

EARTHING & LIGHTNING PROTECTION

Furse CT105-H

IEC 62561-1:2017 test report

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1. Introduction

This report details the testing of the Furse component CT105-H [7TCA083610R0010]; Square tape clamp in accordance with IEC 62561-1:2017 Lightning Protection System Components (LPSC) – Part 1: Requirements for connection components.

1.1. Declaration

The above product supplied by Furse has been successfully tested in accordance with IEC 62561-1:2017 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.

1.2. Scope of conformity

For use in a lightning protection system (LPS) for the connection of two copper tapes in accordance with Furse literature.

In a T connection (B1).

For an impulse current withstand capability of 100kA (class H).

1.3. Variant part numbers

2. Main report

The body of the formal report follows.

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	9AKK107991A7292	A	en	2/22

Test Report Number:31257

Date: 22 February 2021

STATEMENT

The tests and inspections, performed according to IEC/BS EN 62561-1:2012 and described in Test Report Number:31257, of copper alloy square tape clamp CT105-H for use in external lightning systems, in cross connection arrangement (B1) between two copper solid tape conductors 25x3 mm dimensions, cover the standard's requirements according to IEC 62561-1:2017

Inspectors:	Alexander Parlavantzas Mechanical & Aeronautical Engineer	Dionysios Noussas Mechanical Engineer
Signature:		
Date:	22- February- 2021	22- February - 2021



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

TEST REPORT No. 31257

**OF COPPER ALLOY SQUARE TAPE CLAMP, PART NUMBER : CT105-H
IN CROSS ARRANGEMENT (B1),**

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 square tape clamp provided by FURSE (THOMAS & BETTS) with part number CT105-H.

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

2nd km Thiva-Chalkida Old National Road, GR 32200, THIVA

Tel: (+30) 2262024523 - 2262024574,

Fax : (+30) 2262023571

e-mail: 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 : 31257

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: 17

2.7 (8.2.g) Date of issue of report: 2013/08/07

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

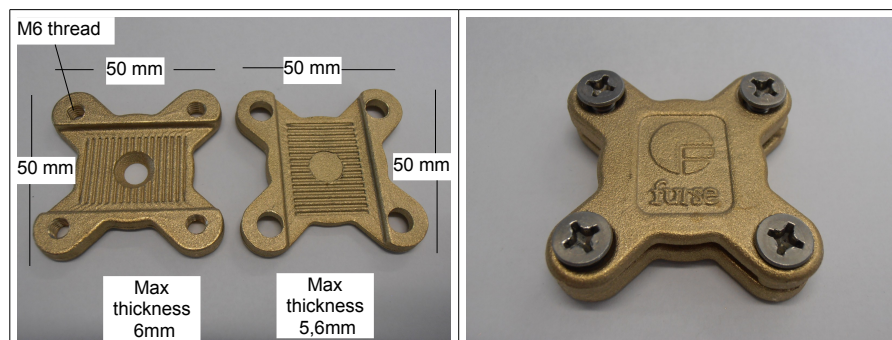
Test engineer

S. MARKOU

Laboratory Technician

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

Square tape clamp of FURSE company, for connection of tape conductors. The clamp is consisted of two copper alloy plates and four M6x12 mm stainless steel cross recessed countersunk head screws. Details of the clamp are shown below.



Photographs of the specimen with approx. dimensions

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

Six square tape clamps, each connected with two copper solid tape conductors 25x3 mm dimensions, in cross connection arrangement (B1) as per Annex B of the standard. For traceability, the specimens were marked with the identification numbers 31257 A, 31257 B & 31257 C (specimens intended for the electrical test) and 31257 D, 31257 E & 31257 F (specimens intended for the static mechanical test).

Specimen configuration is illustrated in clause 3.6.

