

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ACTUATION MECH-ET/ORB DOOR FMEA NO 02-4D-012100-2 REV:02/17/88

ASSEMBLY :ET/ORBITER UMBILICAL DOOR MECHANISMS	CRIT. FUNC:	1
P/N RI :V070-565000	CRIT. HDW:	1
P/N VENDOR:	VEHICLE	102 103 104
QUANTITY :4	EFFECTIVITY:	X X X
:2 LH2 & 2 LO2	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 <i>R.H. Yee for A.C. Ordway</i>	SSM <i>L.C. Minter 2/25/88</i>		
QE W. S. SMITH	REL <i>[Signature]</i>	REL <i>[Signature]</i>		
	QE <i>[Signature]</i>	QE <i>[Signature]</i>		

ITEM:

MULTIPLE LINKAGE ASSEMBLY, DOOR HINGE/DRIVE MECHANISM

FUNCTION:

TO PROVIDE NECESSARY KINEMATIC DOOR MOTION DURING DOOR CLOSE OPERATION AND TO ASSIST IN SECURING OF DOOR.

FAILURE MODE:

PHYSICAL BINDING/JAMMING

CAUSE(S) :

ADVERSE TOLERANCES/WEAR, CONTAMINATION/FOREIGN OBJECT/DEBRIS, DEFECTIVE PART/MATERIAL OR MANUFACTURING DEFECT, VIBRATION

EFFECT(S) ON:

(A)SUBSYSTEM (B)INTERFACES (C)MISSION (D)CREW/VEHICLE

(A) LOSS OF FUNCTION, DOOR CANNOT CLOSE.

(B) THERMAL GRADIENTS 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

THE ORBITER/ET UMBILICAL DOOR MECHANISM IS AN ASSEMBLY OF FOUR-BAR/OVER-CENTER LINKAGES DRIVEN BY AN ELECTROMECHANICAL ACTUATOR THROUGH A TORQUE TUBE, BELLCRANKS AND CONNECTING RODS. MATERIALS USED: A-286 CRES STEEL AND INCONEL 718. CLEANLINESS REQUIREMENTS MAINTAINED PER MA0110-311. SAFETY FACTOR OF 1.4 MINIMUM. DUAL ROTATING SURFACES ON BEARINGS. SPHERICAL BEARINGS USED TO COMPENSATE FOR LINKAGE MISALIGNMENT. "BAGGIE" PRECLUDES ICE FORMATION IN DOOR CAVITY AREA AND LINKAGE.

(B) TEST

ACCEPTANCE TESTS: INSTALLED AND RIGGED PER MLO308-0058. FUNCTIONALLY TESTED DURING RIGGING AT PALMDALE AND FUNCTIONALLY TESTED AT KSC.

QUALIFICATION TESTS: QUAL-CERTIFIED PER CR-49-565000-001, AS PART OF THE QUALIFICATION OF THE ORBITER/ET UMBILICAL CLOSEOUT DOOR MECHANISM SUBSYSTEM. CERTIFICATION BY ANALYSIS INCLUDED: PRESSURE ENVIRONMENT, FUNGUS, HUMIDITY, OZONE, RAIN, SALT SPRAY, SAND/DUST, SHOCK, ACCELERATION, THERMAL VACUUM AND MARGIN OF SAFETY. CERTIFICATION TESTS INCLUDED: STATIC TESTS (WITH LIMIT LOADING ON AN OPEN AND CLOSED DOOR; SIMULATING LIFT-OFF AND RE-ENTRY CONDITIONS), AERO-ACOUSTIC VIBRATION (SIMULATING 400 MISSION CAPABILITY AT 16-8,000 HZ), TEMPERATURE TEST (DOOR AND LATCHES CYCLED FROM OPEN/LATCHED TO CLOSED/LATCHED TO OPEN/LATCHED; 2 TIMES AT +960 +/- 20 DEG F) AND OPERATIONAL-LIFE CYCLE TEST (1,000 CYCLES; DOOR CYCLED OPEN-CLOSE-OPEN; CENTERLINE AND DOOR LATCHES CYCLED FULL EXTENSION-RETRACTION; EXPECT 500 CYCLES PER 100-MISSIONS). BOTH LATCH AND DOOR DRIVE MECHANISMS WERE CYCLED SEVERAL TIMES (DURING AN "OFF-LIMITS BAGGIE TEST") WHILE UTILIZING 0.02 INCH THICK POLYETHYLENE CLEAR PLASTIC - TO SIMULATE JAMMING CONDITIONS. THE BAGGIE PREVENTS ICE FORMATION IN THE ET UMBILICAL CAVITY.

OMRSD: OPEN/CLOSE (1-"G") OPERATIONAL CHECKOUT OF RIGHT-HAND/LEFT-HAND ET DOORS; 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

ASSEMBLED IN A CONTROLLED ENVIRONMENT PER APPLICABLE SPECIFICATION, INSPECTION MONITORS AREA FOR COMPLIANCE TO SPECIFICATION. CLEANLINESS REQUIREMENTS MAINTAINED PER MA0110-311 VERIFIED BY INSPECTION. "BAGGIE" APPLICATION TO PRECLUDE ICE FORMATION IN DOOR CAVITY AREA AND LINKAGE VERIFIED BY INSPECTION. CORROSION PROTECTION PER MA0608-301 VERIFIED BY INSPECTION.

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ASSEMBLY/INSTALLATION

ASSEMBLED PER DETAILED PLANNING INSTRUCTIONS. SAFETY WIRE AND COTTER PINS UTILIZED TO SECURE HARDWARE ARE VERIFIED BY INSPECTION. INSTALLATION WITNESSED AND VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

PENETRANT INSPECTION VERIFIED BY INSPECTION.

CRITICAL PROCESSES

HEAT TREATING AND INSTALLATION OF THREADED FASTENERS PER APPLICABLE SPECIFICATIONS VERIFIED BY INSPECTION.

TESTING

FUNCTIONAL CHECKOUT WITNESSED AND VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING AND PROTECTION VERIFIED BY INSPECTION. 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

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