

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: APU Gearbox

PART NO.: 740413 includes:
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

FM CODE: A07

ITEM CODE: 20-01-28

REVISION: Basic

CRITICALITY CATEGORY: 1R

REACTION TIME: Seconds

NO. REQUIRED: 2

DATE: March 31, 1997

CRITICAL PHASES: Boost

SUPERCEDES: March 1, 1993

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APPROVED: P. Kalia

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FAILURE MODE AND CAUSES: Failure of lube oil pump (System A and B) caused by:

- o Material Defect
- o Contamination
- o Shaft/Gear Failure
- o Manufacturing Defects
- o Improper Assembly

FAILURE EFFECT SUMMARY: Loss of TVC will result in 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 TS2409 testing and are functionally verified during turnaround and refurbishment.
- 2) Fail - Loss of lube pump is not readily detectable (in real time).
- 3) Fail - Contamination.

RATIONALE FOR RETENTION:

A. DESIGN

- o The APU Gearbox is designed and qualified in accordance with end item specification 10SPC-0050. (All Failure Causes)
- o The gearbox lube oil system is designed to operate for twenty missions without an oil change. (All Failure Causes)
- o Shaft material is 4340 steel, heat treated to a hardness of C40-43. (Shaft/Gear Failure)
- o Gear Material is 8620 steel, heat treated to a hardness of C80-83. (Shaft/Gear Failure)
- o The lube oil pump assembly is a matched set unit with tight tolerances. (Improper Assembly)
- o Lube oil is filtered by a 35 micron filter at the pump discharge. (Contamination)
- o APU surfaces exposed to lube oil are cleaned to Level 300 of SN-C-0005. (Contamination)
- o Final gearbox assembly is performed in a Class 100,000 clean room. (Contamination)
- o Material Selection is per MSFC-SPEC-522A. (Material Defect)
- o Qualification testing verified design requirements as reported in Sundstrand Qualification Test Report AER-1539-6, Rev. B. (All Failure Causes)
- o Fluid procurement is controlled per SE-S-0073. (Contamination)

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B. TESTING

- o Acceptance testing of the lube oil pump is performed per Sundstrand ATP TS 2311. (All Failure Causes)
- o Acceptance testing is performed per Sundstrand ATP TS 2409. This includes lube oil cleanliness, GN2 spin, hotfire functional test and post hotfire gearbox cleanliness/contamination check. (All Failure Causes)
- o During refurbishment and prior to reuse, the gearbox assembly is returned and tested to the same ATP as a new unit per Sundstrand ATP TS 2409. (All Failure Causes)
- o Lube oil sampling for (Influent) cleanliness and composition (purity and particulate count) is performed per 10REQ-0021, para. 2.3.2.3. (Contamination)

- o Functional test is performed during hotfire operations per 10REQ-0021, paras. 2.3.11, 2.3.15 and 2.3.16 respectively for: (Shaft/Gear Failure)
 - Low speed GN2 spin
 - High speed GN2 spin
 - Hotfire
- o Gearbox is flushed with clean oil, purged and pressurized to enhance cleanliness with GN2 after hotfire per 10REQ-0021, para. 2.3.16.5.e. (Contamination)

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The above referenced OMRSD testing is performed every flight.

C. INSPECTION

VENDOR RELATED INSPECTIONS

- o Manufacturing and assembly is verified by Source Inspection Plan 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 vendor inspection and buyoff of torque operations is performed per SIP 1128 by USBI QAR. (Improper Assembly)
- o Verification of material certifications is performed per SIP 1128 by vendor and USBI QAR. (Material Defect)
- o Witnessing of acceptance test is performed per SIP 1128 by USBI. (Contamination, Shaft/Gear Failure)
- o Verifications that are required on new units are performed on refurbished units per SIP 1128 by USBI QAR. (All Failure Causes)
- o Critical Processes/Inspections:
 - Heat treat shaft per CP 09.4140-HD-4-01
 - Heat treat gear per AMS 6274

KSC RELATED INSPECTIONS

- o Verification of lube oil (Influent) cleanliness and composition (purity and particulate count) is performed per 10REQ-0021, para. 2.3.2.3. (Contamination)
- o Proper function of TVC system is demonstrated during Hotfire operations per 10REQ-0021, paras. 2.3.11, 2.3.15 and 2.3.16 respectively for: (Shaft/Gear Failure)
 - Low speed GN2 spin
 - High speed GN2 spin
 - Hotfire

- o Verification of post hotfire gearbox lube oil cleanliness and composition (purity and particulate count) per 10REQ-0021, para. 2.3.16.5. (Contamination)

D. FAILURE HISTORY

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

E. OPERATIONAL USE

- o Not applicable to this failure mode.