TIC 1075-13

TYPE TEST CERTIFICATE OF COMPLETE TYPE TESTS

OBJECT Single-core power cable

TYPE 18/30(36) kV, 1x630 mm^2, A2XWcWaY(P) XLPE

Rated voltage, U_0/U (U_m)	**18/30 (36) kV**	**Conductor material**	**Al**
Conductor cross-section	**1x630 mm^2**	**Insulation material**	**XLPE**

MANUFACTURER KEC INTERNATIONAL LIMITED,
Vadodara, Gujarat, India

CLIENT KEC INTERNATIONAL LIMITED,
Vadodara, Gujarat, India

TESTED BY KEMA Nederland B.V.,
Arnhem, The Netherlands

DATE(S) OF TESTS 10 October to 22 November 2013

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

IEC 60502-2 (2005)

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 performances are considered to comply with the above Standard and to justify the ratings assigned by the manufacturer as listed on page 4 to 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.

This Certificate consists of 34 pages in total.

KEMA Nederland B.V.

S.A.M. Verhoeven
Director Testing, Inspections &
Certification The Netherlands

Arnhem, 18 December 2013

Order no: 72122084

Version: 2

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1 IDENTIFICATION OF THE OBJECT TESTED

1.1 Ratings/characteristics of the object tested and proved by tests

Rated voltage, U_0/U (U_m)	18/30 (36) kV
Rated maximum conductor temperature in normal operation	90 °C
Rated conductor cross-section	1x630 mm^2

The test voltages were based on U_0 test = 18 kV.

1.2 Description of the object tested

Standard	IEC 60502-2, Clause 5-14
Manufacturer (as stated by the client)	KEC INTERNATIONAL LIMITED, Vadodara, Gujarat, India
Type	U_0 = 18 kV 1x630 mm^2 XLPE CABLE
Manufacturing date	2013
Sampling procedure	By the manufacturer
Quantity submitted	65 m
Rated voltage, U_0/U (U_m)	18/30 (36) kV
Nominal capacitance between conductor and metal screen	0,355 µF/km
No. of cores (core identification)	1
Overall diameter	65,5 mm
Embossing on the oversheath	KEC INTL.LTD. RPG CABLES 18/30(36)kV ELECTRIC CABLE 1x630mm^2 A2XWCWaY(P) XLPE ELECTRICITY Co. OF GHANA LTD (ECG) 2013
Construction	see List of drawings
Conductor	
– material	Aluminium
– cross-section	630 mm^2
– nominal diameter	29,8 mm
– type	Stranded compacted
– maximum conductor temperature in normal operation	90 °C
– presence and nature of measures to achieve longitudinal watertightness	No
Conductor screen	
– material	Semi-conducting compound 33 kV
– nominal thickness	0,6 mm
– material designation	DYM 515
– manufacturer of the material	DYM, South Korea

Insulation

– material	TR-XLPE
– nominal thickness	8 mm
– material designation	Dow Endurance (TM) HFDB 4202 EC
– manufacturer of the material	DOW CHEMICALS

Insulation (core) screen

– material	Semi conducting compound 33 kV
– strippable	Yes
– nominal thickness	0,6 mm
– material designation	Pramkor 3005 ES
– manufacturer of the material	Pramkor

Metallic screen

– material	Copper tape, 1 layer, and wires
– number of wires	70
– nominal diameter of wires	0,8 mm
– nominal thickness and width of tape	10 x 0,1 mm (Counter Helix)
– cross-sectional area	35 mm^2
– diameter over metallic screen	49,8 mm

Longitudinally watertightness

– presence and nature of measures to achieve longitudinal watertightness along insulation screen	None

Separation sheath

– material	PVC, type ST_2
– nominal thickness	1,6 mm
– manufacturer of the material	YASH POLYMERS

Metallic armour

– material	Aluminium wires
– number of wires	59
– nominal diameter of wires	2,5 mm
– cross-sectional area	289,4 mm^2
– manufacturer of the material	VEDANTA ALUMINIUM

Oversheath

– material	PVC, type ST_2
– nominal thickness	3,0 mm
– nominal overall diameter of the cable (D)	63 mm
– manufacturer of the material	YASH POLYMERS
– colour	Blue
– graphite coating applied	No

Fire retardant (according to IEC 60332-1) No

Manufacturing details insulation system

– location of manufacturing	Vadodra, Gujarat, India
– type of extrusion line	CCV
– type of extrusion	Triple extrusion
– factory identification of extrusion line	EPL-50 Malliffer
– manufacturer of the extrusion line	Maillifer, Finland
– identification of production batch	Cable UID no.2868
– curing means	Dry curing
– cooling means	Dry cured water cooled
– manufacturing length (where cable sample for testing has been taken from)	600 m
– length markings on cable sample sent to KEMA	begin: 0002 m, end: 0067m

1.3 List of drawings

The manufacturer has guaranteed that the object submitted for tests has been manufactured in accordance with the following drawing and/or document. KEMA has verified that this drawing and/or document adequately represents the object tested. The manufacturer is responsible for the correctness of this drawing and/or document and the technical data presented.

