



HERSCHEL

SPIRE

Ref: **SPIRE-RAL-DOC-001888**

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Page: **1**

Issue: **0.1**

Date: **10-Dec-2003**

Cold Verification I – Master Procedure

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Host system	Windows 2000 SP2
Word Processor	Microsoft Word 2000 SR1
File	Cold Thermal Verification I - Draft 0-1.Doc



Document Change Record

Date	Index	Affected Pages	Changes
Nov 2003	0.1	All	First Draft



1 Scope of Document

This procedure describes the activities to be performed during the first CQM cold thermal test campaign, which is a key inspection point (AD 1). The details of the instrument integration and cryostat operations are given in AD 5 and AD 6 respectively. The aim of this document is to ensure that the test objectives are achieved.

2 Documents

2.1 Applicable Documents

	Title	Author	Reference	Date
AD 1	INSTRUMENT AIV PLAN	B.J. Swinyard	SPIRE-RAL-DOC-000410 Issue 3.0D	May 2003
AD 2	Functional Test Specification	S. Ronayette	SPIRE-RAL-NOT-1652 Issue 1.0D	22-Sep-2003
AD 3	SPIRE CQM THERMAL BALANCE TEST SPECIFICATION	A.S.Goizel		02-Dec-2003
AD 4	Performance Test Details For CQM Pre-Vibration Testing	T. Lim	SPIRE-RAL-NOT-1850 Issue 0.2	22-Oct-2003
AD 5	SPIRE Cryostat Integration Procedures	D.L. Smith		
AD 6	SPIRE Cryostat Operating Procedures	D.L. Smith	SPIRE-RAL-DOC-001556 Issue 1.0	Nov-2003
AD 7	SPIRE Cryolab Risk Assesment	D.L. Smith		
AD 8	SPIRE Instrument Operations Procedures	S. Sidher		
AD 9	SPIRE EGSE ILT Startup Procedures	S. Sidher and M. Requena	SPIRE-RAL-DOC-001630	24-Jun-2003
AD 10	DRCU Switch On Procedure	A. Aramburu	SPIRE-RAL-NOT-00	
AD 11	SPIRE Cleanliness Plan	B.J. Swinyard	SPIRE-RAL-DOC-001070 Issue 1.0	9-Jan-2002
AD 12	RAL Safety Codes	CCLRC	http://www-internal.clrc.ac.uk/staff/notices/clrc_safety_codes/sc2.html	July-2003

2.2 Reference Documents

	Title	Author	Reference	Date
RD 1	SPIRE Cryostat Operating Manual	AS Scientific	SPIRE-RAL-DOC-001472 Issue 1.0	08-Jan-2002



3 Test Objectives

This test will be the first occasion that a functioning SPIRE instrument system with an active detector (PLW), cooler, JFET, harness and warm electronics will be integrated and tested. The test flow as illustrated in section 6 includes the warm and cold functional tests, cold thermal balance and performance tests.

As this is the first time that the CQM FPU will have been connected to the warm electronics, this will be more of a shakedown of the functional test procedures. Therefore the warm, short and cold functional tests will be 'manually' executed in a stepwise manner rather than an automatic test sequence. The detailed procedure in section 7 calls the individual test sequences as defined in AD 2.

The objectives of the Thermal Verification as defined in AD 3 are reiterated as follows:

- To validate the instrument thermal control concept as far as possible, given hardware limitations (accuracy of the representation of the calibration cryostat wrt. Herschel, difference between the SPIRE CQM and FM hardware, dummy mechanisms and detectors, etc).
- To correlate the thermal mathematical model of the SPIRE with the TB test results and hence provide more accurate prediction of the instrument in-flight thermal performance.

To achieve the thermal objectives it is necessary that the thermal environment within the SPIRE test cryostat should be as close to the Herschel cryostat as possible. Also, the steady-state test phases have been selected in order to examine the instrument performances its various in-flight operating modes (photometer, spectrometer and off modes).

As this model of SPIRE only has one working detector (PLW), no moving BSM and no spectrometer, only a limited range of performance tests will be carried out. The primary aim of these performance tests is to conform the baseline noise characteristics so that the design of the flight model warm electronics can proceed. To achieve this the detector temperature has to be below 400mK for the data to be meaningful. The details of the performance tests to be carried on this model are given in AD 4.

