DNV·GL

KEMA TYPE TEST CERTIFICATE OF COMPLETE TYPE TESTS

Object Three-core power cable **1533-16**

Type U_0 = 6,35 kV 3x300 mm² CU/XLPE/LAT/PVC/SWA/PE CABLE

Rated voltage, U0/U (Um)	6,35/11 (12) kV	Conductor material	Cu
Conductor cross-section	3x300 mm²	Insulation material	XLPE

Manufacturer National Cables Industry
Sharjah, United Arab Emirates *)

Client National Cables Industry
Sharjah, United Arab Emirates

Tested by DNV GL Netherlands B.V.,
Arnhem, the Netherlands

Date of tests 07 to 31 October 2016

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

IEC 60502-2 (2014)

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 5.

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 client.

This Certificate consists of 44 pages in total.

DNV GL Netherlands B.V.

J.P. Fonteijne
Executive Vice President
KEMA Laboratories

KEMA Laboratories

Arnhem, 19 December 2016

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 equipment tested has fulfilled the requirements of this standard and the relevant ratings assigned by the manufacturer are endorsed by DNV GL. In addition, the test object's technical drawings have been verified and the condition of the test object after the tests is assessed and recorded. The Certificate contains the essential drawings and a description of the equipment 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 equipment tested only. DNV GL 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 DNV GL's Certification procedure applicable to KEMA Laboratories.

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 test object's technical drawings have been verified and the condition of the test object after the tests is assessed and recorded. The report is applicable to the equipment 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 page 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 test 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 DNV GL are issued in bound form. Uncontrolled copies may be provided as loose sheets or as a digital file for convenience of reproduction by the client. The copyright has to be respected at all times.

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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)	6,35/11 (12) kV
Rated maximum conductor temperature in normal operation	90 °C
Rated conductor cross-section	3x300 mm^2

1.2 Description of the object tested

Standard	IEC 60502-2, Clause 5-14
Manufacturer	National Cables Industry Sharjah, United Arab Emirates
Type	U_0 = 6,35 kV 3x300 mm^2 CU/XLPE/LAT/PVC/SWA/PE CABLE
Manufacturing year	2016
Quantity submitted	60 m
Rated voltage, U_0/U (U_m)	6,35/11 (12) kV
Nominal capacitance between conductor and metal screen	0,52 µF/km
No. of cores	3
Core identification	core 1 = red core 2 = yellow core 3 = blue
Overall diameter	approx. 98 mm
Marking on the oversheath	DEWA ELECTRIC CABLE 11000 V 3X300 MM2 CU/XLPE/LAT/PVC/SWA/PE IEC 60502-2, NATIONAL CABLES INDUSTRY, SHARJAH, UAE, PO: 3411600113 (2016)
Construction	see List of drawings

Conductor

• material	copper
• cross-section	300 mm^2
• nominal diameter	20,4 mm
• type	compacted
• maximum conductor temperature in normal operation	90 °C
• presence and nature of measures to achieve longitudinal watertightness	yes water swellling tapes
• swelling material	water swellable tapes
• manufacturer of the material	Known in KEMA Laboratories' files

Conductor screen

• material	extruded semi-conducting compound
• nominal thickness	0,6 mm
• material designation	extruded semi-conducting compound

- manufacturer of the material — Known in KEMA Laboratories' files

Insulation

- material — XLPE
- nominal thickness — 3,4 mm (average)
- nominal inner diameter of the insulation — 22,7 mm
- nominal outer diameter of the insulation — 29,1 mm
- material designation — extruded cross-linked polyethylene (XLPE)
- manufacturer of the material — Known in KEMA Laboratories' files

Insulation (core) screen

- material — extruded semi-conducting compound
- strippable — yes
- nominal thickness — 1,0 mm (minimum)
- material designation — extruded semi-conducting compound-strippable
- manufacturer of the material — Known in KEMA Laboratories' files

Longitudinal watertightness

- presence and nature of measures to achieve longitudinal watertightness along insulation screen — yes, semi-conducting water swellable tape
- number of swelling tapes — 2
- nominal thickness and width (overlap) — 40 x 0,25 mm (overlap: 10%)
- material designation — semi-conducting water swellable tape
- manufacturer of the material — Known in KEMA Laboratories' files

Metal screen

- material — copper tape
- number of wires/tapes — 2 tapes
- nominal thickness and width of tape — 0,075 x 30 mm (overlap: 15%)
- cross-sectional area — 4,5 mm^2

