KEMA TYPE TEST CERTIFICATE OF COMPLETE TYPE TESTS

Object	Three-core power cable	**1142-20**
Type	19/33(36) kV 3x185 mm^2 Cu/XLPE/SWA/PVC CABLE	

Rated voltage, U_0/U (U_m)	19/33 (36) kV	Conductor material	Cu
Conductor cross-section	3x185 mm^2	Insulation material	XLPE

Manufacturer	Energya Power Cable – Elsewedy Helal Industrial Zone A, 10th of Ramadan City, Egypt*)
Client	Energya Power Cable – Elsewedy Helal Industrial Zone A, 10th of Ramadan City, Egypt*)
Tested by	KEMA B.V., Klingelbeekseweg 195, Arnhem, The Netherlands
Date of tests	5 March to 24 June 2020

The test object, constructed in accordance with the description, drawings and photographs incorporated in this certificate has been subjected to the series of proving tests in accordance with

BS 6622: 2007

The results are shown in the record of Proving Tests and the oscillograms attached hereto. The values obtained and the general performance are considered to comply with the above Standards and to justify the ratings assigned by the manufacturer as listed on page 6.

This Certificate applies only to the object tested. The responsibility for conformity of any object having the same type references as that tested rests with the Manufacturer.
*) as declared by the manufacturer

This Certificate consists of 56 pages in total.

KEMA B.V.

Bas Verhoeven
Director, High-Voltage Laboratory

Arnhem, 25 June 2020

INFORMATION SHEET

1 KEMA Type Test Certificate

A KEMA Type Test Certificate contains a record of a series of (type) tests carried out in accordance with a recognized standard. The object tested has fulfilled the requirements of this standard and the relevant ratings assigned by the manufacturer are endorsed by KEMA Labs. In addition, the object's technical drawings have been verified and the condition of the object after the tests is assessed and recorded.
The Certificate contains the essential drawings and a description of the object tested. A KEMA Type Test Certificate signifies that the object meets all the requirements of the named subclauses of the standard. It can be identified by gold-embossed lettering on the cover and a gold seal on its front sheet.
The Certificate is applicable to the object tested only. KEMA Labs is responsible for the validity and the contents of the Certificate. The responsibility for conformity of any object having the same type references as the one tested rests with the manufacturer.
Detailed rules on types of certification are given in KEMA Labs' Certification procedure applicable to KEMA Labs.

2 KEMA Report of Performance

A KEMA Report of Performance is issued when an object has successfully completed and passed a subset (but not all) of test programmes in accordance with a recognized standard. In addition, the object's technical drawings have been verified and the condition of the object after the tests is assessed and recorded. The report is applicable to the object tested only. A KEMA Report of Performance signifies that the object meets the requirements of the named subclauses of the standard. It can be identified by silver-embossed lettering on the cover and a silver seal on its front sheet.
The sentence on the front sheet of a KEMA Report of Performance will state that the tests have been carried out in accordance with …… The object has complied with the relevant requirements.

3 KEMA Test Report

A KEMA Test Report is issued in all other cases. Reasons for issuing a KEMA Test Report could be:

- Tests were performed according to the client's instructions.
- Tests were performed only partially according to the standard.
- No technical drawings were submitted for verification and/or no assessment of the condition of the object after the tests was performed.
- The object failed one or more of the performed tests.

The KEMA Test Report can be identified by the grey-embossed lettering on the cover and grey seal on its front sheet.
In case the number of tests, the test procedure and the test parameters are based on a recognized standard and related to the ratings assigned by the manufacturer, the following sentence will appear on the front sheet. The tests have been carried out in accordance with the client's instructions. Test procedure and test parameters were based on ..... If the object does not pass the tests such behaviour will be mentioned on the front sheet. Verification of the drawings (if submitted) and assessment of the condition after the tests is only done on client's request.
When the tests, test procedure and/or test parameters are not in accordance with a recognized standard, the front sheet will state the tests have been carried out in accordance with client's instructions.

4 Official and uncontrolled test documents

The official test documents of KEMA Labs are issued in bound form. Uncontrolled copies may be provided as a digital file for convenience of reproduction by the client. The copyright has to be respected at all times.

5 Accreditation of KEMA Laboratories

The KEMA Labs are accredited in accordance with ISO/IEC 17025 by the respective national accreditation bodies. KEMA Labs Arnhem, The Netherlands, is accredited by RvA under nos. L020, L218, K006 and K009. KEMA Labs Chalfont, United States, is accredited by A2LA under no. 0553.01. KEMA Labs Prague, the Czech Republic, is accredited by CAI as testing laboratory no. 1035.

REVISION OVERVIEW

Rev. No	Date of issue	Reason for issue
0	25 June 2020	First issue

TABLE OF CONTENTS

1 IDENTIFICATION OF THE OBJECT TESTED

1.1 Ratings/characteristics of the object tested

Rated voltage, U_0/U (U_m)	19/33 (36) kV
Rated maximum conductor temperature in normal operation	90 °C
Rated conductor cross-section	3x185 mm^2

1.2 Description of the object tested

Standard	BS 6622:2007
Manufacturer	Energya Power Cables – Elsewedy Helal Industrial Zone A, 10th of Ramadan City, Egypt
Type	19/33 kV 3x185 mm^2 XLPE/SWA/PVC Cable
Manufacturing year	2019
Quantity submitted	95 m
Rated voltage, U_0/U (U_m)	19/33 (36) kV
Nominal capacitance between conductor and metal screen	0,19 µF/km
No. of cores	3
Core identification	core 1 = brown core 2 = grey core 3 = black
Overall diameter	104,6 mm
Marking on the oversheath	ENERGYA POWER CABLES-ELSEWEDY HELAL ELECTRIC CABLE Cu/XLPE/SWA/PVC 33000 V BS 6622 3 X 185 MM2 2019 Meter marking Line 2 ELECTRIC CABLE 33000 V BS 6622
Construction	see List of drawings

Conductor

• material	copper
• cross-section	185 mm^2
• nominal diameter	15,8 mm
• type	compacted stranded
• maximum conductor temperature in normal operation	90°C
• presence and nature of measures to achieve longitudinal watertightness	no

Conductor screen

• material	semi-conducting PE
• nominal thickness	0,5 mm
• material designation	known in KEMA Labs' files
• manufacturer of the material	known in KEMA Labs' files

Insulation

- material XLPE
- nominal thickness 8 mm
- nominal inner diameter of the insulation 16,8 mm
- nominal outer diameter of the insulation 32,8 mm
- material designation known in KEMA Labs' files
- manufacturer of the material known in KEMA Labs' files

Insulation (core) screen

- material semi-conducting PE
- strippable no
- nominal thickness 0,5 mm
- material designation known in KEMA Labs' files
- manufacturer of the material known in KEMA Labs' files

Metal screen

- material copper tape
- number of wires/tapes one tape
- thickness and width of binder tapes 0,075 x 40 mm overlap 10% (approx.)
- cross-sectional area 5 mm^2

Inner coverings and fillers

- material polypropylene filler

Separation sheath

- material PVC
- nominal thickness 1,48 mm (minimum)
- manufacturer of the material known in KEMA Labs' files

Metal armour

- material galvanized steel wires
- number of wires 83
- nominal diameter of wires 3,15 ± 5% mm
- manufacturer of the material known in KEMA Labs' files

Oversheath

- material PVC type 9
- nominal thickness 3,3 mm (minimum)
- nominal overall diameter of the cable (D) 104,6 mm
- material designation known in KEMA Labs' files
- manufacturer of the material known in KEMA Labs' files
- colour black
- graphite coating applied no

Fire retardant (according to IEC 60332-1) yes

Manufacturing details insulation system

- location of manufacturing: Industrial Zone A, 10th of Ramadan City, Egypt
- type of extrusion line: CCV
- type of extrusion: triple common extrusion
- factory identification of extrusion line: CCV1
- manufacturer of the extrusion line: known in KEMA Labs' files
- identification of production batch: 247/19
- curing means: dry
- cooling means: water
- manufacturing length (where cable sample for testing has been taken from): 300 m
- length markings on cable sample sent to KEMA Labs: begin: 069 m, end: 164 m

1.3 Description of the object subjected to the adherence of screens test

Voltage	19/33 kV
Number of cores	1
Frequency	50 Hz
Conductor:	
• Material	copper
• Cross-section	185 mm^2
• Maximum rated temperature	250 °C
• Insulation material	XLPE
Metallic screen:	
• Material	copper tape
• Cross-section	5 mm^2
Armouring	steel wires

1.4 List of drawings

The manufacturer has guaranteed that the object submitted for tests has been manufactured in accordance with the following drawings and/or documents. KEMA Labs has verified that these drawings and/or documents adequately represent the object tested. The manufacturer is responsible for the correctness of these drawings and/or documents and the technical data presented.

