GRAVITY PROBE B

PROCEDURE FOR

PAYLOAD VERIFICATION II

(PTP) LOW TEMPERATURE, ULTRA-HIGH VACUUM BAKEOUT

Procedure No. P0*547 Rev. –*

1/24/10

Prepared by: *D. Meriwether*

Approvals:

Program Responsibility	Signature	Date
D. Meriwether Test Author		
Chris Gray GMA REE		
D. Murray Test Leader		
B. Muhlfelder ECU Integration Manager		
M. Taber Payload Test Director		
R. Brumley Payload Technical Manager		
B. Bencze Payload Electronics Manager		
R. Whelan System Engineering		
D. Ross GP-B Quality Assurance		

NOTES:

Level of QA required during performance of this procedure:
_X_ Stanford QA Representative
___ Government QA Representative

- Any red lines to the procedure shall require the approval and initial of the Test Author and Stanford QA prior to implementation.
- Stanford QA must be notified at least 24 hour before beginning this procedure.
- ONR must be emailed before beginning this procedure.
- A Quality Assurance representative or their designated representative shall be present during this procedure and shall review any discrepancy noted during assembly or test.
- Test Configuration is not to be changed or broken without approval of QA.
- Upon completion of this procedure, Quality Assurance will certify his/her concurrence that the effort was preformed and accomplished in accordance with the prescribed instructions by signing and dating.
- Discrepancies will be recorded in a D-log or as a DR per Quality Plan P0108

Revision Record:

Rev	Rev Date	ECO #	Summary Description

Acronyms and Abbreviations:

Acronym / Abbreviation	**Meaning**
ECU Monitor Mnemonics	
BE_XXXXX_XXXXXX	Binary Word Monitor
CE_XXXXX_XXXXXX	Current Monitor
DE_XXXXX_XXXXXX	Digital Word Monitor
TE_XXXXX_XXXXXX	Temperature Monitor
TE_XXXXX_X**GT**XXX	GRT TYPE Thermometer
TE_XXXXX_X**PT**XXX	PRT TYPE Thermometer
TE_XXXXX_X**ST**XXX	SDT TYPE Thermometer
TE_XXXXX_XXXXX**D**	Dewer located Thermometer
TE_XXXXX_XXXXX**P**	Probe located Thermometer
TE_XXXXX_XXXXX**Q**	Quartz Block located Thermometer
VE_XXXXX_XXXXXX	Voltage Monitor

CCCA	Command & Control Computer Assembly
CSTOL	Colorado Spacecraft Test and Operations Language
ECU	Experimental Control Unit
EPS	Electrical Power Subsystem
FEU	Flight Equivalent Unit
FSW	Flight Software
FTP	file transfer protocol
GMA	Gas Management Assembly
GP-B	Gravity Probe B
ICD	Interface Control Document
MOC	Mission Operations Center
MSS	Mission Support Software

OASIS-CC	Operations and Science Instrument Support – Command and Control
ONR	Office of Naval Research
PDU	Power Distribution Unit
QA	Quality Assurance
RTC	Real-Time Commands
SPC	Stored Program Commands
TCP/IP	Transmission Control Protocol over Internet Protocol
Tlm	Telemetry
UPS	Uninteruptable Power System
VAC	Volts AC

Table of Contents

A Scope

This is the procedure for low temperature bakeout process as per the Preliminary Low Temperature Bakeout Timeline procedure, M.Taber, 10/17/96. This process involves heating the interior surfaces of the probe to approximately 6-7 Kelvin while the Vatterfly valves are open to vacuum in order to desorb and remove the helium which has condensed and been adsorbed onto these surfaces during spinup of the Gyroscopes. After deabsorption, the Vatterfly Valves are closed and the heaters are turned off allowing the probe temperature to drop back to it's nominal value of 2.5 K. This will have the effect of reducing the He partial pressure to a value below the requirements of 1.3×10^{-9} pa (10^{-11} torr). The bakeout process involves the following heaters and thermometers.

Operation Order	Heater Location	Heater (backup)	Thermometer (backup)
1	Quartz Block Support (QBS)	H-05P (H-06P)	T-10P (T-11P)
2	Vacuum Shell	H-08P (H-09P)	T-13P (T-14P)
3	Cryopump	H-10P (H-11P)	T-15P (T-16P)
4	Pressure Sense Line	H-14P (H-15P)	T-19P (T-20P)
5	Plumbing Saddle	H-12P (H13P)	T-17P (T-18P)
6	Spinup Filter (G1 & 2)	H-01P (H-02P)	T-06P (T-07P)
7	Spinup Filter (G3 & 4)	H-03P (H-04P)	T-08P (T-09P)

B Requirements Verification

Requirements Cross Reference

Expected Data for verification per requirement

B.1.1 Excel spreadsheet analysis of the ECU operated telemetry monitors as displayed and recorded on the ECU Test Set

B.1.2 Printout of Ground Support Equipment Temperature Monitoring readout

C Configuration Requirements

C.1.1 The Leakage Gas system shall be hooked up to the Vatterfly Valve to be used and operating during this procedure.

C.1.2 The FIST Ops Test set shall be connected to the ECU via a 1553 bus for data transmission and a timing signal supplied across a S16D connection. Ref: Figure 1, ECU Test Set Interconnect diagram

C.1.3 The FIST Ops Test set and the ECU shall be provided power through an Uninterruptible Power Supply providing 110 VAC for more than one minute off the commercial power grid. Ref: Figure 1, ECU Test Set Interconnect diagram

C.1.4 The ECU shall be provided with a 1553 connection, a timing signal (10 Hz) and a 28.0 Volt power supply. Ref: Figure 1, ECU Test Set Interconnect diagram

C.1.5 The ECU Power Supply shall be the sole provider of Heater Power to ECU controlled Heaters. Ref: Figure 1, ECU Test Set Interconnect diagram

C.1.6 The Aft ECU shall be attached via cables to the Forward ECU, Top Hat, FEE Base Plate, Cross Flange & Dewar Support ring. Ref: Drawing 5856124, Payload Cable Interconnect Diagram

C.1.7 The Forward ECU shall be attached via cables to the Aft ECU, Probe Top Hat, Dewar Top Plate & FEE Base Plate. Ref: Drawing 5856124, Payload Cable Interconnect Diagram

C.1.8 Flight hardware required

Description	Part No.	Finite Lifetime Object	No. Req'd
Flight GP-B Dewar		N/A	1
Flight GP-B Probe		N/A	1
Flight ECU – Fwd	8A01313-101		1
Flight ECU – Aft	8A00922-101		1
Fwd ECU to Top Hat master Ground Cable Assembly	8A01467-101		1
Aft ECU to Top Hat master Ground Cable Assembly	8A01467-102		1
Fwd ECU J1 to Top Hat I1 Cable Assembly	8A00532-101		1
FEE J12A to Top Hat I2 Cable Assembly	8A00533-101		1
Aft ECU J30, J31 to FEE Base Plate Cable Harness	8A01959-101		1
Fwd ECU J3 to Top Hat I3 Cable Assembly	8A01318-101		1
Fwd ECU J5 to Top Hat I5 Cable Assembly	8A01289-101		1
Fwd ECU J6 to Top Hat I6 Cable Assembly	8A01290-101		1
Fwd ECU J7 to Top Hat I7 Cable Assembly	8A01291-101		1
GMA Valves "A" Secondary	8A01542-101		1
GMA Valves "B" Secondary	8A01541-101		1
GMA Monitor "A" Primary	8A01544-101		1
GMA Monitor "B" Primary	8A01545-101		1
Fwd ECU J8 to Dewar J801 Cable Assembly	8A01315-101		1
Fwd ECU J9 to Dewar J802, FEE J802A Cable Assembly	8A01268-101		1
Leakage Valve #1 to Aft ECU Cable Assembly	8A01546-101		1
Leakage Valve #2 to Aft ECU Cable Assembly	8A01547-101		1
Exhaust Valve #1, #2 Extension Cable	8A01416-101		1
Exhaust Valve #3, #4 Extension Cable	8A01417-101		1

C.1.9 Commercial test equipment

Manufacturer	Model	Serial Number	Calibr. Exp. Date
SUN Workstation (Test Set)	Ultra 1 3D Creator	637F09FB	

C.1.10 Mechanical/Electrical Special test equipment

Description	Part No.	Certification Date
ECU HLD Panel		GSE 2
ECU Timing Supply Panel		GSE 1

