



**SPIRE - Photometer Calibration Source (PCal) - PFM**

**End Item Data Package (EIDP)**

**SPIRE - Photometer Calibration Source (PCal) - PFM**

SPIRE Ref.: SPIRE-UCF-DOC-002797

Cardiff Ref.: HSO-CDF-EIDP-073 Issue 1.0

15<sup>th</sup> March 2005

Prepared by: Peter Hargrave  
Cardiff SPIRE Technical Manager

Approved by: Ian Walker  
Cardiff AIG Programme Manager

Distribution list

RAL	Eric Sawyer	Cardiff	Peter Ade
	Eric Clark		Matt Griffin
	Judy Long		Ian Walker
	Bruce Swinyard		
	Doug Griffin	ATC	Phil Parr-Burman

**Change Record**

Issue	Section	Date	Changes
1.0		15/03/05	First issue for DRB

## ***Table of contents***

<b>SECTION 01 - SHIPPING DOCUMENTS</b>	<b>7</b>
<b>SECTION 02 - TRANSPORTATION, PACKING, HANDLING &amp; INTEGRATION PROCEDURES</b>	<b>10</b>
<b>SECTION 03 - CERTIFICATE OF CONFORMANCE</b>	<b>11</b>
<b>SECTION 04 - QUALIFICATION STATUS LIST / COMPLIANCE MATRIX</b>	<b>12</b>
<b>SECTION 05 - TOP LEVEL DRAWINGS (INC. FAMILY TREE)</b>	<b>15</b>
<b>SECTION 06 - INTERFACE DRAWINGS</b>	<b>16</b>
<b>SECTION 07 - FUNCTIONAL, BLOCK &amp; MECHANICAL DRAWINGS</b>	<b>18</b>
<b>SECTION 08 – ELECTRICAL CIRCUIT DIAGRAMS</b>	<b>24</b>
<b>SECTION 09 - AS BUILT CONFIGURATION ITEMS STATUS LIST</b>	<b>26</b>
<b>SECTION 10 – SERIALISED COMPONENTS LIST</b>	<b>27</b>
<b>SECTION 11 - LIST OF WAIVERS</b>	<b>27</b>
<b>SECTION 12 - COPIES OF WAIVERS</b>	<b>27</b>
<b>SECTION 13 - OPERATIONS MANUAL</b>	<b>28</b>
<b>SECTION 14 - HISTORICAL RECORD</b>	<b>30</b>

<b>SECTION 15 - LOGBOOK / DIARY OF EVENTS</b>	<b>31</b>
<b>SECTION 16 - OPERATING TIME / CYCLE RECORD</b>	<b>31</b>
<b>SECTION 17 - CONNECTOR MATING RECORD</b>	<b>32</b>
<b>SECTION 18 - AGE SENSITIVE ITEMS RECORD</b>	<b>33</b>
<b>SECTION 19 - PRESSURE VESSEL HISTORY / TEST RECORD</b>	<b>33</b>
<b>SECTION 20 - CALIBRATION DATA RECORD</b>	<b>33</b>
<b>SECTION 21 - TEMPORARY INSTALLATION RECORD</b>	<b>35</b>
<b>SECTION 22 - OPEN WORK / DEFERRED WORK / OPEN TESTS</b>	<b>36</b>
<b>SECTION 23 - LIST OF NON-CONFORMANCE REPORTS</b>	<b>36</b>
<b>SECTION 24 - COPIES OF NON-CONFORMANCE REPORTS</b>	<b>36</b>
<b>SECTION 25 - TEST REPORTS</b>	<b>36</b>
<b>SECTION 26 - ASSEMBLY RECORD</b>	<b>36</b>
<b>SECTION 27 - REFERENCE LIST OF EIDP'S</b>	<b>37</b>
<b>SECTION 28 - MASS RECORDS</b>	<b>38</b>
<b>SECTION 29 - CLEANLINESS STATEMENT</b>	<b>39</b>

<b>SECTION 30 - OTHER USEFUL INFORMATION</b>	<b>40</b>
<b>SECTION 31 - DPL/DML</b>	<b>41</b>
<b>SECTION 32 – LIST OF APPENDICES/ATTACHMENTS</b>	<b>41</b>
<b>APPENDIX A</b>	<b>42</b>
<b>THERMOMETER CALIBRATION REPORTS</b>	<b>ERROR! BOOKMARK NOT DEFINED.</b>
<b>APPENDIX B</b>	<b>43</b>
<b>REPORT FROM CRYOGENIC VIBRATION TESTS</b>	<b>ERROR! BOOKMARK NOT DEFINED.</b>
<b>APPENDIX C</b>	<b>44</b>
<b>SCAL-B CALIBRATION REPORT</b>	<b>ERROR! BOOKMARK NOT DEFINED.</b>
<b>APPENDIX D</b>	<b>45</b>
<b>SCAL LIFETEST REPORT</b>	<b>45</b>
<b>APPENDIX E</b>	<b>46</b>
<b>SCAL LIFETEST PROCEDURE &amp; RECORD</b>	<b>ERROR! BOOKMARK NOT DEFINED.</b>
<b>APPENDIX F</b>	<b>47</b>
<b>SCAL ENHANCED WARM-UP TEST REPORT</b>	<b>ERROR! BOOKMARK NOT DEFINED.</b>



## **SECTION 01 - Shipping Documents**

**Minutes of SPIRE PCAL-PFM DRB – to be completed at DRB.....**

**Cardiff, 2005**

**Present:**

### **DRB scope and objectives**

- Review subsystem documentation, qualification and performance status of PFM PCAL unit
- Formal acceptance of the hardware

### **List of relevant documents and status**

- 

### **Review of comments received on EIDP**

- 

### **EIDP run-through**

- 

### **Conclusions and summary of outstanding work**

## DRB Check-list

If all listed points are satisfactory then the item may be accepted. If not, the item may be accepted with the caveat that the requirement in question will be met within an agreed time scale.

No.	Record applicable answers and provide explanations in comment column	Yes/No/NA	Comments
1	Are all documents, drawings, etc. complete, approved, and under configuration control?		
2	Do the released items above reflect all approved changes?		
3	Is the hardware identical to other hardware delivered. If not provide difference list?		
4	Does the hardware fulfil its functional requirements, specifications, RFWs, ICDs etc.?		
5	Does the As-built Configured Items List reflect hardware as delivered?		
6	Have all required environmental tests and analyses been completed?		
7	Are all the required test and qualification procedures and reports completed and available to review.		
8	Have all the Declared Lists, i.e. DML, DMPL, DPL and components (EEE Parts) list been released? (Need not necessarily be included in EIDP, but must be available)		
9	Have PADS been raised and approved where required?		
10	Are relevant Test Readiness Review (TRR) minutes and the Post Test		



	Reviews (PTR) complete and available?		
11	EIDP check: Are all agreed sections of the EIDP complete? Record any anomalies.		

		Signature	Date
Ian Walker	Cardiff SPIRE PA manager		
Peter Hargrave	Cardiff SPIRE Technical Manager		
Matt Griffin	DRB chair		

## **SECTION 02 - Transportation, Packing, Handling & Integration Procedures**

### **Handling**

- Full ESD precautions to be observed when handling PCal.
- Inspection may be carried out in class-100 clean air cabinet.
- The rear cover must not be removed unless an authorised member of Cardiff personnel is present.

### **Storage**

- PCal must be stored in the shipping container provided.

### **Installation**

- Installation of PCal will be carried out by an ESA-approved soldering technician at RAL, according to the PCal ICD – HSO-CDF-ICD-013.

### **Cleaning & Bakeout**

- Outer surface may be cleaned using a clean-room wipe impregnated with iso-propyl alcohol, with a piece of Kapton tape covering the aperture.
- Bakeouts should be kept to a minimum, and the temperature should NEVER exceed 90°C.

