Korea Lunar Exploration Program

DTN Payload Vibration Test Procedure

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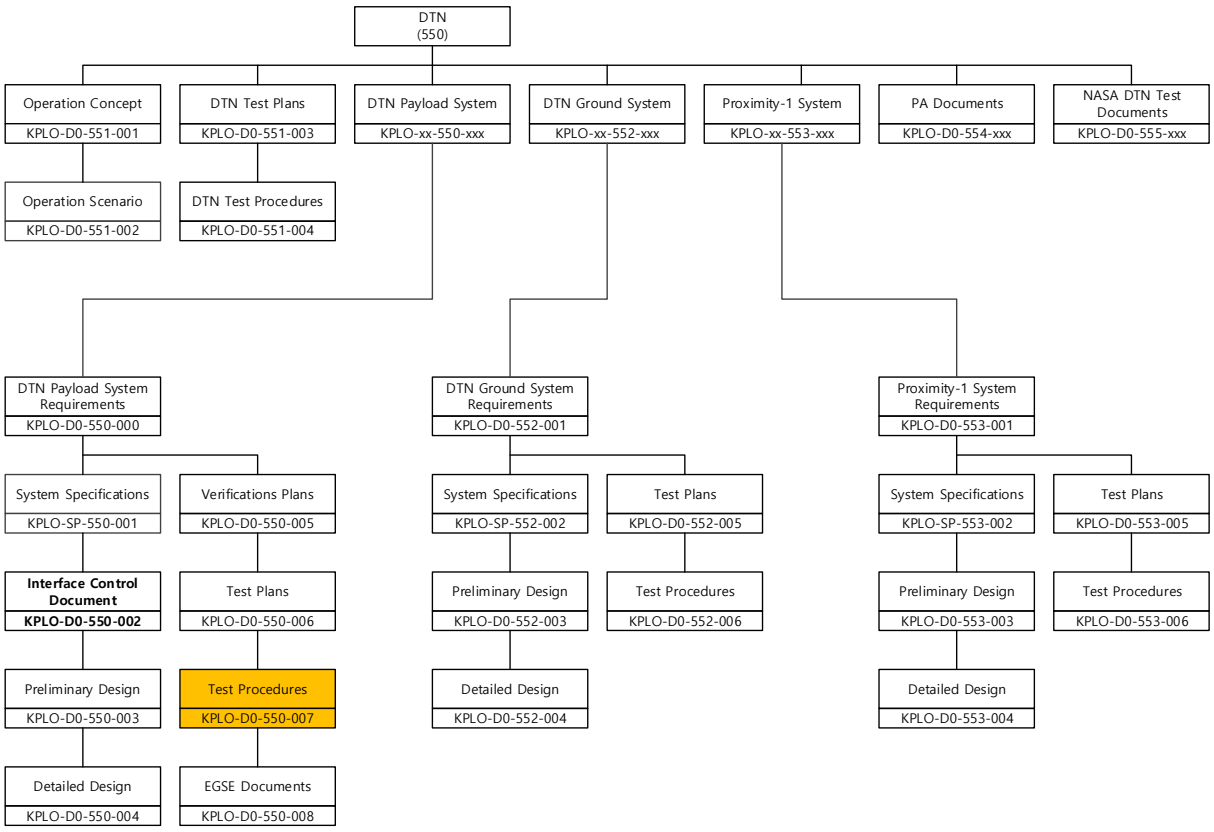
Documents Tree



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1. Introduction

1.1. Purpose and Scope

This document establishes the conditions, requirements and test procedures for vibration testing of the DTNPL payload.

