DNV·GL

KEMA REPORT OF PERFORMANCE

1014-16

Object	A three-phase dry-type transformer		
Type	-	**Serial No.**	ADA2406008/001
	11/0,433 kV – 250 kVA – Dyn11– 50 Hz		
Client	Raychem RPG (P) Ltd., Pune, India		
Manufacturer	Raychem RPG (P) Ltd., Pune, India *)		
Tested by	KEMA Nederland B.V., Arnhem, The Netherlands		
Date of tests	25 January to 3 February 2016		
Test specification	The tests have been carried out in accordance with IEC 60076-11 (2004), subclause 27.4 (Thermal shock test for C2 Class transformers) and subclause 26.3.2 (Environmental test for Class E2 transformers).		
Remarks	The object has complied with the relevant requirements of the standard.		

This report applies only to the object tested. The responsibility for conformity of any object having the same type references as that tested rests with the manufacturer.
*) as declared by the manufacturer

This report consists of 17 pages in total.

KEMA Nederland B.V.

J.P. Fonteijne
Executive Vice President
KEMA Laboratories

KEMA Laboratories

Arnhem, 8 March 2016

INFORMATION SHEET

1 KEMA Type Test Certificate

A KEMA Type Test Certificate contains a record of a series of (type) tests carried out 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 DNV GL. In addition, the test object's technical drawings have been verified and the condition of the test object after the tests is assessed and recorded. The Certificate contains the essential drawings and a description of the equipment tested. A KEMA Type Test Certificate signifies that the object meets all the requirements of the named subclauses of the standard. It can be identified by gold-embossed lettering on the cover and a gold seal on its front sheet.
The Certificate is applicable to the equipment tested only. DNV GL is responsible for the validity and the contents of the Certificate. The responsibility for conformity of any object having the same type references as the one tested rests with the manufacturer.
Detailed rules on types of certification are given in DNV GL's Certification procedure applicable to KEMA Laboratories.

2 KEMA Report of Performance

A KEMA Report of Performance is issued when an object has successfully completed and passed a subset (but not all) of test programmes in accordance with a recognized standard. In addition, the test object's technical drawings have been verified and the condition of the test object after the tests is assessed and recorded. The report is applicable to the equipment tested only. A KEMA Report of Performance signifies that the object meets the requirements of the named subclauses of the standard. It can be identified by silver-embossed lettering on the cover and a silver seal on its front sheet.
The sentence on the front page of a KEMA Report of Performance will state that the tests have been carried out in accordance with …… The object has complied with the relevant requirements.

3 KEMA Test Report

A KEMA Test Report is issued in all other cases. Reasons for issuing a KEMA Test Report could be:

- Tests were performed according to the client's instructions.
- Tests were performed only partially according to the standard.
- No technical drawings were submitted for verification and/or no assessment of the condition of the test object after the tests was performed.
- The object failed one or more of the performed tests.

The KEMA Test Report can be identified by the grey-embossed lettering on the cover and grey seal on its front sheet.
In case 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, the following sentence will appear on the front sheet. The tests have been carried out in accordance with the client's instructions. Test procedure and test parameters were based on ..... If the object 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 client's request.
When the tests, test procedure and/or test parameters are not in accordance with a recognized standard, the front sheet will state the tests have been carried out in accordance with client's instructions.

4 Official and uncontrolled test documents

The official test documents of DNV GL are issued in bound form. Uncontrolled copies may be provided as loose sheets or as a digital file for convenience of reproduction by the client. The copyright has to be respected at all times.

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1 IDENTIFICATION OF THE TEST OBJECT

1.1 Ratings assigned by the manufacturer

Rated power	250 kVA
Rated primary voltage	11 kV
Rated secondary voltage	433 V
Rated primary current	13,12 A
Rated secondary current	333,34 A
Rated frequency	50 Hz

1.2 Description of the test object

Manufacturer	Raychem RPG (P) Ltd., Pune, India
Type	-
Designation	-
Serial number	ADA2406008/001
Year of manufacture	2015
Number of phases	3
Insulation levels	
• HV winding (LI/AC)	75 / 28
• LV winding (LI/AC)	- / 3
Tapping range	± 2 x 2,5%
Number of tappings	5
Impedance voltage	5%
Connection symbol	Dyn11
Type of cooling	AN
Primary winding material	copper
Secondary winding material	copper
Reference temperature	120 °C
Insulation class (HV / LV)	F / F
Climatic class	C2
Environmental class	E2

1.3 List of drawings

The manufacturer has guaranteed that the object submitted for tests has been manufactured in accordance with the following drawings and/or documents. KEMA Laboratories has verified that these drawings and/or documents adequately represent the object tested. The manufacturer is responsible for the correctness of these drawings and/or documents and the technical data presented.

