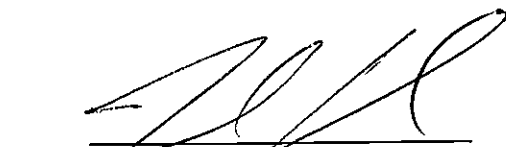


**TEST REPORT –
TESTS ON A HEATING ELEMENT**

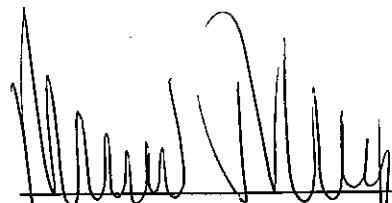
CRIQ file 670-32820

Mr. Roberto Di Marzio
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RICHARD TREMBLAY, P.ENG.
DIRECTOR
TESTS DIVISION

MONTRÉAL, SEPTEMBER 22, 2003

Translation

CRIQ DECLARATION

The product samples mentioned herein were received at the CRIQ on September 9, 2003. Testing took place from September 10 to 12, 2003.

Testing was completed and supervised by the undersigned; they attest to the accuracy of the results.

Corneliu C

Performed by: Corneliu Cercel, Tech.

30.09.2003

Date

A tolerance of $\pm 5\%$ applies to all the vibration data presented herein.

The client identified on the cover page may reproduce this report in its entirety, or the integral text of the report without the appendices. Any other form of reproduction by anyone is subject to prior written approval from the CRIQ.

Total number of pages: 26, including 17 pages in appendix.

The results presented in this report refer only to the product(s) described in section 1.

The equipment and instrumentation used during this test were verified and/or calibrated. The calibration certificates are retraceable to the National Research Council of Canada (CNRC) and/or to the American National Institute of Standards and Technology (NIST) standards and can be provided on request.

CRIQ is registered ISO 9001, certificate no. 008999. The Tests Division is also accredited by the National Council of Canada, certificate no. 138.

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TABLE OF CONTENTS

	Page
1. Introduction	1
1.1 Object.....	1
1.2 Description of equipment under test	1
1.3 Field of application.....	1
1.4 Results	1
1.5 1.5 List of test equipment.....	2
2. Vibration tests.....	2
2.1 Object.....	2
2.2 Test method	2
2.3 Results	3
3. Shock tests	5
3.1 Object.....	5
3.2 Test method	5
3.3 Results	5
4. Conclusion	6

APPENDIX A: Vibration tests

APPENDIX B: Shock tests

Translation

1. INTRODUCTION**1.1 Object**

The object of this project is to perform vibration and shock tests on a heating element manufactured by Industries Tri-volt Inc. in compliance with the standards listed in the table of Section 1.4. The equipment under test is described in the table of Section 1.2.

1.2 Description of equipment under test

The equipment under test, hereinafter designated EUT, is a heating element used notably in railway wagons.

This table identifies the EUT:

Description	Voltage	Manufacturer	Serial no.	CRIQ no.
48-inch heating element	600 Vac nominal	Industries Tri-volt Inc.	N/D Prototype	E016229

1.3 Field of application

All tests are performed on a sample of the product in compliance with the standards listed in the table of Section 1.4. Test methods comply with the methods prescribed by the latter standards.

The test sequence along each axis was:

- 5-hour vibration endurance test along axis
- Shock tests along axis
- 10-minute operational vibration test along axis

1.4 Results

This table summarizes the results of the tests described in this report.

Test name	Standard; Section	EUT	Section	Results
Vibration	IEC 61373; Category 1; Class B	E016229	2	Passed
Shock	IEC 61373; Category 1; Class B	E016229	3	Passed

Translation

1.5 List of test equipment

The test equipment used for the purpose of these tests is described in the table below:

Equipment	Manufacturer; model	Serial no.	Expiry of calibration (y-m-d)
Vibrator table	UDC; T1000IAR20	350	N/A
Controller	Spectral-Dynamics; 2552-9715-1	2932-7859	2004-01-17
Amplifier	PCB; 481M17	150	2004-02-14
Accelerometer	Brüel & Kjaer model 4371	1376653	2004-03-03

2. VIBRATION TESTS**2.1 Object**

The object of these tests is to assess the capacity of the EUT to operate when subjected to vibrations that are likely to occur in its operating environment. A high-level endurance test was also included as part of this test.

2.2 Test method

The vibration test was performed in compliance with the specifications of IEC 61373 (1999), Category 1, Class B.

Tests performed by:	Corneliu Cercel
Date:	September 10, 2003 – Z axis September 11, 2003 – X axis September 12, 2003 – Y axis
Equipment under test:	E016229
Test:	IEC 61373 (1999/01)
Test conditions:	Unit energized; functional tests Unit non-energized; endurance tests
Severity:	5 to 150 Hz; functional tests 5 to 150 Hz; endurance tests
Duration:	10 minutes – functional 5 hours – endurance

While non-operational, the EUT is installed onto a horizontal anchoring plane by means of its normal fasteners. The anchoring plane is installed onto the vibrator table. While still non-energized, the EUT is then subjected to the vibration profiles described in Table 2.1 for 5 hours along the first axis.

Translation

X AXIS (TRANSVERSE)		
FROM (HZ)	TO (HZ)	ASD/CURVE
5	20	0.366
20	150	-6 dB/octave
Y AXIS (LONGITUDINAL)		
FROM (HZ)	TO (HZ)	ASD/CURVE
5	20	0.901
20	150	-6 dB/octave
Z AXIS (VERTICAL)		
FROM (HZ)	TO (HZ)	ASD/CURVE
5	20	1.857
20	150	-6 dB/octave

Table 2.1

The EUT is then subjected to the shock tests along the same axis (see Section 3).

While energized, the EUT is then subjected to 10 minutes of the vibration profiles described in Table 2.2 along the same axis.

Based on the instructions supplied by Industries Tri-volt Inc., functional tests are performed on the EUT by ensuring that the current drawn by the heating element remains constant and presents no variations.

X AXIS (TRANSVERSE)		
FROM (HZ)	TO (HZ)	ASD/CURVE
5	20	0,0060
20	150	-6 dB/octave
Y AXIS (LONGITUDINAL)		
FROM (HZ)	TO (HZ)	ASD/CURVE
5	20	0,0144
20	150	-6 dB/octave
Z AXIS (VERTICAL)		
FROM (HZ)	TO (HZ)	ASD/CURVE
5	20	0,0298
20	150	-6 dB/octave

Table 2.2

These vibration and shock tests were then repeated along the two remaining axes in the same sequence.

2.3 Results

Table 2.3 presents the location of the accelerometers and amplifiers for the measurement and control channels during the vibration tests along the X, Y and Z axes. Photographs of the test setups along the different axes are presented in Appendix A.

Translation

Accelerometer Type	S/N	Setup/Axis	Charge amplifier Brand	Model	Channel no.
Brüel & Kjaer Model 4371 (Control)	1376653	On vibrator table/ based on vibration axis	PCB	481M17	1

Table 2.3

The charts of the acceleration levels generated during these tests are presented in Appendix A. Each test is identified using its respective name and number. All tests are presented in Table 2.4, which also includes the shock tests.

TEST	DESCRIPTION	TEST NAME
1-Z- E016229	Vibration, vertical axis – Endurance	61373-vert-fig2-5heures.009
2-Z- E016229	Shock, vertical axis	30msec2-30msec.018
3-Z- E016229	Vibration, vertical axis – Operational	61373-vert-fig2.006
4-X- E016229	Vibration transverse axis – Endurance	61373-trans-fig2-5heures.002
5-X- E016229	Shock, transverse axis	30msec2-30msec.019
6-X- E016229	Vibration, transverse axis – Operational	61373-trans-fig2.030
7-Y- E016229	Vibration, longitudinal axis – Endurance	61373-longit-fig2-5heures.005
8-Y- E016229	Shock, longitudinal axis	50msec2-30msec.028
9-Y- E016229	Vibration, longitudinal axis – Operational	61373-longit-fig2.006

Identification of name of each test
Table 2.4

The current drawn by the element during these tests remained stable:

- at 0.78 amp when EUT was supplied with 600 volts AC along the vertical Z axis
- at 0.29 amp when EUT was supplied with 240 volts AC along the transverse X axis
- at 0.28 amp when EUT was supplied with 240 volts AC along the longitudinal Y axis

Note: Upon discussion with the client, it was agreed that a 600-volt supply was not absolutely necessary in order to test the heating element. After the first test at 600 volts, the tests resumed with a 240-volt supply (when required).

Translation

3. SHOCK TESTS**3.1 Object**

The object of these tests is to assess the capacity of the EUT to operate when subjected to shocks likely to occur in its operational environment.

3.2 Test method

The shock tests were performed in compliance with the specifications of IEC 61373 (1999), Category 1, Class B.

