FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE
NUMBER: P2-1G-DRG3-X

SUBSYSTEM NAME: LANDING DECELERATION - DRAG PARACHUTE
REVISION : 2 02/06/92

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU :	PILOT MORTAR CARTRIDGE IRVIN/UNIDYNAMICS	MC621-0076-0003 BI4000

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

QUANTITY OF LIKE ITEMS: 1
ONE

FUNCTION:
THE DUAL INITIATOR SINGLE CARTRIDGE DELIVERS A GAS PRESSURE OUTPUT INTO A BREECH STRUCTURE. THE BREECH DELIVERS A SUSTAINED PRESSURE INTO THE MORTAR TUBE SUFFICIENT TO EXPEL THE SABOT/PILOT CHUTE COMBINATION, OPEN THE DOOR AND PROVIDE THE NECESSARY EXIT VELOCITY TO CLEAR THE ORBITER LOWER TAIL SURFACE/SSME RESULTING IN FULL PILOT CHUTE DEPLOYMENT. EITHER INITIATOR CAN IGNITE THE CARTRIDGE.

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SUBSYSTEM: LANDING DECELERATION - DRAG PARACHUTE
LRU :PILOT MORTAR CARTRIDGE
ITEM NAME: PILOT MORTAR CARTRIDGE

CRITICALITY OF THIS FAILURE MODE:1/1

FAILURE MODE:
PREMATURE OPERATION

MISSION PHASE:
LO LIFT-OFF
DO DE-ORBIT

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

■ CAUSE:
EXCESSIVE TEMPERATURE, PREMATURE NSI OUTPUT

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

■ (A) SUBSYSTEM:
PILOT CHUTE DEPLOYED PREMATURELY (DURING LIFT-OFF OR DURING LANDING AT 135 FT. TO 40 FT. ALTITUDE).

(B) INTERFACING SUBSYSTEM(S):
DRAG CHUTE DEPLOYED PREMATURELY

(C) MISSION:
SEE (D)

(D) CREW, VEHICLE, AND ELEMENT(S):
THE ATTACH/JETTISON MECHANISM SHEAR PIN IS DESIGNED TO SHEAR RESULTING IN AUTOMATIC RELEASE OF THE DRAG CHUTE BETWEEN 106,000 AND 125,000 POUNDS LOAD. THIS PROTECTS THE ORBITER FROM SUDDEN AIR SPEED LOSS DUE TO PREMATURE DEPLOYMENT DURING DE-ORBIT EXCEPT FOR TWO SCENARIOS: 1) BETWEEN 135 AND 40 FEET ALTITUDE (APPROXIMATE) PRIOR TO WHEEL TOUCHDOWN THERE MAY BE INSUFFICIENT LOADS TO AUTOMATICALLY RELEASE THE DRAG CHUTE. THERE MAY BE INSUFFICIENT TIME FOR THE CREW TO REACT AND MANUALLY JETTISON THE DRAG CHUTE. THE SUDDEN AIR SPEED LOSS COULD RESULT IN LOSS OF CREW AND VEHICLE. 2) AT HIGH ALTITUDES THE RARIFIED ATMOSPHERE MAY PROVIDE INSUFFICIENT LOADS FOR AUTOMATIC RELEASE, HOWEVER, THE CREW WOULD HAVE SUFFICIENT TIME TO MANUALLY JETTISON THE DRAG CHUTE AND TO RECOVER FROM THE AIR SPEED LOSS.

(E) FUNCTIONAL CRITICALITY EFFECTS:
IF FAILURE WERE TO OCCUR DURING THE FIRST TWO MINUTES OF ASCENT (SRB BURN), THE DRAG CHUTE WOULD BURN AND HAVE NO EFFECT ON VEHICLE. AFTER THE SRB BURN THE VEHICLE HAS AN ALTITUDE OF APPROXIMATELY 130,000 FEET. AT THIS ALTITUDE THERE IS INSUFFICIENT ATMOSPHERE TO INFLATE THE CHUTE AND IT COULD SIMPLY BE JETTISONED. HOWEVER, THE MORTAR COULD DAMAGE THE ENGINE BELL RECIRCULATION LINES AND RESULT IN LOSS OF CREW/VEHICLE IF PREMATURELY DEPLOYED DURING ASCENT.

- DISPOSITION RATIONALE -

(A) DESIGN:
PRESSURE CARTRIDGE FIRING CIRCUITRY CONSISTS OF TWISTED SHIELDED PAIRS FOR ELECTROMAGNETIC INTERFERENCE (EMI) AND RADIO FREQUENCY INTERFERENCE (RFI) PROTECTION. NSI MEETS EMI COMPATIBILITY PER MC999-0002 AND RFI PER AFETRM 127-1. PYRO INITIATOR CONTROLLER (PIC) IS TWO FAILURE TOLERANT FOR PROTECTION AGAINST AN ERRONEOUS OUTPUT.

