



# REPORT OF PERFORMANCE

# TIC 1590-11

<b>OBJECT</b>	multi-core power cable
<b>TYPE</b>	0,6/1 kV, 4x240 mm <sup>2</sup> CU/XLPE/SWA/LSHF
<b>MANUFACTURER</b>	Elsewedy Cables Ltd. Yanbu, Saudi Arabia
<b>CLIENT</b>	Elsewedy Cables Ltd. Yanbu, Saudi Arabia
<b>TESTED BY</b>	KEMA HIGH-VOLTAGE LABORATORY Arnhem, the Netherlands
<b>DATE OF TESTS</b>	11 July 2011 until 23 September 2011
<b>TEST PROGRAMME</b>	Type tests in accordance with IEC 60502-1 (2004) +A1 (2009)
<b>SUMMARY AND CONCLUSION</b>	The object passed the tests.

This Report of Performance 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 report consists of 33 pages in total.

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KEMA Nederland B.V.

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

Arnhem, 2 November 2011

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## 1 IDENTIFICATION OF THE TEST OBJECT

### 1.1 Description of the test object

Manufacturer	Elsewedy Cables Ltd., Yanbu, Saudi Arabia
Type	LV power cable
Year of manufacture	2011
Test according to standard(s)	IEC 60502; IEC 60332-3-24 cat C; IEC 61034; IEC 60754
Rated voltage, $U_0/U$ ( $U_m$ )	0,6/1,0 kV
No. of cores	4
Marking on the cable	ELSEWEDY CABLES 4X240 MM <sup>2</sup> 0.6/1KV CU/XLPE/SWA/LSHF 2011

#### Conductor

- material	copper
- cross-section	240 mm <sup>2</sup>
- approx. diameter/dimensions	25,6 x 17,4 mm
- type/shape of conductor	sector shaped
- maximum conductor temperature in normal operation	90 °C

#### Insulation

- material	XLPE
- nominal thickness	1,7 mm
- material designation	known in KEMA's file
- material supplier	known in KEMA's file
- core identification	red, yellow, blue, black

#### Inner covering/Separation sheath

- type	extruded
- material	LSHF, type ST <sub>8</sub>
- nominal thickness	1,6 mm
- material supplier	known in KEMA's file

#### Binder tape

- approx. dimensions	PP Tape 0,13 x 60 mm
----------------------	-------------------------

Metallic armour

- |                                 |                                   |
|---------------------------------|-----------------------------------|
| - material                      | galvanised Steel Wire             |
| - nominal diameter / dimensions | 59 wires of $\varnothing$ 2,50 mm |
| - material supplier             | known in KEMA's file              |

Oversheath

- |                           |                            |
|---------------------------|----------------------------|
| - material                | LSHF, type ST <sub>8</sub> |
| - nominal thickness       | 3,0 mm                     |
| - outer diameter of cable | 60,40 mm                   |
| - material designation    | known in KEMA's file       |
| - material supplier       | known in KEMA's file       |
| - colour                  | black                      |

Fire retardant

yes

## 1.2 List of documents

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

KEMA has verified that these documents adequately represent the object tested.

The following documents are included in this report:

drawing no./ document no.	revision	date	title
CX1-TL04-W20-00-00-D	2	27-10-2011	Cable drawing
CX1-TL04-W20-00-00, sheet 1 and 2	2	10-07-2011	Cable construction

## **2 GENERAL INFORMATION**

### **2.1 The tests were witnessed by**

The tests were not witnessed.

### **2.2 The tests were carried out by**

<b>Name</b>	<b>Company</b>
Mr. B. Vos	DEKRA Certification B.V., Arnhem, the Netherlands

### **2.3 Subcontracting**

All tests were subcontracted to DEKRA Certification B.V.

### **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 CONDUCTOR

**Standard and date**

Standard IEC 60502-1 (2004) +A1 (2009), clause 5

Test date 22 August 2011

#### 3.1 Measurement of the resistance of the conductors

item	unit	requirement	measured/determined			
			red	yellow	blue	black
- resistance	Ω/km	≤ 0,0754	0,0753	0,0747	0,0747	0,0741

**Result**

The object passed the test.

