

SRB CRITICAL ITEMS LIST

SUBSYSTEM: SEPARATION

ITEM NAME: Separation Bolt, Aft

PART NO.: 10302-0001-801

FM CODE: A01

ITEM CODE: 30-04-01B

REVISION: Basic

CRITICALITY CATEGORY: 1

REACTION TIME: Immediate

NO. REQUIRED: 3

DATE: March 31, 2000

CRITICAL PHASES: Separation

SUPERCEDES: March 1, 1996

FMEA PAGE NO.: B-59

ANALYST: T. Burke/S. Parvathaneni

SHEET 1 OF 5

APPROVED: S. Parvathaneni

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FAILURE MODE AND CAUSES: Fails to separate or rupture of bolt housing caused by:

- o Ruptured firing chamber
- o Gaps between mechanical interfaces
- o Failed insert threads
- o Cartridge blowout
- o Undersize fracture groove (housing material too thick)
- o Improper material
- o Improper material heat treat
- o Jamming of internal parts
- o Extrusion of lead or voids in the lead
- o Corrosion

FAILURE EFFECT SUMMARY: Loss of mission, vehicle, and crew due to SRB impacting ET leading to fire and explosion.

RATIONALE FOR RETENTION

A. DESIGN

- o Design specification USA SRBE 10SPC-0026
 - Materials are selected in accordance with JSC SE-R-0006 and MSFC- SPEC-522A, MIL-S-8844, MIL-S-5000 and MIL-S-46850. (Improper Material) per paragraphs 3.1.1, 3.1.1.6, 3.2.3.1, 3.2.3.2 and 3.2.3.3.
 - Heat treat of the housing and internal components is controlled by MIL-H-6875 per paragraph 3.2.3.1, 3.2.3.2 and 3.2.3.3. (Improper Heat Treat) (BI-1500R2)

- The bolt shall be capable of withstanding and operating under a static tension load of 0 to 375,000 pounds per paragraph 3.3.1. (Improper Fracture Groove)
- The bolt shall be designed for a minimum safety factor of 1.1 on yield strength and 1.4 on ultimate strength per paragraph 3.3.1. (Improper Fracture Groove)
- The safety factor for the firing chamber area shall be 1.5 and the ultimate strength in the fracture groove area shall not be lower than 1.4 per paragraph 3.3.1. (Improper Fracture Groove) (BI-1678)
- Nickel plating per MIL-STD-868, Type I or MIL-C-26074 Class 2 per paragraph 3.1.1.9. (Corrosion)
- o Qualification
 - Function Test at High (+120°F) and low (+20°F) Temperature. (All Failure Causes)
 - Function test at +20°F with one pressure cartridge loaded with 85 percent by weight of the minimum charge load. (All Failure Causes)
- o Qualification of design is documented in Hi-Shear test report QTR 9362801-1109 or in the USA SRBE Analysis Report ER-PYR-89-002 for Teledyne McCormick Selph (TMcS) aft separation bolts.

B. TESTING

- o Lot acceptance test is conducted per Hi-Shear acceptance test procedure ATP 9362801-1101 or Teledyne McCormick Selph (TMcS) ATP 822141.
 - X-ray examination of entire lot of separation bolts. (Cracked Fracture Groove and Defective Material, Jamming of Internal Parts)
 - Hardness test of all housings. (Improper Heat Treat)
 - Function test 10 percent of the lot. (Ambient Temperature)
 - Ultimate load test. (Improper Material and Heat Treat)

C. INSPECTION

The following inspections are performed.

