HIRDLS

SP-OXF-223

HIGH RESOLUTION DYNAMICS LIMB SOUNDER

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Subject/Title: **In- Flight Calibrator Thermal Test Procedure**

Description/Summary/Contents:

This document is the procedure for the thermal vacuum testing of the HIRDLS In-Flight Calibrator (IFC) sub-system at Oxford University.

Keywords: IFC, Thermal, Vacuum, Cycle, Test, Procedure.

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Contents:

1 - Introduction & purpose.

This document is the procedure for the thermal testing of the In- Flight Calibrator (IFC) sub-system. The thermal testing includes the thermal vacuum cycling of the IFC, exposure to extreme survival temperatures, and cycling between a minimum and maximum non-operating temperature.

The IFC shall meet its performance requirements after exposure to the survival temperatures, and after the thermal cycling.

The IFC shall be demonstrated to start up at the specified maximum and minimum start-up temperatures, and operate to its requirements within the specified minimum and maximum operating temperatures.

The procedures herein provide the step-by-step set-up and operations required to complete the required thermal cycle tests.

1.2 - References

RD1	SP-HIR-044	IFC Sub-System Specification Document.
RD2	TP-OXF-179	IFC Test Plan.
RD3	SP-OXF-240	IFC Thermometric Calibration Procedures.
RD4	SP-OXF-225	IFC Limited & Comprehensive Performance Test procedures.
RD5	SP-OXF-254	IFC IPU Simulator set up & operating procedures.
RD6	SP-OXF-253	IFC Aliveness Test Procedure.

2 - Summary of Requirements

The IFC consists of three assemblies; the black body electronics unit (BEU), the Black Body (IFCBB) and the interconnect cable (U25).

The BEU is mounted on the instrument structure (STH) on the +X face of the instrument OBA/EU dividing panel. The IFCBB is mounted on the optical bench (OBA).

The thermal cycling test is designed to determine if any stresses in the assemblies could cause a change in performance of the IFC. Thermally induced stresses in the IFCBB that are of interest are those associated with the precision temperature sensors and the cavity black paint. The IFCBB temperature sensor calibration is performed at assembly level in a separate procedure before the IFC is integrated and is used to establish the stability and calibrate-ability of these sensors. The cavity paint has been the subject of a comprehensive evaluation at Oxford and GSFC, which included thermal cycling.

The performance of the harness (U25) is not affected by the temperature excursions of these tests.

Thermally induced effects in the BEU that are of interest are those associated with the temperature sensor measuring bridge and are dominated by the effects on the reference resistor. Temperature coefficients of other electrical components and circuits are not considered to significantly influence the performance of the IFC. This is best determined by using a known standard in place of the IFCBB. For this the IFCBB simulator is used.

[this is an important issue: since the IFCBB will have undergone thermal cycling in the cryostat, it is of value to replace the IFCBB with the dummy BB in the thermal vacuum test. The dummy has precision resistors of known and small TCR therefore it should be possible to determine any changes in the bridge calibration or transfer function due to thermal cycle and/or thermal excursions.]

Other requirements of this test are that thermal equilibrium in the assemblies has been reached at each plateaux. Typical for large structures is a persistence time of four hours, in the case of the IFC, being so small, four hours soak is considered sufficient. The rate of change of temperature between soaks should be as fast as practical, but less than 20 C/hour.

The test should end on a hot cycle and include a determination of volatile contaminant out-gassing.

3 - General Equipment and Measurements

The IFCBB sensor thermal cycling will be undertaken at Oxford University in the purpose built cryostat. Stability and calibrate-ability of the sensors is determined using a commercial precision a.c. resistance bridge in advance of the BEU. Absolute temperature will be determined relative to an National Physical Laboratory (NPL) standard. PRT resistance values will be measured to the equivalent of ~1mK.

The thermal vacuum cycling will be undertaken at the Rutherford Appleton Laboratory Facility. The start-up and limited performance tests (LPT) will be performed with the Oxford IPU simulator.

