HERSCHEL / PLANCK

Planck Cryogenic Test Operation Plan (CQM)

Product Code : 200000

Rédigé par/*Written by*	Responsabilité-Service-Société *Responsibility-Office -Company*	Date	Signature
T.Blanc / E.Michel	Planck AIT Team	15/04/05	
Vérifié par/*Verified by*			
P. Armand	Planck AIV	25/04/05	
Approbation/*Approved*			
J-Y Charnier	Planck AIT Responsible	22/04/05	
C. Masse	H/P Product Assurance Manager	26/04/05	
J-J. Juillet	H/P Project Manager	29.04.05	

Data management : G. SERRA

Entité Emettrice : Alcatel Space - Cannes
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1. INTRODUCTION

1.1 Scope

This document defines the PLANCK CQM satellite activities performed during the Cryogenic test campaign at CSL.
This document serves as a basis for the leading and modular procedures.
The assessment of the level of delivery in AIT is given in the satellite definition file.

Concerning the Test itself, the Test Specification is the relevant document.

1.2 Specimen Composition

The specimen CQM satellite is mainly composed of (See RD7]):
+ SVM dummy
+ Cryo-structure and Telescope QM (without the QM reflectors)
+ HFI CQM, except Helium tanks:
Detection chain: DPU/REU/PAU/J.FET/FPU QM
Dilution Cooler: DCCU
4K Cooler: CDE/CRU:CCU/CAU + power supply
+ LFI RAA STM (Main Frame)
+ PACE CQM
+ Thermal dummies

In regard to the test configuration, at the arrival the satellite is not in configuration for :
+ External Solar Array STM (not mounted)

2. For details regarding the CQM Build standard, refer to RD7].

2. APPLICABLE AND REFERENCE DOCUMENTS

2.1 Applicable documents

[AD1] Planck CQM AIT Plan
H-P-3-ASPI-PL-0668

[AD2] Planck Cleanliness Control Plan
H-P-1-ASPI-PL-0253

[AD3] Planck CQM Cryogenic & Thermal test specification
H-P-3-ASPI-TS 0645.

[AD4] Planck S/C integration sequence
TN.CSL.PSPA.05002

[AD5] GSE implantation Drawing
CSL 126 00 00 00

[AD6] Planck CQM EMC CE CS Test specification
H-P-3-ASP-TS-0650

2.2 Reference documents

[RD1] Planck GSE ICD
H-P-3-ASP-IS-0492

[RD2] Planck Deployment in clean-rooms
H-P-3-ASPI-TN-0442

[RD3] Planck Cryogenic facility requirement specification
H-P-3-ASPI-TS-0051

[RD4] Herschel/Planck IID-A
SCI-PT-IIDA-04624

[RD5] CQM PACE integration sequence
H-P-3-ASP-TN-0706

[RD6] S/C Test sequence plan
PL/CSL/PSPA/02009

[RD7] Planck CQM Technical Description
H-P-3-ASP-TN-0671

[RD8] HFI instrument ICD with CSL facility
IF-PH212-100444-IAS

2.3 Acronyms

CCS	Check-out Central System (part of ASP EGSE)
COE	Check-Out Equipment
CQM	Cryogenic Qualification Model
FPU	Focal plane Unit
I. EGSE	Instrument EGSE
ISSS	Isotope Supply and Storage System (part of HFI GSE)
MPT	Multi-Purpose Trolley (Planck MGSE)
NCR	Non Conformance Review
PACE	Pipe Assembly Cold End (20 K cooler)
PGSE	Pneumatic GSE
PLM	PayLoad Module
PTR	Post Test Review
QA	Quality Assurance
QM	Qualification Model
RAA	Radiometric Array Assembly (LFI + part of HFI)
STM	Structural and Thermal Model
SA	Solar Array
SVM	SerVice Module
TRR	Test Readiness Review
TSCP	Transportation Satellite Container Planck
WU	Warm Unit (part of instruments)

3. ORGANISATION AND RESPONSIBILITIES

3.1 General

ESA project representative is invited as observer.
+ Approval of the Test Specification

ASP is in charge of
- the satellite activities and test management:
- Preparation (tests definition, except for instruments, Test specification) and execution
- S/C Cleaning, handling, mechanical mounting, electrical checkout, instruments modes set-up.
- Test management (reviews, leading procedure, daily meeting, key points , …)
- Dedicated GSE installation/validations and use (for the list see RD 1)
- S/C data analysis.
- Responsible of the test management and for interfaces between the PLANCK satellite and CSL facility.

HFI is in charge of:
- Preparation, tests definition for HFI instruments
- Dedicated GSE installation/validations and use (ISSS-PGSE and I.EGSE)
- Responsible for interfaces between the HFI GSEs (including the piping) and CSL facility.
- Execution and interpretation of instrument performance data
- Provide relevant test data in order to help the test director concerning the "Key point" status.

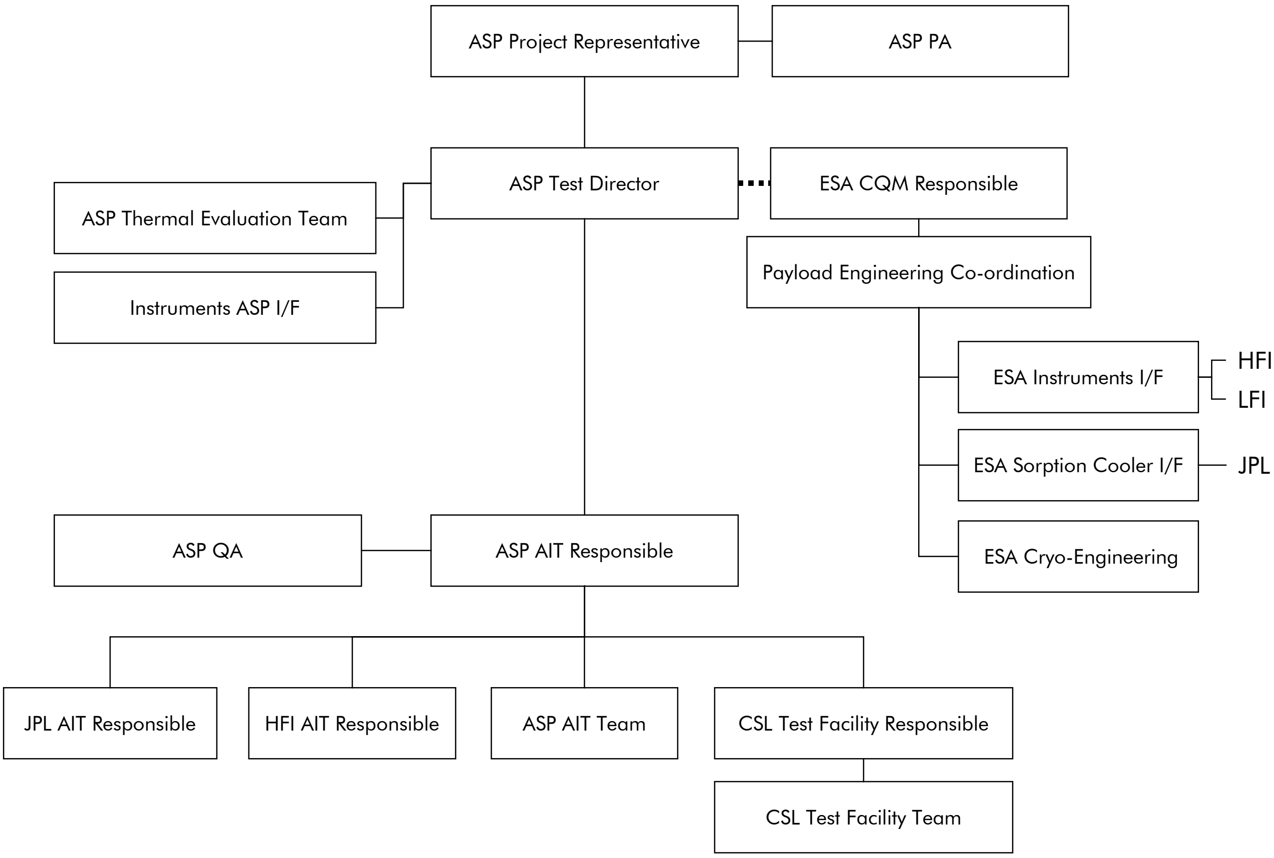
CSL is in charge of
- Dedicated GSE installation/validations and use
- Cleaning of every GSE's and Containers under the control of an ASP responsible.
- The overall test facility activities
- Preparation and execution on the test facility.

JPL is in charge of:
- Controlling the right use of the PACE CQM
- Assisting the PACE GSE operators wrt to the PACE behaviours.

AL is in charge to support ASP to connect and to validate the PACE GSE.

