Title: **HEPLM STM-S/C Sine Vibration Test Assessment**

CI-No: 120 000

Prepared by:	B. Kettner	Date:	23/06/2006
Checked by:	M. von Alberti		28.06.06
Product Assurance:	R. Stritter		29.06.06
Configuration Control:	W. Wietbrock		30.06.06
Project Management:	for W.Fricke		30.6.2006

Distribution: See Distribution List (last page)

Issue	Date	Sheet	Description of Change	Release
1	17.03.06	All	First Issue	
2	23.06.06		Close-out HP-2-ASED-MN-1225, MQR-AI-37 w.r.t. RIDs DJ-02, DJ-04, DJ-06, DJ-08, DJ-09, DJ-10, DJ-11, DJ-13	
		§1.1	RID DJ-08: test objective updated w.r.t. HSS and Waveguide	
		§1.2	RID DJ-06: Statement upon LOU Support Structure reworded	
		§1.2.1	RID DJ-04: paragraph Summary H-EPLM Notch justification added	
		§1.3	RID DJ-08: test objective updated w.r.t. HSS and Waveguide	
		$3.1	Fig. 3.1-1: Editorial update	
		§3.2	RID DJ-10: clarification added w.r.t. /RD1/	
		§3.2	RID DJ-11: clarification added w.r.t. /RD1/	
		§3.2	RID DJ-08: Qualification loads summarized for waveguide and HSS	
		§3.2	Table 3.2-1a: HIFI/LOU Design Loads added	
		§4.1.2	RID DJ-09-1: Clarification added w.r.t. HTT notch	
		§4.1.3	RID DJ-02: Mass and HE filling ratio updated	
		§4.1.3.1	RID DJ-09-2: Editorial update	
		§4.1.5	RID DJ-09-3: Editorial update	
		§4.2.3	RID DJ-02: Mass and HE filling ratio updated	
		§4.2.6	RID DJ-09-4,5,6: Editorial update	
		§4.3.2	RID DJ-09-7: Editorial update	
		§4.3.4	Editorial update: chapter title reworded	
		§4.3.5	RID DJ-09-7: Editorial update	
		§4.3.3	RID DJ-02: Mass and HE filling ratio updated	
		§4.4	RID DJ-06: Assessment added w.r.t. LOU-NCR-1984	
		§4.4.1	RID DJ-06: Assessment added w.r.t. LOU-NCR-1984	
		§4.4.2	RID DJ-06: Assessment added w.r.t. LOU-NCR-1984	
		§4.5	RID DJ-13: Qualification status of TMS added	

Table of Content

1 Scope

1.1 Objective

The Herschel STM S/C test configuration is summarised in the Test Configuration Data List, see HP-2-ASED-MN-1149. The EPLM integration status at the STM test is given in HP-2-ASED-LI-0032.

Herschel is composed of the Service Module (SVM) and the Extended Payload Module (H-EPLM).

For H-EPLM, the following parts are FM resp. PFM build–standard:

- entire cryostat including tanks, suspension system, optical bench assembly, cryostat insulation system, harness, MLI, internal and external piping (excluding instrument dummies, cryostat cover, co-ax cable assembly)
- SVM/PLM struts
- telescope mounting structure (three struts to be exchanged)
- Local Oscillator Unit support structure and waveguide assembly, LOU windows
- Solar Array struts
- structural parts of the Herschel Solar Array and Sunshade (HSS) except the Solar Array panels, which were mass and dynamically representative.

For the SVM, the primary structure is a dedicated STM structure, but the following parts are FM:

- equipment panels for instrument warm units (2 HIFI, 1PACS, 1 SPIRE)
- reaction wheels panel
- +Z panel
- upper closure panel
- lower thermal closure panel
- startracker assembly except startracker dummies

This document provides an assessment of the Herschel STM-S/C vibration sine test results for the H-EPLM subsystems.

The following aspects are covered by this document:

- General system level requirement to be verified by the STM-S/C sine vibration test
- Comparison of the H-EPLM Dynamic Properties between prediction and test
- Verification that the allowables for the H-EPLM subsystems are not exceeded

- Summary of the achieved qualification level for the H-EPLM subsystems
  - For subsystem acceleration
  - For subsystem interface forces
- Engineering assessment of test results
  - Comparison of H-EPLM qualification level with predicted LVCLA
  - Qualification of subsystems, which have not been qualified on unit level
    - LOU waveguide assembly
    - HSS structure, except of the Solar Array Panels. (Note: the solar array panels will be PFM qualified on HSS unit level by acoustic noise test)
  - Qualification of LOU structure considering LOU-NCR-1984
    - Impact of LOU-NCR-1984 on qualification tests
    - Comparison of Y and Z lateral qualification axis

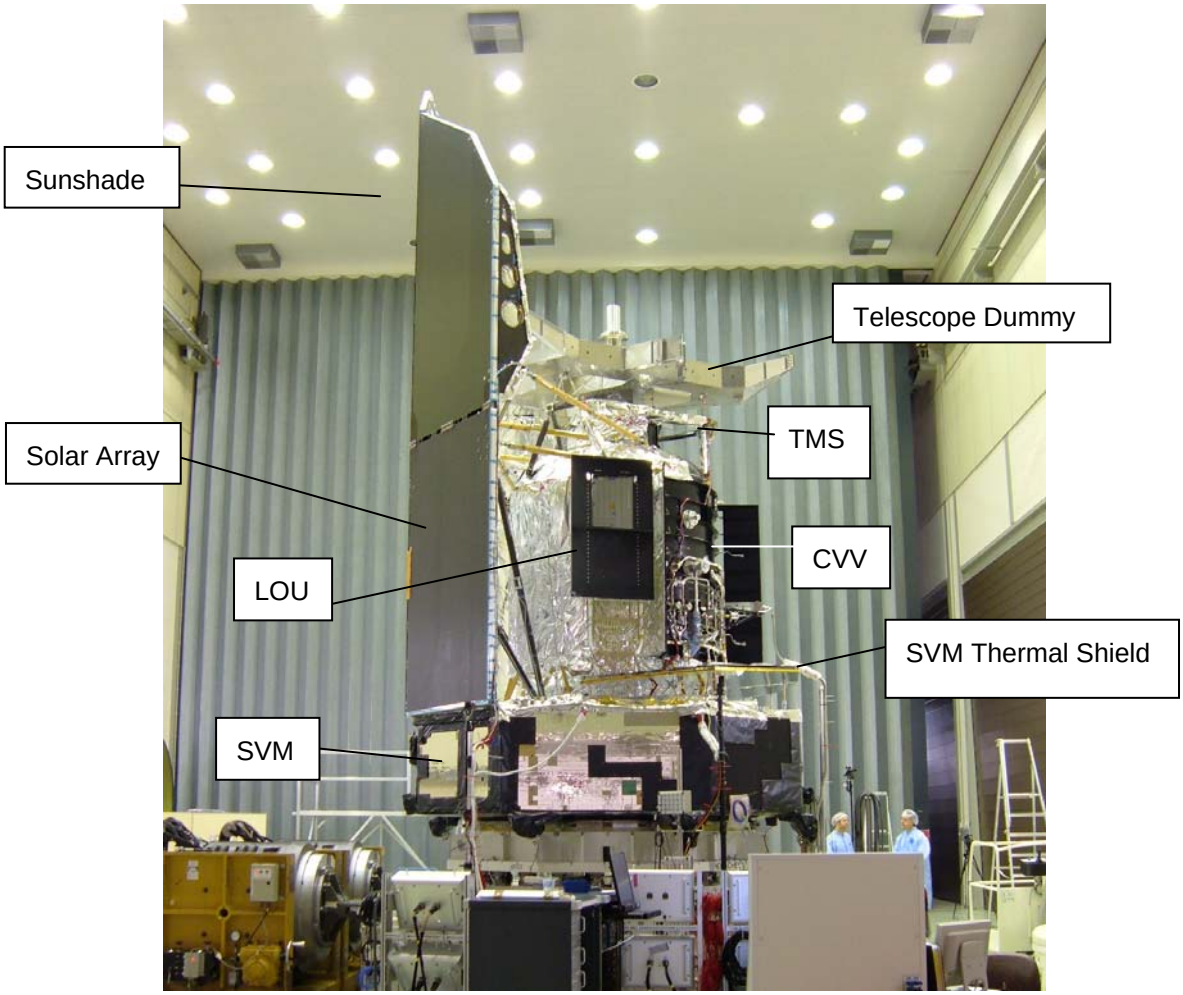


Fig. 1.1-1: S/C-H-EPLM STM Sine Test Configuration

1.2 Summary

The report includes a summary and an engineering assessment of the Herschel STM sine vibration tests performed January/February 2006 at ESTEC.

The axial X qualification run was performed on the ESTEC Hydra Shaker.

The lateral Y and Z axes runs were performed on the ESTEC Multi Shaker.

The report summarises the achieved qualification level for the H-EPLM subsystems and compares the unit level qualification with the expected S/C STM vibration qualification.

It was demonstrated, that :

- A good correlation was achieved for the main eigenfrequencies between the FEM prediction and the measured major eigenfrequencies
- The H-EPLM subsystems sine test qualification loads cover comfortably the predicted AR5 loads without overloading all H-EPLM subsystems w.r.t. their maximum allowable.

After the Y-axis qualification run, a major NCR-1984 was raised caused by a "wrong fixation" of the LOU Dummy to the LOU support structure. An assessment was performed to verify, that the LOU support structure was properly loaded and qualified. In addition an inspection all LOU parts during de-integration will be performed and will be covered by the NRB.

The performed assessment showed, that the LOU support structure was exposed to qualification loads at the I/F, but also not overloaded due to the NCR-1984 problem. The following assessment was performed:

- The comparison of Y-axis qualification loads with " wrong fixation QLY1" with the low level run performed after the fixation correction. (LLY4) verifies, that the achieved load "in wrong fixation " configuration resulted in higher loads compared to the "nominal correct" configuration
- Comparison of X and Y qualification run with associated low level runs scaled to qualification level.
- The analysis of the "wrong" and "correct" LOU fixation configuration verifies, that the -X struts which were not measured, were loaded below their allowables.
- The comparison of both lateral vibration runs verifies that the H-EPLM subsystems were not affected by the LOU fixation error.

1.2.1 Summary of H-EPLM Sine Test Notch Justification

The active H-EPLM notches as performed during the sine qualification test are summarized below. The notches were performed in order not to exceed the subsystem design loads

X axis notches:
X1) Fig. 4.1.2-1: X-axis at 40.44Hz, PACRYO107X (HTT) achieved 14.59g compared with spec = allowed value 15g, see HP-2-ASED-RP-0112 Table 4.1.1-1 X: 15g +/-2.5g lateral; S/C level sine input 40.4Hz = 0.73g

X2) Fig. 4.1.2-1: X-axis at 63.9Hz, PASVTS002X (SVM Thermal Shield) achieved 97.9g compared with spec = allowed value 100g or 6mm at 64Hz, see HP-2-ASED-RP-0112 Table 10.3.3.1-3b, max acoustic unit test response LP2x = PASVTS002x was 290g (3-sigma) or max unit peak deflection 7.1mm. (3 Sigma-peak).

Y axis notches:
Y1) Fig. 4.3.2-2: Y-axis at 29Hz, e.g. PACRYO109Y (HTT) achieved 6.81g compared with spec = allowed 7.3g, see HP-2-ASED-RP-0112 Table 4.1.1-1 X: 2g +/-7.5g lateral or Y: 7.3g, Z: 1.5g); S/C level sine input 29Hz = 0.63g

Z axis notches:
Z1) Fig. 4.2.2-2: Z-axis at 16.4-18.5Hz, PAHSSP001Z (HSS, Backup for first bending mode control)

Z2) Fig. 4.2.2-2: Z-axis at 29Hz, PACRYO106Z (HTT) achieved 6.77g compared with spec = allowed 7.3g, see HP-2-ASED-RP-0112 Table 4.1.1-1 X: 2g +/-7.5g lateral or Y: 1.5g, Z: 7.3g; S/C level sine input 29HZ = 0.53g

Z3) Fig. 4.2.2-2: Z-axis at 86.9Hz, PATMSF001Y (TMS-cross coupling) achieved 7.98g compared with spec = allowed 7.8g, see HP-2-ASED-RP-0112, Table 10.2.4-1 X: 2g, 11g lateral or Y: 7.78g + Z: 7.78g; S/C input 89Hz =0.47g

1.3 Conclusion

The S/C sine qualification test objectives were achieved as summarized in §4.1-4.3. The Structure was not damaged (low level analysis/visual inspection). The FEM prediction is well correlated on the main frequencies. Nevertheless a thorough inspection of the LOU support structure after integration is necessary and the final conclusion must be done in the frame of the LOU NCR-1984 NRB.

The test objectives, as summarized in §1.1, were fulfilled.

2 References

2.1 Applicable Documents

Unless an issue is quoted for a document the current issue is deemed to apply. When an issue is quoted below, that issue and no other must be used.

/AD1/ H-P-2-ASPI-SP-0250
H-EPLM REQUIREMENT SPECIFICATION,

/AD2/ H-P-1-ASPI-SP-0030
Herschel / Planck environment and tests requirements

/AD3/ H-P-1-ASPI-SP-0027
General Design and Interface Specification

/AD4/ H-P-2-ASP-TS-0921
Herschel STM Mechanical Tests Specification
Issue: 2, date 07.07.2005

/AD5/ HP-2-ASED-PL-0041
Instrumentation Plan for mechanical testing of H-EPLM STM
Issue: 2, date 28.11.2005

/AD6/ H-P-1-ASP-TN-0664
Herschel satellite STM technical Description
Issue: 2, date 24.06.2005

/AD7/ H-P-2-ASP-ID-0789
Herschel STM System MTICD
Issue: 2, date 13.09.2005

/AD8/ HP-2-ASED-TP-0060
Sine Vibration Test Procedure for Herschel STM
Issue: 2, date 12.12.2005

2.2 Reference Documents

/RD 1a/ HP-2-ASED-RP-0112, Issue 3, dated 24.11.2005
Mechanical Qualification and properties of procurement Items on HEPLM Unit and on STM-S/C level

/RD 1b/ HP-2-ASED-RP-0112, Issue 4, dated 10.03.2006
Mechanical Qualification and properties of procurement Items on HEPLM Unit and on STM-S/C level

/RD 2/ HP-2-ASED-TN-0132, Issue 1, dated 24.11.2005
HEPLM . STM FE Model Correlation Report

/RD 3a/ HP-2-ASPI-MN-7325, Issue 1, 24.01.2006; interim PTR X axis sine

/RD 3b/ HP-2-ASPI-MN-7377, Issue 1, 02.02.2006; interim PTR Z axis sine

/RD 3c/ HP-2-ASPI-MN-7410, Issue 1, 08.02.2006; Post test Review sine test

/RD 4/ HP-2-ECAS-TR-0018_I1, dated 11.01.2005
LOU Struts PFM Static Load Test Report

3 Herschel Satellite STM Vibration Test Description

3.1 H-EPLM Frequency Requirements

The Herschel STM sine vibration test achived the following /AD 1/ requirements given for H-EPLM subsystems.

The frequency analysis includes the SVM stiffness. (HERS-710).

		=> S/C-STM vibration test
• Lateral frequency	> 13 Hz	**=> measured: Y: 16.1Hz Z: 14.88Hz**
• Longitudinal frequency	> 34 Hz (35 goal)	**=> measured X: 40.3Hz**

The FE prediction model is shown in Fig. 3.1-1.

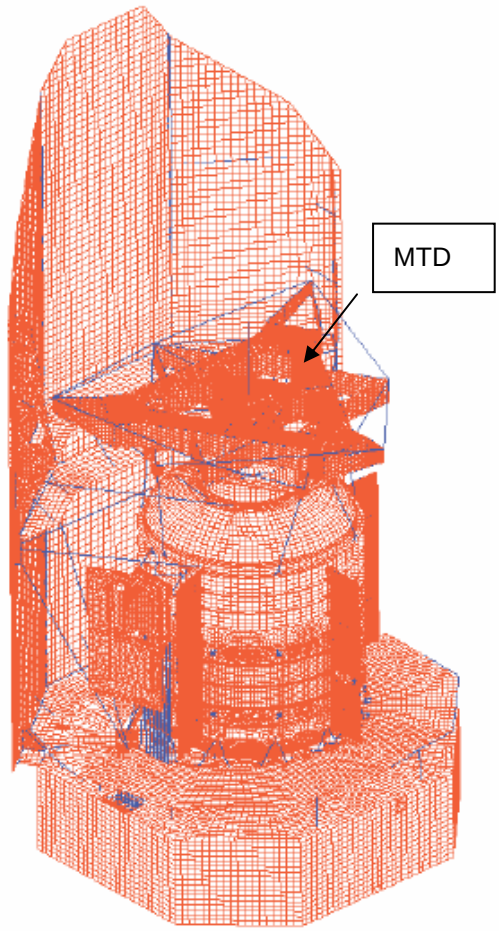


Fig. 3.1-1: STM-FEM Configuration with MTD. The FM-telescope is substituted by the MTD

3.1.1 H-EPLM Subsystem Dynamic Properties Overview

Table 3.1.1-1 below compares the frequency requirements of /AD 1/ HERS 0710, HERS 720 and HERS 730 with the measured S/C-STM sine test frequencies. For HSS and TMS the frequency requirement is hard mounted. For this case the resulting frequency on S/C level is compared with the actually measured frequency. In all cases the /AD 1/ frequency requirements are met.

Item	Requirement a) unit level b) S/C level	Predicted a) Units Level b) S/C level	Measured b) S/C-STM Sine test	Remark
HSS hard mounted; Lateral; (* HERS-720)	a) >24 Hz b) NA	a) 26.3Hz b) 26 Hz	- b) Z: 29.1Hz	b) Y: 53 Hz
HSS hard mounted; Axial; (* HERS-720)	a) >70 Hz b) NA	a) 79.67Hz b) 69Hz, 78Hz	- b) 70Hz, 72.3Hz	b) X-response on HSS up to 100Hz (≤ 4g) lower than design load 15g
OBA lateral (hinged IF); (ASED req).	a) >55Hz b) NA	a) 57.6 Hz b) 42 Hz	- b) 47.2 Hz	2) X-response on HSS up to 100Hz (≤ 4g) lower than design load 15g
OBA axial (hinged IF); (ASED req).	a) >66Hz (ASED req.) b) NA	a) > 100Hz b) 68Hz	- b) 72 Hz	3) X-response on OBA up to 100Hz (≤ 5.3g) lower than design load 16.25g. For 1. S/C axial mode max X-response was 13.2g
Cryostat Cover and Baffle; (ASED req).	> 100Hz	> 100Hz	> 100Hz	No mode below 100Hz
Telescope with TMS; Hard mounted on CVV Lateral; (* HERS-730)	a) >36 Hz b) NA	a) 34.7 Hz b) 27.6 Hz	- b) 29.2Hz	TMS with telescope slightly stiffer than predicted.

Table 3.1.1-1:Comparison of H-EPLM Subsystem Eigenfrequencies Prediction with Test

3.2 Subsystem Design and S/C-STM Qualification Test Load Overview

The design loads of the H-EPLM were defined in AD 1 (HERS 740) and /RD 1a/, which was the allowable baseline defined before the qualification test.
Considering that the Hydra shaker may create significant cross-axis coupling problems, the 3-axis components were provided in a conservative approach. The lateral vectors were divided in equal components in Y and Z direction.
During the actual sine qualification runs this approach would have been in some cases too conservative leading to unnecessary deep notches. Based on the measured acceleration components, the allowable acceleration components were redefined within the 2D and 3D design load vector envelop to avoid too deep notching. This approach was controlled in addition by comparing the measured interface forces with the allowable forces. The actually used "As Run" qualification test allowables are documented in /RD1b/.
It could be demonstrated that all components stayed within the specified design load envelope and especially the associated interface forces were not exceeded.

Based on the performed qualification test, the design allowables were re-assessed in / RD 1b/. All modification are marked by change bars and explained.

Table 3.2-1 compares the design loadcases with the actual achieved S/C-STM sine test qualification loads. The comparison shows, that the achieved qualification loads did not exceed the allowable minimum design loads.

ELPM Item	**Case**	**Design Loads**	**Max qualification level during S/C STM test**
Complete EPLM and CVV	#1 (axial)	12.5 axial +- 1.56 g lateral *)	LCX: PACVVU00_1x: 5.1g _2y: 0.3g _1z: 0.3g LCX: PACVVL00_8x: 5.1g _7y: 0.3g _8z: 0.3g
	#2 (lateral)	2 g axial +- 4 g lateral *) modified within the 3D and lateral vector	LCY: PACVVU00_1x: 2.2g _2y: 0.6g _1z: 0.2g LCY: PACVVL00_8x: 1.3g _7y: 3.4g _8z: 0.4g LCZ: PACVVU00_1x: 0.3g _2y: 0.7g _1z: 1.5g LCZ: PACVVL00_8x: 0.2g _7y: 0.5g _8z: 2.9g
CVV radiator	#1	60g in worst case direction	LCZ: PACVVR00_1O: 5.9g PACVVR00_2O: 7.6g LCY: PACVVR00_1O: 23.2g PACVVR00_2O: 11.6g
Suspended Mass and HE II Tank	#1 (axial)	15 g axial +- 2.5 g lateral	LCX: PACRYO_107x: 14.6g _102y: 1.3g _103z: 1.7g
	#2 (lateral)	2 g axial +- 7.5 g lateral	LCY: PACRYO_104x: 1.4g _105y: 5.8g _106z: 0.8g LCY: PACRYO_107x: 0.3g _102y: 4.6g _103z: 0.7g LCZ: PACRYO_104x: 0.4g _105y: 0.7g _106z: 6.8g LCZ: PACRYO_107x: 0.4g _102y: 0.3g _103z: 5.1g
Optical Bench	#1 (axial)	16.25 g axial +- 4 g lateral 20% mass potential for FPUs	LCX: PACRYO_204x:13.2g _202y: 1.0g _205z: 2.5g
	#2 (lateral)	2 g axial +- 7.5 g lateral	LCY: PACRYO_204x: 0.7g _202y: 4.1g _205z: 0.4g LCZ: PACRYO_204x: 0.4g _202y: 4.7g _205z: 0.9g

ELPM Item	Case	Design Loads	Max qualification level during S/C STM test
He I Tank	#1 (axial)	25 g axial + 4.5 lateral_Y + 4.5g lateral_Z *) *) modified allow. Vector /RD 1b/ old LC#01: 30g axial + 2.5 lateral	LCX: PACRYO_701x: 25.1g _702y: 4.1g _703z: 4.5g *) old L#01 3-D 30.1g > Qual.-3D 25.8g L#02 lateral 7.5g > Qual. lateral 6.1g
	#2 (lateral)	2g axial +-7.5 g lateral	LCY: PACRYO_701x: 0.3g _702y: 5.5g _703z: 0.8g LCZ: PACRYO_701x: 0.9g _702y: - g _703z: 5.7g
Telescope	#1 (axial)	12 g axial +- 4 g lateral *) Used for TMS design	LCX: PATELD00_1x: 6.0g _1y: 2.5g _1z: 3.5g LCX: PATELD00_1x: 11.6g _1y: 1.1g _1z: 0.4g
	#2 (lateral)	2 g axial + 11 g lateral *)	LCY: PATELD00_1x: 1.0g _1y: 6.6g _1z: 2.1g LCZ: PATELD00_1x: 0.2g _1y: 0.5g _1z: 8.1g
Internal Load Definitions			
HSS Sun Shield/ Sun Shade	#1 (axial)	15g axial + (21.25g lateral + 4.25 g/m rotation) rotation which causes 34 g lateral at the top)	LCX: PAHSSP00_1x: 1.9g _1y: 2.1g _1z: 16.0g
	#2 (lateral)	100 g locally at top of sun shade.	LCY: PAHSSP00_1x: 0.2g _1y: 5.6g _1z: 1.8g LCZ: PAHSSP00_1x: 2.0g _1y: 1.3g _1z: 23.5g
LOU	#1 (axial)	25 axial + - 5 lateral *) For design of the support structure only	LCX: PALOUS000_1x: 4.6g _1y: 4.9g _1z: 1.2g LCX: PALOUS000_1x: 9.2g _1y: 3.8g _1z: 1.9g
	#2 (lateral)	2 axial +-14 lateral *)	LCY: PALOUS000_1x: 26.1g _1y: 16.6g _1z: 13.0g *) *) Test in Y: axis NCR-1984 raised
Cryo Component / Cover		22.5 g axial and lateral	LCX: PACVV0_31x: 5.3g _31y: 0.1g _31z: 0.5g LCY: PACVV0_31x: 0.1g _31y: 1.6g _31z: 0.1g
HIFI/LOU Waveguides		22.5g in all 3 directions at the IF.	See below

Table 3.2-1a: H-EPLM design loads as defined in AD 1 (HERS 740) compares with S/C-STM qualification loads

HIFI/ LOU Waveguide achieved Qualification Load Comparison of SC-Level Test with HIFI/LOU Waveguide Unit Test Loads:

Interface	X-Run	Y-Run	Z-Run	unit quasi-static load
PAWAVG002X:	9.1g	6.0g	2.6g	22.5g
PAWAVG002Y:	1.0g	3.4g	0.6g	22.5g
PAWAVG002Z:	1.3g	1.1g	3.4g	22.5g
On Waveguide:				max response unit sine test
PAWAVG001Y:	24.2g	19.0g	8.4g	168g
PAWAVG001Z:	3.3g	1.4g	2.4g	52g

Conclusion:
The waveguide unit level sine qualification test covers the S/C level waveguide responses.

HSS achieved Qualification Load Comparison of SC-Level Test with HSS design loads:
The HSS S/C level sine qualification test responses as given in Fig. 3.2-1 are small compared to the allowable design load factors.

Conclusion:
The HSS design loads (axial 15g, lateral 75g-100g_Top) covers the S/C level responses with good margin. The complete measurement results are listed on Annex 2.1, 3.1 and 4.1.

	Associated Equipment	**Herschel_ ST M_ X QLAX1_1_Fundamental_ "Qualification_Run_X"_ Test 19.01.2006**								
		[Hz]	**15.0**	**25.0**	**35.0**	**45.0**	**55.0**	**65.0**	**75.0**	**85.0**	**95.0**
PAHSSP001X	Top of Sunshade - X	[g]	1.4	1.8	2.7	2.3	2.7	2.3	2.1	1.9	1.1
PAHSSP001Y	Top of Sunshade - Y	[g]	0.3	1.6	2.0	0.7	1.3	1.5	2.5	2.1	1.0
PAHSSP001Z	Top of Sunshade - Z	[g]	0.7	6.2	7.4	8.0	11.2	11.0	15.6	16.0	4.2
PAHSSP002Z	Top of Sunshade mid-panel - Z	[g]	0.5	3.0	2.9	2.3	2.2	1.6	5.8	7.0	4.7
PAHSSP003O	-Y side of Sunshade - oop (local), O	[g]	0.6	11.2	10.2	1.9	3.4	4.4	4.0	6.7	4.7
PAHSSP004O	+Y side of Sunshade mid-panel - oop (local), O	[g]	0.4	6.4	10.0	1.9	1.6	3.2	3.9	12.9	4.3
PAHSSP005X	-Y side of Sunshade - X	[g]	1.4	2.1	3.4	2.7	3.1	2.4	2.2	2.2	1.2
PAHSSP005T	-Y side of Sunshade - T	[g]	0.4	1.2	2.3	0.3	1.3	1.5	1.8	1.2	1.0
PAHSSP005O	-Y side of Sunshade - O	[g]	0.6	7.5	9.2	2.3	1.7	1.6	2.3	3.7	2.9
PAHSSP006X	+Y side of Sunshade - X	[g]	1.4	2.0	2.8	3.1	4.0	3.1	2.8	3.6	1.2
PAHSSP006T	+Y side of Sunshade - T	[g]	0.3	1.6	2.5	0.9	0.9	1.3	2.1	2.0	1.2
PAHSSP006O	+Y side of Sunshade - O	[g]	0.4	4.7	9.6	1.6	1.1	1.5	2.6	4.3	3.4

Table 3.2-1a : HSS S/C- STM X,Y&Z-axes qualification loads

	Associated Equipment	Herschel_ STM_ Y maxB_QLY1_Fundamental "Qualification_Level_Y"_ Test 04.02.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PAHSSP001Y	Top of Sunshade - Y	[g]	8.2	5.6	1.8	2.4	3.0	2.2	3.4	2.6	1.8
PAHSSP001Z	Top of Sunshade - Z	[g]	0.5	1.8	2.8	2.4	3.6	1.7	5.5	2.8	2.0
PAHSSP002Z	Top of Sunshade mid-panel - Z	[g]	0.4	0.9	1.3	0.5	0.5	0.3	1.2	1.5	2.1
PAHSSP003O	-Y side of Sunshade - oop (local), O	[g]	6.4	13.2	3.1	1.6	2.1	1.6	3.5	4.7	9.1
PAHSSP004O	+Y side of Sunshade mid-panel - oop (local), O	[g]	5.7	12.2	3.9	2.1	1.9	1.7	2.7	4.4	7.3
PAHSSP005X	-Y side of Sunshade - X	[g]	2.3	1.4	1.0	3.1	2.3	0.8	2.5	2.1	1.1
PAHSSP005T	-Y side of Sunshade - T	[g]	4.7	2.6	1.2	2.3	2.0	1.4	1.6	1.5	1.2
PAHSSP005O	-Y side of Sunshade - O	[g]	4.6	8.2	2.2	3.6	1.0	0.3	0.5	1.9	2.3
PAHSSP006X	+Y side of Sunshade - X	[g]	2.3	1.4	0.9	2.7	2.9	1.7	1.8	1.5	1.1
PAHSSP006T	+Y side of Sunshade - T	[g]	5.2	2.9	1.3	2.6	2.2	1.3	2.5	1.7	1.2
PAHSSP006O	+Y side of Sunshade - O	[g]	5.0	8.0	2.7	3.2	1.1	0.4	1.1	1.4	2.1

	Associated Equipment		Herschel_ STM_ Z maxB_QLZ1_Fundamental "Qualification Level"_ Test 01.02.2006								
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PAHSSP001X	Top of Sunshade - X	[g]	1.8	2.0	0.5	1.6	1.9	1.2	1.9	1.6	0.4
PAHSSP001Y	Top of Sunshade - Y	[g]	0.4	1.3	1.4	1.2	2.4	1.3	1.3	0.5	1.2
PAHSSP001Z	Top of Sunshade - Z	[g]	11.4	23.5	9.6	5.4	7.4	4.5	9.1	3.6	2.0
PAHSSP002Z	Top of Sunshade mid-panel - Z	[g]	7.1	11.6	4.2	1.6	1.2	0.9	2.0	2.6	2.7
PAHSSP003O	-Y side of Sunshade - oop (local), O	[g]	8.1	20.0	12.5	1.5	1.7	1.8	2.0	6.3	4.7
PAHSSP004O	+Y side of Sunshade mid-panel - oop (local), O	[g]	7.5	21.6	8.6	2.7	1.5	2.9	1.7	8.6	6.6
PAHSSP005X	-Y side of Sunshade - X	[g]	0.3	1.1	0.7	2.1	3.3	1.7	1.9	1.4	0.8
PAHSSP005T	-Y side of Sunshade - T	[g]	4.0	4.2	1.9	1.4	2.0	0.9	0.7	0.5	0.6
PAHSSP005O	-Y side of Sunshade - O	[g]	5.9	12.6	8.2	3.1	1.7	0.5	1.3	2.7	2.4
PAHSSP006X	+Y side of Sunshade - X	[g]	0.6	1.1	0.8	1.6	2.7	1.1	0.8	1.0	1.1
PAHSSP006T	+Y side of Sunshade - T	[g]	3.7	5.8	2.0	1.1	2.4	0.9	1.3	0.5	0.6
PAHSSP006O	+Y side of Sunshade - O	[g]	5.1	14.4	8.1	3.2	1.7	0.6	1.2	3.2	2.2

Table 3.2-1a cont. : HSS S/C- STM X,Y&Z-axes qualification loads

ASED-FEM		Type	Coord.	Description	Min. Design Load	Strut Design = Test Load	HSS Design Loads DSSA-AN-0001_2	CVV = Proof Test Load [Strut bracket]	Comment
					[N]	[N]	[N]	[N]	
25070		BA	axial	HSS strut 1	19302	35000	19302	-	
25050		BA	axial	HSS strut 2	14617	35000	14617	-	
				HSS strut 2&1				11000	Strut Bracket S/C-X
25029		BA	axial	HSS strut 3	10292	35000	10292		
25010		BA	axial	HSS strut 4	23493	35000	23493		
				HSS strut 4&3				11000	Strut Bracket S/C-X
25368		BA	axial	HSS strut 5	9500	9500	16539	12500	CVV Proof Load
25161		BA	axial	HSS strut 6	12500	20000	25109	12500	CVV Proof Load
25087		BA	axial	HSS strut 7	12500	20000	26371	12500	CVV Proof Load
25291		BA	axial	HSS strut 8	9500	9500	15665	12500	CVV Proof Load
25146		BA	axial	HSS strut 9	8683	9500	8683	15300	CVV Proof Load
25132		BA	axial	HSS strut 10	14914	21000	14914	15300	CVV Proof Load
25116		BA	axial	HSS strut 11	14854	21000	14854	15300	CVV Proof Load
25101		BA	axial	HSS strut 12	8672	9500	8672	15300	CVV Proof Load
909015		BA	axial	HSS short struts SB1	1967	-	1967	-	-
909014		BA	axial	HSS short struts SB2	5024	-	5024	-	-
909013		BA	axial	HSS short struts SB3	3051	-	3051	-	-
41009		BA	axial	PLM-SVM Strut +Z, 0°, axial dir.	35000	35000	-	-	-
								-	
50051		BA	axial	Lower SFW Bone +Y /+Z - BA50051	25000	25000	-	-	plus 35kN pretension
50100		BA	axial	Lower SFW Bone +Y /-Z - BA50100	25000	25000	-	-	plus 35kN pretension
50050		BA	axial	Lower SFW Strut +Y /+Z - BA50050	13000	13000	-	-	
50027		BA	axial	Upper SFW Bone +Y /+Z - BA50027	25000	25000	-	-	
50085		BA	axial	Upper SFW Strut +Y /-Z - BA50085	13000	13000	-	-	
52384		BA	axial	Lower TSS +Y/+Z along +Z BA52384	21000	21000	-	-	plus 25kN pretension
52161		BA	axial	Upper TSS +Y/+Z along +Z BA52161	21000	21000	-	-	plus 25kN pretension
60027		BA	axial	TMS Strut, 0°, axial dir., -Z	30000	30000	-	-	
60193		BA	axial	TMS CB Strut +Y/-Z-side, BA60193	2700	3000	-	2700	Baffle I/F
754113		BA	axial	LOU Strut, 0°/180°, T-rosette 0/90; -X/+Z	6000	6000	-	6000	CVV Proof Load

Table 3.2-1b: H-EPLM strut design loads as defined in the associated procurement specs.

See /RD-1b/

(Note: Strut design = Test Loads means the unit level acceptance test loads of the struts before delivery; qualification loads are a factor 1.5 higher)

The following table 3.2-1c compares the minimum design loads as given above with the actual achieved S/C sine test qualification test loads. In all cases, the S/C sine qualification loads did not exceed the unit level acceptance test or design loads.

Forces which are not directly measured, e.g.TSS, SFW-Bones and SFW-struts are derived by FEM analysis by correlating the S/C-FEM load factors with the measured load factors.

H-EPLM Item	Min Design Load (N)	X-Qual. (N)	Y-Qual. (n)	Z-Qual. (N)	Comment
HSS strut1	19303	6021	4653	5379	
HSS strut2	14617	6687	9140	4737	
HSS strut 3	10292	8248	8079	7505	
HSS strut 4	23493	3396	4682	2807	
HSS strut 5	9500	3660	3663	3346	
HSS strut 6	12500	4065	2345	3845	
HSS strut 7	12500	4395	3398	3868	
HSS strut 8	9500	4476	3373	3484	
HSS strut 9	8683	3110	2285	4092	
HSS strut 10	14914	2635	1330	4465	
HSS strut 11	14854	3766	3412	6380	
HSS Strut 12	8672	3216	2682	3960	
HSS short SB1	1967	570	502	1356	
HSS short SB2	5024	312	1971	1548	
HSS short SB3	3051	673	553	2645	
PLM-SVM Struts	35000	10909	12070	9510	
Max TMS Strut	30000	9775	19506	20020	
Max TMS CB Strut	2700	464	714	695	
Max LOU Strut	6000	2706	5348	1070	
The following internal forces are derived by applying the measured acceleration factors on the FEM					
Lower SFW Bones	25000	15504	8805	8717	Derived by analysis
Upper SFW Bone	25000	4009	8980	9754	"
Lower SFW Strut	13000	3269	11204	10509	"
Upper SFW Strut	13000	2464	7241	7573	"
Lower TSS	21000	12835	11676	10689	"
Upper TSS	21000	17360	10620	11950	"

Table 3.2-1c: Comparison of H-EPLM strut design load forces with max. STM-S/C qualification test forces. The qualification test loads did not exceed the min. design loads

4 Sine Vibration test

The Herschel STM-S/C vibration test was performed January/February 2006 at ESTEC.

The test sequence was:

X-Axis sine test on the ESTEC HYDRA Shaker

Z-Axis on the ESTEC Multi Shaker

Y-Axis on the ESTEC Multi Shaker

4.1 Sine Vibration Test X-Axis

The X-axis vibration test was performed on the Hyda-shaker.

The test configuration is shown in Fig. 4.1-1.

Fig. 4.1-1: Herschel S/C STM on the Hydra Shaker

4.1.1 X-Axis Dynamic Properties

The X-axis dynamic properties of the Herschel S/C are summarized and compared with the prediction in Fig. 4.1.1-1.

The FEM prediction is well correlated on the main frequencies.

The HSS support strut eigenfrequencies were in the range of 65Hz- 75Hz

Mode	Calculated	Measured
First axial	38 Hz (Q=28)	40.3 Hz (Q=19)
Optical Bench X	68 Hz (Q=5)	72 Hz (Q=10)
Optical Bench Z	38 Hz (Q=5) 43 Hz (Q=3)	40.6 Hz (Q=3.2) 43.2 Hz (Q=3) 46.6 Hz (Q=4.3) rotation mode around Y
Tank Z		46.6 Hz (Q=3.5) bottom
HSS X (top)	69 Hz (Q=6) 78 Hz (Q=5)	70 Hz (Q=4.3) 72.3 Hz (Q=3.7)
HSS Y (top)		72.8 Hz (Q=4.5)
HSS Z (top)	85 Hz (Q=62)	72.5 Hz (Q=29)

Fig. 4.1.1-1: Main HEPLM Subsystem Frequencies measured during X-axis test.

4.1.2 X-Axis Qualification Input level

The X-axis qualification level was performed according to RD /8/.

The following notch channels were used.

Notching channels	level obtained	frequency	spec	active notch	
FMD Fx	192720	40.33	253330		
FMD My	28721	55.72	196900		
211X	25.9	26.94	35		
362X	7.05	55.72	7.9		
341oop	12.18	62.4	15		SVM
386Y	9.32	56.49	3-60Hz: 33 g 60-85Hz: 6g 85-100Hz: 12g	ACTIVE (64-66Hz)	
384X	9.19	89.13	3-60Hz: 33 g 60-85Hz: 6g 85-100Hz: 12g	ACTIVE (67Hz; 77-83Hz)	
114X	16.22	91.12	25		
PACRYO107X	14.59	40.44	4-46Hz: 15g 46-100Hz: 8g	ACTIVE (40.44Hz)	
PACRYO106Z	3.46	46.69	3-30Hz:4g 30-46Hz: 1.8g 46-100Hz: 4g		
PACRYO101X	11.84	40.44	3-30Hz:8g 30-46Hz: 14.8g 46-100Hz: 8g		
PASVTS002X	97.92	63.97	100g	ACTIVE (63-64Hz)	
PATMSF001Y	6.66	90.12	4-60Hz: 4g 60-100Hz: 8g		
PASA-S003P	14.81	68.17	34		
PASSDS011L	11.31	66.87	28.5		
921Y	1.31	73.25	3-27.5Hz: 20g 30-40Hz:30g 50-80Hz:22g 81-100Hz: 20g	FAILURE	SVM

Fig. 4.1.2-1: X-Qualification axis Notch channels and achieved input

Fig. 4.1.2-2 shows the performed input level (manual notch) with the actually performed level(automatic notch) for the STM-S/C X-Axis Qualification

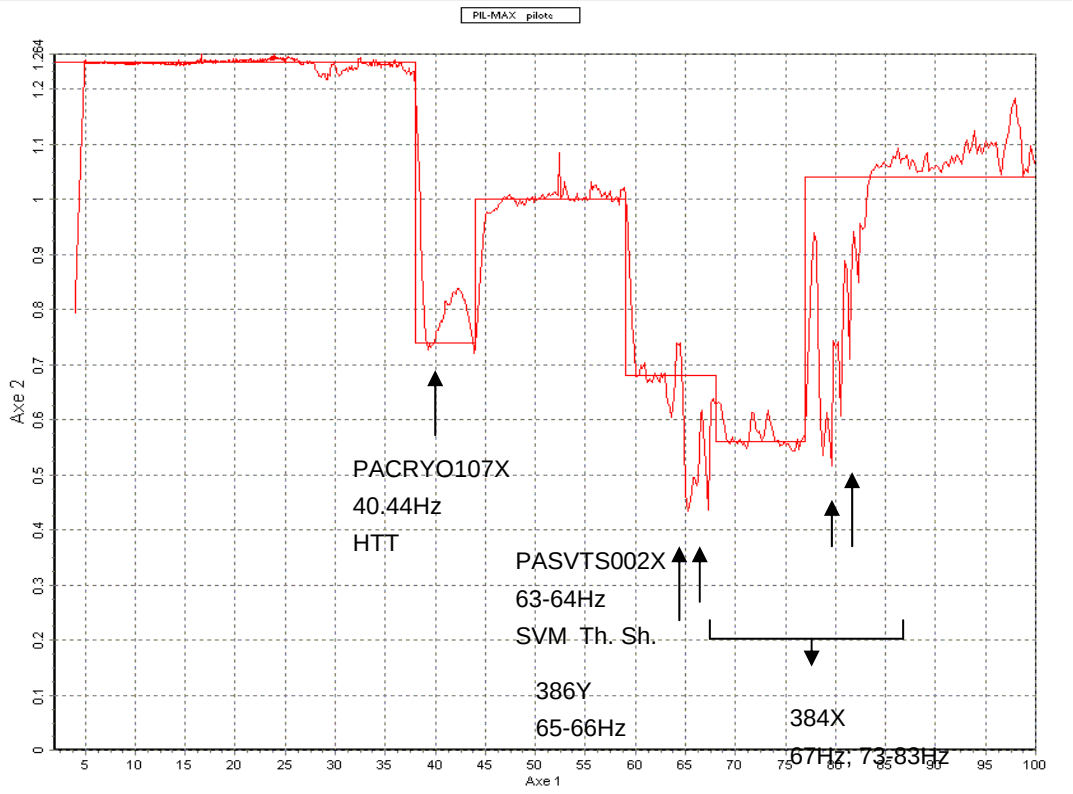


Fig. 4.1.2-2: Performed Input Level for the STM-S/C X-Axis Qualification

The requested HTT notch was performed due to the major first axial S/C mode, which is the driving loadcase for the HTT, and not due to a local HTT mode.
The HTT dynamic properties is driven by the S/C design and is therefore covered by the S/C dynamic analysis. The HTT main load occur at the first axial S/C mode between 30Hz-40Hz.

4.1.3 X-Axis S/C Interface Forces

Interface force:

The IF forces are measured at the Force Measurement Device IF (FMD).
The S/C IF forces are calculated considering the test adapter (VAS) and clampband (CB) mechanical properties:

X-axis qual, 19.01.06		Mass [kg]	CoG X [mm], S/C	CoG Y [mm], S/C	CoG Z [mm], S/C
		3190.5	**n/a**	**-23.0**	**7.0**
Helium mass during measurement	liquid	-219.7		0	-60
	gas	-9.2		0	-60
Helium mass @ STM X-test (He-I)	liquid	289.2		0	-60
Filling ratio: 99.0%	gas	0.4		0	-60
		3251.2	**ΔX=0**	**-22.5**	**5.8**

The S/C IF forces are derived from the measured FMD forces as shown below:
FMD: F x (including VAS,CB) = 192 759 N (40.3 Hz)
S/C : Fx (SC I/F) = 192 759 – 0.68g * 1986 Kg *9.81 = 179510 N
(CLA with static part 224215 N; CLA dynamic part 34930 N, CLA S/C mass = 3441 Kg)

Interface flux:

$$\frac{F}{\pi \times D} = \frac{179469}{\pi \times 2624} = 21.8 N/mm$$

	Associated Equipment	Herschel_ STM_ X QLAX1_1_Global "Qualification_Run_X"_ Test 19.01.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
	FMD										
Sum-FX	FMD X-Force N due to 7.5g, Mass 3320Kg + VAS +FMD Mass	[N]	72921	87828	192759	31219	39810	32495	34143	19849	17535
Sum-FY	FMD Y-Force N due to 2.5g, Mass 3320Kg +VAS + Mass	[N]	3602	8482	7663	2746	5225	5464	2881	7619	9554
Sum-FZ	FMD Z-Force N due to 2.5g, Mass 3320Kg +VAS + Mass	[N]	4027	10503	9917	7083	6887	4620	3418	6035	6708
Sum-MX	FMD XX-Moment Nm with max offset r=0.40m	[Nm]	3041	1237	1931	1710	2457	3273	2836	3922	6239
Sum-MY	FMD YY-Moment Nm incl. FMD offset At S/C I/F 165kNm; X-CoG: 1.992m	[Nm]	15335	6145	6889	13094	28729	17653	11002	8419	5021
Sum-MZ	FMD ZZ-Moment Nm incl. FMD offset At S/C I/F 165kNm; X-CoG: 1.992m	[Nm]	12487	4785	6468	2687	21909	9908	6538	10046	4201
S/C-IF	S/C										
S/C-X	S/C X-Force N due to 7.5g, Mass 3320Kg incl. CB Mass	[N]	51822	67429	179454	13065	21582	20656	21598	1474	9052
S/C-Y	S/C Y-Force N due to 2.5g, Mass 3320Kg incl. CB Mass	[N]	3602	8482	7663	2746	5225	5464	2881	7619	9554
S/C-Z	S/C Z-Force N due to 2.5g, Mass 3320Kg incl. CB Mass	[N]	4027	10503	9917	7083	6887	4620	3418	6035	6708
S/C-XX	S/C XX-Moment Nm with max offset r=0.40m	[Nm]	3041	1237	1931	1710	2457	3273	2836	3922	6239
S/C-YY	S/C YY-Moment Nm incl. FMD offset At S/C I/F 165kNm; X-CoG: 1.992m	[Nm]	15335	6145	6889	13094	28729	17653	11002	8419	5021
S/C-ZZ	S/C ZZ-Moment Nm incl. FMD offset At S/C I/F 165kNm; X-CoG: 1.992m	[Nm]	12487	4785	6468	2687	21909	9908	6538	10046	4201

Fig. 4.1.3-1: Overview FMD and S/C-Interface Forces

Internal responses and loads

All internal measured responses and loads are lower or equal to the design loads as given in RD /1a/.

4.1.3.1 Comparison with coupled load analysis forces

Figure 4.1.3.1-1 shows the expected Herschel load factors for flight. The resulting IF forces are compared with the achieved STM qualification test forces. Generally the dynamic responses are low.

For the comparison of the IF forces the load case "End of EAP" flight is worst case, because 4.55g static load must be superimposed in axial axis.

X-axis: 4.55g static +/- 0.76g dynamic = 5.4g axial

Lateral: 0.13g lateral

The following table gives the maximum loads on the spacecraft.

Loads factors at the center of gravity provided in this table are computed as follows (S/C : M=3441.47Kg CoG=1.976m):

longitudinal : load factor longitudinal = Axial Force/MASS

lateral : load factor lateral = Bending Moment/(MASS * h)
where h = distance between spacecraft CoG and its I/F.

HERSCHEL		Longitudinal direction				Lateral direction (*)			
		I/F Dyn. ACC. (g)	Axial force (KN)	Load at CoG (g)	MUA	I/F Dyn. ACC. (g)	Bending mom^t (KNm)	Load at CoG (g)	MUA
Lift-off (Δt = 26 ms)		+/- 0,72 (2,69 Hz)	+/- 24,46	+/- 0,72	+/-1,5	+/- 0,63 (18,30 Hz)	+/-58,07	+/- 0,87	+/-2,0
Trans. Event	//					+/- 0,73 (3,54 Hz)	+/- 79,22	+/- 1,19	+/-2,0
	⊥					+/- 0,74 (3,20 Hz)	+/- 82,49	+/- 1,24	+/-2,0
Max. Dyn. pressure Event	//					+/- 0,70 (3,60 Hz)	+/- 94,27	+/- 1,41	+/-2,0
	⊥					+/- 0,51 (3,25 Hz)	+/- 61,68	+/- 0,92	+/-2,0
End of EAP flight (gamma max)	In phase	+/- 0,76 (21,34 Hz)	+/- 25,76 (21,34 Hz)	+/- 0,76	+/-1,45	+/- 0,30 (21,34 Hz)	+/- 8,72 (21,34 Hz)	+/- 0,13	+/-1,0
	In opposite phase	+/- 0,05 (21,00 Hz)	+/- 1,77 (21,00 Hz)	+/- 0,05	+/-1,45	+/- 0,27 (20,74 Hz)	+/- 8,12 (20,74 Hz)	+/- 0,12	+/-1,0
End of EAP flight (end of thrust)	In phase	+/- 0,65 (21,34 Hz)	+/- 22,24 (21,34 Hz)	+/- 0,66	+/-1,45	+/- 0,25 (21,34 Hz)	+/- 7,20 (21,34 Hz)	+/- 0,11	+/-1,0
	In opposite phase	+/- 0,05 (21,00 Hz)	+/- 1,71 (21,00 Hz)	+/- 0,05	+/-1,45	+/- 0,24 (20,76 Hz)	+/- 7,12 (20,76 Hz)	+/- 0,11	+/-1,0
EAP Jettisoning	Symmetrical	+/- 0,82	+/- 27,94	+/- 0,83 (0,13 T**)	2,5 (T)	+/- 0,35	+/- 28,99	+/- 0,43	+/-0,9
	Unsym-metrical	+/- 0,71	+/- 24,17	+/- 0,72 (0,02 T**)	2,5 (T)	+/- 0,35	+/- 30,34	+/- 0,45	+/-0,9
End of EPC flight		+/- 0,08 (65,20 Hz)	+/- 2,69	+/- 0,08	+/-1,4				

Fig. 4.1.3.1-1: Predicted Herschel Coupled Load Analysis Load factors from COUPLED LOADS ANALYSIS REPORT; N° 2352/05 - AE/DP/SY/ES

Description	Achieved X-Axis Qualification	LVCLA	
		Max SRB	Factor
HSS strut 1	6021	4096	1.47
HSS strut 2	6687	3064	2.18
HSS strut 3	8248	3196	2.58
HSS strut 4	3396	4103	0.83
HSS strut 5	3660	1711	2.14
HSS strut 6	4065	171	23.70
HSS strut 7	4395	339	12.95
HSS strut 8	4476	1829	2.45
HSS strut 9	3110	67	46.22
HSS strut 10	2635	856	3.08
HSS strut 11	3766	893	4.22
HSS strut 12	3216	77	41.61
HSS short struts SB1	570	76	7.53
HSS short struts SB2	312	177	1.76
HSS short struts SB3	673	145	4.64
PLM-SVM Strut +Z, 0°, axial dir.	9330	6331	1.47
PLM-SVM Strut +Z, 0°, axial dir.	9054	6563	1.38
PLM-SVM Strut -Y, 0°, axial dir.	5766	4674	2.31
PLM-SVM Strut -Y, 0°, axial dir.	10783	7124	0.81
PLM-SVM Strut +Y, 0°, axial dir.	5379	3849	2.80
PLM-SVM Strut +Y, 0°, axial dir.	10909	6361	1.71
PLM-SVM Strut -Z, 0°, axial dir.	6681	4900	1.36
PLM-SVM Strut -Z, 0°, axial dir.	5990	4775	1.25
Max PLM-SVW Strut #01-#08:	10909	7124	1.53
Max TMS Strut #01-#06	9775	6238	1.57
Max TMS Baffle Strut 101A, 111A	464	131.38	3.53
Max LOU Struts #01-#08	2706	1521.57	1.78

Fig. 4.1.3.1-2: Comparison of X-axis Strut forces with predicted LVCLA

4.1.4 Achieved X-axis qualification level

4.1.4.1 Acceleration

- **First axial mode: Achieved Qualification**
  - HTT design loads: 15g axial, 2.5g lateral; => 3-D vector: 15.2g
  - Qualification: 14.8g axial, 2.8 lateral => 3-D vector: 15.1g
  - OBA design loads: 16g axial, 4g lateral => 3-D vector: 16.7g
  - Qualification: 13.7axial, 5.6 lateral => 3-D vector: 14.6g

  - Based on the achieved HTT and OBA accelerations, 85%+/-5% of the allowed dynamic Suspension Strap forces (+/-21kN) are reached.

Only a very minor response exceedance was observed for PACRYO0421X (1st Shield) with 25.1g instead of 25.0g w.r.t. the HEPLM subsystem allowables defined in /RD 1b/

The achieved accelerations are summarized in Annex 2.1

4.1.4.2 IF Forces

- All strut forces (PLM/SVM, TSS, LOU, HSS) were below there unit design and unit acceptance test loads. The IF forces are listen in Annex 2.2-2.4

4.1.5 Comparison of X-Axis Pre and Post Test Low level Run

Comparison of X-axis pre and post test low level run:

- Hydra excitation input at pilots is only comparable at 1. axial mode.
- Hydra cross-axis input shows big differences between 30-40Hz
- Comparison of main subsystems response at 1st eigenmode is very good
  - CVV-Top (PACVVB005)
  - HTT (PACRYO107x)
  - HOT (PACRYO701x)
  - OBA (PACRYO201x)
  - Telescope dummy (PATELD002x)

- Low Level Comparison of LOU
  - Differences in comparison, except at 50Hz,
    - No clear mode below 50Hz
    - Big differences in HYDRA cross-axis input
    - Proposed to review lateral axis low level runs on multi shaker with lateral signature runs w.r.t. 50-100Hz frequency range.

- Open Items: systems with modes > 52Hz, e.g. HSS, but no significant responses

- For the first axial mode with main loading, the pre and post test low level runs match very well for CVV, HTT and OBA w.r.t. frequency and level (much better than specified success criteria 5% frequency and 15% amplitude)

4.1.6 Conclusion

The X-axis qualification was obtained and the test objectives were achieved as shown in Fig. 4.1.6-1. The Structure was not damaged (low level analysis/visual inspection). The FEM prediction is well correlated on the main frequencies.

Test Objectives	Applicability	Remarks
Qualify part of the primary structure w.r.t sine vibration environment	√	Achieved for X-Axis. AE agreed in RD /3a/ with qualification input level
Verify that the first lateral mode is at a frequency higher than 9 Hz	N/A	
Verify that the first axial mode is at a frequency higher than 31 Hz	√	Achieved f=40.3Hz
Validate the dynamic behaviour of the satellite (frequencies, couplings, internal responses, damping factors)	√	Achieved.
Validate subsystem / unit specified sine environment	√	Achieved. The qualification level of all H-EPLM Subsystem were below their defined allowables as given in RD /2b/. See Annex 2
Comparison of X-axis pre and post test low level run within	√	See §4.1.5
Coverage of the predicted launch loads (LVCLA) , especially the static acceleration of the load case "End of EAP"	√	See §4.1.3.1
Validate the FEM used for the coupled load analysis with the launchers by comparison of these dynamic results with the test predictions	A	Good mode correlation already achieved for main modes. For further details refer to RD /2/

Fig. 4.1.6-1: Sine test objective verification (√ = fulfilled)

4.2 Sine Vibration Test Z-Axis

The Z-axis vibration test was performed on the Multi-shaker.

The test configuration is shown in Fig. 4.2-1.

Fig. 4.2-1: Herschel S/C in Z-Axis Sine Test Configuration on Multi-Shaker

4.2.1 Z-Axis Dynamic Properties

The Z-axis dynamic properties of the Herschel S/C are summarized and compared with the prediction in Fig. 4.2.1-1.

