Procedures and Guidelines

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Responsible Office: 570/Guidance, Navigation, and Control Center

Title: Shuttle Spartan Carrier Re-flight Pneumatic System Refurbishment, Modification and Testing

1 PURPOSE

This procedure provides guidelines for the preparation of a Spartan Attitude Control Pneumatics Assembly (SACPA) for use aboard a Spartan 200 Series Service Module in pursuit of the specified Spartan Payload mission objectives.

2 REFERENCE

GPG 8730.4, The GSFC Quality Manual
GPG 8700.1, Design Planning and Interface Management
GPG 8700.2, Design Development and Configuration Control
GPG 8700.3, Design Validation
GPG 8700.4, Technical Review Program

SP200-PROC-001, Refurbishment Procedure, Spartan Attitude Control Pneumatics Assembly, April 12, 1993 (see note A)
SP200-PROC-002, Functional Test Procedure, Spartan Attitude Control Pneumatics Assembly, January 20, 1994 (see note A)
SP200-PROC-003, EED Installation Procedure, Spartan Gas Isolation Valve, December 5, 1993 (see note A)
SP201-PROC-004 Rev. C, Spartan ACS Gas Pressurization Procedure (see note B)
SP201-PROC-005 Rev. C, Spartan ACS Gas Leak Test Procedure (see note B)
SP201-PROC-006 Rev. B, Spartan ACS Gas Pyrotechnic Valve Checkout Procedure (see note B)
SP201-PROC-007 Rev. C, Spartan ACS Gas Pneumatic Assembly Final Close Out Procedure (see note B)
SP201-PROC-011 Rev. B, Spartan ACS Gas Depressurization Procedure (see note B)
SPTN-PROC-003 Rec. C, Spartan 201 Pyro Enabling Procedure (see note B)
SPTN-PROC-042, Response Test Procedure, Spartan Solenoid Valve, December 28, 1994 (see note A)
Impulse Budget, Spartan 201, December, 1992 (see note C)
Attitude Control Pneumatic Assembly Calibration and Test Report, Spartan 201, February, 1993 (see note C)
Attitude Control Pneumatic Assembly Post Flight Performance Evaluation, Spartan 201-01, September, 1993 (see note C)

NOTES:

A. This is a general procedure which is applicable to any Spartan.

B. This is a Technical Operating Procedure (TOP), approved release of which is required for all activities performed at KSC. This document is unique with each Spartan spacecraft although the baseline of this document is generic to Spartan. This document while not mandatory for activities at GSFC, is a useful guide.

C. This document is specific to SP201 but the methodology used is applicable to any Spartan.

3 SCOPE

This procedure defines the process required to prepare a SACPA for flight with assurance that all performance parameters will be met. This process will apply to the refurbishment of a previously flown SACPA or the build of a new assembly which differs from the generic design only in packaging layout.

4 DEFINITIONS

The SACPA is an electro-mechanical assembly for the Spartan 200 Series Spacecraft which stores compressed inert gas and releases this gas upon command from the Attitude Control Electronics Assembly through external nozzles to generate the required control torque on the Spartan spacecraft. The functional design of the SACPA is generic to all Spartan spacecraft flown to date, but the type of inert gas used, quantity of gas stored, magnitude of torque generated, packaging layout, nozzle arm placement and configuration may differ for each mission.

5 AUTHORITIES AND RESPONSIBILITIES

5.1 AETD Employees: All AETD employees are responsible for adherence to this procedure.

5.2 Product Design Lead: Because many steps of this procedure are noted as being optional, it is the responsibility of the Product Design Lead, in partnership with the customer, to determine and document in the design plan (see GPG 8700.1 and GPG 8700.2) which specific steps will be executed. Furthermore, guidelines contained herein may be waived at the discretion of the Product Design Lead and the customer due to extenuating circumstances such as limitation on time and/or resources, or by customer request. These procedures may also be waived in favor of existing contractor ISO 9000 procedures. Such waivers must be documented.

6 IMPLEMENTATION

Note: All procedure steps are the responsibility of the Product Design Lead unless stated otherwise. This list is not intended to represent a required order of execution.

6.1 Requirements Definition
Obtain mass property specifications for the spacecraft from the cognizant GSFC Code. Review spacecraft geometry and determine suitable location of all six nozzle pairs. If

possible nozzle pairs should be geometrically aligned to produce a pure couple and positioned so as to not impinge on the spacecraft surfaces or protuberances.

