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PRINT DATE: 03/31/94

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE
NUMBER: 01-5B-380127-X**

SUBSYSTEM NAME: PURGE, VENT, & DRAIN - ACTRS

REVISION: 1 03/30/94

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: TORQUE TUBE/BELLCRANK	V070-595531
LRU	: TORQUE TUBE/BELLCRANK	V070-595534

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
TORQUE TUBE/BELLCRANK, (DOOR LINKAGE), VENTS 8 AND 9 (AFT FUSELAGE)

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

FUNCTION:
THIS ITEM (AN INTEGRAL TORQUE TUBE/BELLCRANK) ACTS TO TRANSFER TORQUE FROM THE ACTUATOR, TO THE CONNECTING-ROD, AND THEN TO THE DOOR ASSEMBLY; FOR OPENING AND CLOSING EACH OF THE VENT DOORS.

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE

NUMBER: 01-5B-380127-01

REVISION# 1 03/30/94

SUBSYSTEM NAME: PURGE, VENT, & DRAIN - ACTRS

LRU: TORQUE TUBE/ BELLCRANK

ITEM NAME: TORQUE TUBE/ BELLCRANK

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
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(E) FUNCTIONAL CRITICALITY EFFECTS:

POSSIBLE LOSS OF CREW/VEHICLE AFTER TWO FAILURES (FAILURE OF THE BELLCRANK 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 INTEGRAL TORQUE TUBE/BELLCRANKS ARE DESIGNED WITH A FACTOR OF SAFETY OF 1.4 MINIMUM, BUT HAVE A POSITIVE MARGIN OF SAFETY (GREATER THAN 0.01 WHEN SUBJECTED TO ULTIMATE LOADS). MATERIAL: 2124-T851 ALUMINUM WAS CHOSEN FOR ITS HIGH STRENGTH /WEIGHT RATIO, TOUGHNESS AND FATIGUE RESISTANCE; ITS GOOD RESISTANCE TO STRESS AND GALVANIC CORROSION; AND ITS SERVICE TEMPERATURE RANGE OF -320 DEG F TO +350 DEG F.

(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.

(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. INTERIOR AND EXTERIOR CORROSION PROTECTION PER MA0608-301 ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
MATERIAL ISSUED FOR FABRICATION IS VERIFIED BY INSPECTION. MANUFACTURING PROCESSES, INCLUDING PARTS PROTECTION ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
PENETRANT INSPECTION IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES
DRY FILM LUBRICATION 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
PRODUCT ASSURANCE ENG. : T. AI
DESIGN ENGINEERING : A. P. YSON
NASA SSMA :
NASA SUBSYSTEM MANAGER :

K.L. Preston

T. AI

PAE Yson 4/17/94

W.D. Moore 7/6/94

R.E. Drexler 7/6/94