Longitudinal watertightness

- presence and nature of measures to achieve longitudinal watertightness along insulation screen — yes, semi-conducting water swellable tape
- number of swelling tapes — 2
- nominal thickness and width (overlap) — 40 x 0,25 mm (overlap: 10%)
- material designation — semi-conducting water swellable tape
- manufacturer of the material — Known in KEMA Laboratories' files

Metal foil or tape, longitudinally applied, bonded to the sheath	yes
• material	aluminium
• nominal thickness	0,2 mm
Sheath	
• material	extruded PE
• nominal thickness	1,2 mm (approximate thickness)
• nominal overall diameter of the cable (D)	37,1 mm
• material designation	PE laminated aluminium tape
• manufacturer of the material	Known in KEMA Laboratories' files
Fillers	
• material	polypropyelene strings
Binding tape	
• material	polypropyelene tape
Inner / Separation sheath	
• material	extruded PVC, type ST_2
• nominal thickness	1,32 mm (minimum thickness)
• manufacturer of the material	RIYADH CABLES AND METALS
Metal armour	
• material	galvanized steel wires
• number of wires	75
• nominal diameter of wires	3,15 mm
• cross-sectional area	584.5 mm^2
• manufacturer of the material	Known in KEMA Laboratories' files
Oversheath	
• material	extruded polyethylene, type ST_7
• nominal thickness	2,68 mm (minimum)
• nominal overall diameter of the cable (D)	98 mm
• material designation	extruded polyethylene
• manufacturer of the material	Known in KEMA Laboratories' files
• colour	black
• graphite coating applied	yes - graphite powder
Fire retardant (according to IEC 60332-1)	Not Applicable
Manufacturing details insulation system	
• location of manufacturing	Sharjah, United Arab Emirates
• type of extrusion line	CCV
• type of extrusion	triple extrusion
• factory identification of extrusion line	Troester
• manufacturer of the extrusion line	Troester, Germany

• identification of production batch	ID Number 51298283
• curing means	dry
• cooling means	water
• manufacturing length (where cable sample for testing has been taken from)	400 m
• length markings on cable sample sent to KEMA Laboratories	begin: 222 m, end: 282 m

1.3 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 Laboratories 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
11kV, 3x300 mm^2 Cu/XLPE/LAT/SWA/PE CABLE PO#3411600113	-

2 GENERAL INFORMATION

2.1 The tests were witnessed by

Name	Company
Mazin Aziz	DEWA, Dubai, United Arab Emirates

2.2 The tests were carried out by

Name	Company
Andre Sengers	DNV GL Netherlands B.V.,
Jeno Somodi	Arnhem, the Netherlands

2.3 Subcontracting

The following tests were subcontracted to DNV GL - New Energy Technologies, Arnhem, the Netherlands:

- measurement of resistivity of semi-conducting screens in accordance with Subclause 18.2.10.
- non-electrical type tests in accordance with Clause 19, with the exception of the water penetration test of Subclause 19.24.
- check of cable construction in accordance with Clause 5-14.

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 IEC 60502-2, Subclause 15.4

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.

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. Annex G was used as a guide and Annex G, Subclause G.3.1, method 1 was applied.

The tests at elevated temperature are carried out after the conductor temperature has been within the stated limit for at least 2 hours.

3.1.2 Photograph of test set-up

3.2 Bending test

Standard and date

Standard IEC 60502-2, Subclause 18.2.4
Test date 7 October 2016

Environmental conditions

Ambient temperature 12 °C

Characteristic test data

Temperature of test object 11 °C
Maximum bending diameter 20(d + D) + 5%

Length of cable bended 23 m
Length marking of cable bended 222 – 282m

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)
98 mm	20,4 mm	2486,4	2000

Result

The test was carried out successfully.

3.3 Partial discharge test

Standard and date

Standard	IEC 60502-2, Subclause 18.2.5
Test date	12 October 2016

Environmental conditions

Ambient temperature	21 °C

Characteristic test data

Temperature of test object	21 °C
Circuit	direct
Calibration	5 pC
Noise level at 1,73 U_0	<2,5 pC
Declared sensitivity	5 pC
Required sensitivity	≤ 5 pC
Centre frequency	99,5 kHz
Bandwidth (Δf)	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	12,7	10	-
	1,73	11	-	Not detectable
2	2	12,7	10	-
	1,73	11	-	Not detectable
3	2	12,7	10	-
	1,73	11	-	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 18.2.6
Test date 17 October 2016

Environmental conditions

Ambient temperature 21 °C

Characteristic test data

Temperature of test object 97 °C
Length of each core 16,53 m
Standard capacitor 99,88 pF

Core	Voltage applied, 50 Hz (kV)	Capacitance of core [1] (µF/km)	Tan δ
1, 2 and 3	5	0, 445	$4{,}13 \times 10^{-4}$
[1] for information only			

Requirement

The measured value shall not be higher than 40×10^{-4} at ≥ 2 kV.

