




# Product Test Report

## BN105 to IEC 62561-1: 2012

## 1 Revision Record

| Rev | Description     | Prep.  | Check'd | App'd   | Date       |
|-----|-----------------|--------|---------|---|------------|
| 0   | Original issue. | A.P.M. | A.P.M.  |  | 23/09/2013 |

## 2 Introduction

This report details the testing of the Furse component BN105; Type 'B' bond in accordance with IEC 62561-1:2012 Lightning Protection System Components (LPSC) – Part 1: Requirements for connection components.

### 2.1 Declaration


The above product supplied by Furse has been successfully tested in accordance with IEC 62561-1:2012 Lightning Protection System Components (LPSC) – Part 1: Requirements for connection components.

Therefore this component is declared appropriate for use in a lightning protection system (LPS) in line with the scope below.

### 2.2 Scope of Conformity

For use in a lightning protection system (LPS) for the termination of Copper tape in accordance with Furse literature. In a T connection (B6). For an impulse current withstand capability of 100kA (class H).

## 3 Variant Part Numbers

|   |   |                        |                     |
|---|---|------------------------|---------------------|
|  | Document:<br>Product Test Report<br>Furse BN105 to IEC 62561-1:2012 | Doc No:<br>BN105_TR_02 |                     |
|   |   | Rev:<br>0              | Date:<br>23/09/2013 |

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**RESEARCH CENTRE FOR TESTS AND DEVELOPMENT  
SURGE CURRENT  
AND HIGH VOLTAGE LABORATORY  
ELEMKO SA**

**TEST REPORT No. 31263**

**OF COPPER ALLOY “B” BOND, PART NUMBER : BN105  
IN “T” ARRANGEMENT (B6),**

**COMPANY :**



**APPLICABLE STANDARD:  
IEC/BS EN 62561-1:2012**



<http://www.a2la.org/scopepdf/3051-01.pdf>

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## ABBREVIATIONS

IEC : International Electrotechnical Commission  
ISO : International Standardization Organization  
EN : European Norm  
A2LA : American Association for Laboratory Accreditation

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## **1. (8) STRUCTURE AND CONTENT OF THE TEST REPORT**

### **1.1 (8.1) General**

For the purpose of the easier assimilation of this report by the reader and for the better and the complete presentation of the test data, which is required by the standard IEC/BS EN 62561-1, the format of the headings kept the same as it is mentioned in clause 8 of the above standard.

For the better comparison and completeness of this report with the standard's requirements, the corresponding numbering of the standard is also mentioned in each clause, in brackets.

## **2. (8.2) REPORT IDENTIFICATION**

### **2.1 (8.2.a.) Subject of the report**

Description and results presentation of laboratory type testing according to IEC/BS EN 62561-1 on type "B" bond provided by FURSE (THOMAS & BETTS) with part number BN105.

### **2.2 (8.2.b) Name, address and telephone number of the test laboratory**

Research Development and Testing Centre – High Voltage and High Current Testing laboratory  
ELEMKO SA

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Tel: (+30) 2262024523 - 2262024574,

Fax : (+30) 2262023571

e-mail: [elemko@elemko.gr](mailto:elemko@elemko.gr)

### **2.3 (8.2.c) Name, address and telephone number of the sub contracting test laboratory**

There were no tests subcontracted by other laboratory.

**2.4 (8.2.d) Number of test report :** 31263

### **2.5 (8.2.e) Applicant's name and address**

**Request number:** 155

**Name:** FURSE (THOMAS & BETTS)

**Address:** Wilford Road, Nottingham NG2 1EB,  
United Kingdom

**2.6 (8.2.f) Total number of pages:** 16

**2.7 (8.2.g) Date of issue of report:** 2013/08/08

### **2.8 (8.2.h) Dates of performance the tests**

**Initiation date:** 2013/07/12

**Closing date:** 2013/08/01

**2.9 (8.2.i) Authorized person to sign for the testing laboratory for the content of the report****Dr. N. KOKKINOS**

Electrical Engineer Beng, MSc, PhD

Laboratory Technical Manager

**2.10 (8.2.j) The tests were conducted by****L. KATSIKOIANNIS**

Electrical Engineer

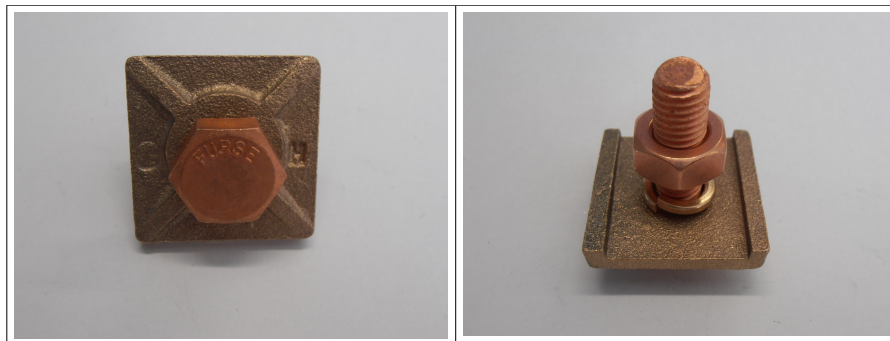
Test engineer

**S. MARKOU**

Laboratory Technician

**3. (8.3) SPECIMEN DESCRIPTION****3.1 (8.3.a) Sample description**

Type "B" bond of FURSE company, for bonding tape conductor to steel structure. It is consisting of an copper alloy plate 34,5x34,5 mm approx. dimensions (LxW), an M10x35 mm copper alloy bolt, an M10 copper alloy nut and an M10 copper alloy spring lock washer.



Photographs of the specimen

**3.2 (8.3.b) Detailed description and unambiguous identification of the test assembly**

Six type "B" bonds, each connected with 25x3 mm copper solid tape conductor and steel metal installation (40x6 mm steel tape) in "T" connection arrangement (B6), as per Annex B of the standard. For traceability, the specimens were marked with the identification numbers 31263 A, 31263 B & 31263 C (specimens intended for the electrical test) and 31263 D, 31263 E & 31263 F (specimens intended for the static mechanical test).

