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PRINT DATE: 06/07/94

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE

NUMBER: 01-5B-380129-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)	V070-595501

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
MECHANISM (DOOR LINKAGE) ASSEMBLY, VENTS 8 AND 9 (AFT FUSELAGE)

QUANTITY OF LIKE ITEMS: 2
(1 RH AND 1 LH)
(ONE PER TWO VENT DOORS)

FUNCTION:
CONVERTS ROTATORY MOTION FROM THE DOOR DRIVE ACTUATOR TO THE NECESSARY KINEMATIC MOTION TO OPEN/CLOSE THE VENT DOORS AND TO HOLD THEM IN POSITION.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE
NUMBER: 01-5B-380129-01**

SUBSYSTEM NAME: PURGE, VENT, & DRAIN - ACTRS
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 POSITION OF VENT DOORS .

(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-28-595501-001) AS PART OF THE SUBSYSTEM CERTIFICATION OF THE AFT FUSELAGE VENT DOOR MECHANISMS. QUALIFICATION TESTS INCLUDE: ELECTRICAL BOND TEST (ELECTRICAL BONDING PER MF0004-002, CLASS R OF MIL-B-5087; WITH RESISTANCE NOT TO EXCEED 0.0025 OHMS BETWEEN STRUCTURAL COMPONENTS), HUMIDITY TEST (PER MIL-STD-810, METHOD 507, PROCEDURE 1V), ACOUSTIC VIBRATION TEST (QAVT) (25-8,000 HZ; SIMULATING LIFT-OFF FOR 34 MINUTES AND AERODYNAMIC LOADING FOR 30 MINUTES), TEMPERATURE CYCLE TEST (MECHANISM THERMALLY CYCLED 5 TIMES UNDER LIMIT LOAD, WITH TEMPERATURES BETWEEN -100 DEG F AND +350 DEG F), OPERATING LIFE CYCLE TEST (CYCLED OVER 2,000 TIMES AT ROOM TEMP; INCLUDES 1,800 CYCLES, FROM CLOSE-OPEN-CLOSE, DUAL MOTOR; AND INCLUDES 100 CYCLES, FROM CLOSE-OPEN-INTERMEDIATE-CLOSE, DUAL MOTOR; AND INCLUDES 200 CYCLES, FROM CLOSE-OPEN-CLOSE, SINGLE MOTOR 1 AND 2) AND EXTREME TEMPERATURE TEST (MECHANISM CYCLED 5 TIMES AT -150 DEG F, WITH CLOSING TORQUE AND LOADS MEASURED). CERTIFICATION BY ANALYSIS INCLUDED: FACTOR OF SAFETY/MARGIN OF SAFETY, FUNGUS, OZONE, SALT SPRAY, SAND/DUST, LANDING SHOCK AND LAUNCH ACCELERATION.

ACCEPTANCE TESTS: INSTALLED AND RIGGED PER ML0308-0017. FUNCTIONALLY TESTED DURING RIGGING AT PALMDALE AND FUNCTIONALLY TESTED AT KSC.

GROUND TURNAROUND TEST:

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

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(C) INSPECTION:

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 ARE 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	:	

:	<i>Hell</i>	<i>6/8/94</i>
:	<i>Sum</i>	
:	<i>For</i>	<i>6/2/94</i>
:	<i>DR</i>	<i>7/6/94</i>
:	<i>R.E. Davis</i>	<i>7/5/94</i>