Result

The object passed the test.

3.5 Heating cycle test

Standard and date

Standard IEC 60502-2, Subclause 18.2.7
Test date 18 to 24 October 2016

Environmental conditions

Ambient temperature 21 °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		
			Heating		Cooling
			Total duration (h)	Duration of conductor at steady temperature (h)	Total duration (h)
20	95 - 100	655	5	2	6

Requirement

The test shall be carried out succesfully.

Result

The object passed the test.

3.6 Partial discharge test

Standard and date

Standard	IEC 60502-2, Subclause 18.2.5
Test date	27 October 2016

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	20 °C
Circuit	direct
Calibration	5 pC
Noise level at 1,73 U_0	<2,5 pC
Declared sensitivity	5 pC
Required sensitivity	≤ 5 pC
Centre frequency	2,277 kHz
Bandwidth (Δf)	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	12,7	10	-
	1,73	11	-	Not detectable
2	2	12,7	10	-
	1,73	11	-	Not detectable
3	2	12,7	10	-
	1,73	11	-	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.

3.7 Impulse test

Standard and date

Standard IEC 60502-2, Subclause 18.2.8
Test date 28 October 2016

Environmental conditions

Ambient temperature 20 °C

Characteristic test data

Temperature of test object 97 °C
Specified test voltage 75 kV

Testing arrangement		Polarity	Voltage applied (% of test voltage)	No. of impulses	See figure on next pages
Voltage applied to	Earthed				
Conductors of all three cores	Metal screens	Positive	55	1	1 (waveshape)
			65	1	2
			80	1	2
			100	10	3 and 4
Conductors of all three cores	Metal screens	Negative	55	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 +55% of the test voltage

