



# Procedures and Guidelines

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**EFFECTIVE DATE:** 11/16/1998  
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**Responsible office:** Code 573/ Guidance, Navigation, and Control Center

**Title:** Shuttle Spartan Carrier ACS Re-Flight Programming & Testing

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## 1. PURPOSE

This procedure describes the GSFC approved method for design-alterations, calibration, integration and testing of the Spartan 200 Series ACS flight hardware for use on the NASA Shuttle.

The Spartan Project and the Principal Investigator establish the unique ACS requirements for the proposed mission.

## 2. REFERENCES

- a. 572-PG-8700.2.1, Shuttle Spartan Carrier Re-Flight Mission Analysis
- b. GPG 8700.3, Design Validation
- c. SP515 1993, Spartan Capabilities Statement
- d. uVAXcftitle, Spartan ACS Mission Configuration Process document
- e. Logicx05.doc, ACS Test Procedure **Logiccheck**
- f. TVchk20105.doc, ACS Test Procedure **TV Check**
- g. Thermal Vacuum 45 minute test procedure (abbreviated TV Check)
- h. 89-13, Micro-TLM PCATS user's manual
- i. SPTN-PROC-R01, Magnetic Control System (MCS) Magnetic Calibration Procedure
- j. SPTN-PROC-R02, Phasing Test Procedure for Magnetic Control System
- k. SPTN-PROC-R03, Spartan Phasing Test Procedure
- l. Uvax Remote.tst, Remote adjust test procedure
- m. SPTN-PROC-R04, Maneuver test—Check of final remote adjust maneuvers using actual remote adjust entries
- n. sp201\_5T.lin, ACS Mission Timeline
- o. flowcht05.doc, ACS Timeline Flow Chart

## 3. SCOPE

These instructions and procedures define the guidelines that apply to the GSE and all ACS flight hardware, both at the subsystem level and the spacecraft level. This work instruction pertains to the performance of this particular task(s) when performed in the GSFC Code 800 facilities, and is conducted by either civil servant or contractor personnel.

## 4. DEFINITIONS

- 4.1 Attitude Control System (ACS) – The ACS is comprised of an electronics cold plate, associated control sensors and a cold gas thruster system. The most common sensors consist of Coarse Sun

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Sensors, Miniature Acquisition Sun Sensors, Spartan Intermediate Sun Sensors, Tuned Restraint Inertial Gyros, and Single-Star Star Trackers. The selection of sensors will vary from mission to mission in order to accomplish the experiments' requirements.

- 4.2 Ground Support Equipment (GSE) – The test equipment is required to calibrate, operate, and test the flight ACS hardware before installation into the Orbiter.
- 4.3 Magnetic Control System (MCS) – The MCS consists of three orthogonally-mounted torque rods, a 3-axis magnetometer, and a control electronics box. The MCS serves as the ACS-backup recovery system. The MCS is an autonomously-operated unit, powered from a dedicated LR40 backup battery. The MCS is not used during the normal flight operations. However, it gets activated should the primary ACS system fail in one of three ways: 1) low battery power, 2) low gas pressure in the Pneumatic System, or 3) sustained high body rates

## **5. RECORDS, REPORTS AND FORMS**

- 5.1 An activity log will be kept that includes the following information:
  - a. An inspection of the components before and after completion of appropriate tests.
  - b. All deviation, discrepancies, and problems during performance of the task or test.
  - c. The date the test was performed, and by whom.
- 5.2 A certification log to record hardware modifications and/or repair.
- 5.3 When applicable, a traveler shall accompany the hardware to log the activities.

## **6. SAFETY PRECAUTIONS AND WARNING NOTICES**

The Spartan hardware does not contain hazardous materials, thus has no Material Safety Data Sheets. However, the 3000 PSIG cold gas storage tanks used in the pneumatics thruster deck are considered a safety hazard to personnel performing pressurization. All involved facility personnel should maintain familiarity with these precautions and notices.

The Spartan ACS is flight hardware. Thus storage and handling must adhere to applicable cleanliness requirements. The facility management is responsible for monitoring and maintenance of proper storage conditions.

## **7. TOOLS, MATERIALS AND TEST EQUIPMENT**

The Spartan ACS requires tools, materials and test equipment to perform the conditioning and preparation of the hardware for re-flight. All activities being performed list the required items in their reference document(s). All required items are presently stored in the GSFC Code 800 facilities.

