STEREO
IMPACT

Boom Suite Comprehensive Performance Test Procedure

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Distribution List

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1. Overview

1.1. *Introduction*

The STEREO IMPACT Boom Suite consists of the Instrument Data Processing Unit (IDPU) plus the boom-mounted instruments (SWEA, STE-D, STE-U, and MAG). The IDPU if the single point interface between these instruments and the STEREO spacecraft for telemetry. The IDPU also interfaces to the SEP Suite and PLASTIC instruments. Testing for those instruments is described elsewhere.

This document describes the Comprehensive Performance Test to be performed on the Boom Suite during testing to ensure the hardware is performing correctly.

1.2. *Document Conventions*

In this document, TBD (To Be Determined) means that no data currently exists. A value followed by TBR (To Be Resolved) means that this value is preliminary. In either case, the value is typically followed by a code such as UCB indicating who is responsible for providing the data, and a unique reference number.

Commands to be typed into the C&T GSE (stgsect) are indicated as follows: */SystemNOP.* After typing the command hit the Enter key to send.

1.3. *Applicable Documents*

The following documents are closely interrelated with this specification. All documents can be found on the Berkeley STEREO/IMPACT FTP site unless otherwise indicated:

http://sprg.ssl.berkeley.edu/impact/dwc/

1. 7381-9012B (IMPACT/Spacecraft ICD, on the APL web page)
2. ICD/IMPACTSerialInterfaceG (instrument interface spec)
3. ICD/IMPACT_CTM_Q (command & telemetry database)

Test Setup

This CPT has been modularized to allow it to be used in a variety of configurations, either stand-alone or with some or all of the instruments attached.

1.4. *Test Equipment*

1. IDPU Serial number_____.
       Configuration issues:_____
2. PROM version number:_____
3. EEPROM code version number:_____
4. Command & Telemetry GSE connected to spacecraft emulator via TCP/IP
       C&T GSE version date_____
       C&T Database version:_____, Date:_____
5. MAG Sensor (ETU, FM1, FM2, none):_____
6. STE-U Preamp/Sensor:_____
7. Boom harness (ETU/FM1/FM2)_____
8. SWEA/STE-D Sensor _____
9. SWEA HV Enable Plug Type_____
       NOTE: MCP HV should not be enabled except in vacuum.
10. SEP sensor _____
11. PLASTIC sensor _____

1.5. *Startup GSE*

1. Power up C&T GSE PC and start C&T GSE software (stgse-ct).
2. Select the PROM display from the C&T GSE Display/Recall Display menu
3. On the C&T GSE PC start up the SSH client and connect to the MOC (at cho.jhuapl.edu; a profile should be set up to allow you to do that – see SSH.txt if not).   You will need a password.
4. Connect C&T GSE to the MOC – push the TCP/IP next to the TLM display on the Received Data Panel:
       Verify the TLM light comes on:_____
5. On the C&T GSE push the Record button. Determine the name of the telemetry file
       File Name:_____

1.6. *Startup IDPU*

<div style="border:2px solid red;color:red;font-weight:bold">
DO NOT POWER ON THE IDPU OR MAG HEATER CIRCUIT
WITHOUT THE MAG SENSOR CONNECTED.
</div>

1. Request the spacecraft TC power-on the IDPU.   Record the bus voltage and IDPU current from the spacecraft displays

    Bus Voltage _____V

    IDPU Current _____mA

2. Verify C&T GSE is getting telemetry. On IDPU SOH panel, UTC time should correspond to time on Emulator PC (typically set to UTC), and should be incrementing every two seconds.

    Verify C&T GSE getting telemetry _____

3. After 10 seconds ISoftwareVersion should change to correspond to the EEPROM software version number. Verify no errors are reported and the version changes

    Record value of ISoftwareVersion _____

    Record value of IERRORCount _____

    Record value of IBootSelect _____

2. DCB Tests

Record Start Time_____

2.1. *Housekeeping Packet Contents and Commanding Test*

Note the terms Housekeeping and State of Health (or SOH) are used interchangeably.

2.1.1. Verify Housekeeping Packet CCSDS Packet Header

- On the C&T GSE under the Main menu select ApID Display. This should bring up a hex packet display window. On that window select ApID 200 (housekeeping). Push clear. A new SOH packet should come up in a few seconds and be displayed in hex in the window

Verify_____

- The first two bytes contain some fixed bit fields plus the ApID. They should be 00 0A

Verify_____

- The second two bytes contain the packet sequence counter, plus two fixed bits in the MSB. The data should be displayed LSByte first, and should increment by one with every new packet, every 2 seconds.

Verify_____

- The third pair of bytes contains the packet size, which should contain the fixed value 09 01.

