

Test Report

Document No.	B7018623	Copy No.	1	Number of pages	17
Apparatus	Polymer-housed surge arrester unit type PA-DM-54 and polymer-housed surge arrester section type PA-DM assembled in thermal model				
Designation	---				
Serial Number	---				
Manufacturer	Joint-Stock Company " Polymer-Apparat"				
Client	Joint-Stock Company " Polymer-Apparat" Ak. Kostantinova Strasse, 1 195427 Saint- Petersburg - Russian Federation				
Tested for	---				
Date(s) of tests	September 18, 2017				
Tested by	CESI.S.p.A. Via Rubattino, 54 20134 Milano - Italy				
Test performed	Heat dissipation behaviour of test sample : Test to verify thermal equivalency between complete arrester and arrester section				

PAD B7018623 (2441806) - CONFIDENTIAL USE

The apparatus, constructed in accordance with the description, drawings and photographs incorporated in this document has been subjected to the series of proving tests in accordance with: IEC 60099-4 – Edition 3.0 (2014-06)

The results are shown in the record of proving tests and the oscillograms attached hereto. The ratings assigned by the Manufacturer are listed on the ratings page.
The document applies only to the apparatus tested. The responsibility for conformity of any apparatus having the same designations with that tested rests with the Manufacturer.

November 27, 2017

Date **Gregori Marco**
B7018623 3059 AUT
Test Engineer in charge

The Manager - Arcidiaco Lorenzo
B7018623 821814 ASP
Approved By Document Digitally Signed

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LAB N° 0030

The laboratory meets the requirements of the Standard EN ISO/IEC 17025: 2005 "General Requirements for the Competence of Testing and Calibration Laboratories". The in force status of the accreditation and the list of accredited tests may be checked in the WEB site: www.accredia.it



CESI

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Notes

STL-Member

CESI Group members are founder members of the SHORT-CIRCUIT TESTING LIAISON (STL) which has been established in 1969. STL is a forum for voluntary international cooperation of testing organizations.

CESI Group Test Documents description

Type Test Certificate of

Issued for type tests of high voltage products ($> 1 \text{ kV}_{ac}$; $> 1,5 \text{ kV}_{dc}$), which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of the test. The Type Test Certificate consists of documents unequivocally identifying the test object and describes all conditions under which the tests were conducted. It gives evidence of the unobjectionable behavior of the test object during the tests in line with the normative documents applied as well as of the results of successful testing.

Test Certificate of (complete / selected) Type Tests

Issued if type tests of low voltage products ($< 1 \text{ kV}_{ac}$; $< 1,5 \text{ kV}_{dc}$) requested by the relevant product standard were passed. For these tests the equipment under test must be clearly identified by technical description, drawings, and additional specifications.

Certificate of Design Verification

Issued for passed design verification tests according to IEC 61439. For these tests the equipment under test must be clearly identified by technical description, drawings, and additional specifications.

Type Test Report

Issued for high and low voltage products if parts of selected type tests have been passed; those shall be carried out in full compliance with the relevant standards but (for high voltage products) do not fulfill all STL requirements for issuing a Type Test Certificate. For these tests the equipment under test must be clearly identified by technical description, drawings, and additional specifications.

Test Report

Issued for all other tests on high and low voltage products which have been carried out according to specifications, standards and/or client instructions

On-Site Test Record

Issued as a record of results acquired during the on-site tests / measurements

Test Award

Can be additionally issued for all named types of test documents above if the tests to be referenced were passed

Tests witnessed by:

Mr. Anton Potapov
Mr. Alexander Kolychex

Joint-Stock Company “ Polymer-Apparat”
Joint-Stock Company “ Polymer-Apparat”

Identification of the object:

Requested

The Manufacturer guarantees that the tested object is manufactured according to the submitted drawings. CESI checked that these drawings adequately represent in shape and dimensions the essential details and the parts of the tested object.

These drawings, identified by CESI and numbered B7023130 n.1 & B7024013 n.1, are annexed to this document.

