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**HIGH
POWER
LABORATORY**

11 - 147

ZKUŠEBNICTVÍ, a.s.

Podnikatelská 547
PRAHA 9 - Běchovice
Czech Republic

zku@zku.cz
www.zku.cz

e-version

zkratovna
Zkušebnictví, a. s.

Podnikatelská 547, 190 11 Praha 9, Běchovice, Czech Republic

TEST REPORT

No. 11 - 147

Test object : Neutral earthing resistor
Type : RP
Design : SDS-6812
Serial No. : CR034553/2-1

Ratings
Rated system voltage : 11 kV
Rated continuous current : 0 A
Rated resistance at 54°C : 15,8 Ω

Manufacturer : Cressall Resistors Ltd
Evington Valley Road, Leicester, LE5 5LZ
United Kingdom

Test performed : Short-time current test
Customer's request based on IEEE 32-1972, section 4.6 and
Cressall Test Acceptance Criteria, Issue B

Customer : Cressall Resistors Ltd
Evington Valley Road, Leicester, LE5 5LZ
United Kingdom

Date of test : 02. 08. 2011

◆ **Interpretation of results:**

The test object passed successfully the short-time current test, no visible damage appeared.

THIS TEST REPORT IS CONFIDENTIAL AND SHALL NOT BE PASSED OVER OR TRANSFERRED TO ANY THIRD PARTY WITHOUT WRITTEN APPROVAL OF THE CUSTOMER.

WITHOUT THE WRITTEN APPROVAL OF THE TESTING LABORATORY ZKRATOVNA SHALL NOT BE REPRODUCED EXCEPT IN FULL.

Praha 9, Běchovice

Tested by: 9.9.2011

Richard Abrahamčík



Robert Jech
Head of the Laboratory



Copy No.: E

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Description of the test object

An outdoor neutral earthing resistor for a purpose of controlling the ground of an alternating current system. The active parts of the resistor are manufactured from a stainless steel alloy. The resistor is equipped with a manually operated switch-disconnector.

The test object was identified according to the drawing No. 119032 Issue B – sheet 1 of 2.

Ratings assigned by the manufacturer

Type	: RP
Serial No.	: CR034553/2-1
Tag number	: NER-11-BH1A
Design	: SDS-6812
Manufacturer	: Cressall Resistors Ltd, United Kingdom
Year of manufacture	: 2011
Rated system voltage	: 11 kV
Rated line-neutral voltage	: 6350 V
Rated frequency	: 50 Hz
Rated short-time current	: 400 A
Rated time for short-time current	: 10 s
Number of phases	: 1
Resistance at 25°C	: 15,6 Ω
Resistance at 54°C	: 15,8 Ω
Rated continuous current	: 0 A
Maximum element temperature-rise	: 760°C
Temperature coefficient of resistance	: $0,36 \times 10^{-3} \text{ K}^{-1}$
Rated insulation level	: 75 kV (BIL)
Overall dimensions (width x depth x height)	: 1308 x 1409 x 1059 mm
Degree of protection	: IP55
Weight	: 350 kg
Installation	: Outdoor

Test specification

The test was carried out according to the customer's instructions. The test procedures, parameters and test assessment criteria are based on Test Acceptance Criteria – IP54 NERs Issue B dated March 16, 2011 by Cressall Resistors Ltd and IEEE 32-1972, section 4.6.

Test parameters

Short-time current test

Test voltage	: 6,35 kV
Test current	: 400 A
Duration of test current	: 10 s

Summary

The test was carried out as required by the test specification. The test object **passed successfully** the short-time current test.

More details of the test performed are given in the enclosed tables and oscillogram.

Test conditions

Working frequency $f = 48,5 \text{ Hz} \div 49,5 \text{ Hz}$

The short-time current test was performed in a single-phase test circuit with a value of the no-load supply voltage of ca 6,5 kV.

The test object was connected to the test circuit by means of two Cu cables with a cross-section of 120 mm^2 each. The connection to the test circuit (earthed side of the test object) was earthed.