Verify_____

- The next 6 bytes contain the packet collect time. This is decoded on the SOH display UTCs,f. This value should correspond to the time code provided by the spacecraft emulator (minus a few seconds of pipeline delay for the housekeeping packets). Verify the time corresponds to the time on the emulator, and that it increments by 2 seconds for every new packet

Verify_____

2.1.2. Verify Key Housekeeping Packet Contents

- ISampleTime – This is the instrument sample time counter. It displays in Hours:minutes:seconds, has a resolution of 1 second and a range of 16 hours (it jumps back to zero and start again every 16 hours). It starts at zero on reset. Verify it counts correctly.

Verify_____

- ISoftwareVersion – This is the code version number, which is fixed in the code. Record the value:

Value_____

- IHardwareVersion – This is the FPGA version number, which is fixed in the hardware, and should equal 4.

Verify_____

- IPollTimeMax, IPollTimeAvg – Monitor the IPollTimeMax and IPollTimeAvg values (on IDPU SOH panel) and record their maximum values:　　　　　　　　　　IPollTimeMax (<1s)_____ms

IPollTimeAvg (<.01s)_____ms

- ITimeJitter – this is a measurement of the maximum jitter in the UTC time code provided over the 1553 interface. With the emulator this is usually zero, and occasionally ~64us, the resolution of the 1553 timing system. Record the maximum value seen:

Value (<1ms)_____µs

- IErrorCode, IErrorData, IErrorCount – this is the error tracking values. IErrorCode should be blank and IErrorCount should be zero.

Verify_____

Cause an error by sending an incorrect command: */SystemFunction 100*. This should cause the IErrorCode to be "**ERROR_CmdBadFunction**", IErrorData to be **100**, and IErrorCount to be **1**.

Verify_____

Clear the error by sending */ClearErrors*. IErrorCode should return to blank and IErrorCount should return to zero.

Verify_____

- ICommandCount, ICommandLastID, ICommandLastSeq – this is the IMPACT command verification system. ICommandCount counts IMPACT commands since reset (modulo 65536), ICommandLastID is the ApID of the most recent IMPACT command received, and ICommandLastSeq is the sequence number of the most recent IMPACT command received. Note their values:

ICommandCount_____
ICommandLastID_____
ICommandLastSeq_____

Send the command */SystemNOP* Note the new values:

ICommandCount_____
ICommandLastID_____
ICommandLastSeq_____

ICommandLastID should be **SystemFunction**. ICommandCount and ICommandLastSeq should have incremented by one from their previous values:

Verify_____

Send a block of 100 commands: *Start IMPACT100* Note the new values:

ICommandCount_____
ICommandLastID_____
ICommandLastSeq_____

ICommandLastID should be **SystemFunction**. ICommandCount and ICommandLastSeq should have incremented by 100 from their previous values:

Verify_____

2.2. *EEPROM Write Test*

- Attempt to write to EEPROM when not enabled:
    Send */IDPUEEPROMLoad 0x20 0x0000 0x12 0x34* (OK the hazardous command)
    This should generate the error **ERROR_CmdVerify**, along with command verification (ICommandLastID = **IDPUEEPROMLoad**)

    Verify_____

- Enable and write to EEPROM:
    Send */ClearErrors* (SOH IErrorCount should return to zero)
    Send */EEPROMEnable* (OK the hazardous command)
    Send */IDPUEEPROMLoad 0x20 0x0000 0x12 0x34* (OK the hazardous command)
    You should get no new errors, though you may see a complaint in the event log about the code page checksum status. The EEPROM Enable bit should be on in the SOH InterfaceEnables display.

    Verify_____

    The EEPROM0 Checksum flag (in ICodePageStatus) should be set

    Verify_____

- Dump the EEPROM page and verify its contents:
    Set the GSE to display ApID 201 hex, memory dump. Clear the display
    Send */DumpMemory 0x20 0x0000 0x0001*
    Verify that you get a memory dump packet, and byte 15=12, byte 16 is 34

    Verify_____

- Return EERPOM contents to zero:
    Send */IDPUEEPROMLoad 0x20 0x0000 0 0* (OK the hazardous command)
    The EEPROM0 Checksum flag (in ICodePageStatus) should be cleared

    Verify_____

- Disable EEPROM Write. Send */EEPROMDisable*. Verify the EEPROM Enable bit is off in the SOH InterfaceEnables display.

    Verify_____

2.3. *C&DH Interface (1553) Test*

2.3.1. Telemetry

Verify correct response to telemetry request. This is performed in step 2.3

2.3.2. Commands

Commands have been tested in previous steps (3.1).

2.3.3. B Side Test

Record which side of the 1553 bus is active.

- On the IDPU SOH panel of the C&T GSE, expand the ISCStatus byte. Record the value of the 1553A/-B bit:

    1553A/-B (A): _____

2.3.4. Spacecraft Status

- The Emulator Spacecraft Status is set on the 1553/Spacecraft Status page. The value is displayed on the housekeeping SOH page under ISCStatus. Verify the value displayed corresponds to the spacecraft status.

Verify_____

2.3.5. Instrument Status

- Send the command */ShutdownIDPU* (OK the hazardous command). Verify the IDPU Power Warning on the SOH page under ISCstatus turns on.

