UK Astronomy Technology Centre / SPIRE	**SPIRE BSM Declared Process List** **Procedure ID SPI-BSM-PRJ-708 ITEM #14** **Version no 1.3**	Ref: SPI-BSM-NOT0724 Page : Page 1 of 17 Date : 17June 2004 Author: BG

SPIRE BSM Declared Processes

Procedure ID SPI-BSM-PRJ-708 ITEM 14

Wiring

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Date:	17June 17, 2004
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Version Control

Date	Index	Remarks
20/05/04	1.1	Removed launch latch section changes to PCAL and temperature sensor wiring. Added staking posts (CTD 0318)
15/06/04	1.2	Add pictures showing staking posts and gluing of ties. (CTD 0322)
17/06/04	1.3	Update version numbers of AD/RDs

Table of Contents

Applicable documents

Applicable documents are project specific and may be assumed to apply fully to the BSM, unless stated otherwise

Ref	Title	Author	Reference	Date
AD 1	SPIRE BSM Declared Process List v 1.6	IP	SPI-BSM-PRJ-0708	15/06/04
AD 2	SPIRE ATC PA PLAN v1.2	BCG	SPI-BSM-PRJ-0711	09/06/03
AD 3	Assembly integration and test log		SPI-BSM-TMP-0003	
AD 4	Project Inspection log		SPI-BSM-TMP-0002	
AD 5				

Reference documents

Reference documents are generic and may only apply in part to the project, or may be for information or reference only.

Ref	Title	Author	Reference	Date
RD 1	SPIRE BSM Declared Materials List v1.5	IP	SPI-BSM-PRJ-0710	15/06/04
RD 2	The manual soldering of high-reliability electrical connections	ECSS	ECSS-Q-70-08A	06/08/99
RD 3	Quality Assurance	ECSS	ECSS-Q-20B	08/03/02
RD 4				
RD 5				
RD 6				
RD 7				

Glossary

Abbr	Definition	Abbr	Definition
AD	Applicable Document	LAM	Laboratoire d'Astrophysique de Marseille
ADP	Acceptance Data Package	LAT	Lot Acceptance Tests
ARB	The Acceptance Review Board	MAPTIS	Materials and Processes Technical Information Service
BSM	Beam Steering Mirror	MSFC	Marshall Space Flight Center
BSMe	Beam Steering Mirror electronics	MCU	Mechanism Control Unit
CAE	Computer Aided Engineering	MIP	Mandatory Inspection Point
CDR	Critical Design Review	MGSE	Mechanical Ground Support Equipment
CoG	Centre of Gravity	MPIA	Max Planck Institute for Astronomy

Abbr	Definition	Abbr	Definition
CIL	Critical Items List	MSSL	Mullard Space Science Laboratory
CQM	Cryogenic Qualification Model	NASA	National Aeronautical Space Agency
CTD	Change to Drawing/Document	NA	Not Applicable
DCL	Declared Components List	NCR	Non Conformance Report
DDR	Detailed Design Review	NCRP	Non Conformance Review Panel
DM	Development Model	OGSE	Optical Ground Support Equipment
DML	Declared Materials List	PA	Product Assurance
DPA	Destructive Physical Analysis	PAD	Part Approval Document
ECSS	European Cooperation for Space Standardisation	PFM	Proto Flight Model
EGSE	Electrical Ground Support Equipment	PPARC	Particle Physics and Astronomy Research Council
EEE	Electrical, Electronic, Electromichanical	PI	Principal Investigator
ESA	European Space Agency	QA	Quality Assurance
FMEA	Failure Modes and Effects Analysis	RAL	Rutherford Appleton Laboratory
FMECA	Failure Modes, Effects and Criticality Analysis	RAL SSD	RAL Space Science Department
FPGA	Field Programmable Gate Array	RD	Reference Document
FPU		SMEC	Spectrometer Mechanism
FSM		SPIRE	Spectral and Photometric Imaging REceiver
GSFC	Focal Plane Unit	STP	Screened twisted Pair
	Flight Spare model	STQ	Screened twisted quad
GSE	Ground Support Equipment	TBC	To Be Confirmed
HoS	Head of Specialism	TBD	To Be Defined
Herschel	ESA Mission name (formerly FIRST)	TBW	To Be Written
IBDR	Instrument Baseline Design Review	UK ATC	United Kingdom Astronomy Technology Centre
KIP	Key Inspection Point	UK SPO	UK SPIRE Project Office
		WE	Warm Electronics

1 Scope

This document will detail the requirements and method for wiring the SPIRE BSM cryogenic mechanism.

2 Introduction

The BSM must be wired and inspected by ESA qualified personnel adhering to the ECSS standards for manual soldering of high-reliability electrical connections (RD2) and Quality assurance (RD3).