Mode	Calculated	Measured
First lateral	14.6 Hz (Q=22)	14.88 Hz (Q=26.5)
2 nd lateral (tank + OB)	26 Hz (Q=7)	29.3 Hz (Q=8)
OB / Tank Z mode	42 Hz (Q=9) 42 Hz (Q=5)	47.2 Hz (Q=5) 47.2 Hz (Q=5) rotation around Y axis
HSS Z (top)	26 Hz (Q=65)	29.1 Hz (Q=36)

Fig. 4.2.1-1: Z-Axis Dynamic Properties

4.2.2 Z-axis Qualification Input level

Fig. 4.2.2-2 shows the performed input level (manual notch) with the actually performed level(automatic notch) for the STM-S/C Z-Axis Qualification

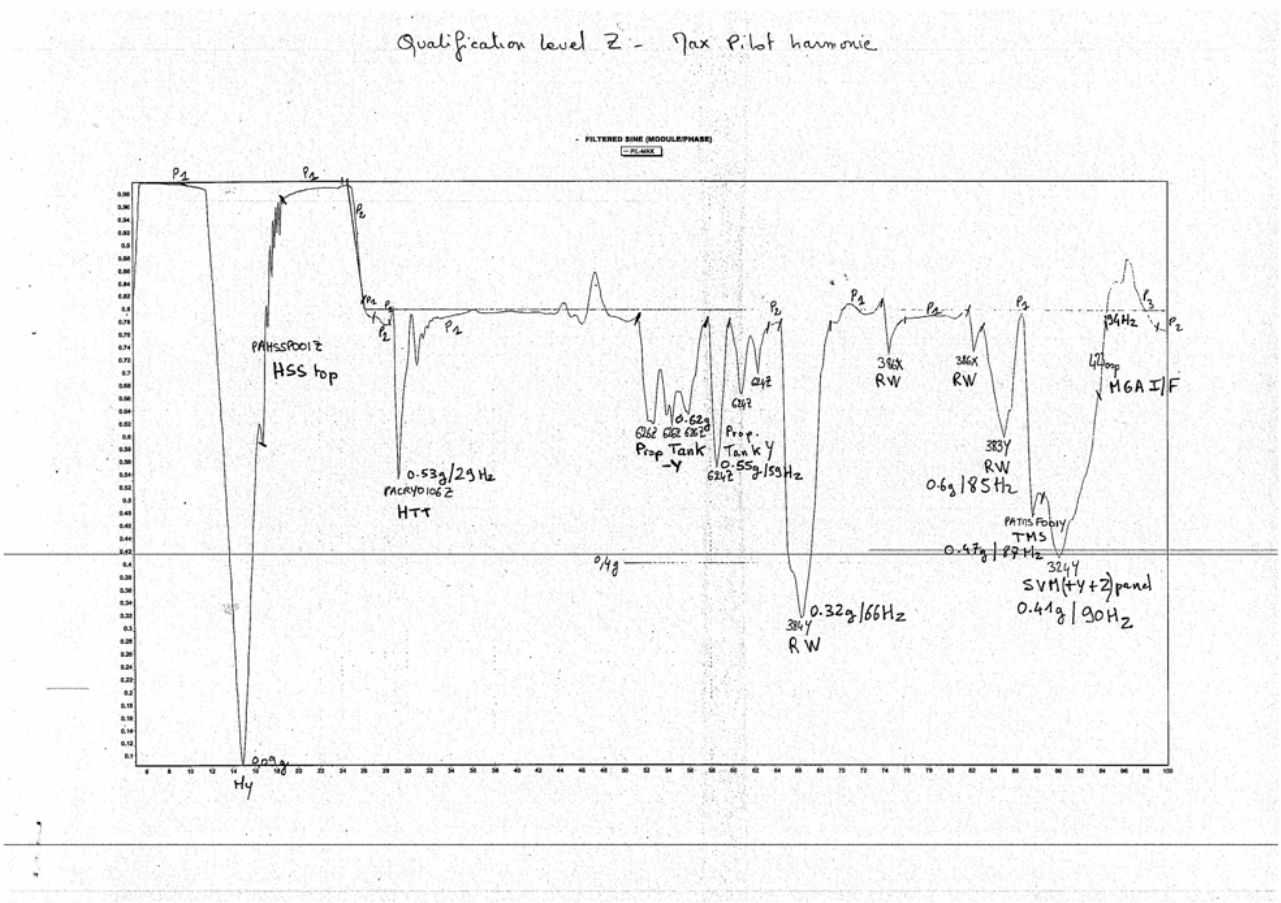


Fig. 4.2.2-2: Performed Input Level for the STM-S/C Z-Axis Qualification

notching channels	level obtained	frequency	Spec	active notch	
FMD My	200880	15.98	196898N.m	ACTIVE (11.7 - 16.4 Hz)	
PATELD001Z	3.6	73.7	14g		back up for first bending mode (4.5g)
384Y	6.3 10.22	64.5 94.7	3-60Hz: 33 g 60-85Hz: 6g 85-100Hz: 12g	ACTIVE (64.46 - 68.07 Hz)	SVM
386Y	9.57	95	3-60Hz: 33 g 60-85Hz: 6g 85-100Hz: 12g		
384X	8.5	94.5	3-60Hz: 33 g 60-85Hz: 6g 85-100Hz: 12g		
624Z	7.11	58	8g	ACTIVE (57.76 - 59.49 Hz)	Notch on RMS value, very noisy
626Z	6.6E	51.4	8g	ACTIVE (51.35 - 57.2 Hz 60.34 - 62.44 Hz)	
324Y	19.5	91.2	20g	ACTIVE (90.04 - 93.69 Hz)	
PAHSSP001Z	23.53	28.9	80g	ACTIVE (16.42 - 18.55 Hz)	back up for first bending moce (11g)
PACRYO106Z	6.77	28.9	7.3g	ACTIVE (28.84 - 30.46 Hz)	
PACRYO108Z	6.4E	28.9	7.3g		
PASA-S008P	14.93	64.7	37g		
PASVTS002X	29.16	60.5	40g		
PALOUR002Z	11.2	47.3	15g		
PATMSF001Y	7.9E	86.9	7.8g		
PATMSF002Z	6.3E	86.9	7.8g		
386X	10.96	94.7	3-60Hz: 33 g 60-85Hz: 6g 85-100Hz: 12g	ACTIVE (73.94 - 74.54 Hz 81.76 - 83.04 Hz)	SVM
323oop	9.51	89.1	15g		
388ip1	7.6E	64.9	no spec		
383Y	6.3E 6.9E	83 86.5	3-60Hz: 33 g 60-85Hz: 6g 85-100Hz: 12g	ACTIVE (83.04 - 86.32 Hz)	
423oop	7.8	96.3	7.5g local 6g global	ACTIVE (93.69 - 94.39 Hz)	

Fig. 4.2.2-2: Z-axis sine test notch channels

4.2.3 Z-Axis S/C Interface Forces

The IF forces are measured at the Force Measurement Device IF (FMD).
The S/C IF forces are calculated considering the test adapter (VAS), the clampband (CB) and the following S/C mass properties.

Z-axis qual, 01.02.06		Mass [kg]	CoG X [mm], S/C	CoG Y [mm], S/C	CoG Z [mm], S/C
		3190.5	**n/a**	**-23.0**	**7.0**
Helium mass during measurement	liquid	-219.7		0	-60
	gas	-9.2		0	-60
Helium mass @ STM Z-test (He-I)	liquid	255.3		0	-60
Filling ratio: 87.4%	gas	4.7		0	-60
		3221.7	**ΔX≈-0.6**	**-22.7**	**6.4**

The S/C IF forces are derived from the measured FMD forces as shown below:

My (including VAS,CB) = 91674 N.m at 5.64Hz, 190 430 N.m (14.88 Hz)

Fz (including VAS,CB) = 52726 N at 5.64 Hz, 49377 N (14.88 Hz).

Verification:

Fz = (3221.7 Kg (S/C) + 87 Kg (CB) + 1760 (VAS) + 139 (LC)) *9.81*0.99g= 50576 N

(this shift is in accordance with the amplification 3%)

Modal CoG (FMD I/F) = 190 430 / 49 377 = 3.856 m

Modal CoG (SC I/F) = 3.856 – 0.450 = 3.407 m (3.321m with the STM FEM at 14.7 Hz)

Fz (S/C I/F) = 49377 N – ((87 Kg (CB) + 1760 (VAS) + 139 (FMD)) *9.81*0.084g = 47740 N

My (S/C I/F) = 47740 * 3.407 = 162 651 N.m at 14.88 Hz

(LVCLA with static part My= 117 837 N.m; with QSL (2.5g)= 166 778 N.m)

		Herschel_ STM_ Z maxB_QLZ1_Global "Qualification Level"_ Test 01.02.200									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
FMD											
Sum-FX	FMD X-Force N due to 7.5g, Mass 3320Kg + VAS +FMD Mass	[N]	2483	7041	6180	10873	8948	6166	8540	2806	1808
Sum-FY	FMD Y-Force N due to 2.5g, Mass 3320Kg +VAS + Mass	[N]	3020	3032	2895	3546	5271	4372	4090	4466	3315
Sum-FZ	FMD Z-Force N due to 2.5g, Mass 3320Kg +VAS + Mass	[N]	77272	56665	27521	34810	32173	19113	23034	25864	17575
Sum-MX	FMD XX-Moment Nm with max offset r=0.40m	[Nm]	1134	1129	802	4486	8638	6207	2983	3251	2401
Sum-MY	FMD YY-Moment Nm incl. FMD offset At S/C I/F 165kNm; X-CoG: 1.992m	[Nm]	200886	62554	29125	15365	27170	14858	6525	10619	12714
Sum-MZ	FMD ZZ-Moment Nm incl. FMD offset At S/C I/F 165kNm; X-CoG: 1.992m	[Nm]	11795	2806	1737	1424	7748	9839	4195	2181	2109

Fig. 4.2.3-1: Measured FMD Interface Forces. The max moment of 200886Nm was caused by a slight overshoot after the first bending mode.

4.2.4 Achieved Z-axis qualification level

4.2.4.1 Acceleration

The achieved Z-axis qualification accelerations are summarized in Annex 4.1. The acceleration response of all subsystems were below the allowables as defined in /RD 1b/.

4.2.4.2 IF Forces

The achieved Z-axis qualification IF forces are summarized in Annex 4.2-4.4. The IF and internal forces of all subsystems were below the allowables defined in /RD 1b/.

4.2.5 Comparison of Z-Axis Pre and Post Test Low level Run

Comparison between low level and post low level showed no difference in the dynamic behaviour. Structure is not damaged

4.2.6 Conclusion

The Z-axis qualification was obtained and the test objectives were achieved as shown in Fig. 4.2.6-1. The Structure was not damaged (low level analysis/visual inspection). The FEM prediction is well correlated on the main frequencies.

The Z-axis qualification run was successfully performed and achieved all test objectives.

Refer for the Z-axis PTR to RD /3b/.

Test Objectives	Applicability	Remarks
Qualify part of the primary structure w.r.t sine vibration environment	√	Achieved for Z-Axis. AE agreed in RD /3b/ with qualification input level
Verify that the first lateral mode is at a frequency higher than 9 Hz	√	Achieved for Y. First eigenfrequency is 14.9Hz
Verify that the first axial mode is at a frequency higher than 31 Hz	N/A	
Validate the dynamic behavior of the satellite (frequencies, couplings, internal responses, damping factors)	√	Achieved.
Validate subsystem / unit specified sine environment	√	Achieved. The qualification level of all H-EPLM Subsystem were below their defined allowables as given in RD /2b/. See Annex 2

Comparison of Z-axis pre and post test low level run within specification	√	See §4.2.5
Coverage of the predicted launch loads (LVCLA) , especially the static acceleration of the load case "End of EAP"	√	Covered by AAE agreement to performed qualification level. (No static load factor applicable)
Validate the FEM used for the coupled load analysis with the launchers by comparison of these dynamic results with the test predictions	A	Good mode correlation already achieved for main modes. For further details refer to RD /2/

Fig. 4.2.6-1: Sine test objective verification (√ = fulfilled)

4.3 Sine Vibration Test Y-Axis

The Z-axis vibration test was performed on the Multi-shaker.

The test configuration on the Multi-Shaker with the test team is shown in Fig. 4.4-1.

Fig. 4.3-1: Herschel S/C in Y-Axis Sine Test Configuration

4.3.1 Y-Axis Dynamic Properties

MODE	CALCULATED	MEASURED
S/C 1st lateral	15.2 Hz (Q=24))	16.15 Hz (Q=50/55)
S/C 2nd lateral (tank + OB)	27.6 Hz (Q=4.5)	29.2 Hz (Q=6)
OB / Tank Z	43.3 Hz (Q=4.5)	48.5 Hz (Q=5.9) 48.7 Hz (Q=5.3) Rotation around Z axis
HSS Y (top)	43.3 Hz (Q=4.1)	53 Hz (Q=4)
Prop Tank +Y (Y-direction)	91 Hz (Q=10)	92/95 Hz (Q=5)
Prop Tank -Y (Y-direction)	89 Hz (Q=12)	95 Hz (Q=3)

The damping factor is much lower on the Y-axis lateral (0.9 %) than in qualification Z test (1.7 %).

Generally the damping factor comes from the links. For the Y-axis lateral mode, HSS is an important part to determine the global stiffness and probably the damping factor is modified by the HSS (less links and big carbon panels).

The difference of 1 Hz between Y&Z-axis main lateral modes could be due (partially) to the air effect on the HSS. This could as well influence the damping factor

4.3.2 Y-axis Qualification Input level

Fig. 4.3.2-1 shows the performed input level (manual notch) with the actually performed level(automatic notch) for the STM-S/C Y-Axis Qualification

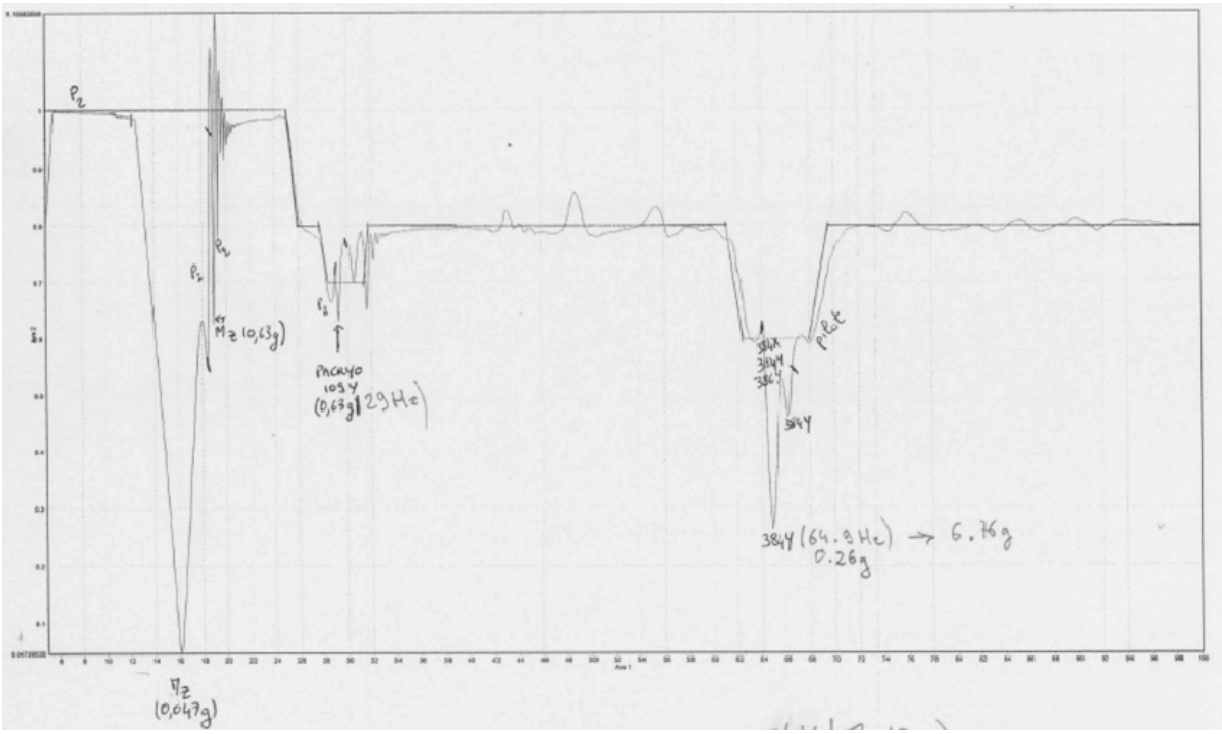


Fig. 4.3.2-1: Y-axis sine test notch channels

NOTCHING CHANNELS	TEST LEVEL [Nm/g]	FREQ. [Hz]	SPECIFICATION [Nm/g]	ACTIVE NOTCH
M_Z	226670	18.71	196800	ACTIVE (12.63 18.66Hz) (18.62-18.69Hz)
PACRYO105Y	5.73	29.03	5.3	-
PACRYO109Y	6.81	29.03	7.3	ACTIVE (29.01-29.41Hz)
PACRYO202Y	4.83	48.53	7.5	-
PAHSSP001Y	8.24	18.71	34	-
PASA-S003L	15.24	71.65	34	-
PALOUR002Z	12.4	48.93	40	-
PATELD001Y	8.84	29.11	14	-
PASA-S005L	19.39	64.33	14	-
332 Y	12.85	66.87	16	-
372 Y	16.55	64.15	16	-
381 X	6.18	64.15	3-60Hz: 33g 60-85-Hz: 6g 85-100Hz: 12g	-
384 X	6.49	64.15	3-60Hz: 33g 60-85-Hz: 6g 85-100Hz: 12g	ACTIVE (64.00-64.07Hz)
384 Y	15.1	55.41		ACTIVE (64.07-64.20Hz) (64.34-64.54Hz)
386 X	6.2	85.51	3-60Hz: 33g 60-85Hz: 6g 85-100Hz: 12g	-
386 Y	12.84	66.41		ACTIVE (64.20-64.34Hz)
324 Y	13.7	89.87	15	-
420 oop	3.73	99.54	6	-

SVM

Fig. 4.3.2-2: Y-axis sine test notch channels

4.3.3 Y-Axis S/C Interface Forces

The IF forces are measured at the Force Measurement Device IF (FMD).
The S/C IF forces are calculated considering the test adapter (VAS), the clampband (CB) and the following S/C mass properties.

Y-axis qual, 06.02.06		Mass [kg]	CoG X [mm], S/C	CoG Y [mm], S/C	CoG Z [mm], S/C
		3190.5	**n/a**	**-23.0**	**7.0**
Helium mass during measurement	liquid	-219.7		0	-60
	gas	-9.2		0	-60
Helium mass @ STM Y-test (He-I)	liquid	242.2		0	-60
Filling ratio: 82.9%	gas	6.3		0	-60
		3210.2	**ΔX≈-1.2**	**-22.8**	**6.6**

- Mz (including VAS, CB) = 87010 N.m (5.6 Hz), 183640 N.m (16.15 Hz), 225500 N.m (18.71 Hz)
- Fy (including VAS, CB) = 51600 N (5.6 Hz), 48800 N (16.15 Hz) and 26000 N (18.71 Hz)

Check on force Fy:

- Fy = [3210 Kg (S/C) + 87 Kg (CB) + 1760 Kg (VAS) + 139 Kg (FMD)] *9.81*0.99g = 50463 N
- Modal cog (FMD I/F) = 183640Nm/ 48800N = 3.763 m at 16.15 Hz
- Modal cog (SC I/F) = 3.762m – 0.450m = 3.313 m at 16.15 Hz (STM FEM Modal CoG = 3.224 m)

At 16.15 Hz: (First bending mode)

- Fy (S/C I/F) = 48800 – [(87 Kg (CB) + 1760 Kg (VAS) + 139 Kg (LC)] *9.81*0.046g =47904N
- Mz (S/C I/F) = 47904 * 3.313 = 158705 N.m
- (CLA with static part My= 117837 N.m; CLA with QSL (2.5g) = 166778 N.m)

For information:

At 18.71 Hz:

- Fy (S/C I/F) = 26 000 N – [(87 Kg (CB) + 1760 (VAS) + 139 (LC)] *9.81*1.10g = 4569N
- Mz (S/C I/F) = 4 569 * 8.223 = 37 572 Nm

4.3.4 Achieved FMD Interface Forces for Y-axis Qualification Level

	Associated Equipment		Herschel_ STM_ Y maxB_QLY1_Global "Qualification_Level_Y"_ Test 04.02.2006								
			1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
CE	FMD X-Force N due to 7.5g, Mass 3320Kg + VAS +FMD Mass	[N]	4946	6866	6715	6180	5631	3698	4615	2530	3197
CE	FMD Y-Force N due to 2.5g, Mass 3320Kg +VAS + Mass	[N]	76648	48002	26406	32173	30718	35223	17776	21549	21364
CE	FMD Z-Force N due to 2.5g, Mass 3320Kg +VAS + Mass	[N]	2013	5598	6471	5073	5008	3082	4386	6045	5849
CE	FMD XX-Moment Nm with max offset r=0.40m	[Nm]	941	2383	1364	3019	6518	2449	2932	3608	3149
CE	FMD YY-Moment Nm incl. FMD offset At S/C I/F 165kNm; X-CoG: 1.992m	[Nm]	5138	3576	2672	3405	7643	9973	3530	3909	2579
CE	FMD ZZ-Moment Nm incl. FMD offset At S/C I/F 165kNm; X-CoG: 1.992m	[Nm]	225652	108178	24539	12864	31457	8974	8763	6507	9336

Fig. 4.3.4 -1: Measured FMD Interface Forces. The max moment of 225652Nm was caused by a an overshoot at 18.71Hz (after the first bending mode at 16.15Hz)

4.3.5 Achieved Y-axis qualification level

4.3.5.1 Acceleration

The achieved Y-axis qualification accelerations are summarized in Annex 3.1. The acceleration response of all subsystems were below the allowables defined in /RD 1b/ except for the LOU CoG position. (PALOUS001X,Y,Z). See chapter 4.3.7 for assessment.

4.3.5.2 IF Forces

The achieved Y-axis qualification IF forces are summarized in Annex 3.2-3.4. The IF forces and internal forces of all subsystems were below the allowables defined in /RD 1b/.

4.3.6 Y-Axis Pre- and Post Test Low level Comparison

The following test configurations have been compared:

- Low Level with LOU not completely linked (10 screws missing) and with probably no gap between base-plate and support-plate. NCR-LOU-1984 was raised.
- 1st Post Test Control Low Level (LLY3) with previous configuration but with a gap between base-plate and support-plate and 8 screws not well-torqued on the LOU radiator.
- 2nd Post test Control Low Level (LLY4)with 9 screws between base-plate and support-plate and 8 screws retorqued on the LOU radiator.
- LOU modes are not identical in these 3 configurations: mode at 27 Hz disappears in 2nd Control Low Level.
- Between the 1st Low Level (LLY3) and 2nd Control Low Level (LLY4) the main modes are similar and the secondary modes are similar between 3 Hz and 40 Hz.
- Between the 1st Low Level and 1st Control Low Level the secondary modes are similar in the frequency range (40-150 Hz) excepted for some **accelerometers in the frequency range (40-50 Hz). Pilot signals and LOU** modes are not identical in this frequency range.
- frequency shift has been observed on accelerometer PAHSSP107O (new peaks at 94 Hz and 98 Hz).
- A visual inspection has been made on the bottom –Y solar array panel and accelerometer has been checked.
- The accelerometer channel seems suspicious.

- After modification, the taping test has been made on the 2 HSS symmetric parts: the results are similar.
- During a visual inspection we have checked the connections between HSS stiffeners and panels and everything seems ok.
- The LOU fixation problem had only an impact on the LOU structure. Other HEPLM structures were not affected.

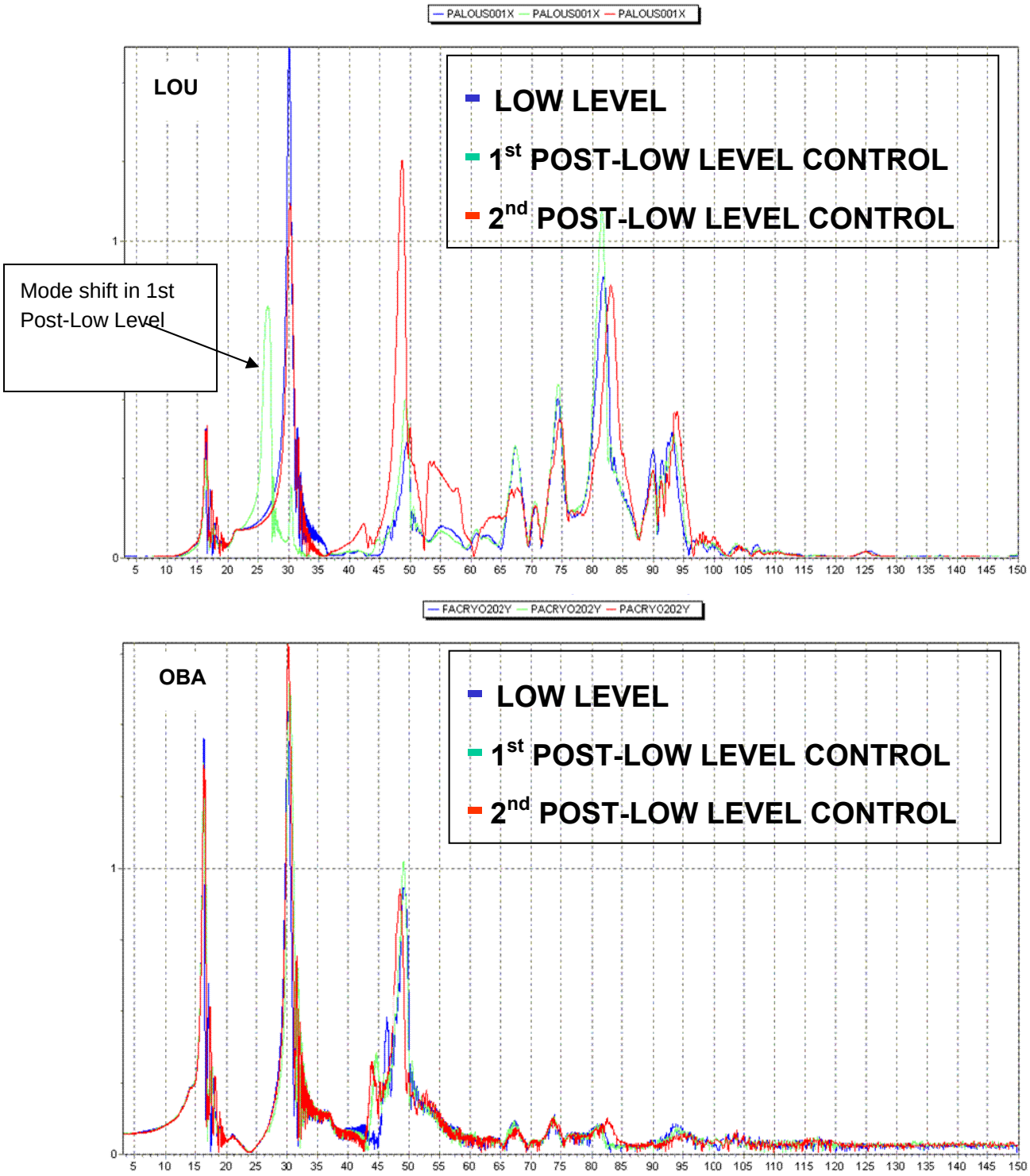


Fig. 4.3.6-1: Comparison of pre- and Post Test Low level Runs.

At LOU CoG (PALOUS001) a mode shift down to 26Hz was notified

- **At OBA, the LOU fixation error had no effect.**

4.3.7 Conclusion

The Y-axis qualification run was successfully performed and achieved all test objectives.

- Input level in accordance with ARIANESPACE requirements.
- Structure is not damaged excepted on the LOU support plate (low level analysis visual inspection).
- For LOU-NCR-1984 assessment refer to §4.4.
- The FEM is well correlated on the main frequency but the damping factor is lower (0.9%) than expected (2%).
- The Structure is not damaged (low level analysis/visual inspection). Refer for the Sine -axis PTR to RD /3c/.

Test Objectives	Applicability	Remarks
Qualify part of the primary structure w.r.t sine vibration environment	√	Achieved. AE agreed in RD /3c/ with qualification input level
Verify that the first lateral mode is at a frequency higher than 9 Hz	√	Achieved for Y. First eigenfrequency is 16.1Hz
Verify that the first axial mode is at a frequency higher than 31 Hz	N/A	
Validate the dynamic behaviour of the satellite (frequencies, couplings, internal responses, damping factors)	√	Achieved. For LOU NC-1984 was raised
Validate subsystem / unit specified sine environment	√	Achieved. The qualification level of all H-EPLM Subsystem were below their defined allowables as given in RD /2b/. See Annex 2 For LOU NCR-1984 was raised
Comparison of Z-axis pre and post test low level run within	√	See §4.2.5
Coverage of the predicted launch loads (LVCLA) , especially the static acceleration of the load case "End of EAP"	√	Covered by AAE agreement to performed qualification level. (No static load factor applicable)
Validate the FEM used for the coupled load analysis with the launchers by comparison of these dynamic results with the test predictions	A	Good mode correlation already achieved for main modes. For further details refer to RD /2/

Fig. 4.3.6-1: Sine test objective verification (√ = fulfilled)

4.4 Assessment of LOU-NCR-1984

During Y-qualification test it was observed, that the LOU CoG acceleration response has exceeded the allowables. The reason of this behaviour was caused by the LOU-Dummy unit which was not correctly fixed to the LOU support structure. See LOU-NCR-1984.

After the detection of the LOU structure fixation error, the structure was fixed correctly and the low level Y-run was repeated (LLY4).

The configuration of the LOU with the LOU support structure is shown in Fig. 4.4-1.

Note: The measurement points are corrected compared to the measurement point plan (AD5)

The strut forces at the -X side are not measured due to access problems.

Conclusion: Based on the following performed assessment summarized below, it is considered that the LOU structure qualification is still achieved.

The comparison of Y-axis qualification loads with " wrong fixation QLY1" with the low level run (LLY4) performed after the fixation correction and scaled to qualification level verifies, that the achieved load "in wrong fixation " configuration resulted in higher loads compared to the "nominal correct" configuration

- The comparison of the axial X-axis qualification test with the low level run scaled to qualification level gave no indication, that the X-axis qualification is affected by the fixation error.
- During Y-axis test the load redistribution of the +X side LOU upper struts were well below the acceptance test load on unit level.
- The comparison of both lateral vibration runs verifies that the H-EPLM subsystems were not affected by the LOU fixation error.
- The inspection of the dismounted LOU structure after test gave no indication of a damage. (Refer to inspection report incl. in LOU-NCR-1984)

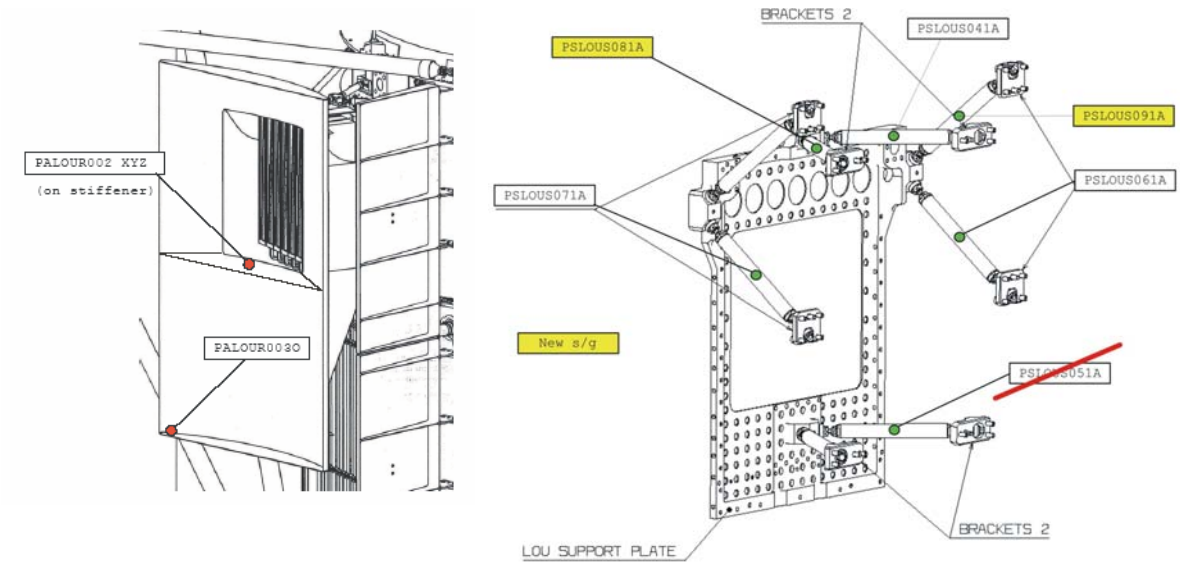


Fig. 4.4-1: LOU Configuration with measurement points. (Note LOU MPs are updated)

4.4.1 Assessment of LOU Qualification Loads

Assessment Y-axis qualification w.r.t. LOU fixation error:

Fig 4.4.1-1a compares for the Y-axis run the low level (LLY4) acceleration response scaled to the qualification level with the actually achieved Y-axis qualification loads. Generally it is expected, that the scaled low level response is higher than the actually achieved qualification level due to a damping increase at qualification loads. For the major subsystems e.g. Sunshade, CVV, SVM thermal Shield, OBA and Telescope dummy this expected behaviour could be observed.

Only for the LOU and the waveguides, the scaled low level response is lower than the qualification level. For this case, the mounting error caused a load redistribution and therefore higher qualification loads. A second consequence of the fixation error is the big difference between filtered and global response data indicating rattling. This effect occurs mainly on the LOU and the LOU waveguides.

	Associated Equipment	Herschel_ STM_ Y maxB_LLY4_Fundamental "Low_Level_Y_Repaired"_ Scaled to qualification level Herschel_ STM_ Y maxB_QLY1_Fundamental "Qualification_Level_Y"_ f / g: fundamental / gloabel response data								
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PALOUS001X	LOU CoG position - X	[g]	0.8 1.5	5.6 18.4	5.3 26.1	9.8 2.3	3.3 1.1	1.1 0.9	3.5 4.0	6.9 5.9	3.7 2.4
PALOUS001Y	LOU CoG position - Y	[g]	2.0 2.3	3.8 16.7	3.7 16.6	6.8 1.3	2.3 0.9	0.7 0.8	1.8 1.6	2.1 1.7	1.0 0.9
PALOUS001Z	LOU CoG position - Z	[g]	0.2 0.2	0.6 13.7	0.5 13.0	1.7 1.7	1.3 1.4	1.5 1.3	0.5 0.3	1.1 1.1	1.2 0.6
PALOUS002X	LOU Baseplate - X	[g]	0.8 1.5	5.1 3.3	4.8 2.1	6.9 2.6	2.3 1.2	1.1 0.9	3.8 4.3	7.8 6.6	4.2 2.8
PALOUS002Y	LOU Baseplate - Y	[g]	2.3 2.6	1.8 4.6	1.8 1.0	0.8 1.0	1.6 1.7	1.3 1.2	2.2 1.6	1.4 1.5	2.0 1.4
PALOUS002Z	LOU Baseplate - Z	[g]	0.1 0.2	0.6 0.5	0.3 0.4	2.4 1.0	1.2 1.2	0.8 0.8	0.4 0.5	1.1 1.0	0.6 0.6
PALOUR002X	LOU Radiator CoG position - X	[g]	1.0 1.8 5.5g	7.6 15.3 49.2g	7.2 14.2 52.9g	19.3 2.5	6.4 1.7	2.2 1.5	3.0 4.3	3.8 5.7	1.4 1.9
PALOUR002Y	LOU Radiator CoG position - Y, R	[g]	2.0 2.5	5.9 20.5f 36.9g	5.8 20.1f 36.4g	18.3 1.8	6.7 0.6	1.6 0.4	3.8 1.8	7.0 2.7	3.1 1.2
PALOUR002Z	LOU Radiator CoG position - Z,T	[g]	0.1 0.2	0.8 2.1	1.0 1.4	5.2 12.4	8.8 5.8	1.3 1.1	1.0 0.9	1.4 1.2	1.5 1.2
PALOUR003O	LOU Radiator Corner local oop - oop (local),R	[g]	1.5 2.7	11.2 49.6f 82.2g	10.9 48.5f 74.7g	51.3 3.3	21.0 12.8	14.8 11.4	10.3 4.7	18.0 7.2	12.6 7.1
PAHSSP003O	-Y side of Sunshade - oop (local), O	[g]	4.1 6.4	6.7 13.2	4.4 3.1f 9.7g	3.8 1.6	3.3 2.1	1.4 1.6	5.3 3.5	5.5 4.7	10.2 9.1
PACCCV031Y	Cryo Cover CVV I/F (Pilot 31 @ AAE test) > Y	[g]	2.5 3.1	0.6 1.6	0.3 0.2	1.7 1.4	1.3 1.3	0.9 1.0	1.7 1.1	1.1 0.8	1.0 0.9
PAWAVG001Y	Waveguide > Y (outer WG on -Z-side)	[g]	0.5 1.4f 16.1g	4.9 3.2f 44.9g	4.4 2.0f 37.2g	5.3 4.2f 6.0g	5.3 4.7f 30.2g	15.2 14.8	8.2 5.6	11.8 8.3	34.4 19.0
PASVTS001X	SVM Thermal Shield, -Z side, over strut support > X	[g]	0.1 0.1	0.2 0.1	0.2 0.1	1.0 0.7	15.6 11.5	5.6 6.7	1.7 0.8	1.1 1.1	0.6 0.7
PATELD001Y	Telescope dummy M2 IF	[g]	4.2 6.2f 6.2g	16.5 8.8f 8.9g	15.3 6.6f 6.7g	3.3 2.2f	1.0 1.1f	0.3 0.2f	0.4 0.2f	0.4 0.2f	0.4 0.2f
PACRYO202Y	OBA (+Y), unit level 23Y	[g]	2.6 2.8f 2.8g	8.5 4.1f 4.3g	8.5 3.7f 3.8g	7.2 4.9f 5.0g	2.2 2.1f 2.1g	0.4 0.5f 0.5g	1.0 0.7f 0.8g	1.0 0.6f 0.6g	0.6 0.4f 0.5g

Fig. 4.4.1-1a: Comparison Y-Axis Low level after repair scaled to Qual.Level with Y-Qual. Run for LOU acceleration plus major subsystems as CVV, HSS, WGs & OBA

Fig 4.4.1-1b compares for the Y-axis run the low level LOU strut forces and strut forces scaled to the qualification level with the actually achieved qualification loads. One can see, that in the 30Hz-40Hz frequency band, the actually achieved qualification strut forces were much higher than the expected forces. But the maxium strut force of 4683N at strut 9 (PSLOU91A) is still well below the LOU strut unit acceptance test level of 8160N /RD 4/ to which all LOU struts were acceptance tested.

The low level run (LLY4) performed after the correct installation of the LOU support structure verifies, that the max LOU strut forces would occur as predicted in the 40-50Hz frequency range, with a much lower strut force of 2682N.

	Associated Equipment		**Herschel_ STM_ Y maxB_LLY4_Fund. "Low_Level_Y_Post/Repaired"_ Scaled to qualification level. Herschel_STM_YmaxB_QLY1_Fundamental "Qual_Level_Y"**								
MP-No.		**[Hz]**	**15.0**	**25.0**	**35.0**	**45.0**	**55.0**	**65.0**	**75.0**	**85.0**	**95.0**
PSLOUS041A	**LOU Strut, 0°/180°, T-rosette 0/90; +X/+Z**	**[N]**	100.2 309	531.5 3220	507.2 3027	1349.3 554	544.1 454	546.0 931	427.2 515	240.8 464	275.5 349
PSLOUS061A	**LOU Strut, 0°/180°, T-rosette 0/90; ++Z**	**[N]**	230.3 400	1174.4 1443	1101.0 1239	**1941.3** 1096	906.6 667	584.6 381	1112.4 1162	1850.7 1632	849.5 571
PSLOUS071A	**LOU Strut, 0°/180°, T-rosette 0/90; --Z**	**[N]**	66.6 187	1327.4 2230	1232.2 2138	**2682.5** 499	881.5 311	293.4 284	684.6 845	1431.3 1355	768.5 544
PSLOUS081A	**LOU Strut, 0°/180°, T-rosette 0/90; --Z**	**[N]**	164.9 242	834.0 2327	772.8 2262	**2643.2** 407	955.4 531	543.4 433	187.0 244	165.5 248	255.6 161
PSLOUS091A	**LOU Strut, 0°/180°, T-rosette 0/90; --Z**	**[N]**	169.3 668	1674.9 4683	1568.0 4277	2419.3 903	805.6 438	444.7 480	869.6 1916	1617.4 2707	944.9 1221

Fig. 4.4.1-1b: Comparison LOU Y-axis Strut Forces of Y-Low level after repair scaled to Y Qual.Level with Y-Qualification Run

Assessment X-axis qualification w.r.t. LOU fixation error:

During X-axis PTR the comparison of the low level pre- and post qualification test showed some frequencies shifts on the LOU and HSS (see Fig. 4.4.1-2a,b) between 37 and 42 Hz on the transverse responses. On the X-axis post test review these shifts were explained at that time by the HYDRA Shaker "non reproducibility" of low levels at the S/C I/F. Therefore the same assessment as provided for the Y-axis was performed for the X-axis in order to demonstrate that the axial S/C sine test was not affected by the LOU mounting error.

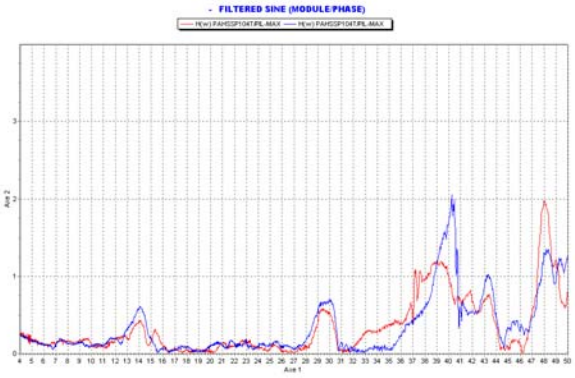


Fig. 4.4.1-2a: Comparison Pre-, Post low level Run for Solar Array, MP PAHSSP104T

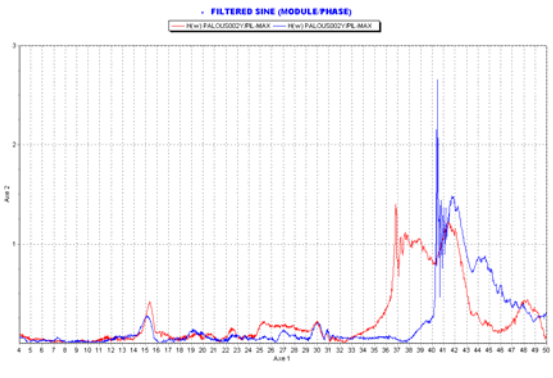


Fig. 4.4.1-2b: Comparison Pre-, Post low level Run for LOU, MP PALOUS002Y

Fig 4.4.1-3a compares for the X-axis run the low level (prior to qual. run) acceleration response scaled to the qualification level with the actually achieved X-axis qualification loads. As it was the case for the Y-axis, the major subsystems e.g. Sunshade, CVV, SVM thermal Shield, OBA and Telescope dummy are not significantly affected. Even for the measurement point PAHSSP104T on the Solar Array, the comparison on qualification level did not show any significant differences compared to the pre- and post low level test comparison.

Therefore the PTR conclusion, that non reproducibility of low levels of the HYDRA has caused the difference seems to be the major cause of the variation.

For the LOU and the LOU waveguides, the difference between scaled and actually achieved fundamental qualification level seems to be still in an acceptable range. Nevertheless the big difference between fundamental and global responses for the LOU baseplate and the LOU waveguide is an indication, that some rattling occurred already during the X-axis test.

	Associated Equipment	Herschel_ STM_ X _4 "Low_Level_X"_ Test 16.01.2006 Scaled to Qual. Level Herschel_ STM_ X QLAX1_1_fundamental and global "Qualification_Run_X" _ Test 19.01.2006 For Qual.- Run Fundamental -f- and global -g- data are given.									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PALOUS001X	LOU CoG position - X	[g]	1.6 1.6f 1.6g	2.6 2.7f 2.8g	9.3 4.6f 9.7g	3.6 0.9f 2.2g	1.8 1.6f 1.6g	4.1 5.2f 5.2g	9.0 9.2f 9.2g	3.6 3.1f 3.2g	4.2 2.3f 2.3g
PALOUS001Y	LOU CoG position - Y	[g]	0.4 0.2f 0.6g	1.0 0.8f 0.9g	11.3 4.9f 9.7g	6.5 1.1f 1.2g	2.6 0.7f 1.1g	2.4 2.5f 2.5g	3.7 3.8f 5.0g	1.3 1.3f 1.5g	1.1 0.9f 0.9g
PALOUS001Z	LOU CoG position - Z	[g]	1.3 0.2f 0.3g	0.4 0.6f 0.7g	2.0 1.2f 4.1g	2.8 1.6f 1.7g	3.2 1.3f 1.4g	3.4 2.9f 2.9g	1.2 1.9f 2.8g	2.0 1.5f 1.5g	1.2 0.0f 0.9g
PALOUS002X	LOU Baseplate - X	[g]	1.8 1.6f 1.6g	2.6 2.5f 2.5g	7.8 6.2f 11.4g	1.8 1.4f 2.6g	1.3 1.7f 1.7g	4.4 5.2f 5.2g	9.7 9.7f 9.7g	4.0 3.4f 3.4g	4.7 2.6f 2.6g

	Associated Equipment	Herschel_ STM_ X _4 "Low_Level_X"_ Test 16.01.2006 Scaled to Qual. Level Herschel_ STM_ X QLAX1_1_fundamental and global "Qualification_Run_X" _ Test 19.01.2006 For Qual.- Run Fundamental -f- and global -g- data are given.									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PALOUS002Y	LOU Baseplate - Y	[g]	0.4 0.3g	0.3 0.5g	1.7 10.2g 0.7 f	0.5 1.0g	1.8 1.4g	2.7 2.4g	2.9 4.2g	1.7 1.6g	1.9 1.3g
PALOUS002Z	LOU Baseplate - Z	[g]	1.3 0.3f 0.3g	0.8 0.8f 1.0g	2.0 0.6f 2.1g	1.3 1.0f 1.2g	1.4 1.2f 1.2g	1.8 2.1f 2.1g	1.6 1.6f 1.7g	2.0 1.5f 1.5g	1.8 0.8f 0.9g
PALOUR002X	LOU Radiator CoG position - X	[g]	1.8 1.8f 1.9g	3.3 3.4f 4.0g	18.5 7.5f 22.7g	10.2 0.9f 3.8g	4.6 2.0f 4.7g	4.3 5.6f 5.7g	6.9 11.1f 12.9g	2.2 2.5f 3.4g	1.9 2.1f 2.5g
PALOUR002Y	LOU Radiator CoG position - Y, R	[g]	0.4 0.2f 1.4g	1.0 1.6f 2.2g	27.1 11.0f 17.9g	15.1 2.4f 3.2g	6.2 1.2f 3.6g	4.2 2.9f 3.2g	7.9 8.1f 9.4g	4.0 3.4f 3.7g	3.2 1.7f 2.0g
PALOUR002Z	LOU Radiator CoG position - Z,T	[g]	1.3 0.2f 0.7g	0.8 1.0f 1.3g	4.6 3.3f 7.1g	17.3 12.5f 12.6g	21.4 12.1f 12.2g	3.1 3.5f 3.6g	2.2 2.0f 2.8g	3.2 2.4f 2.9g	3.3 2.6f 2.7g
PALOUR003O	LOU Radiator Corner local oop - oop (local),R	[g]	0.5 0.5f 3.7g	2.3 3.5f 6.4g	64.6 26.2f 35.3g	38.0 6.1f 8.4g	17.2 10.1f 10.3g	30.8 22.5f 22.7g	28.4 29.5f 31.2g	28.2 19.8f 20.5g	20.5 8.8f 9.1g
PAHSSP003O	-Y side of Sunshade - oop (local), O	[g]	3.7 0.6f 1.2g	8.8 11.2f 12.0g	8.3 10.2f 10.6g	2.6 1.9f 3.5g	5.1 3.4f 3.6g	5.8 4.4f 4.5g	6.7 4.0f 4.2g	8.0 6.7f 6.7g	7.2 4.7f 4.7g
PAHSSP104T	Solar Array, -Y side - T	[g]	0.8 0.2f 0.2g	0.9 0.8f 0.9g	1.3 1.2f 1.4g	1.1 1.7f 1.9g	1.9 1.6f 1.8g	1.7 1.3f 1.7g	2.5 1.5f 1.6g	1.5 0.8f 1.0g	0.5 0.6f 0.7g
PACCCV031X	Cryo Cover CVV I/F (Pilot 31 AAE test) > X	[g]	1.8 1.4f 1.5g	2.3 2.1f 2.1g	6.6 5.3f 6.3g	1.5 1.2f 1.3g	0.7 0.9f 1.5g	2.6 2.2f 4.6g	4.2 3.3f 4.1g	0.9 0.8f 2.4g	1.2 1.7f 3.5g
PAWAVG001Y	Waveguide > Y (outer WG on -Z-side)	[g]	2.0 0.2f 5.9g	1.6 1.1f 8.1g	5.2 2.6f 60.6g	1.7 1.9f 33.6g	8.1 6.8f 45.8g	5.0 4.5f 46.0g	16.3 24.2f 33.1g	17. 14.1f 28.3g	46. 12.6f 181g
PASVTS001X	SVM Thermal Shield, -Z side, strut support > X	[g]	1.8 1.0f 2.0g	1.9 1.8f 3.3g	3.0 3.5f 3.5g	6.7 9.8f 9.8g	41.3 34.2f 34.5g	20.1 17.1f 17.2g	3.5 3.3f 3.8g	3.8 4.8f 5.6g	1.9 1.8f 3.2g
PATELD001X	Telescope dummy M2 beam > Y1	[g]	1.5 1.5f 1.5g	2.3 2.2f 2.2g	7.5 6.0f 6.5g	1.7 1.4f 1.9g	1.9 2.0f 2.0g	4.0 4.7f 5.6g	13.3 11.6f 14.8g	5.5 3.4f 3.5g	1.8 1.4f 2.7g
PACRYO201X	OBA (+Y), unit level 23X	[g]	1.6 1.0f 1.6g	2.8 2.7f 2.8g	16.3 13.0f 13.2g	5.0 4.9f 5.0g	3.4 3.8f 4.2g	3.9 2.6f 2.6g	9.4 5.3f 5.4g	2.8 1.5f 1.5g	1.0 2.3f 2.5g

Fig. 4.4.1-3a: Comparison X-Axis Low level after repair scaled to Qual.Level with X-Qualification Run for LOU acceleration plus major subsystems as CVV, HSS, WGs & OBA

Fig. 4.4.1-3b compared the LOU strut forces from the scaled low level run with the actual qualification run results. The force difference is not significant and can be mostly explained by damping increase at qualification forces. The max. achieved qualification loads are well below the individual LOU strut acceptance test of 8160N.

	Associated Equipment	Herschel_ STM_ X _4 "Low_Level_X"_ Test 16.01.2006 Scaled to Qual. Level Herschel_ STM_ X QLAX1_1_Global "Qualification_Run_X" _ Test 19.01.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PSLOUS041A	LOU Strut, 0°/180°, T-rosette 0/90; +X/+Z		303	264	2152	1084	741	1199	826	323	338
		[N]	176	313	1556	299	282	781	821	234	152
PSLOUS061A	LOU Strut, 0°/180°, T-rosette 0/90; ++Z		437	729	2172	1465	1714	1485	2726	1163	1064
		[N]	410	710	2706	885	881	1622	2697	927	549
PSLOUS071A	LOU Strut, 0°/180°, T-rosette 0/90; --Z		365	667	2638	1234	590	913	1617	1088	915
		[N]	387	726	2051	494	326	1043	1985	695	532
PSLOUS081A	LOU Strut, 0°/180°, T-rosette 0/90; --Z		287	261	2755	1605	899	707	257	317	211
		[N]	182	440	1723	286	409	734	724	242	184
PSLOUS091A	LOU Strut, 0°/180°, T-rosette 0/90; --Z		393	625	2746	1082	427	1168	2256	1043	1081
		[N]	413	718	2246	537	431	1366	2323	864	604

Fig. 4.4.1-3b: Comparison LOU X-axis Strut Forces of X-Low level after repair scaled to Y Qual.Level with Y-Qualification Run

4.4.2 Comparison of Y and Z lateral Qualification Runs

The following Fig. 4.4.2 -1 compares for both lateral axes the achieved qualification levels to investigate, if the LOU fixation error has any significant influence on the H-EPLM subsystems, e.g. HTT, OBA, HOT, TMS, CVV and Telescope Dummy.

The comparison shows, that the achieved acceleration and force level is very similar for both lateral axis. This is not astonishing, because both tests were controlled via subsystem automatic notch channels, which insured that the intended response level was achieved.

4.5 Telescope Mounting Structure (TMS) Qualification

The qualification loads of the TMS are summarized in the Annex 2.2, 3.2 and 4.2.
The maximum achieved TMS strut forces occurred during the lateral sine tests at the second lateral mode.

	Sine-Input:	
X-Qual. at ~38Hz:	0.75g	Strut Force PSTMSS071A: 10035N
X-Qual. at ~72Hz:	0.55g	Strut Force PSTMSS071A: 6495N
Y-Qual. at ~29Hz:	0.68g	Strut Force PSTMSS041A: 19506N
Z-Qual. at ~29Hz :	0.53g	Strut Force PSTMSS081A: 20020N
Z-Qual at ~86.9Hz	0.47g	PATMSF001Y (TMS-cross coupling) achieved 7.98g compared with spec = allowed 7.8g, see /RD1b/, Table 10.2.4-1. Low TMS strut force <1319N

No notching was performed w.r.t. the TMS and Telescope dummy IF forces.
Due to high acceleration cross-coupling during the Z-axis test (PATMSF001Y), notching was performed as show above in order not to exceed the specified design acceleration loads.
The PFM TMS struts acceptance test load on unit level was 35kN to be compared with the S/C level test forces of 20kN. Therefore an additional test margin of factor 1.5 exists.

The repair of the TMS struts is an ongoing activity and will be monitored by means via the NCR HP-122000-ASED-NC-1437. The NCR on the TMS fittings has no impact on the mechanical qualification of the TMS struts. The repaired TMS struts will be submitted again on unit level to the full acceptance tests including the 35kN static test load.

The achieved TMS strut forces were limited by necessary notching on other subsystems max. allowables, e.g. HTT lateral response

For the Herschel S/C FM-acceptance tests, the above given TMS maximum allowable strut qualification forces must be respected.

