

STEREO *IMPACT*

Boom Suite Limited Performance Test Procedure

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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 is 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 Limited Performance Test to be performed on the Boom Suite during testing to ensure the hardware is performing correctly. It is a subset of the Comprehensive Performance Test (CPT), designed to verify the hardware is connected and functional.

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_P (command & telemetry database)

2. Test Setup

This LPT 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.

2.1. Test Equipment

1. IDPU Serial number_____.
Configuration issues:_____
 2. PROM version number:_____, Date: _____
 3. EEPROM code version number:_____, Date:_____
 4. 28V Power Supply_____
 5. Spacecraft Emulator connected to DCB 1553 interface (or spacecraft)
Emulator software version_____
 6. Command & Telemetry GSE connected to spacecraft emulator via TCP/IP
C&T GSE version date_____
 - C&T Database version:_____, Date:_____
 7. MAG Sensor (ETU, FM1, FM2, none):_____
 8. STE-U Preamp/Sensor:_____
 9. Boom harness (ETU/FM1/FM2)_____
 10. SWEA/STE-D Sensor/simulator_____
 11. SWEA HV Enable Plug Type_____
- NOTE: MCP HV should not be enabled except in vacuum.**
12. SEP sensor/simulator_____
 13. PLASTIC sensor/simulator_____

2.2. Startup GSE

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

1. Power up Spacecraft Emulator PC and start Emulator software (Emulator may be configured to auto-start; if not, select IMPACT and start). (If running through the spacecraft, verify spacecraft is powered and functioning, and MOC is ready for PCO to connect).
2. Power up C&T GSE PC and start C&T GSE software (stgsect).
3. Select the PROM display from the C&T GSE Display/Recall Display menu
4. Connect C&T GSE to Emulator – 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 (in the scgse\log directory)
File Name:_____

2.3. **Startup IDPU**

1. Verify supply is connected and configured correctly to power the IDPU: 28V, 500mA current limit to the IDPU service (for now do not power the MAG heater service).
Supply Voltage_____
2. Power-on the supply to turn on the IDPU. If the supply current limit is reached, power off the supply immediately.
Measure supply current _____
3. 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 _____
4. 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 _____

2.4. **Startup SWEA**

1. Verify supply is connected and configured correctly to power the SWEA/STE-D: 28V, 300mA current limit to the SWEA service.
Supply Voltage_____
2. Record the SWEA enable connector used in SWEA-J2.
SWEA Enable_____

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 PROTECTED BY THE ENABLE COMMAND, IS RISKY.

3. Power-on the supply to turn on the SWEA/STE-D. If the supply current limit is reached, power off the supply immediately.
Measure supply current _____
4. On the spacecraft emulator 1553 spacecraft status page turn off the SWEA/STE power shutdown warning. 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_____

3. DCB Tests

Record Start Time _____

3.1. *Housekeeping Packet Contents and Commanding Test*

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

3.1.1. Verify Key Housekeeping Packet Contents

- 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 _____
- 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 (<1) _____
IPollTimeAvg (<.01) _____
- 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) _____
- IErrorCode, IErrorData, IErrorCount – this is the error tracking values. IErrorCode should be blank and IErrorCount should be zero.
Verify _____
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_____

3.2. C&DH Interface (1553) Test

3.2.1. Spacecraft Status

- Record the spacecraft status (ISCStatus on the SOH page). Verify they correspond to the current spacecraft (or emulator) status.
 IDPU Power On/Off_____
 SEP Power On/Off_____
 SWEA Power On/Off_____
 PLASTIC Power On/Off_____
 Thruster Firing_____
 Coarse Pointing_____
 SWAVES Power On/Off_____
 1553 A/-B_____
 Verify_____

3.2.2. SWAVES Transfers

- On the SOH display InterfaceActive value verify the SWAVES interface is Active. This indicates traffic to/from the SWAVES 1553 message buffers.
 Verify_____

Record Completion Time_____

4. MAG Interface

4.1. *MAG Instrument*

Record Start Time_____

Assume the MAG interface is 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.

4.1.1. 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_____

4.1.2. 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. 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:_____

4.1.3. 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 +8900 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_____

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

Verify_____

Record Completion Time_____

4.2. **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.

- Apply power to the MAG heater circuit (28V, current limit at 50 mA). If the supply reaches the current limit, turn it off immediately. Record the power supply current

MAG Heater Supply Current_____

MAG Heater Supply Voltage_____

- Record the MAG temperature on the C&T GSE:
IMAGTemp_____
- If an GSE temperature sensor is available, record the GSE mag temperature:
GSE MAG Temp_____
- 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_____

- Verify no ripple on the MAG measurement on the MAG GSE.
RMS X:_____ Y:_____ Z:_____

- Power off the MAG heater supply

Record Completion Time_____

5. STE-U, STE-D Interface

Record Start Time _____

STE is light sensitive, so a dark bag over the sensors will be needed to avoid light saturation. The STE-U door should be closed.

Verify _____

5.1.1. STE Housekeeping

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

Verify _____

- Verify on the C&T GSE InterfaceActive display that the SWEA/STE-D 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 _____

ISTEUTemp _____

ISTEUDACTemp _____

- 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.

ISWEASTEDCur _____

ISTEDTemp _____

ISWEADACTemp _____

- If available, record the spacecraft-monitored SWEA temperature

SWEA Temp _____

5.1.2. STE Background

- 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.

Verify_____

- 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:

Verify_____

- 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	_____	_____	_____

5.1.3. STE Door Source

- 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 25keV from the Cd109 source and at 6keV from the Fe55 source.

Verify_____

- Set to hi res door monitor mode. *Start STEDoorLUT*. Wait 2 minutes and start an accumulation. Accumulate for at least 10 minutes (you can continue with the SWEA test while STE is accumulating).

Verify_____

Completion Time_____

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_____
- Record the following SOH values from the C&T GSE SWEA/STE-D SOH panel.
MCPHVENB_____
- Record the following SOH values from the C&T GSE SWEA/STE-D SOH panel.
ISWEASTEDCur_____
- If available, record the spacecraft-monitored SWEA temperature
ISWEAMCPTemp_____
- If available, record the spacecraft-monitored SWEA temperature
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 5*. Verify that the SWEA primary power increases by ~90mA for 10 seconds out of every 20 seconds.

Verify_____

- Set the SWEA MCP Heater off. Send */SetSWEAMCPHeater 0*. Verify that the SWEA primary power returns to a steady value.

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 (the Test HV Enable plug enables NRHV but not MCP HV). If no HV enable plug is installed, skip 6.4 and 6.5.

- Verify a high voltage enable plug or enable GSE is 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 two ApID 201 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 two ApID 201 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 two ApID 201 packets are sent.

Verify _____

6.5. SWEA V0

V0 is a programmable voltage in the analyzer that effects the operation of the instrument. NRHV must be on to set V0.

- 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
<i>/SetSWEAManualV0 0xFF</i>		-25 V
<i>/SetSWEAManualV0 0x80</i>		-12.5 V
<i>/SetSWEAManualV0 0x00</i>		0 V

6.6. 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_____