

# ENGINEERING REPORT

Number PCL/C/947

Title Short circuit testing of 370BA cleat at  
160kA to BS EN 61914:2015 clause 9.5.3

Date 31<sup>st</sup> March 2016

<b>Test Engineer:</b> Ferenc Bukor		<b>Approved by:</b> J. P. Rawlinson Technical Manager – LV & MV Accessories	
<b>Prepared by:</b> Luke Morby			
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## TEST REPORT

**Test object:** Cable cleat for electrical installations  
**Designation:** Cable cleat type 370BA12  
**Manufacturer:** Prysmian Cables & Systems Ltd.  
Oak Road, Wrexham Industrial Estate  
WREXHAM – LL13 9PH - UNITED KINGDOM  
**Tested for:** Prysmian Cables & Systems Ltd.  
**Date of tests:** 1<sup>st</sup> April, 2016  
**Project ID:** NTL-16 / 2016  
**Order/Contract:** 4500638594; 29<sup>th</sup> January, 2016  
**Test specification:** IEC 61914:2015; Sub-Clause 9.5  
**Tests performed:** The test objects, constructed in accordance with the description, drawing and photographs incorporated in this report has been subjected to two test for resistance to electromechanical force according to the sub-clause 9.5.3 of the relevant standard.  
**Test results:** The cable cleats withstood the mechanical effects of the applied short-circuit current without any functional damages.

This Test Report has been issued by VEIKI-VNL Electric Large Laboratories Ltd. Testing Laboratory in accordance with above mentioned specification.

The Report applies only to the test object. The responsibility for conformity of any product having the same designations with that tested rests with the Manufacturer.

This Report comprises 15 sheets in total (12 numbered pages, 1 drawing and 2 oscillograms).



Budapest,  
7<sup>th</sup> June, 2016



Ferenc Bukor  
responsible for the test



Balázs Varga  
supervised by



Dr. László Varga  
managing director

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## TEST CERTIFICATES OR REPORTS ISSUED BY VEIKI-VNL ELECTRIC LARGE LABORATORIES LTD. TESTING LABORATORY

### **Type Test Certificate of Complete Type Test**

This certificate provides the verification of all the rated characteristics of the equipment as assigned by the manufacturer, by means of the performance of all type tests specified by the standards.

### **Type Test Certificate of Dielectric Performance**

This certificate provides the verification of all dielectric ratings, by means of the performance of the appropriate type tests specified by the standards.

### **Type Test Certificate of Temperature-Rise Performance**

This certificate provides the verification of temperature-rise limits together with measurement of the main circuit resistance, by means of the performance of the appropriate type tests specified by the standards.

### **Type Test Certificate of Short-Circuit / Making and Breaking Performance**

This certificate provides the verification of rated characteristics with respect short-circuit and/or making and breaking performance, by means of the performance of the appropriate type tests specified by the standards.

### **Type Test Certificate of Switching Performance**

This certificate provides the verification of the switching ratings (e.g. capacitive current), by means of the performance of the appropriate type tests specified by the standards.

### **Prototype Test Report**

Prototype tests are required to verify the suitability of the materials and method of manufacture for composite insulators defined by relevant ANSI standards.

### **Design Test Report**

According to IEC standard: The design tests are intended to verify the suitability of the design, materials and method of manufacture (technology) of composite insulators.

According to ANSI standard: The design tests are intended to verify the insulators electrical and mechanical characteristics that depend on its size and shape.

### **Type Test Report**

This report provides the verification of the rated characteristics of the equipment as assigned by the manufacturer, by means of the performance of the appropriate type tests specified by the standards, for type tests not indicated above.

### **Development Test Report**

This report is issued when the test is intended only to provide the Client with information about the performance of the equipment. The tests are performed in accordance with relevant standards, but are not intended to verify compliance of the equipment.

### **Control Test Report**

This report is issued for tests performed on equipment in service, or removed from service. Tests are performed, and compliance is evaluated in accordance with relevant standards.

### **Test Report**

Test report is issued in all cases not listed above.



