Shenzhen LCS Compliance Testing Laboratory Ltd.
Add: 1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Tel: (86)755-82591330 Fax: (86)755-82591332 Internet: Http://www.LCS-cert.com

ELETRICAL AGEING TEST REPORT

Client company	:	**N.I.U ELECTRIC GROUP CO., LTD**
Client address	:	**NO.166 Liuqing North Road, Liushi Town, Yueqing, Zhejiang, China 325604**

Report on the submitted samples said to be:

Sample Name	:	**INSUALTED PIERCING CONNECTOR**
Trade Mark	:	**NIU**
Sample model	:	**NU-2**
Sample Receiving Date	:	**2015.10.10**
Testing Period	:	**2015.10.11 to 2015.11.06**
Results	:	**Please refer to next page(s).**

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TEST REQUEST

NF C33-004-1998
Insulated cables and their accessories for power systems – Connecting equipment for overhead distributions and services of rated voltage 0.6/1 kV with at least one insulated core – Electrical ageing test

CONCLUSION

PASS

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Signed for and on behalf of LCS

Written By: _____
Suez Su
File administrators

Approved by: _____
Hart Qiu
Manager

1. INTRODUCTION

1.1 Subject

This report presents the mechanical and dielectric in water tests of connectors NU-2 (main 16-95 / Tap 4-35). Tested products are of N.I.U ELECTRIC GROUP CO., LTD's manufacturer.

Test procedures are the ones of the standard NF C 33-004 dated June 1998.

For each test, there is a test sheet grouping procedures and resutls.

1.2 Tested products

Tested products areinsulated piercing connectors NU-2 with sections from 16 mm^2 to 95 mm^2 for main conductor and from 4 mm^2 to 35 mm^2 for tap conductor. These products have been delivered to LCS test laboratory on Oct 10, 2015.

1.3 Sample quantities

The connectors are numbered from 1 to 6.

2. STANDARD DOCUMENTS REFERED TO IN THIS REPORT

NF C 33-004 June 1998,
《Insulated cables and their accessories for power systems - Connecting equipment for overhead distributions and services of rated voltage 0.6/1 kV with at least one insulated core - Electrical ageing test》

NF C 33-209 July 1996,
《Insulated or protected cables for power systems - Bundle assembled cores for overhead systems of rated voltage 0.6/1 kV》

3. GENERAL CONDITIONS

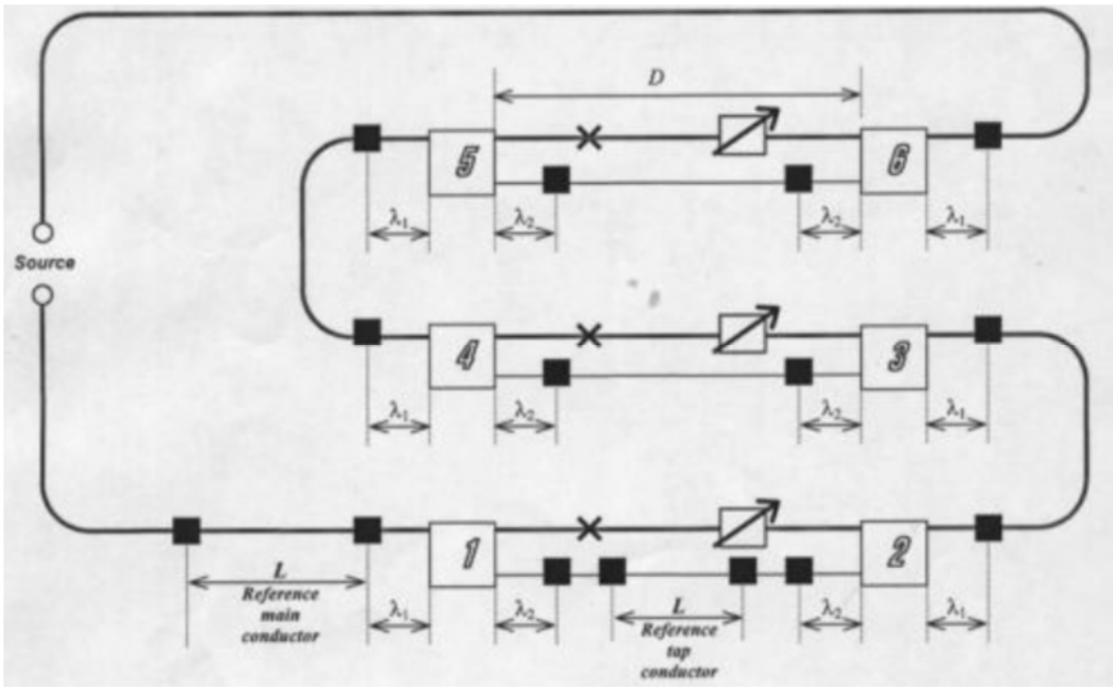
3.1 Temperature
Tests are carried out at the room temperature of the test laboratory between 20°C and 26°C.

