SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ACTUATION MECH-RADIATORS FMEA NO 02-4G -158 -1 REV:03/07/88

ASSEMBLY :RADIATOR DEPLOY MECH
P/N RI :V070-594412,420,460(2 EACH)
P/N VENDOR:
QUANTITY :8
:4 PER SIDE

CRIT. FUNC: 1
CRIT. HDW: 1

VEHICLE EFFECTIVITY:	102	103	104
	X	X	X

PHASE(S): PL LO OO X DO LS

REDUNDANCY SCREEN: A- B- C-

PREPARED BY:		APPROVED BY:		APPROVED BY (NASA):	
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ITEM:
TORQUE SHAFTS

FUNCTION:
TORQUE SHAFTS TRANSMIT ROTARY MOTION FROM POWER DRIVE UNIT (PDU) TO FOUR ROTARY ACTUATORS TO DEPLOY OR STOW TWO RADIATOR PANELS ON PAYLOAD BAY DOOR.

FAILURE MODE:
STRUCTURAL FAILURE

CAUSE(S):
ADVERSE TOLERANCES/WEAR, DEFECTIVE PART/MATERIAL OR MANUFACTURING DEFECT, EXCESSIVE LOAD, FATIGUE, STRESS CORROSION

EFFECTS ON:
(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE

(A) LOSS OF RADIATOR DEPLOYMENT/STOWAGE CAPABILITY.

(B) POSSIBLE INTERFERENCE WITH CLOSING PAYLOAD BAY DOOR IF RADIATOR CANNOT BE STOWED.

(C) REDUCED COOLING CAPACITY IF RADIATOR CANNOT BE DEPLOYED; POSSIBLY RESTRICTING MISSION.

(D) POSSIBLE LOSS OF VEHICLE/CREW IF RADIATOR CANNOT BE STOWED RESULTING IN INTERFERENCE WITH CLOSING OF PAYLOAD BAY DOORS.

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DISPOSITION & RATIONALE:
(A)DESIGN (B)TEST (C)INSPECTION (D)FAILURE HISTORY (E)OPERATIONAL USE

(A) DESIGN
POSITIVE MARGIN OF SAFETY ON SHAFTS AND COUPLINGS AT FULL STALL TORQUE OUTPUT OF PDU. BEARINGS AND INTERMEDIATE FAIRLEAD SUPPORTS (TEFLON) LIMIT VIBRATION. SHAFTS ARE 2024-T3 ALUMINUM ALLOY WITH TITANIUM COUPLINGS. DESIGN OF THE ACTUATION SYSTEM PERMITS PARTIAL WORKAROUND OF THIS FAILURE MODE BY EXTRAVEHICULAR ACTIVITY (EVA) CREW IF PAYLOAD DOES NOT LIMIT ACCESS AND IF RADIATORS ARE FULLY DEPLOYED.

(B) TEST
QUALIFICATION TESTS: THE TWO DIFFERENT ACTUATORS HAVE BEEN CERTIFIED PER CR-29-287-0037-0001G (REF. FMEA/CIL NO. 02-4G-153-1) AND CR-29-147-0016-0001A (REF. FMEA/CIL NO. 02-4G-182-1) RESPECTIVELY. THE RADIATOR DEPLOYMENT MECHANISM HAS BEEN CERTIFIED PER CR-29-594400-001D. QUALIFICATION TESTS OF RADIATOR DEPLOYMENT MECHANISM ON FORWARD 15 FT PAYLOAD BAY DOOR TEST ARTICLE (087) INCLUDE: ACCEPTANCE - TO CONFIRM ALL COMPONENTS HAVE BEEN ASSEMBLED AND RIGGED PER ML0308-0023; CYCLE FUNCTION - CYCLED 42 TIMES UNDER THREE DIFFERENT TEST CONDITIONS (CONTROL, NON-DISTORTED AND DISTORTED) THROUGH UNLATCH, DEPLOY, STOW AND LATCH CYCLE WITH SIMULATED ZERO GRAVITY; ORBITAL FUNCTION - CYCLED 18 TIMES UNDER THREE DIFFERENT TEST CONDITIONS (TAIL SUN, BOTTOM SUN WITH PAYLOAD BAY DOOR PANEL NO. 1 AND BOTTOM SUN WITH PAYLOAD BAY DOOR PANEL NO. 2) THRCUGH UNLATCH AND LATCH CYCLE WITH PAYLOAD BAY DOOR HINGE LINE DISTORTED; ACOUSTIC - TESTED IN ACCORDANCE WITH MF0004-014C (25 HZ TO 8,000 HZ FOR 5 MINUTES); CERTIFICATION BY ANALYSIS/SIMILARITY - PRESSURE, FUNGUS, HUMIDITY, OZONE, TEMPERATURE-CYCLE, TRANS-PACKAGE, LANDING, SHOCK, BASIC DESIGN, ACCELERATION, SALT SPRAY, SAND/DUST, TRANSPORTATION-VIBRATION, LIMIT LOAD, ULTIMATE LOAD AND MARGIN OF SAFETY.

