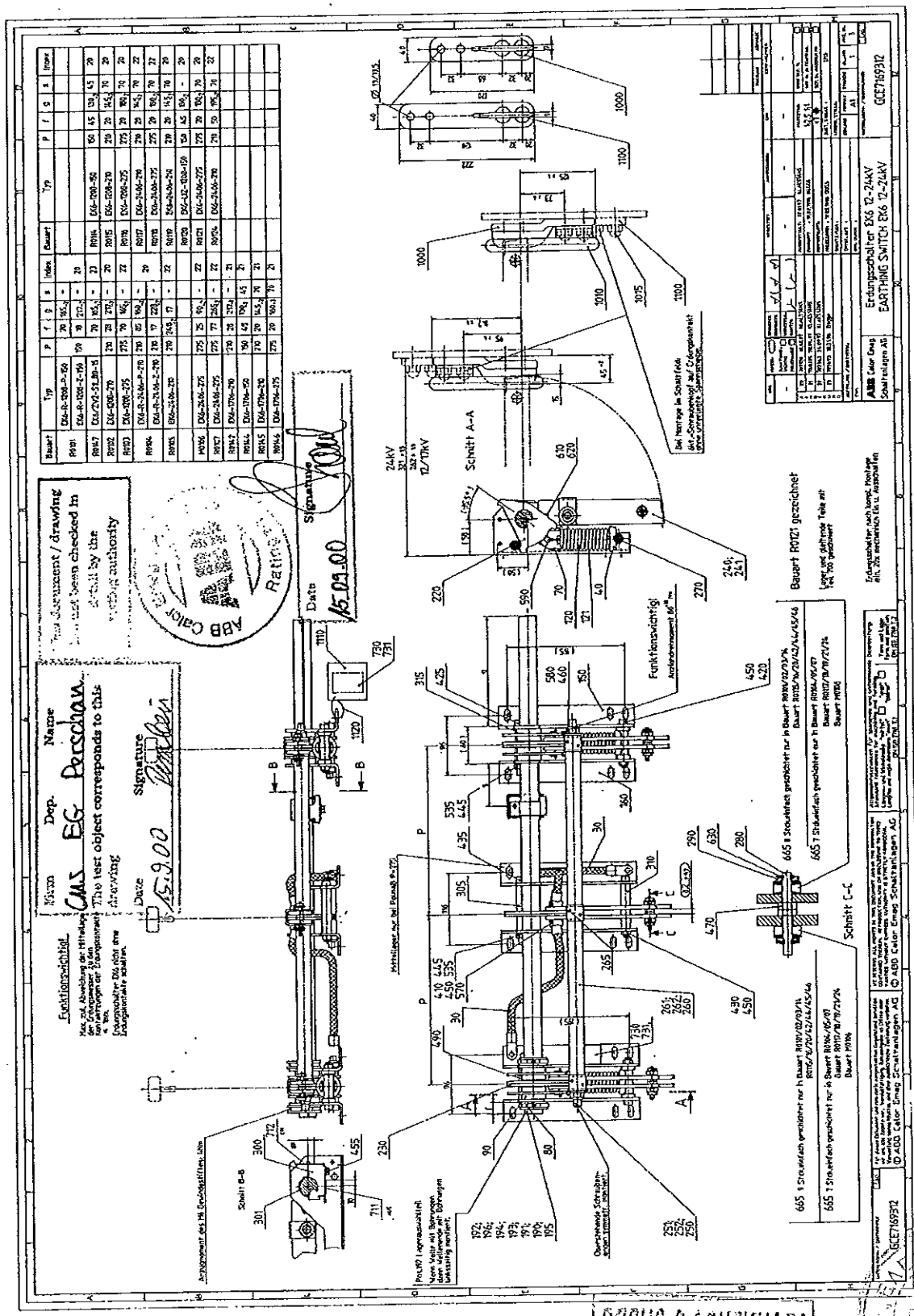


2. Test Locations and Set-up

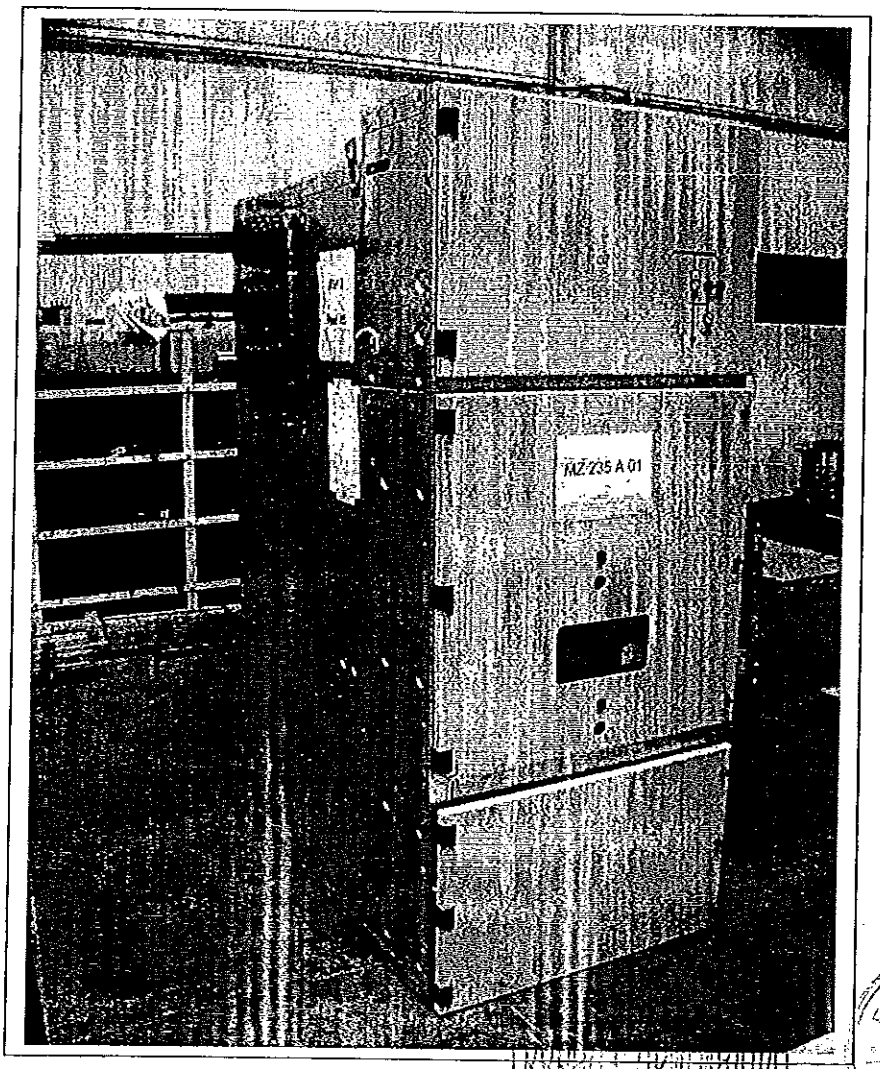
The test was performed in the Mechanical Testing Laboratory

of ABB Calor Emag Mittelspannung GmbH
Dept. LM in Ratingen

at an ambient temperature of approx. 20°C.

Test job no.: 7550027_024A

Test engineer: Koal



3. Mechanical Operation Test

List of interlocks:

1. Withdrawable part in test-position
   - Circuit-breaker ON: prevented to move the withdrawable part in service-position

2. Withdrawable part in service-position
   - Circuit-breaker ON: prevented to move the withdrawable part in test-position

3. Withdrawable part between service and test position:
   - prevented to switch ON the circuit-breaker

4. Withdrawable part in test-position
   - Circuit-breaker OFF and earthing switch ON: prevented to move the withdrawable part in service-position

5. Withdrawable part in test-position
   - circuit-breaker ON and earthing switch ON: prevented to move the withdrawable part in service-position

6. Withdrawable part not in test-position
   - prevented to switch ON the earthing switch

7. Withdrawable part not in test-position
   - prevented to remove the removable part

All the above mentioned interlocks were checked. For this the circuit-breaker, the earthing switch and the withdrawable part were operated 50 times and the removable part was removed and inserted 25 times.

ВЯРНО С ОРИГИНАЛА

Deutscher Akkreditierungs Rat DAR
Reg.-Nr. DAT-P-032/93

ABB Calor Emag Laboratories

ABB

TEST REPORT No. HZ 236 E 06

Issued by an Accredited Laboratory corresponding to EN 45001

Copy-No. 02e

Test Object

2-panel metal-clad air-insulated switchgear type ZS1.2 – 24 kV consisting of
- feeder panel 2000 A with vacuum circuit-breaker type VM1 2420-25, natural ventilated
- feeder panel 1250 A with vacuum circuit-breaker type VM1 2412-25

max. ambient temperature ϑ_{umax} = 40 °C,

Rated voltage	U_n	24	kV
Rated normal current panel	I_n	2000 / 1250	A
Rated frequency	f	50	Hz
Rated short-time withstand current	I_{th}	25	kA
Rated peak withstand current	I_p	63	kA
Rated duration of short-circuit current	t_{th}	3	s
Rated short-circuit breaking capacity at 24 kV	I_{sc}	25	kA
Max. ambient temperature	ϑ_u	40	°C

Manufacturer

ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany

Tests performed

Three-phase temperature-rise test at the rated current of 2000 A / 1250 A at a power frequency of 50 Hz.
Measurement of the resistance of the main circuit before and after the temperature rise test.

Test Specification

IEC Standard 60694/2nd Ed./1996-5, clause 6.4 and 6.5
IEC Standard 60298/3rd Ed./1990-12, clause 6.3 and 6.4

Test Results

The 2-panel ZS1.2-type switchgear passed the above mentioned tests successsfully. The respective requirements are met. The test results are tabulated on sheets 19 to 24.

Test Date

November 11th - November 12th, 2000

Client

ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany

ABB Calor Emag Laboratories Ratingen

November 16th, 2000
Date of Issue

Laboratory Manager

Test Engineer

Total Number of Sheets: 29 Sheets (Test Report)

ABB Calor Emag Mittelspannung GmbH Ratingen
High-Power Testing Laboratory

Oberhausener Straße 33
D - 40472 Ratingen

Phone + 49 (0) 21 02 12-1905
Fax + 49 (0) 21 02 12-1713

Table of Contents

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switchgear – Panel 1

Ratings assigned by the manufacturer

Test Object: Metal-clad air insulated switchgear, incoming panel with vacuum circuit-breaker type VM1
Type: ZS1.2
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen; Germany
Serial-No.: 7550027/2016/00 (switchgear) **Year of manufacture:** 2000
Drawing No.: GCE8010459R0102

Rated voltage	24 kV
Rated lightning impulse withstand voltage	125 kV
Rated switching impulse withstand voltage	- kV
Rated power frequency withstand voltage	50 kV
Rated frequency	50 Hz
Rated normal current of busbar	2000 A
Rated normal current of tee-offs	2000 A
Rated peak withstand current	63 kA
Rated short-time withstand current	25 kA
Rated duration of short-circuit	3 s
Insulating medium	air / vacuum
Rated functional pressure (abs. / 20°C)	- kPa
Minimum functional pressure (abs. / 20°C)	- kPa
Permissible values for internal arc faults:	
Peak current	63 kA
Short-time current	25 kA
Duration of short-circuit	1 s
Max. ambient air temperature	40 °C

The above mentioned switchgear panel is fully described in the mentioned drawings.

Essential characteristics and installed devices:

The power loss of the controlgear in the low voltage compartment was simulated by a heating resistor of 60 W.

Current Transformers:

Manufacturer	Type	Year of manufacture	Insulation class
Wirges GmbH	TPU66.11	2000	E
Voltages	**Frequency**	**Sort-time withst. current**	**Peak withstand current**
24/50/125 kV	50 Hz	25 kA / 3 s	63 kA
Serial Nos.	**L1** 058249, **L2** 058250; **L3** 058251		
Core 1	2000 / 5 A; 15 VA, accuracy class 0.5		
Core 2	2000 / 5 A; 15 VA, accuracy class 5P15		

Date of receipt of test object: 30th October 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switchgear – Panel 2

Ratings assigned by the manufacturer

Test Object: Metal-clad air insulated switchgear, incoming panel with vacuum circuit-breaker type VM1
Type: ZS1.2
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen; Germany
Serial-No.: 7550027/2014/00 (switchgear) **Year of manufacture:** 2000
Drawing No.: GCE8010457R0102

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50	Hz
Rated normal current of busbar	2000	A
Rated normal current of tee-offs	1250	A
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Insulating medium	air / vacuum	
Rated functional pressure (abs. / 20°C)	-	kPa
Minimum functional pressure (abs. / 20°C)	-	kPa
Permissible values for internal arc faults:		
Peak current	63	kA
Short-time current	25	kA
Duration of short-circuit	1	s
Max. ambient air temperature	40	°C

The above mentioned switchgear panel is fully described in the mentioned drawings.

Essential characteristics and installed devices:

The power loss of the controlgear in the low voltage compartment was simulated by a heating resistor of 60 W.

Current Transformers:

Manufacturer	Type	Year of manufacture	Insulation class
Wirges GmbH	TPU63.11	2000	E
Voltages	**Frequency**	**Sort-time withst. current**	**Peak withstand current**
24/50/125 kV	50 Hz	25 kA / 3 s	63 kA
Serial Nos.	**L1** 058240, **L2** 058241; **L3** 058242		
Core 1	1250 / 5 A; 10 VA, accuracy class 0.5		
Core 2	1250 / 5 A; 10 VA, accuracy class 5P15		

Date of receipt of test object: 30th October 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switching Device – Circuit-Breaker of Panel 1

Ratings assigned by the manufacturer

Test Object:	Vacuum circuit-breaker
Type:	VM1 2420-25
Manufacturer:	ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen; Germany
Serial-No.:	7550030/4006/00 **Year of manufacture:** 2000
Drawing No.:	GCE7004924R0136 (circuit-breaker)
Vacuum interrupter:	Type: VG4-S L1: No. 00/061190, L2: No. 00/061193, L3: No. 00/061195
Drawing No.:	GCE7005757R0102 (pole part)

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50 / 60	Hz
Rated normal current	2000	A
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current	25	kA
D.C. component	40	%
Rated short-circuit making current	63	kA
Rated transient recovery voltage:		
Peak value	41	kV
Rate of rise	0.47	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3 s –CO-3 min-CO	
Arc extinguishing medium	vacuum	
Number of poles	3	
Number of units per pole	1	
Rated opening time	35...45	ms
Rated closing time	50...60	ms
Rated voltage of trip coil	230	V
Rated voltage of closing coil	230	V
Rated supply voltage	230	V
Rated frequency of supply voltage	-	Hz
Further specifications:		
Max. ambient air temperature	40	°C

Essential characteristics:

-

Date of receipt of test object: 30th October 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switching Device – Circuit-Breaker of Panel 2

Ratings assigned by the manufacturer

Test Object:	Vacuum circuit-breaker
Type:	VM1 2412-25
Manufacturer:	ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen; Germany
Serial-No.:	7550027/4004/00 **Year of manufacture:** 2000
Drawing No.:	GCE7004924R0121 (circuit-breaker)
Vacuum interrupter:	Type: VG4-S L1: No. 01936, L2: No. 00678, L3: No. 02130
Drawing No.:	GCE7004730R0102 (pole part)

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50 / 60	Hz
Rated normal current	1250	A
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current	25	kA
D.C. component	40	%
Rated short-circuit making current	63	kA
Rated transient recovery voltage:		
Peak value	41	kV
Rate of rise	0.47	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3 s –CO-3 min-CO	
Arc extinguishing medium	vacuum	
Number of poles	3	
Number of units per pole	1	
Rated opening time	35...45	ms
Rated closing time	50...60	ms
Rated voltage of trip coil	230	V
Rated voltage of closing coil	230	V
Rated supply voltage	230	V
Rated frequency of supply voltage	-	Hz
Further specifications:		
Max. ambient air temperature	40	°C

Essential characteristics:

-

Date of receipt of test object: 30th October 2000

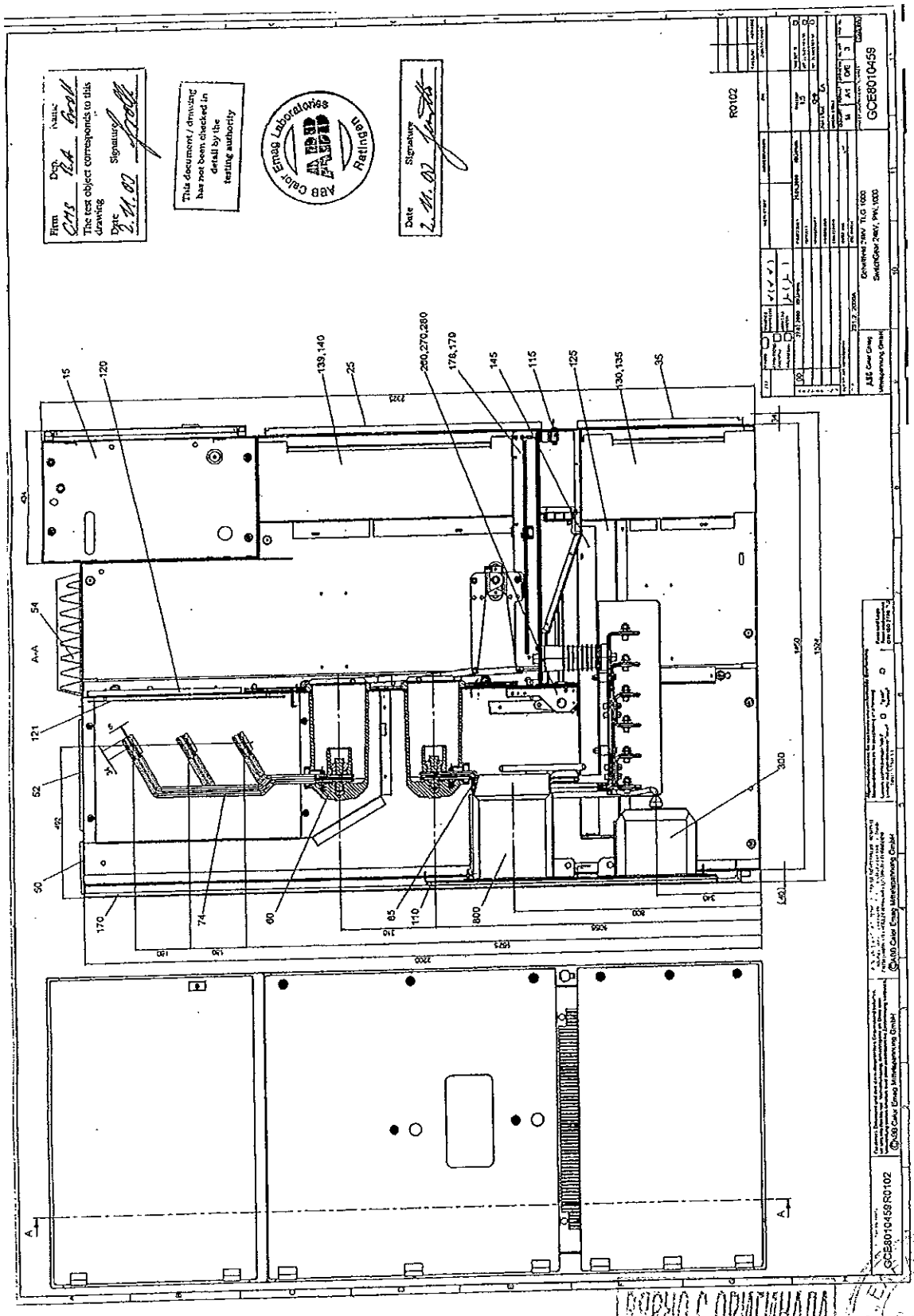
List of Drawings

The manufacturer has guaranteed, that the equipment submitted for test has been manufactured in full accordance with the following drawings. These drawings have been stamped and signed by the manufacturer representative. The drawings has not been checked in detail by the testing authority. The drawings are kept

x with the test documents at the test laboratory.
at the client.

Drawing no.	Title
GCE8010459R0102 index 00	Switchgear, 24 kV, PW. 1000
GCE8010457R0102 index 00	Switchgear, 24 kV, PW. 800
GCE7004924R0136 index 00	Draw out VM1 24 kV in ZS1.2
GCE7004924R0121 index 06	Draw out VM1 24 kV in ZS1
GCE7005757R0102 index 00	Pole part VD4p 2420-25
GCE7004730R0102 index 09	pole part VD4 24 kV 1250 A

ВЯРНО С ОРИГИНАЛА



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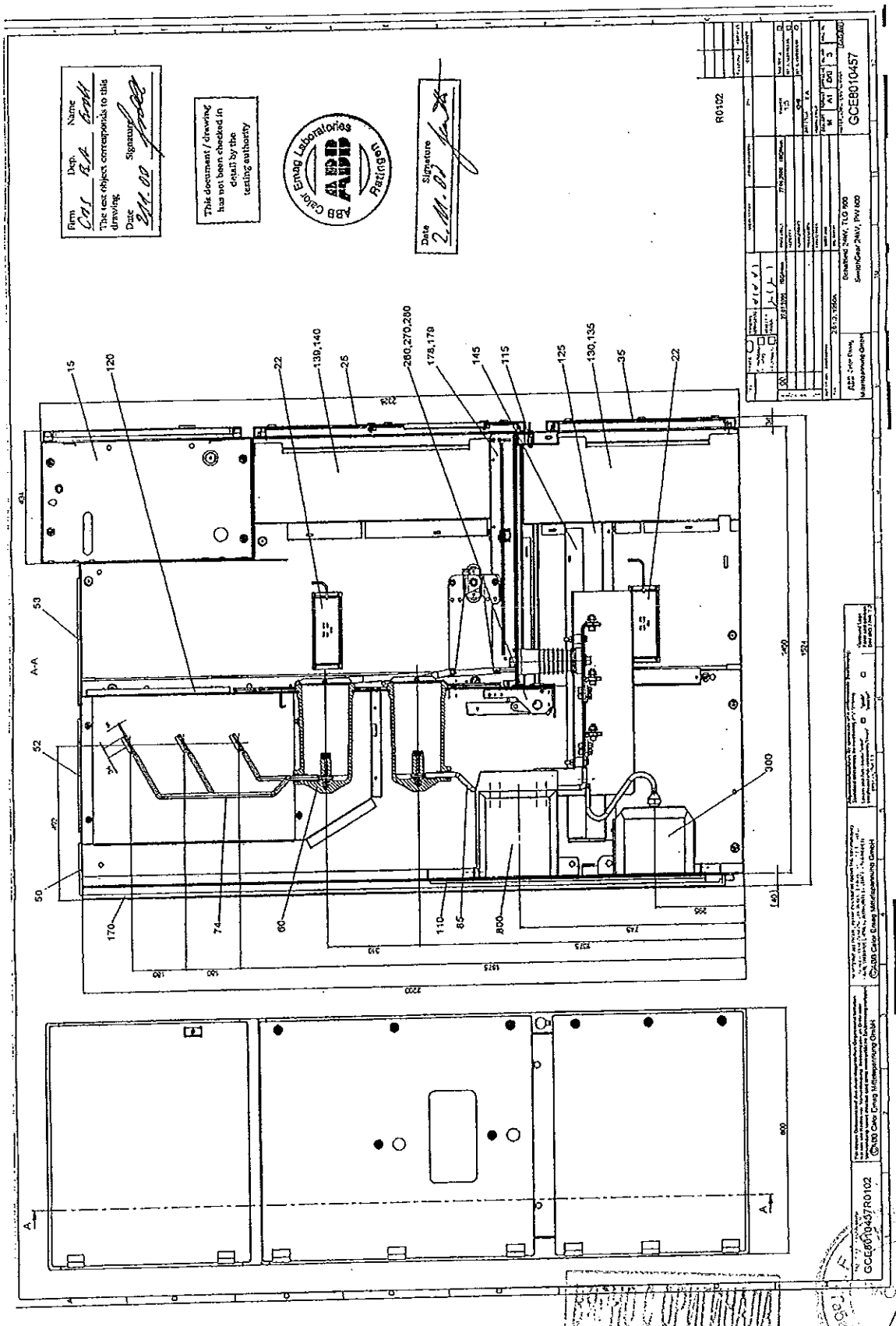
Firm
Dept.
Name
The test object corresponds to this drawing.
Date
Signature
This document / drawing has not been checked in detail by the testing authority
ABB Calor Emag Laboratories
Ratingen
Date
Signature
R0102
GCE8010457
GCE8010457R0102
A-A
15
120
22
139,140
25
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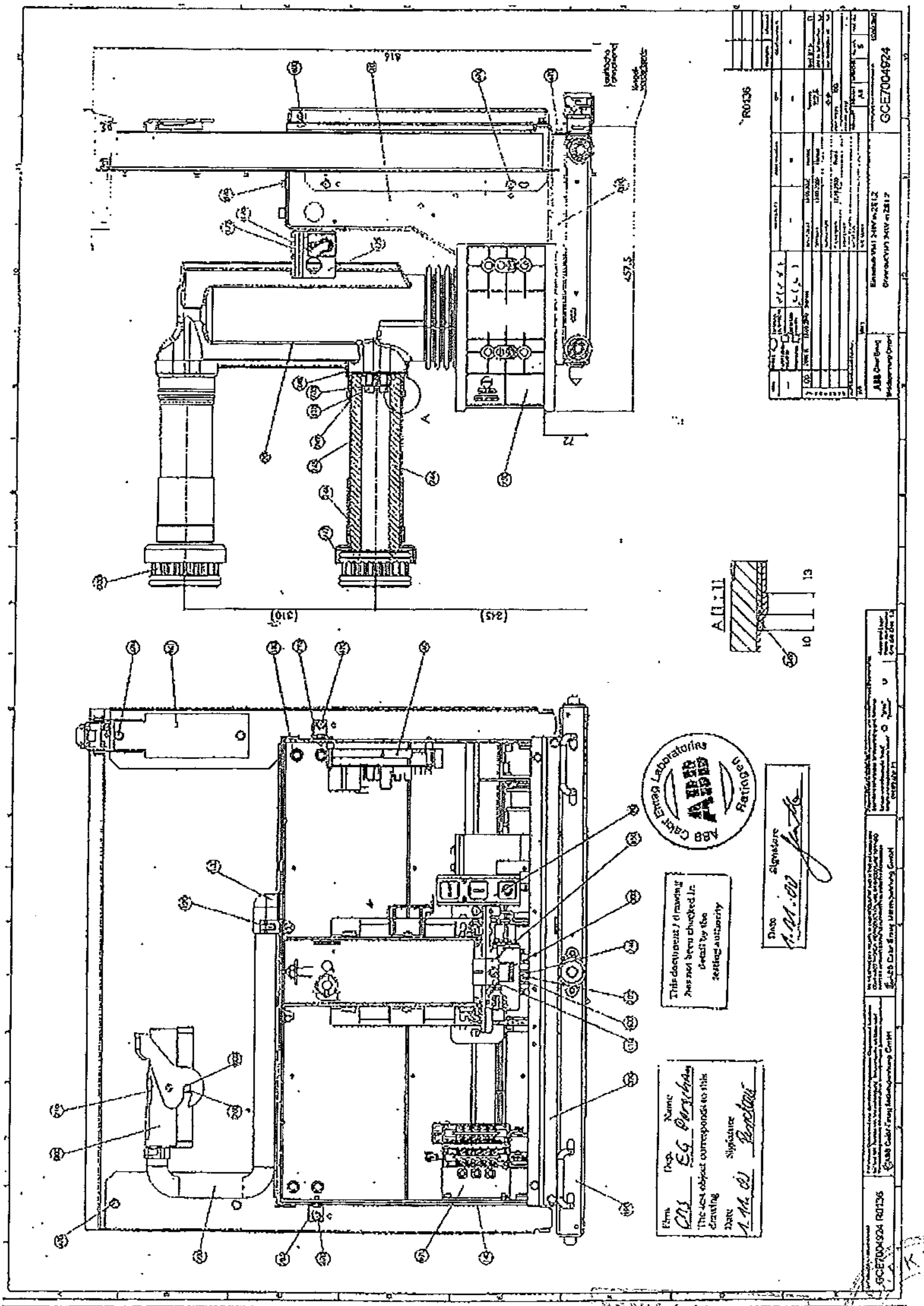


Deutscher Akkreditierungs Rat

DAR

Reg.-Nr.
DAT-P-032/93

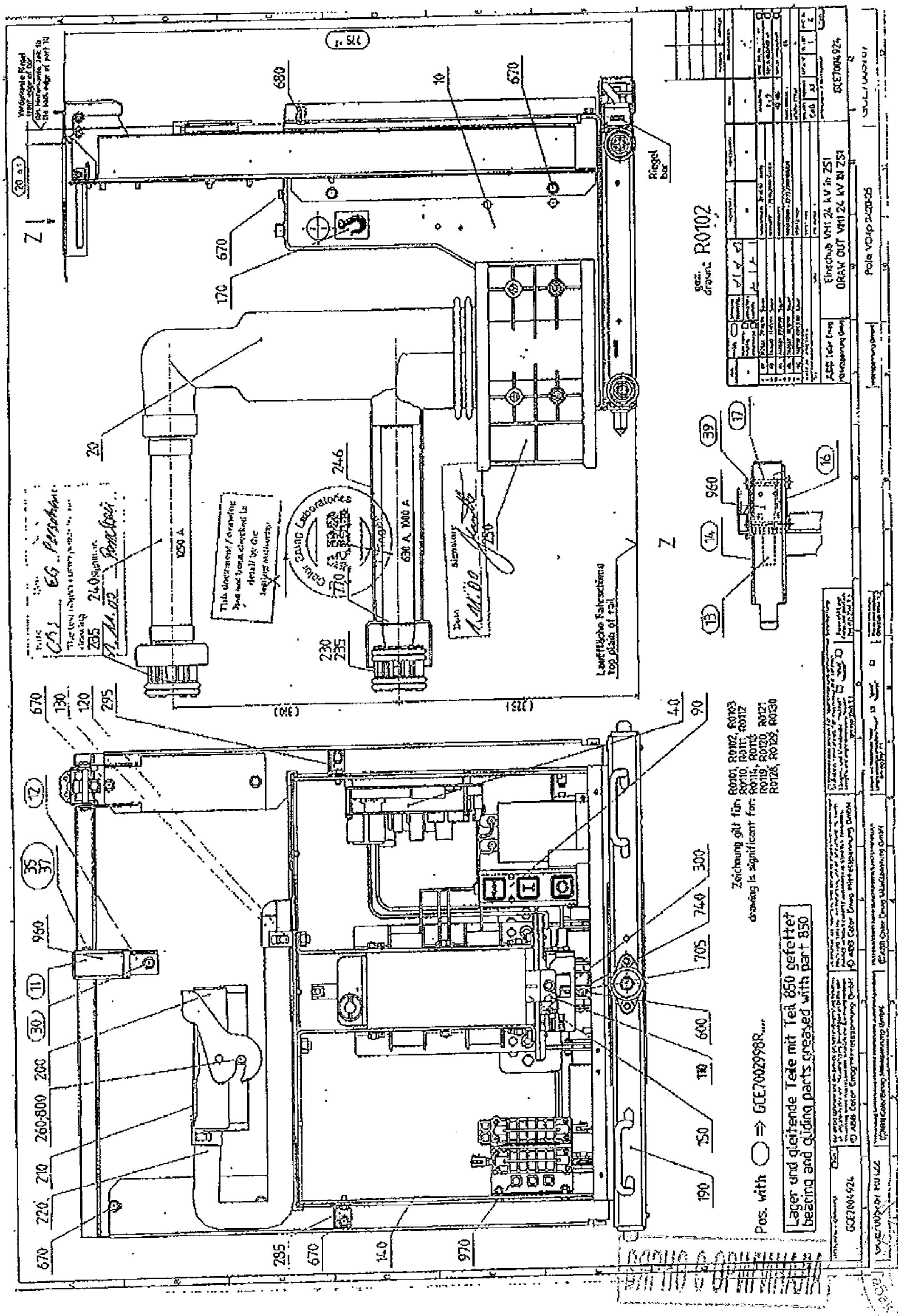
ABB Calor Emag Laboratories

ABB

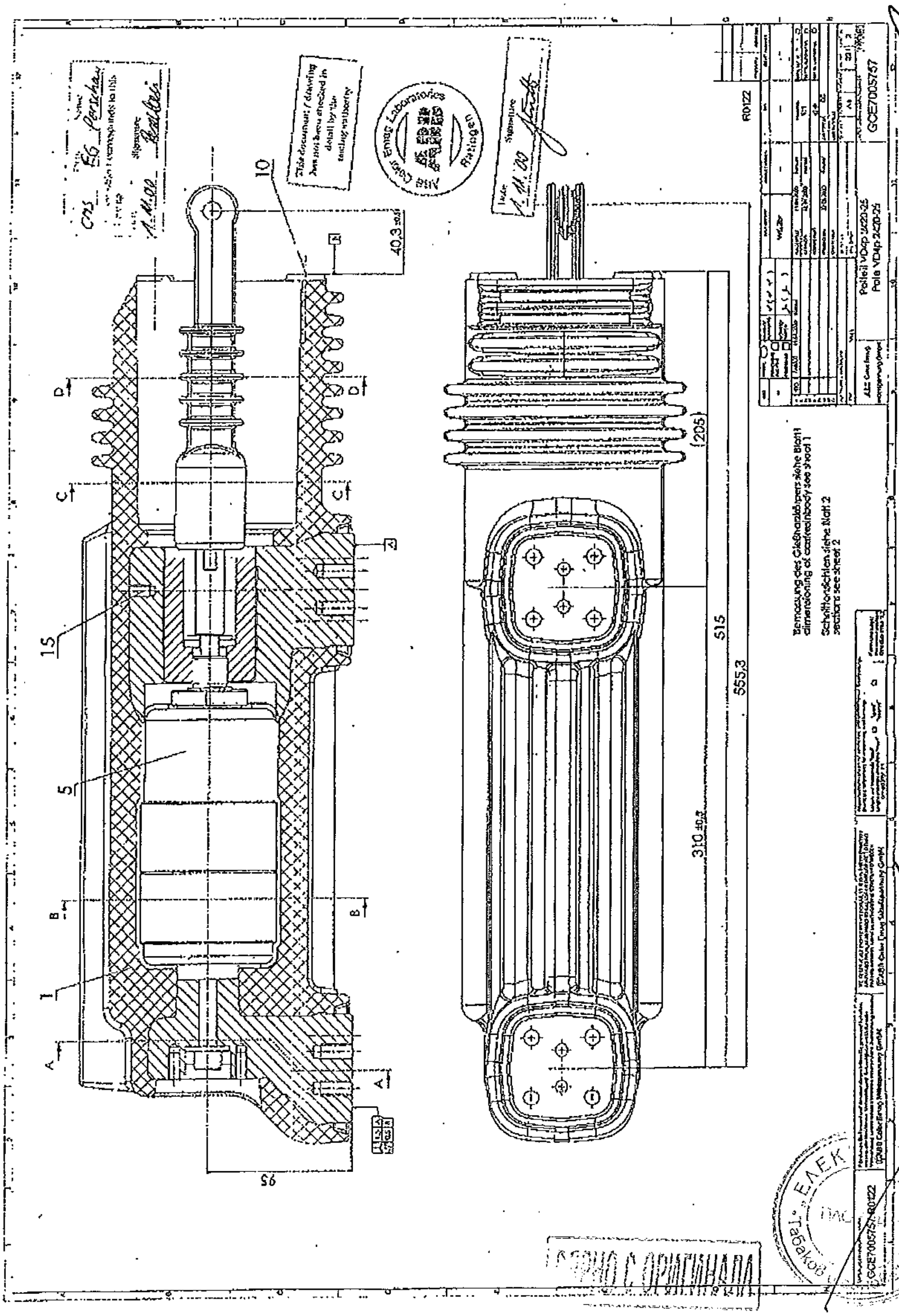
TEST REPORT No. HZ 236 E 06

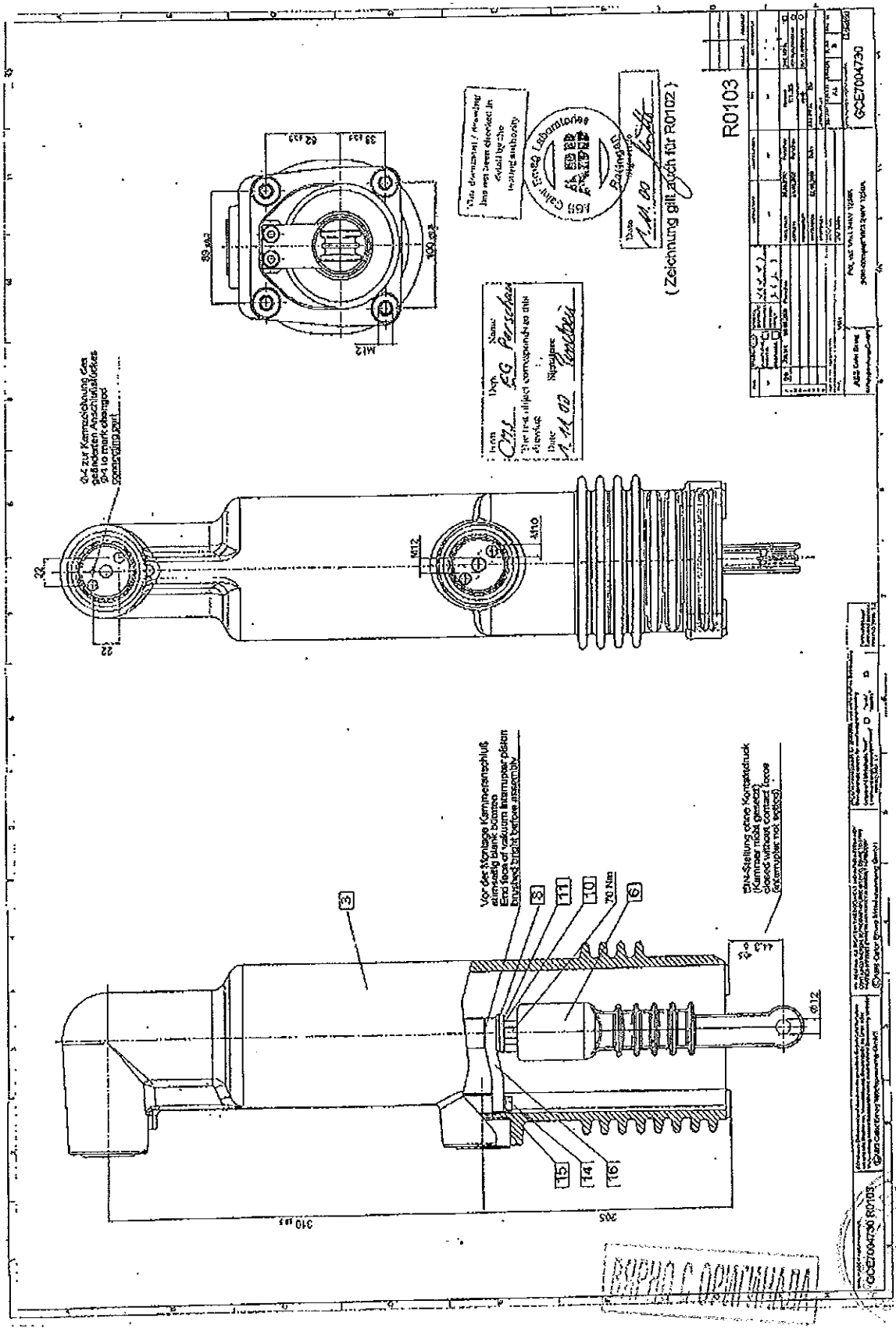
Sheet 11

Issued by an Accredited Laboratory corresponding to EN 45001



Lager und gleitende Teile mit Teil 850 gefettet
bearing and gliding parts greased with part 850
Pos. with ◯ ⇒ GCE7002998R....
Zeichnung gilt für: R0101, R0102, R0103, R0110, R0111, R0112, R0114, R0116, R0119, R0120, R0121, R0126, R0129, R0130
drawing is significant for:
Lauffläche Fahrschiene
top plain of rail
Riegel bar
drawn R0102
Einschub VM1 24 kV in ZS1
DRAW OUT VM1 24 kV IN ZS1
GCE7004924
Z


40,3
10
15
5
1
95
515
555,3
310
(205)
Pole VD4p 24-20-25
GCE7005757
R0122
ABB Calor Emag Laboratories Ratingen


R0103
GCE7004730
(Zeichnung gilt auch für R0102)
ABB Calor Laboratories
Passed
Name Perschke
Signature
Date 9.11.00
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Endstellung ohne Kontaktdruck (Kammer nicht gespannt)
(Kammerverschluß nicht gezeichnet)
70 Nm
[3]
[5]
[11]
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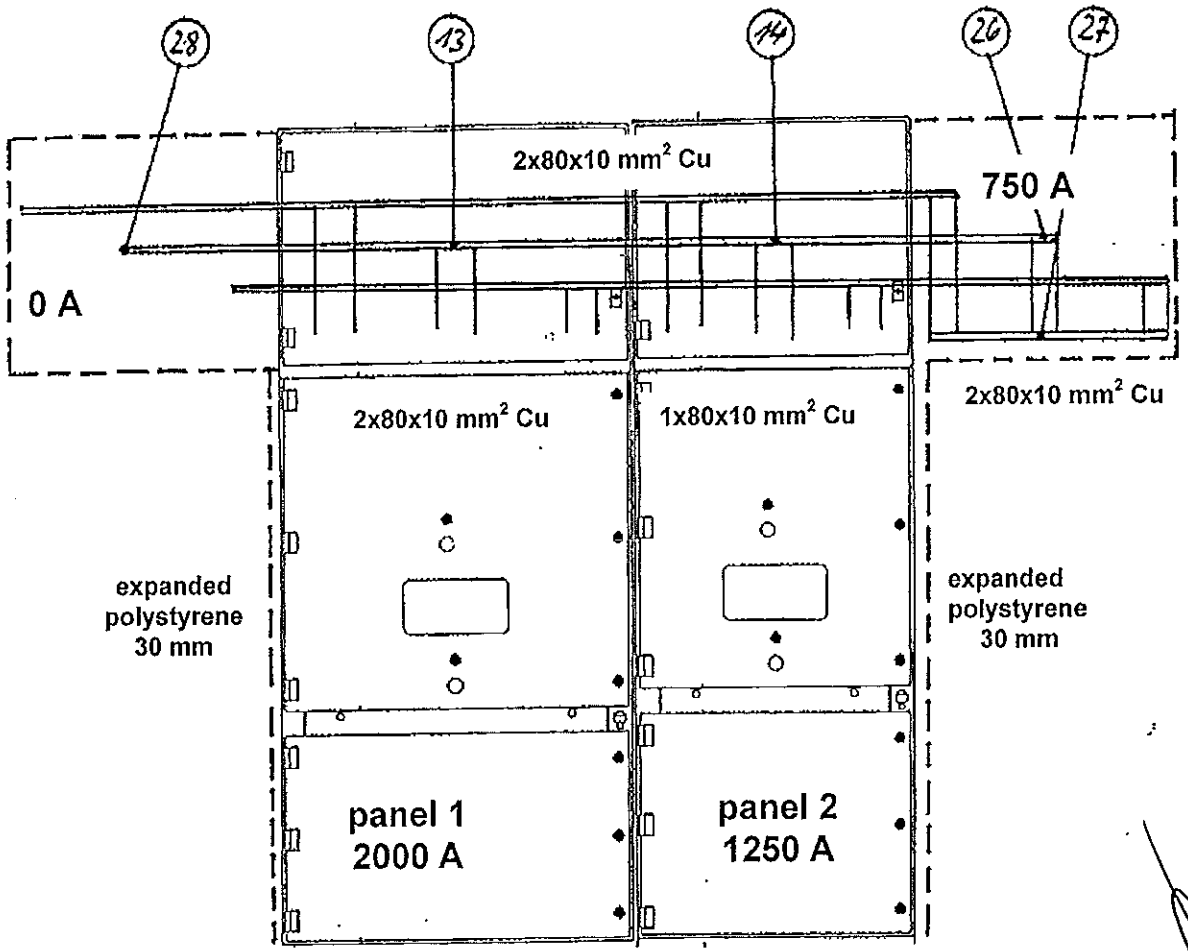
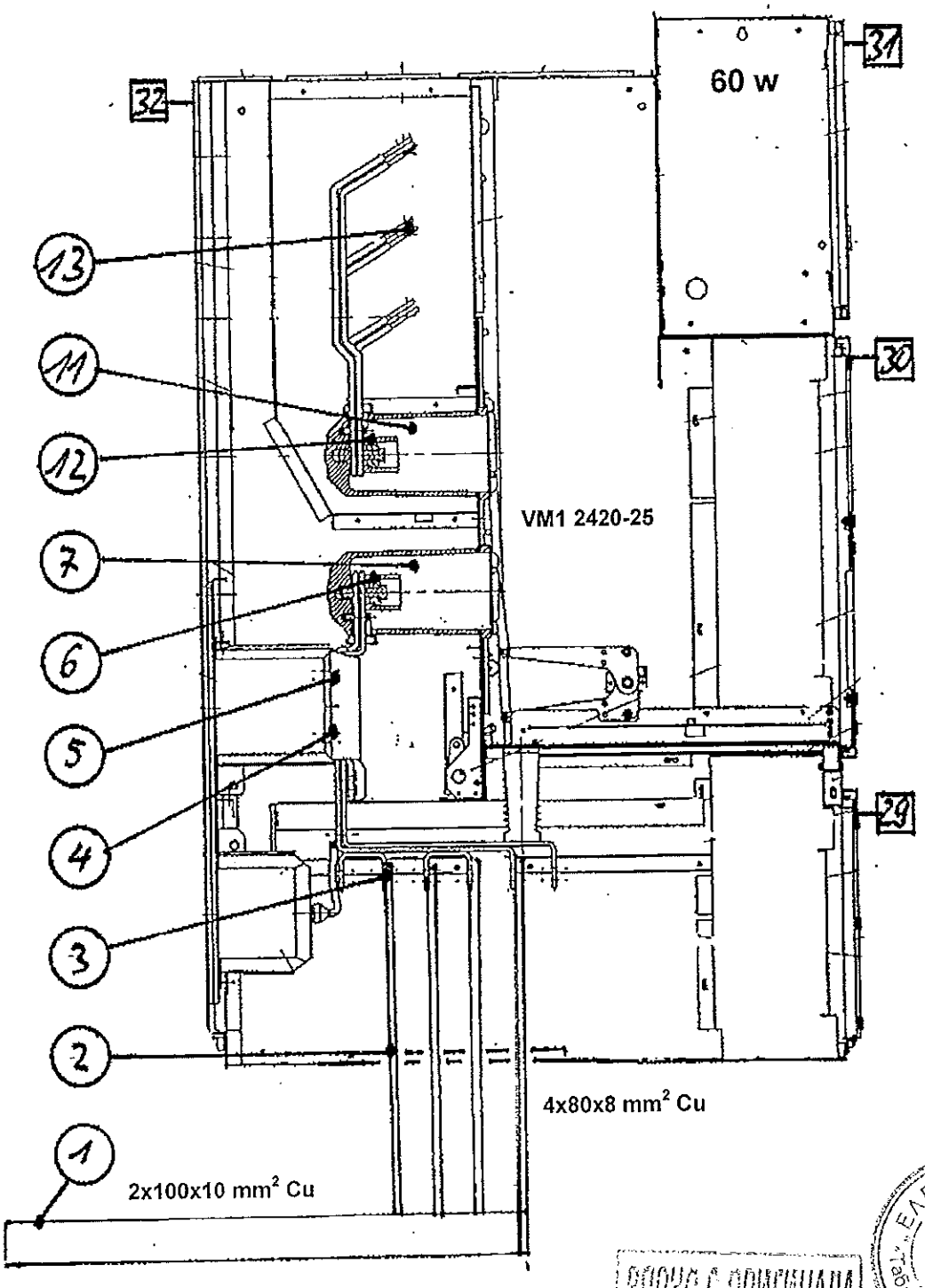
[6]
[15]
[14]
[16]
M12
M10
205
310

Test Arrangement and Measurement Points for Temperatures and Resistances on the Busbars

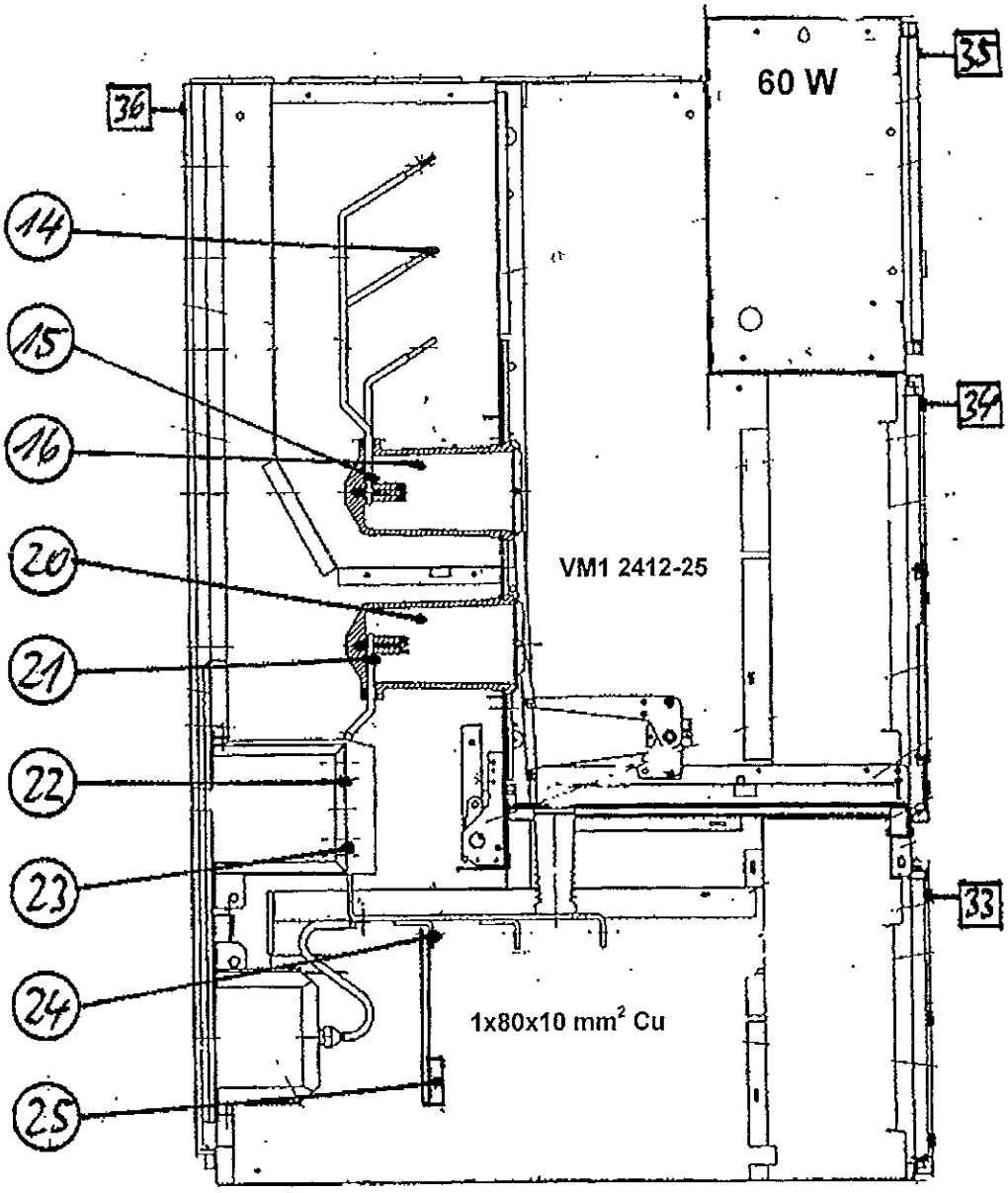


Measurement Points for Temperatures and Resistances of Panel 1

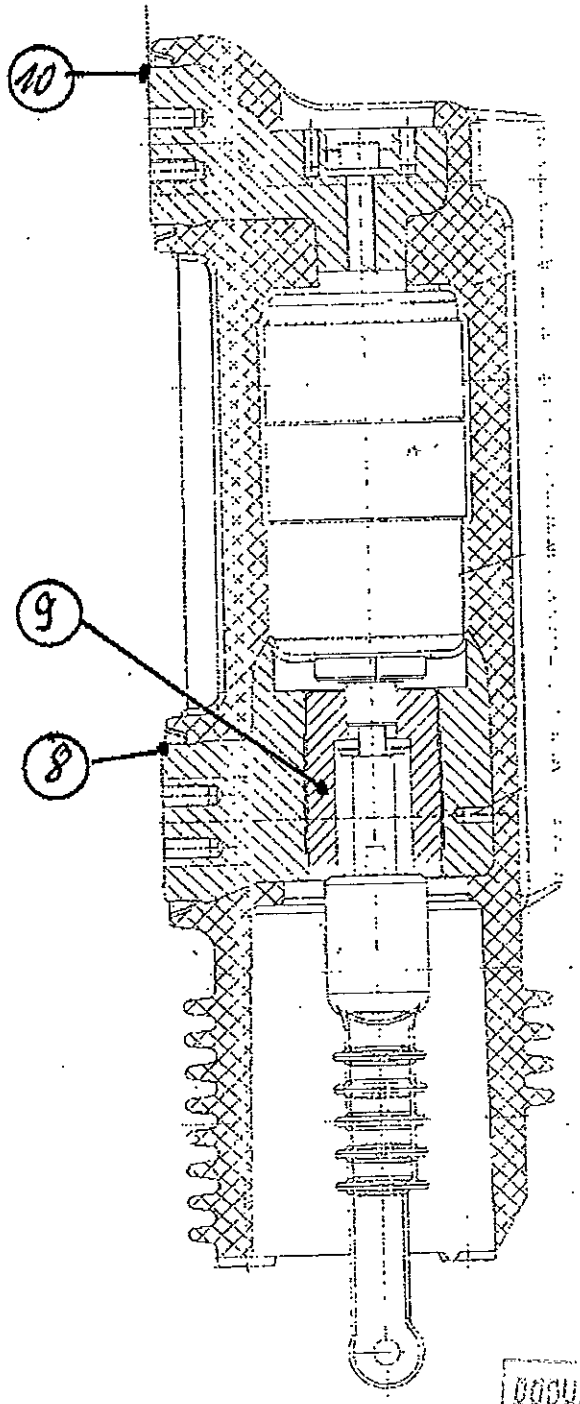


ВЯРНО С ОРИГИНАЛА

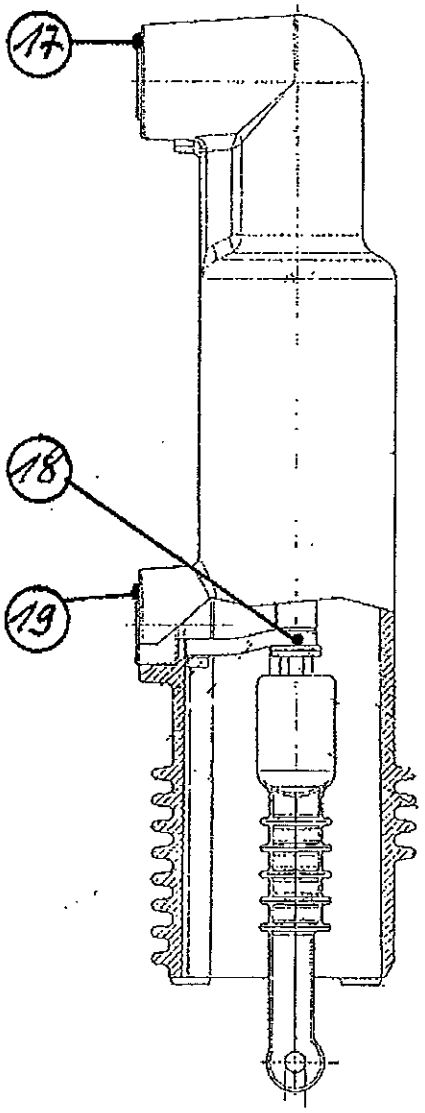
Measurement Points for Temperatures and Resistances of Panel 2



Measurement Points for Temperatures of Circuit-Breaker Poles Panel 1



Measurement Points for Temperatures of Circuit-Breaker Poles Panel 2



ВЕРНО С ОРИГИНАЛА

Measurement of the Resistance of the Main Circuit

Date of test: 11th November 2000 - before temperature rise test
12th November 2000 - after temperature rise test

Condition of test object before test: factory new panels

Ambient air temperature: before temperature rise test 22 °C
after temperature rise test 24 °C

Measurement between points (see sheet 14 - 16)	Resistance of the main circuit μΩ		
	L1 before/after[1)]	L2 before/after[1)]	L3 before/after[1)]
2 - 14 (panel 1)	56.3 / 56.4	53.5 / 53.6	51.6 / 51.5
13 - 25 (panel 2)	95.0 / 94.4	90.4 / 89.1	83.3 / 81.9

Remarks: [1)] Before: before temperature rise test
After: after temperature rise test

Resistance measurement at direct current of: 50 A

The measurement of the resistances are carried out by using the thermocouples at the named measurement points.

Temperature Rise Test

Date of test: 11th and 12th November 2000

Condition of test object before test: factory new panels

Connections to test object: feeder:

two bars 100x10 mm² Cu, length about 2 m outside the panel and four bars 80x8 mm² Cu, length about 0.8 m outside and inside the panel

neutral points:

1. busbar outside feeder panel 2 with two bars 80x10 mm² Cu
2. extended cable connection bars of panel 2 with one bar 80x10 mm² Cu

Duration of test: 9 **h**
Ambient air temperature: 26.1 **°C**
Test current: see sheet 14
Test frequency 50 **Hz**

Distribution of the currents of the panels:

panel or busbar	current in A			
	phase L1	phase L2	phase L3	average value
panel 1, incoming 2000 A	2002	2004	2013	2006
busbar panel 1 - 2	2002	2004	2013	2006
panel 2, outgoing 1250 A	1251	1250	1252	1251

Remarks:

1. The distribution of the currents at the busbar connections of the feeder panel 2 was done by using of iron cores over the extended busbars.
2. The side walls of the panels and the extended busbars were covered by expanded polystyrene sheets of 30 mm thickness.
3. The temperatures were measured by thermocouples type T. For the measurement points of the main circuit the thermocouples were inserted into holes and fixed. The measurement system determines the average value of the ambient temperatures, calculates the differences to the temperatures of all measuring points and records the temperature rises directly.

ВЯРНО С ОРИГИНАЛА

Permitted Temperature Rise of the Main Circuit

according IEC 60694 table 3

Kind of measuring point	Maximum value temperature rise at ambient air temperature not exceeding 40 °C	Measuring point (see sheet 14 to 18)
cable terminal	50	3, 24
Connection, bolted, Cu silver coated in air	75	13, 14, 18, 26, 27,28
Connection, bolted, Cu silver coated in air in contact with insulation material class A	65	8, 10, 17, 19
Connection, bolted, Cu silver coated in air in contact with insulation material class E	75	4, 5, 22, 23
Contact, Cu silver-coated in air	65	6, 7, 9, 11, 12, 15, 16, 20, 21

Continuation from sheet 20

Measuring point (see sheets 15 and 16)	Panel	Description of measuring point	Kind of measuring point	Final temperature rise K	Permitted temperature rise K
29	1	Front door top cable compartment	Access. part expected to be touched in normal operation	4.7	30
30	1	Front door top c.b. compartment	Access. part expected to be touched in normal operation	5.0	30
31	1	Front door top low voltage compartment	Access. part expected to be touched in normal operation	7.6	30
32	1	Rear wall top	Accessible part which need not to be touched in normal op.	14.4	40
33	2	Front door top cable compartment	Access. part expected to be touched in normal operation	3.8	30
34	2	Front door top c.b. compartment	Access. part expected to be touched in normal operation	6.3	30
35	2	Front door top low voltage compartment	Access. part expected to be touched in normal operation	8.1	30
36	2	Rear wall top	Accessible part which need not to be touched in normal op.	11.0	40

Temperature rises and Permitted Temperature rises of the Incoming Panel 1 and the Busbar – right side

ABB Calor Emag Laboratory Test report HZ236E06 12.11.2000

Temperature-rise of switchgear ZS1.2 - 24 kV with UM1 2420-25 with UG4-S

Test current : 2006 A
Ambient temperature : 26.1 °C

temperature-rise in K

perm. temp.rise

No.	Measuring points Name	Temperature-rise 48 / K P1	P2	P3
27	neutral point busbar	26.3	26.9	26.6
26	end of busbar panel 2	35.5	30.2	26.8
14	busbar/jumper bar panel 2	61.9	60.4	54.6
13	jumper bar/busbar panel 1	55.7	59.7	58.7
12	upper disconn. contact pan	58.4	60.6	58.8
11	upper disconn. cont. c.b.	55.7	58.3	56.3
10	upper pole terminal	54.8	57.2	55.1
9	sliding contact stem side	50.7	53.5	52.6
8	lower pole terminal	48.9	51.2	51.3
7	lower disconn. cont. c.b.	48.7	52.0	51.2
6	lower disconn. contact pan	51.0	53.9	52.2
5	upper c.t. terminal	51.2	52.6	50.3
4	lower c.t. terminal	40.9	43.0	42.5
3	cable terminal	29.6	31.4	30.2
2	cable bar inside panel 1	21.8	22.6	23.3
1	feeder bar 1 m before 2	21.6	17.3	24.7

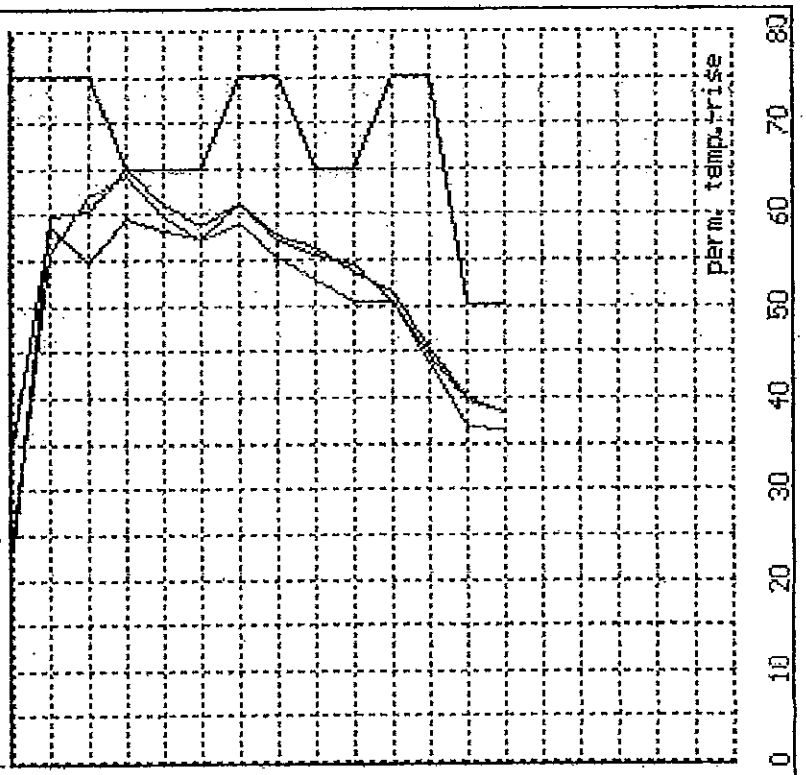
Temperature rises and Permitted Temperature rises of the Feeder Panel 2 and the Busbar – left side

ABB Calor Emag Laboratory Test report HZ236E06 **12.11.2000**

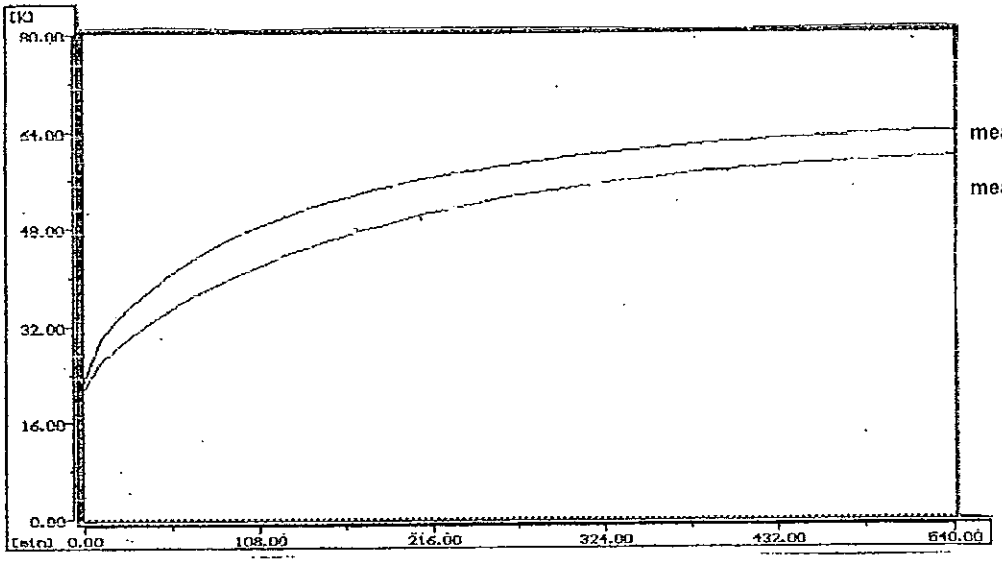
Temperature-rise of switchgear ZS1.2 - 24 kV with UM1 2406-25 with UG4-S

Test current : 1251 A
Ambient temperature : 26.1 °C

No.	Measuring points Name	Temperature rise 45 / K P1	P2	P3
28	end of busbar panel 1	24.9	23.3	34.9
13	busbar/jumper bar panel 1	55.7	59.7	58.7
14	busbar/jumper bar panel 2	61.9	60.4	54.6
15	upper disconn. contact pan	64.1	64.9	59.6
16	upper disconn. cont. c.b.	59.8	61.2	58.1
17	upper pole terminal	57.0	58.7	57.3
18	current lead interr. stem	59.0	61.1	61.2
19	lower pole terminal	55.2	57.7	57.1
20	lower disconn. cont. c.b.	52.9	56.3	55.5
21	lower disconn. cntact pan	50.4	53.5	54.4
22	upper c.t. terminal	50.3	51.6	50.4
23	lower c.t. terminal	43.7	45.4	44.5
24	cable terminal	36.7	40.0	39.7
25	neutral point cable term.	36.5	38.3	38.3



Temperature rise of upper Disconnecting Contacts Panel Side - Phase L2



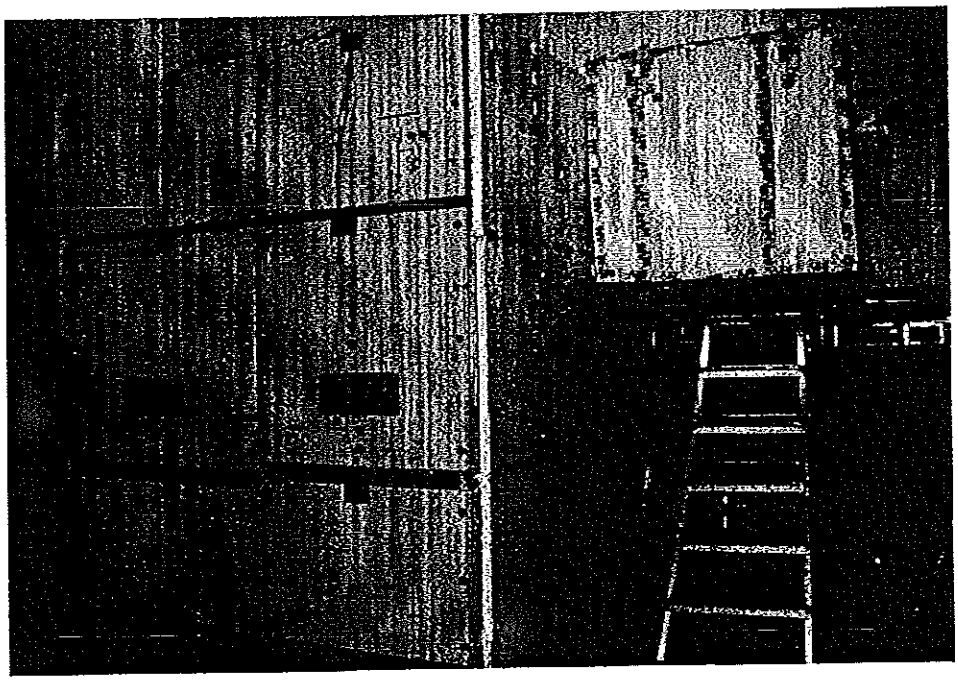


Photo 1: front view left

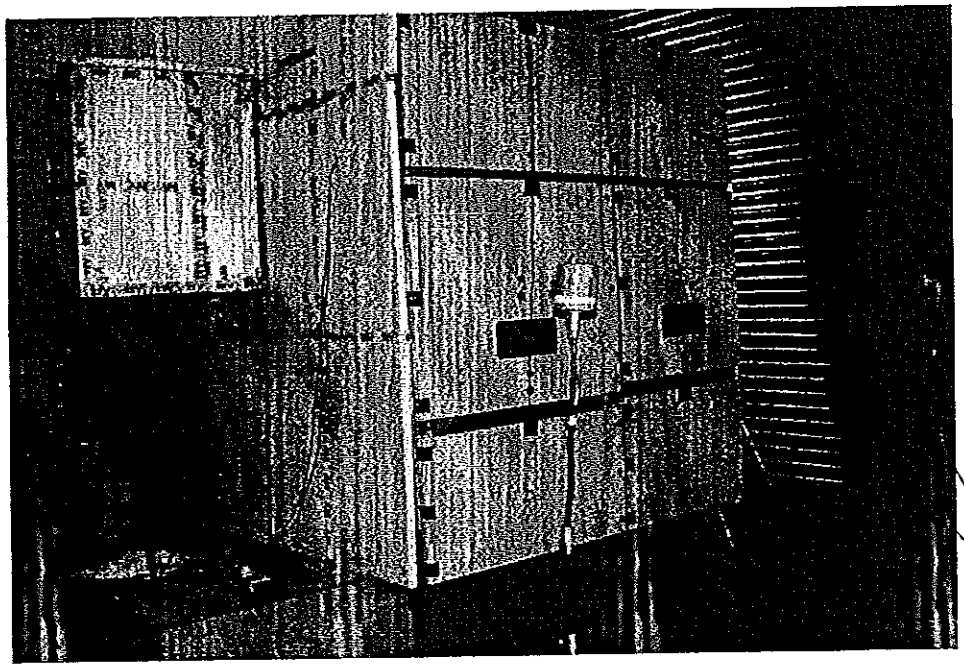


Photo 2: front view right

ВЯРНО С ОРИГИНАЛА

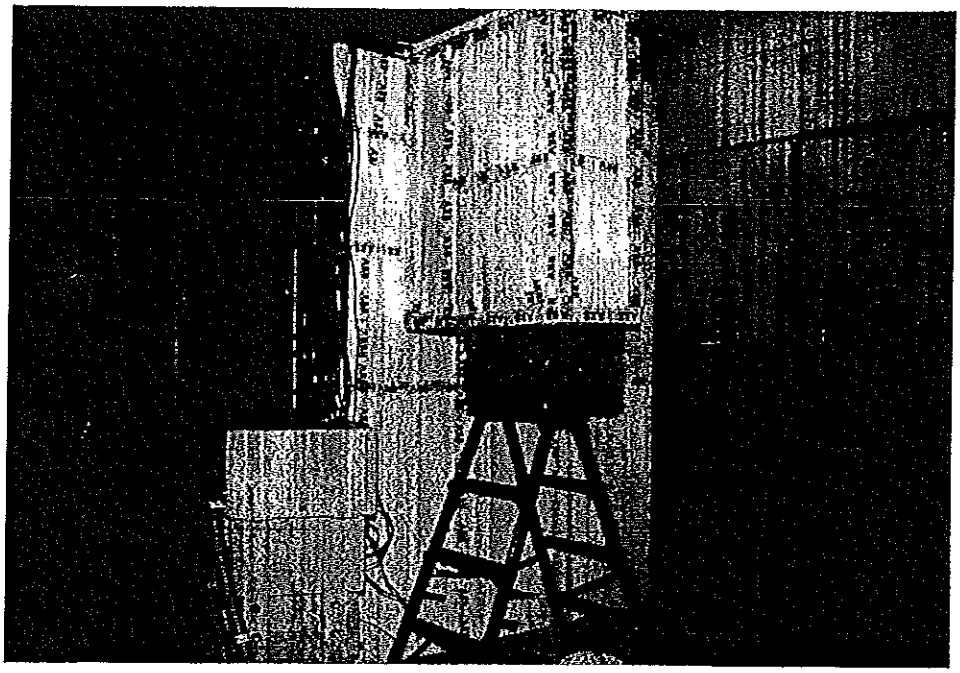


Photo 3: side view left

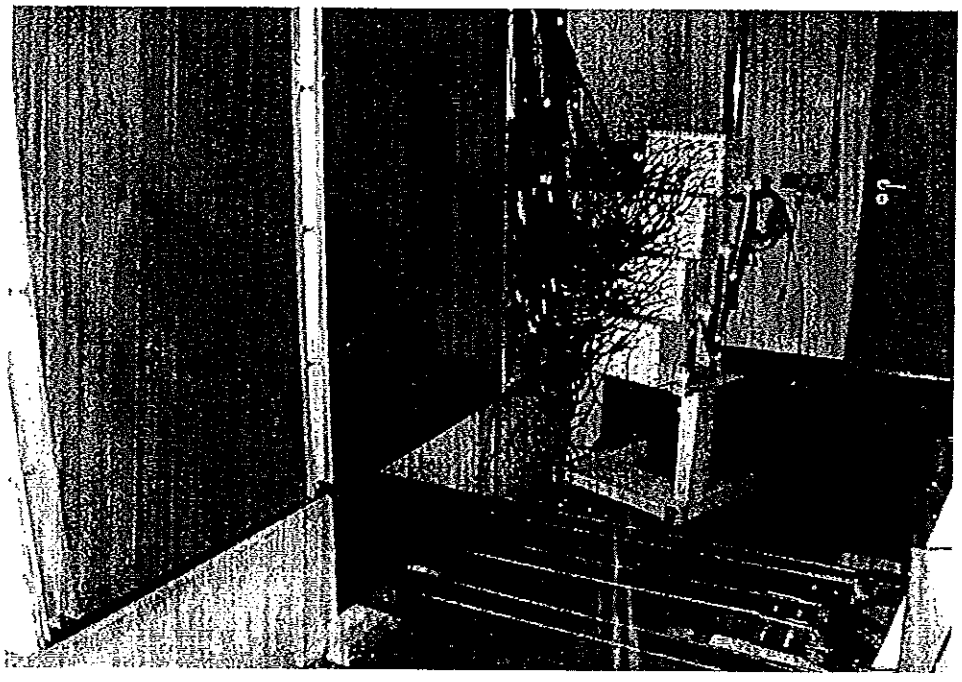


Photo 4: rear view

ВЕРНО С ОРИГИНАЛА

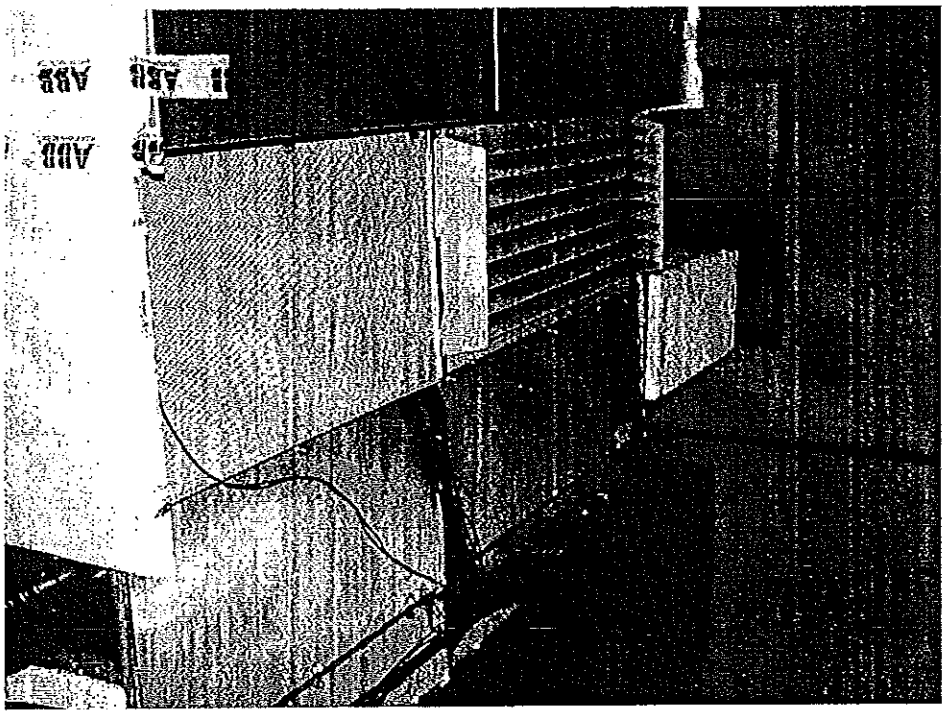


Photo 5: top view

ВЯРНО С ОРИГИНАЛА

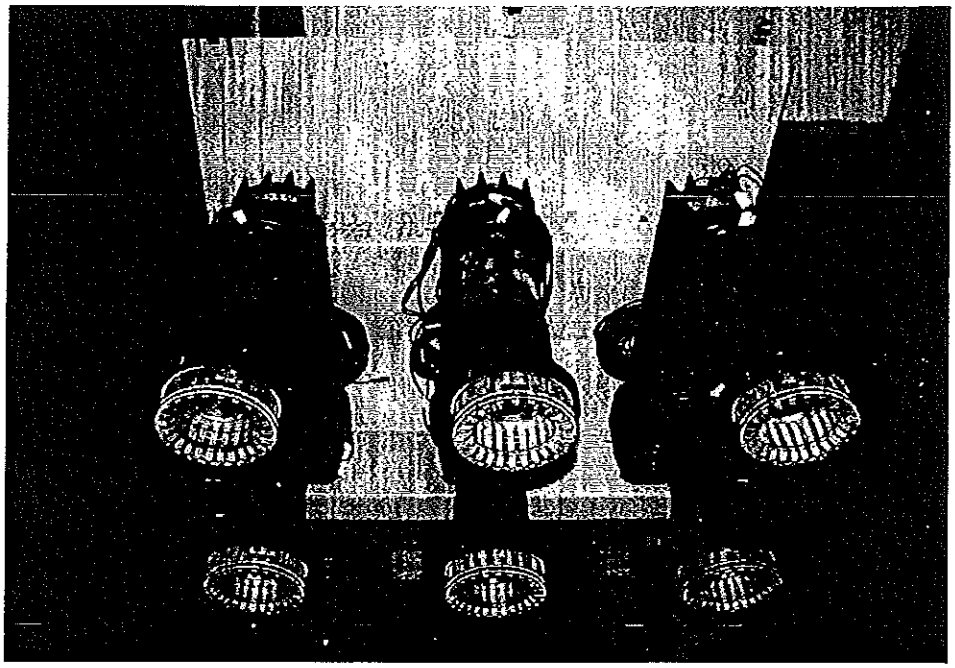


Photo 6: VM1 2420-25

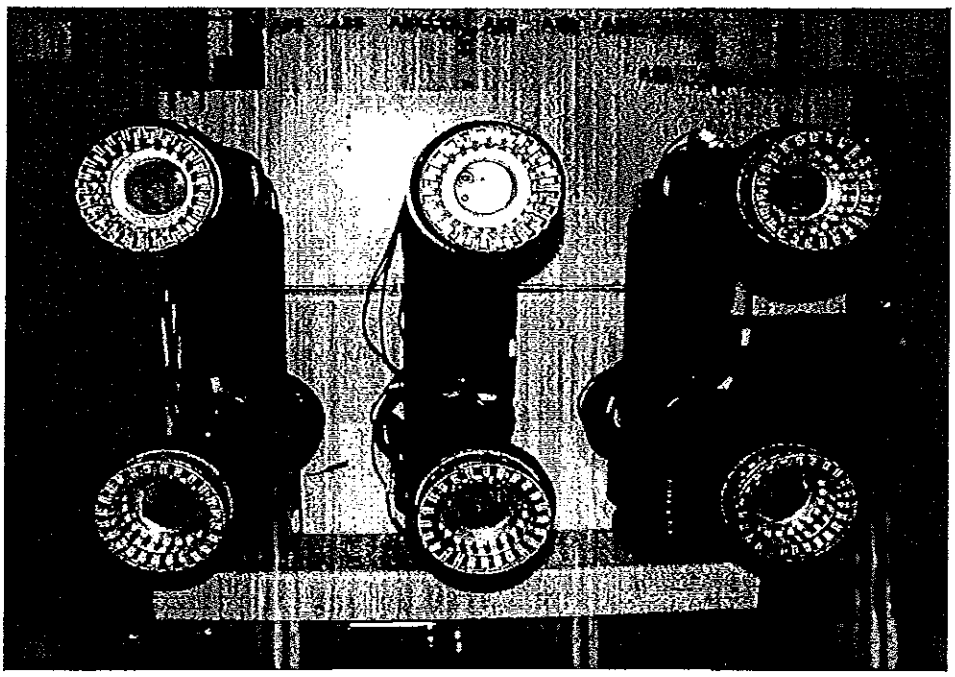


Photo 7: VM1 2420-25

ВЯРНО С ОРИГИНАЛА

Photo 8: VM1 2412-25

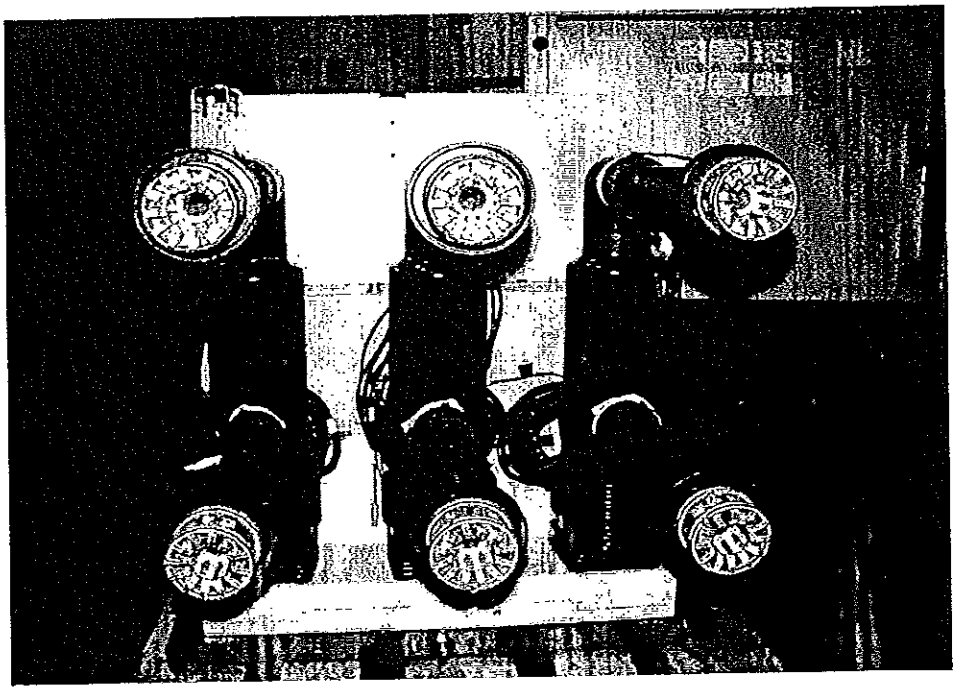


Photo 9: VM1 2412-25

Deutscher Akkreditierungs Rat
DAR
Reg. No.
DAT-P-032/93

ABB Calor Emag Laboratories

ABB

TEST REPORT No. HZ 235 L 02

Issued by an Accredited Laboratory corresponding to EN 45001

Copy-No. 1

Test Object

Three-panel arrangement of metal-clad, air insulated switchgear type ZS1.2 (1000 mm, 1000 mm, 800 mm width) equipped with bushing plates

Rated voltage	U_r	24 kV
Rated normal current	I_r	1600/1600/1000 A
Rated frequency	f_r	50/60 Hz
Rated short-time withstand current	I_k	25 kA
Rated peak withstand current	I_p	63 kA
Rated duration of short-circuit current	t_k	3 s

Manufacturer

ABB Calor Emag Mittelspannung GmbH, Oberhausener Str. 33, 40472 Ratingen, Deutschland

Tests performed

Testing of the behaviour of the metal-clad switchgear under conditions of arcing due to internal faults with 25 kA - 1.0 s in different compartments of the three panels. For further details see sheet-no. 2 to 5.

Test Specification

The test has been carried out in accordance with the client's instructions. Test procedure and test parameters were based on IEC 60298/3rd Ed/1990-12, Clause 6.108, Annex AA in conjunction with PEHLA-Recommendation No. 4 / 3.1995.
(Accessibility Type A: Metal-enclosed switchgear and controlgear with accessibility restricted to authorized personnel only).

Test Results

The assessment of the test was carried out in accordance with criteria 1 to 6 of the above mentioned test specifications.
For further details see sheet-no. 2 to 5 and 16 to 20.

Test Date

12th and 14th December 2000

Client

ABB Calor Emag Mittelspannung GmbH, Oberhausener Str. 33, 40472 Ratingen, Deutschland

ABB Calor Emag Laboratories ABB Ratingen

19th February 2002
Date of Issue

Dr. S. Göttlich
Laboratory Manager

Andreas Brandt
Test Engineer

Total Number of Sheets: 30 Sheets **11 Oszillograms**

This test report refers exclusively to the object tested.
ABB Calor Emag Mittelspannung GmbH is certified according to DIN ISO 9001 by DQS under Reg. No. 373-02

ABB Calor Emag Laboratories Ratingen are accredited according to EN 45001 by DATech under Reg.No. DAT-P-032/93

ABB Calor Emag Mittelspannung GmbH Ratingen
High-Power Testing Laboratory

Oberhausener Straße 33
40472 Ratingen, Deutschland

Phone + 49 (0) 21 02 12-1352
Fax + 49 (0) 21 02 12-1713

Comments on Test Arrangement and on the Test

The test object was a three-panel arrangement of a metal-clad, air insulated switchgear type ZS1.2 for 24 kV, consisting of a 1000 mm width outgoing panel left-handed, of a 1000 mm width incoming panel in centre and a 800 mm width outgoing panel right-handed. The switchgear was installed in a room mock up with a ceiling height of approximately 3 m. The distance between the rear wall of the switchgear and the room mock up was approximately 0.2 m. The pressure relief took place by a top mounted pressure relief duct overcoming 1800 mm at the side wall of the left-handed panel.

Each panel was equipped with a VD4 vacuum circuit-breaker dummy and a common earthing bar of copper 30 x 8 mm^2.

Infeed of current was made three-phase by means of a three core cable 1 x 3 x 185 mm^2 through the closed bottom of the centre panel.

For all tests black cretonne indicators (cotton fabric approximately 150 g/m^2) were placed in front of and on one side of the switchgear as stated in the relevant test regulations.

During the tests the pressure gauge in the compartment under test was measured and recorded. The tests were filmed with a high-speed video camera with a frequency of 500 frames/s.

The evaluation of the RMS-value of the short-circuit current was made according to the Simpson-Formula.

Test Results

Test-no.: HZ 235 L 02 / 03 Internal arcing test in the cable compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire Ø 0.5 mm at the cable terminals.

Peak short-circuit current: 59.7 kA
Short-circuit current: 24.7 kA - 1.03 s equivalent to 25.0 kA - 1.02 s

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Test-no.: HZ 235 L 02 / 04 Internal arcing test in the cable compartment of the left-handed panel (1000 mm width), ignition of arc three-phase by means of a copper wire Ø 0.5 mm at the cable terminals.

Peak short-circuit current: 59.7 kA
Short-circuit current: 24.9 kA - 1.04 s equivalent to 25.0 kA - 1.03 s

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Test Results

Test-no.: HZ 235 L 02 / 05 Internal arcing test in the circuit-breaker compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire Ø 0.5 mm across the lower contact arms of the circuit-breaker.

Peak short-circuit current: 58.8 kA
Short-circuit current: 24.7 kA - 1.04 s equivalent to 25.0 kA - 1.02 s

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Test-no.: HZ 235 L 02 / 06 Internal arcing test in the busbar compartment of the left-handed panel (1000 mm width), ignition of arc three-phase by means of a copper wire Ø 0.5 mm across the busbars.

Peak short-circuit current: 56.8 kA
Short-circuit current: 24.7 kA - 1.04 s equivalent to 25.0 kA - 1.03 s

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЕРНО С ОРИГИНАЛА

Test Results

Test-no.: HZ 235 L 02 / 07 Internal arcing test in the circuit-breaker compartment of the centre panel (1000 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm across the upper contact arms of the circuit-breaker.

Peak short-circuit current: 59.6 kA
Short-circuit current: 24.7 kA - 1.04 s equivalent to 25.0 kA - 1.03 s

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Contents

ВЯРНО С ОРИГИНАЛА

Assessment of the Test

Extraction of IEC 60298/3rd Ed/1990-12, Annex AA

The following criteria allow for the arcing effects.
It is to be observed:

Criterion No. 1

Whether correctly secured doors, covers, etc., do not open.

Criterion No. 2

Whether parts (of the metal-enclosed switchgear and controlgear), which may cause a hazard, do not fly off. This includes large parts or those with sharp edges, for example, inspection windows, pressure relief flaps, cover plates, etc.

Criterion No. 3

Whether arcing does not cause holes to develop in the freely accessible parts of the enclosure as a result of burning or other effects.

Criterion No. 4

Whether the indicators arranged vertically do not ignite. Indicators ignited as a result of paint or stickers burning are excluded from this assessment.

Criterion No. 5

Whether the indicators arranged horizontally do not ignite. Should they start to burn during the test, the assessment criterion may be regarded as having been met, if proof is established of the fact that the ignition was caused by glowing particles rather than hot gases. Pictures taken by high-speed cameras should be produced in evidence.

Criterion No. 6

Whether all earthing connections are still effective.

Remark:

When the PEHLA-Recommendation No. 4 is stated under *Test Specification* in the Test Report the results of each test were assessed by all six criteria.

ВЯРНО С ОРИГИНАЛА

Participants of the Tests

Client:	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland
Representatives of the client:	
Mr. Aufermann	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. EA
Mr. Groll	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. EA
Representatives of the laboratory:	
Mr. Dr. Göttlich	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. LL
Test Engineer:	
Mr. Brandt	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. LL

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switchgear (left-handed and centre)

Test Object: Metal-clad, air insulated switchgear

Type: ZS1.2, 1000 mm width

Manufacturer: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland

Serial-No.: 7550027/2027/00
7550027/2025/00 **Year of manufacture:** 2000

Drawing Nos.: See sheet-no. 10

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50/60	Hz
Rated current (busbar)	2000	A
Rated current (tee-off)	1600	A
Rated short-circuit peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated short-circuit duration	3	s
Insulating medium	air	
Rated filling pressure (abs., 20 ° C)	-	kPa

Prospective values under internal-arc conditions:

Peak withstand current	63	kA
Short-time withstand current	25	kA
Short-circuit duration	1	s

Additional specifications and data:

- busbars 2 x 80 mm x 10 mm / R 5 mm, Cu, insulated
- tee-off bars 2 x 80 mm x 10 mm / R 5 mm, Cu, insulated

Date of receipt of test object: 11th December 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switchgear (right-handed)

Test Object: Metal-clad, air insulated switchgear

Type: ZS1.2, 800 mm width

Manufacturer: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland

Serial-No.: 7550027/2022/00 **Year of manufacture:** 2000

Drawing Nos.: See sheet-no. 10

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50/60	Hz
Rated current (busbar)	2000	A
Rated current (tee-off)	1000	A
Rated short-circuit peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated short-circuit duration	3	s
Insulating medium	air	
Rated filling pressure (abs., 20 ° C)	-	kPa

Prospective values under internal-arc conditions:

Peak withstand current	63	kA
Short-time withstand current	25	kA
Short-circuit duration	1	s

Additional specifications and data:

- busbars 2 x 80 mm x 10 mm / R 5 mm, Cu, insulated
- tee-off bars 1 x 60 mm x 10 mm / R 5 mm, Cu, insulated

Date of receipt of test object: 11th December 2000

ВЯРНО С ОРИГИНАЛА

Table of Drawings of Test Objects

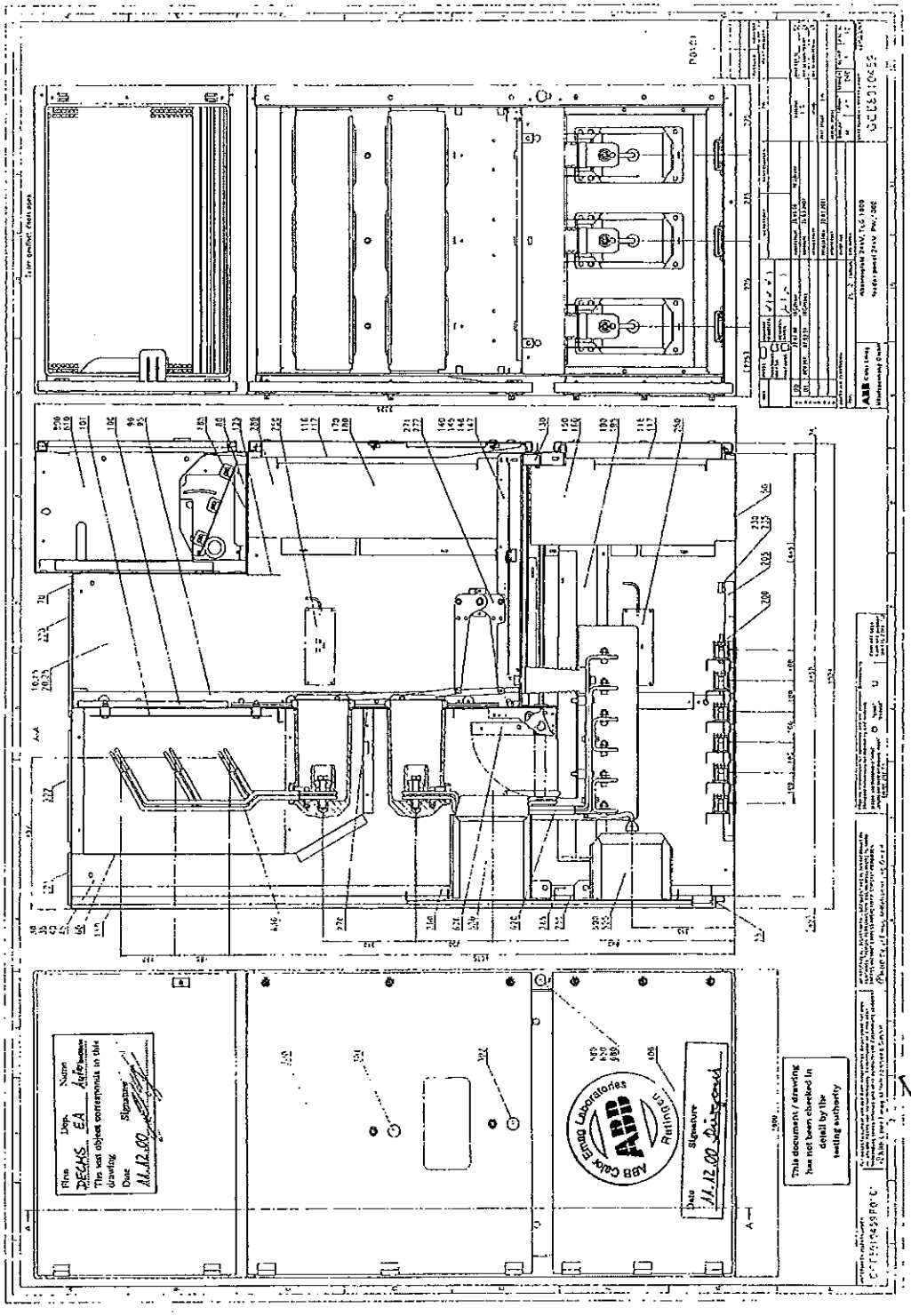
The drawings submitted for identification of the test object were stamped and signed by the test engineer.

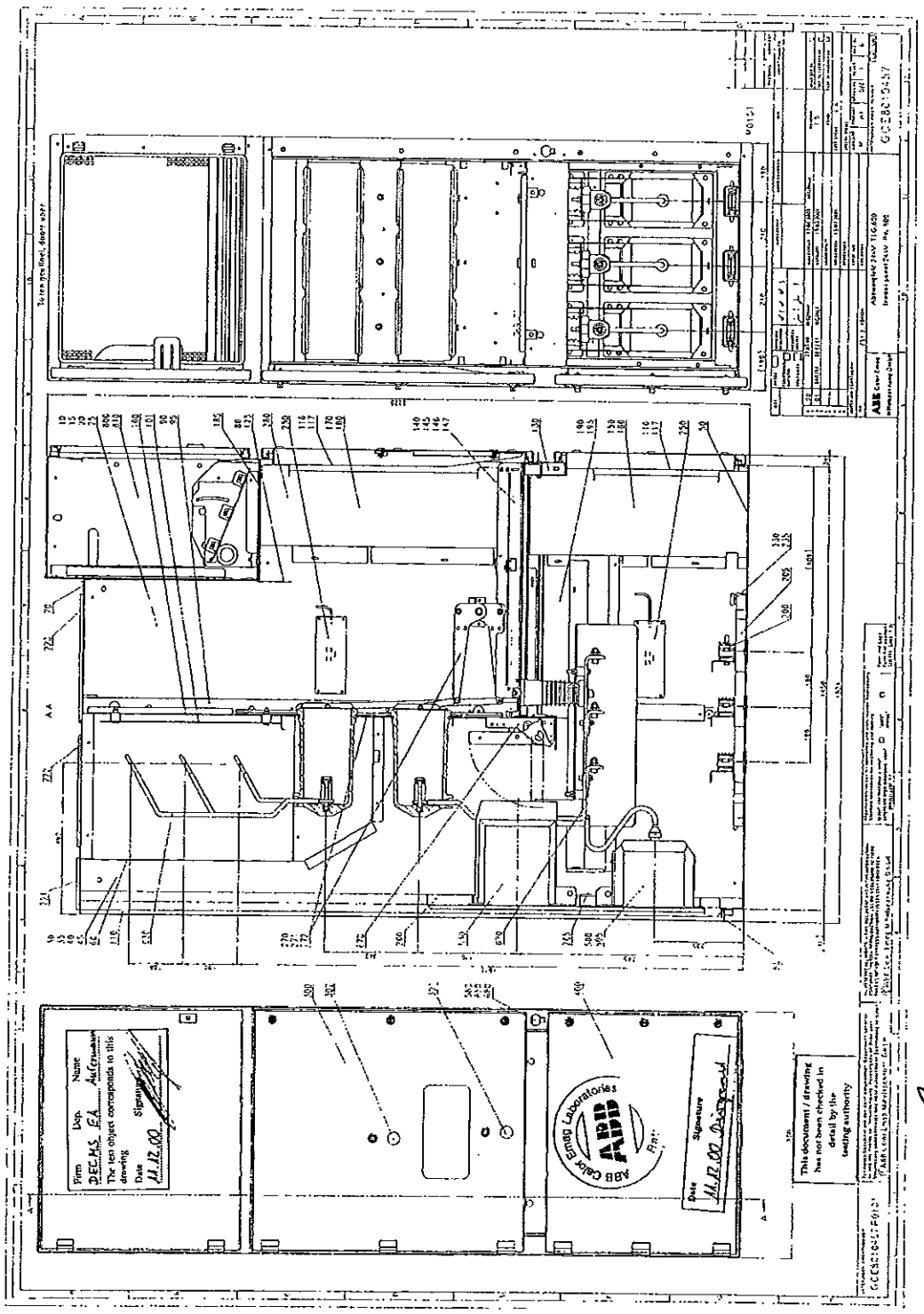
The manufacturer/client has guaranteed by signature on the drawings that the equipment submitted for tests has been manufactured in accordance with the given drawings.

