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SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: APU Housings

PART NO.: 734560 (Turbine housing) FM CODE: AD2
 734561 (Exhaust housing)
 (Part of 740416/734589(ALT.))

ITEM CODE: 20-01-28A REV

CRITICALITY CATEGORY: 1 REACTION TIME: Seconds

NO. REQUIRED: 2 DATE: March 1, 1992

CRITICAL PHASES: Final Countdown, Boost SUPERCEDES: March 5, 1990

FMEA PAGE NO.: A-92 ANALYST: R. Imre/P. Kalia

SHEET 1 OF 3 APPROVED: R. Ailor

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.

RATIONALE FOR RETENTION:

A. DESIGN

- o The APU housing is designed and qualified as per end item specification 10SPC-0050. (All failure causes)
- o Material selection is per MSFC-SPEC-522A. (Material Defect)
- o Turbine housing is designed and tested to a proof pressure of 185 + 5/-0 psig per Sundstrand drawing 734560. (All failure Causes)
- o The aft skirt area is purged with GN2 prior to APU start per OMRSD File II, Vol. 1, requirement number SOOFMO.430. This reduces the O2 concentration to less than four percent. (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

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- 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 TS2409. (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 (SIP 1128) verifies proper manufacturing and assembly. (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 Critical Processes/Inspections:
 - Weld per CPOS.15-02, CPOS.17-01(EBW)
 - Penetrant per CP16.03-01
 - Heat Treat per MIL-H-6875
 - 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

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- o Inspect TVC system for damage - no leaks, signs of rubbing, or discoloration are allowed per LOREQ-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 Post hotfire verification, including inspection and leak check per LOREQ-0021, para. 2.3.16.4. (All Failure Causes)

D. FAILURE HISTORY

Criticality Category 1:

- o Failure: A crack was detected on the gas turbine module second stage housing P/N 734560 S/N V4E014 of APU S/N 165. (Sundstrand Report #SS-0485 dated 12-9-88, PAS #A11904 dated 3-17-89). This APU S/N 165 was processed for turbine blade mapping at Sundstrand when the cracked flange was discovered during visual inspection.

Cause: The housing was overstressed during APU disassembly causing the crack.

Corrective Action: The containment housing was replaced and APU resubmitted to ATP which it passed. Sundstrand has taken following recurrence control:

- APU's returned for any reason will be leak tested per the GTM drawing
 - Containment housing inspections following disassembly has been added to the Job Instruction Sheet (JIS).
 - The tools used to disassemble the housing have been modified to reduce the stress which caused the original damage.
 - A 15 psi helium pressure decay test has been added to the JIS to verify exhaust system integrity prior to shipment.
- o Failure: During disassembly of APU S/N 163 at Sundstrand a crack, 1.25 inch long, running through the wall was noted in the deepest scallop on the flange of the Containment Housing. (Sundstrand Report #SS-0565 dated 9-25-89, PAS #A12486 dated 12-6-89).

Cause: Stress and metallurgical analysis revealed that:

- The maximum strain coincides with the greatest temperature gradient across the housing.
- The crack runs from high stress to low stress region.
- The test data indicates a potential for cracking due to the notch (channel) effect machinery at sea water vent.

Corrective Action: Sundstrand will remove and scrap all GENTZ containment housings that have machined sea water vents.

E. OPERATIONAL USE

- o Not applicable to this failure mode.