INFN Istituto Nazionale di Fisica Nucleare **SEZIONE DI BOLOGNA**	**AMS-02-TOF**

Tipo Doc.: *Doc.Type:*	TEST SEQUENCE			N°DRD: *DRD N°:*	NA
N°Doc.: *Doc. N°:*		Ediz.: *Issue:*	Data: *Date:* **AUG. 2007**	Pagina *Page* **1**	Di *Of* **39**
Titolo : *Title :*	U-TOF VIBRATION TEST SEQUENCE				

	Nome & Funzione *Name & Function*	Firma *Signature*	Data *Date*
Preparato da: *Prepared by:*	C.Guandalini		
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Applicazione autorizzata da: *Application authorized by:*	G.Laurenti		
Customer / Higher Level Contractor			
Accettato da: *Accepted by:*			
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REGISTRAZIONE DELLE MODIFICHE / *CHANGE RECORD*			
EDIZIONE *ISSUE*	DATA *DATE*	AUTORIZZAZIONE *CHANGE AUTHORITY*	OGGETTO DELLA MODIFICA E SEZIONI AFFETTE *REASON FOR CHANGE AND AFFECTED SECTIONS*
1	AUG. 2007		First Issue

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1. SCOPE

This document contains the information for the U-TOF Flight model (FM) vibration test executed by INFN(BO).

The objective of the test setup to be performed according to this procedure is :

- to measure the UTOF first frequency.
- To provide a workmanship verification for the U-TOF.

U-TOF verification followed in this procedure, is**:

- Upper TOF First mode hardmounted (FEA) < 50 Hz (Current First Mode hardmounted(FEA) 43.95 Hz First mode is a drum mode, Current First Mode fixture mounted(FEA) is 33.62 Hz) verified by frequency identification and measurement channels comparison with FEM predictions
- Upper TOF Random Vibration to MEFL (SVP Table 15.1) axes with sine sweep test before & after (notching is foreseen to avoid overtesting of PMTs)

The test shall be successfully performed if the following performances shall be measured:

- The measured first mode shall be > 33.62 Hz for UTOF mounted on fixture .
- FEM model of the fixture well correlated with the fixture calibration test results.
- The UTOF performances shall not be degraded by the vibration environment.

Technical information on the test setup are collected in this document and on the INFN test sequence and shall be referenced during test execution.

The test results shall be collected in a Facility Test Report prepared by SERMS and included in the final test report by INFN.

***This verification approach is based on the contents of RD3, reported hereafter for information only:*

- Upper TOF First mode hardmounted< 50 Hz (Current First Mode 44.9 Hz First mode is a drum mode) Sine Sweep Test of TOF system will be performed.
- *Upper TOF Optional Verification for mission success (Random Vibration to MWL (SVP Table 15.2) 6.8 Grms Level in X, Y, & Z axes with sine sweep test before & after.*

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2. DOCUMENTS

2.1 APPLICABLE DOCUMENTS

AD #	Doc Number	Issue	Date	Rev	Title

2.2 REFERENCE DOCUMENTS

#	Doc Number	Issue	Date	Rev	Title
RD 1	RICSYS-RP-CGS-013_Is1	1	29-06-04		UPPER TOF STRUCTURAL ANALYSYS REPORT
RD 2	AMS02-TN-CGS-000	1	AUG 2007		U-TOF VIBRATION TEST PREDICTION
RD 3	JSC 28792,		August, 2003	Rev. C	Alpha Magnetic Spectrometer – 02 Structural Verification Plan for the Space Transportation System and the International Space Station
RD 4	AMS02-PR-CGS-004	1	August 2007		U-TOF vibration test procedure

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3. ACRONYMS

C.I.	Configuration Item. Also called Part Number (P/N)
CGS	Carlo Gavazzi Space
CP	Control Point
ICD	Interface Control Drawing
FEM	Finite Element Method/Model
MP	Measurement Point
NA	Not Applicable
NCR	Non Conformance Report
P/N	Part Number. Also called Configuration Item C.I.
PA	Product Assurance
PVS	Procedure Variation Sheet
PSD	Power Spectral Density
QA	Quality Assurance
RV	Random Vibration
S/N	Serial Number
UUT	Unit Under Test
TOF	Time Of Flight
UTOF	Upper Time Of Flight

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4. PARTICIPANTS AND RESPONSABILITIES

The test shall be attained by (names shall be filled in the test report) :

NAME	COMPANY\INSTITUTE	ROLE	RESPONSABILITY
	INFN	Test conductor	- UUT transportation and integration - Support to Facility manager for integration of UUT on fixture - Test conduction - Compilation of Step by step procedure - PA\QA management
	INFN	Test Engineer	- Support to test conductor
	CGS	Test Enginer	- Support to test conductor for: o Instrumentation plan evaluation o vibration control quality evaluation o measurements evaluation and comparison to predictions.
	SERMS	Facility test manager	- Facility management and interface to Test Conductor
	SERMS	FacilityTest Engineer	- UUT instrumentation - Facility equipment utilization and test execution - Provision of test results

Tab. 4-1 U TOF vibration test participants and responsibility.

5. NON CONFORMANCE AND FAILURES

Any malfunction/defect which occurred during the test will be reported on the rest report.

6. CALIBRATION REQUIREMENTS

All instruments used for testing shall be calibrated.

Evidence of certification shall be provided by a label attached to the instruments itself, showing the calibration date, the expiring date and the signature of the operator.

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7. TEST ARTICLE

The test article consists of the UTOF assy. The following table shall be compiled during test :

MODEL	ITEM	C.I.	Part number	S/N	NOTES
FM	AMS UPPER TOF FM		AMS TOF UT	na	

The UTOF shall be tested without external harness during vibration.
Following figure shows the UUT in test configuration and the test reference coordinate system.

