DNV·GL

KEMA TEST REPORT

1186-18

Object	Single-core power cable
Type	U_0 = 12 kV 1x240 mm^2 XLPE CABLE 12/20 (24) kV – 1x240 mm^2 – Cu – XLPE - LSHOF
Client	Metal Cable Co., No. 41, Hosseini Rad Alley, Motahari Coner, Valiasr Ave. 1595814613 Tehran, Iran
Manufacturer	Metal Cable Co., No. 41, Hosseini Rad Alley, Motahari Coner, Valiasr Ave. 1595814613 Tehran, Iran *)
Tested by	DNV GL Netherlands B.V., Arnhem, the Netherlands
Date of tests	13 March to 26 May 2018
Test specification	The tests have been carried out in accordance with client's instructions. Test procedure and test parameters were based on IEC 60502-1:2004+AMD1:2009 and IEC 60502-2:2014.
Summary and conclusion	See chapter 1 for test specifications and results.

This report 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 report consists of 42 pages in total.

DNV GL Netherlands B.V.

J.P. Fonteijne
Executive Vice President
KEMA Laboratories

KEMA Laboratories

Arnhem, 27 August 2018

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.

TABLE OF CONTENTS

1 TEST SPECIFICATIONS AND RESULTS

According the client's instruction the following tests have been performed.

Test	Specification	Clause	Deviation	Test result
Determination of the cable conductor temperature	IEC 60502-2	15.4	-	passed
Bending test	IEC 60502-2	18.2.4	-	passed
Partial discharge test	IEC 60502-2	18.2.5	-	passed
Tan δ measurement	IEC 60502-2	18.2.6	-	passed
Heating cycle test	IEC 60502-2	18.2.7	-	passed
Partial discharge test	IEC 60502-2	18.2.5	-	passed
Impulse test	IEC 60502-2	18.2.8	-	passed
Voltage test for 15 min	IEC 60502-2	18.2.8	-	passed
Voltage test for 4 h	IEC 60502-2	18.2.9	-	passed
Resistivity of semi-conducting screens	IEC 60502-2	18.2.10	-	passed
Measurement of thickness of insulation	IEC 60502-2	19.2	-	passed
Measurement of thickness of non-metal sheaths (including extruded separation sheaths, but excluding inner coverings)	IEC 60502-2	19.3	-	passed
Tests for determining the mechanical properties of insulation before and after ageing	IEC 60502-2	19.5	-	passed
Additional ageing test on pieces of completed cable	IEC 60502-2	19.7	-	passed
Additional ageing test on pieces of completed cable	IEC 60502-1	18.5	-	passed
Test on PVC insulation and sheaths at low temperature	IEC 60502-1	18.8	-	passed
Hot set test for XLPE insulation and elastomeric sheaths	IEC 60502-2	19.13	-	passed
Water absorption test on insulation	IEC 60502-2	19.15	-	passed
Flame spread on single cable	IEC 60502-2	19.16	-	passed
Shrinkage test for XLPE insulation	IEC 60502-2	19.18	-	passed
Check of cable construction	IEC 60502-2	5-14	-	passed
Water absorption test on oversheath	IEC 60502-1	18.13	-	passed
Pressure test at high temperature on insulation and non-metal sheaths	IEC 60502-1	18.7	-	passed
Flame spread test on bunched cables	IEC 60332-3-24	Category C	-	passed
Smoke emission test	IEC 61034-2	-	-	passed
Tests for determining the mechanical properties of non-metal sheaths before and after ageing	IEC 60502-1	18.4	-	passed
Acid gas emission test	IEC 60754-1	-	-	passed
pH and conductivity test	IEC 60754-2	-	-	passed
Fluorine content test	IEC 60684-2	-	-	passed

2 IDENTIFICATION OF THE OBJECT TESTED

2.1 Ratings/characteristics of the object tested

Rated voltage, U_0/U (U_m)	12/20 (24) kV
Rated maximum conductor temperature in normal operation	90 °C
Rated conductor cross-section	240 mm^2

2.2 Description of the object tested

Standard	IEC 60502-2, Clause 5-14
Manufacturer	Metal Cable Co., Saveh, Iran
Type	U_0 = 12 kV 1x240 mm^2 XLPE CABLE
Manufacturing year	2017
Quantity submitted	62 m
Rated voltage, U_0/U (U_m)	12/20 (24) kV
Nominal capacitance between conductor and metal screen	0,3 µF/km
No. of cores	1
Overall diameter	38,6 mm
Marking on the oversheath	Metal Cable CO. IEC 60502-2 CU/SC/XLPE/SC/SCT/(CWS+CTS)/LSFOH(N2XSH) 1*240/25 SQMM 12/20(24)KV MADE IN IRAN 164-2 2017