Tests performed by: Corneliu Cercel
Date: September 10, 2003 – Z axis
September 11, 2003 – X axis
September 12, 2003 – Y axis

Equipment under test: E016229
Test: IEC 61373 (1999/01)
Test conditions: Unit non-energized
Severity: 50 m/s² – longitudinal axis
30 m/s² – transverse and vertical axes
Duration: 30 ms
Shape: Half-sine

While non-operational, the EUT was installed onto an anchoring plane by means of its normal fasteners. The anchoring plane was installed onto the vibrator table and the EUT was subjected to three positive shocks followed by three negative shocks.

3.3 Results

The shock tests were performed immediately after each endurance test described in Section 2 herein. Test setups were identical to those used during the latter tests. The charts generated during these tests are presented in Appendix B. Each test is identified using its respective name and number. All tests are presented in Table 2.4.

Translation

4. CONCLUSION

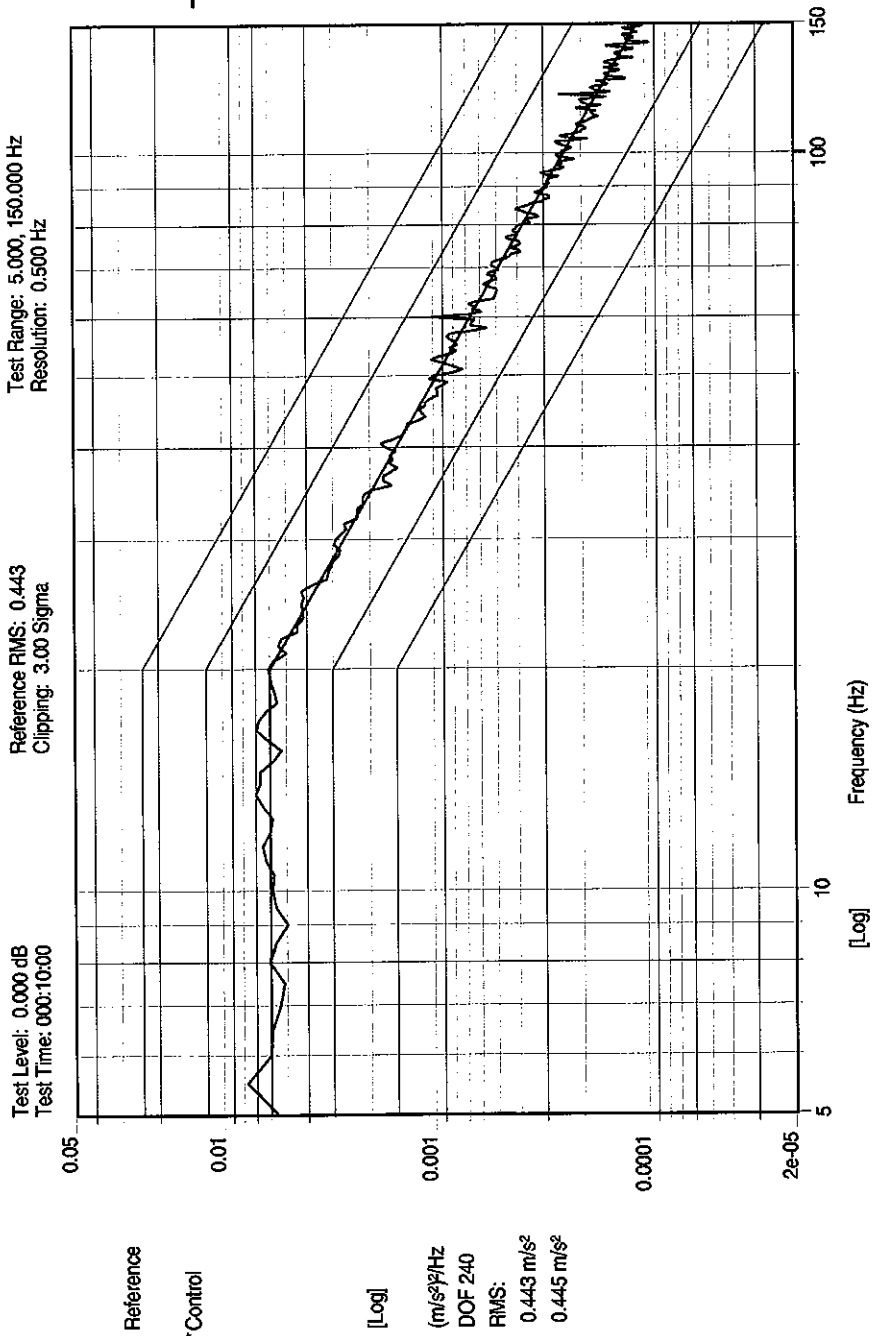
The results presented herein state the test processes as well as the observations compiled during and upon the completion of each test described in the various sections of this report.

The functional tests performed by CRIQ personnel in compliance with the instructions supplied by Industries Tri-volt Inc., during or following the tests performed as part of this project demonstrate the compliance of the EUT with the requirements of the standards listed in the table of Section 1.4.

Final acceptance remains the responsibility of Industries Tri-volt Inc.

APPENDIX A
VIBRATION TESTS

Translation



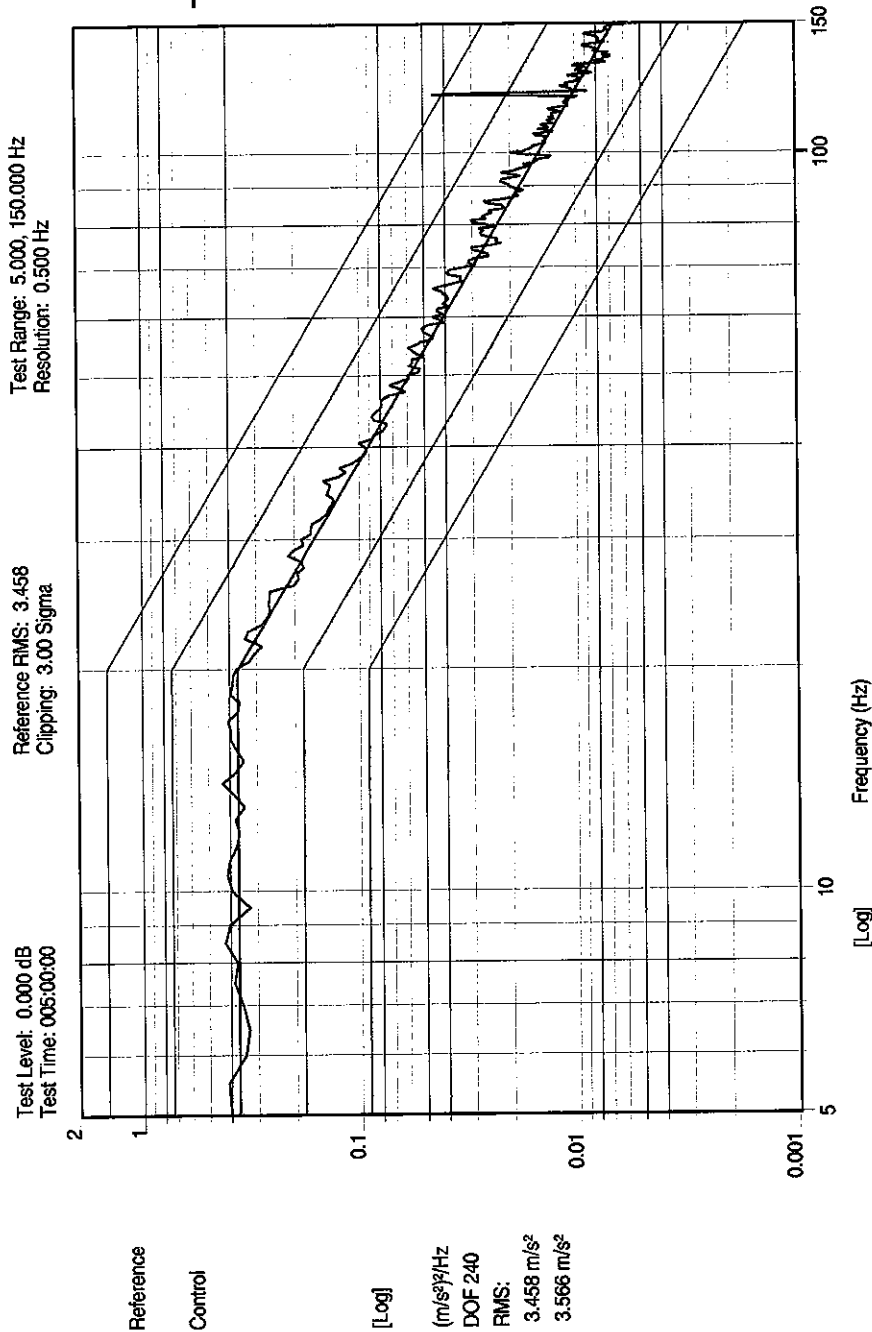
IEC61373 Cat1; Class B; fig.2; TRIVOLT; PE-32820
 Operator=C.Cersei; Sample=E016229; Axe X Transvers
 Test Name: 61373-Trans-fig2.030