Precautions for handling flight hardware will be observed, including handling with clean-room gloves and general cleanliness control, ESD safety.

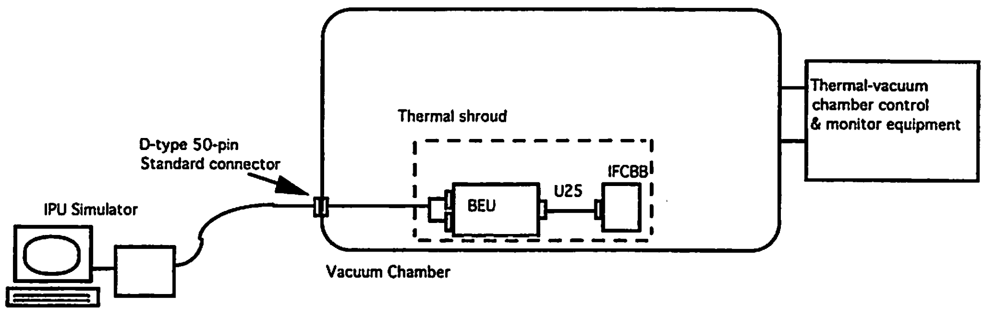
A log book will also be kept to record the overall event.

The vacuum chamber incorporates monitors for total pressure, temperature, residual gas and a temperature compensated quart crystal monitor (TCQM) for out-gassing rate measurement.

The IPU simulator will provide the control and data handling and data logging facility for the IFC.

