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EGU HV LABORATORY

Accredited testing laboratory No.: 1029
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L 1029

TEST REPORT No.: 11788/X/21

CUSTOMER:	Jiangsu Shemar Electric Co., Ltd. 66 Haiwei Road 226 017 Nantong, Jiangsu China
TEST OBJECT:	138 kV Composite insulator
TYPE SPECIFICATION:	SML 222 kN
TEST STANDARDS:	CSA C411.4-16, CSA C411.1-16, IEC 60060-1 Ed. 3.0:2010

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TEST REPORT	No.: 11788/X/21
TEST OBJECT:	138 kV Composite insulator
TYPE SPECIFICATION:	SML 222 kN
DRAWING No.:	21SM510756 Rev. B
MANUFACTURER:	Jiangsu Shemar Electric Co., Ltd.
DATE OF DELIVERY:	2021-12-09
DATE OF TESTS:	From 2022-01-03 till 2022-04-01
ORDER No.:	Contract 23/21
TESTS WITNESSED BY:	N/A
ANNEX	Test report SYNPO, No. T 375/006 Test report Testpolymer EU, No. 59/2022/EN

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1 TEST SUMMARY

Test title	Test standard	Test result
Tests on the core material	CSA C411.4-16, clause 5.2	Passed
Dye penetration test	CSA C411.4-16, clause 5.2.2	Passed
Water diffusion test	CSA C411.4-16, clause 5.2.3	Passed
Water penetration test	CSA C411.4-16, clause 5.3	Passed
Visual inspection of test specimen	CSA C411.4-16, clause 5.3.1	Passed
Visual examination	CSA C411.4-16, clause 5.3.3.1	Passed
Hardness test	CSA C411.4-16, clause 5.3.3.2	Passed
Steep-front impulse voltage test	CSA C411.4-16, clause 5.3.3.3	Passed
Power-frequency voltage test	CSA C411.4-16, clause 5.3.3.4	Passed
Accelerated weathering test 1000h [3)] (see SYNPO test report T 375/006)	CSA C411.4-16, clause 5.4	Passed
Tensile load test	CSA C411.4-16, clause 5.6	Passed
Visual inspection of test specimen	CSA C411.4-16, clause 5.6.1	Passed
Thermal-mechanical test	CSA C411.4-16, clause 5.7	Passed
Visual inspection of test specimen	CSA C411.4-16, clause 5.7.1	Passed
Moisure penetration test	CSA C411.4-16, clause 5.7.3.2	Passed
Assembled core time-load test	CSA C411.4-16, clause 5.8	Passed
Visual inspection of test specimen	CSA C411.4-16, clause 5.8.1	Passed
Determination of the average failing load of the core	CSA C411.4-16, clause 5.8.2.2	Passed
Core time – load test	CSA C411.4-16, clause 5.8.2.3	Passed
Mechanical load-time test	CSA C411.4-16, clause 5.9	Passed
Visual inspection of test specimen	CSA C411.4-16, clause 5.9.1	Passed
Flammability test [3)] (see Testpolymer EU test report 59/2022/EN)	CSA C411.4-16, clause 5.10	Passed

Note:

[3)] The test was done in an external accredited laboratory.

Design tests are intended to verify the suitability of the design, materials and method of manufacture. A composite insulator design is defined by:

- shed material
- housing material
- shed design
- housing design
- core material
- core diameter
- manufacturing process
- metal fitting material
- metal fitting connection zone design
- metal fitting coupling design
- core-housing-metal fitting interface design
- metal fitting method of attachment to core

Composite insulator 138 kV / 222 kN drawing 21SM510756, Rev. B is parent insulator for given design, see CSA C411.4-16 clause 4 and Table 1.

Following insulators have same design:
161 kV / 222 kN, drawing No. 21SM510757, Rev. B (see Figure 2)
230 kV / 222 kN, drawing No. 21SM510758, Rev. B (see Figure 3)
345 kV / 222 kN, drawing No. 21SM510759, Rev. B (see Figure 4)
500 kV / 222 kN, drawing No. 21SM510760, Rev. B (see Figure 5)

2 TESTS PERFORMED

2.1 Tests of core material

The test was carried out according to CSA C411.4-16, clause 5.2.

2.1.1 Dye penetration test

Test date: 2022-01-03

The test was carried out according CSA C411.4-16, clause 5.2.2.

Test specimens

Ten test samples of core rod diameter Ø24 mm, 10 mm in length were prepared and delivered by customer.

Test procedure

Test specimens were placed (with fibres in vertical position) on a layer of glass balls (diameter 2 mm) in a glass vessel. A dye (1 % methyl alcohol solution of Astrazon BR 200) was poured into the vessel, with its level 2,5 mm above the glass balls, see Figure 3. The time taken for the dye to rise (by capillary action) through the specimens was measured.

Testing and measuring equipment:

digital stop-watch Olympia PM-172
slide gauge 150 mm, Kinex CZ, serial No. KN2038

Evaluation:

There were no traces of dye penetration through the insulator core recorded during 15 minutes.

Statement of conformity:

Core rod diameter Ø24 mm, passed the test according to requirements given in CSA C411.4-16, clause 5.2.2.

2.1.2 Water diffusion test

Test date: from 2022-01-03 till 2022-01-07.

The test was carried out according to CSA C411.4-16, clause 5.2.3.

Test specimens

Six test samples of core rod diameter Ø24 mm, 30 mm in length were prepared and delivered by customer.

Pre-stressing

The surfaces of the specimens were cleaned with isopropyl-alcohol and filter-paper immediately before the boiling. The specimens were boiled in a glass container for 100 hours in deionised water with 0,1 % by weight of NaCl.

After boiling, the specimens were removed from the glass container and placed in another glass container filled with tap water at ambient temperature for 15 minutes. The voltage test described in the following clause was carried out within the next three hours.

Voltage test

Immediately before the voltage test the specimens were removed from the glass container and their surfaces dried with filter paper.

Each specimen was placed between the test electrodes. The test voltage was increased at rate of approximately 1 kV/sec up to 12 kV, kept at this level for one minute and then decreased to zero, see Figures 4 and 5.

Testing and measuring equipment

voltage source HVI 30 kV, type HPA-305FC1, serial No. 006 + Analog panel meters model 553
slide gauge 150 mm, Kinex CZ, serial No. KN2038
Multimeter UT60E, serial No. 110055936 + shunt PM-160
Digital stop-watch Fastime, PM-251
Measuring cylinder, type 1000 ml, i.n. 2/044/11
Heating water vessel, type LTHS 4000, serial No. 18102
Weight Sartorius, type S210P, serial No. 39010002

Table 1 The results of the leakage current measurements

Specimen No.	Test voltage (kV)	Leakage current (µA)	Test duration (sec)	Result
1	12,0	30,2	60	passed
2	12,0	31,1	60	passed
3	12,0	30,4	60	passed
4	12,0	30,3	60	passed
5	12,0	30,0	60	passed
6	12,0	30,5	60	passed

Evaluation:

No puncture or external flashover occured. The leakage current did not exceed maximum allowable current of 1 mA (r.m.s.).

Statement of conformity:

Core rod diameter Ø24 mm, passed the test according to requirements given in CSA C411.4-16, clause 5.2.3.

2.2 Water penetration tests

The test was carried out according to CSA C411.4-16, clause 5.3.

2.2.1 Test specimens

Test was carried out according to CSA C411.4-16, clause 5.3.1. The test was performed on composite insulator samples No.: 1, 2, 3 and 4 REF.
No. 1, serial No. 2111150032,
No. 2, serial No. 2111150001,
No. 3, serial No. 2111150007.
No. 4 REF, serial No. 2111150024.

The insulators were examined visually and their dimensions were checked against the manufacturer's drawing (see Figure 1).

Testing and measuring equipment

tape measure 5 m, CXS, PM-241
slide gauge 300 mm, Kinex CZ, serial No.2441/05

Evaluation:

Insulators were without damage and dimensions conform to the drawing.

2.2.2 Test procedure and test results

Tests were carried out according to CSA C411.4-16, clause 5.3.2. The tests were performed on insulator samples No. 1, 2, 3.

2.2.2.1 Hardness test before boiling of the test samples

Test date: 2022-03-23

Tests were carried out according to CSA C411.4-16, clause 5.3.3.2.

The hardness of two sheds of each insulator was measured with a Shore A durometer. Measured values were recorded (see Table 2).

Testing and measuring equipment

durometer Shore A, serial No. 45609010
measuring system for atmospheric conditions Comet, serial No. 10910247

Table 2 Hardness before water immersion test

Sample No.	No. Sheds	Average value
1	shed No. 1	68,3
	shed No. 2	67,5
2	shed No. 1	69,3
	shed No. 2	69,5
3	shed No. 1	69,7
	shed No. 2	69,5
The temperature at the time of hardness measurement: 19,5 °C		

2.2.2.2 Water boiling test

Testing date: from 2022-03-23 till 2022-03-27

Three tested insulators No. 1, 2 and 3 were immersed for 100 hours boiling in tap water adjusted to a conductivity of 0,1 % by weight of NaCl. At the end of boiling, each insulator was allowed to remain in the water until the water cooled to 50 °C and maintained at this temperature until the verification tests started (see Figure 6).

Testing and measuring equipment

Heating water vessel AKV2, inventory No. 2420

2.2.2.3 Visual examination

Testing date: 2022-03-28

Tests were carried out according to CSA C411.4-16, clause 5.3.3.1.

Evaluation:

No cracks and no signs of crumbling or dissolving were observed.

2.2.2.4 Hardness test after boiling of test samples

Tests were carried out according to CSA C411.4-16, clause 5.3.3.2.

The hardness of two sheds of each insulator was measured with a Shore A durometer. Measured values were recorded (see Table 3).

Testing and measuring equipment:

durometer Shore A, serial No. 45609010
measuring system for atmospheric conditions Comet, serial No. 10910247

Table 3 Hardness after water immersion test

Sample No.	No. Sheds	Average value
1	shed No. 1	68,0
	shed No. 2	67,7
2	shed No. 1	69,1
	shed No. 2	69,3
3	shed No. 1	68,7
	shed No. 2	68,7
The temperature at the time of hardness measurement: 19,6 °C		

Evaluation:

The hardness of each specimen did not change from the pre-boiled value more than ±20%.

2.2.2.5 Steep-front impulse voltage test

Tests were carried out according to CSA C411.4-16, clause 5.3.3.3.

Atmospheric conditions:

air pressure	98,0 kPa
air temperature	16,1 °C
relative humidity	50,3 %

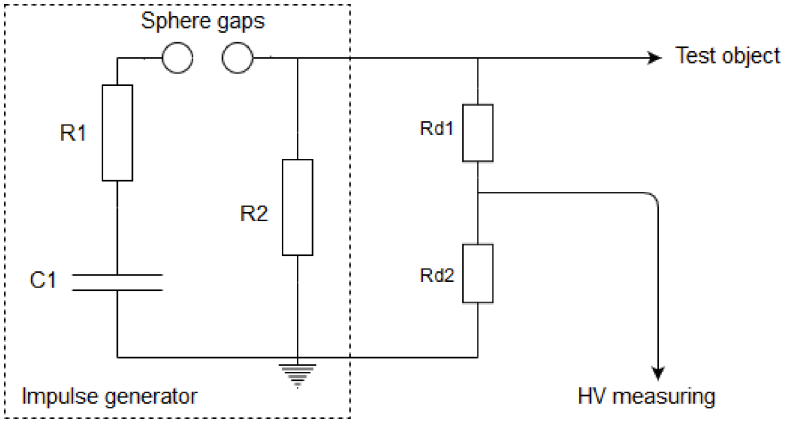
Insulators No. 1, 2, 3 were tested. Insulators were divided by electrode on sections. 25 impulses of both polarities with a steepness of at least 1000 kV/µs were applied on each section:

- original upper metal fitting and an electrode made of a copper strip 20 mm wide and less than 1 mm thick (upper section),
- between two electrode made of a copper strip 20 mm wide and less than 1 mm thick (middle section),
- electrode made of a copper strip 20 mm wide and less than 1 mm thick and an original bottom metal fitting (bottom section).

The test arrangement and the flashover on the insulator are shown in Figure 7.

The wave shape of the test impulse is given in Graph 1.

Testing and measuring equipment



impulse generator TuR Dresden 750 kV, 30 kJ
R_{d1}/R_{d2} - resistive divider Haefely, 800 kV, serial No. 554333
measuring system Haefely Trench, type HiAS 743, serial No. 175247
measuring system for atmospheric conditions Comet, serial No. 14900363
tape measure 7,5 m, Assist, PM-242

Evaluation:

No puncture of any part of the insulators occured.

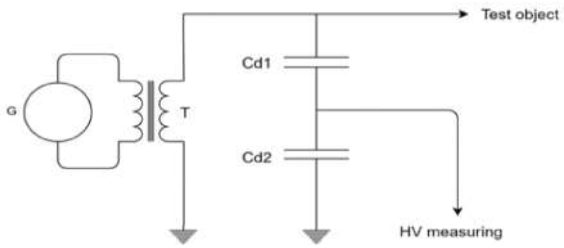
2.2.2.6 Power frequency voltage test

Tests were carried out according to CSA C411.4-16, clause 5.3.3.4.

Atmospheric conditions:

air pressure	98,8 kPa
air temperature	15,6 °C
relative humidity	61,1 %

Testing and measuring equipment



G - synchronous generator BEZ Bratislava 6 kV, 1300 kVA,
T - test transformer TuR Dresden, 1 200kV/1 300 kVA, serial No. 884469
Cd1/Cd2 – divider WMC 160/1200, serial No. 884470
universal voltmeter Haefely DMI 551, serial No. 150505
digital stop-watch Fastime, PM-251
measuring system for atmospheric conditions COMET, serial No. 14900363
digital thermometer Fluke 54II, serial No. 41070290WS + probe 80PK-27
tape measure 7,5 m, Assist, PM-242

This test consisted of the following two tests:

a) Dry power frequency flashover test

Samples No. 1, 2, 3 and 4 REF (as a reference sample) were tested, see Figure 8. Before the flashover test begins, the shank reference temperatures of all samples were measured. The flashover voltage was obtained by increasing the voltage linearly from zero within one minute. The average of five flashover voltages on each insulator was corrected to normal standard atmospheric conditions in accordance with IEC 60060-1, clause 4.3.

The value of reference flashover voltage was obtained from insulator 4 REF.

The test arrangement and the flashover of the insulator are shown in Figure 8.

The average value of the flashover voltages of insulators No. 1, 2, 3 shall be greater than or equal to 90 % of flashover voltage of the reference insulator 4 REF. Table 4 and 5 display the results of these measurements.

Table 4

Insulator No.	Uncorrected flashover values (kV)					Uncorrected flashover average (kV)	Correction factors	Corrected reference flashover voltage (kV)
4 REF	473	479	481	476	471	476	$k_1 = 0,990$ $k_2 = 0,966$ $K_t = 0,957$	498
90 % of corrected reference flashover voltage = 448 kV								
80 % of uncorrected reference flashover voltage = 381 kV								

Table 5

Insulator No.	Uncorrected flashovers values (kV)					Uncorrected flashover average (kV)	Correction factors	Corrected flashover average (kV)
1	476	475	481	473	478	477	$k_1 = 0,990$ $k_2 = 0,966$ $K_t = 0,957$	499
2	478	480	479	473	476	477	$k_1 = 0,990$ $k_2 = 0,966$ $K_t = 0,957$	499
3	483	484	480	476	471	479	$k_1 = 0,990$ $k_2 = 0,966$ $K_t = 0,957$	501

All measured voltages are corrected for the standard reference atmosphere according to IEC 60060-1, clauses 4.3 and 4.4.2.

k_1 air density correction factor,
k_2 humidity correction factor,
K_t atmospheric correction factor.

Evaluation:

Average corrected flashover voltage values of insulators No. 1, 2, 3 exceed 90 % of the reference flashover voltage.

b) Dry power frequency withstand test

Each of tested insulators No. 1, 2, 3 and 4 REF were individually subjected for 30 minutes to 80 % of the average reference flashover voltage. No puncture of the insulator shall occur and the temperature rise ΔT of the shank of insulator immediately after the test shall be less than 10 K with respect to reference temperature. The results are shown in Table 6.

Table 6

Insulator No.	Test voltage (kV)	Result	ΔT (K)	Result
1	381	no puncture	< 10	passed
2	381	no puncture	< 10	passed
3	381	no puncture	< 10	passed
4 REF	381	no puncture	< 10	passed

Evaluation:

No puncture was occured and increase in temperature of the insulator shank was less than 10 K, with respect to reference temperature.

Statemens of conformity:

138 kV Composite insulator, SML 222 kN, drawing No. 21SM510756 Rev. B, passed the the test according to requirements given in CSA C411.4-16, clause 5.3.

2.3 Accelerated weathering test [3)]

Specification of silicone rubber

Manufacturer: Jiangsu Shemar Electric Co., Ltd.
Address: No. 66, Haiwei Road, Sutong Science and Technology Industrial Park, Nantong City, Jiangsu 226017, China

Type: HTV silicone rubber

Color: Light gray

Butch number: N/A

The silicone rubber specification was provided by the customer.

The test was performed according to CSA C411.4-16, clause 5.4.

The test was performed by accredited test laboratory SYNPO a.s.as per test report No. T 375/006.

Evaluation:

No surfaces degradations such as cracks, crumbling or blisters.

Statement of conformity:

Test specimens of HTV silicone rubber passed the test according to requirements given in CSA C411.4-16, clause 5.4.

2.4 Tensile load test

The test was carried out according to CSA C411.4-16, clause 5.6.

2.4.1 Test specimens

Test was carried out according to CSA C411.4-16, clause 5.6.1. The three insulators were examined visually. The tests were performed on composite tension insulators samples No. 1, 2 and 3.

No. 1, serial No. 2111150030,

No. 2, serial No. 2111150013,

No. 3, serial No. 2111150010.

Testing and measuring equipment:

slide gauge 300 mm, Kinex CZ, serial No. 2441/05
tape measure 5 m, CXS, PM-241

Evaluation:

Insulators were without damage and dimensions conform to the drawing (see Figure 1).

2.4.2 Test procedure and test result

Test date: 2022-03-02

Test was carried out according to CS C411.4.-16, clause 5.6.2. Three insulators No. 1, 2 and 3 were subjected to tensile load applied between couplings. The tensile load was increased rapidly but smoothly from zero to approximately 167 kN (75 % of the SML) and then gradually increased in a time between 30 s to 90 s to 222 kN (100 % of SML). The load was sustained at SML for the 60 s. Then was the load increased up to insulator failure.

Records of measured mechanical loading during the mechanical failing test are given in Graphs 2, 3 and 4.

The samples after mechanical failing load test are shown in Figure 9, 10, 11 and 12.

Testing and measuring equipment

Hydraulic loading machine LabTest 5.600SP1, serial No. 15/12

Test results

Table 7

Test sample No.	100 % SML	Composite insulator failing load (kN)	Type of failure
1	222 kN/60 s - OK	325,3	Pull out of the core from the end fitting
2	222 kN/60 s - OK	289,5	Pull out of the core from the end fitting
3	222 kN/60 s - OK	317,3	Pull out of the core from the end fitting

Evaluation:

No failure (breakage, partial pullout or complete pull-out of the core or fracture of the metal fittings) occurred during the 90 s time period on insulators No. 1, 2 and 3.

Statement of conformity:

138 kV Composite insulator, SML 222 kN, drawing No. 21SM510756 Rev. B, passed the test according to requirements given in CSA C411.4-16, clause 5.6.

2.5 Thermal-mechanical test

The test was carried out according to CSA C411.4-16, clause 5.7.

2.5.1 Test specimens

Testing date: 2022-03-24

Test was carried out according to CSA C411.4.-16, clause 5.7.1. The three insulators were examined visually. The tests were performed on composite tension insulators samples No. 1, 2 and 3.

No. 1, serial No. 2111150003,
No. 2, serial No. 2111150027,
No. 3, serial No. 2111150023.

Testing and measuring equipment:

slide gauge 300 mm, Kinex CZ, serial No. 2441/05
tape measure 5 m, CXS, PM-241

Evaluation:

Insulators were without damage and dimensions conform to the drawing (see Figure 1).

2.5.2 Thermal-mechanical tests

Testing date: from 2022-03-28 till 2022-04-01

Tests were carried out according to CSA C411.4-16, clause 5.7.2.

Three insulators No. 1, 2 and 3 were subjected to a tensile mechanical load to 11,1 kN, (5 % of SML, SML = 222 kN) for the duration one minute, the reference total length was measured. Measured values are show in Table 8.

Three insulators No. 1, 2 and 3 were subjected to a mechanical load to 111 kN (50% of SML). Each insulator was subjected to four 24-hour cycles with one cooling period of -50 °C ± 5 °C, followed by one heating period of +50 °C ± 5 °C.

Following the thermal mechanical cycling, each insulator was permitted to reach ambient temperature and a tension load 11,1 kN was applied and the length again measured. The increased length shall be less than 2 mm (Table 8).

The test arrangement during the thermal-mechanical test on the insulator is shown in Figure 13.

Records of measured temperatures and tensile load during the thermal-mechanical testing are given in Graphs 5, 6, 7 and 8.

Dye penetration test of metal end fittings were carried out according to CSA C411.4-16, clause 5.7.3.1 c). Both ends of insulators were subjected to the dye penetration test. After the penetration test the test specimens were inspected. The insulators after the dye penetration test are shown in Figures 14 and 15.

Testing and measuring equipment:

digital thermometer - datalogger, Comet system S0141, serial No. 18931701
digital thermometer - datalogger, Comet system S0141, serial No. 19270819
thermal mechanical chamber Horkan Klima, inventory No. 2237
loading measuring system Format 1, type EGU – 1V, serial No. Z201128287
thermal mechanical chamber LaborTech. Type Creep test 6.500.C3, serial No. ZA/2018/51
slide gauge 1 500 mm, Filleta, serial No. G10066

2.5.3 Moisture penetration test

Test date: 2022-03-29

Tests were carried out according to CSA C411.4.-16, clause 5.7.3.2.

Each insulator end was submerged to a depth of at least 50 mm above the end fitting in dye composed of 1 g of astrazon in 100 g of methanol for a minimum of 15 min. After that the insulator were removed from the solution and wipe dry.

Each insulator was cut 90° to the axis of the core and about 50 mm from both metal fittings. Both metal fittings were cut on each insulator longitudinally into two halves and removed from the insulator.

Testing and measuring equipment:

digital stop-watch Fastime PM-251

2.5.4 Test results

Table 8

Insulator No.	**1**	**2**	**3**
Length before test (mm)	1429,4	1432,1	1431,3
Length after test (mm)	1429,9	1432,2	1431,5

Evaluation:

Increase length was not more than 2 mm.

No dye on the core rod or interfaces was observed after moisture penetration test

No fracture or cracking of the metal end fittings were observed after dye penetration test on insulators.

Statement of conformity:

138 kV Composite insulator, SML 222 kN, drawing No. 21SM510756 Rev. B, passed the test according to requirements given in CSA C411.4-16, clause 5.7.

2.6 Assembled core load-time tests

The test was carried out according to CSA C411.4-16, clause 5.8.

2.6.1 Test specimens

Test was carried out according to CSA C411.4-16, clause 5.8.1. The six insulators were examined visually. The tests were performed on composite tension insulators samples No. 1, 2, 3, 4, 5 and 6.

No. 1, serial No. 2111150015,
No. 2, serial No. 2111150022,
No. 3, serial No. 2111150012.
No. 4, serial No. 2111150025,
No. 5, serial No. 2111150035,
No. 6, serial No. 2111150036.

Testing and measuring equipment:

slide gauge 300 mm, Kinex CZ, serial No. 2441/05
tape measure 5 m, CXS, PM-241

Evaluation:

Insulators were without damage and dimensions conform to the drawing (see Figure 1).

2.6.2 Determination of the average failing load of the core of the assembled insulator

Test date: 2022-03-03

Test was carried out according to CSA C411.4-16, clause 5.8.2.2. Three insulators No. 1, 2 and 3 were subjected to tensile load applied between couplings. The tensile load was increased rapidly but smoothly from zero to approximately 167 kN (75 % of expected mechanical failing load) and then gradually increased in a time between 30 s to 90 s until breakage of the core or complete pull-out occurs. The average value of the three failing loads was calculated.

Records of measured mechanical loading during the mechanical failing test are given in Graphs 9, 10 and 11.

The samples after mechanical failing load test are shown in Figure 16, 17, 18 and 19.

Testing and measuring equipment

Hydraulic loading machine LabTest 5.600SP1, serial No. 15/12

Test results

Table 9

Test sample No.	Type of failure	Composite insulator failing load (kN)
1	Pull out of the core from the end fitting	296,9
2	Pull out of the core from the end fitting	309,8
3	Pull out of the core from the end fitting	263,0
	Average of the failing load	289,0
	60 % of average of the failing load	173,9

2.6.3 Verification of the slope of the strength-time curve of the insulator

Test date: from 2022-03-1 till 2022-03-15

Test was carried out according to CSA C411.4-16, clause 5.8.2.3. Three insulators No. 4, 5 and 6 were subjected to a tensile load applied between couplings. The tensile load was increased rapidly but smoothly, from zero up to 173,9 kN (60 % of the average failing load) and then maintained at this value for 96 hours. Test samples during the mechanical 96 hours load test are shown in Figure 21.

Then diagnostic testing of end fittings was performed on the insulators No. 4, 5 and 6. Both ends of each tested insulator were subjected to the dye penetration test. After the penetration test the test specimens were inspected. The insulators after the dye penetration test are shown in Figure 21 and 22.

Record of mechanical loading applied during mechanical 96 hours test is given in Graph 12.

Testing and measuring equipment

Hydraulic loading machine LabTest 5.600SP1, serial No. 15/12

Evaluation:

No failure (breakage or complete pull-out of the core or fracture of the metal fittings) occurred during 96 h test on insulators No. 4, 5 and 6.

No fracture or cracking of the metal end fittings were observed after dye penetration test on insulators No. 4, 5 and 6.

Statement of conformity:

138 kV Composite insulator, SML 222 kN, drawing No. 21SM510756 Rev. B, passed the test according to requirements given in CSA C411.4-16, clause 5.8.

2.7 Mechanical load-time test

The test was carried out according to CSA C411.4-16, clause 5.9.

2.7.1 Test specimens

The test was carried out according to CSA C411.4-16, clause 5.9.1.

The insulators No. 1, 2, 3, 4 were examined visually and their dimensions were checked against the drawing.

No. 1, serial No. 2111150011,

No. 2, serial No. 2111150005,

No. 3, serial No. 2111150006.

No. 4, serial No. 2111150016.

Testing and measuring equipment:

slide gauge 300 mm, Kinex CZ, serial No. 2441/05
tape measure 5 m, CXS, PM-241

Evaluation:

Insulators were without damage and dimensions conform to the drawing (see Figure 1).

2.7.2 Test procedure and test result

Performance of the test

The test was carried out according to CSA C411.4-16, clause 5.9.1.

This test was performed on the insulators No. 1, 2, 3, 4 at the ambient temperature as described in the following three paragraphs.

a) 96 h withstand test (The test was carried out according to CSA C411.4-16, clause 5.9.2.1.)

All the insulators No. 1, 2, 3, 4 were subjected to a tensile load applied between couplings. The tensile load was increased rapidly but smoothly, from zero up to 155 kN (70 % of SML, SML = 222 kN) and then maintained at this value for 96 hours. The insulators under the test are shown in Figure 23. Applied load during testing is shown in Graph 13.

b) Dye penetration test (The test was carried out according to CSA C411.4-16, clause 5.9.2.2.)

Both ends of the insulator No. 4 were subjected to the dye penetration test for 20 minutes. After the penetration test the specimens were inspected. The insulator No. 4 after the dye penetration test is shown in Figure 27.

c) SML test (The test was carried out according to CSA C411.4-16, clause 5.9.2.3.)

Three remaining insulators No. 1, 2 and 3 were then again subjected to the tensile load applied between the couplings. The tensile load was increased rapidly but smoothly from zero approximately to 167 kN (75 % of SML) and then gradually increased in a time between 30 s to 90 s to 222 kN (100 % of SML). The load was sustained for the 60 s. Then the load was increased up to the failure of the insulator. Record of applied tensile load during testing are shown in Graphs 14, 15 and 16. The insulators after the failing load tests are shown in Figures 24, 25 26 and 28.

Testing and measuring equipment:

digital stop-watch Fastime PM-251
tensile machine LaborTech, type Lab Test 5.600SP1, serial No. 15/12

Test results

a) 96 h withstand test

Dates of test: from 2022-02-25 till 2022-03-01
Insulators: No. 1, 2, 3, 4.
Apllied load: 155,4 kN (70% of 222 kN).
Result: No failure.

b) Dye penetration test

Date of test: 2022-03-01
Insulator: No. 4.
Result: No cracks.

c) SML test

Date of test: 2022-03-01
Insulators: No. 1, 2, 3.
SML: 222 kN.
Result: No failure during 1-min at SML.
Measured failing loads are below in the Table .

Table 10 Test results of the failing load tests

Insulator No.	Failing load (kN)	Type of failure
1	320,1	Pull out of end fitting
2	293,7	Pull out of end fitting
3	294,8	Pull out of end fitting

Evaluation:

No failure (breakage or complete pull-out of the core or fracture of the metal fittings) occurred during the 96 h test at 70 % of SML on insulators No. 1, 2, 3 and 4.

No failure occurred during 1 min withstand test at 100 % of SML on insulators No. 1, 2, 3.

No cracks were observed after dye penetration test on insulator No. 4.

Statement of conformity:

138 kV Composite insulator, SML 222 kN, drawing No. 21SM510756 Rev. B, passed the test according to requirements given in CSA C411.4-16, clause 5.9.

2.8 Flammability test [3)]

Specification of silicone rubber

Manufacturer: Jiangsu Shemar Electric Co., Ltd.
Address: No. 66, Haiwei Road, Sutong Science and Technology Industrial Park, Nantong City, Jiangsu 226017, China

Type: HTV silicone rubber

Color: Light gray

Butch number: N/A

The silicone rubber specification was provided by the customer.

The test was performed according to CSA C411.4-16, clause 5.10.

The test was performed by accredited test Test polymer EU as per report No. 59/2022/EN.

The silicone rubber samples of required dimensions were provided by the customer.

Evaluation:

The silicone material HTV, passed specification V0 and HB.

Statement of conformity:

Test specimens of HTV silicone rubber passed the test according to requirements given in CSA C411.4-16, clause 5.10.

3 UNCERTAINTY OF MEASUREMENTS

QUANTITY	UNCERTAINTY (k=2)	
Steep front impulse voltage	U_m T_1	2,2 % 6,5 %
Power-frequency voltage (divider WMC 160/1200)	1,7 %	
Power-frequency voltage (water diffusion test)	0,3 kV	
Power-frequency leakage current (water diffusion test)	1,3 %	
Mechanical load (CreepTest)	1,0 %	
Mechanical load (LabTest)	1,0 %	
Mechanical load (Horkan Klima)	1,3 %	
Temperature (thermal-mechanical chamber)	3,0 %	
Temperature (Fluke + touch probe)	7,5 %	
Slide gauge, length (2-150 mm)	0,4 %	
Slide gauge, length (2-300 mm)	0,5 %	
Slide gauge, length (100-1 500 mm)	0,8 %	
Tape measure, length (10-5 000 mm)	1,6 %	
Tape measure, length (10-7 500 mm)	1,6 %	
Temperature	4,0 %	
Air pressure	0,5 %	
Relative humidity	6,3 %	
Time	0,7 %	
Body of water (200 – 1000 ml)	10,0 ml	
Weight (Sartorius)	0,9 %	
Hardness A (0-100 HAS)	2,6 %	

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a Normal (Gaussian) distribution corresponds to a coverage probability of approximately 95 %. Details related to the statement of conformity when applied are given in a price quotation submitted to a customer before the testing and on the website of the laboratory.

