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PRINT DATE: 09/12/88

FAILURE MODES EFFECTS ANALYSIS (FMEA) NUMBER: P7-2B-CRW1-X

SUBSYSTEM NAME: SIDE HATCH JETTISON

REVISION : 09/12/88

CLASSIFICATION	NAME	PART NUMBER
LRU	: FRANGIBLE BOLT	MD111-4038

QUANTITY OF LIKE ITEMS: 70

DESCRIPTION/FUNCTION:

FRANGIBLE BOLT. THE FRANGIBLE BOLTS STRUCTURALLY TIE TOGETHER THE COLLAR TO THE ORBITER STRUCTURE. DETONATION OF EITHER EXPANDING TUBE ASSEMBLY SET GENERATES SUFFICIENT FORCE TO BREAK THE FRANGIBLE BOLTS, THUS EFFECTING SEPARATION OF THE COLLAR FROM THE ORBITER DURING CREW EMERGENCY ESCAPE.

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SUMMARY

SUBSYSTEM NAME: SIDE HATCH JETTISON
LRU :FRANGIBLE BOLT
LRU PART #: MD111-4038
ITEM NAME:FRANGIBLE BOLT

FMEA NUMBER	ABBREVIATED FAILURE MODE DESCRIPTION	CIL FLG	CRIT	HS FL
P7-2B-CRW1-01	MECHANISM - FAILS TO START	X	1 1	
P7-2B-CRW1-02	MECHANISM - PREMATURE, FAST OR INADVERTENT OPERATION	X	1R2	

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SUBSYSTEM: SIDE HATCH JETTISON
LRC : FRANGIBLE BOLT
ITEM NAME: FRANGIBLE BOLT

CRITICALITY OF THIS
FAILURE MODE: 1R2

FAILURE MODE:
PREMATURE FRACTURE

MISSION PHASE:

LO LIFT-OFF
RTLS RETURN TO LAUNCH SITE
TAL TRANS ATLANTIC ABORT
AOA ABORT ONCE AROUND
ATO ABORT TO ORBIT
OO ON-ORBIT
DO DE-ORBIT
LS LANDING SEQUENCE

VEHICLE/PAYLOAD/KIT EFFECTIVITY:	102	COLUMBIA
:	103	DISCOVERY
:	104	ATLANTIS
:	105	NEW ORBITER

CAUSE:

EXCESSIVE PRELOAD DUE TO INSTALLATION OR CALIBRATION ERROR, MATERIAL DEFECT, IMPROPER MACHINING OF GROOVE.

CRITICALITY 1/1 DURING ANY MISSION PHASE OR ABORT? NO

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

PASS/FAIL RATIONALE:

A)

B)

C)

NO SINGLE FAILURE CAPABLE OF CAUSING MULTIPLE BOLT FAILURE.

METHOD OF FAULT DETECTION:

NONE.

CORRECTING ACTION: NONE

NO CORRECTIVE ACTION IS POSSIBLE.

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FAILURE MODES EFFECTS ANALYSIS (FMEA) NUMBER: P7-2B-CRW1-C2

- FAILURE EFFECTS -

(A) SUBSYSTEM:

ANALYSIS INDICATES THAT LOSS OF ONE BOLT HAS NO EFFECT ON STRUCTURAL INTEGRITY OF REMAINING BOLTS.

(B) INTERFACING SUBSYSTEM(S):

LOSS OF ONE BOLT RESULTS IN A JOINT GAPPING OF .0012 INCHES. REDUNDANCY AND SEALS WILL MAINTAIN CABIN PRESSURE.

(C) MISSION:

STRUCTURAL FAILURE OF SECOND BOLT COULD RESULT IN EARLY TERMINATION OF MISSION DUE TO INCREASED USE OF CREW MODULE CONSUMMABLES.