**Ratings/characteristics assigned by the manufacturer:**

Test objects:	Cable cleats for electrical installations
Type:	370BA12
Short-circuit current ( $I_k$ ):	72.7 kA
Peak short-circuit current ( $I_p$ ):	160 kA
Duration of short-circuit current ( $t_{sc}$ ):	100 ms
Cross-section of applied Cu cables:	935 mm <sup>2</sup>
External diameter of applied Cu cables:	66 mm
Cable formation:	Flat
Flat core spacing:	150 mm
Linear spacing of the cleats:	600 mm
Test sample length:	3.5 m

**The tests were carried out in accordance with the following standard:**

IEC 61914:2015                      Cable cleats for electrical installations

**Requirements of manufacturer or purchaser:**

The tests were performed with parameters according to the request of the Client.

**List of manufacturer's drawings for identification of the test objects:**

Drawing is attached to the test report.

- 370BA12                      Cable cleat type 370BA12

**Present at the tests in charge of manufacturer or purchaser:**

Mr. Luke Morby	Prysmian Cable & Systems Ltd.
Mr. Leigh Wild	Prysmian Cable & Systems Ltd.

## TESTS PERFORMED ON THE TEST OBJECTS

No.	Description	Relevant clauses of the standard
1	Test for resistance to electromechanical force	9.5.3

## DESCRIPTION OF THE TESTS

### 1. Test circumstances

#### 1.1 Test objects

The test object was cable cleat for flat cable arrangement as can be seen on Photo 1. The drawing of the tested cleat given by the manufacturer is enclosed to the test report.

#### 1.2 Test circuit and arrangement

The three-phase test circuit was supplied from 50 Hz network. The cables received from the client were directly connected to the low-voltage short-circuit transformer. The scheme of the test and measuring circuits are shown in Figure 2. The test arrangement was constructed based on Figure 4 of the standard (See: Figure 1, Photos 2-3). Three cables with cross-section of 935 mm<sup>2</sup> were fixed in flat arrangement to a metal mounting frame (cable ladder) with length of 3.5 m using five pieces of cleats type 370BA12 (Photo 1) in each phase. The spacing between the cleats was 600 mm and between the cables 150 mm.

### 2. Tests carried out

New test samples and cables were used in the test arrangement.  
The tests were carried out in order indicated below:

Name of the tests
1. Two short-circuit tests were performed with rated parameters of 72.7 kA <sub>rms</sub> - 160 kA <sub>peak</sub> / 100 ms.
2. Visual examination.
3. Rainfall imitation for 2 minutes.
4. Voltage withstand test was performed on the arrangement with 2.8 kV <sub>DC</sub> voltage which was maintained 60 s on the test arrangement between the short-circuited cable cores and the cable ladder.

### 3. Results of the tests

All cleats withstood the mechanical effects of the applied short-circuit currents without opening. After the tests no any sign of damage or deterioration could be observed. After the short-circuit tests voltage withstand test in pre-wetted conditions was performed without voltage breakdown. The test parameters and results are collected in Table 1. The conditions of the tested cleats are shown on Photos 5-8.

#### 4. The recorded quantities taken during the tests

During the tests oscillograms were taken. The quantities were recorded by transient recorder with sampling rate of 50  $\mu$ s. The meanings of the symbols on the enclosed oscillograms are the next:

- $I_A, I_B, I_C$  - short-circuit currents flowing through the cables of the arrangement.
- $U_{A0}, U_{B0}, U_{C0}$  - phase voltages during the short-circuit.

Same notations are applied in Figure 2. The test parameters evaluated from the oscillograms are collected in Table 1. The measuring circuits with the applied elements are shown in Figure 2.

#### 5. Uncertainty of measurements

Measured parameter	Uncertainty
Current measurement:	$\pm 1.3 \%$
Voltage measurement:	$\pm 1.2 \%$

The uncertainty values given in this report are standard deviation values multiplied by  $k=2$ . Measurement uncertainty was estimated according to the method described in the EAL-R2 document.

