

SIEMENS

Test Document

Report-No.: HBA 09031 P

Copy No.: 0

Content: 16 Sheets

Test object : Metal oxide surge arresters, nominal discharge current 10 kA and 20 kA.

Type:	3EK7	3EP2	3EP3
	3EP4	3EQ1	3EQ4
	3EQ3	3ES	

Manufacturer: Siemens AG, PTD H 4

Date of Test: June to September, 2000

Testing Station : Siemens AG, Arrester Test Field

Applied Test Specifications:

IEC 60099-4 (1998), Clause 7.5.2

IEEE Std C62.11 - 1999, Clause 8.5

Test performed:

Type test:

- Accelerated ageing test on MO resistors

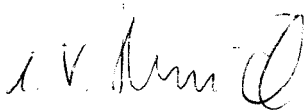
Test Result :

The test objects have passed the test stated above without any objection.

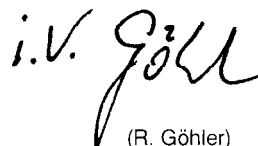
The results obtained and the performance proved of the test objects comply with the requirements of the specifications mentioned above.

Siemens Aktiengesellschaft

PTD H 4



(Dr. V. Hinrichsen)
(Chief engineer)



(R. Göhler)
(Head of Arrester Test Field)

Berlin, May 12th, 2001

Postal Address:

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3 Technical data of the arresters

Type	3EK7	3EP4 ...1..1	3EP4 ...1..2	3EP4 ...1..3
Maximum rated voltage	45 kV	156 kV	147 kV	129 kV
Maximum continuous operating voltage	36 kV	124 kV	117 kV	103 kV
Nominal discharge current	10 kA	10 kA	10 kA	10 kA
Long duration current impulse capability	325 A / 2ms	500 A / 2ms	500 A / 2ms	500 A / 2ms
Line discharge class	1	1	2	3
Energy discharge capability	3,5 kJ / kV _{rated}	3,5 kJ / kV _{rated}	5 kJ / kV _{rated}	5,5 kJ / kV _{rated}
High current impulse capability	100 kA	100 kA	100 kA	100 kA

Type	3EP4 ...2..2	3EP4 ...2..3	3EQ1 ...1..1 3EP2 ...1..1	3EQ1 ...1..2 3EP2 ...1..2
Maximum rated voltage	156 kV	147 kV	210 kV	240 kV
Maximum continuous operating voltage	124 kV	117 kV	168 kV	192 kV
Nominal discharge current	10 kA	10 kA	10 kA	10 kA
Long duration current impulse capability	850 A / 2ms	850 A / 2ms	500 A / 2ms	500 A / 2ms
Line discharge class	2	3	1	2
Energy discharge capability	5 kJ / kV _{rated}	8 kJ / kV _{rated}	3,5 kJ / kV _{rated}	5 kJ / kV _{rated}
High current impulse capability	100 kA	100 kA	100 kA	100 kA

Type	3EQ1 ...1..3 3EP2 ...1..3	3EQ1 ...2..2	3EQ1 ...2..3	3EP2 ...2..2 3EP3 ...2..2 3EQ4 ...2..2
Maximum rated voltage	240 kV	240 kV	288 kV	360 kV
Maximum continuous operating voltage	192 kV	192 kV	230 kV	288 kV
Nominal discharge current	10 kA	10 kA	10 kA	10 kA
Long duration current impulse capability	500 A / 2ms	850 A / 2ms	850 A / 2ms	850 A / 2ms
Line discharge class	3	2	3	2
Energy discharge capability	5,5 kJ / kV _{rated}	5 kJ / kV _{rated}	8 kJ / kV _{rated}	5 kJ / kV _{rated}
High current impulse capability	100 kA	100 kA	100 kA	100 kA

Type	3EP2 ...2..3 3EP3 ...2..3 3EQ4 ...2..3	3EP2 ...3..3 3EP3 ...3..3 3EQ4 ...3..3	3EP2 ...3..4 3EP3 ...3..4	3EQ4 ...3..4
Maximum rated voltage	360 kV	396 kV	468 kV	444 kV
Maximum continuous operating voltage	288 kV	301 kV	374 kV	355 kV
Nominal discharge current	10 kA	20 kA	20 kA	20 kA
Long duration current impulse capability	850 A / 2ms	1200 A / 2ms	1200 A / 2ms	1200 A / 2ms
Line discharge class	3	3	4	4
Energy discharge capability	8 kJ / kV _{rated}	8 kJ / kV _{rated}	10 kJ / kV _{rated}	10 kJ / kV _{rated}
High current impulse capability	100 kA	100 kA	100 kA	100 kA