Verify_____

- After 90 seconds the spacecraft should automatically power down the IDPU (telemetry will stop on the C&T GSE)

Verify_____

- Request that the TC power-up the IDPU again. Verify that telemetry returns at the C&T GSE

Verify_____

2.3.6. SWAVES Transfers

- On the SOH display InterfaceActive value verify the SWAVES interface is Active. This indicates traffic to/from the SWAVES 1553 message buffers. If SWAVES is not powered on, the SWAVES Timeout bit should be set instead.

Verify_____

2.4. *Memory Test*

The DCB has a built-in memory test. The system shuts down all other activity during this test, so there will be no commands or telemetry. It takes about 1 minute. When it comes back up it will restart as if from a reset, but it will report any memory errors it encountered in the error housekeeping.

- Send the command */IDPUMemoryTest 64 0*. Wait for telemetry to resume and verify that no errors are reported.

Verify_____

2.5. *Watchdog Test*

- Verify loss of the timer tic interrupt causes a watchdog reset. Disable the timer interrupt by sending: */IDPUMemoryLoad 0x00 0x1F94 0x18*. Verify the DCB resets after ~2 seconds and gives an **ERROR_WatchdogReset** error.

Verify_____

Record Completion Time_____

3. MAG Instrument

Record Start Time_____

Assume the MAG interface is in the IDPU and a MAG sensor is attached.

Verify_____

3.1. *MAG Housekeeping*

- Verify on the C&T GSE InterfaceActive display that the MAG interface is active (1)

Verify_____
- Turn on the MAG SOH display on the C&T GSE. Verify no red/yellow limits in MAG SOH. Verify MAG command counter should increment once every ~5 seconds.

Verify_____
- Verify nominal temperature for MAG sensor:

IMAGTemp_____
- If a GSE temperature sensor is available, record the GSE mag temperature:

GSE MAG Temp_____

3.2. *MAG Data*

- Enable the C&T GSE telemetry server. Start up the MAG GSE (mags.exe) and connect to the C&T GSE. Verify that the connection light turns on:

Verify_____
- Enable the MAG Chart on the MAG GSE. If the value is saturated (typically 1, sometimes 32768), send the command /MAGEnableIF, which should get it out of saturation.

Verify_____
- Verify the MAG data remains constant to within a few codes over a period of at least a minute. Record the maximum RMS values.

Verify_____

RMS X:_____Y:_____Z:_____

3.3. *MAG High Sensitivity Range*

- If possible, place the MAG sensor in a shield can. Verify that the MAG range changes from low sensitivity (1) to high sensitivity (0), and the field value is constant to within a few codes. Record the maximum RMS field values

Verify_____

RMS X:_____Y:_____Z:_____

3.4. *MAG Calibration Mode*

- Verify that the C&T GSE is recording data.

  Verify_____
- Set the MAG sample rate to 32Hz: */SetMAGRate 1*. Verify telemetry packets come every ~1.5 seconds.

  Verify_____
- Record the 1-packet average on the MAG sensor (AVR on the MAG GSE)

  X_____
  Y_____
  Z_____
  Range_____
- On the C&T GSE send the command */SetMagMode 0xC1* to turn on the MAG Calibration mode. Record the new 1-packet average:

  X_____
  Y_____
  Z_____
  Range_____
- Verify that the measurement changed by +8500 counts +/-200 on each axis

  Verify_____
- Turn off the MAG Cal: send C&T GSE command */SetMagMode 0x81*. Verify that the 1-packet average returns to the original value within a few counts:

  Verify_____
- Use the Decom GSE to analyze the MAG data file recorded by the C&T GSE. Record the characteristics of the turn-on of the Cal mode by the Decom GSE

  X Sample Time:_____ Amplitude:_____ Rate:_____
  Y Sample Time:_____ Amplitude:_____ Rate:_____
  Z Sample Time:_____ Amplitude:_____ Rate:_____

- Use the Decom GSE to analyze the MAG data file recorded by the C&T GSE. Record the characteristics of the turn-off of the Cal mode by the Decom GSE

  X Sample Time:_____ Amplitude:_____ Rate:_____
  Y Sample Time:_____ Amplitude:_____ Rate:_____
  Z Sample Time:_____ Amplitude:_____ Rate:_____

- Set the MAG sample rate back to 8Hz: */SetMAGRate 4*. Verify telemetry packets come every ~5 seconds.

  Verify_____

  Record Completion Time_____

3.5. *MAG Heater Interface*

Record Start Time_____

Assume the MAG interface and MAG heater boards are in the IDPU and a MAG sensor is attached.

Verify_____

> **DO NOT POWER ON THE IDPU OR MAG HEATER CIRCUIT WITHOUT THE MAG SENSOR CONNECTED.**

- Request the TC apply power to the MAG heater circuit.   Record the power supply current on the spacecraft display.

