300mK Strap Supports

Photometer Support Assembly Procedure

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08/02/03	1.0	First Issue for DDR

List of Acronyms

Term	Meaning	Term	Meaning
AD	Applicable Document	IR	Infrared
ADC	Analogue to Digital Converter	IRD	Instrument Requirements Document
AIV	Assembly, Integration and Verification	IRTS	Infrared Telescope in Space
AME	Absolute Measurement Error	ISM	Interstellar Medium
AOCS	Attitude and Orbit Control System	JFET	Junction Field Effect Transistor
APART	Arizona's Program for the Analysis of Radiation Transfer	ISO	Infrared Space Observatory
APE	Absolute Pointing Error	LCL	Latching Current Limiter
ASAP	Advanced Systems Analysis Program	LIA	Lock-In Amplifier
ATC	Astronomy Technology Centre, Edinburgh	LVDT	Linear Variable Differential Transformer
AVM	Avionics Model	LWS	Long Wave Spectrometer (an instrument used on ISO)
BDA	Bolometer Detector Array	MAC	Multi Axis Controller
BFL	Back Focal Length	MAIV	Manufacturing, Assembly, Integration and Verification
BRO	Breault Research Organization	MCU	Mechanism Control Unit = HSMCU
BSM	Beam Steering Mirror	MGSE	Mechanical Ground Support Equipment
CBB	Cryogenic Black Body	M-P	Martin-Puplett
CDF	Cardiff, Department of Physics & Astronomy	NEP	Noise Equivalent Power
CDMS	Command and Data Management System	NTD	Neutron Transmutation Doped
CDMU	Command and Data Management Unit	OBS	On-Board Software
CDR	Critical Design Review	OGSE	Optical Ground Support Equipment
CEA	Commissariat a l'Energie Atomique	OMD	Observing Modes Document
CMOS	Complimentary Metal Oxide Silicon	OPD	Optical Path Difference
CoG	Centre of Gravity	PACS	Photodetector Array Camera and Spectrometer
CPU	Central Processing Unit	PCAL	Photometer Calibration source
CQM	Cryogenic Qualification Model	PFM	Proto-Flight Model
CVV	Cryostat Vacuum Vessel	PID	Proportional, Integral and Differential (used in the context of feedback control loop architecture)
DAC	Digital to Analogue Converter	PLW	Photometer, Long Wavelength
DAQ	Data Acquisition	PMW	Photometer, Medium Wavelength
DCU	Detector Control Unit = HSDCU	POF	Photometer Observatory Function
DDR	Detailed Design Review	PROM	Programmable Read Only Memory
DM	Development Model	PSW	Photometer, Short Wavelength
DPU	Digital Processing Unit = HSDPU	PUS	Packet Utilisation Standard
DSP	Digital Signal Processor	RAL	Rutherford Appleton Laboratory,
DQE	Detective Quantum Efficiency	RD	Reference Document
EDAC	Error Detection and Correction	RMS	Root Mean Squared
EGSE	Electrical Ground Support Equipment	SCAL	Spectrometer Calibration Source
EM	Engineering Model	SCUBA	Submillimetre Common User Bolometer Array
EMC	Electro-magnetic Compatibility	SED	Spectral Energy Distribution
EMI	Electro-magnetic Interference	SMEC	Spectrometer Mechanics
ESA	European Space Agency	SMPS	Switch Mode Power Supply
FCU	FCU Control Unit = HSFCU	SOB	SPIRE Optical Bench
FIR	Far Infrared	SOF	Spectrometer Observatory Function
FIRST	Far Infra-Red and Submillimetre Telescope	SPIRE	Spectral and Photometric Imaging Receiver
FOV	Field of View	SRAM	Static Random Access Memory
F-P	Fabry-Perot	SSSD	SubSystem Specification Document
FPGA	Field Programmable Gate Array	STP	Standard Temperature and Pressure
FPU	Focal Plane Unit	SVM	Service Module
FS	Flight Spare	TBC	To Be Confirmed
FTS	Fourier Transform Spectrometer	TBD	To Be Determined
FWHM	Full Width Half maximum	TC	Telecommand
GSFC	Goddard Space Flight Center	URD	User Requirements Document
HK	House Keeping	UV	Ultra Violet
HOB	Herschel Optical Bench	WE	Warm Electronics
HPDU	Herschel Power Distribution Unit	ZPD	Zero Path Difference
HSDCU	Herschel-SPIRE Detector Control Unit		
HSDPU	Herschel-SPIRE Digital Processing Unit		
HSFCU	Herschel-SPIRE FPU Control Unit		
HSO	Herschel Space Observatory		
IF	Interface		
IID-A	Instrument Interface Document - Part A		
IID-B	Instrument Interface Document - Part B		
IMF	Initial Mass Function		

