TIC 1002-14

TYPE TEST CERTIFICATE OF COMPLETE TYPE TESTS

OBJECT	Single-core power cable
TYPE	A2XS(FL)2Y

Rated voltage, U_0/U (U_m)	**18/30 (36) kV**	**Conductor material**	**AL**
Conductor cross-section	**1x185 mm²**	**Insulation material**	**XLPE**

MANUFACTURER	FKN DOOEL, Negotino, Macedonia
CLIENT	FKN DOOEL, Negotino, Macedonia
TESTED BY	KEMA Nederland B.V., Arnhem, The Netherlands
DATE(S) OF TESTS	13 January to 27 February 2014

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

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 38 pages in total.

KEMA Nederland B.V.

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

Arnhem, 26 March 2014

CONTENTS

page

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	185 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)	FKN DOOEL, Negotino, Macedonia
Type	U_0 = 18 kV 1x185 mm^2 XLPE CABLE
Manufacturing date	2013
Sampling procedure	By the manufacturer
Quantity submitted	60 m
Rated voltage, U_0/U (U_m)	18/30 (36) kV
Nominal capacitance between conductor and metal screen	0,18 µF/km
No. of cores (core identification)	1
Overall diameter	44,5 mm
Marking on the oversheath	A2XS(FL)2Y 1x185RM/25 18/30kV FKN NEGOTINO 2013
Application of marking	Printing
Construction	See List of drawings

Conductor

– material	Aluminium
– cross-section	185 mm^2
– nominal diameter	16,15 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 XLPE
– nominal thickness	0,6 mm
– material designation	KI-XLC-09
– manufacturer of the material	Kalpena Industries Limited-India

Insulation

– material	XLPE
– nominal thickness	8,0 mm
– material designation	KI-XL-8503
– manufacturer of the material	Kalpena Industries Limited-India

Insulation (core) screen

– material	Semi-conducting XLPE
– strippable	No
– nominal thickness	0,7 mm
– material designation	KI-XLC-09
– manufacturer of the material	Kalpena Industries Limited-India

Longitudinally watertightness

– presence and nature of measures to achieve longitudinal watertightness along insulation screen	Yes, swelling tape
– number of swelling tapes	1: one layer of semi-conducting tape between insulation screen and copper screen
– nominal thickness and width (overlap)	0,52 x 60 mm (overlap: 40%)
– material designation	Known in KEMA's files
– manufacturer of the material	Known in KEMA's files

Metallic screen

– material	Copper wires and copper tape
– number of wires	48
– nominal diameter of wires	0,8 mm
– nominal thickness and width of tape	0,15 x 10 mm (open helix)
– cross-sectional area	25 mm^2

Longitudinally watertightness

– presence and nature of measures to achieve longitudinal watertightness along insulation screen	Yes, swelling tape
– number of swelling tapes	1: one layer of non-conducting tape between copper screen and oversheath
– nominal thickness and width (overlap)	Tape: 0,35 x 60 mm (overlap: 40%)
– material designation	Known in KEMA's files
– manufacturer of the material	Known in KEMA's files

Metal foil or tape, longitudinally applied, bonded to the oversheath	Yes
– material	Aluminium
– nominal thickness	0,3 mm

Oversheath

– material	PE, type ST_7
– nominal thickness	3,0 mm
– nominal overall diameter of the cable (D)	44,5 mm
– material designation	KI-BS-0366
– manufacturer of the material	Kalpena Industries Limited-India
– colour	Black
– graphite coating applied	No

Fire retardant (according to IEC 60332-1)	No

Manufacturing details insulation system

– location of manufacturing	Negotino, Macedonia
– type of extrusion line	CCV
– type of extrusion	Triple common extrusion
– factory identification of extrusion line	130199
– manufacturer of the extrusion line	Royle Systems Group
– curing means	Dry cure (nitrogen)
– cooling means	Water
– manufacturing length (where cable sample for testing has been taken from)	3000 m
– length markings on cable sample sent to KEMA	Begin: 0088 m, end: 0148m

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 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/Date
2360300/13	0
DATA SCHEDULE FOR M.V. CABLE **A2XS(FL)2Y 18/30 kV**	11.12.2013

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 Edwin Pultrum	KEMA Nederland B.V.,
Mr Andre Sengers	Arnhem, The Netherlands
Ms Hong He	

2.3 Subcontracting

The following tests were subcontracted to DNVGL Energy - CES:

- measurement of resistivity of semi-conducting screens in accordance with Subclause 18.1.9.
- non-electrical type tests in accordance with Clause 19, with the exception of the water penetration test of Subclause 19.22.