C.1.11 Tools

Description	No. Req'd
8 mm tape drive	1

C.1.12 Expendables

Description	Quantity
8 mm tape	1

D Software Required

D.1.1 Flight Software

Flight Software Name	Version No.
MSS (Mission Support Software)	3.2.5S

D.1.2 CSTOL Scripts

CSTOL Script Name	Version No.
adc_vac_br.prc	V 1.2 : 05/21/01
cal1_br.prc	V 1.1 : 03/07/99
cal2_br.prc	V 1.2 : 02/10/99
dwrtemp_br.prc	V 1.1 : 03/07/99
ecu_p0547.prc	V 1.2 : 08/03/01
ecumisc_br.prc	V 1.1 : 01/15/99
f3250ecu32a.prc	V 1.2 : 05/10/01
gma1_br.prc	V 1.1 : 02/06/99
gmatemp_br.prc	V 1.1 : 02/10/99
htr1_br.prc	V 1.1 : 01/15/99
htr2_br.prc	V 1.1 : 01/15/99
htr3_br.prc	V 1.1 : 01/15/99
htr4_br.prc	V 1.1 : 01/15/99
mag_uv_br.prc	V 1.1 : 02/10/99
muxgain_br.prc	V 1.1 : 02/11/99
muxio_br.prc	V 1.1 : 02/11/99
pid1_br.prc	V 1.1 : 02/11/99
pid2_br.prc	V 1.2 : 02/11/99
pid3_br.prc	V 1.1 : 02/11/99
pid4_br.prc	V 1.1 : 02/12/99
probetemp_br.prc	V 1.1 : 01/15/99
qbstemp_br.prc	V 1.1 : 02/12/99

D.1.3 SPC Scripts

SPC Script Name	Version No.
N/A	

D.1.4 Test Support Software

Test Software Name	Version No.
Oasis (Operating System Software)	V 2.4.5
Framex (front end software)	Framexs

E Procedures Required

Procedure Name	Procedure No.
(PTP) ECU Checkout	P0540

F **Equipment Pretest Requirements**

Equipment	Serial No.	Test Required	Proc. No.	Test Performed Date	By
FLIGHT Fwd ECU	8A01313-ECU GSE	FLIGHT Certification	Ecu_box_tlm.prc		
FLIGHT Aft ECU	8A00922-ECU GSE	FLIGHT Certification	Ecu_box_htr.prc		

G **Personnel Requirements**

G.1.1 As a general requirement, all operations involving flight equipment require at least two persons at all times.

G.1.2 The test leader for this procedure is Dr. Dave Murray <Beeper *650-317-7914, 1281893* >, or his appointed representative.

G.1.3 The Payload Test Director for all activities conducted in FIST Ops is Dr. Mike Taber <Beeper *650-599-8033, 1286139* >, or his appointed representative. The Payload Test Director is also responsible in general for the coordination of all payload tests, and will therefore schedule appropriate times for the performance of this procedure.

G.1.4 The Stanford Quality Assurance representative is Dorrene Ross <Beeper *650-317-7922, 1283969* > or her appointed representative.

G.1.5 The Office of Naval Research representative is Abe Sabbag < Sabbaga@onr.navy.mil> or his appointed representative.

G.1.6 The following personnel are qualified to perform this procedure using the FIST Ops test set:

G.1.6.1 Dave Meriwether <Beeper 650-317-7912 >

G.1.6.2 Thomas Wai <Phone 650-354-5644>

G.1.6.3 Denys Vanrenen <Phone 725-5769>

H Safety Requirements

H.1.1 Standard safety practices to ensure safety of personnel and prevent damage to equipment shall be observed during performance of this test.

H.1.2 Read the CARD's[1] appropriate to ECU Operations before running this test.

H.1.3 All connectors used will have connector savers attached. Protect all electrical connections and/or Connector Savers with ESD dust caps when the connectors are not mated.

H.1.4 Ensure that power is removed from cable assemblies before connecting and disconnecting cable connections.

H.1.5 Grounded wrist straps are to be worn prior to removal of connector caps or covers and during cable mating/demating operations.

H.1.6 Examine all mating connections before attempting to mate them. Remove any foreign particles. Look for any damaged pins or sockets. Do not force the coupling action if excessive resistance is encountered. Ensure that key ways are aligned.

I General Instructions

I.1.1 Test operators shall read this procedure in its entirety and resolve any apparent ambiguities prior to beginning this test.

I.1.2 This procedure operates systems throughout the GP-B satellite. Knowledge of the systems effected, caution in their operation and attention to information displayed must be applied at all times during these operations or Flight Hardware damaged may result.

I.1.3 This procedure shall be conducted on a formal basis to its latest approved and released version.

I.1.4 Tests will be conducted under the environmental conditions existing in the FIST Ops, HEPL Lab at Stanford University.

I.1.5 This procedure operates Flight Hardware. All use of software associated with this procedure must conform to the GP-B Configuration Control process.

I.1.6 In order to expedite test operations, unless specifically noted, the sequence in which major sections or subsections are preformed may be altered at the discretion of the Test Leader or his representative.

I.1.7 Upon completion of the test, all data on the FIST Ops test set under the /opt/usr6/lab and sub-directories shall be transferred to the data archive on the Payload Server. Upon confirmation that the FIST Ops test set data has been successfully archived, the data in the /opt/usr6/lab/bridge, /snaps, /messages and /oasis_raw_data directories may be deleted.

[1] Constraints and Restrictions Document

J References and Applicable Documents

J.1.1 SCIT-01 System Design, Verification, Integration & Test Plans

J.1.2 SCSE 06 Command and Telemetry Handbook, App B sw_cmd 3.2.0

J.1.3 SCSE 16 SECTION 9, Flight Software Design Specification, External Interface Detailed Design, Version Fg

J.1.4 PLSE-12, Science Payload Specification, Version 4.3

J.1.5 MSS3.2.5_Report_Excel.xls; Telemetry Monitor List for MSS 3.2.5

J.1.6 Probe C Drawings

J.1.6.1 1C34300, (Cryopump Htr)

J.1.6.2 1C34142, (Cryopump Htr)

J.1.6.3 1C34883, (Probe schematics)

J.1.6.4 1C34383, (Press. Sense Htr)

J.1.6.5 1C34301, (Plumbing Htr)

J.1.6.6 1C34135, (Press Sense & Plumb Saddle Line Heaters location

J.1.6.7 1C34299, (QBS Htr)

J.1.6.8 23171, (QBS / Final Filter Assembly)

J.1.6.9 1C34124, (Vacuum Shell Htr)

J.1.6.10 1C34197, (Final Filter Htr 1&2)

J.1.6.11 1C34133, (Final Filter Htr 3&4)

J.1.6.12 1C34112, (Probe B Installation – Final Filter)

J.1.7 Dewar Drawings

J.1.8 ECU Drawings

J.1.8.1 8A01940, ECU Aft Master Wire List

J.1.8.2 8A01941, ECU Forward Master Wire List

K **Operations:**

K.1 Hardware Configuration:

K.1.1 Connect the ECU Test Set to the Flight ECU. Ref: Figure 1, ECU Test Set Interconnect diagram

K.1.2 ECU to Probe Cable Connection

K.1.2.1 **CAUTION**: Grounded wrist straps are to be worn during cable mating/demating operations.

K.1.2.2 **CAUTION**: The ECU is to be powered down during cable mating/demating operations.

K.1.2.3 OPERATOR: Insure that the FLIGHT ECU Power Supply is Powered OFF and the Positive (Red) lead into the power supply is disconnected.

K.1.3 Connect the following cables (Ref: Drawing 5856124, Payload Cable Interconnect Diagram)

Cable	Initial
Flight GP-B Dewar	
Flight GP-B Probe	
Flight ECU – Fwd	
Flight ECU – Aft	
Fwd ECU to Top Hat master Ground Cable Assembly	
Aft ECU to Top Hat master Ground Cable Assembly	
Fwd ECU J1 to Top Hat I1 Cable Assembly	
FEE J12A to Top Hat I2 Cable Assembly	
Aft ECU J30, J31 to FEE Base Plate Cable Harness	
Fwd ECU J3 to Top Hat I3 Cable Assembly	
Fwd ECU J5 to Top Hat I5 Cable Assembly	
Fwd ECU J6 to Top Hat I6 Cable Assembly	
Fwd ECU J7 to Top Hat I7 Cable Assembly	
Fwd ECU J8 to Dewar J801 Cable Assembly	
Fwd ECU J9 to Dewar J802, FEE J802A Cable Assembly	
Leakage Valve #1 to Aft ECU Cable Assembly	
Leakage Valve #2 to Aft ECU Cable Assembly	
Exhaust Valve #1, #2 Extension Cable	
Exhaust Valve #3, #4 Extension Cable	

K.1.4 Connect the ECU Test Set to the Flight ECU. Ref: Operating Instructions for ECU Spacecraft Emulator.