## SECTION 03 - Certificate of Conformance

<i>Cardiff University Astronomy Instrumentation Group hereby certifies that the following equipment,</i>		
Spacecraft / Project:	<b>Herschel</b>	
Instrument:	<b>SPIRE</b>	
Model:	<b>PFM</b>	
Subsystem:	<b>Photometer Calibration Source</b>	
Serial No:	<b>PCAL-PFM-000</b>	
<i>As described in this End Item Data Package:</i> <b>HSO-CDF-EIDP-073</b>		
<i>Complies with the requirements set out in:</i> <b>SPIRE Instrument Requirements Document - SPIRE-RAL-PRJ-000034</b> <b>Photometer Calibrator ICD – HSO-CDF-ICD-013 Issue 3.0</b> <b>Photometer Calibrator Specifications – HSO-CDF-SP-003 Issue 1.0</b>		
<b><i>Responsible Authority</i></b>		<b><i>Signature</i></b>
Cardiff Product Assurance	Dr I.Walker	
Cardiff SPIRE Management	Dr P.Hargrave	

## SECTION 04 - Qualification Status List / Compliance Matrix

Test	Status	Applicable document	Test Institute
Dimension and tolerances to specification	Compliant	PCal ICD – HSO-CDF-ICD-013	UWC
Visual inspection (internal & external)	Passed	Cardiff SPIRE PCal logbook	UWC
Mass	Compliant	PCal ICD - HSO-CDF-ICD-013	UWC
Thermal / vacuum cycles	Passed. Prior to delivery, PCal-PFM underwent a total of five thermal / vacuum cycles to <15-K.	Section 14 & 15 Historical record & Logbook	UWC
Power consumption	Compliant		UWC
Vibrations 300K	Passed	AIV-2003-091-VIB, HSO-CDF-RP-078	RAL
Vibrations 4K	Passed	AIV-2003-091-VIB, HSO-CDF-RP-078	RAL
Environmental condition - Vacuum $3 \times 10^{-1}$ mBar	Compliant	Section 14 & 15 Historical record & Logbook	UWC
Differential pressure (a pumping-out rate of 10mB/sec)	Compliant	Section 14 & 15 Historical record & Logbook	UWC
Pre-bake out (not exceeding 80°C)	Performed & compliant	Section 14 & 15 Historical record & Logbook	UWC
Outgassing	Compliant	By design	UWC
Cleanliness checks, by visual inspection.	Passed	Cardiff SPIRE PCal logbook	UWC
Degradation due to high energy radiation.	Compliant	By design	UWC

### Compliance with IRD

Requirement ID	Description	Value	Compliant?
IRD-CALP-R01	Nominal operating output	The area:surface brightness product of the calibrator aperture shall be $\geq 1\%$ of the area:surface brightness product of the telescope image at the position of M4 (with an assumed telescope temperature of 80 K and emissivity of 4%) for $200 < \lambda < 700\mu\text{m}$ .	Yes – see test data
IRD-CALP-R02	Operating range	Commandable in 256 steps, with at least 124 steps covering the range from zero output to 2% of the	Yes – 12-bit DAC current drive in range 0-7mA. Required output achieved at 3.9mA.

		covering the range from zero output to 2% of the power from the telescope	Required output achieved at 3.9mA. 2% of telescope background power at 5.7mA, with 3334 steps from 0 - 5.7mA.
IRD-CALP-R03	Equivalent obscuration of aperture through BSM mirror	The outside envelope of the calibrator housing shall not foul on any part of the BSM for any operational angular position of the BSM	This is the same as IRD-CALP-R09! The old requirement referred to equivalent obscuration of the telescope primary at the BSM pupil....
IRD-CALP-R04	Speed of response	Response to step change in applied power, 90% settling time of radiant power output <350ms (70ms)	Compliant. See test data. Rise time constant at nominal power = 96 mS Fall time constant = 52 ms
IRD-CALP-R05	Repeatability	RMS of output signal better than 1% over 20 cycles on to off during a calibration operation of less than 2 minutes. Drift less than 10% over lifetime of the mission. Repeatability of signal 1% for 12 calibration operations equi-spaced over a period of 12 hours, with uniform base temperature and drive current.	Yes. See life test report. HSO-CDF-RP-091.
IRD-CALP-R06	Operation	Nominally once per hour for no more than 10 seconds.	Yes
IRD-CALP-R07	Frequency	Continuously or pseudo continuously variable between 0 and 2 Hz.	Yes
IRD-CALP-R08	Interface	The calibrator will be integrated into the beam steering mechanism.	Yes – see PCAL ICD. HSO-CDF-ICD-013-3.0
IRD-CALP-R09	Volume envelope	This shall be compatible with the space available within the BSM enclosure as described in the BSM specification document.	Yes
IRD-CALP-R10	Thermal isolation	The thermal conductance between the calibrator body and the SPIRE optical bench shall be > 2 mW/K.	Determined by BSM structure. Not a requirement on PCal.
IRD-CALP-R11	Operating temperature	<6K	Yes
IRD-CALP-R12	Cold power dissipation	Shall be within the specification given in RD8	RD8 is the now-obsolete SPIRE systems budgets document – SPIRE-ATC-PRJ-000450
IRD-CALP-R13	Warm power dissipation	<i>Requirement removed</i>	
IRD-CALP-R14	Operating voltage	Less than 28V at input power level of 5mW	Yes - see PCAL ICD. HSO-CDF-ICD-013-3.0 Operating voltage at nominal output is 0.9V
IRD-CALP-R15	Redundancy	Cold redundancy for the thermal source	Yes

IRD-CALP-R16	Lifetime	The calibration source shall be capable of up to 250,000 operational cycles at the nominal electrical power.	Yes. See life test report. HSO-CDF-RP-091.

## SECTION 05 - Top Level Drawings (Inc. Family Tree)

### Hardware tree

The hardware tree for PCal is shown in Figure 1. Note that the part numbers are given by the general form “PCAL-XXX-nnn”, where “XXX” is the model designation (CQM, PFM etc) and “nnn” is the number given in the hardware tree. For instance, the part number for the PCal flight model rear cover would be “PCAL-PFM-202”.

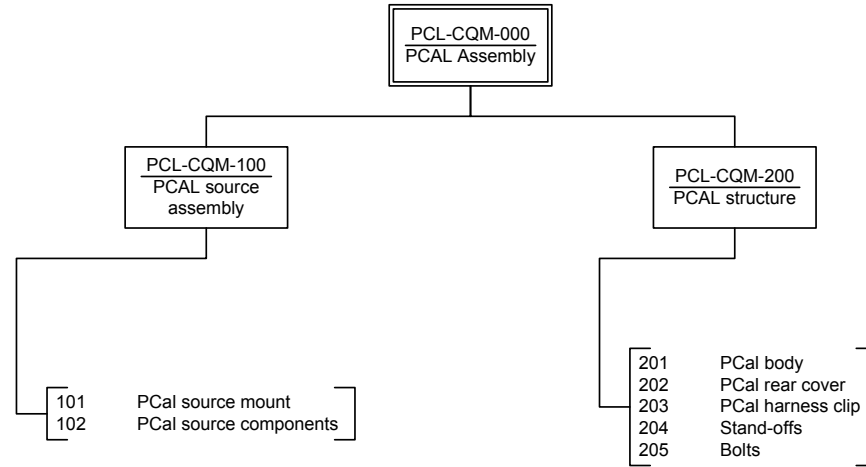


Figure 1 Hardware tree for PCal components.

### TOP LEVEL DRAWING LIST

Drawing No.	Title

# SECTION 06 - Interface Drawings

## *INTERFACE DRAWING LIST*

Drawing No.	Title	Notes
PCAL-ICD-000-B	PCal Interface Control Drawing	This is the flight model interface drawing



