DNV·GL

KEMA TYPE TEST CERTIFICATE OF COMPLETE TYPE TESTS

Object Four-core power cable **1172-17**

Type AL/XLPE/PVC/SWA/PVC

Rated voltage, U_0/U (U_m)	0,6/1 (1,2) kV	Conductor material	AL
Conductor cross-section	4x50 mm^2	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 3 April to 3 May 2017

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 the complete type test requirements of

IEC 60502-1 (2009) subclauses 17 and 18

This Certificate has been issued by DNV GL 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(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 manufacturer

This Certificate consists of 27 pages in total.

DNV GL Netherlands B.V.

J.P. Fonteijne
Executive Vice President
KEMA Laboratories

KEMA Laboratories Arnhem, 27 June 2017

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 TEST OBJECT

1.1 Ratings/characteristics of the object tested

Rated voltage, U_0/U (U_m)	0,6/1,0 (1,2) kV
Rated maximum conductor temperature in normal operation	90 °C
Rated conductor cross-section	50 mm²

1.2 Description of the test object

Standard	IEC 60502-1
Manufacturer	National Cable Industy, Sharjah, United Arab Emirates
Type	AL/XLPE/PVC/SWA/PVC
Manufacturing year	2017
Sampling procedure	by the manufacturer
Rated voltage, U_0/U	600/1000 V
No. of cores	4
Marking on the cable	DEWA ELECTRIC CABLE 600/1000 V 4x50 mm² AL/XLPE/PVC/SWA/PVC, IEC 60502-1 NATIONAL CABLE INDUSTRY, U.A.E. 2017

Conductor

• material	aluminium
• cross-section	50 mm²
• nominal dimension	7,51 x 10,42 mm
• type	class 2, sector shaped
• maximum conductor temperature in normal operation	90 °C

Insulation

• material	XLPE
• nominal thickness	1,0 mm
• material designation	known in KEMA Laboratories' files
• material supplier	Riyadh Cables and Metals
• core identification	red / yellow / blue / black

Fillers PP-strings

Binder tape

• material	PP-tape
• Dimensions	40 x 0,10 mm

Inner covering

• type	extruded
• material	PVC, type ST_2
• nominal thickness	1,0 mm
• material designation	known in KEMA Laboratories' files
• manufacturer of the material	Riyadh Cables and Metals

Metallic armour

• material	galvanized steel wires
• nominal diameter / dimensions	46x1,6 mm
• material supplier	Link Middle East

Oversheath

• material	PVC, type ST_2
• nominal thickness	2,0 mm
• outer diameter of cable	33 mm
• material designation	known in KEMA Laboratories' files
• material supplier	Riyadh Cables and Metals
• colour	black

Manufacturing details insulation system

• location of manufacturing	Sharjah, United Arab Emirates
• factory identification of extrusion line	National Cable Industry, United Arab Emirates
• manufacturer of the extrusion line	Nextrom LP – 120
• identification of the production batch	51471938
• manufacturing length (where cable sample for testing has been taken from)	1000 m
• length markings on cable sample sent to KEMA Laboratories	begin: 17 m, end: 67 m

1.3 List of documents

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
4x50 mm², 0,6/1 kV CU/XLPE/PVC/SWA/PVC Power Cable	02

2 GENERAL INFORMATION

2.1 The tests were witnessed by

Name	Company
Humaid Bakhit Humaid Al Shamsi	Dubai Electricity & Water Authority, Dubai, United Arab Emirates
Altaf Ahmed Noor Ahmed (1 to 3 May 2017)	National Cable Industry, Sharjah, United Arab Emirates

2.2 The tests were carried out by

Name	Company
Bart Vos Eelke Rijpstra Frank Rasing	DNV GL Netherlands B.V., Arnhem, the Netherlands

2.3 Subcontracting

All tests were subcontracted to DNV GL – Energy Advisory, Arnhem, the Netherlands.

2.4 Purpose of 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 this Certificate. Unless otherwise stated, the measurement uncertainties of the results presented in this Certificate are as indicated in that table.

3 CONDUCTOR

Standard and date

Standard IEC 60502-1 clause 5

Test date 11 April 2017

3.1 Measurement of the resistance of the conductor

Item	Unit	Requirement	Measured/determined			
			red	yellow	blue	black
Resistance	Ω/km	≤ 0,641	0,594	0,595	0,594	0,597

Result

The object passed the test.

3.2 Measurement of the number of wires of the conductor

Item	Unit	Requirement	Measured/determined			
			red	yellow	blue	black
Number of wires	-	≥ 6	7	7	7	7

Result

The object passed the test.