#### 3.2 Measurement of the number of wires of the conductors

item	unit	requirement	measured/determined			
			red	yellow	blue	black
- number of wires	-	≥ 34	37	37	37	37

**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 (2004) +A1 (2009), clause 17.1

Test date 23 August 2011

item	unit	requirement	measured/determined			
			red	yellow	blue	black
<b>volume resistivity, <math>\rho</math></b> at 20 °C	$\Omega \cdot \text{cm}$	–	$9,3 \times 10^{16}$	$1,2 \times 10^{17}$	$1,1 \times 10^{17}$	$9,9 \times 10^{16}$
<b>insulation resistance constant, <math>K_i</math></b> at 20 °C	$\text{M}\Omega \cdot \text{km}$	–	341130	446789	391524	362039

#### Result

The test results are for information only.

#### 4.2 Measurement of insulation resistance at max. conductor temperature in normal operation

##### Standard and date

Standard IEC 60502-1 (2004) +A1 (2009), clause 17.2

Test date 26 August 2011

item	unit	requirement	measured/determined			
			red	yellow	blue	black
<b>volume resistivity, <math>\rho</math></b> at 90 °C	$\Omega$ .cm	$\geq 10^{12}$	$2,6 \times 10^{16}$	$1,7 \times 10^{16}$	$1,9 \times 10^{16}$	$1,6 \times 10^{16}$
<b>insulation resistance constant, <math>K_i</math></b> at 90 °C	M $\Omega$ .km	$\geq 3,67$	77886	60678	68183	58167

##### Result

The object passed the test.

### 4.3 Voltage test for 4 h

#### Standard and date

Standard IEC 60502-1 (2004) +A1 (2009), clause 17.3

Test period 22 August 2011

#### Environmental conditions

Temperature  $20 \pm 2$  °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 (2004) +A1 (2009), clause 18.1

Test date 10 August 2011

insulation thickness	unit	requirement	specified	measured/determined			
				red	yellow	blue	black
- nominal	mm	-	1,70	-	-	-	-
- average	mm	$\geq 1,7$		2,0	2,0	2,1	1,9
- minimum ( $t_m$ )	mm	$\geq 1,43$		1,64	1,64	1,56	1,55

#### Result

The object passed the test.

## 5.2 Measurement of thickness of non-metallic sheaths

### Standard and date

Standard IEC 60502-1 (2004) +A1 (2009), clause 18.2

Test date 10 August 2011

### Oversheath

thickness	unit	requirement	specified	measured/determined
- nominal	mm	$\geq 1,8$	3,0	-
- average	mm	-	-	2,7
- minimum ( $t_{\min}$ )	mm	$\geq 2,20$	-	2,53

### Inner sheath

thickness	unit	requirement	specified	measured/determined
- nominal	mm	-	1,6	-
- average	mm	-	-	1,5
- minimum ( $t_{\min}$ )	mm	1,08	-	1,39

### Result

The object passed the test.

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

#### Standard and date

Standard IEC 60502-1 (2004) +A1 (2009), clause 18.3

Test period 19 August 2011 until 29 August 2011

#### Characteristic test data

Temperature during ageing 135 ± 3 °C

Duration 7 days

item	unit	requirement	measured/determined			
			red	yellow	blue	black
<b>without ageing</b>						
- tensile strength	N/mm <sup>2</sup>	≥ 12,5	28,1	27,4	26,5	25,6
- elongation	%	≥ 200	651	633	641	626
<b>after ageing</b>						
- tensile strength	N/mm <sup>2</sup>	-	29,5	27,5	26,7	28,6
- variation with samples without ageing	%	± 25 max.	5	1	1	12
- elongation	%	-	642	618	610	629
- variation with samples without ageing	%	± 25 max.	-1	-2	-5	1

#### 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 (2004) +A1 (2009), clause 18.4

Test period 19 August 2011 until 29 August 2011

### Characteristic test data

Temperature during ageing 100 ± 2 °C

Duration 7 days

### Oversheath

item	unit	requirement	measured/determined
<b>without ageing</b>			
- tensile strength	N/mm <sup>2</sup>	≥ 9,0	10,6
- elongation	%	≥ 125	325
<b>after ageing</b>			
- tensile strength	N/mm <sup>2</sup>	≥ 9,0	11,3
- variation with samples without ageing	%	± 40 max.	7
- elongation	%	≥ 100	246
- variation with samples without ageing	%	± 40 max.	-24

### Inner sheath

item	unit	requirement	measured/determined
<b>without ageing</b>			
- tensile strength	N/mm <sup>2</sup>	≥ 9,0	11,8
- elongation	%	≥ 125	344
<b>after ageing</b>			
- tensile strength	N/mm <sup>2</sup>	≥ 9,0	12,2
- variation with samples without ageing	%	± 40 max.	3
- elongation	%	≥ 100	232
- variation with samples without ageing	%	± 40 max.	-33

### Result

The object passed the test.