Type	3EP2 ...4..5 3EP3 ...4..5 3EQ4 ...4..5 3EQ3 ...4..5	3EP3 ...5..5 3EQ4 ...5..5 3EQ3 ...5..5
Maximum rated voltage	468 kV	612 kV
Maximum continuous operating voltage	374 kV	489 kV
Nominal discharge current	20 kA	20 kA
Long duration current impulse capability	1600 A / 2ms	2100 A / 2ms
Line discharge class	5	5
Energy discharge capability	13 kJ / kV _{rated}	18 kJ / kV _{rated}
High current impulse capability	100 kA	100 kA

Type	3ES2 - D 3ES5 - C	3ES5 - F/G 3ES7 - H	3ES9 - J
Maximum rated voltage	156 kV	444 kV	612 kV
Maximum continuous operating voltage	124 kV	355 kV	489 kV
Nominal discharge current	20 kA	20 kA	20 kA
Long duration current impulse capability	1200 A / 2ms	1600 A / 2ms	2100 A / 2ms
Line discharge class	4	5	5
Energy discharge capability	10 kJ / kV _{rated}	13 kJ / kV _{rated}	18 kJ / kV _{rated}
High current impulse capability	100 kA	100 kA	100 kA

4 Accelerated ageing test

An accelerated ageing test according to IEC 60099-4 (1998), clause 7.5.2 resp. IEEE C62.11-1999, clause 8.5 was performed on three single MO-blocks of each resistor type (test circuit see sheet-no. 16). Test conditions were: constant block temperature 115 °C, constant test voltage equal to 1,2 times U_c , surrounding medium N_2 resp. SF_6 . During the tests running for more than 1000 h power dissipation was measured.

Test setup

1. Voltage sources and ovens for tests in air



2. Containers for tests with surrounding medium N₂ resp. SF₆



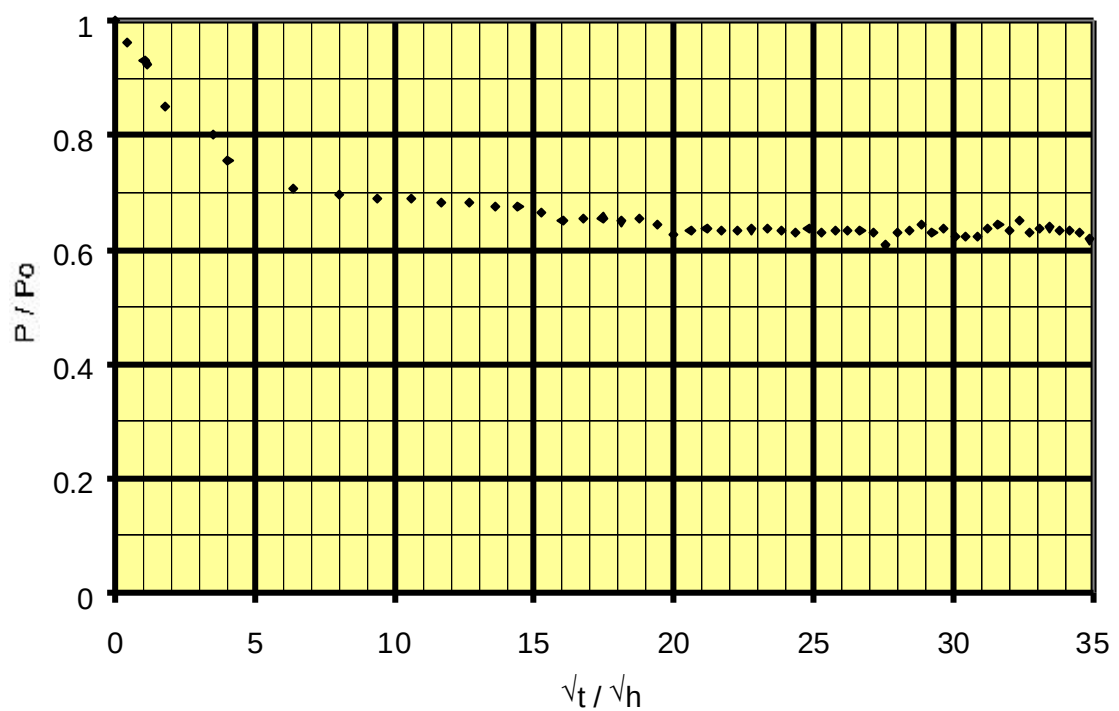
4.1 Test result

In no case any increase of power dissipation was observed during the test time (see sheet-no. 7 to 15). That means no correction of test voltages (rated voltage / duty cycle voltage, maximum continuous operating voltage) within the operating duty tests (IEC) resp. discharge-current withstand tests / duty cycle tests (IEEE) is necessary.