Specimen configuration is illustrated in clause 3.6.

**3.3 (8.3.c) Characterization and condition of the test specimen and/or assembly**

The received specimens were new and in good condition.

**3.4 (8.3.d) Sampling procedure**

Not relevant.

**3.5 (8.3.e) Date of receipt of test items : 2013/07/12**

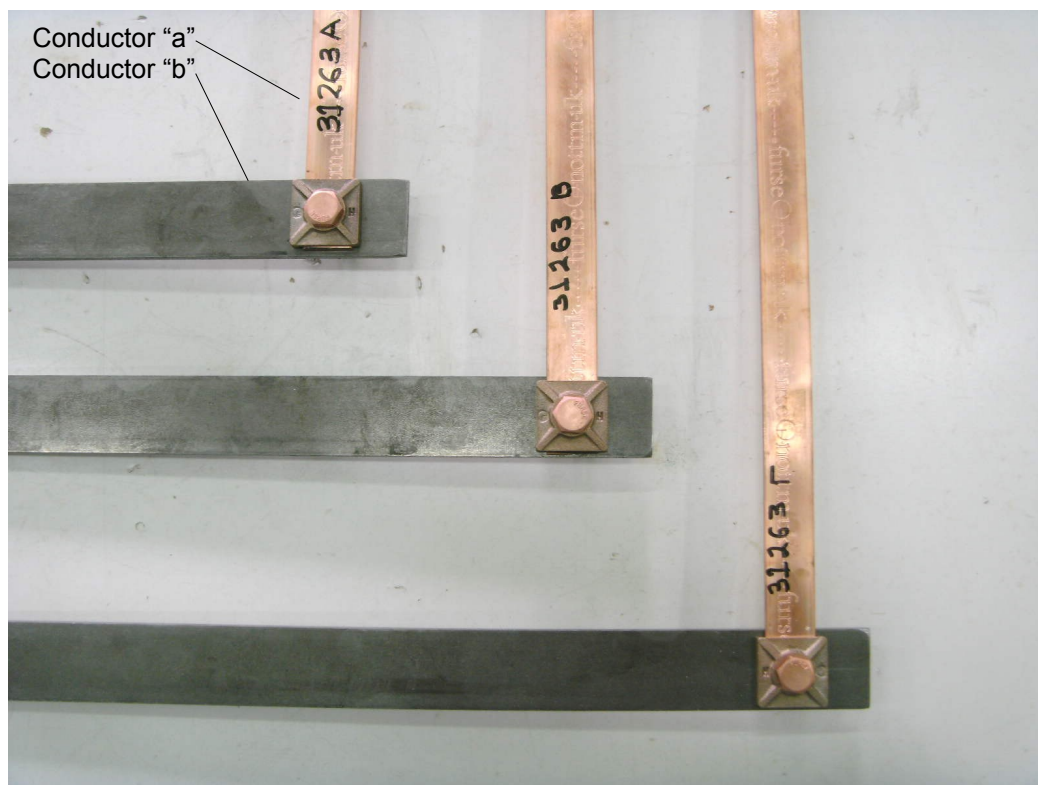
**Research Development and Testing Centre – High Voltage and High Current Testing laboratory ELEMKO SA**

2<sup>nd</sup> km Thiva-Chalkida Old National Road, GR 32200, THIVA

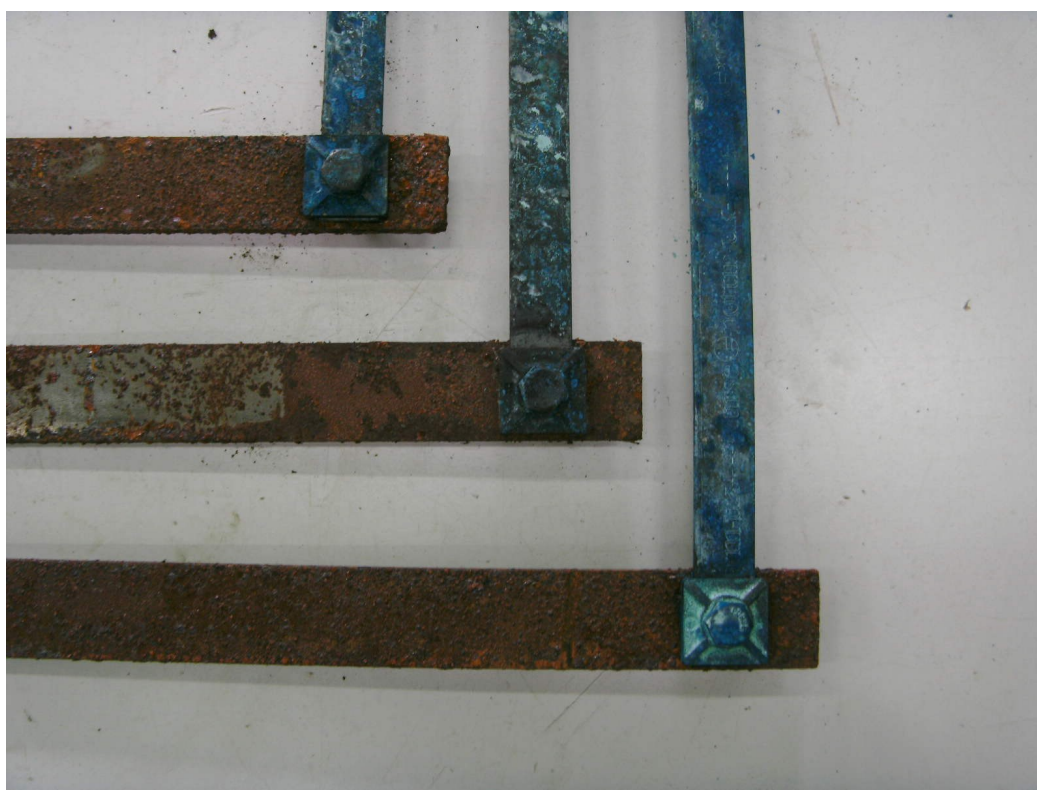
Tel : (+30) 2262024523 - 24574, Fax : (+30) 2262023571



