LNE
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TEST REPORT

Applicant:	ESTAP ELEKTRİK ELEKTRONİK VE BİLGİSAYAR SİSTEMLERİ SANAYİ VE TİCARET ANONİM ŞİRKETİ Merve Mah. Yildirim Sok. No:2 Yenidogan – Sarigazi 34791 Umraniye ISTANBUL TURKEY
Addressee:	Ms Safak Yesilyurt Quality Assurance Manager
Date of order:	18 February 2009 Order no. 000286291.
Subject:	Mechanical tests: vibration and shock tests of the cabinets.
Reference documents:	• CEI 61587-1* (March 2007) • CEI 60068-2-6 (December 2007) • CEI 60068-2-27* (February 2008) • CEI 61010-1* (February 2001) + addendum AC1 (May 2002) and addendum AC2 (April 2003)
Identification of sample:	A cabinet designated Free Standing Estap Cabinet 42U, with additional loads.

For any difficulty in the interpretation of this document, please refer to the original report K020085 – DE/1 (in French) which is the only authentic text.

1. IDENTIFICATION OF EQUIPMENT TESTED

The ESTAP company entrusted to the Laboratoire national de métrologie et d'essai (LNE Trappes – Environmental Testing department) a cabinet designated Free Standing Estap Cabinet 42U (dim.: 2000 x 600 x 600 mm), with additional loads, for the purpose of having it undergo the mechanical tests indicated in the reference documents.

Received on: 18 February 2009
(provided by MESSRS. Dumouchel & Bedel of LEGRAND).

2. REFERENCE DOCUMENTS

The tests were performed in conformity with the indications specified in the standards:

- IEC 61587-1* (March 2007)
- IEC 60068-2-6 (December 2007)
- IEC 60068-2-27* (February 2008)
- IEC 61010-1* (February 2001) + addendum AC1 (May 2002) and addendum AC2 (April 2003)

3. TESTING AND MEASURING RESOURCES

The testing and measuring resources are described in appendix 1.

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4. TEST PARAMETERS

The testing conditions (including the attachment of the cabinet), the locations of the sensors, and the definitions of the directions of excitation are specified on the view in appendix 2.

4.1. SINUSOIDAL VIBRATIONS – SEARCH FOR RESONANCES

Reference documents	• IEC 60068-2-6 standard • IEC61587-1* Standard § 5.3.1
Waveform	sinusoidal
Range of frequencies	5 to 100 Hz
Applied level	1 m/s^2 from 5 to 100 Hz
Sweep mode	Logarithmic
Sweep rate	1 octave/min
Number of axes of excitation	Three, orthogonal
Number of sweep cycles [5 – 100 – 5 Hz] per direction	1
Particular conditions	- Equipment fitted with simulated loads, in conformity with table 7 and figure 8 of standard IEC 61587-1* (information from LEGRAND) – loads placed by LEGRAND personnel - Recording of the accelerations measured by the control, verification, and auxiliary sensors.
Finding at the end of the test	Visual appraisal after each test: no deformation of or damage to parts allowed, that might affect the form, the adjustment, or the function of the equipment tested.

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4.2. SINUSOIDAL VIBRATIONS – HOLD AT RESONANCE

Reference documents:	• IEC 60068-2-6 standard • IEC 61587-1* Standard § 5.3.1
Waveform	sinusoidal
Applied level	1 m/s² at resonance (the most representative frequency found in the previous test) Note: in some cases, rather than a hold at a fixed frequency, restricted sweeps around resonance will be allowed when resonance is not evident (Cf. standard IEC 60068-2-6 § 8.3.2.a.2)
Duration	Hold for at least 10 minutes
Number of axes of excitation	Three, orthogonal
Particular conditions	- Equipment fitted with simulated loads, in conformity with table 7 and figure 8 of standard IEC 61587-1* (information from LEGRAND) – loads placed by LEGRAND personnel - Recording of the accelerations measured by the control, monitor, and auxiliary sensors.
Finding at the end of the test	Visual appraisal after each test: no deformation of or damage to parts allowed, that might affect the form, the adjustment, or the function of the equipment tested.

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4.3. SINUSOIDAL VIBRATIONS – ENDURANCE BY SWEEP

Reference documents:	• IEC 60068-2-6 standard • Standard IEC 61587-1* § 5.3.1 – table 8 ➔ Performance level DL4
Waveform	sinusoidal
Range of frequencies	2 to 200 Hz
Applied levels	1.5 mm from 2 to 9.1 Hz 5 m/s² from 9,1 to 200 Hz
Sweep mode	Logarithmic
Sweep rate	1 octave/min
Number of axes of excitation	Three, orthogonal
Number of sweep cycles [2 – 100 – 2 Hz] per direction	10, or a total test duration per axis of 2 hours 12 minutes and 52 seconds
Particular conditions	- Equipment fitted with simulated loads, in conformity with table 7 and figure 8 of standard IEC 61587-1* (information from LEGRAND) – loads placed by LEGRAND personnel - Recording of the accelerations measured by the control, monitor, and auxiliary sensors.
Finding at the end of the test	Visual appraisal after each test: no deformation of or damage to parts allowed, that might affect the form, the adjustment, or the function of the equipment tested.

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4.4. SHOCK TESTS *

Reference documents:	• IEC 60068-2-27 standard • Standard IEC 61587-1* § 5.3.1 – table 8 → Performance level DL4	
Waveform	Semi-sinusoidal	
Amplitude and duration of the shocks in the vertical (Y) axis only	40 m/s² and 18 ms	Pre and post pulse adjusted to 10%, in single lobes
Direction of the shocks	Only one direction: upward displacement of the vibrating table	
Number of shocks	Three	
Number of axes of excitation	One, Y vertical axis	
Particular conditions	- For safety, cabinet held loosely, in the vertical direction, by a strap, during the shocks - Pre-tests: 1 shock at – 6 dB and 1 shock at – 3 dB. - Equipment fitted with simulated loads, in conformity with table 7 and figure 8 of standard IEC 61587-1* (information from LEGRAND) – loads placed by LEGRAND personnel - Recording of the accelerations measured by the control, verification, and auxiliary sensors.	
Finding at the end of the test	- Visual appraisal after the test: no deformation of or damage to parts allowed, that might affect the form, the adjustment, or the function of the equipment tested. - Check of the continuity of the grounding circuit at the end of all of the tests	

4.5. TEST OF CONTINUITY OF THE GROUNDING CIRCUIT *

This was performed by LEGRAND company personnel using their own equipment.

Test conditions (in conformity with standard IEC 61587-1* § 6.2 and standard IEC 61010-1*):
injection of 12 VDC at 25 A (open circuit) for one minute between different points on the structure of the cabinet.

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5 COURSE AND RESULTS OF THE TESTS

5.1. PERSON PRESENT AT THE TESTS

The tests were held on 18 and 19 February 2009 at the Laboratoire national de métrologie et d'essais of Trappes (EETS section) in the presence of:

- Ms Yesilyurt et Mr Islamoglu (ESTAP - TURKEY), present on 18 February
- Mr Evci (TSE – TURKEY), present on 18 February
- Messrs Dumouchel and Bedel (LEGRAND, FRANCE), present both days

5.2. TABLES OF RESULTS

The tables below specify the course of the tests, any remarks, and the numbers of the appendices containing the photographs and the curves associated with each test.

In these tables:

- "R.A.S. " means **R**ien **A** **S**ignaler (Nothing to Report).
- The findings of the visual inspections are without prejudice to the results of a more thorough examination by the requesting party, after the test, on its own premises (in particular after dismantling of the product).
- F_r designates possible frequencies of resonance (detected during the searches for resonance)
- Q designates the magnification factor (*The magnification factor is the dimensionless ratio of the response amplitude of a system in steady-state forced vibration to the excitation amplitude. In our case, it is the ratio of the acceleration recorded on the auxiliary sensor to that on the control point).*
- The checks of the tolerances of the test parameters are listed in appendix 7.

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Test no.	Designation of the test	Axis of excitation	Duration of test	Remarks	Appendix no.
1	Search for resonance	Y	8 min and 38 sec	Result of the search for resonance: F_r = 51.3 Hz; $Q_{top\ cab.}$ = 6.2; $Q_{bottom\ cab.}$ = 7.1 Visual inspection: R.A.S.	3-1
2	Hold at resonance		10 min and 40 sec	Restricted sweep around resonance: between 41.0 and 61.6 Hz; rate = 0.11 oct/min or 1 sweep cycle performed Visual inspection: R.A.S.	3-2
3	Endurance by sweep		2 hours 12 min and 52 sec	Visual inspection: R.A.S.	3-3
4	Shock test*		3 shocks	Visual inspection: R.A.S.	3-4
5	Search for resonance	Z	8 min and 38 sec	Result of the search for resonance: the first F_r is before 5Hz the second: F_r = 41.2 Hz; Q top cab. = 4.5; $Q_{bottom\ cab.}$ = 5.5 Visual inspection: R.A.S.	4-1
6	Hold at resonance		10 min and 38 sec	Restricted sweep around resonance: between 36 and 54 Hz; rate = 0.11 oct/min or 1 sweep cycle performed Visual inspection: R.A.S.	4-2

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Test no.	Designation of the test	Axis of excitation	Duration of test	Remarks	Appendix no.
7	Endurance by sweep		2 hours 12 min and 52 sec	Visual inspection: R.A.S.	4-3
8	Search for resonance	Y	8 min and 38 sec	Result of the search for resonance: F_r is before 5 Hz Visual inspection: R.A.S.	5-1
9	Hold at resonance		10 min	Hold at fixed frequency of 5 Hz Visual inspection: R.A.S.	5-2
10	Endurance by sweep		2 hours 12 min and 52 sec	Visual inspection: R.A.S.	5-3
11	Tests of continuity of ground*	-	-	Tests of continuity of ground*: Measurements satisfactory → values < 100 mΩ - between the chassis and the side panel = 3.72 mΩ - between the chassis and the hinged rear panel = 4.01 mΩ - between the chassis and the front door = 3.04 mΩ - between the chassis and the top surface = 2.22 mΩ - between the right and left parts of the chassis = 1.96 mΩ	6

5.3. CONCLUSION

No damage to the ESTAP cabinet was observed in the course of the tests covered: vibration and shock tests as per standard IEC 61587-1* (§ 5.3.1). The requirements of conformity to this standard in these tests on this equipment were met.

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At the end of the tests, the equipment was recovered by MESSRS. Dumouchel & Bedel, 20 February 2009.

Trappes, on 17 March 2009

In charge of the test:
Michel CONAN
Patrice PRADAYROL
Emmanuel RUIZ

Test Officer

Michel CONAN

Head of Environmental Testing and Signal Processing Division

Laurent BUGUET

The results which are quoted are only applicable to the sample, the products or material submitted to LNE and which is fully described in this document.

