FAILURE MODES EFFECTS ANALYSIS (FMEA) – NON-CIL HARDWARE
NUMBER: M8-1MR-M006-X

SUBSYSTEM NAME: MECHANICAL - EXTERNAL AIRLOCK
REVISION: 3 9/15/95

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU :	ASSEMBLY, HINGE	V075-593327

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
EXTERNAL AIRLOCK AFT HATCH HINGE ASSEMBLY

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 2
TWO

FUNCTION:
THE HINGES DIRECT MOTION OF THE HATCH BETWEEN THE CLOSED POSITION AND THE OPEN/STOWED POSITION WITH EXTERNAL AIRLOCK AFT HATCH OPEN FOR SPACELAB OPERATIONS (MIR 1) OR EVA OPERATIONS (MULTI-MIR).

REFERENCE DOCUMENTS: V519-593315
M072-593828

FAILURE MODES EFFECTS ANALYSIS (FMEA) – NON-CIL FAILURE MODE
NUMBER: M8-1MR-M006-01

REVISION# 3 9/15/95

SUBSYSTEM NAME: MECHANICAL - EXTERNAL AIRLOCK
LRU: ASSEMBLY, HINGE
ITEM NAME: ASSEMBLY, HINGE

CRITICALITY OF THIS FAILURE MODE: 1R3

FAILURE MODE:
FAILS TO ROTATE (OPEN OR CLOSED)

MISSION PHASE:
OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 104 ATLANTIS

CAUSE:
ROLLER BEARING FAILURE DUE TO: CONTAMINATION/FOREIGN OBJECT/DEBRIS, FAILURE/DEFLECTION OF INTERNAL PART, DEFECTIVE PART/MATERIAL, PHYSICAL BINDING/JAMMING

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

CRITICALITY 1R2 DURING INTACT ABORT ONLY (AVIONICS ONLY)? N/A

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

PASS/FAIL RATIONALE:
A)

B)
N/A - AT LEAST TWO REMAINING PATHS ARE DETECTABLE IN FLIGHT.

C)

METHOD OF FAULT DETECTION:
FAILURE OF HINGE ASSEMBLY TO ROTATE CAN VISUALLY/PHYSICALLY BE DETECTED BY THE FLIGHT CREW.

CORRECTING ACTION: CREW CAN APPLY ADDITIONAL LOAD TO OVERCOME A JAMMED HINGE ON EXTERNAL AIRLOCK AFT HATCH. HINGE MAY BE DISCONNECTED FROM AFT HATCH IF REQUIRED TO ALLOW MANUAL POSITIONING OF HATCH PRIOR TO REPRESSURIZING EXTERNAL AIRLOCK FOR RE-ENTRY OF EVA CREWMEMBERS INTO CREW MODULE THROUGH FIFTH HATCH AND CREW CABIN "A" HATCH.

REMARKS/RECOMMENDATIONS:
EXTERNAL AIRLOCK AFT HATCH IS OPENED ONLY FOR: (1) SPACELAB OPERATIONS (MIR 1) AND IS LEFT OPEN DURING MIR OPERATIONS; OR (2) EVA OPERATIONS (MULTI-MIR). (IT IS CLOSED AND LATCHED ALL OTHER TIMES.) EFFECTS ON EVA RECOVERY ARE MINIMIZED SINCE TUNNEL ADAPTER "C" HATCH IS THE PRIMARY HATCH FOR

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PERFORMING AN EVA AND AN ADDED FIFTH HATCH WILL ISOLATE TUNNEL ADAPTER AND EXTERNAL AIRLOCK VOLUMES.

- FAILURE EFFECTS -

(A) SUBSYSTEM:
NO EFFECT UNTIL FAILURE OF REDUNDANT ROLLER BEARINGS. THEN EXTERNAL AIRLOCK AFT HATCH CANNOT BE PLACED IN ITS OPEN/STOWED POSITION AND/OR ITS CLOSED/LATCHED POSITION IF ITS HATCH HINGE ASSEMBLY FAILS TO ROTATE.

(B) INTERFACING SUBSYSTEM(S):
NO EFFECT FIRST FAILURE. INABILITY TO ROTATE EXTERNAL AIRLOCK AFT HATCH CLOSED, FOLLOWING SECOND BEARING FAILURE, WOULD PRECLUDE DEPRESSURIZING EXTERNAL AIRLOCK VOLUME IN PERFORMING AN EVA (MIR 1) OR PREVENT THE CAPABILITY TO RECOVER FROM AN EVA (MULTI-MIR) THROUGH EXTERNAL AIRLOCK AFT HATCH.

