

TYPE TEST CERTIFICATE OF SHORT-CIRCUIT PERFORMANCE

APPARATUS An outdoor, oil-immersed current transformer

DESIGNATION CTH 550 **SERIAL No.** 2002/3152/D9

Rated voltage	550 kV	Rated primary continuous thermal current	2x2000 A
Rated short-time thermal current	63 kA	Rated frequency	50 Hz

MANUFACTURER ALSTOM Belgium S.A.,
Beyne-Heusay, Belgium

TESTED FOR ALSTOM Belgium S.A.,
Beyne-Heusay, Belgium

TESTED BY KEMA HIGH-POWER LABORATORY
Utrechtseweg 310 - 6812 AR Arnhem - The Netherlands

DATE(S) OF TESTS 6th December 2002 to 9th January 2003

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 60044-1 Sub-clause 7.1 (Short-time current test)

This Type Test Certificate has been issued by KEMA 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 performance are considered to comply with the above Standard and to justify the ratings assigned by the manufacturer as listed on page 3.

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 consists of 20 sheets in total.

This Certificate falls under the scope of the accreditation certificate L020 of the Dutch Council for Accreditation. See information sheet (page 1).

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KEMA Nederland B.V.



P.G.A. Bus
Manager High-Power Laboratory

Arnhem, 17th February 2003

1 Certificate

A Certificate contains a record of a series of type tests carried out strictly in accordance with a recognized standard. The equipment tested has fulfilled the requirements of this standard and the relevant ratings assigned by the manufacturer are endorsed by KEMA. The Certificate is applicable only to the equipment tested. KEMA is responsible for the validity and the contents of the Certificate.

The responsibility for conformity of any apparatus having the same designation as the one tested rests with the manufacturer. The Certificate contains the essential drawings and a description of the equipment tested.

Detailed rules are given in KEMA's Certification procedure.

2 Report of Performance

A Report of Performance contains a record of one or more tests which have been carried out according to the client's instructions. These tests are not necessarily in accordance with a recognized standard. The test results do not verify ratings of the test object.

KEMA issues three types of Reports of Performance:

2.1 *The tests have been carried out strictly in accordance with The apparatus has complied with the relevant requirements.*

This sentence will appear on the front page of a Report of Performance if the tests have been performed in accordance with a recognized standard, but the series of tests does not completely fulfil the requirements for a Certificate of Compliance (for example, if the number of test duties is not a complete series of type tests). The Report contains verified drawings and a description of the equipment tested. Detailed rules are given in KEMA's Certification procedure. The condition of the test object after the tests is assessed and recorded in the Report.

2.2 *The tests have been carried out in accordance with the client's instructions. Test procedure and test parameters were based on*

This sentence will appear on the front page of a Report of Performance if the number of tests, the test procedure and the test parameters are based on a recognized standard and related to the ratings assigned by the manufacturer. If the apparatus does not pass the tests such behaviour will be mentioned on the front sheet. Verification of the drawings (if submitted) and assessment of the condition after the tests is only done on the client's request.

2.3 *The tests have been carried out according to the client's instructions.*

This sentence will appear on the front page of a Report of Performance if the tests, test procedure and/or test parameters are not in accordance with a recognized standard.

3 Standards

When reference is made to a standard, and the date of issue is not stated, this applies to the latest issue, including amendments which have been officially published prior to the date of the tests.

4 Official and uncontrolled test documents

The official test documents of KEMA High-Power Laboratory are issued in bound form. Uncontrolled copies may be provided as loose sheets for convenience of reproduction by the client.

The copyright has to be respected at all times.

5 Accuracy of measurement

In the table of test results the measured quantities are given in three digits. This method of presentation does not indicate an accuracy. The guaranteed uncertainty in the figures mentioned, taking into account the total measuring system, is less than 5%, unless mentioned otherwise.

6 Qualified by STERLAB

KEMA High-Power Laboratory and High-Voltage Laboratory have been entered in the STERLAB register for laboratories under resp. Nrs. L020 and L218 for the testing services as defined in the Field of Accreditation.

The accreditation is carried out in accordance with ISO/IEC 17025.