The BSM has two complete sets of components and wire assemblies, Prime and Redundant. Some of the development models do not have a full set of redundant wiring.

3 materials

The following materials are to be used to wire up the BSM and assemblies.

Screened twisted pair wire – Cu TEK-021(30AWG), EEE callout.
Screened twisted quad wire – Cu TEK-020(30AWG), EEE callout.
Solder – 60/40 tin/lead solder, DML callout.
Lacing tape – Dacron (unwaxed), DML callout.
Heatshrink – Raychem RNF100 clear, EEE callout.

4 Process

The individual components (motors and sensors) will be wired separately with the wires potted before the mechanical build of the BSM. Once the components are fitted into the BSM they will be wired to the connector.

4.1 Assembly Integration and test log

All work must be recorded on the assembly integration and test log.

The assembly log will be started before the wiring process and will be supplied with the parts for wiring.

Check that the item and serial numbers on the assembly log are the same as the hardware.

Enter the task being done, your name and details of materials used including batch numbers.

Add any additional drawing numbers that are being used for the process.

Enter any comments especially if there were any problems encountered whilst performing the task.

4.2 Cleanliness

Wiring work on the SPIRE BSM must be performed either at the Laminar flow bench in the SPIRE lab or in the class 1000 cleanroom.

Gloves and a facemask must be worn when working on or handling the BSM.

If working in the cleanroom, cleanroom garments must also be worn and cleanroom procedures followed.

If working at the Laminar flow bench in the lab Tyvek arm covers must be worn.

Ensure that all flux is removed as per ECSS-Q-70-08A using Isopropal alcohol.

4.3 Inspection

All wiring work must be inspected by an inspector holding a valid ESA certificate giving authorsation to inspect conventional and surface-mount solder assemblies in conformance with ESA PSS-01-708, PSS-01-738 and ECSS-Q-70-08.

An inspection report must be filled out whilst the inspection is being performed.

On the report enter the part description, drawing number and version and the source of the work. The ATC workshop will include wiring work that is done by ATC wireman.

In the "summary of checks performed" section, check the quantity and check that the correct materials were used as stated above in section 3. Take a note of any items that do not conform to this document or the drawings.

In the notes section record any solder joints that are acceptable but at the limits giving the reasons. Also record any unacceptable solder joints again giving details of the non-conformance.

If there are any non-conformance issues raise a non-conformance report.

4.4 Motor assemblies

There are two types of motor assemblies, a Left hand and a Right hand assembly. There are also two of each type, one for chop and one for Jiggle giving four assemblies in total per model. Each of the assemblies consists of two motor coils, one prime and one redundant. In development models the redundant assembly is replaced by a mechanical dummy, which does not require wiring. Once the motor assemblies are wired up they must be inspected by an ESA qualified inspector before being potted.

4.4.1 Left hand motor assembly

Refer to the mechanical drawing SPIRE-BSM-023-005 and electronic drawing SPRE-BSM-025-001 for wiring this motor assembly.

Use screened twisted pair for all four connections, connecting both cores to the same pin.

Cut the outer insulation back enough that the screened wire sits in the channel directly under the coil, supported by the housing. The inner cores for the bottom pins (Pin 1 on the prime coil and Pin 2 on the redundant coil) feed straight up to the motor coils and are soldered onto the solder tabs. The inner cores for the other pins, feed round the right hand side of the motor housing in the groove provided, to the top pins.

Identify each of the screened twisted wires coming out of the motor assembly. For example PRIME PIN 1.

Connect each of the free ends to the cryostat connector and measure the coil resistances cold before potting the wires.

Pot the wires in place referring to SPI-BSM-NOT-0714.

4.4.2 Right hand motor assembly

Refer to the mechanical drawing SPIRE-BSM-023-006 and electronic drawing SPRE-BSM-025-001 for wiring this motor assembly.

Use screened twisted pair for all four connections, connecting both cores to the same pin.

Cut the outer insulation back enough that the screened wire sits in the area directly under the coil, supported by the housing. The inner cores for the bottom pins (Pin 1 on the redundant coil and Pin 2 on the prime coil) feed straight up to the motor coils and are soldered onto the solder tabs. The inner cores for the other pins, feed round the left hand side of the motor housing, in the groove provided, to the top pins.

Identify each of the screened twisted wires coming out of the motor assembly. For example PRIME PIN 1. Connect each of the free ends to the cryostat connector and measure the coil resistances cold before potting the wires.

Pot the wires in place referring to SPI-BSM-NOT-0714.

4.5 Sensor assemblies

There are four sensor assemblies, prime and redundant Jiggle and Prime and redundant Chop. Once the sensor assemblies are wired they must be inspected by an ESA qualified inspector before being potted.

