

SRB CRITICAL ITEMS LIST

SUBSYSTEM: STRUCTURES AND MISCELLANEOUS ITEMS

ITEM NAME: Thermal Protection System - RSS Antenna Cover

PART NO.: 10406-0093

FM CODE0: A01

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CN 042

ITEM CODE: 60-03-09

REVISION: Basic

CRITICALITY CATEGORY: 1

REACTION TIME: Seconds

NO. REQUIRED: 2

DATE: March 1, 2001

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CRITICAL PHASES: Boost, Separation

SUPERCEDES: March 31, 1997

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FMEA PAGE NO.: E-39

ANALYST: W. Keller/S. Parvathaneni

SHEET 1 OF 7

APPROVED: S. Parvathaneni

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FAILURE MODE AND CAUSES: Loss of RSS Antenna Cover 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 substrate preparation or adhesive failure. (Debonding)

FAILURE EFFECT SUMMARY: Loss of mission, vehicle and crew due to generated debris impacting the ET or Orbiter.

RATIONALE FOR RETENTION:

A. DESIGN

- O The RSS Antenna Cover is insulated with SLA-220 (0.70, 0.50, 0.40 and 0.25 inch thicknesses) and on the aft face with 0.25 inch thick glass phenolic laminate bonded to the cover with Sylgard 186 adhesive. Closeout of the antenna/forward skirt interface is accomplished with K5NA/RT 455 (ALT.) or BTA. Damaged SLA-220 is repaired with JS-220 filler.
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- 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 wind tunnel and Aerotherm Arc Jet Facility. The range of thermal environments, acoustic and vibration, stress

and pressure 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.

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

Certification was performed per document SE-019-149-2H, (SRB/TPS Certification Plan). Subsequent changes in TPS materials and/or thickness or configuration 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.

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

SLA-220/Sylgard		
186 Adhesive, JS-220	-	USA SRBE COQ A-TPS-8117
Glass Phenolic Laminate	-	USA SRBE COQ A-TPS-8116
K5NA	-	USA SRBE COQ A-TPS-8108
BTA	-	USA SRBE COQ A-TPS-8120
Hypalon	-	USA SRBE COQ A-TPS-8106
RT 455	-	USA SRBE COQ A-TPS-8130

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The RSS Antenna Cover's insulation requirements are specified on USA SRBE drawing 10406-0093 (Command Antenna Assembly) and Teledyne Lewisburg Procedure No. ATL4414, Rev. F, (Installation Procedure SLA-220 Silicone Sheet and Phenolic Block). Insulation closeout requirements are specified on USA SRBE drawings 10121-0007 and 10122-0007 (Insulation Closeout Installations).

The assembly, installing and repairing of the thermal protection components on the cover of the RS Command Antenna are performed per 10PRC-0572.

Other documents controlling RSS Antenna Cover insulation requirements include:

SLA-220, Glass Phenolic/Sylgard 186:

10753-0022	Silicone Insulation, SLA-220
10SPC-0007	Specification for Insulation, Laminate, Glass Phenolic
10753-0019	Compound Potting Silicone Encapsulating
10PRC-0572	Standard repair of SLA-220

Insulation Topcoat:

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

K5NA/RT 455 (ALT.):

MSFC-SPEC-1918	Ablative Compound, Thermal
MSFC-SPEC-1919	Ablative Compound, Thermal, Application and Cure of

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BTA:

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

O Remove all TPS after every flight

B. TESTING

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

- O Materials vendors test/certify the proper composition/formulation of basic SLA-220, glass phenolic and adhesive materials. (Degraded Properties)
- O The vendor of the glass phenolic parts performs tests in accordance with 10SPC-0007 to verify acceptable volatiles content, resin content and resin flow of the uncured material. Each roll of material requires testing. Vendor prepares and tests flat laminated test panels in accordance with 10SPC-0007 to verify acceptable flexural strength of the cured material. The number of tests required depends on the number of rolls in each lot. (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.
 - 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
- O BTA acceptability is verified per 10REQ-0021, para. 4.1.2 CN 042
 - 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 The required thickness of cover insulation is verified by inspection in accordance with SIP 1351. (Inadequate Thickness)
- O Proper substrate preparation is verified by inspection in accordance with USA SRBE SIP 1351. Adhesive is certified by supplier. (Debonding)

C. INSPECTION

Inspections to verify the processing and application of Cover insulation are accomplished in accordance with ATL4414 and USA SRBE SIP 1351. (Degraded Properties)

- O Insulated RSS Antenna Cover: USA SRBE SIP 1351 controls the USA SRBE QAR inspection criteria at the vendor's facility. Materials certification and process verification are in accordance with USA SRBE SIP 1351. (Degraded Properties/Debonding)

- O K5NA/RT 455 (ALT.) acceptability is verified per 10REQ-0021, para. 4.1.3, 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) CN 042
 - 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 BTA acceptability is verified per 10REQ-0021, para. 4.1.2., including he 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 verified 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 Thickness requirements of RSS Antenna TPS are verified by USA SRBE QAR per SIP 1351 to meet requirements of ATL4414. (Inadequate Thickness)
- O Antenna Cover: Operations such as substrate preparation, adhesive formulation and mixing, application processing, closeout and curing are performed and verified in accordance with USA SRBE SIP 1351. (Debonding)
- O USA SRBE QAR verifies that all material certification, traceability and processing operations are per requirements. (Degraded Properties)
- 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, K5NA/RT 455 (ALT.), SLA-220, Glass Phenolic Laminate, etc.) to identify possible degradation or damage. (Degraded Properties)
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- O Visual inspection verifies the integrity of TPS on the RSS Antenna Covers 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, K5NA/RT 455 (ALT.), etc.) to identify possible damage or degradation prior to delivery to SPC. (Degraded Properties)
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- O Shelf life, formulation, mixing, surface preparation, application, cure and physical properties of K5NA/RT 455 (ALT.) are verified per OMRSD File V, Vol. 1, requirement number B09GEN.010. (Degraded Properties/Debonding)
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Critical Processes/Inspections:

- SLA-220/Phenolic Block bonding per ATL4414
- Insulation topcoat application per 10PRC-0028
- K5NA/RT 455 (ALT.) application per MSFC-SPEC-1919
- BTA application per 10PRC-0546

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D. FAILURE HISTORY

- Failure Histories may be obtained from the PRACA database.

E. OPERATIONAL USE

- Not applicable to this failure mode.

F. WAIVERS

None