



**SPIRE Instrument PFM Filters**

## End Item Data Package (EIDP)

### SPIRE Instrument PFM Filters

SPIRE Ref.: SPIRE-UCF-  
Cardiff Ref.: HSO-CDF-EIDP-059  
22 October 2004

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Approved by: Ian Walker

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# Change Record

Issue	Section	Date	Changes
0.1		02/03/04	First draft for approval at DRB
1.0		22/10/04	Delivery release

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## SCOPE & Component ID

This document is the End Item Data Package (EIDP) covering the following components for the SPIRE instrument flight model:-

- CFIL1      FILT-PFM-101      B723    100cm-1 LPE
- PFIL2      FILT-PFM-102      B745    80cm-1 LPE
- PFIL3      FILT-PFM-103      W879    65cm-1 LPE – A/R coated
- SFIL2      FILT-PFM-113      B705    80cm-1 LPE
- SFIL3S     FILT-PFM-116      B655    65cm-1 LPE
- SFIL3L     FILT-PFM-120      B731    60cm-1 LPE

# SECTION 01 - Shipping Documents

The PFM instrument filter set was hand-carried to RAL by Bruce Sibthorpe of Cardiff University on Monday 25<sup>th</sup> October 2004.

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

**This package contains flight-qualification hardware.  
To be opened only by authorised SPIRE personnel in clean room conditions.**

Hot-pressed filter components:-

- Open sealed bag carefully – do not cut bag below the line marked, to avoid damage to inner bag (see below)
- Handle filters only by edges.
- Install hot-pressed filters according to MSSL drawings & procedures.
- If cleaning should be required, Cardiff personnel MUST be informed. The filters can be cleaned by gentle wiping with a clean-room wipe and Iso-propyl alcohol, followed by a bake at a maximum temperature of 60°C. NEVER USE ACIDS.
- If removal of surface particulate contamination is required, an anti static gun should be used.
- Exposure to UV light should be kept to a minimum. UV lamps for contamination monitoring should only be used when deemed absolutely necessary.





## 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>SPIRE PFM Instrument Filters</b>	
Serial No:	<b>CFIL-1(FILT-PFM-101), PFIL-2(FILT-PFM-102), PFIL-3(FILT-PFM-103), SFIL-2(FILT-PFM-113), SFIL-3S(FILT-PFM-116), SFIL-3L(FILT-PFM-120)</b>	
<i>As described in this End Item Data Package:</i> <b>HSO-CDF-EIDP-059</b>		
<i>Complies with the requirements set out in:</i> <b>SPIRE-RAL-PRJ-000034</b>		
	<b>Responsible Authority</b>	<b>Signature</b>
	Cardiff Filter Management	Prof P.A.R.Ade
		Dr C.E.Tucker
	Cardiff Product Assurance	Dr I.Walker
	Cardiff SPIRE Management	Dr P.Hargrave

## SECTION 04 - Qualification Status List / Compliance Matrix

The following table lists the qualification tests performed. See historical record for test references.

Test	Status						Notes	Test Institute
	CFIL1	PFIL2	PFIL3	SFIL2	SFIL3S	SFIL3L		
Spectral behaviour - Near-band transmission	Performed & compliant	Performed & compliant	Performed & compliant	Performed & compliant	Performed & compliant	Performed & compliant	HSO-CDF-SP-002-2.2 See historical record for test references	UWC
Spectral behaviour - out-of-band blocking, at $\lambda < 15\mu\text{m}$	Open test. Off-cuts to be tested once facility commissioned	Open test. Off-cuts to be tested once facility commissioned	Open test. Off-cuts to be tested once facility commissioned	Open test. Off-cuts to be tested once facility commissioned	Open test. Off-cuts to be tested once facility commissioned	Open test. Off-cuts to be tested once facility commissioned	HSO-CDF-SP-002-2.2 See historical record for test references	UWC
Dimension and tolerances to specification	Compliant.	Compliant.	Compliant.	Compliant.	Compliant.	Compliant.	HSO-CDF-ICD-012-3.0	UWC
Filter flatness	Not required for this element	Not required for this element	Not required for this element	Not required for this element	Not required for this element	Not required for this element	HSO-CDF-ICD-012-3.0	UWC
Inspection for surface defects	Passed	Passed	Passed	Passed	Passed	Passed	UWC Filters database "hundred_acre_wood.mdb"	UWC
Mass	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant	HSO-CDF-ICD-012-3.0	
Thermal cycling (5 cycles 300K-77K-300K)	Passed	Passed	Passed	Passed	Passed	Passed	See historical record for test references	UWC
Cold vibration	Not performed	Not performed	Not performed	Not performed	Not performed	Not performed	MSSL-Technote-SPIRE-26 SPIRE-RAL-REP-002007	RAL
Environmental condition - Vacuum $3 \times 10^{-1} \text{mBar}$	Performed	Performed	Performed	Performed	Performed	Performed	See historical record for test references	UWC
Differential pressure (a pumping-out rate of 10mB/sec)	Performed	Performed	Performed	Performed	Performed	Performed	See historical record for test references	UWC
Pre-bake out (not exceeding 80°C)	Complete	Complete	Complete	Complete	Complete	Complete	UWC PCH SPIRE Filters log-book	UWC
Outgassing	Test not performed. All materials used within ESA / NASA specifications	Test not performed. All materials used within ESA / NASA specifications	Test not performed. All materials used within ESA / NASA specifications	Test not performed. All materials used within ESA / NASA specifications	Test not performed. All materials used within ESA / NASA specifications	Test not performed. All materials used within ESA / NASA specifications	Compliant by design	
Cleanliness checks, by visual inspection.	Passed	Passed	Passed	Passed	Passed	Passed	UWC Filters database "hundred_acre_wood.mdb"	UWC
Degradation due to high energy radiation.	Not tested	Not tested	Not tested	Not tested	Not tested	Not tested	Compliant by design	

## Compliance matrix

Reference document SPIRE Filters Subsystem Specification Document, HSO-CDF-SP-002 V.2.2.

These components are higher frequency blocking filters, and the exact position of the edges is not important (see HSO-CDF-RFW-063).

Name	Filter type	Edges			Function		Comments	PFM filter performance			Difference from specification	Compliant with requirements?
		Trans	cm-1	μm	T = Transmit	B = Block; R = Reflect		Trans	cm-1	μm		
CFIL1	Low-pass edge	90%	60.0	166.7	T	15 - 50 cm-1	Thermal blocker. Common to Photometer and FTS.	90%	71.0	140.8	11.0	Yes. This component is a thermal blocker, not an edge definer.
		50%	100.0	100.0		666.7 - 200 μm		50%	95.0	105.3	-5.0	
PFIL2	Low-pass edge	10%	105.0	95.2	B	110.0 - UV cm-1	Thermal blocker.	10%	98.0	102.0	-7.0	Yes. This component is a thermal blocker, not an edge definer.
						90.91 - UV μm						
PFIL3	Low-pass edge	90%	60.0	166.7	T	15 - 50 cm-1	Thermal blocker.	90%	71.5	139.9	11.5	Yes. This component is a thermal blocker, not an edge definer.
		50%	90.0	111.1		666.7 - 200 μm		50%	84.5	118.3	-5.5	
PFIL3	Low-pass edge	10%	94.5	105.8	B	99.5 - UV cm-1	Thermal blocker.	10%	86.8	115.2	-7.7	Yes. This component is a thermal blocker, not an edge definer.
						100.5 - UV μm						
SFIL2	Low-pass edge	90%	57.0	175.4	T	15 - 50 cm-1	Thermal blocker. Identical to PFIL2.	90%	50.2	199.2	-6.8	Yes. This component is a thermal blocker, not an edge definer.
		50%	60.0	166.7		666.7 - 200 μm		50%	55.3	180.8	-4.7	
SFIL2	Low-pass edge	10%	63.0	158.7	B	68.0 - UV cm-1	Thermal blocker.	10%	56.9	175.7	-6.1	Yes. This component is a thermal blocker, not an edge definer.
						147.1 - UV μm						
SFIL3S	Low-pass edge	90%	60.0	166.7	T	15 - 50 cm-1	Blocker	90%	66.9	149.5	6.9	Yes. This component is a thermal blocker, not an edge definer.
		50%	90.0	111.1		666.7 - 200 μm		50%	89.0	112.4	-1.0	
SFIL3S	Low-pass edge	10%	94.5	105.8	B	100 - UV cm-1	Blocker	10%	91.0	109.9	-3.5	Yes. This component is a thermal blocker, not an edge definer.
						100 - UV μm						
SFIL3L	Low-pass edge	90%	66.5	150.4	T	31.2 - 51.3 cm-1	Blocker	90%	59.1	169.2	-7.4	Yes. This component is a thermal blocker, not an edge definer.
		50%	70.0	142.9		320.5 - 195 μm		50%	63.9	156.5	-6.1	
SFIL3L	Low-pass edge	10%	73.5	136.1	B	78.5 - UV cm-1	Blocker	10%	65.8	152.0	-7.7	Yes. This component is a thermal blocker, not an edge definer.
						127.4 - UV μm						
SFIL3L	Low-pass edge	90%	57.0	175.4	T	14.9 - 66.5 cm-1	Blocker	90%	47.8	209.2	-9.2	Yes. This component is a thermal blocker, not an edge definer.
		50%	60.0	166.7		671.1 - 150 μm		50%	66.4	150.6	6.4	
SFIL3L	Low-pass edge	10%	63.0	158.7	B	68.0 - UV cm-1	Blocker	10%	68.2	146.6	5.2	Yes. This component is a thermal blocker, not an edge definer.
						147.1 - UV μm						

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

## TOP LEVEL DRAWING LIST

Drawing No.	Title
FILT-XXX-101	CFIL-1 FILTER
FILT-XXX-102	PFIL-2 FILTER
FILT-XXX-103	PFIL-3 FILTER
FILT-XXX-113	SFIL-2 FILTER
FILT-XXX-116	SFIL-3S FILTER
FILT-XXX-120	SFIL-3L FILTER