3.2 Conductors used

Nominal cross-sectional area(in mm^2)	Number of strands and composition of core	Φ over insulant (in mm)	Φ over core (in mm)
95	*19 strands aluminium*	*14,4*	*11,2*
35	*7 strands aluminium*	*10,1*	*6,8*

4. TEST PROCEDURES

Procedures and acceptance criteria are the ones of standard NF C 33-004 (connector of class B).
The test loop carried out according to standard NF C 33-004 is the loop “D” in “Z” form.



LEGEND

☐	Connector	———	Aluminium 95mm² main conductor
■	Voltage measure point (equiplizer)	———	Aluminium 35mm² tap conductor
↗	Impedance corrector	X	Contactor

5. PREPARATION OF THE LOOP

- Parameters of the loop are calculated:

λ_1	λ_2	L	D
200mm	*150mm*	*350mm*	*800mm*

- Voltage measures are performed by means of equalizers(welding method: TIG, metal filler : aluminium 1 050A). Thery are placed as shown on the previous schema.

- Conductors that come out of the connectors, as well as the reference conductors, are equipped with terminal lugs for connection to the electric ageing bench.

- On the part of the main conductor between the connectors, are installed:
  - ◇ a dismountable joint (contactor) to enable the resistance measures,
  - ◇ an impedance corrector to regulate intensity so that temperature of the reference main conductor remains between 110°C and 120°C

- Reference conductors are stripped.

6. ASSEMBLY OF THE LOOP

- Conductors are inserted in the connector.
- Screw is tightened up to the 13,5 N.m minimal torque.
- Conductors equipped with terminal lugs are linked between each other, to the electric ageing bench and to contactors by means of bolts.
- Voltage measured points are installed.
- Temperature measured points are installed as follows:

	Type of thermocouple	Place of fixing	Type of hold
Connector	- type K, sheathed in a tube of inconel - diamater 1 mm	- at the lower put of the contact bridge, in a 1,2mm diameter hole	- covered with thermo-conductor grease - holding with a mastic type polywrethane
Reference conductor	- type K, sheathed in a tube of inconel - diamater 1 mm	- at the middle of the reference conductor core	- holding through a splice (copper wire diameter 0,4mm) - covered with thermo-conductor grease
Room temperature	- type K, sheathed in a tube of inconel - diamater 1 mm	- at the middle of the loop at 20cm under the horizontal level containing the connectors	/

7. PROCESS OF A CYCLE

Heating at 120°C of the reference Al 35mm^2 conductor	Duration	5min
	Intensity in the tap	~ 220A
	Intensity in the main	~ 430A
Step at 120°C of the reference Al 35mm^2 conductor	Duration	65 min
	Intensity in the tap	~ 180A
	Intensity in the main	~ 350A
Temperature measure every 10 cycle		
Cooling	Duration	25min
Resistance measure every 10 cycle		
Total duration of a cycle	Duration	95min

8. PERFORMING OF THE TEST – MEASURES

- Resistance measure is performed under a direct current of 15A, every 10 cycle at the end of the cooling time.
- Resistance values are put down at 20°C before using and the real resistances of the connectors (R_j) are calculated according to clause 5.3.3.4 of standard NF C33-004.
- Test is composed of 200 electric ageing cycles.

9. TEST RESULTS

See the following pages.