The thermocouples positions are documented by the photograph in Fig. 2

The test circuit, including measurement points, is illustrated in the diagram REV121.

The tests were witnessed by

Tony Harris, Cressall Resistors Ltd, United Kingdom
Richard Mobbs, Cressall Resistors Ltd, United Kingdom

Notice:

The test results relate only to the tests given in this Test Report. No documents of administrative, business or other character can be substituted by this Test Report.

List of symbols

a) Used in the table of test results

I_1	- test current at the beginning of the test (first period)
I_2	- test current at the end of the test ($t \cong 0,99 t_i$)
I_e	- equivalent value of test current, r.m.s. value
U_1	- test voltage at the beginning of the test (first period)
U_2	- test voltage at the end of the test ($t \cong 0,99 t_i$)
U_e	- equivalent value of test voltage, r.m.s. value
W	- total injected energy
t_i	- duration of test current
$\theta_1, \theta_2, \theta_3$	- temperatures on active parts of neutral earthing resistor
θ_a	- ambient air temperature
θ_{xi}	- initial temperature on adequate place
θ_{xf}	- final temperature on adequate place
$\Delta\theta_x$	- final temperature-rise on adequate place

b) Used in the oscillogram

I	- short-circuit current course
U	- voltage drop course
t	- time
T_1, T_2, T_3	- temperatures on enclosure panels of neutral earthing resistor

The Test Report contains: **13** sheets i.e.:

- 1 introductory sheet
- 1 title sheet
- 3 text sheets
- 3 table sheets
- 1 test circuit diagram
- 4 photograph sheets

1 oscillogram

1 enclosure

Drawing No.: 119032 Issue B – sheet 1 of 2

Table of test results: Short-time current test

Test circuit diagram: REV121

File denomination: resi02hx

Test No.	θ_{1i} θ_{1f} $\Delta\theta_1$ (°C)	θ_{2i} θ_{2f} $\Delta\theta_2$ (°C)	θ_{3i} θ_{3f} $\Delta\theta_3$ (°C)	θ_a (°C)	I_1 I_2 I_e (A)	U_1 U_2 U_e (kV)	t_i (s)	$W^{1)}$ (MJ)
003	31,0	31,7	33,7	19,5	408	6,43	10,0	23,3
	657,0	674,0	666,0		328	6,48		
	626,0	642,3	632,3		361	6,46		
Note: $\Delta\theta_x = \theta_{xf} - \theta_{xi}$								

Note ¹⁾: Total injected energy was analytically evaluated by the curves of course of test voltage and of test current in the evaluation software.

Meteorological conditions

Test No.	Date (dd.mm.yyyy)	Time (hh:mm)	Temperature (°C)	Relative humidity (%)	Atmospheric pressure (hPa)
003	02.08.11	11:18	19,5	82	987

Test circuit parameters

File denomination		resi02hx
Test No.		003
Test circuit diagram		REV121
Generator		S
Rated (phase to phase) voltage (kV)		12,2
Phases connected		R,T
Inductance per phase (mH)		0,247
Inductance of reactors per phase (mH)		2,15
Resistance of resistors per phase (Ω)		0
Supply transformer – Type		---
Connection		---
Transf. ratio		---
Inductance per phase (mH)		---
Total inductance per phase of supply circuit (mH)		2,397
Capacity in parallel (μ F)		---
Resistance in series (Ω)		---
Neutral point of supply circuit		---
Short-circuit point		earthed
Load transformer – Type		---
Connection		---
Transf. ratio		---
Resistance of load resistors (Ω)		---
Inductance of load reactors (mH)		---
Capacity of load capacitors (μ F)		---
Neutral point of load circuit		---
Power factor / impedance of supply circuit (- / %)		0,03
Power factor / impedance of load circuit (- / %)		---
Power factor of test circuit (-)		0,99

