FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: M7-3-M8-X

SUBSYSTEM NAME: TUNNEL ADAPTER

REVISION : 1 05/17/91

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
◘ LRU	:	COUPLING LEAK TEST PORT	ME276-0040-0001
◘ SRU	:	LEAK TEST PORT SEALS	59005-6

PART DATA

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
COUPLING, LEAK TEST PORT, HATCHES "C" & "D"

■ QUANTITY OF LIKE ITEMS: 2
ONE COUPLING, LEAK TEST PORT, PER HATCH "C"
ONE COUPLING, LEAK TEST PORT, PER HATCH "D"

■ FUNCTION:
THIS MALE HALF QUICK DISCONNECT COUPLING PROVIDES A LEAK TEST PORT CONNECTED TO THE VOLUME BETWEEN THE DUAL (REDUNDANT) PERIMETER SEALS AROUND EACH HATCH. THE FEMALE HALF QUICK DISCONNECT COUPLING IS ON THE PNEUMATIC PORTABLE TEST KIT (C70-0749) USED TO VERIFY HATCH SEAL INTEGRITY PRIOR TO LAUNCH. THE TEST PORT COUPLING IS INSTALLED IN THE HATCH STRUCTURE (HATCHES "C" AND "D"), AND IS ACCESSIBLE FROM INSIDE THE TUNNEL ADAPTER. AN O-RING SEAL IS INSTALLED BETWEEN THE TEST PORT COUPLING AND THE HATCH STRUCTURE. THE TEST PORT COUPLING HAS A SPRING-LOADED POPPET WITH CIRCUMFERENTIAL O-RING SEAL. A PROTECTIVE PRESSURE CAP WITH AN O-RING FACE SEAL IS INSTALLED ON THE TEST PORT COUPLING WHEN NOT IN USE. THE PORTABLE TEST KIT IS NOT FLIGHT EQUIPMENT.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: M7-3-M8-01

REVISION# 1 05/17/91 R

SUBSYSTEM: TUNNEL ADAPTER
LRU :COUPLING LEAK TEST PORT
ITEM NAME: LEAK TEST PORT SEALS

CRITICALITY OF THIS FAILURE MODE:1R3

■ FAILURE MODE:
LEAKAGE (O-RING SEALS) BETWEEN TEST PORT COUPLING AND HATCH STRUCTURE OR THROUGH PRESSURE CAP AND POPPET

MISSION PHASE:
PL PRELAUNCH
OO ON-ORBIT

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

■ CAUSE:
CRACKS, LOW TEMPERATURE, MATERIAL DEGRADATION, WEAR, SEAL DAMAGED OR DISPLACED

■ CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

PASS/FAIL RATIONALE:
■ A)
TEST PORT COUPLING SEAL INTEGRITY NOT VERIFIABLE ON VEHICLE.

■ B)
TEST PORT COUPLING SEAL INTEGRITY NOT VERIFIABLE ON VEHICLE.

■ C)
PASSES REDUNDANCY SCREEN "C" SINCE THE FAILURE OF ANY ONE SEAL CANNOT CAUSE THE FAILURE OF ANOTHER REDUNDANT SEAL.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE NUMBER: M7-3-M8-01

- FAILURE EFFECTS -

■ (A) SUBSYSTEM:
NO LEAKAGE OF TUNNEL ADAPTER ATMOSPHERE WOULD OCCUR IF A LEAK TEST PORT COUPLING O-RING SEAL FAILED (POPPET SEAL, PRESSURE CAP SEAL OR INTERFACE FLANGE SEAL). FAILURE OF INTERFACE FLANGE SEAL WOULD RESULT IN AN INCORRECT INDICATION OF HATCH SEAL LEAK RATE DURING PRELAUNCH CHECKOUT. PRESSURE CAP SEAL IS REDUNDANT TO POPPET SEAL FOR ON-ORBIT PHASE OF MISSION.

■ (B) INTERFACING SUBSYSTEM(S):
FAILURE OF INTERFACE FLANGE SEAL OR DUAL FAILURE OF PRESSURE CAP SEAL AND POPPET SEAL WOULD NOT RESULT IN LEAKAGE OF TUNNEL ADAPTER ATMOSPHERE UNLESS HATCH "C" OR "D" INNER O-RING SEAL ALSO FAILS.

■ (C) MISSION:
A LEAK TEST PORT COUPLING O-RING SEAL FAILURE WOULD HAVE NO EFFECT ON A MISSION. SEE (A) AND (B).