4 PRODUCT DRAWINGS

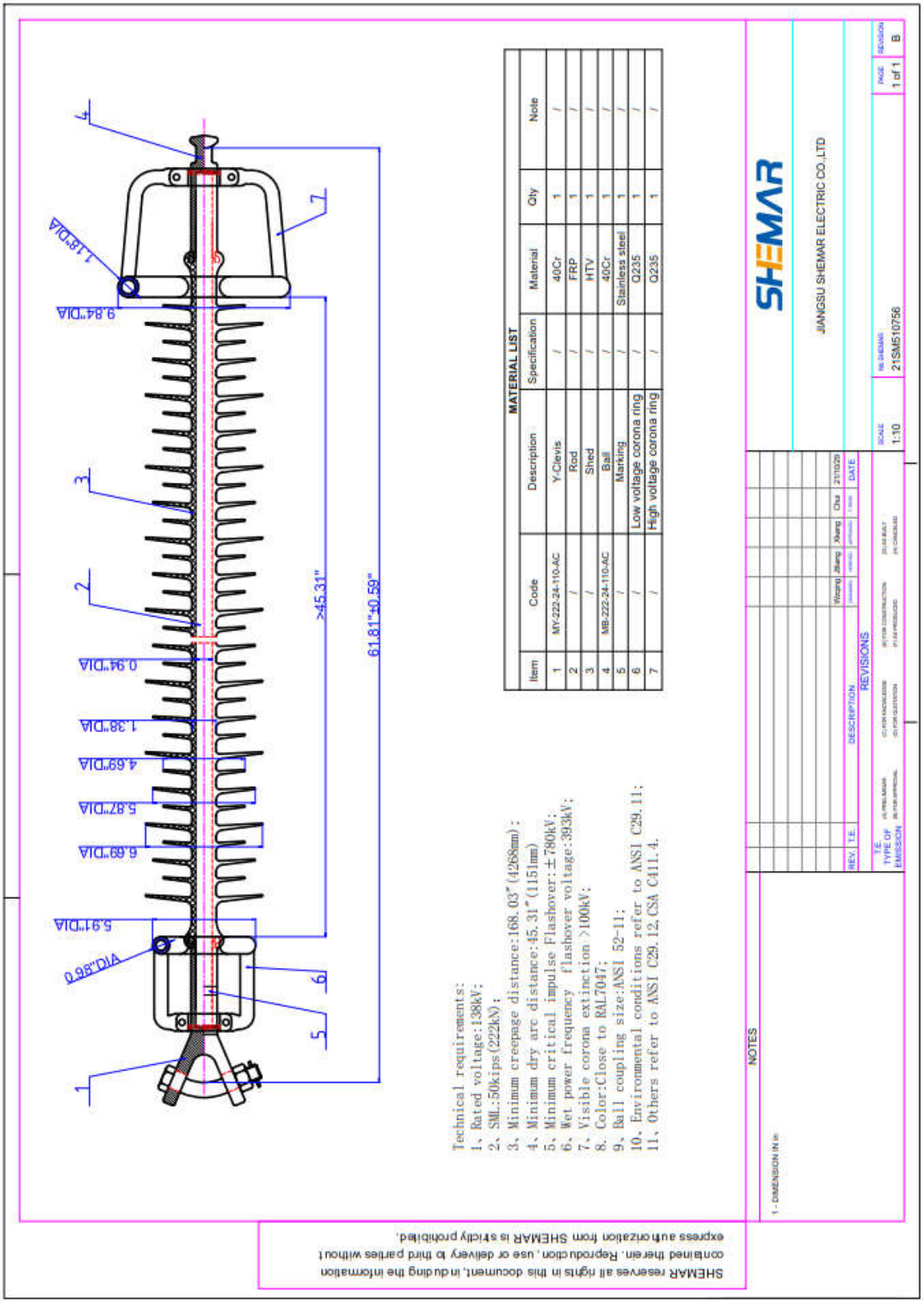


Figure 1
138 kV Composite insulator, SML 222 kN, drawing No. 21SM510756 Rev. B

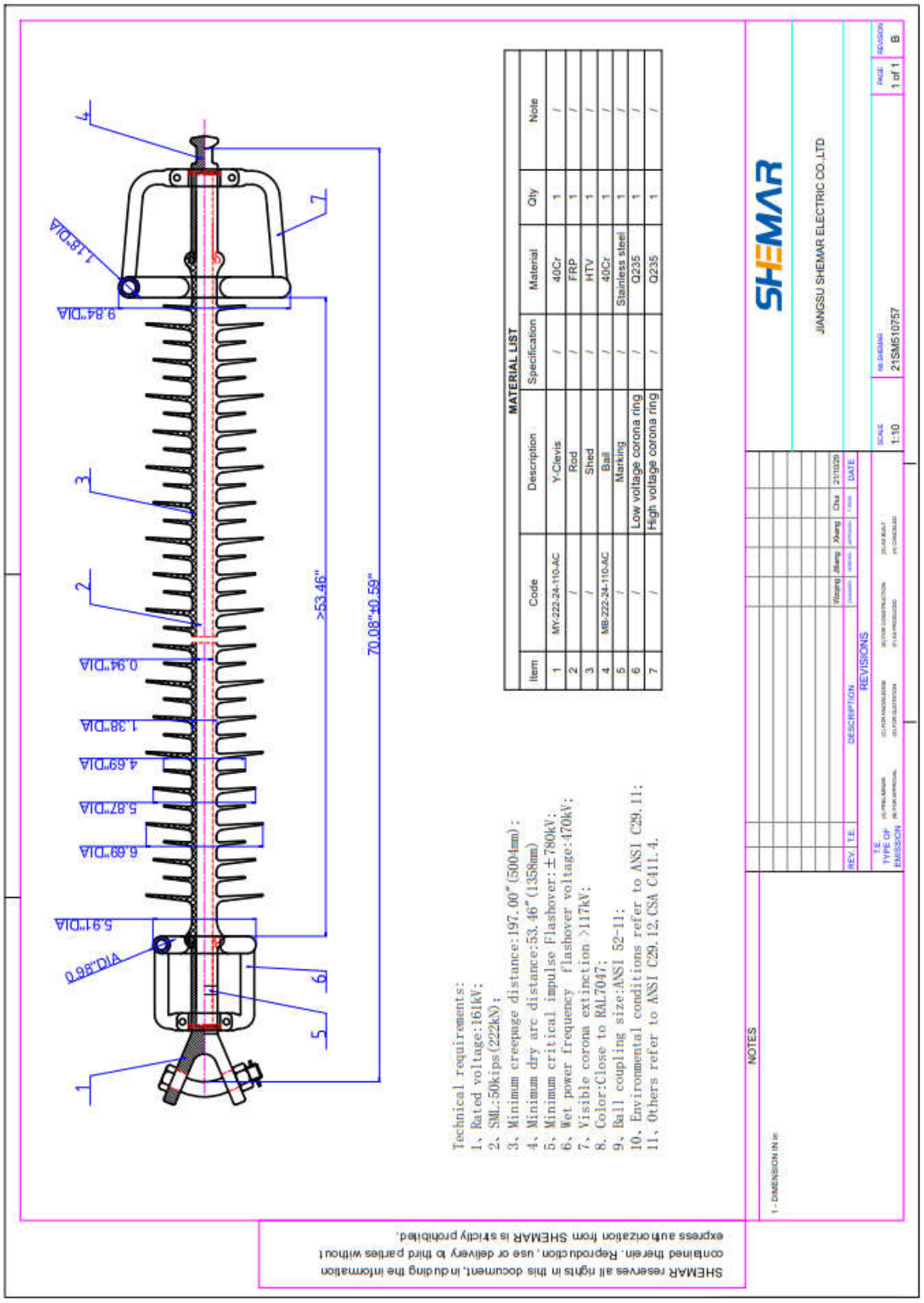


Figure 2
161 kV Composite insulator, SML 222 kN, drawing No. 21SM510757 Rev. B

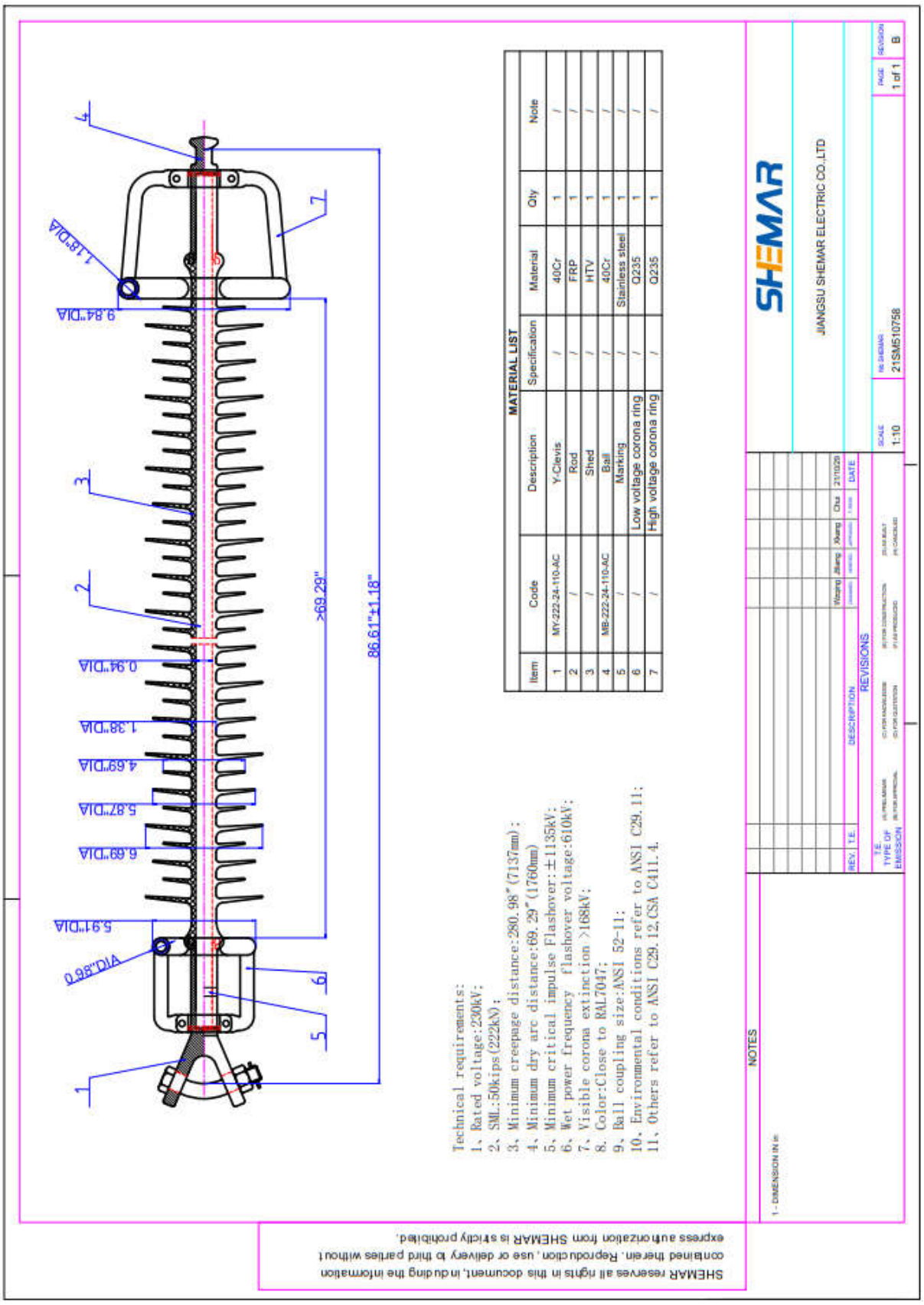


Figure 3
230 kV Composite insulator, SML 222 kN, drawing No. 21SM510758 Rev. B

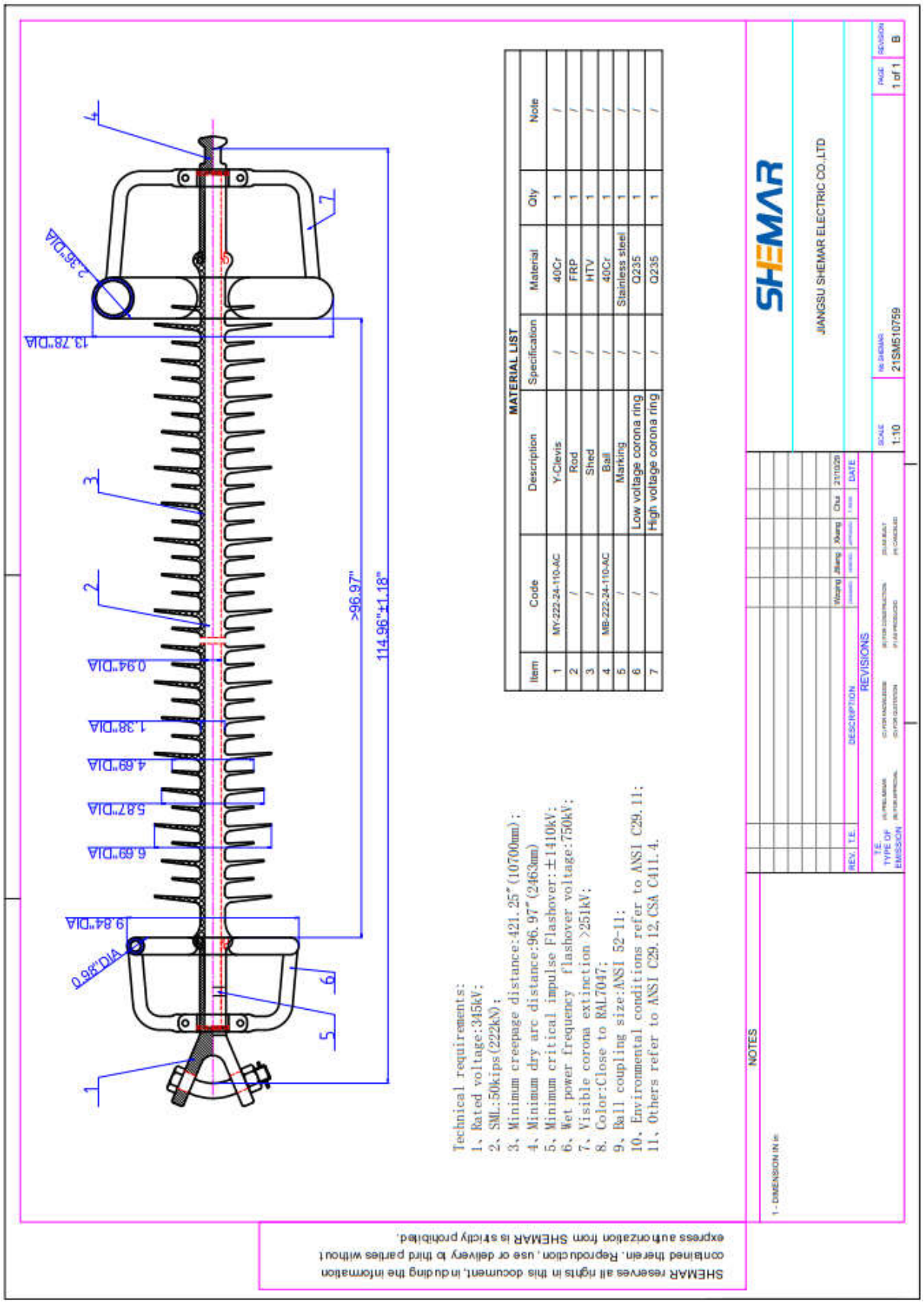


Figure 4
345 kV Composite insulator, SML 222 kN, drawing No. 21SM510759 Rev. B

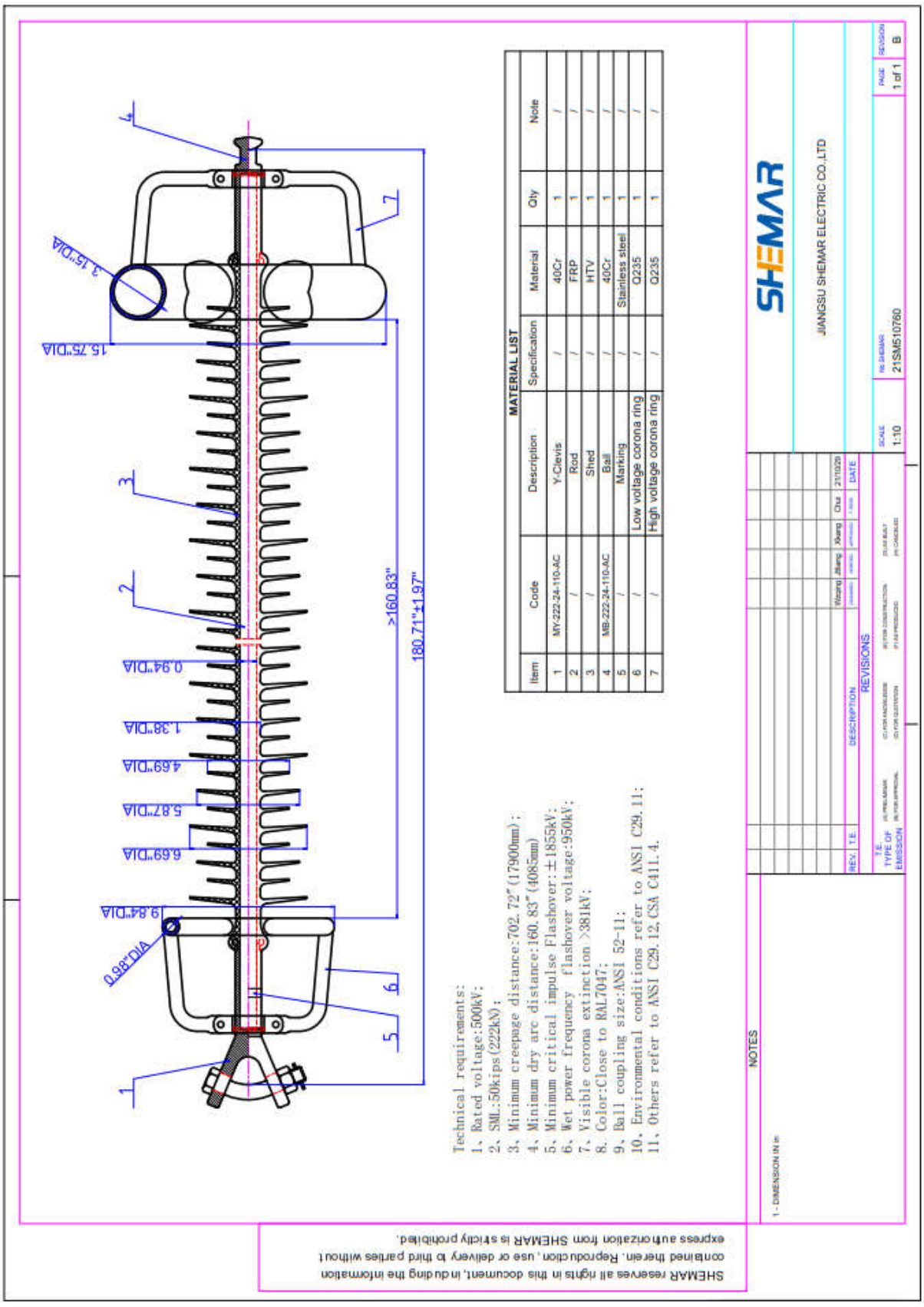
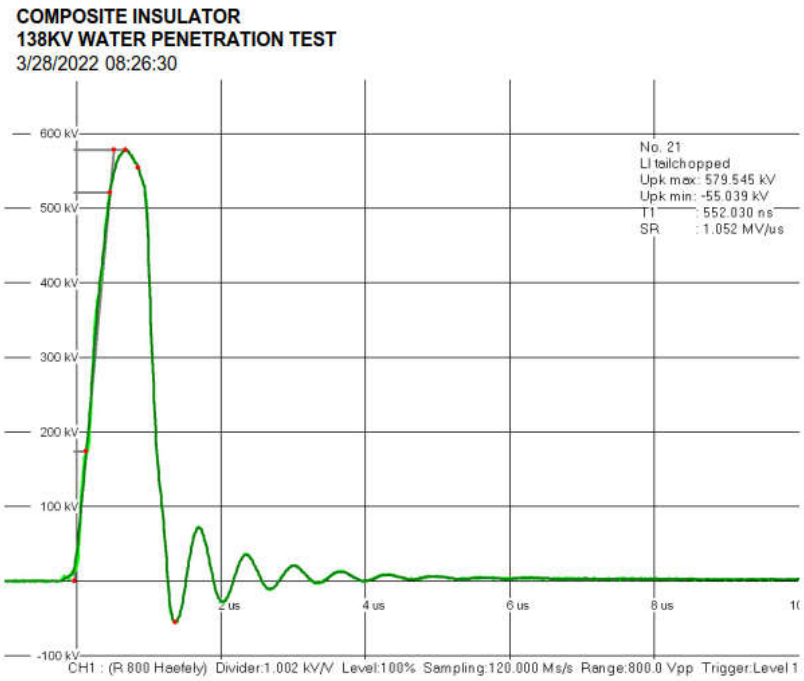
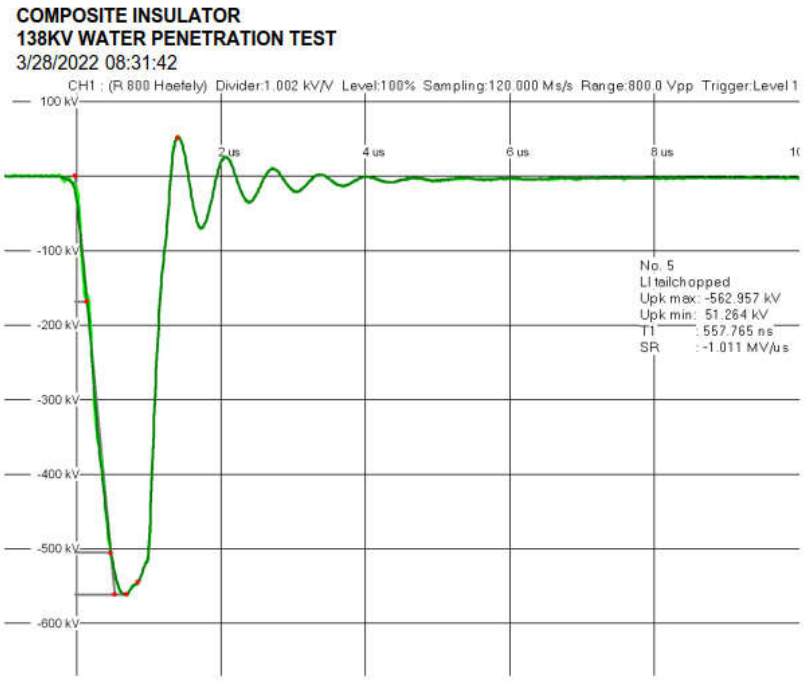


Figure 5
500 kV Composite insulator, SML 222 kN, drawing No. 21SM510760 Rev. B

5 GRAPHS AND RECORDS

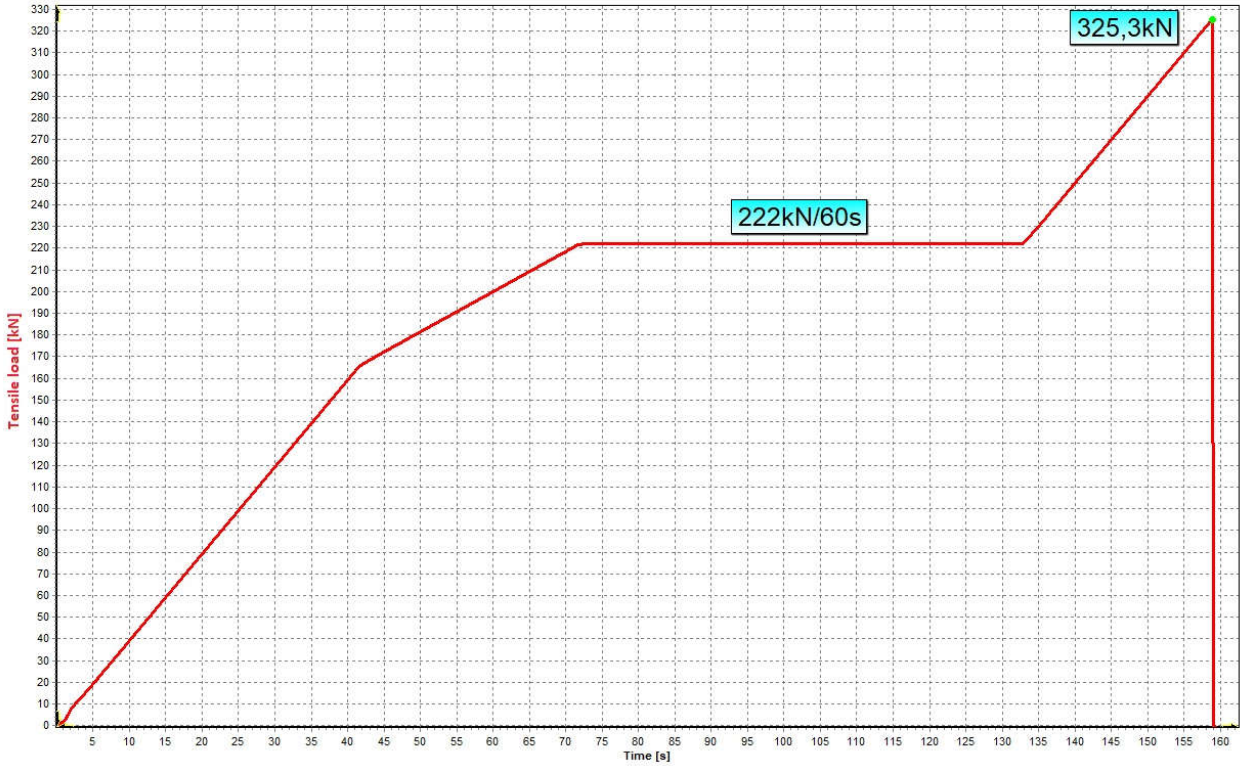


No. 21
Upk max: 579.545 kV
Upk min: -55.039 kV
T1 : 552.030 ns
SR : 1.052 MV/us

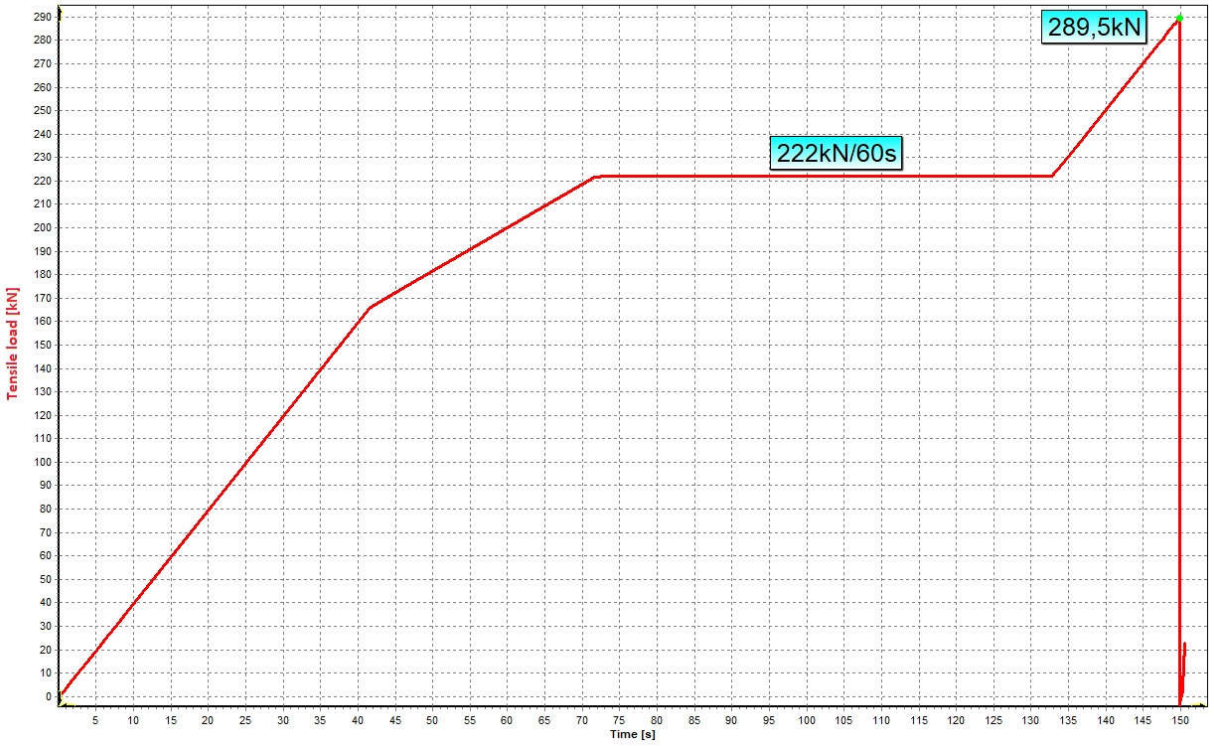


No. 5
Upk max: -562.957 kV
Upk min: 51.264 kV
T1 : 557.765 ns
SR : -1.011 MV/us

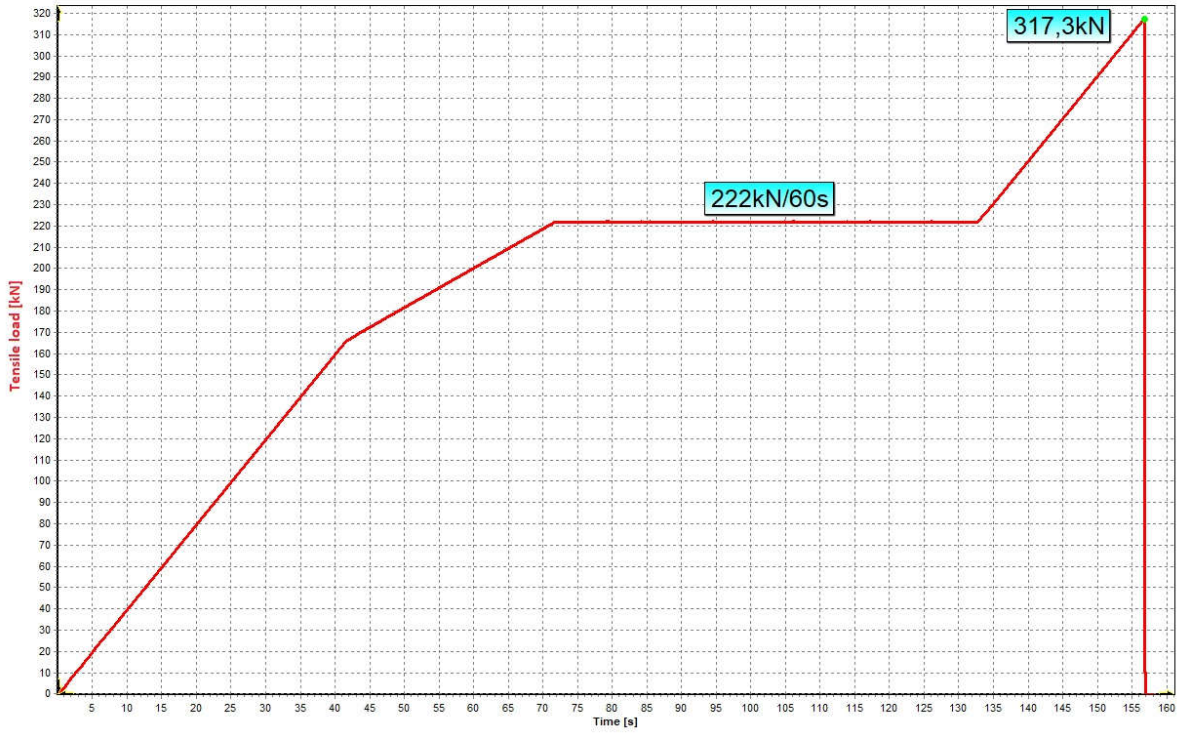
Graph 1
Representative wave shape of steep front impulse (water penetration test)



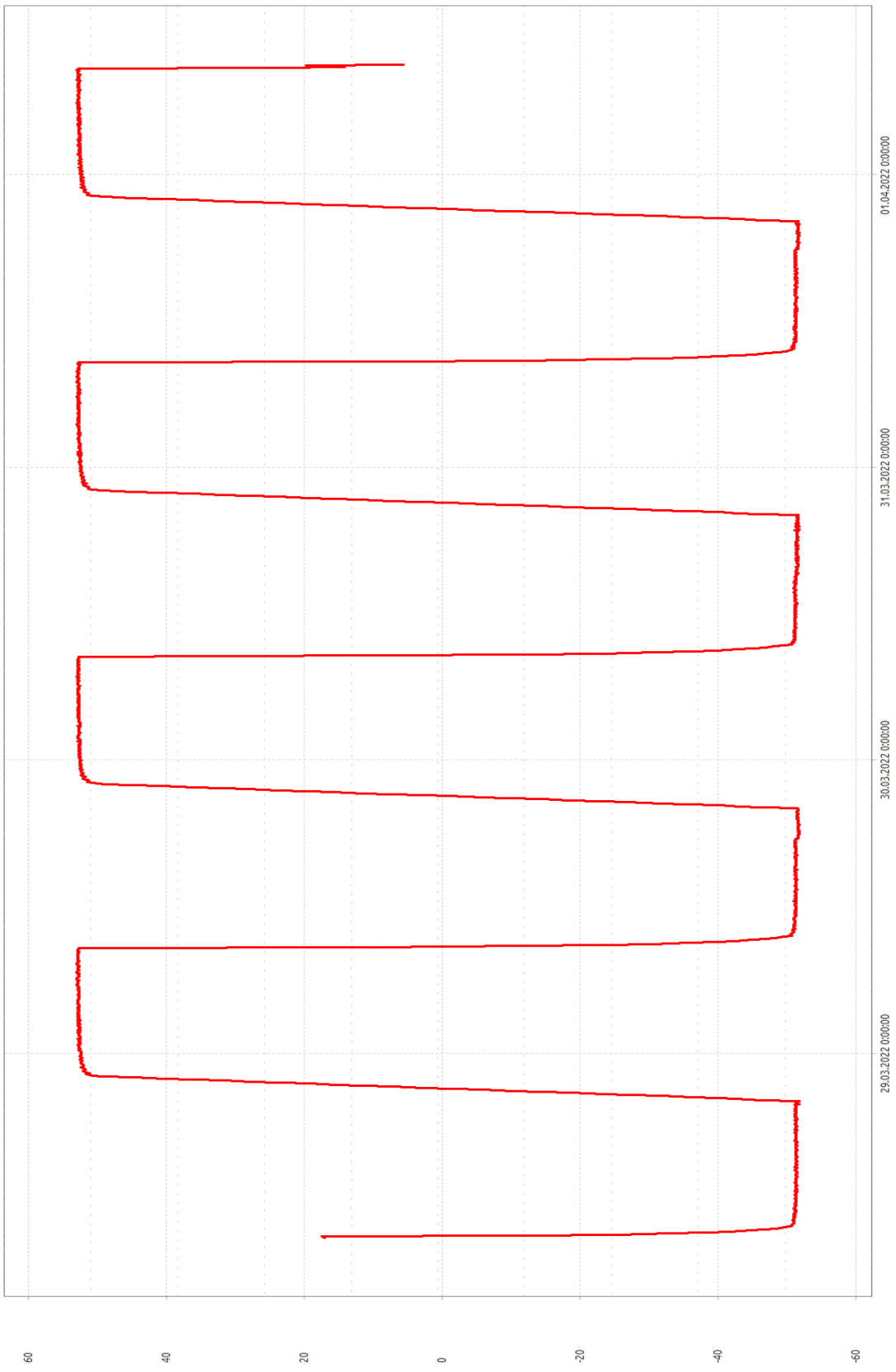
Graph 2
Record of mechanical loading test, tensile load test, sample No. 1



