Title: **SPIRE FPU & JFETS CQM MECHANICAL INTEGRATION PROCEDURE FOR QUALIFICATION PHASE II**

CI-No:

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Distribution: See Distribution List (last page)

Issue	Date	Sheet	Description of Change	Release
Issue 1	19.05.2006	All	Initial Issue	

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1 Scope

This document describes the activities for the HERSCHEL SPIRE CQM Cold Unit integration onto the Optical Bench Plate (OBP).

It summarises the nominal integration flow, test configuration, integration constraints, GSE set up and the step by step procedure.

The document is built up as a step by step procedure. The sequence of the integration steps for the equipment listed below is not mandatory but preferable.

2 Documents/Drawings

The following documents of the latest issue in effect or as defined herein form a part of this document to the extent specified herein.

2.1 Acceptance Data Packages

	SPIRE CQM EIDP	HP-2-RAL-DP-1898, Issue 3
	HIFI CQM EIDP	HP-2-SRON-DP-1001, Issue 3
	PACS CQM EIDP	N/A
	OBA	HP-2-SEN-DP-0004

2.2 Applicable Documents

AD 1	Optical Bench Assembly	HP-2-ASED-ID-0042-02-0A
AD 2	Herschel OBA Integration Procedure	HP-2-ASED-PR-0026, Issue 1
AD 3	PFM CVV internal HIFI SIH integration Procedure	N/A
AD 4	PFM CVV internal PACS SIH integration Procedure	N/A
AD 5	PFM CVV internal SPIRE SIH integration Procedure	HP-2-ASED-TP-0050, Issue 1
AD 6	Red/Green-Tag Item List for Herschel EPLM	HP-2-ASED-LI-0027, Issue 1
AD 7	SPIRE FPU Handling and Integration Procedure	SPIRE-RAL-PRC-002642, Issue 1; 28.04.2006
AD 8	FPU-Herschel Optical Bench Integration Procedure	FPSS-00444; Issue 5
AD 9	Handling Procedure HIFI FPU Transport Container	N/A
AD 10	ESD rules for Herschel PLM & S/C Integration Activities	HP-2-ASED-PR-0062

2.3 Reference Documents

RD 1	Documentation Identification Procedure and Documentation Management	HP-2-ASED-PR-0001
RD 2	PA Plan	HP-2-ASED-PL-0007
RD 3	Contamination Control Plan	HP-2-ASED-PL-0023
RD 4	SPIRE FPU IF Drawing	HP-1-ESA-IC-2124; Issue 3.3; Annex 1

RD 5	PACS FPU IF Drawing	N/A
RD 6	HIFI FPU IF Drawing	HP-1-ESA-IC-2125; Issue 3.2; Annex 1
RD 7	Pre-integrated Optical Bench Assembly	HP-2-ASED-DW-0117
RD 8	HIFI Harness Bracket Fixation Clamp Integration	HP-2-ASED-DW-0133, Issue A

2.4 Abbreviations

For abbreviations see RD 01

3 Configuration

3.1 Initial H/W Configuration

- Cold Unit CQM's placed in clean room class 100 and installed with X-direction upwards on a clean table.
- Note that SPIRE FPU CQM and HIFI FPU CQM need to be settled on distance spacers/auxiliary feet in order not to damage the mounting feet which are for both units identical to flight hardware.
- Optical Bench integrated in cryostat with x-direction upwards.

3.2 XYZ axis orientation

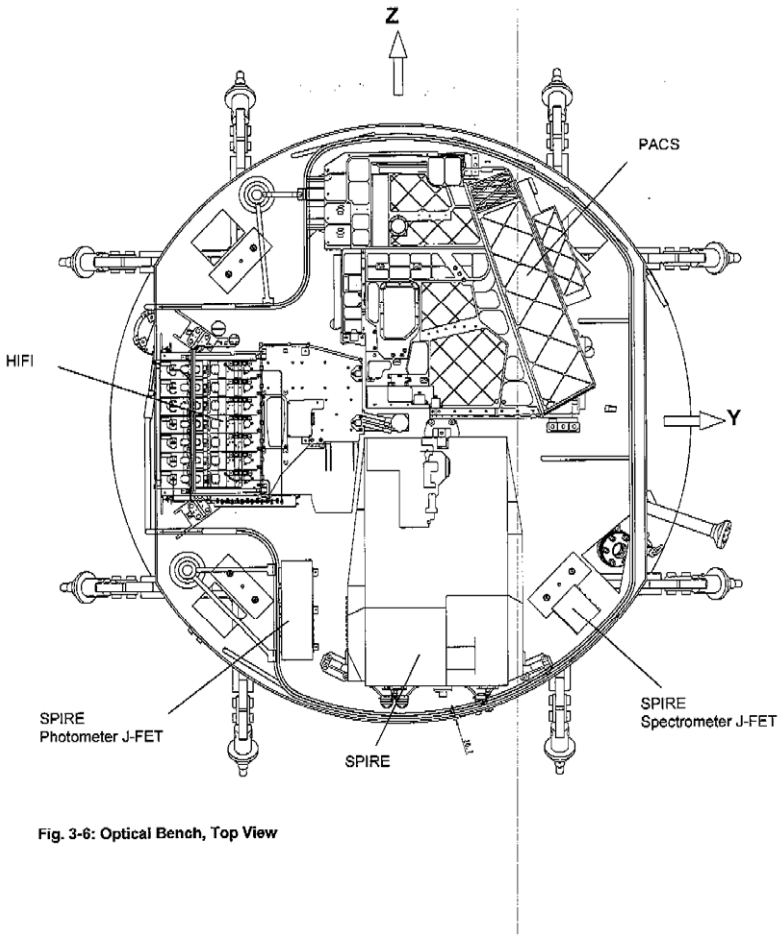


Figure 3.2-1: axis orientation, top view of OBA

4 Conditions

4.1 Personnel

Personnel necessary to complete activities according to this present procedures

Responsibility	Name / Organisation
Operator	*)
Operator	*)
Operator	*)
PA Responsible	*)

*) Names and possible additional personal to be registered prior to the integration activities.

4.2 Environmental

Cleanliness: class 100

Temperature: 22°C ± 3°C

Pressure: ambient

Rel. humidity: 40 % - 65 %

4.3 General Instructions for Integration

4.3.1 General Safety Requirements, Precautions

- Respect of the standard technical rules for mechanical and electrical integration and test activities are sufficient.
- Special hazard precautions are not expected, except for the comments mentioned in the step by step procedure for the relevant item
- The flight H/W has to be handled by authorized personnel only

- During non integration phase the flight H/W has to be protected against contamination by appropriate means like blind flanges, caps or protective foils

The following tasks have to be regarded before start of any integration/test activity:

- IRR has been successfully held to ensure that the relevant procedures, drawings, applicable documents are available, reviewed and approved
- Formal release to start with activity is given by QA
- The necessary GSE and H/W is available, accepted and applicable for use
- Safe working conditions for personnel and H/W are existing and will be applied
- Skilled and authorized personnel is available
- Incoming inspection of H/W have been performed by QA and engineering

4.3.2 QA Requirements

QA shall monitor all operations (handlings, transportation and installation) as necessary to assure compliance with this procedure and the applicable sections of the PA Plan (RD 12).