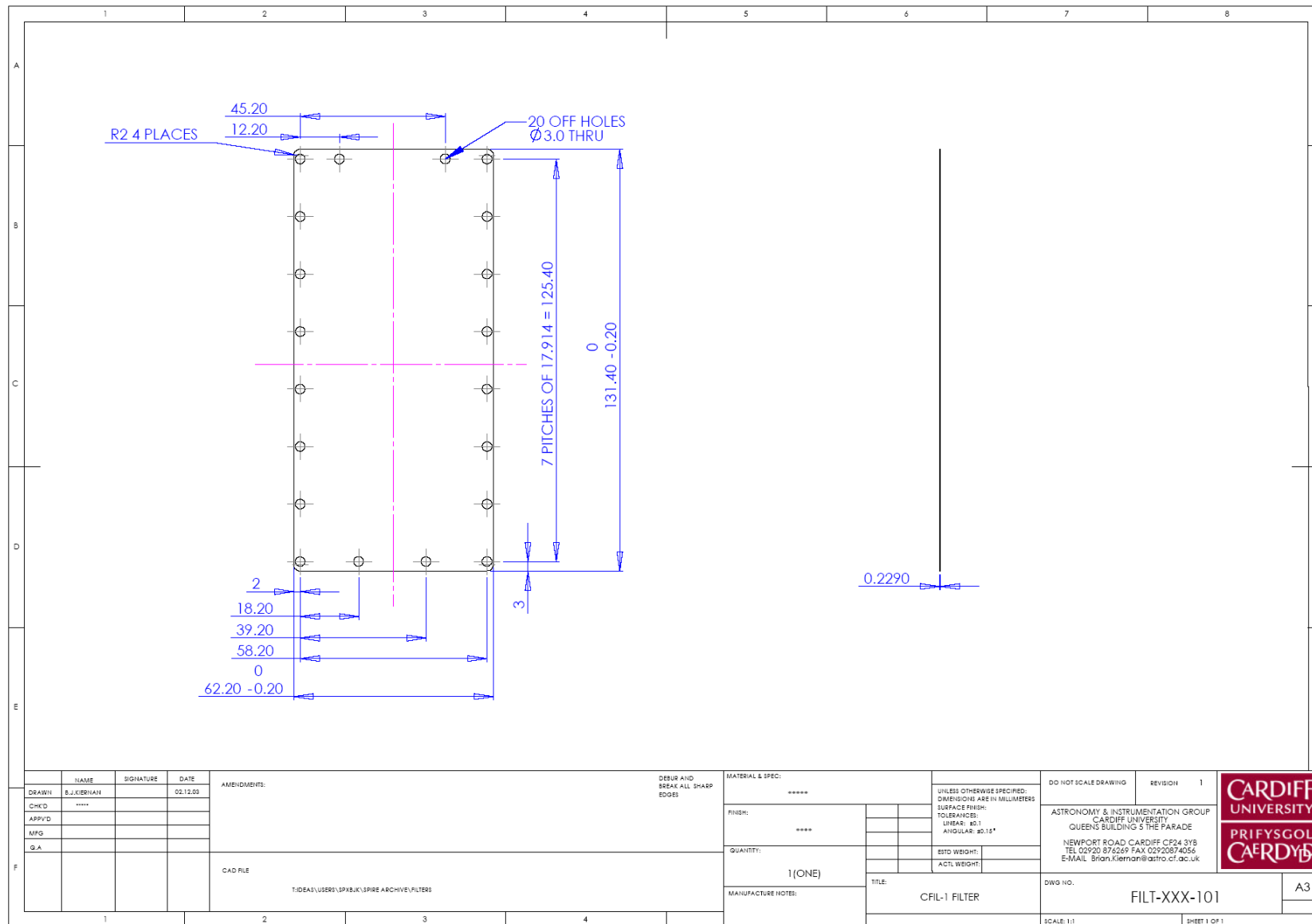


Figure 1 CFIL-1 component drawing

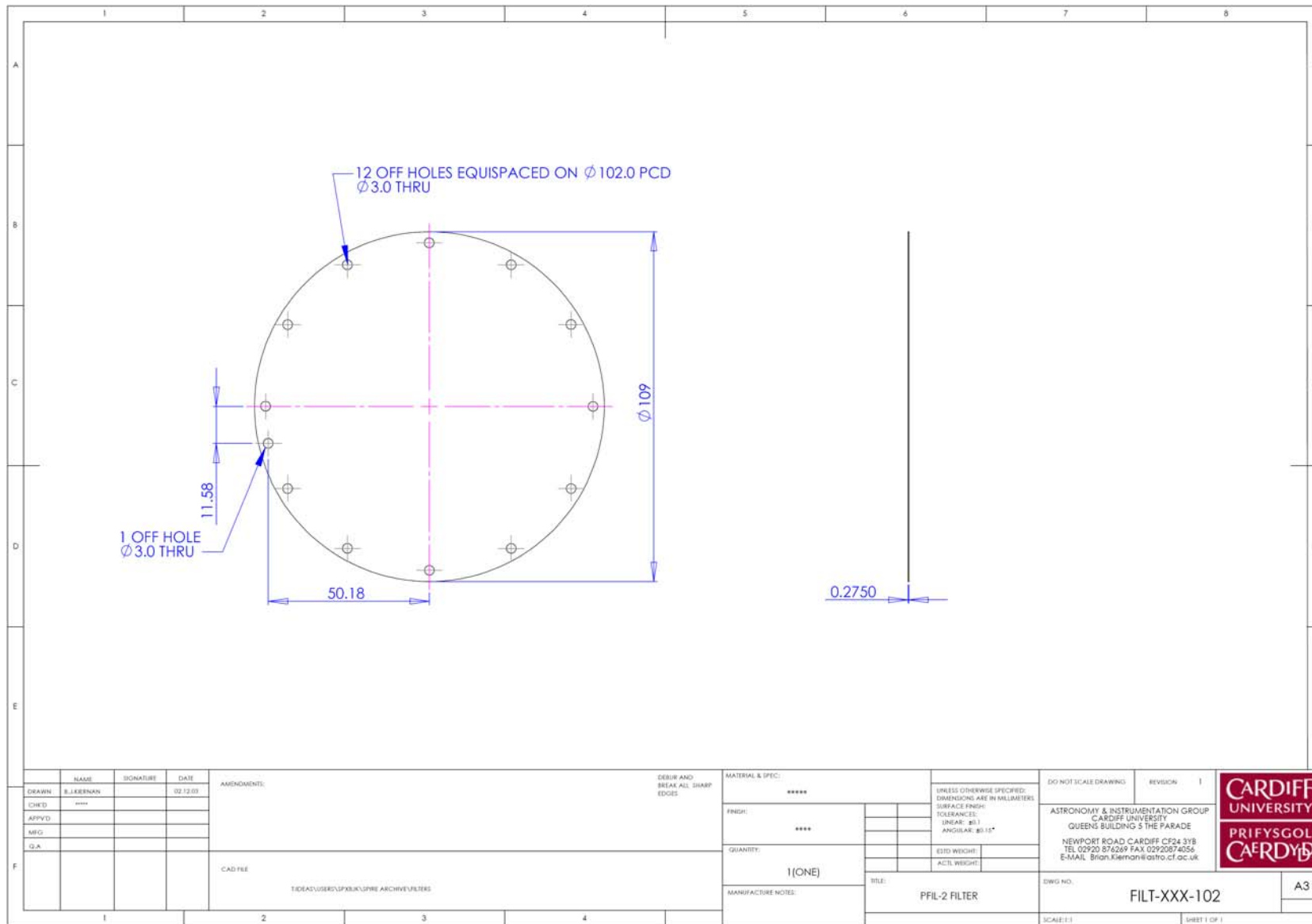


Figure 2 PFIL-2 component drawing

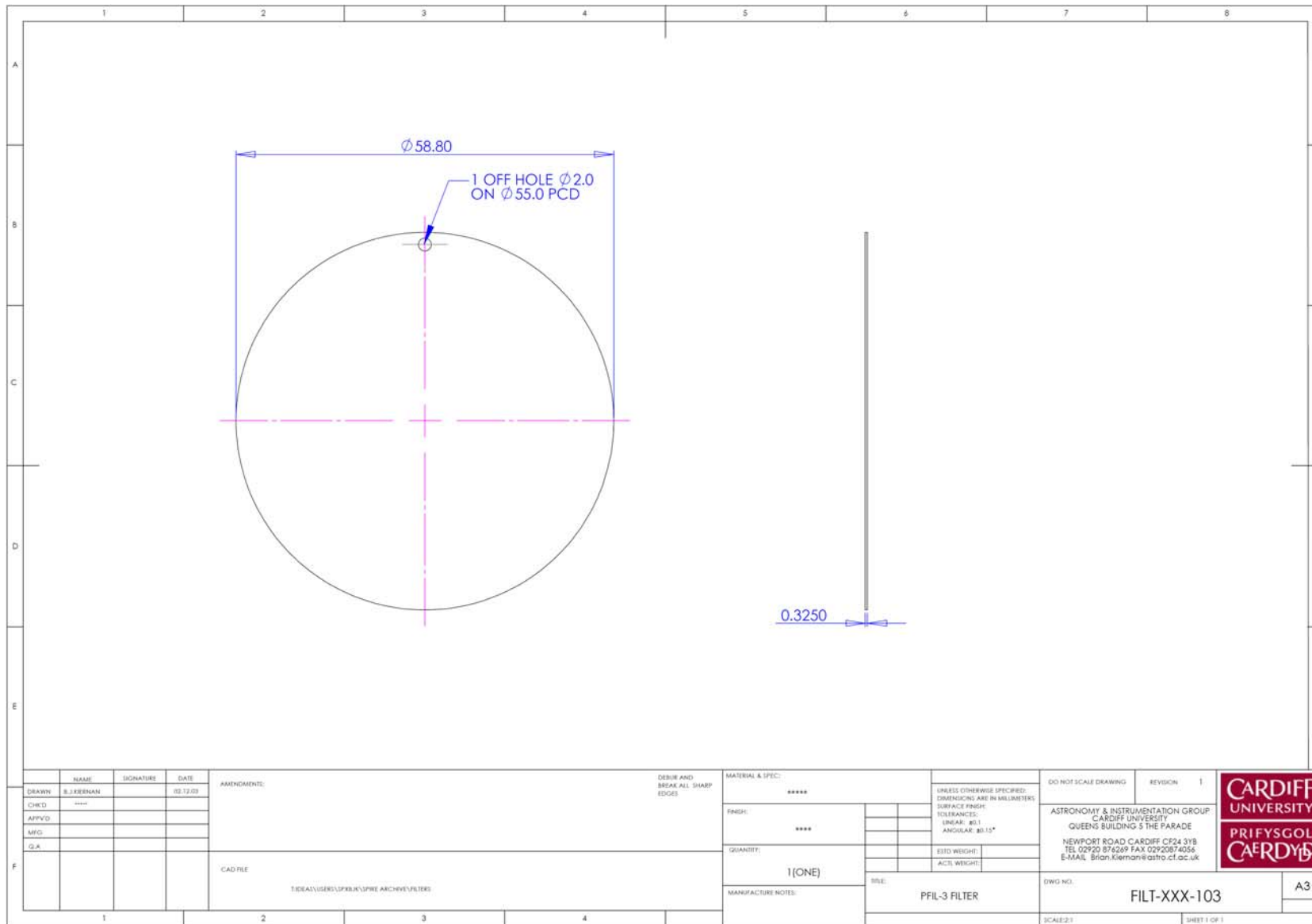


Figure 3 PFIL-3 component drawing

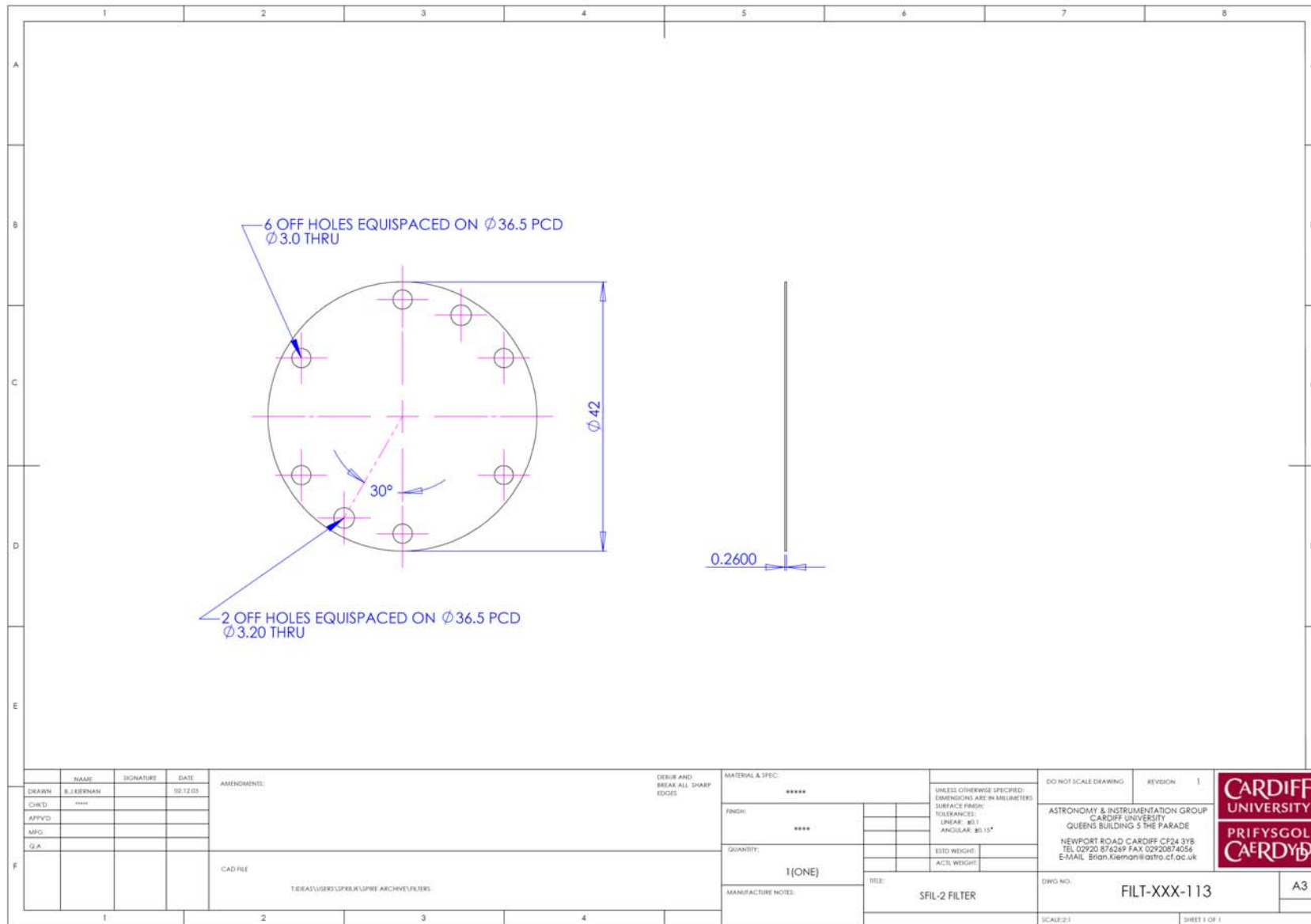


Figure 4 SFIL-2 component drawing



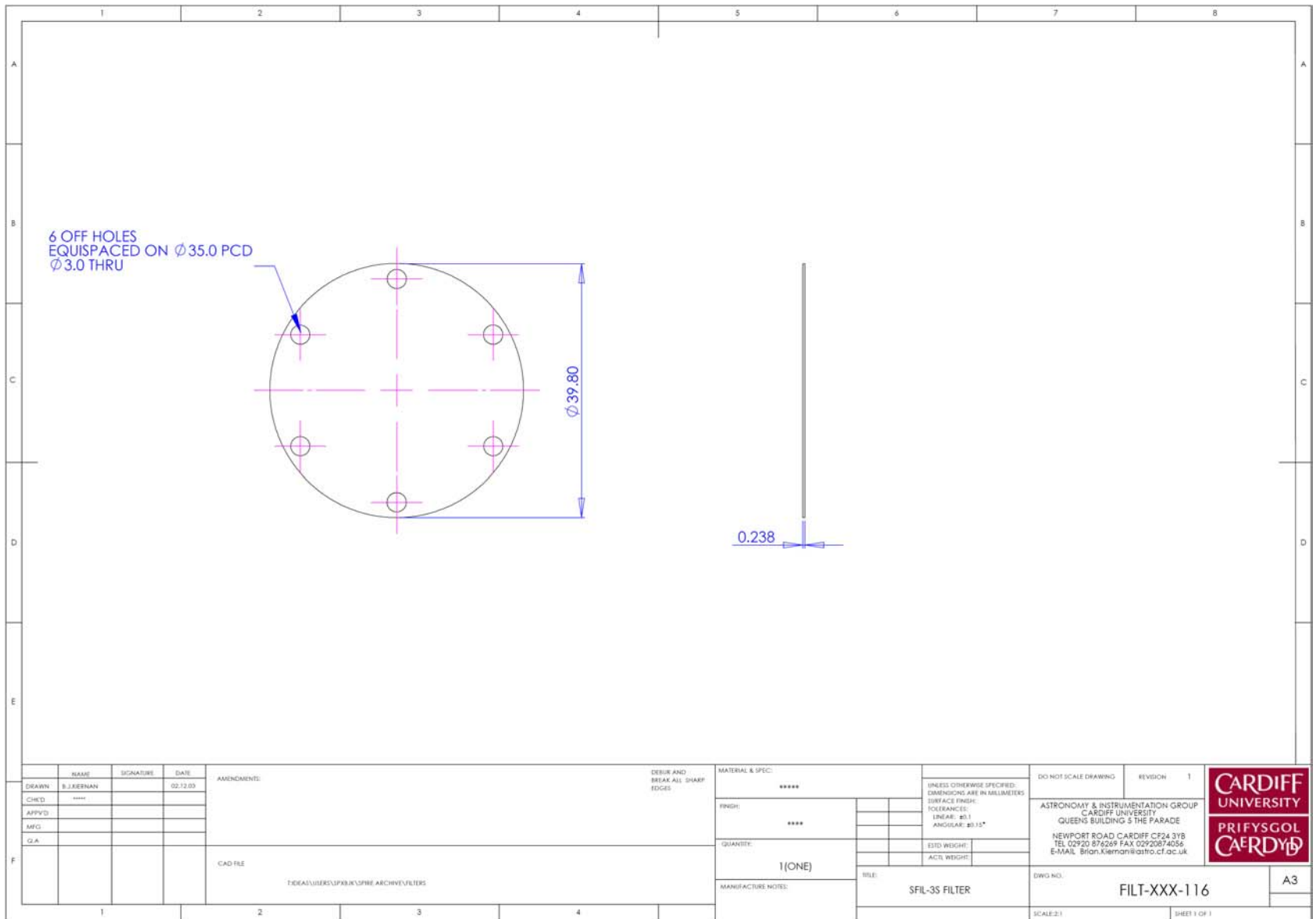


Figure 5 SFIL-3S component drawing

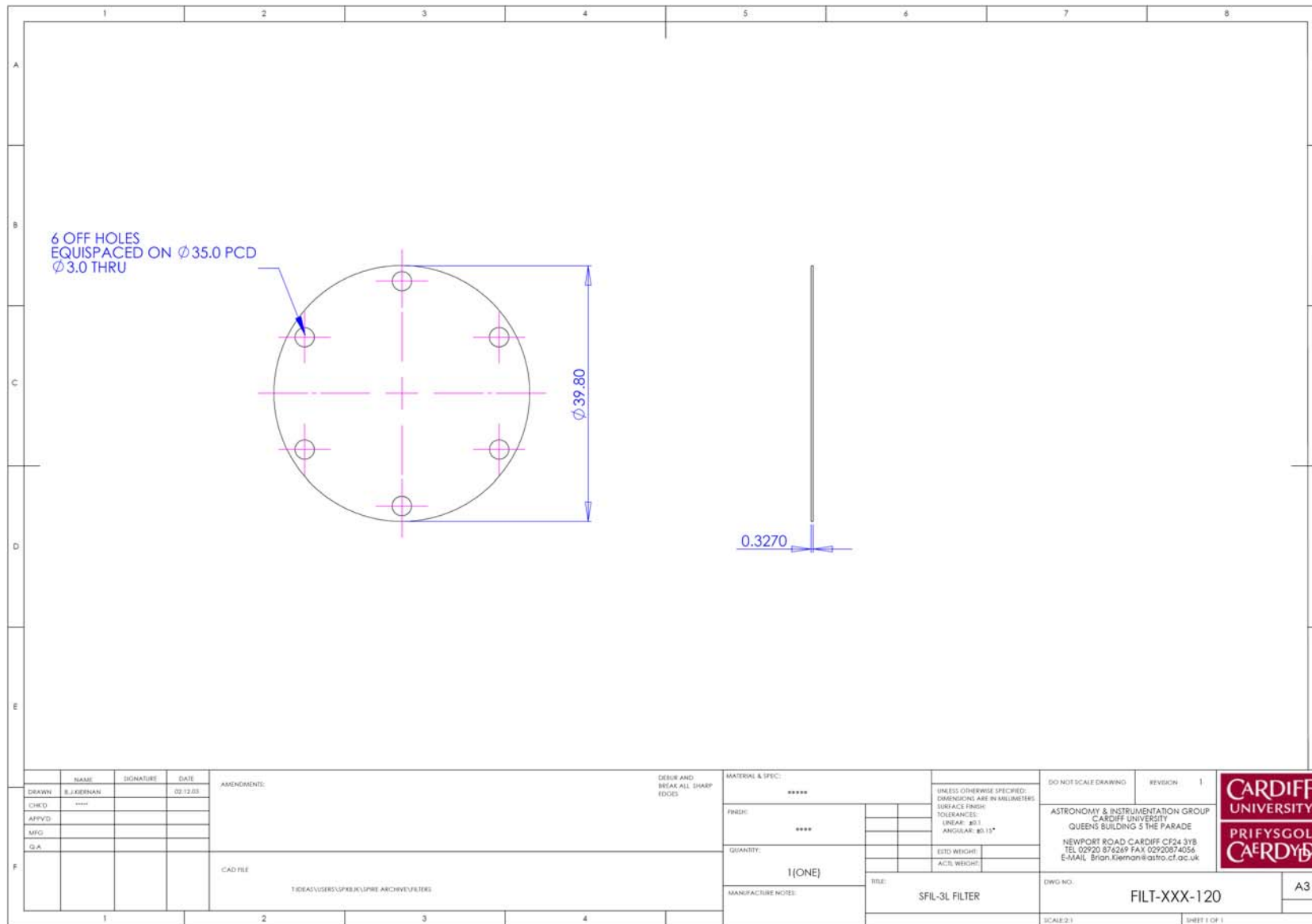


Figure 6 SFIL-3L component drawing

## SECTION 06 - Interface Drawings

### ***INTERFACE DRAWING LIST***

Drawing No.	Title
FILT-XXX-101	CFIL-1 FILTER
FILT-XXX-102	PFIL-2 FILTER
FILT-XXX-103	PFIL-3 FILTER
FILT-XXX-113	SFIL-2 FILTER
FILT-XXX-116	SFIL-3S FILTER
FILT-XXX-120	SFIL-3L FILTER
5264-921	CFIL-1 INTERFACE
5264-922	PFIL-2 INTERFACE
5264-918	PFIL-3 INTERFACE
5264-920	SFIL-2 INTERFACE
5264-919	SFIL-3 INTERFACE