4.1.1 MO-resistor type E41VR502B (Silicone rubber)

Surge arresters type: 3EK7

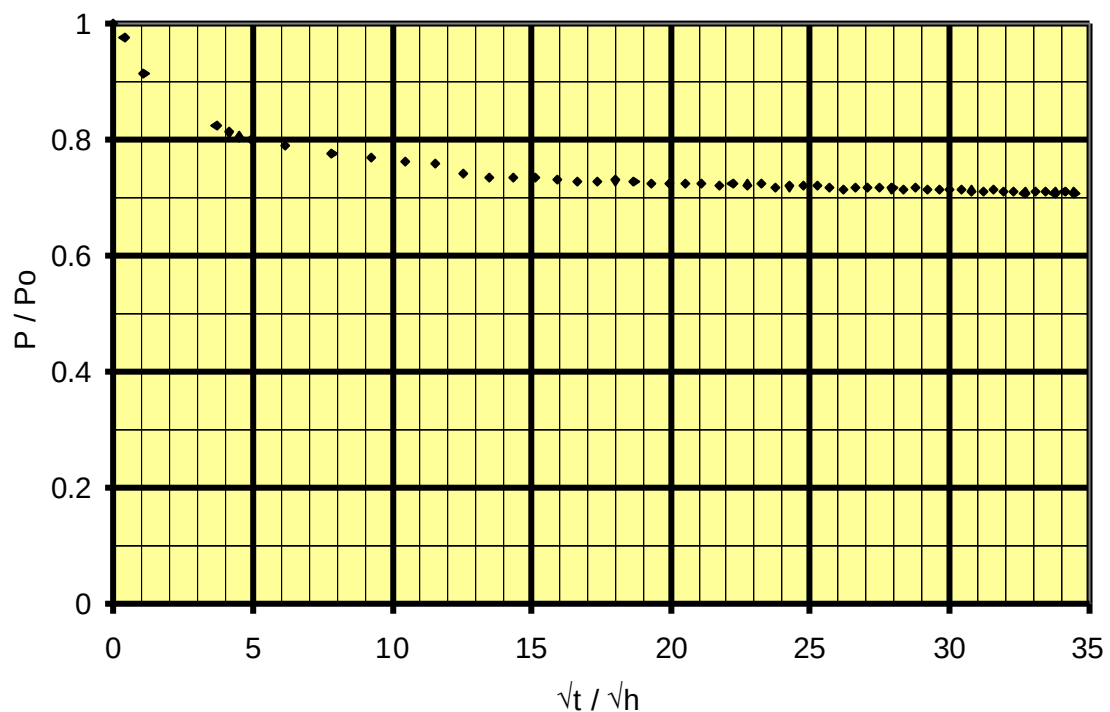
Test voltage	$\hat{u}/\sqrt{2} = 5,6 \text{ kV}$ (1,1 times U_c)
Block temperature	$115 \pm 3 \text{ }^\circ\text{C}$
Surrounding medium	Silicone rubber



4.1.2 MO-resistor type E48KV612 (N₂)

Surge arresters type: 3EP2 ...-1..1 / 3EP2 ...-1..2 / 3EP2 ...-1..3
 3EP4 ...-1..1 / 3EP4 ...-1..2 / 3EP4 ...-1..3
 3EQ1 ...-1..1 / 3EQ1 ...-1..2 / 3EQ1 ...-1..3

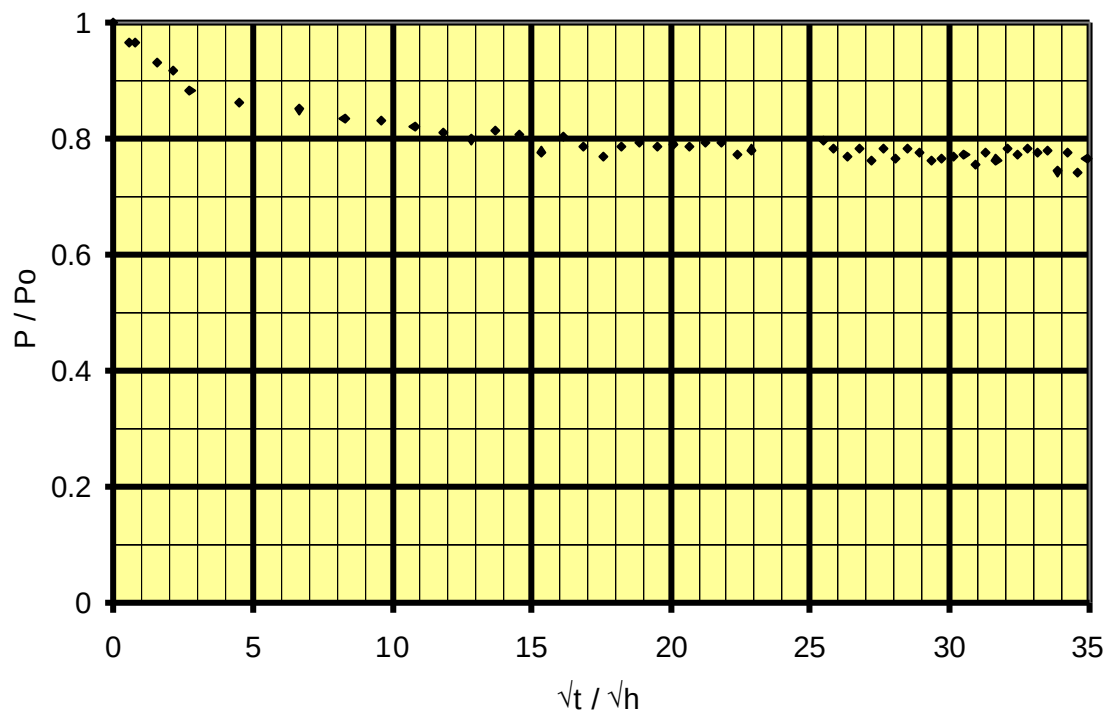
Test voltage	$\hat{u}/\sqrt{2} = 5,3 \text{ kV}$ (1,2 times U_c)
Block temperature	$115 \pm 3 \text{ °C}$
Surrounding medium	N ₂