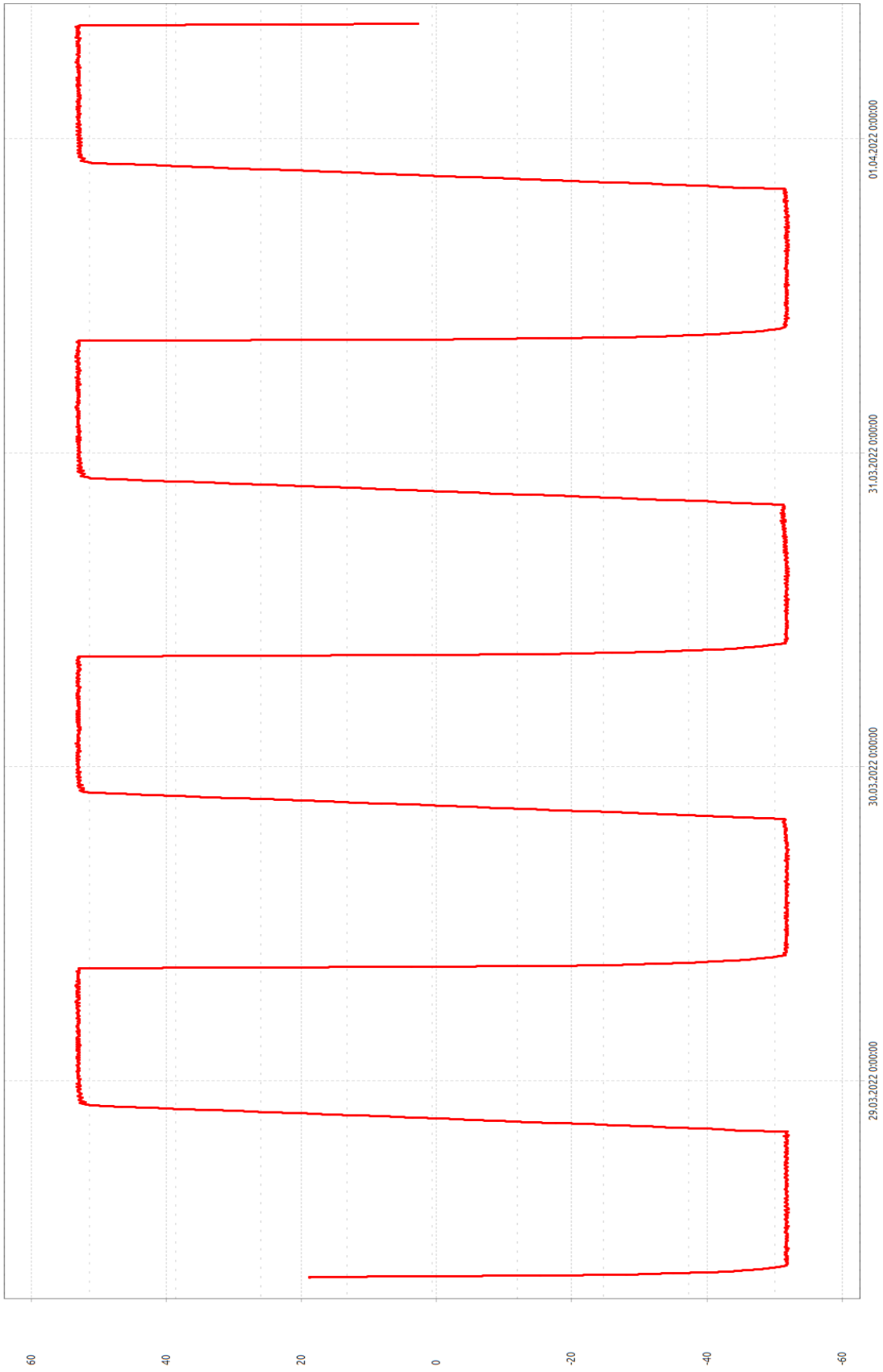
Graph 3
Record of mechanical loading test, tensile load test, sample No. 2



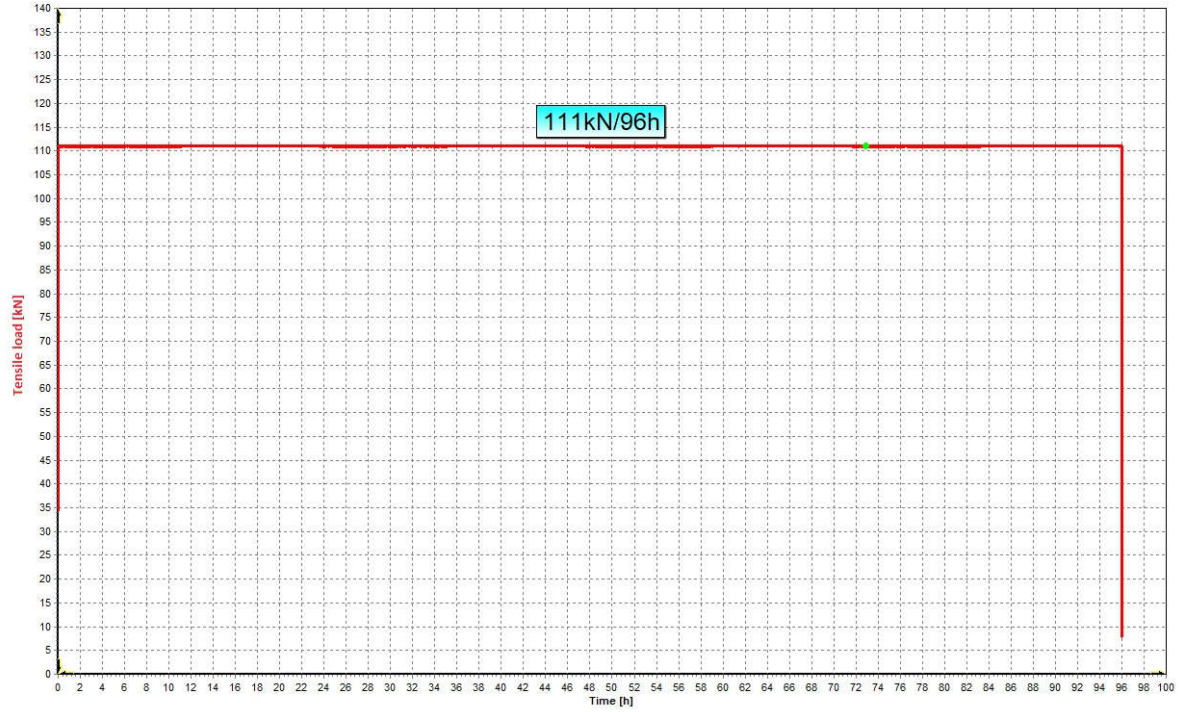
Graph 4
Record of mechanical loading test, tensile load test, sample No. 3



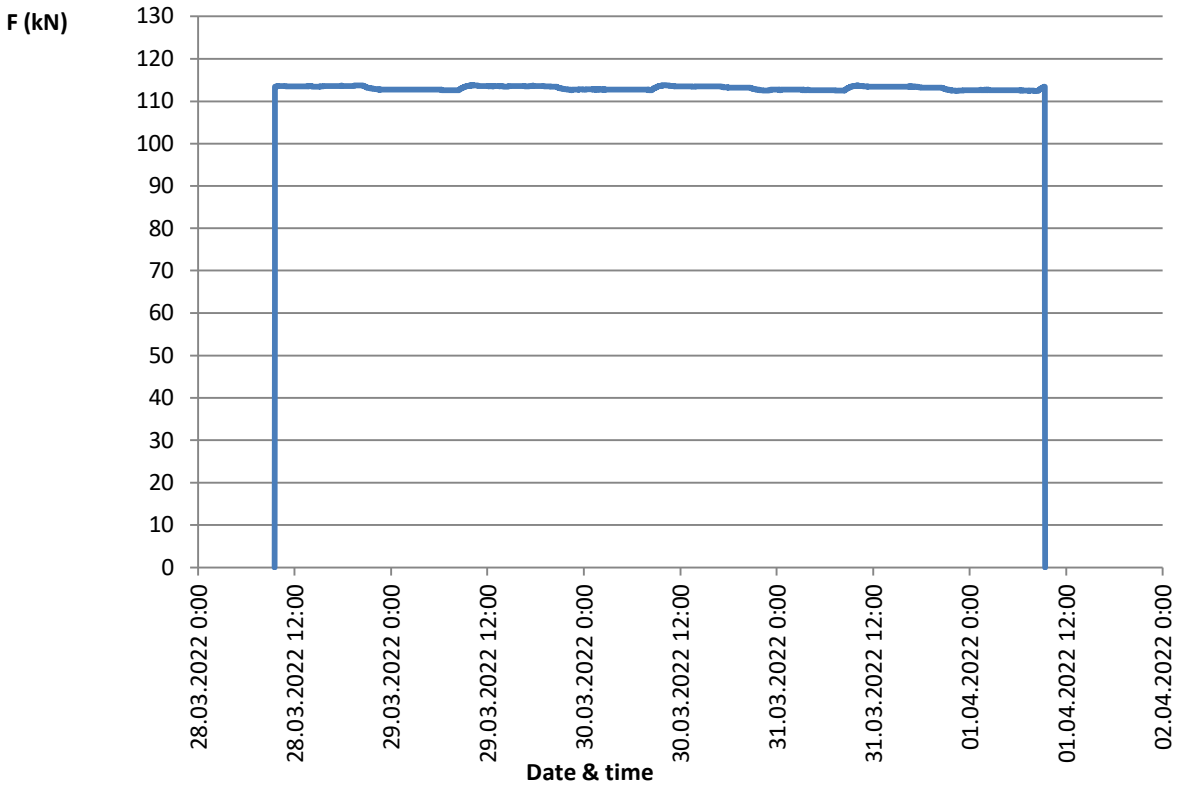
Graph 5
Record of temperature during thermal-mechanical cycles, test samples No. 1 and 2



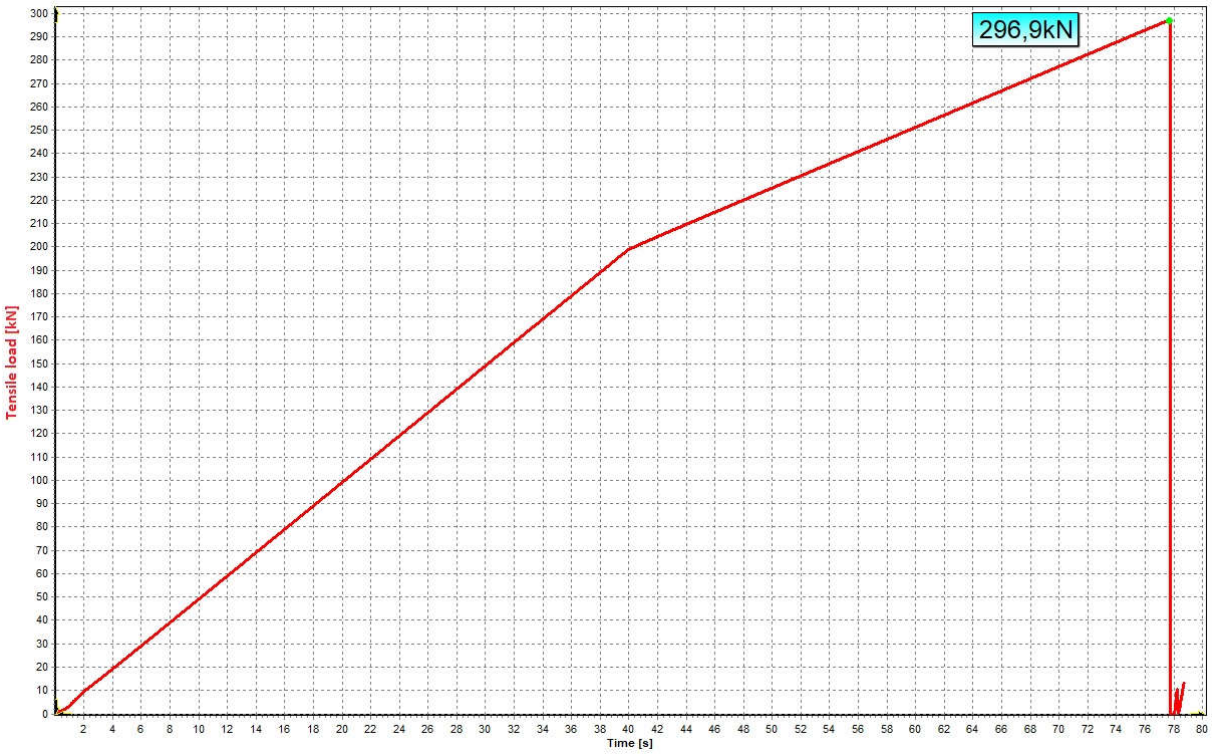
Graph 6
Record of temperature during thermal-mechanical cycles, test sample No. 3



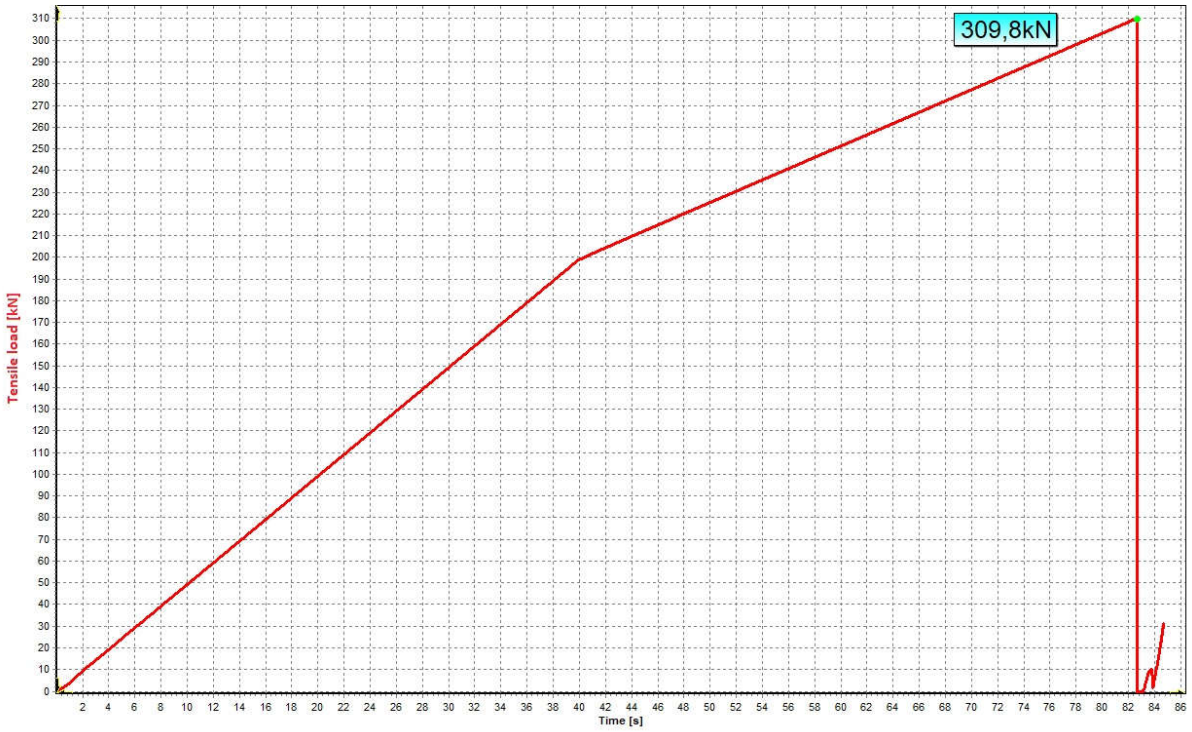
Graph 7
Record of tensile load during thermal-mechanical cycles, test samples No. 1 and 2



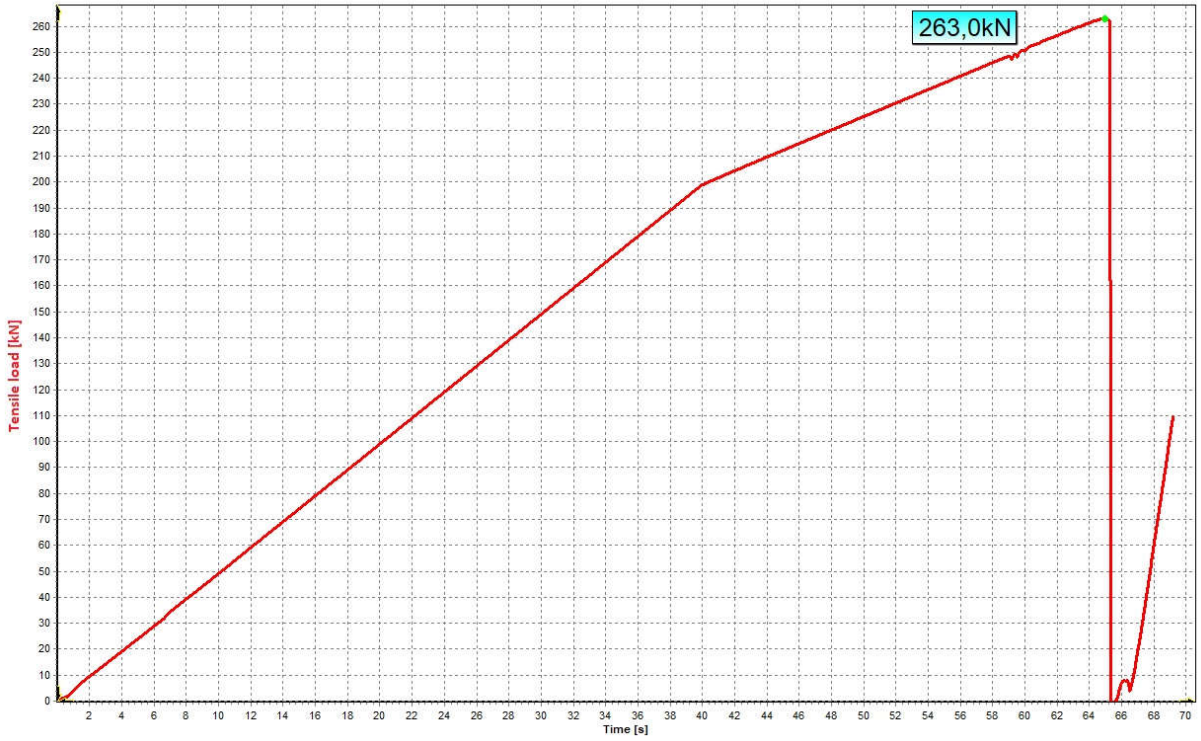
Graph 8
Record of tensile load during thermal-mechanical cycles, test sample No. 3



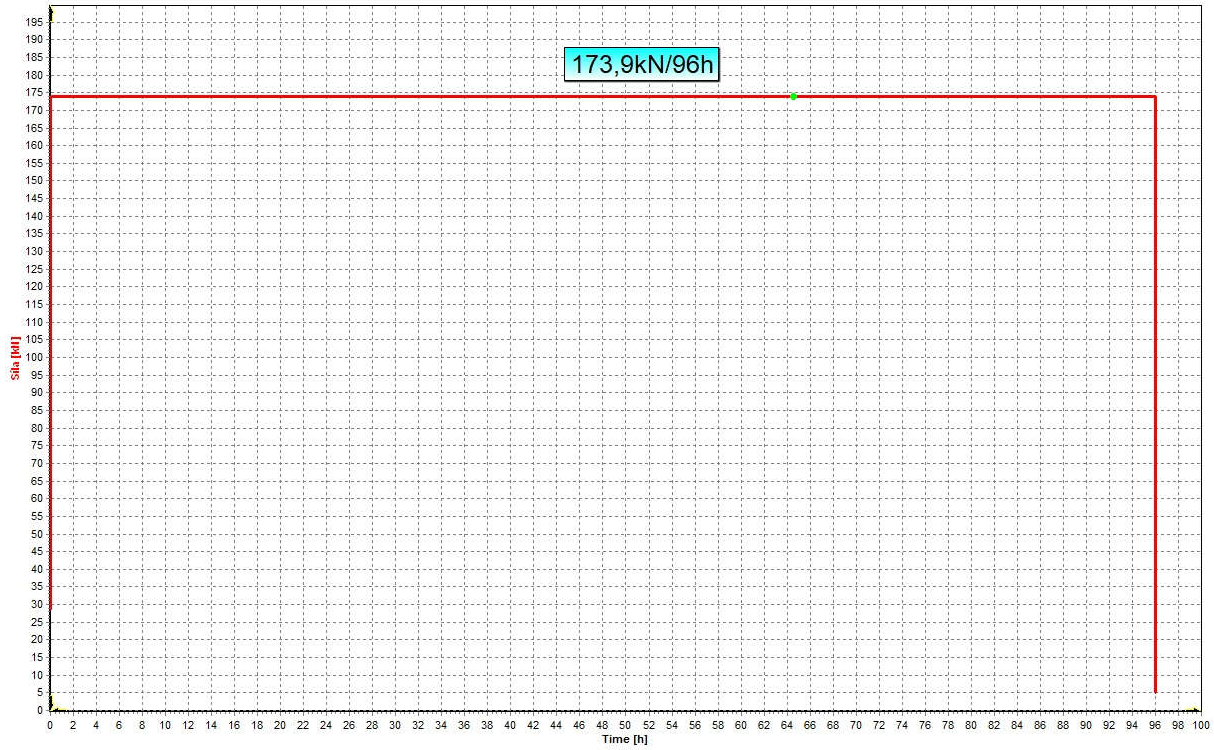
Graph 9
Record of mechanical loading test, assembled core load-time test, sample No. 1



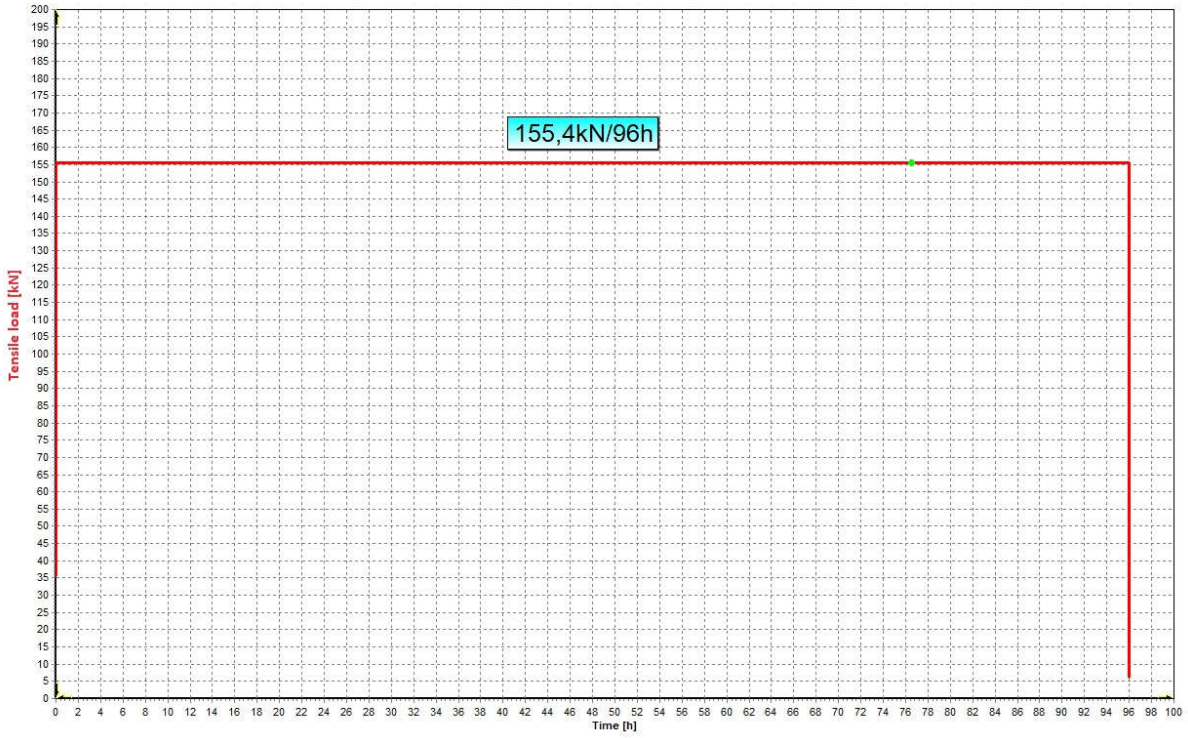
Graph 10
Record of mechanical loading test, assembled core load-time test, sample No. 2



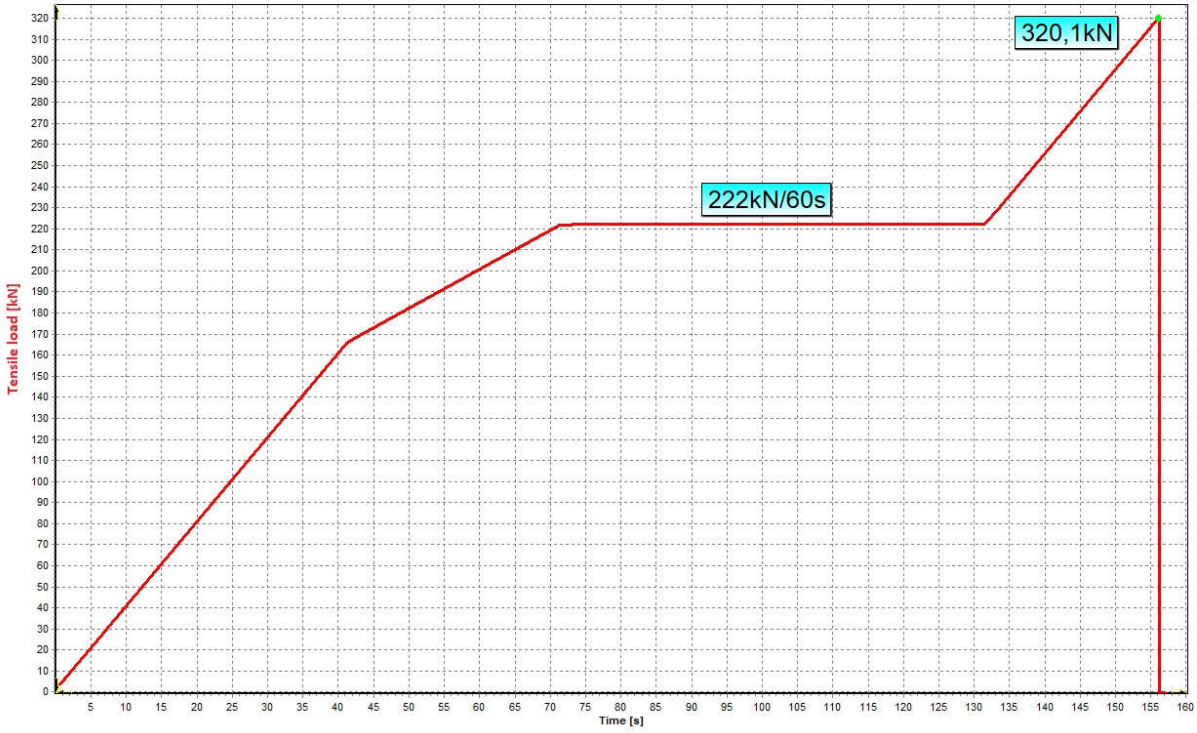
Graph 11
Record of mechanical loading test, assembled core load-time test, sample No. 3



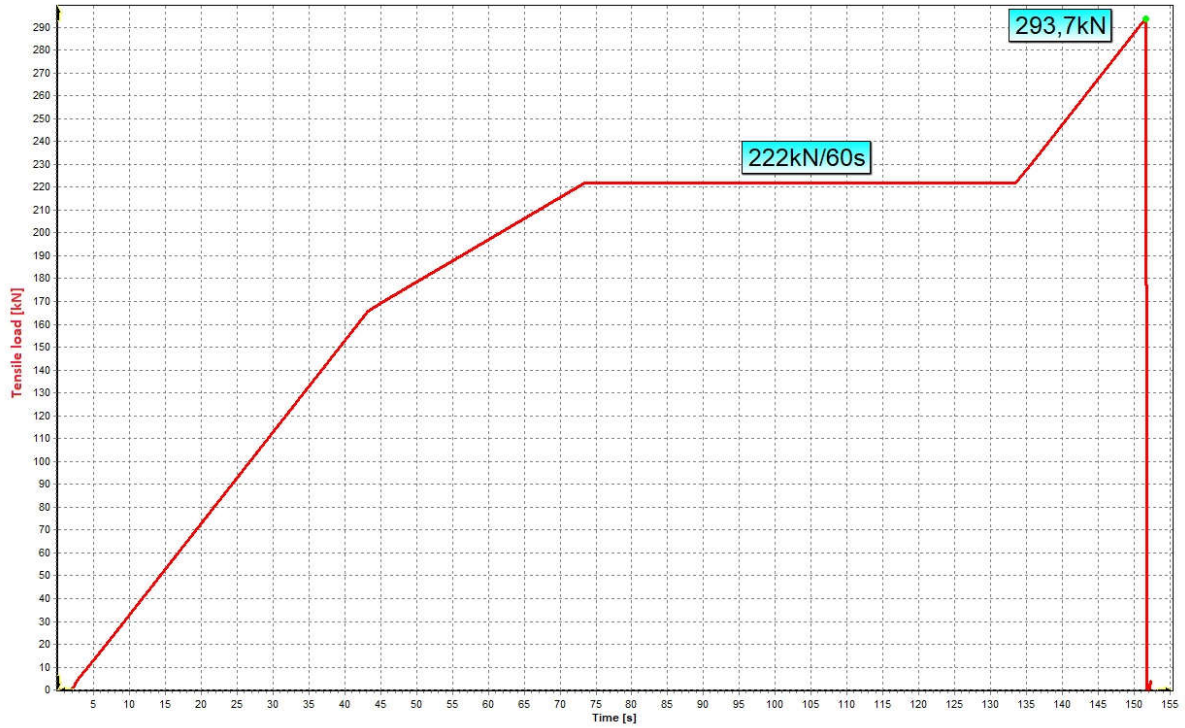
Graph 12
Record of 96 hours mechanical loading test, assembled core load-time test, samples No. 4, 5 and 6



Graph 13
Record of 96 hours mechanical loading test, mechanical load-time test, test samples No. 1, 2 and 3

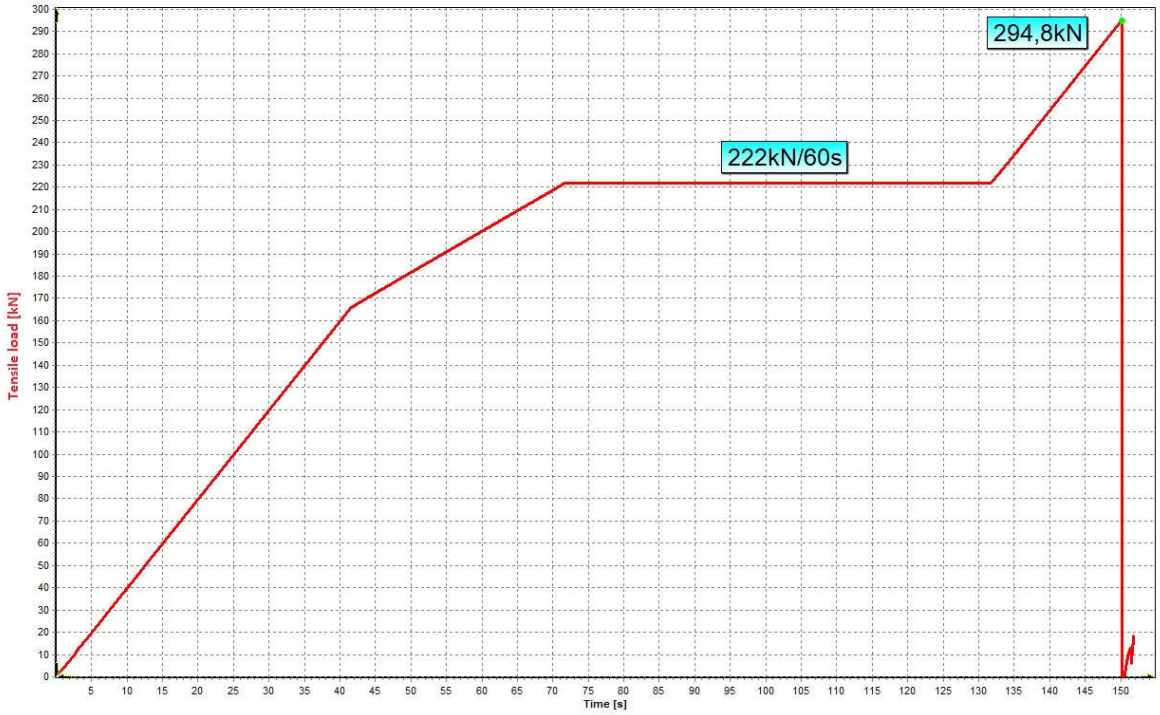


Graph 14
Record of the mechanical loading applied during the mechanical failing load test, mechanical load-time test, test sample No. 1



