KEMA Labs

KEMA TYPE TEST CERTIFICATE OF COMPLETE TYPE TESTS

Object Single-core power cable **1143-20**

Type 19/33(36) kV 1x800 mm^2 XLPE Cable

Rated voltage, U_0/U (U_m)	19/33(36) kV	Conductor material	Cu
Conductor cross-section	1x800 mm^2	Insulation material	XLPE

Manufacturer Energya Power Cables – Elsewedy Helal
Industrial Zone A, 1oth of Ramadan City, Egypt *)

Client Energya Power Cables – Elsewedy Helal
Industrial Zone A, 1oth of Ramadan City, Egypt

Tested by KEMA B.V.,
Klingelbeekseweg 195, Arnhem, The Netherlands

Date of tests 5 March to 1 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 7835:2007

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 Standard(s) 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 59 pages in total.

KEMA B.V.

Bas Verhoeven
Director, High-Voltage Laboratory

Arnhem, 13 July 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	13 July 2020	First issue

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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	1x800 mm^2

1.2 Description of the object tested

Standard	BS 7835
Manufacturer	Energya Power Cables – Elsewedy Helal Industrial Zone A, 10th of Ramadan City, Egypt
Type	19/33 kV 1x800 mm^2 Cu/XLPE/CT/AWA/LSHF Cable
Manufacturing year	2019
Quantity submitted	70 m
Rated voltage, U_0/U (U_m)	19/33 (36) kV
Nominal capacitance between conductor and metal screen	0,379 µF/km
No. of cores	1
Overall diameter	69,5 mm
Marking on the oversheath	ENERGYA POWER CABLES-ELSEWEDY HELAL ELECTRIC CABLE Cu/XLPE/AWA/LSHF 33000 V BS 7835 1 X 800 MM2 2019 Meter marking Line 2 ELECTRIC CABLE 33000 V BS 7835
Construction	see List of drawings

Conductor

• material	copper
• cross-section	800 mm^2
• nominal diameter	34,4 mm
• type	compacted stranded
• maximum conductor temperature in normal operation	90 °C
• presence and nature of measures to achieve longitudinal water tightness	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	36,12 mm
• nominal outer diameter of the insulation	52,12 mm
• material designation	known in KEMA Labs' files
• manufacturer of the material	known in KEMA Labs' files

Insulation (core) screen

• material	semi-conduction PE
• strippable	yes
• 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 tapes	one
• nominal thickness and width of tape	0,075 x 40 mm (overlap: 10%) (approx.)
• cross-sectional area	8 mm^2 (approx.)

Separation sheath

• material	LSHF – inner covering
• nominal thickness	1,08 mm (min.)
• manufacturer of the material	known in KEMA Labs' files

Metal armour

• material	aluminium wires
• number of wires	70
• nominal diameter of wires	2,5mm ± 5%
• manufacturer of the material	known in KEMA Labs' files

Oversheath

• material	LSHF – LTS1
• nominal thickness	2,5 mm (minimum)
• nominal overall diameter of the cable (D)	69,5 mm (approx.)
• material designation	LSHF-LTS1
• 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: 249/19
- 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: 005m, end: 070m

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	aluminium 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
CT70X501XL	2

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 Subcontracting

The following tests were subcontracted to BRE Global United Kingdom and ISQ Portugal

- flame propagation on multiple cables 4,16 subclause 20.15
- smoke emission test 4,17 subclause 20.16
- corrosive and acid gas 4,18 subclause 20.2 (ISQ Portugal).

2.4 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 ELECTRICAL TYPE TESTS

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.

The heating currents in the reference loop and the test loop were kept equal at all times, thus the conductor temperature of the reference loop is representative for the conductor temperature of the test loop.

The tests at elevated temperature are carried out after the conductor temperature has been within the stated limit for at least 2 hours. All single phases of both the reference loop and the test loop carried the same level single-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 7835, subclause 21.3
Test date 5 March 2020

Environmental conditions

Ambient temperature 8 °C

Characteristic test data

Temperature of test object 8 °C
Maximum bending diameter 15(d + D)

Length of cable bended 21 m

Actual external diameter of cable D mm	Actual diameter of cable conductor d mm	Maximum bending diameter D_r mm	Diameter of test cylinder D_t mm
77,5	34,4	≤ 1679	1560

Result

The test was carried out successfully.

3.3 Partial discharge test

Standard and date

Standard	BS 7835, subclause 18.5
Test date	10 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	2,5 pC
Declared sensitivity	5
Required sensitivity	≤ 5 pC
Centre frequency	100 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

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 7835, subclause 21.4
Test date 11 March 2020

Environmental conditions

Ambient temperature 20 °C

Characteristic test data

Temperature of test object 20 °C
Length of test object 17,41 m
Standard capacitor 99,918 pF

Core	Voltage applied, 50 Hz		Capacitance of core [1] µF/km	Tan δ	Maximum increase of Tan δ
	....x U_o	kV			
1	0,5	9,5	0,33	$5,3 \times 10^{-4}$	$0,09 \times 10^{-4}$
	1	19	0,33	$5,5 \times 10^{-4}$	
	2	38	0,33	$5,4 \times 10^{-4}$	
[1] for information only					

Requirement

The measured value shall not be higher than 40×10^{-4} 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 7835, subclause 21.5
Test date	12 March 2020

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	20 and 97 °C
Length of test object	17,41 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	5	0,33	$5{,}3 \times 10^{-4}$
[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	5	0,30	$1{,}2 \times 10^{-4}$
[1] for information only			

Requirement

The measured value shall not be higher than 40×10^{-4} 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 7835, subclause 21.6
Test date 13 to 23 March 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. 1895	5	2	5

Requirement

The test shall be carried out successfully.

Result

The object passed the test.

3.6.2 Partial discharge during and after heating cycle test

3.6.2.1 Partial discharge test after cycle 5

Standard and date

Standard	BS 7835, subclause 21.6
Test date	16 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
Required sensitivity	≤ 10 pC
Centre frequency	100 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.

