HERSCHEL / PLANCK

HERSCHEL FM TV/TB TEST SPECIFICATION

Written by	***Responsibility*** + handwritten signature if no informatic workflow tool
B. DEMOLDER	Thermal architect
Verified by	
Y. ROCHE	Herschel Technical Responsible
B. COLLAUDIN	Herschel/Planck Instrument Manager
D. MONTET	Herschel Satellite Manager
Approved by	
T. GRASSIN	PA manager
J.-M. REIX	Herschel/Planck Programme Manager
T. PAßVOGEL	ESA Programme Manager

The validations evidence are kept through the documentation management system.

DISTRIBUTION RECORD

DOCUMENT NUMBER : H-P-2-ASP-TS-0997 Issue : 2

Date: 06DEC 07

EXTERNAL DISTRIBUTION		INTERNAL DISTRIBUTION	
ESA	**X**	**HP team**	**X**
ASTRIUM	**X**		
THALES ALENIA SPACE -Italia	**X**		
Instrument teams			
		Clt Documentation	**Orig.**

CHANGE RECORDS

ISSUE	DATE	§ CHANGE RECORDS	AUTHOR
1	31 AUG 05	Initial issue A non official issue 2 (non signed) had been sent, dated 29 Oct 07. This version has been commented and modified, to become the official issue 2.	B. Demolder
2	06 DEC07	Issue taking into account the latest programmatic development (as PLM STM campaings), as well as ESA and ASED comments. Due to the depth of changes, change bars are not shown in this issue.	B. Demolder

TABLE OF CONTENTS

1. Tests objectives

1.1 Introduction

The Herschel FM tests in thermal/vacuum conditions will be composed of four types of tests :
- Thermal balance tests (SVM tests in steady and transient phase)
- Thermal verification tests (PLM tests, see §1.3.1)
- Thermal cycling tests (PLM and SVM tests)
- Instrument functional and performance verification in near flight conditions.

In addition, some specific features are tested:
- PLM alignment verification during cool down
- videogrammetry,
- LOU windows decontamination,
- telescope decontamination.

This document is the specific test specification for the Thermal Vacuum (TV) / Thermal Balance (TB) test of the Herschel satellite flight model. This test will be done at ESTEC in the Large Space Simulator (LSS).
It also provides environmental and test facility requirements for other tests listed above.

This specification deals in particular with the following points :
- Test objectives / test definition
- Definition of the tested specimen and deviation from flight configuration
- Success criteria
- Requirements towards test facilities
- Organisation and responsibilities
- Input / output data

1.2 Requirements

The following requirements of RD4 have to be verified by the TV/TB test. This section 1.2 is addressed to ESA for verification purpose. It shall not be considered by ASED.

Requirement reference	Requirement

SFUN-010 H	The Herschel Payload Module shall: Provide the necessary interfaces (mechanical, optical and electrical) with the Agency's provided Telescope and other elements of the spacecraft. Accommodate the focal plane units (FPU) of the instruments, the Local Oscillator Unit (LOU) of HIFI and the Buffer Amplifier Unit (BOLA) of PACS in accordance with the requirements and interface specification of the IID's Part B Provide to the instruments FPU's, the required thermal environment, through a cryogenic subsystem
SENV-070 H/P	The spacecraft shall be designed to withstand any external air pressure between ambient (0.105 Mpa) and vacuum (< 10-4 Pa).
STHE-080 H/P	The TCS shall ensure that all equipment temperatures remain within the thermal design limits defined for each unit, during all phases of the mission, including ground testing. If applicable, it shall also ensure the required temperature stability for equipment. It shall maintain the structural parts with the required temperatures and temperature stabilities such that the necessary alignments are met between units involved in the pointing or alignment required performances.
STHE-110 H/P	Heaters shall be used when necessary. All heaters shall be capable of being commanded from ground
SCVE-175 H/P	The thermal design of the spacecraft shall be validated by a thermal balance test.
SCVE-180 H/P	The test cases shall cover, as far as practical, the extreme environmental conditions envisaged for the complete mission and the most critical predicted thermal situations.
SCVE-185 H/P	The spacecraft thermal sensors (e.g. thermistors, thermo-couples) shall be continuously monitored during the test and be used for the assessment of the stabilisation. In addition, they shall be used for the correlation. Additional measurement points shall be provided by test thermal sensors , mainly for complementing the flight measurement plan and monitoring local or general environmental data.
SCVE-190 H/P	The environment induced by the test facility shall be continuously monitored during the test with a level of details, as it will be required by the thermal mathematical model for the prediction of the test.
SCVE-195 H/P	The Thermal Vacuum test at system level shall be designed to bring all the S/C and Payload units to their worst predicted flight environment without exceeding their qualification range
SMRC-125 H/P	Heating capability shall be provided to prevent the freezing of the propellants.
MISS-110 H	The Herschel spacecraft shall be compatible with any of the following combination of sun aspect angles away from the +Z-axis during all observational modes: +/-30 degrees about the Y-axis and +/-1 degrees about the X-axis.

Table 1-1 Requirements verified by TV/TB test

1.3 Thermal balance tests objectives

1.3.1 H-EPLM

The qualification of the H-EPLM cryostat has been performed at STM level and was confirmed at MQR step 2 (see RD6).
For the internal part of the cryostat, no "classical" balance phase (quasi steady state) is introduced. The verification of the related objectives will be performed through the comparison prediction/measurements in transient phases.

It was agreed that the correlation of the external model of the H-PLM could not be performed using the LSS results of STM1 or FM test (see RD7). Nevertheless, a comparison between prediction and measurements will of course be performed after test to validate the external thermal model.

The objectives of the HEPLM FM test are:

Acceptance of CVV internal Thermal control	
OBJ EPLM 1	evaluation of FM built status and workmanship, internal temperature distribution of EPLM, including LEOP (maximum temperature of HTT and big to small nozzle switching).
OBJ EPLM 2	Validation of TMM and subsequent confirmation of lifetime prediction made on STM
OBJ EPLM 3	acceptance of FM FPU thermal interfaces with H-EPLM
OBJ EPLM 4	Verification of pre-launch and launch sequence
Acceptance of CVV external Thermal control	
OBJ EPLM 5	Consistency check of external temperature distribution of H-EPLM
OBJ EPLM 6	Consistency check of telescope I/F temperature
OBJ EPLM 7	Consistency check of HIFI LOU I/F temperatures

1.3.2 SVM

The qualification of the SVM thermal control has been performed during the H-SVM STM thermal balance. The aim of the thermal balance at system level is to perform acceptance of the SVM and the delta qualification .
The objectives of the SVM FM test are :

Qualification of SVM thermal control	
OBJ SVM 1	Validation of the HIFI control law in near to flight configuration
OBJ SVM 2	validation of the thermal control design changes between STM and FM configuration (RCS heaters, STR baffle heaters, CRS thermal control)
Acceptance of SVM thermal control	
OBJ SVM 3	validation of the thermal Mathematical Model (TMM) in steady state and transient conditions
OBJ SVM 4	validation of the thermal control design concept and thermal performances

1.3.3 System objectives

Acceptance of spacecraft	
OBJ SYS 1	Verification of SVM/PLM thermal interfaces.

1.4 Thermal cycling tests objectives

1.4.1 H-EPLM

Acceptance of CVV internal	
OBJ EPLM 8	Verification of DLCMs (end to end validation)
OBJ EPLM 9	Consistency check of HSS temperatures in cold/hot condition

1.4.2 SVM

The objectives of the SVM FM test are :

Acceptance of SVM	
OBJ SVM 5	SVM functional acceptance at extreme temperatures

1.4.3 System objectives

The system objectives of the FM test are:

Acceptance of FM equipments	
OBJ SYS 2	Verification of instrument performance in nearly flight conditions (except SPIRE spectrometer which needs 90 deg rotation)
OBJ SYS 3	Acceptance of FM equipments in high/low temperature range (warm units)
OBJ SYS 4	Verification of telescope temperatures during decontamination phase
OBJ SYS 5	Functional verification of LOU baffle heating

1.5 other objectives

The other objective of the thermal test are :

Alignment check	
OBJ TV 1	LOU/HIFI FPU alignment using HACS
OBJ TV 2	telescope alignment using videogrammetry

1.6 Adequacy of objectives wrt test phases

The cross-check of each of the previous objectives with respect to the test phase is given in Table 1-2 herunder.

	PHASE NAME	PLM-launch-autonomy	PLM launch-delay	PLM LEOP	PLM RC	INST-THERM-I/F	PLM EXT-COLD	PLM EXT-HOT	dP measure	TEL-DEC	LOU DEC	Launch-Mode	SVM SAFE	SVM TB-COLD	SVM TB-HOT	SVM TV-COLD	SVM TV-HOT	INST-HIFI	INST-PACS	INST-SPIRE	INST-PARA	AFT	WUP	VIDEO	ALIGN
objective n°	**description**	launch autonomy	launch delay	PLM LEOP phase	Rapid cool down	instrument thermal interface checking	External cold stabilisation	External hot stabilisation	delta pressure measurement	decontamination of telescope	decontamination of LOU baffle	SVM launch mode	SVM transition to safe mode	SVM "cold" stabilisation	SVM "Hot" stabilisation	SVM "cold" cycling	SVM "hot" cycling	HIFI TV/TB testing	PACS TV/TB testing	SPIRE TV/TB testing	PACS/SPIRE parallel TV/TB testing	Abbreviated Functional test	Warm up	Videogrammetry	LOU/HIFI FPU alignment using HACS
OBJ EPLM 1	evaluation of FM built status and workmanship, internal temperature distribution of EPLM, including LEOP (maximum temperature of HTT and big to small nozzle switching).	X	X	X					X																
OBJ EPLM 2	Validation of TMM and subsequent confirmation of lifetime prediction made on STM	X	X	X					X																
OBJ EPLM 3	acceptance of FM FPU thermal interfaces with H-EPLM					X																			
OBJ EPLM 4	Verification of pre-launch and launch sequence	X	X									X													
OBJ EPLM 5	Consistency check of external temperature distribution of H-EPLM						X	X																	
OBJ EPLM 6	Consistency check of telescope I/F temperature						X	X																	
OBJ EPLM 7	Consistency check of HIFI LOU I/F temperatures						X	X																	
OBJ EPLM 8	Verification of DLCMs (end to end validation)															X	X								
OBJ EPLM 9	Consistency check of HSS temperatures in cold/hot condition						X	X																	
OBJ SVM 1	Validation of the HIFI control law in near to flight configuration													X											
OBJ SVM 2	validation of the thermal control design changes between STM and FM configuration (RCS heaters, STR baffle heaters, CRS thermal control)												X	X	X										
OBJ SVM 3	validation of the thermal Mathematical Model (TMM) in steady state and transient conditions												X	X	X										
OBJ SVM 4	validation of the thermal control design concept and thermal performances												X	X	X										
OBJ SVM 5	SVM functional acceptance at extreme temperatures															X	X								
OBJ SYS 1	Verification of SVM/PLM thermal interfaces.													X	X										
OBJ SYS 2	Verification of instrument performance in nearly flight conditions (except SPIRE spectrometer which needs 90 deg rotation)																	X	X	X	X				
OBJ SYS 3	Acceptance of FM equipments in high/low temperature range (warm units)															X	X								
OBJ SYS 4	Verification of telescope temperatures during decontamination phase									X															
OBJ SYS 5	Functional verification of LOU baffle heating										X														
OBJ TV 1	LOU/HIFI FPU alignment using HACS																								X
OBJ TV 2	telescope alignment using videogrammetry																							X	