4.1.3 MO-resistor type E58SR133 (N₂)

Surge arresters type: 3EP2 ...-2..2 / 3EP2 ...-2..3
 3EP3 ...-2..2 / 3EP3 ...-2..3
 3EP4 ...-2..2 / 3EP4 ...-2..3
 3EQ1 ...-2..2 / 3EQ1 ...-2..3
 3EQ4 ...-2..2 / 3EQ4 ...-2..3

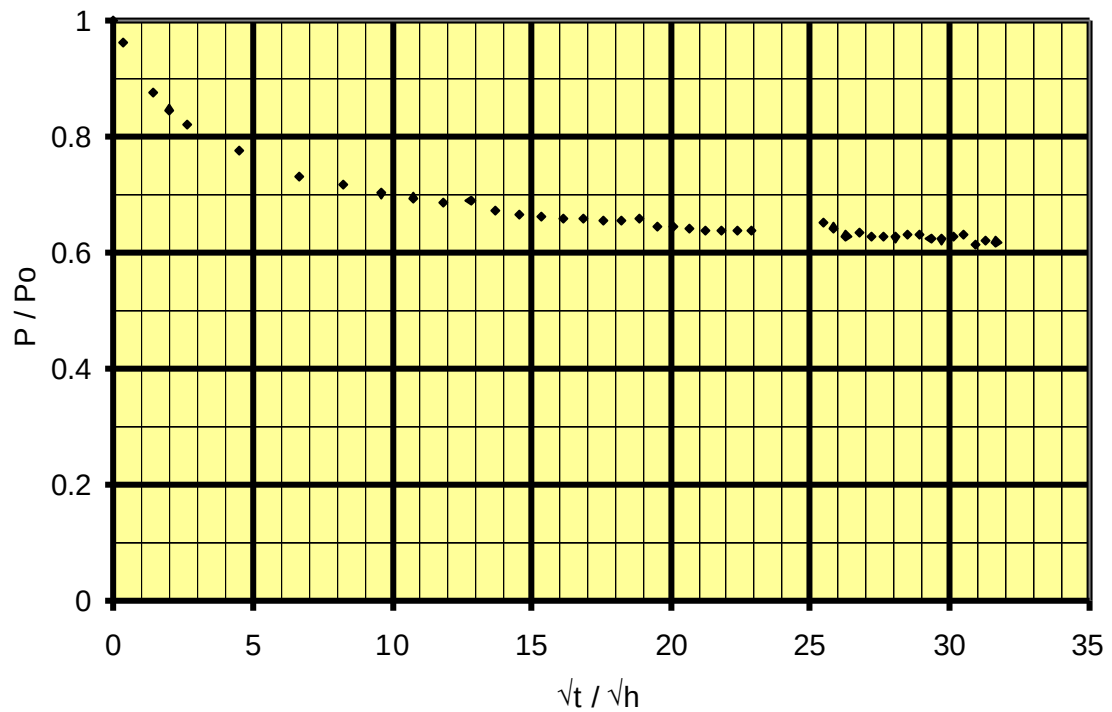
Test voltage	$\hat{u}/\sqrt{2} = 5,4 \text{ kV}$ (1,2 times U_c)
Block temperature	$115 \pm 3 \text{ °C}$
Surrounding medium	N ₂



4.1.4 MO-resistor type E70SR133 (N₂)

Surge arresters type: 3EP2 ...-3..3 / 3EP2 ...-3..4
 3EP3 ...-3..3 / 3EP3 ...-3..4
 3EQ4 ...-3..3 / 3EQ4 ...-3..4

Test voltage	$\hat{u}/\sqrt{2} = 5,2 \text{ kV}$ (1,2 times U_c)
Block temperature	$115 \pm 3 \text{ °C}$
Surrounding medium	N ₂



4.1.5 MO-resistor type E70SR133 (SF₆)

Surge arresters type: 3ES2 - D / 3ES5 - C (metalclad, SF₆-insulated)