3.6.2.2 Partial discharge test after cycle 10

Standard and date

Standard	BS 7835, subclause 21.6
Test date	18 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	≤ 10 pC
Centre frequency	118 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.

3.6.2.3 Partial discharge test after cycle 15

Standard and date

Standard	BS 7835, subclause 21.6
Test date	20 March 2020

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	29 °C
Circuit	direct
Calibration	10 pC
Noise level at 2,0 U_0	3 pC
Declared sensitivity	5 pC
Required sensitivity	≤ 10 pC
Centre frequency	118 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.

3.6.2.4 Partial discharge test after cycle 20

Standard and date

Standard	BS 7835, subclause 21.6
Test date	23 March 2020

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	29 °C
Circuit	direct
Calibration	10 pC
Noise level at 2,0 U_0	3 pC
Declared sensitivity	5 pC
Required sensitivity	≤ 10 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

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 7835, subclause 21.7
Test date 24 March 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				
Conductor	Metal screen	Positive	50	1	1 (waveshape)
			65	1	2
			80	1	2
			100	10	3 and 4
Conductor	Metal screen	Negative	50	1	5 (waveshape)
			65	1	6
			80	1	6
			100	10	7 and 8

Requirement

The cable core shall withstand without failure 10 positive and 10 negative voltage impulses.

Result

The object passed the test.

Lightning impulse test with positive voltage

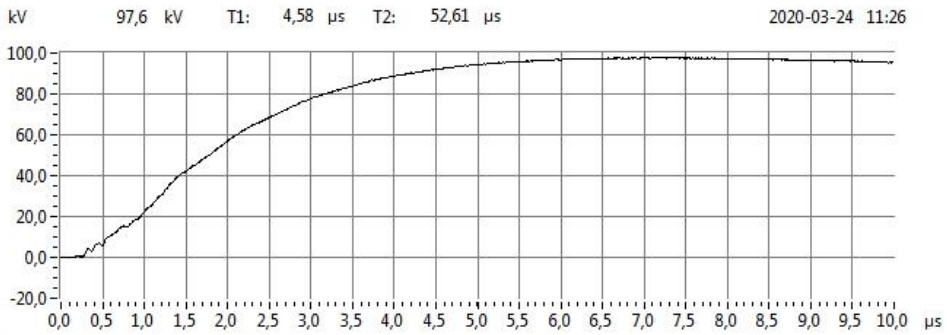


Fig. 1: Waveshape 72220708 1X 800 mm^2 Energya Cable RFW 50% (+)

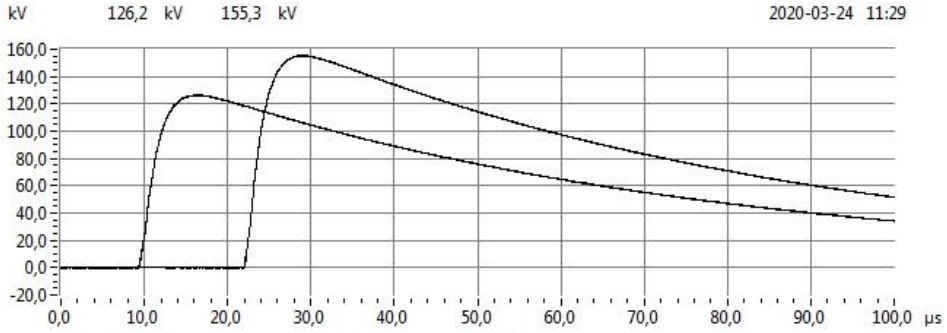


Fig. 2: 72220708 1X 800 mm^2 Energya Cable RFW 65% and 80% (+)

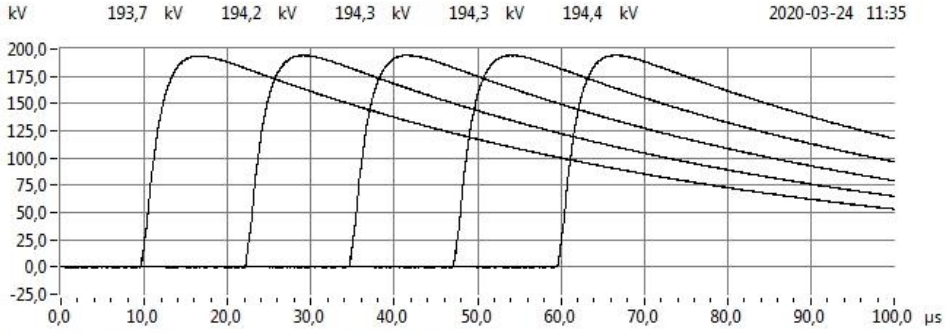


Fig. 3: 72220708 1X 800 mm^2 Energya Cable FW 100% (+)

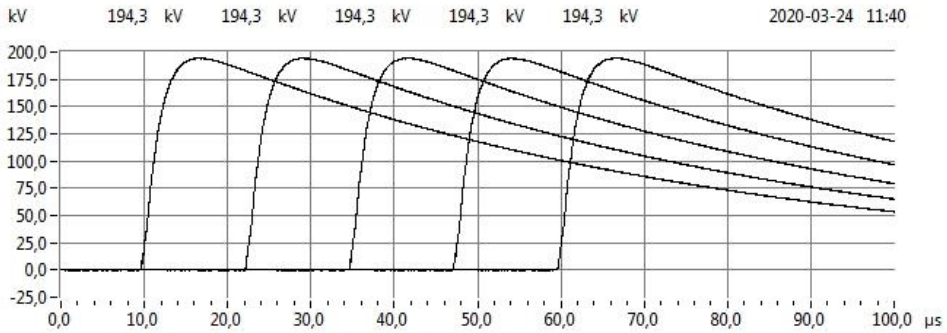


Fig. 4: 72220708 1X 800 mm^2 Energya Cable FW 100% (+)

