

# SPIRE

## SHUTTER SUBSYSTEM CHANGE REQUEST TO SPIRE IRD

Reference: SPIRE-USK-NOT-000830

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Issue	Date
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## 1 REFERENCES

### 1.1 Applicable Documents

	Title	Document No.	Date
AD-1	Instrument Requirements Document	SPIRE-RAL-PRJ-000034 Current issue 1.0	23 Nov 2000
AD-2	Design Requirements for the SPIRE Shutter Subsystem	SPIRE-USK-NOT-000826 Current Issue 1.0	12 Sept 2001
AD-3	Shutter Design Rationale	SPIRE-USK-NOT-000828 Current Issue 1.0	21 Aug 2001
AD-4	SPIRE Systems Budgets	SPIRE-ATC-PRJ-000450 Current Issue 2.0	12 Apr 2001
AD-5	ICD Structure - Mechanical I/F	SPIRE-MSS-PRJ-000617 Current Issue 1.0	Apr 2001
AD-6	SPIRE Harness Definition	SPIRE-RAL-PRJ-000608 Current Issue 0.4	10 Aug 2001

## 2 ABBREVIATIONS

AD	Applicable Document
BOL	Beginning of Life
ESA	European Space Agency
FPU	Focal Plane Unit
IRD	Instrument Requirements Document
RAL	Rutherford Appleton Laboratory
RMS	Root Mean Square
SPIRE	Spectral and Photometric Imaging Receiver
TBD	To Be Determined



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### 3 INTRODUCTION

This document requests a complete rewrite of §3.5.3 of the SPIRE Instrument Requirements Document (AD-1).

The contractor for the shutter is COM DEV Ltd of Cambridge Ontario. One of the requirements of the study contract awarded to COM DEV in January 2001 was to study, clarify and respond to the existing requirements in the IRD. As a result of this engineering study and the simultaneous evolution of our understanding of the role and function of the SPIRE shutter, we now propose to update the IRD to bring it into line with our current design concept.

### 4 RATIONALE

The rationale for the proposed changes is described in detail in AD-2 and is not reproduced here. That document specifies the requirements and constraints which have governed the design activity by COM DEV. It also contains comments specific to each requirement which, although relevant, are not reproduced herein. A complete discussion of the reliability requirement (IRD-SHUT-R11) is provided in AD-3.

### 5 PROPOSED CHANGES

#### 5.1 Performance Requirements

We propose to replace Table 3.5-9 with the following:

<b>Requirement ID</b>	<b>IRD-SHUT-R01</b>
Description	Rejection of direct flux
Value	The shutter vane must physically prevent thermal radiation from the Herschel cryostat lid from directly entering the instrument.
<b>Requirement ID</b>	<b>IRD-SHUT-R02</b>
Description	Rejection of indirect flux
Value	The seal of the shutter vane shall be designed so as to reduce stray light entering the instrument to an acceptable level.
<b>Requirement ID</b>	<b>IRD-SHUT-R03</b>
Description	Vane emissivity
Value	The emissivity of the instrument side of the vane at SPIRE wavelengths shall be greater than 0.9.
<b>Requirement ID</b>	<b>IRD-SHUT-R04</b>
Description	Vane emissivity accuracy
Value	The average emissivity of the instrument side of the vane at SPIRE wavelengths shall be determined to an accuracy of $\pm 2\%$ .
<b>Requirement ID</b>	<b>IRD-SHUT-R05</b>
Description	Vane emissivity uniformity
Value	The emissivity of the instrument side of the vane at SPIRE wavelengths shall be uniform to within 2% (rms).
<b>Requirement ID</b>	<b>IRD-SHUT-R06</b>
Description	Vane temperature
Value	The temperature of the instrument side of the vane shall be controllable over the range 9-25 K.
<b>Requirement ID</b>	<b>IRD-SHUT-R07</b>
Description	Vane temperature control
Value	There shall be at least 16 set points over the temperature range specified in IRD-SHUT-R06.

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<b>Requirement ID</b>	<b>IRD-SHUT-R08</b>
Description	Vane temperature accuracy
Value	The temperature of the instrument side of the vane shall be monitored. The average temperature of the emitting surface must be known to an accuracy of $\pm 0.1$ K.
<b>Requirement ID</b>	<b>IRD-SHUT-R09</b>
Description	Vane temperature uniformity
Value	The temperature of the instrument side of the vane shall be uniform to within 0.1K (rms).
<b>Requirement ID</b>	<b>IRD-SHUT-R10</b>
Description	Vane temperature repeatability
Value	The average temperature of the instrument side of the vane shall be repeatable to within $\pm 0.040$ K.

## 5.2 System Requirements

We propose to replace Table 3.5-10 with the following:

<b>Requirement ID</b>	<b>IRD-SHUT-R11</b>
Description	Reliability
Value	The shutter shall be designed to a reliability requirement of 0.9999.
<b>Requirement ID</b>	<b>IRD-SHUT-R12</b>
Description	Mass
Value	The mass of the subsystem must conform to the allocation in AD-4.
<b>Requirement ID</b>	<b>IRD-SHUT-R13</b>
Description	FPU thermal dissipation
Value	The temperature of the instrument structure in the vicinity of the shutter shall rise by no more than 2 K after 30 minutes when the shutter subsystem is energised.
<b>Requirement ID</b>	<b>IRD-SHUT-R14</b>
Description	Structure interface
Value	The subsystem design shall conform to the structure interface specification in AD-5.
<b>Requirement ID</b>	<b>IRD-SHUT-R15</b>
Description	Harness interface
Value	The subsystem design shall conform to the harness interface specification in AD-6.
<b>Requirement ID</b>	<b>IRD-SHUT-R16</b>
Description	Operating temperature
Value	The shutter mechanism (actuator and vane position sensor) shall be capable of operation at instrument temperature and at room temperature. The vane heater and all thermometry need only function at instrument temperature.
<b>Requirement ID</b>	<b>IRD-SHUT-R17</b>
Description	Operating orientation
Value	The shutter shall be capable of operation in any orientation.
<b>Requirement ID</b>	<b>IRD-SHUT-R18</b>
Description	Transition time
Value	The time required to move the vane into the beam on command shall be less than the thermal stabilisation time (IRD-SHUT-R19).

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<b>Requirement ID</b>	<b>IRD-SHUT-R19</b>
Description	Thermal stabilisation time
Value	The time required to increase the vane temperature by 5K, assuming that the vane is initially at its minimum (unpowered) temperature, shall be less than 10 minutes.