TITLE: # Nitrogen Thermal Cycles of 4K Reference Load Samples Report

DOC. TYPE: REPORT

PROJECT REF.: PL-LFI-TES-RP-013 **PAGE:** I of IV, 5

ISSUE/REV.: 1.0 **DATE:** May 2005

Prepared by	**A. DE ROSA** **L. TERENZI** **LFI** **4K RL Development Team**	**Date:** **Signature:**	**May 23rd, 2005** _____
Agreed by	**L. VALENZIANO** **LFI** **4K RL Development Team**	**Date:** **Signature:**	**May 23rd, 2005** _____
Agreed by	**C. BUTLER** **LFI** **Program Manager**	**Date:** **Signature:**	**May 23rd, 2005** _____
Approved by	**N. MANDOLESI** **LFI** **Principal Investigator**	**Date:** **Signature:**	**May 23rd, 2005** _____

DISTRIBUTION LIST

Recipient	Company / Institute	E-mail address
T. PASSVOGEL	ESA – Noordwijk	tpassvog@estec.esa.nl
G. CRONE	ESA – Noordwijk	Gerald.Crone@esa.int
J. MARTI-CANALES	ESA – Noordwijk	Javier.Marti.Canales@esa.int
J. TAUBER	ESA – Noordwijk	Jan.Tauber@esa.int
J. RAUTAKOSKI	ESA – Noordwijk	Jan.Rautakoski@esa.int
B. COLLAUDIN	ALCATEL – Cannes	bernard.collaudin@space.alcatel.fr
J.P. CHAMBELLAND	ALCATEL – Cannes	Jean-Philippe.Chambelland@space.alcatel.fr
N. MANDOLESI	IASF/INAF – Bologna	mandolesi@bo.iasf.cnr.it
C. BUTLER	IASF/INAF – Bologna	butler@bo.iasf.cnr.it
M. BERSANELLI	UNIMI – Milano	Marco.bersanelli@mi.infn.it
D. MENNELLA	UNIMI – Milano	mennella@mi.iasf.cnr.it
M. TOMASI	IASF/INAF – Milano	tomasi@mi.iasf.cnr.it
M. BALASINI	ALENIA SPAZIO – LABEN	balasini.m@laben.it
G. CAFAGNA	ALENIA SPAZIO – LABEN	cafagna.g@laben.it
M. MICCOLIS	ALENIA SPAZIO – LABEN	miccolis.m@laben.it
R. SILVESTRI	ALENIA SPAZIO – LABEN	silvestri.r@laben.it
P. LEUTENEGGER	ALENIA SPAZIO – LABEN	leutenegger.p@laben.it
L. PAGAN	ALENIA SPAZIO – LABEN	pagan.l@laben.it
4KRL Team - Bologna	INAF/IASF – Bologna	
RWG members		rwg@beta.jpl.nasa.gov
LFI SPCC	IASF/INAF – Bologna	lfispcc@bo.iasf.cnr.it

CHANGE RECORD

Issue	Date	Sheet	Description of Change	Release
1.0	May 2005	All	First issue of the document	LFI IQR

TABLE OF CONTENTS

1 INTRODUCTION

Due to QM 4K RL damages after thermal cycles, a number of studies have been performed to verify cleaning and assembly procedures. Thermal shocks in a N_2 bath controlled environment have been performed in order to verify resistance to thermal stress.
Procedures reported in [AD 14] are applicable.

1.1 PURPOSE AND SCOPE

The purpose of this document is to report results of the thermal shock tests in a controlled environment for the samples.