09:29:15
 12-Sep-2003

**X axis - Chart
 Operational test**

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Translation

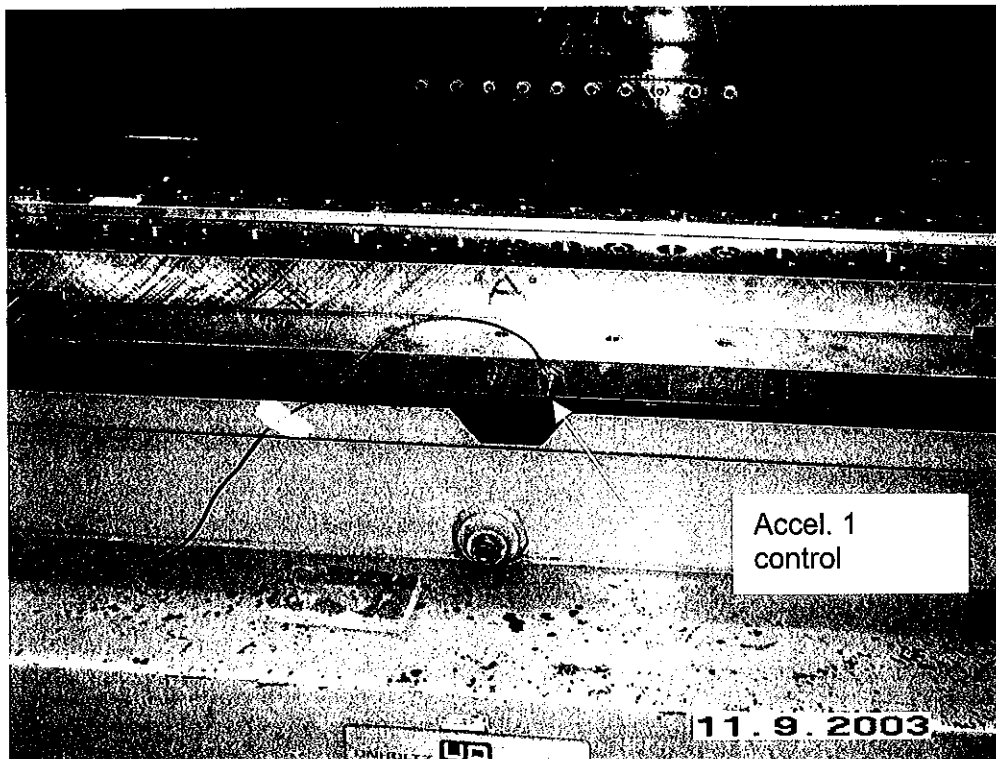


IEC61373 Cat1; Class B; fig 2; Endurance; PE32820; TRIVOLT
Operator=Cerrel C; Echantillon=E016229; Axe X Transversal
Test Name: 61373-Trans-fig2-5heures.003