The following drawing and/or document has been included in this Certificate:

Drawing no./document no.	Revision
XLPE/1/Wa	Rev.0

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 by

Name	Company
Mr A. Sengers	KEMA Nederland B.V.,
Mr E. Pultrum	Arnhem, The Netherlands

2.3 Subcontracting

The following tests were subcontracted to DNV KEMA New Energy Technology (NET):

- measurement of resistivity of semi-conducting screens in accordance with Sub clause 18.1.9.
- non-electrical type tests in accordance with Clause 19.
- check of cable constructions in accordance with clauses 5-14 of IEC 60502-2.

2.4 Purpose of the tests

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

2.5 Measurement uncertainty

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

3 ELECTRICAL TYPE TESTS

3.1 Test arrangement

3.1.1 Determination of the cable conductor temperature

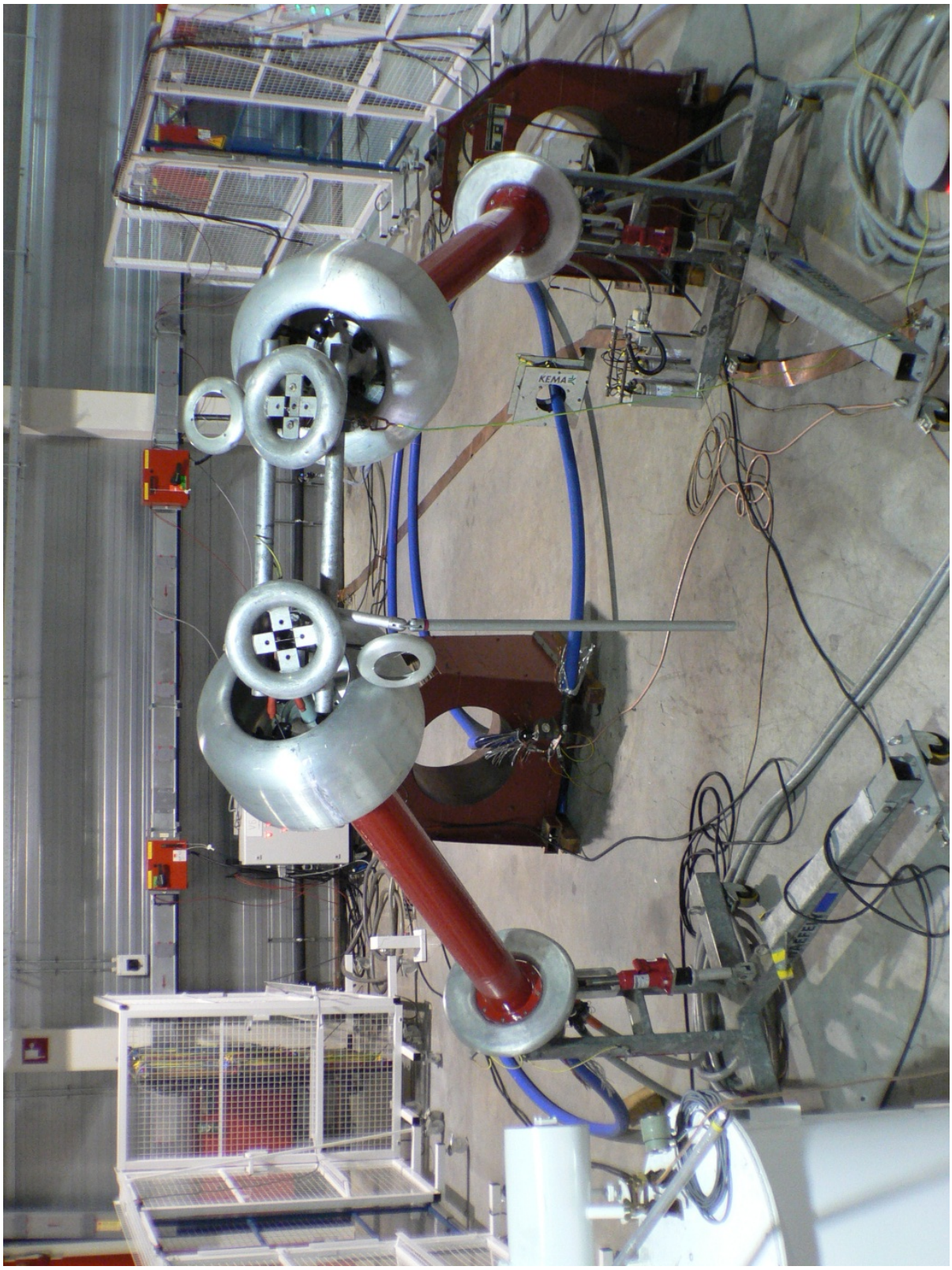
Standard

Standard IEC 60840, Annex A, Subclause A.3.1 was used as a guide

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, thus the conductor temperature of the reference loop is representative for the conductor temperature of the test loop. IEC 60840, Annex A was used as a guide and IEC 60840, Subclause A.3.1, method 1 was applied.

The tests at elevated temperature are carried out two hours after thermal equilibrium has been established.

3.1.2 Photograph of test set-up



3.2 Bending test

Standard and date

Standard IEC 60502-2, Subclause 18.1.3
Test date 10 October 2013

Environmental conditions

Ambient temperature 12 °C

Characteristic test data

Temperature of test object 12 °C
Required bending diameter 20(d + D) + 5%

Length of cable bended 21 m
Length marking of cable bended 29 - 50

Actual external diameter of cable D (mm)	Actual diameter of conductor d (mm)	Required bending diameter D_r (mm)	Diameter of test cylinder D_t (mm)
65,5	29,8	$1811 \leq D_r \leq 2001$	1900

Result

The test was carried out successfully

3.3 Partial discharge test

Standard and date

Standard IEC 60502-2, Subclause 18.1.4
Test date 15 October 2013

Environmental conditions

Ambient temperature 22 °C

Characteristic test data

Temperature of test object 22 °C
