SPIRE Instrument - Beam dividers - PFM

End Item Data Package (EIDP)
SPIRE Instrument - Beam dividers - PFM

SPIRE Ref.: SPIRE-UCF-
Cardiff Ref.: HSO-CDF-EIDP-060 Issue 1.0
11 August 2004

Prepared by: Peter Hargrave
Cardiff SPIRE Technical Manager

Signature Not Verified

Digitally signed by Peter Hargrave
DN: cn=Peter Hargrave, o=Cardiff University, ou=Astrophysics Instrumentation, c=GB
Date: 2004.08.11 15:26:22 +0100'

Approved by: Ian Walker
Cardiff AIG Programme Manager

Distribution list

RAL	Eric Sawyer		
	Eric Clark		
	Judy Long		
	Bruce Swinyard		
	Doug Griffin		
Cardiff	Peter Ade		
	Matt Griffin		
	Ian Walker		
	Carole Tucker		

Astronomy Instrumentation Group,
Department of Physics & Astronomy,
University of Wales, Cardiff,
5 The Parade,
Cardiff
CF24 3YB
+44 (0)2920 876682

H:\Cardiff_workpackages\Deliverables\Shipped\Filters\PFM-Beam-Dividers\EIDP\SBS1-2_PFM_HSO-CDF-EIDP-060.doc

Change Record

Issue	Section	Date	Changes
1.0		11/08/04	First issue – for DRB approval

Table of contents

SECTION 01 - Shipping Documents

SECTION 02 - Transportation, Packing, Handling & Integration Procedures

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

Handling

- Inspection may be carried out in class-100 clean air cabinet.
- Handle beam dividers only by edges.
- 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.

Storage

- The beam divider assemblies must be stored in the transport container provided.

Integration

- The beam dividers each consist of two grids, separated by a dielectric layer. There is a capacitative grid pattern on one side, with an inductive grid pattern on the other. The inductive side may be identified as illustrated in Figure 1
- It is ***ESSENTIAL*** that the beam dividers are mounted such that the grids are in opposition, as shown in Figure 1 and Figure 2.
- The beam dividers should be installed by trained MSSL, RAL or Cardiff technicians, according to the MSSL integration procedure – SPIRE Structure integration & Handling - MSSL/SPIRE/SP011.04

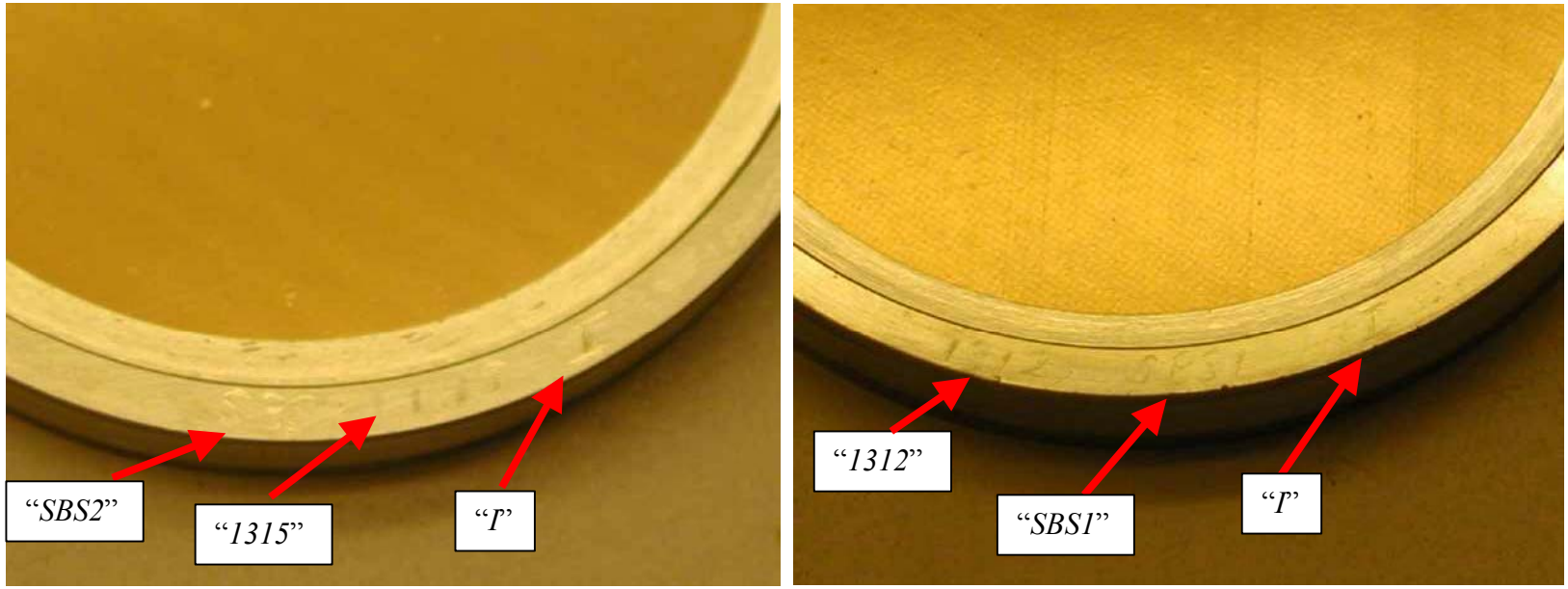


Figure 1 Identifying marks on beam divider rings (found on "I" side only). The inductive grid side is shown above, indicated by an "*I*" mark.

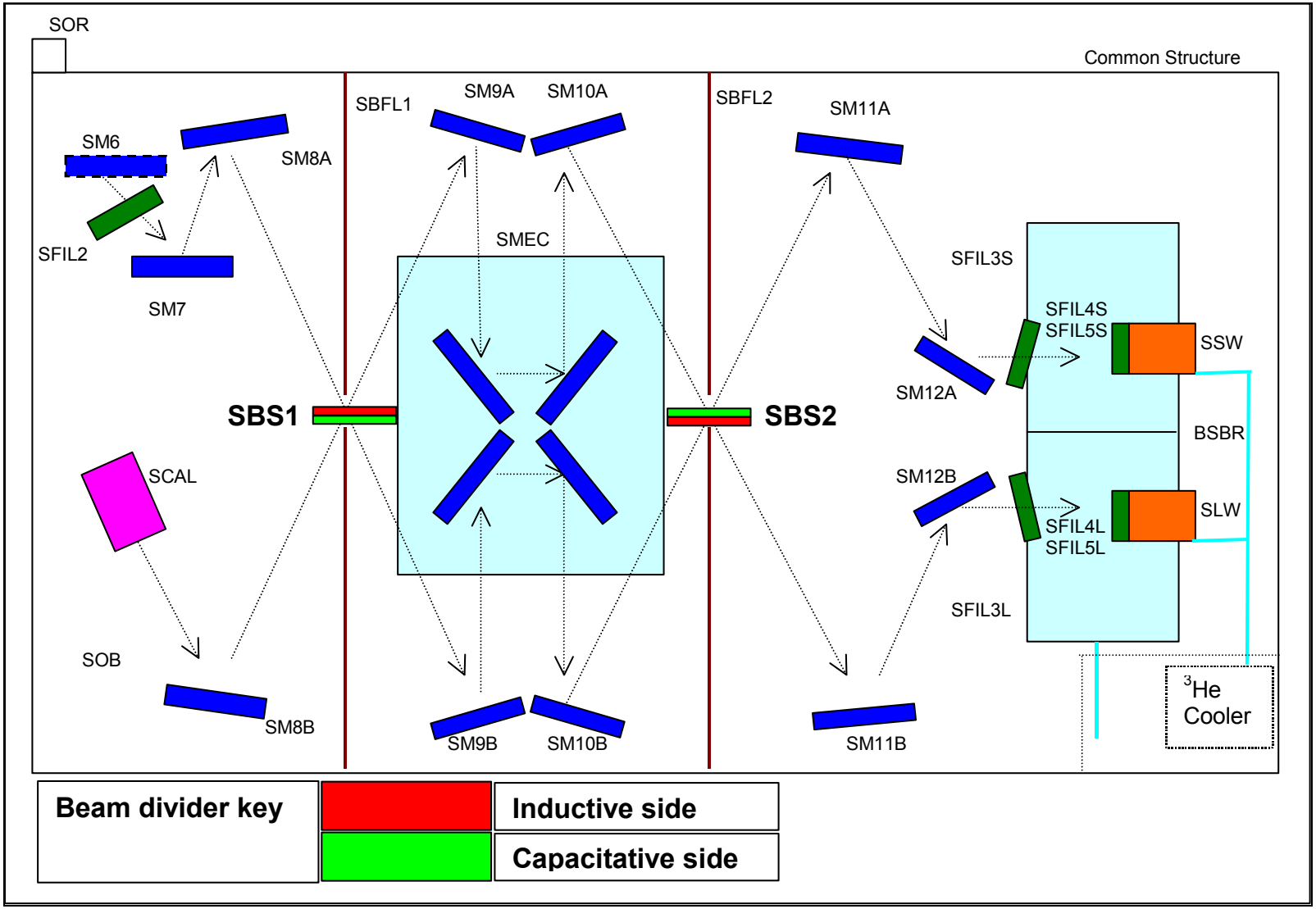


Figure 2 Beam divider mounting guide. These components MUST be mounted with the inductive and capacitative grids in opposition, as indicated.

SECTION 03 - Certificate of Conformance

Cardiff University Astronomy Instrumentation Group hereby certifies that the following equipment,	
Spacecraft / Project:	**Herschel**
Instrument:	**SPIRE**
Model:	**PFM**
Subsystem:	**Beam Dividers – SBS1, SBS2**
Serial No:	**FILT-PFM-410, FILT-PFM-420**
As described in this End Item Data Package: **HSO-CDF-EIDP-060**	
Complies with the requirements set out in: **SPIRE-RAL-PRJ-000034 – SPIRE Instrument Requirements Document** **HSO-CDF-SP-002 V.2.2 - SPIRE Filters Subsystem Specification Document** **HSO-CDF-ICD-012 issue 3.0 - SPIRE filters ICD**	

Responsible Authority		***Signature***
Cardiff Product Assurance	Dr I.Walker	
Cardiff SPIRE Management	Dr P.Hargrave	Signature Not Verified Digitally signed by Peter Hargrave DN: cn=Peter Hargrave, o=Cardiff University, ou=Astrophysics Instrumentation, c=GB Date: 2004.08.11 15:25:55 +01'00'
Cardiff Filter Management	Dr C. Tucker	

SECTION 04 - Qualification Status List / Compliance Matrix

Test	Status	Applicable document / Test reference	Test Institute
Dimension and tolerances to specification	Compliant	Filters ICD – HSO-CDF-ICD-012 issue 3.0	UWC
Visual inspection (internal & external)	Passed	Lab book	UWC
Mass	Compliant	Filters specification document HSO-CDF-SP-002 issue 2.2 Filters ICD – HSO-CDF-ICD-012 issue 3.0	UWC
Thermal / vacuum cycles	Passed	Section 14 – Historical record Section 25 – Test reports	UWC
Power consumption	N/A		
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 $3x10^{-1}$mBar	Passed	Section 14 – Historical record Section 25 – Test reports	UWC
Differential pressure (a pumping-out rate of 10mB/sec)	Compliant	Section 14 – Historical record Section 25 – Test reports	UWC
Pre-bake out (not exceeding 80˚C)	Completed	Section 14 – Historical record Section 25 – Test reports	UWC
Outgassing	Compliant	By design – not tested.	
Cleanliness checks, by visual inspection.	Passed	Section 14 – Historical record Section 25 – Test reports	UWC
Degradation due to high energy radiation.	Compliant	By design – not tested	

Compliance with IRD and beam divider specifications

Reference documents:-
SPIRE Filters Subsystem Specification Document, HSO-CDF-SP-002 V.2.2
SPIRE Instrument Requirements Document – SPIRE-RAL-PRJ-000034 issue 1.2
SPIRE filters ICD – HSO-CDF-ICD-012 issue 3.0

Requirement ID	Description	Value	Compliant?
IRD-OPTS-R05	Theoretical throughput	The theoretical throughput of the spectrometer mirrors; filters; beam splitters and baffles shall be greater than 0.2 (TBC) over the total instrument waveband (TBC) including all losses due to manufacturing defects, surface finish and alignment tolerances.	This is a requirement on the spectrometer optical system as a whole. Analysis shows that the performance of the beam dividers, together with the other filter components (Ref. HSO-CDF-EIDP-059) is compatible with this requirement.
IRD-OPTS-R07	Balancing of ports	In order that the two output ports shall have the same performance and to facilitate accurate compensation of the zero path difference maximum, the beam splitters shall have 2RT equal to R^2+T^2 to within 90% (TBC) over the waveband of the instrument.	Yes. See section 25.2.3
	Mass	< 32g	Yes

