EADS astrium

Test Report

Herschel

Title: **Herschel PFM Cool down and Filling Test Report**

CI-No: CI - 121 000

Prepared by:	for J. Kroeker	Date:	01.05.2009
Checked by:	for M. Langfermann		5.5.09
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Project Management:	Dr. W. Fricke		05/05/09

Distribution: See Distribution List (last page)

Issue	Date	Sheet	Description of Change	Release
1	01.05.2009	all	Initial issue	

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1 Scope

1.1 Objective

This test report describes the cool down of the Herschel PFM cryostat to 4.2 K and the filling of the Herschel HTT following the procedure ref. RD 9 Red marked Herschel PFM Cool Down and Filling; HP-2-ASED-TP-0082 . The filling and the cool down has been performed between the 9th February 2008 and the 5th March 2008 starting after evacuation and successful leak test at ambient temperature. The main requirements are:

1.2 FPU Requirements (acc. to AD 02)

During cool down of the PFM including the FPU's the following requirements have to be regarded:
Temperature gradients (cool-down & warm-up)
The temperature gradient between any of the Herschel Instrument
Interface (L0, L1, L2) shall not exceed the following limit:
T <50K: no requirements
50K<T<80K: Gradient < 50K
T > 80K: Gradient < 35K

Cool-down and warm-up speed: 5K/h above 50 K, no requirements below 50 K.

2 Documents

2.1 Applicable Documents

AD 1H-EPLM Environment and Test Requirements Specification, HP-2-ASED-SP-0004, issue 3

AD 2 Herschel Instruments FPU Straps Temperature Gradients, H-P-100000-ASP-RD-0013

AD 3 Helium Subsystem Safety Analysis, HP-2-ASED-AN-0002

AD 4 PA Plan; HP-2-ASED-PL-0007

2.2 Reference Documents

RD 1 Doc. Identification Procedure and Doc. Management, HP-2-ASED-PR-0001, issue 3

RD 2 CVV Evacuation and Leak test Procedure HP-2-ASED-TP-0071, issue 1

RD 3 Description of the EPLM - FM Cryo Control Instrumentation, HP-2-ASED-TN-0048, issue 2

RD 4 Herschel Cryostat Cover Handling and Operations Manual, HP-2-AAE-MA-0003, issue 4.0

RD 5 Contamination Control Plan, HP-2-ASED-PL-0023

RD 6 Helium Subsystem description; HP-2-ASED-RP-0034

RD 7Herschel FM Cover Flushing; HP-2-ASED-TP-0106

RD 8 Cryo-SCOE operations manual, HP-2-ABSP-MA-0001

RD 9 Red marked Herschel PFM Cool Down and Filling; HP-2-ASED-TP-0082

RD 10 HOT will not be used for SAT FM ground tests and launch autonomy; HP-2-ASED-RW-0009

3 Configuration

3.1 Helium control system

The Herschel Helium Control System is shown in Figure 3-1

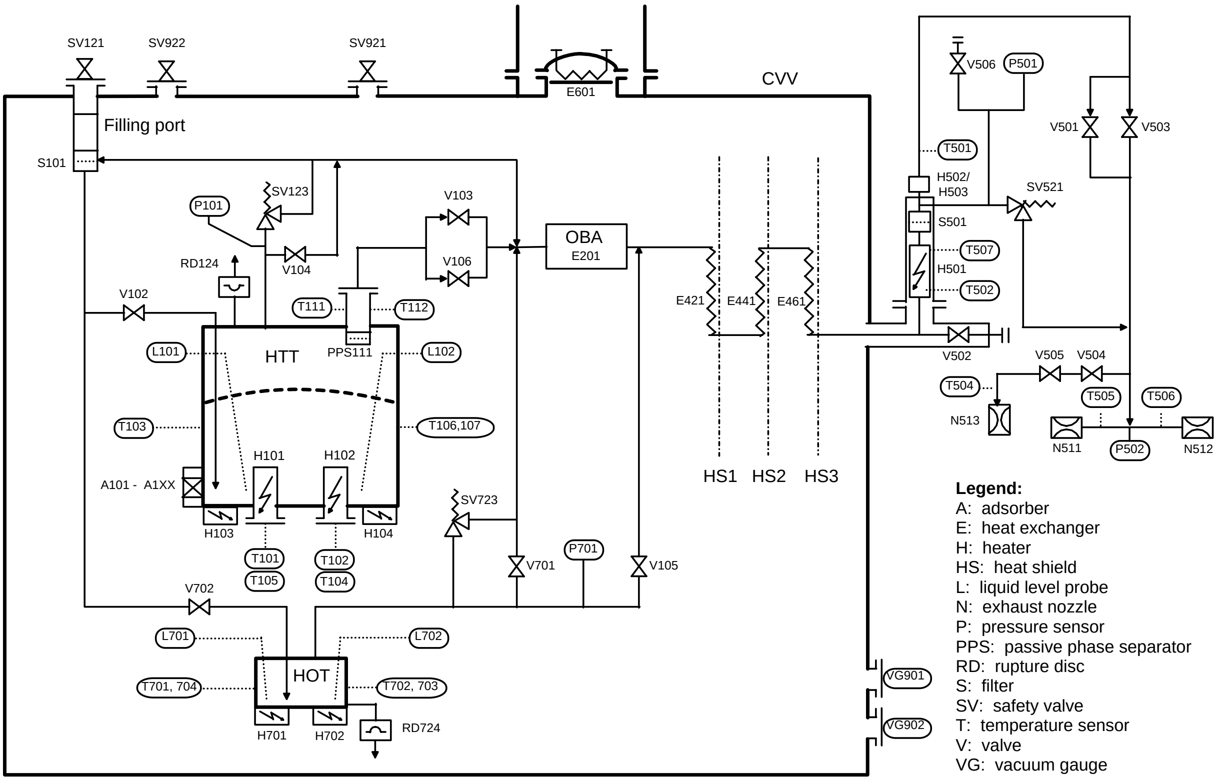


Figure 3-1: Helium subsystem flow diagram

3.2 Principle of the cool down and filling with liquid helium

The cool down of the cryostat is performed with GHe provided from a LHe-Dewar and heated to an adjustable temperature by a dedicated Helium heat exchanger (HEXA). At temperatures below ~80 K the HEXA has been removed and the LHe Dewar directly connected via the LHe transfer line to the filling port air lock for further cooling and liquid filling.

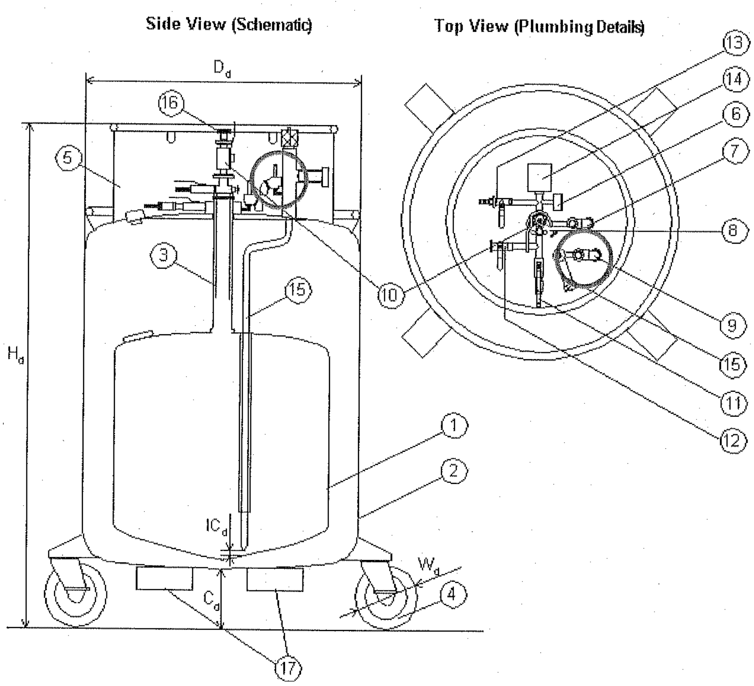
After passing the HTT the flow continues through the OBA with the FPU's and the thermal shields (see also Figure 3-1). The flow outlet at the CVV is the valve V502 where another line, with the first part vacuum isolated, is connected. This line is routed through an arrangement of mass flow meters, selectable by hand valves, and then finally vented to the atmosphere outside of the process facility.

The external vent line system is only used for pressure monitoring during this operation.
The helium flow is controlled by varying the pressure difference in the system, either by the pressure inside the supply dewar or by valves in the filling or venting line.

In order to maintain the high purity of the helium all parts of the connected volumes have been flushed before cool down.

Since cool down is performed with helium over ambient pressure, leak tightness of the various components is not mandatory except inside the CVV vacuum, where continuous leak detecting has been performed.

The helium Dewars (see Figure 3-2) are equipped with a pressure indicator, a liquid level meter, combined with an adjustable pressure controller (Figure 3-3).



Item	Description
1	inner vessel
2	outer vessel
3	collar tube
4	castor
5	protective collar
6	pressure gauge
7	safety valve, gaseous phase
8	safety valve, collar tube
9	safety valve, liquid phase
10	mobile head assembly
11	overflow valve assembly
12	gas withdrawal assembly
13	pressure build-up assembly
14	oscillation damper
15	integrated LHe transfer tube
16	compression joint
17	fork lift recesses
Dd	external diameter
Hd	total height
Cd	ground clearance
ICd	inner clearance of tube
Wd	castor diameter

Figure 3-2: 450 l helium dewar principle

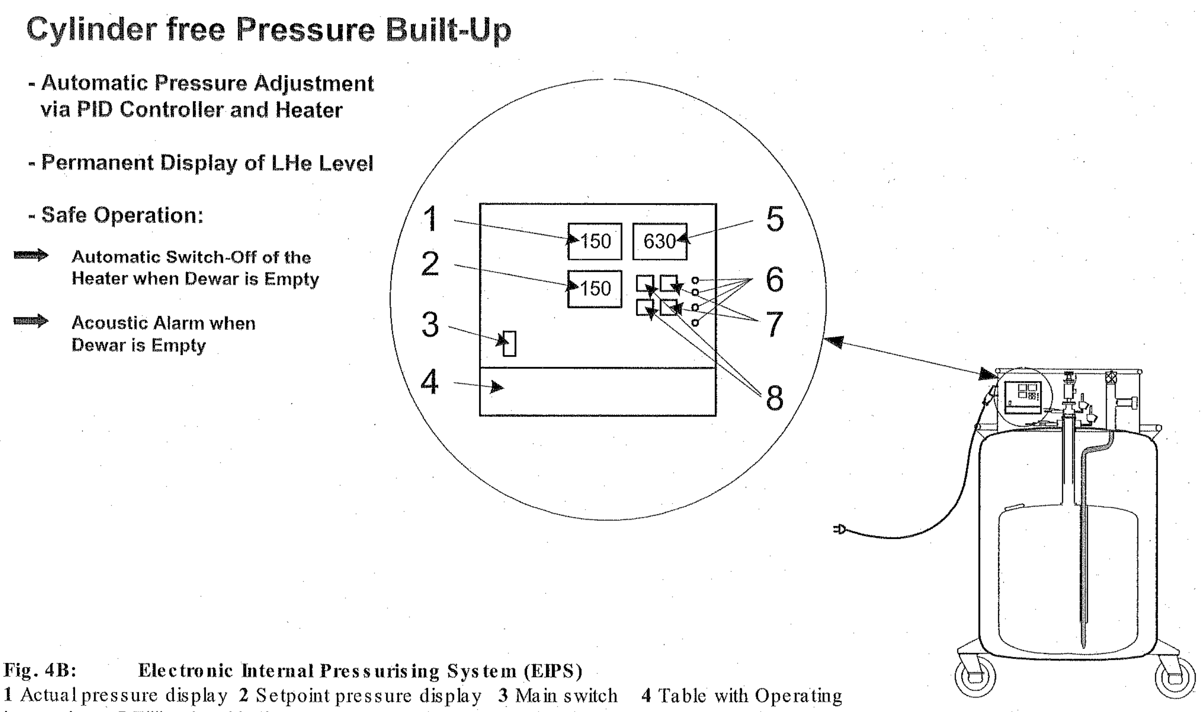


Fig. 4B: Electronic Internal Pressurising System (EIPS)
1 Actual pressure display **2** Setpoint pressure display **3** Main switch **4** Table with Operating instructions **5** Filling level indicator **6** Indicator lamps **7** On/Off button **8** Pressure adjustment button

Figure 3-3: dewars display

3.3 Temperature determination of L0, L1, L2 and L3

For PACS and SPIRE FPU's the main masses (housing ~70 kg) are thermally linked to the Level 1, which are connected to the level 1 cooling line by flexible links (designed for operational conditions). The cooling line is equipped with two Pt1000 (T238 and T239) temperature sensors capable to measure the range fro 20 to 370 K. These sensors have been introduced because of the above requirements. In order to determine the L1 temperature the flow through the vent line has to stop for one hour. The readings from T238 and T239 should show an average for Level 1 afterwards.

The cooling line to the OBP, the level 2, has a good thermal connection to the plate carrying the housing of HIFI. The sensors T207, T255, T253 will be used for Level 2 determination.

For Level 0 there is also no direct temperature measurement, but since the thermally good connected masses on FPU side are low, the HTT upper bulkhead temperature is representative. The PT1000 of the (closed) valves VT103 and VT106 are selected for L0 temperature determination.

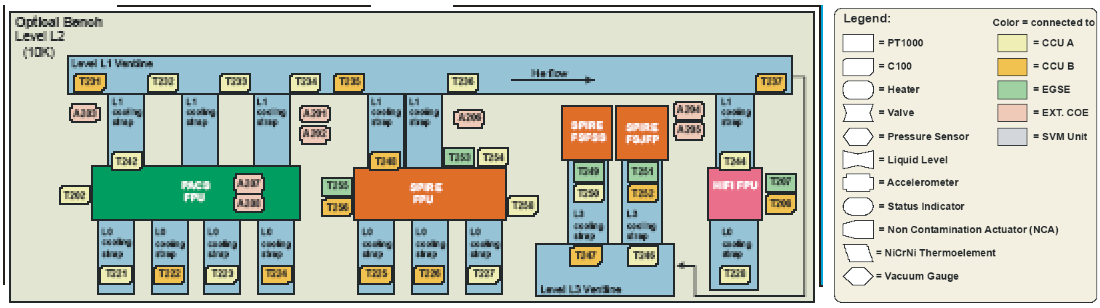


Figure 3-4: Optical bench temperature sensors

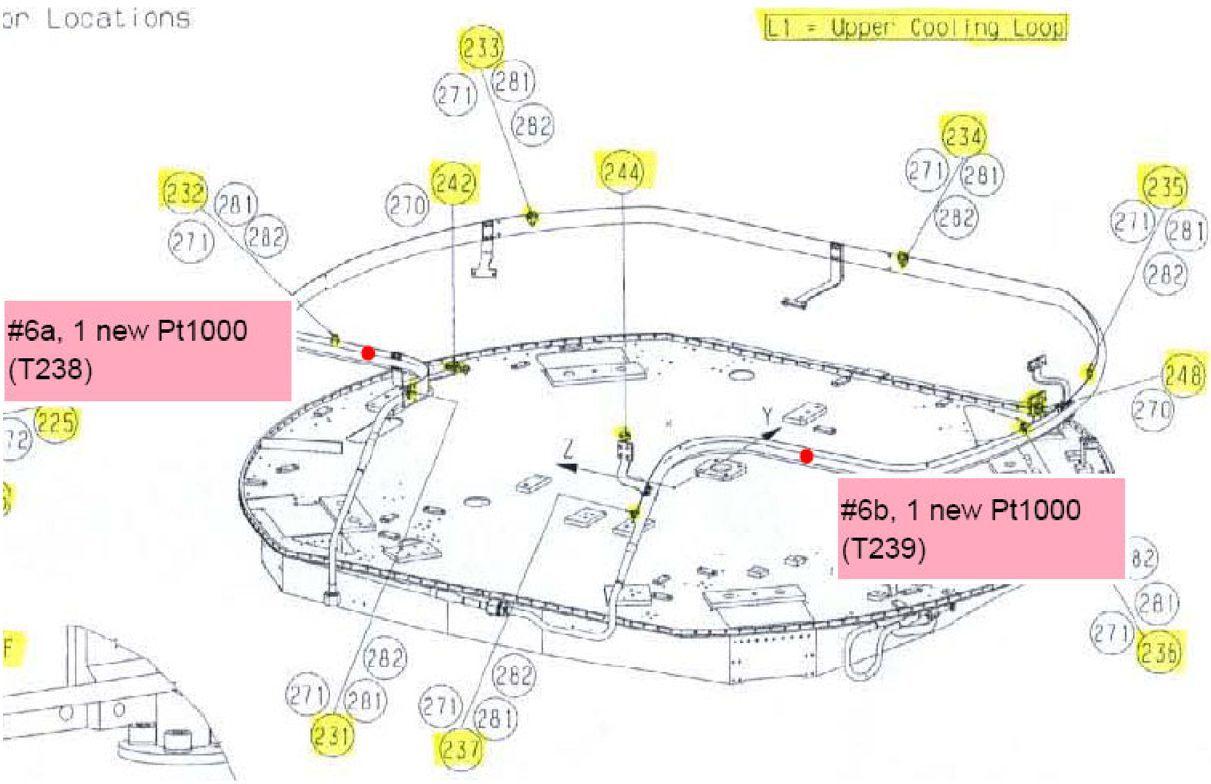


Figure 3-5: the two PT1000 sensors on the level 1 vent line on OBA shown w/o FPU's

3.4 General Hardware Configuration

The H/W configuration is given in the "As Built Configuration List" and the NCR's.