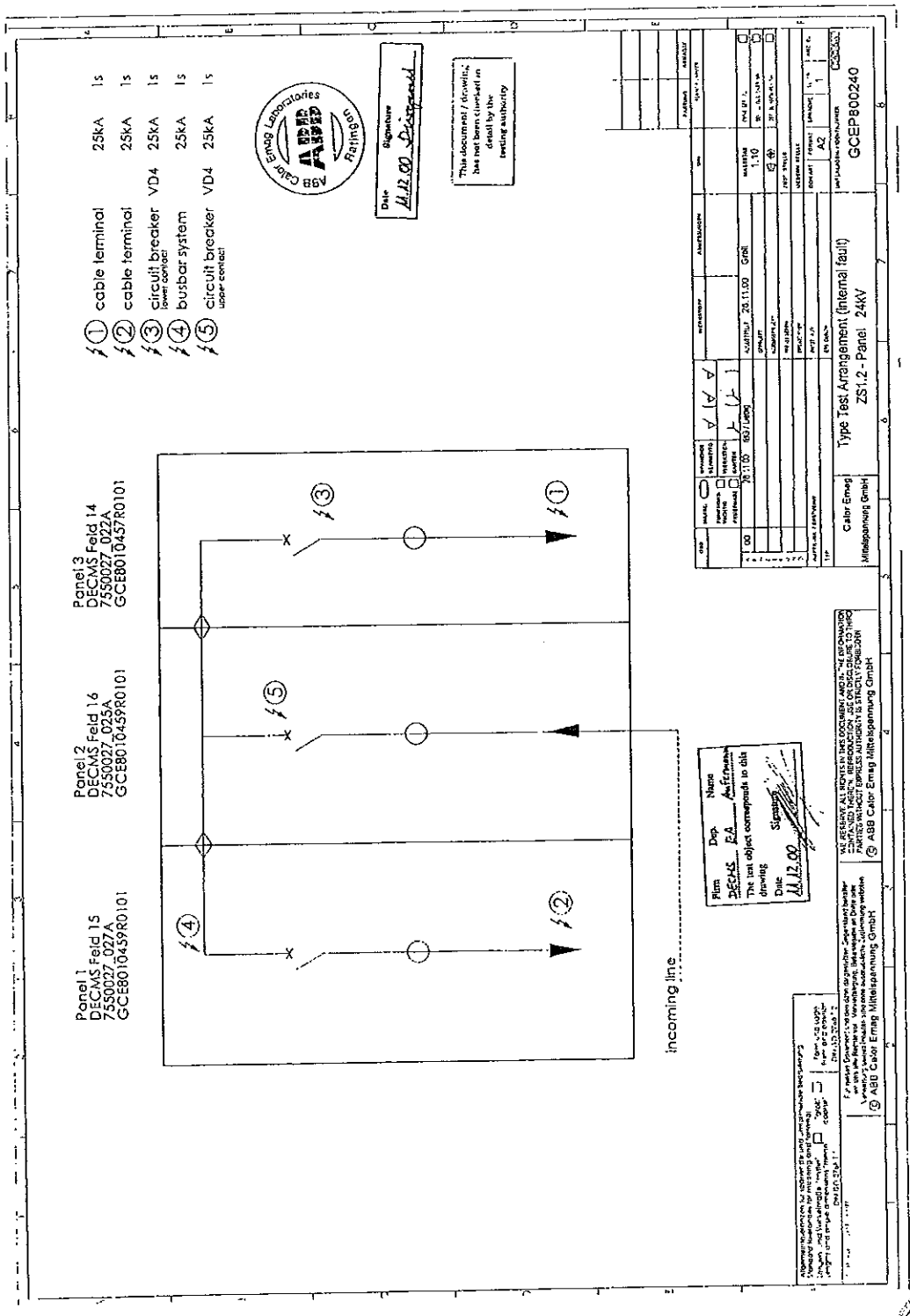
A copy of the following drawing is part of this Test Report:

ZS 1.2, feeder panel 24 kV, PW.1000	GCE8010459R0101, sheet 1, index 01,	
ZS 1.2, feeder panel 24 kV, PW.800	GCE8010457R0101, sheet 1, index 01,	
Type Test Arrangement (internal fault) ZS1.2 – Panel 24kV	GCEP800240	sheet 1, index 00

ВЕРНО С ОРИГИНАЛА




Firm
Dep.
Name
The test object corresponds to this drawing
Date
Signature
ABB Calor Emag Laboratories
This document / drawing has not been checked in detail by the testing authority


① cable terminal 25kA 1s
② cable terminal 25kA 1s
③ circuit breaker VD4 25kA 1s
lower contact
④ busbar system 25kA 1s
⑤ circuit breaker VD4 25kA 1s
upper contact
Panel 1
DECMS Feld 15
7550027 027A
GCE801043 9R0101
Panel 2
DECMS Feld 16
7550027 025A
GCE801043 9R0101
Panel 3
DECMS Feld 14
7550027 022A
GCE801043 7R0101
incoming line
Calor Emag
Mittelspannung GmbH
Type Test Arrangement (internal fault)
ZS1.2 - Panel 24KV
GCEP800240
ABB Calor Emag Mittelspannung GmbH

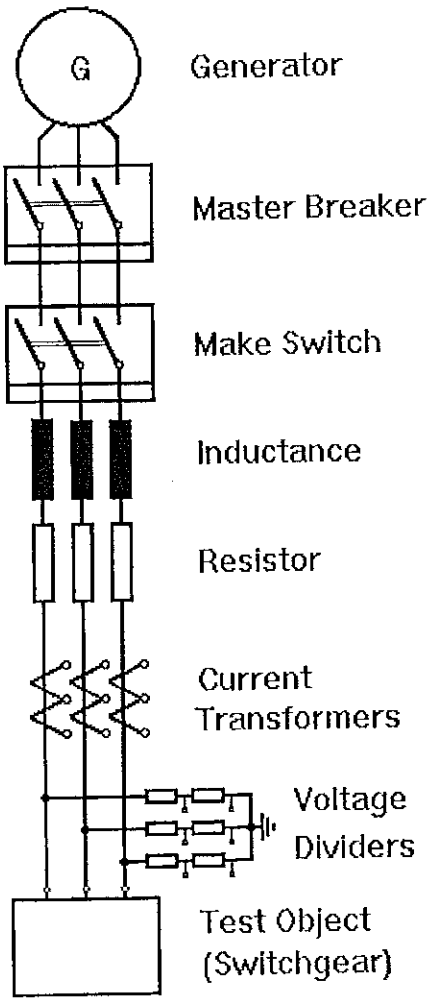
Technical Data of Test Circuit

Test		Internal fault	-	-	-
Oscillogram-No. HZ 235 L 02		02 - 07	-	-	-
Number of phases	(circuit)	3	-	-	-
Number of poles/phases	(test object)	3	-	-	-
Power frequency	Hz	50	-	-	-
Power factor	cos φ	≤ 0.15	-	-	-
Earthing	Generator	earthed via 5 kΩ	-	-	-
	Transformer	not earthed	-	-	-
	Short-circuit point	not earthed	-	-	-
Circuit diagram	Sheet no.:	16	-	-	-
Circuit impedance	mΩ	≈ 170	-	-	-
	-	-	-	-	-
TRV control elements		-	-	-	-
Capacitance in parallel	µF	-	-	-	-
Resistance in series	Ω	-	-	-	-
	-	-	-	-	-
	-	-	-	-	-
Prospective TRV	-	-	-	-	-
TRV peak value u_c	kV	-	-	-	-
Time co-ordinate t_3	µs	-	-	-	-
Time delay t_d	µs	-	-	-	-
Based on	kV	-	-	-	-
Rate-of-rise	kV/µs	-	-	-	-
	-	-	-	-	-
	-	-	-	-	-
Voltage measurements		Divider 375 kΩ / 2 kΩ	-	-	-
Current measurements		Transformer 50 kA / 5 A	-	-	-

Remarks:
HZ 235 L 02 / 01: Current calibration

ВЯРНО С ОРИГИНАЛА

Principle Diagram of Test Circuit



Determination of the Prospective Short-Circuit Current

Condition of test object before test: -

Arrangement: See sheet-no. 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 185 mm^2 through the closed bottom of the centre panel.

For the determination of the prospective short-circuit current the infeeding busbars of the test plant were short-circuited and earthed outside the switchgear under test.

Test-No.: HZ 235 L 02 / 02		Applied voltage (phase-to-phase) 7.30 kV		Duration of short-circuit current 1.03 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	65.8	27.2	25.8	25.0
L2	19.6	26.9	25.9	25.1
L3	51.3	26.9	25.5	24.8
	Average value	27.0	25.7	25.0
Equivalent duration of short-circuit current 1.03 s			**corresponding to a short-circuit current of** 25.0 kA	

Remarks: -

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: Switchgear factory-new.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 185 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the cable compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm at the cable terminals.

Test-No.: HZ 235 L 02 / 03		Applied voltage (phase-to-phase) 7.45 kV		Duration of short-circuit current 1.03 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	59.7	26.9	25.6	24.8
L2	18.3	26.3	25.7	24.9
L3	45.4	26.4	25.2	24.4
	Average value	26.5	25.5	24.7
Equivalent duration of short-circuit current 1.02 s			**corresponding to a short-circuit current of** 25.0 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 23 to 29. The measured pressure gauge was about 42 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Internal Arcing Test

Condition of test object before test: as after test HZ 235 L 02 / 03.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 185 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the cable compartment of the left-handed panel (1000 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 across the cable terminals.

Test-No.: HZ 235 L 02 / 04		Applied voltage (phase-to-phase) 7.45 kV		Duration of short-circuit current 1.04 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	59.7	27.1	25.8	25.1
L2	20.5	26.0	25.7	25.0
L3	47.5	26.6	25.4	24.6
	Average value	26.6	25.7	24.9
Equivalent duration of short-circuit current 1.03 s			**corresponding to a short-circuit current of** 25.0 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 23 to 29. The measured pressure gauge was about 45 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: as after test HZ 235 L 02 / 04.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 185 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the circuit-breaker compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm across the lower contact arms of the circuit-breaker.

Test-No.: HZ 235 L 02 / 05		Applied voltage (phase-to-phase) 7.45 kV		Duration of short-circuit current 1.04 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	58.8	26.8	25.3	24.5
L2	19.4	26.3	25.7	24.8
L3	46.4	27.0	25.6	24.7
	Average value	26.7	25.5	24.7
Equivalent duration of short-circuit current 1.02 s			**corresponding to a short-circuit current of** 25.0 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 23 to 29. The measured pressure gauge was about 31 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: as after test HZ 235 L 02 / 05.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 185 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the busbar compartment of the left-handed panel (1000 mm width), ignition of arc three-phase by means of a copper wire Ø 0.5 mm across the busbars.

Test-No.: HZ 235 L 02 / 06		Applied voltage (phase-to-phase) 7.45 kV		Duration of short-circuit current 1.04 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	56.8	26.6	25.5	24.7
L2	19.3	25.3	26.5	25.0
L3	44.1	26.9	24.7	24.2
	Average value	26.3	25.6	24.7
Equivalent duration of short-circuit current 1.03 s			**corresponding to a short-circuit current of** 25.0 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 23 to 29. The measured pressure gauge was about 60 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Internal Arcing Test

Condition of test object before test: as after test HZ 235 L 02 / 06.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 185 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the circuit-breaker compartment of the centre panel (1000 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm across the upper contact arms of the circuit-breaker.

Test-No.: HZ 235 L 02 / 07		Applied voltage (phase-to-phase) 7.45 kV		Duration of short-circuit current 1.04 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	59.6	26.7	25.2	24.6
L2	18.7	26.7	25.8	25.0
L3	45.9	27.0	25.3	24.7
	Average value	26.8	25.5	24.7
Equivalent duration of short-circuit current 1.03 s			**corresponding to a short-circuit current of** 25.0 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 23 to 29. The measured pressure gauge was about 28 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

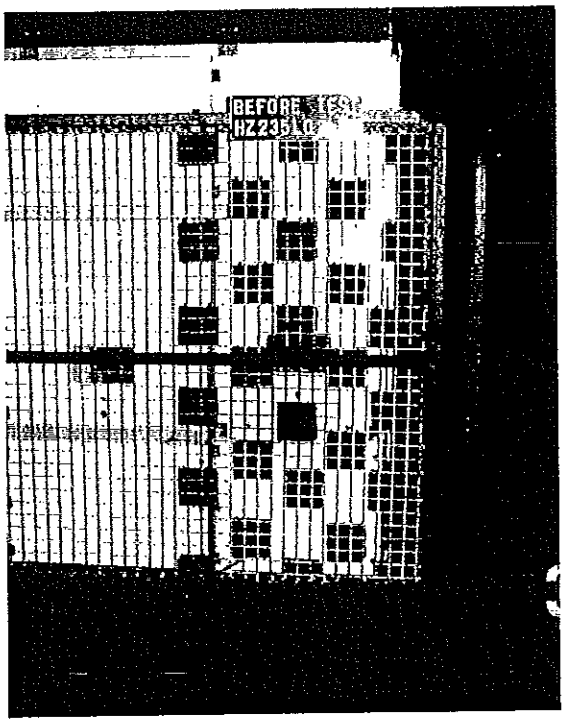


Photo No. 01
Before Test HZ 235 L 02 / 03

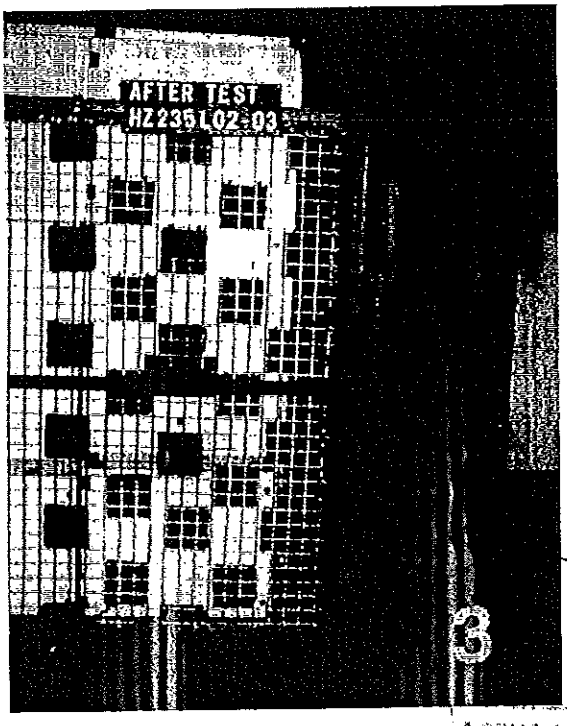


Photo No. 02
After Test HZ 235 L 02 / 03

ВЕРНО С ОРИГИНАЛА

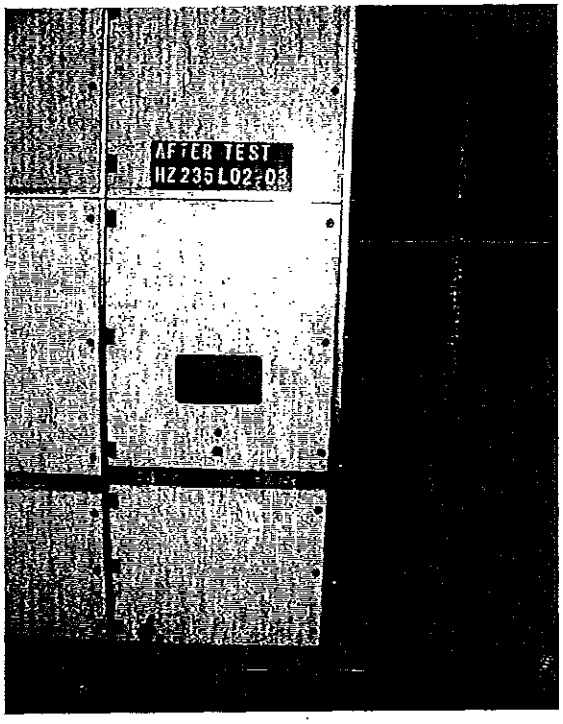


Photo No. 03
After Test HZ 235 L 02 / 03

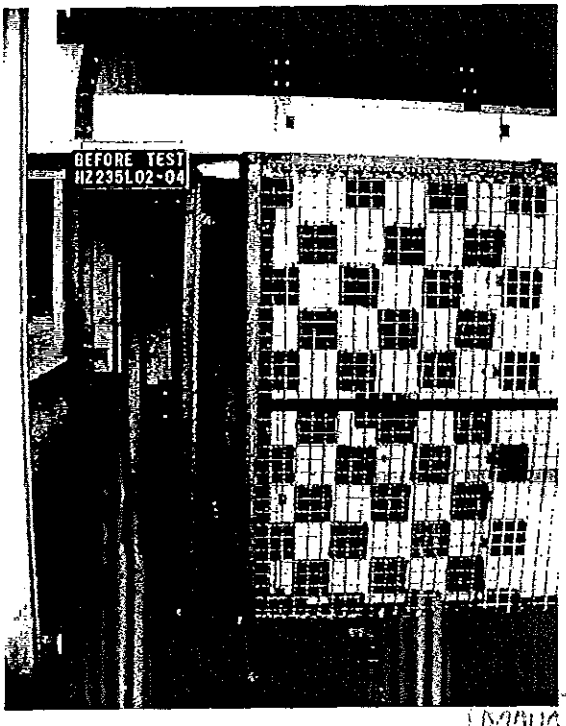


Photo No. 04
Before Test HZ 235 L 02 / 04

ВЯРНО С ОРИГИНАЛА

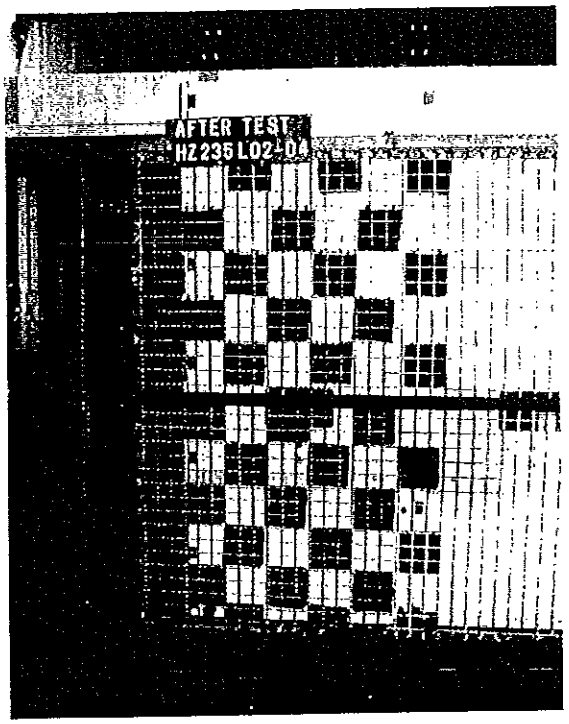
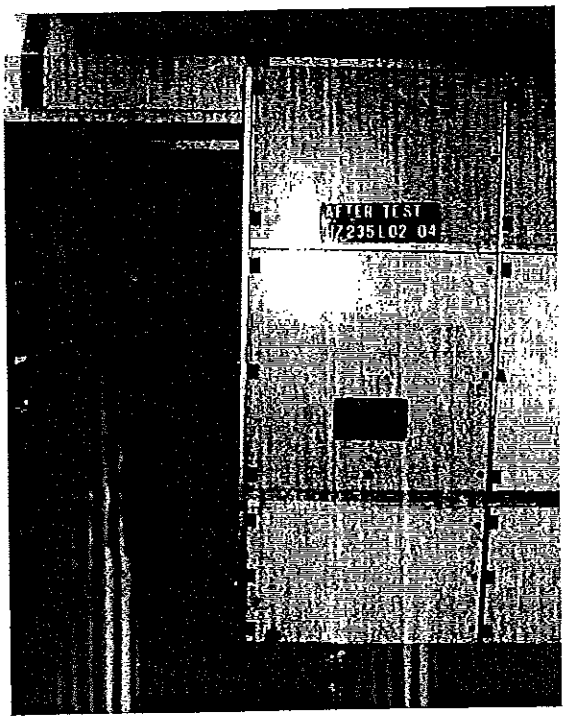


Photo No. 05
After Test HZ 235 L 02 / 04



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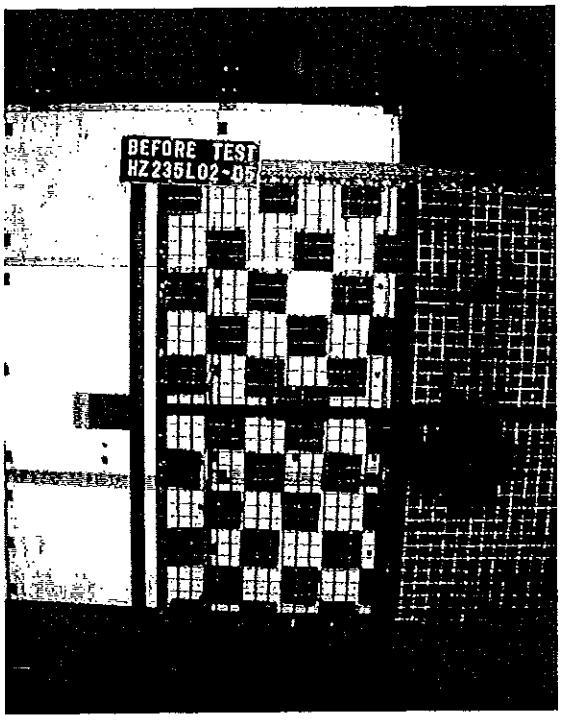

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Before Test HZ 235 L 02 / 05

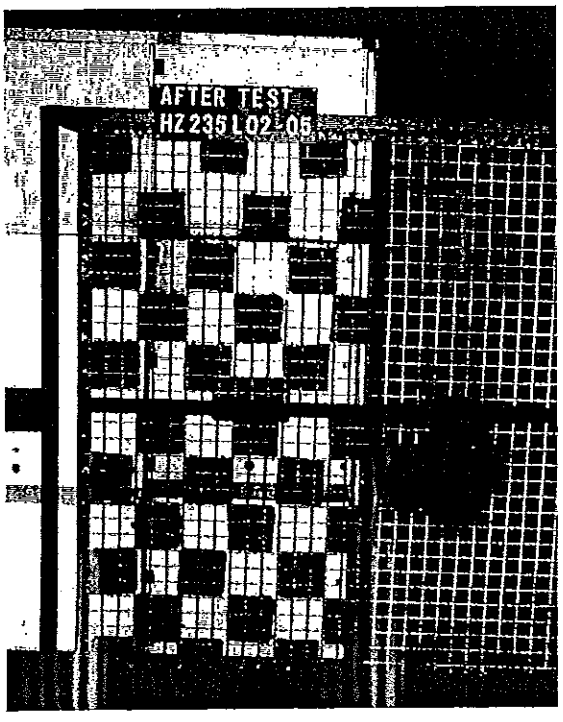
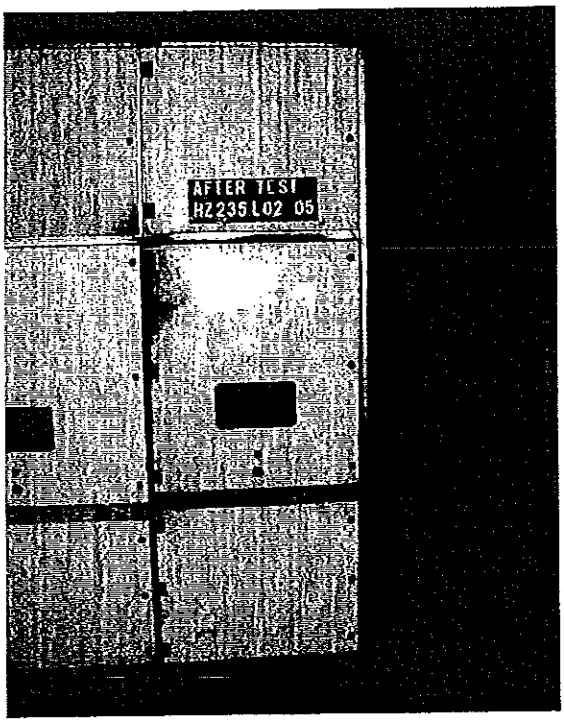


Photo No. 08
After Test HZ 235 L 02 / 05

ВЕРНО С ОРИГИНАЛА



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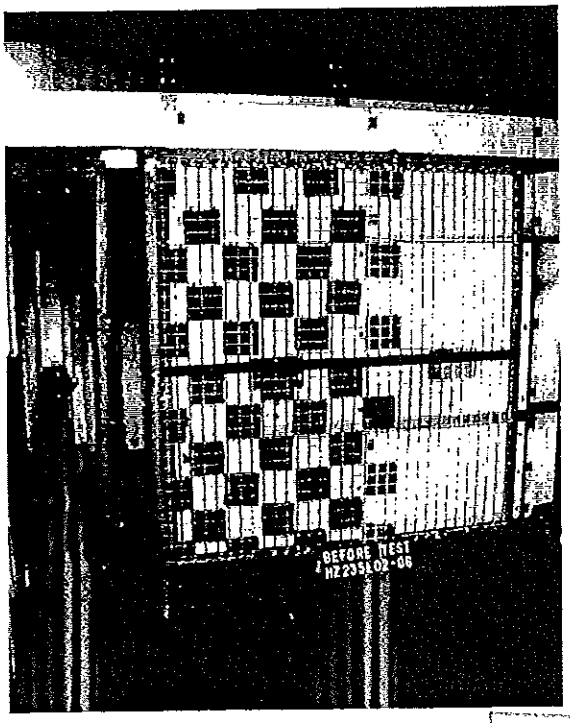

Photo No. 10
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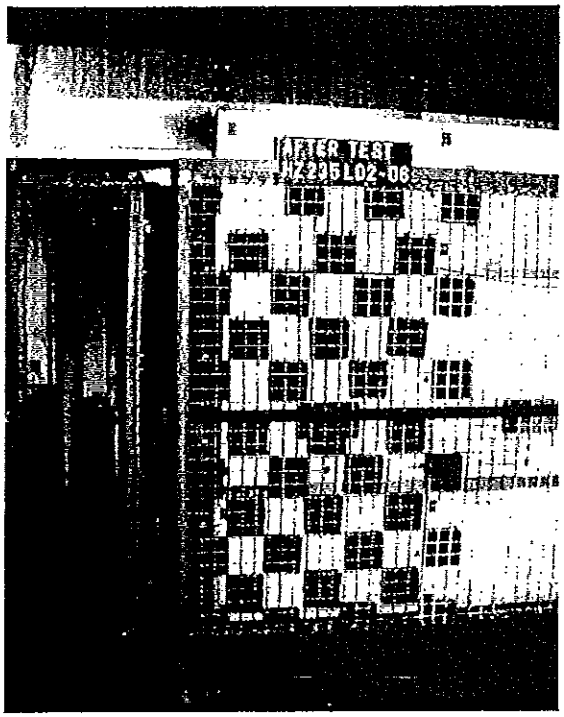

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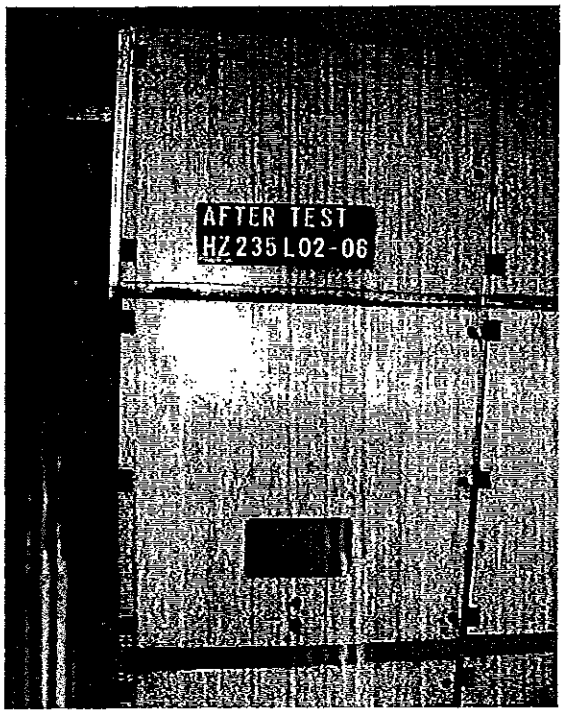

Photo No. 12
After Test HZ 235 L 02 / 06

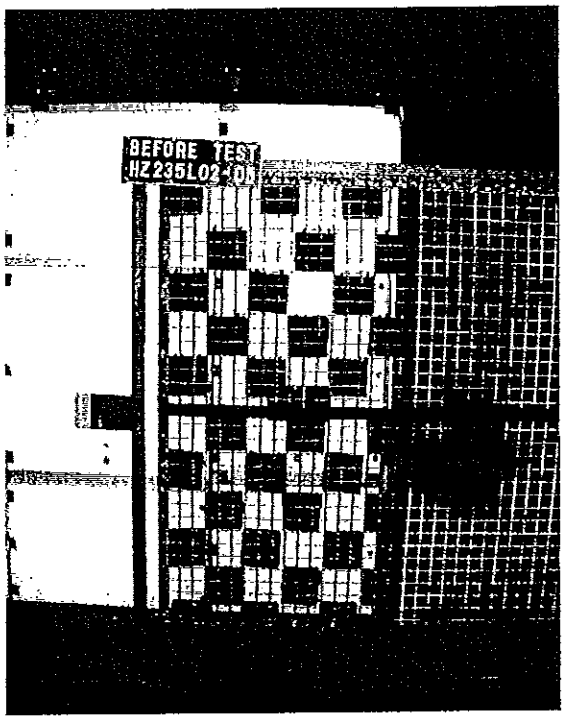

Photo No. 13
Before Test HZ 235 L 02 / 07

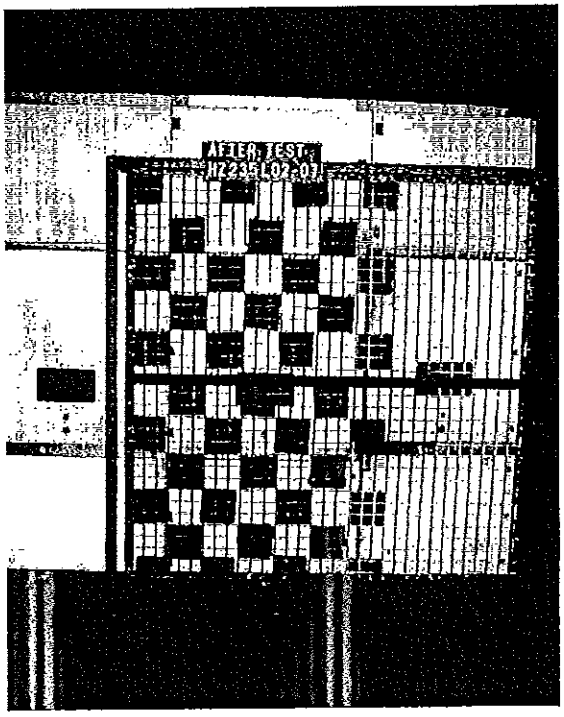

Photo No. 14
After Test HZ 235 L 02 / 07

ВЯРНО С ОРИГИНАЛА

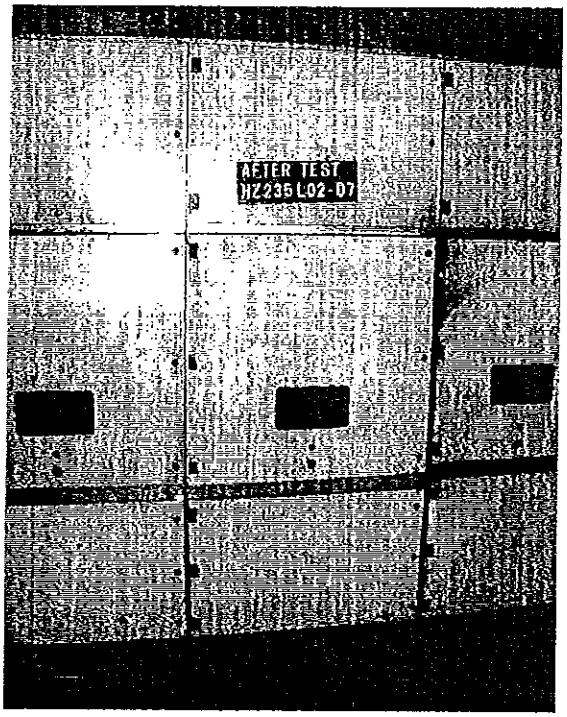

Photo No. 15
After Test HZ 235 L 02 / 07

ВЯРНО С ОРИГИНАЛА

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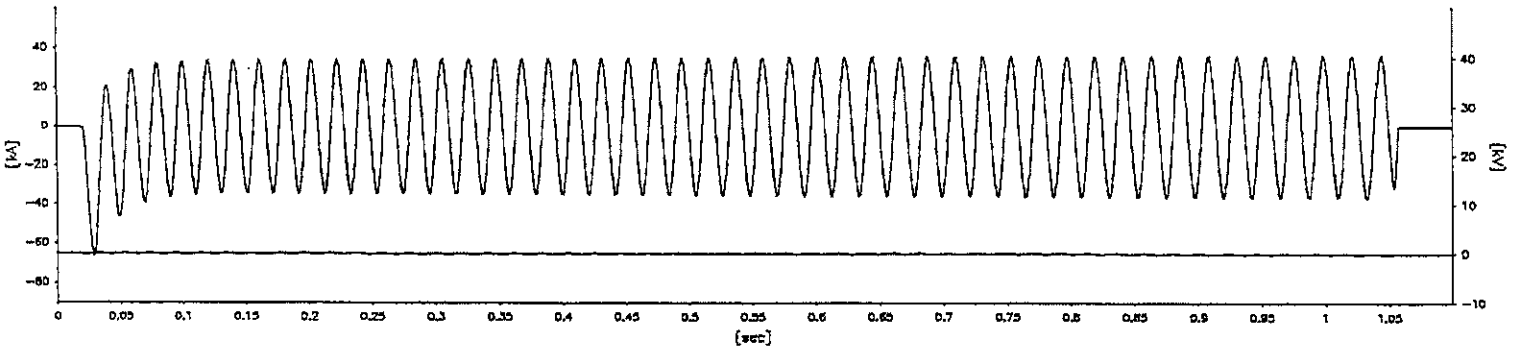

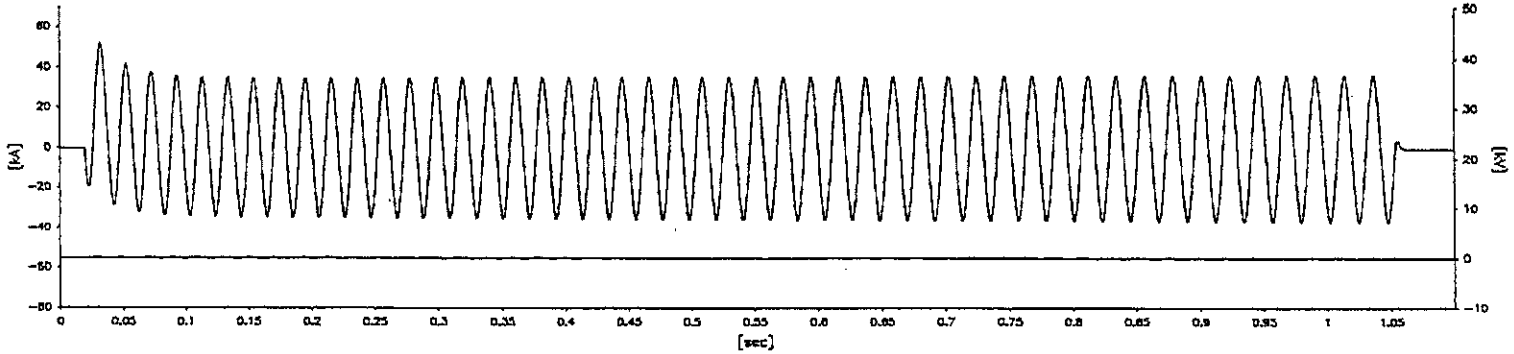

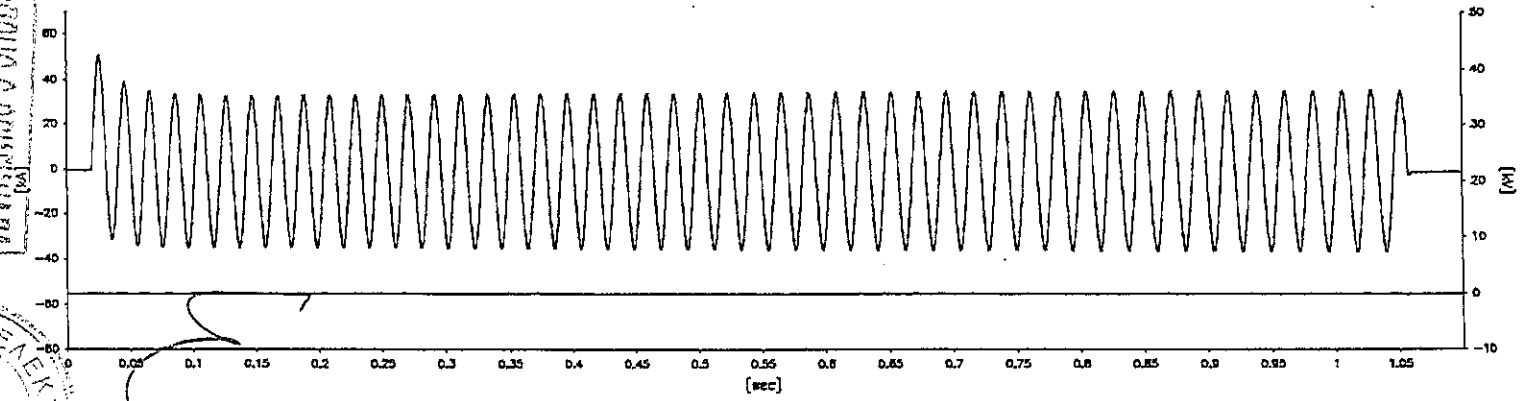

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742

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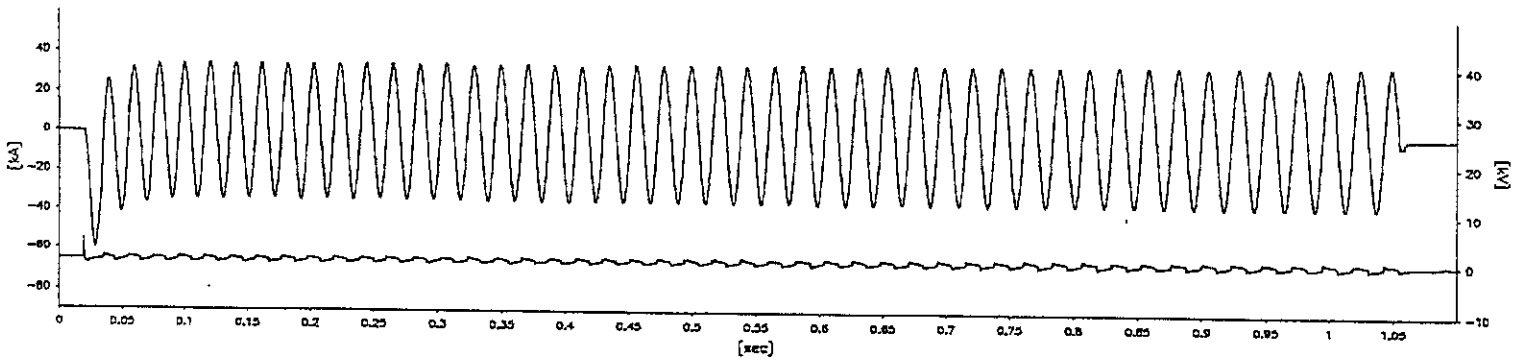

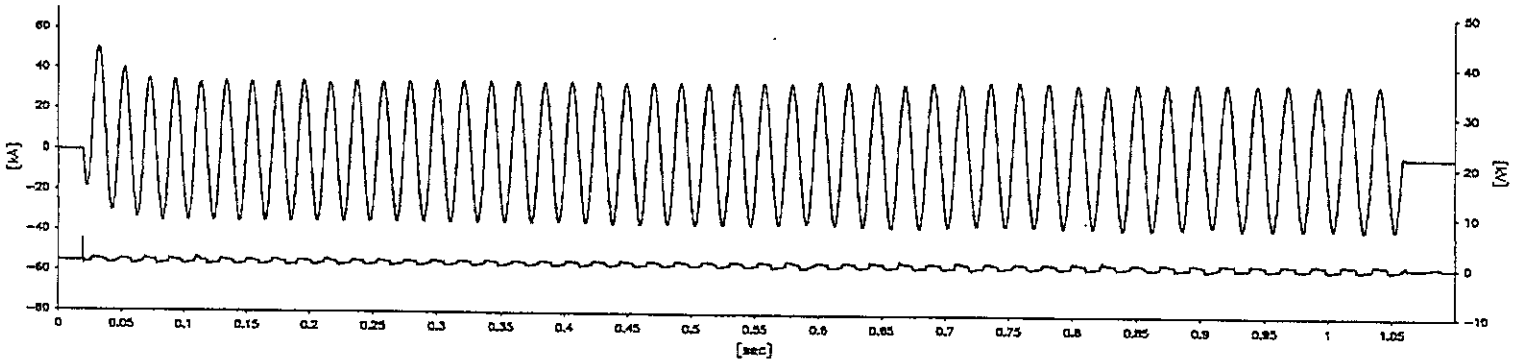

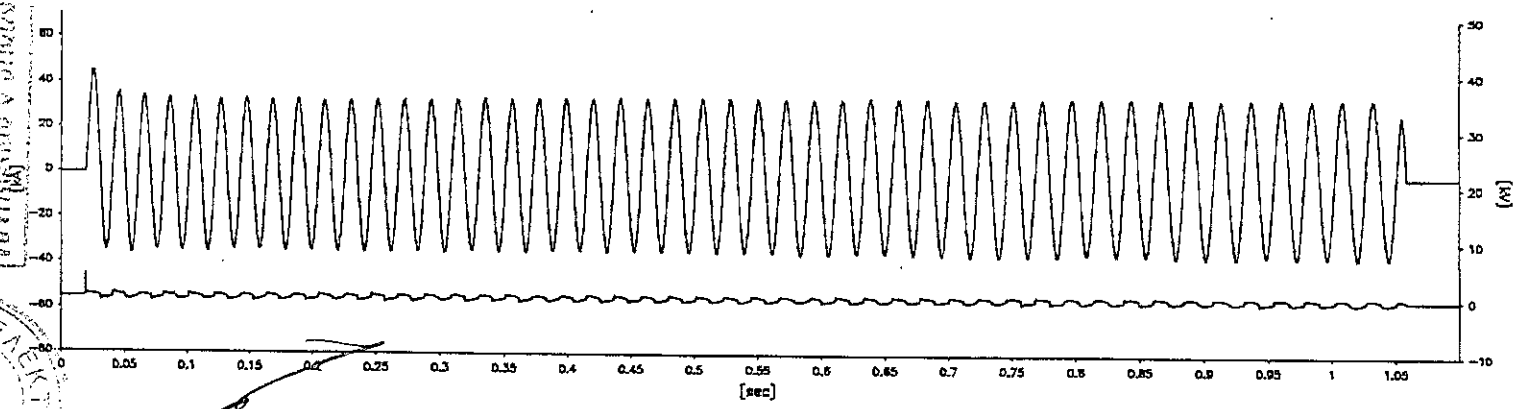

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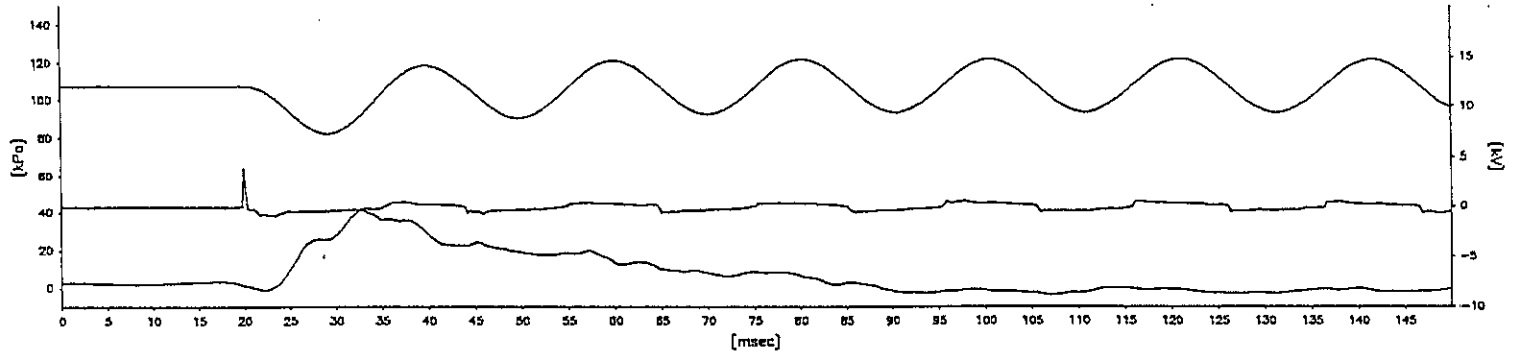

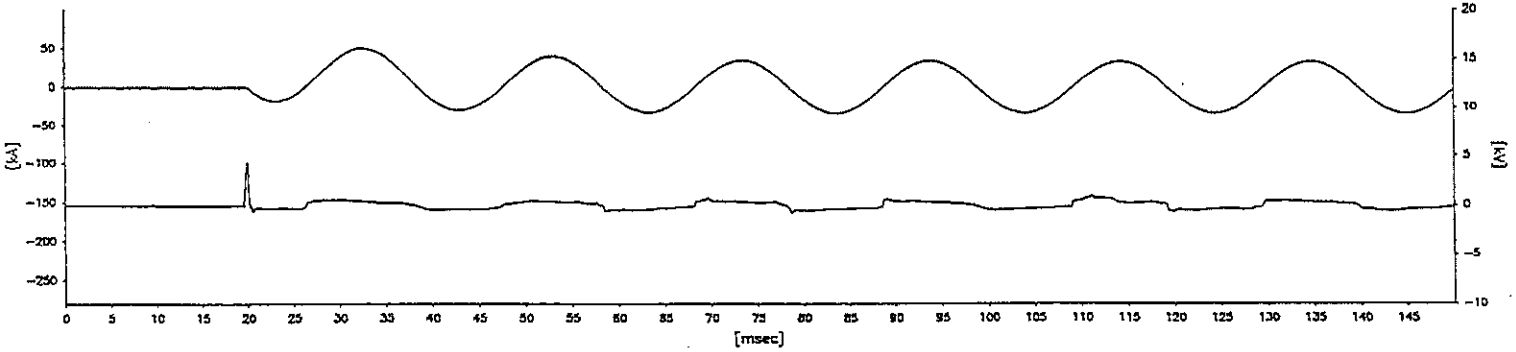

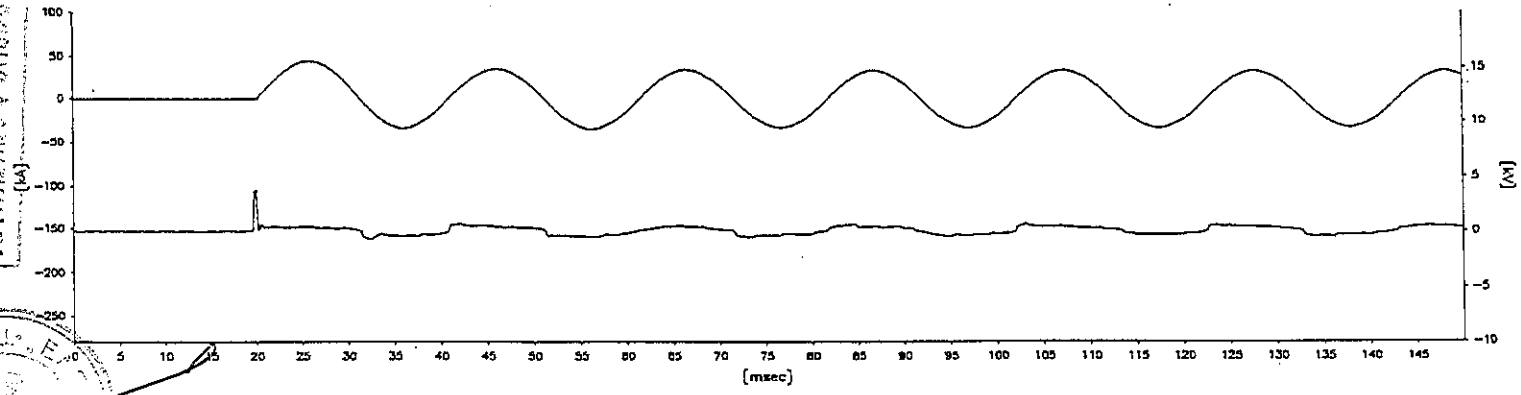

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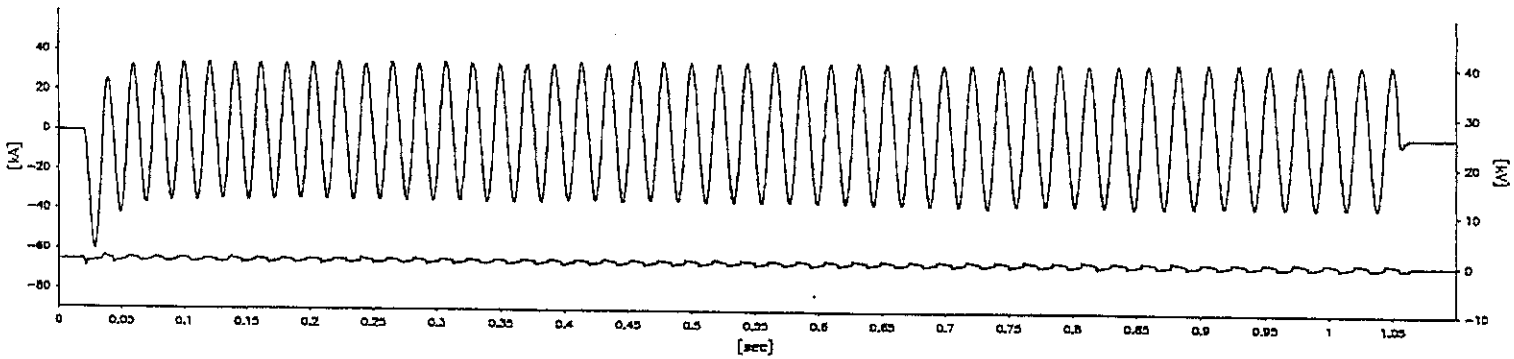

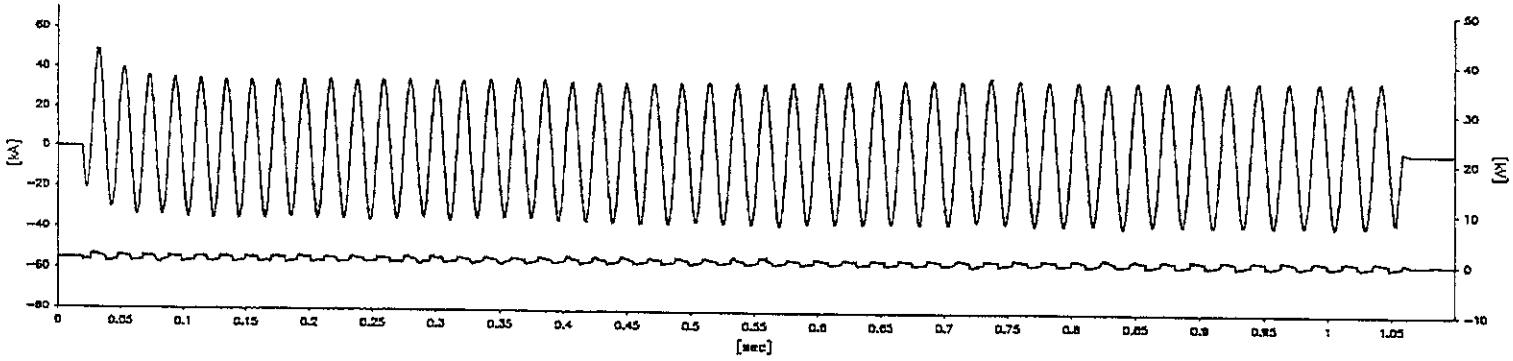

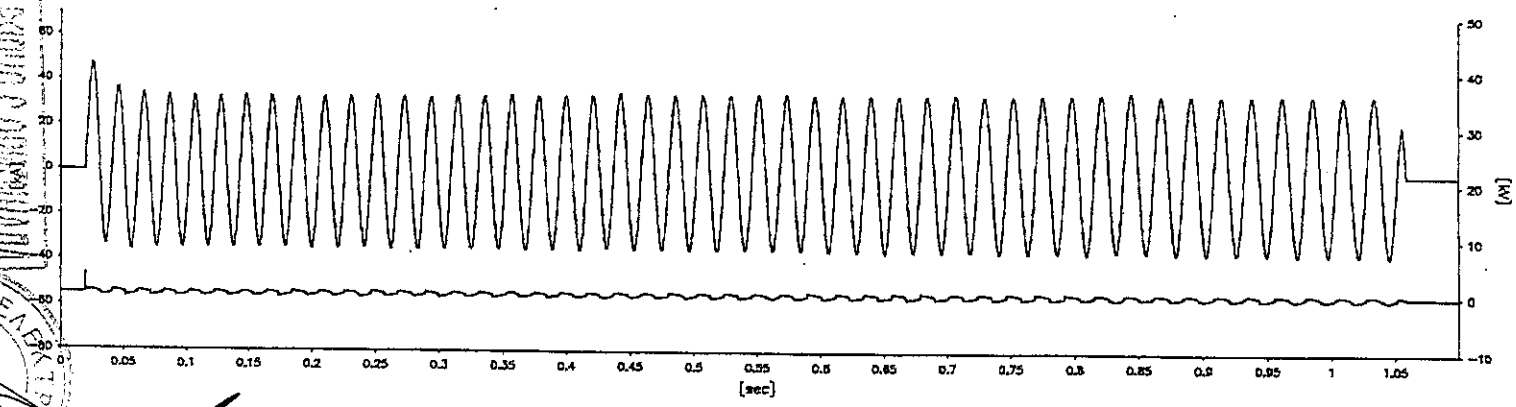

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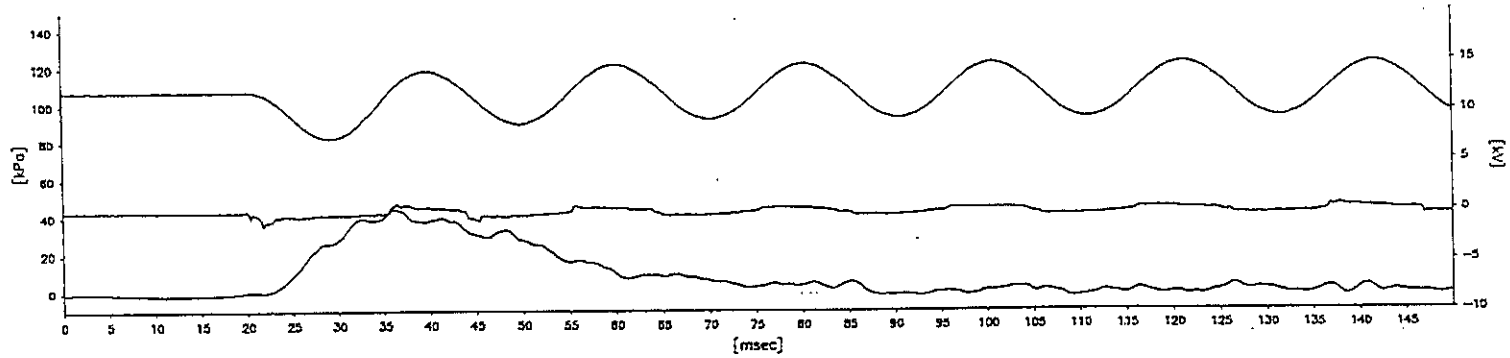

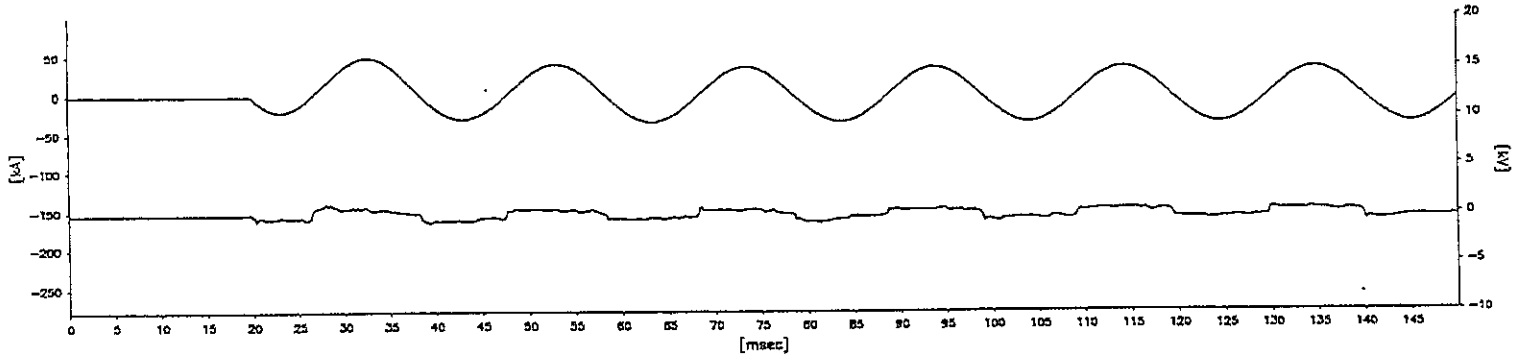

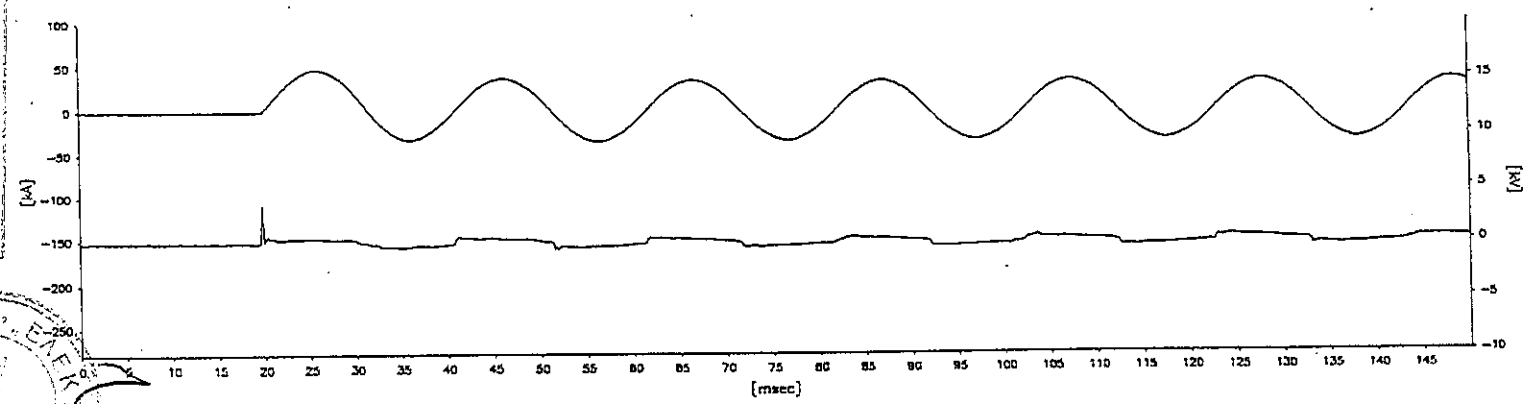

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746

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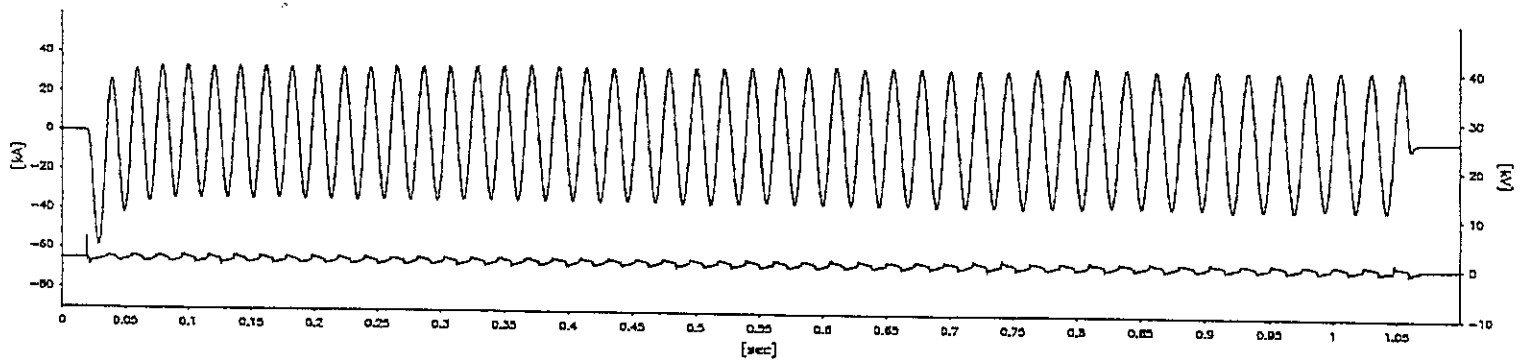

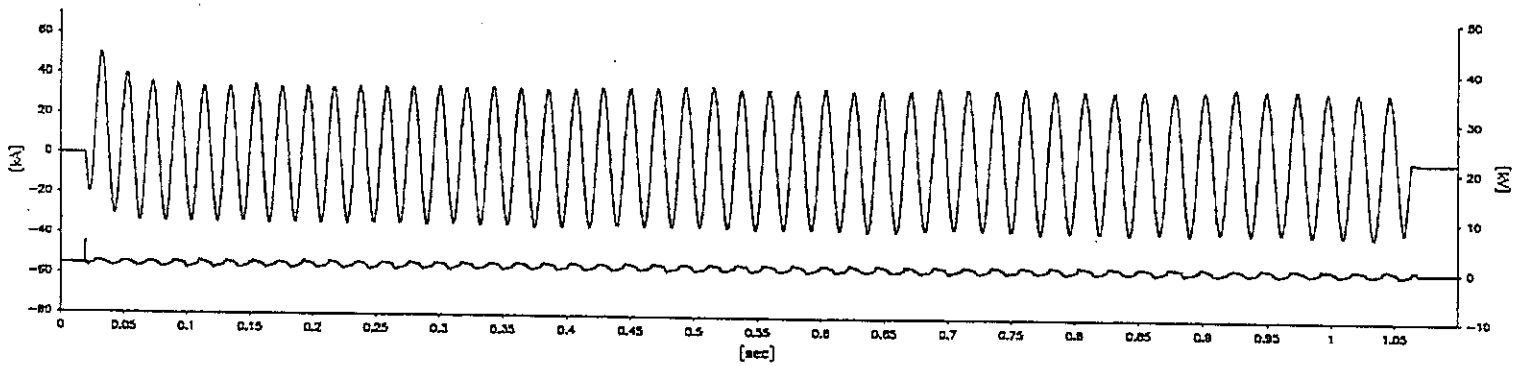

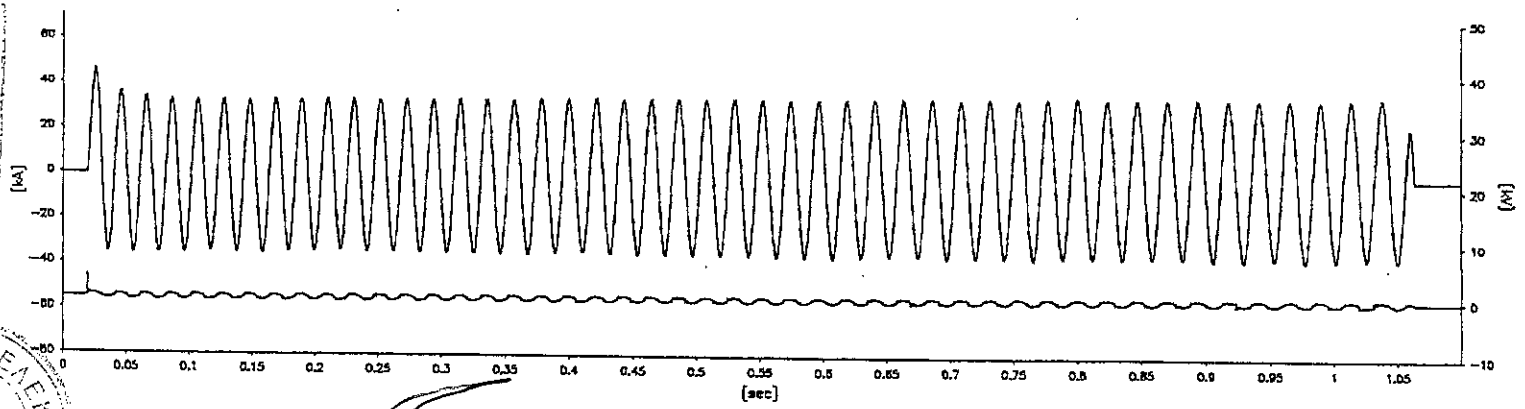

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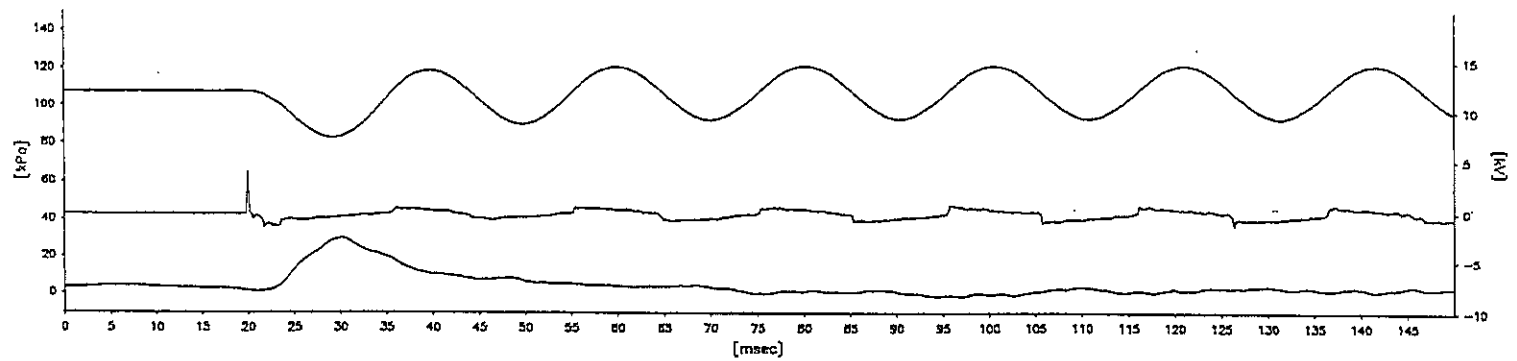

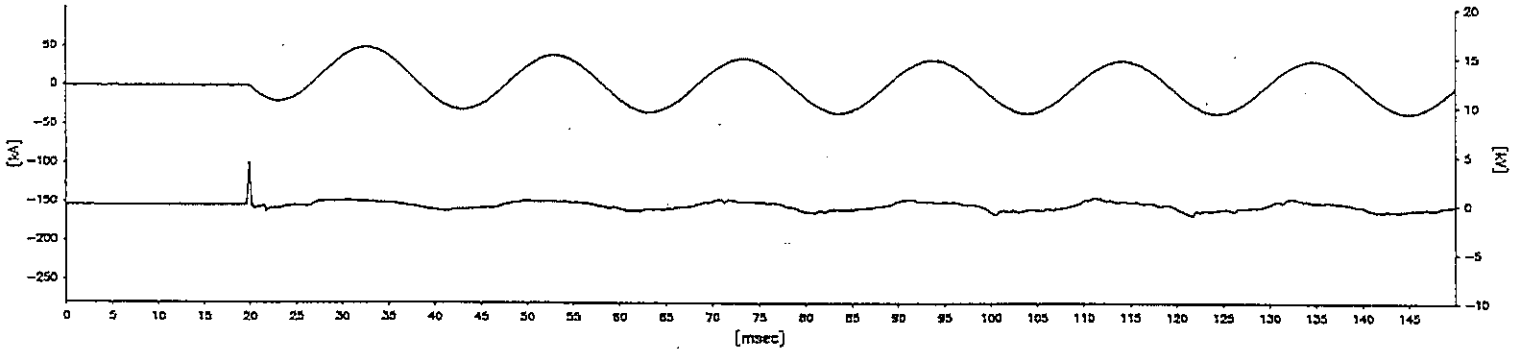

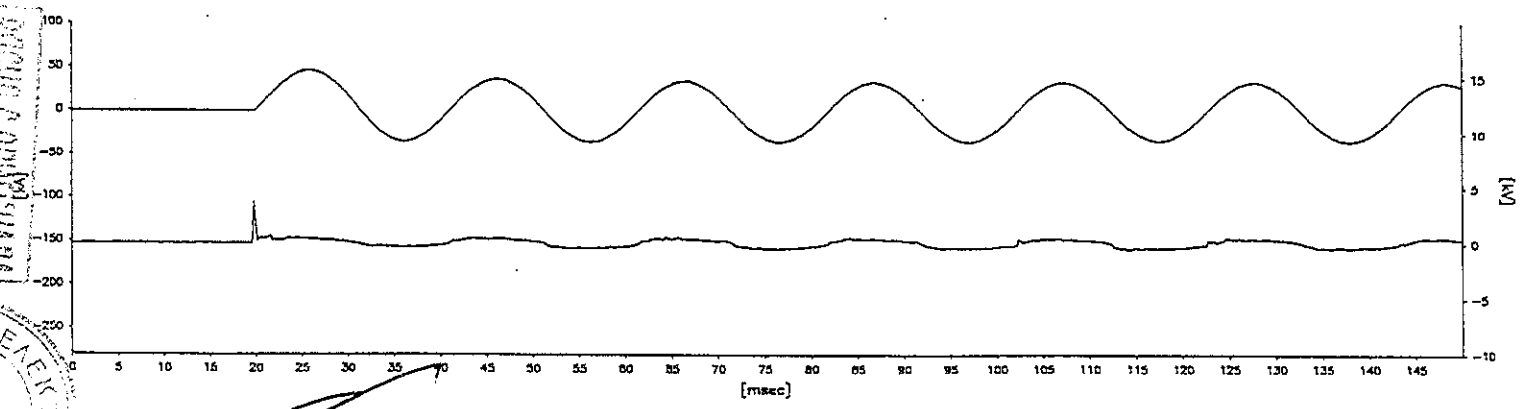

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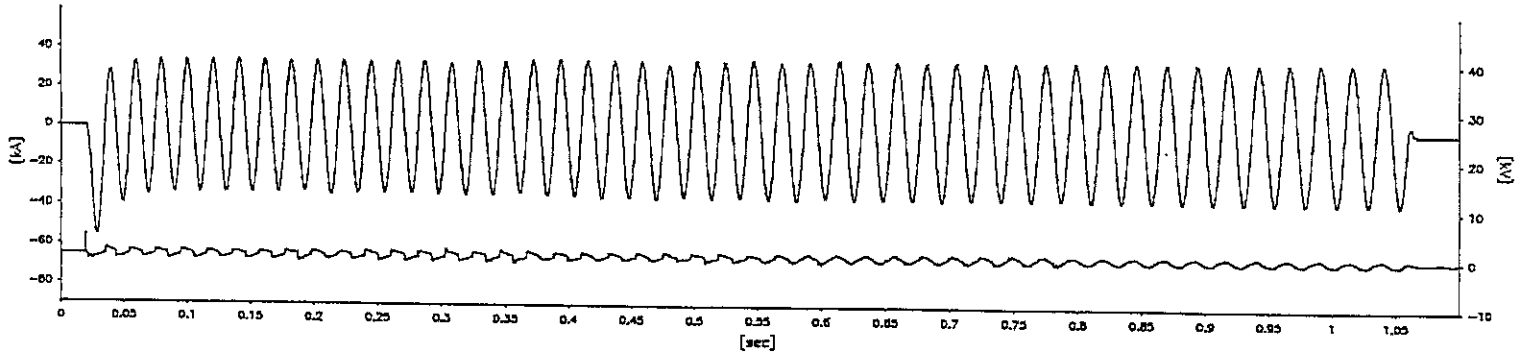

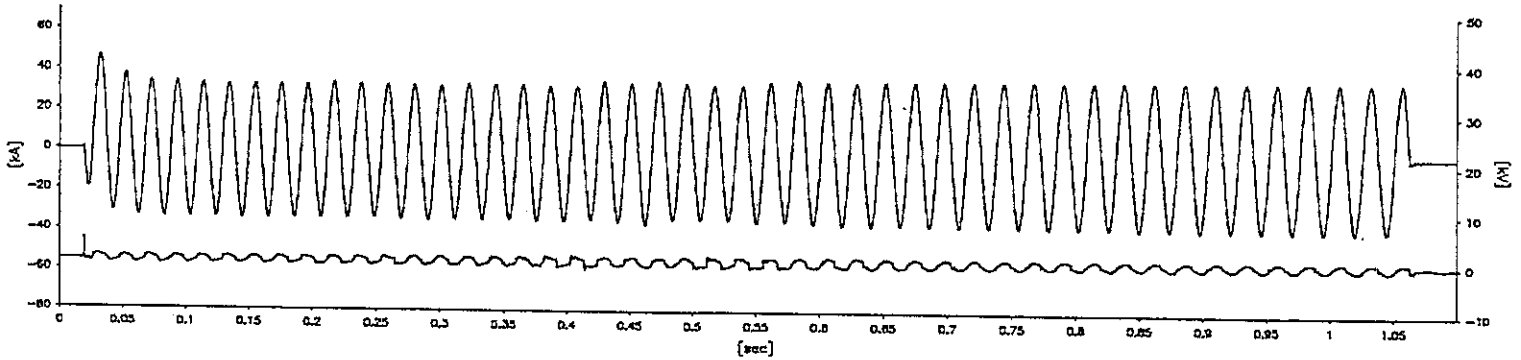

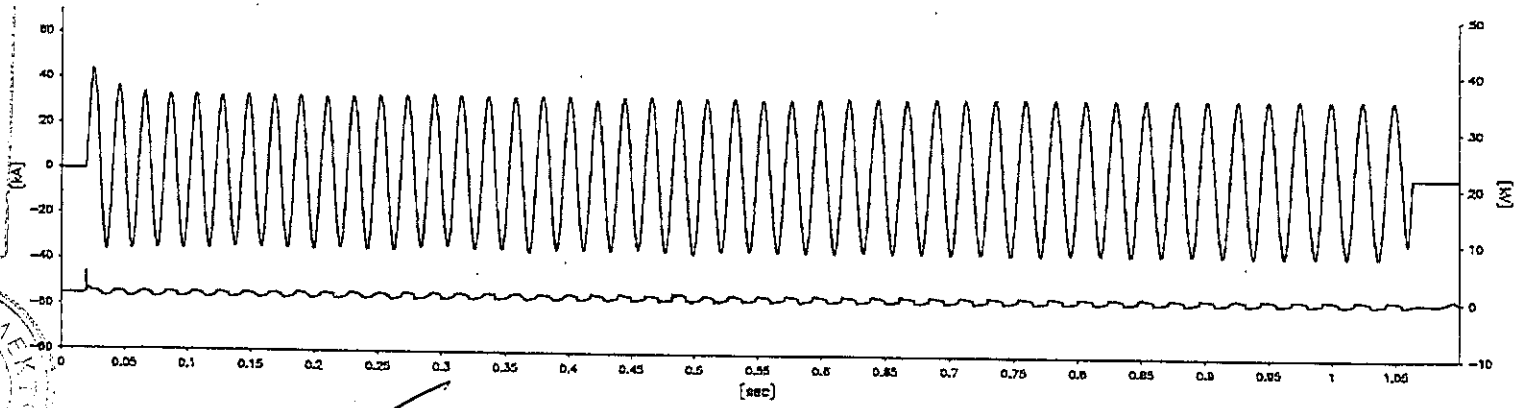

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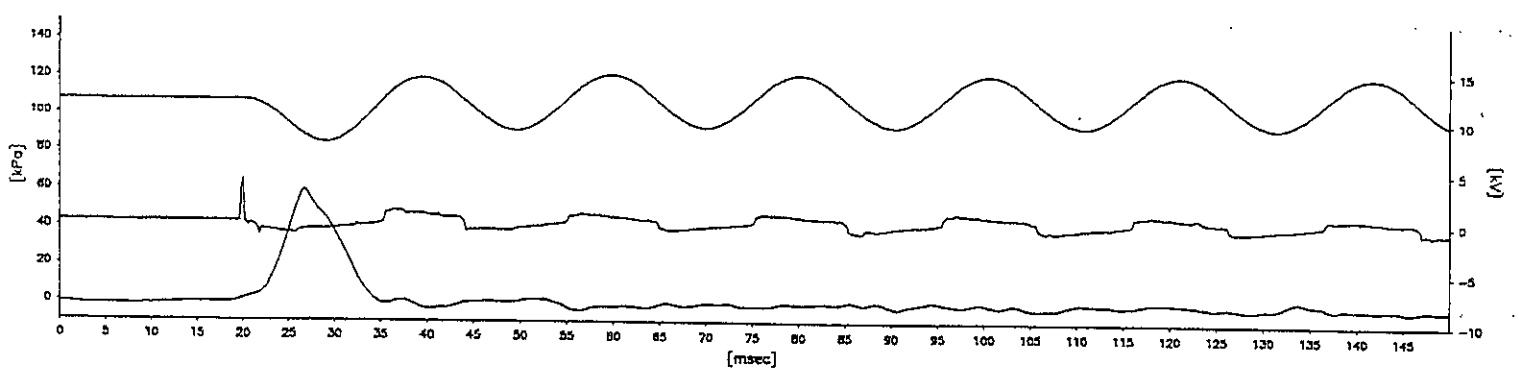

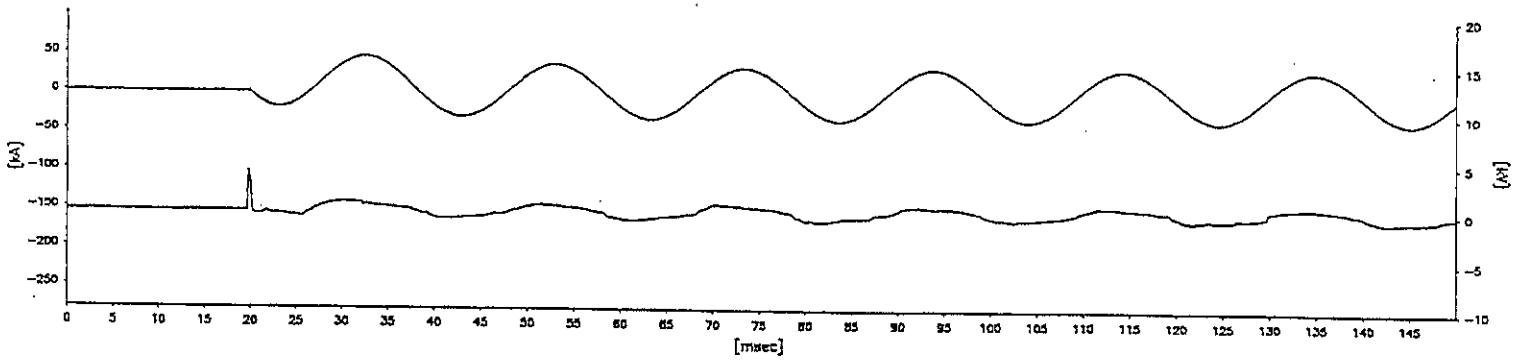

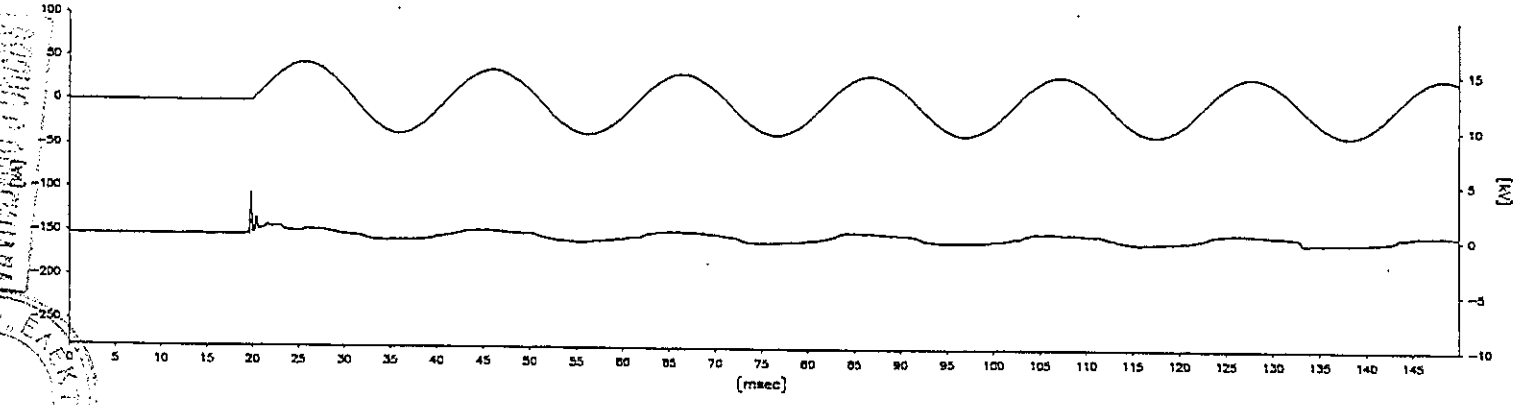

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750

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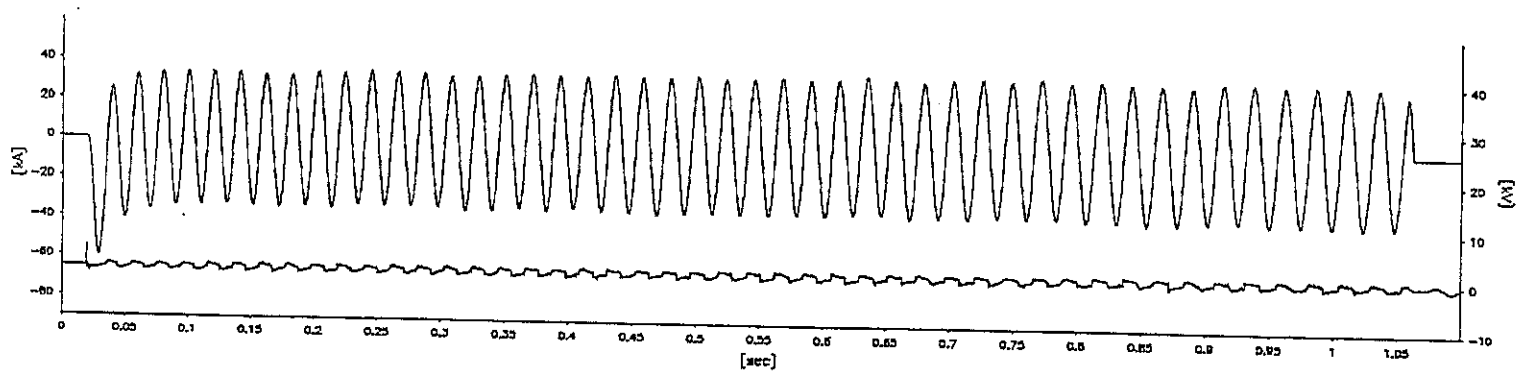

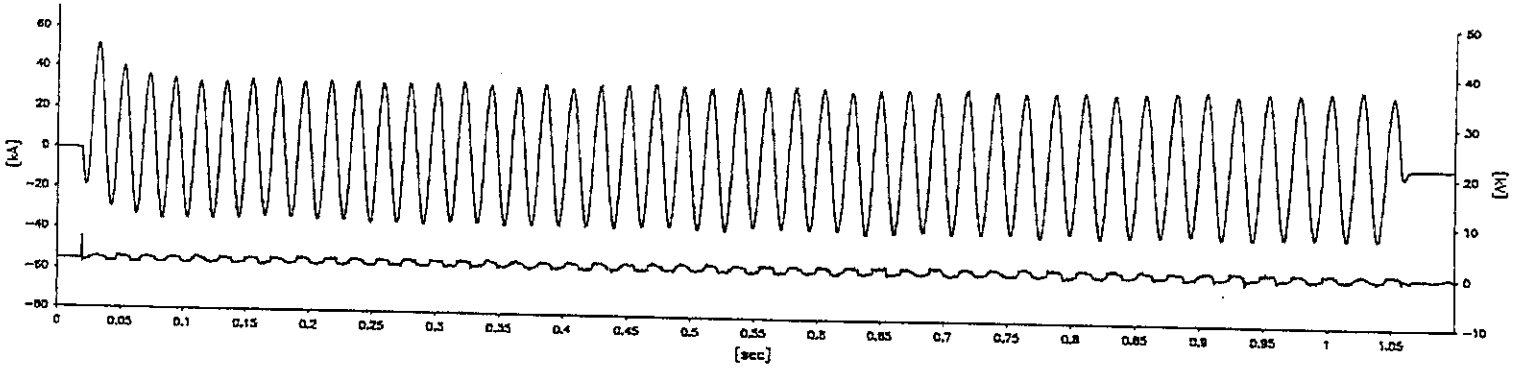

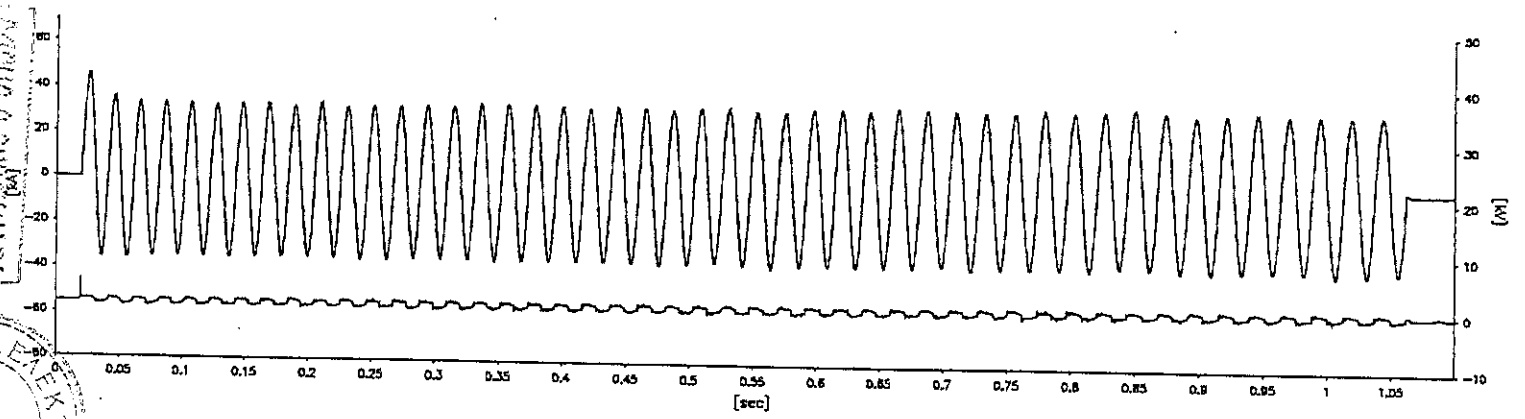

HZ235L02.007

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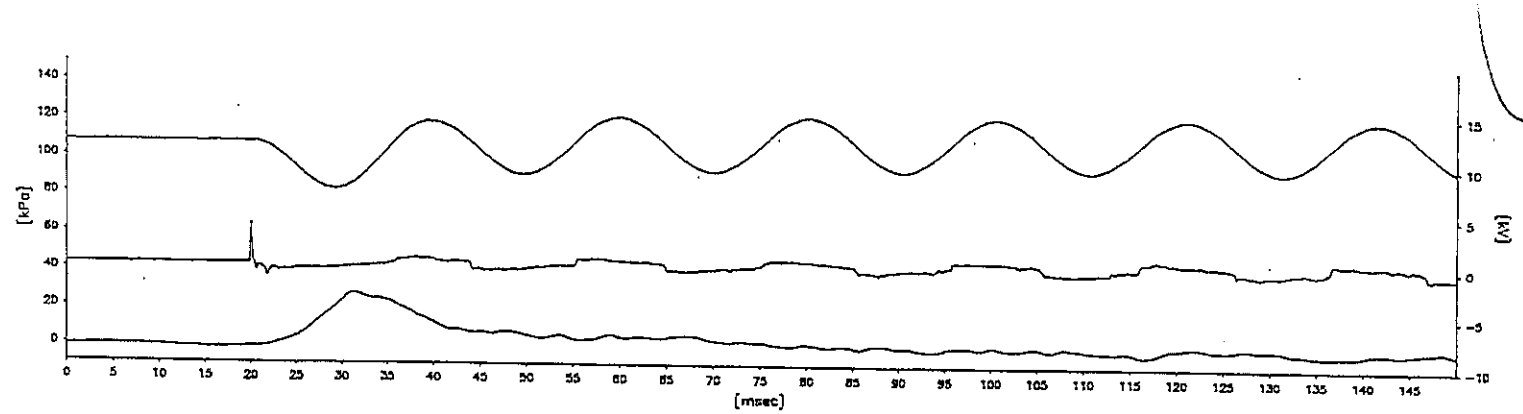
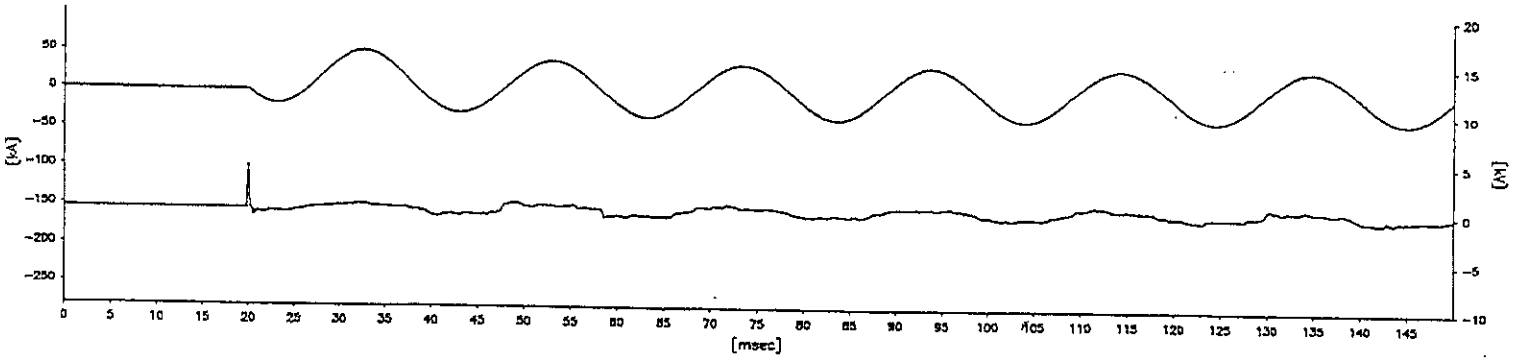
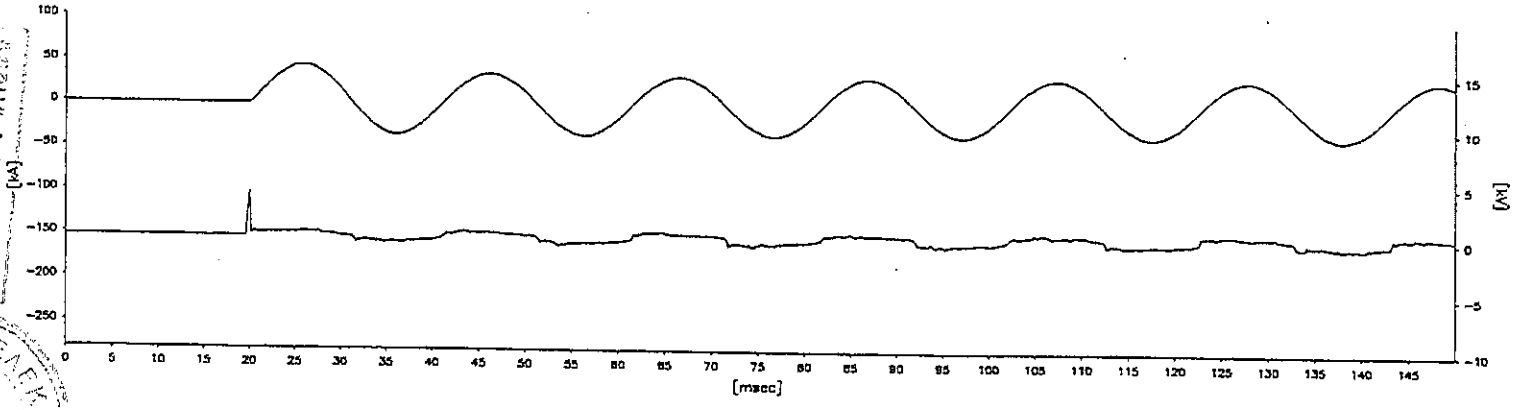
12.12.2000







HZ235L02.007

752

Deutscher Akkreditierungs Rat
DAR
Reg.-Nr.
DAT-P-032/93

ABB Calor Emag Laboratories

ABB

TEST REPORT No. HZ 235 F 01

Sheet 1

Issued by an Accredited Laboratory corresponding to EN 45001

Copy-No. 1e

Test Object

One feeder panel (1000 mm width) of metal-clad, air-insulated switchgear type ZS1.2 equipped with a circuit-breaker type VD4P 2420-25 and an earthing switch type EK6-ZS1-2406-275

Rated voltage	U_r	24	kV
Rated normal current busbar / tee-off	I_r	2500/1600	A
Rated frequency	f_r	50/60	Hz
Rated peak withstand current	I_p	63	kA
Rated short-time withstand current	I_k	25	kA
Rated duration of short-circuit current	t_k	3	s
Rated short-circuit breaking capacity at 24 kV	I_{sc}	25	kA

Manufacturer

ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen

Tests performed

Three-phase peak withstand and short-time withstand current tests of the main circuit and the earthing switch.
For further details see sheet-no. 2.

Test Specification

The tests have been carried out in accordance with the client's instructions.
Test procedure and test parameters were based on:
IEC 60694/2nd Ed./1996-05/Clause 6.6,
IEC 60298/3rd Ed./1990-12/Clause 6.5,
IEC 60129/3rd Ed./1984/Clause 6.5,
IEC 60056/4th Ed./1987/Clause 6.5.

Test Results

The switchgear, the vacuum circuit-breaker and the earthing switch passed the above mentioned peak withstand and short-time withstand current tests successfully.

Test Date

14th September 2000

Client

ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen

ABB Calor Emag Laboratories ABB Ratingen

07th February 2002
Date of Issue

Dr. Stefan Göttlich
Laboratory Manager

Karl-Hermann Diergardt
Test Engineer

Total Number of Sheets: 20 Sheets (Test Report) + 6 Sheets (Oscillograms)

This test report refers exclusively to the object tested.
ABB Calor Emag Mittelspannung GmbH is certified according to DIN ISO 9001 by DQS under Reg. No. 373 - 03

ABB Calor Emag Laboratories Ratingen are accredited according to EN 45001 by DATech under Reg.No. DAT-P-032/93

ABB Calor Emag Mittelspannung GmbH Ratingen
High-Power Testing Laboratory
Oberhausener Str. 33
D - 40472 Ratingen
Phone + 49 (0) 21 02 12-1766
Fax + 49 (0) 21 02 12-1713

Tests performed:

Main circuit with vacuum circuit-breaker type VD4P 2420-25

Infeed by means of copper conductors to the cable terminals of the panel. Short-circuit bridge mounted on the bushings of busbar system outside the panel.

Three-phase peak withstand current tests up to 65.8 kA and short-time withstand current tests up to 25.5 kA - 3.03 s equivalent to 25.6 kA – 3 s.

(Oscillograms HZ 235 F 01 / 04 and 05)

Earthing switch type EK6-ZS1-2406-275

Infeed by means of copper conductors to the cable terminals of the panel. Short-circuit made by the earthing switch.

Three-phase peak withstand current tests up to 66.5 kA and short-time withstand current tests up to 25.1 kA – 3.03 s equivalent to 25.2 kA – 3 s.

(Oscillograms HZ 235 F 01 / 08 and 09)

Contents

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switchgear

Test Object: Metal-clad, air-insulated switchgear

Type: ZS1.2 (1000 mm width)

Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen

Serial-No.: 07550027/2015/00 **Year of manufacture:** 2000

Drawing No's.: See sheet-no. 7

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50/60	Hz
Rated current busbar	2500	A
Rated current tee-off	1600	A
Rated short-circuit peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated short-circuit duration	3	s
Insulating medium	air	
Rated filling pressure (abs., 20° C)	-	kPa

Prospective values under internal-arc conditions:

Peak withstand current	63	kA
Short-time withstand current	25	kA
Short-circuit duration	1	s

Additional specifications and data:

- Current transformers 1600 / 5 / 5 A in cable compartment

Type	Serial-no. of the transformers		
	L1	L2	L3
ABB / TPU 65.11	058243	058244	058245

Date of receipt of test object: 12th September 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switching device

Test Object: Vacuum circuit-breaker

Type: VD4P 2420-25

Vacuum interrupter: VG4S series no.: L1: G4 01196, L2: G4 01192, L3: G4 01194

Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen

Serial-No.: 7008269/4002/00 **Year of manufacture:** 2000

Drawing No's.: See sheet-no. 7

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50/60	Hz
Rated normal current	2000	A
Rated short-circuit breaking current	25	kA
Rated short-circuit making current	63	kA
DC-component	35	%
Pole factor	1.5	
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Rated operating sequence	O-0.3 s-CO-3 min-CO	
Rated times of circuit-breaker:		
- opening time	≤ 40	ms
- closing time	≈ 60	ms
Number of poles	3	
Number of units per pole	1	
Rated auxiliary voltages:		
- voltage of trip coil	220	V-DC
- voltage of closing coil	220	V-DC
- voltage of motor	220	V-DC

Additional specifications and data: -

Date of receipt of test object: 12th September 2000

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switching device

Test Object: Earthing switch

Type: EK6-ZS1-2406-275

Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen

Serial-No.: 06/052/00 **Year of manufacture:** 2000

Drawing No's.: See sheet-no. 7

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50/60	Hz
Rated normal current	-	A
Rated short-circuit breaking current	-	kA
Rated short-circuit making current	63	kA
DC-component	-	%
Pole factor	-	
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Rated operating sequence	-	
Rated times of earthing switch:		
- opening time	-	ms
- closing time	-	ms
Number of poles	3	
Number of units per pole	1	
Rated auxiliary voltages:		
- voltage of trip coil	-	V-DC
- voltage of closing coil	-	V-DC
- voltage of motor	-	V-DC

Additional specifications and data: -

Date of receipt of test object: 12th September 2000

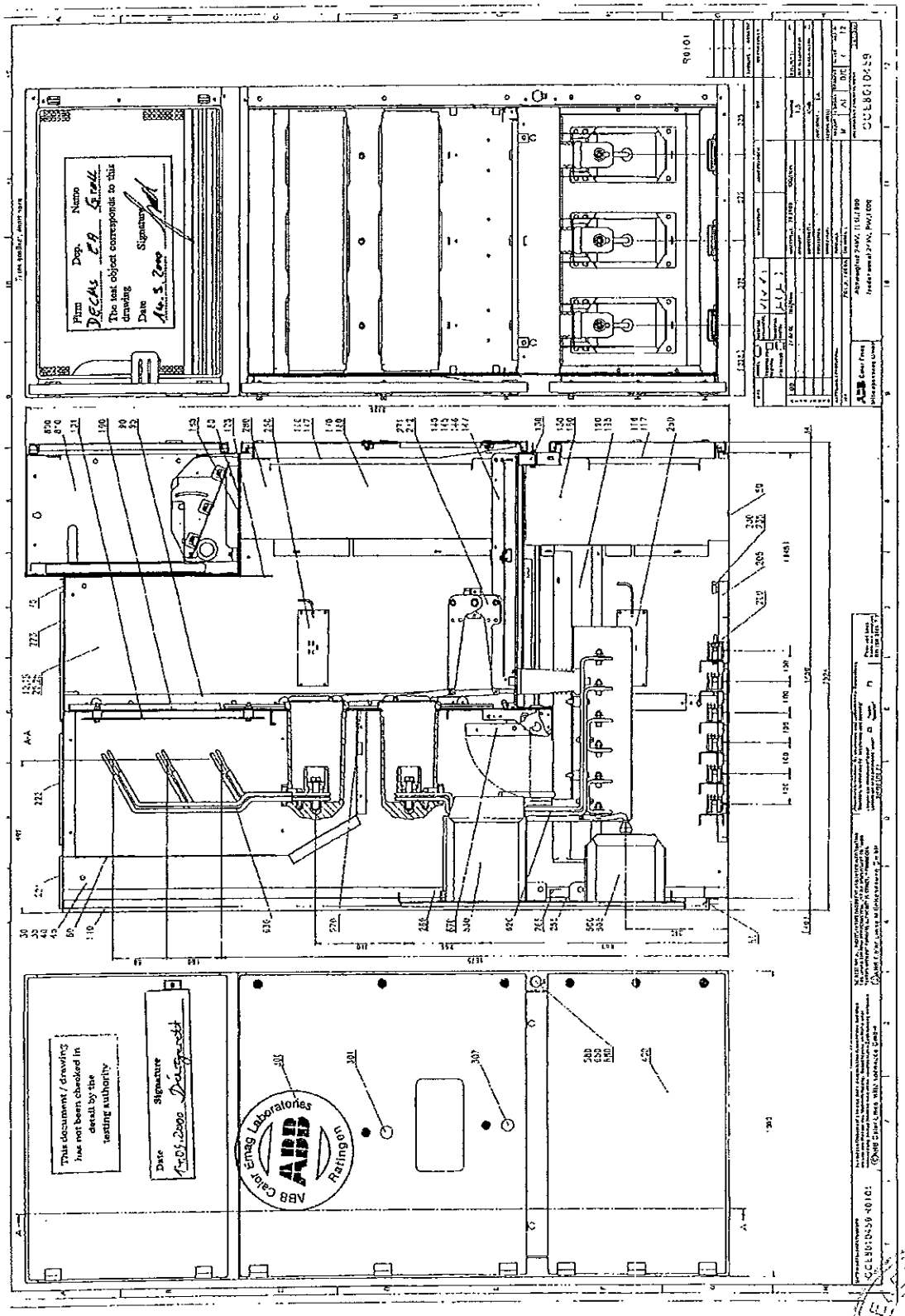
Table of Drawings of Test Objects

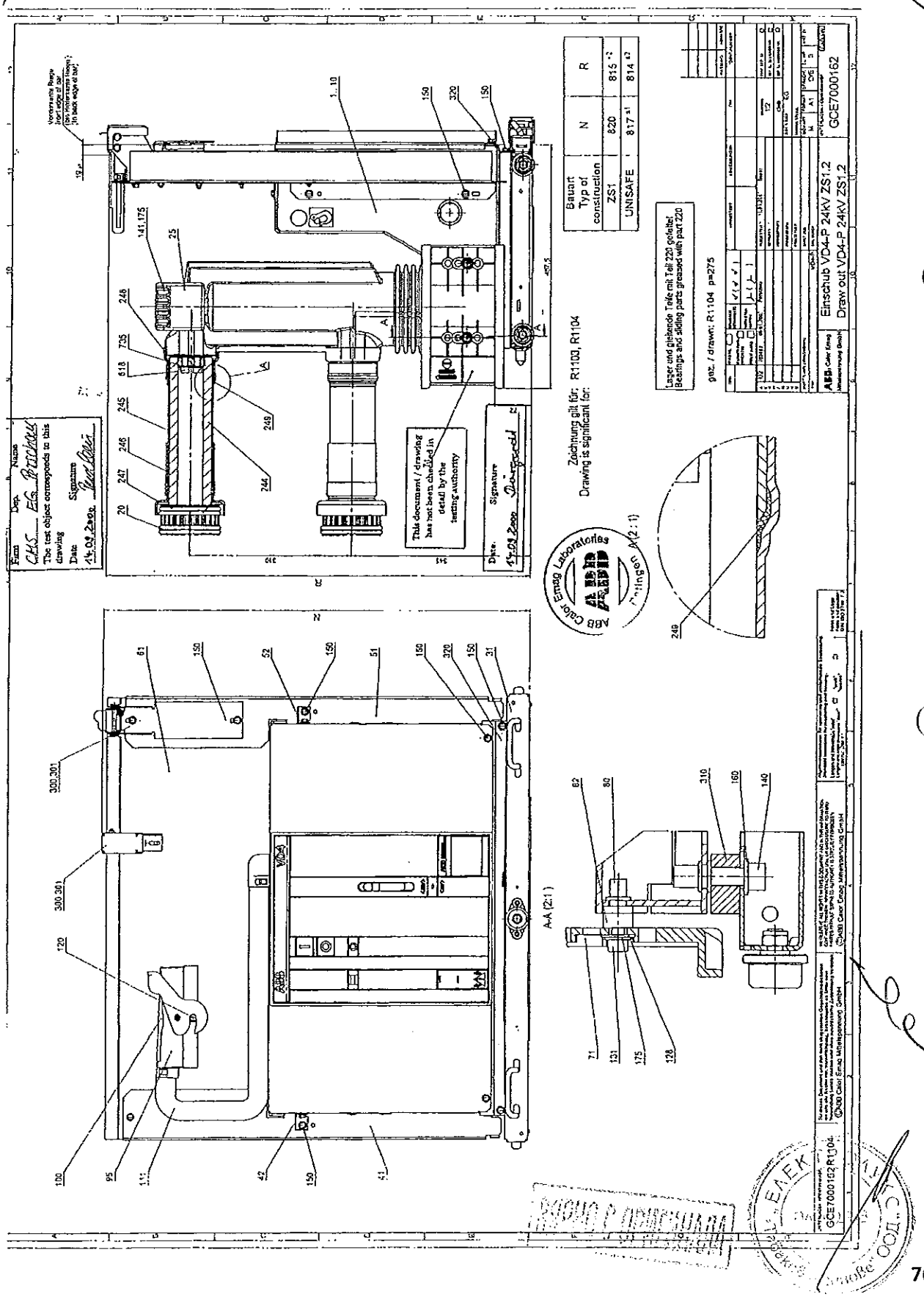
The drawings submitted for identification of the test object were stamped and signed by the test engineer.