4 Test Configuration

4.1 Cryostat

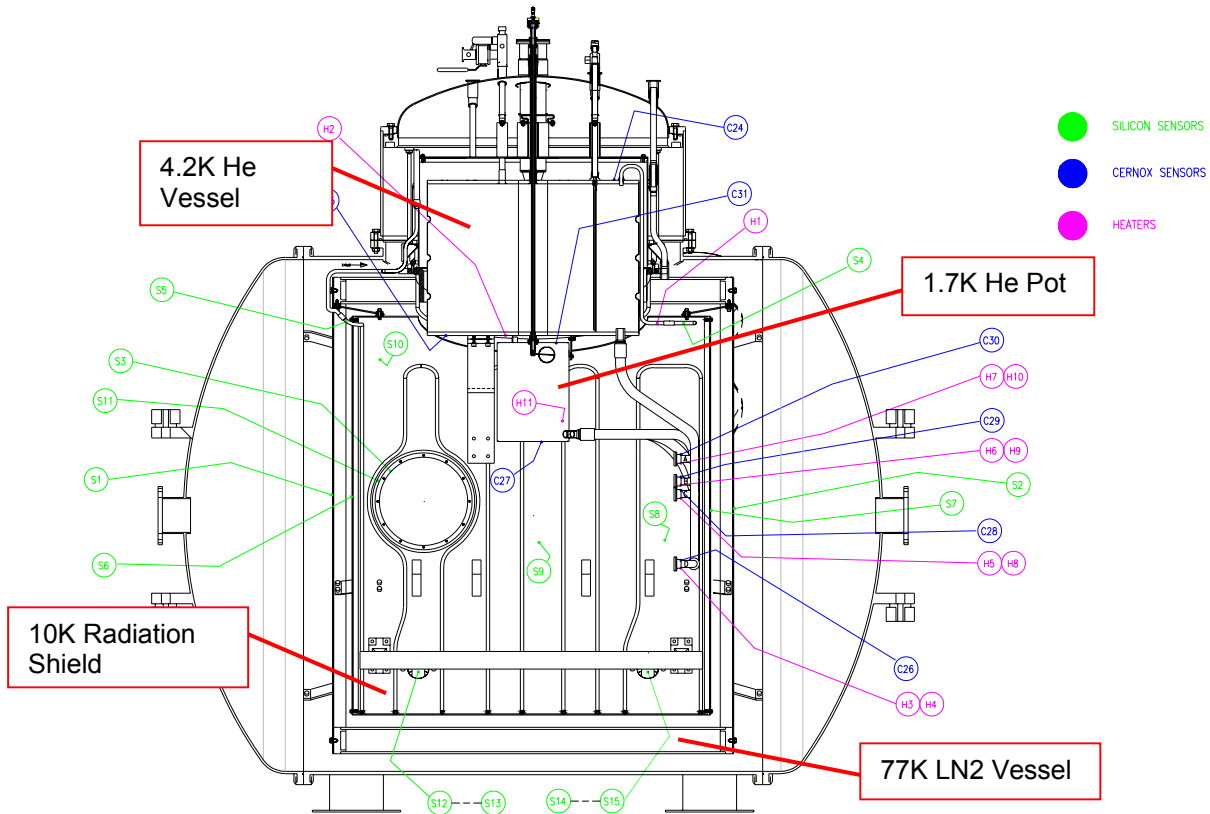


Figure 1: Cross section of SPIRE test cryostat showing the different temperature stages and thermometer locations (Drawing ref RD 1).

The SPIRE Calibration Cryostat has four stages of cooling, an outer liquid nitrogen cooled vessel at 77K, a 10K radiation shield, a 4.2K liquid He vessel and a 1.7K pumped liquid He pot, Figure 1. A more detailed description of the cryostat and its operation is given in AD 6 and RD 1.



4.2 Optical Equipment

4.3 EGSE Configuration

The EGSE will be in ILT configuration with the TFCS active.



5 Constraints

5.1 Safety

All personnel working in the SPIRE test facility must read the facility risk assessment, especially as there are particular hazards associated with the cryostat and laser.

Great care should be taken when handling liquid nitrogen and helium. The main hazards associated with liquid Nitrogen and Helium are:

- Cold "burns" to the person.
- Explosions due to the vaporization of the liquefied gas into an enclosed space.
- Asphyxiation due to exclusion of oxygen.
- Spillage onto structural materials, which can cause thermal contraction of the metal, say steelwork, with resultant cracking.

All people working with the cryostat should have instruction on the safe handling of cryogenic liquids and familiarise themselves with the laboratory safety code [CCLRC Safety Code 2](http://www-internal.clrc.ac.uk/staff/notices/clrc_safety_codes/sc2.html) which can be found on http://www-internal.clrc.ac.uk/staff/notices/clrc_safety_codes/sc2.html The safety code must be followed at all times when handling cryogenic liquids. A risk assessment shall be performed before operating the cryostat.

The personal oxygen monitors provided must be used when entering the lab when the cryostat is cold. These are calibrated every 6 months by the manufacturers (Crowcon in Abingdon).

When the oxygen monitor alarm sounds leave the room immediately and call ext 5996. DO NOT attempt to enter the room afterwards until the all clear has been given.

The gloves provided shall be worn when transferring liquid helium and nitrogen into the tank.

Any dewars with worn or damaged castors or which are difficult to wheel safely should be taken out of service and returned to stores immediately for repair or maintenance.

5.2 Cleanliness

To minimise the level of contamination, the FPU should remain covered until the particulate count is below that for a class 6 (old class 1000) clean room. The maximum concentration limits as specified by ISO EN 14644-1 1999 Standard (particles per m³ of air) for particles greater than the considered sizes are

Size	Specification
0.1µm	1000000
0.2µm	237000
0.3µm	102000
0.5µm	35200
1.0µm	8320
5.0µm	293

The following clothing shall be worn at all times when working in the clean room

Hats



- Coats
- Overshoes
- Gloves – to prevent cross contamination via tools and test equipment

Facemasks provided must be worn when the instrument baffle cover is removed.

Where possible, personnel should work downstream of the instrument from the air-filters.

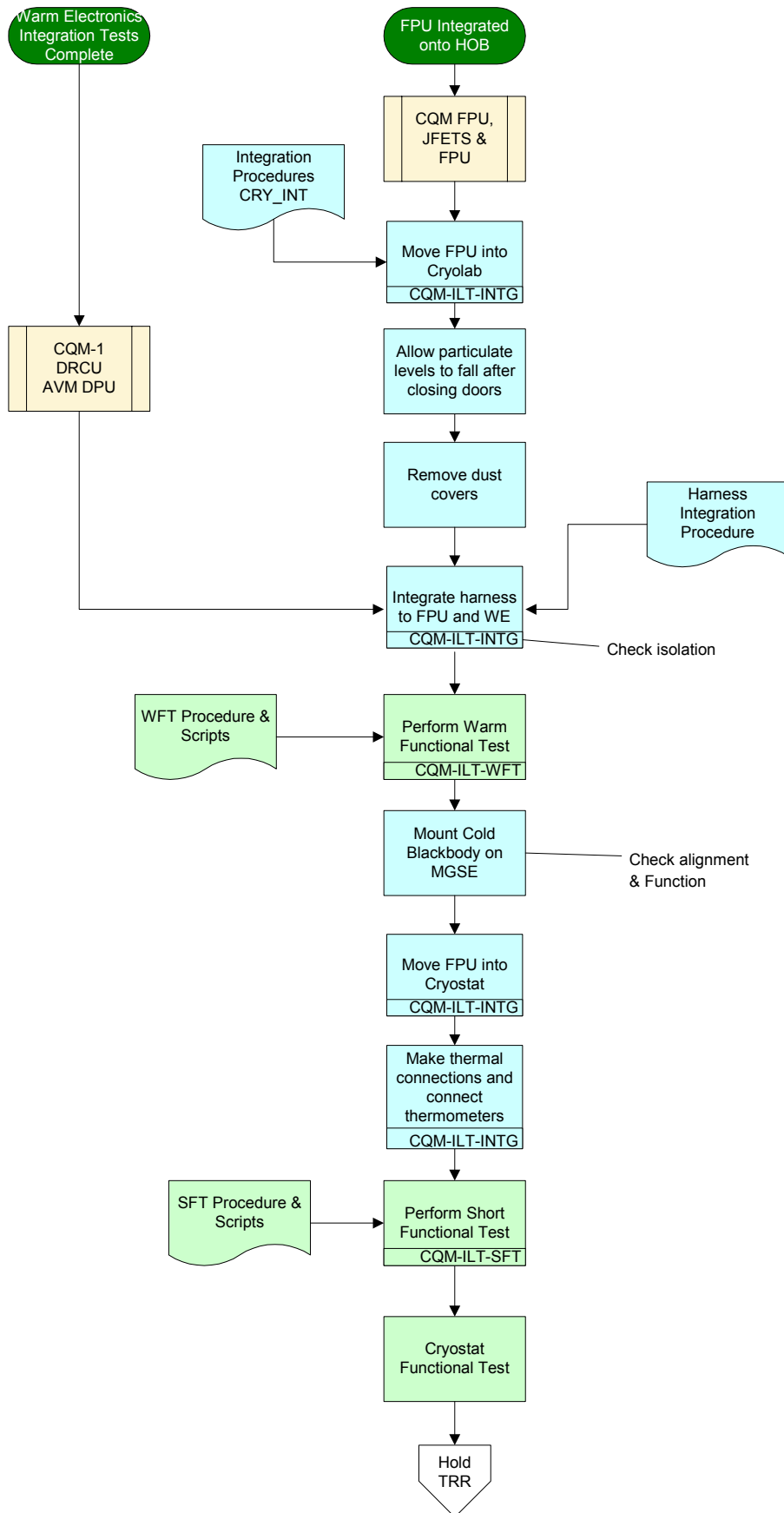
As space is extremely limited, only essential personnel are permitted to work in the clean room.

