

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: 02-4A-593203-X

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SUBSYSTEM NAME: ACTUATION MECHANISM - HATCHES

REVISION : 2 10/08/90

PART NAME  
VENDOR NAME

PART NUMBER  
VENDOR NUMBER

■ LRU : HINGE, I/E HATCH V070-553434

PART DATA

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
HINGE, INGRESS/EGRESS HATCH

■ QUANTITY OF LIKE ITEMS: 2  
TWO

■ FUNCTION:  
THIS ITEM ACTS TO DIRECT THE ROTATION OF THE INGRESS/EGRESS HATCH, AS IT  
OPENS AND CLOSES.

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REVISION# 2 10/08/90 R

SUBSYSTEM: ACTUATION MECHANISM - HATCHES  
LRU :HINGE, I/E HATCH  
ITEM NAME: HINGE, I/E HATCH

CRITICALITY OF THIS  
FAILURE MODE:1/1

- FAILURE MODE:  
FAILS TO ROTATE OPEN

MISSION PHASE:  
PL PRELAUNCH

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

- CAUSE:  
ADVERSE TOLERANCES, CONTAMINATION/FOREIGN OBJECT/DEBRIS, FAILURE/  
DEFLECTION OF INTERNAL PART

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:  
A HINGE FAILURE WILL CAUSE THE LOSS OF OR THE DEGRADED ABILITY TO  
INGRESS OR EGRESS FROM THE ORBITER THROUGH THE SIDE HATCH.

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- (B) INTERFACING SUBSYSTEM(S):  
 NO EFFECT. A FAILURE TO OPEN THE SIDE HATCH DOES NOT AFFECT INTERFACING SYSTEMS.
- (C) MISSION:  
 POSSIBLE LOSS OF MISSION OBJECTIVES AND CREW, IF THE HINGE FAILURE OCCURS WHEN A RAPID EMERGENCY EGRESS ON THE PAD IS REQUIRED (THE OVERHEAD EMERGENCY EGRESS WINDOW IS NOT USABLE ON THE PAD; IT IS USABLE, ONLY, AFTER A LANDING). THIS HINGE FAILURE WILL HAVE NO EFFECT DURING THE FLIGHT. IF THE FAILURE OCCURS DURING A POST-LANDING EMERGENCY, THE OVERHEAD EMERGENCY EGRESS WINDOW OR THE PYROTECHNIC SIDE HATCH CREW ESCAPE SYSTEM CAN BE UTILIZED, AS AN ALTERNATE EMERGENCY EXIT.
- (D) CREW, VEHICLE, AND ELEMENT(S):  
 SAME AS (C).

(E) FUNCTIONAL CRITICALITY EFFECTS:

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 - DISPOSITION RATIONALE -  
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(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. SLEEVE BEARINGS ON 2.0 INCH DIAMETER A286 CRES TORQUE TUBE HAVE TEFLON LINERS AND DRY FILM LUBE ON BEARING SURFACES OF TORQUE TUBE SUPPORTS.

■ (B) TEST:

QUALIFICATION TESTS: QUALIFICATION TESTS WERE PART OF 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). HATCH IS INSTALLED AND RIGGED PER SPECIFICATION MLO308-0003.

OMRSD: GROUND TURNAROUND INCLUDES VISUAL INSPECTION OF OPENING AND CLOSING OF THE CABIN HATCH FROM OUTSIDE-HORIZONTAL, OPENING FROM INSIDE-HORIZONTAL, CLOSING FROM OUTSIDE-VERTICAL, AND OPENING FROM INSIDE-VERTICAL. PROPER FUNCTION IS VERIFIED AT EACH GROUND TURNAROUND.

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■ (C) INSPECTION:

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

CONTAMINATION CONTROL  
CORROSION PROTECTION VERIFIED BY INSPECTION.

ASSEMBLY/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 TESTS, FIELD OR FLIGHT  
FAILURES ASSOCIATED WITH THIS FAILURE MODE.

■ (E) OPERATIONAL USE:

CREW AND/OR GROUND PERSONNEL CAN APPLY ADDED LOAD TO UNJAM HINGE ON THE  
PAD OR AFTER A LANDING. THE OVERHEAD EMERGENCY EGRESS WINDOW MAY BE  
USED BY CREWMEMBERS OR GROUND PERSONNEL ONLY AFTER AN EMERGENCY LANDING.  
THE (PYROTECHNIC) SIDE HATCH CREW ESCAPE SYSTEM HAS NOW BEEN INSTALLED  
AND CAN BE USED FOR EMERGENCY EXIT.

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- APPROVALS -  
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RELIABILITY ENGINEERING: D. M. MAYNE  
DESIGN ENGINEERING : G. ARMENDARIZ  
QUALITY ENGINEERING : M. SAVALA 7/8  
NASA RELIABILITY :  
NASA SUBSYSTEM MANAGER :  
NASA QUALITY ASSURANCE :

: D.M. Mayne = QPRD  
: G. Armendariz QPRD  
: M. Savala 7/8  
: 19/10/90  
: R.H. ... 2/6/91  
: ... 205-71