SECTION 05 - Top Level Drawings

TOP LEVEL DRAWING LIST

Drawing No.	Title
SPIRE-FILT-114 issue B	Beam Splitter Assembly (SBS1, SBS2)

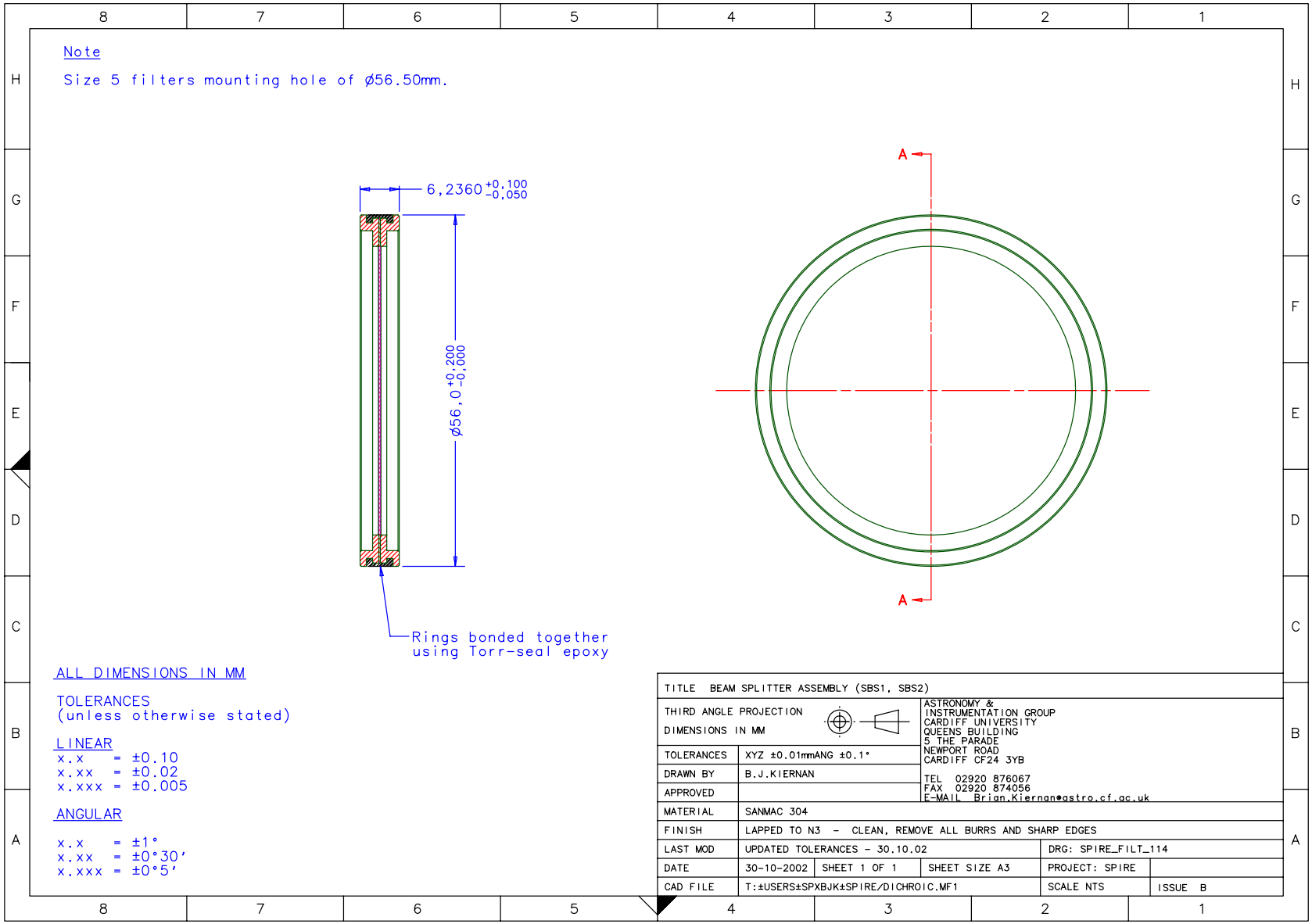


Figure 3 Beam divider assembly

SECTION 06 - Interface Drawings

INTERFACE DRAWING LIST

Drawing No.	Title	Notes
SPIRE-FILT-114 issue B	Beam Splitter Assembly (SBS1, SBS2)	See Figure 3

SECTION 07 - Functional, Block & Mechanical Drawings

FUNCTIONAL & BLOCK DRAWING LIST

Drawing No.	Title

MECHANICAL COMPONENT DRAWING LIST

Drawing No.	Title	Notes
Filt34-6	Filter Ring Size 5	Standard part. See Figure 4.

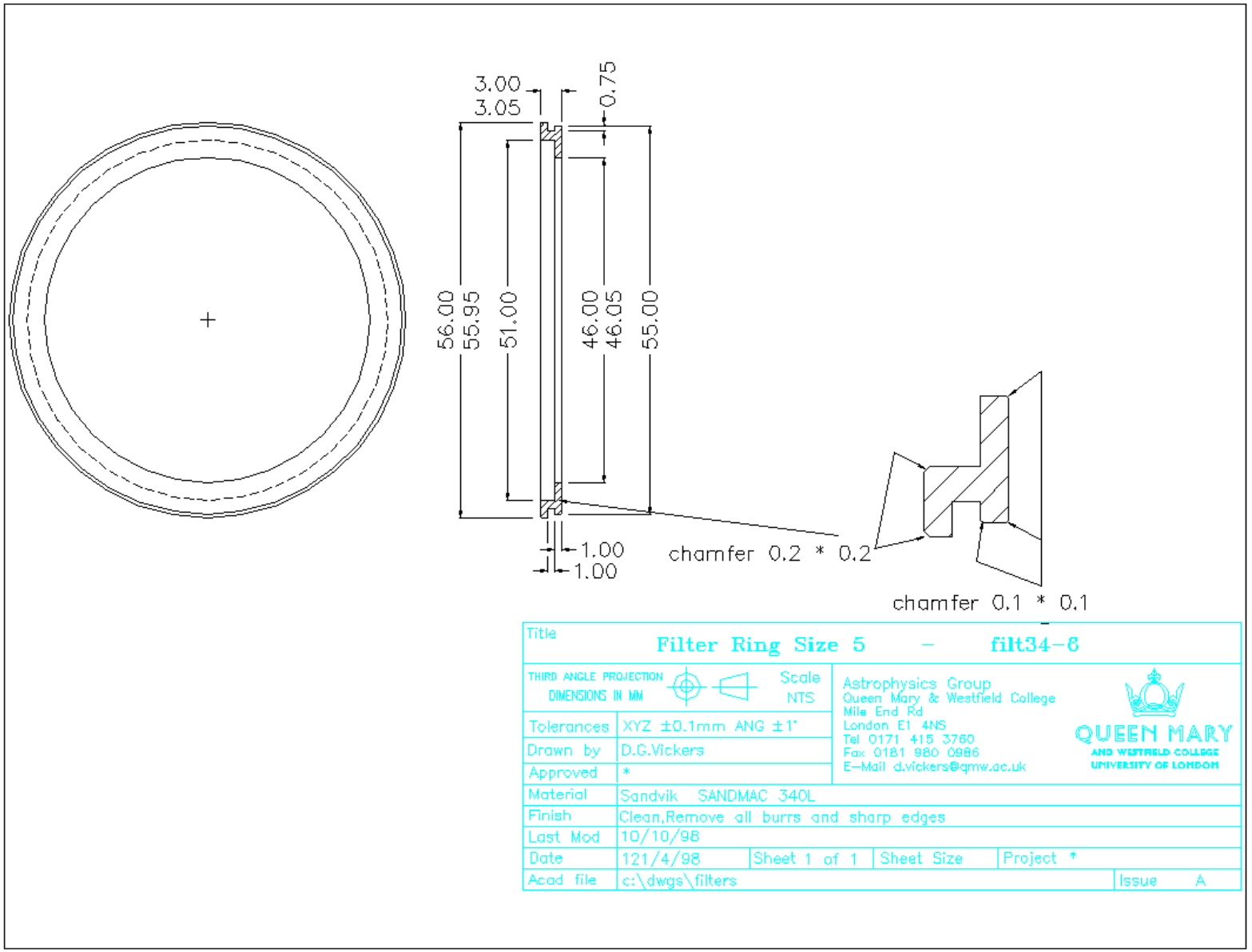


Figure 4 – Size 5 filter ring component drawing (two per assembly)

SECTION 08 – Electrical Circuit Diagrams

N/A

SECTION 09 - As Built Configuration Items Status List

Item	Location	Notes
Filter drawings and manufacturing files	\\Darkstar\Astroworld\Projects\Spire\Cardiff_workpackages\Deliverables\Shipped\Filters\PFM-Beam-Dividers\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-410 Spectroscopic test data SBS1 PFM assembly	\\Darkstar\Astroworld\Projects\Spire\Cardiff_workpackages\Deliverables\Shipped\Filters\PFM-Beam-Dividers\Data	
FILT-PFM-420 Spectroscopic test data SBS2 PFM assembly	\\Darkstar\Astroworld\Projects\Spire\Cardiff_workpackages\Deliverables\Shipped\Filters\PFM-Beam-Dividers\Data	

Component details

Part number	Description	Details
FILT-PFM-411	SBS1 rings	Sanmac 304L – Supplied by TW metals LTD. Certification # A/02-950954. Manufactured by Thomas Keating LTD, December 2002.
FILT-PFM-413	SBS1 grids – filter W871	Manufactured in-house
FILT-PFM-421	SBS2 rings	Sanmac 304L – Supplied by TW metals LTD. Certification # A/02-950954. Manufactured by Thomas Keating LTD, December 2002.
FILT-PFM-423	SBS2 grids – filter W874	Manufactured in-house
	Torr-seal epoxy	Supplied by Varian Vacuum Technologies Sales order # 318929542

Suppliers & manufacturers:-

TW metals LTD	Thomas Keating	Varian Vacuum Technologies
Majestic Road, Nursling Estate, Nursling, Southampton, Hampshire, UK. SO16 OAF (023) 8073 9333	Station Mills, Billingshurst, West Sussex, RH14 9SH	Varian S.p.A Via F.lli Varian, 54 10040 Leini (Torino) Italy www.varianinc.com

Data file details

Component	File name	Data manipulation	Description	Data range, resolution (cm-1)
SBS1	S2684rj.txt	Raw transformed data.	SBS1 warm transmission.	10-140, variable
SBS1	S2694r4.txt	Raw transformed data.	SBS1 warm reflection. Inductive grid side.	10-140, variable
SBS1	S2694r7.txt	Raw transformed data.	SBS1 warm reflection. Capacitative grid side.	10-140, variable
SBS1	T0400r22.txt	Raw transformed data.	SBS1 cold transmission.	10-140, variable
SBS1	S2695rA.txt	Raw transformed data.	SBS1 cold reflection. Inductive side.	10-140, variable
SBS1	Sbs1-t-w-10-140-1.txt	Noise removed, re-binned.	SBS1 warm transmission.	10-140, 0.1
SBS1	Sbs1-i-w-10-140-1.txt	Noise removed, re-binned.	SBS1 warm reflection. Inductive grid side.	10-140, 0.1
SBS1	Sbs1-c-w-10-140-1.txt	Noise removed, re-binned.	SBS1 warm reflection. Capacitative grid side.	10-140, 0.1
SBS1	Sbs1-t-c-10-140-5.txt	Noise removed, re-binned.	SBS1 cold transmission.	10-140, 0.05
SBS1	Sbs1-i-c-10-140-5.txt	Noise removed, re-binned.	SBS1 cold reflection. Inductive side.	10-140, 0.05
SBS2	T0308r10.txt	Raw transformed data.	SBS2 warm transmission.	10-140, variable
SBS2	S2694rA.txt	Raw transformed data.	SBS2 warm reflection. Inductive grid side.	10-140, variable
SBS2	S2694rD.txt	Raw transformed data.	SBS2 warm reflection. Capacitative grid side.	10-140, variable
SBS2	T0398r37.txt	Raw transformed data.	SBS2 cold transmission.	10-140, variable
SBS2	S2694rG.txt	Raw transformed data.	SBS2 cold reflection. Inductive side.	10-140, variable
SBS2	Sbs2-t-w-10-140-1.txt	Noise removed, re-binned.	SBS2 warm transmission.	10-140, 0.1
SBS2	Sbs2-i-w-10-140-1.txt	Noise removed, re-binned.	SBS2 warm reflection. Inductive grid side.	10-140, 0.1
SBS2	Sbs2-c-w-10-140-1.txt	Noise removed, re-binned.	SBS2 warm reflection. Capacitative grid side.	10-140, 0.1
SBS2	Sbs2-t-c-10-140-5.txt	Noise removed, re-binned.	SBS2 cold transmission.	10-140, 0.05
SBS2	Sbs2-c-c-10-140-5.txt	Noise removed, re-binned.	SBS2 cold reflection. Capacitative side.	10-140, 0.05

SECTION 10 – Serialised Components List

None

SECTION 11 - List of Waivers

No waivers.