4.5.1 Jiggle sensor assemblies

Refer to mechanical drawing SPIRE-BSM-023-007 and electronic drawing SPIRE-BSM-025-001.

The Jiggle sensor housings are left and right handed with an extended section to one side with a wiring groove channeled into it.

Use screened twisted pair and screened twisted quad cables to connect to the Jiggle sensors.

Fit the sensor into the housing as illustrated in drawing SPIRE-BSM-023-007, ensuring that the centre tab points along the wiring groove in the housing.

On the right handed version pin one will be at the top and on the left handed it will be at the bottom as illustrated in the mechanical drawing.

Cut the outer insulation back enough so that the screened wire sits in the vertical groove in the sensor housing.

Route the internal cores round the groove in the housing and solder onto the sensor tabs.

Connect the red wires from both the STP and STQ to pin 1, and the black wires to pin 3. The white wire from the STQ connects to pin 2.

Pot the wires in place referring to SPI-BSM-NOT-0717

4.5.2 Chop sensor assemblies

Refer to mechanical drawing SPIRE-BSM-023-007 and electronic drawing SPIRE-BSM-025-001.

The chop sensor housings are the same for both the prime and redundant sensors.

Fit the sensor into the housing as illustrated in drawing SPIRE-BSM-023-007. Place one of the sensors with the centre tab pointing right and one with it pointing left, making the sensor assemblies right and left handed.

On the right handed version pin one will be at the top and on the left handed it will be at the bottom, as illustrated in the mechanical drawing.

Using the inner cores from the STQ having removed the outer insulation and screen connect the a 150mm length of red wire to pin 1, white to pin 2 and black to pin 3.

Route the wires so that they come out from the assembly in the same direction that the centre tab is pointing as shown in the mechanical drawing.

Pot the wires in place referring to SPI-BSM-NOT-0717

4.6 BSM wiring

Refer to photographs in appendix A to assist in the wiring of the BSM. This photograph shows the wiring routing for the different components. In the actual BSM we will be using screened twisted pair and quad wires rather than individual cores as seen in the photograph.

Refer to the electronics schematic SPIRE-BSM-025-001 for the connection details.

Place heat-shrink sleeving over all groups of wires where they pass through holes to prevent the wires from rubbing on the edges of the holes, ensure that the sleeving is shrunk onto the wires without leaving air pockets.

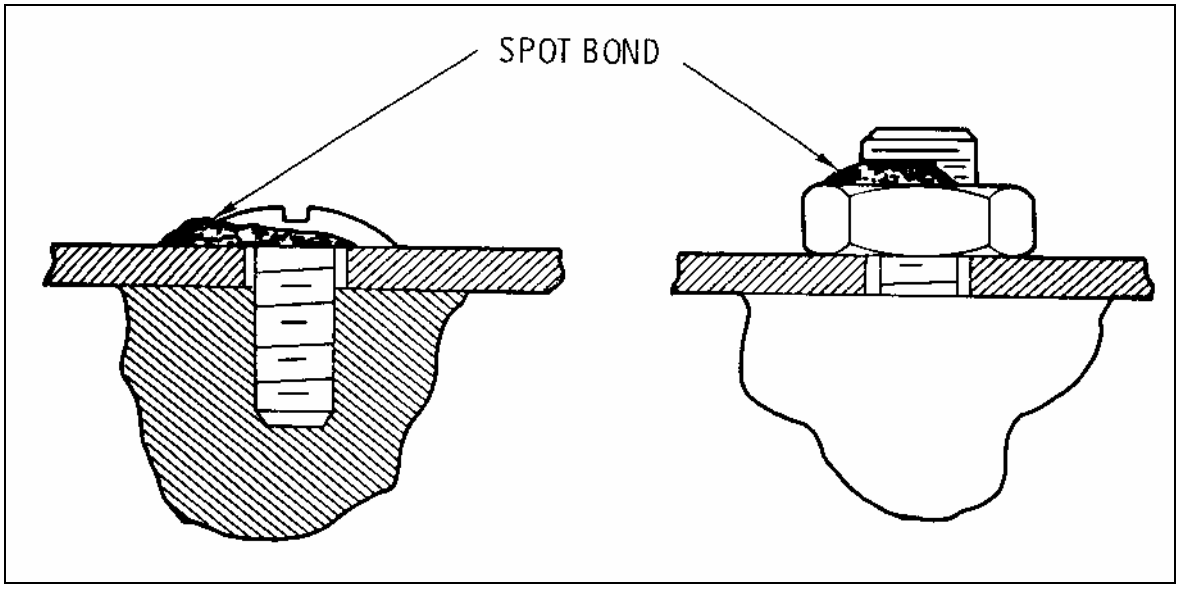
The following sections detail the routing of the wires and where they are fixed, it may be more suitable to rout the wires before securing them to the fixing points detailed.