3.5 Cryostat Configuration

The cryostat status at start of cool down and filling

- The He S/S is filled with GN_2 or GHe at ambient pressure and ambient temperature

- Filling airlock with SV 121 is mounted
- The safety unit with SV622 is connected
- The SV922 is operational
- Turbo pump 'A' (C0711) mounted to SV 921 airlock for continuous evacuation of the cryostat during cool down
- 16 strap pretension measurement devices are mounted to the strap pre-tensioning devices strap pretensions shall be between 5 - 20 kN
- the Cryo SCOE shall be operational and instrumentation connected
- CVV vacuum is < 10^{-4} mbar
- The cryostat cover cooling loop is connected to the transfer lines and a slight overpressure of 0,5 1,5 bar GHe will be monitored with a pressure gauge. The cooling loop has been leak tested after integration into the cryostat, otherwise the test has to be performed before cool-down acc.

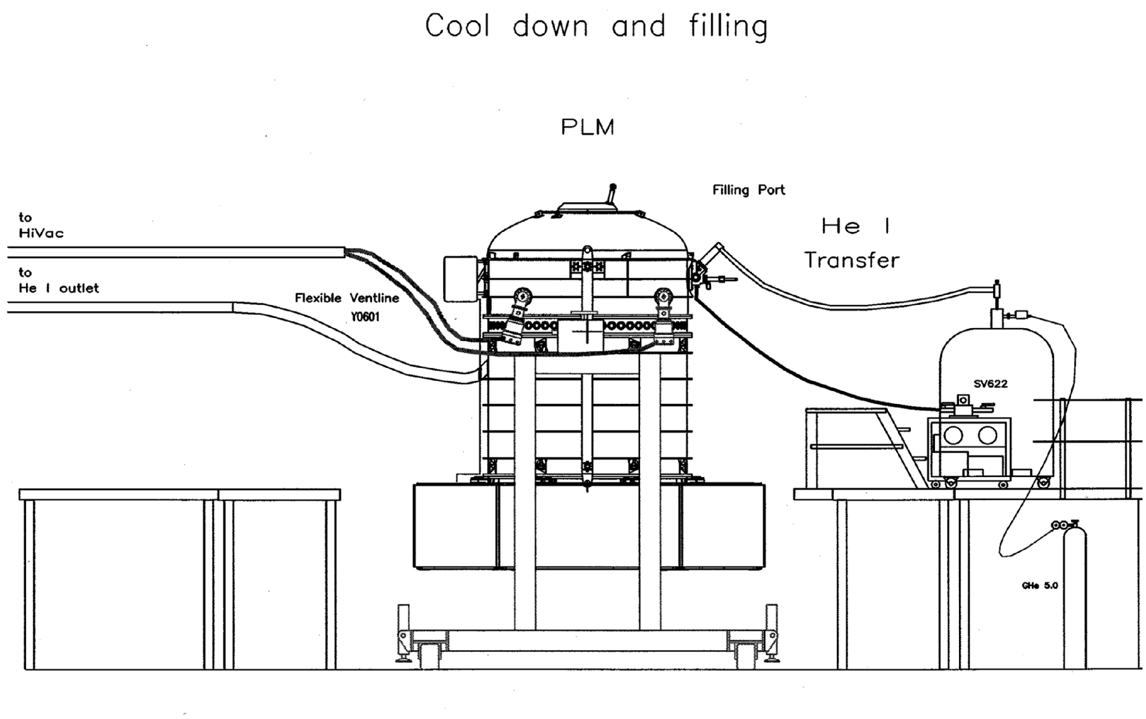


Figure 3-6: Set-up principle during cool down and filling

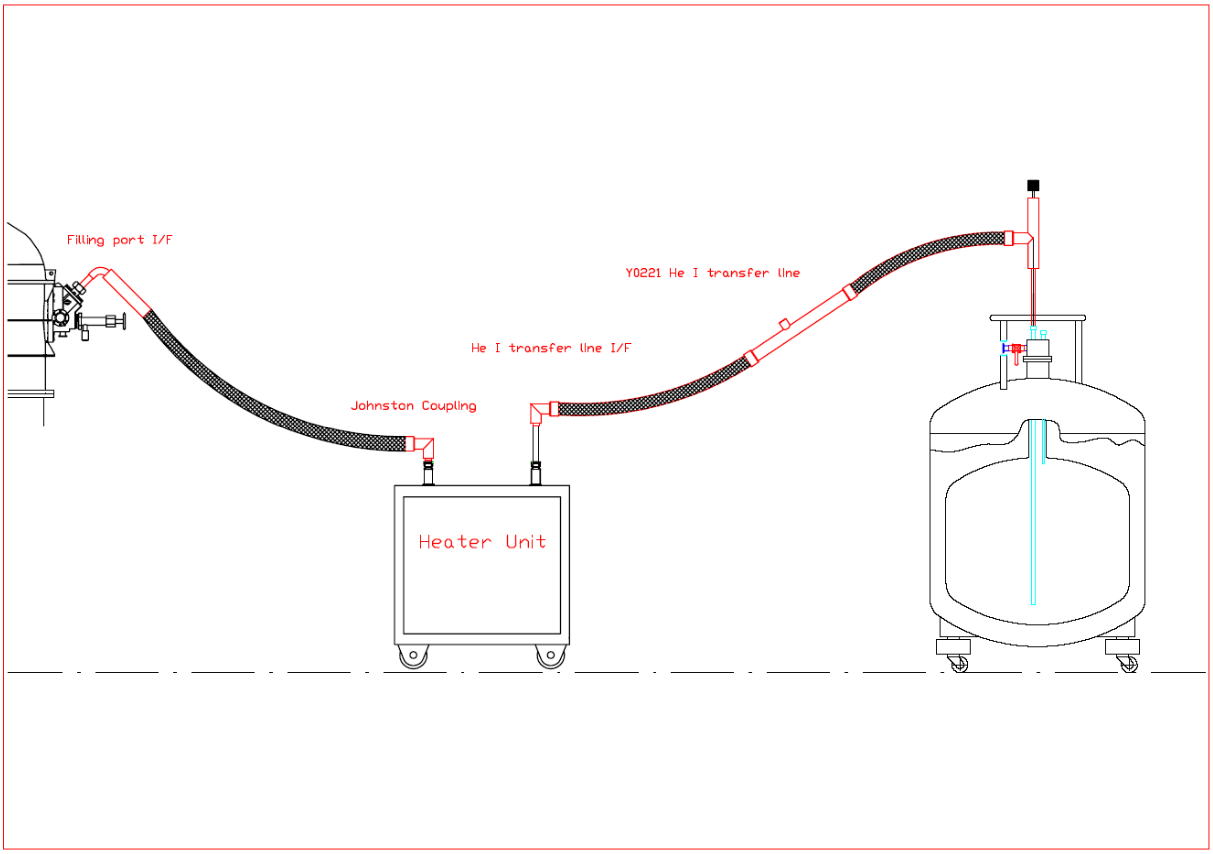


Figure 3-7: set-up for cool down with HEXA

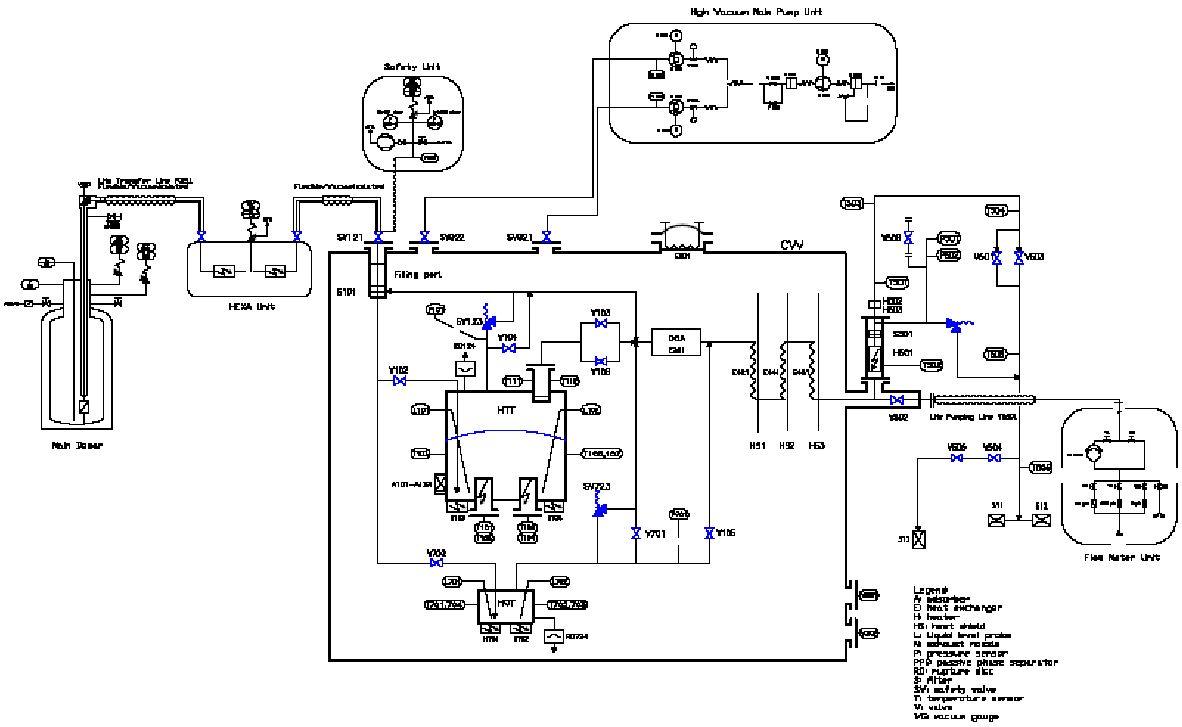


Figure 3-8: CVSE for cool down and filling

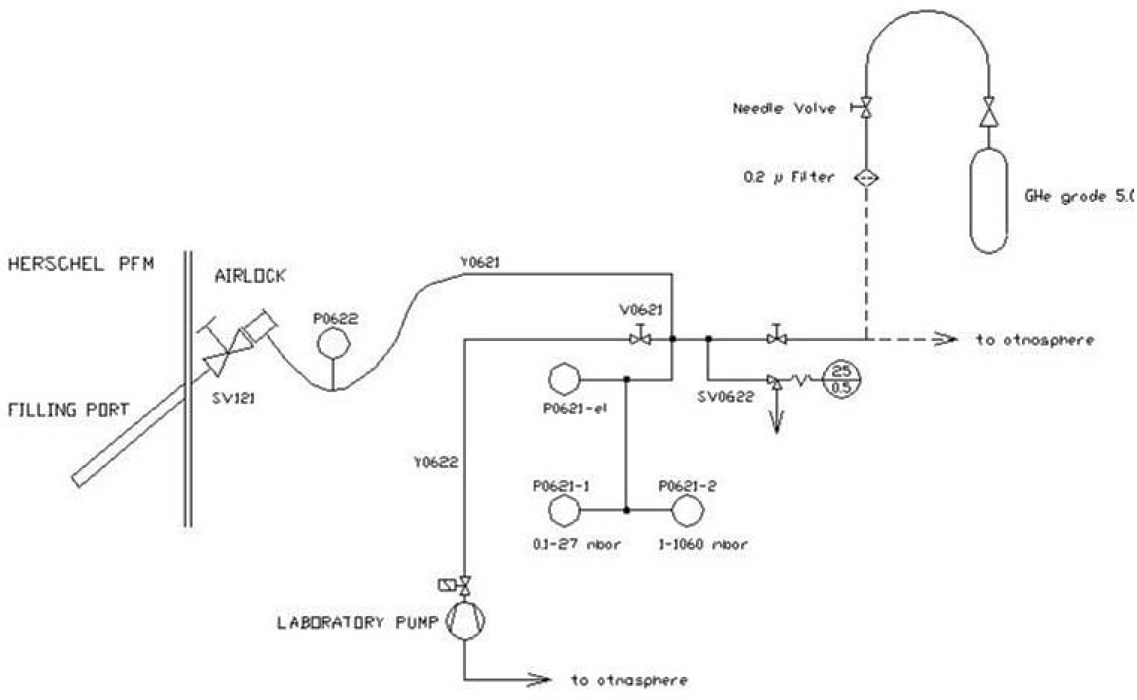


Figure 3-9: Safety Unit

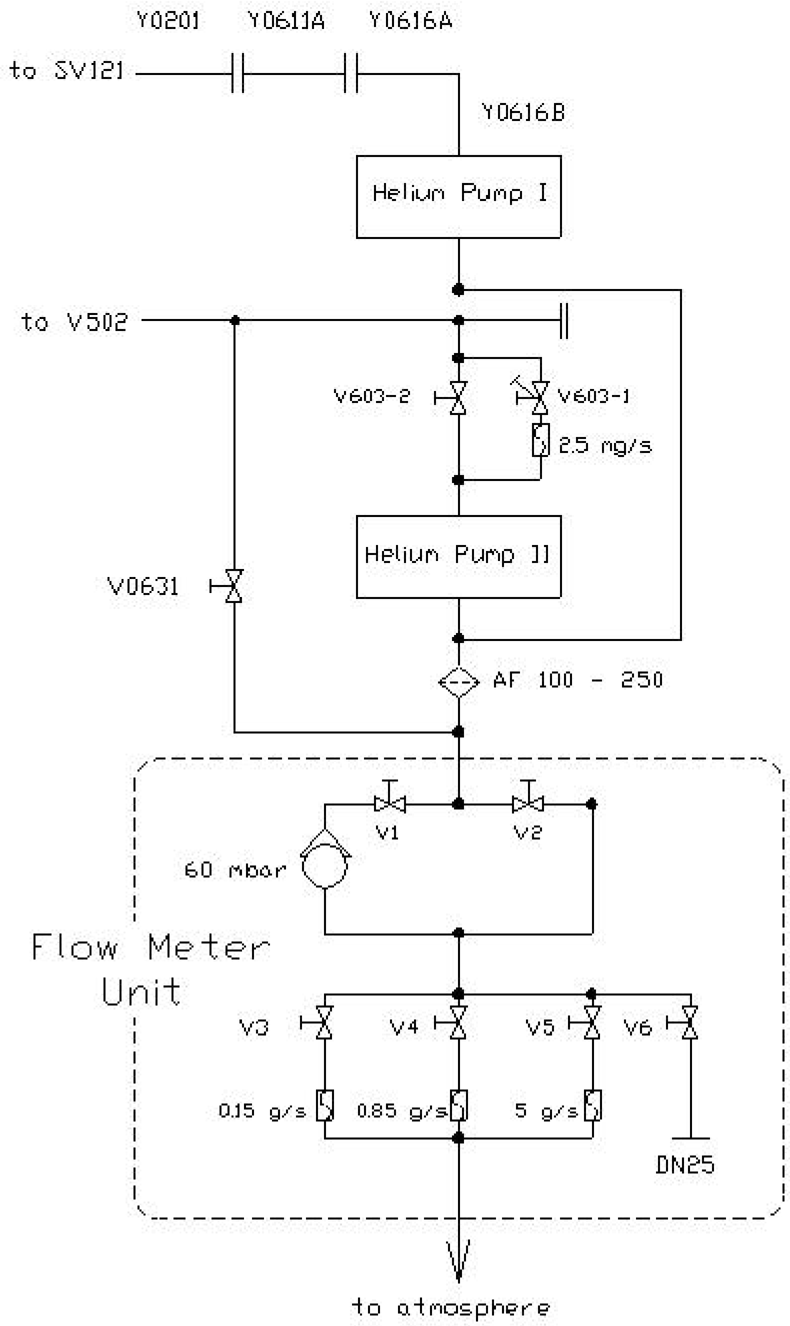


Figure 3-10: Flow Meter Unit

4 Test Overview / Execution / Results

4.1 Test Execution Summary

The cool down and filling was performed following the red marked procedure.

The cool down and filling in coarse steps:

Procedure Nr.		Activity	comment
5.1	**Preparation of LHe Transfer Line**	Preparations	Performed
		Flushing of transfer line with GHe	Performed
5.2	**Check of PLM Status**	Configuration check	Performed
		Helium system flushed with GN2 or GHe	performed
		strap pretension 5 - 15 kN	Strap pretension performed according procedure HP-2-ASED-TP-0133
		Isolation vacuum < 1 x 10^{-4} mbar	7 E-6 mbar
		SV922 installed	Performed
		Valve status check installation of safety unit with SV622 with line Y0621	Performed
		Installation of vent line Y0601/Y0602	Performed
5.3	**Installation of Auxiliary Lines and Components**	Evacuation of tubing via V 502, V 105 and V 701	Performed, V502 blind-flanged
		Leak test of He S/S	performed
5.4	**Installation of transfer line**	Installation of transfer line in dewar and in HEXA	Performed
		Installation of transfer line in SV 121 air lock	Performed
		Evacuation and purging of filling airlock	Performed
5.5	**Evacuation and purging**	Evacuation and flushing of transfer line and air lock	Performed
		Evacuation and flushing with GHe of the He S/S	Measured internal pressure of 3.7E-7 mbar NCR 3952 raised, Leak

Procedure Nr.		Activity	comment
			detected in the HOT area, HOT closed V 705 and V105 closed (13.02.2008) Procedure updated after Helium leak
5.6	**Cool down of the cryostat**	Initiation of flow	Performed
		Valve switching parameters	Performed
		Cool down to 50 K	Performed
		Insertion of transfer line directly into the filling port air lock (removal of HEXA)	Performed
		Cool down to 4.2 K	Performed
		Partly filling the HTT	Performed
		Thermalisation	Performed
		Continuous leak detecting on the CVV vacuum	Performed
5.10	**Liquid helium filling**	Filling of the HOT after thermalisation	Not performed
		Filling of HTT	Performed
		Mounting of flow meter after end of filling	Performed
		Venting via V 502	performed

4.2 Test Result Summary

The following final configuration was achieved:

- HTT Temperature T= 4.29 K
- HTT internal pressure P= 1.042 bar
- HTT Filling level 87,6 %
- HOT Filling level 0%
- Helium background < 6e-9 ml/sec
- Strap pretension F=25,9±1 kN

The maximum temperatures gradients of the HTT and L1, L2 are shown in Figure 4-4 Figure 4-5. The instrumentation did not allow verifying the L0 temperatures at the instrument interfaces directly. The temperature sensor T 103, which is at the bottom of the HTT showed temperature gradients significantly higher than the temperature sensors at the top of the HTT (VT 103 and VT 106) during the cool down, see Figure 4-5. For the verification of the requirement the values of VT 103 and VT 106 are used.