The following drawings and/or documents have been included in this Certificate

Drawing no./document no.	Revision
CT19X503W1	1

2 GENERAL INFORMATION

2.1 The tests were witnessed by

The tests were carried out without a representative of the client present.

2.2 The tests were carried out under responsibility of

Name	Company
A. Kumar,	KEMA B.V.,
H. van Zuilen,	Arnhem, The Netherlands
S. van der Weiden,	
D. Minkhorst	

2.3 Measurement uncertainty

A table with measurement uncertainties is enclosed in this Certificate. Unless otherwise stated, the measurement uncertainties of the results presented in this Certificate are as indicated in that table.

3 TYPE TESTS - ELECTRICAL

3.1 Test arrangement

3.1.1 Determination of the cable conductor temperature

Standard
Standard BS EN 61442

For the tests at elevated temperature, a reference loop for temperature control of the conductor was installed and conductor current was used for heating. The reference cable was cut from the total cable length intended for the type test. This reference loop was installed close to the test loop in order to create the same environmental conditions as for the test loop.

This reference loop was connected in series with the test loop, thus the conductor temperature of the reference loop is representative for the conductor temperature of the test loop. Annex G was used as a guide and Annex G, subclause G.3.1, method 1 was applied.

The tests at elevated temperature are carried out after the conductor temperature has been within the stated limit for at least 2 hours. All three phase of both the reference loop and the test loop carried the same level three phase current. Annex A method 1 of IEC 60840 was used as a guide.

3.1.2 Photograph of test set-up

3.2 Bending test

Standard and date

Standard BS 6622, subclause 20.3
Test date 5 March 2020

Environmental conditions

Ambient temperature 8 °C

Characteristic test data

Temperature of test object 8 °C
Maximum bending diameter 12(d + D)
Length of cable bended 19 m

Actual external diameter of cable D	Actual diameter of cable conductor d	Maximum bending diameter D_r	Diameter of test cylinder D_t
mm	mm	mm	mm
106,5	15,8	≤ 1468	1370

Result

The test was carried out successfully.

3.3 Partial discharge test

Standard and date

Standard	BS 6622, subclause 17.5
Test date	16 March 2020

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	20 °C
Circuit	direct
Calibration	10 pC
Noise level at 2,0 U_0	2 pC
Declared sensitivity	4 pC
Required sensitivity	≤ 10 pC
Centre frequency	2,1 MHz
Bandwidth (Δf)	650 kHz
Test frequency	50 Hz
Coupling capacitor	2,6 nF

Core	Voltage applied, 50 Hz		Duration	Partial discharge level
	... x U_0	kV	s	pC
1	2,25	42,8	< 60	-
	2,0	38	-	Not detectable
2	2,25	42,8	< 60	-
	2,0	38	-	Not detectable
3	2,25	42,8	< 60	-
	2,0	38	-	Not detectable

Note

This PD measurement also covers the PD measurement before the bending test and therefore we have omitted the PD measurement before the bending test.

Requirement

The magnitude of discharge on each core shall not exceed 10 pC at 2,0 U_0.

Result

The object passed the test.

3.4 Tan δ in relation to voltage

Standard and date

Standard BS 6622, subclause 20.4
Test date 16 March 2020

Environmental conditions

Ambient temperature 20 °C

Characteristic test data

Temperature of test object 20 °C
Length of each core 16,8 m
Standard capacitor 99,918 pF

Core	Voltage applied, 50 Hz		Capacitance of core [1]	Tan δ	maximum increase of Tan δ
	....x U_o	kV	µF/km		
1	0,5	9,5	0,19	$4,6 \times 10^{-4}$	$1,0 \times 10^{-4}$
	1	19	0,19	$5,3 \times 10^{-4}$	
	2	38	0,19	$5,6 \times 10^{-4}$	
2	0,5	9,5	0,19	$5,7 \times 10^{-4}$	$2,0 \times 10^{-4}$
	1	19	0,19	$6,3 \times 10^{-4}$	
	2	38	0,19	$7,8 \times 10^{-4}$	
3	0,5	9,5	0,19	$5,2 \times 10^{-4}$	$0,4 \times 10^{-4}$
	1	19	0,19	$5,4 \times 10^{-4}$	
	2	38	0,19	$5,6 \times 10^{-4}$	

[1] for information only

Requirement

The measured value shall not be higher than 40×10^{-4} at U_o. The maximum increase in tan δ from 0,5 U_o to 2 U_o shall not be higher than 20×10^{-4}.

Result

The object passed the test.

3.5 Tan δ in relation to temperature

Standard and date

Standard	BS 6622, subclause 20.5
Test date	18 March 2020

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	97 °C
Length of test object	16,8 m
Standard capacitor	99,918 pF

Measured at ambient temperature 20°C

Core	Voltage applied, 50 Hz	Capacitance of core [1] µF/km	Tan δ
1+2+3	5	0,19	$4{,}1 \times 10^{-4}$
[1] for information only			

Measured at elevated temperature of 97 °C

Core	Voltage applied, 50 Hz	Capacitance of core [1] µF/km	Tan δ
1+2+3	5	0,18	$5{,}5 \times 10^{-4}$
[1] for information only			

Requirement

The measured value shall not be higher than 40×10^{-4} at U_o at ambient temperature and shall not be higher than 80×10^{-4} at elevated temperature.

Result

The object passed the test.

3.6 Heating cycle test including partial discharge measurements

3.6.1 Heating cycle test

Standard and date

Standard BS 6622, subclause 20.6
Test date 20 March to 2 April 2020

Environmental conditions

Ambient temperature 20 °C

Characteristic test data

Heating method conductor current

No. of heating cycles	Steady conductor temperature	Heating current during steady condition	Heating cycle		
			Heating		Cooling
			Total duration	Duration of conductor at steady temperature	Total duration
	°C	A	h	h	h
20	97	approx. 500	5	2	6

Requirement

The test shall be carried out successfully.

Result

The object passed the test.

3.6.2 Partial discharge tests during and after heating cycle test

3.6.2.1 Partial discharge test after cycle 5

Standard and date

Standard	BS 6622, subclause 20.6
Test date	24 March 2020

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	28 °C
Circuit	direct
Calibration	10 pC
Noise level at 2,0 U_0	3 pC
Declared sensitivity	5 pC
Required sensitivity	≤ 5 pC
Centre frequency	125,5 kHz
Bandwidth (Δf)	100 kHz
Test frequency	50 Hz
Coupling capacitor	2,6 nF

Core	Voltage applied, 50 Hz		Duration	Partial discharge level
	... x U_0	kV	s	pC
1	2,25	42,8	< 60	-
	2,0	38	-	Not detectable
2	2,25	42,8	< 60	-
	2,0	38	-	Not detectable
3	2,25	42,8	< 60	-
	2,0	38	-	Not detectable

Requirement

The magnitude of discharge on each core shall not exceed 5 pC at 2,0 U_0.

Result

The object passed the test.

3.6.2.2 Partial discharge test after cycle 10

Standard and date

Standard	BS 6622, subclause 20.6
Test date	27 March 2020

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	28 °C
Circuit	direct
Calibration	10 pC
Noise level at 2,0 U_0	2 pC
Declared sensitivity	4 pC
Required sensitivity	≤ 5 pC
Centre frequency	175,5 kHz
Bandwidth (Δf)	100 kHz
Test frequency	50 Hz
Coupling capacitor	2,6 nF

Core	Voltage applied, 50 Hz		Duration	Partial discharge level
	... x U_0	kV	s	pC
1	2,25	42,8	< 60	-
	2,0	38	-	Not detectable
2	2,25	42,8	< 60	-
	2,0	38	-	Not detectable
3	2,25	42,8	< 60	-
	2,0	38	-	Not detectable

Requirement

The magnitude of discharge on each core shall not exceed 5 pC at 2,0 U_0.

