

Technical Specification for XLPE-insulated High Voltage Cables

This technical specification is valid for the business unit E.ON Sweden of the market unit E.ON Nordic.

With this specification, technical determinations were made beyond existing publications.

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1 Area of Application

This technical specification is valid for XLPE insulated high voltage cables

- Single core: AXLJ 1 x 1 x AXCLJ 1 x 1 x

Suffixes: F = bonded insulation screen

RE = solid conductor

RM = stranded compacted conductor

LT = longitudinal water tightness

TT = longitudinal and radial water tightness

F2 = flame retardant according to IEC 60332-1

F4 = flame retardant according to IEC 60332-3 A, B, C, D

with rated voltages $U_0/U (U_m)$ of 26/45 (52), 38/66 (72,5), 76/132 (145) , 87/150 (170)kV

2 General Requirements

2.1 Standards, Regulations and Ordinances

The cables must comply with the requirements of the standards and regulations listed in the appendix A1, as far as no divergent requirements are made in this specification.

Generally all standards, rules, regulations, provisions and laws applying in the country of the client have to be followed, even if they are not specifically required according to this specification.

The business and communication language is Swedish or English

2.2 Manufacturing Facilities

The relocation to another manufacturing facility for a running order is only admissible in case of mutual consent.

3 Further Requirements

3.1 Cable Construction

3.1.1 Conductors

The conductors made of aluminum or copper can be executed as stranded compacted conductors or as solid conductors. The shape of conductors shall be circular shaped. If the conductors are solid it must be insured that the cable is easy to handle and bend. It must be ensured that the conductor screen material cannot protrude between the wires.

Water tightness (-TL and -TT) is required, the conductors shall be longitudinal watertight with swelling powder or band.

3.1.2 Screens

The conductor screen and insulation screen may not show any irregularities into the insulation.

3.1.2.1 Conductor Screen

No score marks and/or shrink marks may be visible on the conductor screen.

Recognisable minor grinding marks and/or minor conductor images do not count under this.

The thickness of the conductor screen shall be stated as nominal, minimum and maximum value. If possible also the mean value of the thickness of the conductor screen shall be stated.

3.1.2.2 Insulation Screen

The insulation screen shall be bounded.

The thickness of the insulation screen shall be stated as nominal, minimum and maximum value. If possible also the mean value of the thickness of the conductor screen shall be stated.

3.1.2.3 Insulation

The insulation must be free of inclusions.

The cores must be produced with the triple extruding head process and with the dry cross-linking process.

The thickness of the insulation shall be stated as nominal, minimum and maximum value. If possible also the mean value of the thickness of the conductor screen shall be stated.

3.1.3 Semi-conducting Layers

The semi-conducting layers if any between insulation screen and metallic screen must be easily removable and must not show any adherence to the insulation screen.

3.1.4 Metallic Screen

The metallic screen wires of annealed copper can be applied in wound form helically, or in wave form or in parallel with the longitudinal axis of the cable. To ensure that the wave form and parallel wires remain in place they should be embedded in conductive material.

Optional for the helically laid Metallic Screen: a helical counter binder tape may be applied. If so only copper tapes with a thickness of maximum 0,2 mm are admissible.

The metallic screen wires shall be evenly distributed around the cable core and the number of wires shall be chosen so that the average distance between the wires is not more than 4 mm and a maximum distance of 8 mm.

3.1.5 Additional Layer over Metallic Screen

An additional layer is required for cables with longitudinal and radial water tightness (-TT). For the other cable types it is up to the manufacturer responsibility.

The additional layer between the metallic screen and outer sheath must be made of non-hygroscopic material.

The additional layer between the metallic screen and outer sheath may be made of semi-conductive (for -TT cables) or non conductive tape.

3.1.6 Longitudinal Water Tightness (-LT)

Longitudinal water tightness must be ensured according to paragraph 3.1.1 for the conductor.

3.1.7 Longitudinal and Radial Water Tightness (-TT)

Longitudinal water tightness shall be ensured according to paragraph 3.1.1 for the conductor. For longitudinal water tightness of the metallic screen, a copper stabilized swelling fleece tape shall be applied under and/or above the screen wires. At the same time, a proper bedding effect to the wires shall be obtained. Corrosion effects caused by the swelling fleece tapes and by the swelling powder contained in this must not occur.

The radial water tightness shall be realised by a monolateral, polymer-coated aluminium foil. The aluminium foil shall be bonded to the outer sheath and to its overlapping place. The foil shall also have a galvanic contact with the screen wires. The radial water tightness can also be realised by a leadsheath.

3.1.8 Outer sheath

The outer sheath of PVC or PE may only be applied after the gaseous cross-linking products have sufficiently evaporated from the extruded cores.

The outer sheath of PE shall be of type MDPE or HDPE.

The thickness of the conductor screen shall be stated as nominal, minimum and maximum value. If possible also the mean value of the thickness of the conductor screen shall be stated.

No residues or contamination may be present in or on the outer sheath.

The overall section of the single core cable must be circular with a maximum deviation of < 2,5 % of the outer diameter, measured on two axes shifted by 90°.

3.1.8a Option

On request by the buyer the outer sheath shall have a semi-conductive extruded thin layer bonded to the sheath in order to facilitate testing after laying.

3.2 Identification Marks and Symbols

The marking must be resistant to the conditions in the ground.

It shall consist of manufacturer's name, code designation, nominal cross-sectional area of conductor and metallic screen, rated voltage, year of production with last two digits, length marks with indication in meters.

