FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE
NUMBER: M7-3-M4-X

SUBSYSTEM NAME: TUNNEL ADAPTER

REVISION : 1 05/17/91

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■ LRU :	HINGE ASSY	V075-593327

PART DATA

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
HINGE ASSEMBLY, HATCHES "C" & "D"

■ QUANTITY OF LIKE ITEMS: 4
TWO HINGE ASSEMBLIES PER HATCH "C"
TWO HINGE ASSEMBLIES PER HATCH "D"

■ FUNCTION:
THE HINGES DIRECT MOTION OF THE HATCH BETWEEN THE CLOSED POSITION AND THE OPEN/STOWED POSITION INSIDE THE TUNNEL ADAPTER WITH HATCH "C" OPEN FOR EVA OPERATIONS AND HATCH "D" OPEN FOR SPACELAB OPERATIONS.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: M7-3-M4-01

REVISION# 1 05/17/91 R

SUBSYSTEM: TUNNEL ADAPTER
LRU :HINGE ASSY
ITEM NAME: HINGE ASSY

CRITICALITY OF THIS FAILURE MODE:1R2

■ FAILURE MODE:
FAILS TO ROTATE (OPEN OR CLOSED)

MISSION PHASE:
OO ON-ORBIT

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

■ CAUSE:
CONTAMINATION/FOREIGN OBJECT/DEBRIS, DEFECTIVE PART/MATERIAL, FAILURE/DEFLECTION OF INTERNAL PART, PHYSICAL BINDING/JAMMING, CORROSION

■ CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

PASS/FAIL RATIONALE:
■ A)
PASSES REDUNDANCY SCREEN "A" SINCE OPERATION OF THE HATCH HINGE ASSEMBLY IS VERIFIED DURING GROUND TURNAROUND.

■ B)
N/A (MECHANICAL LINKAGE)

■ C)
PASSES REDUNDANCY SCREEN "C" SINCE A FAILURE OF THE HATCH HINGE ASSEMBLY CANNOT CAUSE AN ASSOCIATED FAILURE OF ANOTHER ASSEMBLY.

- FAILURE EFFECTS -

■ (A) SUBSYSTEM:
EITHER HATCH "C" OR HATCH "D" CANNOT BE PLACED IN ITS OPEN/STOWED

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POSITION AND/OR ITS CLOSED POSITION IF ITS HATCH HINGE ASSEMBLY FAILS TO ROTATE.

■ (B) INTERFACING SUBSYSTEM(S):
SAME AS (A).

■ (C) MISSION:
LOSS OF EMERGENCY EVA CAPABILITY IF HATCH "C" CANNOT BE OPENED PRE-EVA. LOSS OF CAPABILITY TO SAFELY RETURN TO THE CREW CABIN POST-EVA IF HATCH "C" CANNOT BE CLOSED. LOSS OF SPACELAB OPERATIONS IF HATCH "D" CANNOT BE OPENED.

■ (D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE IF EMERGENCY EVA PROCEDURES ARE REQUIRED THRU HATCH "C" AND THE QUICK-RELEASE PINS ON THE HATCH HINGE ASSEMBLY FAIL TO RELEASE PRE-EVA. POSSIBLE INJURY TO THE EVA CREWMEMBERS COULD RESULT IF HATCH "C" CANNOT BE CLOSED POST-EVA TO ALLOW THEIR SAFE RETURN BACK INTO THE CREW CABIN THROUGH HATCH "A".

■ (E) FUNCTIONAL CRITICALITY EFFECTS:

- DISPOSITION RATIONALE -

■ (A) DESIGN:
LOW PROBABILITY OF HINGE FAILURE. HINGE BEARINGS HAVE DUAL ROTATING SURFACES. HIGH MECHANICAL ADVANTAGE OF HATCH OPENING FORCE ABOUT HINGE LINE WILL UNJAM HINGE. HINGE LINKAGES ARE ATTACHED TO HATCHES WITH QUICK-RELEASE PINS.

