



Technical Specification 1 (41)

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Technical Specification of 36 kV XLPE Cables and Accessories

Revision History

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1 Common

1.1 Abbreviations

The following abbreviations apply to this document:

<i>Short</i>	<i>Long</i>
PE	Polyethylene
XLPE	Cross Linked Polyethylene

Table 1 - Abbreviations

1.2 Scope of the Document

This specification covers a 36 kV XLPE cable system type that will be included in an electrical system.

If not otherwise specified, parallel groups with three cable phases will be bundled in close trefoil formation and the copper wire screens solidly earthed in both ends, i.e. the cable screens will not be cross-bonded or insulated from earth.

The cable groups will be directly buried in soil and/or installed in tunnel.

1.3 Standards

The cables and accessories shall meet the latest version of the applicable standards and national regulations. Special requirements beyond the standard is specified for each cable.

1.4 Electrical main data

Maximum voltage (U_m)	36 kV
Rated impulse withstand voltage	170 kV (SS-EN 60071-1)

1.5 Testing

Testing of the XLPE-cable system and components shall be performed in accordance with testing requirements in this specification.

Type testing may be excluded in the contract if the Contractor can present acceptable reports from previously performed type testing. Reports that cover the requested cable-type and accessories shall therefore be enclosed with the tender. Note that the cost for a renewed type test must be separately stated in the tender.

The number of sample tests shall follow SS 424 141 16, however the number shall never be less than two (performed on two delivery lengths taken from start and end of manufacturing). Repetition of tests shall be performed according to SS 424 141 16.

1.6 Marking

All cables shall be marked on the outside of the sheath with two text lines equally spaced around the circumference. The markings shall be embossed on the sheath. The following information shall be included:

- a) Manufacturers name or logo.
- b) Voltage level, i.e. "36 kV".
- c) Cable designation, i.e. "AXALJ" or similar.
- d) Cross section of conductor and screen.
- e) Year of manufacturing
- f) Fire propagation class, i.e. "B2ca -s1, d0, a1".
- g) Meter marking of cable (may be printed with indelible ink)

The insulation screen shall contain information regarding batch number. This information shall be printed with indelible ink.

1.7 Delivery drums

Dimension of delivery drums for all cables shall be according to SS 84 28 01.

Marking of the delivery drums shall be made with relevant information for the installation and identification of cables. The markings on the drums shall be indelible and made by plastic laminated notes or tape. The minimum information shall be:

- a) project name
- b) project number
- c) delivery length number
- d) cable designation
- e) voltage level
- f) cross section of conductor
- g) cross section of screen
- h) length of cable on drum
- i) drum type
- j) dimensions
- k) weight with and without cable

1.8 Cable System Documentation

The following information shall be included in Contractor's tender:

Technical specifications shall be delivered and shall as minimum include:

- a) all cable types
- b) all joint types
- c) all termination types
- d) any link boxes

Data sheets for:

- e) all cable types



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- f) all joint types
- g) all termination types

shall be filled in (refer to the annexes) and submitted.

Detailed drawings shall be delivered and shall as minimum include:

- h) the different joint types and associated components (connectors/lugs, joint body, complete joint, bonding lead connection etc.)
- i) the terminations and associated components (stand, support isolators, main isolator, top bolt, earthing connection, box body, clamps etc.
- j) electrical stress grading systems

The joint and termination types shall be of a standard type from which the Contractor has several years of service experience.

Detailed reference list together with type test report(s) shall be submitted for as minimum:

- k) all cable types
- l) all joint types
- m) all termination types
- n) any link boxes

2 Cable for Installation in Ground

The cables shall meet the requirements in SS 4241416, which shall be used as a general engineering standard.

2.1 Standard Conductor Cross-Sections

Conductor cross-sectional area	Max. DC-resistance for the conductor at 20 °C
630 mm ² (Al)	Acc. to SS 4241416 (EN 60228) 0.0469 Ohm/km

2.2 Conductor

Conductor, material / type	Aluminium (compacted, SS-EN 60228)
Type of water sealing system	Swelling powder/yarn/tapes or equivalent. The conductor shall have a completely water blocking construction longitudinally..
Conducting tape around the conductor	Manufacturer's standard (note the requirement of longitudinal water sealing)
Permissible conductor temperature at normal operation.	≥90 °C
Permissible conductor temperature at short circuit.	≥250 °C

2.3 Insulation system

Conductor screen, type / thickness	Cross-linked polyethylene min 0,3 mm acc. to SS 4241416
Insulation material	Cross-linked polyethylene (XLPE), compound DIX 11, acc. to SS 4241416
- minimum insulation thickness	7.1 mm acc. to SS 4241416
- nominal insulation thickness	8 mm acc. to SS 4241416
- insulation eccentricity	Acc. to SS 4241416
Insulation screen, type / thickness	Cross-linked polyethylene / acc. to SS 4241416
Extruding process / vulcanisation process	Triple-extrusion / Dry curing or equivalent

2.4 Metallic Screen

Screen material	Annealed circular Cu-wires with a thin Cu counter helix tape
Minimum screen area (excluding Al-foil/Cu-foil and Cu counter tape)	Acc. to SS 4241416, $\geq 35 \text{ mm}^2$
Max. DC-resistance for the screen at 20 °C	Acc. to SS 4241416, 0.6 Ohm/km Stated resistance value refers to true screen length in the cable and not the length of the complete cable, i.e. with consideration taken to the screen lay/pitch
Minimum dimensions of Cu counter tape (Width x Thickness)	10 x 0.1 mm

2.5 Longitudinal and radial water sealing system

Type of longitudinal water sealing system	Swelling tapes or equivalent (under and/or above wires)
Type of radial water sealing system	Al- or Cu-foil/laminate/tape bonded to the outer sheath.

2.6 Outer Sheath

Type / material	Extruded / HDPE or MDPE, compound DMP10
Minimum thickness (excluding outer conductive layer)	Acc. to SS 4241416
Nominal thickness	Acc. to SS 4241416
Colour	Naturally PE coloured, not black

2.7 Outer conductive layer

Type / material	Extruded and bonded to the outer sheath
Nominal thickness	Manufacturer's standard
Colour	Black

3 Cable for Installation in Tunnel

The cables shall meet the requirements in SS 4241416, which shall be used as a general engineering standard. For some parts specified IEC 60502-2 and IEC 60840 shall be used.

