

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Turbine Assembly (Part of APU)

PART NO.: 734563
752370(Alt.)

FM CODE: A02

ITEM CODE: 20-01-21

REVISION: Basic

CRITICALITY CATEGORY: 1R

REACTION TIME: Seconds

NO. REQUIRED: 2

DATE: March 31, 2000

CRITICAL PHASES: Boost

SUPERCEDES: March 31, 1997

FMEA PAGE NO.: A-63

ANALYST: C.J. Smith/S. Parvathaneni

SHEET 1 OF 5

APPROVED: S. Parvathaneni

CN 038

CN 038

CN 038

CN 038

CN 038

FAILURE MODE AND CAUSES: Failure of turbine wheel to rotate (System A and B) caused by:

- o Contaminated lube oil/loss of lubrication
- o Material defect of bearing components
- o Bearing failure
- o Manufacturing Defect

FAILURE EFFECT SUMMARY: Loss of TVC 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 - Turbine wheel operation is tested and verified during ATP tests.
- 2) Pass - APU turbine speed measurements B46R1406C, B46R1407C, B46R1408C and B46R1409C.
- 3) Fail - Contamination

RATIONALE FOR RETENTION:

A: DESIGN

- o The Turbine Assembly is designed and qualified in accordance with end item specification 10SPC-0050. (All Failure Causes)
- o Turbine design provides for GN2 spin capability for operational checks and tests without having to hot fire the APU. (Material Defect of Bearing Components, Bearing Failure)

- o APU surface exposed to lube oil are cleaned to Level 300 of SN-C-0005. (Contaminated Lube Oil/Loss of Lubrication)
- o Final gearbox assembly is performed in a Class 100,000 clean room. (Contaminated Lube Oil/Loss of Lubrication)
- o Bearing components are corrosion resistant steel alloys which are heat treated and 100 percent x-ray inspected. (Material Defect of Bearing Components)
- o Oil injectors are provided to direct a lube oil spray on the bearings. (Bearing Failure)
- o The lube oil is filtered which will prevent the oil injectors from failing due to contamination. (Contaminated Lube Oil/Loss of Lubrication)
- o Bearing cage material is AMS 6415 heat treated to a Rockwell hardness of C30-Minimum. (Bearing Failure)
- o Ring and ball are M-50 tool steel with a hardness of C60-65. (Bearing Failure)
- o Bearings are a single race design and support the shaft at both ends. (Bearing Failure)
- o Bearing spacers center, align and parallel the bearings to within .0002 inch. (Bearing Failure)
- o Fluid procurement is controlled per SE-S-0073. (Contaminated Lube Oil/Loss of Lubrication)
- 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 GN2 spin and hotfire functional tests with start time and horsepower requirements which are checked and verified and gearbox lube oil which is checked for contamination (All Failure Causes)
- o During refurbishment and prior to reuse, the turbine assembly is inspected with the same verifications as new units and ATP tested per Sundstrand ATP TS 2409. (All Failure Causes)
- o GN2 sampling for cleanliness and composition (purity and particulate count) verification is performed per 10REQ-0021, para. 2.3.2.2.
- o Lube oil (influent) sampling for cleanliness and composition (purity and particulate count) verification is performed per 10REQ-0021, para. 2.3.2.3. (Contaminated Lube Oil/Loss of Lubrication)

- o Functional test is performed during hotfire operations per 10REQ-0021, paras. 2.3.11, 2.3.15 and 2.3.16 respectively for: (All Failure Causes)
 - Low speed GN2 spin
 - High speed GN2 spin
 - Hotfire
- o Gearbox lube oil post hotfire sampling is performed per 10REQ-0021, para. 2.3.16.5.e.1 (Contaminated Lube Oil/Loss of Lubrication)

C. INSPECTION

VENDOR RELATED INSPECTIONS

- o Vendor inspection and test records are verified per SIP 1128 by USA SRBE PQAR. (All Failure Causes)
- o Verification of turbine wheel penetrant inspection is performed per SIP 1128 by vendor and USA SRBE PQAR. (Material Defect)
- o Verification of material certification is performed per SIP 1128 by vendor and USA SRBE PQAR. (Material Defect of Bearing Components)
- o Verifications that are required on new units are performed on refurbished units by USA SRBE PQAR per SIP 1128. (All Failure Causes)
- o Witnessing of final acceptance test is performed per SIP 1128 by USA SRBE PQAR. (All Failure Causes)
- o Critical processes/Inspections:
 - X-Ray per CP 16.01-01
 - Heat treat per CP 16.03-01

KSC RELATED INSPECTIONS

- o GN2 (influent) cleanliness and composition (purity and particulate count) are verified per 10REQ-0021, para. 2.3.2.2. (Contamination)
- o Verification of cleanliness and composition (purity and particulate count) of lube oil (influent) is performed per 10REQ-0021, para. 2.3.2.3. (Contaminated Lube Oil/Loss of Lubrication)
- 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: (All Failure Causes)
 - Low speed GN2 spin
 - High speed GN2 spin
 - Hotfire

- o Verification of post hotfire gearbox lube oil cleanliness and composition (purity and particulate count) is performed per 10REQ-0021, para. 2.3.16.5.e.1 (Contaminated Lube Oil/Loss of Lubrication)

D. FAILURE HISTORY

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

E. OPERATIONAL USE

- o Not applicable to this failure mode.