15:55:26
11-Sep-2003

X axis - Chart
Endurance test

Translation

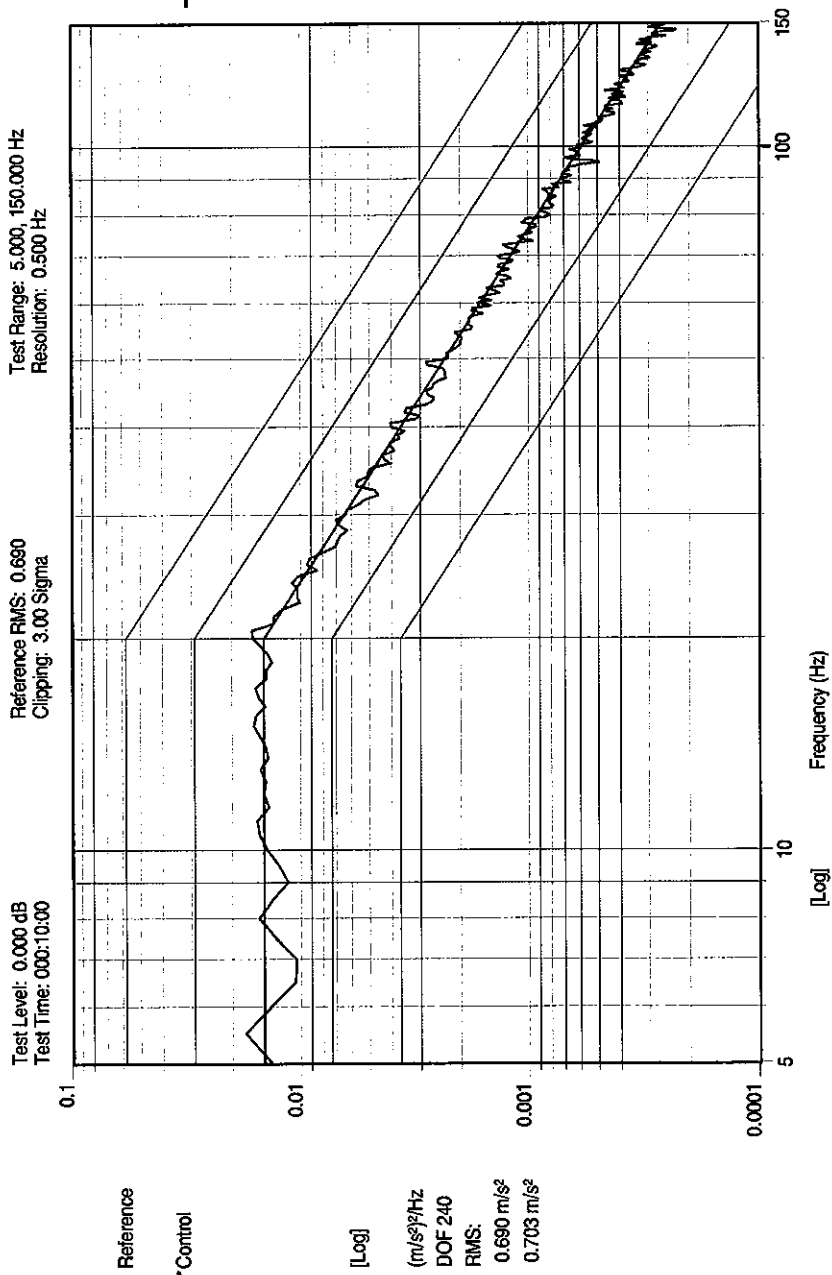


**X axis
Test setup**

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Translation

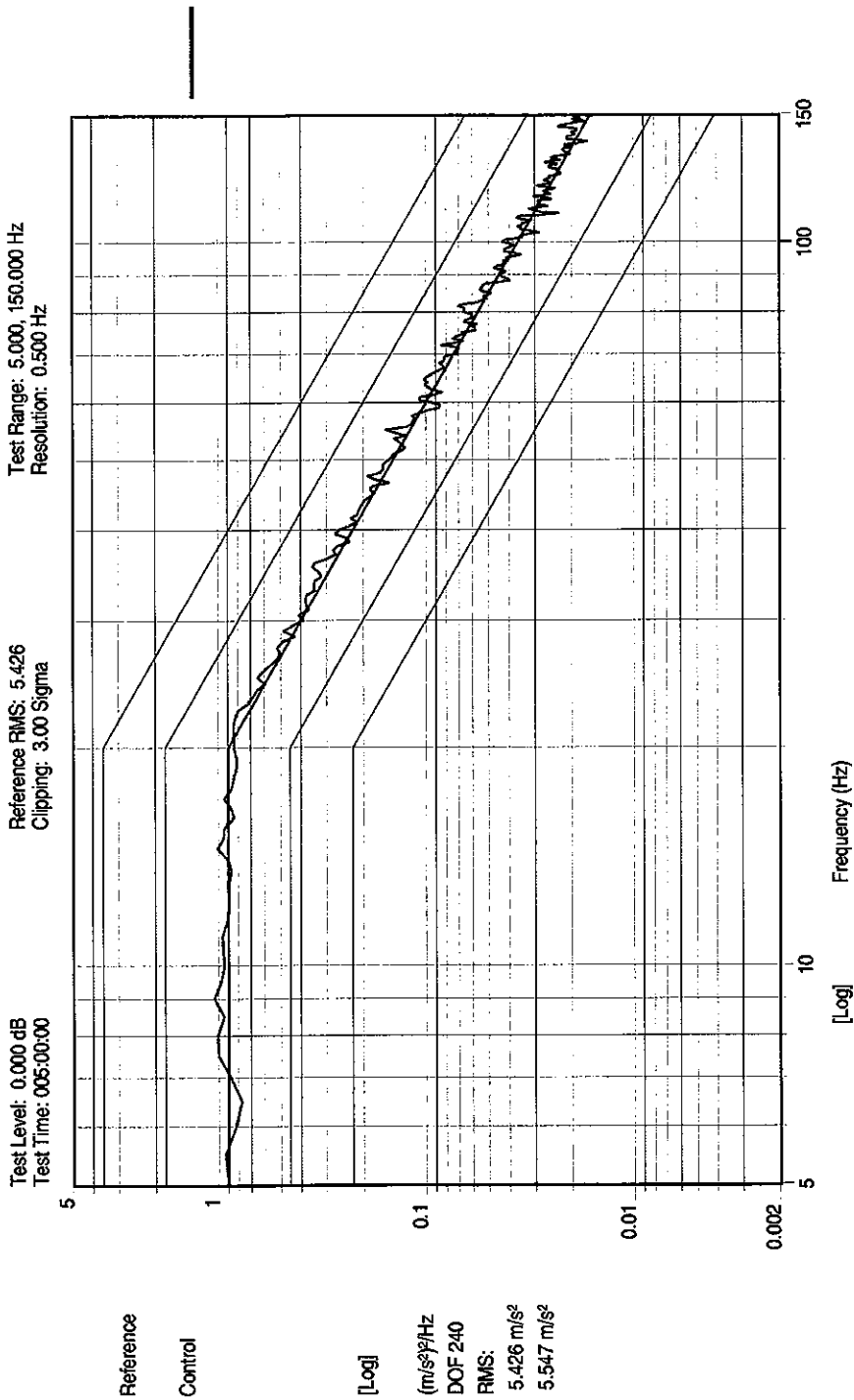


IEC61373 Cat1; Class B; fig.2; TRIVOLT; PE-32820
 Operator=C.Cercet; Echantillon=E016229; Axe Y Longit.
 Test Name: 61373-Longit-fig2.006

15:44:11
 12-Sep-2003

Y axis - Chart
 Operational test

Translation

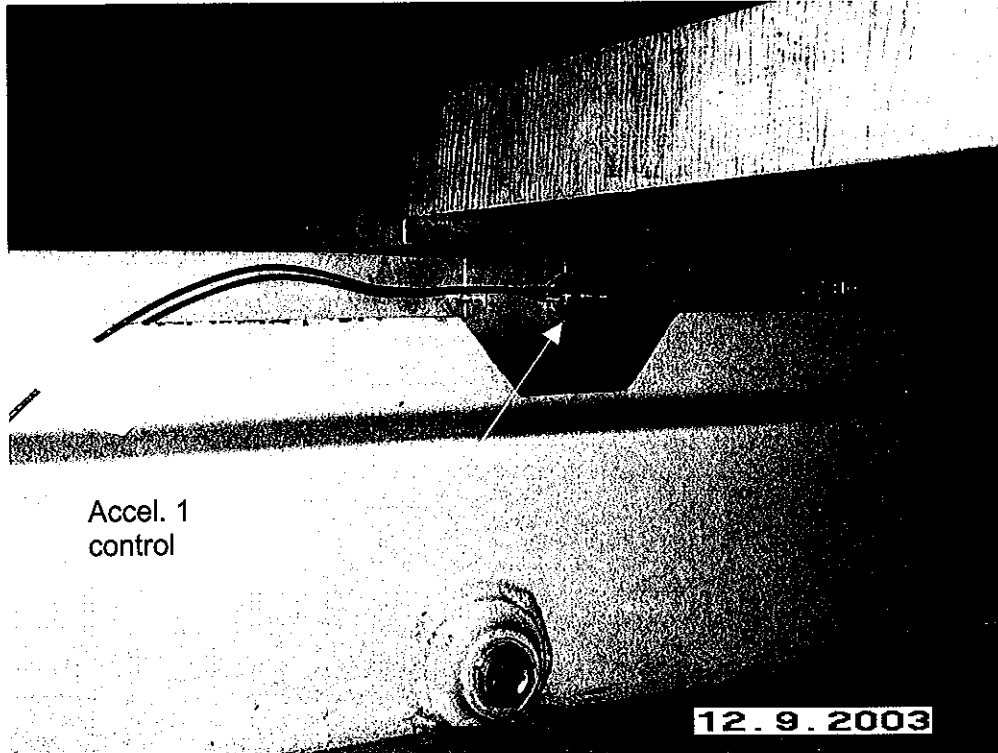
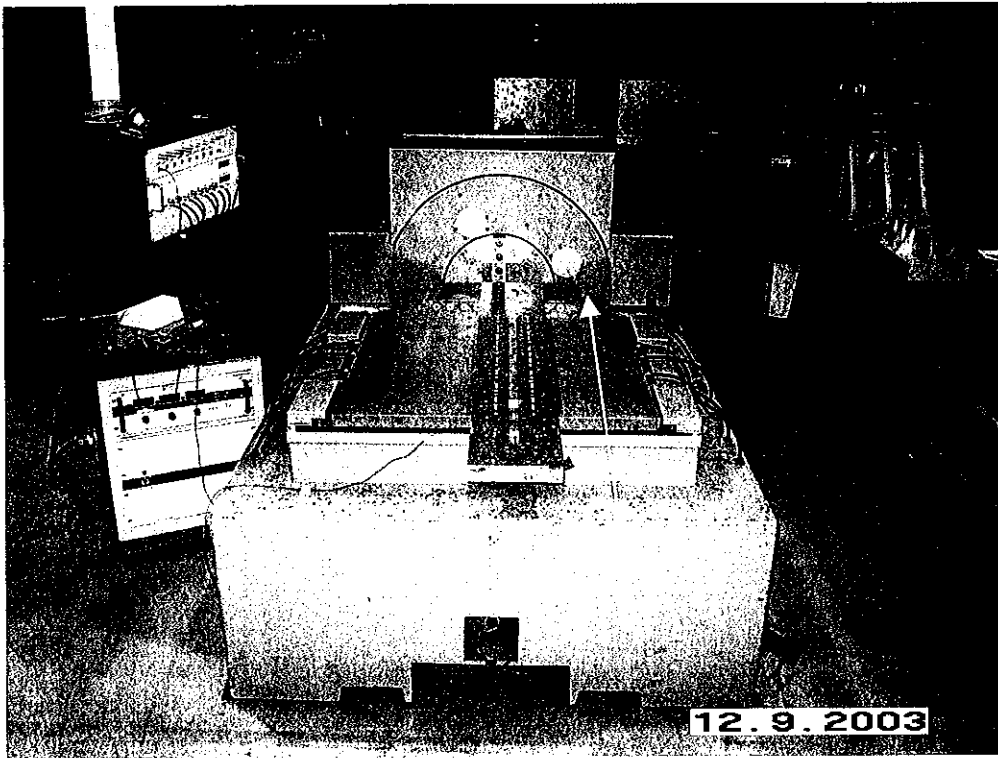


IEC61373 Cat1; Class B; fig.2; Endurance; TRIVOLT; PE-32820
Operator=Cercal C; Sample=E016229; Axe Y Longit
Test Name: 61373-Longit-fig2-5heures.005