Circuit direct
Calibration 5 pC
Noise level at 1,73 U_0 < 2 pC
Sensitivity 4 pC
Required sensitivity ≤ 5 pC
Centre frequency 140 kHz
Bandwidth 100 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	36	10	-
	1,73	31,1	-	Not detectable

Requirement

There shall be no detectable discharge exceeding the declared sensitivity from the test object at 1,73 U_0.

Result

The object passed the test.

3.4 Tan δ measurement

Standard and date

Standard IEC 60502-2, Subclause 18.1.5
Test date 16 October 2013

Environmental conditions

Ambient temperature 21 °C

Characteristic test data

Temperature of test object 97 °C
Length of test object 21,0 m
Standard capacitor 100 pF

Core	Voltage applied, 50 Hz (kV)	Capacitance of core [1] (µF/km)	Tan δ
1	5	0,228	$1,2 \times 10^{-4}$
[1] for information only			

Requirement

The measured value shall not be higher than $40 \times 10^{-4} \geq 2$ kV.

Result

The object passed the test.

3.5 Heating cycle test

3.5.1 Heating cycles.

Standard and date

Standard IEC 60502-2, Subclause 18.1.6
Test dates 17 to 25 October 2013

Environmental conditions

Ambient temperature 20 °C

Characteristic test data

Heating method conductor current
Stabilized temperature 97 °C

No. of heating cycles	Required steady conductor temperature (°C)	Heating current during steady condition (A)	Heating cycle		Cooling cycle
			Total duration (h)	Duration of conductor at steady temperature (h)	Total duration (h)
20	95-100	approx. 1150	5	2	4

Result

The test was carried out successfully.

3.5.2 Partial discharge test

Standard and date

Standard	IEC 60502-2, Subclause 18.1.4
Test date	25 October 2013

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	24 °C
Circuit	direct
Calibration	5 pC
Noise level at 1,73 U_0	< 2 pC
Sensitivity	4 pC
Required sensitivity	≤ 5 pC
Centre frequency	107 kHz
Bandwidth	100 kHz
Test frequency	50 Hz
Coupling capacitor	2600 pF

Core	Voltage applied, 50 Hz		Duration	Partial discharge level
	... x U_0	(kV)	(s)	(pC)
1	2	36	10	-
	1,73	31,1	-	Not detectable

Requirement

There shall be no detectable discharge exceeding the declared sensitivity from the test object at 1,73 U_0.

Result

The object passed the test.