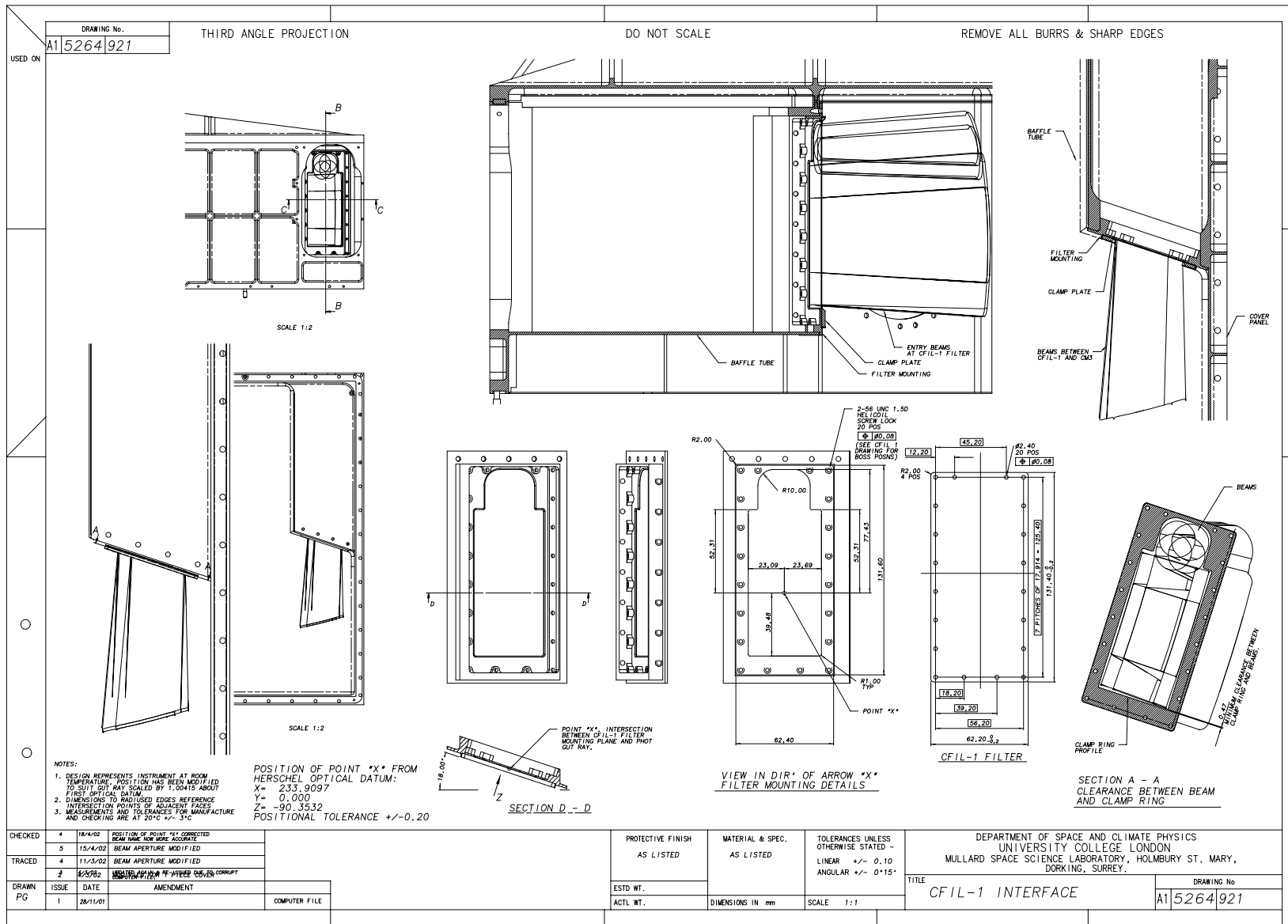


Figure 7 CFIL-1 interface

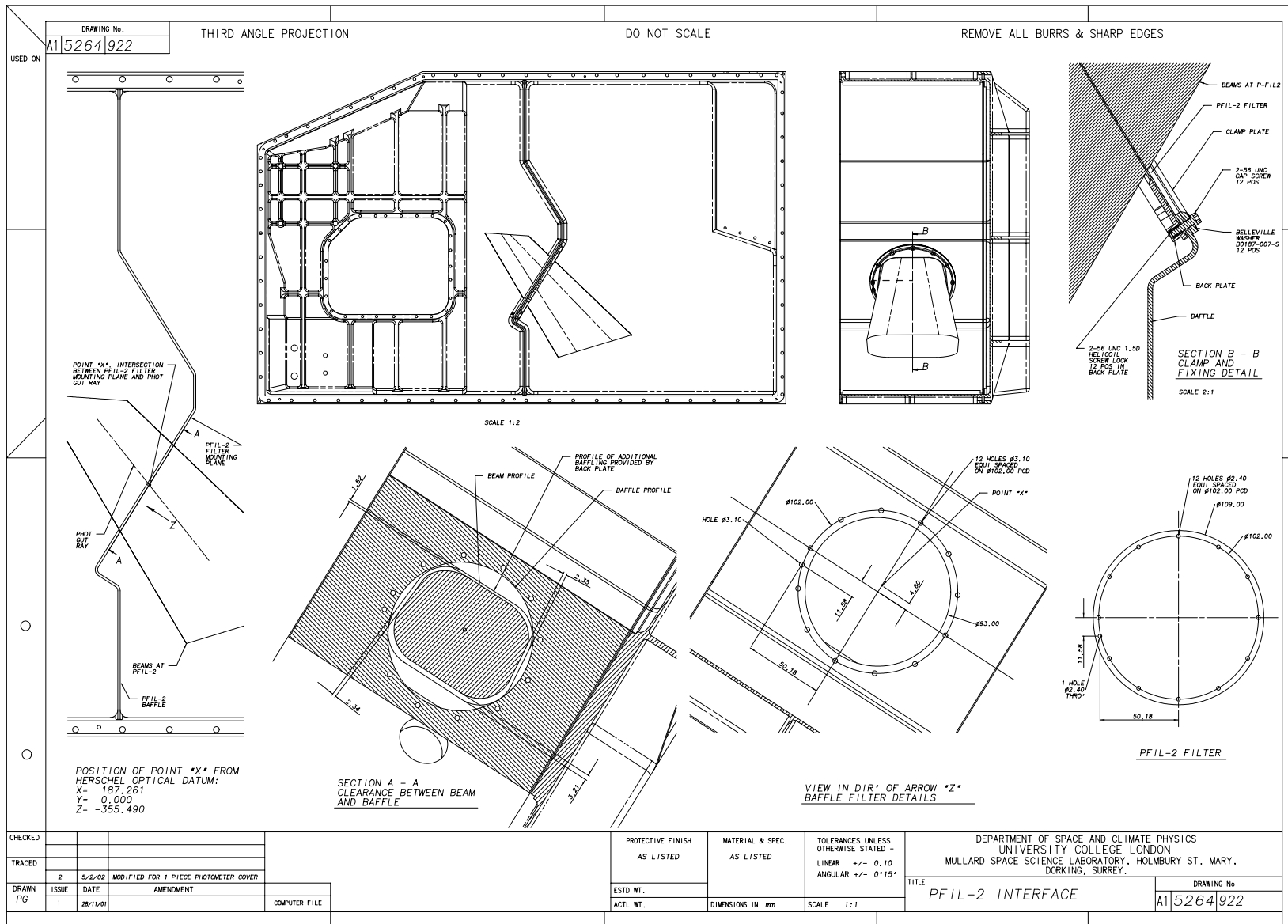


Figure 8 PFIL-2 interface

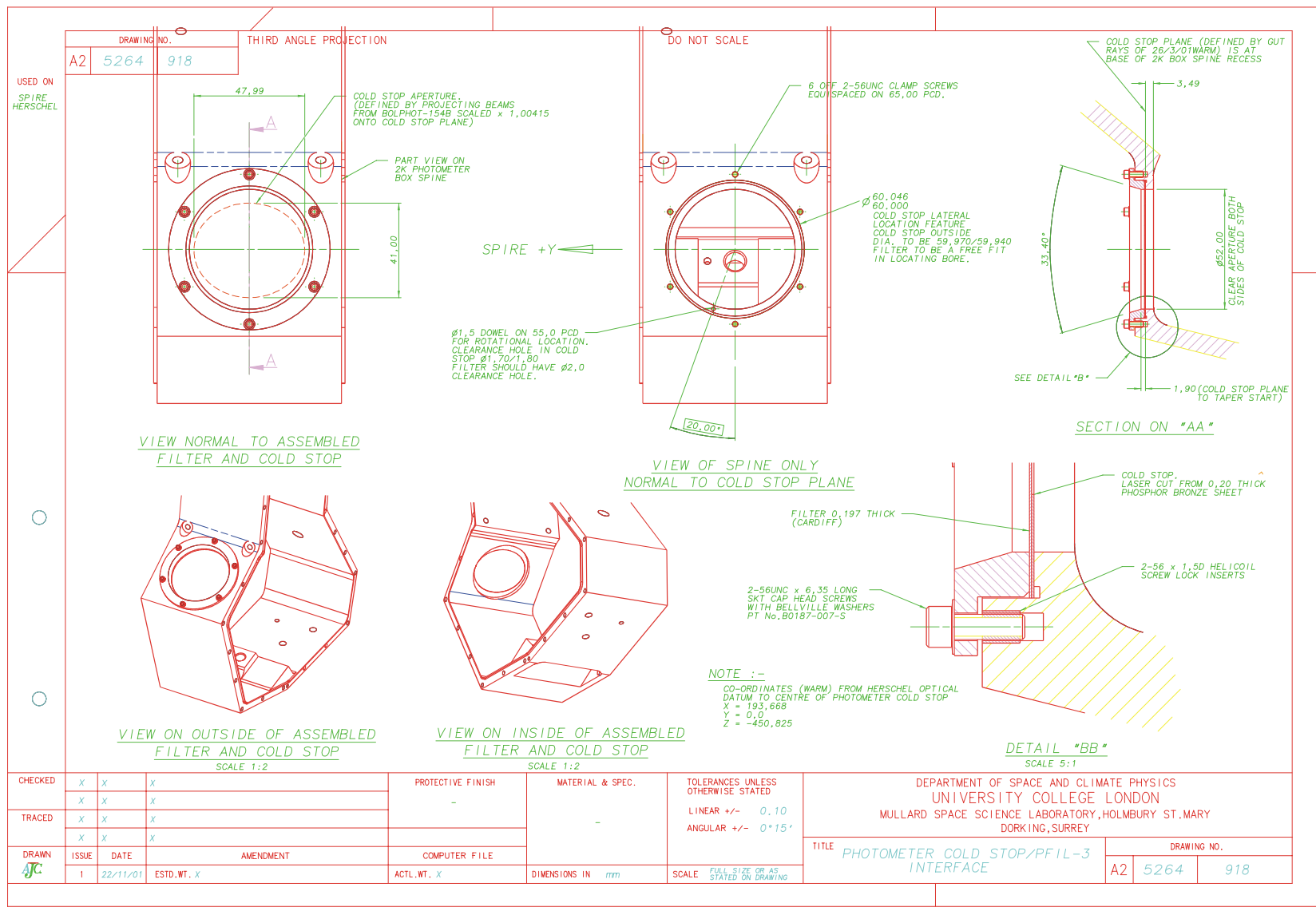


Figure 9 PFIL-3 interface

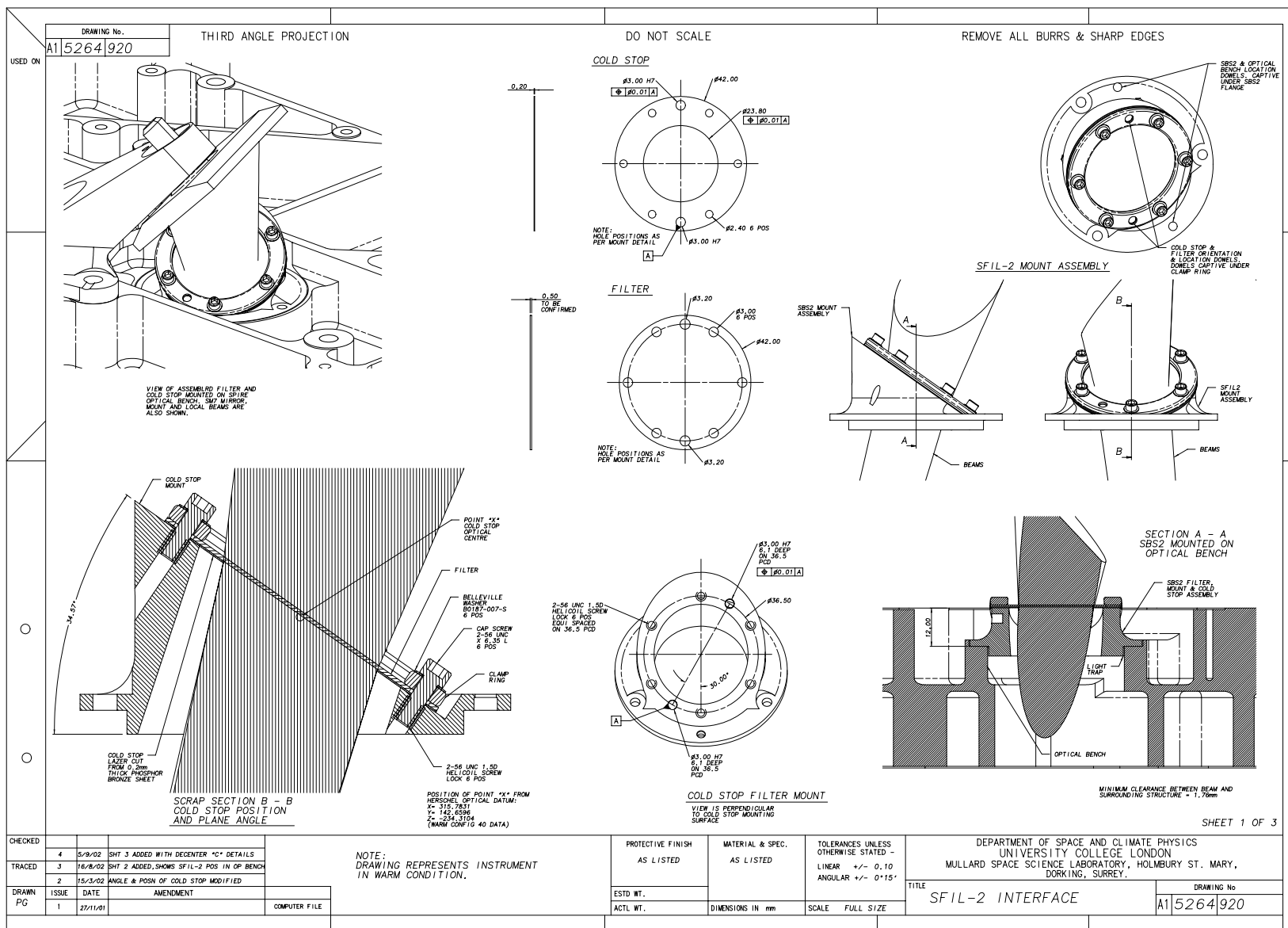


Figure 10 SFIL-2 interface – sheet 1

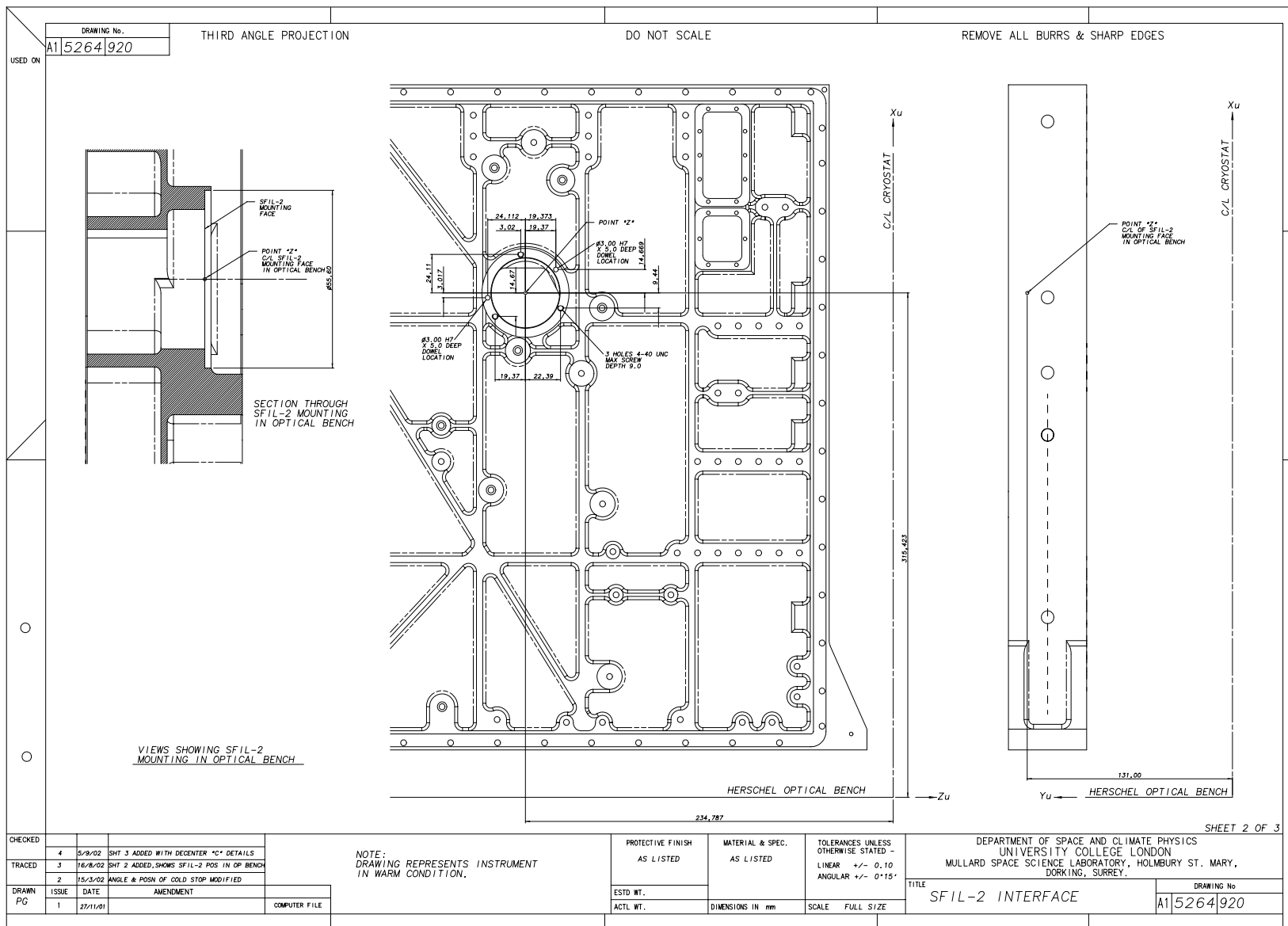


Figure 11 SFIL-2 interface – sheet 2



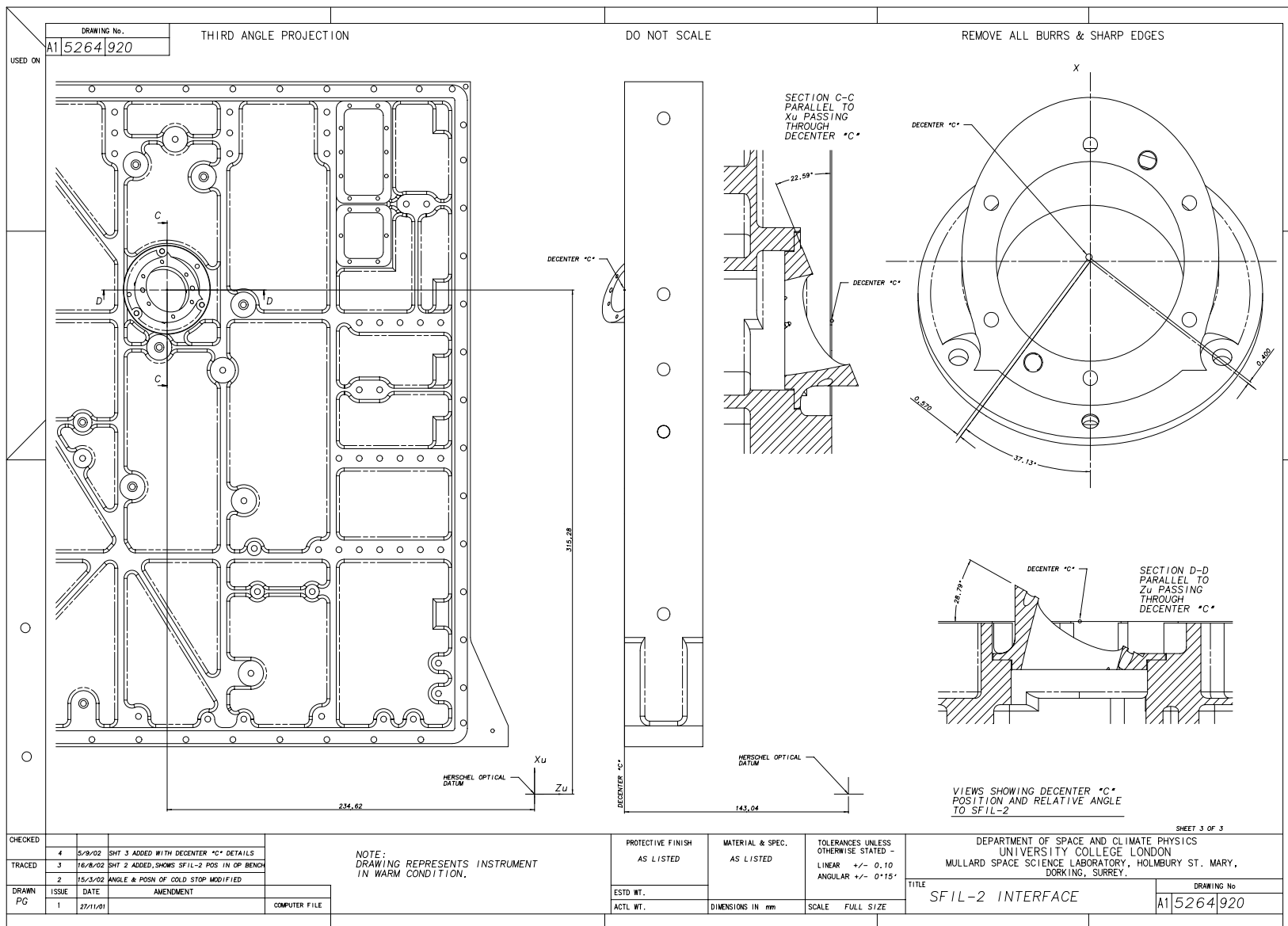


Figure 12 SFIL-2 interface – sheet 3

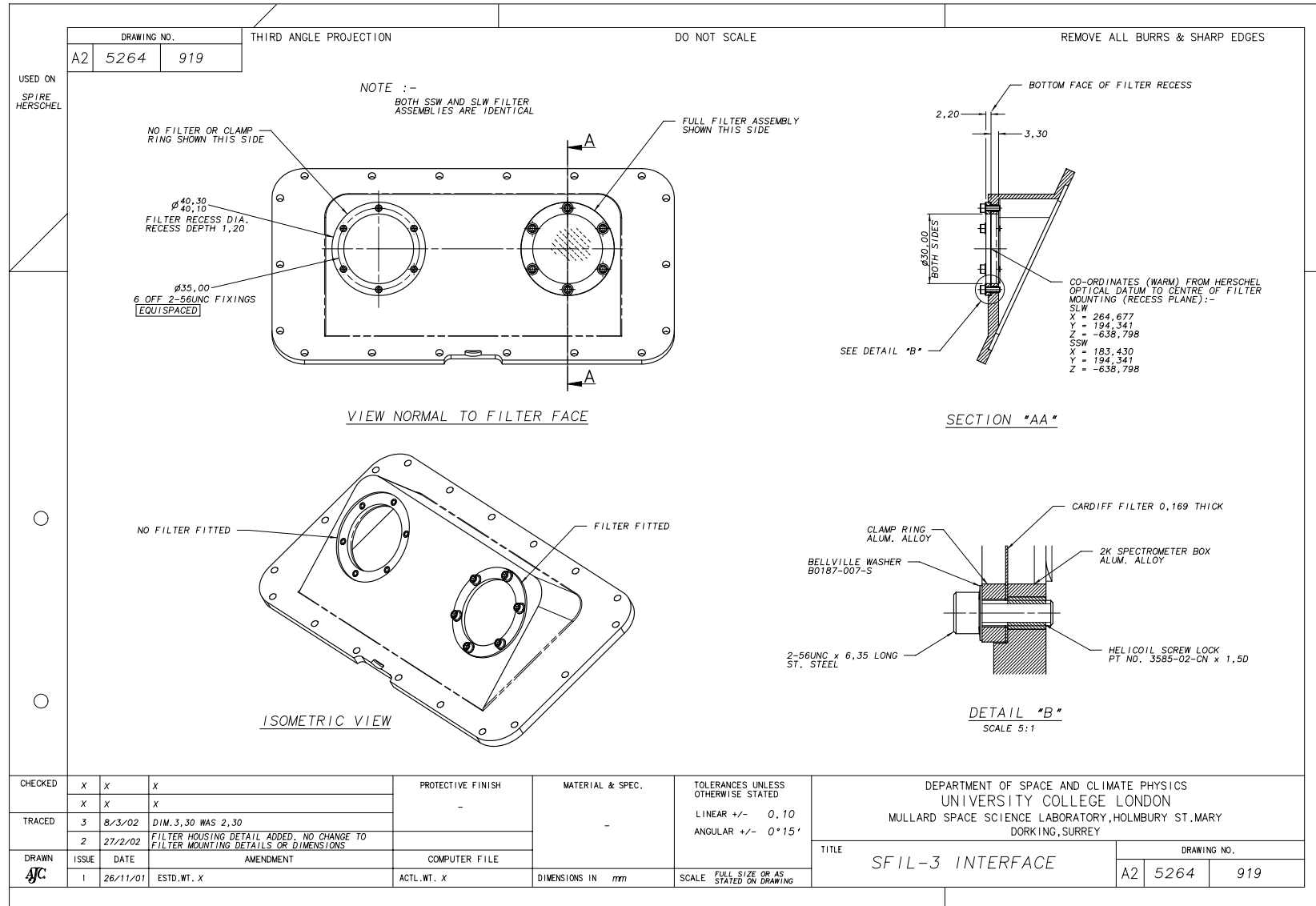


Figure 13 SFIL-3 interface

**SECTION 07 - Functional, Block & Mechanical Drawings**

Not applicable.

***FUNCTIONAL & BLOCK DRAWING LIST***

Drawing No.	Title

***MECHANICAL COMPONENT DRAWING LIST***

Drawing No.	Title

## SECTION 09 - As Built Configuration Items Status List

Item	Reference	Location	Notes
Filter drawings and manufacturing files		\\Darkstar\Astroworld\Projects\Spire\Cardiff_workpackages\Deliverables\Shipped\Filters\PFM-instrument-filters\Drawings\	
Material certificates of conformance		Available at Cardiff for inspection	
Filter manufacture		All grids built according to "UWC Filter Fabrication Procedures.doc" [UWC internal document) located at \\Darkstar\Astroworld\Projects\filters\Filter Production procedures.  Traceability of components through logbooks and "Filter database - Hundred Acre Wood" [UWC internal Access database located at \\Darkstar\Astroworld\Projects\filters\database.	
FILT-PFM-101 Spectroscopic test data CFIL-1 PFM assembly	B723	\\Darkstar\Astroworld\Projects\Spire\Cardiff_workpackages \Configured_Documents\Issued\Data\SPIRE_PFM_CFIL1.xls	
FILT-PFM-102 Spectroscopic test data PFIL-2 PFM assembly	B745	\\Darkstar\Astroworld\Projects\Spire\Cardiff_workpackages \Configured_Documents\Issued\Data\SPIRE_PFM_PFIL2.xls	
FILT-PFM-103 Spectroscopic test data PFIL-3 PFM assembly	W879 ARC	\\Darkstar\Astroworld\Projects\Spire\Cardiff_workpackages \Configured_Documents\Issued\Data\SPIRE_PFM_PFIL3.xls	
FILT-PFM-113 Spectroscopic test data SFIL-2 PFM assembly	B705	\\Darkstar\Astroworld\Projects\Spire\Cardiff_workpackages \Configured_Documents\Issued\Data\SPIRE_PFM_SFIL2.xls	
FILT-PFM-120 Spectroscopic test data SFIL-3L PFM assembly	B731	\\Darkstar\Astroworld\Projects\Spire\Cardiff_workpackages \Configured_Documents\Issued\Data\SPIRE_PFM_SFIL3L.xls	


FILT-PFM-116 Spectroscopic test data SFIL-3S PFM assembly	B655	\\Darkstar\Astroworld\Projects\Spire\Cardiff_workpackages \Configured_Documents\Issued\Data\SPIRE_PFM_SFIL3S.xls	

Part number	Description	Details
FILT-PFM-101	CFIL-1 FILTER – B723	Common input filter. 100cm <sup>-1</sup> blocker
FILT-PFM-102	PFIL-2 FILTER – B745	80cm <sup>-1</sup> blocker
FILT-PFM-103	PFIL-3 FILTER – W879 ARC	70cm <sup>-1</sup> blocker. Anti-reflection coated.
FILT-PFM-113	SFIL-2 FILTER – B705	80cm <sup>-1</sup> blocker
FILT-PFM-116	SFIL-3S FILTER – B655	65cm <sup>-1</sup> blocker
FILT-PFM-120	SFIL-3L FILTER – B731	60cm <sup>-1</sup> blocker


**SECTION 11 - List of Waivers**

HSO-CDF-RFW-063	SPIRE PFM Blocking Filters RFW	Closed
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# SECTION 12 - Copies of Waivers

	REQUEST FOR WAIVER / DEVIATION (RFW/RFD)	PRODUCT ASSURANCE Space Science and Technology Department
	RFW/RFD Number: <b>HR-SP-CDF-RFW-XXX</b> , HSO-CDF-RFW-063	

RFW/RFD Number:	<b>HR-SP-CDF-RFW-XXX</b> , HSO-CDF-RFW-063
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Spacecraft / Project	HERSCHEL	Originator's Name	Peter Hargrave
System / Experiment / Model	SPiRE-PFM	Signature / Date	
Sub-System	Filters	Request Type (Highlight applicable request)	Waiver (RFW)      Deviation (RFD)
Assembly		Organisation	Cardiff University
Sub-Assembly		Ref. Doc. / Drwg No.	
Item	All flight model blocking filters	References	
Serial No.			
RFW/RFD Title	Request for waiver against blocking filter edges		


End Item(s) Affected (Hardware, Software)				
Name	CI-Number	Model(s)		
SPiRE PFM blocking filters		Flight		
Requirement / Interface Documents Affected				
Specification/Drawing Title	Number	Issue	Date	App. Paragraph
Filters specification document	HSO-CDF-SP-002	2.2	29/10/02	3.2 table 1 3.3 table 2

**Description of Deviation / Discrepancy / Non-Conformance**  
 This note requests a waiver on the nominal edge positions for the flight model instrument blocking filters.

**Other Items or Requirements (Potentially) Affected**  
 None

**Need for RFW/RFD and Rationale for Acceptance**  
 The flight blocking filters have been tuned in such a way as to optimise the in-band transmission and out-of-band rejection for each SPiRE band. This means that the actual edge positions are not exactly as stated in HSO-CDF-SP-002 (filters spec. document). This is not important, as the band edges are defined by edge defining filters, which are all exactly to specification, and are not included in this request for waiver.  
 The differences in edge position are summarised in Table 1.  
 Informal MRB held by Eric Sawyer & Bruce Swinyard. 11th August 2004 This RFW is accepted / agreed by SPiRE PROJECT, No Agreement required from Industry or Customer.

	Approved	Rejected	Name	Date
Engineering:			Bruce Swinyard	
Product Assurance:			Eric Clark	
CCB-Chairman:				
Principle Investigator				
Product Assurance:				
Co-Investigator				
Prime Contractor				
ESA Project Office				

	REQUEST FOR WAIVER / DEVIATION (RFW/RFD)	PRODUCT ASSURANCE Space Science and Technology Department
	RFW/RFD Number: <b>HR-SP-CDF-RFW-XXX</b> , HSO-CDF-RFW-063	

RFW/RFD Number:	<b>HR-SP-CDF-RFW-XXX</b> , HSO-CDF-RFW-063
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Table 1 Comparison of nominal edges as stated in HSO-CDF-SP-002 with actual PFM blocker edge positions.

Name	Filter type	Edges			Function		Comments	PFM filter performance			Difference from specification	
		Trans	cm-1	µm	T = Transmit			Trans	cm-1	µm		
					B = Block;	R = Reflect						
CFIL1	Low-pass edge	90%	60.0	166.7	T	15 - 50 cm-1	Thermal blocker. Common to Photometer and FTS.	90%	71.0	140.8	11.0	
		50%	100.0	100.0		666.7 - 200 µm		50%	95.0	105.3		-5.0
		10%	105.0	95.2	B	110.0 - UV cm-1 90.91 - UV µm		10%	98.0	102.0		-7.0
PFIL2	Low-pass edge	90%	60.0	166.7	T	15 - 50 cm-1	Thermal blocker.	90%	71.5	139.9	11.5	
		50%	90.0	111.1		666.7 - 200 µm		50%	84.5	118.3		-5.5
		10%	94.5	105.8	B	99.5 - UV cm-1 100.5 - UV µm		10%	86.8	115.2		-7.7
PFIL3	Low-pass edge	90%	57.0	175.4	T	15 - 50 cm-1	Thermal blocker.	90%	50.2	199.2	-6.8	
		50%	60.0	166.7		666.7 - 200 µm		50%	55.3	180.8		-4.7