Test voltage

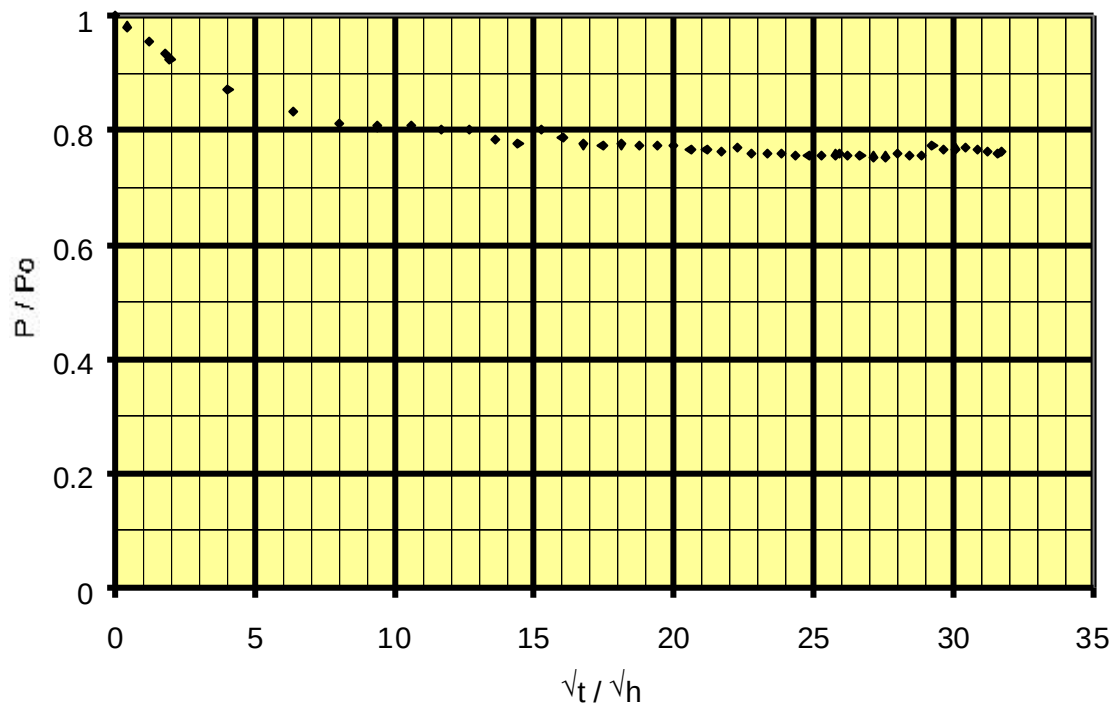
$\hat{u}/\sqrt{2} = 5,2 \text{ kV}$ (1,2 times U_c)