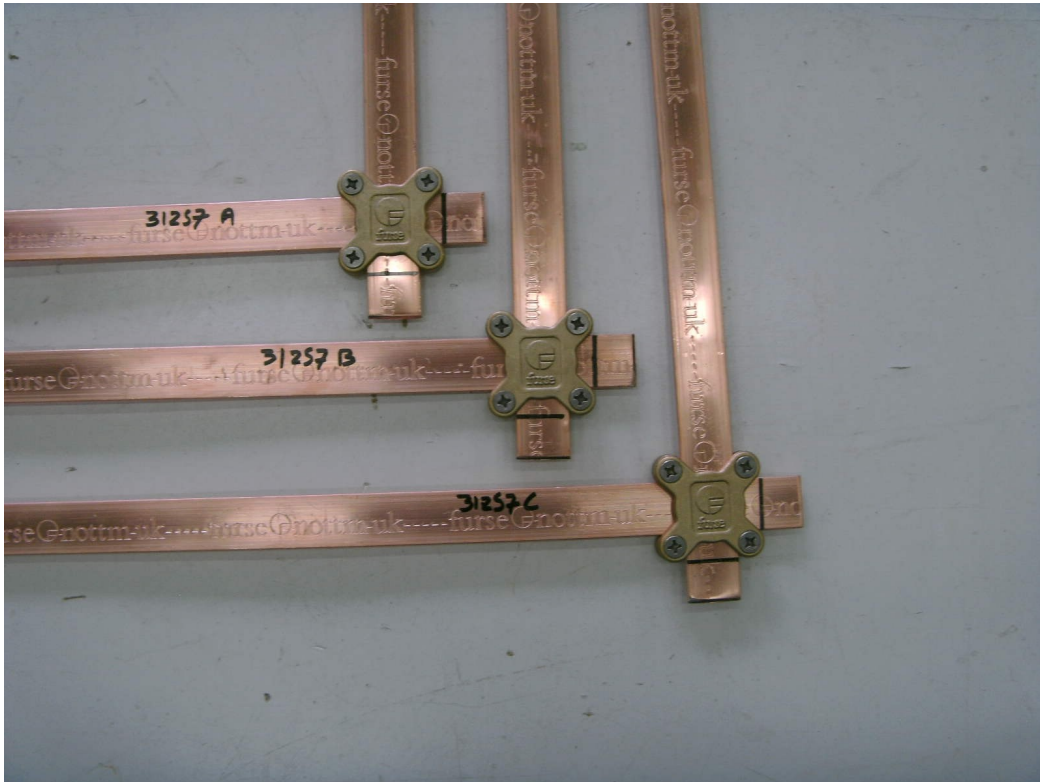
3.3 (8.3.c) Characterization and condition of the test specimen and/or assembly

The received specimens were new and in good condition.