		10%	63.0	158.7	B	68.0 - UV cm-1 147.1 - UV µm		10%	56.9	175.7		-6.1
SFIL2	Low-pass edge	90%	60.0	166.7	T	15 - 50 cm-1	Thermal blocker. Identical to PFIL2.	90%	66.9	149.5	6.9	
		50%	90.0	111.1		666.7 - 200 µm		50%	89.0	112.4		-1.0
		10%	94.5	105.8	B	100 - UV cm-1 100 - UV µm		10%	91.0	109.9		-3.5
SFIL3S	Low-pass edge	90%	66.5	150.4	T	31.2 - 51.3 cm-1	Blocker	90%	59.1	169.2	-7.4	
		50%	70.0	142.9		320.5 - 195 µm		50%	63.9	156.5		-6.1
		10%	73.5	136.1	B	78.5 - UV cm-1 127.4 - UV µm		10%	65.8	152.0		-7.7
SFIL3L	Low-pass edge	90%	57.0	175.4	T	14.9 - 66.5 cm-1	Blocker	90%	47.8	209.2	-9.2	
		50%	60.0	166.7		671.1 - 150 µm		50%	66.4	150.6		6.4
		10%	63.0	158.7	B	68.0 - UV cm-1 147.1 - UV µm		10%	68.2	146.6		5.2

# SECTION 13 - Operations Manual

No operating manual is supplied.



## SECTION 14 - Historical Record

The following table contains *brief* historical details of the manufacture, assembly and testing of the PFM filter set, including the levels of environmental cleanliness.

Refer also to section 25 – Test reports.

A *full* historical record of every stage of manufacture for each individual grid integral to the final mounted filter is traceable at UWC, in both hard copy log-book format and on a Microsoft Access database.

### Filter CFIL1

Date	Action	UWC Test reference
1/10/03	Filter B723 manufactured in class 1000 clean room	
2/10/03	Filter B723 spectroscopically tested in the range 10-140cm-1	T0192r4
2/10/03	Filter B723 spectroscopically tested in the range 20-650cm-1	T0192r13
8/10/03	Filter B723 spectroscopically tested in the range 3-40cm-1	T0195r35
16/1/04	Filter B723 thermally shocked 5 times between 300K and 77K	THERM 0139
16/1/04	Filter B723 cut to CFIL1 drawing	
26/1/04	PFM-CFIL1 spectroscopically tested in the range 10-145cm-1 at five locations over area	T0258r58, T0258r60, T0258r62, T0258r64, T0258r66
29/1/04	PFM-CFIL1 spectroscopically tested in the range 20-650cm-1	T0261r41,
6/2/04	PFM-CFIL1 filter thermally cycled 300K-77K-300K	THERM 0145
10/2/04	PFM-CFIL1 spectroscopically tested in the range 20-650cm-1	T0268r31
	PFM-CFIL1 baked for 17hrs at 350K	

### Filter PFIL2

Date	Action	UWC Test reference
4/11/03	Filter B745 manufactured in class 1000 clean room	
5/11/03	Filter B745 spectroscopically tested in the range 10-140cm-1	T0216r13
6/11/03	Filter B745 spectroscopically tested in the range 20-650cm-1	T02172r13
16/1/04	Filter B745 thermally shocked 5 times between 300K and 77K	THERM 0140
16/1/04	Filter B745 cut to PFIL2 drawing	
26/1/04	PFM-PFIL2 spectroscopically tested in the range 10-145cm-1 at five locations over area	T0258r46, T0258r48,

		T0258r50, T0258r52, T0258r54
29/1/04	PFM-PFIL2 spectroscopically tested in the range 20-650cm-1	T0261r44,
6/2/04	PFM-PFIL2 filter thermally cycled 300K-77K-300K	THERM 0146
10/2/04	PFM-PFIL2 spectroscopically tested in the range 20-650cm-1	T0268r28
	PFM-PFIL2 cleaned & baked for 17hrs at 350K	

### Filter PFIL3

Date	Action	UWC Test reference
12/08/04	Filter W879 manufactured in class 1000 clean room	W879
13/08/04	Filter W879 spectroscopically tested in transmission in the range 5-40cm-1	T0407r13
14/08/04	Filter W879 spectroscopically tested in transmission in the range 10-140cm-1	T0408r4
20/08/04	Filter W879 cut to PFIL3 drawing	
20/09/04	SPIRE PFM PFIL3 spectroscopically tested in transmission in the range 20-600cm-1	T0423r13
20/09/04	SPIRE PFM PFIL3 thermally cycled 3 times between 300K and 77K	THERM 0200
20/09/04	SPIRE PFM PFIL3 spectroscopically tested for uniformity in the range 10-140cm-1	T0423r22, T0423r25, T0423r28
	SPIRE PFM PFIL3 cleaned with acetone, baked for 17hours at 350K	

### Filter SFIL2

Date	Action	UWC Test reference
10/9/03	Filter B705 manufactured in class 1000 clean room	
16/9/03	Filter B705 spectroscopically tested in the range 3-40cm-1	T0178r13
17/9/03	Filter B705 spectroscopically tested in the range 20-650cm-1	T0179r10
16/1/04	Filter B705 thermally shocked 5 times between 300K and 77K	THERM 0144
16/1/04	Filter B705 cut to SFIL2 drawing	
26/1/04	PFM-SFIL2 spectroscopically tested in the range 10-145cm-1 at three locations over area	T0258r4, T0258r6, T0258r8
29/1/04	PFM-SFIL2 spectroscopically tested in the range 20-650cm-1	T0261r29,
6/2/04	PFM-SFIL2 filter thermally cycled 300K-77K-300K	THERM 0147
10/2/04	PFM-SFIL2 spectroscopically tested in the range 20-650cm-1	T0268r16
	PFM-SFIL2 cleaned & baked for 17hrs at 350K	

## Filter SFIL3S

Date	Action	UWC Test reference
11/7/03	Filter B655 manufactured in class 1000 clean room	
15/7/03	Filter B655 spectroscopically tested in the range 3-40cm-1	T0XXXX
15/7/03	Filter B655 spectroscopically tested in the range 20-650cm-1	T0XXXX
16/1/04	Filter B655 thermally shocked 5 times between 300K and 77K	THERM 0141
16/1/04	Filter B655 cut to SFIL3S drawing	
26/1/04	PFM-SFIL3S spectroscopically tested in the range 10-145cm-1 at three locations over area	T0258r22, T0258r24, T0258r26
29/1/04	PFM-SFIL3S spectroscopically tested in the range 20-650cm-1	T0261r32,
6/2/04	PFM-SFIL3S filter thermally cycled 300K-77K-300K	THERM 0149
10/2/04	PFM-SFIL3S spectroscopically tested in the range 20-650cm-1	T0268r19
	PFM-SFIL3S cleaned & baked for 17hrs at 350K	

## Filter SFIL3L

Date	Action	UWC Test reference
11/7/03	Filter B731 manufactured in class 1000 clean room	
15/7/03	Filter B731 spectroscopically tested in the range 3-40cm-1	T0126r19
15/7/03	Filter B731 spectroscopically tested in the range 20-650cm-1	T0127r4
16/1/04	Filter B731 thermally shocked 5 times between 300K and 77K	THERM 0142
16/1/04	Filter B731 cut to SFIL3L drawing	
26/1/04	PFM-SFIL3L spectroscopically tested in the range 10-145cm-1 at three locations over area	T0258r16, T0258r18, T0258r20
29/1/04	PFM-SFIL3L spectroscopically tested in the range 20-650cm-1	T0261r35,
6/2/04	PFM-SFIL3L filter thermally cycled 300K-77K-300K	THERM 0148
10/2/04	PFM-SFIL3L spectroscopically tested in the range 20-650cm-1	T0268r22
	PFM-SFIL3L baked for 17hrs at 350K	

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

Not provided – available from subsystem provider upon request.

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

N/A – See historical record

## **SECTION 20 - Calibration Data Record**

The data shown in this section are the recommended transmission curves to be used for calibration purposes. These data can be found in the Microsoft Excel worksheets listed in section 09, under the sheet entitled “Calibration”.

