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		Filters - Interface Control Document

Filters

Interface Control Document

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Update history

Date	Version	Remarks
7/9/01	1.0	First issue for DDR
6/2/02	2.0	Second issue – Interface drawings added.
12/08/02	2.1	Amended details of 300-mK filter interface – figures 11 and 12.
02/10/02	2.2	Updated interface drawings from MSSL. Updated PDIC1, PDIC2 and SBS drawings. Added details of spectrometer lenses
05/06/03	3.0	Updated interface drawing for JPL 300mK filters following ECR from JPL Figures 12, 13 & 14 now merged into one interface drawing

List of Acronyms

Term	Meaning	Term	Meaning
AD	Applicable Document	IR	Infrared
ADC	Analogue to Digital Converter	IRD	Instrument Requirements Document
AIV	Assembly, Integration and Verification	IRTS	Infrared Telescope in Space
AME	Absolute Measurement Error	ISM	Interstellar Medium
AOCS	Attitude and Orbit Control System	JFET	Junction Field Effect Transistor
APART	Arizona's Program for the Analysis of Radiation Transfer	ISO	Infrared Space Observatory
APE	Absolute Pointing Error	LCL	Latching Current Limiter
ASAP	Advanced Systems Analysis Program	LIA	Lock-In Amplifier
ATC	Astronomy Technology Centre, Edinburgh	LVDT	Linear Variable Differential Transformer
AVM	Avionics Model	LWS	Long Wave Spectrometer (an instrument used on ISO)
BDA	Bolometer Detector Array	MAC	Multi Axis Controller
BFL	Back Focal Length	MAIV	Manufacturing, Assembly, Integration and Verification
BRO	Breault Research Organization	MCU	Mechanism Control Unit = HSMCU
BSM	Beam Steering Mirror	MGSE	Mechanical Ground Support Equipment
CBB	Cryogenic Black Body	M-P	Martin-Puplett
CDF	Cardiff, Department of Physics & Astronomy	NEP	Noise Equivalent Power
CDMS	Command and Data Management System	NTD	Neutron Transmutation Doped
CDMU	Command and Data Management Unit	OBS	On-Board Software
CDR	Critical Design Review	OGSE	Optical Ground Support Equipment
CEA	Commissariat a l'Energie Atomique	OMD	Observing Modes Document
CMOS	Complimentary Metal Oxide Silicon	OPD	Optical Path Difference
CoG	Centre of Gravity	PACS	Photodetector Array Camera and Spectrometer
CPU	Central Processing Unit	PCAL	Photometer Calibration source
CQM	Cryogenic Qualification Model	PFM	Proto-Flight Model
CVV	Cryostat Vacuum Vessel	PID	Proportional, Integral and Differential (used in the context of feedback control loop architecture)
DAC	Digital to Analogue Converter	PLW	Photometer, Long Wavelength
DAQ	Data Acquisition	PMW	Photometer, Medium Wavelength
DCU	Detector Control Unit = HSDCU	POF	Photometer Observatory Function
DDR	Detailed Design Review	PROM	Programmable Read Only Memory
DM	Development Model	PSW	Photometer, Short Wavelength
DPU	Digital Processing Unit = HSDPU	PUS	Packet Utilisation Standard
DSP	Digital Signal Processor	RAL	Rutherford Appleton Laboratory,
DOE	Detective Quantum Efficiency	RD	Reference Document
EDAC	Error Detection and Correction	RMS	Root Mean Squared
EGSE	Electrical Ground Support Equipment	SCAL	Spectrometer Calibration Source
EM	Engineering Model	SCUBA	Submillimetre Common User Bolometer Array
EMC	Electro-magnetic Compatibility	SED	Spectral Energy Distribution
EMI	Electro-magnetic Interference	SMEC	Spectrometer Mechanics
ESA	European Space Agency	SMPS	Switch Mode Power Supply
FCU	FCU Control Unit = HSFCU	SOB	SPIRE Optical Bench
FIR	Far Infrared	SOF	Spectrometer Observatory Function
FIRST	Far Infra-Red and Submillimetre Telescope	SPIRE	Spectral and Photometric Imaging Receiver
FOV	Field of View	SRAM	Static Random Access Memory
F-P	Fabry-Perot	SSSD	SubSystem Specification Document
FPGA	Field Programmable Gate Array	STP	Standard Temperature and Pressure
FPU	Focal Plane Unit	SVM	Service Module
FS	Flight Spare	TBC	To Be Confirmed
FTS	Fourier Transform Spectrometer	TBD	To Be Determined
FWHM	Full Width Half maximum	TC	Telecommand
GSFC	Goddard Space Flight Center	URD	User Requirements Document
HK	House Keeping	UV	Ultra Violet
HOB	Herschel Optical Bench	WE	Warm Electronics
HPDU	Herschel Power Distribution Unit	ZPD	Zero Path Difference
HSDCU	Herschel-SPIRE Detector Control Unit		
HSDPU	Herschel-SPIRE Digital Processing Unit		
HSFCU	Herschel-SPIRE FPU Control Unit		
HSO	Herschel Space Observatory		
IF	Interface		
IID-A	Instrument Interface Document - Part A		
IID-B	Instrument Interface Document - Part B		
IMF	Initial Mass Function		

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1. Scope

This document details the interfaces between filters and the SPIRE structure, and between 300-mK filters and the detector arrays.

2. Documents

2.1. Applicable documents

All applicable documents are listed in the AD chapter of the CIDL (HSO-CDF-LI-029).

3. Subsystem Description

3.1. General overview

The layout of filters on SPIRE is shown schematically by Figure 1 and Figure 2.

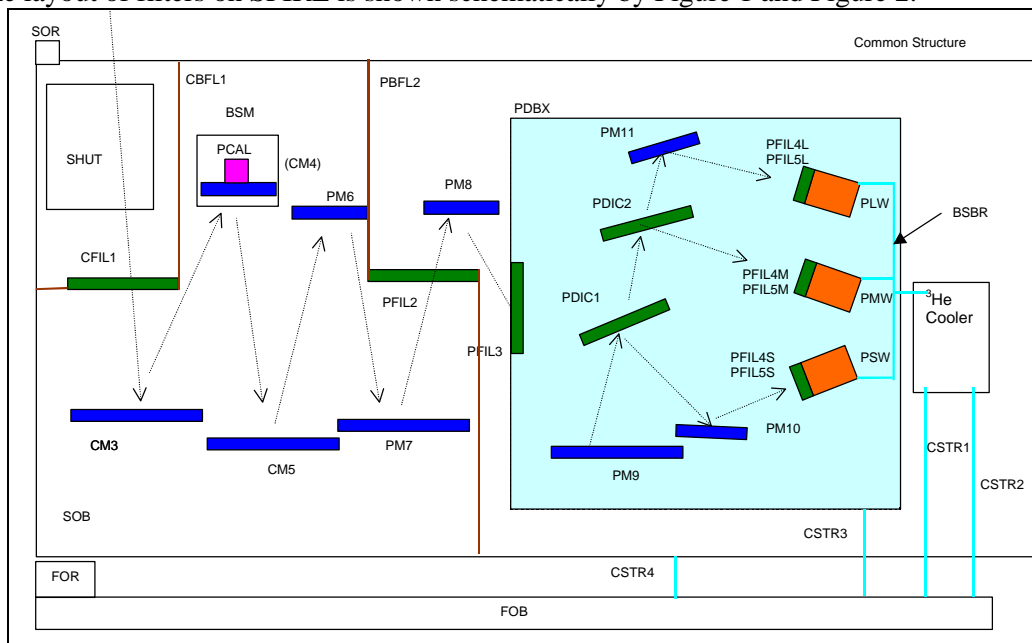


Figure 1 Topology of photometer side of SPIRE. Filters and dichroics are shown in green.