■ (B) TEST:
QUALIFICATION TESTS: QUALIFICATION TESTS WERE PART OF INGRESS/EGRESS HATCH SYSTEM QUALIFICATION (CR-28-593201-001C) AND INCLUDED: CABIN ATMOSPHERE (PER MIL-STD-810B, FOR 1 HOUR), HUMIDITY AT 85% RH FOR 120 HOURS (THERMALLY CYCLED 4 TIMES BETWEEN +60 DEG F AND +125 DEG F, EVERY 24 HOURS), LIFE CYCLE TEST (1,000 CYCLES WITH HATCH IN VERTICAL POSITION; 1,000 CYCLES WITH HATCH IN HORIZONTAL POSITION) AND VIBRATION TEST (RANDOM VIBRATION NORMAL TO HATCH FOR 48 MINUTES). HATCHES ARE INSTALLED AND RIGGED PER SPECIFICATION ML0308-0003.

OMRSD: GROUND TURNAROUND INCLUDES VISUAL INSPECTION OF OPENING AND CLOSING OF TUNNEL ADAPTER HATCHES "C" AND "D" MECHANISM LATCHES AND HINGES. FUNCTIONAL CHECKS OF HATCHES "C" AND "D" ARE PERFORMED BY OPENING AND CLOSING HATCHES FROM INSIDE TUNNEL ADAPTER AND REPEATING FROM OUTSIDE ADAPTER. TESTS ARE PERFORMED WHEN THE TUNNEL ADAPTER IS INSTALLED ON THE VEHICLE.

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NUMBER: M7-3-M4-01

REFERENCE OMRSD V33AD0.0XX AND V33AE0.0XX.

■ (C) INSPECTION:
RECEIVING INSPECTION
SUPPLIER HARDWARE INSPECTED IN ACCORDANCE WITH QUALITY PLANNING REQUIREMENTS DOCUMENT (QPRD).

CONTAMINATION CONTROL
CORROSION PROTECTION VERIFIED BY INSPECTION.

ASSSEMBLY/INSTALLATION
MACHINED DETAIL VERIFIED BY INSPECTION. ALL DETAILS VERIFIED FOR PRIOR INSPECTION BEFORE ASSEMBLY.

NONDESTRUCTIVE EVALUATION
NONDESTRUCTIVE EVALUATION (NDE) PER MT0501-508, CLASS 2, INCLUDES: LOT SAMPLE PENETRANT INSPECT (PER MT0501-504) IS PERFORMED AND VERIFIED ON ALL MACHINED CRES AND ALUMINUM DETAILS. 100% ULTRASONIC INSPECTION OF ALUMINUM HINGE ARMS (PER MIL-I-8950, CLASS A).

CRITICAL PROCESSES
PRECIPITATION HEAT-TREAT VERIFIED BY INSPECTION.

■ (D) FAILURE HISTORY:
THERE HAVE BEEN NO ACCEPTANCE TEST, QUALIFICATION TEST, FIELD OR FLIGHT FAILURES ASSOCIATED WITH THIS FAILURE MODE.

■ (E) OPERATIONAL USE:
CREW CAN APPLY ADDITIONAL LOAD TO OVERCOME JAMMED HINGE ON HATCH "C" PRIOR TO EMERGENCY EVA OR ON HATCH "D" PRIOR TO ENTRY INTO SPACELAB. HINGE MAY BE DISCONNECTED FROM HATCH "C" OR "D" IF REQUIRED TO ALLOW MANUAL POSITIONING OF HATCH PRIOR TO REPRESSURIZING TUNNEL ADAPTER FOR REENTRY OF EVA CREWMEMBERS INTO CREW MODULE THROUGH AIRLOCK HATCH "A".

- APPROVALS -

RELIABILITY ENGINEERING	D. M. MAYNE	D.M. Mayne
DESIGN ENGINEERING	R. A. SMITH	ACR for Ron Smith 5/24/91
QUALITY ENGINEERING	M. SAVALA	
NASA RELIABILITY		
NASA SUBSYSTEM MANAGER		
NASA QUALITY ASSURANCE		