 1.02 | 1 | 0.98 | 0.96 | 0.96 |
| 800 | 500 | 1.03 | 1 | 0.97 | 0.94 | 0.94 |
| 1200 | 630 | 1.04 | 1 | 0.97 | 0.93 | 0.92 |
| 2000 | 800 | 1.04 | 1 | 0.96 | 0.92 | 0.91 |
| | 1200 | 1.07 | 1 | 0.94 | 0.89 | 0.88 |
| | 2000 | 1.09 | 1 | 0.93 | 0.87 | 0.86 |

1 mm² copper screen is equivalent to:

1.66 mm² aluminium sheath

12.40 mm² lead sheath

Rating factor for ground temperature

Table 7

| Rating factor for laying depth | |
|--------------------------------|---------------|
| Laying depth, m | Rating factor |
| 0.50 | 1.10 |
| 0.70 | 1.05 |
| 0.90 | 1.01 |
| 1.00 | 1.00 |
| 1.20 | 0.98 |
| 1.50 | 0.95 |

Table 8

| Rating factor for ground temperature | | | | | | | | |
|--------------------------------------|------------------------|------|----|------|------|------|------|------|
| Conductor temperature, °C | Ground temperature, °C | | | | | | | |
| | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 |
| 90 | 1.07 | 1.04 | 1 | 0.96 | 0.93 | 0.89 | 0.84 | 0.80 |
| 65 | 1.11 | 1.05 | 1 | 0.94 | 0.88 | 0.82 | 0.74 | 0.66 |

Table 9

| Rating factor for ground thermal resistivity | | | | | | | |
|--|------|------|------|------|------|------|------|
| Thermal resistivity, Km/W | 0.7 | 1.0 | 1.2 | 1.5 | 2.0 | 2.5 | 3.0 |
| Rating factor | 1.14 | 1.00 | 0.93 | 0.84 | 0.74 | 0.67 | 0.61 |

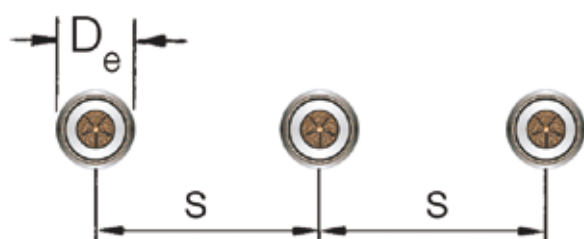


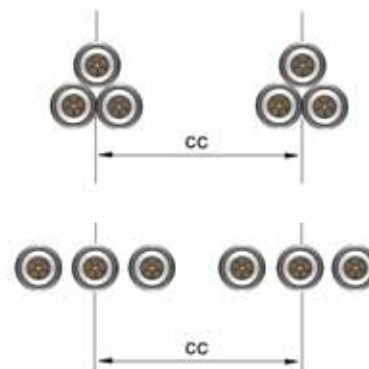
Table 10

| Rating factor for phase spacing One group in flat formation with cross-bonded or single-bonded screens | | | | | | |
|---|----------------|--------------------|------|------|------|------|
| Spacing s, mm | D _e | D _e +70 | 250 | 300 | 350 | 400 |
| Cable diam, mm | Rating factor | | | | | |
| <80 | 0.93 | 1.00 | 1.05 | 1.07 | 1.08 | 1.09 |
| 81-110 | 0.93 | 1.00 | 1.04 | 1.06 | 1.08 | 1.09 |
| 111-140 | 0.93 | 1.00 | 1.03 | 1.06 | 1.09 | 1.11 |

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Table 11

| Rating factor for groups of cables in the ground | | | | | | | | | |
|--|------------------|------|------|------|------|------|------|------|------|
| Distance cc between groups, mm | Number of groups | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 100 | 1 | 0.78 | 0.66 | 0.60 | 0.55 | 0.52 | 0.49 | 0.47 | 0.45 |
| 200 | 1 | 0.81 | 0.70 | 0.65 | 0.61 | 0.58 | 0.55 | 0.54 | 0.52 |
| 400 | 1 | 0.86 | 0.76 | 0.72 | 0.68 | 0.66 | 0.64 | 0.63 | 0.61 |
| 600 | 1 | 0.89 | 0.80 | 0.77 | 0.74 | 0.72 | 0.70 | 0.69 | 0.69 |
| 800 | 1 | 0.91 | 0.83 | 0.81 | 0.78 | 0.77 | 0.75 | 0.75 | 0.74 |
| 2000 | 1 | 0.96 | 0.93 | 0.92 | 0.91 | 0.91 | 0.90 | 0.90 | 0.90 |



Rating factor for cables installed in pipes in the ground

The rating factor given for single-core cables partially installed in separate pipes, applies only when a cable section between screen earthing points must be partially laid in pipes, under the following conditions:

- the cables are laid in trefoil formation over the major portion of the section
- the pipes are laid in flat formation
- the piped length is less than 10% of the section between earthing points
- one cable per pipe
- the pipe diameter is two times the cable diameter.

Example of the use of rating factors

2 groups of 66 kV XLPE cables with aluminium conductors 1 x 500/150 mm² in the ground in trefoil formation. Metal screens bonded at both ends, 90°C conductor temperature. Table 1 gives current rating 610 A, unadjusted value.

| | Table | Rating factor |
|----------------------------|---------------------|-----------------|
| Current rating | 610 A | 1 |
| Screen area | 150 mm ² | 5 |
| Laying depth | 1.5 m | 7 |
| Ground temperature | 30°C | 8 |
| Ground thermal resistivity | 1.5 Km/W | 9 |
| Distance between groups | 400 mm | 11 |
| | | 0.85 (2 groups) |

Table 12

| Rating factor for cables in pipes in ground | | | |
|--|--------------------------------------|-------------------------------------|----------------------------|
| Single-core cables partially installed in separate pipes | Single-core cables in separate pipes | Single-core cables in a common pipe | Three-core cable in a pipe |
| ●●● | ●●● | ●●● | ⊗ |
| 0.94 | 0.90 | 0.90 | 0.90 |

Rating factor for cables installed in air

Table 13

| Rating factor for ambient air temperature | | | | | | | | | | |
|---|------|------|------|------|------|------|-----|------|------|------|
| Air temperature, °C | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| Rating factor | 1.28 | 1.24 | 1.19 | 1.15 | 1.10 | 1.05 | 1.0 | 0.95 | 0.89 | 0.83 |

Adjusted current rating per group;

$$610 \times 0.95 \times 0.95 \times 0.93 \times 0.84 \times 0.85 = 365 \text{ A}$$

Please note that use of rating factors gives good general indication during planning future circuits.

Once a circuit layout is defined, an accurate calculation should be performed to confirm the assumptions.

Overload capacity

An XLPE cable may be overloaded up to 105°C. Singular emergency events are not expected to have any significant impact on the service life of the cable. The number of and the duration of overloads should be kept low, though. Cyclic and emergency ratings can be calculated according to IEC publication 60853.

Short-circuit currents

During short circuit events the maximum allowable temperature in conductor or screen/metallic sheath is determined by the adjoining insulation and sheath materials. This is specified in IEC 61443 "Short circuit temperature limits of electric cables with rated voltage above 30 kV (Um=36 kV). The dynamic forces between the conductors must be taken into account for cable installations.