PRINT DATE: 12/15/88

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 02-4B-006-X

SUBSYSTEM NAME: PAYLOAD BAY DOOR MECHANISMS

REVISION : 0 12/15/88 W

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:	PAYLOAD BAY DOOR C/L ACTUATOR HOOVER ELECTRIC	MC287-0040 15810
SRU	:	GEARBOX PDU HOOVER ELECTRIC	41455-3 15810

QUANTITY OF LIKE ITEMS: 4
4 CENTERLINE LATCH
ACTUATORS

DESCRIPTION/FUNCTION:
4-GANGED LATCH SYSTEM CONTAINS A GEARBOX POWER DRIVE UNIT (PDU) MC287-0040 (REF. FMEA/CIL NO. 02-4B-005-1) PROVIDING THE ROTARY MOTION AND DRIVES THE PUSHRODS.

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SUMMARY

SUBSYSTEM NAME: PAYLOAD BAY DOOR MECHANISMS
LRU PAYLOAD BAY DOOR C/L ACTUATOR, Outrd
LRU PART #: MC287-0040 MC287-0039
ITEM NAME: GEARBOX PDU

FMEA NUMBER	ABBREVIATED FAILURE MODE DESCRIPTION	CIL FLG	CRIT	HZD FLG
02-4B-006-01	PHYSICAL BINDING/JAMMING*	X	1R2	
02-4B-006-02	FAILS FREE*	X	1R2	
02-4B-006-04	PHYSICAL BINDING/JAMMING*	X	1R2	
02-4B-006-05	FAILS FREE*	X	1R2	

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ACTUATION MECH-PBD FMEA NO 02-4B -006 -5 REV:03/08/88

ASSEMBLY :PBD LATCHING MECHANISM
P/N RI :MC287-0039
P/N VENDOR:15800 HOOVER ELEC
QUANTITY :4
:4 BULKHEAD LATCH ACTUATORS

CRIT. FUNC: 1R
CRIT. HDW: 2

VEHICLE EFFECTIVITY:	102	103	104
	X	X	X

PHASE(S): PL LO OO X DO LS

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

PREPARED BY:		APPROVED BY:	APPROVED BY (NASA):
DES	M. A. ALLEN	DES	SSM
REL	M. B. MOSKOWITZ	REL	REL
QE	W. J. SMITH	QE	QE

ITEM:
GEARBOX POWER DRIVE UNIT - BULKHEAD LATCHES

FUNCTION:
4-GANGED LATCH SYSTEM CONTAINS A GEARBOX POWER DRIVE UNIT (PDU) PROVIDING THE ROTARY MOTION AND DRIVES THE PUSHRODS.

FAILURE MODE:
FAILS FREE

CAUSE(S):
STRUCTURAL FAILURE, SLIPS AT LESS THAN MINIMUM ALLOWABLE TORQUE, FAILURE/ DEFLECTION OF INTERNAL PART, FATIGUE, VIBRATION

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

(A) LOSS OF CAPABILITY TO OPEN OR CLOSE SET OF FOUR LATCHES.

(B,C) LOSS OF MISSION IF PAYLOAD BAY DOORS CANNOT BE OPENED. ENTRY MAY PROCEED WITH ANY ONE OF FOUR BULKHEAD LATCH GANGS DISENGAGED, REF. JSC08934.

(D) POSSIBLE LOSS OF CREW/VEHICLE IF MORE THAN ONE GANG OF BULKHEAD LATCHES FAIL.

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

(A) DESIGN
GEARS ARE DESIGNED WITH HIGH MARGINS. MAXIMUM CALCULATED TOOTH BENDING STRESS APPROXIMATELY 80,000 PSI, ULTIMATE ALLOWABLE 180,000 PSI. ALLOWABLE LIFE OF BALL BEARINGS EXCEEDS REQUIRED LIFE BY FACTOR OF 17. GEARBOX IS DESIGNED TO PRECLUDE ENTRY OF FOREIGN MATERIALS THAT CAN JAM THE GEARS. DESIGN OF THE ACTUATION SYSTEM PERMITS PARTIAL WORKAROUND OF THIS FAILURE MODE BY EXTRAVEHICULAR ACTIVITY (EVA) CREW IF PAYLOAD DOES NOT LIMIT ACCESS.