The meter marking must be applied continuously length without discontinuities.

Deviation of meter embossing: reasonable accuracy $\pm 0,5\%$

4 Approval and Testing

The conditions for the application of the product specified in this specification are the presence of a manufacturer-dependent technical product approval and the existence of a supplier inspection system.

The technical product approval may be given, if the manufacturer/supplier – at his own cost – delivers proof of the product characteristics required by the user and ensured by the manufacturer or the supplier by means of a cable sample, if he delivers proof of the aptitude for operational use by a corresponding test run or by references, if he delivers the required test certificates and if he fulfils possible requirements of the user.

The realisation of the approval inspection, or the sampling, can also be performed by an inspector named by the users.

The user is entitled to inspect or to have inspected the product characteristics compliance as well as quality parameters.

Any change to a product approved on basis of this specification is subject to new approval or renewed negotiation. This is also valid for the manufacturing process and the used materials. Changes during a standing order are only allowed by mutual consent. Precondition for the consent and the positive assessment by the user is the proof of an equivalent or higher quality, or of improved benefit, respectively, e. g. in the scope of further technical development.

In certain, justified cases, possible subcontractors have to be disclosed upon the user's request.

If the contractor announces new developments, and if these cannot be realised within an agreed deadline, the mandate may cancel the order.

4.1 Management Quality, Environmental and Health & Safety Control

The manufacturer has to provide proof of an integrated quality management system according to the standard series EN ISO 9001, which guarantees a continuous assurance of the unchanging product properties as requested by the user and agreed upon by the manufacturer.

It is recommended to establish a certified environmental management system for the production sites according to the standard series EN ISO 14001.

It is recommended to check how far the health and safety issues of the production sites fulfil the requirements of the occupational health and safety assessment series (OHSAS 18001).

4.2 Inspection and Testing

The buyer reserves the right to inspect the ordered cables himself or by appointed persons with respect to the compliance to all technical requirements and/or to accept them in the factory.

The acceptance of the cables ordered depends on the result of the inspections and on the content of the documents stated in paragraph 5 of this specification.

The cables must come from the current production.

Stock goods older than 18 months are only accepted in mutual consent.

4.2.1 Partial Discharge Test (PD)

The background noise level of the PD measuring equipment, including the specimen, must be less 2 pC with the test voltage disconnected. Individual, clearly distinctive noise pulses are exempt from this.

The test voltage shall be raised gradually to and held at 1,75 U₀ for 10 s and then slowly reduced to 1,5 U₀.

The magnitude of the discharge at 1,5 U₀ shall not exceed 5 pC.

5 Documentation

The delivery note, or an appendix in form of an overall list accompanying the delivery note, must include the following information apart from the standard indications:

- Cable drum number

Delivery length of each cable drum

- Routine tests report of each delivered cable drum
- Sample tests reports of each production lot of delivered cable types
- Meter embossing at the outer and inner end of the cable on each cable drum

On demand of the user, the manufacturer / supplier must present the following:

- A valid QA-certificate for the manufacturing facility according to EN ISO 9001. The entity of certification must be accredited a member entity of the EAC.
- Type test reports
- The declaration of conformity of the manufacturer for additional requirements from this specification.

All kind of test reports are archived by the manufacturer for at least ten years.

All record, documents and descriptions as well as indication and type signs shall be executed in Swedish or English. Translations of other languages have to be handed over together with original text.

6 Packing and Transport

- The cable drums should be made according to “K” type of standard SS 8428 01. They must be in a flawless state and sufficiently smooth on the core.
- On the cable drums weatherproof and well legible labels shall be fixed, containing the information as follows:
 - cable manufacturer
 - complete cable identification according to applied standard
 - delivery length (in meter)
 - overall weight
 - cable drum number
 - rolling direction arrow
- The cable ends must be fixed in a way that the ends cannot loosen during transport. The fastening must be performed without damaging the cable.
- The cable ends must be sealed with adhesive-coated shrink caps in a water-proof, transport-safe and durable way.
- Lagging is only admissible if demanded by the user. Protection films or other packing materials are admissible.
- Delivery lengths must be complied with a maximum deviation of $\pm 0,5 \%$, if not otherwise agreed.
- Short length quantities are only accepted after previous agreement.
- If not otherwise agreed the maximum overall drum diameter shall not exceed 3,0 meter.

7 Disposal

With the delivery of the cables, the manufacturer/supplier undertakes to indicate the possibilities for disposal/recycling based upon the corresponding laws, regulations and ordinances of Sweden.

8 Appendix

8.1 A-1: Applicable Standards

IEC 60840	Power cables with extruded insulation and their accessories for rated voltages above 30 kV ($U_m=36$ kV) up to 150 kV ($U_m=170$ kV)-Test methods and requirements.
SS 424 14 17	Power cables-HD 632 S1 XLPE-insulated cables and their accessories for rated voltage above 36 kV($U_m=42$ kV) up to ($U_m=170$ kV), part 3 section M, part 4 section M and part 5 section M. se bilaga A
HD 605 S1	Electric cables – Additional test methods
EN 60228	Conductors of Insulated Cables
EN 60811	Insulation and sheathing materials of electric cables - Common test methods –
IEC 60332-1	Test on electric and optical fiber cables under fire conditions.
IEC 60332-3	Test on electrical cables under fire conditions.
SS 8428 01	Dimensions of cable drums