TABLE 1 – TEMPERATURE DATA RECORD

	Number of cycles																				
	1	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
	Temperature θj of connectors																				
Reference conductor 35mm^2	119.2	119.3	119.5	120.2	120.4	119.6	119.5	120.7	119.9	119.4	119.8	119.5	119.4	120.4	119.9	119.6	121.3	119.7	118.6	118.7	118.5
Reference conductor 95mm^2	110.2	114.9	110.8	117.8	111.6	113.4	110.9	113.5	115.2	115.8	113.7	116.6	113.2	116.5	112.1	115.5	111.3	112.8	112.2	112.3	112.6
Connector 1	72.5	71.9	70.6	73.4	72.1	70.6	70.5	71.4	71.3	73.3	73.1	73.2	71.5	74.1	70.4	72.3	71.6	72.4	71.8	71.5	71.6
Connector 2	71.2	71.5	70.8	71.9	70.7	70.4	69.1	70.2	71.3	71.5	71.2	72.4	70.8	70.8	70.1	68.7	66.5	69.3	67.1	68.3	68.7
Connector 3	72.7	73.2	72.1	73.5	71.8	70.3	69.7	71.6	71.9	71.8	72.6	70.3	70.7	73.4	70.4	70.8	68.8	71.1	70.2	70.4	70.8
Connector 4	73.9	75.5	74.3	76.4	75.1	72.2	72.3	73.8	74.2	75.6	76.3	76.3	74.5	76.7	77.3	74.6	72.2	75.5	73.9	74.1	74.3
Connector 5	70.6	69.2	68.5	69.7	69.1	66.8	67.1	68.6	67.2	69.6	71.8	70.4	68.3	68.4	68.2	68.1	66.7	67.8	68.3	67.4	68.5
Connector 6	70.5	71.6	69.8	72.3	71.6	71.3	70.7	70.6	70.6	71.8	73.4	73.9	70.7	74.6	70.6	72.8	71.5	73.2	72.4	72.5	72.4
Room Temp.	23.6	24.1	25.6	23.8	24.2	21.5	22.6	22.8	24.3	24.7	23.9	24.3	25.1	24.9	23.5	23.8	24.6	24.4	25.3	24.2	24.8

