PRINT DATE: 12/15/88

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 02-4B-007-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	:	TORQUE LIMITER HOOVER ELECTRIC	41415-2 15810

QUANTITY OF LIKE ITEMS: 4
4 CENTERLINE LATCH
ACTUATORS

DESCRIPTION/FUNCTION:
PROTECTS ACTUATOR MOTORS/GEARS AND LATCH LINKAGE BY SLIPPING WHEN LINKAGE IS STALLED OR JAMMED. PROTECTS LINKAGE UP TO 10 DEGREES FROM ON CENTER POSITION. ACTUATOR OUTPUT TORQUE IS LIMITED TO 4,000 - 6,500 INCH-LB. ONE TORQUE LIMITER IS INCLUDED IN GEAR TRAIN OF EACH ACTUATOR.

Odd bulkhead actuator MC287-0039, is also in the 02-4B-007-X series

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SUMMARY

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

FMEA NUMBER	ABBREVIATED FAILURE MODE DESCRIPTION	CIL FLG	CRIT	HZD FLG
02-4B-007-01	SLIPS AT LESS THAN MINIMUM ALLOWABLE TORQUE*	X	1R2	
02-4B-007-02	~~STRUCTURAL FAILURE~~ Fails to slip at max allowable ~~torque~~	X	1R3	
02-4B-007-03	SLIPS AT LESS THAN MINIMUM ALLOWABLE TORQUE*	X	1R2	
02-4B-007-04	FAILS TO SLIP AT MAX ALLOWABLE TORQUE*	X	1R3	

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SUBSYSTEM: PAYLOAD BAY DOOR MECHANISMS
LRU PAYLOAD BAY DOOR C/L ACTUATOR
ITEM NAME: TORQUE LIMITER

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:
SLIPS AT LESS THAN MINIMUM ALLOWABLE TORQUE (CENTERLINE LATCHES)

MISSION PHASE:
OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

	102	COLUMBIA
:	103	DISCOVERY
:	104	ATLANTIS

CAUSE:
ADVERSE TOLERANCES/WEAR, CHANGE IN MATERIAL PROPERTIES, CONTAMINATION/ FOREIGN OBJECT/DEBRIS, DEFECTIVE PART/MATERIAL OR MANUFACTURING DEFECT, LOSS OF SPRING FORCE, TEMPERATURE.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? Y
OO

REDUNDANCY SCREEN A) FAIL
B) FAIL
C) PASS

PASS/FAIL RATIONALE:
A)
FAILS REDUNDANCY SCREEN "A" SINCE NO TURNAROUND TESTS ARE PERFORMED TO VERIFY THIS FAILURE.

B)
FAILS REDUNDANCY SCREEN "B" SINCE THERE ARE NO MEANS OF VISUALLY DETECTING TORQUE SLIPPAGE IN FLIGHT.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
GANG OF FOUR LATCHES MAY FAIL TO LATCH.

(B) INTERFACING SUBSYSTEM(S):
FUSELAGE STRUCTURAL INTEGRITY IMPAIRED IF MORE THAN ONE GANG OF CENTER-LINE 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:
SPRING LOADED BALL CLUTCH WITH ALUMINUM BRONZE AND STEEL CLUTCH DISKS. NO WEAR IN NORMAL OPERATION OF ACTUATOR. TORQUE LIMITING ONLY REQUIRED IN JAMMED OR OVERLOAD CONDITION OF LINKAGE. DESIGN OF THE ACTUATION SYSTEM PERMITS PARTIAL WORKAROUND OF THIS FAILURE MADE 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 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 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 MAX OF 0.75 g2/HZ FOR 51 MINS/AXIS LEVEL "A" AND 0.2 g2/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. OPERATING LIFE TEST - ACTUATOR CYCLED 1,500 TIMES AT ROOM TEMP, INCLUDES MOTOR #1 AND #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 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 CENTERLINE LATCH MECHANISM INSTALLATION V070-

594360 (REF. CR-29-594360-001E).

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 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 MOTOR STROKE WITHIN 30 SECONDS; INSULATION RESISTANCE TEST AND INITIAL DIELECTRIC STRENGTH TEST - PER MF0004-002; CYCLE TEST - SINGLE MOTOR, 20 CYCLES EACH AT 30 SEC/STROKE, DUAL MOTOR 80 CYCLES AT 80 SEC/STROKE; FREEPLAY TEST - MAXIMUM OF 0.1 DEGREES WITH 10 INCH-LB REVERSING 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 DEENERGIZED.

OMRSD: NONE. ACTUATOR CANNOT BE CHECKED FOR THIS FAILURE MODE DURING SYSTEM FUNCTIONAL CHECK. MAINTENANCE SAMPLING PERIODICALLY VERIFIES TORQUE LIMITER PERFORMANCE.

(C) INSPECTION:
RECEIVING INSPECTION
CERTIFICATION OF COMPLIANCE, TEST COUPONS, PHYSICAL AND CHEMICAL RECORDS ARE MAINTAINED IN THE MASTER FILE. HISTORICAL FOLDERS, WHICH INCLUDE INSPECTION RECORDS, ARE MAINTAINED FOR EVERY DETAIL PART. 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. SPRINGS ARE MANUFACTURED AND CHECKED BY HOOVER SUPPLIERS. CERTIFICATION IS ON FILE.

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 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
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:
CAR NO. AB7957 : PRIOR TO FIRST FLIGHT OF OV102 (STS-1), PAYLOAD BAY DOOR CENTERLINE LATCH ACTUATOR STALLED DURING CLOSING/LATCHING OF DOORS; FAILURE RESULTED FROM LOW STALL TORQUE CAUSED BY FALL OFF IN TORQUE LIMITER SLIP TORQUE RESULTING FROM LACK OF WEAR-IN, MARGINAL LOAD-DEFECTION CHARACTERISTICS OF SPRING WASHERS, ABSENCE OF GREASE ON DISKS, AND REPEATED USE OF MANUAL DRIVE; TORQUE LIMITER SPRING WASHERS WERE CHANGED TO GIVE INCREASED LOAD, TORQUE LIMITER CLUTCH DISKS WERE LUBRICATED WITH BRAYCO GREASE, WEAR-IN CYCLES REQUIRED UNTIL ACTUATOR STALL TORQUE STABILIZED, USE OF MANUAL DRIVE OPERATION PROHIBITED, AND CENTERLINE LATCH ACTUATOR STALL/MAXIMUM OUTPUT TORQUE REQUIREMENT CHANGED FROM 4,000-6,000 INCH-LB TO 4,000-6,500 INCH-LB.

(E) OPERATIONAL USE:
LATCH TOOLS ARE AVAILABLE FOR EVA WORKAROUND EXCEPT IN THE CASE OF CERTIAN PAYLOADS WHICH LIMIT ACCESS. ABORT DECISION REQUIRED IF DOOR(S) CANNOT BE OPENED.

- APPROVALS -

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