Table of Contents

1. Scope

This document presents the assembly procedure for the 300mK photometer thermal strap supports. Note that this document will soon be updated with step-by-step photographs of the entire assembly sequence.

2. Documents

2.1. Applicable documents

All applicable documents are listed in the AD chapter of the CIDL (HSO-CDF-LI-029).

2.2. Reference documents

3. 300mK Photometer Bus-Bar Support Assembly Procedure

3.1. Assemble photometer support base

Assemble the photometer support base as shown in
Annotated photos of base – indicate bolts & torques…..
Part numbers…..

3.2. Assemble & compress hub

3.2.1. Hub preparation

Stack Belleville spring washers on central hub assembly as shown in Figure 1. A total of twelve Belleville washers are used in this arrangement. Stainless steel disc spring washers (Belleville springs LTD, Worcestershire) are used, part number S105204.

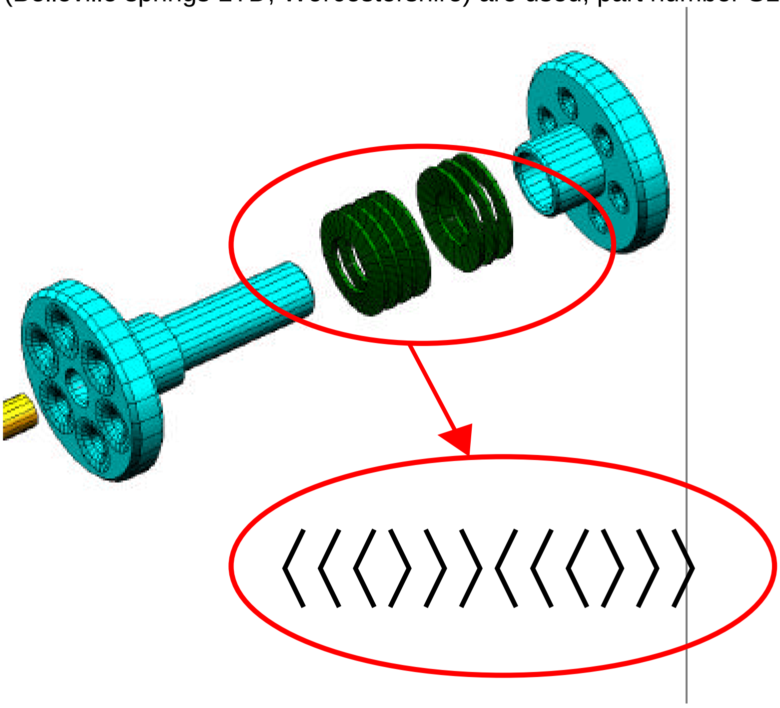

Figure 1 Stacking arrangement of Belleville spring washers on central hub.

3.2.2. Hub alignment & compression

Insert M3 bolt, align hub components, and fully compress hub by applying a torque of ???Ncm to the M3 nut, as shown in Figure 2. When the hub is “fully compressed” in this manner, the resultant compression of the Belleville spring stack is ~90%. The compression force in this situation is approximately 932N.