The following drawings and/or documents have been included in this report:

Drawing no./document no.	Revision
32GA0256 R1	1
32RD0431 R1	1

GENERAL INFORMATION

1.4 The tests were witnessed by

Name	Company
P. K. Mujumdar (25 to 27 January 2016)	Raychem RPG (P) Ltd., Pune, Inda

1.5 The tests were carried out by

Name	Company
S. Smeenk	KEMA Nederland B.V., Arnhem, The Netherlands

1.6 Purpose of the test

Purpose of the test was to verify whether the material complies with the specified requirements.

1.7 Measurement uncertainty

A table with measurement uncertainties is enclosed in this report. Unless otherwise stated, the measurement uncertainties of the results presented in this report are as indicated in that table.

2 CLIMATIC TEST

2.1 Thermal shock test for C2 class transformers

Standard and date

Standard	IEC 60076-11, clause 27.4
Test date	25 January 2016

Environmental conditions (end of cooling period)

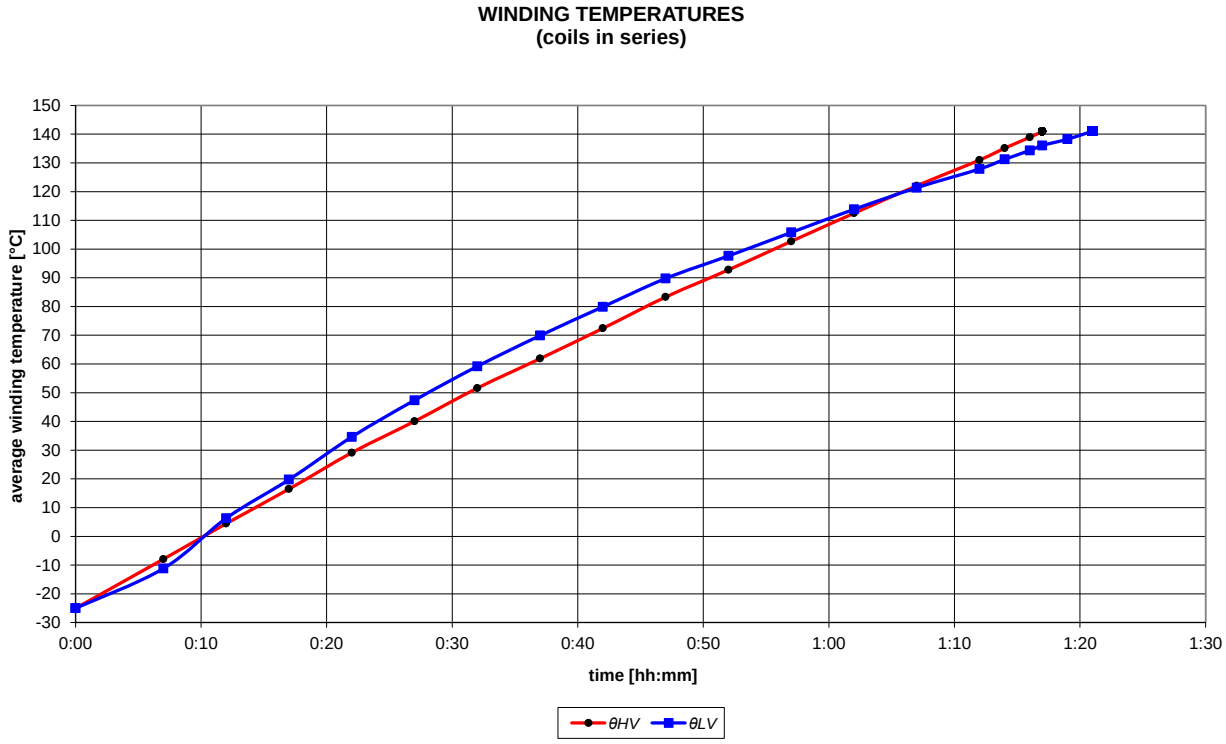
Ambient temperature	-25	°C
Temperature of test object	-25	°C

Characteristic test data

Test current through high voltage winding, three coils connected in series	$2*I_{nom} / \sqrt{3}$ =	15,1 A dc
Test current through low voltage winding, three coils connected in series	$2* I_{nom}$ =	667 A dc

Winding resistances

Winding	At -25 °C (Ω)	At 140 °C (Ω)
HV winding	6,30	11,3
LV winding	2,48 x 10^{-3}	4,42 x 10^{-3}



Graph of the winding temperatures during the test.

