SPIRE-MSS-PRJ-000299

SPIRE

SUBJECT: **ICD 1.1/1.2.1 Structure - Filters**

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Change Record

ISSUE	DATE	
0.1	20th August 1999	New document
1.0	13th June 2000	Official issue – updated to include revised filter information

Table of Contents

Glossary

BSM	Beam Steering Mechanism
C.G.	Centre of Gravity
FTS	Fourier Transform Spectrometer
OBP	Optical Bench Panel
NA	Not Applicable
PDBX	Photometer Detector Box
SDBX	Spectrometer Detector Box
SPIRE	Spectral and Photometric Imaging REceiver

References

Applicable Documents

AD1 Instrument Requirements Document, issue 0.30, May 2000 (FIRST/SPIRE)

REFERENCE DOCUMENTS

RD1 SPIRE filters sub-system specification – Draft 1.0 – 16th May 2000

1. INTRODUCTION

1.1 Purpose of Document

The purpose of this document is to define the interface between the SPIRE structure and the filters. Within this document the mechanical, thermal and optical interfaces are described.

This issue is a draft issue. The purpose of this issue is to define the interface, such that an agreed baseline interface is available at the beginning of the final design process. During the final design process the definitions may be refined and possibly changed, however at the end of the final design process the interface definition is frozen.

1.2 SCOPE

The interfaces considered are between the SPIRE Optical Bench Panel, the common structure, the Photometer Detector Box, the Spectrometer Detector Box and the filters. Throughout the whole document the SPIRE Optical Bench Panel will referred to as OBP, the Photometer Detector Box as PDBX and the Spectrometer Detector Box as SDBX.

The document is divided into 3 parts.

The first part gives the status and description of the document itself

The second part gives the functional description defining the function within the structure.

The third part deals with the mechanical, thermal and optical interfaces.

The following interfaces are considered:

Common structure – 4 K cold stop CFIL2 and CFIL2
OBP – beam splitters (SBS1 and SBS2)
PDBX – 2 K cold stop (PFIL)
SDBX – 2 K cold stop (SFIL)
PDBX - PDIC1 (Dichroic)
PDBX - PDIC2 (Dichroic)

See the topological figures on the next page for the relative positions of the filters with respect to the IR-beam. The beam is a dotted arrow, the mirrors are blue and the filters green. Structure is represented by a solid black line.