4 ELECTRICAL TYPE TESTS

4.1 Measurement of insulation resistance at ambient temperature

Standard and date

Standard IEC 60502-1, clause 17.1
Test date 11 April 2017

Item	Unit	Requirement	Measured/determined			
			red	yellow	blue	black
Volume resistivity, ρ at 20 °C	Ω.cm	-	$5,8x10^{16}$	$6,6x10^{16}$	$6,7x10^{16}$	$5,6x10^{16}$
Insulation resistance constant, K_i at 20 °C	MΩ.km	-	212415	243066	246542	206972

Result

The test results are for information only.

4.2 Measurement of insulation resistance at max. conductor temperature

Standard and date

Standard IEC 60502-1, clause 17.2
Test date 12 April 2017

Item	Unit	Requirement	Measured/determined			
			red	yellow	blue	black
Volume resistivity, ρ at 90 °C	Ω.cm	≥ 10^{12}	$1,4x10^{15}$	$1,2x10^{15}$	$1,2x10^{15}$	$1,3x10^{15}$
Insulation resistance constant, K_i at 90 °C	MΩ.km	≥ 3,67	5204	4431	4437	4636

Result

The object passed the test.

4.3 Voltage test for 4 h

Standard and date

Standard IEC 60502-1, clause 17.3
Test date 14 April 2017

Environmental conditions

Temperature 20 ± 5 °C
Temperature of test object 25 °C

Applied voltage kV	Frequency Hz	Duration h	Measured/determined
2,4	50	4	No breakdown

Requirement

No breakdown of the insulation shall occur.

Result

The object passed the test.

5 NON-ELECTRICAL TYPE TESTS

5.1 Measurement of thickness of insulation

Standard and date

Standard IEC 60502-1, clause 18.1
Test date 20 April 2017

Thickness	Unit	Requirement	Specified	Measured/determined			
				red	yellow	blue	black
Nominal	mm	-	1,0	-	-	-	-
Average	mm	≥ 1,0		1,4	1,2	1,2	1,5
Minimum (t_m)	mm	≥ 0,80		1,15	1,00	1,07	1,35

Result

The object passed the test.

5.2 Measurement of thickness of non-metallic sheaths

Standard and date

Standard IEC 60502-1, clause 18.2
Test date 18 April 2017

Inner covering

Thickness	Unit	Requirement	Approximate	Measured/determined
Nominal	mm	-	1,0	-
Average	mm	-		1,3
Minimum (t_m)	mm	≥ 0,60		1,06

Oversheath

Thickness	Unit	Requirement	Specified	Measured/determined
Nominal	mm	≥ 1,8	2,0	-
Average	mm	-		2,0
Minimum (t_m)	mm	≥ 1,40		1,75

Result

The object passed the test.

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

Standard and date

Standard IEC 60502-1, clause 18.3
Test date 12 to 26 April 2017

Characteristic test data

Temperature during ageing 135 ± 3 °C
Duration 7 days (12 to 19 April 2017)

Item	Unit	Requirement	Measured/determined			
			red	yellow	blue	black
Without ageing						
Tensile strength	N/mm²	≥ 12,5	29,1	22,4	27,0	26,0
Elongation	%	≥ 200	566	507	525	490
After ageing						
Tensile strength	N/mm²	-	23,9	23,2	22,7	22,0
Variation with samples without ageing	%	± 25 max.	-18	4	-16	-15
Elongation	%	-	494	500	467	452
Variation with samples without ageing	%	± 25 max.	-13	-1	-11	-8

Result

The object passed the test.

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

Standard and date

Standard IEC 60502-1, clause 18.4
Test date 12 to 26 April 2017

Characteristic test data

Temperature during ageing 100 ± 2 °C
Duration 7 days (12 to 19 April 2017)

Inner covering

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm²	≥ 12,5	19,3
Elongation	%	≥ 150	191
After ageing			
Tensile strength	N/mm²	≥ 12,5	18,5
Variation with samples without ageing	%	± 25 max.	-4
Elongation	%	≥ 150	195
Variation with samples without ageing	%	± 25 max.	2

Characteristic test data

Temperature during ageing 100 ± 2 °C
Duration 7 days (12 to 19 April 2017)

Oversheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm²	≥ 12,5	18,4
Elongation	%	≥ 150	235
After ageing			
Tensile strength	N/mm²	≥ 12,5	16,8
Variation with samples without ageing	%	± 25 max.	-9
Elongation	%	≥ 150	214
Variation with samples without ageing	%	± 25 max.	-9

Result

The object passed the test.