	Herschel_ STM_ Y maxB_QLY1_Fundamental "Qualification_Level_Y"											Herschel_ STM_ Z maxB_QLZ1_Global "Qualification Level"									
		[Hz]	10-20Hz	20-40Hz	40-50Hz	50-60Hz	60-70Hz	70-80Hz	80-90Hz	90-100Hz		[Hz]	[Hz]	10-20Hz	20-40Hz	40-50Hz	50-60Hz	60-70Hz	70-80Hz	80-90Hz	90-100Hz
FMD												FMD									
	FMD YY-Moment Nm incl. FMD offset At S/C I/F 165kNm; X-CoG: 1.992m											Sum-MY	[Nm]	**200886**	62553.8	15365	27170	14858	6525	10619	12714
Sum-MZ	**FMD ZZ-Moment Nm incl. FMD offset At S/C I/F 165kNm; X-CoG: 1.992m**	**[Nm]**	**225574**	108176.6	12856	31450	8953	8744	6501	9284											
HTT	**Max Allowable vector**			**7.5g**	**7.5g**							HTT			**7.5g**	**7.5g**					
PACRYO105-106Lat	**HTT Lower BH - LAT, 105,106**	**[g]**	1.4	**5.8**	**4.7**	2.7	0.4	0.7	1.6	2.3		PACRYO106Z	[g]	1.5	**6.8**	**4.3**	1.7	0.6	0.6	1.1	1.2
PACRYO108,109 - Lat	**HTT Lower BH - LAT, 108,109**	**[g]**	2.2	**6.8**	4.9	2.7	0.4	0.8	1.6	1.2		PACRYO1037,8,9-3D	[g]	2.0	**6.5**	4.3	1.6	0.6	0.6	1.0	1.5
OBA	**Max Allowable vector**			**8g**	**8g**							OBA			**8g**	**8g**					
PACRYO20_2,3-Lat	**OBA (+Y), 3-D vector Lat-23,26**	**[g]**	2.8	**4.2**	**5.3**	2.1	0.5	0.9	0.7	0.5		**OBA (+Y), 3-D vector Lat-23,26**	[g]	2.3	**4.8**	4.3	1.2	1.2	2.5	1.1	0.9
PACRYO20_5,6-Lat	**OBA (+Y), 3-D vector Lat-24,27**	**[g]**	2.7	3.8	**4.9**	2.0	0.6	0.8	0.6	0.5		PACRYO204,5,6-3-D	[g]	2.5	5.9	**5.3**	1.8	1.3	2.9	1.3	1.4
PACRYO207Y	**PACS FPU Y, Upper Surface, not CoG**	**[g]**	3.4	3.2	**8.1**	3.7	1.0	1.2	1.2	1.8		PACRYO207Y	[g]	0.2	0.5	3.0	1.0	1.2	2.5	0.4	0.8
PACRYO208Z	**PACS FPU Z, Upper Surface, not CoG**	**[g]**	0.1	0.8	3.3	0.5	1.1	2.0	0.8	0.3		PACRYO208Z	[g]	2.8	4.7	**11.2**	3.0	2.2	2.6	1.5	1.0
HOT				**7.5g**	**7.5g**							Thermal Shields and HOT			**7.5g**	**7.5g**					
PACRYO701X	**HOT Upper BH - X**	**[g]**	0.0	0.3	0.5	0.3	0.3	1.0	2.3	3.1		PACRYO701X	[g]	0.3	3.4	1.1	0.6	0.8	1.4	1.7	8.1
PACRYO702Y	**HOT Upper BH - Y**	**[g]**	1.7	**5.5**	**4.1**	2.2	0.6	1.1	2.2	1.6		PACRYO702Y									
PACRYO703Z	**HOT Upper BH - Z**	**[g]**										PACRYO703Z	[g]	1.6	**5.8**	**3.9**	1.3	1.1	0.9	1.0	6.8
TMS - TEL Mounting Structure	**Max Allowable vector**			**11g**					**11g**			TMS - TEL Mounting Structure			**11g**					**11g**	
PATMSF001Y	**TMS Frame on corner, -Z side - Y**	**[g]**	3.8	**2.0**	1.8	2.2	1.4	3.4	**5.1**	3.8		PATMSF001Y	[g]	0.4	1.1	0.7	1.5	1.5	1.5	**8.0**	5.4
PATMSF001Z	**TMS Frame on corner, -Z side - Z**	**[g]**	0.1	0.6	0.2	0.4	0.5	0.4	1.2	1.0		PATMSF001Z	[g]	3.2	**1.6**	0.8	1.2	1.3	1.2	3.7	2.1
TMS - TEL Mounting Structure	**Max Strut Forces: Allowed : 30000N**	**[N]**	**14142**	**19389**	**6887**	**4048**	**4446**	**2114**	**1617**	**1079**		TMS - TEL Mounting Structure	**[N]**	**10259**	**20020**	**3180**	**7076**	**6926**	**2895**	**1319**	**878**
Baffle Struts	**Max Strut Forces: Allowed 3000N**	**[N]**	**563**	**516**	**118**	**101**	**65**	**172**	**232**	**187**		**Baffle Struts**	**[N]**	**549**	**695**	**78**	**185**	**128**	**108**	**397**	**300**
SVM/PLM Struts	**Max Strut Forces: Allowed 30000N**	**[N]**	**12067**	7882	2392	1212	849	674	683	701		SVM/PLM Struts	**[N]**	**9510**	8107	2676	1430	1221	909	589	446
External CVV	**Max Allowable vector**			**4g**								External CVV			**4g**						
PACVVU001Z	**Upper CVV Ring, -Y position, STA 2222 > Z**	**[g]**	0.2	0.6	0.5	0.6	0.3	0.5	0.7	0.3		PACVVU001Z	[g]	2.0	**1.2**	0.5	1.2	0.8	1.0	1.5	0.7
PACVVU002Y	**Upper CVV Ring, -Z position, STA 2222 > Y**	**[g]**	2.4	**1.1**	1.2	1.7	1.3	1.4	0.7	0.8		PACVVU002Y	[g]	0.3	0.6	0.3	1.1	1.1	0.6	0.7	0.8
PACVVL006&7 LAT	**Lower CVV Ring,**	**[g]**	1.6	**3.5**	1.6	2.0	1.8	1.6	1.5	1.3		PACVVL006&7 LAT	[g]	1.6	**3.4**	2.1	1.6	1.7	1.2	0.9	1.1
PACSTR010lat	**STR I/F pad on CVV Lower Bulkhead**	**[g]**	1.5	**3.9**	2.5	1.7	1.7	1.3	1.7	1.5		PACSTR010lat	[g]	1.4	**3.7**	2.6	1.9	1.9	1.4	0.8	1.0
TEL Dummy				**14g**								TEL Dummy			**14g**						
PATELD001Y	**Telescope dummy M2 IF**	**[g]**	6.2	**8.8**	2.2	1.1	0.2	0.2	0.2	0.2		PATELD001Y	[g]	0.3	0.6	0.5	1.1	0.9	0.4	0.4	0.5
PATELD001Z	**Telescope dummy M2 IF**	**[g]**	0.5	2.1	0.3	0.2	0.2	0.2	0.3	0.4		PATELD001Z	[g]	4.5	**8.1**	1.2	0.7	0.8	0.4	0.3	0.2

Fig. 4.4.2-1: Comparison of Major I/F Forces of Sine Test Qualification level for lateral Y and Z-Runs

Annex 1.1: Sine-Vibration Test Low Level Run Sheets

RECEIVED
20 30 4

Sheet 2 of 2

Project: HERSCHEL STM		Test No: 9131
Run Name: low level run X	Run ID: ~~LL_AX1_1~~ LLAX2_1	Date: ~~16~~ 19/01/06

Notching Channels

VIBCO CHANNEL	MP	NOTCH LEVEL	ABORT LEVEL	REMARK
		[g]	[g] [dB]	Please select unit as required
1	FMD Fx	126665 N	+ 6 dB	
3	FMD My	98450 N.m	+ 6 dB	
2	FMD Mz	98450 N.m	+ 6 dB	
4	211X	17.5	+ 6 dB	
5	362X	3.9	+ 6 dB	
6	341OOP	7.5	+ 6 dB	
7	386Y	16.5 3 6	+ 6 dB	4-60Hz 60-85Hz 85-100Hz
8	384X	16.5 3 6	+ 6 dB	4-60Hz 60-85Hz 85-100Hz
9	114X	12.5	+ 6 dB	
10	PACRYO107X	7 4	+ 6 dB	4-46Hz 46-100Hz
11	PACRYO106Z	2.3 2.0	+ 6 dB	4-46Hz 46-100Hz
12	PACRYO201X	7 4	+ 6 dB	4-46Hz 46-100Hz
13	PASVTS002X	50	+ 6 dB	
14	PATMSF001Y	4	+ 6 dB	
15	PASA-S002L	17	+ 6 dB	
16	PASSDS010P	14	+ 6 dB	

Signature

AAS F test director	ASED Test Conductor	AAS I	ESA-ESTEC	ETS

This input sheet is applicable for the control low level X

19/01/06

LLAX2_1

ETST012

RECEIVED 12.1

Test Input Sheet

Sheet 1 of 2

Project: HERSCHEL STM		Test No: 9131
Run Name: low level run X	Run ID: ~~LLAX1~~ LLAX2_1	Date: ~~16~~ 19/01/06

Input Spectrum

FREQUENCY RANGE	INPUT LEVEL	ABORT LEVEL	REMARK Sweep rate / Duration
4 – 100 Hz	0.1 g	~~±6dB~~ +6dB	2 octaves / mn

Signature

AAS F test director	ASED Test Conductor	AAS I	ESA-ESTEC	ETS

This input sheet is applicable for the control low level X

19/01/06

LLAX2_1

Test Input Sheet

LL7 3

Ø customer

Sheet 1 of 2

Project: HERSCHEL STM		Test No: 9131
Run Name: ~~low level Y~~	Run ID: LLY3	Date: ~~[illegible]~~

Control low level Y

06/02/06

Input Spectrum

FREQUENCY RANGE	INPUT LEVEL	ABORT LEVEL	REMARK Sweep rate / Duration
~~3 - 20 Hz~~	~~0.08 g~~	~~+ 3 dB~~	~~2 octaves / min~~
21 – 100 Hz	0.1 g	+ 9 dB	2 octaves / min
101 – 150 Hz	0.05 g	+ 9 dB	2 octaves / min
3 - 14Hz	0.06g	+9dB	2oct/min
15 - 20Hz	0.04g	+12.5dB	2oct/min

Signature

AAS F test director	ASED Test Conductor	AAS I	ESA-ESTEC	ETS

02/02/06

Setup table used for low level control run

Applicable for the 2nd control low level (8/02/06)

8/2/06

06/02/06

Project: HERSCHEL STM		Test No: 9131
Run Name: ~~[redacted]~~	Run ID:- LLY3	Date: ~~[redacted]~~

Control level low Y

06/02/06

Notching Channels

VIECO CHANNEL	MP	NOTCH LEVEL	ABORT LEVEL	REMARK
		[g]	[g] [dB]	Please select unit as required
2	FMD Mz	118140 Nm	+ 4 dB	3-150Hz
3	324Y	7.5 g	+ 6 dB	
4	332Y	8.0 g	+ 6 dB	
5	362Y	7.5 g	+ 6 dB	
6	372Y	8.0 g	+ 6 dB	
7	384X	16.5 g 3.0 g 6.0 g	+ 6 dB	3-60Hz 65-85Hz 90-150Hz
8	384Y	16.5 g 3.0 g 6.0 g	+ 6 dB	3-60Hz 65-85Hz 90-~~100~~Hz 150Hz
9	386X	16.5 g 3.0 g 6.0 g	+ 6 dB	3-60Hz 65-85Hz 90-~~100~~Hz 150Hz
10	423 oop	4.0 g	+ 6 dB	
11	361 oop	7.5 g	+ 6 dB	
12	PATELC001Y	3.1 g 7.0 g	+ ~~6~~ dB + ~~6~~ dB	~~3-20Hz~~ ~~21-150Hz~~
14	PAHSSP001Y	4.4 g	+ ~~6~~ dB	3-20Hz
15	PACRYO206Y	3.3 g 2.65 g	+ 6 dB	3-35Hz 36-150Hz
16	PACRYO202Y	3.3 g 2.65 g	+ 6 dB	3-35Hz 36-150Hz
17	PACRYO109Y	2.8 g 2.65 g	+ 6 dB	3-35Hz 36-150Hz
18	PACRYO105Y	2.8 g 2.65 g	+ 6 dB	3-35Hz 36-150Hz
20	PALOUR002Z	7.5 g	+ 6 dB	3-150Hz
21	PASA-S005P	18.5 g	+ 6 dB	3-150Hz

Signature

AAS F test director	ASED Test Conductor	AAS I	ESA-ESTEC	ETS

Applicable for low level control

8/02/06

8/2/06

02/02/06

06/02/06

Test Input Sheet

Sheet 1 of 2

received : 04/02/06 Ek.
ø customer

Project: HERSCHEL STM		Test No: 9131
Run Name: qualification level Y	Run ID: QLY1	Date: 6/02/06

Input Spectrum

FREQUENCY RANGE	INPUT LEVEL	ABORT LEVEL	REMARK Sweep rate / Duration
5 – 5.6 Hz	+/- 8 mm	+ 4 dB	
5.6 – 25 Hz	1 g	+ 4 dB	2 octaves / min
26 – 27.75 Hz	0.8 g	+ 4 dB	2 octaves / min
28.25 – 31.25 Hz	0.7 g	+ 4 dB	2 octaves / min
31.75 – 61.5 Hz	0.8 g	+ 4 dB	2 octaves / min
62.5 –68 Hz	0.6g	+ 4 dB	2 octaves / min
69.5– 100 Hz	0.8g	+ 4 dB	2 octaves / min

Signature

AAS F test director	ASED Test Conductor	AAS I	ESA-ESTEC	ETS

06 FEB. 2006

3Z

Test Input Sheet

Sheet 1 of 2 received : 31/02/06

Project: HERSCHEL STM		Test No: 9131
Run Name: Qualification run Z	Run ID: QLZ1	Date: 31/01/06

Input Spectrum

FREQUENCY RANGE	INPUT LEVEL	ABORT LEVEL	REMARK Sweep rate / Duration
5 - 5.6 Hz	+/- 8mm	+ 4 dB	
5.6 – 25 Hz	1g	+ 4 dB	2 octaves / mn
26 – 100 Hz	0.8 g	+ 4 dB	2 octaves / mn

Signature

AAS F test director	ASED Test Conductor	AAS I	ESA-ESTEC	ETS

LL23 — Occasional

Sheet 2 of 2 received 01/02/06 — tbc file: [redacted]

Project: HERSCHEL STM [redacted]		Test No: 31
Run Name: ~~low level Z~~ control low level Z	Run ID: ~~LL24~~ LL23	Date: ~~20/01/06~~ 01/02/06

421

Control low level Z (2nd run) 01/02/06 15h30

Notching Channels

VIBCO CHANNEL	MP	NOTCH LEVEL	ABORT LEVEL	REMARK
		[g]	[g] [dB]	Please select unit as required
2	FMD My	~~38 43.5~~ N.m 118140 N.m	~~+6dB~~ 4 dB	
3	FMD Mz	59070 N.m	+ 6 dB	
4	626 Z	4g	+6dB	3 - 150 Hz
5	386X	16.5 3.0 6.0	+ 6 dB	3-60Hz 60-85Hz 85-150Hz
6	384Y	16.5 3.0 6.0	+ 6 dB	3-60Hz 60-85Hz 85-150Hz
7	324Y	7.5	+ 6 dB	
8	PACRYO106Z	2.65	+ 6 dB	
9	PAHSSP002Z	6.5	+ 6 dB	
10	PACRYO108Z	2.65	+ 6 dB	
11	PASA-S008P	18.6	+ 6 dB	
12	PASVTS002X	20	+ 6 dB	
14	PATMSF002Z	3	+ 6 dB	
15	386Y	16.5 3.0 6.0	+ 6 dB	dito 3-60Hz 60-85Hz 85-150Hz
16	PATMSF001Y	3	+ 6 dB	
17	PALOUR002Z	7.5	+ 6 dB	
18	PATEL001Y	1.4	+ 9 dB	3 ← 20 Hz

Signature

AAS F test director	ASED Test Conductor	AAS I	ESA-ESTEC	ETS

extension at freq. range applicable for the control N°2 at

ETST012

1/02/06

Test Input Sheet

Sheet 1 of 2

Test file

Project: HERSCHEL STM		Test No: 9131
Run Name: ~~low level Z~~ Control low level Z	Run ID: ~~HFI~~	Date: ~~30/01/06~~ 01/02/06

Control low level Z (2sd run) 01/02/06 15h3

Input Spectrum

FREQUENCY RANGE	INPUT LEVEL	ABORT LEVEL	REMARK Sweep rate / Duration
3 ② 20 Hz	0.06 g	+ 9 dB	2 octaves / mn
11 100 Hz	0.1 g	+ 9 dB	2 octaves / mn
100 - 150 Hz	0.05g	+ 9dB	2 octaves / mn
~~15.4 - 17 Hz~~	~~0.06g~~	~~+ 10 dB~~	"
15.4 - 17Hz	0.06g	+ 10dB	"

Signature

AAS F test director	ASED Test Conductor	AAS I	ESA-ESTEC	ETS

extension of freq. range: Applicable for Z control low level (2sd run)

				A. Ferrero 1/02/06

Annex 1.2: Sine-Vibration Qualification Level Run Sheets

FINAL INPUT 16 45 4

Sheet 2 of 2

Project: HERSCHEL STM		Test No: 9131
Run Name: Qualification level run X	Run ID: QLAX1_1	Date:19/01/06

Notching Channels

VIBCO CHANNEL	MP	NOTCH LEVEL	ABORT LEVEL	REMARK
		[g]	[g] [dB]	Please select unit as required
1	FMD Fx	253330 N	+ 6 dB	
3	FMD My	196900 N.m	+ 6 dB	
4	211X	35	+ 6 dB	
5	362X	7.8	+ 6 dB	
6	341OOP	15	+ 6 dB	
7	386Y	33 5.2 12	+ 6 dB	4-60Hz 60-85Hz 85-100Hz
8	384X	33 5.5 4.5 12	+ 6 dB	4-60Hz 60-74Hz 74-85Hz 85-100Hz
9	114X	25	+ 6 dB	
10	PACRYO107X	14 8	+ 6 dB	4-46Hz 46-100Hz
11	PACRYO106Z	~~4~~ 4.2 4	+ 6 dB	4-52Hz 52-100Hz
12	PACRYO101X	14 8	+ 6 dB	4-46Hz 46-100Hz
13	PASVTS002X	100	+ 6 dB	
14	PATMSF001Y	8	+ 6 dB	50 – 100 Hz
15	PASA-S003P	24	+ 9 dB	
16	PASSDS011L	28	+ 9 dB	
2	921 Y	22	+ 6 dB	50 – 100 Hz

Signature

AAS F test director	ASED Test Conductor	AAS I	ESA-ESTEC	ETS

Test Input Sheet

Sheet 1 of 2

Project: HERSCHEL STM		Test No: 9131
Run Name: qualification level run-X'	Run ID: QLAX1_1	Date: 19/01/06

Input Spectrum

FREQUENCY RANGE	INPUT LEVEL (g)	ABORT LEVEL	REMARK Sweep rate / Duration
5 – 38 Hz	1.25	+ 6 dB	2 octaves / mn
39 – 44 Hz	0.74	+ 6 dB	
45 – 59 Hz	1	+ 6 dB	
60 – 68 Hz	0.68	+ 6 dB	
69 – 77 Hz	0.56	+ 6 dB	
78 – 100 Hz	1.04	+ 6 dB	
4 – 5 Hz	12.4 mm	+6dB	(25 mm p-p)

Signature

AAS F test director	ASED Test Conductor	AAS I	ESA-ESTEC	ETS

esa

ESA-ESTEC Test Centre Operated by ETS

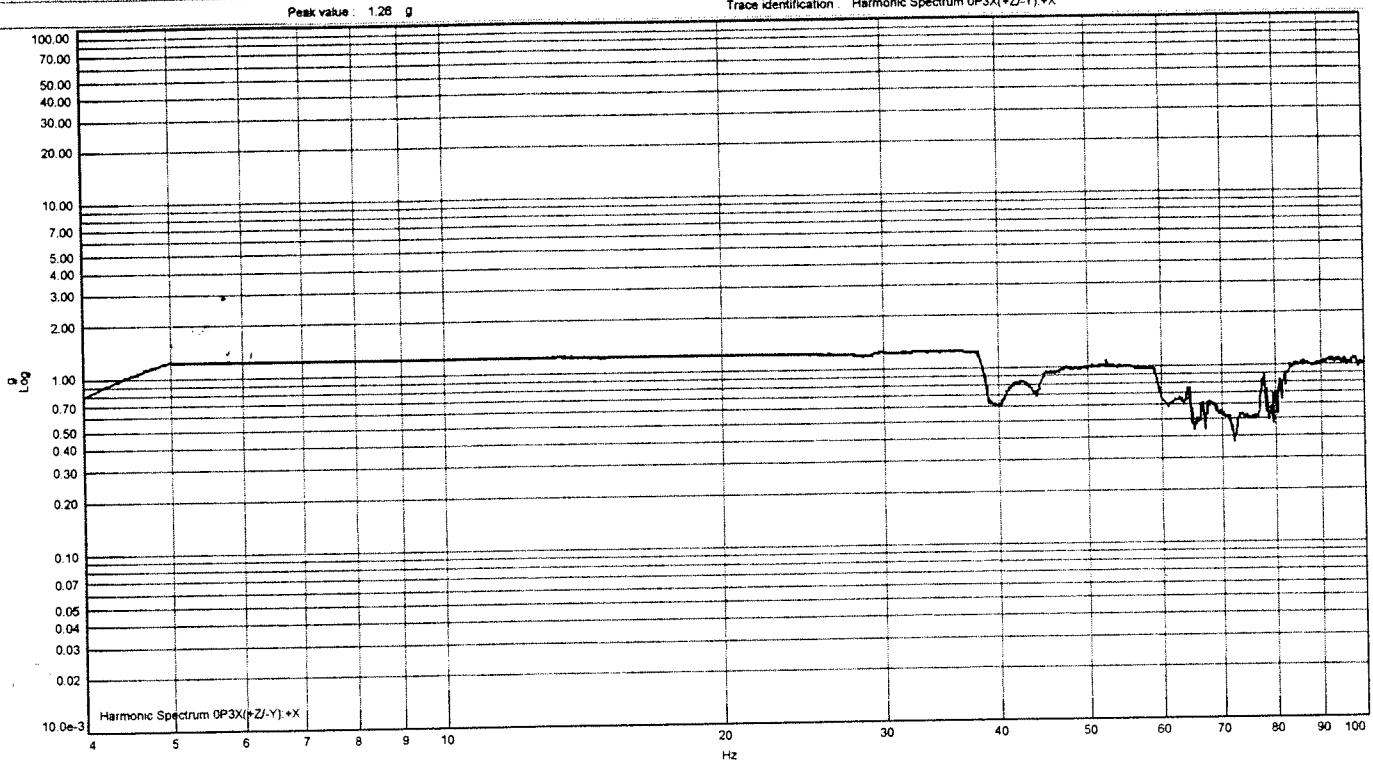
Project : HerschelSine_1
Section : QLAX1_1
Run : SineRed_1

Date : Thu Jan 19 2006
Time : 11:16:42

ets european test services

Peak value : 1.26 g

Trace identification : Harmonic Spectrum 0P3X(+Z/-Y)+X



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

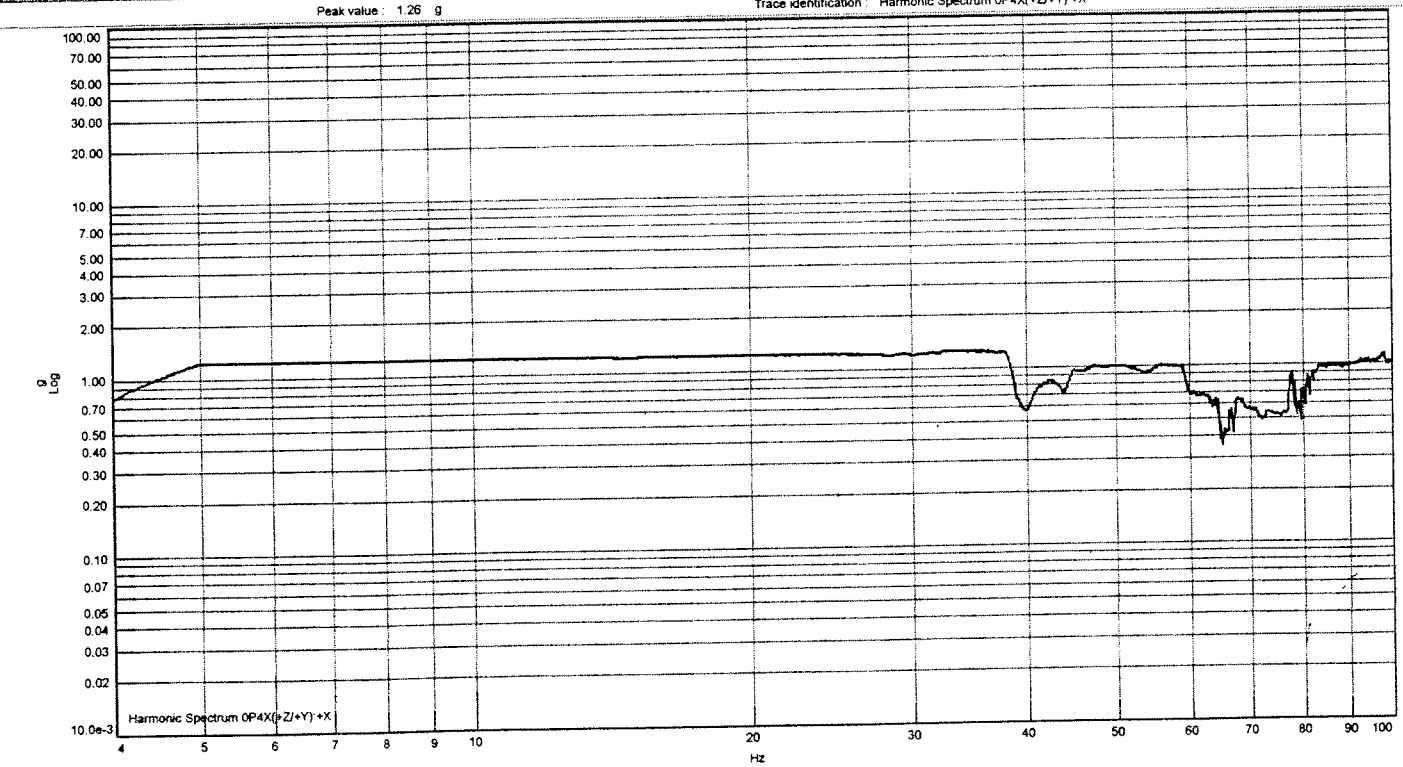
Project : HerschelSine_1
Section : QLAX1_1
Run : SineRed_1

Date : Thu Jan 19 2006
Time : 11:16:42

ets european test services

Peak value : 1.26 g

Trace identification : Harmonic Spectrum 0P4X(+Z/+Y)+X



Memo

Sheet 2 of 2

Project: HERSCHEL STM		Test No: 9131
Run Name: Qual level Y	Run ID: QLY1	Date: 6/02/06

! 3 new channels

VIBCO CHANNEL	MP	NOTCH LEVEL	ABORT LEVEL	REMARK
		[g]	[g] [dB]	Please select unit as required
2	FMD Mz	175 800 Nm	+ 3 dB + 4 dB + 3 dB	5 –18 Hz 18.1 ~~18~~ – 21 Hz 21.1 ~~21~~ - 100 Hz
3	324Y	15 g	+ 4 dB	
4	332Y	16 g	+ 4 dB	
5	362Y	15 g	+ 4 dB	
7	384X	33 g 5.4 g 12.0 g	+ 4 dB	5-55Hz 60-85Hz 90-100Hz
8	384Y	33 g 4.5 g 5.7 g 12.0 g	+ 5 dB	5-57Hz 62-66.7Hz 67.7 – 85 Hz 90-100Hz
9	386X	33 g 6.0 g 12.0 g	+ 6 dB	5-55Hz 60-85Hz 90-100Hz
10	423 oop	7.4 g	+ 4 dB	
12	PATELD001Y	5.5 g 5.5g 14.0g	+ 4 dB + 6 dB + 6 dB	~~5-18 Hz~~ 18.1 ~~18~~ – 21 Hz 21.1 ~~21~~ 100 Hz
14	PAHSSP001Y	8g	+ 6 dB	5-20Hz
16	PACRYO202Y	6 g 5.3 g	+ 6 dB	5-35Hz 36-100Hz
17	PACRYO109Y	5.9 g 5.3 g	+ 4 dB	5-35Hz 36-100Hz
18	PACRYO105Y	5.4 g 5.3 g	+ 6 dB	5-35Hz 36-100Hz
20	PALOUR002Z	15 g	+ 6 dB	40-100Hz
21	! PASA-S005L	37 g	+ 6 dB	5-100Hz
~~15~~	! PASA-S003L	20g	+ 6 dB	50 – 100 Hz
6	386Y	33 g 4.8 g 6 g 12.0 g	+ 5 dB	5-57Hz 62-66.7Hz 67.7 – 85 Hz 90-100Hz

22	381X	33 g 6.0 g 12.0 g	+ 6 dB	5-55Hz 60-85Hz 90-100Hz
11	! 372Y	16 g	+ 6 dB	

Signature

AAS F test director	ASED Test Conductor	AAS I	ESA-ESTEC	ETS

06 FEB. 2006

esa

Project : 9131-HERSCHEL-STM-Y

Section : QLY*

Run : Sine_t

Date : Tue Feb 07 2006

Time : 13:12:03

Mode : Sine Control

ets european test services

Sweeprate : 2 Oct/min

Sweep mode : Log

Startup frequency : 5 Hz

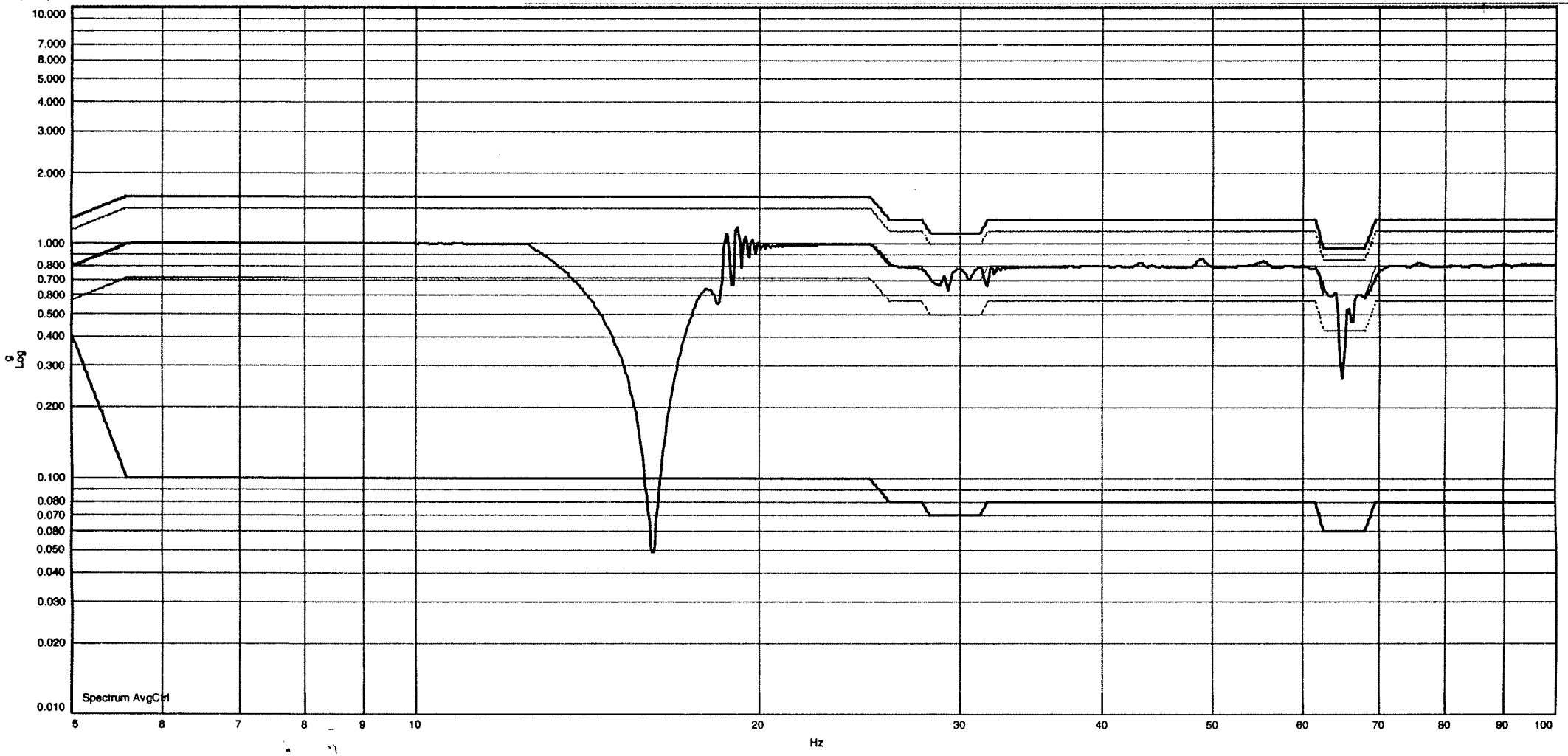
Sweeps done : 1

Frequency resolution : 250 lines/Oct

Control Strategy : Maximum

Nbr of control channels : 4

Trace identification : Spectrum AvgCtrl



Memo

HERSCHEL S/C STM QUALIFICATION LEVEL SINE Y-AXIS

TESTDATE/TIME: Mon Feb 06 11:41:26 2006

QLY1

Ø Customer

on Feb 06 11:41:26 2006

Test.lab Sine vibration control - Project : 9131-HERSCHEL-STM-Y - Section : QLY1 - Run : Sine_1

Normal end

Last sweep number	: 1
Sweep direction	: Up
SweepMode	: Logarithmic
Last sweep rate	: 2.00 Oct/min
Last frequency	: 100.00 Hz
Compression	: 8.00
Total test time	: [00:02:26] [h:min:sec]

Channel	Type	Action	Point Name	Frequency
Input19	Control		0P3Y(+Z/-Y):-Y	5.00 - 5.00
Input1	Control	CHANGE OF CONTROL CHANNEL	0P2Y(-Z/-Y):+Y	5.00 - 12.53
Input2	Measure	CHANGE OF CONTROL CHANNEL	Sum-MZ:+RZ	12.53 - 12.56
		COMP. DOWN (new compression: 4.00)		12.56 - 18.55
Input1	Control	CHANGE OF CONTROL CHANNEL	0P2Y(-Z/-Y):+Y	18.55 - 18.59
		COMP. UP (new compression: 8.00)		18.59 - 18.62
Input2	Measure	CHANGE OF CONTROL CHANNEL	Sum-MZ:+RZ	18.62 - 18.66
		COMP. DOWN (new compression: 4.00)		18.66 - 18.89
Input1	Control	CHANGE OF CONTROL CHANNEL	0P2Y(-Z/-Y):+Y	18.89 - 18.93
		COMP. UP (new compression: 8.00)		18.93 - 24.09
Input19	Control	CHANGE OF CONTROL CHANNEL	0P3Y(+Z/-Y):-Y	24.09 - 25.25
Input1	Control	CHANGE OF CONTROL CHANNEL	0P2Y(-Z/-Y):+Y	25.25 - 29.01
Input17	Measure	CHANGE OF CONTROL CHANNEL	PACRYO109Y:+Y	29.01 - 29.06
		COMP. DOWN (new compression: 4.00)		29.06 - 29.41
Input1	Control	CHANGE OF CONTROL CHANNEL	0P2Y(-Z/-Y):+Y	29.41 - 29.45
		COMP. UP (new compression: 8.00)		29.45 - 30.81
Input19	Control	CHANGE OF CONTROL CHANNEL	0P3Y(+Z/-Y):-Y	30.81 - 30.90
Input1	Control	CHANGE OF CONTROL CHANNEL	0P2Y(-Z/-Y):+Y	30.90 - 30.94
Input19	Control	CHANGE OF CONTROL CHANNEL	0P3Y(+Z/-Y):-Y	30.94 - 31.58
Input1	Control	CHANGE OF CONTROL CHANNEL	0P2Y(-Z/-Y):+Y	31.58 - 42.90
Input19	Control	CHANGE OF CONTROL CHANNEL	0P3Y(+Z/-Y):-Y	42.90 - 43.61
Input1	Control	CHANGE OF CONTROL CHANNEL	0P2Y(-Z/-Y):+Y	43.61 - 46.75
Input19	Control	CHANGE OF CONTROL CHANNEL	0P3Y(+Z/-Y):-Y	46.75 - 46.81
Input1	Control	CHANGE OF CONTROL CHANNEL	0P2Y(-Z/-Y):+Y	46.81 - 46.92
Input19	Control	CHANGE OF CONTROL CHANNEL	0P3Y(+Z/-Y):-Y	46.92 - 47.96
Input1	Control	CHANGE OF CONTROL CHANNEL	0P2Y(-Z/-Y):+Y	47.96 - 64.00
Input7	Measure	CHANGE OF CONTROL CHANNEL	384 X:+X	64.00 - 64.07
Input8	Measure	CHANGE OF CONTROL CHANNEL	384 Y:-Y	64.07 - 64.07
		COMP. DOWN (new compression: 4.00)		64.07 - 64.20
Input6	Measure	CHANGE OF CONTROL CHANNEL	386 Y:-Y	64.20 - 64.34
Input8	Measure	CHANGE OF CONTROL CHANNEL	384 Y:-Y	64.34 - 66.54
Input19	Control	CHANGE OF CONTROL CHANNEL	0P3Y(+Z/-Y):-Y	66.54 - 66.61
		COMP. UP (new compression: 8.00)		66.61 - 68.08
Input1	Control	CHANGE OF CONTROL CHANNEL	0P2Y(-Z/-Y):+Y	68.08 - 71.80
Input19	Control	CHANGE OF CONTROL CHANNEL	0P3Y(+Z/-Y):-Y	71.80 - 73.12
Input1	Control	CHANGE OF CONTROL CHANNEL	0P2Y(-Z/-Y):+Y	73.12 - 73.20
Input19	Control	CHANGE OF CONTROL CHANNEL	0P3Y(+Z/-Y):-Y	73.20 - 73.28
Input1	Control	CHANGE OF CONTROL CHANNEL	0P2Y(-Z/-Y):+Y	73.28 - 87.39
Input19	Control	CHANGE OF CONTROL CHANNEL	0P3Y(+Z/-Y):-Y	87.39 - 88.66
Input25	Control	CHANGE OF CONTROL CHANNEL	0P4Y(+Z/+Y):-Y	88.66 - 88.75
Input19	Control	CHANGE OF CONTROL CHANNEL	0P3Y(+Z/-Y):-Y	88.75 - 88.83
Input25	Control	CHANGE OF CONTROL CHANNEL	0P4Y(+Z/+Y):-Y	88.83 - 88.92
Input19	Control	CHANGE OF CONTROL CHANNEL	0P3Y(+Z/-Y):-Y	88.92 - 89.08
Input25	Control	CHANGE OF CONTROL CHANNEL	0P4Y(+Z/+Y):-Y	89.08 - 91.75
Input37	Control	CHANGE OF CONTROL CHANNEL	0P1Y(-Z/+Y):+Y	91.75 - 94.47
Input1	Control	CHANGE OF CONTROL CHANNEL	0P2Y(-Z/-Y):+Y	94.47 - 94.56
Input37	Control	CHANGE OF CONTROL CHANNEL	0P1Y(-Z/+Y):+Y	94.56 - 100.00
		NORMAL END		

3Z

Sheet 2 of 2

Project: HERSCHEL STM		Test No:
Name: Qualification run Z	Run ID: QLZ1	Date:31/01/06

Notching Channels

VIBCO CHANNEL	MP	NOTCH LEVEL	ABORT LEVEL	REMARK
		[g]	[g] [dB]	Please select unit as required
2	FMD My	182313N.m	+ 3 dB	
3	PATELD001Z	4.5g	+6dB	5-20 Hz
6	384Y	33g 4.6 5.7g 12g	+ 6 dB	5-60Hz 62-65Hz 67-85 Hz 90-100Hz
15	386Y	33g 6g 12g	+ 6 dB	5-60Hz 63-85Hz 90-100Hz
9	384X	33g 6g 12g	+ 6 dB	5-60Hz 65-85Hz 90-100Hz
18	624Z	8.8g	+ 6 dB	
4	626Z	8.8g	+ 6 dB	
7	324Y	20g 16g 20g	+ 5 dB !	5-~~85~~Hz 83 85-~~90~~Hz 89 91. ~~92~~ -100Hz
20	PAHSSP001Z	11g	+6dB	5-20 Hz
8	PACRYO106Z	5.6g 4.8g	+4dB +6dB	5-35Hz 36 – 100 Hz
10	PACRYO108Z	6g 5.3g	+4dB +6dB	5-35Hz 36 – 100 Hz
11	PASA-S008P	30g	+6dB	
12	PASVTS002X	40g	+6dB	
17	PALOUR002Z	15g	+6dB	
16	PATMSF001Y	6g	+6dB	
14	PATMSF002Z	6g	+6dB	
5	386X	33g 5.5g 12g	+ 4 dB	5-60Hz 62 ~~65~~-85Hz 90-100Hz
22	323oop	11.4g	+ 6 dB	80-100Hz

30	388ip1	7.2g	+ 6 dB	62-80Hz
13 ~~34~~ !	383Y	33g 6g 12g	+ 6 dB	5-60Hz 65-85Hz 90-100Hz
32 !	423oop	7.5g	+6dB	

Signature ! new

AAS F test director	ASED Test Conductor	AAS I	ESA-ESTEC	ETS

01/02/06

esa

ESA-ESTEC Test Centre

ets european test services

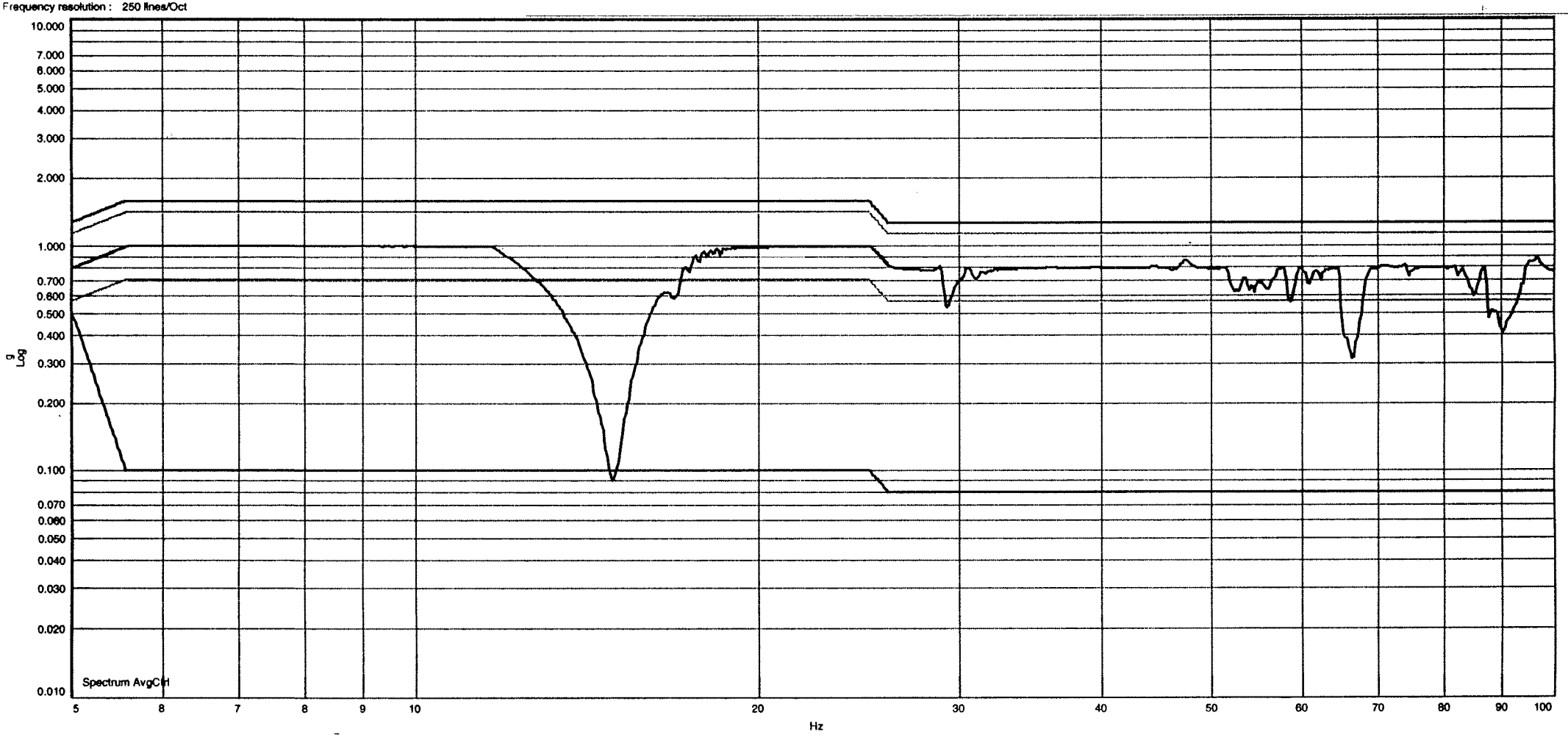
Project : 9131-HERSCHEL-STM-Z
Section : QLZ t
Run : Sine_1

Date : Tue Jan 31 2006
Time : 11:40:27
Mode : Sine Control

Sweeprata : 2 Oct/min
Sweep mode : Log
Startup frequency : 5 Hz
Sweeps done : 1
Frequency resolution : 250 lines/Oct

Control Strategy : Maximum
Nbr of control channels : 4

Trace identification : Spectrum AvgCtrl



Memo

HERSCHEL S/C STM QUALIFICATION LEVEL SINE Z-AXIS

TEST DATE/TIME: Wed Fab 01 10:55:54 2006

ed Feb 01 10:55:54 2006

Test.lab Sine vibration control - Project : 9131-HERSCHEL-STM-Z - Section : QLZ1 -
Run : Sine_1

Normal end

32

Ø Cystomers

Last sweep number	: 1
Sweep direction	: Up
SweepMode	: Logarithmic
Last sweep rate	: 2.00 Oct/min
Last frequency	: 100.00 Hz
Compression	: 8.00
Total test time	: [00:02:27] [h:min:sec]

Channel	Type	Action	Point Name	Frequency
Input25	Control		0P3Z(+Z/-Y):-Z	5.00 - 5.00
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	5.00 - 11.69
Input2	Measure	CHANGE OF CONTROL CHANNEL	Sum-MY:-RY	11.69 - 11.72
		COMP. DOWN (new compression: 4.00)		11.72 - 16.42
Input20	Measure	CHANGE OF CONTROL CHANNEL	PAHSSP001Z:-Z	16.42 - 18.55
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	18.55 - 18.59
		COMP. UP (new compression: 8.00)		18.59 - 24.01
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	24.01 - 26.11
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	26.11 - 27.08
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	27.08 - 28.13
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	28.13 - 28.84
Input8	Measure	CHANGE OF CONTROL CHANNEL	PACRYO106Z:-Z	28.84 - 28.88
		COMP. DOWN (new compression: 4.00)		28.88 - 30.46
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	30.46 - 30.51
		COMP. UP (new compression: 8.00)		30.51 - 30.65
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	30.65 - 41.51
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	41.51 - 41.56
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	41.56 - 42.10
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	42.10 - 42.15
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	42.15 - 42.21
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	42.21 - 42.26
t1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	42.26 - 42.31
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	42.31 - 42.42
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	42.42 - 42.48
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	42.48 - 42.53
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	42.53 - 42.58
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	42.58 - 42.69
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	42.69 - 42.75
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	42.75 - 42.80
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	42.80 - 43.79
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	43.79 - 44.00
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	44.00 - 44.06
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	44.06 - 47.39
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	47.39 - 48.79
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	48.79 - 50.99
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	50.99 - 51.05
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	51.05 - 51.11
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	51.11 - 51.35
Input4	Measure	CHANGE OF CONTROL CHANNEL	626 Z:-Z	51.35 - 51.41
		COMP. DOWN (new compression: 4.00)		51.41 - 57.20
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	57.20 - 57.26
		COMP. UP (new compression: 8.00)		57.26 - 57.76
Input18	Measure	CHANGE OF CONTROL CHANNEL	624 Z:-Z	57.76 - 57.83
		COMP. DOWN (new compression: 4.00)		57.83 - 59.49
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	59.49 - 59.56
		COMP. UP (new compression: 8.00)		59.56 - 59.68
Input37	Control	CHANGE OF CONTROL CHANNEL	0P4Z(+Z/+Y):+Z	59.68 - 59.75
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	59.75 - 60.34
Input18	Measure	CHANGE OF CONTROL CHANNEL	624 Z:-Z	60.34 - 60.40
		COMP. DOWN (new compression: 4.00)		60.40 - 62.44
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	62.44 - 62.51
		COMP. UP (new compression: 8.00)		62.51 - 64.46
Input6	Measure	CHANGE OF CONTROL CHANNEL	384 Y:-Y	64.46 - 64.53
		COMP. DOWN (new compression: 4.00)		64.53 - 68.07
t1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	68.07 - 68.14
		COMP. UP (new compression: 8.00)		68.14 - 73.94
Input5	Measure	CHANGE OF CONTROL CHANNEL	386 X:+X	73.94 - 74.02
		COMP. DOWN (new compression: 4.00)		74.02 - 74.54
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	74.54 - 74.62
		COMP. UP (new compression: 8.00)		74.62 - 81.76
Input5	Measure	CHANGE OF CONTROL CHANNEL	386 X:+X	81.76 - 81.83
		COMP. DOWN (new compression: 4.00)		81.83 - 83.04
Input13	Measure	CHANGE OF CONTROL CHANNEL	383 Y:+Y	83.04 - 86.32
Input1	Control	CHANGE OF CONTROL CHANNEL	0P1Z(-Z/+Y):+Z	86.32 - 86.74
Input16	Measure	CHANGE OF CONTROL CHANNEL	PATMSF001Y:+Y	86.74 - 88.84
Input7	Measure	CHANGE OF CONTROL CHANNEL	324 Y:-Y	88.84 - 93.69
Input32	Measure	CHANGE OF CONTROL CHANNEL	423oop:None	93.69 - 94.39
Input25	Control	CHANGE OF CONTROL CHANNEL	0P3Z(+Z/-Y):-Z	94.39 - 94.49
		COMP. UP (new compression: 8.00)		94.49 - 99.57
Input19	Control	CHANGE OF CONTROL CHANNEL	0P2Z(-Z/-Y):-Z	99.57 - 100.00
		NORMAL END		

Annex 1.3: Sine-Vibration Force Measurement Device IF Forces

esa

ESA-ESTEC Test Centre Operated by ETS

Project HerschelSine_1
Section QLAX1_1
Run SineRed_1

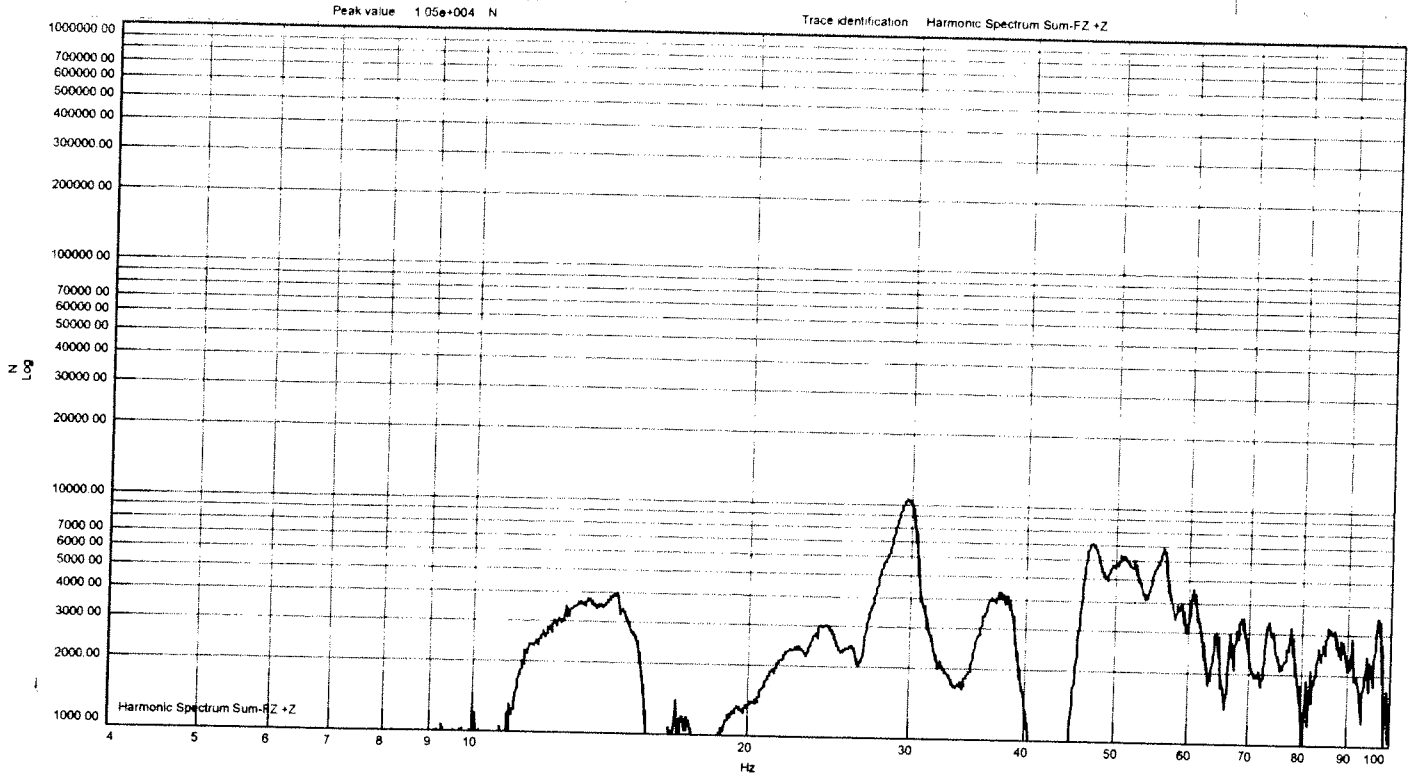
QLAX

Date Thu Jan 19 2006
Time 11 16 42

ets european test services

Peak value 1.05e+004 N

Trace identification Harmonic Spectrum Sum-FZ +Z



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

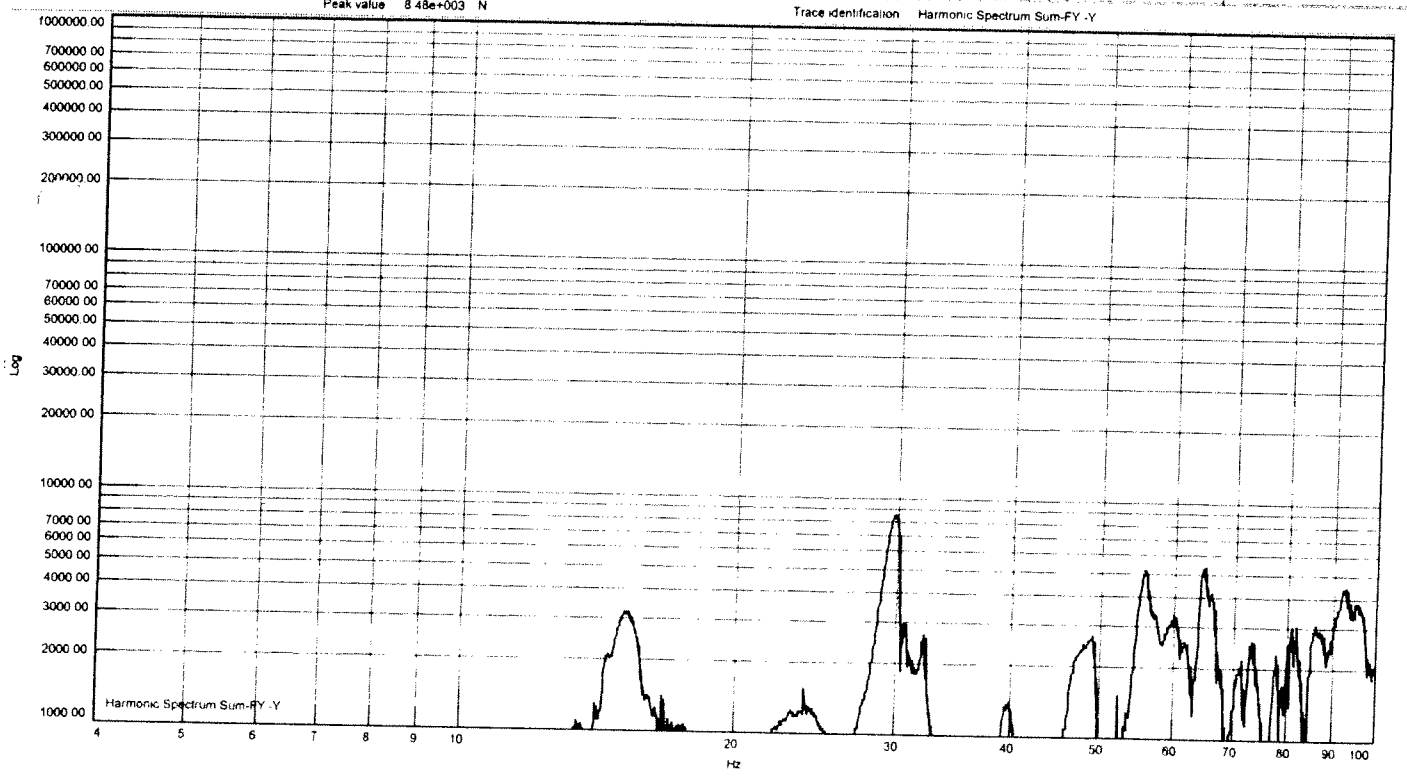
Project HerschelSine_1
Section QLAX1_1
Run SineRed_1

Date Thu Jan 19 2006
Time 11 16 42

ets european test services

Peak value 8.48e+003 N

Trace identification Harmonic Spectrum Sum-FY -Y



emo

esa

ESA-ESTEC Test Centre Operated by ETS

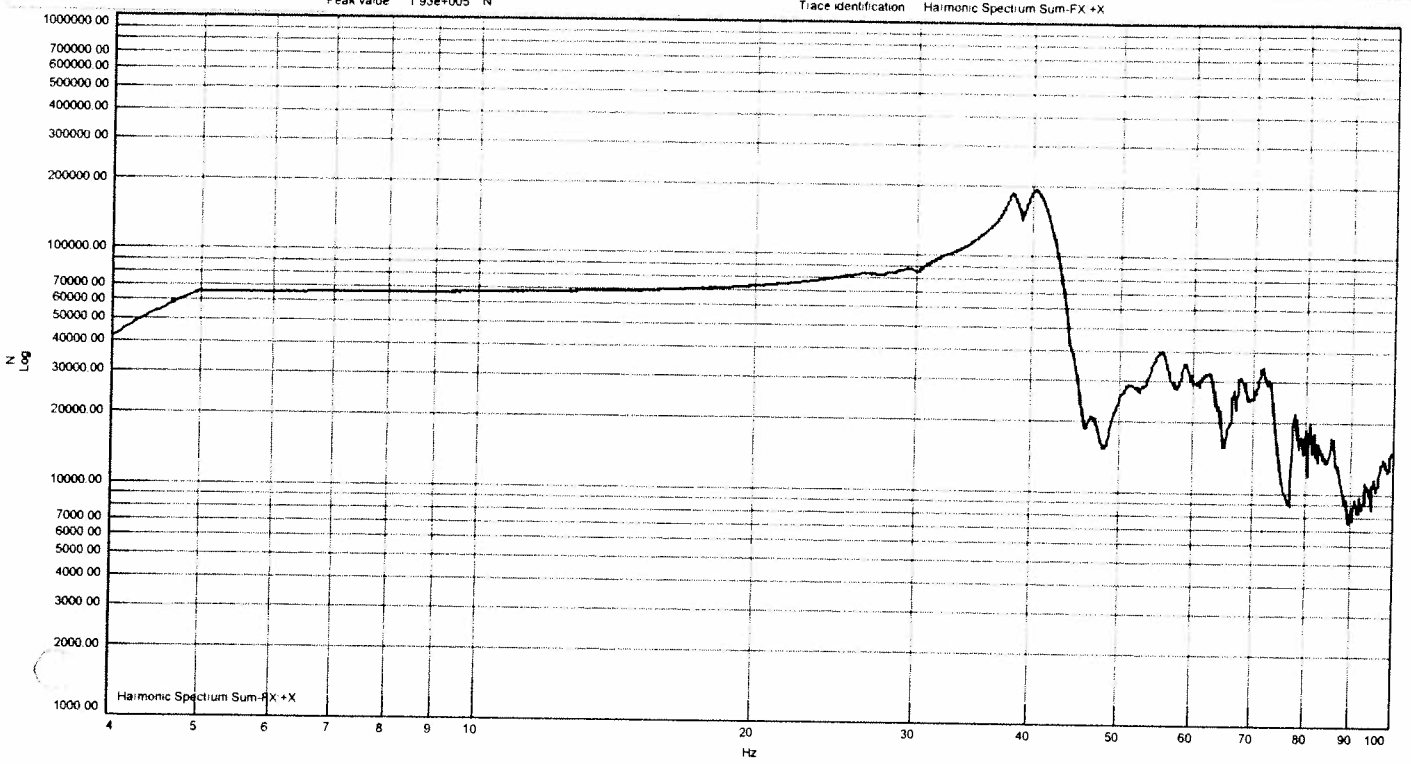
Project HerschelSine_1
Section QLAX1_1
Run SineRed_1