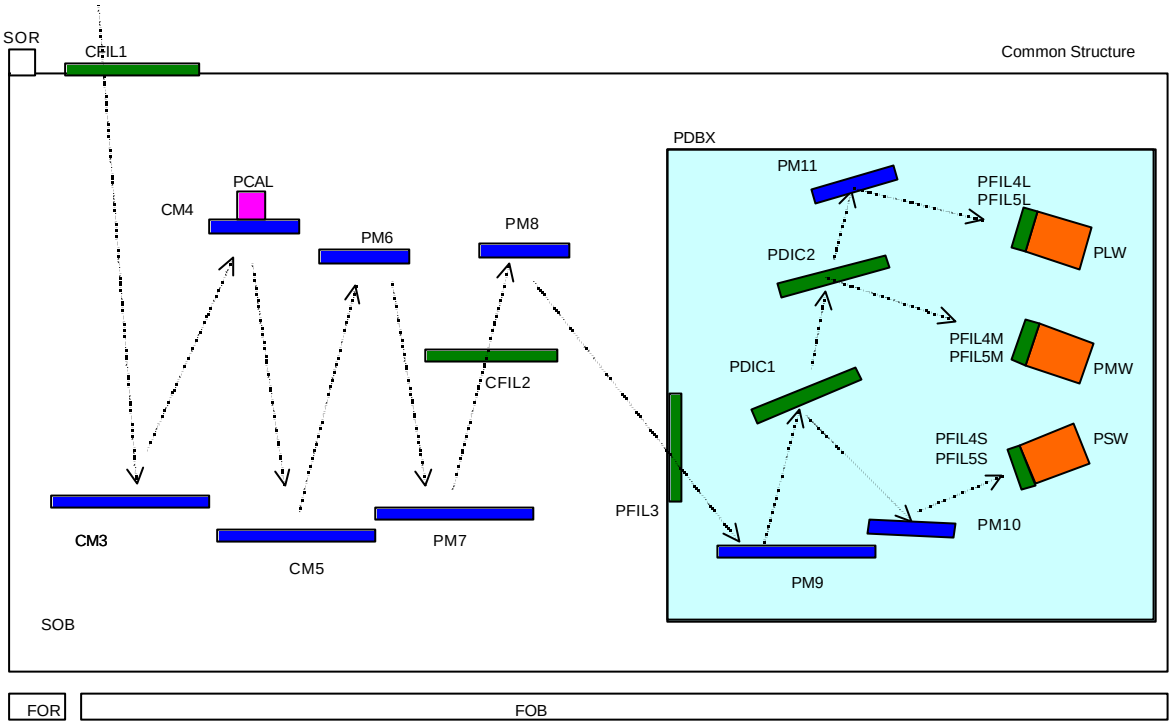

Figure 1-1 Topology of photometer part of SPIRE, filters are green

List of acronyms for figure 1-1

CFIL1	Common Filter 1
CFIL2	Common Filter 2
CM3-5	Common Mirror 3-5
FOB	First Optical Bench Panel
FOR	First Optical Reference
PCAL	Photometer CALibrationsource
PDBX	Photometer Detector BoX
PDIC1	Photometer DIChroic 1
PDIC2	Photometer DIChroic 2
PFIL3	Photometer FILter 3 (entrance PDBX)
PFIL4L/5L	Photometer FILter 4 and 5 at nose PLW
PFIL4M/5M	Photometer FILter 4 and 5 at nose PMW
PFIL4S/5S	Photometer FILter 4 and 5 at nose PSW
PLW	Photometer Long Wave detector
PM6-11	Photometer Mirror 6 to 11
PMW	Photometer Medium Wave detector
PSW	Photomter Short Wave detector
SOB	Spire Optical Bench Panel
SOR	Spire Optical Reference

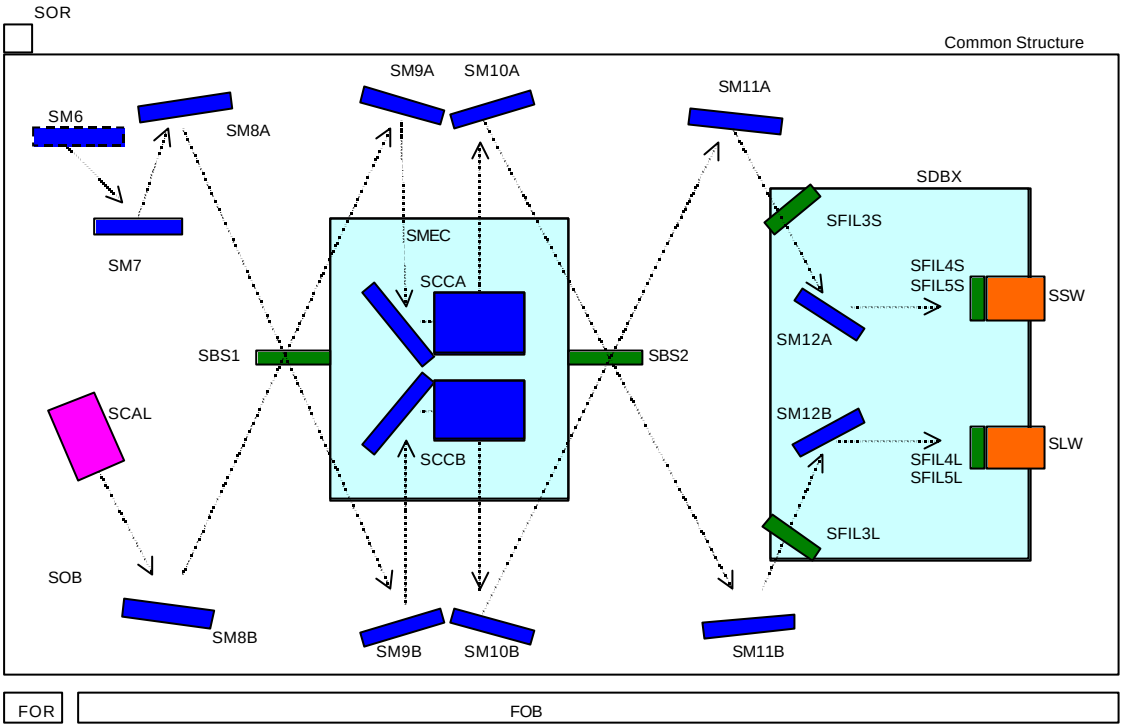

Figure 1-2 Topology of spectrometer part of SPIRE, filters are green

List of acronyms for figure 1-2

FOB	First Optical Bench Panel
FOR	Firs Optical Reference
SBS1	Spectromter Beam Splitter 1
SBS2	Spectromter Beam Splitter 2
SCCA	Spectrometer Corner Cube +X
SCCB	Spectrometer Corner Cube –X
SCAL	Spectrometer CALibration source
SDBX	Spectrometer Detector BoX
SFIL3L	Spectrometer FILter 3 (long wave)
SFIL3S	Spectrometer FILter 3 (short wave)
SFIL4L/5L	Spectrometer FILter at nose SLW
SFIL4S/5S	Spectrometer FILter at nose SSW
SM6-7	Spectrometer Mirror6-7
SM8A-12A	Spectrometer Mirror 8-12 +X chain
SM8B-12B	Spectrometer Mirror 8-12 -X chain
SMEC	Spectrometer MEChanism
SOB	Spire Optical Bench Panel
SOR	Spire Optical Rerference

2. FUNCTIONAL INTERFACE

2.1 Functional Description and Block Diagram

The first filters in the chain, situated on the 4-K box, should reflect back to the sky as much unwanted high frequency radiation as possible. Filters on lower temperature shields should then reject radiation from higher temperature boxes and shields.