3.2 Organisation

The overall organisation during the test is as follows:



+ Except a third shift required, 7 days a week for vacuum phase,
activities are planned in two shifts (from 7:00 to 23:00), 6 days a week (access is required for Sunday as margin).

3.3 Responsibilities

The overall responsibility during the test is as follows:
The responsibilities linked to the test progress shall be mentioned in the ASP test leading procedure.

Organization	Responsibility
ASP Project Representative D. Montet / P. Armand	Alcatel project interface Represents ASP during the test and he is also the I/F point with the ESA representative
ASP PA	ASP Project Assurance Manager
ASP Test Director P. Armand for Phase [0,7] E. Gavila for Phases [1,4,5,6] J.P. Chambelland for Phase [2,3]	Issue the test specification of the relevant test to be performed Go ahead for the test reviews (TRR, key point, PTR) Single point of contact with the ASP Evaluation team concerning the test result status.
ESA CQM Responsible M. Braghin	ESA point of contact I/F with ESA project

Organization	Responsibility
	I/F with ASP test director & ESA Payload Engineering Co-ordination
ESA Co-ordination B. Guillaume	I/F with ASP test director & Instruments evaluation teams
ESA Instruments I/F J. Marti Canales	I/F with HFI & LFI evaluation teams
ESA Sorption cooler I/F A Heske	I/F with JPL evaluation teams
ESA Cryo-Engineering Support C. Damasio	ESA cryo expert
ASP Thermal Evaluation Team Resp. E. Gavila	Evaluate the test data in order to help the test director concerning the "Key point" status. Thermal control of SVM dummy during all phases (limited on structure up to Instruments interfaces) Thermal control of PPLM during all phases (limited on structure up to Instruments interfaces)
ASP AIT responsible	Responsible of the ASP AIT Team Issue the leading procedure of all activities Manage all activities done during the test including "key point" meeting. I/F point with the CSL Test Facility Team Responsible I/F point with the HFI AIT Team Responsible I/F point with JPL responsible Organize the Daily meeting Initialize NCR…
ASP AIT Team	Realize all S/C AIT activities within the arrival and the leaving Issue of the relevant test procedures Operate the ASP GSE (including the PACE GSE) Provide the ASP test data Issue the ASP test report.
Instruments ASP I/F J.P. Chambelland	Issue section of the test specification relevant to the instrument ASP instrument expert
ASP QA	Organize the review (TRR/PTR…) Minute the running meeting (Key point)
HFI AIT Team Responsible	Is in charge of I/F point with the ASP AIT responsible Provide relevant test data in order to help the test director concerning the "Key point" status.
HFI AIT Team	ISSS-GSE and I.EGSE full use Issue the relevant test procedures Process the HFI test data and HFI Test data analysis Issue the HFI test report.
JPL Responsible	I/F point with the ASP AIT responsible Control the right use of the PACE CQM Assist the PACE GSE operators
CSL Team Responsible	I/F point with the ASP AIT responsible
CSL Test Facility Team	Issue the test facility leading procedure (in case of different activities) Issue the relevant test procedures Operate the CSL Test facilities Provide the CSL test data Issue the CSL test report.

Meetings

3.3.1 Before S/C arrival at CSL :

Facility Delivery Review
A Facility Delivery Review will be held at CSL concerning the Test Facilities , main objectives are :
- test facility acceptance review
- facility interfaces for GSE

Test Readiness Review
A Thermal balance and Functional Cryo Test Readiness Review will be held at ASP :
The objectives of the TRR are :
the hardware configuration status
the test facility status
all the appropriate test objectives and the associated test procedures are agreed and approved
supporting documentation is available
all supporting equipment (hardware and software) status
the schedule is available and agreed
all safety aspects have been properly addressed
NCR status
At the end of the TRR, S/C go-ahead transportation is given .

3.3.2 During S/C activities at CSL

AIT Daily Meetings:
A daily meeting ASP is foreseen at 8 h00.

Nota: The day to day AIV report, that will contain the synthesis of most relevant parameters, and the summary of the daily activities, will be sent by E-mail by the ASP Project representative.

Foreseen intermediate Key/Mandatory Points:
+ A Key Point will be held when the S/C is ready to be transferred on CSL brace

+ A Key Point will held before closure of chamber doors and start pumping

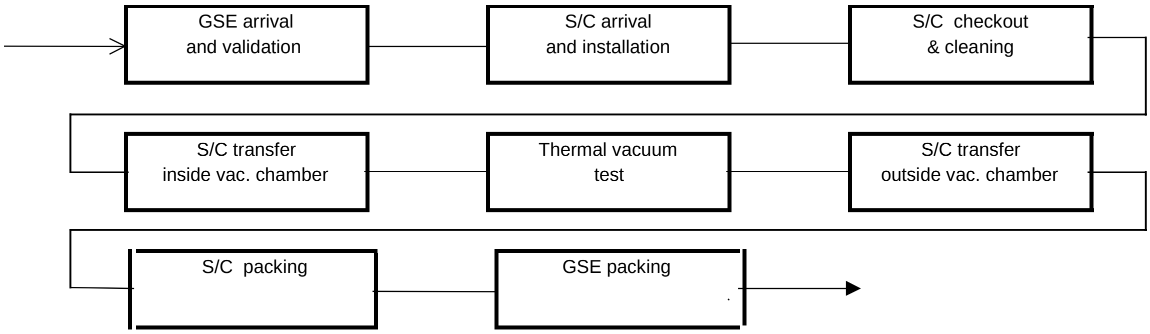
+ A Key Point will be held at the end of the Thermal Balance Sequence.

+ A Key point will be held before the ambient pressure and temperature recovery

Post Test Review(PTR) or the Test Review Board (TRB)
At the End of the Test Campaign, a Post Test Review will be held.
The objectives of the Test Review Board is to confirm that the activities were carried out according to the procedure, to review the results and to release the hardware configuration for the next activity or to decide on the course of action where unacceptable anomalies occurred.

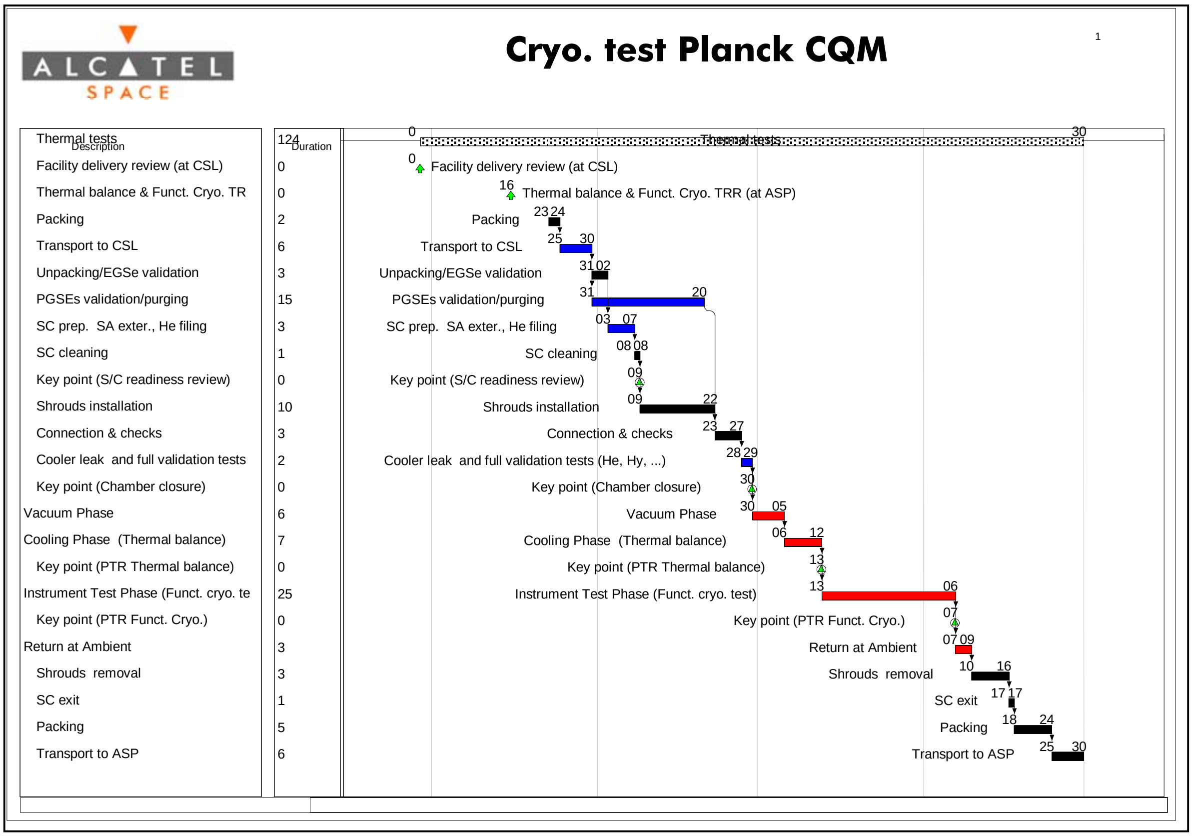
4. TEST SEQUENCE

4.1 Satellite Activities Flow



4.2 Schedule

For information: (duration only)



5. OPERATIONS PLAN

Prior to S/C arrival at CSL, a global (blank test, GSE interfaces, cleanliness…) Facility Delivery Review shall be conducted to verify its compliance wrt the [RD 1] and [RD3] interfaces.

