



HIGH VOLTAGE TESTING LABORATORY

Accredited testing laboratory No.: 1029
Accredited by Czech Accreditation Institute
according to ČSN EN ISO/IEC 17025:2005

TEST REPORT No.: 10625/17

CUSTOMER:

Ensto Finland Oy
Ensio Miettisen katu 2
P.O.Box 77
06101 Porvoo
Finland

TEST OBJECT:

Porcelain pin insulator

TYPE SPECIFICATION:

SDI37

TEST STANDARDS:

IEC 60383-1 Ed.4:1993

Test engineer

Head of High Voltage
Testing Laboratory

Director of
EGU - HV Laboratory a. s.

Test report is confidential and must not be passed over or transferred to any third party without written approval of the customer. Test results relate only to the tests given in presented report and do not substitute any other documents. The report shall not be reproduced except in full without written approval of the testing laboratory.

TEST REPORT**No.: 10625/17****TEST OBJECT:** Porcelain pin insulator**TYPE SPECIFICATION:** SDI37**DRAWING No.:** see Figure 1a,b**MANUFACTURER:** Ensto Finland Oy**DATE OF DELIVERY:** 2017-03-08**DATE OF TESTS:** from 2017-03-23 till 2017-04-26**ORDER No.:** dated on 2017-03-02

TABLE OF CONTENTS

1	TESTS PERFORMED	4
1.1	Verification of the dimensions	4
1.1.1	Test procedure	4
1.1.2	Test results.....	4
1.2	Dry lightning impulse voltage tests	5
1.2.1	Test procedure	5
1.2.2	Test results.....	6
1.3	Wet power-frequency voltage tests	7
1.3.1	Test procedure	7
1.3.2	Test results.....	8
1.4	Puncture withstand test ¹⁾	9
1.4.1	Test procedure	9
1.4.2	Test results.....	9
1.5	Mechanical failing load test - bending.....	10
1.5.1	Test procedure	10
1.5.2	Test results.....	10
1.6	Temperature cycle tests	11
1.6.1	Test procedure	11
1.6.2	Test results.....	11
1.7	Porosity test	12
1.7.1	Test procedure	12
1.7.2	Test results.....	12
2	LIST OF SYMBOLS	13
3	UNCERTAINTY OF MEASUREMENTS	14
4	PRODUCT DRAWING.....	15
5	GRAPHS AND RECORDS.....	17
6	TEST OBJECT AND TEST SETUP PHOTOS	18

1 TESTS PERFORMED

1.1 Verification of the dimensions

1.1.1 Test procedure

Verification of the dimensions was carried out according to IEC 60383-1, clause 17.

The porcelain pin insulators No. 1, 2, 3, 4, 5 were checked.

Testing and measuring equipment:

yard stick, Assist 7,5 m, serial No. 347/10

slide gauge 300 mm, Kinex CZ, serial No. 2441/05

1.1.2 Test results

Table 1 Measured dimensions

Checked dimension	Nominal [mm]	Tolerance [mm]	Test sample No. - measured values [mm]				
			1	2	3	4	5
length 1	212	$\pm 9,98$	206	208	212	207	209
length 2	20	$\pm 5,0$	24	23,2	24,3	21	25
outer diameter	170	$\pm 8,3$	169	167,4	170	167,5	170
diameter	50	$\pm 3,5$	52	49	51	50	51,5
creepage distance	325	> 325	345	336	338	335	341

Conclusion:

Maximum measured differences were lower than calculated tolerances. The creepage distance was higher than the minimal value of 325 mm.

Porcelain pin insulator SDI37 passed the verification of the dimensions according to IEC 60383-1, clause 17.

1.2 Dry lightning impulse voltage tests

1.2.1 Test procedure

The tests were carried out according to IEC 60383-1, clause 13.

The tests were performed on the porcelain pin insulators No. 11, 12, 13.

