CM: FAST-MGMT-010

INTEGRATION AND TESTING DEVELOPMENT PLAN

FOR THE

FAST MISSION

JULY 3, 1990

1. GENERAL DESCRIPTION

The purpose of this document is to set forth a development plan for the Integration and Testing of the FAST Spacecraft. The Integration and Testing Manager who resides in the Instrumentation Branch, Code 743, and the Payload Verification Manager, Code 750, have the responsibility for the contents and implementation of this document. This document will cover the I&T process, spacecraft test configurations, manpower, costing and schedule for delivering a qualified spacecraft for flight.

The goal of I&T is to provide to the SMEX Project a fully qualified flight spacecraft which will meet the mission objectives. The I&T process is the vehicle for achieving that goal and consists of mechanical interface checks, electrical testing and performance verification testing.

The objective of mechanical interface checks is to insure that all spacecraft elements will fit within the area allocated on the structure.

The objectives of electrical testing are as follows:

1) To verify the electrical performance and compatibility between spacecraft subsystems,
2) To verify the performance of the spacecraft software to effectively operate the spacecraft,
3) To verify compatibility between the spacecraft and the ground system,
4) To verify the spacecraft to vehicle interface.

The objectives of performance verification testing are as follows:

1) Provide assurance that the specified mission objectives will be met,
2) Provide assurance that hardware will meet specific performance, interface and safety requirements,
3) Provide confidence that the spacecraft will survive the environments imposed during launch and mission sequence,
4) Determine operating and performance characteristics from simulated mission environments.

2. APPLICABLE DOCUMENTS

GEVS-STS/ELV
Scout Users Manual
PAR for SMEX Spacecraft
FAST Preliminary Verification Plan
FAST Requirements Document
FAST Mission Operations Concepts

3. REQUIREMENTS

The following subsystems: mechanical, power, electrical, SEDS, attitude control and thermal will deliver to the I&T Manager hardware which has been functionally and environmentally tested. Environmental test will include protoflight vibration, thermal/vacuum cycling, EMC, magnetics and strength testing as required. The I&T Team, which will be comprised of the I&T Manager, the Performance Verification Manager and the Subsystem Engineers, will proceed with an I&T program to produce a fully qualified spacecraft which will meet the FAST mission requirements. Specific details of of the I&T program will be contained in the FAST Integration and Test Plan and the FAST Verification Plan.

4. INTEGRATION AND TEST PROCESS

4.1 Mechanical Buildup

The Mechanical Subsystem Group will provide to the I&T Manager an assembled spacecraft structure minus the subsystem elements. The subsystem elements will be mounted to the structure systematically as indicated in the attached I&T Mechanical Build-Up Flow Diagram. The Mechanical Subsystem Group will be responsible for the mechanical attachement of the subsystems to the structure.

4.2 Electrical Tests

4.2.1 Interface Verification Tests (IVT)

Once the wiring harness has been installed on the structure, subsystem interfacing to the harness can begin. Prior to a subsystem being connected to the harness, the power input connector will be checked for proper input voltage on the proper pins. The subsystem can then be connected to the harness; and command and data interface tests can be completed. This same procedure will be used for each subsystem, however there has to be a systematic approach as to the order in which subsystems are tested since there is an inter-dependancy among subsystems. The following is the preferred order for interface testing:

1) Power Supply Electronics (PSE)
2) Power Distribution/Pyro Control Unit (PD/PCU)
3) Command Telemetry Terminal (CTT)
4) Recorder/Processor/Packetizer (RPP)
5) Attitude Control Electronics (ACE)
6) Attitude Control Sensors
7) Transponder
8) Instruments

4.2.2 Functional Tests

Once the subsystems have verified their interfaces with the spacecraft wiring harness, subsystem functional test can be begin. Basically functional tests verifies the interaction between subsystems or the operation of a subsystem to perform within specified requirements using a defined operational procedure. This document will not attempt to list all the functional test to be performed; but examples are:

1) non-essential bus overcurrent disconnect,
2) pyro prime and backup functional tests,
3) I&T GSE to spacecraft test,
4) hardware/software testing,
5) command uplink and data collection test,
6) safehold mode functional test,
7) attitude control sensors testing.