## 5.5 Additional ageing test on pieces of completed cables

### Standard and date

Standard IEC 60502-1 (2004) +A1 (2009), clause 18.5

Test period 19 August 2011 until 29 August 2011

### Characteristic test data

Temperature during ageing 100 ± 2 °C

Duration 7 days

### Insulation

item	unit	requirement	measured/determined			
			red	yellow	blue	black
- tensile strength	N/mm <sup>2</sup>	-	27,8	26,6	26,1	27,7
- variation with samples without ageing	%	± 25 max.	-1	-3	-2	8
- elongation	%	-	638	623	608	649
- variation with samples without ageing	%	± 25 max.	-2	-2	-5	4

### Oversheath

item	unit	requirement	measured/determined
- tensile strength	N/mm <sup>2</sup>	-	10,7
- variation with samples without ageing	%	± 40 max.	1
- elongation	%	-	235
- variation with samples without ageing	%	± 40 max.	-28

### Inner sheath

item	unit	requirement	measured/determined
- tensile strength	N/mm <sup>2</sup>	-	11,2
- variation with samples without ageing	%	± 40 max.	-5
- elongation	%	-	327
- variation with samples without ageing	%	± 40 max.	-5

### Result

The object passed the test.



## 5.6 Pressure test at high temperature on non-metallic sheaths

### Standard and date

Standard IEC 60502-1 (2004) +A1 (2009), clause 18.7

Test date 25 August 2011

### Characteristic test data

Temperature during ageing 90 ± 2 °C

Duration 6 h

Load 18,1 N

### Oversheath

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

### Characteristic test data

Temperature during ageing 90 ± 2 °C

Duration 6 h

Load 12,3 N

### Innersheath

item	unit	requirement	measured/determined
- depth of indentation	%	≤ 50	8

### Result

The object passed the test.

### 5.7 Test on PVC insulation and sheaths and halogen free sheaths at low temperatures

#### Standard and date

Standard IEC 60502-1 (2004) +A1 (2009), clause 18.8  
 Test period 25 August 2011 until 26 August 2011

#### Characteristic test data

Temperature  $-15 \pm 2$  °C  
 Mass of hammer 1250 g

#### Oversheath

item	unit	requirement	measured/determined
- cold elongation	%	$\geq 20$	210
- cold impact test	-	no cracks	no cracks

#### Characteristic test data

Temperature  $-15 \pm 2$  °C  
 Mass of hammer 1250 g

#### Innersheath

item	unit	requirement	measured/determined
- cold elongation	%	$\geq 20$	270
- cold impact test	-	no cracks	no cracks

#### Result

The object passed the test.

### 5.8 Hot set test for XLPE insulation

#### Standard and date

Standard IEC 60502-1 (2004) +A1 (2009), clause 18.11  
 Test date 26 August 2011

#### Characteristic test data

Temperature 200 ± 3 °C  
 Time under load 15 min  
 Mechanical stress 20 N/cm<sup>2</sup>

item	unit	requirement	measured/determined			
			red	yellow	blue	black
- elongation under load	%	≤ 175	120	110	110	120
- permanent elongation	%	≤ 15	0	0	0	0

#### Result

The object passed the test.

### 5.9 Water absorption test on insulation

#### Standard and date

Standard IEC 60502-1 (2004) +A1 (2009), clause 18.13

Test period 18 July 2011 until 5 August 2011

#### Characteristic test data

Temperature 85 ± 2 °C

Duration 14 days

item	unit	requirement	measured/determined			
			red	yellow	blue	black
- variation of mass	mg/cm <sup>2</sup>	≤ 1	< 0,1	< 0,1	< 0,1	< 0,1

#### Result

The object passed the test.

## 5.10 Fire tests

### 5.10.1 Flame spread test on bunched cables

#### Standard and date

Standard IEC 60502-1 (2004) +A1 (2009), clause 18.14.2 and IEC 60332-3-24  
Test date 18 August 2011

#### Characteristic test data

Method of mounting spaced  
Flame application time 20 minutes  
Number of burners 1

item	unit	requirement	calculated/measured
- total volume of non-metallic materials	l/m	-	1,3520
- number of test pieces	-	$\geq 2$	2
- distance between the cables	mm		20
- number of layers	-	1	1
- time to extinction of all burning or glowing	minutes		21:37
- extent of damage	m	$\leq 2,5$	0,5

#### Result

The object passed the test.