3.1 Standard Conductor Cross Sections

Conductor cross-sectional area	Max. DC-resistance for the conductor at 20 °C
500 mm ² (Al)	Acc. to SS 4241416 (EN 60228) 0.0605 Ohm/km
630 mm ² (Al)	Acc. to SS 4241416 (EN 60228) 0.0469 Ohm/km

3.2 Conductor

Conductor, material / type	Aluminium (stranded, circular, compacted, SS-EN 60228)
Type of water sealing system	Swelling powder/yarn/tapes or equivalent. The conductor shall have a completely water blocking construction longitudinally.
Conducting tape around the conductor	Manufacturer's standard (note the requirement of longitudinal water sealing)
Permissible conductor temperature at normal operation.	≥90 °C
Permissible conductor temperature at short circuit.	≥250 °C

3.3 Insulation System

Conductor screen, type / thickness	Cross-linked polyethylene min 0,3 mm acc. to SS 4241416
Insulation material	Cross-linked polyethylene (XLPE), compound DIX 11 acc. to SS 4241416
- minimum insulation thickness	7.1 mm acc. to SS 4241416
- nominal insulation thickness	Acc. to SS 4241416
- insulation eccentricity	Acc. to SS 4241416
Insulation screen, type / thickness	Cross-linked polyethylene acc to SS 4241416
Extruding process / vulcanisation process	Triple-extrusion / Dry curing or equivalent.

3.4 Metallic Screen

Screen Material	Annealed circular Cu-wires with a thin Cu counter helix tape
Minimum screen area (excluding Al-foil/Cu-foil and Cu counter tape)	$\geq 35 \text{ mm}^2$, acc. to SS 4241416
Max. DC-resistance for the screen at 20 °C	0.6 Ohm/km acc. to SS 4241416 Stated resistance value refers to true screen length in the cable and not the length of the complete cable, i.e. with consideration taken to the screen lay/pitch
Minimum dimensions of Cu counter tape (Width x Thickness)	10 x 0.1 mm

3.5 Longitudinal and Radial Water Sealing System

Type of longitudinal water sealing system	Swelling tapes or equivalent (under and/or above wires)
Type of radial water sealing system	Al- or Cu-foil/laminate/tape bonded to the outer sheath.

3.6 Outer Sheath

Type / material	Non-halogen polymer (HFFR)
Minimum thickness (excluding outer conductive layer)	Acc. to SS 4241416
Nominal thickness	Acc. to SS 4241416
Colour	Naturally PE coloured, not black

3.7 Outer Conductive Layer

Type / material	Extruded and bonded to the outer sheath
Nominal thickness	Manufacturer's standard
Colour	Black

3.8 Fire propagation classes

Cables for tunnel installations shall at least fulfil the following fire propagation class:

- B2ca -s1, d0, a1



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The required fire propagation class shall include the complete cable construction including the outer protective layer. The fire propagation classes are defined in EN 13501-6.

4 Outdoor Termination Specification

4.1 General

This specification covers the outdoor termination of the cable system.

The termination shall be of prefabricated type and shall meet the requirements in SS 4241445 and HD 629.1 in applicable parts, which all shall be used as engineering standards.

4.2 Electrical & climatic data

Current capacity (power rating)	Same as for the XLPE-cable
Short time overload capacity	Same as for the XLPE-cable
One phase short circuit current withstand	Same as for the XLPE-cable
DC-voltage test on outer sheath	According to chapter 9
Surrounding air temperature, outdoor	-40 to +40 °C, (-50 °C is required in the northern parts of the power networks, i.e. north of the river "Dalälven")
Solar radiation	Max. 1000 W/m ²
Design wind velocity	34 m/s

4.3 Termination construction

The termination shall electrically and thermally be dimensioned in accordance with above construction parameters and be fully adapted with the XLPE-cable. The termination construction shall fulfil geometrical field control design.

The insulator shall have a leakage/creepage path of minimum 900 mm, i.e. ≥ 25 mm/kV according to site pollution class d (Heavy) in SS-EN 60815.

The proposed termination shall have a system for insulated installation (support insulators etc.) so that regular voltage tests on the outer sheath of the cable phases can be performed.

Earth connections for screen wires, earthing bonds on the termination body/housing etc. shall be designed in such a way that a short circuit current in case of a fault will not damage the termination.

The metallic laminate layer (for radial water tightness) shall be properly connected directly to the screen or the screen connection point on the termination body.

The termination shall be able to withstand normal mechanical axial and radial forces that occur due to wind, normal forces on jumper lines etc.

5 Indoor Termination Specification for 36 kV Cable System

5.1 General

This specification covers the indoor terminations of the cable system.

The terminations shall be of prefabricated type and shall meet the requirements in SS 4241445 and HD 629.1, in applicable parts, which shall be used as engineering standards.

5.2 Electrical & Climatic data

Current capacity (power rating)	Same as for the XLPE-cable
Short time overload capacity	Same as for the XLPE-cable
One phase short circuit current withstand	Same as for the XLPE-cable
DC-voltage test on outer sheath	Same as for the XLPE-cable

5.3 Termination Construction

The termination shall electrically and thermally be dimensioned in accordance with above construction parameters and be fully adapted with the XLPE-cable. The termination construction shall fulfil geometrical field control design. Furthermore, the insulator shall be of prefabricated type.

The proposed termination shall have a system for insulated installation (support insulators etc.) so that regular voltage tests on the outer sheath of the cable phases can be performed.

Earth connections for screen wires, earthing bonds on the termination body/housing etc. shall be designed in such a way that a short circuit current in case of a fault will not damage the termination.

The metallic laminate layer (for radial water tightness) shall be properly connected directly to the screen or the screen connection point on the termination body.

The termination shall be able to withstand normal mechanical axial and radial forces that occur.

6 Straight Through Joint and Repair Joint for Underground Cable System

6.1 General

This specification covers a “Prefabricated Joint” where prefabricated rubber bodies are installed over the prepared cable ends.

The joint will be directly buried in soil. Splicing may be performed both between new cables and between new and existing cables.

The joint shall meet the requirements in SS 4241445 and HD 629.1, which shall be used as a general engineering standard.

The joint shall meet the requirements in IEC 60840, including § 12.4.2 g – test of outer protection for joints (Annex G) or other relevant standard.