SECTION 12 - Copies of Waivers

N/A

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 300mK strap support system
A *full* historical record of every stage of manufacture for each component is traceable at UWC, in both hard copy log-book format and on a Microsoft Access database.

Filter SBS1

Date	Action	UWC Test reference
6/4/04	Filter W871 manufactured in class 1000 clean room	
7/4/04	Filter W871 spectroscopically tested in transmission in the range 10-140cm-1	S2684rj
29/6/04	Filter W871 stretched to achieve flatness prior to mounting	
9/7/04	Filter 1312 mounted from W871 in a class 100 laminar flow cabinet	
16/7/04	Filter 1312 spectroscopically tested in reflection in the range 10-140cm-1	S2694r4, S2694r7
20/7/04	Filter 1312 thermally cycled 3 times between 300K and 77K	THERM 0190
20/7/04	Filter 1312 spectroscopically tested in reflection in the range 10-145cm-1 at 300K and 80K	S2695r7, S2695rA, S2695rd
5/8/04	Filter 1312 spectroscopically tested for uniformity, 10-145cm-1	T0398r19, T0398r22, T0398r25
6/8/04	Filter 1312 spectroscopically tested in transmission in the range 10-145cm-1 at 300K and 80K	T0400r19, T0400r22
	Filter 1312 cleaned with acetone, baked for 17hours at 350K	
	Filter 1312 packaged in membrane box ready for dispatch	

Filter SBS2

Date	Action	UWC Test reference
8/4/04	Filter W874 manufactured in class 1000 clean room	
15/4/04	Filter W874 spectroscopically tested in transmission in the range 10-140cm-1	T0308r10
29/6/04	Filter W874 stretched to achieve flatness prior to mounting	
9/7/04	Filter 1315 mounted from W874 in a class 100 laminar flow cabinet	
16/7/04	Filter 1315 spectroscopically tested in reflection in the range 10-140cm-1	S2694ra, S2694rd
16/7/04	Filter 1315 thermally cycled 3 times between 300K and 77K	THERM 0189
16/7/04	Filter 1315 spectroscopically tested in reflection in the range 10-145cm-1 at 300K and 80K	S2694rd, S2694rg, S2695r4
5/8/04	Filter 1315 spectroscopically tested for uniformity, 10-145cm-1	T0398r10, T0398r13, T0398r16
6/8/04	Filter 1315 spectroscopically tested in transmission in the range 10-145cm-1 at 300K and 80K	T0398r34, T0398r37
	Filter 1315 cleaned with acetone, baked for 17hours at 350K	
	Filter 1315 packaged in membrane box ready for dispatch	

SECTION 15 - Logbook / Diary of Events

Not provided – available from subsystem provider upon request.

SECTION 16 - Operating Time / Cycle Record

See section 14 (historical record).

SECTION 17 – Connector Mating Record

N/A

SECTION 18 – Age Sensitive Items Record

N/A

SECTION 19 – Pressure Vessel History / Test Record

N/A

SECTION 20 - Calibration Data Record

Calibration files are stored at Cardiff at \\Darkstar\Astroworld\Projects\Spire\Cardiff_workpackages\Deliverables\Shipped\Filters\PFM-Beam-Dividers\Data
Copies of these files are stored on the accompanying CD-ROM.
The files listed in Table 1 should be used for calibration purposes. These files are plotted over the SPIRE band as Figure 5 to Figure 10.

Warm reflection and transmission data are used for calibration purposes. This is because the cold data suffers from poor signal-to-noise due to the experimental arrangement. This is valid, as no difference is observed in the performance between 300K and 80K. (See section 25 – Test Reports, Figure 15 and Figure 16).

Table 1 Calibration files for FILT-PFM-410 (SBS1) and FILT-PFM-420 (SBS2)

Component	File name	Data manipulation	Description	Data range, resolution (cm-1)
SBS1	Sbs1-t-w-10-140-1.txt	Noise removed, re-binned.	SBS1 warm transmission.	10-140, 0.1
SBS1	Sbs1-i-w-10-140-1.txt	Noise removed, re-binned.	SBS1 warm reflection. Inductive grid side.	10-140, 0.1
SBS1	Sbs1-c-w-10-140-1.txt	Noise removed, re-binned.	SBS1 warm reflection. Capacitative grid side.	10-140, 0.1
SBS2	Sbs2-t-w-10-140-1.txt	Noise removed, re-binned.	SBS2 warm transmission.	10-140, 0.1
SBS2	Sbs2-i-w-10-140-1.txt	Noise removed, re-binned.	SBS2 warm reflection. Inductive grid side.	10-140, 0.1
SBS2	Sbs2-c-w-10-140-1.txt	Noise removed, re-binned.	SBS2 warm reflection. Capacitative grid side.	10-140, 0.1

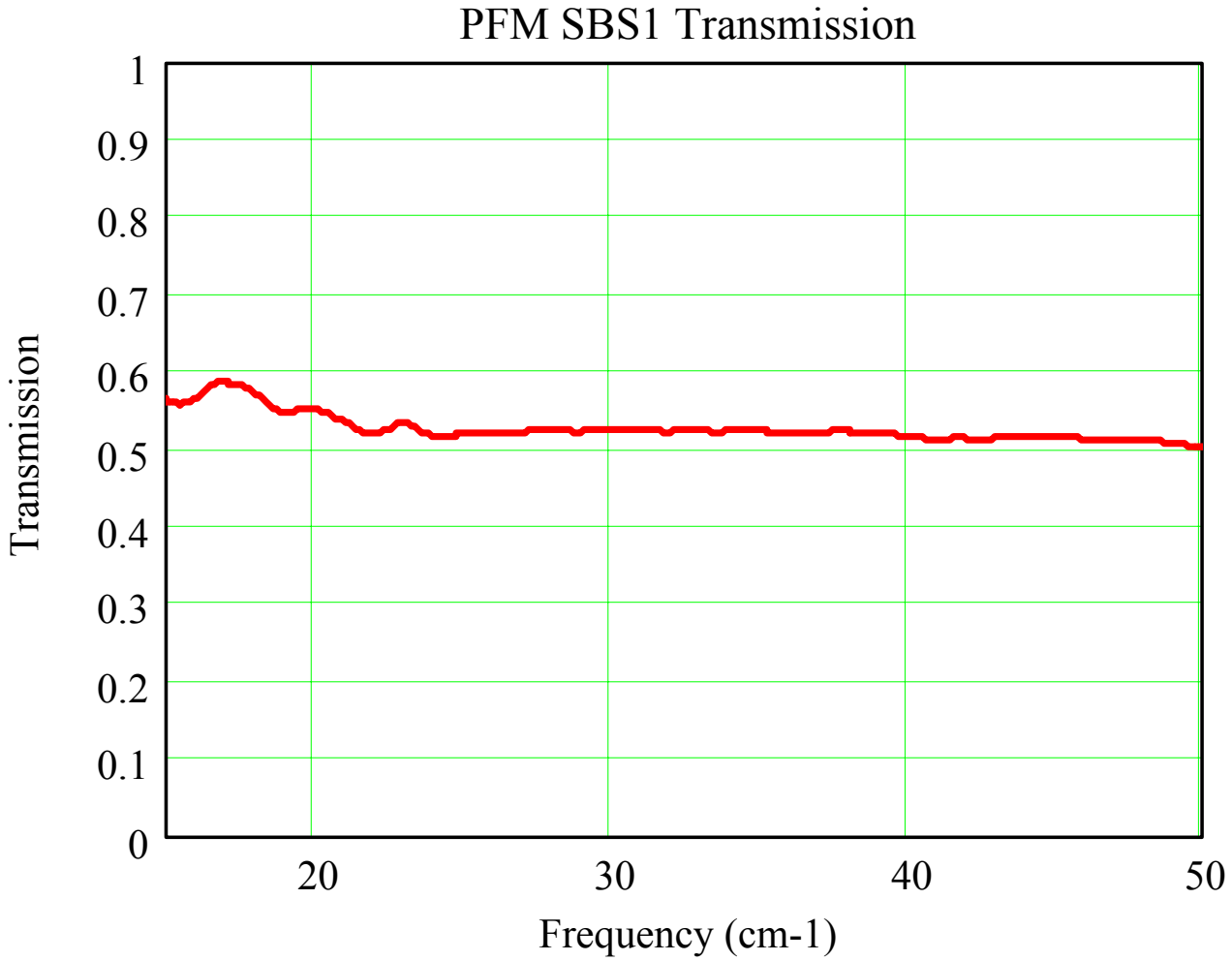


Figure 5 SBS1 transmission

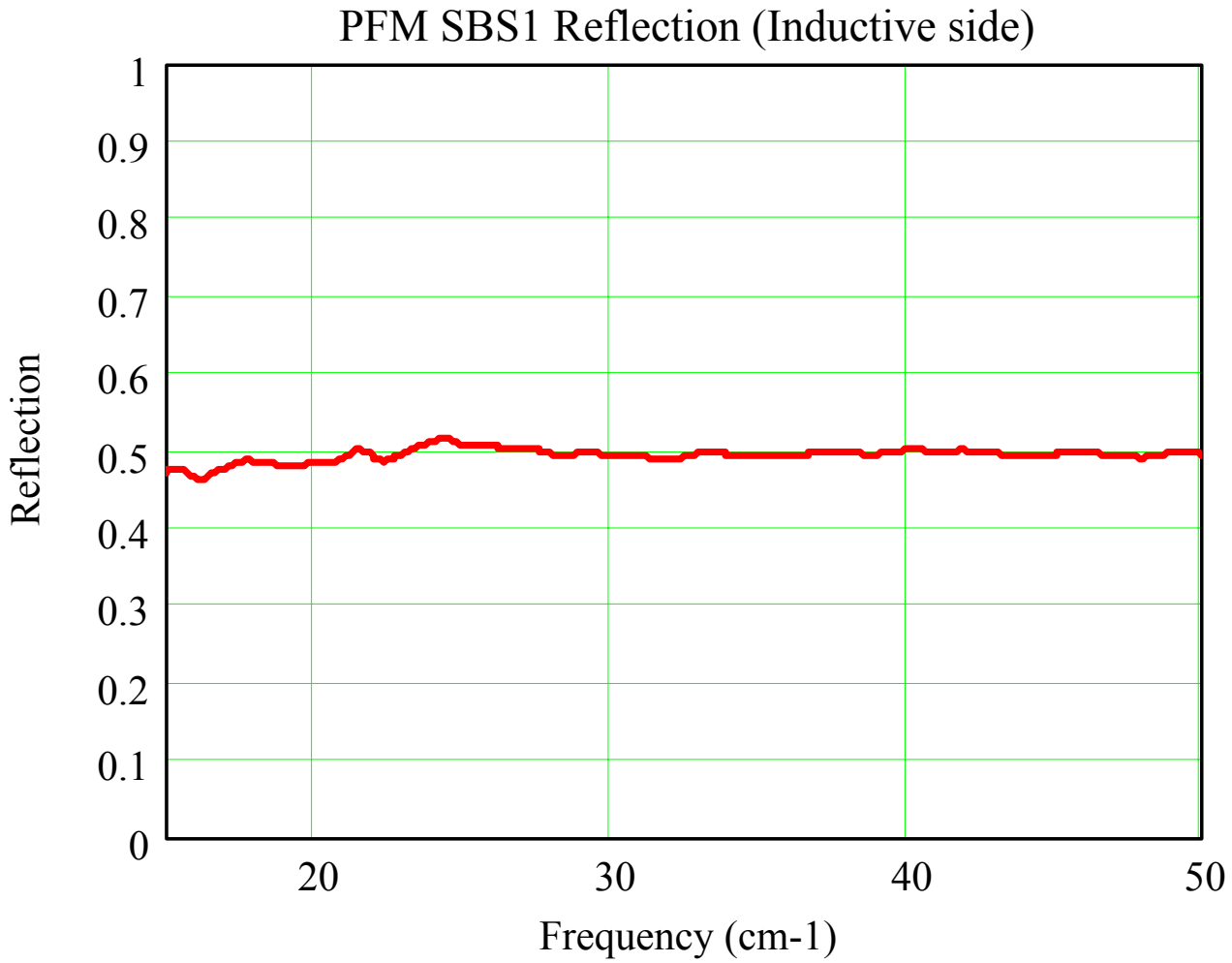


Figure 6 SBS1 reflection (inductive side)