1.2. Applicable & Reference Documents

1.2.1. Applicable Documents

	Document Number	Document Title
AD01	KPLO-D0-550-000	System Requirement of DTN Payload
AD02	KPLO-D0-550-001	System Specification of DTN Payload
AD03	KPLO-SP-320-002	KPLO Environmental Design and Test Specification

1.2.1. Reference Documents

	Document Number	Document Title
RD01	MIL-STD-1540C	Test Requirements for Launch, Upper-Stage, and Space Vehicles
RD02	PSS-01-801	Test Requirements Specification for Space Equipment
RD03	ECSS-E-10-03-A	ECSS Space Engineering-Testing

1.3. Abbreviations

AMS	Asynchronous Message Service
BP	Bundle Protocol
BSS	Bundle Streaming Service
CCSDS	Consultative Committee for Space Data Systems
CFDP	CCSDS File Delivery Protocol
DCC	DTN Control Center
CRC	Cyclical Redundancy Check
DMA	Direct Memory Access
DTN	Delay(Disruption) Tolerant Network
DTNPL	DTN Payload
EOD	End of Data
EOF	End of File
FW	Firm Ware
FSW	Flight Software
ION	Interplanetary Overlay Network
CAS500-1	Korea Pathfinder Lunar Orbiter
LCM	Lander Communication Model
LTP	Licklider Transmission Protocol
OBC	On Board Computer
PDHU	Payload Data Handling Unit
RCM	Rover Communication Model
DTNPL	Single Board Computer
SOD	Start of Data
SOF	Start of File
SOH	Start of Head
TBC	To Be Confirmed
TBD	To Be Defined
TC	Tele-command
TCP	Transmission Control Protocol
TM	Telemetry
UART	Universal Asynchronous Receiver Transmitter

2. Test Article

DTNPL is composed by major functional modules as follows :

- SBC (Single Board Computer)

Figure 2-1 shows the DTNPL QM external view and its coordinate system. Size and mass of test article is given in Table 2-1.

The coordinate system is defined as follows.

- The plane defined by the unit coordinate system axes X and Y is parallel to the mounting surface.
- The unit Z axis is normal to the mounting plane.
- The X axis with the dimension along X (length) being greater than the dimension along Y(width).

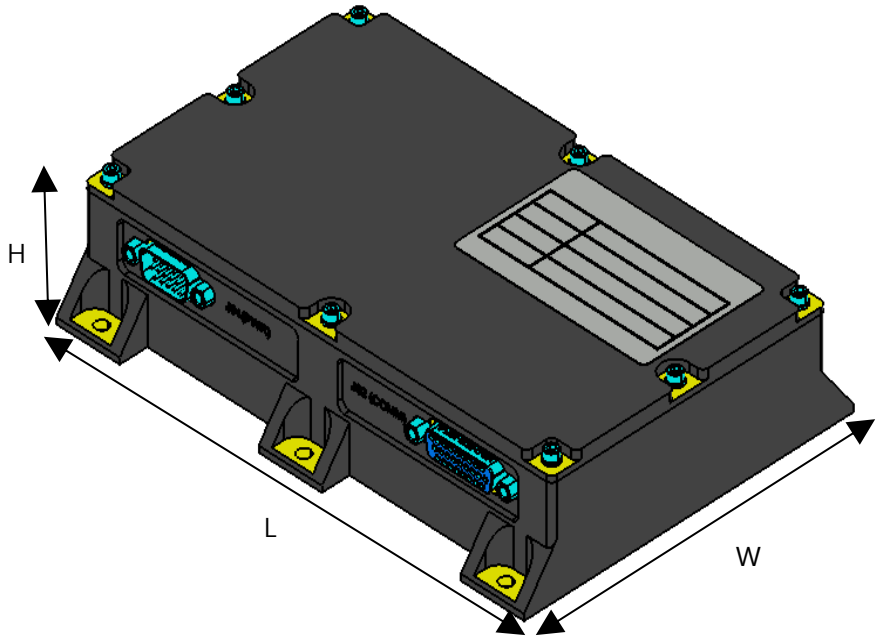

Figure 2-2-1 DTNPL Configurations

Table 2-1 Dimension Criteria

Description	Value
Length measurement	170 mm
Width measurement	120 mm
Height measurement	39 mm
Weighing	0.98 kg

2.1. Verification Cross Reference

The requirements which have to be verified by a successful performance in the test and its relevant test steps are given below:

Applicable Doc.	Requirement	Verified by Test Step	Compliance
KPLO-SP-320-002	Vibration	All	C

2.2. Notification for Qualification and Acceptance Tests

This test procedure shall be approved by the ETRI prior to performance of the test, either by signature on cover page of by performance of a dedicated Test Readiness Review(TRR).