6.2 Electrical data

Current capacity (power rating)	Same as for the XLPE-cable
Short time overload capacity	Same as for the XLPE-cable
One phase short circuit current withstand	Same as for the XLPE-cable
DC-voltage test on outer sheath	Same as for the XLPE-cable

6.3 Joint Construction

The joint shall electrically and thermally be dimensioned in accordance with above construction parameters and be fully adapted with the XLPE-cable. The recovering of the screen wires over the joint area shall be made in such a way that a short circuit current in case of a fault will not damage the joint (current level determined by the XLPE-cable screen).

If not otherwise specified, the screen wires on both sides of the cable shall be recovered straight through the joint, i.e. the joint shall not be of cross-bonded or insulated screen end type.

If required by Client, an earth bonding cable (connected to the wire-screen) shall be brought out from the joint. The bonding cable shall be a PE-insulated flexible bonding cable with a copper conductor of at least the same cross sectional area as the cable screen. The bonding cable shall be connected to the screen wires and brought out from the joint to a grounding point.

The metallic laminate layer (for radial water tightness) shall be properly connected to the screen.

The proposed joint shall have a construction which makes it possible to perform regular voltage-tests on the outer sheath of the cable. This means that the recovered screen wires and the bonding cable must be sufficiently insulated from surrounding ground with a mechanical stable suitable outer cover that also fully prevents moisture penetration.

The XLPE-cable shall be supplied with an extruded conductive layer on the outer sheath and the joint shall therefore be supplied with a system for electrical connection of these layers on both sides.

7 Straight Through Joint for Tunnel Cable System

7.1 General

This specification covers a “Prefabricated Joint” where prefabricated rubber bodies are installed over the prepared cable ends.

The joint will be installed in tunnel. Splicing may be performed both between new cables and between new and existing cables.

The joint shall meet the requirements in SS 4241445 and HD 629.1, which shall be used as a general engineering standard.

7.2 Electrical data

Current capacity (power rating)	Same as for the XLPE-cable
Short time overload capacity	Same as for the XLPE-cable
One phase short circuit current withstand	Same as for the XLPE-cable
DC-voltage test on outer sheath	Same as for the XLPE-cable

7.3 Joint construction

The joint shall electrically and thermally be dimensioned in accordance with above construction parameters and be fully adapted with the XLPE-cable. The recovering of the screen wires over the joint area shall be made in such a way that a short circuit current in case of a fault will not damage the joint (current level determined by the XLPE-cable screen).

If not otherwise specified, the screen wires on both sides of the cable shall be recovered straight through the joint, i.e. the joint shall not be of cross-bonded or insulated screen end type.

If required by Client, an earth bonding cable (connected to the wire-screen) shall be brought out from the joint. The bonding cable shall be a PVC/HFFR-insulated flexible bonding cable with a copper conductor of at least the same cross sectional area as the cable screen. The bonding cable shall be connected to the screen wires and brought out from the joint to a grounding point.

The metallic laminate layer (for radial water tightness) shall be properly connected to the screen.

The proposed joint shall have a construction which makes it possible to perform regular voltage-tests on the outer sheath of the cable. This means that the recovered screen wires and the bonding cable must be sufficiently insulated from surrounding ground with a mechanical stable suitable outer cover that also fully prevents moisture penetration.

The XLPE-cable shall be supplied with an extruded conductive layer on the outer sheath and the joint shall therefore be supplied with a system for electrical connection of these layers on both sides.

The joint shall be installed with a cable with the required fire propagation class in chapter 3. The fire propagation properties of the joint shall match that of the cable and shall be proved with test reports. If this cannot be proven the proposal of fire propagation actions for the joint will be subject to Client’s acceptance.

8 Transition Joint

8.1 General

This specification covers a “Prefabricated Joint”, where prefabricated rubber bodies are installed over the prepared cable ends. The joint shall be used for jointing cables where one cable is an underground cable, the other one is a tunnel cable, both with a construction according to this specification. Conductor cross-section of the cables to be specified separately.

The transition joints will be installed in a tunnel (i.e. in air) and the screen wires on both sides of the cable joint shall be connected to two bonding cables that are brought out from the joint and directly earthed, see principle in Figure. The joint shall not be of straight through type.

The joint shall be supplied with an integrated screen separation.

The joint shall meet the requirements in SS 4241445 and HD 629.1, which shall be used as a general engineering standard.

8.2 Electrical data

Current capacity (power rating)	Same as for the XLPE-cable
Short time overload capacity	Same as for the XLPE-cable
One phase short circuit current withstand	Same as for the XLPE-cable
DC-voltage test on outer sheath	Same as for the XLPE-cable

8.3 Joint construction

The joints shall electrically and thermally be dimensioned in accordance with above construction parameters and be fully adapted with the XLPE-cable types.

From each joint two PVC/HFFR-insulated 35 mm² copper bonding leads shall be brought out, one connected to the screen wires of the underground cable and one connected to the screen wires of the existing tunnel cable. After approved voltage test of each group of underground cable sheaths the six (2x3) bonding leads shall, in pairs, be electrically connected together by a permanent method. The length of the leads shall be chosen in such a way that they in case of a fault can be split apart (insulated) for fault location on the underground cable section and then connected together again.

The bundle shall via a 35 mm² insulated copper bonding lead be connected to an earthing link-box or similar, see Figure 1.

The recovering of the screen wires shall be made in such a way that a short circuit current in case of a fault will not damage the joint (current level determined by the XLPE-cable screen).

The metallic laminate layer on the underground XLPE-cable (for radial water tightness) shall be properly connected to the screen.

The proposed joint shall have a construction which makes it possible to perform voltage-tests on the outer sheath of the cable. This means that the recovered screen wires and the bonding cable must be sufficiently

insulated from surrounding ground with a mechanically stable suitable outer cover that also fully prevents moisture penetration.

The proposed joint shall be used with a cable with fire propagation class B2ca -s1, do, a1. Fire propagation properties of joint and/or proposal of fire propagation actions for joint shall be submitted for approval by Ellevio.