  MAG Heater Supply Current_____mA
- Record the MAG temperature on the C&T GSE:

  IMAGTemp_____C
- If an GSE temperature sensor is available, record the GSE mag temperature:

  GSE MAG Temp_____C
- Record the telemetry MAG heater current (note that this is not expected to be an accurate measure of the actual current, but should correspond to the measurement made above to ~20%). The MAG heater will not come on above 10C, but will take a ~5mA standby current.

  IMAGHeater_____mA
- Verify no ripple on the MAG measurement on the MAG GSE. Record the maximum RMS value seen over a minute

  RMS X:_____Y:_____Z:_____

Record Completion Time_____

4. Startup SWEA/STE-D

> **DO NOT POWER ON SWEA WITH THE MCP HV ENABLED EXCEPT IN VACUUM, P < 1E-5 TORR. POWERING ON WITH THE ENABLE PLUG IN, WHILE STILL PROTECTTED BY THE ENABLE COMMAND, IS RISKY.**

1. Request the TC power-on the SWEA/STE-D service. Wait 10 seconds, then record the current monitor on the spacecraft monitor

    SWEA Current _____mA

2. Verify that on the C&T GSE ISCStatus display the SWEA Power display shows On (1), and on the Interface Active display, SWEAInterface shows active (1).

    Verify_____

5. STE-U / STE-D Instrument

Record Start Time_____

STE is light sensitive, so a dark bag over the sensor will be needed to avoid light saturation. Lights may need to be dimmed around the spacecraft when the STE doors are open. Indicate what kind of bag is on the STE Units

STE Dark Bags_____

If the instrument is not in its default (power-on) mode, return it to that mode. On the C&T GSE do:

- *Start STENormalResLoad*   Verify_____
- */SetSTEThreshold 0 12 12 12 12 12 12 12 12*   Verify_____

5.1. *STE-U Housekeeping*

- Verify on the C&T GSE InterfaceActive display that the STE-U interface is active (1)   Verify_____
- Turn on the STE-U SOH display on the C&T GSE. Verify no red/yellow limits in STE-U SOH, and the STE-U front end is powered on (AFEPWR on the ISTEUDig display = 1).

  Verify_____
- Verify the STE-U door position telemetry corresponds to the door position (STECOVSTAT under ISTEUDig)

  Open/Closed_____
- Record the following SOH values from the C&T GSE ISTE-U SOH panel.

  ISTEUCur_____mA

  ISTEUTemp_____C

  ISTEUDACTemp_____C
- If available, record the spacecraft-monitored Boom temperature

  Boom Temp_____

5.2. *STE-D Housekeeping*

- Verify on the C&T GSE InterfaceActive display that the SWEA interface is active (1)

  Verify_____
- Turn on the SWEA/STE-D SOH display on the C&T GSE. Verify no red/yellow limits, and the STE-D front end is powered on (AFEPWR on the ISWEASTEDDig display = 1).

  Verify_____
- Verify the STE-D door position telemetry corresponds to the door position (STECOVSTAT under ISWEASTEUDig)

  Open/Closed_____

- Record the following SOH values from the C&T GSE SWEA/STE-D SOH panel.

<div align="right">

ISWEASTEDCur_____

ISTEDTemp_____

ISWEADACTemp_____
</div>

- If available, record the spacecraft-monitored SWEA temperature

<div align="right">

SWEA Temp_____
</div>

5.3. *STE Background*

- If the STE-U or STE-D door is closed, run step 5.7.1 to open it

<div align="right">

Verify_____
</div>

- Start the STGSE-STE GSE (ste.exe). Enable the C&T GSE telemetry server and connect the STE gse (TCP/IP button). Verify that the Connect light comes on on the STE GSE.

<div align="right">

Verify_____
</div>

- Speed up the Monitor Rates accumulation interval to 2 seconds. Send */SetSTERateInt 2*. Verify the accumulation interval as displayed on the STE Rates Panel reads 2 seconds:

<div align="right">

Verify_____
</div>

- Display the STE Rates panel and wait for it to update. Set to Raw Counts, so it reads counts per accumulation interval (2 seconds). Record the rates:

	LLD	ULD	RESET
STEU Det0	_____	_____	_____
STEU Det1	_____	_____	_____
STEU Det2	_____	_____	_____
STEU Det3	_____	_____	_____
STED Det0	_____	_____	_____
STED Det1	_____	_____	_____
STED Det2	_____	_____	_____
STED Det3	_____	_____	_____

- Enable the STE Spectra display on the STE GSE and wait for the display to update. Verify no more than a few counts per interval, except perhaps at the lowest few energy channels (depending on the STE temperature).

<div align="right">

Verify_____
</div>

5.4. *STE Threshold Test*

In the following steps adjust the STE thresholds with the command */SetSTEThreshold <n> <v>*, where <n> is the detector number (0-3 for STE-U, 4-7 for STE-D), and <v> is the desired value. You can set 4 thresholds at once with the command */SetSTEThreshold 0 <v0> <v1> <v2> <v3> <v4> <v5> <v6> <v7>*. The DAC settings are ~100eV per step, with the default value set to 12 (~2keV).