- At a temperature T < 50 K; maximum temperature gradient 60 K ; no requirement
- Temperature between 50 K < T< 80 K ; maximum temperature gradient < 50 K ; requirement < 50 K
- Temperature T > 80 K; maximum temperature gradient < 20 K; requirement < 35 K

Cool-down and warm-up speed: 5K/h above 50 K, no requirements below 50 K.

- 300 K to 80 K average gradient 1 K /h
- 80 K to 50 K average gradient 2 K /h
- Local peaks show higher cool down speed, but the temperature gradient is well within the requirements

For the cryostat no specific temperature gradients are required. The following figures are given for information.

The temperature gradient for the HOT is shown in Figure 4-1

The temperature gradient for the HTT is shown in Figure 4-2

The temperature gradient of the Thermal Shields is shown in Figure 4-3

The temperatures of the Optical Bench are shown in Figure 4-6

The temperatures of the Upper and Lower Spatial Frame are shown Figure 4-7

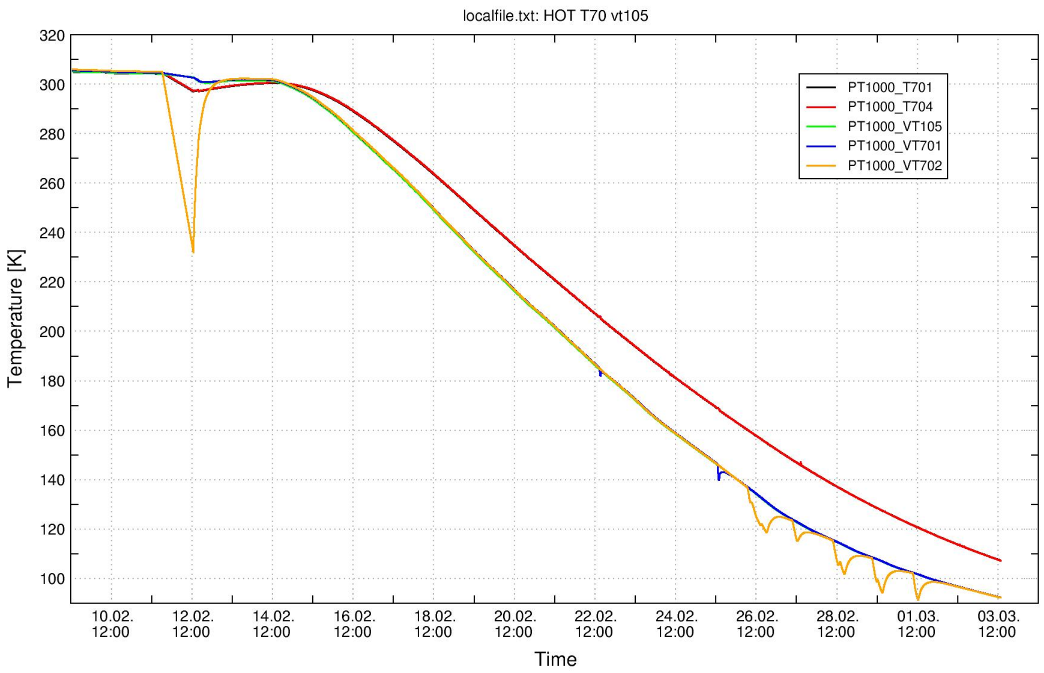


Figure 4-1 HOT Temperatures during Cool Down

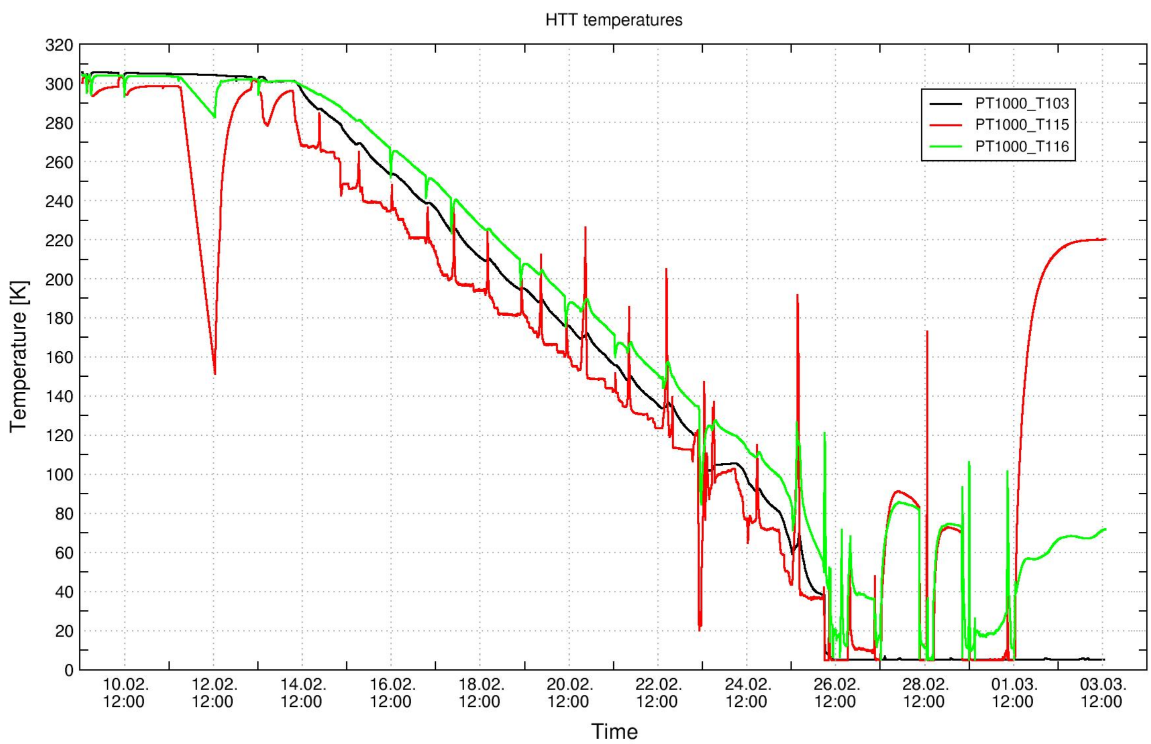


Figure 4-2 HTT Temperature during Cool Down

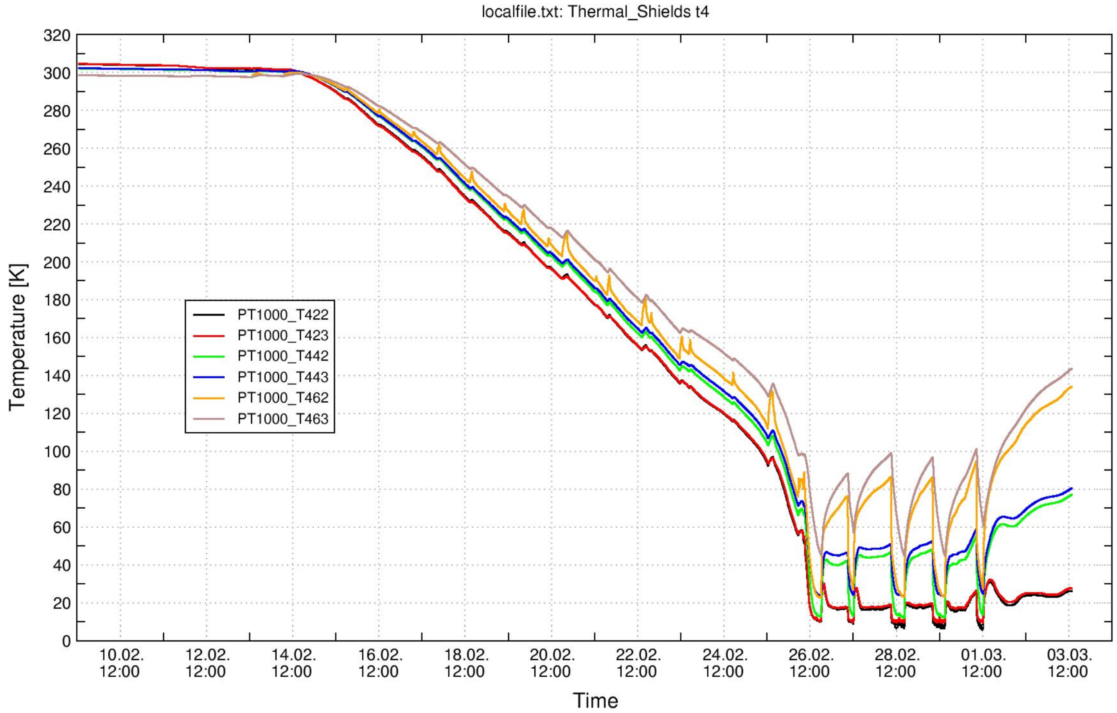


Figure 4-3 Temperature of the Thermal Shields during Cool Down

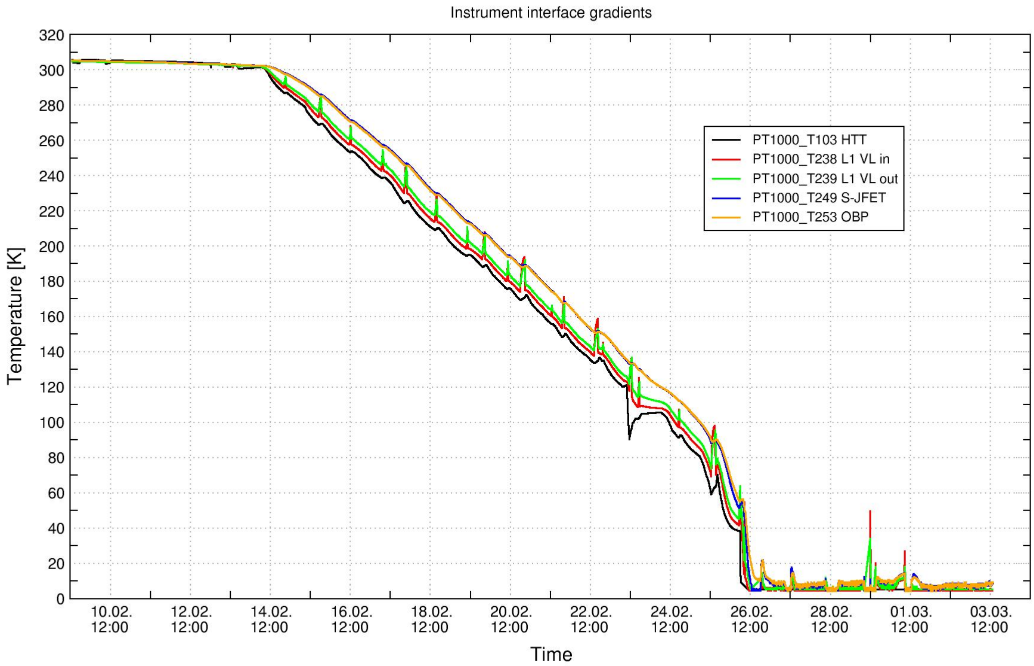


Figure 4-4 HTT and L1 and L2 Temperatures during Cool Down

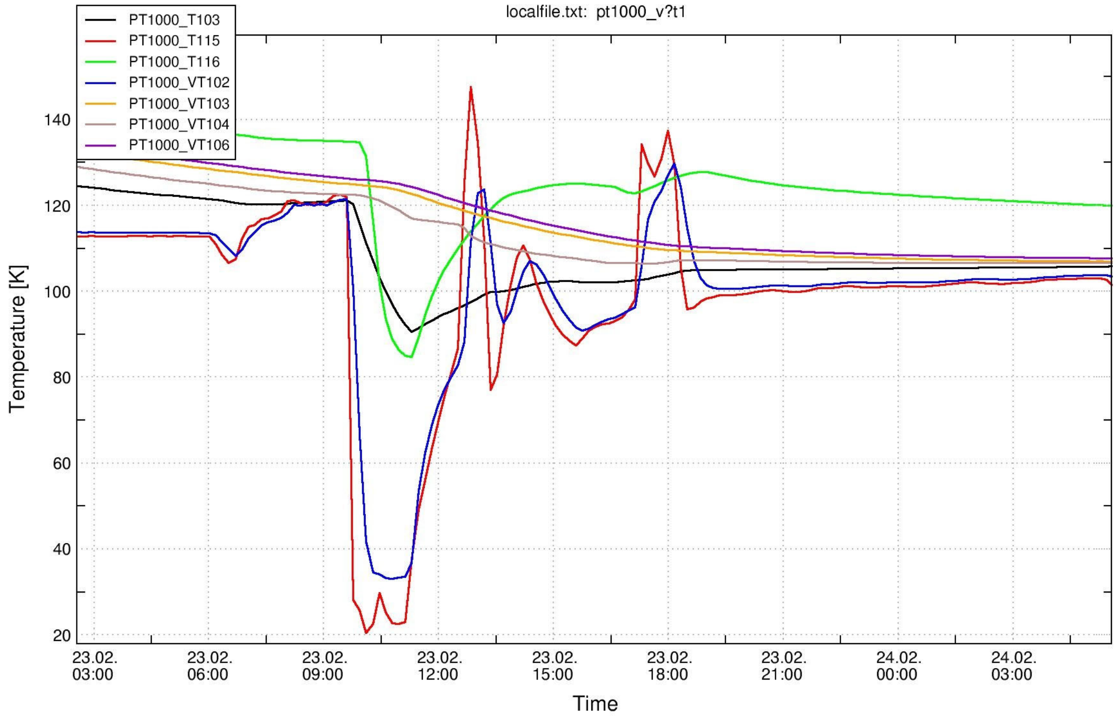


Figure 4-5 HTT Temperatures during Cool Down detail between the 23rd and the 24th.

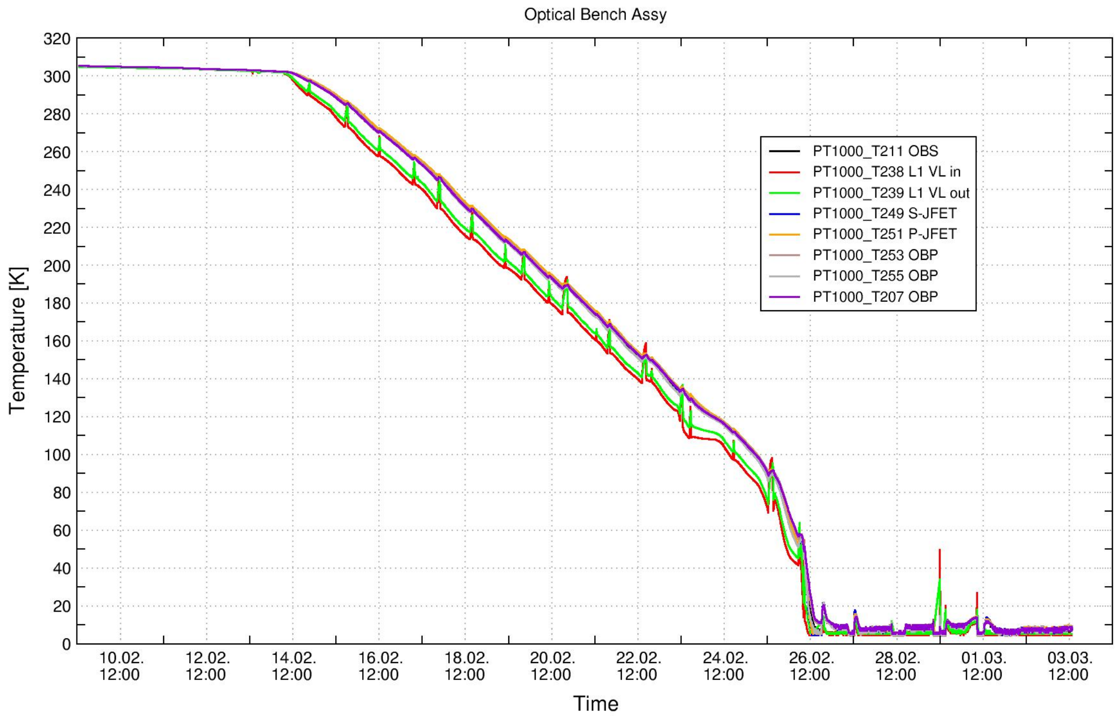


Figure 4-6 Optical Bench Temperature during Cool Down

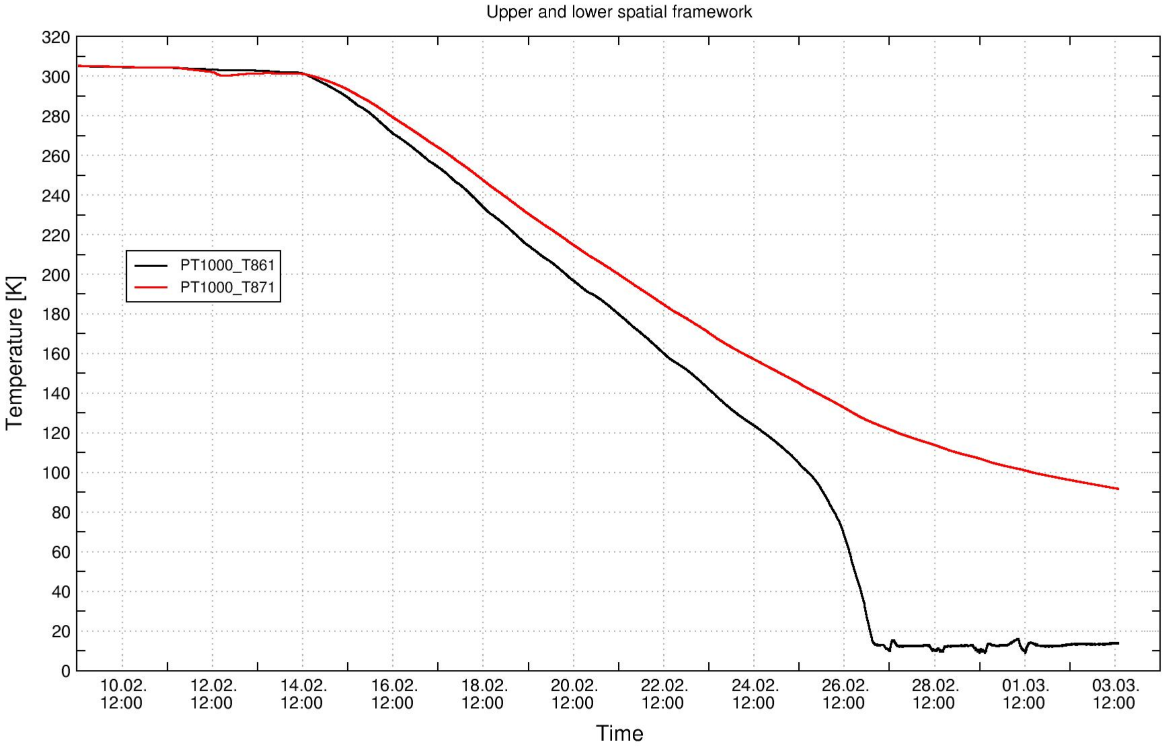


Figure 4-7 Temperature of Upper and Lower Frame Work

4.3 Open Work

none

5 Procedure Variations

Two procedure variation were raised .