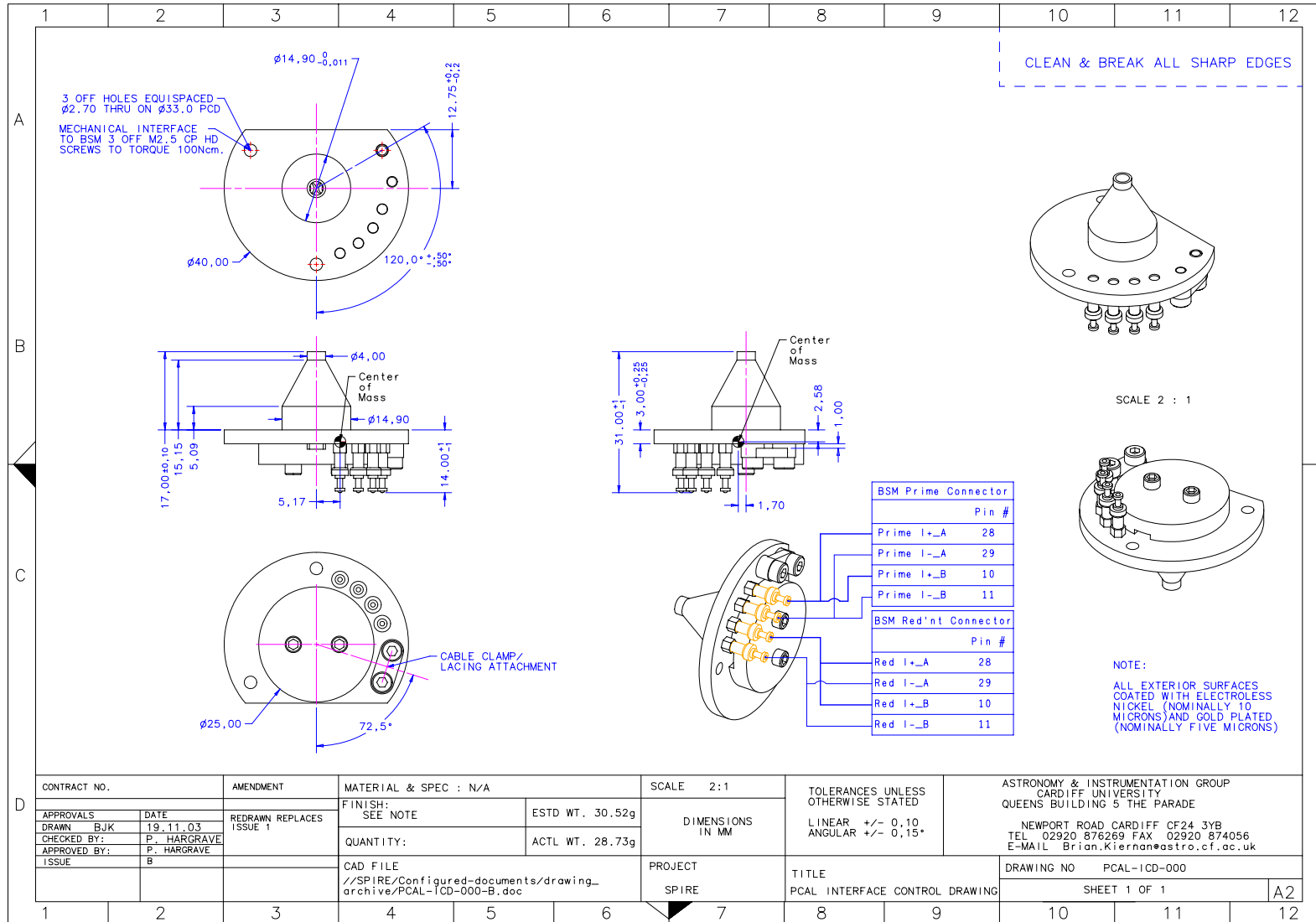


Figure 2 Mechanical interface drawing for PCal-PFM

# SECTION 07 - Functional, Block & Mechanical Drawings

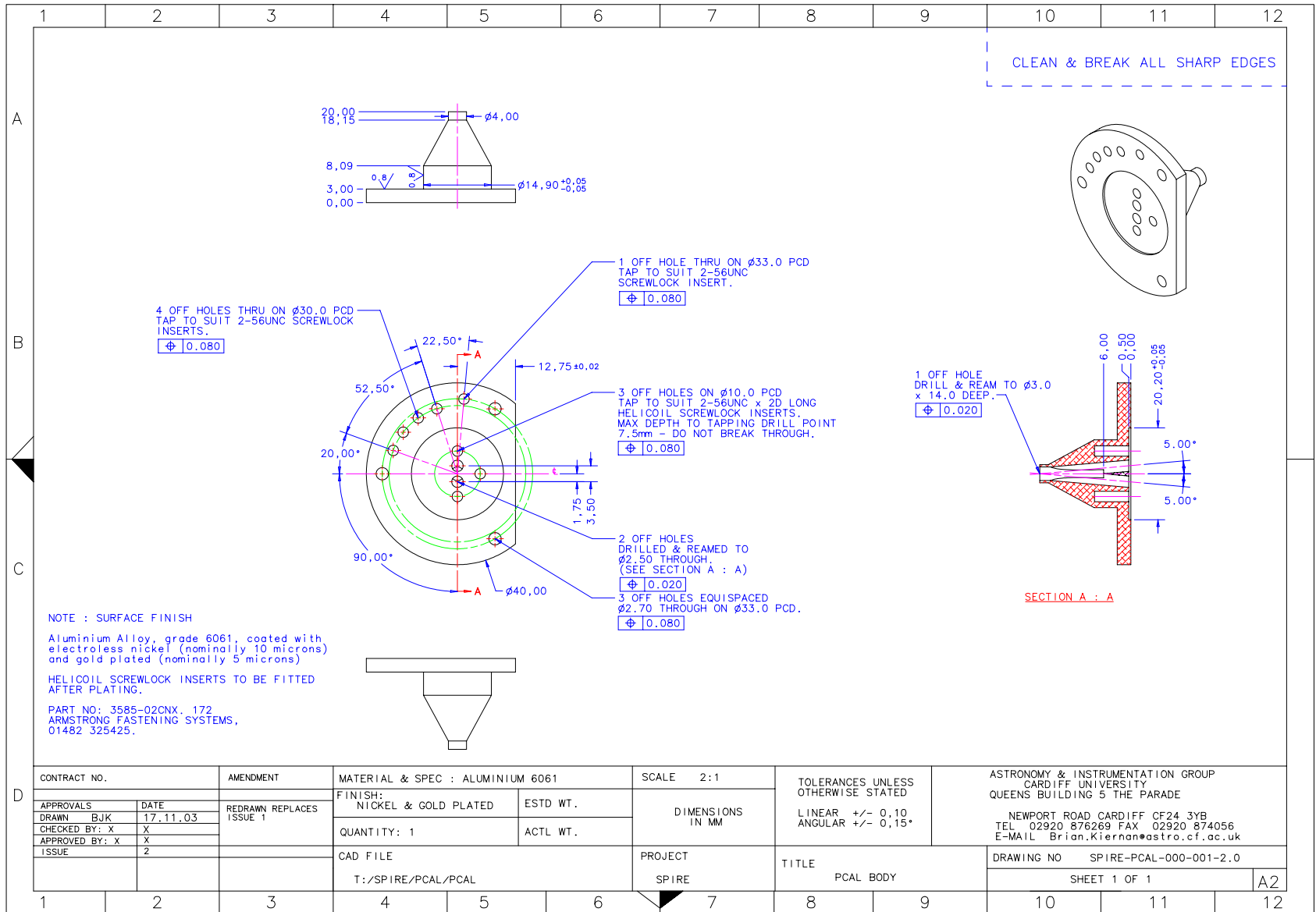
Component drawings are given in this section.