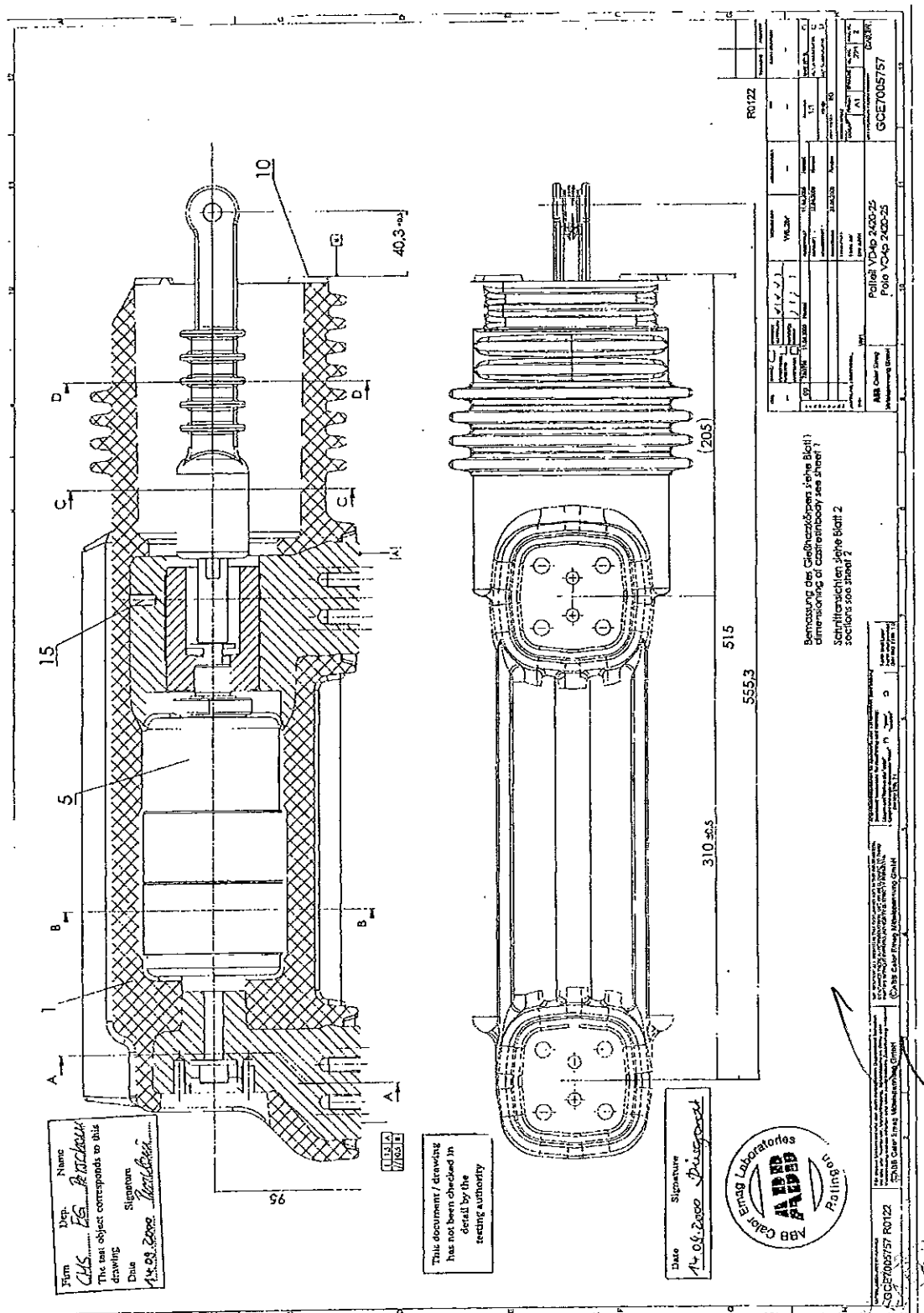
The manufacturer/client has guaranteed by signature on all drawings that the equipment submitted for tests has been manufactured in accordance with the given drawings.

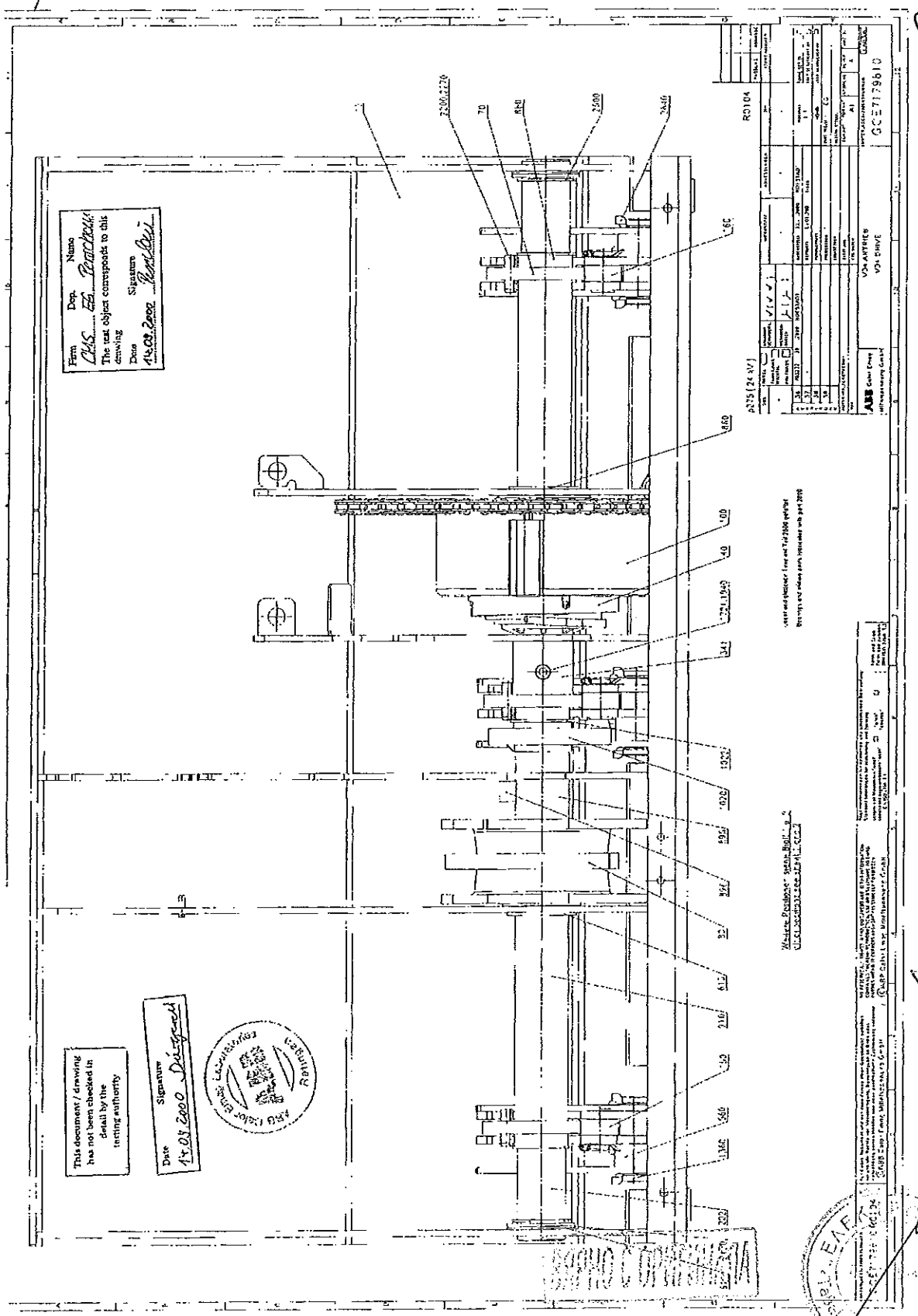
A copy of the following drawings is part of this Test Report:

1. Panel ZS1.2, 24 kV, PW 1000	manufacturing type GCE8010459R0101 according to drawing-no. GCE8010459R0101, sheet-no. 1, index 00
2. Withdrawable circuit-breaker VD4P 2420-25	manufacturing type GCE7000162R1104 according to drawing-no. GCE7000162R1104, sheet-no. 5, index 02
3. Pole part	manufacturing type GCE7005757R0122 according to drawing-no. GCE7005757R0122, sheet-no. 221, index 00
4. Mechanism	manufacturing type GCE7179610R0104 according to drawing-no. GCE7179610R0104, sheet-no. 4, index 36
5. Earthing switch EK6-ZS1-2406-275	manufacturing type GCE7169312R0118 according to drawing-no. GCE7169312R0121, sheet-no. 1, index 24


This document / drawing has not been checked in detail by the testing authority
Date
Signature
ABB Calor Emag Laboratories
ABB
Rating no.


Bauart Typ of construction
N
R
ZS1
820
815
UNISAFE
817
814
Einschub VD4-P 24kV ZS1.2
Draw out VD4-P 24kV ZS1.2
GCE7000162
Zeichnung gilt für: R1103, R1104
Drawing is significant for:
Lager und gleitende Teile mit Teil 220 gefettet
Bearings and sliding parts greased with part 220
ges. / drawn: R1104 pa=275
This document / drawing has not been checked in detail by the testing authority
ABB Calor Emag Laboratories
A-A (2:1)
A (2:1)


10
40,3
15
5
1
96
205
515
555,3
310 ±0,5
R0122
GCE7005757
Pallet VD4p 2420-25
Pole VD4p 2420-25
Bemassung des Gießharzkörpers siehe Blatt 3
dimensioning of castresinbody see sheet 3
Schnittansichten siehe Blatt 2
sections see sheet 2
Firm
Name
Dep.
The test object corresponds to this drawing
Date
Signature
This document / drawing has not been checked in detail by the testing authority
Date
Signature
ABB Calor Emag Laboratories
Pallingen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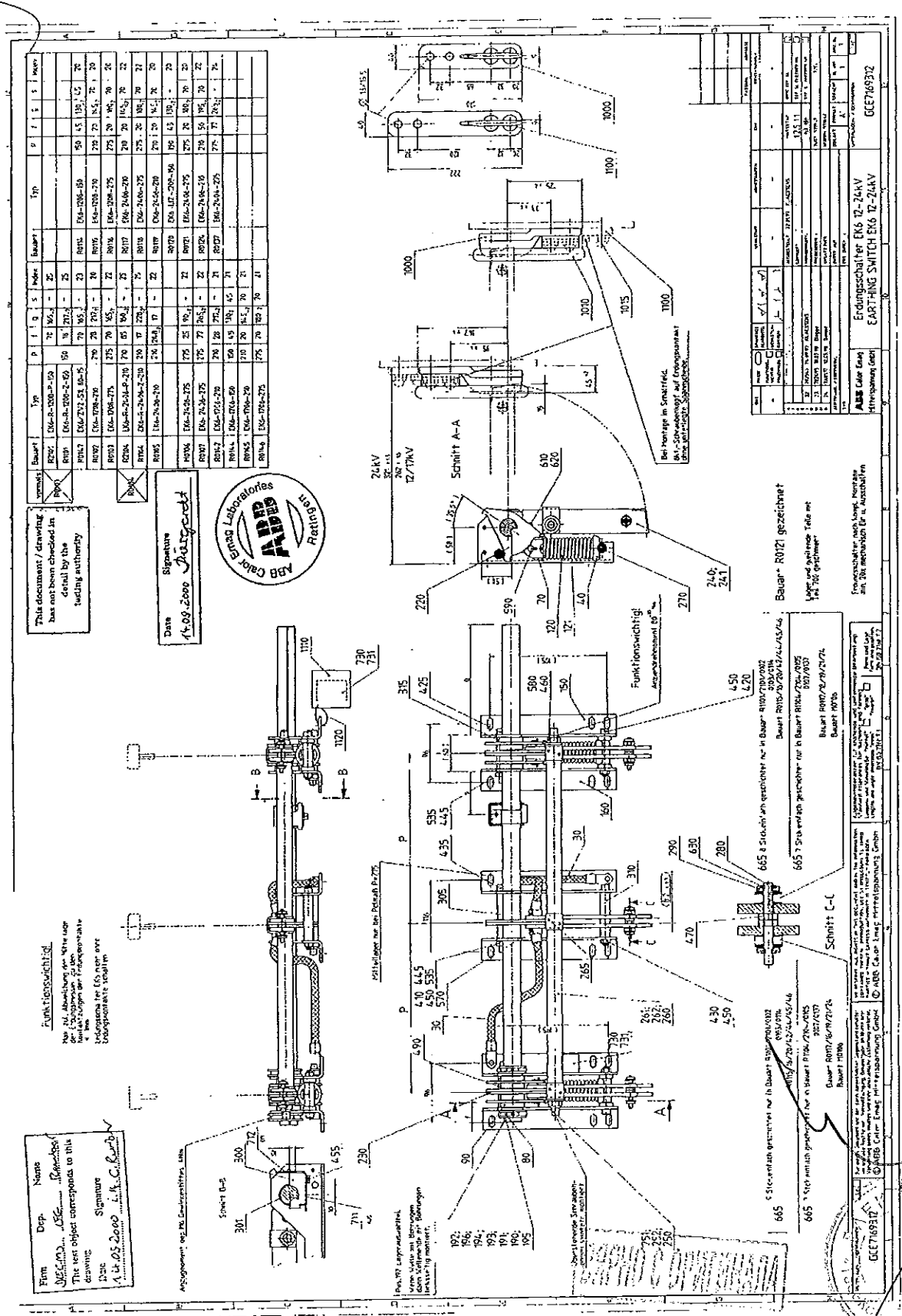
Date
Signature


Schnitt A-A
Schnitt C-C
Schnitt B-B
Funktionswichtig!
Bauart R0121 gezeichnet
Erdungsschalter EK6 12-24kV
EARTHING SWITCH EK6 12-24kV
GCE7169312
This document / drawing has not been checked in detail by the testing authority
Date 14-09-2000
Signature
ABB Calor Emag Laboratories
Ratingen
Firm
Dep.
Name
This test object corresponds to this drawing
Date 14.09.2000
Signature

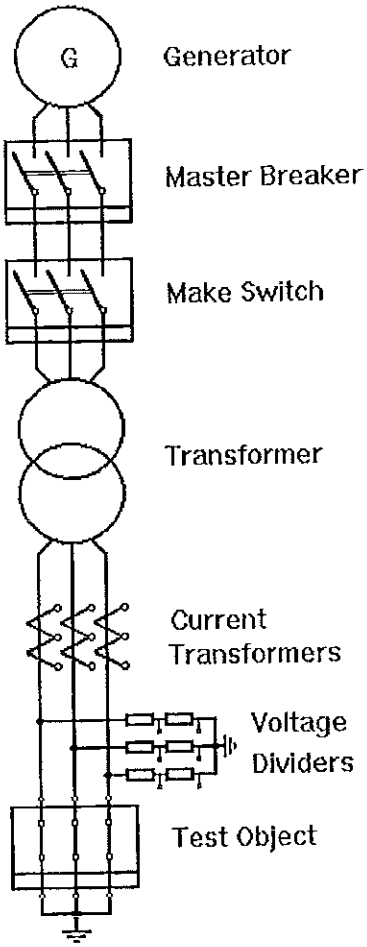
Technical Data of Test Circuit

Test		STC	--	--	--
Oscillogram-No. HZ 235 F 01		02 - 09	--	--	--
Number of phases	(circuit)	3	--	--	--
Number of poles/phases	(test object)	3	--	--	--
Power frequency	Hz	50	--	--	--
Power factor	cos φ	≤ 0.15	--	--	--
Earthing	Generator	earthed via 5 kΩ	--	--	--
	Transformer	not earthed	--	--	--
	Short-circuit point	earthed	--	--	--
Circuit diagram	Sheet no.:	14	--	--	--
Circuit impedance	mΩ	≈ 5	--	--	--
	--	--	--	--	--
TRV control elements		--	--	--	--
Capacitance in parallel	μF	--	--	--	--
Resistance in series	Ω	--	--	--	--
	-	--	--	--	--
	-	--	--	--	--
Prospective TRV	-	--	--	--	--
TRV peak value u_c	kV	--	--	--	--
Time co-ordinate t_3	μs	--	--	--	--
Time delay t_d	μs	--	--	--	--
Based on	kV	--	--	--	--
Rate-of-rise	kV/μs	--	--	--	--
	-	--	--	--	--
	-	--	--	--	--
Voltage measurements		Divider 75 kΩ / 1.1 kΩ	--	--	--
Current measurements		Transformer 50 kA / 5 A	--	--	--

Remarks: -

ВЯРНО С ОРИГИНАЛА

Principle Diagram of Test Circuit



Peak and Short-Time Withstand Current Tests

Actual values
(Main circuit)

Condition of test object before test: Switchgear and equipment new.

Connection to test object: By means of copper conductors to the cable terminals of the panel. Short-circuit bridge mounted on the bushings of busbar outside the panel. The circuit breaker closed.

Oscillogram-No. HZ 235 F 01				04	05	--	--
Peak short-circuit current		L1	kA	65.8	29.8	--	--
		L2	kA	53.6	28.1	--	--
		L3	kA	19.0	32.5	--	--
Short-circuit current	first cycle	L1	kA	27.8	26.2	--	--
		L2	kA	28.6	25.9	--	--
		L3	kA	26.3	25.2	--	--
	last cycle	L1	kA	26.2	25.9	--	--
		L2	kA	27.1	26.9	--	--
		L3	kA	25.3	25.0	--	--
Equivalent r.m.s. value		L1	kA	26.3	25.5	--	--
		L2	kA	27.3	26.4	--	--
		L3	kA	25.4	24.6	--	--
Average value			kA	26.3	25.5	--	--
Duration of short-circuit current			s	0.304	3.03	--	--
Short-time current	1 s	L1	kA	--	--	--	--
		L2	kA	--	--	--	--
		L3	kA	--	--	--	--
Average value			kA	--	--	--	--
Short-time current	3 s	L1	kA	--	25.6	--	--
		L2	kA	--	26.5	--	--
		L3	kA	--	24.7	--	--
Average value			kA	--	25.6	--	--

Remarks:
HZ 235 F 01 / 01: Current calibration
HZ 235 F 01 / 02: No-load operation
HZ 235 F 01 / 03: Test with reduced values
HZ 235 F 01 / 06: No-load operation

Condition of test object after test:
HZ 235 F 01 / 05: No visible change or damage. Circuit-breaker opened by its own mechanism at the first attempt.

Peak and Short-Time Withstand Current Tests

Actual values
(Earthing switch)

Condition of test object before test: Switchgear and equipment as after test 06.

Connection to test object: By means of copper conductors to the cable terminals. Short-circuit made by means of the closed earthing switch inside the panel. Circuit-breaker open in test position.

Oscillogram-No. HZ 235 F 01				08	09	--	--
Peak short-circuit current		L1	kA	66.5	34.1	--	--
		L2	kA	52.9	30.2	--	--
		L3	kA	19.1	36.2	--	--
Short-circuit current	first cycle	L1	kA	27.9	26.9	--	--
		L2	kA	27.9	26.3	--	--
		L3	kA	26.2	25.8	--	--
	last cycle	L1	kA	25.8	25.3	--	--
		L2	kA	26.0	25.6	--	--
		L3	kA	24.8	24.4	--	--
Equivalent r.m.s. value		L1	kA	26.1	25.4	--	--
		L2	kA	26.4	25.6	--	--
		L3	kA	25.1	24.4	--	--
Average value			kA	25.8	25.1	--	--
Duration of short-circuit current			s	0.302	3.03	--	--
Short-time current	1 s	L1	kA	--	--	--	--
		L2	kA	--	--	--	--
		L3	kA	--	--	--	--
Average value			kA	--	--	--	--
Short-time current	3 s	L1	kA	--	25.5	--	--
		L2	kA	--	25.7	--	--
		L3	kA	--	24.5	--	--
Average value			kA	--	25.2	--	--

Remarks:
HZ 235 F 01 / 07: Test with reduced values

Condition of test object after test:
HZ 235 F 01 / 09: No visible change or damage. Earthing switch could be opened easily by its own mechanism.

Actual Values of No-Load Operations

Rated supply voltage of closing coil 220 V dc
Rated supply voltage of opening coil 220 V dc

	Voltage of closing coil V	Closing time ms	Voltage of opening coil V	Opening time ms
Test HZ 235 F 01 / 02	--	--	220	36,4
Test HZ 235 F 01 / 06	--	--	220	37,4

Measurement of the Resistance of the Main-Circuit

Cable terminal against busbar outside the panel.

	Phase L 1	Phase L 2	Phase L 3
Before Test HZ 235 F 01 / 02	67.8 μΩ	60.4 μΩ	54.5 μΩ
After Test HZ 235 F 01 / 06	61.1 μΩ	60.0 μΩ	56.4 μΩ

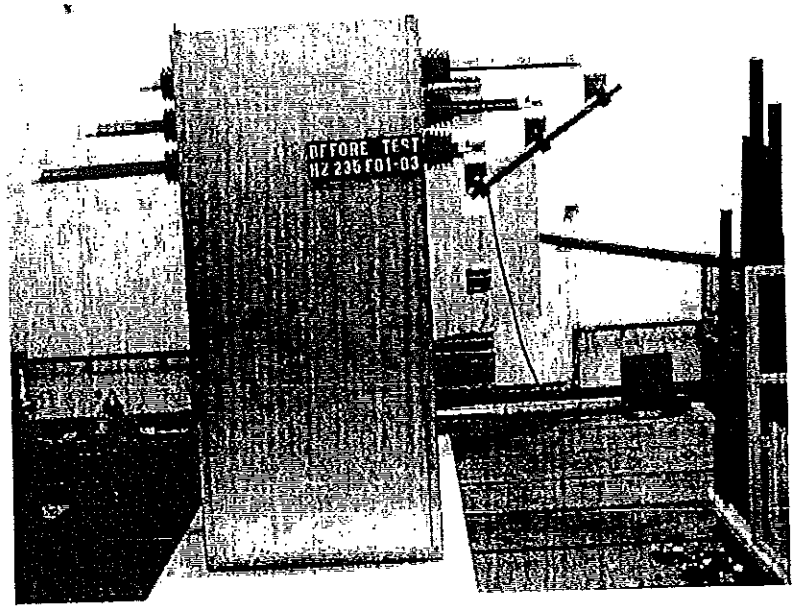


Photo no. 1
Before Test HZ 235 F 01 / 03

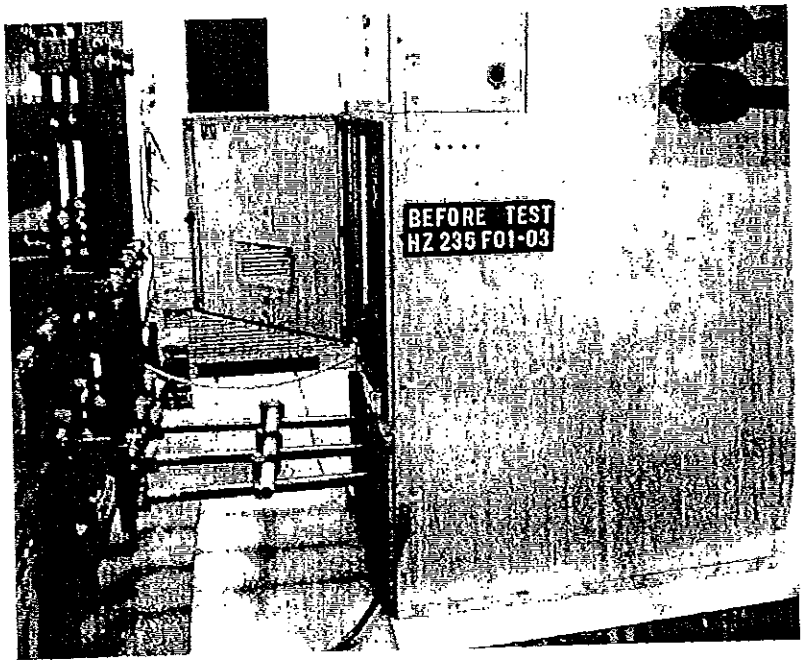
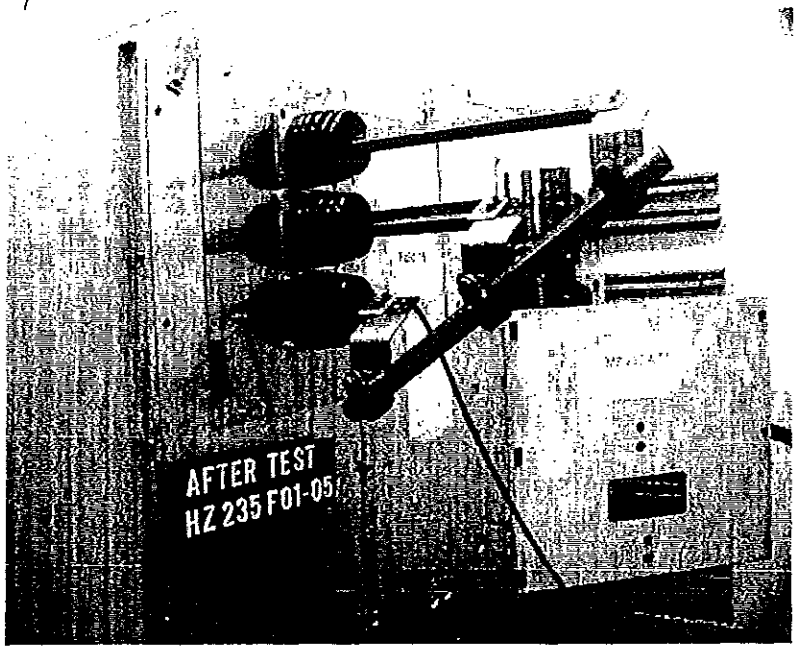


Photo no. 2
Before Test HZ 235 F 01 / 03



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After Test HZ 235 F 01 / 05

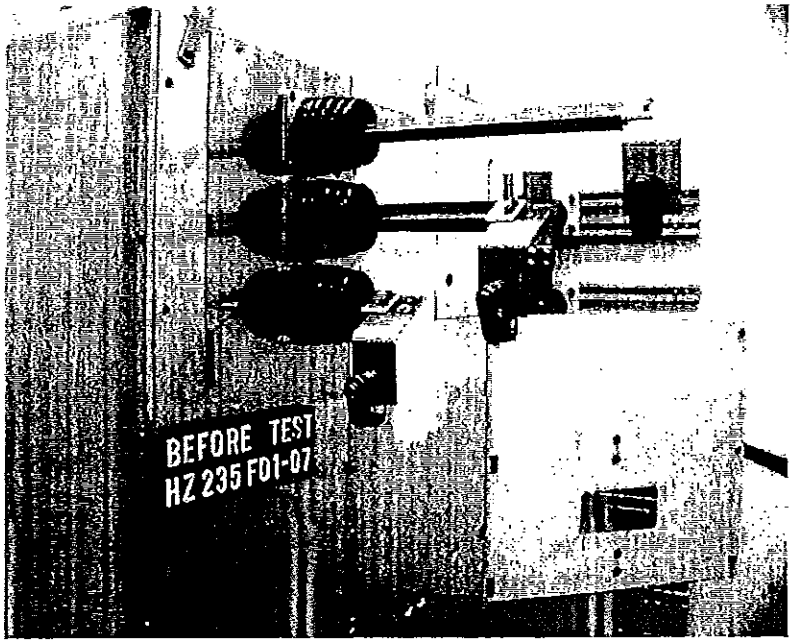


Photo no. 4
Before Test HZ 235 F 01 / 07

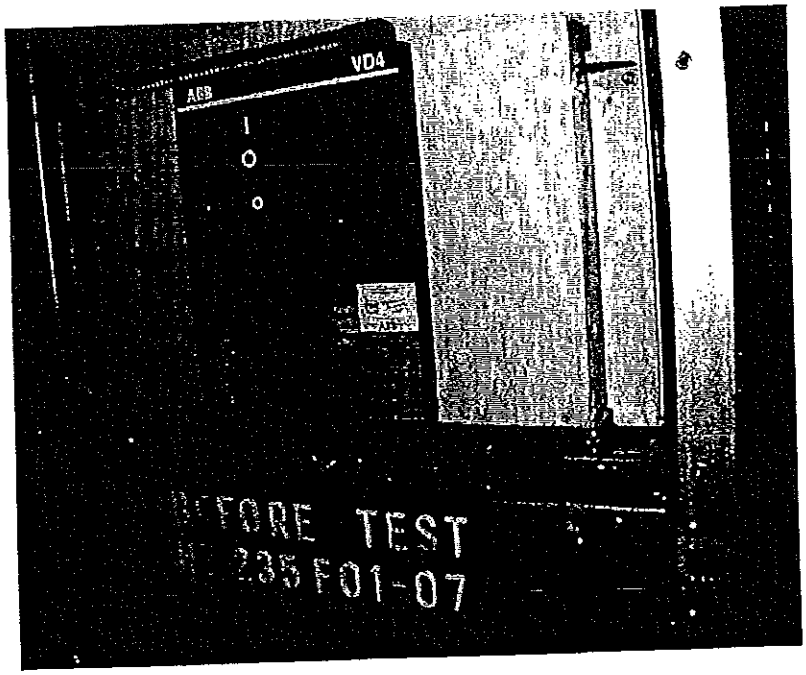


Photo no. 5
Before Test HZ 235 F 01 / 07

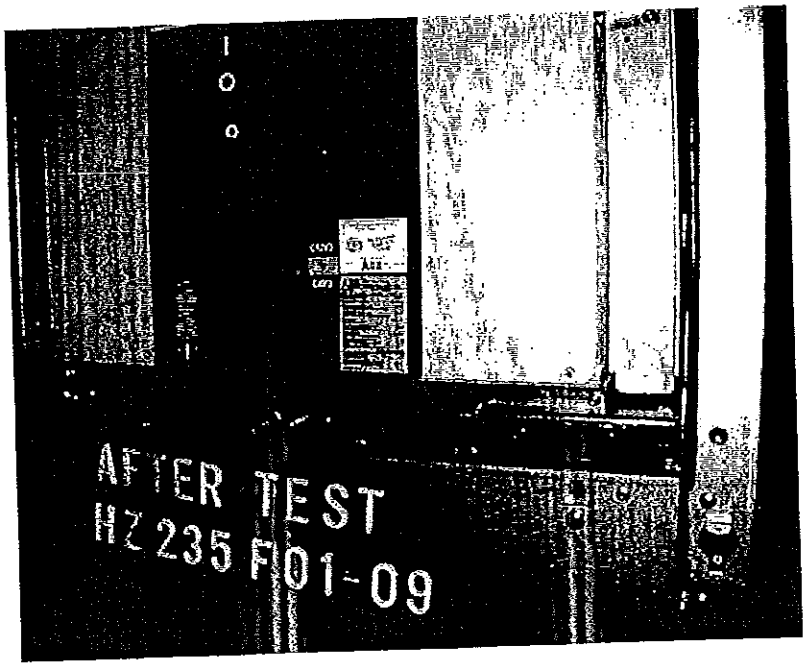
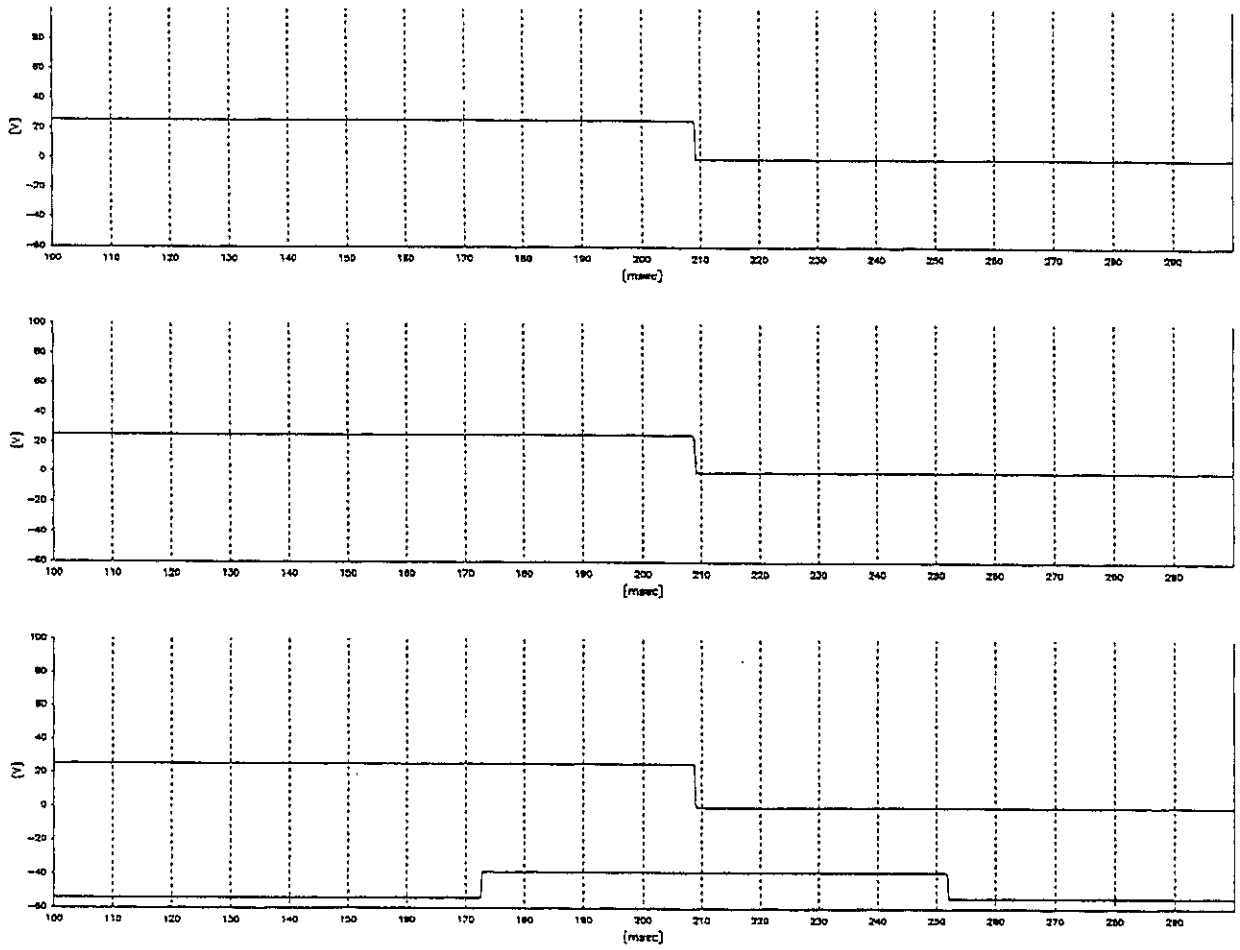


Photo no. 6
After Test HZ 235 F 01 / 09



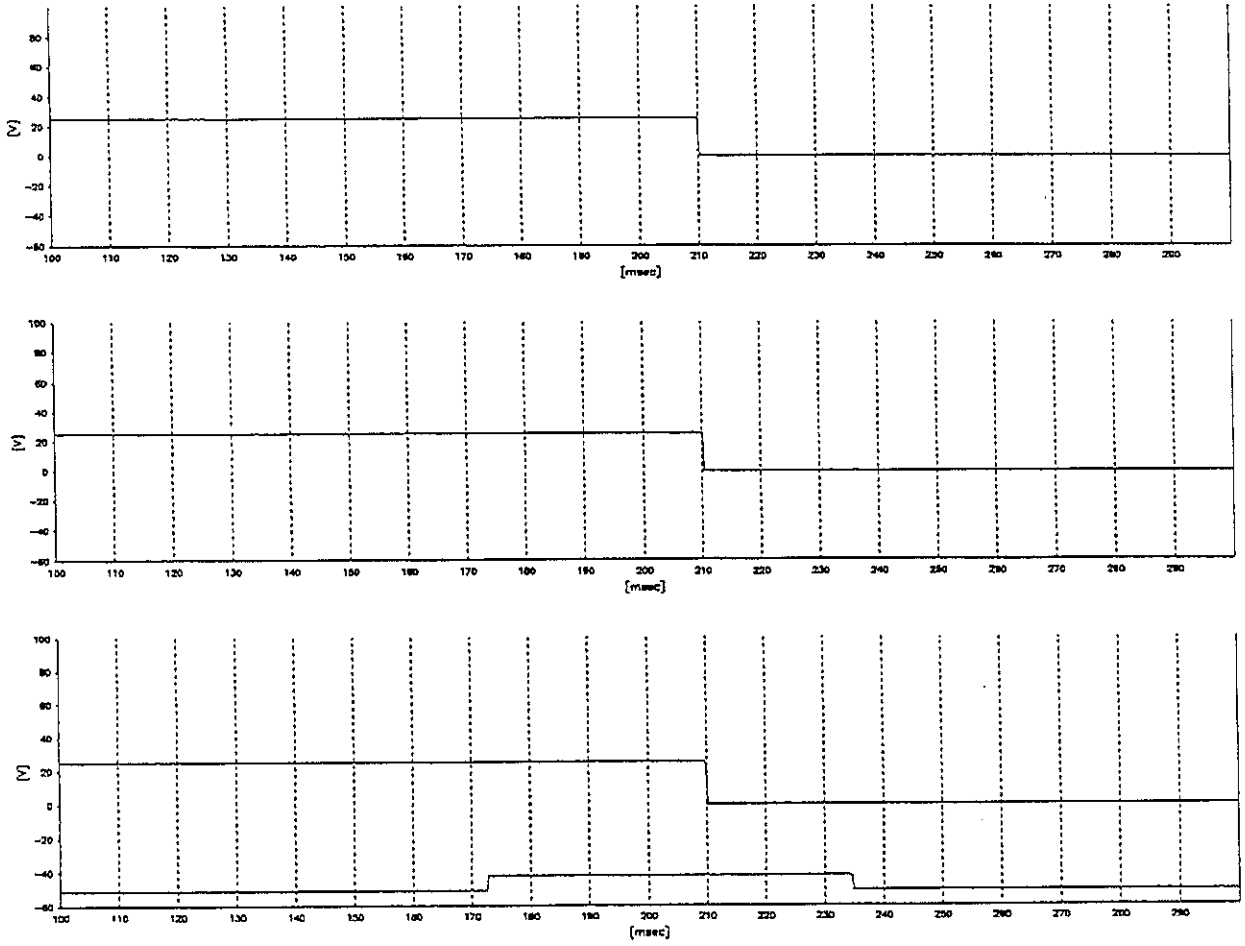
HZ235F01.002

HZ235F01.004

14.9.2000

HZ235F01.005

14.9.2000



HZ235F01.006

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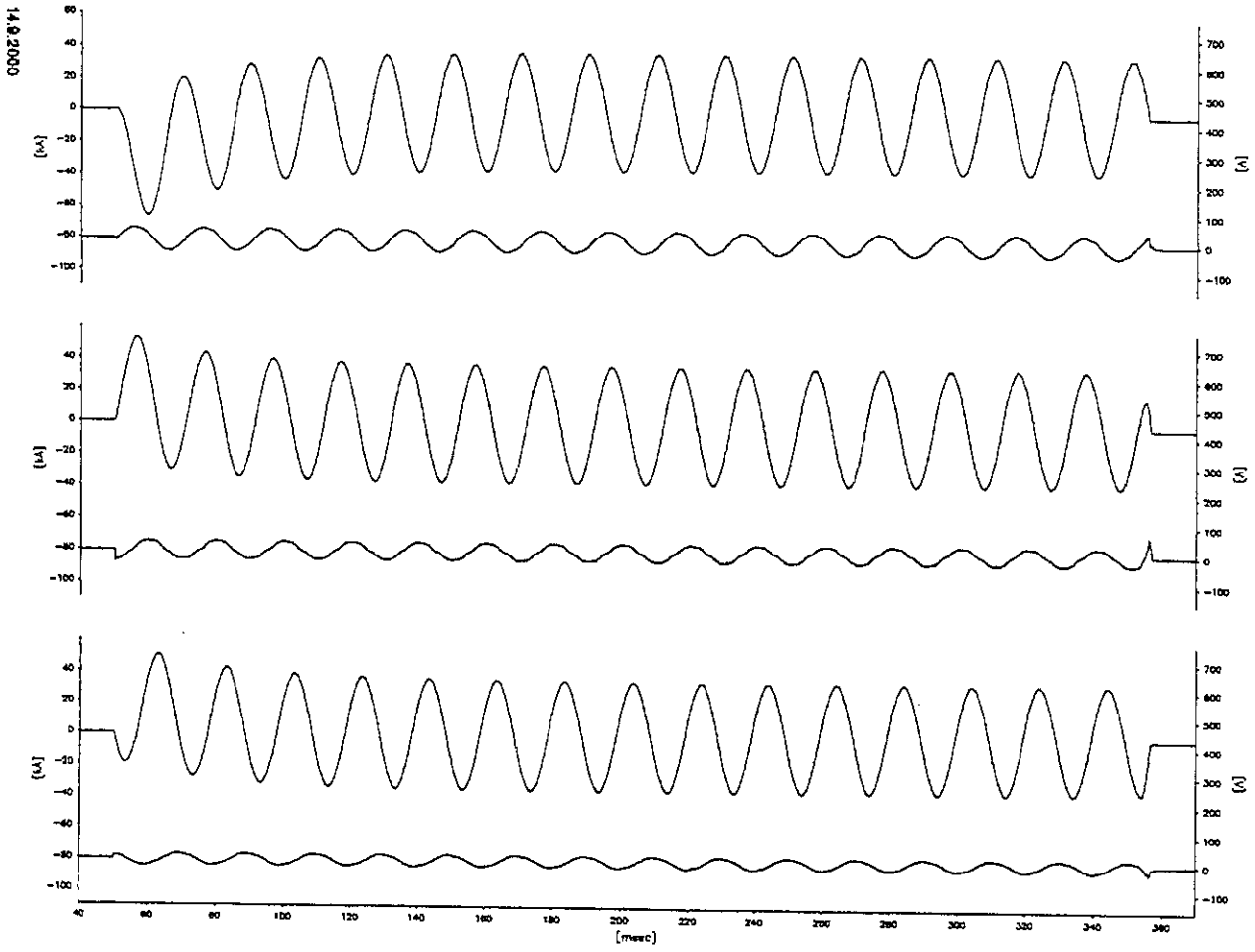

HZ235F01.008

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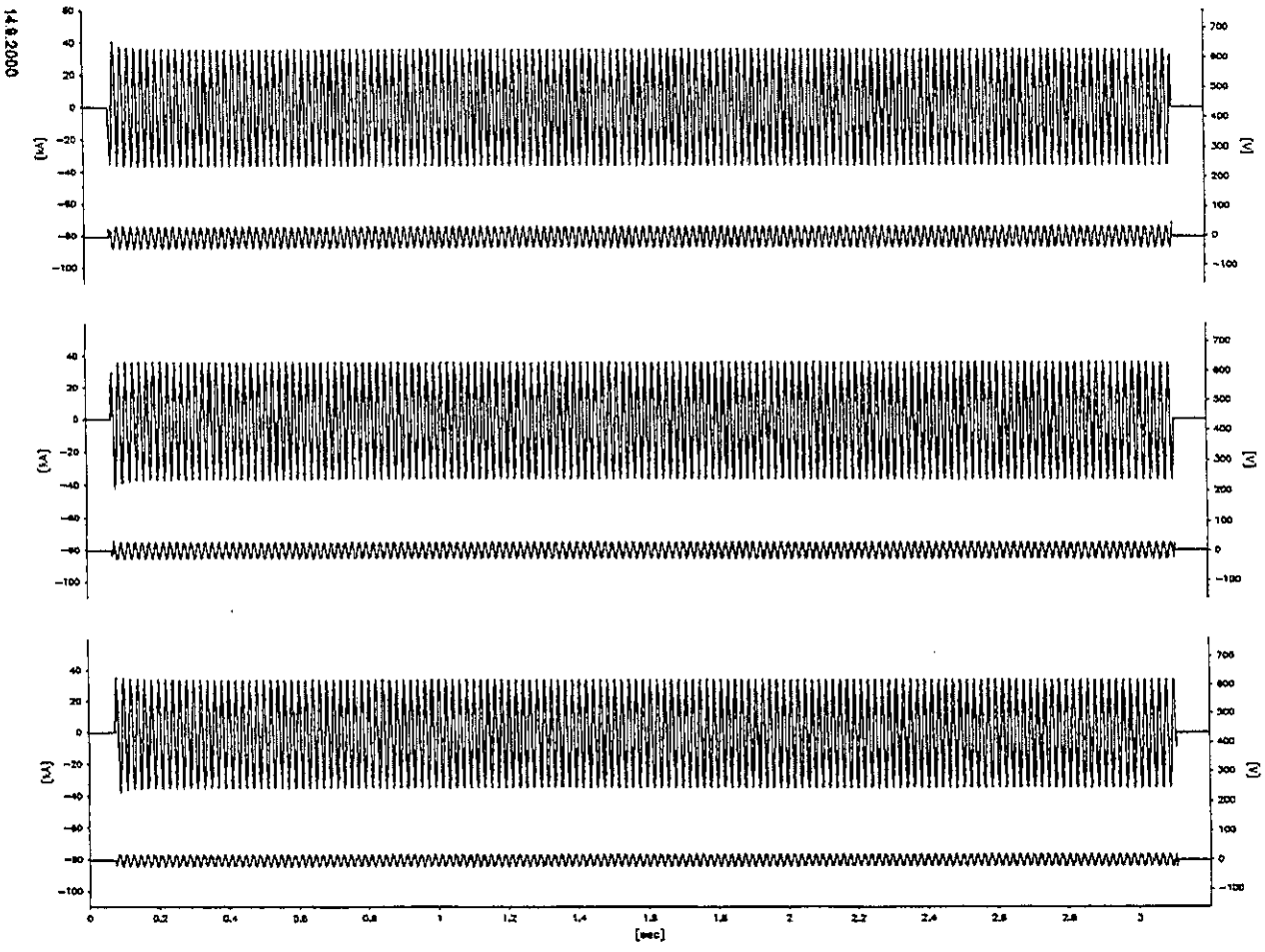


HZ235F01.009

PEHLA

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN
Member of the SHORT-CIRCUIT TESTING LIAISON (STL)

Test Document

Report No.: 0511Ra **Copy No.:** 1 **Contents:** 72 **Sheets**

Test object: Vacuum circuit-breaker type VD4/P 24.06.20 p275 in metal-enclosed air-insulated switchgear type UniGear ZS1, 1000 mm width

Designation: VD4/P 24.06.20 p275 in UniGear ZS1 (1000 mm width)
Rated voltage: 24 kV Rated normal current: 630 A Rated frequency: 50 / 60 Hz
Rated short-circuit breaking current: 20 kA

Manufacturer: ABB P.T. S.p.A.

Client: ABB P.T. S.p.A.

Testing station: PEHLA-Testing Laboratory Ratingen

Date of test: 10th February, 09th and 10th March 2005

Applied test specifications:

The tests have been carried out in full compliance with the below mentioned standards.
Test procedure and test parameters were strictly according to:
IEC 62271-200 / 1st Ed. / 2003-11, Clauses 6.6 and 6.101
IEC 60694 / Ed. 2.2 / 2002-01, Clause 6.6
IEC 62271-100 / Ed. 1.1 / 2003-05, Clause 6.106
According to STL Objectives and Operating Principles PEHLA issues a Test Document following exclusively the above mentioned test specifications and the STL Guides wherever applicable.

Tests performed:

Three-phase short-time withstand current and peak withstand current test of the main circuit.
Three-phase making and breaking capacity test based on 20.0 kA at 24 kV comprising the basic test duties T10, T30, T60, T100s and T100a (dc-component of 35 %).
No-load operations and measurement of the resistance of the main circuit before and after the tests.
Power frequency withstand voltage test at 50.0 kV – 1 min before and after the tests as a condition check.

Test results:

The above mentioned vacuum circuit-breaker in metal-enclosed air-insulated switchgear passed the short-time withstand current and peak withstand current test and the three-phase making and breaking capacity test successfully.

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN

Management Committee

Technical Committee

Mannheim, 20th July 2005

03PE0402

Deutscher Akkreditierungs Rat DAR DAT-P-032/93

Notes

Accreditation

The PEHLA-Testing Laboratory Ratingen has been approved by the DATech (German accreditation body for technology) according to EN ISO/IEC 17025 for tests in the field of high-voltage switchgear and controlgear and power engineering equipment (Registration-No. DAT-P032/93).

STL-Member

PEHLA is founder member of the SHORT-CIRCUIT TESTING LIAISON (STL) which has been established in March 1969. STL is a forum for the international cooperation of the testing organisations with the further full members ASTA (UK), CESI (IT), ESEF (FR), KEMA (NL), SATS (NO; SE, FI), STLNA (US, CA) and JSTC (JP). In the framework of EC, STL (EU) has been recognised in 1992 by EOTC as agreement group.

PEHLA-Documents

A Type Test Certificate

is issued for type tests 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. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

A Test Document

is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

A Test Report

is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients' instructions. Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the test object, and its condition after the tests.

A Test Confirmation

is issued immediately after the tests. It confirms that the tests have been conducted and is valid only until publishing the detailed results in an entire document.

Uncertainty of the measurement systems

The PEHLA - Testing Laboratories apply the PEHLA Guide No. 12 for determining the uncertainties of measurement, based on ENV 13005 (Guide to the expression of uncertainly in measurement). As long as no explicit statements are made, the uncertainties required by the relevant standards have been complied with.

Addresses

Office:	PEHLA-Geschäftsstelle Hallenweg 40 68219 Mannheim Germany Internet: www.pehla.com
Testing Station:	PEHLA-Testing Laboratory Ratingen Oberhausener Str. 33 40472 Ratingen Germany
Manufacturer:	ABB P.T. S.p.A. Via Friuli, 4 24044 Dalmine (BG) Italy
Client:	ABB P.T. S.p.A. Via Friuli, 4 24044 Dalmine (BG) Italy

Table of Contents

List of Test Participants

Representatives of Technical Committee:

Mr. Klaus Niemeyer	PEHLA-Testing Laboratory Berlin-Siemensstadt, Germany
Mr. Joachim Oemisch	PEHLA-Testing Laboratory Berlin-Siemensstadt, Germany
Dr. Thomas Ebke	PEHLA-Testing Laboratory Ratingen, Germany

Test Engineer / Test Operator:

Mr. Joachim Köhler	PEHLA-Testing Laboratory Ratingen, Germany
Dr. Thomas Ebke	PEHLA-Testing Laboratory Ratingen, Germany

Representatives of Client:

Mr. Stefano Magoni	ABB P.T. S.p.A., Dalmine, Italy

Further Participants:

Mr. Frank Idaszek	PEHLA-Testing Laboratory Ratingen, Germany

Technical Data of Test Object
Switchgear

Test object:	Metal-enclosed air-insulated switchgear.
Designation:	UniGear ZS1
Manufacturer:	ABB P.T. S.p.A., Via Friuli, 4, 24044 Dalmine (BG), Italy
Serial No.:	-
Year of manufacture:	2004
Drawing No.:	See sheet 7

Ratings assigned by the manufacturer:

Rated voltage	24	kV	
Rated normal current	630	A	
Rated frequency	50/60	Hz	
Rated lightning impulse withstand voltage	125	kV	
Rated switching impulse withstand voltage	-	kV	
Rated power-frequency withstand voltage	50	kV	
Rated peak withstand current	63/65	kA	
Rated short-time withstand current	25	kA	
Rated duration of short-circuit	3	s	
Insulating medium	-		
Rated filling pressure for insulation	-	MPa	abs. at 20 °C
Minimum functional pressure for insulation	-	MPa	abs. at 20 °C

Permissible values for internal arc faults:

Peak current	63/65	kA
Short-circuit current	25	kA
Duration of short-circuit	1	s

Further data: -

Essential characteristics and installed devices: -

Technical Data of Test Object
Circuit-Breaker

Test object:	Vacuum circuit-breaker
Designation:	VD4/P 24.06.20
Manufacturer:	ABB P.T. S.p.A., Via Friuli, 4, 24044 Dalmine (BG), Italy
Serial No.:	1VC1AE00038562
Year of manufacture:	2004
Serial No. of drive:	-
Drawing No.:	See sheet 7

Ratings assigned by the manufacturer:

Rated voltage	24	kV	
Rated normal current	630	A	
Rated frequency	50/60	Hz	
Rated lightning impulse withstand voltage	125	kV	
Rated switching impulse withstand voltage	-	kV	
Rated power-frequency withstand voltage	50	kV	
Rated peak withstand current	50/52	kA	
Rated short-time withstand current	20	kA	
Rated duration of short-circuit	3	s	
Rated short-circuit breaking current	20	kA	
DC component of the rated short-circuit breaking current	35	%	
Rated short-circuit making current	50/52	kA	
Rated transient recovery voltage	41	kV	
Rate of rise of transient recovery voltage	0.47	kV/µs	
First-pole-to-clear factor	1.5		
Rated operating sequence	O - 0.3 s - CO - 15 s - CO		
Arc extinguishing medium	vacuum		
Rated filling pressure for operation	-	MPa	abs. at 20 °C
Minimum functional pressure for operation	-	MPa	abs. at 20 °C
Insulating medium	-		
Rated filling pressure for insulation	-	MPa	abs. at 20 °C
Minimum functional pressure for insulation	-	MPa	abs. at 20 °C
Driving mechanism (type)	spring charged by motor		
Number of poles	3		
Number of units per pole	1		
Rated opening time	30 – 60	ms	
Rated closing time	50 – 80	ms	
Rated supply voltage of opening device	110	V	d.c.
Rated supply voltage of closing device	110	V	d.c.
Rated supply voltage of auxiliary circuits	110	V	d.c.
Rated frequency of supply voltage	-	Hz	

Further data:
Type and Serial No. of Poles: P4 with VG4, L1: EP00013111, L2: EP00013094, L3: EP00013173

Essential characteristics: -

List of Identified Drawings

The manufacturer has submitted to the testing laboratory drawings and other data containing sufficient information to unambiguously identify by type the essential details and parts of the test object presented for test.
The drawings have been stamped and signed by the manufacturer in order to guarantee that the drawings or data schedules truly represent the test object to be tested.
Further these drawings have been stamped and signed by PEHLA representatives and are kept

☐ at the client.

☒ with the test documents at the test laboratory.

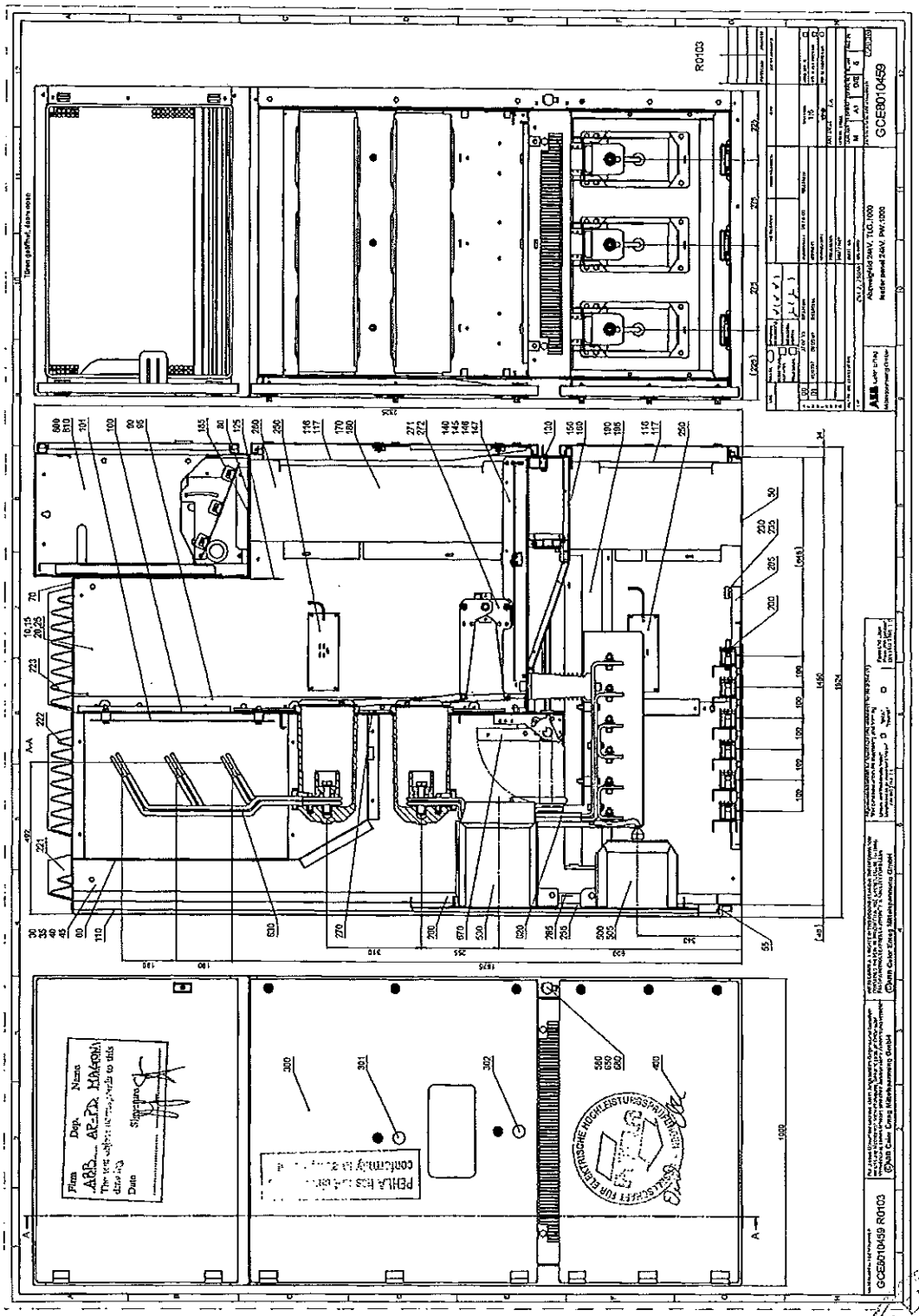
The testing laboratory has checked that drawings and data schedules adequately represent the essential details and parts of the test object to be tested, but is not responsible for the accuracy of the detailed information.
The drawing(s) contained in this document are identical with the checked, stamped and signed drawings.

Drawing No.	Rev.	P/D *)	Title	Additional remarks
GCE8010459 R0103	01	D	Abzweigfeld 24kV, TLG.1000 Feeder panel 24kV, PW.1000	Included in the Test Report
TN 7414	--	D	Interruttore in Vuoto Tipo Vacuum Circuit Breaker Type VD4/P 24kV 630-1250A	Included in the Test Report
GCE8012502 R0103	01	D	MONTAGEPLATTE H=310, KONTAKT 35 Mounting plate H=310, contact 35	-
GCE8685778 P0121	03	D	Kontaktstift	-
N 510509 Gr. 810	--	P	Tabella Materiali N 510509	-
510509 Gr. 810	--	D	Completamento Interruttore C.B. Completion	-
N 1VCR003288 G0015	--	P	Tabella Materiali N 1VCR003288G	-
1VCR003288 G0015	--	D	Struttura con poli Frame with Poles	-
N 1VCR003324 G0015	--	P	Tabella Materiali N 1VCR003324G	-
1VCR003324 G0015	--	D	Interuttore Base Base Breaker	-
N 1VCR003321 G0003	--	P	Tabella Materiali N 1VCR003321G	-
1VCR003321 G0003	--	D	Commando con Albero Operating Mechanism with Shaft	-
N 510508 Gr. 802	--	P	Tabella Materiali N 510508	-
510508 Gr. 802	--	D	Montaggio Passanti e Tulipani Bushing and Tulip Mounting	-
GCE7004730 R0104	11	D	Pol, vst. 24kV 1250A Pole complet 24kV 1250A	-

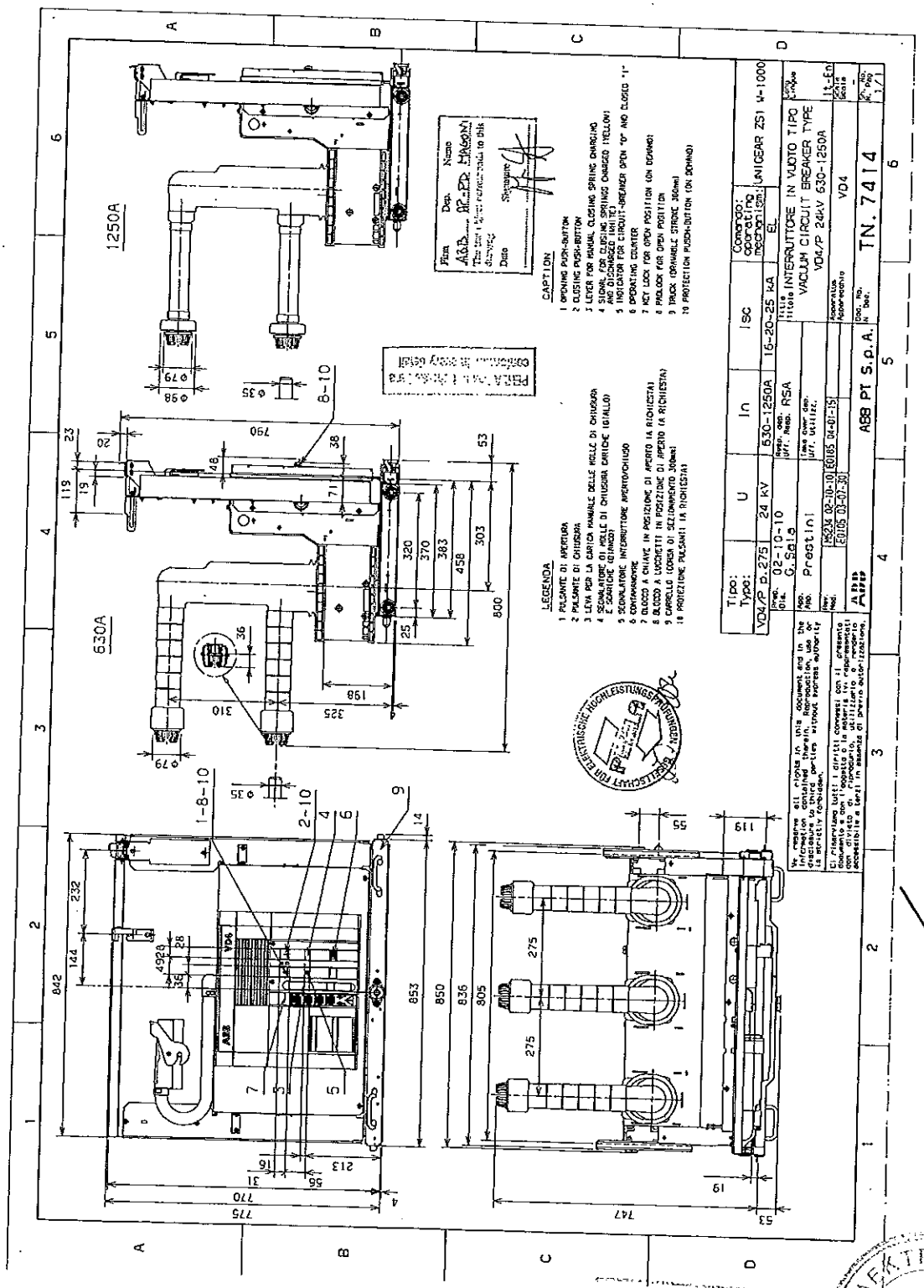
*) P: Parts list, D: Drawing

Remarks: -

Drawing
GCE8010459R0103



Drawing
TN.7414



Technical Data of Test Circuits

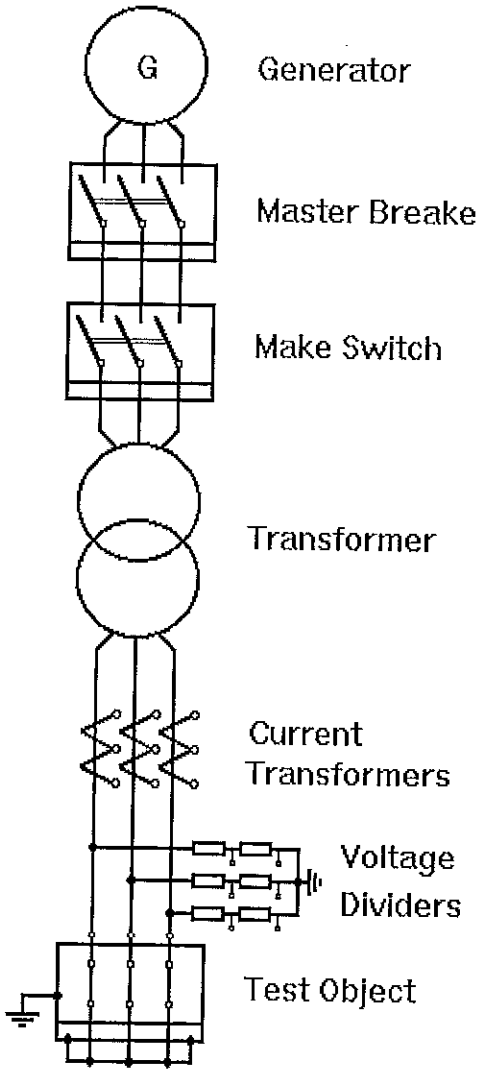
Short-Time Withstand Current and Peak Withstand Current Tests

Test performed		STC	-	-	-
Test No. PEHLA 0511Ra		03 - 04	-	-	-
Circuit diagram	Sheet No.	11	-	-	-
Current circuit		-	-	-	-
Number of phases		3	-	-	-
Power frequency	Hz	50	-	-	-
Power factor		< 0.15	-	-	-
Earthing conditions		-	-	-	-
Generator / System		earthed via 5 kΩ	-	-	-
Transformer		not earthed	-	-	-
Short-circuit point		earthed	-	-	-
Test object		earthed	-	-	-
Test object (test values)		-	-	-	-
Number of phases		3	-	-	-
Measurement		-	-	-	-
Voltage measurement		Dividers 80 kΩ / 1.1 kΩ	-	-	-
Current measurement		Transf. 50 kA / 5 A	-	-	-

Remarks: -

Circuit Diagram

Test Circuit for Three-Phase Tests
Peak Withstand Current and Short-Time Withstand Current Tests



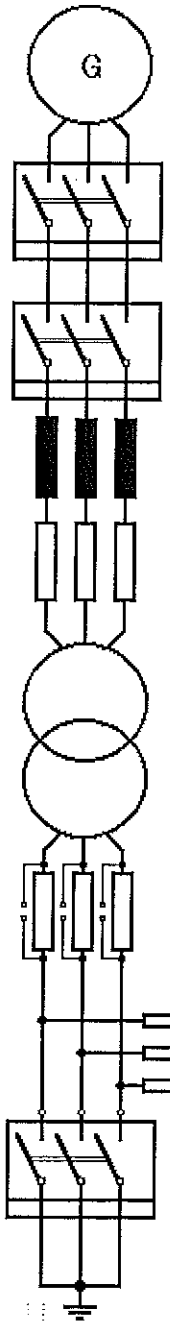
Technical Data of Test Circuit
Short-Circuit Direct Test

Test performed		T30		T60		T100		T10	
Test No. PEHLA 0511Ra		07-08		09-12		13-28		29-30	
Circuit diagram (test circuit)	see sheet	13		13		13		13	
Test object Rated voltage	kV	24		24		24		24	
Rated frequency	Hz	50		50		50		50	
Short-circuit breaking current	kA	6.00		12.0		20.0		2.00	
Units under test		-		-		-		-	
Voltage distribution	%	-		-		-		-	
Number of phases (test circuit)		3		3		3		3	
Power factor (test circuit)		≤ 0.15		≤ 0.15		≤ 0.15		≤ 0.15	
Frequency (test circuit)	Hz	50		50		50		50	
Earthing conditions Generator		earthed via 5 kΩ		earthed via 5 kΩ		earthed via 5 kΩ		earthed via 5 kΩ	
Transformer		not earthed		not earthed		not earthed		not earthed	
Short-circuit point		earthed		earthed		earthed		earthed	
Prospective transient recovery voltage		Required values	Tested values	Required values	Tested values	Required values	Tested values	Required values	Tested values
Evaluation of oscillogram	No.	-	prosp.	-	prosp.	-	prosp.	-	prosp.
Crest value u_c	kV	44.0	44.5	44.0	44.0	41.0	41.0	44.0	47.0
Time t_3	µs	19	38 [1)]	38	38	87	80	19	66 [1)]
Time delay t_d	µs	-	-	-	-	-	-	-	-
Rate of rise u_1/t_1 or u_c/t_3	kV/µs	2.32	1.17	1.16	1.16	0.47	0.51	2.32	0.71
u_1	kV	-	-	-	-	-	-	-	-
t_1	µs	-	-	-	-	-	-	-	-

Remarks: [1)] Due to limitations of the test plant the time coordinate t_3 is higher than the required values.

Circuit Diagram

Test Circuit for Three-Phase Tests
Basic Short-Circuit Making and Breaking Tests



Test Results

Three-phase short-time withstand current and peak withstand current tests

Test performed: Three-Phase Peak and Short-Time Withstand Current Tests, 52 kA / 20 kA – 3s

Date of test: 10th February 2005

Condition of test object before test: Factory new.

Test arrangement: Direct test circuit, circuit-breaker in air-insulated switchgear

Connections to test object: Infeed via copper bars to the busbar connection of the switchgear, short-circuited via copper bar at the cable terminals, short-circuit point earthed via cable.

Test No. PEHLA 0511Ra				03	04	-	-	-	-
Short-circuit current - peak		L1	kA	52.3	36.6	-	-	-	-
		L2	kA	40.6	29.8	-	-	-	-
		L3	kA	46.1	37.1	-	-	-	-
Short-circuit current - rms	First cycle	L1	kA	22.0	20.4	-	-	-	-
		L2	kA	22.7	19.9	-	-	-	-
		L3	kA	22.5	21.4	-	-	-	-
	Last cycle	L1	kA	21.0	21.1	-	-	-	-
		L2	kA	22.0	22.2	-	-	-	-
		L3	kA	21.4	21.5	-	-	-	-
	Equivalent current	L1	kA	21.0	20.6	-	-	-	-
		L2	kA	22.1	21.6	-	-	-	-
		L3	kA	21.4	21.0	-	-	-	-
	Average value		kA	21.5	21.0	-	-	-	-
	Duration of short circuit		s	0.317	3.02	-	-	-	-
Short-time current		L1	kA	-	20.6	-	-	-	-
		L2	kA	-	21.7	-	-	-	-
		L3	kA	-	21.0	-	-	-	-
	Average value		kA	-	21.1	-	-	-	-
	Duration		s	-	3.00	-	-	-	-
Emission of flame/gas/oil				no	no	-	-	-	-
Test result (P/N)				P	P	-	-	-	-

Resistance of the main circuit

Before test	L1	µΩ	26.5	-	-	-	-	-
	L2	µΩ	28.4	-	-	-	-	-
	L3	µΩ	26.9	-	-	-	-	-
After test	L1	µΩ	-	26.2	-	-	-	-
	L2	µΩ	-	27.1	-	-	-	
	L3	µΩ	-	26.2	-	-	-	-

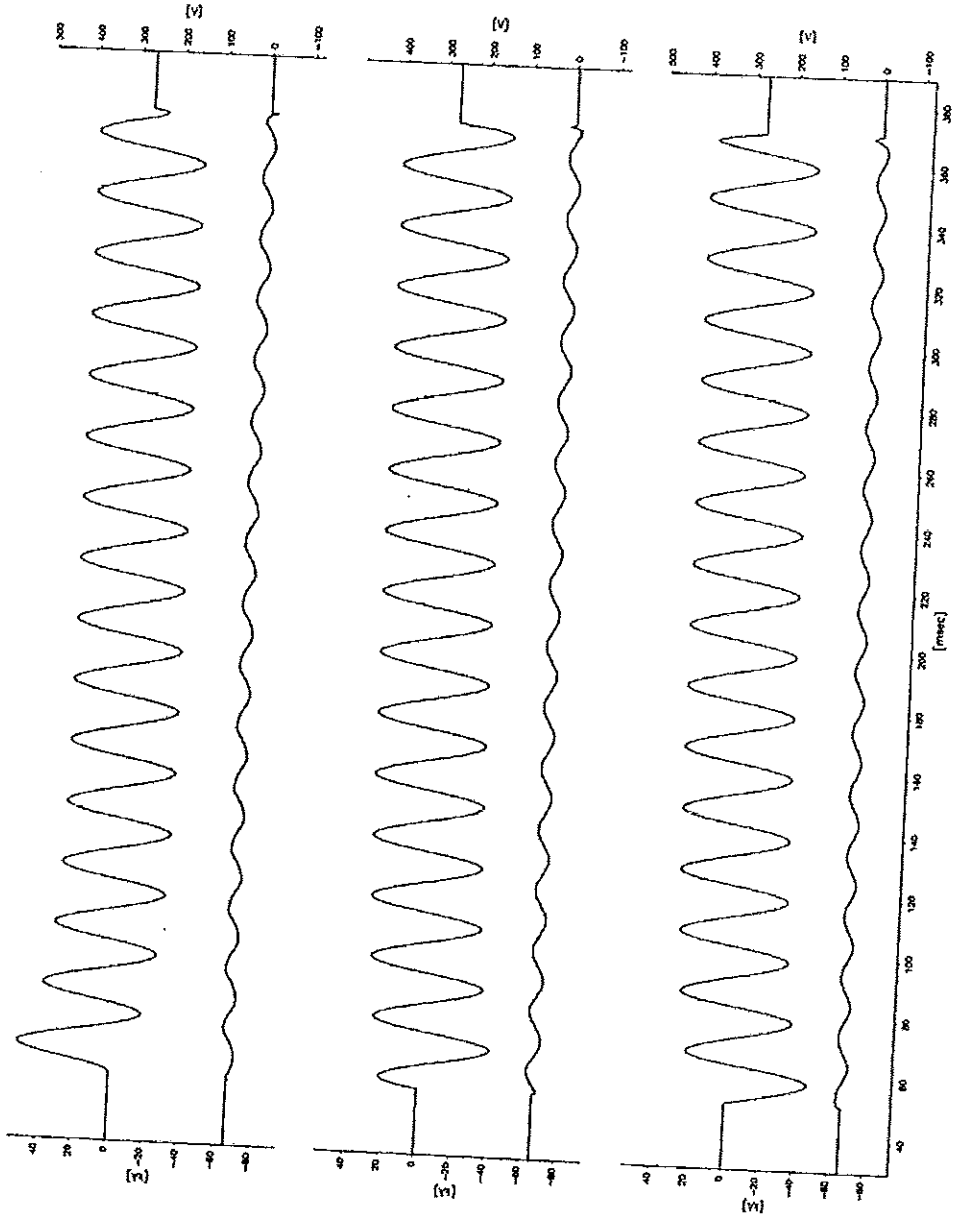
Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard

Remarks: PEHLA 0511Ra / 01: Current calibration

PEHLA 0511Ra / 02: No-load operation

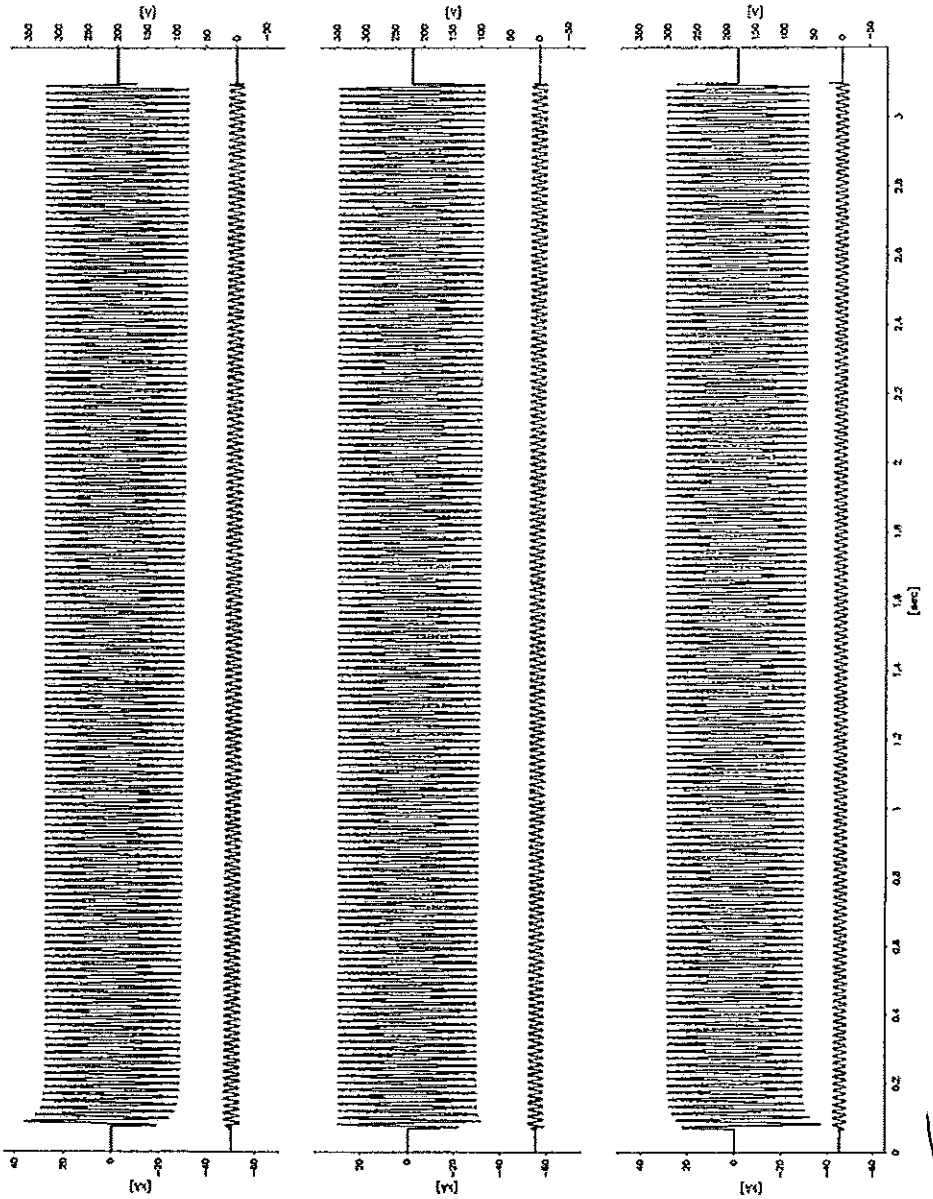
Condition of test object after test: Vacuum circuit-breaker type VD4/P 24.06.20 p275 in metal-enclosed air-insulated switchgear type UniGear ZS1, 1000 mm width without visible or functional change or damage. It opened by its own mechanism energized at rated auxiliary voltage at the first attempt.

Oscillogram
PEHLA 0511Ra / 03



Oscillogram

PEHLA 0511Ra / 04



Test Results
Basic Short-Circuit Making and Breaking Tests

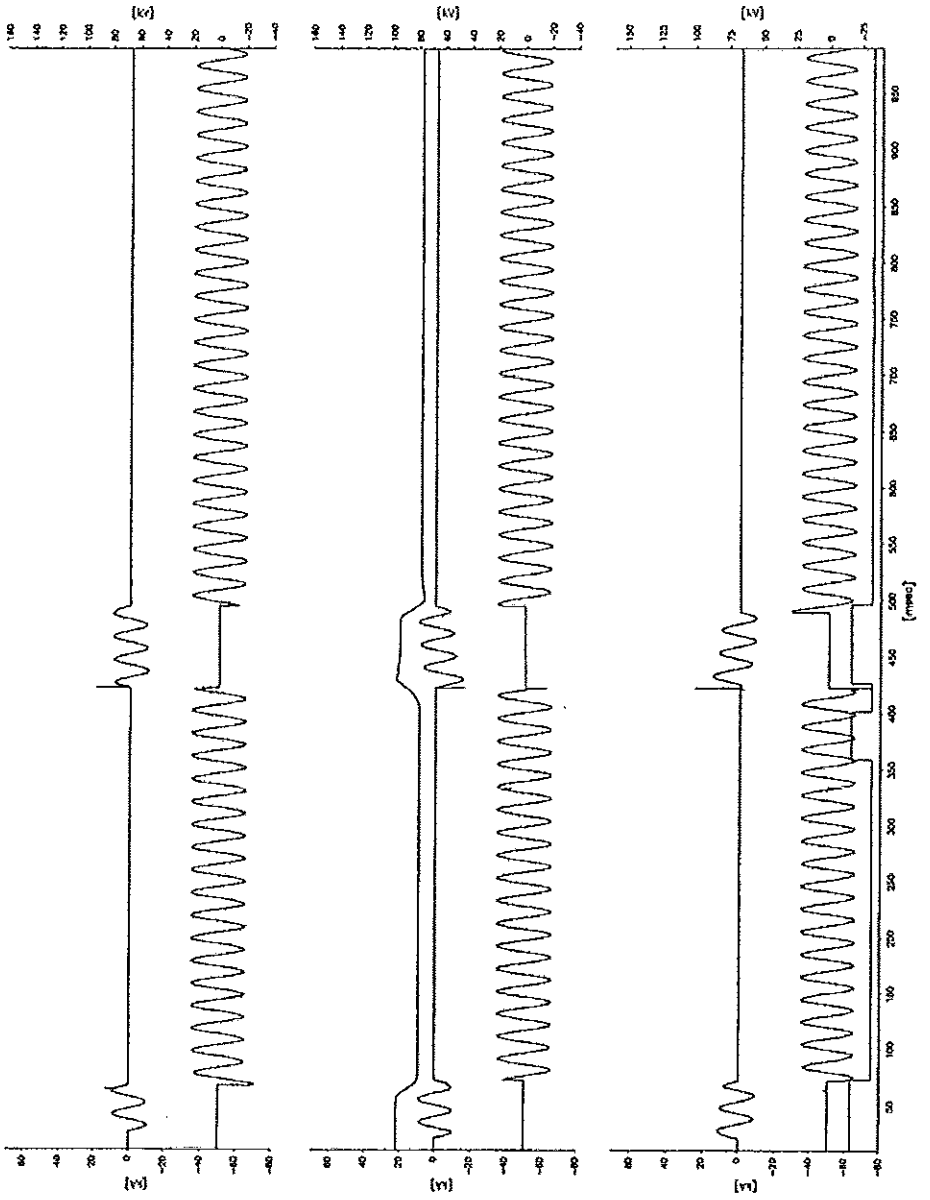
Test performed: Basic short-circuit making and breaking tests (T30)
Date of test: 09th March 2005
Condition of test object before test: As after PEHLA 0511Ra / 04.
Test arrangement: Direct test circuit, circuit-breaker in gas insulated switchgear
Connections to test object: Infeed via copper bars to the busbar connection of the switchgear, short-circuited via copper bar at the cable terminals, short-circuit point earthed via cable.

Test No. PEHLA 0511Ra			07		08	-	-	-
Operating sequence and time intervals			O-0.3s-CO-15s-CO			-	-	-
Applied voltage		kV	-	24.5	24.2	-	-	-
Making current (peak)	L1	kA	-	10.4	11.2	-	-	-
	L2	kA	-	15.1	15.5	-	-	-
	L3	kA	-	14.9	13.2	-	-	-
Breaking current (r.m.s.)	L1	kA	6.58	6.67	6.58	-	-	-
	L2	kA	6.68	6.77	6.81	-	-	-
	L3	kA	6.54	6.73	6.66	-	-	-
	Average value	kA	6.60	6.72	6.69	-	-	-
Recovery voltage (r.m.s)	L1	kV	13.8	14.2	14.0	-	-	-
	L2	kV	14.1	14.2	14.0	-	-	-
	L3	kV	14.1	14.4	14.3	-	-	-
Transient recovery voltage	Voltage u_1	kV	-	-	-	-	-	-
	Time t_1	µs	-	-	-	-	-	-
	TRV peak value u_c	kV	44.5	43.0	44.5	-	-	-
	Time t_3	µs	-	-	-	-	-	-
	Time delay t_d	µs	-	-	-	-	-	-
	Rate of rise u_c/t_3	kV/µs	-	-	-	-	-	-
C-Operation	Voltage of closing device	V	-	94	94	-	-	-
	Closing time	ms	-	63.4	62.6	-	-	-
	Pre-arcing time	ms	-	-	-	-	-	-
	Make time	ms	-	63.4	62.6	-	-	-
O-Operation	Voltage of opening device	V	77	77	77	-	-	-
	Opening time	ms	59.8	60.7	59.0	-	-	-
	Arcing time L1	ms	4.6	8.2	8.2	-	-	-
	L2	ms	9.6	7.8	3.0	-	-	-
	L3	ms	9.4	2.8	8.2	-	-	-
	Break time	ms	69.4	68.9	67.2	-	-	-
Emission of flame/gas/oil, occurrence of NSDD			no	no	no	-	-	-
Number of valid test			-	-	-	-	-	-
Test result			P	P	P	-	-	-

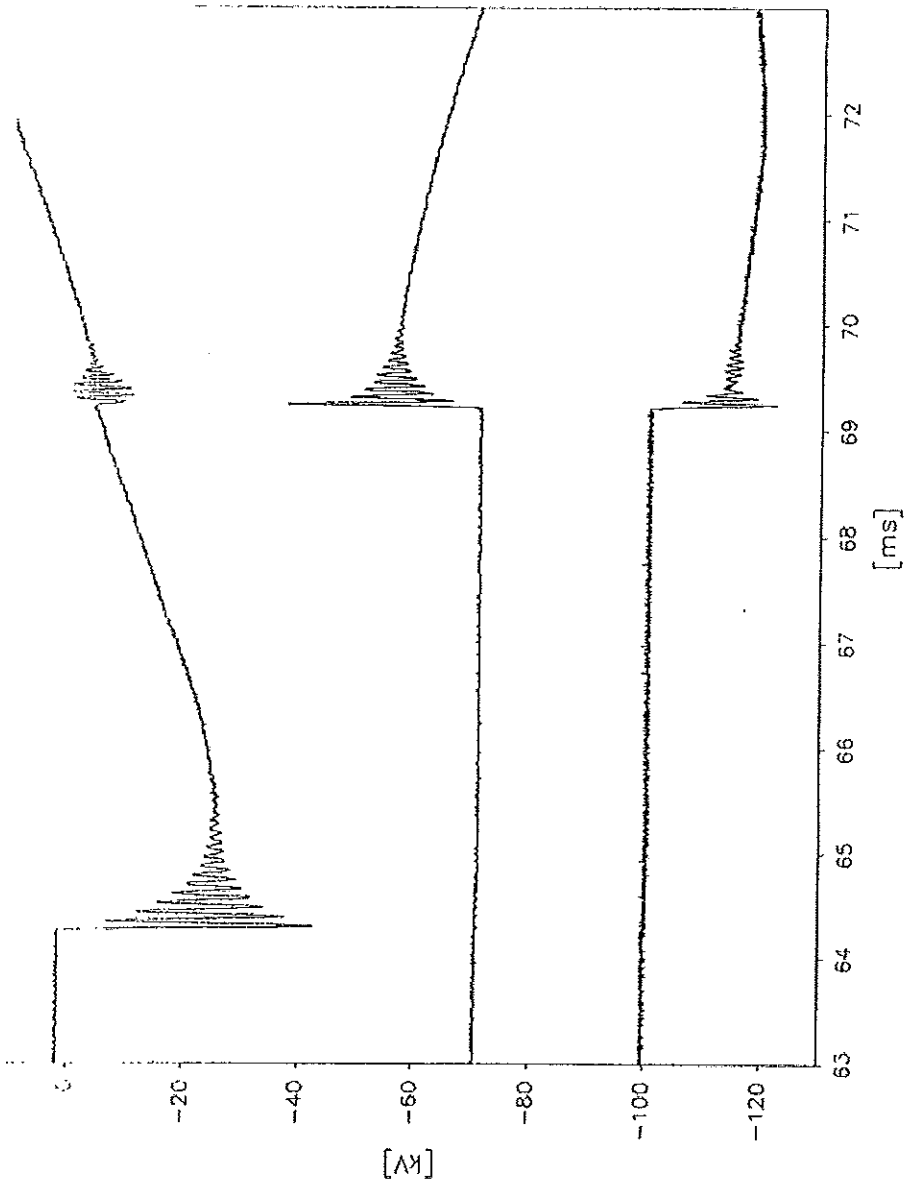
Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard
Remarks: PEHLA 0511Ra / 05 and 06: No-load operations

Condition of test object after test: Switchgear and circuit-breaker were not inspected.

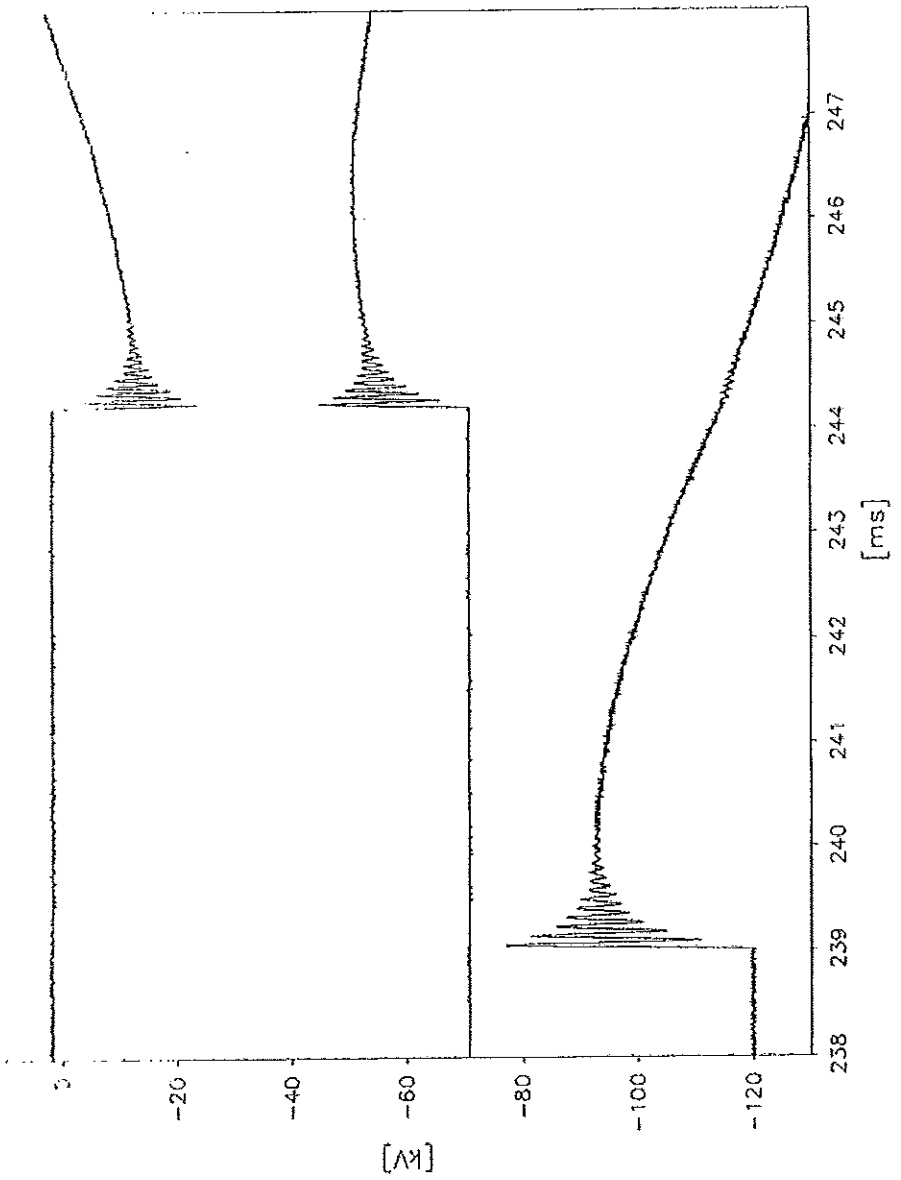
Oscillogram
PEHLA 0511Ra / 07



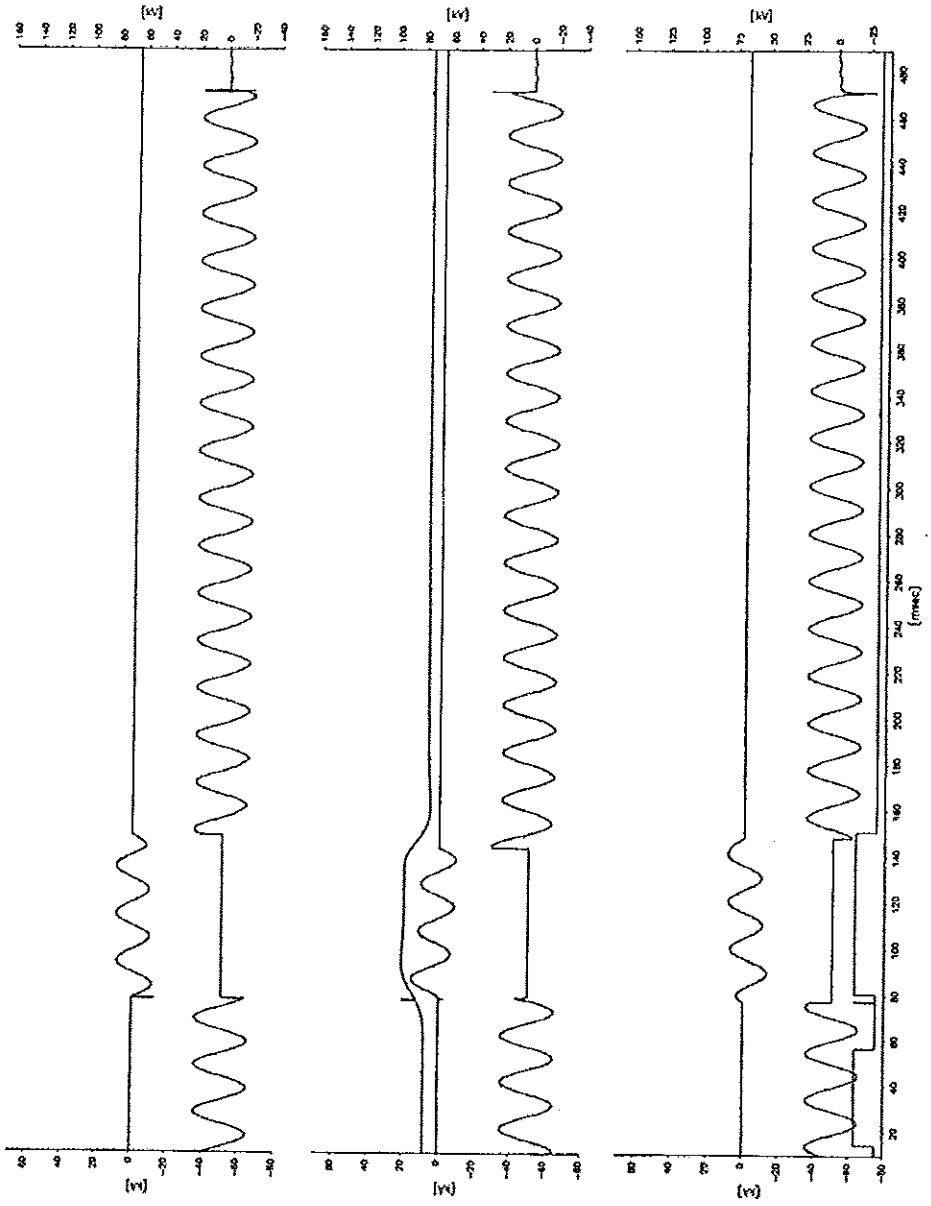
Oscillogram
PEHLA 0511Ra / 07



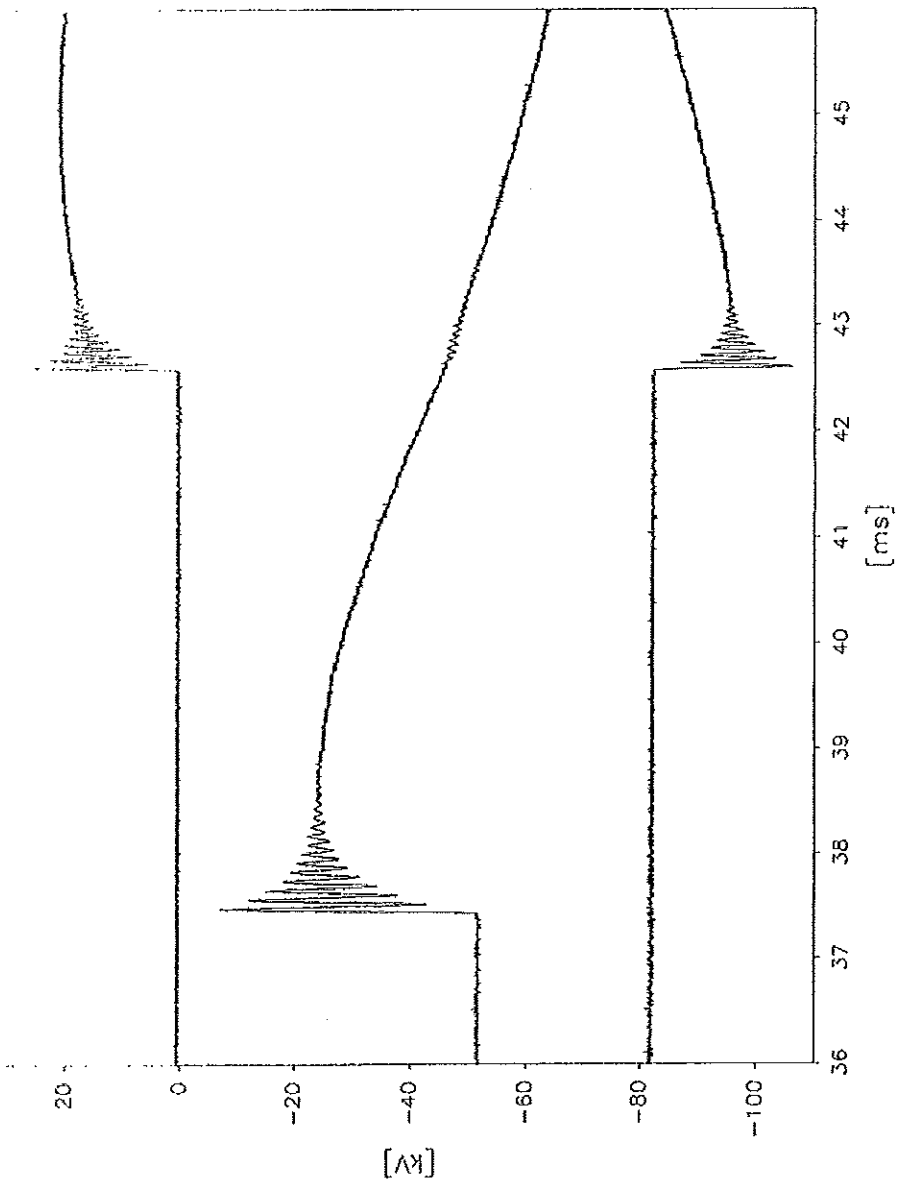
Oscillogram
PEHLA 0511Ra / 07



Oscillogram
PEHLA 0511Ra / 08



Oscillogram
PEHLA 0511Ra / 08



Test Results

Basic Short-Circuit Making and Breaking Tests

Test performed: Basic short-circuit making and breaking tests (T60)
Date of test: 09th March 2005
Condition of test object before test: As after Test Pehla 0511Ra / 08
Test arrangement: Direct test circuit, circuit-breaker in air-insulated switchgear
Connections to test object: Infeed via copper bars to the busbar connection of the switchgear, short-circuited via copper bar at the cable terminals, short-circuit point earthed via cable.