Lightning impulse test with negative voltage

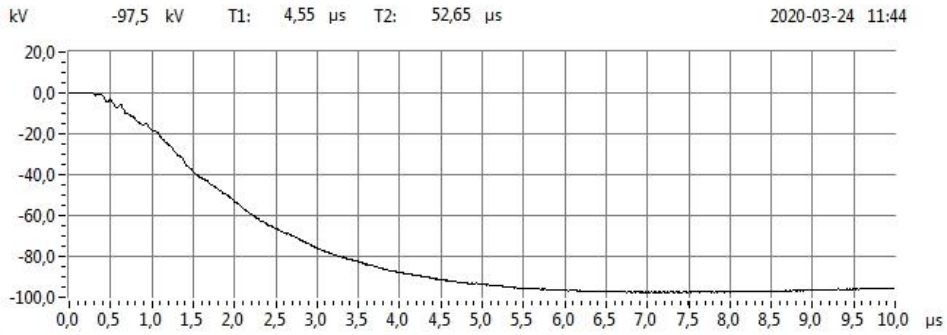


Fig. 5: Waveshape 72220708 1X 800 mm^2 Energya Cable RFW 50% (-)

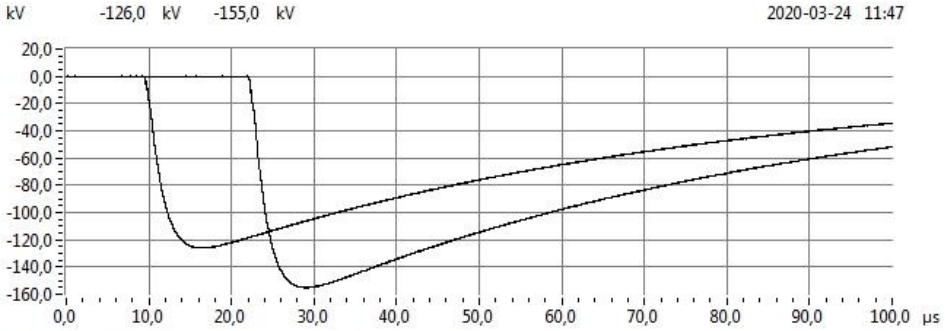


Fig. 6: 72220708 1X 800 mm^2 Energya Cable RFW 65% and 80% (-)

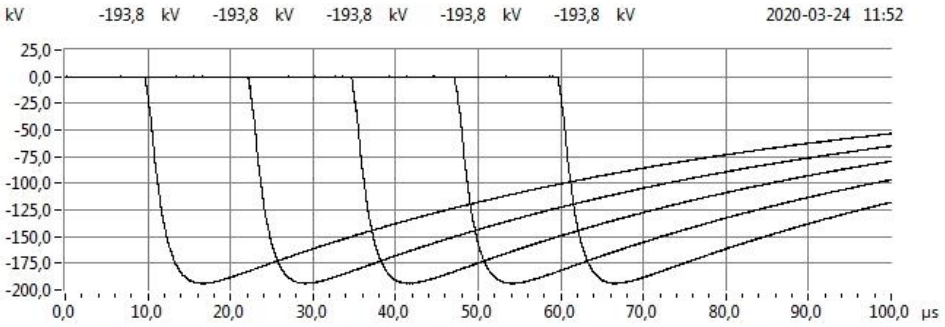


Fig. 7: 72220708 1X 800 mm^2 Energya Cable FW 100% (-)

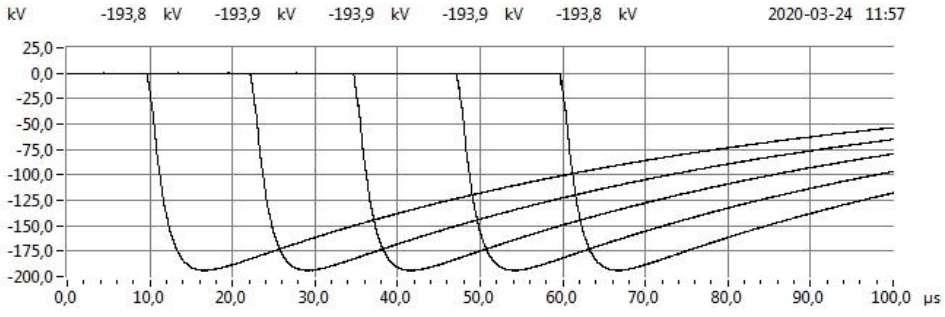


Fig. 8: 72220708 1X 800 mm^2 Energya Cable FW 100% (-)

3.8 Four-hour voltage test

Standard and date

Standard BS 7835 subclause 21.8
Test date 25 March 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
Conductor	Metal screen	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 7835, subclause 18.5
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 7835:2007 subclause 21.9
Test date 27 March 2020

