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FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE

NUMBER: 01-5B-380106-X

SUBSYSTEM NAME: PURGE, VENT, & DRAIN - ATCRS

REVISION: 1

03/30/94

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: TORQUE TUBE/BELLCRANK	V070-592503
LRU	: TORQUE TUBE/BELLCRANK	V070-592508
LRU	: TORQUE TUBE/BELLCRANK	V070-592513

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
TORQUE TUBE/BELLCRANK (DOOR LINKAGE), VENTS 1 AND 2 (RCS & FWD)

QUANTITY OF LIKE ITEMS: 4
(2 RH & 2 LH)
(SHOWN & OPPOSITE)
(1 PER VENT DOOR)
(VD1/VD1/VD2)

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.

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POSSIBLE LOSS OF CREW/VEHICLE AFTER TWO FAILURES (FAILURE OF THE TORQUE TUBE/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 MECHANISM IS 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 TUBE/BELLCRANKS AND ADJUSTABLE CONNECTING-RODS; THAT, IN COMBINATION WITH THE VENT DOORS, FORM A FOUR-BAR/OVER-CENTER HINGE/ACTUATION LINKAGE.

THE INTEGRAL TORQUE /BELLCRANKS ARE DESIGNED WITH A FACTOR OF SAFETY OF 1.4 MINIMUM, BUT HAVE A POSITIVE MARGIN OF SAFETY (GREATER THAN 0.12 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-28-592501-001. AS PART OF THE QUALIFICATION OF THE FWD VENT DOOR MECHANISM. CERTIFICATION BY ANALYSIS INCLUDED: FACTOR OF SAFETY (OUTLINED IN REPORT SD77-SH-0178, SECTION 11.17), 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-28-595501-001) BECAUSE THE BEARINGS, ROD-ENDS, MATERIALS AND PROCESSES ARE IDENTICAL. TESTS INCLUDED: TEMPERATURE CYCLE (MECHANISM MUST FUNCTION BETWEEN -100 DEG 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 ML0308-0013. 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:

RECEIVING INSPECTION

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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 FABRICATION OF TORQUE TUBE TO MACHINING
SPECIFICATIONS AND CLOSE TOLERANCE SPECIFIED ON DRAWING. SPECIAL
ATTENTION TAKEN FOR MACHINING OF SPLINES FOR ACCURACY OF TIP CHAMFER,
END CHAMFER RADIUS, SURFACE FINISH AND ROOT PER DRAWING NOTE.

NONDESTRUCTIVE EVALUATION
PENETRANT INSPECTION VERIFICATION OF PART AFTER MACHINING.

CRITICAL PROCESSES
DRY FILM LUBRICATION AND ANODIZING ARE VERIFIED BY INSPECTION.

TESTING
ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING AND PACKAGING REQUIREMENT 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. Presto 4/6/94
T. AI
A.P. Yson 4/5/94
W.H. Helbre 7/6/94
R.E. Jones 7/6/94