Appendix 1-1

The LNE's vibration and shock testing and measuring resources

Names of equipment	Mark	Model	Latest calibration date	Next calibration date	Establishment name of calibration	Certification number (date)
Electrodynamic exciter	LING	2016 no 50	12/12/2008 & 01/30/2009 (checking)	Dec 2009 (checking)	ACTIDYN	202008 (12/12/2008) & H2959 (01/30/2009)
Power amplifier		DMA-12-HBSR-2016.12 no 100				
Horizontal table	TEAM	482/336 no 216				
PC for signal generation and monitoring	DATA PHYSICS	DELL no 1	12/02/2008	Nov 2009	DCY Services	CV-081202-02-A08 (12/02/2008)
Control sensor	COLUMBIA	3028 no 113	04/24/2008	April 2010	A+ Metrologie	LQ21248/04057 (04/28/2008)
Conditioner of the control sensor	Brüel & Kjaer	2635 no 921719				
Monitoring sensor (tri-axial)	Brüel & Kjaer	4326A no 30083	04/07/2008	April 2009	A+ Metrologie	LQ21248/07147 (04/07/2008)
Conditioner of the monitoring sensor	Brüel & Kjaer	2692-014 Nexus no 2391949 (channels no 1-2-3)				
"Top cabinet" sensor	PCB	HTJM352C67 no 71381	04/10/2007	April 2009	A+ Metrologie	LQ18966/07145 (04/11/2007)
Conditioner	PCB	482A22 no 1064 (channel 2)				
"Bottom cabinet" sensor	PCB	M352C67 no 42494	04/10/2007	April 2009	A+ Metrologie	LQ18966/04078 (04/11/2007)
Conditioner	PCB	482A22 no 1064 (channel 4)				

+ an aluminium transmitter and an aluminium interface plate (dim. 1020 x 995 x 20 mm) used during the tests in the vertical axis

Appendix 1-2

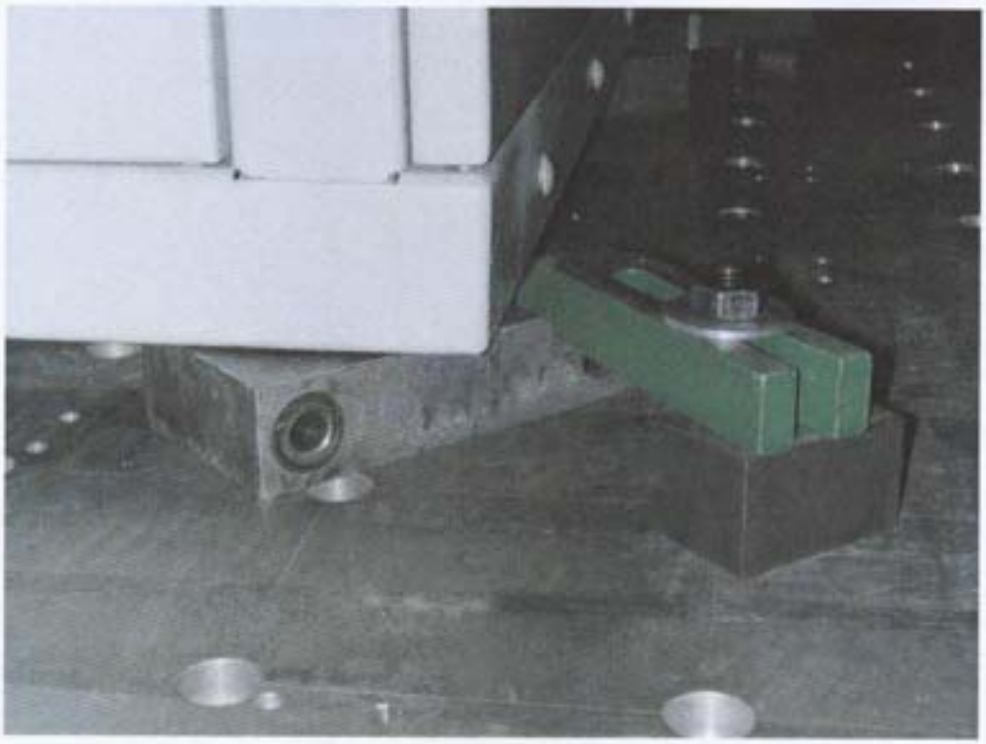
Continuity of ground testing and measuring resources* (provided by the LEGRAND company)

Name of equipment	Mark	Model	Latest calibration date	Next calibration date	Establishment name of calibration	Certification number (date)
Ground continuity tester	SEFELEC	CMG 30 no 135 31600	10/16/2008	10/16/2009	A+ Metrologie	102494 (10/16/2009)

Appendix 2-2

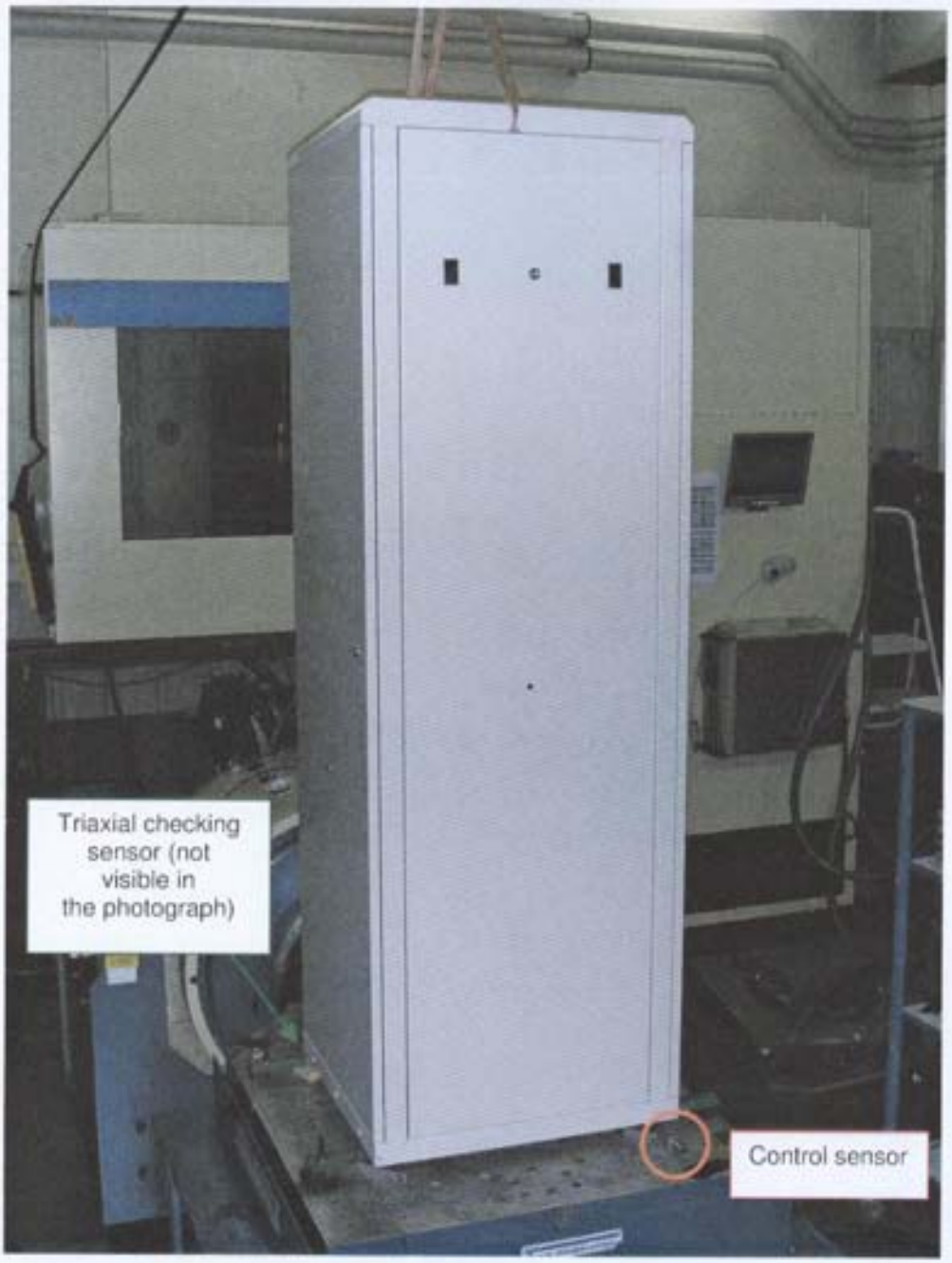
Attachment of the cabinet

The cabinet has jacks that were set down on the vibrating table and held by immobilizing with "Vees"