Strategic placement of filters will enable us to:

- Define the spectral passbands.
- Minimise the thermal loading on the ^{3}He fridge, 2-K, and 4-K stages by rejecting short wavelength thermal energy.
- Minimise stray light getting to the detectors.
- Maximise the in-band spectral transmission.

The sequence of filters starts with the 2 common 4-K filters at the input to the instrument. They minimise radiation from T > 4-K entering the instrument. The filters at the entrance of the detector boxes minimise the transmission of radiation from T > 2-K. The 0.3 K filters at the nose of the detectors are not discussed in this document since they interface only with the detectors. The beam splitters in the FTS part of the instrument reflect 50% and pass 50% of the incident radiation virtually independently of frequency across the entire SPIRE band. The dichroics within the PDBX reflect high frequencies and pass low frequencies and hence aid definition of the SPIRE photometer channels.

The filters are clamped against the structure using a light tight clamp ring. The function of the OBP (reviewing the interface between the OBP and the filters) is to support the beam splitters and their mounts. The mechanical interface should provide for a precise defined and accurately machined mounting surface. The mechanical interface should provide for sufficient stiffness, such that the mechanical loads on the mirrors are minimised. The same holds for the interfaces with the detector boxes and the dichroics. The dichroics and beam splitters are sensitive to warping, and this is considered in the design of the mounts for these components.

There is no block diagram.

2.2 Inputs

No inputs

2.3 Outputs

No outputs

3. MECHANICAL, THERMAL AND OPTICAL INTERFACES

3.1 Mechanical and thermal interface data sheets

The following holds for all interfaces considered in section 3.1.1 up to 3.1.13.

Mechanical environment

The sine and random input at the interfaces considered in this document will be updated after the coupled analysis. The input spectra hold for all interfaces. (TBC)

Quasi-Static

The qualification levels are **provisional**, copied from the qualification loads of ISO.

Quasi Static levels	Case 1	Case 2	Case 3	Case 4
x-direction	22.5 g (TBC)	22.5 g (TBC)	-	-
y-direction	3 g (TBC)	-	6 (TBC)	-
z-direction	-	3 g (TBC)	-	6 (TBC)

Table 3.1-1: Qualification levels for quasi static vibration

Sine

The qualification levels are **provisional** copied from the qualification loads of ISO.

Sine vibration levels	Frequency range	Input at base (QUAL)
X-direction	5-18 Hz 18-100 Hz	22 mm (peak-peak) 100 g
Y-direction	5-18 Hz 18-100 Hz	22 mm (peak-peak) 100 g
Z-direction	5-18 Hz 18-100 Hz	22 mm (peak-peak) 100 g

Table 3.1-2: Qualification levels for sine vibration

Random

The qualification levels are **provisional**, copied from the qualification loads of ISO.

Random vibration levels	Frequency range	Input at base (QUAL.)
X-direction	5 – 150 Hz 150-700 Hz 700 – 2000 Hz	+6 dB Hz 1.44 g^2/Hz -3 dB
Y-direction	5 – 150 Hz 150-700 Hz 700 – 2000 Hz	+6 dB Hz 1.44 g^2/Hz -3 dB
Z-direction	5 – 150 Hz 150-700 Hz 700 – 2000 Hz	+6 dB Hz 1.44 g^2/Hz -3 dB

Table 3.1-3: Qualification levels for random vibration (45 g_{rms})

Alignment

The following requirements hold for the alignment of the I/F lane between the filter mounts and the structure.

Off centre 1 mm all directions simultaneously (TBC). The flatness of the mounting surface for the cold stops is TBD.

The maximum warping of the dichroics induced by the structure is TBD

Tilt 1 arcminute (TBC)

Allowable interface loads

TBD (by MSSL)

3.1.1 Common structure – CFIL1 (4-K)

INTERFACE DATA SHEET

SUBSYSTEM: **Common structure – CFIL1**	UNIT CODE: 1.1/1.2.1

UNIT DESIGNATION

TOTAL NUMBER: 1 IN OPERATION: 1 IN REDUNDANCY: ***NA***

MECHANICAL CHARACTERISTICS

DIMENSIONS [mm]: Circular – 100mm dia. TBC

MASS (including fasteners) tbd + 20 % contingency

C.G.LOCATION [mm] (wrt reference hole R)

X: Y: Z: Uncertainty:

INERTIA (wrt C.G.) [m^2kg]: Ixx: Iyy: Izz Uncertainty:

MATERIAL OF HOUSING: ***NA***

SURFACE FINISH:

TOTAL CONTACT AREA:

SURFACE ROUGHNESS OF CONTACT AREA:

EIGEN FREQUENCY: The first eigenfrequency of the filter shall be above TBD Hz

FOOT THICKNESS:

THERMAL CHARACTERISTICS Common structure – CFIL1

FOOT MATERIAL AND THICKNESS:

SURFACE PROPERTIES:

Thermal capacity: J/°K Conductive coupling: W/°K

QUALIFICATION TEMPERATURE LIMIT (°C) Common Structure – CFIL1

GROUND STORAGE &TRANS		OPERATING MODE		NON OPERATING MODE		START UP
MIN	MAX	MIN	MAX	MIN	MAX	MIN
10	40	-271	40	-271	40	-271

HEAT DISSIPATION (W) Common structure – CFIL1

MODE	AVERAGE	MIN	MAX
OFF	***NA***	***NA***	***NA***
STAND-BY	***NA***	***NA***	***NA***
OPERATING	***NA***	***NA***	***NA***

.

SUBSYSTEM:	UNIT CODE:

MECHANICAL INTERFACE CONTROL DRAWING Common structure– CFIL1

Change control sheet		
Drawing Number		
Issue	Date	Change
A		

SUBSYSTEM: **Common structure CFIL1**	UNIT CODE: 1.1/1.2.1

MECHANICAL INTERFACE CONTROL DRAWING Outer cover – CFIL1

Drawing ……. gives details of the *Common structure – CFIL1* mechanical interface.

3.1.2 Common structure – CFIL2 (4 K)

INTERFACE DATA SHEET

SUBSYSTEM: **Common structure – CFIL-2**	UNIT CODE: 1.1/1.2.1

UNIT DESIGNATION

TOTAL NUMBER: 1 IN OPERATION: 1 IN REDUNDANCY: ***NA***

MECHANICAL CHARACTERISTICS

DIMENSIONS [mm]: Circular – TBD mm dia.

MASS (including fasteners) tbd + 20 % contingency

C.G.LOCATION [mm] (wrt reference hole R)

X: Y: Z: Uncertainty:

INERTIA (wrt C.G.) [m^2kg]: Ixx: Iyy: Izz Uncertainty:

MATERIAL OF HOUSING: ***NA***

SURFACE FINISH:

TOTAL CONTACT AREA:

SURFACE ROUGHNESS OF CONTACT AREA:

EIGEN FREQUENCY: The first eigenfrequency of the filter shall be above TBD Hz

FOOT THICKNESS:

THERMAL CHARACTERISTICS Common structure – CFIL2

FOOT MATERIAL AND THICKNESS:

SURFACE PROPERTIES:

Thermal capacity: J/°K Conductive coupling: W/°K

QUALIFICATION TEMPERATURE LIMIT (°C) Common structure – CFIL2

GROUND STORAGE &TRANS		OPERATING MODE		NON OPERATING MODE		START UP
MIN	MAX	MIN	MAX	MIN	MAX	MIN
10	40	-271	40	-271	40	-271

HEAT DISSIPATION (W) Common structure – CFIL2

MODE	AVERAGE	MIN	MAX
OFF	***NA***	***NA***	***NA***
STAND-BY	***NA***	***NA***	***NA***
OPERATING	***NA***	***NA***	***NA***

.

SUBSYSTEM:	UNIT CODE: 1.1/1.2.1

MECHANICAL INTERFACE CONTROL DRAWING Common structure – CFIL2

Change control sheet		
Drawing Number		
Issue	Date	Change
A		

SUBSYSTEM: **Common structure – CFIL2**	UNIT CODE:

MECHANICAL INTERFACE CONTROL DRAWING Common structure – CFIL2

Drawing ……. gives details of the *Common structure – CFIL2* mechanical interface.

3.1.3 OBP – beam splitters (SBS1 and SBS2)

INTERFACE DATA SHEET

SUBSYSTEM: **OBP – beam splitters**	UNIT CODE: 1.1/1.2.1

UNIT DESIGNATION

TOTAL NUMBER: 2 IN OPERATION: 2 IN REDUNDANCY: ***NA***

MECHANICAL CHARACTERISTICS

DIMENSIONS [mm]: Circular – 46 mm dia.

