SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :P/L RETEN & DEPLOY-LATCHES FMEA NO 02-5E -T04 -3 REV:04/04/88

ASSEMBLY :ACTIVE KEEL ACTUATOR
P/N RI :MC287-0054-0001
P/N VENDOR:2960614-021 SPERRY
QUANTITY :10 MAX
:TWO PER LATCH

CRIT. FUNC: 1R
CRIT. HDW: 2

VEHICLE EFFECTIVITY:	102	103	104
	X	X	X

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

REDUNDANCY SCREEN: A-PASS B-FAIL C-PASS

PREPARED BY:
DES D. S. CHEUNG
REL M. B. MOSKOWITZ
QE W. J. SMITH

APPROVED BY:
DES
REL
QE

APPROVED BY (NASA):
SSM
REL
QE

ITEM:
MOTOR/BRAKE ASSEMBLY

FUNCTION:
KEEL LATCH REACTS FLIGHT LOADS ON PAYLOAD VERTICAL TRUNNION HELD BETWEEN TWO SPHERICAL HALF BEARINGS. REDUNDANT MOTORS ACT THROUGH A DIFFERENTIAL AND GEARBOX TO DRIVE THE LINKAGES, BALLSCREW AND SECONDARY FRAME. THE MOTORS INCORPORATE INTEGRAL BRAKE MECHANISMS AND ARE CONTROLLED BY POSITION SWITCHES LOCATED WITHIN THE LATCH. TWO A/C PHASES ARE REQUIRED TO LIFT THE BRAKE AND POWER THE MOTOR. THERE ARE NO SINGLE FAILURE MODES WHICH WOULD ALLOW A FREE WHEELING MOTOR AFTER APPLICATION OF POWER.

FAILURE MODE:
BRAKE FAILS TO ENGAGE

CAUSE(S):
ADVERSE TOLERANCES/WEAR, CONTAMINATION/FOREIGN OBJECT/DEBRIS, DEFECTIVE PART/MATERIAL OR MANUFACTURING DEFECT, FAILURE/DEFLECTION OF INTERNAL PART, ELECTRICAL FAILURE - OPEN, SHORT, ETC.

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

(A) FIRST FAILURE - NONE. SECOND FAILURE - FAILURE OF ASSOCIATED MOTOR WILL ALLOW OTHER MOTOR TO BACKDRIVE THROUGH THE FAILED BRAKE AND LATCH POSITIONING CAPABILITY WOULD BE LOST.

(B) FIRST FAILURE - NONE. SECOND FAILURE - FAILURE OF ASSOCIATED MOTOR WILL RESULT IN LOSS OF ABILITY TO DRIVE LATCH.

(C) FIRST FAILURE - NONE. SECOND FAILURE - FAILURE OF ASSOCIATED MOTOR WILL RESULT IN A POSSIBLE LOSS OF MISSION DUE TO INABILITY TO RELEASE OR RESTRAIN PAYLOADS.

(D) FIRST FAILURE - NONE. SECOND FAILURE - POSSIBLE LOSS OF CREW/VEHICLE DUE TO UNRESTRAINED PAYLOAD DURING ENTRY.

SUBSYSTEM :P/L RETEN & DEPLOY-LATCHES FMEA NO 02-5E -T04 -3 REV:04/04/88

FAILS REDUNDANCY SCREEN "B" SINCE THERE IS NO VISUAL OR INSTRUMENTED WAY OF DETECTING A FAILURE OF THE MOTOR/BRAKE ASSEMBLY IN FLIGHT.

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

(A) DESIGN
THE MOTOR HAS THE DESIGN REQUIREMENTS OF THREE PHASE, 400 HZ, AC INDUCTION MOTOR AND INTEGRAL BRAKE THAT WILL BE USED IN A SPACE ENVIRONMENT. THE MOTOR IS ENCLOSED WITH COVER TO EXCLUDE CONTAMINATION. IT HAS A FACTOR OF SAFETY OF 1.4 OVER LIMIT LOAD. MATERIAL AND PROCESS FOR THE MOTOR ARE IN ACCORDANCE WITH MC999-0096. DUAL BEARING SURFACES ARE EMPLOYED.

(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 RELEASE OPERATION (SYSTEM 1), LATCHING OPERATION (SYSTEM 1), RELEASE OPERATION (SYSTEM 2), AND LATCHING OPERATION (SYSTEM 2).

SUBSYSTEM :P/L RETEN & DEPLOY-LATCHES FMEA NO 02-5E -T04 -3 REV:04/04/88

(C) INSPECTION

RECEIVING INSPECTION
MATERIAL AND PROCESS CERTIFICATIONS VERIFIED BY INSPECTION. INSPECTION VERIFIES THAT A SAMPLE FROM EACH LOT OF MATERIAL IS SPECTROSCOPICALLY ANALYZED TO VERIFY MATERIAL CHEMISTRY.

CONTAMINATION CONTROL
ALL PARTS ARE CLEANED BEFORE ENTERING STOCK ROOM AND RECLEANED BEFORE ENTERING CLEAN ROOM, VERIFIED BY INSPECTION. MOTOR/BRAKE ASSEMBLY IS ASSEMBLED IN A CLASS 10,000 CLEAN ROOM, VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
ALL PARTS ARE DIMENSIONALLY INSPECTED, VERIFIED BY INSPECTION. ASSEMBLY OPERATIONS ARE VERIFIED BY INSPECTION. RTV APPLICATION TO KEEP MOISTURE OUT OF THE MOTOR IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES
HEAT TREATING AND SOLDERING ARE VERIFIED BY INSPECTION. PASSIVATION OF STAINLESS STEEL PARTS IS VERIFIED BY INSPECTION. EXAMINATION OF SOLDER JOINTS BEFORE THEY ARE CLOSED UP AND SEALED IN WINDINGS IS A MANDATORY INSPECTION POINT. HEAT TREATING OF SHAFTS IS VERIFIED BY HARDNESS TEST.

TESTING
ATP (INCLUDING TESTING AT EXTREME TEMPERATURES AT VARIOUS LOADS AND AT VARIOUS POSITIONS) IS VERIFIED PER PROCEDURE. WINDING RESISTANCE TEST IS VERIFIED BY INSPECTION. HIGH POTENTIAL TEST IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING AND PACKAGING REQUIREMENTS 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
NONE.