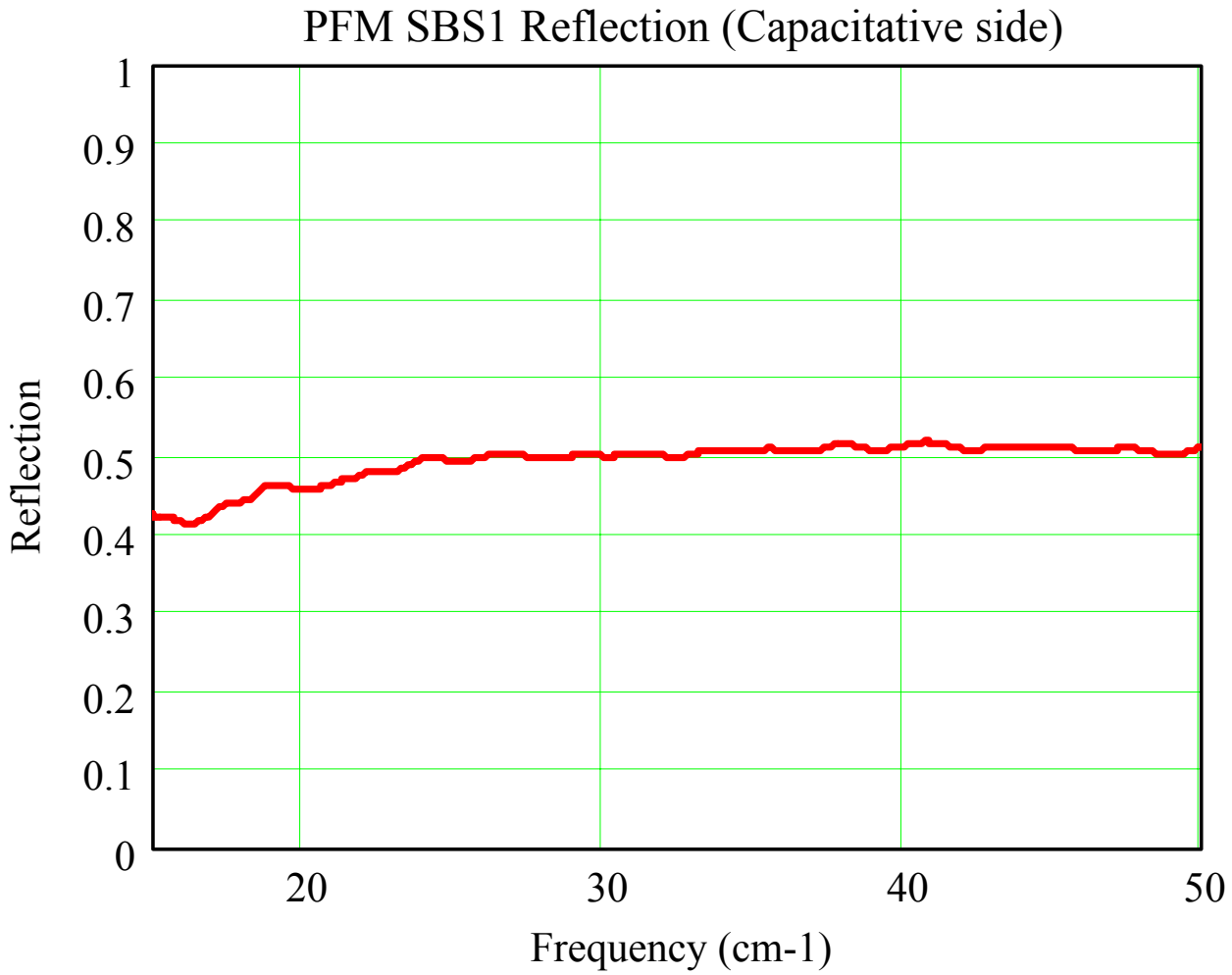


Figure 7 SBS1 reflection (capacitative side)

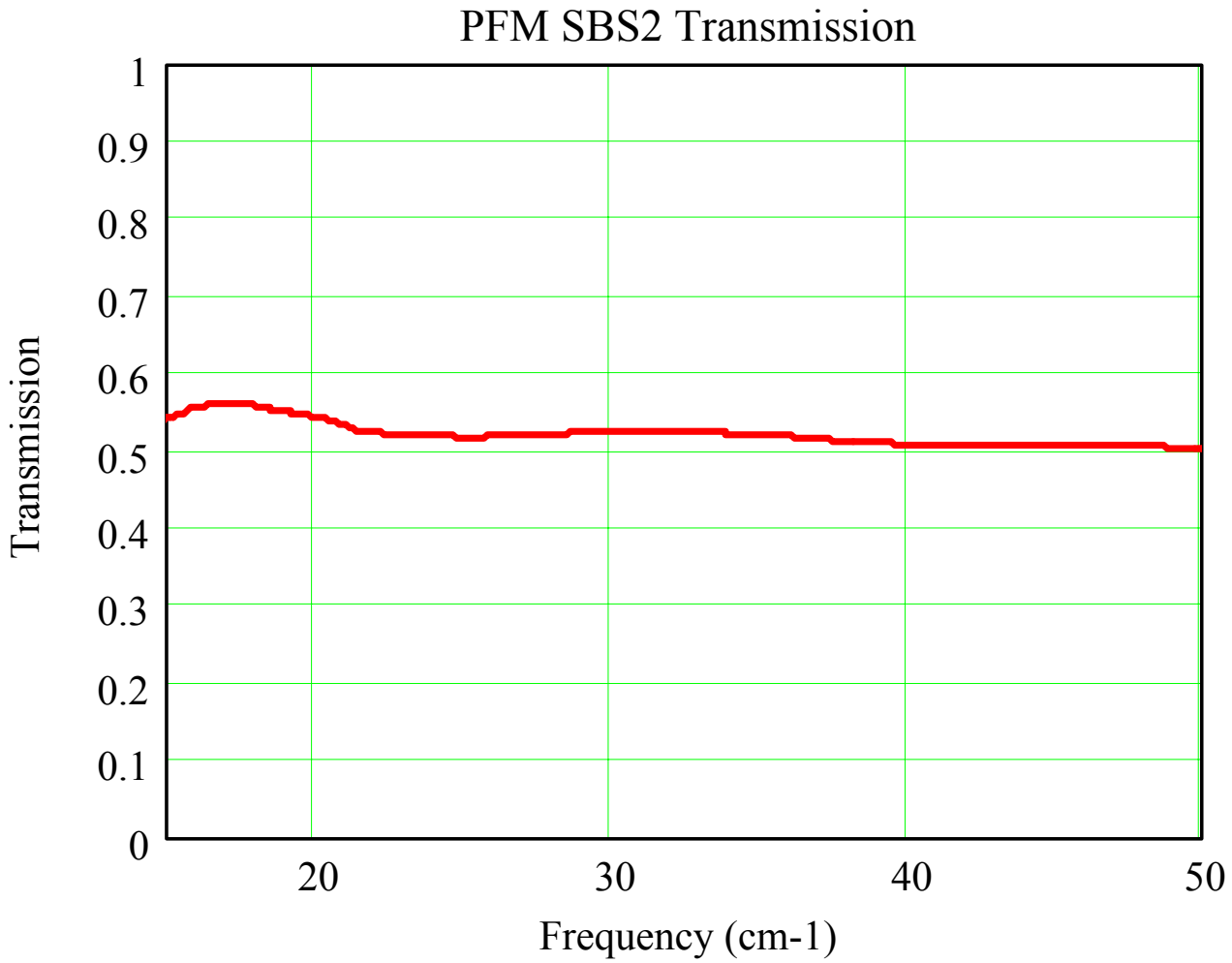


Figure 8 SBS2 transmission

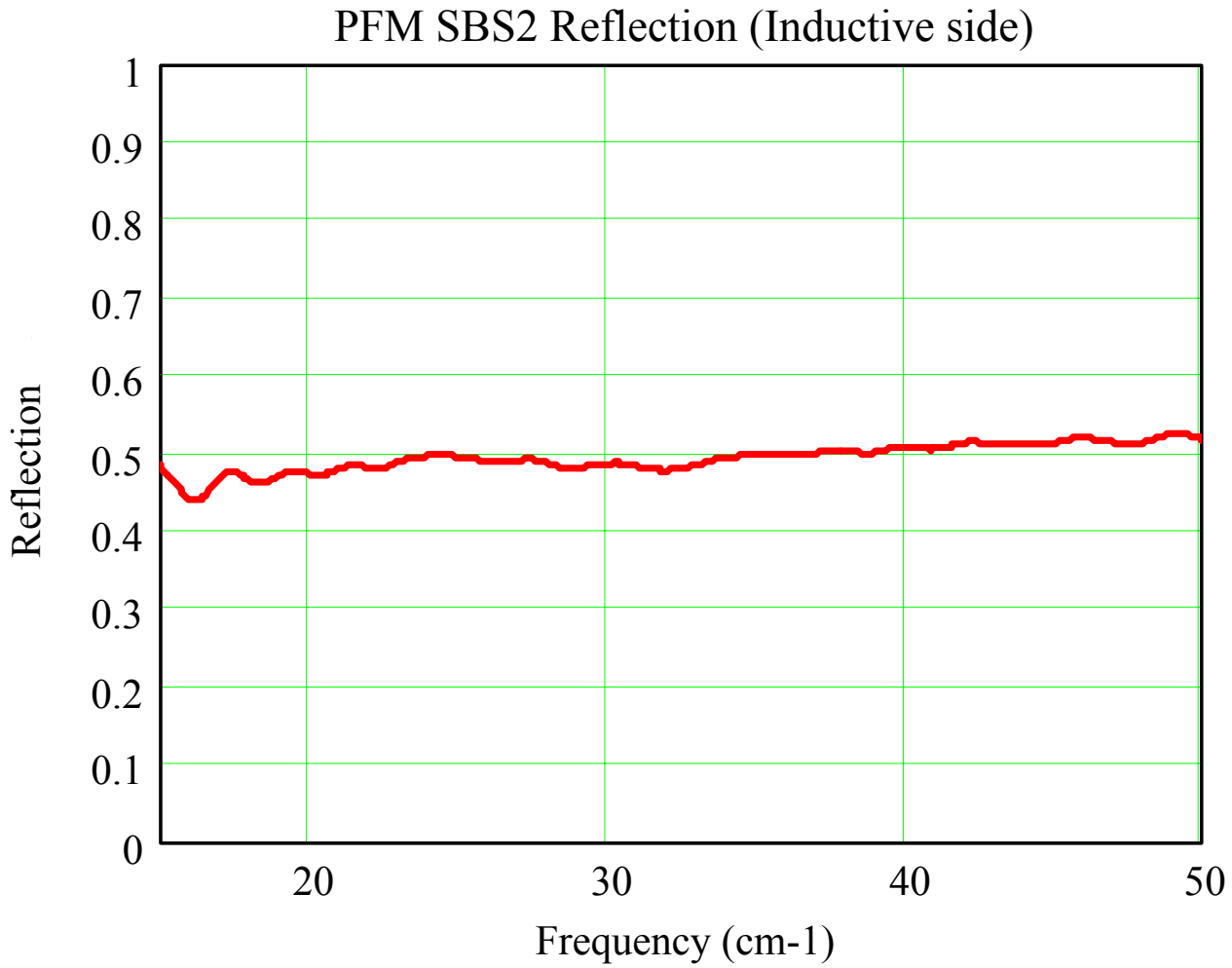


Figure 9 SBS2 reflection (inductive side)

