SPIRE System Level Test Plan
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0 Change Note

1.0 – First issued for SVR2
1.1 – Include PCAL tests; detector thermal stability and detector microphonics reponse.

1 Scope

This document outlines the tests that will be carried out during and after integration of the SPIRE instrument into the Herschel cryostat. This document is intended as an informational note for the purposes of the Science Verification Review (SVR) to allow the review board to comment on the completeness or otherwise of the planned tests.

2 Organisation of the tests

For the system level tests we follow the test campaign organisation proposal by Alcatel *vis.*

EIT-WU – Electrical Integration Test – Warm Units
EIT-WFT – Electrical Integration Test – Warm Functional Test
EIT-SWFT – Electrical Integration Test – Short Warm Functional Test
UFT-WU – Unit Functional Test – Warm Units
IST-CFT – Integrated System Test – Cold Functional Test
IST-SCFT – Integrated System Test – Short Cold Functional Test
IST-SPT – Integrated System Test – Special Performance Test
IST-TV – Integrated System Test – Cold Functional Test
IST-EMC – Integrated System Test – Cold Functional Test
SVT – System Verification Test

When and where each of these phases are carried is not considered in this document, only the tests that SPIRE is required/wishes to be done.

I have broken the SPIRE tests into four sections:

1. Functional Tests
   The standard battery of tests designed to ensure everything is connected and functions as seen during instrument level testing (ILT)

2. Performance Verification Tests
   Again a standard set of tests designed to ensure that the basic instrument performance is the same as, or can be extrapolated from, the results from ILT

3. Instrument Flight Operations
   Tests designed to exercise a subset of the instrument in flight operations to provide standard configurations for thermal verification and System Verification Tests (SVT)

4. Special Engineering Tests
   These are tests designed to evaluate the parts of SPIRE's performance within the Herschel environment that cannot be tested during ILT – they include things like response to microphonics; EMC and thermal balance.

There is some overlap between the sections but I hope that organising the document in this way will make it more readable. The order that the tests appear in these sections does not imply any sequence of execution.

3 SPIRE System Level Tests

3.1 Functional

Name of test	Description	Purpose	When carried out
Warm Functional Test	Full checkout of SPIRE functionality whilst the FPU is warm and either under vacuum or at atmospheric pressure.	Basic electrical integration. instrument health check and characterisation at warm temperature	EIT-WU UFT-WU EIT-WFT
Cold Functional Test	Full checkout of SPIRE functionality once the FPU is cold and either under vacuum or at atmospheric pressure.	Instrument health check and functional characterisation at cold temperatures	EIT-CFT IST-SPT IST-TV
Short Functional Test – warm	Rapid check of SPIRE functionality to be carried out at key inspection points during integration with the FPU warm either under vacuum or at atmospheric pressure.	Functional check the does not require instrument personnel to support.	EIT-SWFT IST-SPT IST-TV
Short Functional Test – cold	Rapid check of SPIRE functionality to be carried out at key inspection points during test with the FPU cold and at operating temperature. Does not require instrument support.	Functional check the does not require instrument personnel to support.	EIT-SCFT IST-SPT IST-TV

3.2 Performance Verification

Name of test	Description	Purpose	When carried out
Photometer Thermal Control Verification	With the instrument in PHOT STBY the photometer thermal control system will be activated using control parameters established during ILT and previous engineering tests (*q.v.*)	To verify thermal stabilisation performance.	IST-SPT IST-TV
Photometer bias optimisation	Measurement of the photometer noise performance as a function of bias amplitude and frequency	Verification of ILT results and system level noise performance	IST-SPT
PCAL Photometer Characterisation	PCAL is flashed on and off at increasing current settings up to the maximum levl	Check response of photometer BDAs to PCAL at various settings to compare to ILT	IST-SPT
Spectrometer bias optimisation	Measurement of the spectrometer noise performance as a function of bias amplitude and frequency	Verification of ILT results and system level noise performance	IST-SPT
Spectrometer SCAL check	Set each spectrometer calibration source to nominal operating temperature and take spectrum against ambient background set to close to nominal telescope power	Final verification of SCAL nulling and thermal performance	IST-SPT
PCAL Spectrometer Characterisation	PCAL is flashed on and off at increasing current settings up to the maximum level	Check response of spectrometer BDAs to PCAL at various settings to compare to ILT	IST-SPT