Date Thu Jan 19 2006
Time 11 16 42

ets european test services

Peak value 1.93e+005 N

Trace identification Harmonic Spectrum Sum-FX +X



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

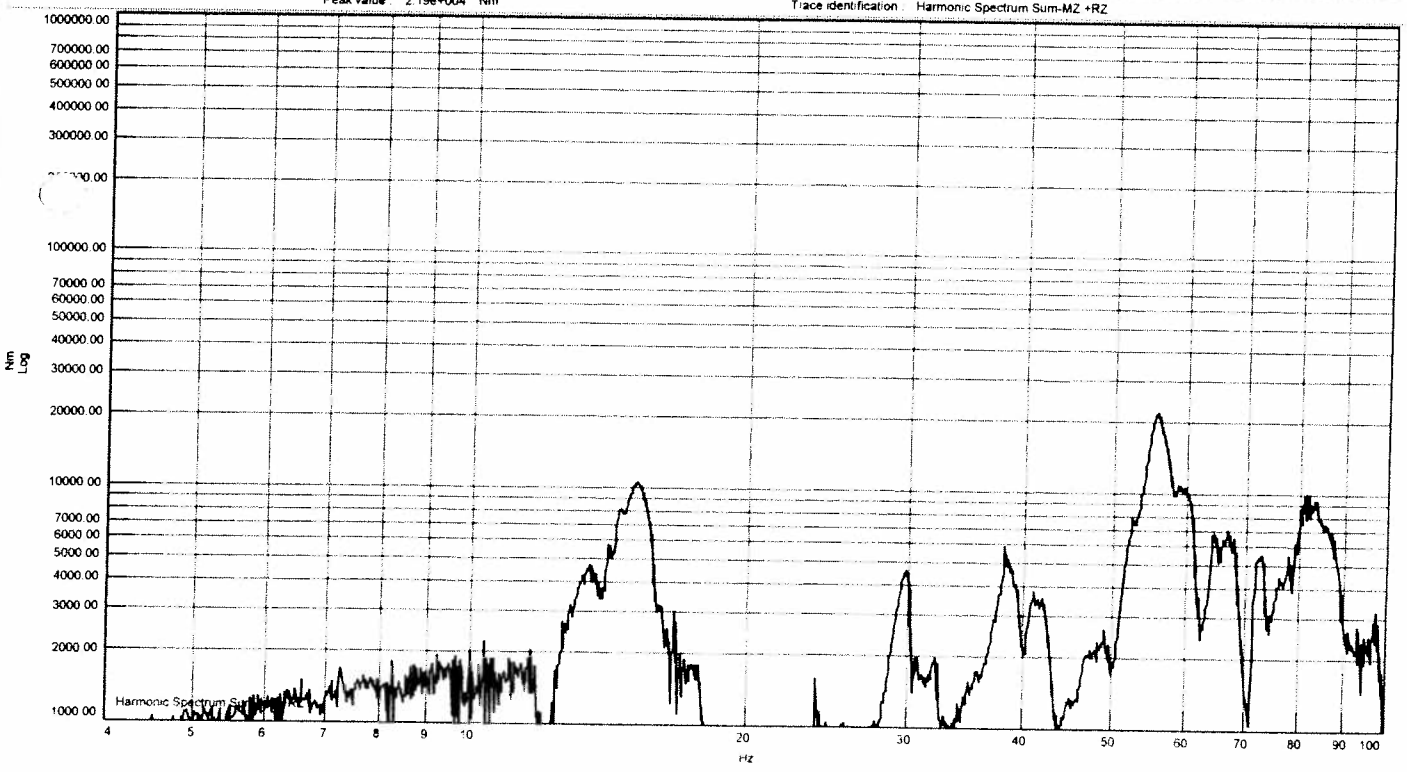
Project HerschelSine_1
Section QLAX1_1
Run SineRed_1

Date Thu Jan 19 2006
Time 11 16 42

ets european test services

Peak value 2.19e+004 Nm

Trace identification Harmonic Spectrum Sum-MZ +RZ



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

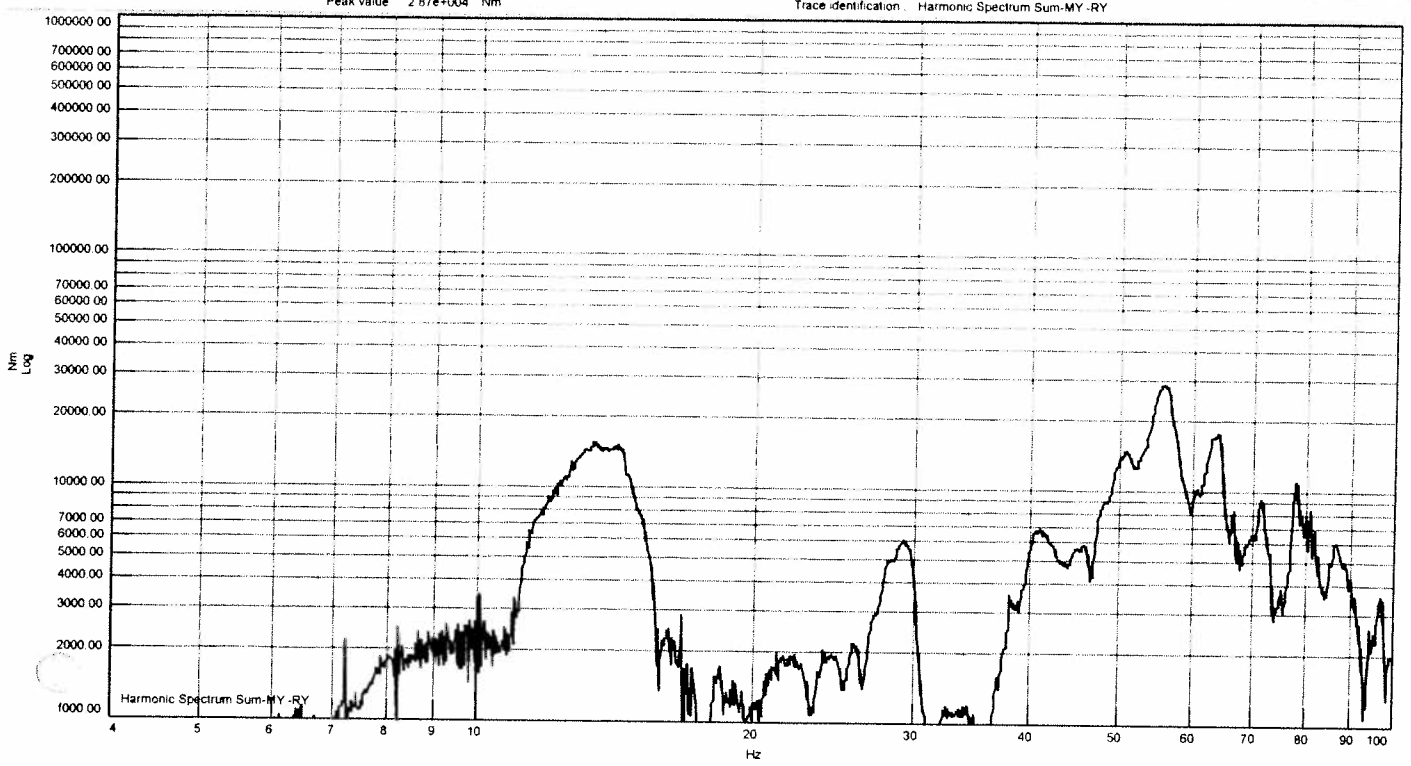
Project HerschelSine_1
Section QLAX1_1
Run SineRed_1

Date Thu Jan 19 2006
Time 11 16 42

ets european test services

Peak value 2.87e+004 Nm

Trace identification Harmonic Spectrum Sum-MY -RY



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

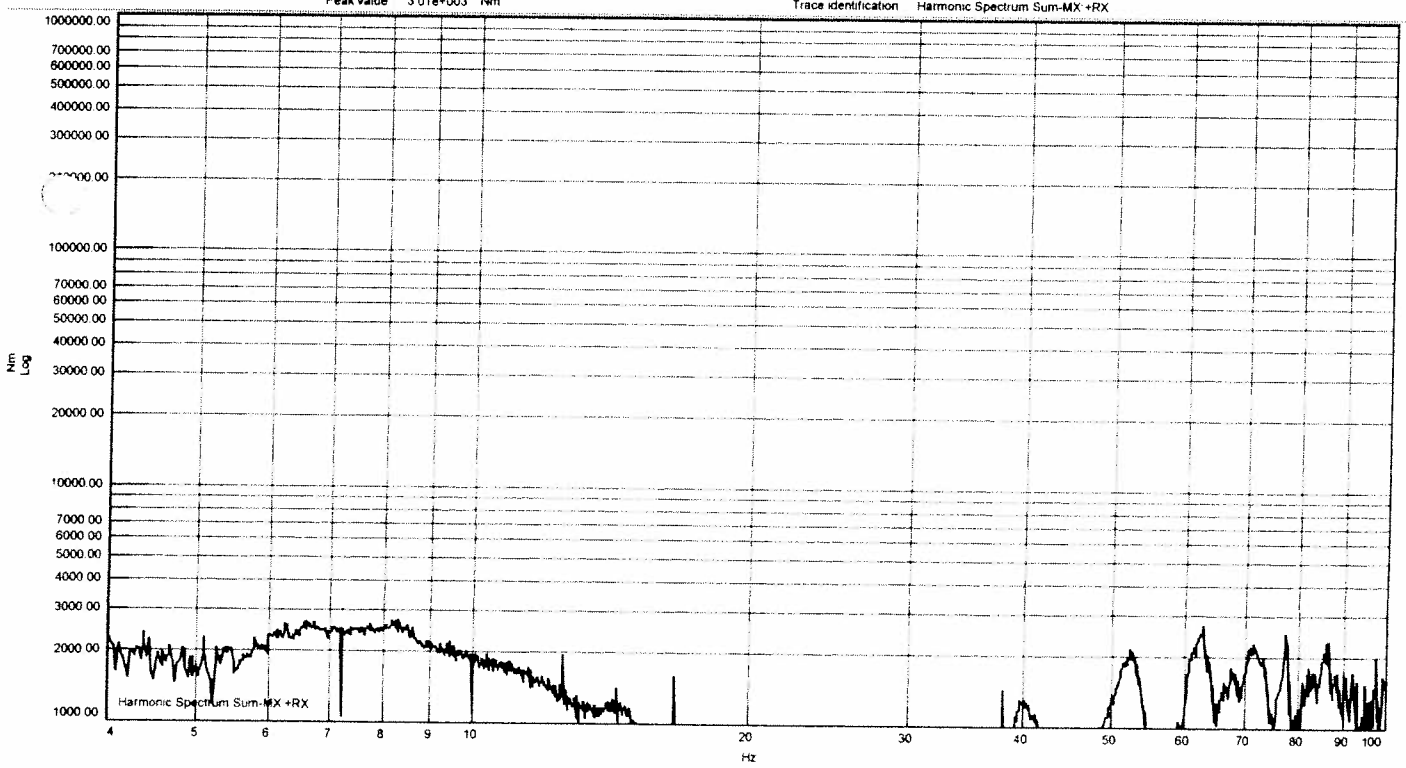
Project HerschelSine_1
Section QLAX1_1
Run SineRed_1

Date Thu Jan 19 2006
Time 11 16 42

ets european test services

Peak value 3.01e+003 Nm

Trace identification Harmonic Spectrum Sum-MX +RX



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

Project : HerschelSine_MSH_db3_1
Section : QLY1
Run : SineRed_2

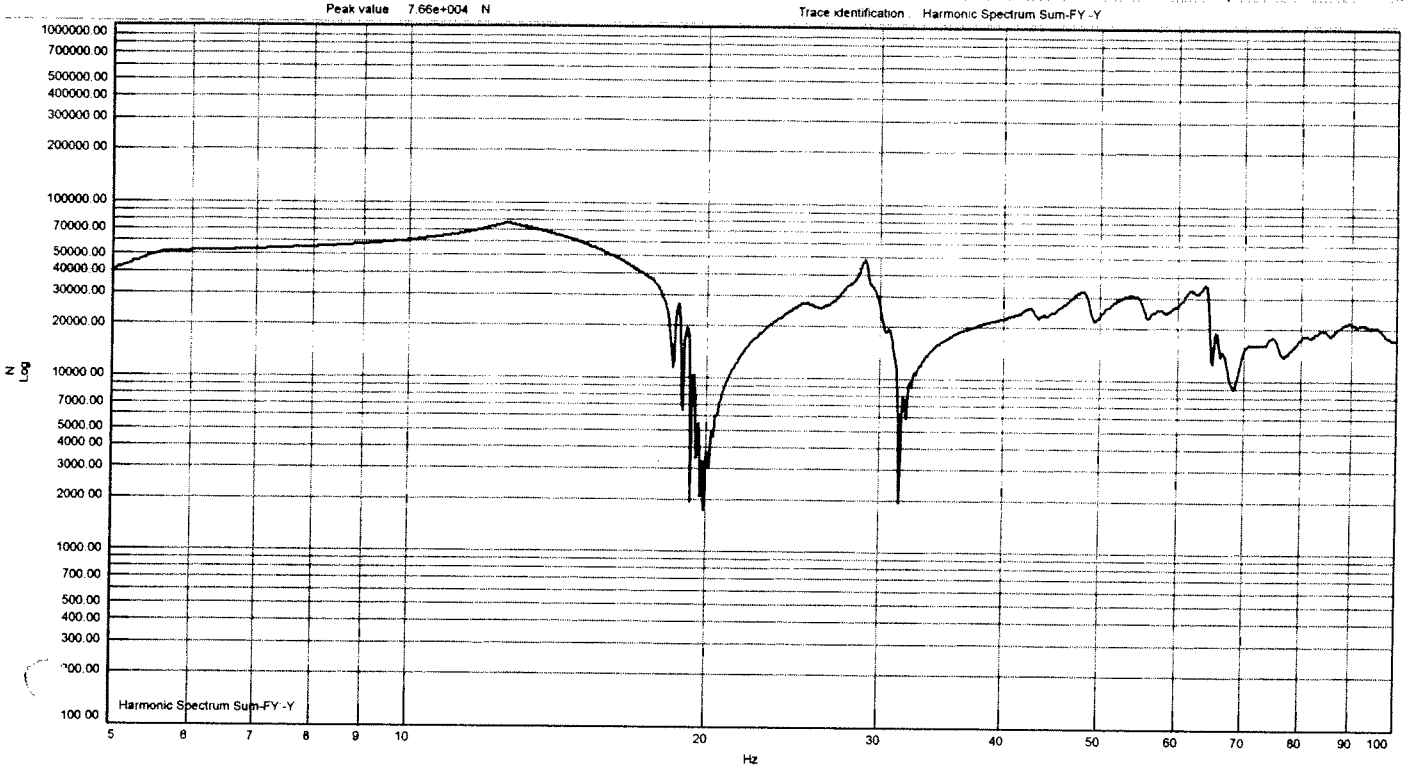
QLY

Date Fri Feb 03 2006
Time 15:31:28

ets european test services

Peak value 7.66e+004 N

Trace identification : Harmonic Spectrum Sum-FY.-Y



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

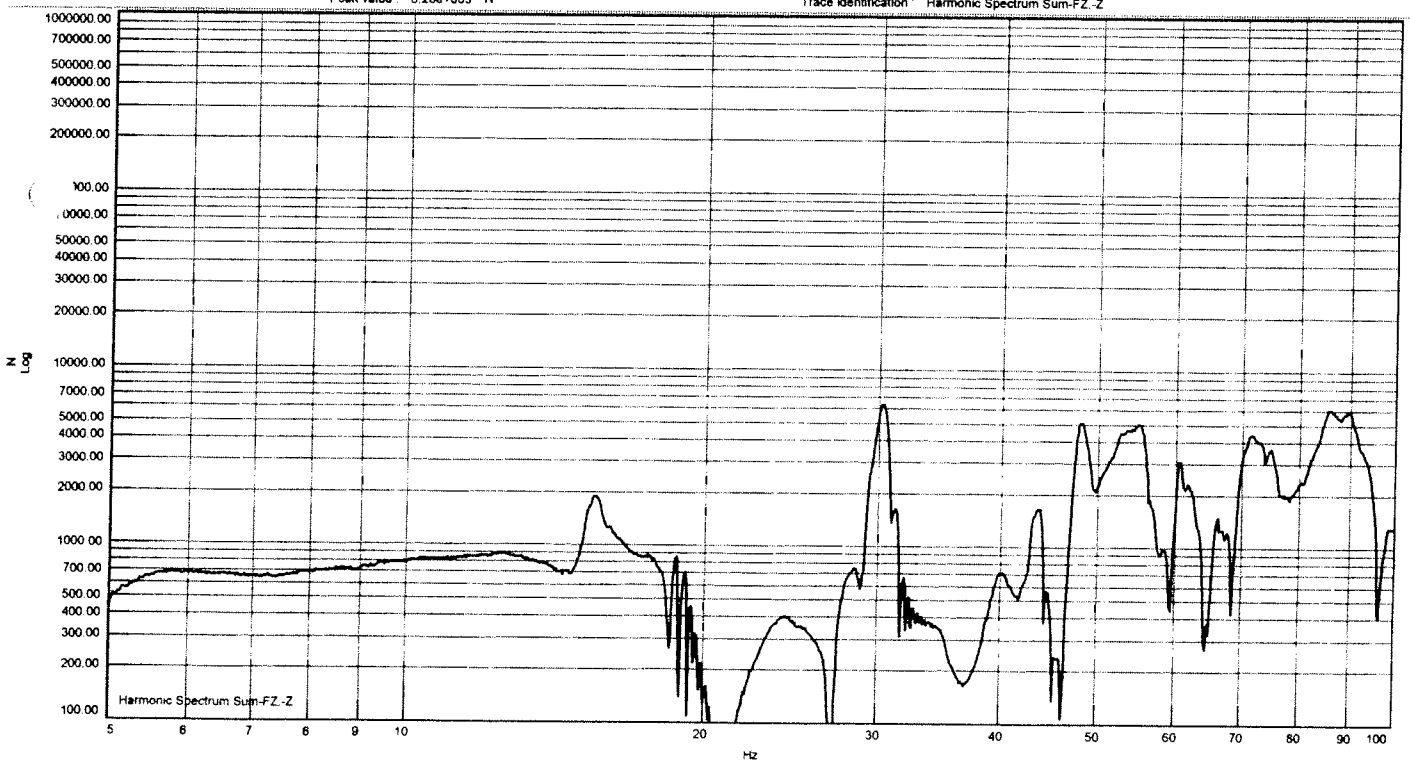
Project : HerschelSine_MSH_db3_1
Section : QLY1
Run : SineRed_2

Date Fri Feb 03 2006
Time 15:31:28

ets european test services

Peak value 6.28e+003 N

Trace identification : Harmonic Spectrum Sum-FZ.-Z



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

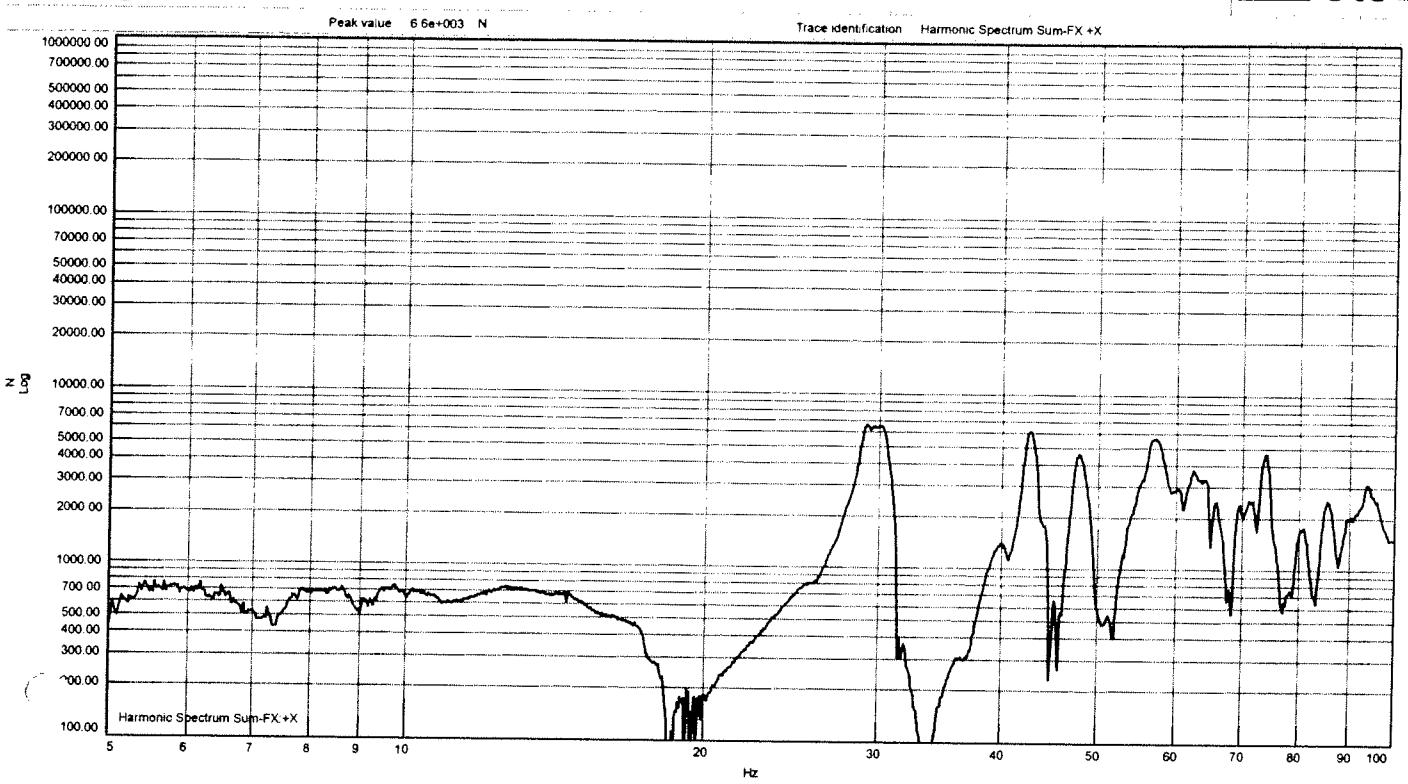
Project HerschelSine_MSH_db3_1
Section QLY1
Run SineRed_2

Date Fri Feb 03 2006
Time 15 31 28

ets european test services

Peak value 6 6e+003 N

Trace identification Harmonic Spectrum Sum-FX +X



Memo

esa

ESA-ESTEC Test Centre Opereted by ETS

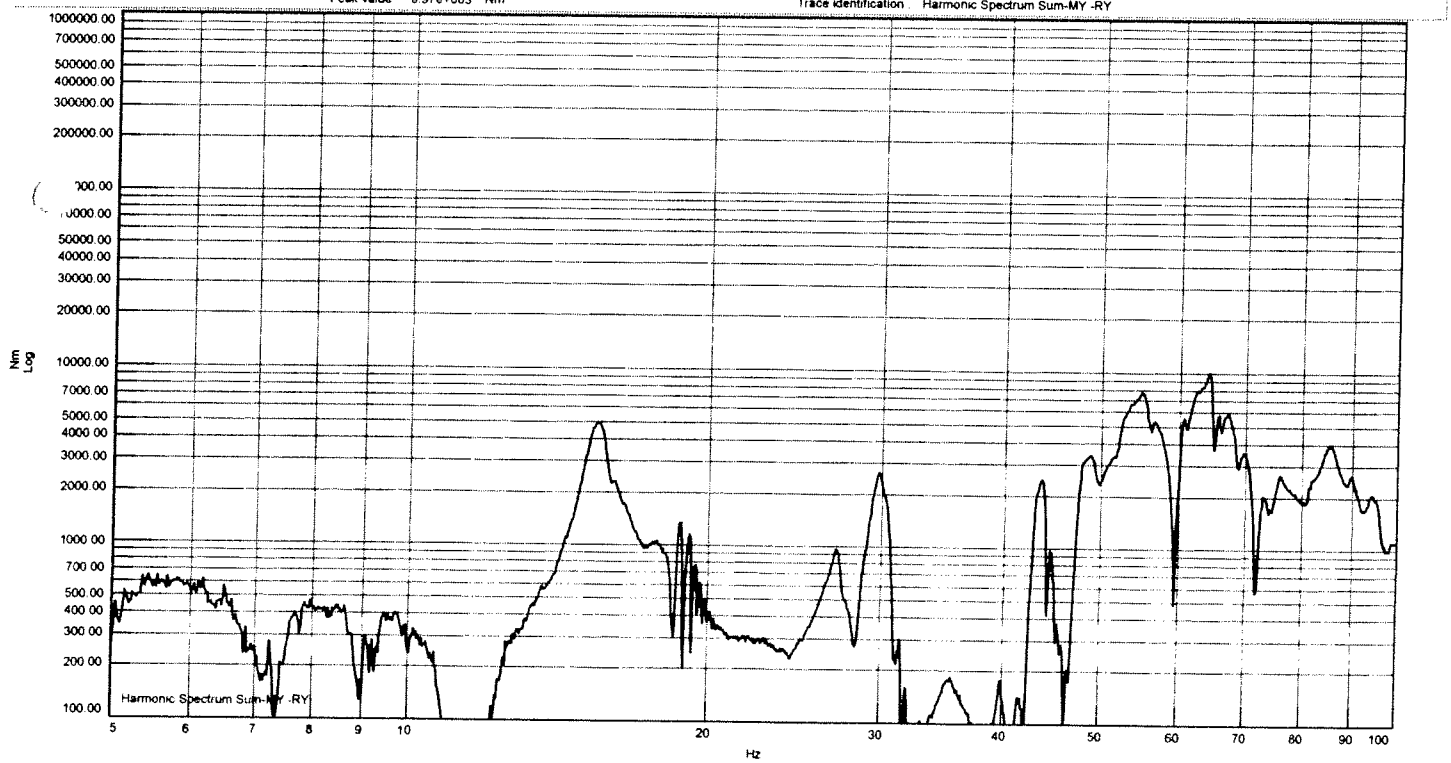
Project : HerschelSine_MSH_db3_1
Section : QLY1
Run : SineRed_2

Date Fri Feb 03 2006
Time 15:31:28

ets european test services

Peak value 9.97e+003 Nm

Trace identification Harmonic Spectrum Sum-MY -RY



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

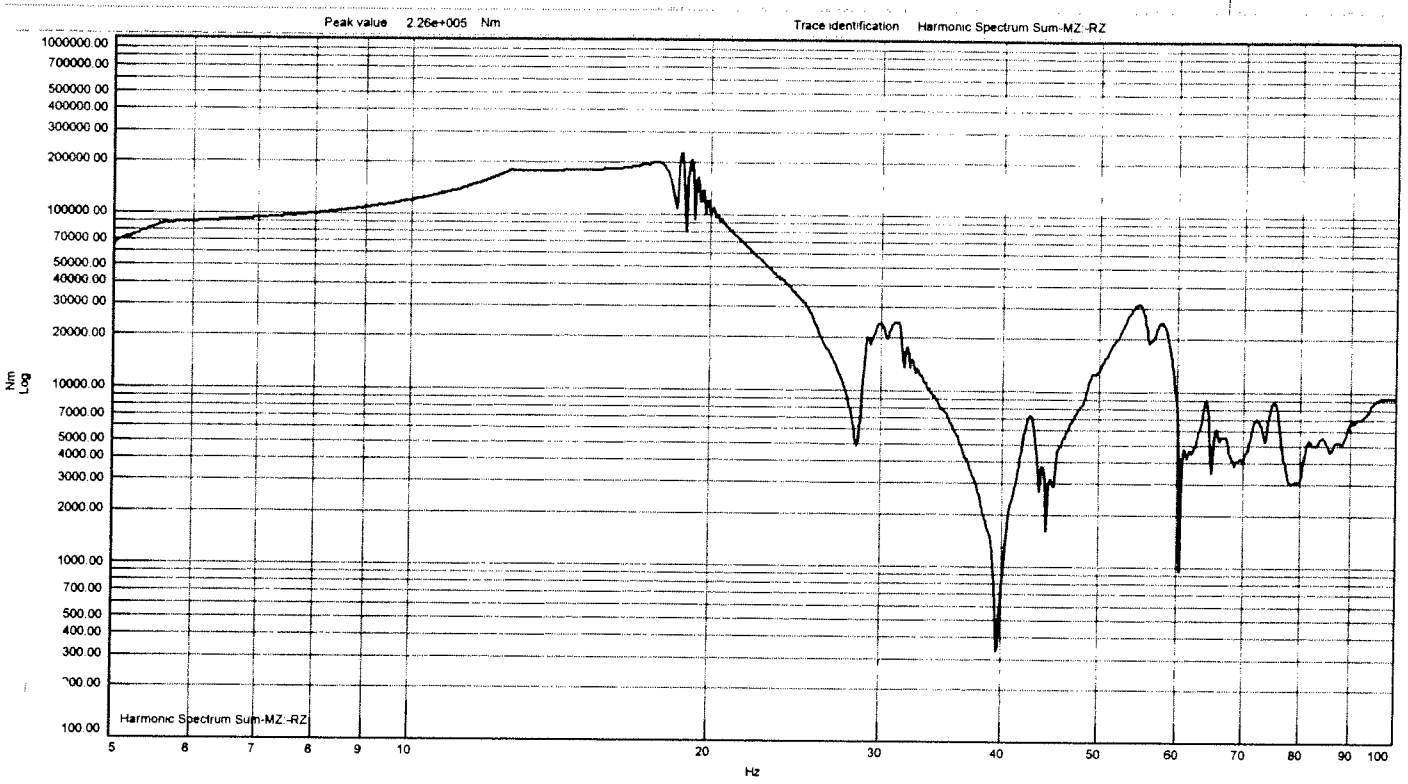
Project HerschelSine_MSH_db3_1
Section QLY1
Run SineRed_2

Date Fri Feb 03 2006
Time 15:31:28

ets european test services

Peak value 2.26e+005 Nm

Trace identification Harmonic Spectrum Sum-MZ-RZ



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

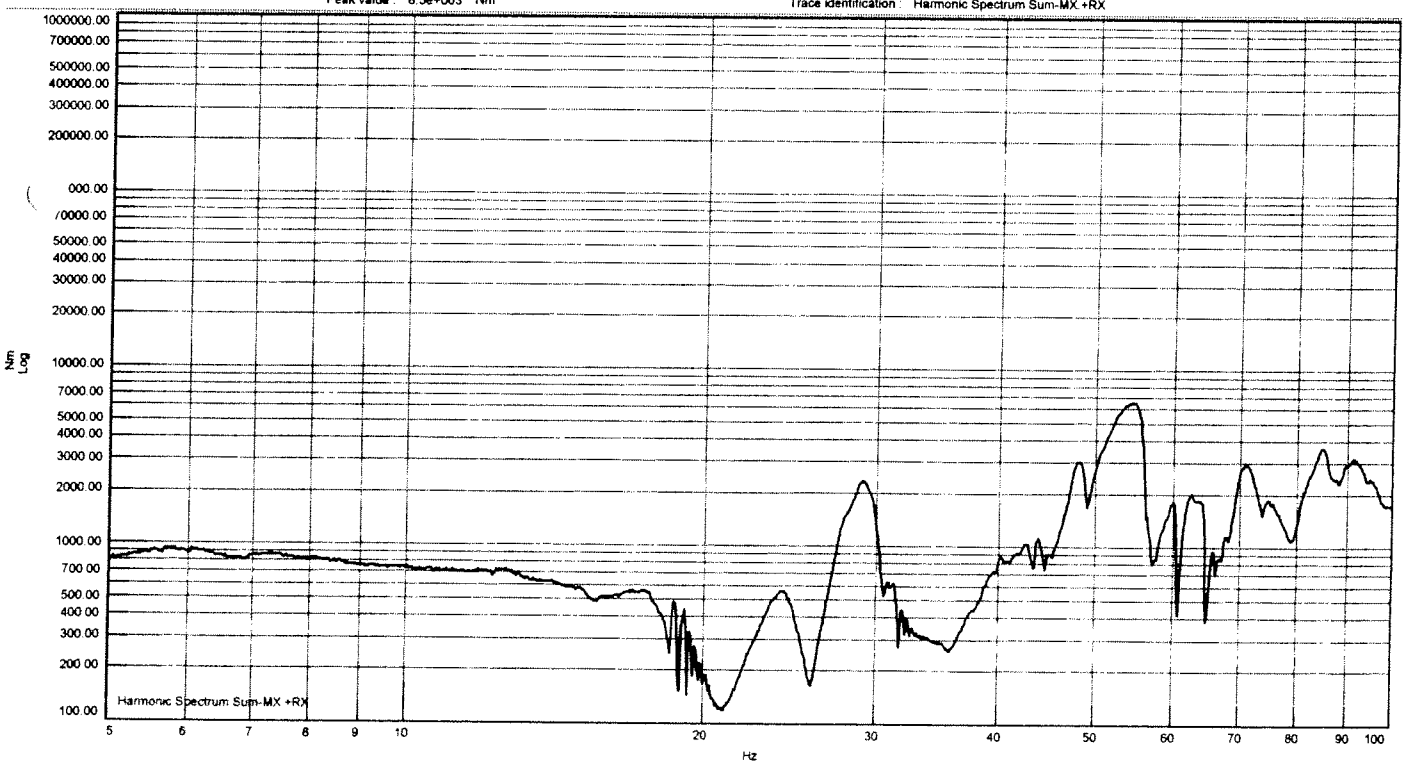
Project HerschelSine_MSH_db3_1
Section QLY1
Run SineRed_2

Date Fri Feb 03 2006
Time 15:31:28

ets european test services

Peak value 6.5e+003 Nm

Trace identification Harmonic Spectrum Sum-MX+RX



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

Project HerschelSine_MSH_1
Section QLZ1
Run SineRed_2

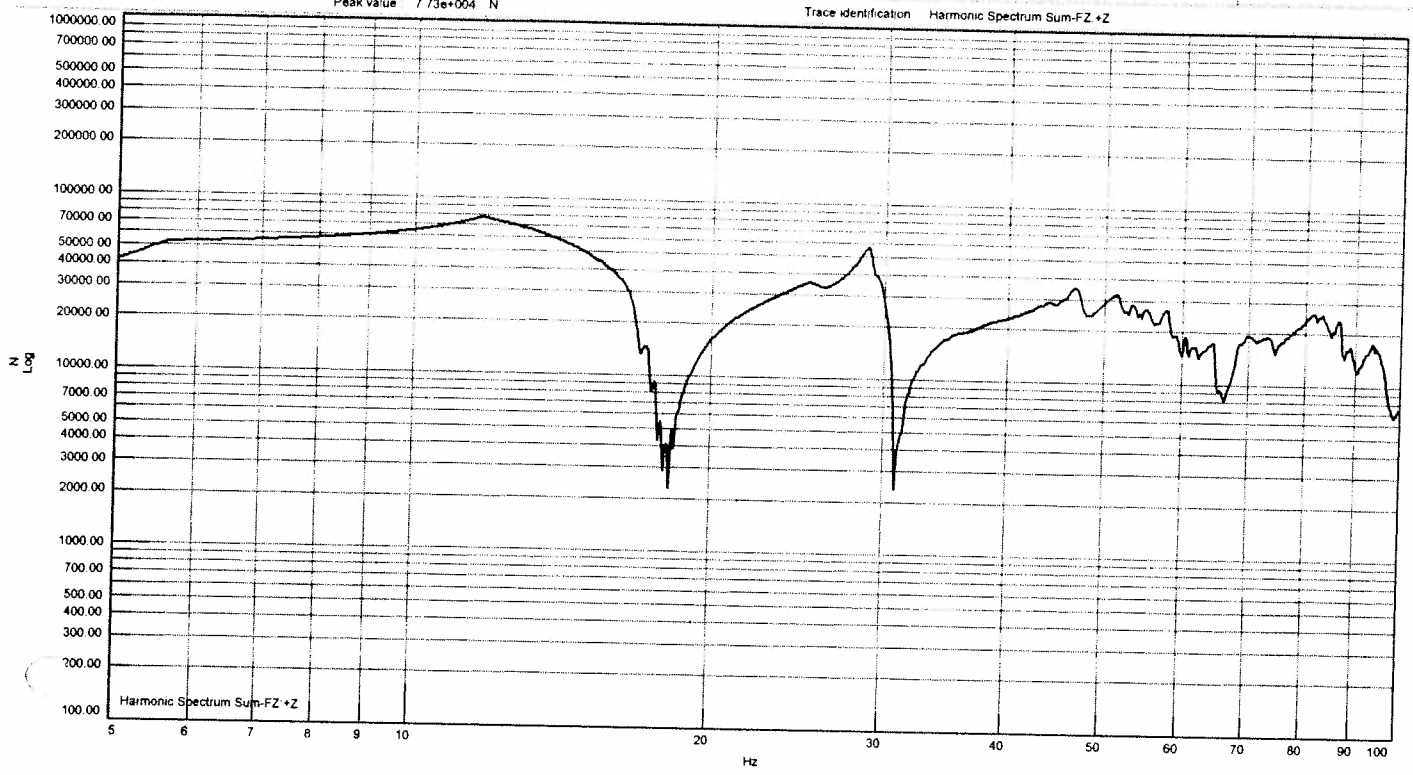
QLZ

Date Wed Feb 01 2006
Time 08.39.25

ets european test services

Peak value 7.73e+004 N

Trace identification Harmonic Spectrum Sum-FZ +Z



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

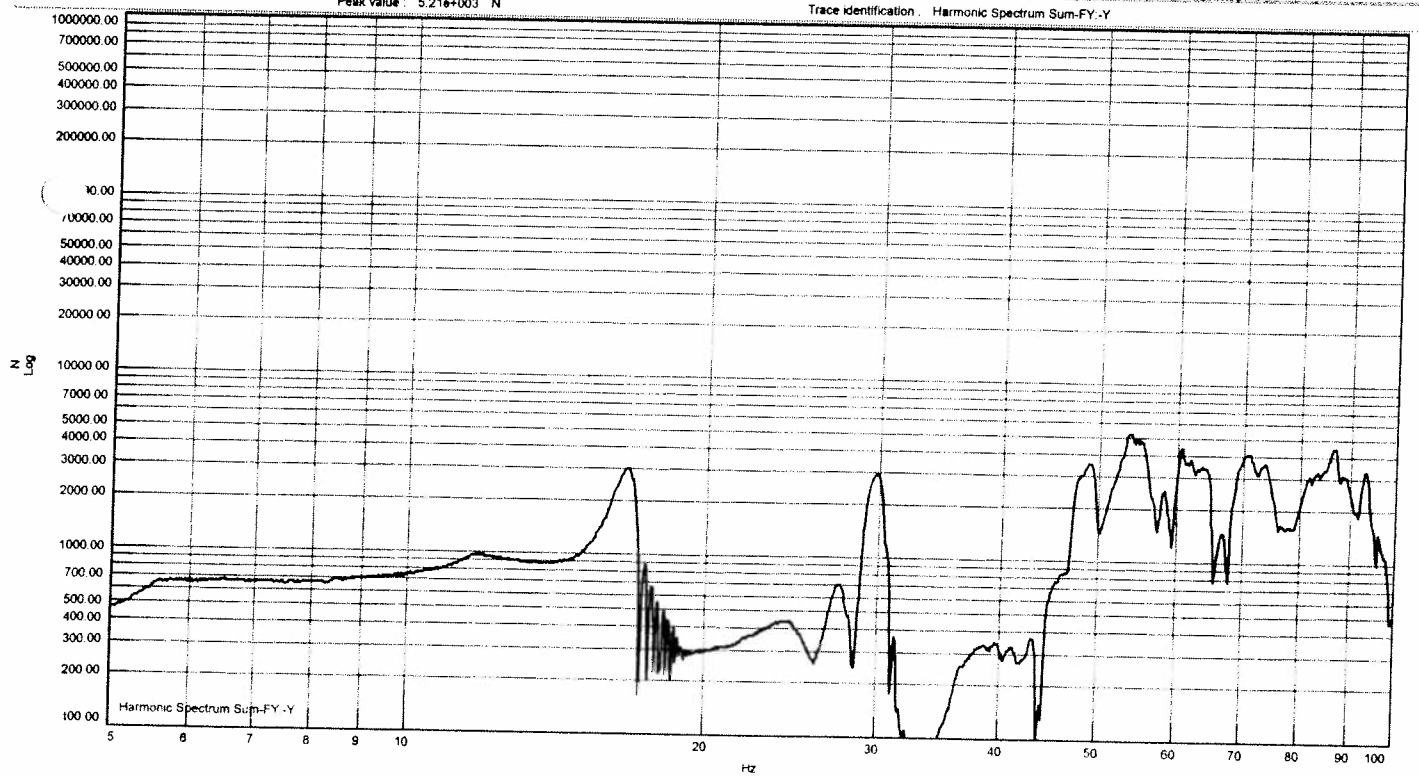
Project HerschelSine_MSH_1
Section QLZ1
Run SineRed_2

Date Wed Feb 01 2006
Time 08.39.25

ets european test services

Peak value 5.21e+003 N

Trace identification Harmonic Spectrum Sum-FY -Y



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

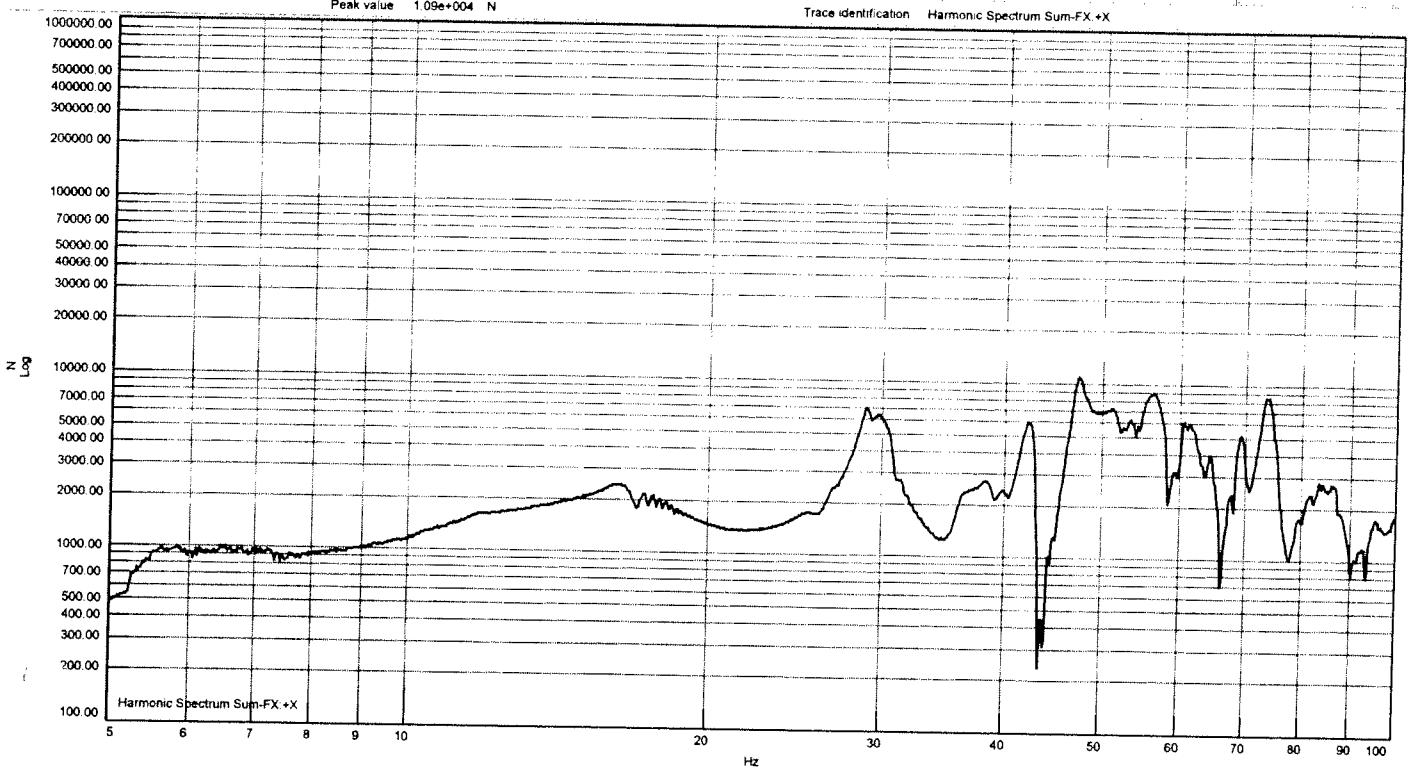
Project HerschelSine_MSH_1
Section QLZ1
Run SineRed_2

Date Wed Feb 01 2006
Time 08 39 25

ets european test services

Peak value 1.09e+004 N

Trace identification Harmonic Spectrum Sum-FX.+X



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

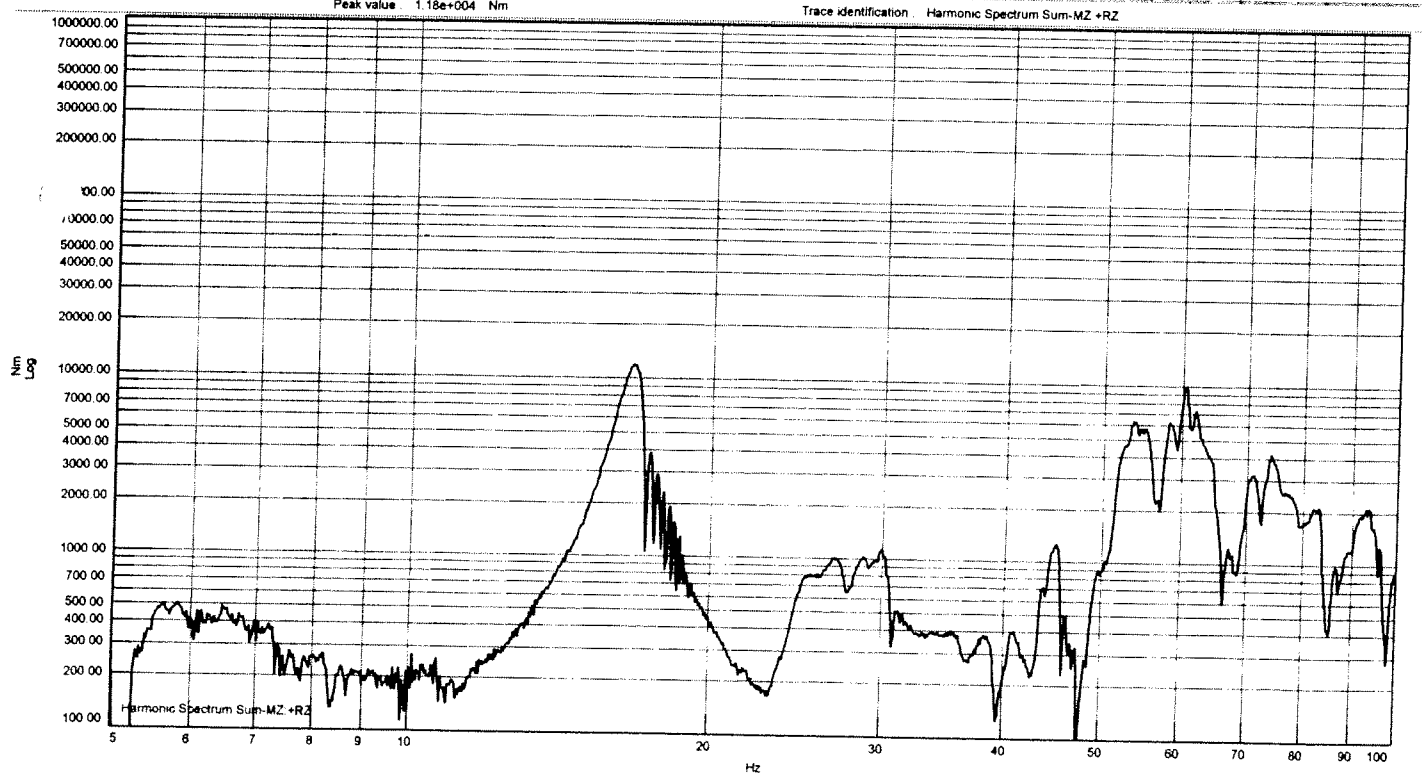
Project HerschelSine_MSH_1
Section QLZ1
Run SineRed_2

Date Wed Feb 01 2006
Time 08 39 25

ets european test services

Peak value 1.18e+004 Nm

Trace identification Harmonic Spectrum Sum-MZ.+RZ



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

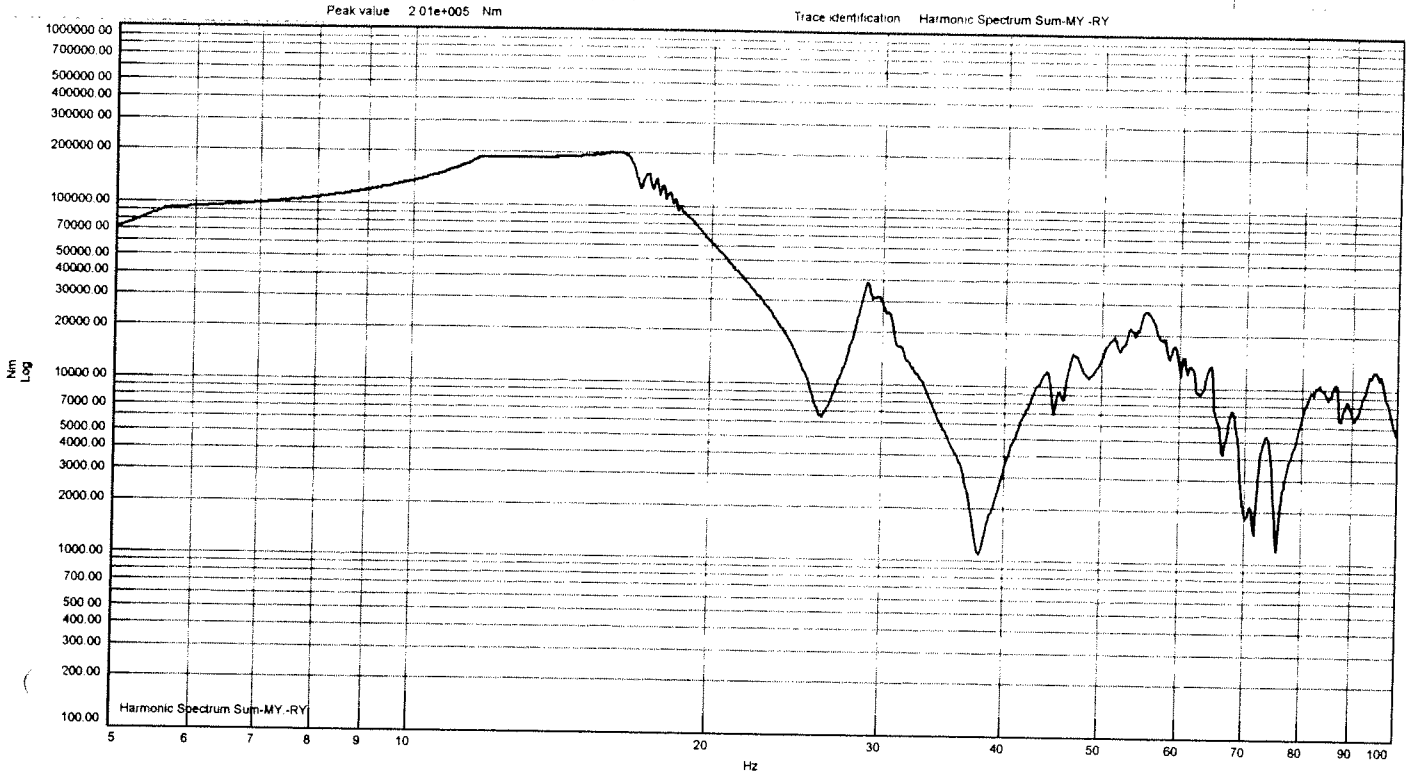
Project HerschelSine_MSH_1
Section QLZ1
Run SineRed_2

Date Wed Feb 01 2006
Time 08:39:25

ets european test services

Peak value 2.01e+005 Nm

Trace identification Harmonic Spectrum Sum-MY -RY



Memo

esa

ESA-ESTEC Test Centre Operated by ETS

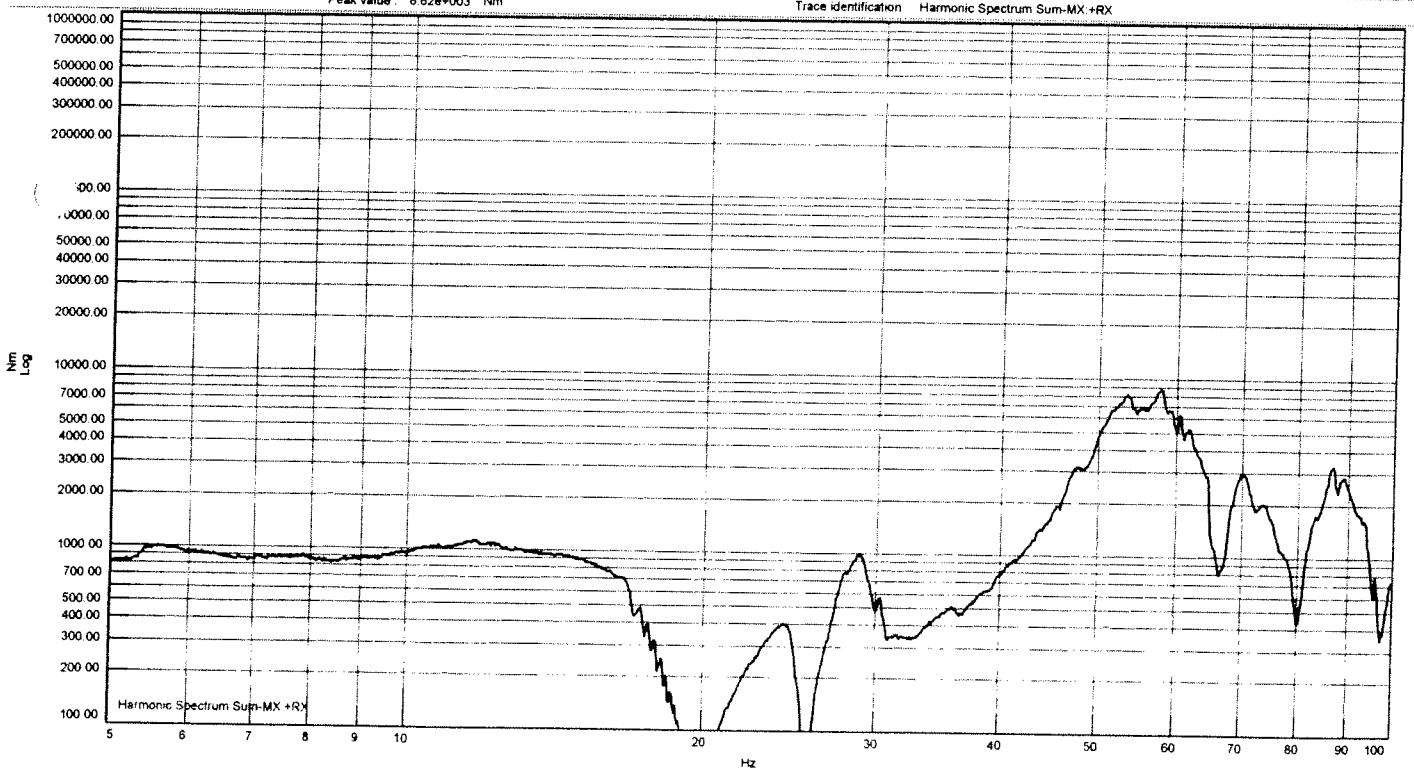
Project HerschelSine_MSH_1
Section QLZ1
Run SineRed_2

Date Wed Feb 01 2006
Time 08:39:25

ets european test services

Peak value 8.62e+003 Nm

Trace identification Harmonic Spectrum Sum-MX +RX



Memo

Annex 2.1: X-Qualification Run HEPLM Acceleration levels:

	Associated Equipment	Herschel_ STM_ X QLAX1_1_Fundamental_ "Qualification_Run_X"_ Test 19.01.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PACRYO101X	HTT Upper BH - X	[g]	1.6	2.7	11.8	4.7	2.7	1.0	0.8	0.6	0.7
PACRYO102Y	HTT Upper BH - Y	[g]	0.1	1.4	1.3	0.3	0.4	0.2	0.5	0.2	1.8
PACRYO103Z	HTT Upper BH - Z	[g]	0.2	1.7	1.7	0.6	0.6	0.6	1.4	1.7	1.4
PACRYO104X	HTT Lower BH - X	[g]	1.4	2.2	8.8	3.5	2.4	0.8	0.7	0.7	0.8
PACRYO105Y	HTT Lower BH - Y	[g]	0.1	1.3	1.5	1.6	0.7	0.5	0.9	1.0	0.9
PACRYO106Z	HTT Lower BH - Z	[g]	0.1	2.0	2.0	3.5	0.8	0.3	0.4	0.9	1.1
PACRYO107X	HTT Upper BH - X	[g]	1.9	3.1	14.6	5.3	3.9	1.8	2.8	1.0	0.1
PACRYO108Z	HTT Lower BH - Z	[g]	0.2	1.8	2.0	3.4	0.4	0.2	0.5	0.9	0.7
PACRYO109Y	HTT Lower BH - Y	[g]	0.1	1.9	1.7	1.4	0.8	0.4	0.8	0.9	1.0
PACRYO201X	OBA (+Y), unit level 23X	[g]	1.6	2.7	13.0	4.9	3.8	2.6	5.3	1.5	2.3
PACRYO202Y	OBA (+Y), unit level 23Y	[g]	0.2	1.2	1.0	1.8	0.9	1.4	1.2	0.4	0.5
PACRYO203Z	OBA (+Y), unit level 23Z	[g]	0.2	1.6	2.7	4.2	0.9	0.3	1.1	1.7	1.1
PACRYO204X	OBA (+Y), unit level 23X	[g]	1.7	2.8	13.2	4.8	3.8	2.5	5.1	1.5	0.9
PACRYO205Z	OBA (+Y), unit level 24Z	[g]	0.2	1.3	2.5	4.2	0.8	0.3	1.2	1.7	0.6
PACRYO206Y	OBA (+Y), unit level 27Y	[g]	0.1	0.9	2.2	2.0	1.4	1.5	1.2	0.5	0.9
PACRYO207Y	PACS FPU Y, Upper Surface, not CoG	[g]	0.2	1.0	1.3	3.2	2.0	2.3	5.0	0.9	4.4
PACRYO208Z	PACS FPU Z, Upper Surface, not CoG	[g]	0.2	1.5	6.2	11.3	2.4	2.6	5.5	3.3	1.3
PACRYO421X	1st Shield - X	[g]	1.8	4.2	25.1	12.9	12.1	2.4	2.2	1.1	0.9
PACRYO422Z	1st Shield - Z	[g]	0.2	1.6	5.2	3.1	3.8	1.1	1.5	0.7	1.7
PACRYO701X	HOT Upper BH - X	[g]	1.8	3.0	16.6	6.3	4.4	2.2	2.6	2.4	5.5
PACRYO702Y	HOT Upper BH - Y	[g]	0.1	1.5	4.1	1.6	0.9	0.5	1.2	1.3	1.2
PACRYO703Z	HOT Upper BH - Z	[g]	0.2	1.7	4.5	3.2	0.5	0.6	0.9	0.8	1.8
PAHSSP001X	Top of Sunshade - X	[g]	1.4	1.8	2.7	2.3	2.7	2.3	2.1	1.9	1.1
PAHSSP001Y	Top of Sunshade - Y	[g]	0.3	1.6	2.0	0.7	1.3	1.5	2.5	2.1	1.0
PAHSSP001Z	Top of Sunshade - Z	[g]	0.7	6.2	7.4	8.0	11.2	11.0	15.6	16.0	4.2
PAHSSP002Z	Top of Sunshade mid-panel - Z	[g]	0.5	3.0	2.9	2.3	2.2	1.6	5.8	7.0	4.7
PAHSSP003O	-Y side of Sunshade - oop (local), O	[g]	0.6	11.2	10.2	1.9	3.4	4.4	4.0	6.7	4.7
PAHSSP004O	+Y side of Sunshade mid-panel - oop (local), O	[g]	0.4	6.4	10.0	1.9	1.6	3.2	3.9	12.9	4.3
PAHSSP005X	-Y side of Sunshade - X	[g]	1.4	2.1	3.4	2.7	3.1	2.4	2.2	2.2	1.2
PAHSSP005T	-Y side of Sunshade - T	[g]	0.4	1.2	2.3	0.3	1.3	1.5	1.8	1.2	1.0
PAHSSP005O	-Y side of Sunshade - O	[g]	0.6	7.5	9.2	2.3	1.7	1.6	2.3	3.7	2.9
PAHSSP006X	+Y side of Sunshade - X	[g]	1.4	2.0	2.8	3.1	4.0	3.1	2.8	3.6	1.2
PAHSSP006T	+Y side of Sunshade - T	[g]	0.3	1.6	2.5	0.9	0.9	1.3	2.1	2.0	1.2
PAHSSP006O	+Y side of Sunshade - O	[g]	0.4	4.7	9.6	1.6	1.1	1.5	2.6	4.3	3.4