All AIT team shall follow CSL safety training/familiarization:
+ Facility training
+ Crane training shall be given to the AIT mechanical team.

Every people who have to work in the clean room at the moment of use of Hydrogen will have to follow a Hydrogen safety rules presentation .

All activities are performed according to matrixes given in chapter 8
For the sequences shared with CSL, the chapters recall the contains of [RD6] : if there is a difference between the 2 documents : ASP operation plan H-P-3-ASP-PL-0502 will be the reference

5.1 EGSE Links

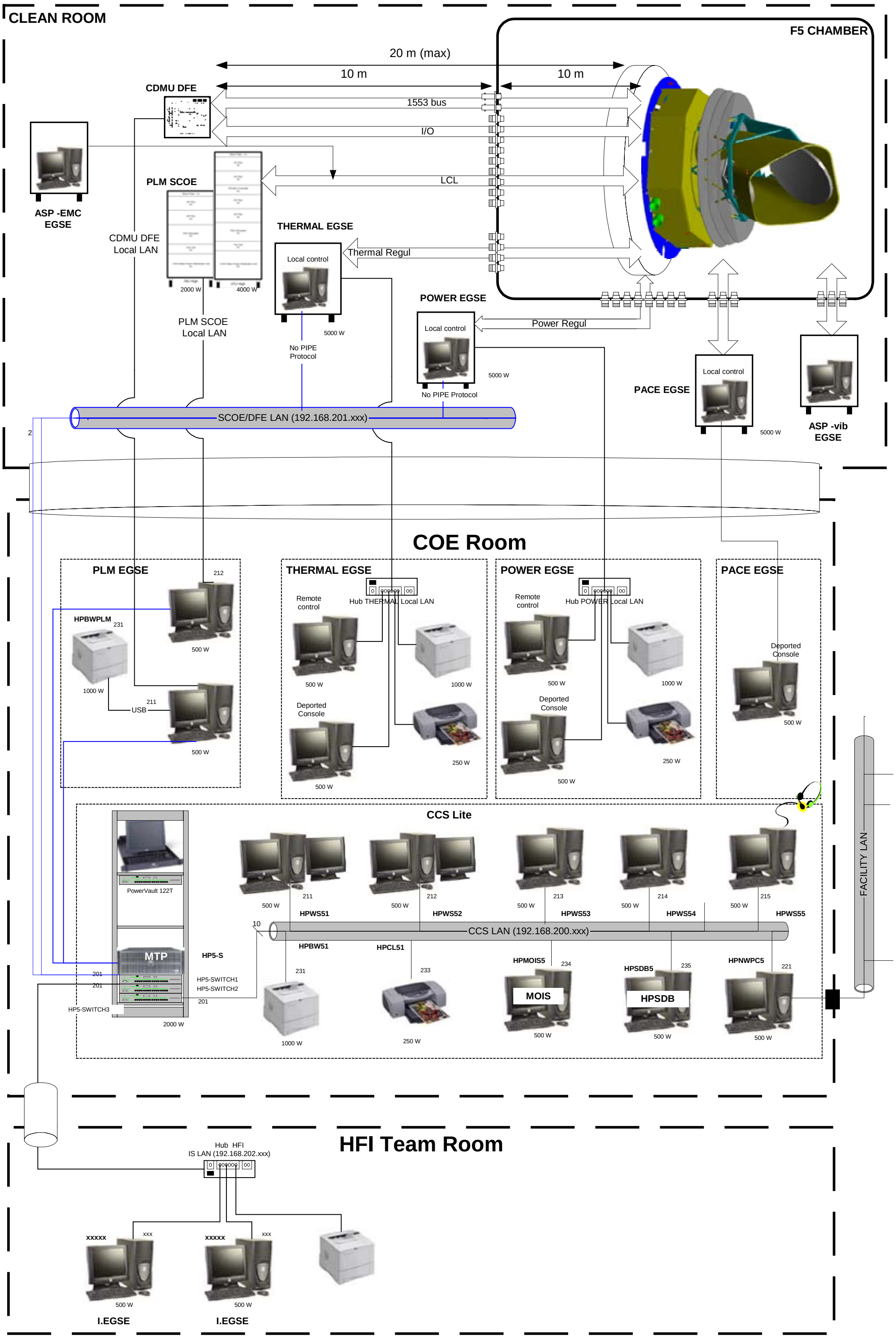


Figure 1- EGSE Links

5.2 Implantation of the GSE at CSL

(See also [RD2] and [AD5] for the sequences in CSL).

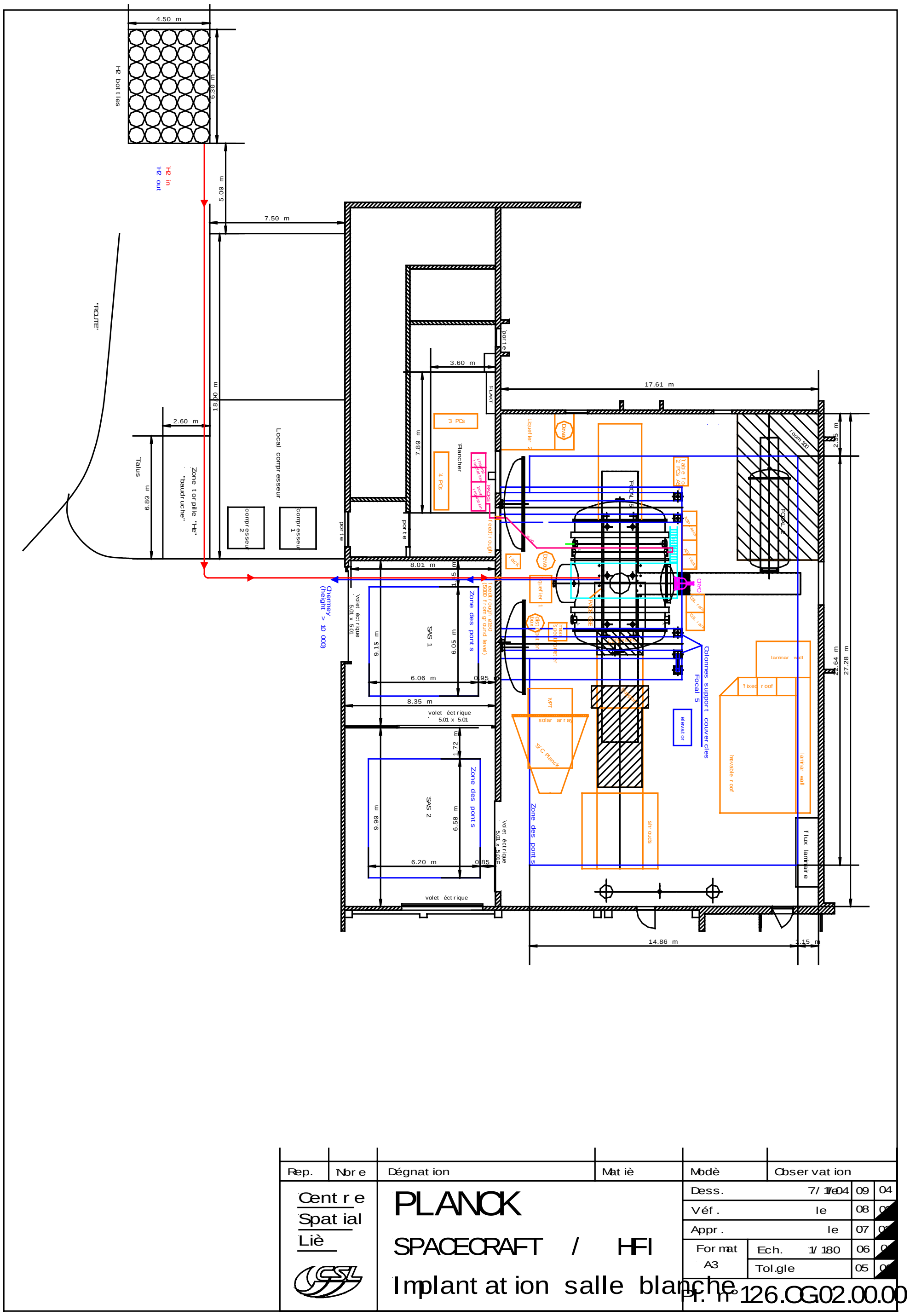


Figure 2- General GSE's Implantation

5.3 S/C & GSE installation/validation at CSL

S/C and GSE arrive by road, the S/C container and GSE containers are loaded on trucks.
The first arrival are GSE, MGSEs, EGSEs (with I. GSE + I SSS)and PGSEs; about 3 days after 1 heavy MGSE (MPT) will arrive and 1 day after SC will arrive.
Once at CSL, S/C container is unloaded by an specific lorry crane, provided by CSL, and moved to the CSL airlock.
Prior to installation, containers and GSE containers are cleaned in front of and inside the airlock.
The S/C container is the last to go in the airlock1 (after all GSE)

The required surfaces for the S/C and GSE installation are detailed in [RD1].
GSE and S/C installations order shall be take into account, free areas around GSE and S/C will be at least 1 meter .