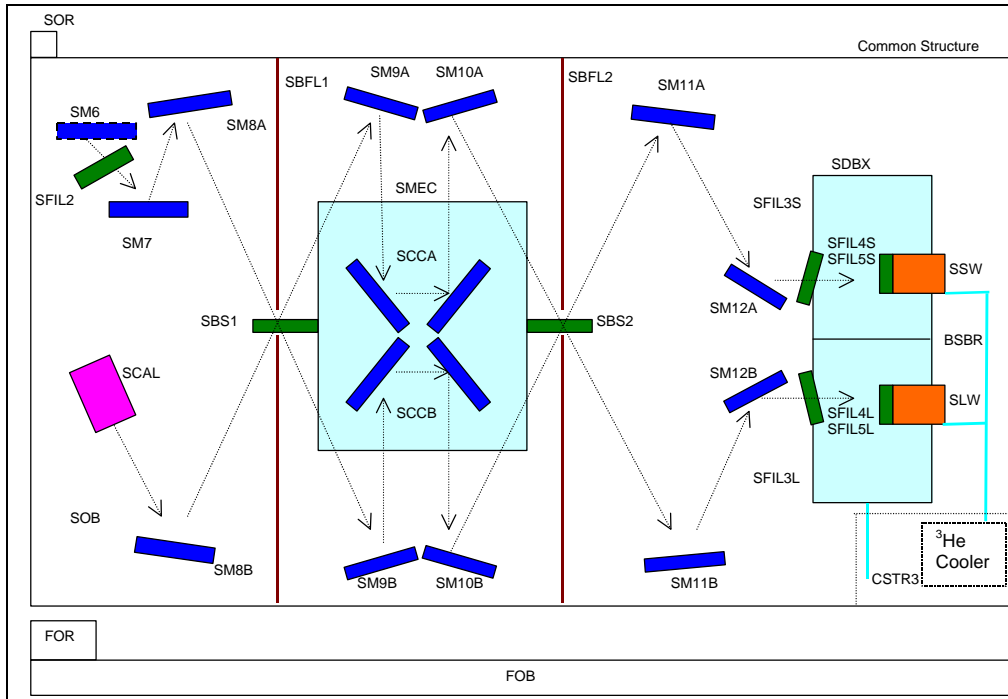


Figure 2 Topology of spectrometer side of SPIRE. Filters and beam splitters are shown in green.

4. Filter interfaces

This section details the interfaces for each of the SPIRE instrument filters. Interface drawings are given in section 4.4.

4.1. Common filter

4.1.1. CFIL1

This filter is mounted on the end of the input baffle snout to SPIRE, and will be rectangular in format. It is a common input filter for both the photometer and spectrometer.

Table 1 CFIL1 details

Type	Hot Pressed
Thickness	0.118 mm
Mass	5 g TBC
Spectral characteristics	LPE 100 cm ⁻¹
Comments	

4.2. Photometer filters

4.2.1. PFIL2

This filter covers an aperture in the baffle, PBFL2, in the photometer box, and is only seen by the photometer detectors.

Table 2 PFIL2 details

Type	Hot Pressed
Thickness	0.131 mm
Mass	3 g TBC
Spectral characteristics	LPE 90 cm ⁻¹
Comments	

4.2.2. PFIL3

This filter covers the 2-K cold stop in the photometer.

Table 3 PFIL3 details

Type	Hot Pressed
Thickness	0.197 mm
Mass	3 g TBC
Spectral characteristics	LPE 60 cm ⁻¹
Comments	

4.2.3. PDIC1

This is the first dichroic in the photometer chain. It is essential that this component remains flat upon cooling, and so it has to be mounted on a substantial ring.

Table 4 PDIC1 details

Type	Hot Pressed (TBD), Ring mounted
Thickness	0.535 mm
Total thickness (including ring)	13.535 mm (+ 0.11, -0.01) mm
Mass	287 g TBC
Spectral characteristics	LPE 32.7 cm ⁻¹ (to give a HPE in reflection of 33.3 cm ⁻¹)
Comments	The mass of this component may be reduced after prototype tests have been completed. This component must remain flat, and therefore needs a substantial ring mount.

4.2.4. PDIC2

This is the second dichroic in the photometer chain. It is essential that this component remains flat upon cooling, and so it has to be mounted on a substantial ring.

Table 5 PDIC2 details

Type	Hot Pressed (TBD), Ring mounted
Thickness (filter material excluding ring)	0.754 mm
Total thickness (including ring)	12.754 mm (+0.11, -0.01) mm
Mass	250 g TBC
Spectral characteristics	LPE 23.2 cm ⁻¹ (to give a HPE in reflection of 23.8 cm ⁻¹)
Comments	The mass of this component may be reduced after prototype tests have been completed. This component must remain flat, and therefore needs a substantial ring mount.

4.2.5. PFIL4S

This filter is fitted to the SW BDA at 300-mK via a rectangular clamp. Blocker over SW array.

Table 6 PFIL4S details

Type	Hot Pressed
Thickness	0.236 mm
Mass	1.5 g
Spectral characteristics	LPE 50 cm ⁻¹
Comments	Clamps to detector module.

4.2.6. PFIL5S

This filter is fitted to the SW BDA at 300-mK in the same clamp as PFIL4S.
Low-pass edge-definer over SW array.

Table 7 PFIL5S details

Type	Hot Pressed
Thickness	0.246 mm
Mass	1.5 g
Spectral characteristics	LPE 48 cm ⁻¹
Comments	Clamps to detector module.

4.2.7. PFIL4M

This filter is fitted to the MW BDA at 300-mK via a rectangular clamp.
Blocker over MW array.

Table 8 PFIL4M details

Type	Hot Pressed
Thickness	0.275 mm
Mass	1.5 g
Spectral characteristics	LPE 43 cm ⁻¹
Comments	Clamps to detector module.

4.2.8. PFIL5M

Baseline – not implemented as edge defined by PDIC1

This filter is fitted to the MW BDA at 300-mK in the same clamp as PFIL4M.
Low-pass edge-definer for MW array.

Table 9 PFIL5M details

Type	Hot Pressed
Thickness	0.358 mm
Mass	1.5g
Spectral characteristics	LPE 33.0cm ⁻¹
Comments	Clamps to detector module.

4.2.9. PFIL4L

This filter is fitted to the LW BDA at 300-mK via a rectangular clamp.
Blocker over LW array.

Table 10 PFIL4L details

Type	Hot Pressed
Thickness	0.394 mm
Mass	1.5 g
Spectral characteristics	LPE 30 cm ⁻¹
Comments	Clamps to detector module.

4.2.10. PFIL5L

Baseline – not implemented as edge defined by PDIC2

This filter is fitted to the LW BDA at 300-mK in the same clamp as PFIL4L.
Low-pass edge-definer for LW array

Table 11 PFIL5L details

Type	Hot Pressed
Thickness	0.510 mm
Mass	1.5g
Spectral characteristics	LPE 23.2cm ⁻¹
Comments	Clamps to detector module.

4.2.11. PFIL6L

Baseline – not implemented, since high-pass edge defined by waveguide cut-on.

This filter is fitted to the LW BDA at 300-mK in the same clamp as PFIL4L
High-pass edge-definer over LW array.

Table 12 PFIL6L details

Type	Hot Pressed
Thickness	0.687 mm
Mass	1.5g
Spectral characteristics	HPE 17.2cm ⁻¹
Comments	Clamps to detector module. This filter may be needed to define the high-pass cut-on for the long wavelength channel (the dichroics define the HPE for the other two channels)

4.3. Spectrometer filters

4.3.1. SFIL2

This filter is positioned at the pupil in the SPIRE optical bench.

Table 13 SFIL2 details

Type	Hot Pressed
Thickness	0.131 mm
Mass	1 g
Spectral characteristics	LPE 90 cm ⁻¹
Comments	

4.3.2. SBS1

This component must remain flat, and therefore it shall be ring mounted.