Table 1-4 Verification of objectives wrt test phase

2. APPLICABLE AND REFERENCE DOCUMENTS

2.1 Applicable documents

AD1 SCI-PT-IIDB/HIFI-02125 "instrument interface document part b instrument HIFI", Iss 3.2
AD2 SCI-PT-IIDB/PACS-02126 "instrument interface document part b instrument PACS", Iss 3.2
AD3 SCI-PT-IIDB/SPIRE-02124 "instrument interface document part b instrument SPIRE", Iss 3.2
AD4 H-P-2-ASP-TS-0939 "Herschel integrated satellite test specification"", iss. 4
AD6 H-P-2-ASP-TS-1083, Test Specification for Herschel Instruments AVM and FM tests performed at satellite level, iss.1
AD7 H-P-2-ASP-PL-0054 Instrumentation Plan for Thermal Testing of Herschel satellite
AD8 H-P-TN-AI-0135 Herschel SVM-FM TV/TB test thermocouples location, iss. 2
AD9 H-P-2-ASP-TN-1336 Guideline for routing instrumentation harnesses in the SVM, iss. 1
AD10 H-P-2-ASP-SP-1268 HERSCHEL FM TV harness PW & 1553, iss. 3
AD11 H-P-2-ASP-SP-1288 HERSCHEL FM TV harness ACMS for Power & Z panel, iss. 3
AD15 HP-2-ASED-PL-0023 HERSCHEL Contamination Control Plan, iss. 2
AD16 HP-2-ASED-PS-0054 videogrammetry requirement specification, iss. 1
AD17 HP-1-ASPI-SP-0030 Environment and Test Requirements, iss. 5.0
AD18 HP-2-ASP-TS-xxxx Herschel FM TV/TB Emergency procedures, TBI
AD19 H-P-2-ASP-TN-1462 HERSCHEL SVM thermal interfaces for herschel fm tv-tb test, iss.1
AD20 H-P-2-ASP-TN-1480 HERSCHEL PLM thermal interfaces for herschel fm tv-tb test, iss.1

2.2 Reference documents

RD1 H-P-1-ASPI-PL-0225 Verification Programme Plan, iss.3
RD2 HP-2-APCO-MA-0022 User's manual thermal test adapter for S/C I/F (TTAS), iss. 2
RD3 H-P-RP-AI-0040 SVM TCS thermal analysis report, iss.7
RD4 SCI-PT-RS-05991 System Requirements Specification, iss. 3.3
RD5 H-P-2-ASED-TS-0017, HSS Thermal Control Rig Specification, iss. 1
RD6 MQR step2 board report, TBI
RD7 H-P-ASP-MN-8845, Herschel internal correlation after STM2 campaign and external modelisation
RD8 H-P-TN-AI-0100, H/P SVM housekeeping packets definition, iss. 1
RD9 H-P-1-ASPI-TN-0386, Unit Switching Status, iss.2
RD10 H-P-2-ASP-SP-1411, HERSCHEL SFT and AFT specification, iss.2
RD11 H-P-1-ASPI-LI-0058 "Hardware matrix", iss. 4
RD12 H-P-ASP- LT-6601 Herschel satellite thermal cycling test
RD13 H-P-ASP-TN-9429 ACR_CTA_panel-Y
RD14 H-P-2-ASP-TS-1454 Herschel ATC health check specification

3. Test specimen definition

3.1 Satellite configuration

The test specimen is HERSCHEL FM satellite.
The configuration is given in RD11, except regarding to some topics listed hereafter.

The satellite specimen is equipped for the TV/TB with AIT test instrumentation consisting in (see AD7) :
- Thermocouples and thermal sensors and its associated harness
- Test heaters and associated harness (including power supply and voltage measurement cables).

The spacecraft shall be grounded by means of a thermal braid connected on the insert MGSE-34-05 of the SVM +Y panel.

Nota : Protective covers (telescope, OSRs, solar array, sensors, thrusters…) shall be removed as late as possible before test and reinstalled as soon as possible after test for cleanliness reasons.

3.1.1 HPLM configuration

The differences between HEPLM STM 1 and FM test are :

Item	STM 1 level	FM level
Telescope	Thermal model	PFM
HSS	None (IR Rig)	FM
HSS struts	None	FM
I/F for HSS struts MLI on CVV	test MLI	FM
STR Assembly	None	FM
I/F for STR struts MLI on CVV	test MLI	FM
He adsorbers	none	FM
LOU	MTD	FM
LOU internal baffle on TS2	None	FM
LOU internal baffle on TS1	None	FM
LOU external baffle	None	FM
SVM MLI	test MLI	FM
SVM/PLM I/F	MGSE	FM
Cryocover	QM	FM
FPUs	MTDs	FM
Nozzles	STM 1	FM
Videogrammetry targets	none	yes
HIFI coax cable	test	FM

Due to the absence of sun-like illumination during the test, a HSS thermal control RIG will be installed on the +Z side of the HSS to heat up both Solar Array and sunshade (see RD5).

3.1.2 SVM configuration

The SVM is installed on the TTAS (see §3.2.4) .

The differences between SVM STM and FM test are :

Item	STM level	FM level
WU	MTDs	FM
Radiator sizing	STM def	FM def
RCS heating	STM def	FM
HIFI panel heater	STM def	FM
Catalytic bed heaters	None	FM
I/F on lower side	None	TTAS
I/F on upper side	TAS	FM (CVV struts)
I/F to HSS	STM	FM
I/F to SVM shield	None	FM
Radiative area	STM (SSM)	FM (osr)
Thermal sensors	STM (TCs)	FM (Thermistors)
Paint on radiators	STM (Z306)	FM(Z307)

The tanks are pressurised at 2 bars absolute with GN2.

Details on SVM TCS thermal lines are provided in Annex 1.

3.2 Instrumentation

This paragraph describes all the sensors and heaters monitored or commanded, but not directly by the spacecraft.

3.2.1 HPLM instrumentation

The PLM instrumentation is described in AD7.

The PLM thermal instrumentation is made of:

- 44 PT100,
- 209 TCs
- 17 heating lines on S/C
- 38 heating lines on IR-RIG
- TBD heating lines on harness.

3.2.2 Cold instruments instrumentation

No test instrumentation is foreseen.

3.2.3 SVM instrumentation

The SVM thermocouple instrumentation is described in AD8 and AD9.
The SVM test heater instrumentation is described in RD12 and RD13 (see drawings referenced in RD12) and reported below. These heater lines shall be connected to an external commanding bay to be provided by ETS. It shall be possible to manually tune the voltage of each channel to any desired value lower than the maximum defined in Table 3-1.

label	Power (W), maximum	Resistance (Ohms)	Voltage (V), maximum
panel (+Y) -ACC	31	208	80
panel (+Y) -battery	32	200	80
panel (+Y) -CDMU	64	100	80
panel (+Y) –PCDU	192	33,33	80
panel (-Z) –SPIRE	61	104	80
panel (-Y-Z) -HIFI 2 (short)	92	69,33	80
Panel (+Y-Z) -DECMEC	46	138,7	80
panel (+Y-Z) -BOLC	54	118,9	80
panel (-Y+Z) -RWS	224	28,57	80
panel (-Y) -HIFI 1 (long)	342	18,7	80

table 3-1: Test heater dissipation on SVM

The SVM instrumentation is made of 271 TCs and 10 external heater lines.

3.2.4 TTAS instrumentation

The TTAS instrumentation is described in the AD8.

Two heating lines (nominal and redundant) are installed on the TTAS.

label	Power (W), maximum	Resistance (Ohms)	Voltage (V), maximum
TTAS N	240	14	60
TTAS R	240	14	60

table 3-3: Test heater dissipation on TTAS

The TTAS shall be covered with test MLI on both sides. The TTAS holes shall remain uncovered for Star Tracker cooling reasons.
The dome inside the TTAS (part of spin box) shall be covered with test MLI after connection of

heaters on dome.

3.2.5 Other instrumentation

It is expected that the harness between the S/C and the LSS ports will pump heat from the S/C. In order to maintain this heat loss acceptable, some bundles should be covered by heaters in a constant powering mode while in vacuum and cold conditions of the LSS. The definition of these heaters is TBD in accordance with analyses to be performed by TASF.

The test harness, such as TCs, heaters, strain gauge, accelerometers…, installed on the spacecraft has to be included in the thermal models for the thermal performance verification.

3.3 Test environment definition

Preparation, test and post-test activities of the Herschel PLM shall be carried out in cleanroom class 100.000 conditions acc. US Fed. Std. 209 B to prevent degradation and contamination of surfaces.

The cleanroom conditions shall be, in accordance with ENVM-040 of [AD17]:

- temperature between 19 and 25°C
- relative humidity between 40 and 60%
- pressure between 970 and 1050 mbar

The facility ambient conditions shall be continuously monitored and recorded.

3.4 Environment in Test Chamber

The sun simulator will not be used during the Herschel FM test.

The chamber pressure shall be lower than 10-5 mbar to be reached in the minimum possible time, with the test specimen installed. During the test, the pressure shall be maintained at this value or below.

The LSS shrouds shall be operated in LN2 mode to guarantee the following values:

- LSS wall temperature: 93 K ± 5 K
- LSS wall emissivity: 0.9 ± 0.05 at LSS cold condition

The gaps of the LSS shall be covered by MLI patches.

The emissivity shall be measured before the test in at least 20 positions on the walls of the chamber around the test specimen.

For cleanliness purpose, during warm up, the coldest external element of the specimen shall be maintained as much as possible hotter than the hottest point of the shroud with a minimum gradient of 10°C.

The chemical contamination shall be measured by appropriate items according to AD15.

3.5 Set-up in LSS

The test set-up principle is shown in Figure 3-1.

The +Z axis of the S/C shall be oriented towards the LSS collimator mirror.

Before transport in LSS,

- the HTT will be topped-up with He-II to at least 98% filling ratio. This ratio shall be measured by LLP and DLCM.
- The HOT will be refilled.

After installation of the S/C in the LSS and before chamber closure:

- The scaffolding will be installed after installation of spacecraft in LSS chamber to allow Top-Up and/or HOT refilling. Top-up is not nominally planned, but could be performed in case of important delay in LSS in order to ensure proper start conditions (temperature/filling ratio) for the TV/TB test.
- the CVSE will be removed from the chamber, except the parts strictly necessary to ensure helium pumping during the test.
- all GSEs, tools, harness, red tag items that are not necessary for the test shall be removed from the chamber.
- the scaffolding will be removed from the chamber.