KIP – Note the distance between the inner faces, indicated in Figure 2

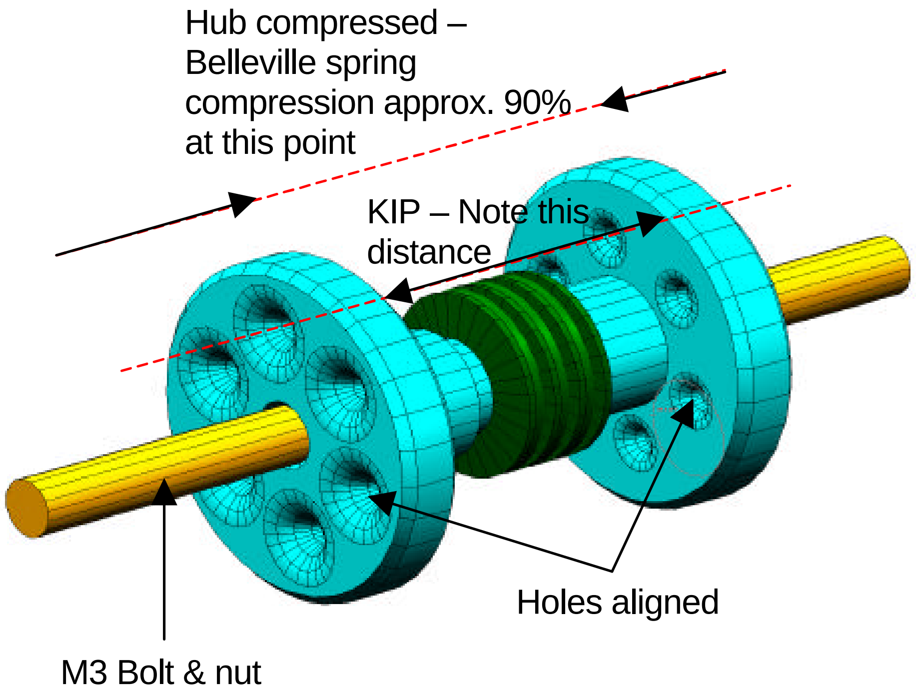

Figure 2 Alignment and compression of central hub assembly.

3.3. Kevlar Lacing

The photometer support system employs two individual Kevlar cords to support the central hub. These cords work in opposition to maintain tension. The routing for the cords is symmetric, as shown in Figure 6, and therefore the lacing procedure is the same for each cord.

3.3.1. Cord preparation

The Kevlar cord (Kevlar 11, Cousin Filterie) is cut to >30cm length, and the ends are sealed with GE varnish. This sealing is purely to contain the fibres and hence aid lacing. No section of cord treated with GE varnish will be in the final assembly.

3.3.2. Starting at fixed capstan

The Kevlar is tied to the fixed capstan (Figure 3) using an adjustable jamming hitch, as shown in Figure 4. The Kevlar is then wrapped around the capstan at least four times, as shown in Figure 5. For convenience while lacing the rest of the structure, the Kevlar-wrapped capstan is temporarily wrapped with Kapton tape to prevent the Kevlar coils from spilling off the capstan.

3.3.3. Kevlar lacing

The Kevlar is laced according to Figure 6. This cord will be terminated on the adjustable capstan on the same side of the assembly as the starting capstan, but only after the second cord is laced and the alignment caps are in place (see later). The second cord is laced in the same way as the first, starting from the fixed capstan on the other side of the assembly, and following steps 3.3.1 to 3.3.3.