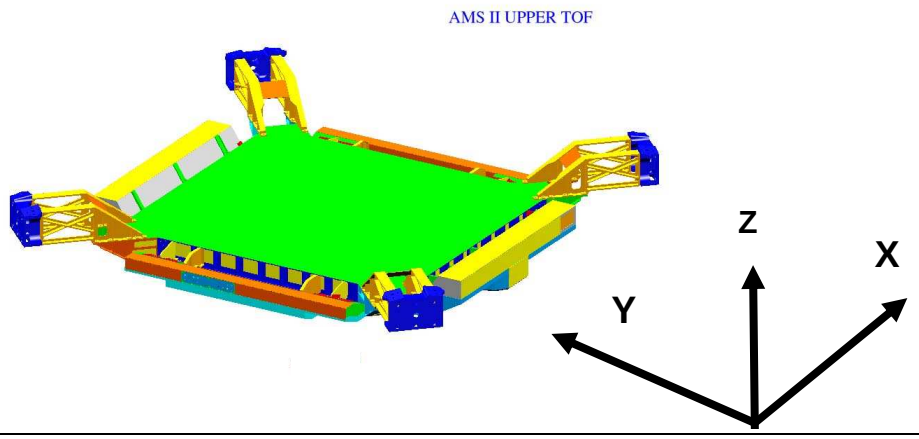

Fig. 7-1 U-TOF and test coordinate system

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8. MEASUREMENT ACCURACY

Test parameter tolerances shall be as follows:

Resonance search.
sweep rate = 2 oct/min ±5%. (1 sweep-up and down), amplitude g

High level sine vibration.
frequency: ±2%
excitation acceleration: ±0.3g

Resonance search.
frequency: ±2%
excitation acceleration: ±0.1g

Random vibration.
frequency: ±2%
power spectral density:

- 20 to 500 Hz (filter bandwidth 25 Hz or narrower)	±1.5 dB
- 500 to 2000 Hz	±3.0 dB
- Overall g_{RMS}	±1.5 dB

9. CONTROL TOLERANCE

The transmissibility characteristic of the rigid fixture and the number of control channels used will guarantee that the controlled input vibration level is transmitted from the exciter to the unit interface without relevant amplification/degradation (less than 3dB between 5 and 500 Hz and ± 6 dB between 500 and 2000 dB Provided that the cumulative bandwidth that exceeds ± 3 dB, does not exceed 300 Hz) with respect to the nominal input.

No relevant discrepancies between the control signal and the different control points shall be present in case of multi-point control.

Cross talks shall not exceed the input.

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10.REQUIREMENTS\SUCCESS CRITERIA CROSS REFERENCE

Cross reference among requirements and procedure steps is provided in Tab. 10-1.

REQ. n°	REQUIREMENT	SUCCESS CRITERION	RESONANCE SEARCH	RANDOM LOW LEVEL	RANDOM FULL LEVEL	RESONANCE SEARCH
LTOF-RVT 0	FEM model of the fixture well correlated with the fixture calibration test results.		X			
LTOF-RVT 1	-Lower TOF First Mode > 33.62 Hz (Current Predicted Mode FIXTURE MOUNTED = 33.62 Hz ,First mode is a drum mode Current Predicted Mode HARD MOUNTED = 43.95 Hz ,First mode is a drum mode	F1> 33.62 Hz	X			X
LTOF-RVT 2	- Lower TOF Optional Verification for mission success (Random Vibration to MEFL UUT not degraded by applicable qualification random environment	No discrepancy on plots, no damage, loose parts or yielding		X	X	
		No frequency shift >5%, no amplitude variation >30%				X

Tab. 10-1 Requirements cross reference

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10.1 FIXTURE TEST RESULTS

A set of test results of the fixtures alone shall be provided by SERM before the U-TOF RVT to correlate the hardmounted and the fixture mounted U-TOF first frequencies and update, if needed, the model used for the predictions of RD2.The results shall be in form of frequency response functions between the shaker\sliding table interface and the fixture most relevant locations for the test purposes.A set of test results of the fixtures alone shall be provided by SERM before the UTOF vibration test. In particular the fixture shall be characterized with a sine sweep run where the shaker input at the fixture base was controlled. The frequencies of the fixture shall be measured and compared to the FEA predictions in order to allow the analytical correlation between the U-TOF hardmounted and fixture mounted first frequency.The test shall be conducted both on the XY and Z Fixtures, however only the X direction shall be characterized for the Fixture XY for symmetry reasons.
The following figures show the tested configurations highlighting the node to be compared to the test results.