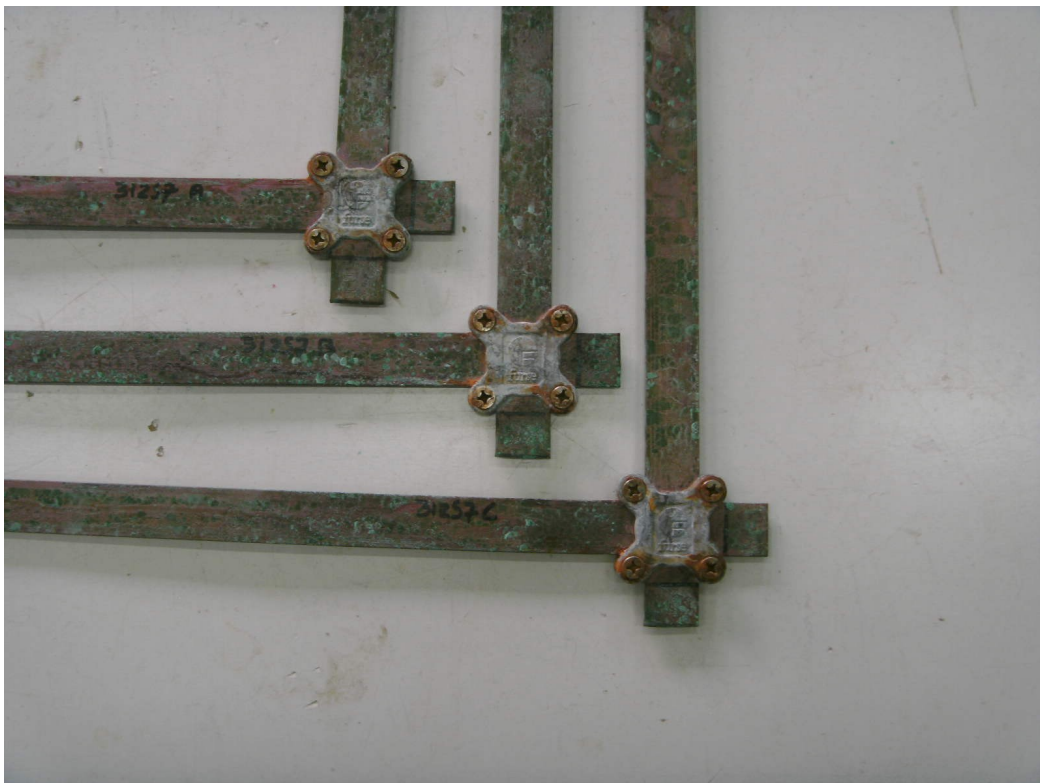
3.4 (8.3.d) Sampling procedure

Not relevant.

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

3.6 (8.3.f) Photographs

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



2. The specimens following the salt mist treatment and humid sulphurous atmosphere treatment tests



3. The specimens following the ammonia atmosphere treatment test.



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



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

4. (8.4) CONDUCTORS

4.1 (8.4.a) Conductors' material

Conductors "a" & "b": Copper.

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

Conductors "a" & "b": 75 mm², 25x3 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 Sollution Product Catalogue, as downloaded from the website of Thomas & Betts, 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.
- Measurement of the displacement of the component's conductors as per clause 6.3.d 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 cross connection (B1) arrangement, according to IEC/BS EN 62561-1 (see 6.4 "configuration of testing assembly"), using two copper solid tape conductors 25x3 mm dimensions.

The screws of the specimens were tightened with a torque wrench. The tightening torque given by the applicant was 5 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_{imp}) 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 μ 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 displacement of the component's conductors by means of a sliding calipers.
- 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 ± 20 N for 1 min (static mechanical test). Each conductor of the specimen assemblies were subjected independently to the mechanical tensile force.

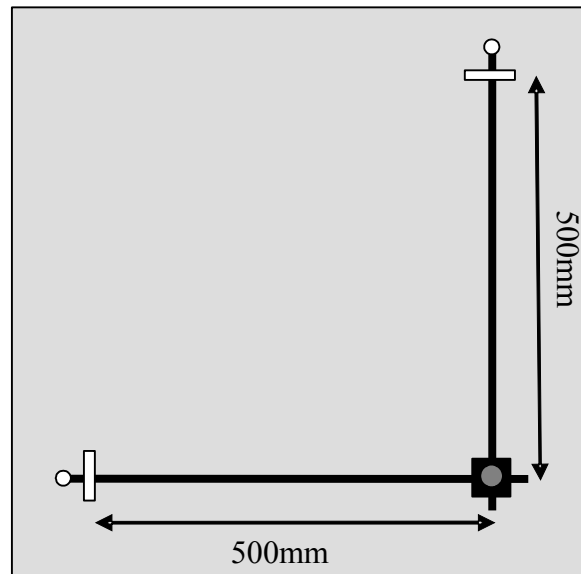
6.2 (8.6.b) Justification for any deviations from, additions to or exclusions from the referenced standard

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



B1: Cross Connector – 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

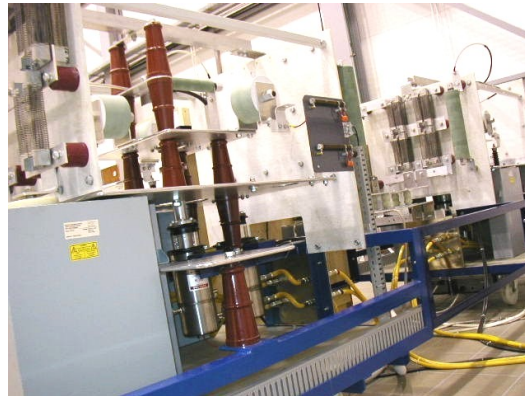
1. Environmental chamber for salt mist ageing, serial nr. 4318.
2. Environmental chamber for humid sulphurous atmosphere ageing, serial nr. 4317.
3. Ammonia ageing chamber.
4. Impulse current generator 0-100kA, 0-65C, 0-187kJ.
5. 4-channel trigger / delay pulse generator serial nr. 09720.
6. Shunt 1 mΩ.
7. 20kg weights.



