

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : SEPARATION MECHANISMS-PYRO FMEA NO P2-3A -U1 -1 REV:10/09/87

ASSEMBLY : UMBILICAL PLATE SEPARATION CRIT. FUNC: 1R  
 P/N RI : SEB26100094 CRIT. HDW: 2  
 VENDOR P/N: VEHICLE 102 103 104  
 QUANTITY : 12 EFFECTIVITY: X X X  
 : SIX PER SIDE PHASE(S): PL LO X OO DO LS

PREPARED BY: REDUNDANCY SCREEN: A-N/A B-N/A C-PASS  
 DES R. H. YEE APPROVED BY: 10/11/87 APPROVED BY (NASA):  
 REL M. B. MOSKOWITZ DES *R. H. Yee for h.c. Ordway* SSM *RWH for T. GAMES*  
 QE E. M. GUTIERREZ REL *R. H. Yee* QE *Steve T. Nelson*

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:  
 FAILS TO FUNCTION OR LOW-ORDER FIRING

CAUSE(S):  
 LOSS OF INPUT - ELECTRICAL/NASA STANDARD INITIATORS (NSI'S), STRUCTURAL FAILURE OF THREADS AT NSI INTERFACE, CONTAMINATION OR IMPROPER LOADING OF PYRO MIXTURE, HANDLING DAMAGE

EFFECT(S) ON:  
 (A)SUBSYSTEM (B)INTERFACES (C)MISSION (D)CREW/VEHICLE  
 (A) LOSS OF REDUNDANCY.  
 (B,C,D) NONE; REDUNDANT MEANS AVAILABLE TO ACCOMPLISH FUNCTION. DUAL FAILURE RESULTS IN LOSS OF CREW/VEHICLE.

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

(A) DESIGN  
 USING DEVICE (FRANGIBLE NUT) UTILIZES TWO (REDUNDANT) DETONATORS. EACH DETONATOR IS DESIGNED TO FRACTURE A NUT WITH A WEB THICKNESS 20% GREATER THAN SPECIFIED. MATERIAL IS A286 CRES FOR CORROSION PROTECTION. EXPLOSIVE MIX IS RDX AND LEAD AZIDE.

(B) TEST  
 COMPONENT QUALIFICATION TESTS: SALT FOG, SHOCK, VIBRATION, THERMAL CYCLING, HIGH TEMPERATURE FIRING AT ALTITUDE, 8 FOOT DROP TEST, SAND/DUST, HIGH/LOW/AMBIENT AND CRYOGENIC (-450 DEG F) FIRINGS. CERTIFICATION REQUIREMENTS (CR) 45-114-0018-0003, CR-45-453-0021-0009; SKB26100097.

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ASSEMBLY QUALIFICATION TESTS: 26 FIRED IN CONJUNCTION WITH 3/4 INCH NUT QUALIFICATION (-200 DEG F/-400 DEG F/AMBIENT); SALT FOG, VIBRATION/LOW TEMPERATURE, SINGLE DETONATOR 120% WEB MARGIN FIRING, LIMIT AND ZERO APPLIED LOADS FIRINGS. CR-45-114-0018-0003.

DELTA QUALIFICATION FOR SRB: VIBRATION AND SHOCK. CR-45-453-0021-0009.

SYSTEM QUALIFICATION TESTS: 8 FIRINGS CRYOGENIC TEMPERATURE WITH FLIGHT PRELOAD 55 K-LB. (UMBILICAL SEPARATION). CR-45-565330.

ACCEPTANCE TESTS: HELIUM LEAK TEST, N-RAY AND X-RAY (PRESENCE AND PROPER ORIENTATION OF PARTS), WEIGHT RECORDS FOR EXPLOSIVE MIX, LOT FIRING TEST ON RANDOM SAMPLES, INSULATION RESISTANCE, NSI BRIDGEWIRE RESISTANCE TEST, TENSILE TEST COUPONS FOR BODY. CR-45-453-0021-0009, ATP 5044; SKB26100097.

PYRO VERIFICATION TEST: SAMPLE LOT FIRING YEARLY AT KSC UNTIL AGE LIFE EXPIRES.

OMRSD: TURNAROUND TESTS INCLUDE - PYRO INITIATOR CONTROLLER (PIC) RESISTANCE CHECK, CIRCUIT CHECKOUT, UMBILICAL WIRE HARNESS INTEGRITY, NSI PREFLIGHT BRIDGEWIRE CHECK, POST-FLIGHT UNFIRED ORDNANCE INSPECTION, VERIFY WIRE LOOP FOR MOTION ALLOWANCE, AND VERIFICATION OF ALL PARTS OF SEPARATION SYSTEM IN DEBRIS CONTAINERS. NEW HARDWARE INSTALLED EACH FLIGHT.

### ) INSPECTION

#### RECEIVING INSPECTION

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

#### CONTAMINATION CONTROL

CONTAMINATION CONTROL AND CORROSION PROTECTION PROCESS 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, 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.

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TESTING

DESTRUCTIVE LOT ACCEPTANCE TESTING BY SAMPLE SIZE VERSUS LOT SIZE.

(D) FAILURE HISTORY

FOR DETONATOR FAILURES ATTRIBUTABLE TO NSI-1, (SEE NSI CIL 02-5-J05-1)  
REF. FIAR NO. HBC0108.

(E) OPERATIONAL USE

NONE.