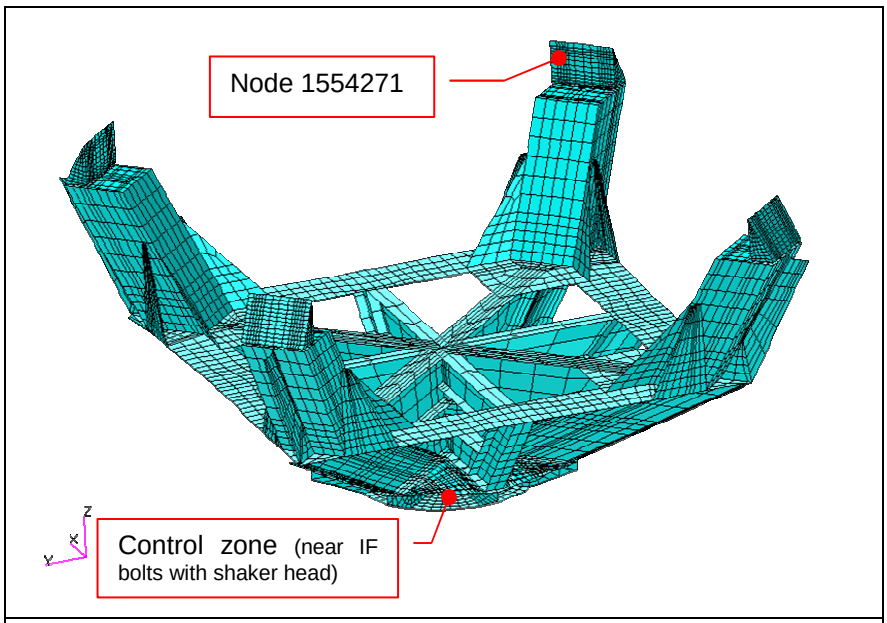

Fig. 10-1 Fixture Z test configuration

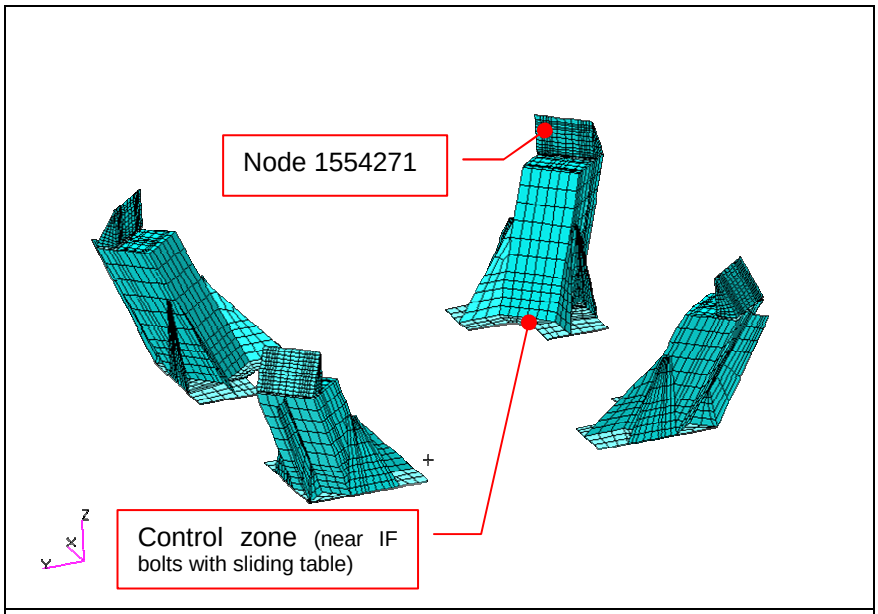

Fig. 10-2 Fixture XY test configuration

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The following figures show the predicted response function of the fixture.

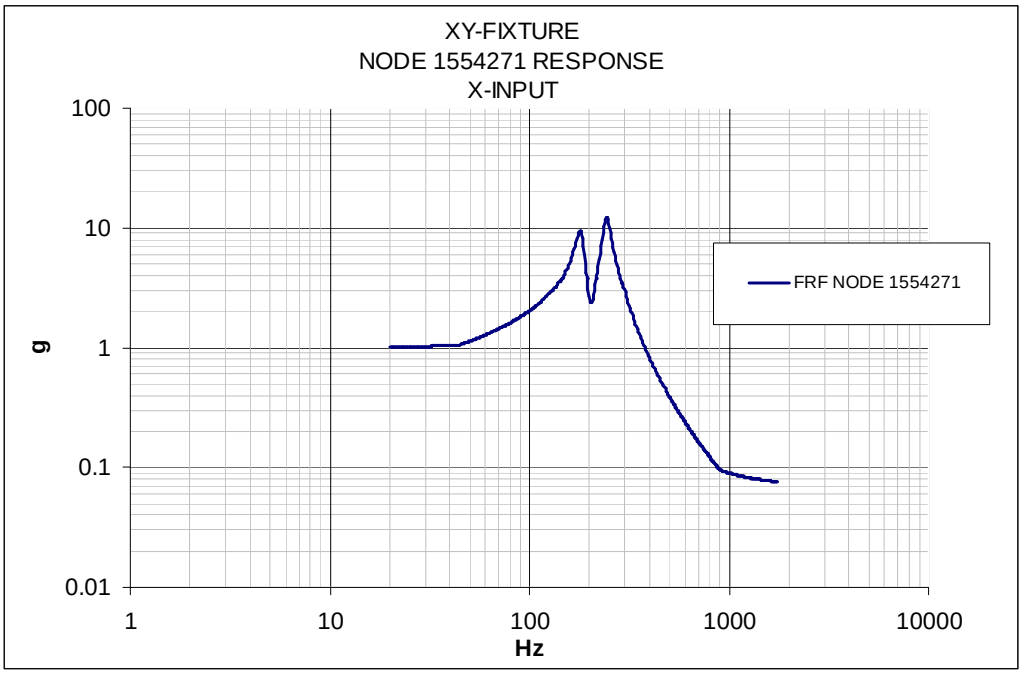

Fig. 10-3 NODE 1554271 response considering Fixture XY - X-Input

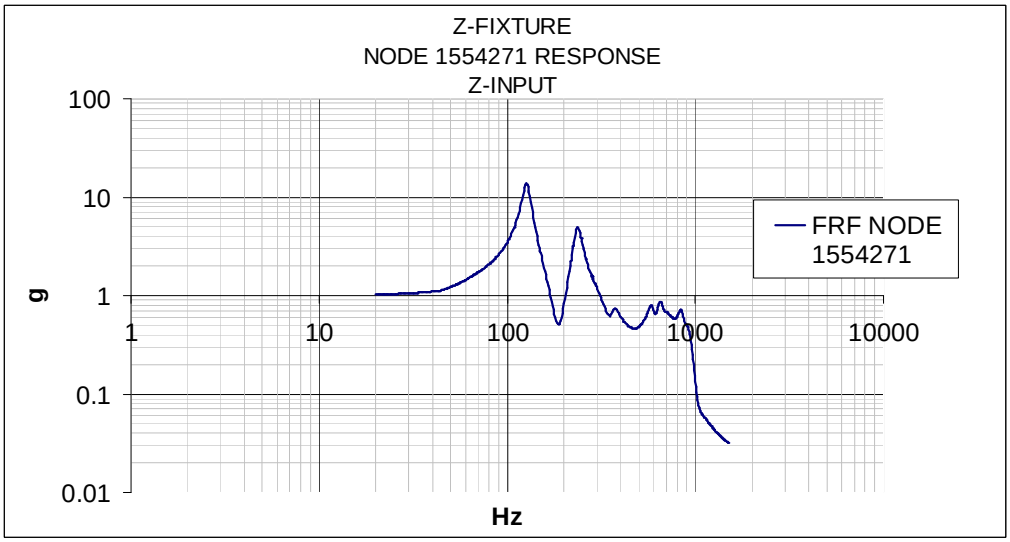

Fig. 10-4 NODE 1554271 response considering Fixture Z - Z-Input

The following table summarizes the first frequencies and the amplification factors.

