

SRB CRITICAL ITEMS LIST

SUBSYSTEM: STRUCTURES AND MISCELLANEOUS ITEMS

ITEM NAME: Thermal Protection System - Aft BSM Case

PART NO.: 10317-0002

FM CODE: A01

ITEM CODE: 60-03-06

REVISION: Basic

CRITICALITY CATEGORY: 1

REACTION TIME: Seconds

NO. REQUIRED: 4

DATE: March 1, 2001

CN 042

CRITICAL PHASES: Boost

SUPERCEDES: March 31, 1998

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FMEA PAGE NO.: E-34

ANALYST: W. Keller/ S. Parvathaneni

SHEET 1 OF 6

APPROVED: S. Parvathaneni

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FAILURE MODE AND CAUSES: Loss of Aft BSM Case thermal protection caused by:

- O Degraded thermal or physical properties due to improper constituents, formulation, mixing, application, cure or natural environments. (Degraded Properties)
- O Inadequate TPS thickness. (Inadequate Thickness)
- O Debonding due to improper application of substrate paint system, improper substrate preparation, adhesive failure or improper application of insulation topcoat. (Debonding)

FAILURE EFFECT SUMMARY: Loss of mission, vehicle and crew due to damage to ET or Orbiter from impact with BSM TPS fragments or loss of required thrust at separation leading to re-contact of SRB with ET/Orbiter.

RATIONALE FOR RETENTION:

A. DESIGN

Design Specification is USA SRBE 10SPC-0067.

- O The Aft BSM Case is insulated with 0.25 inch thick cork bonded with EC-2216 B/A gray adhesive. Closeout and repair are accomplished with BTA or K5NA/RT 455 (ALT.) ablaters after installation. CN 042
- O Thermal protection requirements are presented in SE-019-068-2H, (SRB Thermal Design Data Book). Thermal insulation requirements were established by test and analysis.
- O Material properties were determined by development testing at the MSFC modified Hot Gas Facility and AEDC and Ames wind tunnels. The range of thermal environment, acoustic and vibration, and stress loads were obtained from applicable documentation and encompassed the maximum and

minimum values. Design properties derived from these tests are reported in SE-019-068-2H.

- O Verification testing was performed per "SRB/TPS Verification Test Plan," NASA Letters EP44(79-54), EP44(79-79), EP44(79-120) and EE11 (S-80-34) using analytically determined TPS material thicknesses, maximum heat loads and rates for the applicable regions, and representative model configurations. Subsequent changes in TPS materials were verified on an individual basis using current environments and loads. (e.g. Addition of BTA as an alternate material to K5NA/RT 455 (ALT.) was authorized by approval of ECP-2850F.) Subsequent changes in SRB environments were reviewed to verify that original verification parameters were not exceeded. CN 042

- O Certification was performed per document SE-019-149-2H, (SRB/TPS Certification Plan). Subsequent changes in TPS materials and/or thickness will be certified based on verification test results. Changes to certification requirements (environments and/or loads) are reviewed to verify that existing requirements are not exceeded.

- O The following Certificates of Qualification (COQs) are applicable to the TPS materials required:

Cork/EC-2216 B/A gray

- Adhesive - USA SRBE COQ A-TPS-8109
- K5NA - USA SRBE COQ A-TPS-8108
- BTA - USA SRBE COQ A-TPS-8120
- RT 455 - USA SRBE COQ A-TPS-8130

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- O The Aft BSM Case is insulated with 0.25 inch thick cork bonded with EC-2216 B/A gray adhesive. Cork is coated with vinyl primer and vinyl topcoat. After assembly to the aft skirt and support brackets, uninsulated areas of the motors and supports are closed out with BTA, or K5NA/RT 455 (ALT.). Close-out is coated with chlorosulfonated polyethylene paint. CN 042

B. TESTING

- O All listed vendor related tests are witnessed or monitored by vendor (or sub-tier vendor) QA personnel. When no designated QA organization exists at vendor, tests are witnessed/monitored by CSD QA personnel or tests are evaluated for compliance with specification requirements by CSD personnel.
- O All listed KSC related tests are witnessed or monitored by USA SRBE or SPC personnel.
- O Paint adhesion strength tests and porta-pull tests are performed to verify acceptability of cork/EC-2216 B/A gray materials, substrate paint, adhesive formulation, mixing, processing and cure. (Degraded Properties/Debonding)
- O BTA acceptability is verified per 10REQ-0021, para 4.1.2