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

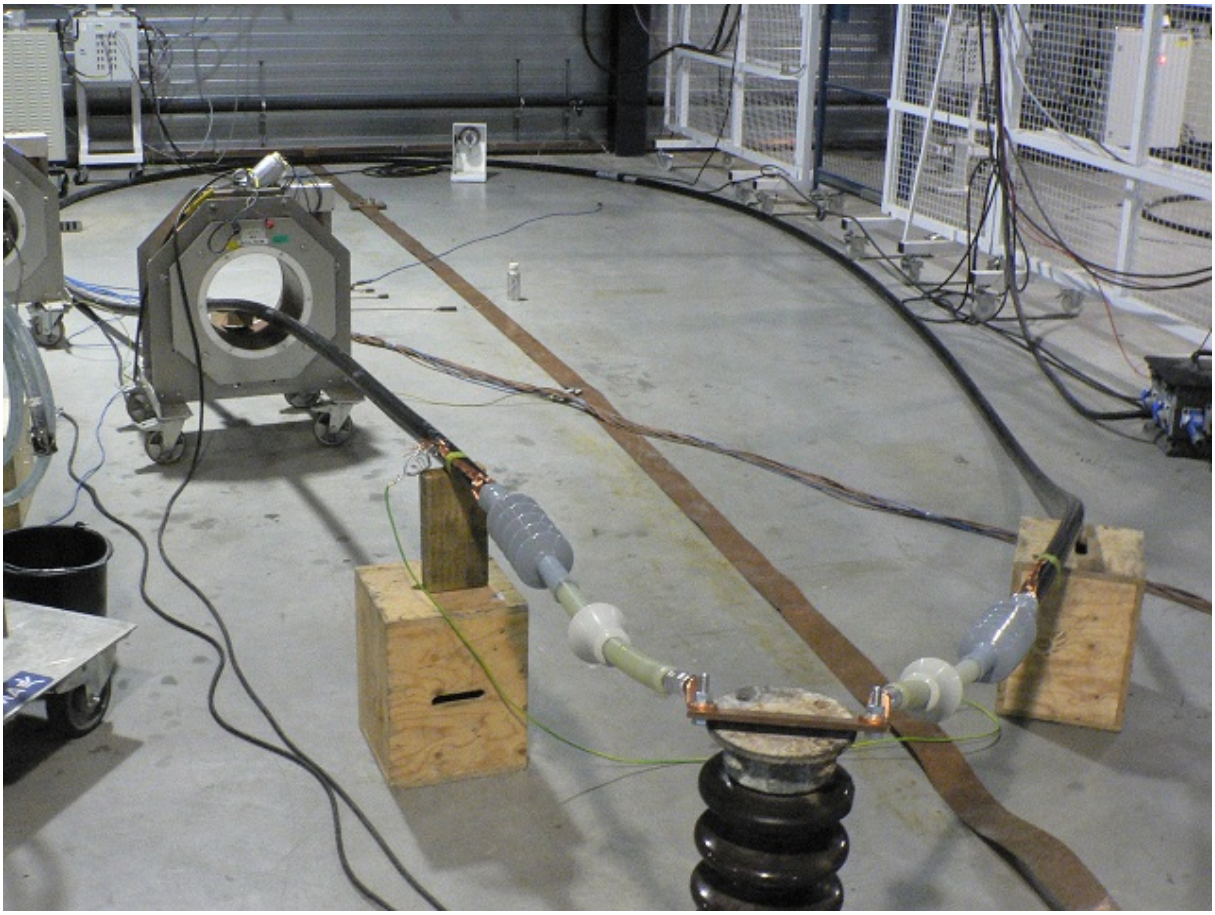
Standard IEC 60840, Annex A, Subclause A.3.1 was used as a guide

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 as for the test loop.