	Associated Equipment	Herschel_ STM_ X QLAX1_1_Fundamental_ "Qualification_Run_X"_ Test 19.01.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PAHSSP007X	-Y side of Sunshade near Horizontal Stiffener - X	[g]	1.5	2.2	3.2	2.7	3.2	2.3	2.0	2.0	1.2
PAHSSP007T	-Y side of Sunshade near Horizontal Stiffener - T	[g]	0.5	0.6	0.8	0.6	1.3	2.6	2.5	1.0	1.0
PAHSSP007O	-Y side of Sunshade near Horizontal Stiffener - O	[g]	0.3	0.5	1.3	0.7	1.0	0.9	0.9	1.0	0.9
PAHSSP008Z	Sunshade mid panel near Horizontal Stiffener - Z	[g]	0.2	0.3	0.5	1.6	2.0	1.3	1.3	2.0	1.9
PAHSSP009T	+Y side of Sunshade near Horizontal Stiffener - T	[g]	0.6	0.9	0.8	1.6	2.1	1.3	1.4	2.1	0.7
PAHSSP009O	+Y side of Sunshade near Horizontal Stiffener - O	[g]	0.2	0.8	1.4	0.7	0.9	0.7	0.7	1.0	0.6
PAHSSP101X	-Y side of Solar Array, near upper hor.stiff. - X	[g]	1.4	1.7	3.2	2.5	2.8	2.1	2.1	1.9	1.1
PAHSSP101T	-Y side of Solar Array, near upper hor.stiff. - T	[g]	0.2	0.5	1.2	0.8	1.0	1.0	0.9	0.8	1.0
PAHSSP101O	-Y side of Solar Array, near upper hor.stiff. - O	[g]	0.2	0.8	0.7	1.0	1.8	2.8	2.4	0.8	1.0
PAHSSP102Y	Solar Array, near upper hor.stiff., mid-panel - Y	[g]	0.2	0.7	1.6	0.3	0.4	0.4	0.4	0.7	0.3
PAHSSP102Z	Solar Array, near upper hor.stiff., mid-panel - Z	[g]	0.3	0.4	0.5	1.6	2.1	1.3	1.4	1.9	2.1
PAHSSP103X	+Y side of Solar Array, near upper hor.stiff. - X	[g]	1.5	2.0	2.7	2.7	3.3	2.8	2.5	3.1	1.1
PAHSSP103T	+Y side of Solar Array, near upper hor.stiff. - T	[g]	0.2	0.7	1.5	0.8	1.4	0.6	0.6	0.9	0.7
PAHSSP103O	+Y side of Solar Array, near upper hor.stiff. - O	[g]	0.5	0.5	0.8	1.8	2.3	2.0	2.0	1.9	0.8
PAHSSP104T	Solar Array, -Y side - T	[g]	0.2	0.8	1.2	1.7	1.6	1.3	1.5	0.8	0.6
PAHSSP104O	Solar Array, -Y side - oop (local), O	[g]	0.3	0.5	3.6	8.0	12.4	4.4	3.8	3.2	2.3
PAHSSP105Z	Solar Array, panel centre - Z	[g]	0.3	0.5	1.4	3.2	4.2	1.9	1.8	2.1	2.5
PAHSSP106T	Solar Array, +Y side - T	[g]	0.3	0.6	1.5	1.2	2.1	0.8	0.6	1.0	0.7
PAHSSP106O	Solar Array, +Y side - oop (local), O	[g]	0.8	0.5	4.4	9.3	12.2	6.0	5.8	2.9	2.1
PAHSSP107X	Solar Array, near lower hor.stiff., -Y side - X	[g]	1.9	2.1	3.9	3.0	3.5	2.2	2.0	1.8	1.0
PAHSSP107T	Solar Array, near lower hor.stiff., -Y side - T	[g]	0.8	1.1	1.0	1.9	2.3	1.9	2.4	1.6	0.9
PAHSSP107O	Solar Array, near lower hor.stiff., -Y side - O	[g]	0.8	0.7	1.6	3.1	3.1	2.6	3.7	3.7	2.9
PAHSSP108X	Solar Array, near lower hor.stiff., +Y side - X	[g]	1.5	1.8	2.5	2.8	3.4	2.7	2.8	3.1	1.0
PAHSSP108T	Solar Array, near lower hor.stiff., +Y side - T	[g]	0.5	0.7	1.3	1.4	3.0	1.8	1.4	1.5	0.9
PAHSSP108O	Solar Array, near lower hor.stiff., +Y side - O	[g]	0.4	0.5	1.9	3.4	7.0	2.7	3.4	3.5	2.5
PASA-S001L	Solar Array Strut 01, local lateral Y'	[g]	0.7	1.1	1.7	1.6	2.7	5.7	12.5	5.0	0.9
PASA-S001P	Solar Array Strut 01, local lateral Z '	[g]	0.2	0.4	1.0	1.4	2.2	2.7	11.7	6.2	2.3

	Associated Equipment	Herschel_ STM_ X QLAX1_1_Fundamental_ "Qualification_Run_X"_ Test 19.01.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PASA-S002L	Solar Array Strut 02, local lateral Y'	[g]	0.5	0.9	1.9	2.8	4.4	14.0	15.2	4.2	1.8
PASA-S002P	Solar Array Strut 02, local lateral Z '	[g]	0.8	1.2	1.7	2.4	2.6	11.8	13.5	2.7	1.1
PASA-S003L	Solar Array Strut 03, local lateral Y '	[g]	0.7	1.1	1.8	3.1	4.5	11.2	18.2	3.6	1.2
PASA-S003P	Solar Array Strut 03, local lateral Z '	[g]	0.5	0.7	1.5	0.8	3.5	14.8	10.9	1.5	0.8
PASA-S004L	Solar Array Strut 04, local lateral Y '	[g]	0.5	0.4	0.6	1.5	2.1	4.9	13.0	5.6	1.4
PASA-S004P	Solar Array Strut 04, local lateral Z '	[g]	0.6	1.0	2.0	1.7	6.1	7.3	12.8	6.2	1.8
PASA-S005L	Solar Array Strut 05, local lateral Y '	[g]	1.6	2.8	6.7	4.6	9.2	19.4	10.3	4.1	1.0
PASA-S005P	Solar Array Strut 05, local lateral Z '	[g]	0.3	0.6	2.3	2.7	7.5	11.8	7.6	2.3	0.9
PASA-S006L	Solar Array Strut 06, local lateral Y'	[g]	1.8	2.9	6.4	3.5	5.7	22.8	22.4	5.9	1.1
PASA-S006P	Solar Array Strut 06, local lateral Z '	[g]	0.2	0.9	1.1	2.9	5.7	11.4	13.7	5.6	1.3
PASA-S007L	Solar Array Strut 07, local lateral Y'	[g]	1.9	3.0	6.8	3.3	7.4	21.8	22.7	5.8	1.1
PASA-S007P	Solar Array Strut 07, local lateral Z '	[g]	0.3	0.9	1.1	3.1	5.2	18.2	16.4	3.7	1.3
PASA-S008L	Solar Array Strut 08, local lateral Y '	[g]	1.7	2.5	7.0	5.4	13.9	17.8	10.1	3.0	1.1
PASA-S008P	Solar Array Strut 08, local lateral Z -'	[g]	0.4	1.0	2.3	1.6	5.3	17.0	6.4	1.9	0.9
PASSDS009L	Solar Array Strut 09, local lateral Y '	[g]	0.4	0.9	2.0	2.9	11.0	9.7	3.1	2.6	0.8
PASSDS009P	Solar Array Strut 09, local lateral Z -'		1.6	3.3	6.1	6.0	10.7	16.0	10.1	3.6	1.0
PASSDS010L	Sunshade Strut 10, local lateral Y '	[g]	0.3	0.6	1.9	1.1	4.7	11.2	7.6	0.9	0.6
PASSDS010P	Sunshade Strut 10, local lateral Z -'	[g]	1.8	2.6	7.2	6.2	11.1	16.6	10.5	4.2	1.2
PASSDS011L	Sunshade Strut 11, local lateral Y '	[g]	0.4	0.4	1.8	0.6	2.5	11.3	5.8	0.7	0.3
PASSDS011P	Sunshade Strut 11, local lateral Z -'	[g]	1.8	2.6	7.4	5.5	14.3	16.4	8.4	3.5	1.2
PASSDS012L	Sunshade Strut 12, local lateral Y '	[g]	0.4	0.7	2.9	2.4	7.5	8.5	2.5	1.9	0.8
PASSDS012P	Sunshade Strut 12, local lateral Z'	[g]	1.6	3.4	6.5	4.7	14.0	14.5	8.0	1.5	0.9
PATMSF001X	TMS Frame on corner, -Z side - X	[g]	1.5	2.4	4.7	1.5	1.2	3.1	3.9	1.4	1.0
PATMSF001Y	TMS Frame on corner, -Z side - Y	[g]	0.2	0.8	0.7	0.6	1.1	3.9	4.0	6.5	6.7
PATMSF001Z	TMS Frame on corner, -Z side - Z	[g]	0.3	0.6	0.6	0.8	0.8	1.5	2.3	3.2	2.2
PATMSF002X	TMS Frame on corner, +Y side - X	[g]	1.5	2.1	5.6	1.6	0.8	3.5	5.1	1.3	0.4
PATMSF002Y	TMS Frame on corner, +Y side - Y	[g]	0.3	0.4	0.4	0.6	0.9	2.8	2.6	2.3	3.2
PATMSF002Z	TMS Frame on corner, +Y side - Z	[g]	0.2	0.9	0.9	0.7	0.8	1.6	3.5	8.0	5.1
PATMSF003X	TMS Frame on corner, -Y side - X	[g]	1.5	2.3	5.6	1.5	1.4	2.3	3.5	1.1	0.4

	Associated Equipment	Herschel_ STM_ X QLAX1_1_Fundamental_ "Qualification_Run_X"_ Test 19.01.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PATMSF003Y	TMS Frame on corner, -Y side - Y	[g]	0.2	0.4	0.5	0.5	0.8	2.6	2.6	2.5	3.1
PATMSF003Z	TMS Frame on corner, -Y side - Z	[g]	0.3	0.9	0.9	0.5	0.8	2.0	1.9	4.0	5.3
PALOUS001X	LOU CoG position - X	[g]	1.6	2.7	4.6	0.9	1.6	5.2	9.2	3.1	2.3
PALOUS001Y	LOU CoG position - Y	[g]	0.2	0.8	4.9	1.1	0.7	2.5	3.8	1.3	0.9
PALOUS001Z	LOU CoG position - Z	[g]	0.2	0.6	1.2	1.6	1.3	2.9	1.9	1.5	0.9
PALOUS002X	LOU Baseplate - X	[g]	1.6	2.5	6.2	1.4	1.7	5.2	9.7	3.4	2.6
PALOUS002Y	LOU Baseplate - Y	[g]	0.1	0.2	0.7	0.3	1.2	2.2	3.5	1.3	1.3
PALOUS002Z	LOU Baseplate - Z	[g]	0.3	0.8	0.6	1.0	1.2	2.1	1.6	1.5	0.8
PALOUR002X	LOU Radiator CoG position - X	[g]	1.8	3.4	7.5	0.9	2.0	5.6	11.1	2.5	2.1
PALOUR002Y	LOU Radiator CoG position - Y, R	[g]	0.2	1.6	11.0	2.4	1.2	2.9	8.1	3.4	1.7
PALOUR002Z	LOU Radiator CoG position - Z,T	[g]	0.2	1.0	3.3	12.5	12.1	3.5	2.0	2.4	2.6
PALOUR003O	LOU Radiator Corner local oop - oop (local),R	[g]	0.5	3.5	26.2	6.1	10.1	22.5	29.5	19.8	8.8
PACVVU001X	Upper CVV Ring, -Y position, STA 2222 > X	[g]	1.4	2.0	5.1	1.2	0.9	1.8	2.8	0.9	0.5
PACVVU001Z	Upper CVV Ring, -Y position, STA 2222 > Z	[g]	0.3	0.3	0.3	0.5	0.7	1.0	0.9	1.3	0.7
PACVVU002X	Upper CVV Ring, -Z position, STA 2222 > X	[g]	1.6	2.1	4.2	1.6	0.8	1.7	2.2	0.6	0.8
PACVVU002Y	Upper CVV Ring, -Z position, STA 2222 > Y	[g]	0.2	0.2	0.3	0.4	1.1	1.8	1.8	0.7	0.4
PACVVU003X	Upper CVV Ring, +Y position, STA 2222 > X	[g]	1.4	2.5	4.9	1.3	0.8	2.1	2.8	0.8	0.7
PACVVU003Z	Upper CVV Ring, +Y position, STA 2222 > Z	[g]	0.7	0.5	0.5	0.5	0.8	0.5	0.9	1.8	0.8
PACVVB005X	Cryostat Baffle I/F +Y near Solar Array Strut, > X	[g]	2.0	2.8	5.8	1.5	1.7	2.9	3.9	1.0	1.3
PACVVB005Y	Cryostat Baffle I/F +Y near Solar Array Strut > Y	[g]	0.3	0.2	0.5	0.6	1.0	1.9	1.7	0.7	0.5
PACVVB005Z	Cryostat Baffle I/F +Y near Solar Array Strut > Z	[g]	0.4	0.3	0.3	0.5	0.8	1.3	1.1	1.5	0.9
PACVVL006X	Lower CVV Ring, -Y position, STA 544 > X	[g]	1.5	2.0	4.4	1.1	0.9	1.5	2.1	0.3	0.8
PACVVL006Z	Lower CVV Ring, -Y position, STA 544 > Z	[g]	0.1	1.0	1.2	1.6	0.7	1.2	1.4	0.8	0.6
PACVVL007X	Lower CVV Ring, -Z position, STA 544 > X	[g]	1.8	1.8	3.3	1.1	0.9	1.5	1.8	0.6	0.9
PACVVL007Y	Lower CVV Ring, -Z position, STA 544 > Y	[g]	0.2	0.7	0.6	0.4	1.2	0.5	1.3	0.8	0.3
PACVVL008X	Lower CVV Ring, +Y position, STA 544 > X	[g]	1.4	2.1	4.1	0.8	0.6	1.7	1.8	0.5	0.8
PACVVL008Z	Lower CVV Ring, +Y position, STA 544 > Z	[g]	0.2	1.1	1.3	1.5	0.3	0.5	1.5	0.7	0.6
PACSTR010X	STR I/F pad on CVV Lower Bulkhead, -Z/+Y >X	[g]	1.5	1.9	4.6	1.0	0.8	3.7	3.2	1.0	1.4
PACSTR010Y	STR I/F pad on CVV Lower Bulkhead, -Z/+Y > Y	[g]	0.1	1.3	1.2	0.8	1.1	0.8	1.0	1.0	0.5

	Associated Equipment	Herschel_ STM_ X QLAX1_1_Fundamental_ "Qualification_Run_X"_ Test 19.01.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PACSTR010Z	STR I/F pad on CVV Lower Bulkhead, -Z/+Y > Z	[g]	0.2	0.9	1.3	2.0	0.5	0.8	1.6	0.5	0.6
PACVVR001O	CVV -Z/+X Radiator, CoG position, oop (local), >T	[g]	0.1	0.5	0.9	0.3	1.2	2.6	3.2	2.1	2.5
PACVVR002O	CVV -Z/-X Radiator, CoG position, oop (local), >T	[g]	0.1	0.7	0.8	0.4	1.5	1.2	6.1	2.7	6.1
PACVVR003O	CVV +Y/+X Radiator, CoG position , oop (local), >T	[g]	0.9	1.2	1.2	0.7	0.8	0.5	2.9	3.0	0.9
PACVVR004O	CVV +Y/-X Radiator, CoG position, oop (local), >T	[g]	0.1	1.0	1.2	1.0	0.6	0.8	3.2	1.9	2.2
PACVVR005O	CVV -Y/+X Radiator, CoG position	[g]	0.2	0.5	0.7	0.4	1.0	1.7	3.3	2.9	1.7
PACVVR006O	CVV -Y/-X Radiator, CoG position	[g]	0.2	0.9	1.2	1.1	1.0	1.6	4.8	3.6	1.6
PACCRM003X	Cryo Cover release mechanism > X	[g]	1.5	2.0	4.9	1.0	0.9	2.1	2.9	0.8	1.4
PACCRM003Y	Cryo Cover release mechanism > Y	[g]	0.2	0.3	0.3	0.6	1.0	2.5	2.5	0.9	1.0
PACCCV031X	Cryo Cover CVV I/F (Pilot 31 @ AAE test) > X	[g]	1.4	2.1	5.3	1.2	0.9	2.2	3.3	0.8	1.7
PACCCV031Y	Cryo Cover CVV I/F (Pilot 31 @ AAE test) > Y	[g]	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.1	0.1
PACCCV031Z	Cryo Cover CVV I/F (Pilot 31 @ AAE test) > Z	[g]	0.3	0.3	0.5	0.6	0.6	0.7	1.2	1.5	0.8
PACCCV032X	Cryo Cover CVV I/F (Pilot 32 @ AAE test) > X	[g]	1.5	2.0	5.3	1.3	0.8	1.9	3.2	0.8	2.0
PACCCV032Y	Cryo Cover CVV I/F (Pilot 32 @ AAE test) > Y	[g]	0.3	0.4	0.7	0.5	0.8	2.0	1.8	0.5	0.6
PACCCV032Z	Cryo Cover CVV I/F (Pilot 32 @ AAE test) Y Z	[g]	1.2	0.6	0.6	0.2	0.1	0.2	0.3	0.2	0.2
PACCYO006X	Cryo Cover yoke>- X	[g]	1.5	2.2	5.4	1.3	0.9	2.0	3.5	0.6	1.9
PACCJC008Y	Cryo Cover Johnston coupling >C419 Y	[g]	0.7	0.9	1.7	0.6	0.7	2.7	2.8	0.7	1.0
PACBAF001O	Cryostat Baffle, +Y, position near I/F - oop (local),R	[g]	1.6	2.2	5.2	1.2	0.7	2.0	2.8	0.6	1.1
PACBAF002O	Cryostat Baffle, -Z, position near I/F - oop (local),R	[g]	1.5	2.1	4.8	1.0	0.9	1.9	2.8	0.7	1.2
PACBAF011O	Cryostat Baffle cone area, -Z, oop (local),N	[g]	1.4	2.0	4.9	1.1	0.8	1.6	2.9	0.6	1.3
PANOZL001X	Nozzle Bracket > X	[g]	1.8	2.4	4.4	1.8	1.8	3.5	3.8	3.2	2.4
PANOZL001Y	Nozzle Bracket > Y	[g]	0.3	0.7	1.2	0.3	1.5	1.2	9.6	1.5	2.2
PACVVV001X	CVV Valve Bracket > X	[g]	1.4	1.9	4.6	1.3	0.9	1.6	2.3	0.5	0.7
PACVVV001O	CVV Valve Bracket > Y	[g]	0.3	0.3	0.8	1.0	0.6	0.7	2.7	1.2	1.8
PACVVV001T	CVV Valve Bracket > Z	[g]	0.2	0.9	0.9	1.1	0.9	1.2	1.3	0.6	0.6
PAWAVG001Y	Waveguide > Y (outer	[g]	0.2	1.1	2.6	1.9	6.8	4.5	24.2	14.1	12.6

	Associated Equipment	Herschel_ STM_ X QLAX1_1_Fundamental_ "Qualification_Run_X"_ Test 19.01.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
	WG on -Z-side)										
PAWAVG001Z	Waveguide > Z (5th WG on +Z-side)	[g]	0.2	0.9	1.5	1.6	2.0	3.5	3.3	6.2	6.6
PAWAVG002X	Waveguide Bracket > X	[g]	1.7	2.5	5.8	1.3	2.1	5.2	9.1	3.0	2.5
PAWAVG002Y	Waveguide Bracket > Y	[g]	0.1	0.8	0.7	0.4	1.0	0.6	1.0	0.8	0.4
PAWAVG002Z	Waveguide Bracket > Z	[g]	0.2	0.9	1.2	1.5	0.8	1.3	1.3	0.9	0.7
PASVTS001X	SVM Thermal Shield, -Z side, over strut support > X	[g]	1.6	1.8	3.5	9.8	34.2	17.1	3.3	4.8	1.8
PASVTS001Y	SVM Thermal Shield, -Z side, over strut support > Y	[g]	0.7	0.3	0.5	0.7	2.6	1.8	3.6	3.0	1.5
PASVTS001Z	SVM Thermal Shield, -Z, over strut support > Z	[g]	0.3	0.2	0.3	0.7	2.6	1.8	2.3	1.3	0.9
PASVTS002X	SVM Thermal Shield, -Y side > X	[g]	1.5	1.8	2.9	5.7	72.9	97.9	10.0	5.0	2.3
PASVTS002Y	SVM Thermal Shield, -Y side > Y	[g]	0.4	0.3	0.5	1.2	11.0	8.2	7.3	4.8	1.9
PASVTS002Z	SVM Thermal Shield, -Y side > Z	[g]	0.3	0.2	0.5	0.6	2.6	5.2	3.8	1.8	1.7
PASVTS003X	SVM Thermal Shield, +Y side > X	[g]	1.4	1.6	2.2	1.7	5.1	4.3	1.9	1.6	1.3
PASVTS003Y	SVM Thermal Shield, +Y side > Y	[g]	0.1	0.1	0.2	0.4	2.0	4.2	4.8	3.5	0.9
PASVTS003Z	SVM Thermal Shield, +Y side > Z	[g]	0.2	0.3	0.3	0.5	4.0	3.4	3.7	1.2	1.5
PATELD001X	Telescope dummy M2 beam > Y1	[g]	1.5	2.2	6.0	1.4	2.0	4.7	11.6	3.4	1.4
PATELD001Y	Telescope dummy M2 beam > Y1	[g]	0.5	2.7	2.5	0.9	0.4	1.3	1.1	0.5	0.3
PATELD001Z	Telescope dummy M2 beam > Z1	[g]	0.7	3.4	3.5	1.3	0.5	0.8	0.4	0.6	0.6
PATELD002X	Telescope dummy -Z/-Y triangle arm > X1	[g]	1.5	2.3	6.4	2.0	9.3	9.2	15.3	8.5	4.3
PATELD002Z	TMD Inner Corner -Y/-Z (as for GA71013) > Z3	[g]	0.3	3.8	3.8	1.2	0.7	1.2	0.9	1.2	0.5
PATELD003X	Telescope dummy -Z arm > X2	[g]	1.5	3.2	5.4	3.5	3.2	29.6	23.4	4.1	1.9
PATELD003Y	TMD Outer Corner -Z (as for GA71017) > Y6	[g]	0.6	3.7	4.0	1.1	1.2	2.8	2.3	3.6	2.4
PATELD004X	Telescope dummy Centre Plate, CoG > X3	[g]	1.8	3.0	8.1	2.9	2.3	9.4	15.0	6.1	4.1

All exceedances w.r.t. /RD 1b/ are marked by shaded field

Exccedance	**Qual. level**	**Allowable**	**Status**
PACRYO421X	25.1g	25.0g	very minor eceedance, accepted.

(Note the X-axis allowable was reduced from 30g to 25g to allow a higher lateral component)

Annex 2.2: X-Qualification Run Max Strut Forces:

	Associated Equipment	Herschel_ STM_ X QLAX1_1_Global "Qualification_Run_X"_ Test 19.01.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PSTMSS041A	TMS Strut, 0°, axial dir., -Z - X'	[N]	1119	5194	4093	2632	1386	3985	4032	2257	1178
PSTMSS051A	TMS Strut, 0°, axial dir., -Z	[N]	1363	7988	7755	2571	2351	3493	4162	1434	988
PSTMSS061A	TMS Strut, 0°, axial dir., +Y	[N]	1470	9905	9826	2757	1437	2862	6229	1664	1319
PSTMSS071A	TMS Strut, 0°, axial dir., +Y	[N]	1461	10035	9625	2658	2549	4162	6495	2201	1674
PSTMSS081A	TMS Strut, 0°, axial dir., -Y	[N]	1438	6669	6710	4052	3401	3305	3178	2370	2182
PSTMSS091A	TMS Strut, 0°, axial dir., -Y	[N]	1342	4408	9775	3596	1498	1911	3010	2623	1247
PSTMSS101A	TMS CB Strut, 0°/180°, T-rosette 0/90	[N]	51.4	398.9	464.0	121.1	74.1	232.5	226.2	334.6	383.2
PSTMSS111A	TMS CB Strut, 0°/180°, T-rosette 0/90	[N]	39.2	271.4	280.7	139.5	82.7	94.9	200.8	461.7	251.4
PSLOUS041A	LOU Strut, 0°/180°, T-rosette 0/90; +X/+Z	[N]	176	313	1556	299	282	781	821	234	152
PSLOUS061A	LOU Strut, 0°/180°, T-rosette 0/90; ++Z	[N]	410	710	2706	885	881	1622	2697	927	549
PSLOUS071A	LOU Strut, 0°/180°, T-rosette 0/90; --Z	[N]	387	726	2051	494	326	1043	1985	695	532
PSLOUS081A	LOU Strut, 0°/180°, T-rosette 0/90; --Z	[N]	182	440	1723	286	409	734	724	242	184
PSLOUS091A	LOU Strut, 0°/180°, T-rosette 0/90; --Z	[N]	413	718	2246	537	431	1366	2323	864	604
PSSVMS011A	PLM-SVM Strut +Y, 0°, axial dir.	[N]	1254	4600	5379	1847	1309	694	999	791	317
PSSVMS021A	PLM-SVM Strut +Y, 0°, axial dir.	[N]	2034	2930	10909	4439	2100	1294	1594	709	424
PSSVMS031A	PLM-SVM Strut -Y, 0°, axial dir.	[N]	2010	4630	10783	4482	1547	1169	1345	570	537
PSSVMS041A	PLM-SVM Strut -Y, 0°, axial dir.	[N]	1632	2213	5766	2877	1209	1112	1525	614	350
PSSVMS051A	PLM-SVM Strut +Z, 0°, axial dir.	[N]	2146	2510	9330	3698	1646	731	1101	709	354
PSSVMS061A	PLM-SVM Strut +Z, 0°, axial dir.	[N]	2063	4663	9054	3440	1056	900	1367	790	376
PSSVMS071A	PLM-SVM Strut -Z, 0°, axial dir.	[N]	1568	1977	6681	2985	1345	923	1545	566	429
PSSVMS081A	PLM-SVM Strut -Z, 0°, axial dir.	[N]	1227	4530	5990	2177	1204	984	1118	556	454

Annex 2.3: X-Qualification Run Max HSS Global Strut Forces

QLX1-Global	7-20 Hz	20-30 Hz	30-40 Hz	40-50 Hz	50-60 Hz	60-70 Hz	70-80 Hz	80-90 Hz	90-100 Hz
HSS09-SB1FA	62	362	373	569	399	188	155	139	148
HSS10-SB2FA	57	312	294	109	205	159	95	98	73
HSS11-SB3FA	94	674	505	585	332	153	126	124	101
HSS1-2_FX	2154	2968	4610	3750	4902	7995	8669	4552	1890
HSS1-2_FY	474	986	1439	1186	1518	1509	2512	1347	448
HSS1-2_FZ	901	1121	1852	1179	1579	3576	3693	1574	748
HSS1-2_MLat	15	11	13	14	17	23	29	13	5
HSS1-2Tors	8	6	7	8	9	12	16	6	2
HSS3-4_FX	1549	2838	4080	3260	4044	8110	9128	3462	1423
HSS3-4_FY	191	365	729	710	675	635	1196	626	178
HSS3-4_FZ	674	1190	1754	1127	1568	3936	4355	1340	602
HSS3-4_MLat	7	11	15	14	16	52	55	20	6
HSS3-4Tors	3	5	7	6	7	27	28	10	3
S01FA	993	2350	3357	2794	3605	2777	6021	3100	929
S01MA	5	6	13	14	13	16	31	27	11
S01MHSS	1	1	3	3	3	4	7	6	2
S02FA	1522	1826	3272	1485	2112	6358	6687	2211	1206
S02MA	20	15	16	19	24	30	39	12	5
S02MHSS	16	11	12	14	19	23	30	9	4
S03FA	1179	2020	3187	1582	2600	7432	8248	2120	1030
S03MA	7	12	14	12	17	68	72	24	7
S03MHSS	6	9	11	9	13	53	56	18	6
S04FA	638	1241	2136	2092	2135	2706	3396	1896	589
S04MA	8	16	28	27	32	36	51	32	8
S04MHSS	2	4	7	6	7	8	12	8	2
S05FA	702	1055	1876	1531	2431	3660	2540	942	402
S05MA	6	9	16	13	13	21	8	5	2
S05MHSS	4	6	10	8	8	13	5	3	1
S06FA	570	1376	2508	919	1550	4065	4129	1316	317
S06MA	3	8	19	6	11	30	28	6	2
S06MHSS	1	3	7	2	4	11	11	2	1
S07FA	642	1200	2728	1077	1607	4395	4098	1030	381
S07MA	3	8	20	6	10	37	32	5	2
S07MHSS	1	3	7	2	4	14	12	2	1
S08FA	852	1428	2460	1822	3025	4476	1953	661	486
S08MA	5	9	13	15	12	22	16	6	2
S08MHSS	3	6	8	10	8	14	11	4	1
S09FA	789	1389	1656	1215	2337	3110	1914	803	288
S09MA	6	6	13	9	16	19	11	6	2
S09MHSS	3	3	6	4	8	9	5	3	1
S10FA	605	1074	1282	998	1519	2635	1891	564	270
S10MA	10	14	23	16	28	35	24	7	3
S10MHSS	3	4	7	5	9	11	7	2	1
S11FA	906	2128	2199	1313	2987	3766	2419	809	474
S11MA	11	13	23	17	28	32	14	6	3
S11MHSS	3	4	7	5	8	10	4	2	1
S12FA	828	2040	1859	1100	2696	3216	1434	427	266
S12MA	4	14	14	5	19	19	10	3	2
S12MHSS	2	7	7	3	9	9	5	2	1

Annex 2.4: X-Qualification Run Max SVM IF Forces:

QLX1-Global	7-20 Hz	20-30 Hz	30-40 Hz	40-50 Hz	50-60 Hz	60-70 Hz	70-80 Hz	80-90 Hz	90-100 Hz
SVM+Y:FX_1-2	2496	6475	14007	4923	2723	1403	1767	1244	549
SVM+Y:FY_1-2	241	626	1355	476	263	136	171	120	53
SVM+Y:FZ_1-2	672	1258	2895	1633	569	504	619	139	113
SVM+Z:FX_5-6	3686	5768	16179	6282	2207	1165	2172	1191	616
SVM+Z:FY_5-6	338	1257	496	389	342	262	183	199	88
SVM+Z:FZ_5-6	728	1140	3197	1241	436	230	429	235	122
SVM1FA	1254	4600	5379	1847	1309	694	999	791	317
SVM2FA	2034	2930	10909	4440	2100	1294	1595	709	424
SVM3FA	2010	4630	10783	4482	1547	1169	1345	570	537
SVM4FA	1633	2213	5767	2877	1209	1112	1525	614	350
SVM5FA	2146	2510	9331	3698	1646	731	1101	709	354
SVM6FA	2063	4663	9054	3440	1056	900	1367	790	376
SVM7FA	1568	1977	6681	2985	1345	923	1545	566	429
SVM8FA	1227	4530	5990	2177	1204	984	1118	556	454
SVM-Y:FX_3-4	2627	5881	14233	5140	2341	1721	2468	986	725
SVM-Y:FY_3-4	254	569	1377	497	227	167	239	95	70
SVM-Y:FZ_3-4	631	1301	2583	1615	490	312	237	152	166
SVM-Z:FX_7-8	2449	5856	11405	4646	2260	1576	2384	877	769
SVM-Z:FY_7-8	309	1197	1018	379	291	202	342	123	74
SVM-Z:FZ_7-8	24	57	112	45	22	15	23	9	8

X-Qualification Run SVM Global IF Forces:

		Measured		
		Fx (N)	Fy (N)	Fz (N)
PLM-SVM IF	Corner +Z	16179	496	3197
	Corner -Z	11405	1018	112
	Corner +Y	14007	1355	2895
	Corner -y	14233	1377	2583

		Fx (N)	Fy (N)	Fz (N)	Mlat (Nm)	Mtors (Nm)	
HSS SVM IF	Strut 1-2	8669	2512	3693	29	16	
	Strut 2-3	9128	1196	4355	55	28	

Annex 3.1: Y-Qualification Run HEPLM Max Acceleration levels:

	Associated Equipment	Herschel_ STM_ Y maxB_QLY1_Fundamental "Qualification_Level_Y"_ Test 04.02.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PACRYO101X	HTT Upper BH - X	[g]	0.6	0.9	0.7	1.8	0.9	0.1	0.4	0.6	0.9
PACRYO102Y	HTT Upper BH - Y	[g]	2.5	4.6	4.0	1.2	0.5	0.5	0.2	1.7	3.2
PACRYO103Z	HTT Upper BH - Z	[g]	0.1	0.7	0.9	1.6	0.4	0.3	0.3	0.6	0.6
PACRYO104X	HTT Lower BH - X	[g]	0.5	1.4	0.9	1.6	0.9	0.2	0.4	0.6	1.1
PACRYO105Y	HTT Lower BH - Y	[g]	1.4	5.8	4.4	4.4	2.6	0.4	0.7	1.3	2.0
PACRYO106Z	HTT Lower BH - Z	[g]	0.1	0.9	1.2	1.5	0.5	0.1	0.2	0.9	1.1
PACRYO107X	HTT Upper BH - X	[g]	0.1	0.3	0.5	0.5	0.4	0.2	0.6	0.2	0.3
PACRYO108Z	HTT Lower BH - Z	[g]	0.1	0.6	1.2	1.2	0.3	0.1	0.1	0.8	0.5
PACRYO109Y	HTT Lower BH - Y	[g]	2.2	6.8	5.2	4.7	2.7	0.4	0.8	1.4	1.1
PACRYO201X	OBA (+Y), unit level 23X	[g]	0.2	0.5	0.5	1.1	0.4	0.7	1.7	0.4	0.3
PACRYO202Y	OBA (+Y), unit level 23Y	[g]	2.8	4.1	3.7	4.9	2.1	0.5	0.7	0.6	0.4
PACRYO203Z	OBA (+Y), unit level 26Z	[g]	0.1	0.7	0.8	2.0	0.4	0.2	0.5	0.4	0.4
PACRYO204X	OBA (+Y), unit level 24X	[g]	0.2	0.7	0.5	0.7	0.5	0.6	1.7	0.8	0.6
PACRYO205Z	OBA (+Y), unit level 24Z	[g]	0.1	0.4	0.7	1.3	0.3	0.2	0.4	0.4	0.4
PACRYO206Y	OBA (+Y), unit level 27Y	[g]	2.7	3.8	3.5	4.8	2.0	0.6	0.7	0.5	0.4
PACRYO207Y	PACS FPU Y, Upper Surface, not CoG	[g]	3.4	3.0	3.2	8.1	3.7	1.0	1.2	1.2	1.8
PACRYO208Z	PACS FPU Z, Upper Surface, not CoG	[g]	0.1	0.6	0.8	3.3	0.5	1.1	2.0	0.8	0.3
PACRYO421X	1st Shield - X	[g]	1.3	4.2	3.2	2.1	0.9	0.7	0.4	0.6	0.7
PACRYO422Z	1st Shield - Z	[g]	0.2	0.7	1.9	3.3	2.0	0.8	0.9	0.7	0.8
PACRYO701X	HOT Upper BH - X	[g]	0.0	0.3	0.3	0.5	0.3	0.3	1.0	2.3	3.1
PACRYO702Y	HOT Upper BH - Y	[g]	1.7	5.5	4.3	4.1	2.2	0.6	1.1	2.2	1.6
PACRYO703Z	HOT Upper BH - Z	[g]	0.1	0.8	1.1	1.1	0.1	0.3	0.4	0.6	1.5
PAHSSP001X	Top of Sunshade - X	[g]	0.2	0.2	0.2	0.3	0.5	0.7	0.9	1.0	0.3
PAHSSP001Y	Top of Sunshade - Y	[g]	8.2	5.6	1.8	2.4	3.0	2.2	3.4	2.6	1.8
PAHSSP001Z	Top of Sunshade - Z	[g]	0.5	1.8	2.8	2.4	3.6	1.7	5.5	2.8	2.0
PAHSSP002Z	Top of Sunshade mid-panel - Z	[g]	0.4	0.9	1.3	0.5	0.5	0.3	1.2	1.5	2.1
PAHSSP003O	-Y side of Sunshade - oop (local), O	[g]	6.4	13.2	3.1	1.6	2.1	1.6	3.5	4.7	9.1
PAHSSP004O	+Y side of Sunshade mid-panel - oop (local), O	[g]	5.7	12.2	3.9	2.1	1.9	1.7	2.7	4.4	7.3
PAHSSP005X	-Y side of Sunshade - X	[g]	2.3	1.4	1.0	3.1	2.3	0.8	2.5	2.1	1.1
PAHSSP005T	-Y side of Sunshade - T	[g]	4.7	2.6	1.2	2.3	2.0	1.4	1.6	1.5	1.2
PAHSSP005O	-Y side of Sunshade - O	[g]	4.6	8.2	2.2	3.6	1.0	0.3	0.5	1.9	2.3
PAHSSP006X	+Y side of Sunshade - X	[g]	2.3	1.4	0.9	2.7	2.9	1.7	1.8	1.5	1.1
PAHSSP006T	+Y side of Sunshade - T	[g]	5.2	2.9	1.3	2.6	2.2	1.3	2.5	1.7	1.2
PAHSSP006O	+Y side of Sunshade - O	[g]	5.0	8.0	2.7	3.2	1.1	0.4	1.1	1.4	2.1
PAHSSP007X	-Y side of Sunshade near Horizontal Stiffener - X	[g]	2.2	1.3	0.9	2.9	2.1	0.7	2.2	1.9	1.1
PAHSSP007T	-Y side of Sunshade near Horizontal Stiffener - T	[g]	1.6	0.7	0.4	1.2	1.6	1.2	1.2	1.0	1.2
PAHSSP007O	-Y side of Sunshade near Horizontal Stiffener - O	[g]	3.2	1.7	0.4	0.5	0.5	0.5	0.3	0.3	0.4
PAHSSP008Z	Sunshade mid panel near Horizontal Stiffener - Z	[g]	0.1	0.1	0.2	0.3	0.4	0.4	0.4	0.5	0.5
PAHSSP009T	+Y side of Sunshade near	[g]	2.2	1.3	0.5	1.7	1.8	1.1	1.1	0.8	0.8

	Associated Equipment	Herschel_ STM_ Y maxB_QLY1_Fundamental "Qualification_Level_Y"_ Test 04.02.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
	Horizontal Stiffener - T										
PAHSSP009O	+Y side of Sunshade near Horizontal Stiffener - O	[g]	3.1	1.6	0.5	0.4	0.7	0.4	0.4	0.3	0.3
PAHSSP101X	-Y side of Solar Array, near upper hor.stiff. - X	[g]	1.8	1.2	0.8	2.6	2.1	0.7	2.2	1.9	0.8
PAHSSP101T	-Y side of Solar Array, near upper hor.stiff. - T	[g]	3.0	1.6	0.4	0.6	0.5	0.4	0.4	0.3	0.3
PAHSSP101O	-Y side of Solar Array, near upper hor.stiff. - O	[g]	1.8	1.1	0.8	1.8	2.0	1.3	0.9	0.5	1.1
PAHSSP102Y	Solar Array, near upper hor.stiff., mid-panel - Y	[g]	3.6	1.9	0.5	0.8	0.6	0.2	0.5	0.3	0.4
PAHSSP102Z	Solar Array, near upper hor.stiff., mid-panel - Z	[g]	0.1	0.1	0.2	0.3	0.5	0.4	0.5	0.5	0.5
PAHSSP103X	+Y side of Solar Array, near upper hor.stiff. - X	[g]	2.1	1.3	0.8	2.3	2.6	1.6	1.6	1.2	0.9
PAHSSP103T	+Y side of Solar Array, near upper hor.stiff. - T	[g]	3.1	1.6	0.5	0.7	1.0	0.3	0.2	0.2	0.2
PAHSSP103O	+Y side of Solar Array, near upper hor.stiff. - O	[g]	1.6	1.1	0.5	1.6	1.9	1.2	0.9	0.4	0.7
PAHSSP104T	Solar Array, -Y side - T	[g]	1.6	1.1	0.5	2.0	1.9	0.6	1.5	1.0	0.6
PAHSSP104O	Solar Array, -Y side - oop (local), O	[g]	1.3	0.8	1.2	2.8	7.2	1.8	3.0	2.4	1.9
PAHSSP105Z	Solar Array, panel centre - Z	[g]	0.4	0.3	0.2	0.9	1.6	1.9	1.0	1.0	1.7
PAHSSP106T	Solar Array, +Y side - T	[g]	1.8	1.1	0.5	2.1	2.3	1.0	1.2	1.0	0.7
PAHSSP106O	Solar Array, +Y side - oop (local), O	[g]	2.2	1.3	1.4	6.9	4.8	2.4	4.8	2.9	2.7
PAHSSP107X	Solar Array, near lower hor.stiff., -Y side - X	[g]	2.5	1.6	1.0	2.3	1.6	0.7	2.0	1.8	1.0
PAHSSP107T	Solar Array, near lower hor.stiff., -Y side - T	[g]	1.4	1.3	0.9	3.2	2.8	1.2	2.5	2.1	1.9
PAHSSP107O	Solar Array, near lower hor.stiff., -Y side - O	[g]	2.0	1.4	1.9	2.3	2.2	1.6	3.8	5.1	5.2
PAHSSP108X	Solar Array, near lower hor.stiff., +Y side - X	[g]	1.8	1.0	0.9	2.6	2.8	1.8	1.6	1.5	1.0
PAHSSP108T	Solar Array, near lower hor.stiff., +Y side - T	[g]	1.4	1.2	0.8	3.7	3.7	1.8	2.5	2.1	1.4
PAHSSP108O	Solar Array, near lower hor.stiff., +Y side - O	[g]	1.3	0.8	1.1	4.1	3.3	2.2	2.9	2.9	4.6
PASA-S001L	Solar Array Strut 01, local lateral Y'	[g]	1.4	0.6	0.6	1.3	4.1	3.6	11.4	3.7	3.1
PASA-S001P	Solar Array Strut 01, local lateral Z '	[g]	1.0	0.9	0.6	2.2	2.7	2.3	10.4	2.1	2.4
PASA-S002L	Solar Array Strut 02, local lateral Y'	[g]	1.4	1.0	1.0	3.7	5.3	9.0	10.6	1.6	1.2
PASA-S002P	Solar Array Strut 02, local lateral Z '	[g]	1.2	0.5	0.6	1.9	3.4	8.7	13.1	2.1	1.0
PASA-S003L	Solar Array Strut 03, local lateral Y '	[g]	1.1	0.9	0.8	3.2	3.4	10.3	15.2	2.0	0.3
PASA-S003P	Solar Array Strut 03, local lateral Z '	[g]	1.4	0.7	0.8	3.2	4.2	9.1	12.7	2.0	1.7
PASA-S004L	Solar Array Strut 04, local lateral Y '	[g]	1.1	1.0	0.7	2.1	2.4	2.2	12.0	2.0	1.3
PASA-S004P	Solar Array Strut 04, local lateral Z '	[g]	1.3	0.6	0.5	1.2	4.5	2.3	13.7	5.6	2.2
PASA-S005L	Solar Array Strut 05, local lateral Y '	[g]	1.8	1.5	0.9	5.8	7.5	19.4	4.4	0.9	0.8
PASA-S005P	Solar Array Strut 05, local		2.6	1.3	0.4	2.4	4.3	12.2	2.9	1.1	0.5

	Associated Equipment	Herschel_ STM_ Y maxB_QLY1_Fundamental "Qualification_Level_Y"_ Test 04.02.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
	lateral Z '	[g]									
PASA-S006L	Solar Array Strut 06, local lateral Y'	[g]	1.2	0.8	0.6	3.4	4.5	12.1	10.6	1.3	0.8
PASA-S006P	Solar Array Strut 06, local lateral Z '	[g]	0.4	0.8	0.4	2.1	4.5	11.9	8.9	0.8	1.1
PASA-S007L	Solar Array Strut 07, local lateral Y'	[g]	1.4	0.9	0.8	5.0	4.6	10.6	15.8	4.6	0.5
PASA-S007P	Solar Array Strut 07, local lateral Z '	[g]	0.2	0.8	0.5	2.8	3.9	10.5	12.8	1.4	1.5
PASA-S008L	Solar Array Strut 08, local lateral Y '	[g]	1.1	1.5	1.0	6.6	8.1	9.2	6.3	3.1	0.6
PASA-S008P	Solar Array Strut 08, local lateral Z -'	[g]	3.0	1.5	0.4	1.4	3.6	15.8	3.4	1.4	0.5
PASSDS009L	Solar Array Strut 09, local lateral Y '	[g]	2.1	1.1	0.3	1.0	6.0	9.1	0.7	0.7	0.2
PASSDS009P	Solar Array Strut 09, local lateral Z -'	[g]	1.4	1.3	1.3	4.9	7.5	17.6	1.5	0.8	0.6
PASSDS010L	Sunshade Strut 10, local lateral Y '	[g]	4.2	2.2	0.5	1.8	5.0	11.0	2.2	1.0	0.7
PASSDS010P	Sunshade Strut 10, local lateral Z -'	[g]	0.9	1.1	0.7	2.5	5.3	9.2	1.1	0.9	0.3
PASSDS011L	Sunshade Strut 11, local lateral Y '	[g]	4.2	2.2	0.5	1.9	4.9	13.7	2.7	1.2	0.8
PASSDS011P	Sunshade Strut 11, local lateral Z -'	[g]	0.6	0.9	0.6	2.7	4.2	9.4	3.4	1.1	0.4
PASSDS012L	Sunshade Strut 12, local lateral Y '			1.4	0.5	1.4	7.2	10.4	1.5	0.7	0.5
PASSDS012P	Sunshade Strut 12, local lateral Z'	[g]	1.6	1.5	1.2	5.7	7.9	5.2	4.3	1.5	0.8
PATMSF001X	TMS Frame on corner, -Z side - X	[g]	0.2	0.2	0.3	0.5	0.6	0.6	1.1	0.8	0.5
PATMSF001Y	TMS Frame on corner, -Z side - Y	[g]	3.8	2.0	1.4	1.8	2.2	1.4	3.4	5.1	3.8
PATMSF001Z	TMS Frame on corner, -Z side - Z	[g]	0.1	0.4	0.6	0.2	0.4	0.5	0.4	1.2	1.0
PATMSF002X	TMS Frame on corner, +Y side - X	[g]	1.3	1.6	1.1	1.4	1.4	1.4	0.7	0.9	0.3
PATMSF002Y	TMS Frame on corner, +Y side - Y	[g]	3.9	2.0	0.9	1.6	1.2	1.0	1.6	1.6	4.0
PATMSF002Z	TMS Frame on corner, +Y side - Z	[g]	0.7	1.1	0.8	0.2	0.5	0.6	0.7	3.0	4.4
PATMSF003X	TMS Frame on corner, -Y side - X	[g]	1.1	1.7	1.2	1.4	1.0	1.2	1.0	0.6	0.4
PATMSF003Y	TMS Frame on corner, -Y side - Y	[g]	3.9	2.1	1.1	1.4	1.2	0.8	1.6	1.6	4.5
PATMSF003Z	TMS Frame on corner, -Y side - Z	[g]	0.3	0.4	0.6	0.6	0.6	0.5	0.9	2.3	3.3
PALOUS001X	LOU CoG position - X	[g]	1.5	18.4	26.1	2.3	1.1	0.9	4.0	5.9	2.4
PALOUS001Y	LOU CoG position - Y	[g]	2.3	16.7	16.6	1.3	0.9	0.8	1.6	1.7	0.9
PALOUS001Z	LOU CoG position - Z	[g]	0.2	13.7	13.0	1.7	1.4	1.3	0.3	1.1	0.6
PALOUS002X	LOU Baseplate - X	[g]	1.5	3.3	2.1	2.6	1.2	0.9	4.3	6.6	2.8
PALOUS002Y	LOU Baseplate - Y	[g]	2.6	4.6	1.0	1.0	1.7	1.2	1.6	1.5	1.4
PALOUS002Z	LOU Baseplate - Z	[g]	0.2	0.5	0.4	1.0	1.2	0.8	0.5	1.0	0.6
PALOUR002X	LOU Radiator CoG position - X	[g]	1.8	15.3	14.2	2.5	1.7	1.5	4.3	5.7	1.9
PALOUR002Y	LOU Radiator CoG position - Y, R	[g]	2.5	20.5	20.1	1.8	0.6	0.4	1.8	2.7	1.2
PALOUR002Z	LOU Radiator CoG	[g]	0.2	2.1	1.4	12.4	5.8	1.1	0.9	1.2	1.2

	Associated Equipment	Herschel_ STM_ Y maxB_QLY1_Fundamental "Qualification_Level_Y"_ Test 04.02.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
	position - Z,T										
PALOUR003O	LOU Radiator Corner local oop - oop (local),R	[g]	2.7	49.6	48.5	3.3	12.8	11.4	4.7	7.2	7.1
PACVVU001X	Upper CVV Ring, -Y position, STA 2222 > X	[g]	1.3	2.2	1.4	1.5	0.5	0.5	0.9	0.5	0.4
PACVVU001Z	Upper CVV Ring, -Y position, STA 2222 > Z	[g]	0.2	0.6	0.2	0.5	0.6	0.3	0.5	0.7	0.3
PACVVU002X	Upper CVV Ring, -Z position, STA 2222 > X	[g]	0.1	0.2	0.3	0.5	0.2	0.3	0.5	0.2	0.3
PACVVU002Y	Upper CVV Ring, -Z position, STA 2222 > Y	[g]	2.4	1.1	0.7	1.2	1.7	1.3	1.4	0.7	0.8
PACVVU003X	Upper CVV Ring, +Y position, STA 2222 > X	[g]	1.4	2.1	1.6	1.4	0.6	0.6	0.7	0.8	0.5
PACVVU003Z	Upper CVV Ring, +Y position, STA 2222 > Z	[g]	0.4	0.4	0.1	0.6	0.8	0.6	0.3	0.4	0.4
PACVVB005X	Cryostat Baffle I/F +Y near Solar Array Strut, > X	[g]	1.4	1.2	0.7	0.8	0.3	0.3	0.8	0.3	0.2
PACVVB005Y	Cryostat Baffle I/F +Y near Solar Array Strut > Y	[g]	3.0	1.5	0.1	1.5	1.3	1.0	1.1	0.9	0.9
PACVVB005Z	Cryostat Baffle I/F +Y near Solar Array Strut > Z	[g]	0.7	0.3	0.2	0.6	0.7	0.3	0.6	0.8	0.5
PACVVL006X	Lower CVV Ring, -Y position, STA 544 > X	[g]	1.0	1.3	0.8	1.1	0.5	0.3	0.5	0.3	0.4
PACVVL006Z	Lower CVV Ring, -Y position, STA 544 > Z	[g]	0.3	0.8	0.8	0.6	0.7	0.4	0.8	0.5	0.5
PACVVL007X	Lower CVV Ring, -Z position, STA 544 > X	[g]	0.4	0.1	0.2	0.4	0.2	0.3	0.4	0.1	0.3
PACVVL007Y	Lower CVV Ring, -Z position, STA 544 > Y	[g]	1.6	3.4	2.3	1.5	1.9	1.7	1.4	1.4	1.2
PACVVL008X	Lower CVV Ring, +Y position, STA 544 > X	[g]	1.1	1.3	0.9	1.3	0.5	0.2	0.6	0.7	0.7
PACVVL008Z	Lower CVV Ring, +Y position, STA 544 > Z	[g]	0.1	0.4	0.7	0.7	0.6	0.6	0.2	0.3	0.4
PACSTR010X	STR I/F pad on CVV Lower Bulkhead, -Z/+Y >X	[g]	0.4	0.7	0.5	1.1	0.7	1.6	3.0	1.6	0.5
PACSTR010Y	STR I/F pad on CVV Lower Bulkhead, -Z/+Y > Y	[g]	1.4	3.6	2.7	2.4	1.5	1.3	1.3	1.6	1.4
PACSTR010Z	STR I/F pad on CVV Lower Bulkhead, -Z/+Y > Z	[g]	0.6	1.5	1.3	0.9	0.9	1.1	0.3	0.7	0.4
PACVVR001O	CVV -Z/+X Radiator, CoG position, oop (local), >T	[g]	2.1	2.0	2.0	1.4	1.9	4.1	3.1	15.9	23.2
PACVVR002O	CVV -Z/-X Radiator, CoG position, oop (local), >T	[g]	1.7	3.4	2.3	1.5	2.2	2.4	4.3	6.2	11.6
PACVVR003O	CVV +Y/+X Radiator, CoG position , oop (local), >T	[g]	0.9	0.6	0.6	1.0	0.6	0.8	0.4	0.5	0.7
PACVVR004O	CVV +Y/-X Radiator, CoG position, oop (local), >T	[g]	0.2	0.6	0.7	1.1	0.4	0.5	0.3	0.7	1.3
PACVVR005O	CVV -Y/+X Radiator, CoG position	[g]	0.6	0.8	1.1	0.7	0.9	0.6	0.7	0.9	1.4
PACVVR006O	CVV -Y/-X Radiator, CoG position	[g]	0.6	1.3	1.5	0.7	1.1	0.6	1.8	1.0	1.8
PACCRM003X	Cryo Cover release mechanism > X	[g]	0.1	0.1	0.1	0.3	0.1	0.2	0.7	0.4	0.5
PACCRM003Y	Cryo Cover release mechanism > Y	[g]	3.3	1.7	0.3	1.7	1.5	1.2	1.5	1.2	1.4

	Associated Equipment	Herschel_ STM_ Y maxB_QLY1_Fundamental "Qualification_Level_Y"_ Test 04.02.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PACCCV031X	Cryo Cover CVV I/F (Pilot 31 @ AAE test) > X	[g]	0.1	0.1	0.1	0.3	0.1	0.2	0.8	0.5	0.5
PACCCV031Y	Cryo Cover CVV I/F (Pilot 31 @ AAE test) > Y	[g]	3.1	1.6	0.2	1.4	1.3	1.0	1.1	0.8	0.9
PACCCV031Z	Cryo Cover CVV I/F (Pilot 31 @ AAE test) > Z	[g]	0.3	0.1	0.1	0.2	0.3	0.4	0.3	0.5	0.3
PACCCV032X	Cryo Cover CVV I/F (Pilot 32 @ AAE test) > X	[g]	0.1	0.2	0.3	0.3	0.1	0.1	0.7	0.6	0.3
PACCCV032Y	Cryo Cover CVV I/F (Pilot 32 @ AAE test) > Y	[g]	3.2	1.5	0.1	1.3	1.1	0.9	1.1	0.8	0.9
PACCCV032Z	Cryo Cover CVV I/F (Pilot 32 @ AAE test) Y Z	[g]	0.7	0.3	0.2	0.1	0.3	0.3	0.2	0.1	0.2
PACCYO006X	Cryo Cover yoke>- X	[g]	0.1	0.1	0.2	0.2	0.1	0.2	0.7	0.4	0.3
PACCJC008Y	Cryo Cover Johnston coupling >C419 Y	[g]	3.3	1.6	0.3	1.6	1.3	1.1	1.4	1.2	1.2
PACBAF001O	Cryostat Baffle, +Y, position near I/F - oop (local),R	[g]	0.8	0.9	0.6	0.8	0.3	0.2	0.7	0.8	0.7
PACBAF002O	Cryostat Baffle, -Z, position near I/F - oop (local),R	[g]	0.1	0.1	0.1	0.3	0.1	0.2	0.6	0.2	0.4
PACBAF011O	Cryostat Baffle cone area, -Z, oop (local),N	[g]	0.3	0.2	0.2	0.2	0.2	0.2	0.5	0.3	0.2
PANOZL001X	Nozzle Bracket > X	[g]	0.2	0.3	0.4	0.6	0.4	0.6	1.2	1.5	1.0
PANOZL001Y	Nozzle Bracket > Y	[g]	1.8	3.7	2.5	1.8	1.8	2.5	6.4	10.6	2.5
PACVVV001X	CVV Valve Bracket > X	[g]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACVVV001O	CVV Valve Bracket > Y	[g]	1.5	2.5	1.8	1.1	1.0	1.6	0.9	1.5	1.6
PACVVV001T	CVV Valve Bracket > Z	[g]	0.8	1.7	1.3	0.7	1.2	0.6	1.1	0.7	0.7
PAWAVG001Y	Waveguide > Y (outer WG on -Z-side)	[g]	1.4	3.2	2.0	4.2	4.7	14.8	5.6	8.3	19.0
PAWAVG001Z	Waveguide > Z (5th WG on +Z-side)	[g]	0.3	0.5	0.7	0.4	1.5	1.3	1.1	1.1	1.4
PAWAVG002X	Waveguide Bracket > X	[g]	1.4	3.5	2.2	2.5	1.1	1.2	4.3	6.0	2.1
PAWAVG002Y	Waveguide Bracket > Y	[g]	1.7	3.4	2.2	1.7	1.4	1.4	1.1	1.3	1.0
PAWAVG002Z	Waveguide Bracket > Z	[g]	0.2	1.1	0.7	0.6	0.7	0.5	0.7	0.5	0.7
PASVTS001X	SVM Thermal Shield, -Z side, over strut support > X	[g]	0.1	0.1	0.1	0.7	11.5	6.7	0.8	1.1	0.7
PASVTS001Y	SVM Thermal Shield, -Z side, over strut support > Y	[g]	1.4	1.1	1.1	1.7	2.9	2.7	8.5	3.0	2.3
PASVTS001Z	SVM Thermal Shield, -Z, over strut support > Z	[g]	0.2	0.1	0.2	0.3	1.2	0.8	1.8	1.0	1.4
PASVTS002X	SVM Thermal Shield, -Y side > X	[g]	0.5	0.3	0.2	3.5	25.4	25.5	4.9	4.2	5.8
PASVTS002Y	SVM Thermal Shield, -Y side > Y	[g]	1.1	1.3	1.2	2.0	4.6	4.9	12.4	5.9	5.7
PASVTS002Z	SVM Thermal Shield, -Y side > Z	[g]	0.7	0.1	0.1	0.4	2.4	2.4	4.4	2.8	3.0
PASVTS003X	SVM Thermal Shield, +Y side > X	[g]	0.3	0.3	0.2	1.0	2.7	2.5	0.8	0.8	1.7
PASVTS003Y	SVM Thermal Shield, +Y side > Y	[g]	1.2	1.1	1.1	2.0	4.1	2.5	12.1	4.6	2.7
PASVTS003Z	SVM Thermal Shield, +Y side > Z	[g]	0.1	0.2	0.1	0.6	1.5	1.0	5.5	3.3	3.9
PATELD001X	Telescope dummy M2 IF	[g]	0.6	1.2	1.0	0.2	1.9	1.9	3.5	2.6	0.4
PATELD001Y	Telescope dummy M2 IF	[g]	6.2	8.8	6.6	2.2	1.1	0.2	0.2	0.2	0.2