Table 14 SBS1 details

Type	Hot Pressed (TBC), Ring mounted
Thickness (filter material including ring)	6.236 mm
Mass	32 g
Spectral characteristics	15-50 cm ⁻¹ beam splitter
Comments	Size 5 ring

4.3.3. SBS2

This component must remain flat, and therefore it shall be ring mounted.

This component must be mounted in opposition to SBS1 - critical.

Table 15 SBS2 details

Type	Hot Pressed (TBC), Ring mounted
Thickness (filter material including ring)	6.236 mm
Mass	32 g
Spectral characteristics	15-50 cm ⁻¹ beam splitter
Comments	Size 5 ring

4.3.4. SFIL3S

This filter covers the 2-K cold stop at the entrance to the SW side of the spectrometer detector box.

Table 16 SFIL3S details

Type	Hot Pressed
Thickness	0.169 mm
Mass	1 g
Spectral characteristics	LPE 70 cm ⁻¹
Comments	

4.3.5. SFIL4S

This filter is fitted to the SW spectrometer BDA at 300-mK via a rectangular clamp.

Table 17 SFIL4S details

Type	Hot Pressed
Thickness	0.197 mm
Mass	1 g
Spectral characteristics	LPE 60 cm ⁻¹
Comments	Blocker

4.3.6. SFIL5S

This filter is fitted to the SW spectrometer BDA at 300-mK in the same clamp as SFIL4S.

Low-pass edge definer for the LW band.

Filter designed to give the 90% power point at 50cm-1.

Table 18 SFIL5S details

Type	Hot Pressed
Thickness	0.225 mm
Mass	1 g
Spectral characteristics	LPE 52.6 cm ⁻¹
Comments	Edge definer

4.3.7. SFIL6S

Baseline – not implemented, since high-pass edge defined by waveguide cut-on.

This filter is fitted to the SW spectrometer BDA at 300-mK in the same clamp as SFIL4S. High-pass edge-definer for SW band.

Table 19 SFIL6S details

Type	Hot Pressed
Thickness	0.384 mm
Mass	1 g
Spectral characteristics	HPE 30.8 cm ⁻¹
Comments	Designed to allow for a 10um overlap between the SW and LW bands.

4.3.8. SFIL3L

This filter covers the 2-K cold stop at the entrance to the LW side of the spectrometer detector box.

Table 20 SFIL3L details

Type	Hot Pressed
Thickness	0.197 mm
Mass	1 g
Spectral characteristics	LPE 60 cm ⁻¹
Comments	

4.3.9. SFIL4L

This filter is fitted to the LW spectrometer BDA at 300-mK via a rectangular clamp.

Table 21 SFIL4L details

Type	Hot Pressed
Thickness	0.275 mm
Mass	1 g
Spectral characteristics	LPE 43 cm ⁻¹
Comments	Blocker

4.3.10. SFIL5L

This filter is fitted to the LW spectrometer BDA at 300-mK. Low-pass edge-definer for LW band.

Table 22 SFIL5L details

Type	Hot Pressed
Thickness	0.354 mm
Mass	1 g
Spectral characteristics	LPE 33.4 cm ⁻¹
Comments	Designed to allow for a 10 um overlap between the SW and LW bands.

4.3.11. SFIL6L

Baseline – not implemented, since high frequency edge defined by waveguide cut-on.

This filter is fitted to the LW spectrometer BDA at 300-mK. High-pass edge definer for LW band.

Table 23 SFIL6L details

Type	Hot Pressed
Thickness	
Mass	1 g
Spectral characteristics	HPE 14.2 cm ⁻¹
Comments	

4.3.12. Spectrometer lenses

Lenses are required in front of the two spectrometer detectors in order to correct the non-telecetricity of the beams. These are manufactured from high density polyethylene (HDPE), and mounted within the spectrometer 300-mK filter stack, as shown in Figure 3.

Lens design parameters are:

- Radius of curvature 50±1 mm
- Edge thickness 1±0.5 mm
- Material HDPE, n(6K) = 1.575
- Diameter 16±1 mm

Relevant dimensions of the assembly are shown in Figure 4 and Table 24.

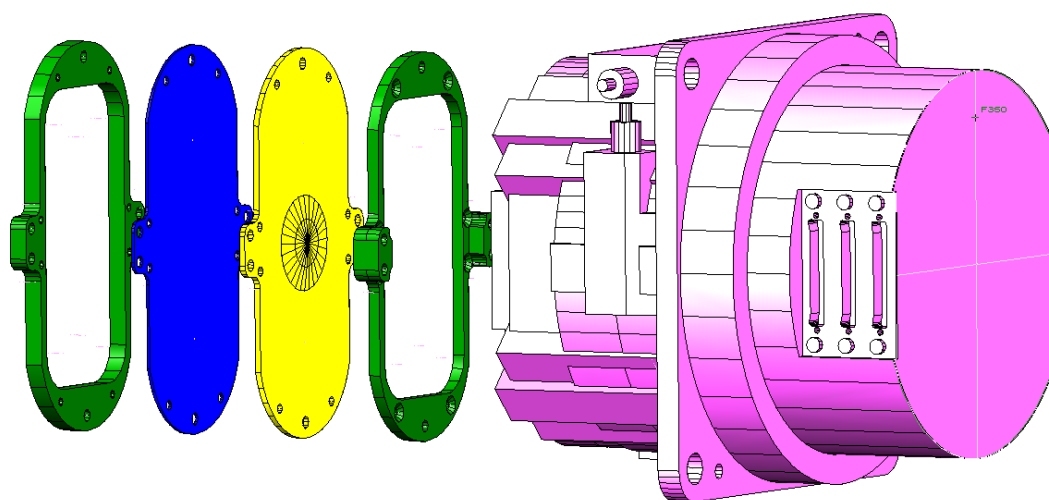


Figure 3 Location of spectrometer lenses in 300-mK filter stack.

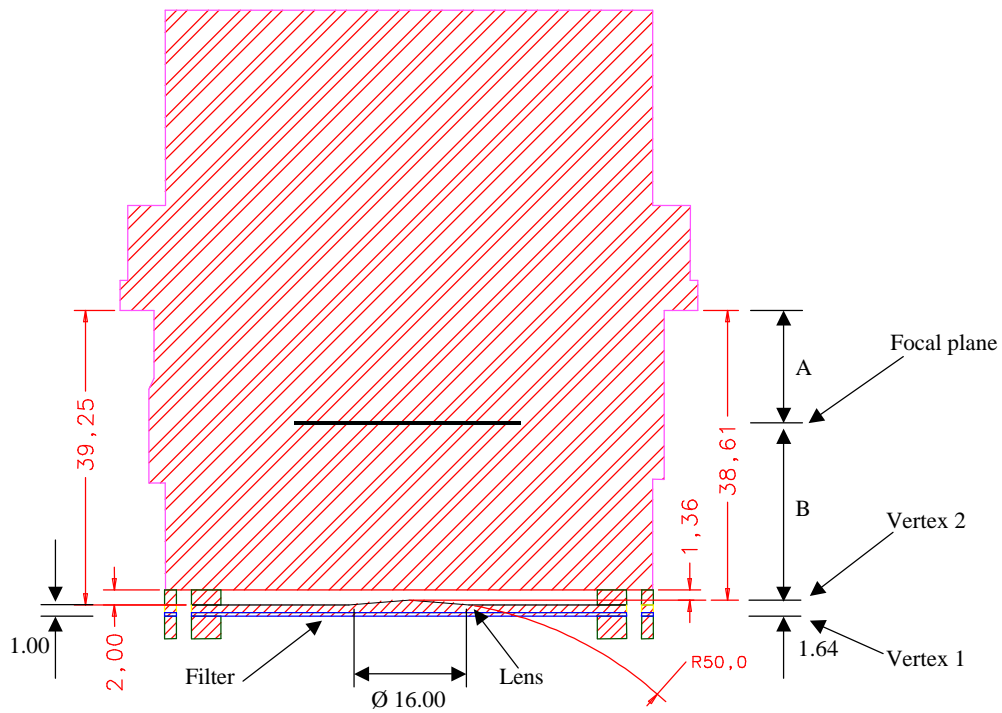


Figure 4 Dimensions of spectrometer lens – filter – detector assembly.