Conductor

• material	copper
• cross-section	240 mm^2
• nominal diameter	18,4 mm
• type	compacted
• maximum conductor temperature in normal operation	90 °C
• presence and nature of measures to achieve longitudinal watertightness	no
• swelling material	known in KEMA Laboratories' files
• manufacturer of the material	known in KEMA Laboratories' files

Conductor screen

• material	semi-conducting PE
• nominal thickness	0,7 mm
• material designation	known in KEMA Laboratories' files
• manufacturer of the material	known in KEMA Laboratories' files

Insulation

• material	XLPE
• nominal thickness	5,5 mm
• nominal inner diameter of the insulation	20 mm
• nominal outer diameter of the insulation	31 mm
• material designation	known in KEMA Laboratories' files
• manufacturer of the material	known in KEMA Laboratories' files

Insulation (core) screen

• material	semi-conduction PE
• strippable	no
• nominal thickness	0,5 mm
• material designation	known in KEMA Laboratories' files
• manufacturer of the material	known in KEMA Laboratories' files

Metal screen

• material	copper wires, 1 layer tape
• number of wires/tapes	43 wires and 1 tape
• thickness and width of binder tapes	0,1 x 10 mm (gap 135 mm)
• nominal diameter of wires	0,86 mm
• cross-sectional area	25 mm^2

Oversheath

• material	halogen free type ST_8
• nominal thickness	2,2 mm
• nominal overall diameter of the cable (D)	38,6 mm
• material designation	known in KEMA Laboratories' files
• manufacturer of the material	known in KEMA Laboratories' files
• colour	red
• graphite coating applied	no

Fire retardant (according to IEC 60332-1) yes

Manufacturing details insulation system

• location of manufacturing	Saveh, Iran
• type of extrusion line	CCV
• type of extrusion	triple common extrusion
• factory identification of extrusion line	Maillefer
• manufacturer of the extrusion line	known in KEMA Laboratories' files
• identification of production batch	WC505406-021 2016-08-15
• curing means	N_2
• cooling means	water
• manufacturing length (where cable sample for testing has been taken from)	500 m
• length markings on cable sample sent to KEMA Laboratories	begin: 371 m, end: 433 m

2.3 List of drawings

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

Drawing no./document no.	Revision
MC – 18641	3 May 2017

3 GENERAL INFORMATION

3.1 The tests were witnessed by

The tests were carried out without a representative of the client present.

3.2 The tests were carried out by

Name	Company
J. Mooren	DNV GL Netherlands B.V.,
I. Chatzis	Arnhem, the Netherlands

3.3 Subcontracting

The following tests were subcontracted to DNV GL / Energy Advisory, MTL Laboratory:

- measurement of resistivity of semi-conducting screens in accordance with subclause 18.2.10.
- non-electrical type tests in accordance with clause 19.
- check of cable construction in accordance with clauses 5 to 14.

The following tests were subcontracted to BRE Global Ltd., Watford, Herts, United Kingdom.

- measurement of smoke emission in accordance with IEC 61034-2
- measurement of flame propagation on multiple cables in accordance with IEC 60332-3-24.

The following tests were subcontracted to ISQ-LABQUI, Portugal

- measurement of pH and conductivity test in accordance with IEC 60754-2
- measurement of acid gas emission test in accordance with IEC 60754-1
- measurement of fluorine test in accordance with IEC 60684-2.

3.4 Purpose of the tests

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

3.5 Measurement uncertainty

A table with measurement uncertainties is enclosed in this report. Unless otherwise stated, the measurement uncertainties of the results presented in this report are as indicated in that table.

