SPIRE Test Cryoharness Specification

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19-October-2001	Issue 0.1	All	First draft for comment

Table of contents

1 Scope of the document

This document describes the requirements for the electrical harnesses to be used for cryogenic testing of the SPIRE instrument.

2 Documentation

2.1 Applicable Documents

	Title	Author	Reference	Date
AD 1	Herschel SPIRE Harness Definition	D. Griffin	SPIRE-RAL-PRJ-000608 Issue 0.8	

2.2 Reference Documents

	Title	Author	Reference	Date
RD 1	SPIRE Test Facility Requirements Specification	D.L. Smith	SPIRE-RAL-PRJ-000463 Issue 1.3	2-April-2001

3 Introduction

The Rutherford Appleton Laboratory is playing a key role in the development of the SPIRE (Spectral and Photometric Imaging REceiver) instrument on the European Space Agency's (ESA) Herschel far infrared space telescope mission due to be launched in 2007. Herschel is part of ESA's Horizons 2000 programme and will be implemented with the collaboration of NASA. Herschel will utilise a super fluid helium cryostat similar to the technology used on the successful ISO mission and will have a lifetime of approximately 3 years.

Prior to the launch of SPIRE, several development models of the instrument will be built which will require testing & qualification in a terrestrial environment. Part of the test & qualification programme will commence in August 2000 at the Rutherford Appleton Laboratory and will require a cryostat to emulate the spacecraft cryogenic environment.

The SPIRE calibration cryogenic system performs a critical role providing the necessary cooling for a low noise receiver instrument. It is vital for successful operation of the instrument that the cryogenic system provides appropriate thermal cooling capacity and stability, mechanical robustness and a high degree of reliability. Furthermore be sufficiently simple to ensure minimum and straightforward instrument integration, operation and maintenance. Further details of the calibration facility requirements and the design concept are given in RD 1.

4 Test Cryoharness Description

The cryoharness is the internal harness between the SPIRE DRCU and the JFET boxes and FPU and is functionally representative of the flight harness. The harness will consist of two main sections. An airside section running from the cryostat wall to the warm electronics, and a vacuum side harness from the tank wall at 300K, through the 77K and 10K shields to the cold electronics at 4K. The design of the harness is simplified by separating the harness into a number of identical smaller items for the detector signals and a separate harness for power. Furthermore, thermal model calculations have shown that with adequate clamping arrangements, the heat load into the SPIRE instrument can be kept below the 5mW limit. The eventual design will be based on the flight model harness specification.

5 Harness Specification

5.1 Cold Harness

Harness between cryostat vacuum interface and SPIRE cold electronics. This is equivalent to the cold harness defined in AD 1, labelled C1 to C13. The warm end of the harness will be at room temperature (approximately 300K) and the cold end of the harness at 10K. To minimise the heat load at the instrument cold interface, the test harness will be clamped at the 77K radiation shield and 10K shield before connecting to the instrument.

5.1.1 Definition

The definition of the layout and connector pin-outs required for the cryogenic harness is given in §4.3 of the instrument harness definition

5.1.2 Length

The overall length of the cold-harness will be between 3m and 3.5m to ensure that the line resistances are within the specified limits. The eventual lengthand routing of the harness will be specified by RAL.

5.1.3 Materials

The materials to be used for the cryoharness are listed below. The contractor will supply all raw materials with the exception of the 128 way connectors which will be issued free of charge by RAL.

5.1.3.1 Wire

The harness will be made up from 12 axis screened twisted pairs, each pair being insulated, all inside one braided shield inside, all inside an outer insulator.

38AWG manganin will be used for lines with maximum resiststance $\geq 200\Omega$

38AWG brass will be used for all lines with maximum resistance $20\Omega < R < 200\Omega$

30AWG brass will be used for all lines with maximum resistances $\leq 20\Omega$

5.1.3.2 Connectors

The vacuum interface connectors will be 128 circular plug of 38999 series type, part no. 340105601B06G2535SNL. These will be supplied free issue by RAL.

The connectors at the instrument end shall be MIL-C-83513 MDM connectors to be supplied by the contractor. The number and type of connector to be used is defined in §4.3.1 to §4.3.13 of AD 1.