Block temperature

$115 \pm 3 \text{ °C}$

Surrounding medium

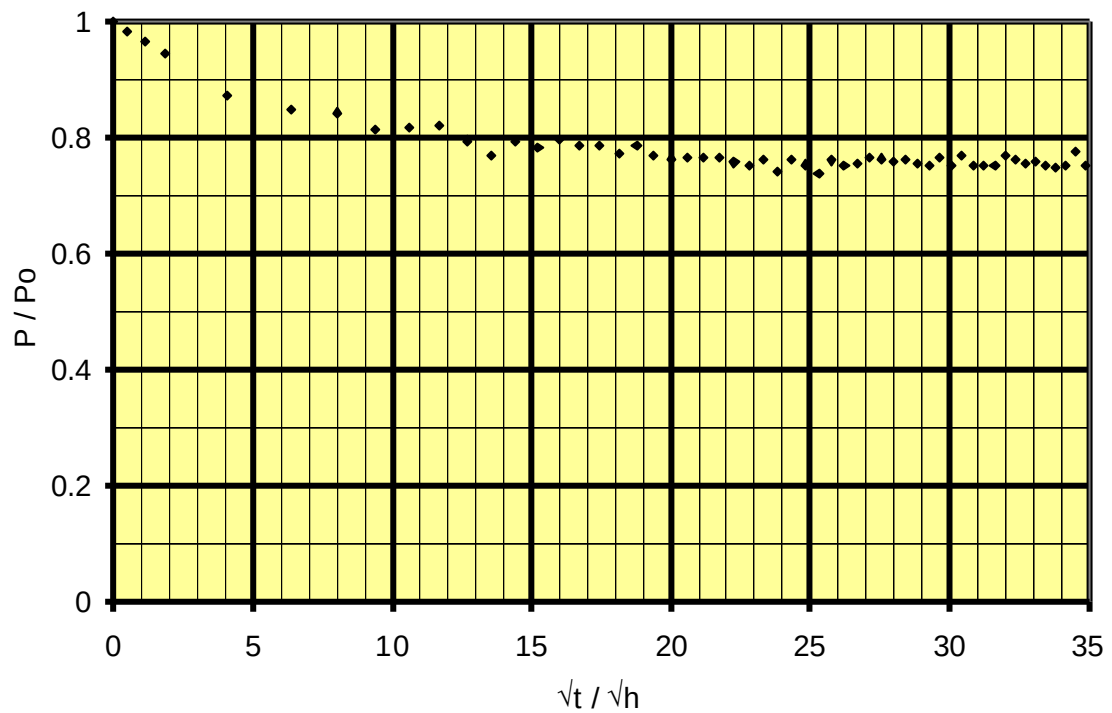
SF₆



4.1.6 MO-resistor type E78SR123 (N₂)

Surge arresters type: 3EP2 ...-4..5 / 3EP2 ...-4..5
 3EP3 ...-4..5 / 3EP3 ...-4..5
 3EQ4 ...-4..5 / 3EQ4 ...-4..5
 3EQ3 ...-4..5 / 3EQ3 ...-4..5

Test voltage $\hat{u}/\sqrt{2} = 5,0 \text{ kV}$ (1,2 times U_c)
 Block temperature $115 \pm 3 \text{ }^\circ\text{C}$
 Surrounding medium N₂



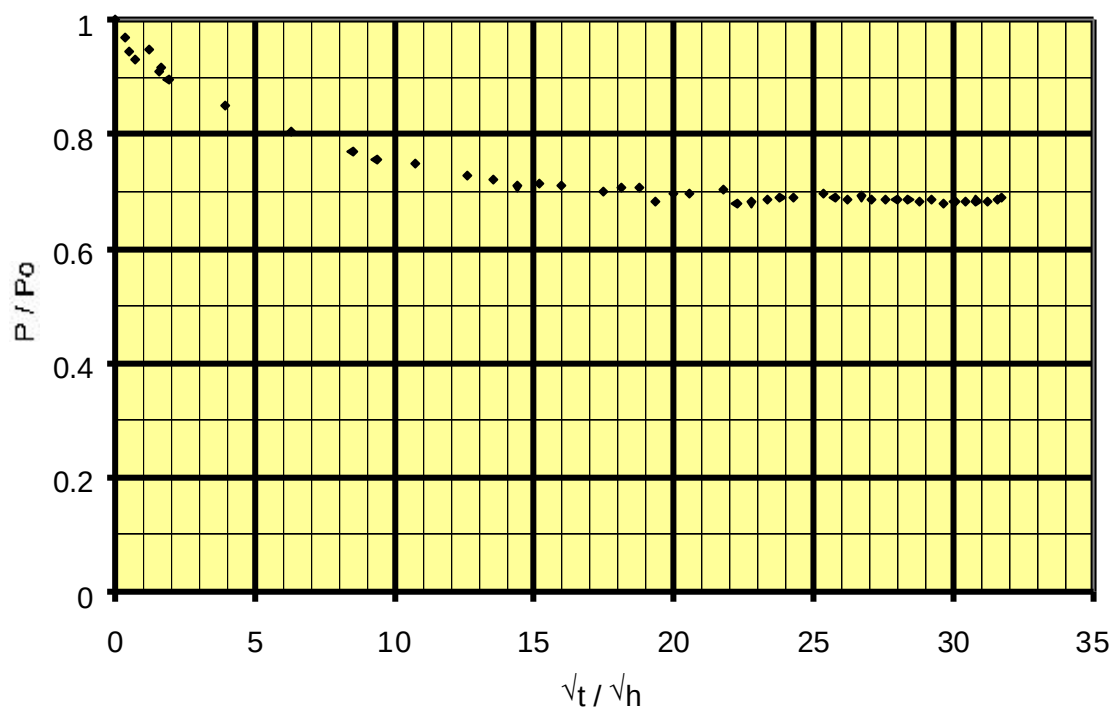
4.1.7 MO-resistor type E78SR123 (SF₆)

Surge arresters type: 3ES5 - F/G / 3ES7 - H (metalclad, SF₆-insulated)

Test voltage $\hat{u}/\sqrt{2} = 5,0 \text{ kV}$ (1,2 times U_c)