Table 24 Position of lens vertex and focal plane wrt detector mounting flange

	SLW	SSW
A (cf JPL ICD 9 Nov 2001)	36.9	26.7
B = 38.61 - A	1.71	11.91

4.4. Filter Interface drawings

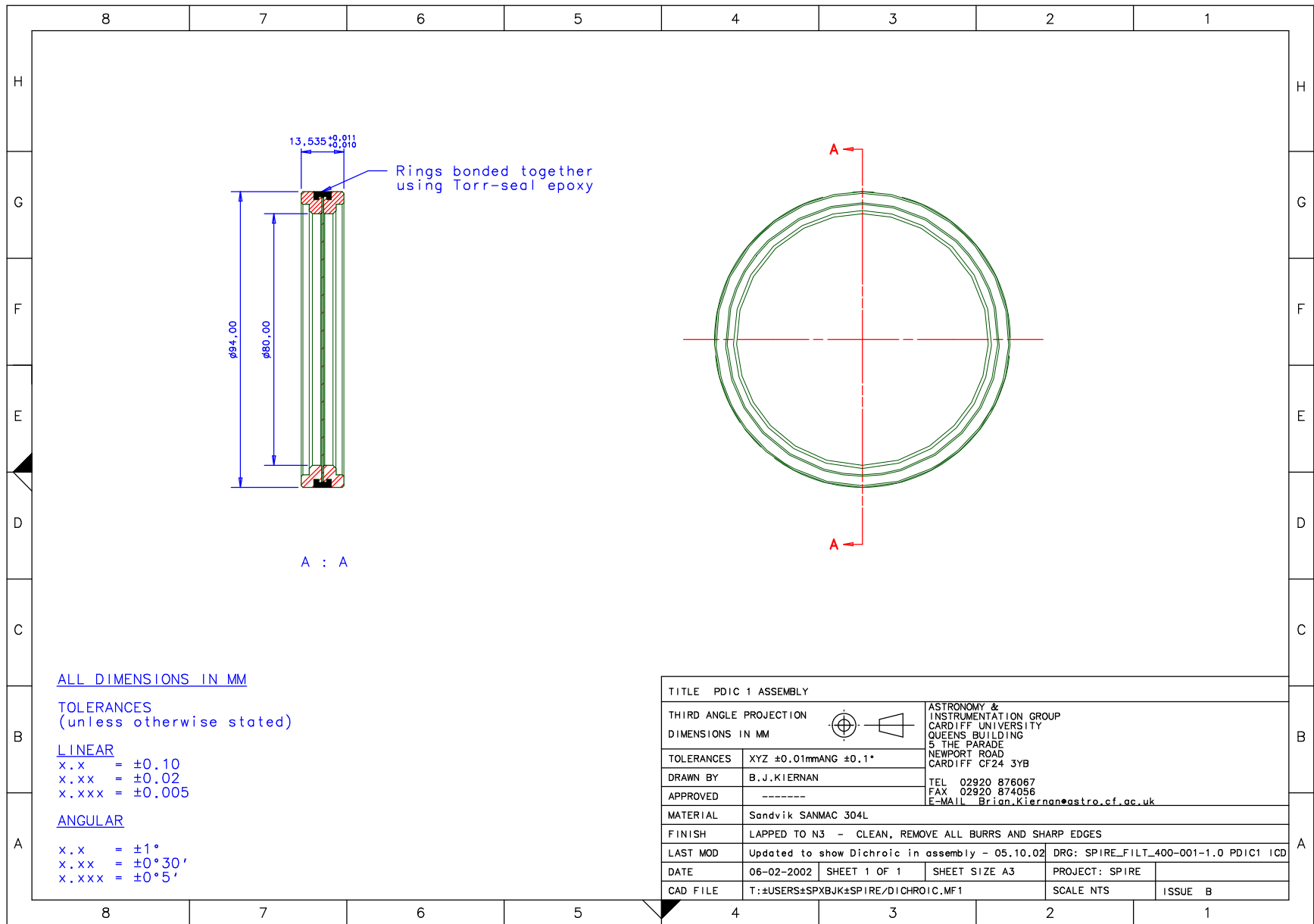


Figure 8 Assembly drawing for PDIC1

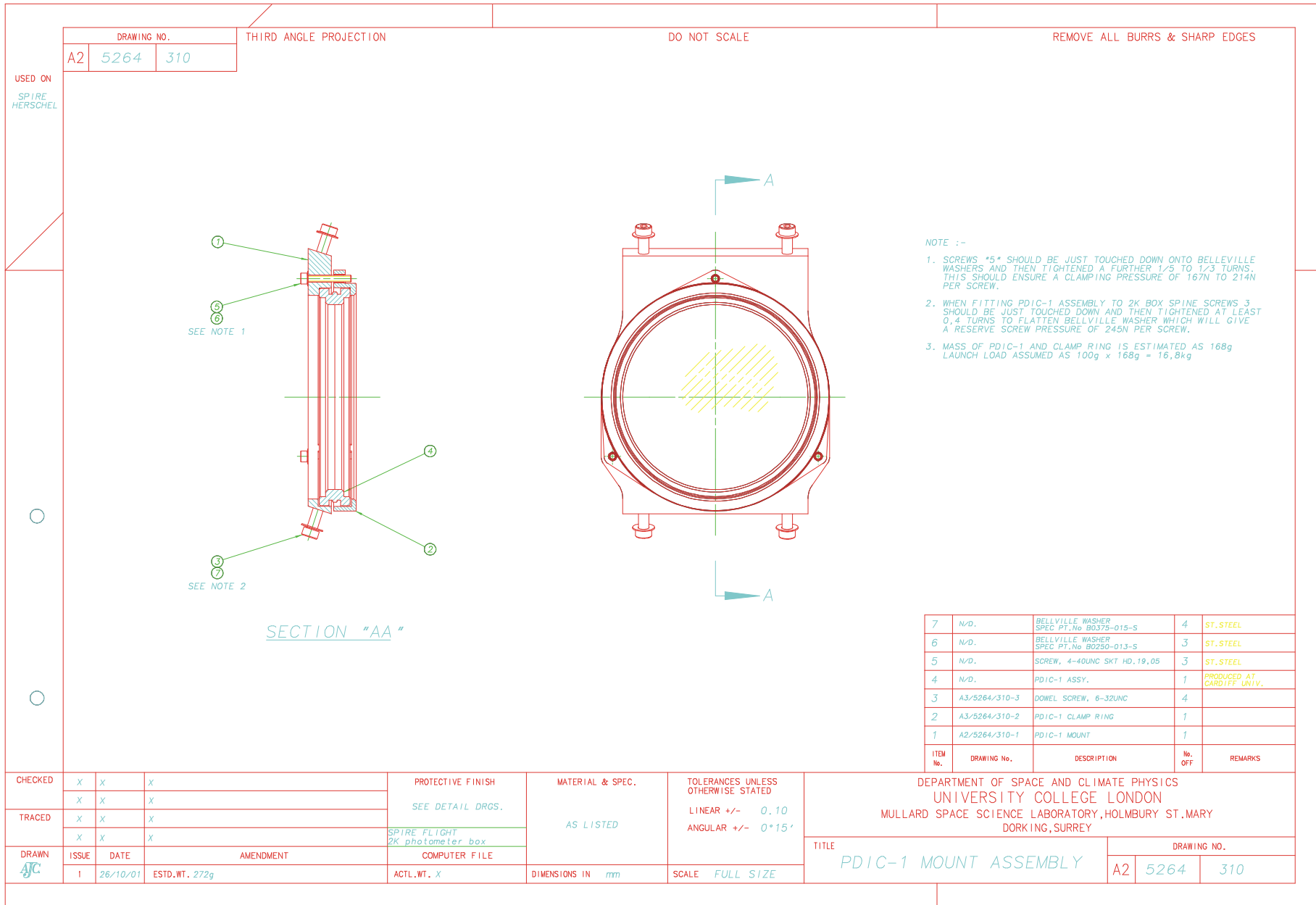


Figure 9 PDIC1 mount

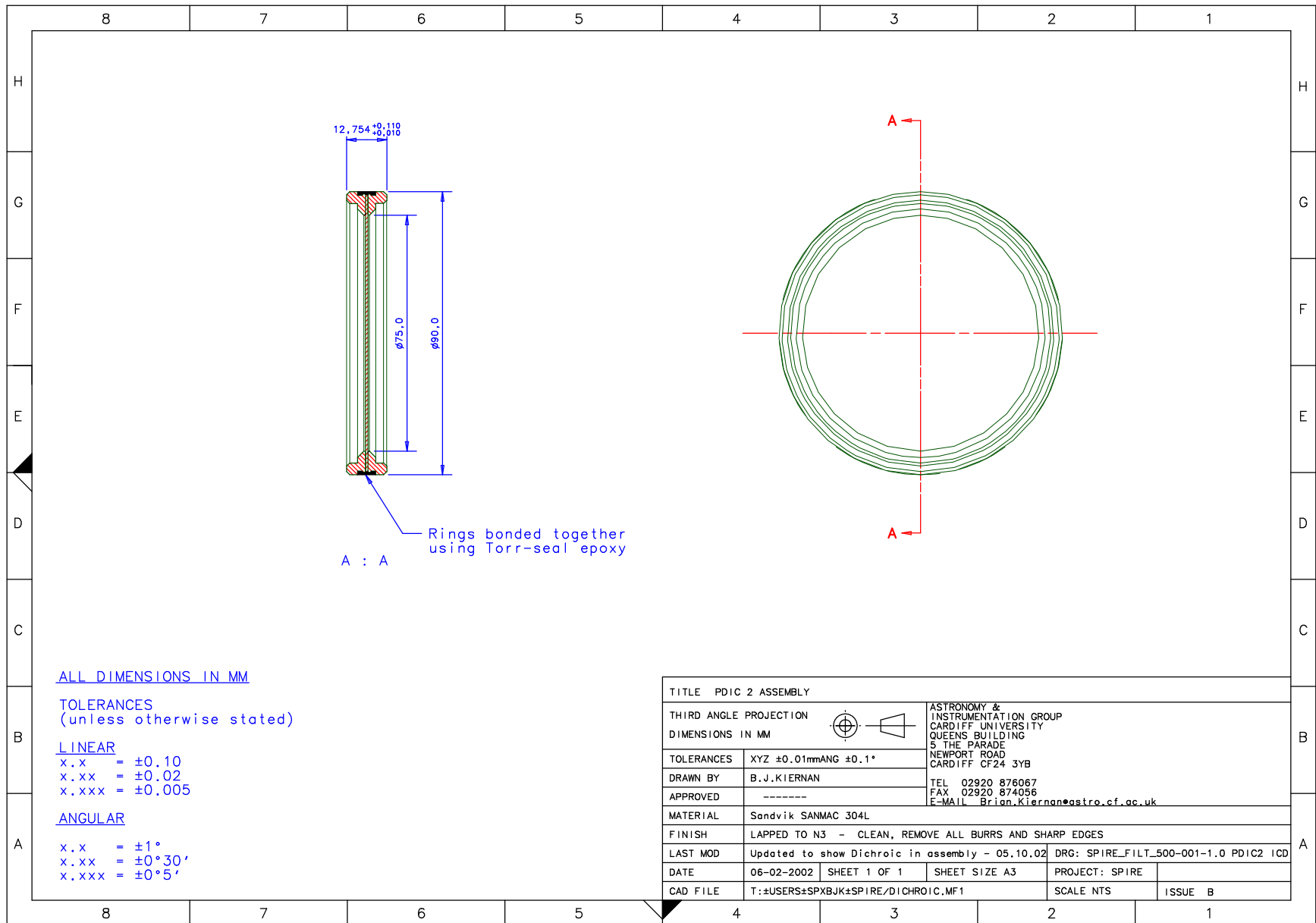


Figure 10 Assembly drawing for PDIC2