Measuring devices used

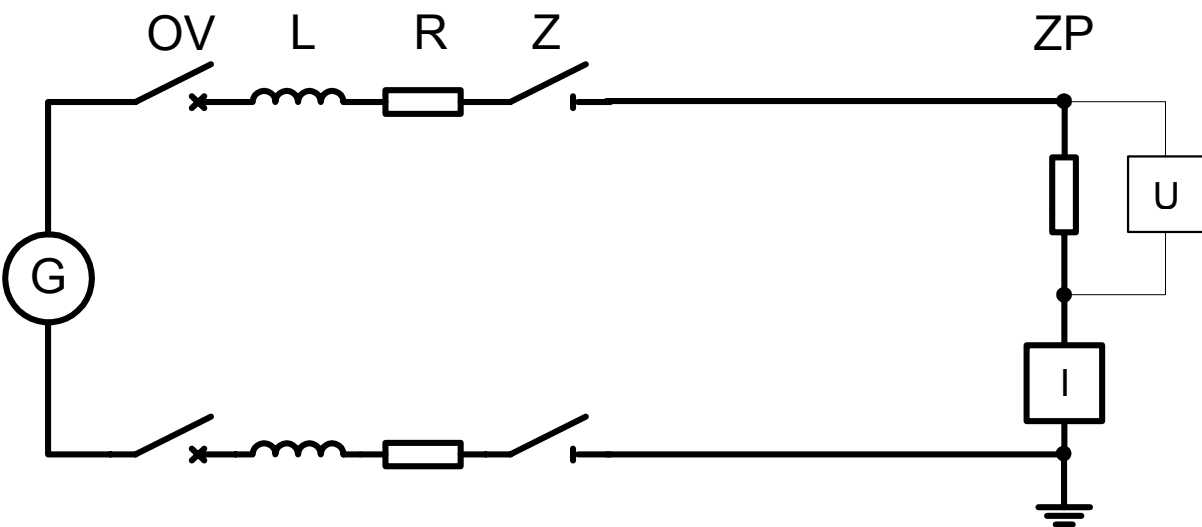
Test circuit diagram: REV121

File denomination: resi02hx.003

Measurand	Measuring sensor / device			Digital measuring system type DMS
	Type	Serial No.	Transfer constant	Input channel, serial No.
I	Cage shunt	007/95	2 kA / 2 V	100-10100-1
U	Resistance voltage divider	DR 006/78	12 kV / 150 V	100-10100-9
T1	Thermocouple to analog converter	1033-KL-3064-09	1 °C / 1 mV	100-10100-7
T2	Thermocouple to analog converter	1033-KL-3065-09	1 °C / 1 mV	100-10100-13
T3	Thermocouple to analog converter	1033-KL-3066-09	1 °C / 1 mV	100-10100-29

Meteorological conditions measurement

Meteorological station, type Vantage Pro 2, serial No. 3788A-6312



G - Short-circuit generator
OV - Master breaker
L, R - Reactors and resistors
Z - Make switch