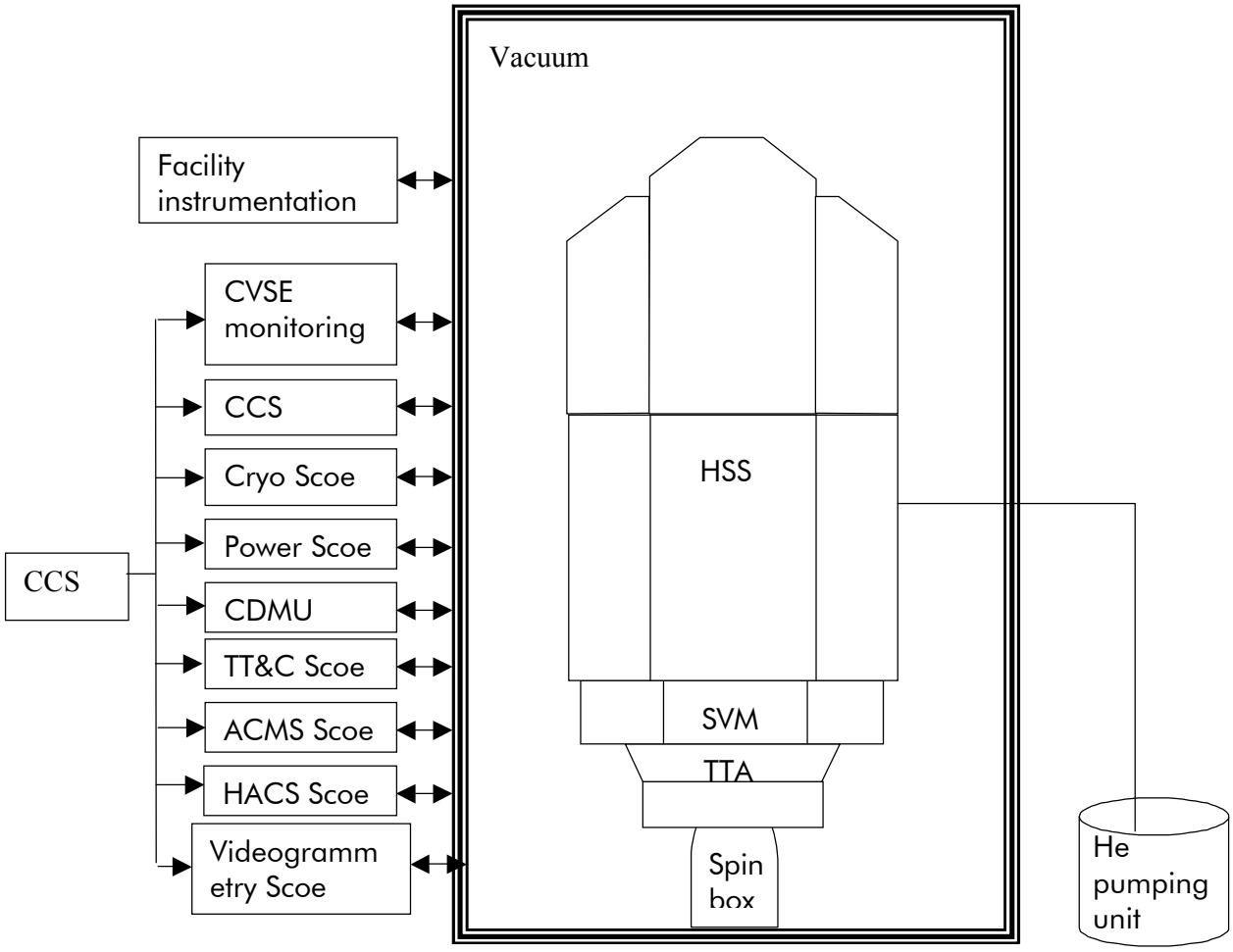


Figure 3-1 : TV/TB test set-up principle

3.6 Specific requirement for instrument testing

During the test phase, the spacecraft has to be tilted to immerse the Passive Phase Separator (PPS) or to regenerate the SPIRE/PACS sorption coolers.
To achieve this, the S/C has to be tilted around the S/C Z axis (+Y axis points slightly up for PPS immersion and points slightly down for Sorption cooler regeneration). The maximum tilting angle will be verified before closure of chamber (during PLM-launch-delay phase).
This set-up shall be achieved by rotating the LSS gimbals stand by 90° to allow tilting in the plane parallel to the LSS collimator mirror. During the PPS operation phases, regular tilting angle adjustments have to be performed.

3.7 GSE

The purpose of this chapter is to describe the interfaces between the specimen and its environment.

3.7.1 Mechanical

The spacecraft is hosted in LSS via the Thermal Test Adapter for Spacecraft, see RD 2.
The MGSE needed for spacecraft TV/TB FM testing or its preparation are listed in table 3-5

Origin	Item	No.	Reference
MGSE reused from ISO	ISO PLM Integration dolly	1	ISO-VV-ZYYR-SP-0043
	ISO Hoisting equipment SN02 / SN 01	1	ISO-VV-ZYYY-SP-0048141121
	ISO Test dolly SN02	1	ISO-VV-ZYYX-SP-0473
	ISO Test dolly (enlarged) SN03	1	-
	Heavy duty working platform	1	-
	Load cells with strap pretension gauge	16	-
	Small overhead crane (CR 100)	1	142127
HERSCHEL PLM and Spacecraft MGSE HERSCHEL SVM MGSE HERSCHEL EPLM Subsystem and Equipment MGSE	Transport Container H-TSC	1	141110
	Vertical Lifting Device VLD	1	142122
	Horizontal Lifting Device (beams) HLDB	1	142124
	General Purpose hoisting Device GPHD	1	142125
	Hoisting sling set HSL	2	142126
	Mobile Access Platform MAP	1	142115
	Handling and Transport Adapter for PLM I/F ADA	1	142133
	Thermal test Adapter for S/C I/F TTAS	1	141140
	Equipment Panel Trolley EPT	1-8	
	Panel Tilting Trolley PTT	1+2	
	Equipment Panel Lifting Device ELD	1	
	SVM Stiffener Set SSS	1	
	Multi Purpose Trolley MPT	1+3	
	Vertical Integration Stand VIS	1+3	
	Handling Clamp Band CB	1+3	
	Test Clamp Band TCB	1+3	
	ACMS Sensor protective covers	1+2	
	Thruster protective covers	1+2	
	OSR protective covers	1+2	
	Equipment Drive Unit EDU	1	
	SSD Protective Devices		
	HERSCHEL Telescope Protective Cover	1	

Origin
MGSE reused from ISO
HERSCHEL PLM and Spacecraft

	Item	**No.**	**Reference**
	ISO PLM Integration dolly	1	ISO-VV-ZYYR-SP-0043
	ISO Hoisting equipment SN02 / SN 01	1	ISO-VV-ZYYY-SP-0048141121
	ISO Test dolly SN02	1	ISO-VV-ZYYX-SP-0473
	ISO Test dolly (enlarged) SN03	1	-
	Heavy duty working platform	1	-
	Load cells with strap pretension gauge	16	-
	Small overhead crane (CR 100)	1	142127
	Transport Container H-TSC	1	141110
	Vertical Lifting Device VLD	1	142122
	Horizontal Lifting Device (beams) HLDB	1	142124
	General Purpose hoisting Device GPHD	1	142125
	Hoisting sling set HSL	2	142126
	Mobile Access Platform MAP	1	142115
	Handling and Transport Adapter for PLM I/F ADA	1	142133
	Thermal test Adapter for S/C I/F TTAS	1	141140
	Equipment Panel Trolley EPT	1-8	
	Panel Tilting Trolley PTT	1+2	
	Equipment Panel Lifting Device ELD	1	
	SVM Stiffener Set SSS	1	
	Multi Purpose Trolley MPT	1+3	
	Vertical Integration Stand VIS	1+3	
	Handling Clamp Band CB	1+3	
	Test Clamp Band TCB	1+3	
	ACMS Sensor protective covers	1+2	

table 3-5: FM satellite MGSE for TV/TB testing

3.7.2 Electrical

The electrical ground support equipment needed for spacecraft TV/TB testing is given in table 3-7
The Herschel alignment camera is operated by its own EGSE.
A schematic of the FM satellite EGSE is shown in Figure 3-2.

Equipment	from	Reference n°	Procurement
Instrument EGSE HIFI	instruments	111520	Done
EGSE HIFI harness	instruments		
Instrument EGSE SPIRE	instruments	112530	Done
EGSE SPIRE harness	instruments		
Instrument EGSE PACS	instruments	113520	Done
EGSE PACS harness	instruments		
Cryo SCOE	ASED	142220	Done
Cryo SCOE harness	ASED		Done
S/C central checkout system	S/C	141210	Done
SCOE LAN	S/C		
S/C CDMU SCOE	S/C	141220	Done
CDMU SCOE harness			
S/C power SCOE	S/C	141230	Done

power SCOE harness			
S/C ACMS SCOE	S/C	141240	Done
ACMS SCOE harness			
S/C TT & C SCOE	S/C	141250	Done
TT & C SCOE harness			
S/C TM/TC front end	S/C	141260	Done
TM/TC front end harness			
HACS SCOE	ASED	TBD by ASED	Done
HACS SCOE harness	ASED	TBD by ASED	Done
Videogrammetry SCOE	ETS	TBD by ASED	TBC by ETS
Videogrammetry SCOE harness	ETS	TBD by ASED	TBC by ETS