	Associated Equipment	Herschel_ STM_ Y maxB_QLY1_Fundamental "Qualification_Level_Y"_ Test 04.02.2006									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PATELD001Z	Telescope dummy M2 IF	[g]	0.5	1.6	2.1	0.3	0.2	0.2	0.2	0.3	0.4
PATELD002X	Telescope dummy -Z/-Y triangle arm > X1	[g]	1.9	4.4	2.9	1.9	14.3	14.4	2.9	3.8	1.2
PATELD002Z	TMD Inner Corner -Y/-Z (as for GA71013 > X1	[g]	0.5	1.8	2.0	2.3	0.8	1.1	0.3	0.6	0.3
PATELD003X	Telescope dummy -Z arm > X2	[g]	0.3	0.4	1.0	1.3	2.1	4.6	5.5	1.3	0.8
PATELD003X	TMD Outer Corner -Z (as for GA71017) > Y6	[g]	0.3	0.4	1.0	1.3	2.1	4.6	5.5	1.3	0.8
PATELD004X	Telescope dummy Centre Plate, CoG > X3	[g]	0.2	0.9	1.7	0.7	5.4	5.4	4.5	5.2	1.0

Exccedance	**Qual. level**	**Allowable**	**Status (**LOU CoG position)
PALOUS001X	18.4/26.1g	15.0g	
PALOUS001Y	16.7/16.6g	15.0g	
PALOUS001Z	13.7/13.0g	5.0g	

Annex 3.2: Y-Qualification Run HEPLM Max Global Strut Forces

	MPP	BA	Associated Equipment	Herschel_ STM_ Y maxB_QLY1_Global "Qualification_Level_Y"_ Test 04.02.2006									
	MPP	BA		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PSTMSS041A	MPP	BA	TMS Strut, 0°, axial dir., -Z - X'	[N]	14146	19506	14911	6894	3064	2418	2150	1630	798
PSTMSS051A	MPP	BA	TMS Strut, 0°, axial dir., -Z	[N]	12715	17799	13658	5749	2499	2531	1281	858	551
PSTMSS061A	MPP	BA	TMS Strut, 0°, axial dir., +Y	[N]	9062	13871	12237	2170	3232	3219	446	488	676
PSTMSS071A	MPP	BA	TMS Strut, 0°, axial dir., +Y	[N]	6051	11080	11159	3123	3748	3854	689	712	740
PSTMSS081A	MPP	BA	TMS Strut, 0°, axial dir., -Y	[N]	5511	7548	7880	2657	4064	4467	1223	1377	1209
PSTMSS091A	MPP	BA	TMS Strut, 0°, axial dir., -Y	[N]	10351	15229	11559	2328	1867	2556	2472	2923	1209
PSTMSS101A	MPP	BA	TMS CB Strut, 0°/180°, T-rosette 0/90	[N]	563	714	702	123	101	65	173	232	187
PSTMSS111A	MPP	BA	TMS CB Strut, 0°/180°, T-rosette 0/90	[N]	90	587	597	107	45	37	62	178	185
PSLOUS041A	MPP	BA	LOU Strut, 0°/180°, T-rosette 0/90; +X/+Z	[N]	833	4749	4697	556	455	934	514	464	350
PSLOUS061A	MPP	BA	LOU Strut, 0°/180°, T-rosette 0/90; ++Z	[N]	488	2075	1936	1099	667	382	1162	1632	571
PSLOUS071A	MPP	BA	LOU Strut, 0°/180°, T-rosette 0/90; --Z	[N]	473	2635	2551	500	313	284	845	1355	544
PSLOUS081A	MPP	BA	LOU Strut, 0°/180°, T-rosette 0/90; --Z	[N]	535	2914	2871	413	532	433	244	248	161
PSLOUS091A	MPP	BA	LOU Strut, 0°/180°, T-rosette 0/90; --Z	[N]	1018	5348	5048	907	442	480	1916	2707	1222
PSSVMS011A	MPP	BA	PLM-SVM Strut +Y, 0°, axial dir.	[N]	7345	4904	4099	2393	844	269	323	339	269
PSSVMS021A	MPP	BA	PLM-SVM Strut +Y, 0°, axial dir.	[N]	12070	6542	3964	1732	615	332	368	471	266
PSSVMS031A	MPP	BA	PLM-SVM Strut -Y, 0°, axial dir.	[N]	11495	6954	5414	1969	789	410	506	302	295
PSSVMS041A	MPP	BA	PLM-SVM Strut -Y, 0°, axial dir.	[N]	7969	4908	2907	1921	717	337	463	383	219
PSSVMS051A	MPP	BA	PLM-SVM Strut +Z, 0°, axial dir.	[N]	8382	5596	4696	1606	1038	849	496	611	332
PSSVMS061A	MPP	BA	PLM-SVM Strut +Z, 0°, axial dir.	[N]	8169	6812	6553	2002	1213	510	472	483	397
PSSVMS071A	MPP	BA	PLM-SVM Strut -Z, 0°, axial dir.	[N]	7180	7138	5486	1216	911	695	603	564	488
PSSVMS081A	MPP	BA	PLM-SVM Strut -Z, 0°, axial dir.	[N]	7358	7916	6846	1801	1105	616	675	683	702

Annex 3.3: Y-Qualification Run HSS Global Max Strut Forces:

QLY1-Global	5-20	20-30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80	80 - 90	90 - 100
HSS09-SB1FA	227	341	205	501	318	160	151	139	133
HSS10-SB2FA	1975	909	139	378	170	77	86	46	46
HSS11-SB3FA	554	339	155	268	280	126	165	161	112
HSS1-2_FX	8687	4593	1742	3691	5145	5165	7133	2308	1811
HSS1-2_FY	964	685	459	1089	1422	975	1956	710	609
HSS1-2_FZ	4608	2413	659	1236	1818	2440	3239	738	524
HSS1-2_MLat	11	6	4	16	13	18	23	6	4
HSS1-2Tors	6	3	2	8	7	9	11	3	2
HSS3-4_FX	8228	4563	2333	3719	3982	6017	8948	2791	1628
HSS3-4_FY	234	432	274	751	665	218	1560	636	366
HSS3-4_FZ	4167	2322	1025	1339	1524	3018	4222	944	612
HSS3-4_MLat	12	11	6	19	17	23	49	15	5
HSS3-4Tors	6	5	3	8	8	12	23	6	2
S01FA	1282	1375	1022	2508	3168	2009	4653	1648	1463
S01MA	8	5	4	15	18	18	41	16	12
S01MHSS	2	1	1	4	4	4	10	4	3
S02FA	9140	4748	1033	1670	2618	4504	5900	939	567
S02MA	15	7	5	19	14	23	23	5	2
S02MHSS	12	6	4	15	11	18	18	4	2
S03FA	8079	4512	1809	1968	2401	5816	7936	1344	940
S03MA	16	10	5	19	17	29	56	12	3
S03MHSS	12	8	4	15	13	23	44	9	2
S04FA	1325	1473	845	2249	2114	1057	4682	1853	1067
S04MA	17	19	11	30	28	14	61	32	14
S04MHSS	4	5	3	7	7	3	15	8	3
S05FA	874	1563	670	1433	1975	3663	817	378	363
S05MA	6	4	4	14	12	26	9	4	2
S05MHSS	4	3	2	9	8	17	6	2	1
S06FA	1949	1491	955	979	1165	2345	2233	315	277
S06MA	6	4	2	5	9	18	10	3	2
S06MHSS	2	2	1	2	3	7	4	1	1
S07FA	2357	1797	1049	1080	1012	2707	3398	739	259
S07MA	7	5	3	9	8	10	18	3	3
S07MHSS	3	2	1	3	3	4	7	1	1
S08FA	982	2205	1434	1842	2158	3373	1060	653	329
S08MA	7	8	8	12	10	21	15	7	2
S08MHSS	5	5	5	8	6	14	10	4	1
S09FA	1783	2090	1590	947	1566	2285	292	198	245
S09MA	11	6	8	7	12	16	3	2	2
S09MHSS	5	3	4	4	6	8	1	1	1
S10FA	996	1019	1200	541	719	1330	362	178	177
S10MA	16	13	15	7	9	17	6	3	3
S10MHSS	5	4	5	2	3	5	2	1	1
S11FA	1676	1861	1564	743	1499	3412	817	309	278
S11MA	12	11	7	7	6	22	5	2	1
S11MHSS	4	3	2	2	2	7	1	1	0
S12FA	1762	2682	1688	1121	1675	2099	754	291	227
S12MA	13	10	9	10	11	16	5	3	2
S12MHSS	6	5	4	5	5	8	2	1	1

Annex 3.4: Y-Qualification Run SVM Max Global IF Forces:

QLY1-Global	5-20	20-30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80	80 - 90	90 - 100
SVM+Y:FX_1-2	16697	9575	6134	3548	1254	435	594	695	435
SVM+Y:FY_1-2	1615	926	593	343	121	42	58	67	42
SVM+Y:FZ_1-2	2433	1317	1270	357	188	96	139	69	89
SVM+Z:FX_5-6	14565	10919	9482	3176	1981	1190	710	960	641
SVM+Z:FY_5-6	157	944	1053	208	76	151	107	71	53
SVM+Z:FZ_5-6	2878	2158	1874	628	391	235	140	190	127
SVM1FA	7345	4904	4099	2393	844	269	323	339	269
SVM2FA	12071	6542	3964	1732	615	332	368	471	266
SVM3FA	11495	6954	5414	1969	789	410	506	302	295
SVM4FA	7969	4908	2907	1921	717	337	463	383	219
SVM5FA	8382	5596	4696	1606	1039	849	496	612	332
SVM6FA	8169	6812	6553	2002	1213	510	472	483	397
SVM7FA	7180	7138	5486	1216	911	695	603	564	488
SVM8FA	7358	7916	6846	1801	1105	616	675	683	702
SVM-Y:FX_3-4	16739	10202	6747	3342	1296	467	790	577	423
SVM-Y:FY_3-4	1619	987	653	323	125	45	76	56	41
SVM-Y:FZ_3-4	1815	1454	1535	348	239	173	137	86	62
SVM-Z:FX_7-8	13084	13549	10565	2652	1814	1179	1133	1116	1066
SVM-Z:FY_7-8	165	786	885	330	94	152	155	57	106
SVM-Z:FZ_7-8	128	132	103	26	18	12	11	11	10

Y-Qualification Run SVM Global IF Forces:

		MEASURED			ALLOWABLE			ALLOWABLE REACHED %		
		Fx [N]	Fy [N]	Fz [N]	Fx [N]	Fy [N]	Fz [N]			
PLM-SVM I/F	Corner +Z	14600	1100	3000	27800	5996	2458	53	18	122
	Corner -Z	`13600	1000	200	27457	5490	4248	61	31	42
	Corner +Y	16700	1700	2500	27457	5490	4248	61	31	59
	Corner -Y	16700	1700	1800	27457	5490	4248	61	31	42

		MEASURED					ALLOWABLE					ALLOWABLE REACHED %				
		F_X [N]	F_Y [N]	F_Z [N]	M_{Lat} [Nm]	M_{Tors} [Nm]	F_X [N]	F_Y [N]	F_Z [N]	M_{Lat} [Nm]	M_{Tors} [Nm]					
HSS-SVM I/F	Struts 1-2	9600	2000	4600	22.5	11	27457	5490	4248	40	15	31	36	108	56	73
	Struts 2-3	9000	1500	4300	49	24	27457	5490	4248	40	15	33	27	101	123	160

Annex 4.1: Z-Qualification Run HEPLM Max Acceleration levels:

	Associated Equipment		Herschel_ STM_ Z maxB_QLZ1_Fundamental "Qualification Level"_ Test 01.02.2006								
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PACRYO101X	HTT Upper BH - X	[g]	0.4	1.1	1.1	1.3	0.3	0.3	0.5	0.3	0.6
PACRYO102Y	HTT Upper BH - Y	[g]	0.2	0.3	0.2	0.7	0.3	0.2	0.2	0.5	1.0
PACRYO103Z	HTT Upper BH - Z	[g]	2.2	5.1	5.1	0.8	0.9	0.8	1.2	1.1	1.7
PACRYO103 - 3D	HTT Upper BH - 3D	[g]	2.2	5.2	5.2	1.7	1.0	0.8	1.3	1.3	2.1
PACRYO104X	HTT Lower BH - X	[g]	0.6	0.4	0.3	2.3	0.5	0.7	0.7	0.4	0.8
PACRYO105Y	HTT Lower BH - Y	[g]	0.1	0.7	0.6	1.4	0.4	0.2	0.3	0.6	0.7
PACRYO106Z	HTT Lower BH - Z	[g]	1.5	6.8	6.1	4.3	1.7	0.6	0.6	1.1	1.1
PACRYO104,5, 6 - 3D	HTT Upper BH - 3D	[g]	1.6	6.8	6.1	5.1	1.8	0.9	1.0	1.3	1.5
PACRYO107X	HTT Upper BH - X	[g]	0.1	0.4	0.4	0.9	0.4	0.3	0.8	0.4	0.2
PACRYO108Z	HTT Lower BH - Z	[g]	2.0	6.5	5.9	4.2	1.5	0.4	0.5	0.9	0.8
PACRYO109Y	HTT Lower BH - Y	[g]	0.1	0.4	0.4	1.0	0.6	0.3	0.2	0.4	0.4
PACRYO1037, 8,9- 3D	HTT Upper BH - LAT8Z,9Y	[g]	2.0	6.5	5.9	4.3	1.6	0.5	0.5	0.9	0.9
PACRYO201X	OBA (+Y), unit level 23X	[g]	0.1	0.4	0.4	0.6	0.4	0.9	2.4	0.6	0.4
PACRYO202Y	OBA (+Y), unit level 23Y	[g]	0.2	0.6	0.5	1.3	0.7	0.7	0.5	0.2	0.2
PACRYO203Z	OBA (+Y), unit level 26Z	[g]	2.3	4.5	4.5	3.8	0.7	0.4	0.6	0.9	0.6
PACRYO201_2 ,3-3-D	OBA (+Y), Lat vector, 23x,23y,26z-3D		2.3	4.6	4.5	4.1	1.1	1.2	2.5	1.1	0.8
PACRYO204X	OBA (+Y), unit level 24X	[g]	0.1	0.4	0.4	1.0	0.3	0.9	2.3	0.5	0.4
PACRYO205Z	OBA (+Y), unit level 24Z	[g]	2.3	4.7	4.3	4.2	0.9	0.3	0.6	1.0	0.7
PACRYO206Y	OBA (+Y), unit level 27Y	[g]	0.2	0.9	0.6	1.3	1.3	0.9	0.4	0.2	0.8
PACRYO204,5, 6-3-D	OBA (+Y), 24,27-3D	[g]	2.3	4.8	4.4	4.5	1.7	1.2	2.5	1.1	1.2
PACRYO207Y	PACS FPU Y, Upper Surface, not CoG	[g]	0.2	0.3	0.2	2.9	1.0	1.2	2.5	0.4	0.8
PACRYO208Z	PACS FPU Z, Upper Surface, not CoG	[g]	2.8	4.6	4.6	11.2	3.0	2.2	2.6	1.5	1.0
PACRYO421X	1st Shield - X	[g]	0.1	0.4	0.6	1.6	0.7	0.4	0.4	0.3	0.2
PACRYO422Z	1st Shield - Z	[g]	2.5	5.0	5.0	3.7	1.4	1.4	0.8	0.4	1.1
PACRYO701X	HOT Upper BH - X	[g]	0.3	0.9	0.7	0.6	0.3	0.8	1.4	1.7	2.3
PACRYO702Y	HOT Upper BH - Y	[g]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACRYO703Z	HOT Upper BH - Z	[g]	1.6	5.7	5.1	3.9	1.3	1.1	0.9	1.0	1.5
PAHSSP001X	Top of Sunshade - X	[g]	1.8	2.0	0.5	1.6	1.9	1.2	1.9	1.6	0.4
PAHSSP001Y	Top of Sunshade - Y	[g]	0.4	1.3	1.4	1.2	2.4	1.3	1.3	0.5	1.2
PAHSSP001Z	Top of Sunshade - Z	[g]	11.4	23.5	9.6	5.4	7.4	4.5	9.1	3.6	2.0
PAHSSP002Z	Top of Sunshade mid-panel - Z	[g]	7.1	11.6	4.2	1.6	1.2	0.9	2.0	2.6	2.7
PAHSSP003O	-Y side of Sunshade - oop (local), O	[g]	8.1	20.0	12.5	1.5	1.7	1.8	2.0	6.3	4.7
PAHSSP004O	+Y side of Sunshade mid-panel - oop (local), O	[g]	7.5	21.6	8.6	2.7	1.5	2.9	1.7	8.6	6.6
PAHSSP005X	-Y side of Sunshade - X	[g]	0.3	1.1	0.7	2.1	3.3	1.7	1.9	1.4	0.8
PAHSSP005T	-Y side of Sunshade - T	[g]	4.0	4.2	1.9	1.4	2.0	0.9	0.7	0.5	0.6
PAHSSP005O	-Y side of Sunshade - O	[g]	5.9	12.6	8.2	3.1	1.7	0.5	1.3	2.7	2.4
PAHSSP006X	+Y side of Sunshade - X	[g]	0.6	1.1	0.8	1.6	2.7	1.1	0.8	1.0	1.1
PAHSSP006T	+Y side of Sunshade - T	[g]	3.7	5.8	2.0	1.1	2.4	0.9	1.3	0.5	0.6
PAHSSP006O	+Y side of Sunshade - O	[g]	5.1	14.4	8.1	3.2	1.7	0.6	1.2	3.2	2.2
PAHSSP007X	-Y side of Sunshade near Horizontal Stiffener - X	[g]	0.9	1.1	0.8	2.0	3.2	1.6	1.9	1.5	0.9

	Associated Equipment		Herschel_ STM_ Z maxB_QLZ1_Fundamental "Qualification Level"_ Test 01.02.2006								
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PAHSSP007T	-Y side of Sunshade near Horizontal Stiffener - T	[g]	2.4	0.9	0.3	0.4	1.6	1.1	1.2	1.1	0.6
PAHSSP007O	-Y side of Sunshade near Horizontal Stiffener - O	[g]	2.1	1.1	0.7	0.5	0.7	0.6	0.5	0.3	0.3
PAHSSP008Z	Sunshade mid panel near Horizontal Stiffener - Z	[g]	3.1	1.3	0.5	0.8	1.1	0.6	0.8	0.8	0.7
PAHSSP009T	+Y side of Sunshade near Horizontal Stiffener - T	[g]	2.7	1.1	0.4	0.8	1.9	1.7	0.6	1.5	0.9
PAHSSP009O	+Y side of Sunshade near Horizontal Stiffener - O	[g]	1.9	2.1	1.1	0.4	0.5	0.5	0.4	0.5	0.6
PAHSSP101X	-Y side of Solar Array, near upper hor.stiff. - X	[g]	0.6	0.3	0.5	1.9	2.8	1.4	1.7	1.4	0.6
PAHSSP101T	-Y side of Solar Array, near upper hor.stiff. - T	[g]	1.7	1.0	0.7	0.7	0.9	0.6	0.5	0.3	0.3
PAHSSP101O	-Y side of Solar Array, near upper hor.stiff. - O	[g]	2.3	1.1	0.7	0.4	2.3	1.0	1.3	0.5	1.1
PAHSSP102Y	Solar Array, near upper hor.stiff., mid-panel - Y	[g]	0.3	1.3	0.8	0.3	0.6	0.3	0.2	0.5	0.5
PAHSSP102Z	Solar Array, near upper hor.stiff., mid-panel - Z	[g]	3.0	1.5	0.6	0.9	1.1	0.7	0.9	0.9	0.8
PAHSSP103X	+Y side of Solar Array, near upper hor.stiff. - X	[g]	0.6	0.7	0.5	1.4	2.3	1.0	0.7	1.1	0.8
PAHSSP103T	+Y side of Solar Array, near upper hor.stiff. - T	[g]	1.6	1.8	1.0	0.5	0.5	0.7	0.4	0.4	0.7
PAHSSP103O	+Y side of Solar Array, near upper hor.stiff. - O	[g]	1.9	0.8	0.7	0.8	1.8	2.1	0.5	1.1	1.8
PAHSSP104T	Solar Array, -Y side - T	[g]	1.2	1.6	0.7	1.2	2.2	1.0	0.8	0.4	0.8
PAHSSP104O	Solar Array, -Y side - oop (local), O	[g]	1.5	1.5	1.6	8.1	8.8	4.3	1.6	3.0	7.2
PAHSSP105Z	Solar Array, panel centre - Z	[g]	1.8	0.9	0.7	2.3	2.5	3.4	2.4	2.2	2.1
PAHSSP106T	Solar Array, +Y side - T	[g]	1.1	0.9	0.7	1.0	1.2	1.3	0.7	0.6	1.4
PAHSSP106O	Solar Array, +Y side - oop (local), O	[g]	2.4	1.7	1.8	4.3	20.6	4.0	2.0	4.2	7.8
PAHSSP107X	Solar Array, near lower hor.stiff., -Y side - X	[g]	0.6	0.6	0.6	1.7	2.6	1.4	1.7	1.5	0.8
PAHSSP107T	Solar Array, near lower hor.stiff., -Y side - T	[g]	0.9	2.5	0.8	1.2	3.8	2.2	1.0	0.8	2.2
PAHSSP107O	Solar Array, near lower hor.stiff., -Y side - O	[g]	1.3	1.5	1.2	3.0	2.3	2.1	1.2	3.9	8.6
PAHSSP108X	Solar Array, near lower hor.stiff., +Y side - X	[g]	0.6	0.5	0.4	1.5	2.4	0.9	0.8	1.1	1.2
PAHSSP108T	Solar Array, near lower hor.stiff., +Y side - T	[g]	0.9	1.5	0.8	1.7	2.3	2.1	1.3	1.1	1.7
PAHSSP108O	Solar Array, near lower hor.stiff., +Y side - O	[g]	1.0	1.4	0.9	2.6	4.5	3.3	2.7	5.2	10.2
PASA-S001L	Solar Array Strut 01, local lateral Y'	[g]	1.1	0.7	0.5	1.2	3.8	6.1	14.3	2.6	1.9
PASA-S001P	Solar Array Strut 01, local lateral Z '	[g]	1.4	0.9	0.7	1.3	2.4	3.6	15.0	8.0	1.6
PASA-S002L	Solar Array Strut 02, local lateral Y'		0.9	1.0	0.6	1.2	3.3	10.0	13.0	3.0	1.1
PASA-S002P	Solar Array Strut 02, local lateral Z '		1.5	0.6	0.8	1.5	5.7	10.4	9.7	1.9	1.2
PASA-S003L	Solar Array Strut 03, local lateral Y '	[g]	1.3	0.7	0.5	1.4	5.4	6.2	12.4	2.7	1.1
PASA-S003P	Solar Array Strut 03, local lateral Z '	[g]	1.2	0.7	0.9	2.6	3.8	14.1	15.1	1.9	0.7
PASA-S004L	Solar Array Strut 04, local lateral Y '		1.3	1.2	0.7	1.3	4.1	2.4	17.1	7.1	1.6
PASA-S004P	Solar Array Strut 04, local lateral Z '		1.1	0.9	0.7	2.1	3.0	4.5	5.6	2.9	2.0
PASA-S005L	Solar Array Strut 05, local lateral Y '		0.2	0.4	0.4	2.7	9.1	11.8	1.2	1.2	0.5
PASA-S005P	Solar Array Strut 05, local lateral Z '		1.6	1.1	0.6	1.4	4.0	15.3	2.9	0.6	1.1
PASA-S006L	Solar Array Strut 06, local lateral Y'	[g]	0.6	1.3	1.2	1.7	5.7	9.0	4.4	1.3	0.4
PASA-S006P	Solar Array Strut 06, local lateral Z '	[g]	2.7	1.0	0.6	1.4	5.3	13.7	9.8	2.8	1.5
PASA-S007L	Solar Array Strut 07, local lateral Y'		0.8	1.2	0.8	2.7	5.4	8.8	11.2	1.2	0.4
PASA-S007P	Solar Array Strut 07, local lateral Z '		2.8	1.0	0.5	1.8	5.7	20.5	18.5	2.3	0.7

	Associated Equipment		Herschel_ STM_ Z maxB_QLZ1_Fundamental "Qualification Level"_ Test 01.02.2006								
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PASA-S008L	Solar Array Strut 08, local lateral Y '	[g]	0.5	0.3	0.5	4.0	8.7	13.1	4.5	1.3	0.3
PASA-S008P	Solar Array Strut 08, local lateral Z -'	[g]	1.6	0.5	0.6	1.5	5.6	14.9	3.4	1.4	0.8
PASSDS009L	Solar Array Strut 09, local lateral Y '		2.8	2.4	0.9	1.0	10.0	13.0	1.9	1.4	0.9
PASSDS009P	Solar Array Strut 09, local lateral Z -'		0.3	1.8	1.1	3.2	8.7	8.8	1.1	1.0	0.7
PASSDS010L	Sunshade Strut 10, local lateral Y '	[g]	0.5	1.1	0.7	0.6	4.7	13.3	2.2	0.5	0.2
PASSDS010P	Sunshade Strut 10, local lateral Z -'	[g]	1.7	2.4	0.7	3.4	10.3	10.1	2.5	1.1	0.3
PASSDS011L	Sunshade Strut 11, local lateral Y '	[g]	0.4	1.1	0.7	0.8	5.6	11.6	2.1	0.5	0.2
PASSDS011P	Sunshade Strut 11, local lateral Z -'	[g]	1.7	2.8	1.0	3.4	10.6	14.7	3.4	1.4	0.3
PASSDS012L	Sunshade Strut 12, local lateral Y '	[g]	2.8	1.2	0.8	1.5	10.0	13.7	1.7	1.6	0.5
PASSDS012P	Sunshade Strut 12, local lateral Z'	[g]	0.4	1.5	1.4	3.2	10.6	7.2	2.8	1.2	0.5
PATMSF001X	TMS Frame on corner, -Z side - X	[g]	1.1	1.6	1.4	1.4	2.5	2.5	1.1	1.3	0.7
PATMSF001Y	TMS Frame on corner, -Z side - Y	[g]	0.2	0.7	0.3	0.4	1.5	1.5	1.5	8.0	5.4
PATMSF001Z	TMS Frame on corner, -Z side - Z	[g]	3.2	1.3	1.2	0.6	1.2	1.3	1.1	2.7	1.3
PATMSF002X	TMS Frame on corner, +Y side - X	[g]	0.4	0.9	0.9	0.6	2.3	2.2	2.1	0.5	0.2
PATMSF002Y	TMS Frame on corner, +Y side - Y	[g]	0.5	0.3	0.3	0.4	0.8	1.1	0.9	1.4	2.1
PATMSF002Z	TMS Frame on corner, +Y side - Z	[g]	3.0	1.7	1.3	0.5	1.5	1.1	1.3	6.4	3.2
PATMSF003X	TMS Frame on corner, -Y side - X	[g]	0.3	1.0	1.0	0.3	0.5	0.7	1.2	0.4	0.2
PATMSF003Y	TMS Frame on corner, -Y side - Y	[g]	0.5	0.9	0.9	0.3	1.1	0.8	0.9	2.3	2.0
PATMSF003Z	TMS Frame on corner, -Y side - Z	[g]	3.1	1.9	1.9	0.4	1.3	1.0	1.3	3.8	2.5
PALOUS001X	LOU CoG position - X	[g]	0.1	0.4	0.4	0.5	0.7	0.9	3.1	1.7	0.6
PALOUS001Y	LOU CoG position - Y	[g]	0.2	0.5	0.6	0.4	0.8	0.5	1.8	0.8	0.9
PALOUS001Z	LOU CoG position - Z	[g]	2.1	2.5	1.5	2.0	2.3	3.2	1.4	1.7	1.3
PALOUS002X	LOU Baseplate - X	[g]	0.3	0.4	0.3	0.5	0.6	0.9	3.0	1.9	0.6
PALOUS002Y	LOU Baseplate - Y	[g]	0.2	0.2	0.1	0.2	1.0	0.9	1.1	0.8	1.2
PALOUS002Z	LOU Baseplate - Z	[g]	2.2	1.8	1.0	1.0	2.1	2.4	1.0	1.4	1.4
PALOUR002X	LOU Radiator CoG position - X	[g]	0.2	0.7	0.9	0.6	1.5	1.3	3.2	1.8	1.1
PALOUR002Y	LOU Radiator CoG position - Y, R	[g]	0.2	0.9	1.2	0.7	0.5	0.5	3.7	1.0	0.5
PALOUR002Z	LOU Radiator CoG position - Z,T	[g]	2.2	4.3	2.7	11.2	9.1	3.7	1.4	2.5	2.9
PALOUR003O	LOU Radiator Corner local oop - oop (local),R	[g]	0.6	2.8	2.9	2.5	16.4	24.6	18.0	13.1	15.7
PACVVU001X	Upper CVV Ring, -Y position, STA 2222 > X	[g]	0.3	0.2	0.2	0.3	0.3	0.4	0.9	0.3	0.2
PACVVU001Z	Upper CVV Ring, -Y position, STA 2222 > Z	[g]	2.0	1.1	0.7	0.5	1.2	0.8	1.0	1.5	0.7
PACVVU002X	Upper CVV Ring, -Z position, STA 2222 > X	[g]	0.8	1.3	1.1	1.4	0.6	0.8	0.8	0.3	0.2
PACVVU002Y	Upper CVV Ring, -Z position, STA 2222 > Y	[g]	0.3	0.6	0.3	0.3	1.1	1.0	0.6	0.7	0.8
PACVVU003X	Upper CVV Ring, +Y position, STA 2222 > X	[g]	0.3	0.5	0.4	0.3	1.0	1.0	1.2	0.3	0.1
PACVVU003Z	Upper CVV Ring, +Y position, STA 2222 > Z	[g]	1.9	0.5	0.4	0.6	1.3	1.1	0.8	1.1	1.3
PACVVB005X	Cryostat Baffle I/F +Y near Solar Array Strut, > X	[g]	1.1	0.6	0.6	0.8	0.4	0.6	1.0	0.7	0.4
PACVVB005Y	Cryostat Baffle I/F +Y near Solar Array Strut > Y	[g]	0.7	0.3	0.1	0.5	1.0	1.1	0.5	0.5	0.3
PACVVB005Z	Cryostat Baffle I/F +Y near Solar Array Strut > Z	[g]	2.5	0.9	0.4	0.4	1.1	0.8	0.9	1.4	0.4
PACVVL006X	Lower CVV Ring, -Y position, STA 544 > X	[g]	0.3	0.2	0.2	0.7	0.3	0.4	0.6	0.2	0.2
PACVVL006Z	Lower CVV Ring, -Y position, STA 544 > Z	[g]	1.6	3.3	2.4	2.1	1.3	1.5	1.2	0.8	0.6
PACVVL007X	Lower CVV Ring, -Z position, STA 544 > X	[g]	0.5	1.0	0.8	1.1	0.5	0.8	0.8	0.3	0.3
PACVVL007Y	Lower CVV Ring, -Z position, STA 544 > Y	[g]	0.1	0.5	0.4	0.4	0.9	0.7	0.3	0.4	1.0

	Associated Equipment		Herschel_ STM_ Z maxB_QLZ1_Fundamental "Qualification Level"_ Test 01.02.2006								
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PACVVL006&7 LAT	Lower CVV Ring,	[g]	1.6	3.4	2.5	2.1	1.6	1.7	1.2	0.9	1.1
PACVVL008X	Lower CVV Ring, +Y position, STA 544 > X	[g]	0.1	0.2	0.1	0.3	0.2	0.3	0.7	0.2	0.2
PACVVL008Z	Lower CVV Ring, +Y position, STA 544 > Z	[g]	1.5	2.9	2.7	2.1	1.6	1.5	1.2	1.0	1.2
PACSTR010X	STR I/F pad on CVV Lower Bulkhead, -Z/+Y >X	[g]	0.4	0.4	0.4	0.2	0.6	0.7	0.9	0.3	0.2
PACSTR010Y	STR I/F pad on CVV Lower Bulkhead, -Z/+Y > Y	[g]	0.6	1.7	1.3	0.8	0.7	0.8	0.8	0.5	0.4
PACSTR010Z	STR I/F pad on CVV Lower Bulkhead, -Z/+Y > Z	[g]	1.3	3.3	2.9	2.5	1.8	1.8	1.2	0.6	0.9
PACSTR010lat	STR I/F pad on CVV Lower Bulkhead, -lateral	[g]	1.4	3.7	3.2	2.6	1.9	1.9	1.4	0.8	1.0
PACVVR001O	CVV -Z/+X Radiator, CoG position, oop (local), >T	[g]	0.1	0.9	0.5	0.4	1.0	1.3	1.0	3.0	5.9
PACVVR002O	CVV -Z/-X Radiator, CoG position, oop (local), >T	[g]	0.1	0.8	0.5	0.4	1.0	1.0	0.9	1.7	7.6
PACVVR003O	CVV +Y/+X Radiator, CoG position , oop (local), >T	[g]	2.0	1.9	1.9	0.8	1.2	1.4	1.9	1.8	2.0
PACVVR004O	CVV +Y/-X Radiator, CoG position, oop (local), >T	[g]	1.7	2.8	2.8	1.6	1.3	1.0	2.5	2.0	3.4
PACVVR005O	CVV -Y/+X Radiator, CoG position	[g]	2.0	2.0	1.3	0.5	1.3	1.2	2.0	2.1	2.0
PACVVR006O	CVV -Y/-X Radiator, CoG position	[g]	1.7	3.0	2.1	1.3	1.3	1.0	3.7	1.7	2.6
PACCRM003X	Cryo Cover release mechanism > X	[g]	0.7	0.5	0.2	0.6	0.2	0.4	1.0	0.4	0.3
PACCRM003Y	Cryo Cover release mechanism > Y	[g]	0.2	0.2	0.1	0.3	1.0	1.0	0.9	0.5	0.5
PACCCV031X	Cryo Cover CVV I/F (Pilot 31 @ AAE test) > X	[g]	0.7	0.3	0.2	0.5	0.2	0.4	1.2	0.3	0.4
PACCCV031Y	Cryo Cover CVV I/F (Pilot 31 @ AAE test) > Y	[g]	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0
PACCCV031Z	Cryo Cover CVV I/F (Pilot 31 @ AAE test) > Z	[g]	2.7	1.0	0.2	0.5	1.0	1.0	0.9	1.4	0.4
PACCCV032X	Cryo Cover CVV I/F (Pilot 32 @ AAE test) > X	[g]	0.1	0.6	0.6	0.2	0.2	0.3	1.3	0.4	0.4
PACCCV032Y	Cryo Cover CVV I/F (Pilot 32 @ AAE test) > Y	[g]	0.2	0.0	0.0	0.3	0.8	0.8	0.6	0.3	0.5
PACCCV032Z	Cryo Cover CVV I/F (Pilot 32 @ AAE test) Y Z	[g]	0.7	0.2	0.1	0.3	1.0	0.3	0.2	0.2	0.2
PACCYO006X	Cryo Cover yoke>- X	[g]	0.2	0.3	0.3	0.3	0.2	0.2	1.3	0.1	0.2
PACCJC008Y	Cryo Cover Johnston coupling >C419 Y	[g]	0.1	0.1	0.2	0.3	0.8	0.9	0.9	0.4	0.7
PACBAF001O	Cryostat Baffle, +Y, position near I/F - oop (local),R	[g]	0.1	0.3	0.3	0.2	0.2	0.4	1.1	0.2	0.6
PACBAF002O	Cryostat Baffle, -Z, position near I/F - oop (local),R	[g]	0.5	0.7	0.5	0.7	0.3	0.5	1.0	0.4	0.2
PACBAF011O	Cryostat Baffle cone area, -Z, oop (local),N	[g]	0.6	0.2	0.2	0.4	0.5	0.4	1.3	0.4	0.2
PANOZL001X	Nozzle Bracket > X	[g]	1.4	1.9	1.4	1.8	0.9	1.4	3.8	0.8	1.3
PANOZL001Y	Nozzle Bracket > Y	[g]	0.1	0.9	0.6	0.5	0.9	0.9	1.4	1.2	2.9
PACVVV001X	CVV Valve Bracket > X	[g]	0.6	0.6	0.5	1.0	0.4	0.5	0.7	0.3	0.2
PACVVV001O	CVV Valve Bracket > Y	[g]	1.0	1.1	1.0	1.5	1.5	1.0	1.8	0.7	0.8
PACVVV001T	CVV Valve Bracket > Z	[g]	1.5	2.7	1.8	1.4	1.2	1.2	1.2	0.9	0.7
PAWAVG001Y	Waveguide > Y (outer WG on -Z-side)	[g]	0.1	0.3	0.3	1.2	2.1	3.6	4.0	3.5	8.4
PAWAVG001Z	Waveguide > Z (5th WG on +Z-side)	[g]	1.3	2.4	1.2	2.3	2.2	1.3	1.7	2.3	2.1
PAWAVG002X	Waveguide Bracket > X	[g]	0.3	0.4	0.4	0.9	0.5	0.9	2.6	1.3	1.9
PAWAVG002Y	Waveguide Bracket > Y	[g]	0.1	0.3	0.3	0.4	0.6	0.5	0.5	0.3	0.3

	Associated Equipment		Herschel_ STM_ Z maxB_QLZ1_Fundamental "Qualification Level"_ Test 01.02.2006								
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PAWAVG002Z	Waveguide Bracket > Z	[g]	1.5	3.4	2.6	2.0	1.2	1.5	1.3	0.8	0.9
PASVTS001X	SVM Thermal Shield, -Z side, over strut support > X	[g]	0.3	0.4	0.3	3.3	16.8	7.8	1.0	0.9	0.6
PASVTS001Y	SVM Thermal Shield, -Z side, over strut support > Y	[g]	0.5	0.2	0.1	0.5	0.9	1.3	2.6	2.9	2.8
PASVTS001Z	SVM Thermal Shield, -Z, over strut support > Z	[g]	1.1	1.1	1.0	1.7	2.0	1.4	2.1	2.7	3.5
PASVTS002X	SVM Thermal Shield, -Y side > X	[g]	0.2	0.2	0.5	4.2	21.8	29.2	8.3	3.1	3.4
PASVTS002Y	SVM Thermal Shield, -Y side > Y	[g]	0.2	0.2	0.3	1.5	3.2	3.4	4.8	2.5	2.5
PASVTS002Z	SVM Thermal Shield, -Y side > Z	[g]	1.1	1.2	1.1	2.1	2.5	2.0	2.7	3.6	2.8
PASVTS003X	SVM Thermal Shield, +Y side > X	[g]	0.2	0.2	0.1	0.3	1.7	1.1	1.1	1.1	1.9
PASVTS003Y	SVM Thermal Shield, +Y side > Y	[g]	0.1	0.1	0.1	0.2	2.2	1.7	4.3	2.5	1.4
PASVTS003Z	SVM Thermal Shield, +Y side > Z	[g]	1.1	1.1	1.1	1.5	2.3	1.7	3.6	4.3	7.5
PATELD001X	Telescope dummy M2 IF > X1	[g]	0.2	0.2	0.2	0.6	2.9	2.8	3.6	1.1	0.3
PATELD001Y	Telescope dummy M2 IF > Y1	[g]	0.3	0.5	0.5	0.5	0.4	0.3	0.4	0.2	0.2
PATELD001Z	Telescope dummy M2 IF > Z1	[g]	4.5	8.1	8.1	1.2	0.5	0.8	0.3	0.3	0.2
PATELD002X	Telescope dummy -Z/-Y triangle arm > X1	[g]	0.9	2.0	1.9	2.1	21.2	20.5	5.9	2.7	0.7
PATELD002Z	TMD Inner Corner -Y/-Z (as for GA71013) > Z3	[g]	4.4	8.3	8.3	1.1	1.0	1.0	0.5	0.8	0.3
PATELD003X	Telescope dummy -Z arm > X2	[g]	0.5	0.7	0.5	0.5	1.1	2.2	1.3	0.3	0.1
PATELD003Y	TMD Outer Corner -Z (as for GA71017) > Y6	[g]	0.6	1.8	1.0	1.2	1.3	0.8	0.7	0.9	1.2
PATELD004X	Telescope dummy Centre Plate, CoG > X3	[g]	1.3	5.1	5.0	2.0	25.8	24.5	5.0	3.1	1.0

No exceedance w.r.t. the HEPLM Subystem allowables (/RD 1b/) occurred.

Annex 4.2: Z-Qualification Run HEPLM Global Strut Forces:

		Herschel_ STM_ Z maxB_QLZ1_Global "Qualification Level"_ Test 01.02.200									
		[Hz]	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
PSTMSS041A	TMS Strut, 0°, axial dir., -Z - X'	[N]	1638	3622	2819	1680	4725	3897	1538	902	297
PSTMSS051A	TMS Strut, 0°, axial dir., -Z	[N]	1615	4047	4020	1940	7031	6926	972	690	280
PSTMSS061A	TMS Strut, 0°, axial dir., +Y	[N]	7711	13111	13065	2520	7076	6894	2895	763	534
PSTMSS071A	TMS Strut, 0°, axial dir., +Y	[N]	9912	19296	19220	2230	3181	2766	2517	1319	604
PSTMSS081A	TMS Strut, 0°, axial dir., -Y	[N]	10259	19980	20020	3180	3078	3396	1029	1071	878
PSTMSS091A	TMS Strut, 0°, axial dir., -Y	[N]	9794	16315	16395	3423	4914	4727	1868	947	729
PSTMSS101A	TMS CB Strut, 0°/180°, T-rosette 0/90	[N]	366	530	530	49	65	103	108	329	300
PSTMSS111A	TMS CB Strut, 0°/180°, T-rosette 0/90	[N]	549	695	691	78	185	128	84	397	205
PSLOUS041A	LOU Strut, 0°/180°, T-rosette 0/90; +X/+Z	[N]	508	827	561	308	615	1020	420	200	291
PSLOUS061A	LOU Strut, 0°/180°, T-rosette 0/90; ++Z	[N]	337	933	686	743	657	835	996	630	222
PSLOUS071A	LOU Strut, 0°/180°, T-rosette 0/90; --Z	[N]	60	331	265	87	313	301	522	573	123
PSLOUS081A	LOU Strut, 0°/180°, T-rosette 0/90; --Z	[N]	433	817	659	226	601	766	358	121	108
PSLOUS091A	LOU Strut, 0°/180°, T-rosette 0/90; --Z	[N]	117	457	459	127	403	675	1070	326	200
PSSVMS011A	PLM-SVM Strut +Y, 0°, axial dir.	[N]	7748	7000	6975	2002	1089	865	739	589	394
PSSVMS021A	PLM-SVM Strut +Y, 0°, axial dir.	[N]	7483	7105	7143	1736	865	695	838	546	446
PSSVMS031A	PLM-SVM Strut -Y, 0°, axial dir.	[N]	8518	8107	7480	1146	1007	804	512	512	257
PSSVMS041A	PLM-SVM Strut -Y, 0°, axial dir.	[N]	8081	7301	6298	2676	1430	1221	909	547	306
PSSVMS051A	PLM-SVM Strut +Z, 0°, axial dir.	[N]	9396	5696	4190	1415	581	581	466	221	252
PSSVMS061A	PLM-SVM Strut +Z, 0°, axial dir.	[N]	9510	5323	4839	812	419	483	225	407	297
PSSVMS071A	PLM-SVM Strut -Z, 0°, axial dir.	[N]	9079	4720	4651	2265	1000	669	522	329	318
PSSVMS081A	PLM-SVM Strut -Z, 0°, axial dir.	[N]	8345	6319	4002	1842	578	644	523	256	339

Annex 4.3: Z-Qualification Run HSS Max Global Strut Forces:

QL1Z-Global	5-20	20-30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80	80 - 90	90 - 100
HSS09-SB1FA	481	1353	402	410	733	124	103	221	617
HSS10-SB2FA	115	1551	390	137	431	162	50	73	82
HSS11-SB3FA	676	2649	827	683	569	282	151	194	556
HSS1-2_FX	4439	6277	2646	2829	4781	5700	8298	3545	1670
HSS1-2_FY	659	1362	638	758	1208	1129	2217	1122	477
HSS1-2_FZ	2222	2639	1136	1025	1823	2657	3067	1129	705
HSS1-2_MLat	22	16	15	12	17	25	26	7	11
HSS1-2Tors	12	9	8	6	9	13	14	3	6
HSS3-4_FX	3497	5995	2745	2247	4840	6507	7521	2450	1357
HSS3-4_FY	192	538	342	431	917	354	889	445	206
HSS3-4_FZ	1802	3044	1361	846	1773	3291	3848	1014	570
HSS3-4_MLat	10	10	4	13	29	34	37	17	5
HSS3-4Tors	5	4	2	6	14	18	19	9	2
S01FA	1030	2692	1337	1722	2625	2266	5379	2631	1099
S01MA	8	9	4	9	16	25	31	21	6
S01MHSS	2	2	1	2	4	6	7	5	1
S02FA	4257	4490	1970	1532	2918	4862	4737	1587	1250
S02MA	32	22	21	16	21	32	33	8	15
S02MHSS	24	17	17	12	16	25	25	6	12
S03FA	3532	5910	2605	1399	2673	6373	7505	1714	972
S03MA	12	8	5	14	33	45	48	22	5
S03MHSS	10	6	4	11	25	35	37	17	4
S04FA	805	1950	1008	1315	2807	1561	2712	1379	673
S04MA	11	26	13	17	37	20	59	26	9
S04MHSS	2	6	3	4	9	5	14	6	2
S05FA	613	802	527	902	1812	3346	628	343	392
S05MA	6	4	2	8	20	19	5	3	2
S05MHSS	4	2	2	5	13	12	3	2	1
S06FA	1508	3845	1665	471	1350	2546	1813	457	467
S06MA	14	8	3	4	8	20	13	4	3
S06MHSS	5	3	1	1	3	7	5	2	1
S07FA	1992	3753	2264	688	1545	3804	3868	528	403
S07MA	14	6	4	4	7	23	16	4	2
S07MHSS	5	2	1	2	3	9	6	1	1
S08FA	981	993	1034	1273	2271	3484	1017	513	241
S08MA	7	6	3	8	15	23	9	5	2
S08MHSS	4	4	2	5	10	15	6	3	1
S09FA	2410	4092	1622	647	2340	2749	406	336	217
S09MA	13	11	5	5	16	16	2	3	2
S09MHSS	6	6	2	2	8	8	1	2	1
S10FA	3479	4465	1728	530	1401	1731	464	155	129
S10MA	44	57	22	9	19	23	6	2	2
S10MHSS	13	17	7	3	6	7	2	1	1
S11FA	5295	6380	2827	754	2429	3139	839	356	202
S11MA	20	27	10	7	21	30	8	3	1
S11MHSS	6	8	3	2	6	9	2	1	0
S12FA	2579	3960	2363	655	2463	2933	519	347	171
S12MA	13	7	7	6	18	23	3	4	1
S12MHSS	6	3	4	3	9	11	2	2	1

Annex 4.4: Z-Qualification Run SVM Global IF Forces:

QL1Z-Global	5-20	20-30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80	80 - 90	90 - 100
SVM+Y:FX_1-2	13095	12129	12142	3205	1480	1342	1130	915	722
SVM+Y:FY_1-2	1267	1173	1175	310	143	130	109	89	70
SVM+Y:FZ_1-2	387	181	196	389	289	94	238	185	39
SVM+Z:FX_5-6	16638	9651	7946	1950	725	791	603	541	448
SVM+Z:FY_5-6	378	995	283	298	170	190	142	135	59
SVM+Z:FZ_5-6	3288	1907	1570	385	143	156	119	107	88
SVM1FA	7748	7000	6975	2002	1089	865	739	589	394
SVM2FA	7483	7105	7143	1736	865	695	838	546	446
SVM3FA	8518	8107	7480	1146	1007	804	512	512	257
SVM4FA	8081	7301	6298	2676	1430	1221	909	547	306
SVM5FA	9396	5696	4190	1415	581	581	466	221	252
SVM6FA	9511	5323	4839	812	419	483	225	407	297
SVM7FA	9079	4721	4651	2265	1000	669	522	329	318
SVM8FA	8345	6319	4003	1842	578	644	523	256	339
SVM-Y:FX_3-4	14275	13251	11850	3248	2014	1711	1102	883	484
SVM-Y:FY_3-4	1381	1282	1146	314	195	166	107	85	47
SVM-Y:FZ_3-4	304	661	609	811	267	232	328	48	52
SVM-Z:FX_7-8	15682	9924	7789	3695	1209	1181	941	405	561
SVM-Z:FY_7-8	582	1096	437	220	336	199	120	107	63
SVM-Z:FZ_7-8	153	97	76	36	12	12	9	4	5

Z-Qualification Run SVM Global IF Forces:

		Measured			Allowable			% Allowable Reached		
		FX	FY	FZ	FX	FY	FZ			
PLM SVM I/F	Corner +Z	16600	3300	150	27800	5996	2458	60%	55%	6%
	Corner -Z	15500	500	250	27457	5490	4248	56%	9%	6%
	Corner +Y	13000	1400	300	27457	5490	4248	47%	26%	7%
	Corner -Y	14500	1500	300	27457	5490	4248	53%	27%	7%

		Measured					Allowable					% Allowable Reached				
		FX	FY	FZ	M Lat	M Tors	FX	FY	FZ	M _at	M Tors					
HSS SVM I/F	Struts 1-2	8300	2200	3100	26	13.5	27457	5490	4248	40	15	30%	40%	73%	65%	90%
	Struts 2-3	7800	200	3800	37.5	**19**	27457	5490	4248	40	15	28%	4%	89%	94%	**127%**

Annex 5.1: X-Qualification Run SVM IF Force Plots:

Strut-Force PLM
X-Qual.