Tie the wires using lacing cord.

All ties must be secured by gluing them with staking compound, Scotch-weld 2216 B/A Grey.

Secure the wires coiled in the area next to the connectors to staking posts using lacing cord.

Stake the connector nuts, they are not locked, using staking compound Scotch-weld 2216 B/A Grey. Apply a spot bond covering 25 – 50% of the fastener circumference as illustrated below



4.6.1 Chop Motor

4.6.1.1 Chop motor (upper)

The chop motor (upper) is a right handed motor assembly. It will be fixed to the front of the BSM with the wires passed through to the back.

Tie all of the wires to fixing point 8, shown in the photographs in appendix A. Leaving enough slack to produce a loop so that the wires do not rub against the launch latch.

Leave the pin 2 wires flying at this point and feed the pin 1 wires through hole H1

Loop the prime pin 1 wires round the prime loop and attach to the prime connector as per the schematic diagram.

Loop the redundant wires round the redundant wire loop and attach to the redundant connector as per the schematic diagram.

4.6.1.2 Chop motor (lower)

The chop motor (lower) is a left handed motor assembly. It will be fixed to the front of the BSM with wires passed through to the back.

Tie the pin 2 wires to fixing point 6 and pass the pin 1 wires through hole H1.

Loop the prime pin 1 wires round the prime loop and attach to the prime connector as per the schematic diagram.

Loop the redundant wires round the redundant wire loop and attach to the redundant connector as per the schematic diagram.

4.6.1.3 Chop motor interconnection

The pin 2 wires from the upper and lower motor assemblies are soldered together.

Make an in line connection for both of the cores of the twisted pair wire, connecting like colours together. Refer to ECSS-Q70-08A section 9.9.

Tie the pin 2 wires to fixing point 7.

4.6.2 Jiggle Motor

The Jiggle motor (RH) will be fixed to the front of the BSM with the wires passed through to the back.

Leave the pin 2 wires flying at this point.

Loop the prime pin 1 wires round the prime loop and attach to the prime connector as per the schematic diagram.

Loop the redundant wires round the redundant wire loop and attach to the redundant connector as per the schematic diagram.

4.6.2.1 Jiggle motor (LH)

The Jiggle motor (LH) will be fixed to the front of the BSM with wires passed through to the back.

Leave the pin 2 wires flying at this point.

Loop the prime pin 1 wires round the prime loop and attach to the prime connector as per the schematic diagram. Refer to ECSS-Q70-08A section 9.9.

Loop the redundant wires round the redundant wire loop and attach to the redundant connector as per the schematic diagram.

4.6.2.2 Jiggle motor interconnection

The pin 2 wires from the LH and RH motor assemblies are soldered together.

Make an in line connection for both of the cores of the twisted pair wire, connecting like colours together.

Tie the wires down at fixing point 3 (p-clip)

4.6.3 Chop sensors

CAUTION Take extreme care when handling the flexi tapes. These are delicate and expensive with no spares.

4.6.3.1 Prime sensor

The prime sensors will have flying leads at the front of the BSM, tie these to the Jiggle frame and solder onto the Prime sensor connector mounted on the side of the Jiggle frame.

A flexi tape will pass through to the back of the BSM where it will be connected to another connector mounted in a bracket.

Solder the screened wires to this connector and pass through hole H2.

Loop the wires round the prime loop and attach to the prime connector.

4.6.3.2 Redundant sensor

The redundant sensors will have flying leads at the front of the BSM, tie these to the Jiggle frame and solder onto the redundant sensor connector mounted on the side of the Jiggle frame.

A flexi tape will pass through to the back of the BSM where it will be connected to another connector mounted in a bracket.

Solder the screened wires to this connector and pass through hole H2.

Loop the wires round the redundant loop and attach to the redundant connector.

4.6.4 Jiggle position sensors

4.6.4.1 Prime sensor

The prime sensor will be mounted on the front of the BSM with wires passing through to the back.

Tie the wires to fixing points 10 and 9.

Pass the wires through hole H2.

Loop the wires round the prime loop and connect to the prime connector.

4.6.4.2 redundant sensor

The redundant sensor will be mounted on the front of the BSM with wires passing through to the back.

Pass the wires through hole H2.

Loop the wires round the redundant loop and connect to the redundant connector.

4.6.5 PCAL

The connections to the PCAL unit will be performed by RAL after delivery.

4.6.5.1 Prime PCAL

Attach the prime wires to the prime connector.

Loop the wires round the prime wire loop and pass through hole H1

Leave flying wires to be attached to PCAL at a later date.