table 3-7: EGSE for FM satellite TV/TB testing

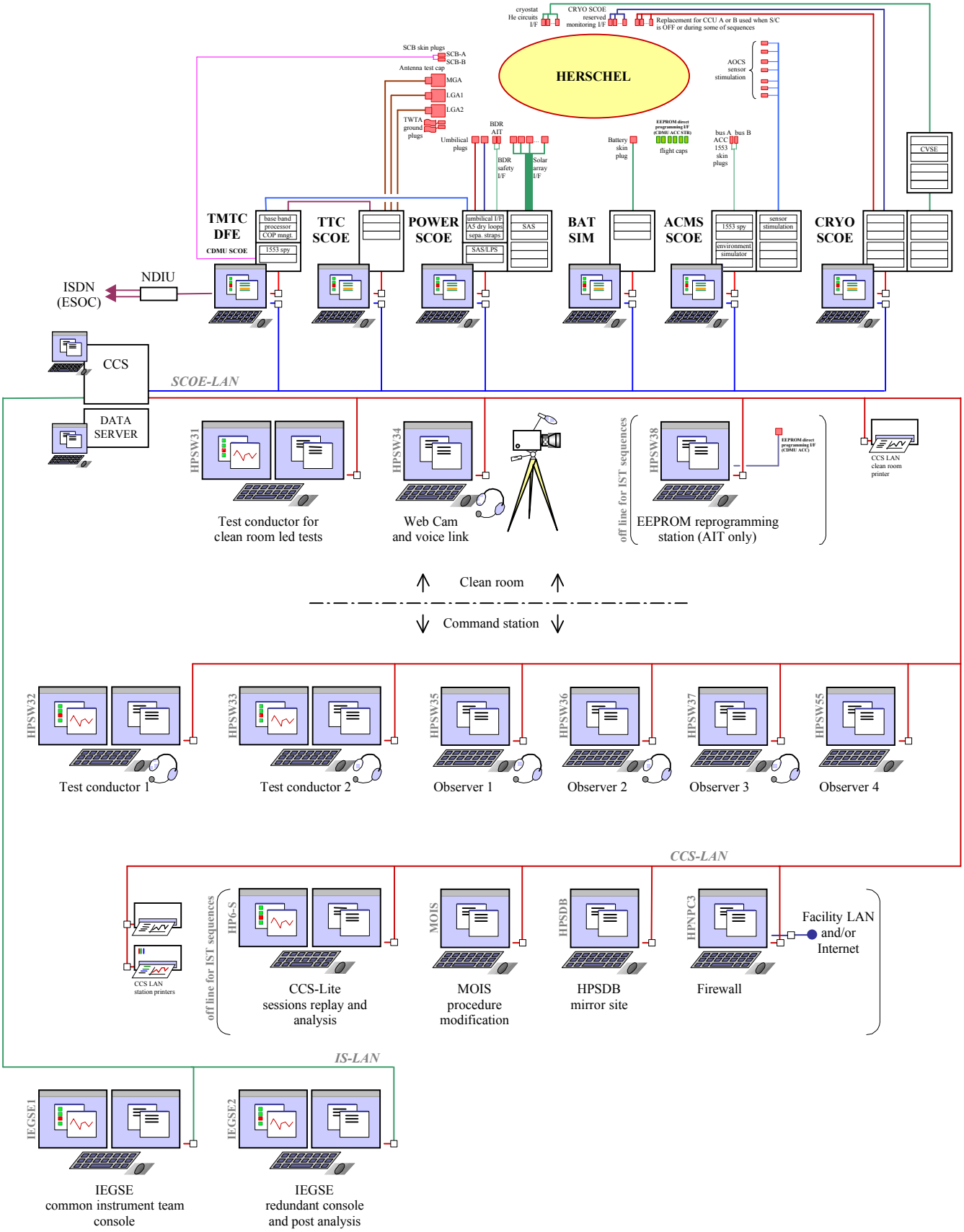


Figure 3-2 : CCS linked EGSE configuration

3.7.3 Thermal

3.7.3.1 With test adapter

See RD 2

3.7.3.2 With test harness

The heat leaks through test harness have to be minimised by maintaining its temperature close to its interface temperature with the specimen.

All TCs (SVM, PLM, IR rig) will be routed via the LSS Spin Box connectors.
PLM PT 100 will be routed to the via the feedthrough connectors (on main chamber walls).

3.7.4 Cryogenic

The CVSE shall allow :
- the filling and top up of the cryostat during test preparation on test floor and while in the chamber
- the nominal/safety exhaust of helium gas and pressure measurement on “deer head” during TV/TB test.

3.8 handling

The specimen has to be moved from test floor into the LSS before the test, and from the LSS to the test floor after the test. When on the test floor, the S/C shall be either on the VIS or the MPT.
The transportation from test floor to the LSS shall be made in He II conditions.
It shall be possible to transport Herschel from the LSS to the test floor in He II conditions.

4. Test definition

A special physical test configuration is needed to achieve the objectives defined above :
- A LEOP test is foreseen in this TV/TB. It will allow to verify the maximum temperature reached after launch in the HTT.
- In order to get the right initial conditions for the simulated launch, a launch autonomy phase + launch delay has to be implemented at the beginning of the test.
- A Balance phase on the HTT is not foreseen as qualification of the cryostat has been performed at STM2 level (see RD6).
- The –Z side shall therefore be exposed to the coldest possible environment in the LSS during the test phases. The CVV will not reach the predicted in-orbit temperature during the test (lowest temp on CVV~100K).
- The helium vented by the cryostat is routed outside the chamber via one corrugated hose to special large external vacuum pumps for helium. In addition, three pressure pick-up lines will

be routed from the cryostat to the measurement devices outside the LSS.
- For He-II top-up, HOT evacuation, PPS operation, nozzle switching CCU oparations (S/C ON) are mandatory.
- For safety reasons (overpressure inside the cryostat) another corrugated tube must be routed from the cryostat to a safety device outside the LSS. This tube will be filled with helium with slight overpressure.
- Two special alignment cameras will be mounted at the LOU support plate outside the CVV looking through two alignment windows into the cryostat. Illumination is achieved with two external Laser diodes (red and green) routed by optical fibres.
- A camera will be installed in the chamber for videogrammetry measurements.

Sections 4.1 to 4.3 gather for each phase of the TV/TB:
- the start and stop criteria,
- the activities to be performed,
- the expected duration.

These sections shall be read in conjunction with:
- the overall chronology, described in section 4.4,
- the detailed S/C and test chamber status chronology in section 4.5:
    - S/C state and transitions (referring to already tested sequences in AD4),
    - activation of external heaters
    - S/C tilt angle.

4.1 thermal phases

4.1.1 PLM

PLM-launch-autonomy	**Title** : launch autonomy		Duration : 2 (TBC) days
	Start criteria : preparation phase completed	Stop criteria : end of launch autonomy	
	Activity : - refill of HOT - Follow on of POC scenario - Perform HOT depletion - FPUs must NOT be switched ON during this phase		

PLM-launch-delay	**Title** : launch delay		Duration : 1 day
	Start criteria : end of launch autonomy	Stop criteria : end of launch delay	

	Activity : - Wait 24 hours - FPUs must NOT be switched ON during this phase (exception of SMEC) - Perform Launch lock simulation on SPIRE SMEC (2h before launch + 45 min + 25min + 18 min, see LAUNCH-MODE on SVM) - Tilting capability in LSS have to be checked at the end of this phase in both directions. A titling capability of 20° shall be demonstrated. - Perform HOT evacuation and PPS start-up - Close LSS chamber

PLM-LEOP	**Title** : PLM LEOP phase		Duration : 5 days
	Start criteria : preparation phase completed	Stop criteria : maximum temperature reached on HTT	
	Activity : - Evacuate LSS chamber - cooldown of LSS shroud - perform videogrammetry - Set SVM and HSS temp to low boundaries - wait for maximum temperature on HTT - FPUs must not be switched ON during this phase		

PLM-RC	**Title** : Rapid cooldown		Duration : 2 days
	Start criteria : preparation phase completed	Stop criteria : -Thtt <1,75K, drift<0.21mK/1h -Tlvl1 <5K, drift<0.21mK/1h -Tlvl2 <12K, drift<0.54mK/1h	
	Activity : - Perform rapid cooldown of HTT down to T_{htt}=1.7K (TBC) - During RC, perform two switching from all to small nozzle with PPS operating : - after LEOP phase (max temp of HTT) - at 1.8K or higher (TBC).		

INST-THERM-I/F	**Title** : instrument thermal interface checking		Duration : 1 day
	Start criteria : HIFI testing completed	Stop criteria : Completion of tests	
	Activity : - Set massflow to 2,2 mg/s - Set HIFI dissipations (TBD) for the validation of thermal interfaces - Set PACS dissipations (TBD) for the validation of thermal interfaces - Set SPIRE dissipations (TBD) for the validation of thermal interfaces		

PLM-EXT-COLD	**Title** : External cold stabilisation		Duration : 10 days tbc
	Start criteria : preparation phase completed	Stop criteria : external temperature stabilised	

	Activity : - Set IR-RIG temperature to 20°C for sunshield, -80°C for sunshade - wait for stabilisation of CVV temperature

PLM-EXT-HOT	**Title** : External hot stabilisation		Duration : 10 days tbc
	Start criteria : PLM-COLD completed	Stop criteria : external temperature stabilised	
	Activity : - Set IR-RIG temperature to 100°C for sunshield, 20°C for sunshade - wait for stabilisation of CVV temperature		

dP measure	**Title** : delta pressure measurement		Duration : 8 hours
	Start criteria : end of activities on instrument FPUs	Stop criteria : test performed	
	Activity : - perform dP measurement with big and small nozzles - request PPS operation		

TEL-DEC	**Title** : decontamination of telescope		Duration : 1 days
	Start criteria :	Stop criteria : Telescope cycling	
	Activity : - Warm up telescope (decontamination mode) using flight thresholds - Wait for telescope cycling (M1 and M2)		

LOU-DEC	**Title** : decontamination of LOU baffle		Duration : 8hours
	Start criteria :	Stop criteria : Lou cycling	
	Activity : - Warm up LOU baffle (decontamination mode) with reduced thresholds (200°C TBC) (functional verification only) - Wait for LOU baffle cycling		

4.1.2 SVM

Launch-Mode	**Title** : SVM launch mode		Duration : 1 day
	Start criteria : cooling of LSS	Stop criteria : SVM in quasi equilibrium	
	Activity : - SVM ON in LAM mode 3 (see RD 9) - TCS non operating, dissipation TBD W on SVM - Launch lock dissipation ON for 2h + 45 min +25min + 18 min		

SVM-SAFE	**Title** : SVM transition to safe mode		Duration : 1 days
	Start criteria : Launch mode completed	Stop criteria : Verification of thermal line completed, stability criteria fulfilled	
	Activity : - Switch to survival mode - wait for cycling on TCS lines		

SVM-TB-COLD	**Title** : SVM "cold" stabilisation	Duration : 3 days
	Start criteria : SVM safecompleted	Stop criteria : activities completed
	Activity : - SVM ON, instruments dissipation in mode 4 (parallel mode), wait for stabilisation - SVM ON, HIFI prime (check STB to prime switching), wait for stabilisation - Add TBD W on HIFI panels heaters (simulate change of attitude), wait for stabilisation Validation of RCS design modification by tuning test heaters	

SVM-TB-HOT	**Title** : SVM "Hot" stabilisation	Duration : 2 days
	Start criteria :	Stop criteria : SVM in quasi equilibrium
	Activity : - DTCP simulation (New Norcia, duration 12h) - STR validation (2 STRs in parallel TBC by analysis) Validation of RCS design modification by tuning test heaters and LVA ring temperature (if necessary)	

4.2 Thermal cycling test

4.2.1 SVM

SVM-TV-COLD	**Title** : SVM "cold" cycling	Duration : 1 days
	Start criteria : SVM equipments at cold acceptance level –0/+5°C on coldest one	Stop criteria : Completion of functional tests
	Activity : - Perform SVM unit functional tests - Perform SFT on instruments (at the end of the sequence in order not to blur LEOP phase by FPUs dissipation) - perform DLCM - Perform as a minimum one switch ON/OFF for each heater (with possible exception of RCS)	

SVM-TV-HOT	**Title** : SVM "hot" cycling	Duration : 1,5 days
	Start criteria : SVM equipments at cold acceptance level –0/+5°C on coldest one	Stop criteria : Completion of functional tests

	Activity : - perform DLCM - Perform SVM unit functional tests - Perform SFT on instruments - Perform CCU testing

4.2.2 Instruments testing

INST-HIFI 0-1-2-3-4	**Title** : HIFI TV/TB testings		Duration : 7 days
	Start criteria : TBD by HIFI	Stop criteria : Completion of functional tests	
	Activity : - Perform functional/performance test on HIFI, see AD6 This phase is split in five sub phases. The HIFI sub phases and other instruments phases are alternated in order to save time.		

INST-PACS	**Title** : PACS TV/TB testing		Duration : 2 days
	Start criteria : TBD by PACS	Stop criteria : Completion of functional tests	
	Activity : - Perform functional/performance test on PACS, see AD6 - S/C tilted by 20° mini to -Y during cooler recycling. Depending on the filling level of the HTT, it may be requested to close the HTT to prevent LHe from flowing out of tank.		