K.1.5 Power on the Flight Aft SRE or 10 Hz clock equivalent.

K.2 ECU Test Set Initialization:

K.2.1 Start the Temperature Sensor and Heater Verification CSTOL procedure:

CSTOL ACTIONS:

K.2.1.1 TYPE Go to start ecu_p0547.prc.

K.2.1.2 Oasis Binary and Message File recording started

K.2.1.3 MSS 3.2.5 ECU format loaded (nominal Format ID: F3250ECU32A).

CSTOL HOLD:

K.2.1.3.1 RECORD Message File name (*.event_messages):

_____

K.2.1.3.2 ECU state Monitors displayed

K.2.1.3.3 ECU state change recording started.

K.3 Flight ECU Initialization:

CSTOL ACTIONS:

K.3.1 Type Go to Command on the ECU Processing.

CSTOL HOLD:

K.3.2 ECU Power Supply / HLD Simulator Initialization

K.3.2.1 Turn on the FLIGHT ECU Power Distribution unit Circuit Breaker.

K.3.2.2 Turn on power to the HP DC Power Supply.

K.3.2.3 Boot the PC and standby until the LabView ECU Test program comes up.

K.3.2.4 Turn on Power to SC Emulator (SN 001).

K.3.2.5 In LabView, click “Power Settings” button to “ON”

K.3.2.6 Confirm that the ECU A-side 28V is Off

K.3.2.7 Confirm that the ECU B-side 28V is Off

K.3.2.8 Confirm 28V on HP Power Supply

K.3.2.9 Check that Undervoltage Light is On.

K.3.3 HLD Initialization

K.3.3.1 Toggle A-side 1553 switch to B-side then A-side

K.3.3.2 Toggle A-side Power Converter On then Off

K.3.3.3 Toggle B-side Power Converter On then Off

K.3.3.4 Click on All ECU to A Power

K.3.3.5 Toggle A-side Heat Pulse Enable On then Off

K.3.3.6 Toggle B-side Heat Pulse Enable On then Off

K.3.3.7 Click on all 8 Disable HLD's (Dewer htr's, SIA htr's, GMA htr's, UV htr's)

K.3.4 Reset Undervoltage trip. (powers on ECU Unswitched Power)

K.3.4.1 *Confirm Vehicle Time is updating*

K.3.5 Click ECU A-side 28V On

K.3.5.1 *Confirm Rollover counters are updating and synchronous*

K.3.6 Click A-side Power Converters On

K.3.7 Click A-side All Enable

K.3.8 Click B-side All Enable

K.3.8.1 *Confirm 28V on HP Power Supply*

K.3.9 RECORD: HP DC Power Supply Voltage _____(Nominal 28 Volts)

K.3.10 RECORD: HP DC Power Supply Current _____(Nominal 0.88 Amps)

K.3.10.1 *In the LabView "Power Settings" window, confirm DC Voltage is 28V and Current Limit is 4A.*

CSTOL ACTIONS:

K.3.11 TYPE go to begin Flight ECU Confidence Test

K.3.11.1 Start ECU state change recording

K.3.11.2 ECU State Monitors displayed

K.3.11.3 Rollover Counter status (`BE_Failure_A, BE_Failure_B`) displayed in FSW_SM_DI_10hz_1

K.3.11.4 ECU state and locked ADC monitor (`DE_Ecu_Status`) displayed in ECU_Critical_1

K.3.11.5 ECU Electronics Port 1 or 2 monitor (`BC_Ecu_1_2_Sel`) displayed in VES_IoDirective1

K.3.11.6 Active 1553 bus monitor (`BC_1553_A_B_Sel`) displayed in VES_IoDirective1

CSTOL ACTION:

K.3.11.7 Type GO to Command ECU Processing On.

K.3.11.8 Select the Primary ECU Electronics Port (RT 7 nominal)

K.3.11.9 ECU state and locked ADC monitor (`DE_Ecu_Status`) limit checked (nominal = 10000000).

K.3.11.10 ECU Electronics Port 1 or 2 monitor (`BC_Ecu_1_2_Sel`) limit checked (nominal = Side_A).

K.3.11.11 Active 1553 bus monitor (`BC_1553_A_B_Sel`) limit checked (nominal = Port_1).

K.3.11.12 Rollover Counter status (`BE_Failure_A, BE_Failure_B)` limit checked (nominal = false).

K.3.11.12.1 *Review the ECU_Critical_1 display and confirm that both ECU Rollover Counters (`DE_Roll_Cntr__A, DE_Roll_Cntr__B`) are in synch and incrementing*

K.3.12 Review the StartLab Window and check for any new errors.

K.3.12.1.1 *Check that the StartLab Window errors have stopped updating.*

CSTOL ACTIONS:

K.3.13 Type GO to start Low Temperature Bakeout bridge file recording. Ref: ECU3.2.5Report_Excel.xls, LTB Lite Worksheet

K.3.14 Wait one full data cycle for complete monitor update

K.3.15 ECU Initialization monitors[2] limit checked

K.3.16 TYPE GO to display and record the Low Temperature Bakeout Monitors.

CSTOL HOLD:

K.3.17 Set FDAS temperature alarm threshold to 1 Kelvin above current temperature.

[2] Ref: ECU3.2.5Report_Excel.xls, ECU Initialization Monitor's & Limits

K.3.18 RECORD the following Probe Heater Monitors:

Monitor Name	Description	Eng. Values	Count	Limit	Pass/Fail
DE_HSP_CryPm__A	HSP Cryo Pump /A: H-11P			0	
DE_HSP_CryPm__B	HSP Cryo Pump /B: H-10P			0	
DE_HSP_Fi_1_2_A	HSP Gas Inlet Filter: H-01P			0	
DE_HSP_Fi_1_2_B	HSP Gas Inlet Filter: H-02P			0	
DE_HSP_Fi_3_4_A	HSP Gas Inlet Filter: H-03P			0	
DE_HSP_Fi_3_4_B	HSP Gas Inlet Filter: H-04P			0	
DE_HSP_Pl_____A	HSP Plumbing Saddle /A: H-13P			0	
DE_HSP_Pl_____B	HSP Plumbing Saddle /B: H-12P			0	
DE_HSP_PrsSen_A	HSP Pressure Sense Line /A: H-15P			0	
DE_HSP_PrsSen_B	HSP Pressure Sense Line /B: H-14P			0	
DE_HSP_QBS____A	HSP QBS /A: H-05P			0	
DE_HSP_QBS____B	HSP QBS /B: H-06P			0	
DE_HSP_VS_____A	HSP Vacuum Shell /A: H-09P			0	
DE_HSP_VS_____B	HSP Vacuum Shell /B: H-08P			0	

K.3.18.1 RECORD the following Probe Temperature Monitors:

Monitor Name	Description	Temperature	Count
TE_CryPm_aGT15P	Cryo-pump GRT/a: T-15P		
TE_CryPm_bGT16P	Cryo-pump GRT/b: T-16P		
TE_Fi1_2_aGT06P	Final filter 1&2 GRT/a: T-06P		
TE_Fi1_2_bGT07P	Final filter 1&2 GRT/b: T-07P		
TE_Fi3_4_aGT08P	Final filter 3&4 GRT/a: T-08P		
TE_Fi3_4_bGT09P	Final filter 3&4 GRT/b: T-09P		
TE_Gyro_1_GT01Q	Gyroscope #1 GRT: T-01Q		
TE_Gyro_2_GT02Q	Gyroscope #2 GRT: T-02Q		
TE_Gyro_3_GT03Q	Gyroscope #3 GRT: T-03Q		
TE_Gyro_4_GT04Q	Gyroscope #4 GRT: T-04Q		
TE_HEX1Dw_ST03D	HEX-1 dewar SDT: T-03D		
TE_HEX1Pr_ST01P	HEX-1 probe SDT: T-01P		
TE_HEX2Dw_ST06D	HEX-2 dewar SDT: T-06D		
TE_HEX2Pr_ST02P	HEX-2 probe SDT: T-02P		
TE_HEX3Dw_ST07D	HEX-3 dewar SDT: T-07D		
TE_HEX3Pr_ST03P	HEX-3 probe SDT: T-03P		
TE_HEX4Dw_ST08D	HEX-4 dewar SDT: T-08D		
TE_HEX4Pr_ST04P	HEX-4 probe SDT: T-04P		
TE_HEX4Pr_ST27P	HEX-4 probe SDT: T-27P		
TE_MTkIn_aGT10D	Main tank internal GRT/a: T-10D		
TE_MTkIn_bGT11D	Main tank internal GRT/b: T-11D		
TE_PlSad_aST17P	Plumbing saddle STA194 SDT/a: T-17P		
TE_PlSad_bST18P	Plumbing saddle SDT/b: T-18P		
TE_PPEx_aGT12AD	Porous plug exit GRT/a: T-12AD		
TE_PPEx_bGT12BD	Porous plug exit GRT/b: T-12BD		
TE_PrSLn_aST19P	Press sense line STA156 SDT/a: T-19P		
TE_PrSLn_bST20P	Press sense line SDT/b: T-20P		
TE_Q_Aft__GT05Q	Quartz block aft end GRT: T-05Q		
TE_Q_Flng_GT06Q	Quartz block flange GRT: T-06Q		
TE_Q_ForEGGT17Q	Quartz block forward end GRT: T-17Q		
TE_Q_ForESST18Q	Quartz block forward end SDT: T-18Q		
TE_Q_G3_G4ST07Q	Quartz block G3/G4 SDT: T-07Q		
TE_QBS_a__GT10P	Quartz block support GRT/a: T-10P		
TE_QBS_b__GT11P	Quartz block support GRT/b: T-11P		
TE_QBS_SDTST12P	Quartz block support SDT: T-12P		
TE_SciTel_ST16Q	Science telescope SDT: T-16Q		
TE_St2Dw_aGT01D	Station 200 dewar GRT/a: T-01D		
TE_St2Dw_bGT02D	Station 200 dewar GRT/b: T-02D		
TE_St2Pr_aGT05P	Station 200 probe GRT: T-05P		
TE_St2Pr_bGT28P	STA 200 probe GRT/b: T-28P		
TE_TelCP_1GT14Q	Tele corrector plate #1 GRT: T-14Q		
TE_TelCP_2GT15Q	Tele corrector plate #2 GRT: T-15Q		
TE_TelD_1_GT12Q	Tele detector #1 GRT: T-12Q		
TE_TelD_2_GT13Q	Tele detector #2 GRT: T-13Q		
TE_TelDM_YGT21Q	Tele detector mount +Y GRT: T-21Q		
TE_VSPr_a_ST13P	Vacuum shell probe SDT/a: T-13P		
TE_VSPr_b_ST14P	Vacuum shell probe SDT/b: T-14P		

QBS Heater Activity Record

QBS Heater Mode	Value
DE_QBSHOpClLp_A	
DE_QBSHOpClLp_B	

DE_HSP_QBS__A	VE_QBS_H_a_H05P (Volts)	TE_QBS_a__GT10P (Kelvin)	DE_HSP_QBS__B	VE_QBS_H_b_H06P (Volts)	TE_QBS_b__GT11P (Kelvin)

Vacuum Shell Heater Activity Record

DE_HSP_VS_____A	TE_VSPr_a_ST13P (Kelvin)	TE_VSPr_b_ST14P (Kelvin)

Cryo Pump Heater Activity Record

DE_HSP_CryPm__A	TE_CryPm_aGT15P (Kelvin)	TE_CryPm_bGT16P (Kelvin)

Pressure Sense Line Heater Activity Record

DE_HSP_PrsSen_A	TE_PrSLn_aST19P (Kelvin)	TE_PrSLn_bST20P (Kelvin)

Plumbing Saddle Heater Activity Record

DE_HSP_Pl_____A	TE_PlSad_aST17P (Kelvin)	TE_PlSad_bST18P (Kelvin)

Final Filter 1 & 2 Heater Activity Record

DE_HSP_Fi_1_2_A	VE_FF1_2_aH01P (Volts)	TE_Fi1_2_aGT06P (Kelvin)	TE_Fi1_2_bGT07P (Kelvin)

Final Filter 3 & 4 Heater Activity Record

DE_HSP_Fi_3_4_A	VE_FF3_4_aH03P (Volts)	TE_Fi3_4_aGT08P (Kelvin)	TE_Fi3_4_bGT09P (Kelvin)

K.4 Low Temperature Bakeout Vatterfly Valve / Heater configuration:

CSTOL HOLD:

K.4.1 Low Temperature Bakeout Vatterfly Valve / Heater configuration (Optional):

CSTOL ACTIONS:

K.4.2 TYPE GO to start the Vatterfly Valve Optional Use Test.

K.4.2.1 Reply NO to skip Vatterfly Valve Operation if no or Vatterfly Valves are to be Operated by the ECU.

K.4.3 Ensure that a Manual Vatterfly Valve Controller is available, on location and has a signed off procedure.

K.4.4 OPERATOR: Confirm that the Vatterfly Valves LV1, LV2, EV1, EV2, EV3 and EV4 are Covered, Leak Checked and both sides of the Valves are either in a Vacuum or Helium environment.

K.4.4.1 **WARNING**: Opening a Vatterfly Valve, on the ground, without a leak free cover and a Vacuum environment IS EXTREMELY DANGEROUS.

K.4.5 **The following people MUST Initial below, signifying that Vatterfly Valves LV1, LV2, EV1, EV2, EV3 and EV4 are safe to Operate on the Ground, before continuing with Vatterfly Valve Checkout.**

K.4.5.1 **Payload Technical Manager (or delegate):**_____

K.4.5.2 **Payload Test Director (or delegate):**_____

K.4.5.3 **Test Leader (or delegate):**_____

K.4.5.4 **Test Operator:**_____

K.4.5.5 **Quality Assurance (or delegate):**_____

K.4.6 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		1	
VE_VAT_A_CLOSED	Vatt valve-A closed		15565-17203	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	
VE_VAT_B_CLOSED	Vatt valve-B closed		15565-17203	
VE_VAT_B_OPEN	Vatt valve-B open		<100, >65535	
BE_Htr_gagOnOfA	Valve htrs and Vac gauge On/			
BE_Htr_gagOnOfB	Valve htrs and Vac gauge On/			
TE_VAT_LV2_SDTb	Leakage valve 2 SDT/b			
TE_VAT_LV2_SDTa	Leakage valve 2 SDT/a			
TE_VAT_LV1_SDTb	Leakage valve 1 SDT/b			
TE_VAT_LV1_SDTa	Leakage valve 1 SDT/a			
TE_VAT_EV4_SDTb	Exhaust valve 4 SDT/b			
TE_VAT_EV4_SDTa	Exhaust Valve 4 SDT/a			
TE_VAT_EV3_SDTb	Exhaust valve 3 SDT/b			
TE_VAT_EV3_SDTa	Exhaust Valve 3 SDT/a			
TE_VAT_EV2_SDTb	Exhaust valve 2 SDT/b			
TE_VAT_EV2_SDTa	Exhaust Valve 2 SDT/a			
TE_VAT_EV1_SDTb	Exhaust valve 1 SDT/b			
TE_VAT_EV1_SDTa	Exhaust Valve 1 SDT/a			

K.4.7 Start Vatterfly Valve monitor recording.

CSTOL ACTIONS:

K.4.7.1 TYPE GO to signify that a Manual Vatterfly Valve Controller is available and on location.

K.4.7.2 TYPE GO to signify that the Vatterfly Valves are in a Leak Free Vacuum Environment and that it is safe to operate them on the ground.

