

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ACTUATION MECH-ET/ORB DOOR FMEA NO 02-4D-014000-3 REV:02/17/88

ASSEMBLY :ET/ORBITER UMBILICAL DOOR MECH CRIT. FUNC: 1  
P/N RI :MC147-0013 CRIT. HDW: 1  
P/N VENDOR:15650 HOOVER ELECTRIC VEHICLE 102 103 104  
QUANTITY :2 (1 FORWARD & 1 AFT) EFFECTIVITY: X X X  
:(1 PER ACTUATOR) PHASE(S): PL LO X OO DO X LS

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ITEM:  
GEARBOX/DIFFERENTIAL, CENTERLINE LATCH ACTUATOR

FUNCTION:  
TO TRANSMIT/DISTRIBUTE PROPER POWER/TORQUE FROM EITHER OR BOTH ELECTRIC MOTORS TO THE LATCH MECHANISM.

FAILURE MODE:  
PHYSICAL BINDING/JAMMING

CAUSE(S):  
ADVERSE TOLERANCES/WEAR, 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, DOORS CANNOT CLOSE.  
(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

TWO CENTERLINE LATCHES, DRIVEN BY INDIVIDUAL ELECTROMECHANICAL ACTUATORS, EXTEND AND ROTATE (TO ENGAGE AND HOLD BOTH ORBITER/ET UMBILICAL DOORS FULLY OPEN FOR LIFT-OFF AND ASCENT) AND THEN ROTATE AND RETRACT FLUSH WITH THE OUTER MOLDLINE (OML); TO RELEASE THE DOORS FOR CLOSURE AFTER ORBITER/ET SEPARATION. EACH CENTERLINE LATCH 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; 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). MOTORS DESIGNED TO OPERATE IN EMERGENCY 2-PHASE CONDITION. DESIGN DOES NOT INCORPORATE A TORQUE LIMITER (IN ORDER THAT OUTPUT TORQUE NOT BE MECHANICALLY RESTRICTED).

QUALIFICATION TESTS: QUAL-CERTIFIED PER CR-45-147-0013-0001.

QUALIFICATION TESTS INCLUDED: HUMIDITY TEST, SHOCK TEST, QUALIFICATION ACCEPTANCE VIBRATION TESTS (QAVT), THERMAL VACUUM TEST, THERMAL CYCLING TEST, OPERATING LIFE TEST (2,000 CYCLES AT 65 INCH-LB LOAD, 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 TEST (ATT) (CYCLED BETWEEN -80 DEG F AND +330 DEG F; MOTOR 1, MOTOR 2 AND DUAL MOTOR), POWER CONSUMPTION TEST (OPERATED AT RATED LOAD AT -50 DEG F, SINGLE MOTOR DEPLOYED WITHIN 12 SEC, DUAL MOTORS DEPLOYED WITHIN 6 SEC, 83 WATTS/MOTOR MAX, 0.41 AMPS/PHASE/MOTOR MAX; 160 WATTS/MOTOR MAX STARTING POWER AND 0.83 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 LATCHED-UNLATCHED-LATCHED AT 12 SEC/DIRECTION; DUAL MOTOR, 60 CYCLES FROM LATCHED-UNLATCHED-LATCHED AT 6 SEC/DIRECTION), FREEPLAY TEST (MAX ANGULAR FREEPLAY AT THE OUTPUT GEAR NOT TO EXCEED 1.5 DEGREES ROTATION, WITH 10 INCH-LB OF REVERSING TORQUE), STALL/MAXIMUM TORQUE TEST (MAX ACTUATOR OUTPUT 281 INCH-LB), IRREVERSIBILITY TEST (ACTUATOR MUST BE IRREVERSIBLE TO THE ULTIMATE STATIC LOAD IN EITHER DIRECTION), COAST TEST (OPERATED AT RATED LOAD, MAX OUTPUT GEAR ROTATION AFTER REMOVAL OF ELECTRICAL POWER IS 20 DEGREES) AND MANUAL DRIVE TEST (ACTUATOR MUST BE CAPABLE OF MEETING OUTPUT LOAD/STROKE REQUIREMENTS WITH A MAXIMUM OF 50 TURNS AT THE MANUAL INPUT DRIVE).

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OMRSD: OPERATIONAL CHECKOUT OF ET DOOR CENTERLINE LATCHES (UNLOCK/STOW); MOTOR 1, MOTOR 2 AND DUAL MOTOR OPERATION. FREQUENCY - ALL VEHICLES AT GROUND TURNAROUND.

(C) INSPECTION

RECEIVING INSPECTION

RAW MATERIAL AND PROCESS CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS REQUIREMENTS VERIFIED BY INSPECTION. CONTROLLED ENVIRONMENT VERIFIED BY INSPECTION. CLEANLINESS MAINTAINED PER MA0110-311 VERIFIED BY INSPECTION. CORROSION PROTECTION PER MA0608-301 VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

ASSEMBLY VERIFIED BY INSPECTION. LUBRICANT APPLICATION IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

PENETRANT INSPECTION VERIFIED BY INSPECTION.

CRITICAL PROCESSES

HEAT TREATING OF DETAIL PARTS AND BEARING INSTALLATION VERIFIED BY INSPECTION. RIGGING VERIFIED BY INSPECTION.

TESTING

CHECKOUT OF UNIT VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PARTS PROTECTION AND HANDLING 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

NONE.