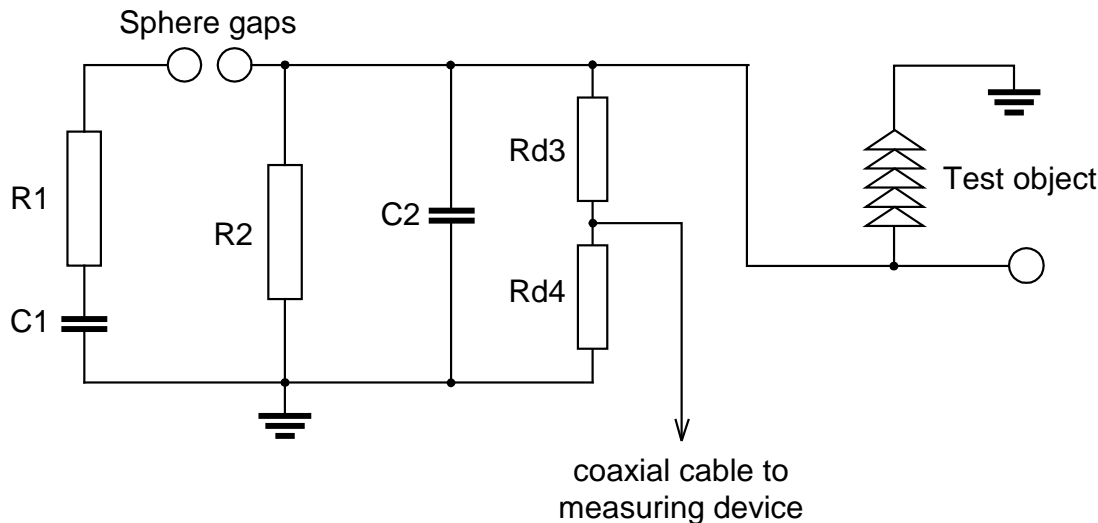
The 50% lightning impulse flashover voltages of both polarities were determined by the up and down method with 30 impulses according to IEC 60060-1, clause 7.3.1.4.

The 10% lightning impulse flashover voltages of both polarities were calculated from the 50% lightning impulse flashover voltages according to IEC 60060-1, clause 7.3.1.4.

The test arrangement is shown in Figure 2.

The wave shape of lightning impulse voltage 1,2/50 μ s is given in Graph 1.

Testing and measuring equipment:



impulse generator TuR Dresden 750 kV, 30 kJ, serial No. 862512

R_{d3}/R_{d4} – resistive divider TuR Dresden SMR 10/770, serial No. 895742

measuring system Haefely Trench, type HiAS 743, serial No. 175247

measuring system for atmospheric conditions Comet, serial No. 14900363

yard stick 7,5 m, Assist, serial No. 347/10

1.2.2 Test results

Table 2 Test results of lightning impulse voltage tests

Test sample No.	11		12		13	
Polarity	+	-	+	-	+	-
p (kPa)	98,5	98,5	98,5	98,5	98,5	98,5
t (°C)	17,1	17,1	17,1	17,1	17,2	17,2
RH (%)	45,2	45,2	47,2	47,2	46,8	46,8
k₁	0,982	0,982	0,982	0,982	0,982	0,982
k₂	0,988	1,000	0,990	1,000	0,988	1,000
K_t	0,971	0,982	0,972	0,982	0,970	0,982
U₅₀ (kV)	158	208	159	202	156	203
U₁₀ (kV)	151	200	153	194	150	195
<i>Measured arcing distance: 200 mm</i>						

Conclusion:

The 10% dry lightning impulse flashover voltages (U₁₀) of both polarities were higher than the specified dry lightning impulse withstand voltage of 125 kV. The acceptance criteria according to IEC 60060-1, clause 7.3.1.4 were met.

Porcelain pin insulator SDI37 passed the dry lightning impulse voltage tests according to IEC 60383-1, clause 13.

1.3 Wet power-frequency voltage tests

1.3.1 Test procedure

The tests were carried out according to IEC 60383-1, clause 14.