In the course of this procedure QA shall pay particular attention to

- integrity of every tightening surfaces and seals
- ensure adequate cleanliness conditions
- ensure that all safety aspects are considered
- the application of adequate protections to critical surfaces
- the records in the log sheet
- to ensure that tools and test equipment used is within current calibration cycle

4.3.3 ESD constraints

During all handling activities of the SPIRE CQM unit attention should be paid to AD 10 (ESD rules for Herschel PLM & S/C Integration Activities)

NOTE: for SPIRE:

The SPIRE instrument contains very sensitive detectors that are susceptible to damage by Electro static discharge. On delivery all connectors will be protected by covers or shorting plugs as appropriate.

During handling, all personnel shall wear anti static protection (wrist straps or other suitable method).

When the Cryo harness is not connected to the DRCU and the FPU Faraday Shield Link connected to Backshell at the warm end, then the FPU is electrically floating and prone to ESD damage.

4.4 GSE

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

4.4.1 MGSE

Qty.	Designation/Manufacturer	Provided by	Drawing/Ident. NR:	Calibr. Date
	Set of tools	ASED		
	GPHD (General Purpose Hoisting Device)	ASED		
	5 T crane	ASED		
	Torque wrench to cover 1.5 to 8.25 Nm	ASED		
	Allan key, spanners etc	ASED		

Table 4-1: MGSE

4.4.2 EGSE

Qty.	Designation/Manufacturer	Provided by	Drawing/Ident. NR:	Calibr. Date
	Digital Volt Meter	ASED		

Table 4-2: EGSE

4.4.3 OGSE

N/A

4.4.4 Special Integration Equipment

Qty.	Designation/Manufacturer	Provided by	Drawing/Ident. NR:	Calibr. Date
	FPU and JFET handling frame.	RAL		

Qty.	Designation/Manufacturer	Provided by	Drawing/Ident. NR:	Calibr. Date
	FPU/JFET/baseplate lifting gear	RAL		
	JFET fixation hardware	RAL		
	Isolation washers, special screws and studs	RAL		
	L3 pressure plates 2-off	RAL		
	L1 strap screws M8 2off, M3 4off (these screws will be prepared for wire locking)	RAL		
	Wire for locking above screws.	RAL		
	L1 bushes for the vent line end	RAL		
	Temporary FPU Grounding Strap including M4 x 6mm fastener to connect to OBA **NOTE**: Could possibly be attached to the unused harness support bracket holes, or any other convenient tapped hole.	RAL		
	Fixation bolts: • FPU M6 12 off • L0 straps M4 16 off • L0 pressure plate 4 off • L3 strap M4 4off	ASED		

5 Step by Step Procedure

5.1 SPIRE FPU CQM sequence

5.1.1 General

5.1.1.1 Handling

NOTE:

The FPU is a delicate optical instrument and should be handled with extreme care at all time.

Contamination of the optical surfaces within the instrument is prevented by the aperture cover. This cover should remain in place unless it is necessary to remove it.

WARNING: The bipod legs (looking like A-frames) on two corners of the instrument are very thin section CFRP components, and easily damaged. Care must be taken at all times not to put side loads into these items. These are at risk at all times when the FPU is not attached to a rigid plate. When it is attached to a rigid plate i.e. the HOB or its transport plate then it is tolerant of loads from vibration, lateral expansion, thermal tests, etc.

For electrical integration of SPIRE SIH refer to HP-2-ASED-TP-0050 (AD 5)

5.1.1.2 DELIVERY CONDITION

The SPIRE instrument is delivered in the following condition:-

- The FPU is supplied in a dedicated, re-useable, container.
- No cube is fitted to the FPU.

- FPU aperture cover fitted (red tag item). See AD 7, § 8 for further details.
- **Harnesses between the FPU and JFETs fitted**.
- FPU and JFETs attached to a baseplate.
- Shorting plus or covers will be fitted to all electrical connectors See AD 7, § 8 for further details.
- FPU and JFETs double wrapped in lumalloy film.
- Witness mirrors and/or PFO plates will be fitted to the baseplate
- Silica gel moisture control devices will not be used.
- The photo detector will be pre-fitted to the L0 strap.

5.1.1.3 Shock recorders

Attached to the FPU baseplate, inside the transportation container are re-settable shock indicators These operate in three axis and are set to 5,10 and 25g.

Upon inspection, if any of these recorders have triggered the project team at RAL should be informed.

'Tip and Tell' tilt sensors are attached to the outside of the FPU container.

Upon inspection, if any of these recorders have triggered the project team at RAL should be informed

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
5.1.2	***Unpacking and Inspection***						
.1	The FPU is supplied attached to a baseplate together with the JFETs and the JFET harness already integrated. It is bagged in polythene or lumalloy film.						
.2	In an area with a cleanliness of class 100,000 minimum, undo the eight latches that secure the container lid and remove the lid.						
.3	Connect unit with central GND						
.4	The protective bagging encloses the FPU, JFETs and harness and is taped to the baseplate. Unscrew and remove the four off M8 cap head screws that secure the baseplate to the anti vibration mounts.						
.5	Attach the lifting frame Ref MSSL/5264/404 to a crane. Lower the lifting frame to the baseplate and attach to the eyebolts provided on the baseplate.						
.6	The FPU, JFETs and baseplate can now be lifted out of the container with a crane.						
.7	Clean bagging material and baseplate, then transport to RR100 airlock.						
.8	Remove bagging						

Location:	PA: Date:	Operator: Date:		

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
.9	Transport to RR100 on a table for further investigations. Shorting plugs on the JFP and JFS provide ESD protection at this stage.						
.10	Cleanliness inspection of external surfaces						
.11	If necessary, perform additional cleaning of the CQM						
.12	Before any equipment mounting perform visual inspection of the I/Fs: - Mounting feet - Thermal links attachment areas - Electrical connectors	No scratches, no visible damages, connector pins undamaged			**NOTE**: Thermal links attachment areas are gold-plated and are not to be damaged.		

Location:	PA: Date:	Operator: Date:		

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
5.1.3	***Preparation for integration on Optical Bench Plate***						
.1	The FPU is supplied with the JFETs and associated harness already fitted. The following tasks need to be carried out before integration onto the OBP. Only standard tools are required at this stage.						
.2	The JFETs will be fitted to the spacecraft together with the FPU. They will need supporting during this activity. The SPIRE supplied MGSE provides provision to support the JFETS during integration.						
.3	Fit the lifting attachment to the FPU as shown in annex A. Attach the lifting wires to the JFETS.						
.4	The FPU is supplied with the alignment cube fitted, and should be left in place until all alignment activities are complete, it can be removed and replaced within the alignment tolerances required if necessary.						
.5	Remove the detector level 0 thermal strap and the Torlon support frames; leave the other two thermal straps in place						
.6	The FPU is electrically connected to the baseplate for ESD protection, this strap is to be disconnected from the baseplate.						