5.1.3.3 Other

All materials used for the cryoharness must be suitable for vacuum and low temperature use. Recommended vacuum materials include:

- Stainless Steel
- Aluminium
- Copper
- Gold
- Manganin
- Brass

- Glass and Quartz
- Teflon
- Polymide (Trade named Vespel)
- Viton
- Carbon Composites
- Crystalline Filter Materials (e.g. MgF, LiF etc)
- Solder
- Kynar

Where materials not on this list are to be used (e.g. black paint, adhesives), their outgassing properties must conform to ESA and NASA outgassing rates as referenced in the SPIRE PA plan. The contractor must specify and seek approval from RAL of the materials to be used in the construction of the test harness.

5.2 Warm Harness

Harness between cryostat vacuum interface and SPIRE warm electronics. This is equivalent to the intermediate harness defined in AD 1, labelled I1 to I13. This harness will be at room temperature (approximately 300K).

5.2.1 Definition

The definition of the layout and connectors required for the cryogenic harness is given in §4.2 of the instrument harness definition

5.2.2 Length

The overall length of the warm-harness will be between 4m and 5m to ensure that the line resistances are within the specified limits. The eventual length and routing of the harness will be specified by RAL.

5.2.3 Materials

The materials to be used for the cryoharness are listed below. The contractor will supply all raw materials with the exception of the 128 way connectors which will be issued free of charge by RAL.

5.2.3.1 Wire

The harness will be made up from 12 axis screened twisted pairs, each pair being insulated, all inside one braided shield inside, all inside an outer insulator.

26AWG copper will be used for all harnesses.

5.2.3.2 Connectors

The vacuum interface connectors will be 128 way hermetic recepticle, of 38999 series type, part no. TVS07Y-25-35PN(W118). These will be supplied free issue by RAL.

The connectors at the instrument end shall be MIL-C-24308 D-type connectors to be supplied by the contractor. The number and type of connector to be used is defined in §4.2.1 to §4.2.13 of AD 1.

6 Testing

6.1 Electrical properties

Before delivery of the harness, the electrical resistance, impedance and inductance must be demonstrated to conform to the requirements in the Annex of AD 1.

6.2 Thermal cycling

Each harness should be undergo at least two thermal cycles to 77K to relieve any internal stresses. The electrical properties must be measured before and after each cycle and any changes in performance noted. Significant changes in the properties may lead to the harness being rejected.

6.3 Load testing

The harness will be disconnected from the SPIRE instrument a number of times during the lifetime of the harness. A test shall be performed on each harness to ensure that they are capable of withstanding light forces while being connected/disconnected. The electrical properties must be measured before and after the test and any changes in performance noted. Significant changes in the properties may lead to the harness being rejected.

A detailed design review shall take place prior to the manufacture with the supplier & members of the RAL SPIRE team present. Detailed manufacturing drawings will be supplied to RAL 1 week prior to the detail design review RAL will have the opportunity to comment & change the design as required.

7 Schedule

The SPIRE project has formally agreed milestone dates that have to be met if a launch in 2007 is to be achieved. Testing of the SPIRE instrument is planned to start August 2002 and requires a completed test harness. It is therefore necessary that the cryoharness be delivered to RAL by May 2002. The contractor should be able to demonstrate that they can meet this delivery date. A schedule showing the key activities and milestones will be provided by the contractor. The milestone dates should include the delivery of the materials, completion of the design drawings for review, start of manufacture, test and inspection points and final delivery.

8 Quality Assurance

SPIRE is an ISO9000 project and has to demonstrate that its quality control procedures are being followed as defined by the RAL product assurance dept. The SPIRE project does not require that the contractor is ISO9000 accredited, although the contractor should be able to demonstrate that quality control procedures are in place and being followed. The SPIRE project may wish to review the reports from key inspection points. The SPIRE project should be notified of all major non-conformances and changes to the agreed design. A certificate of conformance will be required as part of the delivery to RAL..

The final design of the harness shall be reviewed in detail by RAL prior to manufacture. Detailed manufacturing drawings will be supplied to RAL at least 2 weeks prior to the review so that RAL will have the opportunity to comment & change the design as required. Once the design has been accepted it will be placed under configuration control. If a change to the baseline design is required, an engineering change request must be submitted to RAL. A panel will consider the request and any likely repercussions to the project. If a requirement cannot be changed then a waiver may be requested.