Graph 15

Record of the mechanical loading applied during the mechanical failing load test, mechanical load-time test, test sample No. 2



Graph 16

Record of the mechanical loading applied during the mechanical failing load test, mechanical load-time test, test sample No. 3

6 TEST OBJECT AND TEST SETUP PHOTOS

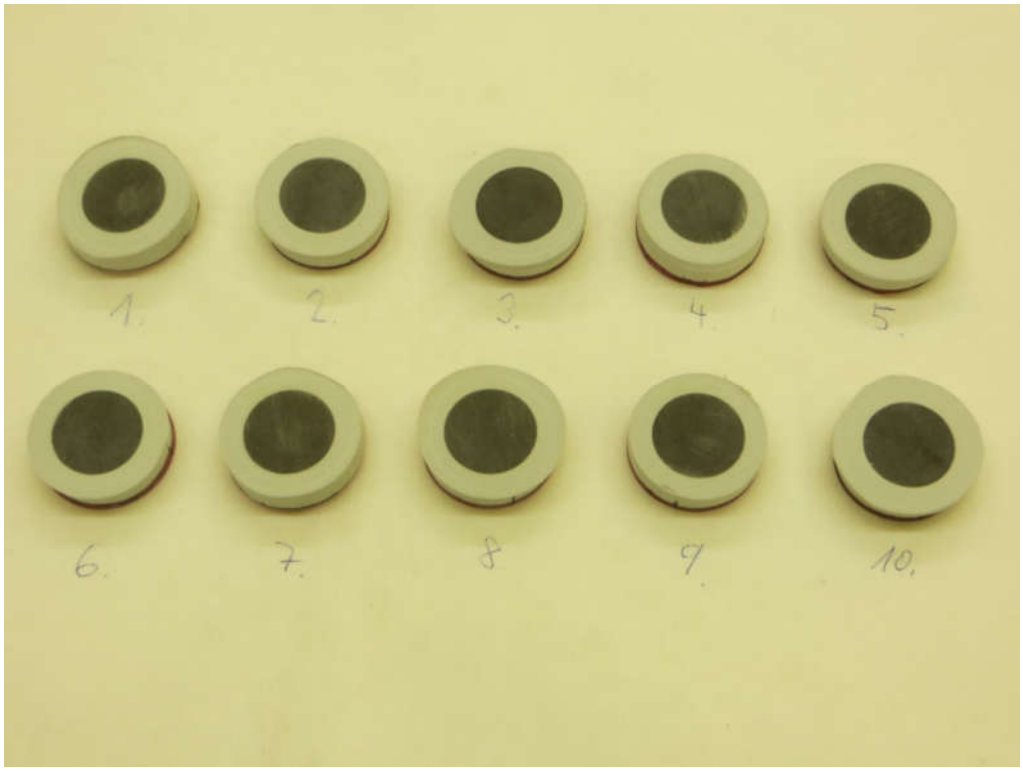


Figure 3
Test specimens after the dye penetration test

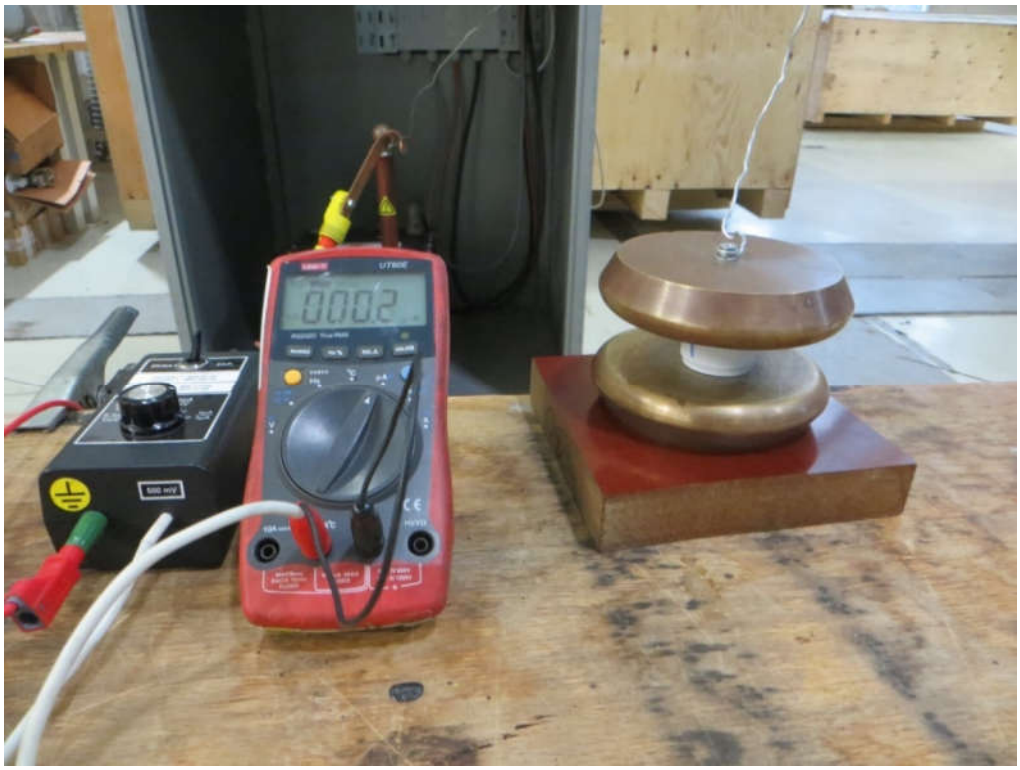


Figure 4
Test specimens during the voltage test – water diffusion test

Figure 5
Test specimens after the voltage test – water diffusion test

Figure 6
Test samples No. 1, 2 and 3, water penetration test

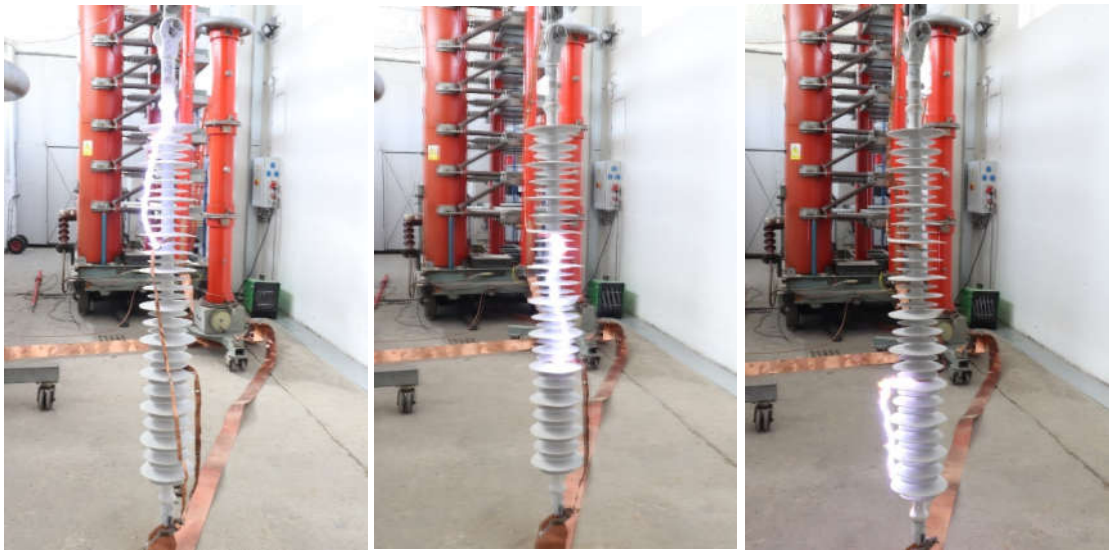


Figure 7
Test sample, during the steep-front impulse voltage test, water penetration test

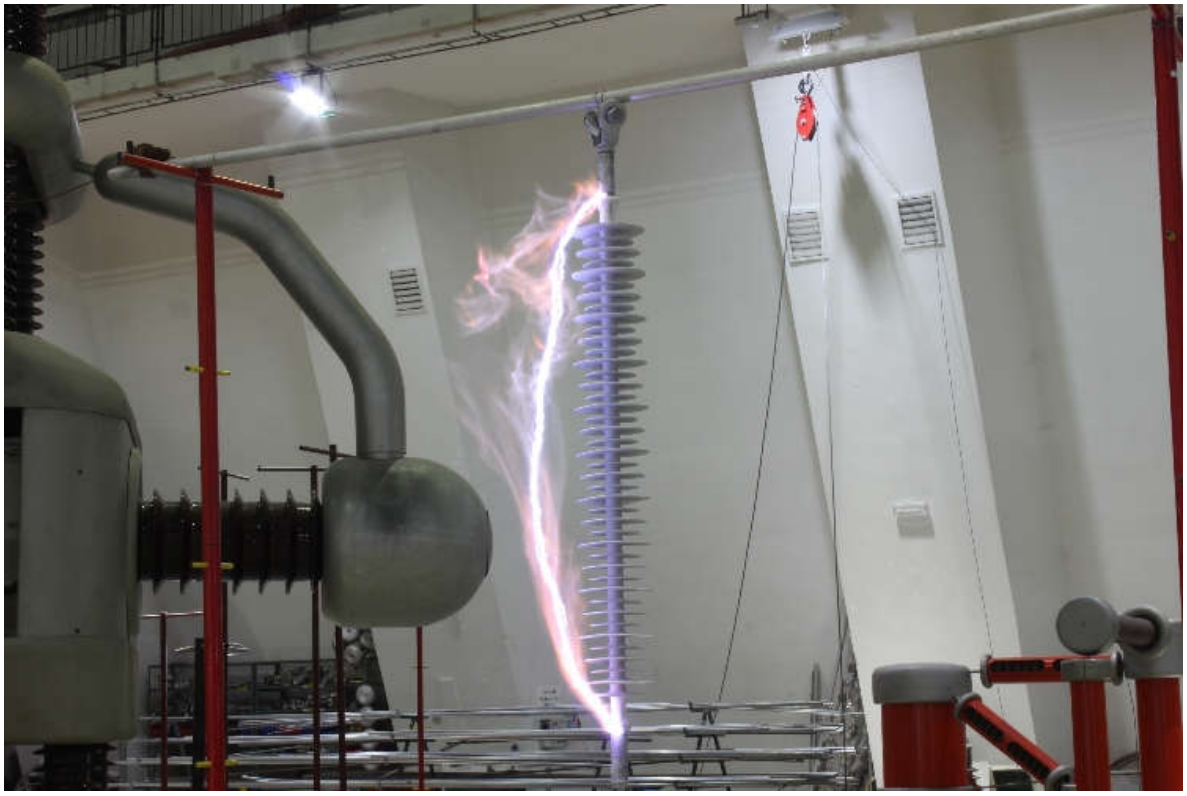


Figure 8
Test sample, during the dry power frequency flashover test, water penetration test

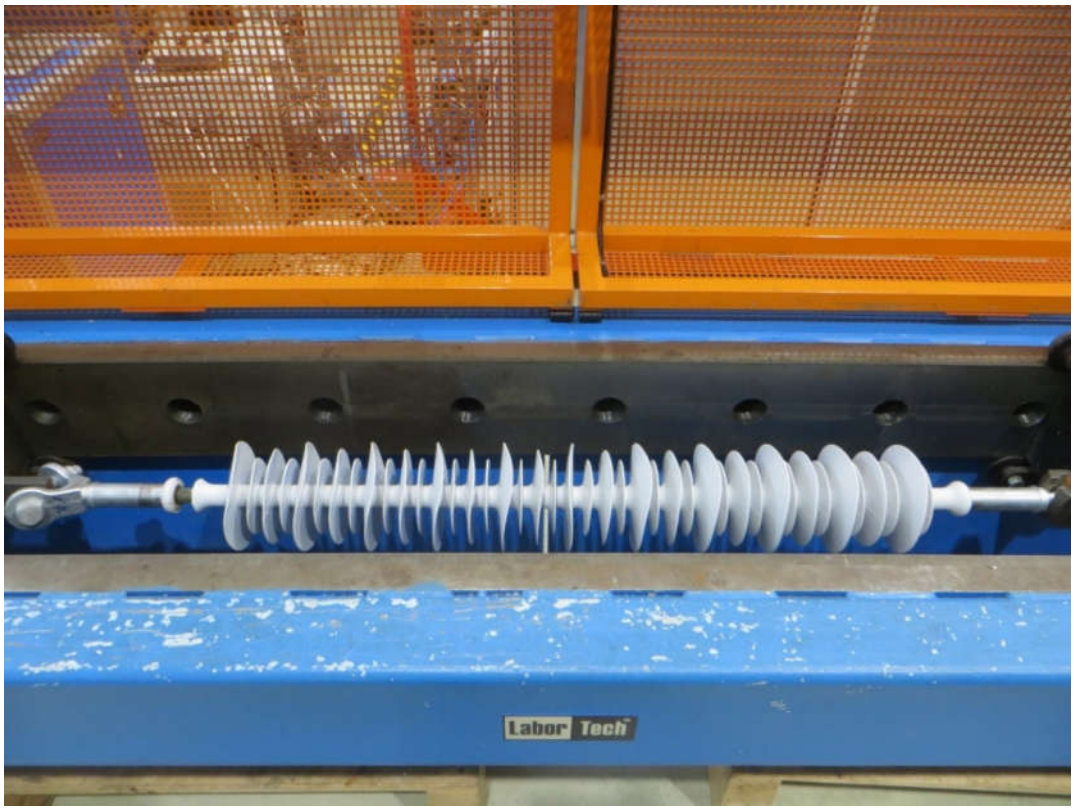


Figure 9
Test sample No. 1, after the mechanical failing load test, tensile load test

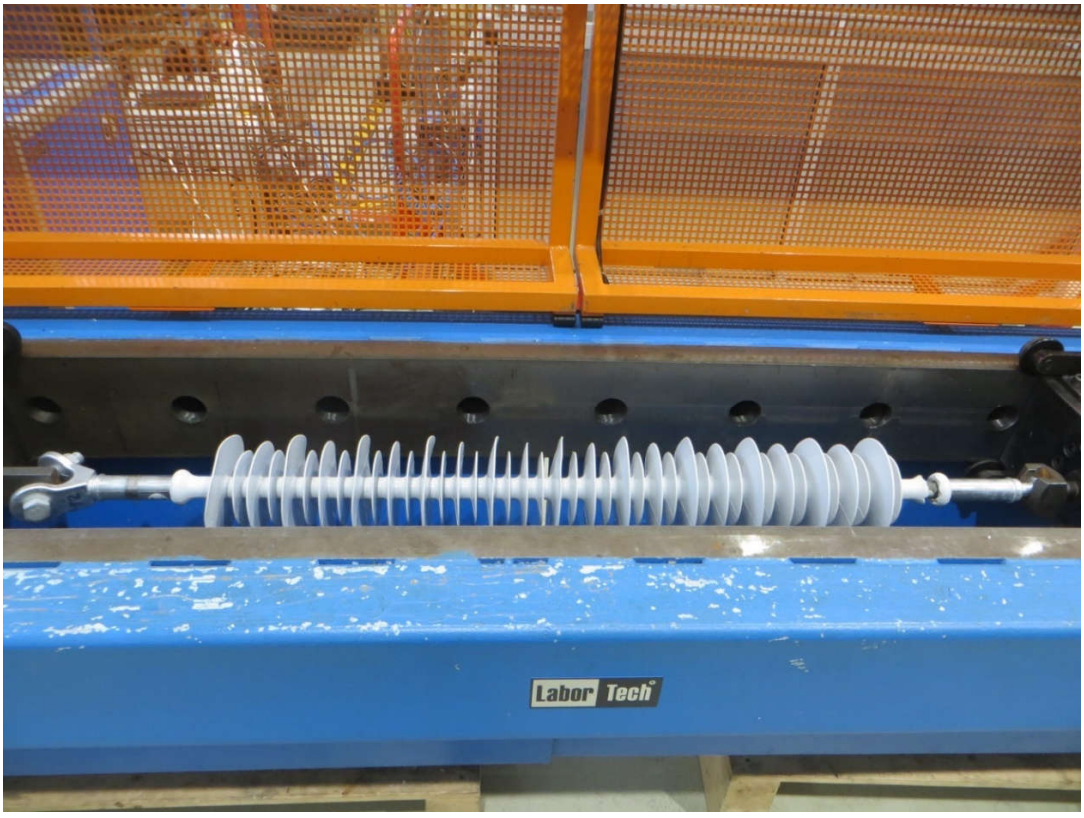


Figure 10
Test sample No. 1, after the mechanical failing load test, tensile load test

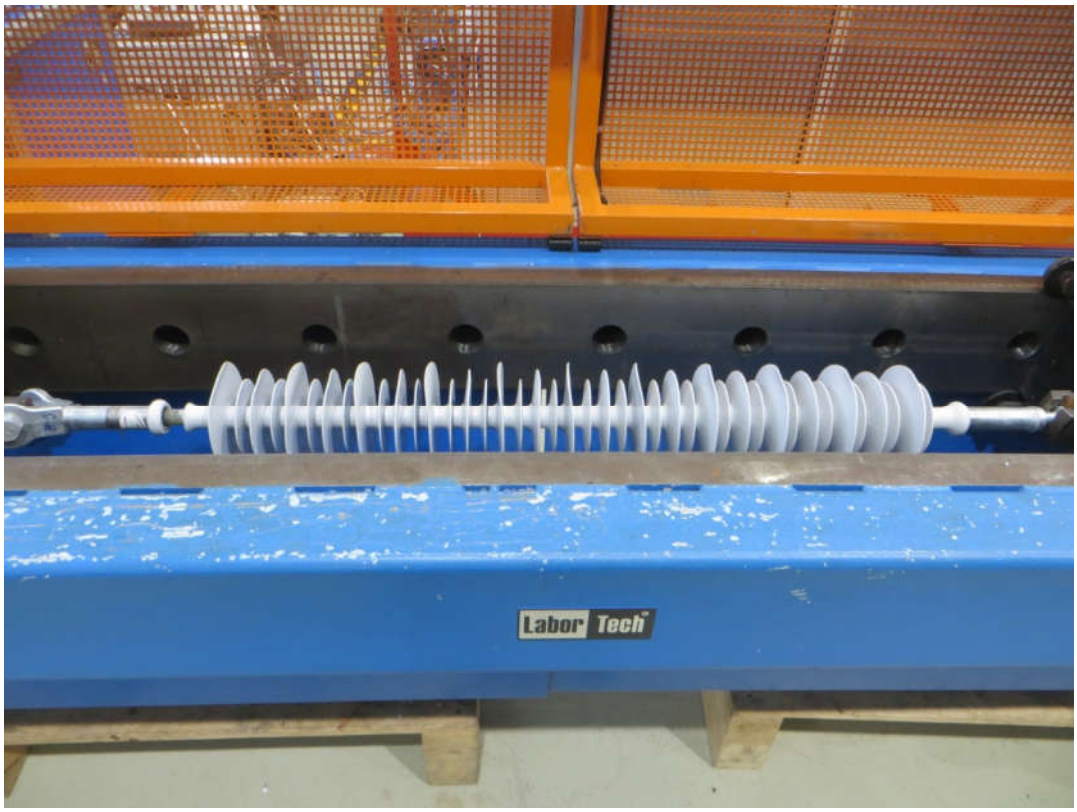


Figure 11
Test sample No. 1, after the mechanical failing load test, tensile load test

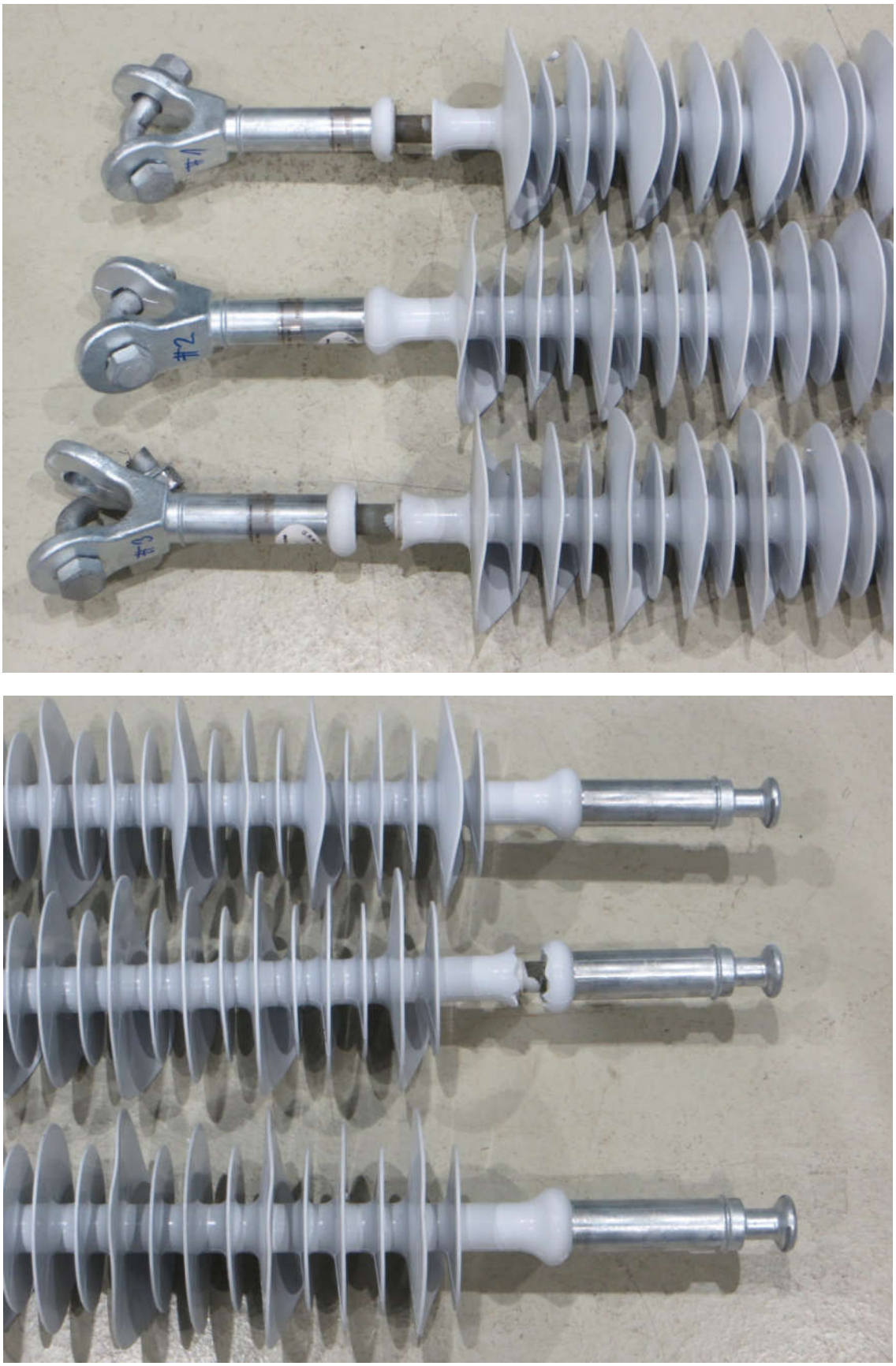


Figure 12
Test samples No. 1, 2 and 3 after the mechanical failing load test, tensile load test

Figure 13
Test samples No. 1, 2 and 3 during thermal-mechanical cycles, thermal-mechanical test

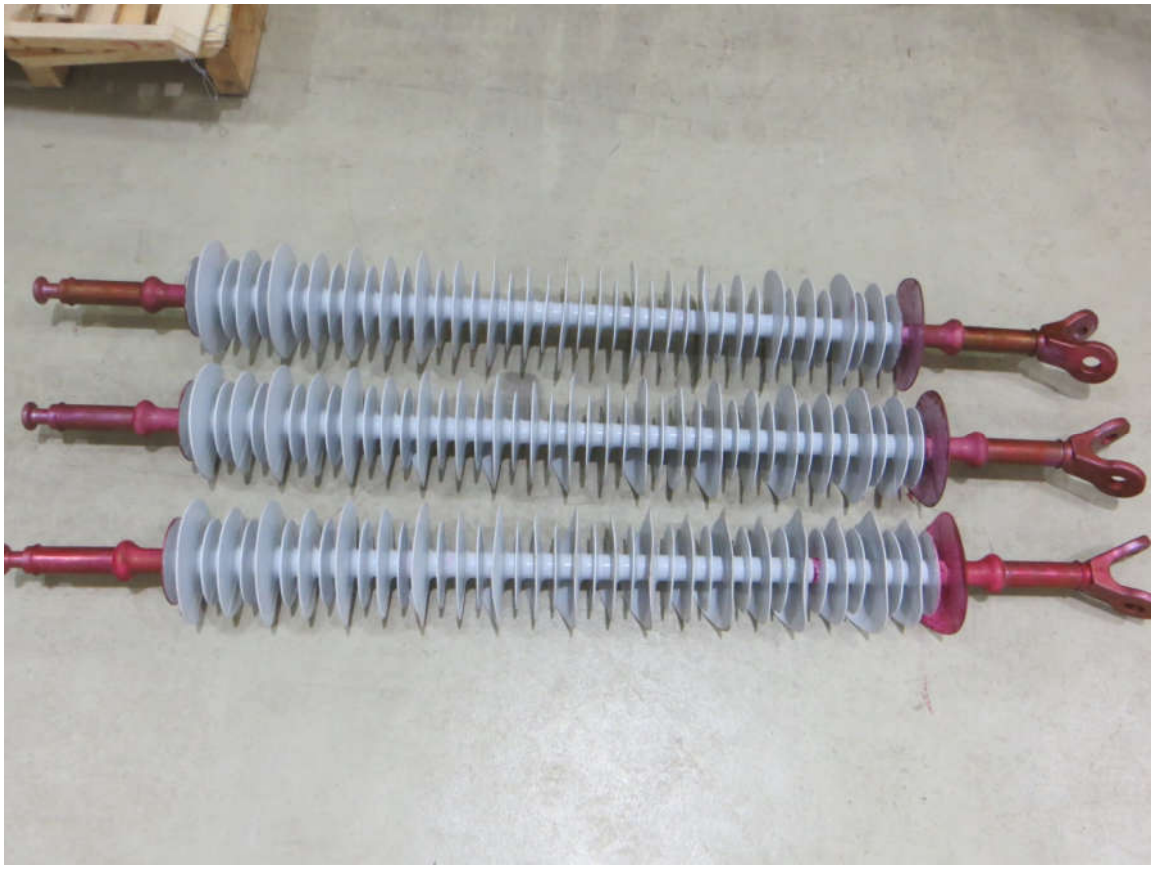


Figure 14
Test samples No. 1, 2 and 3 during diagnostic testing of the fittings, thermal-mechanical test

Figure 15
Test samples No. 1, 2 and 3 after diagnostic testing of the fittings, thermal-mechanical test

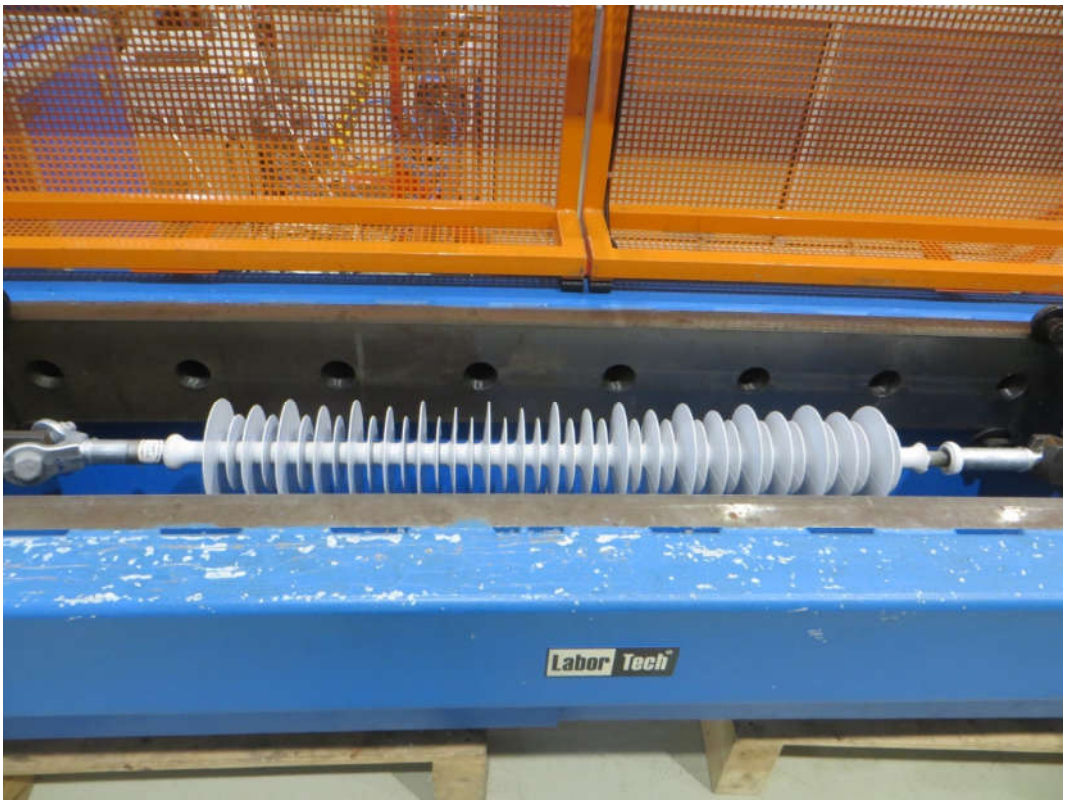


Figure 16
Test sample No. 1, after the mechanical failing load test, assembled core load-time test

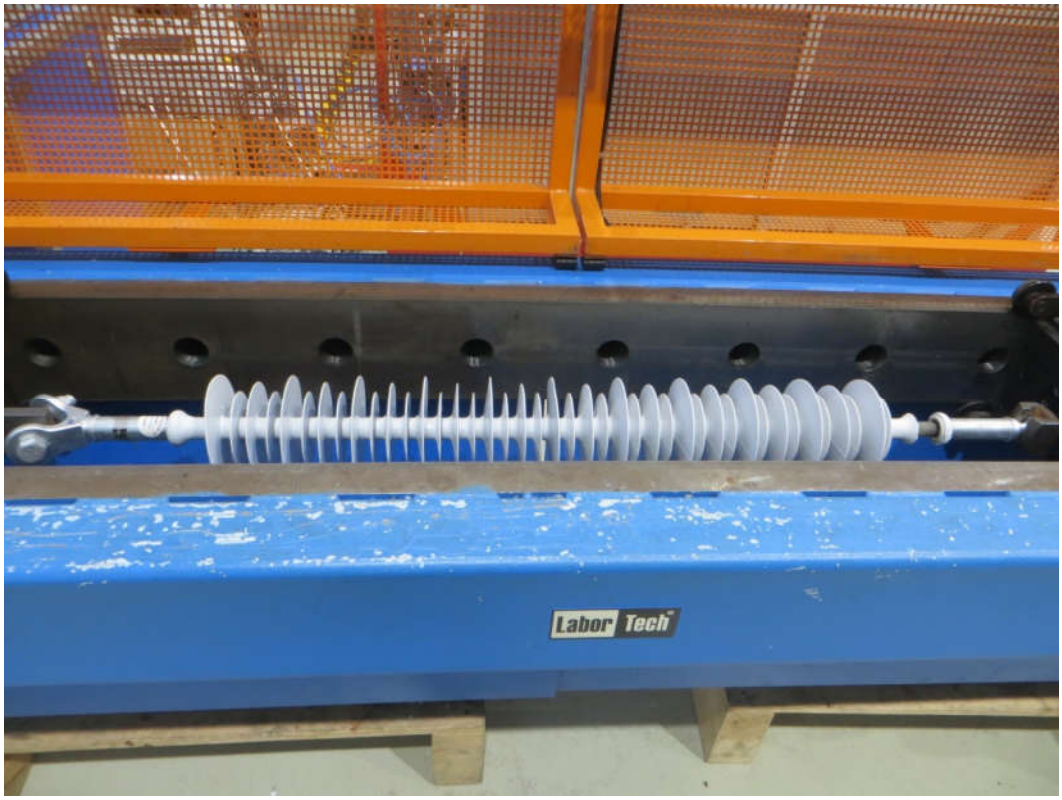


Figure 17
Test sample No. 2, after the mechanical failing load test, assembled core load-time test