Location:	PA: Date:	Operator: Date:		

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
.7	The Herschel/SPIRE EQM Cryo harness implements only a subset of the PFM Cryo harness bundles for cost a schedule reasons. As a consequence, a number of open connectors are present on the SPIRE Cold Plane Units. These open connectors are to be sealed against RFI by backshells to be supplied by ASED. This activity is to be carried out at this stage providing that the extra length of backshell does not cause a mechanical interference during the integration of the instrument onto the OBA.						

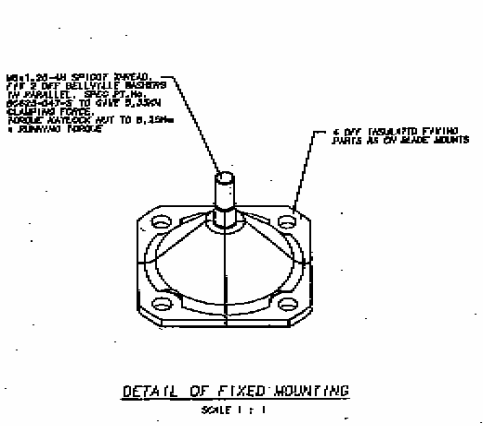
Location:	PA: Date:	Operator: Date:		

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
5.1.4	***Removal from Base Plate***						
.1	**WARNING:** The bipod legs on two corners of the instrument are very thin section CFRP components, and easily damaged. Care must be taken at all times not to put side loads into these items. These are at risk at all times when the FPU is not attached to a rigid plate. **Note:** All screws that interface to the spacecraft are metric threads.						
.2	Undo the five M4 fasteners which secure the Photometer JFET rack (HSJP) (8 JFETs) to the baseplate. Leave the screws in position as they cannot be removed form the JFET rack.						
.3	Undo the four M4 fasteners that secure the Spectrometer JFET rack (HSJS) (2 JFETs) to the baseplate. **Note**: Two of these fasteners are studs with nuts on the top, the nuts should be removed and the studs left in place.						
.4	The two remaining L0 straps are also secured to the baseplate. To release these from the baseplate, undo the 4 off M4 fasteners on each strap and remove the fasteners. **NOTE:** The undersides of these straps form the thermal interface to the spacecraft helium tank pods. Their surfaces are flat and soft gold plated, these surfaces can easily be damaged and the thermal performance of the instrument may suffer as a result.						
.5	Unbolt the cone from the FPU by undoing the M8 nut, thus leaving the cone on the baseplate.						

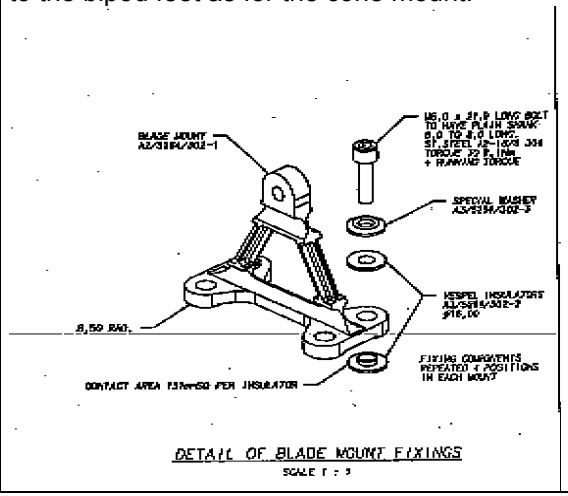
Location:	PA: Date:	Operator: Date:		

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
.6	Undo and remove the 8 fasteners on the blade mounts that attach the FPU to the baseplate.						
.7	The FPU and JFETs can now be lifted together from the baseplate.						
.8	Undo and remove the FPU cone from the baseplate and re-attach it onto the Optical Bench. **Note:** there are special washers (part number A3/5264/302-3) under the head of each screw and also Vespel insulating bushes (A3/5264/302-2) either side of the mounting flange.	8.1 Nm.	+/- 10% above running torque				
.9	The FPU and JFETs are now ready for integration.						

Location:	PA: Date:	Operator: Date:		

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
5.1.5	***Mechanical integration of FPU and JFETs onto OBP***						
.1	Fix the cone to the OBP using the four M6x21 cap head screws. Note: there are special washers (part number A3/5264/302-3) under the head of each screw and also Vespel insulating bushes (A3/5264/302-2) either side of the mounting flange. 	8.1 Nm	+/- 10% above running torque				
.2	Fix the Spectrometer JFET studs (2 off) as indicated on interface drawing 0-KE-0104-360. Note: these should be screwed into the OBP until 45mm of stud are protruding from the surface.	45 mm	+/- 0.5 mm				
.3	Lift the FPU and JFETs above the OBP						

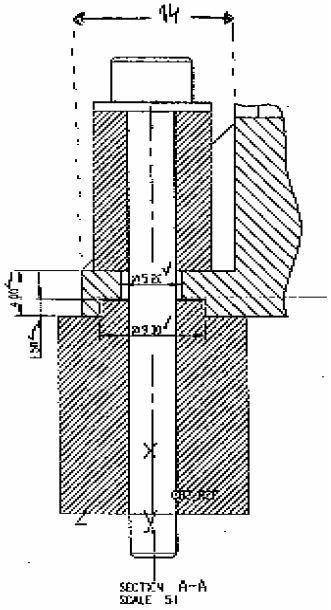
Location:	PA: Date:	Operator: Date:		

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
.4	Very gently lower the assembly onto the OBP, ensuring that the JFET studs engage on the JFETs and the cone mount engages in its location on the FPU. NOTE: the cone is very thin walled section and large moments can be applied if the FPU is not lowered with its interface plane parallel to the OBP						
.5	The flexible ends of the L0 straps are unsupported at this stage and will need to be guided by hand into place as the FPU is lowered						
.6	When all units are resting on the HOB, fit the attachment screws (M6X21) to the bipod feet as for the cone mount. 	8.1 Nm	+/- 10% above running torque				

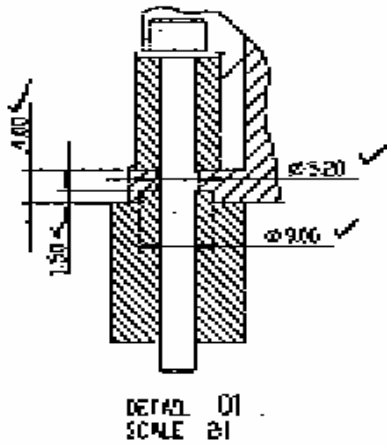
Location:	PA: Date:	Operator: Date:		

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
.7	Fit the two Bellville washers and the M8 Kaylock nut to the cone mount.	8.25Nm	+/- 10% above running torque				
.8	Remove the lifting/handling fixture.						
.9	SPIRE JFET Photometer and Spectrometer CQMs will be delivered with fixation hardware: Isolation washers, special screws and studs.				The thermal compensators are already mounted on the unit.		