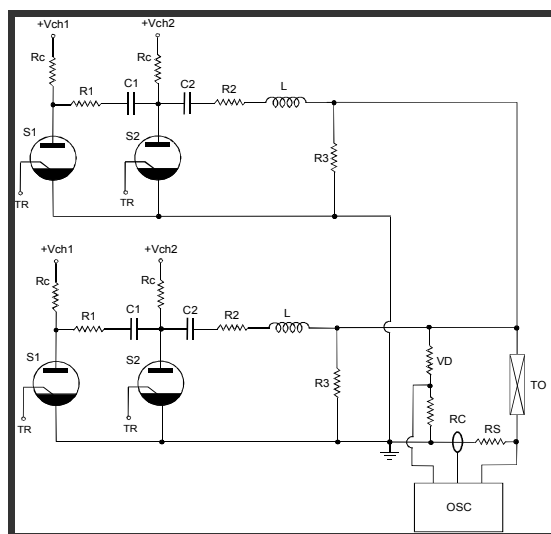
Photograph of the environmental ageing chamber used for salt mist ageing.



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



Photograph of the 100kA, 10/350μs 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, 10/350μs impulse current generator.

8. (8.8) MEASURING INSTRUMENTS DESCRIPTION

Instrument	Calibration date	Calibration interval
1. Electronic torque wrench, 0–6Nm, serial nr. 11058031.	2012/08/17	1 year
2. Torque meter, 0-30Nm, serial nr. 0901610877	2012/08/31	1 year
3. Digital micro-ohmmeter, 5μΩ-400Ω, serial nr. 166423.	2013/05/30	1 year
4. 4-channel, digital oscilloscope, serial nr. LCRY3203N57222.	2012/09/12	1 year
5. Temperature, barometric pressure and humidity meter.	2013/07/24 (internal)	1 year
6. Digital sliding callipers (thickness gauge), 0-150±0.01mm serial nr. 1U206306.	2012/08/17	1 year
7. Balance, serial number 83017901.	2011/11/21	3 years

9. (8.9) RESULTS AND PARAMETERS RECORDED

REQUIREMENTS			RESULTS									PASS/ FAIL
CLAUSE	TEST - INSPECTION	IDENTIFICATION OF SPECIMEN										
		31257A			31257B			31257C				
5.2	<u>Installation instructions shall contain:</u> <ul style="list-style-type: none">• classification of the component• recommended tightening torque• range of conductors - materials• connection configuration		Inspection's results: <ul style="list-style-type: none">• provided• provided• provided• provided									PASS
6.2.2; Annex C1	<u>Conditioning/ageing</u> Salt mist treatment (IEC 60068-2-52)		Start : 2013/07/12 End : 2012/07/15									PASS
6.2.2; Annex C2	<u>Conditioning/ageing</u> Humid sulphurous atm. treatment (ISO 6988)		Start : 2013/07/15 End : 2013/07/22									PASS
6.2.2; Annex C3	<u>Conditioning/ageing</u> Ammonia atmosphere treatment (ISO 6957)		Start : 2013/07/24 End : 2013/07/25									PASS
6.3	<u>Electrical test</u> (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	100,5	100,5	100,5	100,5	100,5	100,5	100,5	100,5	
		W/R (MJ/ Ω):	2,224	2,258	2,257	2,267	2,260	2,260	2,246	2,255	2,263	
		shot nr:	8030	8031	8032	8033	8034	8035	8036	8037	8038	
		Environmental conditions: Humidity – Temper. - Atm. pres.	52% - 30° C – 993 mbar									
6.3.a	<u>Contact resistance R_c ($\mu\Omega$)</u> (requirement $R_c \leq 1000 \mu\Omega$) ($R_{c\text{before}}$: before ageing, $R_{c\text{after}}$: after ageing)		$R_{c\text{before}}$: 21 $R_{c\text{after}}$: 30			$R_{c\text{before}}$: 28 $R_{c\text{after}}$: 40			$R_{c\text{before}}$: 28 $R_{c\text{after}}$: 46			PASS
6.3.d	<u>Length of the conductor from connector (mm)</u> (requirement: not less than 3 mm)		"a": 20,0 "b": 20,0			"a": 20,0 "b": 20,0			"a": 20,0 "b": 20,0			PASS
6.3.c	<u>Loosening torque T_L (Nm)</u> (requirement $0,25T_T \leq T_L \leq 1,5T_T$) (T_T :tightening torque)		T_T : 5,0 T_L : 7,0			T_T : 5,0 T_L : 6,5			T_T : 5,0 T_L : 7,0			PASS
6.3.b	<u>Visual inspection</u> (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\pm20N for 1 min</u> (applicable to screw-less components. Requirement: conductor's movement < 1mm, no damage to conductor or component)		-			-			-			N/A
6.4*	<u>Static mechanical test 900N\pm20N for 1 min</u> (On a 2 nd set of specimens. Requirement: movement of the conductor < 1mm, no damage to conductor or component)	Conductor:	31257D		31257E		31257F					PASS
			"a"	"b"	"a"	"b"	"a"	"b"	"a"	"b"		
		Force (N):	908	908	908	908	908	908	908	908		
		Movement (mm):	0	0	0	0	0	0	0	0		
6.5	Marking shall be durable and legible. 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	Y	Y	Y	Y	PASS	
Comments:			NO COMMENTS									