	Frequency 1 [Hz]	Ampl. 1	Frequency 2 [Hz]	Ampl. 2
Fixture Z	126	12.6	238	4.85
Fixture XY	181	9.34	246	11.68

Tab. 10-2 First frequencies and amplification factors by FEA for the single fixture

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11.INSTRUMENTATION, SPECIAL TOOLS AND TEST EQUIPMENT

The complete list of the instrumentation used during the test shall be recorded in Tab. 11-1.

The list shall be filled up during tests and reported in Test Report.

This list can be replaced by a “Declaration of Facility and Test Readiness”, which summarizes the used test and measurement equipment in tabular form. The same declaration, including calibration and maintenance data, is later part of the finally summary test report.

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N.	EQUIPMENT	MANUFACTURER	P/N	S/N	ACCURACY (*)	NEXT CAL. DATE	REMARKS\SUPPLIER
	Dinamometric wrenches for UUT						INFN
	Dinamometric wrenches for FIXTURE						SERMS
	Hoisting fixture	INFN			NA	NA	INFN

Tab. 11-1 Instrument list

(*) Where not specified the accuracy is as stated on the instrument manufacturer data sheet

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12.TEST LEVELS

12.1 RESONANCE SEARCH LEVELS

During resonance search the following level shall be used:

Linear frequency scan band:	5-2000 Hz
Scan speed	2 oct/min (sweep up only)
Level:	0.3 g (peak)
Control:	Multipoint input control is used with maximum strategy. Based on preliminary test results other possible control strategies shall be evaluated to provide the best test performance, according to requirements of chapter 9

Tab. 12-1 Resonance search level

12.2 RANDOM VIBRATION LEVELS

The proposed baseline levels shall be applied according to the same procedure used for the LTOF. The monitored PMT accelerometers shall be verified and in case the measured gRMS levels shall exceed the limit of 6.8 gRMS a notching shall be applied.

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JSC 28792, Rev. C

Table 15-1: Maximum Expected Flight Levels for AMS-02

X Axis	20-58 Hz	0.0025 g^2/Hz
	58-125 Hz	+9 dB/Octave
	125-300 Hz	0.025 g^2/Hz
	300-900 Hz	-9 dB/Octave
	900-2000 Hz	0.001 g^2/Hz
	Overall = 3.1 Grms	
Y Axis	20-90 Hz	0.008 g^2/Hz
	90-100 Hz	+9 dB/Octave
	100-300 Hz	0.01 g^2/Hz
	300-650 Hz	-9 dB/Octave
	650-2000 Hz	0.001 g^2/Hz
	Overall = 2.3 Grms	
Z Axis	20-45 Hz	0.009 g^2/Hz
	45-125 Hz	+3 dB/Octave
	125-300 Hz	0.025 g^2/Hz
	300-900 Hz	-9 dB/Octave
	900-2000 Hz	0.001 g^2/Hz
	Overall = 3.2 Grms	

Note: MEFL Test duration: 60 seconds per axis

Tab. 12-2 LTOF MEFL Random spectrum FROM AD1

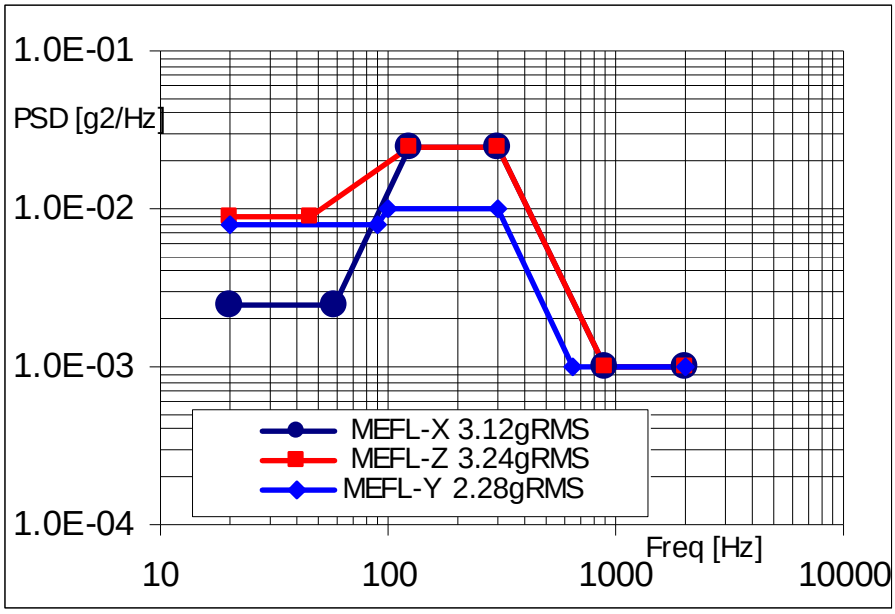

Fig. 12-1 LTOF MEFL Random spectrum FROM AD1

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13.TEST PREDICTIONS AND NOTCHING APPROACH