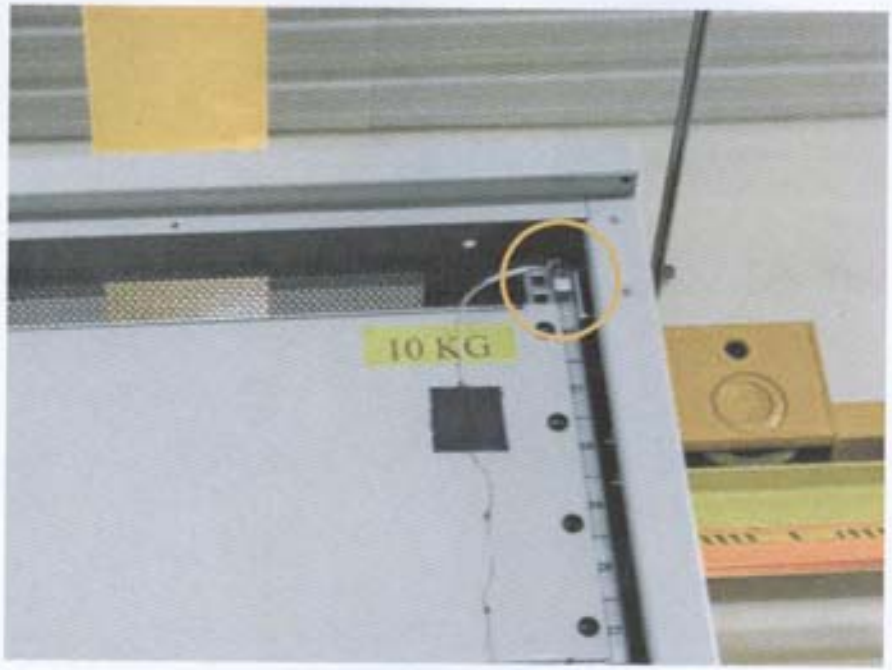
Appendix 2-3

Locations of the control and monitoring sensors

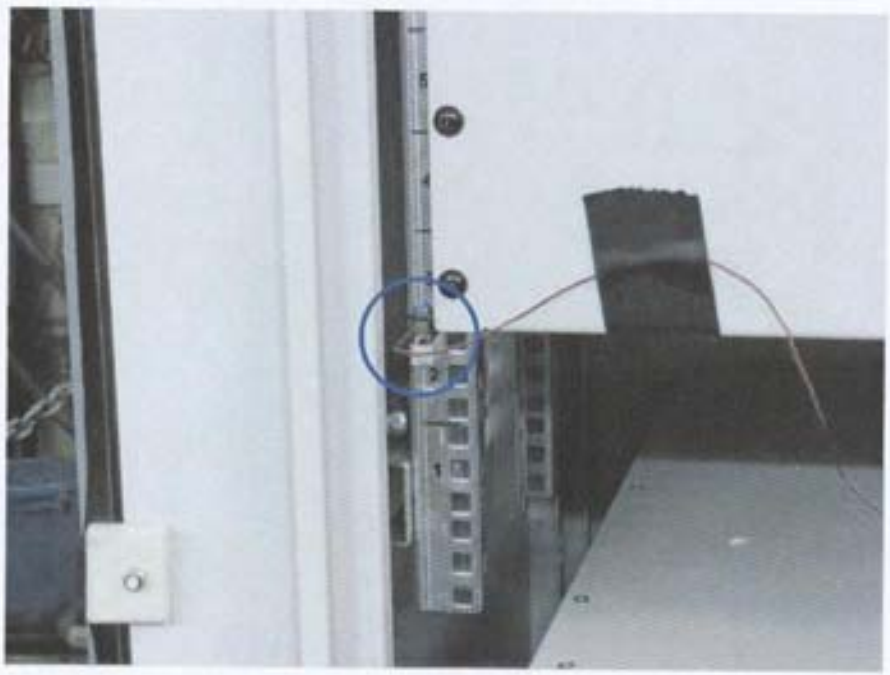


Appendix 2-4

Locations of the auxiliary sensors



"top cabinet" sensor



"bottom cabinet" sensor

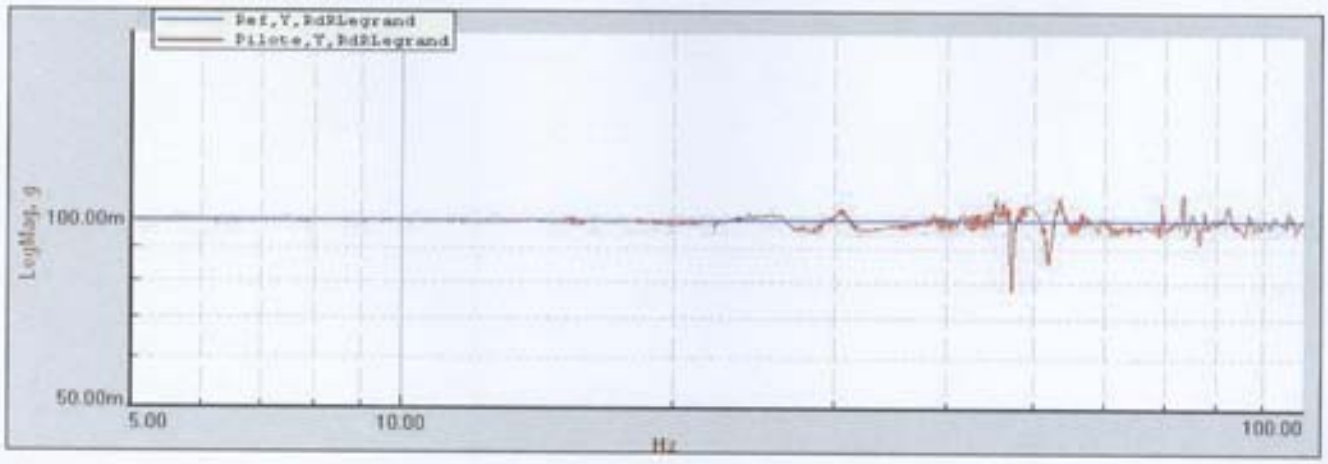
Appendix 3-1

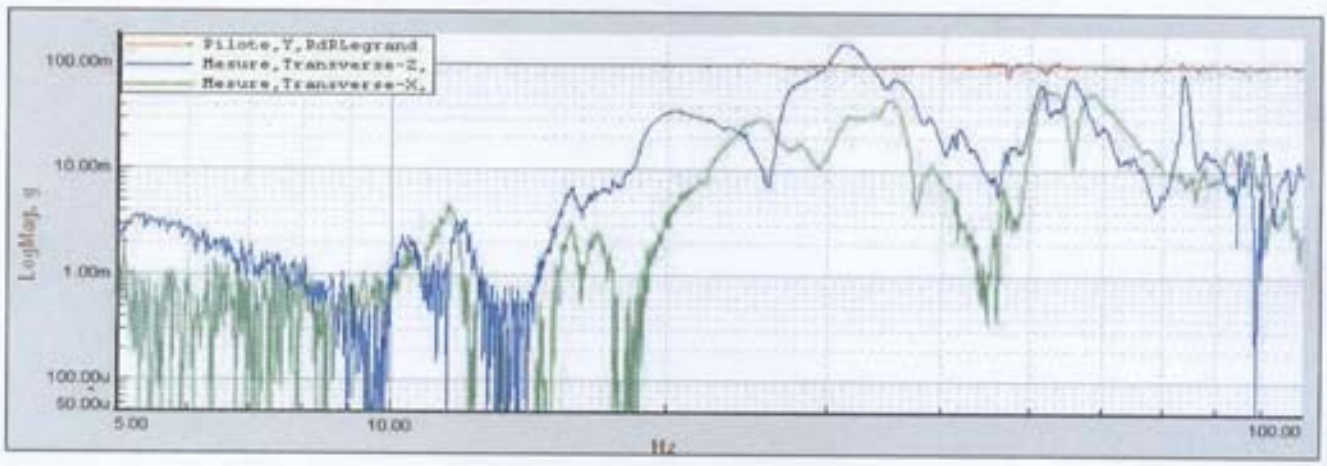
Search for resonance - Y axis (lowering phase)

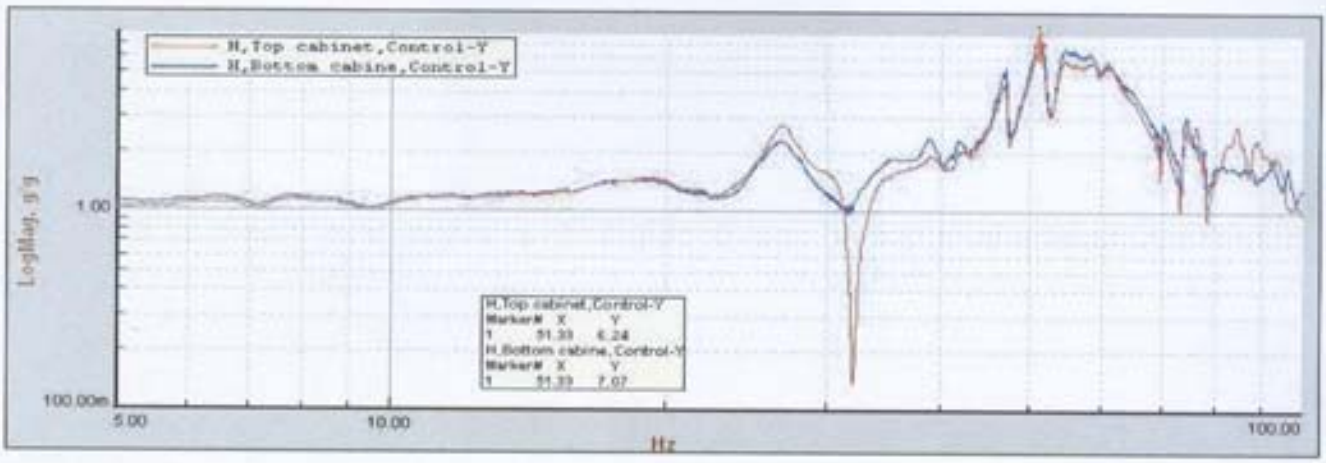
Top grap : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Ref" profile

Middle graph : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Transverse-" transverse measurements

Bottom graph : "H" amplification factors (Q) recorded on the two auxiliary sensors