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RATINGS ASSIGNED BY THE MANUFACTURER

Voltage	550 kV
Frequency	50 Hz
Primary continuous thermal current	2x2000 A
Short-time thermal current	63 kA
Duration of short-circuit	2 s
Dynamic current	160 kA _{peak}

Core	1S1-1S2	2S1-2S2	3S1-3S2	4S1-4S2	5S1-4S2
Ratio	2x1000A/1A	2x2000A/1A	2x2000A/1A	2x2000A/5A	2x2000A/5A
Burden	10VA	25VA	30VA	50VA	50VA
Accuracy class	TPY	0.2	5P20	10P20	0.5
Instrument security factor		FS ≤ 5			

DESCRIPTION OF APPARATUS TESTED

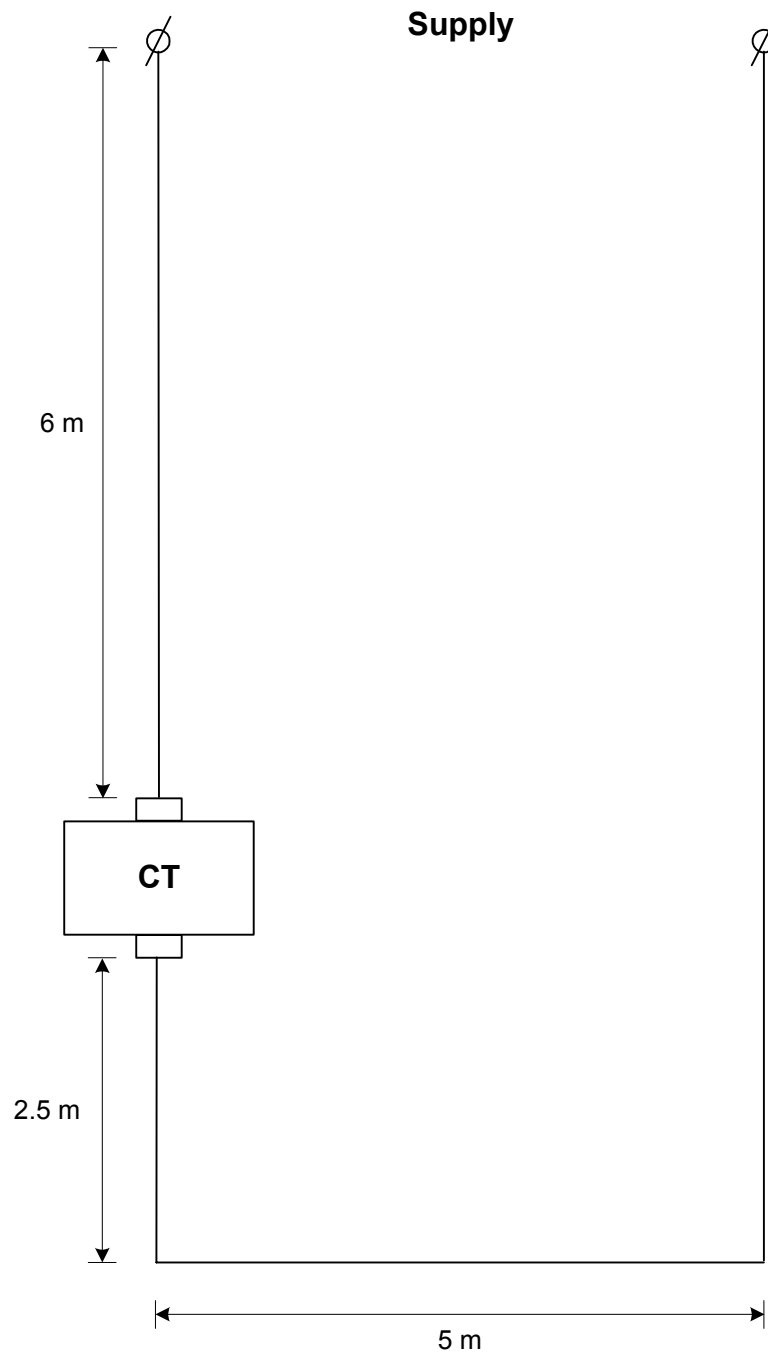
An outdoor, oil immersed type current transformer

DRAWING

The manufacturer has guaranteed that the equipment submitted for tests has been manufactured in accordance with the following drawing.

KEMA has verified that this drawing corresponds to the equipment tested.

P0000416 Rev. 0



THE TESTS WERE WITNESSED BY

Name
Company

Hauptert, J.
Ledoux, D.

ALSTOM Belgium S.A.,
Beyne-Heusay, Belgium

THE TESTS WERE OBSERVED BY

Name
Company

Bruil, R.