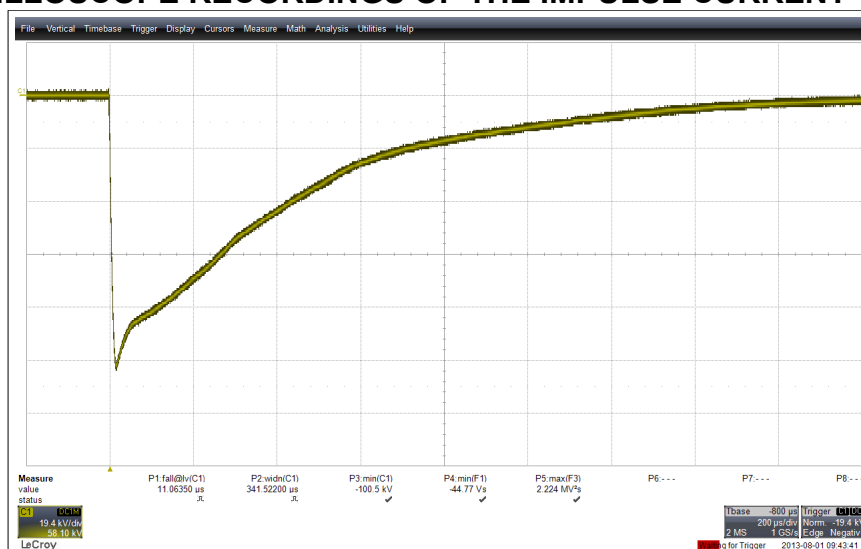
* Not accredited for these tests Y: Fulfills the requirements. N: Do not fulfill the requirements. N/A: Not applicable

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

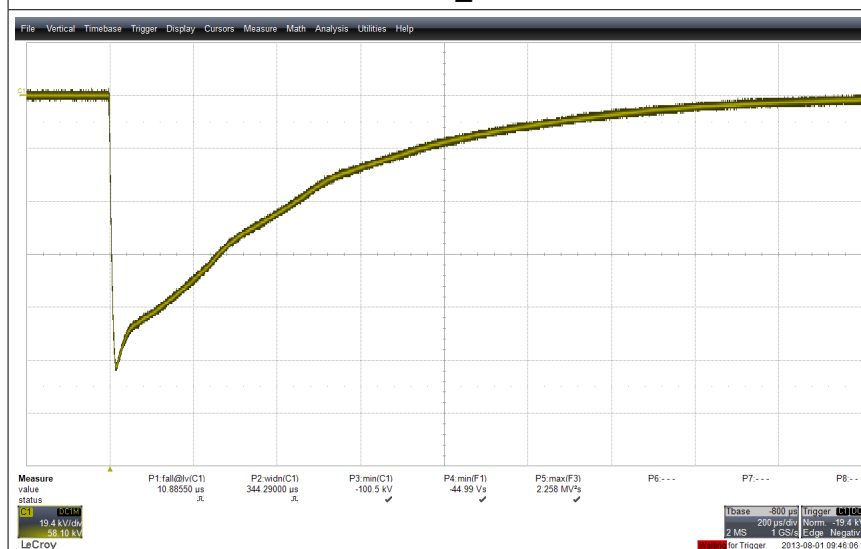
2nd km Thiva-Chalkida Old National Road, GR 32200, THIVA