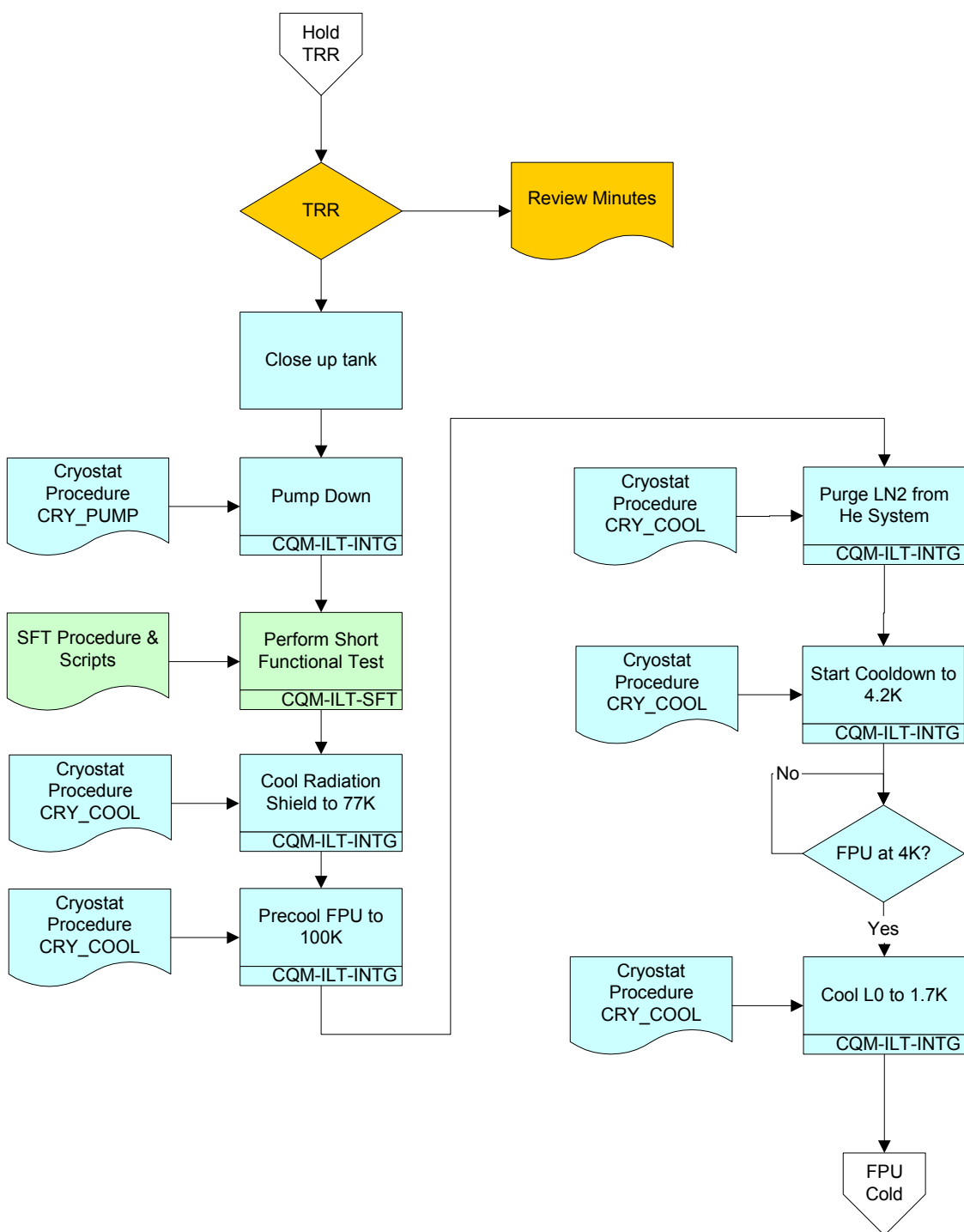
5.3 ESD Precautions

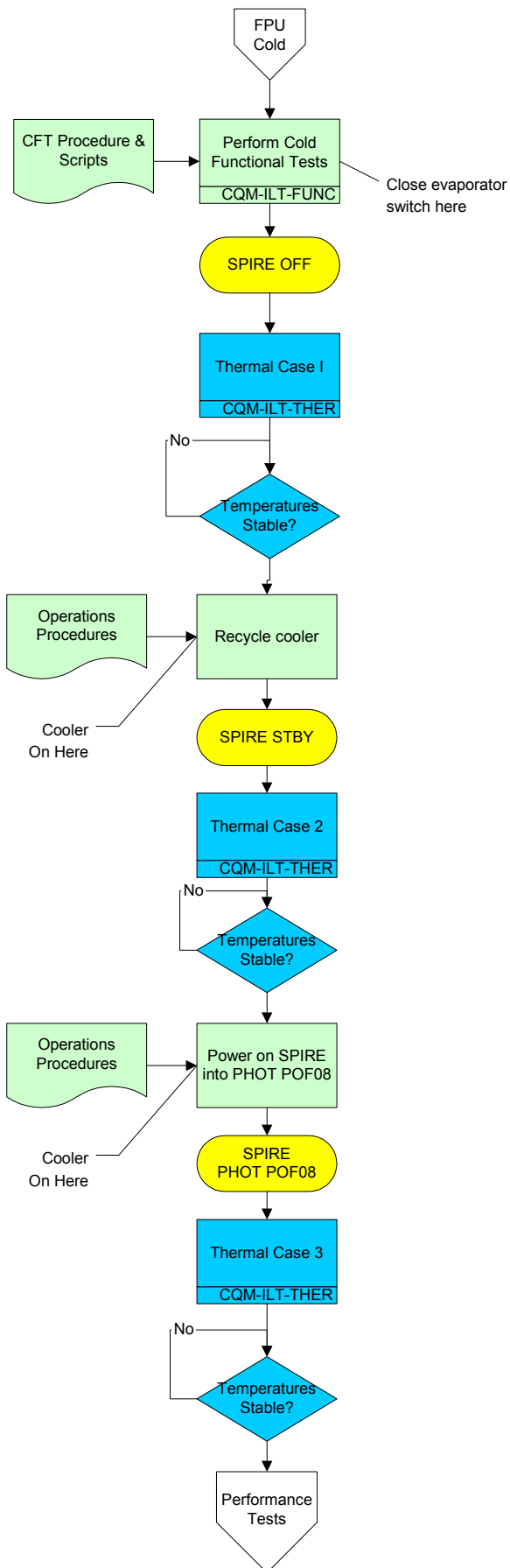
The SPIRE FPU, JFETS, DRCU and DPU are sensitive to electrostatic discharge. To prevent accidental damage to sensitive components, the units shall be grounded via a suitable earth strap while work is being performed. The earth straps may only be removed once the electronics have been connected together in accordance with the harness integration procedure. The ESD wrist straps provided must be worn at all times when working directly with the instrument.