(D) CREW, VEHICLE, AND ELEMENT(S):

FAILURE OF SECOND BOLT COULD RESULT IN LOSS OF CREW/VEHICLE IF ATMOSPHERIC REVITALIZATION/PRESSURE CONTROL SYSTEM CANNOT COMPENSATE FOR LOSS OF CREW MODULE CONSUMMABLES FOR TIME NECESSARY FOR RE-ENTRY.

Criticality/

Required Fault Tolerance/Achieved Fault Tolerance: 1R/1/1

RATIONALE FOR CRITICALITY:

TWO FAILURES REQUIRED FOR EFFECT.

TIME FROM FAILURE TO CRITICAL EFFECT: IMMEDIATE

TIME FROM FAILURE OCCURRENCE TO DETECTION: IMMEDIATE

TIME FROM DETECTION TO COMPLETED CORRECTIVE ACTION: N/A

TIME REQUIRED TO IMPLEMENT CORRECTIVE ACTION LESS THAN TIME TO EFFECT? N/A

NO CORRECTIVE ACTION POSSIBLE.

- DISPOSITION RATIONALE -

(A) DESIGN:

LOSS OF ONE BOLT DOES NOT EFFECT CREW/VEHICLE. BOLT DESIGN (MATERIAL STRENGTH, CRITICAL DIMENSIONS) DICTATES A MINIMUM BREAKING STRENGTH OF 3400 LBS.

(B) TEST:

QUALIFICATION TEST: NONE.

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ACCEPTANCE TEST: DISCONTINUITIES EXAMINATION, HARDNESS, 100% PROOF TEST, MIN/MAX GROOVE DIAMETER VERIFICATION FOR EACH LOT ESTABLISHES MINIMUM BREAKING LOAD RANGE OF 3400/3500 LBS. RANDOM SAMPLE TENSILE STRENGTH TEST (5% OF LOT), RANDOM SAMPLE TORSIONAL STRENGTH TEST (5% OF LOT). TEST THREE (3) COUPONS FROM HEAT LOT.

SYSTEM TEST: ONE (1) INTEGRATED SYSTEM TEST (COLLAR, HINGE, THRUSTER) PRIOR TO STS-26. FIVE ADDITIONAL INTEGRATED SYSTEM TESTS PLANNED.

(C) INSPECTION:

RECEIVING INSPECTION

RAW MATERIAL IS VERIFIED BY INSPECTION TO ASSURE SPECIFIC SHUTTLE REQUIREMENTS ARE SATISFIED.

CONTAMINATION CONTROL

CONTAMINATION CONTROL AND CORROSION PROTECTION PROCESSES VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

OPERATIONS VERIFIED BY MIPS ON SHOP TRAVELER.

NONDESTRUCTIVE EVALUATION

ALL CRITICAL DIMENSIONS ARE INSPECTED.

CRITICAL PROCESSES

CRITICAL PROCESSES SUCH AS WELDING, PLATING, HEAT TREATING, PASSIVATION, AND ANODIZING ARE VERIFIED BY INSPECTION.

TEST

ATP IS VERIFIED BY INSPECTION.

STORAGE

STORAGE ENVIRONMENT VERIFIED BY INSPECTION.

HANDLING AND PACKAGING

HANDLING AND PACKAGING IS VERIFIED BY INSPECTION PER THE REQUIREMENTS OF APPLICABLE SPECIFICATIONS.

(D) FAILURE HISTORY:

NO FAILURE HISTORY.

(E) OPERATIONAL USE:

REMARKS:

- APPROVALS -

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NUMBER: P7-2B-CRW1-02

RELIABILITY ENGINEERING: C. FERRARELLA
DESIGN ENGINEERING : R. YEE
QUALITY ENGINEERING : E. GUTIERREZ
NASA RELIABILITY :
NASA DESIGN :
NASA QUALITY ASSURANCE :

: *C.F. Ferrarella 9/13/88*
: *R. Yee 9/11/88*
: *E. Gutierrez 9-27-88*
: *Thomas J. ... 9-27-88*
: *M.B. ...*