1.2 KEYWORDS/ACRONYMS

RL Reference Load
DUT Device Under Test
SUT Sample Under Test
RF Radio Frequency
QM Qualification Model
FM Flight Model

2 APPLICABLE AND REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

[AD 1] *FIRST/Planck Instrument Interface Document*, Part A (SCI-PT-IIDA-04624, 3/0)
[AD 2] *FIRST/Planck Instrument Interface Document,* Part B (SCI-PT-IIDB/LFI-04142, 2/0)
[AD 3] *LFI Interface Control Document* (PL-LFI-PST-ID-010, 2.0)
[AD 4] *LFI/HFI Interface Document* (PL-LFI-PST-ID-001, 1.0)
[AD 5] *LFI Specification* (PL-LFI-PST-SP-001, 3.0)
[AD 6] *Planck LFI Instrument Design and Development Plan* (PL-LFI-PST-PL-002, 2.0)
[AD 7] *Planck LFI Product Assurance Plan* (PL-LFI-PST-PL-003, 3.0)
[AD 8] *Planck LFI Assembly Integration* & Verification Plan (PL-LFI-PST-Pl-004, 3.0)
[AD 9] *FIRST/Planck Operations Interface Requirements Document* (SCI-PT-RS-07360, 2/1)
[AD 10] *LFI Configuration and Data Management CADM Plan* (PL-LFI-PST-PL-001, 3.0)
[AD 11] *LFI Instrument Deliverable Documentation List* (DDL) (PL-LFI-PST-LI-007, 1.0)
[AD 12] *4K Reference Load Requirement Specification* (PL-LFI-TES-SP-001, 3.1)
[AD 13] *4K Reference Load Test Plan* (PL-LFI-TES-PL-001)
[AD 14] *Nitrogen Thermal Cycles of 4K Reference Load Samples Procedures* (PL-LFI-TES-PR-011)

2.2 REFERENCE DOCUMENTS

[RD 1] *4K Reference Load Horn Design* (PL-LFI-TES-TN-001, 1.0)
[RD 2] *Planck LFI Mechanical Design* (PL-LFI-LAB-RP-001, 3.0)
[RD 3] *HFI Temperature stability requirements* (SR-PH211-990141-IAS, Issue 01)
[RD 4] *LFI signal oscillations induced by Sorption Cooler temperature variation* (PL-LFI-PST-TN-010, Issue 1.0)
[RD 5] *HFI thermometers and heaters specifications* (SP-PHAC0-100044-IAS, Issue 0/0,12.2.00)
[RD 6] The 4KRL Cryo Facility (PL-LFI-TES-TN-010, 1.0)
[RD 7] *Preliminary evaluation of the impact of temperature fluctuations in the HFI 4K stage on LFI* (PL-LFI-PST-TN-048, 1.0)
[RD 8] *LFI 4K Reference Load thermal model* (PL-LFI-PST-TN-049, 1.0)
[RD 9] *LakeShore Model 340 Temperature controller user's manual,* Rev. 1.8

3 SAMPLES PREPARATION

Two 30 GHz targets are prepared. The two samples have been assembled following the normal 30 GHz target assembly procedure, but they are not located into the cases. Their bases are bonded on aluminum supports (Fig. 1). The two samples have followed two different cleaning procedures:

- **Sample 1**. Cleaned with aceton according to old procedures (Fig. 2, left)
- **Sample 2**. Cleaned using isopropylic alcool, following same procedures(Fig. 2, right).

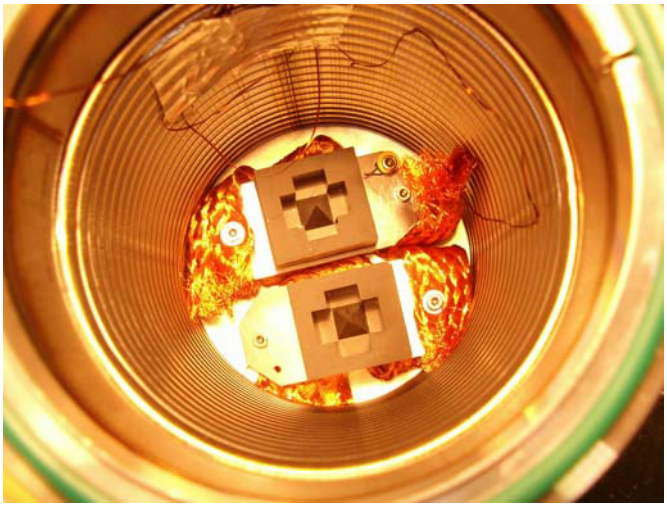

Fig. 1The two samples imounted inside the dedicated cryochamber.