Requirements

The transformer shall withstand the dielectric routine tests at 80% of the specified test voltages.
The windings shall show no visible abnormalities such as cracks or slits.

Result

The object passed the test.

2.2 Separate source AC withstand voltage test at 80% of test voltage

Standard and date

Standard IEC 60076-11, clause 19
Test date 26 January 2016

Environmental conditions

Ambient temperature	20 °C	Ambient air pressure	1001 hPa
Temperature of test object	20 °C	Humidity	9 g/m^3

Voltage applied to terminals	Earthed	Applied voltage (kV)	Frequency (Hz)	Duration (min)	Observations
1U, 1V, 1W	2U, 2V, 2W, 2N, core, frame	22,4	50	1	No particularities
2U, 2V, 2W, 2N	1U, 1V, 1W, core, frame	2,4	50	1	No particularities

Requirement

There shall be neither flashover nor breakdown during the dielectric tests.

Result

The object passed the test.

2.3 Induced AC withstand voltage test at 80% of test voltage

Standard and date

Standard IEC 60076-11, clause 20
Test date 26 January 2016

Environmental conditions

Ambient temperature	20 °C	Ambient air pressure	1001 hPa
Temperature of test object	20 °C	Humidity	9 g/m^3

Voltage applied to terminals	Earthed	Applied voltage; phase-phase (kV (…x Ur))	Frequency (Hz)	Duration (min)	Observations
2U, 2V, 2W	2N, core, frame	17,6 (1,6)	100	1	No particularities

Requirement

There shall be neither flashover nor breakdown during the dielectric tests.

Result

The object passed the test.

2.4 Partial discharge measurement

Standard and date

Standard	IEC 60076-11, clause 22
Test date	26 January 2016

Environmental conditions

Ambient temperature	20	°C	Ambient air pressure	1001	hPa
Temperature of test object	20	°C	Humidity	9	g/m^3

Characteristic data

Noise	≤1	pC	Test frequency	100	Hz
Sensitivity	2	pC	Calibration level	5	pC
Center frequency	200	Hz			
Bandwidth	160	kHz			
U_r	11	kV			

Phase	Applied voltage; phase-phase (kV (...xU_r))	Phase earthed	Duration (s)	Partial discharge level (pC)	Inception		Extinction	
					(kV)	(pC)	(kV)	(pC)
1U-1V-1W	17,6 (1,6)	None	60	Not detectable	-	-	-	-
1U	14,3 (1,3)	None	180	Not detectable	-	-	-	-
1V	14,3 (1,3)	None	180	Not detectable	-	-	-	-
1W	14,3 (1,3)	None	180	Not detectable	-	-	-	-

Requirement

The maximum level of partial discharges shall be 10 pC.

Result

The object passed the test.

3 ENVIRONMENTAL TESTS FOR CLASS E2 TRANSFORMERS

3.1 Condensation test

Standard and date

Standard IEC 60076-11, clause 26.3.2
Test date 27 January 2016

Environmental conditions

Ambient temperature	Approx. 18	°C	Ambient air pressure	1011	hPa

Characteristic test data

Temperature of test object	5..18	°C
Humidity (relative)	> 93	%
Dimensions of test room	5x5x3	m
Conductivity of atomized water	1,1	S/m
Duration of exposure	6	h

After 6 hours of condensation, the test object was subjected to the induced voltage test as described below.

Transformers to be used in a system with solidly earthed neutral or via low impedance

Voltage applied to terminals	Earthed	Applied voltage; phase-phase on LV windings (V (…xU $_r$))	Frequency (Hz)	Duration (min)	Observations
2U, 2V, 2W	2N, core, frame	476 (1,1)	50	15	A small amount of smoke was observed located near one of the lower support blocks of the U-coil

Requirements

- There shall be no flashover during the voltage application.
- Visual inspection shall not show any serious tracking.

