

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 02-4B-005-X

SUBSYSTEM NAME: PAYLOAD BAY DOOR MECHANISMS

REVISION : 0 12/15/88 W

|     |   | PART NAME<br>VENDOR NAME                         | PART NUMBER<br>VENDOR NUMBER |
|-----|---|--|------------------------------|
| LRU | : | PAYLOAD BAY DOOR C/L ACTUATOR<br>HOOVER ELECTRIC | MC287-0040<br>15810          |
| SRU | : | MOTOR, ACTUATOR DRIVE<br>HOOVER ELECTRIC         | 40905<br>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<br>MODE DESCRIPTION | CIL<br>FLG | CRIT | HSD<br>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  |            |

SHUTTLE CRITICAL ITEMS LIST - ORBITER

NUMBER: 02-4B-005-04

REVISION: 0 12/15/88 W

SUBSYSTEM: PAYLOAD BAY DOOR MECHANISMS  
 LRU PAYLOAD BAY DOOR C/L ACTUATOR  
 ITEM NAME: MOTOR, ACTUATOR DRIVE

CRITICALITY OF THIS  
 FAILURE MODE: 1R3

FAILURE MODE:  
 BRAKE FAILS TO ENGAGE (CENTERLINE)

MISSION PHASE:  
 OO ON-ORBIT

|                                  |       |           |
|----------------------------------|-------|-----------|
| VEHICLE/PAYLOAD/KIT EFFECTIVITY: | 102   | COLUMBIA  |
|                                  | : 103 | DISCOVERY |
|                                  | : 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

REDUNDANCY SCREEN A) PASS  
 B) FAIL  
 C) PASS

PASS/FAIL RATIONALE:

A)  
 B)  
 FAILS REDUNDANCY SCREEN "B" SINCE NORMAL OPERATIONS INCLUDE DUAL MOTOR OPERATION.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:  
 ACTUATOR IS DRIVEN PAST ELECTRICAL LIMIT INTO MECHANICAL STOP.

(B) INTERFACING SUBSYSTEM(S):  
 SMALL INCREASE IN ACTUATOR TRAVEL TRANSFERRED TO LATCH LINKAGE.

(C) MISSION:  
 NO EFFECT. IF BOTH A MOTOR AND BRAKE ON THE SAME SHAFT FAIL THE REMAINING MOTOR WILL BACKDRIVE THROUGH THE FAILED MOTOR AND THE

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ACTUATOR WILL HAVE NO OUTPUT TORQUE RESULTING IN INABILITY TO LATCH A GANG OF CENTERLINE LATCHES. SAFE ENTRY MAY PROCEED WITH ANY GANG OF CENTERLINE LATCHES DISENGAGED, REF JSC08934. POSSIBLE LOSS OF CREW/VEHICLE IF MORE THAN ONE GANG OF CENTERLINE LATCHES FAIL TO LATCH.

(D) CREW, VEHICLE, AND ELEMENT(S):  
SAME AS (C)

## (B) 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 (SEE EFFECTS) 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-29-287-0040-0001H. 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 g<sup>2</sup>/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 g<sup>2</sup>/HZ FOR 51 MINS/AXIS FOR LEVEL "A" AND 0.2 g<sup>2</sup>/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<sup>-6</sup> 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. SHOCK TEST - BASIC DESIGN SHOCK PER MIL-STD-810B, METHOD 516.1, PROCEDURE 1.

QUAL TESTS ALSO INCLUDE: 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).

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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 G<sup>2</sup>/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 SINGLE MOTOR FUNCTIONAL TEST IN BOTH DIRECTIONS TO VERIFY INTEGRITY OF INDIVIDUAL BRAKE OPERATION. SINGLE MOTOR FUNCTIONAL IS VERIFIED TO REQUIRE LESS THAN 40 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 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 HOOVER DRAWINGS ARE MAGNETIC PARTICLE INSPECTED PER MIL-I-6868 OR FLUORESCENT PENETRANT INSPECTED PER MIL-I-6866, DEPENDING ON ALLOY.

## CRITICAL PROCESSES

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CRIMPING CONTROLS ARE MAINTAINED IN ACCORDANCE WITH MSC-SPEC-Q-1A VERIFIED BY INSPECTION. SOLDERING IS VERIFIED BY INSPECTION IN ACCORDANCE WITH NHBS300.4(3A).

TESTING  
ACCEPTANCE TESTING IS VERIFIED BY INSPECTION.

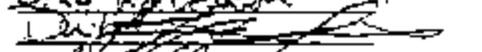
HANDLING/PACKAGING  
HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:  
THERE HAVE BEEN NO ACCEPTANCE TEST, QUALIFICATION TEST, FIELD OR FLIGHT FAILURES ASSOCIATED WITH THIS FAILURE MODE.

(E) OPERATIONAL USE:  
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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RELIABILITY ENGINEERING: M. B. MOSKOWITZ  
DESIGN ENGINEERING : M. A. ALLEN  
QUALITY ENGINEERING : W. J. SMITH  
NASA RELIABILITY :  
NASA SUBSYSTEM MANAGER :  
NASA QUALITY ASSURANCE :

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