K.4.7.3 TYPE GO to send the LV1a no-op command

CSTOL HOLD:

K.4.7.4 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		1	
VE_VAT_A_CLOSED	Vatt valve-A closed		15565-17203	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	

CSTOL ACTIONS:

K.4.7.5 TYPE GO to send the LV1b no-op command

CSTOL HOLD:

K.4.7.6 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfB	Vatterfly Valves Select On/Off /B		1	
VE_VAT_B_CLOSED	Vatt valve-B closed		15565-17203	
VE_VAT_B_OPEN	Vatt valve-B open		<100, >65535	

CSTOL ACTIONS:

K.4.7.7 TYPE GO to send the LV2a no-op command

CSTOL HOLD:

K.4.7.8 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		2	
VE_VAT_A_CLOSED	Vatt valve-A closed		15565-17203	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	

CSTOL ACTIONS:

K.4.7.9 TYPE GO to send the LV2b no-op command

CSTOL HOLD:

K.4.7.10 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfB	Vatterfly Valves Select On/Off /B		2	
VE_VAT_B_CLOSED	Vatt valve-B closed		15565-17203	
VE_VAT_B_OPEN	Vatt valve-B open		<100, >65535	

CSTOL ACTIONS:

K.4.7.11 TYPE GO to send the EV1a no-op command

CSTOL HOLD:

K.4.7.12 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		3	
VE_VAT_A_CLOSED	Vatt valve-A closed		15565-17203	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	

CSTOL ACTIONS:

K.4.7.13 TYPE GO to send the EV1b no-op command

CSTOL HOLD:

K.4.7.14 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfB	Vatterfly Valves Select On/Off /B		3	
VE_VAT_B_CLOSED	Vatt valve-B closed		15565-17203	
VE_VAT_B_OPEN	Vatt valve-B open		<100, >65535	

CSTOL ACTIONS:

K.4.7.15 TYPE GO to send the EV2a no-op command

CSTOL HOLD:

K.4.7.16 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		4	
VE_VAT_A_CLOSED	Vatt valve-A closed		15565-17203	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	

CSTOL ACTIONS:

K.4.7.17 TYPE GO to send the EV2b no-op command

CSTOL HOLD:

K.4.7.18 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfB	Vatterfly Valves Select On/Off /B		4	
VE_VAT_B_CLOSED	Vatt valve-B closed		15565-17203	
VE_VAT_B_OPEN	Vatt valve-B open		<100, >65535	

CSTOL ACTIONS:

K.4.7.19 TYPE GO to send the EV3a no-op command

CSTOL HOLD:

K.4.7.20 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		5	
VE_VAT_A_CLOSED	Vatt valve-A closed		15565-17203	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	

CSTOL ACTIONS:

K.4.7.21 TYPE GO to send the EV3b no-op command

CSTOL HOLD:

K.4.7.22 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfB	Vatterfly Valves Select On/Off /B		5	
VE_VAT_B_CLOSED	Vatt valve-B closed		15565-17203	
VE_VAT_B_OPEN	Vatt valve-B open		<100, >65535	

CSTOL ACTIONS:

K.4.7.23 TYPE GO to send the EV4a no-op command

CSTOL HOLD:

K.4.7.24 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		6	
VE_VAT_A_CLOSED	Vatt valve-A closed		15565-17203	

VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	

CSTOL ACTIONS:

K.4.7.25 TYPE GO to send the EV4b no-op command

CSTOL HOLD:

K.4.7.26 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfB	Vatterfly Valves Select On/Off /B		6	
VE_VAT_B_CLOSED	Vatt valve-B closed		15565-17203	
VE_VAT_B_OPEN	Vatt valve-B open		<100, >65535	

K.4.8 Vatterfly Valve Operation (Optional)

CSTOL ACTIONS:

K.4.8.1 TYPE GO to start the Vatterfly Valve Optional Operation Algorithm

K.4.8.1.1 Reply NO to start the Open Loop (Pressure Sense Line and Plumbing Saddle) Heater Checkout if no or no more Vatterfly Valves are to be Operated

K.4.8.1.2 Reply LV1 to Operate Leakage Valve 1

K.4.8.1.3 Reply LV2 to Operate Leakage Valve 2

K.4.8.1.4 Reply EV1 to Operate Exhaust Valve 1

K.4.8.1.5 Reply EV2 to Operate Exhaust Valve 2

K.4.8.1.6 Reply EV3 to Operate Exhaust Valve 3

K.4.8.1.7 Reply EV4 to Operate Exhaust Valve 4

K.4.9 Leakage Valve 2, Side A Operation (If Required)

CSTOL HOLD:

K.4.9.1 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Count	Temp (K)	Limit
TE_VAT_LV2_SDTa	Leakage valve 2 SDT/a			217.5K(-56°C) - 313.5K(+40°C)
TE_VAT_LV2_SDTb	Leakage valve 2 SDT/b			217.5K(-56°C) - 313.5K(+40°C)

CSTOL ACTIONS:

K.4.9.2 If the Leakage Valve 2 temperature is hotter than the required temperature limits as defined above.

K.4.9.2.1 Oasis will report the Temperature and the limits and then Standby for Problem Resolution. Once High Temperature Problem is Resolved,

CSTOL HOLD:

K.4.9.2.2 TYPE GO to Continue after High Temperature Problem has been resolved.

CSTOL ACTIONS:

K.4.9.3 If the Leakage Valve 2 temperature is colder than the required temperature limits as defined above.

K.4.9.3.1 Oasis will report that the Temperature is to Cold to Operate the Vatterfly Valve and provide the Operating limits

K.4.9.3.2 TYPE GO to Command On the LV2a Heater

K.4.9.3.3 The LV2a Heater will turn off after Leakage Valve 2 has warmed to it's Operating Temperature

K.4.9.3.4 the Leakage Valve 2 No-Op command is then issued and LV2 limits are checked.

CSTOL HOLD:

K.4.9.4 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		2	
VE_VAT_A_CLOSED	Vatt valve-A closed		15565-17203	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	
TE_VAT_LV2_SDTa	Leakage valve 1 SDT/a		217.5K(-56°C) - 313.5K(+40°C)	
TE_VAT_LV2_SDTb	Leakage valve 1 SDT/b		217.5K(-56°C) - 313.5K(+40°C)	

CSTOL ACTIONS:

K.4.10 TYPE GO to Open Leakage valve 2.

CSTOL HOLD:

K.4.11 Once prompted, RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		F1 (hex)	
VE_VAT_A_CLOSED	Vatt valve-A closed		<100, >65535	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	

K.4.12 Return to Section K.3.6 (Vatterfly Valve Operation Options)

K.4.13 Leakage Valve 1, Side A Operation if required

K.4.13.1 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Count	Temp (K)	Limit
TE_VAT_LV1_SDTa	Leakage valve 1 SDT/a			217.5K(-56°C) - 313.5K(+40°C)
TE_VAT_LV1_SDTb	Leakage valve 1 SDT/b			217.5K(-56°C) - 313.5K(+40°C)

CSTOL ACTIONS:

K.4.13.2 If the Leakage Valve 1 temperature is not within the required temperature limits as defined above.

K.4.13.2.1 When prompted to, TYPE YES to Command On the LV1a Heater

K.4.13.2.2 Once the Leakage Valve 1 temperature is within the required temperature limits, TYPE GO to Command Off the LV1a Heater and then send the Vatterfly Valve No-Op command

K.4.13.3 If the Leakage Valve 1 temperature is within the required temperature limits as defined in Section K.5.9.1

K.4.13.3.1 When prompted to, TYPE NO to Send the Vatterfly Valve No-Op command.

CSTOL HOLD:

K.4.13.4 Once prompted, RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		1	
VE_VAT_A_CLOSED	Vatt valve-A closed		15565-17203	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	
TE_VAT_LV1_SDTa	Leakage valve 1 SDT/a		217.5K(-56°C) - 313.5K(+40°C)	
TE_VAT_LV1_SDTb	Leakage valve 1 SDT/b		217.5K(-56°C) - 313.5K(+40°C)	

CSTOL ACTIONS:

K.4.14 TYPE GO to send the Open command.

CSTOL HOLD:

K.4.15 Once prompted, RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		F1 (hex)	
VE_VAT_A_CLOSED	Vatt valve-A closed		<100, >65535	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	

K.4.16 Exhaust Valve 1, Side A Operation, if required

K.4.16.1 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Count	Temp (K)	Limit
TE_VAT_EV1_SDTa	Exhaust valve 1 SDT/a			217.5K(-56°C) - 313.5K(+40°C)
TE_VAT_EV1_SDTb	Exhaust valve 1 SDT/b			217.5K(-56°C) - 313.5K(+40°C)

CSTOL ACTIONS:

K.4.16.2 If the Exhaust Valve 1 temperature is outside of the required temperature limits as defined above.

K.4.16.2.1When prompted to, TYPE YES to Command On the EV1a Heater

K.4.16.2.2Once the Exhaust Valve 1 temperature is within the required temperature limits, TYPE GO to Command Off the EV1a Heater and then send the Vatterfly Valve No-Op command

K.4.16.3 If the Exhaust Valve 1 temperature is within the required temperature limits, as defined above.

K.4.16.3.1When prompted to, TYPE NO to Send the Vatterfly Valve No-Op command.

CSTOL HOLD:

K.4.16.4 Once prompted, RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		3	
VE_VAT_A_CLOSED	Vatt valve-A closed		15565-17203	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	
TE_VAT_EV1_SDTa	Exhaust valve 1 SDT/a		217.5K(-56°C) - 313.5K(+40°C)	
TE_VAT_EV1_SDTb	Exhaust valve 1 SDT/b		217.5K(-56°C) - 313.5K(+40°C)	

CSTOL ACTIONS:

K.4.17 TYPE GO to send the Open command.