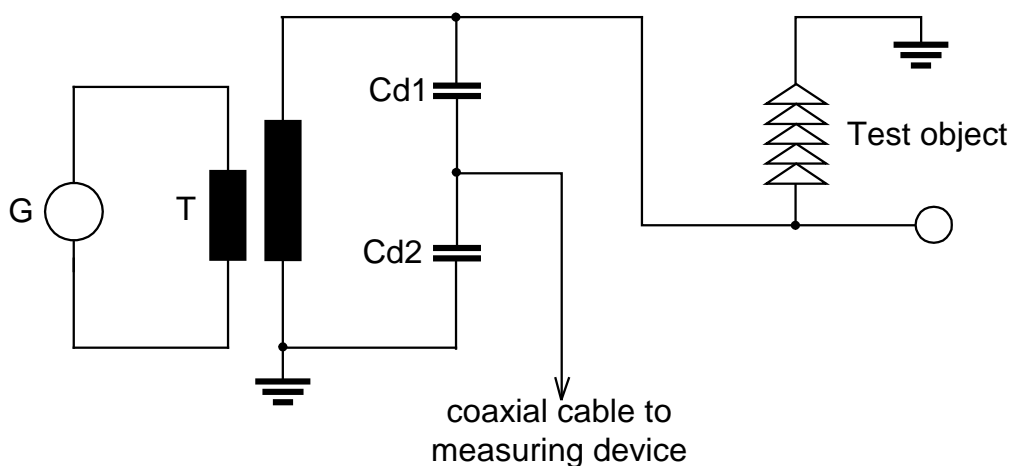
The tests were performed on the porcelain pin insulators No. 11, 12, 13.

The flashover voltage was obtained by increasing the voltage linearly from zero within one minute. The average value of five flashover voltages was calculated.

The maximum power-frequency withstand voltage was applied to the test object for 60 seconds. The test was carried out according to IEC 60060-1, clause 6.3.1.

The test arrangement is shown in Figure 3.

Testing and measuring equipment:



G - synchronous generator BEZ Bratislava 6 kV, 50 Hz, 1300 kVA, serial No. BRA 20980

T - test transformer Fischer Köln, 6/250 kV, 250 kVA, serial No. P38879

Cd1/Cd2- capacitive divider type LK-250, serial No. 001-12

universal voltmeter Siemens MU 15, serial No. 879953

measuring system for atmospheric conditions COMET, serial No. 14900363

conductivity meter WTW cond 3110, serial No. 11060082

yard stick 7,5 m, Assist, serial No. 347/10

digital stopwatch Olympia, PM-173

plastic measuring cylinder 50ml, i. No. 1/153/14 & 2/153/14

1.3.2 Test results

Table 3 Test results of wet power frequency test

Test sample No.		11		12		13	
p (kPa)		98,5		98,5		98,5	
t (°C)		17,3		17,2		17,3	
RH (%)		56,2		59,2		61,0	
r. i. (mm/min)	v. c.	1,6		1,6		1,6	
	h. c.	1,4		1,4		1,4	
Conductivity (μS/cm)		100		100		100	
Factors related to		U _F	U _{MW}	U _F	U _{MW}	U _F	U _{MW}
k ₁		0,987	0,988	0,989	0,989	0,988	0,988
k ₂		1,000	1,000	1,000	1,000	1,000	1,000
K _t		0,987	0,988	0,989	0,989	0,988	0,988
U _F (kV)		58		56		57	
U _{MW} (kV)		51		51		51	
Measured arcing distance: 200 mm							

Conclusion:

Measured maximum wet power-frequency withstand voltages U_{MW} were higher than the specified value of 50 kV.

Porcelain pin insulator SDI37 passed the wet power-frequency voltage tests according to IEC 60383-1, clause 14.

1.4 Puncture withstand test ¹⁾

1.4.1 Test procedure

The puncture test was carried out according to IEC 60383-1, clause 15.

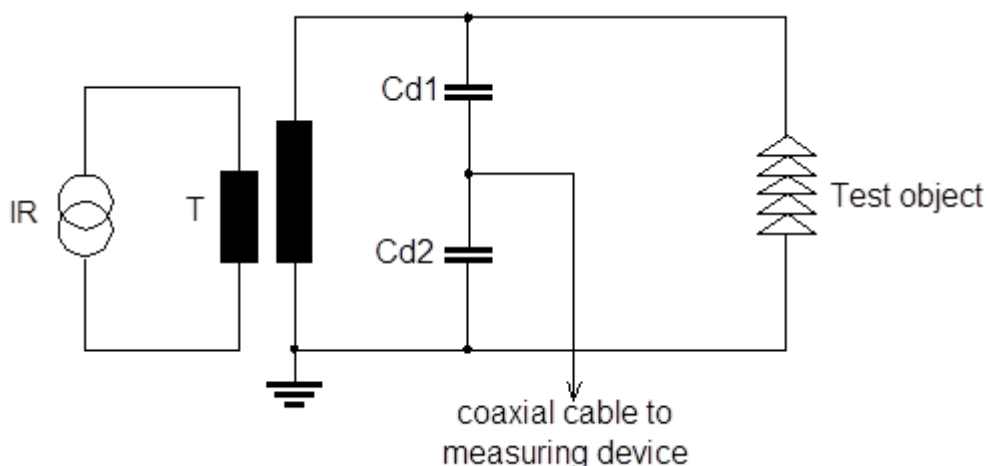
The test was performed on the porcelain pin insulator No. 14.