## **8. IMPLEMENTATION**

- 8.1 Re-flight Plan

- a. Interface with experiment group and other GSFC branches to develop flight requirements.
- b. Incorporate the product of the ISO document 572-PG-8700.2.1, Shuttle Spartan Carrier Re-Flight Mission Analysis.
- c. Calibrate and compensate the TRIG gyros.
- d. Calibrate and test the star tracker.
- e. Calibrate and test the sun sensors.

#### 8.2 Calibrate and Test the ACS system

- a. Modify flight hardware for specific mission requirements.
- b. Modify flight software including configuration tables and mission timeline.
- c. Test modified system logic functions.
- d. Modify GSE software for specific flight requirements.
- e. Perform hardware-software integration.
- f. Generate the mission specific air bearing test procedures.
- g. Set up air bearing telemetry formats.
- h. Calibrate and test air bearing systems.
- i. Perform air bearing test and evaluate results.

#### 8.3 Calibrate and Test the Magnetic Control System

- a. Calibrate magnetometer in the magnetic calibration facility.
- b. Perform magnetic control system functional test.

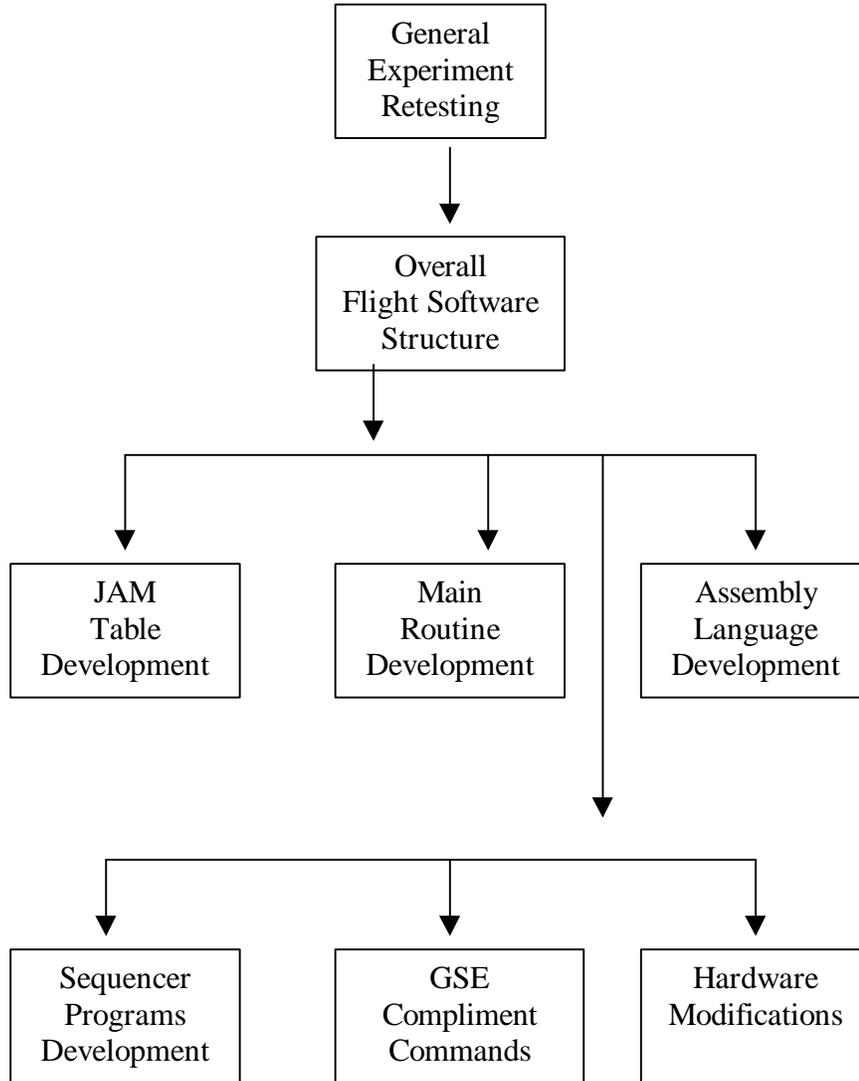
#### 8.4 Perform integration tests with PFCS, carrier, and Instruments

- a. Ambient payload level test and evaluation
- b. EMI/EMC tests
- c. Acoustic or vibration tests

- d. Thermal vacuum tests
- e. Magnetic ACS calibration at magnetic calibration facility
- f. Full flight duration system tests

