

TYPE TEST CERTIFICATE OF COMPLETE TYPE TEST

OBJECT single-core power cable

TYPE 19/33 (36) kV 1x630 mm² AL/XLPE/MDPE

Rated voltage, U ₀ /U (U _m)	19/33 (36) kV	Conductor material	AL
Conductor cross-section	1x630 mm ²	Insulation material	XLPE

MANUFACTURER Elsewedy
Damascus, Syria

CLIENT Elsewedy
Cairo, Egypt

TESTED BY KEMA HIGH-VOLTAGE LABORATORY
Arnhem, the Netherlands

DATE OF TESTS 3 June 2009 until 20 July 2009

The 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 7870-4.10

This Type Test Certificate has been issued by KEMA following exclusively the STL Guides.


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 and to justify the ratings assigned by the manufacturer as listed on page 4 and 5.

The Certificate applies only to the object tested. The responsibility for conformity of any object having the same designations with that tested rests with the Manufacturer.

This Certificate consists of 40 pages in total.

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The sealed and bound version of the Certificate is the only valid version.

KEMA Nederland B.V.


P.G.A. Bus
KEMA T&D Testing Services
Managing Director

Arnhem, 31 August 2009

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1 IDENTIFICATION OF THE TEST OBJECT

1.1 Description of the test object

Manufacturer	El Sewedy cables – Syria
Type	19/33 kV 1x630 mm ² AL/XLPE/MDPE
Year of manufacture	2007
Sampling procedure	by the manufacturer
Quantity submitted	50 m
Rated voltage, U ₀ /U (U _m)	19/33 (36) kV
No. of cores	1
Marking on the cable	EL SEWEDY CABLES ELECTRIC CABLE 33000V BS 7870-4.10 1X630AL MM2 AL/XLPE/MDPE 2007

Conductor

- material	aluminium
- cross-section	630 mm ²
- nominal diameter	30 +/- 0,2 mm
- type	stranded compacted
- maximum conductor temperature in normal operation	90 °C

Conductor screen

- material	extruded thermosetting semi-conductive
- nominal thickness	approx. 0,7 mm
- material designation	LE 0595
- manufacturer	Borealis

Insulation

- material	XLPE
- nominal thickness	8,0 mm
- material designation	LE 4201
- manufacturer	Borealis

Insulation screen

- material	extruded thermosetting semi-conductive
- strippable	no
- nominal thickness	approx. 1,0 mm
- material designation	LE 0595
- manufacturer	Borealis

Metallic screen

- material copper wires
- number and nominal diameter of wires 42 wires of Ø 1,04 mm
- nominal thickness and width of tape 0,1 x 20 mm (open helix binder)
- nominal thickness/diameter approx. 52,3 mm

Oversheath

- material MDPE, type ST₇
- nominal thickness 2,7 mm
- nominal overall diameter of cable approx. 58,7 mm
- manufacturer Borouge – UAE
- colour Black

Longitudinally watertightness

- along insulation screen yes screen region
 - number of swelling tapes two (under and over metallic screen)
 - nominal thickness and width 0,1 x 50 mm (overlap of 10%)
 - material designation water blocking polyester tapes
 - manufacturer Tianrong
- along the conductor not claimed

Fire retardant (IEC 60332-1-2)

no

1.2 List of documents

The manufacturer has guaranteed that the object submitted for tests has been manufactured in accordance with the following document.

KEMA has verified that this document adequately represents the object tested.

The following document is included in this Certificate:

drawing no./ document no.	revision	date	title
AB5-TT01-U60-00-00	0	28 May 2009	cable construction drawing and datasheet

2 GENERAL INFORMATION

2.1 The tests were witnessed by

The tests were not witnessed.

2.2 The tests were carried out by

Name	Company
Mr J.J.M. Mooren	KEMA Nederland B.V.,
Mr H.J. Arnoldus	Arnhem, the Netherlands

2.3 Subcontracting

The following tests were subcontracted to KEMA Quality:

- material tests in accordance with clause 8.1.1 until 8.1.5 of BS 7870-4.10.

2.4 Purpose of the test

Purpose of the test was to verify whether the material complies with the specified requirements.

2.5 Measurement uncertainty

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

2.6 Applicable standards

When reference is made to a standard and the date of issue is not stated, this applies to the latest issue, including amendments, which have been officially published prior to the date of the tests.

3 ELECTRICAL TYPE TESTS

3.1 General

3.1.1 Tests at elevated conductor temperature

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

The heating currents in both 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. Annex A, method 1 of IEC 60840 was used as a guide.

