SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :P/L RETEN & DEPLOY-LATCHES FMEA NO 02-5E -T11 -1 REV:04/04/88

ASSEMBLY :ACTIVE KEEL ACTUATOR
P/N RI :V073-544560
P/N VENDOR:61300
QUANTITY :5 MAX

CRIT. FUNC: 1
CRIT. HDW: 1

| VEHICLE EFFECTIVITY: | 102 | 103 | 104 |
|---|---|---|---|
| | X | X | X |

PHASE(S): PL LO X OO X DO X LS

REDUNDANCY SCREEN: A- B- C-

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ITEM:
LATCH/TRUNNION AND BRIDGE INTERFACES

FUNCTION:
THE KEEL LATCH CAN BE MOUNTED IN A PRIMARY (FIXED) CONFIGURATION OR A SECONDARY CONFIGURATION WHERE IT IS FREE TO SLIDE (WITHIN LIMITS) ALONG THE BRIDGE TO ALLOW DYNAMIC REACTION OF PAYLOAD/ORBITER STRUCTURE DURING LAUNCH AND ENTRY. DESIGN ALSO INCLUDES SPHERICAL BEARINGS WITHIN THE LATCH TO ALLOW LIMITED ROTATION AND SLIDING OF THE PAYLOAD TRUNNION IN THE LATCH TO FURTHER RELIEVE LAUNCH AND ENTRY LOADS.

'URE MODE:
.YSICAL BINDING/JAMMING

CAUSE(S):
ADVERSE TOLERANCES/WEAR, CONTAMINATION/FOREIGN OBJECT/DEBRIS, LOSS OF LUBRICANT

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

(A) LOSS OF ABILITY FOR PAYLOAD/ORBITER TO FLEX AND RELIEVE LAUNCH AND ENTRY LOADS.

(B) FAILURE WILL CAUSE PAYLOAD/ORBITER TO BE SUBJECTED TO EXCESSIVE LOADS DURING ASCENT AND ENTRY.

(C) FAILURE OF LATCH TO SLIDE ON BRIDGE MAY PRECLUDE BERTHING OF PAYLOAD OR CLOSING OF LATCH AND RESULT IN LOSS OF MISSION.

(D) POSSIBLE LOSS OF CREW AND VEHICLE DUE TO EXCESSIVE LOADS DURING ASCENT OR ENTRY.

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

(A) DESIGN
THE PAYLOAD SUPPORT POINTS ARE SELECTED TO MINIMIZE POINT TORSIONAL, BENDING AND RADIAL LOAD IMPARTED TO THE PAYLOADS. TRUNNION FRICTION LOADS ARE MINIMIZED TO CF = 0.10 TO 0.25, BRIDGE FRICTION Cf = 0.10 TO 0.12 DEPENDING UPON ENVIRONMENT AND LOAD. MATERIAL, FINISHES AND LUBRICANT ARE SELECTED TO PROVIDE MINIMUM COEFFICIENT OF FRICTION. TRUNNION INTERFACE USE SPHERICAL BEARING AND FIBRILOID LINER. BRIDGE INTERFACE USES DRY LUBE FINISH (VITROLUBE 1220 WITH GRAPHITE TOP COAT).

(B) TEST
ACCEPTANCE TESTS: THE FOLLOWING TESTS ARE PERFORMED FOR ALL FLIGHT ARTICLES AND WERE PERFORMED FOR EACH QUALIFICATION TEST ARTICLE: VIBRATION - RANGE 20 TO 2,000 HZ MAXIMUM LEVEL OF 0.04 g2/HZ FROM 80 TO 350 HZ, ALL AXES, OPEN AND CLOSED POSITIONS, WHILE UNDER LOAD. THERMAL - STABILIZED RANGE FROM -100 DEG F TO +350 DEG F. FUNCTIONAL TESTS CONDUCTED AT -100 DEG F, +70 DEG F AND +350 DEG F. LOADS/ALIGNMENT - VERIFY RETENTION OF LATCHED POSITION AT 60% LIMIT LOAD, AS WELL AS SPHERICAL BEARING TORQUE RESISTANCE AND TRAVEL LIMITS. ELECTRICAL - VERIFY (WITHIN DESIGN LIMITS) CONTINUITY, DIELECTRIC STRENGTH, INSULATION RESISTANCE, AND SWITCH OPERATION.

