

SRB CRITICAL ITEMS LIST

SUBSYSTEM: SEPARATION

ITEM NAME: NASA Standard Detonator, NSD, Forward and AFT BSMs

PART NO.: SEB 26100094-201

FM CODE: A02

ITEM CODE: 30-01-01, 30-02-01

REVISION: Basic

CRITICALITY CATEGORY: 1

REACTIONTIME: Immediate

NO. REQUIRED: 2 Forward and 2 Aft

DATE: March 31, 1998

CRITICAL PHASES: Boost

SUPERCEDES: March 1, 1994

FMEA PAGE NO.: B-4, B-29

ANALYST: Bob White/V. Patel

SHEET 1 OF 5

APPROVED: P. Kalia

FAILURE MODE AND CAUSES: Premature Operation caused by:

- o Electromagnetic interference
- o Shock/vibration
- o High temperature
- o Increased sensitivity due to contamination
- o Electrostatic discharge

FAILURE EFFECT SUMMARY: Premature firing of the aft or forward separation motors results in loss of required separation thrust at separation leading to loss of mission, vehicle and crew.

RATIONALE FOR RETENTION:

A. DESIGN

- o The NSD is GFE supplied by Johnson Space Center (JSC) and consists of a NASA Standard Initiator (NSI) (SEB26100001) with a backup ring welded to the body of the NASA Standard Detonator. The NSI is controlled by specification SKB26100066 and drawing SEB26100001. The NSD design is controlled by drawing SEB26100094 and specification SKB26100097. 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.
- o The NSD is able to withstand a model lightning flash without jeopardizing the strength or function required to safely continue the mission per National Space Transportation System (NSTS)-07636. The NSD is electrically bonded to the SRB structure through its mating pyrotechnic component. The electrical bonding resistance is required to be less than 2.5 milliohms across each interface per NSTS 07636.

The NSD will withstand 25,000 volt electrostatic discharge between both pins shorted together and the NSD body per JSC specification SKB26100066.

- o Electromagnetic control measures are defined by MSFC Electromagnetics Effects Control Plan 10PLN-0067.
- o The NSD will not ignite when the bridgewire is subjected to a dc current of 1 amp for 5 minutes or a dc power of 1 watt for 5 minutes within the temperature range of 300°F to -260°F per JSC specification SKB26100066.
- o Lightning protection requirements are specified by NSTS 07636, Lightning Protection Criteria Documents.
- o 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°F for one hour (maximum expected temperature is ambient). NSI has been qualified to a no fire condition when subjected to 1 watt/1 amp for 5 minutes. CR-45-114-0018-0003, CR-45-453-0021-0009; SKB26100097.

- o The NSI passed exposure to test currents of 40 kiloamperes. The PIC/cable/NSI combination tested with no failures to at least 640 volts during lightning test on the shuttle SRB nozzle severance system. L&T report 629
- o Design Verification Tests:

NSI and wiring was tested for close proximity RFI susceptibility prior to Apollo-Soyuz Test Project (ASTP).

## B. TESTING

### VENDOR RELATED TESTING

- o 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 ( $1 \times 10^{-6}$  CC 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; SKB2610097. (Contamination)

### KSC RELATED TESTING

- o Integrated Power "ON" Stray Voltage Test is checked per OMRSD File II, Vol. 1, requirement numbers S00000.140. (EMI, Electrostatic Discharge)

- o Integrated Power "OFF". Stray Voltage Test is checked per OMRSD File II, Vol. 1, requirement number S00GEN.635. (EMI, Electrostatic Discharge)
- o GO PIC test with live pyrotechnics per OMRSD File II, Volume 1, requirement no. S00000.410. (EMI, Electrostatic Discharge)
- o GO PIC test with live pyrotechnics during launch countdown per OMRSD File II, Volume 1, requirement no. S00FAU.015. (EMI, Electrostatic Discharge)

C. INSPECTION

VENDOR RELATED INSPECTION

- o Receiving Inspection  
Raw material is verified by inspection to assure specific shuttle requirements are satisfied. (Contamination)
- o Contamination Control  
Contamination control and corrosion protection processes and storage environments are monitored and verified by inspection. (Contamination)
- o Assembly/Installation  
Selected manufacturing/assembly steps are identified by NASA and Quality Assurance and verified by Government inspection mandatory inspection points (MIPS). (All Failure Causes)
- o 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, DCMC, and NASA Quality and Engineering. (Contamination)
- o Critical Processes  
All manufacturing processes such as welding, plating, heat treating, passivation and anodizing are verified by inspection. (Electrostatic Discharge)
- o Storage  
Storage environment verified by inspection. (Contamination/High Temperature)

#### KSC RELATED INSPECTION

- o Receiving inspection verifies that the NSDs have been flight certified by JSC as required by NSTS 08060 per OMRSD File V, Volume 1, requirement no. B000FL.002. (All Failure Causes)
- o Verification that insulation resistance test is acceptable per OMRSD File V, Volume 1, requirement no. B000FL.001. (Electrostatic Discharge)
- o Inspection for damage and contamination per OMRSD File V, Volume 1, requirement no. B000FL.001. (Contamination)
- o Bonding between all metallic faying surfaces is verified per OMRSD File V, Volume 1, requirement no. B75000.020. (Electrostatic Discharge)
- o Shelf life is verified by SPC Quality per OMRSD File II, Volume 3, Table no. C00CA0.040-000. (Increased Sensitivity due to Contamination)

#### D. FAILURE HISTORY

- o Failure Histories may be obtained from the PRACA database.

#### E. OPERATIONAL USE

- o Not applicable to this failure mode.