PRINT DATE: 03/31/94

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL HARDWARE
NUMBER: 01-5B-380118-X

SUBSYSTEM NAME: PURGE, VENT, & DRAIN - ACTRS

REVISION: 1 03/30/94

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:	PUSH/PULL ROD ASSEMBLY	V070-594575

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
PUSH/PULL ROD ASSEMBLY (DOOR LINKAGE), VENTS 3, 5 OR 6 (PLB)

QUANTITY OF LIKE ITEMS: 6
(3 RH & 3 LH)
(1 PER VENT DOOR)

FUNCTION:
THIS ITEM ACTS TO TRANSFER FORCE AND MOTION FROM THE BELLCRANK TO THE VENT DOOR ASSEMBLY.

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FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE
NUMBER: 01-5B-380118-01

REVISION# 1 03/30/94

SUBSYSTEM NAME: PURGE, VENT, & DRAIN - ACTRS
LRU: PUSH/PULL ROD ASSEMBLY
ITEM NAME: PUSH/PULL ROD ASSEMBLY

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:
STRUCTURAL FAILURE

MISSION PHASE:
DO DE-ORBIT

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

CAUSE:
CORROSION, DEFECTIVE PART/MATERIAL OR MANUFACTURING DEFECT, EXCESSIVE LOAD, FAILURE/DEFLECTION OF INTERNAL PART, FATIGUE

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

(E) FUNCTIONAL CRITICALITY EFFECTS:

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POSSIBLE LOSS OF CREW/VEHICLE AFTER TWO FAILURES (FAILURE OF THE PUSH/PULL ROD 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.

THE PUSH/PULL CONNECTING-RODS (TURN-BUCKLES) JOIN THE BELLCRANKS TO THE VENT DOORS AND ARE ADJUSTABLE TO ALLOW PROPER RIGGING AND INSTALLATION OF THE DOORS. THE RODS ARE DESIGNED WITH A FACTOR OF SAFETY OF 1.4 AND HAVE A POSITIVE MARGIN OF SAFETY (GREATER THAN 0.06, WHEN SUBJECTED TO ULTIMATE LOADS) AND ARE MADE FROM A-286 CRES; WHICH IS ACCEPTABLE, AS INSTALLED, TO MEET STRESS GALVANIC CORROSION STANDARDS. DUAL ROTATING SURFACES ON ALL BEARINGS. SPHERICAL BEARINGS ARE USED TO COMPENSATE FOR LINKAGE MISALIGNMENT.

(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 (+/- 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.

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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 IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
INSPECTION VERIFICATION OF DETAIL COMPONENTS FABRICATED BY DRAWING AND MACHINING SPECIFICATIONS.

NONDESTRUCTIVE EVALUATION
PENETRANT INSPECTION PERFORMED AFTER MACHINING COMPLETE IN ORDER TO DETECT FLAWS IN MATERIAL AND MACHINING OPERATIONS.

CRITICAL PROCESSES
PASSIVATION PER MA0110-302 IS 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:
NONE.

- APPROVALS -

PAE MANAGER	: K. L. PRESTON	: K. L. Preston 4/6/94
PRODUCT ASSURANCE ENG.	: T. AI	: [illegible]
DESIGN ENGINEERING	: A. P. YSON	: [illegible] 4/15/94
NASA SSMA	:	: [illegible] 7/6/94
NASA SUBSYSTEM MANAGER	:	: [illegible] 7/6/94