ZP - Test object
I, U - Current and voltage measurement

Test circuit diagram REV121



Fig. 1
Neutral earthing resistor before the tests

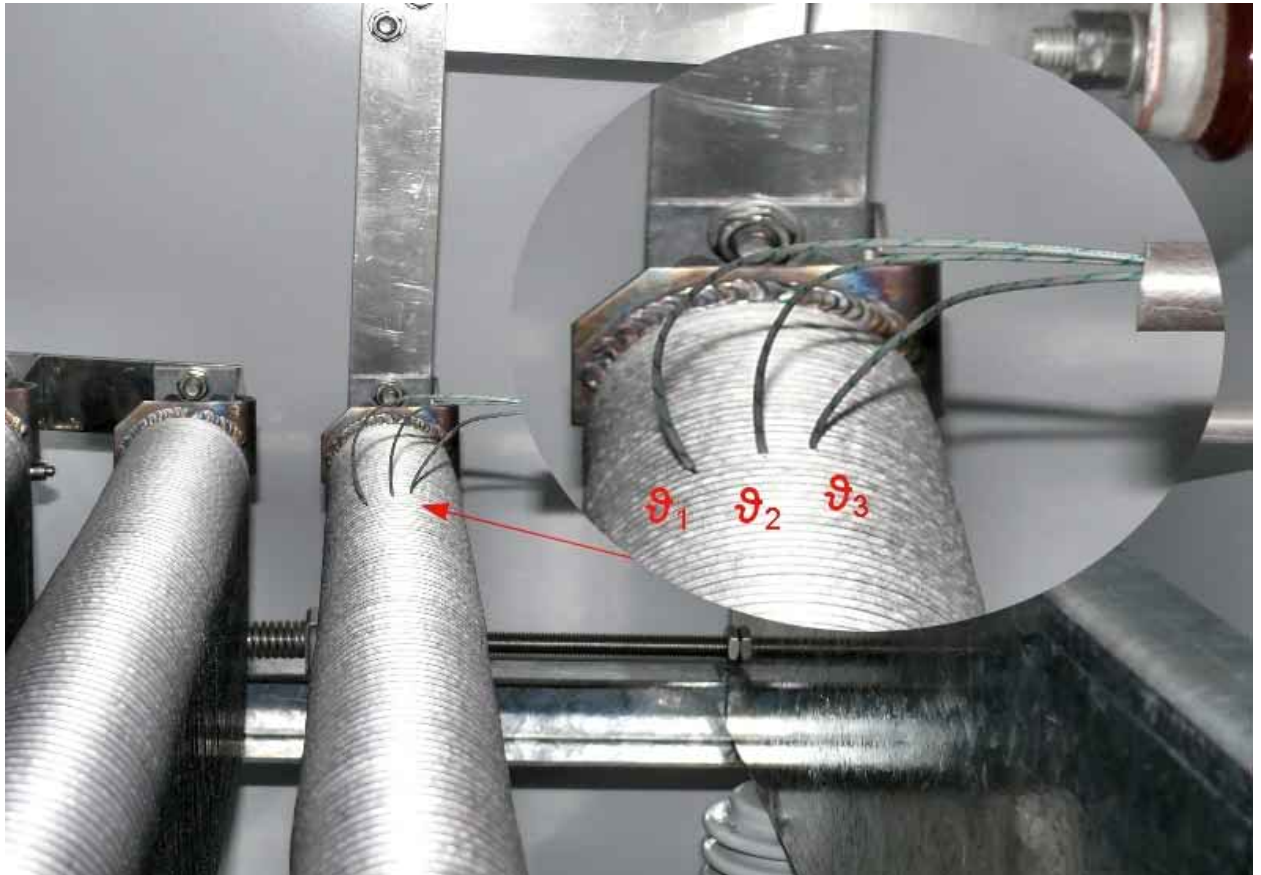


Fig. 2
Neutral earthing resistor before the tests and the thermocouples positions on active part



Fig. 3
Test object after the tests (removed cover)