- Adjust the threshold for each detector while monitoring the Spectra and LLD rates. Find the lowest threshold value at which the Spectra count rate is < 10/sec (100/sample). Record the threshold setting and count rate below. From the spectra display note the lowest energy bin receiving counts.

	Threshold	LLD	Energy Bin
STEU Det0	_____	_____	_____
STEU Det1	_____	_____	_____
STEU Det2	_____	_____	_____
STEU Det3	_____	_____	_____
STED Det0	_____	_____	_____
STED Det1	_____	_____	_____
STED Det2	_____	_____	_____
STED Det3	_____	_____	_____

5.5. *STE Test Pulser*

- Enable the STE-U test pulser. Send command */STEUPulserEnable*. Verify that the ENBSTETP bit comes on the ISTEUDig SOH display.

                                                                    Verify_____

- Enable the STE-D test pulser. Send command */STEDPulserEnable*. Verify that the ENBSTETP bit comes on the ISWEASTEDDig SOH display.

                                                                    Verify_____

- The test pulser in default mode ramps up in amplitude over an interval of 32 seconds, followed by 8 seconds of dead time before it starts again. Looking at the monitor rates you should see the LLDs firing at 2KHz for 32 out of each 40 seconds, dropping down to the background rate for the other 8 seconds. The reset rates should follow the same cycle, but the 2KHz counts shall be distributed amongst the resets. Turn on the Monitor Rates vs time plot, select a representative LLD, ULD, and RESET rate counter and run a few cycles. The ULD rates should see 2KHz for a short time in each 40-second interval, just before the LLD rates drop.

                                                                    Verify_____

- Set the STE binning mode to linear (with ~1.56keV resolution, mode 1). Send the command *Start STELinear*. Wait 1-2 minutes for the new LUT to load. On the STE GSE Spectra panel enable the Accumulate mode and accumulate a few test pulser cycles. Verify that the counts are spread evenly across the channels except the first few (below the LLD).

                                                                    Verify_____

- Set the test pulser to discrete amplitude mode. Send the command */SetSTEUCtrl 0x72F2* and */SetSTEDCtrl 0xF2F6.* Wait ~40 seconds for a new test pulser cycle and reset the spectra accumulator. Verify that the counts now appear in ~7 discrete lumps, and the STE Mode ID indicates 1.

                                                                    Verify_____

- Increase the resolution of the display 4x (~0.39Kev/bin, mode 2). Start STEHiResCycle. This will use all 256 energy channels for one detector, cycling through the 4 detectors for 4 minutes each. In this mode the 4 curves on the spectra display that normally represent the 4 detectors now represent the four quarters of the spectra for the first detector. Verify that STE mode cycles through mode 2,3,4, and 5, returning to mode 0 at the end.

<div align="right">Verify_____</div>

- Disable the STE test pulser: send commands */STEUPulserDisable, /SetSTEUCtrl 0x70F0,   /STEDPulserDisable* and */SetSTEDCtrl 0xF0F4.* Verify that the ENBSTETP bit goes off (0) on the ISTEUDig SOH display. Verify that the ENBSTETP bit goes off (0) on the ISWEASTEDDig SOH display.   Verify the spectra and monitor rates return to background levels.

<div align="right">Verify_____</div>

5.6. *STE Door Source*

- If the STE-U or STE-D door is open, run step 5.7.2 to close it

<div align="right">Verify_____</div>

- Set the STE GSE Spectra display to accumulate, and accumulate a few minutes of data to get reasonable statistics on the STE door source. There should be peaks at 82keV from the Cd109 source and at 5keV from the Fe55 source. There will also be a number of florescence lines excited by the Cd109 source in the instrument.

<div align="right">Verify_____</div>

- Start STEHiResCycle. This will use all 256 energy channels for one detector, cycling through the 4 detectors for 4 minutes each. In this mode the 4 curves on the spectra display that normally represent the 4 detectors now represent the four quarters of the spectra for the first detector. Verify that STE mode cycles through mode 2,3,4, and 5, returning to mode 0 at the end.

<div align="right">Verify_____</div>

- Set to hi res door monitor mode. *Start STEDoorLUT*. Wait 2 minutes and start an accumulation. Accumulate for at least 10 minutes.

<div align="right">Verify_____</div>

<div align="right">Completion Time_____</div>

5.7. *STE Door Test:*

This proc test the STE-U and STE-D door open/closed proc. It assumes the door is closed to begin with.

<div style="border:2px solid red; color:red">

TO BE PERFORMED ONLY IF THE INSTRUMENT IS IN A CLEAN ROOM OR BAGGED TO AVOID CONTAMINATION TO STE DETECTOR.

BE SURE BAG, BLANKETS, ETC DO NOT IMPEDE THE COVER ACTION.

