HESSI SPACECRAFT

THERMAL VACUUM FUNCTIONAL TESTS

HSI_MIT_058A

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DAVE CURTIS

As Run on: _____ (Date/Time)

By   _____ (Test Conductor)

DOCUMENT REVISION RECORD

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Project Manager: _____ _____
                                          Peter Harvey   Date

System Engineer: _____ _____
                                          David Curtis   Date

QA: _____ _____
                                          Ron Jackson   Date

1. INTRODUCTION

1.1 Purpose
This document establishes the Electrical configuration of the HESSI spacecraft for Thermal Vacuum tests and calls out the test procedures to be used before and during the test.

2. FIRST MOTION TEST

2.1 Setup
a. The EGSE racks and computers shall be located sufficiently close to the thermal vacuum chamber that the harnesses reach the feed-throughs
b. The spacecraft shall be installed in the chamber in the vertical orientation with the solar array first motion fixture installed and connected to the arrays per HSI_MIT_054, section 0.5
c. The EGSE shall be harnessed to the spacecraft via the feed-throughs for the TAC, Umbilical, and Battery Relay Box. The RF and PMT connections are not needed for this test.
d. The FEP shall remain out until after the closeout aliveness test; it must be installed before the chamber is closed.
e. The RF hats should be installed, and the transmit hats should be terminated with 50 ohm 5 watt terminators in case the RF is accidentally turned on.
f. The actuator enable plug should be installed, but the vacuum valve plug should not.
g. Heaters and temperature sensors shall be harnessed to JPL power supplies and monitors via feed-throughs and verified.

2.2 Ambient Aliveness Test
Once the GSE is set up, perform the aliveness test to verify that the GSE and harnessing is correct. The FEP should be OUT for this test. The aliveness test consists of HSI_MIT_010 followed by HSI_MIT_011.

2.3 First Motion Test Closeout Checklist

2.3.1 Items to Remove
1. SAS plastic Covers (3x)   Verify_____
2. Battery Cell Monitor Box   Verify_____
3. Spectrometer Vacuum Pump   Verify_____
4. TMS alignment laser in front of Imager   Verify_____
5. CSS Dust Covers (8x)   Verify_____
6. Vacuum Valve GSE   Verify_____
7. Vacuum Valve actuator plug VV-J1 (disconnect)   Verify_____

    8. FSS Stimulus   Verify_____

    9. FSS dust cover (red plastic)   Verify_____

2.3.2 Items to Install

1. Umbilical to GSE   Verify_____

2. Test Access Connector (TAC) to GSE   Verify_____

3. RAS Thermal Vac Cover   Verify_____

4. PMT Cover   Verify_____

5. Flight Enable Plug (FEP)   Verify_____

6. Battery Relay Box   Verify_____

7. RF Antenna hats (4x)   Verify_____

8. Spectrometer pump port cap   Verify_____

9. Actuator Enable plug (connect)   Verify_____

10. First Motion Fixture   Verify_____

11. Imager TMS Scaffold   Verify_____

12. Thermal blankets   Verify_____

2.3.3 Other closeouts

1. Cage Spectrometer Attenuator Actuators   Verify_____

2. Close RAS aperture shutter   Verify_____

3. Inspect blankets and harasses near solar array to ensure clearance

                                                            Verify_____

QA Verify:

2.4 First Motion Test

When it is determined that the system has reached the desired temperature, the solar array first motion test shall be performed. Use procedure HSI_MIT_054, section 0.6 to deploy the arrays. Snap PACI page (temperatures) and append to the as-run proc. Also attach thermal data from JPL sensors.

2.5 Actuator Test

The spectrometer shutter actuators cannot be run in the horizontal position, so the only opportunity to test them at the system level in vacuum is during the First Motion test sequence. Following the First Motion test, power up the following services:

1. CPU

2. IDPU
3. IDPU_SW

Snap the PACI and IDPU Thermal pages and append to the as-run proc.

Perform the actuator tests called out in HSI_MIT_013, sections 3.6 (Spectrometer Shutters) and 3.7 (RAS shutter).

2.6 Post-test

1. Warm the spacecraft back to ambient and open chamber.
2. Roll spacecraft out of chamber onto rail extensions
3. Remove solar arrays and store for shipping
4. Remove first motion fixture
5. Attach Spectrometer vacuum pump per HSI_MIT_022 when possible and pump for at least 4 hours prior to next test

3. THERMAL VACUUM / THERMAL BALANCE TESTS

3.1 Setup

a. The spacecraft shall be installed in the chamber in the horizontal orientation in the thermal vacuum MGSE

b. The EGSE shall be harnessed to the spacecraft via the feed-throughs for the TAC, Umbilical, and Battery Relay Box.

c. Attach the Antenna hats to the RF rack using the clean RF cables inside the chamber and the standard RF cables outside.