3.2 Partial discharge test

Standard and date

Standard BS 7870-4.10, clause 8.2.1

Test date 12 June 2009

Environmental conditions

Ambient temperature 21 °C

Temperature of test object 21 °C

Characteristic test data

Circuit	balanced
Calibration	5 pC
Noise	2 pC
Sensitivity	4 pC
Required sensitivity	≤ 5 pC
Bandwidth	40 - 400 kHz
Test frequency	50 Hz
Coupling capacitor	2600 pF

core	voltage applied, 50 Hz		duration (s)	partial discharge level (pC)
	... x U_0	(kV)		
1	2,25	42,75	< 60	-
1	2	38	-	not detectable

Requirement

The minimum detectable discharge shall not be more than 5 pC at 2 U_0 .

Result

The test was passed.

3.3 Bending test

Standard and date

Standard BS 7870-4.10, clause 8.2.2
Test date 3 June 2009

Environmental conditions

Ambient temperature 16 °C
Temperature of test object 16 °C

Characteristic test data

Single core cable (others) < 20 (d+ D)

measured outer diameter of cable D (mm)	measured diameter of cable conductor d (mm)	required bending diameter D _r (mm)	diameter of test cylinder D _t (mm)
59,8	30,2	< 1800	1770

Procedure

The test sample shall be bent around a test cylinder at ambient temperature for at least one complete turn. It shall then be unwound and repeated, except that the sample shall be bent in the reverse direction without axial rotation. This cycle of operation shall be carried out three times.

Requirement

After completion of the bending test, the cable oversheath shall be visibly examined for cracking. A partial discharge test shall be performed where the minimum detectable discharge shall be not more than 5 pC at 2 U₀ (see clause 3.2).

Observation

The test was carried out successfully and the oversheath showed no evidence of cracking when examined.

Result

The test was passed.

3.4 Tan δ in relation to voltage

Standard and date

Standard BS 7870-4.10, clause 8.2.3

Test date 12 June 2009

Environmental conditions

Ambient temperature 21 °C

Temperature of test object 21 °C

Characteristic test data

Length of test object 15,2 m

Standard capacitor 100 pF

core	voltage applied, 50 Hz		core capacitance ¹⁾ (μF/km)	tan δ	Δ tan δ
	... x U ₀	kV			
1	0,5	9,5	0,236	3,2x10 ⁻⁴	0,1x10 ⁻⁴
1	1	19	0,236	3,2x10 ⁻⁴	
1	2	38	0,236	3,3x10 ⁻⁴	
1	0,5 - 2	9,5 - 38	-		
1) for information only					

Requirement

The measured tan δ shall not be higher than 40×10^{-4} at U_0 . The maximum increase in tan δ from 0,5 U_0 to 2 U_0 shall not be higher than 20×10^{-4} .

Result

The test was passed.

3.5 Tan δ in relation to temperature

Standard and date

Standard BS 7870-4.10, clause 8.2.4

Test date 15 June 2009

Environmental conditions

Ambient temperature 20 °C

Characteristic test data

Length of test object 15,2 m

Standard capacitor 100 pF

Measured at ambient temperature of 20 °C

core	voltage applied, 50 Hz (kV)	core capacitance ¹⁾ (μ F/km)	tan δ
1	9,5	0,236	$3,2 \times 10^{-4}$
1) for information only			

Measured at elevated temperature of 97 °C

core	voltage applied, 50 Hz (kV)	core capacitance ¹⁾ (μ F/km)	tan δ
1	9,5	0,218	$2,0 \times 10^{-4}$
1) for information only			

Requirement

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

Result

The test was passed.

3.6 Heat cycle test and partial discharge tests

3.6.1 Heating cycle test

Standard and date

Standard BS 7870-4.10, clause 8.2.5
Test period 16 June 2009 until 24 June 2009

Environmental conditions

Ambient temperature 18-21 °C

Characteristic test data

Stabilized temperature 97 °C

no. of heating cycles	required stable conductor temperature (°C)	heating current during stable condition (A)	heating per cycle		cooling per cycle
			total duration (h)	duration of conductor at stable temperature (h)	total duration (h)
20	95-100	1230	5	2	3

Procedure

The heating cycle shall be of at least an 8 h duration. The conductor temperature shall be maintained within the stated temperature limits for at least 2 h of each heating period. This shall be followed by at least 3 h of natural cooling in air, to a conductor temperature within 10 K of ambient temperature.

Observation

The test is carried out successfully.

3.6.2 Partial discharge test after cycle 3

Standard and date

Standard BS 7870-4.10, clause 8.2.1
Test date 17 June 2009

Environmental conditions

Ambient temperature 21 °C
Temperature of test object 28 °C

Characteristic test data

Circuit balanced
Calibration 5 pC
Noise 2 pC
Sensitivity 4 pC
Required sensitivity ≤ 5 pC
Bandwidth 40 - 400 kHz
Test frequency 50 Hz
Coupling capacitor 2600 pF

core	voltage applied, 50 Hz		duration (s)	partial discharge level (pC)
	... x U_0	(kV)		
1	2,25	42,75	< 60	-
1	2	38	-	not detectable

Requirement

The minimum detectable discharge shall not be more than 5 pC at 2 U_0 .