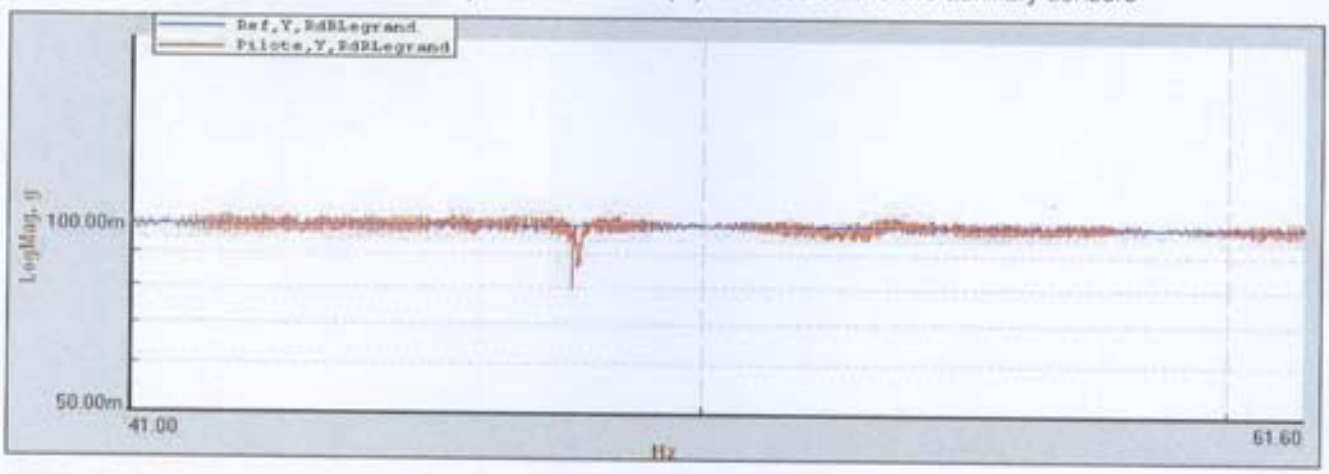
Appendix 3-2

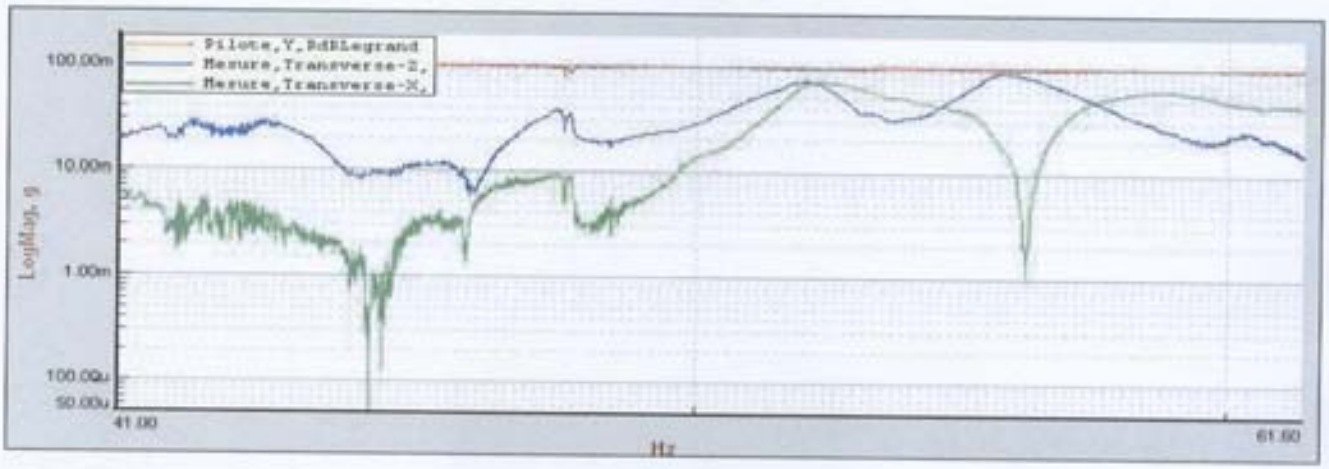
Hold at resonance - Y axis

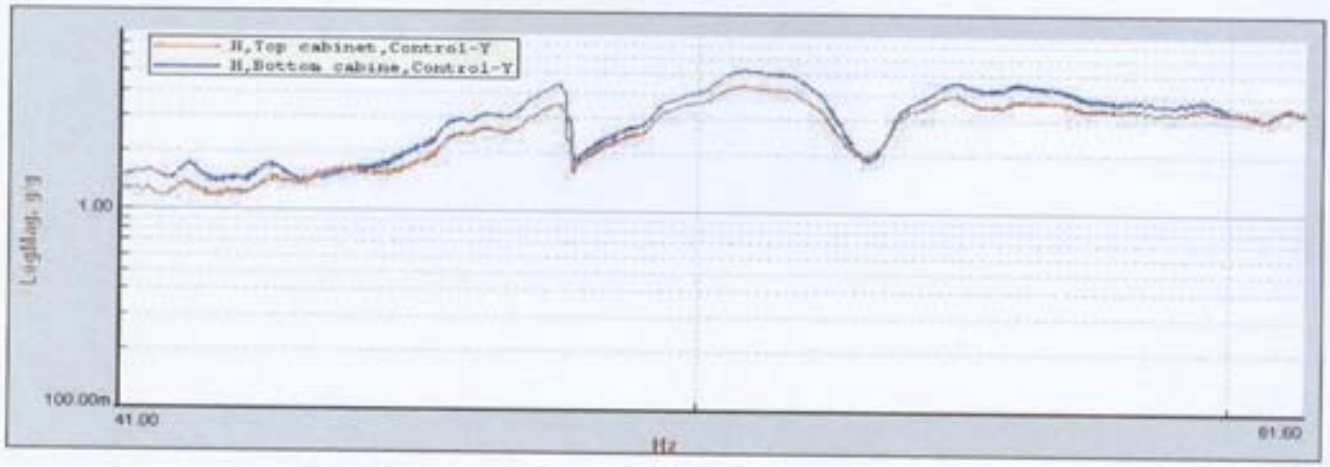
Top grap : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Ref" profile

Middle graph : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Transverse-" transverse measurements

Bottom graph : "H" amplification factors (Q) recorded on the two auxiliary sensors







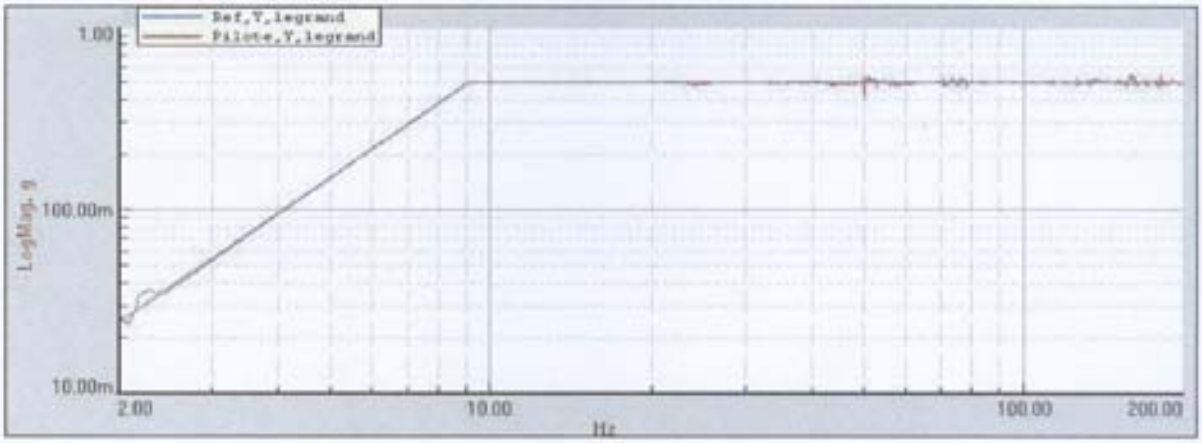
Appendix 3-3

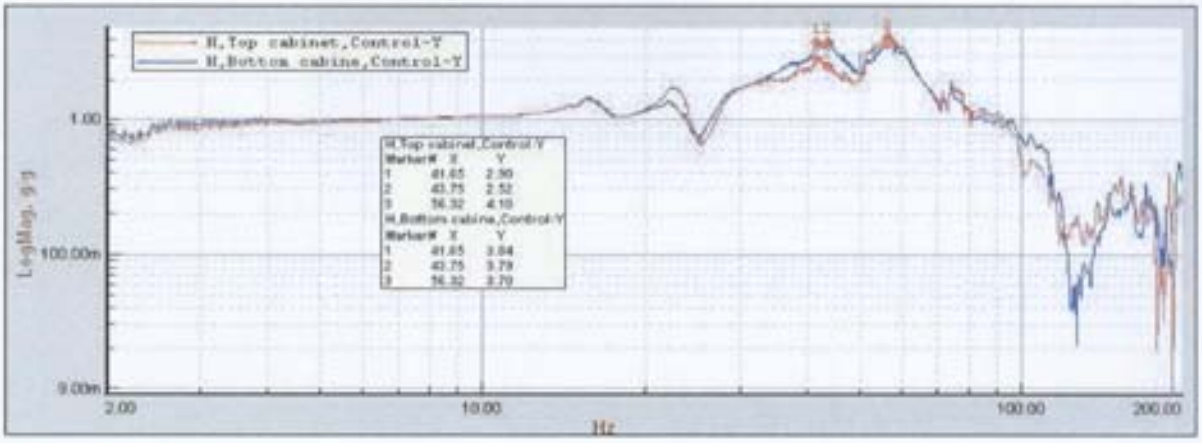
Endurance by sweep - Y axis (last sweep)

Top grap : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Ref" profile

Middle graph : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Transverse-" transverse measurements

Bottom graph : "H" amplification factors (Q) recorded on the two auxiliary sensors





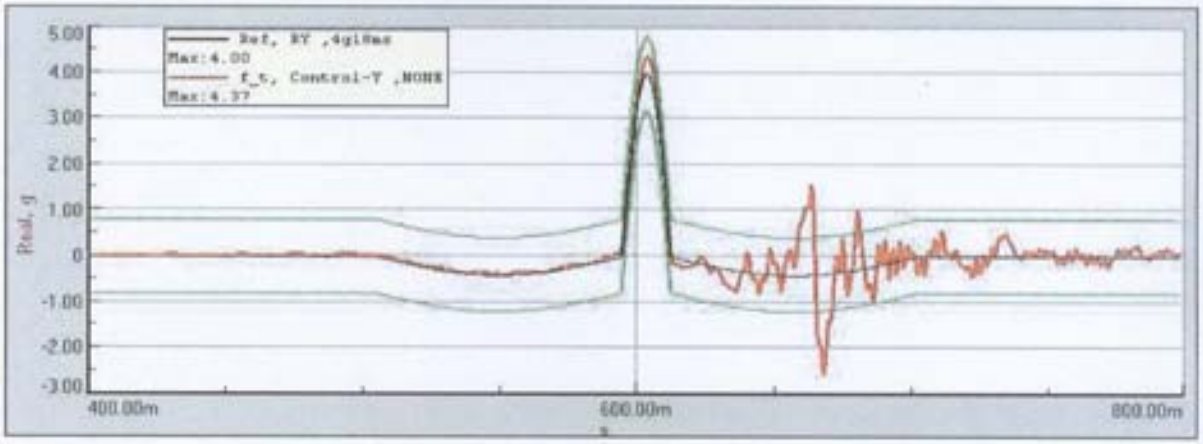
Appendix 3-4

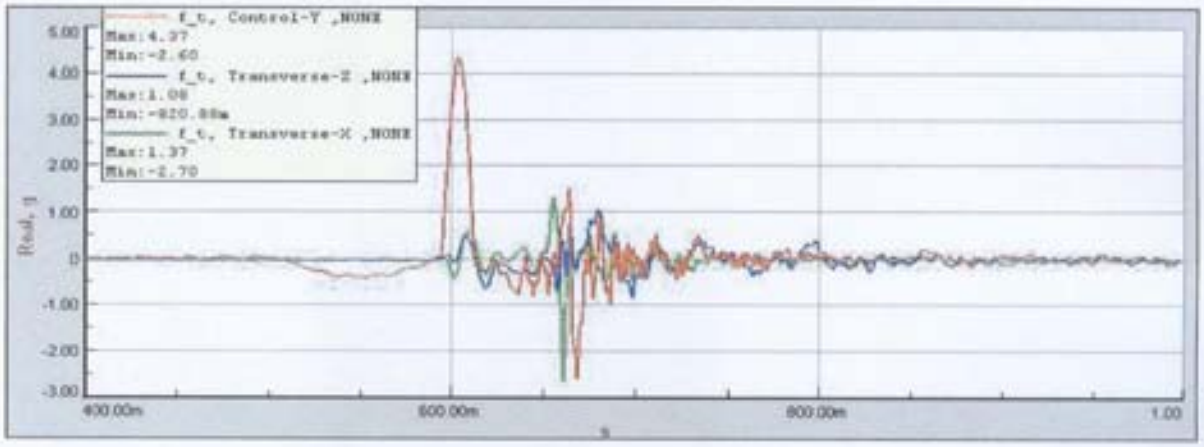
Shock test* - Y axis (last shock)