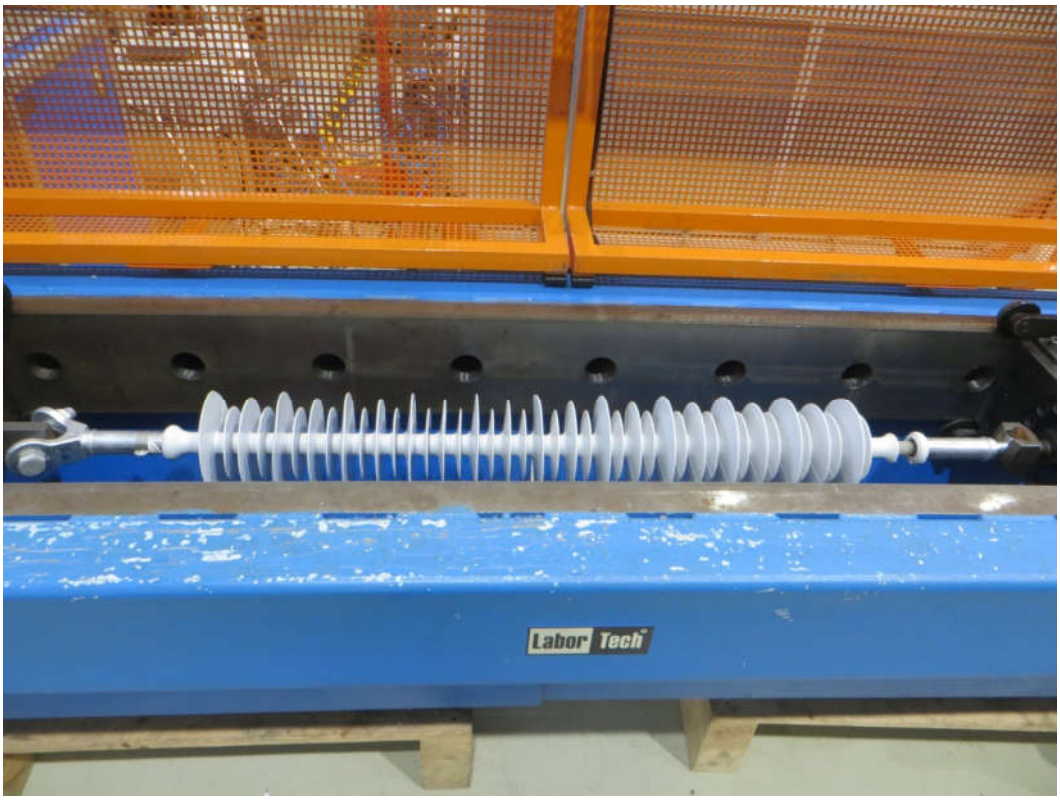


Figure 18
Test sample No. 3, after the mechanical failing load test, assembled core load-time test

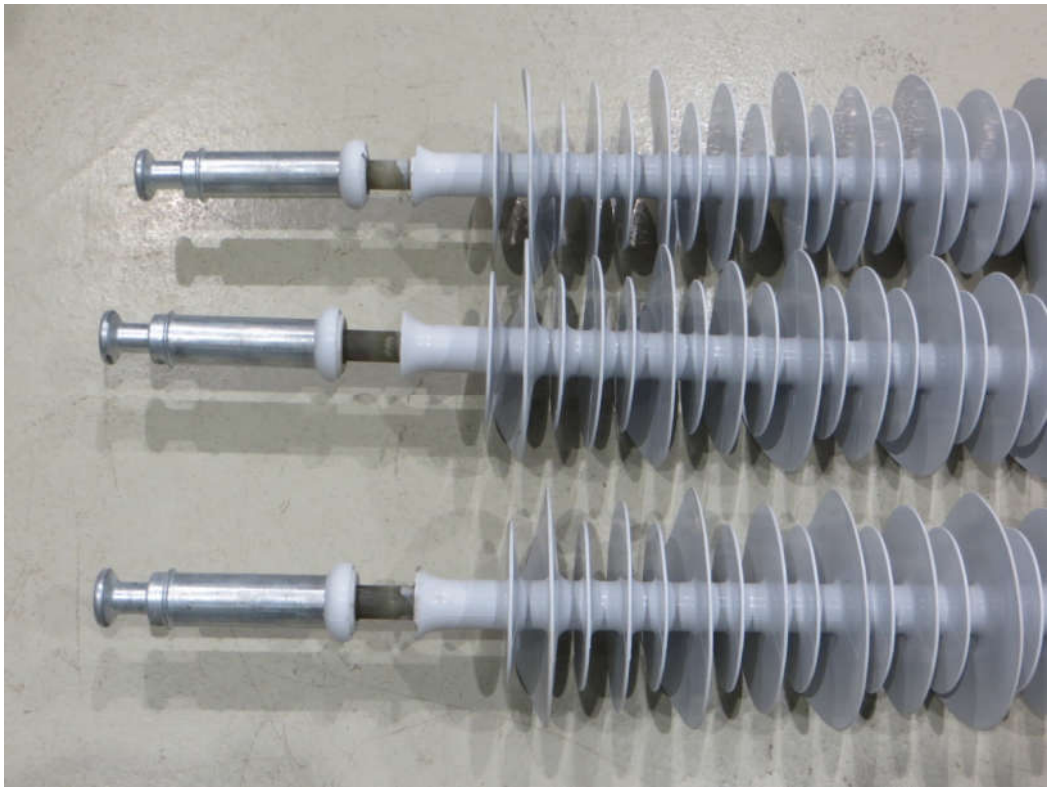


Figure 19
Test samples No. 1, 2 and 3, after the mechanical failing load test assembled core load-time test

Figure 20
Test samples No. 4, 5 and 6, during the verification of the 96 hours mechanical load test, assembled core load-time test

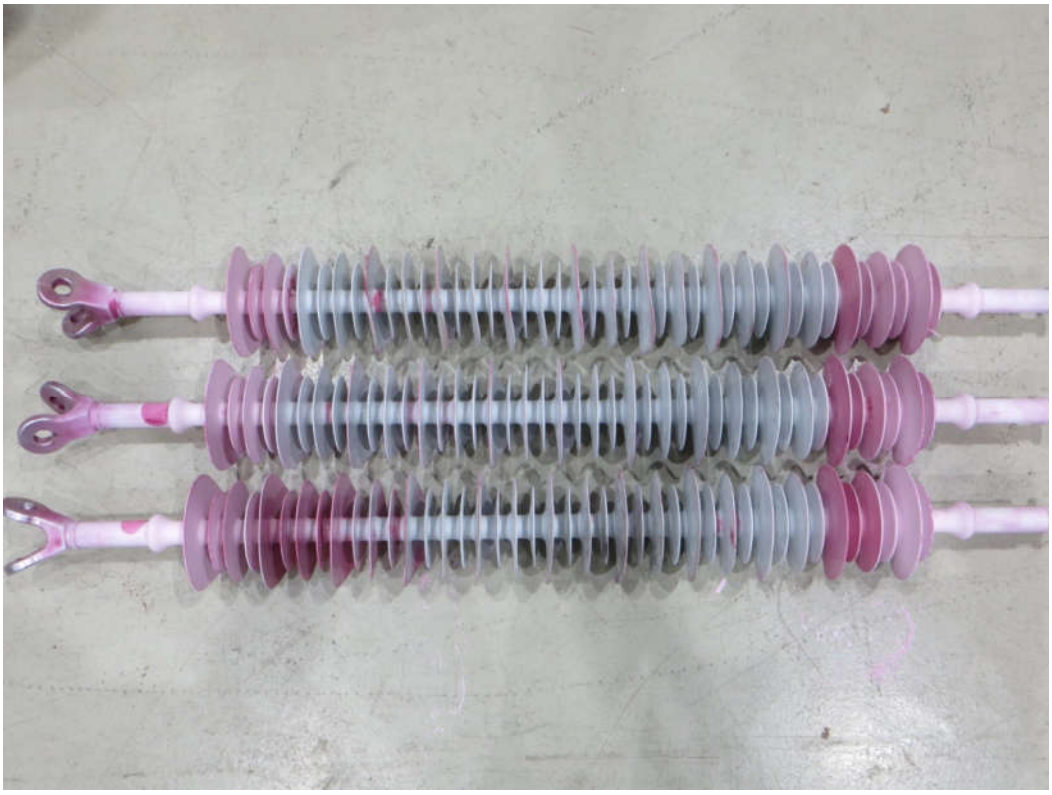


Figure 21
Test samples No. 4, 5 and 6 after diagnostic testing of the fittings, assembled core load-time test

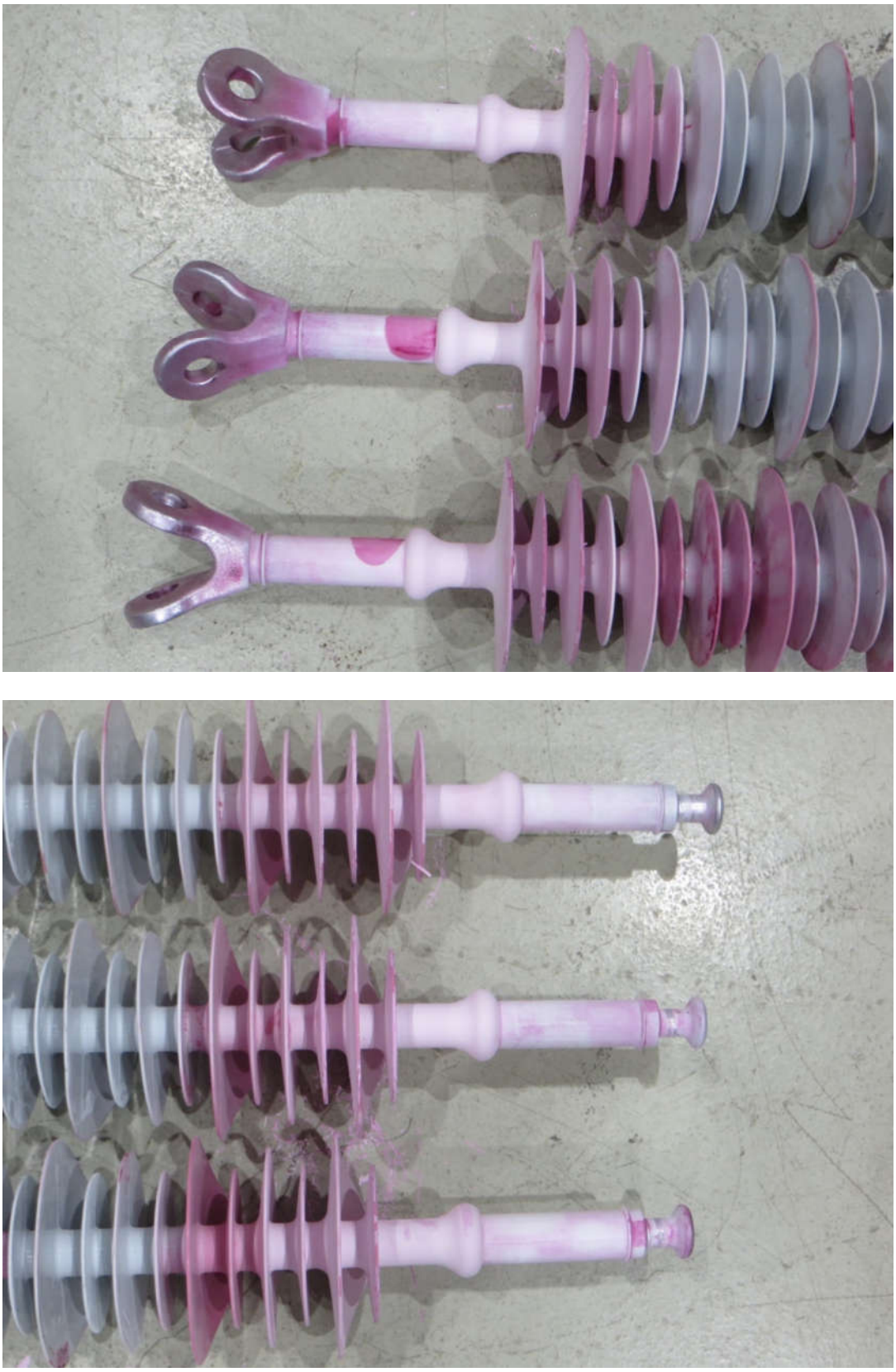


Figure 22
Test samples No. 4, 5 and 6 after diagnostic testing of the fittings, assembled core load-time test

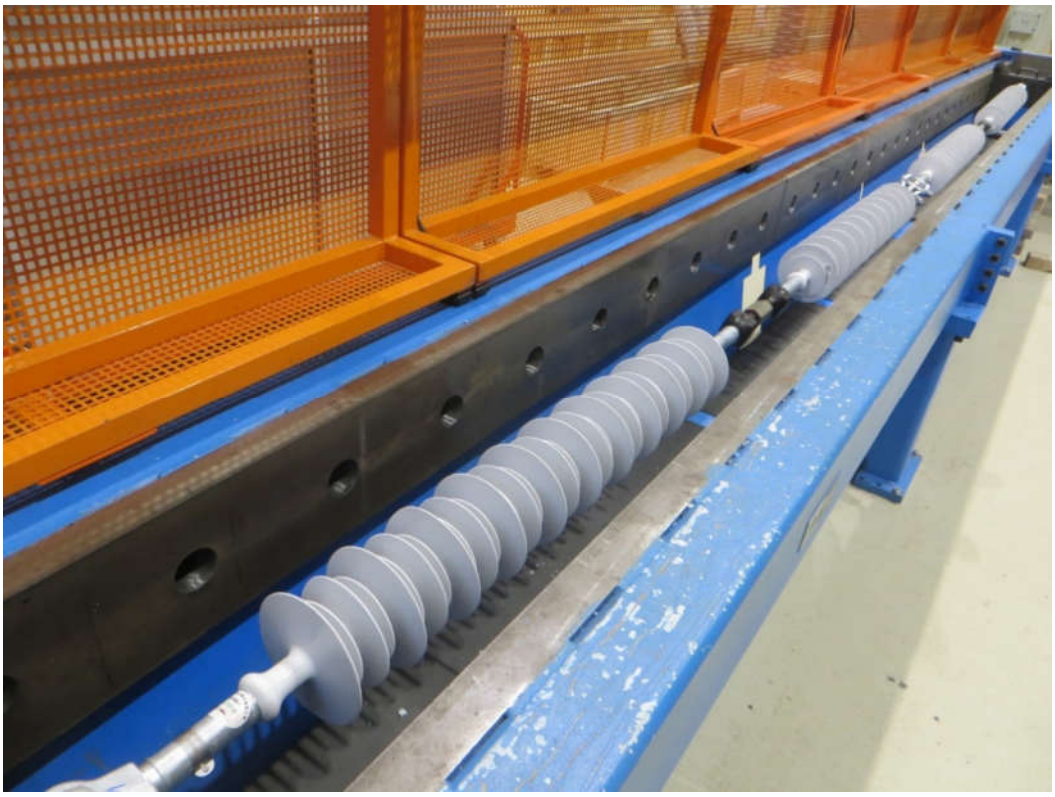


Figure 23
Test samples No. 1, 2, 3 and 4 during the verification of the 96 hours mechanical load test, mechanical load-time test

Figure 24
Test sample No. 1 after the mechanical failing load test, mechanical load-time test

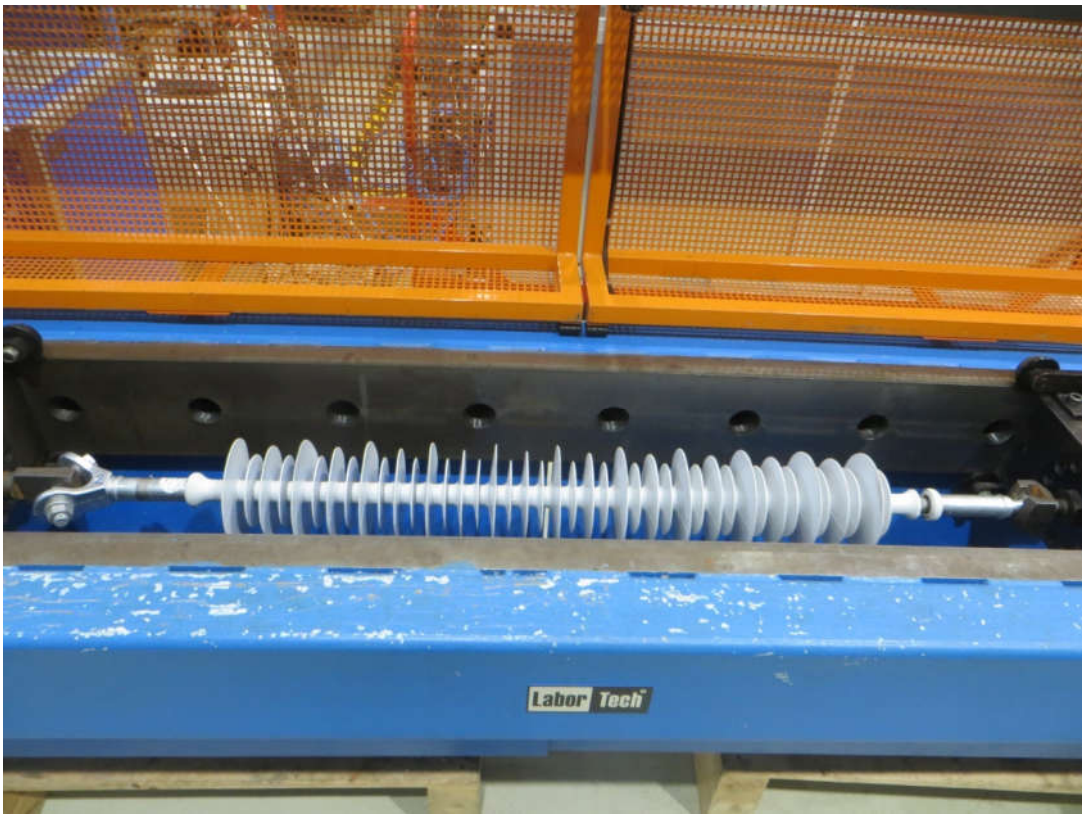


Figure 25
Test sample No. 2 after the mechanical failing load test, mechanical load-time test

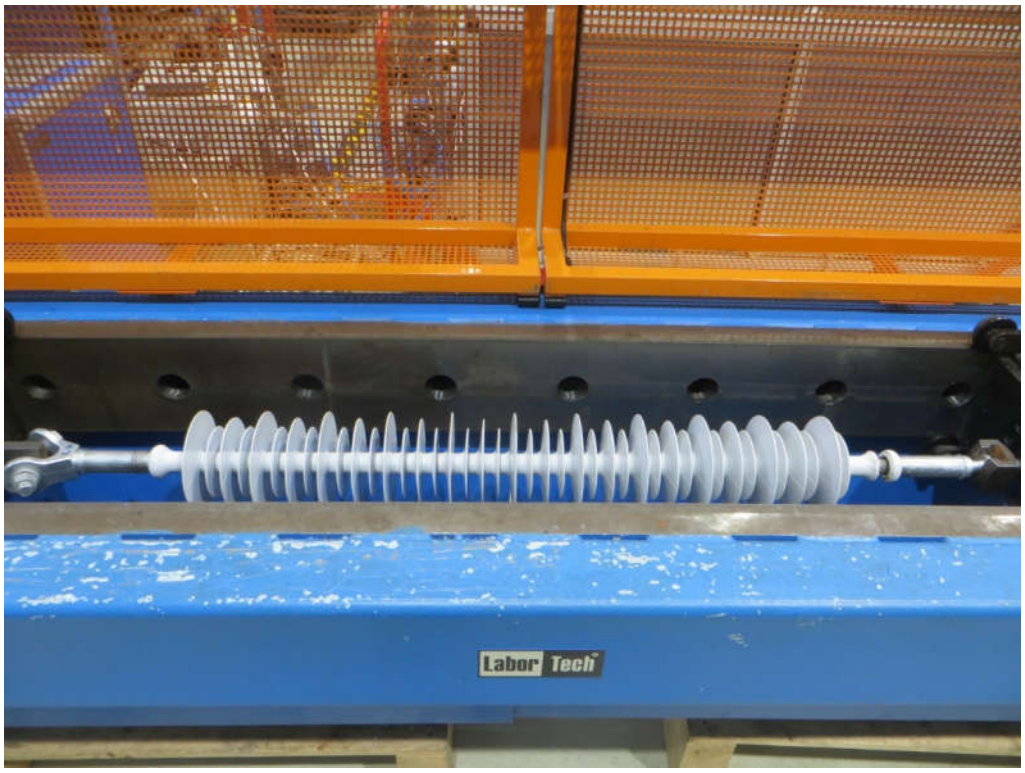


Figure 26
Test sample No. 3 after the mechanical failing load test, mechanical load-time test

Figure 27
Test sample No. 4 after the dye penetration test, mechanical load-time test

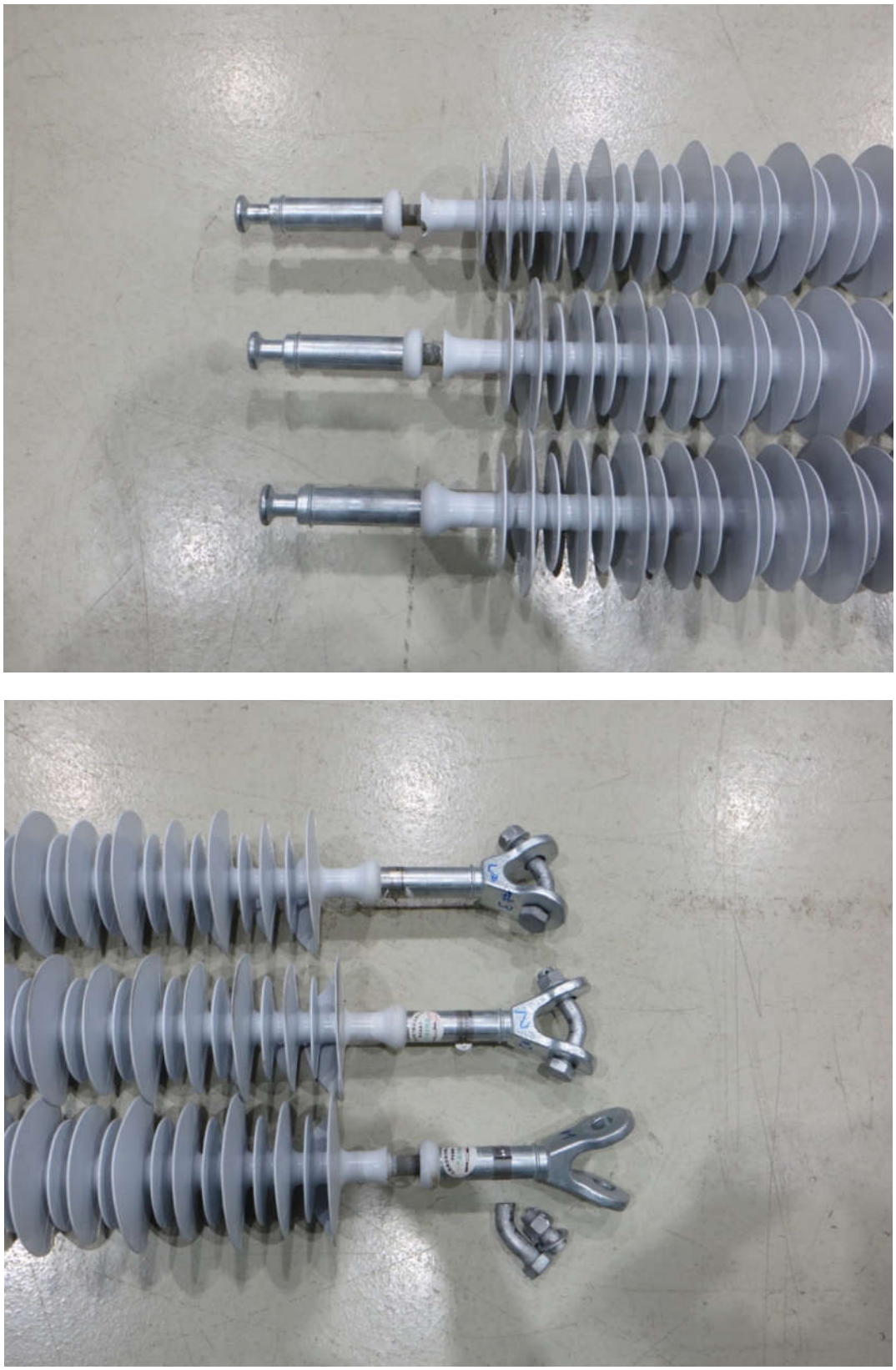


Figure 28
Test sample No. 1, 2 and 3 after the mechanical failing load test, mechanical load-time test

- end of test report -

EGU HV Laboratory a.s.
E G U - H V Laboratory a. s.
EGU HV LABORATORY, Podnikatelská 267, 190 11 Praha 9 - Běchovice

EGU HV LABORATORY

Accredited testing laboratory No.: 1029
Accredited by Czech Accreditation Institute
according to ČSN EN ISO/IEC 17025:2018

L 1029

TEST REPORT No.: 11788/H/21

CUSTOMER:	Jiangsu Shemar Electric Co., Ltd. 66 Haiwei Road 226 017 Nantong, Jiangsu China
TEST OBJECT:	138 kV Composite insulator
TYPE SPECIFICATION:	SML 222 kN
TEST STANDARDS:	CSA C411.4-16, CSA C411.1-16, IEC 60383-1 Ed.4:1993, NEMA 107:2016

Michal Novotný **Test engineer**	Marek Brosch **Head of EGU HV LABORATORY**	Jan Lachman, Ph.D. **Director of EGU - HV Laboratory a. s.**

TEST REPORT No.: 11788/H/21

TEST OBJECT:	138 kV Composite insulator
TYPE SPECIFICATION:	SML 222 kN
DRAWING No.:	21SM510756 Rev. B
MANUFACTURER:	Jiangsu Shemar Electric Co., Ltd.
DATE OF DELIVERY:	2021-12-09
DATE OF TESTS:	From 2022-02-28 till 2022-03-04
ORDER No.:	Contract 23/21
TESTS WITNESSED BY:	N/A

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1 TEST SUMMARY

Test title	Test standards	Test result
Corona test	CSA C411.4-16, clause 6.4.4	Passed
Critical impulse flashover test	CSA C411.4-16, clause 6.2 CSA C411.1-16, clause 6.5.1 to 6.5.3	Passed
Wet power frequency voltage flashover test	CSA C411.4-16, clause 6.3 CSA C411.1-16, clause 6.4	No criteria

2 TESTS PERFORMED

2.1 Corona test

2.1.1 Test procedure

Date of test: 2022-02-28

The test was carried out according to CSA C411.4-16, clause 6.4.4 and customer requirements. The test was performed on one composite insulator assembly, including grading rings, serial No. 2111150026.

After the test room was thoroughly darkened the voltage above corona point was applied and held for 5 minutes. The voltage was then reduced until corona disappeared from the test object to measure the corona extinction voltage. This procedure was three (3) times repeated. Field glasses were used for the observation of the corona. Measured extinction voltages are shown in Table 2.

The test arrangement was set up according to CSA C411.4-16, clause 6.4.2.2 (see Figure 2). The single conductor was simulated using an aluminium tube of 14 m length and 30 mm diameter. Both ends of the tube were terminated with corona shielding spheres (screening electrode) with a diameter of 300 mm. Conductor was at a height of 4 m above the ground.

The exact line configuration (conductor surface voltage gradient E_2) was not known in time of the test. The client specified test voltage (minimum corona extinction voltage) as 120% of maximum design phase-to ground service voltage i.e. $V_T = 1{,}2 \times 145/\sqrt{3} = 100$ kV.

The test object at the specified test voltage is shown in Figure 4. The corona discharges are shown in Figure 5.

Radio interference voltage RIV was measured according to NEMA 107. RIV (expressed in decibels relative to 1 µV across 150 Ω) was measured at the frequency of 1,0 MHz in compliance with the circuit diagram in Figure 3-3a of NEMA 107, Section 3.

The circuit RIV factor was 0,42.

Measured RIV values are shown in Table 1.

Testing and measuring equipment:

coupling capacitance, 1 000 pF, 800 kV, serial No. 11100108.10.1
measuring impedance Power Diagnostix, NEMA 150 Ω, type CIT4M/V8µ0/RIV, serial No. 12533
test transformer TuR Dresden 5,7/1 200 kV, 1 500 kVA
inductive regulator ČKD Praha 6/ 0 - 3 kV, 50 kVA
capacitive divider TuR Dresden 1 200 kV, 150 pF, type WMC 160/1200, serial No. 884470
universal voltmeter Haefely Trench, type DMI 551, serial No. 150505
RIV meter - measuring receiver Power Diagnostix, type RIV meter, serial No. 035
calibrator Power Diagnostix, type CAL3B, serial No. 3014
measuring system for atmospheric condition COMET, serial No. 10910247
digital stop-watch Kalenji, PM-259
field glasses Nikon Action EX 7x50, serial.No. 320695
measuring telescopic stick 5m, type BMI, serial No. 102

2.1.2 Test results

Table 1 Test results of the RIV test

U_m (kV)	**145**		
Atm. conditions p (kPa) t (°C) RH (%)	 100,5 15,8 33,1		
Test voltage (kV)	**RIV ↓ (µV)**	**RIV ↑ (µV)**	**RIV ↓ (µV)**
180	31 623	31 623	31 623
170	28 184	28 184	28 184
160	25 119	25 119	25 119
150	3 548	2 818	3 162
140	22	22	22
130	22	22	22
120	22	22	22
110	22	22	22
100	**22**	**22**	**22**
90	22	22	22
80	22	22	22
70	22	22	22
|	|	|	|
0	22	22	22

Table 2 Test results of the corona test

U_m (kV)	**145**
Atm. conditions p (kPa) t (°C) RH (%)	 100,5 15,8 33,1
Measurement No.	**U_e (kV)**
1 2 3	144 142 143
Average value Location of corona	**143** Corona ring
Criteria: U_e > 100 kV	

Evaluation:

Measured corona extinction voltages U_e were greater than the specified minimum corona extinction voltage of 100 kV.

Statement of conformity:

138 kV Composite insulator, SML 222 kN, drawing No. 21SM510756 Rev. B, passed the test according to requirements given in CSA C411.4-16, clause 6.4.4.

2.2 Critical impulse flashover test

2.2.1 Test procedure

Date of test: 2022-03-01

The test was carried out according to CSA C411.4-16, clause 6.2 and CSA C411.1, clause 6.5.1 to 6.5.3.

The tests were performed on three insulators:

No. 1, serial No. 2111150026,
No. 2, serial No. 2111150004,
No. 3, serial No. 2111150020.

The critical impulse voltages of both polarities were determined by the up and down method with 30 impulses according to CSA C411.1-16, clause 6.5.3.

All measured voltages were corrected to the standard reference atmospheric conditions according to CSA C411.1-16, clause 6.2.5 and 6.2.6.

The representative wave shape of the lightning impulse 1,2/50 µs is given Graph 1.

The test arrangement was set up in compliance with IEC 60383-1, clause 34 (see Figure 6).

Testing and measuring devices:

impulse generator HighVolt IGL 180/1800G, serial No. IGG2295141
capacitive/resistive divider HighVolt, type MCR 0,4/2000-1000/1000 H391-41, serial No. MCR2295141/103732
measuring system High Volt, type HiRES S4D, serial No. HIGG2295141
tape measure 7,5 m, Assist, PM-242
measuring system for atmospheric condition COMET, serial No. 14900363

2.2.2 Test results

Table 3 Test results of the critical impulse flashover test

Test sample No.	**1**		**2**		**3**	
Impulse polarity	+	–	+	–	+	–
Atm. conditions:						
air pressure (kPa)	100,0	100,0	99,9	99,9	100,0	100,0
air temperature (°C)	17,0	17,0	16,5	16,5	16,7	16,7
relative humidity (%)	28,1	28,1	28,2	28,2	28,9	28,9
Correction factors:						
air density correction factor k_1	0,997	0,997	0,998	0,998	0,998	0,998
humidity correction factor k_2	0,947	0,958	0,948	0,956	0,949	0,954
atmospheric correction factor K_t	0,945	0,955	0,946	0,955	0,948	0,953
Critical impulse flashover voltage (kV)	**744**	**782**	**748**	**779**	**750**	**767**
Polarity	+			-		
Average critical impulse flashover value of the three insulators (kV)	**747**			**776**		
Measured arcing distance: 1 151 mm						
Drawing specified critical impulse flashover voltage: 780 kV						
CSA C411.-16, Table 2 specified critical impulse flashover voltage: 780 kV						

Evaluation:

The average critical impulse flashover value of the three insulators was equal to or exceed 95% of the rated critical impulse flashover value specified by CSA C411.4-16, Table 2 and drawing 780 kV, i.e. 741 kV.

Statement of conformity:

138 kV Composite insulator, SML 222 kN, drawing No. 21SM510756 Rev. B, passed the test according to requirements given in CSA C411.4-16, clause 6.2. and client requirements.