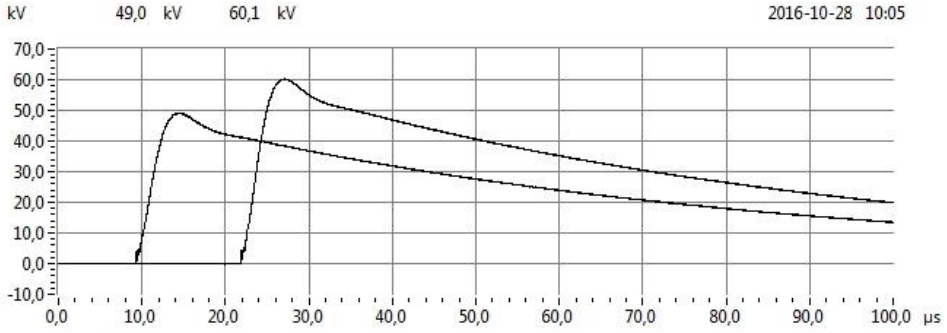

Fig. 2: +65% and +80% of the test voltage

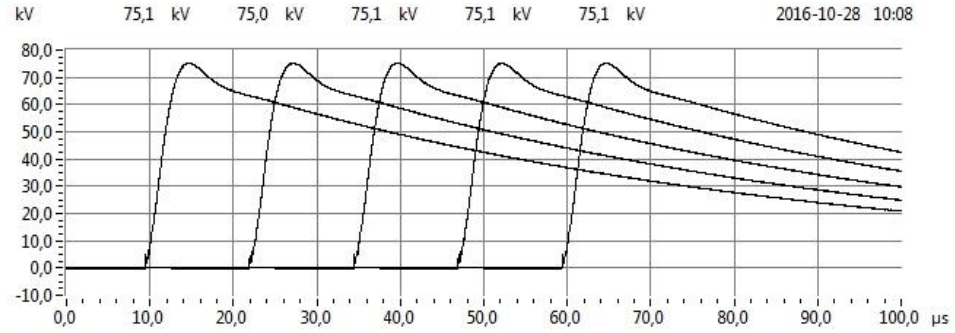

Fig. 3: +100% of the test voltage

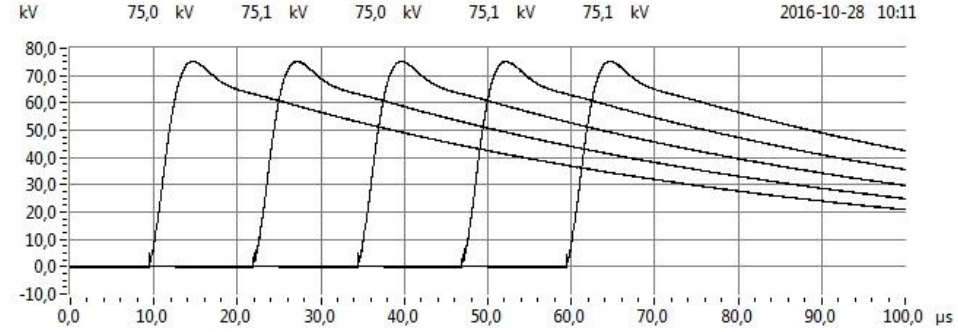

Fig. 4: +100% of the test voltage

Lightning impulse test with negative voltage

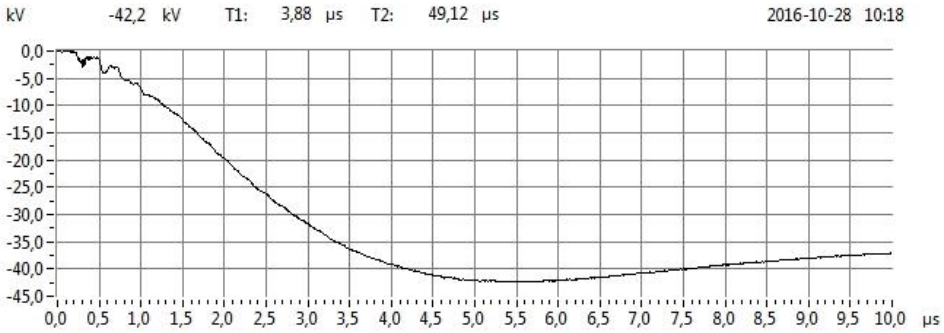

Fig. 5: Waveshape -55% of the test voltage

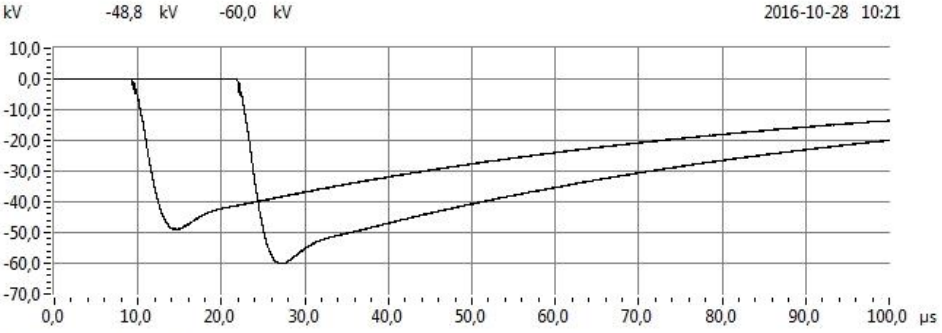

Fig. 6: -65% and -80% of the test voltage

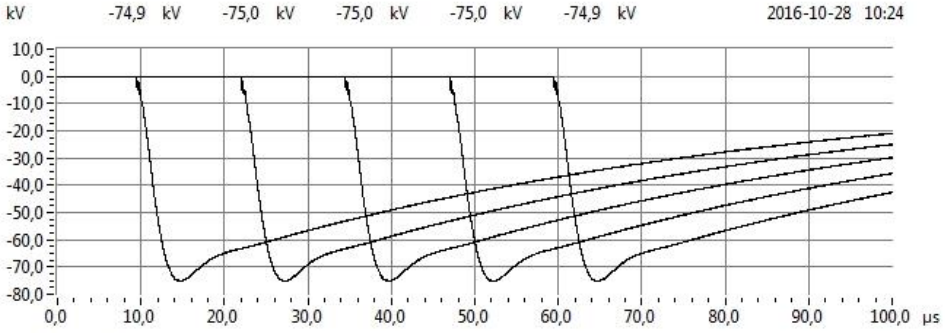

Fig. 7: -100% of the test voltage

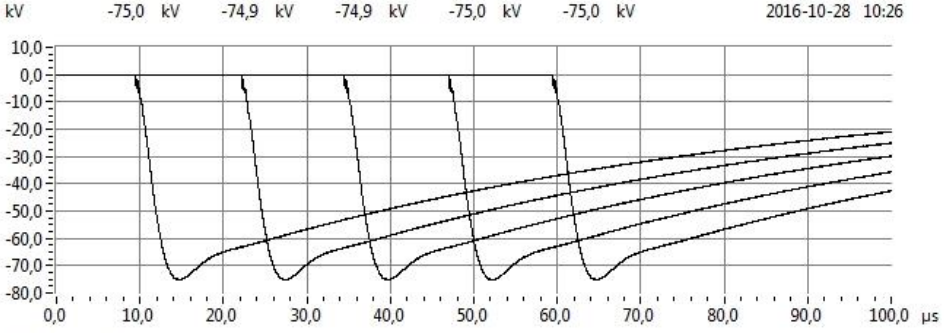

Fig. 8: -100% of the test voltage

3.8 Voltage test for 15 min

Standard and date

Standard IEC 60502-2, Subclause 18.2.8
Test date 31 October 2016

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)
Conductors	Metal screens	3,5	22,2	15

Requirement

No breakdown of the insulation shall occur.

Result

The object passed the test.

3.9 Voltage test for 4 h

Standard and date

Standard IEC 60502-2, Subclause 18.2.9
Test date 31 October 2016

Environmental conditions

Ambient temperature 20 °C

Characteristic test data

Temperature of test object 20 °C

Testing arrangement		Voltage applied, 50 Hz		Duration
Voltage applied to	Earth connected to	… x U_0	(kV)	(h)
Conductors	Metal screens	4	25,4	4

Requirement

No breakdown of the insulation shall occur.

Result

The object passed the test.

3.10 Resistivity of semi-conducting screens

Standard and date

Standard IEC 60502-2, Subclause 18.2.10
Test date 25 October 2016

Characteristic test data

Temperature during ageing 100 °C
Duration 7 x 24 h (07 to 14 October 2016)
Resistivity measured at 90 ± 2 °C

Item	Unit	Requirement	Measured/determined		