5.3.1 EGSE & PGSE installation

Before GSEs arriving, CSL will have some preparation activities to carry on (see RD6] which concern mainly the sas cleaining and conditioning. Shrouds and S/C support will be pushed inside the chamber to set free place in the clean room for the installation activities. 1/3 of the guiding bars will be removed by CSL to allow the ASP materials passing, coming from the sas 2.

GSE are transferred in clean-room/electrical station as presented in the chapter 5.1.
<u>In the control room (COE Room):</u>
+ CCS lite
+ PACE-GSE work station
+ Power & Thermal EGSE's work stations
<u>In the clean room :</u>
+ EGSE PLM cabinets
+ ISSS-PGSE
+ PACE-EGSE and PGSE cabinets
+ Power and Thermal EGSE's cabinets
+Accelerometers Acquisition system
+ EMC standard tools : Curent injection probes, curent monitoring probes, spectral analyser with pre-selector, Signal generator, Power amplifier (ref AD06])
+ part of I. EGSE (the other part is in HFI's desk
GSE are validated in stand alone, then communication links validation is done between control room and clean-room.
Nota: Concerning Hydrogen PACE-GSE, this GSE is already in place and validated (this GSE is not used during assembly phase at ASP Cannes).

Detailed foreseen combined sequence (see[RD6])

Arrival of the truck(s) with the ASP and instruments EGSE for S/C Planck	ASP
Unloading with a 2.5T forklift with skilled person (CSL)	ASP +CSL(forklift)
Entry of the EGSE in the airlock 1	ASP
Cleaning of the EGSEin the airlock 1 and inspection	CSL (cleaning) + ASP/CSL (inspection)
Unpacking of the EGSE (5 stations ASP + 1 I.SSS + work station in COE room the latter) and storage of the boxes on CSL parking space	CSL (boxes parking) + ASP (unpacking)
Entry of the EGSE in the airlock 2, cleaning and inspection	CSL (cleaning)+ CSL/ASP (inspection)
The CSL S/C support + shrouds are pushed inside the chamber	CSL

The last 1/3 of guiding bars is removed near the other bars	CSL
Entry of the EGSE in the clean room and installation in the clean room (with EMC and μvib installation) and COE Room installation	ASP
Cable routing between COE room and clean room	ASP
Validationof the EGSE	ASP

5.3.2 MGSE installation

Prior the S/C arrival, handling MGSE is installed inside the clean-room :
+ Multi-Purpose Trolley
+ Forklift truck (provided by CSL)
+ Horizontal hoisting device
+ …

Nota: The HHA and TRA MGSE's will already be mounted on the S/C during the transport sequence.

5.3.3 S/C installation & visual inspection

After unloading, S/C container instrumentation data recorded during the satellite transportation (vibration, shock, relative humidity and temperature) are checked.
S/C container is place in front of airlock door, after airlock door opening, a specific joint is done between container and the airlock. When the cleanliness of the airlock is come back to "100000 US std" condition, S/C container door can be opened

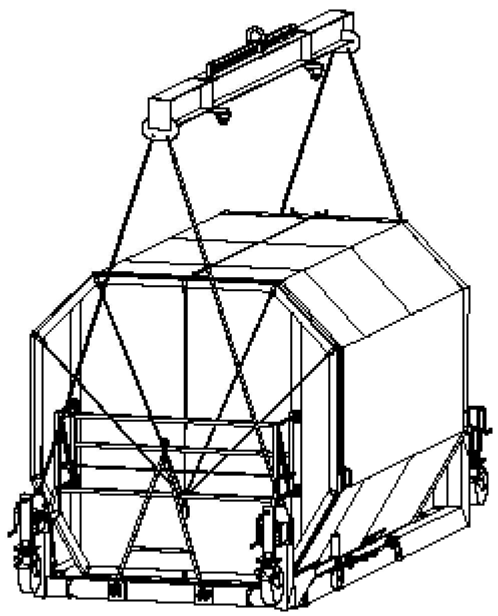
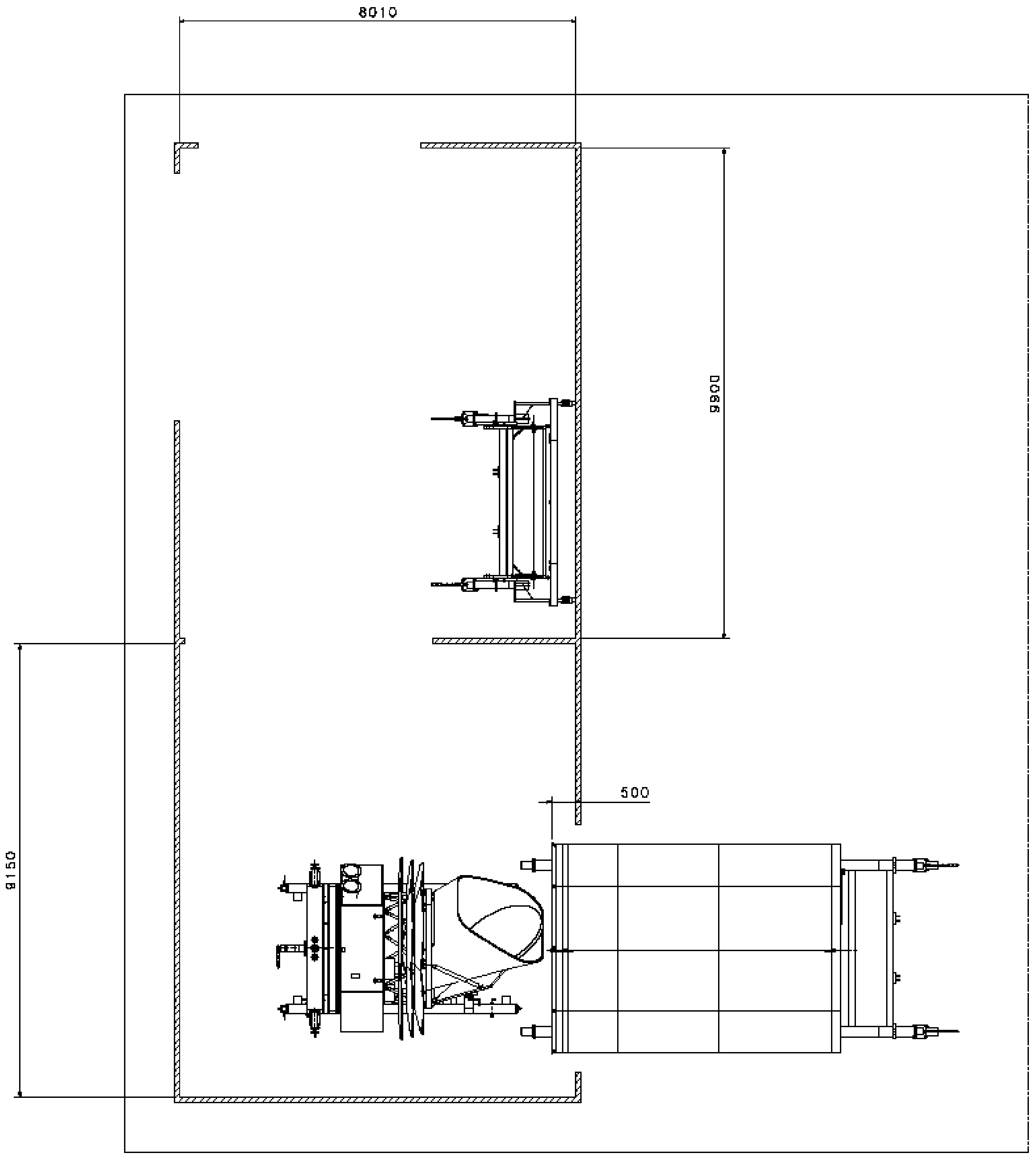


Figure 2- PLANCK container

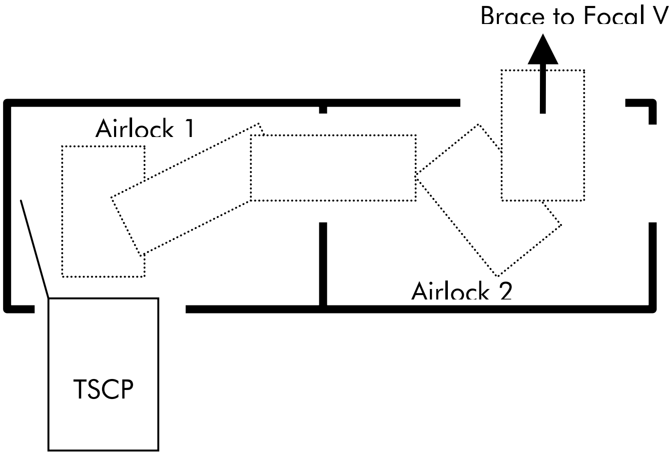
The container will be set up at the entrance of the sas 1.
Set up of plastic sheet between container and door frame .