4.2.3 Comprehensive Electrical Performance Test (CEPT)

The CEPT is another functional test, but requires more interaction between all the subsystems. It will demonstrate that the hardware and software meet their performance requirements. It will also demonstrate the ability of the spacecraft to respond to a given stimuli. The test duration is TBD but will include simulations thru the launch phase, orbit insertation and a minumum number of orbits to verify operation of all spacecraft functions. This test will follow a specific timeline which will duplicate with reasonable accuracy actual mission sequencing. The initial CEPT will serve as a baseline in which follow on testing results can be compared.

4.2.4 Ground Network Compatability Tests

The spacecraft will be made available for mission operations tests and simulations conducted by the Flight Operations Team (FOT) and I&T Team. These tests are required for:

1. Verifing spacecraft compatibility with the network
2. Verifing spacecraft compatibility with the POCC and PACOR
3. Validating ground system capabilities and performance
4. Testing data base specifications
5. Validating spacecraft operations procedures
6. Personnel training and readiness assessments

The SAMPEX Mission Operations Concepts Document outlines the approach and conceptual requirements for accomplishing the above objectives.

4.3 Performance Verification Testing

Following the successful completion of all electrical tests, the spacecraft will be subjected to a full systems verification approach in which the entire payload is tested under conditions that simulate the flight operations and environment as realistically as possible. The verification test program includes the following: SPIN BALANCE, MASS PROPERTIES, EMC, VIBRATION, STATIC LOADS, MECHANICAL SHOCK, ACOUSTICS, DEPLOYMENT TESTS, THERMAL BALANCE, THERMAL VACUUM and MAGNETIC CALIBRATION

5. INTEGRATION AND TEST CONFIGURATION

5.1 Mechanical and Electrical Integration Configuration

The mechanical buildup and electrical testing of the spacecraft will utilize the Code 740 class 10k clean room facility in building 5 at the GSFC. All personnel and equipment entering the clean room will meet standard clean room requirements. The spacecraft configuration will vary depending on what phase of testing the spacecraft is undergoing. The primary goal is to eventually have the spacecraft in an all up configuration minus the solar arrays and thermal blankets. During initial electrical testing some subsystem GSE will be connected to the spacecraft. However, the goal will be to have only the I&T GSE interfacing to the spacecraft for command and data functions after initial electrical testing has been completed. The spacecraft will receive +28 volt power from a test battery which will be installed in the spacecraft. The spacecraft will also receive +28 power from an external power supply which will be controlled by the power system GSE via the spacecraft umbilical. Some components of the I&T GSE may be located inside the clean room to facilitate testing. However there are provisions for all of the GSE to be located in a joining room if required.

5.2 Verification Testing Configuration

Spacecraft verification testing will utilize the Test & Evaluation (T&E) facilities at the GSFC. However, it may be necessary to seek other facilities for a spin balance and/or spin deployment tests. In general, for most of the verification testing the spacecraft will be in an all up configuration including solar arrays and thermal blankets. However, during thermal/vacuum testing (not including thermal balance) the thermal blankets will not be attached to the spacecraft. During most of the testing it will be required that the spacecraft be powered and monitored;

and, during thermal/vacuum testing the spacecraft will be subjected to functional testing. Therefore, the GSE configuration will be identical to the Integration GSE configuration.

5.3 Launch Site Configuration

The spacecraft will be shipped to the launch site in all up configuration. Following a post shipping visual inspection, the spacecraft will be prepared for prelaunch testing. The ideal situation is to leave the spacecraft in an all up configuration as much as possible during electrical testing. After the initial health status of the spacecraft is checked a comprehensive electrical performance test will be conducted to verify that all spacecraft subsystems are performing satisfactorily. The GSE configuration will be the same as the integration GSE configuration. During actual launch operations the I&T GSE and power system GSE will be located in the launch site blockhouse. The I&T GSE interface with the spacecraft will be via the RF link while the power system GSE interface will be via the spacecraft umbilical.