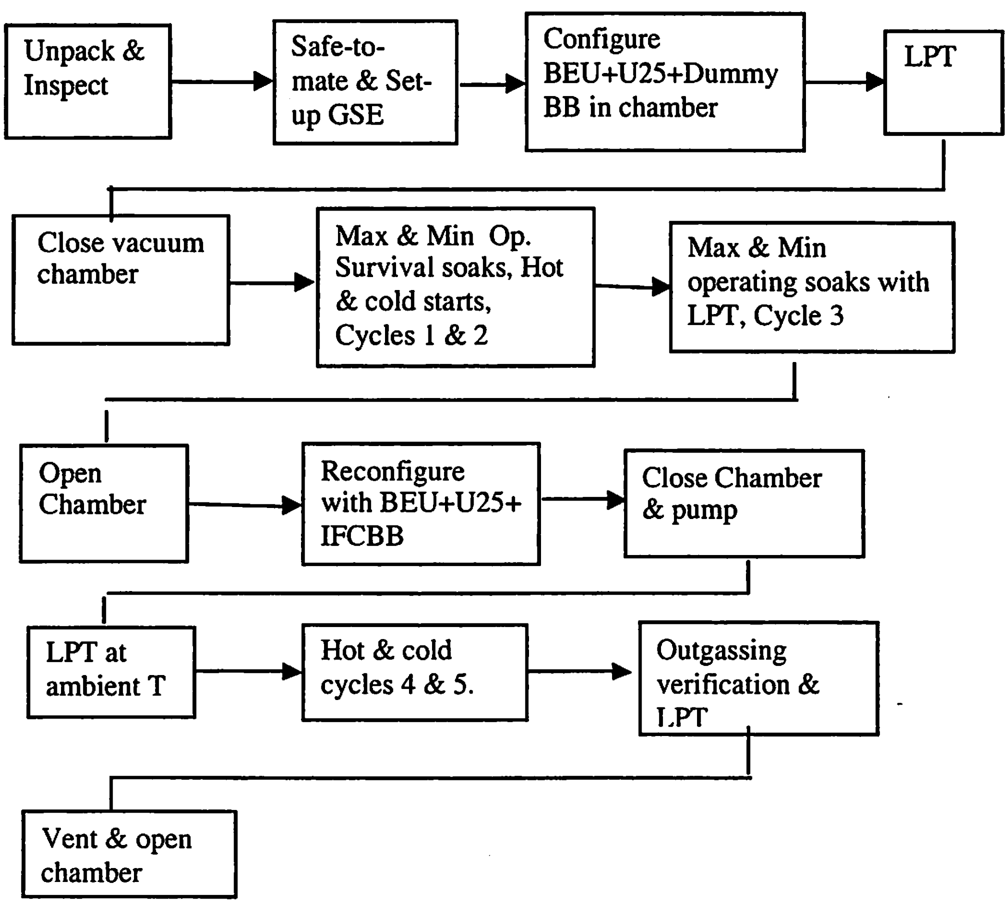
4 - Test Configuration

The following diagram shows the equipment set-up and interconnections at the RAL facility. A single 50-way standard D-type <or 44-way high-density D-type TBV> connector feed-through is provided on the chamber wall. The IPU simulator and interconnect cabling is provided by Oxford University.



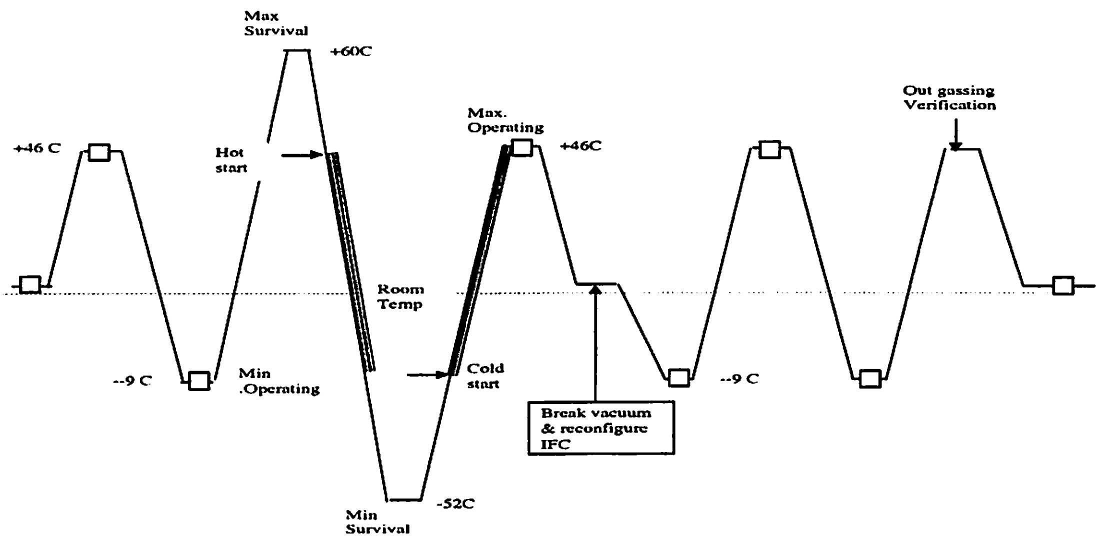
5 - Test flow summary

The following flow chart shows the sequence of events at the RAL facility.



6 - Test Specification

The following figure shows the thermal vacuum cycle temperature profile and the points at which limited performance tests (LPT), and start-up tests occur, and out-gassing verification.



Notes:
A: Maintain plateaux @ ±1 K of target temperature for 2 hours.
B: Max nominal rate of change of temperature ±20K/hr.
C: Pressure <10-5 torr
D:

7 - Procedure tables

Instruction set with data & signature/tick-boxes.

1. Preparatory procedure to verify ready to go:

Step	Instruction	Specn.	Record	Date /time	INIT
1.1	Ready to mate, install in facility.	n/a		ddmmyy HH:MM	
1.2	IPU simulator & GSE set up	RD1			
1.3	LPT	RD4			
1.4	Power down sequence.	visual			

2. Pump-down & start thermal cycle.

2.0.1	Close vacuum chamber .	visual			
2.0.2	Pump-down, verify vacuum. Check ambient IFC temperature.	$<10^{-5}$ torr R.T.			
2.0.3	Perform L.P.T.	RD4			
2.0.4	IFC power off.				
2.1.1	Set chamber target temperature.	+46 C			
2.1.2	Verify max. operating temperature reached	$+46 \pm 1$C			
2.1.3	Verify max. operating temp. soak	4 hrs			
2.1.4	Perform LPT	RD4.			