2.3. Precaution and Warnings

For all testing and handling, ESD requirements concerning personnel, facilities and test equipment shall be regarded.

No special hazard exists during the test.

The following precautions apply:

- Only trained personnel are allowed to handle the test specimen.
- A test cable or breakout box shall never be connected of disconnected when the test specimen is powered.
- Correct set-up of the test equipment has to be checked carefully prior to the connection/switch-on of flight hardware, e.g. bonding, grounding, voltages, current limiters, etc.
- The test specimen shell be protected by a clean, antistatic bag all the time no activities are performed at the hardware.

3. . Test Specifications

3.1. Sine vibration

Table 3-1 is the qualification sinusoidal vibration specifications for the DTNPL in all three axes.

Table 3-1 Sine Vibration Level

Frequency(Hz)	Acceleration(g's)	ETC
5-20	Max Shaker Limit	- Sweep Rate: 2 Oct./min
20-100	20g	

3.2. Random vibration

Table 3-2 is the qualification random vibration specifications for the DTNPL in all three axes.

Table 3-2 Random Vibration Level

Frequency(Hz)	Acceleration(g's)	ETC
20	0.026	- For testing: 2 minute per axis
50	0.16	
800	0.16	
2000	0.026	
Overall	14.1 grms	

3.3. DTNPL Function test item

- Initialization
- Operation Test

3.4. Test condition tolerances

Table 3-3 Test Condition Tolerances

Items	Tolerances
Sine Vibration Amplitude Frequency	 ±10% ±2%
Random Vibration Accel. Spectral Density RMS Level	 ±3 dB +10%

3.5. Pass/fail criteria

The pass/fail for the Vibration test is verified by the detailed visual check, function test. The pass/fail criteria are shown in the Table 3-4.

Table 3-4 Pass/Fail criteria

Item	Requirement
Function	No anomaly

4. Test Equipment

The vibration excitation system and data acquisition system in SaTRec will be used for the vibration test.
The specifications of the shaker system and data measurement system are as shown in Table 4-1.

Table 4-1 Shaker system

Item	Manufacturer	Description
Vibration Accelerometer	FAMTECH	2 ton
Test Fixture	Lumir	
Sensor	-	

5. Vibration test configuration

5.1. Sensor location

Location and information of the sensors are indicated in Figure 5-1. Normally two sensors will be attached beside mounting points and the maximum value is going to be used as criteria to know the responsive. The test sensor descriptions will be recorded on the Test Report.