Result

The object passed the test.

3.2 Humidity penetration test

Standard and date

Standard	IEC 60076-11, clause 26.3.2
Test dates	28 January to 3 February 2016

Characteristic test data

Temperature of test object	50 °C
Humidity (relative)	90 %
Dimensions of test room	3,4x5,0x4,0 m
Duration of test	144 h

3.2.1 Repetition of separate source AC withstand voltage test at 80% of test voltage

Standard and date

Standard	IEC 60076-11, clause 19
Test date	3 February 2016

Environmental conditions

Ambient temperature	21 °C	Ambient air pressure	1013 hPa
Temperature of test object	30-50 °C	Humidity	7 g/m^3

Voltage applied to terminals	Earthed	Applied voltage (kV)	Frequency (Hz)	Duration (min)	Observations
1U, 1V, 1W	2U, 2V, 2N, core, frame	22,4	50	1	-
2U, 2V, 2W, 2N	1U, 1V, 1W, core, frame	2,4	50	1	-

Requirement

There shall be neither flashover nor breakdown during the dielectric tests.

Result

The object passed the test.

3.2.2 Induced AC withstand voltage test at 80% of test voltage

Standard and date

Standard IEC 60076-11, clause 20
Test date 3 February 2016

Environmental conditions

Ambient temperature	21 °C	Ambient air pressure	1013 hPa
Temperature of test object	30-50 °C	Humidity	7 g/m^3

Voltage applied to terminals	Earthed	Applied voltage; phase-phase (kV (…x Ur))	Frequency (Hz)	Duration (min)	Observations
2U, 2V, 2W	2N, core, frame	17,6 (1,6)	100	1	-

Requirement

There shall be neither flashover nor breakdown during the dielectric tests.

Result

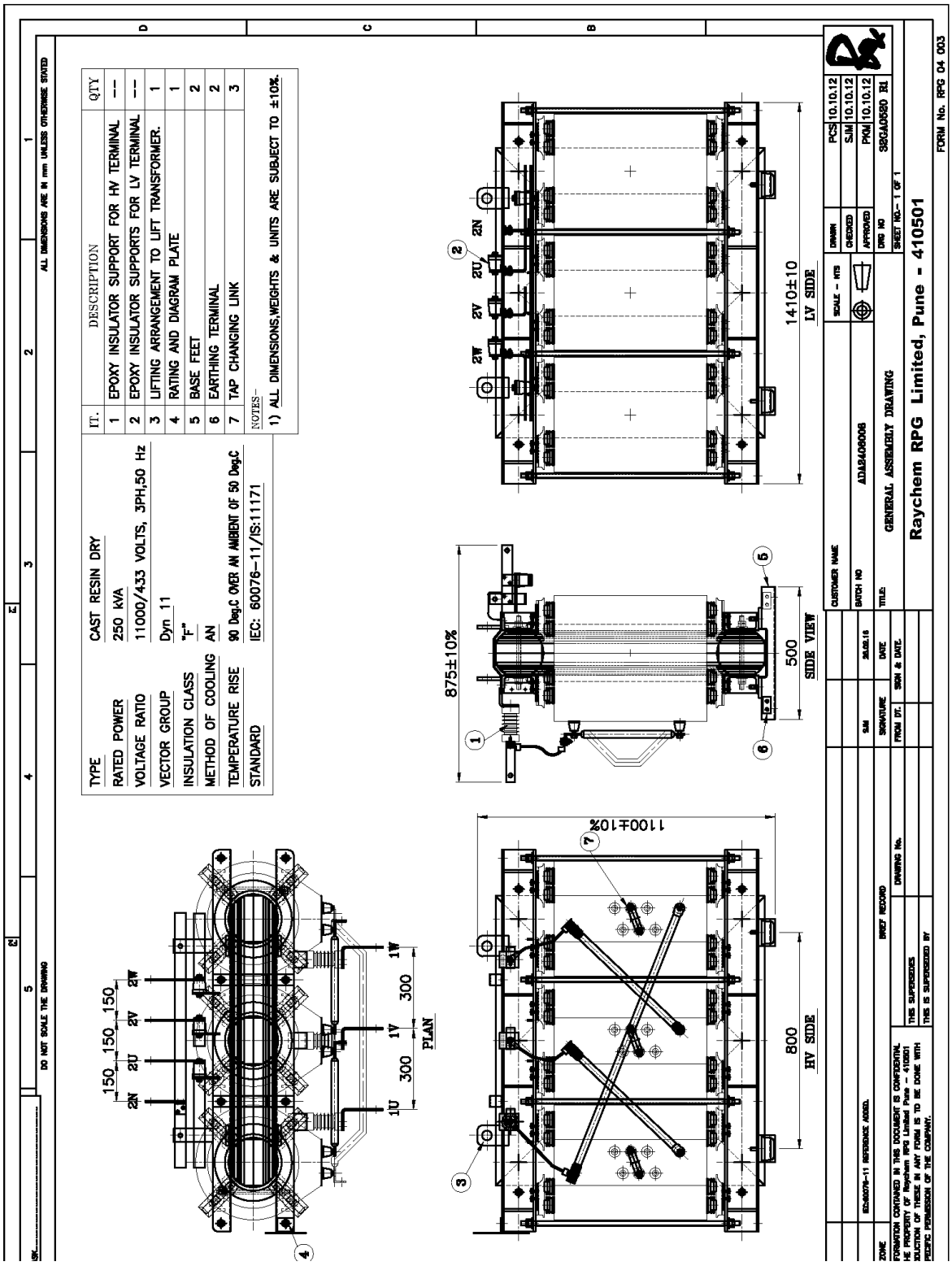
The object passed the test.