### 3.6 (8.3.f) Photographs



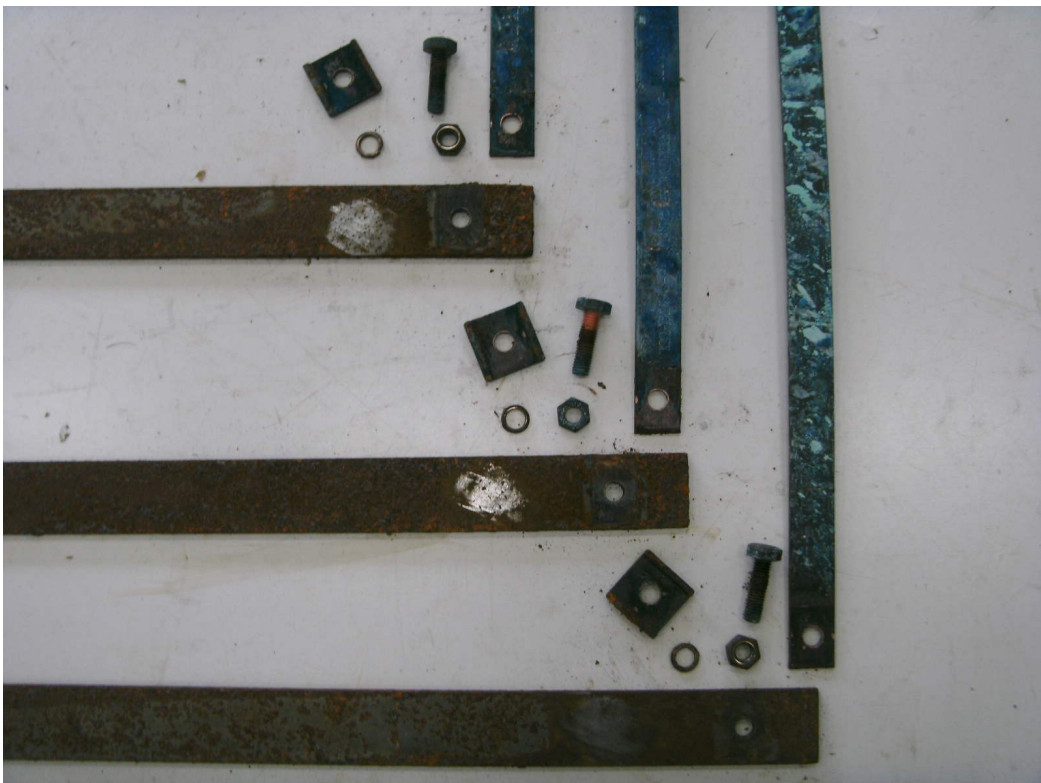
1. The assembled specimens before the initiation of the test sequence



2. The specimens following the termination of conditioning/ageing tests



3. The specimens following the termination of the electrical tests.



4. The specimens fully disassembled following the termination of the tests.

## **4. (8.4) CONDUCTORS**

### **4.1 (8.4.a) Conductors' material**

Conductor "a": Copper.

Conductor "b": Steel .

### **4.2 (8.4.b) Nominal cross-section area, dimensions and shape**

Conductor "a": 75 mm<sup>2</sup>, 25x3 mm solid tape.

Conductor "b": 240 mm<sup>2</sup>, 40x6 mm solid tape.

## **5. (8.5) STANDARDS AND REFERENCES**

### **5.1 (8.5.a) Test standard used**

- BS EN 62561-1:2012 "Lightning protection system components (LPSC) – Part 1: Requirements for connection components". (IEC 62561-1:2012, modified) - COMMON MODIFICATIONS.
- IEC 62561-1:2012 "Lightning protection system components (LPSC) – Part 1: Requirements for connection components".

### **5.2 (8.5.b) Other relevant documentation**

- EN 62305-1 "Protection against lightning – Part 1: General principles" (IEC 62305-1).
- EN 62305-3 "Protection against lightning – Part 3: Physical damage to structures and life hazards" (IEC 62305-3, mod.).
- EN 62305-4 "Protection against lightning – Part 4: Electrical and electronic systems within structures" (IEC 62305-4).
- Furse, Thomas & Betts, Total Solution Product Catalogue, as downloaded from the website of Thomas & Betts, [www.tnb.com](http://www.tnb.com) in July 2013.

## **6. (8.6) TEST PROCEDURE**

### **6.1 (8.6.a) Description of the test procedure**

According to IEC/BS EN 62561-1 the following tests has to be performed:

- Inspection on installation instructions literature provided by applicant as per clause 5.2 of the standard.
- Lightning current carrying capability as per clause 6.3 of the standard.

This test is consisted of:

- Conditioning / ageing test as per clause 6.2.2 of the standard.
- Electrical test as per clause 6.3 of the standard.
- Contact resistance measurement test as per clause 6.3.a of the standard.
- Visual inspection of the specimens after the completion of the tests as per clause 6.3.b of the standard.
- Screw clamping loosening torque as per clause 6.3.c of the standard.
- Static mechanical test to a second set of three new specimens as per clause 6.4 of the standard.
- Marking test as per clause 6.5 of the standard.



For each test 3 specimens were used. The specimens were assembled in a typical arrangement as per Annex B of the standard, according to the applicant's instructions.

Before beginning of tests all specimens were cleaned by using a suitable degreasing agent and each one was marked for identification.

The tests were performed according the standard IEC/BS EN 62561-1. Requirements and results are illustrated in detail in clause 9 "Results and parameters recorded" of the present report.