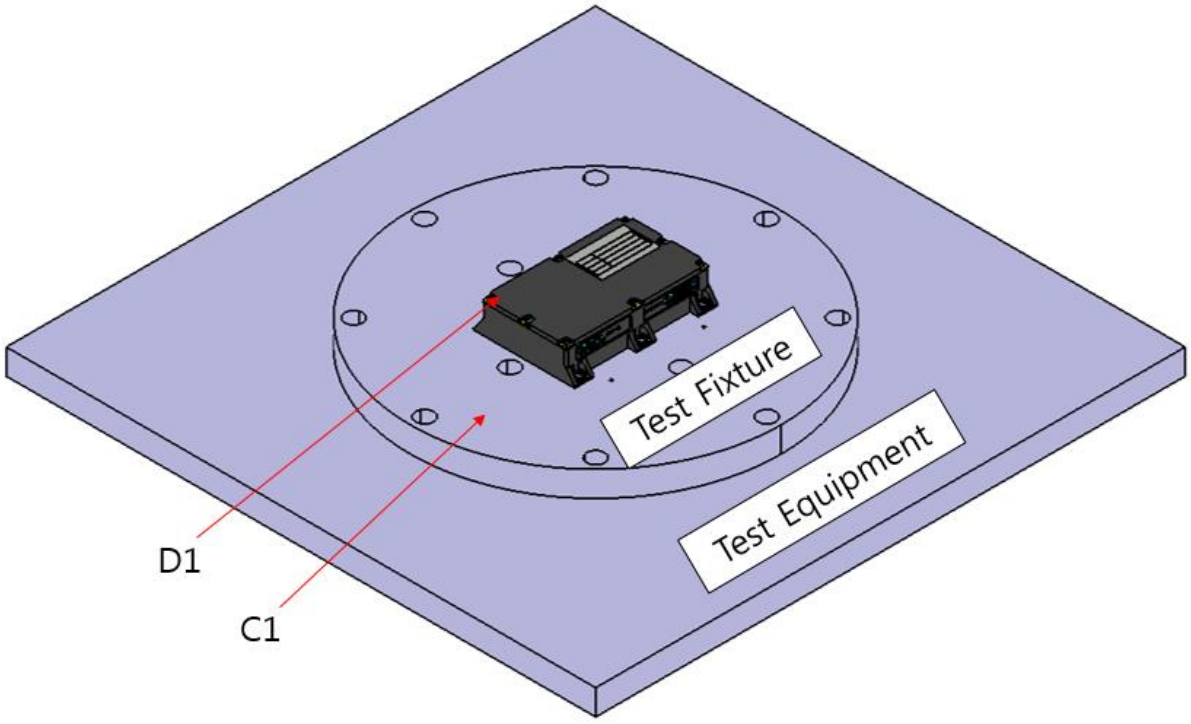

Figure 5-1 Location for Sensors for Test

No.	Position	Sensor S/N	Coordinate		Remark
			Sensor	Equip	
1	C1				Control
2	D1				Measure
3					
4					