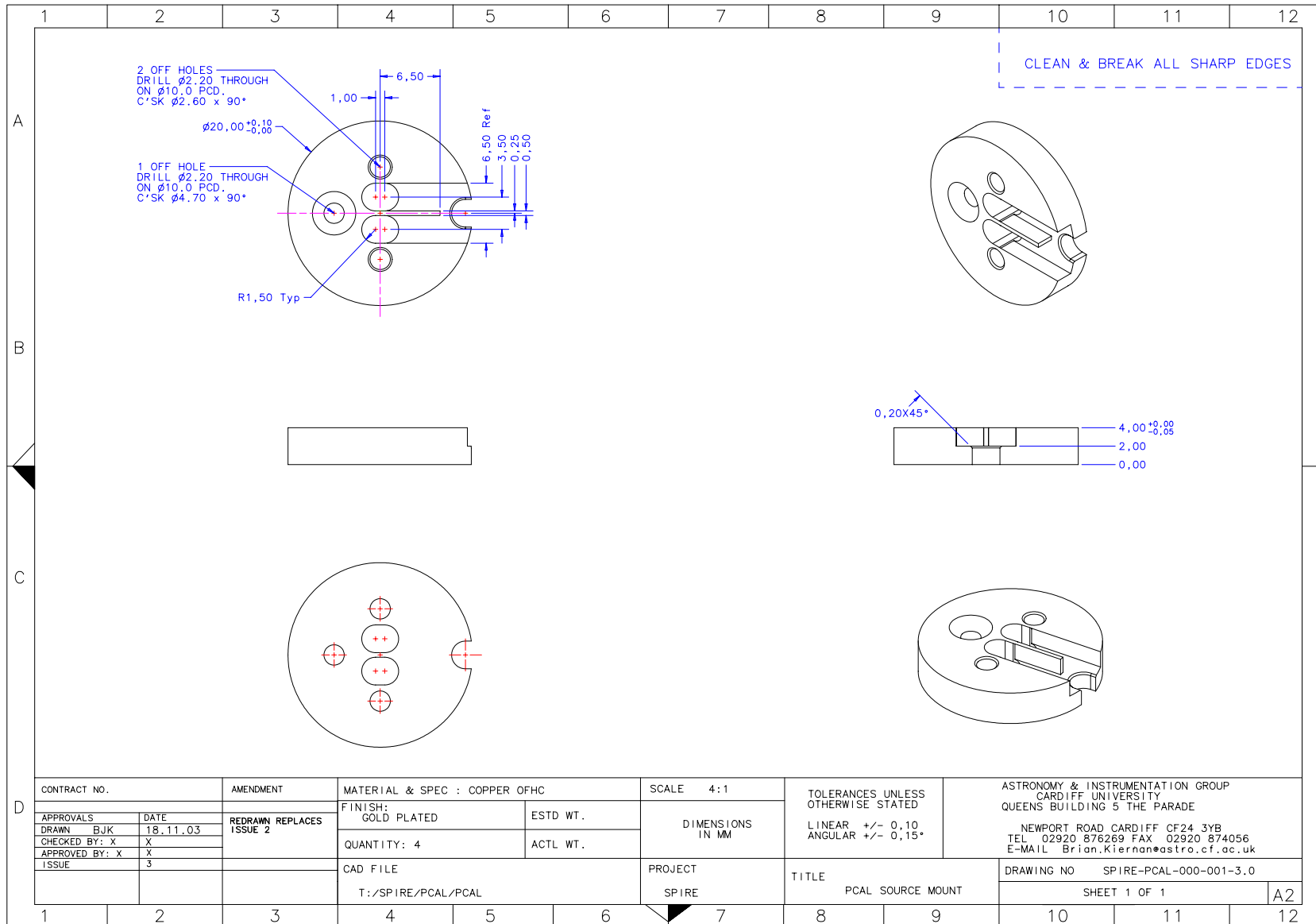
## FUNCTIONAL & BLOCK DRAWING LIST

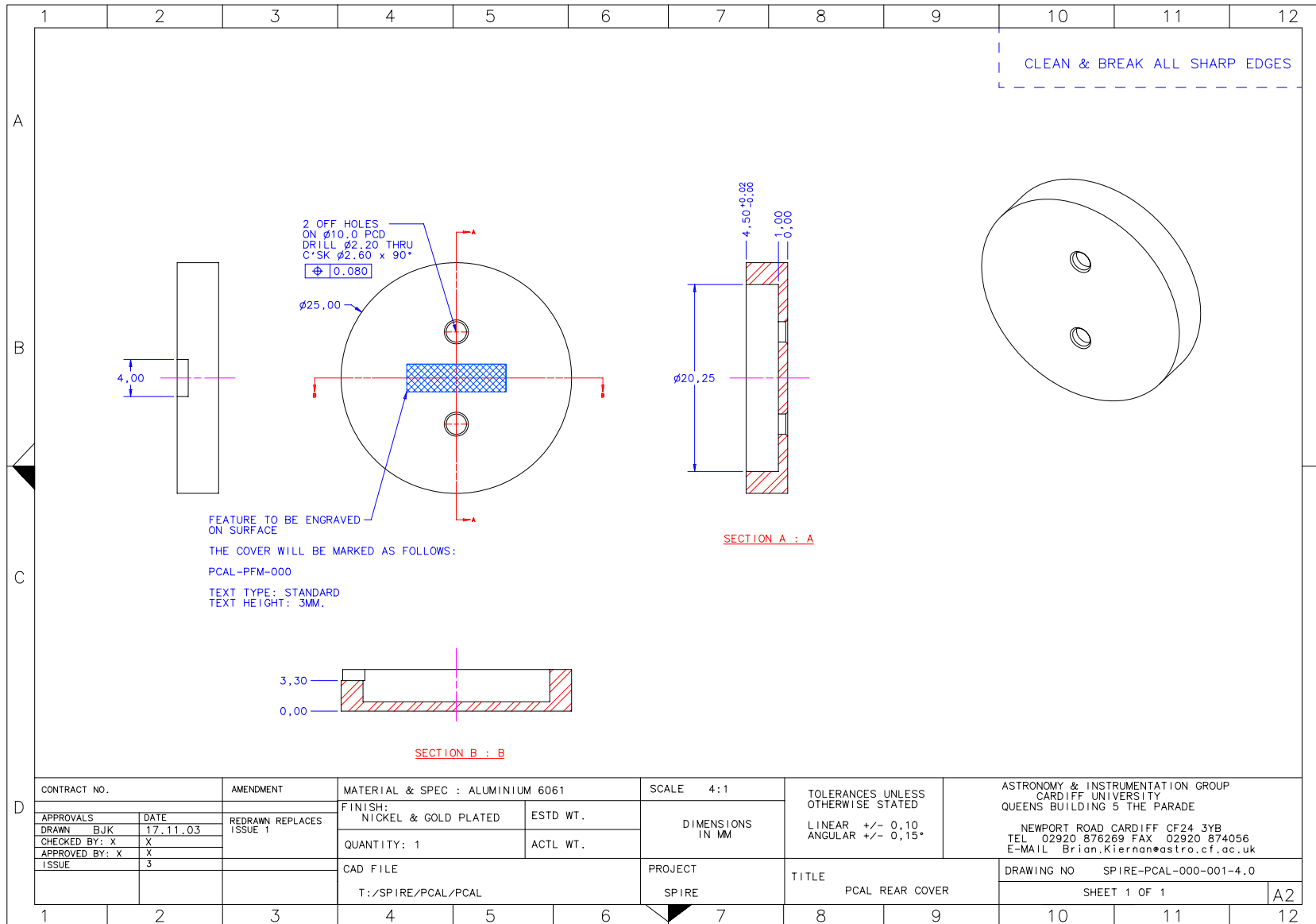
Drawing No.	Title

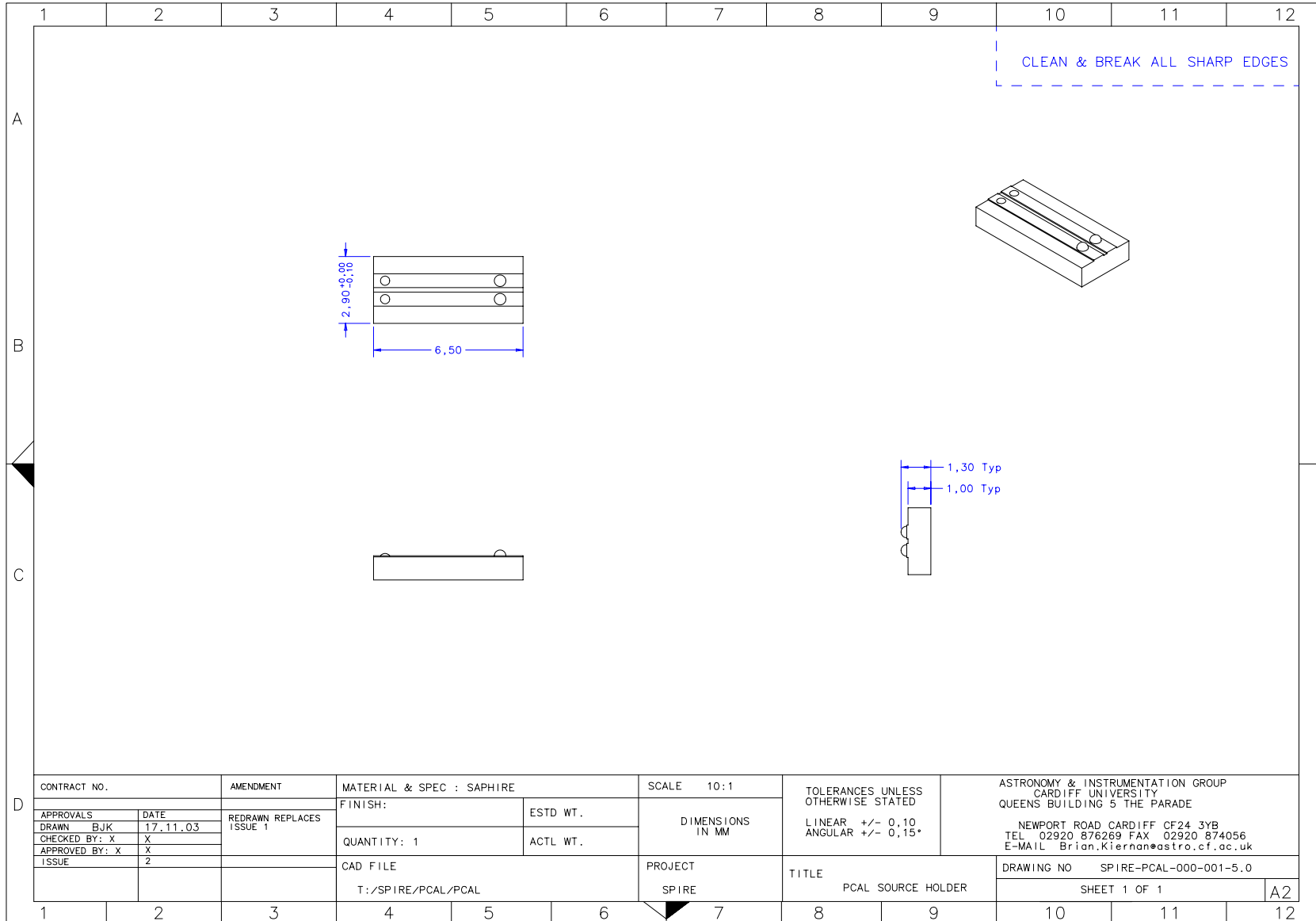
## MECHANICAL COMPONENT DRAWING LIST

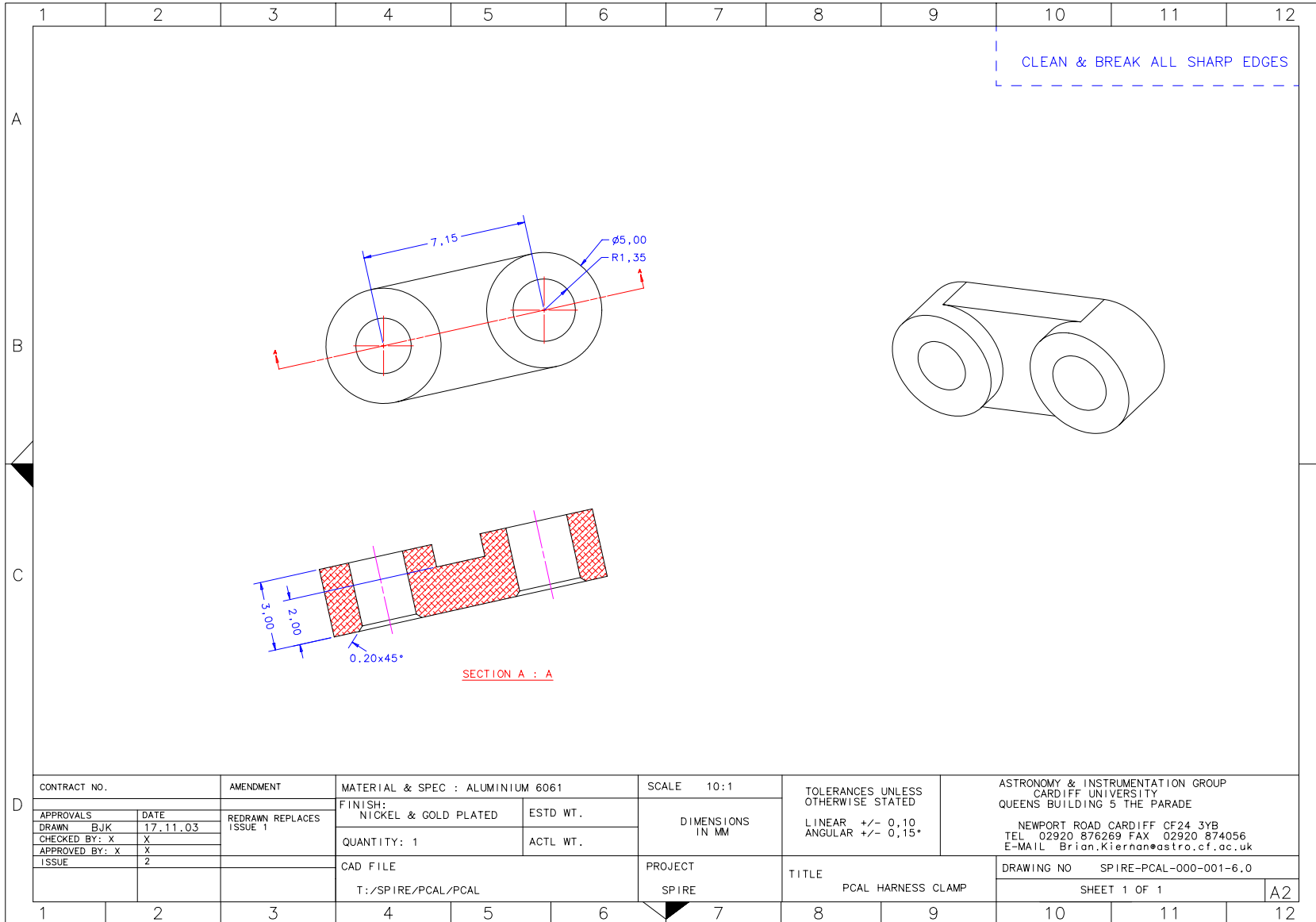
Drawing No.	Title	Notes
SPIRE-PCAL-000-001-2.0	PCAL BODY	
SPIRE-PCAL-000-001-3.0	PCAL SOURCE MOUNT	
SPIRE-PCAL-000-001-4.0	PCAL REAR COVER	
SPIRE-PCAL-000-001-5.0	PCAL SOURCE HOLDER	
SPIRE-PCAL-000-001-6.0	PCAL HARNESS CLAMP	











CONTRACT NO.		AMENDMENT	MATERIAL & SPEC : ALUMINIUM 6061		SCALE 10:1	TOLERANCES UNLESS OTHERWISE STATED LINEAR +/- 0.10 ANGULAR +/- 0.15°	ASTRONOMY & INSTRUMENTATION GROUP CARDIFF UNIVERSITY QUEENS BUILDING 5 THE PARADE NEWPORT ROAD CARDIFF CF24 3YB TEL 02920 876269 FAX 02920 874056 E-MAIL Brian.Kiernan@astro.cf.ac.uk	
APPROVALS		DATE	FINISH:	ESTD WT.	DIMENSIONS IN MM			
DRAWN	BJK	17.11.03	NICKEL & GOLD PLATED				DRAWING NO SPIRE-PCAL-000-001-6.0	
CHECKED BY:	X		QUANTITY: 1	ACTL WT.		SHEET 1 OF 1		
APPROVED BY:	X		CAD FILE		PROJECT		TITLE PCAL HARNESS CLAMP	
ISSUE	2	REDRAWN REPLACES ISSUE 1	T:/SPIRE/PCAL/PCAL		SPIRE	A2		

## SECTION 08 – Electrical Circuit Diagrams

The four prime PCAL wires (part of the BSM/PCal prime harness) are terminated on the two prime solder terminals. This harness is duplicated for the redundant systems. The PCAL wiring will consist of an insulated, screened, twisted quad sub-harness. The maximum harness impedance requested for PCAL is 10 Ohms per wire. A schematic of the BSM prime connector wiring is shown in Figure 3. The redundant wiring will be an exact copy of this harness.