3.6 Impulse test followed by a voltage test

3.6.1 Impulse test

Standard and date

Standard IEC 60502-2, Subclause 18.1.7
Test date 25 October 2013

Environmental conditions

Ambient temperature 21 °C

Characteristic test data

Temperature of test object 97 °C
Specified test voltage 170 kV

Testing arrangement		Polarity	Voltage applied (% of test voltage)	No. of impulses	See figure on next pages
Voltage applied to	Earthed				
Conductor	Metal screens	Positive	50	1	1 (waveshape)
			65	1	2
			80	1	2
			100	10	3 and 4
Conductor	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

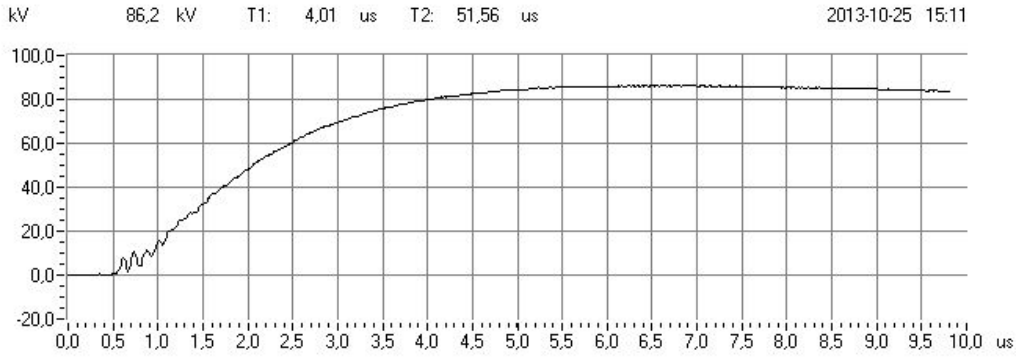


Fig. 1: Waveshape 72122084, KEC, +50% of test voltage

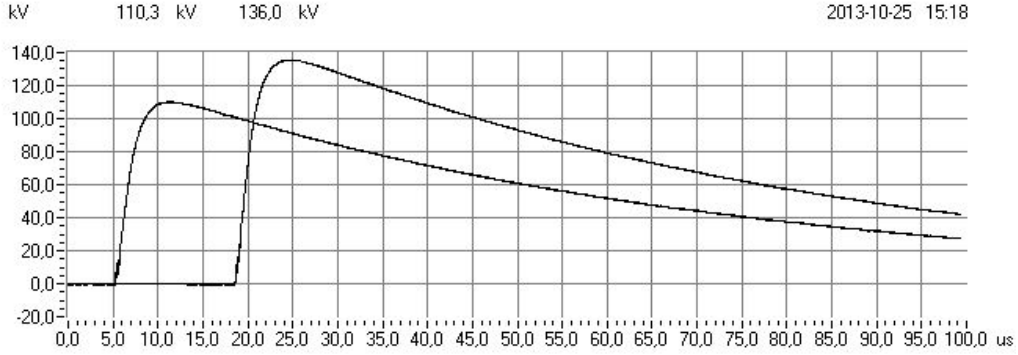


Fig. 2: 72122084, KEC, +65% and +80% of test voltage

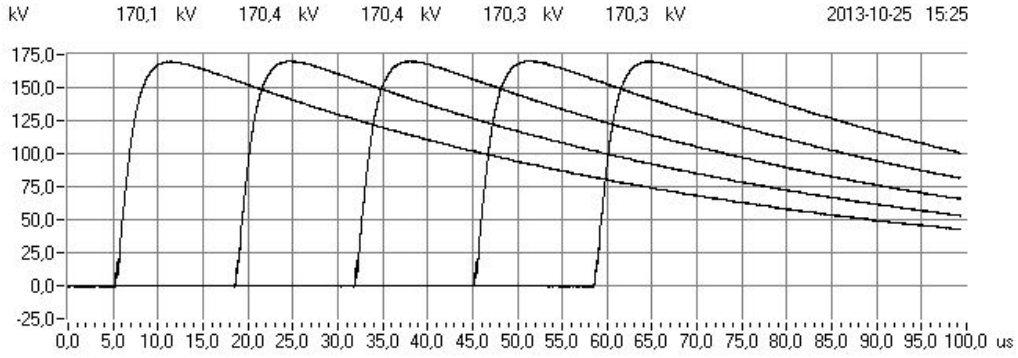


Fig. 3: 72122084, KEC, +100% of test voltage

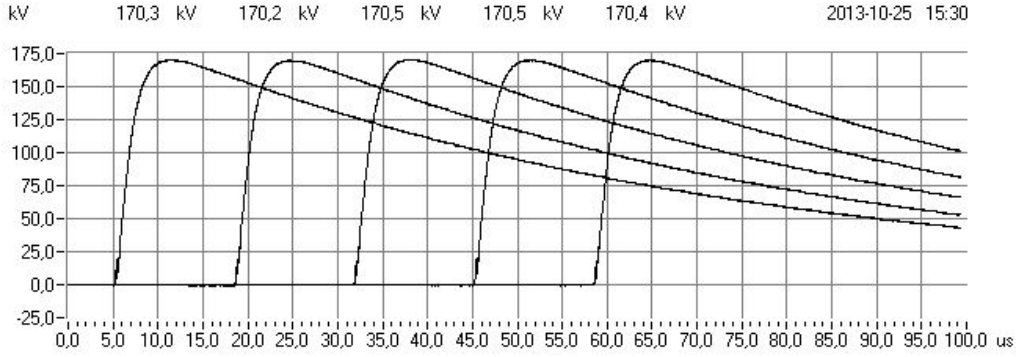


Fig. 4: 72122084, KEC, +100% of test voltage

Lightning impulse test with negative voltage

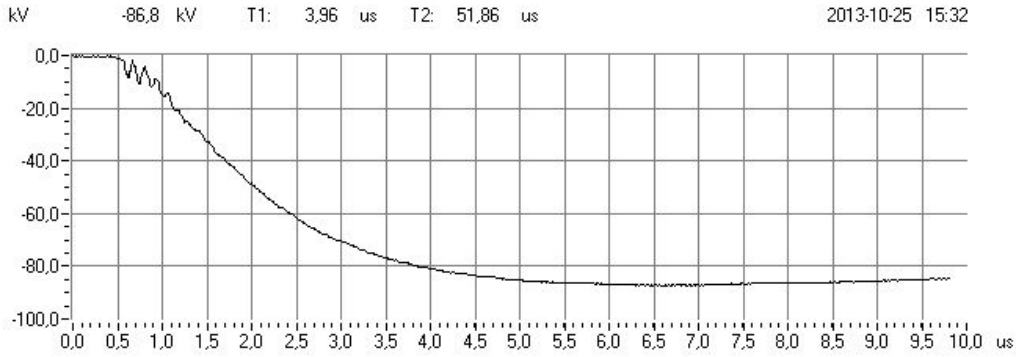


Fig. 5: Waveshape 72122084, KEC, -50% of test voltage

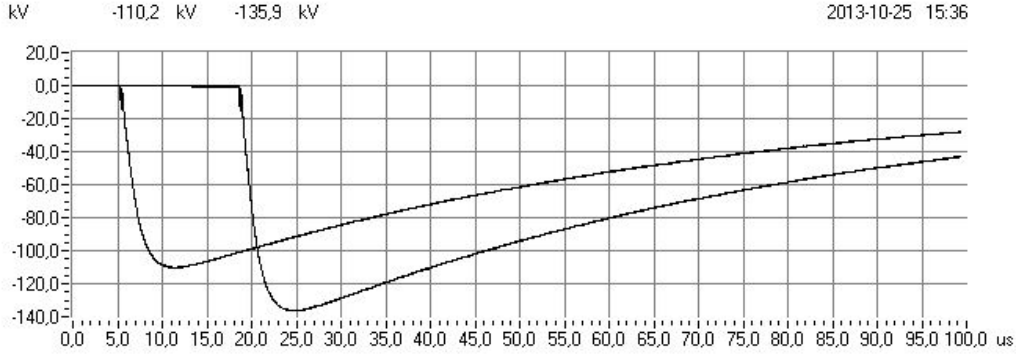


Fig. 6: 72122084, KEC, -65% and -80% of test voltage

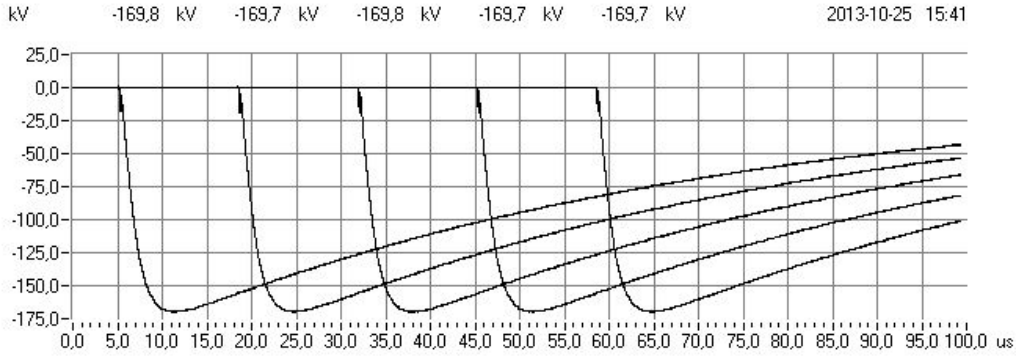


Fig. 7: 72122084, KEC, -100% of test voltage

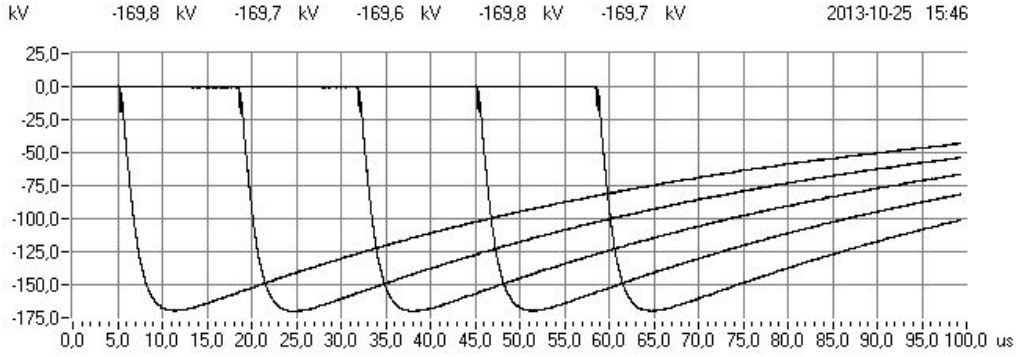


Fig. 8: 72122084, KEC, -100% of test voltage

3.6.2 Voltage test

Standard and date

Standard IEC 60502-2, Subclause 18.1.7
Test date 28 October 2013

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)	(min)
Conductor	Metal screens	3,5	63	15

Requirement