#### 6. Measuring devices used for the tests

No.	Designation	Manufacturer	Type	Serial number
[1]	Rogowski A, B, C	3D-Motion Control Engineering Ltd.	DCM-R1 Rogowski Coil / DCM R1 Secondary Converter	2010-RC-001/2010-IU-001/1 2010-RC-002/2010-IU-001/2 2010-RC-003/2010-IU-001/3
[2]	Voltage divider A, B, C	VEIKI-VNL Ltd.	R-C-R	FO-21; FO-22; FO-23
[3]	VONAL Transient recorder	VEIKI-VNL Ltd.	VONAL VF1	VF 0009-00014
[4]	Thermometer	Testo	922 (05609221)	33632206/508



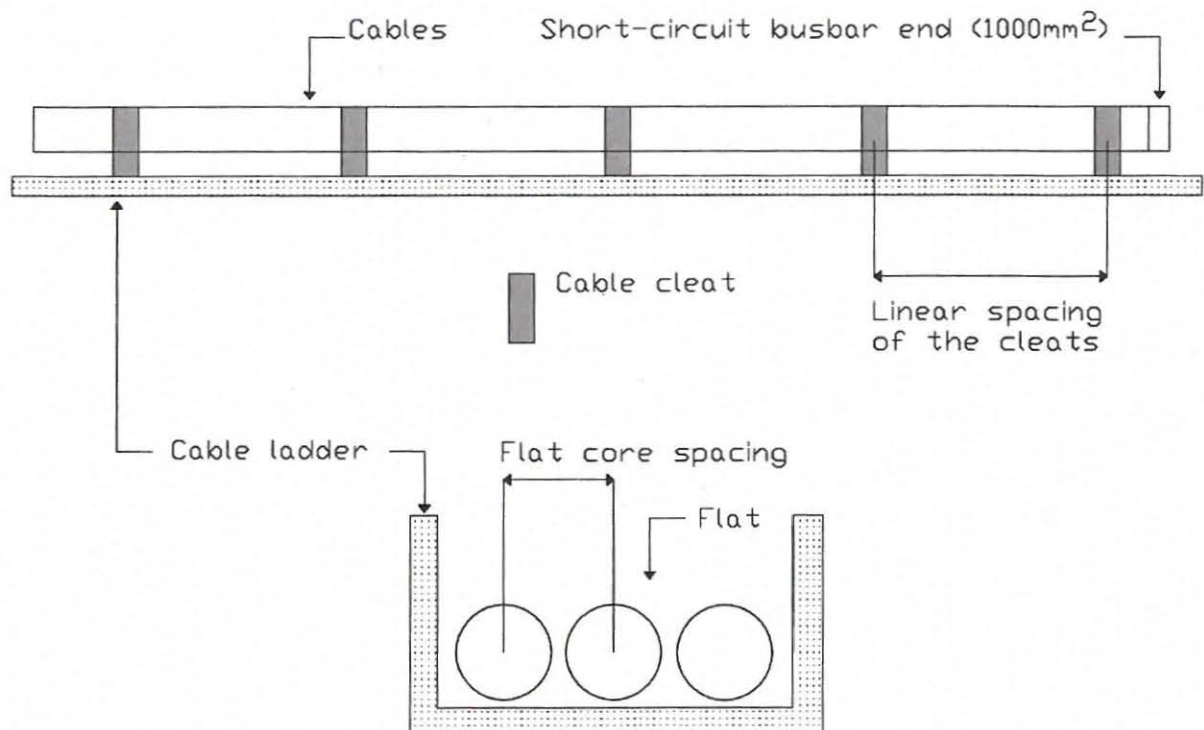
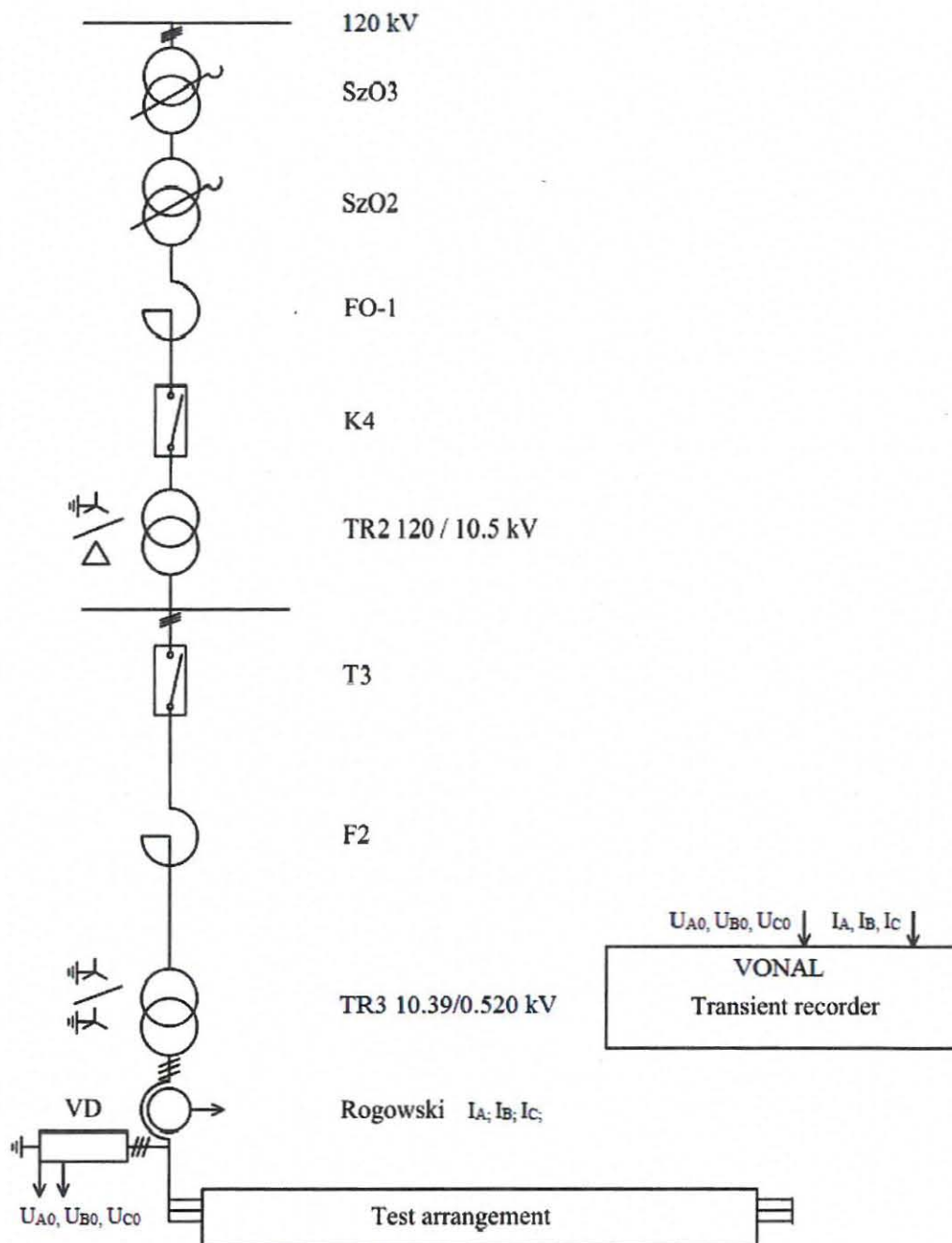