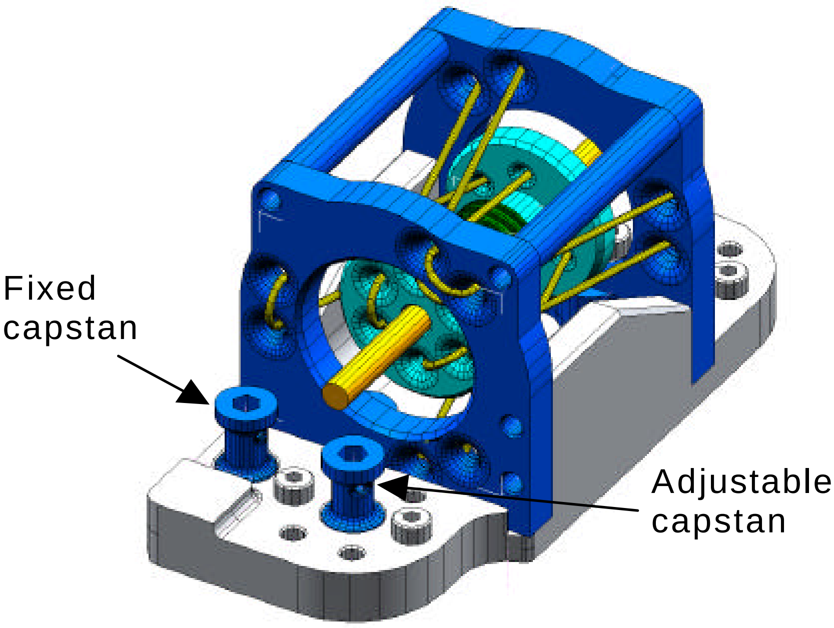

Figure 3 Support overview, showing capstans

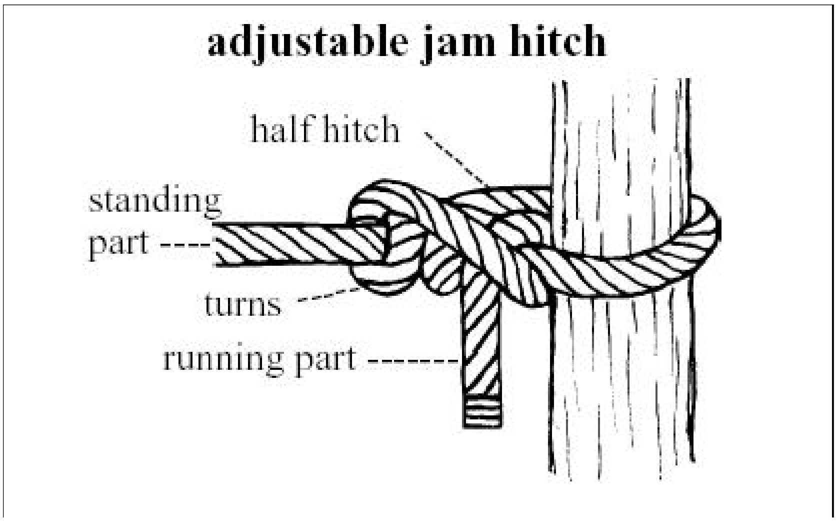

Figure 4 Detail of knot used to tie Kevlar to capstans.

Figure 5 Details of Kevlar wrapping around fixed capstan at start of run.

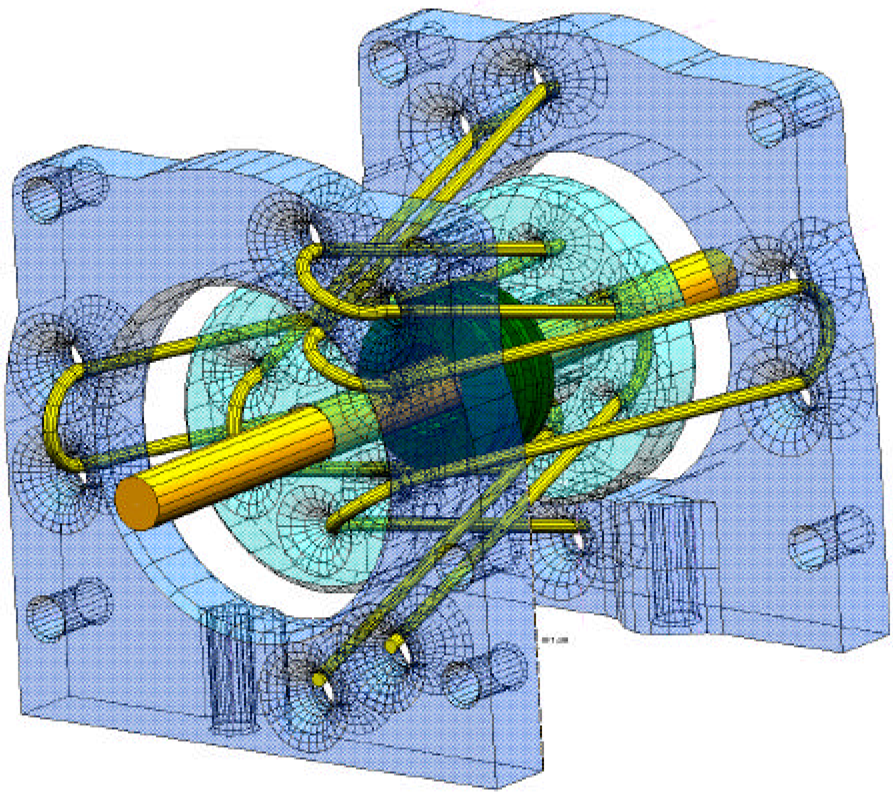

Figure 6 Kevlar routing

3.3.4. Hub alignment

With the Kevlar cords laced, but un-terminated on the adjustable capstans, the alignment caps are placed on the support assembly to hold the central hub aligned with respect to the support structure. A view of the support assembly with an alignment cap in place is shown in Figure 7.