Location:	PA: Date:	Operator: Date:		

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
.10	When the Photometer unit is resting on the optical bench fit the attachment screws M4x45 to the feet. Note that there are washers under the head of each screw. 	2,1 Nm	+/- 10% above running torque				

Location:	PA: Date:	Operator: Date:		

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
.11	After the Spectrometer unit is resting on the optical bench fit the attachment screws M4x45 to the feet. Note that there are washers under the head of each screw. 	2,1 Nm	+/- 10% above running torque				

Location:	PA: Date:	Operator: Date:		

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
5.1.6	***Integration of thermal links***						
.1	**L0 straps:** • The cooler pump and evaporator straps: These will be in place at this stage. Ensure that the lower flexibles of these two straps align with the pod interfaces. Fit the attachment screws (10 x M4 for the evaporator strap, 6 x M4 screws for the pump).						
.2	• Detector strap: The light baffle, upper flexible strap should already be in place on the FPU. Fit the Torlon support frames. Move the level 0 main strap into place and align the dowel holes (see Assembly drawing 5264/309). Push in Dowels and ensure that the flexibles are aligned. Place the cold strap support clamp plates over the top. Fit the 4 x 4-40 UNC fixings to the cold strap support clamp plates to secure the main strap.	0.76 Nm	+/- 10% above running torque				
.3	Ensure that the lower flexibles align with the pod interface. Fit the 6 x M4 attachment screws.	2.1 Nm	+/- 10% above running torque				

Location:	PA: Date:	Operator: Date:		

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
.4	Fit the joining plates of the main supports to the joining plates of the upper flexibles, using 8 x 4-40 UNC bolts and Kaylock nuts.	0.76 Nm	+/- 10% above running torque				
.5	**L1 straps.** Fit the two L1 straps to the FPU using at each location, 1 x Bellville washer type B0750-056-S and 1 x M8 bolt.	10.5 Nm	+/- 10% above running torque				
.6	And 2 x M4 bolts and 2 x Bellville washers (type B0375-020-S) under each screw head	1.5 Nm	+/- 10% above running torque				
.7	On final assembly the M8 fasteners to be wire locked to the M4 fasteners. Screws will be prepared for wire locking						
.8	**L3 straps:** • Fit the two L3 straps to the JFET's using the attachment hardware (L3 thermal strap clamp provided by SPIRE) as shown in interface drawings 0-KE-0104-350 and 0-KE-0104-360. **Note**: Spacecraft temperature sensors, two sensors on each clamp, fit to this interface.	2.5 Nm	+/- 10% above running torque				

Location:	PA: Date:	Operator: Date:		

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
5.1.7	***Isolation measurement***						
.1	Measure and record the electrical isolation between the chassis of the FPU and the cryostat.	> 1 MΩ					
.2	Fix the temporary grounding strap from the FPU to the OBA. Repeat the measurement of the resistance between the cryostat and the FPU to ensure that grounding has been successful.	< 3Ω					

Location:	PA: Date:	Operator: Date:		

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
5.1.8	***Removal of Red Tag items before Integration of Optical Bench shield***						
.1	**Alignment Cube:** Unscrew the fixing screws and store them with the alignment cube in the "red tag box"				No alignment cube on SPIRE CQM integrated		
.2	**Aperture cover:** To be removed at the latest opportunity prior to closure of the cryostat taking into account the possibility that the cover may not be able to be removed once the Instrument Shield is integrated. The aperture cover is removed by unscrewing the four 2-56 UNC (imperial) cap head screws, which are captive in the cover, and lifting the cover clear.						
.3	**Temporary grounding strap:** Removed during the Cryo harness Integration Procedure.						
.4	**Shorting plugs:** Removed during the Cryoharness Integration Procedure.						
.5	When removed all red tag items shall be bagged and stored in the dedicated “SPIRE red tag box” and mentioned in the Red/Green-Tag Item List for Herschel EPLM (AD 6)	P-2-ASED-LI-0027, Issue 1					
.6	There are no Green Tag Items						

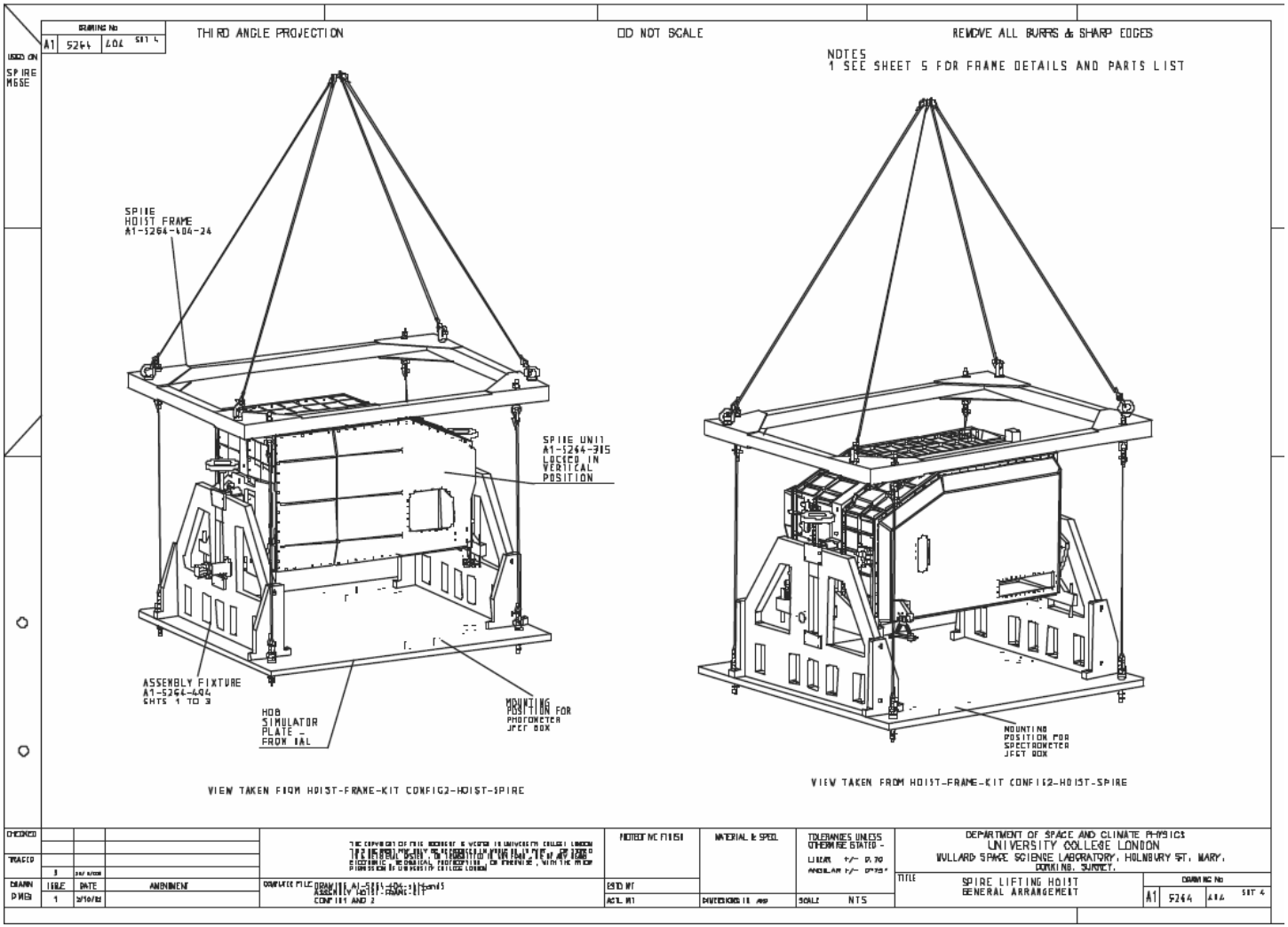
Location:	PA: Date:	Operator: Date:		

