SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :P/L RETEN & DEPLOY-LATCHES FMEA NO 02-5E -K02 -1 REV:04/04/88

ASSEMBLY :LIGHTWEIGHT KEEL LATCH CRIT. FUNC: 1R
P/N RI :MC287-0054-0001 CRIT. HDW: 2
P/N VENDOR:2960614-021 VEHICLE EFFECTIVITY: 102 X 103 X 104 X
QUANTITY :40 MAX PHASE(S): PL LO OO X DO X LS
:TWO PER LATCH ASSEMBLY

REDUNDANCY SCREEN: A-PASS B-PASS 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:
LIGHTWEIGHT 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:
LOSS OF OUTPUT

CAUSE(S):
CONTAMINATION/FOREIGN OBJECT/DEBRIS, DEFECTIVE PART/MATERIAL OR MANUFACTURING DEFECT, ELECTRICAL FAILURE-OPEN, SHORT, ETC., FAILURE/DEFLECTION OF INTERNAL PART, BRAKE FAILS TO DISENGAGE

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

(A) FIRST FAILURE - LATCH OPERATES AT SINGLE MOTOR SPEED. SECOND FAILURE - LOSS OF CAPABILITY TO OPERATE LATCH.

(B) SECOND FAILURE WILL RESULT IN LOSS OF ABILITY TO DRIVE LATCH OPEN OR CLOSE.

(C) SECOND FAILURE WILL RESULT IN A POSSIBLE LOSS OF MISSION DUE TO INABILITY TO RELEASE OR RESTRAIN PAYLOAD.

(D) SECOND FAILURE WILL RESULT IN POSSIBLE LOSS OF CREW/VEHICLE DURING ENTRY DUE TO UNRESTRAINED PAYLOAD.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :P/L RETEN & DEPLOY-LATCHES FMEA NO 02-5E -K02 -1 REV:04/04/88

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 FACTOR OF SAFETY OF 1.4 OVER LIMIT LOAD. MATERIAL AND PROCESS FOR THE MOTOR ARE IN ACCORDANCE WITH MC999-0096. THIS MOTOR IS SAME AS USED ON ALL PAYLOAD RETENTION LATCHES.

(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. THERMAL - STABILIZED RANGE FROM -180 DEG F TO +255 DEG F. FUNCTIONAL TESTS CONDUCTED AT -80 DEG F, AMBIENT AND +255 DEG F. LOADS/ALIGNMENT - VERIFY RETENTION OF LATCHED POSITION AT 80% 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 44-544300-001 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, SAFETY FACTOR, RELIABILITY, MAINTAINABILITY, MATERIALS AND PROCESSES, ELECTRICAL DESIGN AND SAFETY. CERTIFICATION BY SIMILARITY INCLUDED VACUUM, HUMIDITY, 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, FOR ALL AXES. FLIGHT VIBRATION LEVEL - 20 TO 2,000 HZ WITH MAXIMUM LEVEL OF 0.01 g2/HZ AT 100 TO 300 HZ, FOR ALL AXES. SHOCK BENCH HANDLING TEST IN ACCORDANCE WITH MIL-STD-810C METHOD 516.2 PROCEDURE V. THERMAL - STABILIZED RANGE FROM -100 DEG F TO +275 DEG F. FUNCTIONAL TESTS CONDUCTED AT -100 DEG F, AMBIENT, AND +275 DEG F AT 10 -6 TORR, HUMIDITY. LOAD TESTS - BY ANALYSIS OR COMBINED AXIS LOADING TO 140% LIMIT LOAD. LIFE CYCLE TESTS - 1,062 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 LOADING IN BOTH DIRECTIONS THROUGHOUT THE ENTIRE TEMPERATURE RANGE, AS SPECIFIED IN THE 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 -K02 -1 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. INSPECTION VERIFIES THAT PARTS ARE CLEANED TO LEVEL "VISIBLY CLEAN" OF MA0110-301 PRIOR TO ASSEMBLY. 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 IS 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 ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

CAR NO. AB7259 : MOTOR FAILED DIELECTRIC STRENGTH TEST; ALUMINUM FILLED ADHESIVE HAD BLED INTO MOTOR WINDINGS, CREATING AN ELECTRICAL PATH; THE ADHESIVE IN THE BRAKE WINDING COILS WAS CHANGED TO A NON-CONDUCTIVE TYPE.

CAR NO. AC0617 : ACTUATOR DID NOT OPEN WITHIN THE REQUIRED 30 SECOND TIME LIMIT; CAUSE OF EXCESSIVE LATCH OPERATING TIME WAS FAILURE OF ONE MOTOR TO OPERATE DUE TO FAILURE OF BRAKE TO RELEASE WHICH RESULTED FROM GUIDE PINS THAT VIBRATED OUT OF PRESS FIT HOLES; GUIDE PINS WERE REDESIGNED FOR POSITIVE RETENTION IN THE MOTOR BRAKE ARMATURE.

CAR NO. AC9552 : RTV (AN ENVIRONMENTAL SEAL WHICH KEEPS MOISTURE OUT OF THE MOTOR) CAME LOOSE FROM THE MOTOR SURFACE DURING TESTING OF PAYLOAD RETENTION LATCH ASSEMBLY; SUSPECT CAUSE WAS SPERRY PROCESS PROBLEM; MOTORS WERE RE-INSPECTED AND RE-WORKED.

(E) OPERATIONAL USE
NONE.