MASS (including fasteners) tbd + 20 % contingency

C.G.LOCATION [mm] (wrt reference hole R)

SBS1 - X: Y: Z: Uncertainty:

SBS2 - X: Y: Z: Uncertainty:

INERTIA (wrt C.G.) [m^2kg]:

SBS1 - Ixx: Iyy: Izz: Uncertainty:

SBS2 - Ixx: Iyy: Izz : Uncertainty:

MATERIAL OF HOUSING: ***NA***

SURFACE FINISH:

TOTAL CONTACT AREA:

SURFACE ROUGHNESS OF CONTACT AREA:

EIGEN FREQUENCY: The first eigenfrequency of the filter shall be above TBD Hz

FOOT THICKNESS:

THERMAL CHARACTERISTICS OBP – beam splitters

FOOT MATERIAL AND THICKNESS:

SURFACE PROPERTIES:

Thermal capacity: J/°K Conductive coupling: W/°K

QUALIFICATION TEMPERATURE LIMIT (°C) OBP – beam splitters

GROUND STORAGE &TRANS		OPERATING MODE		NON OPERATING MODE		START UP
MIN	MAX	MIN	MAX	MIN	MAX	MIN

10	40	-271	40	-271	40	-271

HEAT DISSIPATION (W) OBP – beam splitters

MODE	AVERAGE	MIN	MAX
OFF	***NA***	***NA***	***NA***
STAND-BY	***NA***	***NA***	***NA***
OPERATING	***NA***	***NA***	***NA***

.

SUBSYSTEM: **OBP – beam splitters**	UNIT CODE: 1.1/1.2.1

MECHANICAL INTERFACE CONTROL DRAWING OBP – beam splitters

Change control sheet		
Drawing Number		
Issue	Date	Change
A		

SUBSYSTEM: **OBP – beam splitters**	UNIT CODE: 1.1/1.2.1

MECHANICAL INTERFACE CONTROL DRAWING OBP – beam splitters

Drawing ……. gives details of the *OBP – beam splitters* mechanical interface.

3.1.4 PDBX – PFIL3 (2 K cold stop)

INTERFACE DATA SHEET

SUBSYSTEM: **PDBX – PFIL3**	UNIT CODE: 1.1/1.2.1

UNIT DESIGNATION

TOTAL NUMBER: 1 IN OPERATION: 1 IN REDUNDANCY: ***NA***

MECHANICAL CHARACTERISTICS

DIMENSIONS [mm]: Circular – 54 mm dia.

MASS (including fasteners) tbd + 20 % contingency

C.G.LOCATION [mm] (wrt reference hole R)

X: Y: Z: Uncertainty:

INERTIA (wrt C.G.) [m^2kg]: Ixx: Iyy: Izz: Uncertainty:

MATERIAL OF HOUSING: ***NA***

SURFACE FINISH:

TOTAL CONTACT AREA:

SURFACE ROUGHNESS OF CONTACT AREA:

EIGEN FREQUENCY: The first eigenfrequency of the filter shall be above TBD Hz

FOOT THICKNESS:

THERMAL CHARACTERISTICS PDBX – PFIL3

FOOT MATERIAL AND THICKNESS:

SURFACE PROPERTIES:

Thermal capacity: J/°K Conductive coupling: W/°K

QUALIFICATION TEMPERATURE LIMIT (°C) PDBX – PFIL3

GROUND STORAGE &TRANS		OPERATING MODE		NON OPERATING MODE		START UP
MIN	MAX	MIN	MAX	MIN	MAX	MIN
10	40	-271	40	-271	40	-271

HEAT DISSIPATION (W) PDBX – PFIL3

MODE	AVERAGE	MIN	MAX
OFF	***NA***	***NA***	***NA***
STAND-BY	***NA***	***NA***	***NA***
OPERATING	***NA***	***NA***	***NA***

.

SUBSYSTEM: **PDBX – PFIL3**	UNIT CODE: 1.1/1.2.1

MECHANICAL INTERFACE CONTROL DRAWING PDBX – PFIL3

Change control sheet		
Drawing Number		
Issue	Date	Change
A		

SUBSYSTEM: **PDBX – PFIL3**	UNIT CODE: 1.1/1.2.1

MECHANICAL INTERFACE CONTROL DRAWING PDBX – PFIL3

Drawing ……. gives details of the *PDBX – PFIL3* mechanical interface.

3.1.5 SDBX – SFIL3L/S (Spectrometer 2 K cold stops)

INTERFACE DATA SHEET

SUBSYSTEM: **SDBX – SFIL3**	UNIT CODE: 1.1/1.2.1

UNIT DESIGNATION

TOTAL NUMBER: 2 IN OPERATION: 2 IN REDUNDANCY: ***NA***

MECHANICAL CHARACTERISTICS

DIMENSIONS [mm]: Circular – 43 mm dia. (TBC)

MASS (including fasteners) tbd + 20 % contingency

C.G.LOCATION [mm] (wrt reference hole R)

SFIL3L - X: Y: Z: Uncertainty:

SFIL3S - X: Y: Z: Uncertainty:

INERTIA (wrt C.G.) [m^2kg]:

SFIL3L - Ixx: Iyy: Izz Uncertainty:

SFIL3L - Ixx: Iyy: Izz Uncertainty:

MATERIAL OF HOUSING: ***NA***

SURFACE FINISH:

TOTAL CONTACT AREA:

SURFACE ROUGHNESS OF CONTACT AREA:

EIGEN FREQUENCY: The first eigenfrequency of the filter shall be above TBD Hz

FOOT THICKNESS:

THERMAL CHARACTERISTICS SDBX – SFIL3

FOOT MATERIAL AND THICKNESS:

SURFACE PROPERTIES:

Thermal capacity: J/°K Conductive coupling: W/°K

QUALIFICATION TEMPERATURE LIMIT (°C) SDBX – SFIL3

GROUND STORAGE &TRANS		OPERATING MODE		NON OPERATING MODE		START UP
MIN	MAX	MIN	MAX	MIN	MAX	MIN

10	40	-271	40	-271	40	-271

HEAT DISSIPATION (W) SDBX – SFIL3

MODE	AVERAGE	MIN	MAX
OFF	***NA***	***NA***	***NA***
STAND-BY	***NA***	***NA***	***NA***
OPERATING	***NA***	***NA***	***NA***

.

SUBSYSTEM: **SDBX – SFIL3**	UNIT CODE: 1.1/1.2.1

MECHANICAL INTERFACE CONTROL DRAWING SDBX – SFIL3

Change control sheet		
Drawing Number		
Issue	Date	Change
A		

SUBSYSTEM: **SDBX – SFIL3**	UNIT CODE: 1.1/1.2.1

MECHANICAL INTERFACE CONTROL DRAWING SDBX – SFIL3

Drawing ……. gives details of the *SDBX – SFIL3* mechanical interface.

3.2 Harness interface data sheets

NA

HARNESS LAYOUT

NA

HARNESS LAYOUT

NA

3.3 Optical interface data sheets

INTERFACE DATA SHEET

SUBSYSTEM:	UNIT CODE:

OPTICAL CHARACTERISTICS

SUBSYSTEM:	UNIT CODE:

OPTICAL INTERFACE CONTROL DRAWING

Change control sheet		
Drawing Number		
Issue	Date	Change
A		New issue

SUBSYSTEM:	UNIT CODE:

OPTICAL INTERFACE CONTROL DRAWING

Drawing …….. gives details of the *subsystem a to subsystem b* optical interface

4. APPENDIX A – PROPOSED MOUNTS FOR FILTER COMPONENTS

This appendix shows conceptual designs for the various filter components.

