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PRINT DATE: 10/22/92

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE
NUMBER: M7-3A-E3C-X

SUBSYSTEM NAME: TUNNEL ADAPTER - ECLSS

REVISION : 1 10/22/92

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■ LRU :	GAUGE, DELTA-P	MC250-0004-0007
■	CARLETON TECHNOLOGIES	2767-0001-1

PART DATA

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
| DIFFERENTIAL PRESSURE GAUGE, TUNNEL ADAPTER / SPACELAB HATCH "D"

| ■ QUANTITY OF LIKE ITEMS: 2

■ FUNCTION:
PROVIDES STATUS OF HATCH "D" DIFFERENTIAL PRESSURE BETWEEN THE TUNNEL
ADAPTER AND SPACELAB SO THAT CREW CAN ASCERTAIN CONDITIONS BEFORE
OPENING THE HATCH. GAUGE MEASURES DELTA PRESSURE BETWEEN PLUS 20 AND
MINUS 20 PSID.

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NUMBER: M7-3A-E3C-02

SUBSYSTEM: TUNNEL ADAPTER - ECLSS
LRU :GAUGE, DELTA-P
ITEM NAME: GAUGE, DELTA-P

REVISION# 1 10/22/92 R

CRITICALITY OF THIS
FAILURE MODE:1R2

■ FAILURE MODE:
EXTERNAL AND INTERNAL LEAKAGE

MISSION PHASE:
00 ON-ORBIT

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

■ CAUSE:
MECHANICAL SHOCK, VIBRATION, CORROSION, POROSITY

■ CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

■ REDUNDANCY SCREEN A) PASS
 ■ B) PASS
 ■ C) PASS

PASS/FAIL RATIONALE:

- A)
- B)
- C)

- FAILURE EFFECTS -

- (A) SUBSYSTEM:
INABILITY TO ISOLATE THE SPACELAB FROM TUNNEL ADAPTER ENVIRONMENT.
- (B) INTERFACING SUBSYSTEM(S):
POSSIBLE EXCESSIVE LOSS OF CONSUMABLES IF EVA IS CONDUCTED.
- (C) MISSION:
POSSIBLE EARLY MISSION TERMINATION DUE TO EXCESSIVE LOSS OF CONSUMABLES.

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- (D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT.

- (E) FUNCTIONAL CRITICALITY EFFECTS:
SECOND ASSOCIATED FAILURE (LEAKAGE OF OTHER DELTA PRESSURE GAUGE) CAN CAUSE LOSS OF EVA CREW IF CONTINGENCY EVA IS REQUIRED AND TUNNEL ADAPTER CANNOT BE REPRESSURIZED FOR RETURN TO CABIN.

- DISPOSITION RATIONALE -

- (A) DESIGN:

THE PRESSURE GAUGE CONSISTS OF A BOURDON TUBE, LINKAGE ASSEMBLY, AND INDICATOR WINDOW, ALL HOUSED IN AN ALUMINUM ENCLOSURE.

THE BOURDON TUBE, FABRICATED OF BERYLLIUM COPPER, RESEMBLES A CLOCK-SPRING, ONE END OF WHICH IS FIXED TO A PRESSURE PORT WHILE THE OTHER END IS FREE TO MOVE UNDER THE INFLUENCE OF POSITIVE OR NEGATIVE PRESSURE.

THE LINKAGE ASSEMBLY AMPLIFIES THE MOTION OF THE FREE END OF THE BOURDON TUBE TO APPROXIMATELY 72 DEGREE SWING OF THE POINTER. LINKAGE JOURNALS ARE SUPPORTED BY JEWEL BEARINGS FOR MINIMUM RESISTANCE AND MAXIMUM RELIABILITY.

THE INDICATOR WINDOW, SECURELY ATTACHED TO THE HOUSING AND BEZEL, IS FABRICATED OF GLASS WITH A TRANSPARENT POLYPROPYLENE TAPE COVERING TO INSURE THAT ANY GLASS FRAGMENTS RESULTING FROM ACCIDENTAL BREAKAGE OF THE WINDOW WILL BE FULLY CONTAINED AND WILL NOT HAMPER NORMAL OPERATION OF THE GAUGE.

THE UNIT IS FLANGE MOUNTED WITH A SINGLE SILASTIC 675 SILICONE RUBBER O-RING WHICH COMPENSATES FOR ROUGHNESS OF THE FLANGE, PREVENTING EXTERNAL LEAKAGE. THE FLANGE IS MADE OF 6061-T6 ALUMINUM WITH A 32/FINISH IN BOTTOM OF O-RING GROOVE.