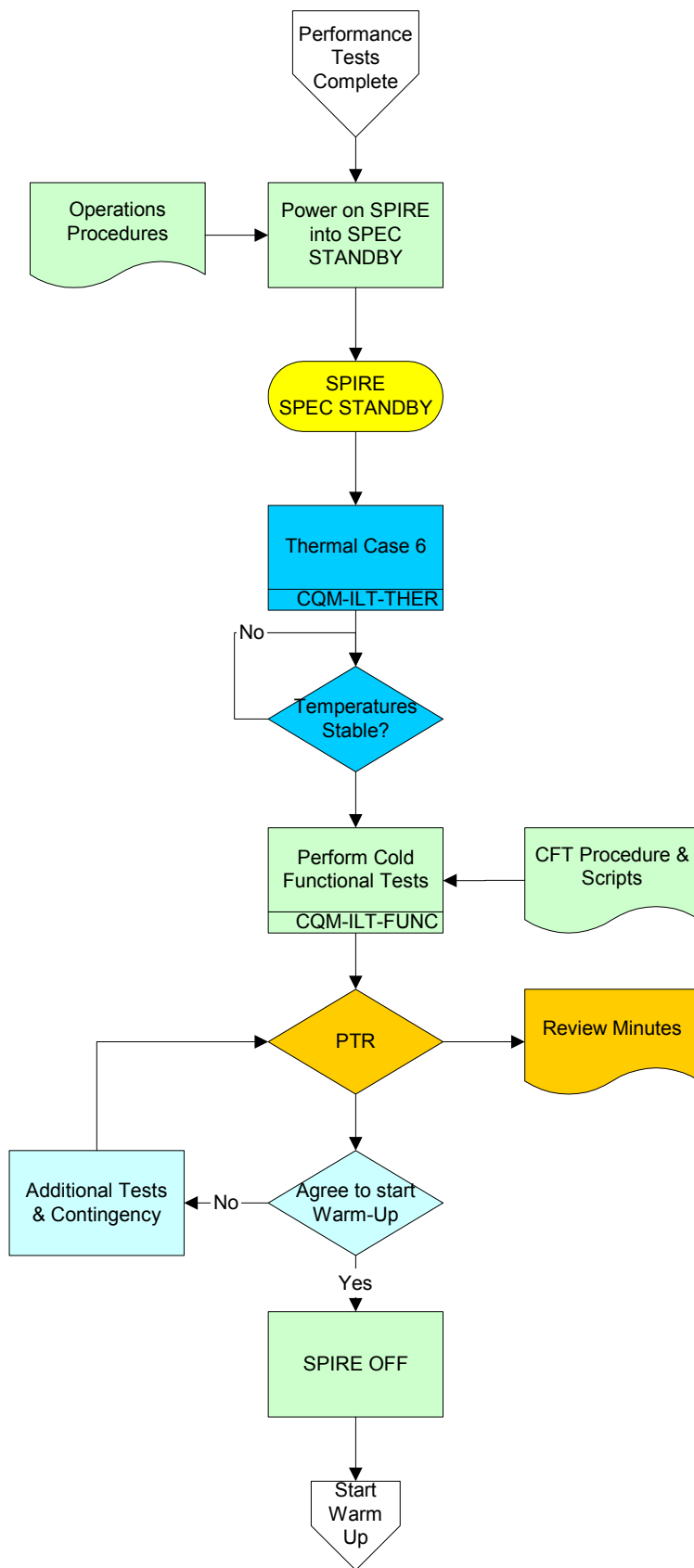


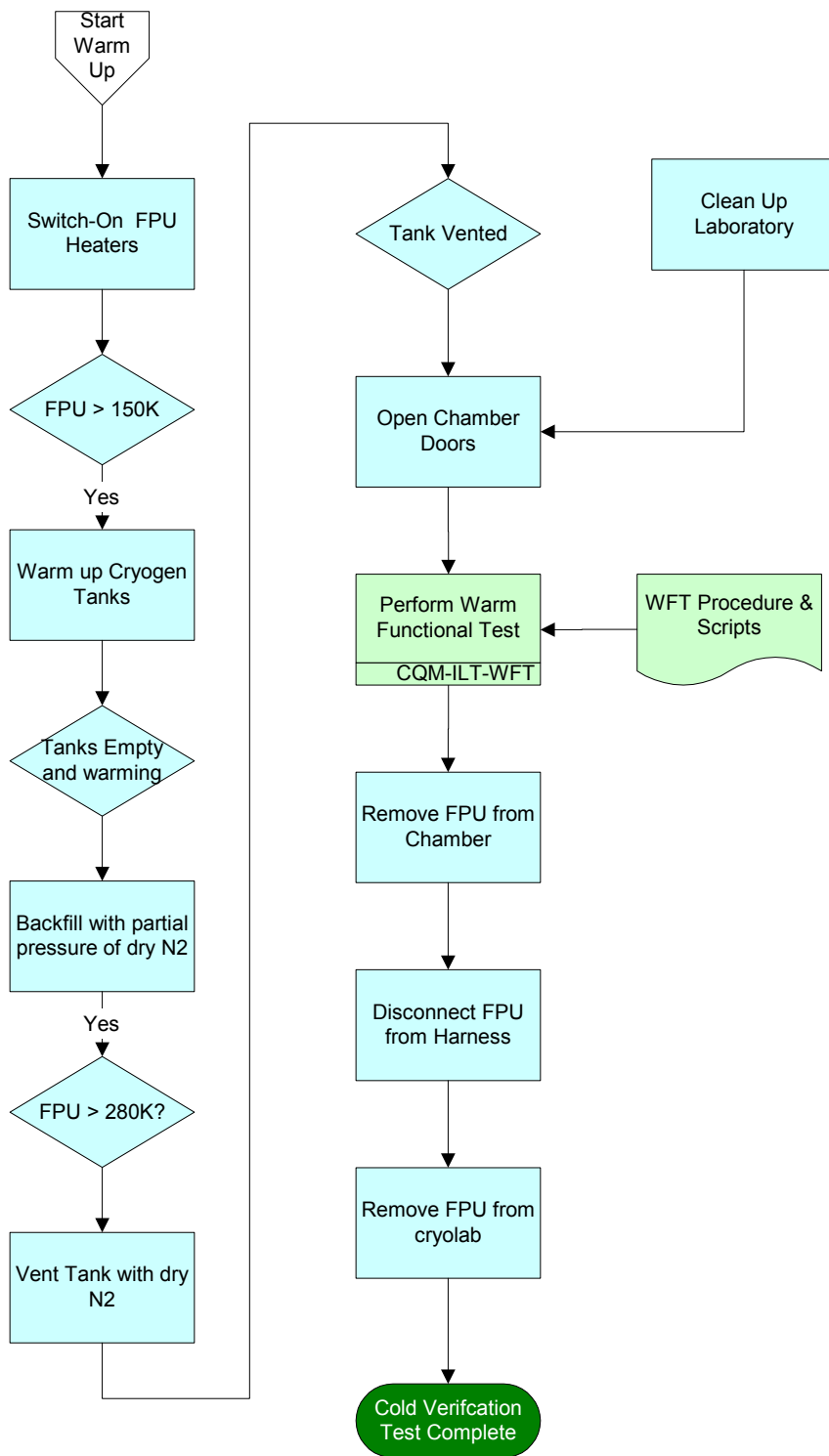
6 Procedure Flowchart













7 Test Procedure

Objectives:	See section 3 This is a key inspection point.
Initial Conditions:	CQM SPIRE Chamber at Atmospheric Pressure (~1000mbar) Tank doors open Vacuum system control electronics OFF Turbo Pump fan unit power OFF N2 supply closed 3 Phase supply OFF EGSE ILT OFF
Final Conditions:	As before
Constraints:	Pumping must not start until a test readiness review has been held and authorisation to proceed has been given. Grounding straps provided must be worn at all times when working on FPU and WE
Total Duration:	32 Days



Step.	Action	Comments	Task Complete															
1	Hold Test Readiness Review																	
1.1	Required Personnel Instrument Manager – Eric Sawyer AIV Manager – Dave Smith PA Manager – Eric Clark System Engineer – Doug Griffin Thermal Engineer – Anne Sophie Goizel Calibration Scientist – Tanya Lim Instrument Specialist – Sunil Sidher Instrument Scientist – Bruce Swinyard																	
2	Move FPU into Cryolab																	
2.1	Open Lab Doors and Move FPU into Lab on MGSE																	
2.2	Monitor Particulate levels in laboratory																	
	Particulate levels for class 6 clean room (old class 1000) Maximum concentration limits (particles per m ³ of air) for particles > than the considered sizes below.																	
	<table border="1"> <thead> <tr> <th>Size</th> <th>Specification</th> <th>Measured</th> </tr> </thead> <tbody> <tr> <td>0.1µm</td> <td>1000000</td> <td></td> </tr> <tr> <td>0.2µm</td> <td>237000</td> <td></td> </tr> <tr> <td>0.3µm</td> <td>102000</td> <td></td> </tr> <tr> <td>0.5µm</td> <td>35200</td> <td></td> </tr> </tbody> </table>	Size	Specification	Measured	0.1µm	1000000		0.2µm	237000		0.3µm	102000		0.5µm	35200			
Size	Specification	Measured																
0.1µm	1000000																	
0.2µm	237000																	
0.3µm	102000																	
0.5µm	35200																	



Step.	Action	Comments	Task Complete
	1.0µm	8320	
	5.0µm	293	
2.3	Remove covers when levels for class 6 clean room are achieved		
3	Integrate Harness to FPU and Warm Electronics		