d. Attach the Frangibolt simulator GSE to the frangibolt connectors on the spacecraft (8 places), via feed throughs.

e. Attach the Solar Array Simulator harness to the solar array power connectors on the spacecraft (8 places) to the EGSE via feed-throughs

f. Attach the RAS-PMT stimulus to the pulser test setup via a BNC wire and feed-through.

g. The FEP shall be installed.

h. The actuator enable plug should be installed for the Ambient functional, but the vacuum valve plug should not; the actuator enable plug shall be removed for final closeout.

i. The RAS filter box should be installed.

j. The RAS Thermal Vac cover shall be installed (after the ambient functional):
    1. Apply silverized tape on new Alu plate (Paul)
    2. Mount Alu plate
    3. Verify that lower part of RAS is cleaned

k. The Imager flight scaffold shall be blanketed and installed
    1. Mount silverized tape on chimneys, flat and conical part
    2. Mount chimneys with peek washer and torque with 1.8Nm
    3. Mount MLI
    4. Demount TMS scaffold after first motion test
    5. Replace Kapton tape on lens support ring, by Alu tape, cover adhesive part towards lens by Alu.
    6. Mount scaffold do not torque scaffold with flight torque moment

l. Heaters and temperature sensors shall be harnessed to JPL power supplies and monitors via feed-throughs and verified.

3.2 Ambient Functional Test

This test shall verify that the spacecraft and GSE are configured correctly prior to closeout of the chamber. In addition, the RAS Filter Box must be verified. This shall be accomplished with a subset of the LPT, augmented as needed. Perform:

1. HSI_MIT_016 (launch vehicle interface test, including SEP)

2. HSI_MIT_010 (full power-on)

3. HSI_MIT_057, section 3.4 (LPT CSS test)

4. HSI_MIT_057, section 3.6 (LPT RF test; repeat for AFT antennas)

5. HSI_MIT_057, section 3.7 (LPT Electrical Power test)

6. HSI_MIT_057, section 5.1 (LPT PMT test)

7. HSI_MIT_057, section 5.5 (LPT Imager Functional)

8. Repeat Imager Functional accumulation with the following configurations (60 sec accumulation each):
    - v8s0r0_001.cmd (Mode 0 noise)
    - v8s0r1_001.cmd (Mode 1 noise)
    - v7r4_001 (LED)
    - v7s6r7_001 (Communication)
    - Mount RAS Stimulus and power on both; run v7s5r0esthr_001 followed by v7_thr_002 and take an accumulation.
    - Get these files to Alex Zehnder at PSI ASAP to verify RAS filter box functioning properly.

9. Ensure the actuator enable plug is in and cage the Spectrometer shutters (un-stick them and then lock them down) - Requires Paul Turin!

10. HSI_MIT_011 (power off)

3.3 Thermal Vac Test Closeout Checklist

3.3.1   Items to Remove
1. First Motion Fixture   Verify_____

2. SAS plastic Covers (3x)   Verify_____

3. Battery Cell Monitor Box   Verify_____

4. Spectrometer Vacuum Pump   Verify_____

5. TMS alignment laser in front of Imager   Verify_____

6. CSS Dust Covers (8x)   Verify_____

7. Vacuum Valve GSE   Verify_____

8. Actuator Enable Plug (removed)   Verify_____

9. FSS Stimulus   Verify_____

10. FSS dust cover (red plastic)   Verify_____

3.3.2   Items to Install
1. Umbilical to GSE   Verify_____

2. Test Access Connector (TAC) to GSE   Verify_____

3. RF Antenna hats to GSE   Verify_____

4. Solar Array Power connectors to EGSE (8x)   Verify_____

5. Frangibolt connectors to Simulator (8x)   Verify_____

6. RAS Thermal Vac Cover   Verify_____

7. PMT Cover, harnessed to external EGSE   Verify_____

8. Flight Enable Plug (FEP)   Verify_____

9. Battery Relay Box   Verify_____

10. RF Antenna hats (4x)   Verify_____

11. Spectrometer pump port cap   Verify_____

12. Imager Flight Scaffold (blanketed)   Verify_____

13. Thermal blankets   Verify_____

3.3.3 Other closeouts

4. Cage Spectrometer Attenuator Actuators   Verify_____

5. Verify Open RAS aperture shutter   Verify_____

6. Inspect blankets and harasses near solar array to ensure clearance

                        Verify_____

> **QA Verify:**

3.4 Pump Down

During pump-down the spacecraft will be in Launch mode:

a. Power up the spacecraft using HSI_MIT_049, section 5 via the Launch Vehicle Interface. Bring up the CPU.

b. Command the system to launch mode. Run procedure SC_MM_LAUNCH to set the mission mode to Launch. Verify that PACI telemetry shown LAUNCH mode.

c. Power off the CPU.

d. Adjust the TAC voltage to match the battery voltage (as indicated on the ITOS PACI page) plus 0.7V.