Initially it was checked that the installation instructions were adequate so as the selection of the tested connection components and its installation could be performed in a suitable and safe manner.

Marking on the specimens was made by moulding and it was visually inspected.

The assembly was made in "T" connection (B6) arrangement, according to IEC/BS EN 62561-1 (see 6.4 "configuration of testing assembly"), using a 25x3 mm copper solid tape conductor and a 40x6 mm steel tape (metal installation).

The bolts of the specimens were tightened with a torque wrench. The tightening torque given by the applicant was 17 Nm.

The test assemblies identified as A, B and C were subjected to a conditioning /ageing test according to IEC/BS EN 62561-1 consisting of:

- salt mist treatment for 3 days according to IEC 60068-2-52:1996, except clauses 7, 10 and 11 which are not applicable;
- humid sulphurous atmosphere treatment for 7 days according to ISO 6988:1985, except clauses 9 and 10 which are not applicable.
- ammonia atmosphere treatment for 1 day according to ISO 6957:1988, except 8.4 and clause 9 which are not applicable.

After conditioning/ageing test and without cleaning the test assemblies A, B & C, each one was stressed three (3) times by an impulse current with a negative polarity. In order to test them for class H lightning current withstand capability, the applied impulse test currents had a peak magnitude (I<sub>imp</sub>) of 100 kA  $\pm 10\%$ , and a specific energy (W/R) of 2,50 MJ/ $\Omega \pm 35\%$  measured up to a waveform duration of 5 ms and a front duration equal or less than 50  $\mu$ s, as per table 1 of IEC/BS EN 62561-1.

Upon completion of the tests the following measurements and inspections were performed on each test assembly:

- The contact resistance measurement by means of a digital micro-ohmmeter.
- The measurement of the loosening torque by means of a torque meter.
- The visual inspection in order to ensure that each test specimen:
  - did not exhibit any crack, nor any loose parts or deformation impairing its normal use;
  - did not damage the conductors and / or the metal installations.

The test assemblies identified as D, E and F were subjected to a mechanical tensile force of 900N  $\pm$  20N for 1 min (static mechanical test). Each conductor of the specimen assemblies were subjected independently to the mechanical tensile force.

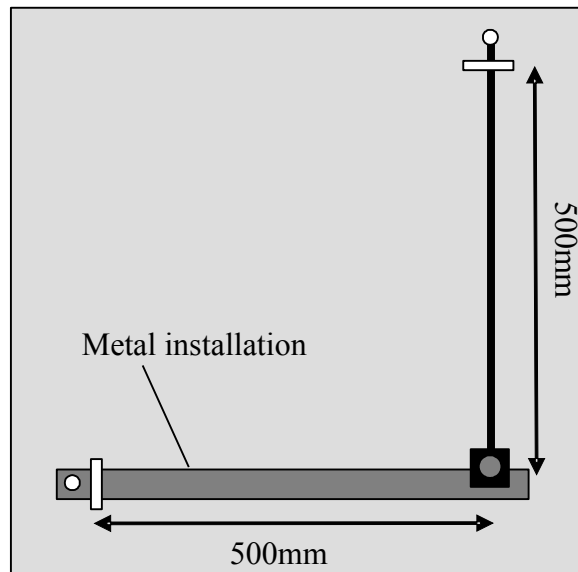
## **6.2 (8.6.b) Justification for any deviations from, additions to or exclusions from the referenced standard**

There are no deviations from, additions to or exclusions from the referenced standard.

## **6.3 (8.6.c) Other information relevant to the tests**

All information is tabled in clause 9 of this report.

#### 6.4 (8.6.d) Configuration of the testing assembly



*B6: Clamp for T-connection – Test Arrangement*

#### 6.5 (8.6.e) Location of the arrangement in the testing area

Environmental / Ageing tests were performed in our laboratory's "conditioning test room".  
The electrical tests were performed in our laboratory's "high voltage area".  
Mechanical tests were performed in our laboratory's "Mechanical tests room".

### 7. (8.7) TESTING EQUIPMENT DESCRIPTION

1. Environmental chamber for salt mist ageing, serial nr. 4318.
2. Environmental chamber for humid sulphurous atmosphere ageing, serial nr. 4077.
3. Ammonia ageing chamber.
4. Impulse current generator 0-100kA, 0-65C, 0-187kJ.
5. 4-channel trigger / delay pulse generator serial nr. 09720.
6. Shunt 1 mΩ.
7. 20kg weights.



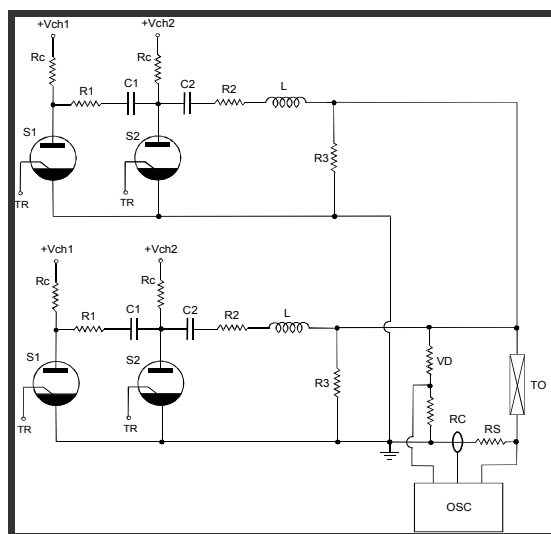
Photograph of the environmental ageing chamber used for salt mist ageing.



Photograph of the environmental ageing chamber used for humid sulphurous atmosphere ageing.



Photograph of the 100kA, 10/350 $\mu$ s impulse current generator.



|                                      |                        |
|--------------------------------------|------------------------|
| Vch1 : Start bank charging voltage   | S1 : Start switches    |
| Vch2 : Sustain bank charging voltage | S2 : Sustain switches  |
| Rc : Charging Resistors              | TR : Triggering module |
| R1 : Start Resistor                  | VD : Voltage Divider   |
| R2 : Sustain resistor                | RC : Rogowski coil     |
| R3 : Bleeding resistor               | RS : Resistive shunt   |
| L : Stray inductance                 | TO : Test object       |
| C1 : Start Capacitor                 | OSC: Oscilloscope      |
| C2 : Sustain Capacitor               |                        |

Figure a : A schematic diagram of the 100kA, 10/350 $\mu$ s impulse current generator.