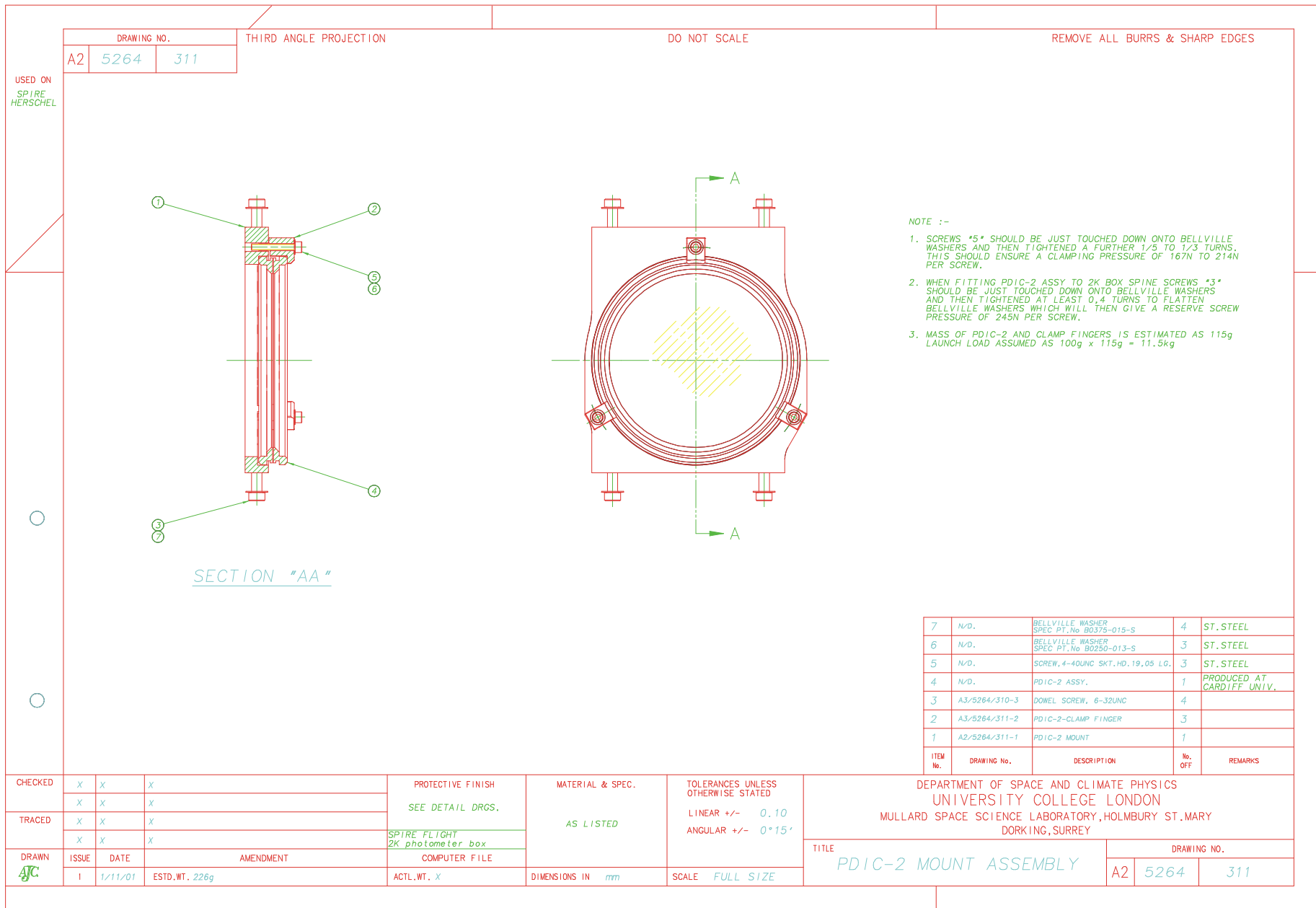


Figure 11 PDIC2 mount

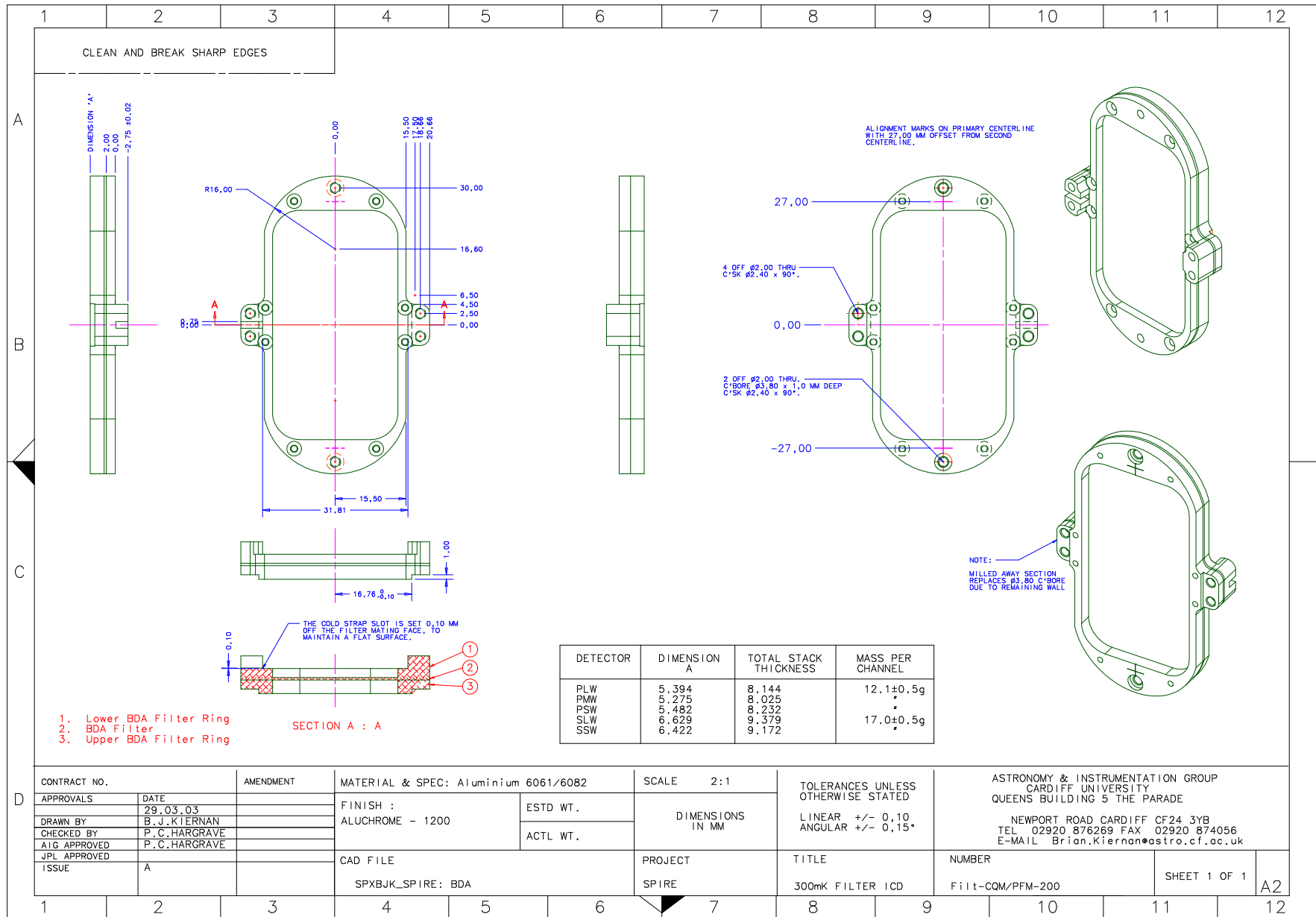


Figure 12 Interface drawing for 300mK filters

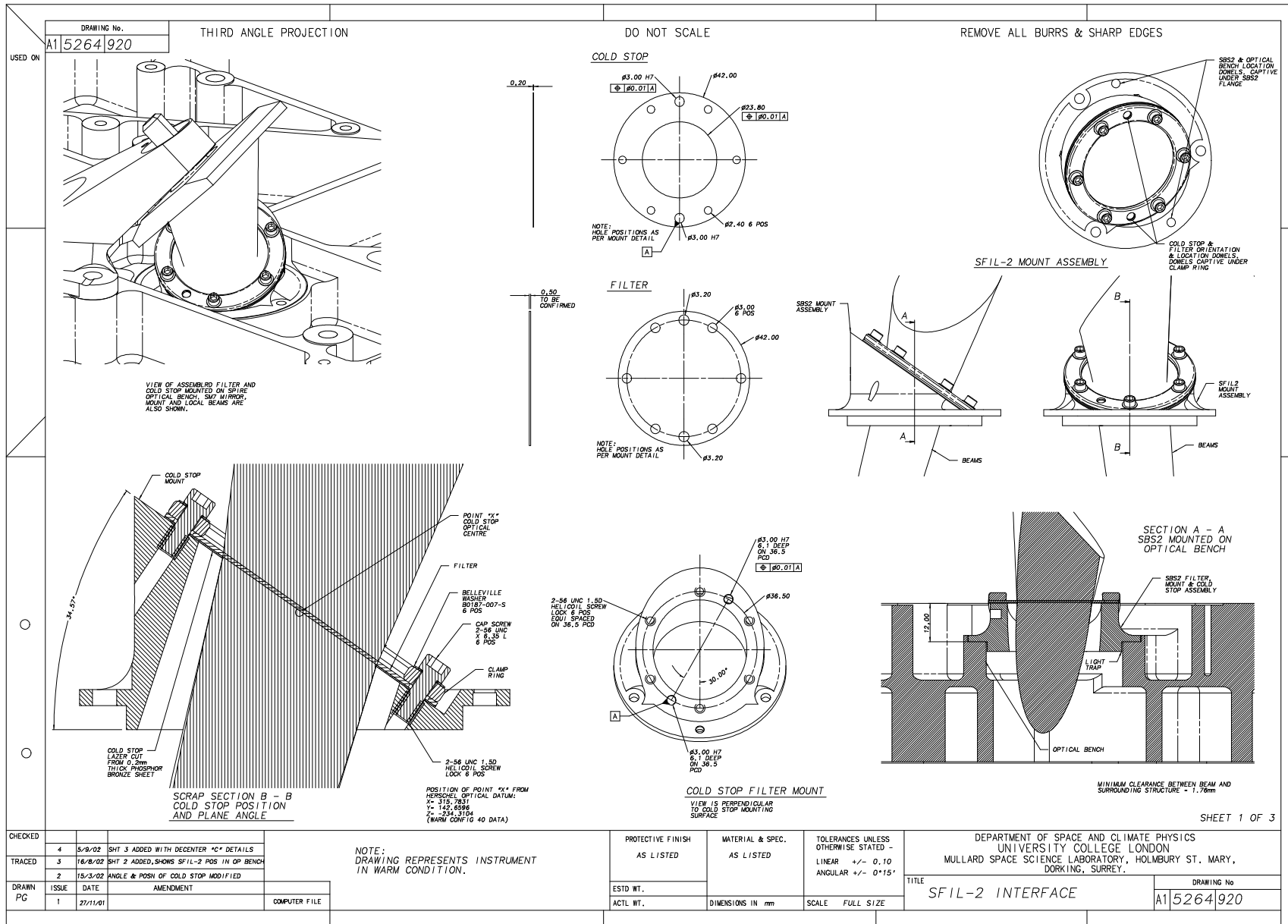


