

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: M7-3-M2-X

S050270A
ATTACHMENT -
PAGE 105 OF 140

SUBSYSTEM NAME: TUNNEL ADAPTER

REVISION : 1 05/17/91

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■ LRU :	LATCH MECHANISM, HATCH "D"	V519-593302

PART DATA

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
LATCH MECHANISM, HATCH "D"

■ QUANTITY OF LIKE ITEMS: 1
ONE

■ FUNCTION:

THIS MECHANISM IS MOUNTED ON THE SPACELAB SIDE OF HATCH "D" TO SECURE IT IN THE CLOSED AND SEALED POSITION. THIS ASSEMBLY CONSISTS OF SEVENTEEN (17) APOLLO CM PROVEN HATCH-TYPE LATCHES WHICH ARE JOINED BY RODS AND LINKS. THE RODS AND LINKS MOVE CIRCUMFERENTIALLY, CAUSING THE LATCHES TO MOVE AXIALLY TO SECURE THE HATCH IN A CLOSED AND SEALED POSITION. TWO "KICKER" LATCHES INCORPORATE PROVISION FOR "BREAKING FREE" THE HATCH SEALS AGAINST ANY SMALL RESIDUAL DELTA PRESSURE, WHEN OPENING THE HATCH. THE LATCHES ARE DRIVEN BY A MANUALLY OPERATED REDUCTION GEARBOX (ACTUATOR).

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: M7-3-M2-02

S050270A
ATTACHMENT -
PAGE 110 OF 140

REVISION# 1 05/17/91 R

SUBSYSTEM: TUNNEL ADAPTER
LRU :LATCH MECHANISM, HATCH "D"
ITEM NAME: LATCH MECHANISM, HATCH "D"

CRITICALITY OF THIS
FAILURE MODE:2/2

■ FAILURE MODE:
FAILS TO DISENGAGE

MISSION PHASE:
00 ON-ORBIT

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

■ CAUSE:
ADVERSE TOLERANCES/WEAR, CONTAMINATION/FOREIGN OBJECT/DEBRIS, FAILURE/
DEFLECTION OF INTERNAL PART, PHYSICAL BINDING/JAMMING

■ CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

PASS/FAIL RATIONALE:

■ A)
N/A

■ B)
N/A

■ C)
N/A

- FAILURE EFFECTS -

■ (A) SUBSYSTEM:
PERSONNEL CANNOT OPEN HATCH "D" TO ENTER THE SPACELAB IF THE LATCHES
FAIL TO DISENGAGE RESULTING IN THE LOSS OF THE PRIMARY MISSION
OBJECTIVE.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE

NUMBER: M7-3-M2-02

S05027DA

ATTACHMENT -

PAGE 111 OF 140

- (B) INTERFACING SUBSYSTEM(S):
SAME AS (A).
- (C) MISSION:
SAME AS (A).
- (D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT ON CREW/VEHICLE.
- (E) FUNCTIONAL CRITICALITY EFFECTS:

 - DISPOSITION RATIONALE -

- (A) DESIGN:
LATCH MECHANISM BASED ON PROVEN APOLLO DESIGN. LINKAGE ATTACHMENTS HAVE DUAL ROTATING SURFACES. MAXIMUM UNLATCHING FORCE IS 20 LB AT THE HANDLE, ACTUATOR AND LINKAGE DESIGNED FOR 150 LB LIMIT LOAD AT THE HANDLE. POSITIVE MARGINS ON ALL COMPONENTS. SEAL COMPRESSIVE FORCE ASSISTS UNLATCHING. LATCH AND LINKAGE MATERIALS (INCONEL, A286 CRES AND BERYLLIUM COPPER) CHOSEN FOR HIGH STRENGTH AND LOW WEAR. DRY FILM LUBE ON BEARING SURFACES. DESIGN STRESS ANALYSIS REPORT S077-SH-0178, VOL. 6.

- (B) TEST:
QUALIFICATION TESTS: LATCHES AND ACTUATOR SYSTEM QUALIFIED BY SIMILARITY (PER CR-28-593201-001C) TO THE MECHANISMS ON THE INGRESS/EGRESS HATCH. REFERENCE FMEA/CIL 02-4A-593201-01. ACTUATOR ALSO COMPONENT QUALIFIED BY SIMILARITY TO ACTUATOR ON INGRESS/EGRESS HATCH (PER CR-28-287-0036-0006C); REFERENCE FMEA/CIL 02-4A-593202-01. CERTIFICATION BY SIMILARITY/ANALYSIS (PER MF0004-014) INCLUDED: FUNGUS, SALT/FOG, OZONE, SAND/DUST, TEMPERATURE CYCLE, CRASH/SHOCK, ACCELERATION, CABIN ATMOSPHERE, LIFE CYCLE (2,000 CYCLES), VIBRATION AND STRUCTURAL LOAD REQUIREMENTS.