Result

The object passed the test.

3.6.2.3 Partial discharge test after cycle 15

Standard and date

Standard	BS 6622, subclause 20.6
Test date	30 March 2020

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	28 °C
Circuit	direct
Calibration	10 pC
Noise level at 2,0 U_0	2,5 pC
Declared sensitivity	5 pC
Required sensitivity	≤ 5 pC
Centre frequency	165 kHz
Bandwidth (Δf)	100 kHz
Test frequency	50 Hz
Coupling capacitor	2,6 nF

Core	Voltage applied, 50 Hz		Duration	Partial discharge level
	... x U_0	kV	s	pC
1	2,25	42,8	< 60	-
	2,0	38	-	Not detectable
2	2,25	42,8	< 60	-
	2,0	38	-	Not detectable
3	2,25	42,8	< 60	-
	2,0	38	-	Not detectable

Requirement

The magnitude of discharge on each core shall not exceed 5 pC at 2,0 U_0.

Result

The object passed the test.

3.6.2.4 Partial discharge test after cycle 20

Standard and date

Standard	BS 6622, subclause 20.6
Test date	2 April 2020

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	24 °C
Circuit	direct
Calibration	10 pC
Noise level at 2,0 U_0	3 pC
Declared sensitivity	5 pC
Required sensitivity	≤ 5 pC
Centre frequency	175 kHz
Bandwidth (Δf)	160 kHz
Test frequency	50 Hz
Coupling capacitor	2,6 nF

Core	Voltage applied, 50 Hz		Duration	Partial discharge level
	... x U_0	kV	s	pC
1	2,25	42,8	< 60	-
	2,0	38	-	Not detectable
2	2,25	42,8	< 60	-
	2,0	38	-	Not detectable
3	2,25	42,8	< 60	-
	2,0	38	-	Not detectable

Requirement

The magnitude of discharge on each core shall not exceed 5 pC at 2,0 U_0.

Result

The object passed the test.

3.7 Impulse test

Standard and date

Standard BS 6622, subclause 20.7
Test date 3 April 2020

Environmental conditions

Ambient temperature 20 °C

Characteristic test data

Temperature of test object 98 °C
Specified test voltage 194 kV

Testing arrangement		Polarity	Voltage applied (% of test voltage)	No. of impulses	See figure on next pages
Voltage applied to	Earthed				
Conductors of all three cores	Metal screens	Positive	50	1	1 (waveshape)
			65	1	2
			80	1	2
			100	10	3 and 4
Conductors of all three cores	Metal screens	Negative	50	1	5 (waveshape)
			65	1	6
			80	1	6
			100	10	7 and 8

Requirement

Each core of the cable shall withstand without failure 10 positive and 10 negative voltage impulses.

Result

The object passed the test.

Lightning impulse test with positive voltage

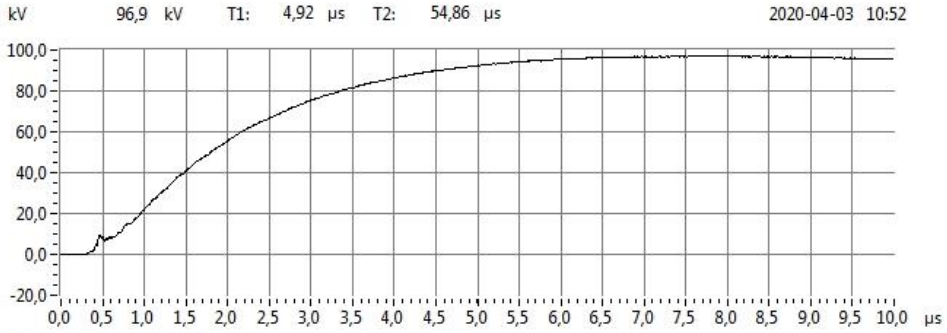


Fig. 1: Waveshape 72220709 Energya Cable 3X185 mm2 RFW 50% (+)

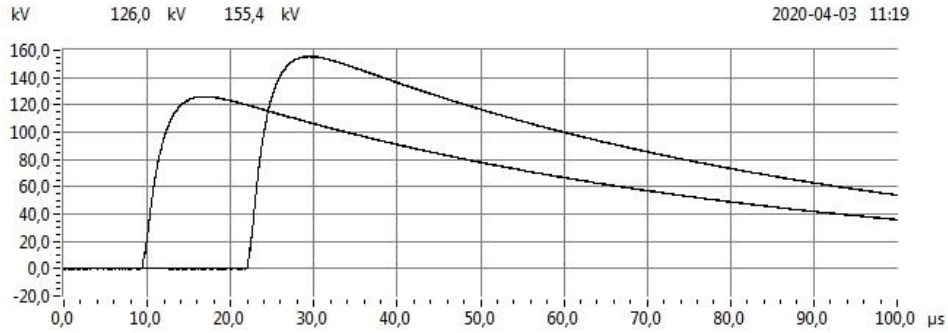


Fig. 2: 72220709 Energya Cable 3X185 mm2 RFW 65% and 80% (+)

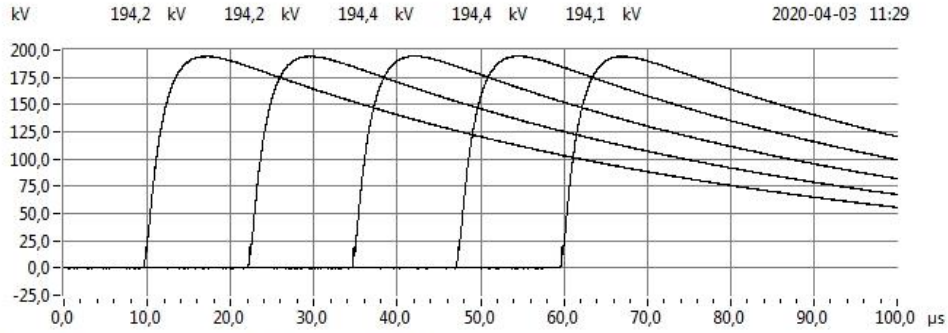


Fig. 3: 72220709 Energya Cable 3X185 mm2 FW 100% (+)

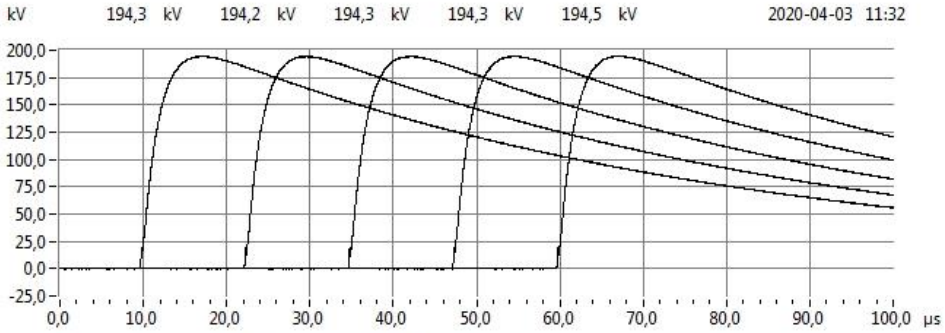


Fig. 4: 72220709 Energya Cable 3X185 mm2 FW 100% (+)

Lightning impulse test with negative voltage

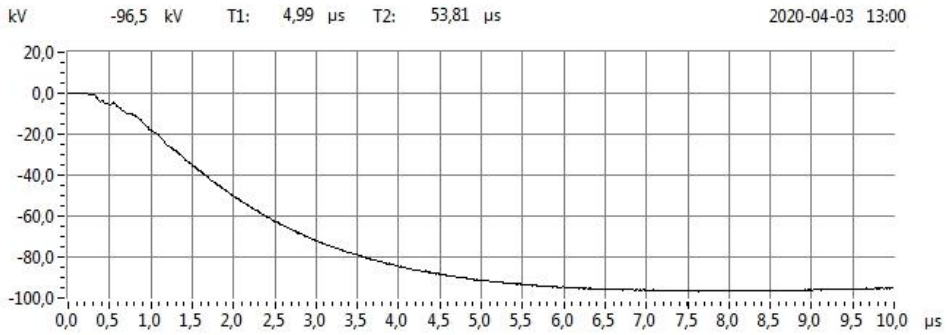


Fig. 5: Waveshape 72220709 Energya Cable 3X185 mm2 RFW 50% (-)

