SRB CRITICAL ITEMS LIST

SUBSYSTEM: STRUCTURES & MISCELLANEOUS ITEMS

ITEM NAME: Thermal Protection System - Aft BSM Covers and Motor Supports (includes CDF Tunnel)

PART NO.: 10115-0001(LH), 10116-0001 (RH) FM CODE: A01

ITEM CODE: 60-03-05 REVISION: Basic

CRITICALITY CATEGORY: 1 REACTION TIME: Seconds

NO. REQUIRED: 1 Set DATE: March .1, 2001 DCN 042

CRITICAL PHASES: Boost SUPERCEDES: March .31, 1998 DCN 042

FMEA PAGE NO.: E-33 ANALYST: S. Parvathaneni

SHEET 1 OF 7 APPROVED: S. Parvathaneni DCN 042

FAILURE MODE AND CAUSES: Loss of Aft BSM Covers and Motor Supports 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 loss of required thrust at separation leading to recontact of SRB with ET or Orbiter.

RATIONALE FOR RETENTION:

A. DESIGN

O The Aft BSM Covers and Motor Supports are insulated with BTA or cork (minimum thicknesses of 0.50 inch on forward fairings, 1.0/1.13 inch on aft supports and 1.0 inch on CDF Tunnel) bonded with EC-2216 adhesive.

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, 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. Subsequent changes in SRB environments were reviewed to verify that original verification parameters were not exceeded).

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:

BTA	-	USA SRBE COQ A-TPS-8120
Cork/EC-2216 B/A Clear Amber		
Adhesive	-	USA SRBE COQ A-TPS-8109
Hypalon	-	USA SRBE COQ A-TPS-8106
Deft	-	USA SRBE COQ A-TPS-8125
Zinc Primers	-	USA SRBE COQ A-TPS-8129
Hentzen	-	USA SRBE COQ A-TPS-8131

DCN 042

O Aft BSM Covers and Motor Supports insulation requirements (materials,thickness, etc.) are specified in USA SRBE drawings 10115-0008, 10116-0008 (TPS Closeout Installation) and drawing 10100-0059 (SRB TPS Closeout Installation). Insulation requirements of cork insulated forward support covers are specified on drawings 10750-0006 and 10750-0019 through 10750-0021 (Cover, Insulated - Separation Motors, Aft Skirt).

O Other documents controlling Aft BSM Fairings and Motor Supports insulation requirements include:

Insulation topcoat:

10PRC-0013	Paint, Chlorosulfonated Polyethylene 09463
10SPC-0028	TPS Topcoat, Application of

O BTA:

10753-0032	BTA Insulation Formulation
10PRC-0546	BTA Procedure for Troweled Application

O Cork/EC-2216 B/A Clear Amber Adhesive:

10753-0009	Cork Insulation
10753-0007	Adhesive Cork Bonding
10PRC-0018	Insulation Application, Cork

O Substrate Protective Finish:

10A00527	Sealing of Fasteners Subject to Seawater Exposure on the SRB, excluding the SRM.
10PRC-0442	Protective Finish Application for Aluminum and Steel Alloys

O Remove all TPS after every flight

B. TESTING

Testing to verify the acceptability of the insulation application is accomplished in accordance with the following:

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 Cork application is verified per 10REQ-0021, para. 4.1.4.

- o Cork/adhesive bonding verification is accomplished by fabricating one cork panel for each day of cork application operations. The panel is processed into four flatwise tensile specimens and one test panel for topcoat analysis. (Debonding)

C. INSPECTION

O Cork insulation acceptability is verified per 10REQ-0021, para. 4.1.4 including the following:

- o Preparation of surfaces to be insulated: verify that the surface is abraded, clean and dry before insulation application is made. (Debonding)

- o Proper formulation and mixing of adhesive (EC-2216 B/A): verify formulation and mixing of amber adhesive accelerator (Part A) to adhesive base (Part B). (Degraded Properties)

- o Cork thickness: verify cork thickness is in compliance with drawing requirements. (Inadequate Thickness)

- o ntegrity of bonded cork: inspect bonded cork for integrity of cured bond lines, and absence of wrinkles, cracks and blisters. (Debonding)

- o Verify process control acceptance of cork bonding by flatwise tensile strength tests. (Debonding)

O BTA acceptability is verified per 10REQ-0021, para. 4.1.2., including the following

- 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 and 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 Topcoat (chlorosulfonated polyethylene paint) application acceptability is verifed per 10REQ-0021, para. 4.1.5.

- 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 topcoat material: verify chlorosulfonated polyethylene paint/activator mix ratio by weight. (Degraded Properties)

- o Topcoat application integrity and thickness: verify dry tape test adhesion and topcoat thickness on test panel. Inspect completed topcoat application after final coat is complete for absence of overspray, blisters, sags, runs, cracking, peeling and discoloration. (Degraded Properties/Debonding)

O On repainted components, USA SRBE Quality performs surface inspections prior to application of conversion coating, primer and topcoat; performs topcoat inspection and verifies adhesion test. (Debonding)

O Perform TPS assessment walkdown inspection prior to rollout per OMRSD File V, Vol. 1, requirement number B09TP0.010.

- o Visually assess the TPS (Cork, SLA-220, Glass Phenolic Laminate, etc.) to identify possible degradation or damage. (Degraded Properties)

O Visual inspection verifies the integrity of TPS and/or TPS topcoat on the aft BSM covers and motor support prior to rollout per OMRSD File V, Vol.1, 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, etc.) to identify possible damage or degradation prior to delivery to SPC. (Degraded Properties)

Critical Processes/Inspections:

O Cork application per 10PRC-0018

O BTA application per 10PRC-0546
O Insulation top coat application per 10PRC-0028
O Substrate protective finish per 10PRC-0442

D. FAILURE HISTORY

O Failure Histories may be obtained from the PRACA database.

E. OPERATIONAL USE

O Not applicable to this failure mode.