CERTIFICATION TESTS INCLUDED: ZERO-"G" AND ONE-"G" OPERATION (USING APPROPRIATE GSE EQUIPMENT) AND HATCH SEALING/LEAK TEST (WITH 15.0 PSID ACROSS HIGH-PRESSURE SIDE OF HATCH, WITH MAXIMUM ALLOWABLE LEAK RATE OF 1.03 SCIM), PROOF PRESSURE 17.7 PSID FOR 2.0 +/- 1.0 MINUTE (PER MLO206-0089). LATCH MECHANISM INSTALLED AND RIGGED PER TECH ORDER INSTALLATION M072-593301.

OMRSD: MECHANISM IS FUNCTIONALLY OPERATED FOR EVIDENCE OF BINDING, SURFACE CONTAMINATION AND POSSIBLE DAMAGE. VISUALLY INSPECT TUNNEL ADAPTER HATCH "D" MECHANISM LATCHES AND HINGES. FUNCTIONAL CHECK OF HATCH "D" IS PERFORMED BY OPENING AND CLOSING HATCH FROM INSIDE TUNNEL

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: M7-3-M2-02

S050270A
ATTACHMENT -
PAGE 112 OF 140

ADAPTER AND REPEATING FROM SPACELAB SIDE. ACTUATOR HANDLE AND LOCK LEVER FORCES ARE CHECKED. TESTS ARE PERFORMED WHEN THE TUNNEL ADAPTER IS INSTALLED ON THE VEHICLE.

REFERENCE OMRSD V33AEO.OXX

■ (C) INSPECTION:

RECEIVING INSPECTION
MATERIAL AND PROCESS CERTIFICATIONS VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
ASSEMBLY IS PERFORMED IN CLEAN ENVIRONMENT WHICH IS MONITORED BY INSPECTION.

ASSEMBLY/INSTALLATION
ASSEMBLY, ADJUSTMENT, TORQUING AND RIGGING ARE VERIFIED BY INSPECTION (M072-593301).

NONDESTRUCTIVE EVALUATION
PENETRANT INSPECTION OF DETAIL HARDWARE IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES
DRY FILM LUBRICATION IS VERIFIED BY INSPECTION.

TESTING
FUNCTIONAL TESTING IS VERIFIED BY INSPECTION.

■ (D) FAILURE HISTORY:

CAR NO. 09F005: AIRLOCK HATCH "A" (BETWEEN CREW MODULE AND AIRLOCK) DURING STS-9 MISSION WAS DIFFICULT TO OPEN; UPPER CENTER GUIDE SUPPORT BRACKET DEBONDED FROM THE HATCH AND HATCH MOVED UPWARD AFTER LATCHES WERE RELEASED, ALLOWING AIRLOCK FLANGE TO BECOME TRAPPED BETWEEN UPPER CENTER LATCH "KICKER" ARM AND ROLLER; DEBONDED GUIDE SUPPORT WAS REBONDED.

■ (E) OPERATIONAL USE:

IF HATCH "D" CANNOT BE OPENED NO OPERATIONAL WORKAROUND IS POSSIBLE BECAUSE LATCH MECHANISM IS ON SPACELAB SIDE OF HATCH AND IS INACCESSIBLE TO CREW MEMBERS IN TUNNEL ADAPTER.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE

NUMBER: M7-3-M2-02

S050270A
ATTACHMENT -
PAGE 113 OF 140

- APPROVALS -

RELIABILITY ENGINEERING: D. M. MAYNE
DESIGN ENGINEERING : R. A. SMITH
QUALITY ENGINEERING : M. SAVALA
NASA RELIABILITY :
NASA SUBSYSTEM MANAGER :
NASA QUALITY ASSURANCE :

D.M. Mayne
: *ACP* *Pal 4/20 5/21/91*
: *M.L. ... 6/10/91*
: *D.M. ... 7/24/91*
: *Conduct ... 7/26/91*
: *ONE* *...*