5.2. Vibration test setup

5.2.1. Vibration Test setup for x Axis

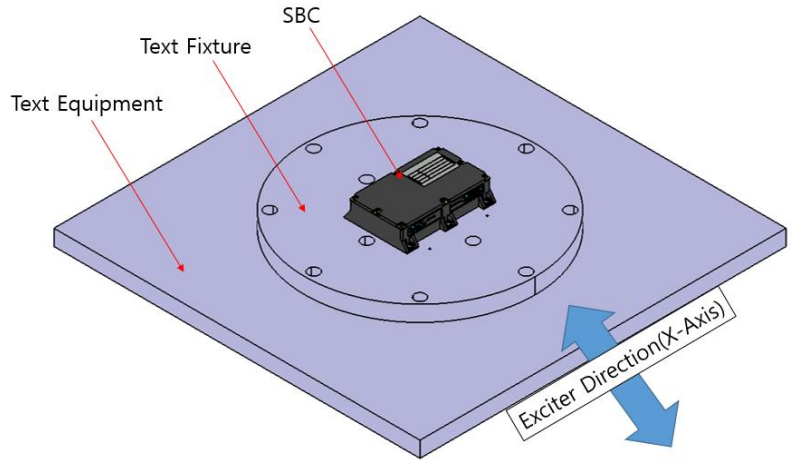

Figure 5-2 Test Configuration for X Axis

5.2.2. Vibration Test setup for Y Axis

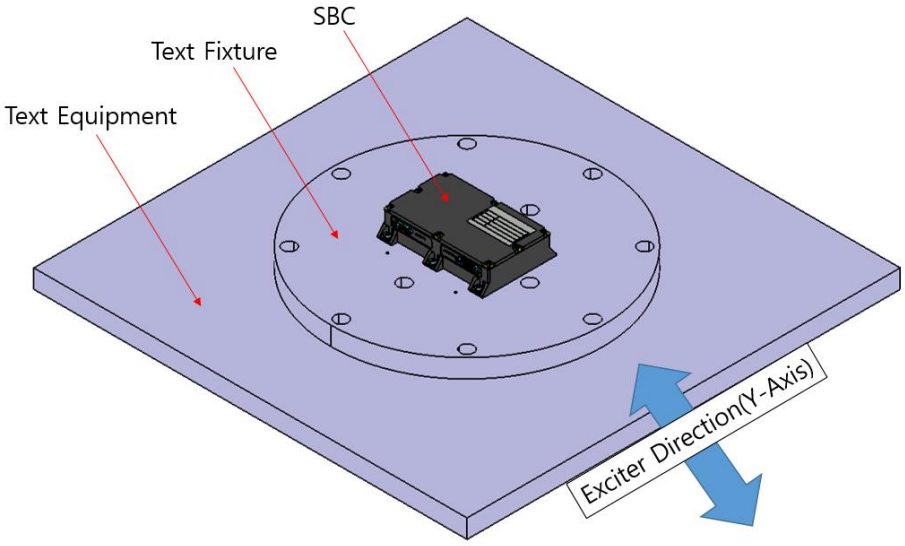

Figure 5-3 Test Configuration for Y Axis

5.2.3. Vibration Test setup for Z Axis

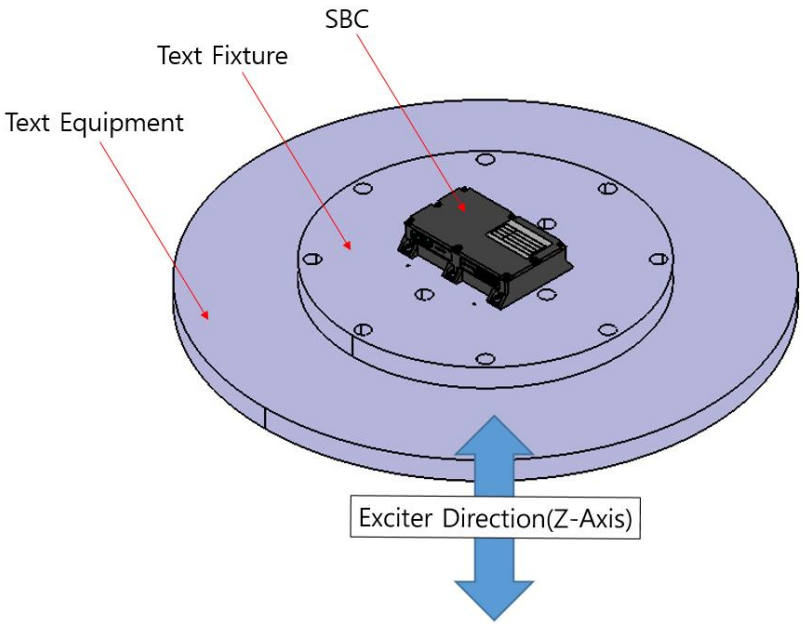

Figure 5-4 Test Configuration for Z Axis

6. Test Environments

The following test environment conditions shall be recorded prior to measurement.