4 CYCLES IN NITROGEN BATH

Following the procedure steps described in [AD 14], 21 cycles were performed with visual inspections after cycle 1, 3, 5, 9, 11, 21. The following table reports the log for the cycles.

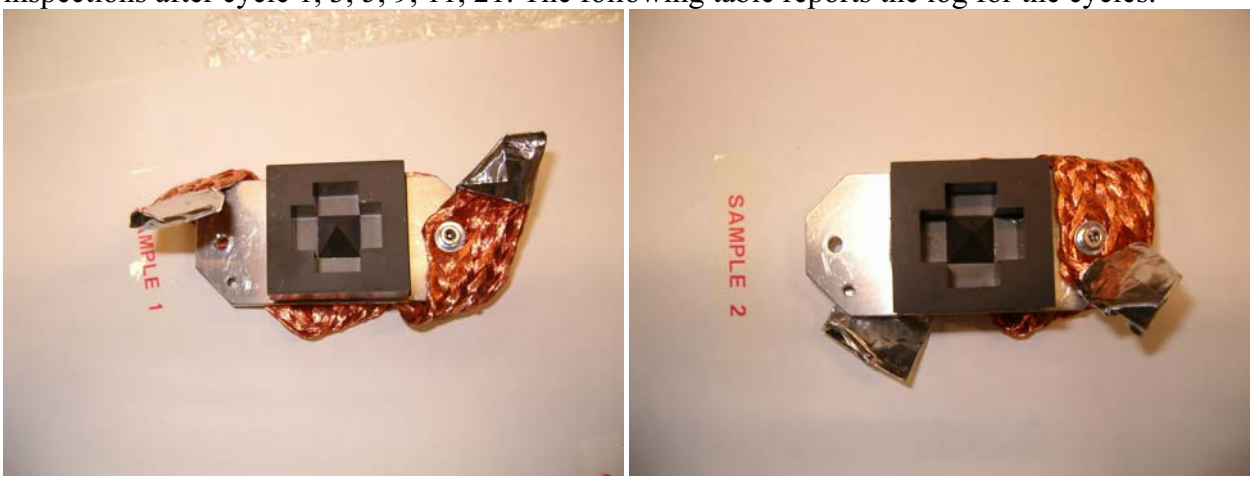

Fig. 2 The two samples during a visual inspection. The copper thermal straps are visible.

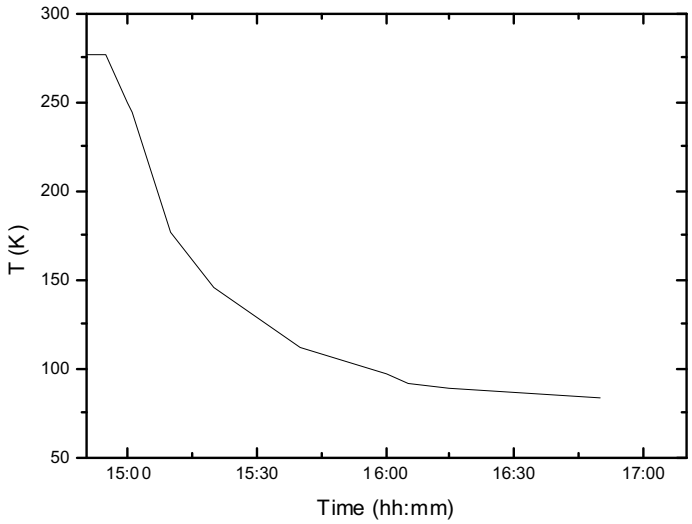

Fig. 3 Cooldown data for the 16th; it shows typical timescales involved in the cycles.