## 8. (8.8) MEASURING INSTRUMENTS DESCRIPTION

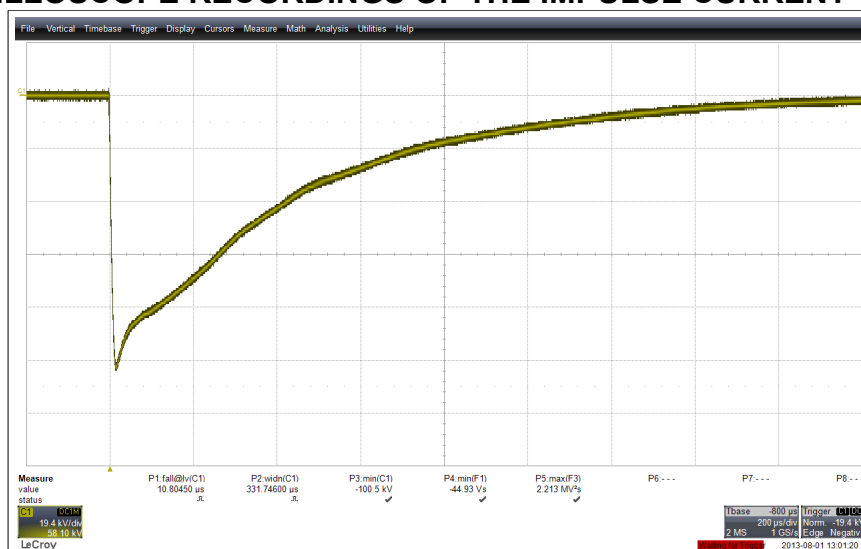
| Instrument  | Calibration date         | Calibration interval |
|---|--------------------------|----------------------|
| 1. Torque meter, 0-30Nm, serial nr. 0901610877  | 2012/08/31               | 1 year               |
| 2. Digital micro-ohmmeter, 5 $\mu\Omega$ -400 $\Omega$ , serial nr. 166423.             | 2013/05/30               | 1 year               |
| 3. 4-channel, digital oscilloscope, serial nr. LCRY3203N57222.                          | 2012/09/12               | 1 year               |
| 4. Temperature, barometric pressure and humidity meter.                                 | 2013/07/24<br>(internal) | 1 year               |
| 5. Digital sliding callipers (thickness gauge), 0-150 $\pm$ 0.01mm serial nr. 1U206306. | 2012/08/17               | 1 year               |
| 6. Balance, serial number 83017901.   | 2011/11/21               | 3 years              |

