

PAGE: 1

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.

PAGE: 2

PRINT DATE: 09/12/88

FAILURE MODES EFFECTS ANALYSIS (FMEA)

NUMBER: P7-2B-CRW1-X

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	HC FL
P7-2B-CRW1-01	MECHANISM - FAILS TO START	X	1 1	
P7-2B-CRW1-02	MECHANISM - PREMATURE, FAST OR INADVERTENT OPERATION	X	1R2	

PAGE: 3

FAILURE MODES EFFECTS ANALYSIS (FMEA) NUMBER: P7-2B-CRW1-01

REVISION: 09/12/88

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

CRITICALITY OF THIS
FAILURE MODE: 1 1

FAILURE MODE:
FAILURE TO FRACTURE UPON DETONATION OF EITHER XTA'S.

MISSION PHASE:
RTLS RETURN TO LAUNCH SITE
TAL TRANS ATLANTIC ABORT
AOA ABORT ONCE AROUND
DO DE-ORBIT
LS LANDING SEQUENCE

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

CAUSE:
OVER-STRENGTH BOLT MATERIAL. IMPROPER MACHINING OF GROOVE.

CRITICALITY 1/1 DURING ANY MISSION PHASE OR ABORT? YES
AOA ABORT ONCE AROUND
DO DE-ORBIT
LS LANDING SEQUENCE
RTLS RETURN TO LAUNCH SITE
TAL TRANS ATLANTIC ABORT

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

PASS/FAIL RATIONALE:
A)

B)

C)

METHOD OF FAULT DETECTION:
NONE

CORRECTING ACTION: NONE
NO CORRECTIVE ACTION POSSIBLE.

FAILURE MODES EFFECTS ANALYSIS (FMEA) NUMBER: P7-2B-CRW1-01

- FAILURE EFFECTS -

(A) SUBSYSTEM:

FAILURE TO EFFECT SEPARATION OF THE COLLAR FROM THE ORBITER DURING CREW EMERGENCY ESCAPE.

(B) INTERFACING SUBSYSTEM(S):

FAILURE TO EFFECT SEPARATION OF THE HATCH FROM THE ORBITER DURING CREW EMERGENCY ESCAPE.

(C) MISSION:

NONE

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

LOSS OF CREW DUE TO INABILITY TO ESCAPE THROUGH SIDE HATCH.

Criticality/

Required Fault Tolerance/Achieved Fault Tolerance: 1/1/0:

RATIONALE FOR CRITICALITY:

ONE BOLT IS CAPABLE OF PREVENTING HATCH SEPARATION (DEPENDING ON ITS LOCATION). SUBSEQUENT FIRING OF THRUSTERS COULD SEPARATE HATCH BUT MAY RESULT IN AN IMPACT BETWEEN ORBITER AND HATCH. THIS IN TURN COULD CAUSE ERRATIC ORBITER TRAJECTORY AFFECTING SAFE EGRESS.

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:

EITHER EXPANDABLE TUBE ASSEMBLY FOR EACH COLLAR ASSEMBLY IS CAPABLE OF SEVERING ALL FRANGIBLE BOLTS WHEN LOADED AT 85% OF ITS MINIMUM ALLOWABLE CORE LOADING. BOLT DESIGN (MATERIAL STRENGTH AND CRITICAL DIMENSIONS) DICTATES A MAXIMUM BREAKING STRENGTH RANGE OF 3900 TO 4500 LBS.

PAGE: 5

PRINT DATE: 09/12/8

FAILURE MODES EFFECTS ANALYSIS (FMEA) NUMBER: P7-2B-CRW1-01

(B) TEST:
PRIOR TO STS-26

SYSTEM TEST - COLLAR SEVERANCE SYSTEM COMPONENT QUAL (10 FIRING), ONE
(1) INTEGRATED SYSTEM TEST.

ACCEPTANCE TEST - MIN/MAX GROOVE DIAMETER VERIFICATION FOR EACH LOT
ESTABLISHES MAX BREAKIN LOAD RANGE OF 3900 TO 4000 LBS, RANDOM SAMPLE
TENSILE STRENGTH TEST (5% OF LOT), RANDOM SAMPLE TORSIONAL STRENGTH
TEST (5% OF LOT), TENSILE TEST THREE (3) COUPONS FROM HEAT LOT.

LONG TERM
SYSTEM TEST - FIVE (5) ADDITIONAL INTEGRATED SYSTEM TESTS.

(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 TRAVELLER.

NONDESTRUCTIVE EVALUATION
ALL CRITICAL DIMENSIONS ARE INSPECTED.

TEST
ATP IS VERIFIED BY INSPECTION.

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

STORAGE
STORAGE ENVIRONMENT VERIFIED BY INSPECTION.

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

(D) FAILURE HISTORY:
NO FAILURE HISTORY.

(E) OPERATIONAL USE:
NONE.

PAGE: 6

FAILURE MODES EFFECTS ANALYSIS (FMEA)

NUMBER: P7-2B-CRW1-01

REMARKS:

- APPROVALS -

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

: C.F. Ferrarella for RSL 7/2/88
 : ~~W. Lee for h.c. O'Brien 9/17/88~~
 : ~~J.P. Sullivan~~
 : ~~W.D. ... 9-27-88~~
 : ~~Thomas ... 9-27-88~~
 : ~~...~~