14:59:45
12-Sep-2003

**Y axis - Chart
Endurance test**

Translation

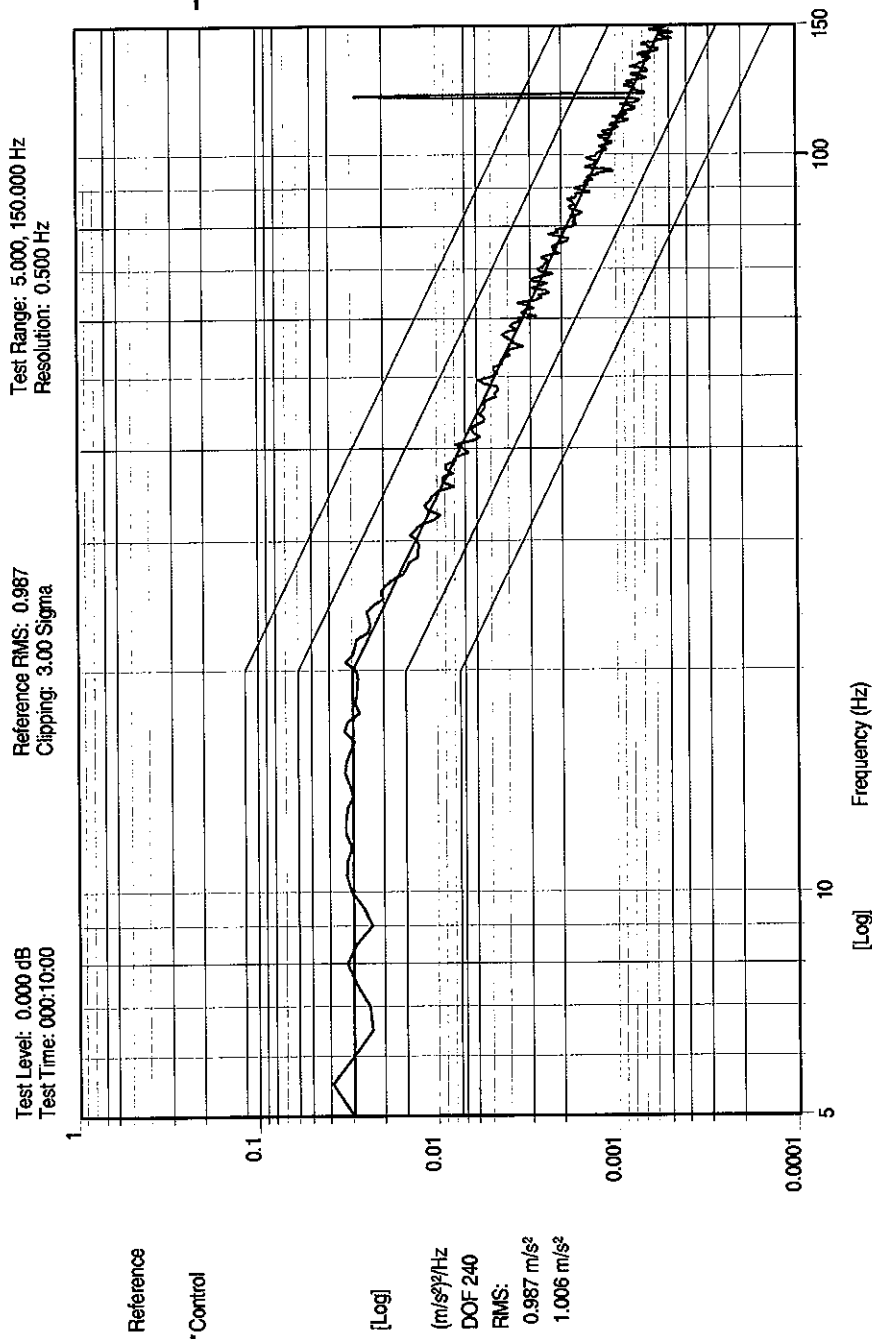


Y axis
Test setup

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Translation



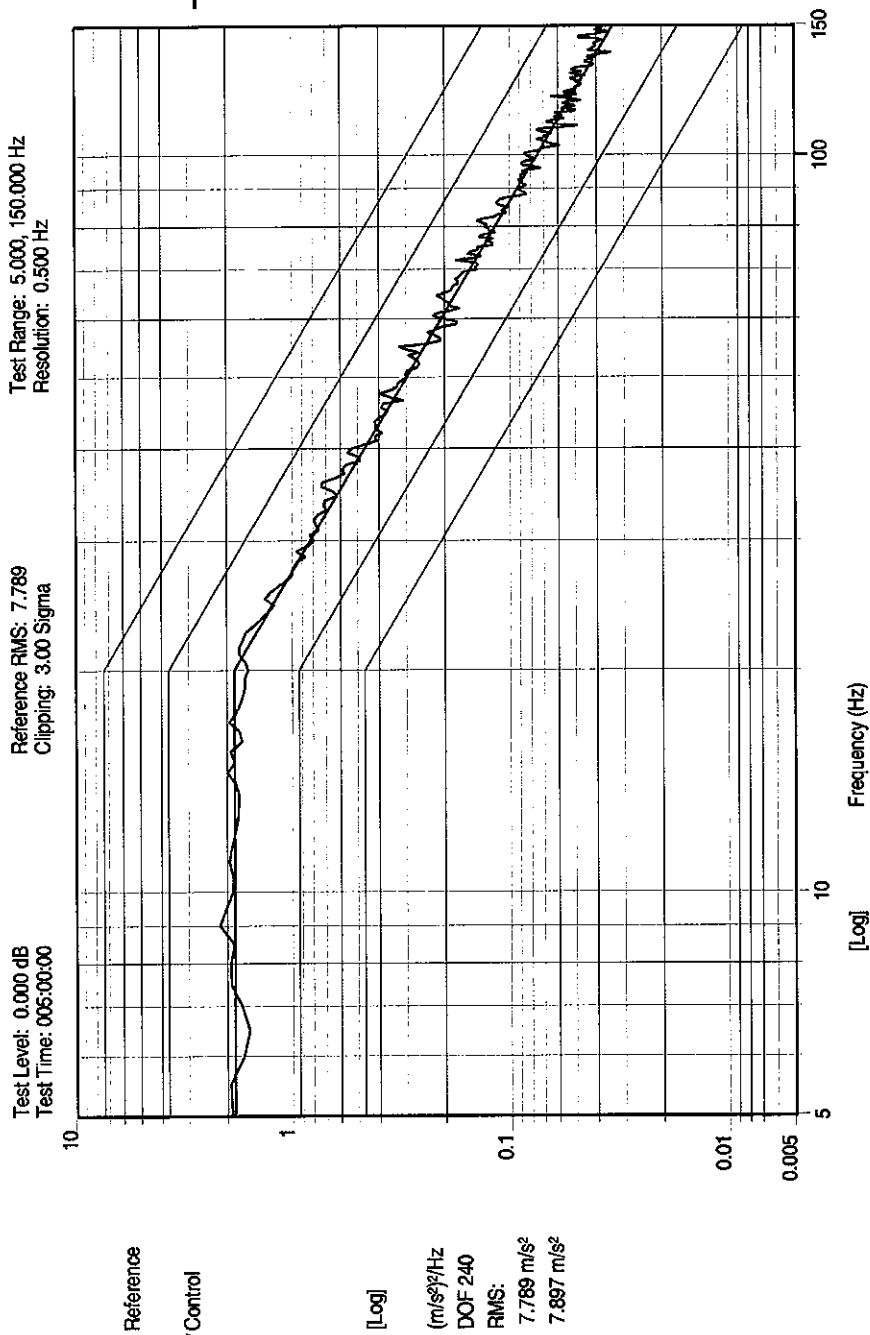
IEC61373 Cat1; Class B; Tableau1; fig.2; TRIVOLT; PE-32820
Operator=C.Cercol; Echantillon=E016229; Axe Z Vertical
Test Name: 61373-Vert-fig2.006

15:40:36
10-Sep-2003

**Z axis – Chart
Operational test**

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Translation

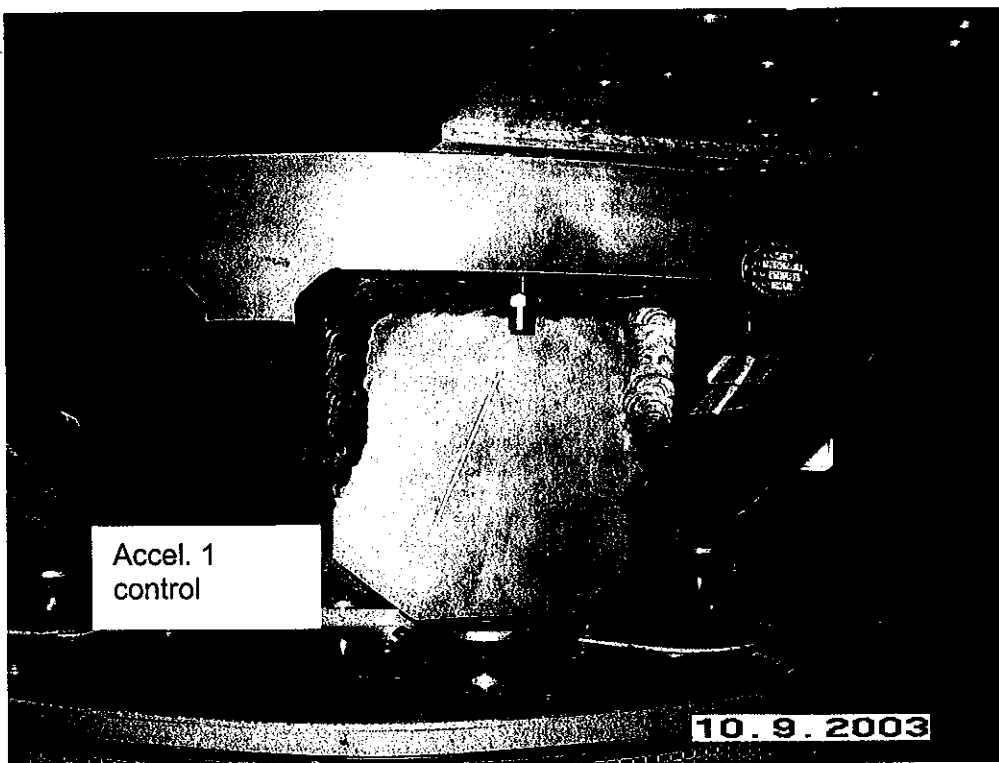
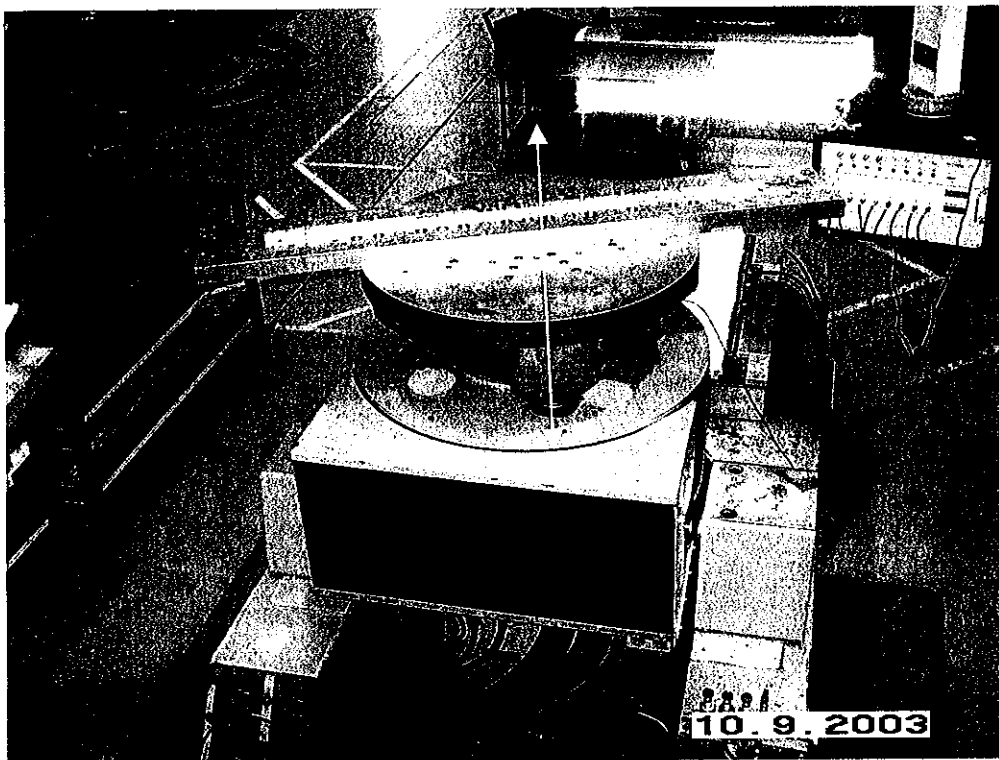