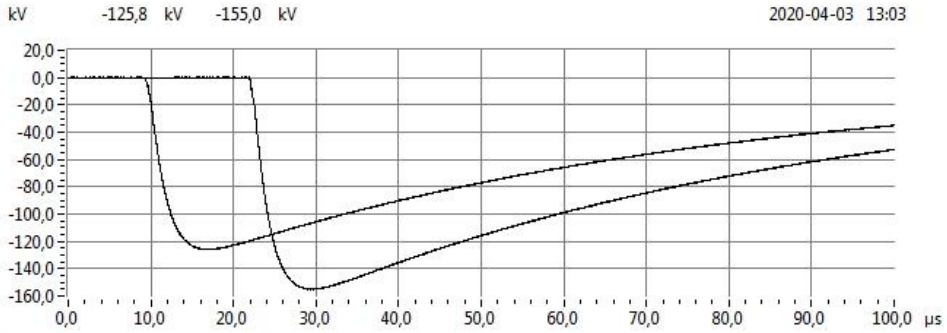


Fig. 6: 72220709 Energya Cable 3X185 mm2 RFW 65% and 80% (-)

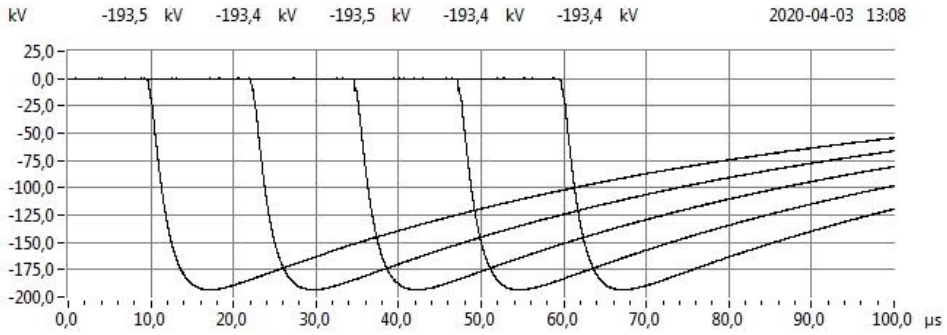


Fig. 7: 72220709 Energya Cable 3X185 mm2 FW 100% (-)

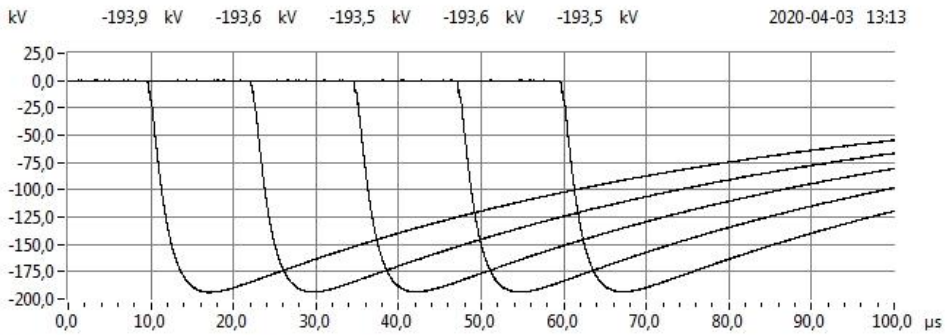


Fig. 8: 72220709 Energya Cable 3X185 mm2 FW 100% (-)

3.8 Four-hour voltage test

Standard and date

Standard BS 6622, clause 20.8
Test date 4 April 2020

Environmental conditions

Ambient temperature 20 °C

Characteristic test data

Temperature of test object 20 °C

Testing arrangement		Voltage applied, 50 Hz		Duration
Voltage applied to	Earth connected to	… x U_0	kV	h
Conductors	Metal screens	4	76	4

Requirement

No breakdown of the insulation shall occur.

Result

The object passed the test.

3.9 Adherence of screens at short circuit temperature

3.9.1 Partial Discharge test subjected before short circuit current test

Standard and date

Standard	BS 6622, subclause 17.5
Test date	19 March 2020

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	20 °C
Circuit	direct
Calibration	10 pC
Noise level at 2,0 U_0	2 pC
Declared sensitivity	4 pC
Required sensitivity	≤ 5 pC
Centre frequency	400 kHz
Bandwidth (Δf)	100 kHz
Test frequency	50 Hz
Coupling capacitor	2,6 nF

Core	Voltage applied, 50 Hz		Duration	Partial discharge level
	... x U_0	kV	s	pC
1	2,25	42,8	<60	-
	2,0	38	-	Not detectable

Requirement

The magnitude of discharge on each core shall not exceed 5 pC at 2,0 U_0.

Result

The object passed the test.

3.9.2 Thermal short-circuit test

Standard and date

Standard	BS 6622:2007, subclause 20.9
Test date	27 March 2020

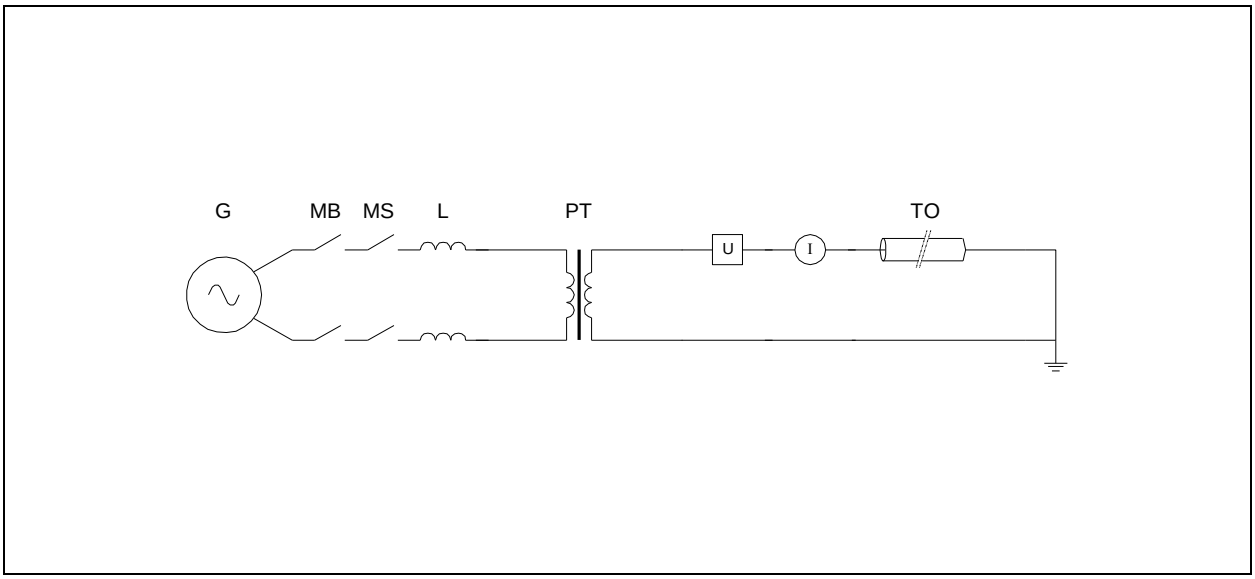
3.9.2.1 Condition before test

Cable previously subjected to a partial discharge test.

Measurement of resistance:
at 20,8 °C: 983,6 µΩ
at core temperature 24,8 °C: 999,1 µΩ.

Current for 250 °C: 33,1 kA for 1 sec.

