Test Report
No. TR-010-2019

For

Type Testing of
3×300 + 150 mm², Al/XLPE/PVC
0.6/1kV Power Cable

جامعة الملك سعود
King Saud University
قسم
الهندسة الكهربائية - الرياض
Electrical Engineering
Department - Riyadh
مختبر الجهد العالي
High Voltage Laboratory

Test carried out at

The High Voltage Laboratory

Ramadan, 1440 H
May, 2019 G

Total No. of Pages including Appendix: 14

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TEST REPORT No. TR-010-2019

OBJECT	Low Voltage Power Cable
TYPE	3 × 300 + 150 mm^2 Al/XLPE/PVC, 0.6/1kV
MANUFACTURER	NATIONAL CABLES INDUSTRIES, Sharjah - UAE
TRADE NAME	NATIONAL CABLES INDUSTRIES
DATE OF TEST	MAY, 2019
TEST REFERENCE STANDARDS	**IEC 60502-1:2009 & 11-SDMS-01 Rev. 03**
SUMMARY AND CONCLUSION	***All tests passed.***

This Report of Performance applies only to the object tested. The responsibility for conformity of any production having the same designations as the tested sample rests with the manufacturer.

Prof. Dr. Abdulrehman A. Al-Arainy
Manager
High Voltage Laboratory,
King Saud University,
Riyadh, KSA

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This report consists of 14 pages in total.

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1. IDENTIFICATION OF THE TEST OBJECT

1.1 Description of the test object

OBJECT	Low Voltage Power Cable
KSU LAB ID #	**HVS – 010/2019**
MANUFACTURER	NATIONAL CABLES INDUSTRIES SHARJAH - UAE
TYPE	3 × 300 + 150 mm^2 , Al/XLPE/PVC
YEAR OF MANUFACTURE	2019
SAMPLING PROCEDURE	23 meter cable sample cut from the drum
RATED VOLTAGE	0.6/1kV
NO. OF CORES	3 + 1/2

Manufacturer specified values

1. Conductor		
Material	**Aluminum**	
Size	**3 x 300 + 150**	mm^2
Minimum no. of wires	**37 / 19**	
Max. DC Resistance at 20 °C	**0.1 / 0.206 (N)**	Ω / km
2. Insulation		
Material	**XLPE**	
Thickness :		
- Nominal	**1.80 / 1.40 (N)**	mm
- Minimum at any point	**1.52 / 1.16 (N)**	mm
Diameter over core assembly	**50.8** (Approximate)	mm
3. Assembly		
Binder	**Polypropylene [Tape]**	
Diameter over binder tape	**51.3**	mm
4. Outer Sheath		
Material	**Polyvinyl Chloride [PVC - ST2]**	
Color	**Black**	
Thickness :		
- Nominal	**2.90**	mm
Overall cable diameter	**57 (Approximate)**	mm

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1.2 List of documents

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

SPECIFICATION	REVISION	DATE	TITLE
11-SDMS-01	Rev. 03	July 2018 G	Specifications for low voltage power and control cables

2. GENERAL INFORMATION

2.1 The tests were carried out by: following members of HV laboratory of King Saud University

1. **Prof. Yasin Khan**
2. **Eng. Nissar R. Wani**

2.2 Purpose of the test

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

2.3 Applicable test standards

IEC 60502-1: 2009 & 11-SDMS-01 Rev. 03:2018

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.

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3 MEASUREMENTS ON CONDUCTOR

Standard
Standard IEC 60502-1 (2009), Clause 5

Item	Unit	Requirement	Measured/Determined				Result
			Red	Yellow	Blue	Black (N)	
Number of wires	No's	37 / 19	37	37	37	19	Pass
Conductor Resistance @20°C	Ω / km	0.100 Phase 0.206 (N)	0.098	0.095	0.098	0.181	Pass

4 NON-ELECTRICAL TYPE TESTS

4.1 Measurement of thickness of insulation

Standard
Standard IEC 60502-1 (2009), clause 18.1

Results of the measurement of thickness of XLPE insulation

thickness	Unit	Requirement specified	Measured/Determined				Result
			Red	Yellow	Blue	Black (N)	
Nominal ($T_{nom.}$)	mm	≥ 1.8 / 1.4 (N)	1.83	1.81	1.84	1.70	Pass
Minimum ($T_{min.}$)	mm	1.52 / 1.16 (N)	1.58	1.60	1.55	1.55	

