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PRINT DATE:

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE  
NUMBER: P2-3A-A6 -X

SUBSYSTEM NAME: SEPARATION MECHANISMS - PYRO

REVISION: 1 03/27/95

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	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: DETONATOR .	SEB26100094
LRU	: BOOSTER CARTRIDGE	SKD26100099-402

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**PART DATA**

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**

TWO DETONATOR/BOOSTER CARTRIDGE SUBASSEMBLIES ARE INSTALLED IN EACH ORBITER/ET AFT ATTACH FRANGIBLE NUT (TWO FRANGIBLE NUTS PER VEHICLE). EACH DETONATOR/BOOSTER CARTRIDGE IS INDIVIDUALLY CAPABLE OF FRACTURING NUT WHEN DETONATOR IS ELECTRICALLY INITIATED.

**REFERENCE DESIGNATORS:**

**QUANTITY OF LIKE ITEMS: 4**

**FUNCTION:**

DELIVERS A SHOCK OUTPUT TO FRACTURE FRANGIBLE NUT WHICH, IN CONJUNCTION WITH A BOLT, STRUCTURALLY TIES TOGETHER THE ORBITER AND ET IN TWO PLACES AT THE AFT ATTACH POINTS.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : SEPARATION MECHANISMS-PYRO FMEA NO P2-3A -A6 -2 REV:10/09/87

ASSEMBLY : AFT ATTACH FRANGIBLE NUT CRIT. FUNC: 1  
P/N RI : SKD26100099-401 AND CRIT. HDW: 1  
: SEB26100094 VEHICLE 102 103 104  
QUANTITY : 4 EFFECTIVITY: X X X  
PHASE(S): PL X LO X OO DO LS

PREPARED BY: REDUNDANCY SCREEN: A- B- C-  
DES R. H. YEE APPROVED BY: 10/1/87 APPROVED BY (NASA):  
REL M. B. MOSKOWITZ DES *R. H. Yee for A.C. Ordway* SSM *RWH for T.J. Graves*  
QE E. M. GUTIERREZ REL *E.M. Gutierrez* & REL *Stacy T. ...*  
QE *E.M. Gutierrez 10/1/87* QE *Stacy T. ...*  
10-27-87

ITEM: DETONATOR/BOOSTER CARTRIDGE, ORBITER/ET AFT ATTACH

FUNCTION: DELIVERS A SHOCK OUTPUT TO FRACTURE THE FRANGIBLE NUT WHICH IN CONJUNCTION WITH A BOLT, STRUCTURALLY TIES TOGETHER THE ORBITER/EXTERNAL TANK (ET) IN TWO PLACES AT THE AFT ATTACH POINTS.

FAILURE MODE: INADVERTENT OPERATION

CAUSE(S): EXCESSIVE TEMPERATURE, ERRONEOUS SIGNAL TO NASA STANDARD INITIATOR (NSI)

EFFECT(S) ON: (A)SUBSYSTEM (B)INTERFACES (C)MISSION (D)CREW/VEHICLE  
(A,B,C,D) LOSS OF CREW/VEHICLE.

DISPOSITION & RATIONALE: (A)DESIGN (B)TEST (C)INSPECTION (D)FAILURE HISTORY (E)OPERATIONAL USE

(A) DESIGN  
DETONATOR/BOOSTER USES RDX EXPLOSIVE MIX FOR HI-TEMP PROTECTION. NSI MEETS EMI COMPATIBILITY PER MC999-0002. FIRING CIRCUITRY CONSISTS OF TWISTED SHIELDED PAIRS FOR ELECTROMAGNETIC INTERFERENCE (EMI) AND RADIO FREQUENCY INTERFERENCE (RFI) PROTECTION. PYRO INITIATOR CONTROLLER (PIC) IS TWO FAILURE TOLERANT FOR PROTECTION AGAINST AN ERRONEOUS OUTPUT.

(B) TEST  
QUALIFICATION TESTS: DETONATOR ORIGINALLY QUALIFICATION TESTED FOR APOLLO IN 1965. ADDITIONALLY QUALIFIED FOR ORBITER AFT ATTACH PER CERTIFICATION REQUIREMENTS (CR) 45-565201. AUTOIGNITION TEST VERIFIED NO FIRE WHEN EXPOSED TO 340 DEG F FOR 1 HOUR (MAXIMUM EXPECTED FLIGHT TEMPERATURE IS +200 DEG F). NSI HAS BEEN QUALIFIED TO A NO FIRE CONDITION WHEN SUBJECTED TO 1 WATT/1 AMP FOR 5 MINUTES. CR-45-114-0018-0007.

DESIGN VERIFICATION TEST: NSI AND WIRING WAS TESTED FOR CLOSE PROXIMITY RFI SUSCEPTIBILITY PRIOR TO APOLLO-SOYUZ TEST PROJECT (ASTP).

## SHUTTLE CRITICAL ITEMS LIST - ORBITER

SYSTEM : SEPARATION MECHANISMS-PYRO FMEA NO P2-3A -A6 -2 REV:10/09/87

ACCEPTANCE TESTS: ACCEPTANCE TESTS INCLUDE TENSILE TEST (3 COUPONS FROM SAME HEAT TREAT), EXAMINATION OF PRODUCT (WEIGHT, WORKMANSHIP, FINISH, DIMENSIONS, CONSTRUCTION, AND CERTIFIED M&P). BRIDGE WIRE RESISTANCE AND 50 VOLT INSULATION RESISTANCE TEST FOR NSI. NEUTRON AND X-RAY (PRESENCE OF EXPLOSIVE MIX, NO FOREIGN MATERIAL, AND PROPER ASSEMBLY), LEAKAGE (1 X 10 TO-6CC PER SEC HELIUM), AND WEIGHT (PYRO CHARGE AND ALL OTHER CARTRIDGE PARTS WEIGHED PRE- AND POST-ASSEMBLY. TOTALS MUST BE WITHIN SPECIFIED TOLERANCE). CR-45-114-0018-0007, ATP 5044, ATP 8634; IKD26100099.

MRSD: TURNAROUND TESTS INCLUDE - FIRING LINE RESISTANCE CHECK, PYRO INITIATOR CONTROLLER (PIC) GO AND NO-GO RESISTANCE TESTS, POWER OFF/ON STRAY VOLTAGE TESTS, PIC RESISTANCE TEST ON EACH INSTALLED NSI POST HOOKUP), PRE-INSTALLATION PYRO INITIATOR ELECTRICAL TEST, PYRO FIRING CIRCUITRY VERIFICATION, AND ISOLATION HI-POT VERIFICATION.

### INSPECTION

#### REIVING INSPECTION

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

#### CONTAMINATION CONTROL

CONTAMINATION CONTROL AND CORROSION PROTECTION PROCESSES 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).

#### DESTRUCTIVE EVALUATION

CARTRIDGE PARTS ARE X-RAYED AND N-RAYED TO VERIFY CORRECT ASSEMBLY AND PRESENCE OF ALL DETAIL PARTS AND EXPLOSIVES. X-RAYS AND N-RAYS ARE REVIEWED BY ENDOR, DCAS AND NASA QUALITY AND ENGINEERING.

#### CRITICAL PROCESSES

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

#### STORAGE

STORAGE ENVIRONMENT VERIFIED BY INSPECTION.

#### FAILURE HISTORY

NO HISTORY OF PREMATURE FIRINGS INCLUDING SATURN AND APOLLO.

#### OPERATIONAL USE

NONE.