5.5 Additional ageing test on pieces of completed cables

Standard and date

Standard IEC 60502-1, clause 18.5
Test date 12 to 26 April 2017

Characteristic test data

Temperature during ageing 100 ± 2 °C
Duration 7 days (14 April to 21 April 2017)

Insulation

Item	Unit	Requirement	Measured/determined			
			red	yellow	blue	black
Tensile strength	N/mm²	-	22,3	19,8	22,8	22,4
Variation with samples without ageing	%	± 25 max.	-23	-12	-16	-14
Elongation	%	-	460	443	461	480
Variation with samples without ageing	%	± 25 max.	-19	-13	-12	-2

Inner covering

Item	Unit	Requirement	Measured/determined
Tensile strength	N/mm²	-	19,2
Variation with samples without ageing	%	± 25 max.	1
Elongation	%	-	199
Variation with samples without ageing	%	± 25 max.	4

Oversheath

Item	Unit	Requirement	Measured/determined
Tensile strength	N/mm²	-	19,3
Variation with samples without ageing	%	± 25 max.	5
Elongation	%	-	198
Variation with samples without ageing	%	± 25 max.	-16

Result

The object passed the test.

5.6 Loss of mass test on PVC sheaths of type ST_2

Standard and date

Standard IEC 60502-1, clause 18.6
Test date 12 to 21 April 2017

Characteristic test data

Temperature during ageing 100 ± 2 °C
Duration 7 days (13 to 20 April 2017)

Inner covering

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

Oversheath

Item	Unit	Requirement	Measured/Determined
Loss of mass	mg/cm^2	≤ 1,5	0,8

Result

The object passed the test.

5.7 Pressure test at high temperature on non-metallic sheaths

Standard and date

Standard IEC 60502-1, clause 18.7
Test date 2 May 2017

Characteristic test data (inner covering)

Temperature during ageing 90 ± 2 °C
Duration 6 h
Load 4 N

Inner covering

Item	Unit	Requirement	Measured/Determined
Depth of indentation	%	≤ 50	29

Characteristic test data (oversheath)

Temperature during ageing 90 ± 2 °C
Duration 6 h
Load 8 N

Oversheath

Item	Unit	Requirement	Measured/Determined
Depth of indentation	%	≤ 50	30

Result

The object passed the test.

5.8 Test on PVC insulation and sheaths and halogen free sheaths at low temperatures

Standard and date

Standard	IEC 60502-1, clause 18.8
Test date	12 to 18 April 2017

Characteristic test data (inner covering)

Temperature	-15 ± 2	°C
Period of application	> 16	h
Mass of hammer	750	g

Inner covering

Item	Unit	Requirement	Measured/Determined
Cold elongation	%	≥ 20	71
Cold impact test	-	No cracks	No cracks

Characteristic test data (oversheath)

Temperature	-15 ± 2	°C
Period of application	> 16	h
Mass of hammer	1000	g

Oversheath

Item	Unit	Requirement	Measured/Determined
Cold elongation	%	≥ 20	104
Cold impact test	-	No cracks	No cracks

Result

The object passed the test.

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

Standard and date

Standard IEC 60502-1, clause 18.9
Test date 18 April 2017

Characteristic test data

Temperature 150 ± 3 °C
Period of application 1 h
Diameter of mandrel 2 mm
Number of turns 6

Inner covering

Item	Unit	Requirement	Measured/Determined
Soundness	-	No cracks	No cracks

Characteristic test data

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

Oversheath

Item	Unit	Requirement	Measured/Determined
Soundness	-	No cracks	No cracks

Result

The object passed the test.

5.10 Hot set test for XLPE insulation

Standard and date

Standard IEC 60502-1, clause 18.11
Test date 20 April 2017

Characteristic test data

Temperature	200 ± 3	°C
Time under load	10	min
Mechanical stress	20	N/cm^2

Item	Unit	Requirement	Measured/determined			
			red	yellow	blue	black
Elongation under load	%	≤ 175	40	36	39	44
Permanent elongation	%	≤ 15	4	0	2	3

Result

The object passed the test.

5.11 Water absorption test on insulation

Standard and date

Standard IEC 60502-1, clause 18.13
Test date 11 April to 1 May 2017

Characteristic test data

Temperature 85 ± 2 °C
Duration 14 days

Item	Unit	Requirement	Measured/determined			
			red	yellow	blue	black
Variation of mass	mg/cm^2	≤ 1	0,02	0,01	0,01	0,03

Result

The object passed the test.