The data necessary to permit repetition of the tests are contained in the document marked: -----

The reported expanded uncertainties are determined in accordance with the Publication JCGM 100 “Evaluation of measurement data – Guide to the expression of uncertainty in measurement” and are based on a standard uncertainty multiplied by a coverage factor $K=2$, which for a normal distribution provides a level of confidence of approximately 95%

- Voltage a.c.	: ± 3,0%
- Residual peak voltage (impulse tests)	: ± 3,0%
- Current a.c.	: ± 3,0%
- Peak current (impulse tests)	: ± 3,0%
- Time (impulse tests)	: ± 10,0%
- Time (a.c. tests)	: ± 1,5%

Laboratory information

Receipt date of the sample	September 2017
Test location	CESI – Via Rubattino 54 – Milan
CESI testing team	Mr. L. Podavitte, Mr. I Guacci
Test laboratory	P177 (Surge Arrester laboratory)
ODV SAP	70006781

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Summary of test result	10 to 12	
Instrument used for the test	13	September 18, 2017
Technical data	14	
Pages annexed:		
Client's drawing (arrester section assembled in thermal model) ; CESI n. B7023130- n.1 page		
Client's drawing (complete arrester) ; CESI n. B7024013- n.1 page		
Client's drawing (MO resistor) ; CESI n. B7020387 - n.1 page		

Rated characteristics of the tested objects assigned by the Client**Polymer-housed surge arrester**

Manufacturer	Joint-Stock Company "Polymer-Apparat"
Type	PA-DM-54
MO resistors supplier	Joint-Stock Company "Polymer-Apparat"
Serial no.	000035
Drawing code	PA-OPN.035.001.054.01
Arrester class	Distribution
Designation	DH
Design	B
Rated voltage – U_r	54 kV
Continuous operating voltage - U_c	43,2 kV
Rated frequency	48÷62 Hz
Nominal discharge current (8/20 μ s impulse shape)	10 kA
Reference current - I_{ref}	1 mA
Year of manufacturer	08/2017

Polymer-housed surge arrester section assembled in thermal model

Manufacturer	Joint-Stock Company "Polymer-Apparat"
Type	PA-DM
MO resistors supplier	Joint-Stock Company "Polymer-Apparat"
Serial no.	000011
Drawing code	PA-DM.001.ST.01
Arrester class	Distribution
Designation	DH
Design	B
Rated voltage – U_r	1,25 x U_c
Continuous operating voltage - U_c	4,34 kV
Rated frequency	48÷62 Hz
Nominal discharge current (8/20 μ s impulse shape)	10 kA
Reference current - I_{ref}	1 mA
Year of manufacturer	08/2017

Reference Standard

IEC 60099-4 – Edition 3.0 (2014-06)– clause 8.6 & Annex B
 “ Metal-Oxide Surge Arresters without gaps for AC systems

Test carried out and identification of the test objects

Test carried out	Number of test objects	Test object identification
Heat dissipation behaviour of test sample	1	PA-DM-54 - s/n. 368162
	1	PA-DM (Section) - s/n. 368160

Test setting for the test

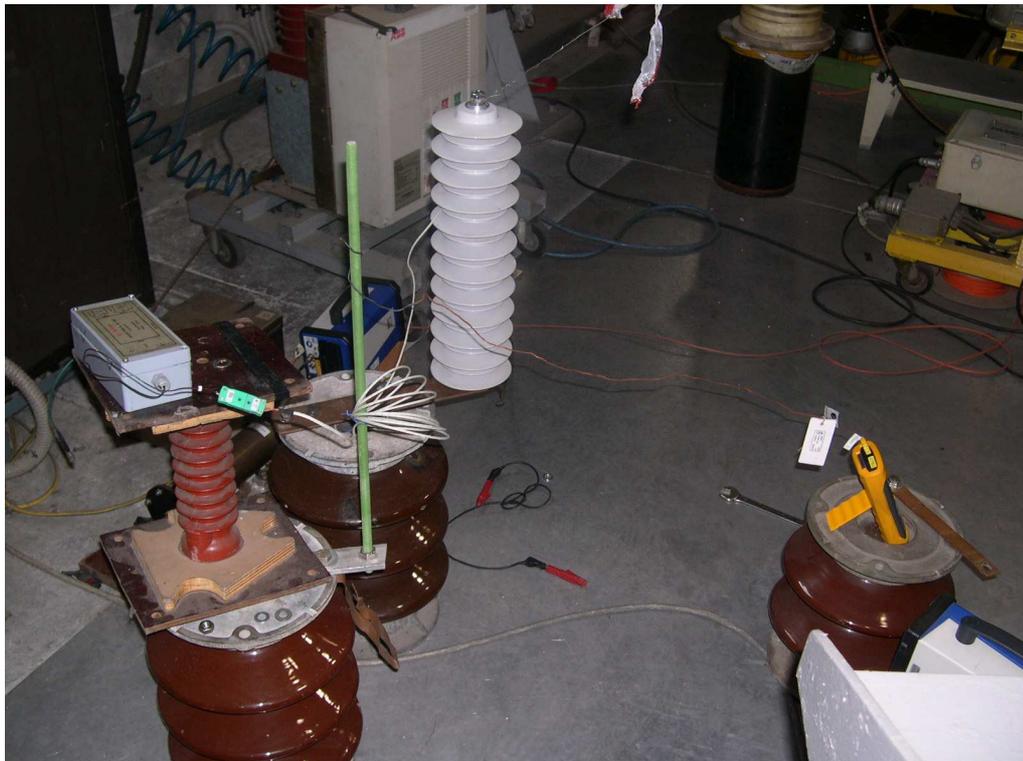


Photo no. 1

Complete arrester



Photo no. 2

Arrester section assembled in thermal model

Test procedure on complete arrester

The complete arrester was placed in the testing laboratory (see photograph no.1 on page 7) at still air ambient temperature of 21,1 °C. The ambient temperature was held at 21,1 °C \pm 3K during the test .

