

PAGE: 1

PRINT DATE:

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE
NUMBER: P2-3A-A4 -X**

SUBSYSTEM NAME: SEPARATION MECHANISMS - PYRO

REVISION: 1 03/27/95

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	AFT ATTACH FRANGIBLE NUT	SKD26100099-302

PART DATA

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
AFT ATTACH FRANGIBLE NUT**

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 2

FUNCTION:

IN CONJUNCTION WITH A BOLT, STRUCTURALLY TIES TOGETHER THE ORBITER/
EXTERNAL TANK (ET) AT TWO AFT ATTACH POINTS. FRACTURES UPON RECEIVING A
SHOCK OUTPUT FROM EITHER OR BOTH DETONATOR/BOOSTER CHARGES.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE
NUMBER: P2-3A-A4 - 01**

REVISION# 1 03/27/95

SUBSYSTEM NAME: SEPARATION MECHANISMS - PYRO

LRU: AFT ATTACH FRANGIBLE NUT

ITEM NAME: AFT ATTACH FRANGIBLE NUT

CRITICALITY OF THIS
FAILURE MODE: 1/1

FAILURE MODE:
PREMATURE FRACTURE, STRUCTURAL FAILURE

MISSION PHASE:
PL PRELAUNCH
LO LIFT-OFF

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

CAUSE:
MATERIAL DEFECT, FATIGUE, CORROSION, EXCESSIVE PRELOAD/LOW PRELOAD,
PREMATURE PYRO FIRING (CIL P2-3A-A8-2)

CRITICALITY 1/1 DURING INTACT ABORT ONLY? YES
LO
PL

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

PASS/FAIL RATIONALE:
A)
B)
C)

- FAILURE EFFECTS -

- (A) SUBSYSTEM:**
LOSS OF ORBITER/VET STRUCTURAL INTEGRITY AT AFT ATTACH POINT. EXCESSIVE
LOAD AND POSSIBLE PREMATURE FRACTURE AT OTHER ATTACH POINTS.
- (B) INTERFACING SUBSYSTEM(S):**
POSSIBLE DEGRADATION/LOSS OF ORBITER/VET UMBILICAL INTEGRITY
- (C) MISSION:**
POSSIBLE INABILITY TO REACH ORBIT

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE
NUMBER: P2-3A-A4 - 01**

(D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE

(E) FUNCTIONAL CRITICALITY EFFECTS:

-DISPOSITION RATIONALE-

(A) DESIGN:

DESIGN MARGIN EQUAL TO OR GREATER THAN 1.4. NUT MATERIAL IS INCONEL 718 TO RESIST CORROSION. ULTIMATE TENSILE STRENGTH 180-200 KSI.

(B) TEST:

DEVELOPMENT TEST: NUT (ONE SAMPLE) STRUCTURAL CAPABILITY EXCEEDED 1.6 LIMIT.

COMPONENT QUALIFICATION TESTS OF -301 NUT: SALT FOG, LIMIT AND ULTIMATE STRUCTURAL LOAD TEST WITH BENDING MOMENT. CERTIFICATION REQUIREMENTS (CR) 45-114-0018-0007.

COMPONENT DELTA QUALIFICATION TESTS OF -302 NUT: ULTIMATE LOAD TEST OF NUT WITH 581,400 LBS. AXIAL LOAD AND 75,215 IN-LB MOMENT. CR NO. EP-A-1-28100099-302.

SYSTEM QUALIFICATION TESTS OF -301 NUT: 8 SEPARATION SYSTEM FIRINGS, AMBIENT, PRE-LOADED TO FLIGHT CONDITION, STRUCTURAL LOAD TESTS TO LIMIT, LIMIT WITH JOINT TORQUE 2 DEGREES, AND 1.4 LIMIT. CR45-565201-001.

ACCEPTANCE TESTS: 100% HARDNESS, 100% OF LOT TO LIMIT PROOF LOAD WITH NO THREAD OR WEB DEFORMATION, LIMIT AND ULTIMATE LOAD (FAILURE REJECTS LOT), DYE PENETRANT. MATERIAL INTEGRITY VERIFIED BY TENSILE TEST COUPONS. CR45-114-0018-0007, ATP 8645; SKD26100099.

OMRSD: TURNAROUND TESTS INCLUDE - FIT CHECK/THREAD BINDING, ORBITER/VET MATING TORQUE VERIFICATION PER MLO302-0016 AND V072-565201, AND VERIFICATION OF ALL PARTS OF SEPARATION SYSTEM IN DEBRIS CONTAINERS. NEW HARDWARE INSTALLED EACH FLIGHT.

(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 AND STORAGE ENVIRONMENTS ARE MONITORED AND VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

SELECTED MANUFACTURING/ASSEMBLY STEPS ARE IDENTIFIED BY NASA AND QUALITY ASSURANCE AND VERIFIED BY GOVERNMENT INSPECTION MANDATORY INSPECTION POINTS (MIPS).

NONDESTRUCTIVE EVALUATION

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE
NUMBER: P2-3A-A4 - 01**

100% DYE PENETRANT BEFORE AND AFTER PROOF LOAD, 100% WEB THICKNESS
DIMENSIONAL VERIFICATION.

CRITICAL PROCESSES

ALL MANUFACTURING PROCESSES SUCH AS PLATING, HEAT TREATING, AND
PASSIVATION ARE VERIFIED BY INSPECTION.

STORAGE

STORAGE ENVIRONMENTS ARE MONITORED BY INSPECTION.

(D) FAILURE HISTORY:

NONE.

(E) OPERATIONAL USE:

NONE.

- APPROVALS -

PAE MANAGER : K. L. PRESTON
DESIGN ENGINEERING : P. YSON
PRODUCT ASSURANCE ENGR : D. MAYNE
NASA SSMA :
NASA SUBSYSTEM MANAGER :

Atell / on 3/21/95
PAE Yson 3-29-95
D.M. Mayne 3-27-95
Willi Edelwart 5-7-95
William C. Hoffman 5/2/95