The test sample was immersed in insulating medium.

The voltage was increased rapidly to the specified withstand voltage of 110 kV.

The test sample during the test is shown in Figure 4.

Testing and measuring equipment:



IR - inductive regulator ČKD Praha 6/ 0 - 3 kV, 50 kVA

T - test transformer Fischer Köln, 6/250 kV, 250 kVA, seial No. P38879

Cd1/Cd2- capacitive divider type LK-250, serial No. 001-12

universal voltmeter Siemens MU 15, serial No. 879953

measuring system for atmospheric conditions COMET, serial No. 10910247

1.4.2 Test results

Table 4 Test results of puncture test

Test sample No.	Test voltage [kV]
14	110

Conclusion:

No puncture occurred during the test at the specified withstand puncture voltage of 110 kV.

Porcelain pin insulator SDI37 passed the puncture withstand test according to IEC 60383-1, clause 15.

1.5 Mechanical failing load test - bending

1.5.1 Test procedure

The bending tests were carried out according to IEC 60383-1, clause 19.1.

The test were performed on the porcelain pin insulators No. 6, 7, 8, 9, 10.

The test sample during bending test is shown in Figure 5.

Testing and measuring equipment:

hydraulic loading machine Amsler, serial No. 55/9

1.5.2 Test results

Table 5 Test results of bending test

Test sample No.	Failing load [kN]
6	32,0
7	33,0
8	> 35,0
9	20,5
10	32,0

Conclusion:

Measured bending failing loads were higher than the specified breaking load of 12,5 kN.

Porcelain pin insulator SDI37 passed the mechanical failing load test - bending according to IEC 60383-1, clause 19.1.

1.6 Temperature cycle tests

1.6.1 Test procedure

The temperature cycle tests were carried out according to IEC 60383-1, clause 23.1.

The tests were performed on the porcelain pin insulators No. 1, 2, 3, 4, 5.

The test sample was first immersed in a hot water bath for 18 minutes. Then it was withdrawn and immersed in a cold water bath for 18 minutes. This heating and cooling cycle was performed three times in succession. The difference of temperature between hot water bath and cold water bath was more than 70K.

The test samples during the temperature cycle test are shown in Figure 6.

Testing and measuring equipment:

digital stop-watch Olympia, type Sport, PM-172

digital thermometer – Fluke 54 II, serial No. 77590015 + measuring probe serial No. 01/EGU/58

hydraulic loading machine Amsler, serial No. 55/9

1.6.2 Test results

Table 6 Test results of temperature cycle test

Temperature of water	Hot [°C]	Cold [°C]
1st cycle	76,7	5,9
2nd cycle	76,6	5,9
3rd cycle	76,6	5,9

Table 7 Mechanical routine test

Test sample No.	Applied load [kN]	Duration [s]	Result
1	10	60	Passed
2	10	60	Passed
3	10	60	Passed
4	10	60	Passed
5	10	60	Passed

Conclusion:

No cracking, no mechanical breakage occurred on all tested porcelain pin insulators after the temperature cycle test.

All tested porcelain pin insulators passed one minute mechanical routine test.

Porcelain pin insulator SDI37 passed the porosity test according to IEC 60383-1, clause 23.

1.7 Porosity test

1.7.1 Test procedure

The porosity test was carried out according to IEC 60383-1, clause 25.

The test fragments were used from the porcelain pin insulators No. 6, 7, 8, 9, 10 at the place where the fracture occurred during the bending test.

Ceramic fragments from the test samples were immersed in the 1% alcohol solution of fuchsin under the pressure of 15 MPa for 16 hours.

After immersing the fragments were washed, dried and again broken. The fragments were submitted to visual inspection.

Broken ceramic fragments after the porosity test are shown in Figure 7.