ACCEPTANCE TESTS: THE RADIATOR DEPLOYMENT MECHANISMS WERE RIGGED PER CONTROLLED SPECIFICATION ML0308-0023. OPERATION OF RADIATORS DEPLOYMENT MECHANISMS WERE VERIFIED IN CHECKOUT AT KSC WHICH INCLUDED RADIATOR FUNCTIONAL CHECK.

OMRSD: GROUND TURNAROUND INCLUDES VISUAL INSPECTION OF HARDWARE TO ENSURE THAT PARTS ARE NOT BROKEN OR DEFORMED AND MONITORING FUNCTIONAL TEST FOR EVIDENCE OF BINDING OR JAMMING. THESE TESTS ARE PERFORMED FIRST FLIGHT AND FOR EVERY FLIGHT WHERE THE RADIATORS WILL BE DEPLOYED.

(C) INSPECTION

RECEIVING INSPECTION
MATERIALS AND PROCESS CERTIFICATIONS VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
CONTAMINATION CONTROL AND CORROSION PROTECTION VERIFIED BY INSPECTION.

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ASSEMBLY/INSTALLATION
PROCESSING MATERIALS WHICH CONTACT TITANIUM IS PER APPLICABLE SPECIFICATION. MACHINING OPERATIONS ARE PER DRAWING AND MACHINING SPECIFICATION AND VERIFIED BY INSPECTION. ALL ASSEMBLY DETAILS AND COMPONENTS ARE MANUFACTURED PER DRAWING AND APPLICABLE SPECIFICATIONS AND ALL ARE VERIFIED BY INSPECTION. CENTERING CENTERLINE OF SPLINE VERIFIED BY INSPECTION. LENGTH DIMENSION IS VERIFIED PRIOR TO DRILLING, AND ALL OPERATIONS ARE VERIFIED BY INSPECTION. THE COMPLETE ASSEMBLY IS VERIFIED BY INSPECTION. FABRICATION OF ALUMINUM TUBING PER MA0102-306 VERIFIED BY INSPECTION. APPLICATION OF DRY FILM LUBE LB0140-004 PER DRAWING REQUIREMENTS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
PENETRANT INSPECTION OF ALUMINUM TORQUE SHAFTS AND TITANIUM COUPLINGS PER MTO501-504 VERIFIED BY INSPECTION.

CRITICAL PROCESSES
HEAT TREATMENT OF ALUMINUM TUBING VERIFIED BY INSPECTION.

TESTING
ATP VERIFIED BY INSPECTION.

HANDLING/PACKAGING
IDENTIFICATION AND PACKAGING ARE PER APPLICABLE SPECIFICATIONS AND VERIFIED BY INSPECTION.

(D) FAILURE HISTORY
THERE HAVE BEEN NO ACCEPTANCE TEST, QUALIFICATION TEST, FIELD OR FLIGHT FAILURES ASSOCIATED WITH THIS FAILURE MODE.

(E) OPERATIONAL USE
EVA WORKAROUND IS POSSIBLE IF RADIATORS ARE FULLY DEPLOYED.