4.6.5.2 Redundant PCAL

Attach the redundant wires to the prime connector.

Loop the wires round the redundant wire loop and pass through hole H1

Leave flying wires to be attached to PCAL at a later date.

4.6.6 Launch latch

The launch latch is no longer installed.

4.6.7 Temperature sensor

The temperature sensors will be fitted and wired by RAL after delivery.

4.6.7.1 Prime temperature sensor

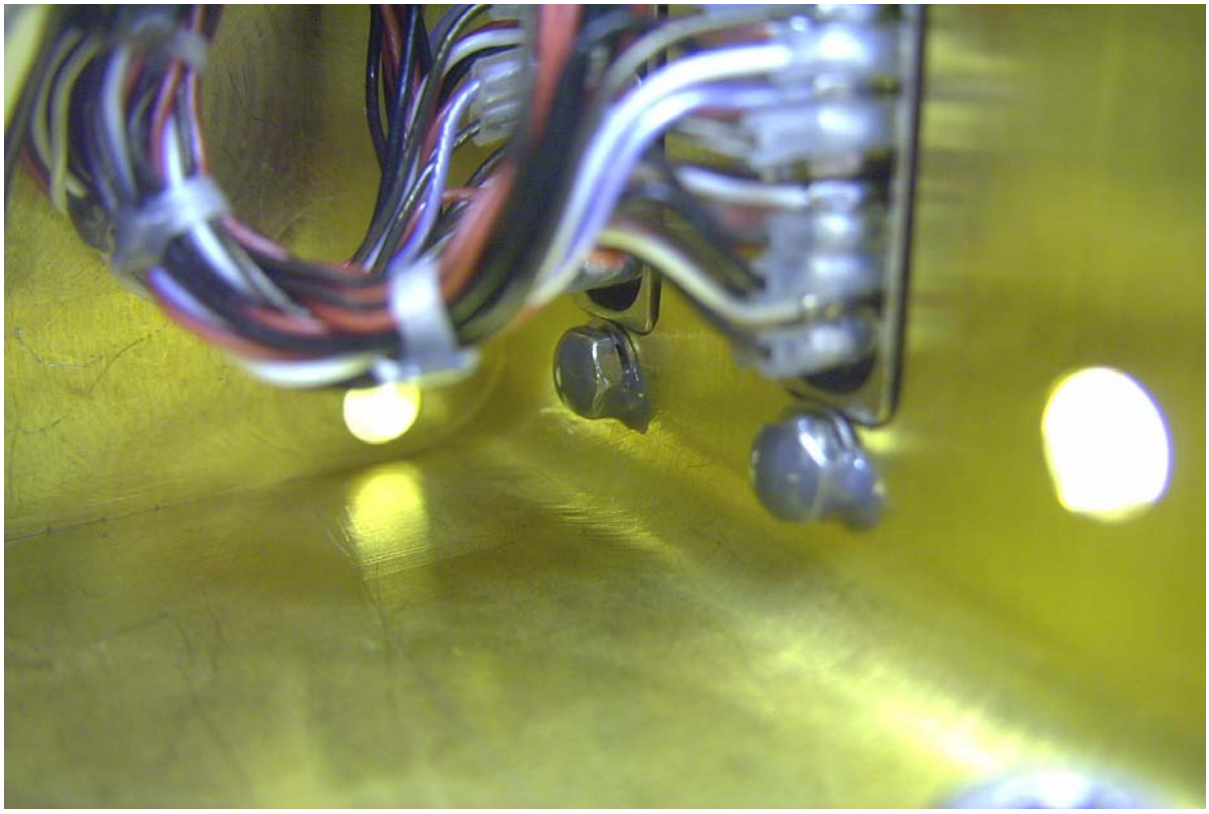
- Attach the prime wires to the prime connector.
- Loop the wires round the prime wire loop and pass through hole H1
- Leave flying wires to be attached to the temperature sensor at a later date.