The complete arrester was supplied by the manufacturer fitted with a optical thermal sensors attached to the MO resistors (see drawing attached on this test report).

The surge arrester was heated to a temperature of approximately 140 °C by the application of a power frequency overvoltage with an amplitude above the reference voltage.

The heating time was 22 min. (the maximum time according to the reference standard is 60 min.).

When the specified temperature of about 140 °C was reached the voltage source was disconnected and the cooling time curve was determined over a period of not less than 2 hours.

Test procedure on arrester section

The arrester section was placed in the testing laboratory (see photograph no.2 on page 8) at still air ambient temperature of 22,2 °C.

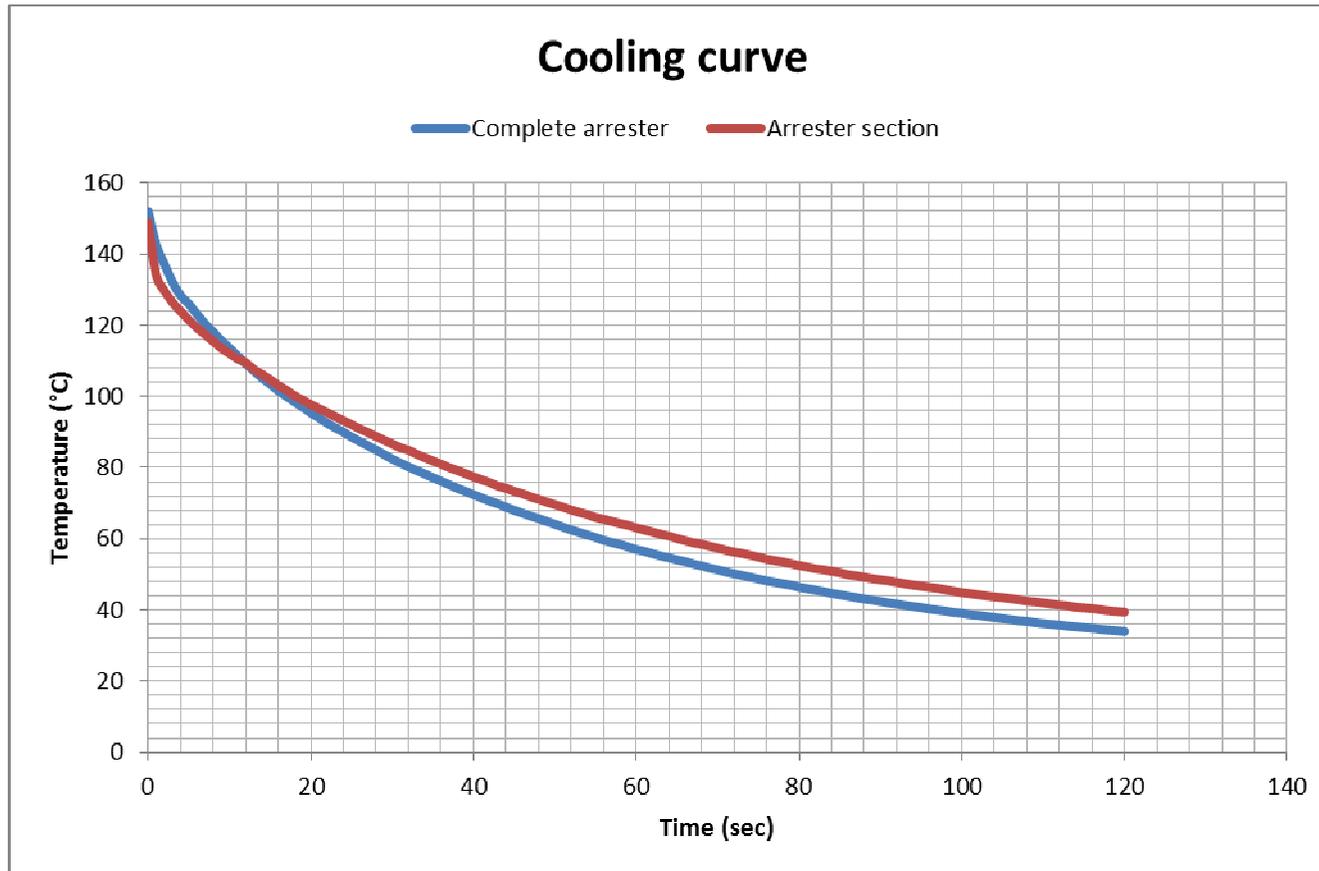
The ambient temperature was held at 22,2°C \pm 3K during the test .