3.9.2.2 Test circuit S01



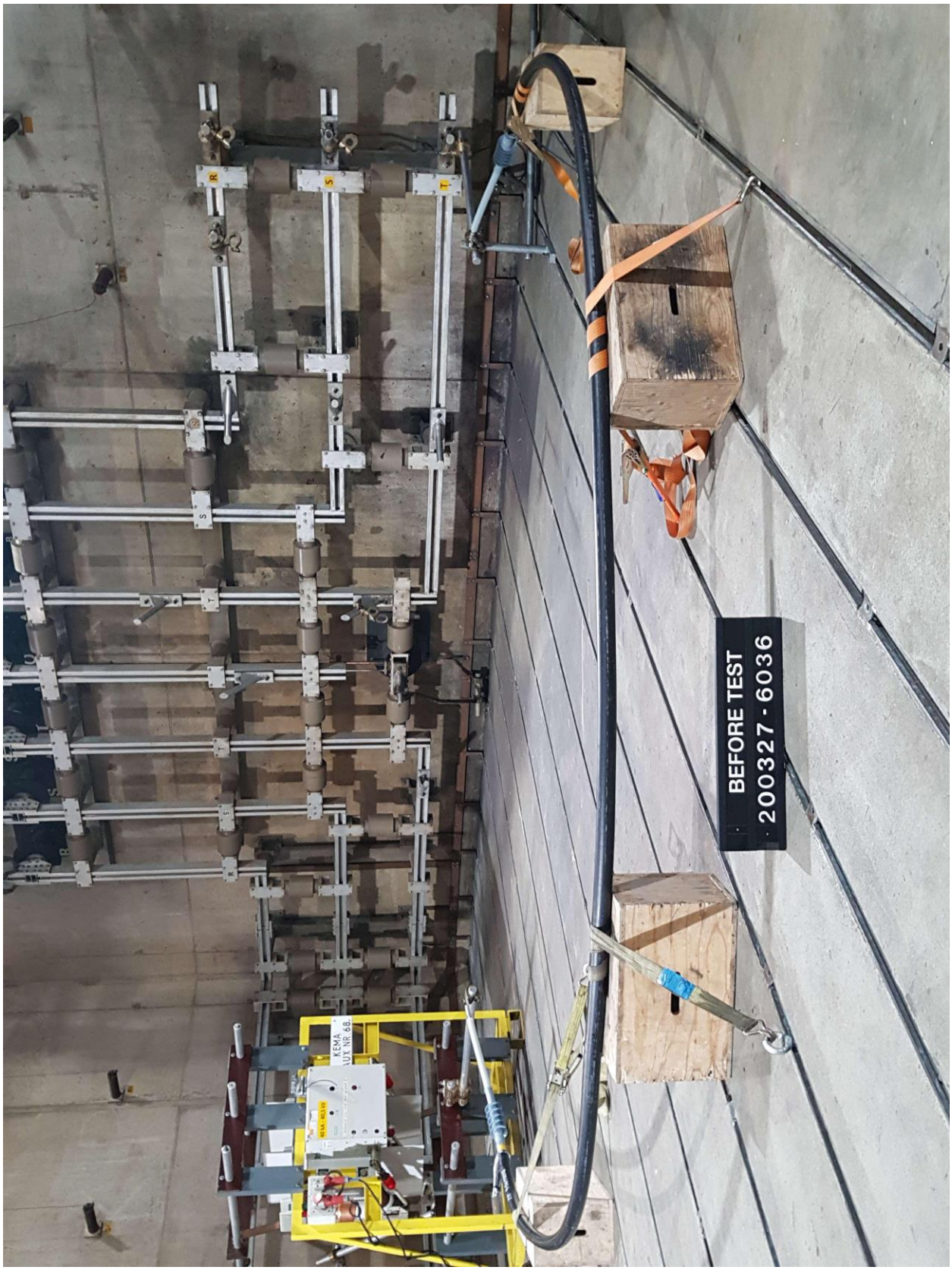
G	= Generator	TO	= Test Object	U	= Voltage Measurement to earth
MB	= Master Breaker	L	= Reactor	I	= Current Measurement
MS	= Make Switch				
PT	= Power Transformer				

Supply		
Power	MVA	99,6
Frequency	Hz	50
Phase(s)		1
Voltage	kV	3,01
Current	kA	33,1
Impedance	Ω	0,091
Power factor		< 0,1
Neutral		isolated

Load	
Short-circuit point	earthed

Remarks: -

3.9.2.3 Photograph before test



3.9.2.4 Test results and oscillograms

Overview of test numbers
200327-6036

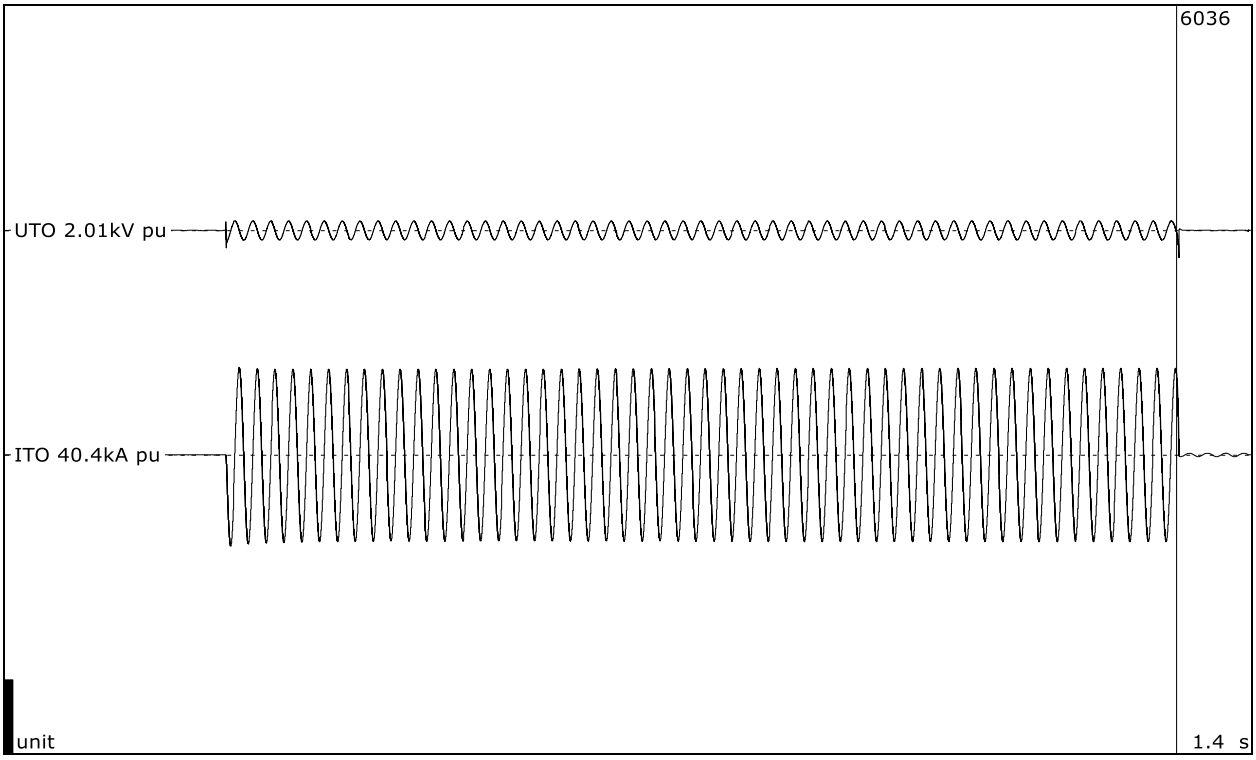
Remarks
-

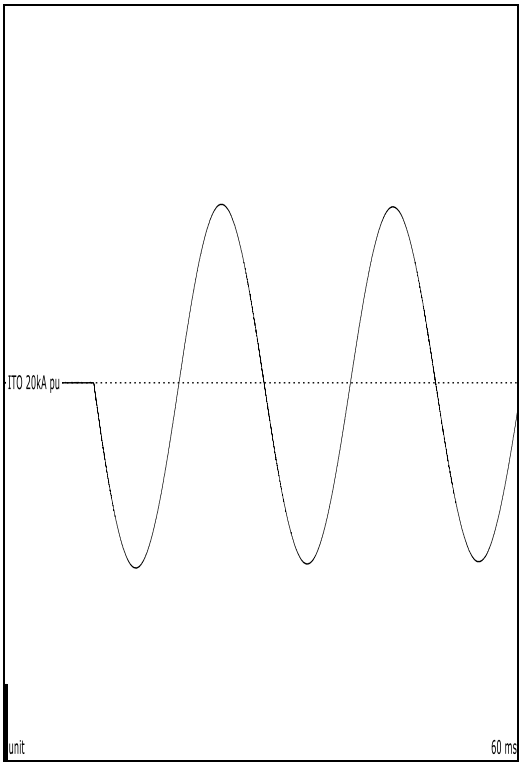
Phase indications
If more than one phase is recorded on oscillogram, the phases are indicated by the digits 1, 2 and 3. These phases 1, 2 and 3 correspond to the phase values in the columns of the accompanying table, respectively from left to right.