After the S/C container opening, the S/C grounding is installed on CSL "plant grounding".
Planck container door will be stored in airlock 2 .
A visual inspection is done on external components, on transport safe covers or safe plugs installed before transportation. AIT covers and flags are mounted after visual inspection. ASP removes Molecular & particular witnesses for analysis.



The brace, with PLANCK satellite on it, will be driven thanks to EDU (Equipment Drive Unit) through airlock 1 and airlock 2 to enter into "FOCAL V" room.

S/C is transfer from transport trolley to MPT (X axis horizontal).
MGSE (Horizontal hoisting devices) are removed from the clean-room
Note: S/C grounding is required during these operations.



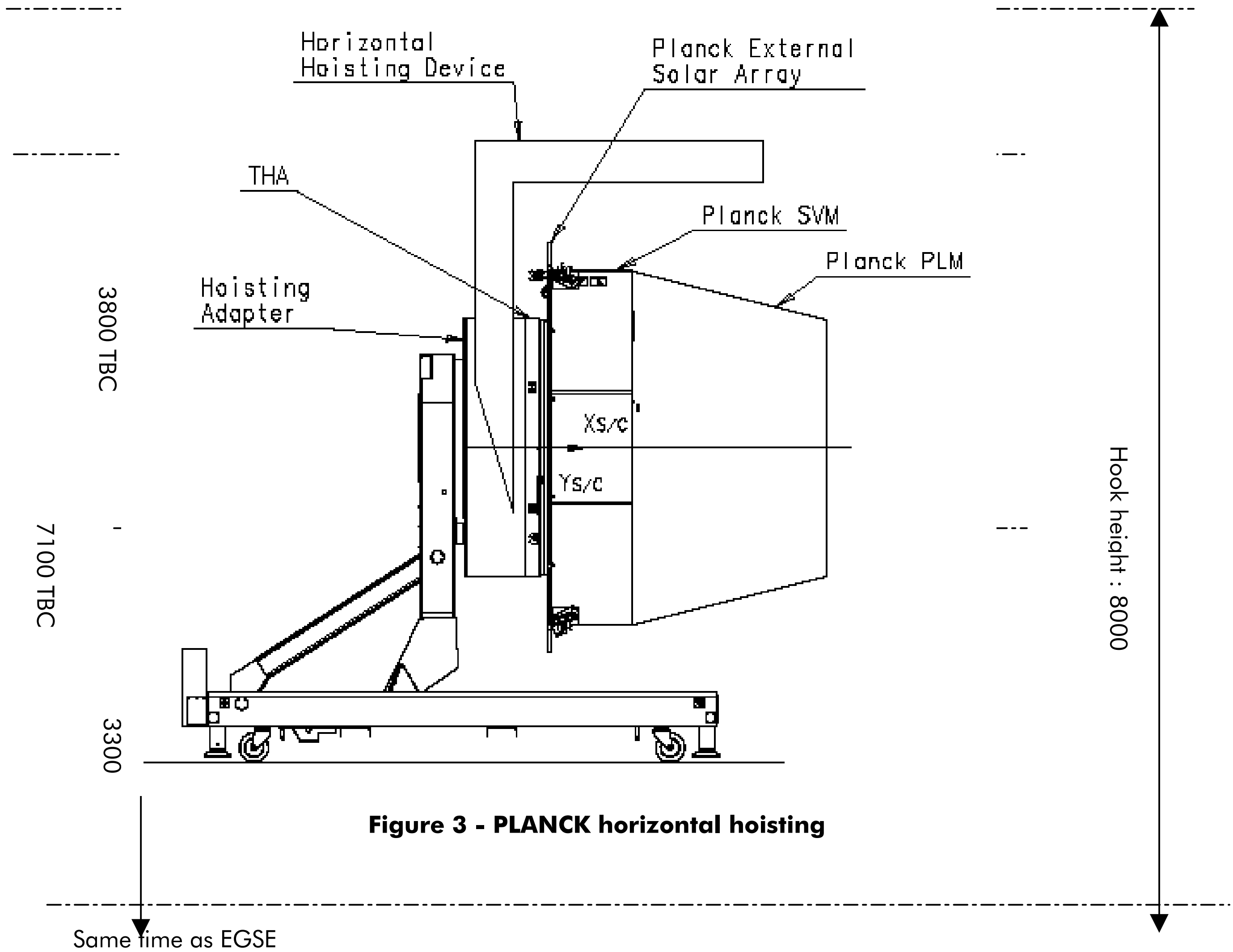


Figure 3 - PLANCK horizontal hoisting

Arrival of the truck(s) with MGSE for S/C Planck	ASP
Unloading with **a 3.5 T AMOS** forklift (CSL skilled person under ASP responsability)	ASP +CSL(forklift)
Entry of the MGSE in the airlock 1	ASP
Cleaning of the MGSE in the airlock 1 and inspection	CSL (cleaning) + CSL/ASP (inspection)
Unpacking of the MGSE (HHD, EDU, comabi, …)	CSL (boxes parking) + ASP (unpacking)
Entry of the MGSE in the airlock 2 + HHD assembly, cleaning and inspection and storage of the boxes + MGSE protection covers on CSL parking space	CSL (cleaning)+ ASP (inspection + storage)
Entry of the MGSE in the clean room and installation (HHD mounting) in the clean room	ASP

Detailed foreseen combined sequence (see[RD6])

Arrival of the jig crane (container + chain + S/C = 17 t) and installation (with a person able to use it)	CSL
Arrival of the truck with the MPT and parking	ASP
Unloading of the MPT with **with a 8 T forklift (provided by CSL)**	ASP (+CSL skilled operators)
Entry of the MPT in the airlock 1	ASP
Cleaning of the MTP in the airlock 1 and inspection	CSL (cleaning) + ASP (inspection)
Entry of the MPT in the airlock 2, cleaning and inspection	CSL (cleaning)+ ASP (inspection)
Entry of the MPT in the clean room and installation in the clean room. Be careful : position very important (no interference when shrouds will get out of the focal5)	ASP
Arrival of the truck with the S/C and parking	ASP
Unloading of the S/C container (total mass = 17 t) just in front of the airlock 1 shutter (Asp responsibility)	ASP (+CSL operators)
Cleaning of the S/C container door and the surface around it and inspection	CSL (cleaning : 2 shifts a day) + ASP (inspection)
Opening of the airlock 1 shutter	CSL
Positioning of the container at the entry of the airlock1 (pushed approximately 0.5 meter in the airlock with a **3.5T** forklift).	ASP(+CSL operators)
Closing of the shutter until the upper of the container	CSL
Installation of the plastic around the container	CSL (+ASP control)
Cleaning of the S/C container door and the surface around it and inspection	CSL (cleaning : 2 shifts a day) + ASP (inspection)
To wait for the air replacement in the airlock 1 and check with the particular witnesses analyses	CSL
When the class 100 000 (t°c , hydro, ..) is confirmed in the airlock 1; the container door can be opened. (duration TBD : CSL)	ASP
The shutter between airlock 1 and airlock 2 is opened	CSL
The container door is moved in airlock 2 (manually)	ASP
The S/C on its transport support is removed from the container	ASP
The S/C must be turned by 90° with the EDU + tractor (with skilled person ASP TBC)	ASP + CSL (elec + pneumatic providing)
S/C is inspected and cleaned if necessary (bottle B50 with LN2 provided by CSL)	ASP for inspection and cleaning
The S/C is introduced in the airlock 2 (class 100 000)	ASP
The airlock 1/airlock2 shutter is closed	CSL
The S/C is inspected and cleaned if necessary	ASP (cleaning on S/C and inspections)
The shutter between airlock 2 and clean room is opened	CSL