5.12 Fire tests

5.12.1 Flame spread test on single cables

Standard and date

Standard IEC 60502-1, clause 18.14.1
Test date 12 April 2017

Characteristic test data

Duration 120 s

Item	Unit	Requirement	Measured/determined
Length free of charring	mm	> 50	408
Downward limit charred surface	mm	< 540	513

Result

The object passed the test.

5.13 Shrinkage test for XLPE insulation

Standard and date

Standard IEC 60502-1, clause 18.16
Test date 24 April 2017

Characteristic test data

Temperature 130 ± 3 °C
Duration 1 h

Item	Unit	Requirement	Measured/determined			
			red	yellow	blue	black
Shrinkage	%	≤ 4	2	3	3	3

Result

The object passed the test.

6 VERIFICATION OF CABLE CONSTRUCTION

Verification of cable construction was carried out in accordance with clauses 5-13 of IEC 60502-1. The results are presented below.

	Observed/determined
Marking on the cable	DEWA ELECTRIC CABLE 600/1000 V 4x50 mm² AL/XLPE/PVC/SWA/PVC, IEC 60502-1 NATIONAL CABLE INDUSTRY, U.A.E. 2017
Construction	Class 2 Aluminium conductor, sector shaped
	XLPE insulation (red,yellow,blue,black)
	Filler material
	Polypropylene binder tape
	Inner covering, PVC type ST_2
	Galvanized Steel Wire Armour
	Outer sheath, PVC type ST_2
Outer diameter of the cable, average	34,0 mm

Result

No significant deviations from the specified requirements are found.

7 DRAWING

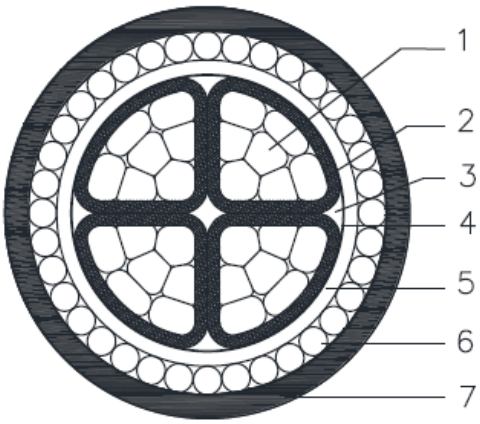
الوطنية لصناعة الكابلات
NATIONAL CABLES INDUSTRY

Cross Sectional Drawing

4x50 mm², 0.6/1 kV AL/XLPE/PVC/SWA/PVC POWER CABLE

REFERENCE STANDARD : DEWA Specs. 1.5.1.3.5.01-Rev.3 and IEC 60502-1

1. Conductor	:	Aluminium, Sectoral Stranded Compacted
2. Insulation	:	Cross-Linked Polyethylene (XLPE)
3. Fillers	:	Polypropylene Strings
4. Binding Tape	:	Polypropylene Tapes
5. Inner Sheath	:	Extruded Polyvinyl Chloride (PVC, Type ST2)
6. Armour	:	Galvanized Steel Wire Armour
7. Outer Sheath	:	Extruded Polyvinyl Chloride (PVC, Type ST2), Color: BLACK



Size	A1	A2	A3	A4	t1	t2	d3	t4
mm²	mm	mm	mm	mm	mm	mm	mm	mm
4x50	23.7	25.7	28.9	33.0	1.0	1.0	1.6	2.0

A1 = Approx. dia over assembled cores
A2 = Approx. diameter over bedding
A3 = Approx. diameter over armour
A4 = Approx. overall diameter

t1 = Nominal thickness of insulation
t2 = Nominal thickness of bedding
d3 = Nominal diameter of armour wire
t4 = Nominal thickness of outer sheath

Color Code: **Red, Yellow, Blue & Black**

Embossing on the Outer Sheath in Max 150 mm spacing along TWO lines :

DEWA ELECTRIC CABLE 600/1000 V, 4x50 SQMM, AL/XLPE/PVC/SWA/PVC, IEC 60502-1
NATIONAL CABLES INDUSTRY, UAE, 2017

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FORM # TE01/F06 Rev. 02

8 MEASUREMENT UNCERTAINTIES

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

Measurement	**Measurement uncertainty**
Tensile strength test	1%
Measurement of dimensions	5 μm
Measurement loss of mass	0,11 mg : 8,0 gr
Measurement of conductor resistance	0,03% of measured value
Measurement at low temperature	0,1 °c
Measurement in heating cabinets	0,1 °c
Voltage test	2.10^{-3}.u + 20v 2.10^{-3}.i + 0,2%