Testing and measuring equipment:

digital stop-watch Olympia, type Sport, PM-172
pressure meter TH60 MPa

1.7.2 Test results

Conclusion:

There were no traces of dye penetration on the freshly broken fragments after the porosity test.

Porcelain pin insulator SDI37 passed the porosity test according to IEC 60383-1, clause 25.

2 LIST OF SYMBOLS

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

p	air pressure (kPa)
t	air temperature (°C)
RH	relative humidity (%)
k₁	air density correction factor
k₂	humidity correction factor
K_t	atmospheric correction factor
U₅₀	50% dry lightning impulse flashover voltage (kV)
U₁₀	10% dry lightning impulse flashover voltage (kV)
U_F	wet power-frequency flashover voltage (kV)
U_{MW}	maximum wet power-frequency withstand voltage (kV)
r.i.	average value of the measured rainfall intensity (mm/min): - v.c. - vertical component - h.c. - horizontal component
Conductivity	water conductivity (μS/cm).

Explanatory notes for tests and standards:

- 1) The test is not a subject of EGU-HV Laboratory accreditation


3 UNCERTAINTY OF MEASUREMENTS

QUANTITY	UNCERTAINTY (k=2)	
<i>Lightning impulse voltage</i>	U _m T ₁ T ₂	1,5 % 5,3 % 4,1 %
<i>Power-frequency voltage (wet PF)</i>	1,5 %	
<i>Mechanical load</i>	1,0 %	
<i>Length – yard stick (1 – 7500 mm)</i>	630 µm	
<i>Length – slide gauge (0,2 – 300 mm)</i>	120 µm	
<i>Temperature of water</i>	2,6 °C	
<i>Temperature</i>	0,7 °C	
<i>Air pressure</i>	0,04 kPa	
<i>Relative humidity</i>	5,3 %	
<i>Time</i>	0,7 %	
<i>Conductivity (0,1 µS/cm – 1000 mS/cm)</i>	1,0 %	
<i>Rainfall intensity</i>	10 %	
<i>Pressure</i>	2,0 %	

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 %.

4 PRODUCT DRAWING


1/3



Saves Your Energy

PRODUCT SPECIFICATION


4/4/2017



6418677408731

SDI37
Porcelain pin insulator

Code	SDI37
GTIN	6418677408731
Name	Porcelain pin insulator 24 kV, with pulling sleeve
Description	SDI37 is used with bare wires or covered conductors. Suitable for installation on pin SOT24 (SFS 4385). The plastic sleeve in the top-groove of the insulator enables pulling of conductor without using pulleys. The conductor can be tied to the top-groove or to the neck. In angles, always tie to the neck. Creepage distance 325 mm. Neck diameter 85 mm.



Technical specification

Dimensions

Weight:	3.8 kg
Insulator neck:	85 mm
Creepage distance:	325 mm

Electrical values

Highest system voltage:	24 kV
Dry lightning impulse withstand voltage:	≥ 125 kV
Wet power frequency withstand voltage:	≥ 50 kV