## 9. (8.9) RESULTS AND PARAMETERS RECORDED

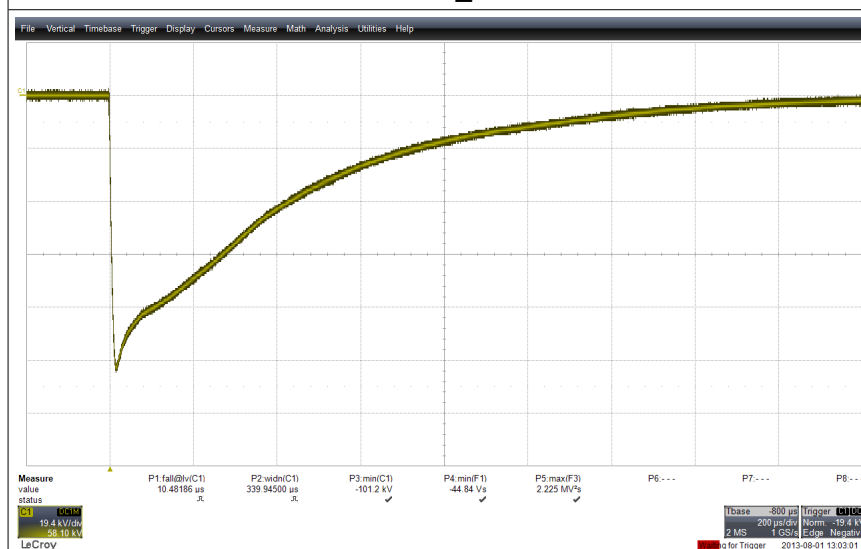
| REQUIREMENTS       |  |   | RESULTS  |       |                    |   |                    |        |   |       |       | PASS/<br>FAIL |  |
|--------------------|--|---|--|-------|--------------------|---|--------------------|--------|---|-------|-------|---------------|--|
| CLAUSE             | TEST - INSPECTION  | IDENTIFICATION OF SPECIMEN                                  |  |       |                    |   |                    |        |   |       |       |               |  |
|                    |  | 31263A  |  |       | 31263B             |   |                    | 31263C |   |       |       |               |  |
| 5.2                | <u>Installation instructions shall contain:</u> <ul style="list-style-type: none"><li>• classification of the component</li><li>• recommended tightening torque</li><li>• range of conductors - materials</li><li>• connection configuration</li></ul> |   | Inspection's results: <ul style="list-style-type: none"><li>• provided</li><li>• provided</li><li>• provided</li><li>• provided</li></ul>            |       |                    |   |                    |        |   |       |       | PASS          |  |
| 6.2.2;<br>Annex C1 | <u>Conditioning/ageing</u><br>Salt mist treatment (IEC 60068-2-52)   |   | Start : <b>2013/07/17</b> End : <b>2013/07/20</b>  |       |                    |   |                    |        |   |       |       | PASS          |  |
| 6.2.2;<br>Annex C2 | <u>Conditioning/ageing</u><br>Humid sulphurous atm. treatment (ISO 6988)   |   | Start : <b>2013/07/23</b> End : <b>2013/07/30</b>  |       |                    |   |                    |        |   |       |       | PASS          |  |
| 6.2.2;<br>Annex C3 | <u>Conditioning/ageing</u><br>Ammonia atmosphere treatment (ISO 6957)  |   | Start : <b>2013/07/31</b> End : <b>2013/08/01</b>  |       |                    |   |                    |        |   |       |       | PASS          |  |
| 6.3                | <u>Electrical test</u><br>(Impulse current of 100 kA peak $\pm$ 10% and specific energy W/R 2,5 MJ/ $\Omega$ $\pm$ 35%)  | Test current:   | A1   | A2    | A3                 | B1  | B2                 | B3     | C1  | C2    | C3    |               |  |
|                    |  | Peak (kA):  | 100,5  | 101,2 | 100,5              | 100,5   | 100,5              | 100,5  | 101,2   | 100,5 | 101,2 |               |  |
|                    |  | W/R (MJ/ $\Omega$ ):  | 2,213  | 2,225 | 2,228              | 2,216   | 2,235              | 2,217  | 2,211   | 2,223 | 2,222 |               |  |
|                    |  | shot nr:  | 8084   | 8085  | 8086               | 8087  | 8088               | 8089   | 8090  | 8091  | 8092  |               |  |
|                    |  | Environmental conditons:<br>Humidity – Temper. - Atm. pres. | 48% - 33° C – 995 mbar   |       |                    |   |                    |        |   |       |       |               |  |
| 6.3.a              | <u>Contact resistance Rc (<math>\mu\Omega</math>)</u><br>(requirement $R_c \leq 1000 \mu\Omega$ )<br>( Rc <sub>before</sub> : before ageing, Rc <sub>after</sub> : after ageing)   |   | Rc <sub>before</sub> : 128<br><br>Rc <sub>after</sub> : <b>66</b>  |       |                    | Rc <sub>before</sub> : 125<br><br>Rc <sub>after</sub> : <b>85</b> |                    |        | Rc <sub>before</sub> : 112<br><br>Rc <sub>after</sub> : <b>93</b> |       |       | PASS          |  |
| 6.3.d              | <u>Length of the conductor from connector (mm)</u><br>(requirement: not less than 3 mm)  |   | “a”: -      “b”: -   |       | “a”: -      “b”: - |   | “a”: -      “b”: - |        |   |       |       | N/A           |  |
| 6.3.c              | <u>Loosening torque TL (Nm)</u><br>(requirement $0,25T_T \leq T_L \leq 1,5T_T$ )<br>( <i>T<sub>T</sub></i> :tightening torque)   |   | T <sub>T</sub> : <b>17,0</b><br><br>T <sub>L</sub> : <b>18,0</b>   |       |                    | T <sub>T</sub> : <b>17,0</b><br><br>T <sub>L</sub> : <b>17,0</b>  |                    |        | T <sub>T</sub> : <b>17,0</b><br><br>T <sub>L</sub> : <b>22,0</b>  |       |       | PASS          |  |
| 6.3.b              | <u>Visual inspection</u><br>(requirement: no cracks or loose parts or deformation impairing its normal use, no damage to the conductors and/or metal installations)  |   | Y  |       |                    | Y   |                    |        | Y   |       |       | PASS          |  |
| 6.3.g*             | <u>Tensile force 900N±20N for 1 min</u><br>(applicable to screw-less components.)  |   | -  |       |                    | -   |                    |        | -   |       |       | N/A           |  |
| 6.4*               | <u>Static mechanical test 900N±20N for 1 min</u><br>(On a 2 <sup>nd</sup> set of specimens. Requirement: movement of the conductor < 1mm, no damage to conductor or component)   | Conductor:  | 31263D   |       |                    | 31263E  |                    |        | 31263F  |       |       | PASS          |  |
|                    |  |   | “a”  |       | “b”                |   | “a”                |        | “b”   |       |       |               |  |
|                    |  |   | Force (N):   |       | 908                |   | 908                |        | 908   |       | 908   |               |  |
|                    |  |   | Movement (mm):   |       | 0                  |   | 0                  |        | 0   |       | 0     |               |  |
| 6.5                | Marking shall be durable and legible.<br>The components shall be marked with (a) name or trade mark, (b) identifying symbol, (c) classification. Where this proves to be impractical (b) & (c) may be given on the smallest packing unit.              | Visual check:   | Y  |       | Y                  |   | Y                  |        | Y   |       | PASS  |               |  |
|                    |  |   | Only inspection performed as the marking (trade mark, classification) is made by moulding. Identifying symbol is given on the smallest packing unit. |       |                    |   |                    |        |   |       |       |               |  |
| Comments:          |  |   |  |       |                    |   |                    |        |   |       |       |               |  |
| NO COMMENTS        |  |   |  |       |                    |   |                    |        |   |       |       |               |  |

\* Not accredited for these tests Y: Fulfils the requirements. N: Do not fulfil the requirements. N/A: Not applicable