4 ELECTRICAL TYPE TESTS

4.1 Test arrangement

4.1.1 Determination of the cable conductor temperature

Standard

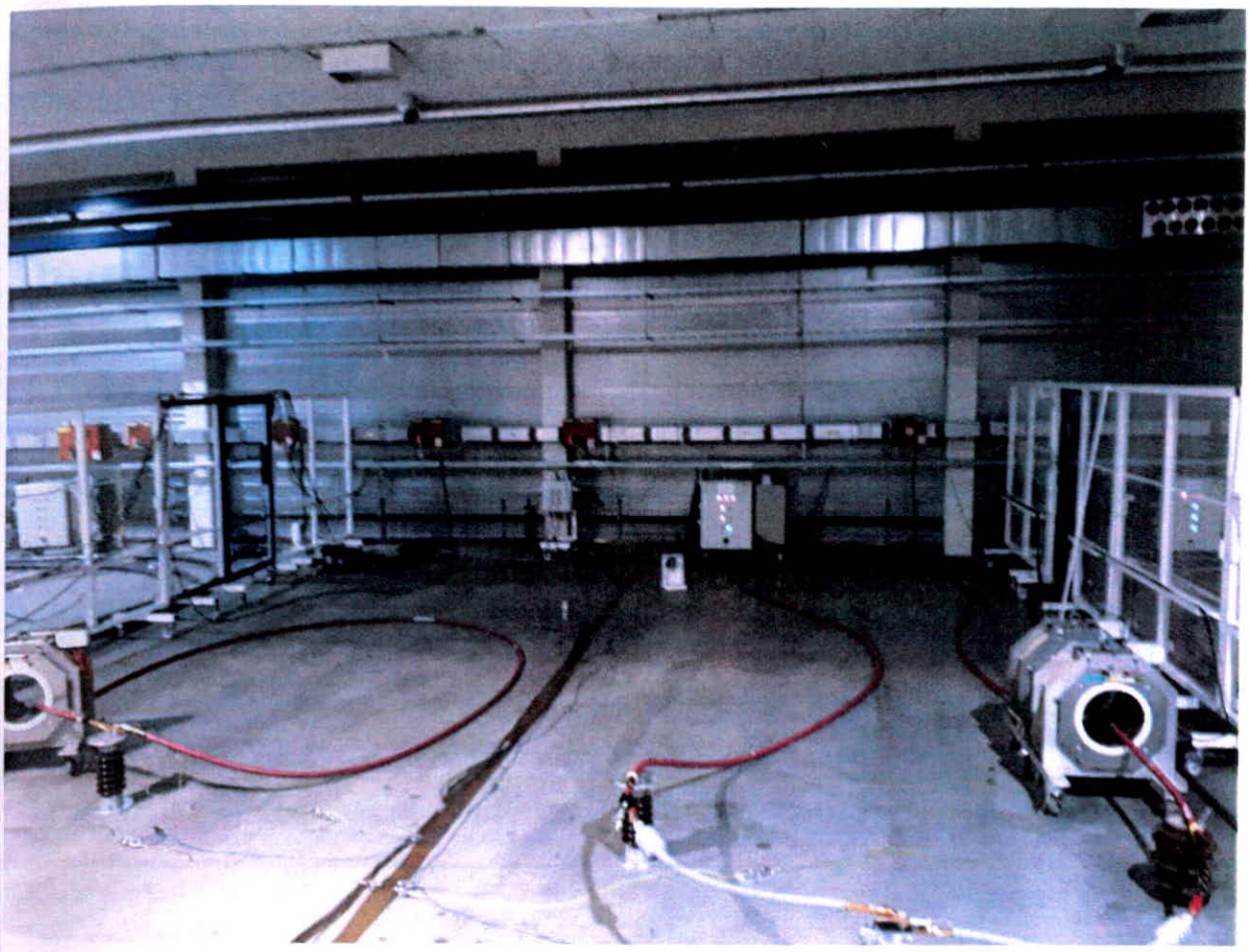
Standard IEC 60502-2, subclause 15.4

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. 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. 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.

4.1.2 Photograph of test set-up



4.2 Bending test

Standard and date

Standard IEC 60502-2, subclause 18.2.4
Test date 13 March 2018

Environmental conditions

Ambient temperature 6 °C

Characteristic test data

Temperature of test object 25 °C
Maximum bending diameter 20(d + D) + 5%
Length of cable bended 62 m
Length marking of cable bended 371 - 432

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
39,0	18,4	1205	1150

Result

The test was carried out successfully.

4.3 Partial discharge test

Standard and date

Standard	IEC 60502-2, subclause 18.2.5
Test date	21 March 2018

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	20 °C
Circuit	direct
Calibration	10 pC
Noise level at 1,73 U_0	2,0 pC
Declared sensitivity	3 pC
Required sensitivity	≤ 5 pC
Centre frequency	315 kHz
Bandwidth (Δf)	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	24	10	-
	1,73	20,8	-	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.

4.4 Tan δ measurement

Standard and date

Standard	IEC 60502-2, subclause 18.2.6
Test date	22 March 2018

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	97 °C
Length of test object	18,30 m
Standard capacitor	99,88 pF

Core	Voltage applied, 50 Hz kV	Capacitance of core [1] µF/km	Tan δ
1	5	0,273	$7,6 \times 10^{-4}$
[1] for information only			

Requirement

The measured value shall not be higher than $40 \times 10^{-4} \geq 2$ kV.

Result

The object passed the test.

4.5 Heating cycle test

Standard and date

Standard IEC 60502-2, subclause 18.2.7
Test date 23 to 30 March 2018

Environmental conditions

Ambient temperature 20 °C

Characteristic test data

Heating method conductor current
Stabilized temperature 97 °C

No. of heating cycles	Required steady conductor temperature	Heating current during steady condition	Heating cycle		
			Heating		Cooling
			Total duration	Duration of conductor at steady temperature	Total duration
	°C	A	h	h	h
20	95 - 100	approx. 889	8	2	3

Requirement

The test shall be carried out successfully.

Result

The object passed the test.