			Core 1	Core 2	Core 3
Conductor screen					
without ageing	Ωm	≤ 1000	370	473	389
after ageing	Ωm	≤ 1000	164	168	92
Insulation screen					
without ageing	Ωm	≤ 500	10	9	9
after ageing	Ωm	≤ 500	9	12	11

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 19.2

Test date 25 October 2016

Item	Unit	Requirement	Specified	Measured/determined		
				Core 1	Core 2	Core 3
Nominal	mm	-	3,4	-	-	-
Average	mm	-	-	3,4	3,4	3,4
Minimum [t_{min}]	mm	≥ 2,96	-	3,24	3,28	3,22
Maximum [t_{max}]	mm	-	-	3,62	3,66	3,53
(t_{max} – t_{min}) / t_{max}	-	≤ 0,15	-	0,10	0,11	0,09

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 19.3
Test date 25 October 2016

Inner sheath/Separation sheath

Item	Unit	Requirement	Specified	Measured
Nominal	mm	-	1,9	-
Average	mm	-	-	2,34
Minimum	mm	≥ 1,32	-	1,92

Oversheath

Item	Unit	Requirement	Specified	Measured
Nominal	mm	-	3,6	-
Average	mm	-	-	4,78
Minimum	mm	≥ 2,68	-	3,63

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.

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

Standard and date

Standard IEC 60502-2, Subclause 19.5
Test date 19 October 2016

Characteristic test data

Temperature during ageing 135 ± 3 °C
Ageing duration 7 x 24 h (11 to 18 October 2016)

Item	Unit	Requirement	Measured/determined		
			Core 1	Core 2	Core 3
Without ageing					
Tensile strength	N/mm^2	≥ 12,5	27,6	27,2	27,5
Elongation at break	%	≥ 200	566	567	559
After ageing in air oven					
Tensile strength					
• value after ageing	N/mm^2	-	25,9	25,7	25,4
• variation	%	± 25 max.	-6	-6	-7
Elongation at break					
• value after ageing	%	-	576	599	603
• variation	%	± 25 max.	2	6	8

Result

The object passed the test.