- (B) TEST:

QUALIFICATION TEST FOR 100 MISSION LIFE: SINUSOIDAL VIBRATION - 5 TO 35 HZ AT +/- 0.25 G PEAK PER AXIS. RANDOM VIBRATION - 0.09 G**2/HZ FOR 48 MINUTES PER AXIS. DESIGN SHOCK - 20 G PER AXIS. ACCELERATION OF 5 G IN EACH DIRECTION ALONG EACH OF THREE MUTUALLY PERPENDICULAR AXES. THE ACCELERATION WAS MAINTAINED FOR 5 MINUTES IN EACH OF THE SIX DIRECTIONS. TEMPERATURE TEST FOR 6 HOURS AT -100 AND AT +120. WINDOW IMPACT TEST - ONE INCH SPHERICAL STEEL BALL DROPPED FIVE TIMES ON CENTER OF GAUGE WINDOW FROM A HEIGHT OF 4 FT. BURST PRESSURE TEST AT

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32 PSI (TWICE OPERATING PRESSURE) FOR 5 MINUTES. LEAK TEST AT 20 PSI
GHE, 6×10^{-4} SCCM MAX LEAKAGE.

ACCEPTANCE TEST - PROOF PRESSURE 30 PSI GN2 FOR 3 MINUTES, BOTH
POSITIVE AND NEGATIVE DELTA-P. LEAK CHECK AT 20 PSIG GHE, 6×10^{-4}
SCCM MAX LEAKAGE.

OMRSD - 3.2 PSID LEAK CHECK PERFORMED AT OPF AFTER TUNNEL ADAPTER
INSTALLATION. 2 PSID LEAK CHECK DURING LAUNCH COUNTDOWN.

- (C) INSPECTION:
RECEIVING INSPECTION
RECEIVING INSPECTION VERIFIES MATERIAL AND PROCESS CERTIFICATIONS.

CONTAMINATION CONTROL
CORROSION PROTECTION PROVISIONS AND CONTAMINATION CONTROL PLAN
VERIFIED BY INSPECTION. CLEANLINESS TO LEVEL 200A VERIFIED BY
INSPECTION.

ASSEMBLY/INSTALLATION
MANUFACTURING PROCESSES, INSTALLATION AND ASSEMBLY VERIFIED BY
INSPECTION. VISUAL INSPECTION OF SEAL RING USING 10X MAGNIFICATION,
INTERNAL O-RINGS VERIFIED BY INSPECTION. FASTENER INSTALLATION WITH
ADHESIVE VERIFIED BY INSPECTION. DIMENSIONS AND SURFACE FINISHES
VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
HELIUM LEAK TESTING IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES
MECHANICAL SOLDER CONNECTIONS VERIFIED BY INSPECTION. MECHANICAL
SOLDERING USES FLUX ONLY IN COMPONENT "TINNING"; THE FLUX IS REMOVED
BEFORE THE SOLDER IS REFLOWED AND THE JOINT IS MADE. SOLDERING TO
PLUG FREE END OF THE BOURDON TUBE IS VERIFIED BY INSPECTION. SILVER
BRAZE PLUG TO SEAL A PRESSURE PASSAGE IS VERIFIED BY INSPECTION. HEAT
TREATMENT AND BENDING OF BERYLLIUM COPPER BOURDON TUBE IS VERIFIED BY
INSPECTION. PASSIVATION IS VERIFIED BY INSPECTION.

TESTING
ATP VERIFIED BY INSPECTION.

HANDLING/PACKAGING
PARTS PROTECTION VERIFIED BY INSPECTION.

- (D) FAILURE HISTORY:
NO APPLICABLE FAILURE HISTORY.

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■ (E) OPERATIONAL USE:
NONE.

- APPROVALS -

RELIABILITY ENGINEERING: H. M. TO :
DESIGN ENGINEERING : S. CASTILLO :
QUALITY ENGINEERING : M. SAVALA :
NASA RELIABILITY : :
NASA SUBSYSTEM MANAGER : :
NASA QUALITY ASSURANCE : :
EDITORIALLY APPROVED : RI :
EDITORIALLY APPROVED : JSC :
TECHNICAL APPROVAL : VIA CR :

Tom D. Adams 1/22/92
M. Savala 2/17/92
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