4.6 Partial discharge test

Standard and date

Standard	IEC 60502-2, subclause 18.2.5
Test date	30 March 2018

Environmental conditions

Ambient temperature	20 °C

Characteristic test data

Temperature of test object	20 °C
Circuit	direct
Calibration	10 pC
Noise level at 1,73 U_0	2,5 pC
Declared sensitivity	5 pC
Required sensitivity	≤ 5 pC
Centre frequency	100 kHz
Bandwidth (Δf)	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	24	10	-
	1,73	20,8	-	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.

4.7 Impulse test

Standard and date

Standard IEC 60502-2, subclause 18.2.8
Test date 3 April 2018

Environmental conditions

Ambient temperature 20 °C

Characteristic test data

Temperature of test object 97 °C
Specified test voltage 125 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

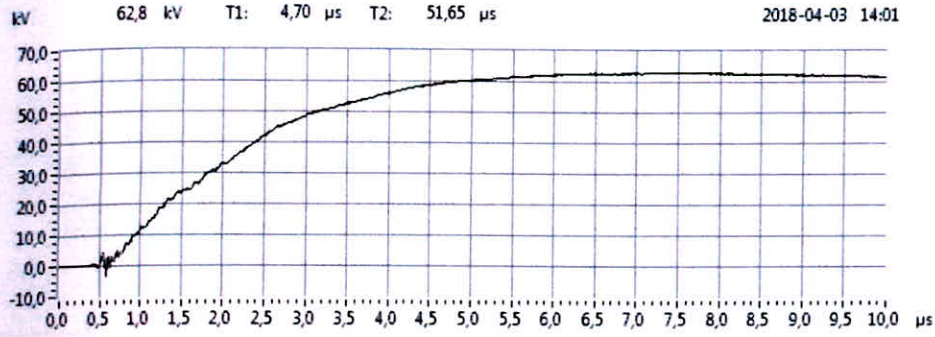


Fig. 1: Waveshape 72127508 Metal cable 50% of test voltage

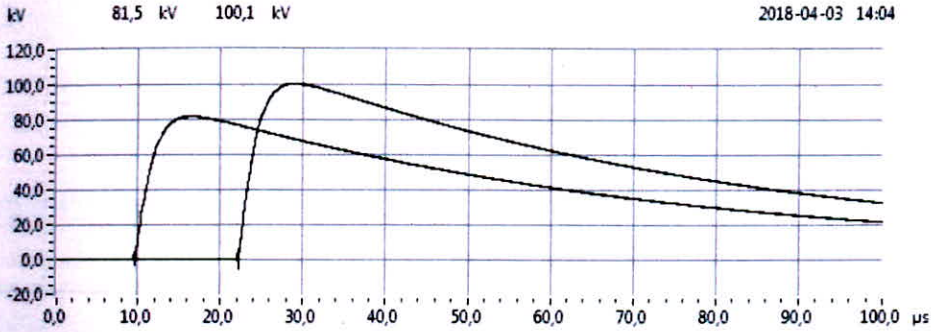