The S/C is turned by 90° and introduced in the class 10 000 clean room. (focal 5's doors are open)	ASP
The shutter between airlock 2 and clean room is closed	CSL
Transfer of the S/C from the transport trolley to the MPT(see AD4)	ASP
The S/C is placed along the guiding bars system	ASP
Removal of the S/C "groove + optical" protections	ASP
Installation of the CSL optical protection	ASP
The S/C support is removed in the container and the container's door is closed	ASP
Removed the container(with forklift + crane) and storage of the container in Atelier de la Meuse	CSL
The last 1/3 of guiding bars is installed in front of Focal 5	CSL

5.4 Satellite checkout tests and preparations

These tests are performed with the satellite on MPT, X-axis on horizontal
Note: S/C and operators grounding required for all functional tests.
EGSE are connected on S/C with dedicated harnesses (as during assembly phase in ASP Cannes)
HFI needs 4 bottles B50 of Helium4 N60 (Alphagaz 2) (the same week as S/C arrival) see IF-PH212-400444-IAS for more details

5.4.1 SC checkout tests

SC / EGSE connections and check (with HFI) ASP
4K cooler compressor safe/arming removal plug ASP
Power-up and electrical check status of WUs (HFI Acquisition chain, 4 K cooler, 0.1 K cooler)
Electrical check status of thermal test equipment (Thermal sensors & heaters) ASP

5.4.2 SC end of preparations

External solar array mounting after shrouds exit
5 pipes(Pre-cooling, inlet and exhaust 0.1 K) mounting on external side of the satellite + leak test + DCCU valve opening
End of external thermocouples installation
Pose des heaters sur le TRA CSL
End of external MLI mounting/fastening
SC / EGSE disconnection except at S/C interface (cables are rolled up) ASP
S/C visual inspection and external cleaning TBD

5.4.3 PACE GSE preparation

- H2 rack providing (same week as S/C arrival) + He Alphagaz2 : 3 bottles B50 + LN2 Alphagaz 1 : 2 bottles B20 (1 week before S/C arrival) CSL
- gauges calibration Air liquide
- pipes leak test ASP
- test fonctionnel ASP
- spectro de masse installation (+ phone on PACe platform) CSL

The S/C is then ready to be transferred on CSL brace
S/C Delivery Readiness Review .
At this point, the S/C is ready to be handed to CSL support for combined operations.

5.5 S/C combined operations with CSL at ambient

5.5.1 Transfer of the S/C on the S/C Support

S/C transfer to CSL MGSE support
S/C axis checking (when we are in front of the baffle)

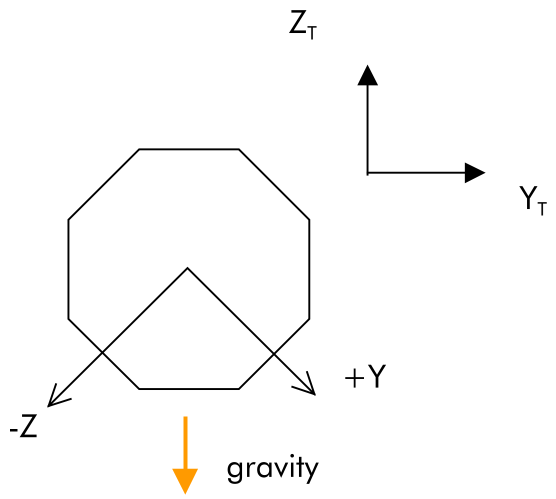


Figure 4 - Tests orientation (S/C axis)

Detailed foreseen combined sequence (see[RD6])

The shrouds are removed from Focal 5 and placed at the extremity of the guiding bars before the installation of Solar array	CSL
The S/C support is removed from Focal 5 and placed in front of the chamber on the "external" feet	CSL
The S/C is taken with the crane (Maximale mass 5,3T) and placed in front of the support	ASP
Fixation of the S/C on the support and removal of the crane	ASP
Installation of the accelerometers on the support and wiring	CSL + ASP
Installation of the electronic level (nivel 20 (put on the HHA without specific interface) on the S/C for the horizontally measurement and do the pre-measurement. (location TBD, but it must be again possible to remove the nivel 20 when the S/C is in Focal 5, in the shrouds (cylindrical part))	CSL

5.5.2 S/C transfer inside the vacuum chamber

GSE are connected on facility test harnesses, pipes and lines validated at focal5 interfaces (before S/C connection)
+ EGSE PLM to focal5 interface
+ Power regulation EGSE to focal5 interface
+ Thermal regulation EGSE to focal5 interface
+ ISSS GSE to focal5 interface
+ PACE-GSE to focal5 interfaceIn parallel, CSL operations :
S/C rolling inside the vacuum chamber Shrouds installation around the S/CDetailed foreseen combined sequence (see[RD6])

Cleaning of the S/C support and shrouds	CSL
S/C molecular & particular witnesses replacing	ASP
Installation of the facility contamination witness samples on the SVM side	CSL
Displacement of the support inside Focal 5 until 1 m before the nominale position	CSL
EGSE connection on tape (the S/C is stopped 1 m before nominale position)	ASP
Validation of the EGSE connection	ASP
Connection TC niveau intermédiaire + tape	CSL/ASP
Positioning of the S/C support on the bench feet	CSL
Fixation of the support on the feet with screws (the four external feet will be fixed on the support)	CSL
Visual inspection	CSL
Removal of the carridge from support	CSL
- Measurement of the S/C horizontally with the Nivel 20 [If the horizontally of the S/C is not good , a manual adjustment on the support is foreseen. But, this can be done if the S/C support is not loaded and then this asks to remove all the set from the chamber and from the support]	CSL
- Removal of the Nivel 20	CSL
- Installation of the penning gauge inside the shrouds on the lower part of the thermal tent, near the helium panel with charcoal	CSL
Displacement of the shrouds (cylindrical part) around the S/C until an intermediate position	
Visual inspection	CSL + ASP
Partial Opening of the flaps (to 60° TBC)	CSL
Visual inspection	CSL + ASP
Displacement of the shrouds to the nominal position	CSL
Complete opening of the flaps (0°)	

5.5.3 Last connections and checks before shrouds closure

When the S/C is in thermal vacuum position inside the chamber :
On pipes :
+ S/C grounding checking
+ Isotopes, pre-cooling and exhaust 0.1 K pipes are connected, sniff test and purging performed
+ PACE-PGSE 20 K pipes are connected, sniff test and purging performed
On harnesses
+ EGSE PLM is connected : S/C power up and WUs check status
+ EGSE PACE is connected : temperature acquisition/heaters check status
+ Power EGSE is connected : heaters check status
+ Thermal EGSE is connected : heaters check status
+ EMC probes are connected and checked
+ 4K cooler compressor safe plug is disconnected
+ Accelerometer are connected and checked (ambient 4 K cooler + CSL MGSE support checked)
+ Thermocouples, Lakeshore diodes & tests Pt 100 are connected and checked (CSL)

Detailed foreseen combined sequence (see[RD6])

S/C harness connection after internal tape validation	ASP
S/C sensors harness connection between the intermediate connectors and the Focal 5 flange	CSL
Set-up harness connection (accelerometers, penning gauge) between the intermediate connectors and the Focal 5 flange	CSL
S/C electrical checks (the chain is complete : CCS, instruments, I GSE, …)	ASP
S/C thermal sensors electrical checks	CSL (+ ASP check)
Set-up electrical checks	CSL
μvib set-up	ASP
CSL pipes installation in focal 5	CSL
HFI piping (5 pipes) connection on the flange and between the S/C and the flange	HFI
Leak test on the HFI piping (CSL can lend a leak detector)	HFI
PACE GSE piping (2 pipes) connection on the S/C + electrical connection/check	ASP*
Leak test on the PACE Hydrogen piping with an "ASM 122"	ASP*
EMC set-up	ASP
EMC calibration	ASP
SVM LN2 shrouds piping (8 circuitry) connection	CSL
Leak tests (this leak test is made by the outside of the chamber) with CSL leak detector	CSL
Security training for PACE GSE use in hydrogen phases for CSL + ASP	AL

- with support of AL

5.5.4 Shrouds closure

+ Optical cavity contamination protection removal, molecular & particular witnesses replacing

CSL operations : 4 K optical shield installation, shrouds end of assembly, shrouds leak test after connections, vacuum chamber closure

Safety note: During the Hydrogen PACE-GSE using phase, restricted access to the PACE GSE station will be set in place .