Explanation of the letter symbols and abbreviations on the oscillograms

pu	Per unit (the reference length of one unit is represented by the black bar on the oscillogram)
ITO	Current through test object
UTO	Voltage across test object

Thermal short-circuit test





Test number: **200327-6036**

Phase		-
Current	kA_{peak}	-49,2
Current, a.c. component, beginning	kA_{RMS}	33,2
Current, a.c. component, middle	kA_{RMS}	33,0
Current, a.c. component, end	kA_{RMS}	33,1
Current, a.c. component, average	kA_{RMS}	33,1
Current, a.c. component, three-phase average	kA_{RMS}	-
Duration, current	s	1,07
Equivalent RMS value and duration		33,1 kA during 1,07 s

Gas pressure at 20 °C	-	Ambient temperature	15 °C

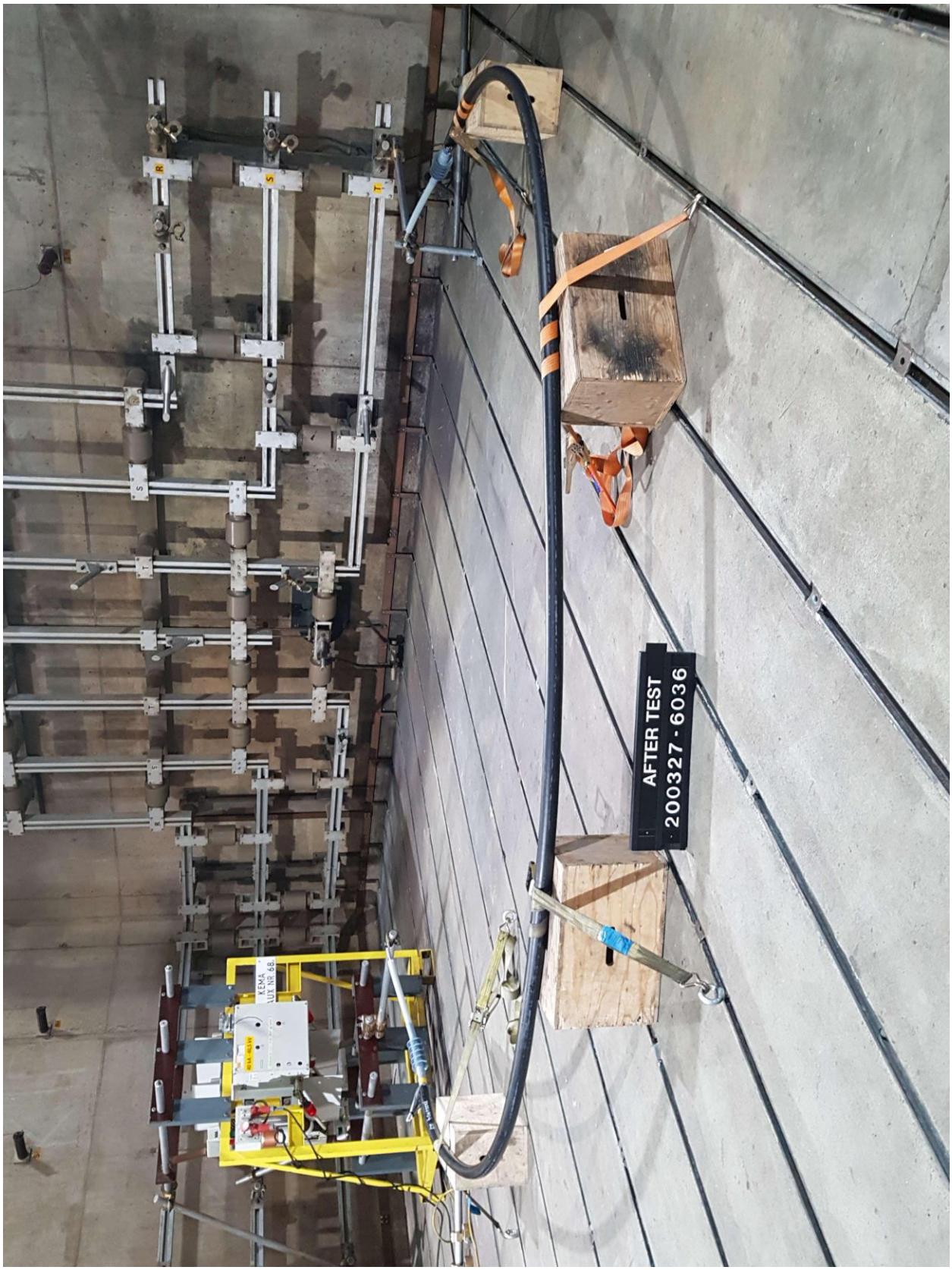
Observations:

3.9.2.5 Condition / inspection after test

Externally no visible change.

Measurement of resistance:
1205 µΩ (measured 10 minutes after test)

3.9.2.6 Photograph after test



3.9.3 Partial Discharge subjected after short-circuit current test

Standard and date

Standard	BS 6622, subclause 17.5
Test date	30 March 2020

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	20 °C
Circuit	direct
Calibration	10 pC
Noise level at 2,0 U_0	3 pC
Declared sensitivity	5 pC
Required sensitivity	≤ 5 pC
Centre frequency	126,5 kHz
Bandwidth (Δf)	100 kHz
Test frequency	50 Hz
Coupling capacitor	2,6 nF

Core	Voltage applied, 50 Hz		Duration	Partial discharge level
	... x U_0	kV	s	pC
1	2,25	42,8	< 60	-
	2,0	38	-	Not detectable

Requirement

The magnitude of discharge on each core shall not exceed 5 pC at 2,0 U_0.

Result

The object passed the test.

4 TYPE TESTS - MATERIALS

4.1 Resistivity of semi-conducting screens

Standard and date

Standard BS 6622, subclause 19.2 and 19.4
Test date 20 April 2020

Characteristic test data

Resistivity measured at 90 ± 2 °C

Item	Unit	Requirement	Measured/determined		
			Core 1	Core 2	Core 3
Conductor screen					
without ageing	Ωm	≤ 500	172	121	232
Insulation screen					
without ageing	Ωm	≤ 500	6	4	5

Result

The object passed the test.

4.2 Tests for determining the mechanical properties of insulation before and after ageing

Standard and date

Standard BS 6622, subclause 19.3
Test date 30 March 2020

Characteristic test data

Temperature during ageing 135 ± 3 °C
Ageing duration 7 x 24 h (27 March to 3 April 2020)

Item	Unit	Requirement	Measured/determined		
			Core 1	Core 2	Core 3
Without ageing					
Tensile strength	N/mm^2	≥ 12,5	25,3	25,4	27,1
Elongation at break	%	≥ 200	546	574	571
After ageing in air oven					
Tensile strength					
• value after ageing	N/mm^2	-	31,3	29,9	30,0
• variation	%	± 25 max.	24	18	11
Elongation at break					
• value after ageing	%	-	592	584	576
• variation	%	± 25 max.	8	2	1

Result

The object passed the test.

4.3 Tests for determining the mechanical properties of non-metal sheaths before and after ageing

Standard and date

Standard BS 6622, subclause 19.12
Test date 30 March 2020

Characteristic test data

Temperature during ageing 100 ± 2 °C
Ageing duration 7 x 24 h (27 March to 3 April 2020)

Inner sheath/Separation sheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm²	≥ 12,5	17,8
Elongation at break	%	≥ 150	263
After ageing in air oven			
Tensile strength			
• value after ageing	N/mm²	≥ 12,5	17,9
• variation	%	± 25 max.	1
Elongation at break			
• value after ageing	%	≥ 150	262
• variation	%	± 25 max.	-1

Characteristic test data

Temperature during ageing 100 ± 2 °C
Ageing duration 7 x 24 h (27 March to 3 April 2020)

Oversheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm²	≥ 12,5	18,6
Elongation at break	%	≥ 150	253
After ageing in air oven			
Tensile strength			
• value after ageing	N/mm²	≥ 12,5	18,7
• variation	%	± 25 max.	1
Elongation at break			
• value after ageing	%	≥ 150	231
• variation	%	± 25 max.	-9

Result

The object passed the test.