Step-No.	Integration-Step-Description	Nominal Value	Tolerance	Actual Value	Remarks	P	N
5.1.9	***Final visual inspection***						
.1	Visual inspection of the SPIRE FPU CQM, with regard to damages and visible contamination.	No damages, visible clean					
.2	Visual inspection of the mounting of the feet and of the thermal links to the SPIRE FPU CQM, with regard to damages and visible contamination	No damages, visible clean					
.3	Visual inspection of the electrical connectors to the SPIRE FPU CQM, with regard to damages and visible contamination	No damages, visible clean					
.4	Check that all Red Tag Items are dismounted prior to closure of optical bench with optical bench shield.						
.5	MIP						

Location:	PA: Date:	Operator: Date:		

6 ANNEX A

6.1 DRAWINGS OF SPIRE FPU MGSE



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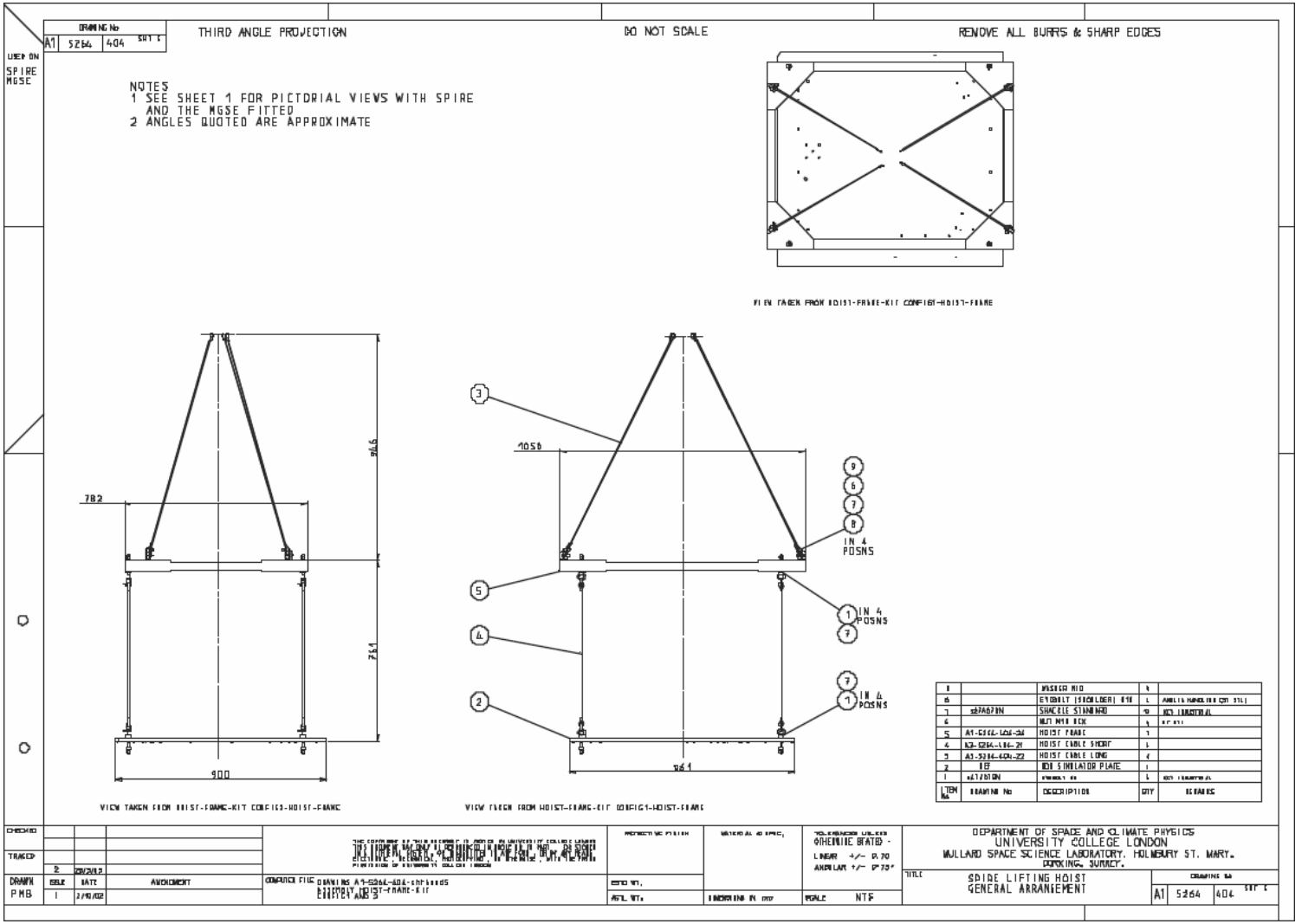

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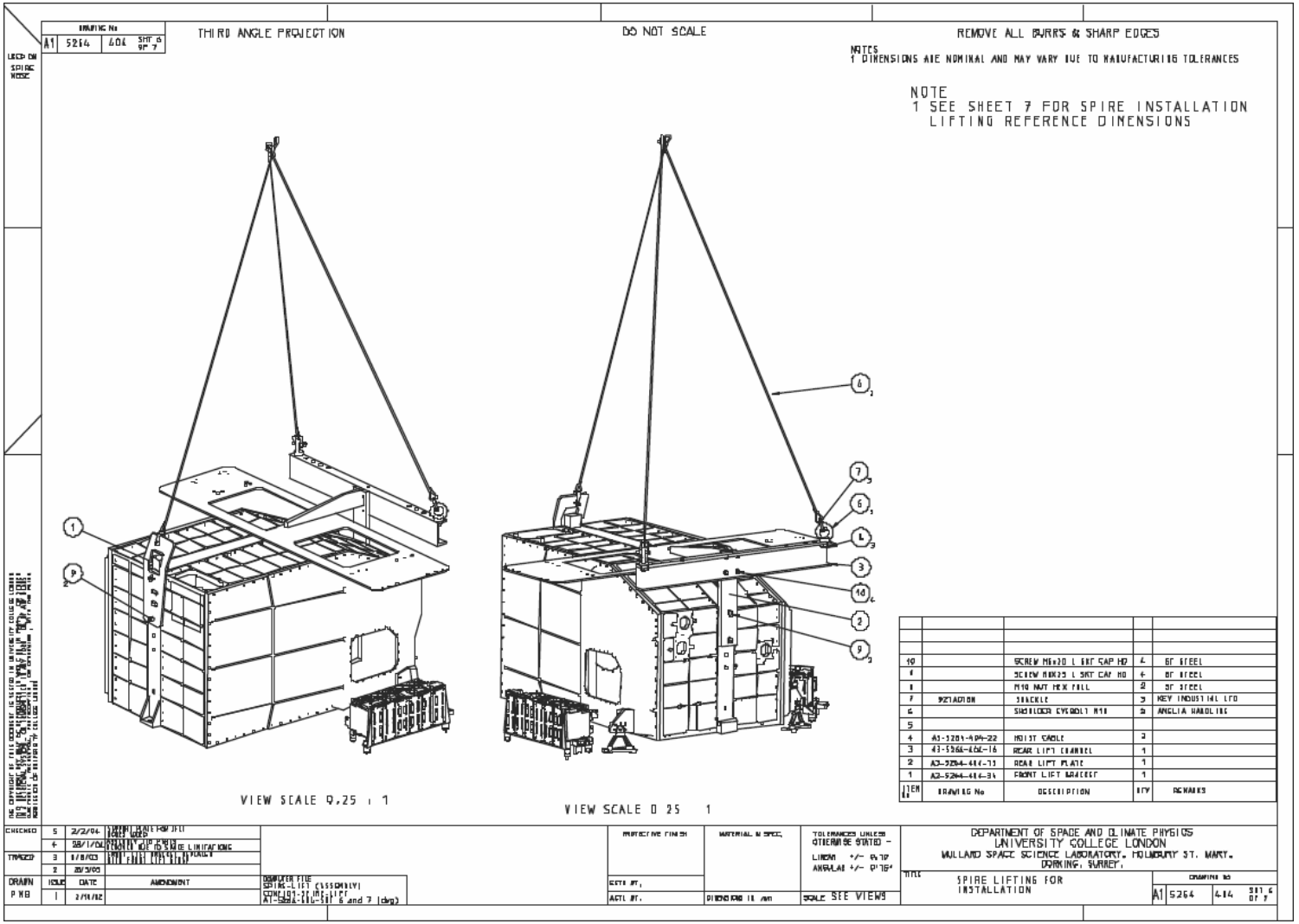

