

SRB CRITICAL ITEMS LIST

SUBSYSTEM: SEPARATION

ITEM NAME: Forward ET Attachment Components

PART NO.: 10160-0165
10160-0166
10160-0167

FM CODE: A01

REVISION: Basic

ITEM CODE: 30-03-03

REACTION TIME: Immediate

CRITICALITY CATEGORY: 1

DATE: March 1, 2002

NO. REQUIRED: 1

SUPERCEDES: March 31, 2000

CRITICAL PHASES: Final Countdown, Boost

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FMEA PAGE NO.: B-48

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FAILURE MODE AND CAUSES: Assembly fails to rotate at bolt head/spherical washer or nut/spherical washer interfaces caused by:

- o Galling
- o Corrosion
- o Inadequate dry film lubricant on the spherical surfaces
- o Damaged bearing surfaces

FAILURE EFFECT SUMMARY: Failure of the bolt to rotate in the washer at SSME ignition or during boost will overstress and fracture the forward separation bolt resulting in premature separation, at SRB thrust tailoff, leading to fire and explosion with loss of mission, vehicle, and crew.

RATIONALE FOR RETENTION:

- A. DESIGN: The SRB forward attachment thrust fittings consist of two inserts (with matching spherical surfaces), two spherical washers, a spherical nut, and a separation bolt.

The spacer, the washer, and the spherical nut are fabricated from Inconel 718, heat treated to 180,000 PSI. The spherical surfaces are lubricated with a dry film lubricant to minimize friction.

The rotating assembly is designed to be a minimum moment joint. The forward attachment fittings transmit only axial loads into the separation bolt.

No additional moment type load is introduced into the forward separation bolt until the joint relative rotation angle exceeds 2 degrees with the maximum shim thickness installed, and the minimum radial gap occurring. Maximum normal operating range is 1 1/2 degrees.

The materials used in the design were selected in accordance with 10PLN-0150 (Materials Control and Verification Program Management Plan for SS SRB Program) and MSFC-SPEC-522 (Design Criteria for Controlling Stress Corrosion Cracking).

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The design allowables are in compliance with MIL-HDBK-5 (Metallic Materials and Elements for Aerospace Vehicle Structures) and MSFC-HDBK-505 (Structural Strength Program Requirements).

Heat treat operations are in compliance with AMS 5664 (Alloy Bars, Forgings, and Rings, Corrosion and Heat Resistant).

Strength, thermal, and functional analyses were performed. Structural factors of safety of 1.4 on ultimate and 1.1 on yield were used in the analyses. In addition, a maximum operating temperature range of -40 to +140°F was considered in the analysis.

The SRB forward attachment components are qualified for use by test and analysis as documented in USA SRBE certificate of qualification A-STR-7119-1.

Structural tests were performed for critical ground and flight load condition. These tests represent maximum frictional loads due to rotation in the washers. Functional tests were performed during verification testing per document SE-019-106-2H. Lubrication tests were made on the lubricant to determine the coefficient of friction (static or dynamic) under applied pressure up to 110,000 psi.

B. TESTING: None

C. INSPECTION:

VENDOR RELATED INSPECTIONS

- o USA SRBE Source Inspection Plan SIP 1453 controls the USA SRBE PQAR inspection criteria at the vendor's facility. (All Failure Causes)
- o Materials are controlled by specification AMS 5664. Vendor QA and USA SRBE PQAR verify material certification and test results in accordance with SIP 1453. (Galling, Corrosion)
- o The first article is subjected to precision inspection by vendor QA and verified by USA SRBE PQAR in accordance with SIP 1453. (Damaged Bearing Surfaces)
- o Parts are dimensionally inspected to the drawing requirements by vendor QA and verified by USA SRBE PQAR in accordance with SIP 1453. (Damaged Bearing Surfaces)
- o USA SRBE PQAR verifies lubricant and transportation protection in accordance with SIP 1453. (Inadequate Lubricant)
- o Vendor QA and USA SRBE PQAR verifies heat treat data and charts in accordance with SIP 1453. (Galling)

The following critical processes and inspections have been identified:

- o Heat treat operations are performed in accordance with AMS 5664. (Galling)

- o Application of the dry film lubricant is in accordance with the vendors proprietary process or BOOSTERLUBE™ dry film lubricant application is per 10PRC-0647. Alternately, the application of the ceramic-bonded lubricant is per 10PRC-0575. (Inadequate Lubricant, Galling)
- o Dye penetrant inspection is in accordance with MIL-STD-6866. (Damaged Bearing Surfaces)

ASSEMBLY/CHECKOUT RELATED INSPECTIONS

- o After each flight reusable components of the Forward ET Attach Components are inspected by USA SRBE QA for flight damage, corrosion, cuts, dents, gouges, or other unusual conditions. The acceptance criteria is contained in 10SPC-0131 (Refurbishment Engineering Specification for Shuttle Solid Rocket Booster Assembly Project). (Galling, Corrosion, Inadequate dry film lubricant, Damaged bearing surfaces)

PRELAUNCH CHECKOUT RELATED INSPECTIONS

The OMRSD, File V, Vol. 1, requirement number B08SB0.050 requires that the condition of the dry film lube on the SRB mating surfaces is verified to be free of grease or foreign materials and no individual nicks, gouges, scratches or voids exceeding 1 percent of the total surface area.

The installation of the washer, spacer and spherical nut is as follows:

- Verify surfaces free of nicks, gouges, grease and foreign material per OMRSD File II, Vol. 1, requirement number S00HB0.020.
 - Ensure spacer flange seats properly into thrust post.
 - Install separation spherical nut. Verify fully seated.
 - Torque on separation bolt is verified per OMRSD File II, Vol. 1, requirement number S00HB0.060.
- o Verify condition of the dry film lube on SRB mating surfaces per 10REQ-0021, paragraph 4.6.1.

D. FAILURE HISTORY

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

E OPERATIONAL USE

- o Not applicable to this failure mode.