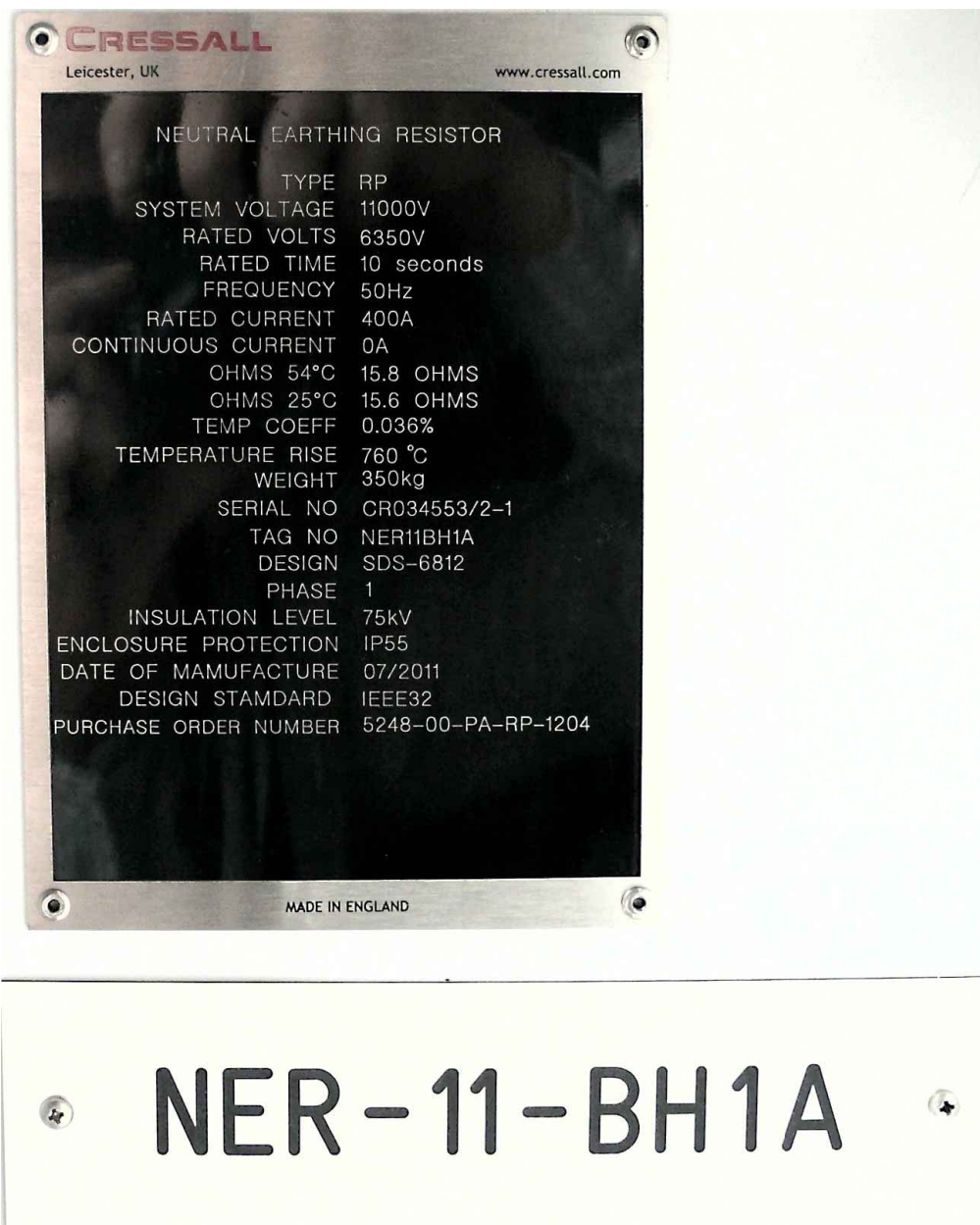
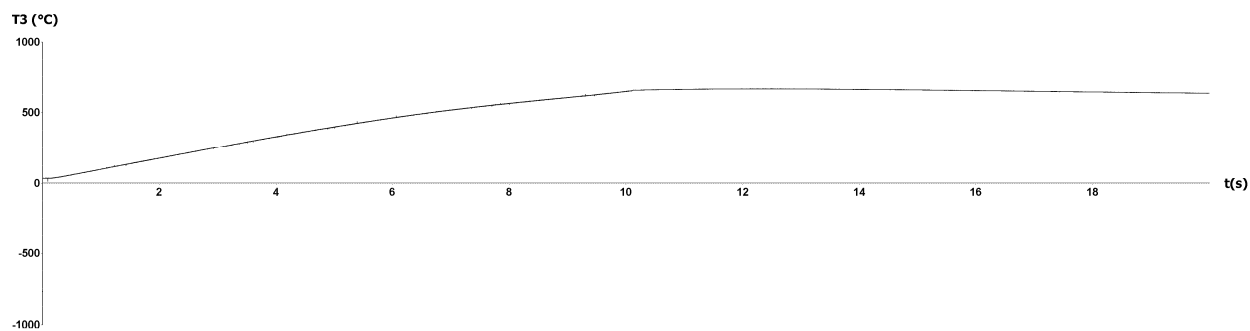
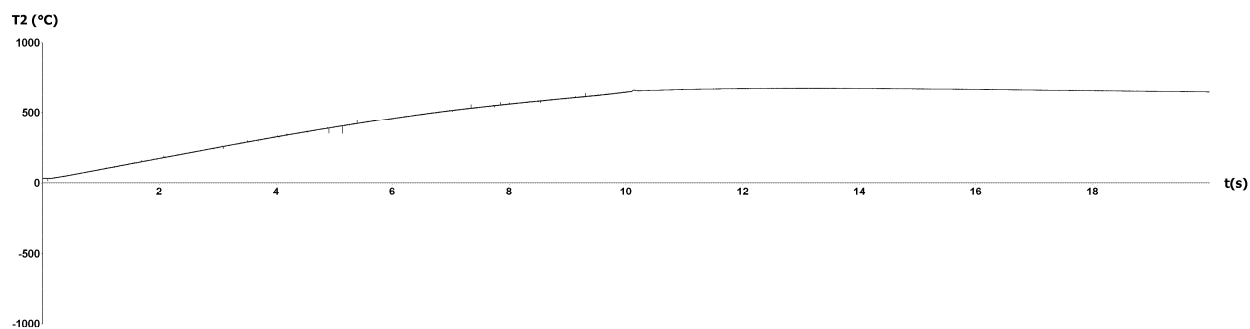