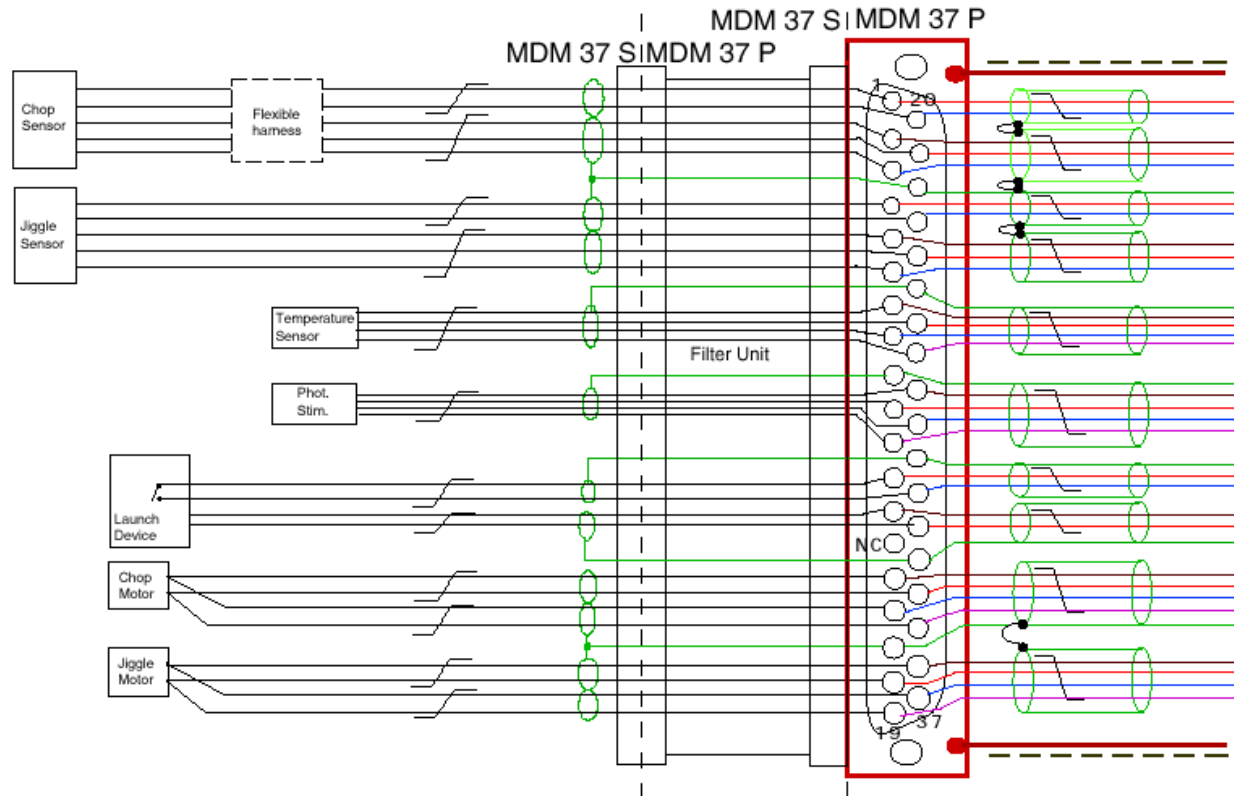


Figure 3 Schematic of pin allocations for PCAl/BSM prime and redundant connectors. Both prime and redundant connectors are MDM-37 way socket connectors, with jackposts.



Table 1 Pin allocations for PCal-PFM electrical connectors (refer also to ICD – HSO-CDF-ICD-013).

<b>BSM Prime connector Pin#</b>	<b>Label (in accordance with Harness Definition Document)</b>	<b>Function</b>
28	Prime I+ <u>A</u>	Current drive
29	Prime I- <u>A</u>	Current return
10	Prime I+ <u>B</u>	Voltage sense +
11	Prime I- <u>B</u>	Voltage sense -
<b>BSM Redundant connector Pin#</b>	<b>Label (in accordance with Harness Definition Document)</b>	<b>Function</b>
28	Red I+ <u>A</u>	Current drive
29	Red I- <u>A</u>	Current return
10	Red I+ <u>B</u>	Voltage sense +
11	Red I- <u>B</u>	Voltage sense -

## SECTION 09 - As Built Configuration Items Status List

Files are located in the directories indicated below, and on the accompanying CD-ROM.

Item	Reference	Location	Notes
PCal drawings and manufacturing files		\\Darkstar\Astroworld\Projects\SPIRE\Cardiff_workpackages\Configured_Documents\PCAL\PFM-build\Drawings	
Material certificates of conformance		Available at Cardiff for inspection	
Calibration data files		\\Darkstar\Astroworld\Projects\SPIRE\Cardiff_workpackages\Configured_Documents\PCAL\PFM-build\Calibration files	
Test data		\\Darkstar\Astroworld\Projects\SPIRE\Cardiff_workpackages\Configured_Documents\PCAL\PFM-build\Test data	
Test reports		\\Darkstar\Astroworld\Projects\SPIRE\Cardiff_workpackages\Configured_Documents\PCAL\PFM-build\Test reports	
Calibration analysis worksheet		\\Darkstar\Astroworld\Projects\SPIRE\Cardiff_workpackages\Configured_Documents\PCAL\PFM-build\Calibration files	

Part number	Description	Details	C. of C. / Batch number
<b>PCAL-PFM-100</b>	HBI-7 – PCal PFM source assembly	Mounting ring manufactured and gold-plated at Cardiff. Source assembled by Haller-Beeman Associates	HBI-7
<b>PCAL-PFM-201</b>	PCAL BODY	Electro-mec (Reading) LTD, 28 Portman Rd, Reading, Berks RG30 1EA	24452 – 17/05/04
<b>PCAL-PFM-202</b>	PCal rear cover		24452 – 17/05/04
<b>PCAL-PFM-203</b>	PCal harness clip		24452 – 17/05/04
<b>PCAL-PFM-204</b>	Stand offs	Wearnes-Cambion LTD. Part # CA 572-4882-01-05-16	0240025 – 08/11/02
<b>PCAL-PFM-205</b>	2-56 x 3/8 skt cap bolts	Precision Technology Supplies LTD, The Birches Industrial Estate, Imberhome Lane, East Grinstead, West Sussex. RH19 1XZ	17010
	2-56 x 1/4 csk bolts		26469

**SECTION 10 – Serialised Components List**

As section 9.

**SECTION 11 - List of Waivers**

No Waivers

Waiver Number	Title	Status

**SECTION 12 - Copies of Waivers**

N/A

## SECTION 13 - Operations Manual

### *Warm functional test procedure*

**PCal must NEVER be operated with SPIRE warm (>50K)!**

Impedances may be checked at room temperature using either the warm electronics or a multimeter connected in a four-wire configuration to the relevant device lines indicated in section 8. **Drive current MUST be limited to 50 micro-Amps.** Measured impedance values at room temperature (~300K), 77K and 4.2K are shown for reference.

	Impedance ( $\Omega$ )		
	Room Temperature	77K	4K
<b>Prime Source</b>	<b>212.3</b>	<b>201.6</b>	<b>202.1</b>
<b>Redundant Source</b>	<b>194.9</b>	<b>184.9</b>	<b>185.0</b>

### *PCal PFM Specifications as delivered*

Specification	Related Requirement	Value	Comments
Thermal source ID		HBI-7	Sapphire substrate, brass wires, indium soldered
Thermal source redundancy	IRD-CALP-R15	Prime and redundant sources are provided	
Prime source impedance – 300K		212.3 $\Omega$	
Prime source impedance – 77K		201.6 $\Omega$	
Prime source impedance – 4K		202.1 $\Omega$	
Redundant source impedance – 300K		194.9 $\Omega$	
Redundant source impedance – 77K		184.9 $\Omega$	
Redundant source impedance – 4K		185.1 $\Omega$	
Prime source 90% rise time	IRD-CALP-R04	96 ms	Value for 3.1 mW applied power. Time constant varies as a function of applied power.
Prime source 90% fall time	IRD-CALP-R04	52 ms	Value for 3.1 mW applied power. Time constant varies as a function of applied power.
Redundant source 90% rise time	IRD-CALP-R04	100 ms	Value for 3.1 mW applied power. Time

			constant varies as a function of applied power.
<b>Redundant source 90% fall time</b>	IRD-CALP-R04	54 ms	Value for 3.1 mW applied power. Time constant varies as a function of applied power.
<b>Power dissipation at nominal operating output</b>	IRD-CALP-R01, IRD-CALP-R12	3.1 mW	
<b>Current drive for nominal operating output</b>		Prime - 3.9 mA Redundant – 4.03 mA	
<b>Nominal current range</b>	IRD-CALP-R02	Prime – 0-4.9 mA Redundant – 0-5.2 mA	This current range is for a maximum power dissipation of 5mW
<b>Absolute maximum current rating</b>	IRD-CALP-R02	7 mA	This current level will dissipate 9.9 mW in the PCal emitter (prime)
<b>Nominal operating voltage</b>	IRD-CALP-R14	Prime - 0.79 V Redundant – 0.75 V	Voltage at nominal output
<b>Voltage range</b>		Prime – 0-1.41 V Redundant – 1.35 V	This voltage range is for a maximum power dissipation of 9.9 mW (at 7 mA drive)
<b>Stability &amp; repeatability</b>	IRD-CALP-R05	RMS better than 1% over lifetime. Cycle-to-cycle repeatability better than 1%.	Two identical sources (four emitters) have undergone 375,000 cycles each (5mW applied) without any degradation or variation in the performance of the devices.
<b>Frequency</b>	IRD-CALP-R07	Prime – 96 ms Redundant – 100 ms	Time constant at nominal power. Time constant varies as a function of applied power from 66.6 ms to 125 ms (1mW to 5mW)
<b>Operating temperature</b>	IRD-CALP-R11	<10K	PCal must not be operated above 10K ambient, apart from continuity checks (10 micro-Amp maximum drive)
<b>Lifetime</b>	IRD-CALP-R16	>375,000 cycles	At 5mW power dissipation per cycle
<b>Mass</b>		28.9g	
<b>Volume</b>	IRD-CALP-R09		The volume envelope for PCal is shown in the ICD – HSO-CDF-ICD-013 issue 3.0

## SECTION 14 - Historical Record

Summary. See section 15 – Logbook / Diary of events – for detailed record.