Figure 13 SFIL2 Interface drawing A

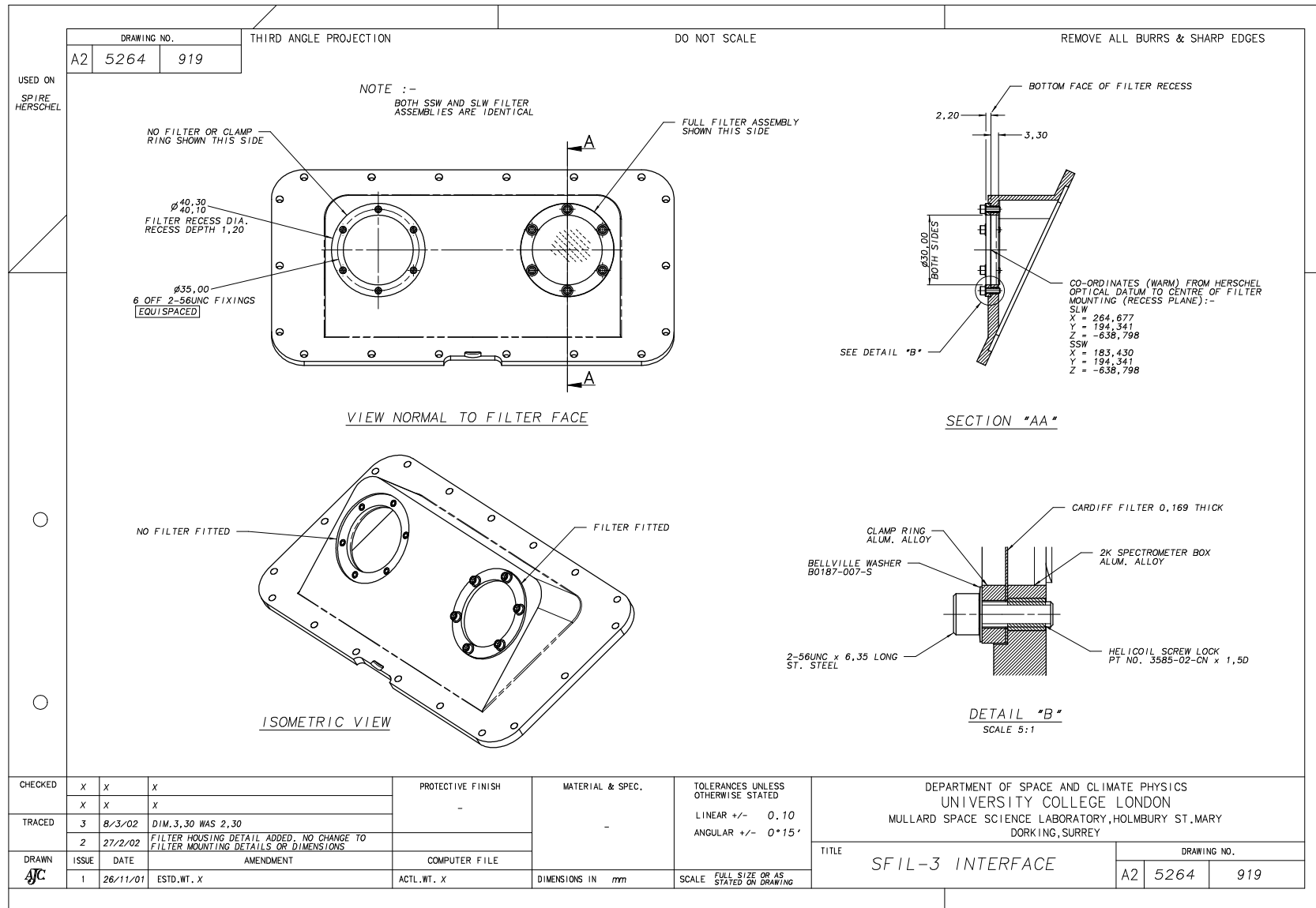


Figure 16 SFIL3 interface drawing

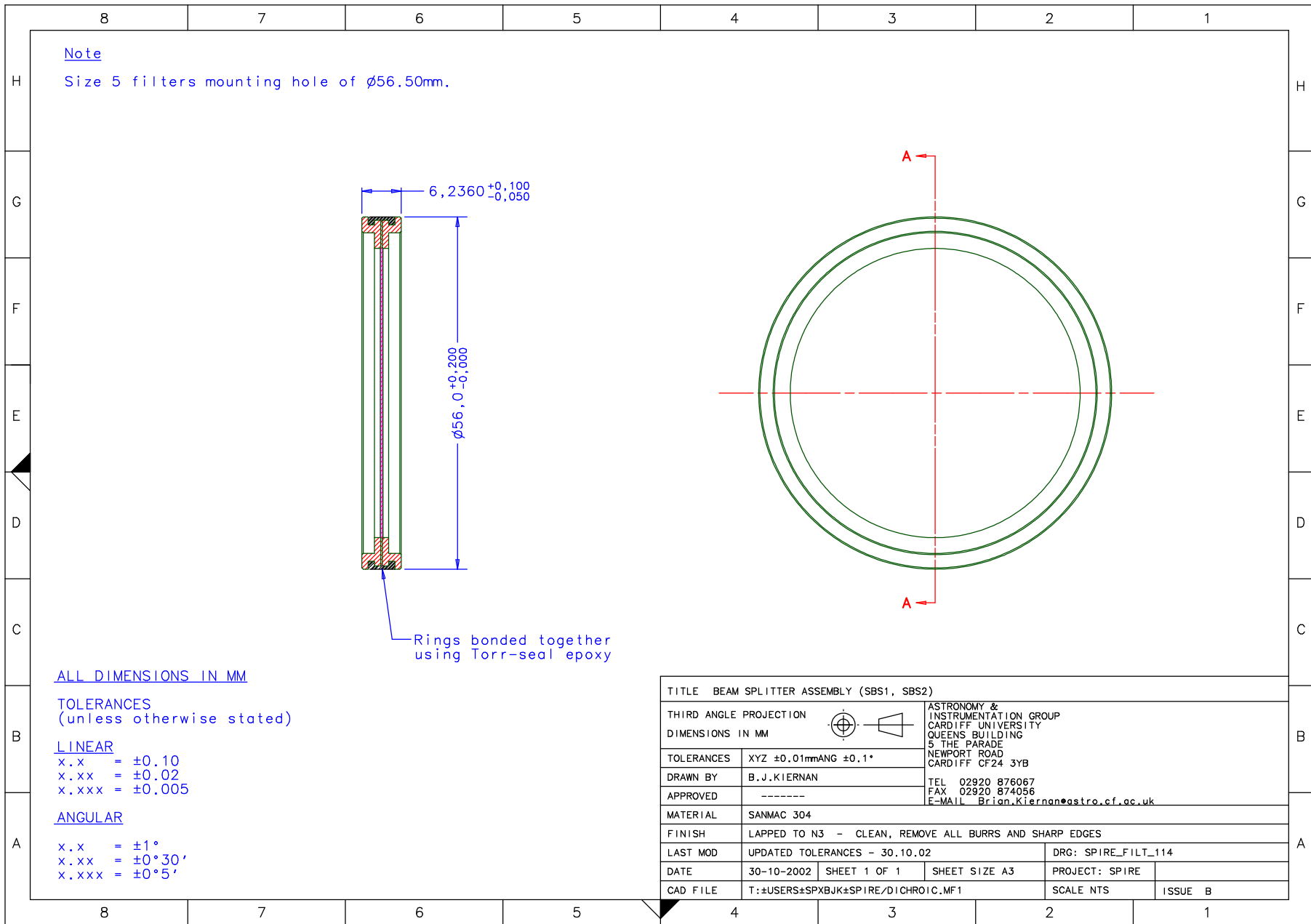