Block temperature $115 \pm 3 \text{ °C}$

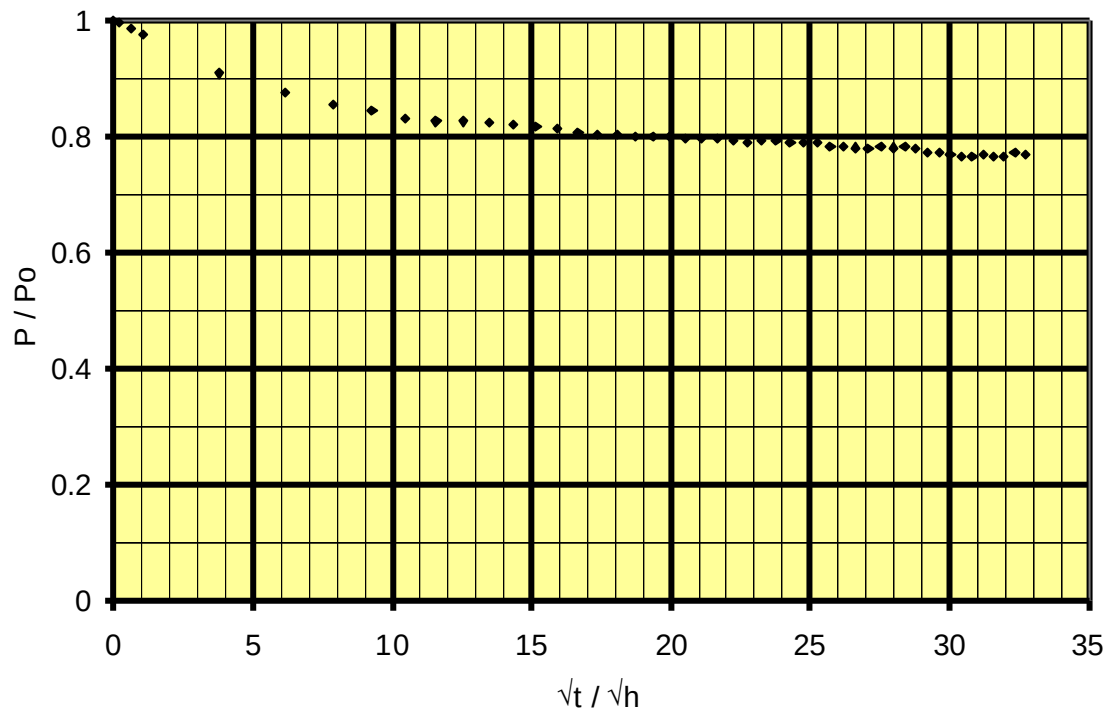
Surrounding medium SF₆



4.1.8 MO-resistor type E99SR113 (N₂)

Surge arresters type: 3EP3 ...-5..5 / 3EP3 ...-5..5
 3EQ4 ...-5..5 / 3EQ4 ...-5..5
 3EQ3 ...-5..5 / 3EQ3 ...-5..5

Test voltage $\hat{u}/\sqrt{2} = 4,8 \text{ kV}$ (1,2 times U_c)
 Block temperature $115 \pm 3 \text{ }^\circ\text{C}$
 Surrounding medium N₂



4.1.9 MO-resistor type E99SR113 (SF₆)

Surge arresters type: 3ES9 - J (metalclad, SF₆-insulated)

Test voltage

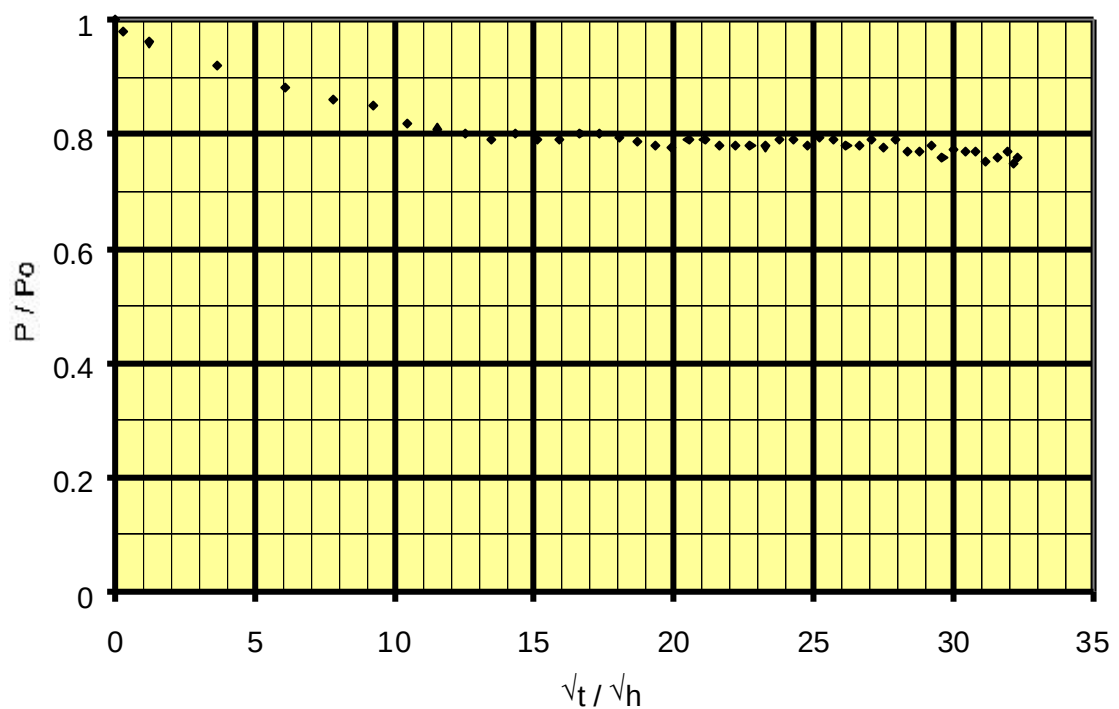
$\hat{u}/\sqrt{2} = 4,8 \text{ kV}$ (1,2 times U_c)