The arrester section was supplied by the manufacturer and one optical thermal sensor has been used (see drawing attached on this test report).

The MO resistor was heated to a temperature of approximately 140 °C by the application of a power frequency overvoltage with an amplitude above the reference voltage.

The heating time has been of 22 min. (the maximum time according to the reference standard is 60 min.).

When the specified temperature of about 140 °C was reached the voltage source was disconnected and the cooling time curve was determined over a period of not less than 2 hours.



Test result and the calculation of the temperature compensation

The cooling curve (see pag.10) of the arrester section hasn't been for all instants equal or higher than the cooling curve of the arrester. The compensation may be made adding a ΔT to the start temperature ϑ_{start} of the prorated section during the preheating (thermal recovery part) for Operating duty test and Power-frequency voltage versus time test.

Sample	T	T _A	T ₀	T ₀ - T _A	Heating time	Date
Complete arrester	is the measured temperature during cooling every minute	21,1 °C	152,0 °C	130,9 °C	22 min	September 18, 2017
Arrester section	is the measured temperature during cooling every minute	22,2 °C	148,8 °C	125,8 °C	22 min	September 18, 2017

Legend:

- T is the measured temperature instant by instant
- T_A is the average ambient temperature during test
- T₀ is the maximum heating temperature
- T_{rel} $(T - T_A) / (T_0 - T_A)$
- ΔT temperature compensation

The two relative temperatures T_{rel}.arrester and T_{rel}. arrester section have been plotted (see page 12) for the cooling time ($\geq 7200s$).

During the cooling time the difference T_{rel}.arrester - T_{rel}. arrester section has been calculated and the max value has to be considered.

$$K = \max (T_{rel,arrester} - T_{rel,arrester\ section}) = 0,044329149$$

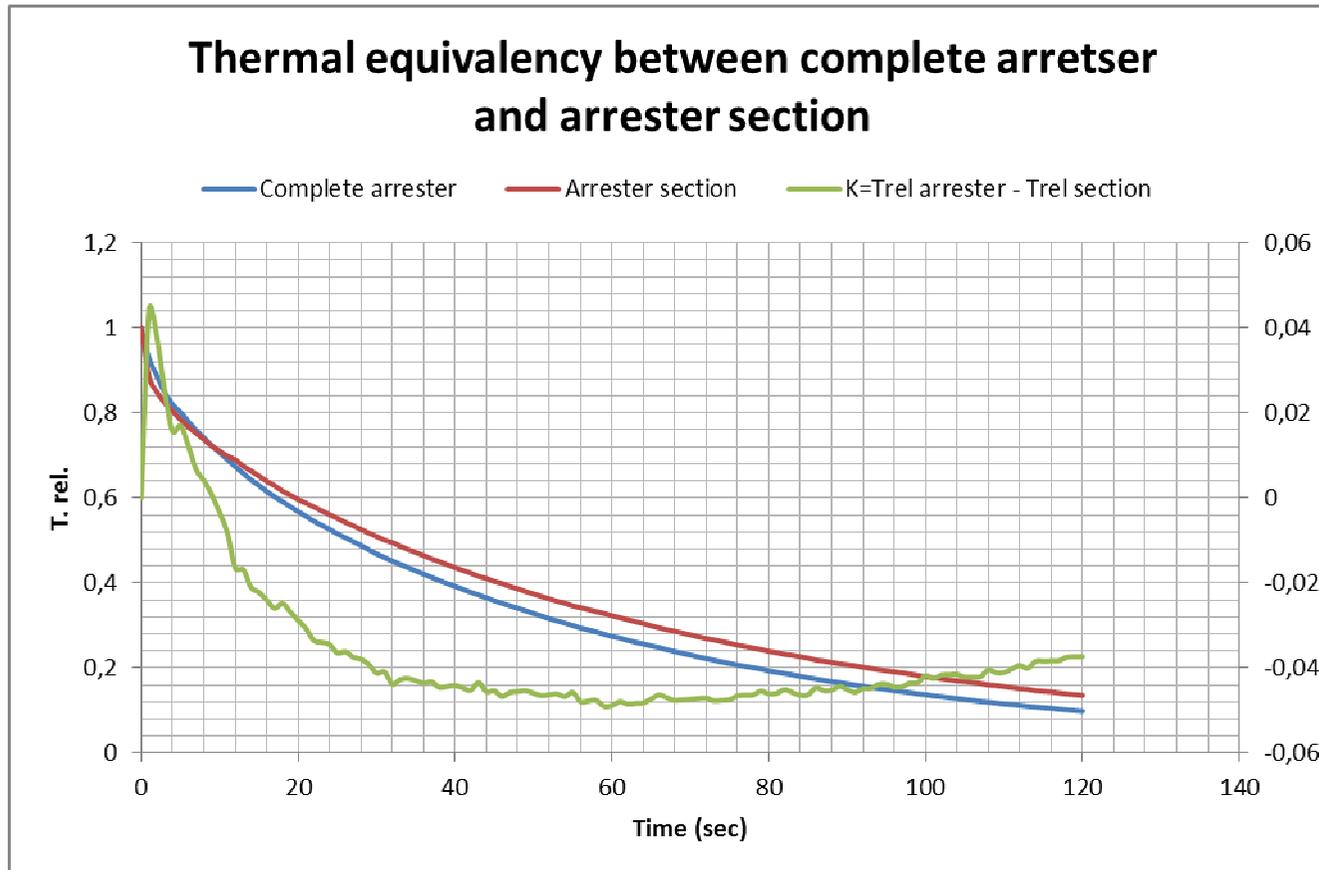
$$\Delta T = K (T_0 - T_A)_{max} = 0,044329149 * 130,9 = 5,80 \text{ °C}$$

