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.

PRINT DATE: 12/15/88

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

SUMMARY

SUBSYSTEM NAME: PAYLOAD BAY DOOR MECHANISMS
LRU PAYLOAD BAY DOOR C/L ACTUATOR, MC287-0040
LRU PART #: MC287-0040
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	

PRINT DATE: 12/15/88

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

SUBSYSTEM: PAYLOAD BAY DOOR MECHANISMS REVISION: 0 12/15/88 W
LRU PAYLOAD BAY DOOR C/L ACTUATOR
ITEM NAME: GEARBOX PDU CRITICALITY OF THIS FAILURE MODE:1R2

FAILURE MODE:
FAILS FREE (CENTERLINE LATCHES).

MISSION PHASE:
OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA
: 103 DISCOVERY
: 104 ATLANTIS

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

CRITICALITY 1/1 DURING INTACT ABORT ONLY? Y
OO

UNDANCY SCREEN A) PASS
B) PASS
C) PASS

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF CAPABILITY TO OPEN OR CLOSE A GANG OF FOUR LATCHES.

(B) INTERFACING SUBSYSTEM(S):
FUSELAGE STRUCTURAL INTEGRITY IMPAIRED IF MORE THAN ONE GANG OF CENTERLINE LATCHES FAIL TO LATCH. SAFE ENTRY MAY PROCEED WITH ANY GANG OF CENTERLINE LATCHES DISENGAGED, REF JSC08934.

(C) MISSION:
LOSS OF MISSION IF PAYLOAD BAY DOORS CANNOT BE OPENED.

(D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE IF MORE THAN ONE GANG OF CENTERLINE LATCHES FAIL TO LATCH.

(E) FUNCTIONAL CRITICALITY EFFECTS

- DISPOSITION RATIONALE -

(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-29-287-0040-0001H. QUALIFICATION TEST INCLUDES: HUMIDITY TESTS - PER MIL-STD-810B, METHOD 507, PROCEDURE IV, CYCLE ACTUATOR DURING SECOND AND FOURTH HUMIDITY CYCLE. QUALIFICATION ACCEPTANCE VIBRATION TEST (QAVT) - 20 TO 2,000 HZ RANGE WITH MAXIMUM OF 0.067 g2/HZ FOR 2 1/2 MINS/AXIS. 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 MAXIMUM OF 0.75 g2/HZ FOR 51 MINS/AXIS FOR LEVEL "A" AND 0.2 g2/HZ FOR 27 MINS/AXIS FOR 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 TO +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 1. OPERATION LIFE TEST - ACTUATOR CYCLED 1,500 TIMES AT ROOM TEMPERATURE, INCLUDES MOTOR NO. 1 AND NO. 2 CYCLED 250 TIMES EACH INDIVIDUALLY WITHIN 40 SECONDS/STROKE AND 1,000 TIMES WITH BOTH MOTORS DRIVING TOGETHER WITHIN 20 SECONDS/STROKE. MECHANICAL STOP TEST -100 TIMES WITH BOTH MOTORS INTO HARD STOP IN EACH DIRECTION AT NO LOAD. POWER CONSUMPTION TEST - SEE ACCEPTANCE TESTS. IRREVERSIBILITY TEST - SEE ACCEPTANCE TESTS. FREEPLAY TEST - SEE 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 CENTERLINE LATCH MECHANISM INSTALLATION V070-594360 (REF. CR-29-594360-001E).

ACCEPTANCE TESTS: EXAMINATION OF PRODUCTS WEIGHT, WORKMANSHIP, DIMENSIONS, CONSTRUCTION, CLEANLINESS, FINISH, IDENTIFICATION MARKING, TRACEABILITY AND USE OF MATERIALS AND PROCESSES. ACCEPTANCE VIBRATION TEST (AVT) - 20 TO 2,000 HZ RANGE WITH MAXIMUM OF 0.04 g2/HZ FOR 30 SECONDS/AXIS. 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.

ACCEPTANCE TESTS ALSO INCLUDE: POWER CONSUMPTION TEST - SINGLE MOTOR STROKE WITHIN 60 SECONDS, DUAL MOTORS STROKE WITHIN 30 SECONDS. INSULATION RESISTANCE TEST PER MF0004-002. DIELECTRIC STRENGTH TEST - PER MF0004-002. CYCLE TEST - SINGLE MOTOR 20 CYCLES EACH AT 30 SEC/STROKE, DUAL MOTOR 80 CYCLES AT 80 SECONDS/STROKE. FREEPLAY TEST - MAXIMUM OF 0.1 DEGREE WITH 10 INCH-LB REVERING TORQUE IN EACH DIRECTION. STALL/MAXIMUM TORQUE TEST - MAXIMUM OUTPUT NOT TO EXCEED 6,500 INCH-LB OR BE LESS THAN 4,000 INCH-LB. IRREVERSIBILITY TEST - ACTUATOR IS IRREVERSIBLE TO A LOAD OF 4,000 INCH-LB MINIMUM UNDER STATIC CONDITIONS. TRAVEL LIMIT TESTS - ACTUATOR STOPPED BY LIMIT SWITCHES AND BY HARD STOPS WITH SWITCHES AND BY HARD STOPS WITH SWITCHES DEENERGIZED.

OMRSD: GROUND TURNAROUND INCLUDES MONITORING FUNCTIONAL TEST OF DOOR OPERATIONS AND VERIFYING PROPER FUNCTION OF TRANSMISSION. PROPER FUNCTION OF THE COMPONENTS IS VERIFIED PERIODICALLY AS PART OF THE MAINTENANCE SAMPLING PROGRAM.

(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 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 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 MANUFACTURED AND CHECKED BY HOOVER SUPPLIERS. CERTIFICATION IS ON FILE.

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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.

- APPROVALS -

RELIABILITY ENGINEERING	M. B. MOSKOWITZ	
DESIGN ENGINEERING	M. A. ALLEN	
QUALITY ENGINEERING	W. J. SMITH	
NASA RELIABILITY		
NASA SUBSYSTEM MANAGER		
NASA QUALITY ASSURANCE		