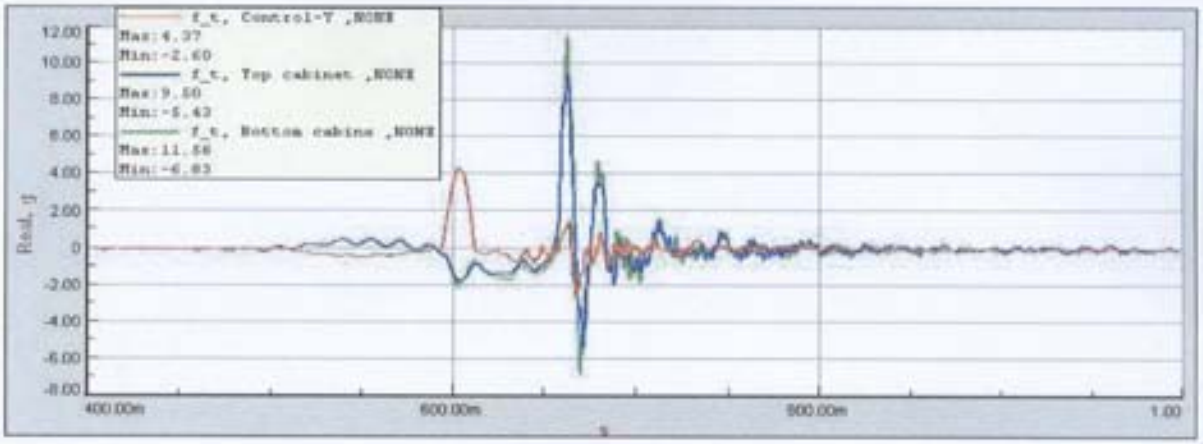
Top graph: Acceleration versus time curve recorded on the "Control" control point superimposed on the "Ref" profile and on the normalized tolerances (green lines)

Middle graph: Acceleration versus time curve recorded on the "Control" control point superimposed on the "Transverse-" transverse measurements

Bottom graph: Acceleration versus time curve recorded on the "Control" control point superimposed on the measurements of the auxiliary sensors







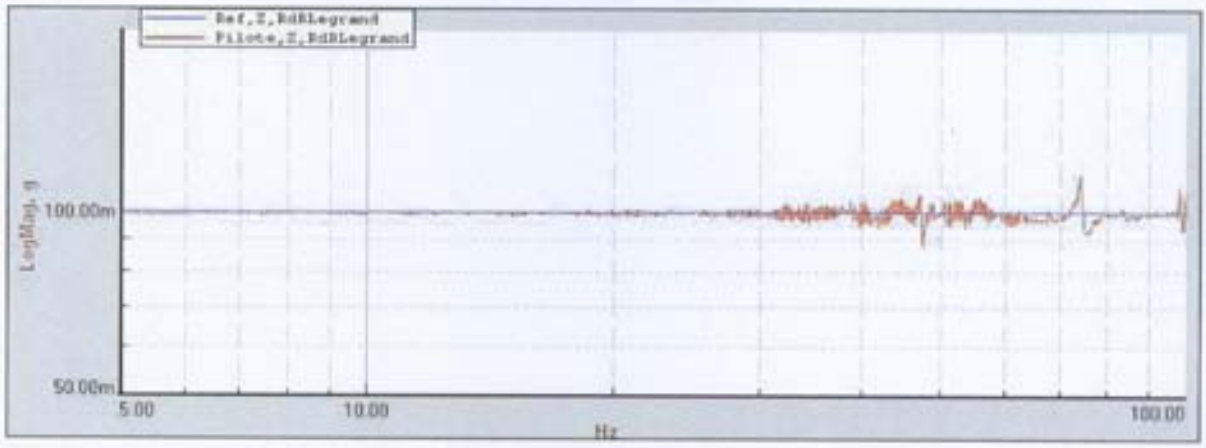
Appendix 4-1

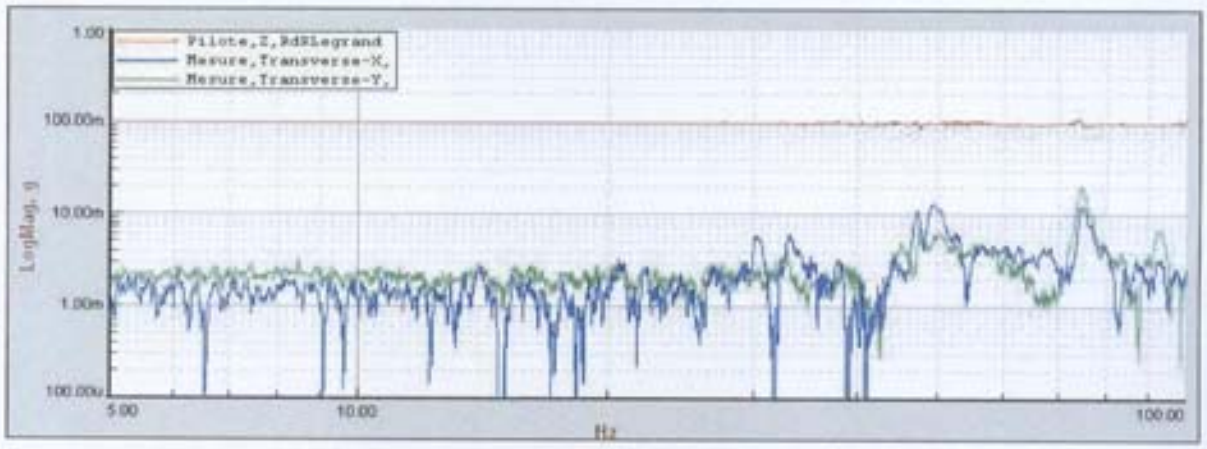
Search for resonance - Z axis (lowering phase)

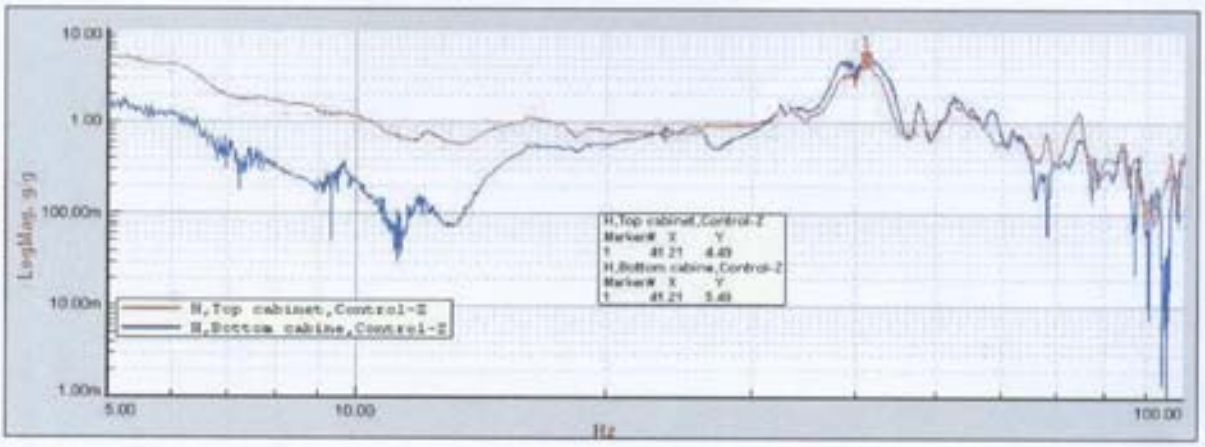
Top grap : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Ref" profile

Middle graph : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Transverse-" transverse measurements

Bottom graph : "H" amplification factors (Q) recorded on the two auxiliary sensors







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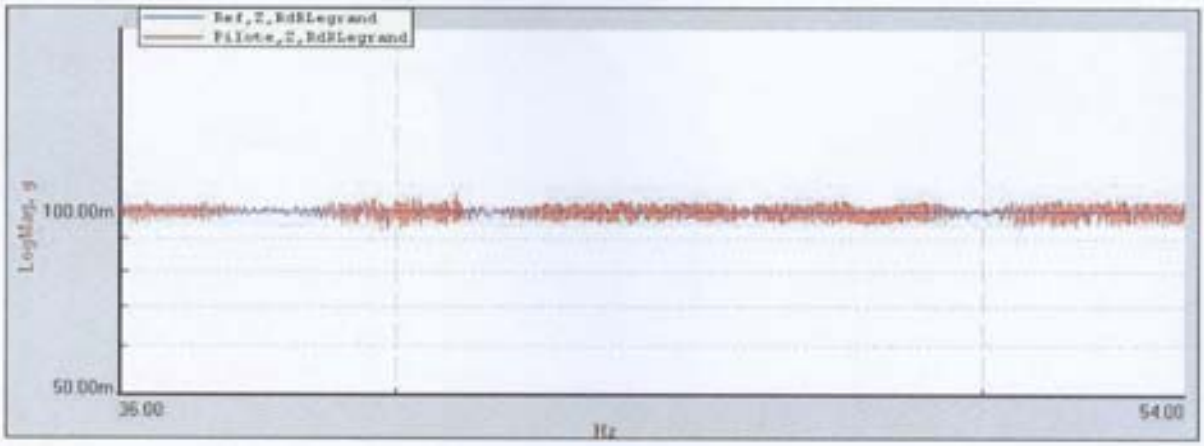
Appendix 4-2