IEC61373 Cat1; Class B; fig. 2; Endurance; PE32820; TRIVOLT
 Operator=C.Ceruel; Echantillon=E016229; Axe Z Vertical
 Test Name: 61373-Vert-fig2-5heures.009

15:08:30
 10-Sep-2003

**Z axis - Chart
Endurance test**

Translation



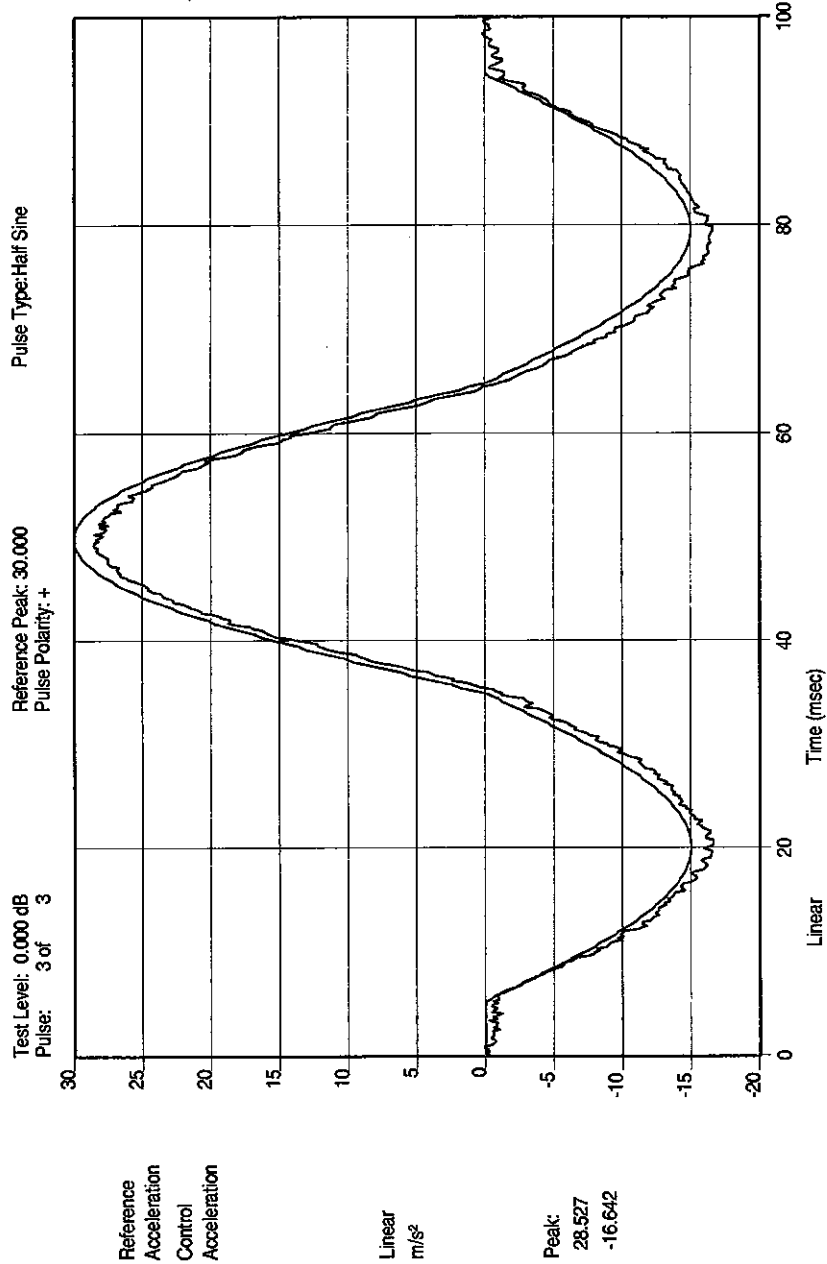
Z axis
Test setup

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APPENDIX B
SHOCK TESTS

Translation

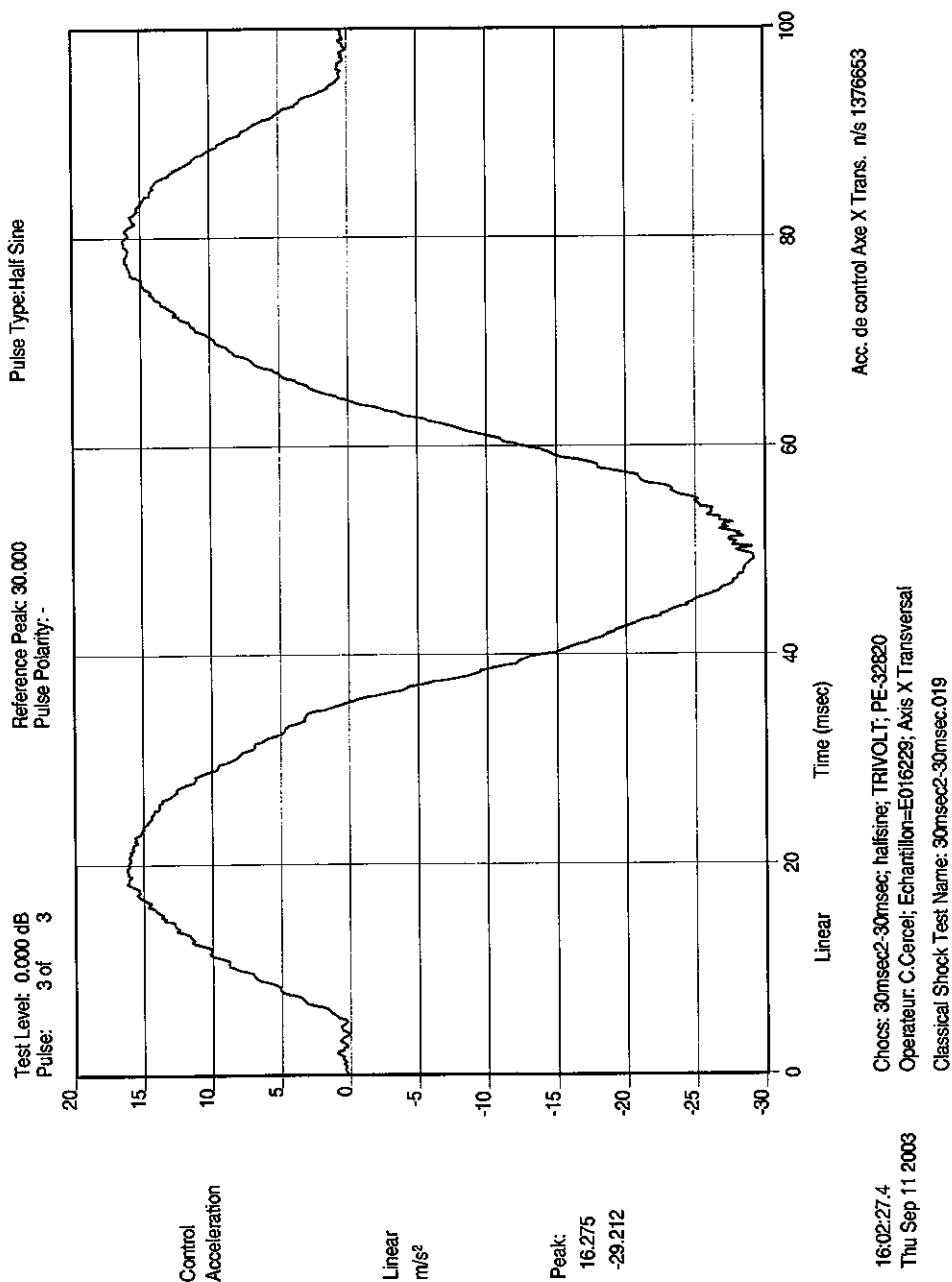


Acc. de control Axe X Trans. n/s 1376653