Figure 1  
Principal test arrangement



- SzO2; SzO3 - regulating transformers
- FO-1, F2 - reactors
- K4 - protective circuit-breaker
- Tr2, Tr3 - short-circuit transformers
- T3 - making switch
- Rogowski (I) - Rogowski current measuring system [1]
- VD - voltage dividers [2]
- VONAL - transient recorder [3]

Figure 2  
The test and measuring circuits of the tests



<b>Tests for resistance to electromechanical force on cable cleats</b>							
Test circumstances: - Test arrangement : Figure 1, Photos 2-3 - Test and measuring circuits: Figure 2							
Oscillogram No.	Parameters of short-circuit currents						
	Highest current peak			RMS value of the A.C. component			Duration of short-circuit
	[kA]			[kA]			t
	I <sub>A</sub>	I <sub>B</sub>	I <sub>C</sub>	I <sub>A</sub>	I <sub>B</sub>	I <sub>C</sub>	[ms]
BHD 0110	117.9	159.0*	126.4	65.3	69.8	64.9	130.1
BHD 0111	118.0	158.8*	126.2	65.2	69.7	64.8	103.1
Comments, remarks:  *achieved test parameters accepted by the Client  The ambient temperature was 29.5 °C during the tests. Photos 5-8 show the condition of the samples after the tests. During the tests all cleats withstood the mechanical effects of the applied short-circuit currents without any damages. After the electromechanical test voltage withstand test in pre-wetted conditions was performed on the arrangement without voltage breakdown.							