Note – “Thermal / Vacuum cycle” means one cycle 300K – 4K – 300K under vacuum in the test dewar.

Date	Event	Notes
15/07/04	HBI-7 source received from Haller-Beeman associates	
27/07/04	Visual inspection and impedance checks	Carried out by P. Hargrave. Inspection_test_report_HBI-1_HBI-8.doc
15/09/04	HBI-7 source mounted in DM structure for photometric testing	P. Hargrave. Electrical wires left over-length for this installation. Wires will be cut to length and soldered to new stand-offs prior to delivery.
17/09/04	Thermal / vacuum cycle, photometric calibration	I. Didschuns. HBI-7_Results-34.doc.
15/11/04	Selection of HBI-7 source as flight model source	
17/11/04	HBI-7 source mounted in flight model structure	P. Hargrave. Extended wires left in place for photometric tests.
23/11/04	Thermal / vacuum cycle, final photometric calibration as PFM assembly	I. Didschuns. HBI-7_Results-39.doc
06/12/04	PCal-PFM assembly removed from test dewar & placed in storage.	P. Hargrave.
09/02/05	New stand-offs installed and wires cut to final length.	P. Hargrave
02/02/05	Thermal / vacuum cycles (2 off)	P. Hargrave. Impedances monitored before & after.
14/02/05	Visual inspection & final packing.	P. Hargrave

## **SECTION 15 - Logbook / Diary of Events**

See historical record.

Laboratory logbook "PCAL LOG #1" stored securely at Cardiff University.

See also "X:\Cardiff\_workpackages\Configured\_Documents\PCAL\PFM-build\Test reports\Inspection\_test\_report\_HBI-1\_HBI-8.doc".

## **SECTION 16 - Operating Time / Cycle Record**

See also section 14 and section 15.

PCal-PFM has undergone a total of four thermal / vacuum cycles 300K – 4K – 300K.

While at 4K (baseplate temperature), the PCal sources have been heated to varying temperatures, by the application of currents in the range 0 – 7.0 mA, a number of times as indicated in section 14 and the associated test reports. It is estimated that the total number of "flashes" carried out on each source is less than 200.

## SECTION 17 – Connector Mating Record – N/A

Connector Mate / Demate log									
Project		SPIRE		Experiment					
Subsystem				Model		PFM	ID		
ID		ID		ID		ID		ID	
Mate date	Demate date	Mate date	Demate date	Mate date	Demate date	Mate date	Demate date	Mate date	Demate date
<b>After 5 cycles, carry out visual inspection. Record result below.</b>									
Connect I/D		Debris	Bent pins	Remarks		Pass	Fail	Signature	
ID		ID		ID		ID		ID	
Mate date	Demate date	Mate date	Demate date	Mate date	Demate date	Mate date	Demate date	Mate date	Demate date
<b>After 10 cycles, carry out visual inspection with magnification. Record result below.</b>									
Connect I/D		Debris	Bent pins	Remarks		Pass	Fail	Signature	
<b>NOTE: In case of failure, an NCR is required.</b>									



## SECTION 18 – Age Sensitive Items Record

There are no age-sensitive items.

## SECTION 19 – Pressure Vessel History / Test Record

N/A

## SECTION 20 - Calibration Data Record

The calibration data in this section are presented in terms of the requirement on photometric output, and plotted as Figure 4. The photometric output in this plot is expressed in terms of the area:surface-brightness product of the PCal aperture, as a fraction of the area:surface-brightness product of the telescope image at the position of M4. The required output (>1% of telescope image) is achieved with a power dissipation of 1.7mW (2.59mA).

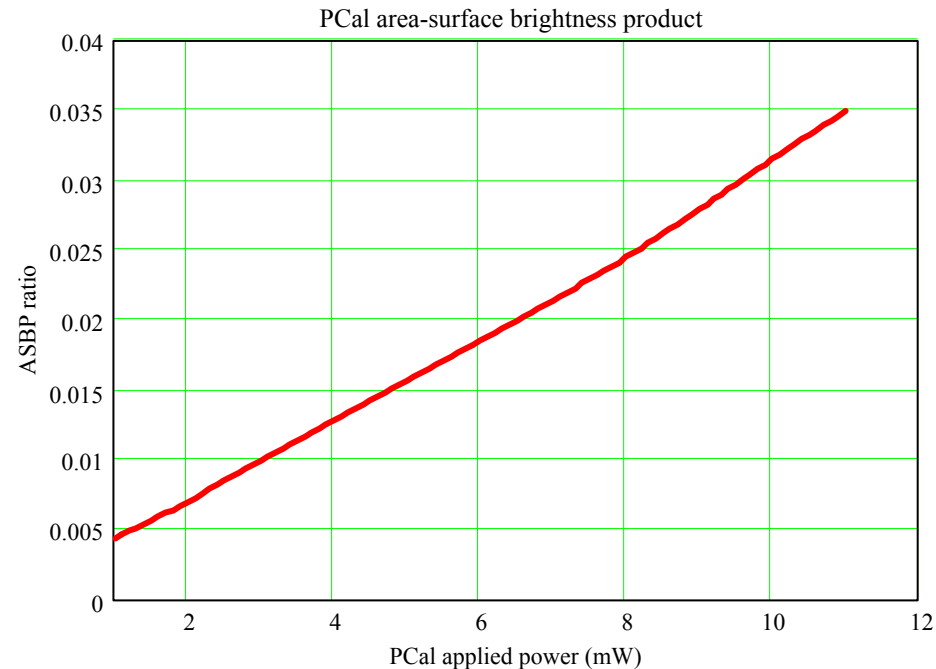
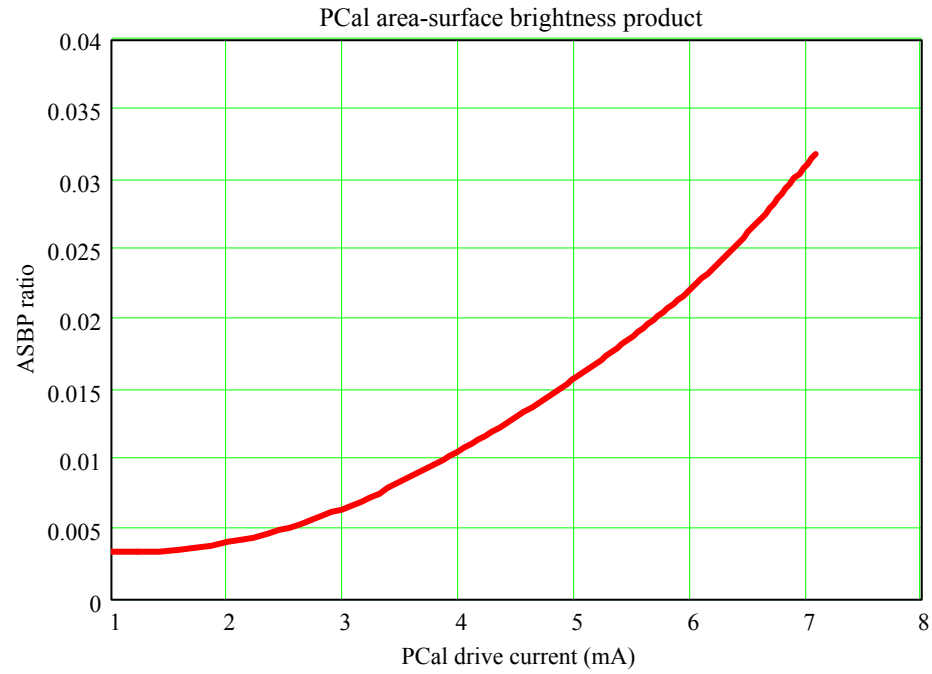
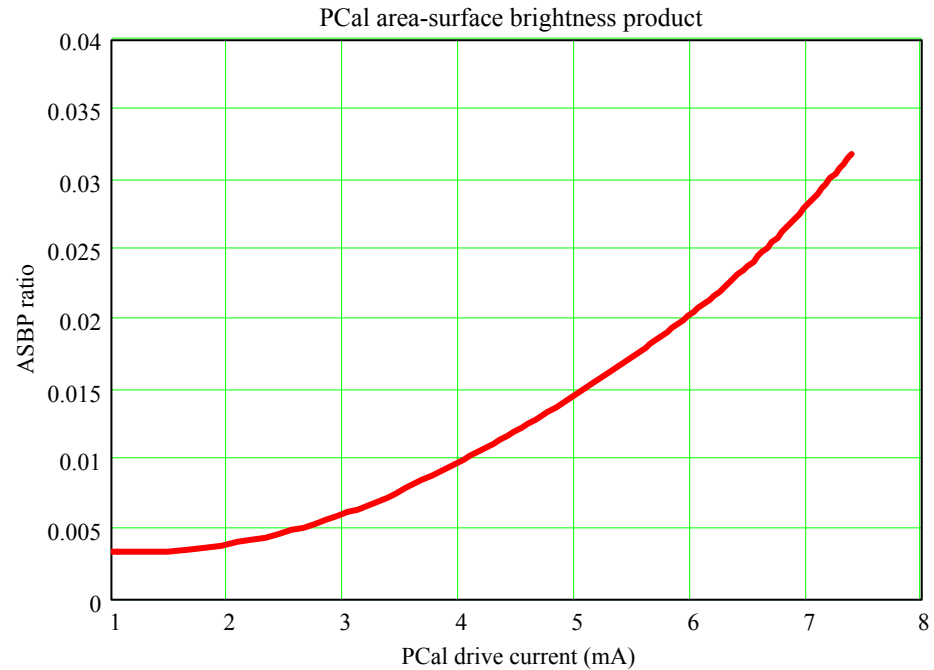