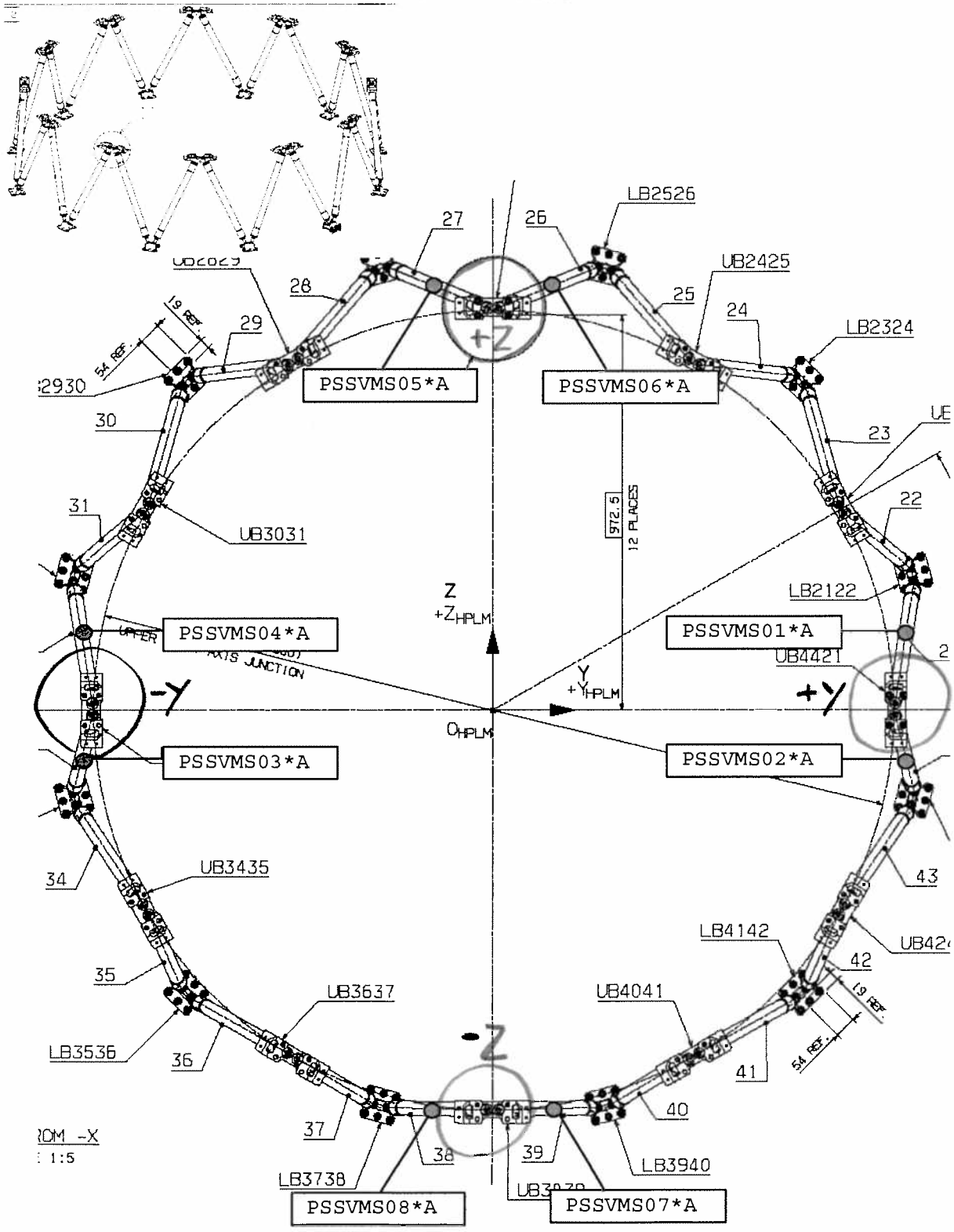
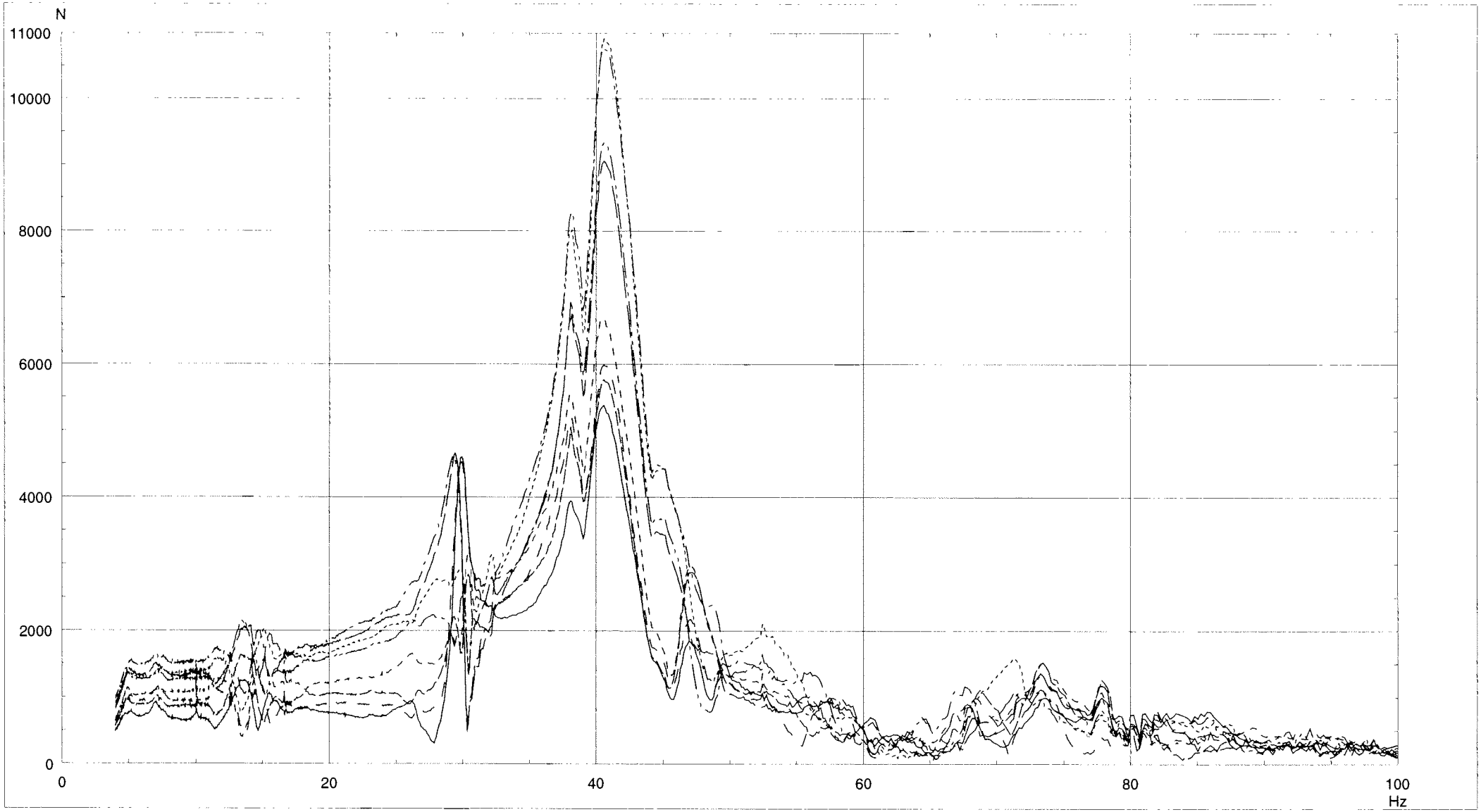


Figure 5-19: SVM/PLM Struts

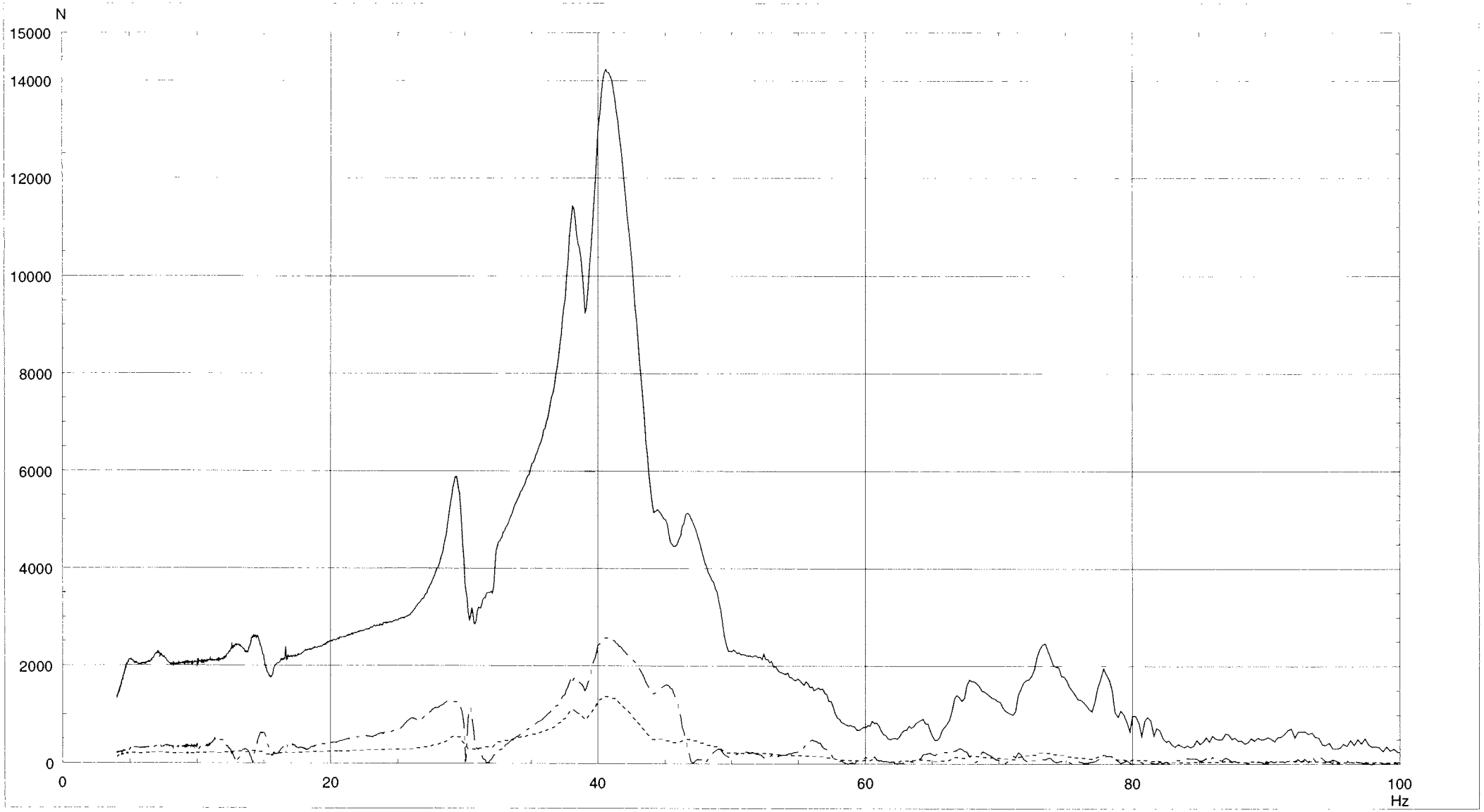


EADS Astrium GmbH | 24/01/2006

HERSCHEL STM

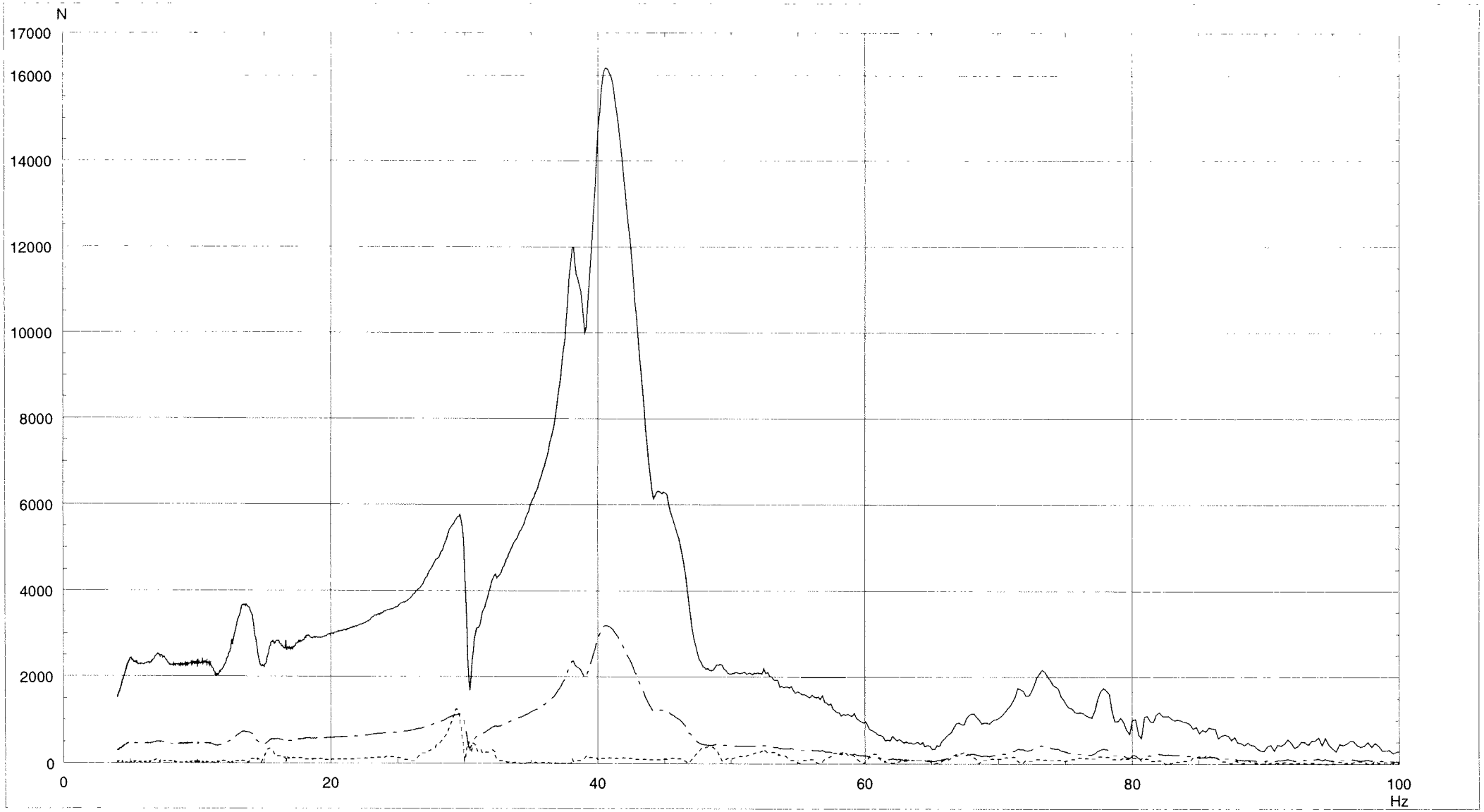
QLAX1_1_com	STM	Global
QLAX1_1_com	STM	Global
QLAX1_1_com	STM	Global
QLAX1_1_com	STM	Global
QLAX1_1_com	STM	Global
QLAX1_1_com	STM	Global
QLAX1_1_com	STM	Global
QLAX1_1_com	STM	Global

SVM1FA
SVM2FA
SVM3FA
SVM4FA
SVM5FA
SVM6FA
SVM7FA
SVM8FA



EADS Astrium GmbH	24/01/2006	QLAX1_1_comSTM	Global	SVM-Y:FX_3-4
		QLAX1_1_comSTM	Global	SVM-Y:FY_3-4
		QLAX1_1_comSTM	Global	SVM-Y:FZ_3-4

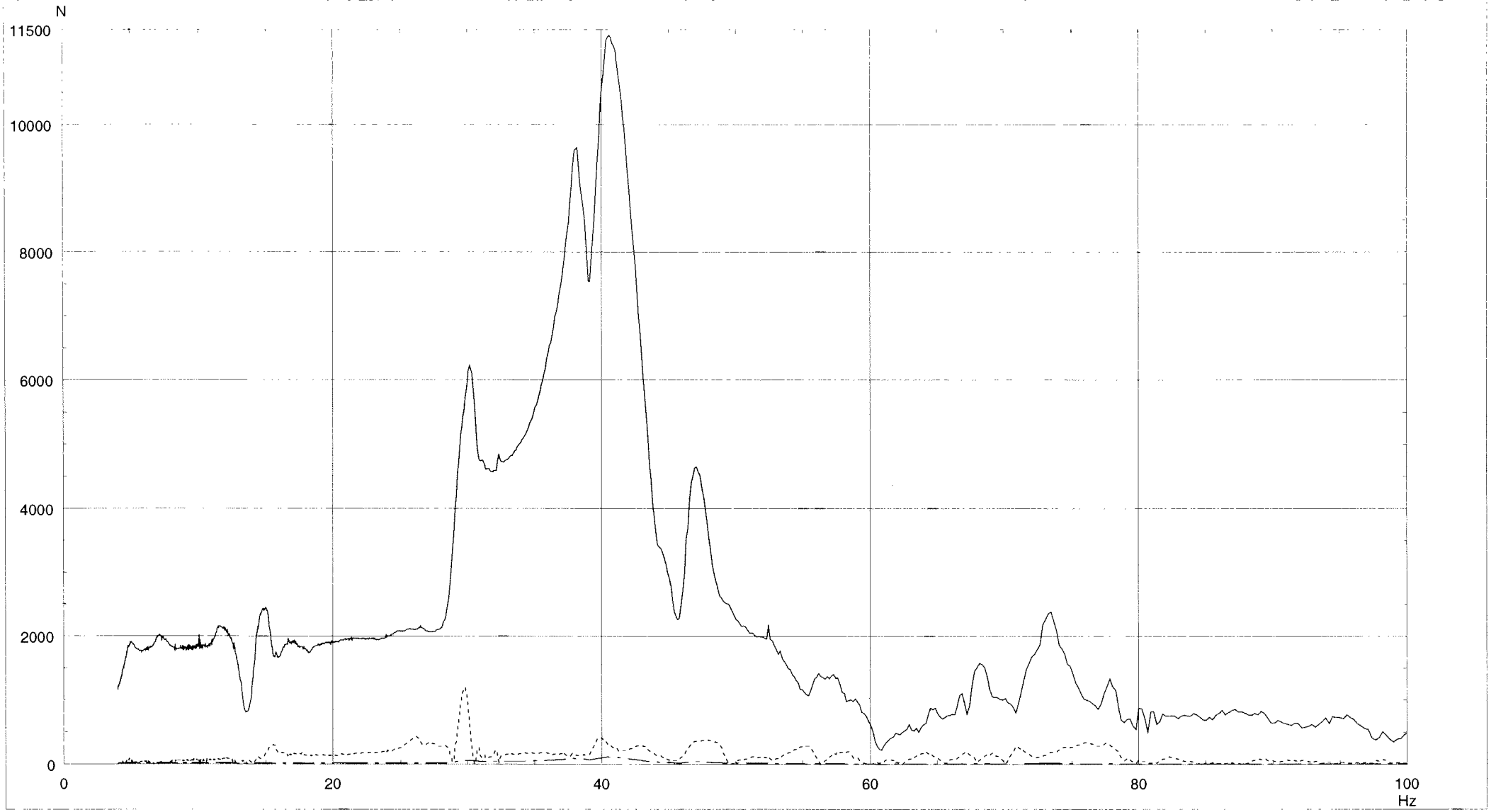
HERSCHEL STM



EADS Astrium GmbH | 24/01/2006

HERSCHEL STM

QLAX1_1_com STM	Global	—— SVM+Z:FX_5-6
QLAX1_1_com STM	Global	------ SVM+Z:FY_5-6
QLAX1_1_com STM	Global	— - - SVM+Z:FZ_5-6



EADS Astrium GmbH | 24/01/2006

HERSCHEL STM

QLAX1_1_comSTM	Global	SVM-Z:FX_7-8
QLAX1_1_comSTM	Global	SVM-Z:FY_7-8
QLAX1_1_comSTM	Global	SVM-Z:FZ_7-8

Strut-force HSS
X-Qual.

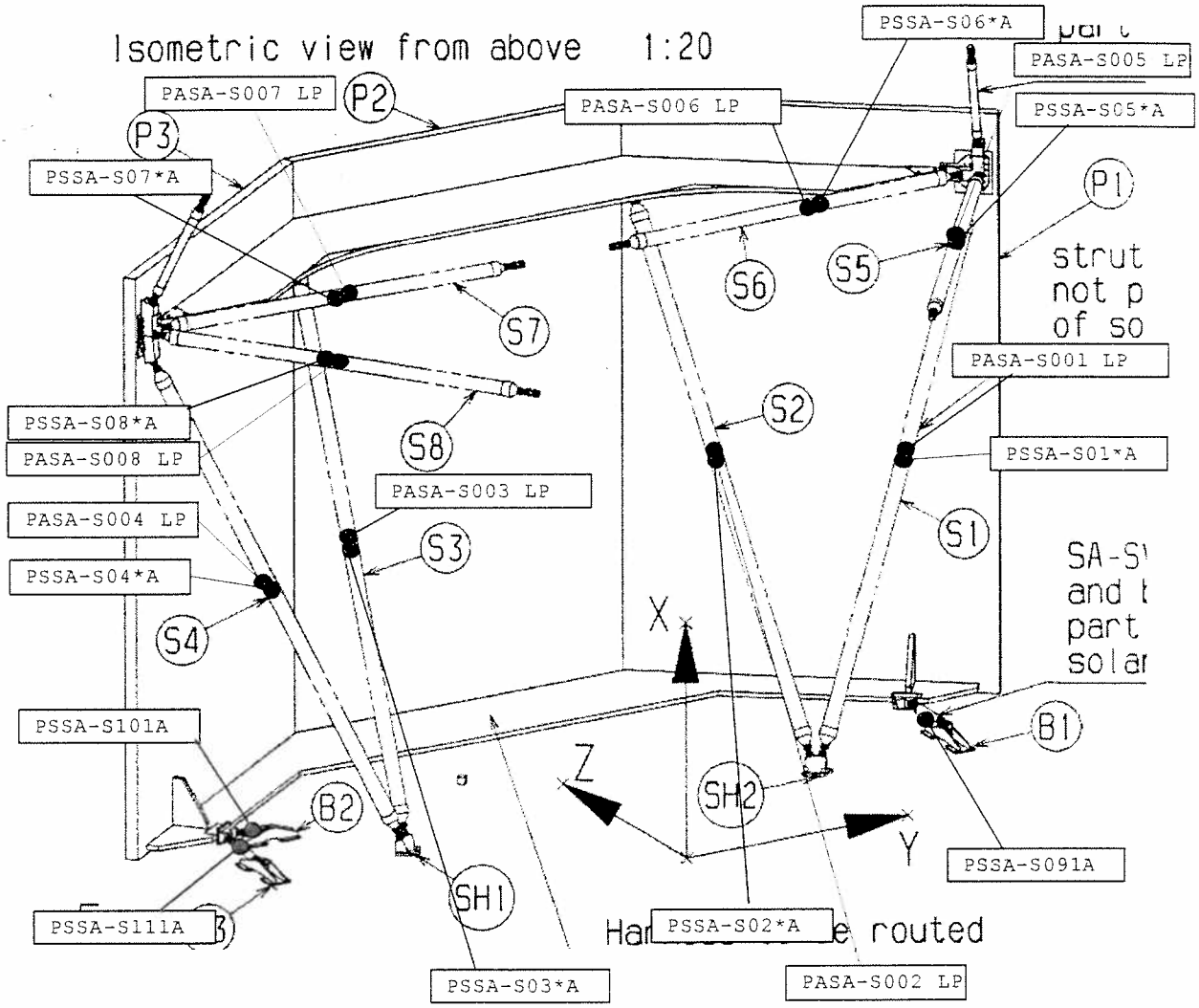
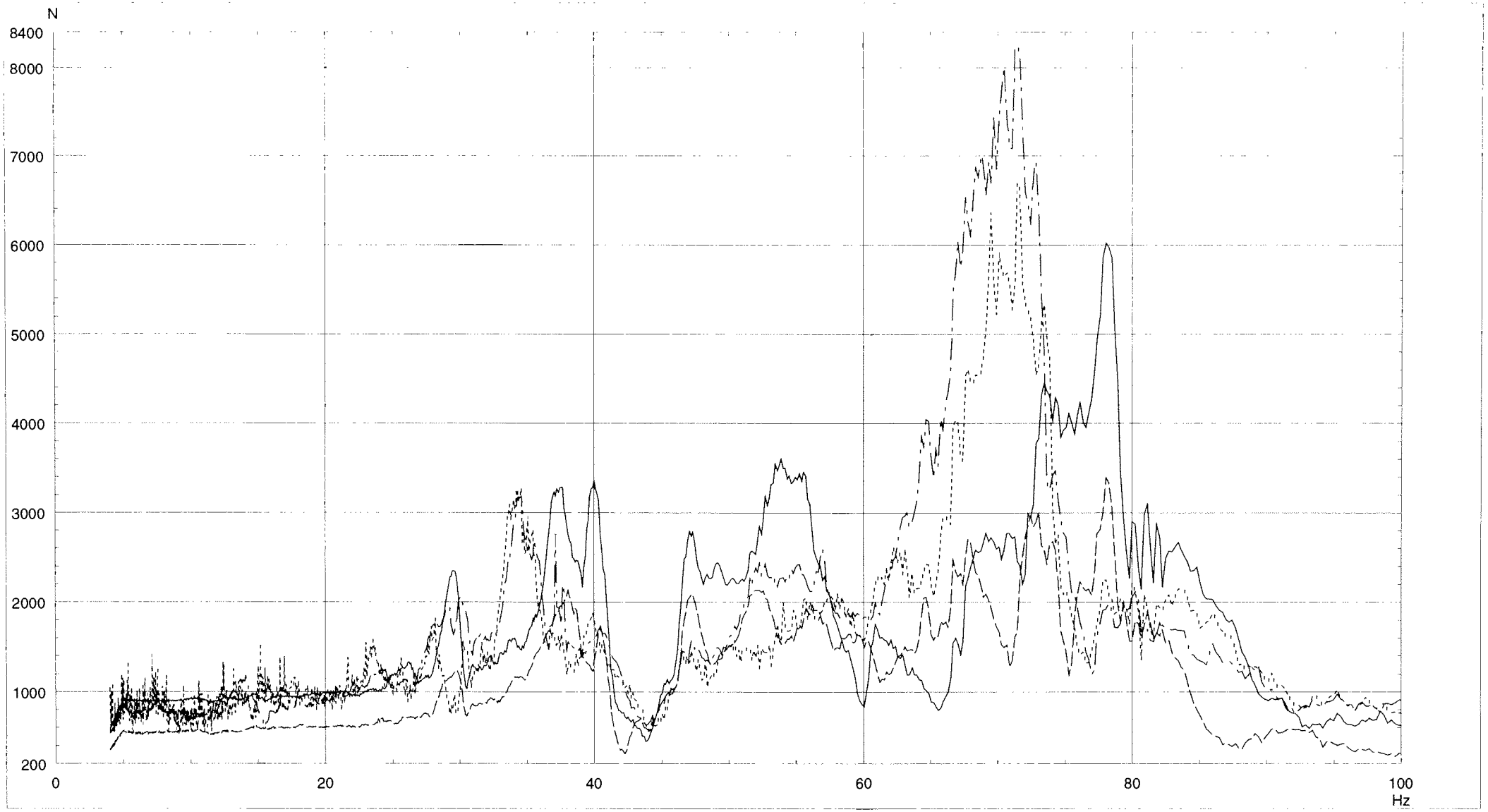


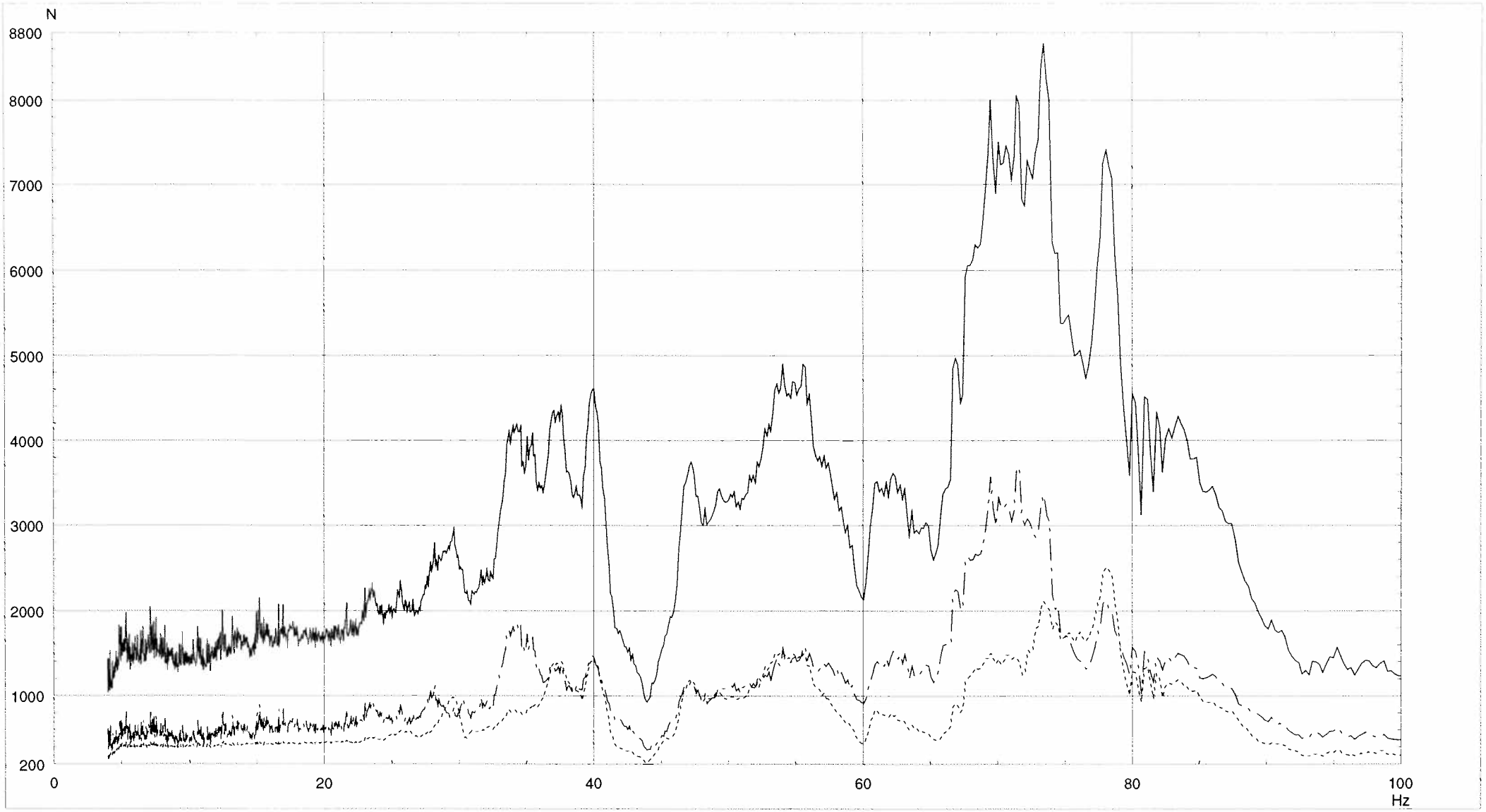
Figure 5-9: Solar Array Struts

HSS-Strut # 1-4
SVM-I/F # 1,2 ; +Y
3,4 ; -Y



EADS Astrium GmbH	24/01/2006	QLAX1_1_com STM	Global	S01FA
		QLAX1_1_com STM	Global	S02FA
		QLAX1_1_com STM	Global	S03FA
		QLAX1_1_com STM	Global	S04FA

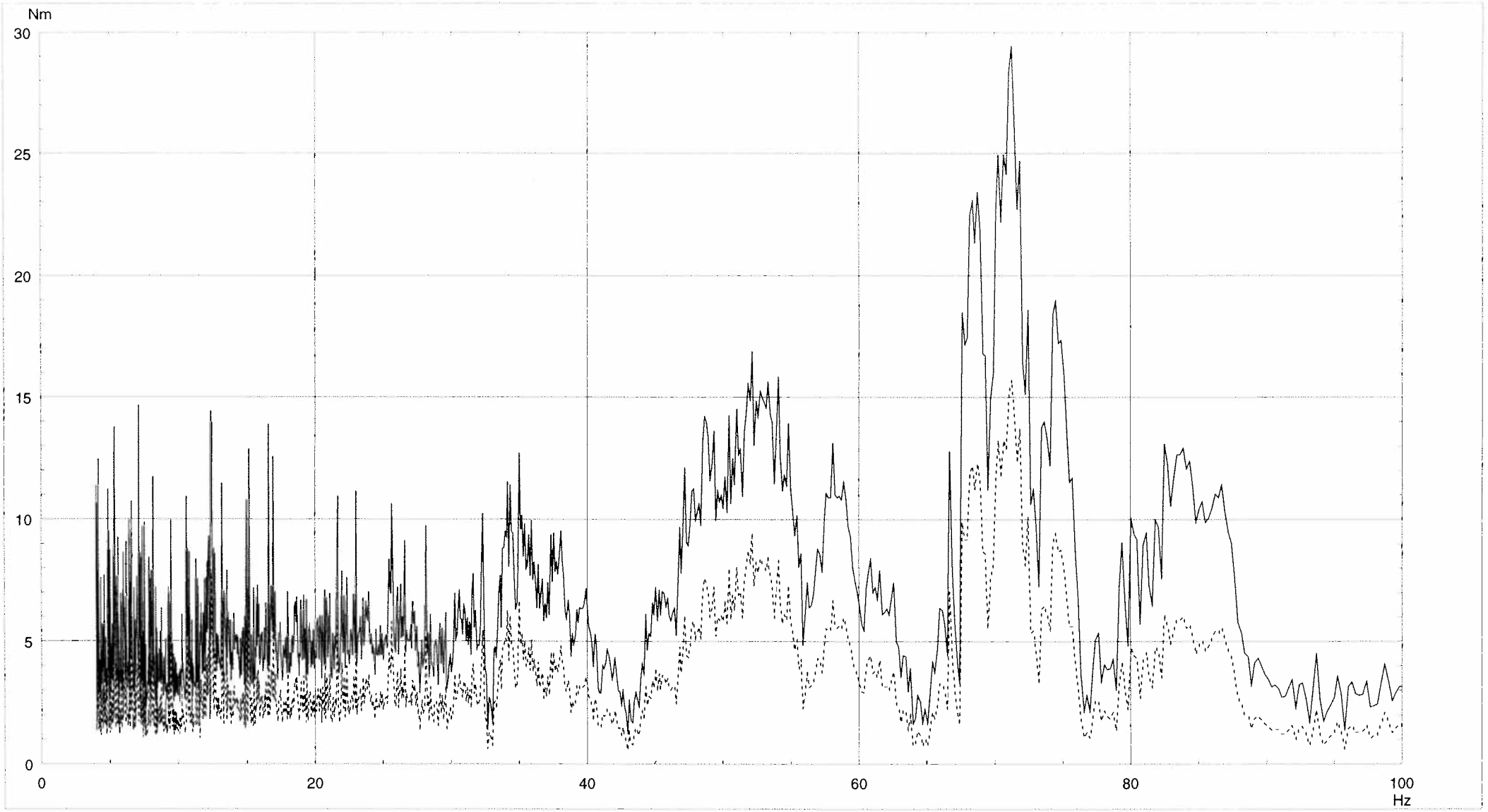
HERSCHEL STM



EADS Astrium GmbH 24/01/2006

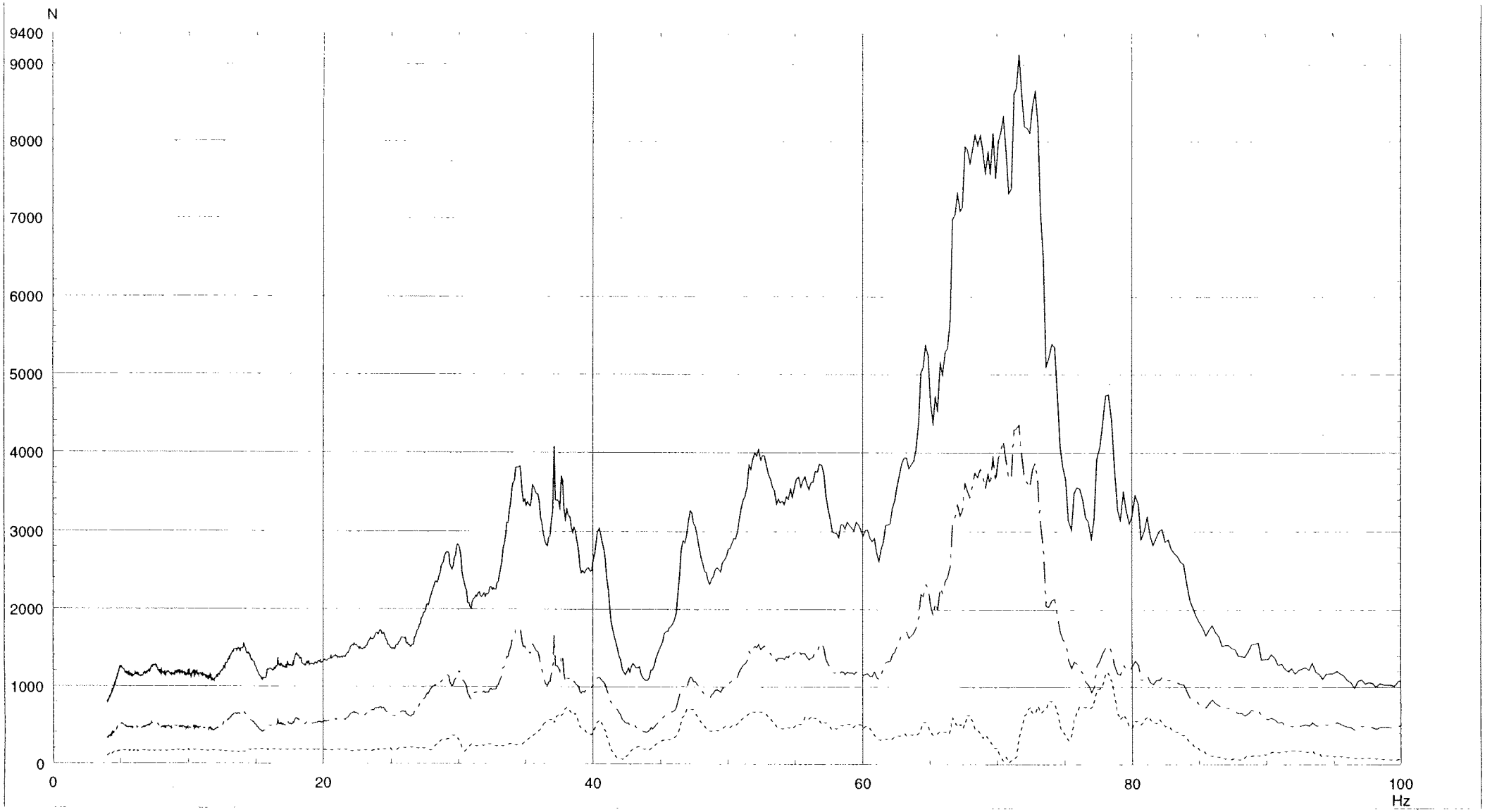
QLAX1_1_comSTM	Global	—— HSS1-2_FX
QLAX1_1_comSTM	Global	····· HSS1-2_FY
QLAX1_1_comSTM	Global	— - - HSS1-2_FZ

HERSCHEL STM



EADS Astrium GmbH	24/01/2006			
		QLAX1_1_com STM	Global	—— HSS1-2_MLat
		QLAX1_1_com STM	Global	------ HSS1-2Tors

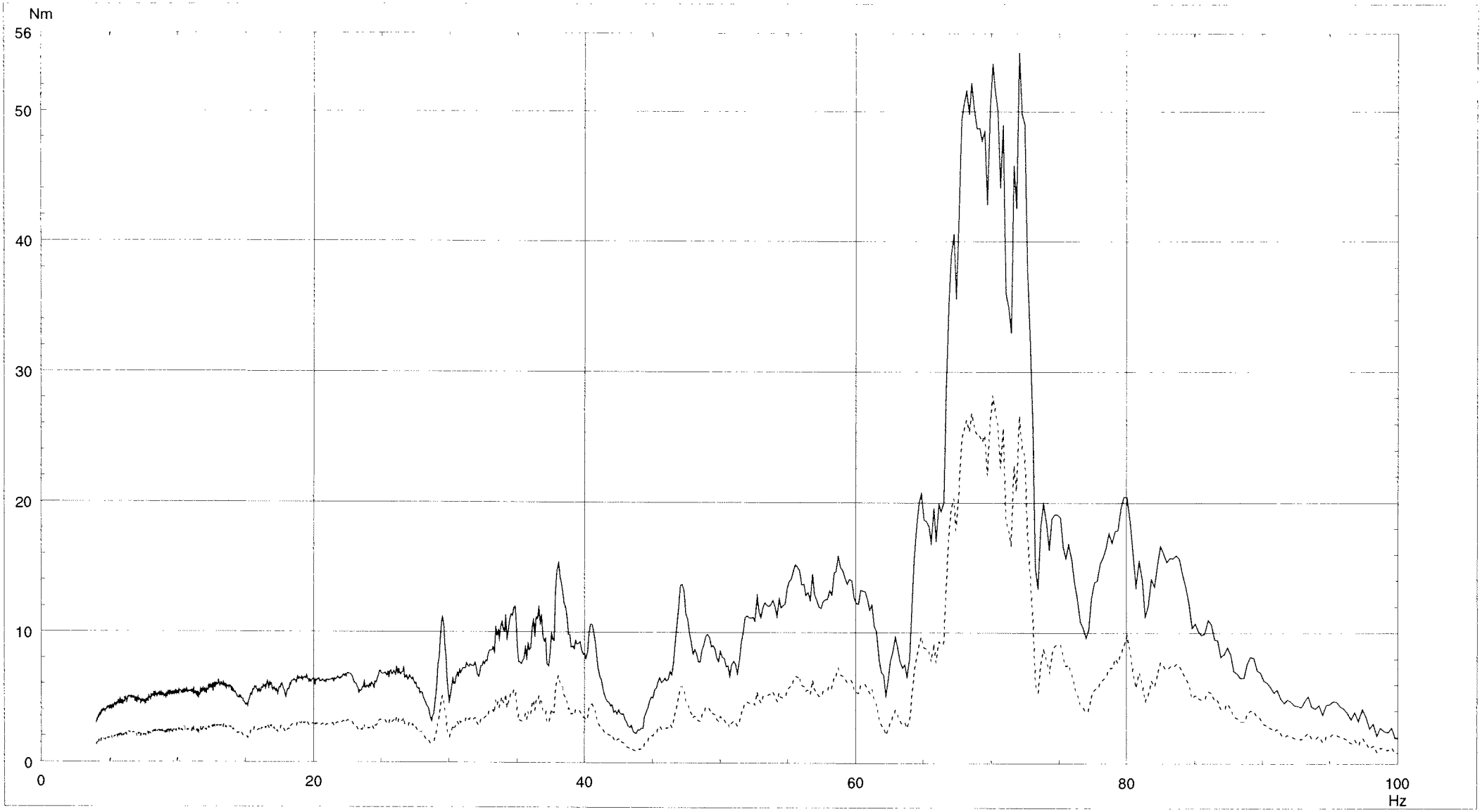
HERSCHEL STM



EADS Astrium GmbH | 24/01/2006

HERSCHEL STM

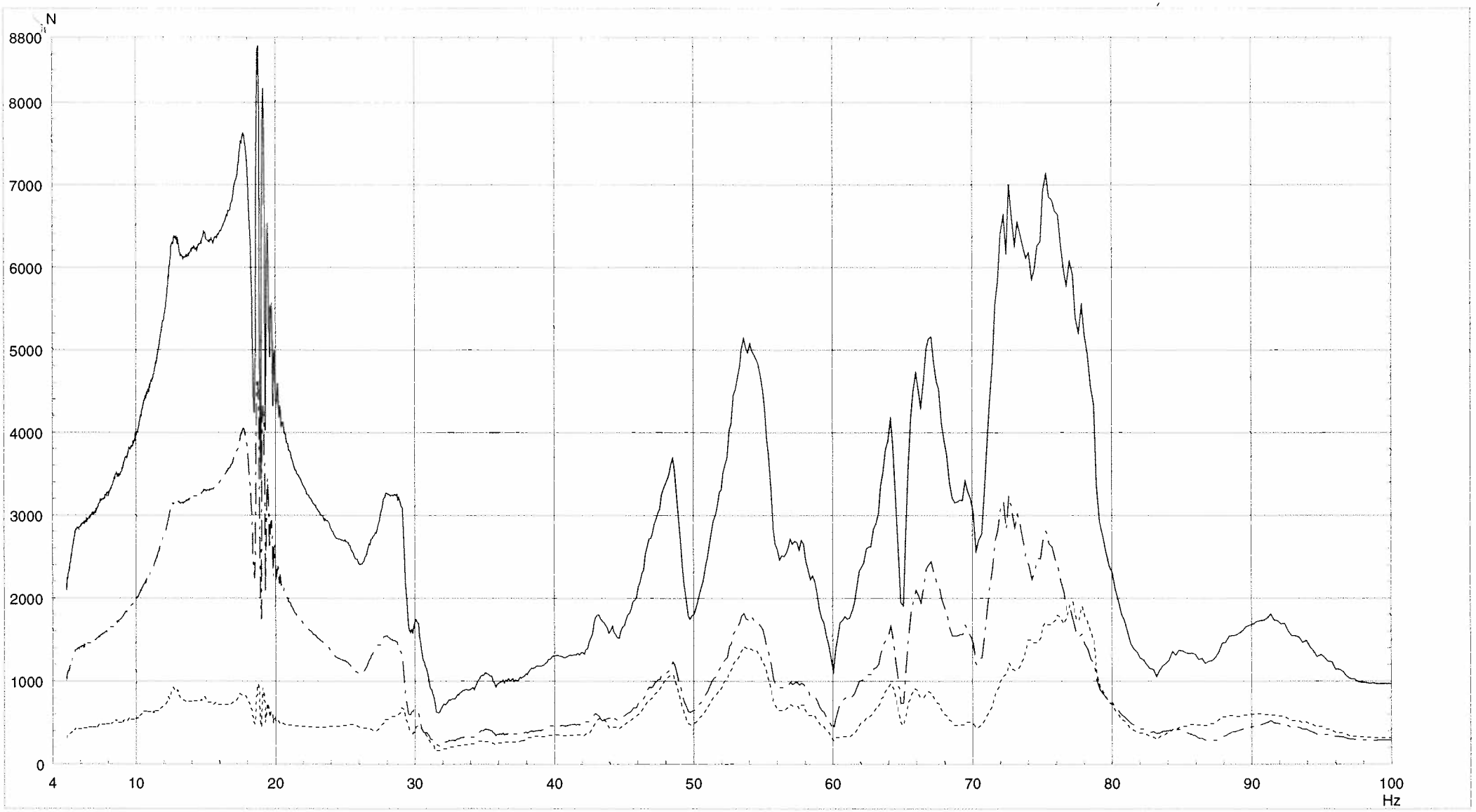
QLAX1_1_comSTM	Global	HSS3-4_FX
QLAX1_1_comSTM	Global	HSS3-4_FY
QLAX1_1_comSTM	Global	HSS3-4_FZ



EADS Astrium GmbH	24/01/2006			
		QLAX1_1_com STM	Global	—— HSS3-4_MLat
		QLAX1_1_com STM	Global	------ HSS3-4Tors

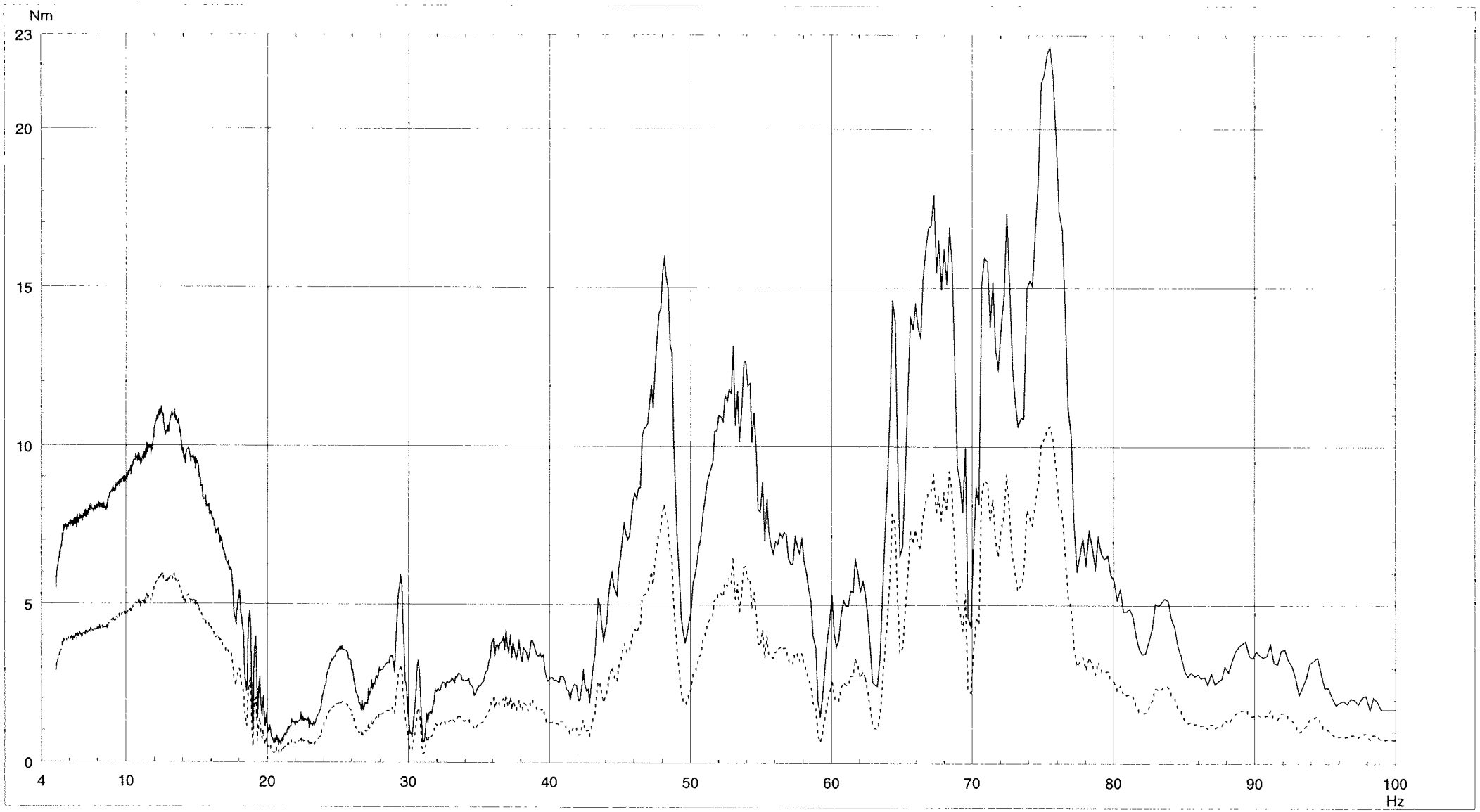
HERSCHEL STM

Annex 5.2: Y-Qualification Run SVM IF Force Plots:



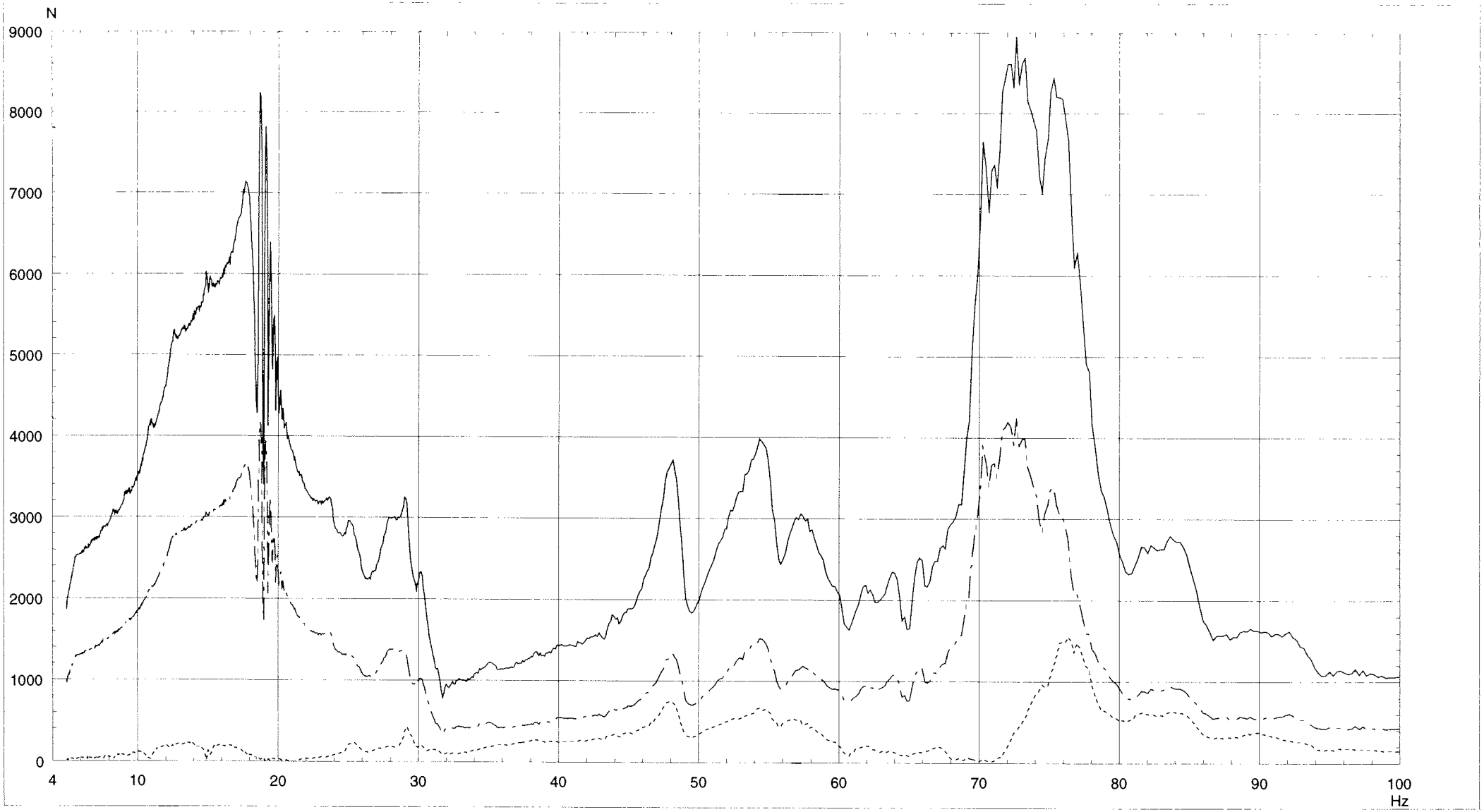
EADS Astrium GmbH	06/02/2006	QLY1	STM	Global	HSS1-2_FX
		QLY1	STM	Global	HSS1-2_FY
		QLY1	STM	Global	HSS1-2_FZ

HERSCHEL STM



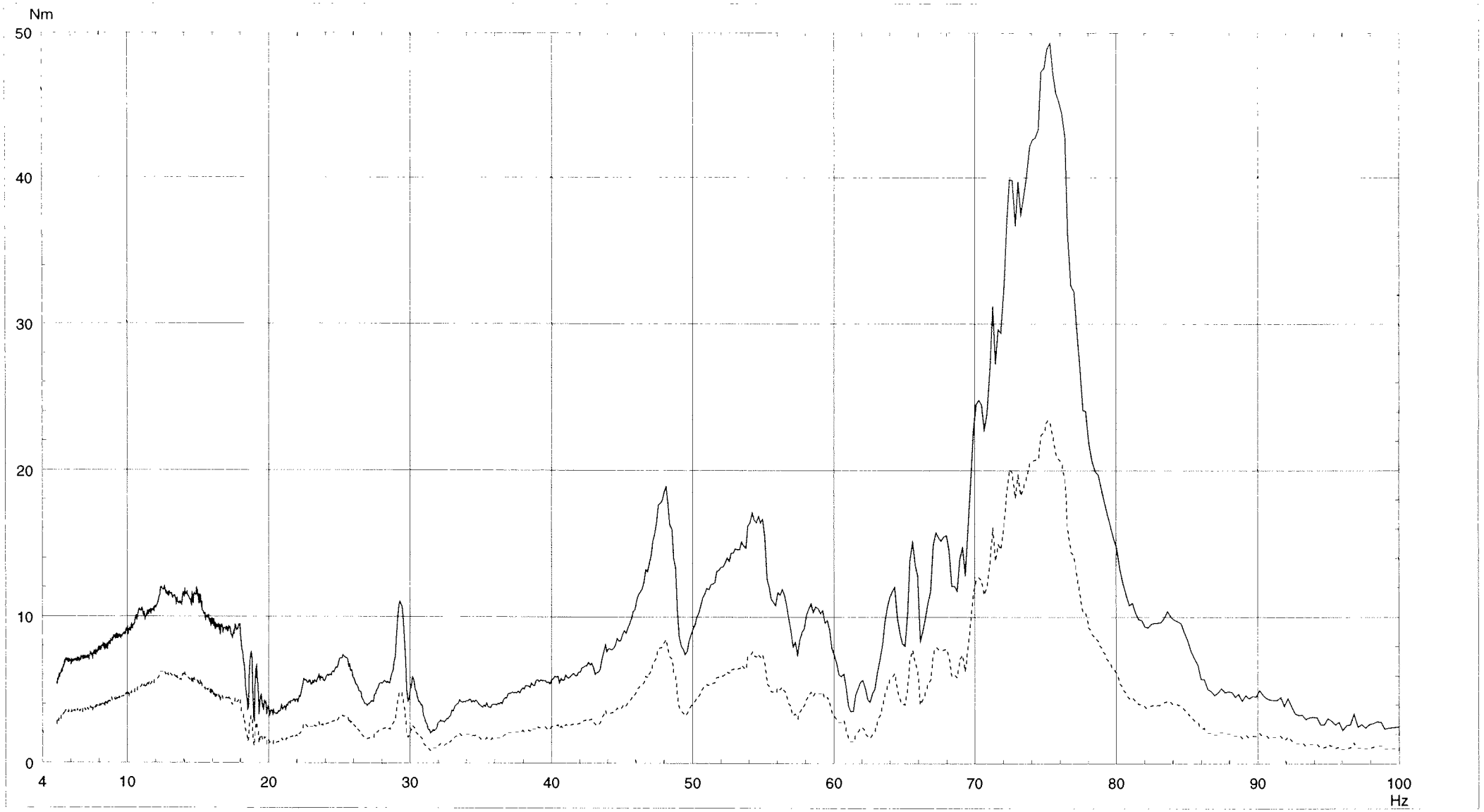
EADS Astrium GmbH	06/02/2006				
		QLY1	STM	Global	—— HSS1-2_MLat
		QLY1	STM	Global	------ HSS1-2Tors

HERSCHEL STM



EADS Astrium GmbH	06/02/2006				
		QLY1	STM	Global	HSS3-4_FX
		QLY1	STM	Global	HSS3-4_FY
		QLY1	STM	Global	HSS3-4_FZ

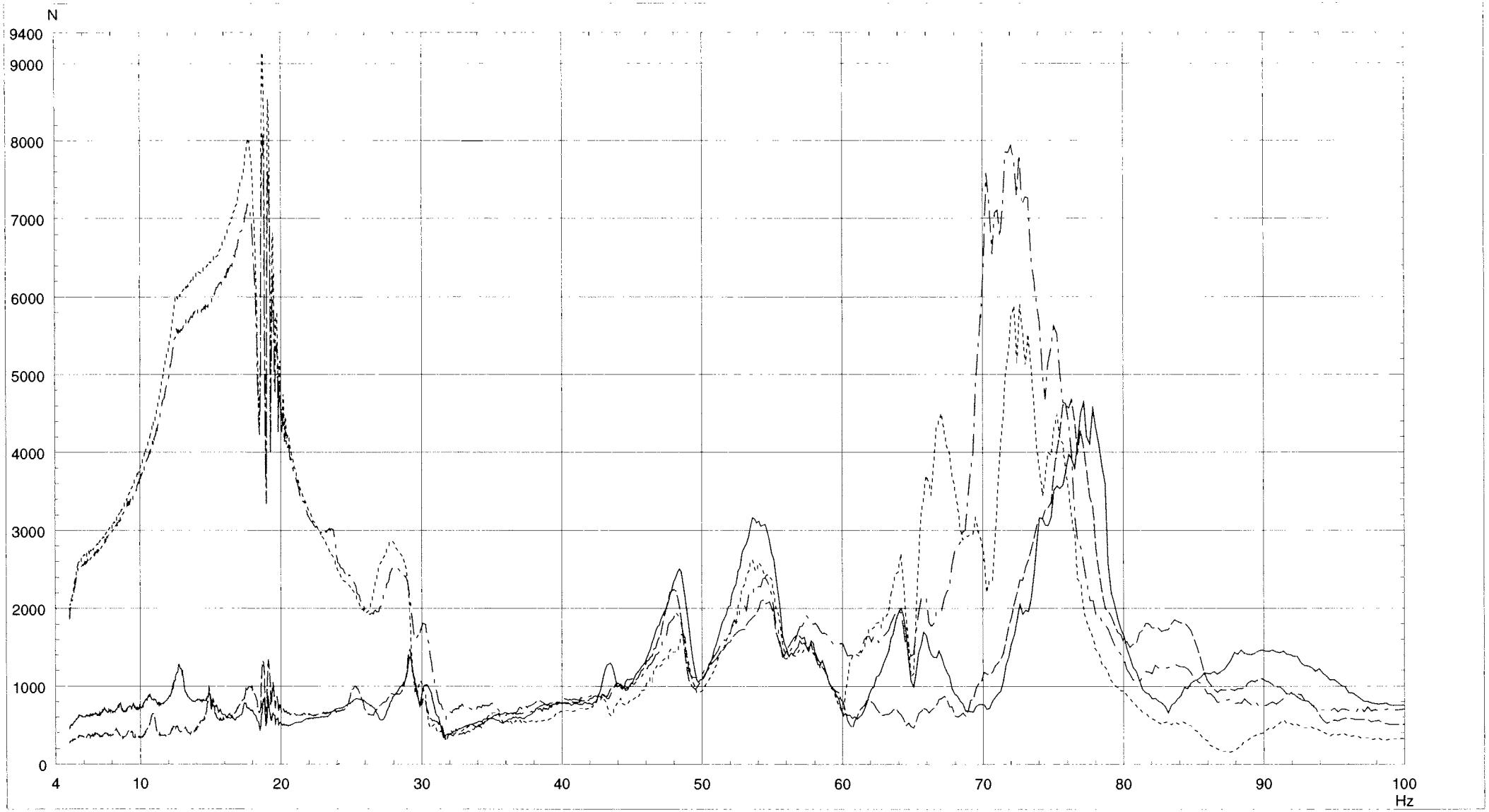
HERSCHEL STM



EADS Astrium GmbH | 06/02/2006

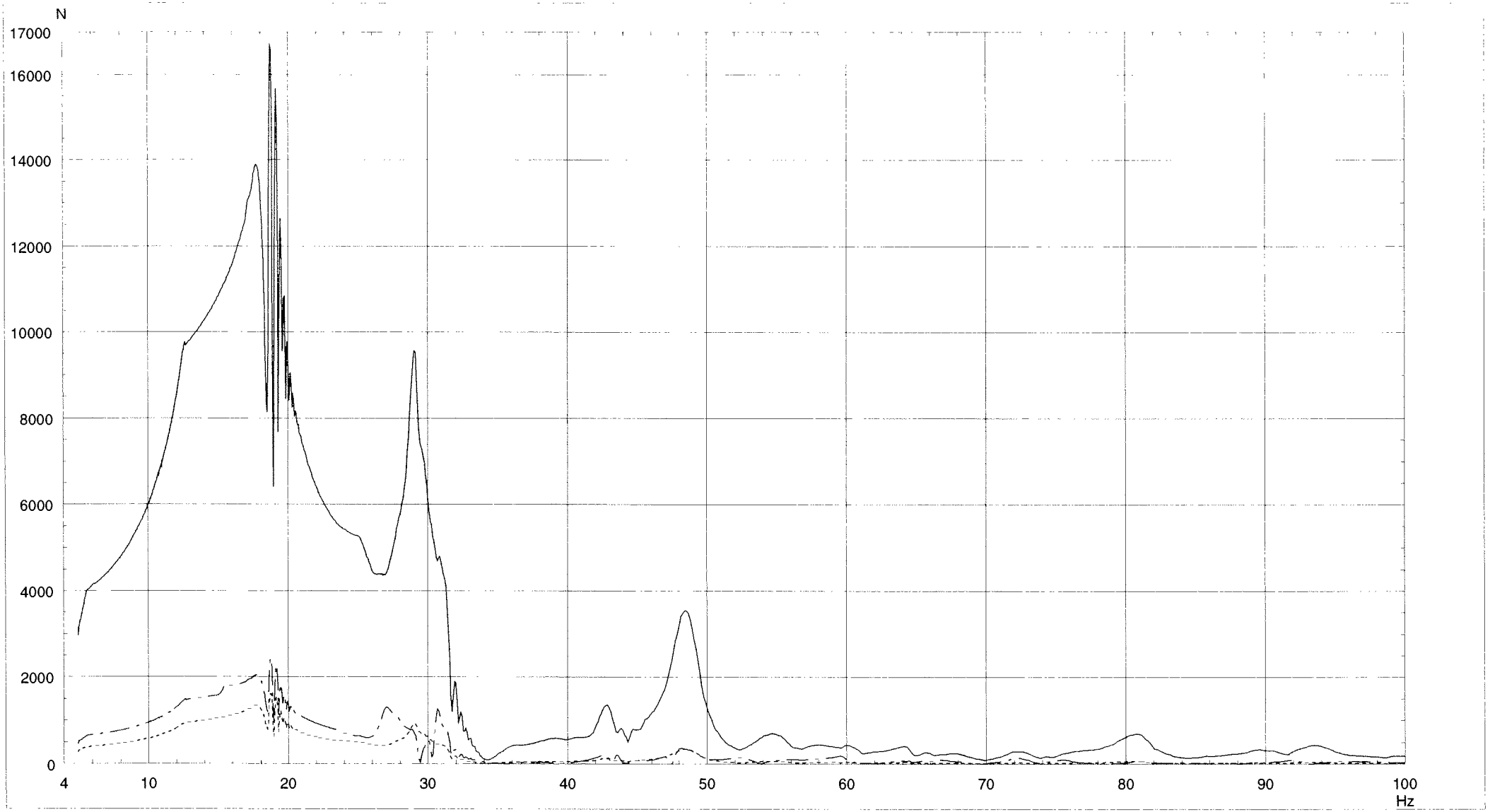
HERSCHEL STM

QLY1	STM	Global	HSS3-4_MLat
QLY1	STM	Global	HSS3-4Tors



EADS Astrium GmbH	06/02/2006	QLY1	STM	Global	S01FA
		QLY1	STM	Global	S02FA
		QLY1	STM	Global	S03FA
		QLY1	STM	Global	S04FA