Procedure variation 1

Reason for change: flushing of external vent line

Date: 09.02.2008

Test step changed: 5.5

Change:

In order to evacuate and flush the external vent line including the A frame (closed by the dear head) the valve V 501 shall be opened during 5.5.2 "Evacuation / Pressurization cycles". The valve V 501 shall be closed before 5.6 " Cool down of cryostat".

Procedure variation 2

Reason for change: Leak rate too high; NCR 3952

Date: 10.02.2009

Test Step changed: 5.5.2.7

Change:

When the He S/S is evacuated <20 mbar:

1. close V104,V105,V102;V702 (all internal)
2. Flush the He S/S tubing with GHe from Dewar to ~1 bar. Wait for 20 min, note leak rate
3. Open V105 and V 702 and flush to ~1 bar, wait and note leak rate after 20 min.
4. Open V102 and V 104 and flush to ~1 bar, wait and note leak rate after 20 min. Verification of HTT leak tightness, close V102 and V104 (HTT at 1 bar GHe), evacuate the He S/S including HOT until leak rate is below 1E10-8 mbar l/sec. Afterwards the He S/S + HOT will be kept under vacuum for further evacuation until next NRB.

6 Non-conformances

One non-conformance was raised.

NCR number: HP-121000-ASED-NC-3952

Title: Leak rate of the He S/S higher than nominal.

The Helium leak was localised in the area of the HOT. The NRB has decided to evacuate and to valve off the HOT. The HOT will consequently not be used during the launch autonomy.

The NCR is closed, see also the RfW HOT will not be used for SAT FM ground tests and launch autonomy, HP-2-ASED-RW-0009; issue 1.1

7 Conclusion

The cool down and filling of the PFM cryostat has been performed following the procedure including the two addressed procedure variations. The following final status was achieved

- HTT Temperature T= 4.29 K
- HTT internal pressure P= 1.042 bar
- HTT Filling level 87,6 %
- HOT Filling level 0%
- Helium background < 6e-9 ml/sec
- Strap pretension F=25,9±1 kN

All objectives as defined in the procedure were achieved.

The temperature gradients and the cool down speed were within the Instrument requirements.

One mayor non conformance, HP-121000-ASED-NC-3952, was raised during the test: Leak rate of the He S/S higher than nominal. The NRB has decided to evacuate and to valve off the HOT. The HOT will consequently not be used during the launch autonomy. This decision has a significant influence on the:

- Launch preparation
- Launch autonomy
- LEOP phase
- Lifetime
- verification tests

The NCR is closed.

The cool down and filling has been performed successfully.

8 Annex 1: As-run Procedure (Filled out TP)

red lined copy for PFM cool down

As Run

Title: **Herschel PFM Cool down and filling**

This procedure contains hazardous operations

CI-No: 121000

Prepared by:	M. Langfermann	Date:	21.09.07
Checked by:	R. Hohn		24.09.07
Product Assurance:	R. Stritter		24.09.07
Configuration Control:	W. Wietbrock		24.09.07
Project Management:	W. Fricke		24/09/07

Distribution: See Distribution List (last page)

Issue	Date	Sheet	Description of Change	Release
1	30.06.05		Initial issue for STM phase	
2	19.04.06		Modifications for PFM 1.3 FPU requirements §3.5 and §5.10, valve heating in case of filter blockage §5.6 FPU requirements as temperature gradient limits added §5 log sheets replaced by cryostat log book ANNEX Log Sheets removed §1 applicable for He-I refilling	
3	19.06.06		§ 3.2 and 5.10 He 3 background measurement due to presence of sorption coolers. § 3.5 wording: The HOT shall always be the colder than the HTT and OBA $ 5 strap tension measurements introduced § 5.6 leak test of cryo cover added	
4	03.07.07		New helium heat exchanger HEXA added in general 3.1 cryostat description deleted, only helium control system diagram remains figure 3.6 deleted 3.3 temperature determination of L0, L1, L2, and L3 added 3.4 1.1 Approach to fulfil the FPU requirements added 5.6 cryo cover leak test removed (is now part of the leak test procedure) 5. Step by step modifications because of FPU requirements and new HEXA operations	
4.1	21.09.07		Change on request of TAS-F (H-P-ASP-MN-9577 § 5.2.1.7 introduced: overpressure in the cryo cover	

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List of Tables

1 Scope

1.1 Objective

This test procedure describes the cool down of the Herschel PFM cryostat to 4.2 K and the filling of the Herschel HTT. Cool-down and filling will be started after evacuation and successful leak test at ambient temperature. This procedure can also be used to refill the cryostat (HTT and/ or HOT) with liquid helium (He-I) if necessary.

This Technical Operations Procedure summarises the nominal activity flow, operational and safety constraints, GSE set up and the step by step procedure.

1.2 FPU Requirements (acc. to AD 02)

During cool_downt of the PFM including the FPU's the following requirements have to be regarded:
Temperature gradients (cool-down & warm-up)
The temperature gradient between any of the Herschel Instrument
Interface (L0, L1,, L2) shall not exceed the following limit:
T <50K: no requirements
50K<T<80K: Gradient <50K
T > 80K: Gradient < 35K

Coool-down and warm-up speed: 5K/h above 50 K, no requirements below 50 K.

1.3 Activity Flow

The activity flow below summarizes the activities to be performed during cool down and filling. Cool down and filling is completed with the steps in section 5.6. Sections 5.7 to 5.9 have to be repeated for each exchange of dewar.

The cool down and filling in coarse steps:

5.1	**Preparation of LHe I Transfer Line**	Preparations Flushing of transfer line with GHe
0	**Check of PLM Status**	Configuration check according chapter 3.1 and 3.6 Helium system flushed with GN2 or GHe strap pretension 5 - 15 kN Isolation vacuum < 1 x 10^{-4} mbar

		SV922 installed Valve status check installation of safety unit with SV622 with line Y0621 Installation of vent line Y0601/Y0602
5.3	**Installation of Auxiliary Lines and Components**	Evacuation of tubing via V 502, V 105 and V 701 Leak test of He S/S
5.4	**Installation of transfer line**	Installation of transfer line in dewar and in HEXA Installation of transfer line in SV 121 air lock Evacuation and purging of filling airlock
5.5	**Evacuation and purging**	Evacuation and flushing of transfer line and air lock Evacuation and flushing with GHe of the He S/S

5.6	**Cool down of the cryostat**	Initiation of flow Valve switching parameters Cool down to 50 K Insertion of transfer line directly into the filling port air lock (removal of HEXA) Cool down to 4.2 K Partly filling the HTT Thermalisation Continuous leak detecting on the CVV vacuum
5.8	**Establish safe configuration for interrupts (overnight, week-end)**	• Establish safe configuration: • Restart
5.9	**Exchange of LHe Dewar**	• Removal of transfer line • Installation of new dewar and transfer line

5.10	**Liquid helium filling**	Filling of the HOT after thermalisation Filling of HTT Mounting of flow meter after end of filling Final configuration: • HTT filled with LHe I • Venting via V 502

2 Documents

2.1 Applicable Documents

[AD1] H-EPLM Environment and Test Requirements Specification, HP-2-ASED-SP-0004, issue 3

[AD2] Herschel Instruments FPU Straps Temperature Gradients, H-P-100000-ASP-RD-0013

[AD3] Helium Subsystem Safety Analysis, HP-2-ASED-AN-0002

[AD4] PA Plan; HP-2-ASED-PL-0007

2.2 Reference Documents

[RD1] Doc. Identification Procedure and Doc. Management, HP-2-ASED-PR-0001, issue 3

[RD2] CVV Evacuation and Leak test Procedure HP-2-ASED-TP-0071, issue 1

[RD3] Description of the EPLM - FM Cryo Control Instrumentation, HP-2-ASED-TN-0048, issue 2

[RD4] Herschel Cryostat Cover Handling and Operations Manual, HP-2-AAE-MA-0003, issue 4.0

[RD5] Contamination Control Plan, HP-2-ASED-PL-0023

[RD6] Helium Subsystem description; HP-2-ASED-RP-0034

[RD7] Herschel FM Cover Flushing; HP-2-ASED-TP-0106

[RD8] Cryo-SCOE operations manual, HP-2-ABSP-MA-0001

2.3 Abbreviations

All abbreviations used within this document are listed in [RD1].

3 Configuration

3.1 Helium control system

The Herschel Helium Control System consists of all components which are in contact with cryogenic fluids (super-fluid and normal boiling Helium).

The Herschel Helium Control System, is shown in Figure 3-1

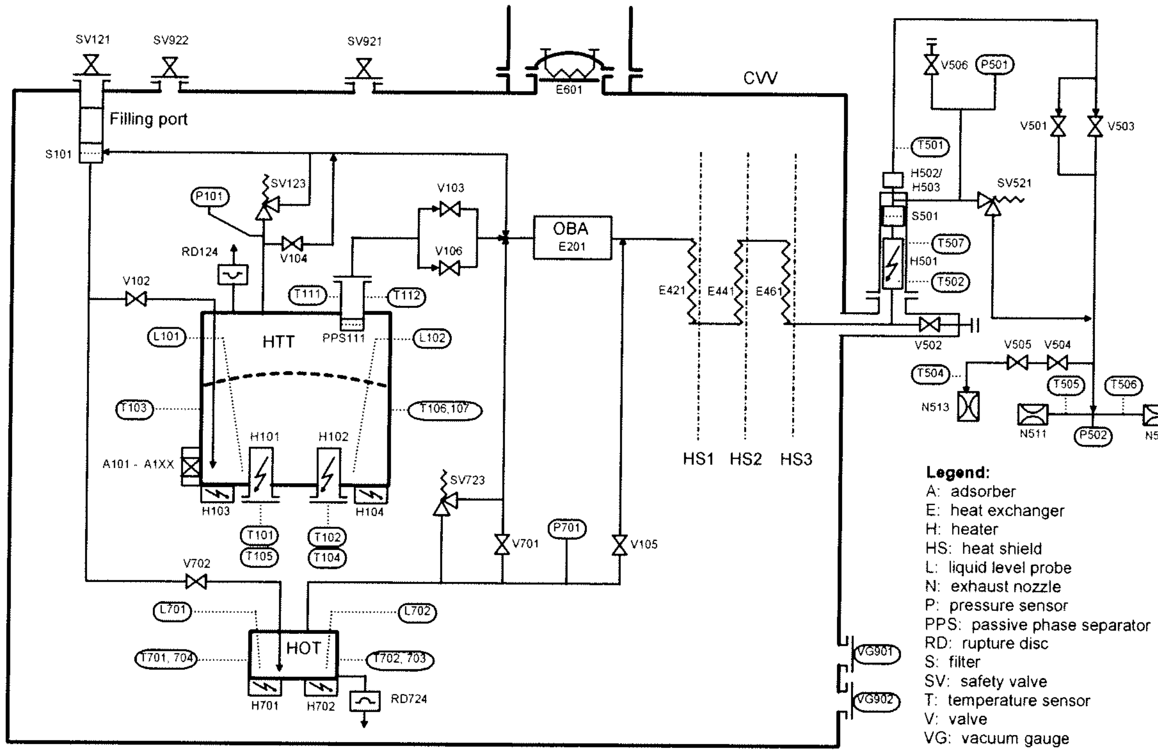


Figure 3-1: Helium subsystem flow diagram

3.2 Principle of the cool down and filling with liquid helium

The cool down of the cryostat will be performed with GHe provided from a LHe-Dewar and heated to an adjustable temperature by a dedicated Helium heat exchanger (HEXA). At temperatures below ~80 K the HEXA will be removed and the LHe Dewar directly connected via the LHe transfer line to the filling port air lock for further cooling and liquid filling.

For cooling of the Herschel cryostat liquid helium in high purity quality in dedicated dewars with 450 l volume will be used. This helium will be transferred via vacuum isolated lines (partly flexible) and a Helium heat exchanger (HEXA) into the filling port. From there the helium can be routed either through the HTT (V102 in and V104 out) or the HOT (V702 in and V105 out, bypassing the OBA) by switching the electromechanical valves (V102, V702).
After passing the HTT the flow continues through the OBA with the FPU's and the thermal shields (see also Figure 3-6). The flow outlet at the CVV is the valve V502 where another line, with the first part vacuum isolated, is connected. This line is routed through an arrangement of mass flow meters, selectable by hand valves, and then finally vented to the atmosphere outside of the process facility.

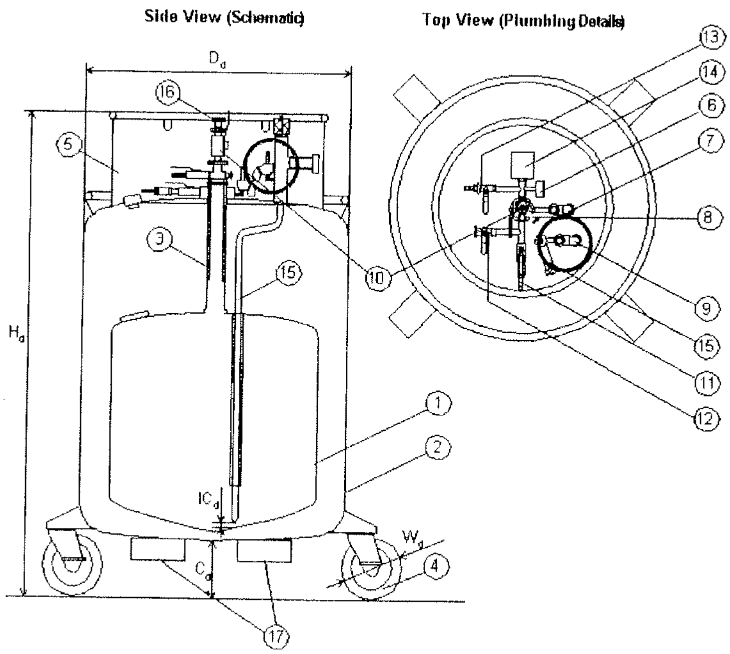
The external vent line system is only used for pressure monitoring during this operation.
The helium flow can be controlled by varying the pressure difference in the system, either by the pressure inside the supply dewar or by valves in the filling or venting line.

In order to maintain the high purity of the helium all parts of the connected volumes have to be flushed before cool down.

Since cool down is performed with helium over ambient pressure, leak tightness of the various components is not mandatory except inside the CVV vacuum, where continuous leak detecting is required.

After cool down a background measurement for Helium 3 shall be performed, to ensure tightness of the sorption coolers from PACS and SPIRE.

The helium Dewars (see Figure 3-2) are equipped with a pressure indicator, a liquid level meter, combined with an adjustable pressure controller (Figure 3-3).