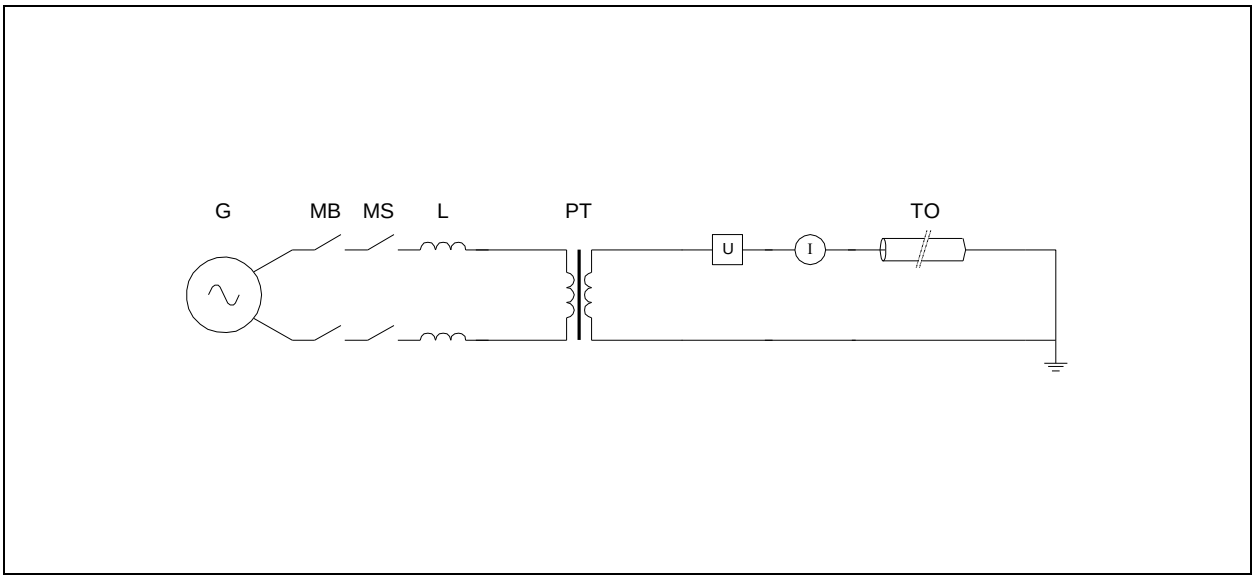
3.9.2.1 Condition before test

Cable previously subjected to a partial discharge test.

Measurement of resistance:
at 20,8 °C : 978,8 µΩ
at core temperature 26,4 °C : 1000,2 µΩ

Current for 250 °C : 32,9 kA for 1 sec

3.9.2.2 Test circuit S01



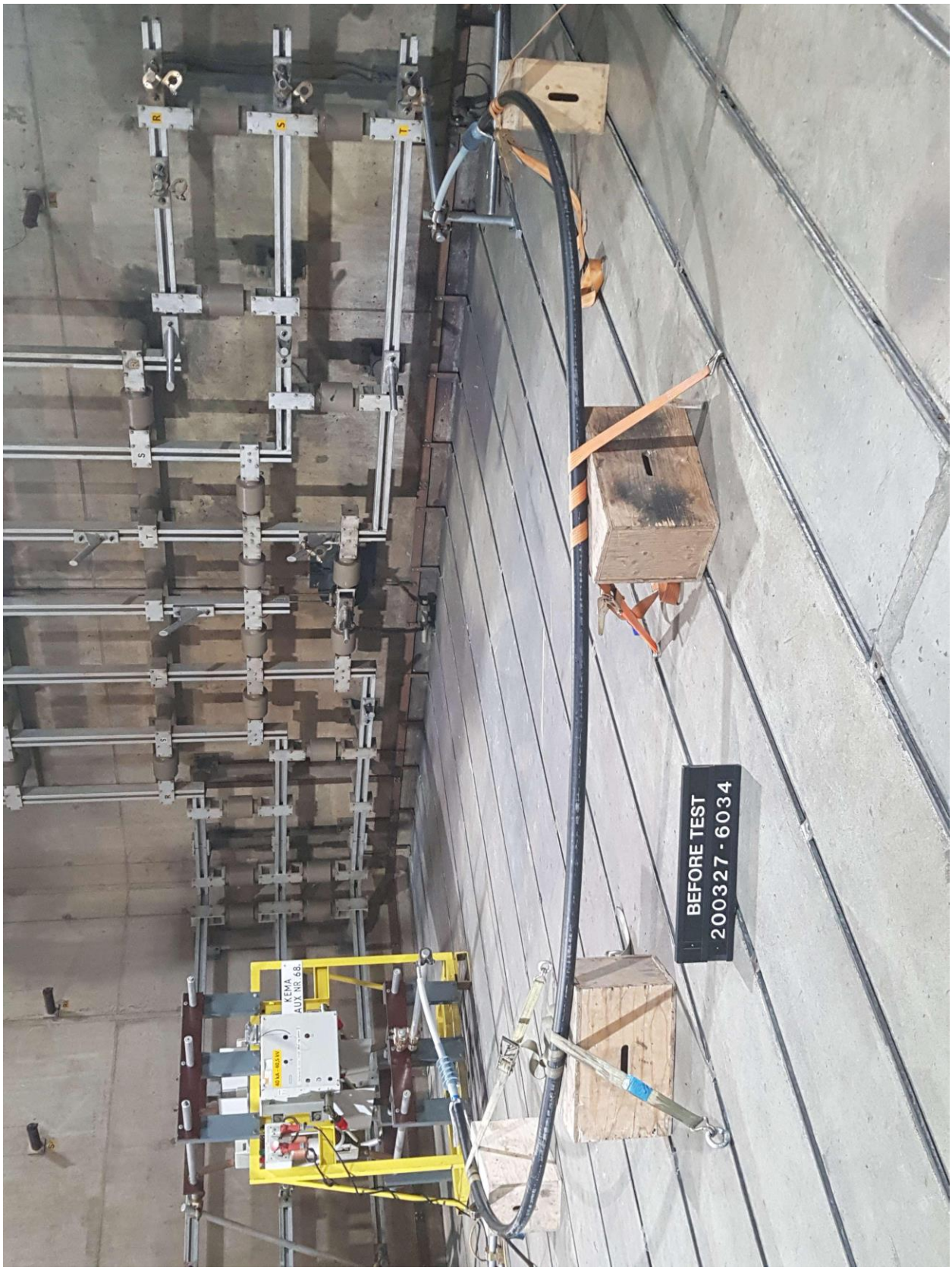
G	= Generator	TO	= Test Object	U	= Voltage Measurement to earth
MB	= Master Breaker	L	= Reactor	I	= Current Measurement
MS	= Make Switch				
PT	= Power Transformer				

Supply		
Power	MVA	97,4
Frequency	Hz	50
Phase(s)		1
Voltage	kV	2,96
Current	kA	32,9
Impedance	Ω	0,09
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
200327-6034

