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FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE

NUMBER: 01-5B-380120-X

SUBSYSTEM NAME: PURGE, VENT, & DRAIN - ACTRS

REVISION: 1

06/02/94

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	MECH ASSY (DOOR LINKAGE)	V070-594571

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

MECHANICAL (DOOR LINKAGE) ASSEMBLY, VENTS 3, 5 OR 6 (PAYLOAD BAY)

QUANTITY OF LIKE ITEMS: 6

(3 RH & 3 LH)

(1 PER VENT DOOR)

FUNCTION:

CONVERTS ROTARY MOTION FROM THE DOOR DRIVE ACTUATOR TO THE NECESSARY KINEMATIC MOTION TO OPEN/CLOSE THE VENT DOOR AND TO HOLD IT IN POSITION.

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NUMBER: 01-5B-380120-01**

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LRU: MECH ASSY (DOOR LINKAGE)
ITEM NAME: MECH ASSY (DOOR LINKAGE)

REVISION# 1 06/02/94

CRITICALITY OF THIS
FAILURE MODE: 1R2

FAILURE MODE:
PHYSICAL BINDING/JAMMING

MISSION PHASE:
DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

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

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) PASS
B) FAIL
C) PASS

PASS/FAIL RATIONALE:
A)

B)
FAILS SCREEN "B" BECAUSE THERE IS NO DETECTION DEVICE TO INDICATE FAILURE
DURING FLIGHT.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF ABILITY TO CONTROL VENT DOOR POSITION.

(B) INTERFACING SUBSYSTEM(S):
NO EFFECT FIRST FAILURE

(C) MISSION:
NO EFFECT FIRST FAILURE

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT FIRST FAILURE

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(E) FUNCTIONAL CRITICALITY EFFECTS:

POSSIBLE LOSS OF CREW/VEHICLE AFTER TWO FAILURES (PHYSICAL BINDING/JAMMING OF THE MECHANICAL ASSEMBLY AND OPPOSITE VENT DOOR FAILS CLOSED) DUE TO LOSS OF VENTING CAPABILITY WHICH CAN RESULT IN STRUCTURAL OVERLOAD DUE TO PRESSURE DIFFERENTIAL ON ENTRY. LOCALIZED THERMAL DAMAGE ONLY, IF A DOOR IS FAILED OPEN ON ENTRY; THERMAL ANALYSIS (SAS-TA-RCC-78-152, -79-012 AND 79-065) SHOWS THAT CREW AND VEHICLE WILL SURVIVE.

-DISPOSITION RATIONALE-

(A) DESIGN:

THE VENT DOOR MECHANISMS ARE DESIGNED TO OPEN OR CLOSE (AS NEEDED) AND HOLD IN PLACE EACH OF THE VENT DOORS INTO THE ORBITER FUSELAGE/CAVITIES; TO REGULATE INTERNAL PRESSURE AND AIR (DURING PRE-FLIGHT, ASCENT, ORBIT AND DESCENT). THE VENT DOORS ARE OPENED OR CLOSED BY ELECTROMECHANICAL ACTUATORS CONNECTED TO TORQUE TUBES, BELLCRANKS AND ADJUSTABLE CONNECTING-RODS; THAT, IN COMBINATION WITH THE VENT DOORS, FORM A FOUR-BAR/OVER-CENTER HINGE/ACTUATION LINKAGE. MECHANICAL CONFIGURATION IS ENCLOSED AND DESIGNED TO PRECLUDE JAMMING DURING A CRITICAL FAILURE MODE (DOOR CLOSED). FACTOR OF SAFETY 1.4 MINIMUM. DUAL ROTATING SURFACES ON ALL BEARINGS AND ON ALL SPHERICAL BEARINGS THAT ARE USED TO COMPENSATE FOR LINKAGE MISALIGNMENT. PRINCIPLE MATERIALS USED: A-286 CRES, 2024-T851 AND 2124-T851 ALUMINUM (FOR HIGH STRENGTH/WEIGHT RATIO AND FATIGUE RESISTANCE). CLEANLINESS MAINTAINED PER MA0110-311 DURING INSTALLATION AND RIGGING.