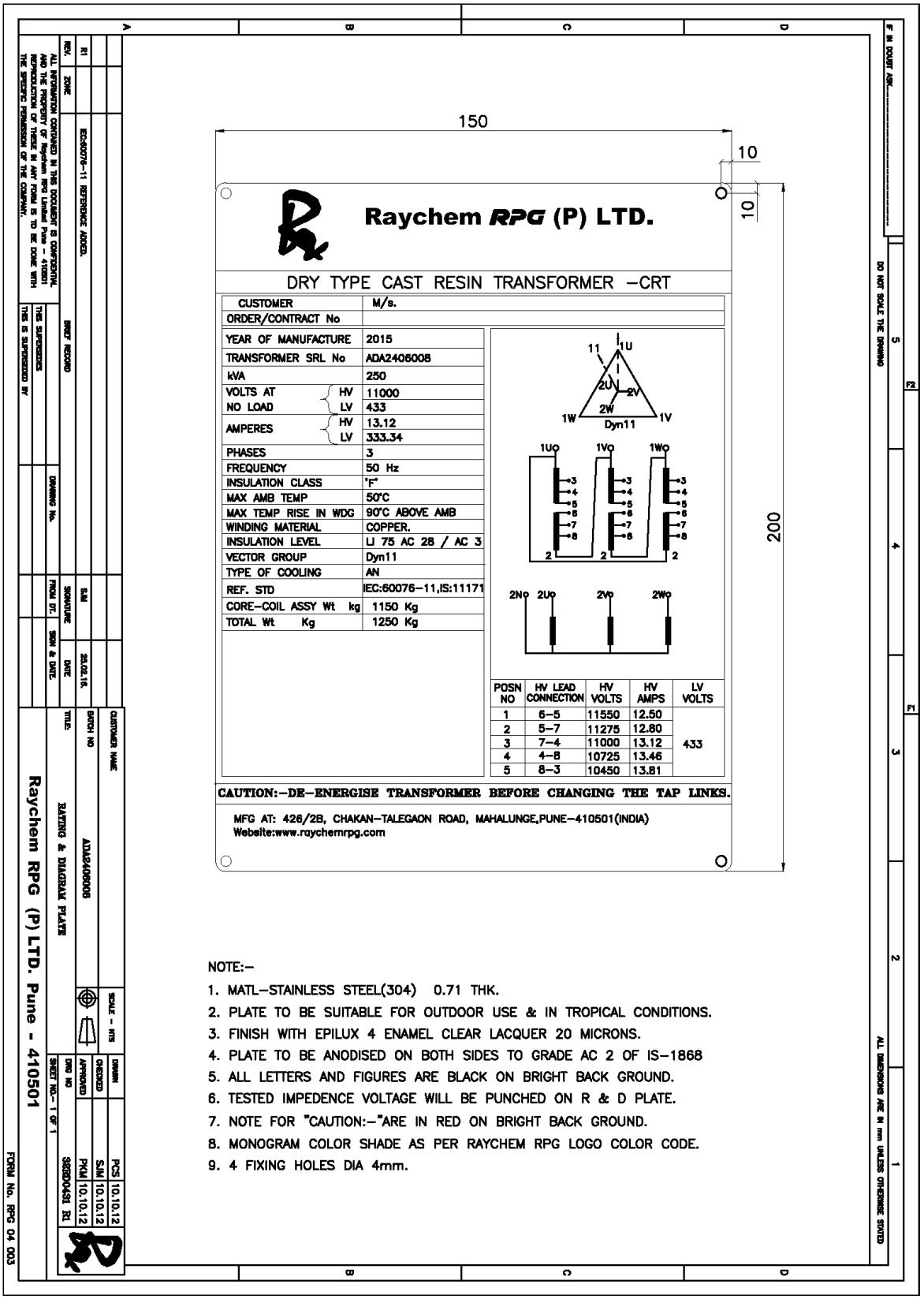
4 PHOTOGRAPHS

Transformer in the test bay for the condensation test.

Transformer in the climatic chamber and prepared for the thermal shock test.

5 DRAWINGS


DESCRIPTION
EPOXY INSULATOR SUPPORT FOR HV TERMINAL
EPOXY INSULATOR SUPPORTS FOR LV TERMINAL
LIFTING ARRANGEMENT TO LIFT TRANSFORMER.
RATING AND DIAGRAM PLATE
BASE FEET
EARTHING TERMINAL
TAP CHANGING LINK
TYPE CAST RESIN DRY
RATED POWER 250 kVA
VOLTAGE RATIO 11000/433 VOLTS, 3PH,50 Hz
VECTOR GROUP Dyn 11
INSULATION CLASS "F"
METHOD OF COOLING AN
TEMPERATURE RISE 90 DegC OVER AN AMBIENT OF 50 DegC
STANDARD IEC: 60076-11/IS:11171
NOTES-
1) ALL DIMENSIONS,WEIGHTS & UNITS ARE SUBJECT TO ±10%.
1410±10
LV SIDE
875±10%
500
SIDE VIEW
11004±10%
800
HV SIDE
PLAN
Raychem RPG Limited, Pune - 410501
GENERAL ASSEMBLY DRAWING
FORM No. RPG 04 003



NOTE:–

1. MATL–STAINLESS STEEL(304) 0.71 THK.
2. PLATE TO BE SUITABLE FOR OUTDOOR USE & IN TROPICAL CONDITIONS.
3. FINISH WITH EPILUX 4 ENAMEL CLEAR LACQUER 20 MICRONS.
4. PLATE TO BE ANODISED ON BOTH SIDES TO GRADE AC 2 OF IS–1868
5. ALL LETTERS AND FIGURES ARE BLACK ON BRIGHT BACK GROUND.