# CFIL-1

## CFIL-1 PFM Calibration data

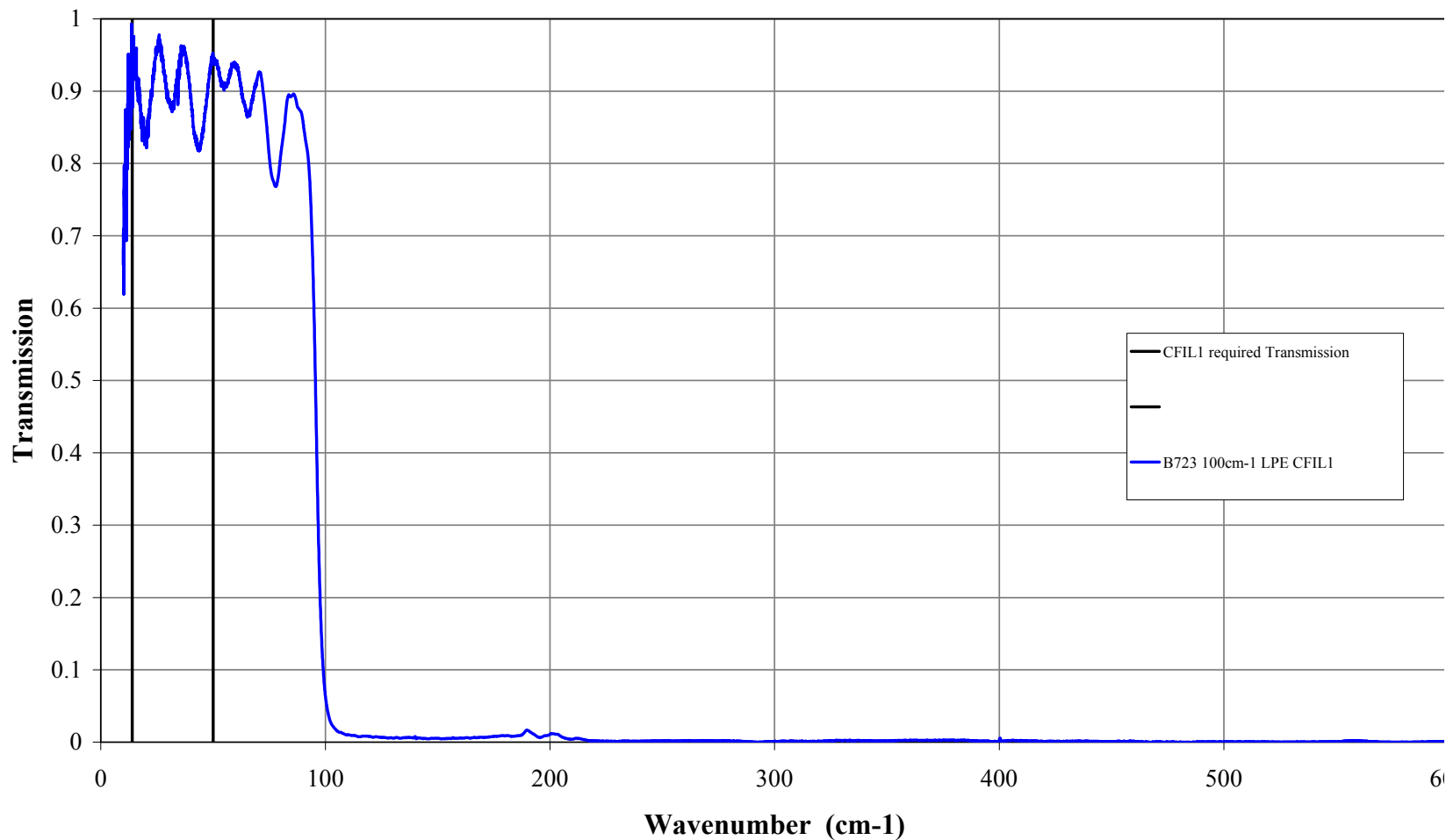


Figure 14 CFIL-1 PFM calibration curve – 0-600cm<sup>-1</sup>

### CFIL-1 PFM Calibration data

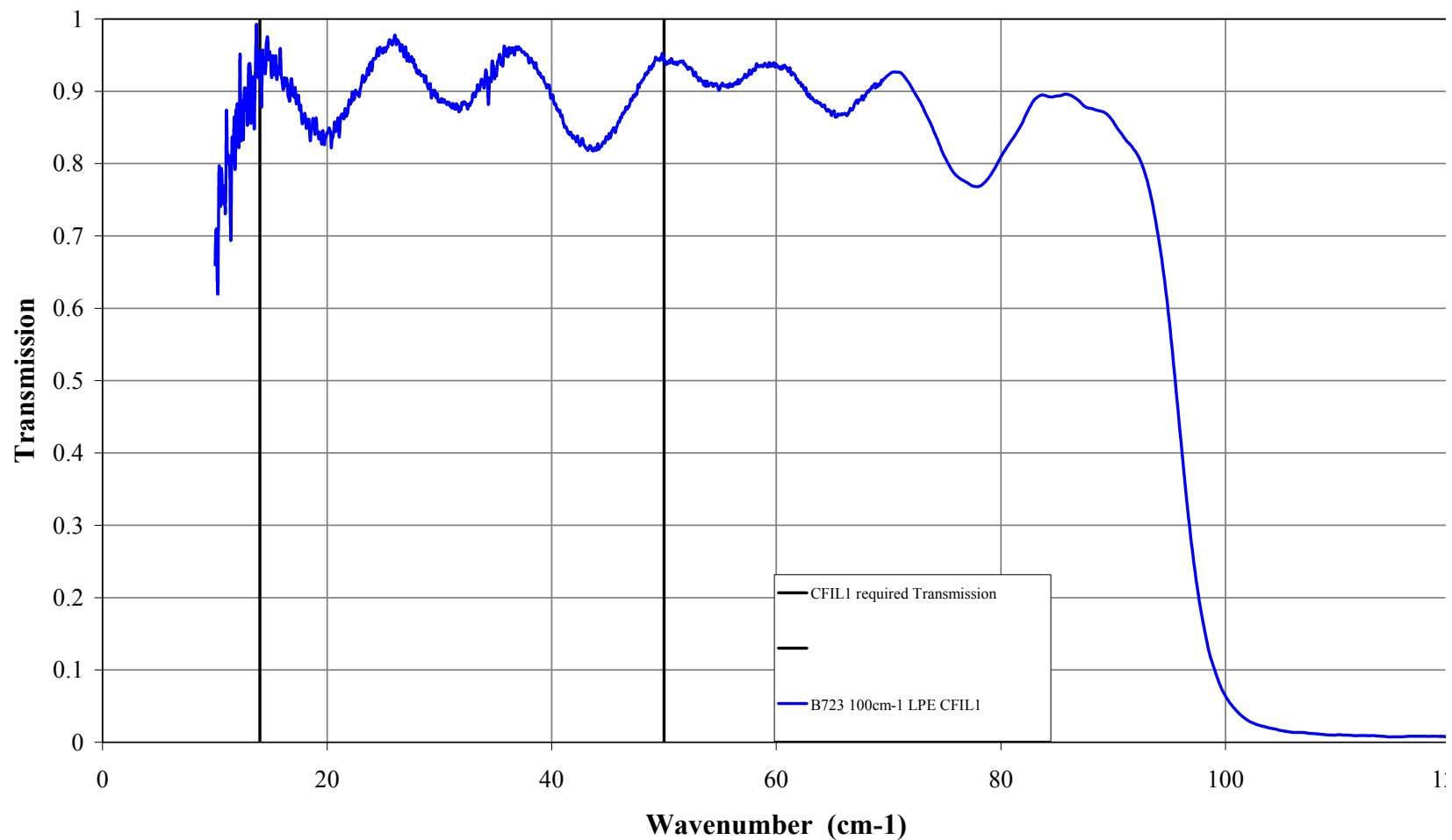


Figure 15 CFIL-1 PFM calibration curve - 0-120cm<sup>-1</sup>

# PFIL-2

## PFIL-2 PFM Calibration data

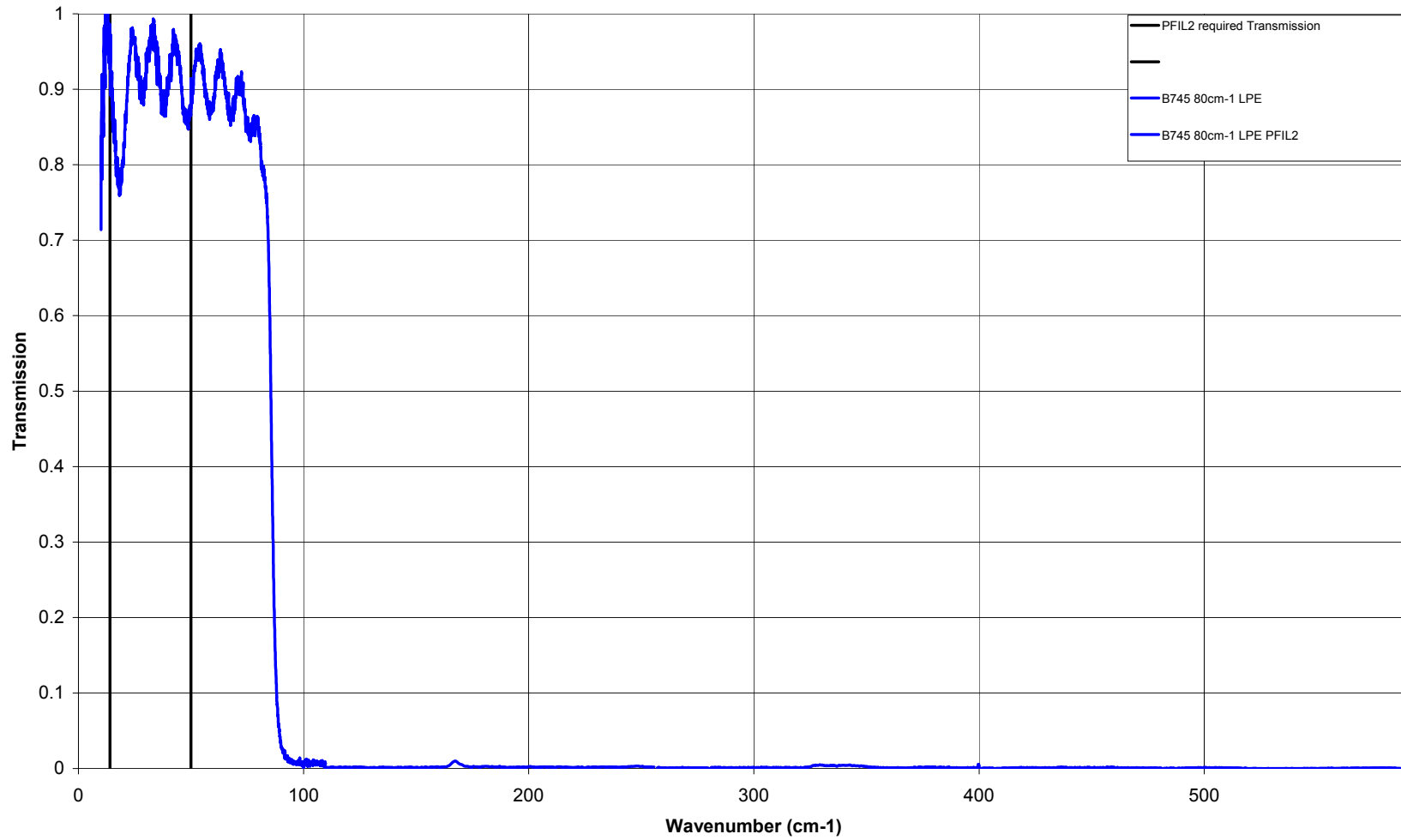


Figure 16 PFIL-2 PFM 0-600cm<sup>-1</sup>

### PFIL-2 PFM Calibration data

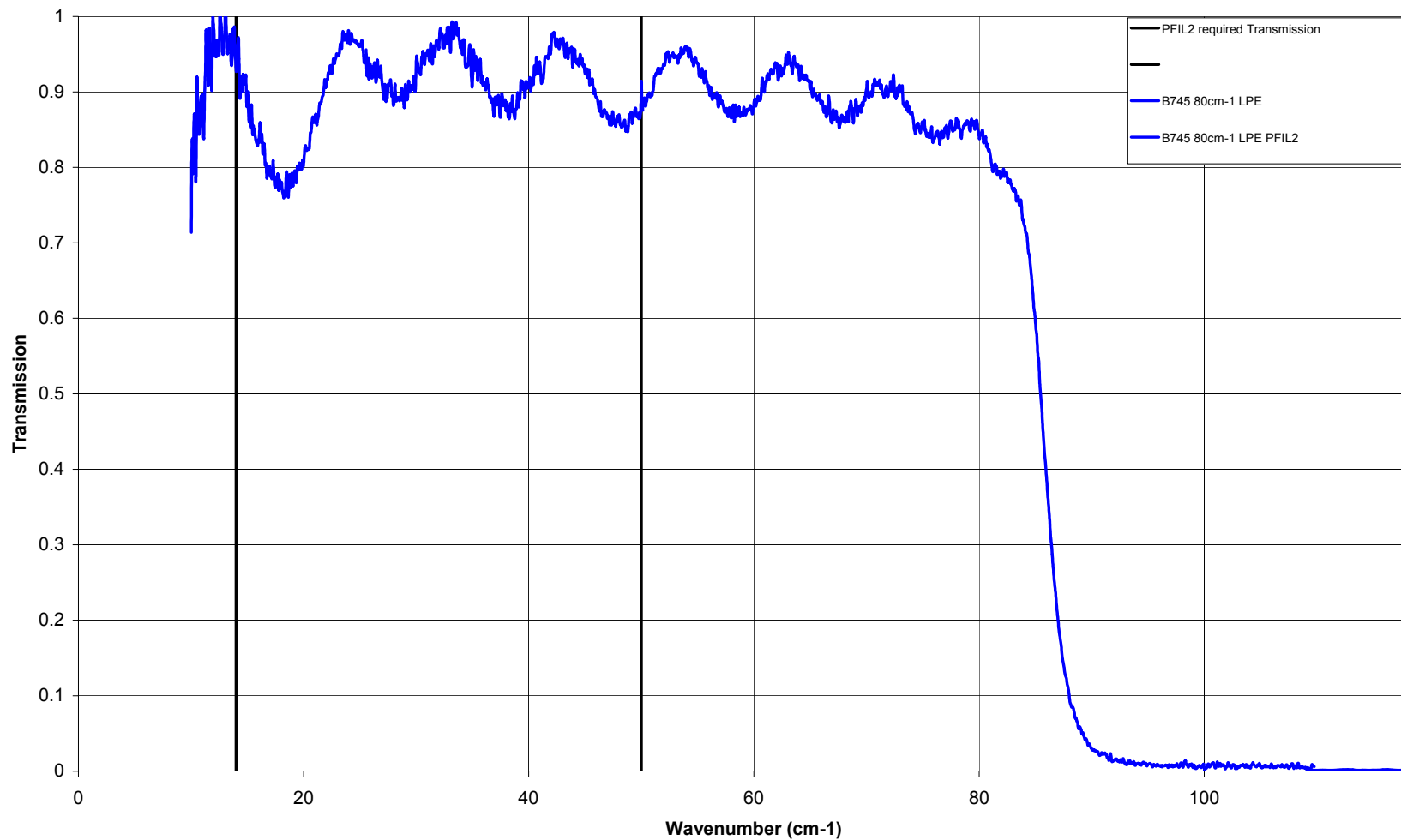
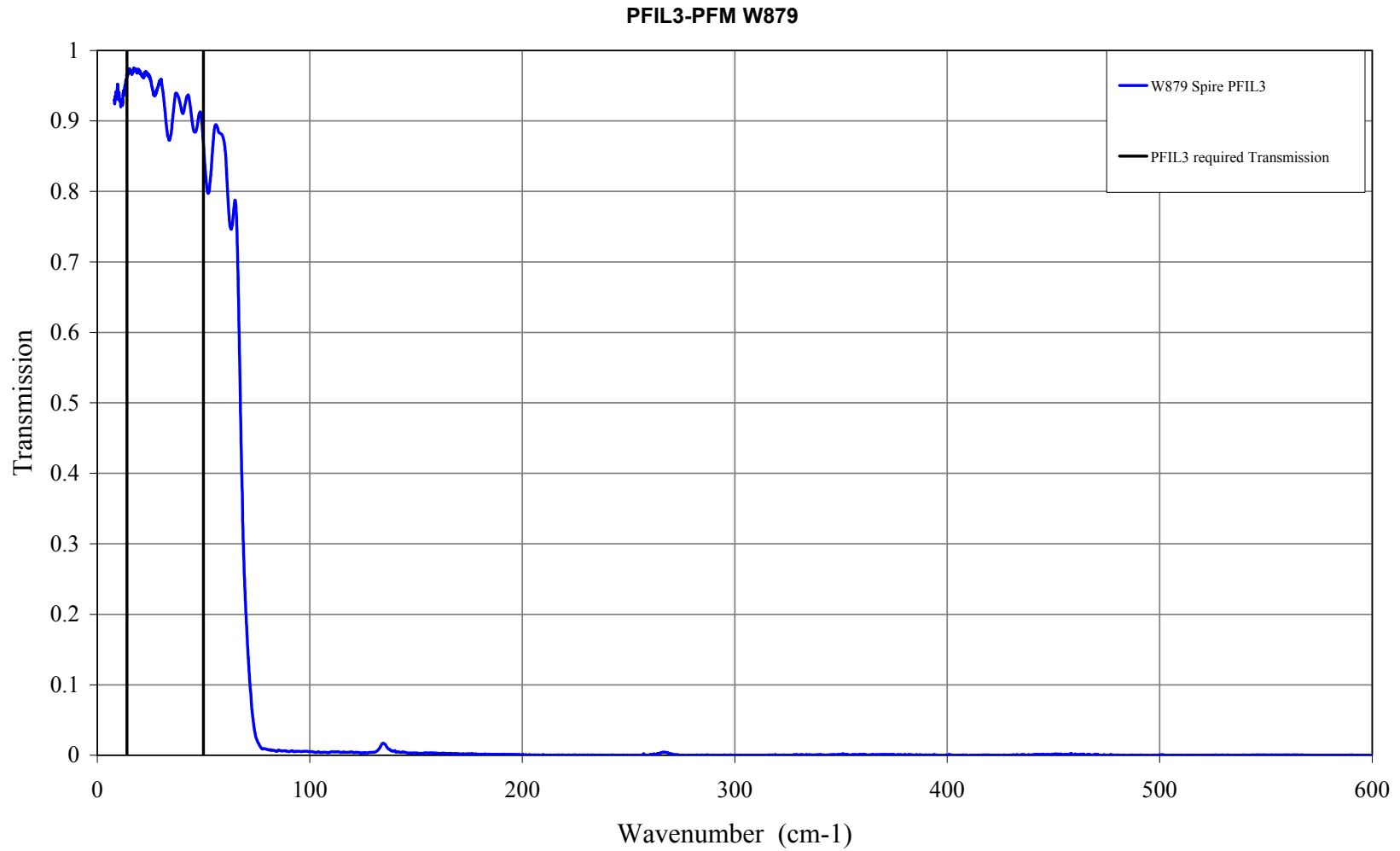