Chocs: 30msec2-30msec; halfsine; TRIVOLT; PE-32820
Operateur: C.Cersei; Echantillon=E016229; Axis X Transversal
Classical Shock Test Name: 30msec2-30msec.019

16:01:08.7
Thu Sep 11 2003

**X axis – Charts
Shock tests**

Translation

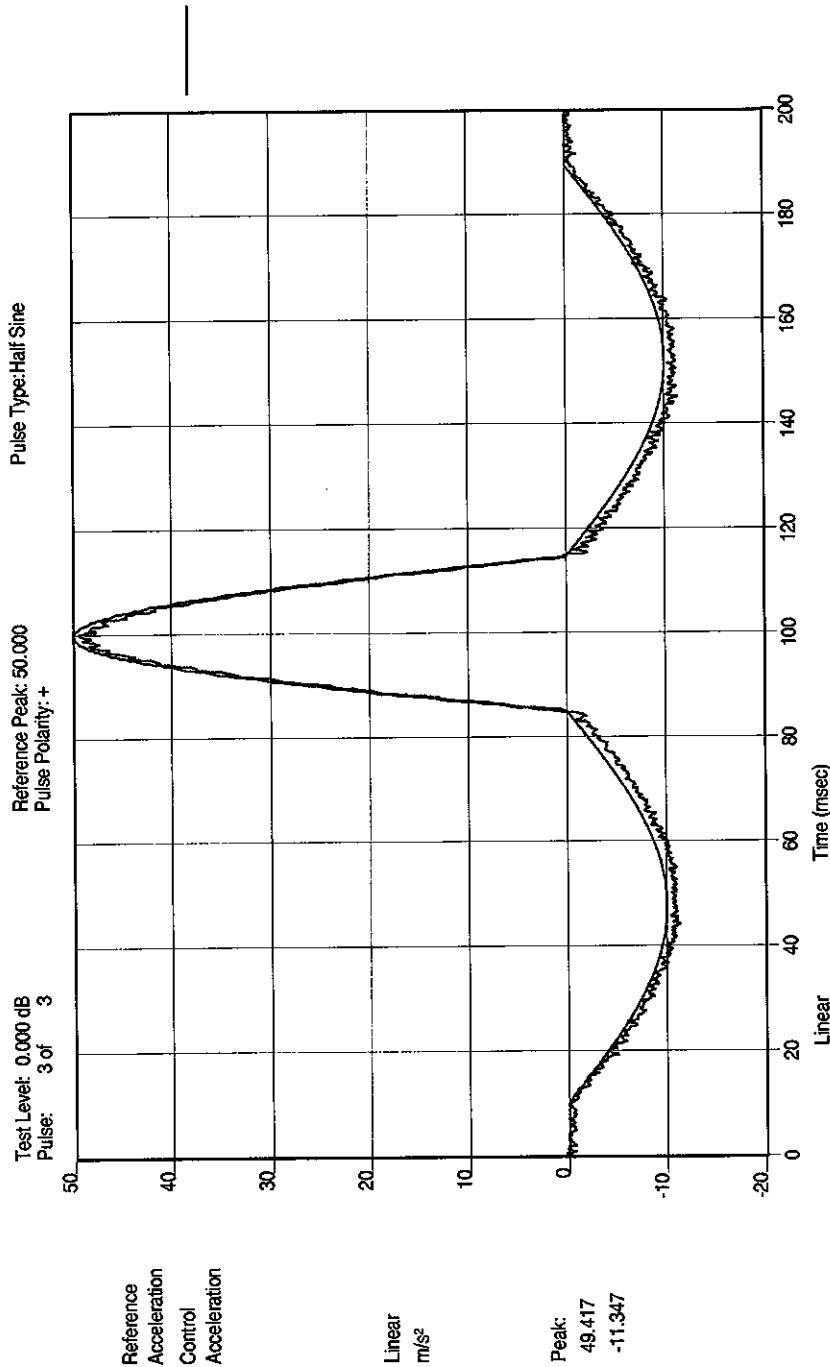


**X axis – Charts
Shock tests**

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Translation



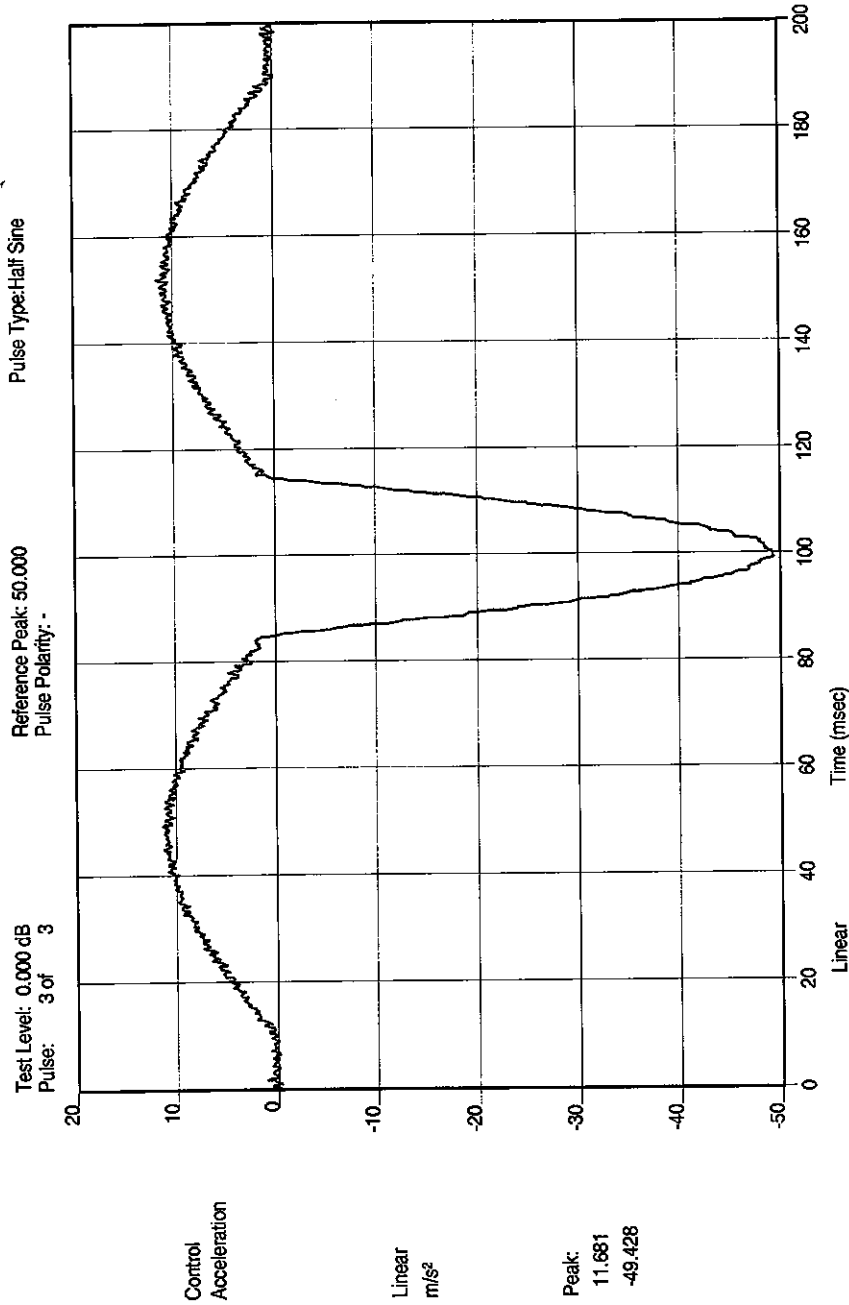
Acc. de controle sur la table n/s 1376653