Result

The test was passed.

3.6.3 Partial discharge test after cycle 9

Standard and date

Standard BS 7870-4.10, clause 8.2.1

Test date 19 June 2009

Environmental conditions

Ambient temperature 21 °C

Temperature of test object 26 °C

Characteristic test data

Circuit balanced

Calibration 5 pC

Noise 2,5 pC

Sensitivity 5 pC

Required sensitivity ≤ 5 pC

Bandwidth 40 - 400 kHz

Test frequency 50 Hz

Coupling capacitor 2600 pF

core	voltage applied, 50 Hz		duration (s)	partial discharge level (pC)
	... x U_0	(kV)		
1	2,25	42,75	< 60	-
1	2	38	-	not detectable

Requirement

The minimum detectable discharge shall not be more than 5 pC at 2 U_0 .

Result

The test was passed.

3.6.4 Partial discharge test after cycle 15

Standard and date

Standard BS 7870-4.10, clause 8.2.1
Test date 22 June 2009

Environmental conditions

Ambient temperature 18 °C
Temperature of test object 18 °C

Characteristic test data

Circuit balanced
Calibration 5 pC
Noise 2,5 pC
Sensitivity 5 pC
Required sensitivity ≤ 5 pC
Bandwidth 40 - 400 kHz
Test frequency 50 Hz
Coupling capacitor 2600 pF

core	voltage applied, 50 Hz		duration (s)	partial discharge level (pC)
	... x U_0	(kV)		
1	2,25	42,75	< 60	-
1	2	38	-	not detectable

Requirement

The minimum detectable discharge shall not be more than 5 pC at 2 U_0 .

Result

The test was passed.

3.6.5 Partial discharge test after cycle 20

Standard and date

Standard BS 7870-4.10, clause 8.2.1
Test date 24 June 2009

Environmental conditions

Ambient temperature 20 °C
Temperature of test object 20 °C

Characteristic test data

Circuit balanced
Calibration 5 pC
Noise 2 pC
Sensitivity 4 pC
Required sensitivity ≤ 5 pC
Bandwidth 40 - 400 kHz
Test frequency 50 Hz
Coupling capacitor 2600 pF

core	voltage applied, 50 Hz		duration (s)	partial discharge level (pC)
	... x U_0	(kV)		
1	2,25	42,75	< 60	-
1	2	38	-	not detectable

Requirement

The minimum detectable discharge shall not be more than 5 pC at 2 U_0 .

Result

The test was passed.

3.7 Impulse test

Standard and date

Standard BS 7870-4.10, clause 8.2.6

Test date 25 June 2009

Environmental conditions

Ambient temperature 20 °C

Temperature of test object 97 °C

Characteristic test data

Specified test voltage 194 kV

testing arrangement		polarity	voltage applied (% of test voltage)	no. of impulses	see figure
voltage applied to	earthed				
conductor	metallic screen	positive	55 75 90 100	1 1 1 10	1 (waveshape) 2 2 3 and 4
conductor	metallic screen	negative	55 75 90 100	1 1 1 10	5 (waveshape) 6 6 7 and 8

Requirement

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

Result

The test was passed.