CSTOL HOLD:

K.4.18 Once prompted, RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		F3 (hex)	
VE_VAT_A_CLOSED	Vatt valve-A closed		<100, >65535	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	

K.4.19 Exhaust Valve 2, Side A Operation, if required

K.4.19.1.1RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Count	Temp (K)	Limit
TE_VAT_EV2_SDTa	Exhaust valve 2 SDT/a			217.5K(-56°C) - 313.5K(+40°C)
TE_VAT_EV2_SDTb	Exhaust valve 2 SDT/b			217.5K(-56°C) - 313.5K(+40°C)

CSTOL ACTIONS:

K.4.19.2 If the Exhaust Valve 2 temperature is outside of the required temperature limits as defined above.

K.4.19.2.1When prompted to, TYPE YES to Command On the EV2a Heater

K.4.19.2.2Once the Exhaust Valve 2 temperature is within the required temperature limits, TYPE GO to Command Off the EV2a Heater and then send the Vatterfly Valve No-Op command

K.4.19.3 If the Exhaust Valve 2 temperature is within the required temperature limits, as defined above.

K.4.19.3.1When prompted to, TYPE NO to Send the Vatterfly Valve No-Op command.

CSTOL HOLD:

K.4.19.4 Once prompted, RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		4	
VE_VAT_A_CLOSED	Vatt valve-A closed		15565-17203	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	
TE_VAT_EV2_SDTa	Exhaust valve 2 SDT/a		217.5K(-56°C) - 313.5K(+40°C)	
TE_VAT_EV2_SDTb	Exhaust valve 2 SDT/b		217.5K(-56°C) - 313.5K(+40°C)	

CSTOL ACTIONS:

K.4.20 TYPE GO to send the Open command.

CSTOL HOLD:

K.4.21 Once prompted, RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		F4 (hex)	
VE_VAT_A_CLOSED	Vatt valve-A closed		<100, >65535	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	

K.4.22 Exhaust Valve 3, Side A Operation, if required

K.4.22.1 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Count	Temp (K)	Limit
TE_VAT_EV3_SDTa	Exhaust valve 3 SDT/a			217.5K(-56°C) - 313.5K(+40°C)
TE_VAT_EV3_SDTb	Exhaust valve 3 SDT/b			217.5K(-56°C) - 313.5K(+40°C)

CSTOL ACTIONS:

K.4.22.2 If the Exhaust Valve 3 temperature is outside of the required temperature limits as defined above.

K.4.22.2.1When prompted to, TYPE YES to Command On the EV3a Heater

K.4.22.2.2Once the Exhaust Valve 3 temperature is within the required temperature limits, TYPE GO to Command Off the EV3a Heater and then send the Vatterfly Valve No-Op command

K.4.22.3 If the Exhaust Valve 3 temperature is within the required temperature limits, as defined above.

K.4.22.3.1When prompted to, TYPE NO to Send the Vatterfly Valve No-Op command.

CSTOL HOLD:

K.4.22.4 Once prompted, RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		5	
VE_VAT_A_CLOSED	Vatt valve-A closed		15565-17203	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	
TE_VAT_EV3_SDTa	Exhaust valve 3 SDT/a		217.5K(-56°C) - 313.5K(+40°C)	
TE_VAT_EV3_SDTb	Exhaust valve 3 SDT/b		217.5K(-56°C) - 313.5K(+40°C)	

CSTOL ACTIONS:

K.4.23 TYPE GO to send the Open command.

CSTOL HOLD:

K.4.24 Once prompted, RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		F5 (hex)	
VE_VAT_A_CLOSED	Vatt valve-A closed		<100, >65535	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	

K.4.25 Exhaust Valve 4, Side A Operation, if required

K.4.25.1 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Count	Temp (K)	Limit
TE_VAT_EV4_SDTa	Exhaust valve 4 SDT/a			217.5K(-56°C) - 313.5K(+40°C)
TE_VAT_EV4_SDTb	Exhaust valve 4 SDT/b			217.5K(-56°C) - 313.5K(+40°C)

CSTOL ACTIONS:

K.4.25.2 If the Exhaust Valve 4 temperature is outside of the required temperature limits as defined above.

K.4.25.2.1When prompted to, TYPE YES to Command On the EV4a Heater

K.4.25.2.2Once the Exhaust Valve 4 temperature is within the required temperature limits, TYPE GO to Command Off the EV4a Heater and then send the Vatterfly Valve No-Op command

K.4.25.3 If the Exhaust Valve 4 temperature is within the required temperature limits, as defined above.

K.4.25.3.1When prompted to, TYPE NO to Send the Vatterfly Valve No-Op command.

CSTOL HOLD:

K.4.25.4 Once prompted, RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		6	
VE_VAT_A_CLOSED	Vatt valve-A closed		15565-17203	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	
TE_VAT_EV4_SDTa	Exhaust valve 4 SDT/a		217.5K(-56°C) - 313.5K(+40°C)	
TE_VAT_EV4_SDTb	Exhaust valve 4 SDT/b		217.5K(-56°C) - 313.5K(+40°C)	

CSTOL ACTIONS:

K.4.26 TYPE GO to send the Open command, and then 10 seconds later, the Stop command.

CSTOL HOLD:

K.4.27 Once prompted, RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		F6 (hex)	
VE_VAT_A_CLOSED	Vatt valve-A closed		<100, >65535	
VE_VAT_A_OPEN	Vatt valve-A open		<100, >65535	

K.5 Open Loop Heater Checkout

K.5.1 Quartz Block Support Heaters (QBS)

K.5.1.1 Side A QBS DC Open Loop Heater Control Checkout. (QBSDCOLA)

CSTOL ACTIONS:

K.5.1.1.1 TYPE GO to Command Side A QBS Heater to DC Open Loop Control mode. (Mode 83)

CSTOL HOLD:

K.5.1.1.2 RECORD the following Monitors:

Monitor Name	Description	Eng. Values	Count	Limit	Pass/Fail
DE_HSP_QBS____A	HSP QBS /A: H-05P			0	
DE_QBSHOpClLp_A	QBS htr Open/Closed Loop AC/DC			83	

CSTOL ACTIONS:

K.5.1.1.3 TYPE GO to Command the Side A QBS Heater Setpoint to 1.0 Volts (QBS Heater Setpoint = 10). Ref: ECU Htr Setpoints.xls, Flight Worksheet

CSTOL HOLD:

K.5.1.1.4 Once prompted, RECORD the following Monitors:

Monitor Name	Description	Eng. Values	Count	Limit	Pass/Fail
DE_HSP_QBS____A	HSP QBS /A: H-05P			10	
DE_QBSHOpClLp_A	QBS htr Open/Closed Loop AC/DC			83	
TE_QBS_a__GT10P	Quartz block support GRT/a: T-10P				
TE_QBS_b__GT11P	Quartz block support GRT/b: T-11P				
VE_QBS_H_a_H05P	QBS htr V: H-05P			911 - 1113	
VE_QBS_H_b_H06P	QBS htr V: H-06P			<100	

K.5.1.2 Side B QBS DC Open Loop Heater Control Checkout. (QBSDCOLB)

CSTOL ACTIONS:

K.5.1.2.1 TYPE GO to Command Side B QBS Heater to DC Open Loop Control mode. (Mode 83)

CSTOL HOLD:

K.5.1.2.2 RECORD the following Monitors:

Monitor Name	Description	Eng. Values	Count	Limit	Pass/Fail
DE_HSP_QBS____B	HSP QBS /B: H-06P			0	
DE_QBSHOpClLp_B	QBS htr Open/Closed Loop AC/DC			83	

CSTOL ACTIONS:

K.5.1.2.3 TYPE GO to Command the Side B QBS Heater Setpoint to 1.0 Volts (QBS Heater Setpoint = 10). Ref: ECU Htr Setpoints.xls, Flight Worksheet

CSTOL HOLD:

K.5.1.2.4 RECORD the following QBS Heater Monitors:

Monitor Name	Description	Eng. Values	Count	Limit	Pass/Fail
DE_HSP_QBS____B	HSP QBS /B: H-06P			10	
DE_QBSHOpClLp_B	QBS htr Open/Closed Loop AC/DC			83	
TE_QBS_a__GT10P	Quartz block support GRT/a: T-10P				
TE_QBS_b__GT11P	Quartz block support GRT/b: T-11P				
VE_QBS_H_a_H05P	QBS htr V: H-05P			<100	
VE_QBS_H_b_H06P	QBS htr V: H-06P			911 - 1113	

