

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: APU Housings

PART NO.: 734560 (Turbine housing) FM CODE: A04
734561 (Exhaust housing)
(Part of 740416/734589(ALT))

Including components for following interfaces:

Exhaust Housing/Containment Housing:

- E-Seals
- 58887-7
- 58887-8
- Bolts
- 57904-4
- 57904-8
- Nut (Self Locking)
- MS21043-5

Exhaust Housing/Exhaust Duct:

- E-Seals
- 10209-0012-801
- 10209-0012-802
- Bolts
- NAS 1004-9H
- Washer
- NAS 1587-4C
- Threaded Insert
- (fixed to flange)
- 5900529-4

Exhaust Housing/Gas Generator:

- E-Seals
- 58887-4
- 58887-6
- Bolts
- 755286-12
- 755286-14
- Washers
- 718731
- AN 960C10L

ITEM CODE: 20-01-28A

REVISION: Basic

CRITICALITY CATEGORY: 1R

REACTION TIME: Seconds

NUMBER REQUIRED: 2

DATE: March 31, 2000

CRITICAL PHASES: Final Countdown,
Boost

SUPERCEDES: March 1, 1995

FMEA PAGE NUMBER: A-93A

ANALYST: C.J. Smith/S. Parvathaneni

SHEET 1 OF 4

APPROVED: S. Parvathaneni

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FAILURE MODE AND CAUSES: External leakage of hot gas at Exhaust Housing inter face to (i) Gas Generator Flange, (ii) Containment Housing of Turbine and (iii) Exhaust Duct (System A and/or B), caused by:

- o Defective or damaged sealing surface
- o Defective or damaged seals
- o Improper torque
- o Thread failure
- o Contamination

FAILURE EFFECT SUMMARY: Hot gas leakage from APU Exhaust housing interfaces would act as a ignition source for Hydrazine and/or Hydraulic fluid leakage or contained in the system. Also items will act as ignition source for leaking lube oil from APU gear box resulting in fire and explosion will lead to loss of mission, vehicle and crew.

REDUNDANCY SCREENS AND MEASUREMENTS:

- 1) Fail - Redundancy cannot be verified during turn-around or refurbishment.
- 2) Fail - Undetectable loss of redundancy.
- 3) Fail - Contamination

RATIONALE FOR RETENTION

A. DESIGN

- o The APU Housing is designed and qualified in accordance with end item specification 10SPC-0050. (All failure causes)
- o Exhaust housing is connected with the exhaust duct by 8 hole flanges with two redundant high temperature "E" seals. The flanges are connected together with NAS 1004-9H bolts, washer NAS 1587-4C to the threaded insert 5900525-4 mounted on the exhaust housing flange. (Defective or damaged sealing surface, defective or damaged seal)
- o All threaded fittings are torqued per engineering specifications. (Improper Torque)
- o E-seals are pressure and spring activated by design and also E-seals are silver and gold plated to enhance the seal. (Defective or Damaged Sealing Surface)
- o The aft skirt area is purged with GN2 prior to APU start up per OMRSD File II, Vol. 1, requirement number S00FM0.430. This reduces the O2 concentration to less than four percent. (All Failure Causes) CN 038
- o Qualification testing verified design requirements as reported in Sund strand APU Qualification Test Report AER-1539-6, Rev. B. (All FailureCauses)
- o APU Exhaust Housing/Exhaust Duct interface is qualified for design requirements per NASA TM-78258, SRB TVC subsystem test verification report. (All Failure Causes)

B. TESTING

- o Acceptance testing is performed per Sundstrand ATP TS 2409. This includes hotfire test and post ATP decontamination and precision cleaning. (All Failure Causes)
- o During refurbishment and prior to reuse the APU housing components are returned to the vendor for rework and ATP testing per Sundstrand ATP TS 2409. (All Failure causes)

- o Functional test is performed during hotfire operations per 10REQ-0021 which includes: (All Failure Causes)
 - Low speed spin, para. 2.3.11
 - High speed spin, para. 2.3.15
 - Hotfire, para. 2.3.16
- o The turbine exhaust system is leak checked with GN2 at 14 +1/-0 psig. Pressure leak greater than 2.5 psi in ten minutes is not acceptable per 10REQ-0021, para. 2.3.3.2. (Defective or Damaged Sealing Surface, Thread Failure)
- o Exhaust housing cavity is pressure tested to 15 ± 2 psig of helium and checked for pressure decay rate, from initial pressure, not to exceed (i) 1.0 psig/min for single leak and (ii) 1.5 psig/min for multiple leaks in 10 minutes per Sundstrand drawing 737722/1700061(Alt.). Normal exhaust pressure is 7-8 psig. Exhaust housing cavity is retested after hotfiring per 10 REQ-0021, para. 2.3.3.2. (Defective or Damaged Sealing Surface, Thread Failure, Improper Torque).

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C. INSPECTION

VENDOR RELATED INSPECTIONS

- o Source Inspection Plan (SIP 1128) verifies proper manufacturing and assembly. (All Failure Causes)
- o Vendor inspection and test records are verified per SIP 1128 by USA SRBE PQAR. (All Failure Causes)
- o Witnessing of acceptance testing 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 Critical Processes/Inspections:
 - Weld per CP05.15-02
 - Penetrant per CP16.03-01
 - Heat Treat per MIL-H-6875
 - X-Ray per CP16.01-01
 - Silver plating per AMS 2410 and Gold plating per MIL-G-45204 of E-Seal (para. 3.5.1 and 3.5.1.1 for quality requirements).

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KSC RELATED INSPECTIONS

- o Performance of turbine exhaust system leak check per 10REQ-0021, para. 2.3.3.2. (Defective or Damaged Sealing Surface, Thread Failure)
- o Proper function of TVC system is demonstrated during hotfire to demonstrate proper function per 10REQ-0021, para. 2.3.16. (Defective or Damaged Sealing Surface, Thread Failure)

- o E-seals for Exhaust housing/Exhaust duct interface are inspected prior to installation for absence of physical defects per 10 REQ-0021 para 2.3.0. (Contamination, Defective or Damaged Seal)
- o Sealing surfaces are inspected by USA SRBE prior to installation verifying nocontaminant or obstruction exists per 10REQ-0021 para 2.3.0. (Defective or Damaged Sealing Surface, Contamination)
- o Inspect TVC system for damage - no leaks, signs of rubbing, or discolor-ation 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. (Defective or Damaged Sealing Surface, Thread Failure)
- o Post hotfire verification, including inspection and leak check per10REQ-0021, para. 2.3.16.4. (Defective or Damaged Sealing Surface, Thread Failure)

D. FAILURE HISTORY

- o Criticality 1R
- o Failure Histories may be obtained from the PRACA database

E. OPERATIONAL USE

- o Not applicable to this failure mode.