4.4 Additional ageing test on pieces of completed cable

Standard and date

Standard BS 6622, subclause 19.13
Test date 30 March 2020

Characteristic test data

Temperature during ageing 100 ± 2 °C
Ageing duration 7 x 24 h (19 to 26 March 2020)

Insulation

Item	Unit	Requirement	Measured/determined		
			Core 1	Core 2	Core 3
Without ageing					
Tensile strength	N/mm²	≥ 12,5	25,3	25,4	27,1
Elongation at break	%	≥ 200	546	574	571
After ageing in air oven					
Tensile strength					
• value after ageing	N/mm²	-	31,5	28,7	29,8
• variation	%	± 25 max.	25	13	10
Elongation at break					
• value after ageing	%	-	613	606	573
• variation	%	± 25 max.	12	6	0

Separation sheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm²	≥ 4	17,8
Elongation at break	%	≥ 50%	263
After ageing in air oven			
Tensile strength			
• value after ageing	N/mm²	≥ 4	17,9
Elongation at break			
• value after ageing	%	≥ 50%	262

Oversheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm²	≥ 12,5	18,6
Elongation at break	%	≥ 150	253
After ageing in air oven			
Tensile strength			
• value after ageing	N/mm²	≥ 12,5	18,2
• variation	%	± 25 max.	-2
Elongation at break			
• value after ageing	%	≥ 150	297
• variation	%	± 25 max.	17

Result

The object passed the test.

4.5 Resistivity of semi-conducting screens after ageing

Standard and date

Standard BS 6622, subclause 19.13
Test date 1 May 2020

Characteristic test data

Temperature during ageing 100 °C
Duration 7 x 24 h (19 to 26 March 2020)
Resistivity measured at 90 ± 2 °C

Item	Unit	Requirement	Measured/determined		
			Core 1	Core 2	Core 3
Conductor screen					
after ageing	Ωm	≤ 1000	210	131	182
Insulation screen					
after ageing	Ωm	≤ 1000	2	2	2

Result

The object passed the test.

4.6 Loss of mass test on PVC sheaths of type 9

Standard and date

Standard BS 6622, subclause 19.12
Test date 24 March to 1 April 2020

Characteristic test data

Temperature treatment 100 ± 2 °C
Duration 7 x 24 h (24 to 31 March 2020)

Inner sheath/Separation sheath

Item	Unit	Requirement	Measured/determined
Loss of mass	mg/cm^2	≤ 1,5	0,2

Oversheath

Item	Unit	Requirement	Measured/determined
Loss of mass	mg/cm^2	≤ 1,5	0,2

Result

The object passed the test.

4.7 Pressure test at high temperature on insulation and non-metal sheaths

Standard and date

Standard BS 6622, subclause 19.12
Test date 10 April 2020

Characteristic test data

Temperature 90 ± 2 °C
Heating time 6 h
Mandrel diameter 83 mm
Load 18 N

Inner sheath/Separation sheath

Item	Unit	Requirement	Measured/determined
Depth of indentation	%	≤ 50	19

Characteristic test data

Temperature 90 ± 2 °C
Heating time 6 h
Mandrel diameter 110 mm
Load 23 N

Oversheath

Item	Unit	Requirement	Measured/determined
Depth of indentation	%	≤ 50	20

Result

The object passed the test.

4.8 Test on PVC insulation and sheaths at low temperature

Standard and date

Standard BS 6622, subclause 19.12
Test date 30 April 2020

Characteristic test data

Temperature -15 ± 2 °C
Cooling time ≥ 16 h
Mass of hammer 1500 g

Inner sheath/Separation sheath

Item	Unit	Requirement	Measured/determined
Cold elongation test	%	≥ 20	114
Cold impact test	-	No cracks	No cracks

Characteristic test data

Temperature -15 ± 2 °C
Cooling time ≥ 16 h
Mass of hammer 1500 g

Oversheath

Item	Unit	Requirement	Measured/determined
Cold elongation test	%	≥ 20	120
Cold impact test	-	No cracks	No cracks

Result

The object passed the test.

4.9 Test for resistance of PVC insulation and sheaths to cracking (heat shock test)

Standard and date

Standard BS 6622, subclause 19.12
Test date 16 April 2020

Characteristic test data

Temperature 150 ± 3 °C
Duration 1 h
Diameter of mandrel 8 mm
Number of turns 4

Inner sheath/Separation sheath

Item	Unit	Requirement	Measured/determined
Visual examination	-	No cracks	No cracks

Characteristic test data

Temperature 150 ± 3 °C
Duration 1 h
Diameter of mandrel 10 mm
Number of turns 2

Oversheath

Item	Unit	Requirement	Measured/determined
Visual examination	-	No cracks	No cracks

Result

The object passed the test.

4.10 Measurement of the insulation resistance constant on PVC outer sheaths Type 9

Standard and date

Standard BS 6622, subclause 19.12.1
Test date 24 June 2020

Characteristic test data

Resistivity measured at 20 ± 5 °C

Item	Unit	Requirement	Measured/determined
Insulation resistance constant K	MΩ ·km	>0,0035	9,12x 10^{14}

Result

The object passed the test.

4.11 Hot set test for XLPE insulation

Standard and date

Standard BS 6622, subclause 19.3
Test date 26 March 2020

Characteristic test data

Air temperature 200 ± 3 °C
Time under load 15 min
Mechanical stress 20 N/cm^2

Insulation

Item	Unit	Requirement	Measured/determined		
			Core 1	Core 2	Core 3
Elongation under load	%	≤ 175	47	46	45
Permanent elongation after cooling	%	≤ 15	-2	-1	-3

Result

The object passed the test.

4.12 Water absorption test on insulation

Standard and date

Standard BS 6622, subclause 19.3
Test date 24 March to 13 April 2020

Characteristic test data

Temperature of water 85 ± 2 °C
Duration 14 x 24 h (27 March to 10 April 2020)
Test methode Gravimetric

Insulation

Item	Unit	Requirement	Measured/determined		
			Core 1	Core 2	Core 3
Increase of mass	mg/cm^2	≤ 1,00	< 0,1	0,1	0,1

Result

The object passed the test.

4.13 Flame spread on single cables

Standard and date

Standard BS 6622, subclause 19.14
Test date 21 April 2020

Characteristic test data

Overall diameter of test piece 107,3 mm
Time for flame application 480 s
Flame type 1 kW pre-mixed flame

Complete cable	Unit	Requirement	Measured/determined
The distance between the lower edge of the top support and the onset of charring	mm	≥ 50	395
The distance between the lower edge of the top support and charring extends downwards to a point	mm	≤ 540	510

Result

The object passed the test.

4.14 Measurement of mass of zinc coating

Standard and date

Standard BS 6622, subclause 19.8
Test date 13 May 2020

Item	Unit	Requirement	Measured/determined
number of wires tested	-	-	9
Mass of zinc coating galvanized steel wires	g/m^2	206	325

Result

The object passed the test.

4.15 Wrapping test for galvanized steel wires

Standard and date

Standard BS 6622, subclause 19.9
Test date 13 May 2020

Item	Unit	Requirement	Measured/determined
number of wires tested	-	-	9
Number of turns	-	1	1
Mandrell diameter	mm	4 x diameter wire	12,7
result	-	No break of wires	No break of wires

Result

The object passed the test.

5 SAMPLE TESTS

5.1 Measurement of thickness of insulation

Standard and date

Standard BS 6622, subclause 18.7
Test date 7 April 2020

Item	Unit	Requirement	Specified	Measured/determined		
				Core 1	Core 2	Core 3
Nominal	mm	8,0	8,0	-	-	-
Average	mm	-	-	9,23	9,21	9,33
Minimum [t_{min}]	mm	≥ 7,10	-	9,05	9,06	9,19
Maximum [t_{max}]	mm	-	-	9,48	9,39	9,53
($t_{max} - t_{min}$) / t_{max}	-	≤ 0,15	-	0,05	0,03	0,04

Result

The object passed the test.