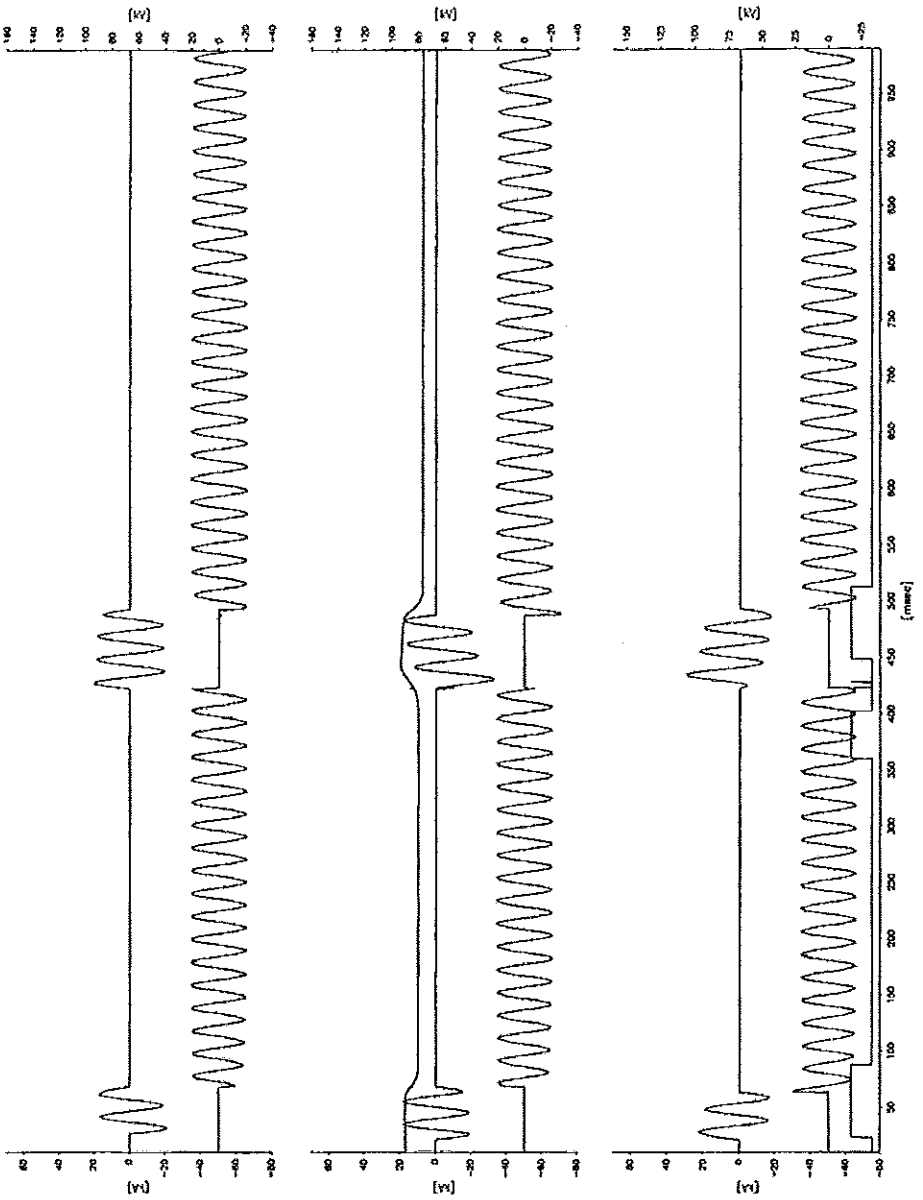
Test No. PEHLA 0511Ra			11		12	-	-	-
Operating sequence and time intervals			O-0.3s-CO-15s-CO			-	-	-
Applied voltage		kV	-	25.0	24.1	-	-	-
Making current (peak)	L1	kA	-	20.1	25.5	-	-	-
	L2	kA	-	32.5	32.9	-	-	-
	L3	kA	-	29.8	25.7	-	-	-
Breaking current (r.m.s.)	L1	kA	12.5	13.0	12.5	-	-	-
	L2	kA	12.8	13.5	12.8	-	-	-
	L3	kA	12.6	13.1	13.1	-	-	-
	Average value	kA	12.6	13.2	12.8	-	-	-
Recovery voltage (r.m.s)	L1	kV	14.1	14.2	13.6	-	-	-
	L2	kV	14.2	14.5	13.8	-	-	-
	L3	kV	14.2	14.8	14.4	-	-	-
Transient recovery voltage	Voltage u_1	kV	-	-	-	-	-	-
	Time t_1	µs	-	-	-	-	-	-
	TRV peak value u_c	kV	41.6	42.0	42.5	-	-	-
	Time t_3	µs	-	-	-	-	-	-
	Time delay t_d	µs	-	-	-	-	-	-
	Rate of rise u_c/t_3	kV/µs	-	-	-	-	-	-
C-Operation	Voltage of closing device	V	-	94	94	-	-	-
	Closing time	ms	-	62.8	63.5	-	-	-
	Pre-arcing time	ms	-	-	-	-	-	-
	Make time	ms	-	62.8	63.5	-	-	-
O-Operation	Voltage of opening device	V	77	77	77	-	-	-
	Opening time	ms	58.6	56.5	59.4	-	-	-
	Arcing time L1	ms	7.8	7.6	8.2	-	-	-
	L2	ms	3.4	7.6	3.8	-	-	-
	L3	ms	9.0	2.6	8.8	-	-	-
	Break time	ms	67.6	64.1	68.2	-	-	-
Emission of flame/gas/oil, occurrence of NSDD			no	no	no	-	-	-
Number of valid test			-	-	-	-	-	-
Test result			P	P	P	-	-	-

Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard

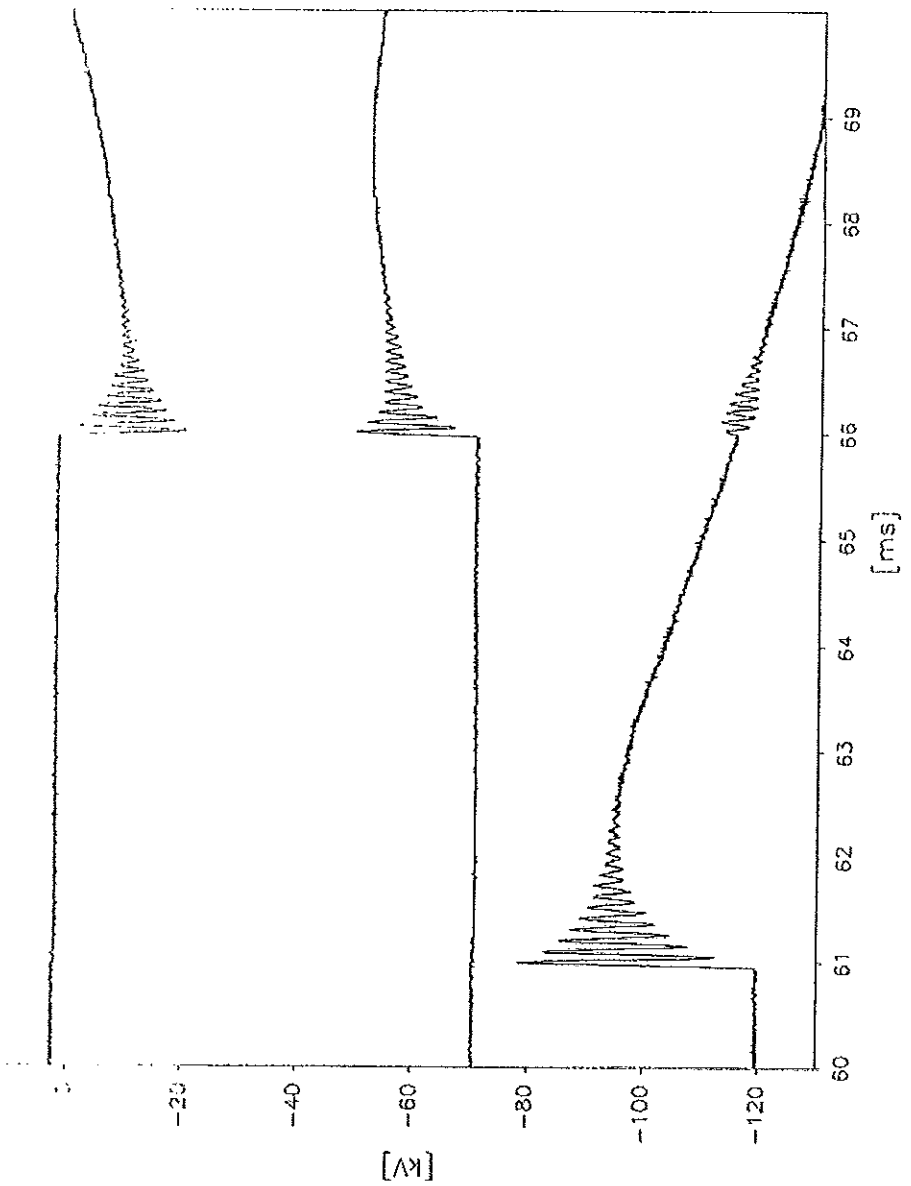
Remarks: PEHLA 0511Ra / 09 and 10: Tests with reduced values

Condition of test object after test: Switchgear and circuit-breaker were not inspected.

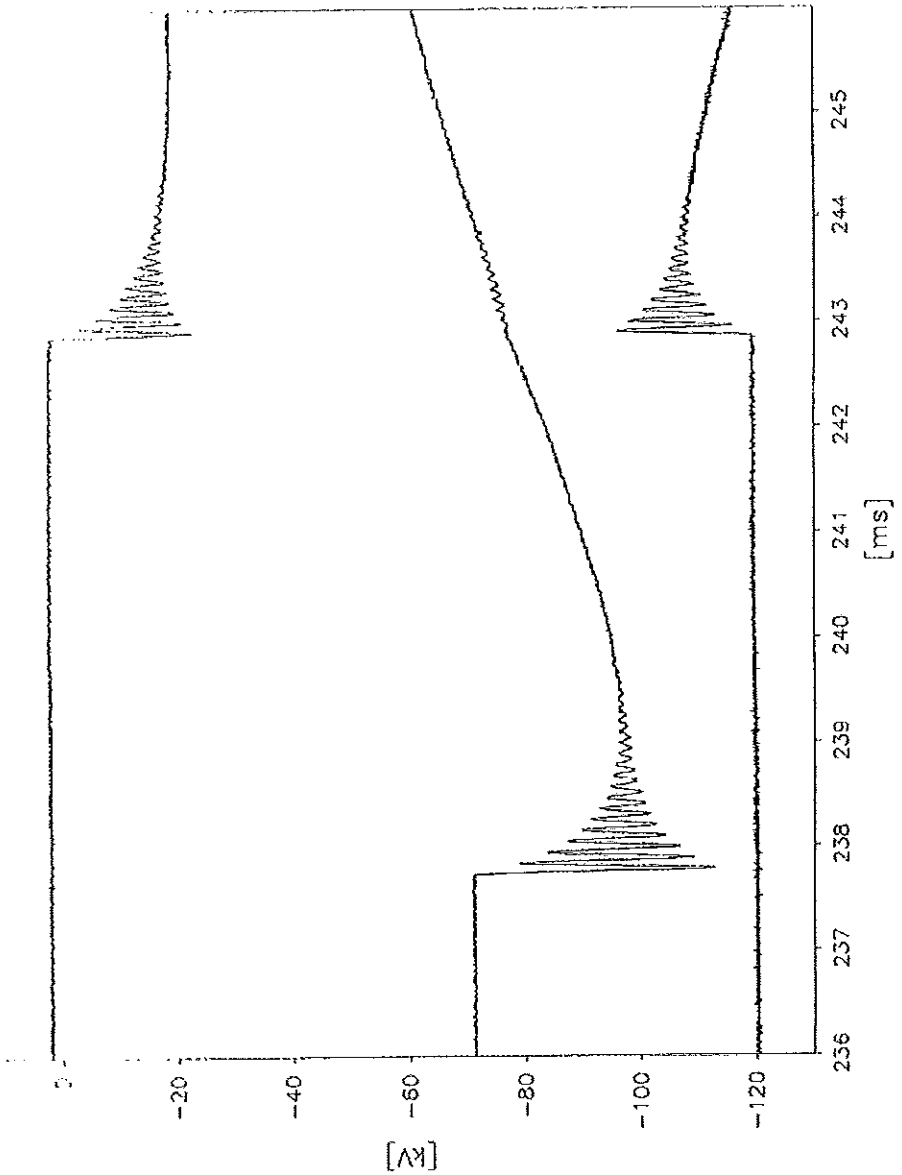
Oscillogram
PEHLA 0511Ra / 11



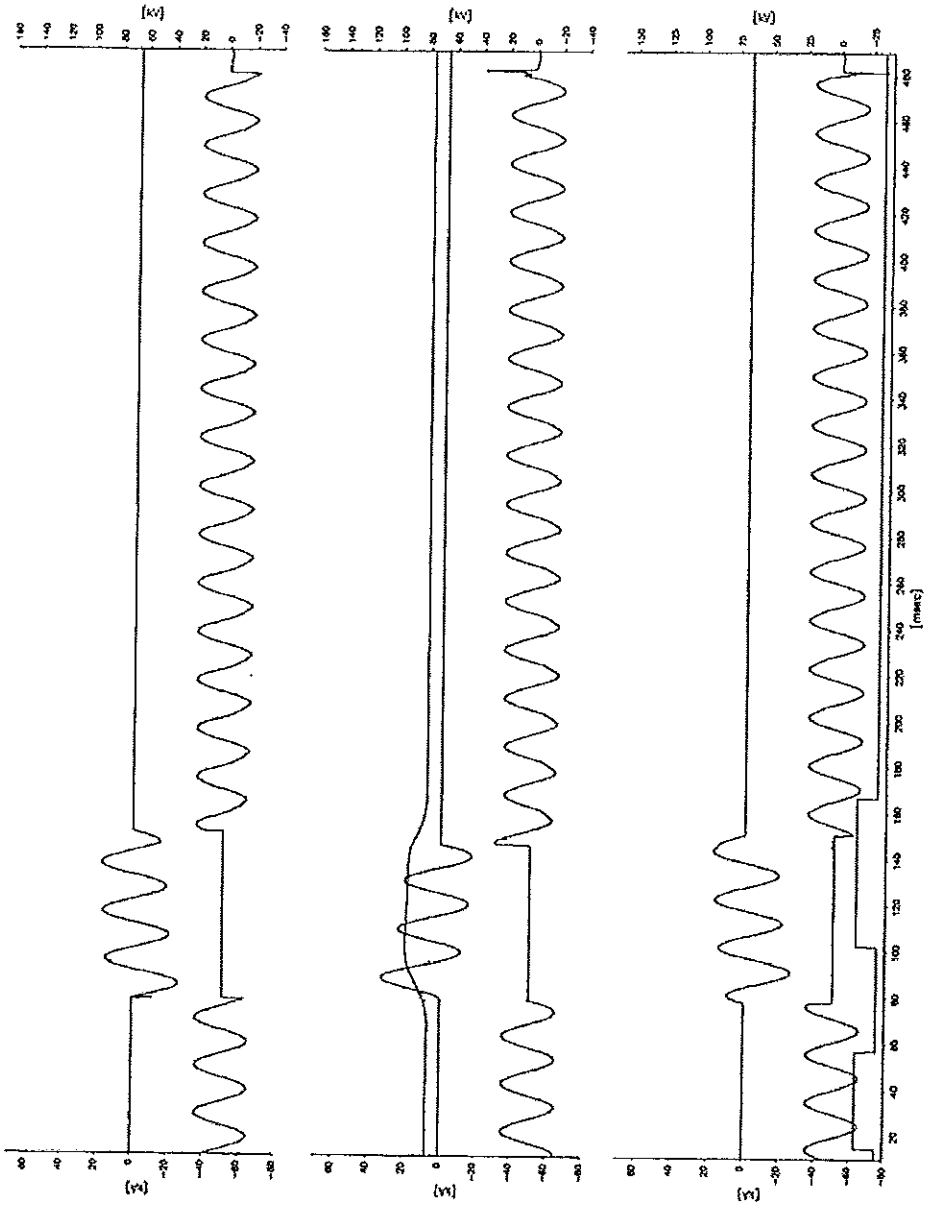
Oscillogram
PEHLA 0511Ra / 11



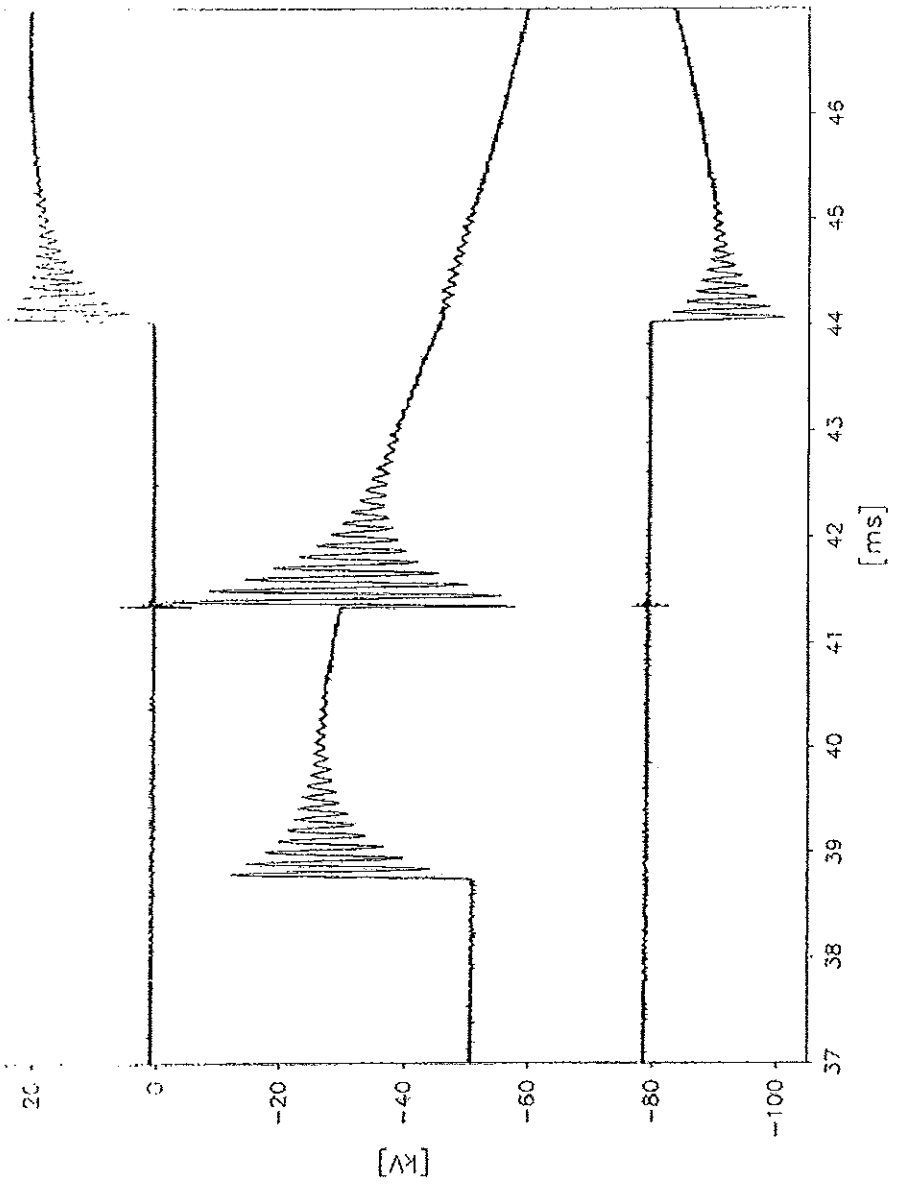
Oscillogram
PEHLA 0511Ra / 11



Oscillogram
PEHLA 0511Ra / 12



Oscillogram
PEHLA 0511Ra / 12



Test Results

Basic Short-Circuit Making and Breaking Tests

Test performed: Basic short-circuit making and breaking tests (T100s)
Date of test: 09th March 2005
Condition of test object before test: As after PEHLA 0511Ra / 12.
Test arrangement: Direct test circuit, circuit-breaker in gas insulated switchgear
Connections to test object: Infeed via copper bars to the busbar connection of the switchgear, short-circuited via copper bar at the cable terminals, short-circuit point earthed via cable.

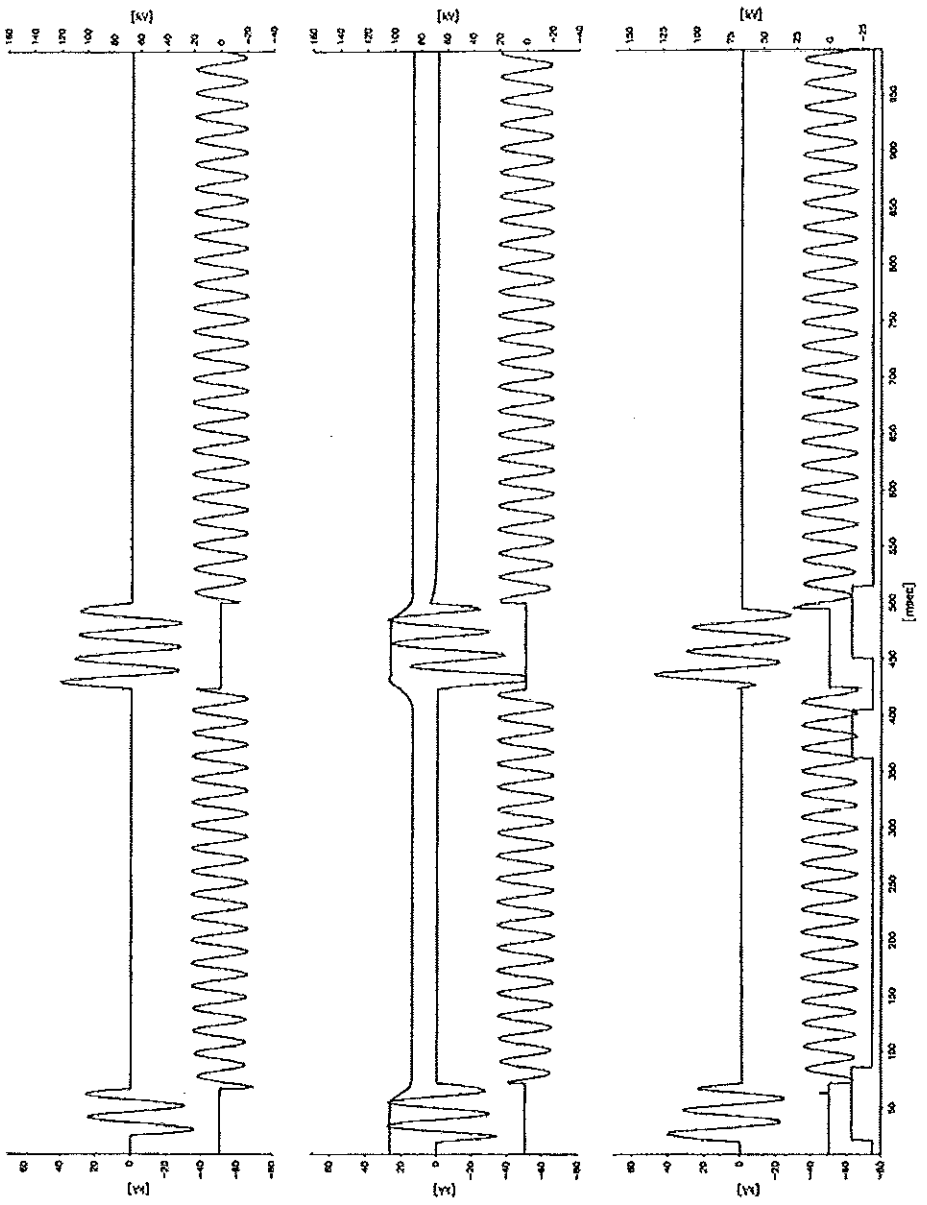
Test No. PEHLA 0511Ra			15		16	-	-	-
Operating sequence and time intervals			O-0.3s-CO-15s-CO			-	-	-
Applied voltage		kV	-	25.3	24.3	-	-	-
Making current (peak)	L1	kA	-	40.3	47.5	-	-	-
	L2	kA	-	49.7	49.7	-	-	-
	L3	kA	-	48.0	38.5	-	-	-
Breaking current (r.m.s.)	L1	kA	20.4	20.3	19.8	-	-	-
	L2	kA	20.5	20.0	21.1	-	-	-
	L3	kA	19.6	19.8	20.1	-	-	-
	Average value	kA	20.2	20.0	20.4	-	-	-
Recovery voltage (r.m.s)	L1	kV	13.7	14.1	14.0	-	-	-
	L2	kV	14.2	14.7	14.0	-	-	-
	L3	kV	14.0	14.5	14.1	-	-	-
Transient recovery voltage	Voltage u_1	kV	-	-	-	-	-	-
	Time t_1	µs	-	-	-	-	-	-
	TRV peak value u_c	kV	41.0	40.0	40.0	-	-	-
	Time t_3	µs	-	-	-	-	-	-
	Time delay t_d	µs	-	-	-	-	-	-
	Rate of rise u_c/t_3	kV/µs	-	-	-	-	-	-
C-Operation	Voltage of closing device	V	-	94	94	-	-	-
	Closing time	ms	-	62.9	63.0	-	-	-
	Pre-arcing time	ms	-	-	-	-	-	-
	Make time	ms	-	62.9	63.0	-	-	-
O-Operation	Voltage of opening device	V	77	77	77	-	-	-
	Opening time	ms	61.0	61.3	61.6	-	-	-
	Arcing time L1	ms	3.8	7.4	6.6	-	-	-
	L2	ms	8.6	8.4	2.6	-	-	-
	L3	ms	8.8	3.2	6.8	-	-	-
	Break time	ms	69.8	69.7	68.4	-	-	-
Emission of flame/gas/oil, occurrence of NSDD			no	no	no	-	-	-
Number of valid test			-	-	-	-	-	-
Test result			P	P	P	-	-	-

Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard

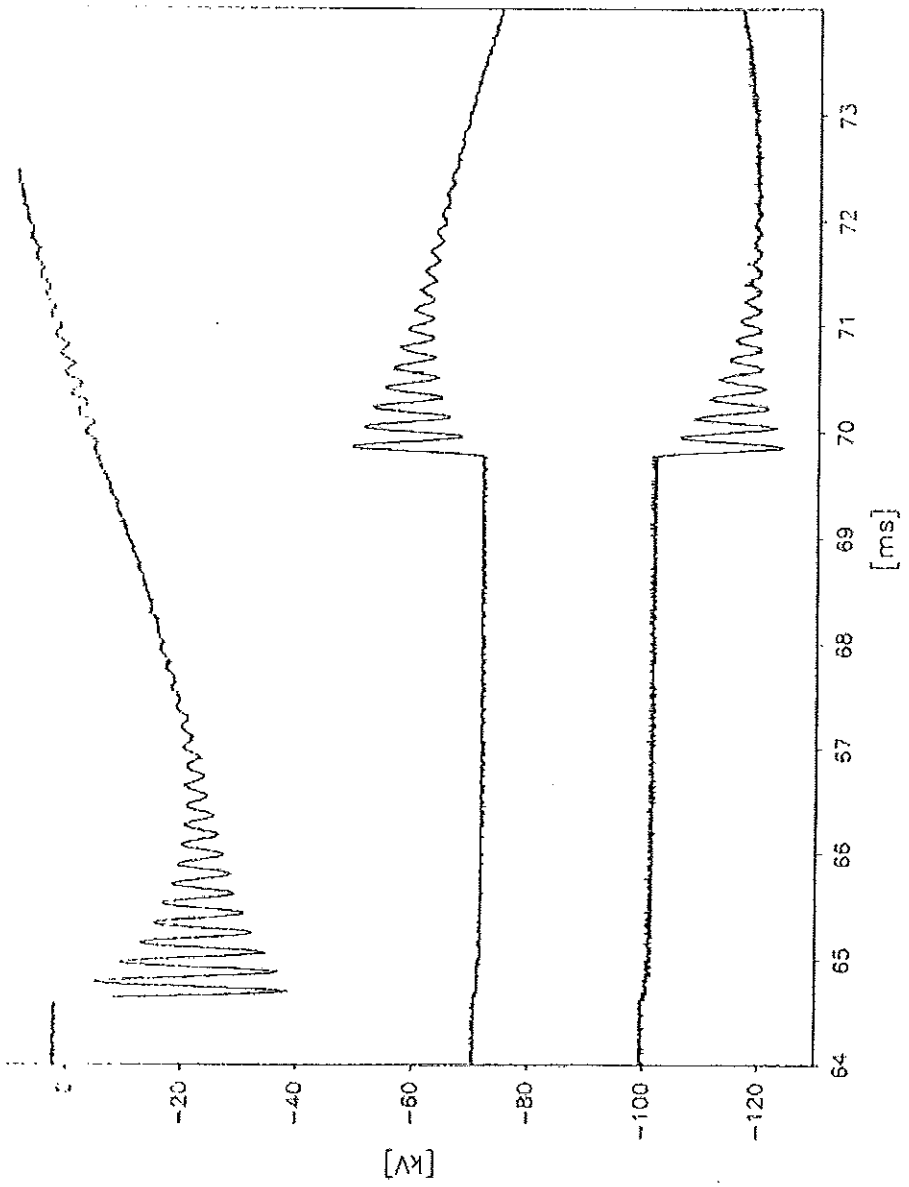
Remarks: PEHLA 0511Ra / 13 and 14: Tests with reduced values

Condition of test object after test: Switchgear and circuit-breaker were not inspected.

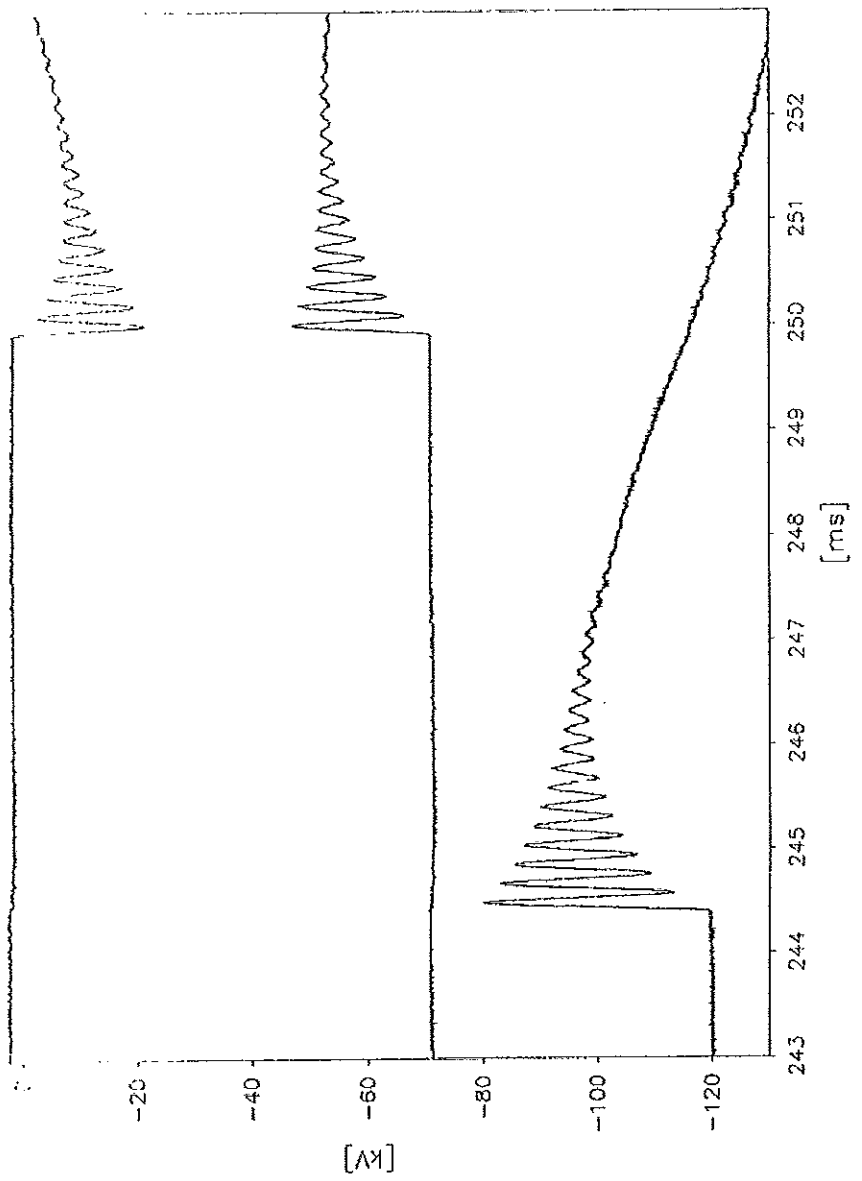
Oscillogram
PEHLA 0511Ra / 15



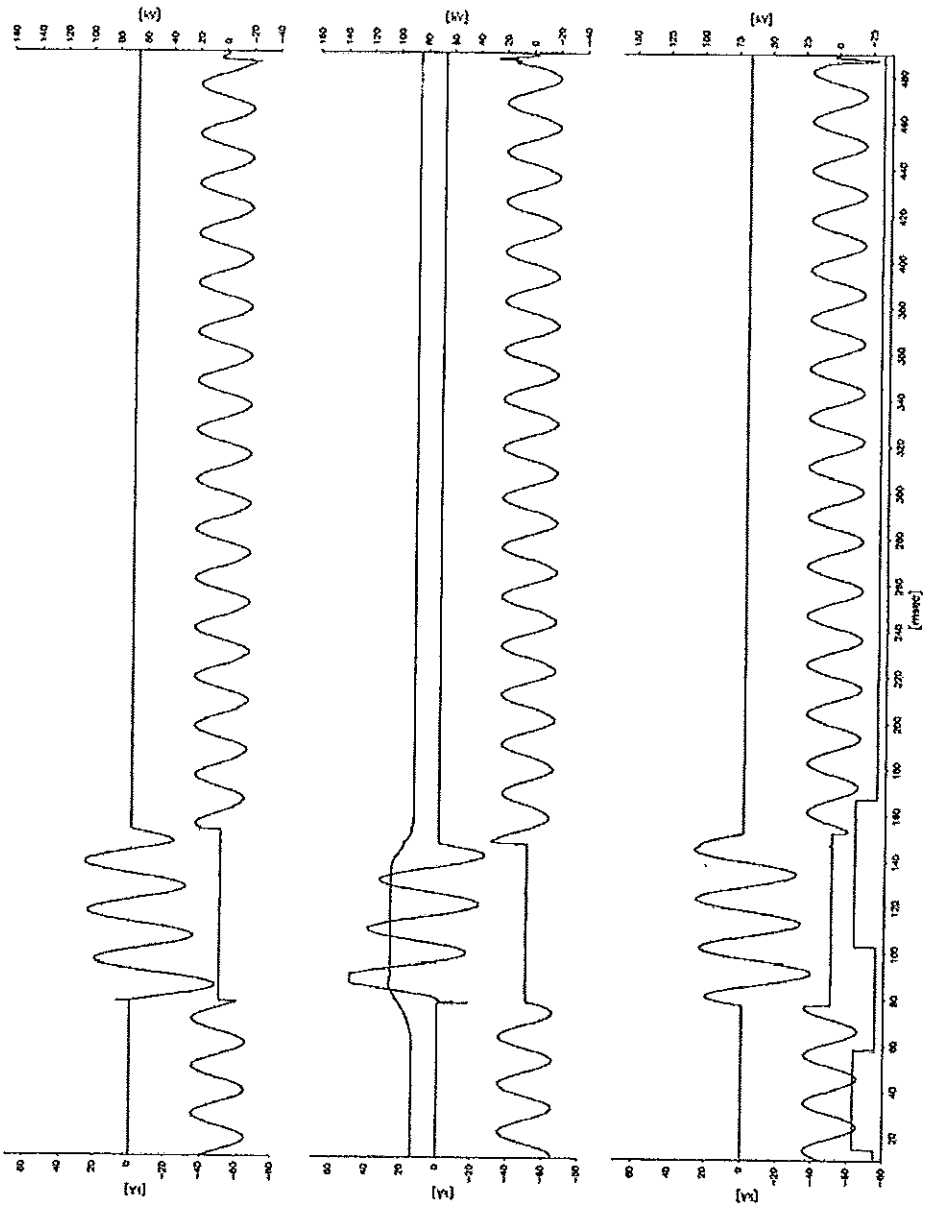
Oscillogram
PEHLA 0511Ra / 15



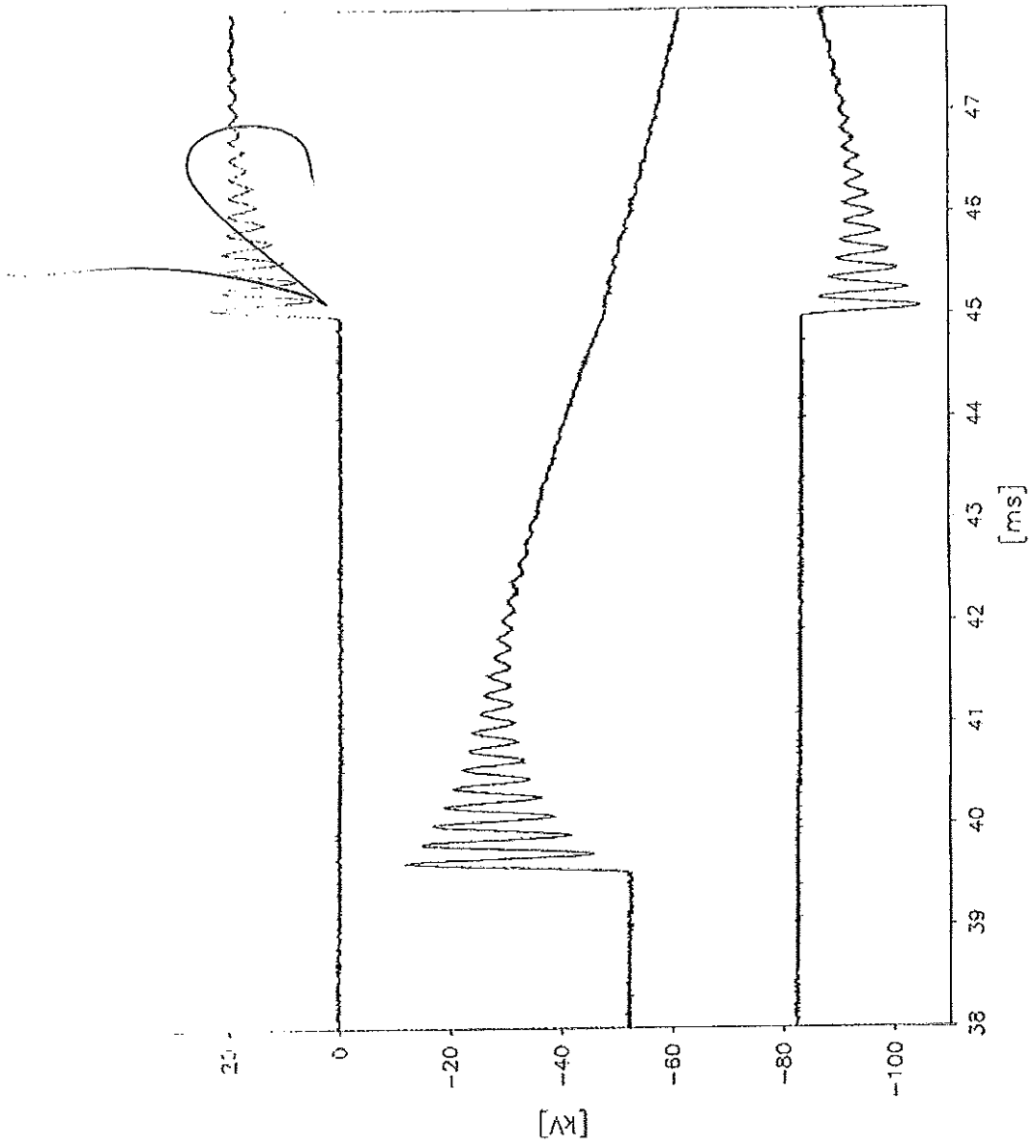
Oscillogram
PEHLA 0511Ra / 15



Oscillogram
PEHLA 0511Ra / 16



Oscillogram
PEHLA 0511Ra / 16



Test Results
Basic Short-Circuit Making and Breaking Tests

Test performed: Basic short-circuit making and breaking tests (T100a)
Date of test: 09th March 2005
Condition of test object before test: As after PEHLA 0511Ra / 16.
Test arrangement: Direct test circuit, circuit-breaker in gas insulated switchgear
Connections to test object: Infeed via copper bars to the cable terminals of the switchgear, short-circuited via copper bars at the busbar connection, short-circuit point earthed via cable.

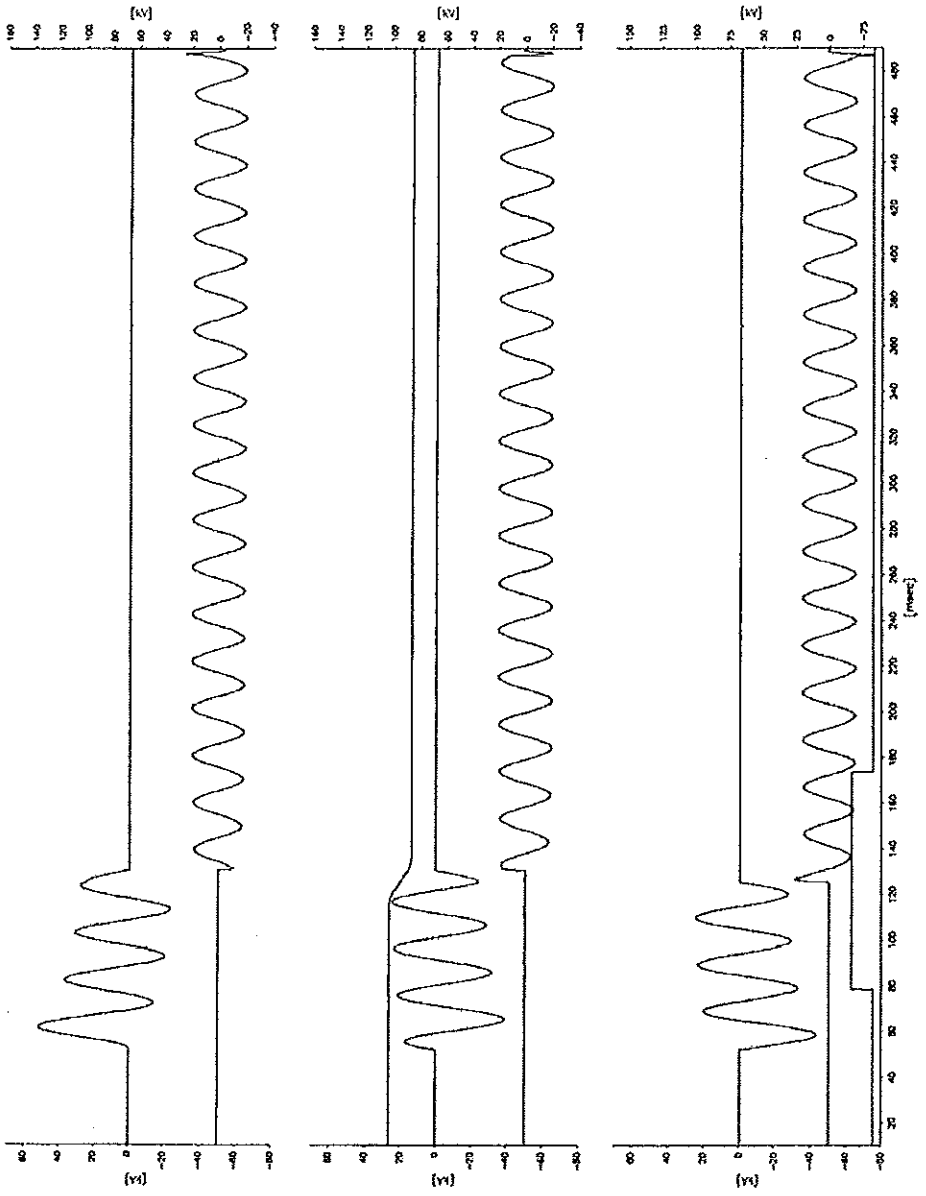
Test No. PEHLA 0511Ra			19	20	21	-	-	-
Operating sequence and time intervals			O-3min-O-3min-O			-	-	-
Applied voltage		kV	-	-	-	-	-	-
Breaking current (r.m.s.)	L1	kA	18.7	18.6	17.9	-	-	-
	L2	kA	18.2	19.0	18.7	-	-	-
	L3	kA	18.7	18.0	18.8	-	-	-
	Average value	kA	18.5	18.5	18.5	-	-	-
Breaking current - last current loop (peak)	L1	kA	-	-	-	-	-	-
	L2	kA	-	-	-	-	-	-
	L3	kA	-	-	-	-	-	-
Duration of the last current loop	L1	ms	-	-	-	-	-	-
	L2	ms	-	-	-	-	-	-
	L3	ms	-	-	-	-	-	-
DC-component	L1	%	< 20	< 20	< 20	-	-	-
	L2	%	< 20	< 20	< 20	-	-	-
	L3	%	< 20	< 20	< 20	-	-	-
Recovery voltage (r.m.s)	L1	kV	13.6	13.4	13.7	-	-	-
	L2	kV	13.9	13.5	13.9	-	-	-
	L3	kV	13.7	13.8	13.8	-	-	-
Transient recovery voltage	Voltage u_1	kV	-	-	-	-	-	-
	Time t_1	µs	-	-	-	-	-	-
	TRV peak value u_c	kV	39.9	38.9	38.4	-	-	-
	Time t_3	µs	-	-	-	-	-	-
	Time delay t_d	µs	-	-	-	-	-	-
	Rate of rise u_c/t_3	kV/µs	-	-	-	-	-	-
O-Operation	Voltage of opening device	V	121	121	121	-	-	-
	Opening time	ms	46.6	46.9	47.7	-	-	-
	Arcing time L1	ms	5.2	8.4	8.6	-	-	-
	L2	ms	5.2	3.6	8.6	-	-	-
	L3	ms	0.8	8.4	3.8	-	-	-
	Break time	ms	51.8	55.3	56.3	-	-	-
Emission of flame/gas/oil, occurrence of NSDD			no	no	no	-	-	-
Number of valid test			-	-	-	-	-	-
Test result			P	P	P	-	-	-

Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard

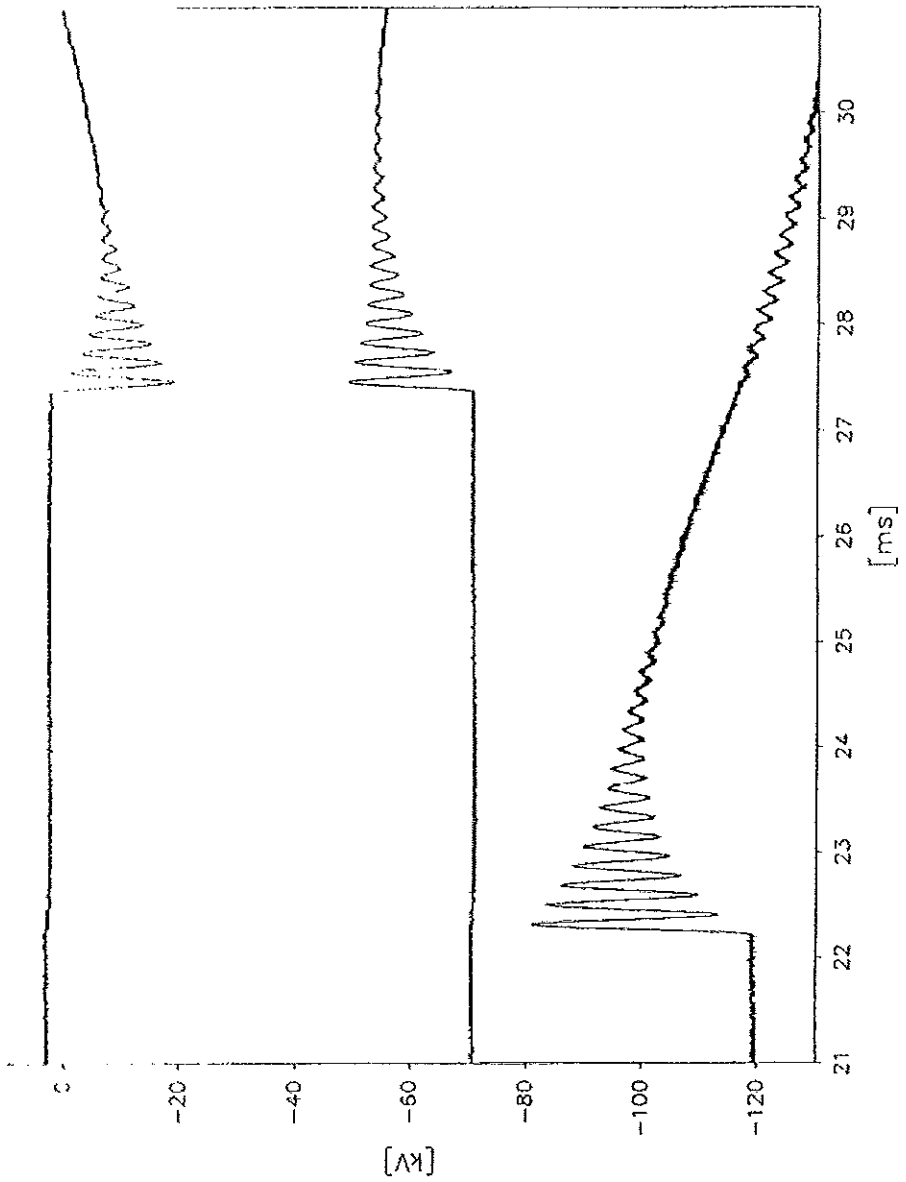
Remarks:
Before PEHLA 0511Ra / 17: Infeed direction inverted
PEHLA 0511Ra / 17 and 18: Test with reduced values
PEHLA 0511Ra / 19 to 21: Tests for determination of DC-component

Condition of test object after test: Switchgear and circuit-breaker were not inspected.

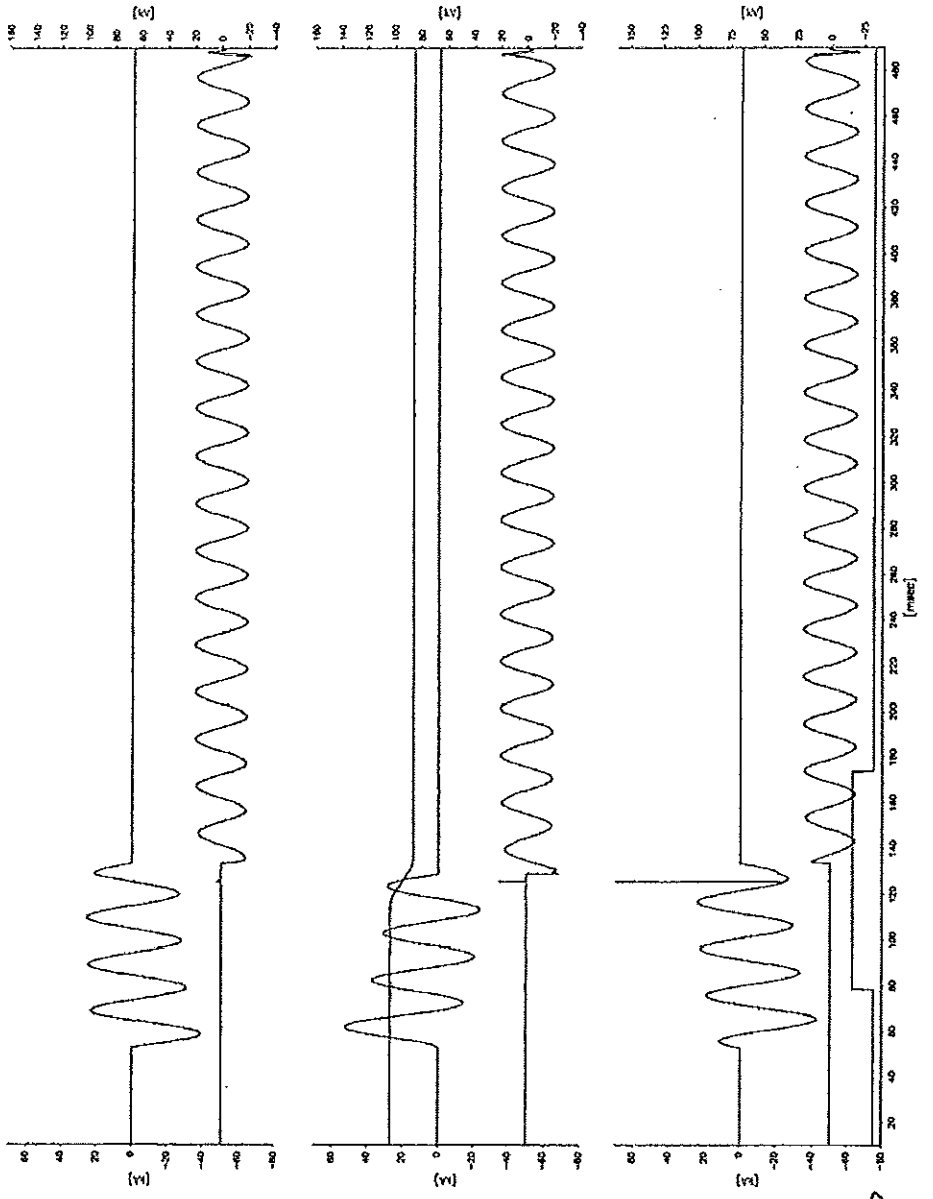
Oscillogram
PEHLA 0511Ra / 19



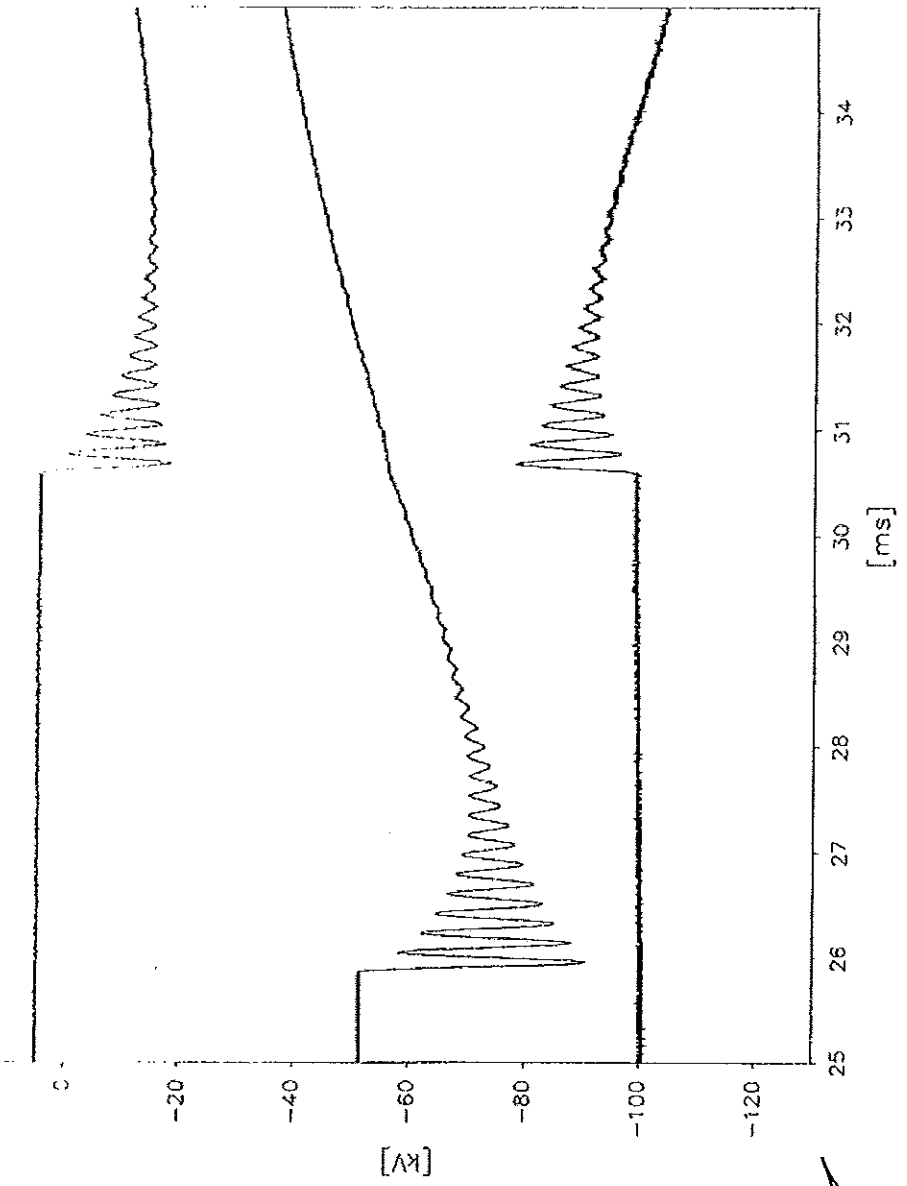
Oscillogram
PEHLA 0511Ra / 19



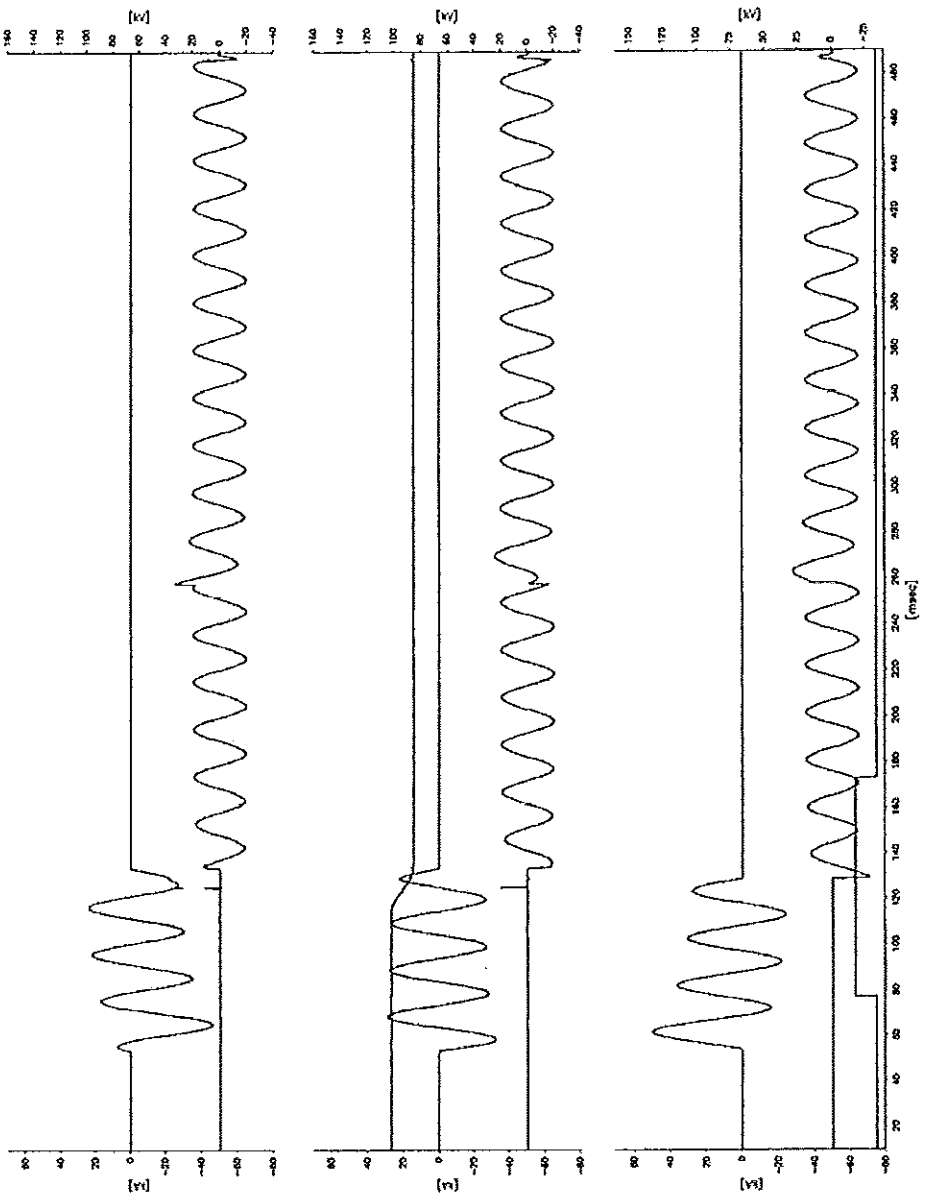
Oscillogram
PEHLA 0511Ra / 20



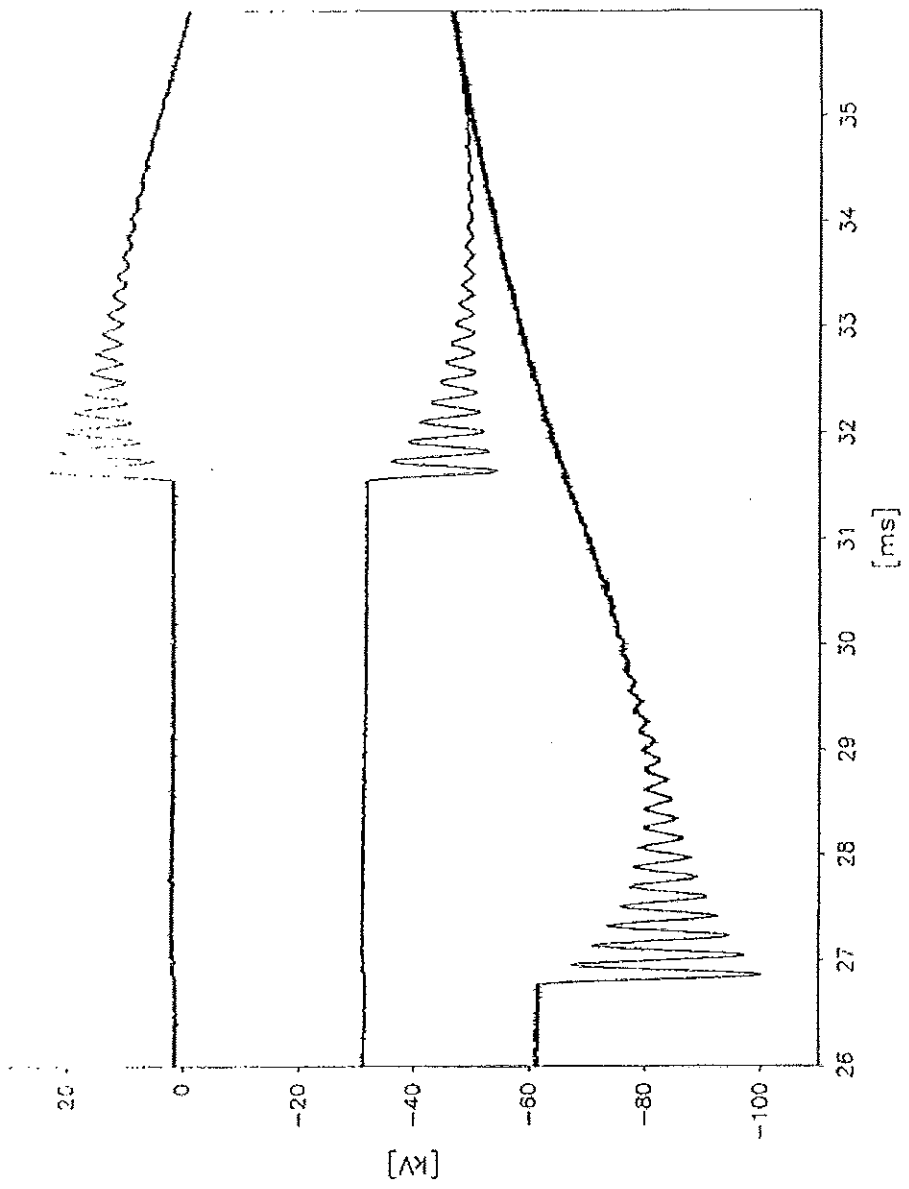
Oscillogram
PEHLA 0511Ra / 20



Oscillogram
PEHLA 0511Ra / 21



Oscillogram
PEHLA 0511Ra / 21



Test Results
Basic Short-Circuit Making and Breaking Tests

Test performed: Basic short-circuit making and breaking tests (T100a)
Date of test: 09th March 2005
Condition of test object before test: As after PEHLA 0511Ra / 21.
Test arrangement: Direct test circuit, circuit-breaker in gas insulated switchgear
Connections to test object: Infeed via copper bars to the cable terminals of the switchgear, short-circuited via copper bars at the busbar connection, short-circuit point earthed via cable.

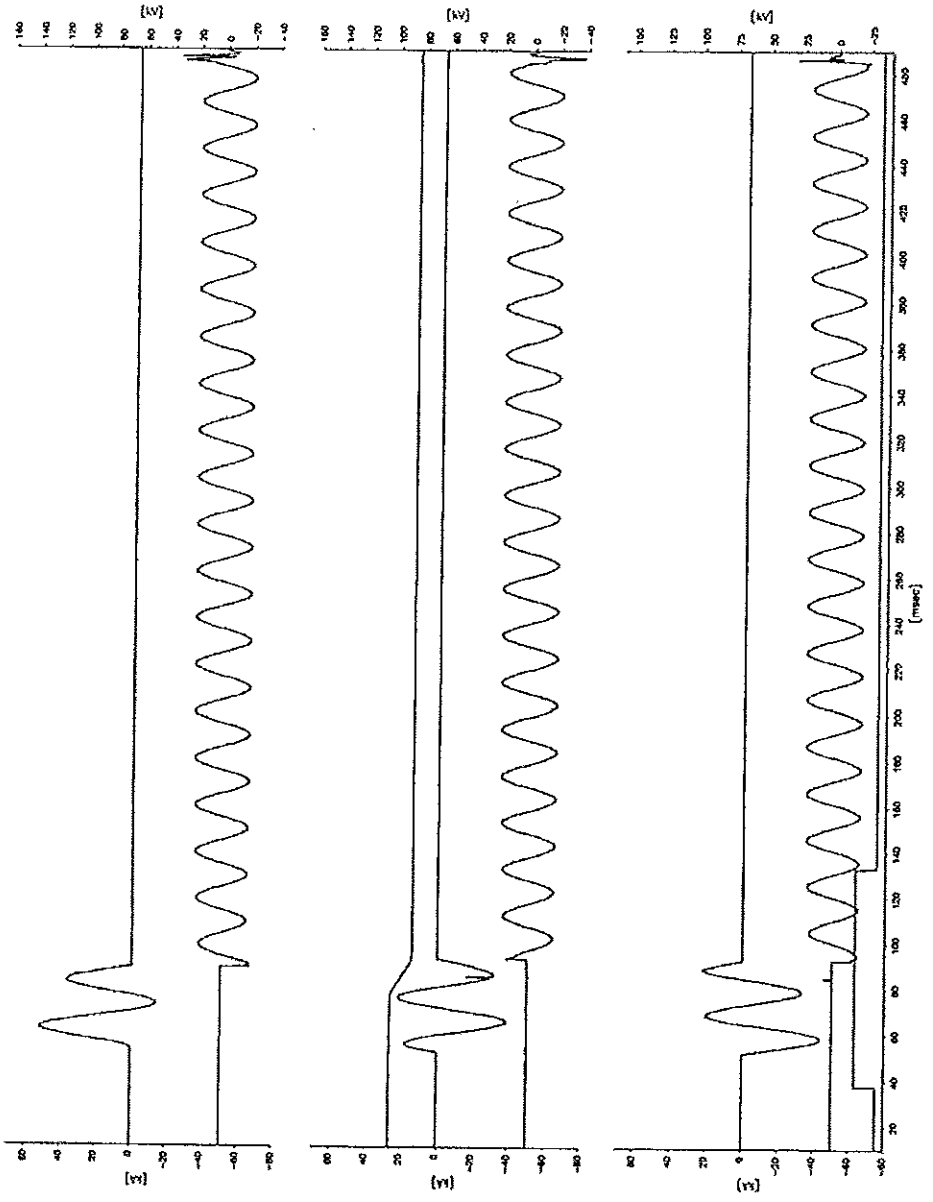
Test No. PEHLA 0511Ra			23	24	25	26	27	28
Operating sequence and time intervals			O-3min-O-3min-O-3min-O-3min-O-3min-O-					
Applied voltage		kV	-	-	-	-	-	-
Breaking current (r.m.s.)	L1	kA	20.7	20.5	20.6	20.6	20.5	20.5
	L2	kA	20.1	19.8	19.9	20.9	20.5	20.6
	L3	kA	20.7	20.1	20.0	20.5	19.7	19.8
Average value		kA	20.5	20.1	20.2	20.7	20.2	20.3
Breaking current - last current loop (peak)	L1	kA	36.9	-	-	-	-	-
	L2	kA	-	37.3	37.3	37.3	-	-
	L3	kA	-	-	-	-	36.0	36.0
Duration of the last current loop	L1	ms	12.8	-	-	-	-	-
	L2	ms	-	12.6	12.6	12.6	-	-
	L3	ms	-	-	-	-	12.2	12.2
DC-component	L1	%	32.2	< 20	< 20	< 20	35.7	35.7
	L2	%	< 20	37.8	39.9	37.8	< 20	< 20
	L3	%	< 20	28.3	29.7	28.0	33.7	34.0
Recovery voltage (r.m.s)	L1	kV	13.9	13.7	13.7	13.7	13.7	13.8
	L2	kV	13.9	13.6	14.1	13.7	14.1	14.0
	L3	kV	14.2	13.5	14.1	14.1	14.0	14.1
Transient recovery voltage Voltage u_1		kV	-	-	-	-	-	
Time t_1		µs	-	-	-	-	-	
TRV peak value u_c		kV	40.8	39.6	37.4	41.4	37.4	37.4
Time t_3		µs	-	-	-	-	-	-
Time delay t_d		µs	-	-	-	-	-	-
Rate of rise u_c/t_3		kV/µs	-	-	-	-	-	-
O-Operation Voltage of opening device		V	121	121	121	121	121	121
Opening time		ms	47.0	47.3	45.8	44.6	47.0	46.0
Arcing time	L1	ms	3.8	6.6	6.4	6.0	0.8	0.8
	L2	ms	7.8	6.4	8.0	10.2	6.6	6.6
	L3	ms	8.0	0.8	1.8	10.4	6.4	6.6
Break time		ms	55.0	53.7	53.8	55.0	53.6	52.6
Emission of flame/gas/oil, occurrence of NSDD			no	no	no	no	no	no
Number of valid test			-	-	-	-	-	-
Test result			P	P	P	P	P	P

Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard

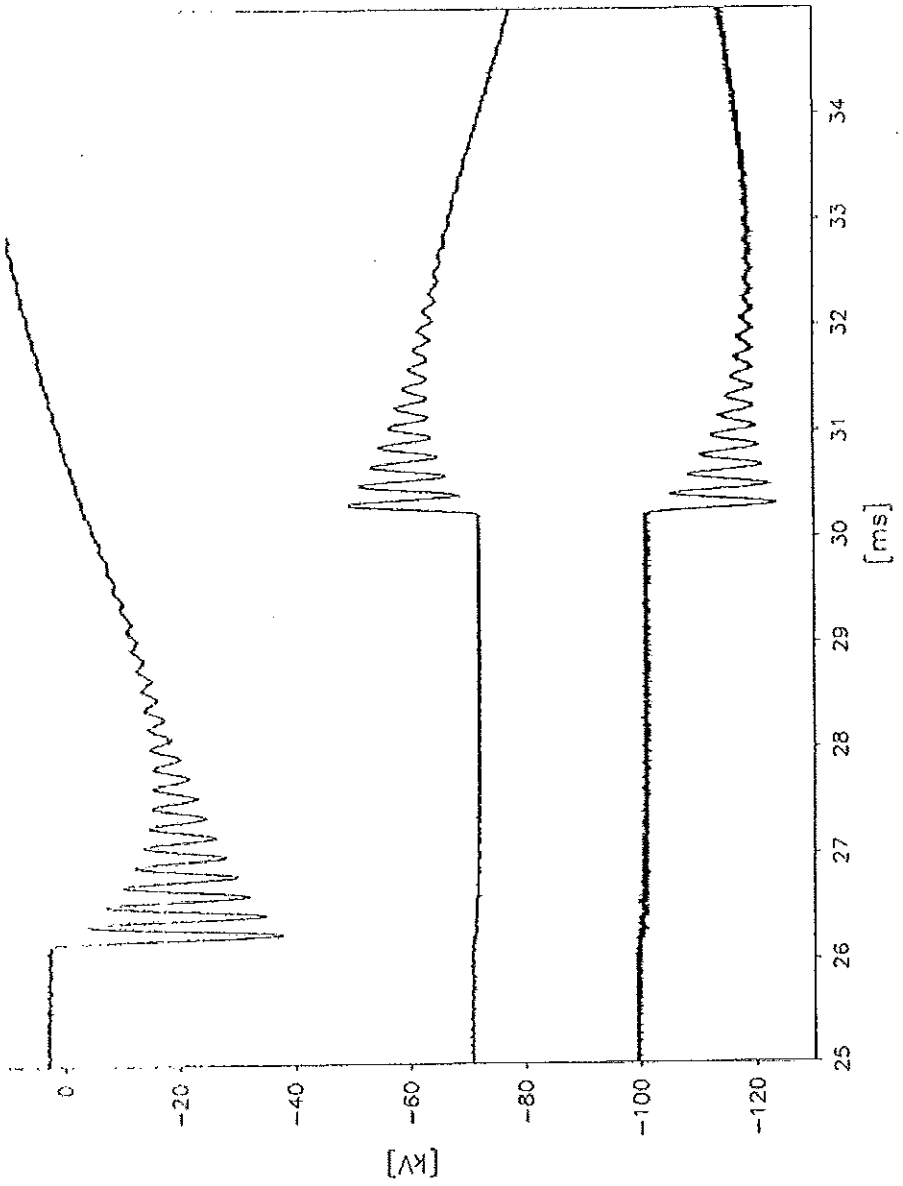
Remarks: PEHLA 0511Ra / 22: Test with reduced values.

Condition of test object after test: Switchgear and circuit-breaker were not inspected.

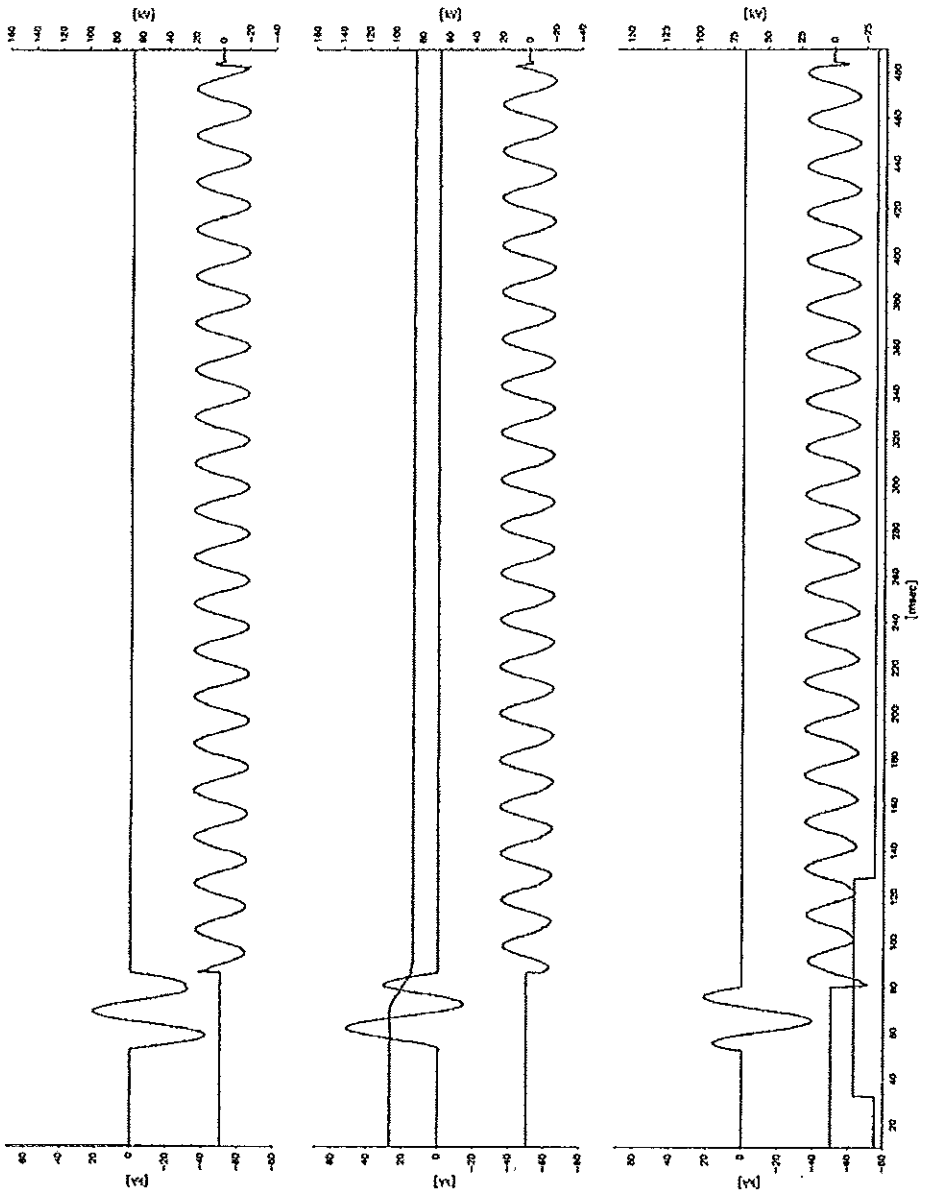
Oscillogram
PEHLA 0511Ra / 23



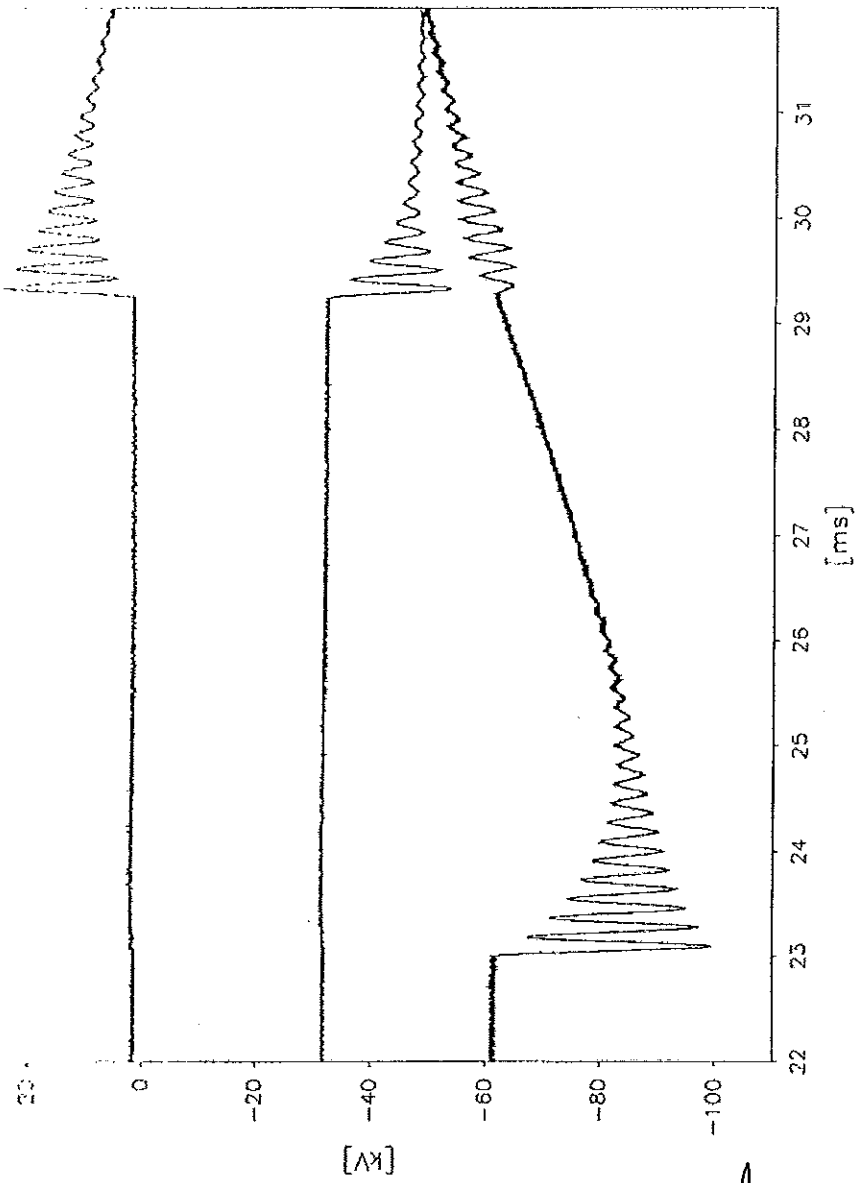
Oscillogram
PEHLA 0511Ra / 23



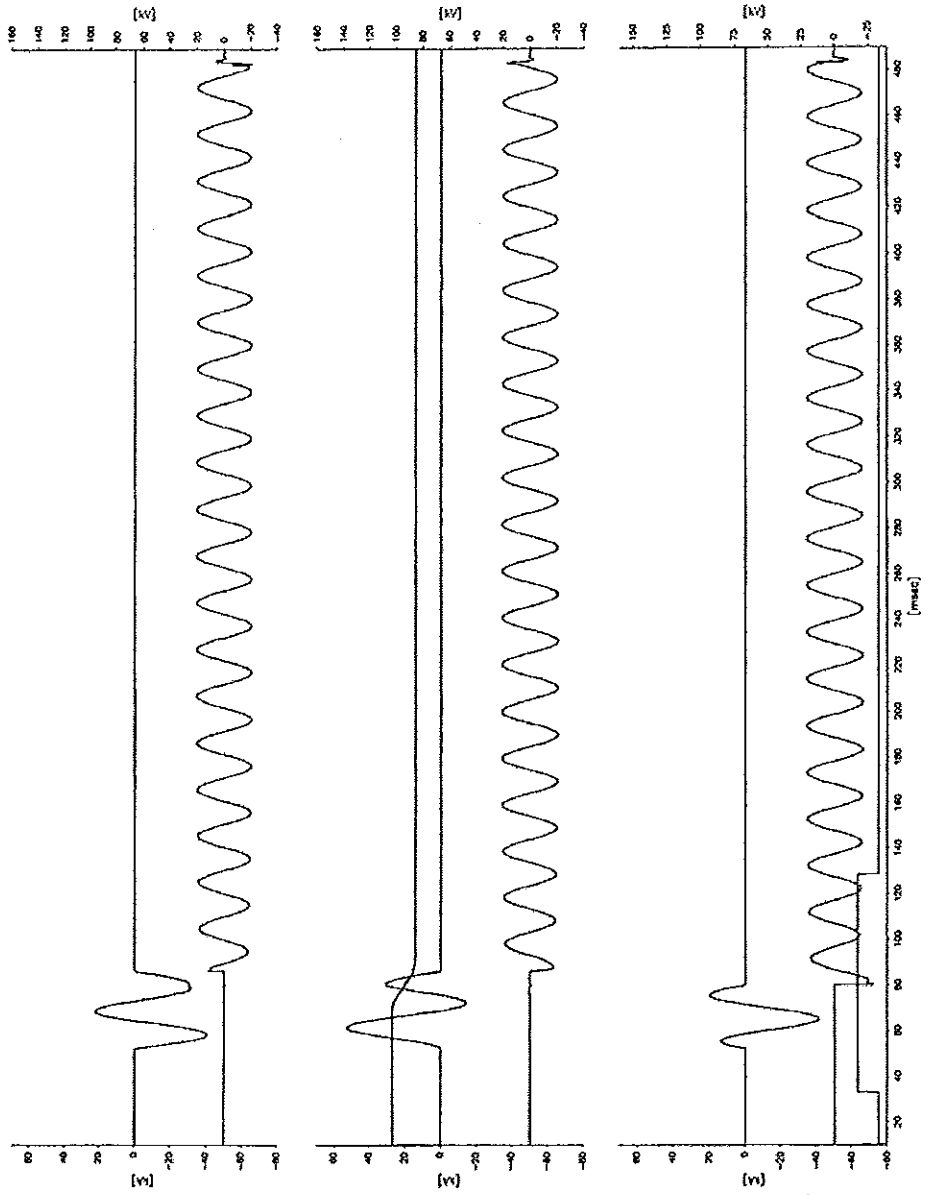
Oscillogram
PEHLA 0511Ra / 24



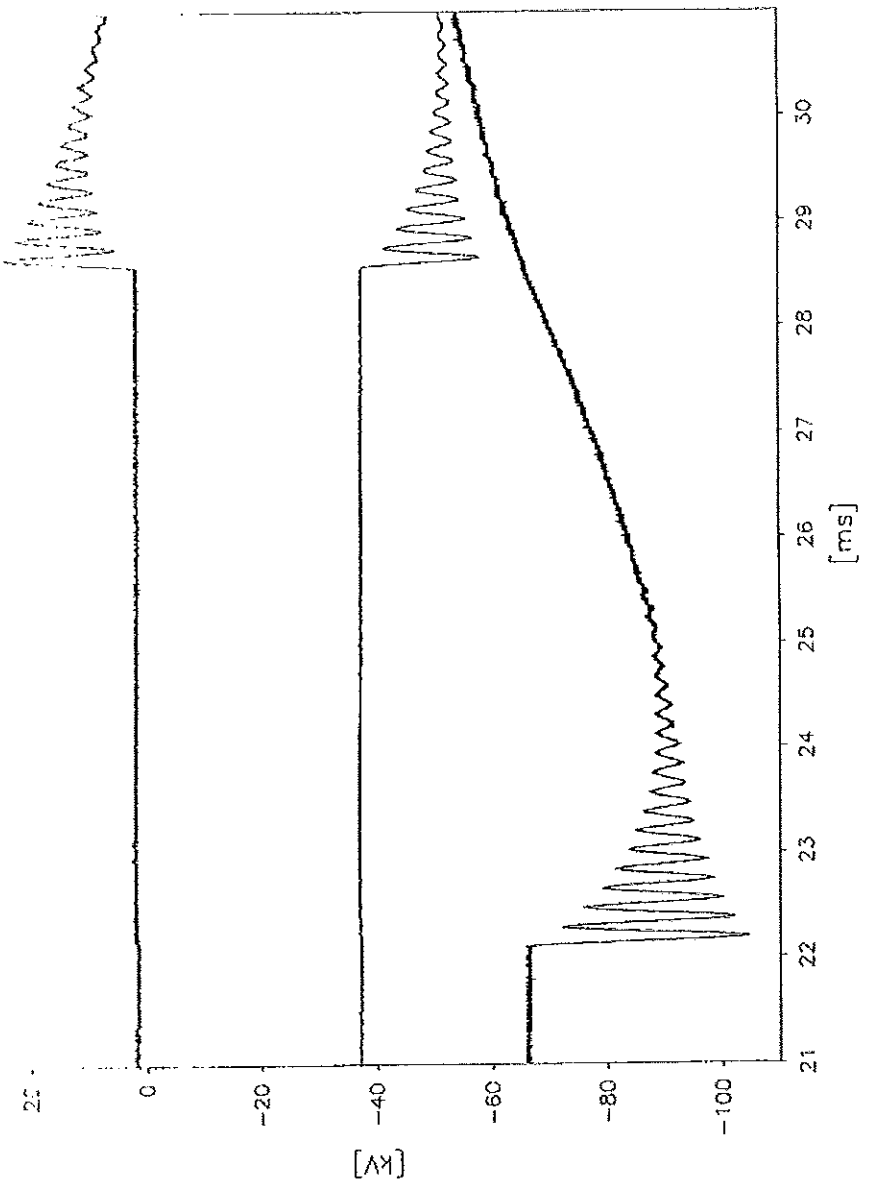
Oscillogram
PEHLA 0511Ra / 24



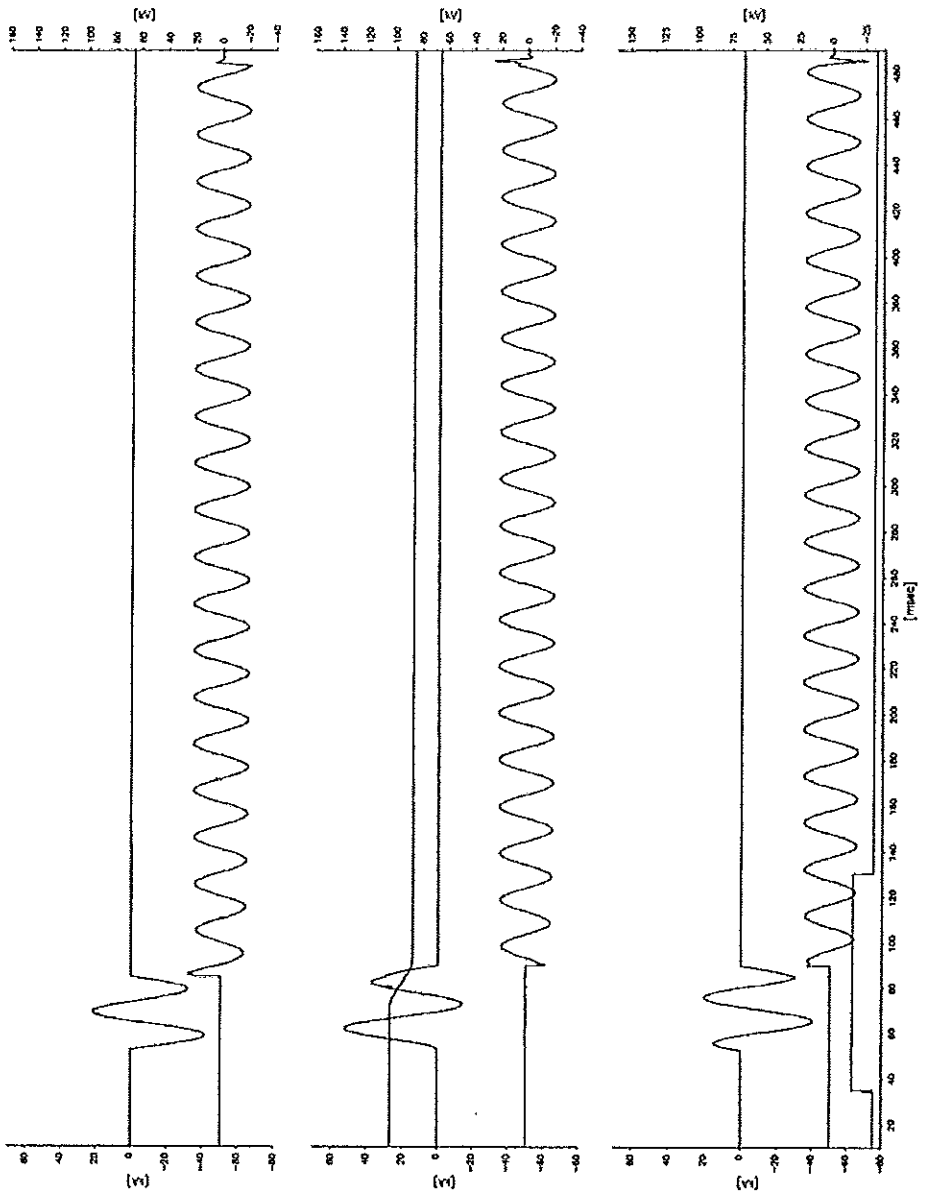
Oscillogram
PEHLA 0511Ra / 25



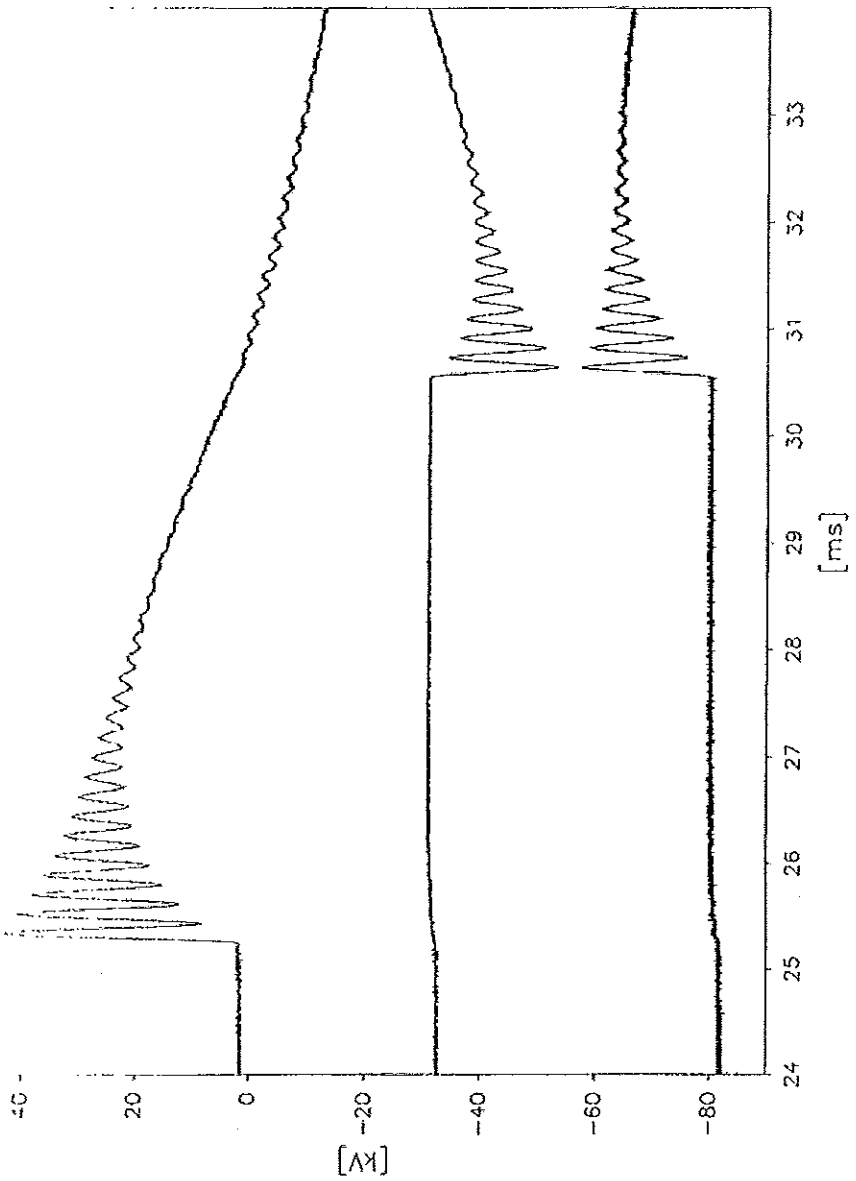
Oscillogram
PEHLA 0511Ra / 25



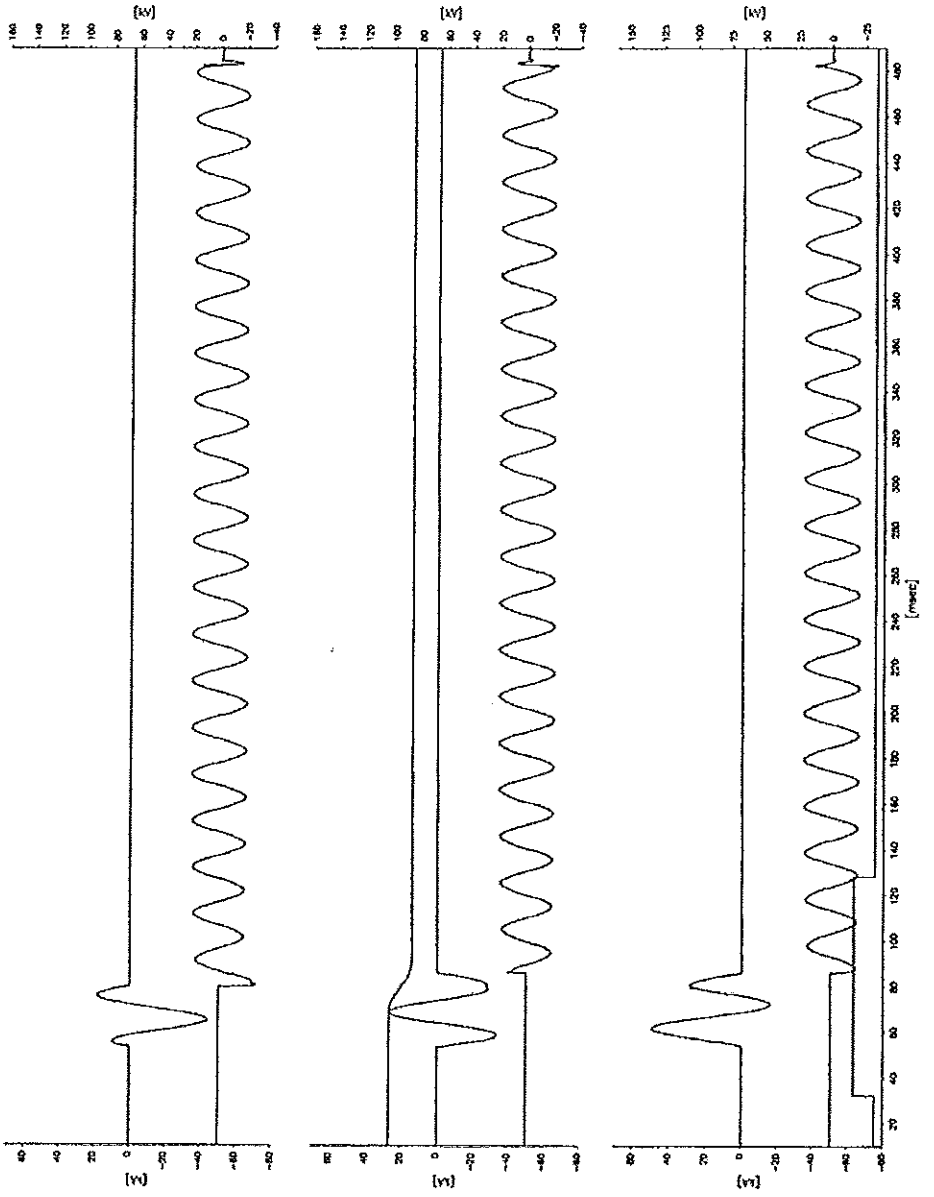
Oscillogram
PEHLA 0511Ra / 26



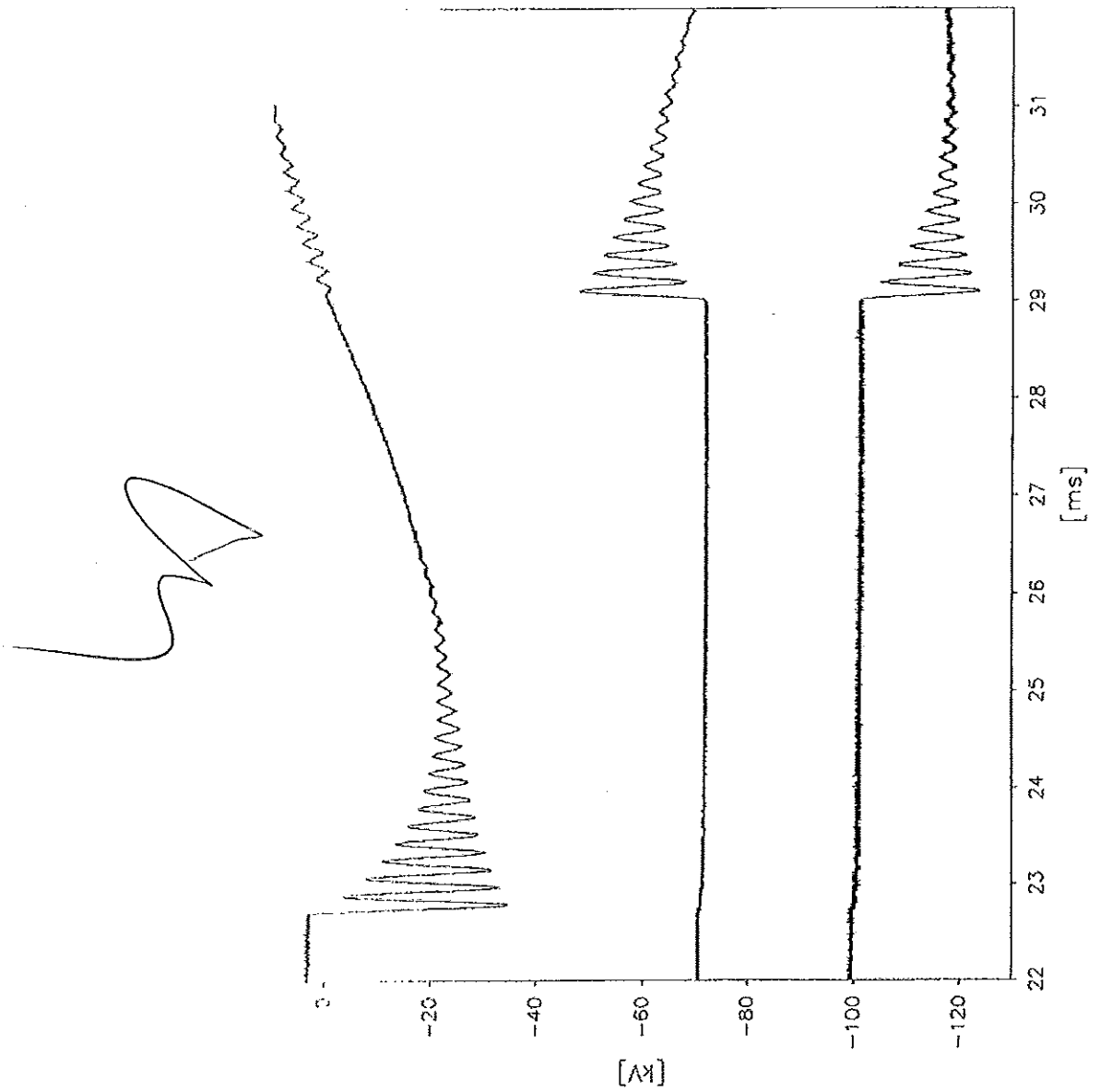
Oscillogram
PEHLA 0511Ra / 26



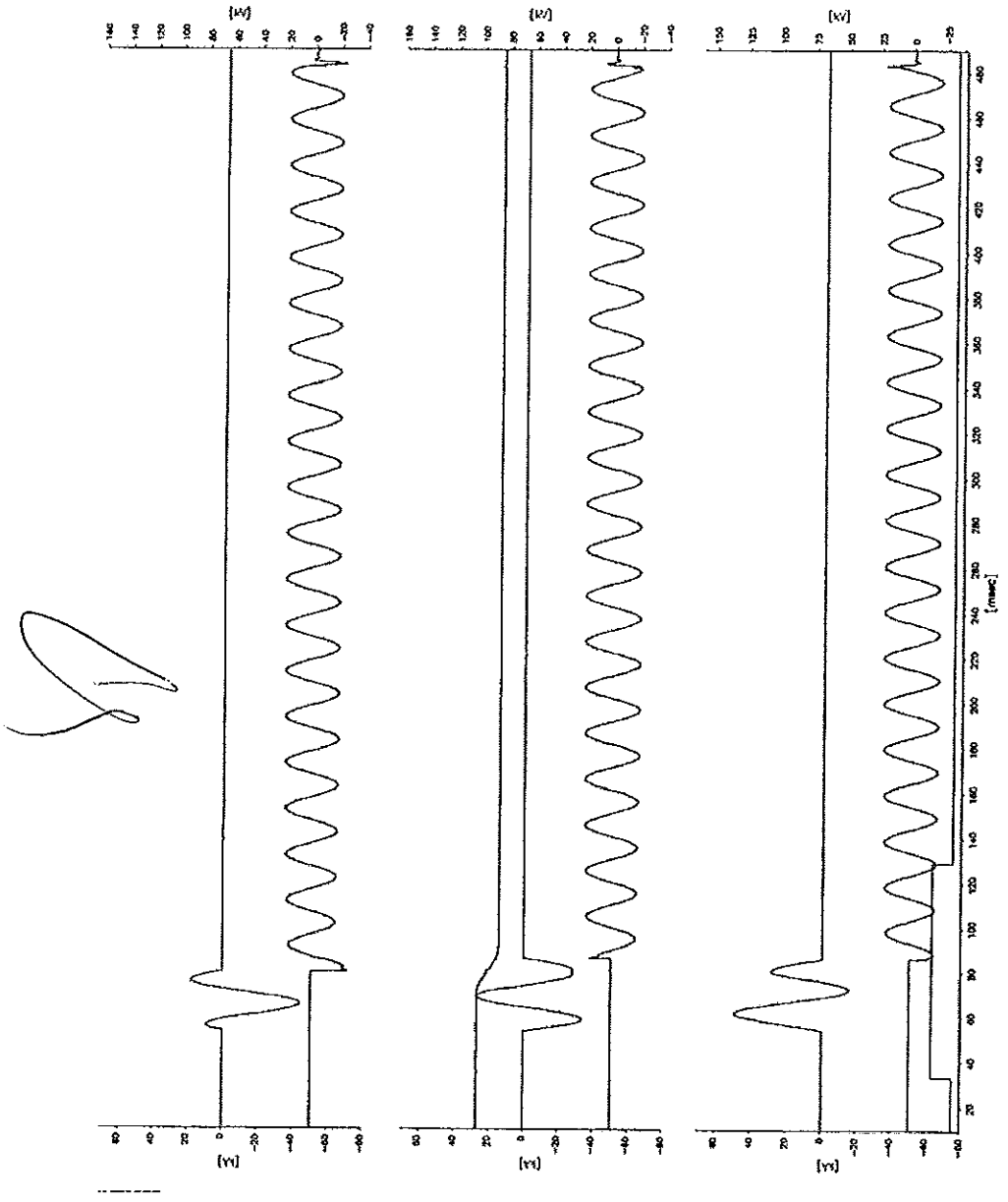
Oscillogram
PEHLA 0511Ra / 27



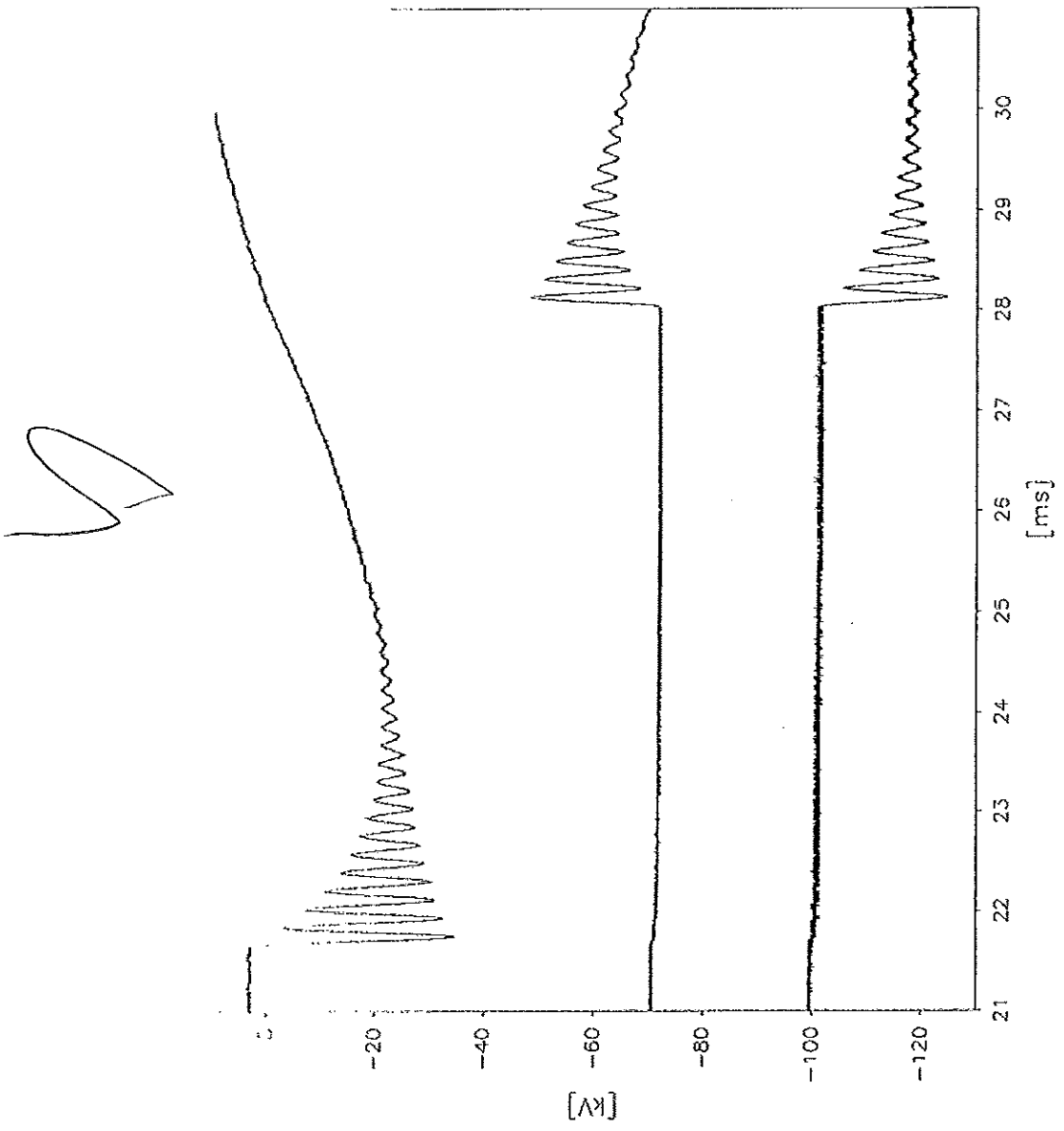
Oscillogram
PEHLA 0511Ra / 27



Oscillogram
PEHLA 0511Ra / 28



Oscillogram
PEHLA 0511Ra / 28



Test Results
Basic Short-Circuit Making and Breaking Tests

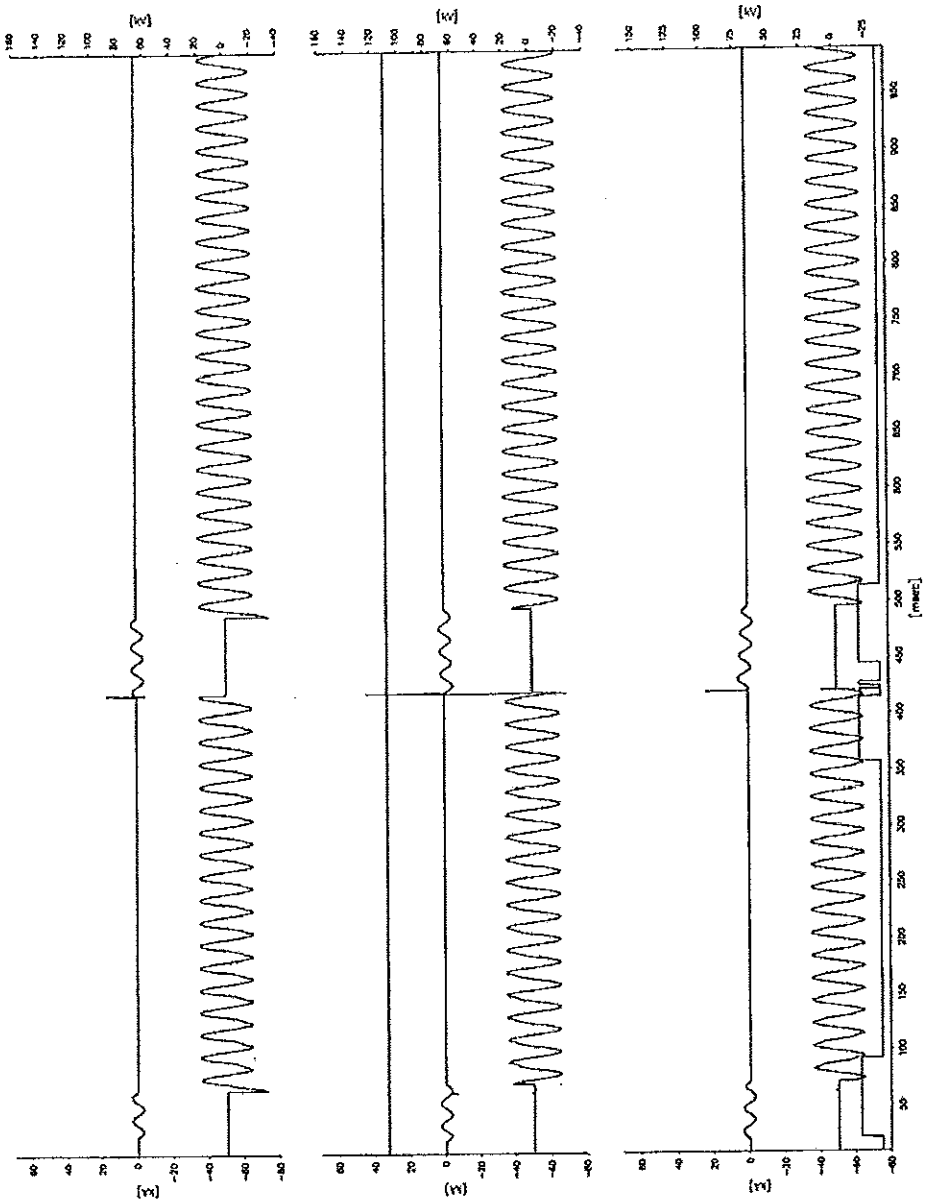
Test performed: Basic short-circuit making and breaking tests (T10)
Date of test: 10th March 2005
Condition of test object before test: As after PEHLA 0511Ra / 28.
Test arrangement: Direct test circuit, circuit-breaker in gas insulated switchgear
Connections to test object: Infeed via copper bars to the busbar connection of the switchgear, short-circuited via copper bar at the cable terminals, short-circuit point earthed via cable.