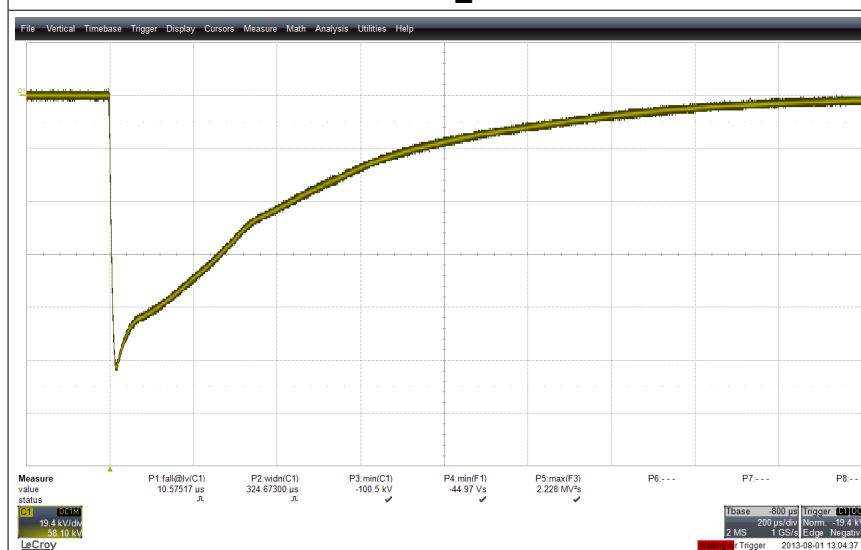
## OSCILLOSCOPE RECORDINGS OF THE IMPULSE CURRENT TESTS



31263\_A1

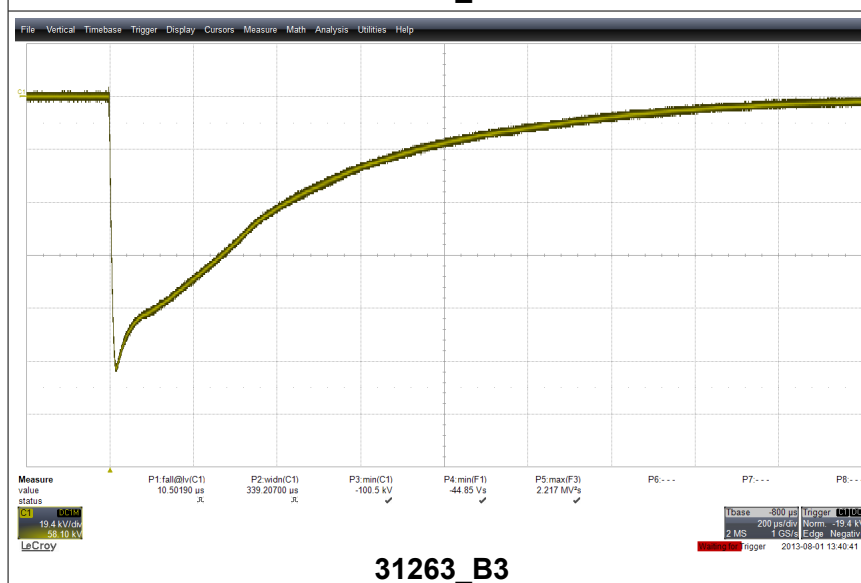
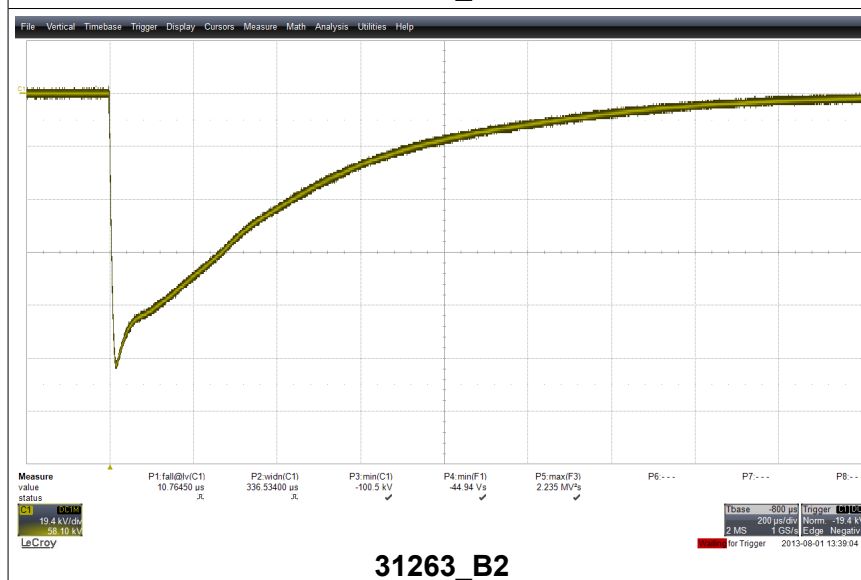
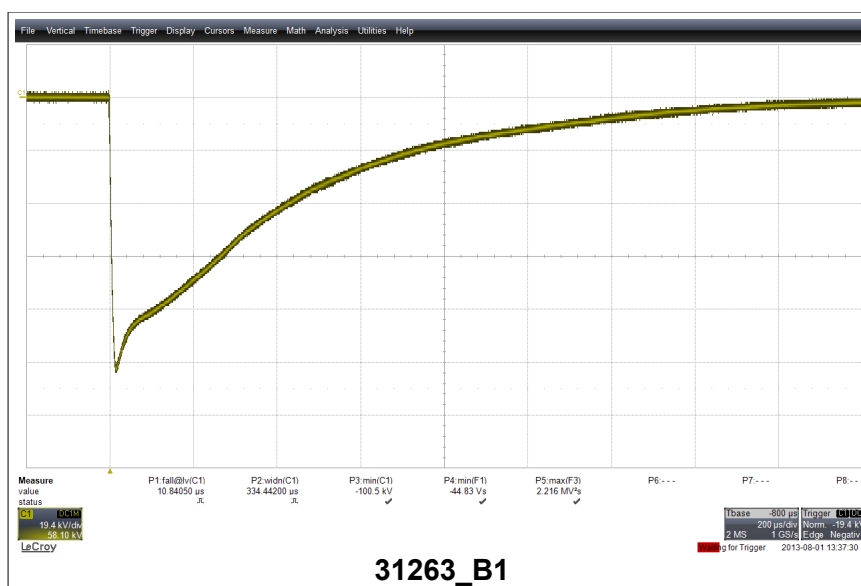