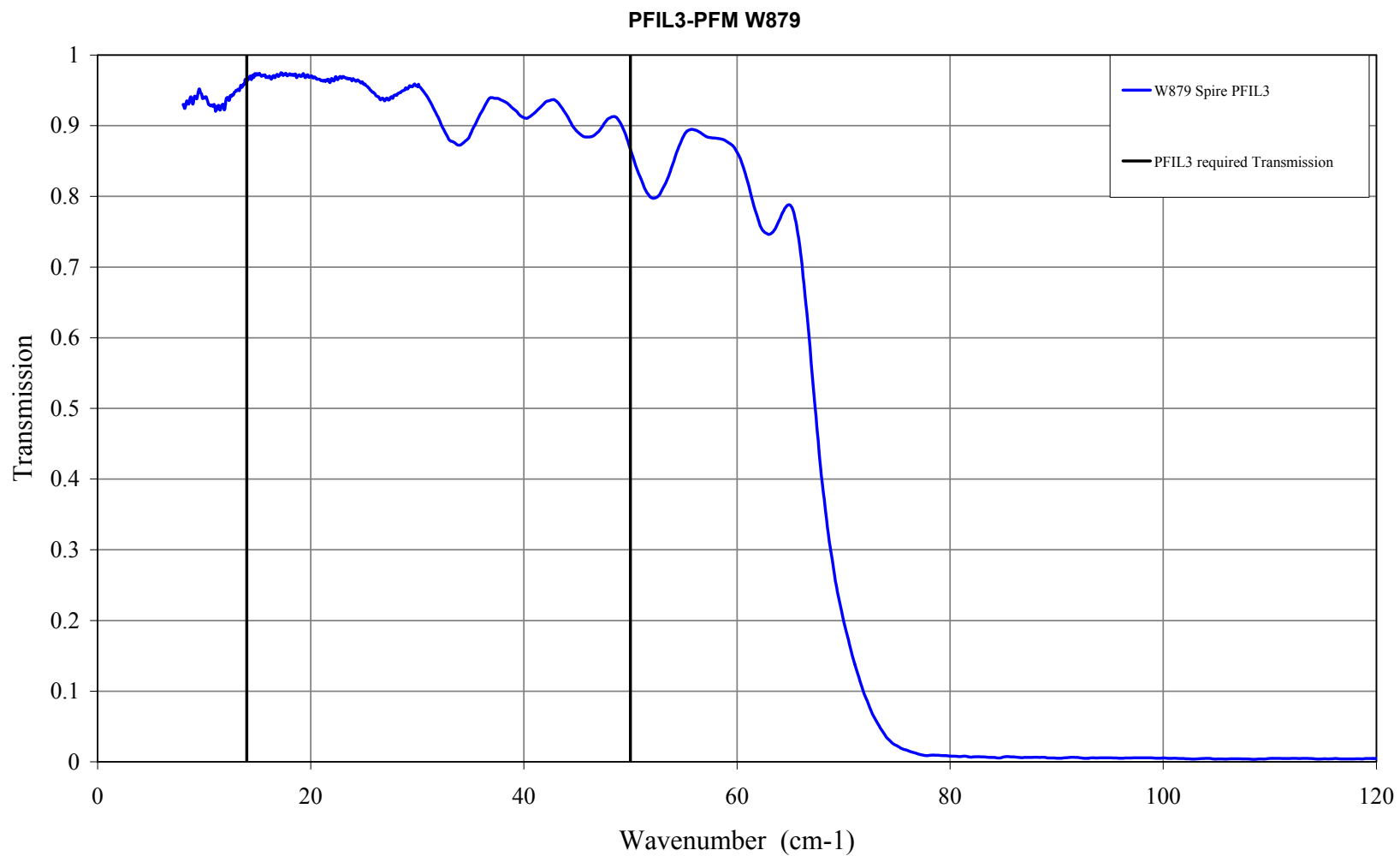
Figure 17 PFIL-2 PFM 0-120cm<sup>-1</sup>