Fig. 2: 72127508 Metal cable 65% and 80% of test voltage

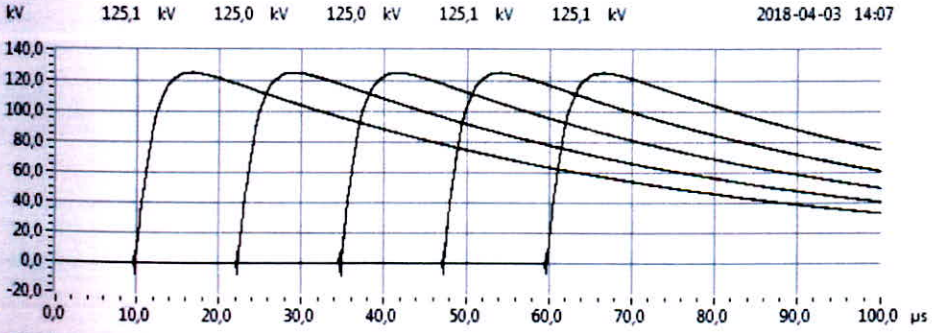


Fig. 3: 72127508 Metal cable 100% of test voltage

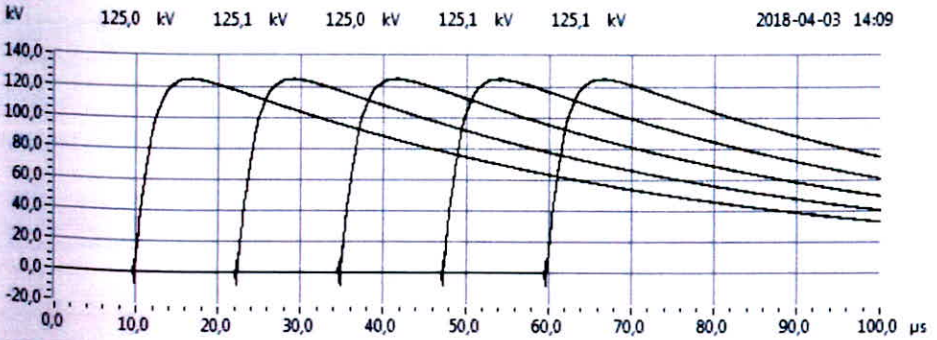


Fig. 4: 72127508 Metal cable 100% of test voltage

Lightning impulse test with negative voltage

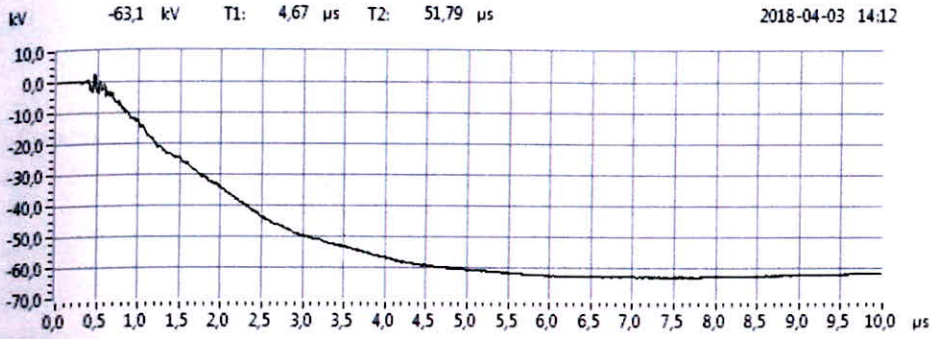


Fig. 5: Waveshape 72127508 Metal cable -50% of test voltage

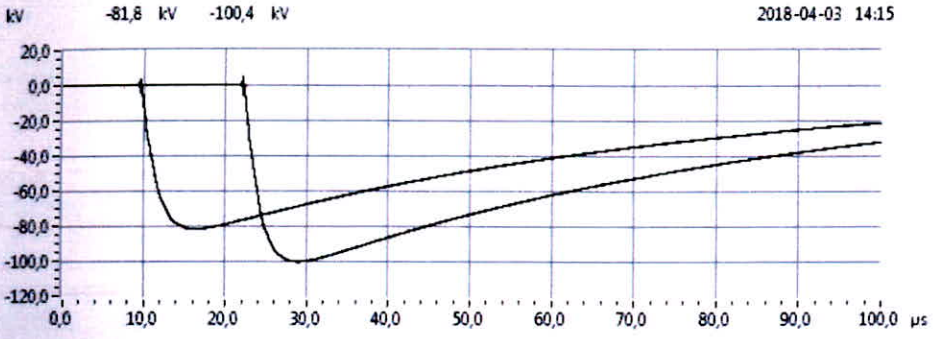


Fig. 6: 72127508 Metal cable -65% and -80% of test voltage

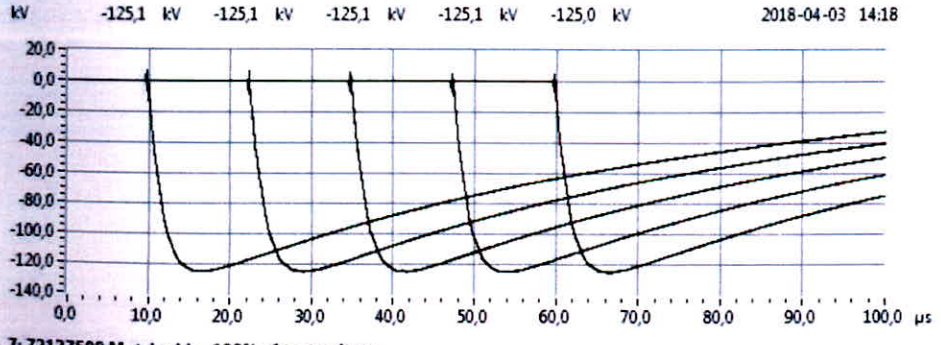


Fig. 7: 72127508 Metal cable -100% of test voltage

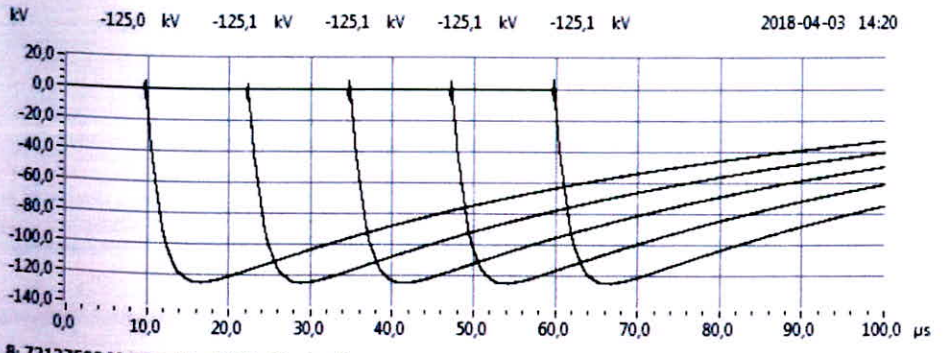


Fig. 8: 72127508 Metal cable -100% of test voltage

4.8 Voltage test for 15 min

Standard and date

Standard IEC 60502-2, subclause 18.2.8
Test date 4 April 2018

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
Conductor	Metal screen	3,5	42	15

Requirement

No breakdown of the insulation shall occur.