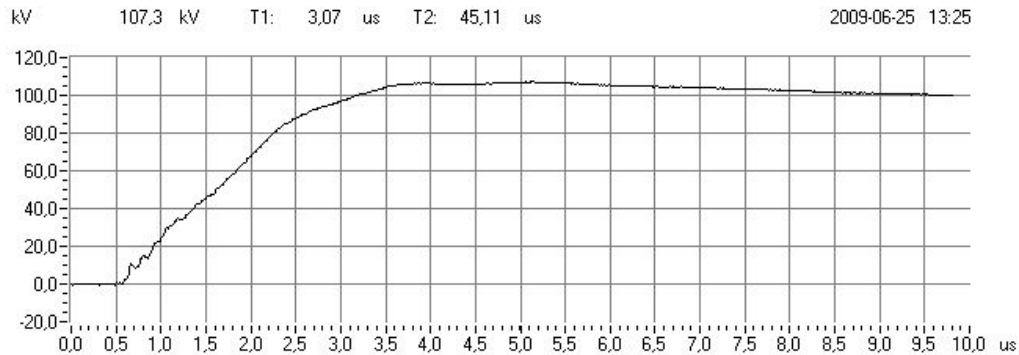


Fig. 1: Waveshape 70870224 Elsewedy 55% of test voltage

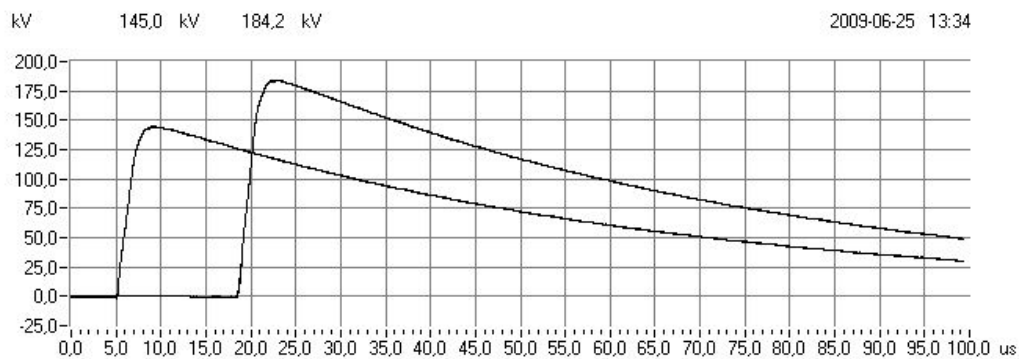


Fig. 2: 70870224 Elsewedy 75% and 95% of test voltage

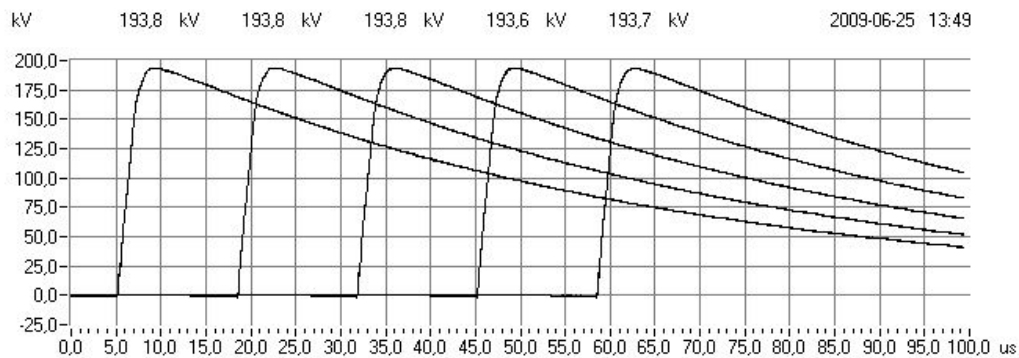


Fig. 3: 70870224 Elsewedy 100% of test voltage

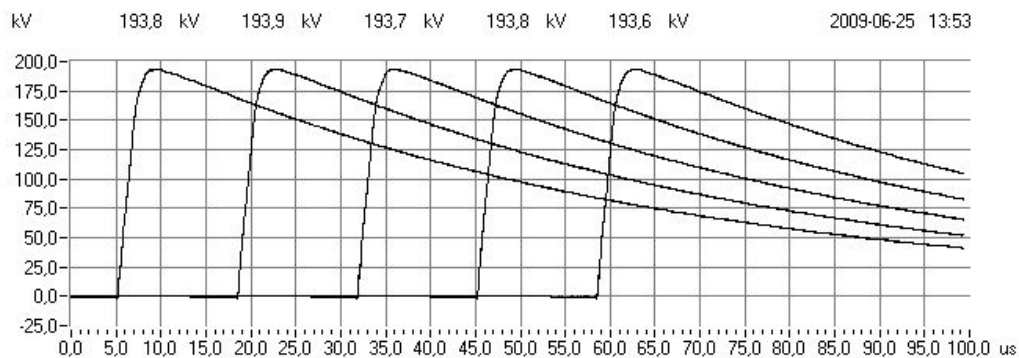


Fig. 4: 70870224 Elsewedy 100% of test voltage



Fig. 5: Waveshape 70870224 Elsewedy -55% of test voltage

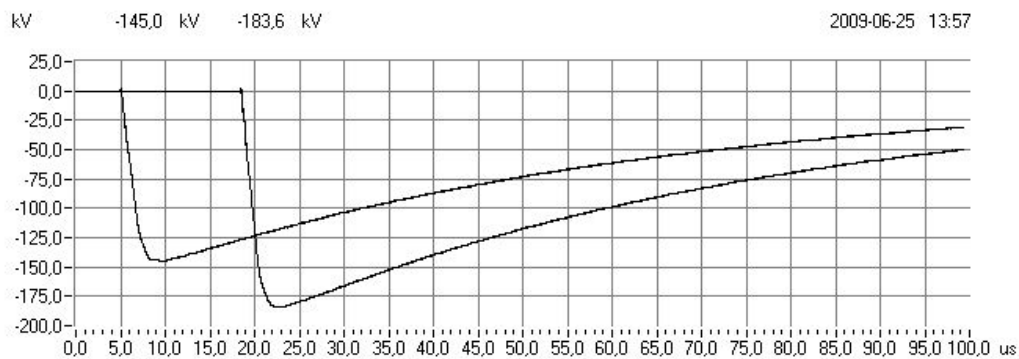


Fig. 6: 70870224 Elsewedy -75% and -95% of test voltage

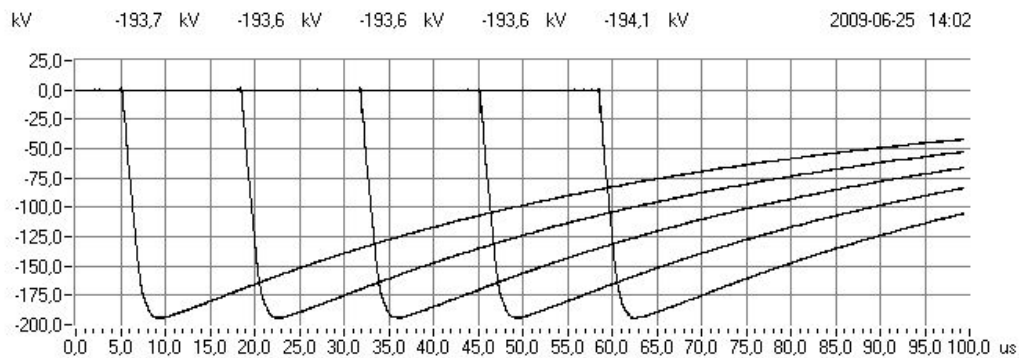


Fig. 7: 70870224 Elsewedy -100% of test voltage

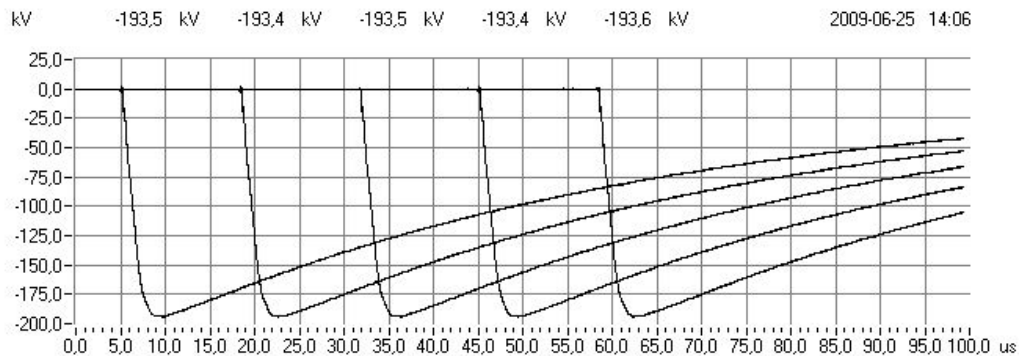


Fig. 8: 70870224 Elsewedy -100% of test voltage

3.8 Four hour voltage test

Standard and date

Standard BS 7870-4.10, clause 8.2.7

Test date 30 June 2009

Environmental conditions

Ambient temperature 20 °C

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	metallic screen	4	76	4

Requirement

No breakdown of the insulation shall occur.

Result

The test was passed.

4 MATERIAL TYPE TESTS

The material type tests were carried out in the period from 1 July 2009 up to and including 20 July 2009.

4.1 Conductor screen

4.1.1 Resistivity of conductor screen

Standard BS 7870-4.10, clause 8.1.1

Characteristic test data

Conductivity measured at 90 °C