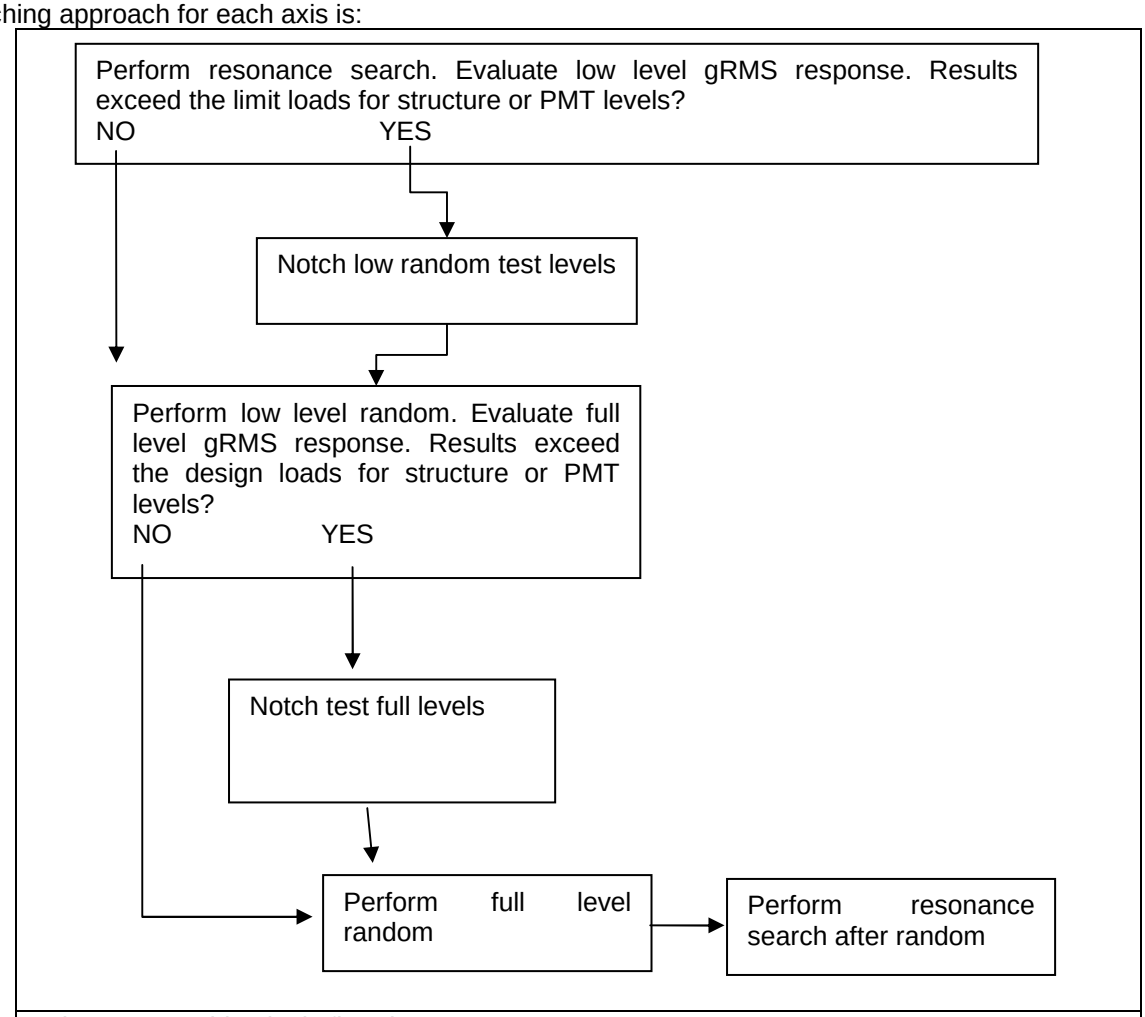
Notching shall be based both on analytical predictions and the measurements available during test. Notched levels and rationale used to derive them shall be recorded in a PVS datasheet.

13.1 NOTCHING PHILOSOPHY

During test if required a notching shall be implemented for the following scope:

1. not to exceed structural stress\force design levels
2. not to exceed at critical components level (PMT) their qualification levels.

The notching approach for each axis is:



Tab. 13-1: notching logic flowchart RD1

Notched levels and rationale shall be recorded in a PVS datasheet.

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13.2 NOTCHING FOR STRENGHT PURPOSES

For each run the gRMS response measured on **MP10**, the most representative point on the UTOF structure, shall be used and multiplied by the ratio COG\MP to evaluate the real acceleration at CoG during test:

	MP10\CoG ratio
X DIRECTION	1.24
Y DIRECTION	0.90
Z DIRECTION	0.22

Table 13-1 COG/MP ratio

According to RD2 , in case the calculated equivalent static test loads is exceeding the 1-sigma limits reported in the following table, a notching has to be evaluated to avoid structure overtesting.

	1-sigma acceleration Limits at CoG [gRMS]
X DIRECTION	23.66
Y DIRECTION	21.15
Z DIRECTION	3.4

Table 13-2 U-TOF acceleration limit values

The following figures show the central point behavior and the CoG response for each direction.