(B) TEST

QUALIFICATION TESTS: THE QUALIFICATION ACTUATOR IS CERTIFIED PER CR-29-287-0039-0001D. QUALIFICATION TESTS INCLUDE: HUMIDITY TESTS - (PER MIL-STD-810B METHOD 507 PROCEDURE IV, CYCLE ACTUATOR DURING SECOND AND FOURTH HUMIDITY CYCLE); QUAL-ACCEPTANCE VIBRATION TEST (QAVT) - 20 TO 2,000 HZ RANGE WITH MAX, OF 0.067 g^2/HZ FOR 2 1/2 MINS/AXIS IN ACCORDANCE WITH SP-T-0023B; ELECTRICAL CIRCUITS - MONITORED FOR CONTINUITY DURING VIBRATION AND ACTUATOR CYCLED BEFORE AND AFTER VIBRATION TEST; FLIGHT VIBRATION TESTS - 20 TO 2,000 HZ RANGE WITH MAX OF 0.75 g^2/HZ FOR 51 MINS/AXIS LEVEL A AND 0.2 g^2/HZ FOR 27 MINS/AXIS-LEVEL B; THERMAL VACUUM TESTS - THERMALLY CYCLED 5 TIMES BETWEEN -167 DEG F AND +250 DEG F AT A VACUUM OF 1 X 10 -6 TORR; ACTUATOR CYCLED AT EACH -100 DEG F AND +250 DEG F; THERMAL CYCLING TEST - CYCLED 5 TIMES BETWEEN -167 DEG F AND +330 DEG F WITH ACTUATOR CYCLED AT EACH -100 DEG F MINIMUM HEAT DISSIPATING MODE AND +250 DEG F AT MAXIMUM HEAT DISSIPATING MODE WITH AT LEAST 60 MINUTES DWELL AT EACH TEMPERATURE EXTREME.

QUAL TESTS ALSO INCLUDE: SHOCK TEST - BASIC DESIGN SHOCK PER MIL-STD-810B METHOD 516.1 PROCEDURE I AND TRANSIENT SHOCK AT 5-35 HZ +/-0.25 g PEAK; OPERATING LIFE TEST - ACTUATOR CYCLED 1,500 TIMES AT ROOM TEMP, INCLUDES MOTOR #1 AND #2 CYCLED 250 TIME EACH INDIVIDUALLY WITHIN 60 SECONDS/STROKE AND 1,000 TIMES WITH BOTH MOTORS DRIVING TOGETHER WITHIN 30 SECONDS/STROKE; MECHANICAL STOP TEST - 100 TIMES WITH BOTH MOTORS INTO HARD STOP IN EACH DIRECTION AT NO LOADS. POWER CONSUMPTION TEST, IRREVERSIBILITY TEST FREEPLAY TESTS WERE CONDUCTED AS DEFINED IN THIS ACCEPTANCE TESTS. CERTIFICATION BY ANALYSIS/SIMILARITY INCLUDED FUNGUS, OZONE, ACCELERATION, TRANSPORTATION-PACKAGING, SAND/DUST, SALT SPRAY, LANDING SHOCK, AND EXPLOSIVE ATMOSPHERE. THE ACTUATORS WERE, SUBJECTED TO SYSTEM QUALIFICATION TESTS FOR FORWARD LATCH MECHANISM INSTALLATION V070-594160 (REF. CR-29-594160-001D) AND AFT LATCH MECHANISM INSTALLATION V070-594260 (REF. CR-29-594260-001E).