Test No. PEHLA 0511Ra			29		30	-	-	-
Operating sequence and time intervals			O-0.3s-CO-15s-CO			-	-	-
Applied voltage		kV	-	24.5	24.2	-	-	-
Making current (peak)	L1	kA	-	4.02	3.6	-	-	-
	L2	kA	-	4.85	5.2	-	-	-
	L3	kA	-	5.48	5.3	-	-	-
Breaking current (r.m.s.)	L1	kA	2.21	2.31	2.30	-	-	-
	L2	kA	2.28	2.34	2.28	-	-	-
	L3	kA	2.24	2.31	2.25	-	-	-
	Average value	kA	2.24	2.32	2.28	-	-	-
Recovery voltage (r.m.s)	L1	kV	13.8	14.5	14.3	-	-	-
	L2	kV	14.0	14.6	14.2	-	-	-
	L3	kV	13.7	14.6	14.5	-	-	-
Transient recovery voltage	Voltage u_1	kV	-	-	-	-	-	-
	Time t_1	µs	-	-	-	-	-	-
	TRV peak value u_c	kV	46.5	48.5	44.0	-	-	-
	Time t_3	µs	65.0	65.0	65.0	-	-	-
	Time delay t_d	µs	-	-	-	-	-	-
	Rate of rise u_c/t_3	kV/µs	0.715	0.746	0.677	-	-	-
C-Operation	Voltage of closing device	V	-	94	94	-	-	-
	Closing time	ms	-	63.4	64.4	-	-	-
	Pre-arcing time	ms	-	-	-	-	-	-
	Make time	ms	-	63.4	64.4	-	-	-
O-Operation	Voltage of opening device	V	77	77	77	-	-	-
	Opening time	ms	61.3	63.1	60.4	-	-	-
	Arcing time L1	ms	3.8	2.2	9.4	-	-	-
	L2	ms	9.0	7.0	9.4	-	-	-
	L3	ms	9.0	7.0	4.0	-	-	-
	Break time	ms	70.3	70.1	69.8	-	-	-
Emission of flame/gas/oil, occurrence of NSDD			no	no	no	-	-	-
Number of valid test			-	-	-	-	-	-
Test result			P	P	P	-	-	-

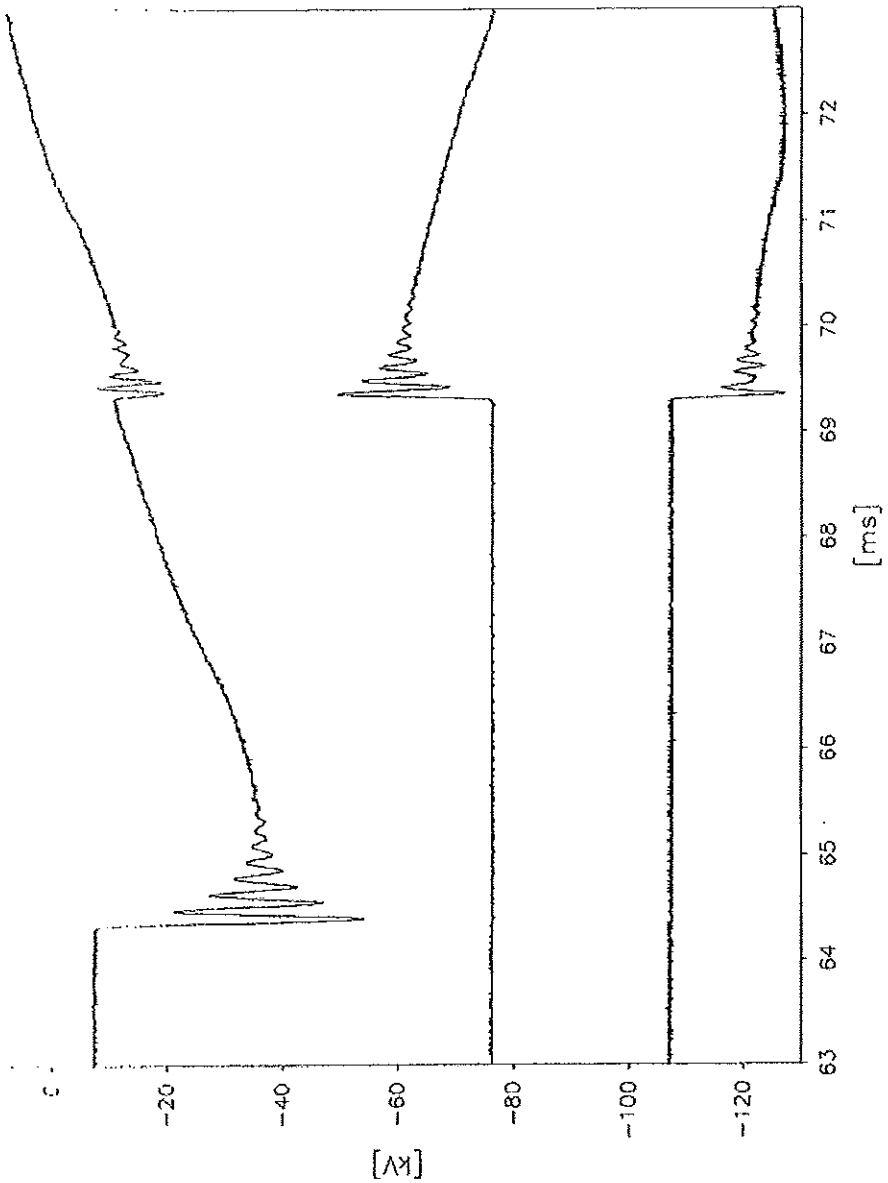
Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard
Remarks: PEHLA 0511Ra / 31: No-load operation

Condition of test object after test: The condition of the circuit-breaker after the test series corresponds to the conditions given in clause 6.102.9.4 of IEC 62271-100 / Ed. 1.1 / 2003-05. Visual inspection, no-load measurements before and after the test series, measurements of the resistance of the main circuit before and after the test series as well as a power frequency voltage check according to clause 6.2.11 of IEC 62271-100 / Ed. 1.1 / 2003-05 (with 80% and 100% of the rated power frequency withstand voltage) after the test series are carried out to prove the condition of the circuit-breaker.

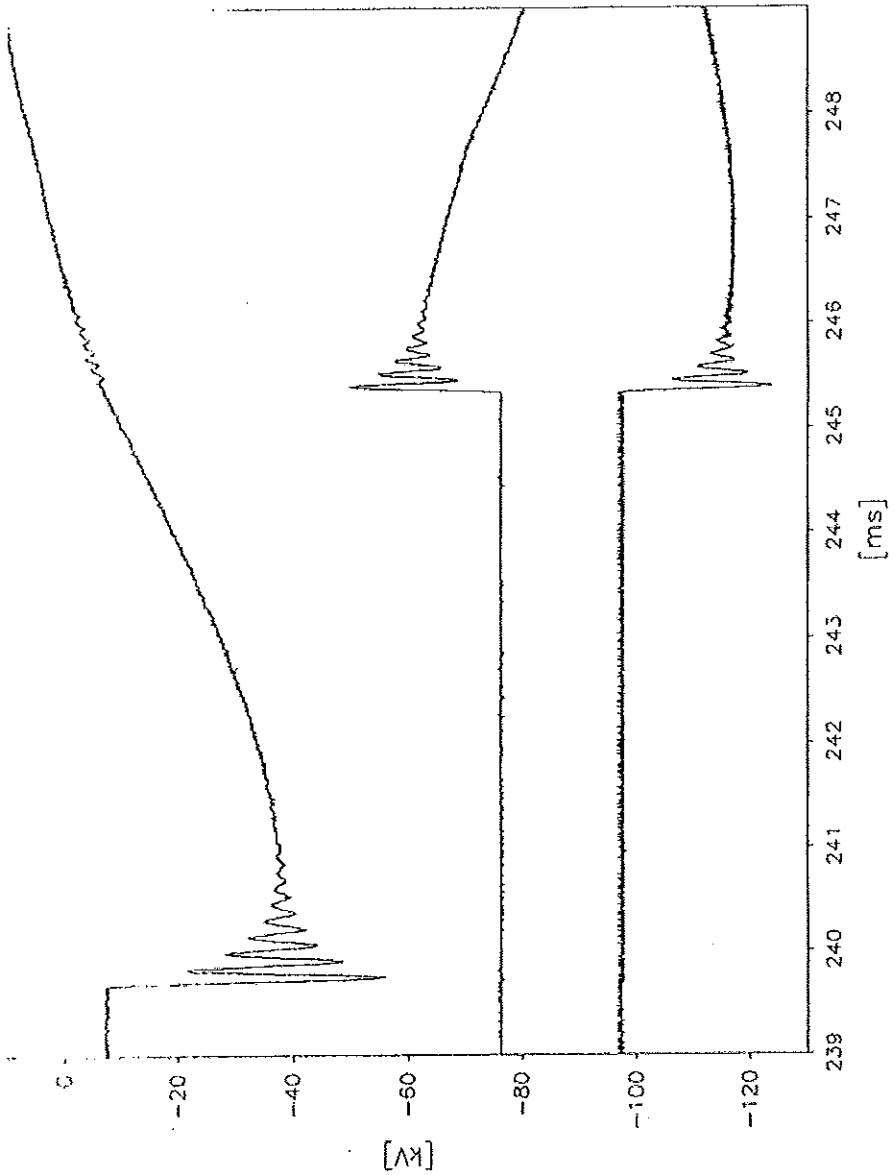
Oscillogram
PEHLA 0511Ra / 29



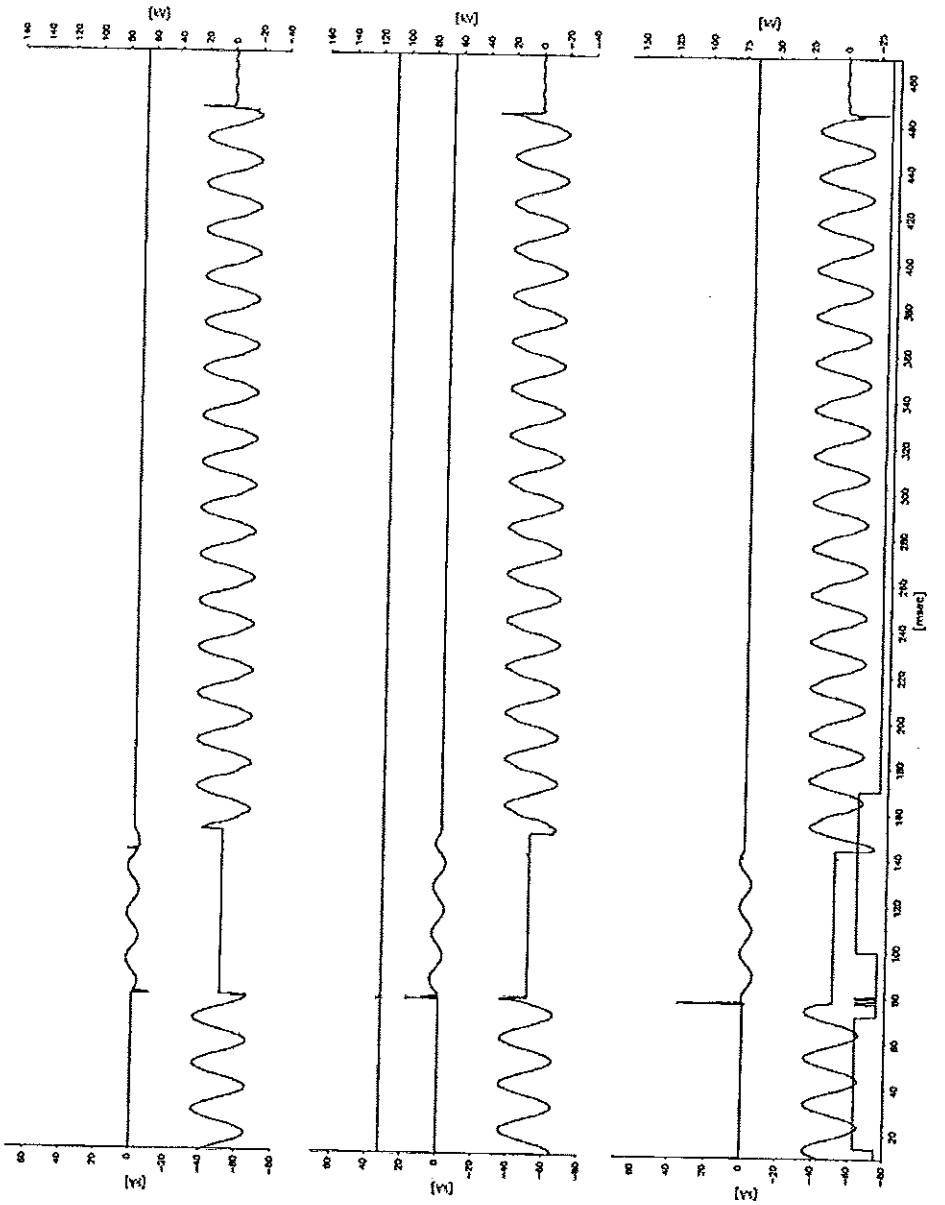
Oscillogram
PEHLA 0511Ra / 29



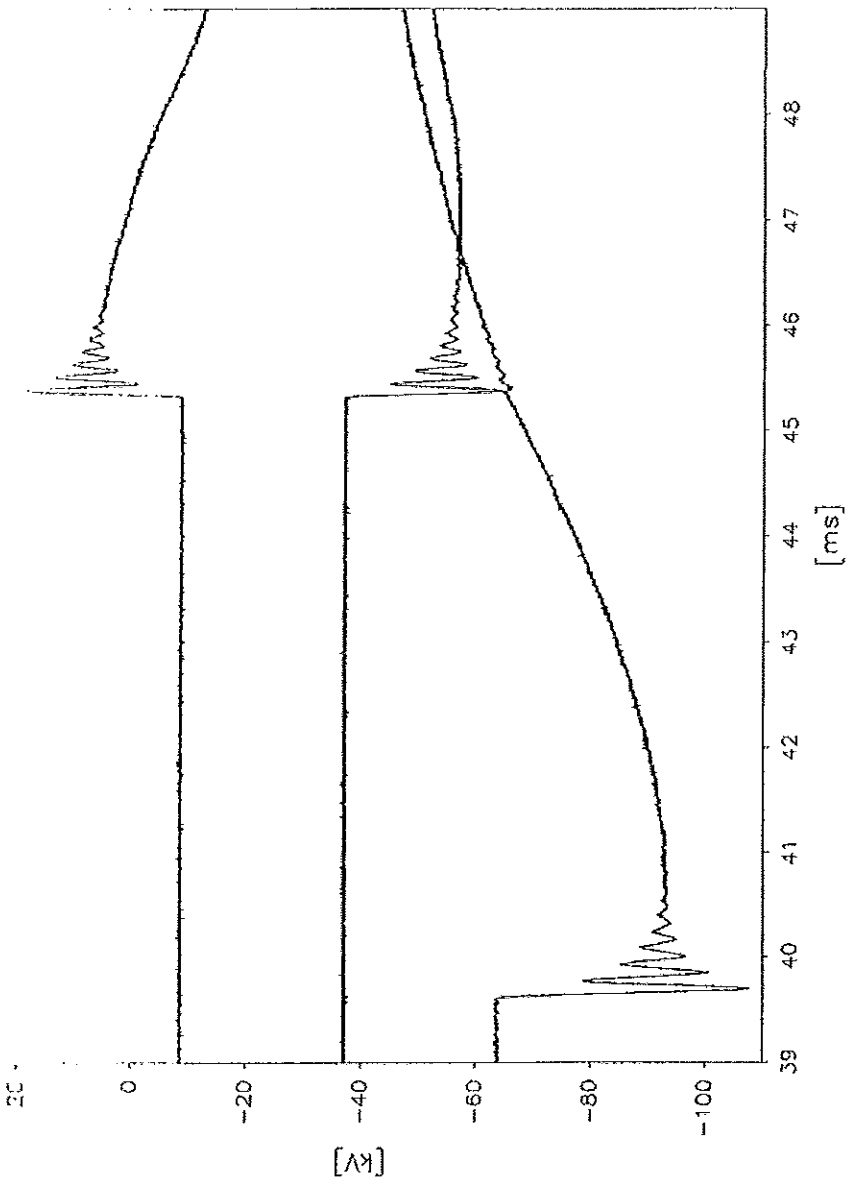
Oscillogram
PEHLA 0511Ra / 29



Oscillogram
PEHLA 0511Ra / 30



Oscillogram
PEHLA 0511Ra / 30



Test Results
No-load Operations

Test performed: No-load operation
Date of test: 09th March 2005
Condition of test object before test: As after Test PEHLA 0511Ra / 05.

Test No. PEHLA 0511Ra				06		06A		06B	
Operating sequence				O – 0.3s – CO		O – 0.3s – CO		O – 0.3s – CO	
C-Operation	Voltage of closing device		V	-	110	-	121	-	94
	Closing time	L1	ms	-	59.6	-	57.6	-	63.6
		L2	ms	-	59.8	-	57.8	-	63.8
		L3	ms	-	59.6	-	57.4	-	63.4
O-Operation	Voltage of opening device		V	110	110	121	121	77	77
	Opening time	L1	ms	46.0	45.6	43.2	43.8	61.0	60.0
		L2	ms	45.8	45.4	43.0	43.6	60.8	59.8
		L3	ms	46.0	45.6	43.2	43.8	60.8	60.0

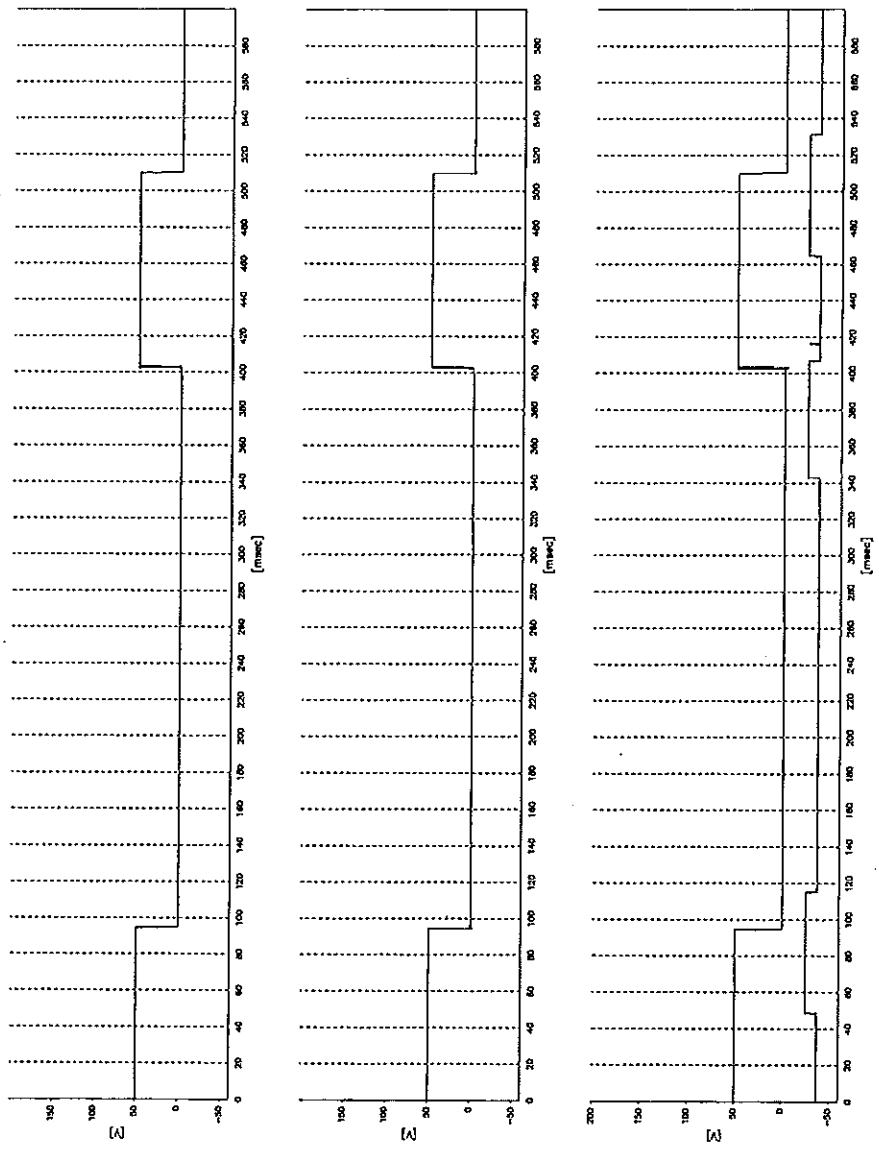
Remarks: The voltage values correspond to 100% of the rated supply voltage in Test PEHLA 0511Ra / 06, 110% in Test PEHLA 0511Ra / 06A and 70% (O) resp. 85% (C) in Test PEHLA 0511Ra / 06B.

Test performed: No-load operation
Date of test: 10th March 2005
Condition of test object before test: As after Test PEHLA 0511Ra / 30.

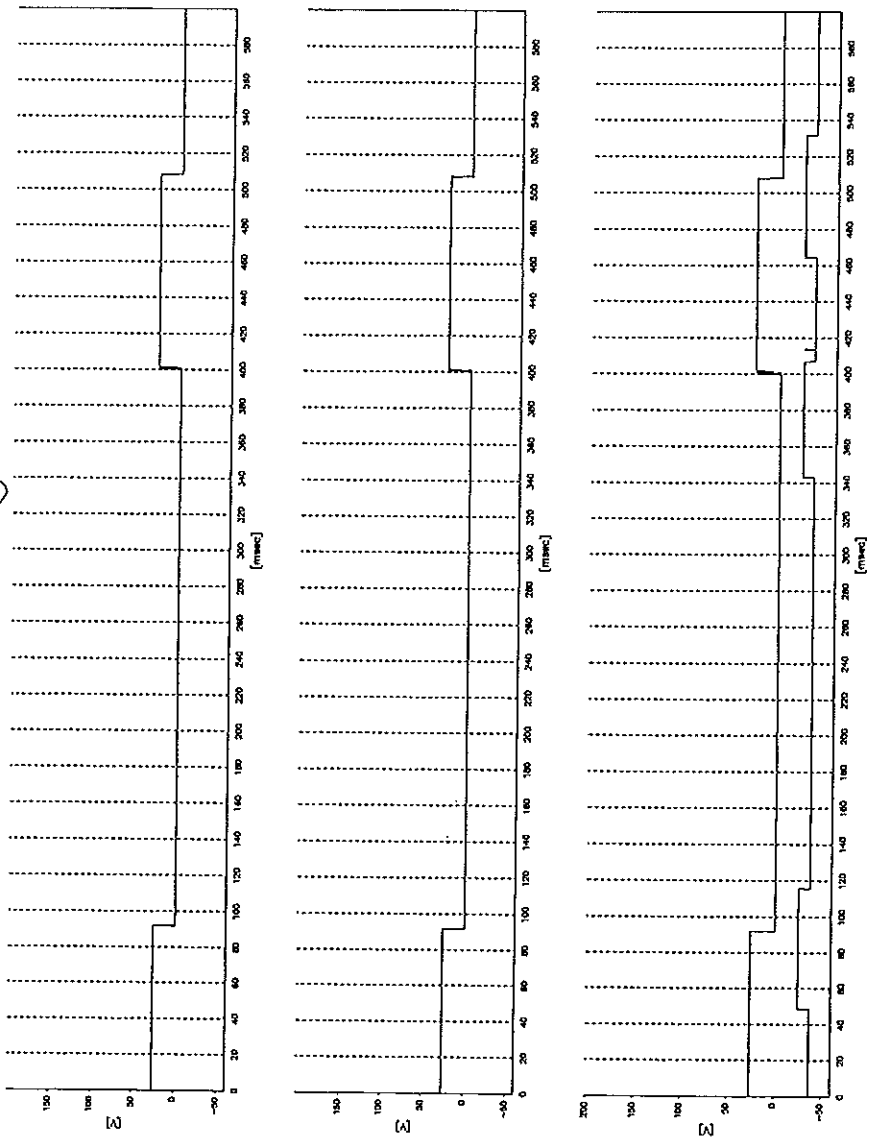
Test No. PEHLA 0511Ra				31		31A		31B	
Operating sequence				O – 0.3s – CO		O – 0.3s – CO		O – 0.3s – CO	
C-Operation	Voltage of closing device		V	-	110	-	121	-	94
	Closing time	L1	ms	-	60.6	-	58.6	-	64.8
		L2	ms	-	60.6	-	58.6	-	64.8
		L3	ms	-	60.0	-	58.0	-	64.2
O-Operation	Voltage of opening device		V	110	110	121	121	77	77
	Opening time	L1	ms	46.2	46.0	43.6	43.0	58.8	57.8
		L2	ms	45.8	45.6	43.2	42.6	58.4	57.2
		L3	ms	46.4	46.2	43.8	43.4	59.0	58.0

Remarks: The voltage values correspond to 100% of the rated supply voltage in Test PEHLA 0511Ra / 31, 110% in Test PEHLA 0511Ra / 31A and 70% (O) resp. 85% (C) in Test PEHLA 0511Ra / 31B.

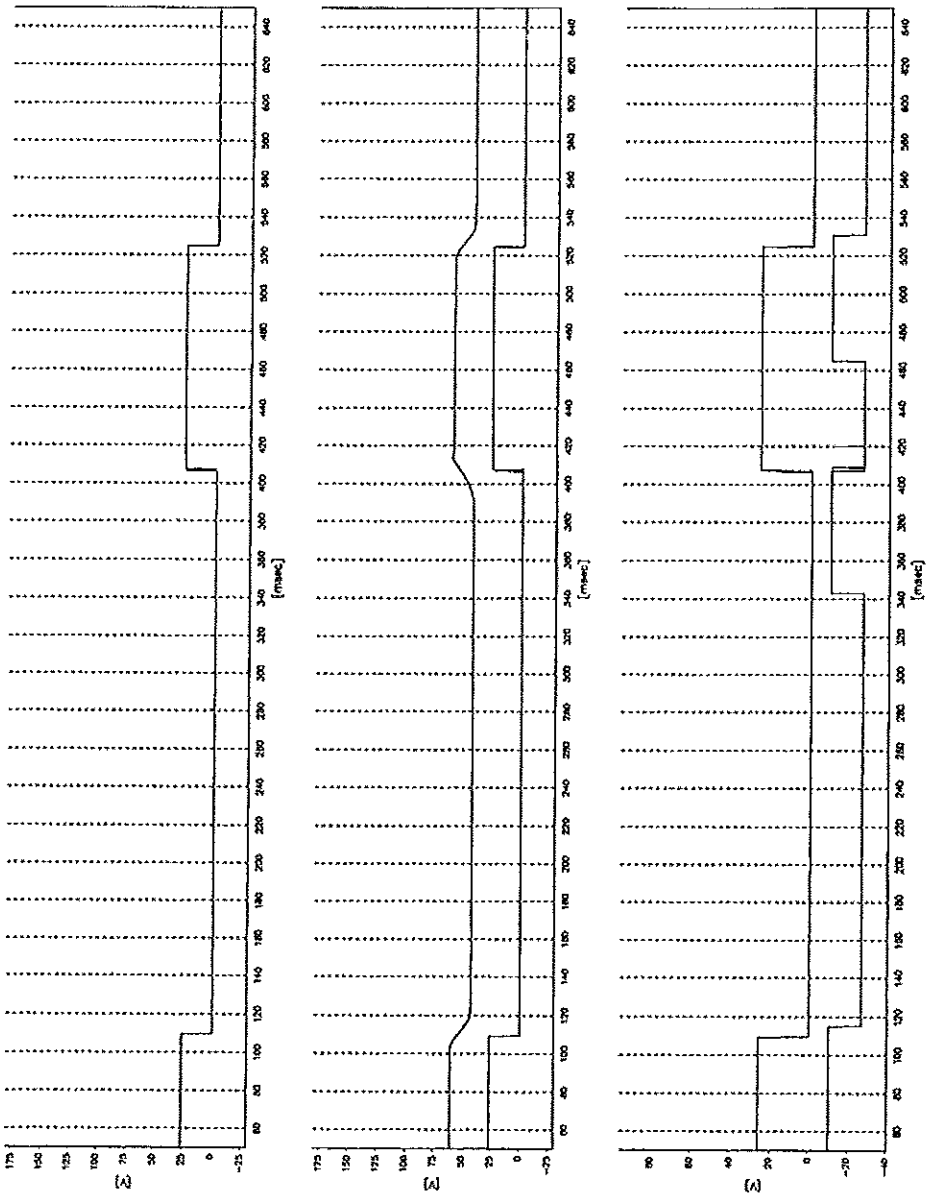
Oscillogram
PEHLA 0511Ra / 06



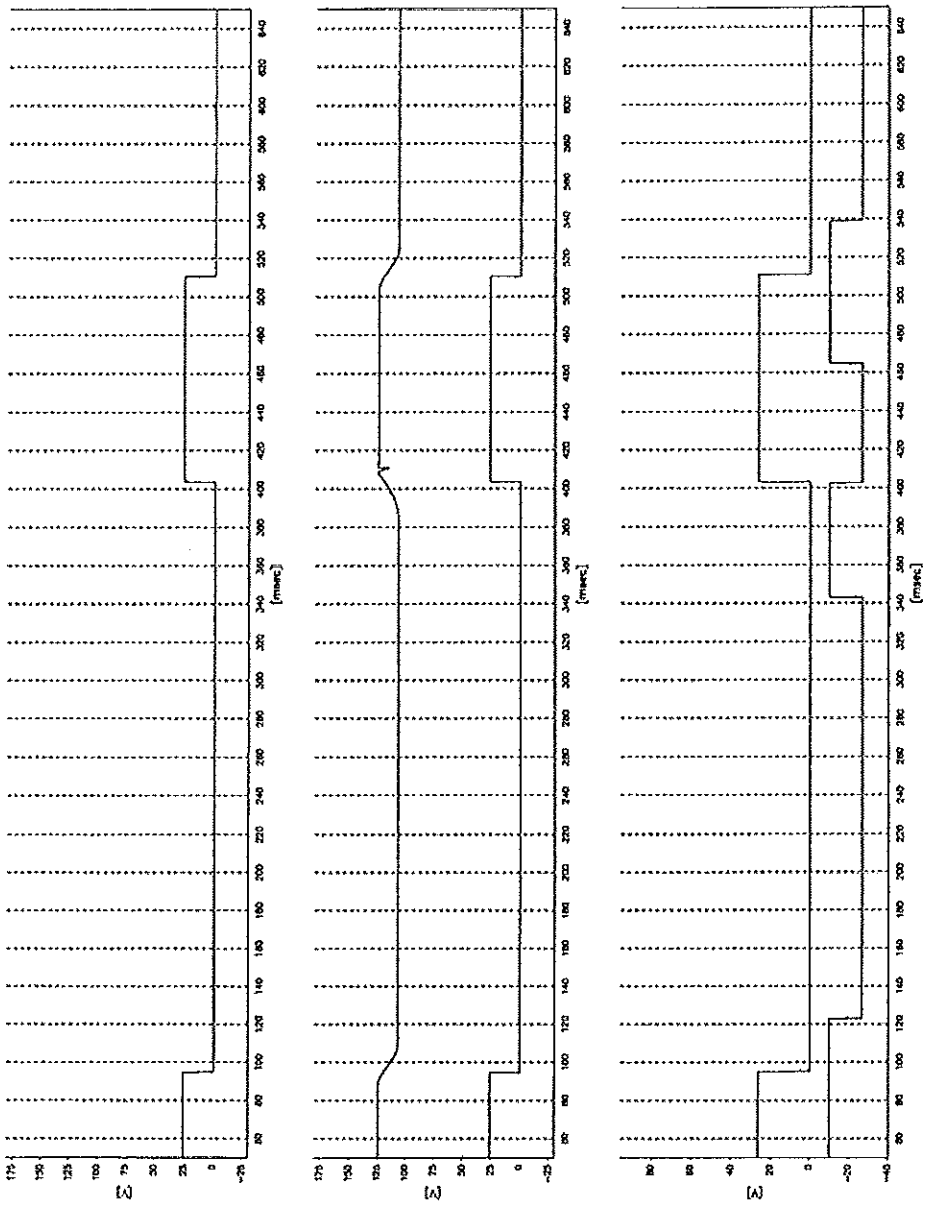
Oscillogram
PEHLA 0511Ra / 06A



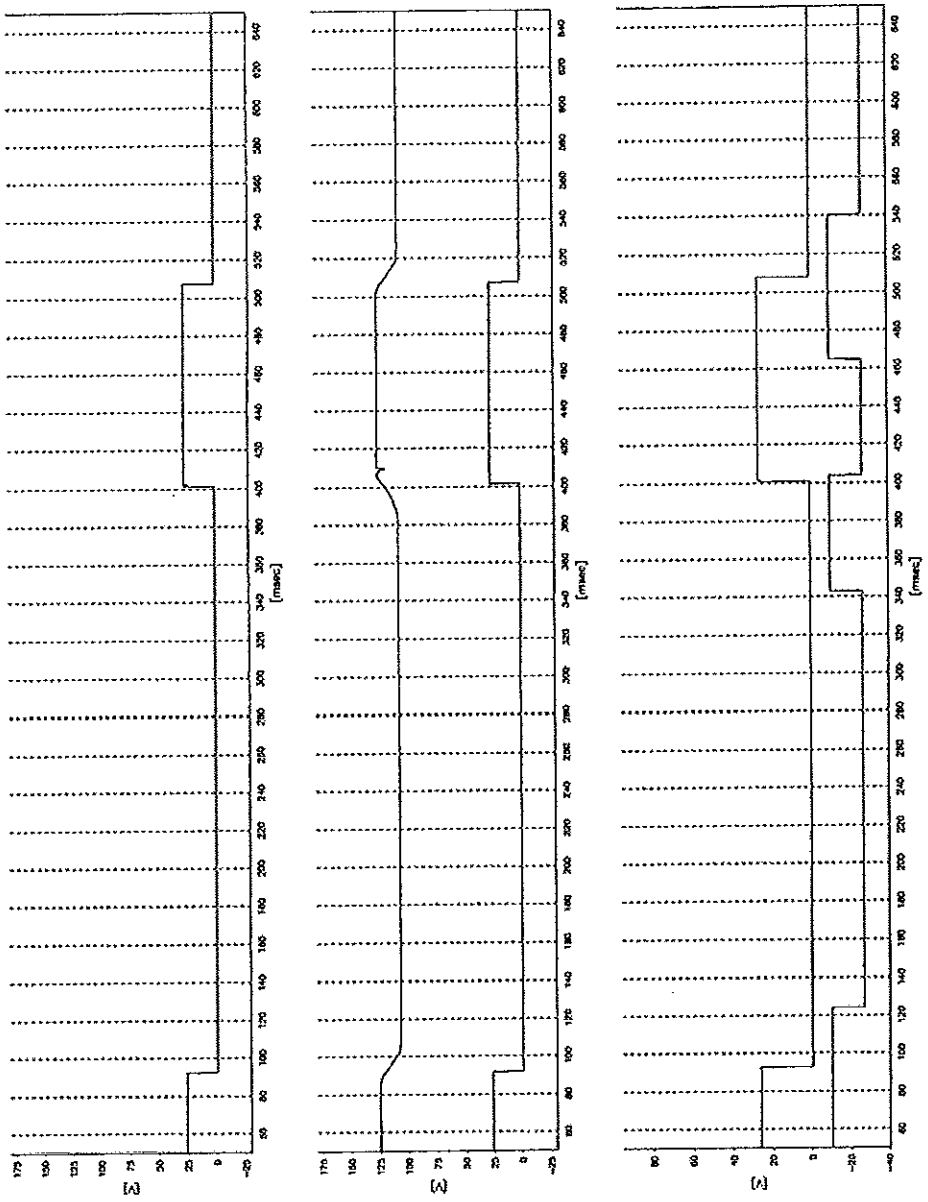
Oscillogram
PEHLA 0511Ra / 06B



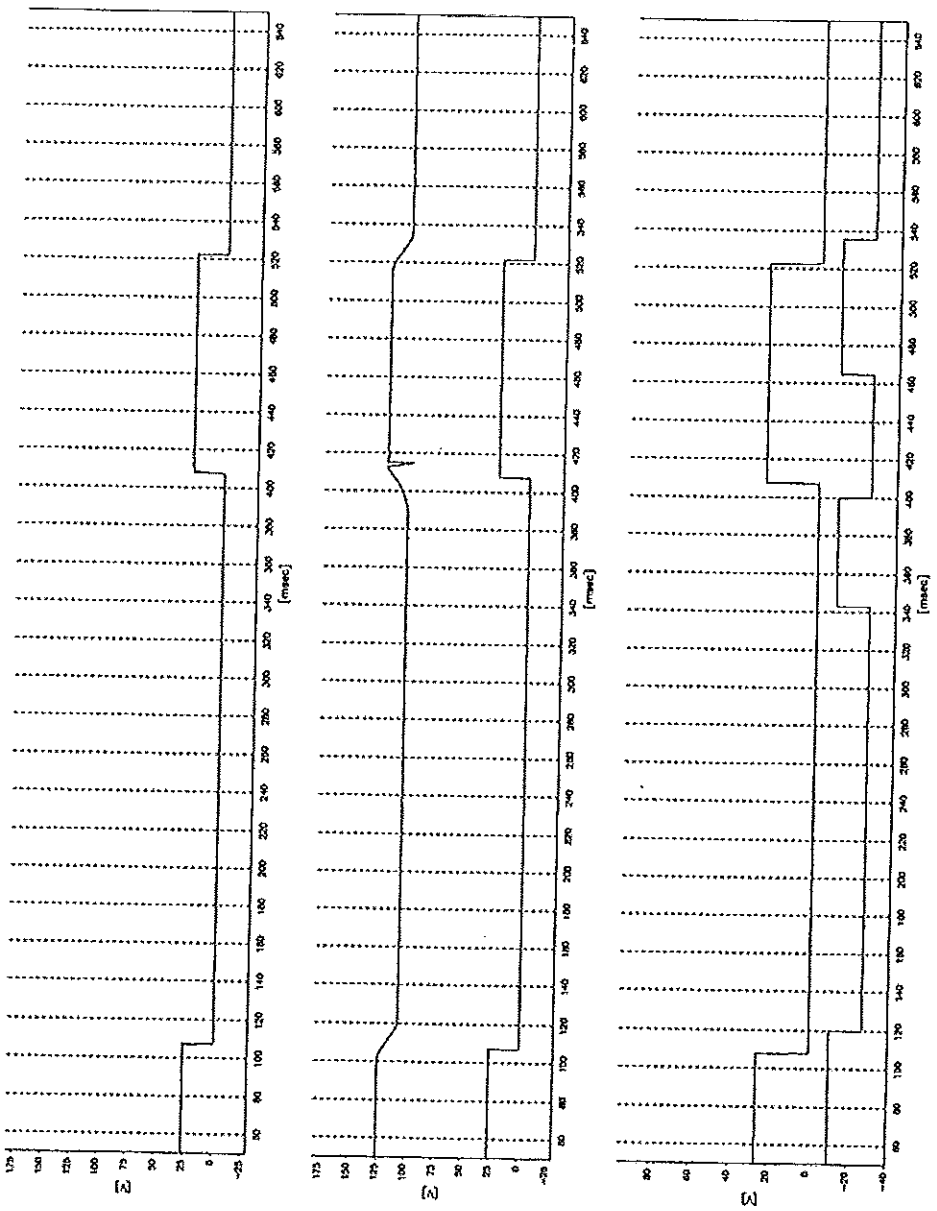
Oscillogram
PEHLA 0511Ra / 31



Oscillogram
PEHLA 0511Ra / 31A



Oscillogram
PEHLA 0511Ra / 31B



Test Results
Voltage Test as a Condition Check

Test performed: Voltage test as a condition check according to IEC 62271-100 Subcl. 6.2.11

Date of test: 10th March 2005

Condition of test object before test: As after test PEHLA 0511Ra / 31

Test arrangement: High voltage test transformer connected to the contact arms of the circuit-breaker

Connections to test object: Connection of high voltage to one contact arm of the open poles via copper wire Ø 0.5 mm, the other contact arm earthed via copper wire Ø 0.5 mm

Test arrangement			Test voltage	Result
Condition	Voltage applied to	Earthed	kV	
-	-	-	40.0 – 1 min	ok
-	-	-	50.0 – 1 min	ok

Remarks: -

Condition of test object after test: No visible or functional change or damage.

Measurement of the Resistance of the Main Circuit

Test performed: Measurement of the Resistance of the Main Circuit

Date of test: 09th March 2005

Condition of test object: As after Test PEHLA 0511Ra / 06.

Measurement before test No. PEHLA 0511Ra / 07			
Ambient air temperature: 21.0 °C			
Resistance measurement at direct current of: 100 A (d.c.)			
Measurement between points (see sheet 70)	Resistance of the main circuit μΩ		
	L1	L2	L3
1 - 2	26.2	27.1	26.2
-	-	-	-
-	-	-	-

Remarks: -

Date of test: 10th March 2005

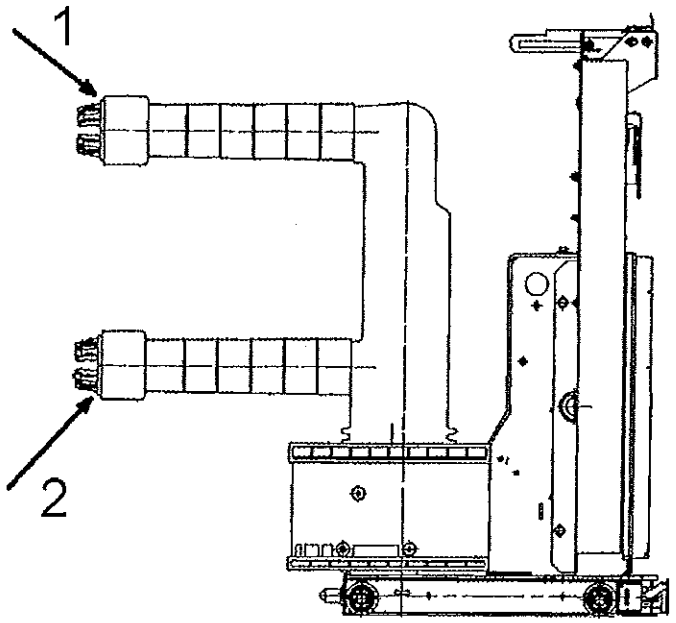
Condition of test object: As after Test PEHLA 0511Ra / 30.

Measurement after test No. PEHLA 0511Ra / 31			
Ambient air temperature: 21.0 °C			
Resistance measurement at direct current of: 100 A (d.c.)			
Measurement between points (see sheet 70)	Resistance of the main circuit μΩ		
	L1	L2	L3
1 - 2	32.2	36.8	29.7
-	-	-	-
-	-	-	-

Remarks: -

Measurement of the Resistance of the Main Circuit

Measurement points



Photos

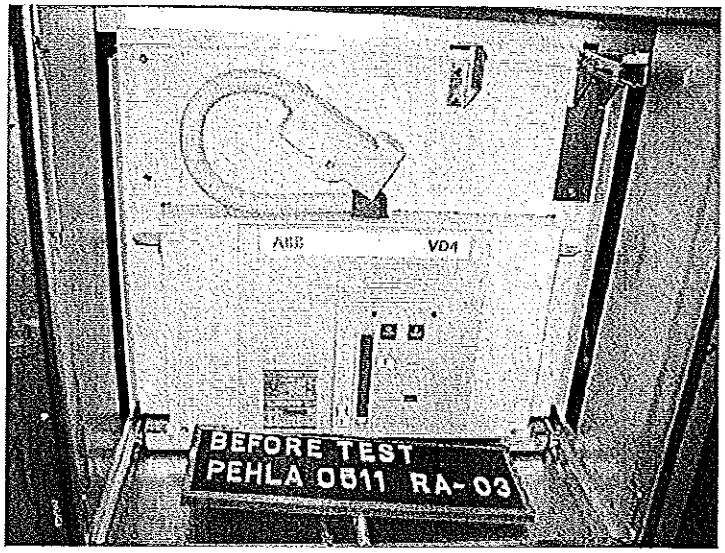


Photo No. 01
Before Test no. PEHLA 0511Ra / 03

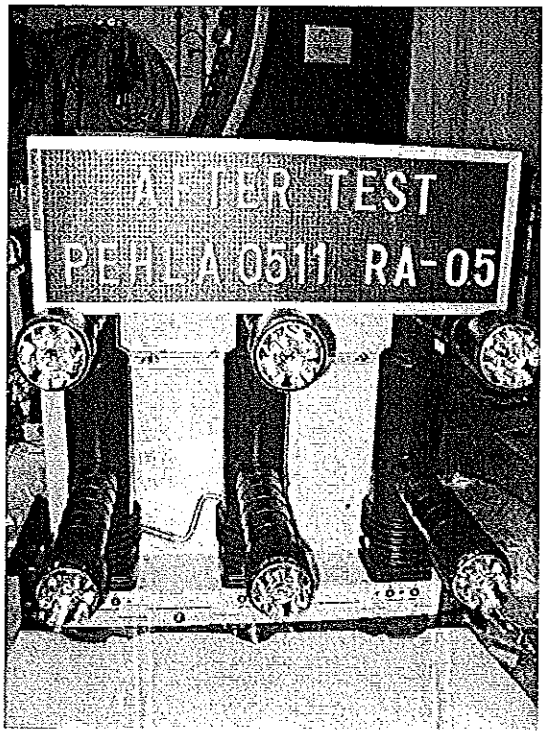


Photo No. 02
After Test no. PEHLA 0511Ra / 05

Photos

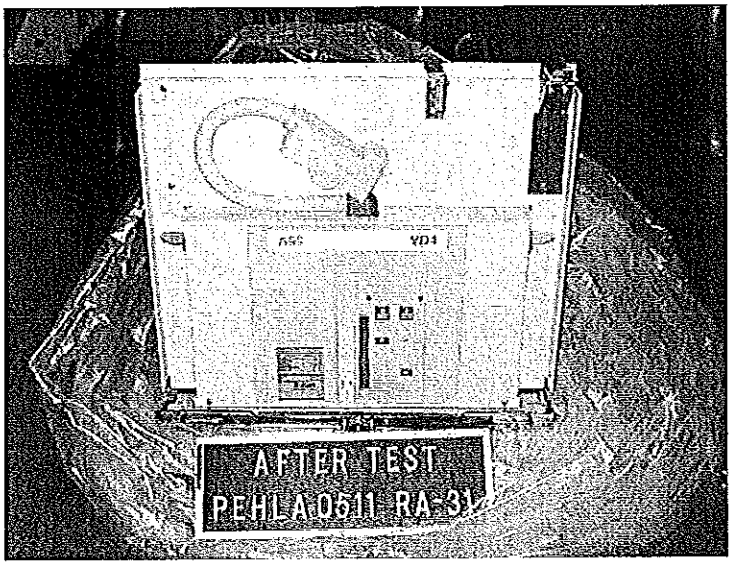


Photo No. 03
After Test no. PEHLA 0511Ra / 31

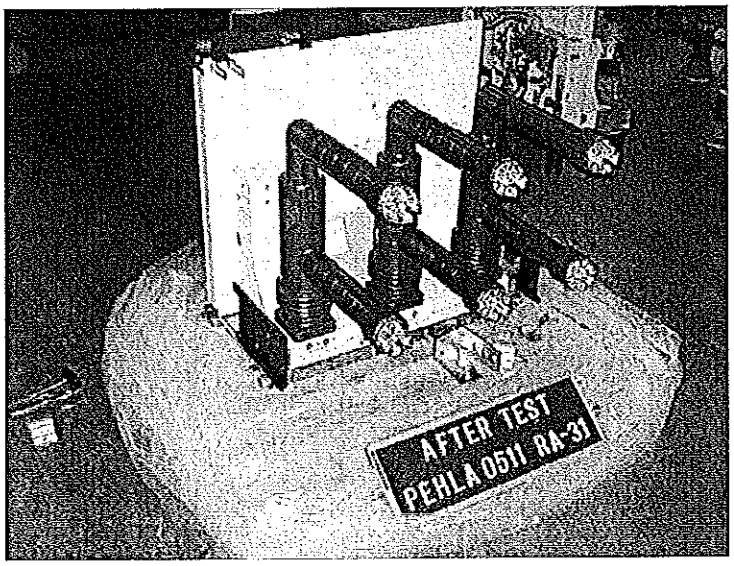


Photo No. 04
After Test no. PEHLA 0511Ra / 31

PEHLA

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN
Member of the Short-Circuit-Testing Liaison (STL)

Test Report

Report No.: 0045 Ra **Copy No.:** 0 **Contents:** 19 Sheets

Equipment under test:	Metal-clad air-insulated switchgear panel type ZS1.2, rated voltage 24 kV, drawing-no. GCE 8010459 R0104, with vacuum circuit-breaker type VD4P 2420-25.
Manufacturer:	ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Client:	ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Testing station:	PEHLA - Testing Station Ratingen
Date of test:	28th November 2000
Applied test specifications:	IEC 60298: 1990-12, clauses 6.1.1, 6.1.3 - 6.1.7, IEC 60694: 1996-05, clauses 6.2.1, 6.2.3 - 6.2.6.
Tests performed:	Dielectric type test. Standard lightning impulse withstand voltage test at 125 kV and power-frequency withstand voltage test at 50 kV to earth, between phases and across open switching device.
Test results:	The ZS1.2-type panel passed the dielectric type test successfully. The respective requirements are met.

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN

Technical Committee

Mannheim, 07th December 2000

Deutscher Akkreditierungs Rat DAR

Accreditation

The PEHLA-Testing Station Ratingen has been approved by the DATech (German accreditation body for technology) according to DIN EN 45001 for tests in the field of high-voltage switchgear and controlgear and power engineering equipment (Registration-No. DAT-P-032/93).

Under reference to DIN EN 45001 PEHLA states the following:

- The accreditation of the PEHLA-Testing Station or any of its test reports by themselves in no way constitute or imply product approval by DATech or any other body.
- If someone refers to a test in an accredited PEHLA-Testing Station this reference shall include the accreditation body, i.e. DATech, the relevant scope of the accreditation and the appropriate registration number.

STL-Member

PEHLA is foundation-member of the Short-Circuit Testing Liaison (STL) which has been founded in March 1969. STL is a forum for the international cooperation of the testing organisations with the further full members ASTA (GB), CESI (I), ESEF (F), KEMA (NL), SATS (N; S, SF) and STLNA (USA). In the framework of EC, STL has been recognised in 1992 by EOTC as agreement group.

PEHLA-Documents

A Certificate

is issued for type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STLGuides valid at the time of the test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Document

is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Report

is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients instructions.
Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the equipment during test, and its condition after the tests.

Addresses:

Office:	PEHLA-Geschäftsstelle Hallenweg 40 D-68219 Mannheim
Testing Station:	PEHLA-Testing Station Ratingen Oberhausener Str. 33 D-40472 Ratingen
Manufacturer:	ABB Calor Emag Mittelspannung GmbH Oberhausener Str. 33 D-40472 Ratingen
Client:	ABB Calor Emag Mittelspannung GmbH Oberhausener Str. 33 D-40472 Ratingen

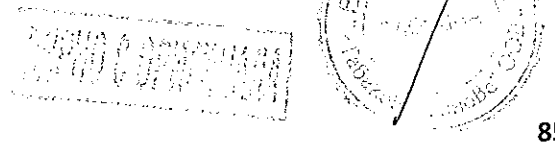


Table of Contents

List of Test Participants

Representatives of the Test Committee:

Mr. A. Meier	PEHLA- Testing Station Ratingen
Mr. W. Stolz	PEHLA- Testing Station Mannheim

Test Engineer:

Mr. U. Lisseck	PEHLA- Testing Station Ratingen

Other Participants: -

Technical Data of Test Object

Switchgear

Ratings assigned by the manufacturer

Test Object: Metal-clad air-insulated switchgear panel
Type: ZS1.2
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.: 07550027/2017/00 **Year of manufacture:** 2000
Drawing No.: GCE8010459 R0104 index 00

Rated voltage	24 kV
Rated lightning impulse withstand voltage	125 kV
Rated switching impulse withstand voltage	- kV
Rated power frequency withstand voltage	50 kV
Rated frequency	50/60 Hz
Rated normal current of busbar	2500 A
Rated normal current of tee-off	2500 A
Rated peak withstand current	63 kA
Rated short-time withstand current	25 kA
Rated duration of short-circuit	3 s
Insulating medium	air
Rated operating pressure (abs./20 °C)	- kPa
Minimum operating pressure (abs./20 °C)	- kPa
Permissible values for internal arc faults:	
Peak current	63 kA
Short-time current	25 kA
Duration of short-circuit	1 s
Max. ambient air temperature	40 °C

The above switchgear panel is fully described in the mentioned drawings.

Essential characteristics and installed devices:

-- busbar 2 x 80 mm x 10 mm / R 5 mm, Cu, insulated, with bushing plate (left and right).
-- busbar tee-off conductor 2 x 100 mm x 10 mm / R 5 mm, Cu, insulated.
-- tulip insulator with contact pin ∅ = 79 mm.
-- current transformer type TPU 65.11, manufacturer: ABB, serial-no. L1: 058 246; L2: 058 247; L3: 058 248.
-- earthing switch type EK6 2406-275, serial-no. 06/050/00.
-- cable conductor 2 x 100 mm x 10 mm / R 5 mm, Cu, bare.

Date of receipt of test object: 27th November 2000

Technical Data of Test Object

Switching Device - Circuit-Breaker

Ratings assigned by the manufacturer

Test Object:	Vacuum circuit-breaker
Type:	VD4P 2420-25
Manufacturer:	ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.:	7008269/4002/00 **Year of manufacture:** 2000
Drawing No.:	GCE 7000162 R1104 index 00 (circuit-breaker)
Vacuum interrupter:	Type VG4S, L1: No. 00G4S01196, L2: No. 00G4S01192, L3: No. 00G4S01194
Drawing No.:	GCE 7005535 R0102 index 02 (interrupter)

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50/60	Hz
Rated normal current	2000	A
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current	25	kA
D.C. component	30	%
Rated short-circuit making current	63	kA
Rated transient recovery voltage:		
Peak value	41	kV
Rate of rise	0.47	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3 s –CO-3 min-CO	
Arc extinguishing medium	Vacuum	
Number of poles	3	
Number of units per pole	1	
Rated opening time	≤ 45	ms
Rated closing time	approx. 60	ms
Rated voltage of trip coil	220	V-DC
Rated voltage of closing coil	220	V-DC
Rated supply voltage	220	V-DC
Rated frequency of supply voltage	-	Hz
Max. ambient air temperature	40	°C
Further specifications:	-	

Essential characteristics: -

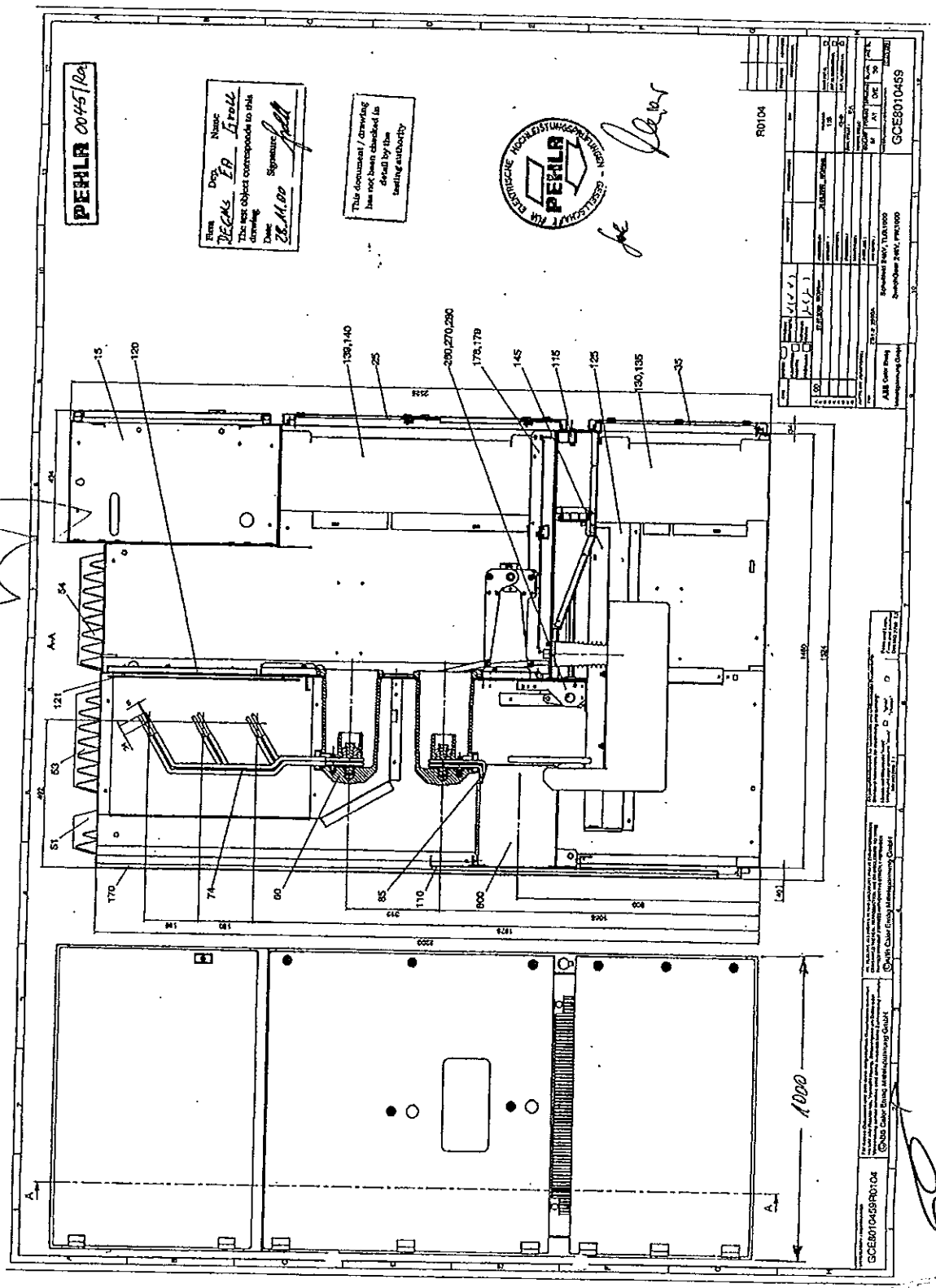
Date of receipt of test object: 27th November 2000

List of Drawings

The manufacturer has guaranteed, that the equipment submitted for test has been manufactured in full accordance with the following drawings. PEHLA has verified that these drawings adequately represented the equipment tested. These drawings have been stamped and signed by PEHLA representatives and are kept
☒ with the test documents at the test laboratory.
☐ at the client.

A copy of the following drawings is part of this Test Report.

Drawing-No.	Index	Title	Additional remarks
GCE 8010459 R0104	00	SwitchGear 24kV; PW.1000	-
GCE 8012050 R0101	01	Cable connecting bar system 2500A	-
GCE 7000162 R1104	00	Einschub für ZS1.2 24kV VD4P 2420..25	-


PEHLA 0045/Ra
This test object corresponds to this drawing
This document / drawing has not been checked in detail by the testing authority
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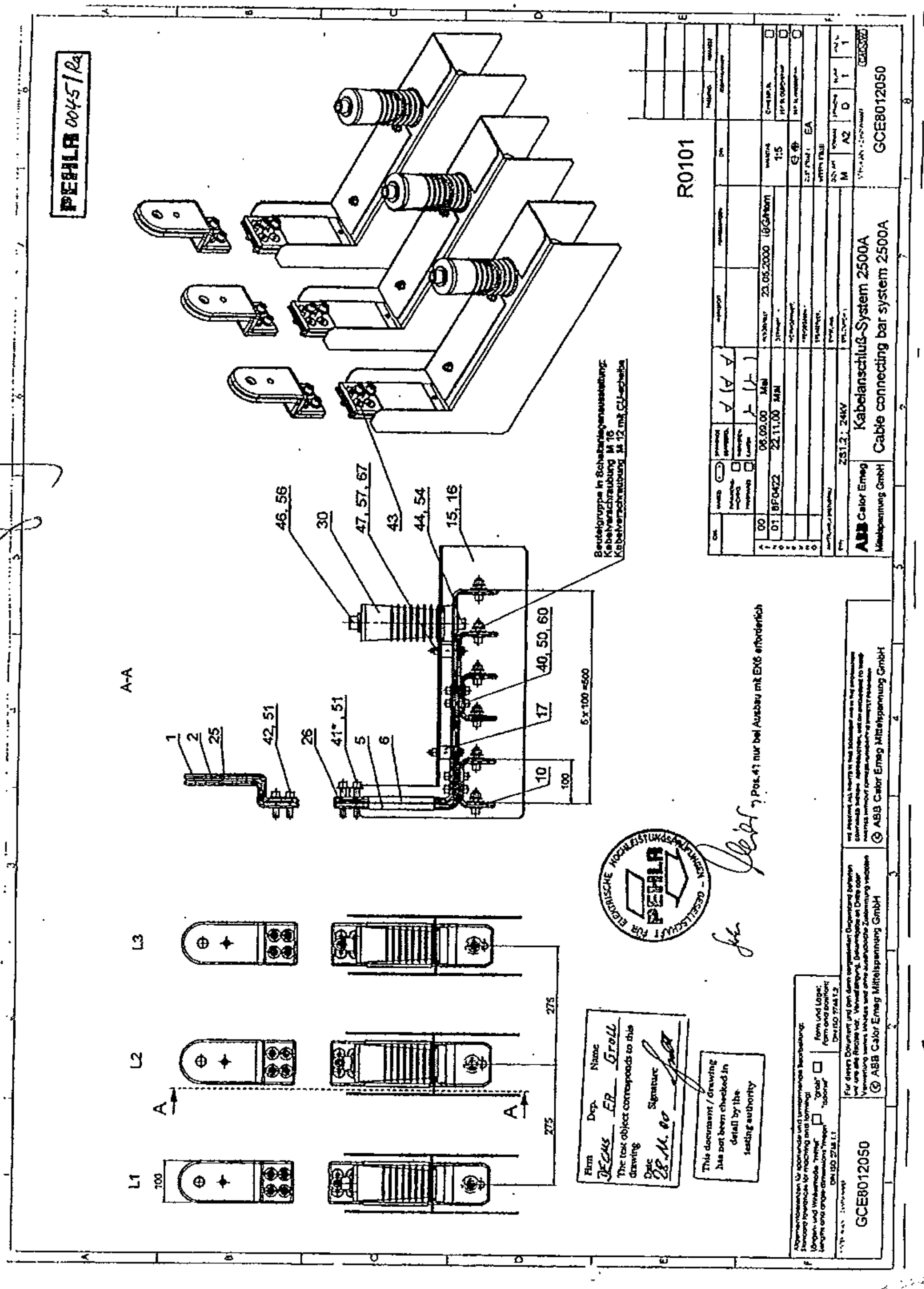
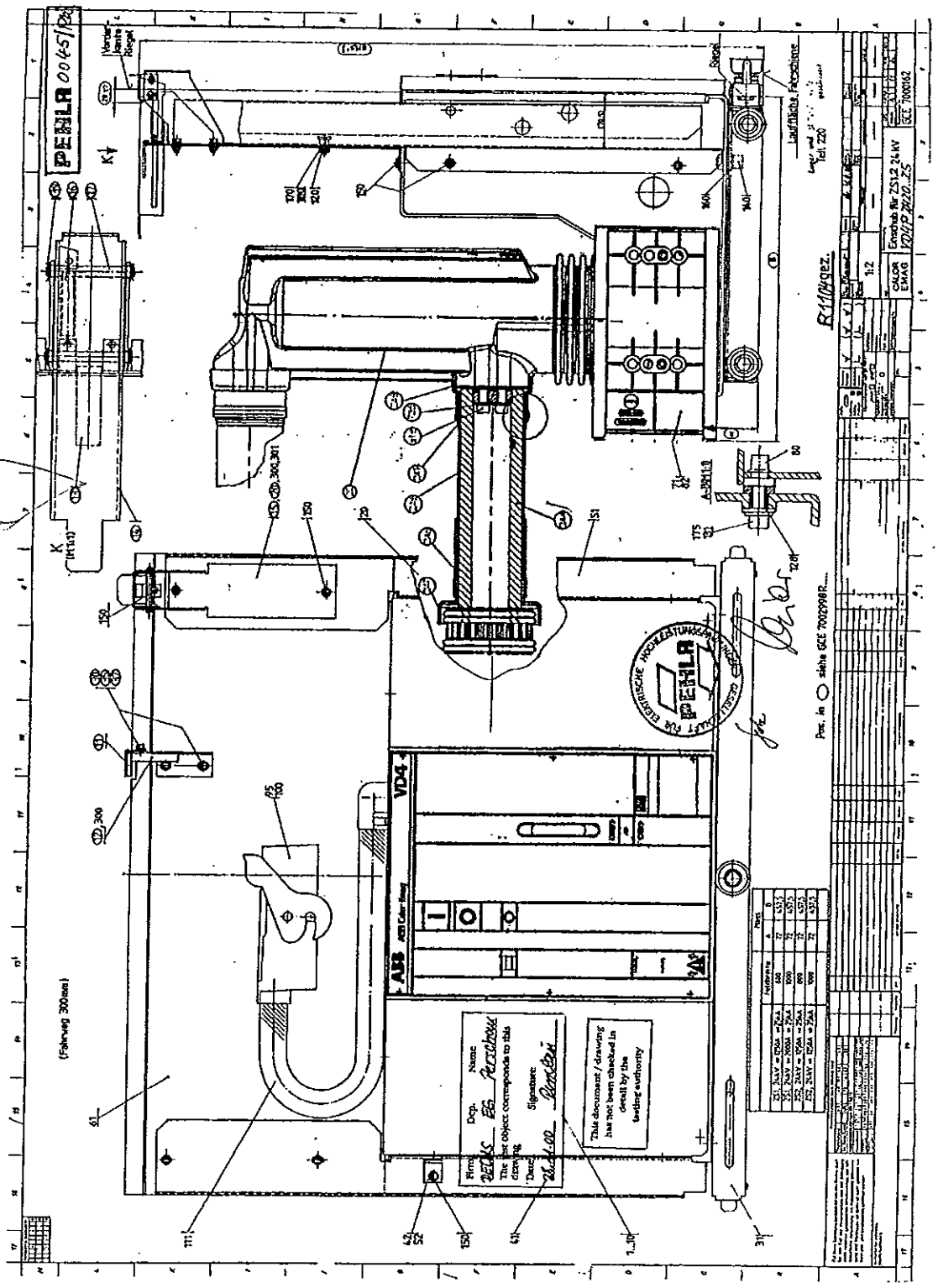
R0104
GCE80104459R0104
1000


PEHLA 0045/Ra
R0101
A-A
L1
L2
L3
Kabelanschluß-System 2500A
Cable connecting bar system 2500A
GCE8012050
ABB Calor Emag Mittelspannung GmbH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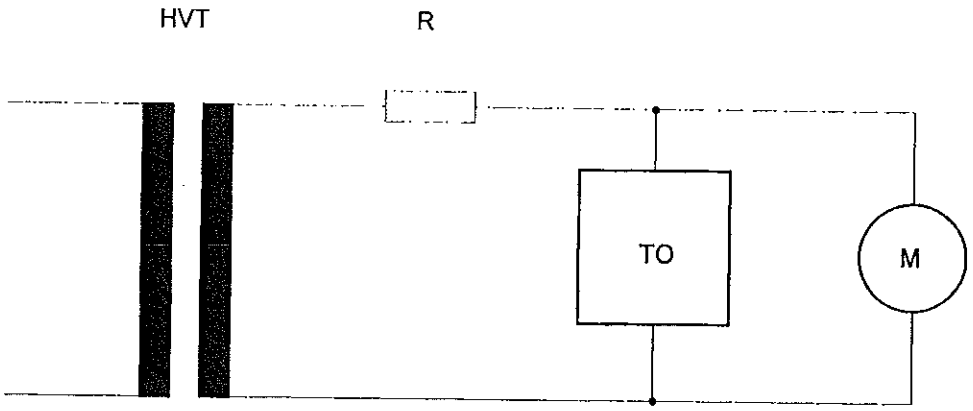
Einzelteile für ZS1.2 24 kV
VDE 0670 Teil 220...ZS
Prüfanordnung
Laufkatze Feinsteuerung
Fahrweg 300mm
VD4
ABB
Dep. EG Name Pernthaler
Firma PEHLA
The test object corresponds to this drawing
Signature
Date 26.1.00
This document / drawing has not been checked in detail by the testing authority

Technical Data of Test Circuit
Power Frequency Voltage



Technical Data

HVT - High Voltage Test Transformer: Type TEO 250/20, serial-no. 268 734, manufacturer: Meßwandler-Bau, Bamberg

Rated Voltage	260	kV
Rated Capacity	50	kVA
Short Circuit Impedance	14.6	%

TO - Test Object: ZS1.2/24 kV-type panel, 2500 A

M - Voltage Measurement: Capacitive Divider Type CM 300 (Ident-No. ELK-000994) in connection with a Peak Voltmeter Type DMI 551/Haefely (Ident-No. ELK-000989)

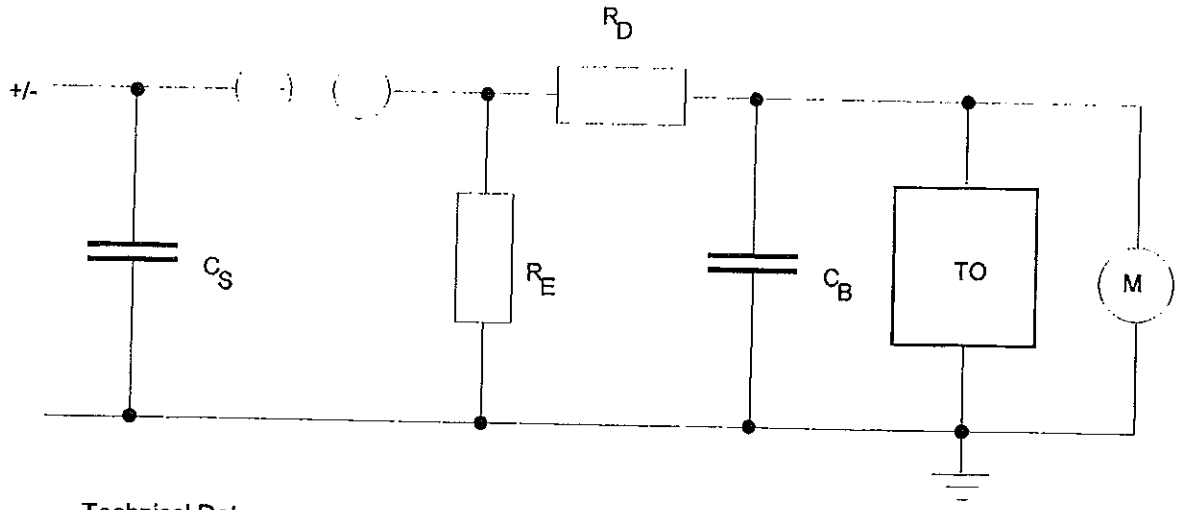
Verification of Calibration:

- Capacitive Divider (Ident-No. ELK-000994, ELK-000990, ELK-000992): calibrated on April 1998 at DEACE/LH, Calibration Report-No. 9800086.

- Peak Voltmeter Typ DMI 551 (Ident-No. ELK-000989): calibrated on April 2000 at DECMS/LK, Calibration Report No. 2000353.

Technical Data of Test Circuit

Lightning Impulse Voltage 1.2/50



Technical Data

Impulse Generator Type SGS-200/6, WO: 513809, manufacturer: Haefely

Maximum Charging Voltage	U_Σ	=	200 kV
Number of Stages	n	=	2
Surge Capacity per Stage	C_S	=	600 nF
Load Capacitance	C_B	=	1000 pF
Damping Resistance	R_D	=	$R_{SI} + R_{SE}$
Internal Front Resistance per Stage	R_{SI}	=	20 Ω
External Front Resistance	R_{SE}	=	300 Ω
Discharge Resistance	R_E	=	2 R_P
Tail Resistance per Stage	R_P	=	115 Ω

TO - Test Object: ZS1.2/24 kV-type panel, 2500 A

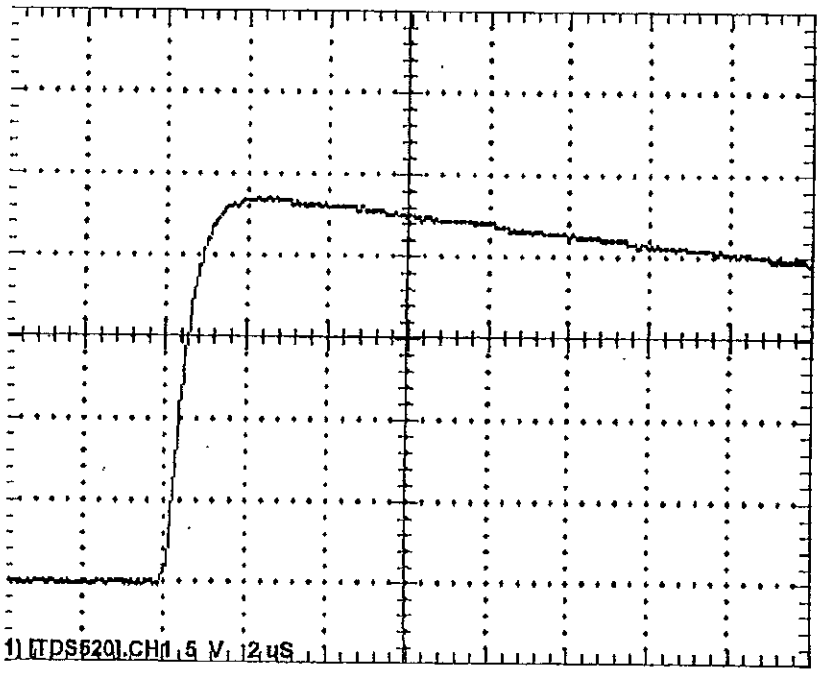
M - Voltage Measurement: Capacitive Divider Type CS 200 SPZ (Ident-No. ELK-000893, ELK-000894) in connection with a Peak Voltmeter Type DMI 551/ Haefely (Ident-No. ELK-000989) and Oscilloscope Type TDS520 (Ident-No. ELK-000545).

Verificatin of Calibration:

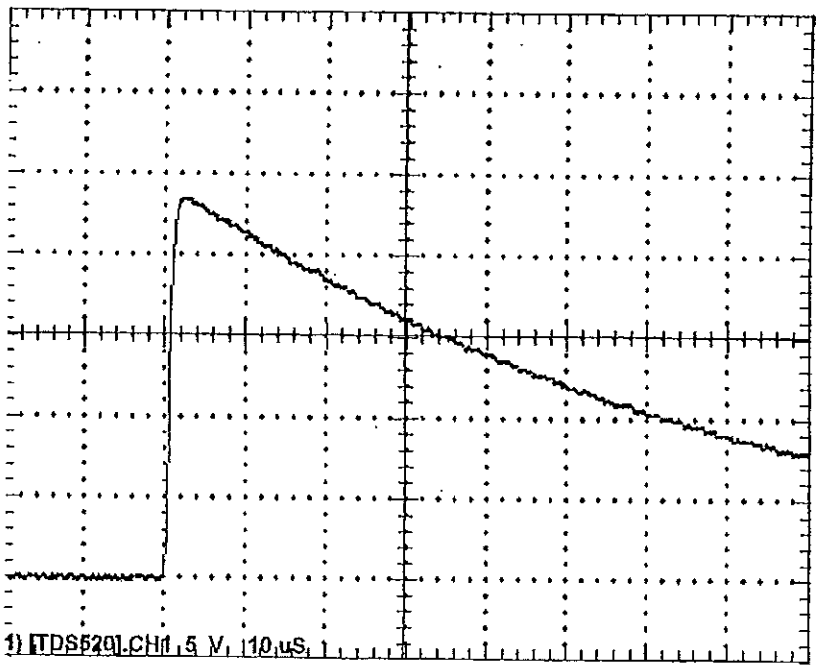
- Capacitive Divider (Ident-No. ELK-000893, ELK-000894, ELK-000922, ELK-001074): Calibrated in February 1998 at FGH Mannheim, FGH-Calibration-Report-No. 050 DKD-K-15901 98-02.
- Peak Voltmeter Type DMI 551 (Ident-No. ELK-000989): Calibrated in Mai 2000 at FGH Mannheim, FGH-Calibration-Report-No. 073 DKD-K-15901 00-05.
- Oscilloscope Type TDS520 (Ident-No. ELK-000545): calibrated in March 2000 at DECMS/LK, Calibration-Report-No. 2000297.

Lightning Impulse Voltage with the Test Object connected

(Standard Value: 1.2 ± 30 % / 50 ± 20 % / peak ±3 %)



T_1 = 1.26 µs



T_2 = 51.0 µs

Atmospheric Conditions during Tests

Date of test: 28th November 2000

IEC17A/567/Q: Corrigendum to subclause 6.2.1 of IEC60694, 2000-01 (Indices: ~ power frequency voltage; + positive lightning impulse voltage; - negative lightning impulse voltage)						
Input data			Correction factors		calculated	applied
air temperature t:		19.5 °C	air density correction factors	$k_{t\sim}$:	1.006	-
air pressure b:		1017 hPa		k_{t+}:	1.006	-
air humidity h:		7.212 g/m³		k_{t-} :	1.006	-
50% disruptive-discharge voltages	$U_{B\sim}$:	kV	air humidity correction factors	$k_{2\sim}$:	0.954	-
	U_{B+}:	kV		k_{2+}:	0.962	-
	U_{B-}:	kV		k_{2-} :	0.962	-
minimum discharge path L:		m	atmospheric correction factors	$K_{t\sim}$:	0.960	0.960
				K_{t+} :	0.967	0.967
				K_{t-} :	0.967	0.967

Lightning Impulse Voltage Test
Power Frequency Voltage Test

Test performed: Test of insulation phase-to-phase, phase-to-ground and against shutter.

Date of test: 28th November 2000

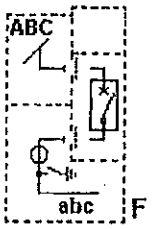
Condition of test object before test: Factory new, clean and dry.

Connections to test object: For further details see the entry in column 'Condition'

Front time T_1: 1.26 µs Time to half-value T_2: 51.0 µs Test frequency f: 50 Hz

All voltage values are corrected with the applied atmospheric correction factor.
The applied test voltages refer to the standard atmosphere of 20 °C, 1013 hPa and 11 g/m³.

Test Arrangement 1:



Condition	Voltage applied to	Earthed	Applied power frequency voltage ~ kV Applied lightning impulse voltage ± kV	Result Test duration or number of impulses / breakdowns
Vacuum circuit-breaker in test position, shutters closed. Infeed of the test voltage at the led-out busbar right hand.	A	BCabcF	50 +125 -125	1 minute/0 15/0 15/0
	B	ACabcF	50 +125 -125	1 minute/0 15/0 15/0
	C	ABabcF	50 +125 -125	1 minute/0 15/0 15/0
Vacuum circuit-breaker in test position, shutters closed. Infeed at the cable connecting bar in the cable compartment.	a	ABCbcF	50 +125 -125	1 minute/0 15/0 15/0
	b	ABCacF	50 +125 -125	1 minute/0 15/0 15/0
	c	ABCabF	50 +125 -125	1 minute/0 15/0 15/0

Remarks: A,a = Phase L1, B,b = Phase L2, C,c = Phase L3, F = Frame

Lightning Impulse Voltage Test
Power Frequency Voltage Test

Test performed: Test of insulation phase-to-phase, phase-to-ground and across open switching device.

Date of test: 28th November 2000

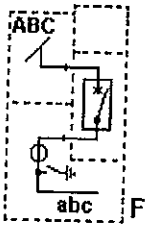
Condition of test object before test: Factory new, clean and dry.

Connections to test object: For further details see the entry in column 'Condition'

Front time T_1: 1.26 µs Time to half-value T_2: 51.0 µs Test frequency f: 50 Hz

All voltage values are corrected with the applied atmospheric correction factor.
The applied test voltages refer to the standard atmosphere of 20 °C, 1013 hPa and 11 g/m³.

Test arrangement 2:



Condition	Voltage applied to	Earthed	Applied power frequency voltage ~ kV / Applied lightning impulse voltage ± kV	Result: Test duration or number of Impulses / breakdowns
Vacuum circuit-breaker in service position and open. Infeed of the test voltage at the led-out busbar right hand.	A	BCabcF	50 +125 -125	1 minute/0 15/0 15/0
	B	ACabcF	50 +125 -125	1 minute/0 15/0 15/0
	C	ABabcF	50 +125 -125	1 minute/0 15/0 15/0
Vacuum circuit-breaker in service position and open. Infeed of the test voltage at the cable connecting bar in the cable compartment.	a	ABCbcF	50 +125 -125	1 minute/0 15/0 15/0
	b	ABCacF	50 +125 -125	1 minute/0 15/0 15/0
	c	ABCabF	50 +125 -125	1 minute/0 15/0 15/0

Remarks: A,a = Phase L1, B,b = Phase L2, C,c = Phase L3, F = Frame

Lightning Impulse Voltage Test
Power Frequency Voltage Test

Test performed: Test of insulation phase-to-phase and phase-to-ground.

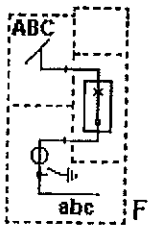
Date of test: 28th November 2000

Condition of test object before test: Factory new, clean and dry.

Connections to test object: Infeed of the test voltage at the led-out busbar right hand.

Front time T_1: 1.26 µs Time to half-value T_2: 51.0 µs Test frequency f: 50 Hz

All voltage values are corrected with the applied atmospheric correction factor.
The applied test voltages refer to the standard atmosphere of 20 °C, 1013 hPa and 11 g/m³.

Test Arrangement 3: 			Applied power frequency voltage ~ kV	Result
Condition	Voltage applied to	Earthed	Applied lightning impulse voltage ± kV	Test duration or number of impulses / breakdowns
Vacuum circuit-breaker in service position and closed	Aa	BCbcF	50 +125 -125	1 minute/0 15/0 15/1
	Bb	ACacF	50 +125 -125	1 minute/0 15/0 15/0
	Cc	ABabF	50 +125 -125	1 minute/0 15/0 15/0

Remarks: A,a = Phase L1, B,b = Phase L2, C,c = Phase L3, F = Frame

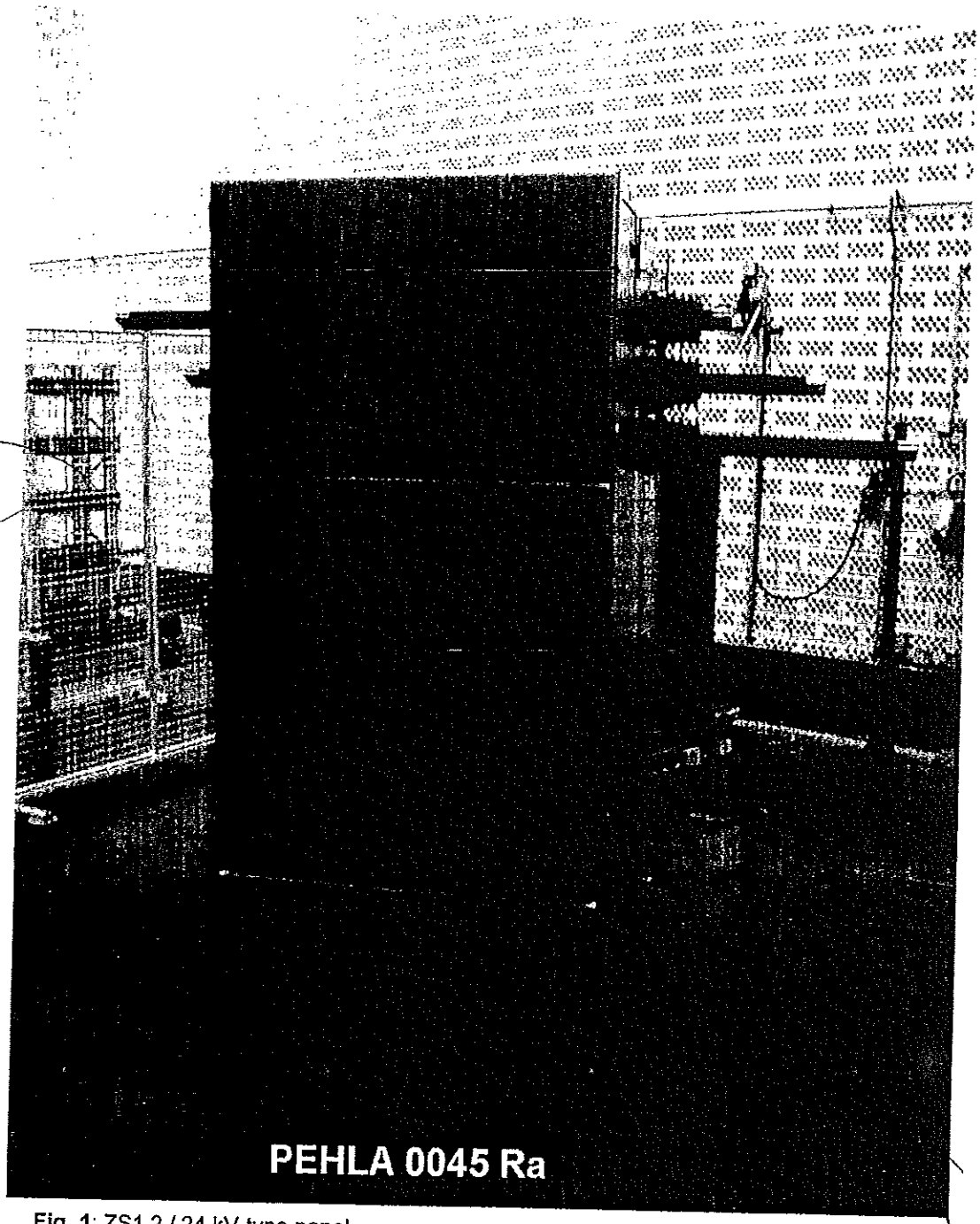


Fig. 1: ZS1.2 / 24 kV-type panel

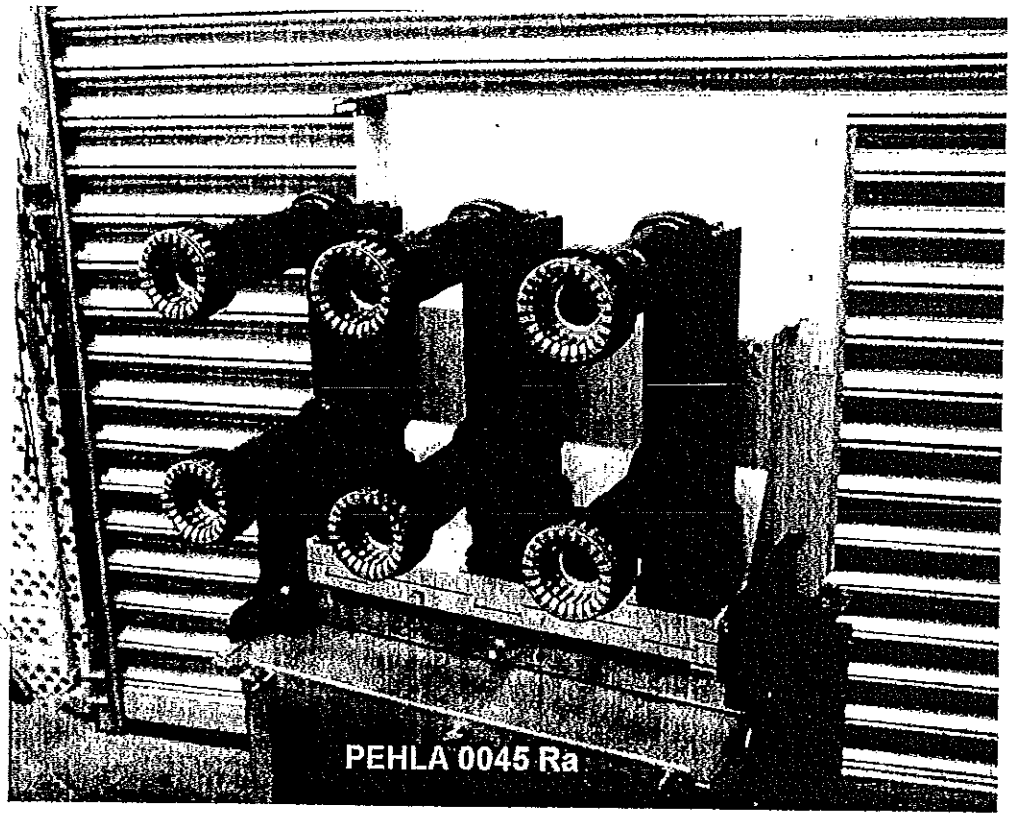


Fig. 2: Vacuum circuit-breaker type VD4P 2420-25

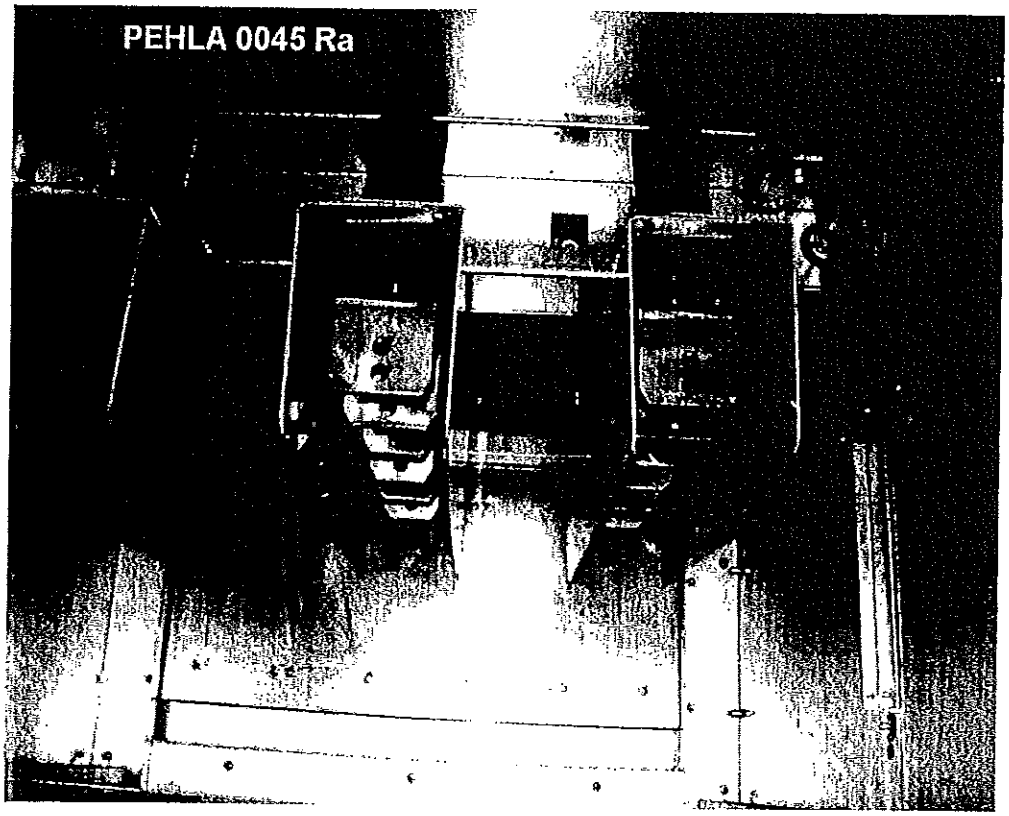


Fig. 3: Cable compartement

Приложение 1.3 - Акредитация

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO

CERTIFICATO DI ACCREDITAMENTO
Accreditation Certificate

Accreditamento n°
Accreditation n°
0253 Rev. **1**

Si dichiara che
We declare that
ABB S.p.A. Power Products Division
Sede/Headquarters:
Via Friuli 4 - 24044 Dalmine BG

è conforme ai requisiti della norma
UNI CEI EN ISO/IEC 17025:2005 "Requisiti generali per la competenza dei Laboratori di prova e taratura"

meets the requirements of the standard
EN ISO/IEC 17025:2005 "General Requirements for the Competence of Testing and Calibration Laboratories" standard

quale
Laboratorio di Prova

as
Testing Laboratory

L'accreditamento attesta la competenza tecnica del Laboratorio relativamente allo scopo riportato nelle schede allegate al presente certificato. Le schede possono variare nel tempo. I requisiti gestionali della ISO/IEC 17025:2005 (sezione 4) sono scritti in un linguaggio idoneo all'attività dei Laboratori di Prova, sono conformi ai principi della ISO 9001:2008 ed allineati con i suoi requisiti applicabili.
Il presente certificato non è da ritenersi valido se non accompagnato dalle schede allegate e può essere sospeso o revocato in qualsiasi momento nel caso di inadempienza accertata da parte di ACCREDIA.
La vigenza dell'accreditamento può essere verificata sul sito WEB (www.accredia.it) o richiesta direttamente ai singoli Dipartimenti .