4.6.7.2 Redundant temperature sensor

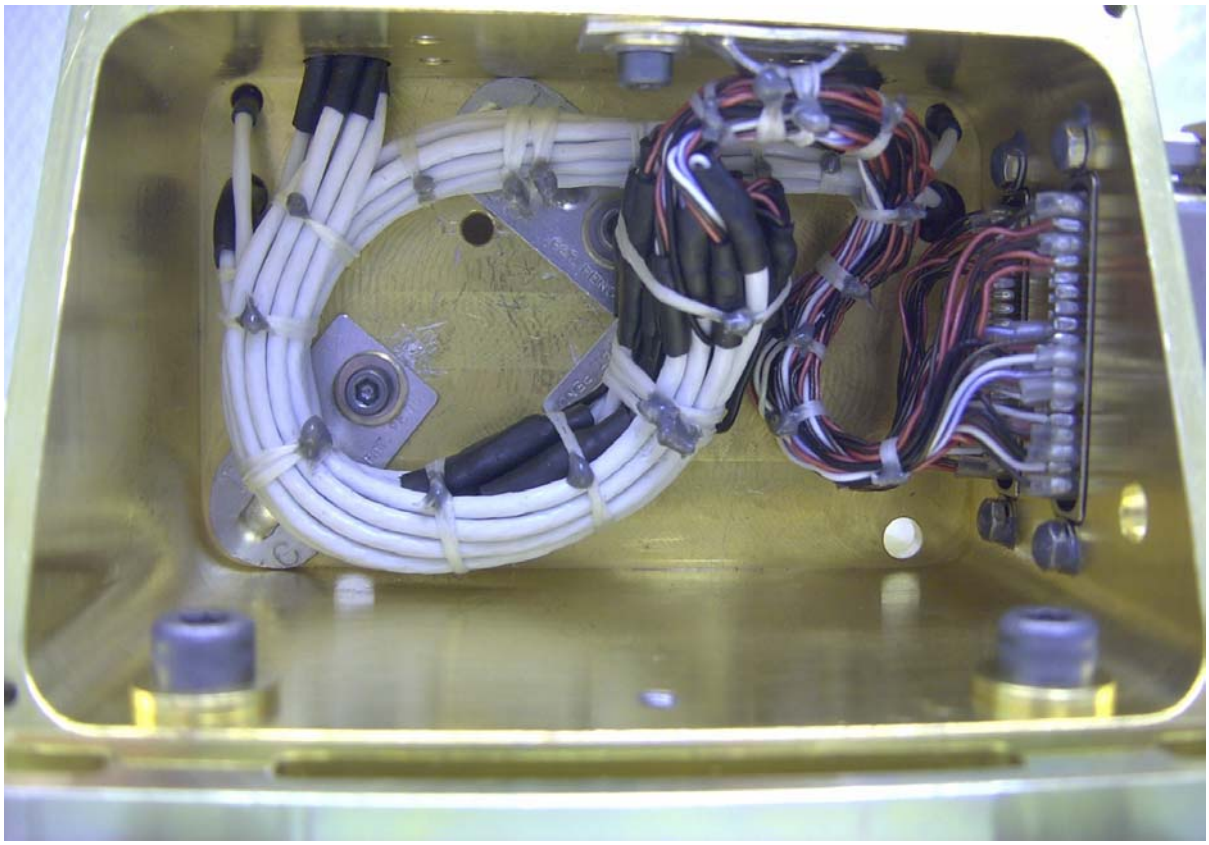
Attach the redundant wires to the prime connector.

Loop the wires round the redundant wire loop and pass through hole H1
Leave flying wires to be attached to the temperature sensor at a later date.

