

# STEREO *IMPACT*

## Boom Suite Performance Test Overview

IMPACT-BOOM-TEST\_A.doc  
Version A – 2005-Jun-13

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Date Run: \_\_\_\_\_

Test Reference: \_\_\_\_\_

## Document Revision Record

Rev.	Date	Description of Change	Approved By
A	2005-Jun-13	Preliminary Draft	-

## 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 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 provides an outline of the Boom Suite Observatory-level performance testing for the purposes of test planning. It includes constraints and requirements for those tests. The detailed procedures for those tests (mostly to be run on the instrument POCs by instrument personnel) are described elsewhere (see references)

### 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.

### 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. TestProcs/IMPACT-BOOM-CPT – Boom Suite Comprehensive Test Procedure
2. TestProcs/IMPACT-BOOM-LPT - Boom Suite Limited performance Test Procedure
3. **TBD-UCB** – Boom Suite Aliveness test procedure
4. **TBD-UCB** – IMPACT Boom deployment test procedure
5. TestProcs/IMP-449 – IMPACT Boom stowing procedure
6. **TBD-UCB** – Boom Suite Instrument Setup for boom deployment

## 2. General Requirements

The electrical tests shall be performed as called out in reference 1-3 by the IMPACT instrument team or their delegate. The tests can be run either from the POC at APL or remotely from the UCB POC. No electrical GSE is required to be attached to the boom suite for these tests.

The boom deployment test is a one-time test to verify the ability to deploy the boom while mated to the spacecraft and using the spacecraft deployment actuation system. The test requires MGSE and UCB personnel to be present as called out in reference 4, and after deployment the boom must be removed from the observatory for re-stowing by UCB personnel as called out in reference 5.

During most of Observatory-level testing the SWEA red-tag cover and the SWEA/STE red-tag purge system shall be in place. These shall be removed at appropriate times by IMPACT personnel or their delegates. The red-tag boom actuation restraining pin shall remain in place except just before the test deployment and just before encapsulation. It shall be removed by an IMPACT team member.

SWEA has a high voltage enable plug. It is accessed under a cover in the side of SWEA and requires special tools to remove. There is a red-tag enable plug which shall be installed for most ground tests, and a green-tag cover which shall be installed for thermal vac and launch by an IMMPACT team member.

Note that all hardware for covers, purge system, and enable plugs are captured, so these activities should be compatible with being performed on the launch pad.

**NEVER POWER UP THE IDPU WITHOUT A MAG SENSOR ATTACHED (FLIGHT OR ETU)**

Normally instruments are not powered on (SWEA, SEP, or PLASTIC) until after the IDPU has been powered on. There is no damage done by violating this rule, but there is no monitoring of these instruments without the IDPU powered on. To run the SEP or PLASTIC tests, the IDPU can be powered on by the spacecraft; it will come up in a state ready to support those tests, and any special configurations required will be part of those tests.

## 3. Boom Suite Comprehensive Performance Test

This test is designed to test all the Boom Suite instruments functionality and collect significant trending data (see reference 1). The constraints and requirements are as follows:

1. The CPT requires powering the IDPU, MAG Heater, and SWEA at appropriate times as called out in the Boom Suite CPT (reference 1). These are controlled by the spacecraft operators, who will be in communication with the IMPACT team during the tests and shall have appropriate test scripts in hand to perform these functions (**TBD-APL**).