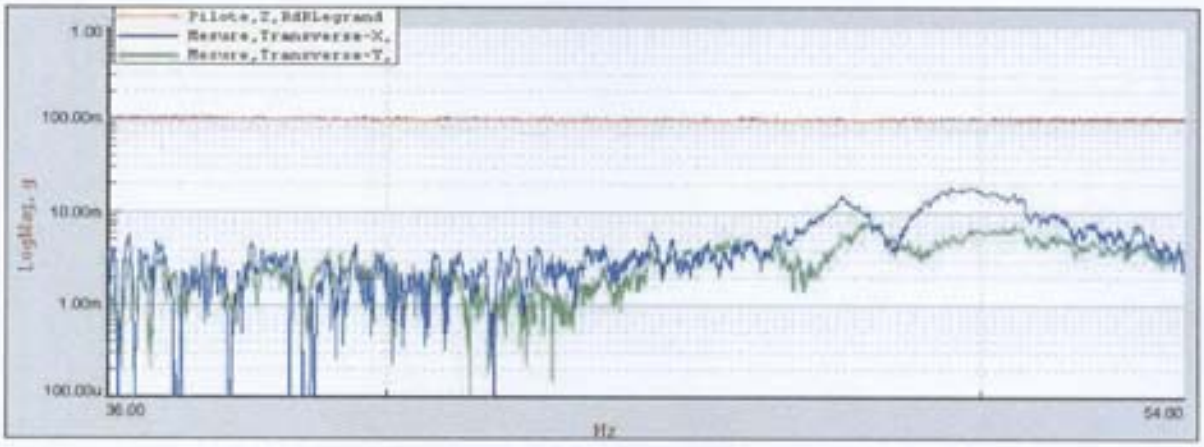
Hold at resonance - Z axis

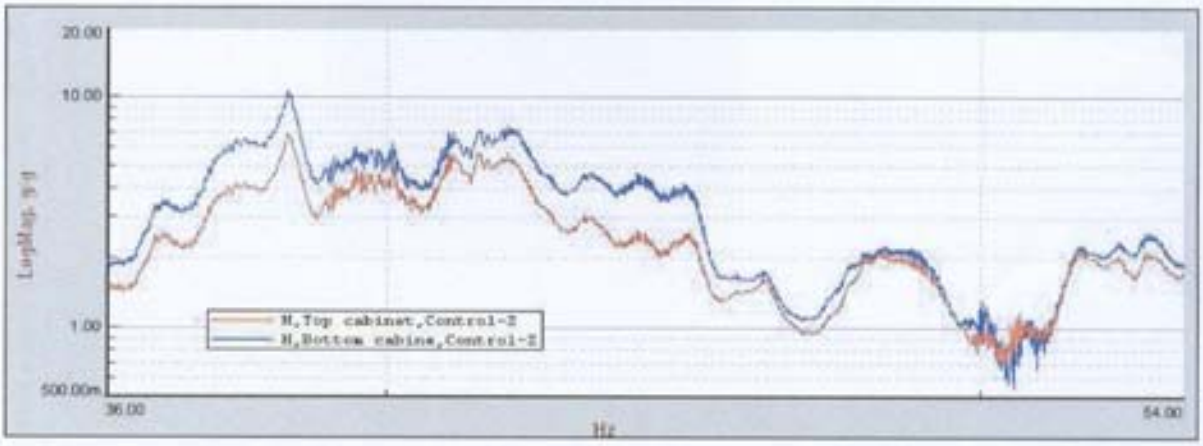
Top grap : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Ref" profile

Middle graph : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Transverse-" transverse measurements

Bottom graph : "H" amplification factors (Q) recorded on the two auxiliary sensors







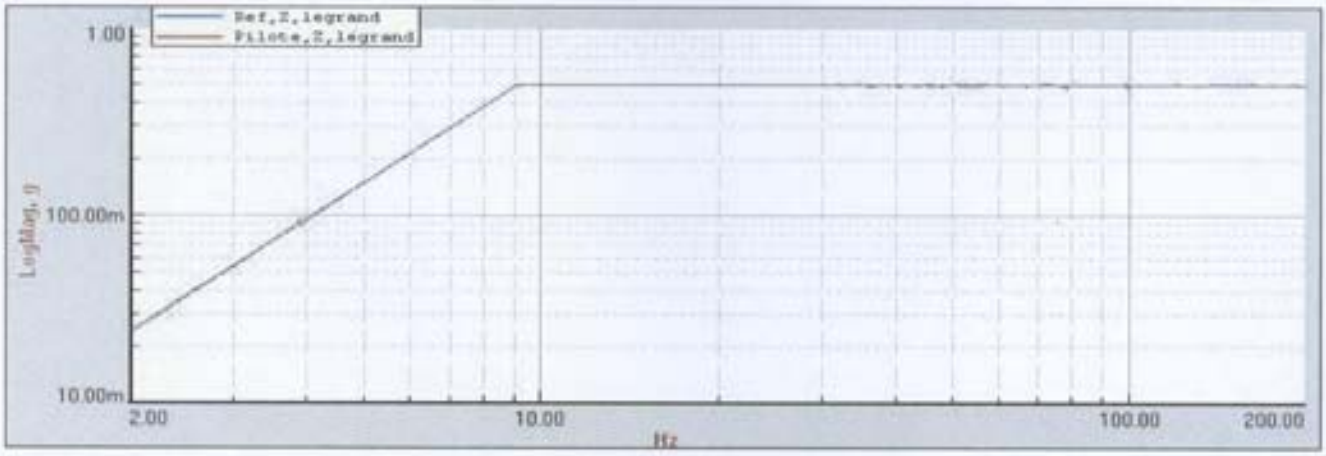
Appendix 4-3

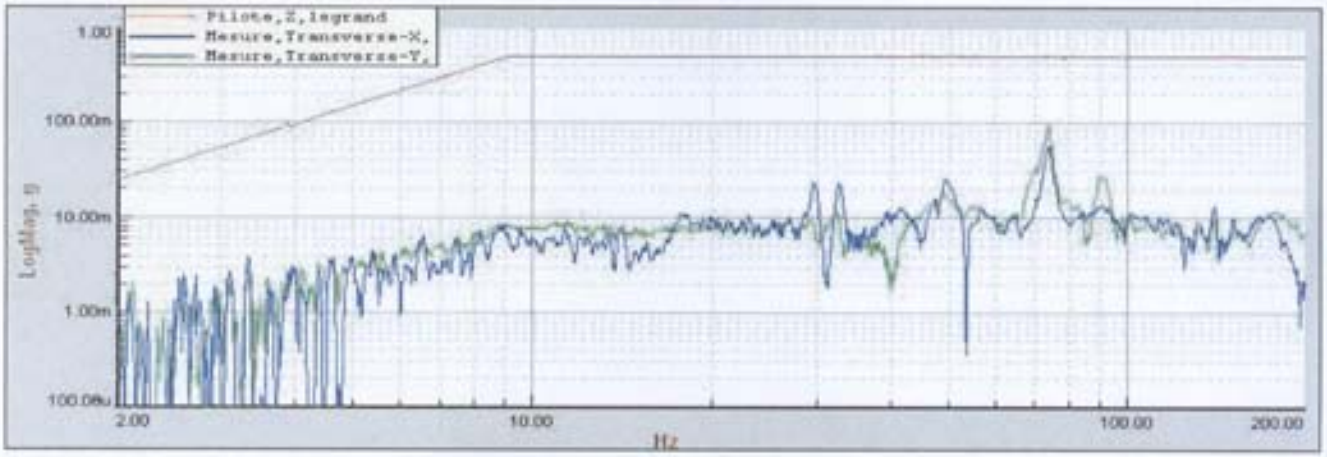
Endurance by sweep - Z axis (last sweep)

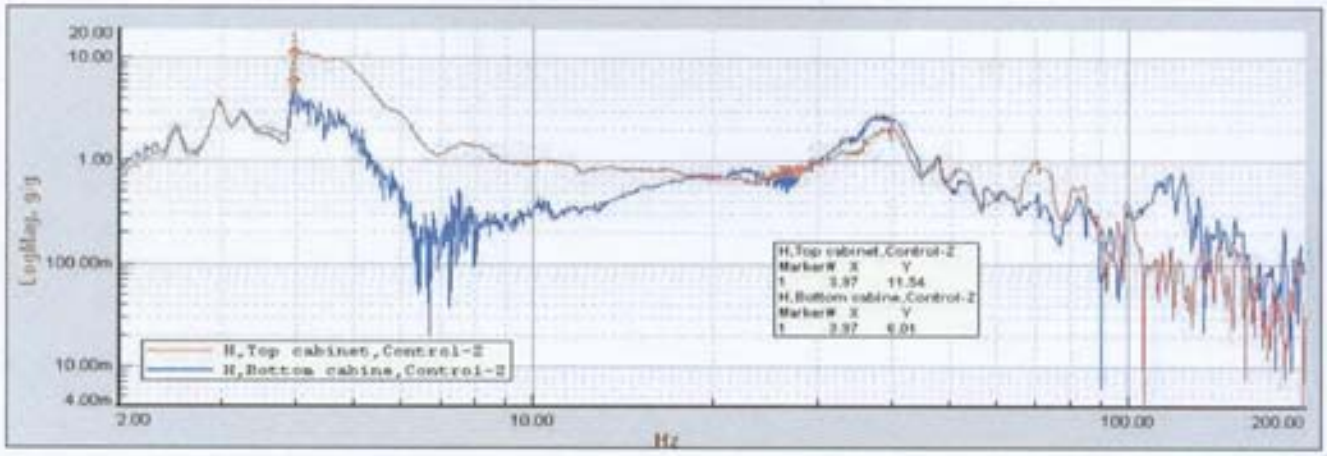
Top grap : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Ref" profile

Middle graph : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Transverse-" transverse measurements

Bottom graph : "H" amplification factors (Q) recorded on the two auxiliary sensors







