

**SMEI Flight DHU**

**Vibration Test Plan**

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## SMEI FM DHU Vibration Test Plan

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## SMEI FM DHU Vibration Test Plan

### 1. Introduction

This document describes the requirements and specification for vibration testing of the SMEI Flight Model Data Handling Unit (DHU).

It is expected that the testing will be performed in the Vibration Test Facility at Rutherford Appleton Laboratory using the LDS 954 vibrator.

### 2. Test Item

The test item is the SMEI Flight Model DHU, whose approximate size and mass are given in Table 2.1.

	Dimensions (mm)	Mass (Kg)
DHU	500 x 460 x 410	7.6

**Table 2.1 - Approximate Dimensions and Mass of SMEI DHU**

The DHU shall be attached to the vibrator interface plate (supplied by Birmingham University), using eight M4 fasteners (tightening torque = 2.3 Nm) fitted to the spacecraft interface attachment holes in the DHU base.

### 3. Test Specification

#### 3.1 Introduction

Vibration in all three DHU axes is required. The directions of the axes are defined as follows:

- Z-axis is perpendicular to the top face of the DHU box, with +Z upwards.
- Y-axis is perpendicular to the connector mounting face, with -Y outwards from this face.
- X-axis forms a right-handed orthogonal set.

The order of the axes for the testing is not important. However, the amount of handling will be reduced by adopting the order:

1. DHU X-axis input on the slip table.
2. DHU Y-axis input on the slip table.
3. DHU Z-axis input on the vibrator head.

For each axis the following set of tests shall be performed (to identical specifications in all cases):

1. Preliminary low-level sine survey.
2. Quasi-static load test.
3. Random vibration.
4. Final low-level sine survey.

### 3.2 Preliminary Low-Level Sine Survey

One sweep shall be performed at 0.5g from 5 Hz to 2000 Hz at 2 octaves per minute.

### 3.3 Quasi-Static Load Test

A minimum of 5 cycles shall be performed at 22.5g and at a frequency of 35 Hz (this frequency is chosen to lie significantly below the lowest natural frequencies seen during previous testing of the DHU).

It is recommended that 10 cycles are performed to guarantee that more than 5 cycles are at the full specified level, taking into account the response time of the vibrator and controller.

### 3.4 Random Vibration

The random vibration levels shall be as specified in Table 3.1 and Figure 3.1 (acceptance levels). The overall test level is 7.24 g rms.

The duration shall be 2 minutes.

Frequency (Hz)	Test Level (g <sup>2</sup> /Hz)
20	0.0330
40	0.0650
470	0.0650
2000	0.0036

**Table 3.1 - Acceptance Vibration Test Levels for SMEI Flight Model DHU**

### 3.5 Final Low-Level Sine Survey

One sweep shall be performed at 0.5g from 5 Hz to 2000 Hz at 2 octaves per minute.

Accelerometer traces shall be examined to confirm that there are no substantial deviations from the characteristic 'signature' recorded in the preliminary low-level sine survey.

## 4. Accelerometer Locations

The control accelerometer shall be mounted on the interface plate.

Two tri-axis monitoring accelerometers shall be mounted at the approximate locations specified in Table 4.1.

Channel No	Accelerometer Type	Response Axis	Mounting Location
2	Tri-axis	X	Centre of DHU top face
3	Tri-axis	Y	Centre of DHU top face
4	Tri-axis	Z	Centre of DHU top face
5	Tri-axis	X	Corner of DHU top face
6	Tri-axis	Y	Corner of DHU top face
7	Tri-axis	Z	Corner of DHU top face