### 5.10.2 Smoke emission test

#### Standard and date

Standard IEC 60502-1 (2004) +A1 (2009), clause 18.14.3 and IEC 61034-2

Test date 18 August 2011

#### Characteristic test data

Number of cables 1

item	unit	requirement	calculated/measured
- light transmittance	%	$\geq 60$	88

#### Result

The object passed the test.

### 5.10.3 Acid gas emission test

#### Standard and date

Standard IEC 60502-1 (2004) +A1 (2009), clause 18.14.4 and IEC 60754-1

Test date 12 September until 21 September 2011

#### Amount of halogen acid gas

HCl content of ..	unit	requirement	calculated/measured
- XLPE insulation (mixed)	%	$\leq 0,5$	< 0,1
- filler between the cores	%	$\leq 0,5$	< 0,1
- binder tape (inner)	%	$\leq 0,5$	< 0,1
- bedding	%	$\leq 0,5$	< 0,1
- binder tape (outer)	%	$\leq 0,5$	< 0,1
- oversheath LSHF	%	$\leq 0,5$	< 0,1

#### Remarks

- No requirements for conformity are included in IEC 60754-1.
- The method specified in IEC 60754-1 is intended for type testing of individual components used in the cable construction. The use of this method will enable the requirements for individual components of a cable construction to be stated in the appropriate cable specification.

#### Result

The object passed the test.

**5.10.4 pH and conductivity test**

**Standard and date**

Standard IEC 60502-1 (2004) +A1 (2009), clause 18.14.5 and IEC 60754-2

Test date 12 September until 21 September 2011

**pH test**

pH value of ..	unit	requirement	calculated/measured
- XLPE insulation (mixed)	%	≥ 4,3	5,2
- filler between the cores	%	≥ 4,3	5,1
- binder tape (inner)	%	≥ 4,3	5,1
- bedding	%	≥ 4,3	4,8
- binder tape (outer)	%	≥ 4,3	4,7
- oversheath LSHF	%	≥ 4,3	4,9

**Conductivity test**

conductivity of ..	unit	requirement	calculated/measured
- XLPE insulation (mixed)	μS/mm	≤ 10	0,3
- filler between the cores	μS/mm	≤ 10	0,9
- binder tape (inner)	μS/mm	≤ 10	0,9
- bedding	μS/mm	≤ 10	0,4
- binder tape (outer)	μS/mm	≤ 10	0,9
- oversheath LSHF	μS/mm	≤ 10	0,4

**Result**

The object passed the test.



### 5.10.5 Fluorine content test

#### Standard and date

Standard IEC 60502-1 (2004) +A1 (2009), clause 18.14.6 and IEC 60684-2

Test date 20 July 2011 until 26 July 2011

#### Amount of fluorine

fluorine content of ..	unit	requirement	calculated/measured
- XLPE insulation (mixed)	%	$\leq 0,1$	< 0,1
- filler between the cores	%	$\leq 0,1$	< 0,1
- binder tape (inner)	%	$\leq 0,1$	< 0,1
- bedding	%	$\leq 0,1$	< 0,1
- binder tape (outer)	%	$\leq 0,1$	< 0,1
- oversheath LSHF	%	$\leq 0,1$	< 0,1

#### Result

The object passed the test.

### 5.11 Shrinkage test for XLPE insulation

#### Standard and date

Standard IEC 60502-1 (2004) +A1 (2009), clause 18.16

Test date 26 August 2011

#### Characteristic test data

Temperature 130 ±3 °C

Duration 1 h

item	unit	requirement	measured/determined			
			red	yellow	blue	black
- shrinkage	%	≤ 4	2	0	2	2

#### Result

The object passed the test.

## 5.12 Water absorption test for halogen free oversheaths

### Standard and date

Standard IEC 60502-1 (2004) +A1 (2009), clause 18.22

Test period 18 July 2011 until 5 August 2011

### Characteristic test data

Temperature  $70 \pm 2$  °C

Duration 24 h

item	unit	requirement	measured/determined
- variation of mass	mg/cm <sup>2</sup>	≤ 10	< 0,1

### 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
construction	<ul style="list-style-type: none"><li>- stranded compacted copper conductors</li><li>- construction 1-6-12-18 wires <math>\varnothing</math> 2,7 mm (approx.)</li><li>- XLPE insulations; red,yellow,blue and black</li><li>- binder tape</li><li>- inner sheath LSHF type ST<sub>8</sub></li><li>- steel wire armour; 59 wires of <math>\varnothing</math>2,5 mm (approx.)</li><li>- binder tape</li><li>- over sheath LSHF type ST<sub>8</sub></li></ul>
outer diameter of the cable, average	62,4 mm

### Result

No deviations from the specified requirements are found.