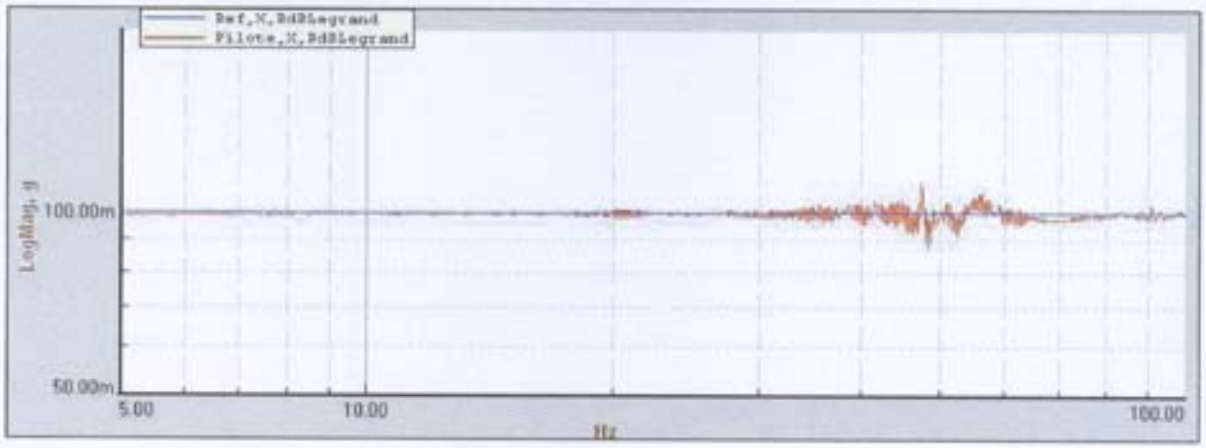
Appendix 5-1

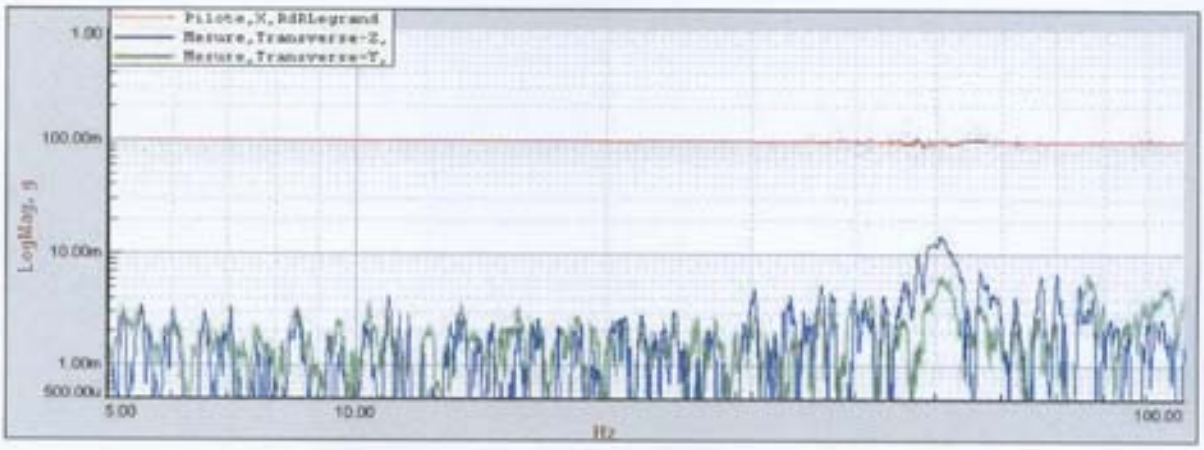
Search for resonance - X axis (lowering phase)

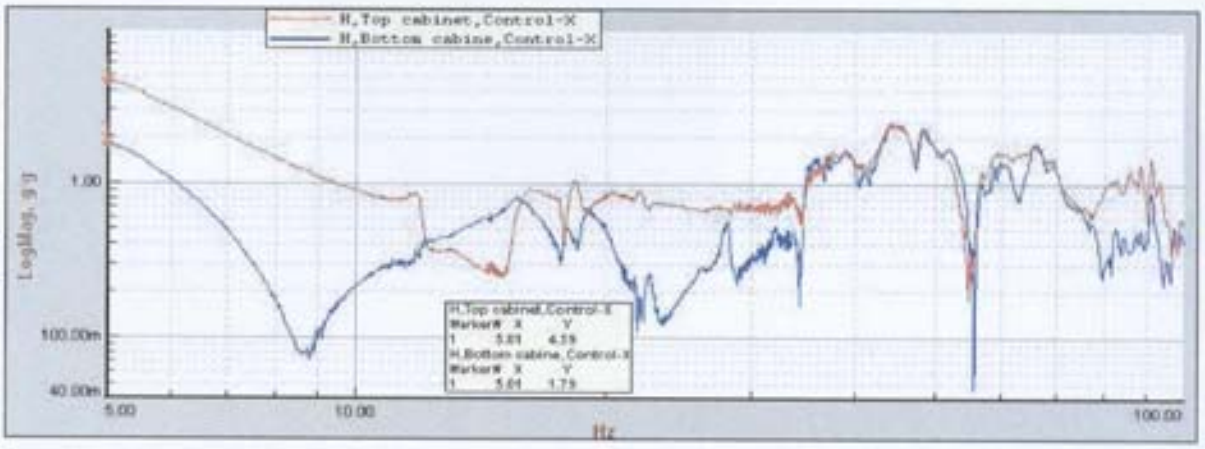
Top grap : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Ref" profile

Middle graph : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Transverse-" transverse measurements

Bottom graph : "H" amplification factors (Q) recorded on the two auxiliary sensors







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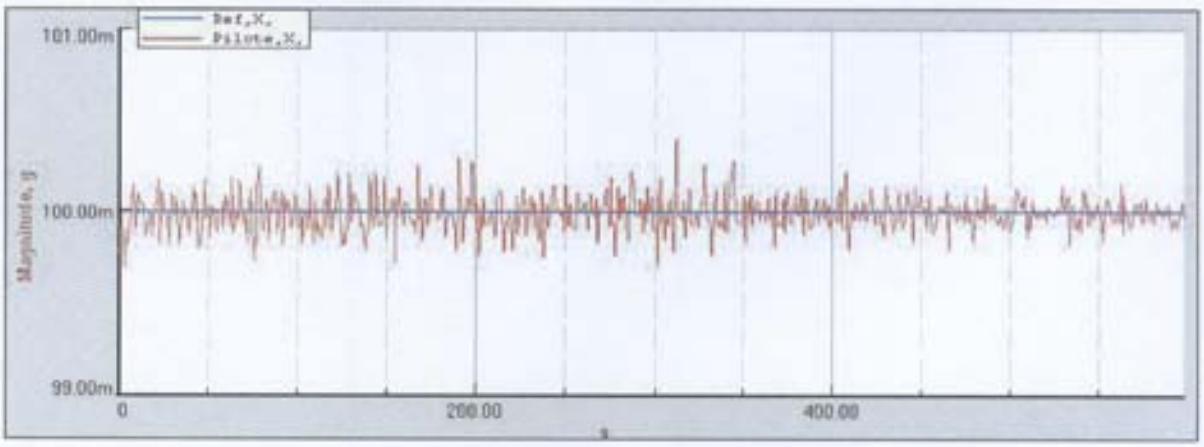
Appendix 5-2

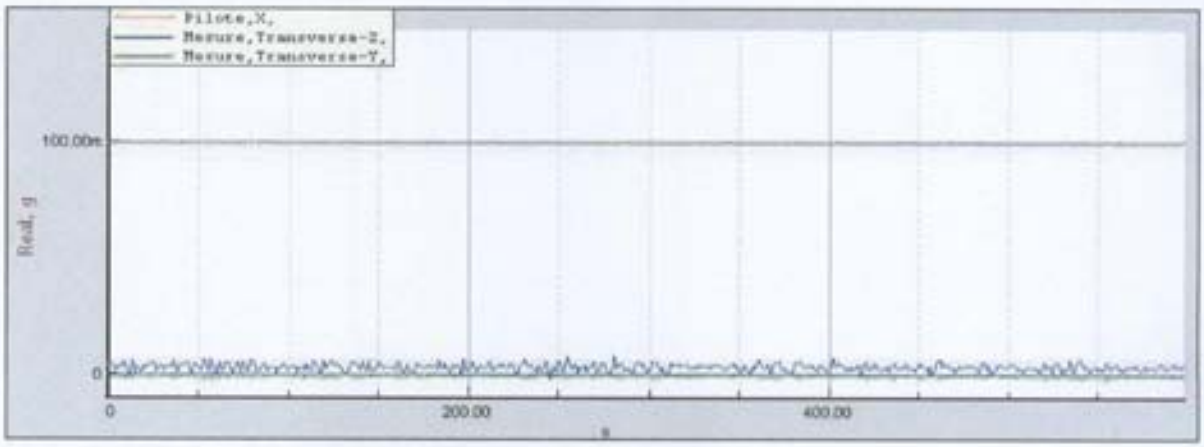
Hold at resonance - X axis

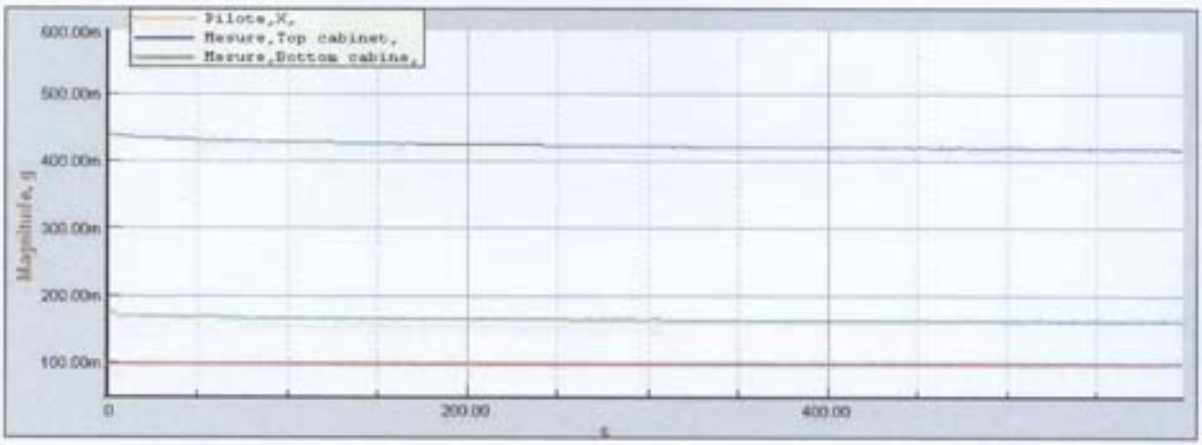
Top grap : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Ref" profile

Middle graph : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Transverse-" transverse measurements

Bottom graph : Accelerometric measurements recorded on the 2 auxiliary sensors







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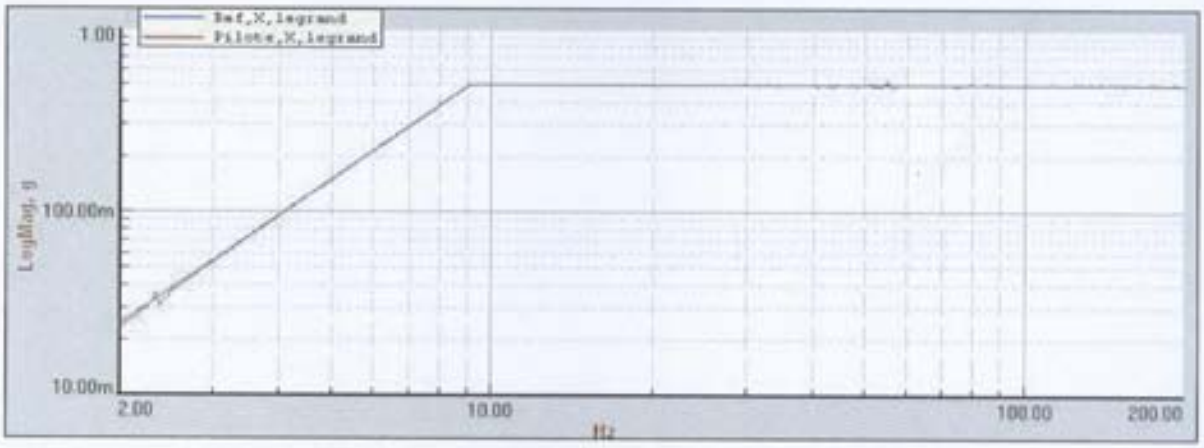
Appendix 5-3