4.2 Assembly

Standard
Standard IEC 60502-1 (2009), clause 7

Binder	Material	Result
Helical tape	Poly Propylene Tape	Pass

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4.3 Measurement of thickness of non-metallic sheathing

Standard
Standard IEC 60502-1 (2009), clause 18.2

Outer Sheath (ST2)

Thickness	Unit	Requirement	Measured/Determined	Result
Nominal	mm	2.9	2.93	Pass
Minimum at any point	mm	2.51	2.57	Pass
Outer diameter	mm	57	56.82	Pass

5 ELECTRICAL TYPE TESTS

5.1 Insulation Resistance Measurements

Standard
Standard IEC 60502-1 (2009), clause 17.1 & 17.2
Sample length: 11 m

At Maximum Conductor Temperature = 90 ± 2 °C

Item	Unit	Requirement	Measured / Determined				Result
			Red	Yellow	Blue	Black (N)	
Volume Resistivity	Ω.cm	10^{12} (min.)	3.27 x 10^{15}	3.36 x 10^{15}	3.92 x 10^{15}	2.99 x 10^{15}	Pass
Insulation Resistance Constant Ki	MΩ.km	3.67 (min.)	12.0 x 10^{3}	12.3 x 10^{3}	14.4 x 10^{3}	11.0 x 10^{3}	Pass

5.2 4 hours AC voltage test:

Standard
Standard IEC 60502-1 (2009), clause 17.3

Characteristic
Temperature during Test 24°C

Item	Required test voltage $4U_o$(kV)	Applied test voltage (kV)	Duration hrs	Measured/Determined	Result
Voltage test	2.4	2.4	4	No Breakdown in any core	Pass

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6 NON-ELECTRICAL TYPE TESTS

6.1 Tests for determining the mechanical properties of the XLPE Insulation before and after ageing

Standard
Standard IEC 60502-1, Clause 18.3

Mechanical properties before ageing

Item	Unit	Requirement	Measured/Determined				Result
			Red	Yellow	Blue	Black (N)	
Tensile strength before ageing	N/mm^2	≥ 12.5	21.21	20.85	22.95	22.59	Pass
Elongation before ageing	%	≥ 200	524.0	545.55	528.45	508.50	

Mechanical properties after ageing

Temperature during ageing 135°C ± 2°C for 7 days

Item	Unit	Requirement	Measured/Determined				Result
			Red	Yellow	Blue	Black (N)	
Tensile strength	N/mm^2	----------	23.23	24.59	26.43	22.91	Pass
Variation with samples without ageing	%	± 25 max.	+9.52	17.93	15.16	1.42	
Elongation	%	---------	541.75	479.80	510.20	481.55	Pass
Variation with samples without ageing	%	± 25 max.	+3.39	-12.05	-3.45	-5.29	

6.2 Tests for determining the mechanical properties of the Non-Metallic Sheaths before and after ageing

Standard
Standard IEC 60502-1(2009), clause 18.4

Characteristic (Outer Sheath)

Material	PVC ST2
Temperature during ageing	100 °C ± 2°C
Duration	7 days

Before ageing

Item	Unit	Requirement	Measured/Determined	Result
Tensile strength Without ageing	N/mm^2	≥ 12.5	17.22	Pass
Elongation Without ageing	%	≥ 150	301.50	

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After ageing

Item	Unit	Requirement	Measured/Determined	Result
Tensile strength	N/mm^2	≥ 12.5	17.03	Pass
Variation with samples without ageing	%	± 25 max.	-1.10	
Elongation	%	≥150	288.15	Pass
Variation with samples without ageing	%	± 25 max.	- 4.43	

6.3 Additional ageing test on pieces of Completed cables

Standard
Standard IEC 60502-1(2009), clause 18.5

Characteristic test data
Temperature during ageing 100 °C ± 2°C
Duration 7 days

Insulation

Item	Unit	Requirement	Measured/Determined				Result
			Red	Yellow	Blue	Black (N)	
Tensile strength	N/mm^2	----------	19.20	21.00	19.32	26.47	Pass
Variation with samples without ageing	%	± 25 max.	- 9.48	+0.72	-15.82	17.17	
Elongation	%	----------	521.35	495.65	476.45	479.75	Pass
Variation with samples without ageing	%	± 25 max.	-0.50	-9.24	-9.84	-5.65	