The accreditation certifies the technical competence of the laboratory limited to the scope detailed in the attached Enclosure. The scope may vary in the time. The management system requirements in ISO/IEC 17025:2005 (Section 4) are written in a language relevant to Testing Laboratories operations and meet the principles of ISO 9001:2008 and are aligned with its pertinent requirements.
The present certificate is valid only if associated to the annexed schedule, and can be suspended or withdrawn at any time in the event of non fulfilment as ascertained by ACCREDIA.
The in force status of the accreditation may be checked in the WEB site (www.accredia.it) or on direct request to appointed Department.

Data di 1ª emissione *1st issue date* 1999-07-08	Data di modifica *Modification date* 2015-07-16	Data di scadenza *Expiring date* 2019-07-11
Il Direttore Generale *The General Director* (Dr. Filippo Trifiletti)	Il Direttore di Dipartimento *Department Director* (Dr.ssa Silvia Tramontin)	Il Presidente *The President* (Ing. Giuseppe Rossi)

ACCREDIA
Sede operativa e legale: Via Guglielmo Saliceto, 7/9 | 00161 Roma - Italy | Tel. +39 06 8440991 | Fax +39 06 8841199
info@accredia.it | www.accredia.it | Partita IVA - Codice Fiscale 10566361001

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH
German Accreditation Body

Entrusted according to Section 8 subsection1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of
EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH (German Accreditation Body) attests that the testing laboratory

PEHLA GbR
PEHLA-Prüffeld Ratingen
Oberhausener Straße 33, 40472 Ratingen

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields:

High-Voltage Switchgear and Controlgear,
Low-Voltage Switchgear and Controlgear Assemblies,
Current and Voltage Transformers,
Power transformers and Busbar Systems

The accreditation certificate shall only apply in connection with the notice of accreditation of 2012-05-09 with the accreditation number D-PL-12072-06 and is valid until 2017-05-08. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 5 pages.

Registration number of the certificate: **D-PL-12072-06-01**

Frankfurt am Main, 2012-05-09

Dipl.-Ing. (FH) Ralf Egner
Head of Division 2

This document is a translation. The definitive version is the original German accreditation certificate.

See notes overleaf.

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Deutsche Akkreditierungsstelle GmbH

Office Berlin
Spittelmarkt 10
10117 Berlin

Office Frankfurt am Main
Gartenstraße 6
60594 Frankfurt am Main

Office Braunschweig
Bundesallee 100
38116 Braunschweig

The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.

The up-to-date state of membership can be retrieved from the following websites:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO

Membro degli Accordi di Mutuo Riconoscimento EA, IAF e ILAC
Signatory of EA, IAF and ILAC Mutual Recognition Agreements

CERTIFICATO DI ACCREDITAMENTO
Accreditation Certificate

Accreditamento n° / *Accreditation n°* **0030** Rev. **2**

Si dichiara che / *We declare that*

CESI S.p.A.
Sede/Headquarters:
Via Rubattino 54 - 20134 Milano MI

è conforme ai requisiti della norma / *meets the requirements of the standard*

UNI CEI EN ISO/IEC 17025:2005 "Requisiti generali per la competenza dei Laboratori di prova e taratura"

EN ISO/IEC 17025:2005 "General Requirements for the Competence of Testing and Calibration Laboratories" standard

quale / *as*

Laboratorio di Prova

Testing Laboratory

L'accreditamento attesta la competenza tecnica del Laboratorio relativamente allo scopo riportato nelle schede allegate al presente certificato. Le schede possono variare nel tempo. I requisiti gestionali della ISO/IEC 17025:2005 (sezione 4) sono scritti in un linguaggio idoneo all'attività dei Laboratori di Prova, sono conformi ai principi della ISO 9001:2008 ed allineati con i suoi requisiti applicabili.
Il presente certificato non è da ritenersi valido se non accompagnato dalle schede allegate e può essere sospeso o revocato in qualsiasi momento nel caso di inadempienza accertata da parte di ACCREDIA.
La vigenza dell'accreditamento può essere verificata sul sito WEB (www.accredia.it) o richiesta direttamente ai singoli Dipartimenti .

The accreditation certifies the technical competence of the laboratory limited to the scope detailed in the attached Enclosure. The scope may vary in the time. The management system requirements in ISO/IEC 17025:2005 (Section 4) are written in a language relevant to Testing Laboratories operations and meet the principles of ISO 9001:2008 and are aligned with its pertinent requirements.
The present certificate is valid only if associated to the annexed schedule, and can be suspended or withdrawn at any time in the event of non fulfilment as ascertained by ACCREDIA.
The in force status of the accreditation may be checked in the WEB site (www.accredia.it) or on direct request to appointed Department.

Data di 1ª emissione *1st issue date* **1992-02-27**	Data di modifica *Modification date* **2016-04-14**	Data di scadenza *Expiring date* **2020-03-09**
Il Direttore Generale *The General Director* (Dr. Filippo Trifiletti)	Il Direttore di Dipartimento *Department Director* (Dr.ssa Silvia Tramontin)	Il Presidente *The President* (Ing. Giuseppe Rossi)

ACCREDIA
Sede operativa e legale: Via Guglielmo Saliceto, 7/9 | 00161 Roma - Italy | Tel. +39 06 8440991 | Fax +39 06 8841199
info@accredia.it | www.accredia.it | Partita IVA - Codice Fiscale 10566361001

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ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO

Membro degli Accordi di Mutuo Riconoscimento EA, IAF e ILAC
Signatory of EA, IAF and ILAC Mutual Recognition Agreements

CERTIFICATO DI ACCREDITAMENTO
Accreditation Certificate

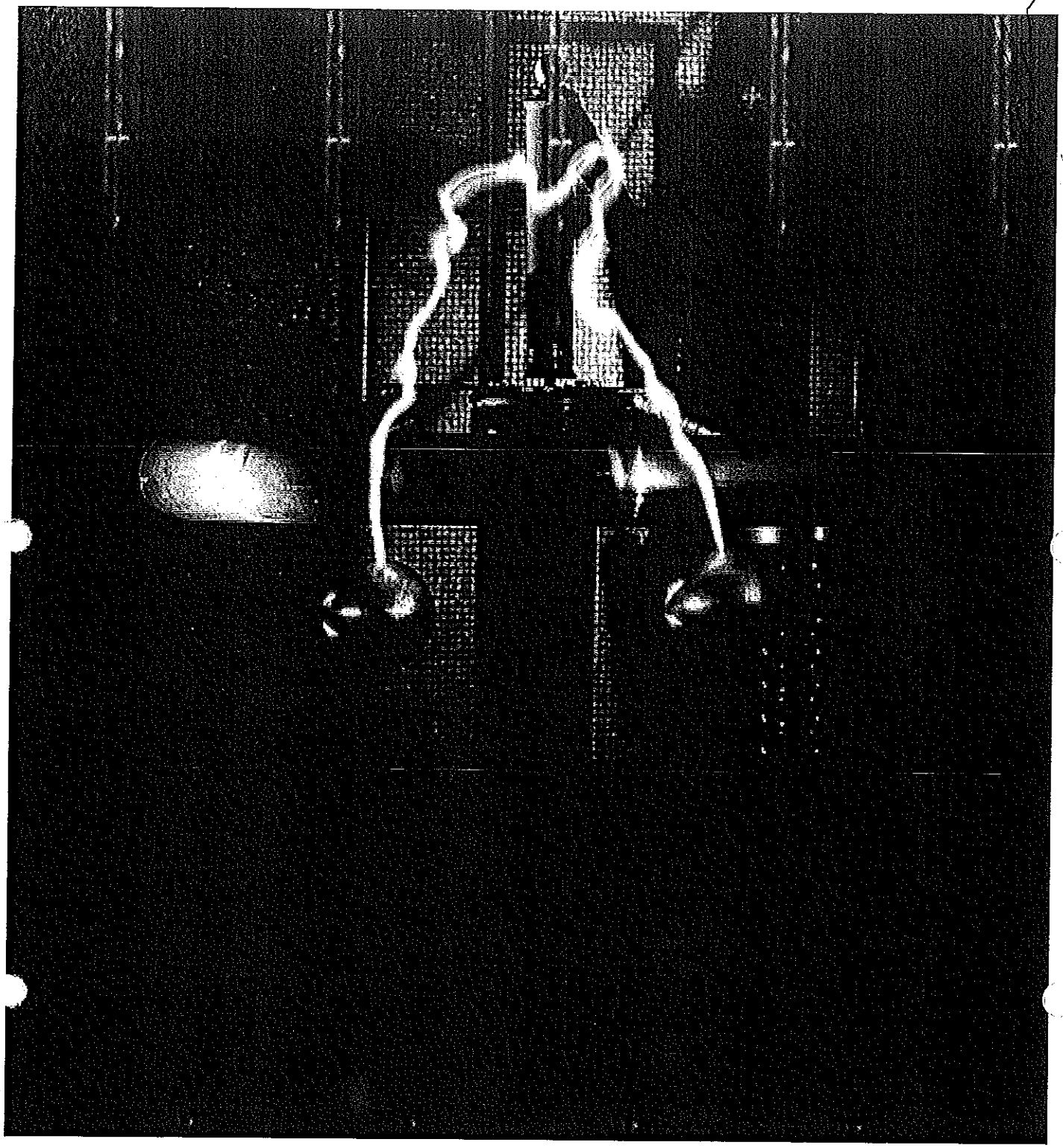
Accreditamento n°
Accreditation n° **0030** Rev. **2**

Si dichiara che
We declare that

Sedi operative:

CESI S.p.A.
Via Rubattino 54
20134 Milano MI
CESI S.p.A. - Sede di Piacenza
Via Nino Bixio 39
29100 Piacenza PC
CESI S.p.A. - Sede di Seriate
Via Pastrengo 9
24068 Seriate BG

Sede operativo e legale: Via Guglielmo Saliceto, 7/9 | 00161 Roma - Italy | Tel. +39 06 8440991 | Fax +39 06 8841199
info@accredia.it | www.accredia.it | Partita IVA - Codice Fiscale 10566361001

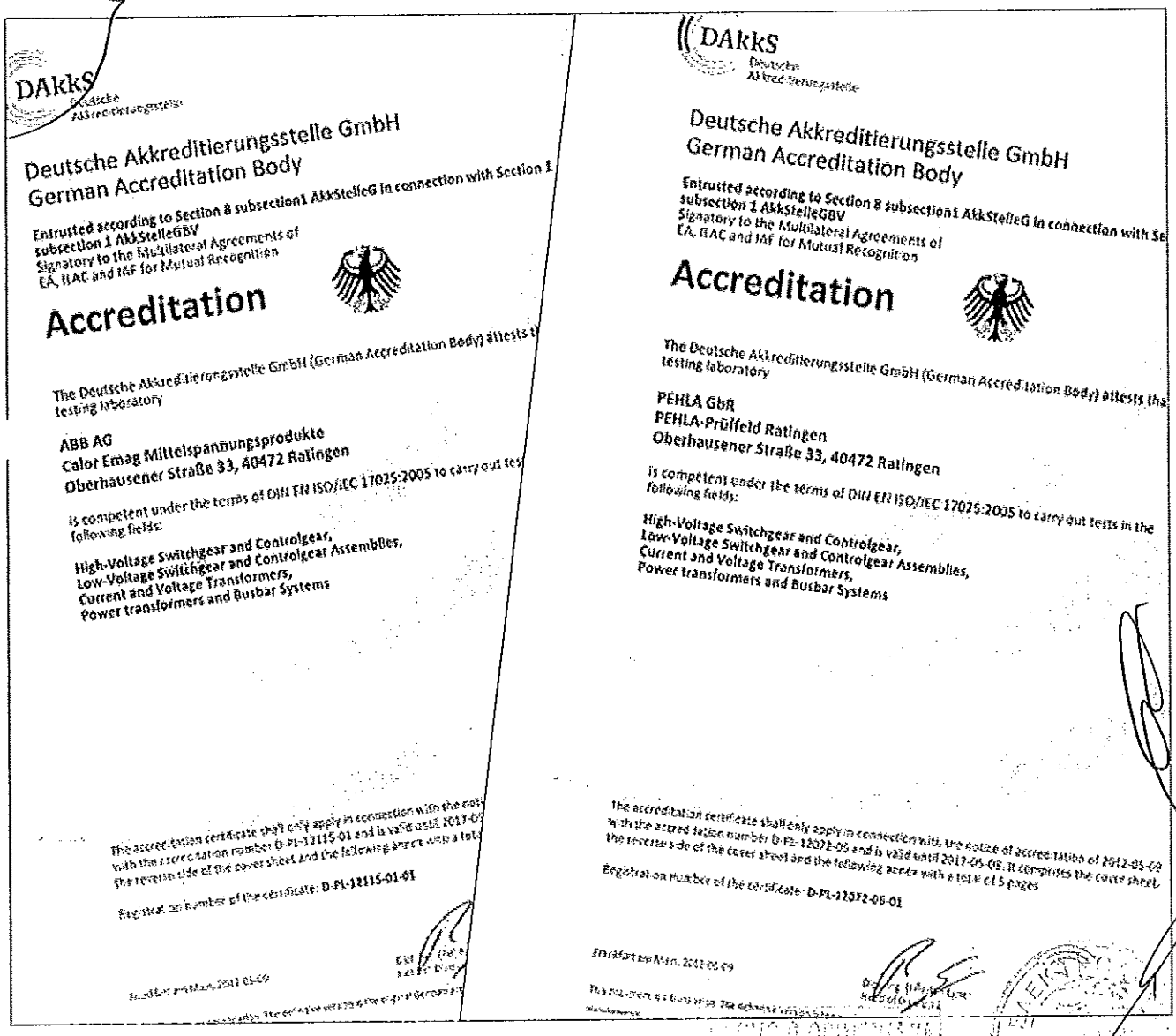


Power and productivity
for a better world™

ABB

Introducing Laboratories Ratingen

Since 1954, the laboratories of ABB AG – Calor Emag Medium Voltage Products have performed tests on medium voltage equipment. Our laboratories, which are located in Ratingen, Germany, contain all the facilities necessary for tests in the medium voltage range.
The ABB Laboratories Ratingen and PEHLA Testing Laboratories Ratingen are accredited by the German Accreditation Authority (DAkkS). As a shareholder of PEHLA GbR we are also a member laboratory of the Short-circuit Testing Liaison. We provide our customers with high performance and independent testing carried out in accordance with customer requirements or national and international standards.



Deutsche Akkreditierungsstelle GmbH
German Accreditation Body

Entrusted according to Section 8 subsection1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH (German Accreditation Body) attests the testing laboratory

ABB AG
Calor Emag Mittelspannungsprodukte
Oberhausener Straße 33, 40472 Ratingen

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields:

High-Voltage Switchgear and Controlgear,
Low-Voltage Switchgear and Controlgear Assemblies,
Current and Voltage Transformers,
Power transformers and Busbar Systems

The accreditation certificate shall only apply in connection with the accreditation number D-PL-12115-01 and is valid until 2017-05-09. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 5 pages.

Registration number of the certificate: D-PL-12115-01-01

Frankfurt am Main, 2012-05-09

Deutsche Akkreditierungsstelle GmbH
German Accreditation Body

Entrusted according to Section 8 subsection1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH (German Accreditation Body) attests the testing laboratory

PEHLA GbR
PEHLA-Prüffeld Ratingen
Oberhausener Straße 33, 40472 Ratingen

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields:

High-Voltage Switchgear and Controlgear,
Low-Voltage Switchgear and Controlgear Assemblies,
Current and Voltage Transformers,
Power transformers and Busbar Systems

The accreditation certificate shall only apply in connection with the accreditation number D-PL-12072-06-01 and is valid until 2017-05-08. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 5 pages.

Registration number of the certificate: D-PL-12072-06-01

Frankfurt am Main, 2012-05-09

Why testing at Laboratories Ratingen?

With 60 years of experience we know how to perform tests professionally. Starting with the planning and preparation phase we cooperate closely with our customers in order to ensure an optimal testing. Our organization provides flexible planning which ensures short-term reservation.
When testing at the Laboratories Ratingen our customers may choose to either prepare the test objects on their own or make use of our assembly and installation service. By request an on-site testing can be performed in the customer's facilities. All test results will be evaluated by our team of highly qualified and experienced experts in close cooperation with the customers. Our laboratories are equipped with a SF_6 module to handle and recycle the gas for environmental safety. The accreditation as ABB Laboratories Ratingen and as PEHLA Testing Laboratories Ratingen ensures that all tests are fully independent.

Services we provide:

- On-site testing and diagnostics with mobile test equipment
- Independent witnessing of tests
- Inspections, examinations and diagnostics
- Manufacturing of prototypes and individual parts
- Assembly of prototypes and test objects
- Assembly and installation work
- Calibration of electrical and mechanical measuring equipment

Our documentation to the customers

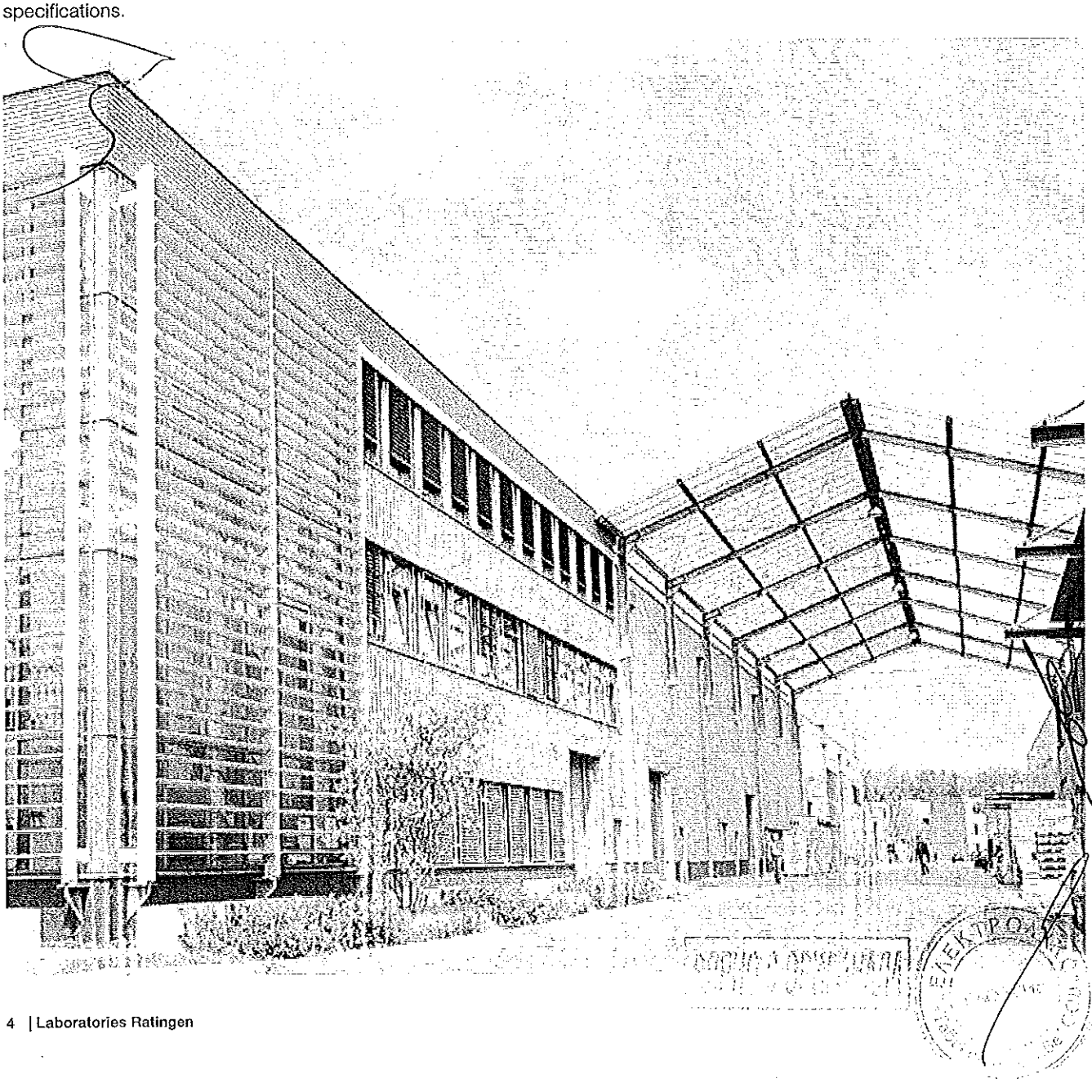
When testing at Laboratories Ratingen different types of documentation can be issued.

Type test certificate
A type test certificate is issued for type tests 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. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

Test document
A test document is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

Test report
A test report is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients' instructions. Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the test object, and its condition after the tests.

Test confirmation
A test confirmation is issued immediately after the tests. It confirms that the tests have been conducted and is valid only until publishing the detailed results in an entire document.



Development tests, type tests or acceptance tests

Laboratories Ratingen are able to offer any kind of test your company needs.

The laboratories are fully equipped to perform complete type tests on medium voltage equipment with state-of-the-art technology. All tests can be carried out as ABB tests or as PEHLA tests.

Tests we provide

- Type tests
- Development tests
- Acceptance tests (also in other test laboratories)
- Certification tests

Our test portfolio:

Tests \ Products	MV circuit-breaker	Metal enclosed switchgear	Power transformer	Disconnector & earthing switch	Switch fuse unit	Earthig facility	Bushing	Instrument transformer	Fuse	Cable accessoriy	Auxiliary circuit	Substation
Making and Breaking test	●	●		●	●				●		●	●
STC test	●	●	●	●		●	●	●		●	●	●
Internal arc test		●										●
Capacitive switching test	●			●								
Temperature rise test	●	●		●	●	●	●	●	●	●	●	●
Climatic test	●	●	●	●	●	●	●	●	●	●	●	
Dielectric test	●	●		●	●	●	●	●	●	●	●	●
IP/IK-coding test	●	●										●
Partial discharge test	●	●		●	●	●	●	●		●		●
Mechanical operation test	●	●		●	●						●	
Mechanical endurance test	●			●	●						●	
High and low temperature test	●	●		●			●		●		●	
Tightness test	●	●		●			●					
Pressure test	●	●		●								

● Tests at Ratingen possible ⬚ Tests not applicable to this product

Overview of standards

High-voltage switchgear and controlgear	IEC 62271-1	IEC 62271-100	IEC 62271-102
	IEC 62271-103	IEC 62271-104	IEC 62271-105
	IEC 62271-106	IEC 62271-110	IEC 62271-111
	IEC 62271-200	IEC 62271-201	IEC 62271-202
	IEC 62271-203	IEC 62271-304	IEC 60529
High-voltage test techniques	IEC 60060-1	IEC 60060-2	IEC 60270
Power transformers	IEC 60076-5	IEC 60076-11	
High-voltage fuses	IEC 60282-1	IEC 60282-2	
Bushings	IEC 60137		
Insulators	IEC 60660		
Instrument transformers	IEC 61869-1	IEC 61869-2	IEC 61869-3
Live working	IEC 60832-1	IEC 60832-2	IEC 61230
Low-voltage switchgear and controlgear	IEC 60947-1	IEC 60947-2	IEC 60947-3
ANSI / IEEE	IEEE C37.04 ANSI C37.54	ANSI C37.06 IEEE C37.60	IEEE C37.09

Other standards on request.

Testing facilities

The Laboratories Ratingen are coordinating tests very well even if different kind of tests in more than one laboratory are required. Customers, who need various tests, can therefore rely on well-organized test procedures – quickly and at fair conditions.

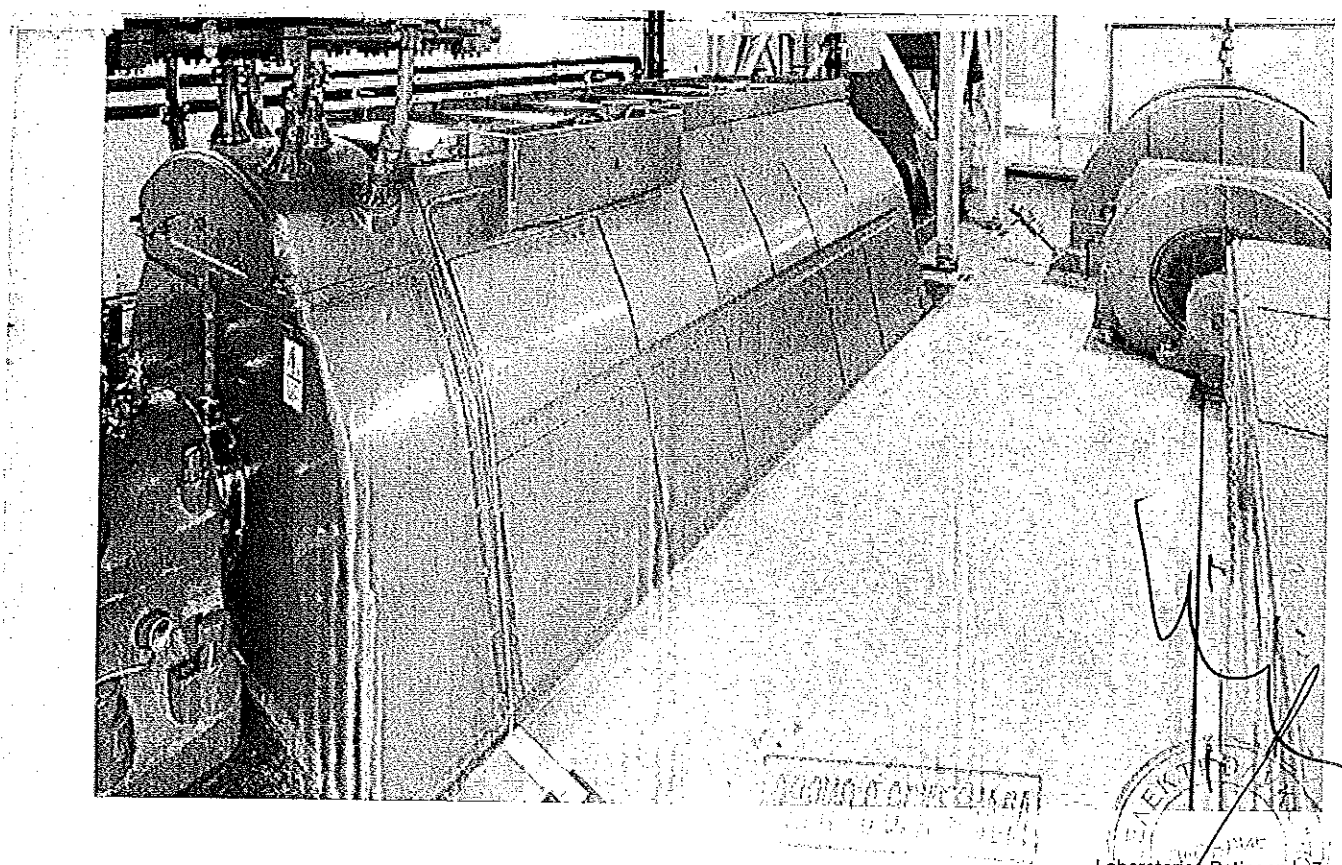
High-power testing laboratory
The high power testing laboratory is equipped with a 2800 MVA short-circuit test generator and oil-insulated power transformers and is therefore able to perform making and breaking tests at several voltage- and short-circuit current levels.

A special dry-type power transformer is available to perform peak-withstand current- and short-time withstand current test up to 250 kA and 100 kA r.m.s for three seconds.

Inside the room simulation of the arcing test bay, internal arcing tests can be performed for switchgear, containers or even substations.

A capacitor bank allows to perform different capacitive tests (e.g. line- or cable-charging current switching tests, back-to-back- and single-capacitor-bank current switching tests).

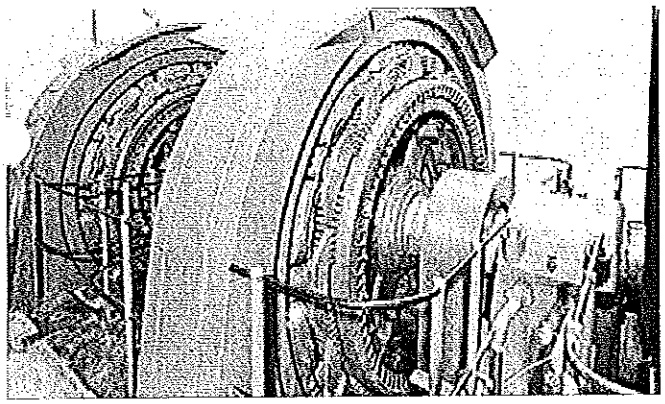
With the miscellaneous equipment like different reactors and resistors, measurement equipment etc., it is possible to perform a wide range of load current switching tests as well.

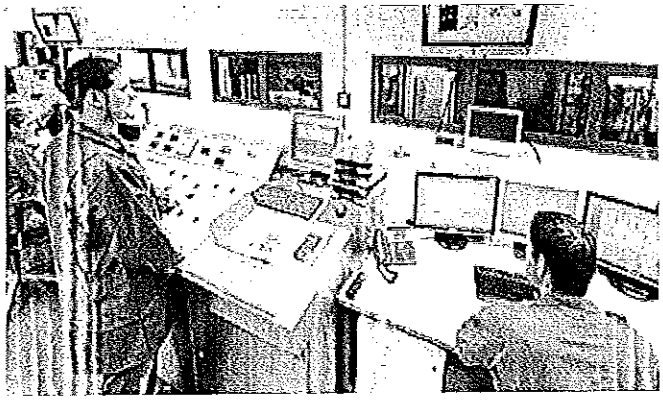


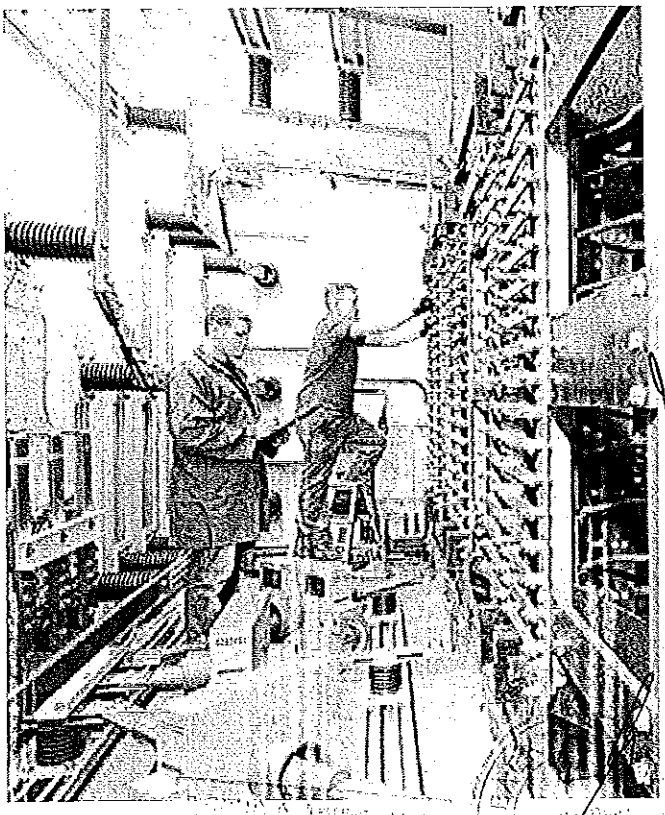
Testing facilities

The tests, which can be performed at our high power testing laboratory, are:

- Short-circuit making and breaking capacity test
  up to
  - 50 kA at 12 kV
  - 31.5 kA at 17.5 kV
  - 25 kA at 24 kV
  - 16 kA at 40.5 kV
- Switching capacity test
  Load currents
  - Capacitive
  - Inductive
  - Ohmic
  - Inductive-ohmic
- Peak withstand current test
  - Up to 250 kA
- Short-time withstand current test
  - Up to 100 kA and up to 3s (4s)
- Internal arc fault test
  - Up to 50 kA
- Different tests
  - beyond the standards according to client's instructions



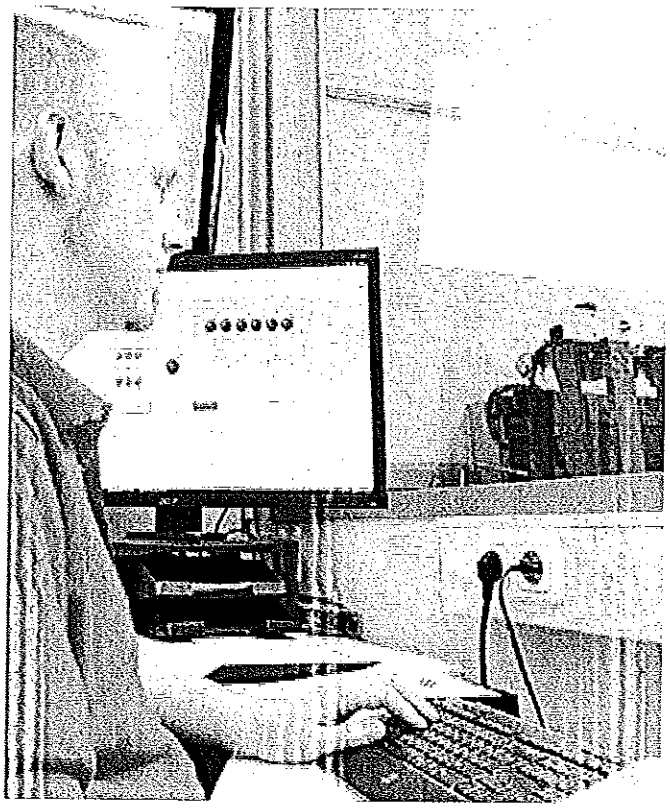


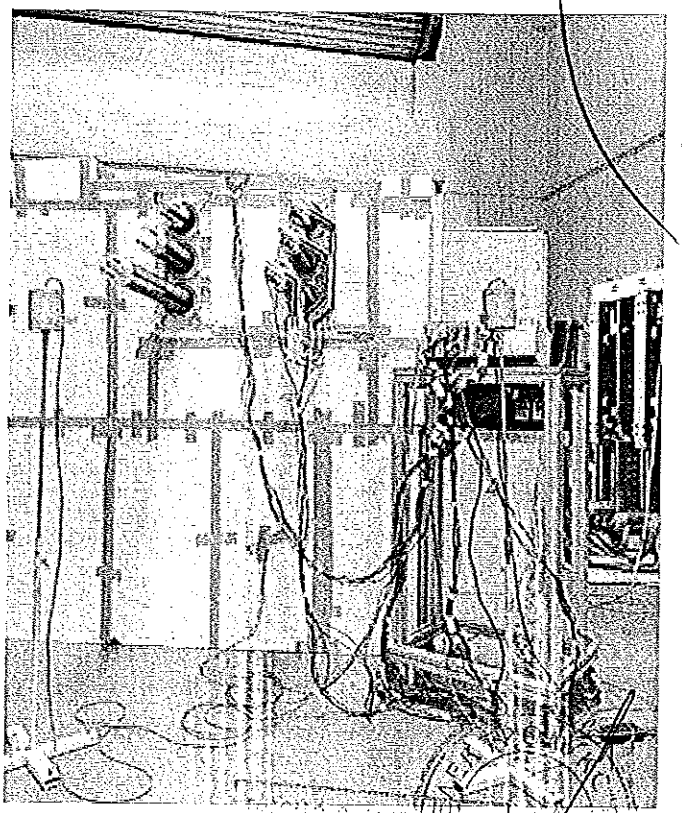


Temperature-rise testing laboratory
The temperature-rise testing laboratory is suited to perform tests with a continuous current up to 5000 A on switchgear and switching devices. Through automated and computer controlled tests we use our recourses in the most efficient and effective way. Therefore we can offer precise, reliable and quick tests during day and night-time to our customers.

During the test, currents and temperatures are checked every 10 minutes. Shorter measurement intervals for currents and temperatures are possible. A control circuit guarantees a constant three-phase current through the entire test. The test is automatically stopped if a temperature limit is exceeded or the test duration is over.

- Temperature-rise tests
  - Up to 180 measuring points can be connected
  - Single-phase and three-phase
    - Up to 5000 A at 50 Hz
    - Up to 4000 A at 60 Hz
- Additionally we can offer
  - Magnetic field measurement
  - Thermal imaging





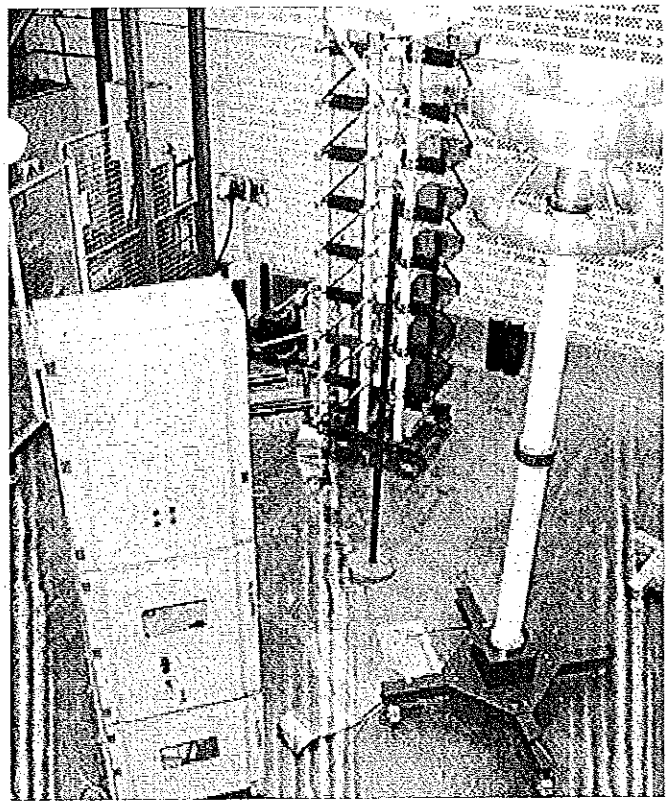
Testing facilities

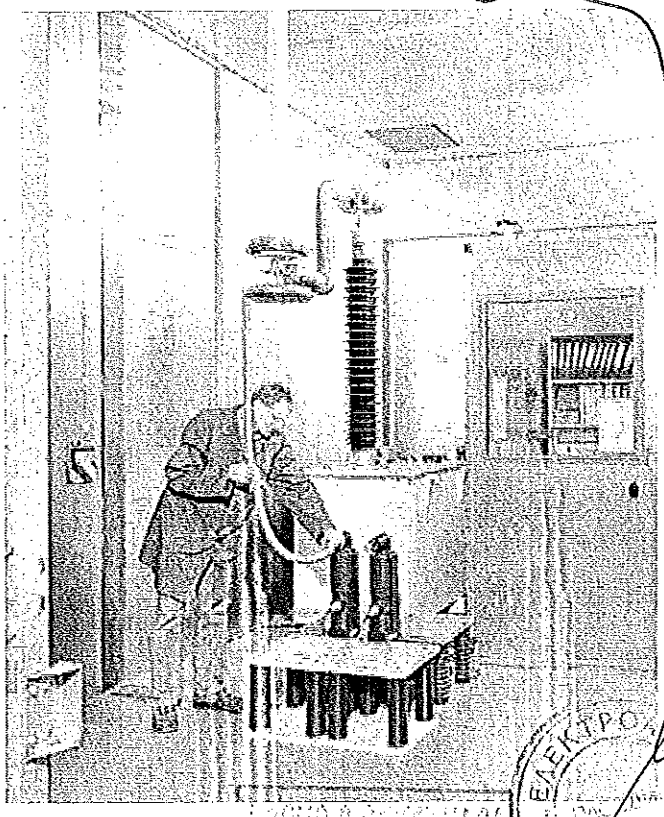
High-voltage testing laboratory
With the test facilities in our high voltage testing laboratory all dielectric and partial discharge tests for medium voltage equipment can be carried out. For sensitive partial discharge tests a special test chamber is available with a background level < 1 pC.

In order to offer on-site testing the high-voltage laboratory has mobile test equipment.

The high-voltage testing laboratory performs the following tests:

- Standard lightning impulse voltage tests
  - Up to 800 kV
- Power-frequency voltage tests
  - Stationary up to 260 kV
  - Mobile up to 230 kV
- Partial discharge tests
  - Stationary up to 150 kV
  - Mobile up to 230 kV
- Degree of protection tests
- Tests on auxiliary and control circuits





Mechanical testing laboratory
The mechanical testing laboratory offers different functional, environmental and material tests especially on medium and low voltage equipment and their components.

The functional tests include endurance tests on switching devices, kinematic chain tests and function tests on any kind of interlocking or control system. For long-duration tests automatic control and monitoring systems are available to supervise various signals for diagnostics.

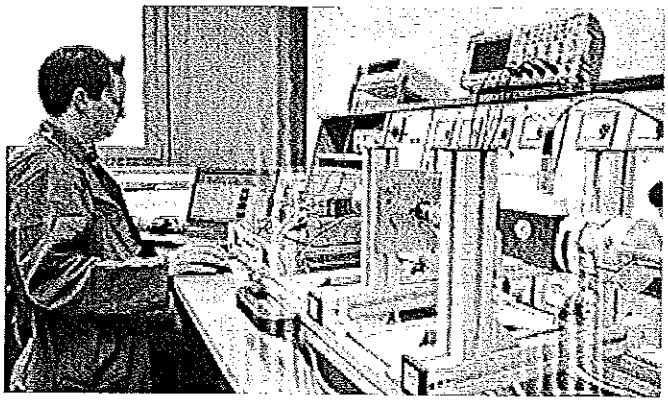
A wide range of measurement equipment is able to record via special sensors many additional data for detailed investigation of the test objects characteristics, like travels, rotation angles, forces, torques, pressures, temperatures, binary signal states and gas densities.

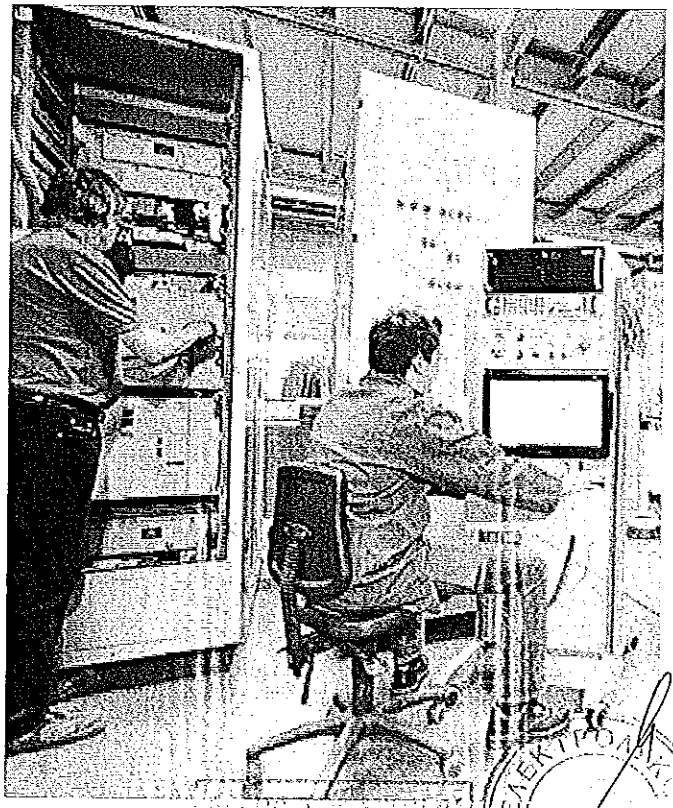
For gas-filled equipment we offer additionally gas-tightness and pressure withstand tests.

The environmental tests combine the above mentioned measurements and functional tests with special conditions during storage and/or operation like extreme temperatures, humidity, vibrations, inclination and other impacts.

Material testing concentrates on load tests like tensile, compression, mechanical impact IK-coding, torsion and bending tests.

High-speed video recording can be used for visual examination of very fast processes (up to 10,000 pic./s).





Testing facilities

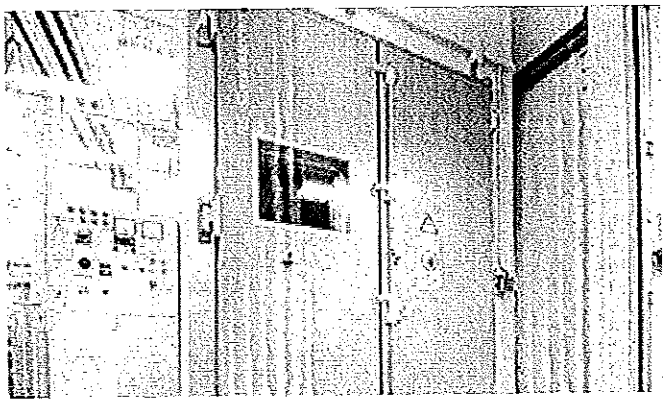
Material testing laboratory
In this laboratory various climatic tests on materials, components and complete medium voltage switchgear panels can be carried out.

The testing facilities include two accessible climatic / thermo chambers. The main tests offered by the material testing laboratory are:

- Temperature tests
  - Range: -70 °C to +150 °C
  - Test voltage: 95 kV (1-phase)

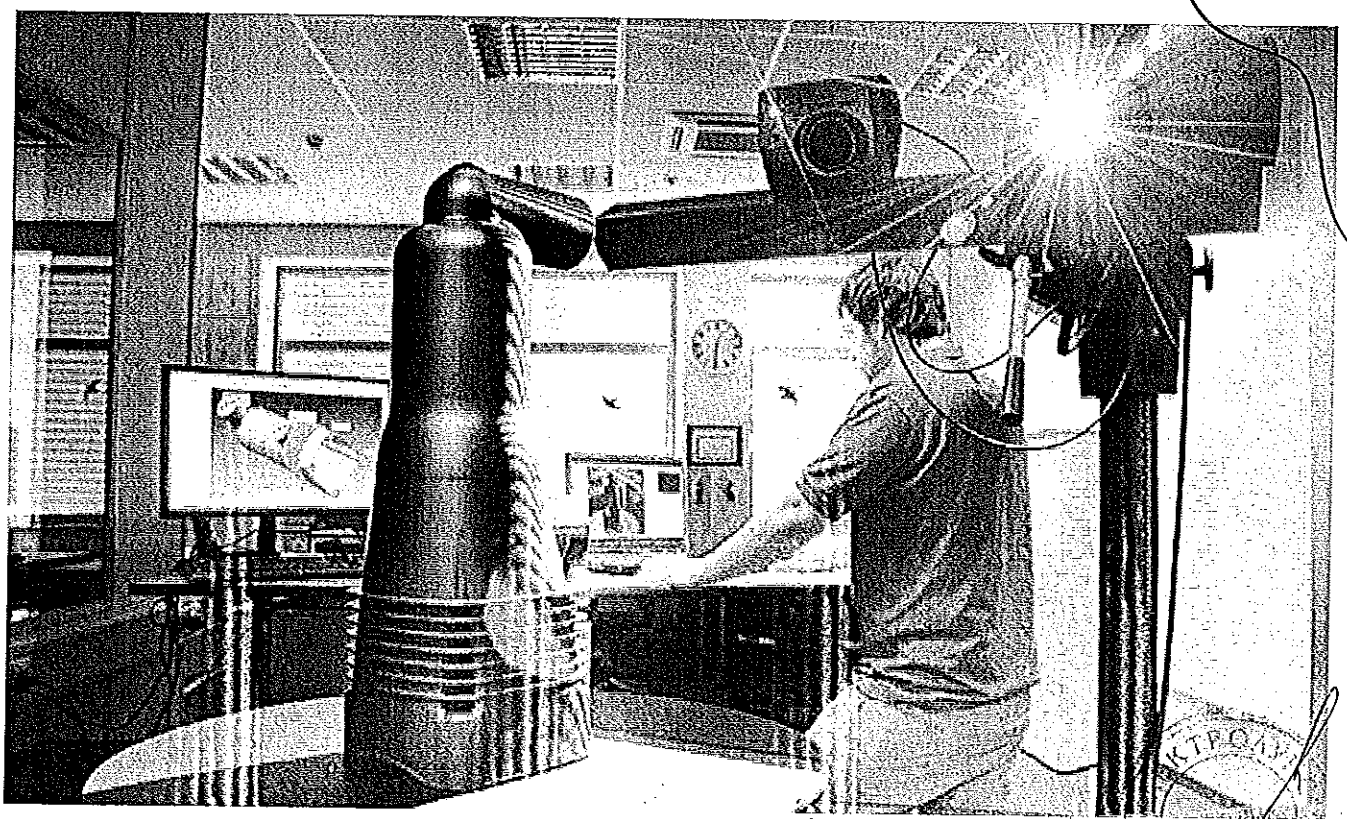
  Climatic tests
  - Temperature range: +20 °C to +90 °C
  - Humidity range: 10 - 98 %
  - Test voltage: 95 kV (1-phase)
- Corrosion tests
  - Salt fog tests
  - Fog tests with sulfur dioxide
  - Tests with condensed water containing climate

Calibration service
At the calibration laboratory we are able to calibrate electrical measurement instruments, force measurement instruments, length measurement equipment, torque wrenches and pressure gas equipment.



Initial sampling inspection
Objects with different size can be digitized with top-quality by 3D-scanning.

The 3D scanner will also be used for
- Quality checks
  - Comparison of nominal/actual measurement data according to CAD data set
  - Measurement of form and position tolerances without complex construction
  - Measurement of free formed surfaces
  - Serial measurement for quality checks, process safety
- Toolroom
  - Generation of drawings for CAD system derives from scan process
  - Check of initial batches

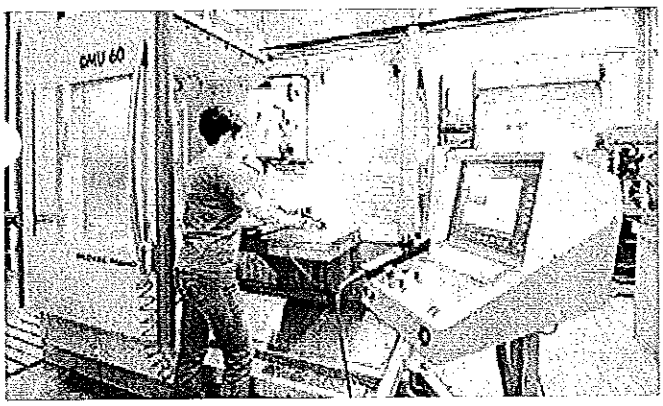


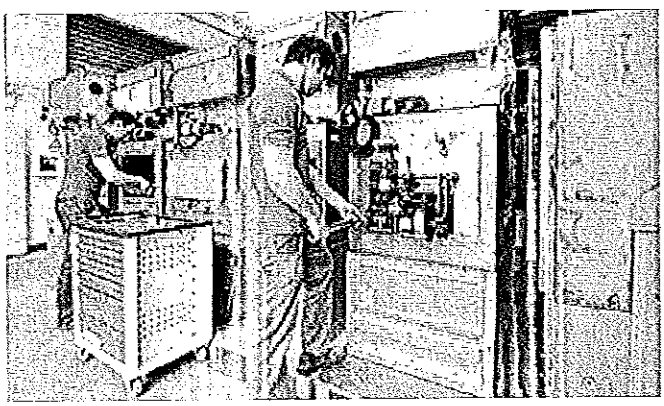
Workshop of the Laboratories

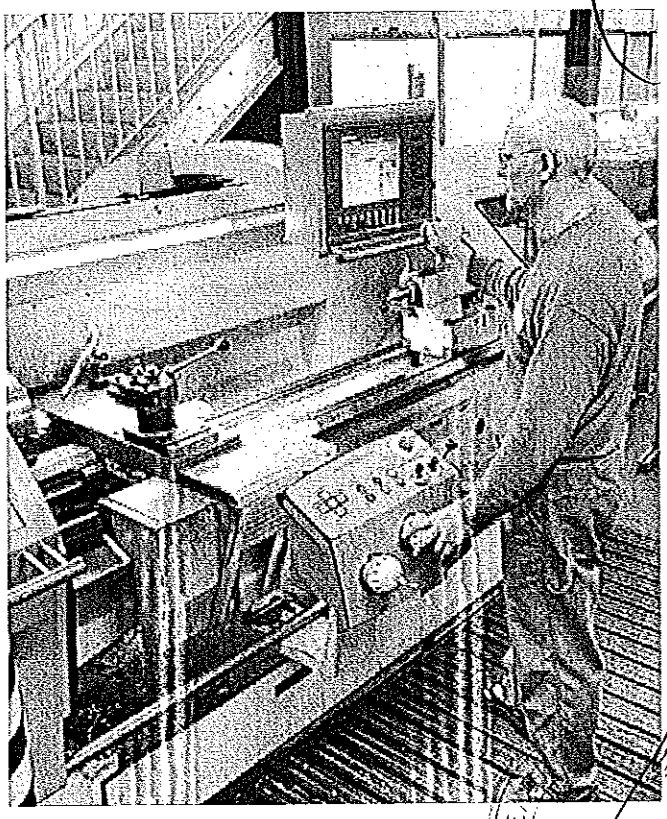
The workshop manufactures prototypes and test arrangements as well as provides complete assembly and installation service in connection with tests.

If defects occur during tests our workshop offers immediate repair service and manufacturing of spare parts.

In order to offer optimal service the workshop is fully equipped for all kind of metal processing.







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Anlage zur Akkreditierungsurkunde D-PL-12115-01-00 nach DIN EN ISO/IEC 17025:2005

Gültigkeitsdauer: 20.04.2017 bis 19.04.2022 Ausstellungsdatum: 20.04.2017

Urkundeninhaber:

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Kallstater Str. 1, 68309 Mannheim

Standort:
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Calor Emag Mittelspannungsprodukte
Oberhausener Straße 33, 40472 Ratingen

Prüfungen in den Bereichen:

Geräte und Anlagen der Nieder-, Mittel- und Hochspannung

Dem Prüflaboratorium ist, ohne dass es einer vorherigen Information und Zustimmung der DAkkS bedarf, die Anwendung der hier aufgeführten genormten oder ihnen gleichzusetzenden Prüfverfahren mit unterschiedlichen Ausgabeständen gestattet.

Das Prüflaboratorium verfügt über eine aktuelle Liste aller Prüfverfahren im flexiblen Akkreditierungsbereich.

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 61869-1 VDE 0414-9-1: April 2010 IEC 61869-1 Edition 1.0, 2007-10	Messwandler – Teil 1: Allgemeine Anforderungen (IEC 61869-1:2007, modifiziert); Deutsche Fassung EN 61869-1:2009 Instrument transformers – Part 1: General requirements (IEC 61869-1:2007, modified); German version EN 61869-1:2009	

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Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 61869-2 VDE 0414-9-2: 2013-07 + DIN EN 61869-2 Berichtigung 1: 2014-06; VDE 0414-9-2 Berichigung 1: 2014-06 IEC 61869-2 Edition 1.0, 2012-09	Messwandler – Teil 2: Zusätzliche Anforderungen für Stromwandler (IEC 61869-2:2012); Deutsche Fassung EN 61869-2:2012 Instrument transformers – Part 2: Additional requirements for current transformers (IEC 61869-2:2012); German version EN 61869-2:2012	
Elektrotechnik	DIN EN 61869-3 (VDE 0414-9-3): Mai 2012 IEC 61869-3 Edition 1.0, 2011-07	Messwandler – Teil 3: Zusätzliche Anforderungen für induktive Spannungswandler (IEC 61869-3:2011); Deutsche Fassung EN 61869-3:2011 Instrument transformers – Part 3: Additional requirements for inductive voltage transformers (IEC 61869-3:2011); German version EN 61869-3:2011	
Elektrotechnik	DIN EN 61869-4 VDE 0414-9-4: April 2015 IEC 61869-4 Edition 1.0, 2013-11	Messwandler - Teil 4: Zusätzliche Anforderungen für kombinierte Wandler (IEC 61869-4:2013) Deutsche Fassung EN 61869-4:2014 Instrument transformers - Part 4: Additional requirements for combined transformers German version EN 61869-4:2014	
Elektrotechnik	DIN EN 61869-5 (VDE 0414-9-5) Mai 2012 IEC 61869-5 Edition 1.0, 2011-07	Messwandler - Teil 5: Zusätzliche Anforderungen für kapazitive Spannungswandler (IEC 61869-5:2011); Deutsche Fassung EN 61869-5:2011 Instrument transformers – Part 5: Additional requirements for capacitor voltage transformers (IEC 61869-5:2011); German version EN 61869-5:2011	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 60060-1 (VDE 0432-1) Oktober 2011 IEC 60060-1 Edition 3.0, 2010-09	Hochspannungs-Prüftechnik – Teil 1: Allgemeine Begriffe und Prüfbedingungen (IEC 60060-1:2010); Deutsche Fassung EN 60060-1:2010 High-voltage test techniques – Part 1: General definitions and test requirements (IEC 60060-1:2010); German version EN 60060-1:2010	
Elektrotechnik	DIN EN 60060-2 (VDE 0432-2) Oktober 2011 IEC 60060-2 Edition 3.0, 2010-11	Hochspannungs-Prüftechnik – Teil 2: Messsysteme (IEC 60060-2:2010); Deutsche Fassung EN 60060-2:2011 High-voltage test techniques – Part 2: Measuring systems (IEC 60060-2:2010); German version EN 60060-2:2011	(without annex A) (ohne Anhang A)
Elektrotechnik	DIN EN 60076-5 (VDE 0532-76-5) Januar 2007 IEC 60076-5 Third Edition, 2006-02	Leistungstransformatoren – Teil 5: Kurzschlussfestigkeit (IEC 60076-5:2006); Deutsche Fassung EN 60076-5:2006 Power transformers – Part 5: Ability to withstand short-circuit (IEC 60076-5:2006); German version EN 60076-5:2006	
Elektrotechnik	DIN EN 60076-11 (VDE 0532-76-11) April 2005 IEC 60076-11 First Edition, 2004-05	Leistungstransformatoren – Teil 11: Trockentransformatoren (IEC 60076-11:2004); Deutsche Fassung EN 60076-11:2004 Power transformers – Part 11: Dry-type transformers (IEC 60076-11:2004); German version EN 60076-11:2004	
Elektrotechnik	DIN EN 60137 (VDE 0674-5) Juli 2009 IEC 60137	Isolierte Durchführungen für Wechselspannungen über 1 000 V (IEC 60137:2008); Deutsche Fassung EN 60137:2008 Insulated bushings for alternating voltages above	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
	Edition 6.0, 2008-07	1000 V (IEC 60137:2008); German version EN 60137:2008	
Elektrotechnik	DIN EN 62271-103 (VDE 0671-103) April 2012 IEC 62271-103 Edition 1.0, 2011-06	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 103: Lastschalter für Bemessungsspannungen über 1 kV bis einschließlich 52 kV (IEC 62271-103:2011); Deutsche Fassung EN 62271-103:2011 High-voltage switchgear and controlgear – Part 103: Switches for rated voltages above 1 kV up to and including 52 kV (IEC 62271-103:2011); German version EN 62271-103:2011	
Elektrotechnik	DIN EN 62271-104 (VDE 0671-104) November 2015 IEC 62271-104 Edition 2.0, 2015-02	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 104: Wechselstrom-Lastschalter für Bemessungsspannungen über 52 kV (IEC 62271-104:2015); Deutsche Fassung EN 62271-104:2015 High-voltage switchgear and controlgear – Part 104: Alternating current switches for rated voltages higher than 52 kV (IEC 62271-104:2015); German version EN 62271-104:2015	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 60270 (VDE 0434) August 2001 + DIN EN 60270 Berichtigung 1: November 2002; VDE 0414-9-2 Berichigung 1: November 2002 IEC 60270 Third edition, 2000-12 + Amendement 1 Third edition, 2015-11	Hochspannungs-Prüftechnik Teilentladungsmessungen (IEC 60270:2000) Deutsche Fassung EN 60270:2001 High-voltage test techniques – Partial discharge measurement (IEC 60270:2000); German version EN 60270:2001	
Elektrotechnik	DIN EN 60282-1 (VDE 0670-4) August 2010 IEC 60282-1 Edition 7.1, 2014-07	Hochspannungssicherungen Teil 1: Strombegrenzende Sicherungen (IEC 60282-1:2009) Deutsche Fassung EN 60282-1:2009 High-voltage fuses – Part 1: Current-limiting fuses (IEC 60282-1:2009); German version EN 60282-1:2009	
Elektrotechnik	IEC 60282-2 Edition 3.0, 2008-04	High-voltage fuses – Part 2: Expulsion fuses	
Elektrotechnik	DIN EN 62271-106 (VDE 0671-106) Juni 2011 IEC 62271-106 Edition 1.0, 2011-08	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 106: Wechselstrom-Schütze, Kombinationsstarter und Motorstarter mit Schützen (IEC 62271-106:2011); Deutsche Fassung EN 62271-106:2011 High-voltage switchgear and controlgear – Part 106: Alternating current contactors, contactor-based controllers and motor-starters (IEC 62271-106:2011); German version EN 62271-106:2011	

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Elektrotechnik	DIN EN 60529 (VDE 0470-1) September 2014 IEC 60529 Edition 2.2, 2013-08	Schutzarten durch Gehäuse (IP-Code) (IEC 60529:1989 + A1:1999 + A2:2013) Deutsche Fassung EN 60529:1991 + A1: 2000 + A2:2013 Degree of protection provided by enclosures (IP Code) (IEC 60529:1989 + A1:1999 + A2:2013) German version EN 60529:1991 + A1: 2000 + A2:2013	
Elektrotechnik	DIN EN 60660 (VDE 0441-3) Dezember 2000 IEC 60660 Edition 2.0, 1999-10	Isolatoren Prüfungen an Innenraum-Stützern aus organischem Werkstoff für Netze mit Nennspannungen über 1 kV bis kleiner 300 kV (IEC 60660:1999) Deutsche Fassung EN 60660:1999 Insulators – Tests on indoor post insulators of organic material for systems with nominal voltages greater than 1 kV up to but not including 300 kV (IEC 60660:1999); German version EN 60660:1999	
Elektrotechnik	DIN EN 60832-1 (VDE 0682-211) Dezember 2010 IEC 60832-1 Edition 1.0, 2010-02	Arbeiten unter Spannung – Isolierende Stangen und auswechselbare Arbeitsköpfe – Teil 1: Isolierende Stangen (IEC 60832-1:2010) Deutsche Fassung EN 60832-1:2010 + Cor.:2010 Live working - Insulating sticks and attachable devices - Part 1: Insulating sticks (IEC 60832-1:2010) German version EN 60832-1:2010 + Cor.:2010	
Elektrotechnik	DIN EN 60832-2 (VDE 0682-212) Dezember 2010 IEC 60832-2 Edition 1.0, 2010-02	Arbeiten unter Spannung – Isolierende Stangen und auswechselbare Arbeitsköpfe Teil 2: Auswechselbare Arbeitsköpfe (IEC 60832-2:2010); Deutsche Fassung EN 60832-2:2010 + Cor.:2010 Live working - Insulating sticks and attachable devices - Part 2: Attachables devices (IEC 60832-2:2010); German version EN 60832-2:2010 + Cor.:2010	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 60947-1: (VDE 0660-100) Oktober 2011	Niederspannungsschaltgeräte – Teil 1: Allgemeine Festlegungen (IEC 60947-1:2007 + A1:2010); Deutsche Fassung EN 60947-1:2007 + A1:2011	
	DIN EN 60947-1/A2 (VDE 0660-100/A2) Mai 2014	Niederspannungsschaltgeräte – Teil 1: Allgemeine Festlegungen (IEC 17B/1806/CDV:2013); Deutsche Fassung EN 60947-1:2007/FprA2:2013	
	IEC 60947-1 Edition 5.2 2014-09 + Amendement 1 + 2	Low-voltage switchgear and controlgear - Part 1: General rules (IEC 60947-1:2007 + A1:2010); German version EN 60947-1:2007 + A1:2011	
Elektrotechnik	DIN EN 60947-2: VDE 0660-101 Januar 2014	Niederspannungsschaltgeräte – Teil 2: Leistungsschalter (IEC 60947-2:2006 + A1:2009 + A2:2013); Deutsche Fassung EN 60947-2:2006 + A1:2009 + A2:2013	
	DIN EN 60947-2 (VDE 0660-101) März 2015	Niederspannungsschaltgeräte – Teil 2: Leistungsschalter (IEC 121A/26/CDV:2014); Deutsche Fassung FprEN 60947-2:2014	
	IEC 60947-2 Edition 5.0 2016-06	Low-voltage switchgear and controlgear – Part 2: Circuit-breakers (IEC 60947-2: 2016); German version EN 60947-2:2006 + A1:2009 + A2:2013	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 60947-3: VDE 0660-10 Dezember 2012	Niederspannungsschaltgeräte - Teil 3: Lastschalter, Trennschalter, Lasttrennschalter und Schalter-Sicherungs-Einheiten (IEC 60947-3:2008 + A1:2012); Deutsche Fassung EN 60947-3:2009 + A1:2012	
	DIN EN 60947-3 Berichtigung 1 (VDE 0660-107 Berichtigung 1) März 2015	Niederspannungsschaltgeräte – Teil 3: Lastschalter, Trennschalter, Lasttrennschalter und Schalter-Sicherungs-Einheiten (IEC 60947-3:2008 + A1:2012); Deutsche Fassung EN 60947-3:2009 + A1:2012, Berichtigung zu DIN EN 60947-3 (VDE 0660-107):2012-12; (IEC-Cor.:2013 zu IEC 60947-3:2008/A1:2012)	
	DIN EN 60947-3/A2:2015-03; VDE 0660-107/A2:2015-03	Niederspannungsschaltgeräte – Teil 3: Lastschalter, Trennschalter, Lasttrennschalter und Schalter-Sicherungs-Einheiten (IEC 121A/7/CDV:2014); Deutsche Fassung EN 60947-3:2009/FprA2:2014	
	IEC 60947-3 Edition 3.1 2012-04 + Amendement 1	Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units (IEC 60947-3:2008 + A1:2012); German version EN 60947-3:2009 + A1:2012	
Elektrotechnik	DIN EN 61230, (VDE 0683-100) Juli 2009	Ortsveränderliche Geräte zum Erden oder Erden und Kurzschließen (IEC 61230:2008); Deutsche Fassung EN 61230:2008	
	IEC 61230 Edition 2.0, 2008-07	Live working - Portable equipment for earthing or earthing and short-circuiting (IEC 61230:2008); German version EN 61230:2008	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 61869-1 VDE 0414-9-1 April 2010 IEC 61869-1 Edition 1.0, 2007-10	Messwandler Teil 1: Allgemeine Anforderungen (IEC 61869-1:2007, modifiziert); Deutsche Fassung EN 61869-1:2009 Instrument transformers - Part 1: General requirements (IEC 61869-1:2007, modified); German version EN 61869-1:2009	
Elektrotechnik	DIN EN 62271-1 VDE 0671-1 August 2009 + DIN EN 62271-1/A1 VDE 0671-1/A1 April 2012 IEC 62271 Edition 1.1, 2011-08	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 1: Gemeinsame Bestimmungen (IEC 62271-1:2007); Deutsche Fassung EN 62271-1:2008 Hochspannungs-Schaltgeräte und –Schaltanlagen Teil 1: Gemeinsame Bestimmungen (IEC 62271-1:2007/A1:2011); Deutsche Fassung EN 62271-1:2008/A1:2011 High-voltage switchgear and controlgear - Part 1: Common specifications (IEC 62271-1:2007); German version EN 62271-1:2008	
Elektrotechnik	DIN EN 62271-100 VDE 0671-100 August 2013 IEC 62271-100 Edition 2.1, 2012-09	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 100: Wechselstrom-Leistungsschalter (IEC 62271-100:2008 + A1:2012); Deutsche Fassung EN 62271-100:2009 + A1:2012 High-voltage switchgear and controlgear – Part 100: Alternating current circuit-breakers (IEC 62271-100:2008 + A1:2012); German version EN 62271-100:2009 + A1:2012	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 62271-102 VDE 0671-102 August 2013 +	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 102: Wechselstrom-Trennschalter und -Erdungsschalter (IEC 62271-102:2001 + Corrigenda 2002 & 2003 + A1:2011); Deutsche Fassung EN 62271-102:2002 + Cor.:2008 + A1:2011	
	DIN EN 62271-102/A2 VDE 0671-102/A2 Dezember 2013	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 102: Wechselstrom-Trennschalter und -Erdungsschalter (IEC 62271-102:2001/A2:2013); Deutsche Fassung EN 62271-102:2002/A2:2013	
	IEC 62271-102 Edition 1.2, 2013-02	High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches (IEC 62271-102:2001 + Corrigenda 2002 & 2003 + A1:2011 + A2:2013); German version EN 62271-102:2002 + Cor.:2008 + A1:2011 + A2:2013	
Elektrotechnik	DIN EN 62271-105 VDE 0671-105 August 2013	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 105: Wechselstrom-Lastschalter-Sicherungs-Kombinationen für Bemessungsspannungen über 1 kV bis einschließlich 52 kV (IEC 62271-105:2012); Deutsche Fassung EN 62271-105:2012	
	IEC 62271-105 Edition 2.0, 2012-09	High-voltage switchgear and controlgear – Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV (IEC 62271-105:2012); German version EN 62271-105:2012	
Elektrotechnik	DIN EN 62271-110 VDE 0671-110 August 2013	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 110: Schalten induktiver Lasten (IEC 62271-110:2012 + corrigendum Oct. 2012); Deutsche Fassung EN 62271-110:2012	
	IEC 62271-110 Edition 3.0, 2012-09	High-voltage switchgear and controlgear – Part 110: Inductive load switching (IEC 62271-110:2012 + corrigendum Oct. 2012); German version EN 62271-110:2012	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	E DIN EN 62271-111 VDE 0671-111 September 2014 IEC 62271-111: 2012(E) IEEE Std C37.60- 2012(E) Edition 2.0 2012-09	Hochspannungs-Schaltgeräte -und Schaltanlagen Teil 111: Automatische Wiedereinschalter und Fehlerunterbrecher für Wechselspannungssysteme bis 38 kV (IEC 17A/1060/CD:2014) High-voltage switchgear and controlgear – Part 111: Automatic circuit reclosers and fault interrupters for alternating current systems up to 38 kV	
Elektrotechnik	DIN EN 62271-200 VDE 0671-200 August 2012 + Berichtigung 1 IEC 62271-200 Edition 2.0, 2011-10 + Corrigendum 1	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 200: Metallgekapselte Wechselstrom-Schaltanlagen für Bemessungsspannungen über 1 kV bis einschließlich 52 kV (IEC 62271-200:2011); Deutsche Fassung EN 62271-200:2012 + Berichtigung 1:2016-01 High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV (IEC 62271-200:2011 + Corrigenda 2015); German version EN 62271-200:2012 + Berichtigung 1:2016-01	
Elektrotechnik	DIN EN 62271-201 VDE 0671-201 Juli 2007 IEC 62271-201 Edition 2.0, 2014-03	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 201: Isolierstoffgekapselte Wechselstrom-Schaltanlagen für Bemessungsspannungen über 1 kV bis einschließlich 52 kV (IEC 62271-201:2006); Deutsche Fassung EN 62271-201:2006 High-voltage switchgear and controlgear - Part 201: AC insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV (IEC 62271-201:2014);	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 62271-202 VDE 0671-202 August 2007 IEC 62271-202 Edition 2.0, 2014-03	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 202: Fabrikfertige Stationen für Hochspannung/Niederspannung (IEC 62271-202:2006); Deutsche Fassung EN 62271-202:2007 High-voltage switchgear and controlgear – Part 202: High-voltage/ low-voltage prefabricated substation (IEC 62271-202:2014);	
Elektrotechnik	DIN EN 62271-203 VDE 0671-203 November 2012 IEC 62271-203 Edition 2.0, 2011-09	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 203: Gasisolierte metallgekapselte Schaltanlagen für Bemessungsspannungen über 52 kV (IEC 62271-203:2011); Deutsche Fassung EN 62271-203:2012 High-voltage switchgear and controlgear – Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV (IEC 62271-203:2011); German version EN 62271-203:2012	
Elektrotechnik	E DIN EN 62271-304 VDE 0671-304 April 2007 IEC/TS 62271-304 Edition 1.0, 2008-05	Zusätzliche Anforderungen an gekapselte Schaltgerätekombinationen und Hochspannungsschaltanlagen von 1 kV bis 52 kV für den Einsatz unter erschwerten klimatischen Bedingungen (IEC 17C/373/CD:2006) High-voltage switchgear and controlgear – Part 304: Design classes for indoor enclosed switchgear and controlgear for rated voltages above 1 kV up to and includuing 52 kV to be used in severe climatic conditions (IEC/TS 62271-304:2008)	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	E DIN IEC 62271-37-013 VDE 0671-37-013: 2012-09 IEC/IEEE 62271-37-013 Edition 1.0, 2015-10	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 37-013: Wechselstrom-Generatorschalter (IEC 17A/993/CD:2011) High-voltage switchgear and controlgear – Part 37-013: Alternating-current generator circuit-breakers	
Elektrotechnik	DIN EN 60068-2-1 VDE 0468-2-1 Januar 2008 IEC 60068-2-1 Edition 6.0, 2007-03	Umgebungseinflüsse - Teil 2-1: Prüfverfahren - Prüfung A: Kälte (IEC 60068-2-1:2007); Deutsche Fassung EN 60068-2-1:2007 Environmental testing – Part 2-1: Tests – Test A: Cold (IEC 60068-2-1:2007); German version EN 60068-2-1:2007	
Elektrotechnik	DIN EN 60068-2-2 VDE 0468-2-2 Mai 2008 IEC 60068-2-2 Edition 5.0, 2007-07	Umgebungseinflüsse - Teil 2-2: Prüfverfahren - Prüfung B: Trockene Wärme (IEC 60068-2-2:2007); Deutsche Fassung EN 60068-2-2:2007 Environmental testing – Part 2-2: Tests – Test B: Dry heat (IEC 60068-2-2:2007) German version EN 60068-2-2:2007	
Elektrotechnik	DIN EN 60068-2-30 Juni 2006 IEC 60068-2-30 Edition 3.0, 2005-08	Umgebungseinflüsse - Teil 2-30: Prüfverfahren - Prüfung Db: Feuchte Wärme, zyklisch (12 + 12 Stunden) (IEC 60068-2-30:2005); Deutsche Fassung EN 60068-2-30:2005 Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle) (IEC 60068-2-30:2005) German version EN 60068-2-30:2005	
Elektrotechnik	IEC 62262 Edition 1.0, 2002-02	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code) German version SN EN 62262:2002	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 60068-2-75 VDE 0468-2-75 2015-08 IEC 60068-2-75 Edition 2.0, 2014-09	Umgebungseinflüsse - Teil 2-75: Prüfungen - Prüfung Eh: Hammerprüfungen (IEC 60068-2-75:2014); Deutsche Fassung EN 60068-2-75:2014 Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests (IEC 60068-2-75:2014) German version EN 60068-2-75:2014	
Elektrotechnik	IEEE Std C37.04- 1999 June 1999	IEEE Standard Rating Structure for AC High-Voltage Circuit Breakers IEEE Std C37.04-1999 (Revision of IEEE Std C37.04-1979)	
Elektrotechnik	IEEE Std C37.06-2009 November 2009	IEEE Standard for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities for Voltages Above 1000 V IEEE Std C37.06-2009 (Revision of ANSI C37.06-2000)	
Elektrotechnik	IEEE Std C37.09-1999 (R2007) June 1999	IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis IEEE Std C37.09™-1999 (R2007) (Revision of IEEE Std C37.09-1979)	
Elektrotechnik	ANSI C37.54-2002 March 2003	American National Standard For Indoor Alternating Current High-Voltage Circuit Breakers Applied as Removable Elements in Metal-Enclosed Switchgear— Conformance Test Procedures	
Elektrotechnik	ANSI C37.20.2-2015	IEEE Standard for Metal-Clad Switchgear	
Elektrotechnik	ANSI C37.20.7-2007	IEEE Guide for Testing Metal-Enclosed Switchgear Rated Up to 38 kV for Internal Arcing Faults	
Elektrotechnik	ANSI C37.122.2-2011	IEEE Guide for the Application of Gas Insulated Substations 1kV to 52kV	
Elektrotechnik	IEEE Std C57.13-2008	IEEE Standard Requirements for Instrument Transformers	

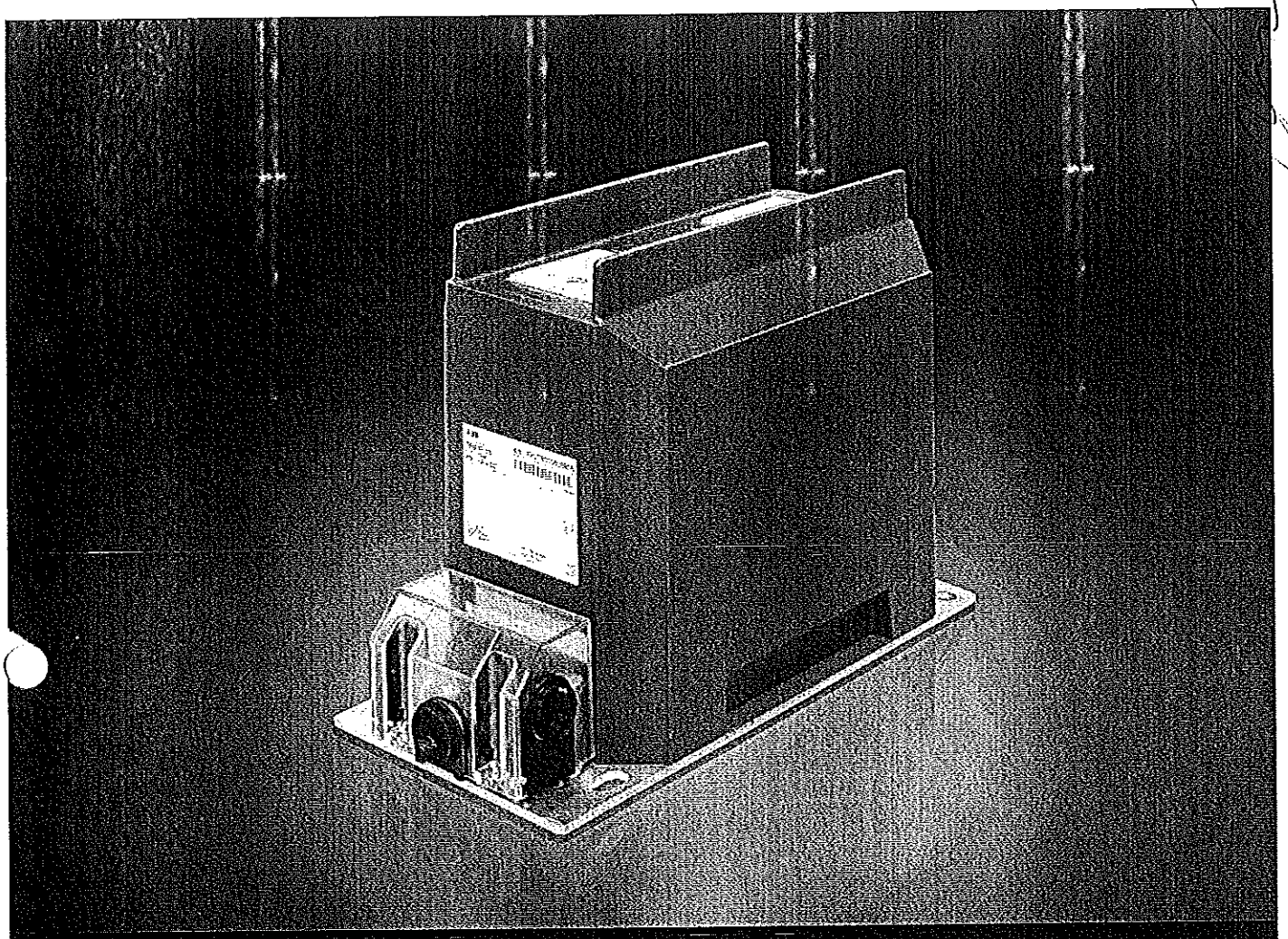
Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	E DIN EN 61180 VDE 0432-10 Juli 2013	Hochspannungs-Prüftechnik für Niederspannungsgeräte Begriffe, Prüfung und Prüfbedingungen, Prüfgeräte	
	DIN EN 61180-1 VDE 0432-10 Mai 1995	Hochspannungs-Prüftechnik für Niederspannungsgeräte Begriffe, Prüfung und Prüfbedingungen (IEC 61180-1:1992); Deutsche Fassung EN 61180-1:1994	
	IEC 61180-1 Edition 1.0, 1992-10	High-voltage test techniques for low voltage equipment – Part 1: Definitions, test and procedure requirements (IEC 61180-1:1992); German version EN 61180-1:1994	
	DIN EN 61180-2 VDE 0432-11 Mai 1995	Hochspannungs-Prüftechnik für Niederspannungsgeräte Prüfgeräte (IEC 61180-2:1994); Deutsche Fassung EN 61180-2:1994	
	IEC 61180-2 Edition 1.0, 1994-06	High-voltage test techniques for low-voltage equipment – Part 2: Test equipment (IEC 61180-2:1994); German version EN 61180-2:1994	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 61439-1 VDE 0660-600-1 Juni 2012 +	Niederspannungs-Schaltgerätekombinationen Teil 1: Allgemeine Festlegungen (IEC 61439-1:2011); Deutsche Fassung EN 61439-1:2011	
	DIN EN 61439-1 Bbl 1 VDE 0660-600-1 Bbl 1 Berichtigung 1 Dezember 2014 +	Berichtigung zu DIN EN 61439-1 Beiblatt 1 (VDE 0660-600-1 Beiblatt 1):2014-06	
	DIN EN 61439-1 VDE 0660-600-1 Beiblatt 1: Juni 2014	Niederspannungs-Schaltgerätekombinationen Teil 1: Allgemeine Festlegungen; Beiblatt 1: Leitfaden für die Spezifikation von Schaltgerätekombinationen (IEC/TR 61439-0:2013)	
	IEC 61439-1 Edition 2.0, 2011-08	Low-voltage switchgear and controlgear assemblies – Part 1: General rules (IEC 61439-1:2011); German version EN 61439-1:2011	
	IEC/TR 61439-0 Edition 2.0, 2013-04	Low-voltage switchgear and controlgear assemblies – Part 0: Guidance to specifying assemblies	
Elektrotechnik	DIN EN 61439-2 VDE 0660-600-2 Juni 2012	Niederspannungs-Schaltgerätekombinationen Teil 2: Energie-Schaltgerätekombinationen (IEC 61439-2:2011); Deutsche Fassung EN 61439-2:2011	
	IEC 61439-1 Edition 2.0, 2011-08	Low-voltage switchgear and controlgear assemblies – Part 2: Power switchgear and controlgear assemblies (IEC 61439-2:2011); German version EN 61439-2:2011	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 61439-3 VDE 0660-600-3 Februar 2013 +	Niederspannungs-Schaltgerätekombinationen Teil 3: Installationsverteiler für die Bedienung durch Laien (DBO) (IEC 61439-3:2012); Deutsche Fassung EN 61439-3:2012	
	DIN EN 61439-3 VDE 0660-600-3 Berichtigung 1 Oktober 2014	Berichtigung zu DIN EN 61439-3 (VDE 0660-600-3):2013-02; (IEC-Cor.:2013 zu IEC 61439-3:2012)	
	IEC 61439-3 Edition 1.0, 2012-02	Low-voltage switchgear and controlgear assemblies – Part 3: Distribution boards intended to be operated by ordinary persons (DBO) (IEC 61439-3:2012); German version EN 61439-3:2012	
Elektrotechnik	DIN EN 61439-4 VDE 0660-600-4 September 2013	Niederspannungs-Schaltgerätekombinationen Teil 4: Besondere Anforderungen für Baustromverteiler (BV) (IEC 61439-4:2012); Deutsche Fassung EN 61439-4:2013	
	IEC 61439-4 Edition 1.0, 2012-11	Low-voltage switchgear and controlgear assemblies – Part 4: Particular requirements for assemblies for construction sites (ACS) (IEC 61439-4:2012); German version EN 61439-4:2013	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 61439-5 VDE 0660-600-5 Oktober 2011	Niederspannungs-Schaltgerätekombinationen Teil 5: Schaltgerätekombinationen in öffentlichen Energieverteilungsnetzen (IEC 61439-5:2010); Deutsche Fassung EN 61439-5:2011	
	E DIN EN 61439-5 VDE 0660-600-5 Juli 2014	Niederspannungs-Schaltgerätekombinationen Teil 5: Schaltgerätekombinationen in öffentlichen Energieverteilungsnetzen (IEC 17D/492/CDV:2013); Deutsche Fassung FprEN 61439-5:2013	
	IEC 61439-5 Edition 2.0, 2014-08	Low-voltage switchgear and controlgear assemblies - Part 5: Assemblies for power distribution in public networks (IEC 61439-5:2014);	
Elektrotechnik	DIN EN 60439-1 VDE 0660-500 Beiblatt 2 Mai 2009	Niederspannungs-Schaltgerätekombinationen Teil 1: Typgeprüfte und partiell typgeprüfte Kombinationen – Technischer Bericht: Verfahren für die Prüfung unter Störlichtbogenbedingungen (IEC/TR 61641:2008)	
	IEC TR 61641 Edition 3.0, 2014-09	Enclosed low-voltage switchgear and controlgear assemblies – Guide for testing under conditions of arcing due to internal fault	

Приложение 2.1 - Каталог на TPU 4x.xx



Medium Voltage Product

Technical parameters	Value
Highest voltage for equipment	3.6 - 12 kV
Power frequency test voltage, 1 min.	10 - 42 kV
Lighting impulse test voltage	40 - 95 kV
Rated primary current	10 - 3 200 A
Rated short-time thermal current	2 - 100 kA/ 1s
Reconnectable (primary till 400-800 A)	primary or secondary

Description

The TPU 4x.xx transformers are cast in epoxy resin and designed for insulation voltages up to 12 kV. The 3.6 kV and 7.2 kV versions have the same dimensions as the 12 kV. For certain types of panels there is a need for extra long creepage distance on the transformers. For this purpose you can order current transformers with „ribs on the top". The transformers are manufactured in conformity with dimensions stated hereunder. The TPU 4x.xx transformers are designed as single-turn or multi-turn versions, with one transformer ratio or with double ratio having the possibility to be reconnectable on the primary or on the secondary side. The number of secondary windings (from 1 to 6 – max. 12 secondary terminals - 2 rows), depends on the combination of the technical parameters (such as the accuracy class, burden, short-circuit current, overcurrent factor...) and the transformer dimensions size.

When agreed between the manufacturer and the customer the TPU transformers can be provided with the voltage indication system. For this purpose, however, it is necessary to know in what insulation level the transformers shall operate. The secondary windings are used for measurement or protection purposes, or for special use (testing winding, „X" class windings). One terminal of each secondary winding used and one terminal of short-circuited and not used winding have to be earthed during the transformer operation. The secondary windings are lead out into a cast-type secondary terminal box with plastic cover. The terminal cover is sealable. The terminals are provided with M5 screws for the termination and with throughgoing holes for direct earting (first row of secondary terminals).

Technical data

The transformer can be mounted in any position. The transformer body is fixed by using four screws. Earth clamp M8 is on the transformer base plate.

Rated primary voltages

3.6 kV; 7.2 kV; 12 kV

Rated primary currents

10; 15; 20; 25; 30; 40; 50; 60; 75; 100; 150; 200; 300; 400; 500; 600; 750; 1 000; 1 250; 1 500; 2 000; 2 500; 3 000 and 3 200 A; primary reconnectable modification max till 400-800 A. Other primary currents can also be agreed upon with the customer.

Rated secondary currents

5 A; 1 A, others on request (possibility to combine different values in one transformer)

Accuracy classes

0.2; 0.2S; 0.5; 0.5S; 1; 3; 5; 5P10; 5P15; 5P20; 10P10; 10P15; 10P20; others on request.

Rated frequency

50 Hz or 60 Hz, others on request

The transformers are designed and manufactured in conformity with the following standards and recommendations: IEC, VDE, ANSI, BS, GOST and CSN, others on request.

