

## SRB CRITICAL ITEMS LIST

SUBSYSTEM: STRUCTURES AND MISCELLANEOUS ITEMS

ITEM NAME: Thermal Protection System - Thermal Curtain Assembly

PART NO.: 10181-0001

FM CODE: A01

ITEM CODE: 60-03-12

REVISION: Basic

CRITICALITY CATEGORY: 1

REACTION TIME: Seconds

NO. REQUIRED: 1

DATE: March 1, 2002

CRITICAL PHASES: Boost

SUPERCEDES: March 1, 2001

FMEA PAGE NO.: E-45

ANALYST: S. Parvathaneni

SHEET 1 OF 5

APPROVED: S. Parvathaneni

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FAILURE MODE AND CAUSES: Loss of Thermal Curtain caused by:

- O Degraded thermal or physical properties due to improper constituents, improper manufacturing such as riveting of retainer strips, handling damage such as snags, tears, soiling, Viton peeling, or natural environments. (Degraded Properties)
- O Improper installation such as torquing, stripped threads in bolts and inserts, improper safety wiring, bottoming of bolts in blind holes and cord tying. (Improper Installation)

FAILURE EFFECT SUMMARY: Loss of mission, vehicle and crew due to loss of flight control and/or recontact of SRB with ET or Orbiter.

RATIONALE FOR RETENTION:

### A. DESIGN

The Thermal Curtain Assembly consists of three quilted layers of quartz cloth, fiberfrax insulation and fiberglass cloth. The outer blanket has two quilted layers. The inner blanket is a single quilted layer. The assembly consists of 24 segments installed circumferentially between the SRB nozzle compliance ring and aft skirt aft ring with mechanical fasteners. Adjoining blanket segments are tied together with ceramic sleeving.

An outer ply of Viton coated nylon protects the thermal blankets from moisture and also offers temporary protection from on-pad fires.

The three different types of threads used in the fabrication of the heat shield curtains are color coded to guard against misuse and to facilitate identification during and after assembly. (Improper Installation)

Prior to loading into the machines, each spool of quartz sewing thread, Type Q-18/Q-24 and fiberglass sewing thread, Type R753-24 are soaked in oil to provide better lubricating capabilities and reduce abrasion in the thread during the sewing operations. (Improper Installation) CN 044

Thermal Curtain materials requirements are controlled by USA SRBE Source Control Drawings. (Degraded Properties)

Stitching is accomplished in accordance with FED-STD-751.

Approved samples of riveted metal retainer to blanket material installations and an approved swatch of the Viton coated nylon outer ply are used as the standards for acceptability. (Improper Installation)

To prevent damage to the Thermal Curtains during shipping, handling, and storage, each segment assembly is protected by non-flight protective foam pillows which are removed at installation. (Degraded Properties)

Fasteners are installed in accordance with MSFC-STD-486.

Thermal protection requirements are presented in SE-019-068-2H, (SRB Thermal Design Data Book). Thermal insulation requirements were established by test and analysis.

Verification testing was performed per "SRB/TPS Verification Test Plan," NASA Letters EP44(79-54) and (EE11(S-80-34) and Wyle Test Report 17209-3 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, were verified on an individual basis using current environments and loads. Subsequent changes in SRB environments were reviewed to verify that original verification parameters were not exceeded. The Thermal Curtain was reverified by overpressure test only, after one of the load bearing layers was removed. The change did not effect the "hot side" of the curtain. The thermal curtain is designed for the SSME/SRB ignition overpressure transient of -5.2 psi (crush) and 3.6 psi (burst). (BI-1668)

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.

USA SRBE Certificate of Qualification (COQs) A-TPS-8101-1A provide Thermal Curtain qualification data.

Thermal Curtain Assembly requirements (materials, stitching, riveting, etc.) are specified on USA SRBE drawings 10181-0012, 10181-0013, 10181-0024 and 10181-0025 (Thermal Curtain Segment Assemblies). Installation requirements are specified on drawings 10111-0001, 10112-0001 (Aft Booster Assembly) and 10100-0014 (Ordnance Installation).