The enlarged measurement uncertainty of temperature is ± 1.5°C

TABLE 2 – TEMPERATURE CURVE RECORD

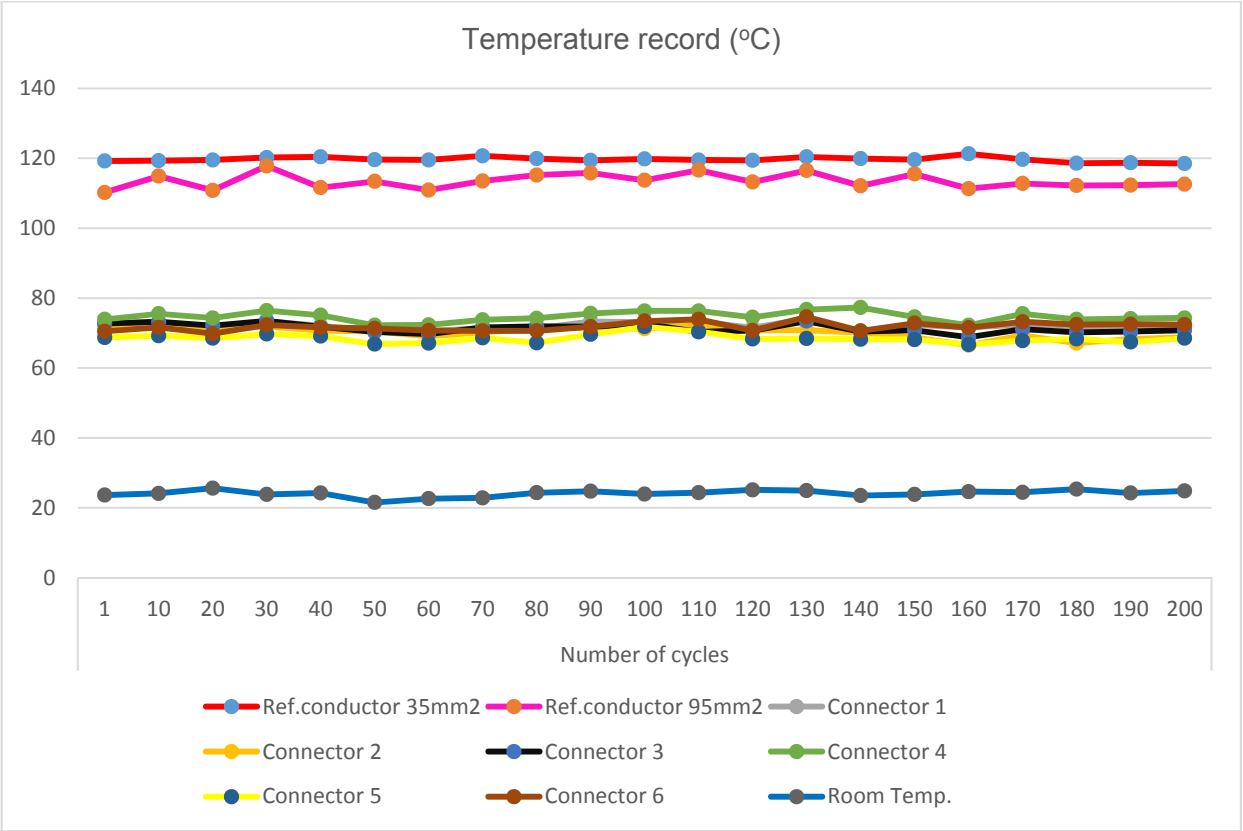
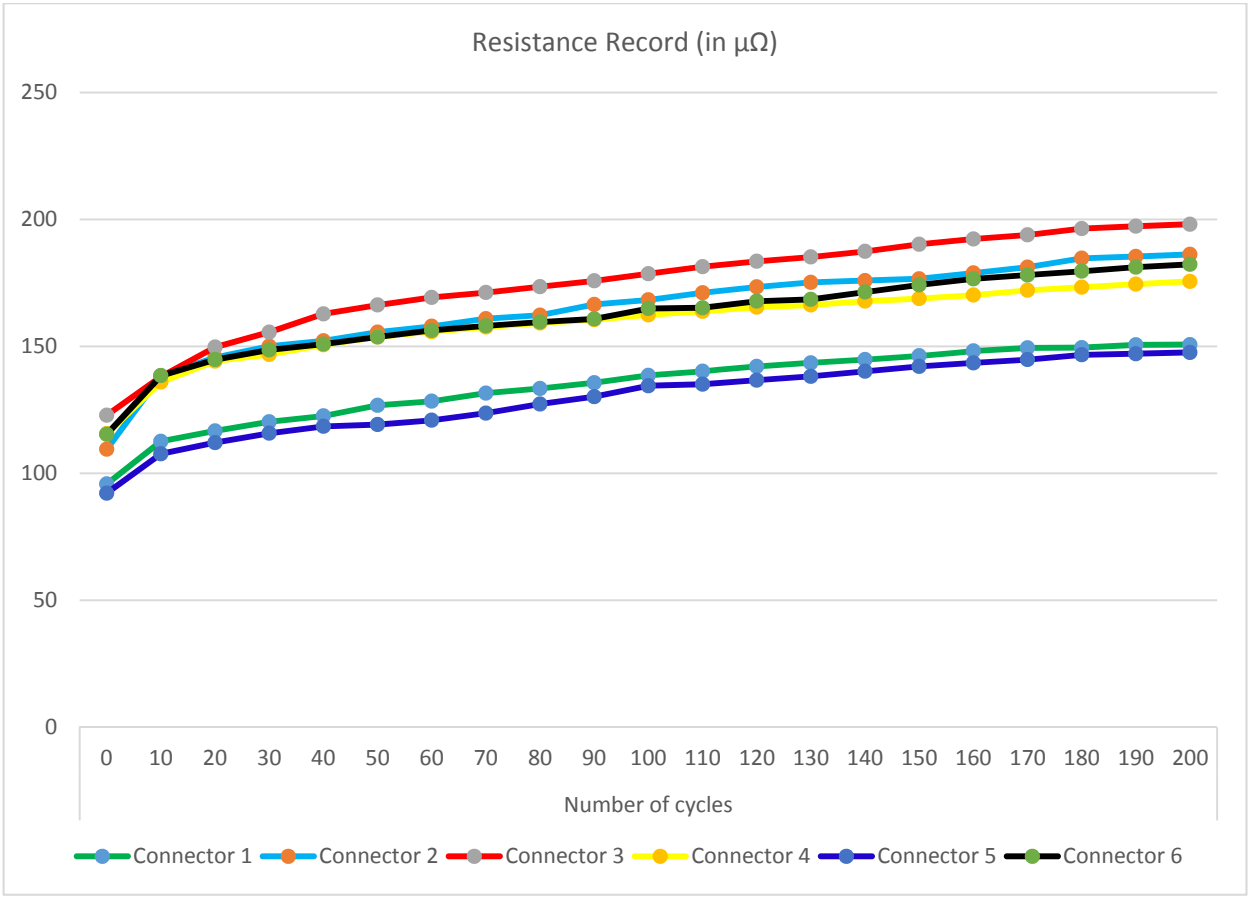