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

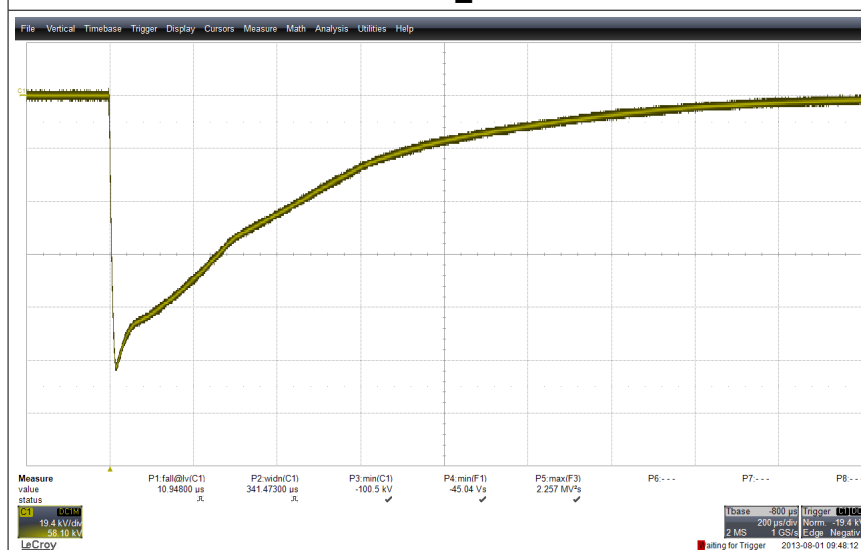
OSCILLOSCOPE RECORDINGS OF THE IMPULSE CURRENT TESTS



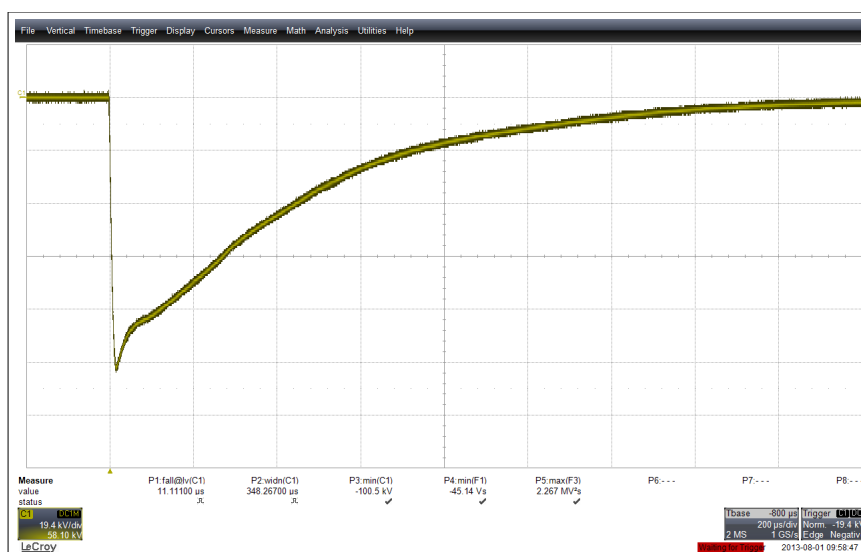
31257_A1



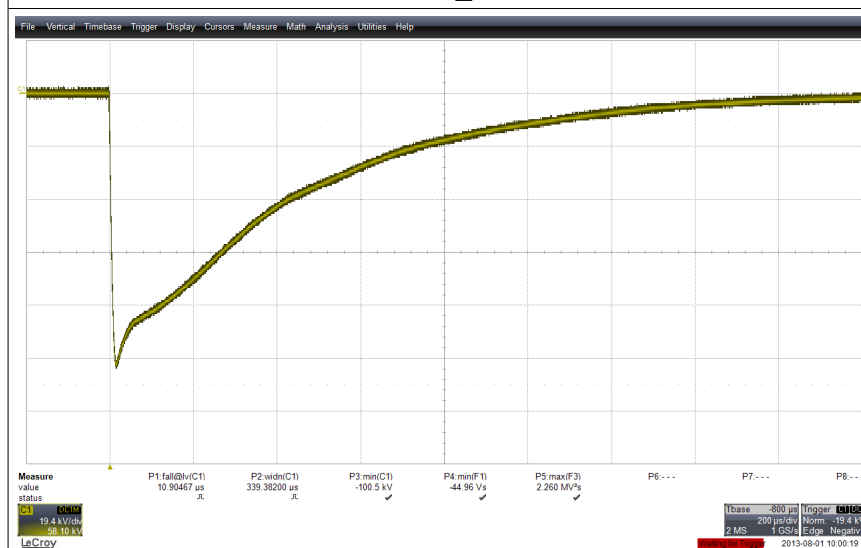
31257_A2



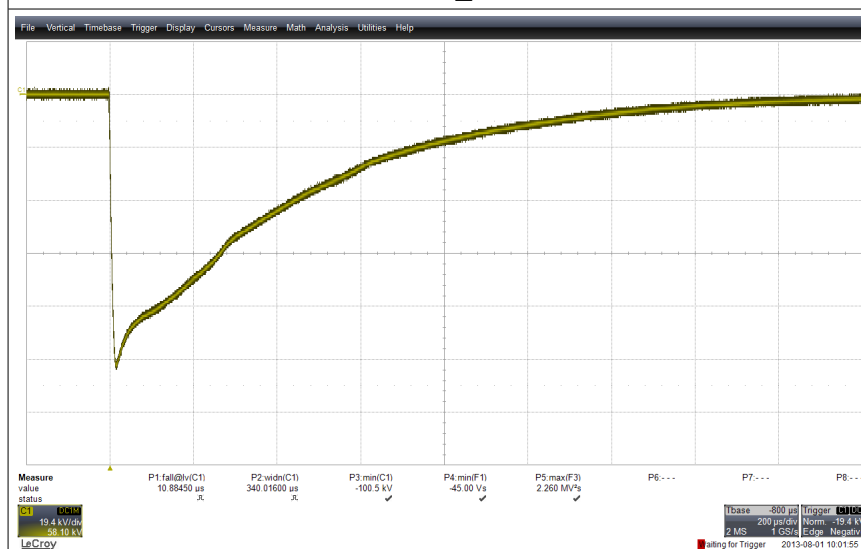
31257_A3



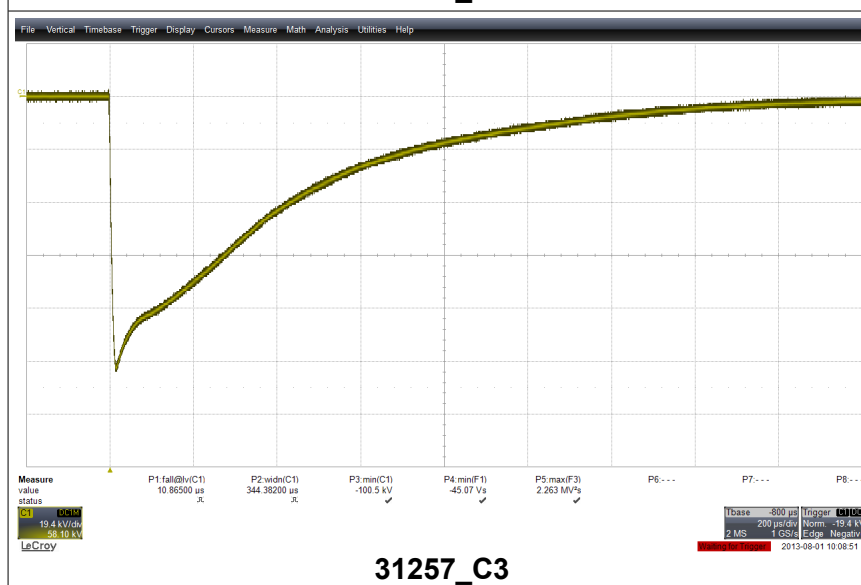
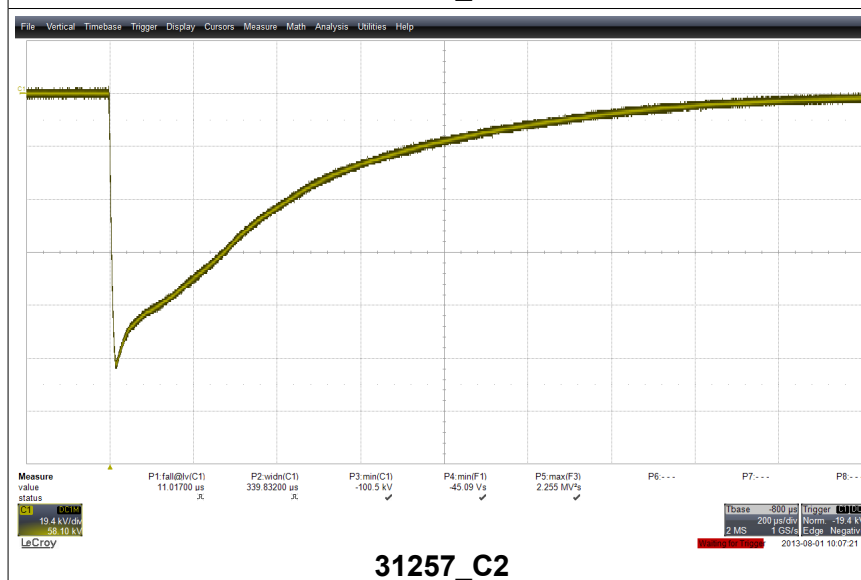