Item	Description
1	inner vessel
2	outer vessel
3	collar tube
4	castor
5	protective collar
6	pressure gauge
7	safety valve, gaseous phase
8	safety valve, collar tube
9	safety valve, liquid phase
10	mobile head assembly
11	overflow valve assembly
12	gas withdrawal assembly
13	pressure build-up assembly
14	oscillation damper
15	integrated LHe transfer tube
16	compression joint
17	fork lift recesses
Dd	external diameter
Hd	total height
Cd	ground clearance
ICd	inner clearance of tube
Wd	castor diameter

Figure 3-2: 450 l helium dewar principle

Cylinder free Pressure Built-Up

- Automatic Pressure Adjustment via PID Controller and Heater
- Permanent Display of LHe Level
- Safe Operation:
  - ➡ Automatic Switch-Off of the Heater when Dewar is Empty
  - ➡ Acoustic Alarm when Dewar is Empty

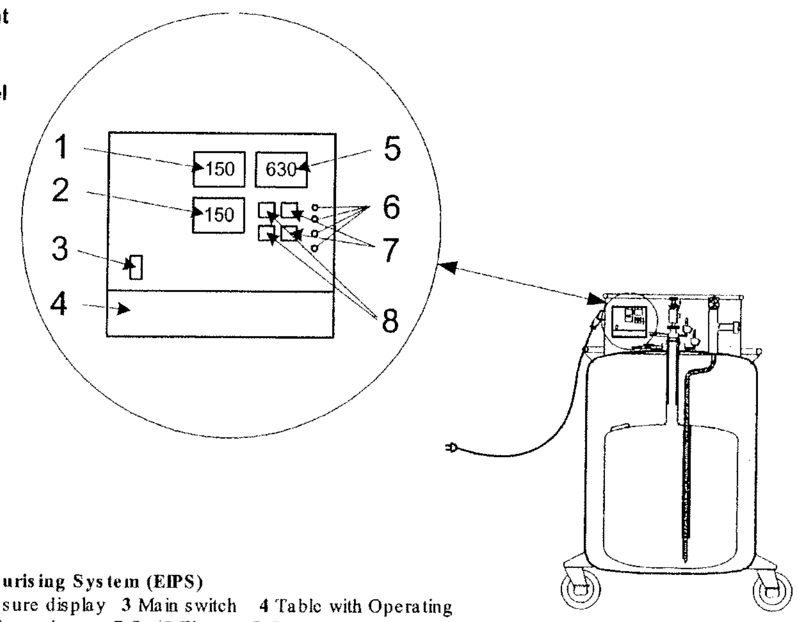


Fig. 4B: Electronic Internal Pressurising System (EIPS)
1 Actual pressure display 2 Setpoint pressure display 3 Main switch 4 Table with Operating instructions 5 Filling level indicator 6 Indicator lamps 7 On/Off button 8 Pressure adjustment button

Figure 3-3: dewars display

3.3 Temperature determination of L0, L1, L2 and L3

For PACS and SPIRE FPU's the main masses (housing ~70 kg) are thermally linked to the Level 1, which are connected to the level 1 cooling line by flexible links (designed for operational conditions). The cooling line is equipped with two Pt1000 (T238 and T239) temperature sensors capable to measure the range fro 20 to 370 K. These sensors have been introduced because of the above requirements. In order to determine the L1 temperature the flow through the vent line has to stop for one hour. The readings from T238 and T239 should show an average for Level 1 afterwards.

The cooling line to the OBP, the level 2, has a good thermal connection to the plate carrying the housing of HIFI. The sensors T207, T255, T253 will be used for Level 2 determination.

For Level 0 there is also no direct temperature measurement, but since the thermally good connected masses on FPU side are low, the HTT upper bulkhead temperature is representative. The PT1000 of the (closed) valves VT103 and VT106 are selected for L0 temperature determination.

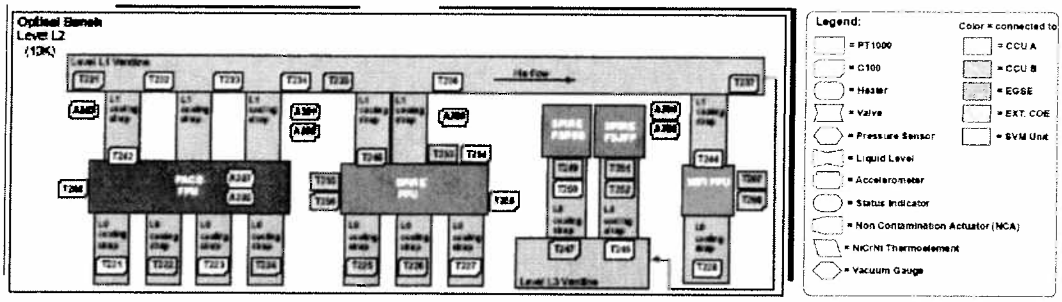


Figure 3-4: Optical bench temperature sensors

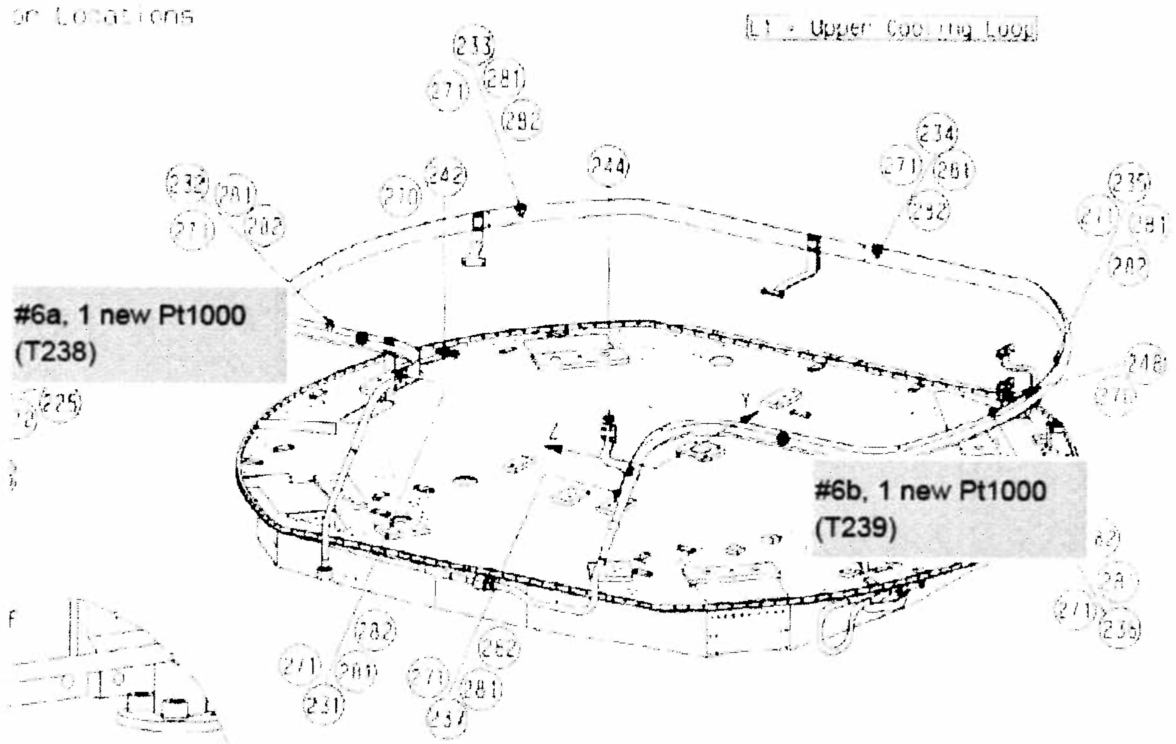


Figure 3-5: the two PT1000 sensors on the level 1 vent line on OBA shown w/o FPU's

3.4 Approach to fulfil the FPU requirements

The 5 K/hour maximum gradient is considered to be unlikely to be violated because of the high masses and flow limitations in the system. Warning (4K/H) and alarm limits are continuously monitored from the SCOE.

The maximum gradient between the different levels has to be controlled by means of flow and inlet temperature adjustments. The maximum flow can be achieved via the safety line by-passing the HTT. The transfer line inside the filling port has to be extracted by ~30 mm from its end position. The HTT valves V102 and V104 can be kept open. In this configuration the maximum difference in temperature can be expected between L2 and L0, since L1 will follow L2 slowly. The thermal shields will cool down fast and the radiative cooling will enhance the process. The flow/ temperature properties have to be adjusted for gradients >25 K and the flow terminated for gradients >30 K, this is valid for any of the above mentioned sensors differences. A script running on the Cryo-SCOE will indicate this on the screen.

Another path is via the HOT (V105 and V702), by-passing the OBA with the transfer line inserted and V102 (HTT) closed. This path can be used to decrease the thermal shield 1 temperature for radiative heat exchange.

Table 1: Cryostat temperature sensors associated to the FPU cooling levels

Level 0	Level 1	Level 2	Level 3
VT103	T238	T207	T249
VT106	T239	T253	T251
		T255	

3.5 General Hardware Configuration

The H/W configuration is given in the "As Built Configuration List" and the NCR's.

3.6 Cryostat Configuration

The cryostat status at start of cool down and filling (principle shown in Figure 3-6 and Figure 3-6) shall be:

- The He S/S is filled with GN_2 or GHe at ambient pressure and ambient temperature
- Filling airlock with SV 121 is mounted
- The safety unit with SV622 is connected
- The SV922 is operational
- Turbo pump 'A' (C0711) mounted to SV 921 airlock for continuous evacuation of the cryostat during cool down
- 16 strap pretension measurement devices are mounted to the strap pre-tensioning devices strap pretensions shall be between 5 - 20 kN
- the Cryo SCOE shall be operational and instrumentation connected
- CVV vacuum is < 10^{-4} mbar
- The cryostat cover cooling loop ~~is at ambient pressure and closed with blind caps~~ is connected to the transfer lines and a slight overpressure 0,5 - 1,5 bar GHe will be monitored with a pressure gauge. The cooling loop has been leak tested after integration into the cryostat, otherwise the test has to be performed before cool-down acc. To para 5.6

3.7 Cryostat constraints

The HOT shall always be the colder than the HTT and OBA. The temperature difference to the HTT shall not exceed 100 K at temperatures above 50 K.

The pressure in the HeS/S shall not exceed 1.4 bar absolute.

Attention: Do not operate liquid level sensors at temperatures above 10 K:

Do not continuous operate L 101, L102, L701, L702 and operate only one sensor at any time

During cool down the strap pre-tensioning will change due to temperature gradients. The tension shall always be between 5 and 20 kN.

During cool down switching of the valves V102 and V702 is necessary to enable separate cooling of the tanks. Closing of one valve is allowed only when both vales are in the open position to avoid pressure waves.

It may occure that a filter inside the liquid helium valve gets blocked by frozen air. In this case the air shall be removed by using the valve heater acc. to §5.11

The two alignment windows on the -Y side shall be visible during cool down with a theodolite

The maximal allowable temperature gradients from the FPU requirements are given in 1.2