3.1	Connect Cryo-Harness to FPU according to integration procedure ref ILT_INTG_HARN (reference Doug Griffin)		
3.2	When harness integrated disconnect grounding strap between FPU and HOB simulator		
4	Perform Warm Functional Test CQM_ILT-WFT		
4.1	Switch on DPU using procedure PROC_OPER_?		
4.2	Switch on DRCU using procedure PROC_OPER_?		
4.3	SPIRE in REDY mode? PROC_OPER_?		
4.4	Perform test FUNC-SCU-01 , SCU Science packet generation check		
4.6	Perform test FUNC-SCU-03 , SCU DC thermometry check		
4.7	Perform test FUNC-SCU-06 , SCU AC thermometry check		
4.8	Perform test FUNC-SCU-02 , SCU Science data check		
4.9	Perform test FUNC-SCU-07 , SCU cooler heater check		
4.10	Perform test FUNC-SCU-08 , SCU Test pattern test		
4.11	SPIRE in REDY mode + thermometers on PROC_OPER_?		
4.12	Perform test FUNC-SCU-04 , SCU PCAL check		
4.13	Perform test FUNC-PCAL-01 , PCAL characterisation test		
4.14	Switch OFF PCAL – PROC-OPER-PCO set bias = 0		
4.15	Perform test FUNC-SCU-05 , SCU SCAL check		



Step.	Action	Comments	Task Complete
4.16	Perform test FUNC-SCAL-01 , SCAL characterisation test		
4.17	Switch OFF SCAL – PROC-OPER-SCO		
4.18	Perform test FUNC-MCU-01 , MCU power on		
4.18	Perform test FUNC-MCU-02 , MCU Science packet generation check		
4.19	Perform test FUNC-MCU-03 , MCU Science data check		
4.20	Perform test FUNC-MCU-04 , MCU test pattern test		
4.21	Perform test FUNC-BSM-01 , BSM power on motor and sensor		
4.22	Switch OFF BSM – PROC-OPER-BOF		
4.23	Switch OFF MCU – CQM-MCU-OFF		
4.24	Perform test FUNC-DCU-01 , DCU Science Packet generation check		
4.25	Perform test FUNC-DCU-02 , DCU Science data check		
4.26	Perform test FUNC-DCU-03 , DCU Test pattern test		
4.27	Perform test FUNC-DCU-04 , DCU LIAs switch on		
4.28	Switch OFF LIAs – PROC_OPER_LIO?		
4.29	Switch off thermometers – PROC_OPER_THO?		
4.30	Switch off DRCU – PROC_OPER_DRO?		
4.31	Switch off DPU – PROC_OPER_DPO?		
4.32	Check that all SPIRE subsystems have been switched OFF		
5	Integrate FPU Into Cryostat		
5.1	Ensure covers are on FPU		
5.2	Move FPU off MGSE into Cryostat		
5.3	Remove MGSE from Laboratory and store in G56 clean room		