2. SWEA MCP high voltage can only be operated at pressures less than 1E-5 Torr (at the instrument). Powering on the MCP at higher pressures can result in damage to the instrument. SWEA has a high voltage enable plug; a red-tag plug disables MCP high voltage during ground tests. A green-tag plug is inserted for launch and thermal vac testing. Note that when the high voltage enable plug is installed, it still requires IDPU and SWEA power to be on, plus two hazardous command to be issued by the POC to power up the MCP high voltage. The LPT and Aliveness tests do not test SWEA high voltage. Section 6.6 and 6.7 of the IMPACT Boom Suite CPT (reference 1) shall be skipped when not at adequate vacuum. Instrument pressure shall be inferred from chamber pressure measurements plus instrument outgassing time by the IMPACT team, depending on the relative location of the chamber pressure sensor and SWEA. Typically we are looking for chamber pressures in the low 10E-6 Torr range for at least a few hours before powering up the MCP high voltage.
3. The SWEA MCP high voltage shall not be powered up until at least one hour after the SWEA door has been opened.
4. The SWEA door is a one-time actuation device controlled by the instrument team (not a spacecraft-powered actuator). The door can be re-closed manually. The door cannot be actuated unless either the red-tag or green-tag SWEA enable plug is installed. An IMPACT team member must be present to re-close the door using a special tool. Opening the door puts the SWEA MCP detector at risk for contamination, and so door actuations should be limited to a few occasions at ambient, plus once in thermal vac. The door should be re-closed as soon as possible after opening, and should not be opened in an environment worse than 10,000. The door opening and closing procedure is part of the boom suite CPT, reference 1 section 6.9. It will not be routinely run as part of every CPT.
5. During thermal vac, the SWEA instrument shall be stimulated by a set of Ni63 radiation sources attached to the instrument. These sources shall be attached by the IMPACT team before the door is closed on the thermal vac test. These sources are only used in thermal vac CPT (see reference 1 section 6.7).
6. The STE doors are actuated by instrument command, and can be opened or closed by command. The STE-D door cannot be opened unless either the red tag or green tag SWEA enable plug is installed. The STE doors are opened and closed as part of the IMPACT Boom suite CPT (reference 1 section 5.7). Opening the door exposes the STE sensor to contamination, and should not be performed in an environment worse than class 10,000, and should not remain open for extended periods. While the STE door is open the sensor is exposed to light which saturates the detector. This does not damage the detector, but makes measurements impossible. During the part of the IMPACT Boom Suite CPT where the STE door is open (reference 1, section 5.3-5.5) the room in which the spacecraft is contained should be as dark as possible. This part of the test takes ~30 minutes.
7. During the Magnetometer parts of the CPT (reference 1 section 3) activity near the spacecraft should be minimized, particularly anything which could produce a magnetic signature (e.g. movement of metallic objects, running motorized tools).
8. To get the Magnetometer into a high-sensitivity range requires a shield-can over the sensor. This test shall be run at most one time on the spacecraft (perhaps

- during EMC magnetics tests). This is called out in the Boom Suite CPT (reference 1 section 3.3).
9. The normal IMPACT boom suite CPT takes about 2 hours (assuming the spacecraft is powered up and ready to go), 2.5 hours in thermal vac due to the extra SWEA tests.
  10. During the IMPACT CPT the Boom Suite takes somewhat more telemetry than its allocation. If the SEP instrument suite is powered off, we do not exceed the IMPACT suite allocation, and even if it is on we remain under ~4000bps. If this is an issue, we have ways to adjust our system to remain within our allocation during the test.
  11. Normally the boom suite CPT should be complete before the SEP Suite or PLASTIC CPTs are performed (at least reference 1 section 2 before PLASTIC; for SEP there is risk of GSE commanding contention throughout).

#### 4. Boom Suite Limited Performance Test

This test is a subset of the CPT designed to test most of the electrical functionality of the boom suite, without some of the performance trending accumulations to save time (see reference 2). No doors or covers are actuated and SWEA MCP High Voltage remains off. The constraints and requirements are as follows:

1. The LPT requires powering the IDPU, MAG Heater, and SWEA at appropriate times as called out in the Boom Suite LPT (reference 2). These are controlled by the spacecraft operators, who will be in communication with the IMPACT team during the tests and shall have appropriate test scripts in hand to perform these functions (**TBD-APL**).
2. The LPT can be performed with either the red-tag or green-tag enable plug in place (though there is some risk involved with the green tag enable plug in place of accidentally powering up the SWEA MCP High Voltage and damaging the instrument if not in vacuum).
3. As the STE doors remain shut, there is no need to darken the room.
4. During the Magnetometer parts of the LPT (reference 2 section 4) activity near the spacecraft should be minimized, particularly anything which could produce a magnetic signature (e.g. movement of metallic objects, running motorized tools).
5. The normal IMPACT boom suite LPT takes about 45 minutes (assuming the spacecraft is powered up and ready to go).
6. During the IMPACT LPT the Boom Suite takes somewhat more telemetry than its allocation. If the SEP instrument suite is powered off, we do not exceed the IMPACT suite allocation, and even if it is on we remain under ~4000bps. If this is an issue, we have ways to adjust our system to remain within our allocation during the test.
7. Normally the boom suite LPT should be complete before the SEP Suite or PLASTIC LPTs are performed (at least reference 1 section 2 before PLASTIC; for SEP there is risk of GSE commanding contention throughout).