(B) TEST:
QUALIFICATION TESTS: SIXTEEN PILOT MORTAR CARTRIDGES WILL BE SUBJECTED TO A TOTAL OF 12 FIRING TESTS IN MORTARS AND FOUR DROP TESTS. QUALIFICATION TESTS INCLUDE RANDOM VIBRATION FOR 6.64 MINUTES IN EACH OF THREE ORTHOGONAL AXES; THERMAL CYCLING BETWEEN -120 F AND +170 F; THREE AMBIENT TEMPERATURE FIRING TESTS, THREE HIGH TEMPERATURE FIRING TESTS AT +180 F, FOUR LOW TEMPERATURE FIRING TESTS AT -85 F, ONE FIRING TEST WITH MARGINAL PROPELLANT LOADING AND ONE STRUCTURAL MARGIN FIRING TEST. THREE CARTRIDGES WILL BE SUBJECTED TO EIGHT FOOT DROP TEST AND ONE CARTRIDGE TO FORTY FOOT DROP TEST.

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NSI AUTOIGNITION TEST WAS +425 F FOR ONE HOUR (MAXIMUM EXPECTED FLIGHT ENVIRONMENT IS +160 F). NSI WAS QUALIFIED TO A NO-FIRE CONDITION WHEN SUBJECTED TO 1 WATT/1 AMP FOR FIVE MINUTES. PRESSURE CARTRIDGE WAS SUBJECTED TO +245 F FOR ONE HOUR TO VERIFY NO AUTOIGNITION.

DESIGN VERIFICATION TEST: NSI AND WIRING WAS TESTED FOR CLOSE PROXIMITY RFI SUSCEPTIBILITY PRIOR TO APOLLO-SOYUZ TEST PROJECT (ASTP). JSC REPORT #EMC-R-PH-002,2/7.

ACCEPTANCE TESTS: 100% INTERNAL PROOF PRESSURE TENSILE TEST, 3 COUPONS ARE TESTED FROM SAME HEAT TREAT, EXAMINATION OF PRODUCT (WEIGHT, WORKMANSHIP, FINISH, DIMENSIONS, CONSTRUCTION, CERTIFIED MATERIALS AND PROCESSES). 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 (0.000001 CC/SEC HELIUM), AND WEIGHT (PYRO CHARGE AND ALL OTHER CARTRIDGE PARTS WEIGHED PRE- AND POST-ASSEMBLY. TOTALS MUST BE WITHIN SPECIFIED TOLERANCE).

OMRSD: GROUND TURNAROUND INCLUDES PYRO INITIATOR CONTROLLER (PIC) RESISTANCE TEST (POST HOOKUP), PIC GO/NO-GO RESISTANCE TEST (PRE-HOOKUP), POWER OFF STRAY VOLTAGE CHECK, POWER ON STRAY VOLTAGE CHECK, NSI ELECTRICAL VERIFICATION.

(C) INSPECTION:
RECEIVING INSPECTION
RAW MATERIAL IS VERIFIED BY INSPECTION TO ASSURE SPECIFIED SHUTTLE REQUIREMENTS ARE SATISFIED.

CONTAMINATION CONTROL
CONTAMINATION CONTROL AND CORROSION PROTECTION PROCESSES ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
PARTS ARE X-RAYED AND N-RAYED TO VERIFY CORRECT ASSEMBLY AND PRESENCE OF ALL DETAIL PARTS AND EXPLOSIVES. VISUAL INSPECTION, IDENTIFICATION PERFORMED, AND PARTS PROTECTION VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
X-RAYS AND N-RAYS ARE REVIEWED BY VENDOR, DCAS, NASA QUALITY, AND ENGINEERING.

CRITICAL PROCESSES
SELECTED MANUFACTURING/ASSEMBLY STEPS ARE IDENTIFIED BY NASA QUALITY ASSURANCE AND VERIFIED BY GOVERNMENT INSPECTION AS MANDATORY INSPECTION POINTS (MIPS). ALL MANUFACTURING PROCESSES, SUCH AS WELDING, PLATING, HEAT TREATING, PASSIVATION, AND ANODIZING ARE VERIFIED BY INSPECTION.

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HANDLING/PACKAGING
STORAGE ENVIRONMENTS ARE MONITORED AND VERIFIED BY INSPECTION.

ACCEPTANCE
ROCKWELL SOURCE INSPECTION WITNESSES ACCEPTANCE TESTING.

■ (D) FAILURE HISTORY:
NONE

□ (E) OPERATIONAL USE:
NONE

- APPROVALS -

RELIABILITY ENGINEERING	D. M. MAYNE	D.M. Mayne
DESIGN ENGINEERING	C. LOWRY	
QUALITY MANAGER	O. J. BUTTNER	2/26/92
NASA RELIABILITY		2/25/92
NASA SUBSYSTEM MANAGER		
NASA QUALITY ASSURANCE		2-25-92