(B) TEST:

QUALIFICATION TESTS: QUAL-CERTIFIED PER CR-28-594571-001. AS PART OF THE QUALIFICATION OF THE PLB VENT DOOR MECHANISM. CERTIFICATION BY ANALYSIS INCLUDED: FACTOR OF SAFETY/MARGIN OF SAFETY (OUTLINED IN REPORT SD77-SH-0178, SECTION 11.17), THERMAL VACUUM (NO MATERIALS ARE USED THAT WOULD BE ADVERSELY AFFECTED BY A PRESSURE OF 0.000001 TORR), FUNGUS AND OZONE (NO FUNGUS/OZONE SUSCEPTIBLE MATERIALS ARE USED), SALT FOG/SAND & DUST (MECHANISM IS WITHIN AN ENCLOSED AREA OF THE VEHICLE; TESTING IS NOT REQUIRED; WHEN THE DOORS ARE OPEN IN A SALT FOG/SAND & DUST ENVIRONMENT, THEY ARE IN THE PURGE POSITION, WITH THE ORBITER BEING PURGED); LANDING SHOCK (1.5 G'S MAX) DESIGN SHOCK (20 G'S), AND ACCELERATION (\pm 5 G'S) ARE ALL MINIMAL WHEN COMPARED TO THE MECHANISM DESIGN LOADS. CERTIFICATION BY ANALYSIS/SIMILARITY TO THE AFT FUSELAGE VENT DOOR MECHANISM (CR-28-595591-001) BECAUSE THE BEARINGS, ROD ENDS, MATERIALS AND PROCESSES ARE IDENTICAL. TESTS INCLUDED: TEMPERATURE CYCLE (MECHANISM MUST FUNCTION BETWEEN -100 F AND + 350 DEG F), HUMIDITY (UP TO 100% PER MIL-STD-810C, METHOD 507, PROCEDURE IV), VIBRATION (16-8,000 HZ FOR 1,740 SECONDS AND 4,000 SECONDS) AND OPERATING LIFE (2,000 CYCLES OF OPENING/CLOSING UNDER MAXIMUM LOAD).

ACCEPTANCE TESTS: INSTALLED AND RIGGED PER ML0308-0015. FUNCTIONALLY TESTED DURING RIGGING AT PALMDALE AND FUNCTIONALLY TESTED AT KSC.

GROUND TURNAROUND TEST:

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

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RECEIVING INSPECTION
MATERIAL AND PROCESS CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
CLEANLINESS TO LEVEL GC PER MA0110-301 IS VERIFIED BY INSPECTION. CORROSION PROTECTION PER MA0608-301 IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
VERIFICATION OF PREVIOUS INSPECTION OF DETAIL COMPONENTS AND ASSEMBLIES. INSPECTION VERIFICATION OF HARDWARE INSTALLATION, RIGGING, ALIGNMENT PER PLANNING DOCUMENT AND DRAWING/SPECIFICATION.

NONDESTRUCTIVE EVALUATION
PENETRANT INSPECTION IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES
ELECTRICAL BOND AND TEST ARE VERIFIED BY INSPECTION.

TESTING
ATP IS VERIFIED BY INSPECTION.

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

(D) FAILURE HISTORY:
CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATABASE.

(E) OPERATIONAL USE:
THE GROUND CREW MAY USE REAL TIME COMMANDS (RTC) TO CYCLE THE VENT DOOR (TO ATTEMPT TO DISLodge DEBRIS OR LOOSEN A STALLED/JAMMED MECHANISM), DEPENDING ON THE FAILURE MODE (OPEN, CLOSED) AND MISSION PHASE REQUIREMENT. RTC CAPABILITY IS ONLY AVAILABLE ON ORBIT AND POST-LANDING (OPERATIONS SEQUENCE 2 AND 9). THE SPEC 51 OVERRIDE PROVIDES LIMITED COMMAND CAPABILITY TO FLIGHT CREW TO OPEN OR CLOSE THE VENT DOORS IN OPS 3 TO OPEN.

- APPROVALS -

PAE MANAGER : K. L. PRESTON
PRODUCT ASSURANCE ENG. : T. AI
DESIGN ENGINEERING : A. P. YSON
NASA SSMA :
NASA SUBSYSTEM MANAGER :

Stallion 6/8/94
Sumlin
Doc Som 6/1/94
W.H. Kibbe 7/6/94
P.E. Davis 7/6/94