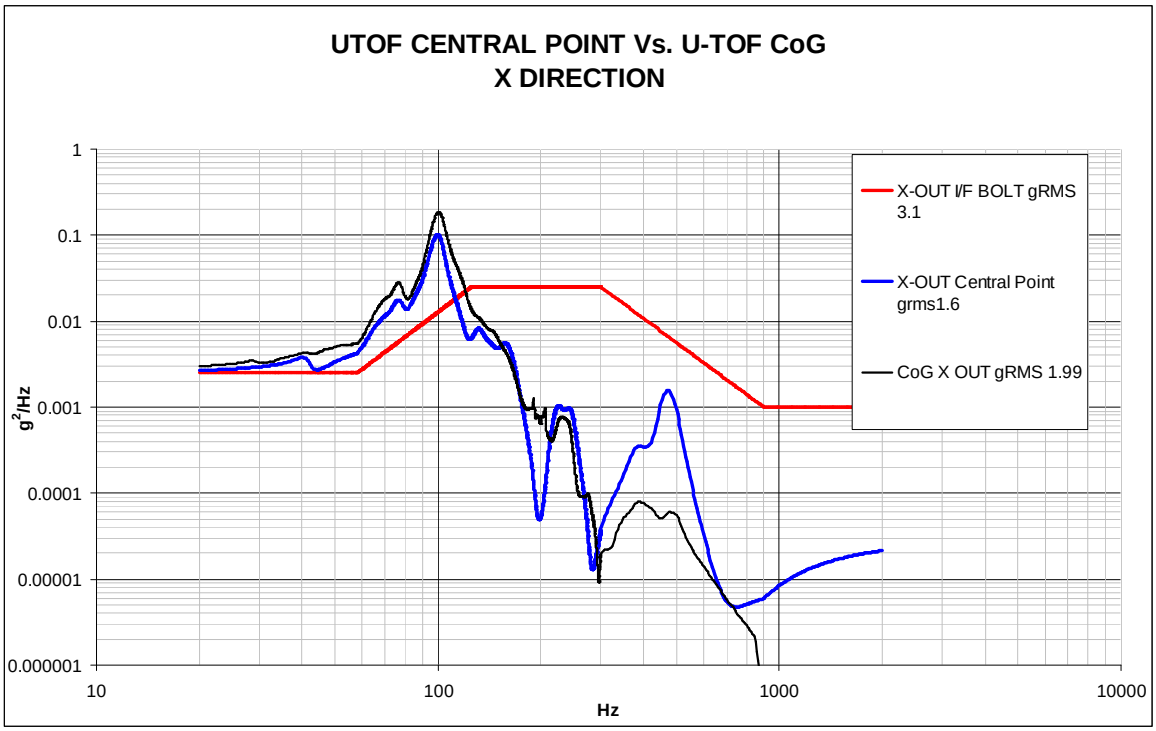

Figure 13-1 U-TOF central point Vs. U-TOF CoG – X-dir

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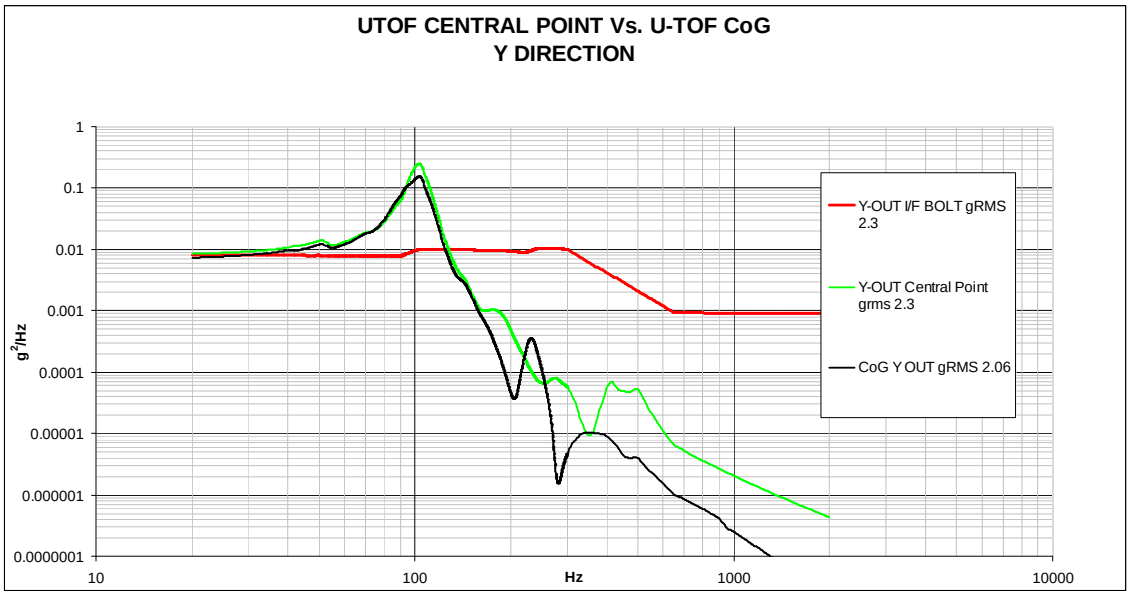

Figure 13-2 U-TOF central point Vs. U-TOF CoG – Y-dir

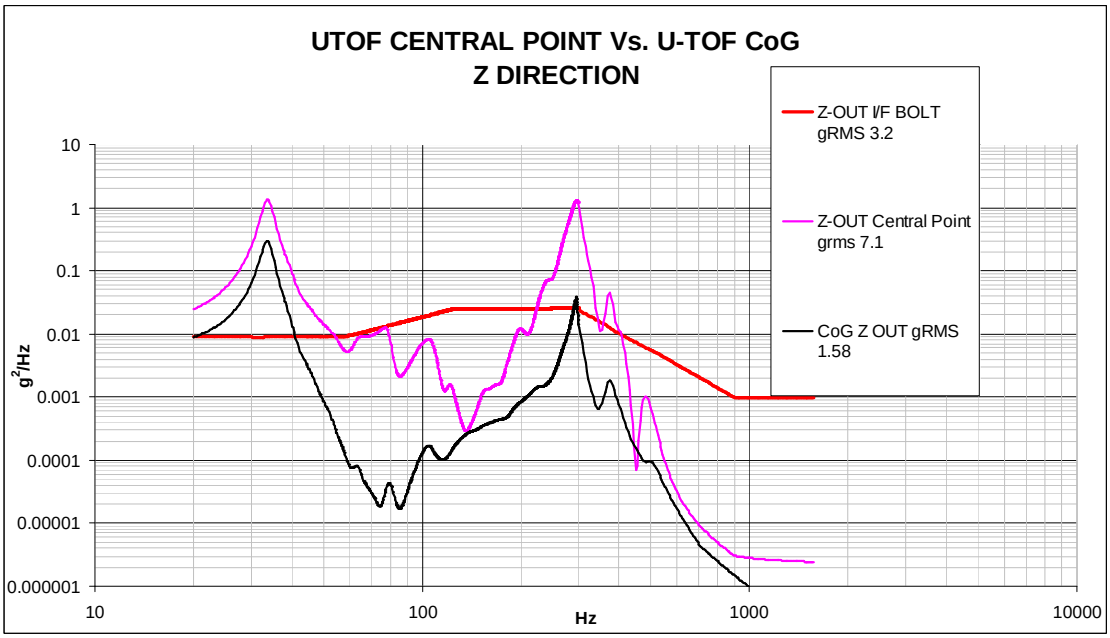

Figure 13-3 U-TOF central point Vs. U-TOF CoG – Z-dir

Based on the predictions of RD2 anyway no notching should be required for this purpose, considering the MEFL levels.

13.3 NOTCHING FOR COMPONENTS SPECIFICATION

Monitored components are the PMT's (MP 21-29). Those components are qualified for a 6.8 gRMS 1sigma level. Therefore the input level shall be notched to guarantee that the measured channels shall not exceed this limit.