- o To verify acceptability of BTA constituents, formulation, mixing, application and cure, three tensile specimens and two density coupons are prepared and tested from at least one batch mixed, for each day of BTA processing. Hardness is measured on the density coupons and on the flight hardware. (Degraded Properties)
- O K5NA/RT 455 (ALT.) acceptability is verified per OMRSD File V, Vol. I, requirement no. B09GEN.010, 10REQ-0021 para. 4.1.3 and MSFC-SPEC-1918/MSFC-SPEC-1919. CN 042
- o To verify acceptability of K5NA/RT 455 (ALT.) constituents, formulation, mixing, application and cure for each lot of K5NA/RT 455 (ALT.) submitted for acceptance, vendor performs tests such as tensile, hardness, specific gravity and thermogravimetric analysis (TGA). (Degraded Properties) CN 042
- o To verify acceptability of K5NA/RT 455 (ALT.) constituents, formulation, mixing application and cure for production hardware, three tensile specimens are prepared and tested from at least one batch mixed, for each day of K5NA/RT 455 (ALT.) processing. Hardness is verified for each batch and on the hardware. (Degraded Properties). CN 042

C. INSPECTION

- o All listed vendor related inspections are conducted 100% by vendor (or sub-tier vendor) QA personnel. Where no designated QA organization exists at a vendor, inspections are witnessed/monitored by CSD QA personnel or inspection records are evaluated for compliance with quality system requirements by CSD QA personnel.
- o All listed KSC related inspections are conducted 100% by USA SRBE or SPC personnel.

VENDOR RELATED INSPECTIONS

Inspections to verify the processing and application of vendor insulation materials with SIP 1141: (Degraded Properties)

- O BSM Case cork insulation and topcoat are visually inspected. Insulation materials are accepted on the basis of supplier certification. (Degraded Properties)
- O Cork thickness inspected. (Inadequate Thickness/Debonding)

KSC RELATED INSPECTION

- O BTA acceptability is verified per 10REQ-0021 para. 4.1.2.
  - o Preparation of surfaces to be insulated: verify that the surface is abraded, clean and dry before insulation application is made. (Debonding)
  - o Formulation of each mix of BTA insulation: verify formulation are mixing of basic ingredients. (Degraded Properties)
  - o Completion of cure: verify BTA material is cured and ready for subsequent operations based on three hardness tests. (Degraded Properties)
  - o Finishing and Inspection: Verify that the BTA after cure is free of defects such as unacceptable sags, voids, cracks and holes. (Degraded Properties)

- o Thickness and integrity of application: Verify BTA applications for compliance with drawing requirements or that the BTA thickness is equal to adjacent insulation thickness and has a smooth surface finish. (Inadequate Thickness)
  
- O K5NA/RT 455 (ALT.) acceptability is verified per 10REQ-0021, para. 4.1.3. CN 042
  
- o Preparation of surfaces to be insulated: verify that the surface is abraded, clean and dry before insulation application is made. (Debonding)
  
- o Verification of the formulation of each lot of K5NA/RT 455 (ALT.) insulation received. (Degraded Properties) CN 042
  
- o Application of K5NA/RT 455 (ALT.): verify that K5NA/RT 455 (ALT.) is applied within the application life. (Degraded Properties) CN 042
  
- o Completion of cure: verify hardness meets Durometer type D 15 minimum. (Degraded Properties)
  
- o Thickness and integrity of application: verify K5NA/RT 455 (ALT.) applications for compliance with drawing requirements or that the K5NA/RT 455 (ALT.) thickness is equal to adjacent insulation thickness and has a smooth surface finish. (Inadequate Thickness) CN 042
  
- O Perform TPS assessment walkdown inspection prior to rollout per OMRSD File V, Vol. I, requirement number B09TP0.010
  
- o Visually assess the TPS (Cork, K5NA/RT 455 (ALT.), SLA-220, Glass Phenolic Laminate, etc.) to identify possible degradation or damage. (Degraded Properties) CN 042

- O Visual inspection verifies the integrity of TPS and/or TPS topcoat on the aft BSM case per OMRSD File V, Vol. I, requirement number B09TP0.010. (Degraded Properties/Debonding)
- O Perform a visual assessment of the Integrity of TPS and/or TPS topcoat on all applicable flight structures per 10REQ-0021, para. 4.1.7.1 prior to transfer to SPC.
  - o Visually assess the TPS (Cork, K5NA/RT 455 (ALT.), etc.) to identify possible damage or degradation prior to delivery to SPC. (Degraded Properties)

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D. FAILURE HISTORY

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

E. OPERATIONAL USE

- O Not applicable to this failure mode.

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