FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE
NUMBER: 02-4B-112-X

SUBSYSTEM NAME: ACTUATION MECHANISMS - PAYLOAD BAY DOORS
REVISION : 2 05/31/90

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
SRU :	TORQUE SHAFT, CENTERLINE	V070-594345

PART DATA

QUANTITY OF LIKE ITEMS: 16
FOUR EACH GANGED SYSTEM

FUNCTION:
INTERCONNECTING SHAFT BETWEEN CENTERLINE LATCHES AND ACTUATOR.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE NUMBER: 02-4B-112-01

REVISION# 2 05/31/90

SUBSYSTEM: ACTUATION MECHANISMS - PAYLOAD BAY DOORS

ITEM NAME: TORQUE SHAFT, CENTERLINE

CRITICALITY OF THIS FAILURE MODE: 1R2

- FAILURE MODE:
  STRUCTURAL FAILURE

  MISSION PHASE:
  OO ON-ORBIT

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

- CAUSE:
  EXCESSIVE LOAD, FATIGUE, MANUFACTURING DEFECT, STRESS CORROSION, MATERIAL DEFECT

- CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF FUNCTION - LOSS OF TWO CENTERLINE LATCHES.

(B) INTERFACING SUBSYSTEM(S):
LOSS OF CENTERLINE LATCH - DOOR TO DOOR INTEGRITY.

3

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
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(C) MISSION:
SAFE ENTRY MAY PROCEED WITH ANY GANG OF CENTERLINE LATCHES DISENGAGED, REF JSC08934. POSSIBLE LOSS OF CREW/VEHICLE IF MORE THAN ONE GANG OF CENTERLINE LATCHES FAIL TO LATCH.

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

(E) FUNCTIONAL CRITICALITY EFFECTS:

- DISPOSITION RATIONALE -

■ (A) DESIGN:
LATCH AND MECHANISM MATERIALS (6AL-4V TITANIUM, INCONEL 718, 2024-T3 ALUMINUM) CHOSEN FOR HIGH STRENGTH/LOW WEAR CHARACTERISTICS. TORQUE SHAFT DESIGNED FOR ACTUATOR STALLED CONDITION. ALL MECHANISMS DESIGNED WITH DUAL ROTATING SURFACES AND DUAL LOCKING DEVICES ON PIVOT SHAFTS. DESIGN OF THE ACTUATION SYSTEM PERMITS PARTIAL WORKAROUND OF THIS FAILURE MODE BY EXTRAVEHICULAR ACTIVITY (EVA) CREW IF PAYLOAD DOES NOT LIMIT ACCESS.

■ (B) TEST:
QUALIFICATION TESTS: THE ACTUATOR IS CERTIFIED PER CR-28-287-0040-0001H (REF. FMEA/CIL NO. 02-4B-005-1). THE PAYLOAD BAY DOOR LATCHING MECHANISM IS CERTIFIED PER CR-29-594360-001E FOR CENTERLINE LATCH MECHANISM. SYSTEM QUALIFICATION TEST ON 15 FOOT PAYLOAD BAY DOOR TEST ARTICLES (087) INCLUDED: ACCEPTANCE TO CONFIRM ALL COMPONENTS HAVE BEEN ASSEMBLED AND RIGGED PER ML0308-0022. ORBITAL FUNCTIONS 3 THERMAL CONDITIONS WITH SIMULATED THERMAL DISTORTIONS OF BULKHEADS AND SILL LONGERONS AND ONE CENTERLINE OVERLAP AND ONE CENTERLINE GAP TEST. OPERATIONAL LIFE TESTS: A TOTAL OF 360 CYCLES WERE CONDUCTED ON THE FORWARD AND 334 CYCLES WERE CONDUCTED ON THE AFT CENTERLINE LATCHES. ACOUSTIC TESTS PER MF0004-014C SPEC. CERTIFICATION BY ANALYSIS/ SIMILARITY: HUMIDITY, FUNGUS, OZONE, PACKAGING, THERMAL VACUUM, SALT SPRAY, SAND/DUST, SHOCK-BASIC, DESIGN ULTIMATE LOADS, ACCELERATION, MARGIN OF SAFETY AND MISSION ACOUSTIC LIFE.

ACCEPTANCE TESTS: THE CENTERLINE LATCHING MECHANISMS WERE RIGGED PER CONTROLLED SPECIFICATION ML0308-0022. OPERATION OF LATCHES IS VERIFIED DURING CHECKOUT AT KSC WHICH INCLUDES PAYLOAD BAY DOOR FUNCTIONAL AND FINAL CHECKOUT PRIOR TO FLIGHT.

OMRSD: GROUND TURNAROUND INCLUDES VISUAL INSPECTION OF HARDWARE TO INSURE THAT PARTS ARE NOT BROKEN OR DEFORMED AND MONITORING FUNCTIONAL TEST FOR EVIDENCE OF BINDING OR JAMMING. PROPER FUNCTION OF THE

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COMPONENTS IS VERIFIED PERIODICALLY AS PART OF THE MAINTENANCE SAMPLING PROGRAM.

(C) INSPECTION:
RECEIVING INSPECTION
RECEIVING INSPECTION VERIFIES MATERIAL AND PROCESS CERTIFICATIONS.

CONTAMINATION CONTROL
CORROSION PROTECTION PER MA0608-301 VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
MACHINE TOLERANCES VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
PENETRANT INSPECTION VERIFIED BY INSPECTION.

CRITICAL PROCESSES
HEAT TREATMENT IS VERIFIED BY INSPECTION.

TESTING
ACCEPTANCE TESTING IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED.

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

(E) OPERATIONAL USE:
EVA CAPABILITY IS POSSIBLE EXCEPT FOR CERTAIN PAYLOADS WHICH LIMIT ACCESS AND DEPENDING ON THE NUMBER OF LATCH TOOLS AVAILABLE. ABORT DECISION REQUIRED IF DOOR(S) CANNOT BE OPENED.

- APPROVALS -

RELIABILITY ENGINEERING	D. M. MAYNE	DM 7/12/90
DESIGN ENGINEERING	M. A. ALLEN	
QUALITY ENGINEERING	O. J. BUTTNER	7/11/90
NASA RELIABILITY		7/ /90
NASA SUBSYSTEM MANAGER		8/17/90
NASA QUALITY ASSURANCE		8-6-90