# PFIL-3



**Figure 18 PFIL-3 PFM 0-600cm<sup>-1</sup>**



**Figure 19 PFIL-3 PFM 0-120cm<sup>-1</sup>**

# SFIL-2

## SFIL-2 PFM Calibration data

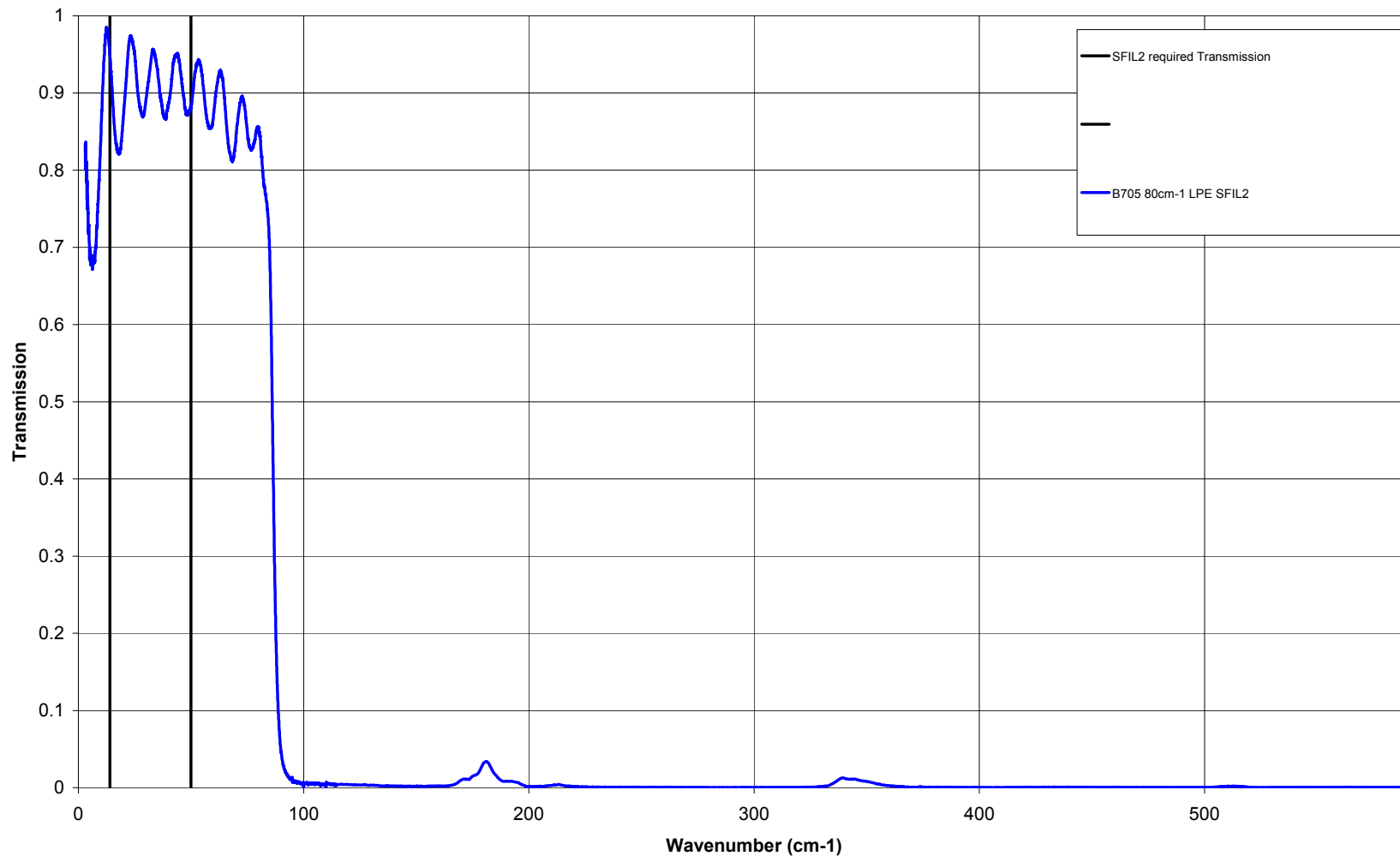


Figure 20 SFIL-2 PFM 0-600cm<sup>-1</sup>

SFIL-2 PFM Calibration data

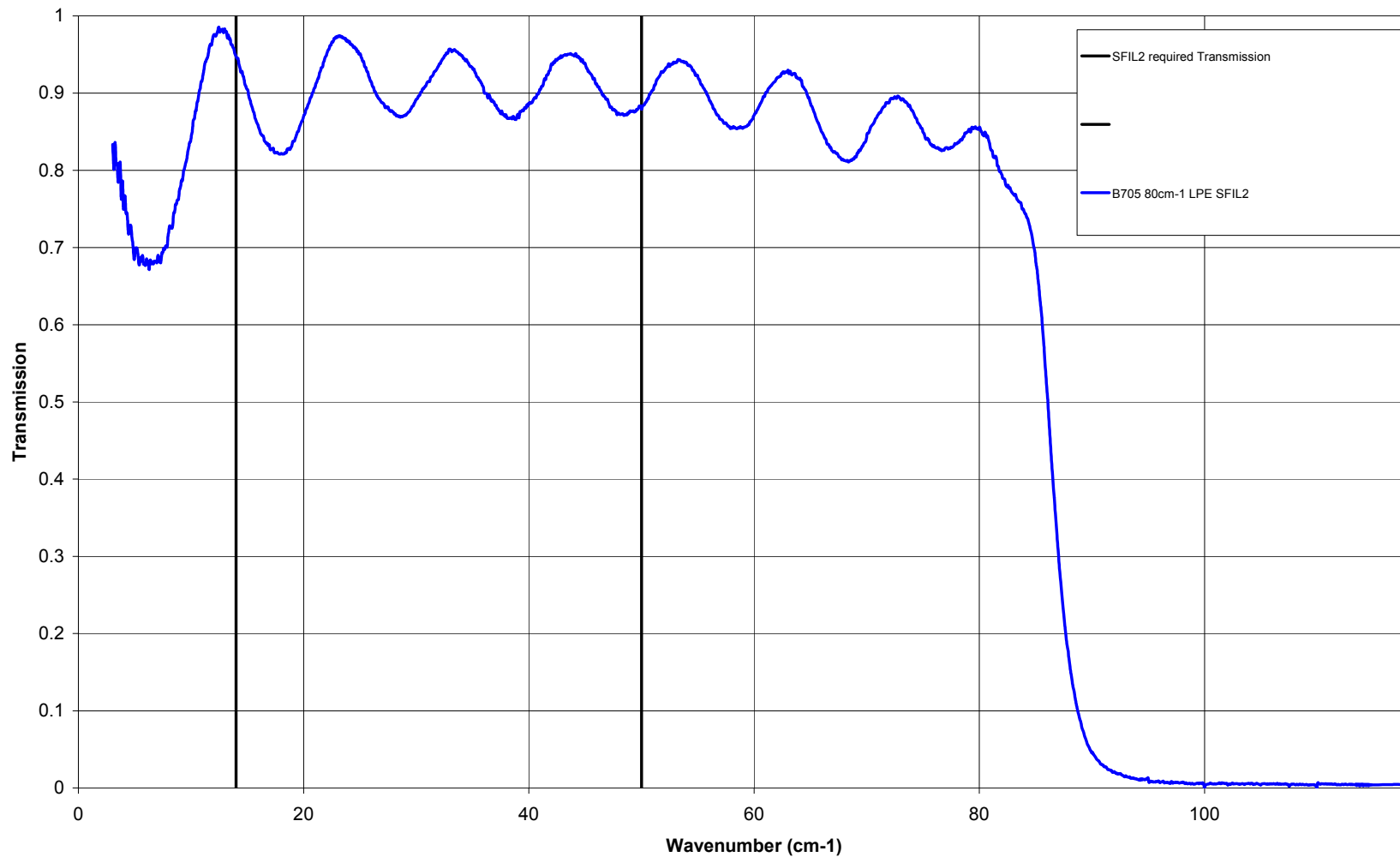


Figure 21 SFIL-2 PFM 0-120cm<sup>-1</sup>

# SFIL-3S

SFIL-3S PFM Calibration data

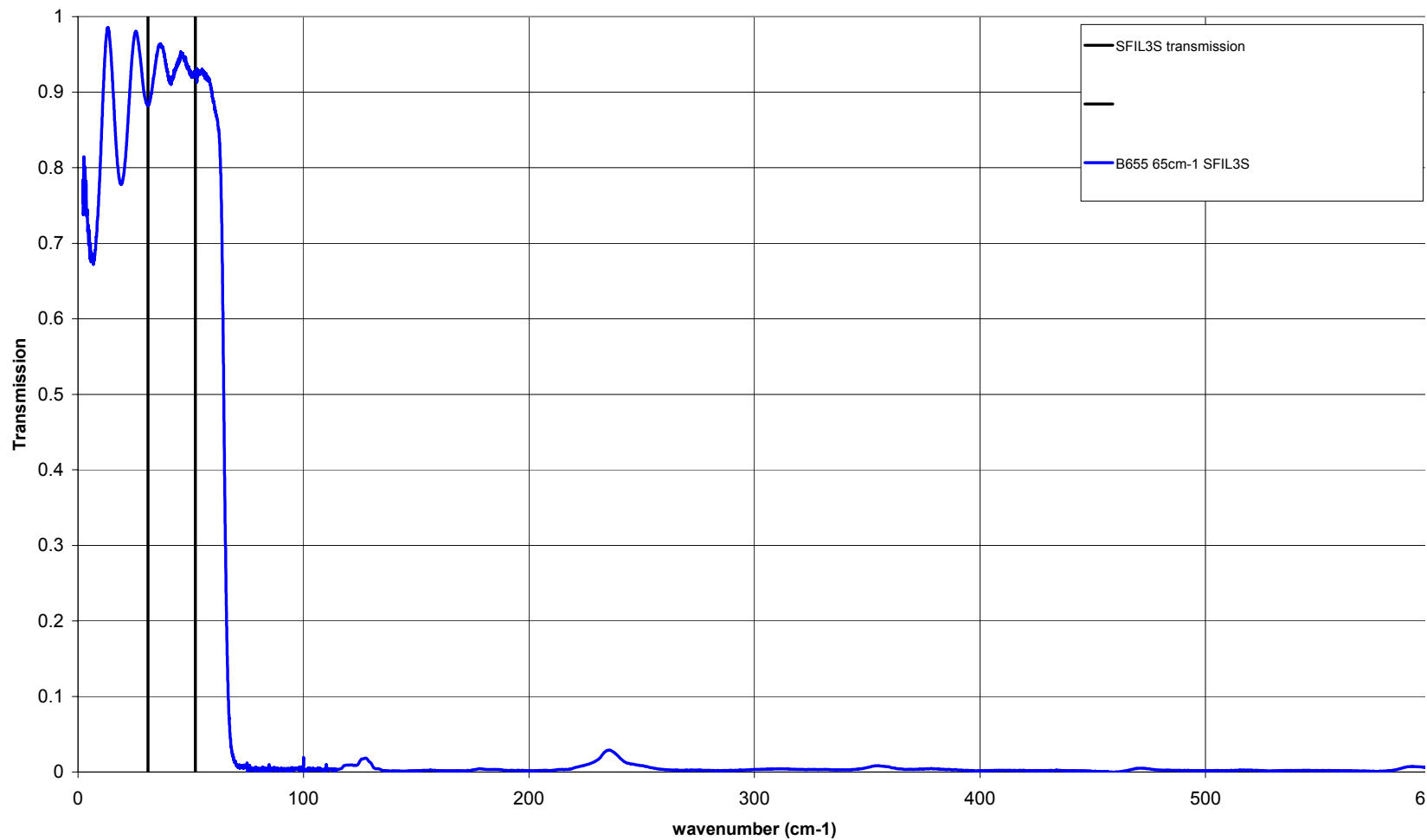


Figure 22 SFIL-3S PFM 0-600cm<sup>-1</sup>

SFIL-3S PFM Calibration data

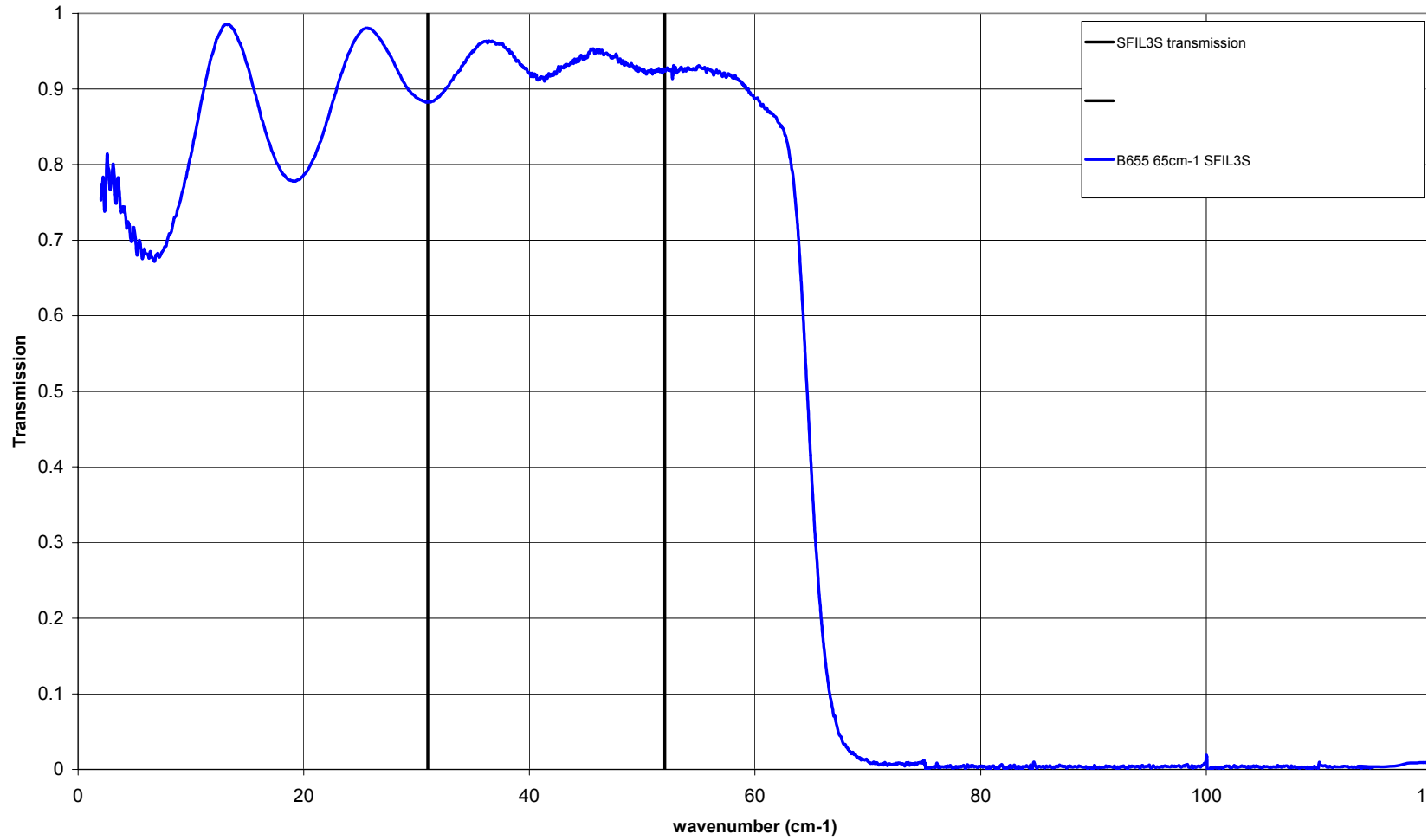


Figure 23 SFIL-3S PFM 0-120cm<sup>-1</sup>

# SFIL-3L

## SFIL-3L PFM Calibration Data

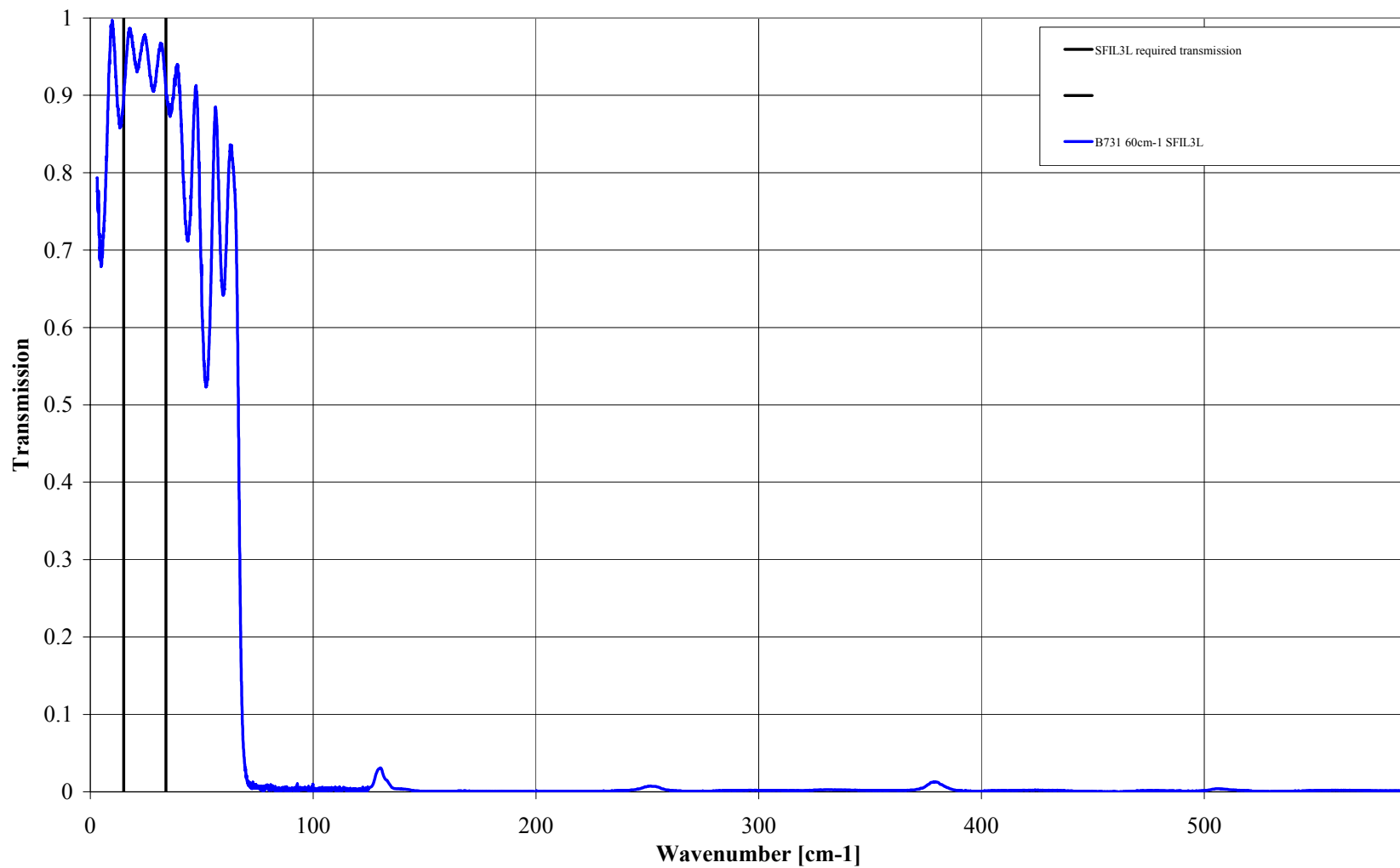


Figure 24 SFIL-3L PFM 0-600cm<sup>-1</sup>

### SFIL-3L PFM Calibration Data

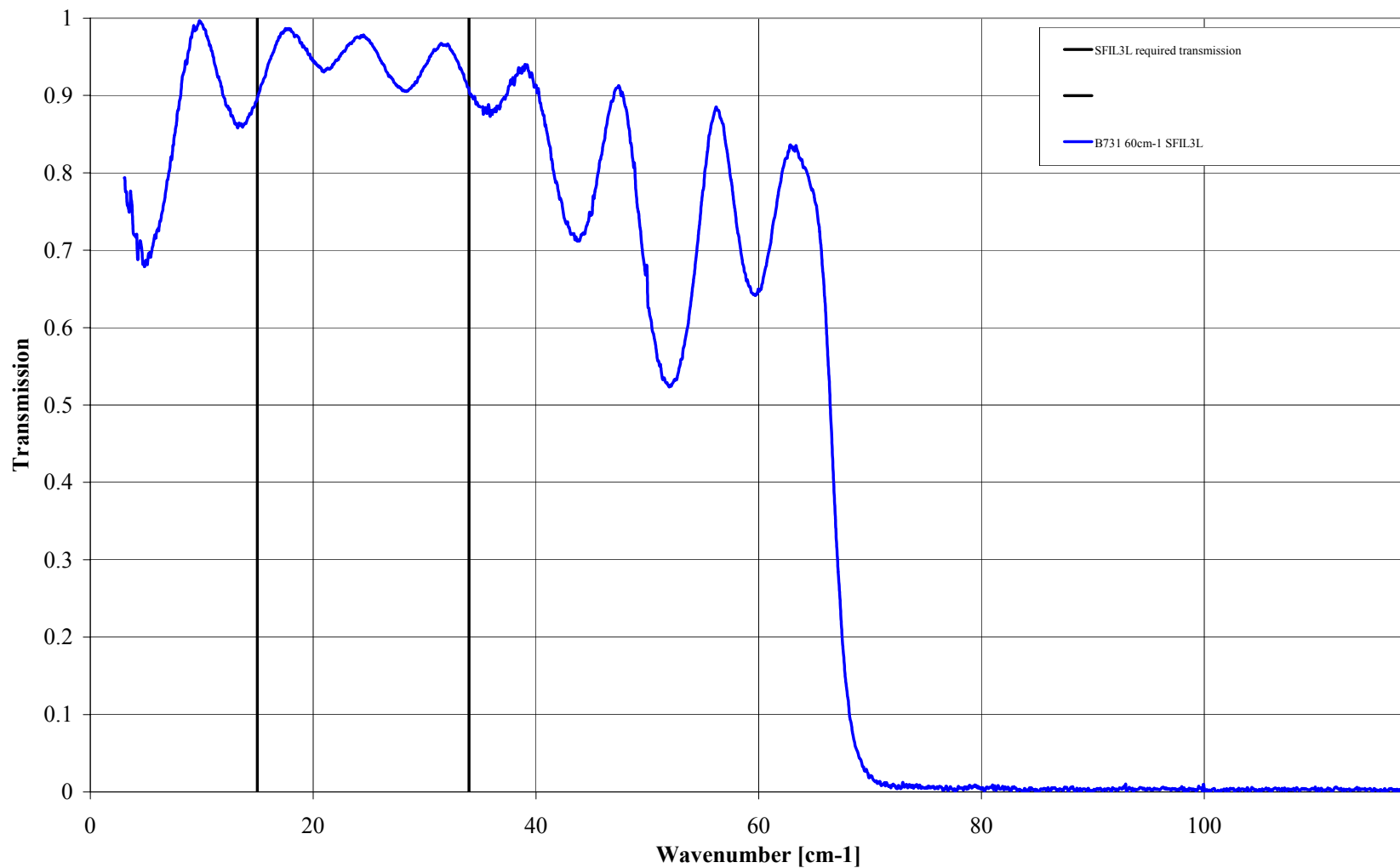


Figure 25 SFIL-3L PFM 0-120cm<sup>-1</sup>



# SECTION 21 - Temporary Installation Record

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

- MIR to UV Spectroscopic test to be performed on the UWC Bomem spectrometer, on an off-cut of the supplied filters. This work has been delayed pending the arrival of a new MIR beam divider for the Cardiff Bomem spectrometer. At this higher frequency range UWC believe that all filter components behave in much the same manner. Therefore a similarity test made on an off-cut of filters at a later date will yield acceptable spectral information for all filters.

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

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

## SECTION 25 - Test Reports

### *Spectroscopic tests*

A series of required physical tests and spectral tests have been specified in the verification matrix defined in the “SPIRE Filters – Subsystem Development Plan” document (reference HSO-CDF-PL-005).

The FIR spectral tests were carried out using a Martin-Puplett polarizing Fourier transform interferometer in the laboratory at UWC. This spectrometer is able to operate in transmission and 30° specular reflectance modes at 300K. It is also possible to perform transmission measurements at 77K. The results of tests are detailed in this section.

Out-of-band transmission measurements *will be* performed, on selected components, from 20μm to 0.5μm, using the UWC Bomem FT spectrometer. This work has been delayed awaiting the installation and commissioning from Bomem of a new beam-splitter.

Thermal shocking of hot-pressed filters (300K - 77K - 300K) is performed using a liquid nitrogen bath. This cycle is performed 3 times. A spectroscopic transmission measurement is made thereafter to verify no filter delamination or degradation.

Thermal cycling (300K - 1.5K - 300K) of component off-cuts is performed within the UWC type MD800 liquid helium bath cryostat such that spectroscopic measurements can simultaneously be made. This cycle is performed once at a vacuum pressure of 10<sup>-2</sup> mBar.

During the evacuating of the Martin-Puplett FTS, the filter component is subjected to a differential pressure rate of change of at least 10mB/sec.

Spectroscopic tests were carried out according to standard UWC FTS procedures.

The uniformity of each component was checked by spectral measurements over three or more points distributed about the area. In each case, the diameter of the FTS geometric beam was approximately 7mm.

Refer to section 14 (Historical record) for the test indices.

Tests results for each filter are shown in this section

## Filter CFIL1

All test data for CFIL1-PFM are stored in the following Microsoft Excel spreadsheet (configured file):-

\\Darkstar\Astroworld\Projects\Spire\Cardiff\_workpackages\Configured\_Documents\Issued\Data\SPIRE\_PFM\_CFIL1.xls

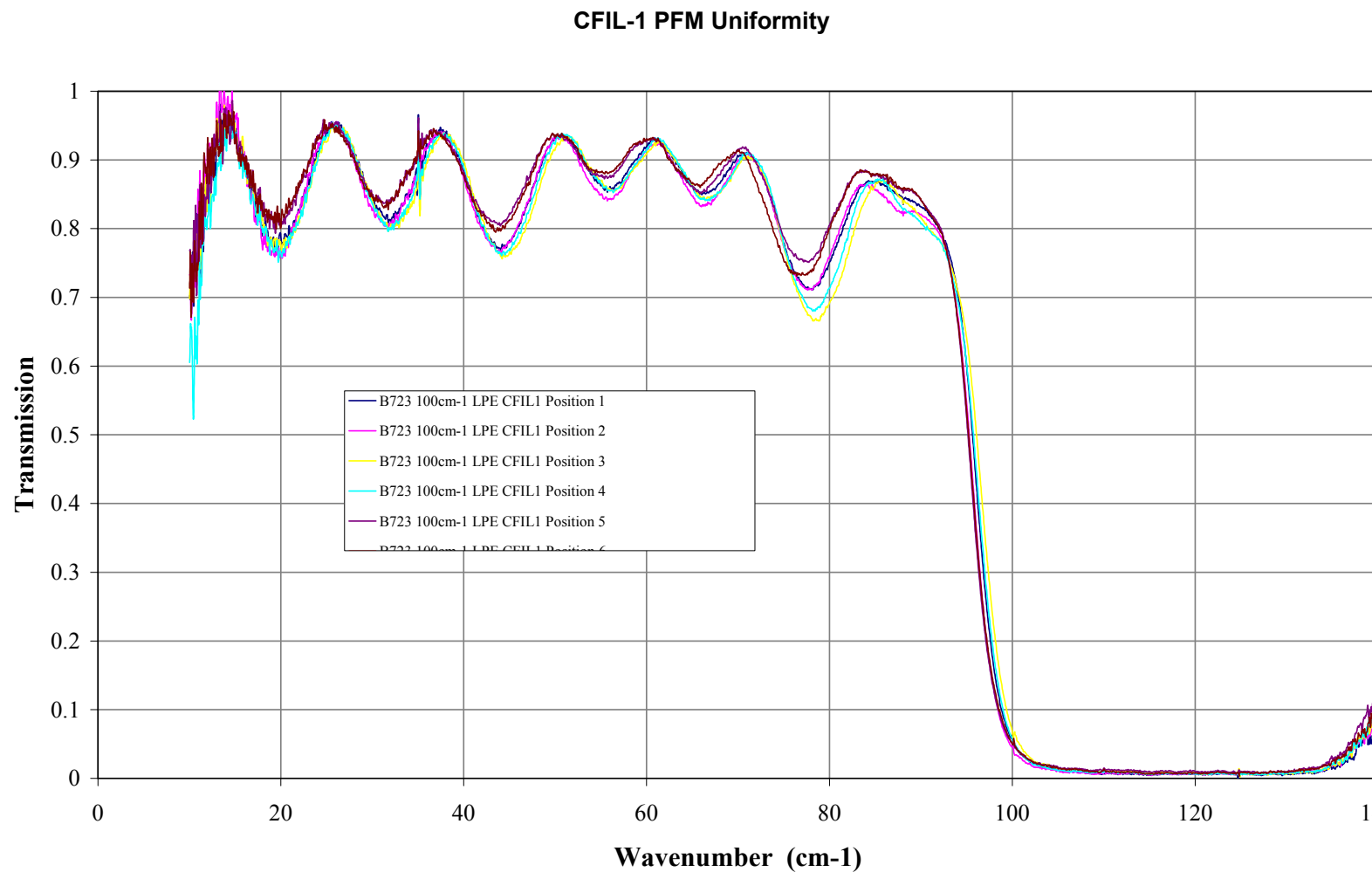
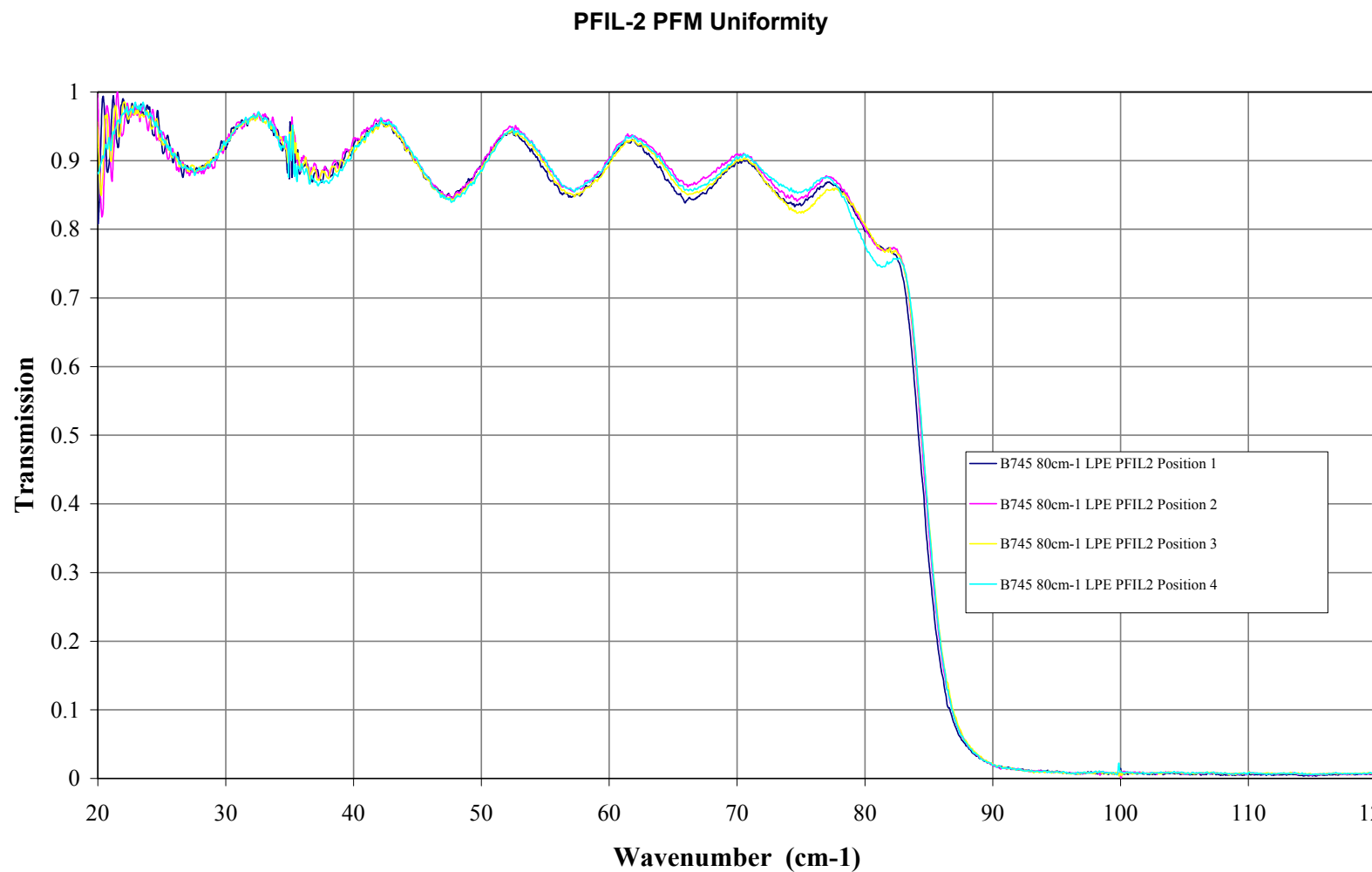


Figure 26 CFIL-1 Uniformity

## Filter PFIL2

All test data for PFIL2-PFM are stored in the following Microsoft Excel spreadsheet (configured file):-