Other documents controlling Thermal Curtain requirements include:

- 10SPC-0005 Cloth, Nylon, Flame Resistant
- 10STD-0002 Standard for Riveting, Fabrication and Inspection for Thermal Curtain Assemblies
- NASM33540 Safety Wiring Installation and Torquing of Fasteners
- 10181-0036 Cloth, Fiberglass
- 10181-0038 Thread, Polyester
- 99613-0001 Thread, Quartz
- 10181-0040 Thread, Fiberglass
- 10181-0041 Tape, Fiberglass
- 10181-0042 Cloth, Quartz
- 10181-0043 Tape, Quartz
- 10181-0044 Insulation, Fiberfrax
- 10181-0045 Sleeving, Ceramic

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O Remove all TPS after every flight

B. TESTING

Testing of Thermal Curtain materials by the Vendor is accomplished in accordance with USA SRBE Statement of Work (SOW) USA SRBE-8306.

- o Pull tests are performed by the Thermal Curtain Vendor to verify that materials meet the requirements of their Source Control Drawings. The materials tested and applicable specifications include: (Degraded Properties)
  - o Fiberglass Cloth 1582 - ASTM-D-579-66
  - o Quartz Cloth, Style 1581 - ASTM-D-579-66
  - o Nylon Cloth - FED-STD-191A
  - o Quartz Thread Q-18/Q-24 - ASTM-D-578

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## C. INSPECTION

Inspection to verify acceptability of Thermal Curtain materials and manufacture are accomplished in accordance with SIP 1201. (Degraded Properties)

Inspection to verify thermal curtain integrity prior to installation are performed per OMRSD File V, Vol. 1, requirement B09TP0.080. (Degraded Properties)

- O Inspection to verify Thermal Curtain integrity prior to delivery to SPC performed per ACO OMRSD 10REQ-0021, para. 4.5.
  - o Cracks or groups of cracks in Viton coating not meeting the criteria shall be repaired by USA SRBE per 10PRC-0573 prior to delivery to SPC. (Degraded Properties)

Thermal curtain componnets are torqued amd lockwired per OMRSD File V, Vol. I, requirement B08GEN.010 and B08GEN.020 (Improper Installation)

Inspections to verify acceptability of Thermal Curtain installation are accomplished per OMRSD File V, Vol. 1, requirement number B09TP0.085. (Improper Installation)

- O USA SRBE PQAR verifies materials certification and testing in accordance with SIP 1201. (Degraded Properties)
- O USA SRBE PQAR verifies that material is stitched per FED-STD-751 in accordance with SIP 1201. (Degraded Properties)
- O USA SRBE PQAR verifies correct thread usage in accordance with SIP 1201. (Improper Installation)
- O USA SRBE PQAR verifies Thermal Curtain retainer installation in accordance with SIP 1201. (Improper Installation)
- O USA SRBE PQAR verifies that Vendor inspection and test records are complete and properly stamped in accordance with SIP 1201. (Degraded Properties)
- O USA SRBE PQAR performs final inspection per drawings and contract requirements in accordance with SIP 1201. (Degraded Properties/Improper Installation)
- O USA GO Quality verifies threaded inserts, installation of thermal curtains, torquing of fasteners, lockwiring and cord (ceramic sleeving) tying in accordance with drawing 10181-0001. (Improper Installation)
- O USA GO Quality verifies the Thermal curtains container integrity seal and shipping damage per OMRSD File V, Vol. I, requirement B09TP0.080. (Improper Installation)
- 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, SLA-220, Glass Phenolic Laminate, etc.) to identify possible degradation or damage. (Degraded Properties)

- O Visual inspection of the Thermal Curtains to verify absence of damage is performed prior to launch per OMRSD File V, Vol. 1, requirement number B09TP0.090 and 10PRC-0578. (Degraded Properties)

CRITICAL PROCESSES/INSPECTIONS:

- O Thermal curtain manufacture/inspection per USA SRBE-8306, 10STD-0002.

D. FAILURE HISTORY

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

E. OPERATIONAL USE

- o Not applicable to this failure mode.

F. WAIVERS

- O None