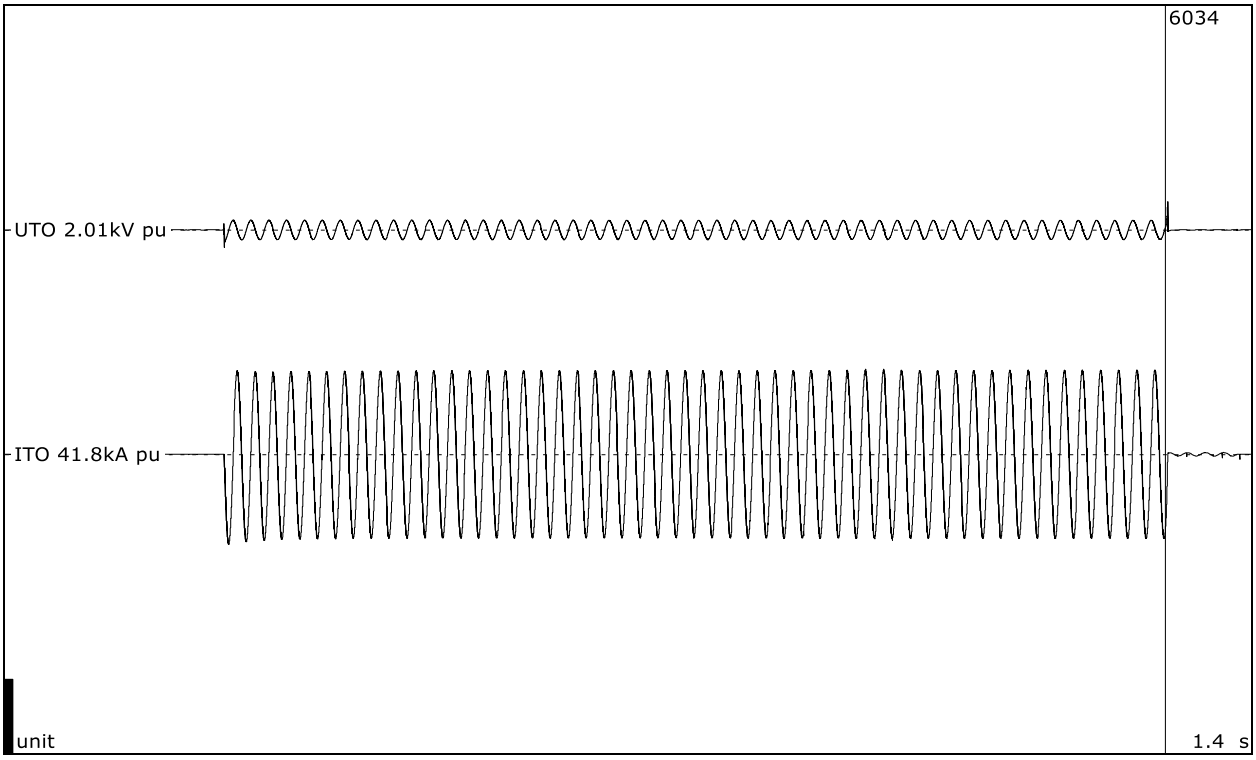
Remarks
-

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

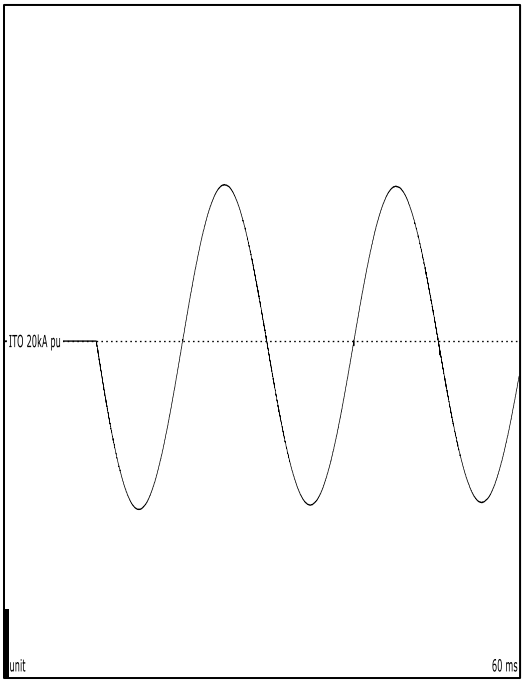
pu	Per unit (the reference length of one unit is represented by the black bar on the oscillogram)
ITO	Current through test object
UTO	Voltage across test object

Thermal short-circuit test



Test number: **200327-6034**

Phase		-
Current	kA_{peak}	-50,2
Current, a.c. component, beginning	kA_{RMS}	33,3
Current, a.c. component, middle	kA_{RMS}	33,1
Current, a.c. component, end	kA_{RMS}	33,2
Current, a.c. component, average	kA_{RMS}	33,3
Current, a.c. component, three-phase average	kA_{RMS}	-
Duration, current	s	1,06
Equivalent RMS value and duration		32,9 kA during 1,09 s