No breakdown of the insulation shall occur.

Result

The object passed the test.

3.7 Voltage test for 4 h

Standard and date

Standard IEC 60502-2, Subclause 18.1.8
Test date 28 October 2013

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 screens	4	72	4

Requirement

No breakdown of the insulation shall occur.

Result

The object passed the test.

3.8 Resistivity of semi-conducting screens

Standard and date

Standard IEC 60502-2, Subclause 18.1.9
Test date 21 November 2013

Characteristic test data

Temperature during ageing 100 °C
Duration 7 days
Resistivity measured at 90 ± 2 °C

Item	Unit	Requirement	Measured/determined
Conductor screen			
-without ageing	Ωm	≤ 1000	0,40
-after ageing	Ωm	≤ 1000	0,90
Insulation screen			
-without ageing	Ωm	≤ 500	2,81
-after ageing	Ωm	≤ 500	3,21

Result

The object passed the test

4 NON-ELECTRICAL TYPE TESTS

4.1 Measurement of thickness of insulation

Standard and date

Standard IEC 60502-2, Subclause 19.1

Test date 19 November 2013

Item	Unit	Requirement	Specified	Measured/determined
Nominal	mm	-	8,00	8,00
Average	mm	-	-	7,82
Minimum [t_{min}]	mm	≥ 7,1	≥ 7,1	7,58
Maximum [t_{max}]	mm	-	-	8,00
($t_{max} - t_{min}$) / t_{max}	-	≤ 0,15	-	0,05

Result

The object passed the test.

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

Standard and date

Standard IEC 60502-2, Subclause 19.2

Test date 8 November 2013

Separation sheath thickness

Thickness	Unit	Requirement	Specified	Measured/determined
Nominal	mm	≥ 1,2	1,6	-
Average	mm	-	-	1,50
Minimum	mm	≥ 1,08	≥ 1,08	1,29

Oversheath thickness

Thickness	Unit	Requirement	Specified	Measured/determined