Table 1

Summary of test circumstances and results of tests for resistance to electromechanical force

PHOTOS



Photo 1  
Test object



Photo 2  
Test arrangement





Photo 3  
Test arrangement before the tests



Photo 4  
Test samples before the tests





Photo 5  
Condition of the test arrangement after the first test



Photo 6  
Condition of the tested cleats after the first test



Photo 7

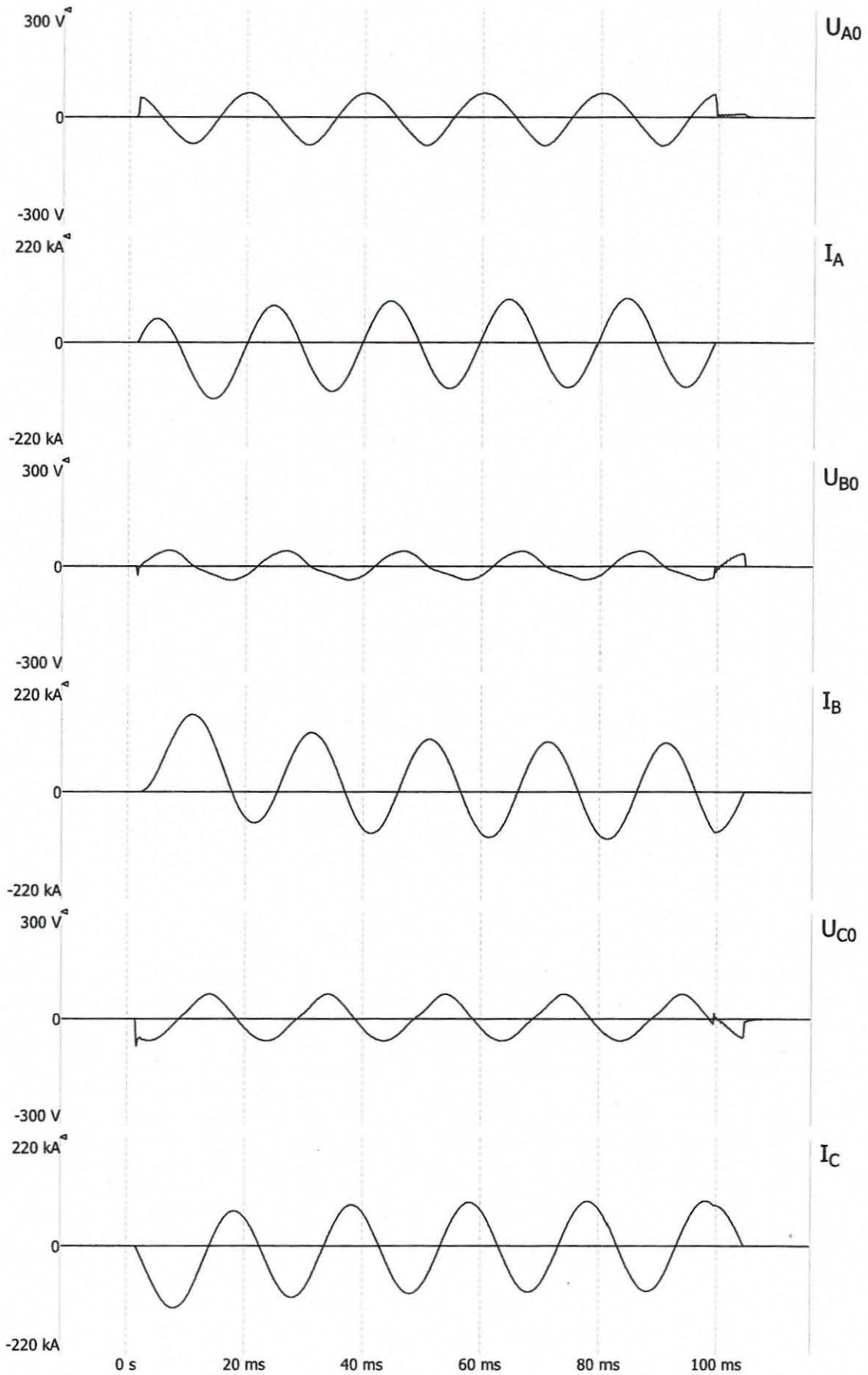
Condition of the test arrangement after the second test