QUALIFICATION TESTS: THE FOLLOWING IS A SUMMATION OF TESTS CONDUCTED PER CR 44-147-0017-0001 TO INCLUDE BOTH NATURAL AND INDUCED ENVIRONMENTAL EFFECTS TO THE LATCH ASSEMBLY AND THE LATCH-TO-BRIDGE/TRUNNION FRICTION/LOAD INTERFACE. FUNCTIONAL TESTS WERE CONDUCTED DURING AND FOLLOWING EACH PHASE OF TESTING TO DETERMINE EFFECTS. ENVIRONMENTS ACCEPTED BY ANALYSIS INCLUDE FUNGUS, OZONE, SALT SPRAY, ACCELERATION, SOLAR RADIATION (THERMAL AND NUCLEAR), METEOROIDS, SAND AND DUST, STORAGE, FACTOR OF SAFETY, RELIABILITY, MAINTAINABILITY, MATERIALS AND PROCESSES, ELECTRICAL DESIGN AND SAFETY. CERTIFICATION BY SIMILARITY INCLUDED TRUNNION FRICTION AND EXPLOSIVE ATMOSPHERE. VIBRATION - QUALIFICATION ACCEPTANCE VIBRATION TEST (QAVT) RANGE OF 20 TO 2,000 HZ WITH MAXIMUM LEVEL OF 0.067 g2/HZ AT 80 TO 350 HZ ALL AXES. FLIGHT VIBRATION LEVEL - 20 TO 2,000 HZ WITH MAXIMUM LEVEL OF 0.15 g2/HZ AT 100 TO 400 HZ ALL AXES, OPEN AND CLOSED POSITIONS. SHOCK BENCH HANDLING PER MIL STD-810C. THERMAL - STABILIZED RANGE FROM -100 DEG F TO +350 DEG F. FUNCTIONAL TESTS CONDUCTED AT -100 DEG F, +70 DEG F, +350 DEG F, THERMAL VACUUM AT 10 -6 TORR, AND HUMIDITY. LOAD TESTS - COMBINED AXIS LOADING TO 100% LIMIT LOAD. LIFE CYCLE TESTS - 1,018 CYCLES IN ADDITION TO CYCLES CONDUCTED DURING QUALIFICATION TESTING WITH VARIOUS LOAD AND MOTOR CONDITIONS. TRUNNION/BRIDGE INTERFACE FRICTION - SINGLE AND COMBINED AXIS LOADING UP TO LIMIT IN BOTH DIRECTIONS THROUGHOUT THE ENTIRE TEMPERATURE RANGE, IN COMPLIANCE WITH INTERFACE CONTROL DOCUMENT.

OMRSD: GROUND TURNAROUND INCLUDES PAYLOAD RETENTION LATCH BEARING INSPECTION.

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:) INSPECTION

RECEIVING INSPECTION
MATERIAL AND PROCESS CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
CLEANLINESS REQUIREMENTS VERIFIED BY INSPECTION. REMOVAL OF TOPCOAT FROM VITROLUBE AND MACHINING OF THE BRIDGE INTERFACE ARE VERIFIED TO BE PERFORMED IN A GENERAL HOUSEKEEPING AREA (GHA) PER MA0110-306, VERIFIED BY ROCKWELL INSPECTION. INSPECTION VERIFIES REPACKAGING BEFORE LEAVING GHA AREA.

ASSEMBLY/INSTALLATION
MACHINING AND DIMENSIONS ARE VERIFIED BY INSPECTION. REMOVAL OF TOPCOAT FROM BRIDGE INTERFACES VITROLUBE COATING IS VERIFIED BY ROCKWELL INSPECTION. ROCKWELL INSPECTION VERIFIES THE X-RAY DIFFRACTION OR GAS CHROMATOGRAPHY ANALYSIS OF TEST SPECIMEN, WHICH INDICATES BY LACK OF TEFLON, THAT TOPCOAT REMOVAL PROCESS IS COMPLETE. ROCKWELL MACHINING ON BRIDGE INTERFACE IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
PENETRANT INSPECTION IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES
CHROME PLATING AND ADHESIVE BONDING OF FIBRILOID LINER TO TRUNNION INTERFACE VERIFIED BY INSPECTION. VITROLUBE APPLICATION TO BRIDGE INTERFACE VERIFIED BY INSPECTION. HEAT TREATING OF THE INCONEL 718 TO 180 KSI MINIMUM TENSILE STRENGTH VERIFIED BY INSPECTION.

TESTING
ATP IS VERIFIED PER PROCEDURE.

HANDLING/PACKAGING
PARTS PACKAGED AND PROTECTED PER APPLICABLE PACKAGING SPECIFICATIONS VERIFIED BY INSPECTION.

D) FAILURE HISTORY

CAR NO. AC3080 : AFTER QUALIFICATION IRREVERSIBILITY TEST, EXCESSIVE TORQUE WAS REQUIRED TO ROTATE TRUNNION SPHERICAL BEARING (300 INCH-LB, WHICH EXCEEDED THE MAXIMUM ALLOWABLE TORQUE OF 200 INCH-LB); CAUSE OF THE EXCESSIVE TORQUE TO GIMBAL THE SPHERICAL BEARING WAS YIELDING DURING APPLICATION OF STATIC LIMIT LOAD IN THE PRIOR IRREVERSIBILITY TEST; SPHERICAL BEARINGS REMOVED AND REPLACED.

CAR NO. AC3103 : DURING ACCEPTANCE TEST OF PAYLOAD RETENTION KEEL LATCH, THE FIBRILOID LINER CAME LOOSE ON THE TOP OF THE STATIC HALF BEARING; MACHINING AND BONDING DEFICIENCIES EXISTED; HALF BEARINGS WITH SEPARATED OR DAMAGED LINERS WERE REPLACED AND LATCHES WERE RETESTED.

:) OPERATIONAL USE
NONE.