SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Gas Generator Valve Module

PART NO.: 5902651
5912183 (alternate)

FM CODE: A04

ITEM CODE: 20-01-14

REVISION: Basic

CRITICALITY CATEGORY: 1

REACTION TIME: Seconds

NO. REQUIRED: 2

DATE: March 31, 2000 CN 038

CRITICAL PHASES:Final Countdown, Boost

SUPERCEDES: March 31, 1999 CN 038

FMEA PAGE NO.: A-46

ANALYST: R. Imre/S. Parvathaneni

SHEET 1 OF 6

APPROVED: S. Parvathaneni CN 038

FAILURE MODE AND CAUSES: External leakage of hydrazine (System A and/or B) at any one of three fitting O-rings or one Lee plug or any one of two nuts (for thread failure only) caused by:

- o Contamination
- o Lee plug failure
- o Improper torque
- o Improperly lockwired
- o Defective or damaged o-ring
- o Defective or damaged sealing surface
- o Thread failure

FAILURE EFFECT SUMMARY: Fire and explosion will lead to loss of mission, vehicle and crew.

REDUNDANCY SCREENS AND MEASUREMENTS: N/A

RATIONALE FOR RETENTION:

A. DESIGN

- o The Gas Generator Valve Module is designed and qualified in accordance with end item specification 10SPC-0050. (All failure causes)

- o O-ring material is ethylene propylene selected for its compatibility with liquid hydrazine. (Defective or Damaged O-Ring)

- o Lee plug material is 303 Cres. (Lee Plug Failure)

- o Lee plug is a metal to metal seal made possible by the insertion of a tapered plug which is stamped into the pin fitting which yields to the orifice and seals. (Lee Plug Failure)

- Hydrazine is filtered through two 25 micron filters upstream of the GGVM. (Contamination)

- The aft skirt area is purged with GN2 prior to APU startup. This reduces the 02 concentration to less than four percent per OMRSD File II, Vol. 1, requirement number S00FM0.430. (All Failure Causes)

- Qualification testing verified design requirements as reported in Sundstrand Qualification Test Report AER-1539-6, Rev. B, and AER 1539-10, Rev. Basic. (All Failure Causes)

- Body and nut material is 6AL-4V Titanium (Lee Plug Failure, Thread Failure)

- Rosan Boss fittings incorporate self locking provisions (lockwire not required) and are used on the dynatube connectors. (Improper Torque, Improperly Lockwired)

- All threaded fittings and connectors are torqued per engineering specifications and are lockwired per MS 33540. (Improper Torque, Improperly Lockwired)

- APU surfaces exposed to hydrazine, except gas generator, are cleaned to level 100 of MA0110-301. (Contamination)

- Fluid procurement is controlled per SE-S-0073. (Contamination)

B. TESTING

- Acceptance testing is performed per Marotta ATP 281951-9002 on each new unit. This includes visual and dimensional examination, Proof Pressure, external leakage, internal leakage and cleanliness level check. (All Failure Causes)

- Abbreviated acceptance testing of units that only require rework of the solder joints is performed per Marotta AATP 281951-9002. this includes visual and dimensional examination, internal leakage and cleanliness level check. (All Failure Causes).

- Acceptance testing of the assembled APU is performed per Sundstrand ATP TS2409. This includes hotfire acceptance test and decontamination and precision cleaning of the fuel system. (Contamination, Lee Plug Failure, Defective or Damaged O-Ring, Defective or Damaged Sealing Surface, Thread Failure)

- During refurbishment and prior to reuse, the GGVM is tested per Sundstrand ATP TS2409 just as new units. (Contamination, Lee Plug Failure, Defective or Damaged O-Ring, Defective or Damaged Sealing Surface, Thread Failure)

- Hydrazine is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.1 and OMRSD File V, Vol. 1, requirement number B42APO.010. (Contamination)

- GN2 is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.2 and OMRSD File V, Vol. 1, requirement number B42AP0.012. (Contamination)

- Hotfire test is performed during hotfire operations to demonstrate proper function per 10REQ-0021, para. 2.3.16. (Lee Plug Failure, Defective or Damaged O-Ring, Defective or Damaged Sealing Surface, Thread Failure)

- Helium (influent) is verified for cleanliness and composition (purity and particulate count) prior to fuel pump shaft seal leak check per 10REQ-0021, para. 2.3.2.5. (Contamination)

- Helium is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.5. (Contamination)

- GN2 (from MLP portable panels) is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board flight hardware per OMRSD File V, Vol. 1, requirement number B42AP0.012. (Contamination)

- Verification of APU Fuel system GN2 blanket pressure check per File V, Vol. I, requirement number B42APO.030. (Lee Plug Failure, Defective or Damaged O-Ring, Defective or Damaged Sealing Surface, Thread Failure)

The above referenced OMRSD testing is performed every flight.