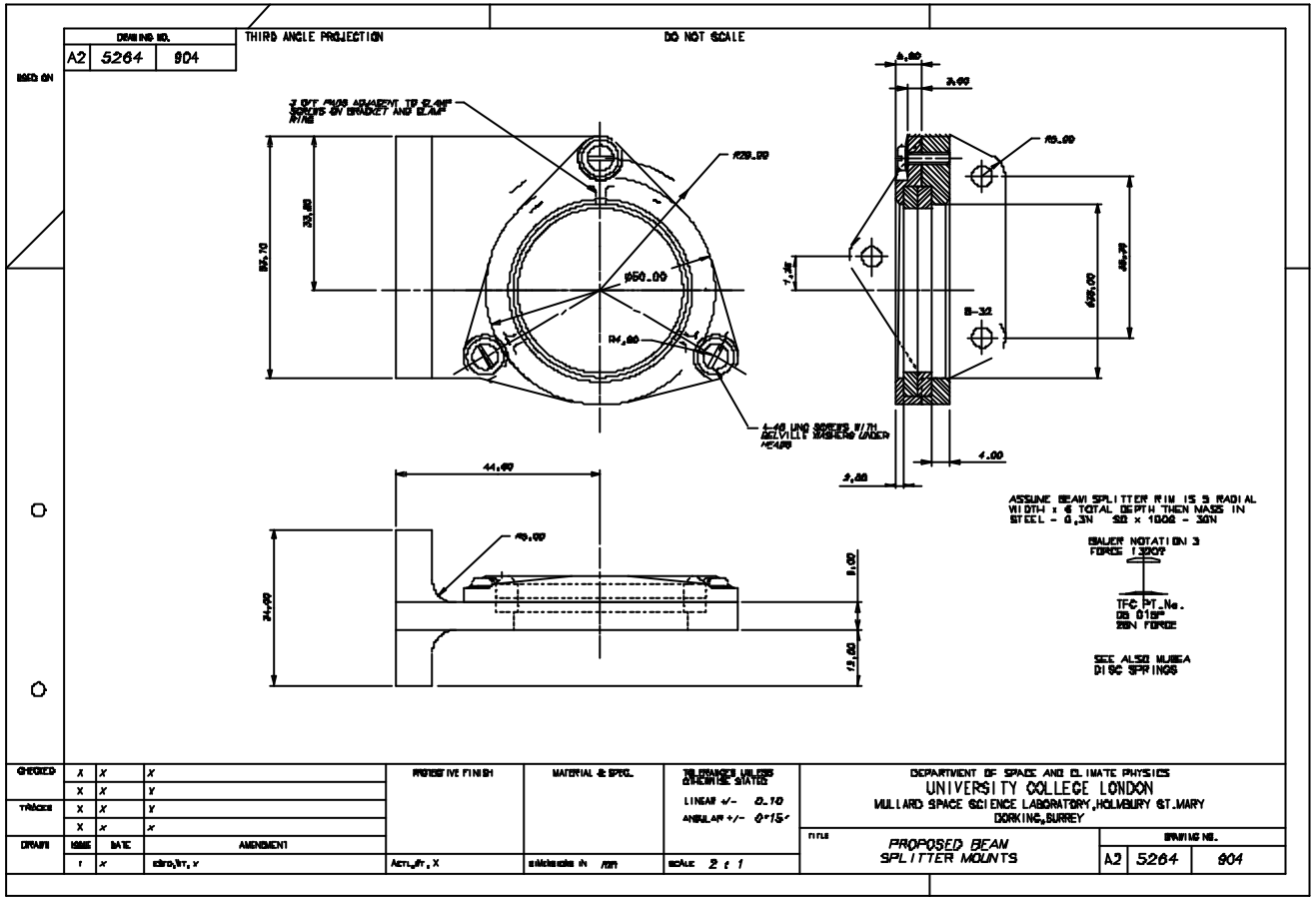

Figure 4-1 Proposed mount for spectrometer beam splitters (SBS1 & SBS2)