Nominal	mm	≥ 1,8	3,0	-
Average	mm	-	-	2,35
Minimum	mm	≥ 2,20	≥ 2,20	2,23

Result

The object passed the test.

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

Standard and date

Standard IEC 60502-2, Subclause 19.3

Test date 1 to 7 November 2013

Characteristic test data

Temperature during aging 135 ± 3 °C

Ageing duration 7 days

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm^2	≥ 12,5	32,8
Elongation at break	%	≥ 200	735
After ageing in air oven			
Tensile strength			
value after ageing	N/mm^2	-	32,0
variation	%	± 25 max.	-2
Elongation at break			
value after ageing	%	-	638
variation	%	± 25 max.	-13

Result

The object passed the test.

4.4 Tests for determining the mechanical properties of non-metallic sheaths before and after ageing

Standard and date

Standard IEC 60502-2, Subclause 19.4

Test date 2 to 8 November 2013

Characteristic test data

Temperature during aging 100 ± 2 °C

Ageing duration 7 days

Separation sheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm^2	≥ 12,5	15,3
Elongation at break	%	≥ 150	194
After ageing in air oven			
Tensile strength			
value after ageing	N/mm^2	≥ 12,5	16,2
variation	%	± 25 max.	6
Elongation at break			
value after ageing	%	≥ 150	171
variation	%	± 25 max.	-12

Oversheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm^2	≥ 12,5	16,4
Elongation at break	%	≥ 150	164
After ageing in air oven			
Tensile strength			
value after ageing	N/mm^2	≥ 12,5	15,2
variation	%	± 25 max.	-7
Elongation at break			
value after ageing	%	≥ 150	154
variation	%	± 25 max.	-6

Result

The object passed the test.