item	unit	requirement	measured/determined
- without ageing	Ωm	≤ 500	0,1

Note

The measurement of conductivity shall be at a temperature within ± 2 °C of the maximum conductor temperature in normal operation.

Result

The test was passed.

4.2 Insulation

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

Standard BS 7870-4.10, clause 8.1.2 table 6

Characteristic test data

Temperature during ageing 135 °C
Duration 7 days

item	unit	requirement	measured/determined
without ageing			
- tensile strength	N/mm ²	≥ 12,5	26,6
- elongation	%	≥ 200	527
after ageing			
- tensile strength	N/mm ²	-	28,2
- variation with samples without ageing	%	± 25 max.	6
- elongation	%	-	563
- variation with samples without ageing	%	± 25 max.	7

Result

The test was passed.

4.2.2 Shrinkage test for XLPE insulation

Standard BS 7870-4.10, clause 8.1.2 table 6

Characteristic test data

Temperature 130 °C
Duration 1 h

item	unit	requirement	measured/determined
- shrinkage	%	≤ 4	< 0,5

Result

The test was passed.

4.2.3 Hot set test for XLPE insulation

Standard BS 7870-4.10, clause 8.1.2 table 6

Characteristic test data

Air temperature 200 °C
Time under load 15 min
Mechanical stress 0,2 N/mm²

item	unit	requirement	measured/determined
- elongation under load	%	≤ 175	75
- permanent elongation	%	≤ 15	7

Result

The test was passed.