\\Darkstar\Astroworld\Projects\Spire\Cardiff\_workpackages\Configured\_Documents\Issued\Data\SPIRE\_PFM\_PFIL2.xls

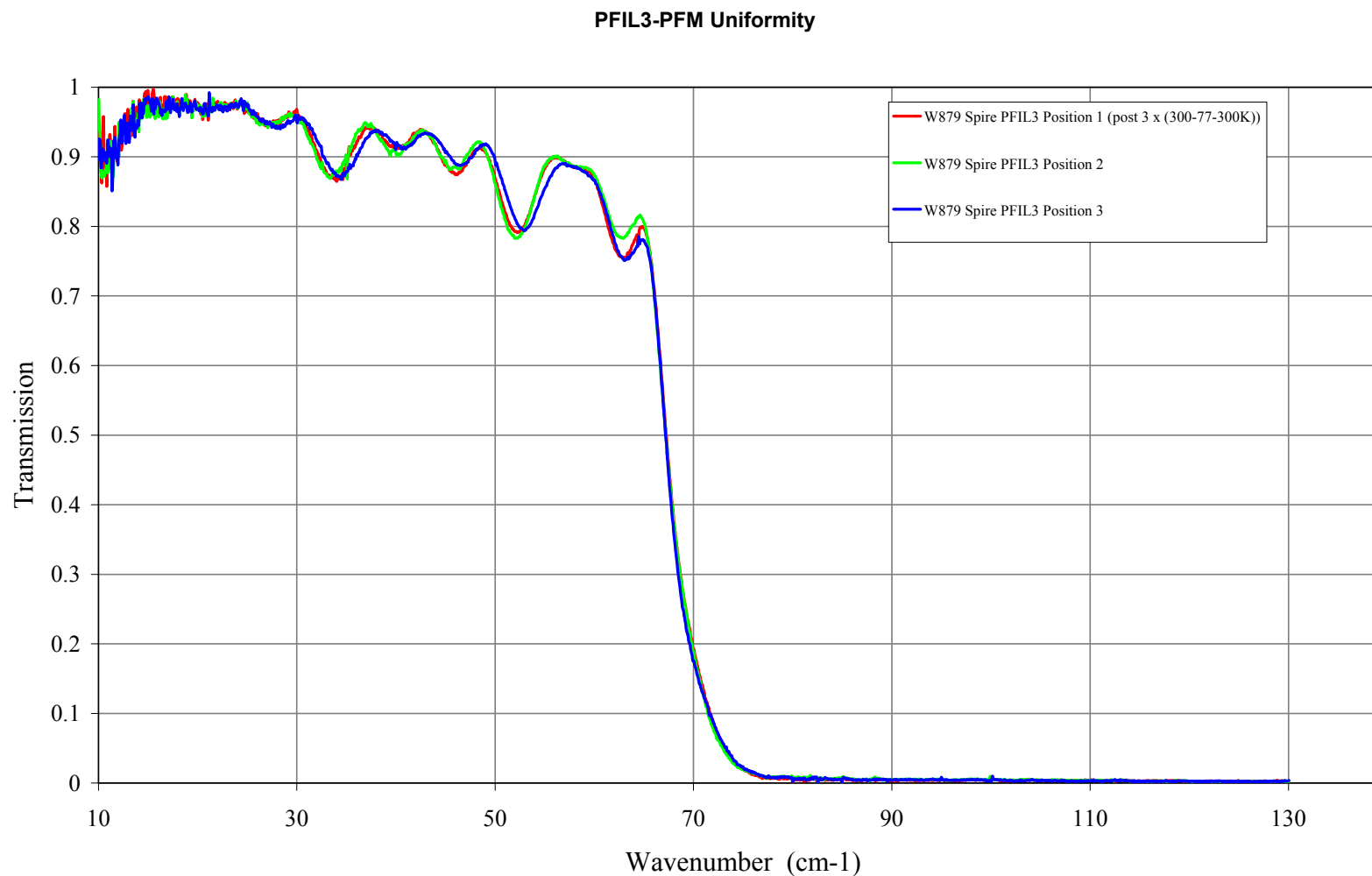


**Figure 27 PFIL-2 Uniformity**

## Filter PFIL3

All test data for PFIL3-PFM are stored in the following Microsoft Excel spreadsheet (configured file):-

\\Darkstar\Astroworld\Projects\Spire\Cardiff\_workpackages\Configured\_Documents\Issued\Data\SPIRE\_PFM\_PFIL3.xls



**Figure 28 PFIL-3 Uniformity**

## Filter SFIL2

All test data for SFIL2-PFM are stored in the following Microsoft Excel spreadsheet (configured file):-

\\Darkstar\Astroworld\Projects\Spire\Cardiff\_workpackages \Configured\_Documents\Issued\Data\SPIRE\_PFM\_SFIL2.xls

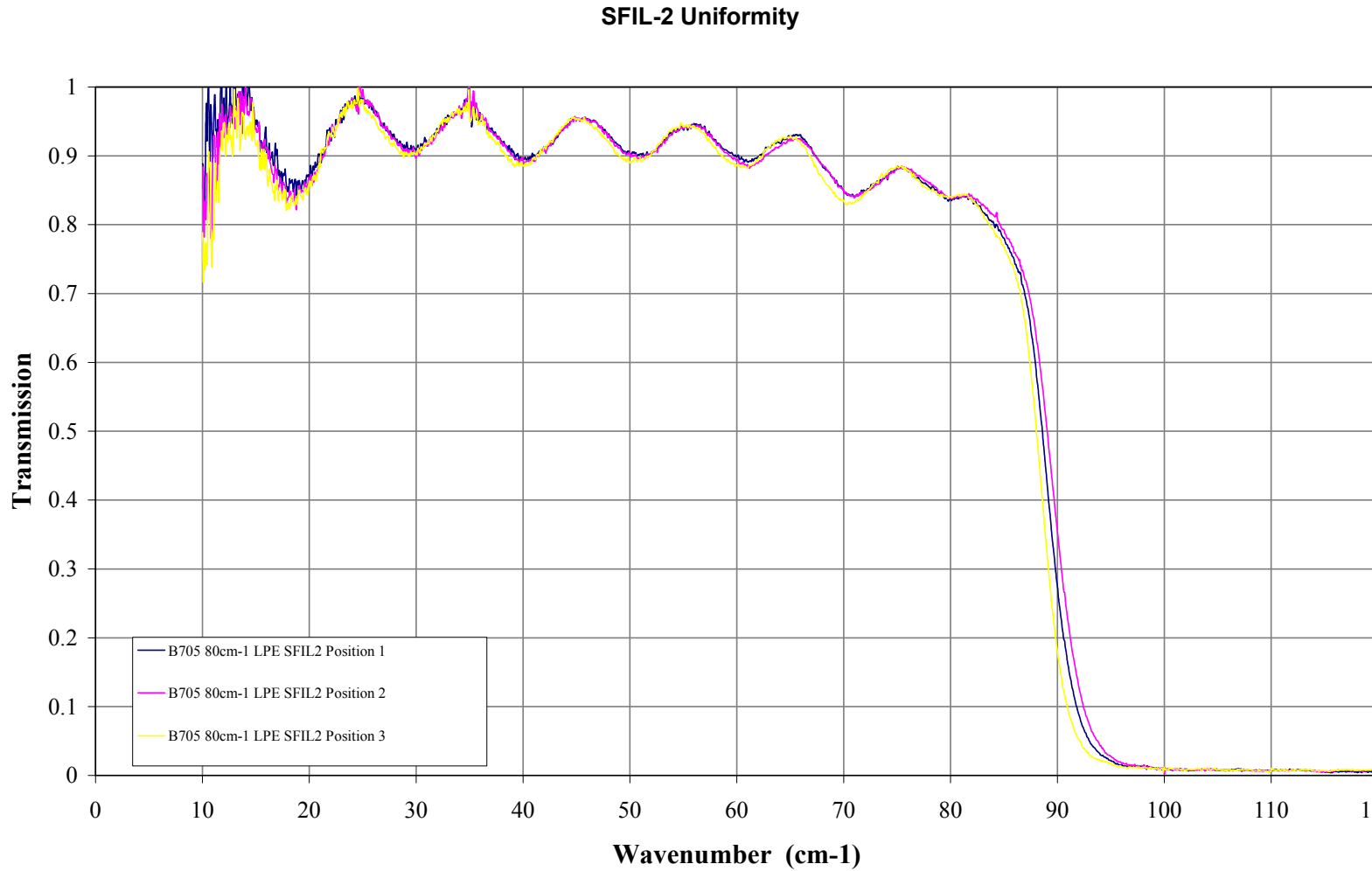


Figure 29 SFIL-2 Uniformity



## Filter SFIL3S

All test data for SFIL3S-PFM are stored in the following Microsoft Excel spreadsheet (configured file):-

\\Darkstar\Astroworld\Projects\Spire\Cardiff\_workpackages\Configured\_Documents\Issued\Data\SPIRE\_PFM\_SFIL3S.xls

SFIL-3S Uniformity

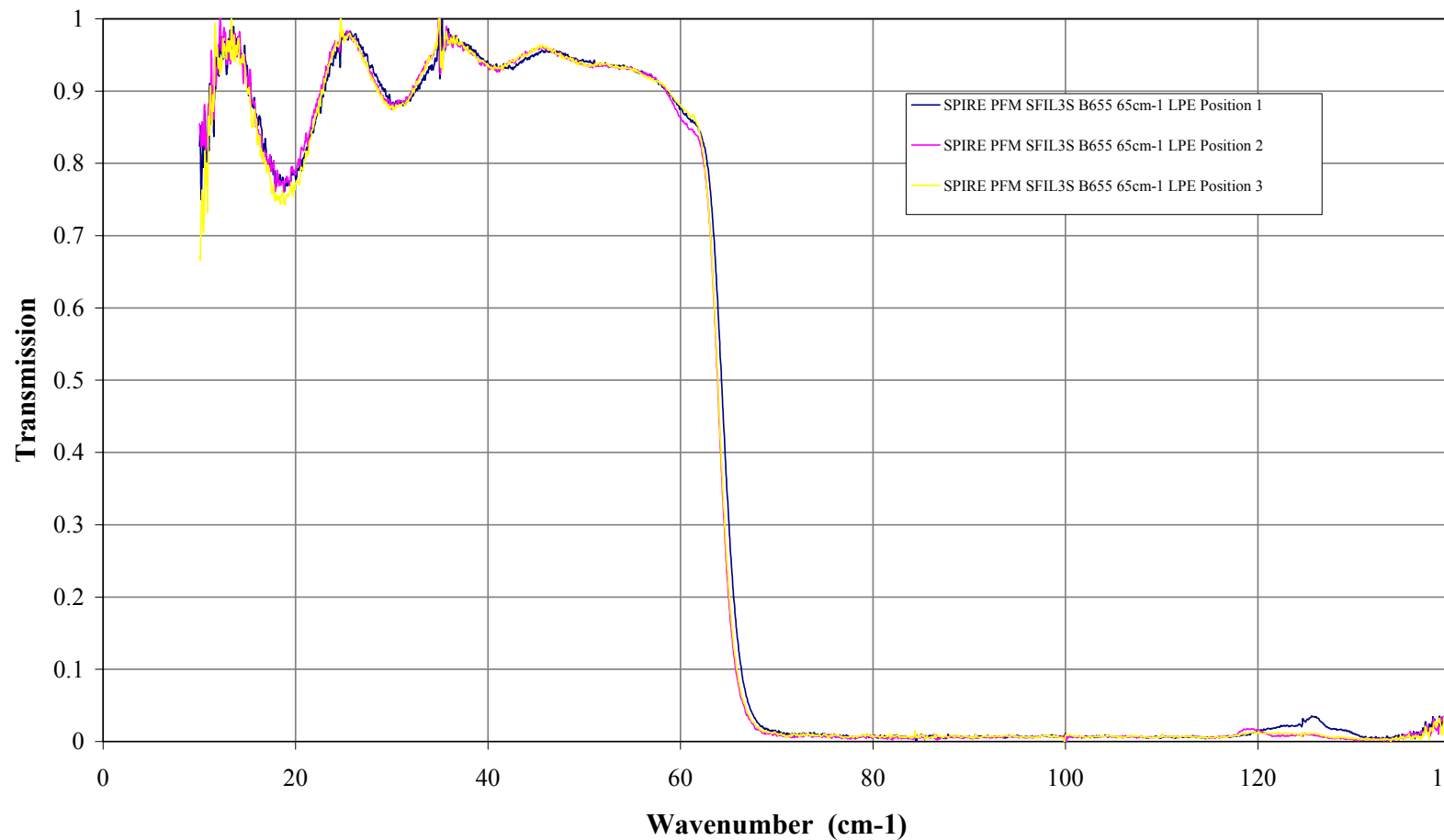


Figure 30 SFIL-3S Uniformity

## Filter SFIL3L

All test data for SFIL3L-PFM are stored in the following Microsoft Excel spreadsheet (configured file):-

\\Darkstar\Astroworld\Projects\Spire\Cardiff\_workpackages\Configured\_Documents\Issued\Data\SPIRE\_PFM\_SFIL3L.xls

SFIL-3L PFM Uniformity

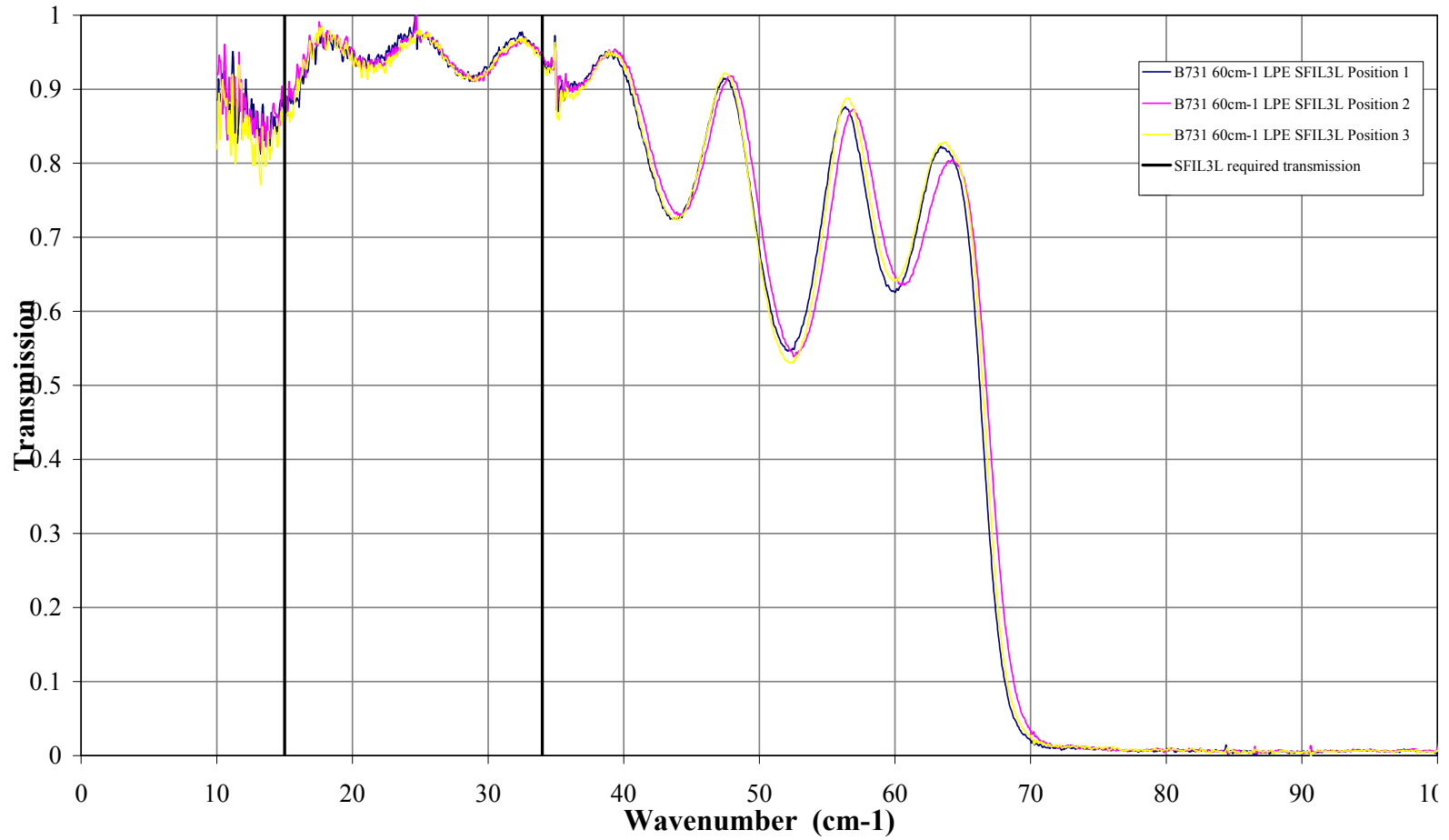


Figure 31 SFIL-3L Uniformity

### ***Radiation tests***

We make the following statement with respect to the requirement that these items show no appreciable degradation due to high energy radiation:

Filters were flown on the ISO space platform, which were structurally and materially identical to those supplied here. Although the specification regarding radiation resistance for ISO was slightly less stringent than for SPIRE, the filters were acceptable for inclusion in the flight instrument.

We do not have the facilities to test this aspect of the specification and therefore wish to declare acceptance on grounds of similarity with the ISO, and other space missions.

### ***Cold vibration qualification status***

Identical components were supplied for SPIRE-CQM testing. All filters have survived cold vibration testing at SPIRE system level.

# SECTION 27 – Reference List of EIDP’s

## 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

Component	Measured Mass (g)	Compliant?
CFIL-1 FILT-PFM-101	1.728	YES
PFIL-2 FILT-PFM-102	2.218	YES
PFIL-3 FILT-PFM-103	0.727	YES
SFIL-2 FILT-PFM-113	0.347	YES
SFIL-3S FILT-PFM-116	0.269	YES
SFIL-3L FILT-PFM-120	0.382	YES

## **SECTION 29 - Cleanliness Statement**

### ***Statement***

The SPIRE PFM instrument filters listed herein have been cleaned and assembled 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 .....Carole Tucker, Cardiff Filter Production Manager

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

Date ..... 2nd November 2004

### **Extra Information**

The manufacture of these filter elements took place within a class 1000 clean-room, following the procedures laid out in the UWC document, "UWC Filter Fabrication Procedures.doc". Although filter testing took place within a standard laboratory environment, the mounted filters were subsequently cleaned (using acetone and a de-ionised air-gun), in a class 100 laminar flow cabinet, prior to packaging.

H:\Cardiff_workpackages\Deliverables\Shipped\Filters\PFM-instrument-filters\EIDP\PFM-filters-HSO-CDF-EIDP-059-1-0.doc	SPIRE Instrument PFM Filters End Item Data Package (EIDP)	Page 62 of 66
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## SECTION 30 - Other Useful Information







# 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>