4.5 Additional ageing test on pieces of completed cable

Standard and date

Standard IEC 60502-2, Subclause 19.5

Test date 1 to 8 November 2013

Characteristic test data

Temperature during aging 100 ± 2 °C

Ageing duration 7 days

Insulation

Item	Unit	Requirement	Measured/determined
Tensile strength			
value after ageing	N/mm^2	-	31,4
variation	%	± 25 max.	-4
Elongation at break			
value after ageing	%	-	701
variation	%	± 25 max.	-5

Separation sheath

Item	Unit	Requirement	Measured/determined
Tensile strength			
value after ageing	N/mm^2	≥ 12,5	15,6
variation	%	± 25 max.	3
Elongation at break			
value after ageing	%	≥ 150	199
variation	%	± 25 max.	2

Oversheath

Item	Unit	Requirement	Measured/determined
Tensile strength			
value after ageing	N/mm^2	≥ 12,5	15,8
variation	%	± 25 max.	-4
Elongation at break			
value after ageing	%	≥ 150	194
variation	%	± 25 max.	18

Result

The object passed the test.

4.6 Loss of mass test on PVC sheaths of type ST_2

Standard and date

Standard IEC 60502-2, Subclause 19.6

Test dates 1 to 8 November 2013

Characteristic test data

Temperature treatment 100 ± 2 °C

Duration 7 days

Inner sheath/separation sheath

Item	Unit	Requirement	Measured/determined
Loss of mass	mg/cm^2	≤ 1,5	0,99

Oversheath

Item	Unit	Requirement	Measured/determined
Loss of mass	mg/cm^2	≤ 1,5	0,82

Result

The object passed the test.

4.7 Pressure test at high temperature on non-metallic sheaths

Standard and date

Standard IEC 60502-2, Subclause 19.7
Test dates 6 to 8 November 2013

Characteristic test data PVC ST_2 (separation sheath)

Temperature 90 ± 2 °C
Heating time 6 hours
Load 8,8 N

Separation sheath

Item	Unit	Requirement	Measured/determined
Depth of indentation	%	≤ 50	36,4

Characteristic test data PVC ST_2 (separation sheath)

Temperature 90 ± 2 °C
Heating time 6 hours
Load 12,1 N

Oversheath

Item	Unit	Requirement	Measured/determined
Depth of indentation	%	≤ 50	36,3

Result

The object passed the test.

4.8 Test on PVC sheaths at low temperature

Standard and date

Standard IEC 60502-2, Subclause 19.8
Test dates 8 to 19 November 2013

Characteristic test data PVC ST2

Temperature -15 ± 2 °C
Cooling time ≥ 16 h
Mass of hammer 1250 g

Separation sheath

Item	Unit	Requirement	Measured/determined
Cold elongation test	%	≥ 20	50
Cold impact test	-	No cracks	No cracks

Oversheath

Item	Unit	Requirement	Measured/determined
Cold elongation test	%	≥ 20	32
Cold impact test	-	No cracks	No cracks

Result

The object passed the test.

4.9 Test on PVC sheaths to cracking (heat shock test)

Standard and date

Standard IEC 60502-2, Subclause 19.9
Test date 7 November 2013

Characteristic test data

Temperature 150 ± 3 °C
Duration 1 h
Diameter of mandrel 4 mm
Number of turns 6

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 6 mm
Number of turns 6

Oversheath

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

Result

The object passed the test.

4.10 Hot set test for XLPE insulation

Standard and date

Standard IEC 60502-2, Subclause 19.11
Test date 5 November 2013

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
Elongation under load	%	≤ 175	48
Permanent elongation after cooling	%	≤ 15	-1

Result

The object passed the test.

4.11 Water absorption test on insulation

Standard and date

Standard IEC 60502-2, Subclause 19.13
Test dates 4 to 22 November 2013

Characteristic test data XLPE

Temperature of water 85 ± 2 °C
Duration 336 h
Test method Gravimetric

Insulation

Item	Duration (h)	Requirement	Measured/determined
Increase of mass	mg/cm2	≤ 1	0,03

Result

The object passed the test.

4.12 Flame spread on single cables

Standard and date

Standard IEC 60502-2, Subclause 19.14
Test date 11 November 2013

Characteristic test data

Overall diameter of test piece 124,84 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	352
The distance between the lower edge of the top support and charring extends downwards to a point	mm	≤ 540	503

Result

The object passed the test.