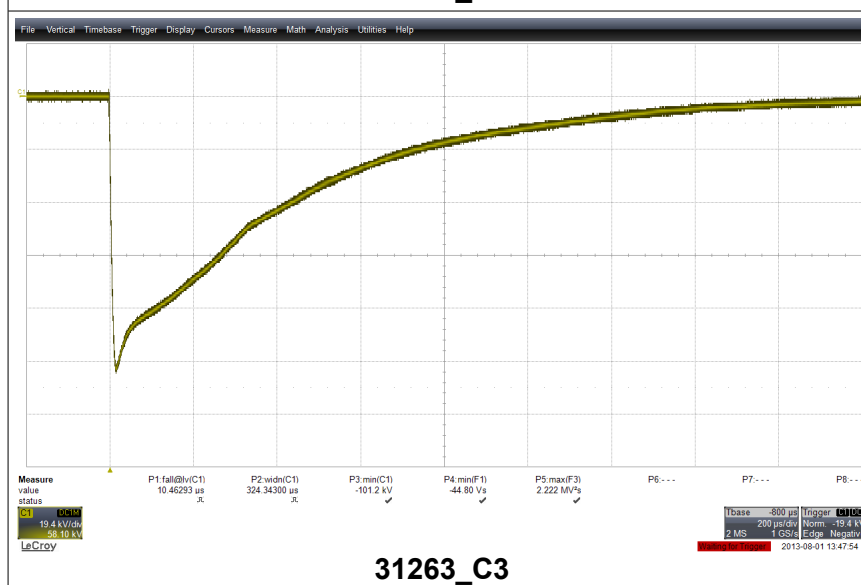
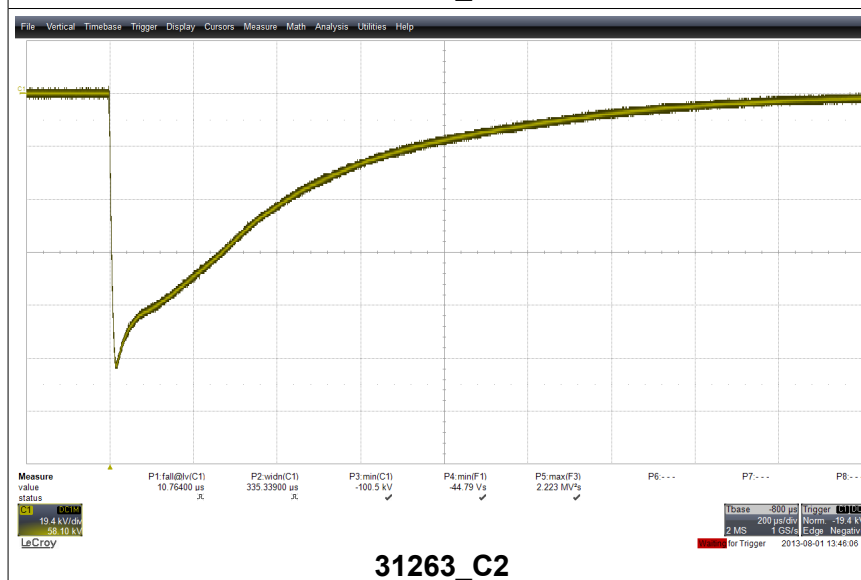
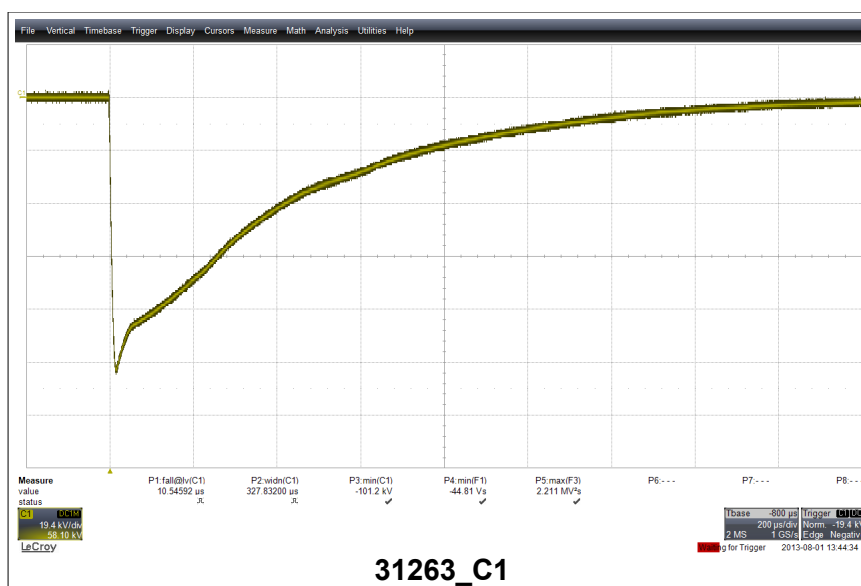
31263\_A2



31263\_A3








## 10. (8.10) TESTS RESULT SUMMARY

The six connection components specimens, type "B" bond with part number BN105, submitted for tests by FURSE (THOMAS & BETTS), have been subjected to the tests according to IEC/BS EN 62561-1 for use in external lightning systems, in "T" connection arrangement (B6) between 25x3 mm copper solid tape conductor and metal installation (40x6 mm steel tape) and have successfully passed the tests. Therefore they satisfy the standard's requirements according to IEC/BS EN 62561-1 and are classified as per their:

- Lightning current carrying capability as: class H (100kA), see Table 1,
- Mechanical capability as: intended to carry static mechanical load, see EN 62561-1, Common Modifications, clause 4.Z1, a).

Test results regarding this connection component specimen are displayed in clause 9 (8.9).

|                  |   |
|------------------|---|
|                  | <b>Laboratory<br/>Technical Manager</b>   |
| <b>NAME</b>      | <b>Dr. N. KOKKINOS</b><br>Electrical Engineer Beng, MSc, PhD  |
| <b>SIGNATURE</b> | <br><b>ELEMKO S.A.</b><br>R. & D. Testing Lab.<br>THIVA - GREECE<br>TEL: +30 210 2645400<br>e-mail: elemko@elemko.gr |

This report only explains the specimens submitted for test and does not produce evidence for the quality for standard fabrication.