Outer Sheath (ST-2)

Item	Unit	Requirement	Measured/Determined	Result
Tensile strength	N/mm^2	----------	17.44	Pass
Variation with samples without ageing	%	± 25 max.	+1.27	
Elongation	%	----------	302.35	Pass
Variation with samples without ageing	%	± 25 max.	+0.28	

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6.4 Loss of mass test on PVC sheathing

Standard
IEC 60502-1(2009), clause 18.6

Characteristic test data
Temperature during ageing 100 °C ± 2°C
Duration 7 days

Sheathing:-

Item	Unit	Requirement	Measured/Determined	Result
loss of mass	mg/cm^2	≤ 1.5	0.84	Pass

6.5 Pressure test at high temperature on non-metallic sheaths & Insulation

Standard
IEC 60502-1(2009), clause 18.7

Characteristic test data (Outer Sheath) ST -2
- Oven Temperature 90 °C ± 2°C
- Time under load 6h
- Load 1256 grams

Calculated as per the specified test method

Item	Unit	Requirement	Measured/Determined	Result
			Median value of 3 samples	
Depth of indentation	%	≤ 50	14.55 %	Pass

6.6 Test on PVC sheaths at low temperatures

(a) Cold Elongation test (PVC Sheath)

Standard
IEC 60502-1 (2009) clause 18.8

Characteristic test data
- Temperature -15 °C ± 2°C

Item	Unit	Requirement	Measured/Determined mean value	Result
Elongation test at low temp.	%	≥ 20	221.10	Pass

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(b) Cold impact test (PVC Sheath)

Standard
IEC 60502-1 (2009) clause 18.8

Characteristic test data

- Temperature -15 °C ± 2°C
- Duration 16 h
- Mass of hammer 1250 gms

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

6.7 Test for resistance of sheaths to cracking (heat shock test)

Standard

IEC 60502-1 (2009), Clause 18.9

Characteristic test data (PVC Outer Sheath)

Temperature 150 °C ± 3°C
Duration 1 h
Sample thickness 2.93
Mandrel diameter 6 mm,
Number of turns 6

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

6.8 Hot set test for XLPE insulation

Standard
Standard IEC 60502-1 (2009), Clause 18.11

Characteristic test data

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

Item	Unit	Requirement	Measured/Determined				Result
			Red	Yellow	Blue	Black (N)	
Elongation under load	%	≤175	32.02	27.53	29.05	33.10	Pass
Permanent elongation	%	≤15	1.03	0.86	3.03	1.45	Pass

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6.9 Water absorption test on insulation

Standard
Standard IEC 60502-1(2009), clause 18.13

Characteristic test data
Temperature 85 °C ± 2°C
Duration 14 days

Item	Unit	Requirement	Measured/Determined				Result
			Red	Yellow	Blue	Black (N)	
Variation of mass	mg/cm^2	≤ 1	0.031	0.041	0.016	0.026	Pass

6.10 Shrinkage test for XLPE insulation

Standard
Standard IEC 60502-1(2009), Clause 18.16

Characteristic test data
Temperature 130 °C ± 3°C
Duration 1 h

Item	Unit	Requirement	Measured/Determined				Result
			Red	Yellow	Blue	Black (N)	
Shrinkage	%	≤ 4	2.60	2.18	2.33	1.84	Pass

6.11 Flame spread test

Standard

IEC 60502-1 (2009), Clause 18.14.1
IEC 60332-1

Characteristic test data:
Time of flame application 240 ± 2 Seconds
Cable diameter 58.50 mm

No.	Testing required	Requirement	Observations	Result
1	The distance between the lower edge of top support and the onset charring	> 50mm	415mm	Pass
2	The distance from the lower edge of top support to the downwards extended charring	< 540mm	450mm	Pass

- This test was carried out at Riyadh Cables test lab under KSU witness

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7 VERIFICATION OF CABLE CONSTRUCTION

Verification of cable construction was carried out in accordance to **IEC 60502-1. (2009)**
The results are presented below.

