

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ACTUATION MECH-ET/ORB DOOR FMEA NO 02-4D-013000-1 REV:02/17/88

ASSEMBLY :ET/ORBITER UMBILICAL DOOR MECHANISMS	CRIT. FUNC:	1
P/N RI :MC287-0041	CRIT. HDW:	1
P/N VENDOR:15690 HOOVER ELECTRIC	VEHICLE	102 103 104
QUANTITY :2 (1 LH2 & 1 LO2)	EFFECTIVITY:	X X X
:(1 PER ACTUATOR)	PHASE(S):	PL LO X OO DO X LS

PREPARED BY:	REDUNDANCY SCREEN:	A-	B-	C-
DES R. H. YEE	APPROVED BY:	APPROVED BY (NASA):		
REL J. S. MULLEN	DES <u>R.H. YEE for Act. O. O. O.</u>	SSM	<u>R.C. M... 2/24/88</u>	
QE W. J. SMITH	REL <u>W.J. Smith</u>	REL	<u>W.J. Smith 2/24/88</u>	
	QE <u>W.J. Smith for R.H. YEE</u>	QE	<u>W.J. Smith 2/24/88</u>	

ITEM:
GEARBOX/DIFFERENTIAL, DOOR "UNLOCK" LATCH ACTUATOR

FUNCTION:
TO TRANSMIT/DISTRIBUTE PROPER POWER/TORQUE FROM EITHER OR BOTH ELECTRIC MOTORS TO THE LATCH MECHANISMS (TO OPEN/CLOSE THE LATCHES).

FAILURE MODE:
PHYSICAL BINDING/JAMMING

CAUSE(S):
CONTAMINATION/FOREIGN OBJECT/DEBRIS, FAILURE/DEFLECTION OF INTERNAL PART
LOSS OF LUBRICANT, TEMPERATURE

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

(A) LOSS OF FUNCTION - DOOR CANNOT BE SECURED IN LATCHED POSITION.

(B) THERMAL LEAKAGE INTO COMPARTMENT.

(C,D) POSSIBLE LOSS OF CREW/VEHICLE DUE TO DAMAGE CAUSED BY THERMAL EFFECTS IF THE DOORS CANNOT BE CLOSED AND FULLY LATCHED FOR SAFE RE-ENTRY.

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DISPOSITION & RATIONALE:

(A) DESIGN (B) TEST (C) INSPECTION (D) FAILURE HISTORY (E) OPERATIONAL USE

(A) DESIGN

EACH ORBITER/ET UMBILICAL DOOR IS PULLED TO A FULLY CLOSED AND LATCHED POSITION BY THREE (3) FOUR-BAR/OVER-CENTER UPLOCK LATCHES DRIVEN BY AN ELECTROMECHANICAL ACTUATOR THROUGH A TORQUE TUBE, BELLCRANKS, AND CONNECTING RODS. EACH LATCH DRIVE ACTUATOR CONSISTS OF A PLANETARY GEARBOX/DIFFERENTIAL DRIVEN BY TWO (REDUNDANT) 3-PHASE ELECTRIC MOTORS; EACH MOTOR HAS AN INTEGRAL SPRING-LOADED FRICTION CLUTCH/BRAKE AND AN INTEGRAL SPRING-LOADED DUAL-DISC PLATE FRICTION TORQUE LIMITER; WITH LIMIT SWITCHES AND MECHANICAL STOPS TO CONTROL/LIMIT ACTUATOR MOVEMENT/ROTATION. THE ACTUATOR HOUSING IS DESIGNED TO PRECLUDE THE ENTRY OF FOREIGN PARTICLES. PARTS ARE CLEANED TO LEVEL 300, PER MA0110-301 (PRIOR TO ASSEMBLY); ASSEMBLED IN A CLASS 100,000 CLEAN ROOM (PER FED-STD-209). DUAL ROTATING SURFACES ON BEARINGS. SAFETY FACTOR 1.4 MINIMUM. PROVISION EXISTS TO CYCLE THE ACTUATOR (TO LOOSEN STALLED/JAMMED MECHANISM). BRAKES MUST BE ELECTRICALLY ENERGIZED TO DISENGAGE AND ARE DESIGNED TO FAIL IN THE ENGAGED POSITION. DIFFERENTIAL IS DESIGNED TO DISTRIBUTE POWER FROM EITHER ONE OR BOTH (REDUNDANT MOTORS). EACH TORQUE LIMITER IS DESIGNED TO PROTECT ITS MOTOR AND DRIVE TRAIN FROM AN OVERLOAD FAILURE. MOTORS DESIGNED TO OPERATE IN EMERGENCY 2-PHASE CONDITION.