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. 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



Impression of the test loop laid down on the laboratory's floor

3.2 Bending test

Standard and date

Standard IEC 60502-2, Subclause 18.1.3
Test date 13 January 2014

Environmental conditions

Ambient temperature 8 °C

Characteristic test data

Temperature of test object 15 °C
Required bending diameter 25(d + D) ± 5%
Length of cable bended 25 m

Nominal outer diameter of cable D (mm)	Nominal diameter of cable conductor d (mm)	Maximum required bending diameter D_r (mm)	Diameter of test cylinder D_t (mm)
44,5	16,2	$1442 \leq D_r \leq 1593$	1550

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	28 January 2014

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 pC
Sensitivity	4 pC
Required sensitivity	≤ 5 pC
Centre frequency	134 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	-	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 31 January 2014

Environmental conditions

Ambient temperature 21 °C

Characteristic test data

Temperature of test object 97 °C
Length of test object 20,92 m
Standard capacitor 100 pF

Core	Voltage applied, 50 Hz (kV)	Capacitance of core [1] (µF/km)	Tan δ
1	5	0,186	$2,5 \times 10^{-4}$
[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 18.1.6

Test dates 31 January to 7 February 2014

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		Cooling
			Total duration (h)	Duration of conductor at steady temperature (h)	Total duration (h)
20	95 - 100	approx. 560	5	2	3

Requirements

No breakdown shall occur.

Result

The object passed the test.

3.6 Partial discharge test

Standard and date

Standard	IEC 60502-2, Subclause 18.1.4
Test date	11 February 2014

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 pC
Sensitivity	4 pC
Required sensitivity	≤ 5 pC
Centre frequency	118 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	-	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 18.1.7

Test date 12 February 2014

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	No. of impulses	See figure on next pages
Voltage applied to	Earthed		(% of test voltage)		
Conductor	Metal screen	Positive	50	1	1 (waveshape)
			65	1	2
			80	1	2
			100	10	3 and 4
Conductor	Metal screen	Negative	50	1	5 (waveshape)
			65	1	6
			80	1	6
			100	10	7 and 8

Requirement

The cable core shall withstand without failure 10 positive and 10 negative voltage impulses.

Result

The object passed the test.

