

244

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: APU Gearbox

PART NUMBER: 740413 FM CODE: A15
 716604 (Lube Oil Pump)
 5903457 (Oil Filter)
 717644A (Relief Valve)
 732186 (Gearbox Equalization Valve)
 5903967 (O-Ring)
 5905446 (O-Ring)
 57399 (O-Ring)
 M83248/1 (O-Ring)
 5904000 (Lube Oil Indicator)
 Internal Gearbox Accumulator, Gears, and Shafts covered under P/N 740413.

ITEM CODE: 20-01-28

REVISION: Basic

CRITICALITY CATEGORY: 1

REACTION TIME: Seconds

NUMBER REQUIRED: 2

DATE: March 1, 1994

CRITICAL PHASES: Final Countdown, Boost

SUPERCEDES: March 1, 1993

FMEA PAGE NUMBER: A-89

ANALYST: R. Imre/P. Kalia

SHEET 1 OF 4

APPROVED: R. Henritze

FAILURE MODE AND CAUSES: Rupture (System A and/or B) caused by:

- o Material defect
- o Manufacturing defect

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 APU Gearbox is designed and qualified in accordance with end item specification 10SPC-0050. (All failure causes) (BI-1167)
- o Material selection is per MSFC-SPEC-522A. (Material Defect)

- o Tubing material is 304L or 321 stainless steel per MIL-T-8606 Type 1. (Material Defect)
- o Tube surface imperfections are controlled per MS33611. (All Failure Causes)
- o Input housing is an A356 Class 12 Grade B aluminum alloy casting per MIL-A-21180. (Material Defect)
- o Output housing is 2219-T852 aluminum. (Material Defect)
- o Gearbox housing is designed for an operating pressure of 20-25 psig in a tube oil environment and is proof pressure tested to 45 psig. (All failure causes)
- o Gearbox is cast with coupons to ensure proper material properties. (Material Defects)
- o The aft skirt area is purged with GN2 prior to APU start. This reduces the O2 concentration to less than four percent per OMSRD File II, Vol. 1, requirement number SOOFMO.430. (All Failure Causes)
- o Qualification testing verified design requirements as reported in Sundstrand Qualification Test Report AER-1539-6, Rev. B. (All Failure Causes)

B. TESTING

- o Acceptance testing is performed per Sundstrand ATP TS 2409 on all new flight units. This includes a GN2 spin and hotfire functional tests with leak checks both before and after and gearbox tube oil check for contamination. (All Failure Causes)
- o During refurbishment and prior to reuse, the gearbox assembly is reworked and inspected with the same assembly verifications and ATP as new units. (All Failure Causes)
- o The gearbox housing is proof pressure tested to 45 psig per Sundstrand drawing 740413 which represents a safety factor of approximately 2.0, based on a normal operating range of 20 to 25 psig. (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

C. INSPECTION

VENDOR RELATED INSPECTIONS

- o Source Inspection Plan verifies proper manufacturing and assembly per SIP 1128 by USBI QAR. (All failure causes)
- o Vendor inspection and test records are verified per SIP 1128 by USBI QAR. (All Failure Causes)
- o Verification of material certifications per SIP 1128 by USBI QAR. (Material Defect)
- o Witnessing of acceptance testing per SIP 1128 by USBI QAR. (All Failure Causes)
- o Verifications that are required on new units are performed on refurbished units per SIP 1128 by USBI QAR. (All Failure Causes)
- o Leak check gearbox assembly is verified per SIP 1128 by USBI QAR. (All Failure Causes)
- o Critical Processes/Inspections:
 - Weld per CP05.15-02
 - Penetrant per CP16.03-01
 - Heat treat per MIL-H-6088
 - X-ray per CP16.01-01

KSC RELATED INSPECTIONS

- o Proper function of TVC system is demonstrated during hotfire operations by USBI per 10REQ-0021 to include: (All Failure Causes)
 - Low speed GN2 spin, para. 2.3.11
 - High speed GN2 spin, para. 2.3.15
 - Hotfire, para. 2.3.16
- o Inspect TVC system 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. (All Failure Causes)
- o Lube oil is verified for cleanliness and composition (purity and particulate count) per 10REQ-0021 para. 2.3.2.3. (Material defects)
- o Verification of lube oil leakage per OMRSD File V, Vol 1, Requirement Number B42APO.090. (Manufacturing defects)
- o Post hotfire verification, including inspection and leak check per 10REQ-0021, para. 2.3.16.4. (All Failure Causes)

D. FAILURE HISTORY

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

E. OPERATIONAL USE

- o Not applicable to this failure mode.

F. WAIVERS

- o BI-1167, dt. 11-11-81, Level III approval SB3-00-7224.
 - o Requirement: APU Gearbox to meet the 10CEI-0001 requirement 3.2.1.7.1.3.1 and the requirements per 10SPC-0050.
 - o Departure from Requirement: The longitudinal yield strength of the output housing 734568-1 is 43788 psi. Per engineering specifications, it should be 44000 psi - minimum.
 - o Rationale for Approval of the Waiver: Stress Analysis indicated that this much, lower than allowable material strength would not degrade the integrity of the housing.