2.3 Wet power frequency voltage flashover test

2.3.1 Test procedure

Date of test: 2022-03-04

The test was carried out according to CSA C411.4-16, clause 6.3 and CSA C411.1-16, clause 6.4.

The tests were performed on three insulators:

No. 1, serial No. 2111150026,
No. 2, serial No. 2111150004,
No. 3, serial No. 2111150020

Characteristics of the artificial rain and precipitation method was in accordance with the CSA C411.1-16, clause 6.4.3.

The wet power-frequency flashover voltage test was performed according to CSA C411.1-16, clause 6.4.4. The flashover voltage was obtained by increasing the voltage continuously from zero up to flashover. The average of five flashovers was calculated.

All measured voltages were corrected to the standard reference atmospheric conditions according to CSA C411.1-16, clause 6.2.5 and 6.2.6.

The test arrangement was set up in compliance with IEC 60383-1, clause 34 (see Figure 7).

Testing and measuring equipment:

synchronous generator BEZ Bratislava 6 kV, 1 300 kVA, 50 Hz
test transformer TuR Dresden 5,7/1200 kV, 1500 kVA, serial No. 884469
capacitive divider TuR Dresden 1200 kV, 150 pF, type WMC 160/1200, serial No. 884470
universal voltmeter Haefely Trench, type DMI 551, serial No. 150505
measuring system for atmospheric conditions Comet, serial No. 10910247
tape measure 5 m, CXS, PM-241
digital stop-watch Kalenji PM-259
conductivity meter WTW Cond 3310, serial No. 10410891
plastic measuring cylinder 50ml, identification No. 1/153/14 & 2/153/14

2.3.2 Test results

Table 4 Test results of the wet power frequency flashover voltage test

Test sample No.	1	2	3
Atm. conditions:			
air pressure (kPa)	98,8	98,8	98,8
air temperature (°C)	16,0	16,0	16,0
relative humidity (%)	45,1	45,1	45,1
Rain parameters:			
vertical (mm/min)	1,6	1,6	1,6
horizontal (mm/min)	1,2	1,2	1,2
Conductivity (µS/cm)	100	100	100
Correction factors:			
air density correction factor k_1	0,989	0,989	0,989
humidity correction factor k_2	1,000	1,000	1,000
atmospheric correction factor K_t	0,989	0,989	0,989
Flashover voltage	**392 kV**	**404 kV**	**401 kV**
The average wet flashover voltage of the three insulators	**399 kV**		
Measured arcing distance: 1 151 mm			
Drawing specified wet power frequency flashover voltage: 393 kV			

3 LIST OF SYMBOLS

RIV	radio interference voltage (µV)
V_t	test voltage specified by client (kV)
U_m	maximum design phase-to-phase service voltage
U_e	extinction corona voltage (kV), corresponding to actual atmosphere
p	air pressure (kPa)
t	air temperature (°C)
RH	relative humidity (%)
k_1	air density correction factor
k_2	humidity correction factor
K_t	atmospheric correction factor
U_{pk}	maximum voltage of recorded curve (kV)
β'	relative overshoot (%)
T_1	front time of recorded curve (µs)
T_2	time to half-value of recorded curve (µs)
vertical c.	average value of rainfall intensity – vertical component (mm/min)
horizontal c.	average value of rainfall intensity – horizontal component (mm/min)
conductivity	water conductivity (µS/cm)

4 UNCERTAINTY OF MEASUREMENTS

QUANTITY	UNCERTAINTY (k=2)	
Lightning impulse voltage	U_{pk} T_1 T_2	1,7 % 8,0 % 3,1 %
Radio interference voltage	1,0 dB	
Power-frequency voltage	1,7 %	
Air pressure	0,5 %	
Temperature	4,0 %	
Relative humidity	6,3 %	
Time	0,7 %	
Telescopic stick	0,8 %	
Length (tape measure)	1,6 %	
Rainfall intensity	10 %	
Conductivity	5,0 %	

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a Normal (Gaussian) distribution corresponds to a coverage probability of approximately 95 %. Details related to the statement of conformity when applied are given in a price quotation submitted to a customer before the testing and on the website of the laboratory.

5 PRODUCT DRAWING

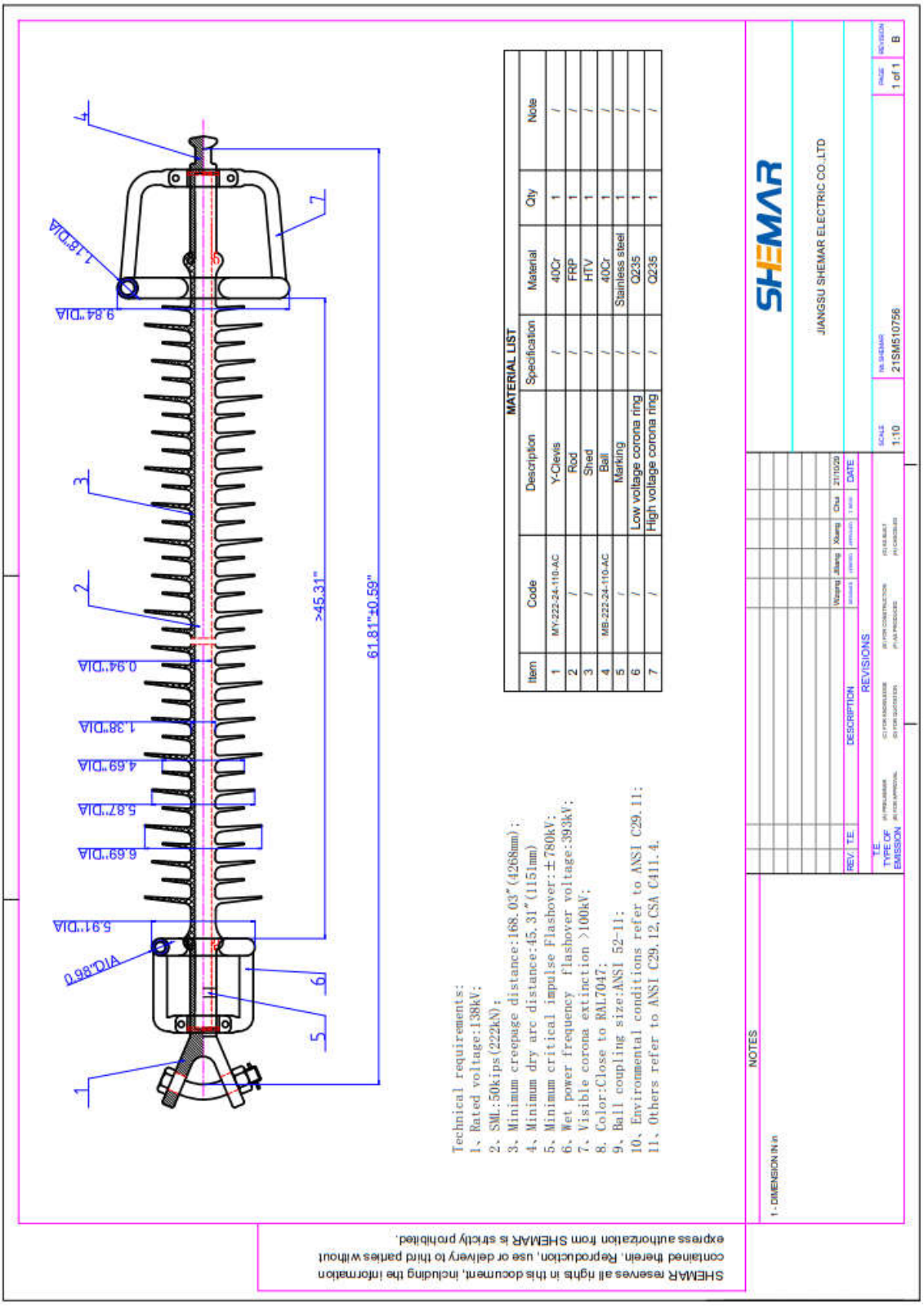


Figure 1
138 kV Composite insulator, SML 222 kN, drawing No. 21SM510756 Rev. B

6 TEST SETUP PHOTOS

Figure 2
Test arrangement for RIV and corona tests

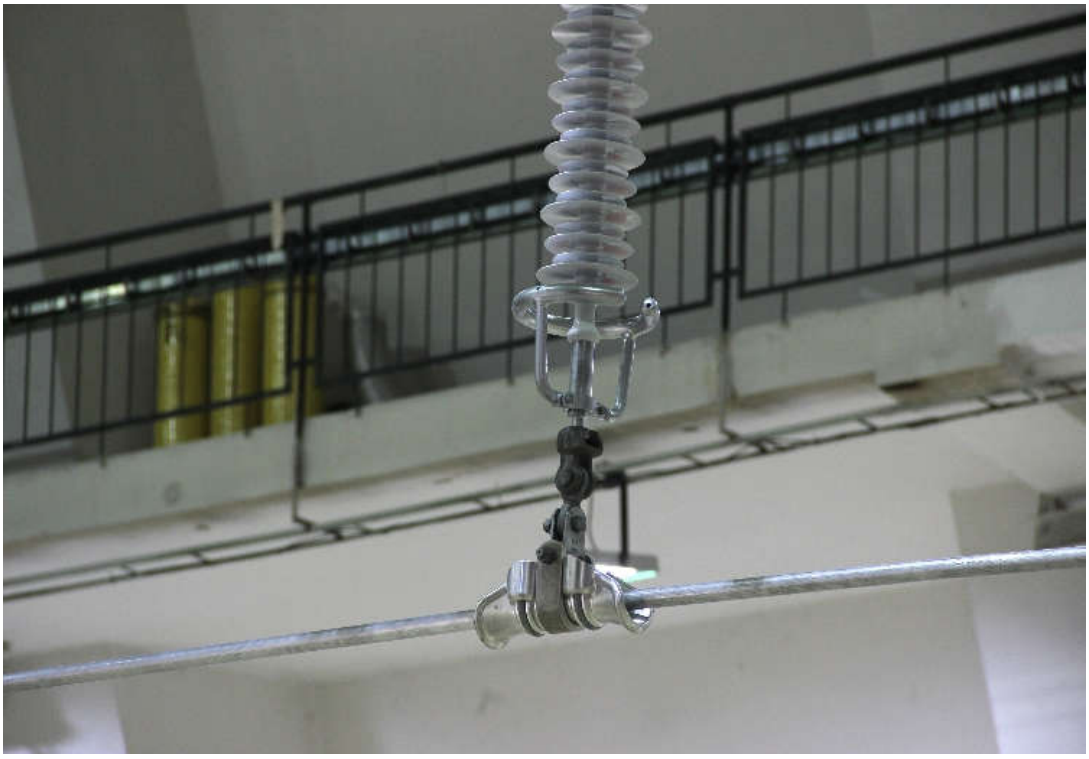


Figure 3
Test arrangement for RIV and corona tests

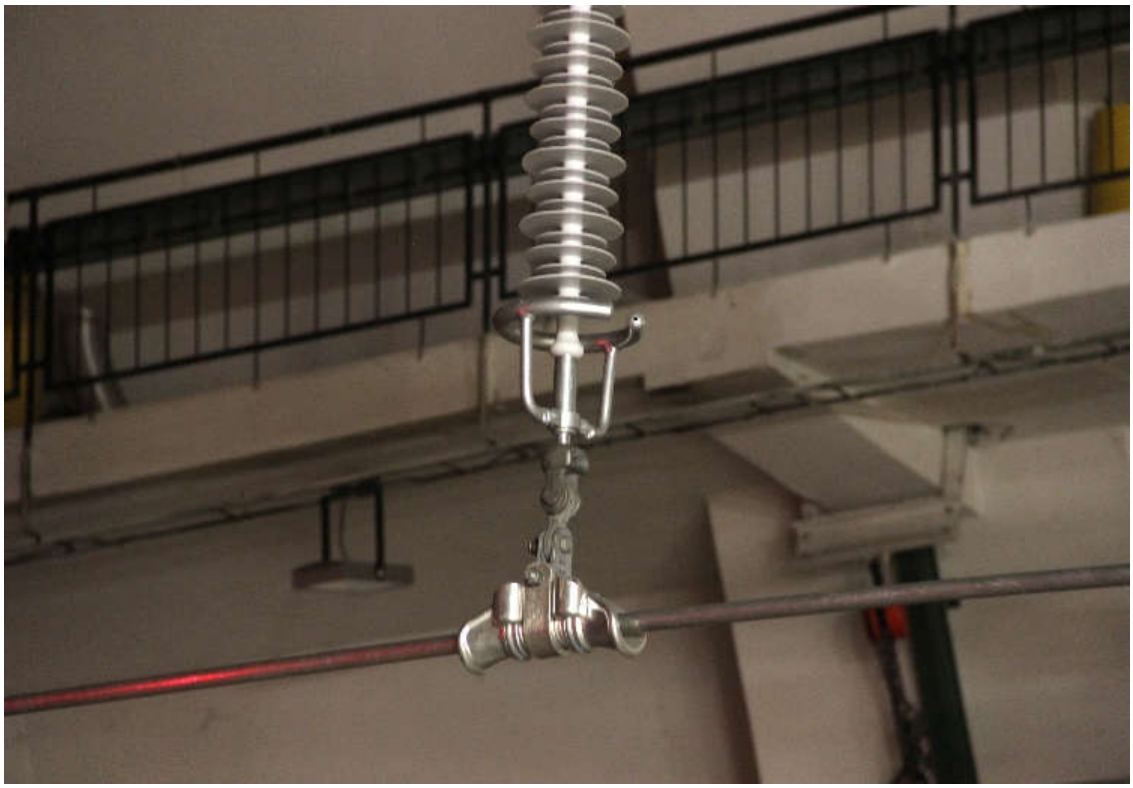


Figure 4
Test object at the test voltage of 100 kV – no positive corona

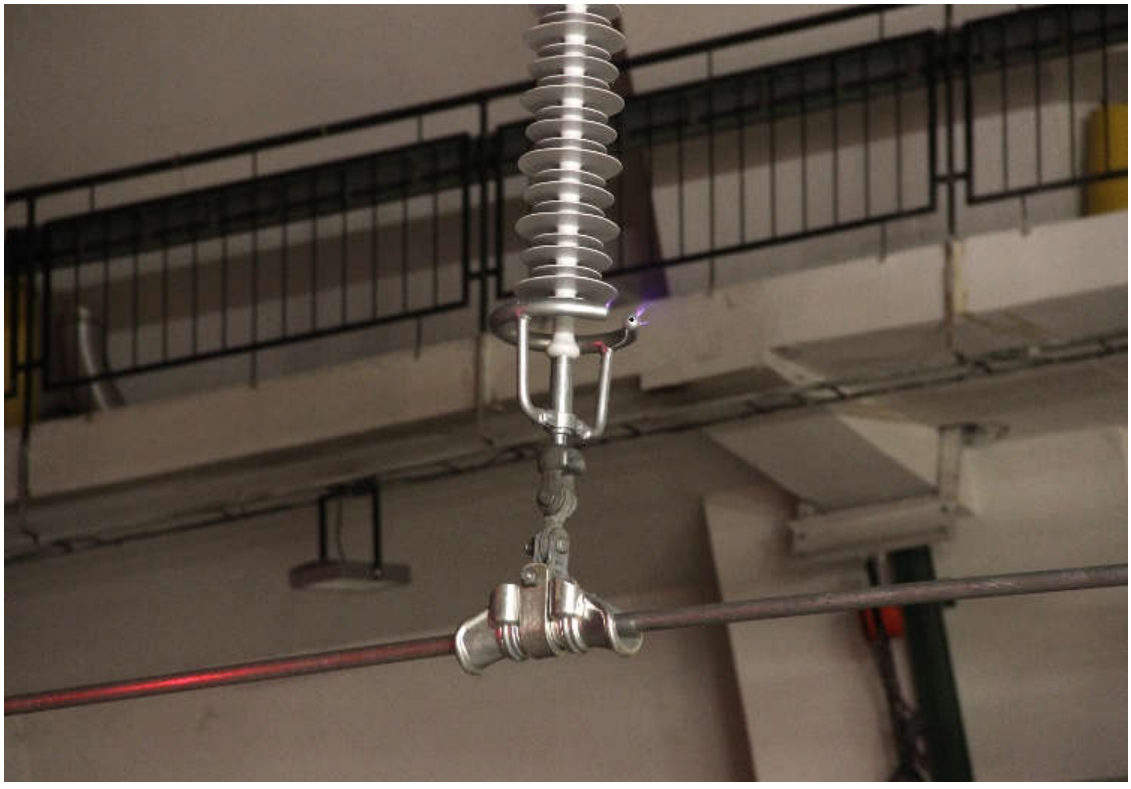
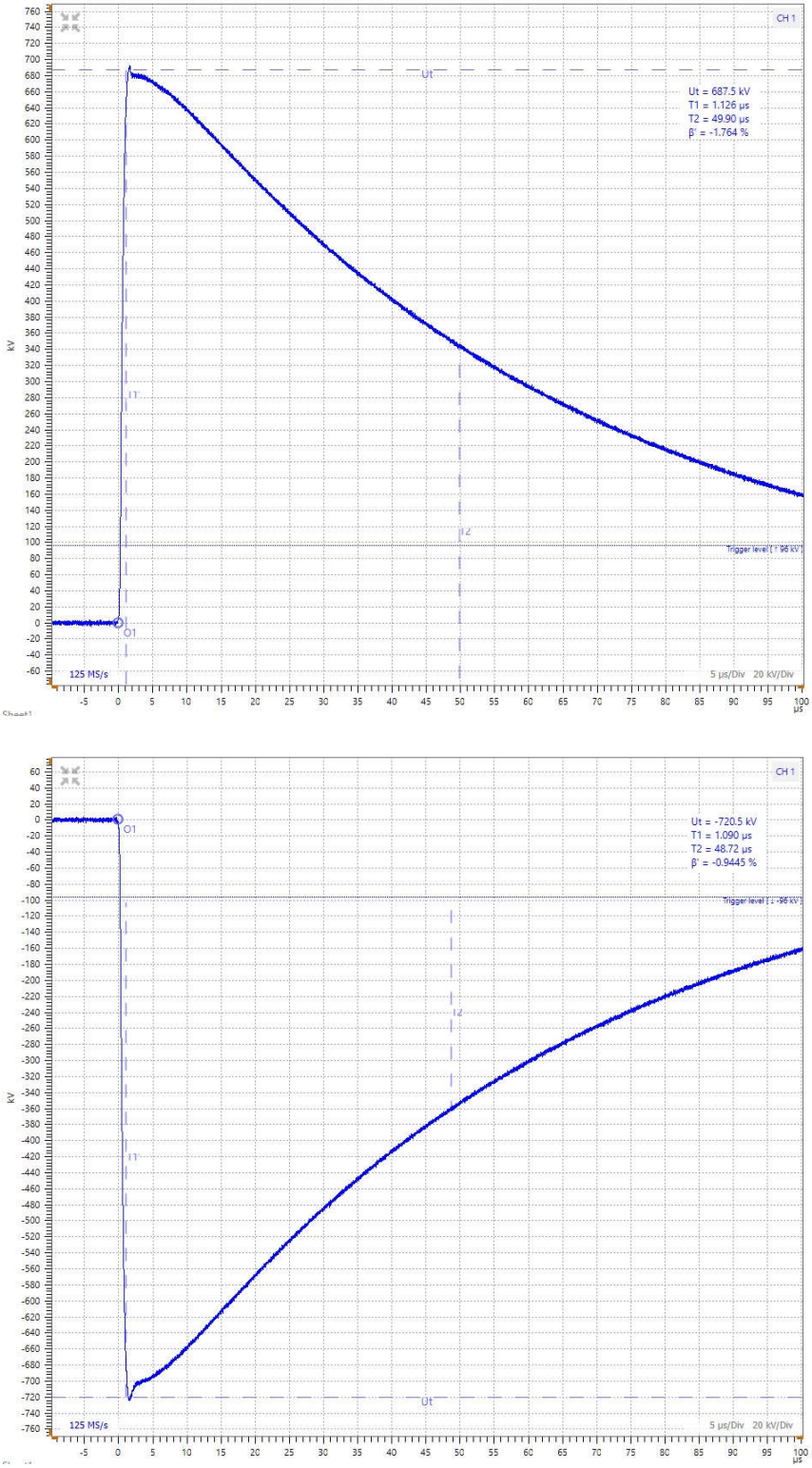


Figure 5
Test object at the test voltage of 180 kV

Figure 6
Test arrangement and flashover under the critical impulse flashover test

Figure 7
Test arrangement and flashover under the wet power frequency voltage flashover test

7 GRAPHS



Graph 1
Representative wave shape of the lightning impulse 1,2/50 µs

- end of test report -

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L 1029

EGU HV LABORATORY

Accredited testing laboratory No.: 1029
Accredited by Czech Accreditation Institute
according to ČSN EN ISO/IEC 17025:2018

TEST REPORT No.: 11788/Z/21

CUSTOMER:	Jiangsu Shemar Electric Co., Ltd. 66 Haiwei Road 226 017 Nantong, Jiangsu China
TEST OBJECT:	138 kV Composite insulator
TYPE SPECIFICATION:	SML 222 kN
TEST STANDARDS:	CSA C411.4-16, CSA C411.1-16, IEC 60060-1 Ed. 3.0:2010

Michal Novotný **Test engineer**	Marek Brosch **Head of EGU HV LABORATORY**	Jan Lachman, Ph.D. **Director of EGU - HV Laboratory a. s.**

TEST REPORT	No.: 11788/Z/21
TEST OBJECT:	138 kV Composite insulator
TYPE SPECIFICATION:	SML 222 kN
DRAWING No.:	21SM510756 Rev. B XL21LS173, Rev. 01
MANUFACTURER:	Jiangsu Shemar Electric Co., Ltd.
DATE OF DELIVERY:	2022-06-15
DATE OF TESTS:	From 2022-06-24 till 2022-09-12
ORDER No.:	Contract 23/21
TESTS WITNESSED BY:	N/A

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1 TEST SUMMARY

Test title	Test standard	Test result
Tracking and erosion test	CSA C411.4-16, clause 5.5	Passed
Visual inspection of test specimen	CSA C411.4-16, clause 5.5.1	Passed
Steep-front impulse voltage test and Power-frequency voltage test	CSA C411.4-16, clause 5.5.4.2	Passed

Design tests are intended to verify the suitability of the design, materials and method of manufacture.
A composite insulator design is defined by:

- shed material
- housing material
- shed design
- housing design
- core material
- core diameter
- manufacturing process
- metal fitting material
- metal fitting connection zone design
- metal fitting coupling design
- core-housing-metal fitting interface design
- metal fitting method of attachment to core

Composite insulator 138 kV / 222 kN drawing 21SM510756, Rev. B is parent insulator for given design, see CSA C411.4-16 clause 4 and Table 1.

Following insulators have same design:
161 kV / 222 kN, drawing No. 21SM510757, Rev. B (see Figure 3)
230 kV / 222 kN, drawing No. 21SM510758, Rev. B (see Figure 4)
345 kV / 222 kN, drawing No. 21SM510759, Rev. B (see Figure 5)
500 kV / 222 kN, drawing No. 21SM510760, Rev. B (see Figure 6)

2 TESTS PERFORMED

2.1 Tracking and erosion test

Test was carried out according to CSA C411.4-16, clause 5.5, method 2 (tracking wheel No. 2).

2.1.1 Test specimens

Test was carried out according to CSA C411.4-16, clause 5.5.1. The test was performed on composite insulator samples with reduced length No.: 1, 2, 3 and 4 REF.

No. 1, serial No. 2205300001,

No. 2, serial No. 2205300002,

No. 3, serial No. 2205300004.

No. 4 REF, serial No. 2205300003.

The insulators were examined visually and their dimensions were checked against the manufacturer's drawing (see Figure 2).

Testing and measuring equipment

tape measure 5 m, CXS, PM-241
slide gauge 150 mm, Kinex CZ, serial No. KN2038
slide gauge 1000 mm, Kinex CZ, serial No. C11121

Evaluation:

Insulators were without damage and dimensions conform to the drawing.

2.1.2 Tracking wheel test method 2

Test date: From 2022-06-24 till 2022-09-11

Test procedure and test results

The saline solution in the tank consisted de-ionised water with 1,40 ± 0,06 g/l of NaCl.

The voltage stress was 35 V/mm of insulator leakage distance. Each insulator was exposed to 30 000 cycles in accordance with CSA C 411.4-16, annex B.

After every four days of testing the insulators were given a 24 hour recovery period. During this period, the test procedure was unchanged except that the saline solution was removed from the dip tank.

The test arrangement of the tracking and erosion test before start is shown in Figure 7. Test samples after tracking and erosion test are shown in Figure 8, 9, 10, 11 and 12.

Testing and measuring equipment:

Regulation transformer TuR Dresden 54kVA, serial No. 830212 + testtransformer ES Brno 100 kVA, serial No. 150604
measuring Transformer UZGT 30, serial No. 02022
Multimeter UT71D, serial No. 1100420241
Conductivity meter, WTW Cond 3310, serial No. 12240282
Water vessel tracking wheel test ”green type” 1,3m^3

Table 1

Test voltage:	22,1 kV
Beginning of the test:	2022-06-24
End of the test:	2022-09-11
Salinity:	1,4 ± 0,06 kg/m^3
Number of cycles:	31 424
The ambient temperature	20 °C ±5 K
Measured creepage distance	630 mm

Table 2

Start of tested period	End of tested period	Rest period (h)	Quantities of cycles
24.6.	28.6.	24	1 964
29.6.	3.7.	24	3 928
4.7.	8.7.	24	5 892
9.7.	13.7.	24	7 856
14.7.	18.7.	24	9 820
19.7.	23.7.	24	11 784
24.7.	28.7.	24	13 748
29.7.	2.8.	24	15 712
3.8.	7.8.	24	17 676
8.8.	12.8.	24	19 640
13.8.	17.8.	24	21 604
18.8.	22.8.	24	23 568
23.8.	27.8.	24	25 532
28.8.	1.9.	24	27 496
2.9.	6.9.	24	29 460
7.9.	11.9.	-	31 424

Evaluation:

No erosion to the core, no shed or housing pucture, no surface tracking occured on tested insulator No. 1, 2 and 3.

2.1.3 Test evaluation

Test date: 2022-09-12

Tests were carried out according to CSA C411.4-16, clause 5.5.4.

Immediately after completion of the tracking wheel test, each insulator was rinsed in deionized water and was tested in accordance with the steep-front impulse voltage test and the power frequency voltage test. The additional identical insulator No. 4 REF was tested as a reference in the power frequency voltage test.

2.1.3.1 Steep-front impulse voltage test

Tests were carried out according to CSA C411.4-16, clause 5.5.4.2 and 5.3.3.3.

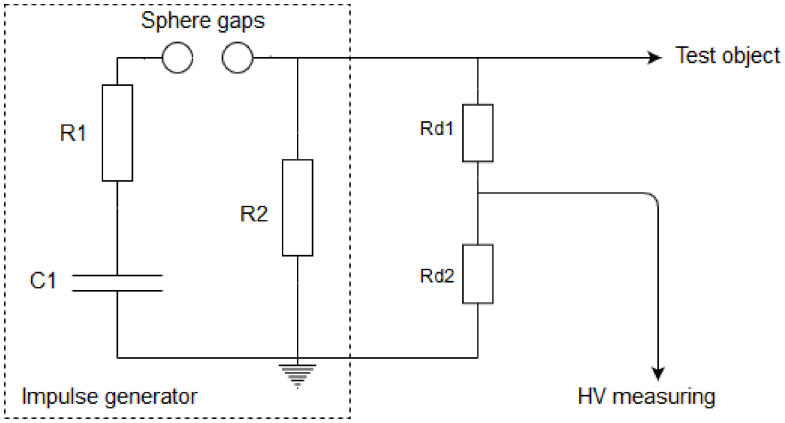
Atmospheric conditions:

air pressure	99,4 kPa
air temperature	21,5 °C
relative humidity	61,7 %

Insulators No. 1, 2, 3 were tested. The test voltage 25 impulses of both polarities with a steepness of at least 1000 kV/µs were applied on each tested insulator.

The test arrangement and the flashover of the insulator are shown in Figure 13.

Testing and measuring equipment



impulse generator Passoni Villa, GTU 600-5, 30 kJ, serial No. 09621
R_{d1}/R_{d2} - resistive divider Haefely, 800 kV, serial No. 554333
measuring system Haefely Trench, type HiAS 743, serial No. 175247
measuring system for atmospheric conditions Comet, serial No. 199101190
tape measure 5 m, CXS, PM-241

Evaluation:

No puncture of any part of the insulators occured.

2.1.3.2 Power frequency voltage test

Tests were carried out according to CSA C411.4-16, clause 5.5.4.2 and 5.3.3.4.

Atmospheric conditions:

air pressure	99,3 kPa
air temperature	25,3 °C
relative humidity	54,9 %

Testing and measuring equipment

Resonant AC source Evergreen, MSR600-1200, serial No. 2001042-EGU,
Capacitive divider Evergreen, HCC600-2, serial No. 200104-EGU
Haefely Trench DMI 551, serial No. 188856
digital stop-watch Kalenji, PM-259
measuring system for atmospheric conditions COMET, serial No. 14900363
digital thermometer Fluke 54II, serial No. 41070290WS + probe 80PK-27
tape measure 5 m, CXS, PM-241

This test consisted of the following two tests:

a) Dry power frequency flashover test

Samples No. 1, 2, 3 and 4 REF (as a reference sample) were tested. Before the flashover test begins, the shank reference temperatures of all samples were measured. The flashover voltage was obtained by increasing the voltage linearly from zero within one minute. The average of five flashover voltages on each insulator was corrected to normal standard atmospheric conditions in accordance with IEC 60060-1, clause 4.3.

The test arrangement and the flashover of the insulator are shown in Figure 14.

The value of reference flashover voltage was obtained from insulator REF.

The average value of the flashover voltages of insulators No. 1, 2, 3 shall be greater than or equal to 90 % of flashover voltage of the reference insulator 4 REF. Table 3 and 4 display the results of these measurements.

Table 3

Insulator No.	**Uncorrected flashover values (kV)**					**Uncorrected flashover average (kV)**	**Correction factors**	**Corrected reference flashover voltage (kV)**
4 REF	131	137	135	132	139	135	$k_1 = 0{,}963$ $k_2 = 1{,}000$ $K_t = 0{,}963$	140
90 % of corrected reference flashover voltage = 126 kV								
80 % of uncorrected reference flashover voltage = 108 kV								

Table 4

Insulator No.	Uncorrected flashovers values (kV)					Uncorrected flashover average (kV)	Correction factors	Corrected flashover average (kV)
1	127	129	128	127	129	128	$k_1 = 0,963$ $k_2 = 1,000$ $K_t = 0,963$	133
2	128	125	132	129	129	129	$k_1 = 0,963$ $k_2 = 1,000$ $K_t = 0,963$	134
3	127	129	126	127	126	127	$k_1 = 0,963$ $k_2 = 1,000$ $K_t = 0,963$	132

Note: Correction factor k2 for humidity was not applied because the arcing distance was <0,5 m.

All measured voltages are corrected for the standard reference atmosphere according to IEC 60060-1, clauses 4.3 and 4.4.2.

k_1 air density correction factor,
k_2 humidity correction factor,
K_t atmospheric correction factor.

Evaluation:

Average corrected flashover voltage values of insulators No. 1, 2, 3 exceed 90 % of the reference flashover voltage.

b) Dry power frequency withstand test

Each of tested insulators No. 1, 2, 3 and 4 REF were individually subjected for 30 minutes to 80 % of the average reference flashover voltage. No puncture of the insulator shall occur and the temperature rise ΔT of the shank of insulator immediately after the test shall be less than 10 K with respect to reference temperature. The results are shown in Table 5.

Table 5

Insulator No.	Test voltage (kV)	Result	ΔT (K)	Result
1	108	no puncture	< 10	passed
2	108	no puncture	< 10	passed
3	108	no puncture	< 10	passed
4 REF	108	no puncture	< 10	passed

Evaluation:

No puncture was occured and increase in temperature of the insulator shank was less than 10 K, with respect to reference temperature.