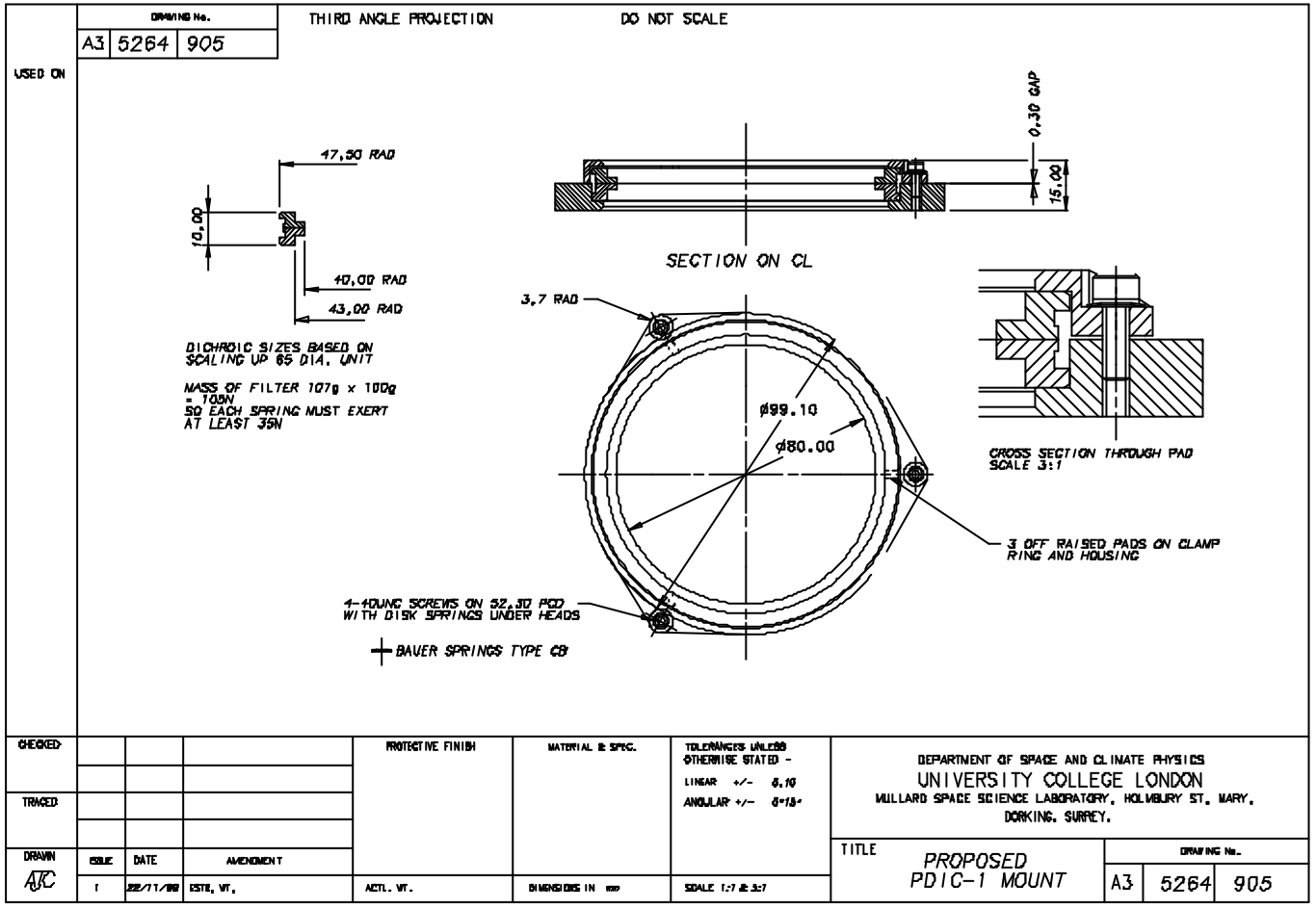

Figure 4-2 Proposed mount for photometer dichroics (PDIC1 shown)

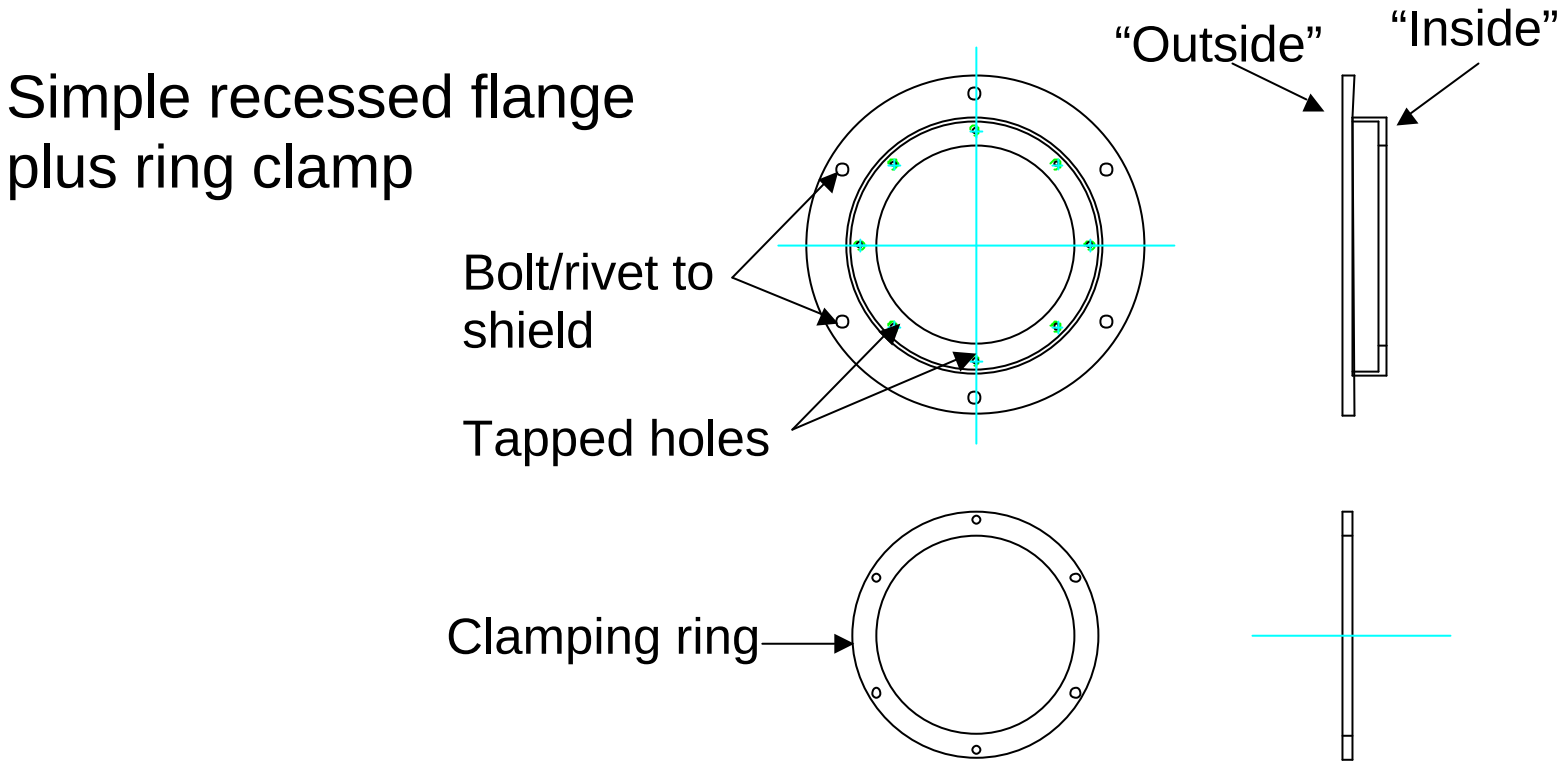

Figure 4-3 Proposed mount for hot-pressed filters