Lightning impulse test with positive voltage

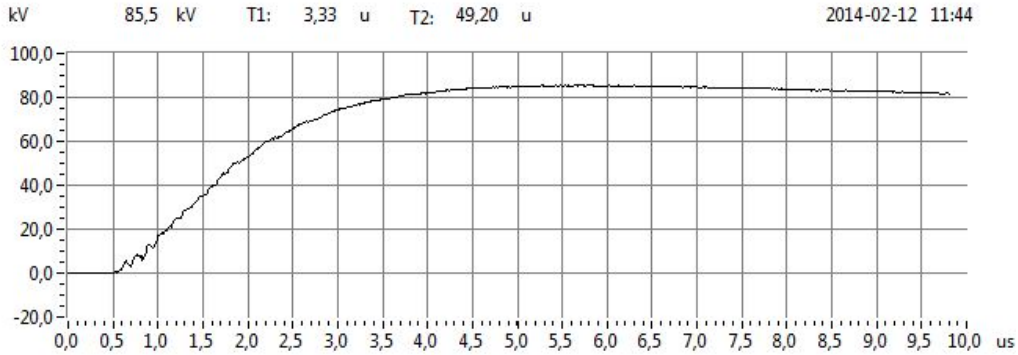


Fig. 1: Waveshape 72121987 +50% FKN DOOEL

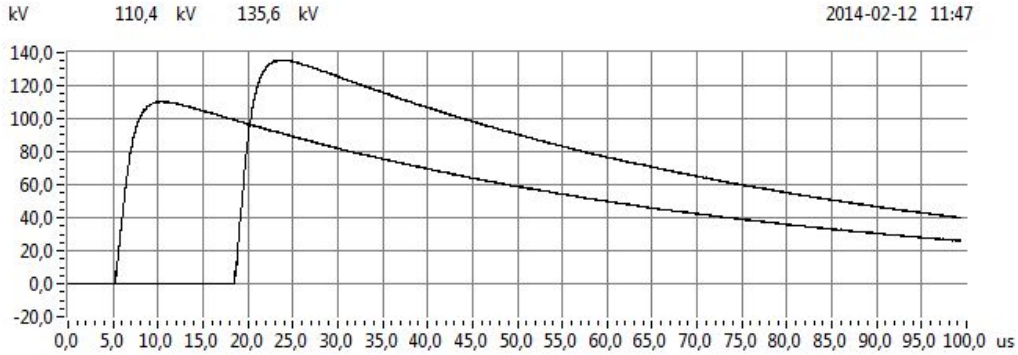


Fig. 2: 72121987 +65% and +80% FKN DOOEL

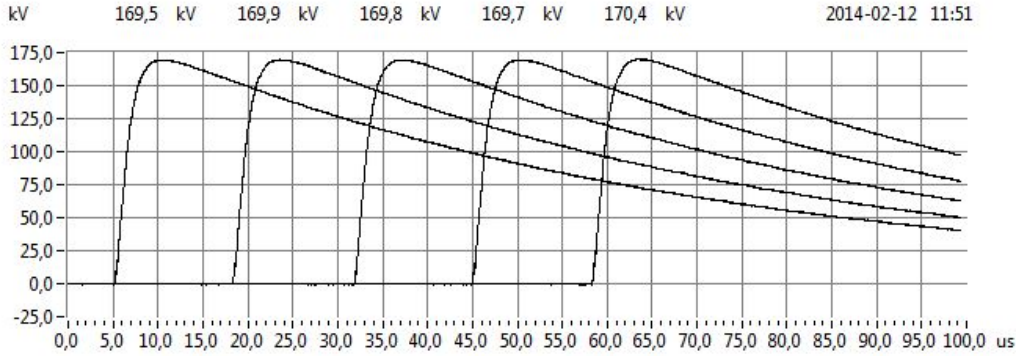


Fig. 3: 72121987 +100% FKN DOOEL

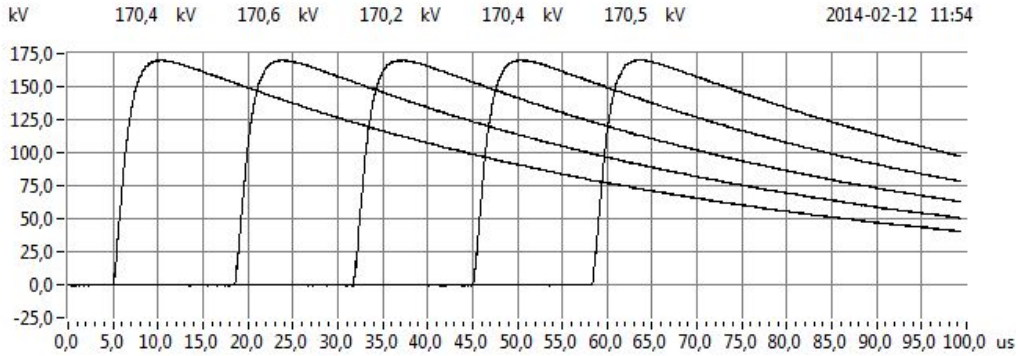


Fig. 4: 72121987 +100% FKN DOOEL

Lightning impulse test with negative voltage

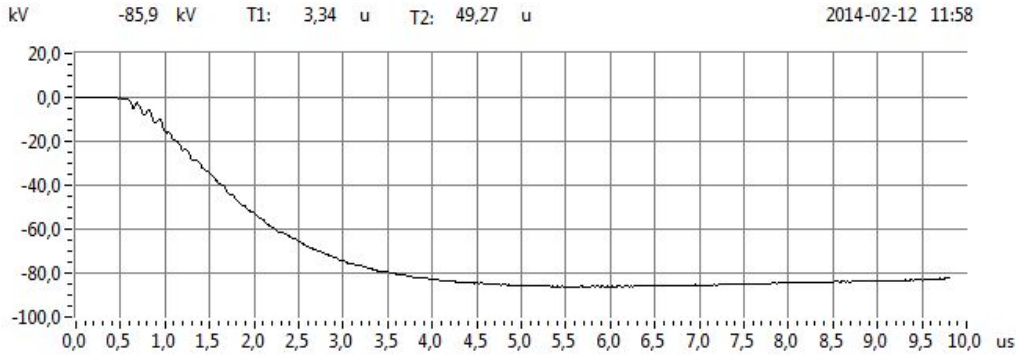


Fig. 5: Waveshape 72121987 -50% FKN DOOEL

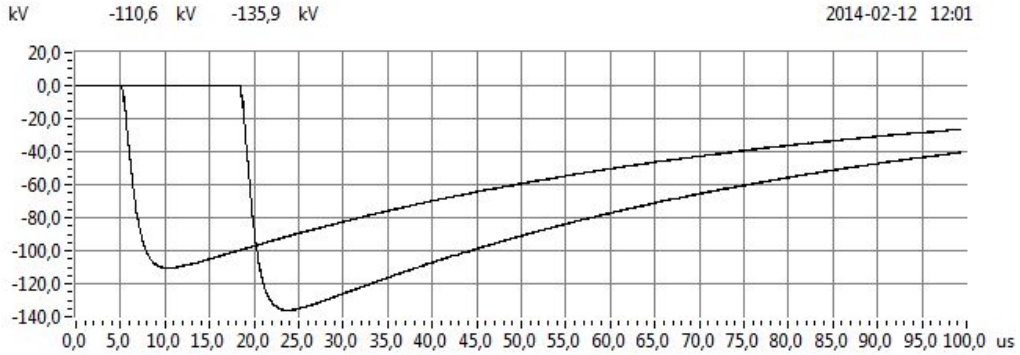


Fig. 6: 72121987 -65% and -80% FKN DOOEL

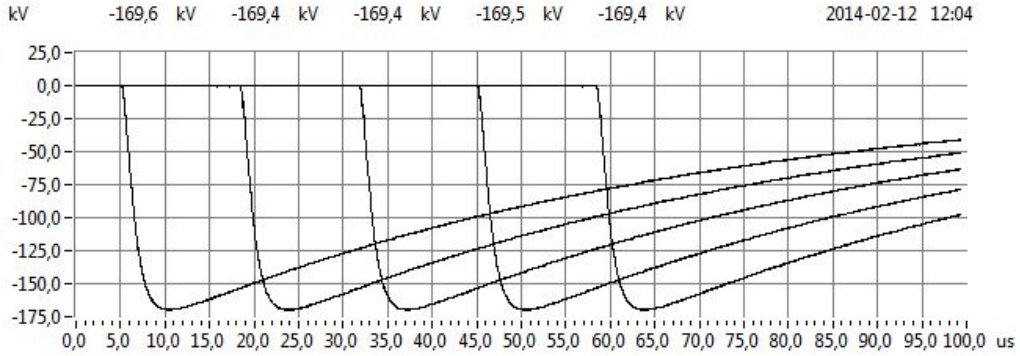


Fig. 7: 72121987 -100% FKN DOOEL

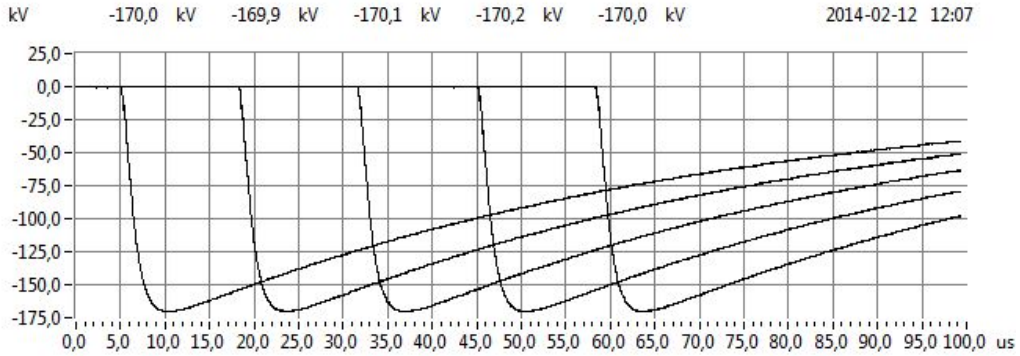


Fig. 8: 72121987 -100% FKN DOOEL

3.8 Voltage test for 15 min

Standard and date

Standard IEC 60502-2, Subclause 18.1.7

Test date 14 February 2014

Environmental conditions

Ambient temperature 21 °C

Characteristic test data

Temperature of test object 21 °C

Testing arrangement		Voltage applied, 50 Hz		Duration
Voltage applied to	Earth connected to	… x U_0	(kV)	(min)
Conductor	Metal screen	3,5	63	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 18.1.8

Test date 14 February 2014

Environmental conditions

Ambient temperature 21 °C

Characteristic test data

Temperature of test object 21 °C

Testing arrangement		Voltage applied, 50 Hz		Duration
Voltage applied to	Earth connected to	… x U_0	(kV)	(h)
Conductor	Metal screen	4	72	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 18.1.9

Test dates 24 January to 17 February 2014

Characteristic test data

Temperature during ageing 100 °C

Duration 7 d

Resistivity measured at 90 ± 2 °C

Item	Unit	Requirement	Measured/determined
Conductor screen			
– without ageing	Ωm	≤ 1000	23
– after ageing	Ωm	≤ 1000	44
Insulation screen			
– without ageing	Ωm	≤ 500	3
– after ageing	Ωm	≤ 500	3

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 20 February 2014

Item	Unit	Requirement	Specified	Measured/determined
Nominal	mm	-	8,0	-
Average	mm	-	-	8,336
Minimum [t_{min}]	mm	≥ 7,10	-	8,170
Maximum [t_{max}]	mm	-	-	8,462
(t_{max} – t_{min}) / t_{max}	-	≤ 0,15	-	0,03