The compensation temperature ΔT resulting from the test is 5,80 °C.

$$\vartheta_{start} = 60 \text{ °C} + 5,80 \text{ °C} = 65,80 \text{ °C}$$

Therefore the ϑ_{start} for thermal recovery test in the Operating duty test and Power-frequency voltage versus time test is equal to 65,80 °C.

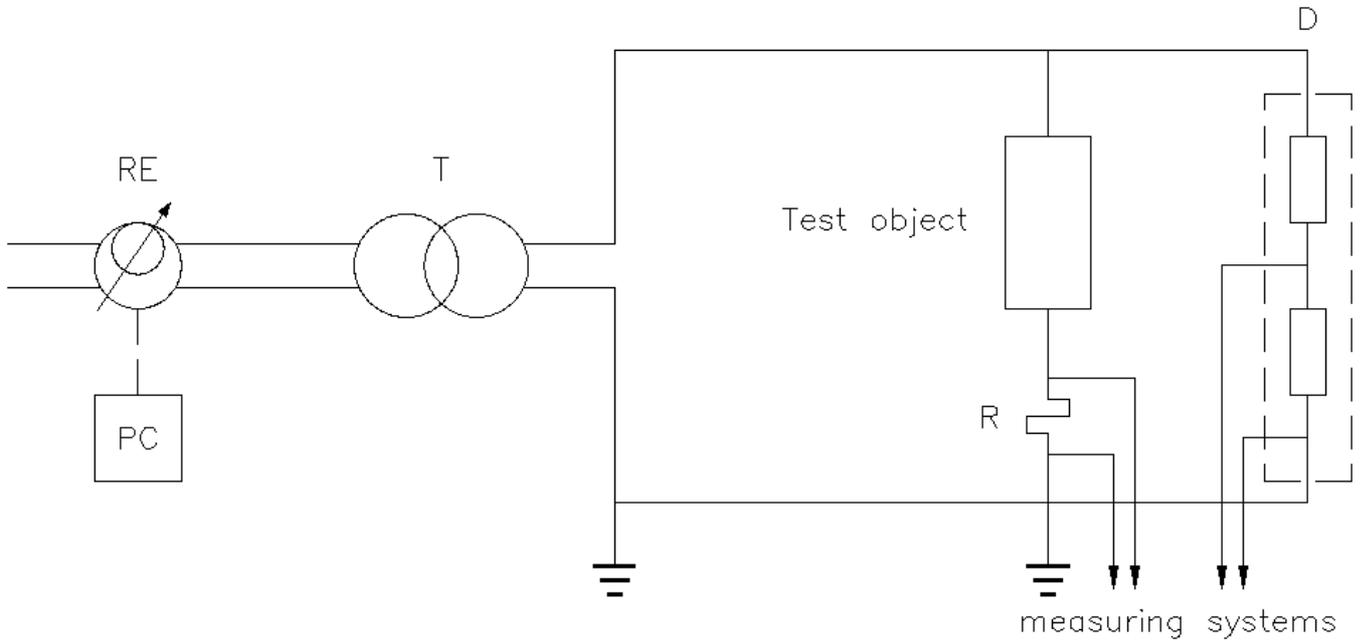




Instruments used for temperature measurement

Instrument type	CESI no.	Note:
ASKIVIANA	022469 - Rx 022468 - Tx	used surge arrester unit and surge arrester section temperature
FLUKE thermometer	030889	used for ambient temperature