INST-SPIRE	**Title** : SPIRE TV/TB testing		Duration : 2 days
	Start criteria : TBD by SPIRE	Stop criteria : Completion of functional tests	
	Activity : - Perform functional/performance test on SPIRE, see AD6 - S/C tilted by 20° mini to -Y during cooler recycling. Depending on the filling level of the HTT, it may be requested to close the HTT to prevent LHe from flowing out of tank		

INST-PARA	**Title** : PACS/SPIRE parallel TV/TB testing		Duration : 1/3 days
	Start criteria : TBD by PACS/SPIRE	Stop criteria : Completion of functional tests	
	Activity : - Perform functional/performance test on PACS/SPIRE, see AD6 - S/C tilted by 20° mini to -Y during cooler recycling		

4.3 Other phases

AFT	**Title** : Abbreviated Functional test		Duration : 1 days
	Start criteria : preparation phase completed	Stop criteria : AFT completed succesfully	

	Activity : - perform AFT as per RD 10

WUP	**Title** : Warm up	Duration : 3 days
	Start criteria : TEL-DEC phase completed	Stop criteria : LSS ready to open chamber
	Activity : - Warm up of IR rig to 20°C - Warm-up of SVM, CVV and external parts to ambient temperature - Keep S/C temperature above shrouds level by 10°C - Re-pressurization of LSS when S/C is warm	

VIDEO	**Title** : Videogrammetry	Duration : 1 days
	Start criteria : Closure of chamber	Stop criteria : completion of test
	Activity : - perform videogrammetry - Measurements shall be taken : - before closure of chamber - after pump down - at the end of PLM-EXT-COLD - at the end of WARM-UP, before repressurisation - and after opening of chamber.	

ALIGN	**Title** : LOU/HIFI FPU alignment using HACS	Duration : N/A
	Start criteria : TBD	Stop criteria : completion of test
	Activity : - verify LOU/HIFI FPU alignment using HACS - This measurement is performed automatically throughout the all test duration.	

4.4 Summary of phases and overall chronology

Test phase	Description
AFT	Abbreviated Functional test
PLM-launch-autonomy	launch autonomy
PLM-launch-delay	launch delay
PLM-LEOP	PLM LEOP phase
PLM-RC	Rapid cooldown
INST-THERM-I/F	instrument thermal interface checking
PLM-EXT-COLD	External cold stabilisation
PLM-EXT-HOT	External hot stabilisation
dP measure	delta pressure measurement
TEL-DEC	decontamination of telescope
LOU-DEC	decontamination of LOU baffle

Launch-Mode	SVM launch mode
SVM-SAFE	SVM transition to safe mode
SVM-TB-COLD	SVM "cold" stabilisation
SVM-TB-HOT	SVM "Hot" stabilisation
SVM-TV-COLD	SVM "cold" cycling
SVM-TV-HOT	SVM "hot" cycling
INST-HIFI 0-1-2-3-4	HIFI TV/TB testings
INST-PACS	PACS TV/TB testing
INST-SPIRE	SPIRE TV/TB testing
INST-PARA	PACS/SPIRE parallel TV/TB testing
WUP	Warm up
VIDEO	Videogrammetry
ALIGN	LOU/HIFI FPU alignment using HACS

In order to optimize the schedule, SVM and PLM activities will be performed as much as possible in parallel.

The proposed sequence is shown in Table 4-1.
The total duration of the test is 31 days:

- 4 days before chamber closure
- 27 days after chamber closure.

The sequence of test phases driving the vacuum phase of the test are :
PLM LEOP
PLM RC
INST-HIFI 0-1
INST-PACS
INST-HIFI 2
INST-SPIRE
INST-HIFI 3
INST-PARA
INST-HIFI 4
INSTR I/F
SVM-TB-HOT
SVM-TV-HOT
LOU-DEC
TEL-DEC
WUP

The driving sequence of the vacuum phase is indicated in bold in **Table 4-1**

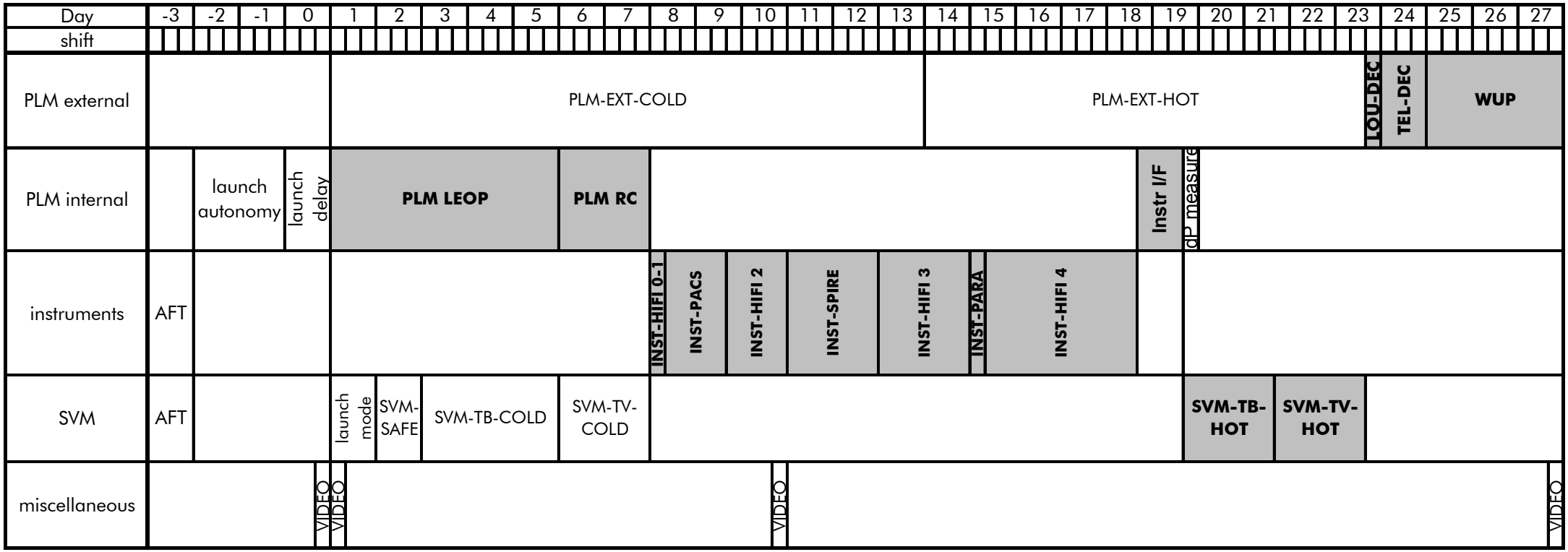


Table 4-1 : Diagram of the main sequence of operation

Nota : ALIGN phase is not included in the sequence. It is performed continuously throughout the TV/TB.

4.5 S/C and test chamber status

Table 4-2 hereunder gives a detailed chronology of the test, including the S/C and facilty status in the different phases.

Phase key points leaders				Phase & Estimated duration (h)	Satellite Step		SVM state			Instrument states			Temperatures			Non flight heaters				Tilt	Remark
					SVM Step	PLM Step															
TASF	ASED	TASI	INSTR				CDMS Mode / active PM	ACMS Mode / active PM	TT&C / XPND	HIFI	PACS	SPIRE	SVM	PLM external	HSS	SVM external heaters	PLM heaters	Infrared rig	TTAS		
X	X			**Phase 0**	**Functional tests & pre-TVTB activities**																
				24	Satellite AFT		various	various	various	various	various	various	ambient	ambient	ambient	OFF	OFF	N/A	N/A	0°	refer to RD10.
				8	Satellite to Launch Mode		Launch / A	S. By / A	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	N/A	N/A	0°	
					Heater line verification		Launch / A	S. By / A	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	N/A	N/A	0°	per **
				72	Launch Autonomy		Launch / A	S. By / A	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	N/A	N/A	0°	
					HOT depletion		Launch / A	S. By / A	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	N/A	N/A	0°	
					Switch ON SPIRE LPU		Launch / A	S. By / A	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	N/A	N/A	0°	2 hours before Launch
					Switch OFF SPIRE LPU		Launch / A	S. By / A	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	N/A	N/A	0°	at the time of the aborted launch
				24	Launch Delay		Launch / A	S. By / A	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	N/A	N/A	0° to 20°	25 hours of launch delay shall include phases 1 and 2
					Videogrammetry measurement		Launch / A	S. By / A	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	N/A	N/A	0°	during launch delay
					Switch ON SPIRE LPU		Launch / A	S. By / A	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	N/A	N/A	0°	2 hours TBC before Launch #2
					HOT evacuation		Launch / A	S. By / A	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	N/A	N/A	0°	
					Switch OFF SPIRE LPU		Launch / A	S. By / A	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	N/A	N/A	0°	3,5 hours after previous switch ON (simulating post separation switch OFF)
	X			**Phase 1**	**Final check before chamber closure**																
					LSS Check		Launch / A	S. By / A	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	OFF	TTAS-A	0°	TTAS-A mode = consisitent with SVM cold (20°C TBC)
					Final check before pumping & Close door		Launch / A	S. By / A	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	OFF	TTAS-A	0°	

	X			**Phase 2**	**PUMP DOWN & LEOP start**														
			24	Pump down and facility leak check	Cool down	Launch / A	S. By / A	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	OFF	TTAS-A	0°	
				Facility Leak check	Cool down	Launch / A	S. By / A	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	OFF	TTAS-A	0°	
				Videogrammetry measurement		SAM / A	SAM / A	ON / A	OFF	OFF	OFF	flight, cold	flight, cold	ambient	OFF	OFF	OFF	TTAS-A	0°, TBC	
				Start LEOP (iniate separation by Power SCOE), CDMS to SAM	LEOP, Cool down	SAM / A	SAM / A	ON / A	OFF	OFF	OFF	flight, cold	flight, cold	ambient	OFF	OFF	OFF	TTAS-A	0° to 20°	
				Shrouds ON	LEOP, Cool down	SAM / A	SAM / A	ON / A	OFF	OFF	OFF	flight, cold	flight, cold	cooling down	SVM-A	OFF	IR-A	TTAS-A	0° to 20°	SVM mode A = SVM panels to TBD cold temps (SM), manual. IR mode A = HSS to TBD cold temps, manual.
X				**Phase 3**	**SAFE MODE AND RECOVERY TO NOM**														
			24	Transition to Safe Mode	LEOP, Cool down	SM / B	SM / B	ON / B	OFF	OFF	OFF	flight, cold	flight, cold	cold	SVM-A	OFF	IR-A	TTAS-A	0°	by set of telecommands to mimic RM sequence (sequence done during IST debug)
				Safe Mode, stabilised	LEOP, Cool down	SM / B	SM / B	ON / B	OFF	OFF	OFF	flight, cold	flight, cold	cold	SVM-A	OFF	IR-A	TTAS-A	0°	Use coax link to test XPND B
				Transition to SAM	LEOP, Cool down	SAM / B	SAM / B	ON / B	OFF	OFF	OFF	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	SVM mode B = SVM panels to TBD cold temps (NOM cold), manual.
				Transition to CDMU NOM	LEOP, Cool down	NOM / B	SAM / B	ON / B	OFF	OFF	OFF	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	
				Transition to ACC OCM	LEOP, Cool down	NOM / B	OCM / B	ON / B	OFF	OFF	OFF	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	
				Transition to ACC SCM	LEOP, Cool down	NOM / B	SCM / B	ON / B	OFF	OFF	OFF	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	
				CDMU Reconfiguration B to A	LEOP, Cool down	SAM / A	SAM / B	ON / B	OFF	OFF	OFF	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	
				ACC Reconfiguration B to A	LEOP, Cool down	SAM / A	SAM / A	ON / B	OFF	OFF	OFF	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	
				TTC Reconfiguration to A	LEOP, Cool down	SAM / A	SAM / A	ON / A	OFF	OFF	OFF	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	
				Transition to CDMU NOM	LEOP, Cool down	NOM / A	SAM / A	ON / A	OFF	OFF	OFF	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	
				Transition to ACC OCM	LEOP, Cool down	NOM / A	OCM / A	ON / A	OFF	OFF	OFF	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	
				Transition to ACC SCM	LEOP, Cool down	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	
	X	X		**Phase 4**	**SVM TB COLD and LEOP END**														
			72	Switch ON instruments (// mode)	LEOP, Cool down	NOM / A	SCM / A	OFF	S. By	//	//	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	// mode test to be confirmed by instruments