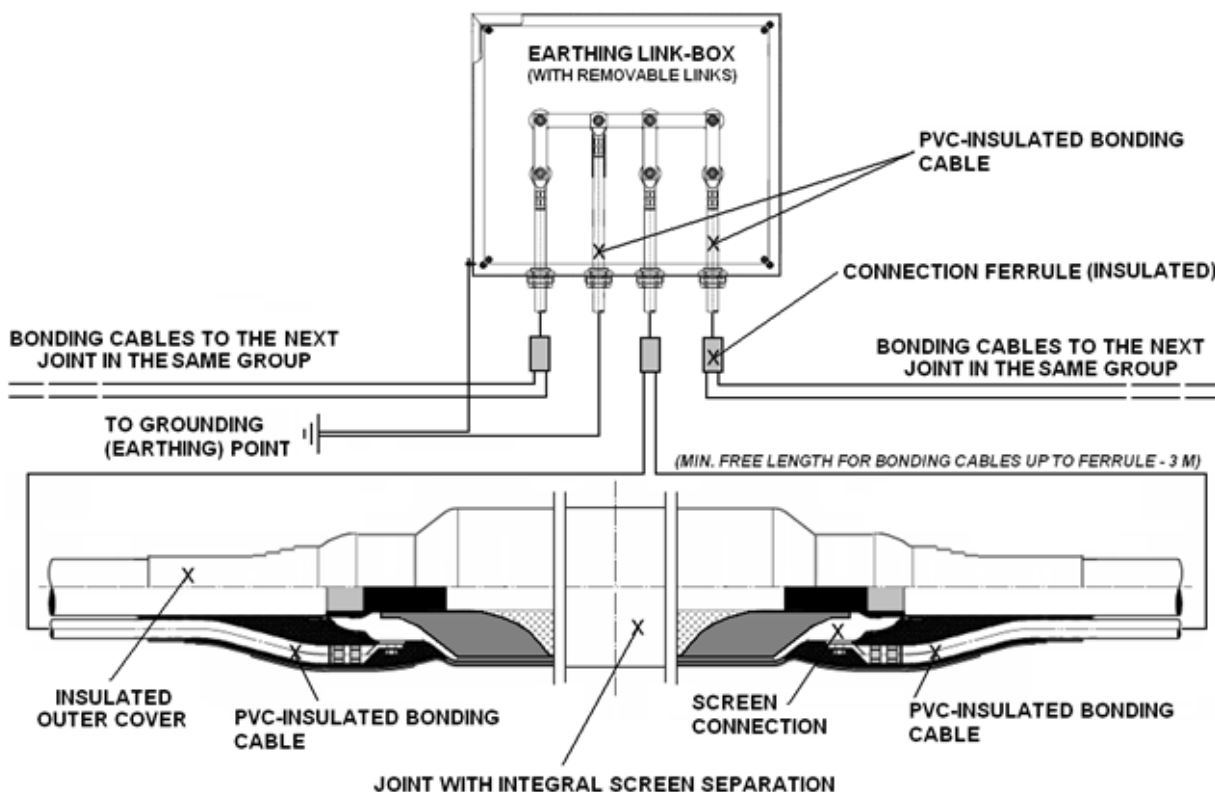


Figure 1 - Principle connection scheme for bonding cables at the transition joints.

9 Type, Sample and Routine Testing

9.1 General

This specification covers testing of a 36 kV cable system with one or several of the items in this specification:

- a) Underground XLPE-cable
- b) XLPE-cable for installation in tunnel
- c) Outdoor termination
- d) Indoor termination
- e) Straight through joint/repair joint for underground cable
- f) Straight through joint for tunnel cable

9.2 Electrical main data

Maximum voltage U_m	36 kV
Rated lightning impulse withstand voltage	170 kV (SS-EN 60071-1)

9.3 Type Test

9.3.1 Electrical tests

Tests shall be performed on a cable length including outdoor termination and joints, according to SS 4241416 attachment A 10M §3.3, which includes the following:

- a) B § 3.3.1 – Bending test
- b) B § 3.3.2 – Partial Discharge-test 27 kV ¹⁾
- c) B § 3.3.3 – Tan δ measurement
- d) B § 3.3.4 – Heating cycle test 36 kV
- e) B § 3.3.5 – Impulse voltage test 170 kV incl. AC-test 45 kV during 15 min.
- f) B § 3.3.6 – Inspection on completion of the tests
- g) B § 3.3.7 – Harmonized long duration test

9.3.2 Non electrical tests

Tests shall be performed on a cable length according to SS 4241416 attachment A 10M §3.4, which includes the following:

- a) B § 3.4.1 - Tests on insulation
- b) B § 3.4.1.1 – Mechanical characteristics before and after ageing
- c) B § 3.4.2 – Tests on core
- d) B § 3.4.2.1 – Shrinkage tests
- e) B § 3.4.3 – Tests on outer sheath
- f) B § 3.4.3.1 – Mechanical characteristics before and after ageing
- g) B § 3.4.3.2 - Pressure test at high temperature
- h) B § 3.4.3.3 – Elongation test at low temperature

¹ Note the demand of a measurement sensitivity ≤ 5 pC or better for both cables and accessories.

- i) B § 3.4.3.4 – Loss of mass test on PVC sheath
- j) B § 3.4.3.5 – Heat shock test on PVC sheath
- k) B § 3.4.3.6 – Carbon black content of PE sheath
- l) B § 3.4.4 – Tests on complete cables
- m) B § 3.4.4.1 – Ageing of pieces of complete cable
- n) B § 3.4.4.2 – Impact test at low temperature
- o) B § 3.4.4.3 – Test under fire conditions
- p) B § 3.4.5 - Other tests
- q) B § 3.4.5.1 – Resistivity of conductor screen and insulation screen
- r) B § 3.4.5.2 – Water penetration test

9.3.3 *Test under fire condition (for installation in tunnels)*

Tests shall be performed according to EN 13501-6.

9.4 **Sample test**

Client shall have the right to witness the sample test of the cable length(s). Notifications of the time and date of the test shall be sent at least 14 days ahead of testing.

9.4.1 *Tests on cable lengths from manufacturing*

The tests shall be performed according to SS 4241416 attachment A 10M §3.2, which includes the following:

- a) B § 3.2.1 – Conductor examination
- b) B § 3.2.2 – Electrical resistance of conductors and metallic screen
- c) B § 3.2.3 – Thickness and irregularities of conductor screen, insulation and insulation screen
- d) B § 3.2.4 – Thickness of non-metallic sheath
- e) B § 3.2.5 – Measurement of external diameter
- f) B § 3.2.6 – Hot set test on insulation
- g) B § 3.2.7 – Adhesion of the insulation screen to the insulation
- h) B § 3.2.8 – Marking and general construction of the cable
- i) Not applicable (B § 3.2.9 – Long duration test)

9.4.2 *Tests on one cable length from manufacturing*

- a) IEC 60502-2 § 19.24 – Water penetration test
- b) IEC 60840 § 12.5.15 – Tests on components of cables with longitudinally applied metal tape or foil, bonded to the oversheath

9.5 **Routine test**

Client shall have the right to witness the routine test of the sample tested length(s) in connection with the witnessing of the sample test.