Circuit A0019



Power frequency supply

- RE - programmable supply type PACIFIC A.C. Power Source 140 ASX.; CESI no. 0560408
- PC - personal computer
- T - voltage transformer type SPECIALTRASFO; power 60 kVA; voltage 220 V/200 kV (used for complete arrester)

Current measuring system

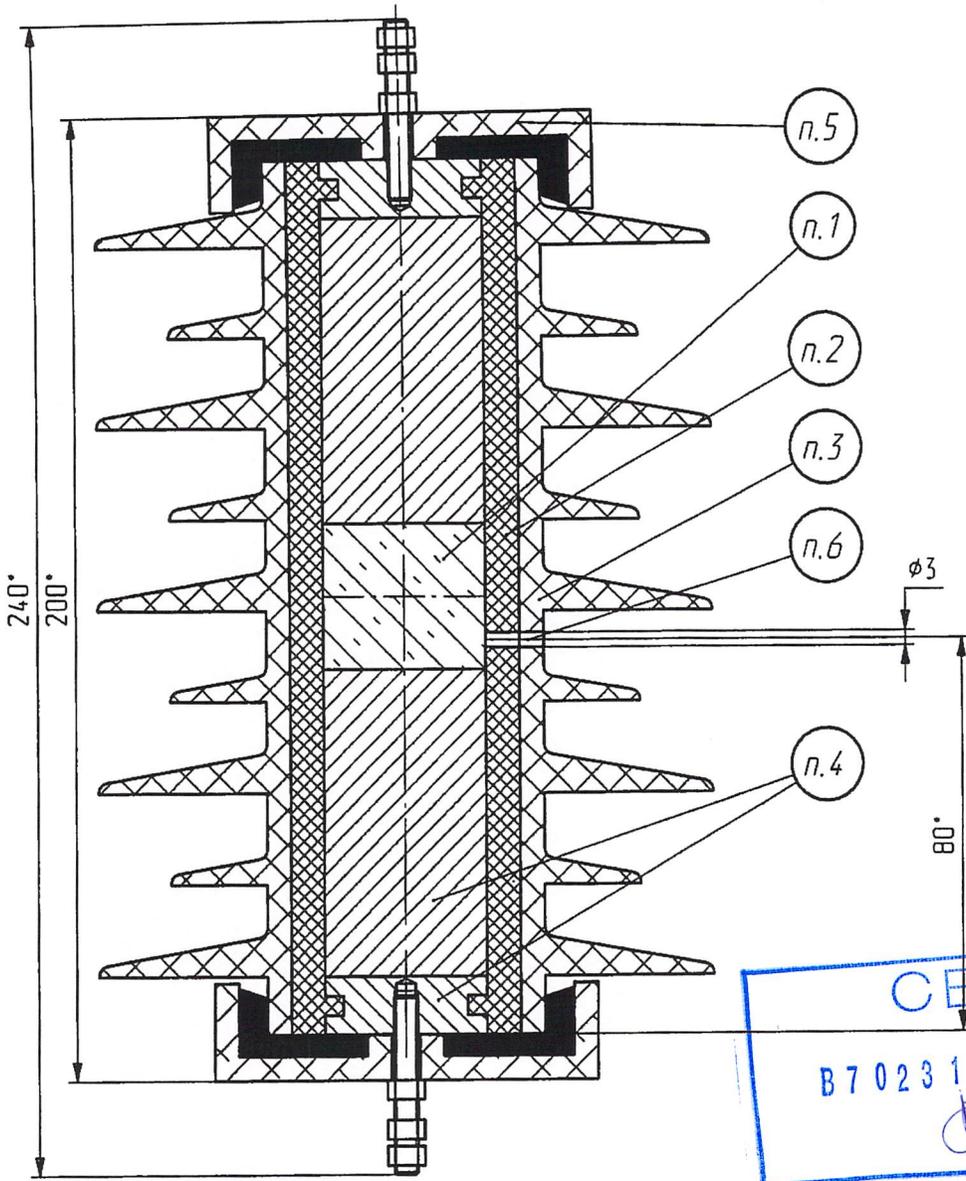
- R - Current shunt CESI No.31120; R= 941,4 Ω
- Electro optical system CESI No.55829/55828
- OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.1)