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

Standard and date

Standard IEC 60502-2, Subclause 19.6
Test date 19 and 24 October 2016

Characteristic test data

Temperature during ageing 100 ± 2 °C
Ageing duration 7 x 24 h (11 to 18 October 2016)

Inner sheath/Separation sheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm²	≥ 12,5	20,7
Elongation at break	%	≥ 150	217
After ageing in air oven			
Tensile strength			
• value after ageing	N/mm²	≥ 12,5	20,1
• variation	%	± 25 max.	-3
Elongation at break			
• value after ageing	%	≥ 150	193
• variation	%	± 25 max.	-11

Characteristic test data

Temperature during ageing 110 ± 2 °C
Ageing duration 10 x 24 h (11 to 21 October 2016)

Oversheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm²	≥ 12,5	31,1
Elongation at break	%	≥ 300	765
After ageing in air oven			
Tensile strength			
• value after ageing	N/mm²	-	32,4
• variation	%	-	4
Elongation at break			
• value after ageing	%	≥ 300	811
• variation	%	-	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 19.7
Test date 18 October 2016

Characteristic test data

Temperature during ageing 100 ± 2 °C
Ageing duration 7 x 24 h (07 to 14 October 2016)

Insulation

Item	Unit	Requirement	Measured/determined		
			Core 1	Core 2	Core 3
Without ageing					
Tensile strength	N/mm²	≥ 12,5	27,6	27,2	27,5
Elongation at break	%	≥ 200	566	567	559
After ageing in air oven					
Tensile strength					
• value after ageing	N/mm²	-	25,8	26,4	27,8
• variation	%	± 25 max.	-7	-3	1
Elongation at break					
• value after ageing	%	-	544	542	566
• variation	%	± 25 max.	-4	-4	1

Inner sheath/Separation sheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm²	≥ 12,5	20,7
Elongation at break	%	≥ 150	217
After ageing in air oven			
Tensile strength			
• value after ageing	N/mm²	≥ 12,5	20,8
• variation	%	± 25 max.	0
Elongation at break			
• value after ageing	%	≥ 150	206
• variation	%	± 25 max.	-5

Oversheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm^2	≥ 12,5	31,1
Elongation at break	%	≥ 300	765
After ageing in air oven			
Tensile strength			
• value after ageing	N/mm^2	-	29,3
• variation	%	-	-6
Elongation at break			
• value after ageing	%	≥ 300	747
• variation	%	-	-2

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 19.8
Test date 19 October 2016

Characteristic test data

Temperature treatment 100 ± 2 °C
Duration 7 x 24 h (11 to 18 October 2016)

Inner sheath/Separation sheath

Item	Unit	Requirement	Measured/determined
Loss of mass	mg/cm^2	≤ 1,5	0,7

Result

The object passed the test.

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

Standard and date

Standard IEC 60502-2, Subclause 19.9
Test date 13 and 14 October 2016

Characteristic test data

Temperature 90 ± 2 °C
Heating time 6 hours
Load 10 N

Inner sheath/Separation sheath

Item	Unit	Requirement	Measured/determined
Depth of indentation	%	≤ 50	24

Characteristic test data

Temperature 110 ± 2 °C
Heating time 6 hours
Load 14 N

Oversheath

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

Result

The object passed the test.

4.8 Test on PVC insulation and sheaths at low temperature

Standard and date

Standard	IEC 60502-2, Subclause 19.10
Test date	14 October 2016

Characteristic test data

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

Inner sheath/Separation sheath

Item	Unit	Requirement	Measured/determined
Cold elongation test	%	≥ 20	35
Cold impact test	-	No cracks	No cracks

Result

The object passed the test.

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

Standard and date

Standard	IEC 60502-2, Subclause 19.11
Test date	13 October 2016

Characteristic test data

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

Inner sheath/Separation sheath

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 and elastomeric sheaths

Standard and date

Standard IEC 60502-2, Subclause 19.13
Test date 11 October 2016

Characteristic test data

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

Insulation

Item	Unit	Requirement	Measured/determined		
			Core 1	Core 2	Core 3
Elongation under load	%	≤ 175	60	60	55
Permanent elongation after cooling	%	≤ 15	-4	-3	-4

Result

The object passed the test.

4.11 Water absorption test on insulation

Standard and date

Standard IEC 60502-2, Subclause 19.15
Test date 11 to 31 October 2016

Characteristic test data

Temperature of water 85 ± 2 °C
Duration 14 x 24 h (14 to 28 October 2016)
Test methode Gravimetric

Insulation

Item	Unit	Requirement	Measured/determined		
			Core 1	Core 2	Core 3
Increase of mass	mg/cm^2	1,00	< 0,01	< 0,01	0,02

Result

The object passed the test.

4.12 Measurement of carbon black content of black PE oversheaths

Standard and date

Standard IEC 60502-2, Subclause 19.17

Test date 11 October 2016

Item	Unit	Requirement	Measured/determined
Carbon black content	%	2,5 ± 0,5	2,6

Result

The object passed the test.