4.13 Shrinkage test for XLPE insulation

Standard and date

Standard IEC 60502-2, Subclause 19.16
Test date 5 November 2013

Characteristic test data

Temperature 130 ± 3 °C
Duration 1 h
Distance L between marks 200 mm

Insulation XLPE

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

Result

The object passed the test.

4.14 Strippability test for insulation screen

Standard and date

Standard IEC 60502-2, Subclause 19.21
Test date 18 November 2013

Item	Unit	Requirement	Measured/determined
Before ageing	N	4 ≤ F ≤ 45	19 – 16 – 20
After ageing	N	4 ≤ F ≤ 45	11 – 13 – 15

Result

The object passed the test.

5 CHECK OF CABLE CONSTRUCTION

Standard and date

Standard IEC 60502-2, Subclause 5-14

Test dates 7 to 19 November 2013

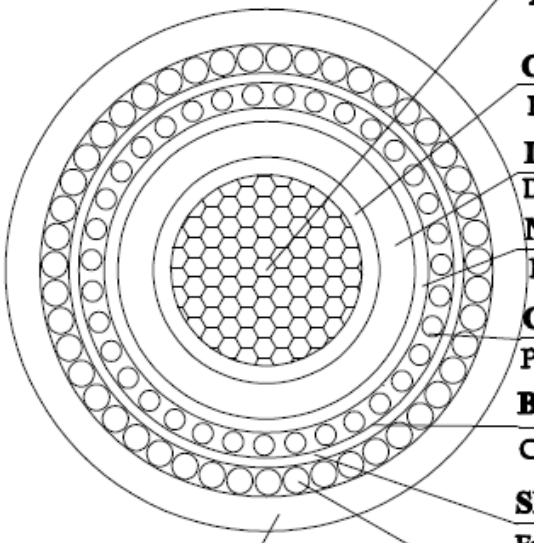
Item	Unit	Requirement	Specified	Measured/determined
Conductor				
Diameter of conductor (d)	mm	28,7 ≤ d ≤ 32,5	29,8	29,78
Number of wires	-	≥ 53	-	55
Diameter of wires	mm	-	-	3,27
Swelling yarns applied	-	-	-	-
Resistance at 20 °C	Ω/km	≤ 0,0469	-	0,04645
Conductor screen				
Diameter over conductor screen	mm	-	-	31,21
Thickness	mm	-	≥ 0,3	0,74
Insulation				
Diameter over insulation	mm	-	-	47,08
Thickness	mm	≥ 7,1	8,0	7,82
Insulation screen				
Diameter over insulation screen	mm	-	-	49,68
Thickness	mm	-	≥ 0,3	0,72
Copper screen				
Number of wires		-	70	70
Diameter of Cu wires	mm	-	0,8	0,84
Binder tape (copper tape)				
Thickness x width of tape	mm	-	0,10 x 10	0,11 x 9,92
Separation sheath				
Diameter over separation sheath	mm	-	-	52,84
Thickness	mm	≥ 1,08	≥ 1,08	1,50
Metallic armour				
Number of wires	-	-	59	60
Diameter of wires	mm	-	2,50	2,49
Binder tape thickness x width	mm	-		0,10 x 63,23
Gap between wires	mm	-		8,54
Oversheath				
Diameter over oversheath	mm	-	63,00	64,62
Thickness	mm	≥ 2,20	≥ 2,20	2,35
Colour	-	-	blue	blue
Embossing on the cable	KEC INTL. LTD RPG CABLES 18-30(36)kV ELECTRIC CABLE 1x630mm2 A2XWCWaY(P)XLPE ELECTRICITY Co OF GHANA LTD (ECG) 2013			

Result

The object passed the test.

6 DRAWINGS

CROSS-SECTIONAL SKETCH OF 1 CORE XLPE ARMOURED CABLE



CONDUCTOR
Aluminium

CONDUCTOR SCREEN
Extruded semicon compound

INSULATION
Dry cured TR-XLPE

NON-METALLIC INSLN SCREEN
Extruded semicon compound (Strippable)

COPPER SCREEN OF 35 mm²
Plain Annealed Copper wires

BINDER TAPE
Copper tape with suitable gap (open helix)

SEPARATION SHEATH
Extruded PVC ST2

ARMOUR
Aluminium Round Wire followed by suitable binder tape

OUTER SHEATH
Extruded PVC ST2

A2XWaY(P) **18/30 (36) KV,** **1 x 630 mm²**	SCALE: N. T. S.	**KEC INTERNATIONAL LTD**
	DATE : 15/12/2012	
	DRAWN BY : KK	
	CHECKED BY : BS	SKETCH NO : XLPE /1/Wa

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%