4.3 Insulation screen

4.3.1 Resistivity of insulation screen

Standard BS 7870-4.10, clause 8.1.3

Characteristic test data

Conductivity measured at 90 °C

item	unit	requirement	measured/determined
insulation screen - without ageing	Ωm	≤ 500	0,4

Note

The measurement of conductivity shall be at a temperature within ± 2 °C of the maximum conductor temperature in normal operation.

Result

The test was passed.

4.4 Oversheath

4.4.1 Tests for determining the mechanical properties of oversheath before and after ageing

Standard BS 7870-4.10, clause 8.1.4 table 7

Characteristic test data

Temperature during ageing 110 °C
Duration 14 days

Oversheath

item	unit	requirement	measured/determined
without ageing			
- tensile strength	N/mm ²	≥ 12,5	33,8
- elongation	%	≥ 300	752
after ageing			
- tensile strength	N/mm ²	-	32,7
- variation with samples without ageing	%	-	-3
- elongation	%	≥ 300	728
- variation with samples without ageing	%	-	-3

Result

The test was passed.

4.4.2 Pressure test at high temperature on oversheath

Standard BS 7870-4.10, clause 8.1.4 table 7

Characteristic test data (oversheath)

Temperature 115 °C
Duration 6 h
Load 12,9 N

Oversheath

item	unit	requirement	measured/determined
- depth of indentation	%	≤ 50	4

Result

The test was passed.

4.4.3 Shrinkage test for PE oversheath

Standard BS 7870-4.10, clause 8.1.4 table 7

Characteristic test data

Temperature 80 °C
Duration 5 h
Heating cycles 5

item	unit	requirement	measured/determined
- shrinkage	%	≤ 3	3

Result

The test was passed.

4.4.4 Measurement of carbon black content of black PE oversheath

Standard BS 7870-4.10, clause 8.1.4 table 7

item	unit	requirement	measured/determined
- carbon black content	%	$2,5 \pm 0,5$	2,5

Result

The test was passed.

4.5 Compatibility test

4.5.1 Additional ageing test on pieces of completed cable

Standard BS 7870-4.10, clause 8.1.5 table 8

Characteristic test data

Temperature during ageing 100 °C
Duration 7 days

item	unit	requirement	measured/determined
insulation			
- tensile strength	N/mm ²	-	24,2
- variation with samples without ageing	%	± 25 max.	-9
- elongation	%	-	499
- variation with samples without ageing	%	± 25 max.	-5
oversheath			
- tensile strength	N/mm ²	≥ 12,5	32,9
- variation with samples without ageing	%	-	-3
- elongation	%	≥ 300	765
- variation with samples without ageing	%	-	2

Result

The test was passed.

4.5.2 Resistivity of insulation screen

Standard BS 7870-4.10, clause 8.1.5 table 8

Characteristic test data

Temperature during ageing 100 °C
Duration 7 days
Conductivity measured at 90 °C

item	unit	requirement	measured/determined
insulation screen - after ageing	Ωm	≤ 1000	0,8

Note

The measurement of conductivity shall be at a temperature within ± 2 °C of the maximum conductor temperature in normal operation.

Result

The test was passed.

4.5.3 Resistivity of conductor screen

Standard BS 7870-4.10, clause 8.1.5 table 8

Characteristic test data

Temperature during ageing 100 °C
Duration 7 days
Conductivity measured at 90 °C

item	unit	requirement	measured/determined
conductor screen - after ageing	Ωm	≤ 1000	0,9

Note

The measurement of conductivity shall be at a temperature within ± 2 °C of the maximum conductor temperature in normal operation.

Result

The test was passed.

4.6 Cold bend test

4.6.1 Partial discharge test before bending test

Standard and date

Standard BS 7870-4.10, clause 8.2.1

Test date 7 July 2009

Environmental conditions

Ambient temperature 20 °C

Temperature of test object 20 °C

Characteristic test data

Circuit balanced

Calibration 5 pC

Noise 1 pC

Sensitivity 2 pC

Required sensitivity ≤ 5 pC

Bandwidth 40 - 400 kHz

Test frequency 50 Hz

Coupling capacitor 2600 pF

core	voltage applied, 50 Hz		duration (s)	partial discharge level (pC)
	... x U_0	(kV)		
1	2,25	42,75	< 60	-
1	2	38	-	not detectable

Requirement

The minimum detectable discharge shall not be more than 5 pC at 2 U_0 .

Result

The test was passed.

4.6.2 Bending test

Standard and date

Standard BS 7870-4.10, clause 8.1.6

Test date 9 July 2009

Environmental conditions

Ambient temperature 5 °C

Temperature of test object 0 °C

Characteristic test data

Single core cable (others) $< 20(d + D)$

measured outer diameter of cable D (mm)	measured diameter of cable conductor d (mm)	required bending diameter D_r (mm)	diameter of test cylinder D_t (mm)
59,8	30,2	< 1800	1770

Procedure

The test sample shall be bent around a test cylinder at ambient temperature for at least one complete turn. It shall then be unwound and repeated, except that the sample shall be bent in the reverse direction without axial rotation. This cycle of operation shall be carried out two times.