VENDOR RELATED INSPECTION

- o Receiving Inspection:

- Major bolt dimensions, major internal components dimensions, all threads, fracture groove and O-rings are inspected one hundred percent by Contractor Quality Assurance and verified by USA SRBE Quality Assurance per: (Gaps Between Mechanical Interfaces, Failed Insert Threads)
- USA SRBE Quality Assurance.
USA SRBE SIP 1120
- Contractor Quality Assurance
Hi-Shear Corporation Inspection Check Sheets 9362801-1103 or Teledyne McCormick Selph ICS 660377
- o Lot Acceptance Test: X-ray film is examined by certified vendor personnel and verified by USA SRBE personnel. Groove determination, ultimate load test and magnetic particle inspection are witnessed one hundred percent. (All Failure Causes)
 - USA SRBE Quality Assurance
USA SRBE Source Inspection Plan (SIP) 1120
 - Contractor Quality Assurance
Hi-Shear Corporation Acceptance test procedure 9362801-3 and Acceptance test procedure 9362801-1101 or Teledyne McCormick Selph (TMcS) ATP 822141
- o Lot review and certification per USA SRBE plan 10PLN-0041.
- o Critical Processes/Inspections/Operations: The following critical processes, inspections and operations are used to assure structural integrity of the Aft Separation Bolt.
 - X-ray per HSC ATP 9362801-1101 or TMcS ATP 822141 (Improper Material, Jamming of Internal Parts)
 - Ultrasonic Inspection per MIL-STD-2154 (Improper Material)
 - Heat treatment per HSC 9362801-888 or TMcS Manufacturing and Quality Specifications 620153, 620154 and 620155 (Improper Heat Treat)
 - Magnetic Particle Inspection per ASTM-E-1444 and HSC 9362801-888(Cracked Fracture Groove and Improper Material) CN 038
 - Nickel Plating per HSC 9362786-1445 or TMcS 620156. (Corrosion)
 - Housing Groove determination per HSC 9362801-888 or TMcS Manufacturing and Quality Specification 620153.

KSC RELATED INSPECTION

- o Receiving Inspection
 - Each aft separation bolt in the lot is inspected for deep gouges, chips, filings, cracks, corrosion and burrs by SPC Quality Assurance per OMRSD File V, Vol. I requirement no. B000FL.005. (Corrosion)

- Thread checks on NSI pressure cartridge mating threads are performed per OMRSD File V, Volume 1, requirement number B000FL.005. (Cartridge Blowout)
 - Verify visual inspection of aft separation bolt per OMRSD File V, Vol. I requirement number B000FL.005. (Corrosion)
 - Verify that the aft separation bolts received have been flight certified by MSFC as required by NSTS 08060 per OMRSD File V, Volume 1, requirement no. B000FL.002. (All Failure Causes)
- o Installation Inspection
- Installation of the aft separation bolt in the aft strut assembly is verified per 10REQ-0021 para. 4.3.1 and witnessed by USA SRBE Quality. (Corrosion)

D. FAILURE HISTORY

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

E. OPERATIONAL USE

- o Not applicable to this failure mode.

F. WAIVER(S)

- o BI-1500R2, Dated 7-7-86; Level III CCBD No: SB3-01-0464.

Requirement(s):

Drawing 9362804 Rev "L" specifies inserts to be 100% Rockwell Hardness inspected. Required hardness range RC 52 - RC 55.

Departure:

All inserts had at least one reading above RC 55 and the averages of the three readings ranged from RC 54.5 to RC 56.4.

Rationale:

Mechanical (Tensile and Impact) Properties of the inserts are acceptable as certified by Durkee Testing Lab Report No. X-3937.

- o BI-1678, Dated 8-18-88; Level III CCBD No: SB3-01-1529

Requirement(s):

10CEI-0001 par. 3.2.1.9.2.2 "the aft separation bolt shall meet the requirements of 10SPC-0026."
Meet requirements of 10SPC-0026 par. 3.3.1
Structural elements meet MSFC-HDBK-505
Safety factor of 2.0 by analysis
SF 1.4 on ultimate strength
SF 1.5 ultimate strength for firing chamber area

Departure:

The aft separation bolt has not been tested to verify firing chamber safety factor 1.5. Analysis shows SF of 1.74 ultimate strength in the firing chamber.

Rationale:

Based on the 20+ Qualification and 40+ Acceptance Tests to date along with the tight controls on manufacturing of the aft separation bolt, the analytically determined 1.74 safety factor on the firing chamber does not require further verification by test.