Statemens of conformity:

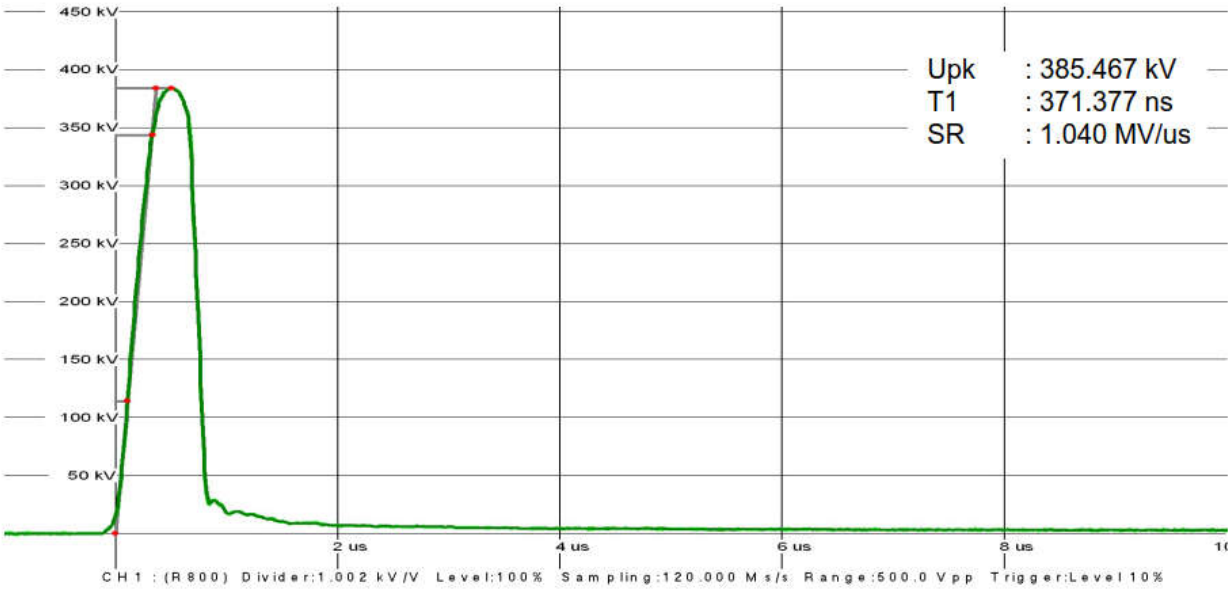
138 kV Composite insulator, SML 222 kN, drawing No. 21SM510756 Rev. A, passed the the test according to requirements given in CSA C411.4-16, clause 5.3.

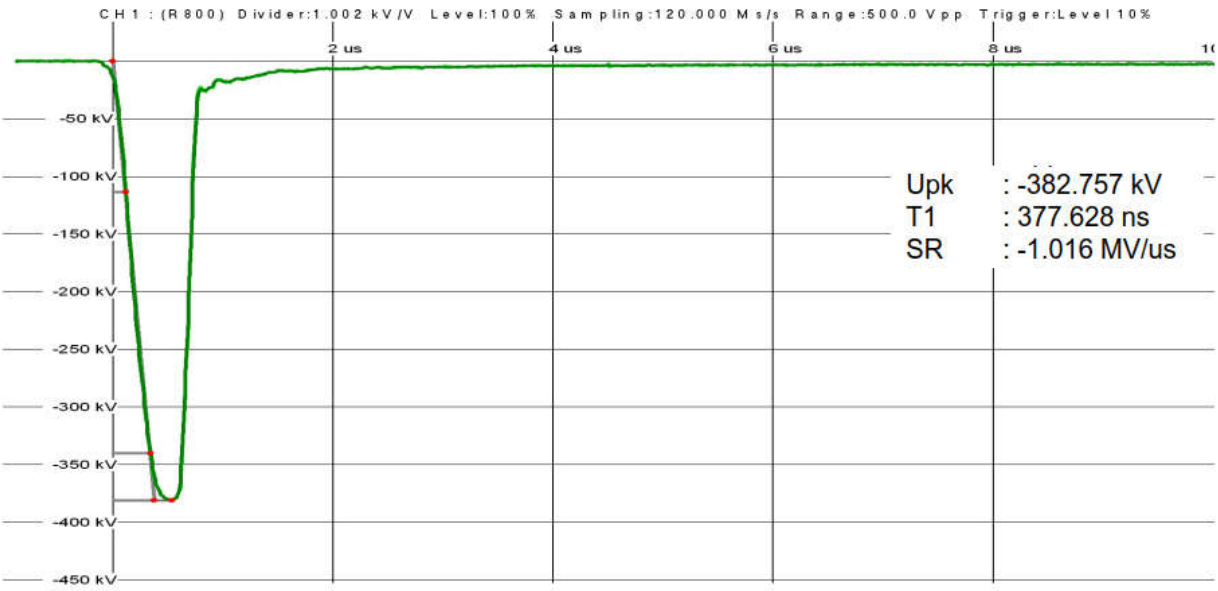
3 UNCERTAINTY OF MEASUREMENTS

QUANTITY	UNCERTAINTY (k=2)	
Steep front impulse voltage	U_m T_1	2,2 % 6,5 %
Power-frequency voltage (wheel test)	1,2 %	
Slide gauge, length (2-150 mm)	0,4 %	
Slide gauge, length (5-400 mm)	0,5 %	
Slide gauge, length (50-1 000 mm)	0,8 %	
Tape measure, length (10-5 000 mm)	1,6 %	
Temperature (Fluke + touch probe)	7,5 %	
Temperature	4,0 %	
Air pressure	0,5 %	
Relative humidity	6,3 %	
Tape measure, length (10-5000 mm)	1,6 %	
Conductivity (0,1 µS/cm – 1000 mS/cm)	5,0 %	
Time	0,7 %	

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a Normal (Gaussian) distribution corresponds to a coverage probability of approximately 95 %. Details related to the statement of conformity when applied are given in a price quotation submitted to a customer before the testing and on the website of the laboratory.

4 GRAPHS





Graph 1
Representative wave shape of steep front impulse

5 PRODUCT DRAWINGS

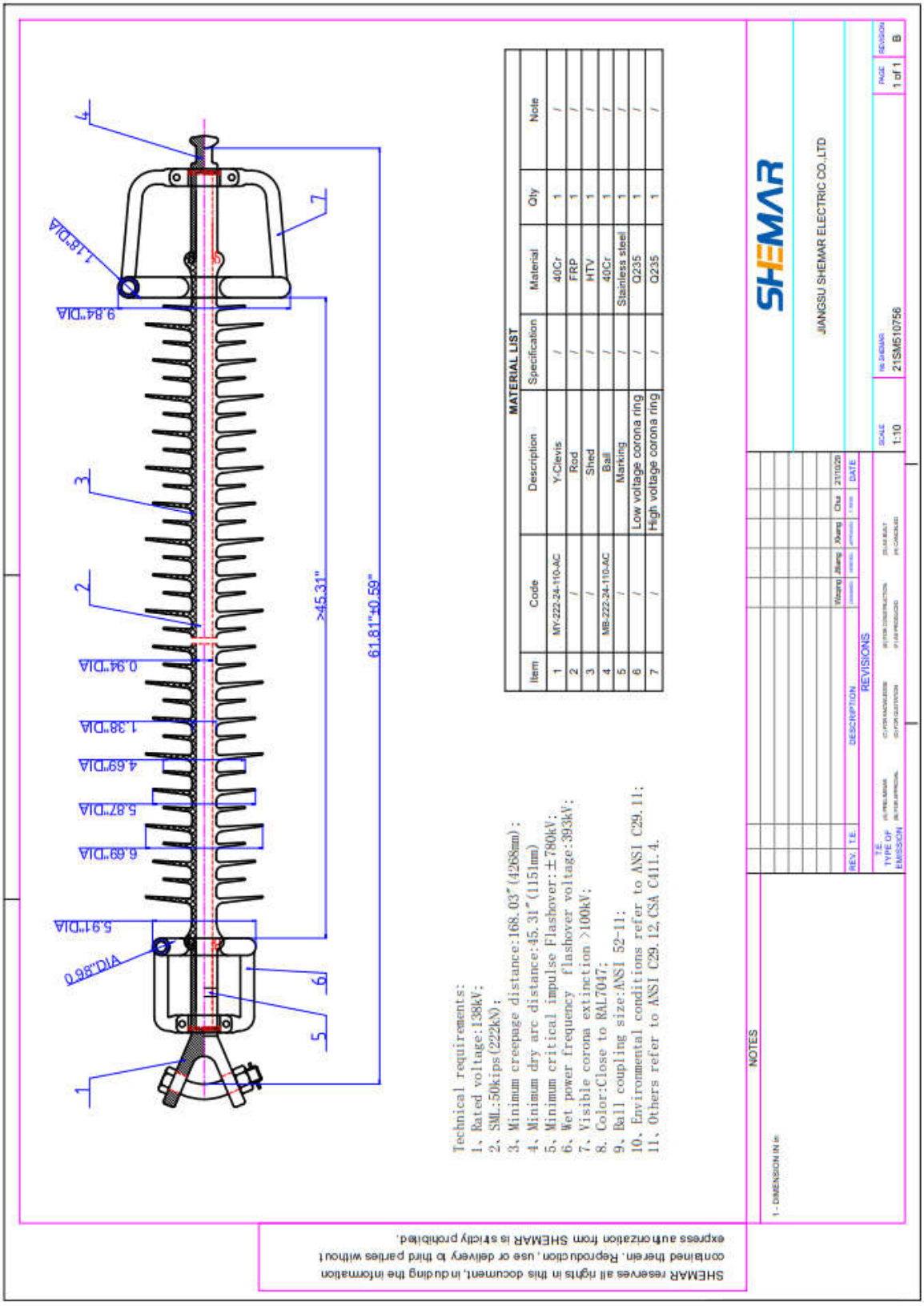


Figure 1
138 kV Composite insulator, SML 222 kN, drawing No. 21SM510756 Rev. B

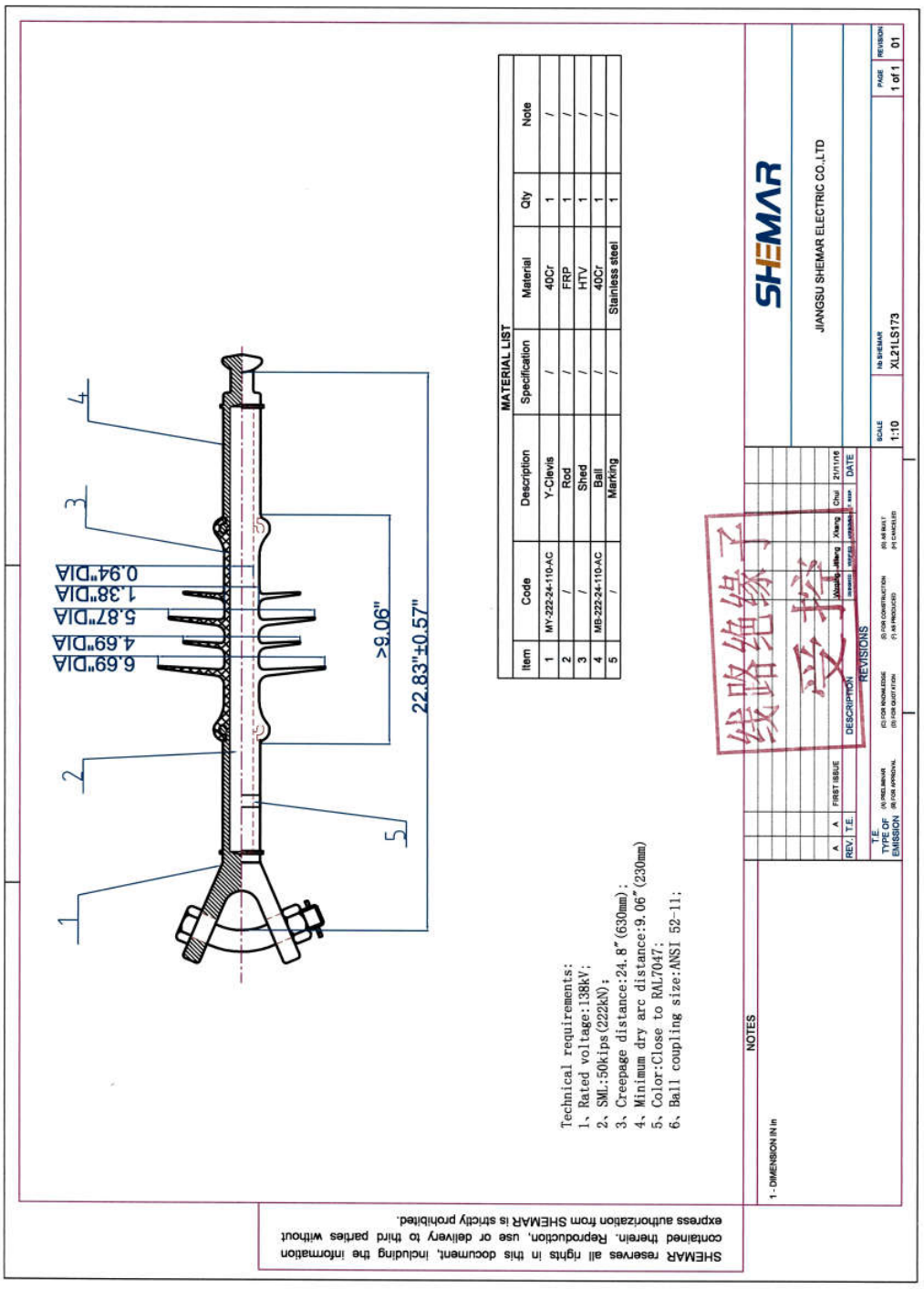


Figure 2
138 kV Composite insulator for tracking end erosion test (tracking wheel), SML 222 kN, drawing No. XL21LS173 Rev. 01

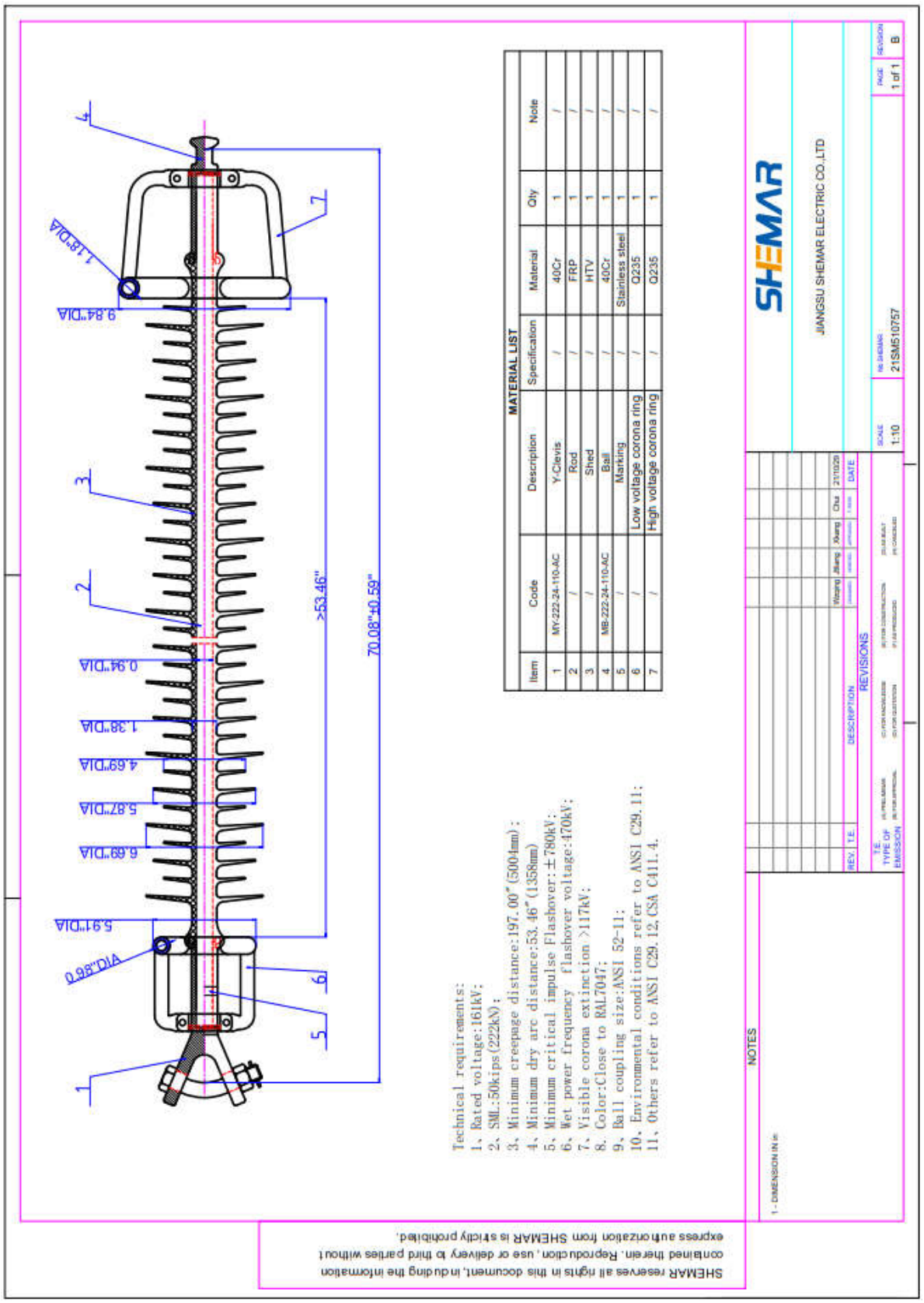


Figure 3
161 kV Composite insulator, SML 222 kN, drawing No. 21SM510757 Rev. B

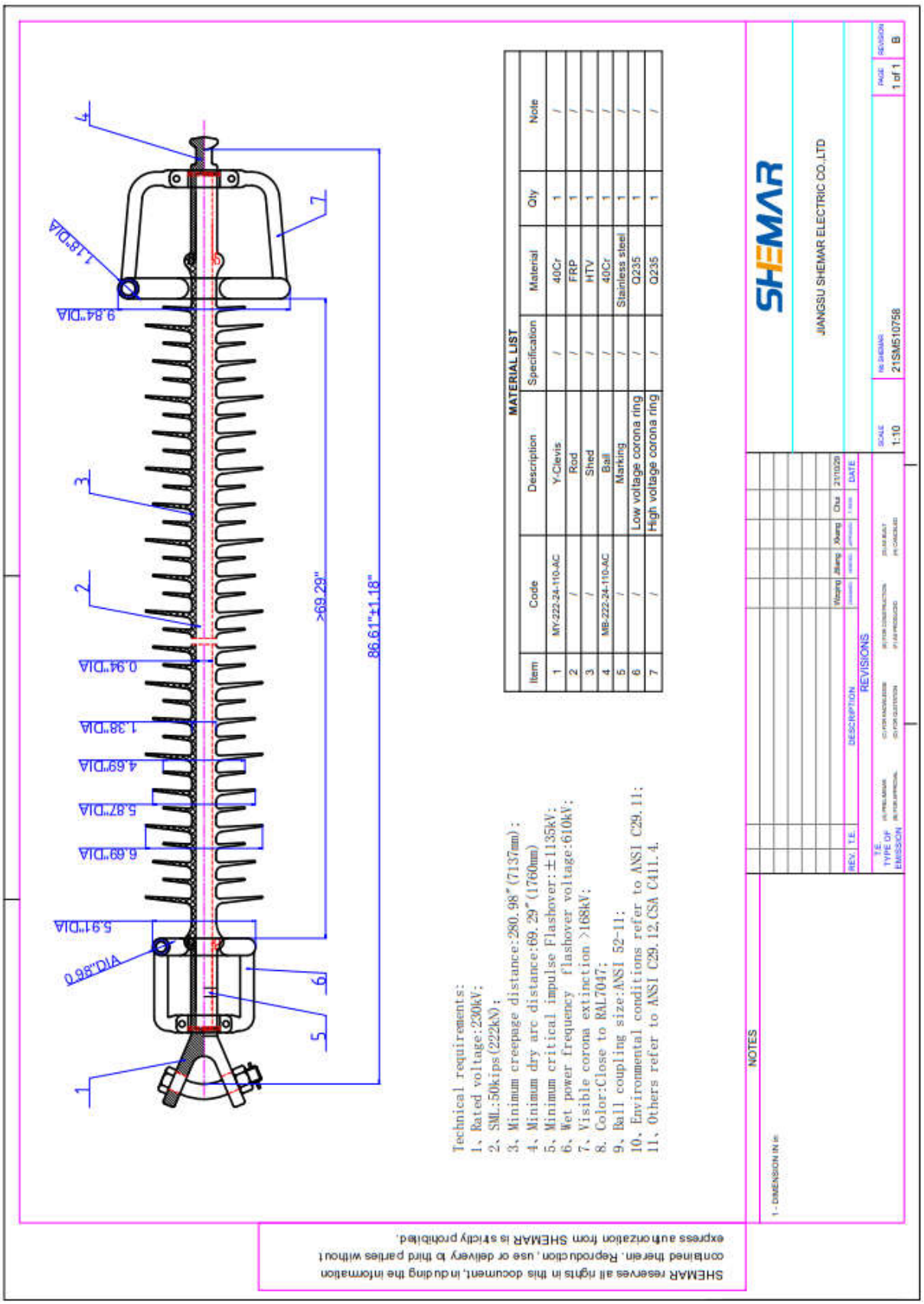


Figure 4
230 kV Composite insulator, SML 222 kN, drawing No. 21SM510758 Rev. B

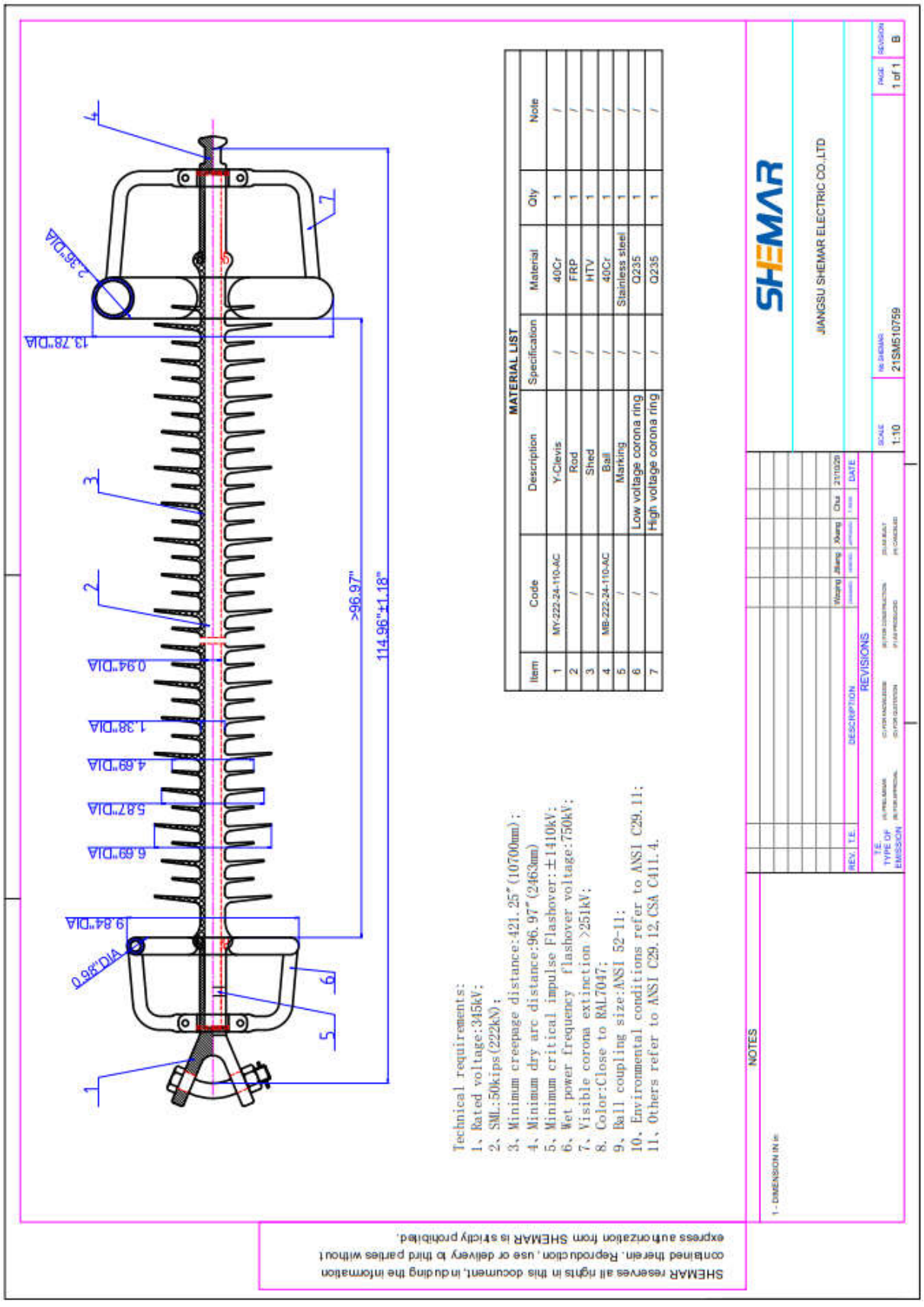


Figure 5
345 kV Composite insulator, SML 222 kN, drawing No. 21SM510759 Rev. B

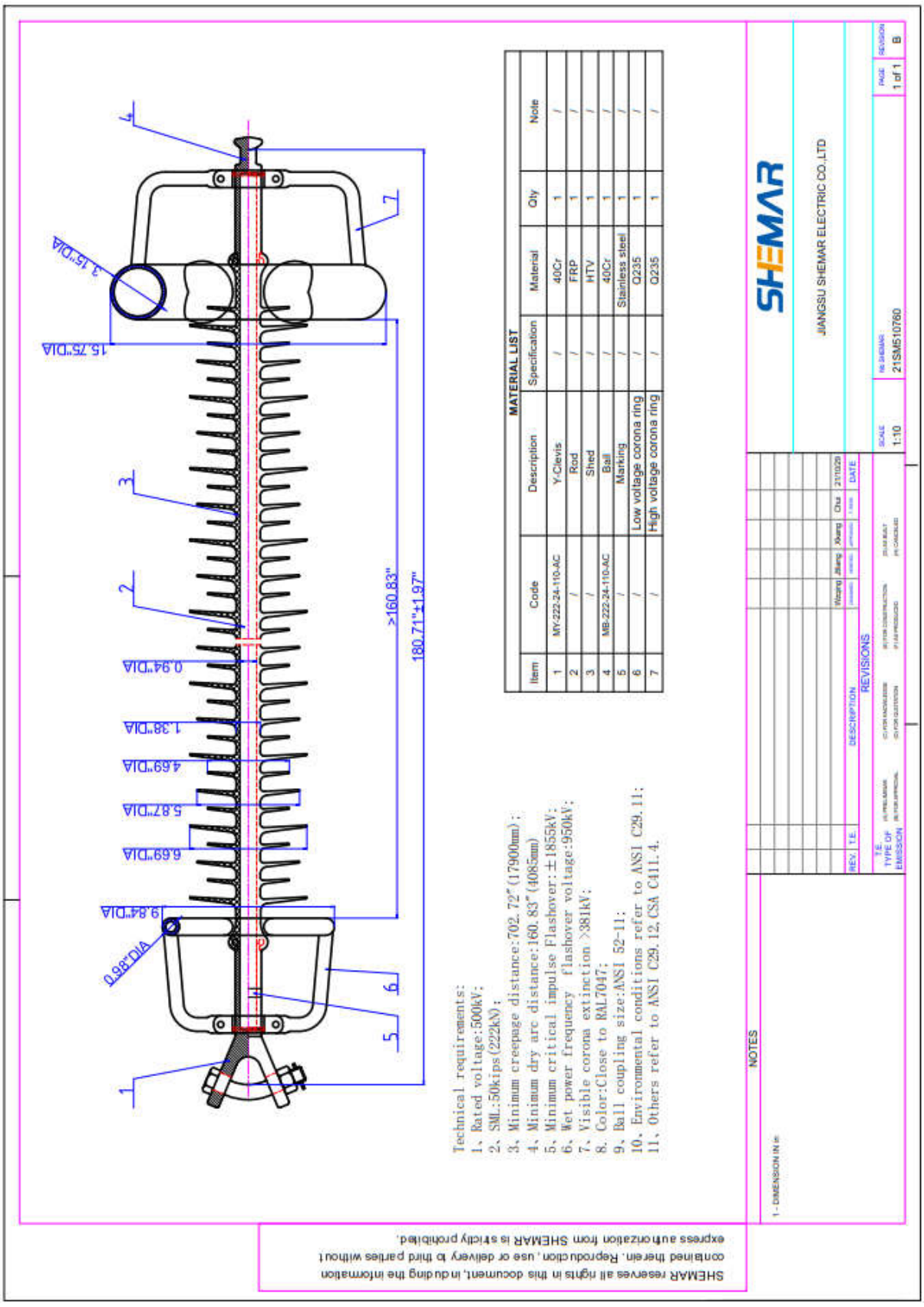


Figure 6
500 kV Composite insulator, SML 222 kN, drawing No. 21SM510760 Rev. B

6 TEST OBJECT AND TEST SETUP PHOTOS

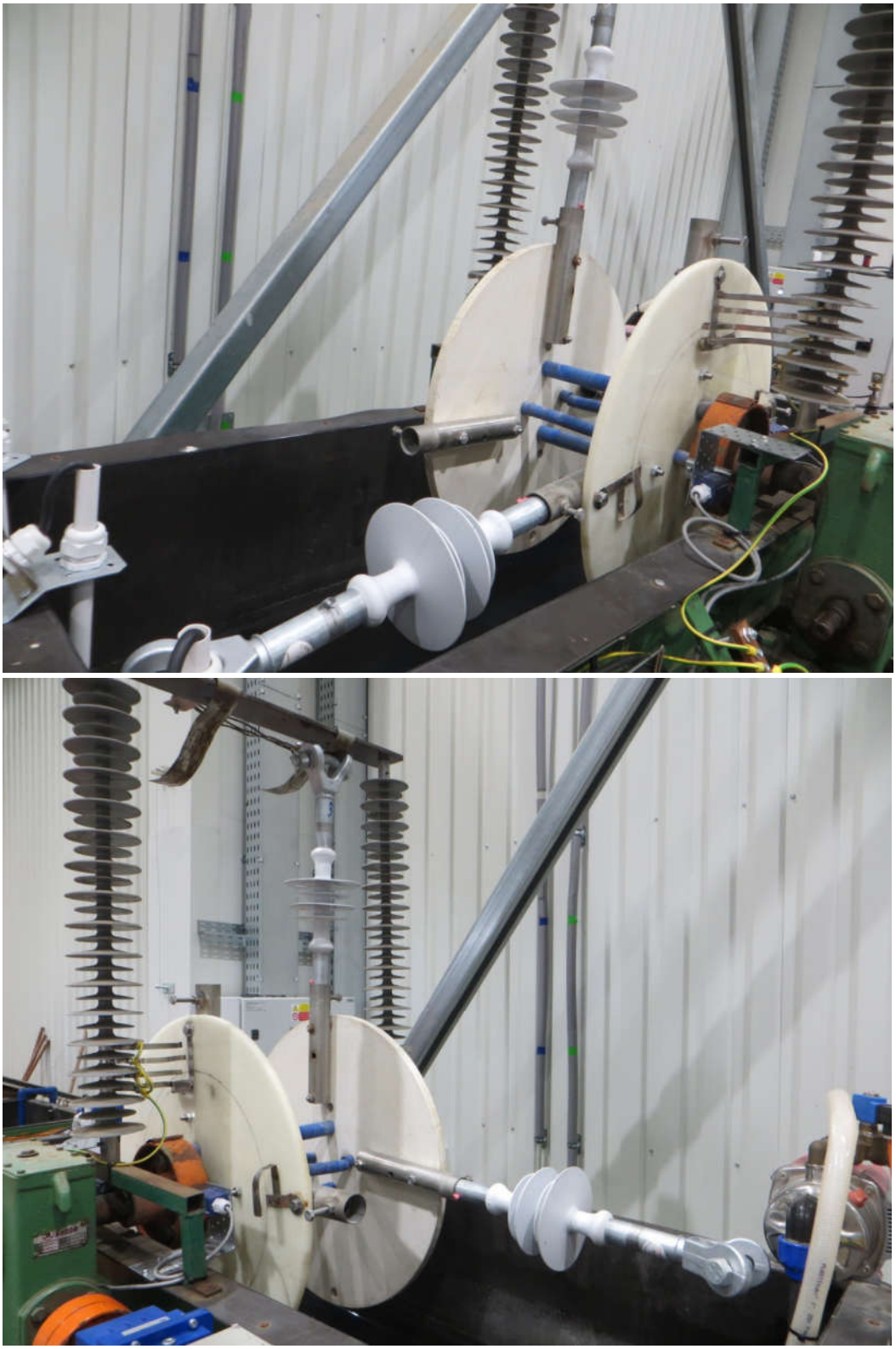


Figure 7
Composite insulator 133 kV, SML 222 kN, test samples No. 1, 2 and 3, before start of the tracking end erosion test

Figure 8
Composite insulator 133 kV, SML 222 kN, test samples No. 1, 2 and 3, after tracking end erosion test

Figure 9
Composite insulator 133 kV, SML 222 kN, test samples No. 1, 2 and 3, after tracking end erosion test