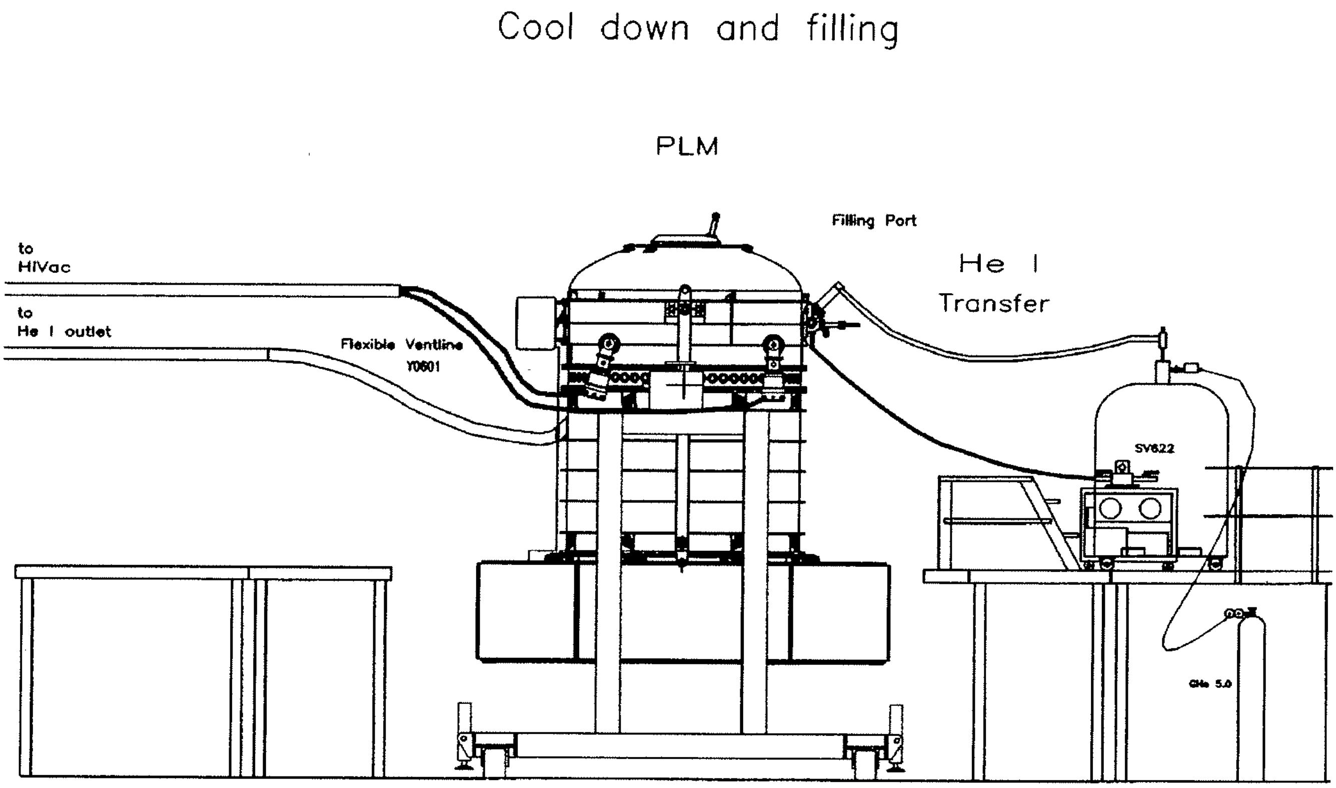


Figure 3-6: Set-up principle during cool down and filling

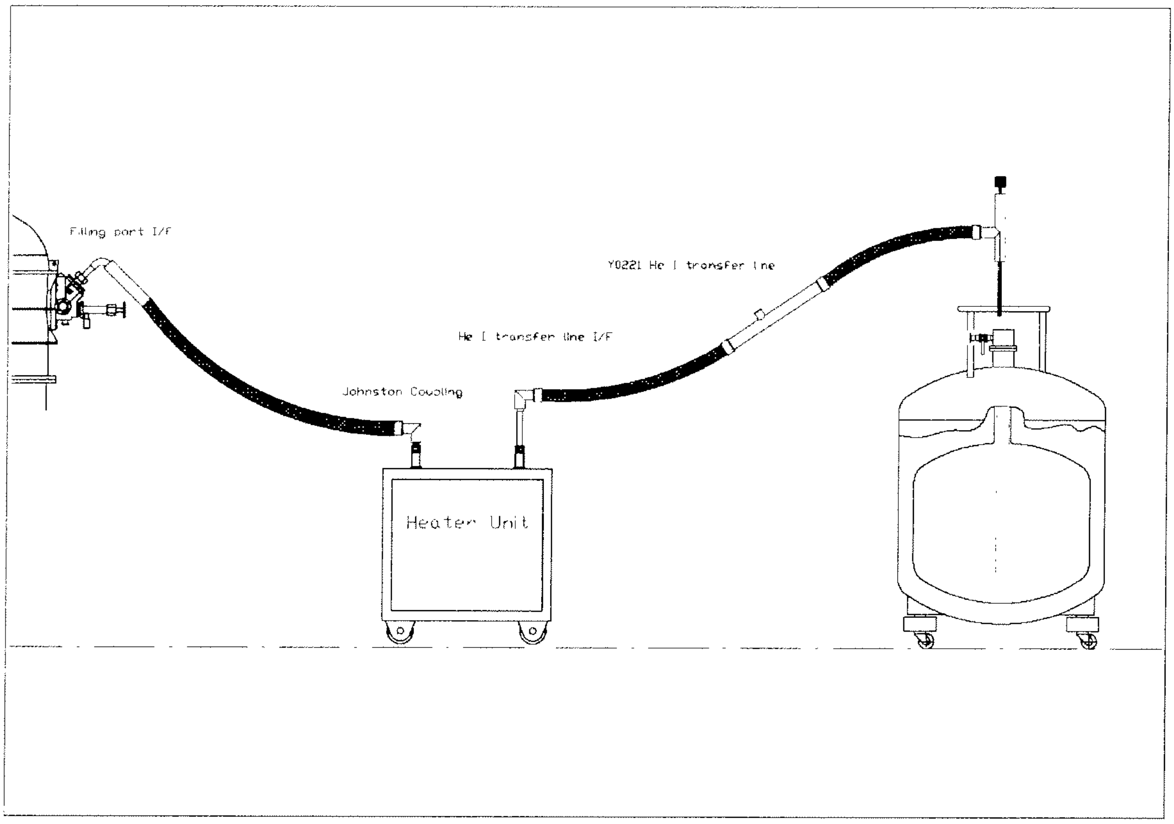


Figure 3-7: set-up for cool down with HEXA

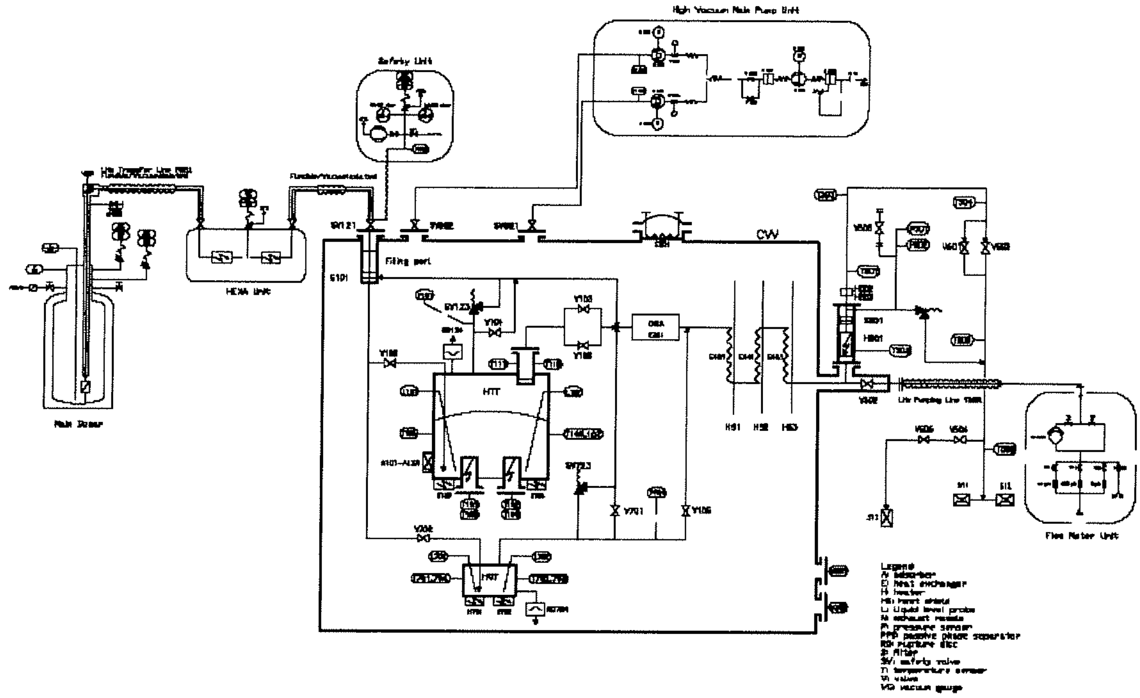


Figure 3-8: CVSE for cool down and filling

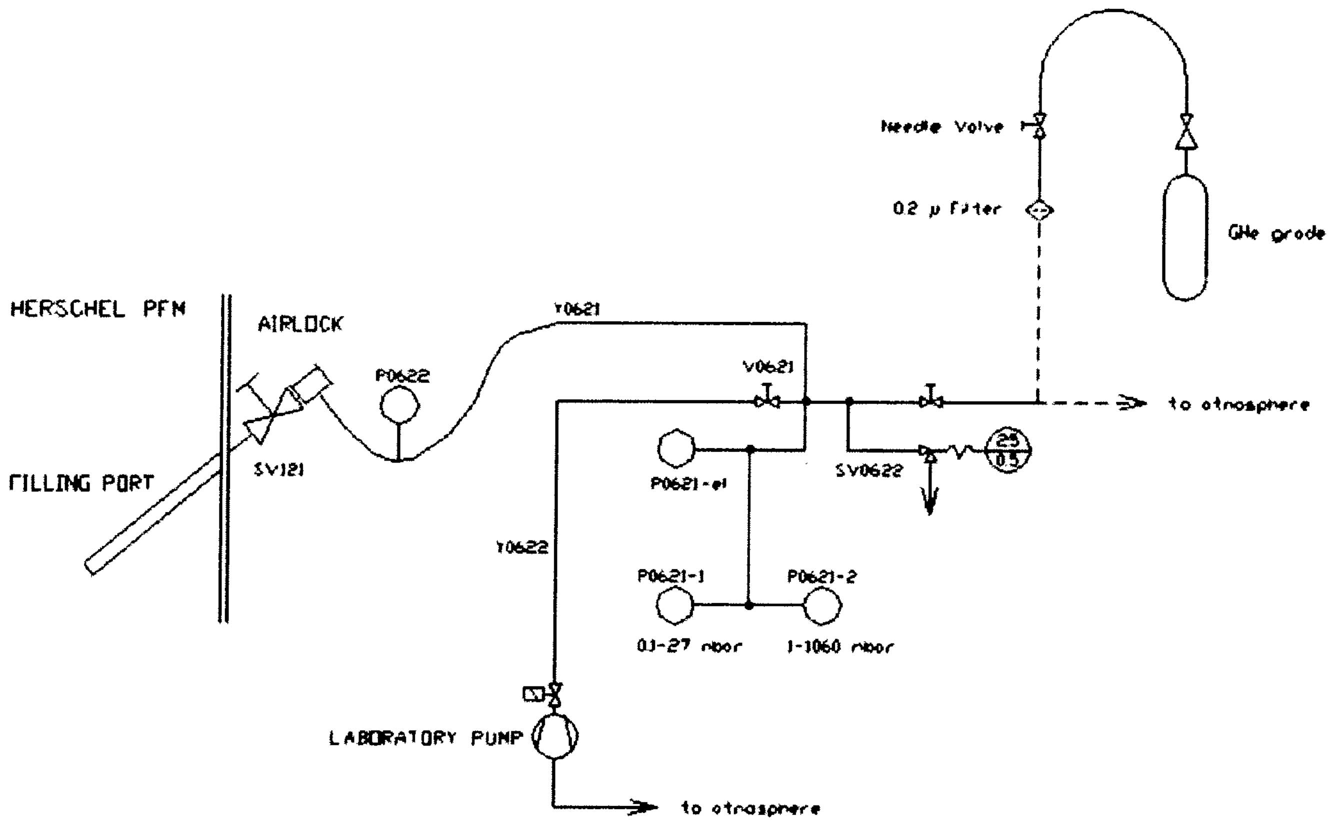


Figure 3-9: Safety Unit

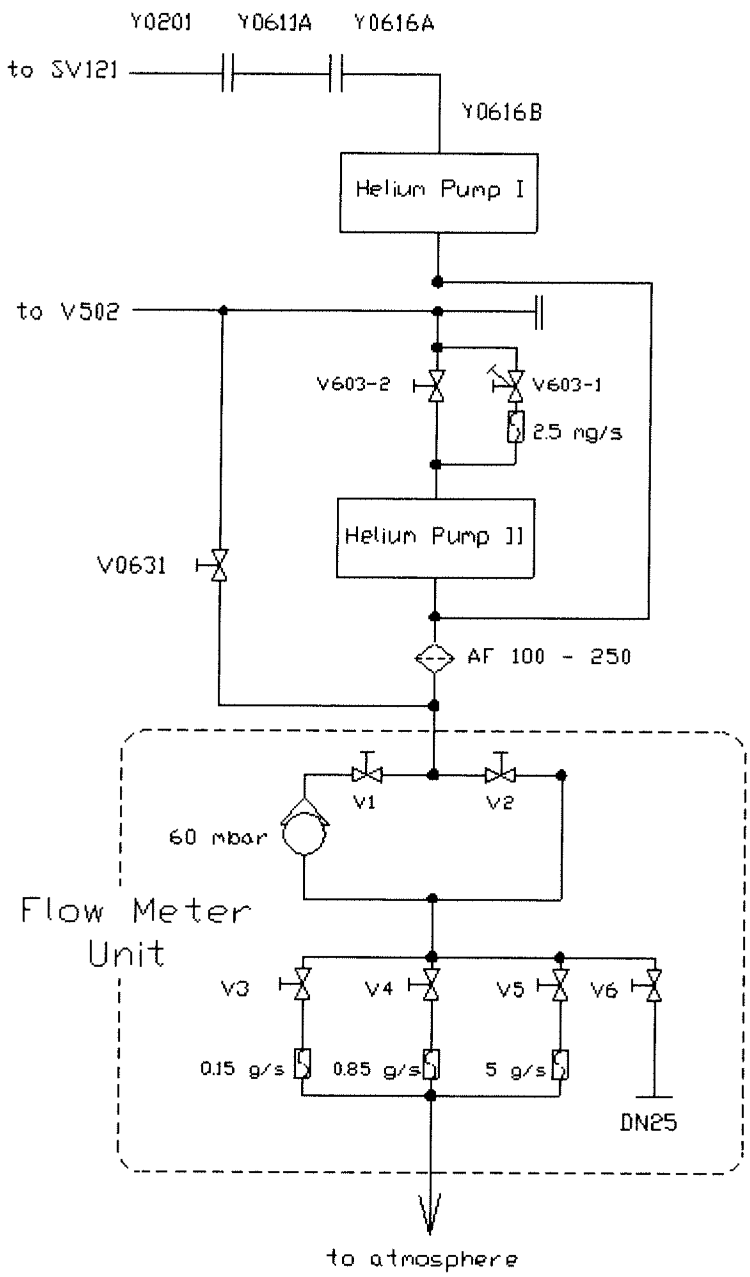


Figure 3-10: Flow Meter Unit

4 Conditions

During the cool down and filling the following personnel has to be present as appropriate:

Responsibility	Name / Organisation
Task Leader	H. Huber; M. Langfermann; A. Runge, H. Woehler
Support Staff	*)
Safety Officer/PA	*)
EGSE Operators	*)
Operations Manager	*)

*) Names and possible additional personal to be registered prior to the start of activities

The Task Leader shall be responsible for directing operations in accordance with this procedure. He shall be assisted by support personnel and will be the counterpart of implementation of any specific requirement set by the Facility representative

The Task Leader is the ultimately responsible for personnel safety due to the tasks defined by this procedure whether the task is defined as hazardous or not. The Task Leader must be knowledgeable about the relevant hazards and safety/emergency provisions, including emergency shut down

The Task Leader shall ensure all requests on site representatives and safety are complied with. Conflicts with previously agreed safety provisions shall be resolved between the Herschel Safety officer and the site safety office.

All activities related to the cryostat and its GSE shall be continuously recorded in the "Herschel cryostat logbook" with date, time, operators name (principle: when, who, what, where and why).

Photographs shall document the different test set-up's and other situations/operations.

The Herschel Safety Officer is responsible for an independent verification that all safety precautions are installed. He ensures that only essential personnel is within the working area. Additionally he ensures that the tasks will be performed in accordance with this procedure or that changes / non-conformances will be documented as necessary. He is also responsible to inform site safety at least 24 hours prior to perform a hazardous operation.

4.1 Precautions and General Safety Requirements

The operations described in this procedure require Liquid Helium. Therefore this procedure contains hazardous operations.

Helium itself is a non-toxic gas. The hazards to be expected are personal injuries from frostbites (cold surfaces, cold gas plumes), asphyxiation due to insufficient oxygen in the remaining air, loss of orientation due to dense fog generation and impacts of cold damaged structures.

Due to the amount of stored energy the Herschel cryostat is a pressure vessel and the general rules for pressure vessel design have to be followed. In addition to these general rules, the safety regulations at CSG launch site have to be considered. The application of these rules leads to a safety concept, which is based on the 'leak before burst' criterion. Herschel is based on the following safety and reliability philosophy:

- Two failure tolerant
- Three independent paths for overpressure relief
- Passive safety system for all operation modes (no active controls for monitoring is required at any time)

The following general safety Precautions shall be fulfilled:

A controlled area has to be established and maintained during hazardous operations

In general operations are considered as hazardous when parts are connected or assembled which contain or will contain or transport liquid helium. When the assembled systems are checked and the flow of liquid helium is established and verified, the task leader may release the controlled area.

Only trained personnel will perform the cool down and the Filling

Use of Buddy system is mandatory (minimal 2 persons in working area)

As far as necessary the personnel shall wear protective gloves, face shields etc.

Prior to begin a pre-task briefing shall be performed to inform all participants about purpose of operation, possible hazards and emergency shut down

After the approval of this procedure changes have to be under configuration control. Online deviations (only non hazardous parts) from this procedure have to be accepted by all parties and have to be officially documented in the procedure variation sheet.

4.2 GSE

All GSE and integration equipment is fit checked and has valid calibration certificates.

4.2.1 MGSE

Qty.	Designation/Manufacturer	Provided by	Drawing/Ident. NR:	Calibr. Date
	Cryostat mounted on TTAP			
	Rotary table			

Table 4-1: MGSE

4.2.2 EGSE

Qty.	Designation/Manufacturer	Provided by	Drawing/Ident. NR:	Calibr. Date
1	PFM Cryo SCOE	ABSp	CI No. 142 210	
1	Test Harness	ABSp	CI No. 142 220	
1		SSBV	CI No. 142 230	
1		SSBV	CI No. 142 240	
1				
	Digital Multimeters (troubleshooting only)	ASED		
	Set of break out boxes (troubleshooting only)	ASED		

Table 4-2: EGSE

4.2.3 OGSE

Qty.	Designation/Manufacturer	Provided by	Drawing/Ident. NR:	Calibr. Date
	Theodolites and support stands	ASED		
	HACs (tbc)			

Table 4-3: OGSE

4.2.4 Cryo Vacuum Servicing Equipment (CVSE)

Qty.	Designation/Manufacturer	Provided by	Drawing/Ident. NR:	Calibr. Date
1	High Vacuum Pumping Unit	BOCE	CI No. 142 310-03	—
2	Turbo pumps (C0711, C0712)	BOCE	CI No. 142 310-03	—
1	Laboratory Vacuum Pump in safety unit	BOCE	CI No. 142 310-04	—
1	Helium heat exchanger unit (HEXA)	CryoVac		—
1	Laboratory Vacuum Pump in CVSE scaffolding	BOCE	CI No. 142 310-04	—
1	CVSE Monitoring Rack	BOCE	CI No. 142 310-06	—
1	Leak Detector	BOCE	CI No. 142 310-07	—
1	Leak detector	Leybold	UL200	11/07
2	LHe transfer lines (Y0211/Y0221)	DeMaCo	CI No. 142 310-08	—
1	Venting line Y0601/Y0602	DeMaCo	CI No. 142 310-09	—
1	Safety line to SV 121 (Y0621/Y0622)	DeMaCo	CI No. 142 310-09	—
1	Scaffolding for CVSE lines		CI No. 142 310-10	—
10	450 l LHe Dewars type HDS 450 -EIPS	Linde		—
1	Helim heat exchanger Unit HEXA	CryoVac		
	50 l / 200 bar GHe grade 5.0	Linde		—
	Set of mass flow meters	ASED		—
	Set of vacuum hoses			—
	Manometer P0621-1(0,1-27 mbar) in safety unit	W & T		07/07
	Manometer P0621-2(1-1200 mbar) in safety unit	W & T		07/07

4.3 General Test Conditions

Ambient conditions:

- temperature: 22 ± 3° C
- humidity: 40 - 60 %
- barometric pressure: ambient atmosphere
- Cleanliness: class 100000 conditions (or better)

5 Step-by-step procedure

5.1 Preparation of LHe I Transfer Line

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.1.1	***Preparations***					
5.1.1.1	Cleaning of inlet filter: • remove the inlet filter from the line • clean the filter in ultrasonic bath with isopropyl alcohol • dry the filter with a heat gun • tie teflon tape around the filter thread and screw the filter onto the tube			✓	✓	
5.1.1.2	Description of installations at transfer line - Interfaces at dewar side, Figure 3-2: • compression fitting • overpressure relief valve • pressure gauge • flex. line DN25 as connection to vacuum line Y0622 and laboratory pump C1100		5 mbar over-pressure 545 mm	✓ fill	✓	

Location: ETS	PA: [signature] Date: 9.1.08	Operator: [signature]	Date: 9.2.08	9.2.08

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.1.1.3	Description of installations at transfer line – Interfaces at HEXA and PLM side: • compression fittings in HEXA inlet and outlet, • compressioj fitting in filling port air lock • upper position in air lock for flushing • lower position in air lock for He transfer		✓	09.02.08	✓	
5.1.1.4	Check that the needle valve in the transferline is open		✓ open		✓	
5.1.2 Evacuation of Transfer Line (Figure 3-9)						
5.1.2.1	Close valve to the GHe bottle		✓		✓	
5.1.2.2	Start laboratory pump in safety unit (SU)		✓		✓	
5.1.2.3	Open V01 and evacuate transfer line for 5 min.		✓ 5min		✓	

5.2 Check of PLM Status

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
	The following configuration set-up is required prior to start of cool down and filling and shall be checked prior to test:					✓
5.2.1.1	PLM/SVM installed on appropriate test stand and CVSE has been set up for cooling and filling					✓
5.2.1.2	16 load cells mounted to the strap pretensioners. ensure proper strap pretensions	12 ±1 kN	20 kN	acc. to HP-2-ASED-TP-0133 issue 1.4 23.1.08		✓
5.2.1.3	Cryo SCOE connected to cryostat, mass flow meter, HEXA, and operational - functional test at ambient temperature successfully performed. Alarm settings acc. 5.7.1.4 to be prepared		✓			✓
5.2.1.4	Turbo pump A mounted on upper bulkhead SV 921 interface, turbo pump is running and airlock to isolation vacuum is open				✓	
5.2.1.5	SV922 installed on CVV			✓		
5.2.1.6	Airlock at filling port installed and leak test of filling port performed. Airlock configured with "Quetschverschraubung" for LHe I transfer line.			✓		
5.2.1.7	Ensure a permanent small overpressure in the cryo cover cooling line during cool down of the cryostat, by e.g connecting a volume to the cover transfer line.			✓		

Location: Estec	PA: [signature]	Date: 9.2.08	Operator: [signature]	Date: 9.2.08	

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.2.1.8	The manometer P0621-2 (1-1200 mbar) installed in safety unit and connected with the safety line of filling port airlock.			✓		
5.2.1.9	Safety unit (Figure 3-9) connected with filling airlock and leak test performed.			✓		
5.2.1.10	Plug of SV 121 is closed - SV 121 is activated			\		
5.2.1.11	He S/S flushed with GN_2 or GHE at ambient temperature and pressure; T 103 P 101	 < 313 K 0,95 - 1,2 bar	 305 K 1,03 bar	✓		
5.2.1.12	Blind flanges installed at external vent line and leak tested		✓	Deadhead ✓		
5.2.1.13	5 g/s mass flow meter installed in the vent line and connected with the Cryo SCOE		✓	✓		
5.2.1.14	Check valves status: V 102, V 702, V103, V106, V 701, SV 121, V 502 V 104, V 105 V501, V503, V504, V505, V506	 Closed Open N/A	 cl. op. N/A		✓	
5.2.1.15	Check isolation vacuum: VG 901 (VG 902)	 < 1 x 10^{-4} mbar		7×10^{-6} ✓		