Result

The object passed the test.

4.9 Voltage test for 4 h

Standard and date

Standard IEC 60502-2, subclause 18.2.9
Test date 4 April 2018

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
Conductor	Metal screen	4	48	4

Requirement

No breakdown of the insulation shall occur.

Result

The object passed the test.

4.10 Resistivity of semi-conducting screens

Standard and date

Standard IEC 60502-2, subclause 18.2.10
Test date 26 April 2018

Characteristic test data

Temperature during ageing 100 °C
Duration 7 x 24 h (14 to 21 March 2018)
Resistivity measured at 90 ± 2 °C

Item	Unit	Requirement	Measured/determined
Conductor screen			
• without ageing	Ωm	≤ 1000	34
• after ageing	Ωm	≤ 1000	37
Insulation screen			
• without ageing	Ωm	≤ 500	1
• after ageing	Ωm	≤ 500	1

Result

The object passed the test.

5 NON-ELECTRICAL TYPE TESTS

5.1 Measurement of thickness of insulation

Standard and date

Standard IEC 60502-2, subclause 19.2

Test date 15 March 2018

Item	Unit	Requirement	Specified	Measured/determined
Nominal	mm	-	5,5	-
Average	mm	-	-	5,49
Minimum [t_{min}]	mm	≥ 4,85	-	5,27
Maximum [t_{max}]	mm	-	-	5,61
(t_{max} – t_{min}) / t_{max}	-	≤ 0,15	-	0,06

Result

The object passed the test.

5.2 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 15 March 2018

Oversheath

Item	Unit	Requirement	Specified	Measured/determined
Nominal	mm	≥ 1,4	2,2	-
Average	mm	-	-	2,30
Minimum	mm	≥ 1,56	-	2,13

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 60502-2, subclause 19.5
Test date 13 April 2018

Characteristic test data

Temperature during ageing 135 ± 3 °C
Ageing duration 7 x 24 h (20 to 27 March 2018)

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm²	≥ 12,5	35,0
Elongation at break	%	≥ 200	627
After ageing in air oven			
Tensile strength			
value after ageing	N/mm²	-	33,7
variation	%	± 25 max.	-4
Elongation at break			
value after ageing	%	-	643
variation	%	± 25 max.	3

Result

The object passed the test.

5.4 Additional ageing test on pieces of completed cable

Standard and date

Standard IEC 60502-2, subclause 19.7
IEC 60502-1, subclause 18.5
Test date 16 April 2018

Characteristic test data

Temperature during ageing 100 ± 2 °C
Ageing duration 7 x 24 h (14 to 21 March 2018)

Insulation

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm²	≥ 12,5	33,7
Elongation at break	%	≥ 200	643
After ageing in air oven			
Tensile strength			
value after ageing	N/mm²	-	31,8
variation	%	± 25 max.	-5
Elongation at break			
value after ageing	%	-	635
variation	%	± 25 max.	-1

Oversheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm²	≥ 9,0	11,6
Elongation at break	%	≥ 125	147
After ageing in air oven			
Tensile strength			
value after ageing	N/mm²	≥ 9,0	12,3
variation	%	± 40 max.	6
Elongation at break			
value after ageing	%	≥ 100	165
variation	%	± 40 max.	12

Result

The object passed the test.

5.5 Test on PVC insulation and sheaths at low temperature

Standard and date

Standard	IEC 60502-1, subclause 18.8
Test date	26 April 2018

Characteristic test data

Temperature	-15 ± 2 °C
Cooling time	≥ 16 h
Mass of hammer	1000 g

Oversheath

Item	Unit	Requirement	Measured/determined
Cold elongation test	%	≥ 20	55
Cold impact test	-	No cracks	No cracks

Result

The object passed the test.

5.6 Hot set test for XLPE insulation and elastomeric sheaths

Standard and date

Standard	IEC 60502-2, subclause 19.13
Test date	20 March 2018

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
Elongation under load	%	≤ 175	71
Permanent elongation after cooling	%	≤ 15	-4

Result

The object passed the test.

5.7 Water absorption test on insulation

Standard and date

Standard IEC 60502-2, subclause 19.15
Test date 9 April 2018

Characteristic test data

Temperature of water 85 ± 2 °C
Duration 14 x 24 h (23 March to 6 April 2018)
Test method Gravimetric

Insulation

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

Result

The object passed the test.