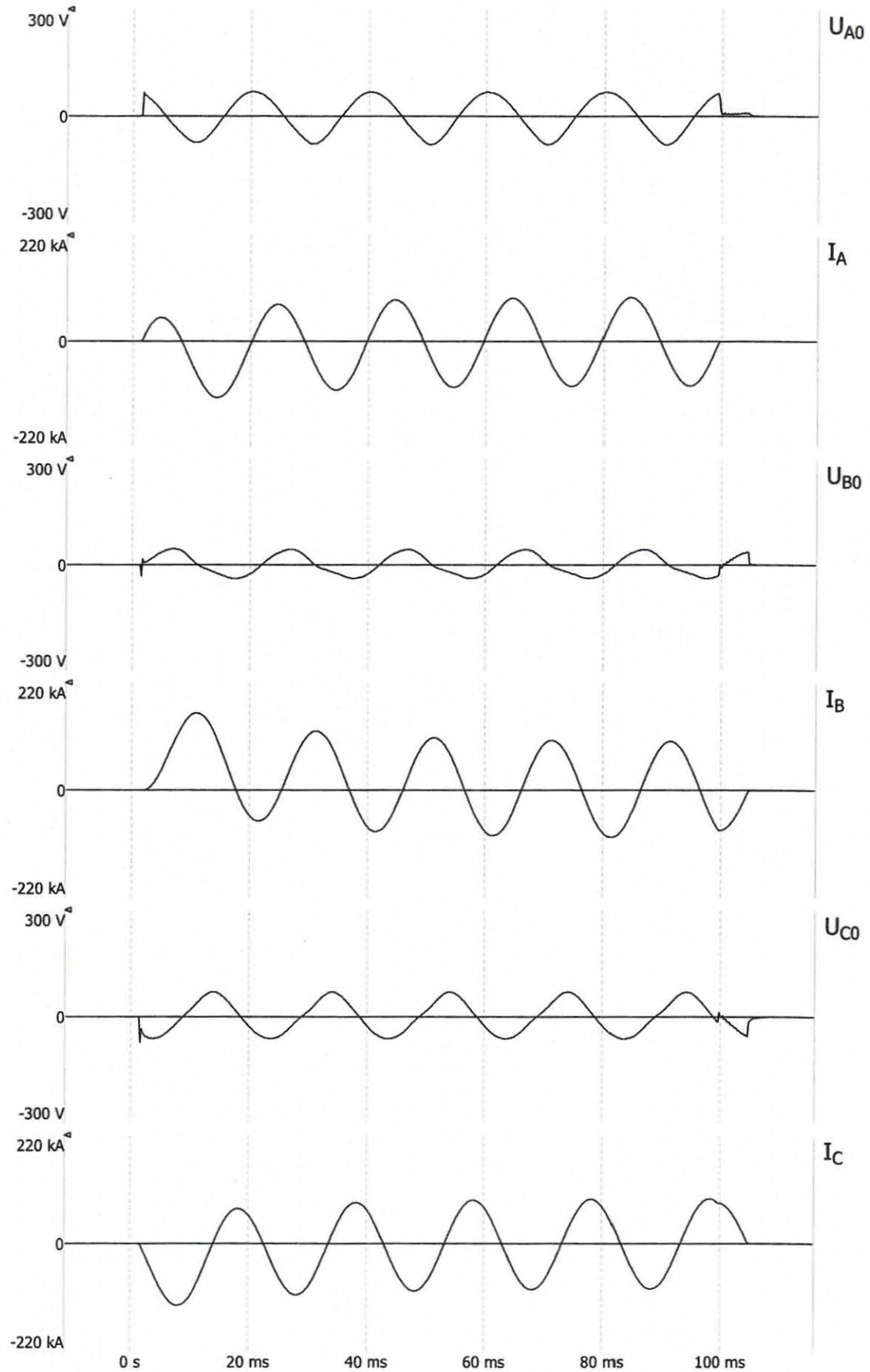
Photo 8

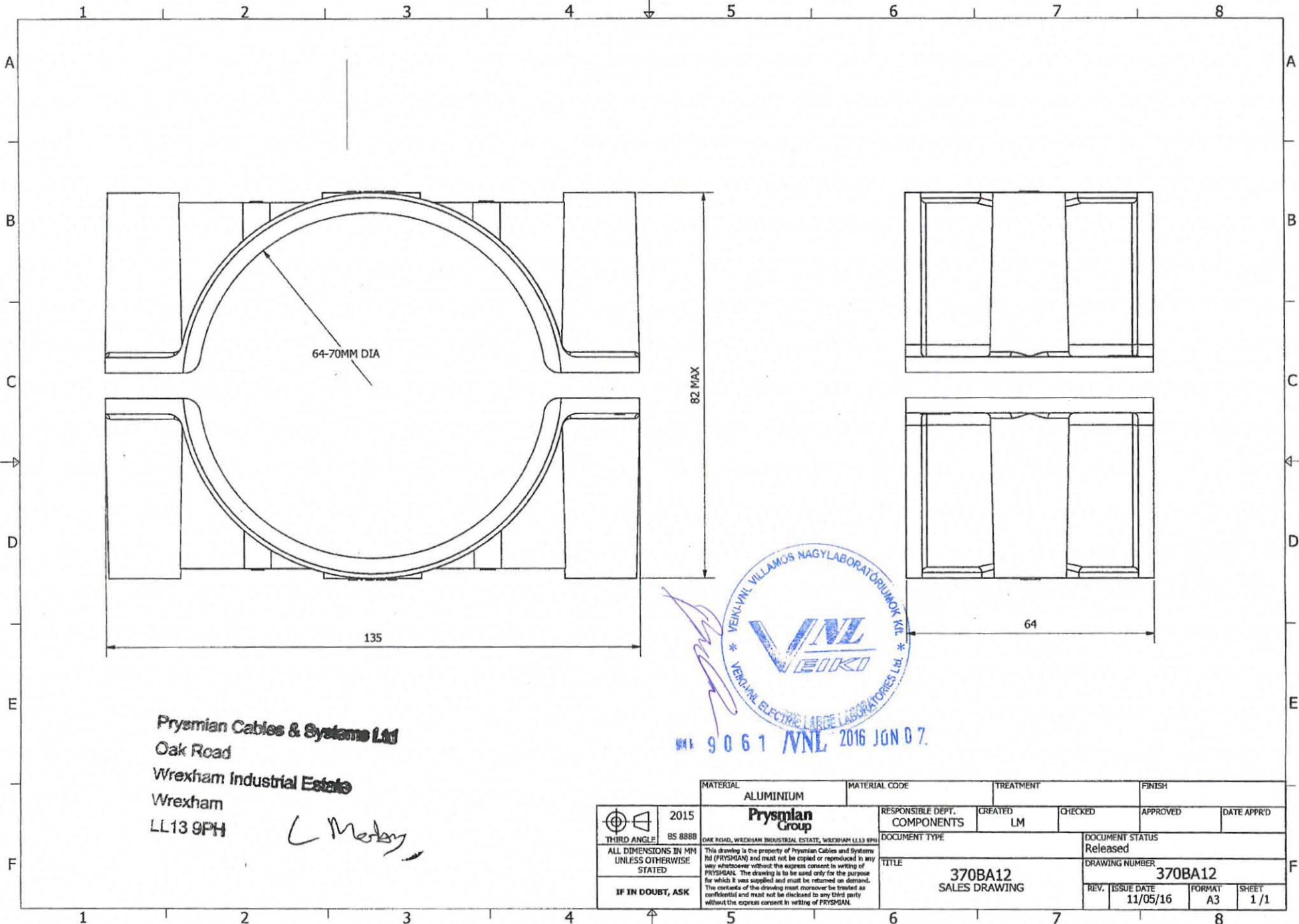
Condition of the tested cleats after the second test











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*C. Morley*



MATERIAL ALUMINIUM		MATERIAL CODE		TREATMENT		FINISH	
2015 BS 8888		Prysmian Group		RESPONSIBLE DEPT. COMPONENTS	CREATED LM	CHECKED	APPROVED
THIRD ANGLE ALL DIMENSIONS IN MM UNLESS OTHERWISE STATED		DOCUMENT TYPE 370BA12 SALES DRAWING				DOCUMENT STATUS Released	
IF IN DOUBT, ASK		TITLE 370BA12 SALES DRAWING				DRAWING NUMBER 370BA12	
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