Cantilever strength

5 kN

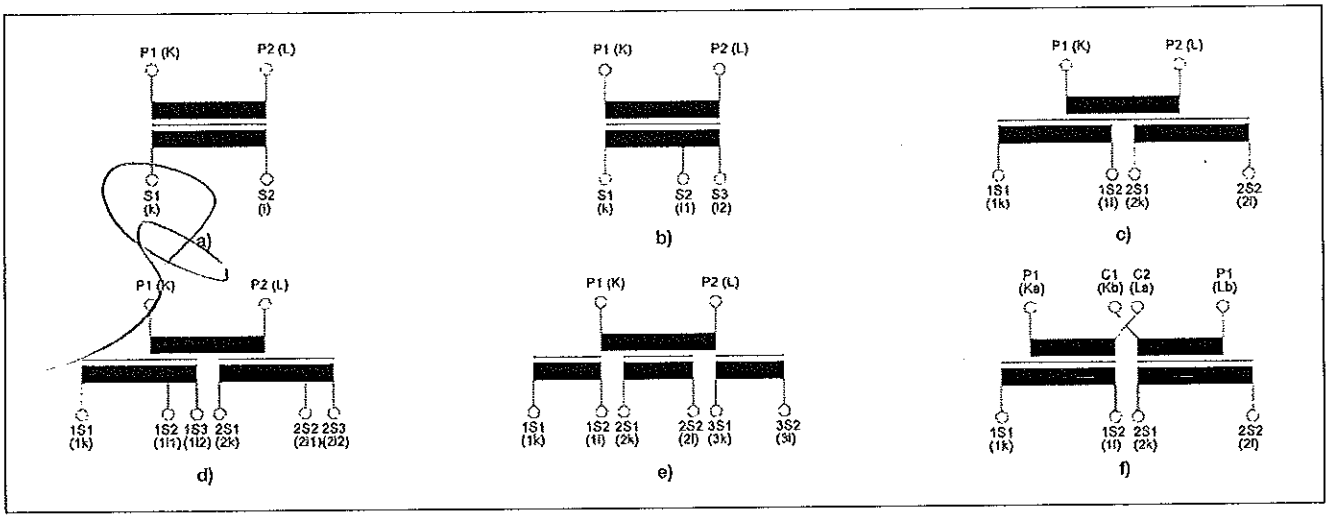
Permissable torques for screw connections		
M5	max 3.5 Nm	min 2.8 Nm
M8	max 20 Nm	min 16 Nm
M12	max 70 Nm	min 56 Nm

Code designation - TPU current transformers

TPU	x	x	.	x	x
	voltage	current		dimension	primary terminals
	4....up to 12 kV	0... to 600 A multiturn 1... to 1 250 A, combi multiturn, singleturn* 3...to 1 250 A singleturn 4...to 1 500 A singleturn 5...to 2 000 A singleturn 6...to 2 500 A singleturn 7...to 3 000 A singleturn 8...to 3 200 A singleturn		1..short 148 mm, DIN 2..long 148 mm, DIN 3..short, wide.. 184 mm 4..long, wide...184 mm 5..middle 148 mm, DIN	1..no pr.rec., no ribs /40x80mm, 80x80mm/ 2..prim. rec., no ribs /40x80mm, 80x80mm/ 3..no pr.rec., with ribs /60x68mm, 80x80mm/ 4..prim. rec., with ribs /40x80mm, 80x80mm/

* TPU 41.41 and TPU 41.43 only

Marking of current transformer outlets - example



a) Single-core design | b) Double-core design | c) Three-core design | d) Single-core design, reconnectable on the secondary side | e) Double-core design, reconnectable on the secondary side | f) Double-core design, reconnectable on the primary side

Standartized insulation levels of TPU 4x.xx transformers

3.6 / 21 / 45 kV	7.2 / 27 / 60 kV	12 / 28 / 75 kV
3.6 / 10 / 40 kV	7.2 / 20 / 60 kV	12 / 35 / 75 kV
		12 / 42 / 95 kV

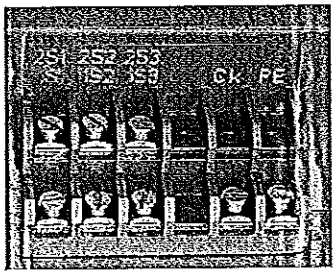


Fig. 2. 1 Secondary terminal box
(3 secondaries and voltage indicator)

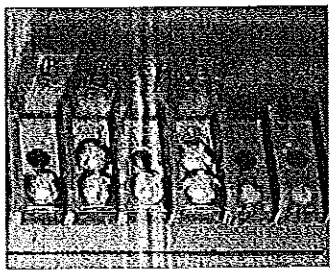
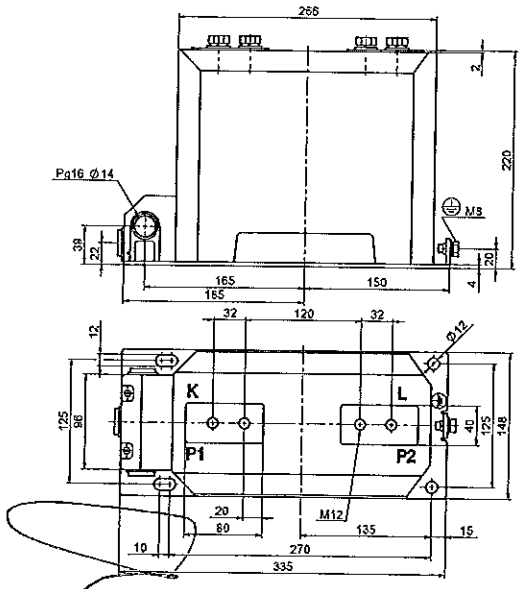


Fig. 2. 2 Secondary terminal box
(2 secondaries and grounding screw)

Dimensional Drawing

TPU 40.11
TPU 43.11

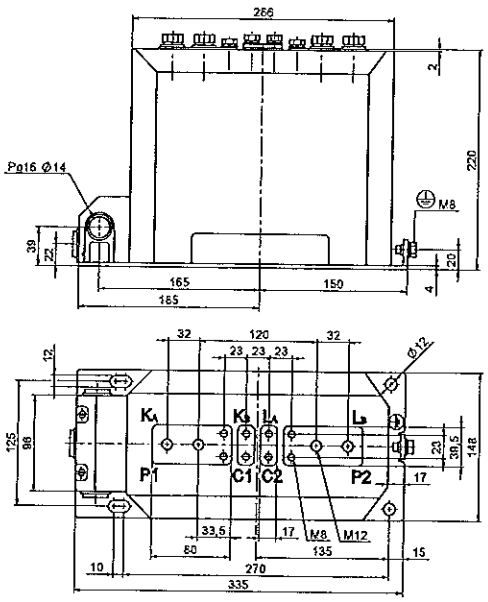
Weight: 20-24kg
Creepage distance: 201 mm



Drawing n.	Polarity
44614000	P1 to secondary terminal
44614010	P2 to secondary terminal

TPU 40.12

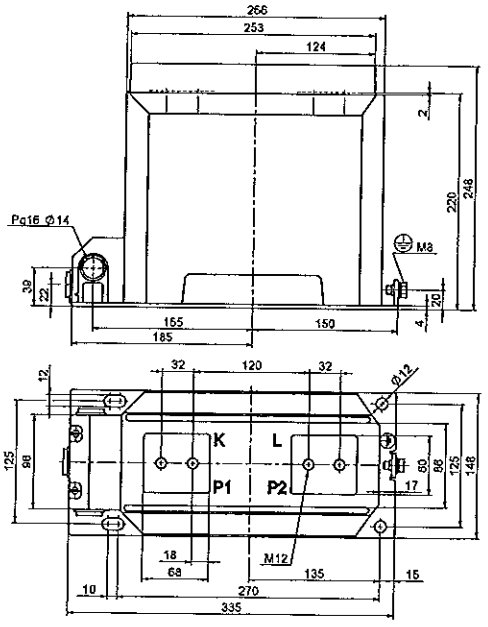
Weight: 19-25kg
Creepage distance: 338 mm



Drawing n.	Polarity
44614020	P1 to secondary terminal
44614030	P2 to secondary terminal

TPU 40.13
TPU 43.13

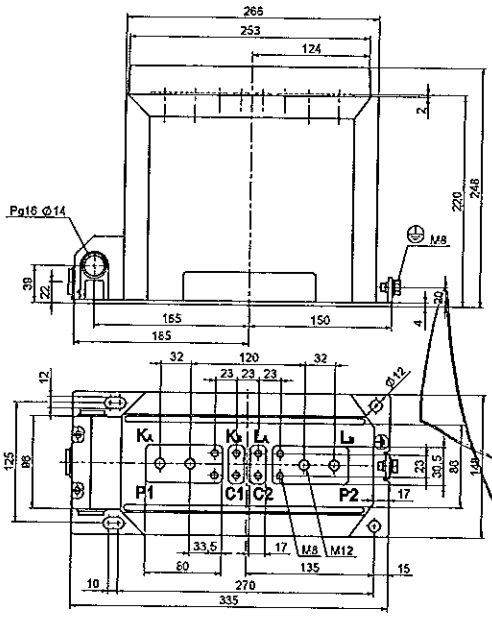
Weight: 20-24kg
Creepage distance: 214mm



Drawing n.	Polarity
44614040	P1 to secondary terminal
44614050	P2 to secondary terminal

TPU 40.14

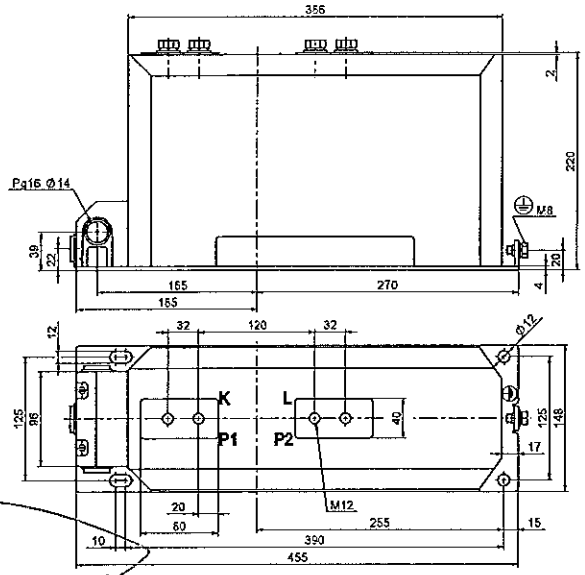
Weight: 19-25kg
Creepage distance: 201mm



Drawing n.	Polarity
44614060	P1 to secondary terminal
44614070	P2 to secondary terminal

TPU 40.21
TPU 43.21

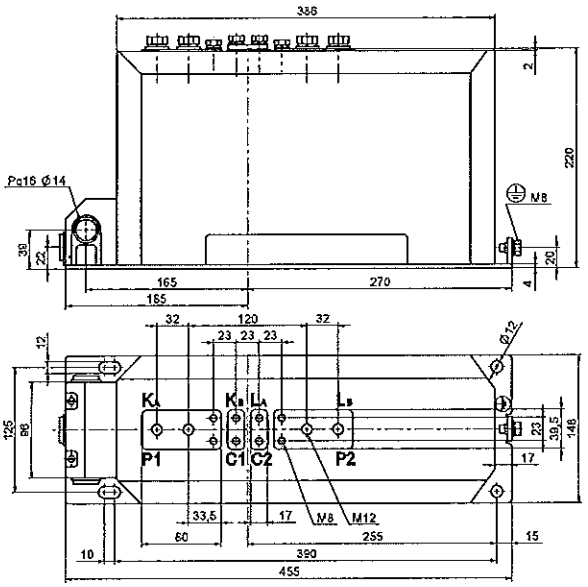
Weight: 29-37kg
Creepage distance: 201mm



Drawing n.	Polarity
44614080	P1 to secondary terminal
44614090	P2 to secondary terminal

TPU 40.22

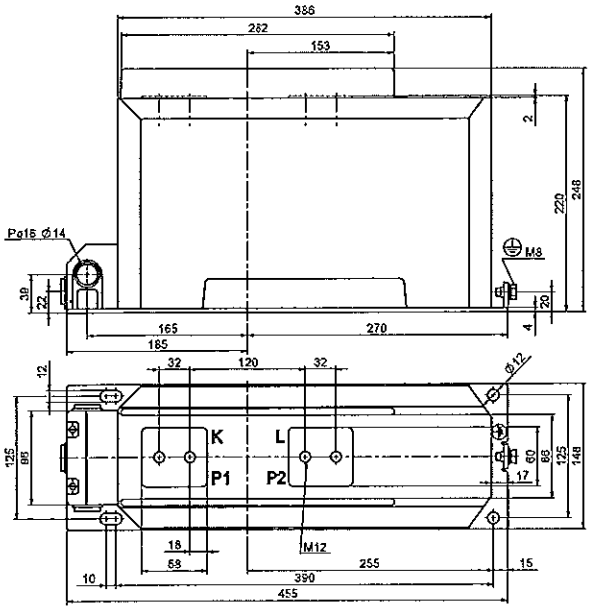
Weight: 29-37kg
Creepage distance: 215mm



Drawing n.	Polarity
44614100	P1 to secondary terminal
44614110	P2 to secondary terminal

TPU 40.23
TPU 43.23

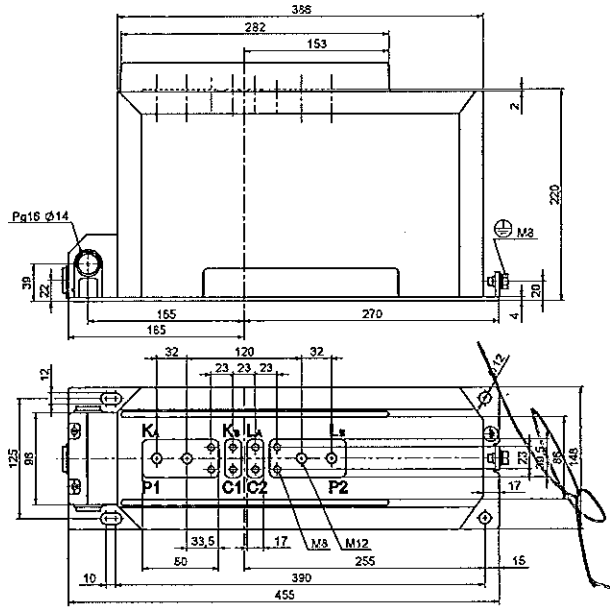
Weight: 29-37kg
Creepage distance: 214mm



Drawing n.	Polarity
44614120	P1 to secondary terminal
44614130	P2 to secondary terminal

TPU 40.24

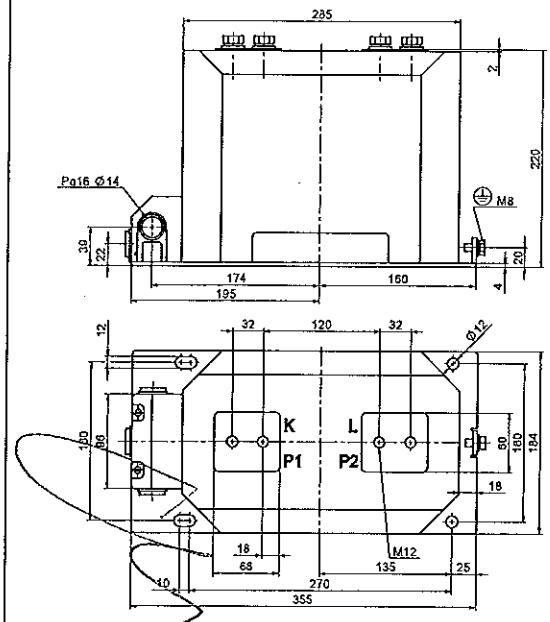
Weight: 29-37kg
Creepage distance: 215mm



Drawing n.	Polarity
44614140	P1 to secondary terminal
44614150	P2 to secondary terminal

TPU 40.31
TPU 43.31

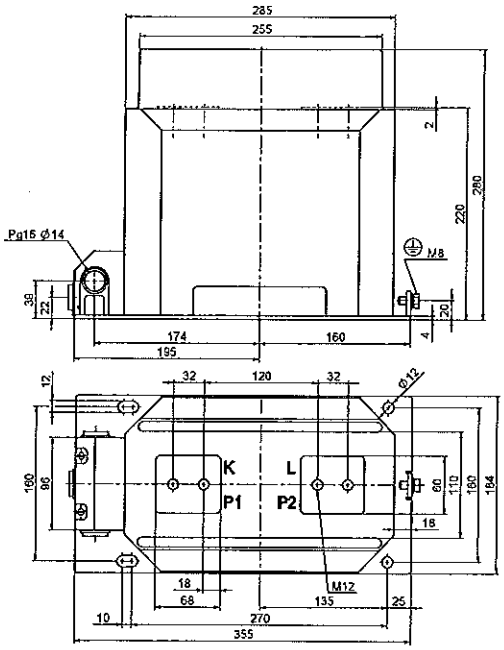
Weight: 31-39kg
Creepage distance: 215mm



Drawing n.	Polarity
44614160	P1 to secondary terminal
44614170	P2 to secondary terminal

TPU 40.33
TPU 43.33

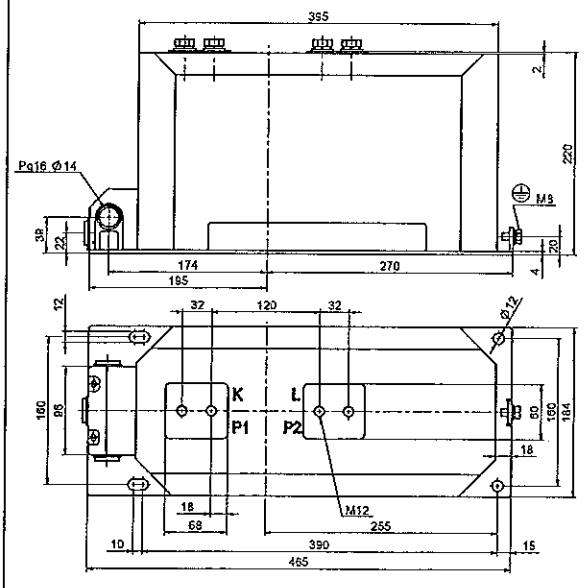
Weight: 31-39kg
Creepage distance: 215mm



Drawing n.	Polarity
44614180	P1 to secondary terminal
44614190	P2 to secondary terminal

TPU 40.41
TPU 41.41
TPU 43.41

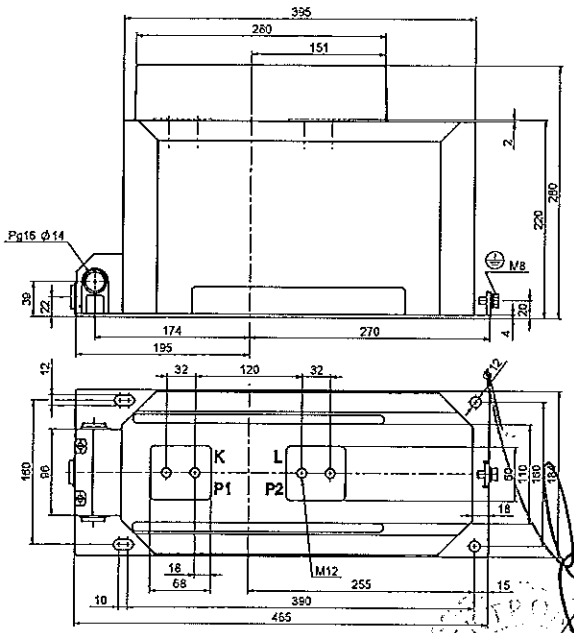
Weight: 45-55kg
Creepage distance: 215mm



Drawing n.	Polarity
44614200	P1 to secondary terminal
44614210	P2 to secondary terminal

TPU 40.43
TPU 41.43
TPU 43.43

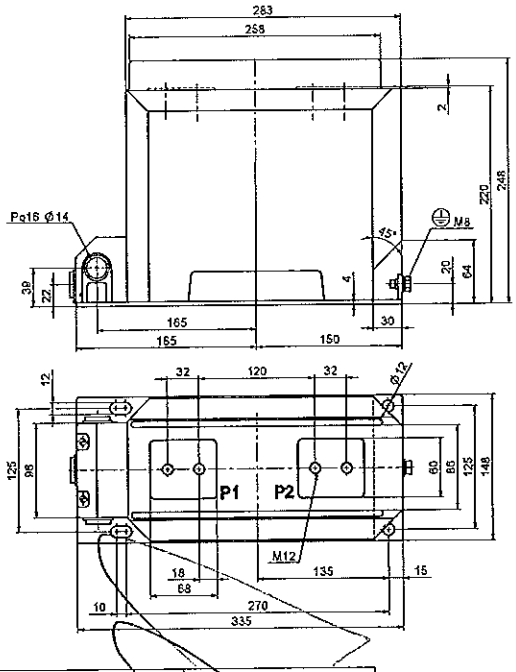
Weight: 45-55kg
Creepage distance: 215mm



Drawing n.	Polarity
44614220	P1 to secondary terminal
44614230	P2 to secondary terminal

TPU 40.53
TPU 43.53

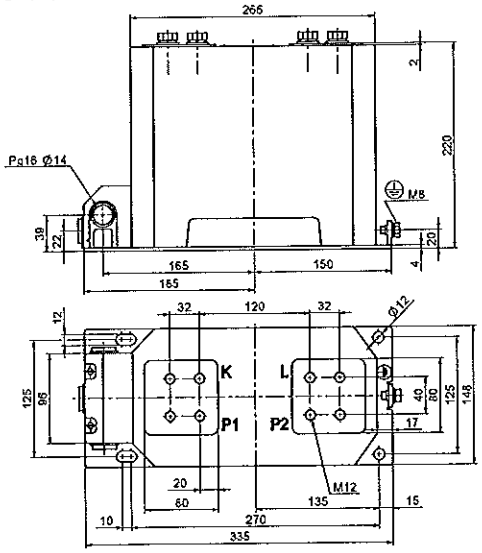
Weight: 28kg
Creepage distance: 214mm



Drawing n.	Polarity
1VL4600921R0101	P1 to secondary terminal
1VL4600921R0102	P2 to secondary terminal

TPU 44.11
TPU 45.11
TPU 46.11
TPU 47.11
TPU 48.11

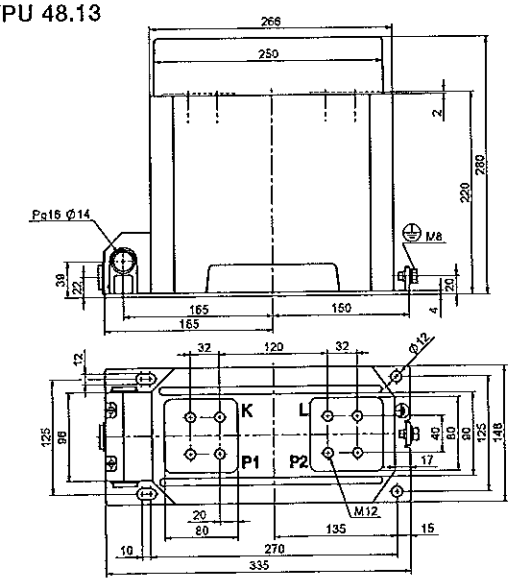
Weight: 25-31kg
Creepage distance: 201mm



Drawing n.	Polarity
44614240	P1 to secondary terminal
44614250	P2 to secondary terminal

TPU 44.13
TPU 45.13
TPU 46.13
TPU 47.13
TPU 48.13

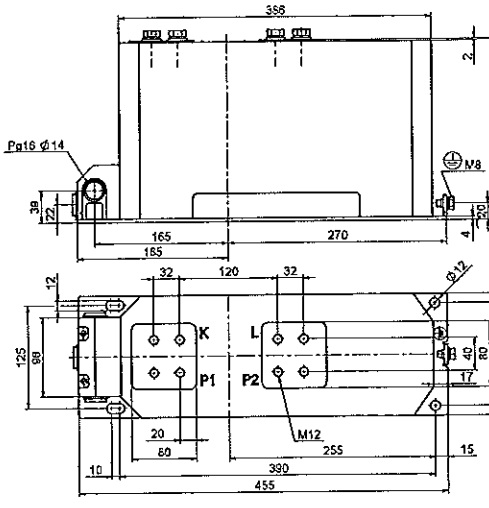
Weight: 25-31kg
Creepage distance: 201mm



Drawing n.	Polarity
44614260	P1 to secondary terminal
44614270	P2 to secondary terminal

TPU 44.21
TPU 45.21
TPU 46.21
TPU 47.21
TPU 48.21

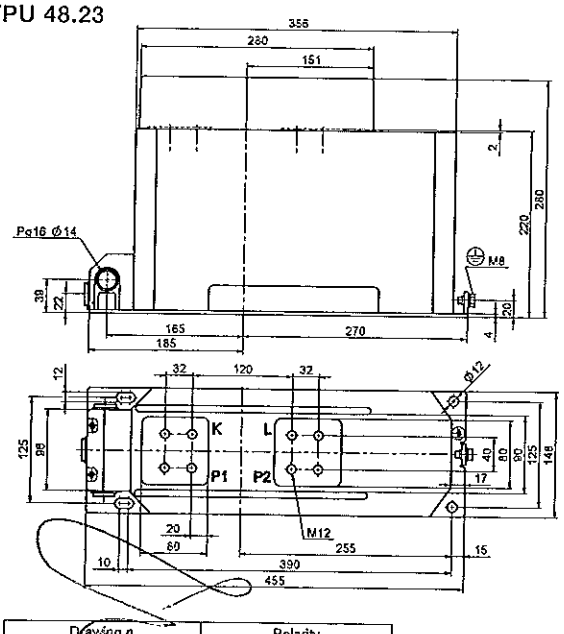
Weight: 40-45kg
Creepage distance: 201mm



Drawing n.	Polarity
44614280	P1 to secondary terminal
44614290	P2 to secondary terminal

TPU 44.23
TPU 45.23
TPU 46.23
TPU 47.23
TPU 48.23

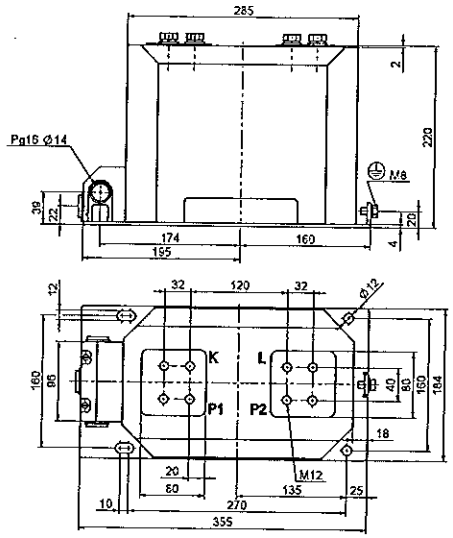
Weight: 40-45kg
Creepage distance: 201mm



Drawing n.	Polarity
44614300	P1 to secondary terminal
44614310	P2 to secondary terminal

TPU 44.31
TPU 45.31
TPU 46.31
TPU 47.31
TPU 48.31

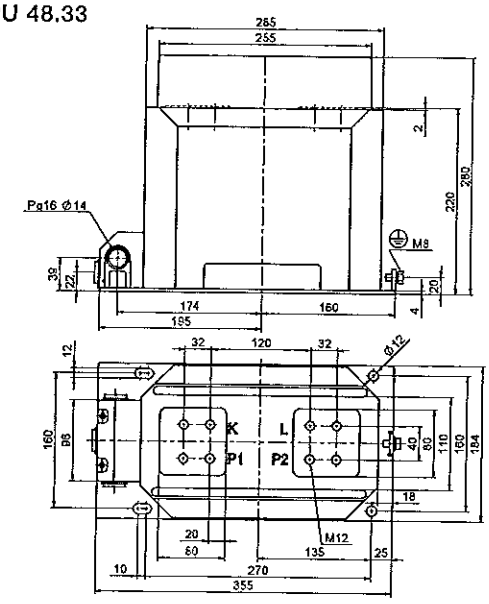
Weight: 34-42kg
Creepage distance: 210 mm



Drawing n.	Polarity
44614320	P1 to secondary terminal
44614330	P2 to secondary terminal

TPU 44.33
TPU 45.33
TPU 46.33
TPU 47.33
TPU 48.33

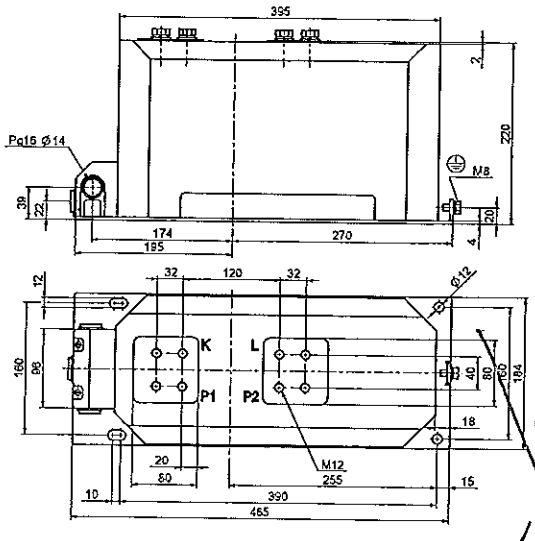
Weight: 34-42kg
Creepage distance: 210mm



Drawing n.	Polarity
44614340	P1 to secondary terminal
44614350	P2 to secondary terminal

TPU 44.41
TPU 45.41
TPU 46.41
TPU 47.41
TPU 48.41

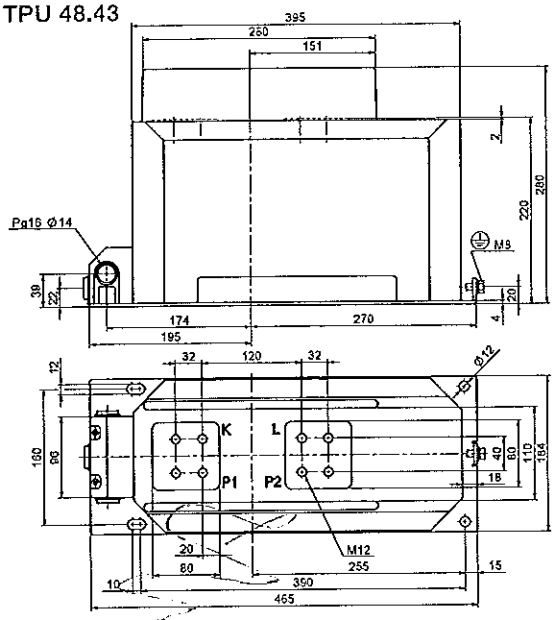
Weight: 46-58kg
Creepage distance: 210mm



Drawing n.	Polarity
44614360	P1 to secondary terminal
44614370	P2 to secondary terminal

TPU 44.43
TPU 45.43
TPU 46.43
TPU 47.43
TPU 48.43

Weight: 46-58kg
Creepage distance: 210mm



Drawing n.	Polarity
44614380	P1 to secondary terminal
44614390	P2 to secondary terminal

Contact us

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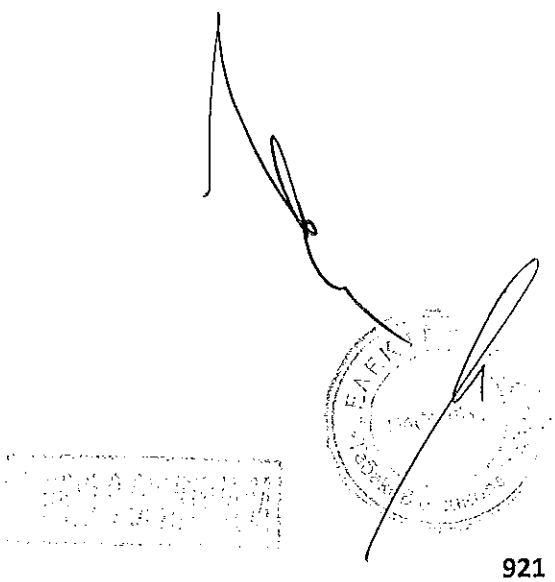
www.abb.com

1VLC000501 Rev.7, en 2017.02.07

Приложение 2.2 - Удостоверение за одобрен тип



РЕПУБЛИКА БЪЛГАРИЯ
Български институт по метрология

REPUBLIC OF BULGARIA
Bulgarian Institute of Metrology

ДОПЪЛНЕНИЕ № 15.09.4507.2

КЪМ УДОСТОВЕРЕНИЕ
ЗА ОДОБРЕН ТИП СРЕДСТВО ЗА ИЗМЕРВАНЕ № 06.01.4507
Measuring Instrument Type-approval Certificate-Revision 1

Издадено на производител: *Issued to manufacturer:*	ABB S.r.o., Република Чехия
На основание на: *In Accordance with:*	чл. 30, ал.2 от Закона за измерванията
Относно: *In Respect of:*	измервателни токови трансформатори за средно напрежение тип TPU xx.xx (TPU 4x.xx, TPU 6x.xx, TPU 7x.xx)
Технически и метрологични характеристики: *Technical and metrological characteristics:*	приложение, неразделна част от настоящото удостоверение за одобрен тип средство за измерване
Срок на валидност: *Valid until:*	14.09.2025 г.
Средството за измерване е вписано в регистъра на одобрените за използване типове средства за измерване под №: *Reference №:*	4507
Дата на издаване на първоначалното удостоверението за одобрен тип: *Date:*	05.01.2006 г.
Дата на издаване на допълнението към удостоверението за одобрен тип: *Date:*	14.09.2015 г.

ПРЕДСЕДАТЕЛ:
доц. д-р Димитър Станков

Издадено на производител: ABB S.r.o., Република Чехия

Относно: измервателни токови трансформатори за средно напрежение тип TPU xx.xx (TPU 4x.xx, TPU 6x.xx, TPU 7x.xx)

Описание на допълнение № 15.09.4507.2 към удостоверение за одобрен тип № 06.01.4507

Издаденото допълнение № 15.09.4507.2 към удостоверение за одобрен тип № 06.01.4507 е за удължаване на срока на валидност на одобряване на типа до 14.09.2025 година.

РЕПУБЛИКА БЪЛГАРИЯ
Български институт по метрология

REPUBLIC OF BULGARIA
Bulgarian Institute of Metrology

ДОПЪЛНЕНИЕ № 15.09.4507.1

КЪМ УДОСТОВЕРЕНИЕ ЗА ОДОБРЕН ТИП СРЕДСТВО ЗА ИЗМЕРВАНЕ № 06.01.4507

Measuring Instrument Type-approval Certificate-Revision 1

Издадено на производител: *Issued to manufacturer:*	ABB S.r.o., Република Чехия
На основание на: *In Accordance with:*	чл. 32, ал. 1 от Закона за измерванията (ДВ, бр. 46 от 2002 г., изм. бр. 88 от 05 г., изм. и доп. бр. 95 от 2005 г.)
Относно: *In Respect of:*	измервателни токови трансформатори за средно напрежение тип TPU xx.xx
Технически и метрологични характеристики: *Technical and metrological characteristics:*	приложение, неразделна част от настоящото удостоверение за одобрен тип средство за измерване
Срок на валидност: *Valid until:*	05.01.2016 г.
Средството за измерване е вписано в регистъра на одобрените за използване типове средства за измерване под №: *Reference №:*	4507
Дата на издаване на допълнението към удостоверението за одобрен тип: *Date:*	03.09.2015 г.

ПРЕДСЕДАТЕЛ:

доц. д-р Димитър Станков

Издадено на производител: ABB S.r.o., Република Чехия

Относно: измервателни токови трансформатори за средно напрежение тип TPU xx.xx

Описание на допълнението към удостоверение за одобрен тип № 06.01.4507

В **т. 1.1. Технически и метрологични характеристики** да се допълни:

- Номинални първични токове:
  - за TPU 4x.xx: от 10 A до 3200 A;
  - за TPU 6x.xx: от 10 A до 3200 A;
  - за TPU 7x.xx: от 10 A до 2500 A.

В **т. 1.3. Схеми на местата за поставяне на знаци, удостоверяващи резултатите от контрола и места за пломбиране** да се допълни:

- Знакът за одобрен тип ще бъде гравиран на табелата с номинални данни от завода производител;
- Знакът за първоначална проверка (марка за залепване) се поставя до гравирания знак за одобрен тип.

Приложение 2.3 - Типови изпитания

PEHLA

GESELLSCHAFT FÜR ELEKTRISCHE
HOCHLEISTUNGSPRÜFUNGEN
Member of the
SHORT-CIRCUIT TESTING LIAISON (STL)

Certificate No. 14199Ra

Copy No. 1

TYPE TEST CERTIFICATE OF COMPLETE TYPE TEST

APPARATUS:	Current transformer
DESIGNATION:	TPU 43.11 Rated voltage: 12 kV Rated normal current: 1250 A Rated frequency: 50 Hz
SERIAL NUMBER:	1VLT5114049692
MANUFACTURER:	ABB s.r.o., PPMV, Brno, Czech Republic under license of ABB Technology Ltd., Zurich, Switzerland
TESTED FOR:	ABB Technology Ltd., Zurich, Switzerland
DATE(S) OF TEST:	20th, 22nd and 23rd October and 04th and 17th November 2014
TESTED BY:	PEHLA-Testing Laboratory Ratingen, Germany ABB s.r.o. Laboratory Brno, Czech Republic on behalf of PEHLA-Testing Laboratory Ratingen, Germany

The apparatus, constructed in accordance with the description, drawings and photographs incorporated in this certificate has been subjected to the series of proving tests in accordance with

IEC 61869-1, Ed. 1.0, 2007-10, cl. 7.3.2, 7.3.3, 7.3.4, 7.3.6
IEC 61869-2, Ed. 1.0, 2012-09, cl. 7.2.2, 7.2.3, 7.2.6.201 - 203, 7.2.201, 7.3.1, 7.3.5.201 - 203, 7.3.201, 7.3.203 and 204, 7.5.2

This Type Test Certificate has been issued by PEHLA following exclusively the STL Guides.

The results are shown in the record of Proving Tests and the oscillograms attached hereto. The values obtained and the general performances are considered to comply with the above Standard(s) and to justify the ratings assigned by the manufacturer as listed on page No. 7.

The Certificate applies only to the apparatus tested. The responsibility for conformity of any apparatus having the same designations with that tested rests with the Manufacturer.

This Certificate comprises 33 sheets in total.

PEHLA GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN

GESELLSCHAFT FÜR ELEKTRISCHE
HOCHLEISTUNGSPRÜFUNGEN

M. Wollinger

Management Committee

H. Spitzer

Dr. T. Ebke

Technical Committee

Mannheim, 21st January 2015

DAkkS Deutsche Akkreditierungsstelle D-PL-12072-06-01

Notes

Accreditation

The PEHLA GbR, PEHLA-Testing Laboratory Ratingen has been approved by the DAkkS (German Accreditation Body) according to EN ISO/IEC 17025 for tests in the field of high-voltage switchgear and controlgear and power engineering equipment (Registration-No. D-PL-12072-06-01).

STL-Member

PEHLA is founder member of the SHORT-CIRCUIT TESTING LIAISON (STL) which has been established in 1969. STL is a forum for the international cooperation of the testing organisations with the further full members ASTA (UK), CESI (IT), CPRI (IND), ESEF (FR), KEMA (NL), KERI (KR), SATS (NO, SE, FI), STLNA (US, CA) and JSTC (JP). In the frame-work of EC, STL (EU) has been recognised in 1992 by EOTC as agreement group.

PEHLA-Documents

A Type Test Certificate

is issued for type tests 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. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

A Test Document

is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

A Test Report

is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients' instructions. Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the test object, and its condition after the tests.

A Test Confirmation

is issued immediately after the tests. It confirms that the tests have been conducted and is valid only until publishing the detailed results in an entire document.

Uncertainty of the measurement systems

The PEHLA - Testing Laboratories apply the PEHLA Guide No. 12 for determining the uncertainties of measurement, based on ENV 13005 (Guide to the expression of uncertainty in measurement). As long as no explicit statements are made, the uncertainties required by the relevant standards have been complied with.

Addresses

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Internet: www.pehla.com

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68309 Mannheim
Germany
as shareholder and contractor of PEHLA GbR

Testing Station:
PEHLA-Testing Laboratory Ratingen
Oberhausener Str. 33
40472 Ratingen
Germany

ABB s.r.o. Laboratory
Vídeňská 117
619 00 Brno
Czech Republic
on behalf of PEHLA-Testing Laboratory Ratingen

Manufacturer:
ABB s.r.o.
Vídeňská 117
619 00 Brno
Czech Republic
under license of ABB Technology Ltd. Zurich, Switzerland

Tested for:
ABB Technology Ltd.
Affolternstrasse 44
8050 Zurich,
Switzerland

Table of Contents

List of Test Participants

Part 1: 20th, 22nd and 23rd October 2014, ABB s.r.o. Laboratory Brno, Czech Republic

Representatives of Technical Committee:

Dr. Horst Günther	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Nikolaus Beierlein	PEHLA-Testing Laboratory Regensburg, Germany

Test Engineer / Test Operator:

Mr. Jiri Zila	ABB s.r.o. Laboratory Brno, Czech Republic
Dr. Otakar Benes	ABB s.r.o. Laboratory Brno, Czech Republic
Mr. Petr Prikryl	ABB s.r.o. Laboratory Brno, Czech Republic

Representatives of Client:

Mr. Marcel Jancik	ABB s.r.o. Brno, Czech Republic

Further Participants:

-

List of Test Participants

Part 2: 04th November 2014, PEHLA Testing Laboratory Ratingen, Germany

Representatives of Technical Committee:

Ms. Barbara Schlegel	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Herbert Feld	PEHLA-Testing Laboratory Berlin-Marzahn, Germany

Test Engineer / Test Operator:

Ms. Barbara Schlegel (Test Engineer)	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Joachim Köhler (Test Operator)	PEHLA-Testing Laboratory Ratingen, Germany

Representatives of Client:

Mr. Marcel Jancik	ABB s.r.o. PPMV, Brno, Czech Republic
Mr. Jiri Zila	ABB s.r.o. PPMV, Brno, Czech Republic

Further Participants:

-

List of Test Participants
Part 3: 17th November 2014, ABB s.r.o. Laboratory Brno, Czech Republic

Representatives of Technical Committee:

Dr. Horst Günther	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Nikolaus Beierlein	PEHLA-Testing Laboratory Regensburg, Germany

Test Engineer / Test Operator:

Mr. Jiri Zila	ABB s.r.o. Laboratory Brno, Czech Republic
Dr. Otakar Benes	ABB s.r.o. Laboratory Brno, Czech Republic
Mr. Petr Prikryl	ABB s.r.o. Laboratory Brno, Czech Republic

Representatives of Client:

Mr. Marcel Jancik	ABB s.r.o. PPMV, Brno, Czech Republic

Further Participants:

-

Technical Data of Test Object
Current Transformer

Test object:	Current transformer
Designation:	TPU 43.11
Manufacturer:	ABB s.r.o., PPMV, Brno, Czech Republic under license of ABB Technology Ltd., Zurich, Switzerland
Serial No.:	1VLT5114049692
Year of manufacture:	2014
Drawing No.:	1VL34610500

Ratings assigned by the manufacturer:

Highest voltage for equipment	12	kV
Rated primary current	1250	A
Rated continuous thermal current	120	%
Rated secondary current	5/5	A
Rated frequency	50	Hz
Rated peak withstand current	100	kA
Rated short-time withstand current	40	kA
Duration of short-circuit	3	s
Core 1		
Accuracy class	0.5 S FS 5	
Rated burden	15	VA
Core 2		
Accuracy class	5P10	
Rated burden	15	VA
Power-frequency voltage between sections	3	kV
Inter-turn overvoltage	4.5	kV_{peak}
Insulation class	E	
Temperature category	-5/40	

Further data: -

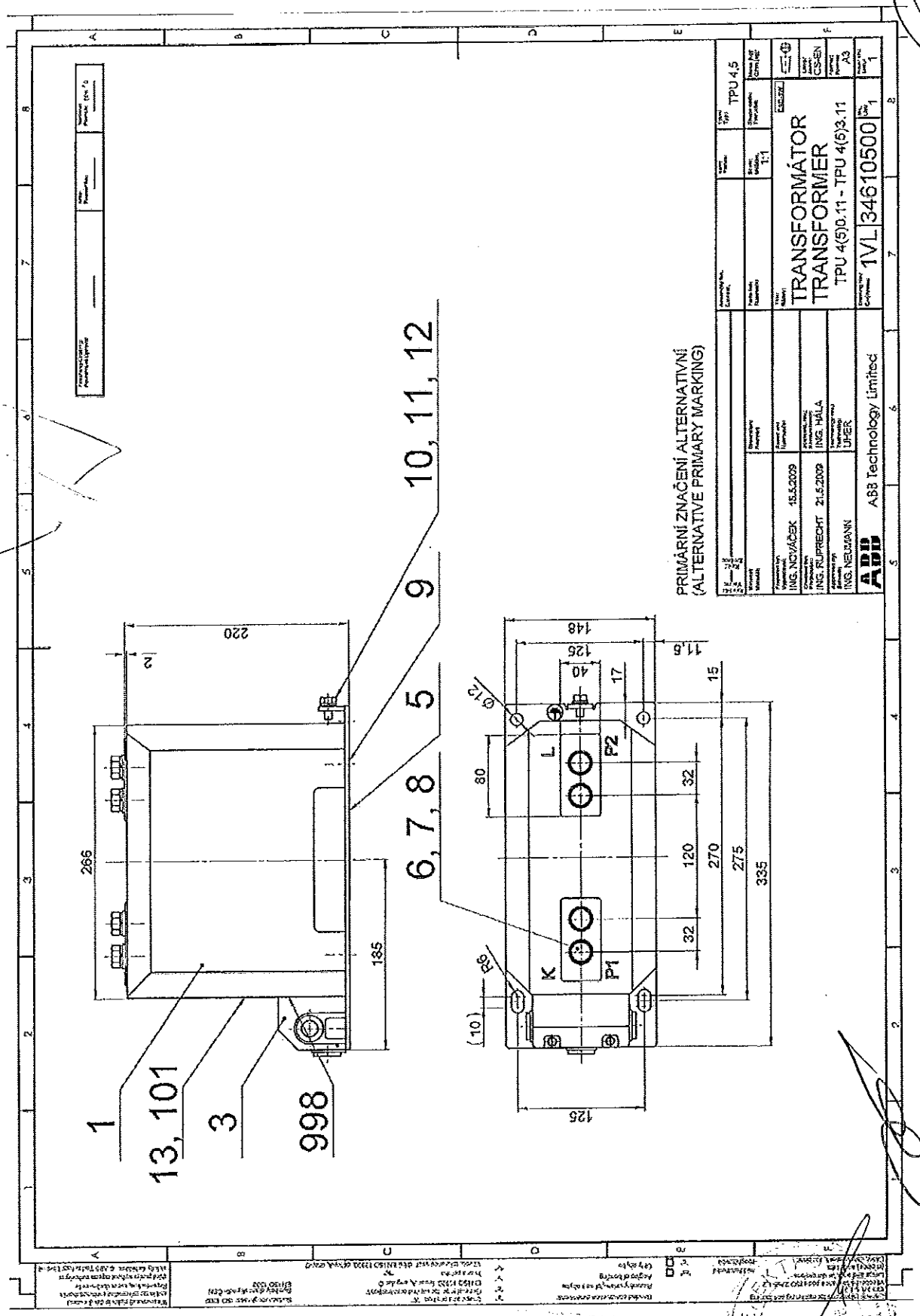
List of Identified Drawings

The manufacturer has submitted to the testing laboratory drawings and other data containing sufficient information to unambiguously identify by type the essential details and parts of the test object presented for test.
The drawings have been stamped and signed by the manufacturer in order to guarantee that the drawings or data schedules truly represent the test object to be tested.
Further these drawings have been stamped and signed by PEHLA representatives and are kept
☐ at the client.
☒ with the test documents at the test laboratory.
The testing laboratory has checked that drawings and data schedules adequately represent the essential details and parts of the test object to be tested, but is not responsible for the accuracy of the detailed information.
The drawing(s) contained in this document are identical with the checked, stamped and signed drawings.

Drawing No.	Rev.	P/D *)	Title	Additional remarks
1VL34610500	-	D	Transformer TPU 4(5)0.11 – TPU 4(5)3.11	Included in test report
-	-	P	Transformer TPU 43.11 assembly	-
1VL4600028R0101	001	D	Casting TPU 4(5)3.11	-
1VL4600032R0101	001	D	Internal parts TPU 4(5)3.11(5)	-
1VL3461099A-100A 34610990	002	D	Positioning plate of TPU	-
1VL3461039A 34610390	-	D	Svorkovnice	-

*) P: Parts list, D: Drawing

Drawing No. 1VL34610500
Current Transformer



Test Results
Accuracy Test

Test performed: Accuracy test
Date of test: 20th October 2014
Condition of test object: Factory new
Ambient air temperature: 22.7 °C
Humidity: 46.8 %

1. Test performed: **Test for ratio error and phase displacement**

secondary winding 1S1 - 1S2

accuracy class		0.5 S									
rated current primary / secondary	A	1250 / 5									
test current	%	120	100	20	5	1	120	100	20	5	1
	A	1500	1250	250	62.5	12.5	1500	1250	250	62.5	12.5
rated burden	VA	15									
burden during test	VA	15					3.75				
power factor cosφ		0.8									
limited ratio error	%	0.500	0.500	0.500	0.750	1.500	0.500	0.500	0.500	0.750	1.500
limited phase displacement δ	min	30.00	30.00	30.00	45.00	90.00	30.00	30.00	30.00	45.00	90.00
ratio error	%	-0.039	-0.039	-0.044	-0.056	-0.071	-0.018	-0.018	-0.012	-0.10	0.002
phase displacement δ	min	0.95	0.75	1.00	2.50	2.92	0.66	0.68	1.14	1.55	1.63

secondary winding 2S1 - 2S2

accuracy class		5P	
rated current primary / secondary	A	1250 / 5	
test current	%	120	100
	A	1500	1250
rated burden	VA	15	
burden during test	VA	15	
power factor cosφ		0.8	
limited ratio error	%	1.000	
imited phase displacement δ	min	60.00	
ratio error	%	-0.084	-0.089
phase displacement δ	min	1.73	1.81

Result: Test passed

Test Results
Accuracy Test before STC Test (2)

2. Test performed: **Tests for winding resistance (R_{ct}), knee point, security factor and composite error**

2.1 Measuring winding 1S1 – 1S2

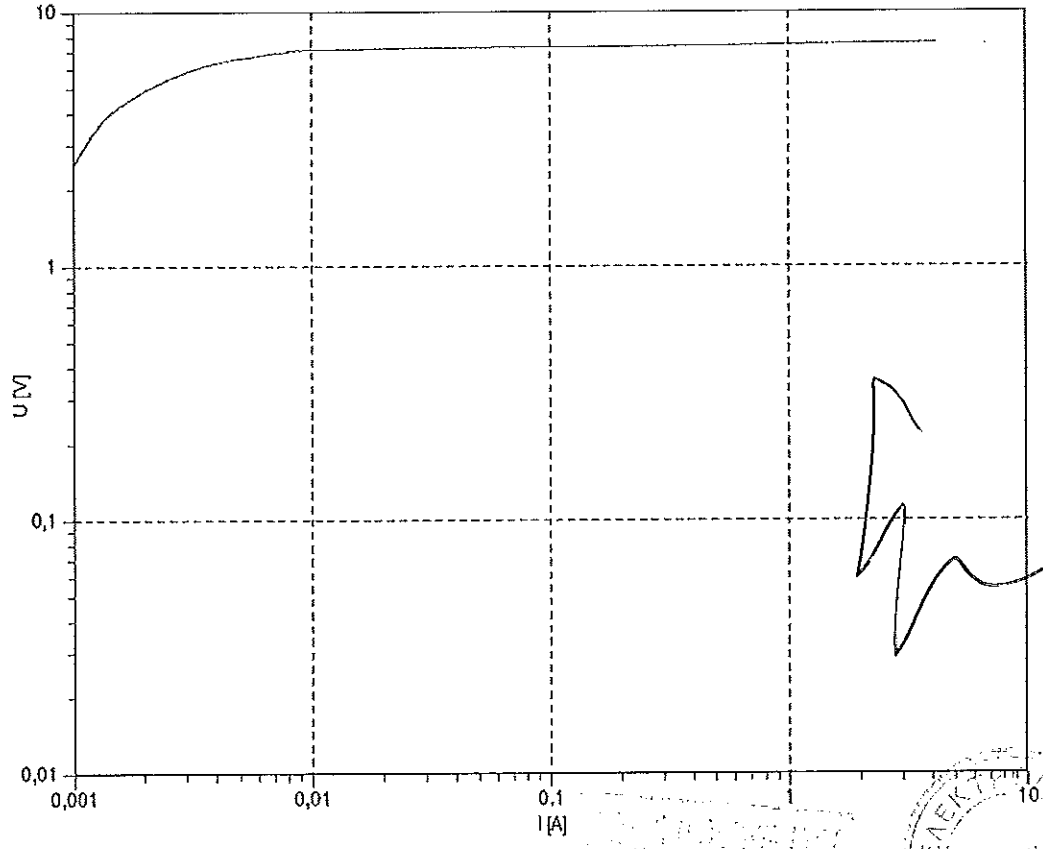
EXCITATION CURVE

RATED DATA

Type	:	TPU 43.11
Serial number	:	1VLT5114049692
Year of production	:	2014
Ratio	:	1250//5/5 A
Burden	:	15/15 VA
Accuracy class	:	0,5/5P
Security factor / ALF	:	5/10

MEASURED VALUES

Winding	:	1s1 - 1s2
Resistance of winding (75°C)	:	0,2370 Ohm
Security factor e->n	:	1,97
Knee point U / I	:	5,87 V / 0,0032 A



Test Results
Accuracy Test before STC Test (3)

2.2 Measuring winding 2S1 – 2S2

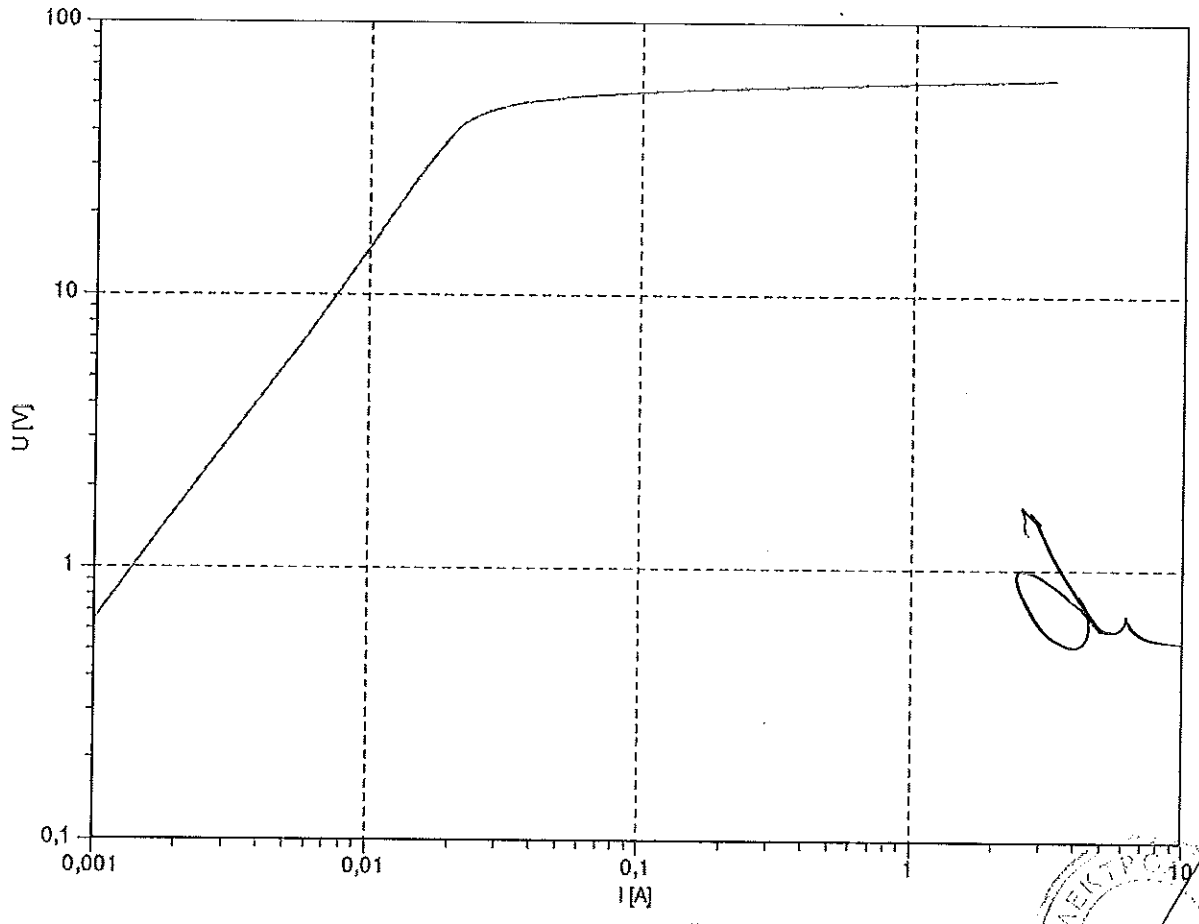
EXCITATION CURVE

RATED DATA

Type	:	TPU 43.11
Serial number	:	1VLT5114049692
Year of production	:	2014
Ratio	:	1250//5/5 A
Burden	:	15/15 VA
Accuracy class	:	0,5/5P
Security factor / ALF	:	5/10

MEASURED VALUES

Winding	:	2s1 - 2s2
Resistance of winding (75°C)	:	0,3912 Ohm
Security factor e->n	:	13,39
Composite error	:	0,1 %
Knee point U / I	:	47,32 V / 0,0289 A



Test Results

Power-Frequency Voltage Withstand Test on Secondary Terminals

Test performed:	Power-frequency voltage withstand test on secondary terminals
Date of test:	20th October 2014
Condition of test object:	As after previous accuracy test
Ambient air temperature:	22.7 °C
Humidity:	46.8 %

- The test voltage of 3 kV, 50 Hz was applied for 60 s in turn between the short circuited terminals of each winding and earth. The frame F and all the other terminals were connected to earth.

Voltage applied to winding	Connected to earth	Test voltage / duration	Result
(1S1-1S2)	(2S1-2S2) + F	3 kV / 60 s	passed
(2S1-2S2)	(1S1-1S2) + F	3 kV / 60 s	passed

Result: Test passed

Test Results
Inter-Turn Overvoltage Test

Test performed:	Inter-turn overvoltage test
Date of test:	20th October 2014
Condition of test object:	As after previous accuracy test and power-frequency voltage withstand test on secondary terminals
Ambient air temperature:	22.7 °C
Humidity:	46.8 %

- The primary winding of the current transformer was excited for 60 s with the extended rated current. The secondary winding was open-circuited. The applied current was limited if the voltage of 4.5 kV peak was obtained before reaching the extended rated current.

Tested winding	Test primary current / duration	Voltage at secondary winding	Result
(1S1-1S2)	1500 A / 60 s	1.86 kV_{peak}	passed
(2S1-2S2)	1500 A / 60 s	1.96 kV_{peak}	passed

Result: Test passed

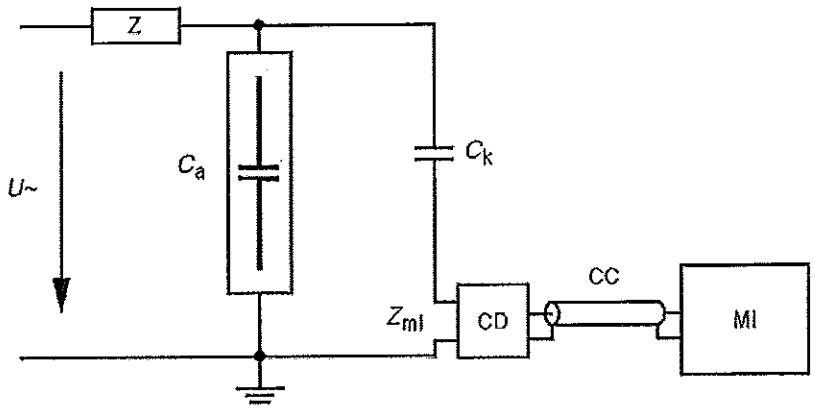
Test Results
Verification of Markings

Test performed:	Verification of markings
Date of test:	20th October 2014
Condition of test object:	As after previous accuracy test, power-frequency voltage withstand test on secondary terminals and inter-turn overvoltage test

Result: The terminal markings of the test object are verified to be correct in accordance with the requirements of the applied test specifications.

Technical Data of Test Circuit

Power-Frequency Voltage Withstand Tests on Primary Terminals and Partial Discharge Measurement



Technical Data:

High voltage supply:

Frequency Inverter, Type SL 11000-3, ZSE Praha, serial No. 3400497

Motor frequency: Selectable range up to 220 Hz

U ~

High Voltage Test Transformer type T100, HIGH VOLT Prüftechnik Dresden GmbH serial No. 885168

Primary voltage	230	V
Rated voltage	100	kV
Rated power	6.6	kVA

100 kV Alternating Voltage Measuring system WGBS 11/100-135, HIGH VOLT Prüftechnik Dresden GmbH, serial No. 884900, consisting of:

100 kV voltage measuring capacitor, type CDCT 0615B12, serial No.0521589-10001

Low voltage measuring part, Type MC 20-4, serial No. 885172

Peak voltmeter, type MU 18, serial No. 885173

C_a	Test object
Z	Filter 40 mH
Z_{mi}	Input impedance of measuring system 50 Ω
CC	Connecting coaxial cable, type L34/10 (50 Ω, length 10 m)
C_k	Coupling capacitor 100 kV / 1nF
CD	Coupling device
MI	Measuring instrument system

Tolerances: According to the IEC 60060-2 cl. 7.1.1 the limits of the measurement uncertainly amount are 3% for the $U_{peak} / \sqrt{2}$

Test Procedure

Power-Frequency Voltage Withstand Tests on Primary Terminals and Partial Discharge Measurement

The power-frequency withstand test on primary terminal and the partial discharge measurement (routine tests) were performed before and after lightning impulse voltage test, temperature-rise test and the short circuit withstand capability test (type tests).

The PD measurements were performed in accordance with IEC61869-1, Ed. 1.0, 2007-10 clause 7.3.2.2 procedure A. Procedure A means the partial discharge test voltages are reched while decreasing the voltage after the power-frequency withstand test. The corresponding partial discharge levels are measured in a time within 30 s.

Calibration:
Before starting the PD measurements the PD test circuit was calibrated in the actual test arrangement.

PD test procedure:
After the power-frequency voltage was applied the voltage is decreased without interruption to 1.2 U_m and the PD level is measured in a time of 30 s. After that the voltage is decreased without interruption furthermore to 1.2 $U_m/\sqrt{3}$ and the PD level is measured in a time of 30 s.

Criteria to pass the test:
The maximum permissible partial discharge quantities are specified IEC61869-1, Ed. 1.0, 2007-10 clause 5.3.3.1 as follows:

at 1.2 x U_m / PD ≤ 50 pC
at 1.2/√3 x U_m / PD ≤ 20 pC

The measured PD values before type tests are given in the table on sheet 18.
The measured PD values after type tests test are given in the table on sheet 27.

Test Results

Power-Frequency Voltage Withstand Tests on Primary Terminals and Partial Discharge Measurement

Test performed:	Power-frequency voltage withstand test on primary terminals and partial discharge measurement
Date of test:	20th October 2014
Condition of test object:	As after previous accuracy test, power-frequency voltage withstand test on secondary terminals and inter-turn overvoltage test
Test frequency:	50 Hz

Temperature ϑ: 22.7 °C Humidity f: 46.8 % Pressure p: 994 hPa
The atmospheric correction factor was not applied.

Test Arrangement:

See photo at page 31

Test performed: **Power-frequency voltage test**

Test arrangement		Test Voltage	Result
Voltage applied to	Earthed	Power frequency voltage in kV	Test duration / disruptive discharges
Primary terminal	Secondary windings and frame	28	60 s / 0

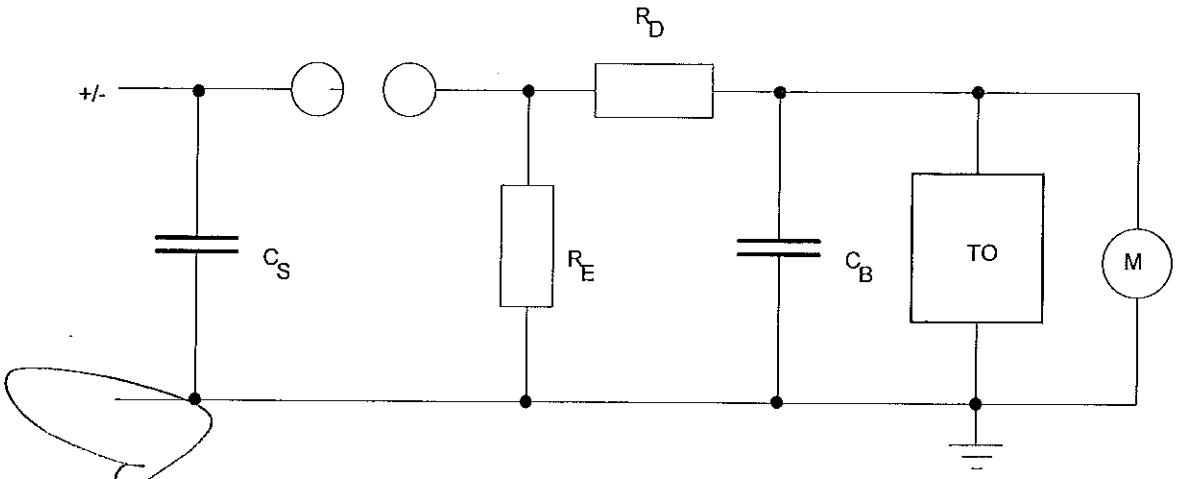
Test performed: **Partial discharge measurement**

Pre-stress: 28 kV for 60 s
Background noise level: 0.2 pC

Test arrangement		Result	
Voltage applied to	Earthed	Test voltage for 30 s	
		14.4 kV	8.3 kV
		Partial discharge in pC	
Primary terminal	Secondary windings and frame	≤ 0.2	≤ 0.2

Result: Tests passed

Technical Data of Test Circuit
Lightning Impulse Voltage Test on Primary Terminals



Technical Data:

Maximum Charging Voltage	U_Σ	=	400	kV
Number of Stages	n	=	4	
Surge Capacity per Stage	C_S	=	1000	nF
Load Capacitance	C_B	=	2000	pF
Damping Resistance	R_D	=	R_{SI}	
Internal Front Resistance per Stage	R_{SI}	=	43	Ω
Discharge Resistance	R_E	=	4	R_P
Tail Resistance per Stage	R_P	=	66	Ω

TO - Test Object

M - Voltage Measurement

Measurement:

Measuring Divider Type SMC 2000/400 (Serial-No. 885217)

Measuring Cable, Length L35/25 (50 Ω, length 25 m)

Impulse Voltage Measuring System, 25 MHz Digital Recorder, Type TR-AS 25-8 (Serial-No. 247)

Tolerances:

According IEC60060-1 Edition 3.0 2010-09 clause 7.2.2

Test voltage value	± 3 %
Front time T_1	± 30 %
Time to half-value T_2	± 20 %

Test Results
Impulse Voltage Withstand Test on Primary Terminals

Test performed: Lightning impulse voltage test
Date of test: 20th October 2014
Condition of test object: As after routine tests

Temperature ϑ: 22.7 °C Humidity f: 46.8 % Pressure p: 994 hPa
According to IEC61869-1 cl. 7.2.3.2.1 no correction for atmospheric conditions.

Front time T_1: 1.2 µs Time to half-value T_2: 50 µs

Test arrangement		Test Voltage	Result
Voltage applied to	Earthed	Lightning impulse voltage kV	number of impulses / disruptive discharges
Primary terminal	Secondary windings and frame	+ 75	15 / 0
		- 75	15 / 0

Result: Test passed

Test Results
Temperature-Rise Test

Test performed: Temperature-rise test
Date of test: 22nd and 23rd October 2014
Condition of test object: As after routine tests and impulse voltage withstand test
Connections to test object: Infeed of current to the primary winding. The infeed bars consist of Cu bars 2 x 80 x 10 mm²

Duration of test: 17:00 h
Test frequency: 50 Hz

Ambient temperature:

Description	Temperature °C
At the beginning of test	24.2
At the end of test	32.3

Test current:

Description	Current A
At the beginning of test	1500
At the end of test	1500

Temperature rise at primary bars:

Measuring point	Description of the measuring point	Nature of measuring point	Final temperature °C	Limited temperature K	Final temperature rise K
1	Left side of infeed bar	One side silver coated Cu in air	70.3	75.0	38.0
2	Right side of infeed bar	One side silver coated Cu in air	70.8		38.5

Calculation of temperature rises of windings according formula:

$$\Theta = \frac{R_{end} - R_{start}}{R_{start}} \times (235°C + \vartheta_{astart}) - (\vartheta_{aend} - \vartheta_{astart})$$

Θ	calculated temperature rise
R_{start}	resistance start of test - cold condition
R_{end}	resistance end of test - reaching a stable temperature
ϑ_{astart}	ambient temperature start test
ϑ_{aend}	ambient temperature end of test

secondary winding	R_{start}	R_{end}	ϑ_{astart}	ϑ_{aend}	Θ	Θ_{lim}
	in Ω	in Ω	in °C	in °C	in K	in K
1S1 - 1S3	0.195	0.224	24.2	32.3	30.4	80.0
2S1 - 2S3	0.325	0.376			32.6	

Remarks:
- The permissible temperature rises are valid for an ambient air temperature of 40 °C.
- The temperatures were measured by thermocouples type L. The thermocouples were inserted into drilling holes and fixed by peening.
- The maximum increase of temperature-rise in the last hour was smaller than 1.0 K.

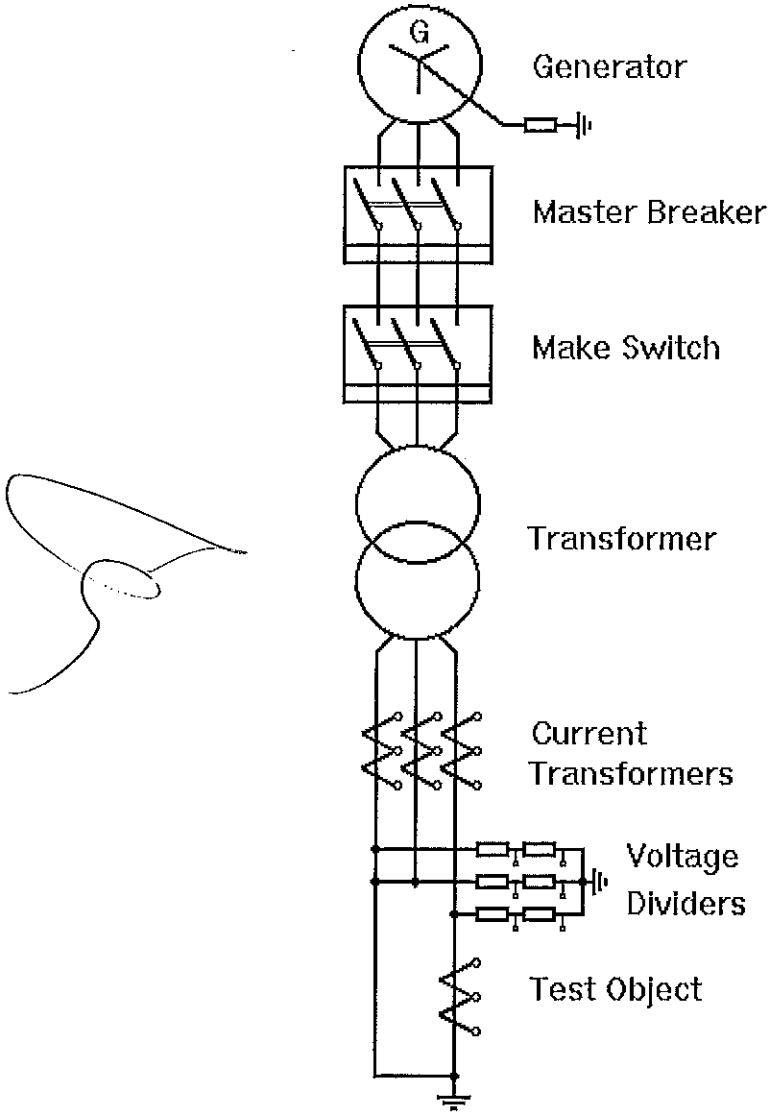
Result: Test passed

Technical Data of Test Circuit
Short-Time Current Tests

Test performed		STC	-
Test No.	PEHLA 14199Ra /	02 - 05	-
Test circuit			
Circuit diagram	Sheet No.	23	-
Current circuit			
Number of phases		3	-
Power frequency	Hz	50	-
Power factor		< 0.15	-
Earthing conditions			
Generator / System		earthed via 5 kΩ	-
Transformer		not earthed	-
Short-circuit point		earthed	-
Test object		earthed	-
Test object (test values)			
Number of phases		1	-
Measurement			
Voltage measurement		Voltage Dividers 1000 V / 1 V	-
Current measurement		Current Transf. 50 kA / 5 A	-

Remarks: -

Circuit Diagram
Short-Time Current Tests



Test Results
Short-Time Current Tests

Test performed: Short-time current tests
Date of test: 04th November 2014
Condition of test object before test: As after routine tests, impulse voltage withstand test and temperature-rise test
Test arrangement: Direct test circuit.
Connections to test object: Infeed via copper bars with a length of approx. 0.5 m each to the terminals of the current transformer. Secondary windings short-circuited. One side of the infeed and the current transformer earthed via cable.
Gas pressure (abs. rel. to 20 °C): - MPa

Test No.				PEHLA 14199Ra /	03	04	05	-	-	-
Peak withstand current		L1	kA		102	72.2	69.3	-	-	-
		L2	kA		-	-	-	-	-	-
		L3	kA		-	-	-	-	-	-
Short-circuit current	First cycle	L1	kA		42.8	39.1	37.5	-	-	-
		L2	kA		-	-	-	-	-	-
		L3	kA		-	-	-	-	-	-
	Last cycle	L1	kA		41.8	40.9	43.5	-	-	-
		L2	kA		-	-	-	-	-	-
		L3	kA		-	-	-	-	-	-
	Equivalent current	L1	kA		41.6	39.4	40.2	-	-	-
		L2	kA		-	-	-	-	-	-
		L3	kA		-	-	-	-	-	-
	Average value		kA		-	-	-	-	-	-
	Duration of short-circuit		s		0.322	1.04	3.11	-	-	-
Short-time withstand current		L1	kA		-	40.2	40.9	-	-	-
		L2	kA		-	-	-	-	-	-
		L3	kA		-	-	-	-	-	-
	Average value		kA		-	-	-	-	-	-
	Related to rated duration of short-circuit		s		-	1.00	3.00	-	-	-
Duration of short-circuit			s		-	1.01	3.14	-	-	-
Related to rated short-time withstand current			kA		-	40.0	40.0	-	-	-
Emission of flame/gas/oil					no	no	no	-	-	-
Test result (P/N)					P	P	P	-	-	-
Resistance of the main circuit before test		L1	µΩ		-	-	-	-	-	-
Test current: - A (d.c.)		L2	µΩ		-	-	-	-	-	-
		L3	µΩ		-	-	-	-	-	-
	Ambient air temperature		°C		-	-	-	-	-	-
Resistance of the main circuit after test		L1	µΩ		-	-	-	-	-	-
Test current: - A (d.c.)		L2	µΩ		-	-	-	-	-	-
		L3	µΩ		-	-	-	-	-	-
	Ambient air temperature		°C		-	-	-	-	-	-

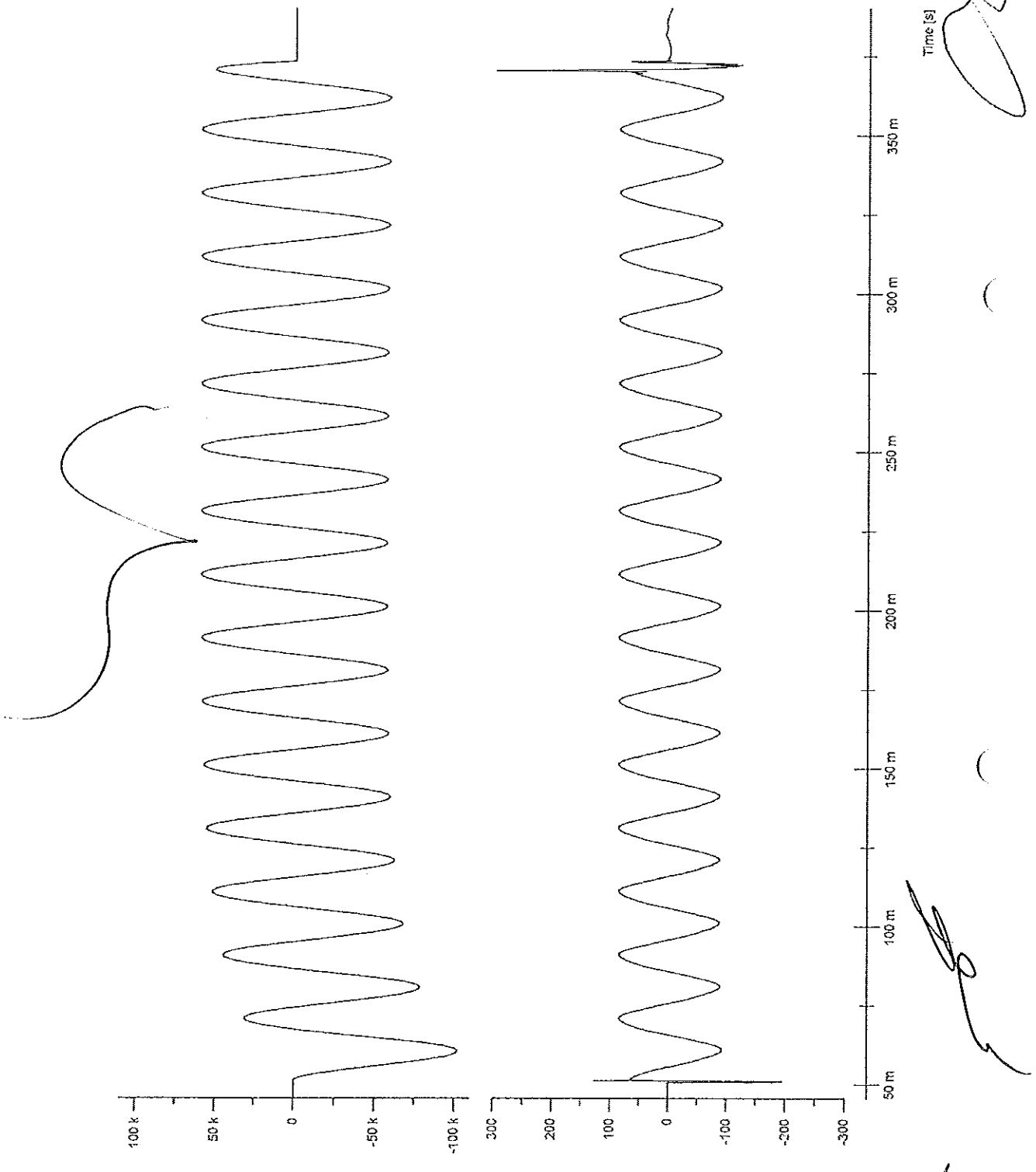
Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard

Remarks: PEHLA 14199Ra / 01: Current calibration
PEHLA 14199Ra / 02: Pre-test with reduced values

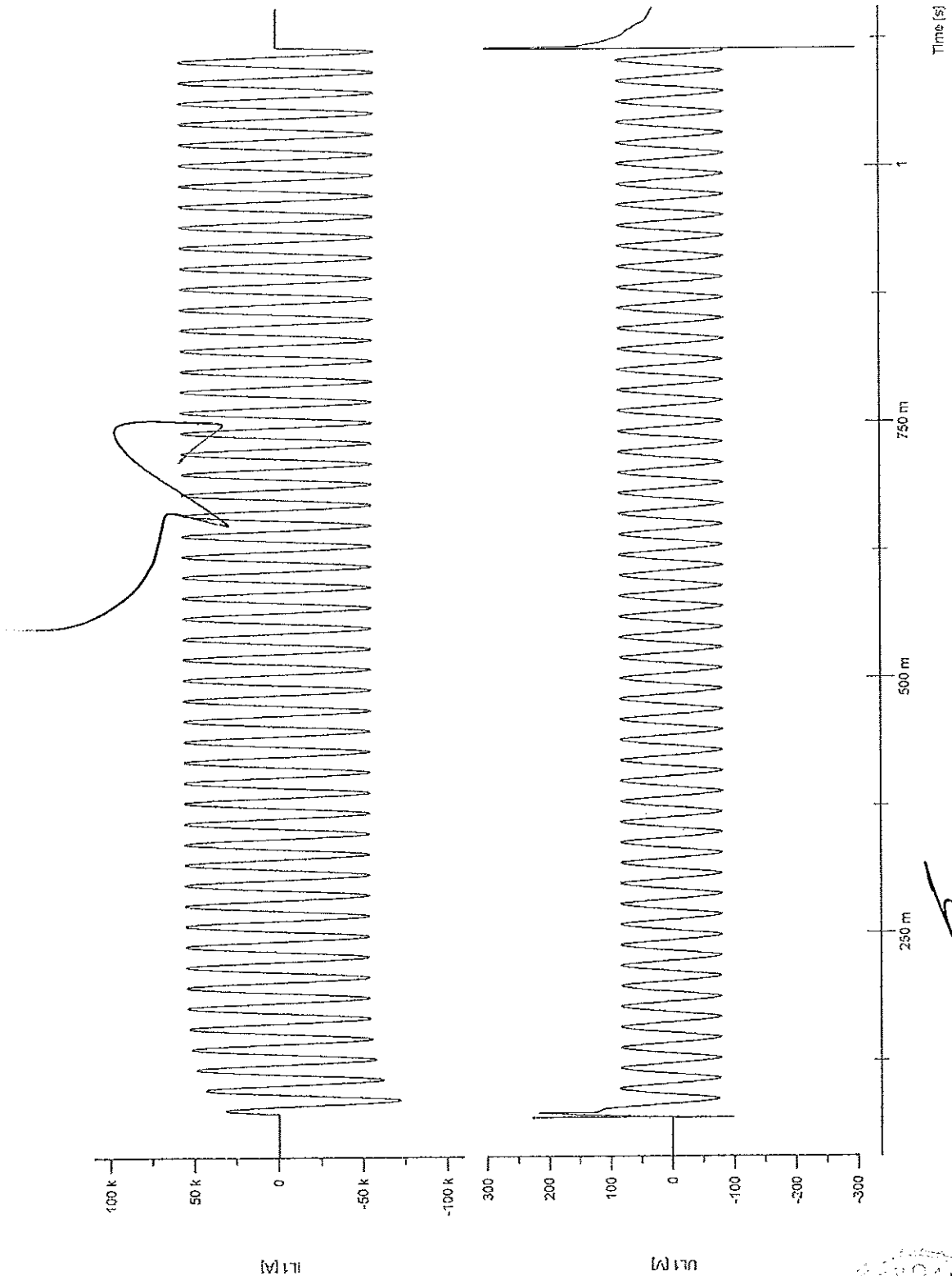
Condition of test object after test: No visible or functional change or damage.
Result: Test passed

Oscillogram No. PEHLA 14199Ra / 03

Dynamic Test



Oscillogram No. PEHLA 14199Ra / 04
Thermal Test - 1s



Test Results

Power-Frequency Voltage Withstand Tests on Primary Terminals and Partial Discharge Measurement after STC Tests

Test performed: Power-frequency voltage withstand test on primary terminals and partial discharge measurement

Date of test: 17th November 2014

Condition of test object: As after routine tests, impulse voltage withstand test, temperature-rise test and short-time current tests

Test frequency: 50 Hz

Temperature ϑ: 23.1 °C Humidity f: 41.1 % Pressure p: 985 hPa
The atmospheric correction factor was not applied.

Test Arrangement:

See photo at page 31

Test performed: **Power-frequency voltage test**

Test arrangement		Test Voltage	Result
Voltage applied to	Earthed	Power frequency voltage in kV	Test duration / disruptive discharges
Primary terminal	Secondary windings and frame	28 [1]	60 s / 0

Test performed: **Partial discharge measurement**

Pre-stress: 28 kV for 60 s
Background noise level: 0.2 pC

Test arrangement		Result	
Voltage applied to	Earthed	Test voltage for 30 s	
		14.4 kV	8.3 kV
		Partial discharge in pC	
Primary terminal	Secondary windings and frame	0.5	≤ 0.2

Remarks:

1) According client's requirements the power frequency voltage test and the partial discharge measurement were done at 100 % of the test voltage

Result: Tests passed

Test Results

Power Frequency Voltage Withstand Tests on Secondary Terminals after STC Test

Test performed:	Power-frequency voltage withstand test on secondary terminals
Date of test:	17th November 2014
Condition of test object:	As after routine tests, impulse voltage withstand test,temperature-rise test, short-time current tests, power-frequency withstand test on primary terminals and partial discharge measurement
Ambient air temperature:	23.1 °C
Humidity:	41.1 %

- The test voltage of 3 kV, 50 Hz was applied for 60 s in turn between the short circuited terminals of each winding and earth. The frame F and all the other terminals were connected to earth.

Voltage applied to winding	Connected to earth	Test voltage / duration	Result
(1S1-1S2)	(2S1-2S2) + F	3 kV / 60 s	passed
(2S1-2S2)	(1S1-1S2) + F	3 kV / 60 s	passed

Result: Test passed

Test Results
Accuracy Test after STC Tests and Voltage Tests

Test performed: Accuracy test
Date of test: 17th November 2014
Condition of test object: As after routine tests, impulse voltage withstand test, temperature-rise test, short-time current tests, voltage test after STC tests
Ambient air temperature: 23.1 °C
Humidity: 41.1 %

Test performed: **Test for ratio error and phase displacement**

secondary winding 1S1 - 1S2

accuracy class		0.5 S									
rated current primary / secondary	A	1250 / 5									
test current	%	120	100	20	5	1	120	100	20	5	1
	A	1500	1250	250	62.5	12.5	1500	1250	250	62.5	12.5
rated burden	VA	15									
burden during test	VA	15					3.75				
power factor cosφ		0.8					1.0				
limited ratio error	%	0.500	0.500	0.500	0.750	1.500	0.500	0.500	0.500	0.750	1.500
limited ratio error after STC	%	0.250	0.250	0.250	0.375	0.750	0.250	0.250	0.250	0.375	0.750
ratio error before STC	%	-0.039	-0.039	-0.044	-0.056	-0.071	-0.018	-0.018	-0.012	-0.10	0.002
upper limit of ratio error after STC	%	0.211	0.211	0.206	0.319	0.679	0.232	0.232	0.238	0.275	0.752
lower limit of ratio error after STC	%	-0.289	-0.289	-0.294	-0.431	-0.821	-0.268	-0.268	-0.262	-0.475	-0.748
ratio error after STC	%	-0.036	-0.035	-0.049	-0.056	-0.039	-0.015	-0.017	-0.011	-0.010	0.002

secondary winding 2S1 - 2S2

accuracy class		5P	
rated current primary / secondary	A	1250 / 5	
test current	%	120	100
	A	1500	1250
rated burden	VA	15	
burden during test	VA	15	
power factor cosφ		0.8	
limited ratio error	%	1	
limited ratio error after STC	%	0.5	
ratio error before STC	%	-0.084	-0.089
upper limit of ratio error after STC	%	0.416	0.411
lower limit of ratio error after STC	%	-0.584	-0.589
ratio error after STC	%	-0.200	-0.199

Test performed: **Test for composite error**

secondary winding 2S1 - 2S2

accuracy class		5P
limited comp. error before STC test	%	5
limited comp. error after STC test	%	2.5
composite error before STC	%	0.1
limit comp. Erro after STC	%	2.6
composite error after STC	%	0.1

Result: Test passed

Photos

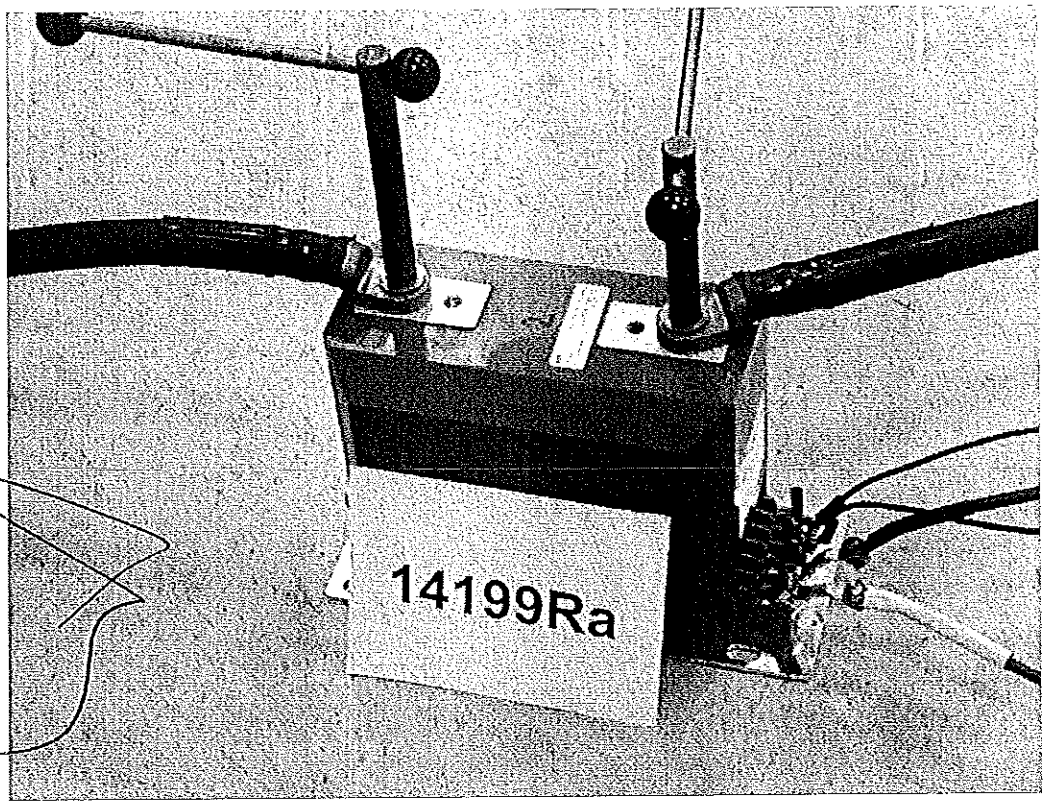


Photo No. 01:
During accuracy test

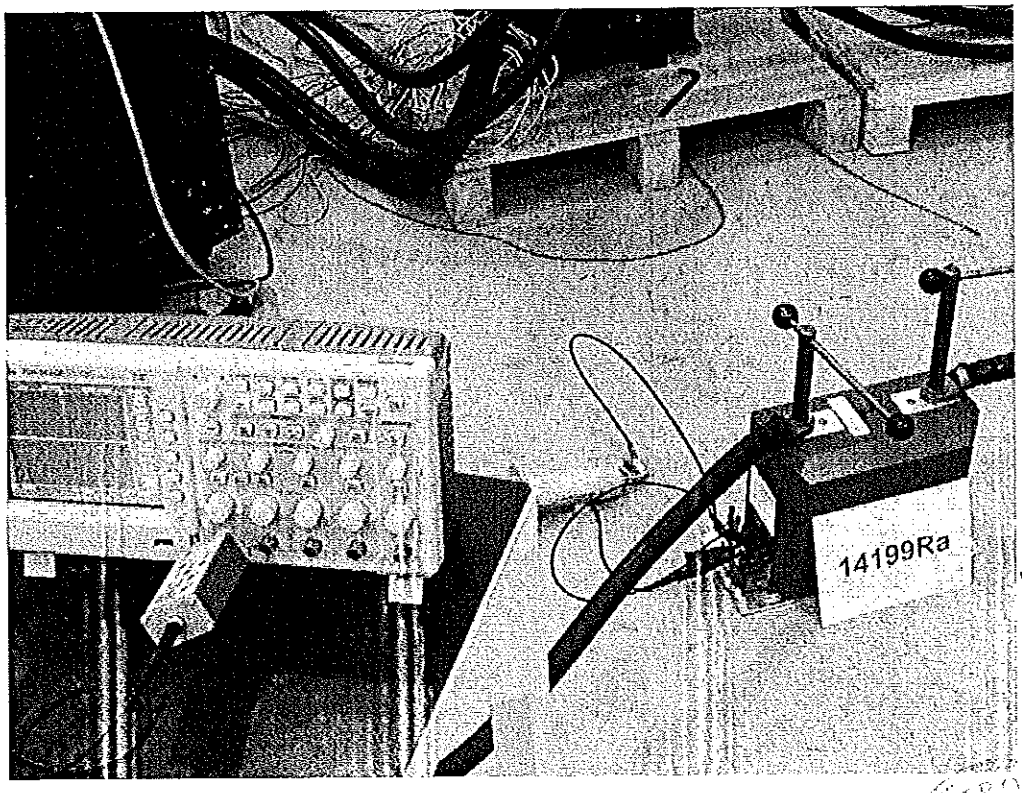


Photo No. 02:
During inter-turn overvoltage

Photos

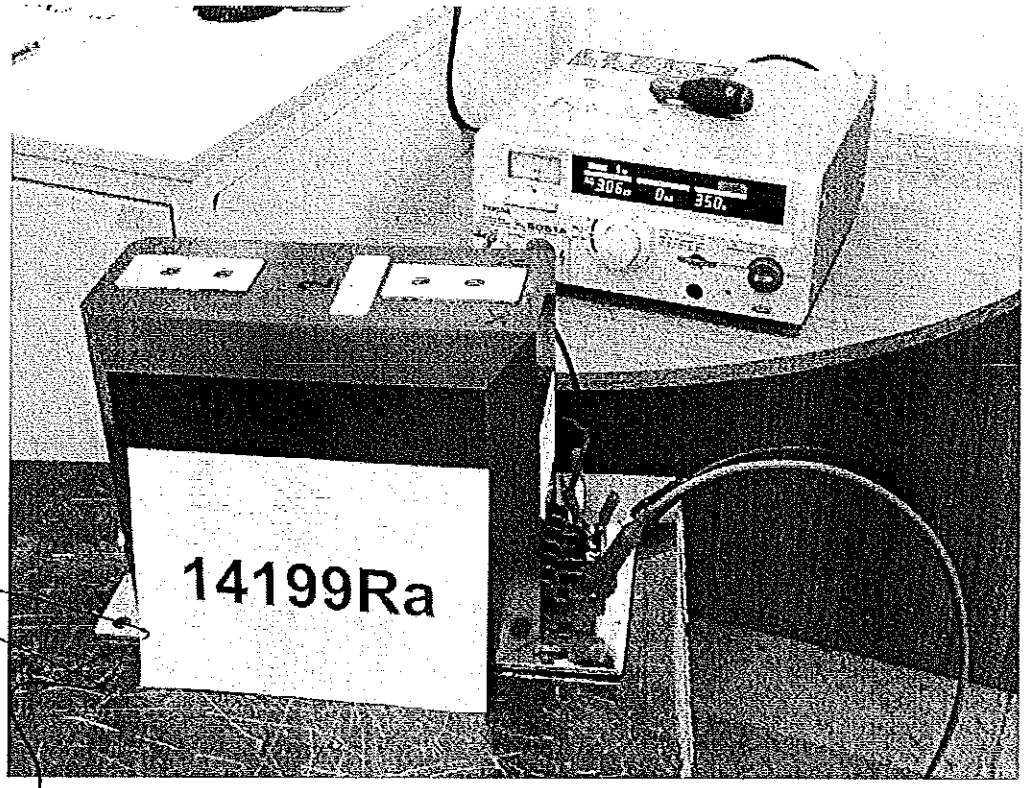


Photo No. 03:
During 3 kV test

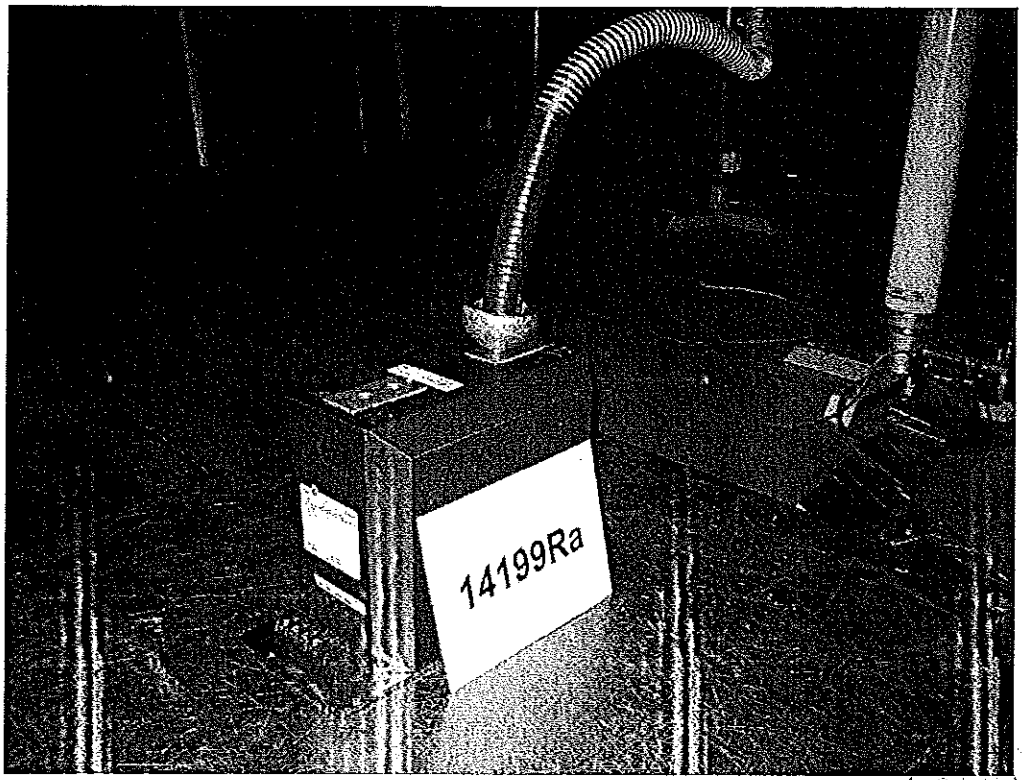


Photo No. 04:
Power frequency and PD test

Photos

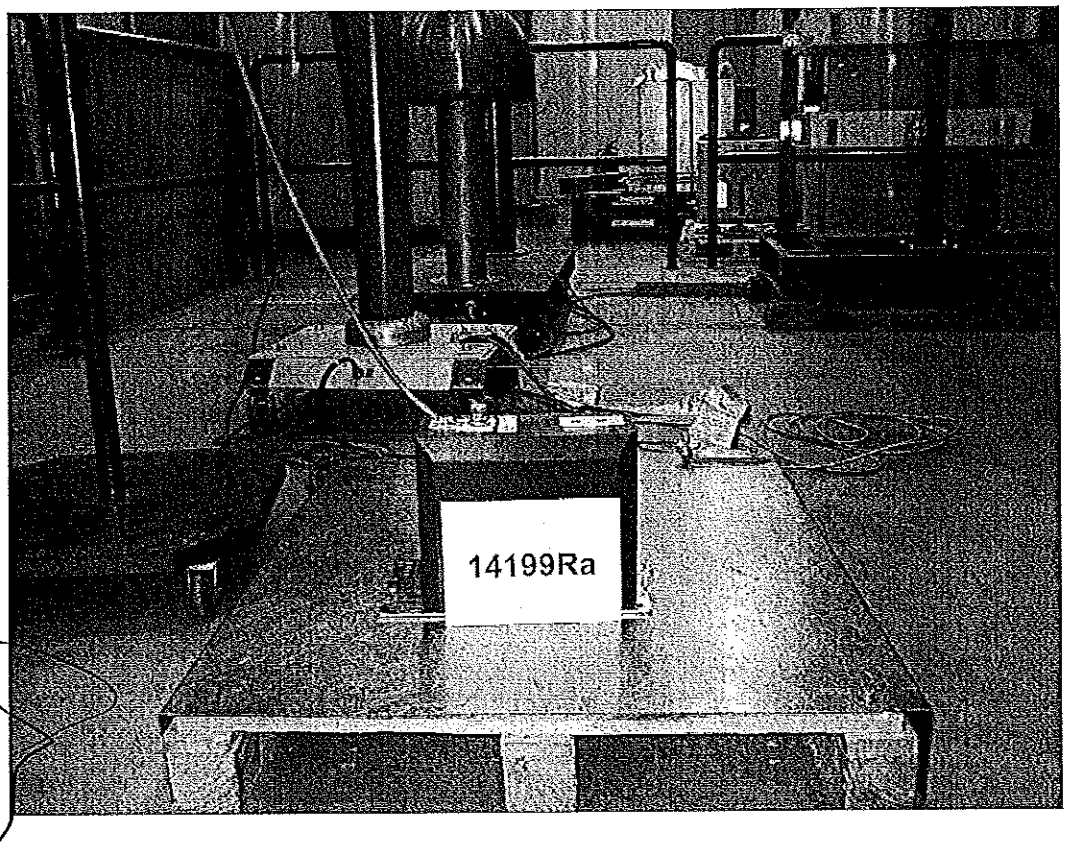


Photo No. 05:
BIL test

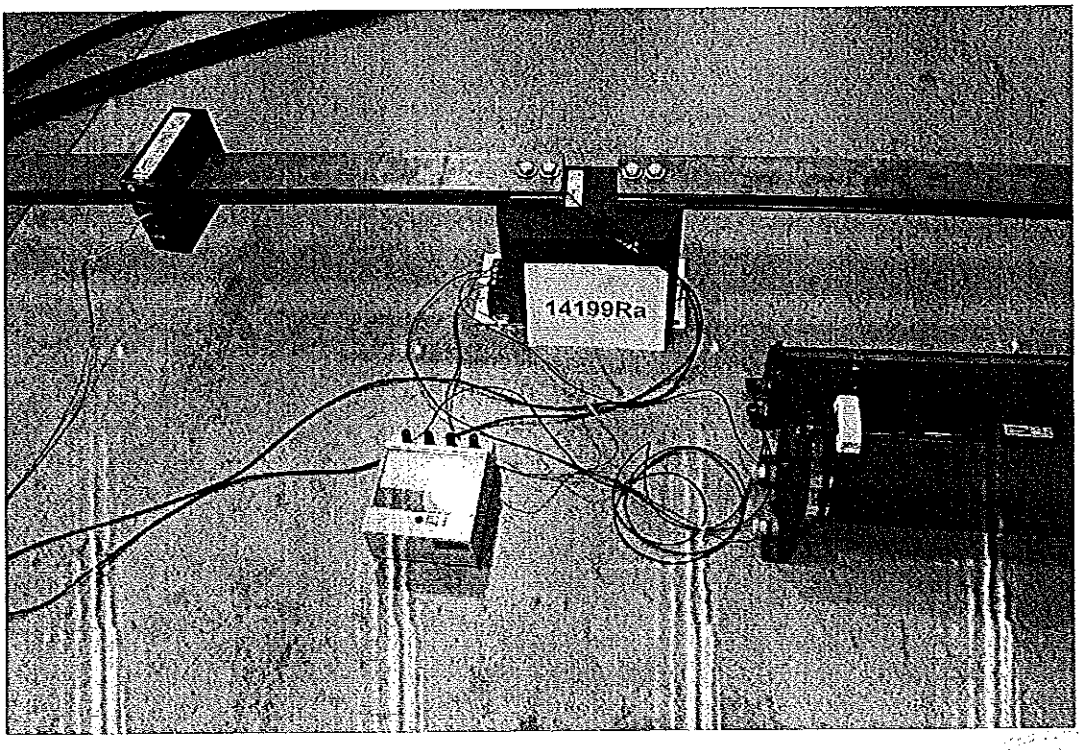


Photo No. 06:
Temperature-rise test

Photos

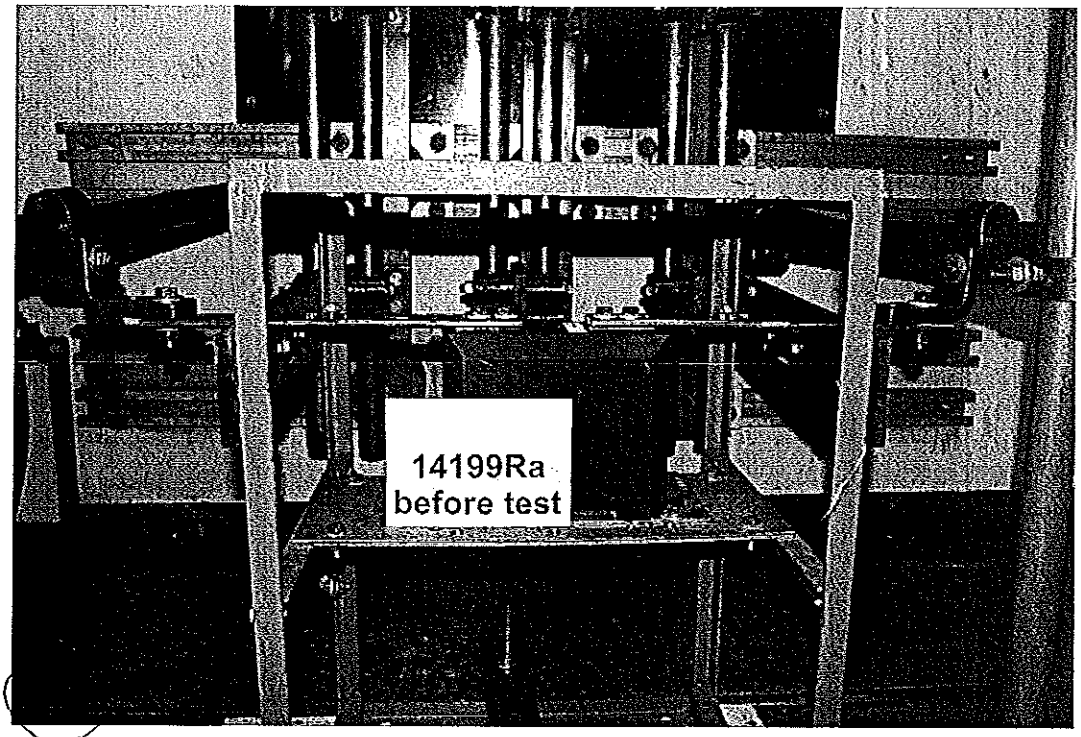


Photo No. 07:
Before STC test

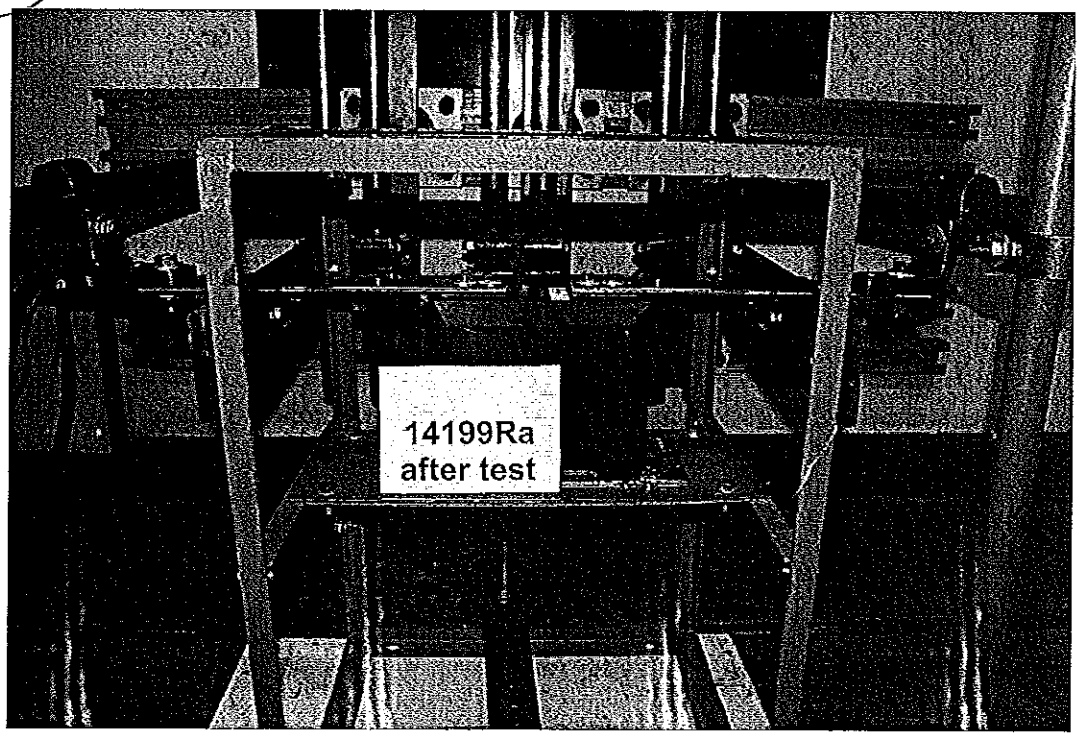


Photo No. 08:
After STC test

Приложение 2.4 - Акредитация на лабораторията на АББ

NÁRODNÍ AKREDITAČNÍ ORGÁN

EA MLA Signatory
Český institut pro akreditaci, o.p.s.
Olšanská 54/3, 130 00 Praha 3

issues

according to section 16 of Act No. 22/1997 Coll., on technical requirements for products, as amended

CERTIFICATE OF ACCREDITATION

No. 852 / 2015

ABB, s.r.o.
with registered office Štětkova 1638/18, 140 00 Praha 4, Company Registration No. 49682563

to the Testing Laboratory No. 1693
ABB s.r.o. Technical Laboratory PPMV Brno

Scope of accreditation:

Testing of air-insulated high-voltage switchgear and controlgear, instrument current and voltage transformers for high-voltage, electronic instrument current and voltage transformers for high-voltage to the extent as specified in the appendix to this Certificate.

This Certificate of Accreditation is a proof of Accreditation issued on the basis of assessment of fulfillment of the accreditation criteria in accordance with

ČSN EN ISO/IEC 17025:2005

In its activities performed within the scope and for the period of validity of this Certificate, the Body is entitled to refer to this Certificate, provided that the accreditation is not suspended and the Body meets the specified accreditation requirements in accordance with the relevant regulations applicable to the activity of an accredited Conformity Assessment Body.