Figure 17 Assembly drawing for SBS1 and SBS2

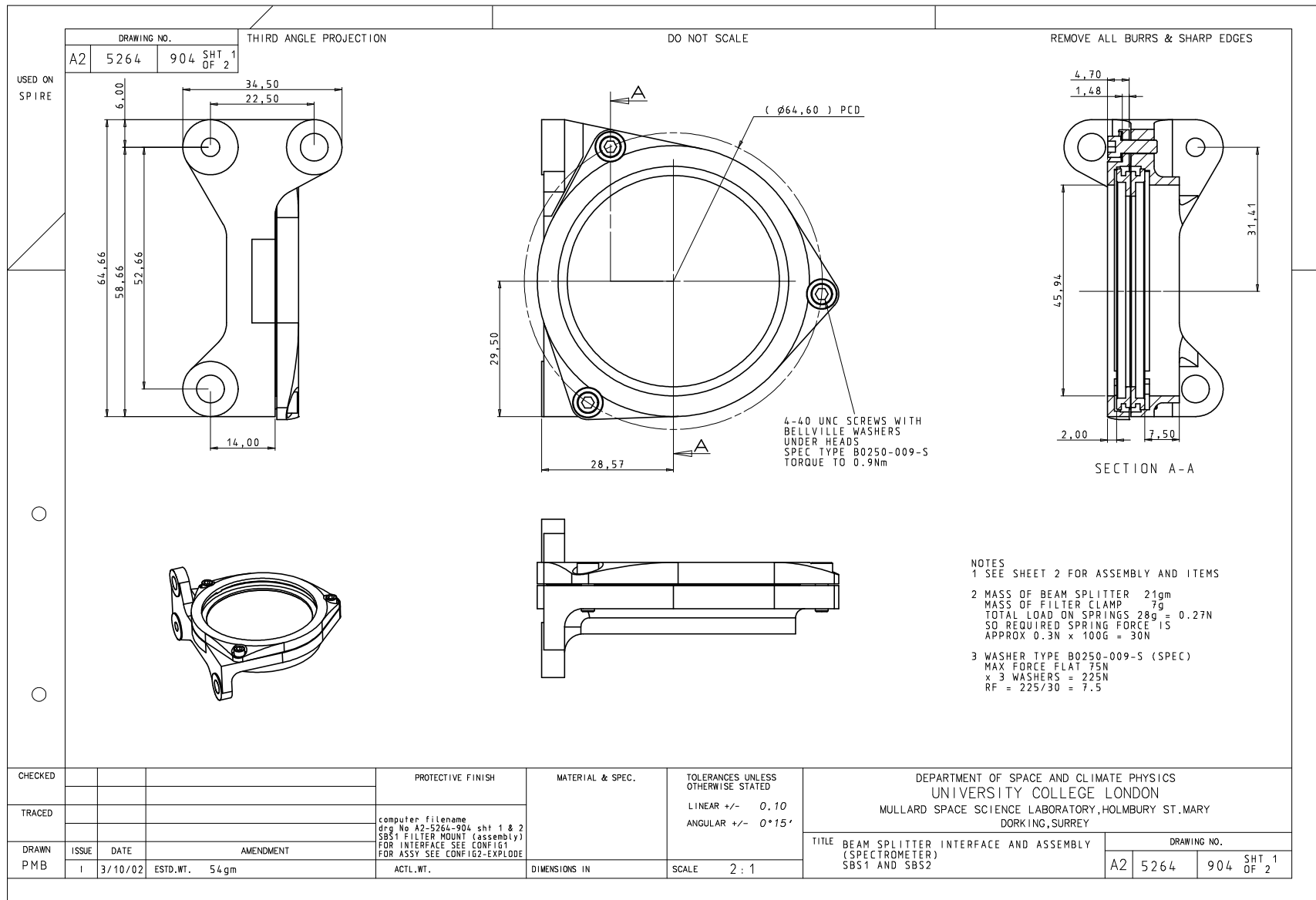


Figure 18 SBS1 and SBS2 mounts

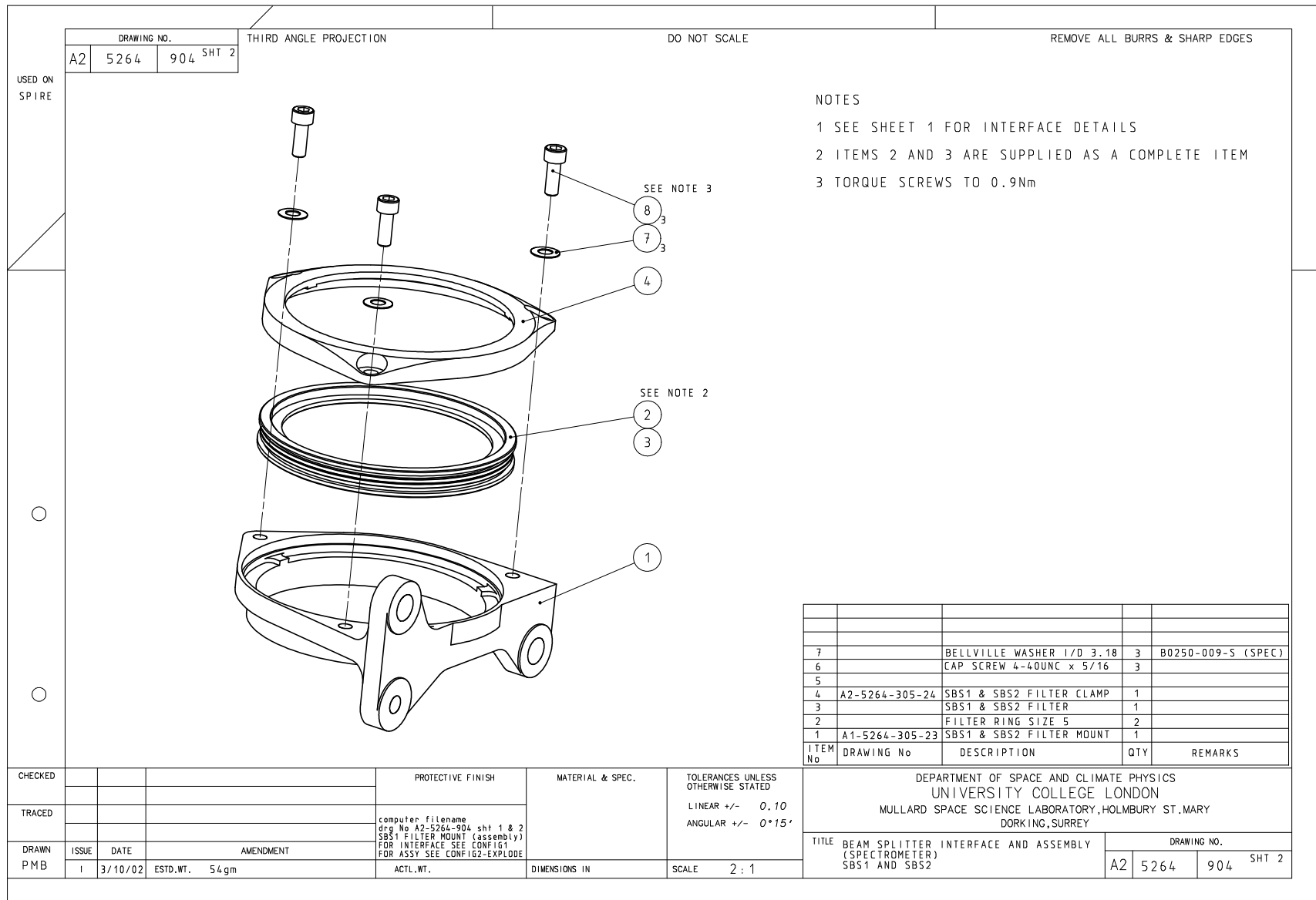


Figure 19 SBS1 and SBS2 clamp

5. Optical Interface