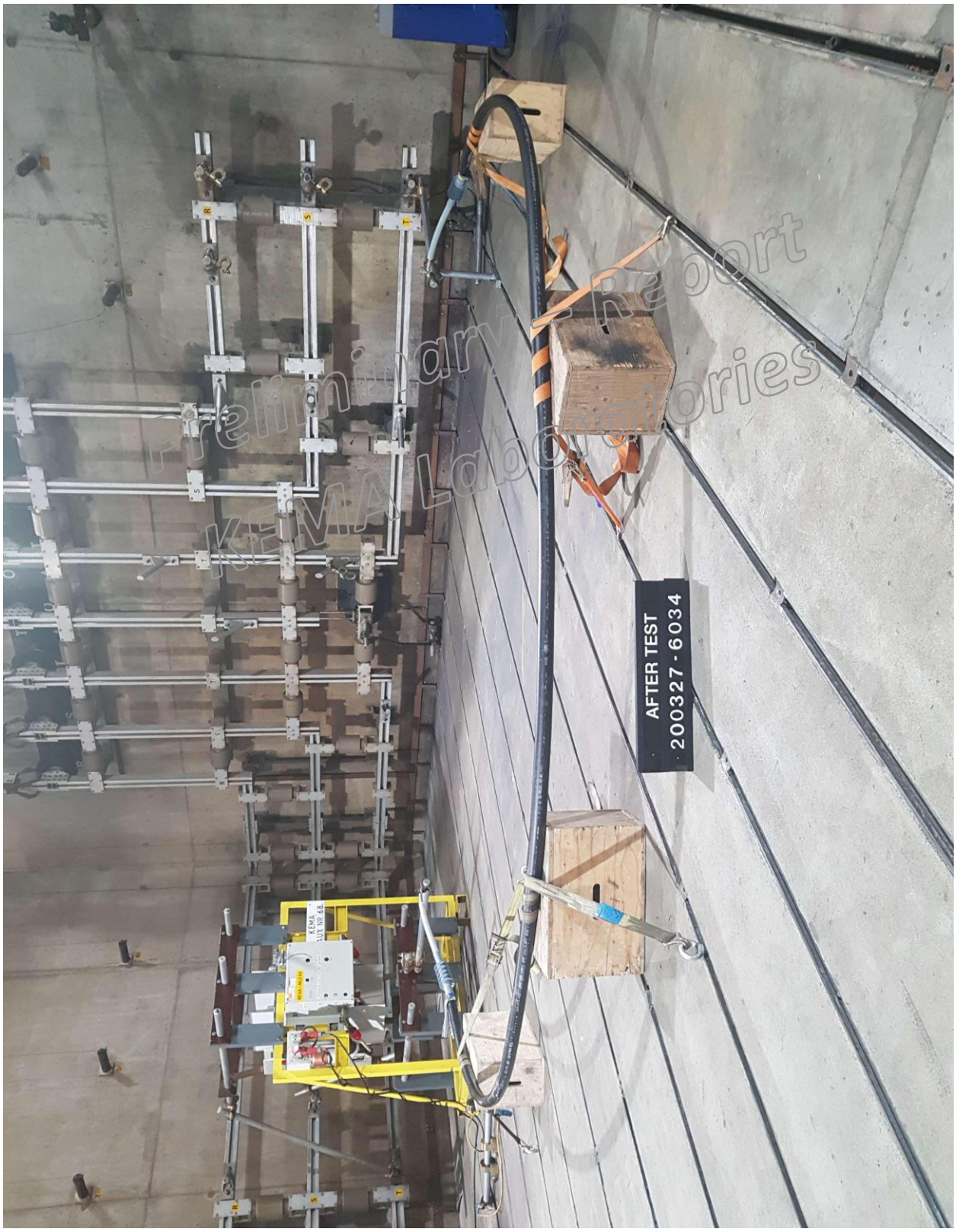


3.9.2.5 Condition / inspection after test

Externally no visible change.

Measurement of resistance:
1189,6 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 7835, subclause 18.5
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 MATERIALS – TYPE TEST

4.1 Resistivity of semi-conducting screens

Standard and date

Standard BS 7835, subclause 20.3 and 20.5
Test date 1 May 2020

Characteristic test data

Temperature during ageing 100 °C
Resistivity measured at 90 ± 2 °C

Item	Unit	Requirement	Measured/determined
Conductor screen			
without ageing	Ωm	≤ 500	4
Insulation screen			
without ageing	Ωm	≤ 500	2

Result

The object passed the test.

4.2 Measurement of thickness of insulation

Standard and date

Standard BS 7835 subclause 19.7.1, 19.7.2 and 19.8.1
Test date 7 April 2020

Item	Unit	Requirement	Specified	Measured/determined
Nominal	mm	8	8	-
Average	mm	-	-	9,37
Minimum [t_{min}]	mm	≥ 7,10	-	9,163
Maximum [t_{max}]	mm	-	-	9,706
Difference between minimum and maximum measured diameters	mm	≤ 0,5		0,5
($t_{max} - t_{min}$) / t_{max}	-	≤ 0,15	-	0,06

Result

The object passed the test

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

Standard and date

Standard BS 7835 Subclause 19.12 and 19.15
Test date 7 May 2020

Inner sheath/Separation sheath*

Item	Unit	Requirement	Calculated/ Specified	Measured/determined
Nominal	mm	-	1,6	-
Average	mm	-	-	2,53
Minimum	mm	≥ 1,08	-	2,36

Oversheath*

Item	Unit	Requirement	Calculated/ Specified	Measured/determined
Nominal	mm	≥ 1,4	3,4	-
Average	mm	-	-	3,87
Minimum	mm	≥ 2,50	-	3,70

Note

The nominal thickness of the separation sheath and oversheath is calculated according to Subclause 13.3.3 and Annex A.}

Result

The object passed the test

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

Standard and date

Standard BS 7835 Clause 20.4
Test date 31 March 2020

Characteristic test data

Temperature during ageing 135 ± 2 °C
Ageing duration 7 x 24 h (27 March to 03 April 2020)

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm^2	≥ 12,5	27,2
Elongation at break	%	≥ 200	592
After ageing in air oven			
Tensile strength			
• value after ageing	N/mm^2	-	30,8
• variation	%	± 25 max.	13
Elongation at break			
• value after ageing	%	-	607
• variation	%	± 25 max.	2

Result

The object passed the test.

4.5 Water immersion test

Standard and date

Standard BS 7835 Clause 20.13
Test date 3 April 2020

Characteristic test data

Temperature during ageing 70 ± 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/mm^2	≥ 10	13,0
Elongation at break	%	≥ 100	159
After ageing in air oven			
Tensile strength			
• value after ageing	N/mm^2	≥ 10	12,7
• variation	%	± 30	-2
Elongation at break			
• value after ageing	%	≥ 100	172
• variation	%	± 30	8

Result

The object passed the test.

4.6 Measurement for aluminium wires

Standard and date

Standard BS 7835, Clause 19.14 20.12

Test date 7 May and 8 June 2020

Item	Unit	Requirement	Measured/determined
Without ageing			
Wire diameter	mm	2,5 ± 5%	2,58
Tensile strength	N/mm^2	≥ 125	192

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

Standard and date

Standard BS 7835 Clause 20.8 and 20.13
Test date 1 April 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/mm^2	≥ 4	12,3
Elongation at break	%	≥ 50	147

Oversheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm^2	≥ 10	13,0
Elongation at break	%	≥ 100	159
After ageing in air oven			
Tensile strength			
• value after ageing	N/mm^2	≥ 10	14,0
• variation	%	± 40	8
Elongation at break			
• value after ageing	%	≥ 100	132
• variation	%	± 40	-17

Result

The object passed the test.