KEMA High-Power Laboratory,
Arnhem, The Netherlands

Sloot, W.J.W.M.

KEMA High-Voltage Laboratory,
Arnhem, The Netherlands

THE CURRENT TRANSFORMER WAS INSPECTED BY

Name
Company

Bruil, R.

KEMA High-Power Laboratory,
Arnhem, The Netherlands

NOTE

After the tests of this Certificate the CT complied with IEC 60044-1, Sub-clause 7.1.

TEST NUMBER

021211-4006

CONDITION BEFORE TEST

Current transformer new.

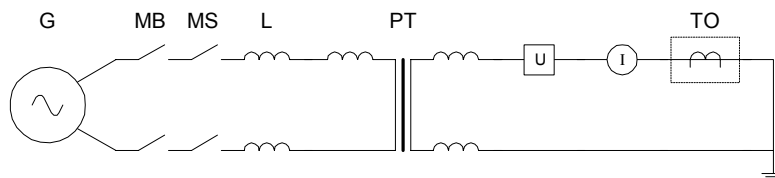
All secondary windings directly short-circuited and earthed, except for winding 1S1-1S2 that was short-circuited and earthed by means of a shunt.

CONDITION AFTER TEST

Current transformer did not reveal externally any change or damage.

For condition verification tests before and after short-time current test see enclosed record of tests 03-1024.

TEST-CIRCUIT S01



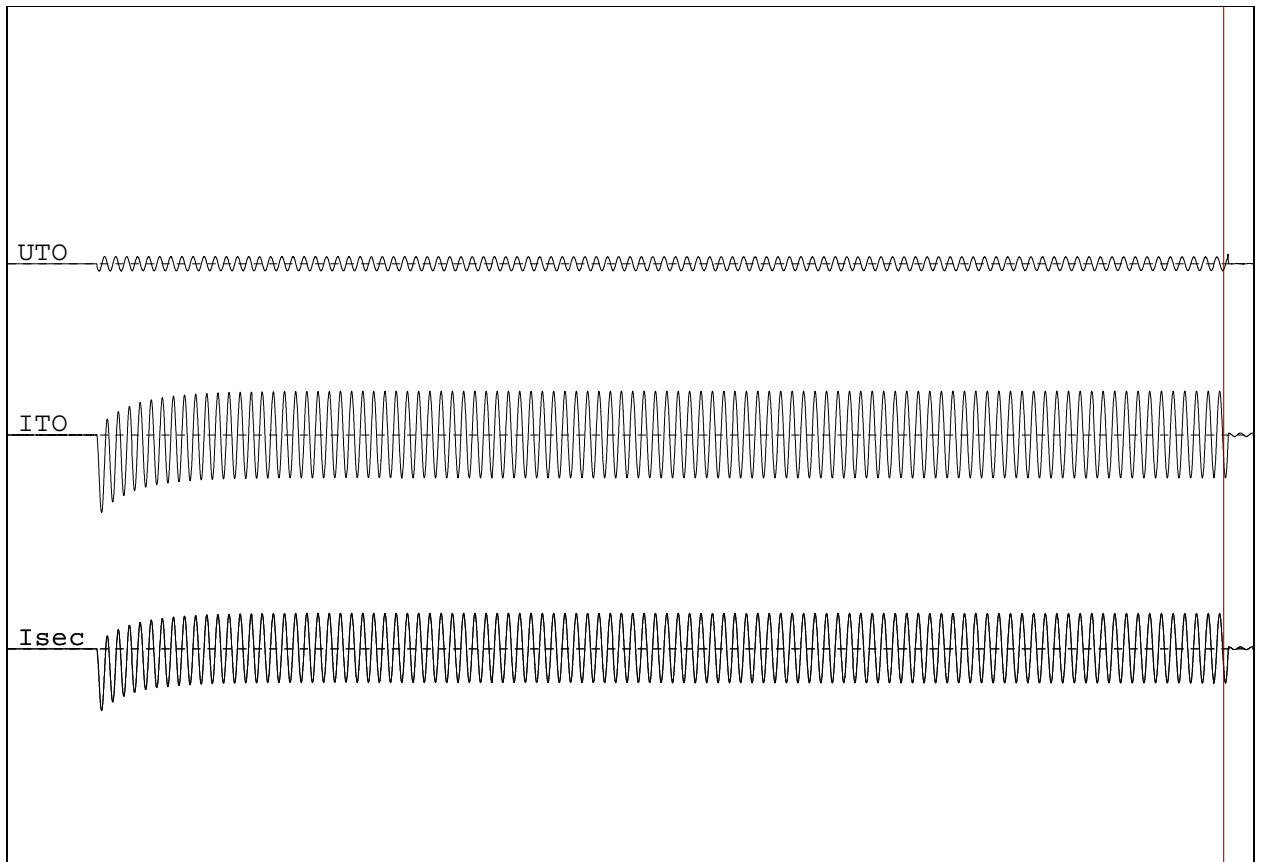
G	= Generator	TO	= Test Object	U	= Voltage Measurement to earth
MB	= Master Breaker	L	= Reactor	I	= Current Measurement
MS	= Make Switch				
PT	= Power Transformer				