Location: Estec	PA: [signature]	Date: 9.2.08	Operator: [signature]	Date: 9.2.08	

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.2.1.16	Pressure gauge (P506) connected to external vent line			N/A		
5.2.1.17	Fill out cryostat log book				✓	

Location: Ester	PA:	Date: 9.2.08	Operator:	Date: 9.2.08		

5.3 Installation of Auxiliary Lines and Components

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.3.1.1	Connect GHe supply bottle grade 5.0 with 2 µm filter to valve safety unit. See Figure 3-8				✓	
5.3.1.2	Installation of vent line Y0601 to V 502 (V 502 still closed).			✓ Due to untight V502 → V502 open & blind flanged		
5.3.1.3	Connect He pumping unit to the flow meter unit with Y0601		N/A			
5.3.1.4	Connect leak tester at the entrance of PLM evacuation line (upstream of backing pump). Start leak detection and ensure continuous monitoring				✓	
5.3.1.5	Fill out cryostat log books				✓	

Location: Estec	PA: Date:	Operator: [signature] Date: 09.02.08		

5.4 Installation of Transfer Line

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.4.1	***Preparation of LHe Dewar (acc. to CVSE setup procedure, HP-2-ASED-PR-0095)***			✓		
5.4.1.1	Check that the dewar is released for use on Herschel.			✓	✓	
5.4.1.2	Check that head of dewar is equipped with one feed through 16 mm. Check that the dewar is equipped with *Electronic Internal Pressurizing System* (EIPS). Fix the blind plug in feed through 16 mm.			✓	✓	
5.4.1.3	Position 450 l dewar near SV 121 on working platform. Activate break mechanism at dewar wheels.			✓	✓	
5.4.1.4	Establish a clear control area of about 2 m around the dewar			**Start of Hazardous operation**	✓	
5.4.1.5	Open overpressure relief valve of dewar gently and depressurize to atmospheric pressure. **ATTENTION:** cold gas, use leather gloves and eye glasses			✓	✓	
5.4.2	***Installation of Transfer Line into Dewar***			✓	✓	
5.4.2.1	Remove compression fitting from transfer line (dewar side) and open needle valve			✓	✓	

Location: Estec	PA: [signature]	Date: 9.2.08	Operator: [signature]	Date: 9.2.08	

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.4.2.2	Remove blind plug 16 mm from head of supply dewar and insert transfer line in the dewar by about 200 mm			✓	✓	
5.4.2.3	Stop transfer line flushing: -close needle valve V0211 (or V0221)			✓	✓	
5.4.2.4	Push the transfer line slowly in the dewar until stop at filter reaches the bottom of dewar (the filter is equipped with a 100 mm distance pin to avoid that the transfer line is taking LHe from the bottom of the dewar)			✓	✓	
5.4.2.5	Adjust dewar pressure at EIPS to 100 mbar overpressure as needed during filling activities			✓	✓	
5.4.3 Installation of Transfer Lines and HEXA						

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.4.3.1						
5.4.3.2	Insert transfer line from Dewar into the compression fitting of the HEXA inlet			✓	✓	
5.4.3.3	Insert transfer line from HEXA to filling port into the HEXA outlet and the filling port air lock compression fittings.			✓	✓	
5.4.3.4	fix transfer line in upper position in air lock			✓	✓	
5.4.3.5	Tighten compression fittings.			✓	✓	
5.4.3.6	**Attention:** Don't damage the seal at transfer line when installing transfer line in SV 121.			✓	✓	

5.5 Evacuation and Purging of He S/S

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.5.1 Evacuation and flushing of filling port						
5.5.1.1	Evacuate vacuum line and airlock via safety unit with lab. vac. pump C1100			✓	✓	
5.5.1.2	Close Y0621 (line to vacuum lab. pump)			✓	✓	

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.5.1.3	Pressurize line Y0621 and air lock SV 121 with He from dewar by opening the needle valve (V0211) in the transfer line			✓	✓	
5.5.1.4	Close the needle valve in transfer line			✓	✓	
5.5.1.5	Repeat evacuation and pressurization of Y0621 and airlock SV 121 two times			✓	✓	
5.5.1.6	Close V0621 (line to lab. vac. pump)			**End of Hazardous operation**	✓	
5.5.2 Evacuation / Pressurization Cycles						
5.5.2.1	Open V 104		is open	open V102		
5.5.2.2	Check valve status: V103, V106, V 701, SV 121, V 502 V 104, V 105, V 102, V 702, V501, V503, V504, V505, V506	 closed open N/A	 closed open —		✓	
5.5.2.3	Open V 502 and SV 121 and insert transfer line into the filling port				✓	
5.5.2.4	Pump down HeS/S via V502 up to the valve in transfer line down to P 101 approx. 10 mbar	< 10 mbar	via SV/Air lock		✓	

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.5.2.5	Close valve at helium pump and note P 501				✓	
5.5.2.6	Pressurize He S/S via needle valve in transfer line (V0211) P 501 approx. 1 bar absolute (slight overpressure)			**Start of Hazardous operation**	✓	
5.5.2.7	Observe leak detector and note leak rate	$< 10^{-7}$ mbar l/sec	3.7 $\times 10^{-7}$ mbar	NCR 3952	✓	
5.5.2.8	Close needle valve in transfer line				✓	
5.5.2.9	Repeat evacuation and flushing two times			**End of Hazardous operation**		
5.5.2.10	Fill out cryostat log book				✓	

Cooldown procedure redlined on 13/02/08 after leak detection on HOT tubing

TASF [signature] ESA [signature]

5.6 Cool down of Cryostat

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.6.1	***Initial Configuration***					
5.6.1.1	He S/S flushed with helium see para 5.5				✓	

Location: Estec	PA:	Date:	Operator: [signature]	Date: 13-02.08		

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.6.1.2	Check valve status with SCOE: V103, V106, V 701, V702, V105 V 102, ~~V 702~~, V 104, ~~V 105~~, SV 121, V 502 V501, V503, V504, V505, V506	closed open N/A	✓ ✓	12.2.08	x	
5.6.1.3	~~bypass helium pump to mass flow meter unit (Figure 3-10)~~	N/A				
5.6.1.4	Check CVSE status • SCOE in acquisition mode and displaying T103, P101, , T701 and ~~P701~~ versus time • SCOE displaying HTT; HOT and OBA temperature slope, warning limit any OBA Pt1000 sensor at -4K/hr, alarm limit at -5K/hr ✓ activated. A second warning limit for T103 minus either T207;T251;T253;T255 >|25 K| and an alarm limit for |30 K| shall be activated. ✓ • Dewar pressurized to ~100 mbar overpressure ✓ • Valve in transfer line closed ✓ • Leak tester connected to running turbo and recording ✓				x	
5.6.1.5	Establish restricted area for hazardous operation				✓	

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.6.2 Start Cool Down				**Start of Hazardous operation**		
5.6.2.1	Slightly open the valve in the transfer line, observe mass flow meter		o. k.		x	
5.6.2.2	Adjust HEXA outlet temperature setpoint to immediately T_{HEXA} = T207 - 35 K ±10 K (tbd) and switch on temperature controller	T207 = T_{HEXA} =	303 K 268 K	Hexa temperature settings have to be optimized during operations.	x	
5.6.2.3	When mass flow is constant: Close V102 for cooling HOT only					
5.6.2.4	Adjust HEXA outlet temperature set-point to T_{HEXA} = T103 - 80 K ±10 K (tbd) For HOT and thermal shield cooling		T103= T_{HEXA}=			
5.6.2.5	When T422 ~= T103 - 75 K reduce and adjust mass flow to keep T422 stable Observe VT102 and VT702 the tanks inlet valves temperatures					

Location: Estec	PA:	Date: 13.2.08	Operator:	Date: 13.02.08	

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.6.2.6	Perform active OBA cooling twice per day: Stop flow for 1 hour once per day for L1 temperature determination Open V102 than close V702 after ~ 30 sec Adjust HEXA to T_{HEXA} = T238 - 35 K ±10 K ~~(tbd)~~ Increase mass flow			See cryostat log book	✓	
5.6.2.7	~~When VT103 temperature is decreased by ~25 K switch back to HOT cooling~~ ~~Open V702 than close V102 after ~ 30sec.~~ ~~Adjust HEXA outlet temperature set-point to~~ ~~T_{HEXA} = T103 - 80 K ±10 K (tbd)~~ ~~When T422 ~= T103 - 75 K reduce and adjust mass flow to keep T422 stable~~			**End of Hazardous operation**		
5.6.2.8	~~Repeat the steps above~~ repeat step 5.6.2.6				✓	
5.6.2.9	Observe pressure requirements during cool down: • P 101 • ~~P701~~ P501 Decrease dewar pressure if necessary	 ≤ 1,2 bar ≤ 1,2 bar	 ✓ ✓	[signature]		

Location: Estec	PA: Date:	Operator: [signature] Date:		

HOT closed

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.6.2.10	Check strap pre-tensioning ~~twice~~ once a day. If tension is out of range, stop cooling and inform engineering	5 - 20 kN	11 KN			
5.6.2.11	If pressure in dewar or P101 drops or T103 or T701 is increasing, the transfer line inside the dewar could be out of the liquid phase Proceed with ~~Fehler! Verweisquelle konnte nicht gefunden werden.~~ § 5.9 (Exchange of Dewar)		✓			
5.6.2.12	For interrupts in cooling (overnight, week-ends, ...) Proceed with ~~§~~ 5.8, Establish safe condition		✓			
5.6.2.13	If HTT and OBA temperature (T103, T211) is below 50 K than switch to HOT cooling: open V702, then close V102 after ~30 sec		✓			
5.6.2.14	IF temperatures of HTT and OBA are below ~ 80K, the HEXA should be removed acc. to § ~~Fehler! Verweisquelle konnte nicht gefunden werden.~~ 5.7 from the cooling line in order to allow effective cooling and liquid helium filling			26.2.08		
5.6.2.15	~~When T701 is below 20 K switch SCOE monitor from T701 to T703~~					
5.6.2.16	~~observe pressure and mass flow when T703 reaches ~ 4.2 K, wait 5 min and switch to HTT~~ ~~(a drop down should occur when liquid helium enters the HOT)~~					

Location: Estec	PA:	Date:	Operator: [signature]	Date: 26.02.08		

HOT closed

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.6.2.17	~~switch to HTT cooling~~: ~~open V102, then close V702 after ~30 sec~~					
5.6.2.18	~~Check HOT temperature < 10K and read out liquid level probe L701 with SCOE~~					
5.6.2.19	When T103 is below 20 K switch SCOE monitor from T103 to T106	✓			✓	
5.6.2.20	observe pressure and mass flow when T106 reaches ~ 4.2 K a drop down should occur when liquid helium enters the HTT	✓		26.2.08	✓	
5.6.2.21	Continue cooling/filling until the dewar is empty	✓			✓	
5.6.2.22	Check HTT temperature < 20K and read out liquid level probe L101 with SCOE	✓			✓	
5.6.2.23	If liquid level is below 50 l, continue filling with new dewar up to max. 200 l	N			✓	
5.6.3	***End of Cool Down and thermalisation***					
5.6.3.1	Close valve V0211 (or V0221) in transfer line to stop LHe flow	✓			✓	
5.6.3.2	Make a printout of the final strap pretensions	5 - 20 kN	✓		✓	
5.6.3.3	Close V102 and V702	✓			✓	

Location: Estec	PA:	Date:	Operator:	Date: 26.02.08	

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.6.3.4	remove the transfer line acc. 5.9.2					
5.6.3.5	Check valve status: V 102, V 702, V103, V106, V 701 V 104, V 105, SV 121, V 502 V501, V503, V504, V505, V506	 closed open N/A	✓			
5.6.3.6	Fill out cryostat log book		✓			

5.7 Removal of HEXA

See log book

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
	IF temperatures of HTT and OBA are below ~ 80K, the HEXA should be removed from the cooling line in order to allow effective cooling and liquid helium filling					
	Note temperatures VT103, T238; T207	< 80 K				
	Close needle valve in transfer line Open the overpressure relief valve on dewar					

Location:	PA: Date:	Operator: Date:		

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.7.1.1	Prepare second transfer line according step 5.1			**Start of Hazardous operation**		
5.7.1.2	Retract transfer line in filling port airlock and close SV121					
5.7.1.3	Remove transfer line from airlock and HEXA and close both compression fittings immediately.					
5.7.1.4	Remove transfer line from Dewar and HEXA					
5.7.1.5	Insert second transfer line in Dewar and airlock as described in § ~~**Fehler! Verweisquelle konnte nicht gefunden werden.**~~ 5.9 (Exchange of Dewar)					

5.8 Establishing safe condition

See log book

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
	The following activities have to be performed to get the cryostat in safe configuration and to restart cool down and filling. Safe conditions are also present during exchange of dewars (~~see **Fehler! Verweisquelle konnte nicht gefunden werden.**)~~ § 5.9					
5.8.1	***Establish safe condition***					

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.8.1.1	Close needle valve in transfer line and stop LHe flow			**Start of Hazardous operation**		
5.8.1.2	Switch valves in flow meter unit to 60 mbar back flow valve operation					
5.8.1.3	Verify pressure increase > 20 mbar (P501, P101)					
5.8.1.4	Shut down (EIPS). Reduce pressure in dewar by opening the overflow relief valve			**End of Hazardous operation**		
5.8.1.5	Fill out cryostat log book					
5.8.2	***Restart of cool down or filling***	see	cryo	log book		
5.8.2.1	Verify overpressure in HeS/S					
5.8.2.2	Close the overflow relief valve at dewar					
5.8.2.3	Increase dewar pressure to 100 mbar with EIPS			**Start of Hazardous operation**		
5.8.2.4	Release HeS/S overpressure by switching from back flow valve to single flow meter operation					
5.8.2.5	Slightly open needle valve in transfer line -> HeS/S pressure should increase					
5.8.2.6	Continue with cool down or filling			**End of Hazardous operation**		

Location:	PA: Date:	Operator: Date:		

5.9 Exchange of LHe Dewar

See log book

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.9.1	***General Remarks***					
5.9.1.1	The following paragraphs have to be repeated at each dewar exchange					
5.9.1.2	**Attention:** Do not empty dewars completely Remaining liquid level in dewar shall always be >100 mm					
5.9.1.3	Use leather gloves and protect eyes by glasses when installing or removing transfer line LHe supply dewar.					
5.9.1.4	At each dewar change write down in cryostat log book: • dewar No. • liquid level and Dewar weight at start • liquid level and Dewar weight at end • LHe-consumption					
5.9.1.5	Fill out cryostat log book					
5.9.2	***Removing Transfer Line***					
5.9.2.1	Prepare second transfer line according step 5.1					
5.9.2.2	Close needle valve in transfer line to stop LHe flow			**Start of Hazardous operation**		

Location:	PA:	Date:	Operator:	Date:		

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.9.2.3	Reduce pressure in dewar, Open the overpressure relief valve on dewar					
5.9.2.4	Cooling via HEXA: Open compression fitting on Hexa and remove transfer line and close the fitting immediately.					
5.9.2.5	Cooling w/o HEXA: Retract transfer line to upper position in airlock SV 121 Close airlock SV 121					
5.9.2.6	Remove transfer line from airlock, close compression fitting with blind plug and protect open end of transfer line.					
5.9.2.7	Remove transfer line from supply dewar and prepare it for next use.					
5.9.3	***Installation of new Dewar and Transfer Line***					
5.9.3.1	Install second transfer line into a full supply dewar and into HEXA or air lock SV 121. (see chapter 5.4 for details)					
5.9.3.2	Evacuation and flush the transfer line including air lock (see 5.5.1)					
5.9.3.3	open SV 121					

Location:	PA: Date:	Operator: Date:		

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.9.3.4	Insert transfer line completely into airlock and retract it again about 1 mm. Fix the compression fitting					
5.9.3.5	Increase dewar pressure to 100 mbar with EIPS					
5.9.3.6	Open slightly the needle valve in transfer line ->pressure and flow in HeS/S should increase			**End of Hazardous operation**		

Location:	PA: Date:	Operator: Date:		

5.10 Liquid Helium filling

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.10.1.1	Verify sufficient thermalisation					
5.10.1.2	Install transfer line to new dewar (see para 5.9.3)			**Start of Hazardous operation**	✓	
5.10.1.3	Open V102 Check valve states: V102, V104, ~~V105~~, V502 V103, V106, V702, V701, V501, V503, V506, SV121 V105	 Open Closed	 Open closed		✓	
5.10.1.4	Slightly open valve in transfer line				✓	
5.10.1.5	Increase pressure in dewar			**End of Hazardous operation**	✓	
5.10.1.6	Check filling efficiency with level read out in dewar, L101 and mass flow rate every hour				✓	
5.10.1.7	Exchange dewars if necessary				✓	
5.10.1.8	A quick and significant increase of the mass flow rate in the vent line and pressure oscillations at P 501 indicates that HTT is completely filled				✓	

Location: Estec	PA:	Date:	Operator: Uu	Date: 26.02.08	

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.10.1.9	Stop filling by closure of the needle valve in transfer line			**Start of Hazardous operation**	✓	
5.10.1.1(	Close valve V102		closed	~~stays open~~ 13[25]	✓	
5.10.1.1'	remove the transfer line acc. 5.9.2			**End of Hazardous operation**	✓	
5.10.2 End of Filling						
5.10.2.1	Close V 102		closed	01.03.08 13[25]	✓	
5.10.2.2	Remove transfer line acc. to 5.9.2				✓	
5.10.2.3	enable 60 mbar overpressure one way valve (frog)				✓	
5.10.3 Final Configuration						
5.10.3.1	Check mass flow rate	< 50 mg/s	27 mg/sec	14[50]	✓	
5.10.3.2	Check valve status: • V 102, V103, V106, V 701, V 702, V501, V503, SV121 V 105 • V 104, ~~V 105~~, V 502,	 closed open	 closed open		✓	