3.3.5. Termination on adjustable capstans

With the alignment caps in place, the two free ends of Kevlar cord, one on each side of the assembly, are pulled hand tight. The ends of the cords are then tied to their respective adjustable capstans using an adjustable jam hitch (Figure 4), leaving 3cm of “slack” Kevlar. This is to ensure that there is enough slack to allow at least four turns of cord around the adjustable capstan. Each adjustable capstan is then turned, carefully winding the slack cord onto it, ensuring that no cord is overlapping another. Finally, the initial pre-tension is set by winding each capstan to a torque of 60±5Ncm and locking the capstan with two bolts, as shown in Figure 8. Note that the central hub compression has NOT been released at this point. The temporary kapton tape should be removed from the fixed capstans, and the excess cord on all capstans trimmed to leave 10mm cord free.

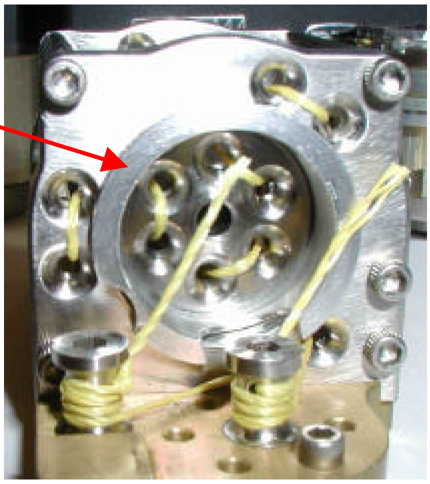

Figure 7 View of support assembly showing on

e of the alignment caps in place.

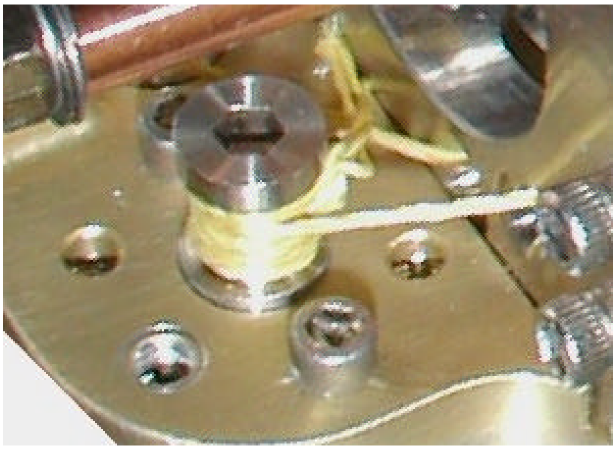

Figure 8 Kevlar terminated on adjustable capstan

3.3.6. Kevlar pre-conditioning

Experiments at JPL have indicated a benefit from pre-conditioning of Kevlar cords by baking under tension. Additionally, there is a significant amount of friction between the cords and the radiused holes through which the cords pass. This friction can lead to small differences in the tensions in individual Kevlar runs which could potentially lead to slight misalignment of the central hub. Therefore, the following procedure is followed, with the alignment caps in place throughout:-

- Thermal shock of entire assembly – immerse in liquid nitrogen for 10 minutes
- Bake out entire assembly at 80°C for 24 hours. The Kevlar is under relatively low tension from the torque applied to the adjustable capstans in step 3.3.5.

3.3.7. Final tensioning and conditioning

The compression of the central hub can now be released by removing the axial M3 nut & bolt. Care should be taken to avoid twisting the hub when undoing the bolt. Note that the alignment caps should still be in place throughout this procedure. The whole assembly should then be immersed in liquid nitrogen for 10 minutes, followed by another bake at 80°C for 24 hours. The alignment caps can now be removed.

KIP – Note the new distance between the hub inner faces, as indicated in Figure 2

3.3.8. Cleaning procedure