## APPENDIX A MEASUREMENT UNCERTAINTIES

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

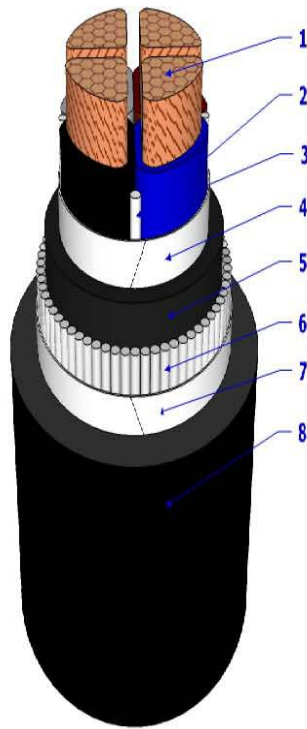
measurement	measurement uncertainty
tensile strenght test	1%
measurement of dimensions	$\pm 5 \mu\text{m}$
measurement loss of mass	0,11 mg : 8,0 gr
measurement of conductor resistance	$\pm 0,03\%$ of measured value
measurement at low temperature	0,1 °C
measurment in heatingcabinets	0,1 °C
voltage test	$2 \cdot 10^{-3} \cdot U + 20\text{V}$ $2 \cdot 10^{-3} \cdot I + 0,2\%$



## **APPENDIX B MANUFACTURER'S DRAWING/DATA SHEET**

4 pages (including this page)

**ELSEWEDY  
CABLES**



<i>Size</i> : 4 x 240 mm <sup>2</sup>		<i>Type</i> : Cu/XLPE/SWA/LSHF
<i>Voltage</i> : 0.6 / 1 (1.2) kV		<i>Standard</i> : IEC 60502-1: 2004
<i>Code</i> : CX1-TL04-W20-00-00		<b>EL-SEWEDY CABLES</b>
Sr.	Description	
1.	<b>Copper Conductor (Sector shape)</b>	
2.	XLPE Insulation	
3.	<b>Polypropylene Filler</b>	
4.	Binder Tape	
5.	LSHF Bedding	
6.	<b>Galvanized steel wire Armor</b>	
7.	Binder Tape	
8.	LSHF Sheath	
Not to Scale	Drawn by Mr. Edgar	Approved by Eng. Islam Elsafty

EI Sewedy Cables KSA

Technical Department

**4X240 - 0.6 / 1 kV Cable**

**Cu/XLPE/SWA/LSHF**

Cable Construction

<b>1. Conductor</b>		
Material		<b>Copper</b>
No of cores X Size	mm <sup>2</sup>	<b>4X240</b>
No. of wires		<b>37</b>
Conductor Diameter	mm	<b>Sector Shape</b>
<b>2. Insulation</b>		
Material		<b>Cross Linked Poly Ethylene (XLPE)</b>
Thickness	mm	<b>1.7 (nominal)</b>
	mm	<b>1.43 (minimum at any point)</b>
Diameter	Mm	<b>Sector shape</b>
Core Identification		<b>Red, Yellow, Blue, Black</b>
<b>3. Assembly</b>		
Material		<b>Poly Propylene Filler</b>
Binder		<b>Poly Propylene Tape</b>
Diameter	mm	<b>47.3 (Approx.)</b>
<b>4. Inner Covering</b>		
Material		<b>LSHF</b>
Thickness	Mm	<b>1.6 (nominal)</b>
		<b>1.08 (minimum at any point)</b>
Diameter	Mm	<b>49.9 (approx.)</b>
<b>5. Armor</b>		
Material		<b>Galvanized round steel wire</b>
Number X diameter		<b>59X2.5 mm</b>
Diameter	Mm	<b>55.4</b>
<b>6. Sheath</b>		
Material		<b>LSHF (ST8)</b>
Color		<b>black</b>
Thickness	Mm	<b>3.0 (nominal)</b>
		<b>2.2 (minimum at any point)</b>
Diameter	Mm	<b>60.4 (approx.)</b>



El Sewedy Cables KSA

Technical Department

**4X240 - 0.6 / 1 kV Cable****Cu/XLPE/SWA/LSHF**

Cable Construction

**Applicable Standards :**

- IEC 60502-1
- IEC 60332-3-24 cat C
- IEC 61034
- IEC 60754