■ (D) CREW, VEHICLE, AND ELEMENT(S):
SAME AS (C).

■ (E) FUNCTIONAL CRITICALITY EFFECTS:

- DISPOSITION RATIONALE -

■ (A) DESIGN:
O-RING SEALS IN LEAK TEST PORT COUPLING ARE ETHYLENE PROPYLENE. O-RING SEAL AT COUPLING INTERFACE FLANGE IS BUTYL RUBBER. PROTECTIVE PRESSURE CAP SEAL IS REDUNDANT TO POPPET VALVE SEAL WHEN TEST PORT COUPLING IS NOT IN USE. TEST PORT COUPLING SEAL LEAKAGE WILL NOT RESULT IN LEAKAGE OF TUNNEL ADAPTER ATMOSPHERE OVERBOARD UNLESS HATCH INNER PERIPHERAL O-RING SEAL ALSO FAILS.

■ (B) TEST:
ACCEPTANCE TESTS OF LEAK TEST PORT COUPLING INCLUDE EXAMINATION OF PRODUCT, PROOF PRESSURE TEST AND OPERATIONAL TEST. PROOF PRESSURE TEST OF THE LEAK TEST PORT (MALE HALF COUPLING) WITH PRESSURE CAP INSTALLED IS 30 PSIG TWO TIMES FOR TWO MINUTES EACH. OPERATIONAL TEST OF THE LEAK TEST PORT WITH PRESSURE CAP INSTALLED AND POPPET HELD OPEN IS 15 PSIG GN2 WITH LEAKAGE NOT TO EXCEED ONE BUBBLE IN FIVE MINUTES. WITH PRESSURE CAP REMOVED AND 15 PSIG APPLIED, LEAKAGE IS NOT TO EXCEED ONE BUBBLE IN FIVE MINUTES.

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QUALIFICATION TESTS: NO QUALIFICATION TEST OF COUPLING WERE PERFORMED.

OMRSD: TUNNEL ADAPTER HATCH "C" AND "D" SEAL LEAK TESTS ARE PERFORMED WHEN TUNNEL ADAPTER IS INSTALLED, BUT WOULD NOT DETECT TEST PORT COUPLING SEAL LEAKAGE.

REF. OMRSD V60AB0.015.

■ (C) INSPECTION:
RECEIVING INSPECTION
RAW MATERIAL IS VERIFIED BY INSPECTION TO ASSURE SPECIFIC SHUTTLE REQUIREMENTS ARE SATISFIED.

CONTAMINATION CONTROL
CLEANLINESS OF SIGNIFICANT INTERNAL AND EXTERNAL SURFACES TO LEVEL GC (GENERALLY CLEAN) OF MA0110-301 IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
OPERATIONS VERIFIED BY ASSEMBLY AND TEST OPERATIONS ON SHOP TRAVELER.

CRITICAL PROCESSES
CRITICAL PROCESSES SUCH AS WELDING, PLATING, HEAT TREATING, PASSIVATION AND ANODIZING ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
NO NONDESTRUCTIVE EVALUATION (NDE) IS DONE/PERFORMED.

TESTING
ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING AND PACKAGING IS VERIFIED BY INSPECTION PER THE REQUIREMENTS OF SPECIFICATION MA0110-301.

■ (D) FAILURE HISTORY:
NONE

■ (E) OPERATIONAL USE:
LEAKAGE OF TEST PORT COUPLING SEALS ON TUNNEL ADAPTER HATCH "C" OR HATCH "D" WOULD HAVE NO EFFECT ON A MISSION. LEAKAGE OF TEST PORT COUPLING SEAL(S) AND FAILURE OF INNER PERIPHERAL SEAL ON HATCH "C" WOULD RESULT IN LOSS OF CREW MODULE/SPACELAB ATMOSPHERE OVERBOARD AND WOULD REQUIRE MONITORING OF CONSUMABLES TO ASSESS FEASIBILITY OF CONTINUING THE MISSION.

PRINT DATE: 05/17/91

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- APPROVALS -

RELIABILITY ENGINEERING	D. M. MAYNE	D.M.Mayne
DESIGN ENGINEERING	E. L. SALLEE	E.L. Sallee
QUALITY ENGINEERING	M. SAVALA	M.S. Savala 5/17/91
NASA RELIABILITY		Brenda C. Shaw
NASA SUBSYSTEM MANAGER		Owen Dillon 7/17/91
NASA QUALITY ASSURANCE		7/17/91