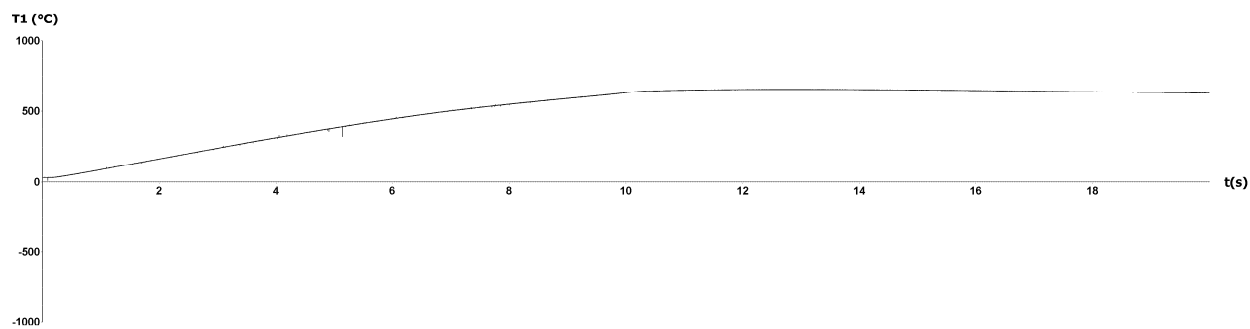
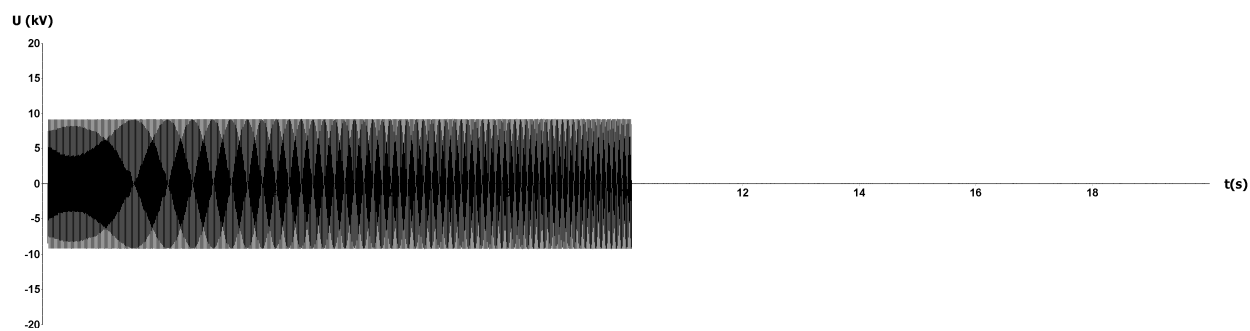
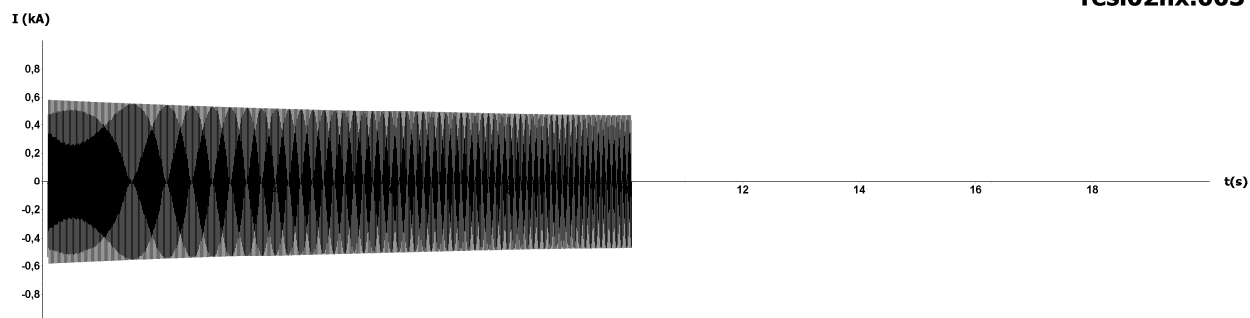