	Measured / Determined
Marking of the cable	**Arabic Embossing:** الوطنية لصناعة الكابلات ، الامارات العربية المتحدة ، ٢٠١٩ ، ٣X٣٠٠ + ١٥٠ مم٢ الومنيوم/ اكس ال بي اي/ بي في سي ٠,٦/١ ك ف ، املاك الشركة السعودية للكهرباء. **English Embossing:** NATIONAL CABLES INSDUSTRIES-UAE, 2019, 3 X 300 + 150 MM^2, AL/XLPE/PVC , 0.6/1 kV, PROPERTY OF SAUDI ELECTRICITY COMPANY
Color of the cores	RED , YELLOW, BLUE & BLACK
Color of the outer sheath	Black
Construction	3 x 300 + 150 mm^2 - Aluminum wires - XLPE Insulation - Polypropylene Binder Tape - PVC – ST2 Outer Sheath
Outer diameter of the cable (mm)	56.82mm approx.

Note: See also the manufacturer's drawing in **appendix A**.

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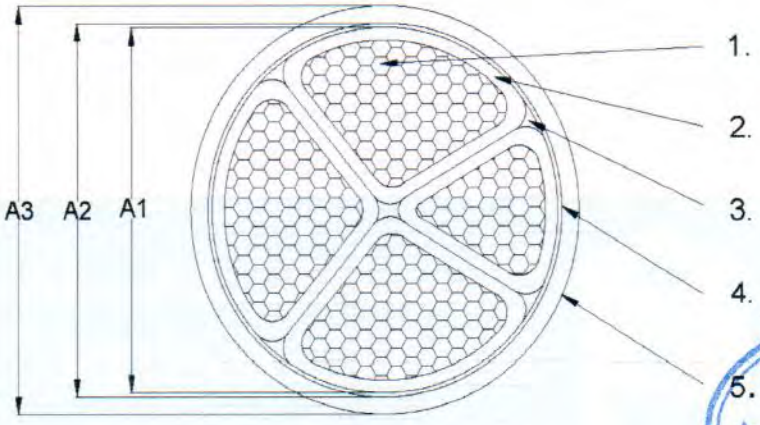
8 Appendix A. Manufacturer's drawing / data sheet

NCI
الوطنية لصناعة الكابلات
NATIONAL CABLES INDUSTRY

TYPICAL CROSS SECTIONAL DRAWING FOR
3x300+150 mm² AL/XLPE/PVC 0.6/1 kV Cable
Reference standard: IEC 60502-1 & 11-SDMS-01 REV. 03



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DIMENSIONS:

No.	DETAILS	
	Conductor Cross Section, mm² (Ph/N)	300 / 150
1	Conductor (Sectoral stranded compacted)	Aluminium
2	Nominal thickness of XLPE insulation, mm (Ph/N)	1.8 / 1.4
3	Filler (Assembling)	Polypropylene String
4	Approximate thickness of binder tape, mm	0.125
5	Nominal thickness of PVC outer sheath, mm	2.9
A1	Approximate diameter over core assembly, mm	50.8
A2	Approximate diameter over binder tape, mm	51.3
A3	Approximate diameter over outer sheath, mm	57

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شهادة اعتماد
ACCREDITATION CERTIFICATE

اللجنة السعودية للاعتماد
Saudi Accreditation Committee

تشهد اللجنة السعودية للاعتماد (ساك) بأن

Saudi Accreditation Committee (SAC) Declare that

High Voltage King Saud University Laboratory

Address: **Riyadh**

Scope : **Electrical and electronic**

مختبر الجهد العالي بجامعة الملك سعود

العنوان: **الرياض**

المجال : **الكهربائية والإلكترونية**

قد حقق متطلبات اللجنة السعودية للاعتماد (ساك) وتم اعتماده وفقاً لمتطلبات المواصفة القياسية السعودية ساسو / آيزو/ آى إي سي **17025** وذلك في المجال الملحق بهذه الشهادة

Has met the Requirements of Saudi Accreditation Committee (SAC) and has been accredited in compliance with SASO/ISO/IEC **17025** for the scope attached with this Certificate

رئيس اللجنة
SAC Chairman

سعد بن عثمان القصبي
Saad O. Alkasabi

اللجنة السعودية للاعتماد
Saudi Accreditation Committee

تاريخ الانتهاء / Expire Date : 12/06/1441

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