Observation

The test was carried out successfully and the oversheath showed no evidence of cracking when examined.

Result

The test was passed.

4.6.3 Partial discharge test after bending test

Standard and date

Standard BS 7870-4.10, clause 8.2.1

Test date 20 July 2009

Environmental conditions

Ambient temperature 20 °C

Temperature of test object 20 °C

Characteristic test data

Circuit balanced
 Calibration 5 pC
 Noise 2 pC
 Sensitivity 4 pC
 Required sensitivity ≤ 5 pC
 Bandwidth 40-400 kHz
 Test frequency 50 Hz
 Coupling capacitor 2600 pF

core	voltage applied, 50 Hz		duration (s)	partial discharge level (pC)
	... x U_0	(kV)		
1	2,25	42,75	< 60	-
1	2	38	-	not detectable

Requirement

The minimum detectable discharge shall not be more than 5 pC at 2 U_0 .

Result

The test was passed.

4.6.4 Examination cold bend test sample

Standard and date

Standard BS 7870-4.10, clause 8.1.6

Test date 9 and 20 July 2009

Requirement

After completion of the bending test, the cable oversheath and insulation shall be visibly examined for cracking.

Observation

The test was carried out successfully and the oversheath and insulation showed no evidence of cracking when examined.

5 VERIFICATION OF CABLE CONSTRUCTION

Verification of cable construction was carried out. The results are presented below.

item	unit	requirement	specified	measured/ determined
conductor				
- diameter of conductor	mm	$28,7 \leq d \leq 32,5$	30 +/- 0,2 mm	30,2 mm
- number of wires		≥ 53	53 minimum	55
- diameter of wires	mm	-	-	Ø 3,9 mm
- resistance at 20°C	Ω/km	$\leq 0,0469$	-	0,0466

	determinations
marking of the cable	EL SEWEDY CABLES ELECTRIC CABLE 33000V BS 7870-4.10 1X630 AL MM2 AL/XLPE/MDPE/2007
colour of the outer sheath	black
construction	<ul style="list-style-type: none"> - conductor of aluminium wires 55 x Ø 3,9 mm approx. - conductor construction 1-6-11-16-21 - semi conducting tape - semi conducting conductor screen - XLPE insulation - semi conducting insulation screen - semi conducting tape 60x0,3 mm approx. - screen of copper wires 42x Ø 1,0 mm approx. - copper tape open helix 0,10x19,9 mm approx. - non-conductive waterblocking tape 48x0,3 mm approx. overlap 30% approx. - oversheath MDPE
outer diameter of the cable (mm)	59,8 average
outer diameter of the core (mm)	50,5 average

Result

No significant deviations from the specified requirements were found.

6 ADDITIONAL TESTS AS PER IEC 60502-2

6.1 Water penetration test

Standard and date

Standard IEC 60502-2, clause 19.22 and Annex F
Test period 22-26 June 2009

Atmospheric conditions

Ambient temperature 20 °C
Temperature of test object 20-97 °C

Characteristic test data

Length of cable sample 3 m
Water height above cable centre 1 m

no. of heating-cycles	required steady conductor temperature	heating current	heating per cycle		cooling per cycle
	(°C)	(A)	total duration (h)	duration of conductor at steady temperature (h)	total duration (h)
10	95-100	1240	5	2	3

Note

The manufacturer has claimed that barriers have been included, which prevents longitudinal water penetration in the region of the metallic layers.

Procedure

The cable sample was prepared in accordance with the procedure as mentioned in clause F.1 of IEC 60502-2. Following this, the tube was filled within 5 minutes with water up to a height of the water in the tube of 1 m above the cable centre. After 24 hours the first heating cycle was started. For the procedure of the heating cycles reference is made to clause F.2 of IEC 60502-2.

Requirement

No water shall emerge from the ends of the cable sample

Result

The test was passed.

APPENDIX A MEASUREMENT UNCERTAINTIES

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: $\leq 3\%$ time parameters: $\leq 10\%$
capacitance measurement	0,3%
$\tan \delta$ measurement	$\pm 0,5\% \pm 5 \times 10^{-5}$
partial discharge measurement	$< 10 \text{ pC} : 2 \text{ pC}$ $10 - 100 \text{ pC} : 5 \text{ pC}$ $> 100 \text{ pC} : 20\%$
measurement of impedance	$\leq 1\%$
ac-resistance measurement	
measurement of losses	$\leq 1\%$
measurement of insulation resistance	$\leq 10\%$
measurement of dc resistance	$1 \mu\Omega - 5 \mu\Omega : 1\%$ $5 \mu\Omega - 10 \mu\Omega : 0,5\%$ $10 \mu\Omega - 200 \mu\Omega : 0,2\%$
radio interference test	2 dB
calibration of current transformers	$2,2 \times 10^{-4} \text{ li/lu}$ and $290 \mu\text{rad}$
calibration of voltage transformers	$1,6 \times 10^{-4} \text{ Ui/Uu}$ en $510 \mu\text{rad}$
measurement of conductivity	5%
measurement of temperature	$-50^\circ\text{C} - -40^\circ\text{C} : 3 \text{ K}$ $-40^\circ\text{C} - 125^\circ\text{C} : 2 \text{ K}$ $125^\circ\text{C} - 150^\circ\text{C} : 3 \text{ K}$
tensile test	1%
sound level measurement	type 1 meter as per IEC 651 and ANSI S1.4.1971
measurement of voltage ratio	0,1%