μ vibrations check (4 K cooler on)
S/C survey procedure validation

Detailed foreseen combined sequence (see[RD6])

Installation of the mobile platform on the guiding bars	CSL
Moving of the mobile platform just in front of the baffle	CSL
Removal of the specific CSL protection(s) from the baffle	ASP
Removal of the mobile platform	CSL
Installation of the molecular and particular witnesses inside the shrouds	CSL
Moving of the shrouds cover with the optical shield fixed on it	CSL
Fixation of the cover on the shrouds	CSL
Displacement (the movement is motorised) of the optical shield until the FPU (the movement and the final position are visualised with a optical fibre/camera introduced inside the shrouds)	CSL
Removal of the optical fibber/camera from the shrouds	CSL
Dismounting of the motor used for the optical shield displacement	CSL
Closing the hole with copper plate with MLI	CSL
Cover harness (thermal sensors) connection and electrical part	CSL
Final piping connection for the LN2 shrouds circuitry and leak test	CSL
Final piping connection for the He shrouds circuitry and leak test	CSL
Final piping connection for the He circuitry for the panel with charcoal and leak test	CSL
Final piping connection for the optical shield circuitry and leak test	CSL
Installation of the final thermal insulation on the shrouds (to close all possible apertures and to avoid thermal leaks) cover side and S/C support side	CSL
Cleaning of Focal5 (the remaining surface, the rest having been cleaned prior to S/C + shrouds entry	CSL
Installation of the particular and molecular witnesses inside the chamber	CSL
Removal of the protection in front of the primary pumping piping	CSL
Removal of the protection in front of the air inlet	CSL
Removal of a part of the guiding bars system (near Focal5)	CSL
Focal 5 lids closure	CSL

5.6 Thermal vacuum test

The more precise informations are available in the Test Specification document (AD3]).

5.6.1 Pumping/vacuum phase

S/C power-up and status check and "launch mode", 4K cooler lock mode.
Start of the use of the PACE GSE with Hefor flushing.
+ leak test at 53 bars (ASP) + H2 warm operation (ASP/AL)
Facility pump down (decontamination/out-gassing phase)
Leaks & μ vibrations checks (coolers, shrouds ..)

5.6.2 Thermal Balance test

Facility cryogenic shrouds cooling down (LN2/20K/4K)
60 K cool down on the 3rd groove with test heaters dissipation
PLM transient case, with test heaters

5.6.3 Functional Cryogenic test

<u>Safety note:</u> During the Hydrogen PACE-GSE using phase, restricted access to the PACE station will be set in place .
μ vibrations check (4 K cooler on)
In parallel, ISSS&PACE GSE coolers lines flushing
Switch on 20 K cooler (via PACE GSE)
Switch on 0.1 K pre-cooling (via ISSS-PGSE)
20 K stabilization on FPUs
Switch on 4 K cooler and stop the 0.1 K pre-cooling line
Switch on 0.1 K cooler (TBD)
4K stabilization FPU, and on 4 K optical shield shroud
0.1K stabilization on bolo-meters of HFI FPU
Switch on HFI detection chain (TBD)
HFI detection chain functional tests, including EMC check (in noisy mode TBD)

Transient/failure case tests :
4 K cooler off/on
0.1 K cooler off/on

5.6.4 Ambient return

Instruments off and S/C warm up using the FPU heater (LFI main Frame (see DA3]), according the instrument possibilities.

Detailed foreseen combined sequence (see[RD6])

FPU warm up	ASP
Shrouds warm up + pressure recovery	CSL

5.7 Final operations

(TBD) Mainly reverse sequence, than arrival/preparation operations

5.7.1 Shrouds opening

After chamber opening by CSL, and guiding rail reinstallation in front of Focal 5

Detailed foreseen combined sequence (see[RD6])

Removal of the final thermal insulation on the shrouds (used to close all possible apertures and to avoid thermal leaks)	CSL
Disconnection of the optical shield piping circuitry	CSL
Disconnection of the He shrouds piping circuitry	CSL
Disconnection of the LN2 shrouds piping circuitry	CSL
Cover harness (thermal sensors) disconnection	CSL
Mounting of the motor used for the optical shield displacement	CSL
Removal (the movement is motorised) of the optical shield from the FPU (the movement will be visualised with a optical fibre/camera introduced inside the shrouds)	CSL
Dismounting of the cover from the cylindrical part	CSL
Removal of the shrouds cover with the optical shield fixed on it	CSL
Removal of the molecular and particular witnesses inside the shrouds	CSL
Installation of the mobile platform just in front of the baffle	CSL
Installation of the protection(s) on the baffle	ASP
Removal of the mobile platform	CSL
Penning gauge (inside the shrouds) harness disconnection and removal from the shrouds	CSL

5.7.2 Electrical and piping Disconnection

Detailed foreseen combined sequence (see[RD6])

Disconnection of the panel equipped with charcoal circuitry	CSL
Disconnection of the shrouds He + LN2 piping	CSL
Disconnnection of the SVM piping + active closure (flaps)	
- Set-up harness dismounting between the intermediate connectors and the Focal 5 flange	CSL
S/C sensors harness dismounting between the intermediate connectors and the Focal 5 flange	CSL
S/C harness dismounting	ASP
Disconnection of the HFI piping circuitry (5 pipes)	HFI
Disconnection of the hydrogen piping circuitry (2 pipes)	ASP

5.7.3 S/C Removal of the S/C from the S/C Support

Shrouds removal of focal 5 (move flaps (to 60° TBC by CSL NCR) + push the shrouds (30 mm TBC by CSL NCR) + move the flaps to 0° + removal)	CSL
S/c removal of focal 5	CSL

PACE GSE dismounting
Asp activities on the S/C: (TBD) Mainly reverse sequence, than before entering in the vacuum chamber
Installation of the MPT along the guiding bars
Installation of the hoisting device on the crane and displacement near the S/C
Fixation of the hoisting device on the S/C
Removal of the S/C from the support
Installation of the S/C on the MPT
Asp activities on the S/C: (TBD) Mainly reverse sequence, than before transferring on the S/C Support

5.7.4 Departure preparation

Detailed foreseen combined sequence (see[RD6])

Connect 4K safe plug	ASP
When the class 100 000 is confirmed in the airlock 1 and when the container is placed in front of the shutter of the airlock1 (the plastic between the container and the shutter is prepared) : The S/C is pushed in front of the airlock2 shutter and turned by 90° to be introduced in the airlock2.	ASP
The shutter between airlock 2 and clean room is opened	CSL
The S/C is introduced in the airlock2	ASP
The shutter between airlock 2 and clean room is closed	CSL
The airlock 1/airlock2 shutter is opened	CSL
The S/C is introduced in the airlock 1 (class 100 000)	ASP
The shutter between airlock 1 and airlock 2 is closed	CSL
The shutter (airlock 1) and the container door are opened	CSL+ASP
The S/C is be turned by 90°	ASP
The S/C on its transport support is installed in the container	ASP
The container door can be closed.	ASP
Loading of the S/C container on the truck with the jig crane	ASP

Packing and departure of GSE

6. ACCESS REQUIREMENTS

When the S/C is in thermal vacuum position inside the chamber, accesses are required for :

6.1 Pipes connections :

Isotopes, pre-cooling and exhaust 0.1 K (ISSS-PGSE)
PACE 20 K (PACE-PGSE)

6.2 Harnesses connections :

WUs harnesses (EGSE PLM)
EGSE PACE harness
Power regulator EGSE harnesses
Temperature regulator EGSE harnesses
EMC probes & accelerometers harnesses
If necessary 4K compressor arm harness

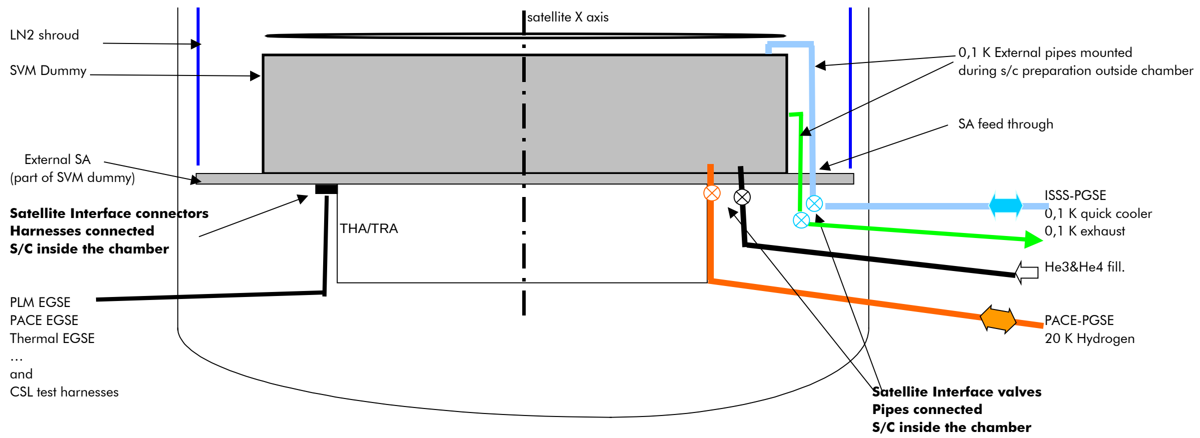


Figure 5- Access S/C inside vacuum chamber

6.3 Contamination protection

In order to remove/mount the S/C optical cavity protection, several accesses are need :
- Before shroud installation around S/C for grooves skins
- After S/C installation in vacuum chamber for optical cavity skin