9.5.1 Tests on each manufactured cable length²⁾

Electrical tests shall be performed according to SS 4241416 attachment A 10M §3.1, which include the following:

- a) B § 3.1.1 - PD-test, 27 kV
- b) B § 3.1.2 - Voltage test on insulation, 60 kV during 15 min.
- c) B § 3.1.3 - Voltage test on non-metallic screen

9.5.2 Tests on main insulation of termination(s) and prefabricated joint(s)

Electrical tests shall be performed according to applicable parts of SS 4241445 which includes PD-test, AC and DC voltage test, etc.

Note the demand of a measurement sensitivity ≤ 5 pC or better for both cables and accessories.

²⁾ Note the demand of a measurement sensitivity ≤ 5 pC or better for both cables and accessories.

10 Test after installation

10.1 Tests on complete cable system performed by contractor.

10.1.1 Phase sequence test

Shall be performed according to an established standard method.

10.1.2 DC-voltage Test on Outer Sheath

MDPE, HDPE sheath: 5 kV DC, 1 min

HFFR sheath: 2 kV DC, 1 min

Maximum permissible leakage currents at sheath test according to SELC-11:005 (see www.selcable.se), see summary in table below:

Sheath material	Test voltage (kV, DC)	Newly installed cable		Maximum leakage current, recurring revisions
		Recommended maximum leakage current	Maximum leakage current with remark	
PE	5	10 μ A/km	1 mA/km	1 mA/km
PVC	2	0,5 mA/km	10 mA/km	50 mA/km
HFFR	2	2 mA/km	50 mA/km	500 mA/km

Table 2 – Maximum leakage current at testing of the outer sheath

10.2 Test on complete cable system performed by Client

10.2.1 AC voltage test of the insulation

AC voltage test on the complete cable installation shall be performed at normal operating voltage or at least U_0 during 24 h.

A.Data Sheet - Underground Cable

1. CONSTRUCTION DATA

1.1	Conductor		
1.1.1	Type (segmented, compacted etc.)		
1.1.2	Material		
1.1.3	Cross sectional area		mm ²
1.1.4	Nominal diameter		mm
1.1.5	Allowable tensile strength		N/mm ²
1.1.6	Number of segments in the conductor		pcs.
1.1.7	Number of wires in each segment		pcs.
1.1.8	Longitudinal water sealing system: - type description (swelling powder/yarn etc.) - test report enclosed with bid (Y/N)		

1.2	Insulation System		
1.2.1	Conductor screen		
1.2.1.1	Material		
1.2.1.2	Nominal thickness		mm
1.2.1.3	Min. thickness		mm
1.2.2	XLPE-Insulation		
1.2.2.1	Material (type of quality etc.)		
1.2.2.2	Nominal insulation thickness		mm
1.2.2.3	Min. insulation thickness at any point around circumference		mm
1.2.2.4	Diameter over insulation		mm
1.2.3	Insulation screen		
1.2.3.1	Material		
1.2.3.2	Nominal thickness		mm
1.2.3.3	Min. thickness		mm

1.2.3.4	Type of extruding and vulcanisation process (cond. screen + insulation + insul. screen)	
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1.3	Screen, longitudinal and radial water sealing system	
1.3.1	Longitudinal water sealing system underneath screen wires: - type description (swelling tapes etc.) - test report enclosed with bid (Y/N)	
1.3.2	Nominal thickness	mm
1.3.3	Screen, material and type	
1.3.4	Screen, nominal wire diameter	mm
1.3.5	Screen, number of wires	pcs.
1.3.6	Pitch angle	deg
1.3.7	Screen, cross-sectional area	mm ²
1.3.8	Type and dimensions of copper counter helix tape(-s)	
1.3.9	Copper counter helix tape(-s) cross-sectional area	mm ²
1.3.10	Longitudinal water sealing layers above screen wires: - type description (swelling tapes etc.) - test report enclosed with bid (Y/N)	
1.3.11	Nominal thickness of longitudinal water sealing layer	mm
1.3.12	Radial water sealing layer: - type description (Al-foil/Cu-foil/laminate/tape) - layer bonded to the outer sheath (Y/N)	
1.3.13	Radial water sealing layer: - nominal thickness of Al/Cu - nominal thickness of entire foil	mm mm
1.3.14	AL-foil/Cu-foil cross-sectional area	mm ²
1.3.15	Diameter (centre of screen and water sealing systems)	mm

1.4	Outer PE-sheath	
1.4.1	Material (extruded MDPE or HDPE)	
1.4.2	Material density	kg/dm ³
1.4.3	Nominal thickness	mm

1.4.4	Min. thickness (at any point around circumference)		mm
1.4.5	Colour		

1.5	Outer conductive layer (for DC-voltage testing of outer sheath)		
1.5.1	Material		
1.5.2	Nominal thickness		mm
1.5.3	Colour		
1.5.4	Application process	Extruded and bonded to the outer sheath	

1.6	Reaction to fire Properties		
1.6.1	Class of reaction to fire		
1.6.2	Smoke production classification		
1.6.3	Flaming droplets/particles classification		
1.6.4	Acidity classification		

1.7	Cable dimensions and weight		
1.7.1	Nominal overall cable diameter		mm
1.7.2	Nominal weight of complete cable		kg/m

2. ELECTRICAL AND THERMAL DATA

Impedance and inductance calculations shall be based on the following:

Phases in trefoil formation, screens solidly earthed in both ends.