6. TESTED IMPEDENCE VOLTAGE WILL BE PUNCHED ON R & D PLATE.
7. NOTE FOR "CAUTION:–"ARE IN RED ON BRIGHT BACK GROUND.
8. MONOGRAM COLOR SHADE AS PER RAYCHEM RPG LOGO COLOR CODE.
9. 4 FIXING HOLES DIA 4mm.

6 MEASUREMENT UNCERTAINTY

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		≤ 3%
time parameters		≤ 10%
capacitance measurement		0,3%
tan δ measurement		± 0,5% ± 5 x 10^{-5}
partial discharge measurement:	< 10 pC	2 pC
	10 to 100 pC	5 pC
	> 100 pC	20%
measurement of impedance AC-resistance measurement		≤ 1%
measurement of losses		≤ 1%
measurement of insulation resistance		≤ 10%
measurement of DC resistance:	1 to 5 μΩ	1%
	5 to 10 μΩ	0,5%
	10 to 200 μΩ	0,2%
radio interference test		2 dB
calibration of current transformers		2,2 x 10^{-4} I_i/I_u and 290 μrad
calibration of voltage transformers		1,6 x 10^{-4} U_i/U_u and μrad
measurement of conductivity		5%
measurement of temperature:	-50 to -40 °C	3 K
	-40 to125 °C	2 K
	125 to 150 °C	3 K
tensile test		1%
sound level measurement		type 1 meter as per IEC 60651 and ANSI S1,4,1971
measurement of voltage ratio		0,1%