Fig. 4
Nameplate

Short-time current test 6,46 kV / 361 A / 10,0 s

resi02hx.003



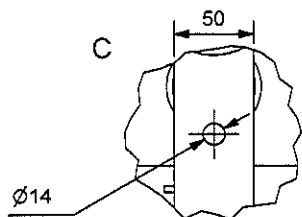
ENCLOSURE MATERIAL
FRAME: 2mm STAINLESS STEEL GRADE 316
COVERS: 2mm STAINLESS STEEL GRADE 316
FINISH: RAL 7035

DEGREE OF PROTECTION

A RESISTOR ENCLOSURE INGRESS (IEC60529) IP55
HV CABLEBOX INGRESS (IEC60529) IP55
ELECTRICAL (IEC60071) 75kV BIL (GRADED TO EARTH)

TECHNICAL DATA

SYSTEM VOLTAGE 11kV
LINE NEUTRAL VOLTAGE 6.35kV
RATED CURRENT 400A
RATED TIME 10s
CONTINUOUS CURRENT 0A
RESISTANCE AT 54°C 15.8 Ohms (±5%)
MAX ELEMENT TEMP RISE 760°C
ESTD. ENCLOSURE SURFACE TEMP. AFTER 10SECS. 200°C
ELEMENT TYPE EDGEWOUND 'RP' TYPE
ELEMENT MATERIAL STAINLESS STEEL ALLOY
TEMP COEFF OF RESISTANCE 0.036% PER °C
RESISTANCE CHANGE FOR 760°C RISE 27% APPROX
APPROX UNIT WEIGHT 350kg



NOTES

- PLEASE NOTE THE UNIT REQUIRES A MINIMUM OF 600mm HORIZONTAL CLEARANCE FOR ACCESS PURPOSES (EXCEPT AT THE REAR FACE 100mm ONLY REQUIRED)
- ENCLOSURE SUITABLE FOR OUTSIDE INSTALLATION
- ALL FASTENERS ARE STAINLESS STEEL
- ALL INSULATION IS CERAMIC

TAG NUMBERS:

NER11BH1A NER6BH1A
NER11BH1B NER6BH1B
NER12H1A NER3CH1A
NER12H1B NER3CH1B

ISOLATION SWITCH TO BE EQUIPPED WITH MECHANICAL KEY INTERLOCK BASED ON THE FOLLOWING:
- KEY CAN BE REMOVED FROM NER ONLY WHEN ISOLATION SWITCH IS CLOSED
- KEY SHALL BE TRAPPED WHILE ISOLATION SWITCH IS OPENED