6.1. equipment to be tested

Model Name:_____

6.2. test location

_____

6.3. Test personnel

The personnel required for the performance of the tests is listed below:

Test Engineers

The test engineers are responsible for:

- Operation of measuring instrumentation, data acquisition, data handling, data recording
- Identification and compilation of data sheet
- Safety precaution for test articles
- Test personnel to be present in the test area
- The accuracy of the measured values & Data report

Test Manager

The test manager is responsible for:

- Test articles and technical aspects of the test performance
- Record the correct software version for test article and EGSE
- Examination of disturbances
- Test article integration and handling
- Test performance
- Evaluation of test results & Providing of test reports

Quality Assurance Engineer

The QA engineer is responsible for:

- Surveillance of test equipment according to regulations as well as the test procedure
- Statement that the test articles to be tested have passed all checks before testing
- Checking the identification markings on the test articles
- Supervision of the proceeding with respect to quality assurance performance

The customer has the fight to participate or observe the test

Table 6-1 Test personnal

Responsibility	Company /Dep.	Name
Test Engineer	Lumir / R&D	
Test Manager	Lumir / R&D	
Quality Assurance Engineer	Lumir / PA	
Facility Engineer	SaTRec	

6.4. Vibration test equipment

Table 6-2 Vibration Test Equipment List

Name	Model No.	Manufacturer

7. Test Description

7.1. Vibration test

The test shall be performed in accordance with the following sequences and the test results are recorded per the indicated method.

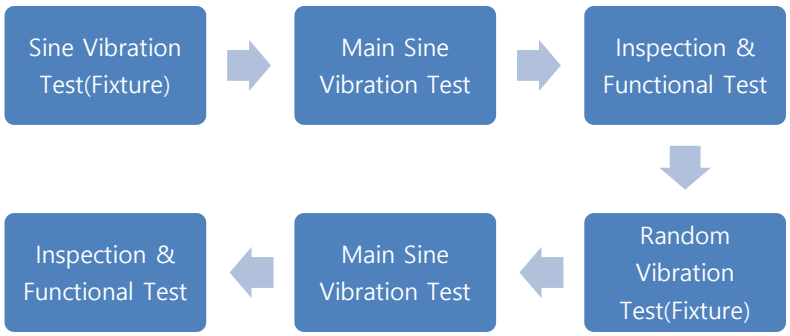

Figure 7-1 Vibration Test Flow for DTNPL

8. Test Procedure

The test will be performed in accordance with Figure 5-2 and 7-1.

8.1. X-axis test set up

(a) For the X axis evaluation, check and install the shaker. (√) _____

(b) Assemble the test fixture and sensors on the shaker. (√) _____

(c) Perform the fixture evaluation per the test specification that is indicated in Table 3-1 & 3-2. (√) _____

Start Date / Time	
End Date / Time	
Temperature ℃ (16 to 32℃)	
Relative Humidity % (20 to 70%)	

(d) Generate plot for the verification compliance with the spectrum level and tolerance for each channel, and verify the results. (√) _____

_____

_____

_____

8.1.1. Sine vibration test for x axis

(a) Check equipment mounting and sensor status before the sine test for X axis. (√) _____

(b) Input the test condition data in the controller of the shaker and verify. (√) _____

(c) Perform the fixture evaluation per the test specification that is indicated in Table 3-1. (√) _____

Start Date / Time	
End Date / Time	
Temperature ℃ (16 to 32℃)	
Relative Humidity % (20 to 70%)	

(d) Generate plot for the verification compliance with the spectrum level and tolerance for each channel, and verify the results. (√) _____

_____

_____

_____

(e) After the sine test is finished, perform the visual inspection of the equipment. (√) _____

_____

_____

_____

8.1.2. Random vibration test for x axis

(a) Check equipment mounting and sensor status before the random test for X axis. (√) _____

(b) Input the test condition data in the controller of the shaker and verify. (√) _____

(c) Perform the fixture evaluation per the test specification that is indicated in Table 3-2. (√) _____

Start Date / Time	
End Date / Time	
Temperature ℃ (16 to 32℃)	
Relative Humidity % (20 to 70%)	

(d) Generate plot for the verification compliance with the spectrum level and tolerance for each channel, and verify the results. (√) _____

_____

_____

_____

(e) After the random test is finished, perform the visual inspection of the equipment. (√) _____