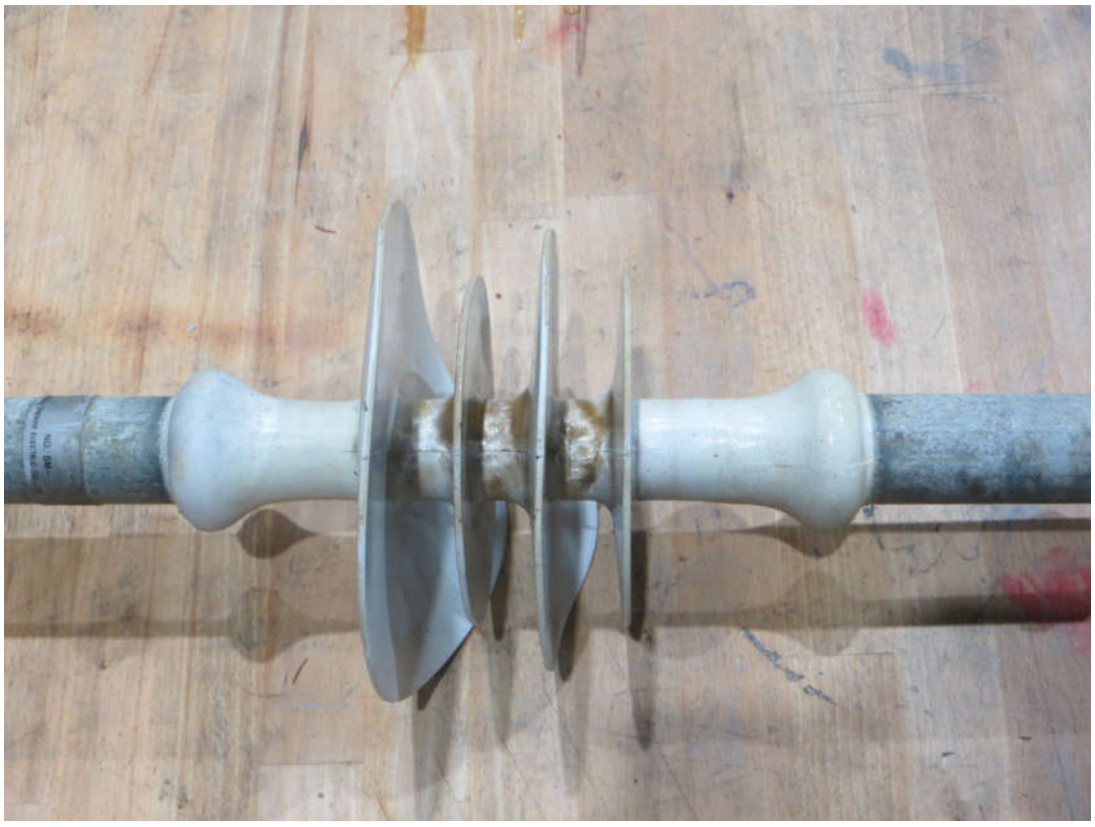


Figure 10
Test sample No. 1 after the tracking end erosion test

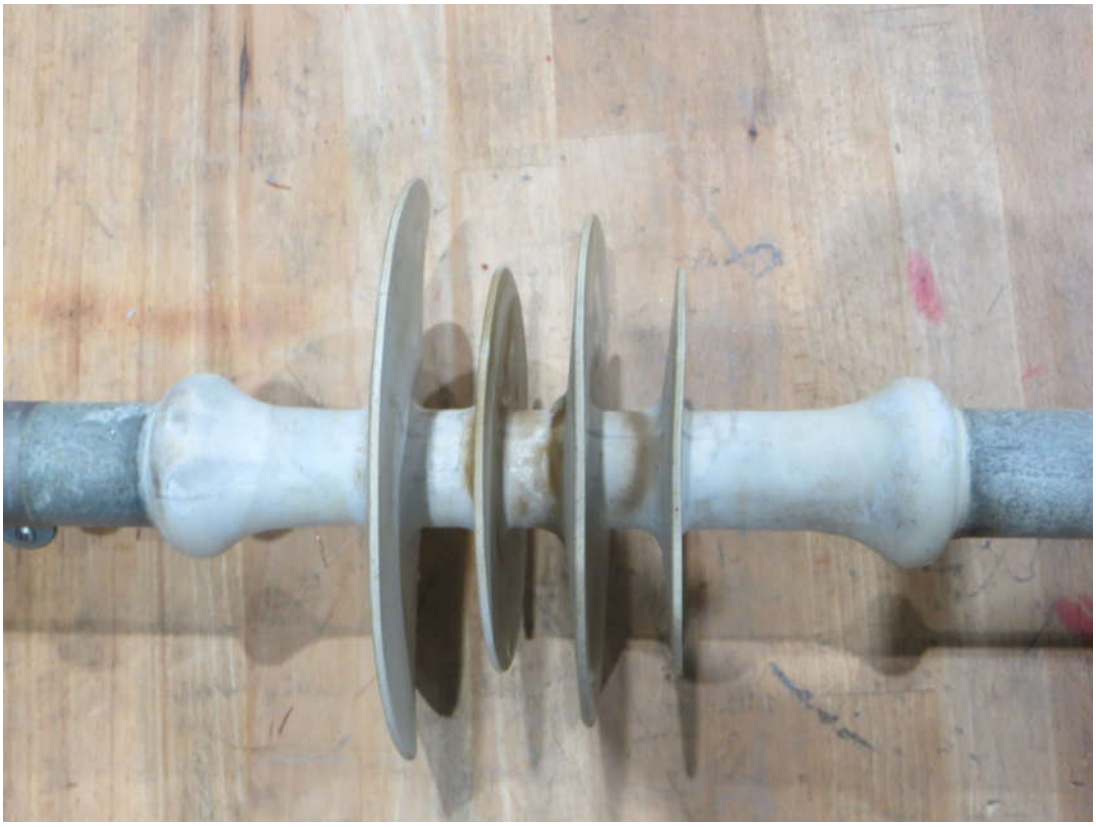


Figure 11
Test sample No. 2 after the tracking end erosion test

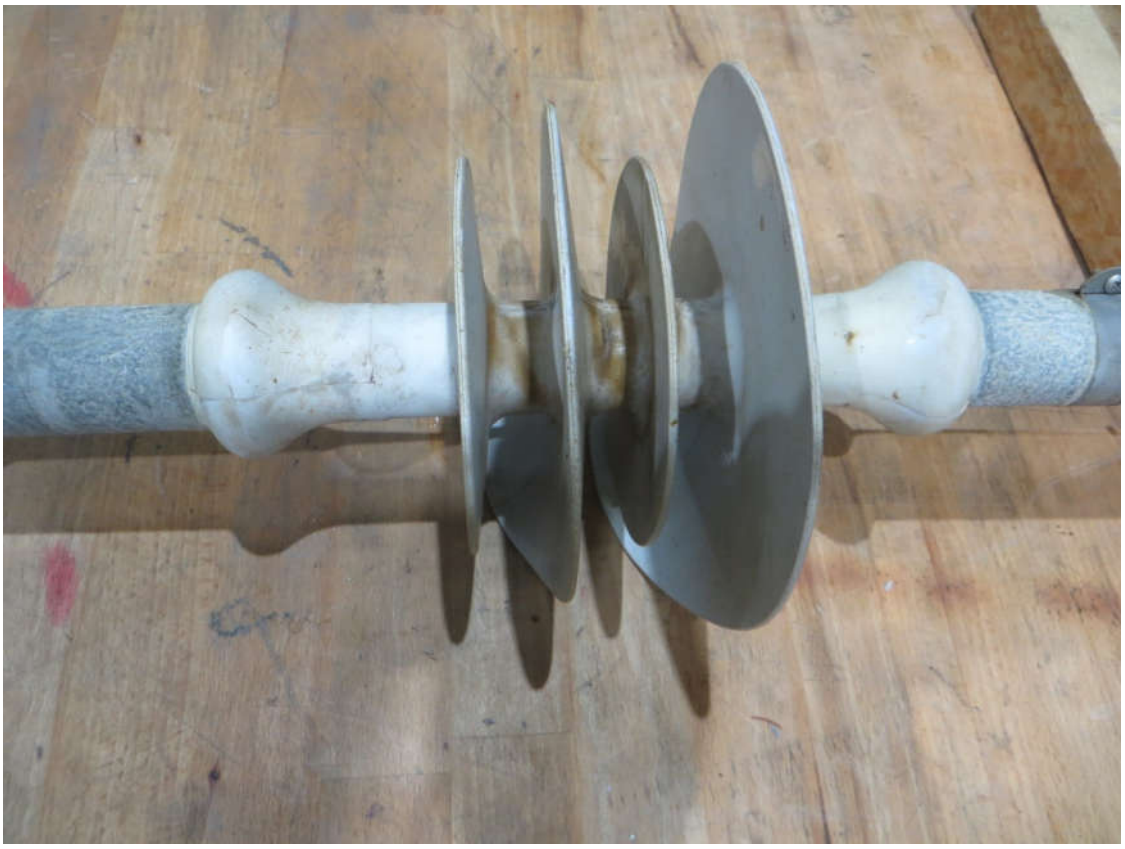


Figure 12
Test sample No. 3 after the tracking end erosion test

Figure 13
Test sample, during the steep-front impulse voltage test

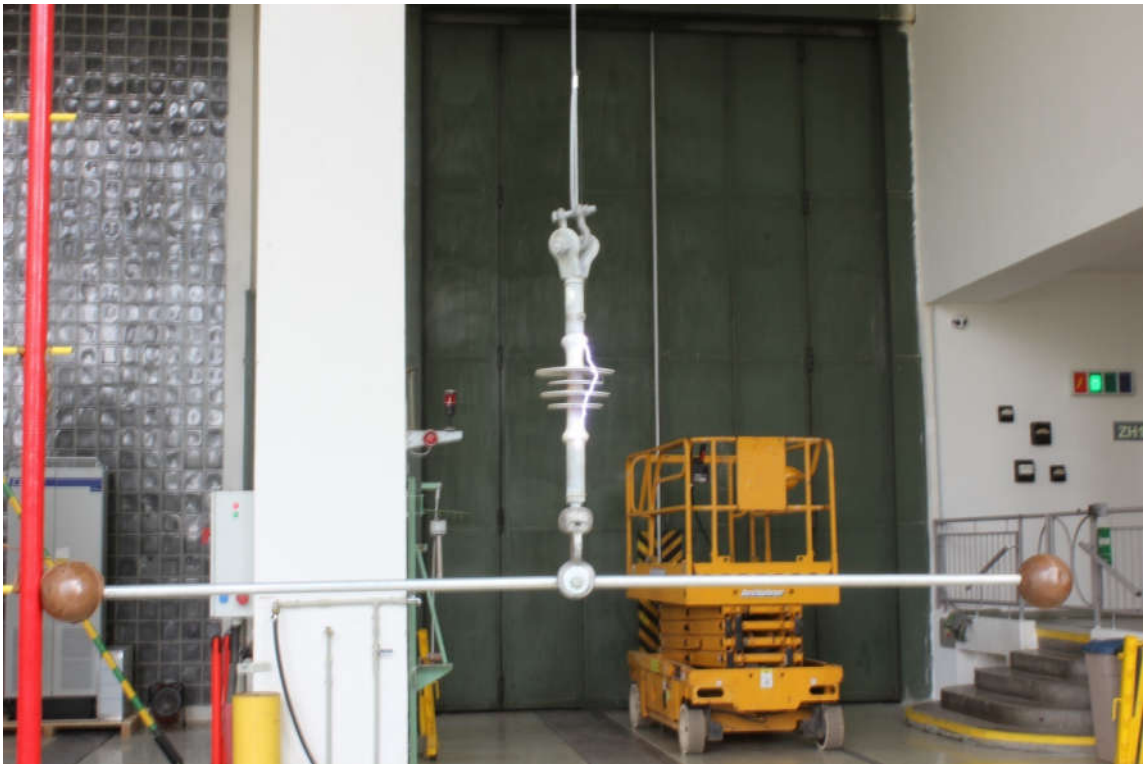


Figure 14
Test sample, during the dry power frequency flashover test

- end of test report -

Testpolymer EU s.r.o.

Testing laboratory No. 1595
accredited by ČIA
according to ČSN EN ISO/IEC 17025: 2018

L 1595

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laboratory manager : Eva Kovářová
tel.: + 420 582 383 680

kovarova@testpolymer.cz
www.testpolymer.cz

Test report No. 59/2022/EN

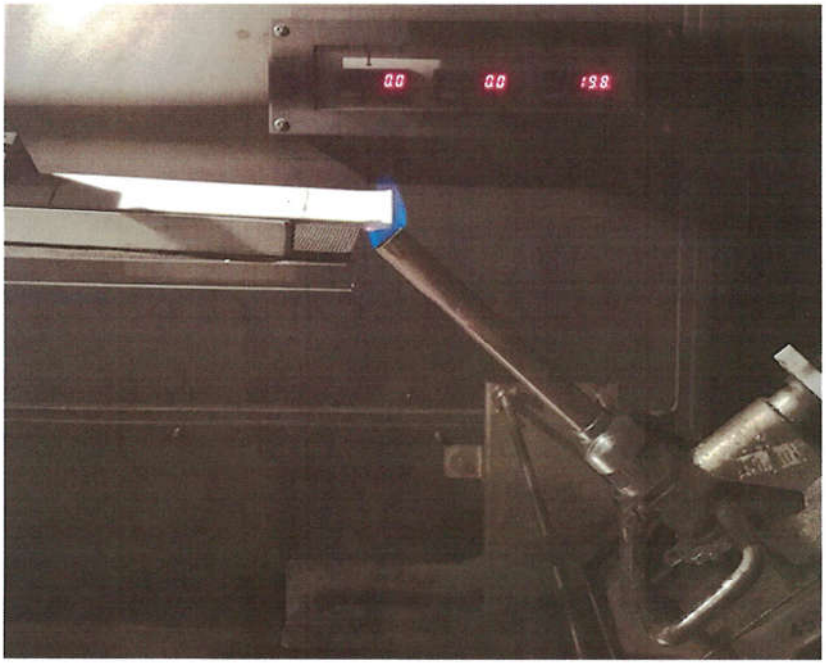
Customer:	**EGU - HV Laboratory a.s., Podnikatelská 267, 190 11 Praha 9, Běchovice**
	Company ID: 25634330, Tax ID: CZ25634330
Customer´s order:	**6/11788/2022**
Application form:	**2200223**
Tested material:	**HTV silicone material**
Detailed description:	**Manufacturer: Jiangsu Shemar Electric Co., Ltd.**
Form of material:	test specimens - sampled and delivered by customer
Preparation of samples:	test specimens supplied by customer
Date of receipt of the sample:	10.1.2022

Tests	Test specifications
Fire hazard testing - horizontal and vertical flame tests	UL 94: 2013 revision 05/2021 ČSN EN 60695-11-10 ed.2: 2014

These tests were performed in accordance with the standard ČSN EN 62217 ed.2: 2013, article 9.3.4.

Test No. 15	**Fire hazard testing - Horizontal and vertical flame tests - method A - horizontal burning test**

Photo of the position of the test specimen during the test:



Test report No. 59/2022/EN

Test standard:	ČSN EN 60695-11-10 ed. 2: 2014	
Test equipment:	Chamber Atlas HVUL2	
Ignition source:	Burner with an inner diameter 9.5 mm	
	The gas used: Methane 2.5	
Test conditions:	Blue flame height 20 mm, the exposure time 30s	
	No forced ventilation was used during the test	
	Temperature: 22,0 - 23,0°C	Humidity: 48,0 - 49,0%
Description of the sample (sample type, the color, the location in the product, the number of samples tested):	Test specimens of grey color 125x13x3mm, 3 pieces	
Conditioning of samples:	48 hours at 23±2°C and 50±5% relative humidity	
Conditioning of cotton indicator:	24 hours in desiccator 23±2°C	
Deviations from the standard:	no	
Test progress:	After removing the ignition flame, the test specimens do not burn. The flame did not exceed the 25 mm mark. A support fixture was used during the test due to the bending of the test specimens.	
Test specimen No.1	burning stopped before 25 mm	
Test specimen No.2	burning stopped before 25 mm	
Test specimen No.3	burning stopped before 25 mm	

No. of test specimen	Damaged length L (mm)	Burning time t (s)	Linear burn rate (mm/min)	**Linear burn rate average value (mm/min)**	Sample standard deviation (mm/min)
1	0	0	0	**0**	0
2	0	0	0		
3	0	0	0		

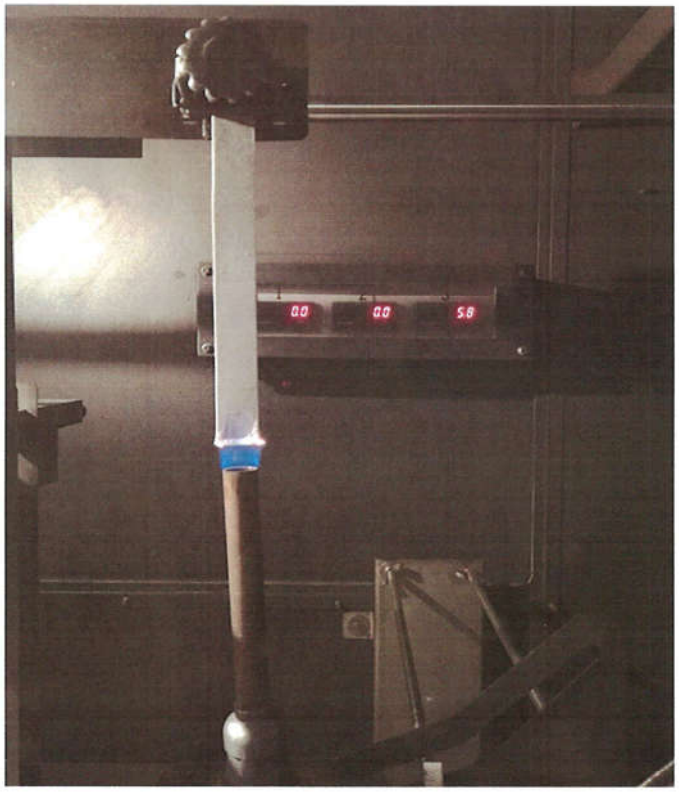
Statement of conformity to specifications - classification	Measured results (burning rate, damaged length) on tested three samples meet all requirements for classification **HB** according to article 8.4 ČSN EN 60695-11-10 ed.2 This statement of conformity to specifications is given in the sense of the shared risk decision rule; without including measurement uncertainty.

Tested and evaluated by:	Ing. Lukáš Navrátil	Date:	13.1.2022

Test report No. 59/2022/EN

Test No. 15	**Fire hazard testing - horizontal and vertical flame tests - method B - vertical burning test**

Photo of the position of the test specimen during the test:



Test standard:	ČSN EN 60695-11-10 ed. 2: 2014	
Test equipment:	Chamber Atlas HVUL2	
Ignition source:	Burner with an inner diameter 9.5 mm	
	The gas used: Methane 2.5	
Test conditions:	Blue flame height 20 mm, the exposure time 2 x 10s	
	No forced ventilation was used during the test	
	Temperature: 22,0 - 23,0°C	Humidity: 48,0 - 49,0%
Description of the sample (sample type, the color, the location in the product, the number of samples tested):	Test specimens of grey color 125x13x3mm, 10 pieces	
Conditioning of samples:	5 pieces - 48 hours in the climate chamber at 23±2°C and 50±5% relative humidity; 5 pieces -168 ±2 hours in the hot air oven at 70±2°C and cooled in desiccator min. 4 hours at room temperature	
Conditioning of cotton indicator:	24 hours in desiccator 23±2°C	
Deviations from the standard:	Not detected	
Test progress:	The test specimens do not burn after the first or after the second application of the flame. The material does not drip or ignite absorbent cotton.	

Test report No. 59/2022/EN

No. of test specimen:	Afterflame time after the first flame application t_1 (s)	Afterflame time after the second flame application t_2 (s)	Afterflame plus afterglow time after the second flame application t_2+t_3 (s)	Afterflame up to the holding clamp: YES - NO	Flaming particles or drops: YES - NO	Cotton indicator ignited by flaming particles or drops: YES - NO
Specimens conditioned in climate chamber						
1	0	0	0	NO	NO	NO
2	0	0	0	NO	NO	NO
3	0	0	0	NO	NO	NO
4	0	0	0	NO	NO	NO
5	0	0	0	NO	NO	NO
Specimens conditioned in hot air oven						
1	0	0	0	NO	NO	NO
2	0	0	0	NO	NO	NO
3	0	0	0	NO	NO	NO
4	0	0	0	NO	NO	NO
5	0	0	0	NO	NO	NO

Statement of conformity to specifications - classification	The measured results (burning and afterglow times and the condition of the cotton indicators) on the ten samples tested meet all the requirements for classification **V-0** according to article 9.4 ČSN EN 60695-11-10 ed. 2. This statement of conformity to specifications is given in the sense of the shared risk decision rule; without including measurement uncertainty.

Tested and evaluated by:	Ing. Lukáš Navrátil	Date:	13.1.2022, 18.1.2022

Declaration:

Test results relates only to the test subject and refer to the sample as received
Laboratory is not responsible for sampling and specimen preparations done by customer.
Without the written consent of the Head of Laboratory, the protocol cannot be reproduced other than the entire.
All results are metrologically traceable.

Test report was created by:

Jana Trbušková
Chief laboratory technician

AKREDITOVANÁ ZKUŠEBNÍ LABORATOŘ Testpolymer EU s.r.o. č. 1595

Test report was approved by:

Eva Kovářová
Laboratory manager

In Bohuslavice: 19.1.2022

End of test report

SYNPO, akciová společnost
S. K. Neumanna 1316
532 07 Pardubice - Zelené Předměstí
The Czech Republic

Department of Evaluation and Testing
Testing Laboratory No. 1105.2 accredited by CAI according to ČSN EN ISO/IEC 17025:2018

TEST REPORT
T 375/006

Name and contact information of the customer	**EGU – HV Laboratory a.s.** Podnikatelská 267, 190 11 Praha 9 – Běchovice The Czech Republic
Test item(s)	**Manufacturer: Jiangsu Shemar Electric Co., Ltd.** **Address : No. 66, Haiwei Road, Sutong Science and Technology Industrial Park, Nantong City, Jiangsu 226017, China** **Type : HTV**
Test procedure/method	Test No. 35: **Standard Practice for Xenon-Arc Exposure of Plastics Intended for Outdoor Applications** ASTM D2565-16 *(The test was included in the flexible scope of accreditation)* Test No. 1 : **Determination of the degree of degradation of coatings** APP 1 (*ČSN EN ISO 4628 -1, 4, 5)* Test No. 33 : **Surface roughness measurement (Ra, Rz, Ry, Rq)** (*ČSN EN ISO 4287, ČSN EN ISO 4288)*
Date of receipt of item(s)	January 7, 2022
Internal laboratory number	22 0066
Date of the test	January 7, 2022– February 18, 2022
Tested by	Gabriela Štěpánková
The report made by	Gabriela Štěpánková, Ondřej Janča

This report contains 6 pages and 1 annex.

In Pardubice on March 29, 2022

Digitálně podepsal Ing. Vladimír Špaček, CSc.

Dr. Vladimír Špaček
Head of testing laboratory

TEST REPORT T 375/006
Page/Total pages: 2/6
Annexes: 1

DESCRRIPTION OF THE TEST ITEM

Test item:	**Manufacturer: Jiangsu Shemar Electric Co., Ltd.** **Address : No. 66, Haiwei Road, Sutong Science and Technology Industrial Park, Nantong City, Jiangsu 226017, China** **Type : HTV**
Data delivered by the customer[1] :	-
Internal lab number:	**22 0066**

[1]The laboratory is not responsible for the data delivered by customer.

FURTHER SPECIFICATION OF THE TEST PERFORMANCE

The samples of testing were received from the contractor (3 pieces) and submitted to the test without any treatment of surface protection or heat storage.

Test No. 35: Standard Practice for Xenon-Arc Exposure of Plastics Intended for Outdoor Applications ASTM D2565-16
(The test was included in the flexible scope of accreditation)

Test was performed according to ASTM D2565-16
Testing device: Q-SUN Xe-3HS (Q-Lab Corporation, GB). Cycle number 1^{H}.
Exposure cycling: regular switching of drying period for 102 minutes at (63 ± 2) °C light followed by 18 minutes of light and front spray.
Light source: Xenon lamps with irradiance energy of 0.35 W/m^2/nm at 340 nm. Used UBP placed horizontally at the site of sample exposure was fasten by anticorrosion screw.
The test samples were putted in testing area and the position of samples during the test was not changed – for measurements only.

Test No. 33: Surface roughness measurement
Test was performed according to ČSN EN ISO 4288 - Geometrical product specifications (GPS) - Surface texture: Profile method – Rules and procedures for the assessment of surface texture. Parameters of surface texture were measured according to *ČSN EN ISO* 4287- Geometrical product specifications (GPS) - Surface texture: Profile method - Terms, definitions and surface texture parameters.

Testing device: SURFTEST SJ-201 (Mitutoyo, Ltd., Japan).
Ra - arithmetical mean deviation of the assessed profile (roughness)
Rz - maximum height of profile (roughness).

Measurements were performed six times on each sample.

Measurement conditions: basic roughness length 0,8 mm

TEST REPORT T 375/006
Page/Total pages: 3/6
Annexes: 1

DESCRRIPTION OF THE TEST ITEM

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Data delivered by the customer[1] :	-
Internal lab number:	**22 0066**

[1]The laboratory is not responsible for the data delivered by customer.

APP 1 - Determination of the degree of degradation of coatings

The evaluation of surface failure (defects) was performed according standard ČSN EN ISO 4628 Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance; Part 1: General introduction and designation system; Part 4: Assessment of degree of cracking; Part 5: Assessment of degree of flaking

Lighting used in the evaluation of defect on the surface finish: the fluorescent tube, standard observation: the observation angle 0° / light incidence of angle 45°.

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Department of Evaluation and Testing, Testing Laboratory No. 1105.2 accredited by CAI according to ČSN EN ISO/IEC 17025:2018

TEST REPORT T 375/006

Annexes: 1

VISUAL EVALUATION OF SURFACE DEFFECTS ACCORDING TO ČSN EN ISO 4628 DURING THE EXPOSURE AFTER XENON TEST ACCORDING TO ASTM D2565-16

(January 7, 2022 – February 18, 2022)

(The test was included in the flexible scope of accreditation)

Sample name	Internal Lab Number	Surface failure	Cracking	Flaking
		ČSN EN ISO 4628-1	*ČSN EN ISO 4628-4*	*ČSN EN ISO 4628-5*
		degree + verbal	*degree*	*degree*
250 hours				
HTV	22 0066/1	**0, no visual changes**	**0 (S0)**	**0 (S0)**
	22 0066/2	**0, no visual changes**	**0 (S0)**	**0 (S0)**
	22 0066/3	**0, no visual changes**	**0 (S0)**	**0 (S0)**
500 hours				
HTV	22 0066/1	**0, no visual changes**	**0 (S0)**	**0 (S0)**
	22 0066/2	**0, no visual changes**	**0 (S0)**	**0 (S0)**
	22 0066/3	**0, no visual changes**	**0 (S0)**	**0 (S0)**
750 hours				
HTV	22 0066/1	**0, no visual changes**	**0 (S0)**	**0 (S0)**
	22 0066/2	**0, no visual changes**	**0 (S0)**	**0 (S0)**
	22 0066/3	**0, no visual changes**	**0 (S0)**	**0 (S0)**
1000 hours				
HTV	22 0066/1	**0, no visual changes**	**0 (S0)**	**0 (S0)**
	22 0066/2	**0, no visual changes**	**0 (S0)**	**0 (S0)**
	22 0066/3	**0, no visual changes**	**0 (S0)**	**0 (S0)**

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Department of Evaluation and Testing, Testing Laboratory No. 1105.2 accredited by CAI according to ČSN EN ISO/IEC 17025:2018

TEST REPORT T 375/006

Annexes: 1

MEASUREMENT OF SURFACE ROUGHNESS ACCORDING TO ČSN EN ISO 4287, 4288

(January 7, 2022 – February 18, 2022)

Sample name	Internal Lab Number	Arithmetical mean deviation of the assessed roughness Ra			Maximum height of profile (roughness) Rz		
		Measuring range [µm]			Measuring range [µm]		
		Mean	Max.	Min.	Mean	Max.	Min.
Before exposure							
HTV	22 0066/1	**0,67**	0,69	0,64	**4,74**	4,92	4,53
	22 0066/2	**0,66**	0,73	0,60	**4,99**	5,25	4,82
	22 0066/3	**0,71**	0,75	0,67	**5,28**	5,64	4,87
250 hours							
HTV	22 0066/1	**0,67**	0,70	0,63	**4,84**	5,11	4,56
	22 0066/2	**0,69**	0,75	0,65	**5,06**	5,47	4,52
	22 0066/3	**0,72**	0,76	0,65	**5,24**	5,78	4,25
500 hours							
HTV	22 0066/1	**0,64**	0,67	0,60	**5,01**	5,36	4,60
	22 0066/2	**0,72**	0,77	0,60	**5,33**	6,11	4,70
	22 0066/3	**0,76**	0,80	0,70	**5,65**	6,27	4,90
750 hours							
HTV	22 0066/1	**0,67**	0,70	0,64	**5,18**	5,56	4,88
	22 0066/2	**0,77**	0,80	0,74	**5,64**	5,96	5,32
	22 0066/3	**0,78**	0,80	0,75	**5,76**	6,22	5,29
1000 hours							
HTV	22 0066/1	**0,74**	0,78	0,68	**5,81**	6,09	5,22
	22 0066/2	**0,79**	0,81	0,77	**5,95**	6,22	5,69
	22 0066/3	**0,79**	0,83	0,76	**6,14**	6,55	5,78

TEST REPORT T 375/006
Page/Total pages: 6/6
Annexes: 1

DESCRRIPTION OF THE TEST ITEM

Test item:	**Manufacturer: Jiangsu Shemar Electric Co., Ltd.** **Address : No. 66, Haiwei Road, Sutong Science and Technology Industrial Park, Nantong City, Jiangsu 226017, China** **Type : HTV**
Data delivered by the customer[1] :	-
Internal lab number:	**22 0066**

[1]The laboratory is not responsible for the data delivered by customer.

Statement of conformity

The laboratory uses a binary decision rule according to ILAC-G08: 09/2019, article 4.2.1

Test items	**Prescribed test**	**Parameter** no surface defects such as cracks, crumbling or blisters result according to CSA C411.4.-16 article 5.4.3	**Fulfillment of parameters**
HTV	ASTM D2565-16	no cracks, crumbling or blisters	**Yes**

-End-

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Department of Evaluation and Testing, Testing Laboratory No. 1105.2 accredited by CAI according to ČSN EN ISO/IEC 17025:2018

TEST REPORT T 375/006
Annexes: 1/1

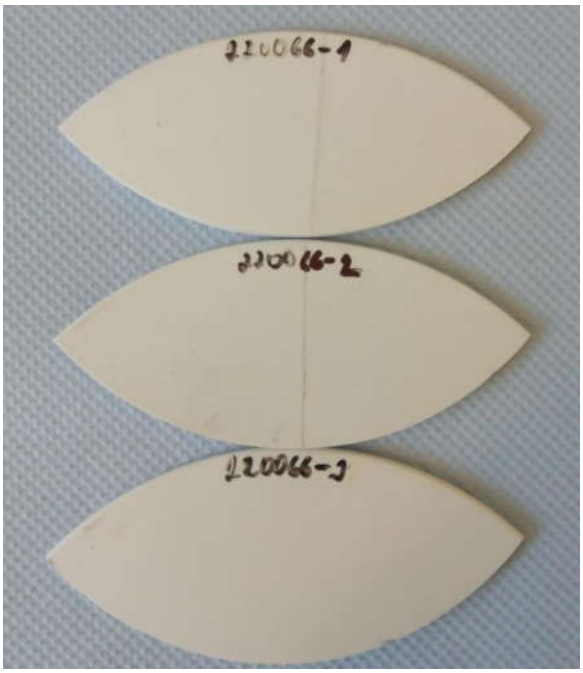
DESCRRIPTION OF THE TEST ITEM

Test item:	**Manufacturer: Jiangsu Shemar Electric Co., Ltd.** **Address : No. 66, Haiwei Road, Sutong Science and Technology Industrial Park, Nantong City, Jiangsu 226017, China** **Type : HTV**
Data delivered by the customer[1] :	-
Internal lab number:	**22 0066**

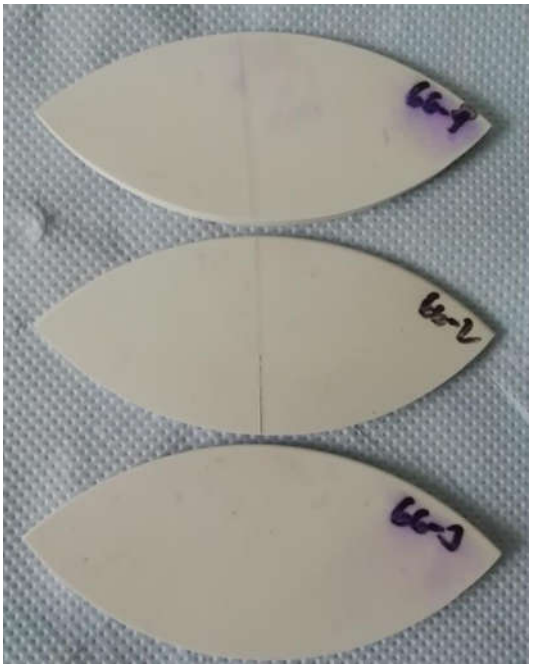
[1]The laboratory is not responsible for the data delivered by customer.

THE PHOTOS OF TEST SAMPLES AFTER 1000 HOURS OF EXPOSURE UNDER XENON LAMPS ACCORDING TO ASTM D2565-16
(The test was included in the flexible scope of accreditation)

1



2



Pic 1 : Exposure after 1000hrs (top face)
Pic 2 : Exposure after 1000hrs (lower face)