Supply		
Power	MVA	321
Frequency	Hz	50
Phase(s)		1
Voltage	kV	5.1
Current	kA	63
Impedance	Ω	0.081
Power factor		< 0.1
Neutral		not earthed

Load	
Short-circuit point	earthed

Remarks: -





TEST NUMBER: 021211-4006

Phase		1
Peak value of current	kA	-159
Symmetrical current, beginning	kA	62.7
Symmetrical current, middle	kA	62.8
Symmetrical current, end	kA	62.9
Symmetrical current, average	kA	62.9
Duration	s	2.05
Thermal equivalent	63 kA during 2.04 s	

Remarks: No visible disturbance.



RECORD OF TESTS

Record no. 70270237.000-HVL 03-1024
 Client Alstom Belgium S.A.
 54, Rue de Magnee
 Beyne-Heusay
 Belgium

Date 6 December 2002 until 9 January 2003
 Object current transformer
 Type CTH 550, serial no. 2002/3152/D9

TEST PROGRAMME

The programme was specified by the client and was as follows:

- tests to check compliance of the short-time current test as per clause 7.1 of IEC 60044-1 (1996) including Amendment 1 (2000). Following tests were carried out before and after the short-time current test:

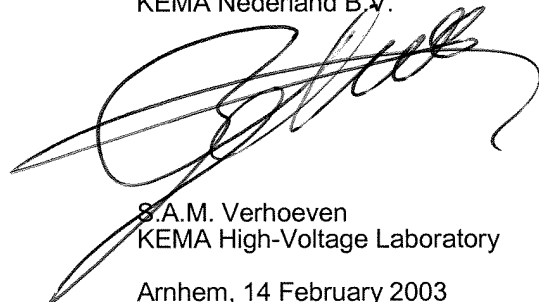
1	power-frequency withstand test on primary winding	IEC 60044-1, incl. Amd. 1
2	partial discharge measurement	clause 8.2.1
3	power-frequency withstand test on secondary windings	clause 8.2.2
4	power-frequency withstand test, between sections	clause 8.3
5	inter-turn overvoltage test	clause 8.3
6	determination of errors	clause 8.4
		clauses 11.4 and 12.4.

SUMMARY AND CONCLUSION

The results obtained relate only to the work ordered and to the material tested.
 All tests were passed.

Author W.J.W.M. Sloot

KEMA Nederland B.V.



S.A.M. Verhoeven
 KEMA High-Voltage Laboratory
 Arnhem, 14 February 2003

This B-report consists of:
 8 pages

DESCRIPTION AND RESULTS OF THE TEST**MEASUREMENT UNCERTAINTY**

The last page of this report contains a table with measurement uncertainties. Unless otherwise indicated in the report, the measurement uncertainties of the results presented are as indicated in this table.

GENERAL

The test object was subjected, before and after the short-time current test to the tests mentioned below.

1 POWER-FREQUENCY WITHSTAND TEST ON PRIMARY WINDING

The current transformer was subjected to the power-frequency withstand test on the primary winding in accordance with clause 8.2.1 of IEC 60044-1 (1996) including Amendment 1 (2000). Before the short-time current test, the test was carried out with 100% of the specified test value. After the short-time current test, the test was carried out with 90% of the specified test value. The results are presented in appendix 1 page 1.
The test was passed.

2 PARTIAL DISCHARGE MEASUREMENT

The current transformer was subjected to a partial discharge measurement in accordance with clause 8.2.2 of IEC 60044-1 (1996) including Amendment 1 (2000). The measurement was carried out during the power-frequency withstand test on the primary winding. After having received the one-minute power-frequency test voltage, the voltage was reduced to $1,2U_m$ for the first measurement, then the voltage was reduced to U_m for the second measurement. Finally the voltage was reduced to $1,2U_m/\sqrt{3}$ for the last measurement. The results are presented in appendix 2 page 1.
The test was passed.