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 20 February 2014

Oversheath thickness

Thickness	Unit	Requirement	Specified	Measured/determined
Nominal	mm	≥ 3,0	3,0	-
Average	mm	-	-	3,261
Minimum	mm	≥ 2,20	-	3,041

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 dates 5 February to 12 February 2014

Characteristic test data

Temperature during ageing 135 ± 3 °C

Ageing duration 7 d

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm^2	≥ 12,5	29,8
Elongation at break	%	≥ 200	574
After ageing in air oven			
Tensile strength			
– value after ageing	N/mm^2	-	32,6
– variation	%	± 25 max.	9
Elongation at break			
– value after ageing	%	-	654
– variation	%	± 25 max.	14

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 dates 5 February to 27 February 2014

Characteristic test data

Temperature during ageing 110 ± 2 °C

Ageing duration 10 d

Oversheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm^2	≥ 12,5	28,9
Elongation at break	%	≥ 300	999
After ageing in air oven			
Tensile strength			
– value after ageing	N/mm^2	-	27,9
– variation	%	-	-4
Elongation at break			
– value after ageing	%	≥ 300	918
– variation	%	-	-8

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 dates 24 January to 7 February 2014

Characteristic test data

Temperature during ageing 100 ± 2 °C

Ageing duration 7 d

Insulation

Item	Unit	Requirement	Measured/determined
Tensile strength			
– value after ageing	N/mm^2	-	26,9
– variation	%	± 25 max.	-10
Elongation at break			
– value after ageing	%	-	566
– variation	%	± 25 max.	-2

Oversheath

Item	Unit	Requirement	Measured/determined
Tensile strength			
– value after ageing	N/mm^2	-	34,0
– variation	%	-	17
Elongation at break			
– value after ageing	%	≥ 300	1080
– variation	%	-	8

Result

The object passed the test.

4.6 Pressure test at high temperature on insulation and non-metallic sheaths

Standard and date

Standard IEC 60502-2, Subclause 19.7

Test date 28 January 2014

Characteristic test data

Temperature 110 ± 2 °C

Heating time 6 h

Oversheath

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

Result

The object passed the test.

4.7 Hot set test for XLPE insulation

Standard and date

Standard IEC 60502-2, Subclause 19.11

Test date 30 January 2014

Characteristic test data

Air temperature 200 ± 3 °C

Time under load 15 min

Mechanical stress 20 N/cm^2

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

Result

The object passed the test.

4.8 Water absorption test on insulation

Standard and date

Standard IEC 60502-2, Subclause 19.13

Test dates 28 January to 17 February 2014

Characteristic test data

Temperature of water 85 ± 2 °C

Duration 336 h

Insulation XLPE

Item	Unit	Requirement	Measured/determined
Increase of mass	mg/cm^2	≤ 1,00	0,01

Result

The object passed the test.

4.9 Measurement of carbon black content of black PE oversheaths

Standard and date

Standard IEC 60502-2, Subclause 19.15

Test date 28 January 2014

Item	Unit	Requirement	Measured/determined
Carbon black content	%	2,5 ± 0,5	2,50

Result

The object passed the test.

4.10 Shrinkage test for XLPE insulation

Standard and date

Standard IEC 60502-2, Subclause 19.16

Test date 27 January 2014

Characteristic test data

Temperature 130 ± 3 °C

Duration 1 h

Insulation XLPE

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

Result

The object passed the test.

4.11 Shrinkage test for PE oversheaths

Standard and date

Standard IEC 60502-2, Subclause 19.20

Test date 27 to 31 January 2014

Characteristic test data

Temperature 80 ± 2 °C

Duration 5 h

Heating cycles 5

Item	Unit	Requirement	Measured/determined
Shrinkage	%	≤ 3	0,9

Result

The object passed the test.

4.12 Water penetration test

Standard and date

Standard IEC 60502-2, Subclause 19.22

Test dates 30 January to 3 February 2014

Environmental conditions

Ambient temperature 21 °C

Characteristic test data

Length of cable sample 3 m

Water height above cable centre 1 m

Heating method conductor current

No. of heating cycles	Required steady conductor temperature (°C)	Heating current during steady condition (A)	Heating		Cooling
			Total duration (h)	Duration of conductor at steady temperature (h)	Total duration (h)
10	95 - 100	approx. 560	5	2	3

Item	Requirement	Measured/determined
Water penetration under sheath	No water shall emerge from the ends of the test piece during the period of testing	No water emerged from the ends

Note

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

Result

The object passed the test.