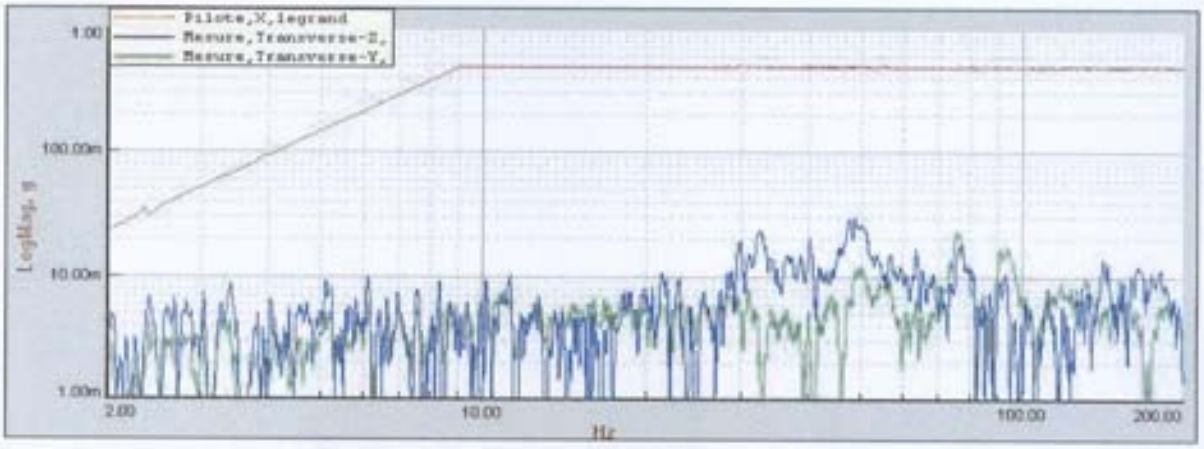
Endurance by sweep - X axis (last sweep)

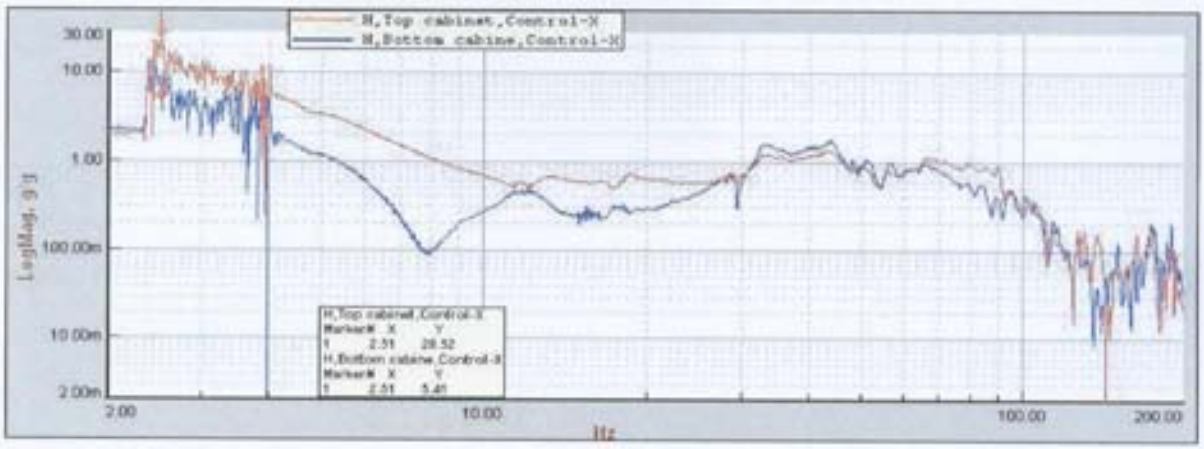
Top grap : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Ref" profile

Middle graph : Excitation spectrum recorded on the "Pilote" control point superimposed on the "Transverse-" transverse measurements

Bottom graph : "H" amplification factors (Q) recorded on the two auxiliary sensors







Appendix 6-1

Conditions of ground continuity measurements *

ground continuity between the chassis and the rear panel

ground continuity between the chassis and the side panel

ground continuity between the chassis and the top surface

Appendix 6-2

Conditions of ground continuity measurements * (concluded)

ground continuity between the chassis and the front door

ground continuity between the right and left uprights

Appendix 7-1

Checks of the tolerances of the test parameters

Sinusoidal vibrations - IEC 60068-2-6 tolerances sheet (page 1/2)

IEC 60068-2-6 (December 2007)	TEST No. and customer: K020085/2 - LEGRAND - ESTAP	Frequency range: 2-200 Hz
SINUSOIDAL	Operators and dates: MC, ER, and PP, 18 and 19/02/09	Rq: ESTAP cabinet

Parameters	Requirements	OK / NOK	Check and remarks
Local atmospheric conditions of test	T°: 15 to 35°C - RH: 25 to 75% Patm: 860 to 1060 mbar	OK	22°C - 26% RH - 1007 mbar
Transverse movement	ytransverse < 0.5 x yspecified for F< 500 Hz (check points) ytransverse <1 x yspecified for F > 500 Hz (check points)	NOK	Frequency ranges in Hz beyond the tolerances (due to the reaction of the cabinet on the test setup, the cabinet being simply set down) Res. search in Y: [27-37] - [51-59] - [73-74] Restricted sweeps in Y: [51-54] - [55-60] Endurance in Y: [15-17] - [42-48] X and Z: RAS
Tolerance on the signal	< 5% (< 32% distortion)	OK	LNE report ref. G110288 / CQPE / 2, analysis performed from 5Hz
Tolerance on the amplitude	± 15% (reference point)	NOK	Frequency ranges in Hz beyond the tolerances the tolerances (due to the reaction of the cabinet on the test setup, the cabinet being simply set down) Res. search in Y: [47] Restricted sweeps in Y: [48] Endurance in Y: [2.2] X and Z: RAS
	± 25% for F < 500 Hz (check points) ± 50% for F > 500 Hz (check points)	NOK	Frequency ranges in Hz beyond the tolerances the tolerances (due to the reaction of the cabinet on the test setup, the cabinet being simply set down) Res. search in Y: [25-27] - [28-35] - [50-51] - [88-92] - [97-100] Restricted sweeps in Y: [50-51] - [56-57] Endurance in Y: [15-16] - [24-27] - [40-43] - [80-137] Fixed freq in X: [5] Endurance in X: [2-5] The rest: RAS

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Appendix 7-2

Checks of the tolerances of the test parameters

Sinusoidal vibrations - IEC 60068-2-6 tolerances sheet (page 2/2)

IEC 60068-2-6 (December 2007)	TEST No. and customer: K020085/2 - LEGRAND - ESTAP	Frequency range: 2 - 200 Hz
SINUSOIDAL	Operators and dates: MC, ER, and PP, 18 and 19/02/09	Rq: ESTAP cabinet

Parameters	Requirements		OK / NOK	Check and remarks
Test setup	Refer to table 9 of specification Aéro 601 11 (Feb. 1994)		OK	In Y: No resonances detected in range 2-200 Hz (sweep 1) In X and Z: technical acceptance of the LING + horizontal table (from 5 Hz)
Movement of rotation	Must be indicated in the particular specification		/	No indication
Pursuit filter parameters	the width of the pursuit filter must be <=Freq excitation		OK	= freq of excitation up to 20 Hz and = 16 Hz from 20 to 200 Hz
tolerance on the frequency	Endurance and quasi-fixed freq	± 0.05 Hz for F < 0.25 Hz ± 20% for F = [0.25 - 5 Hz] ± 1 Hz for F = [5 - 50 Hz] ±2% for F >50Hz	OK	Finding of DCY check ref. CV-08120202-A08
	Fixed freq	± 2%		
	Res. search	± 0.05 Hz for F< 0.5 Hz ± 10% for F = [0.5 - 5 Hz] ± 0.5 Hz for F = [5 - 100 Hz] ± 0.5% for F > 100 Hz		
Tolerance on the sweep rate	± 10%		OK	Inspection sheet - Sinusoidal sweep rate ref "Year 2008 - check sweep rate PC control unit no 1"
Duration of the test	from 0 to + 5%		OK	Sheet of check of duration of test on control unit ref "Year 2008 - check of test duration PC control unit no 1"
Number of acquisitions	at least 3 in the -3 dB band of the frequencies of resonance		OK	

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Appendix 7-3

Checks of the tolerances of the test parameters

Shocks - IEC 60068-2-27 tolerances sheet* (page 1/1)

IEC 60068-2-27* (February 2008)	TEST No. and customer: K0 20085/2 - LEGRAND ESTAP	Shock: Semi-sinusoidal - 4 g 18 ms, only one way, vertical (table moved up)
SHOCKS	Operators and dates: MC, ER, and PP, on 18/02/09	Rq: ESTAP cabinet

Parameters	Requirements	OK / NOK	Check and remarks
Local atmospheric conditions of the	T°: 15 to 35°C - RH: 25 to 75% Patm: 860 to 1060 mbar	OK	22°C - 26% RH - 1007 mbar
Tolerance on acceleration	In the profiles indicated in figures 1, 2, and 3 of the standard (reference point)	NOK	3 overshoots after the shock, due to the reaction of the cabinet on the test setup, the cabinet being simply set down
Transverse movement	γpeak transverse < 0.3 x γpeak specified (check point)	NOK	2 overshoots after the shock, due to the reaction of the cabinet on the test setup, the cabinet being simply set down
Test setup	Refer to table 9 of specification RE-Aéro 601 11 (Feb. 1994)	OK	In Y: No resonances detected in the range 2-200 Hz (sweep 1) In X and Z: technical acceptance of the LING + horizontal table
Tolerance on the variation of rate	± 15% with respect to nominal (check point)	OK	Delta V nominal = 0.45 m/s, +/- 15% ==> [0.38 to 0.52 m/s] Delta V measured = 0.48 m/s
Frequency characteristics of the measurement chain	In the profiles indicated in the standard (fig. 4)	OK	Record: "Treatment of accelerometric pass bands for shocks"
Low-pass filter on check point	if used filter (point at - 3 dB), $F_{cut} < (1.5 / D)$ D = impulse duration	OK	

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