ACCEPTANCE TESTS: INCLUDES EXAMINATION OF PRODUCT (FOR WEIGHT, WORKMANSHIP, DIMENSIONS, CONSTRUCTION, CLEANLINESS, FINISH, IDENTIFICATION MARKING; TRACEABILITY, USE OF CERTIFIED MATERIALS AND PROCESSES); ACCEPTANCE VIBRATION TESTS (AVT) - 20 TO 2,000 HZ RANGE WITH MAX OF 0.04 g^2/HZ FOR 30 SECONDS/AXIS IN ACCORDANCE WITH SP-T-0023 B) ELECTRICAL CIRCUITS MONITORED FOR CONTINUITY DURING VIBRATION TESTS AND ACTUATOR CYCLED BEFORE AND AFTER VIBRATION TESTS; ACCEPTANCE THERMAL TEST (ATT) - THERMALLY CYCLED FROM +70 DEG F TO +310 DEG F TO +250 DEG F TO -147 DEG F TO -100 DEG F TO +310 DEG F TO +250 DEG F TO +70 DEG F WITH CONTINUITY MONITORED THROUGHOUT, THE ACTUATOR WAS CYCLED AT EACH +250 DEG F AND -100 DEG F; POWER CONSUMPTION TEST - SINGLE MOTOR STROKE WITHIN 60 SECONDS, DUAL MOTOR STROKE WITHIN 30 SECONDS; INSULATION RESISTANCE TEST AND INITIAL DIELECTRIC WITHSTANDING VOLTAGE TEST - PER MF0004-002; CYCLING TEST - SINGLE MOTOR, 20 CYCLES EACH AT 60 SEC/STROKE, DUAL MOTOR 80 CYCLES AT 30 SEC/STROKE; FREEPLAY TEST - MAXIMUM OF 0.1 DEGREES WITH 10 INCH-LB REVERSING TORQUE IN EACH DIRECTION; STALL/MAXIMUM TORQUE TEST - TORQUE LIMITER HOLDS AT 14,200 INCH-LB AND SLIPS ABOVE 19,880 INCH-LB); IRREVERSIBILITY TEST - ACTUATOR IS IRREVERSIBLE FROM LATCHING DIRECTION WITH 14,200 INCH-LB LOAD; AND TRAVEL LIMIT TESTS - ACTUATOR STOPPED BY LIMIT SWITCHES AND BY HARD STOPS WITH SWITCHES DEENERGIZED.

OMRSD: GROUND TURNAROUND INCLUDES MONITORING FUNCTIONAL TEST OF DOOR OPERATIONS AND VERIFYING PROPER FUNCTION OF TRANSMISSION.

(C) INSPECTION

RECEIVING INSPECTION
CERTIFICATION OF COMPLIANCE, TEST COUPONS, PHYSICAL AND CHEMICAL RECORDS ARE MAINTAINED IN THE MASTER FILE. RECEIVING INSPECTION PERFORMS VISUAL AND DIMENSIONAL EXAMINATION OF ALL INCOMING PARTS. QUALITY CONTROL MAINTAINS SURVEILLANCE OF RAW MATERIAL, LIMITED LIFE MATERIALS, CHEMICAL AND METALLURGICAL TESTS AND REPORTS. GEARS ARE HARDNESS CHECKED AND VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
POLYETHYLENE SHEETING, USED TO BAG AND SEAL PARTS AFTER CLEANING, IS VERIFIED BY INSPECTION. A CLASS 100,000 CLEAN ROOM FACILITY IS USED FOR ASSEMBLY AND VERIFIED BY INSPECTION. ALL METAL PARTS ARE VERIFIED BY INSPECTION TO BE CLEANED. FINAL INSPECTION INCLUDES CHECKS FOR CONTAMINATION USING BORESCOPES, 5X AND 10X MAGNIFICATION DEVICES, AND FILTRATION METHODS.

ASSEMBLY/INSTALLATION
INSPECTION VERIFIES THAT GEARBOXES ARE PROPERLY LUBRICATED. INSPECTION VERIFIES AND RECORDS DIMENSIONS OF ALL DETAIL PARTS. SPRINGS ARE MANUFACTURED AND CHECKED BY HOOVER SUPPLIERS. CERTIFICATION IS ON FILE.

NONDESTRUCTIVE EVALUATION
ALL DETAIL PARTS TO HOOVER DRAWINGS ARE MAGNETIC PARTICLE INSPECTED PER MIL-I-6868 OR FLUORESCENT PENETRANT INSPECTED PER MIL-I-6866, DEPENDING ON ALLOY.

CRITICAL PROCESSES
HEAT TREATING IS VERIFIED BY INSPECTION.

TESTING
ACCEPTANCE TESTING IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING AND PACKAGING REQUIREMENTS ARE 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
LATCH TOOLS ARE AVAILABLE FOR EVA WORKAROUND EXCEPT IN THE CASE OF CERTAIN PAYLOADS WHICH LIMIT ACCESS.