6.2 Impulse Budget

Determine gas flow rates required to achieve desired thrust level. Calculate impulse budget for the preliminary ACS timeline. See Impulse Budget, Spartan 201, December, 1992 for the methodology used on previous Spartans. Calculate the total impulse requirement for the ACS mission timeline. Compare the impulse requirement with the planned available stored impulse. Resolve any shortfall between requirement and availability by adjusting one or both parameters.

6.3 Hardware Preparation

If the mission is a re-flight, refurbish the SACPA in accordance with SP200-PROC-001, Refurbishment Procedure, Spartan Attitude Control Pneumatics Assembly, April 12, 1993. If the re-flight mission has different performance requirements than the previous mission, some modifications may be required as part of the refurbishment activity. If the mission requires a new packaging configuration or nonstandard performance parameters, assemble the new system using new items from a stock of flight proven components.

6.4 STS Safety Reviews

Support the STS Safety Review Process by providing the necessary inputs for the safety data packages. Both Flight and Ground Safety Reviews are involved. Each mission must be evaluated to assure that previous safety analysis and testing is still valid. The Safety Data Package must be updated for each reflight, while a new unique requires the development of the entire data package. Due to the presence of high pressure gas, the SACPA is a safety critical system. The following data must be provided for each mission:

a) Statement of Refurbishment and Certification of reflown hardware.
b) Table of Limited Life Components with missions or age to date.
c) List of installed pyrotechnic devices. This should include both the flight and spare pyro valves.
d) Updated pressure vessel log.
e) Closeout of all Flight Safety Verification Tracking Log items.
f) Closeout of all Ground Safety Verification Tracking Log items.

6.5 System Calibration

Determine desired solenoid valve flow rates in conjunction with the three pressure regulator output settings which will produce the desired angular accelerations upon command from the ACS electronics module. See Attitude Control Pneumatic Assembly Calibration and Test Report, Spartan 201, February, 1993 for the methodology used on previous Spartans.

6.6 Functional Testing

After the flow rates and pressure levels have been set, perform a complete function test in accordance with SP200-PROC-002, Functional Test Procedure, Spartan Attitude Control Pneumatics Assembly, January 20, 1994.

6.7 Thrust Nozzle Alignment

Nozzle misalignment can create translational forces on the spacecraft which over the duration of the mission may cause some deviation in Spartan's orbit. If the nozzles are positioned off axis to avoid jet impingement on the spacecraft, an analysis must be performed to determine the magnitude of the worst case translational impulse.

6.8 Leak Testing

Leak test the control component, manifold and tubing assembly in accordance with SP201-PROC-005 Rev. C, Spartan ACS Gas Leak Test Procedure. Pressurize the storage circuit in accordance with SP201-PROC-004 Rev. C, Spartan ACS Gas Pressurization Procedure and conduct a long term leak test by monitoring the system pressure over the time period of spacecraft integration.

6.9 Qualification Testing

If a new hardware assembly is built, a qualification level vibration test should be performed as a subassembly. This test performed in a flight pressurized condition serves to uncover material or workmanship defects in any of the components. This screening is particularly important in regard to the many mechanical tube fittings utilized.

6.10 Pre-integration Preparation

Install squibs (NSI's) in the flight and spare Gas Isolation Valves in accordance with SP200-PROC-003, EED Installation Procedure, Spartan Gas Isolation Valve, December 5, 1993. Lockwire pressure regulator caps and all electrical connectors configured for it. Torque check all fasteners on the SACPA.

6.11 Integration and Test

Provide technical support for the SACPA during the Integration and Test cycle.

6.12 Retest of Ground Servicing Equipment

The GSE used for pressurizing, leak testing and depressurizing the system at the launch site requires periodic retest to verify its capability to withstand the maximum pressure and to validate the accuracy of its pressure gauges and relief valves. The Spartan Gas Pressurization Cart, charging hoses and pressure gauges require periodic retest. Certification tags must be reviewed for each mission to verify that the valid use period will extend beyond the time period for all pre and post flight servicing.