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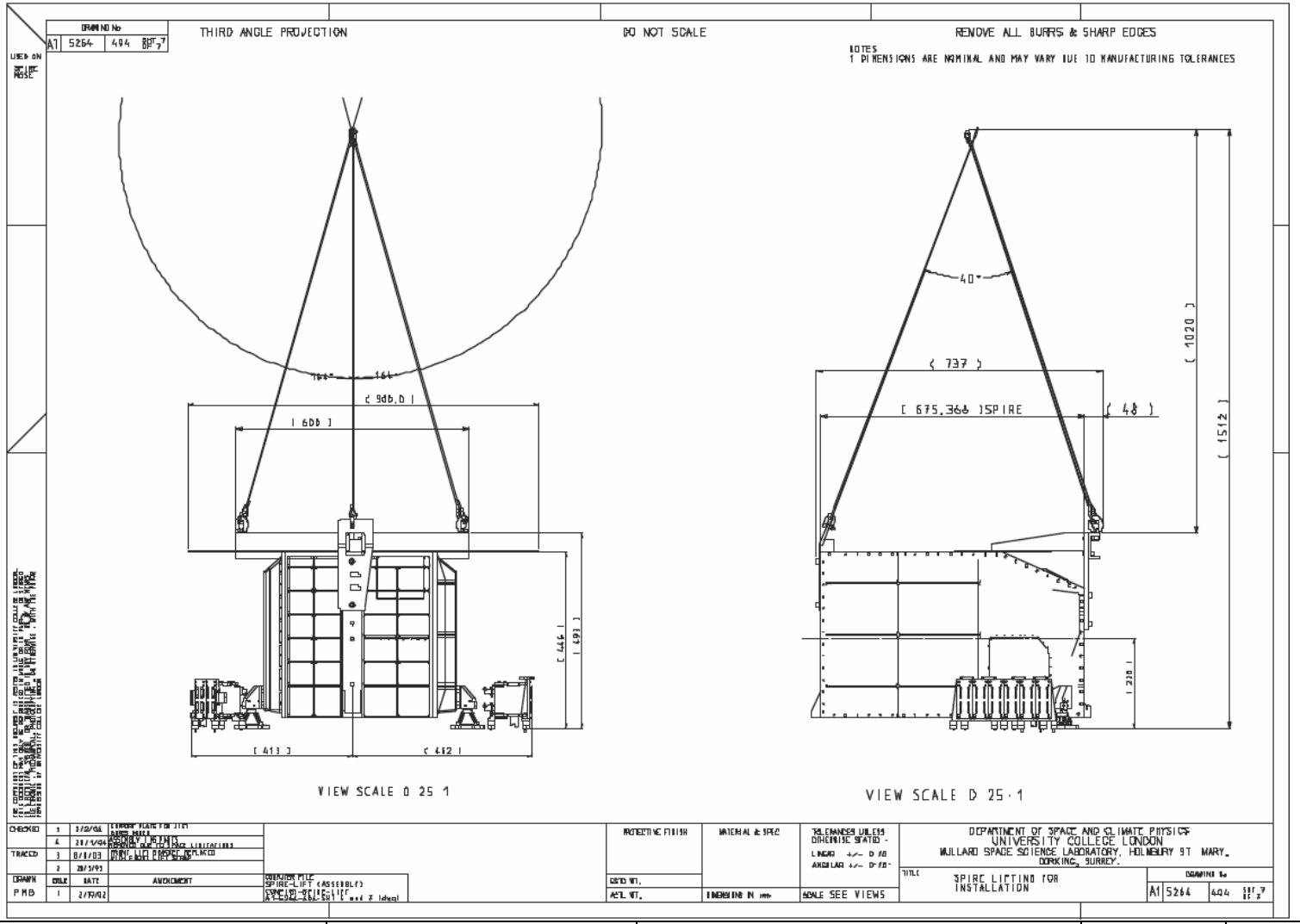