TABLE 3 – RESISTANCE DATA RECORD

	Number of cycles																				
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
	Resistance Rj of connectors																				
Connector 1	95.8	112.6	116.7	120.3	122.6	126.8	128.4	131.6	133.4	135.7	138.6	140.2	142.1	143.5	144.8	146.3	148.2	149.4	149.5	150.6	150.7
Connector 2	109.5	138.4	145.6	150.1	152.2	155.6	157.9	160.9	162.3	166.5	168.3	171.1	173.4	175.2	175.9	176.6	178.9	181.2	184.7	185.4	186.2
Connector 3	122.9	138.1	149.7	155.6	162.8	166.3	169.3	171.2	173.5	175.8	178.6	181.4	183.5	185.2	187.4	190.2	192.3	193.9	196.4	197.3	198.1
Connector 4	115.6	135.9	144.2	146.8	150.6	153.7	155.8	157.6	159.2	160.5	162.4	163.8	165.4	166.3	167.8	168.8	170.2	172.1	173.3	174.5	175.6
Connector 5	92.2	107.7	112.1	115.8	118.5	119.2	120.9	123.7	127.3	130.2	134.5	135.1	136.7	138.2	140.2	142.1	143.5	144.8	146.7	147.1	147.6
Connector 6	115.4	138.5	144.8	148.6	150.9	153.7	156.3	158.1	159.6	160.8	164.9	165.2	167.8	168.5	171.4	174.2	176.6	178.1	179.6	181.2	182.3

The enlarged measurement uncertainty of resistances Rj is ± 3.1μΩ.

TABLE 4 – RESISTANCE CURVE RECORD



The results are the ones of clause 5.4 of standard NF C33-004 which defines the following acceptance criteria:

- Relative initial scatter of resistances Rj before the first heating cycle: δ ≤ 0,30
- Stability of resistances Rj (on the 100th last cycles):

$$\frac{\Delta R_j}{\overline{R_j}} \leq 12\%$$

- Stability of temperatures θ_j (on the 100th last cycles):

$$\overline{d_j} - 10 \leq d_j \leq \overline{d_j} + 10$$

with

$d_j = \theta_R - \theta_j$

θ_R: temperature of the warmest reference core

$\overline{d_j}$: mean of the differences d_j

$\theta_j \leq$ Max θ_R

Equivalent to check: Min $d_j \geq 0$

1) Temperature

Sample No.	Temperature stability (in K)			
	$\overline{d_j} - 10$	Min d_j	Max d_j	$\overline{d_j} + 10$
1	43.9	47.2	50.7	54.9
2	41.9	48.9	54.8	61.9
3	40.4	47.8	52.5	60.4
4	36.2	44.0	49.1	56.2
5	42.8	49.5	54.6	62.8
6	38.8	46.7	51.5	58.8

The enlarged measurement uncertainty of differences d_j is ± 1.8 K

2) Resistance

Initial scatter: δ = 0.017

Sample No.	Resistance stability (in %) $\frac{\Delta R_j}{\overline{R_j}}$
1	8.3%
2	10.1%
3	10.3%
4	7.8%
5	9.3%
6	10.0%

The enlarged measurement uncertainty are:
- ± 0.023 for initial scatter δ
- ± 2.5% for variations

APPENDIX – SAMPLE PHOTO

********** THE END **********