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14.TEST CONDITIONS

- The UUT shall be mounted on the vibrator exciter by bolting to the fixture.
- The transmissibility characteristic of the rigid fixture will guarantee that the input vibration levels are transmitted from the exciter to the UUT.
- Unless otherwise specified, all the measurements are to be performed at the following ambient conditions:
  - Temperature : 20℃ ± 5℃
  - Relative humidity : 60% ± 20% RH
  - Pressure : Ambient
  - Cleanliness : visibly clean class
- During vibration on shaker it shall be considered acceptable to reach the following conditions
  - Temperature : 30℃ ± 8℃
  - Relative humidity : 60% ± 30% RH
  - Pressure : Ambient
  - Cleanliness : implementation of means to reduce contamination of the unit in a non visibly clean environment
- Laboratories General disposition shall be applied to maximize personnel safety from potential hazards.
- Skilled personnel shall be employed.
- All used instruments shall meet the necessary tolerances and shall not degrade the UUT performance:
  - for resonance search
    - Frequency : ± 2%
    - Sweep rate : ± 5%
    - Amplitude : ± 10%
  - for random vibration
    - Frequency : ± 5% (or 1 Hz whichever is greater)
    - PSD : -1/+3 dB
    - Overall g_{RMS} : ± 10%
- The accuracy of all the instruments shall be consistent with the tolerances for the variable to be measured, and should be at least one third of the tolerance itself.

15.TEST PROCEDURE VARIATION SHEET

In case that for any reason the test procedure has to be changed, the change shall be described in a Procedure Variation Sheet (PVS) as shown in the next page.

The PVS shall contain:

- Reference to the test procedure to be changed
- Reference to the relevant test, procedure page and paragraph
- Description of the change, possibly in the form was….is…..
- Reason for change
- Test Engineer, and Test conductor signatures and dates

Each PVS shall be identified by a reference number provided in sequential order.

All the generated PVS shall be collected in a dedicated section of the Test Report.

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PROCEDURE VARIATION SHEET ref. N°:		
Test Procedure Ref.:	Page Revised:	Paragraph Revised:
Description of Change:		
Reason for Change:		

CONCURRENCE				
Test Cond.	QA	System Eng.		Customer
Date	Date	Date		Date

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16.TEST DATA SHEETS

The step-by-step procedure sheets are provided in the following pages.

16.1 DATA SHEETS FILLING UP

The following fields of the data sheets:

- UUT DATA (including Model, Item, C.I., S/N)
- Measured value

Shall be filled up during the test performances and shall be part of the Test Report together with photographs, sketches, etc. eventually useful to document the test execution/result.

Remarks field shall be used as a minimum to provide, where appropriate, reference to PVS.

Test Report reference data shall be added in the relevant field.

Each data sheet (including the attachments) shall be certified with the Test Conductor signature and date.

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
1.	**UTOF TEST SETUP**			
1.1.	REMOVE U-TOF FROM TRANSPORT CONTAINER	OK		
1.2.	INSTALL INTERNAL ACCELEROMETERS	OK		
1.3.	INSTALL EXTERNAL ACCELEROMETERS	OK		

DATE:	TEST CONDUCTOR (INFN)	QA (INFN)	CUSTOMER (NA)

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
2.	**TEST X AXIS**			
2.1.	**UNLOADED FIXTURE RESONANCE SEARCH**			
2.1.1.	INSTALL FIXTURE ON SHAKER	OK		
2.1.2.	FIX CONTROL ACCELOMETERS TO FIXTURE	OK		
2.1.3.	PROGRAM SHAKER ACCORDING TO Tab. 12-1 AND PERFORM RESONANCE SEARCH	OK		
2.1.4.	VERIFY PLOTS	Cross talk ok Amplif\degr .ok pilot and copilot ok		
2.1.5.	COMPARE THE OBTAINED PLOTS WITH THE Tab. 10-2	OK		
2.1.6.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		

DATE:	TEST CONDUCTOR (INFN)	QA (INFN)	CUSTOMER (NA)

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
2.2.	**RESONANCE SEARCH BEFORE RANDOM LOW LEVEL**			
2.2.1.	INSTALL UUT TO THE FIXTURE FOR X DIRECTION VIBRATION			
2.2.2.	CONNECT MEASURE ACCELEROMETERS TO DAS	OK		
2.2.3.	PROGRAM SHAKER ACCORDING TO Tab. 12-1 AND PERFORM RESONANCE SEARCH	OK		
2.2.4.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
2.2.5.	FREQUENCY IDENTIFICATION AND EVALUATION OF PLOTS WITH RESPECT TO FEM PREDICTIONS	F_1 > 33.62 Hz PLOTS OK		

DATE:	TEST CONDUCTOR (INFN)	QA (INFN)	CUSTOMER (NA)

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
2.3.	**LOW LEVEL RANDOM**			
2.3.1.	PROGRAM SHAKER ACCORDING TO Tab. 12-2 LOW LEVEL (-6 Db)	OK		
2.3.2.	PERFORM RANDOM VIBRATION	OK		
2.3.3.	ANNEX TO THE TEST REPORT RESPONSE FROM THE MPs AND SAVE FILE	OK		
2.3.4.	VERIFY PLOTS	No deformation No damage No loose parts No discrepancy wrt previous plots		
2.3.5.	VERIFY COG ACCELERATION AND NOTCHING	OK		
2.3.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING	OK		

DATE:	TEST CONDUCTOR (INFN)	QA (INFN)	CUSTOMER (NA)

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
2.4.	**FULL LEVEL RANDOM**			
2.4.1.	PROGRAM SHAKER ACCORDING TO Tab. 12-2 FULL LEVEL -0dB	OK		
2.4.2.	PERFORM RANDOM VIBRATION	OK		
2.4.3.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
2.4.4.	VERIFY PLOTS	No deformation No damage No loose parts No discrepancy wrt previous plots		
2.4.5.	VERIFY COG ACCELERATION AND NOTCHING	OK		
2.4.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING	OK		

DATE:	TEST CONDUCTOR (INFN)	QA (INFN)	CUSTOMER (NA)

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
2.5.	**RESONANCE SEARCH AFTER FULL LEVEL RANDOM**			
2.5.1.	PROGRAM SHAKER ACCORDING TO Tab. 12-1 AND PERFORM RESONANCE SEARCH	OK		
2.5.2.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
2.5.3.	VERIFY PLOTS	freq shift ok amplif var. ok		
2.5.4.	CHECK INTERFACE BOLTS TORQUE	OK		
2.5.5.	REMOVE UUT FROM FIXTURE	OK		
2.5.6.	REMOVE FIXTURE	OK		