RESISTOR ENCLOSURE
HINGED DOOR WHICH
CAN BE PADLOCKED
IN CLOSED POSITION

STAINLESS STEEL
RATING PLATE

NEUTRAL CONNECTION
M12 CLEARANCE
NEUTRAL CABLE
1C - 630 mm sq

BOLTED REMOVABLE
COVER

PORCELAIN M12
EARTH BUSHING
1.2kV / 30kV BIL
EARTH CABLE -
2 - 1C x 240 mm sq

EARTH CABLE ENTRY
VIA REMOVABLE
UNDRILLED ALUMINIUM
GLAND PLATE 200x200x3 THK
(SEE SHEET 2)

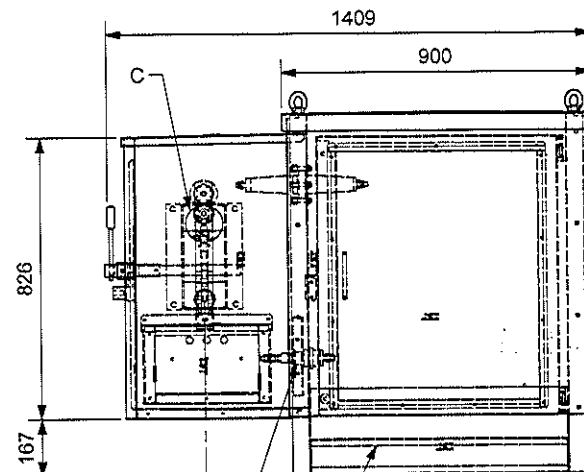
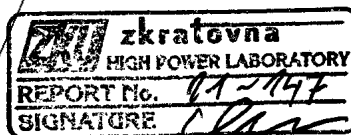
2 x M10 FRAME EARTH
(DIAGONALLY
OPPOSITE)
WITH ASSOCIATE NUTS,
WASHER ETC
SUITABLE FOR EARTH
CABLE - 1C X 70mm sq

NEUTRAL CABLE ENTRY
VIA REMOVABLE
UNDRILLED ALUMINIUM
GLAND PLATE
260x260x3 THK
(SEE SHEET 2)

4 x FIXING
HOLES Ø18

Ø18 (4 HOLES)

Ø10 (6 HOLES)



ANTI CON HEATER
FITTED IN CABLE BOX
AND RESISTOR
COMPARTMENT

LIFTING EYE

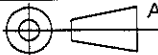
BASE PLATE FITTED

INCLINED CANOPY TO
PREVENT WATER BUILD UP

RESISTOR ENCLOSURE
HINGED DOOR WHICH
CAN BE PADLOCKED
IN CLOSED POSITION

HEATER AND ISOLATOR
AUXILIARIES IN LV
TERMINAL BOX
3mm THICK GLAND
PLATE FITTED

SINGLE POLE OFF LOAD ISOLATOR 12kV 400A
PADLOCKABLE IN OPEN / CLOSED POSITION
2N/C AND 2 N/O AUXILIARY CONTACTS
MECHANICAL / CODED KEY INTERLOCK
(FORTRESS BM1)

B	5406	ADDED CUSTOMER'S NOTE		25/05/2011	KA	AK
ISSUE	ECN	DESCRIPTION		DATE	DRAWN	APPROVED
MATERIAL: SEE ABOVE				WEIGHT: N/A		
FINISH: SEE ABOVE				1st CONTRACT: CR034553		
TOLERANCE: +/- 5 mm (UOS)		 A3		DRAWING TITLE		
DIMENSIONS IN mm (UOS)				NER ARRANGEMENT 11kV		
CRESSALL		TEL: (+44)(0)116 273 3633		DRAWING.No. 119032		
Evington Valley Road, Leicester.LE5 5LZ UK.		FAX: (+44)(0)116 273 7911 email: sales@cressall.com www.cressall.com				
© Cressall Resistors Ltd 2011		DRAWING STATUS: Released		SHEET 1 of 2		ISS B