4.8 Compatibility test

Standard and date

Standard BS 7835 Clause 20.14
Test dates 31 March, 23 April and 1 May 2020

Characteristic test data

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

Mechanical properties

Insulation

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm^2	≥ 12,5	27,2
Elongation at break	%	≥ 200	592
After ageing in air oven			
Tensile strength			
• value after ageing	N/mm^2	-	29,9
• variation	%	± 25 max.	10
Elongation at break			
• value after ageing	%	-	550
• variation	%	± 25 max.	-7

Inner sheath/Separation sheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm^2	≥ 4	12,3
Elongation at break	%	50	147
After ageing in air oven			
Tensile strength			
• value after ageing	N/mm^2	≥ 4	15,8
• variation	%	-	28
Elongation at break			
• value after ageing	%	50	190
• variation	%	-	30

Oversheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm^2	≥ 10	13,0
Elongation at break	%	≥ 100	159
After ageing in air oven			
Tensile strength			
• value after ageing	N/mm^2	≥ 10	16,6
• variation	%	± 40	28
Elongation at break			
• value after ageing	%	≥ 100	166
• variation	%	± 40	4

Maximum resistivity insulation screen and conductor screen

Characteristic test data

Maximum resistivity measured at 90 ± 2 °C (after 30 minutes)

Item	Unit	Requirement	Measured/determined
Conductor screen			
after ageing	Ωm	≤ 1000	13
Insulation screen			
after ageing	Ωm	≤ 1000	2

Cold strippability test

Sample 1

Item	Unit	Requirement	Measured/Determined
After ageing	N	8 ≤ F ≤ 45	22,6 ≤ F ≤ 25,6

Sample 2

Item	Unit	Requirement	Measured/Determined
After ageing	N	8 ≤ F ≤ 45	29,4 ≤ F ≤ 31,2

Sample 3

Item	Unit	Requirement	Measured/Determined
After ageing	N	8 ≤ F ≤ 45	27,5 ≤ F ≤ 29,7

Result

The object passed the test.

4.9 Pressure test at high temperature on oversheath material

Standard and date

Standard	BS 7835 Clause 20.13
Test date	15 April 2020

Characteristic test data

Temperature	80 ± 2 °C
Heating time	6 h
Load	16 N

Oversheath

Item	Unit	Requirement	Measured/determined
Depth of indentation	%	≤ 50	17

Result

The object passed the test

4.10 Test for tear resistance

Standard and date

Standard BS 7835 Clause 20.13
Test date 14 May 2020

Oversheath

Item	Unit	Requirement	Measured/determined
Tear resistance	N/mm	≥ 5	8

Result

The object passed the test

4.11 Shrinkage test on oversheaths

Standard and date

Standard BS 7835 Clause 20.18
Test date 17 April 2020

Oversheath

Item	Unit	Requirement	Measured/determined
Shrinkage	%	≤ 4	2,7

Result

The object passed the test

4.12 Test on PVC insulation and sheaths at low temperature

Standard and date

Standard	BS 7835 Clause 20.13
Test date	10 April 2020

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	%	≥ 30	43
Cold impact test	-	no cracks	no cracks

Result

The object passed the test.

4.13 Hot set test for XLPE insulation

Standard and date

Standard	BS 7835 clause 19.6
Test date	26 Mar 2020

Characteristic test data

Air temperature	200 ± 3 °C
Time under load	15 min
Mechanical stress	0,2 N/mm^2

Insulation

Item	Unit	Requirement	Measured/determined
Elongation under load	%	≤ 175	50
Permanent elongation after cooling	%	≤ 15	-5

Result

The object passed the test.

4.14 Water absorption test on insulation

Standard and date

Standard BS 7835 Clause 8
Test date 24 Mar to 13 Apr 2020

Characteristic test data

Temperature of water 85 ± 2 °C
Duration 14 x 24 h
Test methode Gravimetric

Insulation

Item	Unit	Requirement	Measured/determined
Maximum variation in mass	mg/cm^2	<1	0,03

Result

The object passed the test.

4.15 Flame spread on single cables

Standard and date

Standard BS 7835 Clause 19.16
Test date 21 Apr 2020

Characteristic test data

Overall diameter of test piece 77,3 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.

4.16 Flame propagation on multiple cables

Standard and date

Standard	BS 7835 Clause 20.15
Test date	15 May 2020

Characteristic test data

Number of test pieces	2
The total volume of non-metallic material, per meter of test sample, of the test pieces	3.3009
The method of mounting	spaced
The number of layers	1
Flame application time	20 min
The number of burners	1

	Unit	Requirement	Measured/determined
The extent of damage;	m	< 2,5	0,36
The time to extinction of all burning or glowing	min	-	20

Result

The object passed the test.

4.17 Smoke emission test

Standard and date

Standard BS 7835 Clause 19.17
Test date 15 May 2020

Characteristic test data

Diameter of the cable 69,5 mm
The number and disposition of test pieces in the test sample 1

	Unit	Requirement	Measured/determined
Transmission level	%	60	76

Result

The object passed the test.

4.18 Corrosive and acid gas

Standard and date

Standard BS 7835 clause 20.2
Test date 1 June 2020

Characteristic test data

All non-metallic items as specified in table below.

Sample Ref.	Requirement %	HCl %	HF %
Outer sheath	0,5	< 0,024	< 0,005
Binder tape	0,5	< 0,024	< 0,005
Bedding	0,5	< 0,024	< 0,005
Semi conductive insulation screen	0,5	< 0,024	< 0,005
XLPE insulation	0,5	< 0,024	< 0,005
Semi conductive conductor screen	0,5	< 0,024	< 0,005
Tape over conductor	0,5	< 0,024	< 0,005

Result

The object passed the test.