(C) MISSION:
NO EFFECT FIRST FAILURE.
MIR 1 - PARTIAL LOSS OF MISSION OBJECTIVES IF THE EXTERNAL AIRLOCK AFT HATCH FAILS TO ROTATE OPEN FOLLOWING SECOND BEARING FAILURE (LOSS OF ACCESS TO THE SPACELAB). INABILITY TO PERFORM A PLANNED EVA IF AFT HATCH FAILS TO ROTATE CLOSED.
MULTI-MIR - LOSS OF PLANNED EVA CAPABILITIES OUT EXTERNAL AIRLOCK IF SECOND FAILURE PREVENTS OPENING OF EXTERNAL AIRLOCK AFT HATCH.

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT FIRST FAILURE.
MIR 1 - SECOND BEARING FAILURE COULD RESULT IN POSSIBLE LOSS OF CREW/VEHICLE IF CONTINGENCY EVA IS REQUIRED AND EXTERNAL AFT HATCH CANNOT BE CLOSED FOR DEPRESSURIZING ODS VOLUME.
MULTI-MIR – POSSIBLE LOSS OF CREW AND VEHICLE IF SECOND FAILURE OCCURS WHILE EVA IS PERFORMED OUT EXTERNAL AIRLOCK AFT HATCH AND HATCH CANNOT BE CLOSED AND SEALED FOR CREW RETURN TO CABIN.

(E) FUNCTIONAL CRITICALITY EFFECTS:
FIRST BEARING FAILURE - NO EFFECT SINCE HINGE CONTAINS REDUNDANT BEARINGS.
SECOND BEARING FAILURE:

MIR 1 - (1) INABILITY TO ROTATE EXTERNAL AIRLOCK AFT HATCH OPEN WOULD LOSE MISSION OBJECTIVES ASSOCIATED WITH SPACELAB. - CRITICALITY 2R3 CONDITION; (2) INABILITY TO ROTATE EXTERNAL AIRLOCK AFT HATCH CLOSED WOULD LOSE CAPABILITY TO DEPRESSURIZE TUNNEL/AIRLOCK VOLUMES FOR PERFORMING CONTINGENCY EVA. (INSUFFICIENT CONSUMABLES AVAILABLE TO REPRESSURE ODS VOLUME AND SPACELAB TOGETHER.) LOSS OF CONTINGENCY EVA TO CORRECT A CRIT 1 CONDITION COULD RESULT IN LOSS OF CREW AND VEHICLE. - CRITICALITY 1R3 CONDITION. THIS WOULD FIRST REQUIRE A FAILURE TO OPEN TUNNEL ADAPTER "C" HATCH SINCE IT IS PRIMARY FOR PERFORMING AN EVA.

MULTI-MIR - (1) INABILITY TO ROTATE EXTERNAL AIRLOCK AFT HATCH OPEN. LOSS OF CONTINGENCY EVA OUT EXTERNAL AIRLOCK AFT HATCH, TO CORRECT A CRIT 1 CONDITION, COULD RESULT IN LOSS OF CREW AND VEHICLE. - CRITICALITY 1R3 CONDITION. (2) INABILITY TO ROTATE EXTERNAL AIRLOCK AFT HATCH CLOSED

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RESULTING IN DEGRADED EVA RECOVERY CAPABILITIES THROUGH AFT HATCH. THIS WOULD FIRST REQUIRE A FAILURE TO OPEN TUNNEL ADAPTER "C" HATCH SINCE IT IS PRIMARY FOR PERFORMING AN EVA.

DESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)): 1R2

(F) RATIONALE FOR CRITICALITY DOWNGRADE:
THIRD FAILURE (INABILITY TO DISCONNECT HINGE OR HOLD HATCH IN CLOSED POSITION) - INABILITY TO CLOSED AND SEAL EXTERNAL AIRLOCK AFT HATCH. EXTERNAL AIRLOCK VOLUME CANNOT BE REPRESSURIZED FOLLOWING A PLANNED EVA OUT THE AFT HATCH. POSSIBLE LOSS OF EVA CREW MEMBERS IF HABITABLE VOLUMES CANNOT BE REPRESSURIZED FOR CREW RETURN TO CABIN (EVA CREW MEMBERS MUST REMAIN IN AIRLOCK UNTIL LANDING).

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: HOURS TO DAYS

TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS

TIME FROM DETECTION TO COMPLETED CORRECTIVE ACTION: MINUTES TO HOURS

IS TIME REQUIRED TO IMPLEMENT CORRECTIVE ACTION LESS THAN TIME TO EFFECT?
YES

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:
CREW WOULD HAVE AMPLE TIME TO REMOVE HATCH AND HOLD HATCH IN CLOSED POSITION TO ALLOW REPRESSURIZATION OF EXTERNAL AIRLOCK TO HOLD HATCH IN CLOSED POSITION BEFORE FAILURE BECAME CATASTROPHIC.

HAZARDS REPORT NUMBER(S): DM1OHA06(F)

HAZARD(S) DESCRIPTION:
EVA HAZARD.

- APPROVALS -

PRODUCT ASSURANCE ENGR.	:	M. W. GUENTHER	: M. W. Guenther
DESIGN ENGINEER	:	T. S. COOK	: T S Cook