3 POWER-FREQUENCY WITHSTAND TEST ON SECONDARY WINDINGS

The current transformer was subjected to the power-frequency withstand test on the secondary windings in accordance with clause 8.3 of IEC 60044-1 (1996) including Amendment 1 (2000). Before the short-time current test, the test was carried out with 100% of the specified test value. After the short-time current test, the test was carried out with 90% of the specified test value. The results are presented in appendix 1 page 1. The test was passed.

4 POWER-FREQUENCY WITHSTAND TEST, BETWEEN SECTIONS

The current transformer was subjected to the power-frequency withstand test, between sections, in accordance with clause 8.3 of IEC 60044-1 (1996) including Amendment 1 (2000). Before the short-time current test, the test was carried out with 100% of the specified test value. After the short-time current test, the test was carried out with 90% of the specified test value. The results are presented in appendix 1 page 1. The test was passed.

5 INTER-TURN OVERVOLTAGE TEST

The current transformer was subjected to the inter-turn overvoltage test, in accordance with procedure A of clause 8.4 of IEC 60044-1 (1996) including Amendment 1 (2000). Before the short-time current test, the test was carried out with 100% of the specified test value. After the short-time current test, the test was carried out with 90% of the specified test value. With the secondary windings connected to a high-impedance peak voltmeter, a substantially sinusoidal current was injected into the primary winding. The windings of each core were tested for 60 seconds with a r.m.s. primary current value equal to the rated current value. The primary current was limited in case the peak-voltage, measured on the secondary winding under test, reached 4,5 kV. The windings from the cores not under test were short-circuited. The test was passed.

6 DETERMINATION OF ERRORS

The current transformer was subjected to error measurements, in accordance with clauses 11.4 and 12.4 of IEC 60044-1 (1996) including Amendment 1 (2000).

The measurements were carried out with a standard current transformer and an error measuring bridge.

The transformation errors determined after the short-time current test do not differ from those recorded before the test by more than half the limits of error appropriate to its accuracy class.

The results are presented in appendix 3 page 1.

The test was passed.

Client Alstom Belgium S.A., Beyne-Heusay, Belgium
 Test object current transformer, type CTH 550, serial no. 2002/3152/D9, 525 kV, 50 Hz
 Requirements IEC 60044-1, clauses 8.2 and 8.3
 Test date 6 December 2002 and 9 January 2003

RESULTS OF THE DIELECTRIC TESTS

Atmospheric conditions

Ambient temperature 19-20 °C Ambient air pressure 1009-1003 hPa
 Object temperature 19-20 °C Humidity 9-10 g (H₂O)/m³

power-frequency withstand test on primary winding				
voltage applied to	earthed	applied voltage (kV)	duration (s)	result
before short-time current test				
P1-P2	all secondary terminals and frame	680	60	passed
after short-time current test				
P1-P2	all secondary terminals and frame	612	60	passed

power-frequency withstand test on secondary winding and between sections				
voltage applied to	earthed	applied voltage (kV)	duration (s)	result
before short-time current test				
1S1-1S2	P1-P2, all other secondary terminals and frame	3	60	passed
2S1-2S2		3	60	passed
3S1-3S2		3	60	passed
4S1-4S2		3	60	passed
5S1-5S2		3	60	passed
after short-time current test				
1S1-1S2	P1-P2, all other secondary terminals and frame	2,7	60	passed
2S1-2S2		2,7	60	passed
3S1-3S2		2,7	60	passed
4S1-4S2		2,7	60	passed
5S1-5S2		2,7	60	passed

Remark

The test voltages were not corrected for standard atmospheric conditions.

Client Alstom Belgium S.A., Beyne-Heusay, Belgium
 Test object current transformer, type CTH 550, serial no. 2002/3152/D9, 525 kV, 50 Hz
 Requirements IEC 60044-1, clause 8.2.2
 Test date 6 December 2002 and 9 January 2003

RESULTS OF THE PARTIAL DISCHARGE MEASUREMENTS

Atmospheric conditions

Ambient temperature 19-20 °C Ambient air pressure 1009-1003 hPa
 Object temperature 19-20 °C Humidity 9-10 g (H₂O)/m³

power-frequency withstand test on secondary winding and between sections				
applied voltage	duration	measured partial discharge level	requirement	result
(kV)	(s)	(pC)	(pC)	
before short-time current test				
1,2 U _m	30	< 10	≤ 10	passed
U _m	30	< 10	≤ 10	passed
1,2U _m /√3	30	< 5	≤ 5	passed
after short-time current test				
1,2 U _m	30	< 10	≤ 10	passed
U _m	30	< 10	≤ 10	passed
1,2U _m /√3	30	< 5	≤ 5	passed

Remark

The test was carried out immediately after the power-frequency withstand test on primary winding in accordance with procedure A of clause 8.2.2 of IEC 60044-1.