2.1	Electrical and thermal data		
2.1.1	Max. AC system voltage		kV
2.1.2	Lightning impulse level		kV
2.1.3	Max. conductor DC resistance at 20 °C		Ω/km
2.1.4	Permissible conductor temperature: - at max. continuous current (≥ 90 °C) - at short circuit		°C °C
2.1.5	Max. conductor AC resistance at: - 90 °C - 65 °C		Ω/km Ω/km

2.1.6	Screen earthing system		
2.1.7	Nominal capacitance of cable		μF/km
2.1.8	Inductance of cable		mH/km
2.1.9	Positive and negative sequence impedance (R+jX) at 50 Hz and continuous conductor temperature 65 °C		Ω/km
2.1.10	Zero sequence impedance (R+jX) at 50 Hz and continuous conductor temperature 65 °C		Ω/km
2.1.11	Positive and negative sequence impedance (R+jX) at 50 Hz and continuous conductor temperature 90 °C		Ω/km
2.1.12	Zero sequence impedance (R+jX) at 50 Hz and continuous conductor temperature 90 °C		Ω/km
2.1.13	Nominal electric field strength at Um - at insulation screen - at conductor screen		kV/mm kV/mm
2.1.14	Permissible short circuit current in copper wire screen at continuous current capacity (90 °C initial conductor temperature): - during 0.5 s - during 1.0 s		kA kA

3. DOCUMENTATION, SERVICE EXPERIENCE ETC.

3.1	Drawings and documents <u>to be enclosed</u>		
3.1.1	Sectional drawing No.		
3.1.2	Type test reports No. (incl. documentation covering longitudinal water sealing systems)		
3.1.3	Reference list No.		

4. CABLE HANDLING AND DRUM DATA

4.1	Cable handling data		
4.1.1	Minimum cable bending radius: - at laying - when installed (single bending)		m m
4.1.2	Maximum pulling force in conductor		kN
	Maximum pulling force with pulling stock applied on the outside of cable		kN

4.2	Drum data (delivery lengths see separate documentation !)		
4.2.1	Cable length on drum		m
4.2.2	Type of drums (wood/steel)		
4.2.3	Drum width		mm
4.2.4	Outer drum diameter		mm
4.2.5	Barrel diameter		mm
4.2.6	Spindle hole diameter		mm
4.2.7	Total weight (cable and drum)		kg

B.Data Sheet - Tunnel Cable

1. CONSTRUCTION DATA

1.1	Conductor		
1.1.1	Type (round, compacted etc.)		
1.1.2	Material		
1.1.3	Cross sectional area		mm ²
1.1.4	Nominal diameter		mm
1.1.5	Allowable tensile strength		N/mm ²
1.1.6	Number of segments in the conductor		pcs.
1.1.7	Number of wires in the conductor		pcs.
1.1.8	Longitudinal water sealing system: - type description (swelling powder/yarn etc.) - test report enclosed with bid (Y/N)		

1.2	Insulation System		
1.2.1	Conductor screen		
1.2.1.1	Material		
1.2.1.2	Nominal thickness		mm
1.2.1.3	Min. thickness		mm
1.2.2	XLPE-Insulation		
1.2.2.1	Material (type of quality etc.)		
1.2.2.2	Nominal insulation thickness		mm
1.2.2.3	Min. insulation thickness at any point around circumference		mm
1.2.2.4	Diameter over insulation		mm
1.2.3	Insulation screen		
1.2.3.1	Material		
1.2.3.2	Nominal thickness		mm
1.2.3.3	Min. thickness		mm

1.2.3.4	Type of extruding and vulcanisation process (cond. screen + insulation + insul. screen)	
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1.3	Screen, longitudinal and radial water sealing system	
1.3.1	Longitudinal water sealing system underneath screen wires: - type description (swelling tapes etc.) - test report enclosed with bid (Y/N)	
1.3.2	Nominal thickness	mm
1.3.3	Screen, material and type	
1.3.4	Screen, nominal wire diameter	mm
1.3.5	Screen, number of wires	pcs.
1.3.6	Pitch angle	deg
1.3.7	Screen, cross-sectional area	mm ²
1.3.8	Type and dimensions of copper counter helix tape(-s)	
1.3.9	Copper counter helix tape(-s) cross-sectional area	mm ²
1.3.10	Longitudinal water sealing layers above screen wires: - type description (swelling tapes etc.) - test report enclosed with bid (Y/N)	
1.3.11	Nominal thickness of longitudinal water sealing layer	mm
1.3.12	Radial water sealing layer: - type description (Al-foil/Cu-foil/laminate/tape) - layer bonded to the outer sheath (Y/N)	
1.3.13	Radial water sealing layer: - nominal thickness of Al/Cu - nominal thickness of entire foil	mm mm
1.3.14	AL-foil/Cu-foil cross-sectional area	mm ²
1.3.15	Diameter (centre of screen and water sealing systems)	mm

1.4	Outer PE-sheath	
1.4.1	Material (extruded HFFR)	
1.4.2	Material density	kg/dm ³
1.4.3	Nominal thickness	mm

1.4.4	Min. thickness (at any point around circumference)		mm
1.4.5	Colour		

1.5	Outer conductive layer (for DC-voltage testing of outer sheath)		
1.5.1	Material		
1.5.2	Nominal thickness		mm
1.5.3	Colour		
1.5.4	Application process	Extruded and bonded to the outer sheath	

1.6	Reaction to fire Properties		
1.6.1	Class of reaction to fire		
1.6.2	Smoke production classification		
1.6.3	Flaming droplets/particles classification		
1.6.4	Acidity classification		

1.7	Cable dimensions and weight		
1.7.1	Nominal overall cable diameter		mm
1.7.2	Nominal weight of complete cable		kg/m

2. ELECTRICAL AND THERMAL DATA

Impedance and inductance calculations shall be based on the following:

Phases in trefoil formation, screens solidly earthed in both ends.