6.13 Prelaunch Service

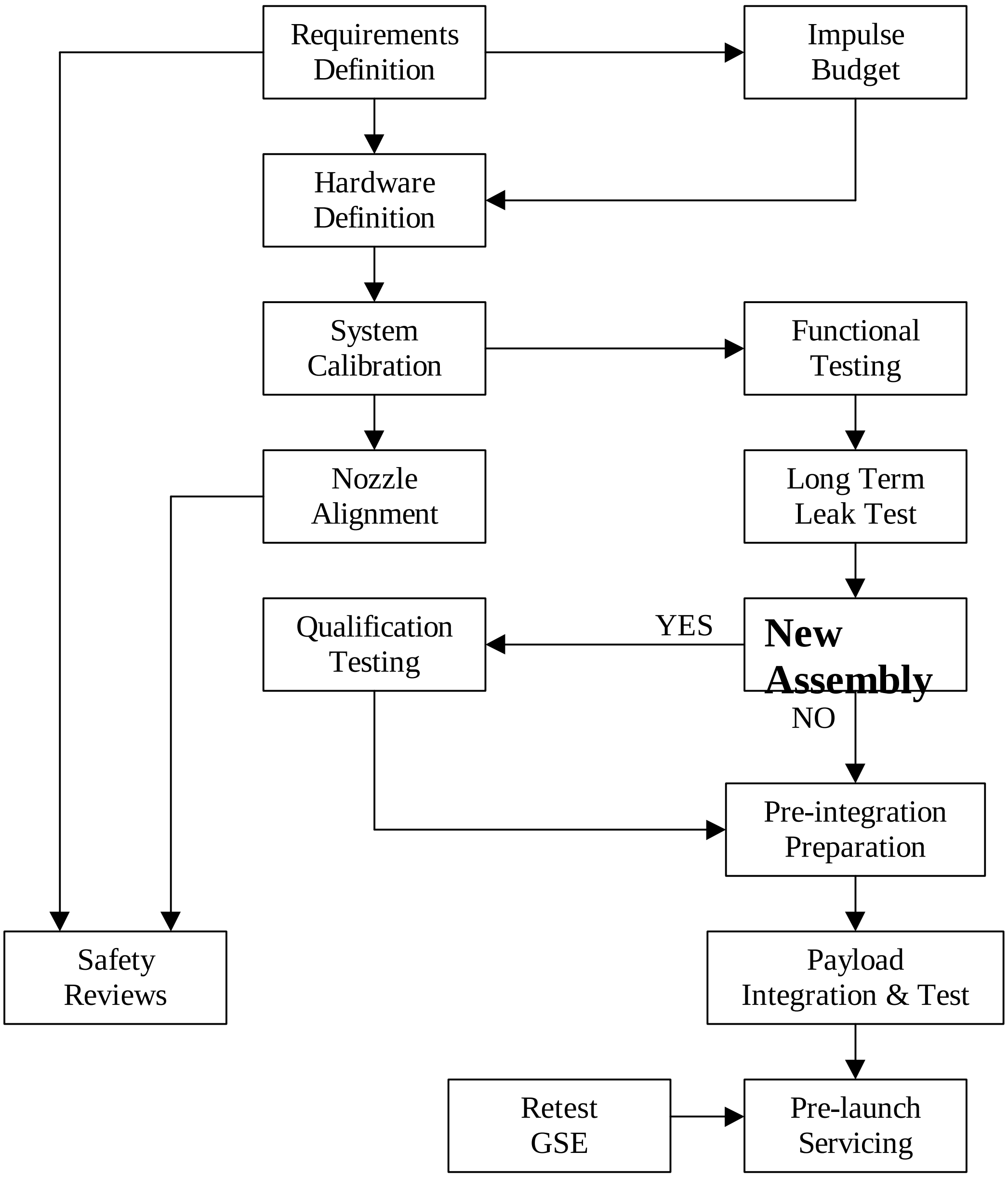
Perform prelaunch servicing of the SACPA at KSC in accordance with the appropriate approved TOP's.

7 EVALUATION

Review the data recordings obtained from the mission and evaluate the performance of the SACPA. Generate a report to document the conclusion reached.

8 FLOW DIAGRAM

SPARTAN ATTITUDE CONTROL PNEUMATIC ASSEMBLY PROCESS FLOW CHART



CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Baseline	11/24/1998	Initial Release