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
3.	**TEST Y AXIS**			
3.1.	**RESONANCE SEARCH BEFORE RANDOM LOW LEVEL**			
3.1.1.	INSTALL UUT TO THE FIXTURE FOR Y DIRECTION VIBRATION			
3.1.2.	CONNECT MEASURE ACCELEROMETERS TO DAS	OK		
3.1.3.	PROGRAM SHAKER ACCORDING TO Tab. 12-1 AND PERFORM RESONANCE SEARCH	OK		
3.1.4.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
3.1.5.	FREQUENCY IDENTIFICATION AND EVALUATION OF PLOTS WITH RESPECT TO FEM PREDICTIONS	F_1 > 33.62 Hz PLOTS OK		

DATE:	TEST CONDUCTOR (INFN)	QA (INFN)	CUSTOMER (NA)

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
3.2.	**LOW LEVEL RANDOM**			
3.2.1.	PROGRAM SHAKER ACCORDING TO CHP 12.2 LOW LEVEL (-6 Db)	OK		
3.2.2.	PERFORM RANDOM VIBRATION	OK		
3.2.3.	ANNEX TO THE TEST REPORT RESPONSE FROM THE MPs AND SAVE FILE	OK		
3.2.4.	VERIFY PLOTS	No deformation No damage No loose parts No discrepancy wrt previous plots		
3.2.5.	VERIFY COG ACCELERATION AND NOTCHING	OK		
3.2.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING	OK		

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
3.3.	**FULL LEVEL RANDOM**			
3.3.1.	PROGRAM SHAKER ACCORDING TO CHP 12.2 FULL LEVEL -0dB	OK		
3.3.2.	PERFORM RANDOM VIBRATION	OK		
3.3.3.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
3.3.4.	VERIFY PLOTS	No deformation No damage No loose parts No discrepancy wrt previous plots		
3.3.5.	VERIFY COG ACCELERATION AND NOTCHING	OK		
3.3.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING	OK		

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
3.4.	**RESONANCE SEARCH AFTER FULL LEVEL RANDOM**			
3.4.1.	PROGRAM SHAKER ACCORDING TO Tab. 12-1 AND PERFORM RESONANCE SEARCH	OK		
3.4.2.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
3.4.3.	VERIFY PLOTS	freq shift ok amplif var. ok		
3.4.4.	CHECK INTERFACE BOLTS TORQUE	OK		
3.4.5.	REMOVE UUT FROM FIXTURE	OK		
3.4.6.	REMOVE FIXTURE	OK		

DATE:	TEST CONDUCTOR (INFN)	QA (INFN)	CUSTOMER (NA)

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
4.	**TEST Z AXIS**			
4.1.	**UNLOADED FIXTURE RESONANCE SEARCH**			
4.1.1.	INSTALL FIXTURE ON SHAKER	OK		
4.1.2.	FIX CONTROL ACCELOMETERS TO FIXTURE	OK		
4.1.3.	PROGRAM SHAKER ACCORDING TO Tab. 12-1 AND PERFORM RESONANCE SEARCH	OK		
4.1.4.	VERIFY PLOTS	Cross talk ok Amplif\degr .ok pilot and copilot ok		
4.1.5.	COMPARE THE OBTAINED PLOTS WITH THE Tab. 10-2	OK		
4.1.6.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
4.2.	**RESONANCE SEARCH BEFORE RANDOM LOW LEVEL**			
4.2.1.	INSTALL UUT TO THE FIXTURE FOR X DIRECTION VIBRATION			
4.2.2.	CONNECT MEASURE ACCELEROMETERS TO DAS	OK		
4.2.3.	PROGRAM SHAKER ACCORDING TO Tab. 12-1 AND PERFORM RESONANCE SEARCH	OK		
4.2.4.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
4.2.5.	FREQUENCY IDENTIFICATION AND EVALUATION OF PLOTS WITH RESPECT TO FEM PREDICTIONS	F_1 > 33.62 Hz PLOTS OK		

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
4.3.	**LOW LEVEL RANDOM**			
4.3.1.	PROGRAM SHAKER ACCORDING TO Tab. 12-2 LOW LEVEL (-6 Db)	OK		
4.3.2.	PERFORM RANDOM VIBRATION	OK		
4.3.3.	ANNEX TO THE TEST REPORT RESPONSE FROM THE MPs AND SAVE FILE	OK		
4.3.4.	VERIFY PLOTS	No deformation No damage No loose parts No discrepancy wrt previous plots		
4.3.5.	VERIFY COG ACCELERATION AND NOTCHING	OK		
4.3.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING	OK		

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
4.4.	**FULL LEVEL RANDOM**			
4.4.1.	PROGRAM SHAKER ACCORDING TO Tab. 12-2 FULL LEVEL -0dB	OK		
4.4.2.	PERFORM RANDOM VIBRATION	OK		
4.4.3.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
4.4.4.	VERIFY PLOTS	No deformation No damage No loose parts No discrepancy wrt previous plots		
4.4.5.	VERIFY COG ACCELERATION AND NOTCHING	OK		
4.4.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING	OK		

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
4.5.	**RESONANCE SEARCH AFTER FULL LEVEL RANDOM**			
4.5.1.	PROGRAM SHAKER ACCORDING TO Tab. 12-1 AND PERFORM RESONANCE SEARCH	OK		
4.5.2.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
4.5.3.	VERIFY PLOTS	freq shift ok amplif var. ok		
4.5.4.	CHECK INTERFACE BOLTS TORQUE	OK		
4.5.5.	REMOVE UUT FROM FIXTURE	OK		
4.5.6.	REMOVE FIXTURE	OK		

DATE:	TEST CONDUCTOR (INFN)	QA (INFN)	CUSTOMER (NA)

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UUT DATA :	**Model**	**Item**	**C.I.**	**S/N**

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
5.	**TEST SETUP DISMANTLING**			
5.1.	REMOVE FROM U-TOF THE INTERNAL AND EXTERNAL ACCELEROMETERS	OK		
5.2.	INSERT U-TOF ON TRANSPORT CONTAINER READY FOR SHIPMENT	OK		

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