			Stabilisation in // mode	LEOP, Cool down	NOM / A	SCM / A	OFF	S. By	//	//	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	
			HIFI Prime	LEOP, Cool down	NOM / A	SCM / A	OFF	**Prime**	S. By	S. By	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	
			Stabilisation 1 in // HIFI prime	LEOP, Cool down	NOM / A	SCM / A	OFF	**Prime**	S. By	S. By	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	
			Add power on HIFI panels	LEOP, Cool down	NOM / A	SCM / A	OFF	**Prime**	S. By	S. By	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	
			Stabilisation 2 in // HIFI prime	LEOP, Cool down	NOM / A	SCM / A	OFF	**Prime**	S. By	S. By	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	
X	**X**		**Phase 5**	**SVM TV COLD, RCD**															
			48	Instruments in Stand By	Rapid Cool Down	NOM / A	SCM / A	OFF	S. By	S. By	S. By	flight, cold	flight, cold	cold	SVM-B	OFF	IR-A	TTAS-A	0°	
				TV cold, TT&C cell	Rapid Cool Down	NOM / A	SCM / A	ON / A	S. By	S. By	S. By	flight, cold	flight, cold	cold	SVM - C	OFF	IR-A	SVM - C	0°	Order of 6 TV steps to be optimised. Use coax link to test XPND B. Mode SVM-C to have minimum temperature in the TT&C cell.
				TV cold, Power cell	Rapid Cool Down	NOM / A	SCM / A	OFF	S. By	S. By	S. By	flight, cold	flight, cold	cold	SVM - D	OFF	IR-A	SVM - D	0°	Order of 6 TV steps to be optimised. Use coax link to test XPND B. Mode SVM-D to have minimum temperature in the Power cell.
				TV cold, RW cell	Rapid Cool Down	NOM / A	SCM / A	OFF	S. By	S. By	S. By	flight, cold	flight, cold	cold	SVM - E	OFF	IR-A	SVM - E	0°	Order of 6 TV steps to be optimised. Use coax link to test XPND B. Mode SVM-E to have minimum temperature in the RW cell.
				TV cold, HIFI cells	Rapid Cool Down	NOM / A	SCM / A	OFF	**Prime**	S. By	S. By	flight, cold	flight, cold	cold	SVM - F	OFF	IR-A	SVM - F	0°	Order of 6 TV steps to be optimised. Use coax link to test XPND B. Mode SVM-F to have minimum temperature in the HIFI cells.
				TV cold, PACS cell	Rapid Cool Down	NOM / A	SCM / A	OFF	S. By	**Prime**	S. By	flight, cold	flight, cold	cold	SVM - G	OFF	IR-A	SVM - G	0°	Order of 6 TV steps to be optimised. Use coax link to test XPND B. Mode SVM-G to have minimum temperature in the PACS cell.
				TV cold, SPIRE cell	Rapid Cool Down	NOM / A	SCM / A	OFF	S. By	S. By	**Prime**	flight, cold	flight, cold	cold	SVM - H	OFF	IR-A	SVM - H	0°	Order of 6 TV steps to be optimised. Use coax link to test XPND B. Mode SVM-G to have minimum temperature in the SPIRE cell.
				-	Switch big => small nozzles	NOM / A	SCM / A	OFF	S. By	S. By	S. By	flight, cold	flight, cold	cold	SVM-A	OFF	IR-A	TTAS-A	0°	
				DLCM & LLP measurement		NOM / A	SCM / A	OFF	S. By	S. By	S. By	flight, cold	flight, cold	cold	SVM-A	OFF	IR-A	TTAS-A	0°	
		X	**Phase 6**	**HIFI TEST**															
			11	HIFI TVTB test 1		NOM / A	SCM / A	OFF	**Prime**	S. By	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-A	TTAS-A	0°	Test defined in AD6, section **. Duration TBC (negotiation in progress with HIFI).
				HIFI to Stand By mode		NOM / A	SCM / A	OFF	S. By	S. By	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-A	TTAS-A	0°	
		X	**Phase 7**	**PACS TEST**															
			32	PACS TVTB test		NOM / A	SCM / A	OFF	S. By	**Prime**	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-B	TTAS-A	0° to 20°	Test defined in AD6, section **
				PACS to Stand By mode		NOM / A	SCM / A	OFF	S. By	S. By	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-B	TTAS-A	0° to 20°	
		X	**Phase 8**	**HIFI TEST**															

		28	HIFI TVTB test 2	NOM / A	SCM / A	OFF	**Prime**	S. By	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-A	TTAS-A	0°	Test defined in AD6, section **. Duration TBC (negotiation in progress with HIFI).
			HIFI to Stand By mode	NOM / A	SCM / A	OFF	S. By	S. By	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-A	TTAS-A	0°	
		Phase 9	**SPIRE TEST**															
		48	SPIRE TVTB test	NOM / A	SCM / A	OFF	S. By	S. By	**Prime**	flight, cold	flight, hot	hot	SVM-A	OFF	IR-B	TTAS-A	0° to 20°	Test defined in AD6, section **
			SPIRE to Stand By mode	NOM / A	SCM / A	OFF	S. By	S. By	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-A	TTAS-A	0°	
X		**Phase 10**	**HIFI TEST and START EXTERNAL PLM HOT**															
		53	HIFI TVTB test 3	NOM / A	SCM / A	OFF	**Prime**	S. By	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-A	TTAS-A	0°	Test defined in AD6, section **. Duration TBC (negotiation in progress with HIFI).
			HIFI to Stand By mode	NOM / A	SCM / A	OFF	S. By	S. By	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-A	TTAS-A	0°	
			Videogrammetry measurement	NOM / A	SCM / A	OFF	S. By	S. By	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-A	TTAS-A	0° TBC	
			- Heat up PLM	NOM / A	SCM / A	OFF	S. By	S. By	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-B	TTAS-A	0° to 20°	Mode IR-B to have maximum HSS temperature (100°C on SA, 20°C on Sunshade)
		Phase 11	**PARALLEL TEST**															
		8	Parallel test	NOM / A	SCM / A	OFF	S. By	//	//	flight, cold	flight, hot	hot	SVM-A	OFF	IR-B	TTAS-A	0° to 20°	Test defined in AD6, section **. // mode test to be confirmed by instruments
			PACS to St. By (TBC, depending on definition of phase 10)	NOM / A	SCM / A	OFF	S. By	S. By	**Prime**	flight, cold	flight, hot	hot	SVM-A	OFF	IR-B	TTAS-A	0° to 20°	
			SPIRE to St. By (TBC, depending on definition of phase 10)	NOM / A	SCM / A	OFF	S. By	S. By	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-B	TTAS-A	0° to 20°	
		Phase 12	**HIFI TEST**															
		78	HIFI TVTB test 4	NOM / A	SCM / A	OFF	**Prime**	S. By	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-A	TTAS-A	0°	Test defined in AD6, section **. Duration TBC (negotiation in progress with HIFI).
			HIFI to Stand By mode	NOM / A	SCM / A	OFF	S. By	S. By	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-A	TTAS-A	0°	
X		**Phase 13**	**INSTRUMENT I/F TEST**															
		24	Set mass flow to 2.2 mg/s	NOM / A	SCM / A	OFF	S. By	S. By	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-B	TTAS-A	0° to 20°	Test defined in AD6, section **
			Switch ON/OFF HIFI instrument for thermal I/F test	NOM / A	SCM / A	OFF	**Prime**	S. By	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-B	TTAS-A	0° to 20°	Test defined in AD6, section **
			Switch ON/OFF PACS instrument for thermal I/F test	NOM / A	SCM / A	OFF	S. By	**Prime**	S. By	flight, cold	flight, hot	hot	SVM-A	OFF	IR-B	TTAS-A	0° to 20°	Test defined in AD6, section **
			Switch ON/OFF SPIRE instrument for thermal I/F test	NOM / A	SCM / A	OFF	S. By	S. By	**Prime**	flight, cold	flight, hot	hot	SVM-A	OFF	IR-B	TTAS-A	0° to 20°	
	X	**Phase 14**	**SVM TB HOT & dP measurement**															