_____

_____

_____

8.2. Y-axis test

(a) For the Y axis evaluation, check and install the shaker. (√) _____

(b) Assemble the test fixture and sensors on the shaker. (√) _____

(c) Perform the fixture evaluation per the test specification that is indicated in Table 3-1 & 3-2. (√) _____

Start Date / Time	
End Date / Time	
Temperature ℃ (16 to 32℃)	
Relative Humidity % (20 to 70%)	

(d) Generate plot for the verification compliance with the spectrum level and tolerance for each channel, and verify the results. (√) _____

_____

_____

_____

8.2.1. Sine vibration test for Y axis

(a) Check equipment mounting and sensor status before the sine test for X axis. (√) _____

(b) Input the test condition data in the controller of the shaker and verify. (√) _____

(c) Perform the fixture evaluation per the test specification that is indicated in Table 3-1. (√) _____

Start Date / Time	
End Date / Time	
Temperature ℃ (16 to 32℃)	
Relative Humidity % (20 to 70%)	

(d) Generate plot for the verification compliance with the spectrum level and tolerance for each channel, and verify the results. (√) _____

_____

_____

_____

(e) After the sine test is finished, perform the visual inspection of the equipment. (√) _____

_____

_____

_____

8.2.2. Random vibration test for Y axis

(a) Check equipment mounting and sensor status before the random test for Y axis. (√) _____

(b) Input the test condition data in the controller of the shaker and verify. (√) _____

(c) Perform the fixture evaluation per the test specification that is indicated in Table 3-2. (√) _____

Start Date / Time	
End Date / Time	
Temperature ℃ (16 to 32℃)	
Relative Humidity % (20 to 70%)	

(d) Generate plot for the verification compliance with the spectrum level and tolerance for each channel, and verify the results. (√) _____

_____

_____

_____

(e) After the random test is finished, perform the visual inspection of the equipment. (√) _____

_____

_____

_____

8.3. Y axis test

(a) For the Z axis evaluation, check and install the shaker. (√) _____

(b) Assemble the test fixture and sensors on the shaker. (√) _____

(c) Perform the fixture evaluation per the test specification that is indicated in Table 3-1 & 3-2. (√) _____

Start Date / Time	
End Date / Time	
Temperature ℃ (16 to 32℃)	
Relative Humidity % (20 to 70%)	

(d) Generate plot for the verification compliance with the spectrum level and tolerance for each channel, and verify the results. (√) _____

_____

_____

_____

8.3.1. vibration test for z axis

(a) Check equipment mounting and sensor status before the sine test for Z axis. (√)_____

(b) Input the test condition data in the controller of the shaker and verify. (√)_____

(c) Perform the fixture evaluation per the test specification that is indicated in Table 3-1. (√)_____

Start Date / Time	
End Date / Time	
Temperature ℃ (16 to 32℃)	
Relative Humidity % (20 to 70%)	

(d) Generate plot for the verification compliance with the spectrum level and tolerance for each channel, and verify the results. (√)_____

_____

_____

_____

(e) After the sine test is finished, perform the visual inspection of the equipment. (√)_____

_____

_____

_____

8.3.2. Random vibration test for z axis

(a) Check equipment mounting and sensor status before the random test for Z axis. (√) _____

(b) Input the test condition data in the controller of the shaker and verify. (√) _____

(c) Perform the fixture evaluation per the test specification that is indicated in Table 3-2. (√) _____

Start Date / Time	
End Date / Time	
Temperature ℃ (16 to 32℃)	
Relative Humidity % (20 to 70%)	

(d) Generate plot for the verification compliance with the spectrum level and tolerance for each channel, and verify the results. (√) _____

_____

_____

_____

(e) After the random test is finished, perform the visual inspection of the equipment. (√) _____

_____

_____

_____

9. Test conclusions

The PA shall review the test data for acceptance of the Vibration test.

The following sign off is verification that the test article has satisfactorily passed Vibration test.

PA: _____ Date: _____