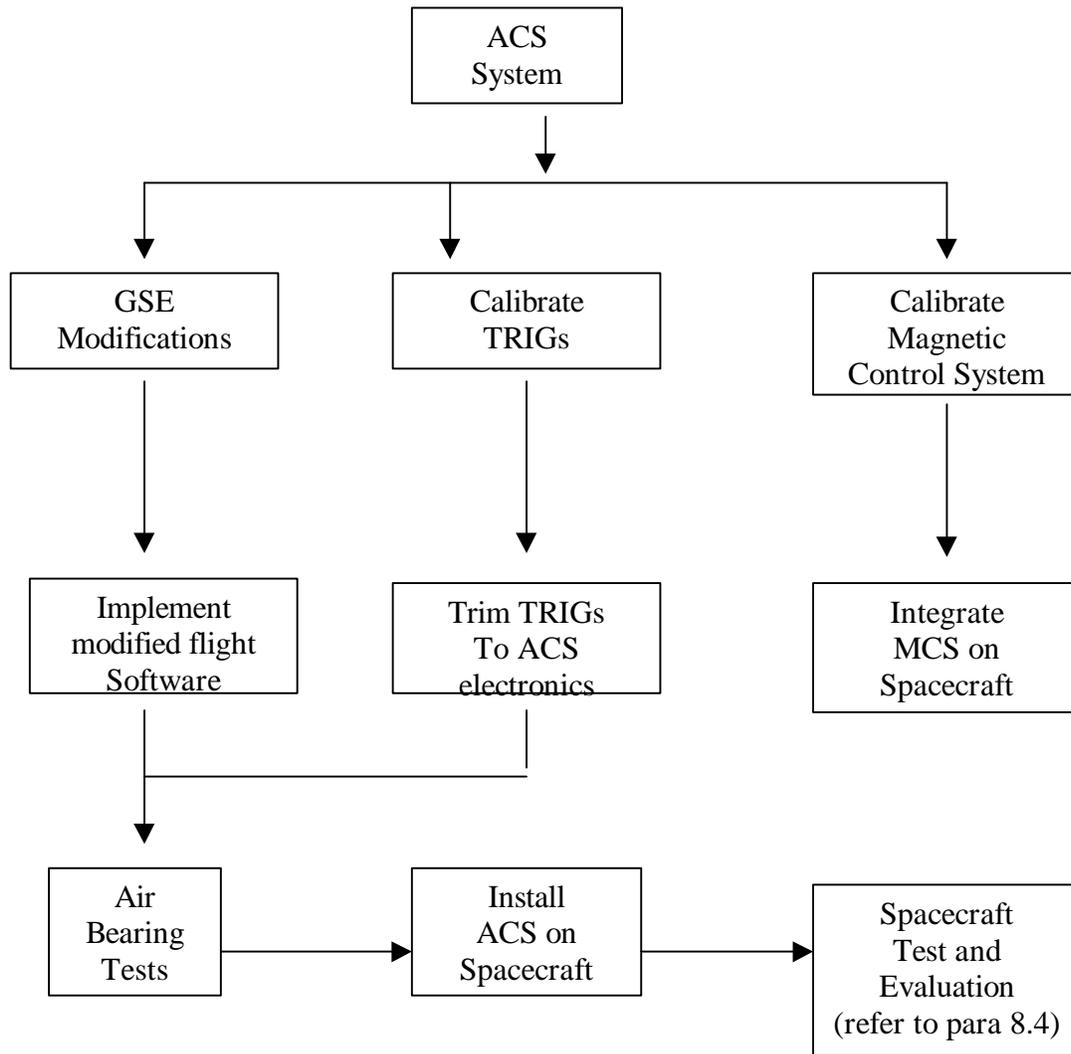
## **9. FLOW DIAGRAM**

The following two diagrams illustrate the process flows required to recondition the Spartan 200 series ACS in preparation for the next flight as a shuttle payload. Note that many of the process activities can be performed in parallel because they are not dependent on the others to be completed sequentially.



Flow Diagram 1.0

## Spartan ACS Mission Specific Software Developments



Flow Diagram 2.0

## Spartan ACS Mission-Specific Hardware Tests

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**CHANGE HISTORY LOG**

<b>Revision</b>	<b>Effective Date</b>	<b>Description of Changes</b>
Baseline	11/16/1998	Initial Release