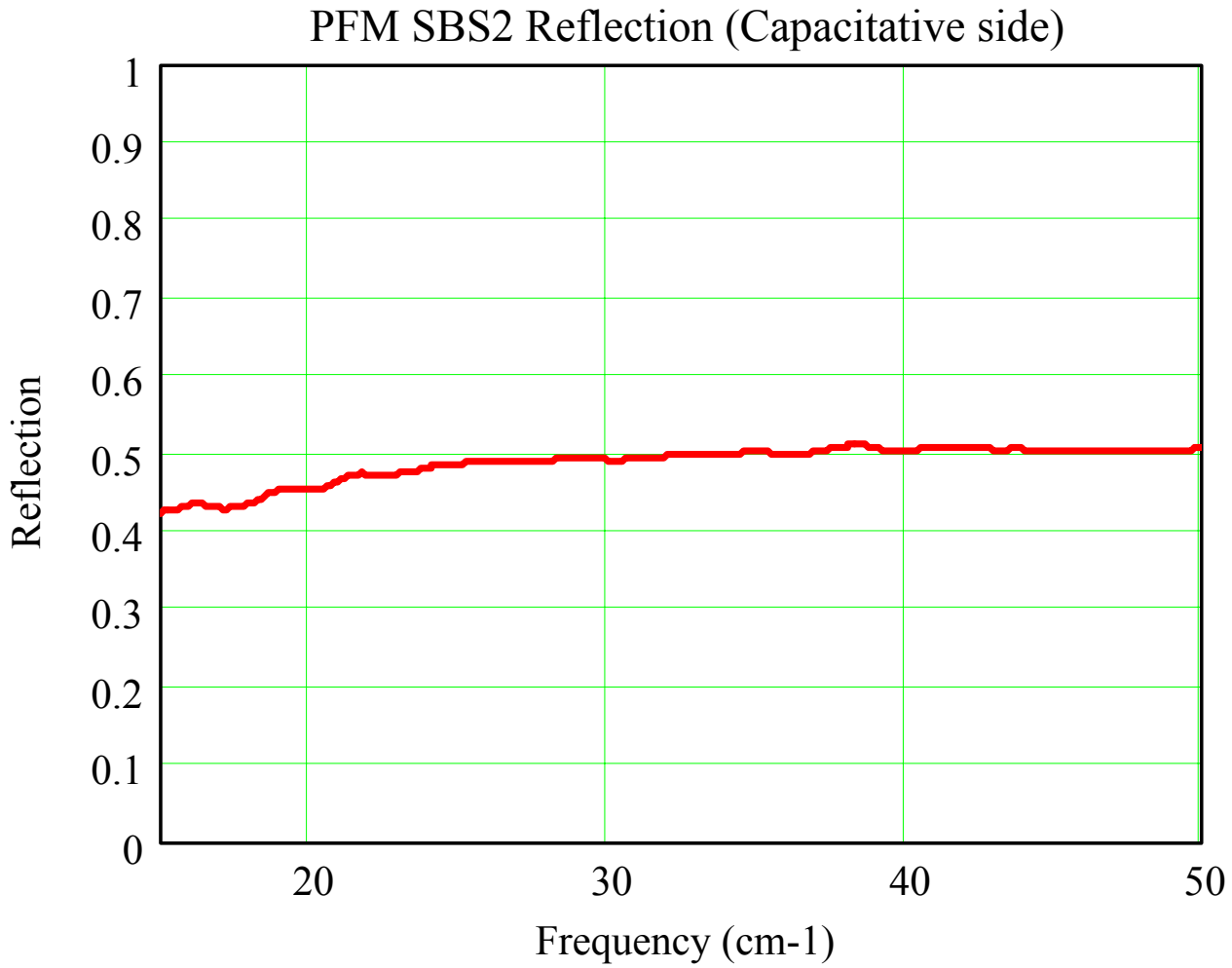


Figure 10 SBS2 reflection (capacitative side)

SECTION 21 - Temporary Installation Record

N/A

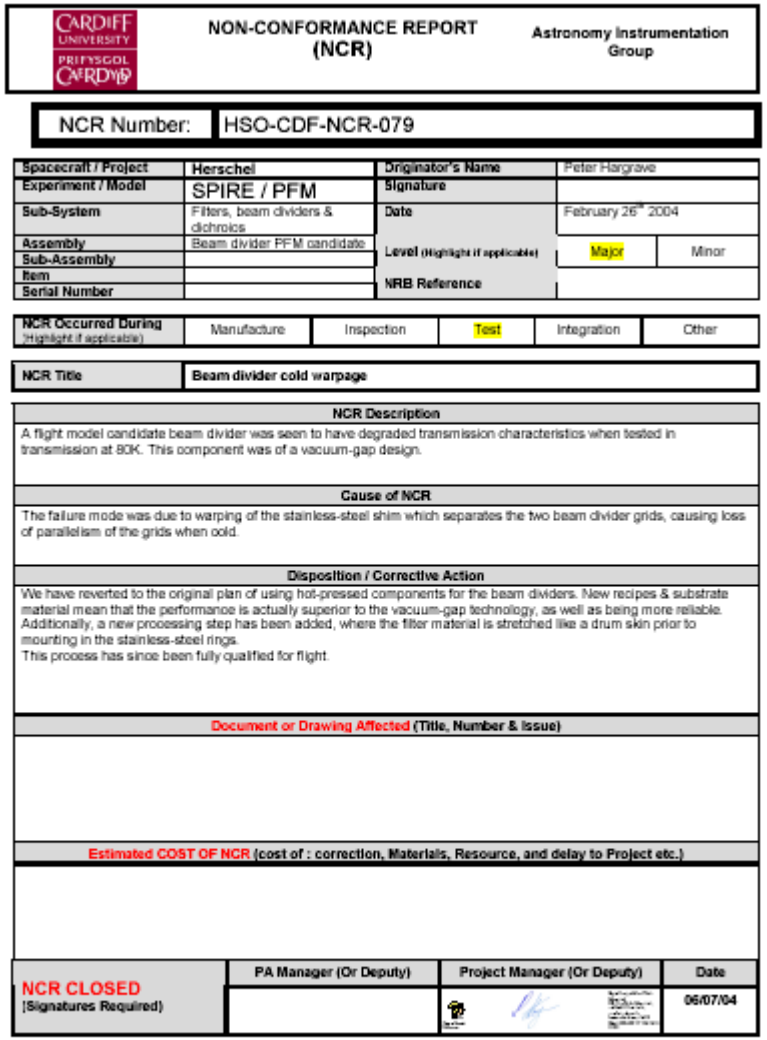
SECTION 22 - Open Work / Deferred Work / Open Tests

None.

SECTION 23 - List of Non-Conformance Reports

Number	Non-Conformance Details	Status	Raised Date
HSO-CDF-NCR-079	Cold warping of beam divider PFM candidate	Closed	26/02/04

SECTION 24 - Copies of Non-Conformance Reports



CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD

NON-CONFORMANCE REPORT (NCR)

Astronomy Instrumentation Group

NCR Number:	HSO-CDF-NCR-079

Spacecraft / Project	Herschel	**Originator's Name**	Peter Hargrave	
Experiment / Model	SPIRE / PFM	**Signature**		
Sub-System	Filters, beam dividers & dichroics	**Date**	February 26th 2004	
Assembly	Beam divider PFM candidate	**Level** (Highlight if applicable)	Major	Minor
Sub-Assembly				
Item		**NRB Reference**		
Serial Number				

NCR Occurred During (Highlight if applicable)	Manufacture	Inspection	Test	Integration	Other

NCR Title	**Beam divider cold warpage**

NCR Description

A flight model candidate beam divider was seen to have degraded transmission characteristics when tested in transmission at 80K. This component was of a vacuum-gap design.

Cause of NCR

The failure mode was due to warping of the stainless-steel shim which separates the two beam divider grids, causing loss of parallelism of the grids when cold.

Disposition / Corrective Action

We have reverted to the original plan of using hot-pressed components for the beam dividers. New recipes & substrate material mean that the performance is actually superior to the vacuum-gap technology, as well as being more reliable. Additionally, a new processing step has been added, where the filter material is stretched like a drum skin prior to mounting in the stainless-steel rings.
This process has since been fully qualified for flight.

Document or Drawing Affected (Title, Number & Issue)

Estimated COST OF NCR (cost of : correction, Materials, Resource, and delay to Project etc.)

NCR CLOSED (Signatures Required)	**PA Manager (Or Deputy)**	**Project Manager (Or Deputy)**	**Date**
			06/07/04

Ref ISO/SPAP 004 ISO9: Form PA 006 Non-Conformance Report(NCR) Issue 07 Page 1 of 1

SECTION 25 - Test Reports

25.1. Visual inspection

As standard practice, each filter element is checked individually for pattern geometry and defects under an optical microscope, following the procedures laid out in the UWC internal document “UWC_Filter_production_PA_V2.0.doc”.
The assembled filter then undergoes a series of optical, thermal and mechanical tests

25.2. Optical tests

The FIR spectral tests were carried out at UWC, using two Martin-Puplett polarizing Fourier transform interferometers. These spectrometers are able to operate in transmission or specular reflectance modes at 300K. It is also possible to perform transmission and reflection measurements at 77K, using a cold finger inserted into the sample chamber of the FTS.

The as-manufactured, unmounted beam dividers were spectrally tested in- and near-band, following the standard FTS procedures of UWC.

Once mounted, the beam dividers were spectrally tested in reflection (both sides) and transmission at 300K and 77K.
Measurements were made in transmission at three different locations on each component, as a test for uniformity.

25.2.1. Warm measurements

Spectral measurements were made on SBS1 and SBS2 in transmission and reflection. For each device, reflection measurements were made with each side of the component (inductive grid side, or capacitative grid side) facing the incident beam. Example data are shown in Figure 11 and Figure 12.