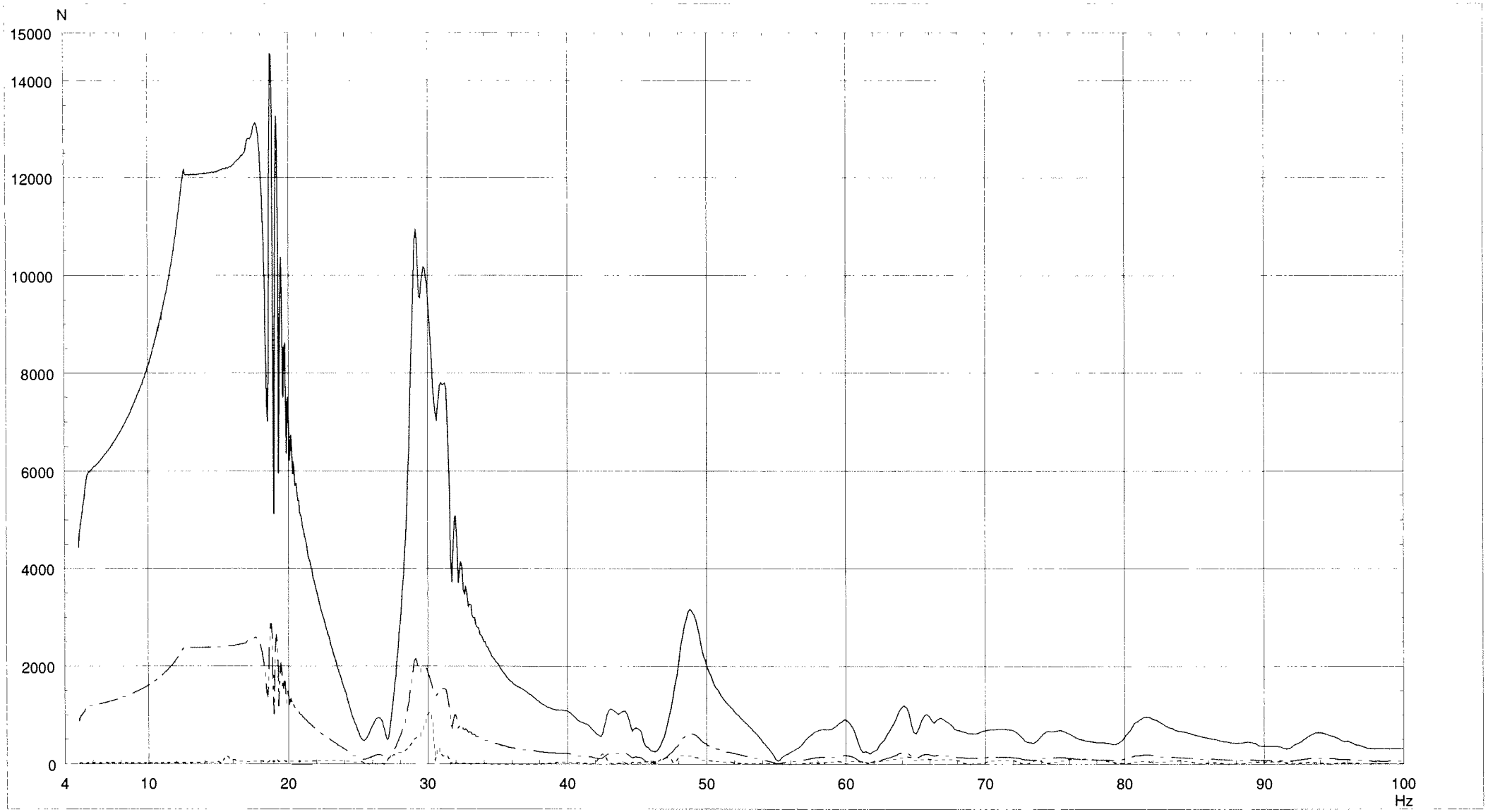
HERSCHEL STM



EADS Astrium GmbH 06/02/2006

HERSCHEL STM

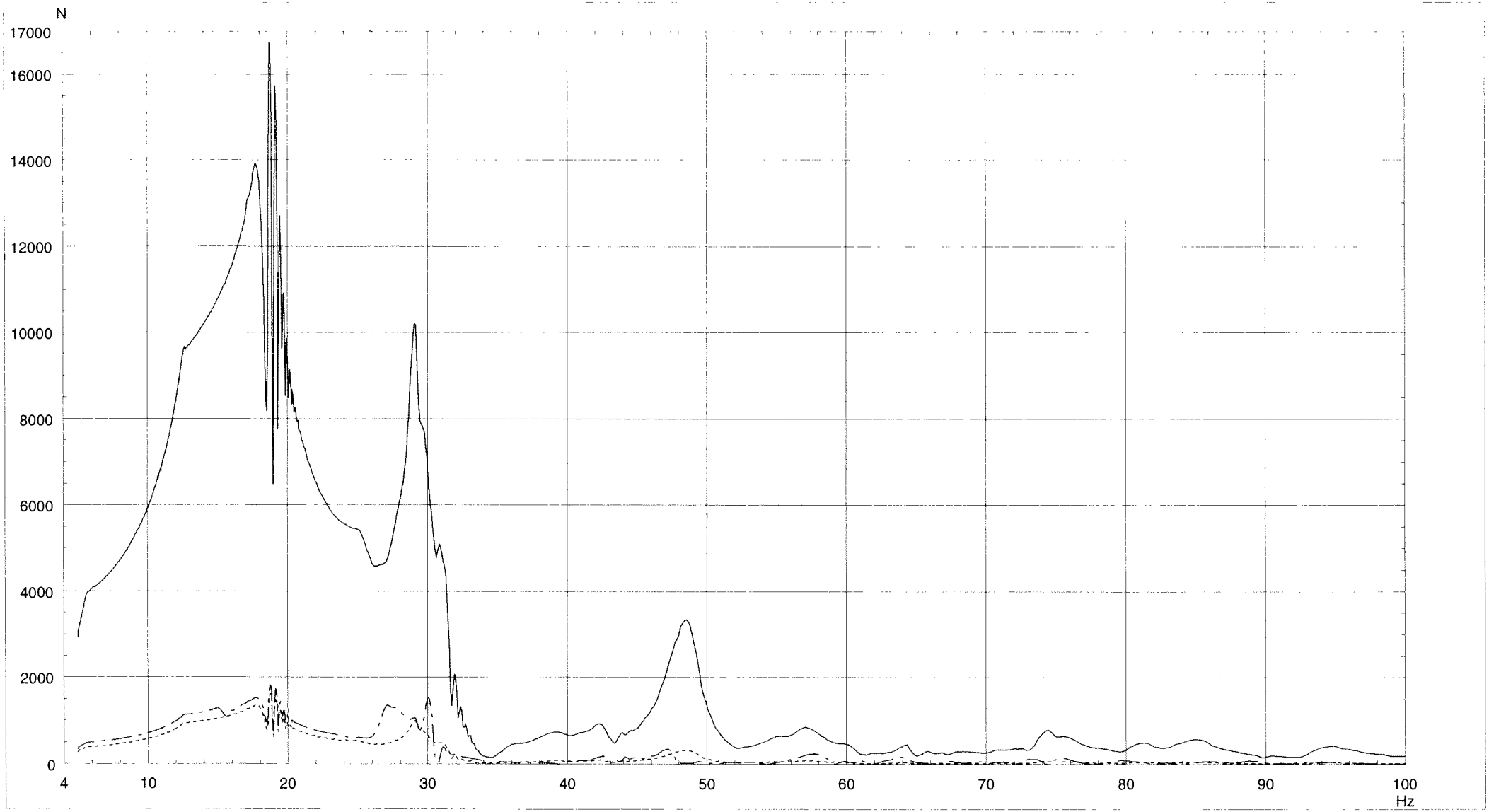
QLY1	STM	Global	SVM+Y:FX_1-2
QLY1	STM	Global	SVM+Y:FY_1-2
QLY1	STM	Global	SVM+Y:FZ_1-2



EADS Astrium GmbH 06/02/2006

HERSCHEL STM

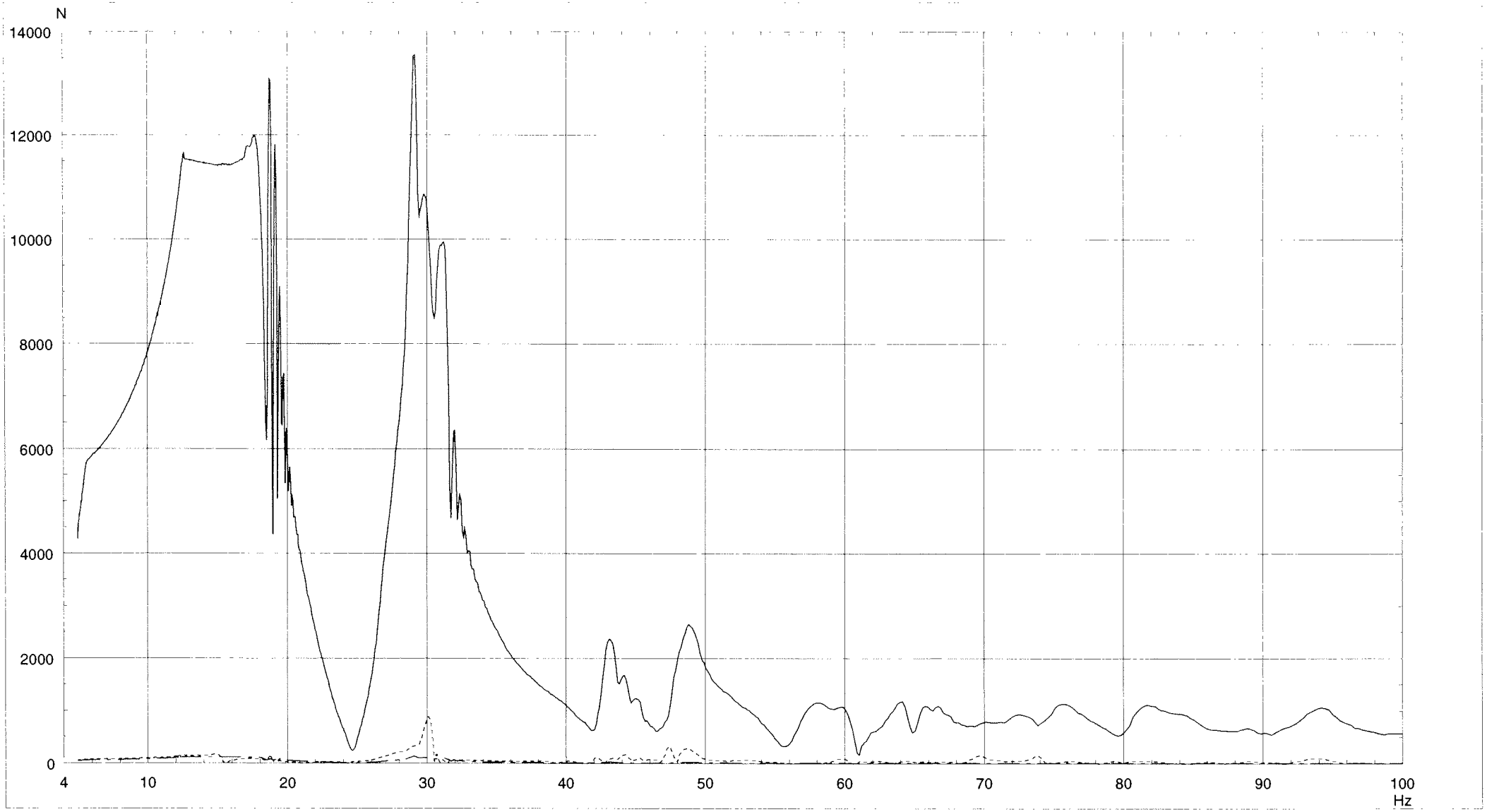
QLY1	STM	Global	SVM+Z:FX_5-6
QLY1	STM	Global	SVM+Z:FY_5-6
QLY1	STM	Global	SVM+Z:FZ_5-6



EADS Astrium GmbH | 06/02/2006

HERSCHEL STM

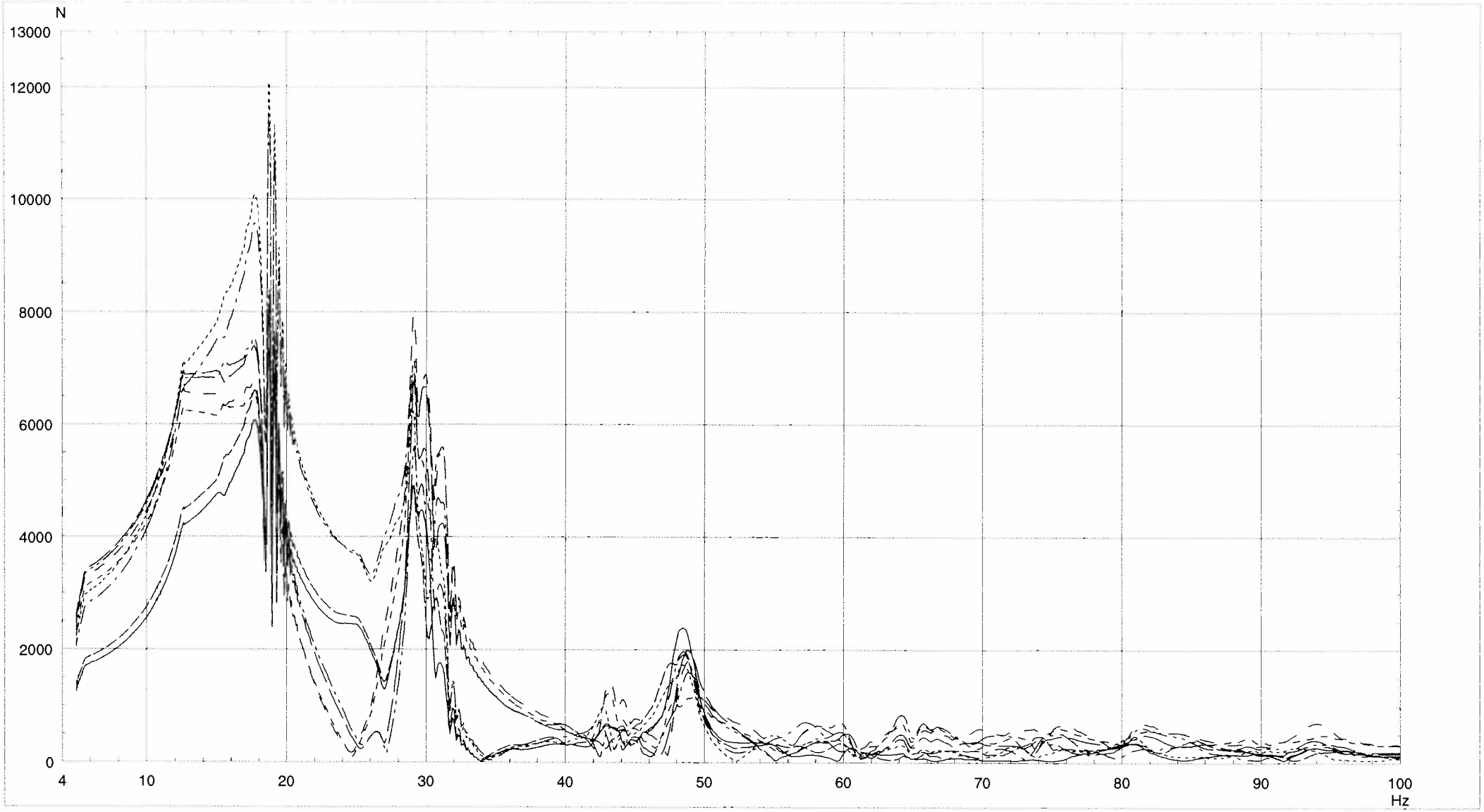
QLY1	STM	Global	SVM-Y:FX_3-4
QLY1	STM	Global	SVM-Y:FY_3-4
QLY1	STM	Global	SVM-Y:FZ_3-4



EADS Astrium GmbH 06/02/2006

HERSCHEL STM

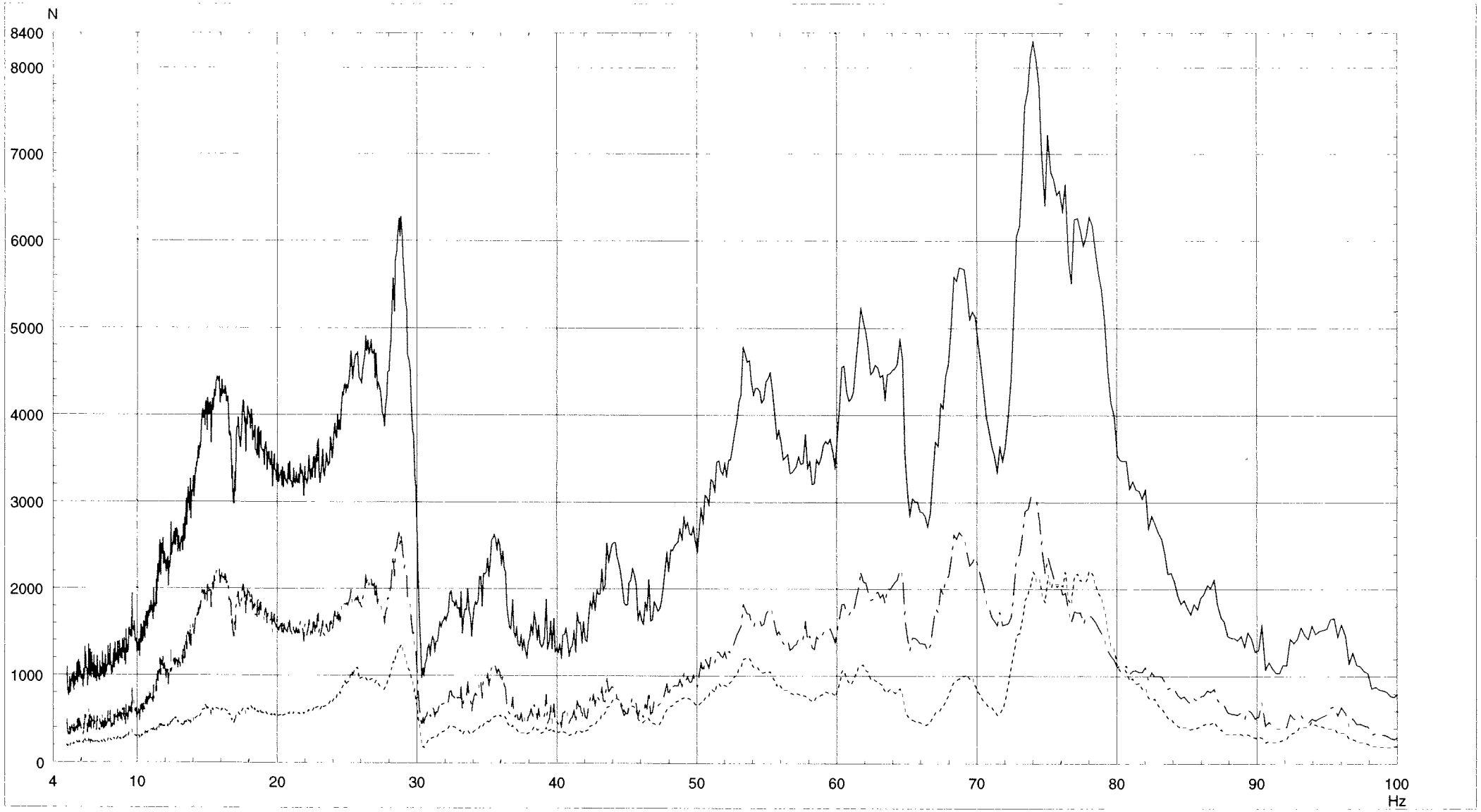
QLY1	STM	Global	SVM-Z:FX_7-8
QLY1	STM	Global	SVM-Z:FY_7-8
QLY1	STM	Global	SVM-Z:FZ_7-8



EADS Astrium GmbH	06/02/2006	QLY1	STM	Global	SVM1FA
		QLY1	STM	Global	SVM2FA
		QLY1	STM	Global	SVM3FA
		QLY1	STM	Global	SVM4FA
		QLY1	STM	Global	SVM5FA
		QLY1	STM	Global	SVM6FA
		QLY1	STM	Global	SVM7FA
		QLY1	STM	Global	SVM8FA

HERSCHEL STM

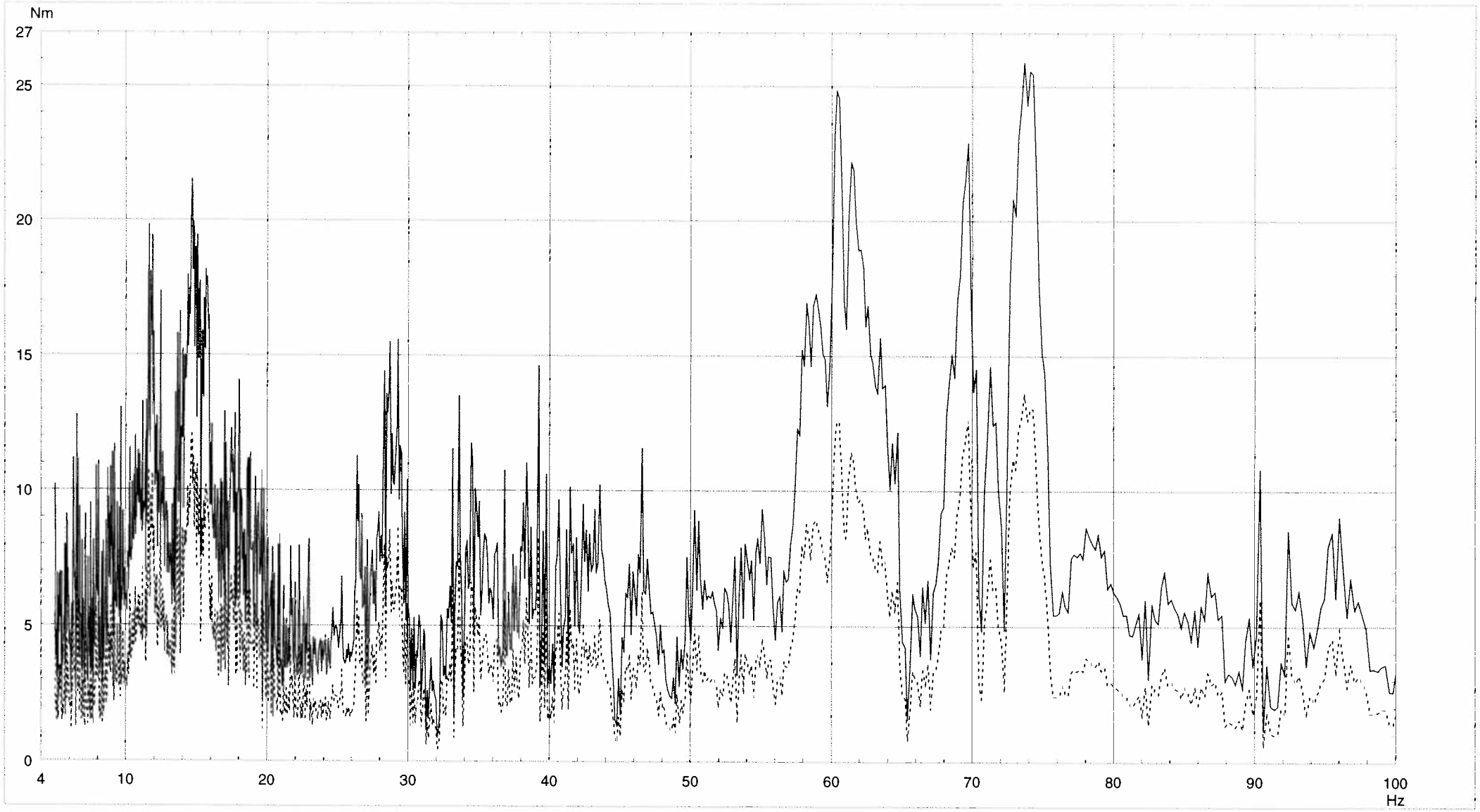
Annex 5.3: Z-Qualification Run SVM IF Force Plots:



EADS Astrium GmbH | 01/02/2006

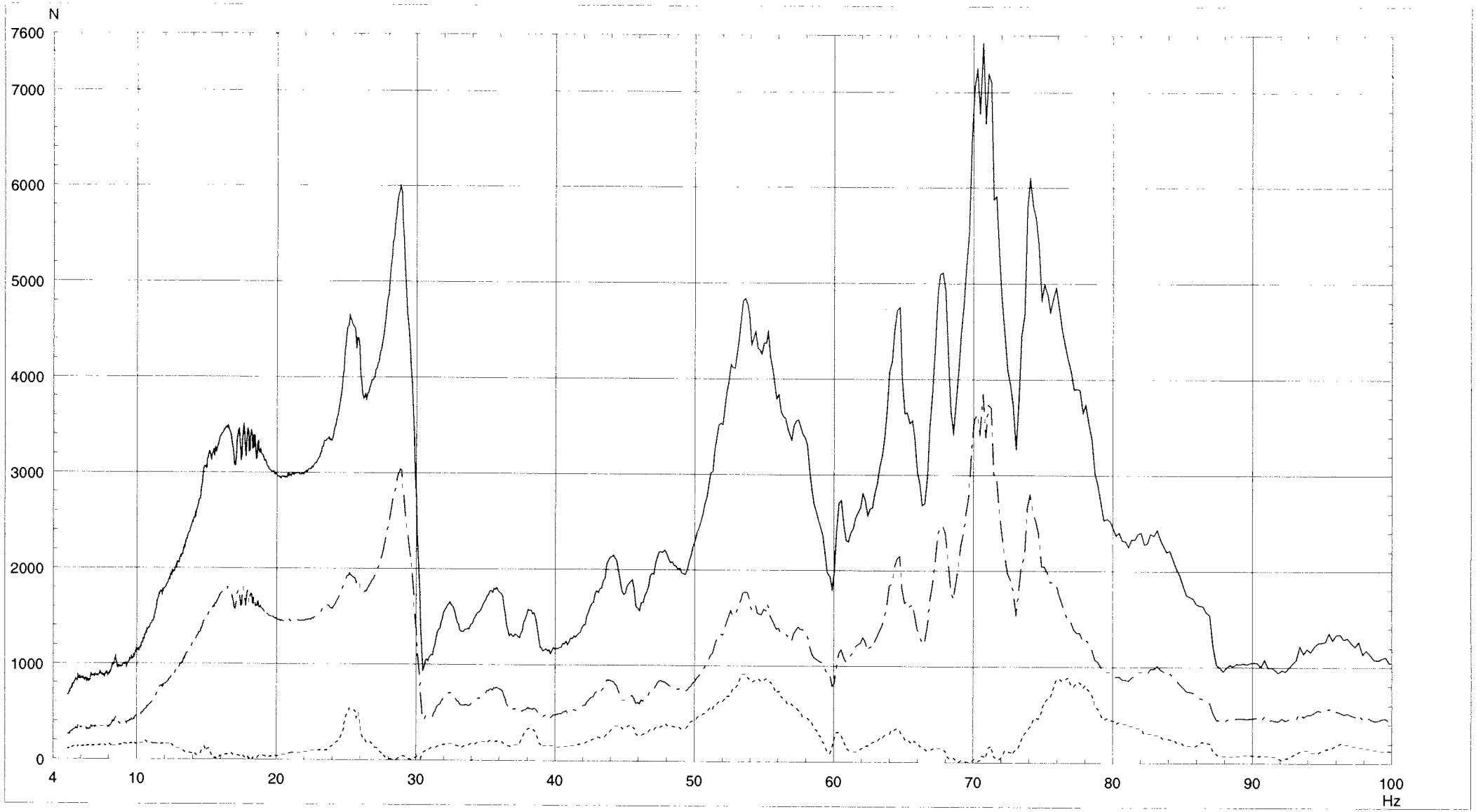
HERSCHEL STM

QLZ1	STM	Global	HSS1-2_FX
QLZ1	STM	Global	HSS1-2_FY
QLZ1	STM	Global	HSS1-2_FZ



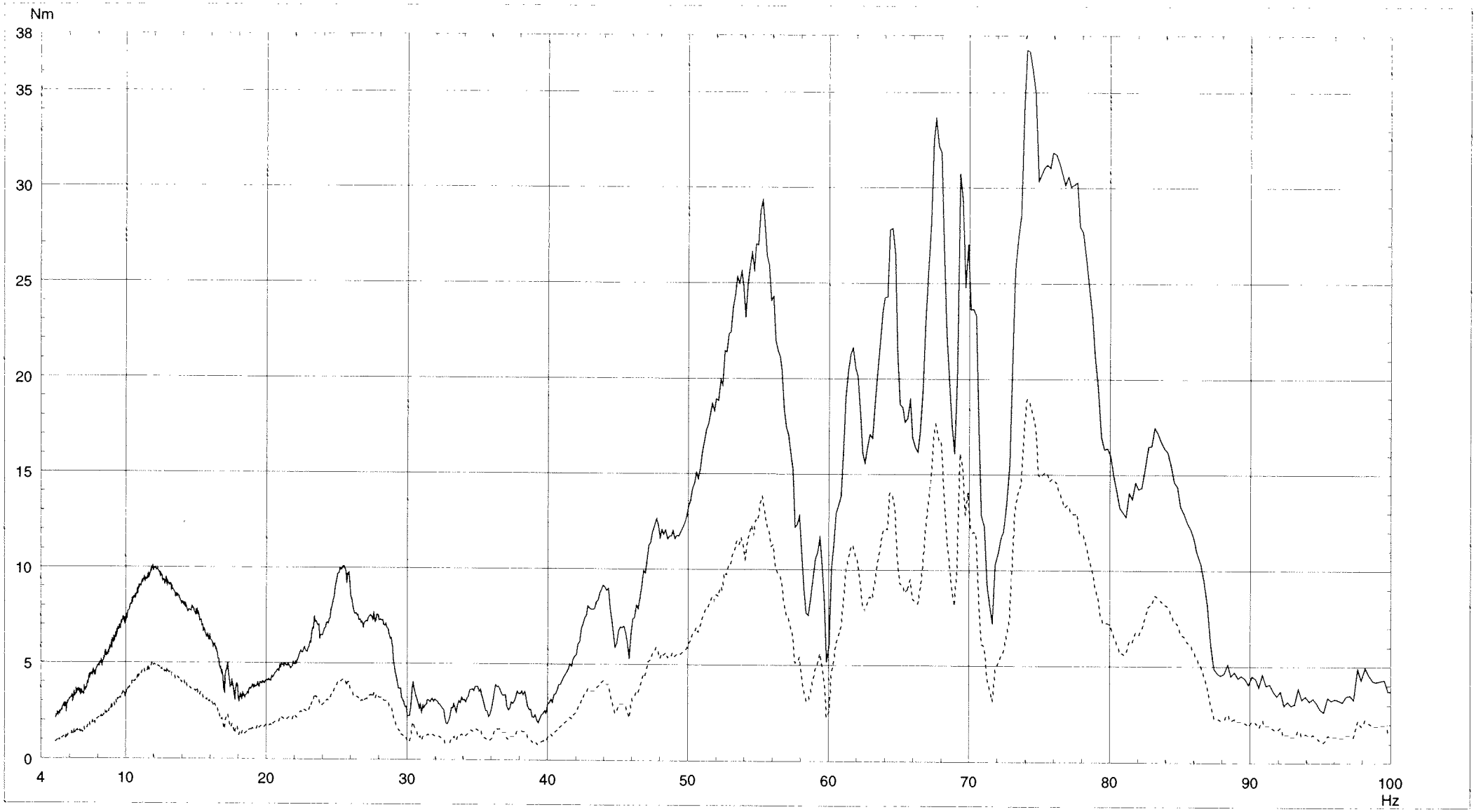
EADS Astrium GmbH	01/02/2006				
		QLZ1	STM	Global	HSS1-2_MLat
		QLZ1	STM	Global	HSS1-2Tors

HERSCHEL STM



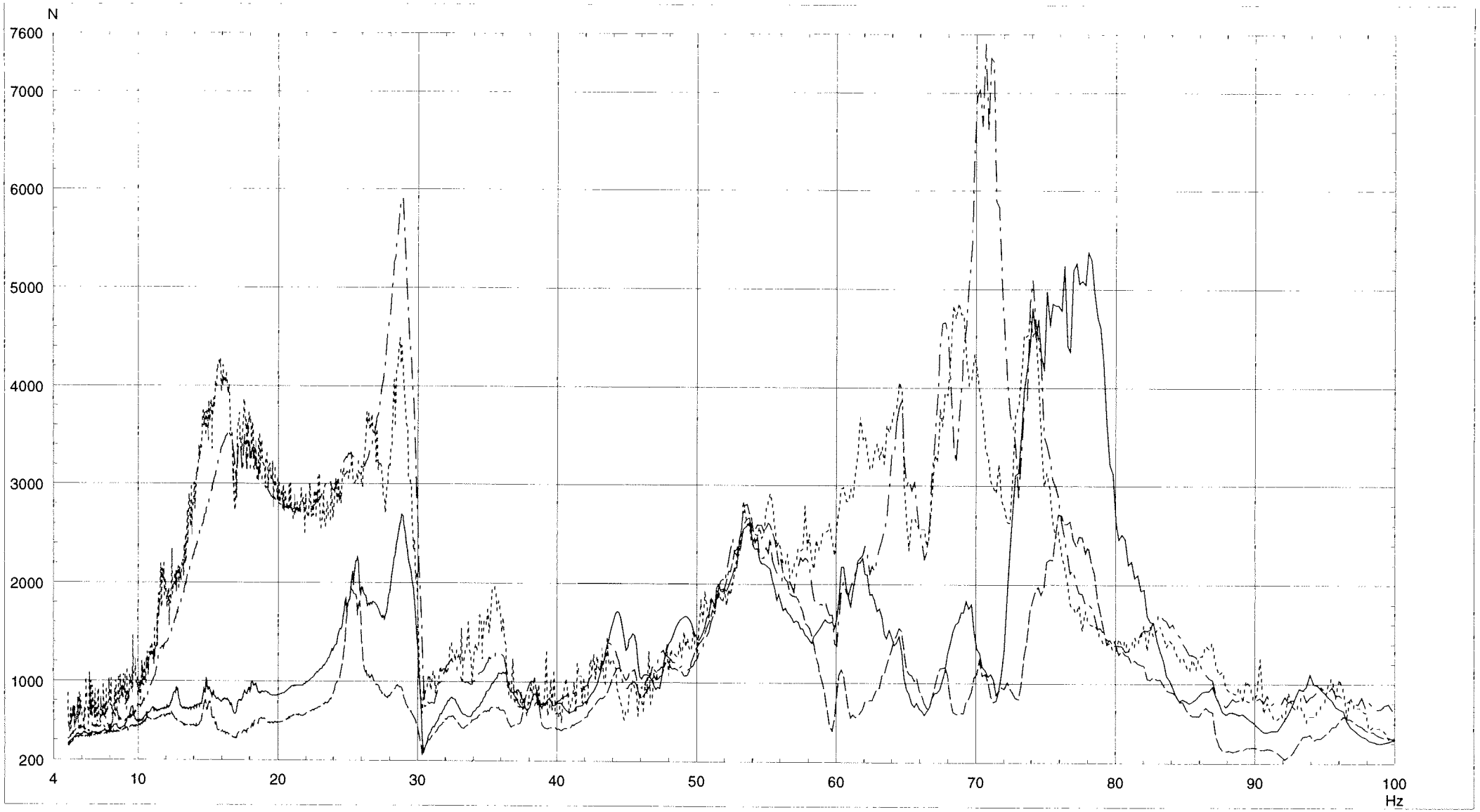
EADS Astrium GmbH	01/02/2006	QLZ1	STM	Global	HSS3-4_FX
		QLZ1	STM	Global	HSS3-4_FY
		QLZ1	STM	Global	HSS3-4_FZ

HERSCHEL STM



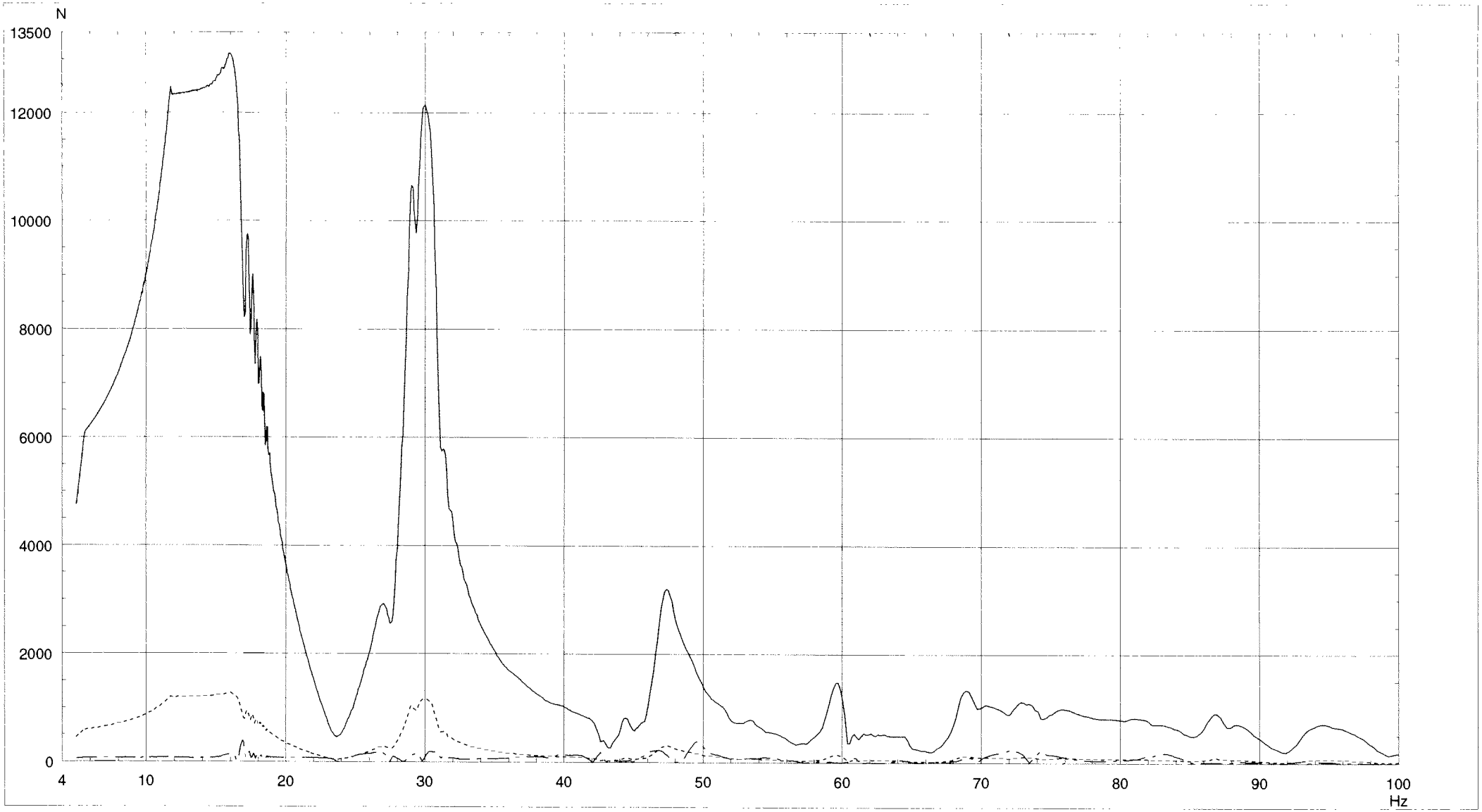
EADS Astrium GmbH	01/02/2006				
		QLZ1	STM	Global	—— HSS3-4_MLat
		QLZ1	STM	Global	------ HSS3-4Tors

HERSCHEL STM



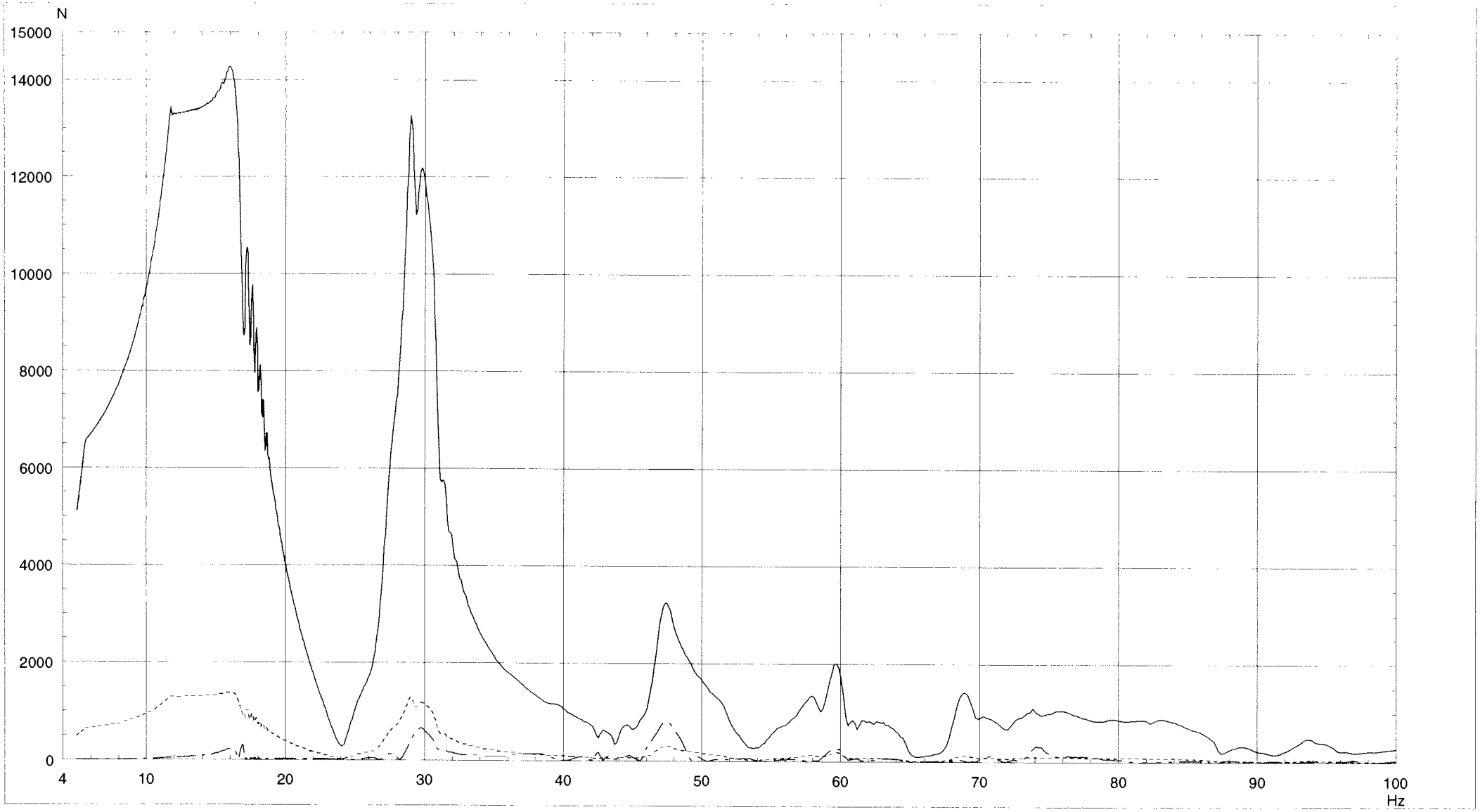
EADS Astrium GmbH	01/02/2006	QLZ1	STM	Global	S01FA
		QLZ1	STM	Global	S02FA
		QLZ1	STM	Global	S03FA
		QLZ1	STM	Global	S04FA

HERSCHEL STM



EADS Astrium GmbH	01/02/2006	QLZ1	STM	Global	SVM+Y:FX_1-2
		QLZ1	STM	Global	SVM+Y:FY_1-2
		QLZ1	STM	Global	SVM+Y:FZ_1-2

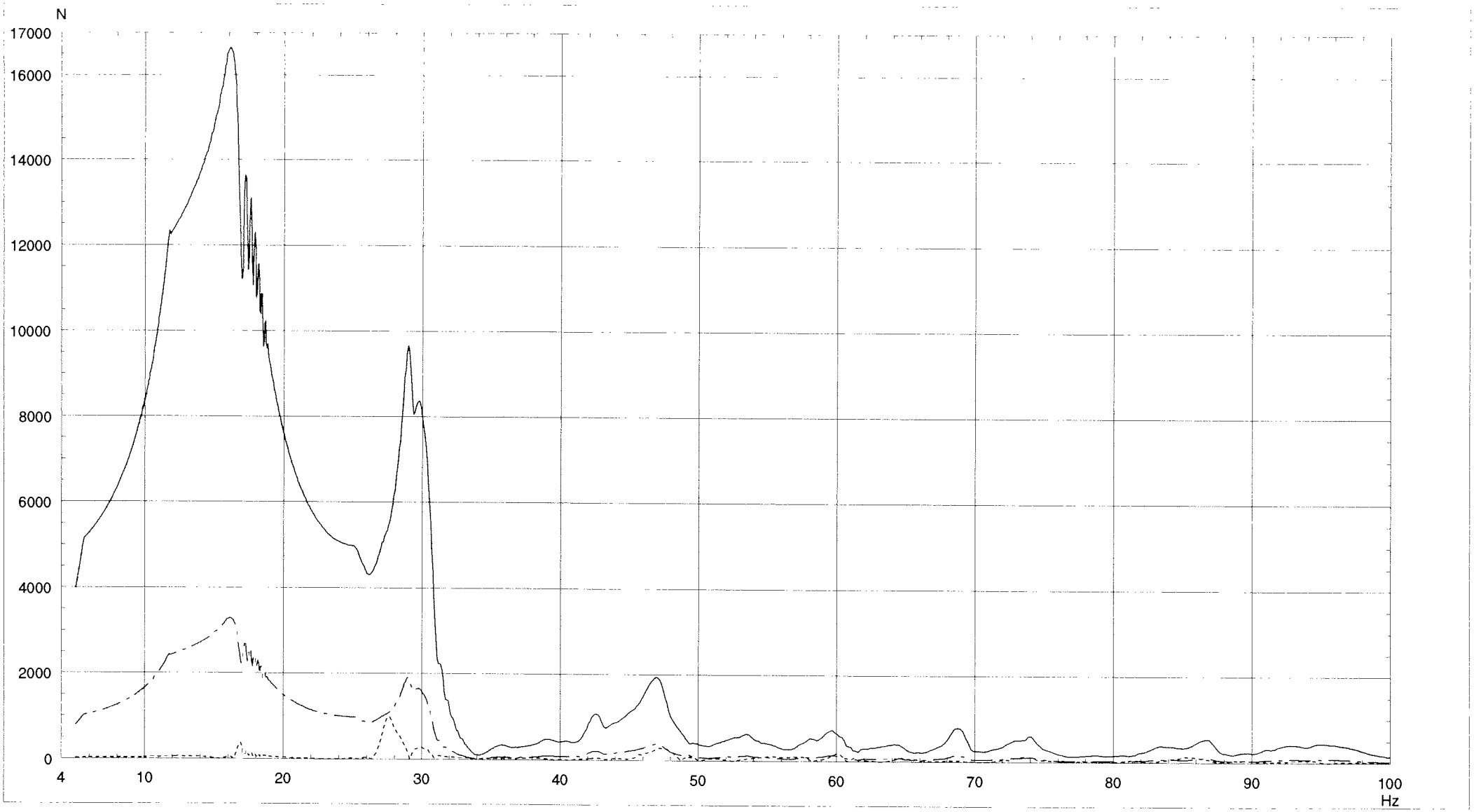
HERSCHEL STM



EADS Astrium GmbH | 01/02/2006

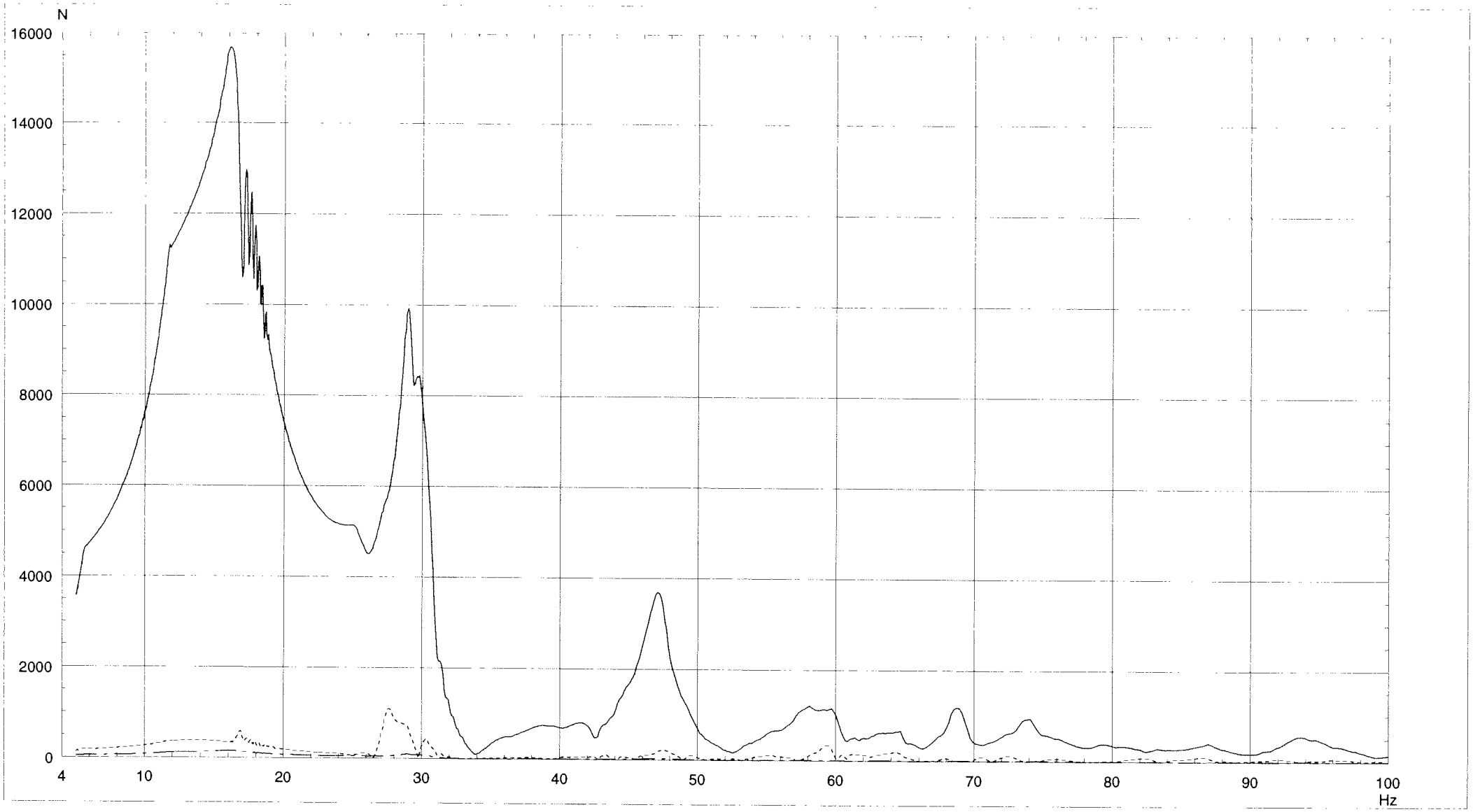
HERSCHEL STM

QLZ1	STM	Global	SVM-Y:FX_3-4
QLZ1	STM	Global	SVM-Y:FY_3-4
QLZ1	STM	Global	SVM-Y:FZ_3-4



EADS Astrium GmbH	01/02/2006	QLZ1	STM	Global	—— SVM+Z:FX_5-6
		QLZ1	STM	Global	------ SVM+Z:FY_5-6
		QLZ1	STM	Global	— - - SVM+Z:FZ_5-6

HERSCHEL STM



EADS Astrium GmbH | 01/02/2006

HERSCHEL STM

QLZ1	STM	Global	—— SVM-Z:FX_7-8
QLZ1	STM	Global	------ SVM-Z:FY_7-8
QLZ1	STM	Global	— - - SVM-Z:FZ_7-8

E N D O F D O C U M E N T

	Name	Dep./Comp.		Name	Dep./Comp.
X	Alberti von Mathias Dr.	AOE22	X	Schink Dietmar	AED44
X	Barlage Bernhard	AED11	X	Schlosser Christian	OTN/AOA54
X	Bayer Thomas	AOA52		Schmidt Rudolf	FAE22
	Brune Holger	AOA55	X	Schweickert Gunn	AOE22
	Fehringer Alexander	AOE13		Sonn Nico	AOE51
	Fricke Wolfgang Dr.	AED 65		Steininger Eric	AED32
	Geiger Hermann	AOA52	X	Stritter Rene	AED11
	Gerner Willi	AED11		Thörmer Klaus-Horst Dr.	OTN/AED65
	Grasl Andreas	OTN/AOA54		Wagner Klaus	AOE22
	Grasshoff Brigitte	AET12	X	Wietbrock Walter	AET12
X	Hauser Armin	AOE22	X	Wöhler Hans	AOE22
	Hendry David	Terma Resid.		Wössner Ulrich	ASE442
	Hengstler Reinhold	AOA 5	X	Alcatel	ASP
X	Hinger Jürgen	AOE22	X	ESA/ESTEC	ESA
	Hofmann Rolf	ASE442		**Instruments:**	
X	Hohn Rüdiger	AED65		MPE (PACS)	MPE
	Huber Johann	AOA52		RAL (SPIRE)	RAL
	Hund Walter	ASE442		SRON (HIFI)	SRON
X	Idler Siegmund	AED312		**Subcontractors:**	
	Ilsen Stijn	Terma Resid.		Air Liquide, Space Department	AIR
	Ivády von András	FAE22		Air Liquide, Space Department	AIRS
X	Jahn Gerd Dr.	AOE22		Air Liquide, Orbital System	AIRT
	Kalde Clemens	APE3		Alcatel Bell Space	ABSP
	Kameter Rudolf	OTN/AOA54		Astrium Sub-Subsyst. & Equipment	ASSE
X	Kettner Bernhard	AET42		Austrian Aerospace	AAE
X	Knoblauch August	AET32		Austrian Aerospace	AAEM
	Koelle Markus	AOA53		APCO Technologies S. A.	APCO
	Koppe Axel	AED312		Bieri Engineering B. V.	BIER
X	Kroeker Jürgen	AED65		BOC Edwards	BOCE
X	Kunz Oliver Dr.	AOE22		Dutch Space Solar Arrays	DSSA
	Lamprecht Ernst	OTN/ASI21		EADS CASA Espacio	CASA
	Lang Jürgen	ASE442		EADS CASA Espacio	ECAS
	Langenstein Rolf	AED15		EADS Space Transportation	ASIP
X	Langfermann Michael	AOA51		Eurocopter	ECD
	Mack Paul	OTN/AOA54		European Test Services	ETS
	Maute Thomas	AOA52		HTS AG Zürich	HTSZ
	Müller Jörg	AOA52		Linde	LIND
	Müller Martin	AOA53		Patria New Technologies Oy	PANT
	Müller Ralf	FAE22		Phoenix, Volkmarsen	PHOE
X	Peltz Heinz-Willi	AOE13		Prototech AS	PROT
	Pietroboni Karin	AED65		QMC Instruments Ltd.	QMC
	Platzer Wilhelm	AED22		Rembe, Brilon	REMB
	Reichle Konrad	AOA52		Rosemount Aerospace GmbH	ROSE
	Reuß Friedhelm	AED62		RYMSA, Radiación y Microondas	RYM
X	Rühe Wolfgang	AED6		SENER Ingenieria SA	SEN
	Runge Axel	OTN/AOA54		Stöhr, Königsbrunn	STOE
	Sachsse Bernt	AED21		Terma A/S, Herlev	TER