## 5. Boom Suite Aliveness Test

The aliveness test is a quick test to demonstrate the basic health of the suite (see reference 3). After power-on of the IDPU and SWEA a single command script will be run to configure the instruments in an optimal state to verify their operation for a few minutes. The constraints and requirements are as follows:

1. The test requires powering the IDPU, MAG Heater, and SWEA at appropriate times as called out in the Boom Suite Aliveness Test (reference 3). These are controlled by the spacecraft operators, who will be in communication with the IMPACT team during the tests and shall have appropriate test scripts in hand to perform these functions (TBD-APL).
2. The Aliveness Test can be performed with the red-tag or green-tag enable plug in place, or with no SWEA enable plug in place (though there is some risk involved with the green tag enable plug in place of accidentally powering up the SWEA MCP High Voltage and damaging the instrument if not in vacuum).
3. As the STE doors remain shut, there is no need to darken the room.
4. The normal IMPACT Boom Suite Aliveness test takes about 10 minutes (assuming the spacecraft is powered up and ready to go).
5. Normally the Boom Suite Aliveness Test should be complete before the SEP Suite or PLASTIC tests are performed.

## 6. IMPACT Boom Deployment Test

This is a mechanical test of the deployment of the IMPACT boom while attached to the spacecraft as called out in reference 4. The constraints and requirements are as follows:

1. The spacecraft must be oriented so that the IMPACT boom deploys vertically up. Adequate vertical clearance must be provided. Also space to walk the boom out after deployment must be provided, plus room to stow the boom. All areas must be at least class 10,000.
2. Special off-load GSE must be set up and attached to the boom as called out in reference 4. The IMPACT team shall be responsible for setting this up. This fixture must be attached to the ceiling over the spacecraft.
3. The deployment can be run with the boom suite powered off, but it is desirable for at least the IDPU and SWEA to be powered on so that the instruments can be monitored during the deployment (as they will be in flight). Reference 6 calls out the procedure for configuring the instruments for deployment.
4. The Boom Deployment Restraining pin must be removed before deployment by an IMPACT team member (who can verify that the actuator has not been inadvertently fired prior to removing the pin).
5. In flight the Boom Deployment Heater will be powered up ~30 minutes prior to deployment to ensure that the boom deployment mechanism is warm enough. While the heater will not come on at room temperature, it might be good to power this up to follow test as you fly.
6. Deployment is actuated by spacecraft command. The appropriate actuator enable plug should be installed to allow this.
7. Personnel in the vicinity of the spacecraft should be warned to stand clear of the boom and off-load fixture prior to deployment.



8. An IMPACT team member need to be in the spacecraft bay to time the deployment. A video of the deployment may also be desirable.
9. After deployment an IMPACT team member will inspect the boom to verify it has deployed completely and locked.
10. The spacecraft, or at least the IMPACT Suite, must be powered down so that the boom can be removed.
11. The Spacecraft team shall disconnect the boom from the spacecraft while the IMPACT team supports the boom. The IMPACT team will then walk the bottom end of the boom away from the spacecraft while the top end of the boom (still attached to the off-load fixture) descends vertically. Once horizontal, the boom shall be disconnected from the off-load fixture and walked away.
12. Current plans call for the boom to be re-attached to the spacecraft in a horizontal configuration for the EMC test. The IMPACT Team will provide MGSE supports for the boom for this configuration and aid the spacecraft team in re-attaching the boom.
13. Final stowing must take place off the spacecraft following the procedure in reference 5. IMPACT team members will supply the MGSE and personnel required. Adequate clean room space must be provided.