Cycle #	Start (Date; Time)	End	Max T	Min T	Notes
1	08/04/2005; 11.45	08/04/2005; 15.30	283.5 K	81.19 K	Visual inspection OK
2	08/04/2005; 15.40	11/04/2005; 9.50	290.7 K	82.62 K	
3	11/04/2005; 9.55	11/04/2005; 12.25	291 K	78.12 K	Visual Inspection OK
4	11/04/2005; 12.55	11/04/2005; 16.01	282.0 K	82.42 K	
5	11/04/2005; 16.01	11/04/2005; 18.12	292.0 K	83.08 K	Visual Inspection OK
6	12/04/2005; 11.41	12/04/2005; 14.25	296 K	83.5 K	
7	12/04/2005; 14.30	12/04/2005; 18.30	285 K	85.7 K	
8	12/04/2005; 18.15	13/04/2005; 9.30	293 K	83.5 K	
9	13/04/2005; 9.40	13/04/2005; 12.25	289.3 K	79.72 K	Visual Inspection OK
10	13/04/2005; 13.15	13/04/2005; 16.10	294 K	81.34 K	
11	13/04/2005; 16.15	14/04/2005; 9.30	293.2 K	95.0 K	Connector repaired. Visual Inspection OK Sample 1 coated with GE
12	14/04/2005; 11.40	14/04/2005; 14.40	300.6 K	83.0 K	
13	14/04/2005; 14.50	14/04/2005; 17.00	301.3 K	84.0 K	
14	14/04/2005; 17.40	15/04/2005; 9.50	290.0 K	90.0 K	
15	15/04/2005; 10.00	15/04/2005; 14.50	290.0 K	90.0 K	
16	15/04/2005; 14.55	16/04/2005; 12.00	291.0 K	84.0 K	
17	18/04/2005; 12.30	18/04/2005; 17.15	291.0 K	83.8 K	
18	18/04/2005; 17.24	19/04/2005; 9.30	290.6 K	84.10	
19	19/04/2005; 9.40	19/04/2005; 13.10	290.8 K	82.92 K	
20	19/04/2005; 13.20	19/04/2005; 16.00	280.0 K	83.0 K	
21	19/04/2005; 16.05	20/04/2005; 10.00	293.0 K	83.07 K	Visual Inspection OK

Table 1 Thermal cycles log

5 CYCLES IN 4K CRYOFACILITY

Following thermal stress cycles, the two samples are mounted into the 4K facility, in order to verify also stress down to 4 K.
Two cycles were performed (Fig. 4). Visual inspection after the opening of the facility showed no damage. The sensor on the sample 1 (red curve in figure) was linked to the target face by GE varnish.

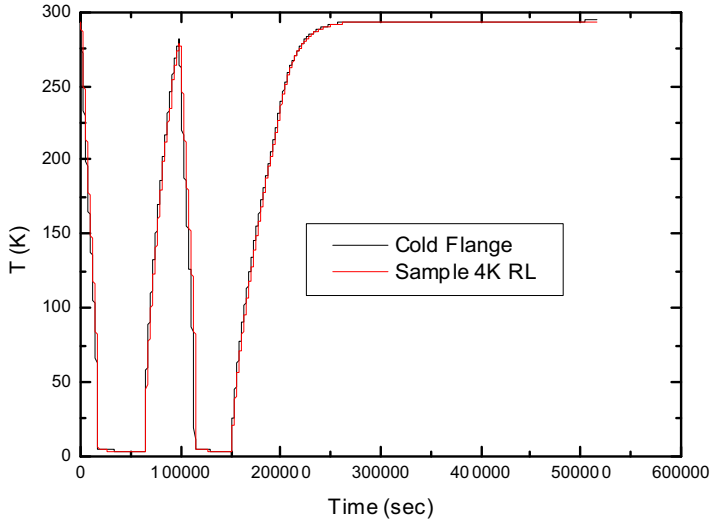

Fig. 4 Temperature data for the two cycles in the 4 K facility,minimum temperature reached is less than 4 K.

6 CONCLUSIONS

Two samples prepared according to old and new cleaning procedures were tested with 21 fast thermal stress cycles down to about 80 K and 2 thermal cycles down to less than 4 K.
The samples reported no damage.