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FIRST/Planck Project

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Subject : Cold Vibration Facility - Specification

Dear all,

As mentioned in the fax PT-06148 of Thomas Paßvogel, you will find here attached the draft specification of the FIRST/Planck instrument cold vibration test facility (document PT-06194).

This draft specification is proposed to be reviewed and discussed in the context of the FIRST Instrument Communality.

From your comments and/or further inputs, which we expect in January 1999, a new version will be issued and later distributed to potential test facilities in Europe.

Best regards,

Bernard GUILLAUME

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FIRST/Planck Project

FIRST/Planck Instrument Cold Vibration Specification for Test Facility

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DOCUMENT CHANGE RECORD			
DATE	ISS/REV	CHAPTERS	REMARKS
22 December 98	draft		

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1 INTRODUCTION

ESA's Horizon 2000 Science Programme has two important missions for performing astronomical investigations in the far-infrared, sub-millimetre and millimetre wavelength range:

- FIRST, the Far Infrared and Sub-millimetre Telescope, an observatory type mission;
- Planck (previously named COBRAS/SAMBA), a survey mission.

It was decided in early 1997 to merge the two missions with a single launcher and two spacecraft in a "Carrier" configuration. The combined mission will be launched by the year 2007.

The Far Infra-Red and Sub-millimetre Telescope (FIRST) is the fourth "cornerstone" (CS4) mission in the European Space Agency (ESA) long term space science plan "Horizons 2000". FIRST is a multi-user (observatory type) mission, which targets the far-infrared and sub-millimetre part of the spectrum. FIRST will address key scientific topics such as deep broadband extra-galactic surveys, follow-up spectroscopy of especially interesting program objects discovered in the survey, detailed studies of the physics and chemistry of the interstellar medium in galaxies, including star formation, observational astro chemistry of gas and dust and detailed high-resolution spectroscopy of a number of comets.

The implementations of the Project employs the use of a cryostat system for the Focal Plane Units (FPU's) of the scientific instruments. The cryostat consists of a Helium tank filled at a temperature of 1.6 K and the necessary supporting system. The system will be launched in cold conditions, i.e. the FPU's will be at cryogenic temperature at launch. In order to achieve a proper qualification of the units on ground, it is required to perform the mechanical tests at cryogenic temperatures (< 20 K).

This specification defines the requirements on the vibration facility, suitable to provide the necessary environment.

2 DOCUMENTATION

Reference Document

RD-1 FIRST/Planck Instrument Interface Document Part A PT-IID-A-04624

3 TEST SPECIFICATION

3.1 General

The cold vibration facility shall provide the correct thermal environment during the vibration tests of the instruments. Special requirements concerning the temperature, the temperature stability and pressure stability are defined in the following paragraphs as well as requirements concerning the mass and the volume envelope of the instruments to be tested.

It is not foreseen to make extensive functional tests with the instruments inside the cold vessel before, during and after the cold vibration tests, however, short electrical functional tests shall be possible.

It is up to the test facility to define the way the cold vibration test will be implemented either with the shaker inside the cold test chamber or with a cryogenic vessel on top of the shaker.

3.2 Cleanliness

CLEAN-005 The facility and the cold vessel shall provide and clean environment of class 100 (tbc) during the test preparation and during the whole test vibrations.

CLEAN-010 Tbc witness samples shall be located inside the cold vessel and inside the facility during the during the test preparation and during the whole test vibrations for cleanliness verification.

3.3 Environment Requirements

3.3.1 Room Temperature Environment

ENVI-005 The cold test facility shall allow vibration tests of the instruments at room temperature

3.3.2 Cryogenic Temperature Environment

ENVI-010 During the vibration tests, the cold test facility shall guarantee a cold temperature of < 20 K

ENVI-015 During the vibration tests, the cold test facility shall provide a temperature stability of ± 5 K (tbc)

ENVI-020 During the cold vibration test, the temperature shall be measured continuously by at least tbc different locations inside the cold vessel

ENVI-025 A controlled cool down of the instrument from ambient to < 20 K inside the cold vessel shall be possible in 1 day.
The same shall be possible for a controlled warm-up of the instrument inside the cold vessel from < 20 K to ambient in 1 day.