5.8 Flame spread on single cable

Standard and date

Standard IEC 60502-2, subclause 19.16
Test date 13 April 2018

Characteristic test data

Overall diameter of test piece 39 mm
Time for flame application 120 s
Flame type 1 kW pre-mixed flame

Complete cable	Unit	Requirement	Measured/determined
The distance between the lower edge of the top support and the onset of charring	mm	≥ 50	406
The distance between the lower edge of the top support and charring extends downwards to a point	mm	≤ 540	502

Result

The object passed the test.

5.9 Shrinkage test for XLPE insulation

Standard and date

Standard IEC 60502-2, subclause 19.18
Test date 30 March 2018

Characteristic test data

Distance L between marks 200 mm
Temperature 130 ± 3 °C
Duration 1 h

Insulation

Item	Unit	Requirement	Measured/determined
Shrinkage	%	≤ 4	0,6

Result

The object passed the test.

6 CHECK OF CABLE CONSTRUCTION

Standard and date

Standard IEC 60502-2, clause 5-14

Test date 15 March 2018

Item	Unit	Requirement	Specified	Measured/determined
Conductor				
Diameter of conductor (d)	mm	17,6≤d≤19,2 [1)]	18,4 (nom.)	19,04
Number of wires	-	≥ 34	37	37
Diameter of wires	mm	-	3,02	2,98 (after compacting)
Swelling yarns applied	-	-	-	no
Resistance at 20 °C	Ω/km	≤ 0,0754	-	0,0747
Conductor screen				
Diameter over conductor screen	mm	-	20	19,73
Thickness	mm	-	0,7 (nom.)	0,66
Insulation				
Diameter over insulation	mm	-	31	30,80
Thickness	mm	≤ 4,85	5,5 (nom.)	5,49
Insulation screen				
Diameter over insulation screen	mm	-	-	31,69
Thickness	mm	-	0,5 (nom.)	0,41
Semi-conducting tape				
Thickness x width of tape	mm	-	-	0,10 x 50
Overlap	%	-	-	20
Metal screen				
Number of Cu wires	-	-	43	43
Diameter of Cu wires	mm	-	0,86	0,83
Thickness x width of tape	mm	-	0,1 x 10	0,101 x 10,3
PP Tape				
Thickness x width of tape	mm	-	-	0,035 x 50
Overlap	%	-	-	14
Oversheath				
Diameter over layer	mm	-	38,6	38,66
Average thickness	mm	-	2,2 (nom.)	2,30
Minimum thickness	mm	≤ 1,56	-	2,13
Colour	-	-	red	red
Marking on the cable	Metal Cable CO. IEC 60502-2 CU/SC/XLPE/SC/SCT/(CWS+CT)/LSFOH(N2XSH) 1x240/25 SQMM 12/20(24)KV MADE IN IRAN 164-2 2017			

[1)] Dimensional limits do not have the status of a requirement but as a guideline only

Result

The object passed the test. The object has ST8 sheath, which is not covered by IEC 60502-2.

7 ADDITIONAL TESTS

7.1 Water absorption test on oversheath

Standard and date

Standard IEC 60502-1, subclause 18.13
Test date 30 March 2018

Characteristic test data

Temperature of water 70 ± 2 °C
Duration 24 h (27 March 2018)
Test methode Gravimetric

Oversheath

Item	Unit	Requirement	Measured/determined
Increase of mass	mg/cm^2	10	0,9

Result

The object passed the test.

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

Standard and date

Standard	IEC 60502-1, subclause 18.7
Test date	5 April 2018

Characteristic test data

Temperature	80 ± 2 °C
Heating time	6 h
Mandrell diameter	34 mm
Load	9 N

Oversheath

Item	Unit	Requirement	Measured/determined
Depth of indentation	%	≤ 50	26

Result

The object passed the test.

7.3 Flame spread test on bunched cables

Standard and date

Standard IEC 60332-3-24, Category C
Test date 10 April 2018

Characteristic test data

Flame application time 20 min
Number of burners 1

Item	Unit	Requirement	Calculated/measured
Total volume of non-metallic materials	l/m	1,5	0,83
Number of test pieces	-	≥ 2	2
Number of layers	-	≥ 1	1
Time to extinction of all burning or glowing	min	≤ 60	48
Extent of damage	m	≤ 2,5	0,55

Result

The object passed the test.

7.4 Smoke emission test

Standard and date

Standard IEC 61034-2
Test date 10 April 2018

Characteristic test data

Number of cables 2

Item	Unit	Requirement	measured
Light transmittance	%	≥ 60	74,7

Result

The object passed the test.

