

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : AUXILIARY POWER (APUS) FMEA NO 04-2 -L2 -11 REV: 02, 26

ASSEMBLY : LUBE OIL COOLING ABORD CRIT. FUNK: 1
P/N RI : VQ70-465302/323 RTLS, AOA, ATC, TAL CRIT. HDW:
P/N VENDOR: VEHICLE 102 103 104
QUANTITY : 3 EFFECTIVITY: X X X
: 1 LOOP (FEED & RETURN) PHASE(S): PL X LO X CO X DO X LS
: PER APU

REDUNDANCY SCREEN: A-PASS B-PASS C-PASS
PREPARED BY: M HAMMEL DES APPROVED BY: [Signature] APPROVED BY (NASA):
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ITEM:
LINES, LUBE OIL COOLING LOOP

FUNCTION:
TO CARRY LUBE OIL FROM THE APU GEARBOX TO THE HYDRAULIC WATER BOTTLE &
BACK TO THE APU GEARBOX (SYSTEM PRESSURE - 150 PSI MAXIMUM).

FAILURE MODE:
LEAKAGE (GROSS EXTERNAL).

CAUSE(S):
RUPTURE, CRACK, SEAL OR FITTING FAILURE.

EFFECT(S) ON:
(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE
(A) POSSIBLE LOSS OF ONE APU SYSTEM BEFORE MISSION COMPLETION.
GRADUAL DECREASE IN FLOW TO BEARINGS, INCREASED BEARING TEMPERATURE.
OVERTEMPERATURE INDICATION TO PMS. POSSIBLE SHUTDOWN.
(B) POSSIBLE LOSS OF SHAFT POWER TO ONE HYDRAULIC PUMP.
(C) ABORT DECISION IS REQUIRED IF FAILURE OCCURS PRIOR TO ENTRY
COMMITMENT.
(D) NO EFFECT UNLESS LUBE OIL IS IGNITED (IGNITION TEMPERATURE IS 760
DEG F) OR UNTIL SECOND SYSTEM LOST. CRITICALITY 1 FOR SSME-INDUCED RT
ATO, AOA, OR TAL DUE TO THE POSSIBLE ADDITIONAL LOSS OF ASSOCIATED
APU/HYD AND MAIN ENGINE
(E) FUNCTIONAL CRITICAL EFFECT - POSSIBLE LOSS OF CREW/VEHICLE IF
EXPOSED LUBE OIL IS IGNITED, CAUSING LOSS OF ADJACENT AND REDUNDANT
HARDWARE.

DISPOSITION & RATIONALE:
(A) DESIGN (B) TEST (C) INSPECTION (D) FAILURE HISTORY (E) OPERATIONAL USE
(A) DESIGN
PROVEN DESIGN. LINES UNDER 1 IN., 21-6-9 CRES BRAZED IN PLACE, DESIGN
BURST PRESSURE 4 TIMES OPERATING PRESSURE MINIMUM.

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DYNATUBE-DUAL SEAL FITTINGS 17-4 ATTACHED WITH BRAZED SLEEVE AND WITH DUAL-SEALING SURFACES. THE BRAZED CONSTRUCTION ELIMINATES JOINTS AND POSSIBLE LEAK PATHS.

FASTENING CLAMPS ALLOW FREEDOM OF MOVEMENT. TUBING BENDS ARE CONTROLLED BETWEEN FIXED POINTS TO FACILITATE INSTALLATION AND TO ACCOMMODATE VEHICLE GROWTH AND MOVEMENT.

(B) TEST

INITIAL TUBING PROOF PRESSURE AT 1.5 TIMES OPERATING PRESSURE. SUBSYSTEM FUNCTIONAL AND LEAK TESTS AFTER INSTALLATION.

DUAL SEAL DYNATUBE FITTING QUALIFIED BY RESISTOFLEX TO IMPULSE CYCLES AT 400 DEG F TO -65 DEG F FOR 200,000 CYCLES, 12,000 PSI BURST. SINE VIBRATION +/- 0.41 G TO +/- 10 G, FOR 3 HR IN 20 MIN SWEEPS FROM 5 TO 2,000 CPS.

ROCKWELL PERFORMED TUBING CERTIFICATION TESTS PER ORBITER TUBING VERIFICATION PLAN (SD 75-SH-205). THIS TESTING INCLUDED WORST CASE USAGE, PRESSURE CYCLING, FATIGUE, AND OFF LIMIT-TESTING FOR LINES, JOINTS, AND PANELS. SYSTEM EVALUATION TESTS ON CV-101 AND AT SUNDSTRAND ALLOWED EVALUATION OF THE INSTALLED-SYSTEM CONDITION.

CMPSD: POSTFLIGHT SYSTEM INSPECTION AND PRESSURE DECAY LEAK TESTS ON LUBE SYSTEM ARE PERFORMED EVERY FLOW.

(C) INSPECTION

RECEIVING INSPECTION

MATERIALS AND PROCESSES CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS TO LEVEL 100 IS VERIFIED BY INSPECTION. CORROSION PROTECTION PROVISIONS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

MANUFACTURING, ASSEMBLY, AND INSTALLATION PROCEDURES ARE VERIFIED BY INSPECTION. INSTALLATION OF LINE SUPPORT ISOLATORS IS VERIFIED BY INSPECTION. TUBE AND AXIAL ALIGNMENT OF DYNATUBE FITTINGS IS VERIFIED BY INSPECTION. GREASE AND TORQUE ARE VERIFIED BY INSPECTION. NO TUBE PRELOADS PRESENT DURING INSTALLATION IS VERIFIED BY INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. ELECTRICAL BOND IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

RADIOGRAPHIC INSPECTION OF BRAZES IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES

BRAZING PER SPECIFICATION REQUIREMENTS IS VERIFIED BY INSPECTION.

TESTING

TEST EQUIPMENT AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION. ATP IS WITNESSED AND VERIFIED BY INSPECTION. PROOF AND LEAK TESTS ARE VERIFIED BY INSPECTION.

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HANDLING/PACKAGING

HANDLING, PACKAGING, STORAGE, AND SHIPPING PROCEDURES ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

NO FAILURES.

(E) OPERATIONAL USE

SHUT DOWN APU BASED ON SYSTEM TEMPERATURES AND FLIGHT PHASE. ALSO, IF APU SHUTS DOWN, REMAINING APU'S GO TO HIGH SPEED AND AUTOMATIC SHUTDOWN IS INHIBITED TO PRECLUDE INADVERTENT SHUTDOWNS.

IF ENTRY, PERFORM HOT RESTART IF REQUIRED TO GAIN SECOND APU.