	48	Transition to instrument parallel mode		NOM / A	SCM / A	ON / A	S. By	//	//	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	TTAS-B	0°	// mode = maximum dissipation of instruments. // mode test TBC by instruments. SVM-M: SVM panels to TBD hot temps (NOM cold), manual. TTAS-B mode = consisitent hot SVM cold (temperature = TBD, can be equal to TTAS-A)
		Stabilisation in // mode	external hot	NOM / A	SCM / A	ON / A	S. By	//	//	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
		HIFI Prime	external hot	NOM / A	SCM / A	ON / A	**Prime**	S. By	S. By	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
		Stabilisation 1 in // HIFI prime	external hot	NOM / A	SCM / A	ON / A	**Prime**	S. By	S. By	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
		Add power on HIFI panels	external hot	NOM / A	SCM / A	ON / A	**Prime**	S. By	S. By	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
		Stabilisation 2 in // HIFI prime	external hot	NOM / A	SCM / A	ON / A	**Prime**	S. By	S. By	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
		-	dP measurement	NOM / A	SCM / A	ON / A	**Prime**	S. By	S. By	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
X	**Phase 15**	**SVM TV HOT**																
	48	DLCM & LLP measurement		NOM / A	SCM / A	ON / A	S. By	S. By	S. By	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
		TV hot, TT&C cell	external hot	NOM / A	SCM / A	ON / A	S. By	S. By	S. By	flight, hot	flight, hot	hot	SVM - N	OFF	IR-B	SVM - N	0°	Order of 6 TV steps to be optimised. Use coax link to test XPND B. Mode SVM-N to have minimum temperature in the TT&C cell.
		TV hot, Power cell	external hot	NOM / A	SCM / A	ON / A	S. By	S. By	S. By	flight, hot	flight, hot	hot	SVM - O	OFF	IR-B	SVM - O	0°	Order of 6 TV steps to be optimised. Use coax link to test XPND B. Mode SVM-O to have minimum temperature in the Power cell.
		TV hot, RW cell	external hot	NOM / A	SCM / A	ON / A	S. By	S. By	S. By	flight, hot	flight, hot	hot	SVM - P	OFF	IR-B	SVM - P	0°	Order of 6 TV steps to be optimised. Use coax link to test XPND B. Mode SVM-P to have minimum temperature in the RW cell.
		TV hot, HIFI cells	external hot	NOM / A	SCM / A	ON / A	S. By	S. By	S. By	flight, hot	flight, hot	hot	SVM - Q	OFF	IR-B	SVM - Q	0°	Order of 6 TV steps to be optimised. Use coax link to test XPND B. Mode SVM-Q to have minimum temperature in the HIFI cells.
		TV hot, PACS cell	external hot	NOM / A	SCM / A	ON / A	S. By	S. By	S. By	flight, hot	flight, hot	hot	SVM - R	OFF	IR-B	SVM - R	0°	Order of 6 TV steps to be optimised. Use coax link to test XPND B. Mode SVM-R to have minimum temperature in the PACS cell.
		TV hot, SPIRE cell	external hot	NOM / A	SCM / A	ON / A	S. By	S. By	S. By	flight, hot	flight, hot	hot	SVM - S	OFF	IR-B	SVM - S	0°	Order of 6 TV steps to be optimised. Use coax link to test XPND B. Mode SVM-S to have minimum temperature in the SPIRE cell.
		Switch OFF instruments		NOM / A	SCM / A	ON / A	S. By	S. By	S. By	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
		Transition to SAM		NOM / A	SCM / A	ON / A	S. By	S. By	S. By	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
X	**Phase 16**	**LOU Decontamination**																
	8	Swith instruments OFF		NOM / A	SCM / A	ON / A	OFF	OFF	OFF	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	in order not to stress the windows, limited temperature threshold = 200°C
		Reset max temperature threshold, select heater lines 1+2		NOM / A	SCM / A	ON / A	OFF	OFF	OFF	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	in order not to stress the windows, limited temperature threshold = 200°C

			Switch ON LOU decontamination (lines 1+2)	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
			Switch OFF decontamination	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
			select heater lines 1+3	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
			Switch ON LOU decontamination (lines 1+3)	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
			Switch OFF decontamination	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
			Reset max temperature threshold to default value	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	HPSDB default value TBD, following LOU baffle assembly thermal testing
X			**Phase 17**	**Telescope Decontamination**															
			24	Initiate Tel decontamination with heater line mask	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	Mask = all lines enabled, except lines 5 and 9 disabled
				Set mask to all lines active	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	Mask = all lines enabled
				Tel decontamination	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
X	X	X	X	**Phase 18**	**PLM warm up**														
				72	- Switch ON CVV warm-up heaters	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	flight, hot	flight, hot	hot	SVM-M	ON	IR-B	20°C	0°	During warm-up, control shroud temperature < CVV temperature - 10 K
					Videogrammetry measurement	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	flight, hot	flight, hot	hot	SVM-M	ON	IR-B	20°C	0°	
					- Switch OFF CVV warm-up heaters	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	flight, hot	flight, hot	hot	SVM-M	OFF	IR-B	20°C	0°	
	X			**Phase 19**	**End of test**														
				10	Chamber repressurisation	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	target = ambient							0°	
					Videogrammetry measurement	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	target = ambient							0°	
					Chamber opening	NOM / A	SCM / A	ON / A	OFF	OFF	OFF	target = ambient							0°	
				2	S/C switch OFF	OFF	OFF	OFF	OFF	OFF	OFF	target = ambient							0°	
	X			**Phase 20**	**Preparation of S/C removal from LSS**														
					Installation of basic scaffolding, installation of Tel cover, cryo SCOE activities, harness disconnection, …	OFF	OFF	OFF	OFF	OFF	OFF	ambient	ambient	ambient	OFF	OFF	OFF	OFF	0°	

Table 4-2 : Detailed test chronology

4.6 Parameters to be measured/Measurement accuracy

4.6.1 S/C TM/TC data

During all test phases, housekeeping TM and all TC will be acquired and archived.

The TM/TC shall be received and sent through the TM/TC DFE and the umbilical during all phases, with the following exception:
During the SVM hot and cold TV tests, when the TT&C equipment is tested, the TM and TC signals will pass through coax cables at the interface of the TT&C subsystem (antennas are short circuited, no antenna test caps will be used).

When the S/C is in survival mode, in order to receive more than just the essential housekeeping telemetry (see RD8), the Tx rate will be commanded to 5 kbps.

The acquisition frequencies shall be :
CCU, 8sec
CDMU, baseline acquisition frequency is 64 sec. A 8 sec acquisition frequency is needed for verification of Fine Control Law on HIFI units and STR stability during SVM thermal balance phases. Please note that a packet with 8sec frequency has to be developed.

A special packet is defined for DLCM testing with 1 sec of acquisition frequency.
See RD8 and HPSDB.

4.6.2 S/C test instrumentation

The S/C test sensors are divided in two families, CRYO SCOE acquired sensors and ETS acquired sensors.

For CRYO SCOE sensors, the acquisition frequency shall be 30sec.
For ETS sensors, the acquisition frequency shall be 120sec.

4.6.3 Facility parameters

Monitoring of sensors shall be started/recorded as soon as thermocouples are connected to the data logger. Frequency of acquisition shall be 1 minute.

4.7 Emergency procedures

Some specific measures are applicable through AD18 to cover the following failure cases to be treated urgently:
- partial loss of power,
- loss of umbilical link,

- CDMU failure,
- CDMU 1553 bus failure,
- unit temperature outside allowed range,
- LSS failure (shroud temperature, abnormal pressure).

5. Success criteria – Test approval

5.1 Success criteria

The execution of the S/C FM TB/TV test will be declared successful if:
- No major damage occurs to the test specimen as a result of testing (including visual inspection)
- All test phase have been performed with required test conditions as defined in the test procedure and recorded

5.1.1 External HPLM thermal balance success criteria

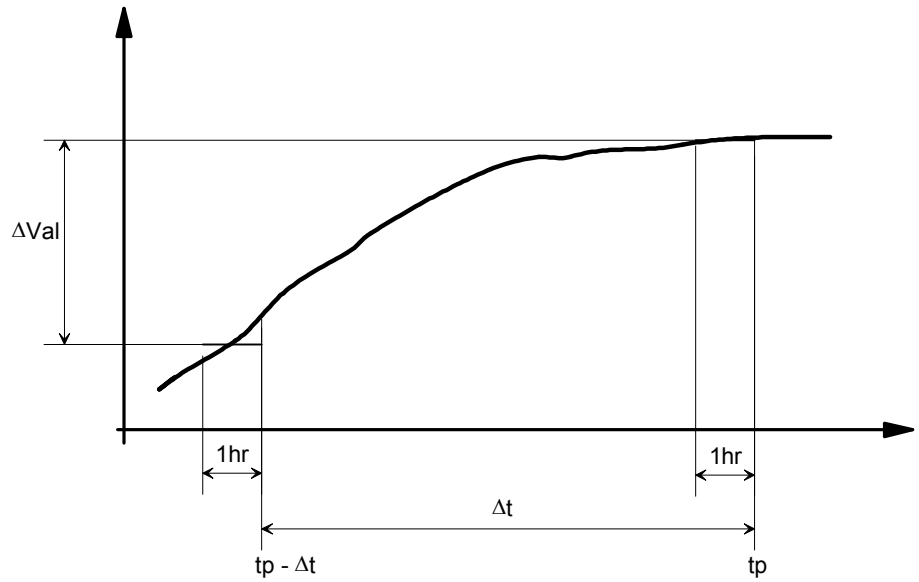
The equilibrium to be reached at the end of the PLM-EXT-COLD/HOT phases shall be used for verification of the cryostat external TMM. Steady-state is reached when the equilibrium temperature sensors fulfil the following criteria :

$$\Delta Val = | Val_{average,\ tp} - Val_{average,\ tp - \Delta t} | < Threshold$$

$Val_{average,\ tp}$:Value averaged over 1 hour, averaging begins 1 hr before present time tp
$Val_{average,\ tp - \Delta t}$: Value averaged over 1 hour, averaging begins at $\Delta t + 1$ hr and ends at Δt before present time tp
With

Value	Δt	Threshold
Temperature of CVV	24 hrs	0.3 K

The equilibrium criterion illustrated in the following figure shall be checked continuously via the LSS TDH and the Cryo SCOE, respectively.



5.1.2 SVM thermal balance success criteria

The Steady State will be considered reached when the temperature of the TC's relevant to the S/C will not vary by more than 1°C / 8 hrs.
For units controlled by fine control law the above criterion shall be applied to nearby units or average temperature.

5.1.3 Instrument functional testing success criteria

Refer to relevant specification to be issued by the instruments.

5.1.4 SVM functional testing / cycling success criteria

All nominal heating lines have been switched ON/OFF.
The verification of redundant heater circuit will be performed before and after TV/TB test. See RD14
As per cycling procedure.
Refer to relevant specification to be issued.

5.1.5 Videogrammetry

Refer to AD16.

5.1.6 LOU/HIFI FPU alignment using HACS

Refer to relevant specification to be issued.

5.1.7 Telescope Decontamination

Telescope decontamination phase is considered successful when stable duty cycle is observed in M1/M2 heaters