K.5.2 Side A Probe Vacuum Shell Heater (H-9P) Checkout. (VSHELLA)

CSTOL ACTIONS:

K.5.2.1 TYPE GO to Command H-9P to 1.0 Volts (Setpoint = 9).[9]

CSTOL HOLD:

K.5.2.2 RECORD the following Monitors:

Monitor Name	Description	Eng. Values	Count	Limit	Pass/Fail
DE_HSP_VS_____A	HSP Vacuum Shell /A: H-09P			9	
TE_VSPr_a_ST13P	Vacuum shell probe SDT/a: T-13P				
TE_VSPr_b_ST14P	Vacuum shell probe SDT/b: T-14P				

K.5.3 Side A Cryopump Heater (H-11P) Checkout. (CPUMPA)

CSTOL ACTIONS:

K.5.3.1 TYPE GO to Command H-11P to 1.0 Volts (Setpoint = 9).[9]

CSTOL HOLD:

K.5.3.2 RECORD the following Monitors:

Monitor Name	Description	Eng. Values	Count	Limit	Pass/Fail
DE_HSP_CryPm__A	HSP Cryo Pump /A: H-11P			9	
TE_PlSad_aST17P	Plumb s.addle STA194 SDT/a: T-17P				
TE_CryPm_aGT15P	Cryo-pump GRT/a: T-15P				
TE_St2Pr_aGT05P	Station 200 probe GRT: T-05P				
TE_St2Dw_aGT01D	Station 200 Dewar GRT/a: T-01D				
TE_HEX1Dw_ST03D	HEX-1 Dewar SDT: T-03D				
TE_HEX1Pr_ST01P	HEX-1 probe SDT: T-01P				

[9] Ref: ECU Htr Setpoint.xls, Flight Worksheet
[9] Ref: ECU Htr Setpoint.xls, Flight Worksheet

K.5.4 Plumbing Saddle Heater (H-13P) Checkout.

CSTOL ACTIONS:

K.5.4.1 TYPE GO to Command H-13P to 1.0 Volts (Setpoint = 9).[9]

CSTOL HOLD:

K.5.4.2 RECORD the following Monitors:

Monitor Name	Description	Eng. Values	Count	Limit	Pass/Fail
DE_HSP_Pl_____A	HSP Plumbing Saddle /A: H-13P				
DE_HSP_Pl_____B	HSP Plumbing Saddle /B: H-12P			0	
TE_PlSad_aST17P	Plumb saddle STA194 SDT/a: T-17P				
TE_PlSad_bST18P	Plumb saddle SDT/b: T-18P				

K.5.5 Pressure Sense Line Heater (H-15P) Checkout.

CSTOL ACTIONS:

K.5.5.1 TYPE GO to Command H-15P to 1.0 Volts (Setpoint = 9).[9]

CSTOL HOLD:

K.5.5.2 RECORD the following Monitors:

Monitor Name	Description	Eng. Values	Count	Limit	Pass/Fail
DE_HSP_PrsSen_A	HSP Press Sense Line /A: H-15P				
DE_HSP_PrsSen_B	HSP Press Sense Line /B: H-14P			0	
TE_PrSLn_aST19P	Press sense line STA156 SDT/a: T-19P				
TE_PrSLn_bST20P	Press sense line SDT/b: T-20P				

K.6 Low Temperature Bakeout Initialization

CAUTION: The length of time needed for heater / controller checkout is not well established at this point. The control loop parameters (particularly the gain) may have to be set differently for the checkout process than they are for the bakeout process.

K.6.1 OPERATOR ACTION: Set FDAS Temperature alarm threshold for Cryopump and vacuum shell heaters to 9 K and 8 K, respectively

K.6.2 ECU Thermal Control PID Algorithm Initialization (Optional)

K.6.2.1 Set ECU Thermal Control Algorithm Temperature table, temperature control point, to command a 0.3 K increase in temperature above the temperatures as recorded in Section K.3.1.4

CSTOL ACTIONS:

K.6.2.2 TYPE GO to load the PID Algorithm Low Temperature Bakeout Initialization. (Optional)

K.6.3 TYPE GO to start Low Temperature Bakeout PID Heater Checkout. (Optional)

[9] Ref: ECU Htr Setpoint.xls, Flight Worksheet
[9] Ref: ECU Htr Setpoint.xls, Flight Worksheet

CSTOL HOLD:

K.6.3.1 RECORD the following PID Monitors:

Monitor Name	Description	Eng. Values	Expected Value	Pass/Fail
SE_EcuPidError	Error word		0	
SE_EcuPidMode	0 For Pid, 1 For Window Bakeout		0	
RE_ConfigApp_1	1 If App Is On		1	
RE_ConfigApp_2	1 If App Is On		1	
RE_ConfigApp_3	1 If App Is On		1	
RE_ConfigApp_4	1 If App Is On		1	
RE_ConfigApp_5	1 If App Is On		1	
RE_TempControl1	Computed temps			
RE_TempControl2	Computed temps			
RE_TempControl3	Computed temps			
RE_TempControl4	Computed temps			
RE_TempControl5	Computed temps			

K.7 Low Temperature Bakeout

K.7.1 Set DDAS Lead Bag Temperature alarm threshold to 4.0 K

K.7.1.1 OPERATOR ACTION: RECORD: ECU Test Set time:_____

K.7.1.2 OPERATOR ACTION: RECORD: ECU Test Set time + 1 hour:_____

K.7.1.3 OPERATOR ACTION: RECORD: ECU Test Set time + 2 hours:_____

K.7.1.4 OPERATOR ACTION: RECORD: ECU Test Set time + 12 hours:_____

K.7.1.5 OPERATOR ACTION: RECORD: ECU Test Set time + 16 hours:_____

K.7.1.6 OPERATOR ACTION: RECORD: ECU Test Set time + 28 hours:_____

K.7.2 Increase QBS (H-5P) temperature to 6 K

K.7.3 Increase Vacuum Shell Heater (H-9P) temperature to 7 K

K.7.4 Increase Cryopump Heater (H-11P) temperature to 6.2 K

K.7.4.1 Wait 1 hour

OPERATOR ACTIONS:

K.7.5 Set FDAS Temperature alarm threshold for Spinup filters, Plumbing Saddle & Pressure Sense Line heaters to 8 K

K.7.5.1 RECORD the following Monitors:

Monitor Name	Description	Eng. Values	Count	Limit	Pass/Fail
DE_HSP_Pl_____A	HSP Plumbing Saddle /A: H-13P			0	
DE_HSP_Pl_____B	HSP Plumbing Saddle /B: H-12P			0	
TE_PlSad_aST17P	Plumb saddle STA194 SDT/a: T-17P				
TE_PlSad_bST18P	Plumb saddle SDT/b: T-18P				

CSTOL ACTIONS:

K.7.6 Increase H-13P Heater Setpoint until the Side A Plumbing Saddle temperature SDT (Plumb

saddle STA194 SDT/a: T-17P) reaches 7 Kelvin

CSTOL HOLD:

K.7.6.1 RECORD the following Monitors:

Monitor Name	Description	Eng. Values	Count	Limit	Pass/Fail
DE_HSP_Pl_____A	HSP Plumbing Saddle /A: H-13P				
DE_HSP_Pl_____B	HSP Plumbing Saddle /B: H-12P			0	
TE_PlSad_aST17P	Plumb saddle STA194 SDT/a: T-17P				
TE_PlSad_bST18P	Plumb saddle SDT/b: T-18P				

CSTOL ACTIONS:

K.7.7 Increase H-15P Heater Setpoint until the Side A Pressure Sense Line temperature SDT (Press sense line STA156 SDT/a: T-19P) reaches 7 Kelvin

CSTOL HOLD:

K.7.7.1 RECORD the following Monitors:

Monitor Name	Description	Eng. Values	Count	Limit	Pass/Fail
DE_HSP_PrsSen_A	HSP Press Sense Line /A: H-15P			0	
DE_HSP_PrsSen_B	HSP Press Sense Line /B: H-14P			0	
TE_PrSLn_aST19P	Press sense line STA156 SDT/a: T-19P				
TE_PrSLn_bST20P	Press sense line SDT/b: T-20P				

K.7.8 Increase Spinup filter (G3 & 4) (H-03P) temperature to 7 K

K.7.9 Increase Spinup filter (G1 & 2) (H-01P) temperature to 7 K

K.7.10 Wait 10 Hours

CSTOL ACTIONS:

K.8 Low Temperature Bakeout Completion

K.8.1 TYPE GO to CLOSE Vatterfly Valve/s

CSTOL HOLD:

K.8.1.1 RECORD the following Vatterfly Valve Monitors:

Monitor Name	Description	Value	Expected Value	Pass/Fail
BE_VflyVSeOnOfA	Vatterfly Valves Select On/Off /A		0	
VE_VAT_A_CLOSED	Vatt valve-A closed		<100, >65535	
VE_VAT_A_OPEN	Vatt valve-A open		15565-17203	
TE_VAT_LV1_SDTa	Leakage valve 1 SDT/a			
TE_VAT_LV1_SDTb	Leakage valve 1 SDT/b			

PID ACTIONS:

K.8.2 Command Off the Cyropump Heater (H-11P)

K.8.2.1 Wait 4 hours

K.8.3 Command off Spinup filter Heater (G3 & 4) (H-03P)

K.8.4 Command off Spinup filter Heater (G1 & 2) (H-01P)

K.8.5 Command off Vacuum Shell Heater (H-9P)

CSTOL ACTIONS:

K.8.6 Type Go to Turn OFF the Plumbing Saddle (H-13P) Heater

CSTOL HOLD:

K.8.6.1 RECORD the following Monitors:

Monitor Name	Description	Eng. Values	Count	Limit	Pass/Fail
DE_HSP_Pl_____A	HSP Plumbing Saddle /A: H-13P			0	
DE_HSP_Pl_____B	HSP Plumbing Saddle /B: H-12P			0	
TE_PlSad_aST17P	Plumb saddle STA194 SDT/a: T-17P				
TE_PlSad_bST18P	Plumb saddle SDT/b: T-18P				

CSTOL ACTIONS:

K.8.7 Type Go to Turn OFF the Pressure Sense Line (H-15P) Heater CSTOL HOLD:

K.8.7.1 RECORD the following Monitors:

Monitor Name	Description	Eng. Values	Count	Limit	Pass/Fail
DE_HSP_PrsSen_A	HSP Press Sense Line /A: H-15P			0	
DE_HSP_PrsSen_B	HSP Press Sense Line /B: H-14P			0	
TE_PrSLn_aST19P	Press sense line STA156 SDT/a: T-19P				
TE_PrSLn_bST20P	Press sense line SDT/b: T-20P				

PID ACTIONS:

K.8.8 Decrease QBS (H-5P) temperature to nominal temperature over the next 12 hours

CSTOL HOLD:

K.8.8.1 Wait for PID Algorithm to complete and then RECORD the following Monitors: (Optional)

Monitor Name	Description	Eng. Values	Expected Value	Pass/Fail
SE_EcuPidError	Error word		0	
SE_EcuPidMode	0 For Pid, 1 For Window Bakeout		0	
RE_ConfigApp_1	1 If App Is On		0	
RE_ConfigApp_2	1 If App Is On		0	
RE_ConfigApp_3	1 If App Is On		0	
RE_ConfigApp_4	1 If App Is On		0	
RE_ConfigApp_5	1 If App Is On		0	
RE_TempControl1	Computed temps			
RE_TempControl2	Computed temps			
RE_TempControl3	Computed temps			
RE_TempControl4	Computed temps			
RE_TempControl5	Computed temps			

CSTOL ACTIONS:

K.8.9 FLIGHT ECU Closure:

K.8.9.1 Type GO to Snap & Clear Monitors.

K.8.9.2 Command Off ECU.

K.8.9.3 Snap & Clear ECU Monitors.

K.8.9.4 End ECU Message File Recording.

K.8.9.5 End Bridge File Recording.

K.8.9.6 End Oasis Binary File Recording.

K.8.9.7 OPERATOR: Power down ECU power supply.

K.8.9.8 RECORD: Voltage:_____ (Nominal: 0.0) Amperage:_____ (Nominal: 0.0).

K.8.10 Data Analysis

K.8.10.1 Load Data into Excel spreadsheet

K.8.10.2 Sort data into Monitors and graph Heater Set Point

K.8.10.3 Attach data charts and a sample of the data to this document

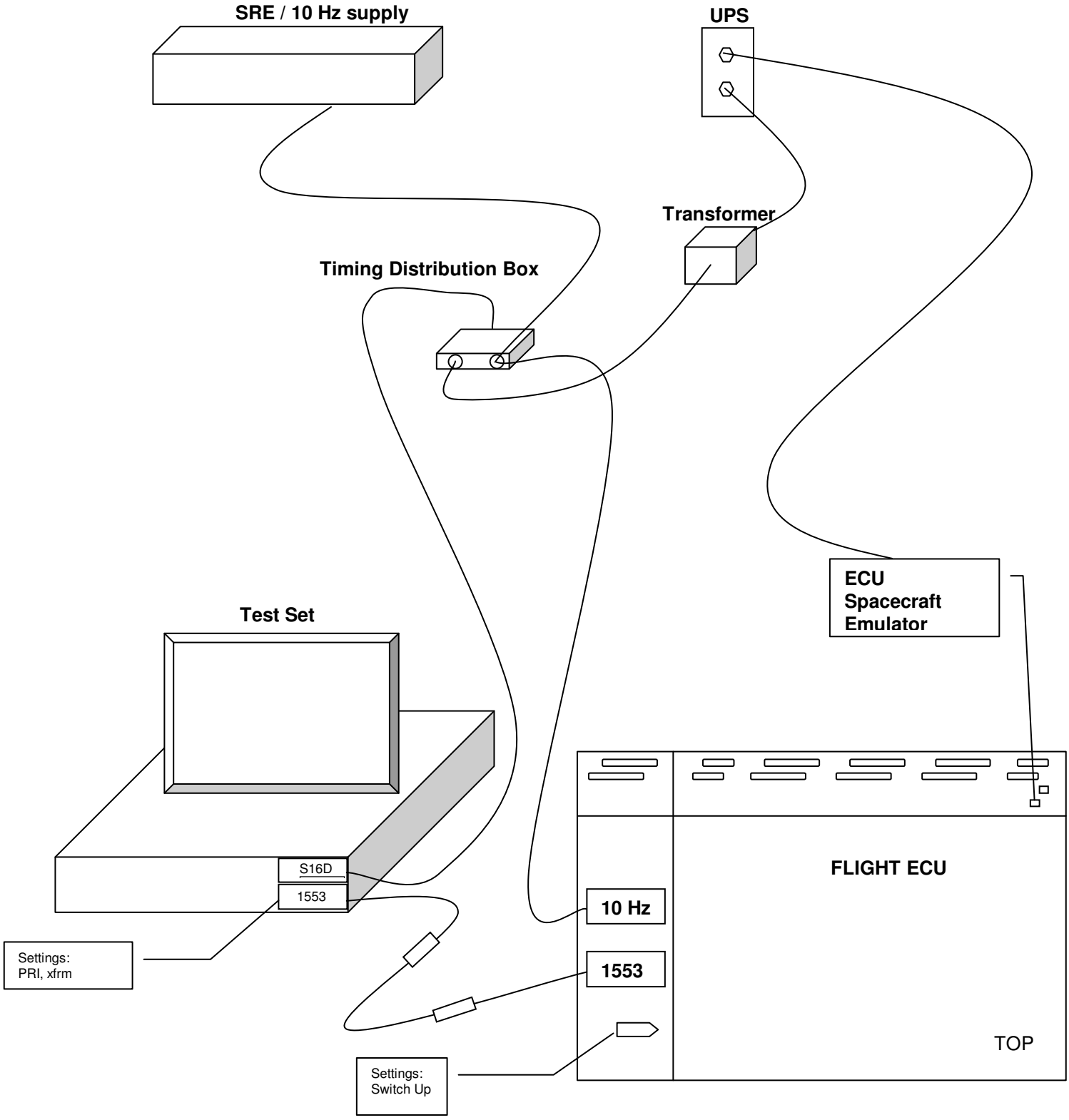
K.8.11 Test completed:

Completed by: _____
Witnessed by: _____
Date: _____
Time: _____

Test Leader: _____
Date: _____
Time: _____

Quality Engineer: _____
Date: _____
Time: _____

Figure 1


SRE / 10 Hz supply
UPS
Transformer
Timing Distribution Box
ECU
Spacecraft
Emulator
Test Set
S16D
1553
Settings:
PRI, xfrm
FLIGHT ECU
10 Hz
1553
TOP
Settings:
Switch Up