                Record Battery Voltage:_____

e. Enable the battery relay.

f. Set the TAC current limit to 0.2A above the essential bus current as read out on the PACI page (should be about 0.8A). Set the TAC voltage to 36V. The TAC should current-limit, with the battery current at about 0.2A.

                Record TAC Voltage: _____

                Record Battery Current:_____

Monitor the spacecraft status via the ITOS PACI page as the chamber pumps down.

3.5 Spectrometer Cool-down

Early in the Thermal Vac testing we will start running the cryocooler to cool down the detectors. This will take several days and requires continuous operation of the spacecraft.

Functional tests performed during cool-down will have to work around the cool-down.
To start the cool-down. To start cool-down, do the following:

a. Power up the spacecraft using HSI_MIT_010 (make sure the system is now in Mission Mode)

b. Run ITOS command "CFGMON CRYOPOWER" to calculate the Cryocooler power level on the Spectrometer power page.

c. Verify that the CPC Status on the SOH Spectrometer Power page is "TRIPPED"
                                                                TC Verify:_____

d. Start the ITOS script "ICRYO_ON". Verify that CPC Status is now "OK"
                                                                TC Verify:_____

e. Record the ICT1T Temperature on the SOH Spectrometer Power ITOS page
                                                                ICT1T:_____

f. Record the accelerometer setting on the SOH Spectrometer Power ITOS page. Should be about 10mG   IACCEL:_____

g. Start the ITOS proc "ICRYOMAIN_RAMP(20)". Record the following values:
                                                                DATE_____
                                                                TIME_____
                                                        ICRYOMAIN_____
                                                            ICRYOBAL_____
                                                        ICRYOPHASE_____
                                                        CRYO POWER_____
                                                                IACCEL_____

h. Wait 2 minutes, then record ICT1T (should have decrease from previous measurement in (d))   ICT1T:_____

i. Start an ITOS plot of the following quantities: ICT1T, ICT2T, ICP1T, IPC2T, ITST, IRAD1T, IRAD2T, CRYO POWER with a long time base (4 hours).

Monitor the cryocooler periodically throughout the Thermal Vacuum test:

a. Monitor the radiator temperatures; if they reach yellow limit, notify Paul Turin, and power down the cryocooler (ICRYOMAIN_RAMP(0))

b. As the cold-tip temperature ICT1T comes down, the cryocooler power level can be ramped up. ITOS will compute the maximum power level for the current temperature; run ICRYOMAIN_RAMP(100); it will tell you the maximum allowed power level; you can then ramp to that power level.

c. Later in the test, the power level shall be set as called out in the Thermal Vacuum test plan, HSI_MIT_060.

3.6 Imager Heaters

During most of the test, the Imager Heaters will be powered to keep the RAS and Grid Trays at their desired temperatures. This requires that the IDPU be powered on. Following the start of the Spectrometer cool-down, enable the Imager heaters and set their set-points as follows:

a. Send the ITOS command "/IPWMMODE CP=0,RAS=On, UGT=Primary, LGT=Primary". Verify that the following on the Thermal page:

- UGTPWM =Primary
- LGTPWM = Primary
- IRASPWM = Enabled   TC Verify_____

b.   Send the ITOS command "/IDPUARM HTR". Verify HTR on the Thermal
     page shows "ENABLED"   TC Verify_____

c.   Send the ITOS command "/IRASSETPT VALUE=-10". Verify that
     IRASSETPT on the Thermal page reads -10   TC Verify_____

d.   Send the ITOS command "/IUGTSETPT VALUE=20". Verify that
     IUGTSETPT on the Thermal page reads 20   TC Verify_____

e.   Send the ITOS command "/ILGTSETPT VALUE=20". Verify that
     ILGTSETPT on the Thermal page reads 20   TC Verify_____

f.   Verify that, after a few minutes, the IRASHTRV, IUGTHTRPV, and
     ILGTHTRPV read 28V periodically   TC Verify_____

The set points may be adjusted periodically through the testing by the Thermal Engineer.

3.7 Full Functionals

A full functional test shall be performed on the first and last cycles (hot and cold). This
will consist of the following tests:

1. HSI_MIT_016 - Launch Vehicle Interface Test (including Separation test); run in
    Mission Mode if the spacecraft is powered on.
2. HSI_MIT_010 - Full power-on, if not already on (usually on)
3. HSI_MIT_012 - Bus functional (skip FSS test since there is no FSS stim)
4. HSI_MIT_013 - Instrument Functional (skip cryocooler test when cooler is
    running, skip actuator tests)
5. HSI_MIT_018 - Detector Functional (when detectors are cold, <100K)
6. HSI_MIT_011 - Power off, if desired (usually not)

3.8 Limited Functionals

During Thermal Vacuum cycles between the first and last, Limited Functionals will be
performed during the dwells. Use HSI_MIT_057.