3.4 Volume and Mass of Equipment Requirements

VOL-005 The maximal envelope of the volume to be tested inside the cold vessel is a cylinder with a height of 500 mm (tbc) and a diameter of 800 mm (tbc). Margins are included in these figures

VOL-010 The maximal mass of a unit to be tested in cold vibration environment as defined in ENVI-005 and ENVI-010 is 60 kg (tbc)

VOL-015 The interfaces points for fixations the instruments during the cold vibration test inside the cold vessel shall be at the base-plate and will be defined on a case by case basis [6 interface points (tbc)]

3.5 Sine Vibrations Requirements

The levels, which are specified here below, are defined at the base of each instrument, i.e. at the base-plate of each instrument as defined in VOL-015.

3.5.1 Acceptance Sine Vibrations

SINE-005 The acceptance sine vibration levels to be applied at cold temperature as defined in COLD-005 are:

Frequency range (Hz)	Level (g)
5 - 100 Hz	10 (tbc)

All axes - sweep rate: 2 oct/min

A notching procedure is not expected to be applied since all instruments have a specified eigen-frequency above 100 Hz.

A low level sine test shall be performed to determine the resonance frequencies to evaluate the behaviour of the test fixture and the item integrity.

SINE-010 Resonance search shall be carried before and after vibration test for each axis at cold temperature.
The frequency range shall be between 5 and 2000 Hz with a level of 0.5 g (sweep rate 2 oct/min).

3.5.2 Qualification Sine Vibrations

SINE-015 The qualification sine vibration levels to be applied at cold temperature as defined in COLD-005 are:

Frequency range (Hz)	Level (g)
5 - 100 Hz	15 (tbc)

All axes - sweep rate: 2 oct/min

3.6 Random Vibrations Requirements

The levels, which are specified here below, are defined at the base of each instrument.

3.6.1 Acceptance Random Vibrations

RAND-005 The acceptance random vibration levels to be applied at cold temperature as defined in COLD-005 are:

Frequency range (Hz)	Level (g)
30 - 150	+ 6 dB / oct
150 - 700	0.018 g^2/Hz (tbc)
700 - 2000	- 3 dB / oct

5 g RMS (tbc)

All axes - sweep rate: 1 min/axis

3.6.2 Qualification Random Vibrations

RAND-010 The qualification random vibration levels to be applied at cold temperature as defined in COLD-005 are:

Frequency range (Hz)	Level (g)
30 - 150	+ 6 dB / oct
150 - 700	0.0.04 g^2/Hz (tbc)
700 - 2000	- 3 dB / oct

7.5 g RMS (tbc)

All axes - sweep rate: 2 min/axis

3.7 Measurements Requirements

MEAS-005 The facility shall provide at least 10 channels in real time for (tbc) measurement of accelerations and (tbc) strain gauges outputs located on the instrument to be tested inside the cold vessel

MEAS-010 During the cool down of the cold vessel and during the cold vibrations tests, the facility shall provide measurements of 10 (tbc) channels of temperature and pressure with a sampling rate of 1/min (tbc)

MEAS-015 All measured data, which have been recorded during cold vibration tests, shall be stored during 10 years

4 PLANNING

The cold vibration test facility shall be fully qualified no later than June 2001.

Assuming that T0 is the date of contractual kick-off, the milestones shall be as follows:

Design Review	T0 + 4 months (tbc)
Manufacturing and Implementation Review	T0 + 15 months (tbc)
Qualification review	T0 + 18 months (tbc)

5 DELIVERABLES

The minimal list of documents will be delivered:

- Set of definition drawings of the test facility and cold vessel
- Manufacturing file
- List of materials and critical items
- Contamination control plan
- Definition File
- Results of qualification tests