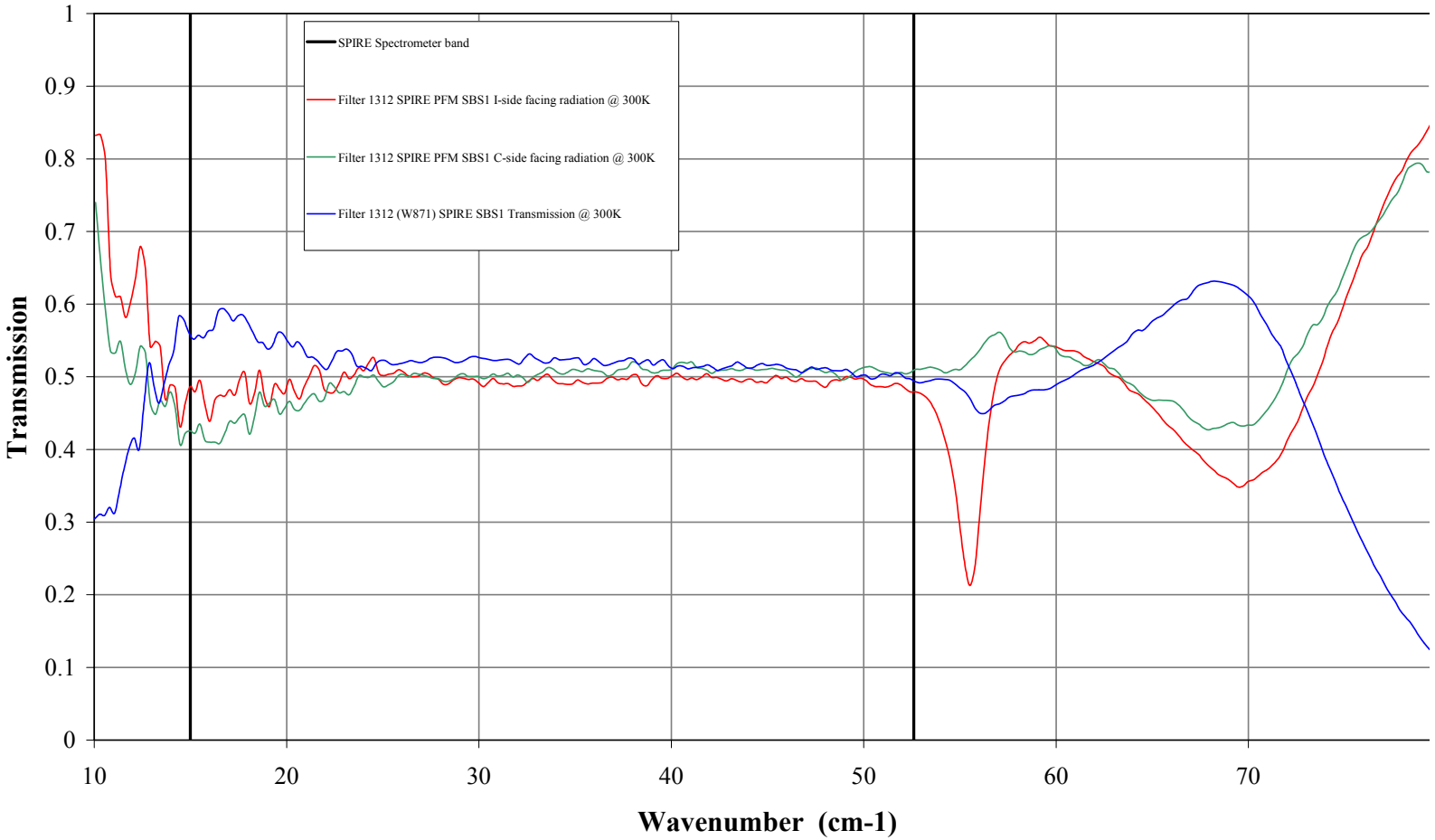


Figure 11 Warm transmission and reflection data for SBS1

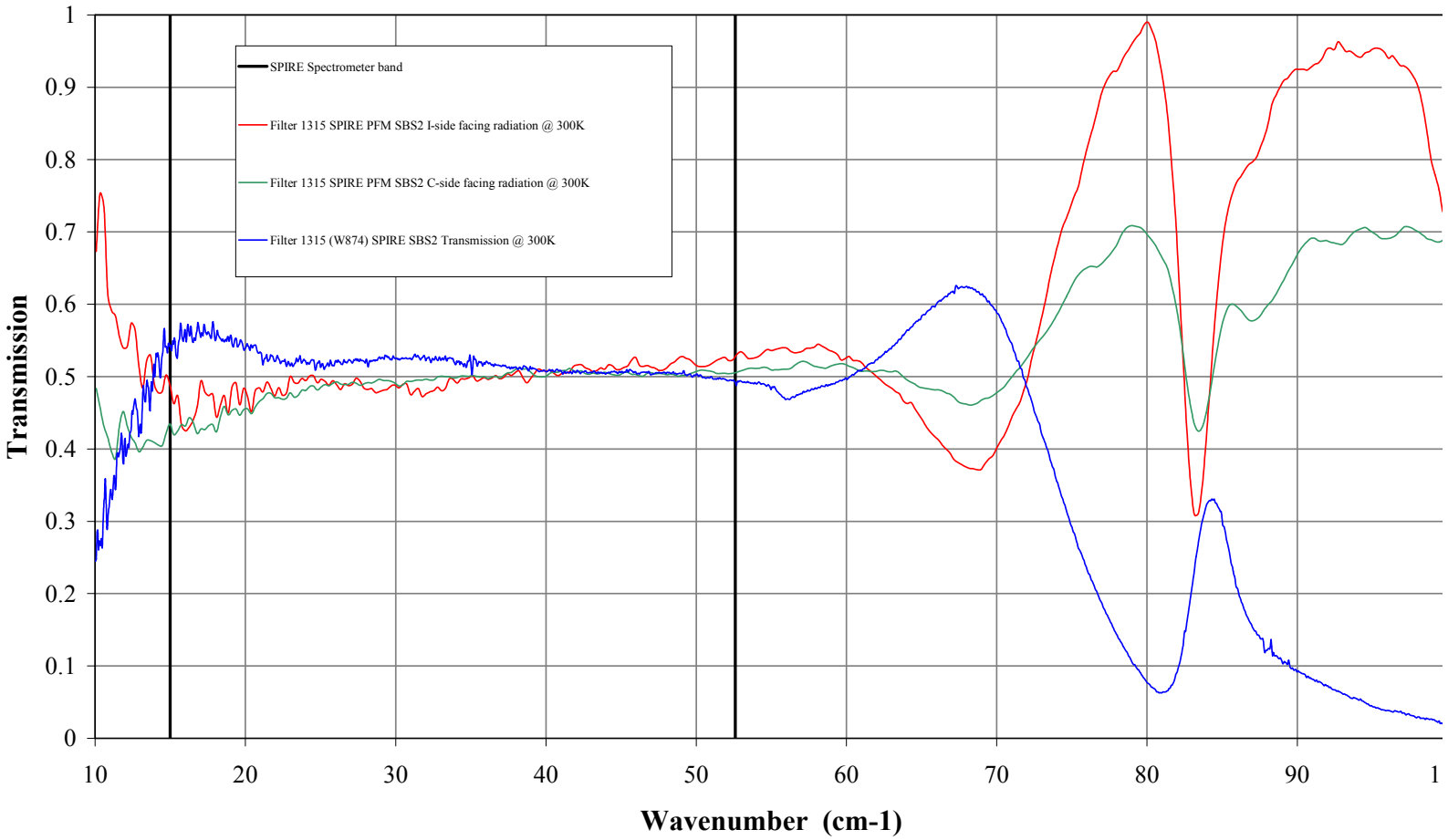


Figure 12 Warm transmission and reflection data for SBS2

25.2.2. Cold measurements

Cold reflection data (inductive side) for SBS1 are shown in Figure 13, and cold reflection data for SBS2 (capacitative side) are shown in Figure 14). Small differences in the data are within the error of the measurement, due to the very low signal-to-noise attained for these measurements.

Transmission data for SBS1 and SBS2 are shown as Figure 15 and Figure 16 respectively. These data show no change in performance between 300K and 80K.

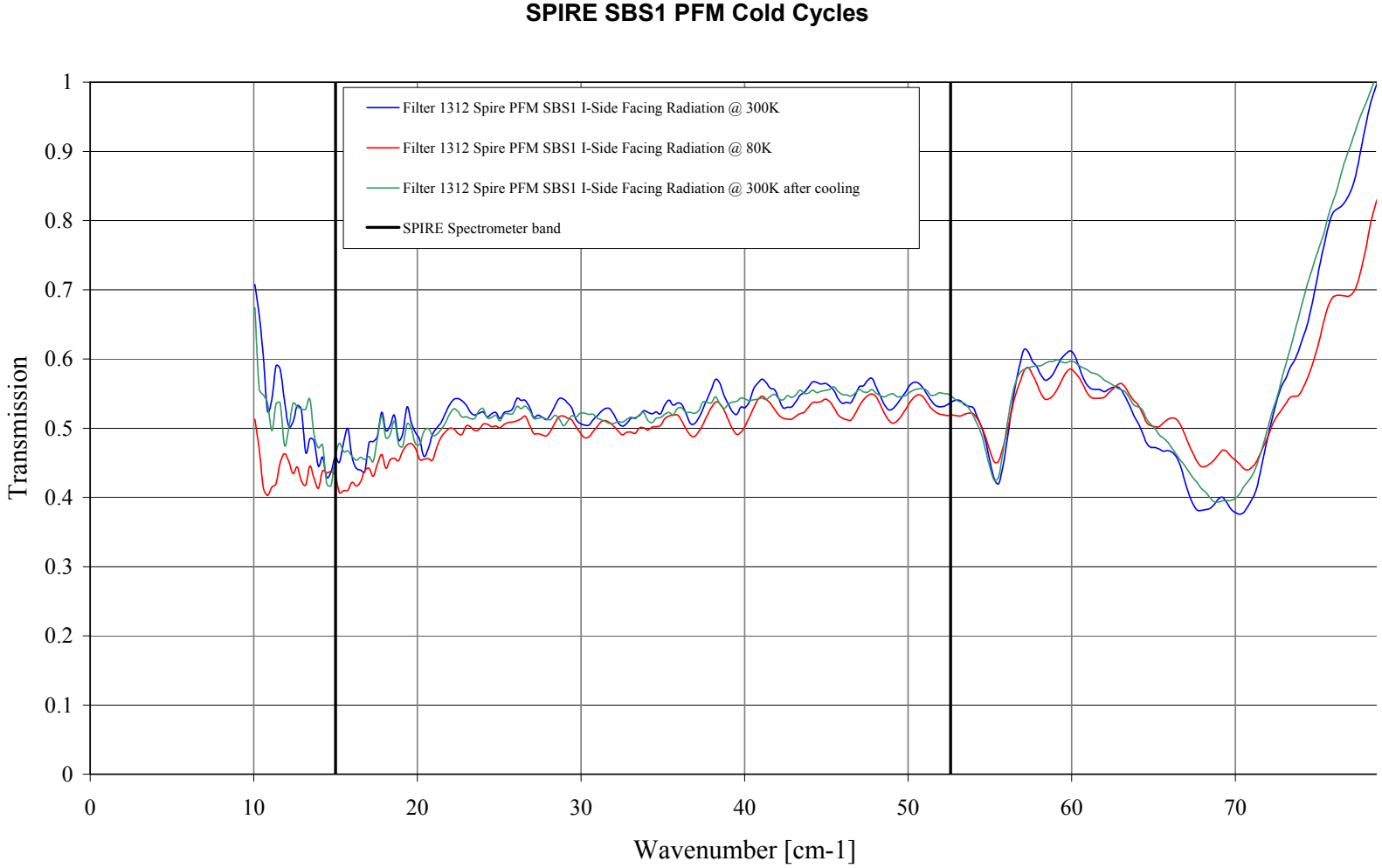


Figure 13 SBS1 cold reflection data – inductive side.

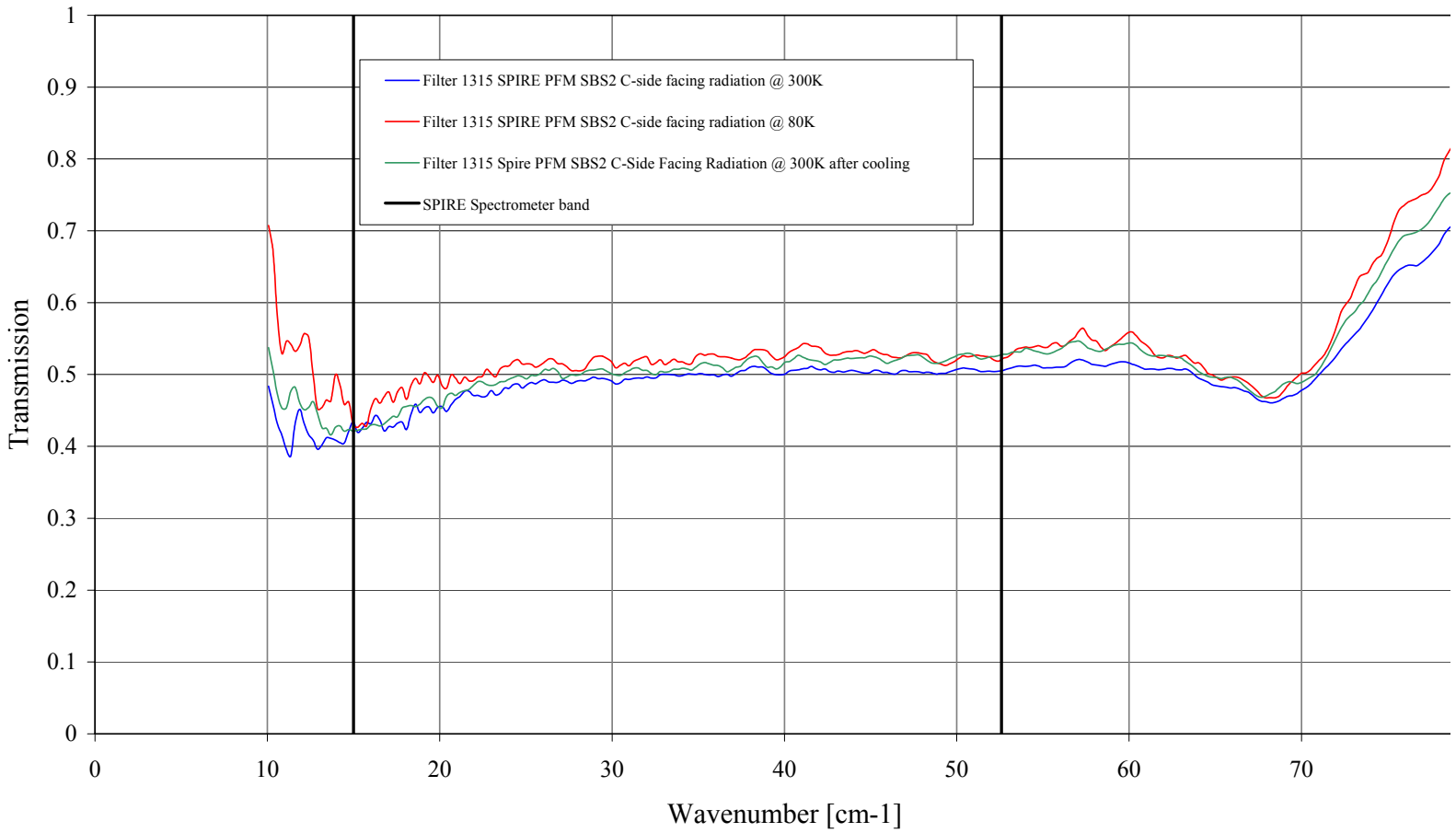


Figure 14 SBS2 cold reflection data – capacitative side.