2.1.5	Set chamber target temperature.	-9 C			
2.1.6	Verify max. operating temperature reached	-9 ±1C			
2.1.7	Verify max. operating temp. soak	4 hrs			
2.1.8	Perform LPT	RD4.			
2.2.1	Set point chamber temperature	+60 C			
2.2.2	Verify max. survival set-point reached	+60±1 C			
2.2.3	Verify max. survival soak duration	4 hrs			
2.2.4	Record off-gassing.				
2.2.5	Set point chamber temperature	-52 C			
2.2.6	Hot start up temperature for IFC	+46 C			
2.2.7	Perform hot start up for IFC	RD4			
2.2.8	Verify min. survival set-point reached	-52±1 C			
2.2.9	Verify min. survival soak duration	4 hrs			
2.2.10	Cold start temperature for IFC	-9 C			
2.2.11	Cold start up for IFC	RD4			
2.3.1	Set point chamber temperature to max op.	+25 C			
2.3.2	Verify maximum operating set-point reached	+25 ±1 C			
2.3.3	Perform LPT	RD4			
2.3.4	IFC power off.	visual			
2.3.5	Verify max op temperature soak duration	4 hrs			
2.3.6	Verify ambient temperature, vent & open chamber, reconfigure IFC with PFM IFCBB.				

2.3.7	Perform aliveness test	RD6			
2.3.8	Set point chamber temperature to min. op.	-9 C			
2.3.9	Verify minimum operating set-point reached	-9 ±1 C			
2.3.10	Perform LPT	RD4			
2.3.11	IFC power off	visual			
2.4.1	Set point chamber temperature to max op	+25 C			
2.4.2	Verify maximum operating set-point reached.	+25 ±1C			
2.4.3	Verify max. operating temperature soak	4 hrs			
2.4.4	Set point chamber temperature to min op	-9 C			
2.4.5	Verify minimum operating set-point reached.	-9 ± 1C			
2.4.6	Verify min. operating temperature soak	4 hrs			
2.5.1	Set point chamber temperature to max op	+25 C			
2.5.2	Verify maximum operating set-point reached.	+25 ±1C			
2.5.3	Record off-gassing				
2.5.4	De-activate chamber temperature control				
2.5.5	Verify chamber ambient temperature	RT ±5 C			
2.5.6	Perform LPT	RD4			
2.5.7	Power down sequence for IFC	visual			
2.5.8	Power-down sequence for IFC and GSE.	visual			
2.5.9	Vent, Open chamber & de-install IFC	visual			

Notes:

ref.1: C&TH control sequence

IFC nominal data

[INSERT TABLE OF NOMINAL VALUES, HEX & CONVERSION]

ref.2 : HCW=255(HEX)

IFC response with dummy BB.

ref. 3: Hot start up is simply a power on sequence.

8 - Results Summary

The results to be obtained are as follows:

Temperature/time profile record.

Total vacuum/time record.

RGA samples, and out-gassing rate measurements at given times.

Make-break log for cable & connectors.

IFC data for each LPT cross referenced to expected values.

Start-up test result.

9 - Acronyms

BEU	(IFC) Blackbody Electronics Unit.
C&TH	Command & Telemetry Handbook.
ESD	Electrostatic Sensitive discharge.
GSE	Ground Support Equipment.
HCW	Heater control Word.
IFC	In-Flight Calibrator.
IFCBB	IFC Black Body.
IPU	(HIRDLS) Instrument Processor Unit.
LPT	Limited Performance Test.
NPL	National Physical Laboratory.
OBA	(HIRDLS) Optical Bench Assembly.
RGA	Residual Gas Analysis.
STH	(HIRDLS) Structure & Thermal Harness.
TQCM	Temperature controlled Quartz crystal monitor.