Chocs: 50msec2-30ms; halfsine; TRIVOLT; PE-32820
Operator: C.Cerpe; Echamillon=E016229; Axe Z Vertical
Classical Shock Test Name: 50msec2-30msec.028

15:19:58.4
Fri Sep 12 2003

**Y axis - Charts
Shock tests**

Translation



Acc. de controle sur la table n/s 1376653

Chocs: 50msec2-30ms; halfsine; TRIVOLT; PE-32820
Operator: C.Cersei; Echantillon=E016229; Axe Z Vertical
Classical Shock Test Name: 50msec2-30msec.028

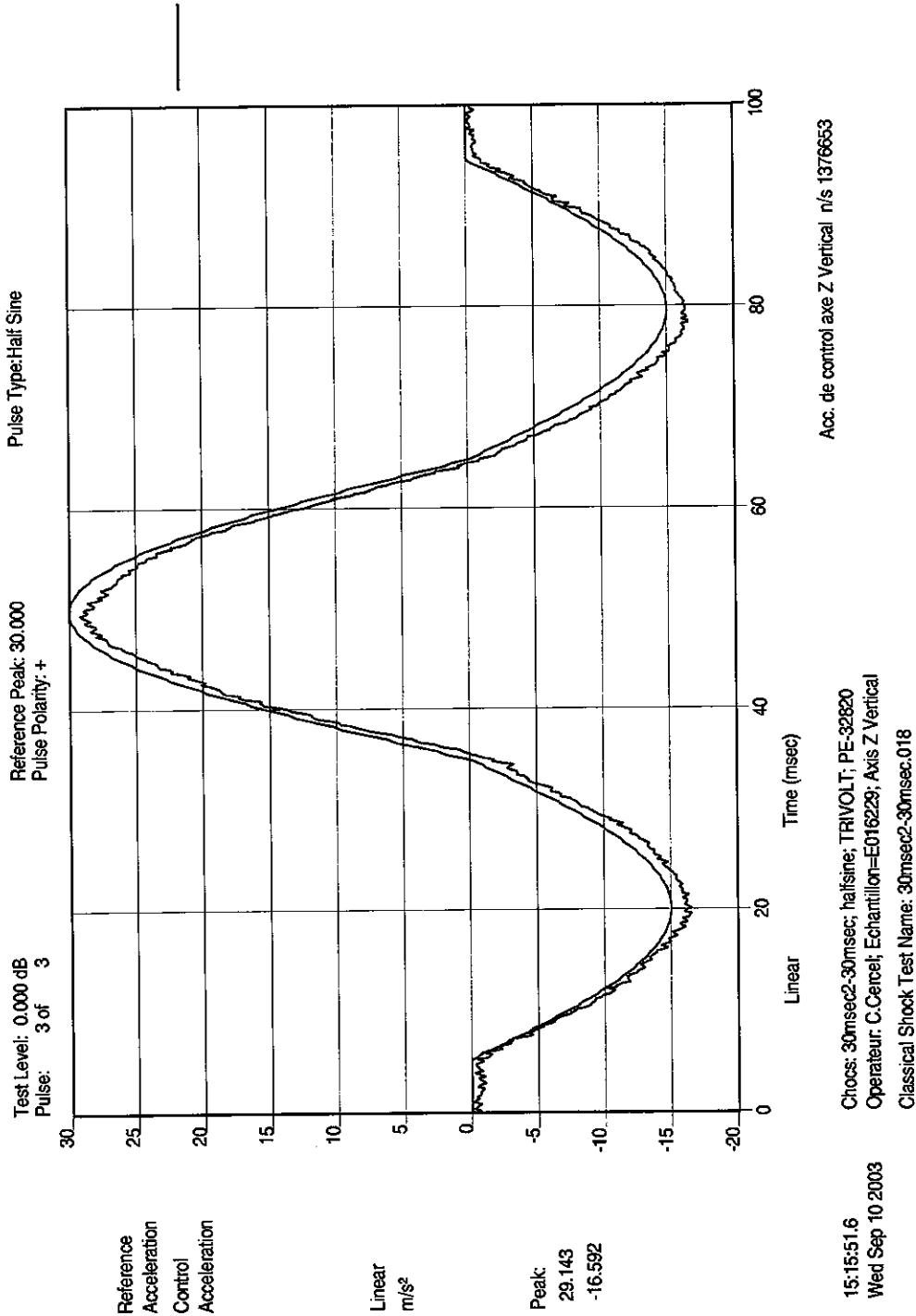
15:21:01.9
Fri Sep 12 2003

Y axis - Charts
Shock tests

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Translation

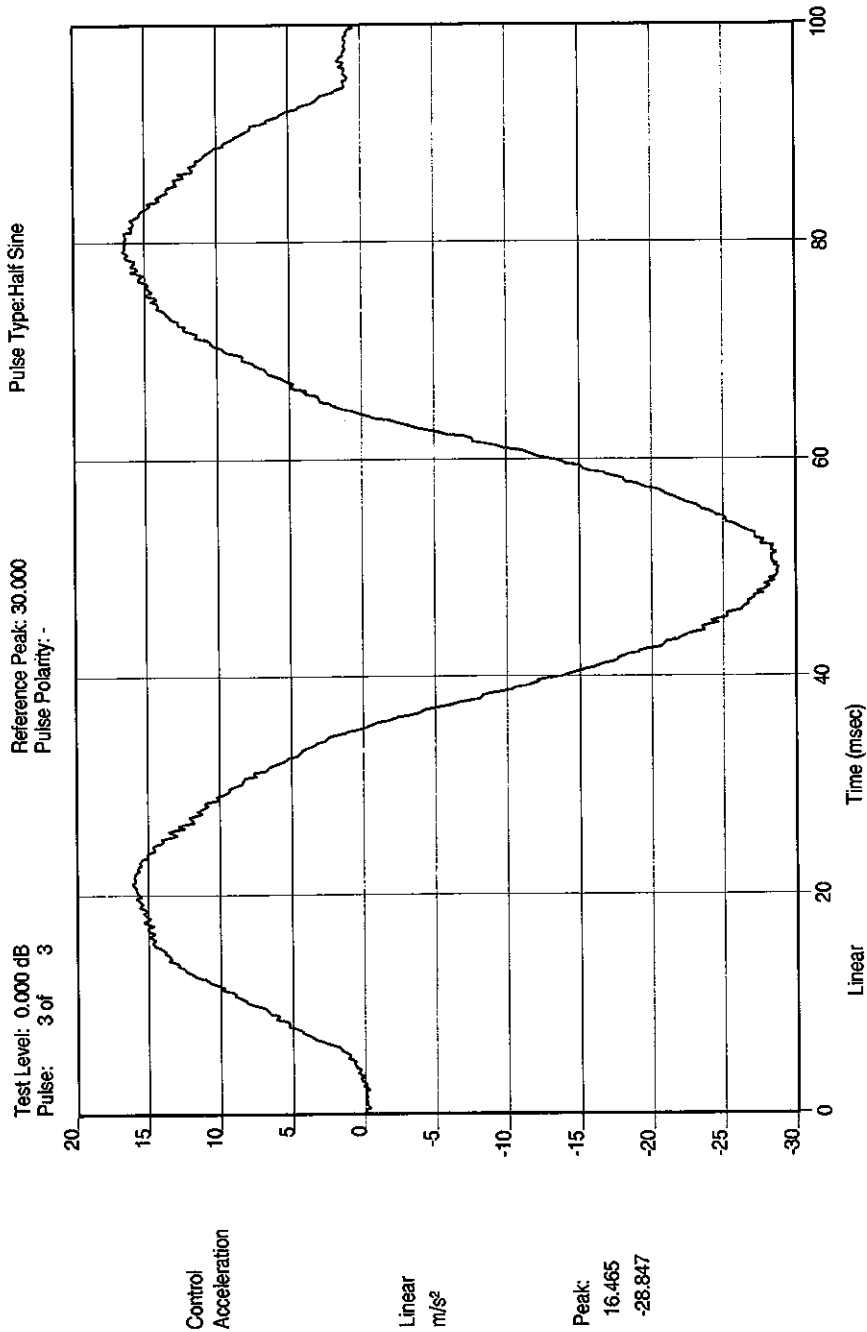


Z axis – Charts Shock tests

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Translation



Acc. de control axe Z Vertical n/s 1376653

Chocs: 30msec2-30msec; halfsine; TRIVOLT; PE-32820
Operateur: C.Cercei; Echantillon=E016229; Axis Z Vertical
Classical Shock Test Name: 30msec2-30msec.018

15:16:52.9
Wed Sep 10 2003

Z axis - Charts Shock tests

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