</div>

5.7.1. STE Door Open

- Verify that the Emulator Spacecraft Status has IDPU Power and Thruster Warnings OFF (they will inhibit opening of the STE door)

    Verify_____
- If at ambient conditions (not vacuum, below +40C), send the following command to adjust the door timing: *start STEDoorAir.* If in vacuum with STE temperatures below –35C do: *start STEDoorVacCold*. If in vacuum and between –35C and +20C do: *start STEDoorVacWarm*. If in vacuum and above between +20C and +40C do: *start STEDoorVacHot*

    STE-U temperature_____C
    STE-D Temperature_____C
    Script:_____

5.7.1.1 STE-U Door Open

- Record the state of the STE-U door housekeeping on the STEDoor SOH display. If ISTEUCovStat is not CLOSED skip this proc:

    ISTEUDoorCount_____
    ISTEUDoorStart_____
    ISTEUDoorDone_____
    ISTEUCovStat_____
    ISTEUCovSW_____
- Command the door open. Send the command */STEUDoorOpen*. Verify by inspection that the cover opens and no instrument error occurs:

    Verify_____
- If the GSE indicates an STE AFE trip (STE housekeeping goes blue), send */STEUAFEOn*

    Verify_____
- Record the STEU Door housekeeping.

    ISTEUDoorCount_____
    ISTEUDoorStart_____
    ISTEUDoorDone_____
    ISTEUCovStat_____
    ISTEUCovSW_____

- Verify that the DoorCount increases by 1, the start and done times are in limit (not red/yellow), ISTEUCovStat is now OPEN, and ISTEUCovSW is now OFF.

  Verify_____

5.7.1.2 STE-D Door Open

- Verify that the SWEA Enable plug in SWEA-J2 supports opening the STE-D Door.

  Verify_____

- Record the state of the STE-D door housekeeping on the STEDoor SOH display. If ISTEDCovStat is not CLOSED skip this proc:

  ISTEDDoorCount_____
  ISTEDDoorStart_____
  ISTEDDoorDone_____
  ISTEDCovStat_____
  ISTEDCovSW_____

- Command the door open. Send the command */STEDDoorOpen*. Verify by inspection that the cover opens and no instrument error occurs:

  Verify_____

- If the GSE indicates an STE AFE trip (STE housekeeping goes blue), send */STEDAFEOn*

  Verify_____

- Record the STED Door housekeeping.

  ISTEDDoorCount_____
  ISTEDDoorStart_____
  ISTEDDoorDone_____
  ISTEDCovStat_____
  ISTEDCovSW_____

- Verify that the DoorCount increases by 1, the start and done times are in limit (not red/yellow), ISTEDCovStat is now OPEN, and ISTEDCovSW is now OFF.

  Verify_____

5.7.2. STE Door Close

5.7.2.1 STE-U Door Close

- Command the door closed. Send the command */STEUDoorClose*. Verify by inspection that the cover closes:

<div align="right">Verify_____</div>

- If the GSE indicates an STE AFE trip (STE housekeeping goes blue), send */STEUAFEOn*

<div align="right">Verify_____</div>

- Record the STEU Door housekeeping.

<div align="right">
ISTEUDoorCount_____
ISTEUDoorStart_____
ISTEUDoorDone_____
ISTEUCovStat_____
ISTEUCovSW_____
</div>

- Verify that the ISTEUDoorCount increases by 1, the start and done times are in limit (not red/yellow), ISTEUCovStat is now OPEN, and ISTEUCovSW is now OFF.

<div align="right">Verify_____</div>

5.7.2.2 STE-D Door Close

- Command the door closed. Send the command */STEDDoorClose*. Verify by inspection that the cover closes:

<div align="right">Verify_____</div>

- If the GSE indicates an STE AFE trip (STE housekeeping goes blue), send */STEDAFEOn*

<div align="right">Verify_____</div>

- Record the STEU Door housekeeping.

<div align="right">
ISTEDDoorCount_____
ISTEDDoorStart_____
ISTEDDoorDone_____
ISTEDCovStat_____
ISTEDCovSW_____
</div>

- Verify that the ISTEDDoorCount increases by 1, the start and done times are in limit (not red/yellow), ISTEDCovStat is now OPEN, and ISTEDCovSW is now OFF.

<div align="right">Verify_____</div>

6. SWEA Test

Record Start Time_____

6.1. *SWEA Housekeeping*

- Verify on the C&T GSE InterfaceActive display that the SWEA interface is active (1)

Verify_____

- Turn on the SWEA/STE-D SOH display on the C&T GSE. Verify no red/yellow limits, and the STE-D front end is powered on (AFEPWR on the ISWEASTEDDig display = 1).

Verify_____

- Record the SWEA door position (SWEACOVSTAT under ISWEASTEUDig)

Open/Closed_____

- Record the SWEA HV Enables state (under ISWEASTEUDig)

NRHVENB_____

MCPHVENB_____

- Record the following SOH values from the C&T GSE SWEA/STE-D SOH panel.

ISWEASTEDCur_____

ISWEAMCPTemp_____

ISWEADACTemp_____

- If available, record the spacecraft-monitored SWEA temperature

SWEA Temp_____

6.2. *SWEA Test Pulser*

- Start the STGSE-SWEA GSE (swea.exe). Enable the C&T GSE telemetry server and connect the SWEA gse (TCP/IP button). Verify that the Connect light comes on on the SWEA GSE.

