

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 02-4B-005-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	:	MOTOR, ACTUATOR DRIVE HOOVER ELECTRIC	40905 15810

QUANTITY OF LIKE ITEMS: 8

DESCRIPTION/FUNCTION:

TO PROVIDE POWER, THROUGH DIFFERENTIAL GEARING FOR TRANSMISSION TO THE POWER DRIVE SHAFT TO LATCH OR UNLATCH THE DOOR.

2 add. bulkhead actuators, these are also on the 02-4B 01

5/1/88

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SUMMARY

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

FMEA NUMBER	ABBREVIATED FAILURE MODE DESCRIPTION	CIL FLG	CRIT	HSD FLG
02-4B-005-01	LOSS OF OUTPUT*		1R3	
02-4B-005-04	FAILS TO ENGAGE*	X	1R1	
02-4B-005-06	FAILS TO ENGAGE*	X	1R3	

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SUBSYSTEM: ACTUATION MECHANISMS - PAYLOAD BAY DOORS  
LRU : PLBD BULKHEAD ACTUATOR  
ITEM NAME: MOTOR, ACTUATOR DRIVE

REVISION: 3 01/01/87

CRITICALITY OF THIS  
FAILURE MODE: 1F3

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- FAILURE MODE:  
BRAKE FAILS TO ENGAGE (BULKHEAD LATCH ACTUATOR)

MISSION PHASE:  
00 ON-ORBIT

- VEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA  
: 103 DISCOVER  
: 104 ATLANTIS

- CAUSE:  
ADVERSE TOLERANCES/WEAR, CONTAMINATION/FOREIGN OBJECT/DEBRIS, DEFECTIVE PART/MATERIAL OR MANUFACTURING DEFECT, FAILURE/DEFLECTION OF INTERNAL PART

- CRITICALITY 1/1 DURING INTACT ABORT ONLY? N
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- REDUNDANCY SCREEN A) PASS
- B) FAIL
- C) PASS

PASS/FAIL RATIONALE:

- A)
- B)  
FAILS REDUNDANCY SCREEN "B" SINCE NORMAL PROCEDURES INCLUDE DUAL MOTOR OPERATION.
- C)

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- FAILURE EFFECTS -

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- (A) SUBSYSTEM:  
LOSS OF BRAKE ON ONE OF TWO MOTORS - NO EFFECT; BULKHEAD LATCH ACTUATOR WILL STOP AFTER POWER IS REMOVED.
- (B) INTERFACING SUBSYSTEM(S):  
SAME AS (A).

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CRITICALITY  
PROGRESSING

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■ (C) MISSION:

IF BOTH A MOTOR AND BRAKE ON THE SAME SHAFT FAIL, THE REMAINING MOTOR WILL BACKDRIVE THROUGH THE FAILED MOTOR AND THE ACTUATOR WILL HAVE NO OUTPUT TORQUE WHICH MAY RESULT IN INABILITY TO UNLATCH A GANG OF BULKHEAD LATCHES RESULTING IN POSSIBLE LOSS OF MISSION.

■ (D) CREW, VEHICLE, AND ELEMENT(S):

IF BOTH A MOTOR AND BRAKE ON THE SAME SHAFT FAIL, THE REMAINING MOTOR WILL BACKDRIVE THROUGH THE FAILED MOTOR AND THE ACTUATOR WILL HAVE NO OUTPUT TORQUE RESULTING IN INABILITY TO LATCH A GANG OF BULKHEAD LATCHES. SAFE ENTRY MAY PROCEED WITH ANY GANG OF BULKHEAD/CENTERLINE LATCHES DISENGAGED, REF JSCB934. POSSIBLE LOSS OF CREW/VEHICLE IF MORE THAN ONE GANG OF BULKHEAD LATCHES FAIL TO LATCH OR IF ONE GANG OF BULKHEAD LATCHES AND ONE GANG OF CENTERLINE LATCHES FAIL TO LATCH.

■ (E) FUNCTIONAL CRITICALITY EFFECTS

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- DISPOSITION RATIONALE -  
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■ (A) DESIGN:

MOTOR IS ENCLOSED TO PREVENT CONTAMINATION, ULTIMATE FACTOR OF SAFETY = 1.4, MATERIALS CHOSEN TO MINIMIZE WEAR AND PREVENT PARTICLE GENERATION. DESIGN OF THE ACTUATION SYSTEM PERMITS PARTIAL WORKAROUND OF SECOND FAILURE BY EXTRAVEHICULAR ACTIVITY (EVA) CREW IF PAYLOAD DOES NOT LIMIT ACCESS. BRAKE DESIGNED TO FAIL IN ENGAGED POSITION.

■ (B) TEST:

QUALIFICATION TESTS: THE QUALIFICATION ACTUATOR IS CERTIFIED PER CR-29-287-0039-00010. QUALIFICATION TESTS INCLUDE: 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 g<sup>2</sup>/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 MAXIMUM OF 0.75 g<sup>2</sup>/HZ FOR 51 MINS/AXIS LEVEL "A" AND 0.2 g<sup>2</sup>/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<sup>-6</sup> 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.

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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-29-594160-0010) 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 MAXIMUM OF 0.04 g<sup>2</sup>/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 TESTS ALSO INCLUDE: 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 SINGLE MOTOR FUNCTIONAL TEST IN BOTH DIRECTIONS TO VERIFY INTEGRITY OF INDIVIDUAL BRAKE OPERATION. SINGLE MOTOR FUNCTIONAL IS VERIFIED TO REQUIRE LESS THAN 60 SECONDS.

■ (C) INSPECTION:

RECEIVING INSPECTION

CERTIFICATION OF COMPLIANCE, TEST COUPONS, PHYSICAL AND CHEMICAL RECORDS ARE VERIFIED BY INSPECTION. RECEIVING INSPECTION PERFORMS VISUAL AND DIMENSIONAL EXAMINATION OF ALL INCOMING PARTS. RECEIVING

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INSPECTION VERIFIES MATERIAL AND PROCESS CERTIFICATIONS.

CONTAMINATION CONTROL

A CLASS 100,000-CLEAN ROOM FACILITY IS USED FOR ASSEMBLY. ALL METAL PARTS ARE VERIFIED BY INSPECTION TO BE CLEANED AND PROPERLY PACKAGED. FINAL INSPECTION INCLUDES CHECKS FOR CONTAMINATION USING BORESCOPES, 5X AND 10X MAGNIFICATION DEVICES, AND MEMBRANE FILTRATION METHODS.

ASSEMBLY/INSTALLATION

INSPECTION VERIFIES AND RECORDS DIMENSIONS OF ALL DETAIL PARTS.

NONDESTRUCTIVE EVALUATION

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

CRITICAL PROCESSES

CRIMPING CONTROLS ARE MAINTAINED IN ACCORDANCE WITH MSC-SPEC-Q-1A VERIFIED BY INSPECTION. SOLDERING IS VERIFIED BY INSPECTION IN ACCORDANCE WITH NHB5300.4(3A).

TESTING

ACCEPTANCE TESTING IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING TO MAINTAIN CLEANLINESS 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:

AFTER MULTIPLE FAILURES LATCH TOOLS ARE AVAILABLE FOR EVA WORKAROUND EXCEPT IN THE CASE OF CERTAIN PAYLOADS WHICH LIMIT ACCESS. ABORT DECISION REQUIRED IF DOOR(S) CAN NOT BE OPENED.

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- APPROVALS -  
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