

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Gas Generator Valve Module

PART NO.: 5902651
5912183 (alternate)

FM CODE: A17

ITEM CODE: 20-01-14

REVISION: Basic

CRITICALITY CATEGORY: 1R

REACTION TIME: Seconds

NO. REQUIRED: 2

DATE: March 31, 1999

CRITICAL PHASES: Boost, Separation

SUPERCEDES: March 31, 1997

FMEA PAGE NO.: A-56E

ANALYST: B. Snook/S. Parvathaneni

SHEET 1 OF 4

APPROVED: P. Kalia

FAILURE MODE AND CAUSES: Shutoff (Secondary) control valve (NC) fails to open or remain open (for phase A only) fails to remain open (for phase B and during separation command period only) (Systems A and B) caused by:

- o Electrical short circuit (power to ground, power to return)

FAILURE EFFECT SUMMARY: Loss of TVC and redundant power buses (A and B) will lead to vehicle breakup and loss of mission, vehicle and crew. One success path remains after the first failure. Operation is not affected until both paths are lost.

REDUNDANCY SCREENS AND MEASUREMENTS:

- 1) Pass - All units are subject to ATP during turnaround and refurbishment.
- 2) Pass - APU turbine speed measurement B46R1406C, B46R1407C, B46R1408C, B46R1409C. Bus power voltage B76V1600C, B76V1601C.
- 3) Pass - No single credible cause.

RATIONALE FOR RETENTION:

A. DESIGN

- o The Gas Generator Valve Module is designed and qualified in accordance with end item specification 10SPC-0050. (Electrical Short Circuit) (BI-1883)
- o The shutoff valve is spring loaded closed. (Electrical Short Circuit)

- o The shutoff valve is a 28 VDC direct acting poppet type solenoid. (Electrical Short Circuit)
- o Qualification testing verified design requirements as reported in Sundstrand Qualification Test Report AER-1539-6, Rev. B and AER 1539-10, Rev. Basic. (Electrical Short Circuit)

B. TESTING

- o Acceptance testing is performed per Marotta ATP 281951-9002 on each new unit. This includes visual examination, dielectric strength test, insulation resistance test, resistance check, pull-in voltage, drop-out voltage, response test and valve cycle test. (Electrical Short Circuit)
- o Abbreviated acceptance testing of units that only require rework of the solder joints is performed per Marotta AATP281951-9002. This includes visual and dimensional examination, internal leakage and cleanliness level check. (All Failure Causes)
- o Acceptance testing of the assembled APU is performed per Sundstrand ATP TS2409. This includes resistance checks, fuel shutoff valve verification and verification of proper valve operation at all rated turbine speeds. (Electrical Short Circuit)
- o During refurbishment and prior to reuse, the GGVM is tested per Sundstrand ATP TS2409. (Electrical Short Circuit)
- o BITE test is performed per IOREQ-0021, para. 2.3.4. (Electrical Short Circuit)
- o TVC system functional test is performed during hotfire per IOREQ-0021, para. 2.3.16. (Electrical Short Circuit)
- o BITE test verifying APU speed control valve operation is performed per OMRSD File V, Vol. 1 Requirement Numbers B42AP0.050 and .060 prior to rollout. (Electrical Short Circuit)
- o APU BITE test is conducted per OMRSD File V, Vol. 1 Requirement Numbers B42AP0.050 and .060. (Electrical Short Circuit)
- o BITE test verifying speed control valve operation is performed during launch countdown (approximately T-11 hours) per OMRSD File V, Vol. 1 Requirement Numbers B42AP0.050 and .060. This is the last check of valve operation prior to APU startup. (Electrical Short Circuit)

The above referenced OMRSD testing is performed every flight.

C. INSPECTION

VENDOR RELATED INSPECTIONS

- o Vendor inspection and test records are verified is performed per SIP 1128 by USBI QAR. (Electrical Short Circuit) (BI-1883)
- o Verification of test data from Marotta is performed per SIP 1128 USBI QAR. (Electrical Short Circuit)

- o Witnessing of acceptance testing is performed per SIP 1128 USBI QAR. (Electrical Short Circuit)
- o Verifications that are required on new units are performed on refurbished units per SIP 1128 by USBI QAR. (Electrical Short Circuit)
- o Critical Processes/Inspections:
 - Solder per Marotta PS281951-9002 and NHB 5300.4 (3A-1) (BI-1883)

KSC RELATED INSPECTIONS

- o Proper function of TVC system is demonstrated during hotfire operations per 10REQ-0021, para. 2.3.16 to include hotfire. (Electrical Short Circuit)
- o Verification of proper valve operation during BITE per OMRSD File V, Vol. 1 Requirement Number B42AP0.050. (Electrical Short Circuit)
- o Verification of APU BITE test per OMRSD File V, Vol. 1 Requirement Numbers B42AP0.050 and .060. (Electrical Short Circuit)
- o Verification of proper performance of BITE test during launch countdown per OMRSD File V, Vol. 1 Requirement Numbers B42AP0.050 and .060. (Electrical Short Circuit)

D. FAILURE HISTORY

Criticality 1R:

- No SRB failure history for this failure mode.

E. OPERATIONAL USE

- o Not applicable to this failure mode.

F. Waivers

- o BI-1883, dt 11-19-90, Level III approval SB3-01-3891, Level II approval PRCBD-S92
 - o Requirement: Per 10CEI-0001 para. 3.3.5.4 soldering of electrical connectors on the SRB & GSE/STE that directly interface with a space shuttle element shall be per NHB 5300.4 (3A-1).
 - o Departure from Requirement: Soldering of GGVM electrical connectors do not meet paragraph 3A704 of NHB 5300.4 (3A-1). Soldering joints have (i) Improper tinning, (ii) Separation of wire strands and (iii) Excessive solder.
 - o Rationale for Approval of the Waiver: The original qualifications of APUs were completed with GGVMs soldered by the same technicians. A Delta Qualification was performed on additional GGVMs also soldered by the same technicians. GGVMs must pass ten functional and electrical tests at Sundstrand and USBI prior to aisle transfer. The GGVM must also pass two Bite tests, the final test at T -9 Hrs, prior to launch. There is no case of a solder related failure on GGVMs.