Step.	Action	Comments	Task Complete
5.4	Secure MGSE to Cryostat Rails		
5.5	Connect CBB to cold strap and harness		
5.6	Connect L2 straps to HOB Plate and MGSE frame		
5.7	Connect L3 straps to JFET Units		
5.8	Connect FPU Thermal Interfaces to Cryostat Links		
5.9	Connect remaining cryostat thermometers		
5.10	Mount and Connect Heaters to HOB simulator and FPU		
5.11	Check Electrical Isolation of FPU to Cryostat		
6	Perform Short Functional Test – CQM-ILT-SFT		
6.1	Switch on DPU using procedure CQM_DPU_ON		
6.2	Switch on DRCU using procedure QQM_DRCU_ON		
6.3	SPIRE in REDY mode?		
6.4	Perform test FUNC-SCU-01 , SCU Science packet generation check		
6.5	Perform test FUNC-SCU-03 , SCU DC thermometry check		
6.6	Perform test FUNC-SCU-06 , SCU AC thermometry check		
6.7	Perform test FUNC-SCU-07 , SCU cooler heater check		
6.8	Perform test FUNC-SCU-04 , SCU PCAL check		
6.9	Switch OFF PCAL – PROC-OPER-PCO?		
6.10	Perform test FUNC-SCU-05 , SCU SCAL check		
6.11	Switch OFF SCAL – PROC-OPER-SCO		
6.12	SPIRE in REDY mode + thermometers on?		
6.13	Perform test FUNC-MCU-01 , MCU power on		



Step.	Action	Comments	Task Complete
6.14	Perform test FUNC-MCU-02 , MCU Science packet generation check		
6.15	Perform test FUNC-BSM-01 , BSM power on motor and sensor		
6.16	Switch OFF BSM – PROC-OPER-BOF		
6.17	Switch Off MCU – CQM-MCU-OFF		
6.18	Perform test FUNC-DCU-01 , DCU Science Packet generation check		
6.19	Perform test FUNC-DCU-04 , DCU LIAs switch on		
6.20	Switch off LIAS – PROC_OPER_LIO		
6.21	Switch off thermometers – PROC_OPER_THO		
6.22	Switch off DRCU – PROC_OPER_DRO		
6.23	Switch off DPU – PROC_OPER_DPO		
7	Cryostat Functional Test		
7.1	Verify operation of cryostat instrumentation using procedure CRY_CHECK (ref AD 6)		
8	Pump-Down Cryostat		
8.1	Start cryostat pump-down using procedure CRY_PUMP (ref AD 6)		
9	Perform Short Functional Test – CQM-ILT-SFT		
9.1	Vacuum chamber at 10 ⁻⁵ mbar?		
9.2	Switch on DPU using procedure PROC_OPER_DPON?		
9.3	Switch on DRCU using procedure PROC_OPER_DRON?		
9.4	SPIRE in REDY mode?		
9.5	Perform test FUNC-SCU-01 , SCU Science packet generation check		
9.6	Perform test FUNC-SCU-03 , SCU DC thermometry check		



Step.	Action	Comments	Task Complete
9.7	Perform test FUNC-SCU-06 , SCU AC thermometry check		
9.8	Perform test FUNC-SCU-07 , SCU cooler heater check		
9.9	Perform test FUNC-SCU-04 , SCU PCAL check		
9.10	Switch OFF PCAL – PROC-OPER-PCO?		
9.11	Perform test FUNC-SCU-05 , SCU SCAL check		
9.12	Switch OFF SCAL – PROC-OPER-SCO		
9.13	SPIRE in REDY mode + thermometers on?		
9.14	Perform test FUNC-MCU-01 , MCU power on		
9.15	Perform test FUNC-MCU-02 , MCU Science packet generation check		
9.16	Perform test FUNC-BSM-01 , BSM power on motor and sensor		
9.17	Switch OFF BSM – PROC-OPER-BOF		
9.18	Switch Off MCU – PROC_OPER_MCO?		
9.19	Perform test FUNC-DCU-01 , DCU Science Packet generation check		
9.20	Perform test FUNC-DCU-04 , DCU LIAs switch on		
9.21	Switch off LIAs – PROC_OPER_LIO?		
10	Cool LN2 Radiation Shield		
10.1	SPIRE in REDY mode + thermometers on?		
10.2	Fill LN2 Radiation shield according to procedure CRY_COOL (ref AD 6)		
10.3	Monitor following temperatures during cooldown....		
11	Precool FPU to 100K		
11.1	Cool SPIRE FPU to 100K using procedure CRY_COOL (ref AD 6)		
12	Perform Short Functional Test Before Filling with He – CQM-ILT-SFT		



Step.	Action	Comments	Task Complete
12.1	FPU at 100K? – Specify thermometers		
12.2	SPIRE in REDY mode + thermometers on?		
12.3	Perform test FUNC-SCU-01 , SCU Science packet generation check		
12.4	Perform test FUNC-SCU-03 , SCU DC thermometry check		
12.5	Perform test FUNC-SCU-06 , SCU AC thermometry check		
12.6	Perform test FUNC-SCU-07 , SCU cooler heater check		
12.7	Perform test FUNC-SCU-04 , SCU PCAL check		
12.8	Switch OFF PCAL – PROC-OPER-PCO?		
12.9	Perform test FUNC-SCU-05 , SCU SCAL check		
12.10	Switch OFF SCAL – PROC-OPER-SCO		
12.11	SPIRE in REDY mode + thermometers on?		
12.13	Perform test FUNC-MCU-01 , MCU power on		
12.14	Perform test FUNC-MCU-02 , MCU Science packet generation check		
12.15	Perform test FUNC-BSM-01 , BSM power on motor and sensor		
12.16	Switch OFF BSM – PROC-OPER-BOF		
12.17	Switch Off MCU – PROC_OPER_MCO		
12.18	Perform test FUNC-DCU-01 , DCU Science Packet generation check		
12.19	Perform test FUNC-DCU-04 , DCU LIAs switch on		
12.20	Switch off LIAs – PROC_OPER_LIO		
13	Cool instrument to 4.2K		
13.1	SPIRE in REDY mode + thermometers on?		
13.2	Cool SPIRE to 4.2K using procedure CRY_COOL (ref AD 6)		