2.1	Electrical and thermal data		
2.1.1	Max. AC system voltage		kV
2.1.2	Lightning impulse level		kV
2.1.3	Max. conductor DC resistance at 20 °C		Ω/km
2.1.4	Permissible conductor temperature: - at max. continuous current (≥ 90 °C) - at short circuit		°C °C
2.1.5	Max. conductor AC resistance at: - 90 °C - 65 °C		Ω/km Ω/km

2.1.6	Screen earthing system		
2.1.7	Nominal capacitance of cable		μF/km
2.1.8	Inductance of cable		mH/km
2.1.9	Positive and negative sequence impedance (R+jX) at 50 Hz and continuous conductor temperature 65 °C		Ω/km
2.1.10	Zero sequence impedance (R+jX) at 50 Hz and continuous conductor temperature 65 °C		Ω/km
2.1.11	Positive and negative sequence impedance (R+jX) at 50 Hz and continuous conductor temperature 90 °C		Ω/km
2.1.12	Zero sequence impedance (R+jX) at 50 Hz and continuous conductor temperature 90 °C		Ω/km
2.1.13	Nominal electric field strength at Um - at insulation screen - at conductor screen		kV/mm kV/mm
2.1.14	Permissible short circuit current in copper wire screen at continuous current capacity (90 °C initial conductor temperature): - during 0.5 s - during 1.0 s		kA kA

3. DOCUMENTATION, SERVICE EXPERIENCE ETC.

3.1	Drawings and documents <u>to be enclosed</u>		
3.1.1	Sectional drawing No.		
3.1.2	Type test reports No. (incl. documentation covering longitudinal water sealing systems)		
3.1.3	Reference list No.		

4. CABLE HANDLING AND DRUM DATA

4.1	Cable handling data		
4.1.1	Minimum cable bending radius: - at laying - when installed (single bending)		m m
4.1.2	Maximum pulling force in conductor		kN
4.1.3	Maximum pulling force with pulling stock applied on the outside of cable		kN

4.2	Drum data (delivery lengths see separate documentation !)		
4.2.1	Cable length on drum		m
4.2.2	Type of drums (wood/steel)		
4.2.3	Drum width		mm
4.2.4	Outer drum diameter		mm
4.2.5	Barrel diameter		mm
4.2.6	Spindle hole diameter		mm
4.2.7	Total weight (cable and drum)		kg

C.Data Sheet - Outdoor Termination

1. CONSTRUCTION DATA

1.1	Type of termination (fluid filled, dry type etc.)	
1.2	Type designation and manufacturer	
1.3	Type of system for insulation of cable screen from earth at the termination	
1.4	Type of insulator	
1.5	Type of connection on termination for the screen wire bundle	
1.6	Description of connection of the metallic Al- lamine to the screen wires	
1.7	Colour of insulator body	

2. ELECTRICAL & CLIMATIC MAIN DATA

2.1	Maximum operating AC voltage		kV
2.2	Lightning impulse withstand voltage		kV
2.3	Continuous and overload current capacity		A
2.4	Creepage distance: - total - protected		mm mm
2.5	Mechanical loads on the top bolt: - in 90° angle to the termination - axially		N N
2.6	Top bolt: - material - surface treatment		
2.7	Top bolt dimensions: - Ø (diameter) - length (for jumper-wire clamp)		mm mm
2.8	Short circuit withstand for the bonding cable to screen connection at the termination		kA
2.9	Max. installation inclination		Degrees
2.10	Weight of complete termination (including filling compound)		kg
2.11	Rated ambient temperature conditions -min -max		°C °C



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2.12	Rated wind conditions -max		m/s
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3. DOCUMENTATION, SERVICE EXPERIENCE ETC.

3.1	Enclosed reference list No./Nos.	
3.2	Enclosed sectional drawing No./Nos.	
3.3	Enclosed type test report No./Nos.	
3.4	Approximately number of 36 kV outdoor terminations of actual type: - sold - in commercial operation - first year of commercial operation	

D.Data Sheet - GIS Termination

1. CONSTRUCTION DATA

1.1	Type of GIS-termination	
1.2	Type designation and manufacturer of GIS-termination	
1.3	Type and description of main-insulator body (epoxy etc.)	
1.4	Method for connection conductor-top bolt (welding, press sleeve, shear-off bolt connection etc.)	
1.5	Method for electric contact between top bolt and top terminal (silver plated electric contacts etc.)	
1.6	Material of stress cone (EPDM-rubber, silicone-rubber etc.)	
1.7	Minimum SF6 gas-pressure withstand (within the metallic enclosure, $\geq 0,85$ MPa)	MPa (abs.)
1.8	Type of system for insulation of cable screen from earth at the termination.	
1.9	Type of connection on termination of the screen wire bundle and a 150 mm ² bonding cable to be brought to an earthing point	
1.10	Description of connection of the metallic laminate (radial water sealing) to the screen wires within termination	
1.11	Method for removal of the outer conductive layer on the XLPE-cable at the termination	
1.12	Description and requirement for fastening/clamping of XLPE-cable beneath the termination body (number of clamps, distance between clamps etc.)	
1.13	Weight of complete termination	Kg
1.14	Dimensions of GIS-termination complies with IEC 62271-209/2007 (Y/N)	
1.15	Termination capable to withstand vacuum conditions occurring during the gas filling of metallic switchgear enclosure (Y/N)	
1.16	Description of considerations (assembly, handling, test voltage limits etc.) to be taken in case of a pre-installation of the main-insulator (epoxy etc.) during GIS-manufacturing, see IEC 62271-209 § 8.1	



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2. ELECTRICAL MAIN DATA

2.1	Maximum operating AC voltage		kV
2.2	Lightning impulse withstand voltage		kV
2.3	Continuous and overload current capacity		A
2.8	Short circuit withstand for the bonding cable to screen connection at the termination		kA
2.10	Weight of complete termination (including filling compound)		kg

3. DOCUMENTATION, SERVICE EXPERIENCE ETC.

3.1	Enclosed reference list No./Nos.	
3.2	Enclosed sectional drawing No./Nos.	
3.3	Enclosed type test report No./Nos.	
3.4	Approximately number of 36 kV outdoor terminations of actual type: - sold - in commercial operation - first year of commercial operation	

E.Data Sheet - Underground Cable Joint

1. CONSTRUCTION DATA

1.1	Type of straight through/repair joint (e.g. prefabricated rubber type etc)		
1.2	Type designation and manufacturer of joint		
1.3	Continuous current capacity	Same as for the cable !	A
1.4	Maximum permissible conductor temperature in the joint: - at max. permissible continuous current - at short circuit		°C °C
1.5	Method and material for conductor jointing (welding, press sleeve, bolt connection, sleeve with electric contacts etc.)		
1.6	Tensile load strength of the conductor joint		kN
1.7	Type and description of main insulation body (one-piece, multi piece, specific technical characteristics etc.)		
1.8	Material of main insulation body (EPDM-rubber, silicone-rubber, XLPE etc.)		
1.9	Method and material for recovering and connection of the copper wire screen at both ends of the joint		
1.10	Description of electric connection of the metallic laminate/tape (radial water sealing layer) to the screen wires within joint		
1.11	Method and material for connection of bonding cable to the screen wires		
1.12	One-phase short circuit current withstand for screen and bonding cable connection	Same or higher as for the cable screen !	kA
1.13	Description of protective outer cover (method, material etc.)		
1.14	Method and material for connection of the conductive layers (on cable outer covering) on both sides of the joint		