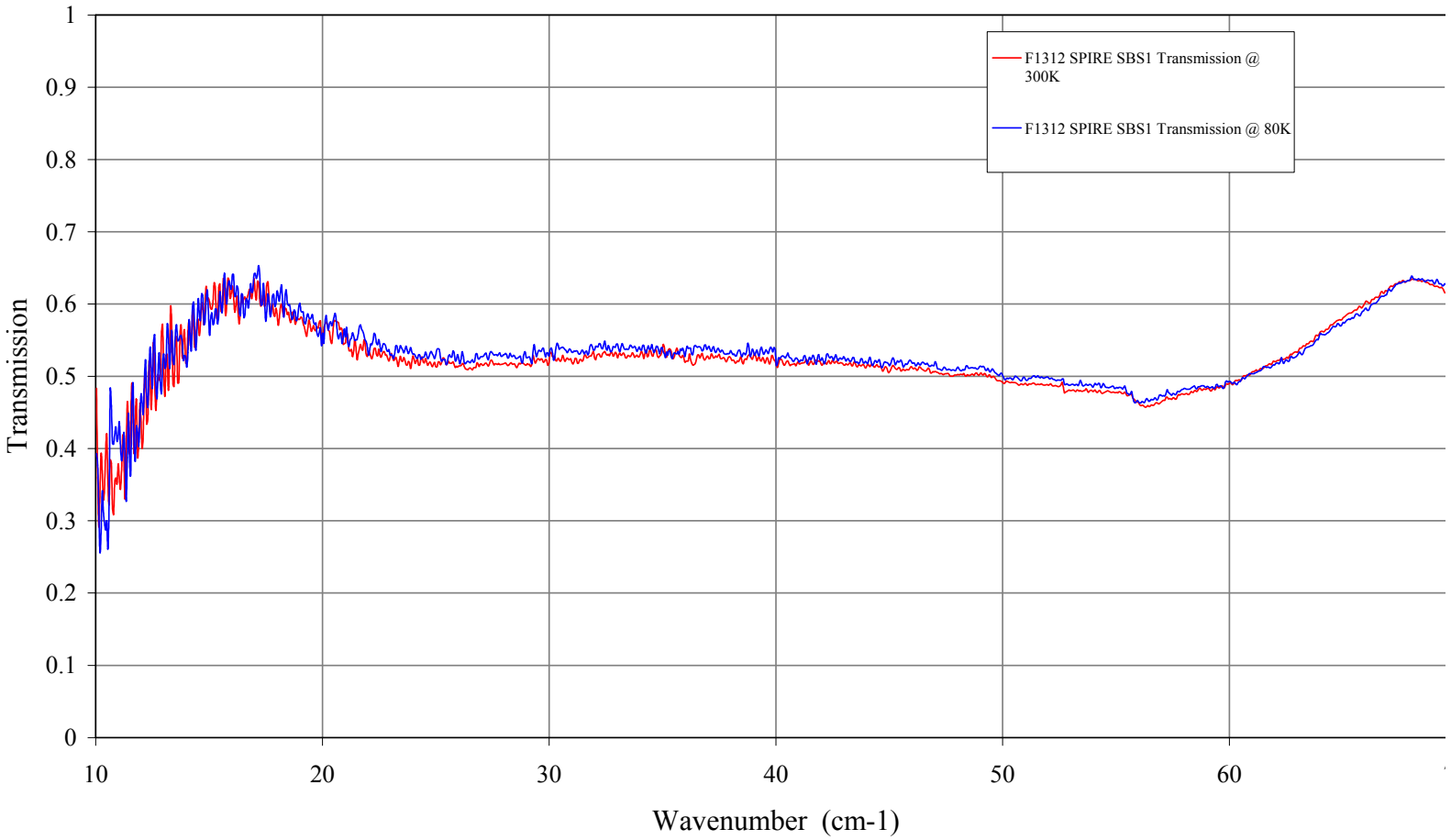


Figure 15 Warm and cold transmission data for SBS1

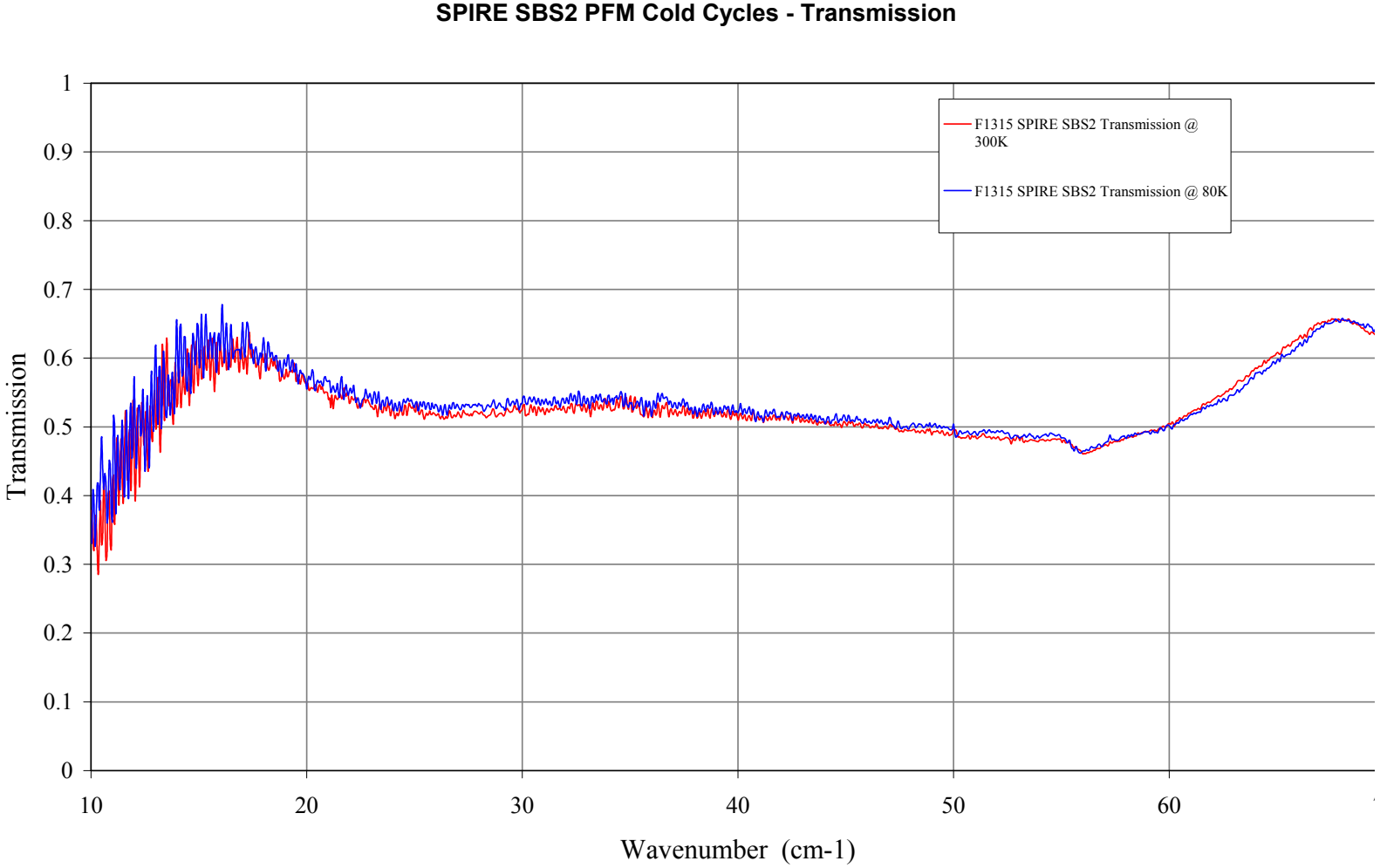


Figure 16 Warm and cold transmission data for SBS2

25.2.3. Efficiency

Beam divider efficiency can be expressed as the product 4*R*T, where R is the reflected component, and T is the transmitted component. For an ideal component, 4RT=100%. The requirement on the components for SPIRE is that 4RT>90% over the SPIRE band.
The requirement in the SPIRE instrument requirements document (SPIRE-RAL-PRJ-000034 issue 1.2) on efficiency is expressed in terms of “balancing of ports” (IRD-OPTS-R07). The requirement is that 2RT is within 90% of R^2+T^2 over the SPIRE band.
Figure 17 and Figure 19 show the efficiency across the SPIRE band for SBS1 and SBS2 respectively.
Figure 18 and Figure 20 show the degree to which the ports are matched. Plotted in each of these traces is the difference between the reflected and transmitted components ($2RT-(R^2+T^2)$).