**Table 4.1 - Locations for Monitoring Accelerometers**

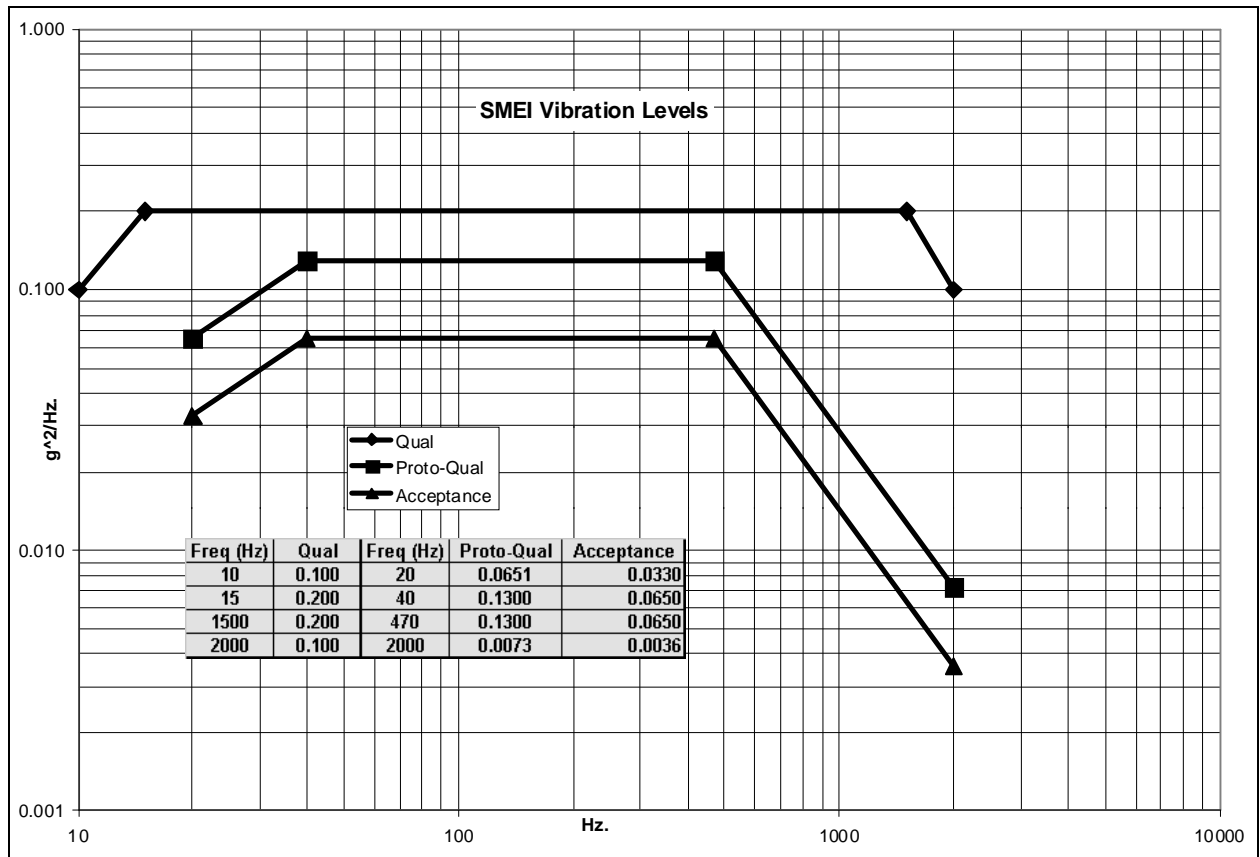


Figure 3.1 - Vibration Test Levels for SMEI (Acceptance Levels to be used for Flight Units)

## 5. Test Item Verification

### 5.1 Pre-Vibration

After the DHU has been installed on the vibrator table but before any vibration has commenced the unit will be connected to the SMEI EGSE. Each of the redundant DHU systems will be switched on in turn, appropriate spacecraft commands will be sent and telemetry data (science and SOH) will be checked and recorded.

### 5.2 Between Vibration Axes

No testing is required between axes of vibration.

### 5.3 Post-Vibration

After completion of the final axis of vibration the DHU will again be connected to the SMEI EGSE and commanding and telemetry functionality will be verified.

(In accordance with normal good practice during vibration testing, visual inspections, *etc* will be carried out to establish that there is no visible damage, unusual noises, significant changes to characteristic 'signatures', *etc* at any stage during the testing).

## 6. Handling Requirements

The test item is a **flight unit** and appropriate precautions shall be taken during handling at the vibration test facility. In particular the following shall be rigorously adhered to:

- The DHU shall be handled with approved cleanroom gloves at all times.
  - Appropriate ESD precautions (grounded wrist straps) shall be used during the instrument testing when connecting the DHU to the EGSE.
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