Voltage measuring system

- D - Voltage divider SAGI; CESI No.11120 (used for arrester section)
- Voltage divider SAGI; CESI No 13027 (used for complete arrester)
- Electro optical system CESI No.11517/11518
- OSC - Oscilloscope type NATIONAL INSTRUMENT NI PXI-1031/NI-PXI 8108/NI-PXI 5122;
- CESI No 056227- 0562226 (on channel No.2)

Software system:

- SW - S.A.D. Surge arrester version 2.0



Перв. применение
Сред. №

Инд. № подл.
Т.контр.
Н.контр.
Утв.
Изм. Лист
Разраб.
Проб.
Инд. № подл.
Взам. инд. №
Подп. и дата

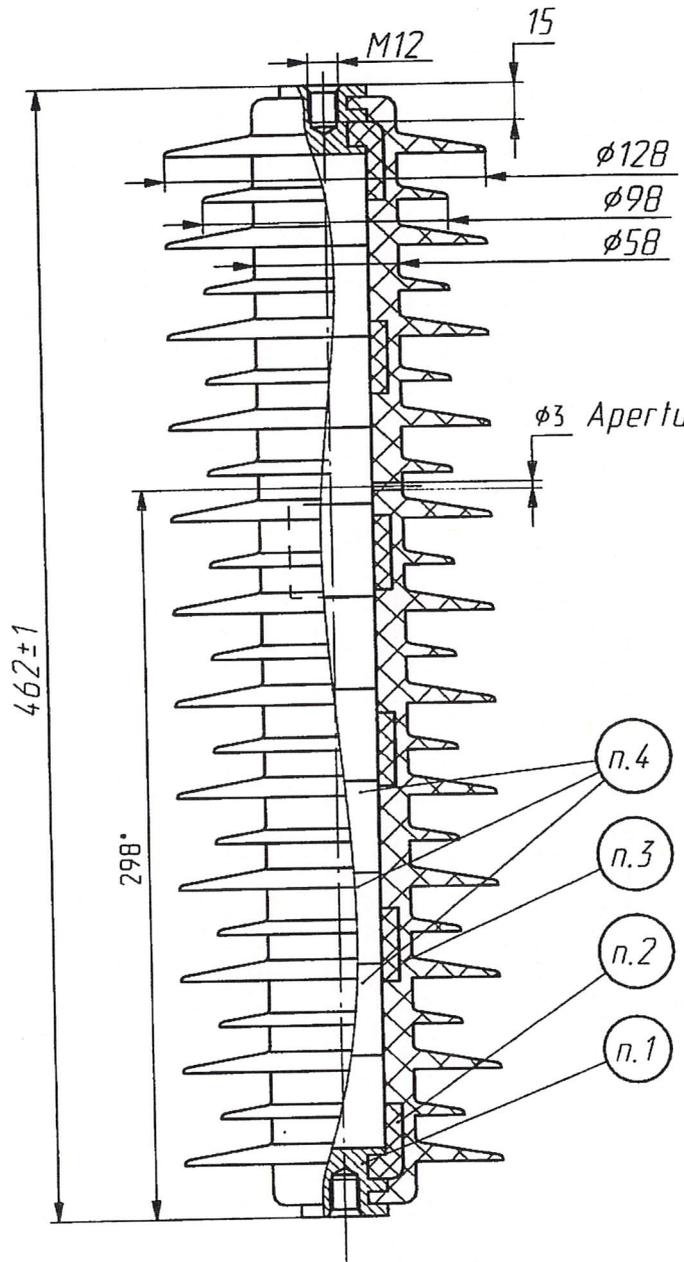
№ n.n.	name	note
n.1	varistor B34/30	000
n.2	Housing	000
n.3	External insulation	000
n.4	Metal flanges and spacers	000
n.5	Additional thermal insulation	000
n.6	Aperture for a thermocouple	Form and size matching is required

1. * - Dimensions for reference

					PA-DM.001.ST.01		
Изм.	Лист	№ докум.	Подп.	Дата	section in thermal model. Surge Arrester PA-DM		
Разраб.	Поправ	В.В.					
Проб.	Поправ	А.В.			Лист 1	Листов 1	1:1
Т.контр.					3AO		
Н.контр.					"Полимер-Аппарат"		
Утв.	Шедид	И.В.			Формат А3		

ПА.ОПН.035.001.054.01

Перв. примен.
Справ. №
Подл. и дата
Инв. № докум.
Взам. инв. №
Подл. и дата
Инв. № подл.