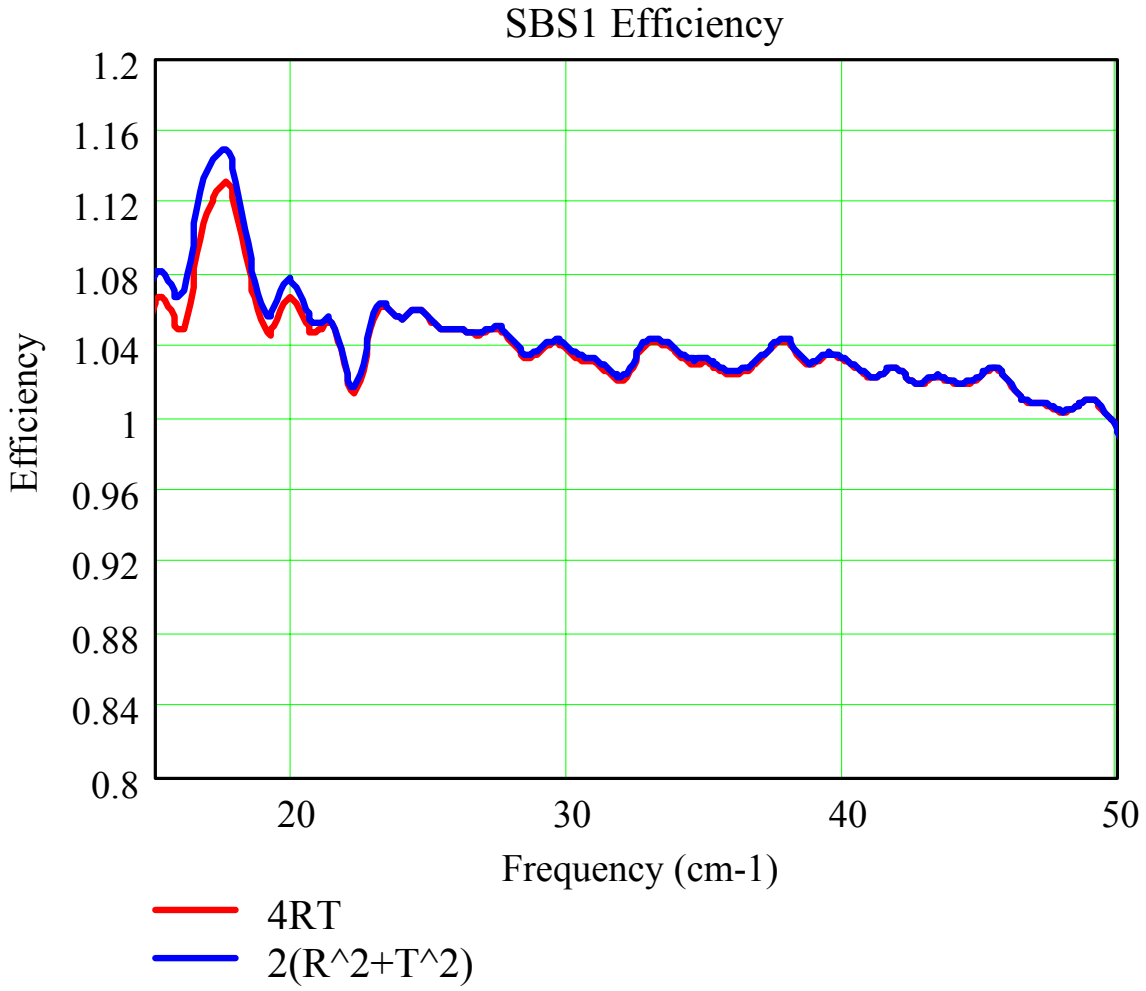


Figure 17 SBS1 efficiency

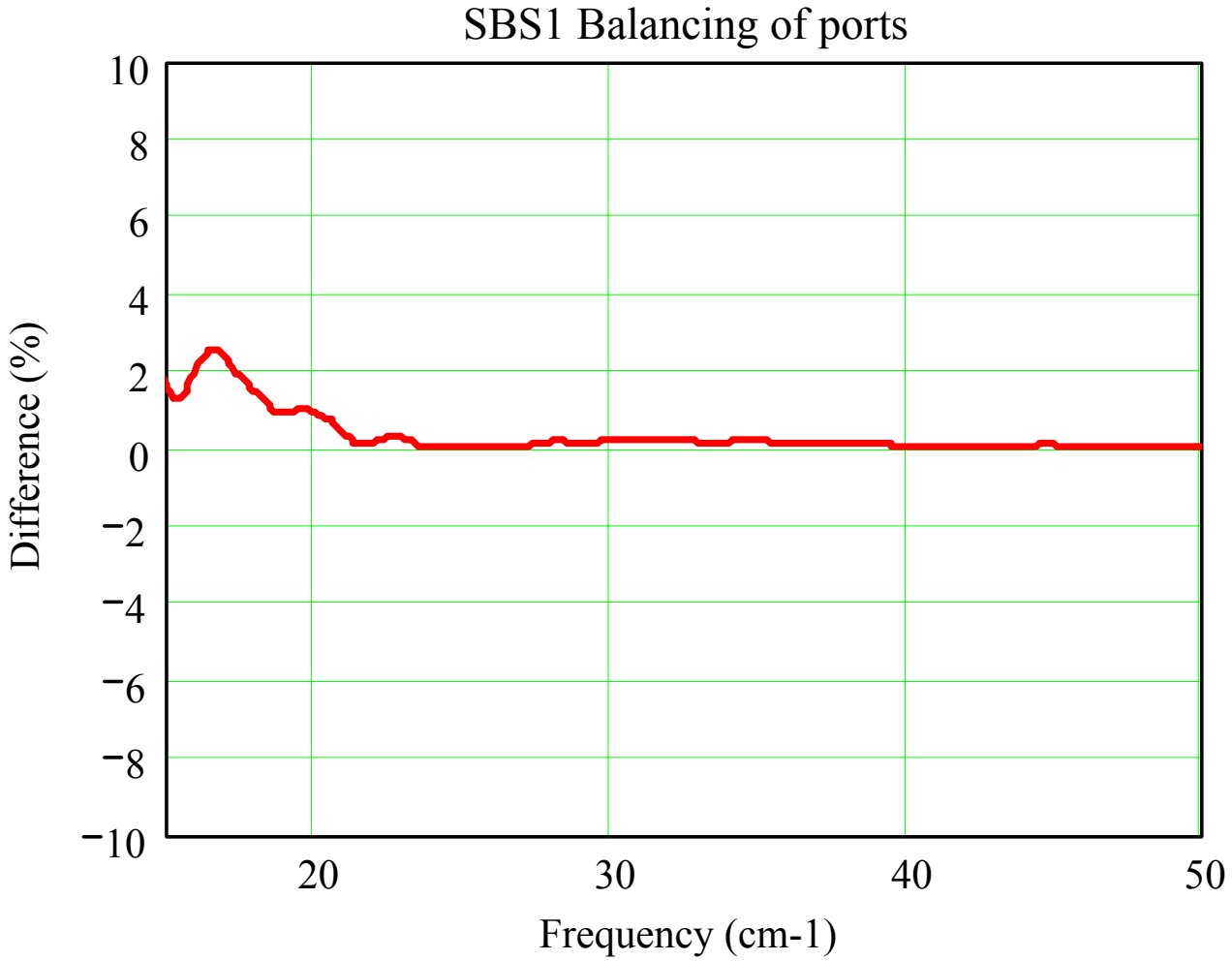


Figure 18 Difference between 2RT and R^2+T^2 for SBS1

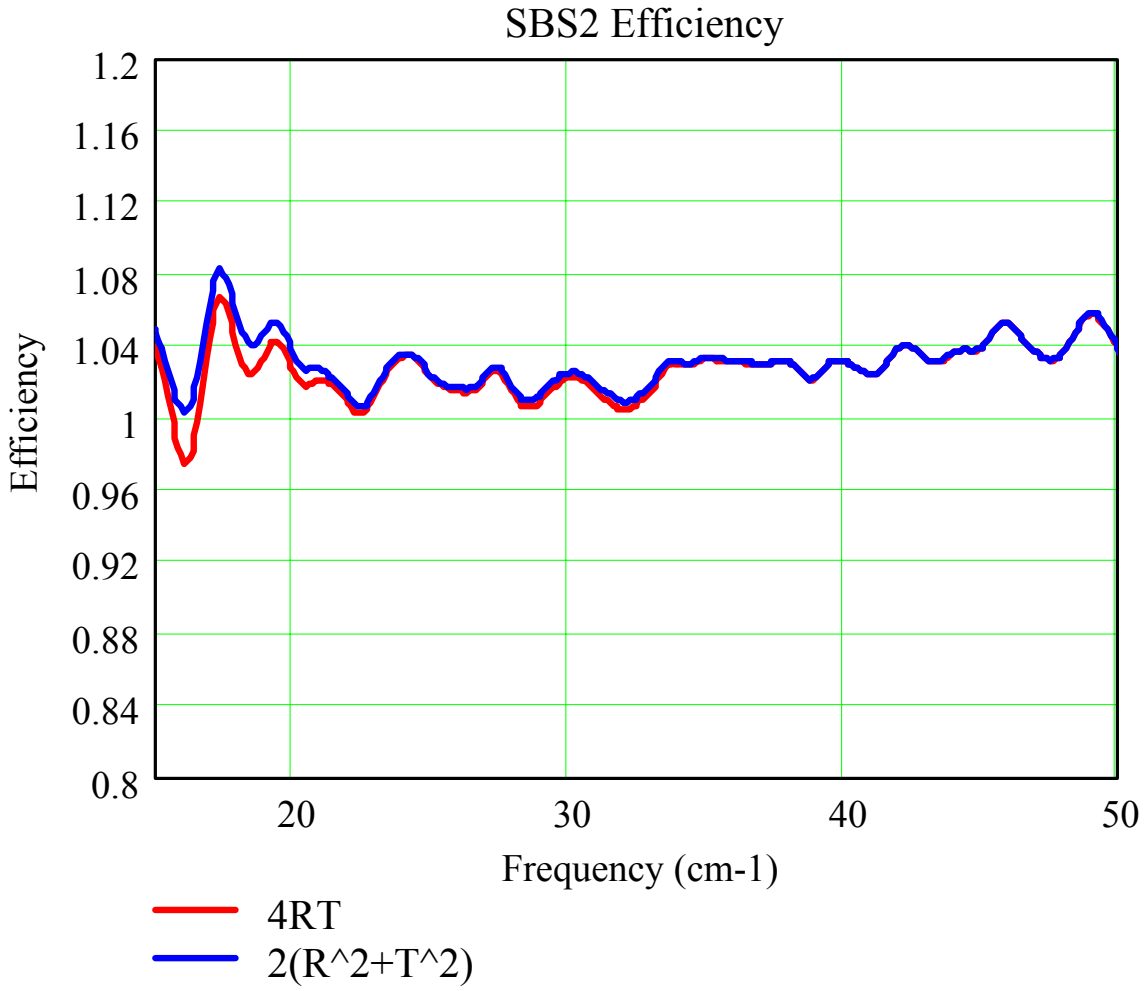


Figure 19 SBS2 efficiency

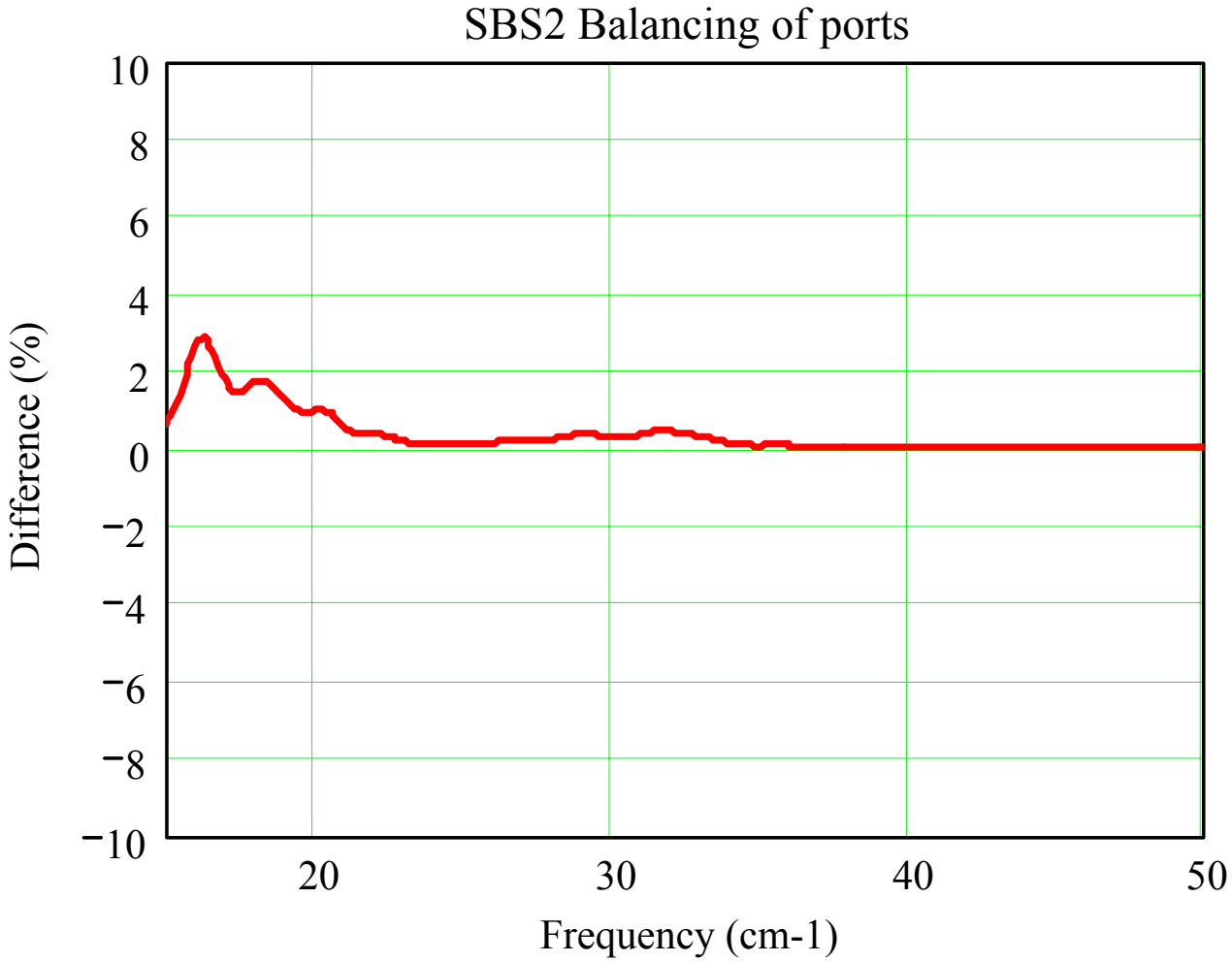


Figure 20 Difference between 2RT and R^2+T^2 for SBS2

25.3. Thermal shocks

Thermal shocking of the hot-pressed beam dividers (W871 and W874) prior to mounting was performed using a liquid nitrogen bath. This cycle (300K - 77K - 300K) was performed 5 times. Any spectroscopic measurement made thereafter could verify no filter de-lamination or degradation.
(If any part of a filter is seen to de-laminate, or show any other signs of weakness, it is rejected and the component remade).

25.4. Thermal cycles

Thermal cycling (300K - 77K - 300K) of the mounted SBS components was performed within the UWC Martin-Puplett FTS such that spectroscopic measurements could simultaneously be made. This cycle was performed three times at a vacuum pressure of 10^{-2} mBar. The beam dividers showed no signs of degradation and their spectral performance was established at 77K.

25.5. Temperature dependence of spectral response

The in-band and near-band spectroscopic transmitted and reflected response of each of SBS1 and SBS2 was measured at 300K and 77K.

25.6. Mechanical tests

During the evacuating of the Martin-Puplett FTS, the beam dividers have been subjected to a differential pressure rate of change of at least 10mB/sec. Each beam divider has been taken to a vacuum pressure of 0.5mbar, within the FTS, on at least 8 separate occasions.

The beam dividers have been cleaned using an acetone in an ultrasonic bath.

The beam dividers have been baked out at 350 K for 17 hours.

25.7. Vibration test report

Warm and cold vibration testing was carried out to full qualification levels on the DM versions of the beam dividers. These components were built and assembled to the same procedure as the PFM components.
The test reports (AIV-2003-091-VIB, HSO-CDF-RP-078) are attached as Appendix A.

SECTION 26 – Assembly record

9/7/04 – FILT-PFM-410 (SBS1) assembled according to procedure ”UWC_Filter_Mounting_Procedure_V1.0.doc”
9/7/04 – FILT-PFM-420 (SBS2) assembled according to procedure ”UWC_Filter_Mounting_Procedure_V1.0.doc”

SECTION 27 - Reference List of EIDP’s

Associated

Title (Listed in alphabetical order)	**ID** (Serial No.)	**Acronym**	**Document No.**	**Issue**	**Date**
MSSL PFM Structure EIDP			MSSL/SPIRE/PA012.01		

Lower Level

Title (Listed in alphabetical order)	**ID** (Serial No.)	**Acronym**	**Document No.**	**Issue**	**Date**

SECTION 28 - Mass Records

Assembly	Final measured mass (g)
FILT-PFM-410 (SBS1)	23.24
FILT-PFM-420 (SBS2)	23.34

SECTION 29 - Cleanliness Statement

Statement

The PFM beam divider assemblies (FILT-PFM-410, FILT-PFM-420) have been cleaned and assembled within a class 1000 clean room to meet the requirements of the Cardiff PA plan (HSO-CDF-PL-007), and 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.

Signature Not Verified

Digitally signed by Peter Hargrave
DN: cn=Peter Hargrave, o=Cardiff University, ou=Astrophysics Instrumentation, c=GB
Date: 2004.08.11 15:24:30 +01'00'

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

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

Date ……..11th August 2004

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 assemblies were integrated to the Cardiff test dewar within the clean room annex (approx. Class 10,000 – exposure ~15 minutes per thermal cycle).

SECTION 30 - Other Useful Information

Photos will be added here prior to delivery

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

Appendix #	Title (Listed in alphabetical order)	Document No.	Issue	Date	Notes
A	SPIRE Cardiff components cold vibration test report	AIV-2003-091-VIB, HSO-CDF-RP-078	1.0		

Appendix A