Verify_____

- On the SWEA GSE turn on the 3D master and 3D numeric displays. Verify that the UTC time code updates every 30 seconds, indicating 3D SWEA data flowing.

Verify_____

- Page through the 16 energies on the SWEA Numeric display and verify the 3D data is all zeros.

Verify_____

- Turn on the SWEA test pulser using the command */SWEAPulserEnable.* Verify that the ENBSWEATP bit comes on (1) in the ISWEASTEDDig display on the C&T GSE.

Verify_____

- The SWEA test pulser should stimulate counts in all anodes, energies, and deflections. Counts should fall off with increasing energy (decreasing energy bin number). Counts for different deflections should be about the same except at the lowest energies (highest energy bin numbers). Counts should be highest

for anodes 0 and 8, down a factor of ~2 for anodes 1 and 9, another factor of ~2 for anodes 2 and 10, etc. Using the 3D numeric and various graphic displays on the SWEA GSE verify this pattern. In particular verify counts in all anodes at least at low energies (high energy bin number).

Verify_____

- Turn off the SWEA test pulser using the command */SWEAPulserDisable.* Verify that the ENBSWEATP bit goes off (0) in the ISWEASTEDDig display on the C&T GSE.

Verify_____

6.3. *SWEA MCP Heater*

The SWEA MCP heater is software controlled to a ground-set power level.   The power is pulse-width modulated on a 20 second period, so operation of the heater can be verified by watching the current consumption on the SWEA primary 28V supply.

- Set the SWEA MCP Heater to 10%: Send */SetSWEAMCPHeater 1.* Verify that the SWEA primary power increases by ~90mA for 2 seconds out of every 20 seconds.

Verify_____

- Record the SWEA MCP Temperature

ISWEAMCPTemp_____

- Set the SWEA MCP Heater to 100%: Send */SetSWEAMCPHeater 10.* Verify that the SWEA primary power increases by ~90mA continuously.

Verify_____

- Measure how long it takes the MCP to rise 2 degrees C from the starting temperature recorded above.

Minutes_____

- Set the SWEA MCP Heater off. Send */SetSWEAMCPHeater 0.* Verify that the SWEA primary power drops ~90mA and stays steady.

Verify_____

6.4. *SWEA NRHV*

The SWEA Non-Regulated High Voltage (NRHV) supply is used to generate the analyzer deflector and sweep supply voltages. It operates at ~1500V, and is protected by a number of hardware and software protections against accidental turn-on. Generally on the bench this supply is safe to be powered up. However, ensure that the MCP is not enabled except in vacuum.

- Verify a high voltage enable plug or enable GSE in installed in SWEA-J2. If not in vacuum, ensure that the MCP HV is not enabled by the plug used.

  Enable Type_____
- Enable NRHV by sending the following two commands separated by no more than 15 seconds.

  /SWEAArmNRHV
  /SWEANRHVOn

  Verify no commanding errors reported on the C&T GSE

  Verify_____
- Verify that the SWEA NRHV state is On (on the C&T GSE ISWEASTEDDig display, NRHVENB = 1).

  Verify_____

- Record the following high voltage values from the C&T GSE SWEA/STE-D Housekeeping display:

  ISWEANR5V_____
  ISWEAAnal_____
  ISWEADefl1_____
  ISWEADefl2_____
- Send */SWEAFHKPAnal* to request a readout of the analyzer HV waveform. Later use DECOM to display the waveform and append to this proc. Verify three ApID 214 packets are sent.

  Verify_____
- Send */SWEAFHKPDef1* to request a readout of the Deflector 1 HV waveform. Later use DECOM to display the waveform and append to this proc. Verify three ApID 214 packets are sent.

  Verify_____
- Send */SWEAFHKPDef2* to request a readout of the Deflector 1 HV waveform. Later use DECOM to display the waveform and append to this proc. Verify three ApID 214 packets are sent.

  Verify_____

6.5. *SWEA V0*

V0 is a programmable voltage in the analyzer that effects the operation of the instrument.

- Set the software to allow manual control of V0. Send */SWEAManualV0.* Verify the ISWEAAUTOV0 (bit 2) is off (0) in the IAUTOLUT display on the C&T GSE.

  Verify_____

- Send the following commands to set the V0 voltage and record the resulting values of ISWEAV0 in the SWEA/STE-D housekeeping display of the C&T GSE.

Command	Measured ISWEAV0 value	Nominal V0 value
/SetSWEAManualV0 0xFF		-25 V
/SetSWEAManualV0 0x80		-12.5 V
/SetSWEAManualV0 0x00		0 V

6.6. *SWEA MCP HV*

> **TO BE PERFORMED ONLY IF SWEA IS IN VACUUM < 1E-5 TORR TO AVOID DAMAGE TO SWEA MCP DETECTOR.**

- Verify the SWEA door has been open for at least 30 minutes. If not, use 6.9 to open it.