φ3 Aperture for a thermocouple (Form and size matching is required)

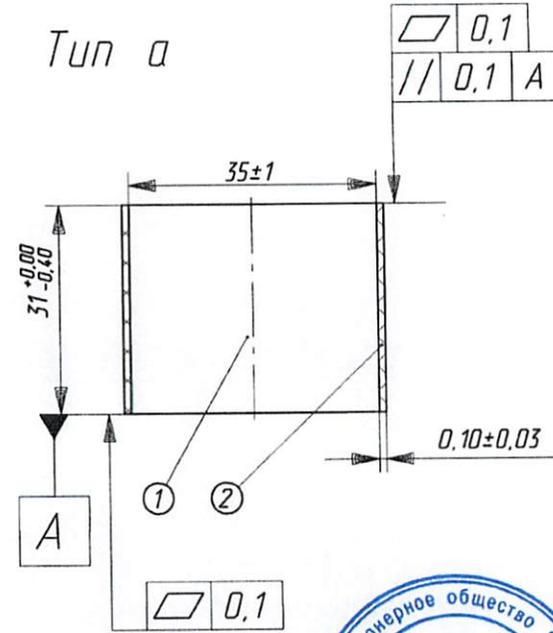
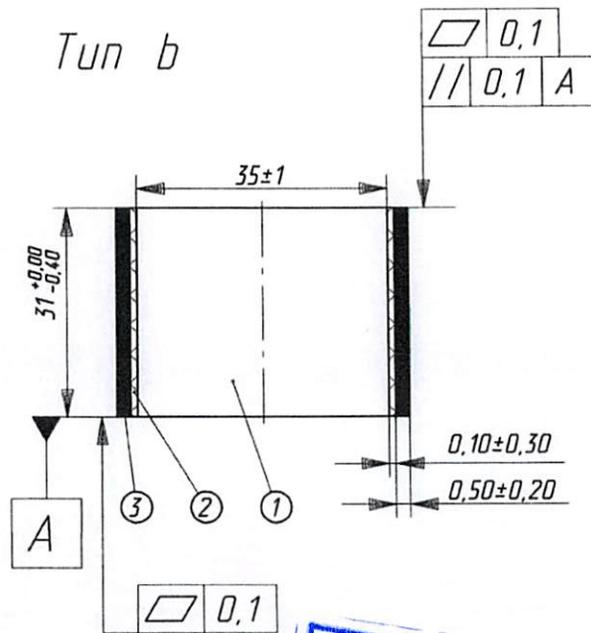
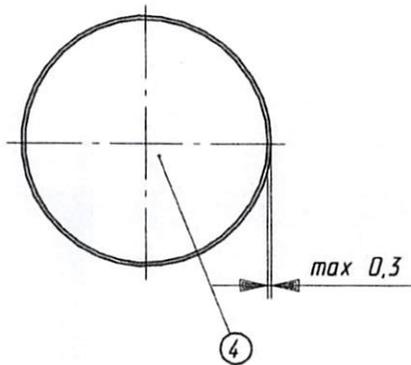


№ п.	Наименование/Name	№ черт./drawing №	Примечания/remark
1	Металлический фланец/Metal flange	ПА.ОПН.035.001.14 Д	
2	Изоляционный корпус/Insulations tube	ПА.ОПН.035.010.01 Д	
3	Защитная силиконовая оболочка/Silicone rubber	ПА.ОПН.035.010.03 Д	
4	Варистор/Metal-oxide varistor	-	

1. Все размеры для справок. All dimensions for reference

ПА.ОПН.035.001.054.01					Лит.	Масса	Масшт.
Изм.	Лист	№ докум.	Подп.	Дата			
Разраб.	Иванов И.					3.8	1:2
Проб.	Потапов А.						
Т.контр.	Колычев А.				Лист 1	Листов 1	
И.контр.	Данилевский С.						3А0
Утв.	Шевцов И.						"Полимер-Аппарат"

PA.VAR.0400.30



1. Металлооксидный варистор (MOV disk)
2. Изоляционное покрытие стекло (Glass insulating collar)
3. Изоляционное покрытие полиуретан (PU insulating collar)
4. Алюминиевый электрод (Al - electrode)



Инв. № дубл.	Подп. и дата
Взам. инв. №	Подп. и дата
Инв. № подл.	Подп. и дата

Изм.	Лист	№ докум.	Подп.	Дата
Разраб.		Поталов А.В.	Нордман	09.17
Проб.		Петухов А.П.	Венчук	09.17
Т.контр.				
Н.контр.				
Утв.		Шевцов И.В.		09.17

PA.VAR.0400.30

Varistor B34/30

Оксид цинка

Лит.	Масса	Масшт.
	0.177	1:1
Лист 1	Листов 1	
ЗАО "Полимер-Аппарат"		