5 CHECK OF CABLE CONSTRUCTION

Standard and date

Standard IEC 60502-2, Clauses 5 to 14

Test dates 27 to 31 January 2014

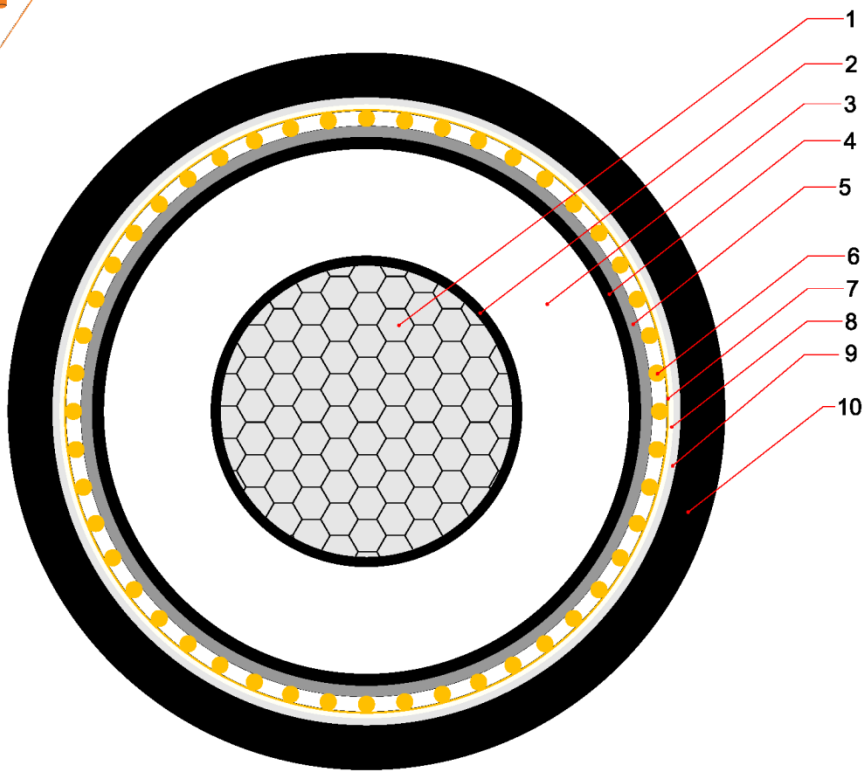
Item	Unit	Requirement	Specified	Measured/determined
Conductor				
Diameter of conductor (d)	mm	15,3≤ d ≤16,8	16,15	16,08
Number of wires	-	≥ 30	37	37
Diameter of wires	mm	-	-	2,53
Swelling yarns applied	-	-	no	no
Resistance at 20 °C	Ω/km	≤ 0,164	-	0,157
Conductor screen				
Diameter over conductor screen	mm	-	-	17,701
Thickness	mm	-	0,6	0,643
Insulation				
Thickness	mm	8,0	8,0	8,336
Insulation screen				
Diameter over insulation screen	mm	-	-	35,731
Thickness	mm	-	0,7	0,679
Semi-conducting swelling tape				
Thickness x width of tape	mm	-	0,52 x 60	0,18 x 59,95
Overlap	%	-	40	36
Metallic screen				
Number of Cu wires	-	-	48	48
Diameter of Cu wires	mm	-	0,8	0,84
Thickness x width of tape	mm	-	0,15 x 10	0,15 x 9,98
Non-conducting swelling tape				
Thickness x width of tape	mm	-	0,35 x 60	0,16 x 57,94
Overlap	%	-	40	can not be determined
Metal foil				
Thickness	mm	-	0,3	0,22
Overlap	mm	-	-	10,68
Oversheath				
Diameter over oversheath	mm	-	44,5	45,125
Thickness	mm	-	3	3,261
Colour	-	-	black	black
Marking on the cable	A2XS(FL)2Y 1x185RM/25 18/30kV FKN NEGOTINO 2013			

Result

The object passed the test.