  Verify_____
- Record the vacuum chamber pressure

  Pressure (<1e-5 Torr)_____
- Verify a high voltage enable plug or enable GSE in installed in SWEA-J2

  Enable Type_____
- Enable MCPHV by sending the following two commands separated by no more than 15 seconds.
  - */SWEAArmMCPHV*
  - */SWEAMCPHVOn*

  Verify no commanding errors reported on the C&T GSE

  Verify_____
- Verify that the SWEA MCPHV state is On (on the C&T GSE ISWEASTEDDig display, MCPHVENB = 1).

  Verify_____

- Record the following high voltage value from the C&T GSE SWEA/STE-D Housekeeping display:

  ISWEAMCP (0V)_____

6.6.1. SWEA MCP HV Ramp Up

Ramp the SWEA MCP HV up to its nominal level through a few steps. Record the indicated data at each step. Note that the IDPU will ramp the voltage up to the desired setting at ~100V/second. Wait for ramping to complete before taking the measurement.

Command	Nominal Voltage	Instrument Current	ISWEAMCP (C&T GSE)	Moment N (SWEA GSE)
/SetSWEAMCP 0	0			
/SetSWEAMCP 36	500			
/SetSWEAMCP 73	1000			
/SetSWEAMCP 109	1500			
/SetSWEAMCP 146	2000			
/SetSWEAMCP 182	2500			
/SetSWEAMCP 190	2600			
/SetSWEAMCP 197	2700			
/SetSWEAMCP 201	2760			

6.7. *SWEA Source Test*

This test uses a Ni63 radiation source or electron gun to stimulate the instrument with electrons during a vacuum test.

- Indicate type of source or gun used:

  _____

- Verify NRHV and MCPHV have been powered on using 4.4 and 4.5.

  Verify_____

- Using the SWEA GSE 3D Numeric display, verify that counts are seen in the expected anodes and energy:

  Max Anodes Count Rate_____
  Anode Counting Highest_____
  Energy Bin counting highest_____

6.8. *SWEA Shutdown*

- Power off the high voltage supplies: Send */SWEAMCPHVOff*, */SWEANRHVOff*. Verify MCPHVENB and NRHVENB are off (0) in ISWEASTEDDig on the C&T GSE.

  Verify_____

  Completion Time_____

6.9. *SWEA Door*

TO BE PERFORMED ONLY IF SWEA IS IN A CLEAN ROOM, VACUUM, OR BAGGED/PURGED TO AVOID CONTAMINATION TO SWEA MCP DETECTOR.

The SWEA door is actuated by a 1-time TiNi mechanism powered by an instrument-controlled circuit. Re-closing the door requires access to the instrument by IMPACT personnel. The door can only be opened if an appropriate enable connector is installed in SWEA-J2. The door must be opened in order to allow electrons to enter the instrument (only an issue during vacuum tests and in flight). While the door is open, the Microchannel Plate (MCP) detector is exposed to contamination.

6.9.1. SWEA Door Open

- Verify that an appropriate enable plug or the enable GSE is installed to allow the SWEA door to be activated. Ensure that the MCP HV is NOT enabled if not in vacuum.

    Enable Type_____
- Verify that the SWEA instrument is powered on and generating telemetry (on the C&T GSE InterfaceActive display, SWEA interface is active (1)).

    Verify_____
- Verify that the SWEA door state is closed (on the C&T GSE ISWEASTEDDig display, SWEACOVSTAT = CLOSED).

    Verify_____
- Verify that the SWEA 28V supply current limit is > 1.5 amp if on a bench supply. If on the spacecraft, verify the autonomy rule for SWEA current is disabled or set to >1.5 Amp (this current will be drawn for <100ms when the door is opened).

    Verify_____
- If practical, set up to monitor the current profile on the SWEA 28V supply during door opening. Set to trigger on current > 0.3A with a time scale covering ~200ms.

    Verify_____
- Send the following two commands separated by no more than 15 seconds.
    /SWEAArmCover
    /SWEACoverOpen
    Verify no commanding errors reported on the C&T GSE

    Verify_____
- Verify that the SWEA door state is open (on the C&T GSE ISWEASTEDDig display, SWEACOVSTAT = OPEN).

    Verify_____

- If the current profile was monitored, record the amplitude and duration of the measured current pulse during the door actuation.

Before/After actuation (Amps)_____
During actuation (Amps)_____
Actuation time (msec)_____

6.9.2. SWEA Door Close

Only authorized IMPACT personnel should perform this action.

Operator_____

- Verify the SWEA instrument is unpowered.

Verify_____

- Insert the actuator reset tool into the SWEA cover and push to close the cover. Verify the cover appears to close normally by inspection and feel

Verify_____

- If the instrument is powered on, Verify that the SWEA door state is closed (on the C&T GSE ISWEASTEDDig display, SWEACOVSTAT = CLOSED).

Verify_____