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
5.10.3.3	Documentation of final values: • T 101 • T 106 • P 101 • L102/L102	 ≈ 4,2 K ≈ 4,2 K < 1,2 bar	 — 4,29 K 1,042 bar 87,6 %		✓	
5.10.3.4	Check helium background with leak detector	< 5 x 10^{-8} mbar l/sec	< 6x10^{-9} mbl/s	05.03.08 10:00	✓	
5.10.3.5	Perform He 3 background measurement in the CVV vacuum with the helium leak detector adjusted to He 3 or via the mass spectrometer.		no change in Background	BG = 2x10^{-8}	✓	
5.10.3.6	Check strap pre tension	5 - 20 kN	25,9 ± 1 kN		✓	
5.10.3.7	Fill out cryostat log book				✓	

5.11 Valve heating in case of filter blockage

Not used

Step-No.	Activity	Nominal Value	Actual Value	Remarks	P	N
	The following activities have to be performed in case of a valve filter blockage which can occur and will be noticed by an increased pressure drop in the valve/ reduced mass flow.					
5.11.1.1	Close the particular valve					
5.11.1.2	Acquire SCOE monitoring for the Pt1000 (VTxxx) of that particular valve					
5.11.1.3	Activate the heater of that particular valve (VHxxx) the specified heater power of ~6W shall be verified on SCOE monitor.					
5.11.1.4	Stop valve heating at a temperature of 80 K (approximately 15 min after start.					
5.11.1.5	Open that particular valve and verify proper mass flow. Otherwise continue heating from step 5.10.1.3 to a 10 K higher temperature					

Location:	PA: Date:	Operator: Date:		

6 Summary Sheets

6.1 Procedure Variation Summary

	Test Change	Curr. No.: #1 Date 9.2.08 Page ~~3~~ 1 of 1	
Test designation Cool down	Test Procedure -PR-0082	Issue 4.1	Rev.
Test step changed 5.5	Reason for Change flushing of external vent line		

in order to evacuate and flush the external vent line including the A-frame (closed by the „deer head) the valve V501 shall be opened during 5.5.2 „Evacuation / Pressurization cycles".
The valve V501 shall be closed before 5.6 „Cool down of cryostat"

Prepared by: M. Langfermann	Resp. Test Leader [illegible]	Project Engineer
PA/QA B. [illegible]	Prime	Customer

6 Summary Sheets

6.1 Procedure Variation Summary

	Test Change	Curr. No.: #2 Date 10.2.08 Page 1 of
Test designation Cool down	Test Procedure -PR-0082	Issue 4.1 / Rev. —
Test step changed 5.5.2.7	Reason for Change Leak rate too high	

When the He S/S is evacuated <20 mbar

1. close V104, V105, V1002, V702 (all internal)
2. flush the He S/S tubing with GHe from Dewar to ~1 bar. Wait for 20 min note LR
3. Open V105 and V702 and flush to ~1 bar wait and note LR after 20 min.
4. Open V1002 and V104 and flush to ~1 bar wait and note LR after 20 min.

Prepared by:	Resp. Test Leader	Project Engineer
M. Langfermann	[signature]	
PA/QA: D. Baloge	Prime	Customer [signature]

6 Summary Sheets

6.1 Procedure Variation Summary

	Test Change		Curr. No.: #3 Date 10.02.08 Page 1 of 1	
Test designation cool down		Test Procedure PR-0082	Issue 4.1	Rev.
Test step changed 5.5		Reason for Change leak in He S/S NCR #3952		

Verification of HTT leak tightness
close V102 and V104 (HTT at 16 bar GHe)
evacuate the He S/S including HOT
until leak rate is below 1×10^{-8} mbar l/sec
Afterwards the He S/S + HOT will be kept
under vacuum for further evacuation
until next NRB

Prepared by: M. Langfermann	Resp. Test Leader [signature]	Project Engineer
PA/QA B. Balogh	Prime	Customer [signature]

6.2 Non Conformance Report (NCR) Summary

NCR - No.	NCR - Title	Date	Open Closed	PA sig.
NC-3952	LEAK RATE OF HE S/S HIGHER THAN NOMINAL	28.02.08	OPEN	[signature]

END OF DOCUMENT

AS-RUN

Status verification of Cryo-SCOE for Cool Down 1/3

Sub-System	SVM-side	CVV-side	SVM-CB	Connector	Connector mated with: saver mated		Flight Connector	SCOE/EGSE Connector	Tags		termination connector	not connected	Sign.
					yes	no			Red	Green			
HIFI	FCU	FPU	311100	J01		X	X						
HIFI	FCU	FPU	311100	J02		X	X						
HIFI	FCU	FPU	311100	J03		X	X						
HIFI	FCU	FPU	311100	J04		X	X						
HIFI	FCU	FPU	311100	J05		X	X						
HIFI-LOU	LCU	LOU	311200	J05								X	
HIFI-LOU	LCU	LOU	311200	J06								X	
HIFI-LOU	LCU	LOU	311200	J07								X	
HIFI-LOU	LCU	LOU	311200	J08								X	
HIFI-LOU	LCU	LOU	311300	J01								X	
HIFI-LOU	LCU	LOU	311300	J03								X	
HIFI-LOU	LCU	LOU	311300	J05								X	
LOU-Baff.	PCDU	LOU-Baff.	311300	J02								X	
LOU-Baff.	PCDU	LOU-Baff.	311300	J04								X	
LOU-Baff.	PCDU	LOU-Baff.	311300	J06								X	
HIFI	3DH	FPU	311300	J07		X	X						
HIFI	3DH	FPU	311300	J08		X	X						
HIFI	3DV	FPU	311300	J09		X	X						
HIFI	3DV	FPU	311300	J10		X	X						
SPIRE	DCU	Interlink	312100	J01A		X	X						
SPIRE	DCU	Interlink	312100	J01B		X	X						
SPIRE	DCU	JFP	312100	J02		X	X						
SPIRE	DCU	JFP	312100	J03		X	X						
SPIRE	DCU	JFP	312100	J04		X	X						
SPIRE	DCU	JFP	312200	J01		X	X						
SPIRE	DCU	JFP	312200	J02		X	X						
SPIRE	DCU	JFP	312200	J03		X	X						
SPIRE	DCU	JFP	312200	J04		X	X						
SPIRE	DCU	JFS	312200	J05		X	X						
SPIRE	DCU	JFS	312200	J06		X	X						
SPIRE	FCU	Launch-Latch	312300	J01		X	X						
SPIRE	FCU	Launch-Latch	312300	J02		X	X						
SPIRE	FCU	FPU	312300	J03		X	X						
SPIRE	FCU	FPU	312300	J04		X	X						
SPIRE	FCU	FPU	312300	J05		X	X						
SPIRE	FCU	FPU	312300	J06		X	X						
PACS	FPU	DEC	313100	J01-2		X	X						
PACS	FPU	ESD-Cap	313100	J01-3		X	X		X				
PACS	FPU	DEC	313100	J02-2		X	X						
PACS	FPU	ESD-Cap	313100	J02-3		X	X		X				
PACS	FPU	DEC	313100	J07-2		X	X						
PACS	FPU	ESD-Cap	313100	J07-3		X	X		X				
PACS	FPU	DEC	313100	J08-2		X	X						

8.2.08 18.25

AS-RUN

Status verification of Cryo-SCOE for Cool Down 2/3

Sub-System	SVM-side	CVV-side	SVM-CB	Connector	Connector mated with: saver mated yes	saver mated no	Flight Connector	SCOE/EGSE Connector	Tags Red	Tags Green	termination connector	not connected	Sign.
PACS	FPU	ESD-Cap	313100	J08-3		X	X			X			
PACS	FPU	MEC	313100	J04		X	X						
PACS	FPU	MEC	313100	J05		X	X						
PACS	FPU	MEC	313100	J06		X	X						
PACS	FPU	BOLC	313200	J01		X	X						
PACS	FPU	BOLC	313200	J02		X	X						
PACS	FPU	BOLC	313200	J03		X	X						
PACS	FPU	BOLC	313200	J04		X	X						
PACS	FPU	BOLC	313200	J05		X	X						
PACS	FPU	BOLC	313200	J06		X	X						
PACS	FPU	BOLC	313200	J07		X	X						
PACS	FPU	BOLC	313200	J08		X	X						
Cryo-Cover	PCDU	NED (601)	314100	J01									
Cryo-Cover	PCDU	NED (602)	314100	J02									
Cryo-Cover	CDMU	SI 601	314100	J03									
Cryo-Cover	CDMU	SI 602	314100	J04									
Cryo-Cover	EGSE	SI603/T601	314200	J01			X						
Cryo-Cover	EGSE	SI604/T602	314200	J02			X						
Cryo-Cover	SAFE/ARM	NED (601)	314200	J03					X				
Cryo-Cover	SAFE/ARM	NED (602)	314200	J04					X				
Cryo-Cover	SAFE/ARM	SI 601	314200	J05					X				
Cryo-Cover	SAFE/ARM	SI 602	314200	J06					X				
Telescope	SVM	Heaters	314300	P01								X	
Telescope	SVM	Heaters	314300	P02								X	
CCH	EGSE	TH´s	315100	J01	X			X					
CCH	EGSE	Acc	315100	J02							N/A		
CCH	EGSE	TH's	315100	J03	X			X					
CCH	EGSE	Acc	315100	J04							N/A		
CCH	CCU-A	Tele. Th's	315100	J05	X			X					
CCH	CCU-B	Tele. Th's	315100	J06	X		X						
CCH	CCU-A	V501/504	316100	J01				X					
CCH	CCU-B	V503/505	316100	J02				X					
CCH	EGSE	V105/701 H701 L701	321100	J01	X			X					
CCH	EGSE	V702 H702 L702	321100	J02	X			X					
CCH	EGSE	H502/503	321100	J03	X			X					
CCH	EGSE	P501	321100	J04	X			X					
CCH	EGSE	L'sV's/H's	321100	J05	X			X					
CCH	EGSE	L'sV's/H's	321100	J06	X			X					
CCH	EGSE/Bridge	H501	321100	J07	X			X					
CCH	EGSE/Bridge	T502	321100	J08	X			X					[illegible]

AS-RUN

Status verification of Cryo-SCOE for Cool-Down 3/3

changed

Sub-System	SVM-side	CVV-side	SVM-CB	Connector	Connector mated with: saver mated yes	saver mated no	Flight Connector	SCOE/EGSE Connector	Tags Red	Tags Green	termination connector	not connected	Sign.
CCH	CCU-A	OBA	321200	J01	X			X					[signature]
CCH	CCU-A	HTT	321200	J02	X			X					
CCH	CCU-A	CVV ext.	321200	J03	X			X					
CCH	CCU-A	CVV ext.	321200	J04	X			X					
CCH	CCU-A	HTT	321200	J05	X			X					
CCH	CCU-B	OBA	321300	J01	X			X					
CCH	CCU-B	HTT	321300	J02	X			X					
CCH	CCU-B	CVV ext.	321300	J03	X			X					
CCH	CCU-B	CVV ext.	321300	J04	X			X					
CCH	CCU-B	HTT	321300	J05	X			X					
CCH	Umbilical	V105/701 H701 L701	321400	J01								X	
CCH	Umbilical	V702 H702 L702	321400	J02								X	
CCH	Umbilical	H501	321400	J03								X	
CCH	Umbilical	T502	321400	J04								X	
			HU1	J01	X			X					
			HU2	J01	X			X					

Status checked

Name:	HUND	Date:	08.02.08 18:00	Sig.:	[signature] 9.2.08 [signature]

Fl.-Mgr 8.2.08 18:25 [signature]

	Name	Dep./Comp.		Name	Dep./Comp.
	Alberti von Mathias Dr.	ASG23		Schuler Günter	ASA42
	Baldock Richard	FAE12		Schweickert Gunn	ASG23
X	Barlage Bernhard	AED13	X	Sonn Nico	ASG51
X	Bayer Thomas	ASA42		Steininger Eric	AED32
	Brune Holger	ASA45	X	Stritter Rene	AED11
	Edelhoff Dirk	AED2		Suess Rudi	OTN/ASA44
	Fehringer Alexander	ASG13		Theunissen Martijn	DSSA
X	Fricke Wolfgang Dr.	AED 65		Vascotto Riccardo	AED11
	Geiger Hermann	ASA42		Wagner Klaus	ASG23
	Grasl Andreas	OTN/ASA44	X	Wietbrock Walter	AET12
	Grasshoff Brigitte	AET12		Wöhler Hans	ASG23
	Hamer Simon	Terma		Wössner Ulrich	ASE252
	Hendrikse Jeffrey	HE Space		Zumstein Armin	ASQ42
X	Hendry David	Terma			
	Hengstler Reinhold	ASA42			
	Hinger Jürgen	ASG23			
X	Hohn Rüdiger	AED65			
	Hölzle Edgar Dr.	AED32			
X	Huber Johann	ASA42			
	Hund Walter	ASE252			
X	Idler Siegmund	AED312			
	Ivády von András	FAE12			
X	Jahn Gerd Dr.	ASG23			
	Kalde Clemens	ASM2			
	Kameter Rudolf	OTN/ASA42			
	Kettner Bernhard	AET42	X	ESA/ESTEC	ESA
	Knoblauch August	AET32	X	Thales Alenia Space Cannes	TAS-F
X	Koelle Markus	ASA43		Thales Alenia Space Torino	TAS-I
X	Koppe Axel	AED312			
X	Kroeker Jürgen	AED65		**Instruments:**	
	La Gioia Valentina	Terma		MPE (PACS)	MPE
	Lang Jürgen	ASE252		RAL (SPIRE)	RAL
X	Langenstein Rolf	AED15		SRON (HIFI)	SRON
X	Langfermann Michael	ASA41			
	Martin Olivier	ASA43			
	Maukisch Jan	ASA43		**Subcontractors:**	
	Much Christoph	ASA43		Austrian Aerospace	AAE
	Müller Jörg	ASA42		Austrian Aerospace	AAEM
	Müller Martin	ASA43		BOC Edwards	BOCE
	Peltz Heinz-Willi	ASG13		Dutch Space Solar Arrays	DSSA
	Pietroboni Karin	AED65		EADS Astrium Sub-Subsyst. & Equipment	ASSE
	Platzer Wilhelm	AED2		EADS CASA Espacio	CASA
	Reichle Konrad	ASA42		EADS CASA Espacio	ECAS
X	Runge Axel	OTN/ASA44		European Test Services	ETS
	Sauer Maximilian Dr.	AED65		Patria New Technologies Oy	PANT
X	Schink Dietmar	AED32		SENER Ingenieria SA	SEN
	Schmidt Thomas	AED15		Thales Alenia Space, Antwerp	TAS-ETCA

	Name	Dep./Comp.		Name	Dep./Comp.
	Baldock Richard	FAE12			
X	Barlage Bernhard	AED13			
X	Bayer Thomas	ASA42			
	Brune Holger	ASA45			
	Chen Bing	HE Space			
	Davis William	Captec			
	Edelhoff Dirk	AED21			
X	Fricke Wolfgang Dr.	AED 65			
	Geiger Hermann	ASA42			
	Grasl Andreas	OTN/ASA44			
	Grasshoff Brigitte	AET12			
	Hamer Simon	Terma			
	Hendrikse Jeffrey	HE Space			
X	Hendry David	Terma			
	Hengstler Reinhold	ASA42			
	Hinger Jürgen	ASG23			
	Hofmann Rolf	ASE252			
X	Hohn Rüdiger	AED65			
	Hopfgarten Michael	AET32			
X	Huber Johann	ASA42			
	Hund Walter	ASE252			
	Ivády von András	FAE12			
X	Jahn Gerd Dr.	ASG23	X	ESA/ESTEC	ESA
	Kölle Markus	ASA43	X	Thales Alenia Space Cannes	TAS-F
	Koppe Axel	AED312		Thales Alenia Space Torino	TAS-I
X	Kroeker Jürgen	AED65			
	Lang Jürgen	ASE252			
X	Langenstein Rolf	AED15		**Instruments:**	
X	Langfermann Michael	ASA41	X	MPE (PACS)	MPE
	Martin Olivier	Altec	X	RAL (SPIRE)	RAL
	Much Christoph	ASA43		SRON (HIFI)	SRON
	Müller Martin	ASA43			
	Peltz Heinz-Willi	ASG15			
	Pietroboni Karin	AED65		**Subcontractors:**	
	Reichle Konrad	ASA42		Austrian Aerospace	AAE
X	Runge Axel	OTN/ASA44		Austrian Aerospace	AAEM
	Schink Dietmar	AED321		BOC Edwards	BOCE
	Schmidt Thomas	AED15		Dutch Space Solar Arrays	DSSA
	Schweickert Gunn	ASG23		EADS Astrium Sub-Subsyst. & Equipment	ASSE
	Steininger Eric	AED321		EADS CASA Espacio	CASA
X	Stritter Rene	AED11		EADS CASA Espacio	ECAS
	Suess Rudi	OTN/ASA44		European Test Services	ETS
X	Wagner Klaus	ASG23		Patria New Technologies Oy	PANT
X	Wietbrock Walter	AET12		SENER Ingenieria SA	SEN
	Wöhler Hans	ASG23		Thales Alenia Space, Antwerp	TAS-ETCA
	Wössner Ulrich	ASE252			