Block temperature

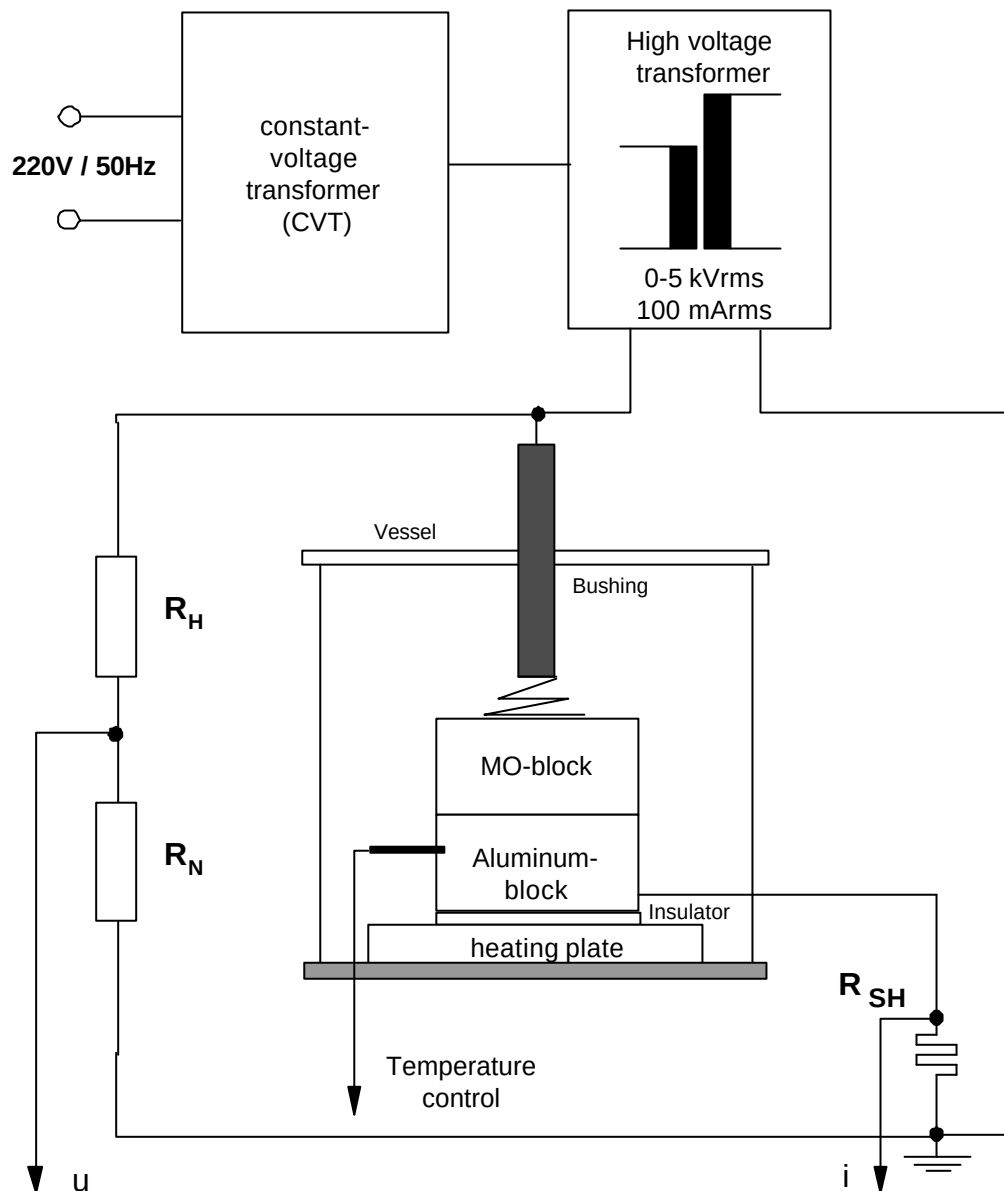
$115 \pm 3 \text{ °C}$

Surrounding medium

SF₆



4.2 Block diagram ageing test



Voltage measurement : u

Voltage divider: 1:1000

Oscilloscope Tektronix type TDS 320 / PC

Leakage current measurement : i

Shunt $R_{SH} = 100 \Omega$

Oscilloscope Tektronix type TDS 320 / PC

Temperature control with Pt100

Test sample : MO-block