Step.	Action	Comments	Task Complete
14	Cool to 1.7K		
14.1	FPU at 4.2K?		
14.2	Cool L0 interface to 1.7K using procedure CRY_COOL (ref AD 6)		
14.3	If FPU L0 at 1.7K proceed to step 15		
15	Perform Cold Functional Tests		
15.1	FPU at 1.7K?		
15.2	SPIRE in REDY mode + thermometers on ?		
15.3	Perform test FUNC-SCU-01 , SCU Science packet generation check		
15.4	Perform test FUNC-SCU-03 , SCU DC thermometry check		
15.5	Perform test FUNC-SCU-06 , SCU AC thermometry check		
15.6	Perform test FUNC-SCU-02 , SCU Science data check		
15.7	Perform test FUNC-SCU-07 , SCU cooler heater check		
15.8	Perform test FUNC-SCU-08 , SCU Test pattern test		
15.9	SPIRE in REDY mode + thermometers on?		
15.10	Perform test FUNC-SCU-04 , SCU PCAL check		
15.11	Perform test FUNC-PCAL-01 , PCAL characterisation test		
15.12	Switch OFF PCAL – PROC-OPER-PCO		
15.13	Perform test FUNC-SCU-05 , SCU SCAL check		
15.14	Perform test FUNC-SCAL-01 , SCAL characterisation test		
15.15	Switch OFF PCAL – PROC-OPER-SCO		
	Cooler functional tests ???		
	CLOSE Heat Switches Here?		



Step.	Action	Comments	Task Complete
15.16	Perform test FUNC-MCU-01 , MCU power on		
15.17	Perform test FUNC-MCU-02 , MCU Science packet generation check		
15.18	Perform test FUNC-MCU-03 , MCU Science data check		
15.19	Perform test FUNC-MCU-04 , MCU test pattern test		
15.20	Perform test FUNC-BSM-01 , BSM power on motor and sensor		
15.21	Switch OFF BSM – PROC-OPER-BOF		
15.22	Switch OFF MCU – PROC_OPER_MCO?		
15.23	Perform test FUNC-DCU-01 , DCU Science Packet generation check		
15.24	Perform test FUNC-DCU-02 , DCU Science data check		
15.25	Perform test FUNC-DCU-03 , DCU Test pattern test		
15.26	Perform test FUNC-DCU-04 , DCU LIAs switch on		
15.27	Perform test FUNC-DCU-05 , DCU Offset test		
15.28	Perform test FUNC-DCU-06 , DCU JFET heaters		
15.29	SPIRE in REDY & JFET on?		
15.30	Allow JFET temperatures to stabilise		
15.31	SPIRE in STBY?		
15.32	Perform test FUNC-DCU-08 , DCU Phase shift test		
15.33	Perform test FUNC-DCU-09 , DCU Bias frequency test		
15.34	Perform test FUNC-DCU-10 , DCU Bias amplitude test		
15.35	Switch On Detectors - FUNC-DCU-11 , DCU detectors switch on		
15.36	Switch OFF Detectors – PROC_OPER_PDO?		
15.37	Switch OFF JFETS – PROC_OPER_JFO?		



Step.	Action	Comments	Task Complete
15.38	Switch OFF LIAs – PROC_OPER_LIO?		
15.39	Switch off thermometers – PROC_OPER_THO?		
15.40	Switch off DRCU – PROC_OPER_DRO?		
15.41	Switch off DPU – PROC_OPER_DPO?		
16	Thermal Test Case 1 – SPIRE OFF		
16.1	SPIRE OFF?		
16.2	Monitor FPU temperatures and allow to stabilise		
16.3	If thermal balance conditions have been reached then proceed to step 17		
17	Thermal Test Case 2 – Recycle Cooler		
17.1	SPIRE OFF?		
17.2	Command SPIRE into PHOTOMETER Standby Mode using procedure reference PROC-OPER-PSY		
17.3	Recycle cooler – PROC_OPER_?		
17.4	Allow temperatures to stabilise		
18	Thermal Test Case 3 – Photometer Calibrate Mode – POF08		
18.1	SPIRE in STBY?		
18.2	Command SPIRE into Photometer Calibrate Mode – POF08 using procedure reference PROC-OPER-PCO?		
18.3	SPIRE in POF08?		
18.4	Monitor FPU temperatures and allow to stabilise		
18.5	While temperatures are stabilising perform the Photometer Noise Test ILT-PERF-DNA-P		
18.6	While temperatures are stabilising perform the PCAL Level test ILT-PERF-CPC-P		



Step.	Action	Comments	Task Complete
18.7	While temperatures are stabilising perform the PCAL Frequency test ILT-PERF-CPT-P		
18.8	If thermal balance conditions have been reached and the above performance tests have been completed, then proceed to step 18		
19	Performance Tests		
19.1	At the start of each day's operation perform the Daily Check ILT-PERF-DCK		
19.2	Noise with Telescope Background ILT-PERF-DNC-P		
19.3	Optical Load Curve ILT-PERF-DAL-P		
19.4	HBB Peakup ILT-PERF-PKB		
19.5	HBB Beam Scan ILT-PERF-OSB-P		
19.6	Laser Peakup ILT-PERF-PKL		
19.7	Laser Time Constant ILT-PERF-DRL-P		
19.8	Spectral Response ILT-PERF-DSR		
19.9	Laser or HBB Peakup Pixel C2 ILT-PERF-PKB or ILT-PERF-PKL		
19.10	Laser or HBB beam scan Pixel C2 ILT-PERF-OSB or ILT-PERF-OSL		
19.11	Laser or HBB Peakup Pixel C8 ILT-PERF-PKB or ILT-PERF-PKL		
19.12	Laser or HBB beam scan Pixel C8 ILT-PERF-OSB or ILT-PERF-OSL		
19.13	Laser or HBB Peakup Pixel A5 ILT-PERF-PKB or ILT-PERF-PKL		
19.14	Laser or HBB beam scan Pixel A5 ILT-PERF-OSB or ILT-PERF-OSL		
19.15	Laser or HBB Peakup ILT-PERF-PKB or ILT-PERF-PKL		
19.16	Spectral Response ILT-PERF-DSR		
19.17	Laser or HBB beam scan ILT-PERF-OSB or ILT-PERF-OSL		
19.18	HBB time constant ILT-PERF-DRB-P		