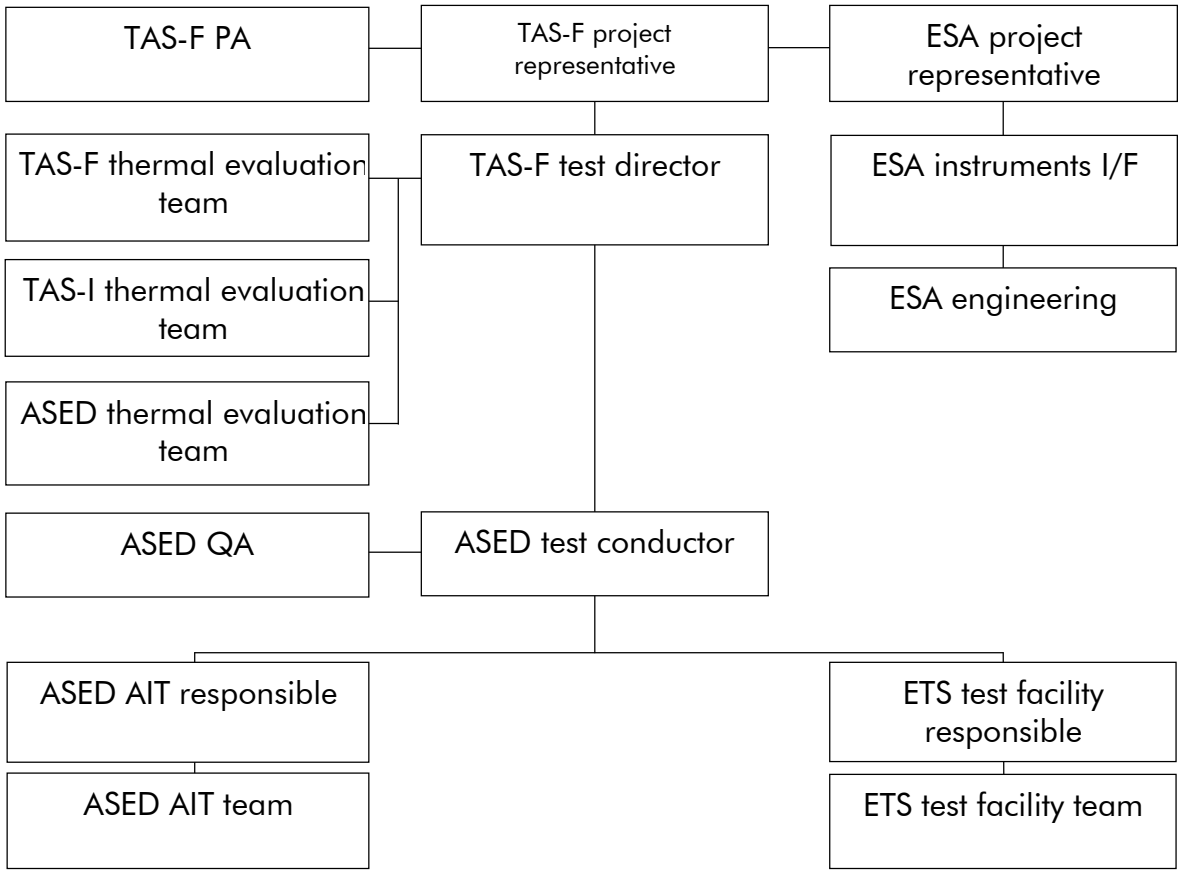
5.1.8 LOU Baffle decontamination

LOU baffle decontamination is considered successful when cycling is observed on the heating lines.

6. Organisation & responsibilities

6.1 Organisation

The general organisation is as follows :



6.2 Tasks and responsibility

The tasks definition and responsibility during the test are defined here-after. The responsibilities linked to the test progress shall be mentioned in the ASED test leading procedure.

Title	Tasks/Responsibility
ESA project representative	➢ ESA point of contact ➢ I/F with TAS-F Project representative ➢ Approve the test strategy
TAS-F Test Director	➢ TAS-F Project point of contact ➢ Manage all activities performed in the frame of the test campaign ➢ I/F with ESA representative ➢ Issue the test specifications ➢ Manage all test activities including evaluation done during the tests in co-operation with the Test Conductor and the engineering support team ➢ Approve the test strategy ➢ Gives go ahead for the test reviews (TRR, key point, PTR)

TAS-F PA	➢ TAS-F PA point of contact ➢ Manage all NCR raised in the frame of the test campaign ➢ I/F with ESA PA ➢ I/F with ASED QA
ASED Test Conductor	➢ ASED point of contact ➢ Issue the leading (sequence of tests, calling up the individual test procedures) procedure of combined activities ➢ I/F point with the Test Facility Responsible ➢ Approve the test strategy ➢ Gives go ahead for the test reviews (TRR, key point, PTR)
TAS-F thermal Evaluation Team	➢ Evaluate the test data in order to help the test director concerning the "key point" status
ASED Thermal Evaluation Team	➢ Evaluate the test data in order to help the test director concerning the "Key point" status. ➢ Thermal control of PLM during all phases
TAS-I Thermal Evaluation Team	➢ Evaluate the test data in order to help the test director concerning the "Key point" status. ➢ Thermal control of SVM during all phases
ASED AIT responsible	➢ Responsible of the ASED AIT Team ➢ Contributes to the test procedures ➢ Organise the running meetings ➢ Initiate NCR
ASED AIT Team	➢ Contributes to the test procedures ➢ Operate the Satellite with relevant GSE ➢ Issue the test summary report e.g. historical record, main events, major NCRs…
ASED QA	➢ Management of the quality of operations ➢ Organise the review (TRR/PTR…) ➢ Minute the running meeting (Key point)
ETS Test Facility Responsible	➢ I/F with ASED Test Conductor
ETS test facility team	➢ Operate the ETS Test facilities ➢ Provide the ETS test data for online evaluation ➢ Issue the ETS test report.

6.3 Test Readiness Review, Post Test Review and Running meeting

The people involved in TRR, PTR and running meetings shall be at least:

- ESA Representative,
- TAS-F Project representative,
- TAS-F PA,
- TAS-F Test Director,
- ASED Test Conductor,
- TAS-F Evaluation Team representative,

- ASED AIT responsible,
- ASED QA,
- ETS Test Facility representative.

During running meeting, evaluation of test results shall be presented by TAS-F Test Director as well as the test strategy form for next run to be approved by all parties.

7. Documentation

7.1 Documents required before the test

- S/C configuration (CIDL, etc)
- Test set-up configuration (CIDL, Definition drawings)
- Test Set-up validation and calibration status
- Test specification
- Test predictions
- Instrumentation plan (thermal sensors list and location)
- Test leading procedure + elementary procedures

AD19 describes the thermal interfaces to be taken into account for SVM test predictions by TAS-I
AD20 describes the thermal interfaces to be taken into account for H-EPLM test predictions by ASED.

7.2 Data acquired during the test

7.2.1 Logbooks

The following logbooks shall be written:
- LSS Facility Test Logbook
- Thermal Control and Cryo-SCOE Logbook, including a close following of the LSS basements activities.
- Power Supply and Data Handling Logbook
- EGSE Logbook
- Instruments Logbook

All activities, deviations etc. shall be described in these logbooks in “real time” under supervision of the Test Director and reviewed by PA.

7.2.2 S/C sensors

A record (paper and electronic format) will provide the following information about each type of specimen sensors (thermal, pressure):
- Test phase designation
- Acquisition date/time
- Temperature sensor number

- Sensor designation
- Measured value
- Alarms status

An excel file gathering:
- information <Time, Temperature> of all specimen thermal sensors will be updated at a given frequency (TBD) and delivered on request to TAS-F thermal team.

An excel file grouping <Time, Power / Amperage> of all specimen heating lines will be updated at a given frequency (TBD) and delivered on request to TAS-F evaluation team.

7.2.3 Test environment sensors (ETS)

A record (paper and electronic format) will provide the following information about test environment sensors:
- Test phase designation
- Acquisition date/time
- For each sensor (temperature, pressure, vacuum etc.)
  - Sensor number
  - Sensor designation
  - Measured value
  - Alarms status

7.2.4 Test environment heaters (ETS)

A record (paper and electronic format) will provide the following information about test heaters (SVM, Infrared Rig, CVV Warm Up heaters, TTAS):
- Test phase designation
- date/time
- For each heater line:
  - heater line number
  - voltage
  - alarm

7.3 Documents issued after the test

7.3.1 Specimen AIT reports - ASED

Test progress description.
Contamination control report.
Logbook reporting all significant events about specimen.
Pictures taken on the specimen in test configuration.
Record (CD-ROM) of all acquired data during test.
Test measurements devices calibration reports.

7.3.2 Test facility - ETS

Test progress description
Pictures taken on the test set-up
Logbook reporting all significant events about test set-up
Record (CD-ROM) of all acquired data during test
Test measurements devices calibration reports

This report shall be issued within 4 weeks after the completion of test.

7.3.3 Evaluation reports

TAS-F will provide the overall Assessment Report of the Spacecraft TV/TB test.
ASED will provide assessment inputs of the H-EPLM parts.
TAS-I will provide assessment inputs of the SVM parts.
ESA will provide assessment inputs of the instruments parts.

ANNEX 1 : Thermal Control Tables (TCT)

The following table provides default values in the HPSDB for the minimum and maximum thresholds of each TCS line. Two cases are distinguished:

- Survival: applicable only to S/C survival mode,
- Nominal: applicable to all other S/C modes.

HERSCHEL Heater line	HEATER's location	Threshold Nom. [°C]	Threshold Surv. [°C]
TCS Line 01	close to XPND1	-9/-6	-9/-6
TCS Line 02	close to XPND2	-9/-6	-9/-6
TCS Line 03	inside BATTERY	1/4	1/4
TCS Line 04	TANKS	N/A	N/A
TCS Line 05	close to FPSPU, FPDPU	-14/-11	-14/-11
TCS Line 06	close to FPBOLC	-14/-11	-14/-11
TCS Line 07	CRS 1	49./49.5	49./49.5
TCS Line 08	close to FPDECMEC	-14/-11	-14/-11
TCS Line 09	RCS PIPES	23/24	23/24
TCS Line 10	close to CCU, HSDCU, HSFCU	-9/-6	-9/-6
TCS Line 11	RCS PIPES	23/24	23/24
TCS Line 12	close to FHWOV	C.L. set at 4.5	-2.5/+0.5
TCS Line 13	close to FHHRV	-9/-6	-9/-6
TCS Line 14	STR1 Primary Baffle	14/14.5	14/14.5
TCS Line 15	close to FHWEV, FHICU	1/4	1/4
TCS Line 16	close to FHWOH	C.L. set at 3.5	-3.5/-0.5
TCS Line 17	close to FHWEH	1/4	1/4
TCS Line 18	close to FHHRH	-9/-6	-9/-6
TCS Line 19	close to FHLCU, FHIFH	-9/-6	-9/-6
TCS Line 20	close to FHLSU	11/14	11/14
TCS Line 21	on RWL2	1/4	1/4
TCS Line 22	on RWL4	1/4	1/4
TCS Line 23	on RWL1	1/4	1/4
TCS Line 24	on RWL3	1/4	1/4
TCS Line 25	on TANK +Y	11/14	11/14
TCS Line 26	on TANK -Y	11/14	11/14
TCS Line 27	close to STR's	C.L. set at 0.0	-7/-4
TCS Line 28	close to FHIFV	-9/-6	-9/-6
TCS Line 29	on FCV A1A	11/17	11/17
TCS Line 30	on FCV C2A	11/17	11/17
TCS Line 31	on FCV C1A	11/17	11/17
TCS Line 32	on FCV A2A	11/17	11/17
TCS Line 33	on FCV C4A	11/17	11/17
TCS Line 34	on FCV C3A	11/17	11/17
TCS Line 35	on RCS PIPES	23/24	23/24
TCS Line 36	STR2 Primary Baffle	14/14.5	14/14.5
TCS Line 37	on RCS PIPES	23/24	23/24
TCS Line 38	close to GYRO	62.5/63.0	62.5/63.0
TCS Line 39	on FCV A1B	11/17	11/17
TCS Line 40	on FCV C2B	11/17	11/17
TCS Line 41	on FCV C1B	11/17	11/17
TCS Line 42	on FCV A2B	11/17	11/17
TCS Line 43	on FCV C4B	11/17	11/17
TCS Line 44	on FCV C3B	11/17	11/17
TCS Line 45	on RCS PIPES	23/24	23/24
TCS Line 46	on RCS PIPES	23/24	23/24
TCS Line 47	on RCS PIPES	23/24	23/24
TCS Line 48	on unit: PT, LF, LV1, LV2	23/24	23/24
TCS Line 49	CRS 2	49./49.5	49./49.5

END OF DOCUMENT