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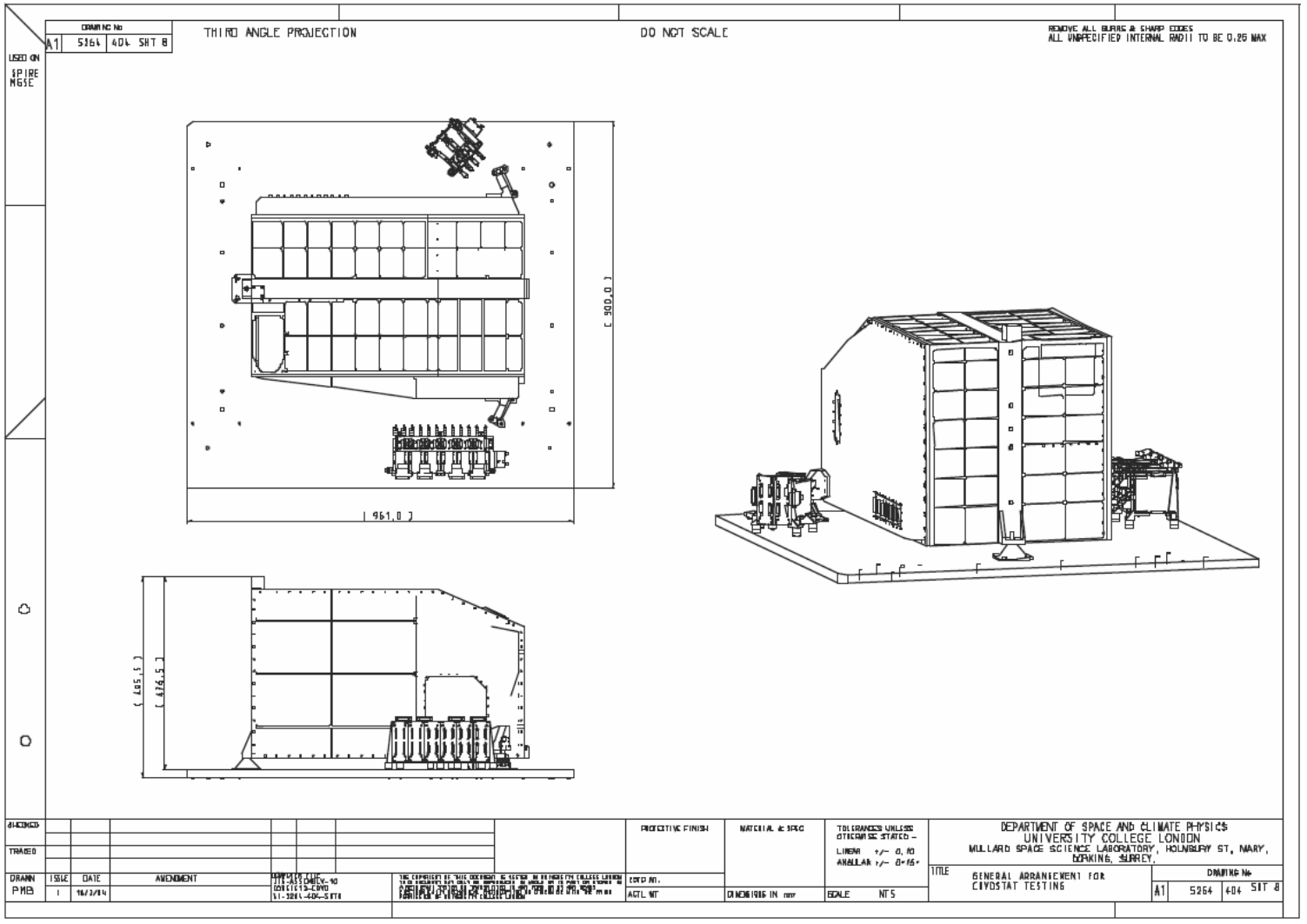

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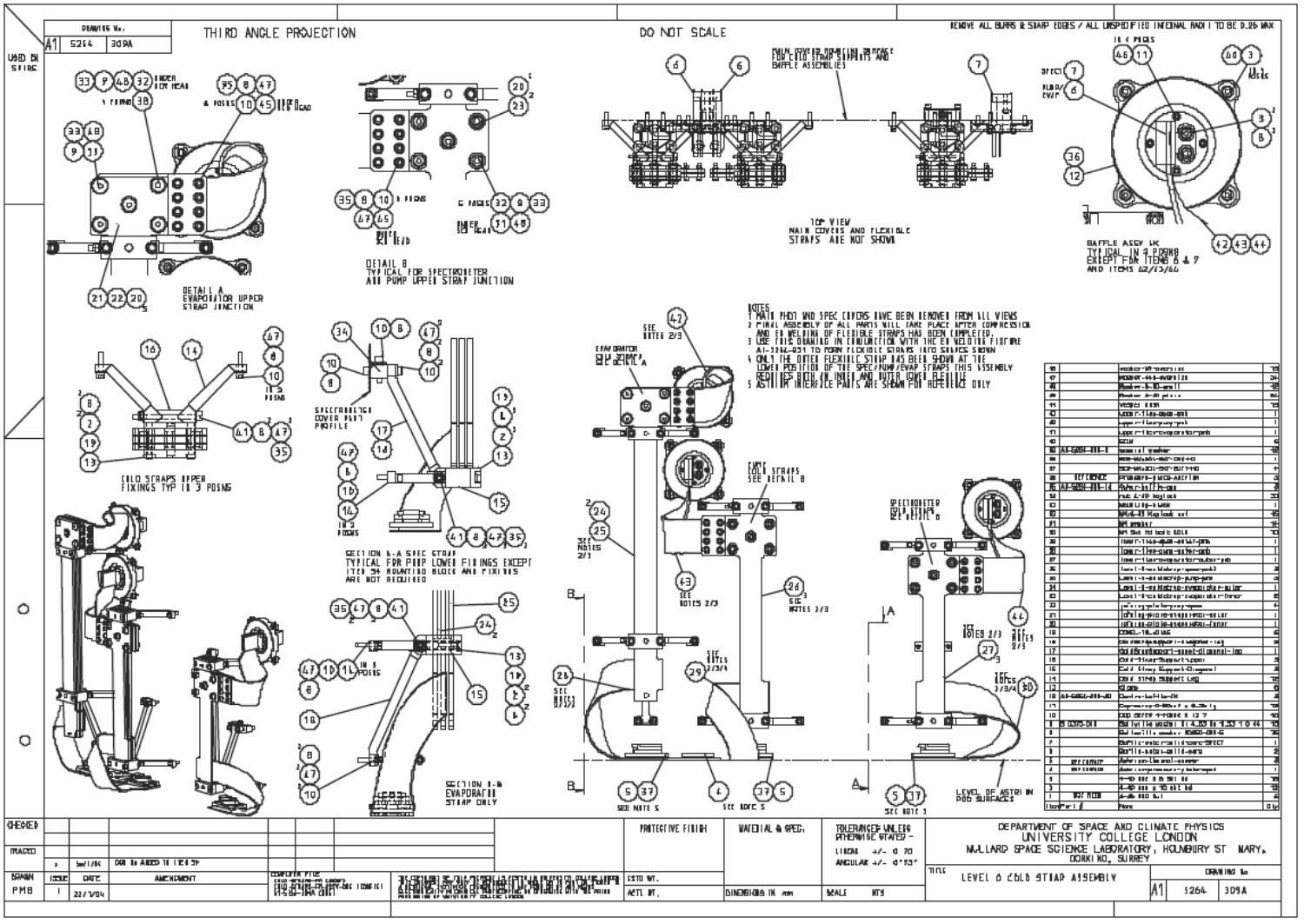
7 ANNEX B