Step.	Action	Comments	Task Complete
19.19	Laser time constant ILT-PERF-DRL-P		
19.20	Beam attenuation HBB ILT-PER-DBA-P		
19.21	Laser Polarisation ILT-PERF-DPL-P		
19.22	Laser beam attenuation ILT-PERF-DLA-P		
19.23	Laser OOB sensitivity ILT-PERF-OBL-P		
19.24	Pupil Scan ILT-PERF-OPI-P		
20	Power On SPIRE into SPEC STANDBY		
20.1	Command SPIRE into spectrometer standby PROC_OPER_?		
21	Thermal Test Case 6		
21.1			
22	Perform Cold Functional Test		
22.1	FPU L0 at 1.7K?		
22.2	SPIRE in REDY mode + thermometers on? PROC_OPER_?		
22.3	Perform test FUNC-SCU-01 , SCU Science packet generation check		
22.4	Perform test FUNC-SCU-03 , SCU DC thermometry check		
22.5	Perform test FUNC-SCU-06 , SCU AC thermometry check		
22.6	Perform test FUNC-SCU-02 , SCU Science data check		
22.7	Perform test FUNC-SCU-07 , SCU cooler heater check		
22.8	Perform test FUNC-SCU-08 , SCU Test pattern test		
22.9	SPIRE in REDY mode + thermometers on?		
22.10	Perform test FUNC-SCU-04 , SCU PCAL check		
22.11	Perform test FUNC-PCAL-01 , PCAL characterisation test		



Step.	Action	Comments	Task Complete
22.12	Switch OFF PCAL – PROC-OPER-PCO		
22.13	Perform test FUNC-SCU-05 , SCU SCAL check		
22.14	Perform test FUNC-SCAL-01 , SCAL characterisation test		
22.15	Switch OFF PCAL – PROC-OPER-SCO		
	Cooler functional tests ??? CLOSE Heat Switches Here?		
22.16	Perform test FUNC-MCU-01 , MCU power on		
22.17	Perform test FUNC-MCU-02 , MCU Science packet generation check		
22.18	Perform test FUNC-MCU-03 , MCU Science data check		
22.19	Perform test FUNC-MCU-04 , MCU test pattern test		
22.20	Perform test FUNC-BSM-01 , BSM power on motor and sensor		
22.21	Switch OFF BSM – PROC_OPER_BOF		
22.22	Switch OFF MCU – PROC_OPER_MCO?		
22.23	Perform test FUNC-DCU-01 , DCU Science Packet generation check		
22.24	Perform test FUNC-DCU-02 , DCU Science data check		
22.25	Perform test FUNC-DCU-03 , DCU Test pattern test		
22.26	Perform test FUNC-DCU-04 , DCU LIAs switch on		
22.27	Perform test FUNC-DCU-05 , DCU Offset test		
22.28	Perform test FUNC-DCU-06 , DCU JFET heaters		
22.29	SPIRE in REDY & JFET on? PROC_OPER_?		
22.30	Allow JFET temperatures to stabilise		
22.31	SPIRE in Photometer standby? PROC_OPER_PRC		



Step.	Action	Comments	Task Complete
22.32	Perform test FUNC-DCU-08 , DCU Phase shift test		
22.33	Perform test FUNC-DCU-09 , DCU Bias frequency test		
22.34	Perform test FUNC-DCU-10 , DCU Bias amplitude test		
22.35	Switch On Detectors - FUNC-DCU-11 , DCU detectors switch on		
23	Post Test Review		
23.1			
24	SPIRE OFF		
24.1	Switch OFF Photometer Detectors – PROC_OPER_PDO?		
24.2	Switch OFF JFETS – PROC_OPER_JFO?		
24.3	Switch OFF LIAs – PROC_OPER_LIO?		
24.4	Switch off thermometers – PROC_OPER_THO?		
24.5	Switch off DRCU – PROC_OPER_DRO?		
24.6	Switch off DPU – PROC_OPER_DPO?		
25	Warm Up		
25.1	Warm SPIRE to ambient using procedure CRY_WARM (ref AD 6)		
26	Let Up to Atmosphere		
26.1	Let up chamber to atmospheric pressure using procedure CRY_LETUP (ref AD 6)		
27	Perform Warm Functional Test		
27.1	Switch on DPU using procedure CQM_DPU_ON		
27.2	Switch on DRCU using procedure QQM_DRCU_ON		
27.3	SPIRE in REDY mode?		



Step.	Action	Comments	Task Complete
27.4	Perform test FUNC-SCU-01 , SCU Science packet generation check		
27.6	Perform test FUNC-SCU-03 , SCU DC thermometry check		
27.7	Perform test FUNC-SCU-06 , SCU AC thermometry check		
27.8	Perform test FUNC-SCU-02 , SCU Science data check		
27.9	Perform test FUNC-SCU-07 , SCU cooler heater check		
27.10	Perform test FUNC-SCU-08 , SCU Test pattern test		
27.11	SPIRE in REDY mode + thermometers on PROC_OPER_?		
27.12	Perform test FUNC-SCU-04 , SCU PCAL check		
27.13	Perform test FUNC-PCAL-01 , PCAL characterisation test		
27.14	Switch OFF PCAL – PROC-OPER-PCO		
27.15	Perform test FUNC-SCU-05 , SCU SCAL check		
27.16	Perform test FUNC-SCAL-01 , SCAL characterisation test		
27.17	Switch OFF PCAL – PROC-OPER-SCO		
27.18	Perform test FUNC-MCU-01 , MCU power on		
27.18	Perform test FUNC-MCU-02 , MCU Science packet generation check		
27.19	Perform test FUNC-MCU-03 , MCU Science data check		
27.20	Perform test FUNC-MCU-04 , MCU test pattern test		
27.21	Perform test FUNC-BSM-01 , BSM power on motor and sensor		
27.22	Switch OFF BSM – PROC-OPER-BOF		
27.23	Switch OFF MCU – PROC_OPER_MCO?		
27.24	Perform test FUNC-DCU-01 , DCU Science Packet generation check		
27.25	Perform test FUNC-DCU-02 , DCU Science data check		



Step.	Action	Comments	Task Complete
27.26	Perform test FUNC-DCU-03 , DCU Test pattern test		
27.27	Perform test FUNC-DCU-04 , DCU LIAs switch on		
27.28	Switch OFF LIAs – PROC_OPER_LIO?		
27.29	Switch off thermometers – PROC_OPER_THO?		
27.30	Switch off DRCU – PROC_OPER_DRO?		
27.31	Switch off DPU – PROC_OPER_DPO?		
28	Remove SPIRE from Cryostat		
28.1	Remove SPIRE from chamber using procedure ref. CRY_DEINT (ref: AD 5)		