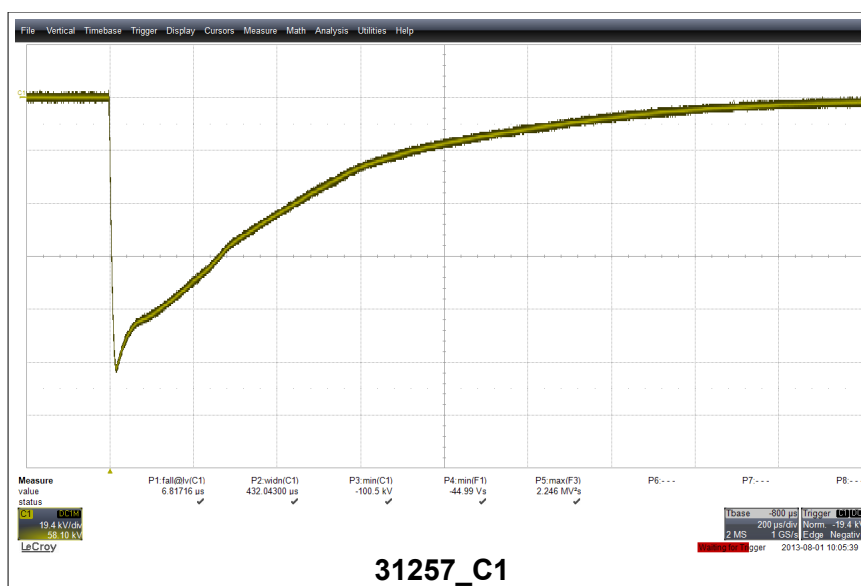
31257_B1



31257_B2



31257_B3




10. (8.10) TESTS RESULT SUMMARY

The six connection components specimens, square tape clamp with part number CT105-H, 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 cross connection arrangement (B1) between two copper solid tape conductors 25x3 mm dimensions 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).

	Laboratory Technical Manager
NAME	Dr. N. KOKKINOS Electrical Engineer Beng, MSc, PhD
SIGNATURE	 ELEMKO S.A. R. & D. Testing Lab. THIVA - GREECE TEL: +30 210 2845400 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.

3. Revisions

Rev.	Page (P) Chapt. (C)	Description	Date Dept./Init.
A	All	First release	2021-02-23 GBNTG R&D/APM

4. Notices

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