4.19 Cold strippability

Standard and date

Standard BS 7835 Clause 19.9.2
Test date 23 Apr 2020

Characteristic test data

Temperature 100 ± 2 °C
Ageing duration 7 x 24 h

Sample 1

Item	Unit	Requirement	Measured/Determined
Before ageing	N	8 ≤ F ≤ 45	36,5 ≤ F ≤ 38,6
After ageing	N	8 ≤ F ≤ 45	22,6 ≤ F ≤ 25,6

Sample 2

Item	Unit	Requirement	Measured/Determined
Before ageing	N	8 ≤ F ≤ 45	38,4 ≤ F ≤ 40,2
After ageing	N	8 ≤ F ≤ 45	29,4 ≤ F ≤ 31,2

Sample 3

Item	Unit	Requirement	Measured/Determined
Before ageing	N	8 ≤ F ≤ 45	37,0 ≤ F ≤ 38,0
After ageing	N	8 ≤ F ≤ 45	27,5 ≤ F ≤ 29,7

Result

The object passed the test.

4.20 Abrasion test

Standard and date

Standard BS 7835, Clause 20.17
Test date 29 April 2020

Characteristic test data

Distance ≥ 600 mm
Strokes 50 (2x 25)
Speed 150 ≥ x ≤ 300 mm/s
Diameter ≥ 70 mm
Force 270 N

Item	Unit	Requirement	Measured/determined
Examination	-	No cracks	No cracks

Requirement

Examination of the sample without magnification shall reveal no cracks or splits in the internal and external surfaces.

Result

The object passed the test.

5 CHECK OF CABLE CONSTRUCTION

Standard and date

Standard BS 7835 Clause 19.7
Test date 7 May 2020

Item	Unit	Requirement	Specified	Measured/determined
Conductor				
Diameter of conductor (d)	mm	-	34,4	34,9
Number of wires	-	≥ 53	-	61
Diameter of wires	mm	-	-	3,68-4,41 (after compacting)
Swelling yarns applied	-	-	-	no
Resistance at 20 °C	Ω/km	≤ 0,0221	-	0,0212
Semi-conducting tape				
Number of tapes	-	-	-	1
Width	mm	-	-	cannot be determined
Thickness	mm	-	-	0,35 (total thickness)
Overlap	mm	-	-	21 mm
Conductor screen				
Diameter over conductor screen	mm	-	-	37,54
Thickness	mm	-	0,5	1,07
Insulation				
Diameter over insulation	mm	-	-	56,38
Minimum diameter insulation	mm			56,156
Minimum diameter insulation	mm			56,710
Thickness	mm	7,10	8	9,37
Insulation screen				
Diameter over insulation screen	mm	-	-	58,94
Thickness	mm	-	0,5	1,25
Copper screen				
Thickness x width of tape	mm	-	0,075 x 40, 10% overlap	0,094 x 49 (10% overlap, approx.)
Inner sheath/LSHF				
Diameter over sheath	mm	-	-	64,21
Thickness	mm	-	1,08 (min.)	2,53
Aluminium wires armour				
Number of wires		-	70	74
Thickness	mm	-	2,5 ± 5%	2,58

Binder tape over armour				
Number of tapes			-	1
Width and thickness	mm	-	-	40 x 0,1
Overlap	%	-	-	50
Total thickness	mm	-	-	0,38 (total thickness)
Oversheath				
Diameter over oversheath	mm	-	69,5	77,33
Thickness	mm	-	2,5 (min.)	3,87
Colour	-	-	black	black

Marking on the cable	Line 1: ENERGYA POWER CABLES-ELSEWEDY HELAL ELECTRIC CABLE Cu/XLPE/AWA/LSHF 33000 V BS 7835 1 X 800 MM2 2019 Meter marking Line 2: ELECTRIC CABLE 33000 V BS 7835}
[1)] Dimensional limits do not have the status of a requirement but as a guideline only	

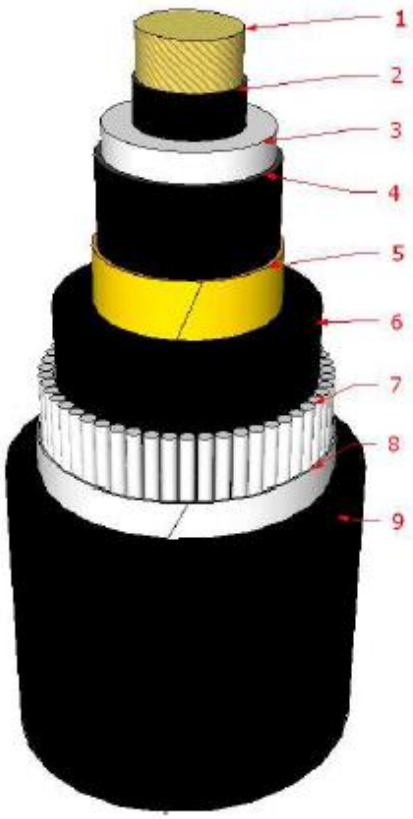
Result

The object passed the test.

6 DRAWING

energya POWER CABLES
A Company of Energya Cables

Item Code: CT70X501XL



Size :	1 x 800	mm^2	Type :	CU/XLPE/CT/AWA/LSHF
Voltage:	19/33	kV	Standard:	BS 7835

Sr.	Description	Thickness mm	Diameter (Approx.) Mm
1.	**Compacted Circualr Copper** Conductor		**34.4**
2.	Inner Semi-Conductive	**0.5 (Nominal)**	
3.	**XLPE** *Insulation*	**8 (Nominal)**	
4.	Outer Semi-Conductive (Strippable)	**0.5 (Nominal)**	
5.	**Copper Tape Screen with 10% overlap**	**0.075 (Nominal)**	
6.	**LSHF Bedding**	**1.08 (Minimum)**	
7.	**Aluminum Wires Armour**	**2.5 ± 5%**	
8.	**Binder Tape**		
9.	**LSHF Sheath**	**2.5 (Minimum)**	

Not to Scale

Prepared By	Eng. Mohamed Abdel Sattar

Monday, 06 July, 2020 Issue.2 Technical Offer No. 1X800 MM2 19/33KV

7 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%