C. INSPECTION

VENDOR RELATED INSPECTIONS

- Verification of test data from Marotta per SIP 1128 by USA SRBE PQAR. (All Failure Causes)

- Verification of material certifications are verified per SIP 1128 by USA SRBE PQAR. (Lee Plug Failure, Thread Failure)

- Verification of GGVM assembly in a 100K clean room per SIP 1128 by USA SRBE PQAR. (Contamination)

- Verification of vendor inspection of seals and sealing surfaces per SIP 1128 by USA SRBE PQAR. (Defective or Damaged O-Ring and Defective or Damaged Sealing Surface)

- Verification of final leak tests per SIP 1128 by USA SRBE PQAR. (Lee Plug Failure, Defective or Damaged O-Ring, Defective or Damaged Sealing Surface)

- Witnessing of acceptance testing per SIP 1128 by USA SRBE PQAR. (Contamination, Lee Plug Failure, Defective or Damaged O-Ring, Defective or Damaged Sealing Surfaces, Thread Failure)

- o Vendor inspection and test records are verified per SIP 1128 by USA SRBE PQAR. (All Failure Causes)
- o Verification of torque operations per SIP 1128 by USA SRBE PQAR. (Improper Torque)
- o Final inspection per drawing requirements is performed by vendor and verified per SIP 1128 by USA SRBE-PQAR. (All Failure Causes)
- o Verifications that are required on new units are performed on refurbished units, per SIP 1128 by USA SRBE PQAR. (All Failure Causes)
- o Verify threads per SIP 1128. (Thread failure)
- o Critical Processes/Inspections
  - None

KSC RELATED INSPECTIONS

- o Inspect all tube and hose assemblies and fittings prior to installation per 10REQ-0021, para. 2.3.0. (Defective or Damaged Sealing Surface)
- o Precision cleaning of tubes/hoses is verified by USA SRBE per 10REQ-0021, para. 2.3.0. (Contamination)
- o Proper function of TVC system is demonstrated during hotfire operations per 10REQ-0021 to include hotfire, para. 2.3.16. (Lee Plug Failure, Defective or Damaged O-Ring, Defective or Damaged Sealing Surface, Thread Failure)
- o Post hotfire verification, including inspection and leak check per 10REQ-0021, para. 2.3.16.4. (Lee Plug Failure, Defective or Damaged O-Ring, Defective or Damaged Sealing Surface, Thread Failure)
- o Helium (influent) cleanliness and composition (purity and particulate count) are verified prior to fuel pump shaft seal leak check per 10REQ-0021, para. 2.3.2.5. (Contamination)
- o Helium cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.5. (Contamination)
- o Hydrazine cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.1 and OMRSD File V, Vol. 1, requirement number B42AP0.010. (Contamination)
- o GN2 cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.2 and OMRSD File V, Vol. 1, requirement number B42AP0.012. (Contamination)

- o Inspect TVC system in aft skirt for damage - no leaks, signs of rubbing or discoloration are allowed per 10REQ-0021 following low speed GN2 spin, para. 2.3.11.3 and high speed GN2 spin, para. 2.3.15.5. (Lee Plug Failure, Defective or Damaged O-Ring, Defective or Damaged Sealing Surface, Thread Failure)

- o GN2 (from MLP portable panels) is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board hydrazine circuits per OMRSD File V, Vol. 1, requirement number B42AP0.012. (Contamination)

- o GN2 (from servicing cart) is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board hydrazine circuits per OMRSD File V, Vol. 1, requirement number B42AP0.012. (Contamination)

- o Hydrazine (from servicing cart) is verified for cleanliness and composition (purity and particulate count) prior to introduction on-board hydrazine circuits per OMRSD File V, Vol. 1, requirement number B42AP0.010. (Contamination)

- o TVC Couplings (Both SRB and GSE) are inspected each time prior to mating per 10REQ-0021 para. 2.3. After transfer to SPC they are inspected prior to mating per File V, Vol. I, requirement number B42GEN.070. (Material Defects).

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- o Verification of APU Fuel system GN2 blanket pressure check per File V, Vol. I, requirement number B42APO.030 (Lee Plug Failure, Defective or Damaged O-Ring, Defective or Damaged Sealing Surface, Thread Failure)

D. FAILURE HISTORY

- o Failure Histories may be obtained from the PRACA database.

E. OPERATIONAL USE

- o Not applicable to this failure mode.