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

Standard and date

Standard IEC 60502-1, subclause 18.4
Test date 16 April 2018

Characteristic test data

Temperature during ageing 100 ± 2 °C
Ageing duration 7 x 24 h (23 to 30 March 2018)

Oversheath

Item	Unit	Requirement	Measured/determined
Without ageing			
Tensile strength	N/mm^2	≥ 9,0	11,6
Elongation at break	%	≥ 125	147
After ageing in air oven			
Tensile strength			
value after ageing	N/mm^2	≥ 9,0	12,0
variation	%	± 40 max.	4
Elongation at break			
value after ageing	%	≥ 100	173
variation	%	± 40 max.	17

Result

The object passed the test.

7.6 Acid gas emission test

Standard and date

Standard	IEC 60754-1
Test date	23 April to 8 May 2018

Amount of halogen acid gas

HCl content of ..	Unit	Requirement	measured
Semi conductive tape	%	≤ 0,5	< 0,02
Semi conductive screens (mixed)	%	≤ 0,5	< 0,02
Insulation	%	≤ 0,5	< 0,02
PP tape	%	≤ 0,5	< 0,02
Oversheath	%	≤ 0,5	< 0,02

Remarks

- No requirements for conformity are included in IEC 60754-1. Requirements taken from IEC 60502-1 table 23.
- 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.

7.7 pH and conductivity test

Standard and date

Standard IEC 60754-2
Test date 23 April to 8 May 2018

pH test

pH value of ..	Unit	Requirement	measured
Semi conductive tape	%	≥ 4,3	5,1
Semi conductive screens (mixed)	%	≥ 4,3	4,6
Insulation	%	≥ 4,3	5,3
PP tape	%	≥ 4,3	4,9
Oversheath	%	≥ 4,3	5,6

Conductivity test

Conductivity of ..	Unit	Requirement	measured
Semi conductive tape	µS/mm	≤ 10	0,8
Semi conductive screens (mixed)	µS/mm	≤ 10	1,5
Insulation	µS/mm	≤ 10	0,5
PP tape	µS/mm	≤ 10	0,6
Oversheath	µS/mm	≤ 10	0,7

Result

The object passed the test.

7.8 Fluorine content test

Standard and date

Standard IEC 60684-2

Test date 23 April to 8 May 2018

Amount of fluorine

Fluorine content of ..	Unit	Requirement	Calculated/measured
Semi conductive tape	%	≤ 0,1	< 0,01
Semi conductive screens (mixed)	%	≤ 0,1	< 0,01
Insulation	%	≤ 0,1	< 0,01
PP tape	%	≤ 0,1	< 0,01
Oversheath	%	≤ 0,1	< 0,01

Result

The object passed the test.

8 DATA SHEET

METAL CABLE CO.			
DATA SHEET			
No.: MC – 18641			Date : 3 May 2017
Medium voltage cable			Acc. IEC 60502-2 , IEC 60332-1 , 12/20(24) KV
CU / SC / XLPE / SC / SCT / (CWS+CT) / LSFOH Cable code : N2XSH			
R	*SPECIFICATION*		
1	Cable size		1x240 / 25 mm^2
2	Conductor	material	Plain annealed copper
		Class	2 , compacted round
		construction	37x3.02 mm
		Conductor dia.	18.5 mm
3	Conductor screen	material	Semi-conductive
		thickness	0.7 mm
4	Insulation	material	XLPE
		Operation temp.	90°C
		thickness	5.5 mm
		colour	Natural
5	Insulation screen	material	Semi-conductive
		thickness	0.5 mm
6	Metallic screen	material	Semi conductive tape + copper wire + copper tape
		Cross-section	25 mm^2
7	Core wrap	material	PP tape
8	Outer jacket	material	LSFOH
		Operation temp.	90°C
		thickness	2.2 mm
		colour	Red
9	Overall diameter approx.		39.0 mm
10	Cable weight approx.		3260 kg/km
11	Cable length (per drum)		1000 m
12	Max. dc conductor resistance at 20°C		0.0754 Ω/km acc. IEC 60228
13	Max. ac conductor resistance at 90°C		0.0965 Ω/km
14	Partial discharge at 21 kv		5 PC
15	Current rating in air 30 °C (flat touching)		647 A
16	Current rating in ground at 20 °C (flat spaced)		470 A
17	Short circuit current (conductor)		34.3 kA at 1 second
18	High voltage test		42.0 kvac for 5 min
19	Capacitance		0.30 µF/km
20	Inductance (tri-foil formation)		0.36 mH/km
21	Flame retardant test		Acc. IEC 60332-1
22	Flame retardant test		Acc. IEC 60332-3
23	Smoke density test		Acc. IEC 61034
24	Halogen free test		Acc. IEC 60754-2
25	Min. bending radius		590 mm
Marking : METAL CABLE CO. IEC 60502-2 N2XSH 1x240/25 RM 12/20 KV MADE IN IRAN 2017			

Technical approval

9 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%