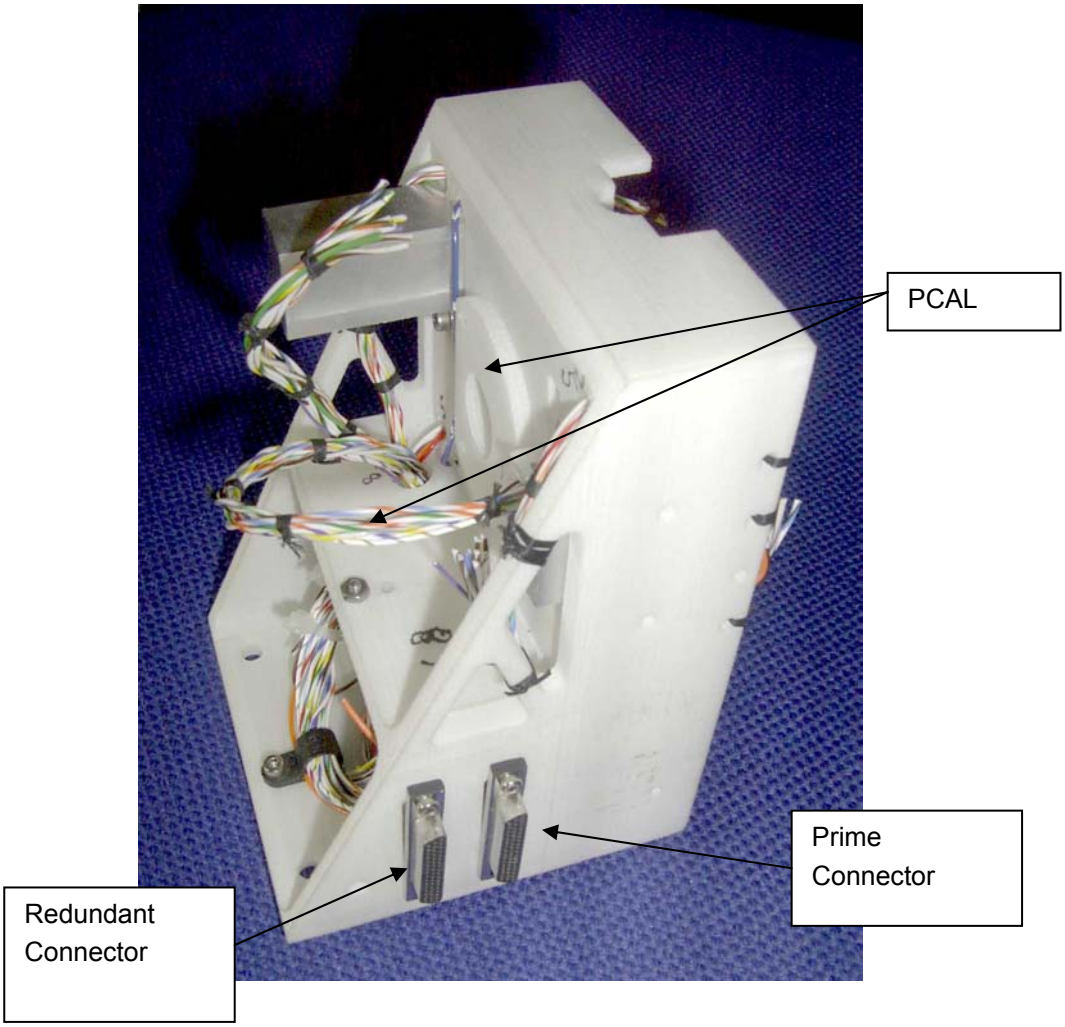
5 Appendix A

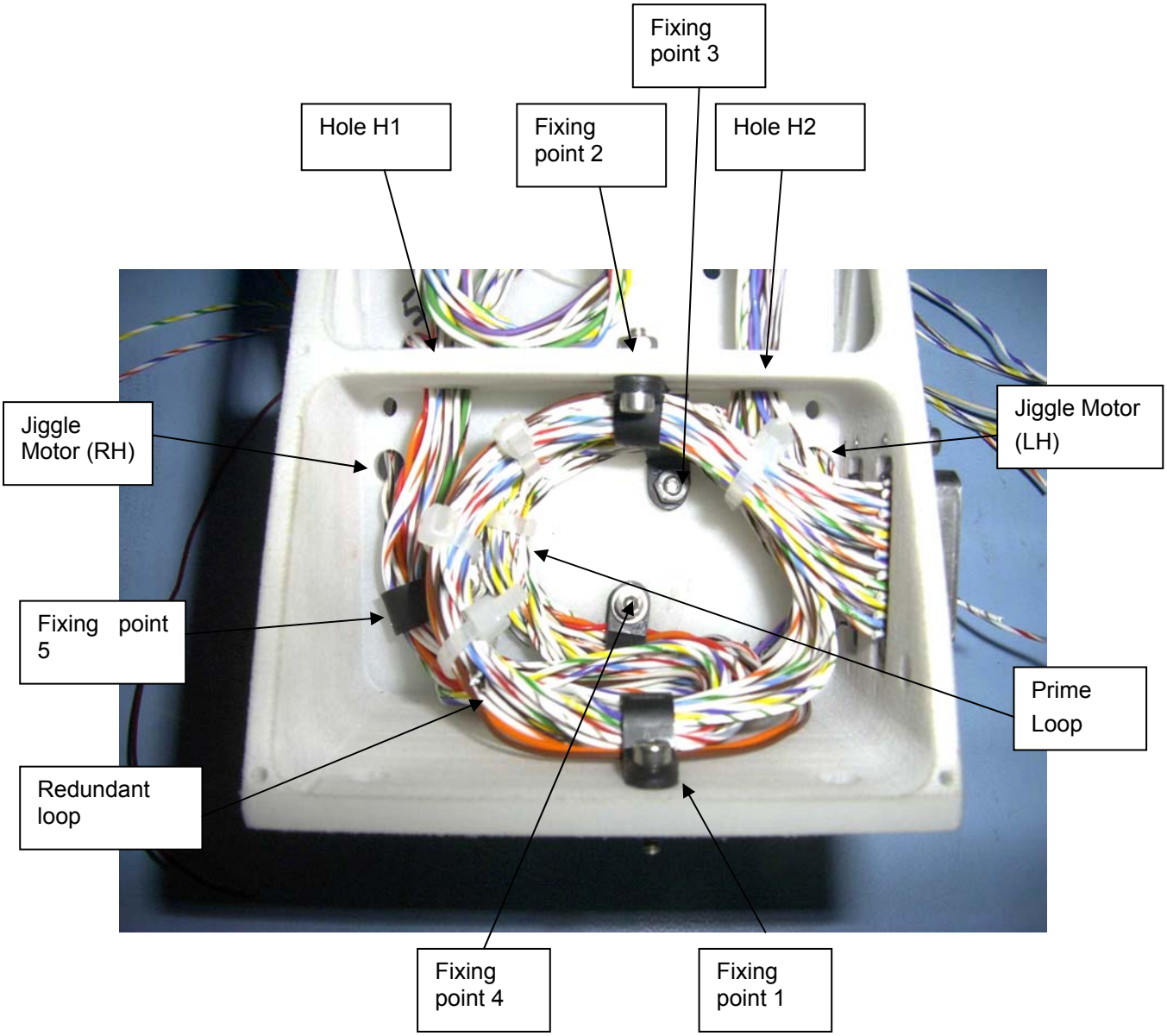


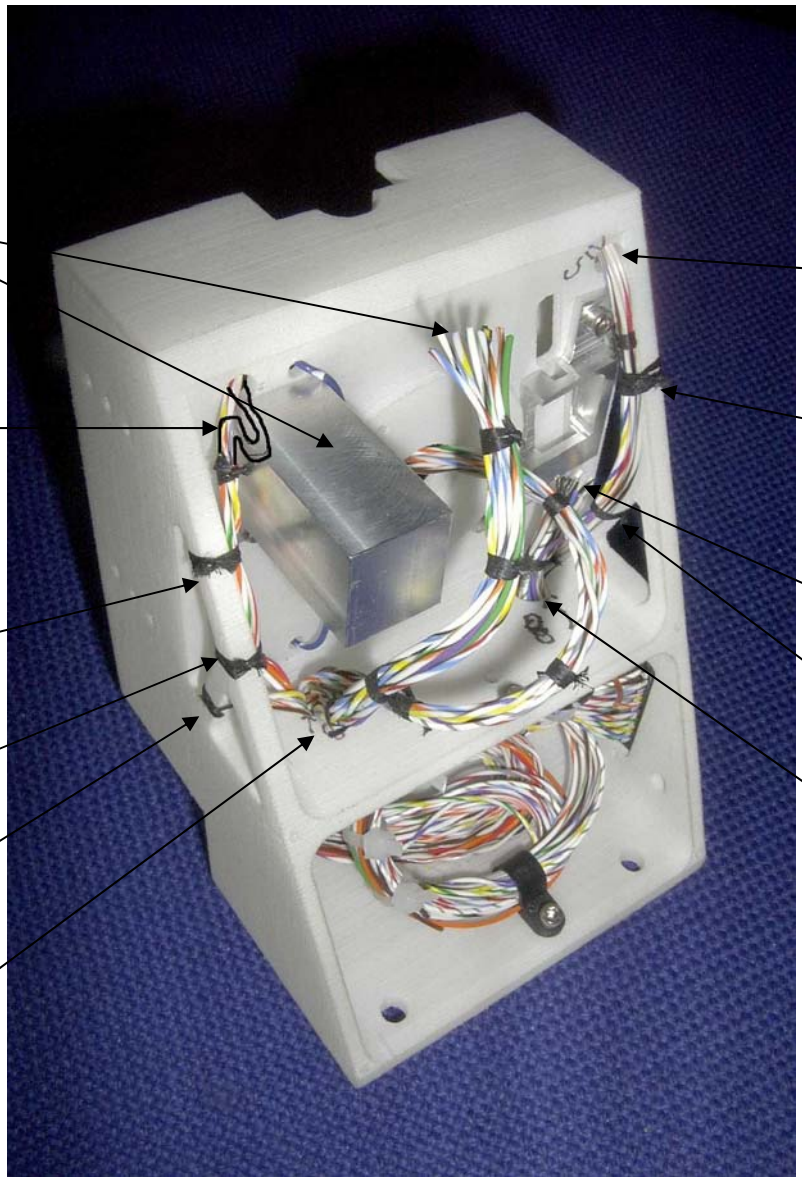
Staking of connector fasteners



Wiring tied to staking posts and tie knots staked.


PCAL
Prime Connector
Redundant Connector


Fixing point 3
Hole H1
Fixing point 2
Hole H2
Jiggle Motor (RH)
Jiggle Motor (LH)
Fixing point 5
Prime Loop
Redundant loop
Fixing point 4
Fixing point 1


Launch Latch
Chop motor (upper)
Fixing point 8
Fixing point 7
Fixing point 6
Hole H1
Jiggle sensor (Prime)
Fixing point 10
Chop sensor
Fixing point 9
Hole H2