2. ELECTRICAL AND THERMAL DATA

2.1	Maximum operating/system AC voltage		kV
2.2	Lightning impulse withstand voltage		kV
2.3	Lightning impulse levels for the integrated screen separation (IEC 60840) - Between parts - Each part to earth		kV kV
2.3	Continuous and overload current capacity		A



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2.4	Maximum permissible conductor temperature in the joint: - at max. permissible continuous current - at short circuit		°C °C
2.5	One-phase short circuit current withstand for the straight through screen connection - during 0.5 s - during 1.0 s		kA kA

3. DOCUMENTATION, SERVICE EXPERIENCE ETC.

3.1	Tests of outer protection of joint performed according to "IEC 60840" (Y/N)	
3.2	Sectional drawing Nos.	
3.3	Type test reports Nos.	
3.4	Reference list No.	
3.5	Approximately number of 36 kV joints of actual type: - sold - in commercial operation - first year of commercial operation	

F. Data Sheet - Tunnel Cable Joint

1. CONSTRUCTION DATA

1.1	Type of straight through/repair joint (e.g. prefabricated rubber type etc)		
1.2	Type designation and manufacturer of joint		
1.3	Continuous current capacity	Same as for the cable !	A
1.4	Maximum permissible conductor temperature in the joint: - at max. permissible continuous current - at short circuit		°C °C
1.5	Method and material for conductor jointing (welding, press sleeve, bolt connection, sleeve with electric contacts etc.)		
1.6	Tensile load strength of the conductor joint		kN
1.7	Type and description of main insulation body (one-piece, multi piece, specific technical characteristics etc.)		
1.8	Material of main insulation body (EPDM-rubber, silicone-rubber, XLPE etc.)		
1.9	Method and material for recovering and connection of the copper wire screen at both ends of the joint		
1.10	Insulated flexible bonding cable connected to the screen wires - Cross-sectional area - PVC/HFFR-insulation (Y/N)		mm ²
1.11	Description of electric connection of the metallic laminate/tape (radial water sealing layer) to the screen wires within joint		
1.12	Method and material for connection of bonding cable to the screen wires		
1.13	One-phase short circuit current withstand for screen and bonding cable connection	Same or higher as for the cable screen !	kA
1.14	Description of and material used for the protective outer cover (heat-shrinkable tubes, adhesive tapes, metallic casing, glass-fibre shells etc.)		
1.15	Method and material for the connection of the conductive layers (on the cable outer covering) on both sides of the joint		
1.16	Method and material for matching the fire propagation class of the cable.		

2. ELECTRICAL AND THERMAL DATA

2.1	Maximum operating/system AC voltage		kV
2.2	Lightning impulse withstand voltage		kV
2.3	Lightning impulse levels for the integrated screen separation, if applicable (IEC 60840) - Between parts - Each part to earth		kV kV
2.3	Continuous and overload current capacity		A
2.4	Maximum permissible conductor temperature in the joint: - at max. permissible continuous current - at short circuit		°C °C
2.5	One-phase short circuit current withstand for the straight through screen connection - during 0.5 s - during 1.0 s		kA kA

3. DOCUMENTATION, SERVICE EXPERIENCE ETC.

3.1	Tests of outer protection of joint performed according to "IEC 60840" (Y/N)	
3.2	Sectional drawing Nos.	
3.3	Type test reports Nos.	
3.4	Reference list No.	
3.5	Approximately number of 36 kV joints of actual type: - sold - in commercial operation - first year of commercial operation	

G. Data Sheet - Transition Joint

1. CONSTRUCTION DATA

1.1	Type of transition joint ("Prefabricated rubber type")		
1.2	Type designation and manufacturer of repair joint		
1.3	Continuous current capacity	Same as for the cable !	A
1.4	Maximum permissible conductor temperature in the joint: - at max. permissible continuous current - at short circuit		°C °C
1.6	Method and material for conductor jointing (welding, press sleeve, bolt connection, sleeve with electric contacts etc.)		
1.6	Tensile load strength of the conductor joint		kN
1.7	Type and description of main insulation body (one-piece, multi piece, specific technical characteristics etc.)		
1.8	Material of main insulation body (EPDM-rubber, silicone-rubber etc.)		
1.9	Method and material for the sectionalizing parts of the joint		
1.10	Insulated flexible bonding cable connected to the screen wires - Cross-sectional area - PVC/HFFR-insulation (Y/N)		mm ²
1.11	Description of electric connection of the metallic Al-laminate/tape (radial water sealing layer) to the screen wires within joint		
1.12	Method and material for connection of bonding cable to the screen wires		
1.13	One-phase short circuit current withstand for screen and bonding cable connection	Same or higher as for the cable screen !	kA
1.14	Description of and material used for the protective outer cover (heat-shrinkable tubes, adhesive tapes, metallic casing, glass-fibre shells etc.)		
1.15	Method and material for the connection of the conductive layers (on the cable outer covering) on both sides of the joint.		
1.16	Construction makes it possible to perform regular voltage-tests on the outer sheath of the cable (Y/N)		

2. ELECTRICAL AND THERMAL DATA

2.1	Maximum operating/system AC voltage		kV
2.2	Lightning impulse withstand voltage		kV
2.3	Lightning impulse levels for the integrated screen separation, if applicable (IEC 60840) - Between parts - Each part to earth		kV kV
2.3	Continuous and overload current capacity		A
2.4	Maximum permissible conductor temperature in the joint: - at max. permissible continuous current - at short circuit		°C °C
2.5	One-phase short circuit current withstand for the straight through screen connection - during 0.5 s - during 1.0 s		kA kA

3. DOCUMENTATION, SERVICE EXPERIENCE ETC.

3.1	Tests of outer protection of joint performed according to "IEC 60840" (Y/N)	
3.2	Sectional drawing Nos.	
3.3	Type test reports Nos.	
3.4	Reference list No.	
3.5	Approximately number of 36 kV joints of actual type: - sold - in commercial operation - first year of commercial operation	