The Certificate of Accreditation is valid until: **11 December 2018**

Prague: 11 December 2015

Jiří Růžička
Director
Czech Accreditation Institute
Public Service Company

The Appendix is an integral part of
Certificate of Accreditation No. 852/2015 of 11/12/2015

Accredited entity according to ČSN EN ISO/IEC 17025:2005:

ABB s.r.o.
ABB s.r.o. Technical Laboratory PPMV Brno
Vídeňská 117, 119 00 Brno

The Laboratory is qualified to update standards identifying the test procedures.
The Laboratory provides expert opinions and interprets test results.

Tests:

Ordinal number [1]	Test procedure/method name	Test procedure/method identification	Tested object
1.1	Temperature rise test	IEC 61869-1 ed.1, p.7.2.2 IEC 61869-2 ed.1, p.7.2.2 ČSN EN 61869-1 p. 7.2.2 ČSN EN 61869-2 p. 7.2.2	Instrument current transformers
1.2	Impulse voltage withstand test on primary terminals	IEC 61869-1 ed.1, p. 7.2.3 IEC 61869-2 ed.1, p. 7.2.3 ČSN EN 61869-1 p. 7.2.3 ČSN EN 61869-2 p. 7.2.3	Instrument current transformers
1.3	Accuracy tests	IEC 61869-2 ed.1, p. 7.2.6, 7.3.5 ČSN EN 61869-2 p. 7.2.6, 7.3.5	Instrument current transformers
1.4	Power-frequency voltage withstand tests on primary terminals	IEC 61869-1 ed.1, p. 7.3.1 IEC 61869-2 ed.1, p. 7.3.1 ČSN EN 61869-1 p. 7.3.1 ČSN EN 61869-2 p. 7.3.1	Instrument current transformers
1.5	Partial discharge measurement	IEC 61869-1 ed.1, p.7.3.2 ČSN EN 61869-1 p. 7.3.2	Instrument current transformers
1.6	Power-frequency voltage withstand tests between sections	IEC 61869-1 ed.1, p. 7.3.3 ČSN EN 61869-1 p. 7.3.3	Instrument current transformers
1.7	Power-frequency voltage withstand tests on secondary terminals	IEC 61869-1 ed.1, p. 7.3.4 ČSN EN 61869-1 p. 7.3.4	Instrument current transformers
1.8	Verification of markings	IEC 61869-1 ed.1, p. 7.3.6 ČSN EN 61869-1 p. 7.3.6	Instrument current transformers
1.9	Determination of the secondary winding resistance	IEC 61869-2 ed.1, p. 7.3.201 ČSN EN 61869-2 p. 7.3.201	Instrument current transformers

Český institut pro akreditaci, o.p.s.

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The Appendix is an integral part of
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Accredited entity according to ČSN EN ISO/IEC 17025:2005:

ABB s.r.o.
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Vídeňská 117, 119 00 Brno

Ordinal number [1)]	Test procedure/method name	Test procedure/method identification	Tested object
1.10	Determination of the secondary loop time constant using the Omicron instrument	IEC 61869-2 ed.1, p. 7.3.202 ČSN EN 61869-2 p. 7.3.202	Instrument current transformers
1.11	Measurement of limit current and voltage	IEC 61869-2 ed.1, p. 7.3.203 ČSN EN 61869-2 p. 7.3.203	Instrument current transformers
1.12	Inter-turn overvoltage test	IEC 61869-2 ed.1, p. 7.3.204 ČSN EN 61869-2 p. 7.3.204	Instrument current transformers
1.13	Determination of the remanence factor	IEC 61869-2 ed.1, p. 7.5.1, 2B.2 ČSN EN 61869-2 p. 7.5.1, 2B.2	Instrument current transformers
1.14	Determination of the instrument security factor (FS) of measuring current transformers	IEC 61869-2 ed.1, p. 7.5.2, 2A.5, 2A.6 ČSN EN 61869-2 p. 7.5.2, 2A.5, 2A.6	Instrument current transformers
2.1	Temperature rise test	IEC 61869-1 ed.1, p.7.2.2 IEC 61869-3 ed.1, p.7.2.2 ČSN EN 61869-1 p. 7.2.2 ČSN EN 61869-3 p. 7.2.2	Instrument voltage transformers
2.2	Impulse voltage withstand test on primary terminals	IEC 61869-1 ed.1, p. 7.2.3 IEC 61869-3 ed.1, p. 7.2.3 ČSN EN 61869-1 p. 7.2.3 ČSN EN 61869-3 p. 7.2.3	Instrument voltage transformers
2.3	Accuracy tests	IEC 61869-3 ed.1, p. 7.2.6, 7.3.5 ČSN EN 61869-3 p. 7.2.6, 7.3.5	Instrument voltage transformers
2.4	Power-frequency voltage withstand tests on primary terminals	IEC 61869-1 ed.1, p. 7.3.1 IEC 61869-3 ed.1, p. 7.3.1 ČSN EN 61869-1 p. 7.3.1 ČSN EN 61869-3 p. 7.3.1	Instrument voltage transformers

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Accredited entity according to ČSN EN ISO/IEC 17025:2005:

ABB s.r.o.
ABB s.r.o. Technical Laboratory PPMV Brno
Vídeňská 117, 119 00 Brno

Ordinal number [1)]	Test procedure/method name	Test procedure/method identification	Tested object
2.5	Partial discharge measurement	IEC 61869-1 ed.1, p.7.3.2 IEC 61869-3 ed.1, p.7.3.2 ČSN EN 61869-1 p. 7.3.2 ČSN EN 61869-3 p. 7.3.2	Instrument voltage transformers
2.6	Power-frequency voltage withstand tests between sections	IEC 61869-1 ed.1, p. 7.3.3 ČSN EN 61869-1 p. 7.3.3	Instrument voltage transformers
2.7	Power-frequency voltage withstand tests on secondary terminals	IEC 61869-1 ed.1, p. 7.3.4 ČSN EN 61869-1 p. 7.3.4	Instrument voltage transformers
2.8	Verification of markings	IEC 61869-1 ed.1, p. 7.3.6 ČSN EN 61869-1 p. 7.3.6	Instrument voltage transformers
3.1	Insulation electric strength tests	IEC 62271-1 ed.1, p. 6.2 IEC 62271-200 ed.2, p. 6.2 ČSN EN 62271-1 p. 6.2 ČSN EN 62271-200 ed.2, p. 6.2	Metal-enclosed switchgear and controlgear
3.2	Measurement of circuit resistance	IEC 62271-1 ed.1, p. 6.4 IEC 62271-200 ed.2, p. 6.4 ČSN EN 62271-1 p. 6.4 ČSN EN 62271-200 ed.2, p. 6.4	Metal-enclosed switchgear and controlgear
3.3	Temperature-rise tests	IEC 62271-1 ed.1, p. 6.5 IEC 62271-200 ed.2 , p. 6.5 ČSN EN 62271-1 p. 6.5 ČSN EN 62271-200 ed.2, p. 6.5	Metal-enclosed switchgear and controlgear
3.4	Tests of mechanical function	IEC 62271-200 ed.2, p. 6.102 ČSN EN 62271-200 ed.2, p. 6.102	Metal-enclosed switchgear and controlgear

Český institut pro akreditaci, o.p.s.

The Appendix is an integral part of
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ABB s.r.o.
ABB s.r.o. Technical Laboratory PPMV Brno
Vídeňská 117, 119 00 Brno

Ordinal number [1)]	Test procedure/method name	Test procedure/method identification	Tested object
3.5	IP code verification IP 2X, IP 3X, IP 4X	IEC 62271-1 ed.1, p. 6.7.1 IEC 62271-200 ed.2, p. 6.7.1 ČSN EN 62271-1 p. 6.7.1 ČSN EN 62271-200 ed.2, p. 6.7.1	Metal-enclosed switchgear and controlgear
3.6	Partial discharge measurement	IEC 62271-1 ed.1, p. 6.2.9 IEC 62271-200 ed.2, p. 6.2.9 ČSN EN 62271-1 p. 6.2.9 ČSN EN 62271-200 ed.2, p. 6.2.9	Metal-enclosed switchgear and controlgear
3.7	Additional tests on auxiliary and control circuits	IEC 62271-200 ed.2, p. 6.10 ČSN EN 62271-200 ed.2, p. 6.10	Metal-enclosed switchgear and controlgear
4.1	Impulse voltage withstand test (Primary voltage terminals Um<300kV)	IEC 60044-7 ed.1, p. 8.2.1 ČSN EN 60044-7 p. 8.2.1	Electronic voltage transformers
4.2	Basic tests	IEC 60044-7 ed.1, p. 8.3.1 ČSN EN 60044-7 p. 8.3.1	Electronic voltage transformers
4.3	Test for accuracy versus temperature	IEC 60044-7 ed.1, p. 8.2.3 ČSN EN 60044-7 p. 8.2.3	Electronic voltage transformers
4.4	Test for accuracy versus frequency	IEC 60044-7 ed.1, p. 8.3.3 ČSN EN 60044-7 p. 8.3.3,	Electronic voltage transformers
4.5	Test of resistance to overheating	IEC 60044-7 ed.1, p. 8.2.4 ČSN EN 60044-7 p. 8.2.4	Electronic voltage transformers
4.6	Impulse voltage withstand test for low-voltage components	IEC 60044-7 ed.1, p. 8.8 ČSN EN 60044-7 p. 8.8	Electronic voltage transformers

Český institut pro akreditaci, o.p.s.

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Accredited entity according to ČSN EN ISO/IEC 17025:2005:

ABB s.r.o.
ABB s.r.o. Technical Laboratory PPMV Brno
Vídeňská 117, 119 00 Brno

Ordinal number [1)]	Test procedure/method name	Test procedure/method identification	Tested object
4.7	Transient performance test	IEC 60044-7 ed.1, p. 8.9 ČSN EN 60044-7 p. 8.9	Electronic voltage transformers
4.8	Power-frequency withstand tests on primary terminals and partial discharge measurement	IEC 60044-7 ed.1, p. 9.2 ČSN EN 60044-7 p. 9.2	Electronic voltage transformers
4.9	Power-frequency voltage withstand test for low-voltage components	IEC 60044-7 ed.1, p. 9.3 ČSN EN 60044-7 p. 9.3	Electronic voltage transformers
Hydraulic loss test5.1	Temperature-rise test	IEC 60044-8 ed.1, p. 8.2 ČSN EN 60044-8 p. 8.2	Electronic current transformers
5.2	Impulse-voltage withstand test (Primary voltage terminals Um<300kV)	IEC 60044-8 ed.1, p. 8.2.3 ČSN EN 60044-8 p. 8.2.3	Electronic current transformers
5.3	Power-frequency voltage withstand test	IEC 60044-8 ed.1, p. 8.7.3 ČSN EN 60044-8 p. 8.3.7,	Electronic current transformers
5.4	Impulse-voltage withstand test	IEC 60044-8 ed.1, p. 8.7.4 ČSN EN 60044-8 p. 8.7.4	Electronic current transformers
5.5	Basic accuracy tests	IEC 60044-8 ed.1, p. 8.2.9 ČSN EN 60044-8 p. 8.2.9	Electronic current transformers
5.6	Temperature cycle accuracy test	IEC 60044-8 ed.1, p. 8.9.3 ČSN EN 60044-8 p. 8.3.9,	Electronic current transformers
5.7	Test for accuracy versus frequency	IEC 60044-8 ed.1, p. 8.9.4 ČSN EN 60044-8 p. 8.9.4	Electronic current transformers
5.8	Test for composite error	IEC 60044-8 ed.1, p. 8.10.1 ČSN EN 60044-8 p. 8.10.1	Electronic current transformers

The Appendix is an integral part of
Certificate of Accreditation No. 852/2015 of 11/12/2015

Accredited entity according to ČSN EN ISO/IEC 17025:2005:

ABB s.r.o.
ABB s.r.o. Technical Laboratory PPMV Brno
Vídeňská 117, 119 00 Brno

Ordinal number [1]	Test procedure/method name	Test procedure/method identification	Tested object
5.9	Power-frequency withstand tests on primary terminals and partial discharge measurement	IEC 60044-8 ed.1, p. 9.2 ČSN EN 60044-8 p. 9.2	Electronic current transformers
5.10	Power-frequency voltage withstand test for low-voltage components	IEC 60044-8 ed.1, p. 9.3 ČSN EN 60044-8 p. 9.3	Electronic current transformers

1) Asterisk at the ordinal number identifies the tests, which the Laboratory is qualified to carry out outside the permanent laboratory premises.

Český institut pro akreditaci, o.p.s.
-1-

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Приложение 2.4 - Акредитация на лабораторията

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH
German Accreditation Body

Entrusted according to Section 8 subsection1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of
EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH (German Accreditation Body) attests that the testing laboratory

PEHLA GbR
PEHLA-Prüffeld Ratingen
Oberhausener Straße 33, 40472 Ratingen

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields:

High-Voltage Switchgear and Controlgear,
Low-Voltage Switchgear and Controlgear Assemblies,
Current and Voltage Transformers,
Power transformers and Busbar Systems

The accreditation certificate shall only apply in connection with the notice of accreditation of 2012-05-09 with the accreditation number D-PL-12072-06 and is valid until 2017-05-08. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 5 pages.

Registration number of the certificate: **D-PL-12072-06-01**

Frankfurt am Main, 2012-05-09

Dipl.-Ing. (FH) Ralf Egner
Head of Division 2

This document is a translation. The definitive version is the original German accreditation certificate.

See notes overleaf.

Deutsche Akkreditierungsstelle GmbH

Office Berlin
Spittelmarkt 10
10117 Berlin

Office Frankfurt am Main
Gartenstraße 6
60594 Frankfurt am Main

Office Braunschweig
Bundesallee 100
38116 Braunschweig

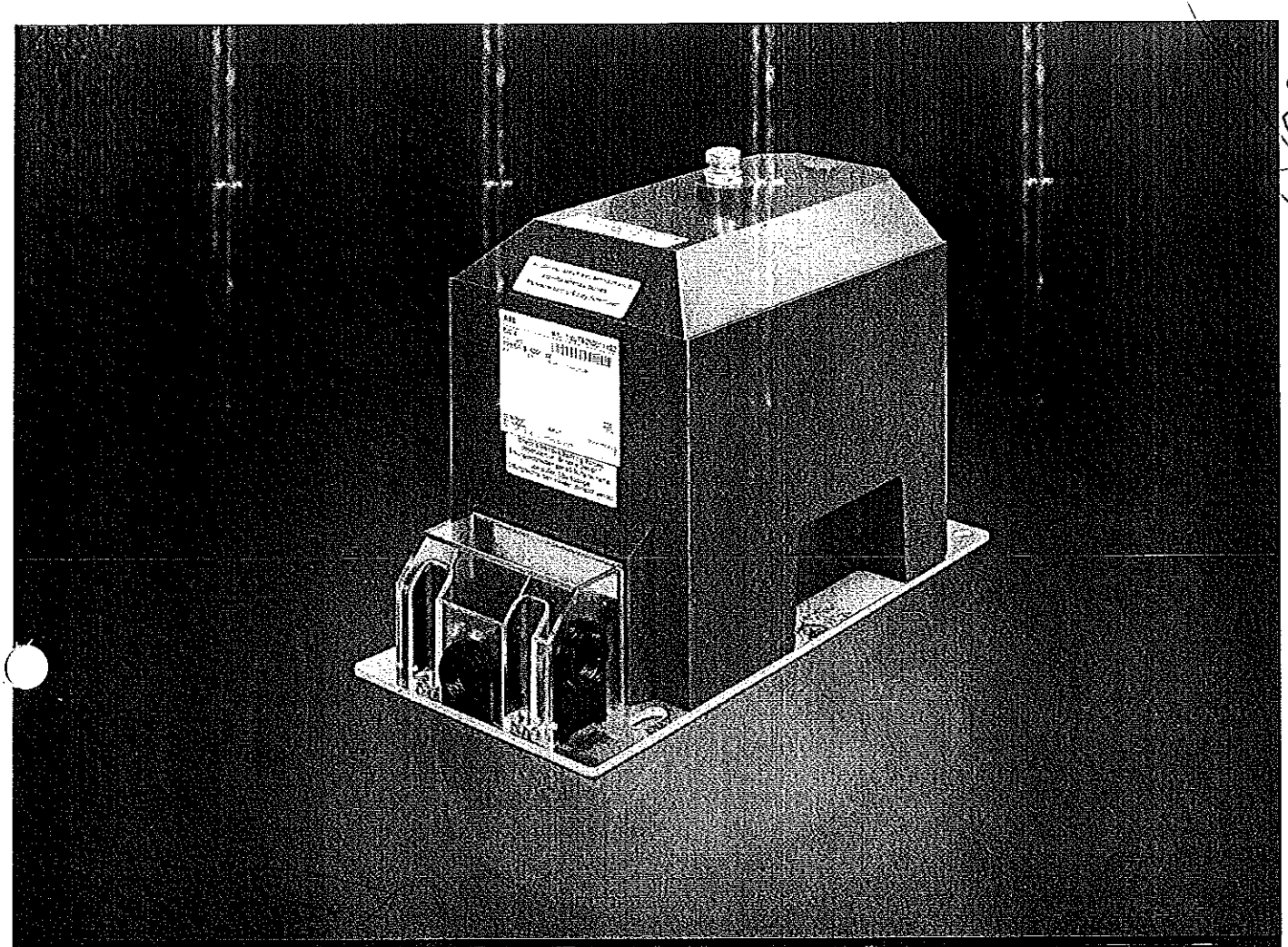
The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkkS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.

No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkkS.

The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.

The up-to-date state of membership can be retrieved from the following websites:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

Приложение 3.1 - Каталог на TJC 4



Medium Voltage Product

Power and productivity
for a better world™

ABB

Parameters	Units
Highest voltage for equipment	3.6 - 12 kV
Power frequency test voltage, 1 min.	10 - 42 kV
Lightning impulse test voltage	40 - 75 kV
Max. rated burden, classes	25/0.2 - 75/0.5 - 150/1 VA/cl
Residual winding	50 - 200/6P VA/cl

Description

The TJC 4 single-pole insulated voltage transformers are cast in epoxy resin and designed mostly for insulation voltages of 3.6 kV to 12 kV.

If no other value is required the transformers are manufactured with a overvoltage factor of 1.9 x Un/8 hrs. One outlet of the primary winding, including the respective terminal is insulated from the earth to a level which corresponds to the rated insulation value. The transformer is mostly equipped with two secondary windings, the first one for either measuring or protection purposes, the other for being connected into an open-delta connection in a threephase system. One terminal of each secondary winding and one of the open-delta connected terminals have to be earthed during the transformer operation. When not required otherwise, the secondary windings are lead out into a casttype secondary terminal board.

The transformer can be mounted in any position. The transformers are fixed by four screws, the M8 bolted earthing clamp is located on the transformer base plate. The secondary terminal board is covered with a transparent and sealable cover made of plastic material.

Rated primary voltages

3/√3 kV; 3.3/√3 kV; 6/√3 kV; 6.6/√3 kV; 10/√3 kV; 11/√3 kV.
Other primary voltages can also be supplied on request.

Rated secondary voltages

100/√3 V; 110/√3 V – accuracy classes 0.2; 0.5; 1 (measuring winding) or 3P; 6P (protection winding).
Other secondary voltages can also be supplied on request.

Rated voltages for open-delta connection

100/3 V; 110/3 V - class 6P.
Other voltages for open-delta connection can also be supplied based on customer requirement.

Rated frequency

50 Hz; 60 Hz.

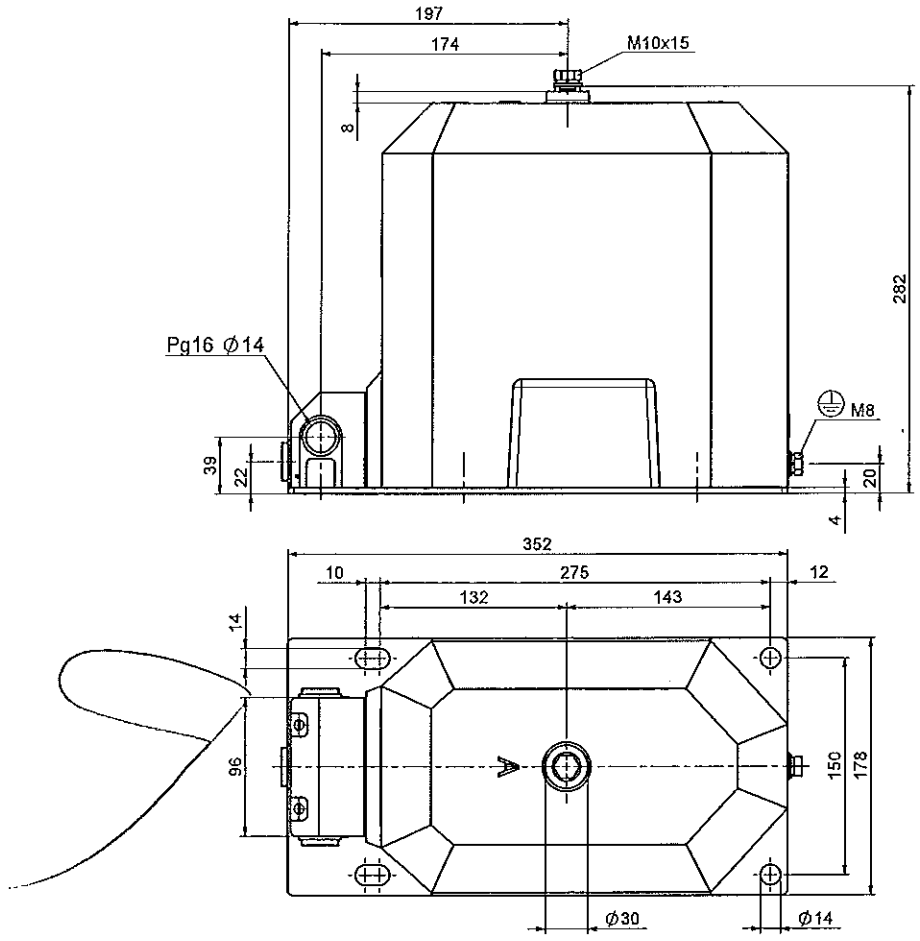
Based on a discussion with the manufacturer the transformer can also be designed for two primary voltage levels (with change over secondary side).

The transformers are manufactured conformably to the requirements and recommendations of the following standards and regulations: IEC, VDE, ANSI, BS, GOST and CSN.

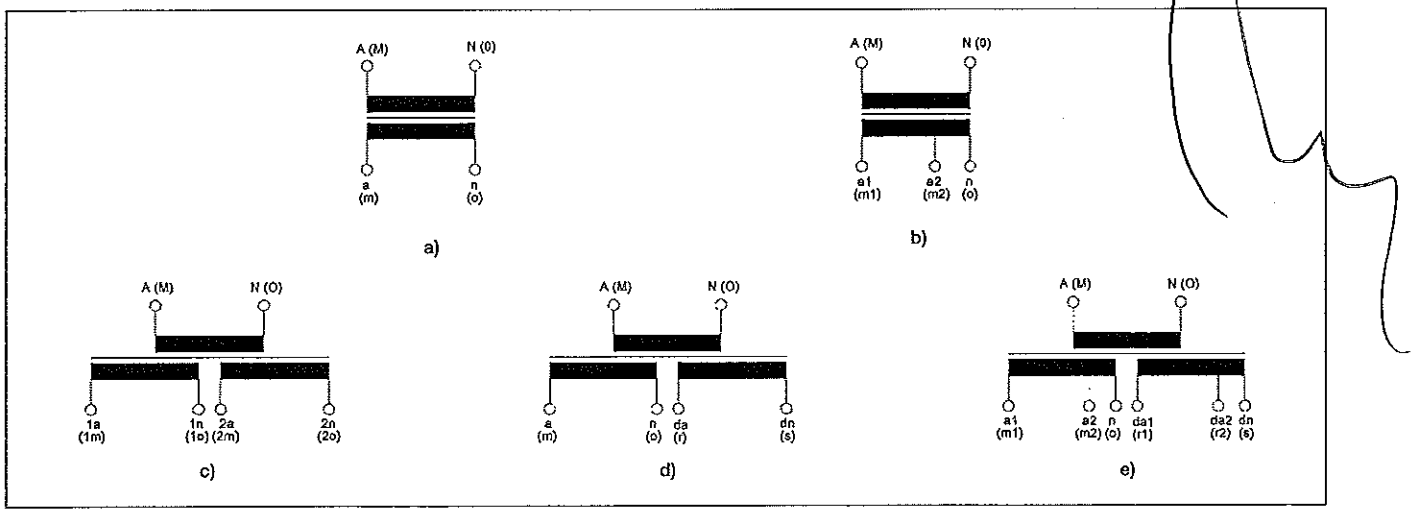
Dimensional Drawing

TJC 4

Weight: appr. 20 kg
Creepage Distance: 338 mm



Marking of the voltage transformer outlets



a) Single-pole insulated transformer | b) Single-pole insulated transformer with a tap | c) Single-pole insulated transformer with two secondary windings | d) Single-pole insulated transformer with two secondary windings, with one of which being the auxiliary (residual) winding | e) Single-pole insulated transformer with two secondary, tapped windings, with one which being the auxiliary (residual) winding.

Standard execution of the transformers

Primary voltage, [V]	Secondary voltage			Residual winding		
	voltage, [V]	accuracy	burden, [VA]	voltage, [V]	accuracy	burden, [VA]
3 000/√3	100/√3	0.2	10;15;25			
3 000/√3	100/√3	0.2	10;15;25	100/3	6P	50
3 000/√3	100/√3	0.2	10;15;25	100/3	6P	100
3 000/√3	100/√3	0.5	15;25;50			
3 000/√3	100/√3	0.5	15;25;50	100/3	6P	50
3 000/√3	100/√3	0.5	15;25;50	100/3	6P	100
3 000/√3	100/√3	1	50;75;100			
3 000/√3	100/√3	1	50;75;100	100/3	6P	50
3 000/√3	100/√3	1	50;75;100	100/3	6P	100
3 300/√3	110/√3	0.2	10;15;25			
3 300/√3	110/√3	0.2	10;15;25	110/3	6P	50
3 300/√3	110/√3	0.2	10;15;25	110/3	6P	100
3 300/√3	110/√3	0.5	15;25;50			
3 300/√3	110/√3	0.5	15;25;50	110/3	6P	50
3 300/√3	110/√3	0.5	15;25;50	110/3	6P	100
3 300/√3	110/√3	1	50;75;100			
3 300/√3	110/√3	1	50;75;100	110/3	6P	50
3 300/√3	110/√3	1	50;75;100	110/3	6P	100
6 000/√3	100/√3	0.2	10;15;25			
6 000/√3	100/√3	0.2	10;15;25	100/3	6P	50
6 000/√3	100/√3	0.2	10;15;25	100/3	6P	100
6 000/√3	100/√3	0.5	15;25;50			
6 000/√3	100/√3	0.5	15;25;50	100/3	6P	50
000/√3	100/√3	0.5	15;25;50	100/3	6P	100
6 000/√3	100/√3	1	50;75;100			
6 000/√3	100/√3	1	50;75;100	100/3	6P	50
6 000/√3	100/√3	1	50;75;100	100/3	6P	100
6 600/√3	110/√3	0.2	10;15;25			
6 600/√3	110/√3	0.2	10;15;25	110/3	6P	50
6 600/√3	110/√3	0.2	10;15;25	110/3	6P	100
6 600/√3	110/√3	0.5	15;25;50			
6 600/√3	110/√3	0.5	15;25;50	110/3	6P	50
6 600/√3	110/√3	0.5	15;25;50	110/3	6P	100
6 600/√3	110/√3	1	50;75;100			
6 600/√3	110/√3	1	50;75;100	110/3	6P	50
6 600/√3	110/√3	1	50;75;100	110/3	6P	100
10 000/√3	100/√3	0.2	10;15;25			
10 000/√3	100/√3	0.2	10;15;25	100/3	6P	50
10 000/√3	100/√3	0.2	10;15;25	100/3	6P	100
10 000/√3	110/√3	0.2	10;15;25			
10 000/√3	110/√3	0.2	10;15;25	110/3	6P	50
10 000/√3	110/√3	0.2	10;15;25	110/3	6P	100
10 000/√3	100/√3	0.5	15;25;50			
10 000/√3	100/√3	0.5	15;25;50	100/3	6P	50
10 000/√3	100/√3	0.5	15;25;50	100/3	6P	100
10 000/√3	110/√3	0.5	15;25;50			
10 000/√3	110/√3	0.5	15;25;50	110/3	6P	50
0 000/√3	110/√3	0.5	15;25;50	110/3	6P	100
10 000/√3	100/√3	1	50;75;100			
10 000/√3	100/√3	1	50;75;100	100/3	6P	50
10 000/√3	100/√3	1	50;75;100	100/3	6P	100
10 000/√3	110/√3	1	50;75;100			
10 000/√3	110/√3	1	50;75;100	110/3	6P	50
10 000/√3	110/√3	1	50;75;100	110/3	6P	100
11 000/√3	100/√3	0.2	10;15;25			
11 000/√3	100/√3	0.2	10;15;25	100/3	6P	50
11 000/√3	100/√3	0.2	10;15;25	100/3	6P	100
11 000/√3	110/√3	0.2	10;15;25			
11 000/√3	110/√3	0.2	10;15;25	110/3	6P	50
11 000/√3	110/√3	0.2	10;15;25	110/3	6P	100
11 000/√3	100/√3	0.5	15;25;50			
11 000/√3	100/√3	0.5	15;25;50	100/3	6P	50
11 000/√3	100/√3	0.5	15;25;50	100/3	6P	100
11 000/√3	110/√3	0.5	15;25;50			
11 000/√3	110/√3	0.5	15;25;50	110/3	6P	50
11 000/√3	110/√3	0.5	15;25;50	110/3	6P	100
11 000/√3	100/√3	1	50;75;100			
11 000/√3	100/√3	1	50;75;100	100/3	6P	50
11 000/√3	100/√3	1	50;75;100	100/3	6P	100
11 000/√3	110/√3	1	50;75;100			
11 000/√3	110/√3	1	50;75;100	110/3	6P	50
11 000/√3	110/√3	1	50;75;100	110/3	6P	100

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1VLC000520 Rev 2, en 2016.10.03

Power and productivity
for a better world™

Приложение 3.2 - Удостоверение за одобрен тип

РЕПУБЛИКА
БЪЛГАРИЯ

ДЪРЖАВНА АГЕНЦИЯ ЗА МЕТРОЛОГИЯ И ТЕХНИЧЕСКИ НАДЗОР
STATE AGENCY FOR METROLOGY AND TECHNICAL SURVEILLANCE

УДОСТОВЕРЕНИЕ
ЗА ОДОБРЕН ТИП СРЕДСТВО ЗА ИЗМЕРВАНЕ
Measuring Instrument Type-approval Certificate

№ 06.01.4505

Издадено на: *Issued to:*	"АВВ България" ЕООД, гр. София, ул. "Триадица" № 5
На основание на: *In Accordance with:*	чл. 32, ал. 1 от Закона за измерванията (ДВ, бр. 46 от 2002 г.)
Относно: *In Respect of:*	измервателен напрежителен трансформатор за средно напрежение тип TJC.. (TJC 4, TJC 6, TJC 7)
Производител: *Manufacturer:*	ABB EJF s.r.o., Република Чехия
Знак за одобрен тип: *Type Approval Mark:*	BG 06 4505
Технически и метрологични характеристики: *Technical and metrological characteristics:*	приложение, неразделна част от настоящото удостоверение за одобрен тип средство за измерване
Срок на валидност: *Valid until:*	05.01.2016 г.
Вписва се в регистъра на одобрените за използване типове средства за измерване под №: *Reference №:*	4505
Дата на издаване на удостоверението за одобрен тип: *Date:*	05.01.2006 г.

ПРЕДСЕДАТЕЛ:
К. Катеринов

Приложение към удостоверение за одобрен тип № 06.01.4505

Издадено на: "АВВ България" ЕООД, гр. София

Относно: измервателен напрежителен трансформатор за средно напрежение тип TJC... (TJC 4, TJC 6, TJC 7)

Описание на типа:

Еднополюсните галванически разделящи напржителни трансформатори тип TJC .... (TJC 4, TJC 6, TJC 7) са херметизирани с отливка от епоксидна смола и са проектирани за номинално ниво на изолацията както следва:

- тип TJC 4 - от 3,6/10/40 kV до 12/28/75 kV;
- тип TJC 6 - от 17,5/38/95 kV до 24(25)/ 50(55)/ 125 kV;
- тип TJC 7 - от 36/70/170 kV до 40,5/95/200 kV.

Трансформаторите се изпълняват с две втори чни намотки, първата от които служи едновременно за измерване и за релейна защита, а другата е за свързване в отворен триъгълник при трифазна система.

Вторичните намотки са изведени на клеморед от лят тип, покрит с прозрачно капаче от пластмасов материал, което може да се пломбира.

По желание на клиента могат да се изработят също и намотки за различни първични и вторични напрежения.

Възможна е също и изработка с две първични напрежения (с превключване на вторичната страна).

Трансформаторите се произвеждат с фактор на пренапрежение от 1,9x Un/8 часа.

Трансформаторът може да се монтира във всяко положение.

1.1. Технически и метрологични характристики:

Тип трансформатор	**TJC 4**	**TJC 6**	**TJC 7**
Максимално напрежение на апарата, kV	от 3,6 до 12	от 17,5 до 24(25)	от 36 до 40,5
Номинално първично напрежение , kV	3/√ 3; 3,3/√ 3; 6/√3; 6,6/√ 3; 10/√ 3; 11/√ 3	11/√ 3 ; 15/√ 3 20/√ 3 ; 22/√ 3	30/√ 3; 33/√ 3; 35/√ 3
Номинално вторично напрежение , kV	100/√ 3 ; 110/√ 3		
Номинална честота, Hz	50; 60		
Клас на точност: - измервателни намотки - защитни намотки	0,2 ; 0,5; 1 3P; 6P		
Изпитващо напрежение с промишлена честота, kV	от 10 до 28	от 38 до 50 (55)	от 70 до 95
Изпитващо импулсно напрежение, kV	от 40 до 75	от 95 до 125	от 170 до 200
Максимален номинален товар/ клас , VA/ клас - измервателни намотки	25 / 0,2 50/ 0,5 100 / 1	25 / 0,2 100 / 0,5 150 / 1	50 / 0,2 150 / 0,5 250 / 1
Максимален номинален товар/ клас , VA/ клас - нулева намотка	50-200 / 6P		

РЕПУБЛИКА БЪЛГАРИЯ
Български институт по метрология

REPUBLIC OF BULGARIA
Bulgarian Institute of Metrology

ДОПЪЛНЕНИЕ № 15.09.4505.1

КЪМ УДОСТОВЕРЕНИЕ
ЗА ОДОБРЕН ТИП СРЕДСТВО ЗА ИЗМЕРВАНЕ № 06.01.4505
Measuring Instrument Type-approval Certificate-Revision 1

Издадено на производител: *Issued to manufacturer:*	ABB S.r.o., Република Чехия
На основание на: *In Accordance with:*	чл. 30, ал.2 от Закона за измерванията
Относно: *In Respect of:*	измервателен напреженов трансформатор за средно напрежение тип TJC...(TJC4; TJC6; TJC7)
Технически и метрологични характеристики: *Technical and metrological characteristics:*	приложение, неразделна част от настоящото удостоверение за одобрен тип средство за измерване
Срок на валидност: *Valid until:*	14.09.2025 г.
Средството за измерване е вписано в регистъра на одобрените за използване типове средства за измерване под №: *Reference №:*	4505
Дата на издаване на първоначалното удостоверението за одобрен тип: *Date:*	05.01.2006 г.
Дата на издаване на допълнението към удостоверението за одобрен тип: *Date:*	14.09.2015 г.

ПРЕДСЕДАТЕЛ:
доц. д-р Димитър Станков

Издадено на производител: ABB S.r.o., Република Чехия

Относно: измервателен напреженов трансформатор за средно напрежение
тип TJC...(TJC4; TJC6; TJC7)

Описание на допълнение № 15.09.4505.1 към удостоверение за одобрен тип № 06.01.4505

Издаденото допълнение № 15.09.4505.1 към удостоверение за одобрен тип № 06.01.4505 е за удължаване на срока на валидност на одобряване на типа до 14.09.2025 година.

Приложение 3.3 - Типови изпитания

PEHLA

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN
Member of the SHORT-CIRCUIT TESTING LIAISON (STL)

Test Document

Report No.: 13051Ra Copy No.: 1 Contents: 30 Sheets

Test object: Inductive Voltage Transformer

Designation: TJC 4 10000/√3//100/√3/100/3
Rated voltage: 12 kV Rated normal current: - A Rated frequency: 50 Hz

Manufacturer: ABB s.r.o. PPMV, Brno, Czech Republic
under license of ABB Technology Ltd., Zurich, Switzerland

Tested for: ABB Technology Ltd., Zurich, Switzerland

Testing station: PEHLA-Testing Laboratory Ratingen, Germany
ABB s.r.o. Laboratory, Brno, Czech Republic
on behalf of PEHLA-Testing Laboratory Ratingen, Germany

Date of test: 15th April – 03rd June 2013

Applied test specifications:

IEC 61869-1, Ed. 1.0, 2007-10,
IEC 61869-3, Ed. 1.0, 2011-07,
According to client's requirement the power-frequency test voltage was increased to the value acc. GOST 1516.3-96

According to STL Objectives and Operating Principles PEHLA issues a Test Document following exclusively the above mentioned standards and the STL Guides wherever applicable.

Tests performed:

Routine and type test of voltage transformer. For details of individual tests see sheet 3.

Test results:

The test object passed the tests performed in accordance with the applied test specifications.

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN

Management Committee

M. Wollinger R. Hutmacher
Technical Committee

Mannheim, 14th August 2013

02PE1302

DAkkS Deutsche Akkreditierungsstelle D-PL-12072-05-01

Notes

Accreditation

The PEHLA GbR, PEHLA-Testing Laboratory Ratingen has been approved by the DAkkS (German Accreditation Body) according to EN ISO/IEC 17025 for tests in the field of high-voltage switchgear and controlgear and power engineering equipment (Registration-No. D-PL-12072-06-01).

STL-Member

PEHLA is founder member of the SHORT-CIRCUIT TESTING LIAISON (STL) which has been established in 1969. STL is a forum for the international cooperation of the testing organisations with the further full members ASTA (UK), CESI (IT), CPRI (IND), ESEF (FR), KEMA (NL), SATS (NO, SE, FI), STLNA (US, CA) and JSTC (JP). In the frame-work of EC, STL (EU) has been recognised in 1992 by EOTC as agreement group.

PEHLA-Documents

A Type Test Certificate

is issued for type tests 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. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

A Test Document

is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

A Test Report

is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients' instructions. Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the test object, and its condition after the tests.

A Test Confirmation

is issued immediately after the tests. It confirms that the tests have been conducted and is valid only until publishing the detailed results in an entire document.

Uncertainty of the measurement systems

The PEHLA - Testing Laboratories apply the PEHLA Guide No. 12 for determining the uncertainties of measurement, based on ENV 13005 (Guide to the expression of uncertainty in measurement). As long as no explicit statements are made, the uncertainties required by the relevant standards have been complied with.

Addresses

Office: PEHLA-Geschäftsstelle
Hallenweg 40
68219 Mannheim
Germany
Internet: www.pehla.com

Client: ABB AG
Kallstadter Str. 1
68309 Mannheim, Germany
as shareholder and contractor of PEHLA GbR

Testing Station: PEHLA-Testing Laboratory Ratingen
Oberhausener Str. 33
40472 Ratingen
Germany

ABB s.r.o. Laboratory
Vídeňská 117
619 00 Brno
Czech Republic
on behalf of PEHLA-Testing laboratory Ratingen, Germany

Manufacturer: ABB s.r.o.
Vídeňská 117
619 00 Brno
Czech Republic
under license of ABB Technology Ltd. Zurich, Switzerland

Tested for: ABB Technology Ltd.
Affolterstrasse 44
8050 Zurich
Switzerland

Tests performed:

Continued from sheet 1

1. a) Power-frequency voltage withstand tests on primary terminals at 42 kV (GOST value covering IEC value) for 40 s at 180 Hz combined with partial discharge measurement at 14.4 kV and 8.3 kV
   b) Power-frequency voltage withstand tests between sections and on secondary terminals at 3 kV for 1 min at 50 Hz
   c) Test for accuracy
   d) Verification of markings
   e) Lightning impulse voltage test on primary terminals at 75 kV
   f) Temperature-rise test
2. a) Short-circuit withstand capability test at rated voltage
3. a) Power-frequency voltage withstand tests on primary terminals at 42 kV (GOST value covering IEC value) for 40 s at 180 Hz combined with partial discharge measurement at 14.4 kV and 8.3 kV
   b) Power-frequency voltage withstand tests between sections and on secondary terminals at 3 kV for 1 min at 50 Hz
   c) Test for accuracy

Table of Contents

List of Test Participants
Part 1: 15th – 20th April 2013, ABB s.r.o. Laboratory Brno, Czech Republic

Representatives of Technical Committee:

Dr. Horst Günther	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Nikolaus Beierlein	PEHLA-Testing Laboratory Regensburg, Germany

Test Engineer / Test Operator:

Dr. Otakar Beneš	ABB s.r.o. Laboratory, Brno, Czech Republic
Mr. Jiří Žila	ABB s.r.o. Laboratory, Brno, Czech Republic
Mr. Petr Prikryl	ABB s.r.o. Laboratory, Brno, Czech Republic

Representatives of Client:

Mr. Josef Vyoral	ABB s.r.o. PPMV, Brno, Czech Republic

Further Participants:

-

List of Test Participants
Part 2: 14th May 2013, PEHLA Testing Laboratory Ratingen

Representatives of Technical Committee:

Dr. Thomas Ebke	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Nikolaus Beierlein	PEHLA-Testing Laboratory Regensburg, Germany

Test Engineer / Test Operator:

Mr. Matthias Kinast (Test Engineer)	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Joachim Köhler (Measurement)	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Joachim Köhler (Machine Operator)	PEHLA-Testing Laboratory Ratingen, Germany

Representatives of Client:

Mr. Josef Vyoral	ABB s.r.o. PPMV, Brno, Czech Republic
Mr. Jiří Žila	ABB s.r.o. PPMV, Brno, Czech Republic
Mr. Jan Svindrich	ABB s.r.o. PPMV, Brno, Czech Republic

Further Participants:

-

List of Test Participants
Part 3: 03rd June 2013, ABB s.r.o. Laboratory Brno, Czech Republic

Representatives of Technical Committee:

Dr. Horst Günther	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Nikolaus Beierlein	PEHLA-Testing Laboratory Regensburg, Germany

Test Engineer / Test Operator:

Dr. Otakar Beneš	ABB s.r.o. Laboratory, Brno, Czech Republic
Mr. Jiří Žila	ABB s.r.o. Laboratory, Brno, Czech Republic
Mr. Petr Prikryl	ABB s.r.o. Laboratory, Brno, Czech Republic

Representatives of Client:

Mr. Josef Vyoral	ABB s.r.o. PPMV, Brno, Czech Republic

Further Participants:

-

Technical Data of Test Object
Inductive Voltage Transformer

Test object:	Inductive Voltage Transformer
Designation:	TJC 4 10000/√3//100/√3/100/3
Manufacturer:	ABB s.r.o., PPMV, Brno, Czech Republic
Serial No.:	1VLT5213004567
Year of manufacture:	2013
Drawing No.:	1VL3420070A

Ratings assigned by the manufacturer:

Highest voltage for equipment	12 kV
Rated primary voltage	10000/√3 V
Rated secondary voltage	100/√3 / 100/3 V
Rated burden	25 / 100 VA
Ratio	10000/√3 // 100/√3 / 100/3 V
Accuracy class	0.2 / 3P
Insulation class	E
Rated frequency	50 Hz
Power-frequency test voltage	28 (GOST 42) kV
Lightning-impulse test voltage	75 kV
Voltage factor for 8 h	1.9
Temperature category	-5 / 40
Dimensions [mm]	338 x 148 x 221
Mass	20 kg

Further data:
Thermal limiting output for windings designated as "a-n" is 400 VA

Essential characteristics:
Single pole transformer

List of Identified Drawings

The manufacturer has submitted to the testing laboratory drawings and other data containing sufficient information to unambiguously identify by type the essential details and parts of the test object presented for test.
The drawings have been stamped and signed by the manufacturer in order to guarantee that the drawings or data schedules truly represent the test object to be tested.
Further these drawings have been stamped and signed by PEHLA representatives and are kept

☐ at the client.

☒ with the test documents at the test laboratory.

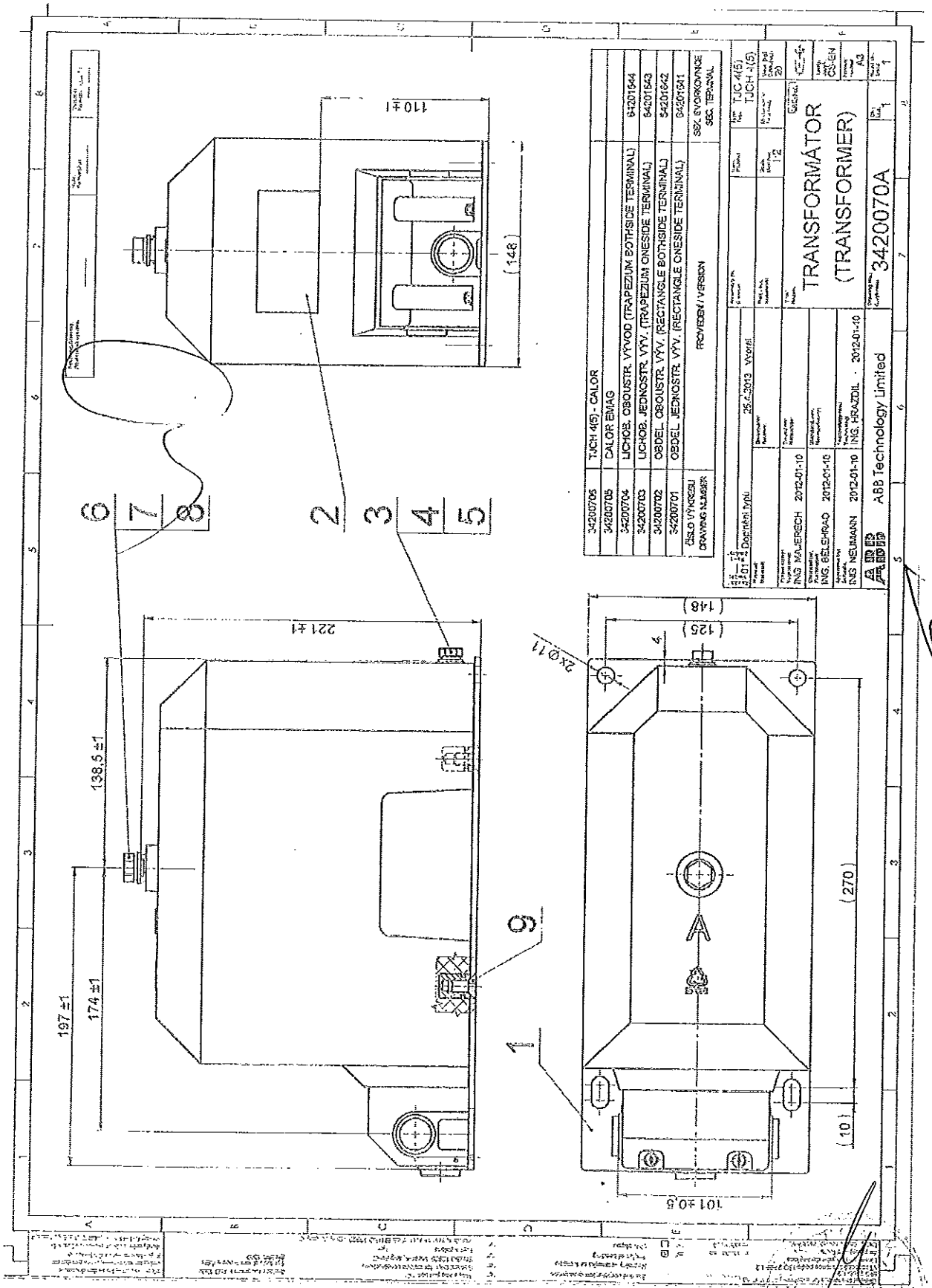
The testing laboratory has checked that drawings and data schedules adequately represent the essential details and parts of the test object to be tested, but is not responsible for the accuracy of the detailed information.
The drawing(s) contained in this document are identical with the checked, stamped and signed drawings.

Drawing No.	Rev.	P/D *)	Title	Additional remarks
1VL3420070A	001	D	Transformer TJC 4	Included in test report
BoM TJC 4	--	P	TJC 4 assembly	-
14200301	002	D	Casting	-
1420035A	001	D	Internal parts	-
1VL3420188A-0189A	001	P/D	C – core	-
1VL3420198A	-	P/D	Terminal board	-

*) P: Parts list, D: Drawing

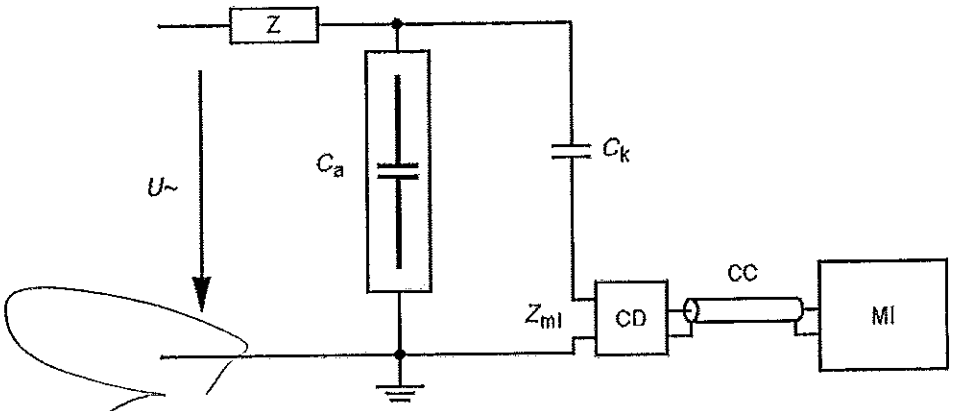
Remarks: -

Drawing No.
1VL3420070A



Technical Data of Test Circuit

Power-Frequency Voltage Withstand Tests on Primary Terminals and Partial Discharge Measurement



Technical Data:

High voltage supply:

Frequency Inverter, Type SL 11000-3, ZSE Praha, serial No. 3400497

Motor frequency: Selectable range up to 220 Hz

U ~ High Voltage Test Transformer type T100, HIGH VOLT Prüftechnik Dresden GmbH serial No. 885168

Primary voltage	230	V
Rated voltage	100	kV
Rated power	6.6	kVA

100 kV Alternating Voltage Measuring system WGBS 11/100-135, HIGH VOLT Prüftechnik Dresden GmbH, serial No. 884900, consisting of:

100 kV voltage measuring capacitor, type CDCT 0615B12, serial No.0521589-10001

Low voltage measuring part, Type MC 20-4, serial No. 885172

Peak voltmeter, type MU 18, serial No. 885173

C_a	Test object
Z	Filter 40 mH
Z_{mi}	Input impedance of measuring system 50 Ω
CC	Connecting coaxial cable, type L34/10 (50 Ω, length 10 m)
C_k	Coupling capacitor 100 kV / 1nF
CD	Coupling device
MI	Measuring instrument system

Tolerances: According to the IEC 60060-2 cl. 7.1.1 the limits of the measurement uncertainly amount are 3% for the $U_{peak} / \sqrt{2}$

Test Procedure

Power-Frequency Voltage Withstand Tests on Primary Terminals and Partial Discharge Measurement

The power-frequency withstand test on primary terminal and the partial discharge measurement were performed before and after lightning impulse voltage test, temperature-rise test and the short circuit withstand capability test (type tests).

The PD measurements were performed in accordance with IEC61869-1, Ed. 1.0, 2007-10 clause 7.3.2.2 procedure A and IEC61869-3, Ed. 1.0, 2011-07 clause 7.3.2. Procedure A means the partial discharge test voltages are reched while decreasing the voltage after the power-frequency withstand test. The corresponding partial discharge levels are measured in a time within 30 s.

The test frequency of the test voltage is increased above the rated value. Therefore the duration at the power-frequency withstand test was reduced acc. IEC61869-3 cl. 7.3.1.303.1.

Calibration:
Before starting the PD measurements the PD test circuit was calibrated in the actual test arrangement.

PD test procedure:
After the power-frequency voltage was applied the voltage is decreased without interruption to 1.2 U_m and the PD level is measured in a time of 30 s. After that the voltage is decreased without interruption furthermore to 1.2 $U_m/\sqrt{3}$ and the PD level is measured in a time of 30 s.

The partial discharge inception voltage and the partial discharge extinction voltage were recorded.

Criteria to pass the test:
The maximum permissible partial discharge quantities are specified IEC61869-1, Ed. 1.0, 2007-10 clause 5.3.3.1 as follows:

at 1.2 x U_m / PD ≤ 50 pC
at 1.2/√3 x U_m / PD ≤ 20 pC

The measured PD values before lightning impulse withstand voltage test, temperature-rise test and the short circuit withstand capability test are given in the table on sheet 13.
The measured PD values after lightning impulse withstand voltage test, temperature-rise test and the short circuit withstand capability test are given in the table on sheet 25.

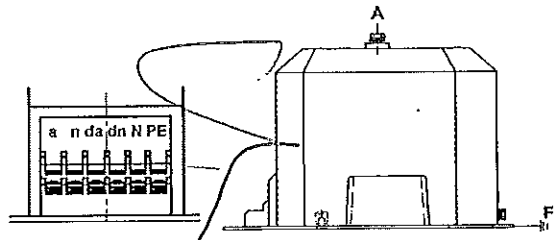
Test Results

Power-Frequency Voltage Withstand Tests on Primary Terminals and Partial Discharge Measurement

Test performed:	Power-frequency voltage withstand test on primary terminals and partial discharge measurement
Date of test:	15th April 2013
Condition of test object:	Factory new
Test specification:	IEC61869-3, Ed. 1.0, 2011-07 clause 7.3.1 and 7.3.2
Test frequency:	180 Hz

Temperature ϑ: 23.9 °C Humidity f: 32.3 % Pressure p: 998 hPa
The atmospheric correction factor was not applied.

Test Arrangement:



Legend:

A	spherical conductor upon the transformer terminal "A"
F	earthed ground-plate
a, n, da, dn, N, PE	contacts secondary winding board

Power-frequency voltage test:

Test arrangement		Test Voltage	Result
Voltage applied to	Earthed	Power frequency voltage in kV	Test duration / disruptive discharges
A	n, dn, N, PE, F	42[1)]	40 s / 0

Partial discharge measurement:

Pre-stress: 42[1)] kV for 40 s

Test arrangement		Result			
Voltage applied to	Earthed	U_i PD inception in kV	U_e PD extinction in kV	Test voltage for 30 s	
				14.4 kV	8.3 kV
				Partial discharge in pC	
A	n, dn, N, PE, F	21	18	0.6	0.5

Remarks: [1)] According to client's requirement the power frequency test voltage was increased to 42 kV (value acc. GOST 1516.3-96). The GOST values covering the IEC values.

Result: The power-frequency voltage withstand test was passed successfully.
The partial discharge test was passed successfully.
The criteria to pass the test are met.

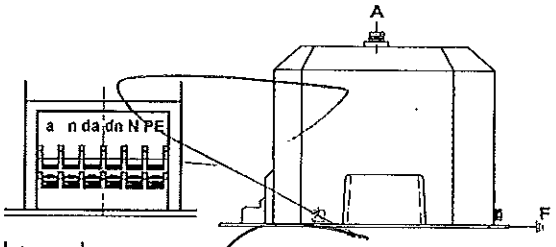
Test Results

Power-Frequency Voltage Withstand Tests between Sections and on Secondary Terminals

Test performed:	Power-frequency voltage test between sections and on secondary terminals
Date of test:	15th April 2013
Condition of test object:	Pre-stressed by power-frequency voltage tests on primary terminals
Test specification:	IEC61869-1, Ed. 1.0, 2007-10 clause 7.3.3 and 7.3.4
Test frequency:	50 Hz

Temperature ϑ: 23.9 °C Humidity f: 32.3 % Pressure p: 998 hPa
The atmospheric correction factor was not applied.

Test Arrangement:



Legend:

A	spherical conductor upon the transformer terminal "A"
F	earthed ground-plate
a, n, da, dn, N, PE	contacts secondary winding board

Test arrangement		Test Voltage	Result
Voltage applied to	Earthed	Power frequency voltage kV	Test duration in min / disruptive discharges
a, n	da, dn, N, PE, F	3	1 min / 0
da, dn	a, n, N, PE, F	3	1 min / 0
N	a, n, da, dn, F	3	1 min / 0

Result: The power-frequency voltage test between sections and on secondary terminals was passed successfully.

Test Equipment:

Manufacturer:	HCK Essen
Type:	WP-500-4
Serial-No.:	G170-9402002
Rated Voltage:	0 - 4 kV
Ident-No.:	ELK-000807/806/805

Test Results
Accuracy Test before Type Tests

Test performed: Accuracy test as routine test
Date of test: 16th April 2013
Condition of test object: Pre-stressed by power-frequency voltage tests
Test specification: IEC61869-3, Ed. 1.0, 2011-07 clause 7.3.5
Ambient air temperature: 21.7 °C
Humidity: 24.2 %

secondary winding a - n

accuracy class		0.2					
voltage	%	120	100	80	120	100	80
burden	VA	25			6.25		
rated burden / burden		1			4		
power factor cosφ		0.8			0.8		
limited voltage error F	%	± 0.2					
limited phase displacement δ	min	± 10					
voltage error F	%	-0.199	-0.198	-0.200	0.074	0.076	0.074
phase displacement δ	min	-0.63	-0.82	-0.89	0.26	0.14	0.04

secondary winding da - dn

accuracy class		3P					
voltage	%	190	100	5	190	100	5
burden	VA	100			25		
rated burden / burden		1			4		
power factor cosφ		0.8			0.8		
limited voltage error F	%	± 3.0					
limited phase displacement δ	min	± 60					
voltage error F	%	-1.952	-1.938	-2.150	-0.236	-0.224	-0.447
phase displacement δ	min	34.2	32.1	39.7	12.6	10.4	19.0

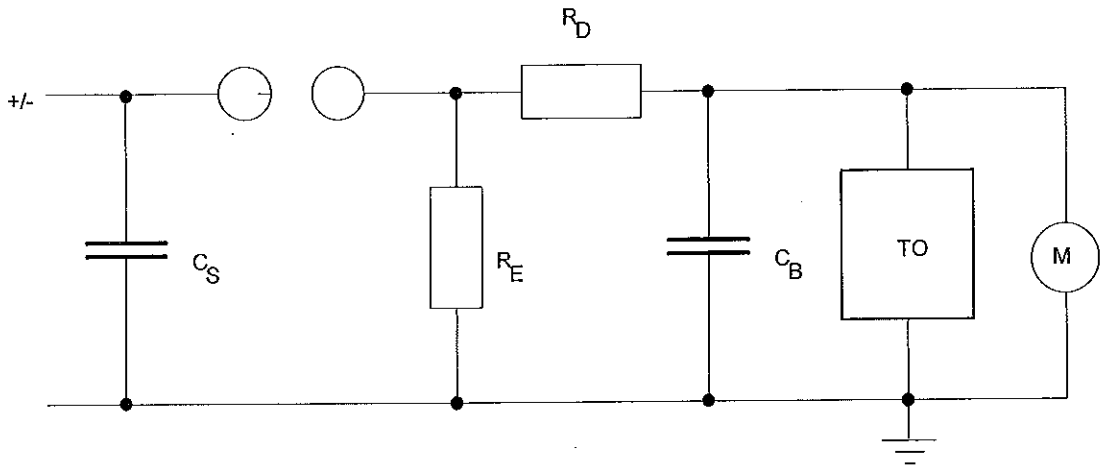
Result: The accuracy test was passed successfully.

Test Results
Verification of Markings

Test performed:	Verification of markings
Date of test:	16th April 2013
Condition of test object:	Pre-stressed by power-frequency voltage tests and accuracy test
Test specification:	IEC61869-1, Ed. 1.0, 2007-10 clause 7.3.6

Result: The terminal markings of the test object are verified to be correct in accordance with the requirements of the applied test specifications (IEC 61869-1, clause 6.13).

Technical Data of Test Circuit
Lightning Impulse Voltage Test on Primary Terminals



Technical Data:

Maximum Charging Voltage	U_Σ	=	400	kV
Number of Stages	n	=	4	
Surge Capacity per Stage	C_S	=	1000	nF
Load Capacitance	C_B	=	2000	pF
Damping Resistance	R_D	=	R_{SI}	
Internal Front Resistance per Stage	R_{SI}	=	43	Ω
Discharge Resistance	R_E	=	4	R_P
Tail Resistance per Stage	R_P	=	66	Ω

TO - Test Object

M - Voltage Measurement

Measurement:

Measuring Divider Type SMC 2000/400 (Serial-No. 885217)

Measuring Cable, Length L35/25 (50 Ω, length 25 m)

Impulse Voltage Measuring System, 25 MHz Digital Recorder, Type TR-AS 25-8 (Serial-No. 247)

Tolerances:

According IEC60060-1 Edition 3.0 2010-09 clause 7.2.2

Test voltage value	± 3	%
Front time T_1	± 30	%
Time to half-value T_2	± 20	%

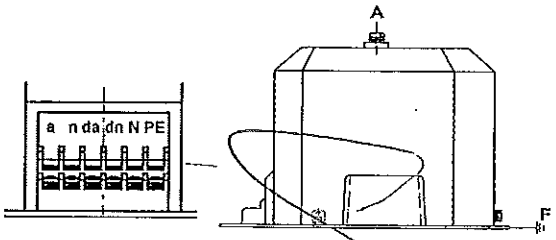
Test Results
Lightning Impulse Voltage Test on Primary Terminals

Test performed: Lightning impulse voltage test
Date of test: 17th April 2013
Condition of test object: Pre-stressed by routine tests
Test specification: IEC61869-3, Ed. 1.0, 2011-07 clause 7.2.3

Temperature ϑ: 23.3 °C Humidity f: 35.2 % Pressure p: 995 hPa
According to IEC61869-1 cl. 7.2.3.2.1 no correction for atmospheric conditions.

Front time T_1: 1.19 – 1.22 µs Time to half-value T_2: 51.0 – 51.7 µs

Test Arrangement:



Legend:
A spherical conductor upon the transformer terminal "A"
F earthed ground-plate
a, n, da, dn, N, PE contacts secondary winding board

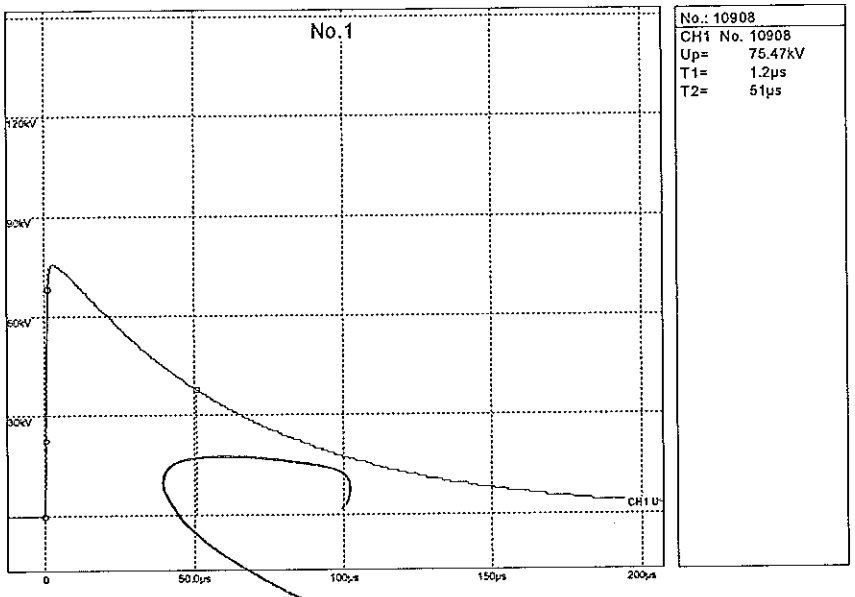
Test arrangement		Test Voltage	Result
Voltage applied to	Earthed	Lightning impulse voltage kV	number of impulses / disruptive discharges
A	n, dn, N, PE, F	+ 75	15 / 0
		- 75	15 / 0

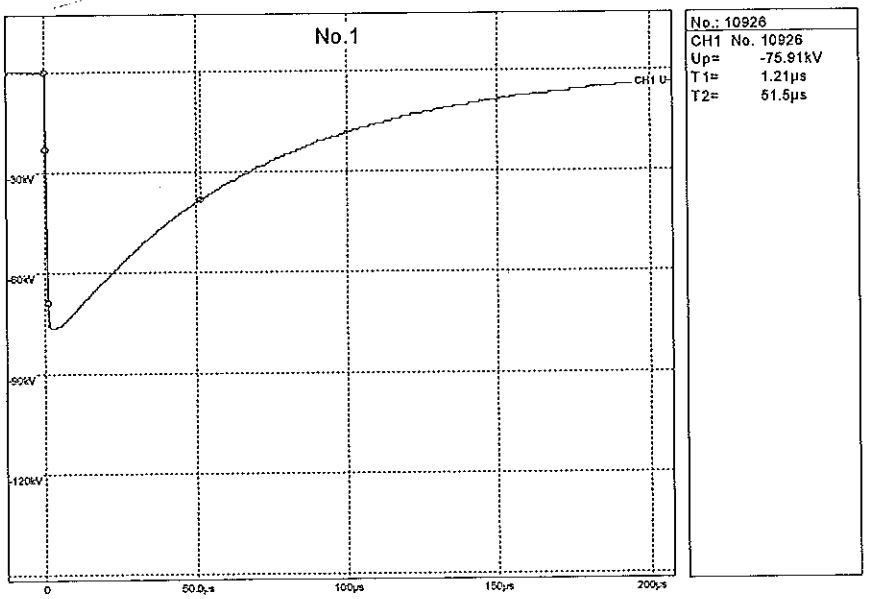
Result: The lightning impulse voltage test was passed successfully.

Test Results

Lightning Impulse Voltage Test on Primary Terminals - Voltage Curves

Example





Test Results
Temperature-Rise Test

Test performed: Temperature-rise test of voltage transformer with voltage factor
Date of test: 18th – 20th April 2013
Condition of test object: Pre-stressed by routine tests and lightning impulse voltage test
Test specification: IEC61869-3, Ed. 1.0, 2011-07 clause 7.2.2
Duration of test: see below
Ambient air temperature: see below °C
Test frequency: 50 Hz

$$\Theta = \frac{R_{end} - R_{start}}{R_{start}} \times (235°C + \vartheta_{astart}) - (\vartheta_{aendt} - \vartheta_{astart})$$

Θ	calculated temperature rise
R_{start}	resistance start of test - cold condition
R_{end}	resistance end of test - reaching a stable temperature
ϑ_{astart}	ambient temperature start test
ϑ_{aend}	ambient temperature end of test

rated voltage	kV	10/√3	5.77		
			voltage factor		thermal limiting output
		start of test	1.2	1.9	
test voltage	kV		6.93	10.97	5.77
date of measurement		18.04.13	19.04.13	19.04.13	20.04.13
time		16:30	9:00	17:00	8:45
duration of test	h		16:30	08:00	15:45
ambient temperature θ_1	°C	23.8			
ambient temperature θ_2	°C		25.0	24.8	24.8
factor for Cu bar	234.5				

primary winding A - N

resistance R_1	kΩ	1.810			
resistance R_2	kΩ		1.885	1.976	1.993
temperature rise at time t	K		9.5	22.7	25.1
limited temperature rise	K		75	85	75

secondary winding a - n

burden at test	VA		25	25	400
resistance R_1	Ω	0.185			
resistance R_2	Ω		0.190	0.206	0.206
temperature rise at time t	K		5.8	28.3	28.3
limited temperature rise	K		75	85	75

secondary winding da - dn

burden at test	VA		100	100	0
resistance R_1	Ω	0.198			
resistance R_2	Ω		0.212	0.219	0.22
temperature rise at time t	K		17.1	26.4	27.7
limited temperature rise	K		75	85	75

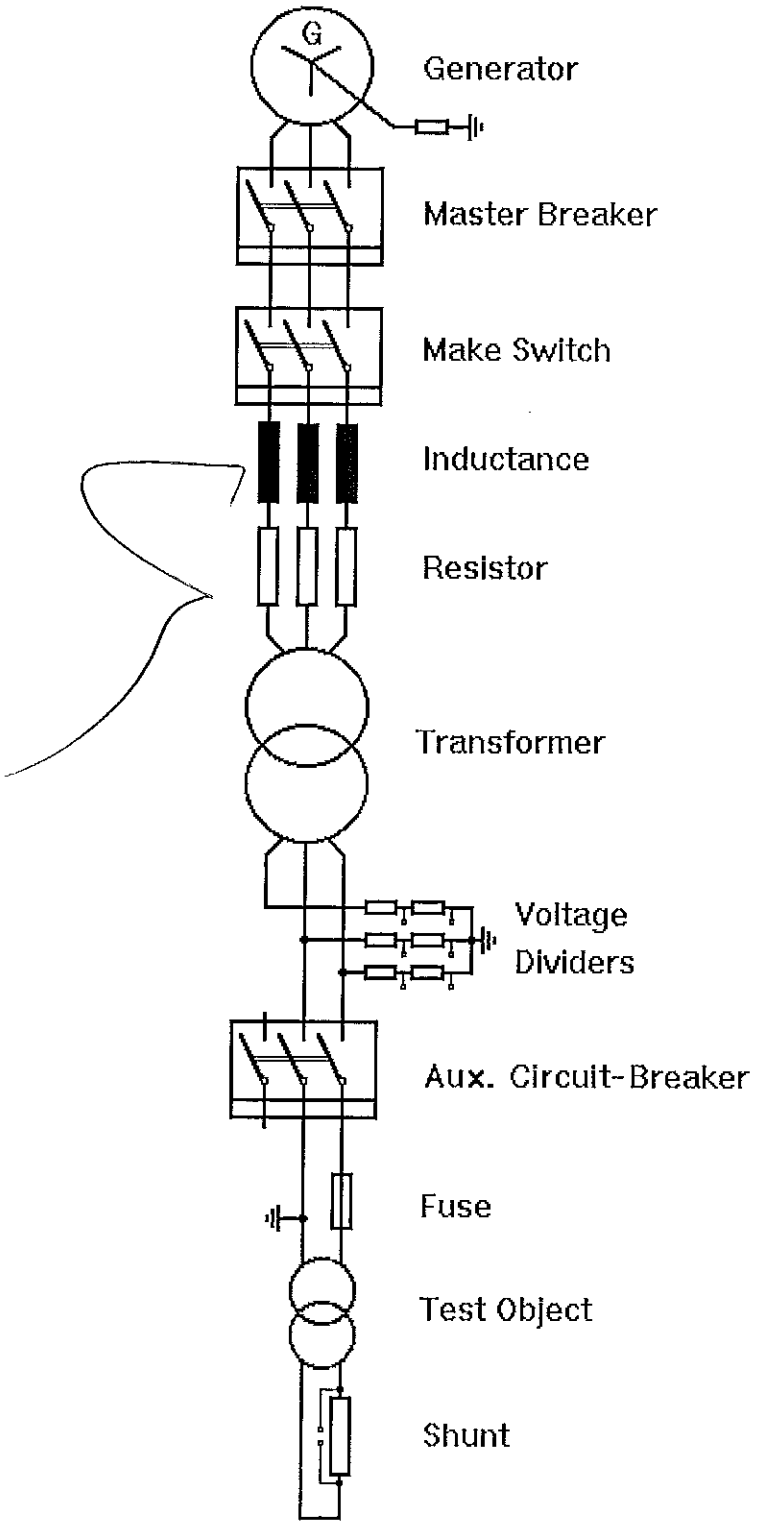
Result: The temperature-rise test was passed successfully.

Technical Data of Test Circuit
Short-Circuit Withstand Capability Test

Test performed		Short-Circuit Withstand Capability Test	-
Test circuit			
Circuit diagram	Sheet No.	22	-
Current circuit			
Number of phases		2	-
Power frequency	Hz	50	-
Power factor		< 0.15	-
Earthing conditions			
Generator / System		earthed via 5 kΩ	-
Transformer		not earthed	-
Short-circuit point		-	-
Test object		earthed	-
Test object (test values)			
Number of phases		1	-
Measurement			
Voltage measurement		Voltage Divider	-
Current measurement		Shunt 1 mΩ	-

Remarks: -

Circuit Diagram
Short-Circuit Withstand Capability Test



Test Results
Short-Circuit Withstand Capability Test

Test performed: Short-Circuit Withstand Capability Test
Date of test: 14th May 2013
Condition of test object before test: Pre-stressed by routine tests, lightning impulse voltage test and temperature-rise test

Test arrangement: Direct test circuit
Connections to test object: Phases L1 and L2 of the test plant connected to the voltage transformer via cable. Phase L1 of the test plant fused. Phase L2 of the test plant earthed via cable. Secondary terminals short-circuited via cable and measurement shunt

Voltage applied to terminal		A	A
Terminal earthed		N	N
Short-circuited at terminals		a-n	da-dn
Open terminals		da-dn	a-n
Voltage applied	kV	5.85	5.86
Current between short-circuited terminals	A	113	116
Test duration	s	1.04	1.04
Diameter of secondary winding [1]	mm	2.00	1.60
Current density	A/mm²	35.9	57.5
Emission of flame/gas/oil		no	no
Test result (P/N)		P	P

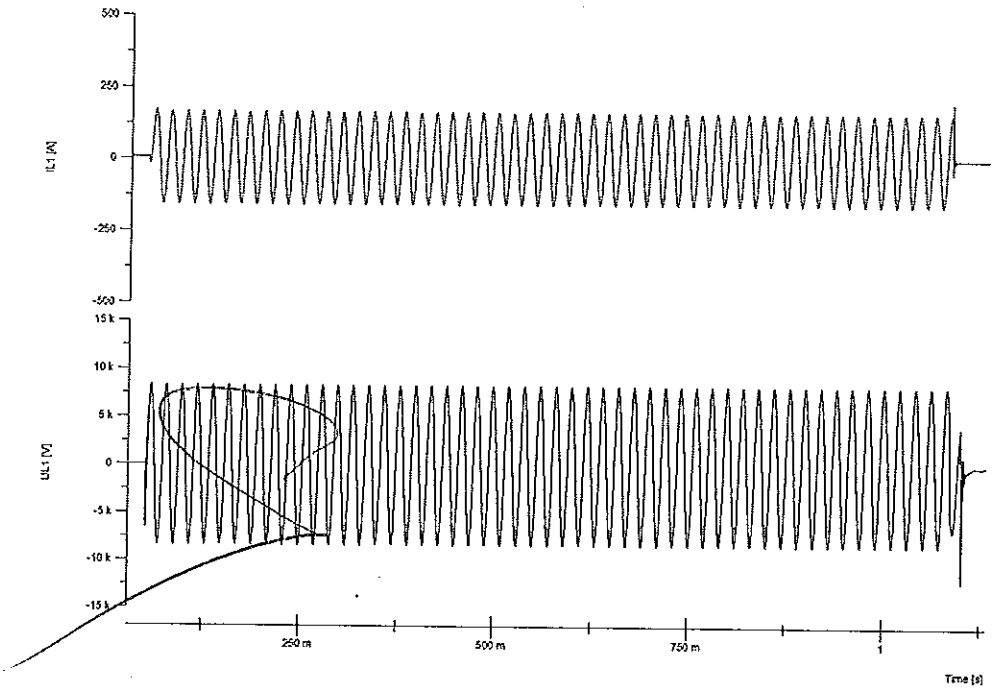
Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard

Remarks: [1] Value taken from the technical documentation supplied by the manufacturer

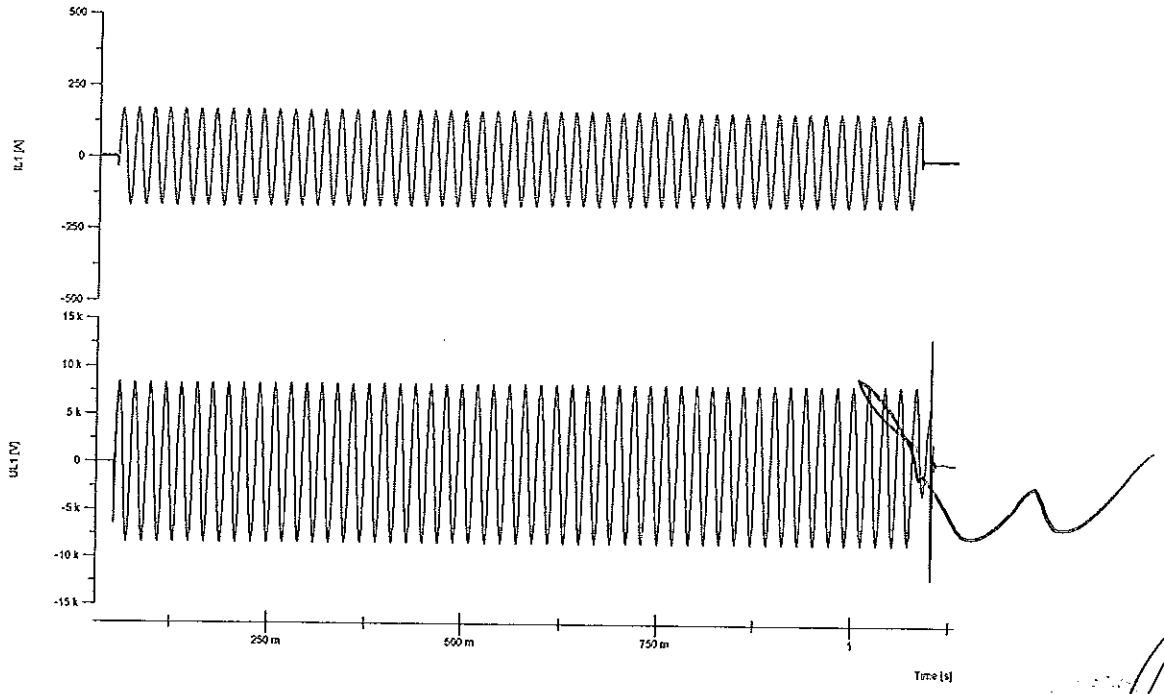
Condition of test object after test:
- The voltage transformer is not visibly damaged.
- Examination of the insulation next to the windings is not applicable, current density below 180 A/mm²
- Dielectric tests and Determination of errors as documented on the following sheets.

Oscillograms
Short-Circuit Withstand Capability Test

Voltage applied: A, earthed: N, short-circuited: a-n, open: da-dn



Voltage applied: A, earthed: N, short-circuited: da-dn, open: a-n



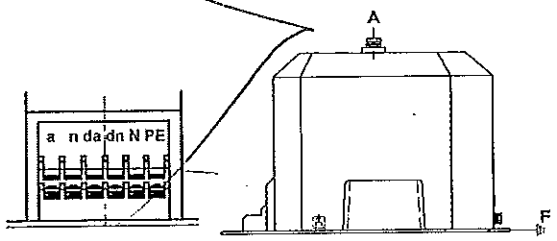
Test Results

Power-Frequency Voltage Withstand Tests on Primary Terminals and Partial Discharge Measurement after Type Tests

Test performed:	Power-frequency voltage withstand test on primary terminals combined with partial discharge measurement
Date of test:	03rd June 2013
Condition of test object:	Pre-stressed by routine and type tests
Test specification:	IEC61869-3, Ed. 1.0, 2011-07 clause 7.3.1 and 7.3.2
Test frequency:	180 Hz

Temperature ϑ: 21.5 °C Humidity f: 49.1 % Pressure p: 991 hPa
The atmospheric correction factor was not applied.

Test Arrangement:



Legend:

A	spherical conductor upon the transformer terminal "A"
F	earthed ground-plate
a, n, da, dn, N, PE	contacts secondary winding board

Power-frequency voltage test:

Test arrangement		Test Voltage	Result
Voltage applied to	Earthed	Power frequency voltage in kV	Test duration / disruptive discharges
A	n, dn, N, PE, F	42[1)]	40 s / 0

Partial discharge measurement:

Pre-stress: 42[1)] kV for 40 s

Test arrangement		Result			
Voltage applied to	Earthed	U_i PD inception in kV	U_e PD extinction in kV	Test voltage for 30 s	
				14.4 kV	8.3 kV
				Partial discharge in pC	
A	n, dn, N, PE, F	26	20	0.6	0.6

Remarks: [1)] According to client's requirement the power frequency test voltage was increased to 42 kV (value acc. GOST 1516.3-96). The GOST values covering the IEC values

Result: The power-frequency voltage withstand test was passed successfully.
The partial discharge test was passed successfully.
The criteria to pass the test are met.

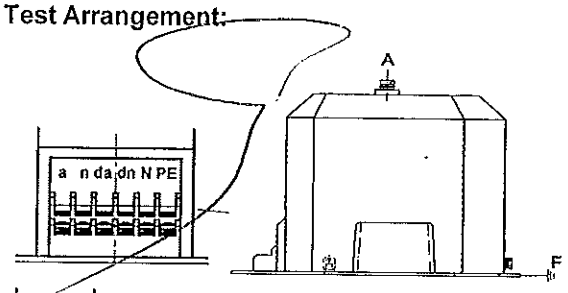
Test Results

Power-Frequency Voltage Withstand Tests between Sections and on Secondary Terminals after Type Tests

Test performed:	Power-frequency voltage withstand test between sections and on secondary terminals
Date of test:	03rd June 2013
Condition of test object:	Pre-stressed by routine and type tests
Test specification:	IEC61869-1, Ed. 1.0, 2007-10 clause 7.3.3 and 7.3.4
Test frequency:	50 Hz

Temperature ϑ: 21.5 °C Humidity f: 49.1 % Pressure p: 991 hPa
The atmospheric correction factor was not applied.

Test Arrangement:



Legend:

A	spherical conductor upon the transformer terminal "A"
F	earthed ground-plate
a, n, da, dn, N, PE	contacts secondary winding board

Test arrangement		Test Voltage	Result
Voltage applied to	Earthed	Power frequency voltage kV	Test duration in min / disruptive discharges
a, n	da, dn, N, PE, F	3	1 min / 0
da, dn	a, n, N, PE, F	3	1 min / 0
N	a, n, da, dn, F	3	1 min / 0

Result: The power-frequency voltage withstand test between sections and on secondary terminals was passed successfully.

Test Equipment:

Manufacturer:	HCK Essen
Type:	WP-500-4
Serial-No.:	G170-9402002
Rated Voltage:	0 - 4 kV
Ident-No.:	ELK-000807/806/805

Test Results
Accuracy Test after Type Tests

Test performed: Accuracy test as type test
Date of test: 03rd June 2013
Condition of test object: Pre-stressed by routine and type tests
Test specification: IEC61869-3, Ed. 1.0, 2011-07 clause 7.2.6
Ambient air temperature: 21.5 °C
Humidity: 49.1 %

secondary winding a - n

accuracy class		0.2					
voltage	%	120	100	80	120	100	80
burden	VA	25			6,25		
rated burden / burden		1			4		
power factor cosφ		0.8			0.8		
limited voltage error F	%	± 0.2					
limited phase displacement δ	min	± 10					
voltage error F	%	-0.186	-0.184	-0.186	0.086	0.088	0.089
phase displacement δ	min	-0.86	-1.08	-1.20	0.04	-0.08	-0.19

secondary winding da - dn

accuracy class		3P					
voltage	%	190	100	5	190	100	5
burden	VA	100			25		
rated burden / burden		1			4		
power factor cosφ		0.8			0.8		
limited voltage error F	%	± 3.0					
limited phase displacement δ	min	± 60					
voltage error F	%	-1.86	-1.84	-1.99	-0.204	-0.190	-0.328
phase displacement δ	min	31.7	29.7	35.7	11.7	9.43	14.8

Result: The accuracy test was passed successfully.

Photos of Test Object

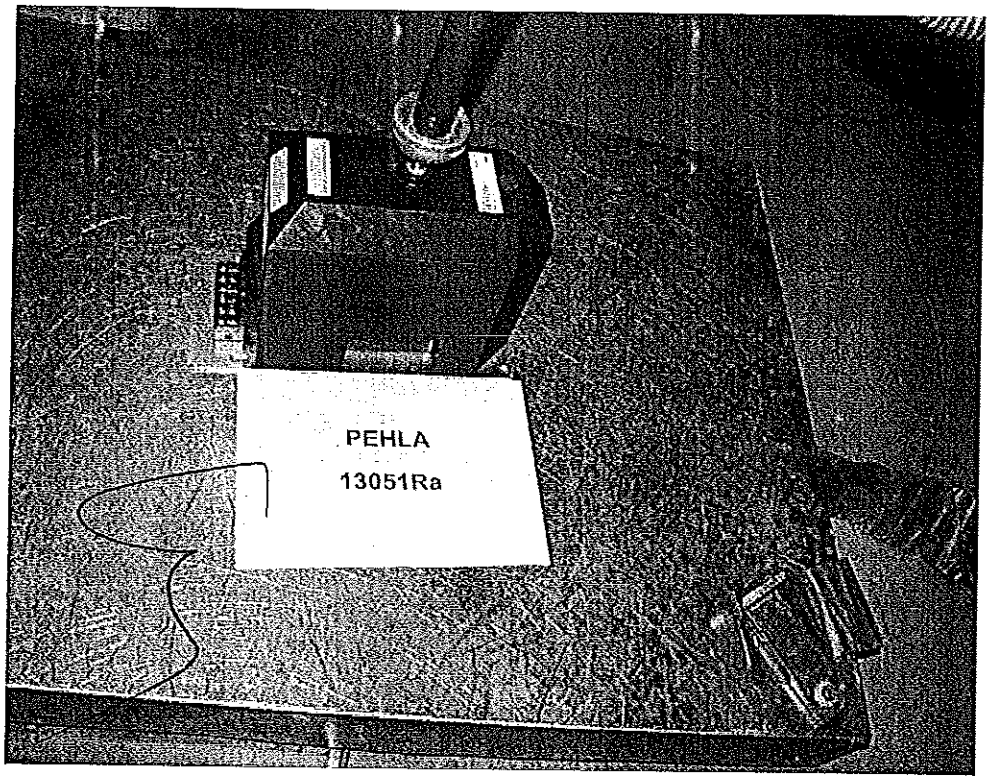


Fig. 1: Power-frequency voltage at primary terminal and PD test

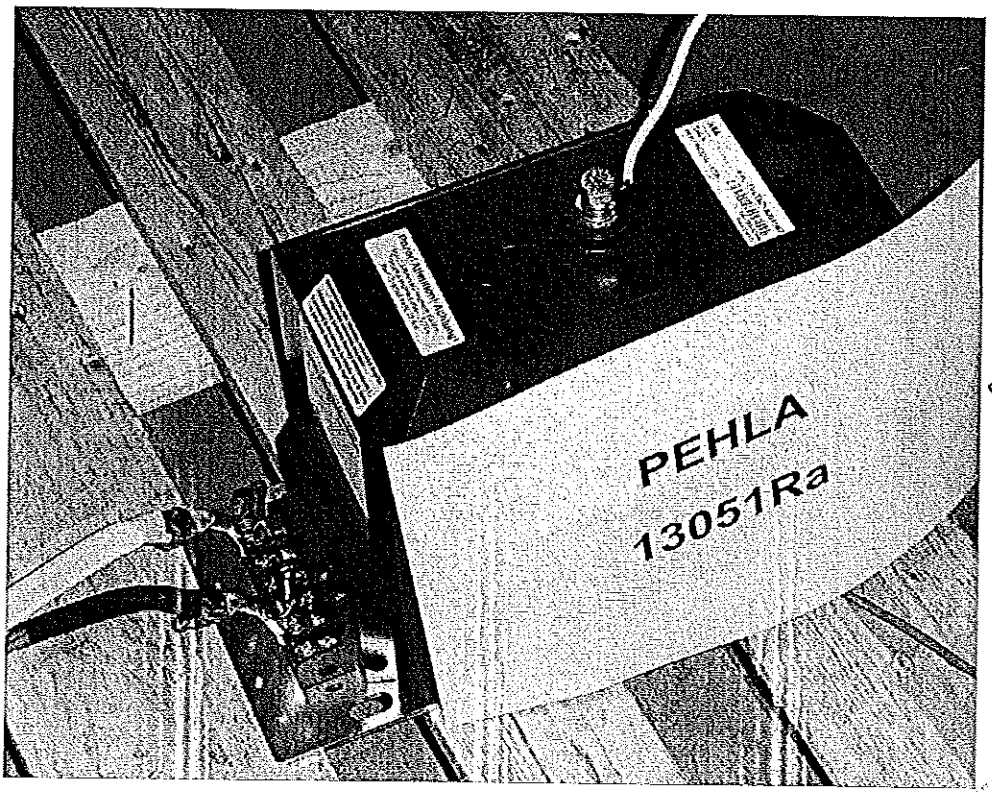


Fig. 2: Accuracy test

Photos of Test Object

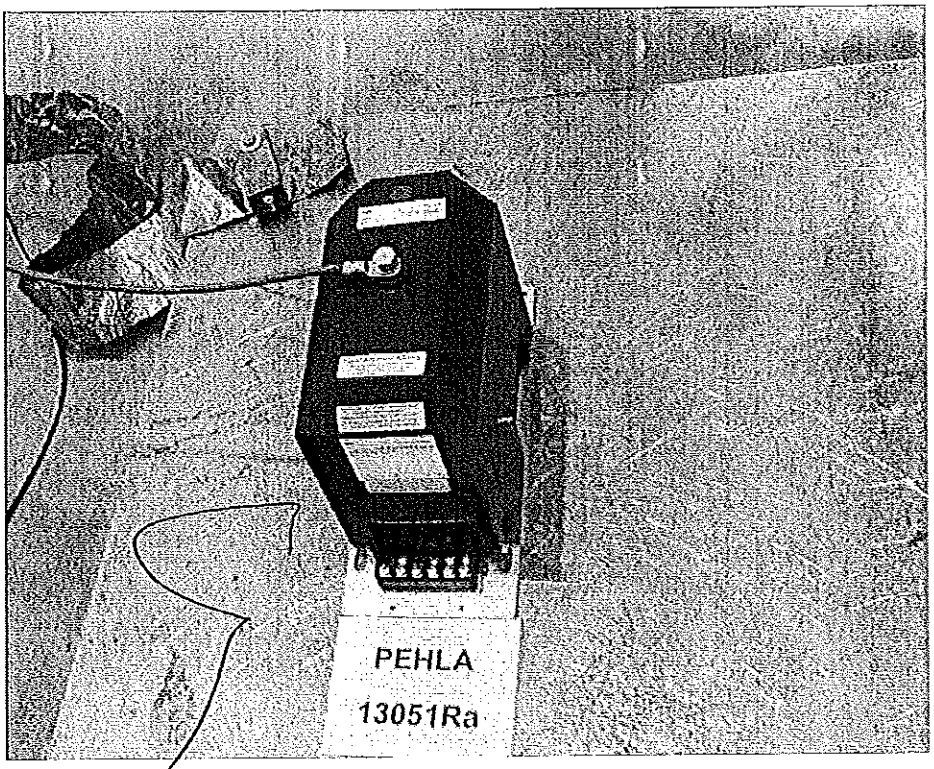


Fig. 3: Lightning impulse voltage test

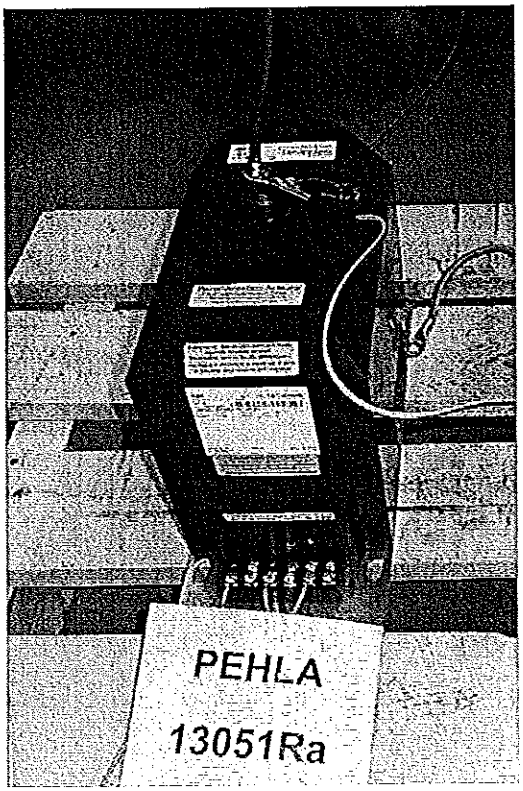


Fig. 4: Temperature-rise test

Photos of Test Object

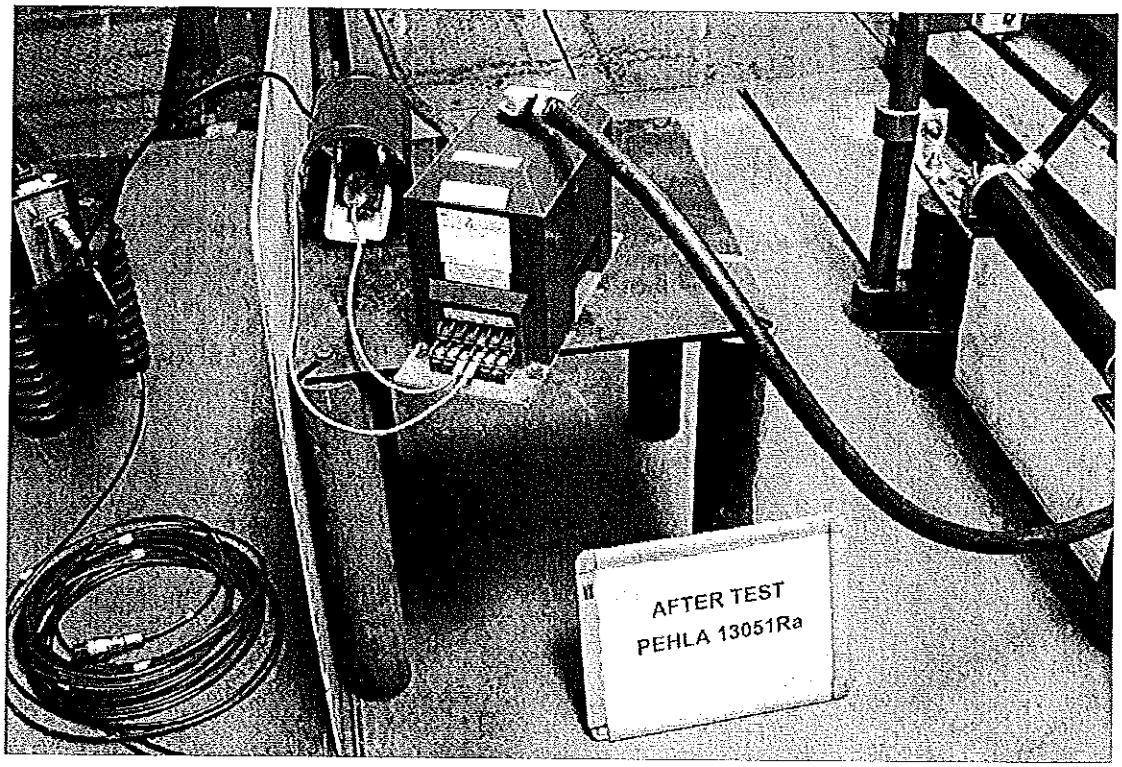


Fig. 5: Short-circuit withstand capability test

Приложение 3.4 - Акредитация

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH
German Accreditation Body

Entrusted according to Section 8 subsection1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of
EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH (German Accreditation Body) attests that the testing laboratory

PEHLA GbR
PEHLA-Prüffeld Ratingen
Oberhausener Straße 33, 40472 Ratingen

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields:

High-Voltage Switchgear and Controlgear,
Low-Voltage Switchgear and Controlgear Assemblies,
Current and Voltage Transformers,
Power transformers and Busbar Systems

The accreditation certificate shall only apply in connection with the notice of accreditation of 2012-05-09 with the accreditation number D-PL-12072-06 and is valid until 2017-05-08. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 5 pages.

Registration number of the certificate: **D-PL-12072-06-01**

Frankfurt am Main, 2012-05-09

Dipl.-Ing. (FH) Ralf Egner
Head of Division 2

This document is a translation. The definitive version is the original German accreditation certificate.

See notes overleaf.

1014

Deutsche Akkreditierungsstelle GmbH

Office Berlin
Spittelmarkt 10
10117 Berlin

Office Frankfurt am Main
Gartenstraße 6
60594 Frankfurt am Main

Office Braunschweig
Bundesallee 100
38116 Braunschweig

The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.

The up-to-date state of membership can be retrieved from the following websites:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

Д Е К Л А Р А Ц И Я

за конфиденциалност и извършен оглед на обект по предмета на поръчката

Долуподписаният Георги Николов Табаков в качеството ми на представляващ „Електролукс Табаков и синове“ ООД,участник в процедура за възлагане на обществена поръчка с реф. № PPD 17 – 052 и предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика“,

Д Е К Л А Р И Р А М, Ч Е :

1/ Представител на участника, когото представлявам е извършил оглед на енергийния обект от обхвата на Обособена позиция 1 /ОП 1/ - Модернизация (ретрофит) на закрита разпределителна уредба 10 kV в подстанция „Младост“;, а именно: „Младост”и съм запознат със съществуващото положение в обекта.

2/ Няма да разпространявам поверителна информация, във връзка с извършения оглед на обекта на Възложителя, като ми е известно, че за поверителна се счита всяка информация, относно пропускателния режим в обекта, организацията на работната сила и работния процес, наличното оборудване и техническите схеми на функционирането му, системите за защита и сигурност в обекта и всичко, което е свързано с наличното оборудване, съоръжения и тяхното функциониране в съответния обект.

3/ Прилагам документ за извършен оглед, съставен на място в подстанцията.

Приложение: съгласно текста

Дата 25.07.2017 г.

Декларатор:
/Георги Табаков-Управител/

1016

ДЕКЛАРАЦИЯ

за конфиденциалност във връзка с посещение на обект

Долуподписаният Светлана Георгиева Качкина ....
(собствено, бащино и фамилно име)

ЕГН 6612113475, притежаващ лична карта № 640386823, издадена на 30.06.2010 от МВР - Пловдив, с постоянен адрес: гр. Пловдив, ЖК „Тракия" бл. 14 вх. Б

Представител на „Електролукс Табаков и синове" ООД
(наименование на юридическото лице/физическото лице и вид на търговеца)

Със седалище и адрес на управление:

гр. Пловдив, ул. „Седянка" 9,

заинтересовано лице по смисъла на §2, т.14 от Допълнителните разпоредби на Закона за обществените поръчки за открита процедура за възлагане на обществена поръчка с предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика ", реф. № PPD 17 - 052, във връзка с посещението на обекта, предмет на обществената поръчка, с цел запознаване със съществуващото му положение, включително с действащите електрически съоръжения и спецификата на ПС „Младост"

ДЕКЛАРИРАМ:

1. Няма да разгласявам по никакъв начин информацията станала ми известна при запознаване със съществуващото му положение, включително с действащите електрически съоръжения и спецификата на ПС „Младост"

2. Наясно съм, че разгласяване на информация по смисъла на настоящата декларация представлява всякъкъв вид устно или писмено изявление, предаване наинформация на хартиен, електронен или друг носител, включително по поща, факс или електронна поща, както и всякакъв друг начин на разгласяване наинформация, в това число чрез средствата за масово осведомяване, печатните издания или интернет.

Известна ми е отговорността по чл.313 от Наказателния кодекс.

Дата 17.07.2017 г.

Декларатор: ____________
подпис

____
трите имена

Лице на Възложителя: Красимир Димитров

ДЕКЛАРАЦИЯ

за приемане на условията в проекта на договор

Долуподписаният Георги Николов Табаков в качеството ми на представляващ „Електролукс Табаков и синове“ ООД, участник в обществена поръчка с реф. № PPD 17 – 052 и предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика", Обособена позиция 1 /ОП 1/ - Модернизация (ретрофит) на закрита разпределителна уредба 10 kV в подстанция „Младост”;

Д Е К Л А Р И Р А М, ЧЕ:

Приемам условията в проекта на договор, приложен в документацията за участие.

Дата 25.07.2017 г.

Декларатор:
/Георги Табаков-Управител/

1018

Д Е К Л А Р А Ц И Я
за срока на валидност на офертата

Долуподписаният Георги Николов Табаков, притежаващ лична карта №641449027, издадена на 17.11.2010 г..от МВР– гр. Пловдив, адрес с.Белащица, общ.Родопи, обл.Пловдив, ул."Съединение" №2Б в качеството ми на Управител на „Електролукс Табаков и синове" ООД участник в процедура за възлагане на обществена поръчка с предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика", реф. № PPD 17-052,
Обособена позиция 1 /ОП 1/ - Модернизация (ретрофит) на закрита разпределителна уредба 10 kV в подстанция „Младост";

Д Е К Л А Р И Р А М, ЧЕ:

С подаване на офертата за участие в обществената поръчка, направените от нас предложения и поети ангажименти са валидни за срока, посочен в обявлението, считано от крайния срок за подаване на офертите.

Дата 25.07.2017 г.

Декларатор:
/Георги Табаков-Управител/

1018