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PRINT DATE: 03/31/94

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE  
NUMBER: 01-5B-380126-X**

**SUBSYSTEM NAME: PURGE, VENT, & DRAIN - ACTRS**

**REVISION: 1 03/30/94**

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	<b>PART NAME VENDOR NAME</b>	<b>PART NUMBER VENDOR NUMBER</b>
LRU	: PUSH/PULL ROD ASSEMBLY	V070-595512

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**PART DATA**

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
PUSH/PULL ROD ASSEMBLY (DOOR LINKAGE), VENTS 8 AND 9 (AFT)

**QUANTITY OF LIKE ITEMS: 4**  
(2 RH & 2 LH)  
1 PER VENT DOOR

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

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE  
NUMBER: 01-5B-380126-01**

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

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE  
NUMBER: 01-5B-380128-01**

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

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.

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**-DISPOSITION RATIONALE-**

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**(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-28-595501-001) 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 IS VERIFIED BY INSPECTION.

**ASSEMBLY/INSTALLATION**

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

**NONDESTRUCTIVE EVALUATION**

PENETRANT INSPECTION PERFORMED AFTER MACHINE 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 -**

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

:	<i>K.L. Preston</i>	<i>4/6/94</i>
:	<i>T. AI</i>	
:	<i>AP Yson</i>	<i>4/5/94</i>
:	<i>W.R. Kelle</i>	<i>7/6/94</i>
:	<i>R. Edwards</i>	<i>7/9/94</i>