Client Alstom Belgium S.A., Beyne-Heusay, Belgium
 Test object current transformer, type CTH 550, serial no. 2002/3152/D9, 525 kV, 50 Hz
 Requirements IEC 60044-1, clauses 11.4 and 12.4
 Test date 6-9 December 2002

RESULTS OF THE ERROR MEASUREMENTS

terminals class burden	I/I _n	burden		transformation errors				result
				before s.t.c. test		after s.t.c. test		
				ratio error	phase error	ratio error	phase error	
		(%)	(VA)	cos β	(%)	(mrad)	(%)	
P1-P2 1S1-1S2 10 VA class TPY	100	10	0,8	−0,02	3,5	−0,03	+ 3,7	passed
P1-P2 2S1-2S2 class 0,2 25 VA F _s ≤ 5	120 100 20 5 120 100 20 5	25 6,25	0,8 0,8	+0,17 +0,17 +0,16 +0,14 +0,19 +0,19 +0,19 +0,18	−0,1 −0,1 −0,2 −0,3 −0,1 −0,1 −0,2 −0,4	+0,16 +0,16 +0,16 +0,17 +0,19 +0,19 +0,20 +0,23	+0,1 0,0 +0,2 +0,6 +0,1 0,0 +0,1 +0,4	 passed
P1-P2 3S1-3S2 30 VA 5P20	100	30	0,8	−0,07	+0,3	−0,03	0,0	passed
P1-P2 4S1-4S2 50 VA 10P20	100	50	0,8	−0,05	+0,2	−0,06	+0,2	passed
P1-P2 5S1-5S2 class 0,5 50 VA	120 100 20 5 120 100 20 5	50 12,5	0,8 0,8	−0,06 −0,06 −0,06 −0,08 −0,02 −0,02 −0,03 −0,03	0,0 0,0 +0,2 +0,3 0,0 0,0 +0,1 +0,1	−0,06 −0,06 −0,06 −0,07 −0,03 −0,02 −0,02 −0,02	+0,1 0,0 +0,3 +0,5 +0,1 0,0 +0,1 +0,3	 passed

The measurement uncertainties in the results presented are as specified below unless otherwise indicated.

measurement	measurement uncertainty
dielectric tests and impulse current tests	peak value: $\leq 3\%$ time parameters: $\leq 10\%$
capacitance measurement	0,3%
$\tan \delta$ measurement	$\pm 0,5\% \pm 5 \times 10^{-5}$
partial discharge measurement	$< 10 \text{ pC} : 2 \text{ pC}$ $10 - 100 \text{ pC} : 5 \text{ pC}$ $> 100 \text{ pC} : 20 \%$
measurement of impedance ac-resistance measurement	$\leq 1\%$
measurement of losses	$\leq 1\%$
measurement of insulation resistance	$\leq 10\%$
measurement of dc resistance	$1 \mu\Omega - 5 \mu\Omega : 1\%$ $5 \mu\Omega - 10 \mu\Omega : 0,5\%$ $10 \mu\Omega - 200 \mu\Omega : 0,2\%$
radio interference test	2 dB
calibration of current transformers	$2,2 \times 10^{-4} \text{ li/lu}$ and $290 \mu\text{rad}$
calibration of voltage transformers	$1,6 \times 10^{-4} \text{ Ui/Uu}$ en $510 \mu\text{rad}$
measurement of conductivity	5%
measurement of temperature	$-50 \text{ }^\circ\text{C} - -40 \text{ }^\circ\text{C} : 3 \text{ K}$ $-40 \text{ }^\circ\text{C} - 125 \text{ }^\circ\text{C} : 2 \text{ K}$ $125 \text{ }^\circ\text{C} - 150 \text{ }^\circ\text{C} : 3 \text{ K}$
tensile test	1%
sound level measurement	type 1 meter as per IEC 651 and ANSI S1.4.1971
measurement of voltage ratio	0,1%