Features

Insulator pin:	SOT24
----------------	-------

Mechanical

Breaking load:	12.5 kN
----------------	---------

Ratings

ETIM class:	EC002357
-------------	----------

Specification

Use:	Used with bare wires or covered conductors.
------	---

Ensto Finland Oy

 Ensio Miettisen katu 2
 06100 Porvoo
 Finland

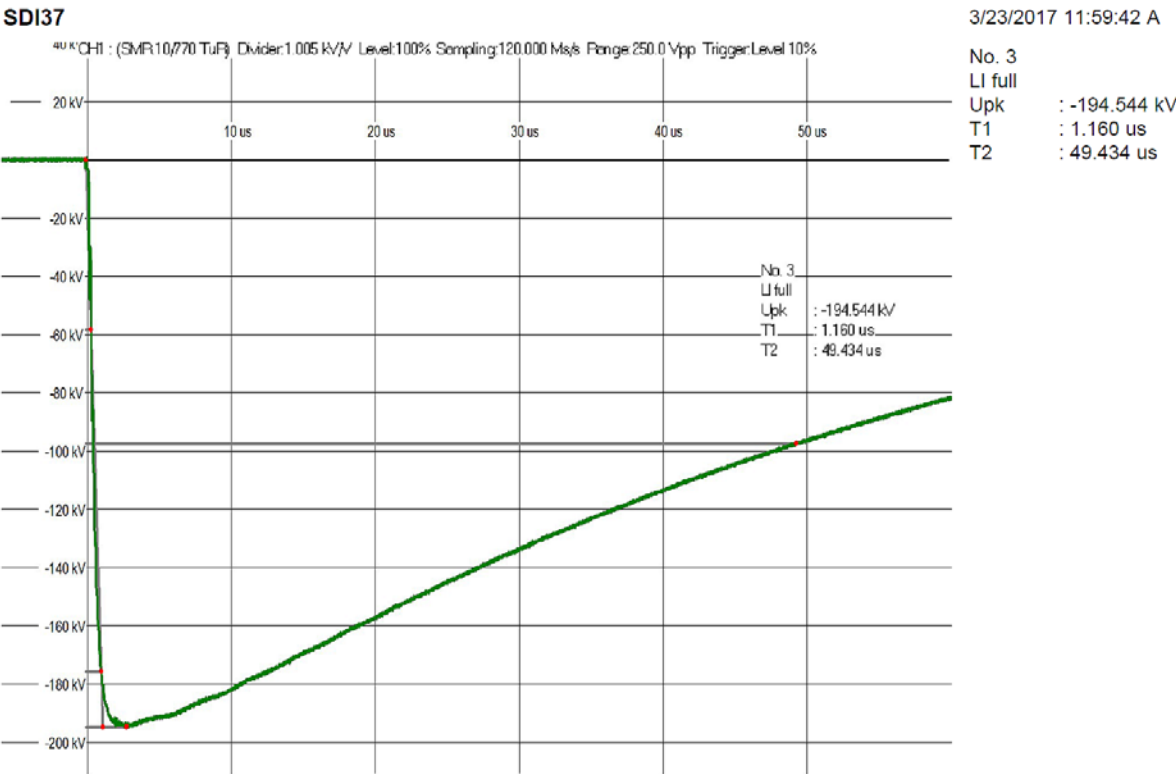
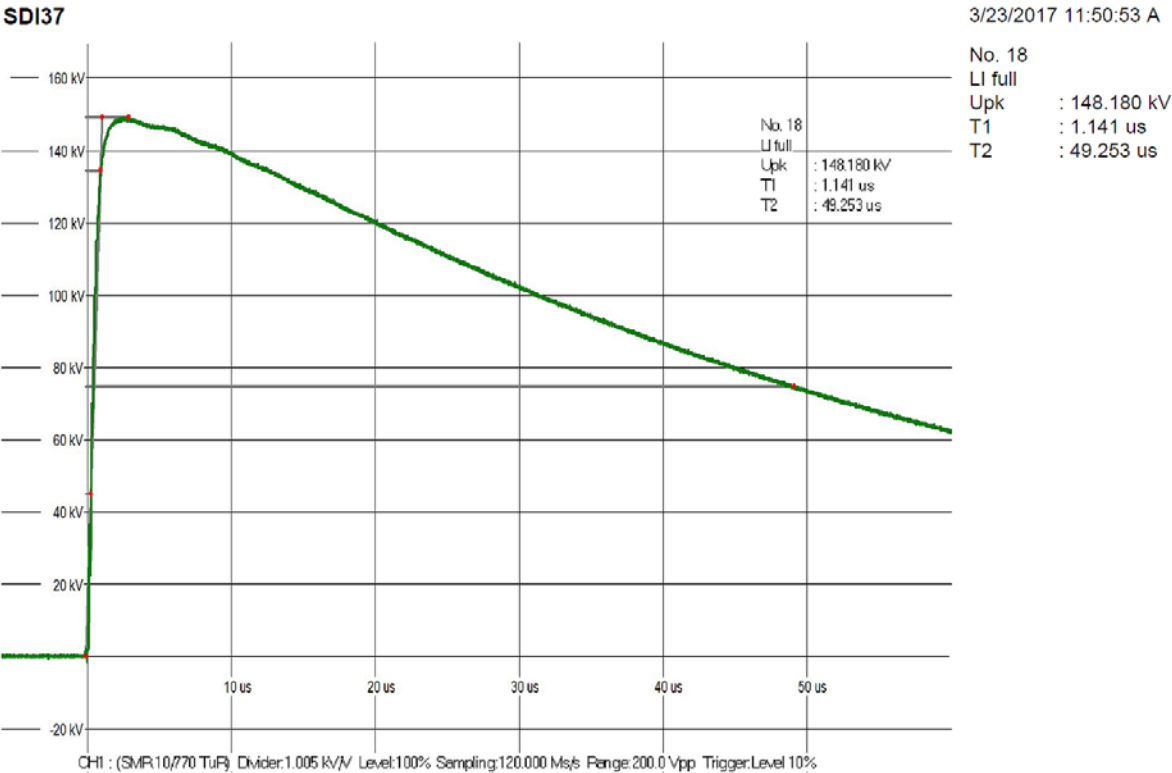
 email: ensto@ensto.com
 phone: +358 204 76 21
www.ensto.com