(B) TEST

QUALIFICATION TESTS: QUAL-CERTIFIED PER CR-45-287-0041-0001.
QUALIFICATION TESTS INCLUDED: HUMIDITY TEST, SHOCK TEST, QUALIFICATION ACCEPTANCE VIBRATION TESTS (QAVT), THERMAL VACUUM TEST, THERMAL CYCLING TEST, OPERATING LIFE TEST (2,000 CYCLES, 100-MISSION, 10-YEAR LIFE; EXPECT 500 CYCLES PER 100 MISSIONS), MECHANICAL STOP TEST, POWER CONSUMPTION TEST, FREE-PLAY TEST, AND IRREVERSIBILITY TEST.

ACCEPTANCE TESTS: INCLUDES EXAMINATION OF PRODUCT (FOR WEIGHT, DIMENSIONS, CONSTRUCTION, CLEANLINESS AND FINISH), ACCEPTANCE VIBRATION TESTS (AVT) (20-2,000 HZ, 30 SEC TO 5 MINUTES, IN EACH OF THREE ORTHOGONAL AXES, WITH ELECTRICAL CIRCUITS MONITORED FOR CONTINUITY), ACCEPTANCE THERMAL TESTS (ATT) (CYCLED BETWEEN -80 DEG F AND +330 DEG F; MOTOR 1, MOTOR 2 AND DUAL MOTOR), POWER CONSUMPTION TEST (OPERATED AT MAXIMUM LOAD AT -50 DEG F, SINGLE MOTOR DEPLOYED WITHIN 12 SEC, DUAL MOTORS DEPLOYED WITHIN 6 SEC, 210 WATTS/MOTOR MAX, 0.83 AMPS/MOTOR MAX; 616 WATTS/MOTOR MAX STARTING POWER AND 3.5 AMPS/PHASE/MOTOR MAX STARTING CURRENT), INSULATION RESISTANCE TEST AND DIELECTRIC STRENGTH TEST (PER MF0004-002), CYCLING TEST (OPERATED AT RATED LOAD; SINGLE MOTOR, 20 CYCLES EACH FROM CW-CCW-CW ROTATION AT 12 SEC/DIRECTION; DUAL MOTOR, 60 CYCLES FROM CW-CCW-CW ROTATION AT 6 SEC/DIRECTION), FREEPLAY TEST (MAX ANGULAR FREEPLAY AT OUTPUT SHAFT +/-0.25 DEGREES ROTATION, WITH 10 INCH-LB OF REVERSING TORQUE), STALL/MAXIMUM TORQUE TEST (MAX ACTUATOR OUTPUT 6,000 INCH-LB), IRREVERSIBILITY TEST (ACTUATOR MUST BE IRREVERSIBLE TO THE STATIC LIMIT LOAD OF 950 INCH-LB, IN EITHER DIRECTION), MECHANICAL LIMITS TEST AND ELECTRICAL LIMITS TEST (ACTUATOR CYCLED THROUGH ITS FULL TRAVEL TO VERIFY COMPLIANCE WITH MECHANICAL AND ELECTRICAL LIMITS).

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OMRSD: LATCH/RELEASE OPERATIONAL CHECKOUT OF RIGHT-HAND/LEFT-HAND ET
UNLOCK DOOR LATCHES; MOTOR 1, MOTOR 2 AND DUAL MOTOR OPERATION.
FREQUENCY - ALL VEHICLES AT GROUND TURNAROUND.

(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.

CONTAMINATION CONTROL

CLEANING OF ALL METAL PARTS IS VERIFIED BY INSPECTION. FINAL INSPECTION
INCLUDES CHECKS FOR CONTAMINATION, 5X AND 10X MAGNIFICATION DEVICES, AND
MEMBRANE FILTRATION METHODS.

ASSEMBLY/INSTALLATION

INSPECTION VERIFIES AND RECORDS DIMENSIONS OF ALL DETAIL PARTS. BEARINGS
AND GEARBOX LUBRICATION IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

HIGH STRESS PARTS, I.E., OUTPUT SHAFT, GEAR, ETC., ARE MAGNETIC OR
FLUORESCENT PENETRANT INSPECTED.

CRITICAL PROCESSES

HEAT TREATING IS VERIFIED BY INSPECTION.

TESTING

ACCEPTANCE TESTING IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

BAGGING OF PARTS IS 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

CREW WILL CYCLE LATCH TO ATTEMPT TO DISLodge DEBRIS OR LOOSEN
STALLED/JAMMED MECHANISM.