6 DRAWINGS

DESIGN DRAWING
A2XS(FL)2Y 1x185RM/25 18/30kV



DESIGN DATA		
No.	DESCRIPTION	
1	Conductor: Stranded compacted circular aluminium	Ø16,15 mm
2	Conductor screen: Extruded semi-conducting layer	0,6 mm
3	Insulation: XLPE	8,0 mm
4	Insulation screen: Extruded semi-conducting layer(Bonded Type)	0,7 mm
5	Semi-conducting water blocking tape	0,52 mm
6	Metallic Screen: Helically applied copper wires	Ø8mm x 48
7	Open helix copper tape	0,15 mm
8	Non-conducting water blocking tape	0,35 mm
9	Aluminium copolymer tape	0,3 mm
10	Outer sheath: HDPE, Black	3,0 mm

Code: **2360300/13**

2360300

CABLE FACTORY FKN - NEGOTINO MACEDONIA

DATA SCHEDULE FOR M.V. CABLE **A2XS(FL)2Y 18/30 kV**

No	DESCRIPTION	UNIT	DETAILS
	Code name		2360300
I.	**SIZE CHARACTERISTIC**		**1x185RM/25**
	Standard		IEC 60502-2
1	***conductor***		
1.1	- material		Al
1.2	- cross section	sq.mm	185
1.3	- class (IEC 228)		II
1.4	- number of wires		37
1.5	- diameter *(appr.)*	mm	16,15
1.6	- netto weight of Al *(appr.)*	kg/km	505
2	***semi-conductive screen on conductor***		
2.1	- construction (design)		extruded semi-conductive layer
2.2	- thickness	mm	0,6
3	***insulation***		
3.1	- construction (design)		extruded XLPE layer
3.2	- thickness	mm	8
4	***semi-conductive screen on insulation***		
4.1	- construction (design)		extruded semi-conductive layer
4.2	- thickness	mm	0,7
5	***triple extrusion***		yes
6	***semi conductive swellable tape***		yes
6.1	- construction (design)		helicoidally wrapped
6.2	- width x thickness	mm x mm	60 x 0,52
7	***metallic screen***		
7.1	- number x diameter	n x ϕ	48 x 0.8
7.2	- nature of conduct helix		Cu
	- width x thickness	mm x mm	10 x 0.15
7.3	- cross section of wires/conduct helix	sq.mm	25
8	***non conductive swellable tape***		yes
8.1	- construction (design)		helicoidally wrapped
8.2	- width x thickness	mm x mm	60 x 0,35
9	***armour***		
7.1	- nature of the tape		**Al/Co** (Aluminium/ Copolimer)
7.2	- width x thickness (Al/Co)	mm x mm	135 x 0.3
7.3	- thickness of Al	mm	0,2
10	***outer sheath***		
10.1	- construction (design)		extruded HDPE sheath
10.2	- thickness	mm	3
10.3	- colour		black

11.12.2013

2360300

No	DESCRIPTION	UNIT	DETAILS
11	***method of tightness(applied materials)***		
11.1	- longitudinal		swellable tapes
11.2	- transversal		Al/Co tape + PE sheath
12	***overall diameter (appr.)***	mm	44,5
13	***weight of cable (appr.)***	kg/km	2085
14	***packing***		
14.1	- length	m	1000
14.2	- wooden drum		Nº 24
	- width x diameter	m x m	1.45 x 2.4
14.3	- total weight *(appr.)*	kg	2935
II.	**ELECTRICAL CHARACTERISTICS :**		
1	***impendance***		
1.1	- resistance of direct current at 20ºC	Ohm/km	0,164
1.2	- resistance of alternating current at 90ºC	Ohm/km	0,212
1.3	- self inductance,laying manner	mH/km	0,41
1.4	- self inductance,laying horizontally (7cm)	mH/km	0,63
1.5	- capacitance	microF/km	0,18
1.6	- capacitance current to earth	A/km	3,4
2	***current loading***		
2.1	- cable in earth(manner arrangement)	A	364
	- cable in earth(horizontal arrangement)	A	399
	- soil resistance 100ºC		
	- soil temperature 20ºC		
	- laying depth 0.7m		
2.2	- cable in air , manner (30ºC)	A	421
	- cable in air , horizontally (30ºC)	A	492
3	***max. permitted temp. of conductor***	ºC	250
4	***max. working temperature***	ºC	90
5	***max. permitted working voltage***	kV	36
6	***testing voltage (50 Hz, 5min)***	kV	72
7	***admissible short- circuit current***		
7.1	- in conductor		
	duration 1 sec	kA	17,1
7.2	- in metallic screen		
	duration 1 sec	kA	5,1

FKN SI ISO 9001 Q-054 ISO 14001 E-416 ISO 18001 H-068

Verified by:
el.eng. Gjorgji Kocev

Constructed by :
el. eng. Metodija Kamchev

FABRIKA ZA KABLI FKN DOOEL NEGOTINO

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%