3.3 Flight Operations

Name of test	Description	Purpose	When carried out
SPIRE to Ready mode (REDY)	Only temperature sensors are switched on and housekeeping is collected.	Required for transition between modes and is the default mode that SPIRE will in when not prime instrument	IST-SPT IST-TV SVT
Cooler Recycle (CREC)	Once we have established the correct operating parameters for the cooler we can use an automatic procedure.	This will be the standard cooler recycle procedure for the majority of the IST.	IST-SPT IST-TV SVT
Photometer Standby (PHOT STBY)	Sets the instrument to be ready to go into one of the photometer observation modes.	This instrument setting will be used many times during IST both in transitions between test configurations and as a default condition.	IST-SPT IST-TV SVT
Photometer Scan Mode (POF5)	This sets the SPIRE instrument to its nominal scan mode AOT configuration.	We plan using this mode for thermal testing and operations checkout.	IST-SPT IST-TV SVT
Photometer 7-Point jiggle/chop with nodding (POF2)	This sets the SPIRE instrument to its nominal chop and jiggle mode AOT configuration.	We plan using this mode for thermal testing and operations checkout.	IST-SPT IST-TV SVT
Spectrometer Standby (SPEC STBY)	Sets the instrument to be ready to go into one of the spectrometer observation modes.	This instrument setting will be used many times during IST both in transitions between test configurations	IST-SPT IST-TV SVT
Spectrometer high resolution spectrum (SOF1)	This sets the SPIRE instrument to its spectrometer mode AOT configuration where the SMEC is scanned over its full operating range.	We plan using this mode for thermal testing and operations checkout	IST-SPT IST-TV SVT
Cooler Hold time	A full 48 hour cycle of flight like operations is conducted following a cooler recycle under close to flight thermal conditions	Check the cooler hold time performance in flight like environment	IST-TV

3.4 Special Engineering

Name of test	Description	Purpose	When carried out
Ambient background verification	Loadcurves and calibrator flashes with the cryocover set to a number of different conditions. Carried out for both photometer and spectrometer	We need to test the straylight environment within the cryostat under different loading conditions. This test also checks the BDA temperatures.	IST-SPT IST-TV
Spectrometer mechanism micro vibration test	SPIRE set to spectrometer mode with the SMEC continuously scanning. During the test the S/C reaction wheels are activated and taken through a range of rotation speeds while the SMEC performance is monitored for interference	Final verification of the response of the SMEC to spacecraft induced microphonics	IST-SPT
Photometer detector microphonics test	SPIRE set to PHOT STBY with low ambient background. During the test the S/C reaction wheels are activated and taken through a range of rotation speeds while the detector signals are monitored for interference	Characterisation of the response of the photometer detectors to spacecraft induced microphonics	IST-SPT
Spectrometer detector microphonics test	SPIRE set to SPEC STBY with low ambient background. During the test the S/C reaction wheels are activated and taken through a range of rotation speeds while the detector signals are monitored for interference	Characterisation of the response of the spectrometer detectors to spacecraft induced microphonics	IST-SPT
Photometer thermal stability vs bias	SPIRE set to PHOT STBY with low ambient background and highly stable thermal conditions. Photometer detector bias increased in small steps and transient allowed to die away whilst monitoring signal level.	Characterisation long term thermal time constants of detectors in close to flight thermal conditions.	IST-SPT IST-TV
Photometer EMI Susceptibility Tests	SPIRE set to most sensitive photometer mode.	Completion of formal radiative susceptibility tests as specified by IID-A	IST-EMC

Name of test	Description	Purpose	When carried out
Spectrometer EMI Susceptibility Tests	SPIRE set to most sensitive spectrometer mode	Completion of formal radiative susceptibility tests as specified by IID-A	IST-EMC
Spectrometer EMC Tests	SPIRE set to most noisy spectrometer mode	Completion of formal radiative emission tests as specified by IID-A	IST-EMC
PTC Headroom Characterisation	The power on the PTC heater is increased in steps whilst observing the response of the BDA and PTC thermistors.	Determine the required PTC power setting required to enable stable operation of the photometer detectors under ground nominal thermal conditions.	IST-SPT
300mK Decontamination Test	The cooler pump is heated with both heat switches off in order to raise the temperature of the 300 mK stage as high as possible	To test efficiency of heating the 300 mK system using the pump in case it is needed to removed Helium condensed on the detectors.	IST-SPT