4.13 Shrinkage test for XLPE insulation

Standard and date

Standard IEC 60502-2, Subclause 19.18
Test date 18 October 2016

Characteristic test data

Length of cable sample 300 mm
Temperature 130 ± 3 °C
Duration 1 h

Item	Unit	Requirement	Measured/determined		
			Core 1	Core 2	Core 3
Shrinkage	%	≤ 4	1,4	1,4	1,4

Result

The object passed the test.

4.14 Shrinkage test for PE oversheaths

Standard and date

Standard IEC 60502-2, Subclause 19.22
Test date 18 October 2016

Characteristic test data

Temperature 80 ± 2 °C
Duration 5 h
Number of heating cycles 5 (11 to 17 October 2016)

Item	Unit	Requirement	Measured/determined
Shrinkage	%	≤ 3	1,8

Result

The object passed the test.

4.15 Strippability test for insulation screen

Standard and date

Standard IEC 60502-2, Subclause 19.23
Test date 20 October 2016

Characteristic test data

Temperature 100 ± 2 °C
Ageing duration 7 x 24 h (07 to 14 October 2016)

Item	Unit	Requirement	Measured/determined		
			Core 1	Core 2	Core 3
Before ageing	N	4 ≤ F ≤ 45	16 ≤ F ≤ 19	17 ≤ F ≤ 20	15 ≤ F ≤ 19
After ageing	N	4 ≤ F ≤ 45	12 ≤ F ≤ 18	11 ≤ F ≤ 16	7 ≤ F ≤ 11

Result

The object passed the test.

4.16 Water penetration test

Standard and date

Standard IEC 60502-2, Subclause 19.24
Test date 17 to 22 October 2016

Environmental conditions

Ambient temperature 21 °C

Characteristic test data

Length of cable sample 3 m
Water height 1 m above cable centre
Heating method conductor current

No. of heating cycles	Required steady conductor temperature (°C)	Heating current during steady condition (A)	Heating cycle		
			Heating		Cooling
			Total duration (h)	Duration of conductor at steady temperature (h)	Total duration (h)
10	95 - 100	approx. 1011	5	2	5

Item	Unit	Requirement	Measured/determined
Water penetration under sheath and conductor side 1	cm	≤ 300	20
Water penetration under sheath and conductor side 2	cm	≤ 300	25

Note

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

Result

The object passed the test.

5 CHECK OF CABLE CONSTRUCTION

Standard and date

Standard IEC 60502-2, Subclause 5-14

Test date 25 Oct 2016

Item	Unit	Requirement	Specified	Measured/determined		
				Core red	Core yellow	Core blue
Conductor						
Diameter of conductor (d)	mm	19,7≤d≤21,6[1)]	20,4	20,8	20,8	20,8
Number of wires	-	≥ 34	61	61	61	61
Diameter of wires	mm	-	2,65	2,65	2,65	2,65
Resistance at 20 °C	Ω/km	≤0,06010	-	0,059831	0,060049	0,059820
Swellable tape		-	present	present	present	present
Conductor screen						
Diameter over conductor screen	mm	-	-	22,95	22,88	22,93
Thickness	mm	-	0,6 (minimum)	1,11	1,06	1,04
Insulation						
Diameter over insulation	mm	-	-	29,9	29,9	29,8
Thickness	mm	-	3,4	3,4	3,4	3,4
Insulation screen						
Diameter over insulation screen	mm	-	-	32,6	32,6	32,5
Thickness	mm	-	1,0 (minimum)	1,36	1,33	1,30
Swellable tape						
Number of tapes		-	2	2	2	2
Thickness x width of tape	mm	-	0,25 x 40	0,25 x 40	0,25 x 40	0,25 x 40
Metal screen						
Number op tapes			2	2	2	2
Diameter over screen	mm	-	-	33,9	33,9	33,9
Thickness x width	mm	-	0,075 x 30	0,07 x 30	0,07 x 30	0,07 x 30
overlap	%		15 minimum	20	20	20
Swellable tape						
Number of tapes		-	2	2	2	2
Thickness x width of tape	mm	-	0,25 x 40	0,25 x 40	0,25 x 40	0,25 x 40
Radial water barrier						
PE laminated aluminium tape thickness x diameter	mm	-	0,2 x 34,5	0,2 x 34 (approx.)	0,2 x 34 (approx.)	0,2 x 34 (approx.)
Primary PE sheath thickness x diameter	mm	-	1,2 x 37,1	1,2 x 37,9	1,2 x 37,9	1,2 x 37,9