Figure 4 Area:surface-brightness product (ASBP) of PCal aperture as a fraction of the ASBP of the telescope image at M4, plotted as a function of applied power.



**Figure 5 Area:surface-brightness product (ASBP) of PCal aperture as a fraction of the ASBP of the telescope image at M4, plotted as a function of drive current (prime source).**



**Figure 6 Area:surface-brightness product (ASBP) of PCal aperture as a fraction of the ASBP of the telescope image at M4, plotted as a function of drive current (redundant source).**

## SECTION 21 - Temporary Installation Record

See section 14 – Historical record.

The HBI-7 source was temporarily installed in the PCAL-DM structure for the initial photometric tests (test #34) on 15/09/04.

The full PCal-PFM assembly (flight source in flight structure) was installed in the test cryostat on 17/11/04, with extended wires.

The final PCal-PFM assembly (new stand-offs, wires cut to length) was installed in the test dewar on 02/02/05 for final thermal / vacuum cycling, after which impedance & visual checks were made.

## **SECTION 22 - Open Work / Deferred Work / Open Tests**

Absolute calibration check. The flight-spare PCal assembly will be calibrated directly against a cryogenic black-body source, using a 300mK bolometer. This work is surplus to the delivery requirements. There is no requirement for absolute calibration.

## **SECTION 23 - List of Non-Conformance Reports**

None.

## **SECTION 24 - Copies of Non-Conformance Reports**

N/A

## **SECTION 25 - Test Reports**

See appendices.

## **SECTION 26 – Assembly Record**

N/A

## SECTION 27 - Reference List of EIDP's

None

### Associated

<u>Title</u> (Listed in alphabetical order)	<u>ID</u> (Serial No.)	<u>Acronym</u>	<u>Document No.</u>	<u>Issue</u>	<u>Date</u>

### Lower Level

<u>Title</u> (Listed in alphabetical order)	<u>ID</u> (Serial No.)	<u>Acronym</u>	<u>Document No.</u>	<u>Issue</u>	<u>Date</u>

**SECTION 28 - Mass Records**

Assembly	Final measured mass
PCal-PFM assembly	28.9g

**SECTION 29 - Cleanliness Statement – will be signed once final approved version PDF'd**  
**Statement**

The PFM Photometer Calibration Source assembly (PCAL-PFM-000) has been cleaned, assembled and tested within a class 1000 clean room to meet the requirements of the Cardiff PA plan (HSO-CDF-PL-007).

Signed .....Peter Hargrave, Technical Manager, Cardiff-SPIRE deliverables.

Signed .....Ian Walker, Programme Manager, Cardiff AIG.

Date .....

**Extra Information**

A dedicated Herschel-Planck clean room is available in the Cardiff AIG labs, class 1 000, with class 100 laminar flow cabinets.

For cooldown tests (thermal cycles) the PFM assembly was integrated to the Cardiff test dewar within the clean room annex (approx. Class 10,000 – exposure ~15 minutes per thermal cycle).

The PFM assembly was also integrated to the RAL cold vibration test facility. For the duration of this test, the Scal-PFM assembly was kept in a sealed bag with vent holes.

**SECTION 30 - Other Useful Information**

Photos will go here once I've downloaded them.....



## SECTION 31 - DPL/DML

Refer to the Cardiff-SPIRE PFM deliverables lists.

Cardiff-SPIRE-DML	HSO-CDF-LI-074
Cardiff-SPIRE-DMPL	HSO-CDF-LI-075
Cardiff-SPIRE-DPL	HSO-CDF-LI-076

## SECTION 32 – List of Appendices/Attachments

<u>Appendix #</u>	<u>Title</u> (Listed in alphabetical order)	<u>Document No.</u>	<u>Issue</u>	<u>Date</u>	<u>Notes</u>
A	PCal-PFM assembly test report	HSO-CDF-RP-094	1.0		HBI-7_Results-39-HSO-CDF-RP-094.doc HBI-7-39.doc
B	HBI-7 test report	HSO-CDF-RP-093	1.0		HBI-7_Results-34-HSO-CDF-RP-093.doc HBI-7-34.doc
C	Reports from Cryogenic Vibration Tests	HSO-CDF-RP-078 AIV-2003-091-VIB	1.0 1.0		cold-shake2-rpt-HSO-CDF-RP-078.doc AIV-2003-091-VIB SPIRE CARDIFF COMPONENTS.pdf
D	HBI-8 lifetest report HBI-8 lifetest procedure	HSO-CDF-RP-091 HSO-CDF-PR-092	1.0 1.0		HBI-8 life test-Results-HSO-CDF-RP-091.doc Test procedure and record-HBI-8-HSO-CDF- PR-092.doc <b>Flight replica device.</b>
E	HB-27 lifetest report	HSO-CDF-RP-067	1.0		HB27 life test-Results-HSO-CDF-RP-067.doc <b>Small difference from flight device.</b>
F	PCal FMECA report	HSO-CDF-RP-032	2.0		Pcal_FMECA_HSO_CDF_RP_032_2_0.doc
G	PCal Interface control document	HSO-CDF-ICD-013	3.0		PCAL_ICD_HSO_CDF_ICD_013_3_0.doc
H	Inspection & test report – PCal candidate sources	HSO-CDF-RP-095	1.0		Inspection_test_report_HBI-1_HBI-8.doc
I	Copies of certificates of conformance				

**Appendix A**  
**PCal-PFM Assembly test report**

**Appendix B**  
**HBI-7 test report**

**Appendix C**  
**Reports from cryogenic vibration tests**

**Appendix D**  
**PCal-PFM replica lifetest report and procedure**

**Appendix E**  
**HB-27 lifetest report**

**Appendix F**  
**PCal FMECA report**

**Appendix G**  
**PCal-PFM ICD**



## **Appendix H**

### **Inspection & test report – PCal candidate sources**

## **Appendix H**

### **Inspection & test report – PCal candidate sources**