APPENDIX B MANUFACTURER'S DRAWING/DATA SHEET

4 pages (including this page)

drawing no./ document no.	revision	date	title
AB5-TT01-U60-00-00	0	28 May 2009	cable construction drawing and datasheet

El Sewedy Cables

Technical Department

19 / 33 kV Cable

Cable Construction

1. Conductor

Material		Aluminum
Size	mm ²	630
No. of wires		53 (Min.)
Conductor Diameter	mm	30 (+/-) 0.2

2. Conductor Screen

Material		Extruded semi-conducting material
Thickness	mm	0.7 (Approximate)
Diameter	mm	31.4 (Approx.)

3. Insulation

Material		Cross Linked Poly Ethylene (XLPE)
Thickness	mm	8.0 (nominal)
	mm	7.1 (Minimum at any point)
Diameter	mm	47.4 (Approx.)

4. Insulation Screen

Material		Extruded semi-conducting material (Bonded Type)
Thickness	mm	1.0 (Approximate)
Diameter	mm	49.4 (Approx.)

**5. Water Blocking
Tape**

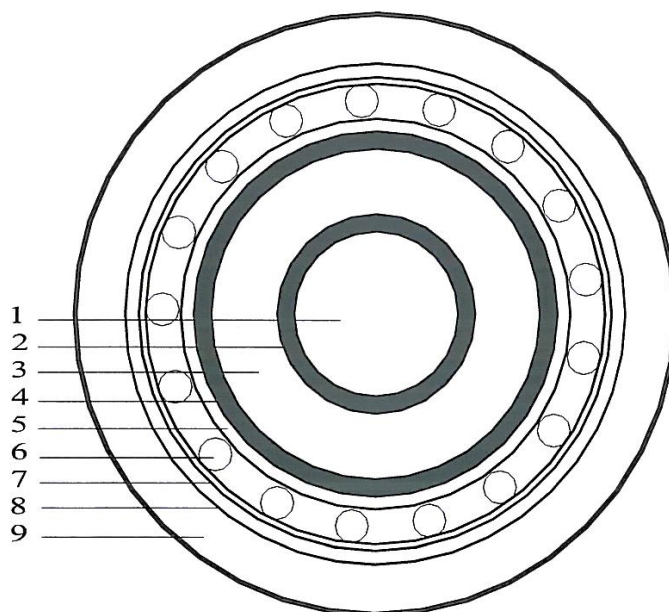
Material	Semi-Conductive Water Blocking Tape
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6. Metallic Screen

Material		Copper Wire and tape Screen
Diameter of copper wires	mm	1.04
No. of copper wires		42
Thickness of copper tapes	mm	0.1
Overlap percentage	%	Open Helix
No. of Tapes	No.	1
Total C.S.A	mm ²	35
Diameter	mm	52.3 (Approx.)

**7. Water Blocking
Tape**

Material	Non-Conductive Water Blocking Tape
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<i>Size</i> : 1 x 630 <i>mm²</i>		<i>Type</i> : AL/XLPE/MDPE	
<i>Voltage:</i> 19 / 33 <i>kV</i>		<i>Standard:</i> BS 7870 - 4.10	
<i>Code</i> : AB5-TT01-U60-00-00		EL-SEWEDY CABLES	
<i>Sr.</i>	<i>Description</i>	<i>Thickness mm</i>	<i>Diameter mm</i>
1.	Aluminum Conductor (Compacted)		30
2.	Inner Semi-conductor	0.7 (Approx.)	
3.	XLPE Insulation	8 (Nominal)	
4.	Outer Semi-conductor (Bonded)	1.0 (Approx.)	
5.	Semi-Conductive Water Blocking Tape		
6.	Copper Wire Screen		42 X 1.04
7.	Copper Tape Binder (Open Helix)	0.1	
8.	Non-Conductive Water Blocking Tape		
9.	MDPE Sheath	2.7 (Nominal)	58.7 (Approx.)
<i>Not to Scale</i>		<i>Drawn by</i> Mr. Ahmad Ghomkhoy	
		<i>Approved by</i> Eng. Ahmad Saleh	