Item	Unit	Requirement	Specified	Measured/determined
Fillers			polypropylene	present
Binding Tape				
thickness	mm	-	0,125	
Inner sheath				
Diameter over oversheath	mm	-	84,4	82,76
Thickness	mm	-	1,32 (minimum)	2,34 (average)
Colour	mm	-	-	black
Metal armour				
Number of wires	-	-	75	79
diameter of wires	mm	-	3,15	3,09
Oversheath				
Diameter over oversheath	mm	-	98,0	97,41
Thickness	mm	-	2,68 (minimum)	4,28 (average)
Colour	-	-	black	black
Marking on the cable	DEWA ELECTRIC CABLE 11000 V, 3X300 MM2, CU/XLPE/LAT/PVC/SWA/PE IEC60502-2, NATIONAL CABLES INDUSTRY, SHARJAH, UAE, PO:3411600113 (2016)			
[1)] Dimensional limits do not have the status of a requirement but as a guideline only				

Result

The object passed the test.

6 DRAWINGS

NCI
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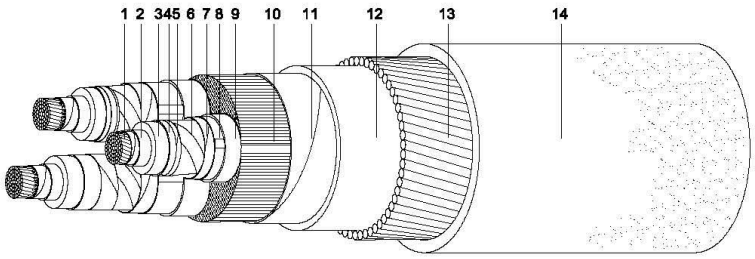
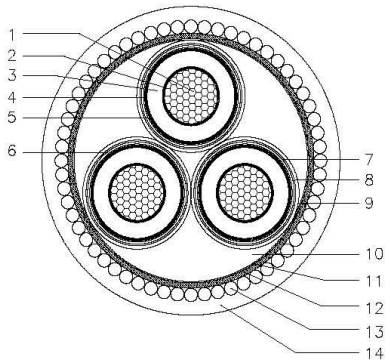
NATIONAL CABLES INDUSTRY

11 kV, 3x300 mm² CU/XLPE/LAT/SWA/PE CABLE
PO # 3411600113





Sl. No	DESCRIPTION	DETAILS	Nom. thick / dia (mm)	Approx. dia (mm)
	Reference Standard	**IEC Publication No. 60502-2 & DEWA Specs. 1.5.1.3.4.03-Rev. 0**		
01	Conductor	Copper - Round Stranded Compacted, Water tight (with water swellable tapes).		20.4
02	Conductor Screen	Extruded semi-conductive compound (Bonded Type)	Min 0.6	22.3
03	Insulation	Extruded Cross-linked Polyethylene (XLPE)	3.4 (Avg.)	29.1
04	Insulation Screen	Extruded semi-conductive compound (Strippable Type)	Min 1.0	31.3
05	Longi. water barrier	Semi-conductive Water Swellable Tape	0.3	32.3
06	Metallic Screen	Copper Tape(s) **(With Min. 15% Overlap)**	0.075	32.6
07	Longi. water barrier	Semi-conductive Water Swellable Tape	0.3	33.6
08	Radial water barrier	PE Laminated Aluminium Tape	0.2	34.5
09	Primary Sheath	Extruded Polyethylene (PE)	1.2	37.1
10	Assembly / Fillers	Polypropylene String Fillers	-	80.2
11	Binding Tape	Polypropylene Tape(s)	0.125	80.6
12	Inner Sheath	Extruded Polyvinyl Chloride (PVC Type- ST2)	Min 1.32	84.4
13	Armour	Galvanized Round Steel Wires (275 g/m²)	3.15	90.7
14	Outer Sheath	Extruded Polyethylene (PE Type-ST7) Black with Graphite Powder Coating.	Min 2.68	98.0

Embossing on the Outer Sheath in Max 50 cm Spacing along TWO lines equally spaced:

DEWA ELECTRIC CABLE 11000 V, 3x300 SQMM, CU/XLPE/LAT/PVC/SWA/PE
IEC 60502-2, NATIONAL CABLES INDUSTRY, SHARJAH, UAE, PO: 3411600113 (2016)

P.O. Box: 27472 Sharjah, U.A.E. ☎Tel: 06-5311888 🖷 Fax: 06-5311577
E-mail: n_c_i@emirates.net.ae Website: www.nci.ae

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%