5.2 Measurement of circularity of cores

Standard and date

Standard BS 6622, subclause 18.8
Test date 07 April 2020

Item	Unit	Requirement	Specified	Measured/determined		
				Core 1	Core 2	Core 3
Minimum [d_{min}]	mm	-	-	37,727	37,791	37,865
Maximum [d_{max}]	mm	-	-	37,839	37,928	38,033
($d_{max} - d_{min}$)	mm	≤ 0,5	-	0,1	0,1	0,2

Result

The object passed the test.

5.3 Measurement of thickness of non-metal sheaths (including extruded separation sheaths, but excluding inner coverings)

Standard and date

Standard BS 6622, subclause 18.12 and 18.15
Test date 7 April 2020

Separation sheath

Item	Unit	Requirement	Specified	Measured/determined
Nominal	mm	≥ 1,2	2,1	-
Average	mm	-	-	3,91
Minimum	mm	≥ 1,48	-	3,18

Oversheath

Item	Unit	Requirement	Specified	Measured/determined
Nominal	mm	≥ 1,8	4,4	-
Average	mm	-	-	4,90
Minimum	mm	≥ 3,30	-	3,98

Note

The nominal thickness of the separation sheath and over sheath is calculated according to subclause 13.3.3 and Annex A.

Result

The object passed the test.

5.4 Measurement of armour wires

Standard and date

Standard BS 6622, subclause 18.14
Test date 7 April 2020

Armour wires

Item	Unit	Requirement	Specified	Measured/determined
Total wires	-	-	83	85
diameter	mm	3,15 ± 5%	3,15 (nominal)	3,11 (average)
Number wires measured	-	10%	-	9
Minimum	mm	≥ 2,99	-	3,09
Maximum	mm	≤ 3,31	-	3,14

Result

The object passed the test.

6 CHECK OF CABLE CONSTRUCTION

Standard and date

Standard BS 6622, subclauses 4 to 19
Test date 8 April 2020

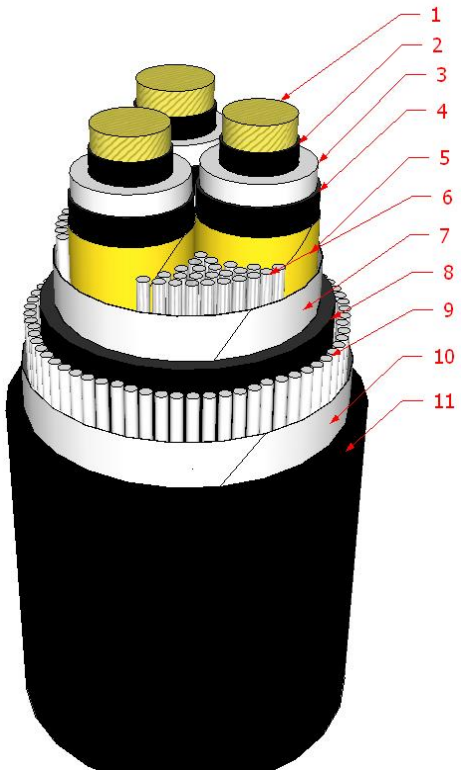
Item	Unit	Requirement	Specified	Measured/determined		
				Core 1	Core 2	Core 3
Conductor						
Diameter of conductor (d)	mm	15,4 ≤ d ≤ 18,0 [1)]	15,8 ± 0,4	15,75	15,75	15,75
Number of wires	-	≥ 30	-	37	37	37
Diameter of wires	mm	-	-	2,45	2,45	2,45
Resistance at 20 °C	Ω/km	≤ 0,0991	-	0,0980	0,0983	0,0982
Water blocking yarns between conductor layers		-	-	no	no	no
Conductor screen						
Diameter over conductor screen	mm	-	-	18,11	18,22	18,06
Thickness	mm	-	0,5	1,09	1,16	1,07
Insulation						
Diameter over insulation	mm	-	-	36,63	36,72	36,82
Thickness	mm	≥ 7,10	8	9,23	9,21	9,33
Insulation screen						
Diameter over insulation screen	mm	-	-	38,83	38,94	39,02
Thickness	mm	-	0,5	1,05	1,07	1,06
Metal screen						
Thickness x width of tape	mm	-	0,075 x 40	0,095 x 39,90	0,095 x 39,90	0,095 x 39,90

Item	Unit	Requirement	Specified	Measured/determined
Fillers				
Filler material	-	-	present	present
Binder tape	mm	-	-	57,7 x 0,1 (approx.)
Inner covering				
Diameter over covering	mm	-	-	90,6
Thickness	mm	-	2,1	3,91
Steel armour wires				
Number of wires	-	-	83	85
Thickness of wires	mm	3,15 ± 5%	3,15(nominal)	3,11 (average)
Steel tape				
Number of tapes	-	-	1	1
Thickness x width of tape	mm	-	-	0,318 x 30,13
Binder tape				
Number of tapes	-	-	-	2
Thickness x width of tape	mm	-	-	0,1 x 59,1 (approx.)
Oversheath				
Diameter over oversheath	mm	-	104,6	107,34
Thickness	mm	-	4,4	4,90
Colour	-	-	black	black
Marking on the cable	Line 1: ENERGYA POWER CABLES-ELSEWEDY HELAL ELECTRIC CABLE Cu/XLPE/SWA/PVC 33000V BS6622 3X185 MM2 2019 Meter marking Line 2: ELECTRIC CABLE 33000V BS6622			
[1)] Dimensional limits do not have the status of a requirement but as a guideline only				

Result

The object passed the test.

7 DRAWING



Size :	**3 x 185**	*mm^2*	*Type :*	CU/XLPE/CT/SWA/PVC
Voltage:	**19/33**	*kV*	*Standard:*	BS 6622

Item Code : CT19X503W1

Sr.	**Description**	**Thickness** *mm*	*Diameter* **(Approx.)** *Mm*
1.	**Compacted Circualr Copper** Conductor		**15.8 ± 0.4**
2.	**I**nner **S**emi-**C**onductive	**0.5 (Nominal)**	
3.	**XLPE** *Insulation*	**8 (Nominal)**	
4.	**O**uter **S**emi-**C**onductive (Bonded)	**0.5 (Nominal)**	
5.	**Copper Tape Screen With 10% Overlap**	**0.075 (Nominal)**	
6.	**P.P Filler**		
7.	**Binder Tape**		
8.	**PVC Bedding**	**1.48 (Minimum)**	
9.	**Galvanized Steel Wires Armour**	**3.15 ± 5%**	
10.	**Binder Tape**		
11.	**PVC Sheath**	**3.3 (Minimum)**	

Not to Scale

Prepared By	**Eng. Ahmed Adel**

8 MEASUREMENT UNCERTAINTY

The measurement uncertainties in the results presented are as specified below unless otherwise indicated.

Measurement	**Measurement uncertainty**
Dielectric tests and impulse current tests:	
peak value	≤ 3%
time parameters	≤ 10%
Capacitance measurement	0,3%
Tan δ measurement	± 0,5% ± 5 x 10^{-5}
Partial discharge measurement:	
< 10 pC	2 pC
10 to 100 pC	5 pC
> 100 pC	20%
Measurement of impedance AC-resistance measurement	≤ 1%
Measurement of losses	≤ 1%
Measurement of insulation resistance	≤ 10%
Measurement of DC resistance:	
1 to 5 µΩ	1%
5 to 10 µΩ	0,5%
10 to 200 µΩ	0,2%
Radio interference test	2 dB
Calibration of current transformers	2,2 x 10^{-4} I_i/I_u and 290 µrad
Calibration of voltage transformers	1,6 x 10^{-4} U_i/U_u and 510 µrad
Measurement of conductivity	5%
Measurement of temperature:	
-50 to -40 °C	3 K
-40 to125 °C	2 K
125 to 150 °C	3 K
Tensile test	1%
Sound level measurement	type 1 meter as per IEC 60651 and ANSI S1,4,1971
Measurement of voltage ratio	0,1%