6. GSE

6.1 Mechanical GSE

The Mechanical Subsystem Group will provide all the ground support and ground handling equipment for the spacecraft as detailed in the Mechanical Subsystem Development Plan.

6.2 Unique Subsystem GSE

Each subsystem will provide their own GSE for stand alone box level testing as detailed in the subsystem development plans. This unique subsystem GSE may also be used during initial subsystem interface testing prior to the I&T GSE being interfaced with the spacecraft.

6.3 I&T GSE

Once the subsystem interface testing is completed the I&T GSE will be the primary interface to the spacecraft for data handling, command generation and status, health and safety monitoring. The subsystems will have access to spacecraft data via I&T subsystem GSE's which will interface with the I&T GSE Local Area Network (LAN). The I&T GSE will utilize the Spacecraft Test and Operations Language (STOL). All spacecraft

test procedures involving the I&T GSE will be converted to STOL. The I&T GSE Group will be responsible for converting written test procedures to STOL. The I&T GSE Group (Code 743) is responsible for the I&T GSE and the terminals which will be connected to the LAN for subsystem data monitoring. They also will either provide or assist in all I&T GSE software requirements.

6.4 Test Cables

All subsystem unique test cables will be supplied by the subsystems. All spacecraft unique test cables (e.g. S/C umbilical, thermal/vacuum cables) will be the responsibility of the I&T Manager.

7. MANPOWER SUPPORT

7.1 Civil Service Manpower

	MY FY91	MY FY92	MY FY93
SAMPEX I&T Manager/743	0.2	0.6	0.8
I&T ENGINEER #1/743	0	0.1	0.2
I&T Engineer #2/743	0	0.1	0.2
Administrative/743	0.2	0.2	0.2
TOTAL/743	0.4	1.0	1.4
SAMPEX Verification Manager/750	TBD	TBD	TBD
T&E Support/754	TBD	TBD	TBD
TOTAL/750	TBD	TBD	TBD

NOTE: Subsystem manpower support for I&T will be reflected in each subsystems manpower allocations

7.2 Contractor Manpower

	FY90	FY91	FY92
I&T TECHNICIAN	0	0.2	0.5
Total MY	0	0.2	0.5
Total $K	0	50.0	50.0

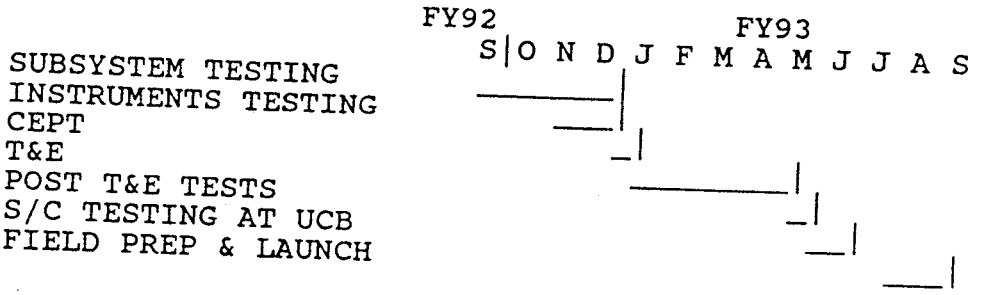
8. COSTING PLAN

	$K FY91	$K FY92	$K FY93
T&E Services			
* Mass Prop - Spin Bal	0	0	TBD
Vib., Shock, Sine Burst	0	0	TBD
Acoustics	0	0	TBD
* Deployment	0	0	TBD
Thermal Balance	0	0	TBD
Thermal Vacuum	0	0	TBD
EMC	0	0	TBD
Mag Cal	0	0	TBD
T&E TOTALS	0	0	200.0

* Spin bal. and deployment may not be done at GSFC

I&T Misc. Lab Equipment	0	10.0	0
COST TOTALS	0	10.0	210.0

9. SCHEDULE



10. DOCUMENTATION (TO BE PRODUCED)

Verification Specifications
Verification Procedures
Verification Reports
-- Responsibility of Verification Manager

Integration & Test Plan
Spacecraft Test Procedures -
-- Responsibility of I&T Manager

All documentation contents will require the support of subsystem personnel.