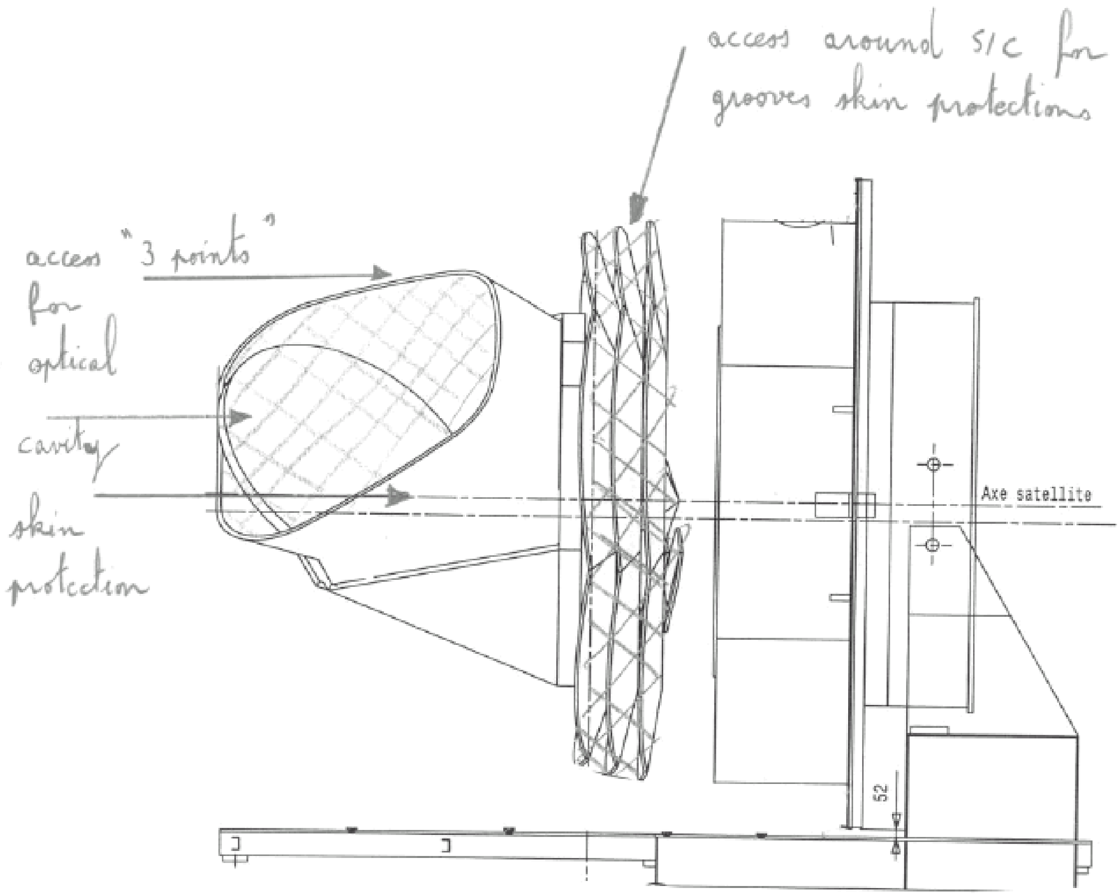


Figure 6- Access S/C in front of vacuum chamber

7. CLEANLINESS AND CONTAMINATION CONTROL

7.1 Cleanliness

The requirements on cleanliness are recalled in the AD 2.

During all the AIT, standard cleanliness monitoring is done on particulate and molecular witness samples.

During AIT phase, there are several particulate cleaning periods of the satellite. One at the end of satellite integration, another before the thermal vacuum test. The cleaning operation will be done by a vacuum cleaner, tools and procedure has to be developed
This nominal cleaning concerns only the external parts of the structure including the grooves, not mirrors neither FPU.

7.2 Specific Protections

To limit particulate contamination during AIT, several types of covers are necessary . These covers will be dismounted for some performances and environmental tests .
Skin protections & covers are provided by ASP AIT ., protections 1, covers 4 and 5 are not used at CSL.

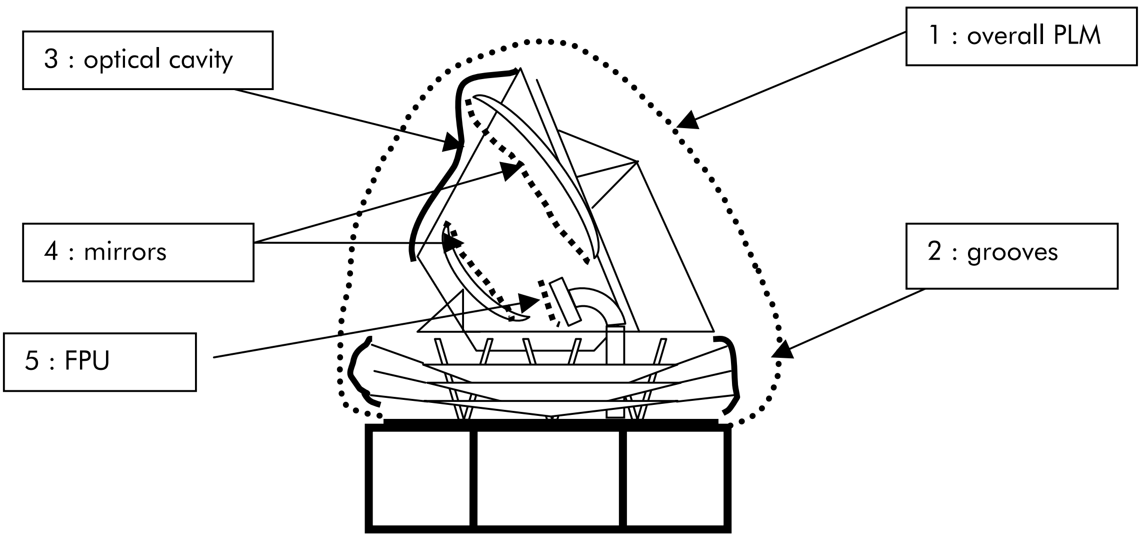


Figure 7- S/C skins protections

8. NON FLIGHT ITEMS, PROCEDURES & GSE LISTS

8.1 Tests/operations procedures

The procedures will be performed in the sequence as described in the following matrixes TBD .

Test description	Test Specif.	Procedures issue/revision	S/C Preparation	S/C Initial checkout	S/C Thermal balance	S/C Funct. Cryo.	S/C Final checkout	S/C packing	Remark
S/C activities									
Mechanical operations									
S/C transport to/from CSL			x					x	
S/C horizontal handling			x					x	
External SA mounting			x					x	& dismounting
Mechanical test configuration				x					External pipes mount., 4 K panel unlock
S/C cleaning				x					& witnesses/protection management
S/C valves connections & leak test				x					0,1K & 20K PACE connections
Thermal test configuration				x					MLI, Thermocouples finalisation
Electrical operations									
S/C electrical connections				x					to EGSEs
4 K compressor arm/safe plug				x			x		
S/C on-off				x	x	x	x		
Ambiant HFI check-out				x					
Ambiant thermal check-out				x					heaters & sensors
HFI detections chains acquisition						x			
HFI 4K cooler modes						x			
HFI 0,1K cooler modes						x			
System operations									
S/C survey				x					in case of failure during vac. Test
Thermal balance					x				
Cryo. Functional Test						x			
EMC CE/CS						x			

Test description	Test Specif.	Procedures issue/revision	S/C Preparation	S/C Initial checkout	S/C Thermal balance	S/C Funct. Cryo.	S/C Final checkout	Remark
GSE activities								
Mechanical operations								
PACE-PGSE installation/validation			x					
PACE-PGSE connection/purge & leak test				x				
PACE-PGSE modes test						x		
ISSS-PGSE installation/validation			x					
ISSS-PGSE connection/purge & leak test				x				
ISSS-PGSE modes test						x		
Electrical operations								
CCS validation			x					
EGSE PLM validation			x					
I.EGSE validation			x					
EGSE connections			x					
Thermal reg. EGSE validation			x					
Power reg. EGSE validation			x					
Hrns EGSEs > S/C validation			x	x				2 configurations

8.2 GSE and Non-Flight Items List

GSE list and ICD are given in RD1

"Non-Flight Items" used on satellite CQM are :

- Contamination witnesses (optical cavity, on grooves, ..)
- Contamination protective covers (on baffle – optical cavity – on grooves)
- 4 K lock safe plug
- μ accelerometers
- Temperature sensors (thermocouples, diodes …)
- EMC probes
- Optical cubes

END OF DOCUMENT