Figure 1a
Porcelain pin insulator SDI37

Construction:	SDI37 has an incorporated plastic thimble in the top, which enables the conductors to be pulled directly in the insulator groove without other pulleys.
Installation:	A pulling rope is first passed through the plastic sleeves and the conductor is then pulled in the normal manner. If necessary the sleeve can be rotated so that the rope/conductor cannot come out of the groove. When the conductor has been tightened it is tied to either the top groove or the side neck of the insulator as appropriate. The plastic pulling sleeve can be left in place.
Markings:	SDI37
Standard:	SFS 5004, IEC 383
ETIM	
ETIM	
Length:	212 mm
Outer diameter:	170 mm
Bolt dimension metric (M.):	24
Packaging	
Default package	
Unit:	PCS
Size:	3
Length:	520 mm
Width:	180 mm
Height:	180 mm
Weight (net):	11.4 kg
Volume:	0.0168
Pallet package	
Unit:	PCS
Size:	90
Length:	1200 mm
Width:	800 mm
Height:	1030 mm
Weight (net):	342 kg
Weight (brt):	362 kg
Volume:	0.9888

Figure 1b
Porcelain pin insulator SDI37

5 GRAPHS AND RECORDS



Graph 1
The wave shape of lighting impulse voltage 1,2/50 μ s

6 TEST OBJECT AND TEST SETUP PHOTOS

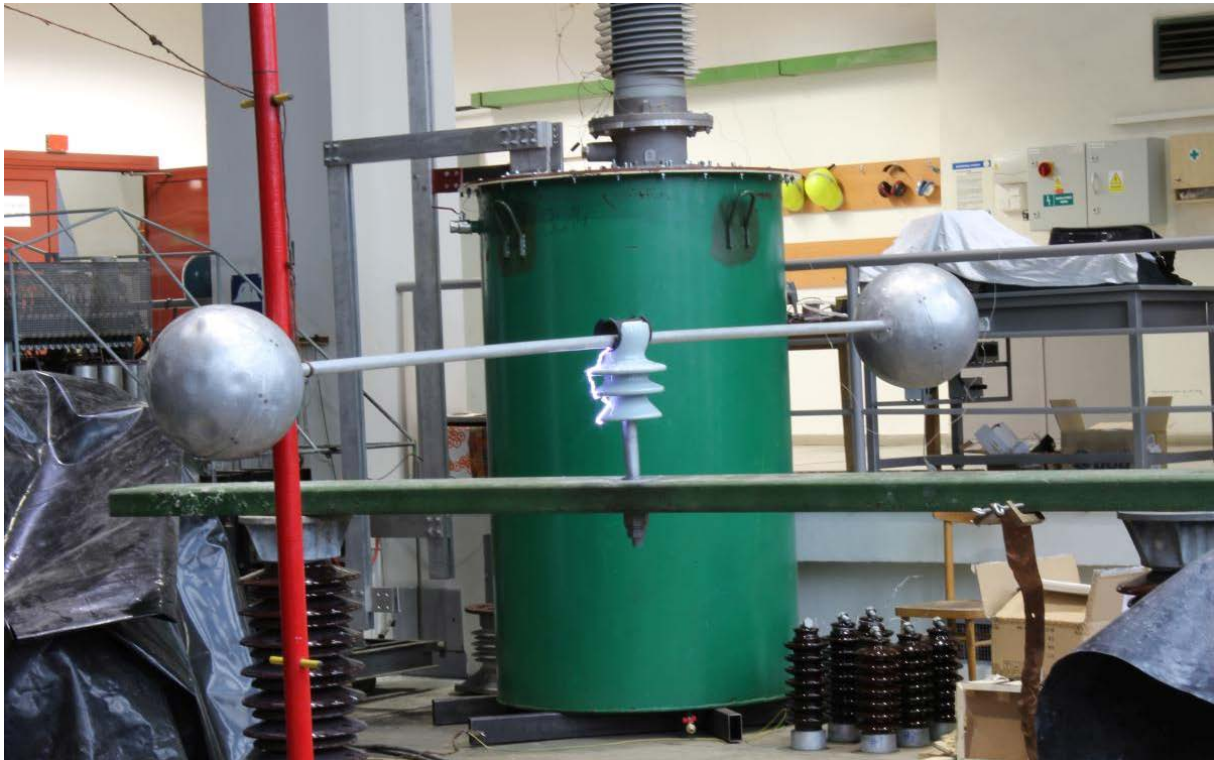


Figure 2
Dry lightning impulse voltage test



Figure 3
Wet power-frequency voltage test

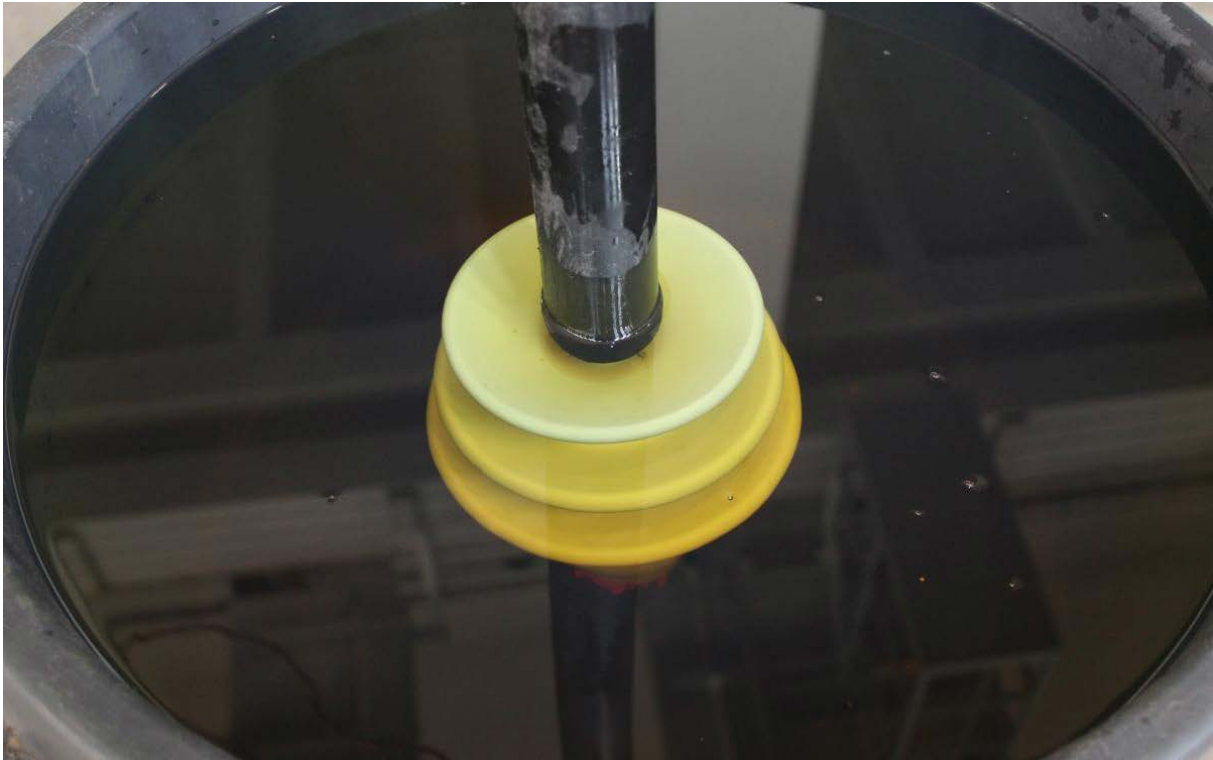


Figure 4
Puncture withstand test



Figure 5
Bending test



Figure 6
Temperature cycle test



Figure 7
Porosity test (test sample No. 10)

- end of test report -