

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : SEPARATION MECHANISMS-PYRO FMEA NO P2-3A -U1 -2 REV:10/09/87

ASSEMBLY : UMBILICAL PLATE SEPARATION CRIT. FUNC: 1  
 P/N RI : SEB26100094 CRIT. HDW: 1  
 VENDOR P/N: VEHICLE 102 103 104  
 QUANTITY : 12 EFFECTIVITY: X X X  
 : SIX PER SIDE PHASE(S): PL X LO X CO 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. GRAVES*  
 QE E. M. GUTIERREZ QE *J. J. [unclear]* 10-27-87

ITEM: DETONATOR, FRANGIBLE NUT

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

FAILURE MODE: ADVERTENT 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 USES RDX AND LEAD AZIDE 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 UMBILICAL ATTACH PER CERTIFICATION REQUIREMENT (CR) 45-565330 AND WITH THE 3/4 INCH FRANGIBLE NUT AUTOIGNITION TEST VERIFIED NO FIRE WHEN EXPOSED TO 340 DEG F FOR 1 HOUR (MAXIMUM EXPECTED TEMPERATURE IS AMBIENT). NSI HAS BEEN QUALIFIED TO NO FIRE CONDITION WHEN SUBJECTED TO 1 WATT/1 AMP FOR 5 MINUTES. CR-45-4-0018-0003, CR-45-453-0021-0009; SKB26100097.

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

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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). BRIDGEWIRE RESISTANCE AND 50 VOLT INSULATION RESISTANCE TEST FOR NSI. NEUTRON AND X-RAY (PRESENCE OF EXPLOSIVE MIX, NO FOREIGN MATERIAL, AND PROPER ASSEMBLY). LEAKAGE ( $1 \times 10^{-6}$  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-45-453-0021-0009, ATP 5044; SKB26100097.

OMRSD: 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.

### (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

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 VENDOR, 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.

### (D) FAILURE HISTORY

NO FAILURE HISTORY OF PREMATURE FIRINGS INCLUDING SATURN AND APOLLO.

### (E) OPERATIONAL USE

NONE.