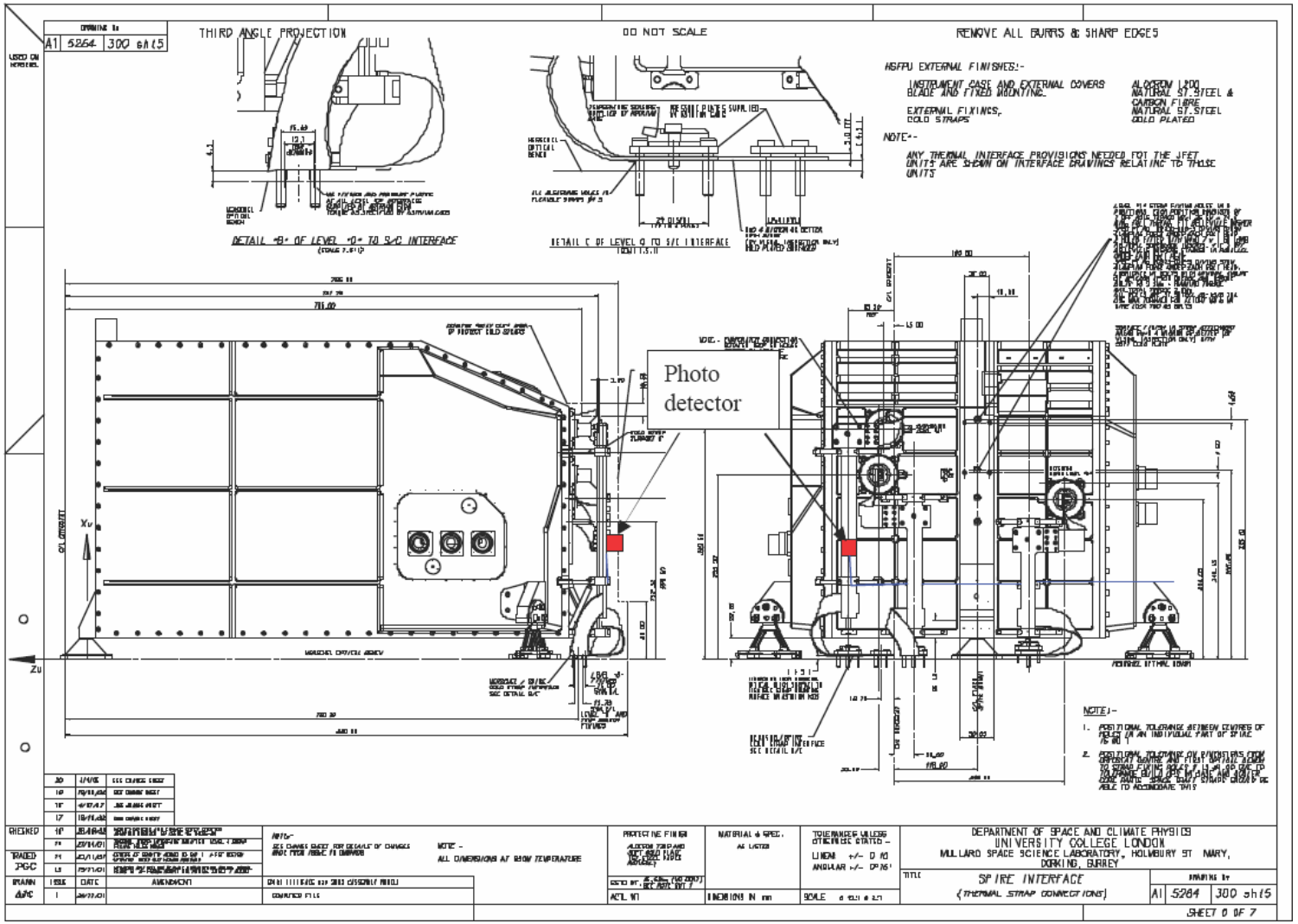
7.1 L0 Thermal Strap Assembly



Location:	PA: Date:	Operator: Date:		

8 ANNEX C

8.1 Location of Photo detector



Location:	PA: Date:	Operator: Date:		

9 Summary Sheets

9.1 Procedure Variation Summary

	Test Change	Curr. No.: Date: Page 1 of

Test designation	Test Procedure	Issue	Rev.
		1	

Test step changed	Reason for Change:

Prepared by:	Resp. Test Leader	Project Engineer
PA/QA		

9.2 Non Conformance Report (NCR) Summary

Status list of applicable NCR to be attached

9.3 Sign-off Sheet

	Date	Signature
Integration Manager		
Operator		
PA Responsible		

E N D O F D O C U M E N T

	Name	Dep./Comp.		Name	Dep./Comp.
	Alberti von Mathias Dr.	ASG22		Schweickert Gunn	ASG22
x	Barlage Bernhard	AED13		Steininger Eric	AED32
x	Bayer Thomas	ASA42	x	Stritter Rene	AED11
	Brune Holger	ASA45	x	Suess Rudi	OTN/ASA44
	Edelhoff Dirk	AED2		Thörmer Klaus-Horst Dr.	OTN/AED65
x	Fehringer Alexander	ASG13		Wagner Klaus	ASG22
x	Fricke Wolfgang Dr.	AED 65	x	Wietbrock Walter	AET12
x	Geiger Hermann	ASA42		Wöhler Hans	ASG22
x	Grasl Andreas	OTN/ASA44			
	Grasshoff Brigitte	AET12			
	Hartmann Hans	AED32	x	Alcatel Alenia Space Cannes	ASP
x	Hauser Armin	ASG22	x	ESA/ESTEC	ESA
x	Hendry David	Terma			
x	Hengstler Reinhold	ASA42		**Instruments:**	
	Hinger Jürgen	ASG22		MPE (PACS)	MPE
X	Hohn Rüdiger	AED65	x	RAL (SPIRE)	RAL
x	Hölzle Edgar Dr.	AED32		SRON (HIFI)	SRON
	Huber Johann	ASA42		**Subcontractors:**	
x	Hund Walter	ASE252		Air Liquide, Space Department	AIR
x	Idler Siegmund	AED312		Air Liquide, Space Department	AIRS
	Ilsen Stijn	Terma		Air Liquide, Orbital System	AIRT
	Ivády von András	FAE12		Alcatel Alenia Space Antwerp	ABSP
	Jahn Gerd Dr.	ASG22		Austrian Aerospace	AAE
x	Kalde Clemens	ASM2		Austrian Aerospace	AAEM
x	Kameter Rudolf	OTN/ASA42		APCO Technologies S. A.	APCO
x	Kettner Bernhard	AET42		Bieri Engineering B. V.	BIER
	Knoblauch August	AET32		BOC Edwards	BOCE
	Koelle Markus	ASA43		Dutch Space Solar Arrays	DSSA
	Koppe Axel	AED312		EADS Astrium Sub-Subsyst. & Equipment	ASSE
x	Kroeker Jürgen	AED65		EADS CASA Espacio	CASA
	La Gioia Valentina	Terma		EADS CASA Espacio	ECAS
x	Lamprecht Ernst	OTN/ASQ22		EADS Space Transportation	ASIP
x	Lang Jürgen	ASE252		Eurocopter	ECD
x	Langenstein Rolf	AED15		European Test Services	ETS
x	Langfermann Michael	ASA41		HTS AG Zürich	HTSZ
	Much Christoph	ASA43		Linde	LIND
	Müller Jörg	ASA42		Patria New Technologies Oy	PANT
	Müller Martin	ASA43		Phoenix, Volkmarsen	PHOE
	Peltz Heinz-Willi	ASG13		Prototech AS	PROT
	Pietroboni Karin	AED65		QMC Instruments Ltd.	QMC
	Platzer Wilhelm	AED2		Rembe, Brilon	REMB
	Reichle Konrad	ASA42		Rosemount Aerospace GmbH	ROSE
	Runge Axel	OTN/ASA44		RYMSA, Radiación y Microondas S.A.	RYM
	Schink Dietmar	AED32		SENER Ingenieria SA	SEN
	Schlosser Christian	OTN/ASA44		Stöhr, Königsbrunn	STOE
	Schmidt Rudolf	FAE12		Terma A/S, Herlev	TER