

SRB CRITICAL ITEMS LIST

SUBSYSTEM SEPARATION

ITEM NAME: Separation Bolt, AFT

PART NO.: 10302-0001-801

FM CODE: A02

ITEM CODE: 30-04-01B

REVISION: Basic

CRITICALITY CATEGORY: 1

REACTION TIME: Immediate

NO. REQUIRED: 3

DATE: March 1, 2002

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CRITICAL PHASES: Boost

SUPERCEDES: March 31, 2000

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FMEA PAGE NO.: B-60

ANALYST: T. Burke/S. Finnegan

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SHEET 1 OF 4

APPROVED: S. Parvathaneni

FAILURE MODE AND CAUSES: Premature release or separation caused by:

- o Defective material
- o Improper heat treat
- o Cracked fracture groove
- o Improper fracture groove (housing material too thin)
- o Corrosion

FAILURE EFFECT SUMMARY: During final countdown and boost, premature separation of the upper aft strut will result in loss of electrical power to the SRB leading to loss of vehicle control and loss of mission, vehicle, and crew. Premature separation of diagonal or lower aft strut will result in SRB breakaway leading to Orbiter/ET fire and explosion and loss of mission, vehicle, and crew.

RATIONALE FOR RETENTION

A. DESIGN

- o Design specification USA SRBE 10SPC-0026
 - o Materials are selected in accordance with JSC SE-R-0006 and MSFC-SPEC-522A and MIL-S-8844 per paragraphs 3.1.1, 3.1.1.6 and 3.2.3.1. (Defective Material)
 - o 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 Grooves)
 - o The bolt shall be designed for a minimum safety factor of 1.1 on yield and 1.4 on ultimate strength per paragraph 3.3.1. (Improper Fracture Groove)

- o The safety factor for the ultimate strength in the fracture groove area shall not be lower than 1.4 per paragraph 3.3.1. (Improper Fracture Groove)
- o Nickel plating per MIL-STD-868, type I or MIL-C-26074, class 2, per para. 3.1.1.9. (Corrosion)
- o Heat treat of the 4340 steel is controlled by **SAE-AMS-H-6875** per para. 3.2.3.1. (Improper Heat Treat) | |
- o Qualification
 - 30 day stress corrosion test while torqued to 1000 foot pounds. (Corrosion)
 - Failure load test to demonstrate design loads. (All Failure Causes)
 - Salt Fog (Corrosion)
 - Vibration (Cracked Fracture Groove)
- 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) **or Pacific Scientific test report 2-502480-1QTR0106** 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 **or Pacific Scientific ATP2-502480-1**. | |
 - Hardness test of all housings per the above and HSC 9362801-1103 or TMcS Manufacturing and Quality Specifications 620153, 620154, and 620155 **or Pacific Scientific MCD2-502480-1**. (Improper Heat Treat) | |
 - Proof load all housings per the above and procedure 9362801-888 or TMcS Manufacturing and Quality Specification 620153 **or Pacific Scientific MCD2-502480-1**. (All Failure Causes) | |
 - Stress Corrosion/Ultimate Load Test 2 housings per the above and 9362801-104 or TMcS SCP 70052 **or Pacific Scientific ATP2-502480-1** and detecting of critical areas. (All Failure Causes) | |
 - X-ray examination of entire lot of separation bolts. (Cracked Fracture Groove)
- o Bolt housing lot acceptance test is conducted per Hi-Shear test procedure 9362801-888 or TMcS Manufacturing and Quality Specification 620153 **or Pacific Scientific MCD2-502480-1**. | |
 - Independent Chemical Analysis on one sample from each lot of housing material. (Defective Material)
 - Ultrasonic inspection of each bar of housing material. (Defective Material)

- Tensile Test of a minimum of three heat treated bar specimens. (Defective Material and Improper Heat Treat)
- Hardness test 100% of the housings. (Improper Heat Treat)
- Groove determination of six housings per lot.(Improper FractureGroove)
- Proof load 100% of the Bolt Housings. (All Failure Causes)
- Magnetic particle inspection 100% of the Bolt Housings before and after proof load. (Defective Material and Cracked Fracture Groove)

C. INSPECTION

The following inspections are performed.

VENDOR RELATED INSPECTION

- o Receiving Inspection. Raw material certification test reports and heat treatment data are verified one hundred percent. (Defective Material/ Improper Heat Treat)

Bolt dimensions and threads are inspected by Contractor Quality Assurance and verified by USA SRBE Quality Assurance per:

- USA SRBE Quality Assurance.
USA SRBE Source Inspection Plan (SIP) 1120.
- Contractor Quality Assurance
Hi-Shear Corporation Inspection Check Sheets 9362801-1103 or Teledyne McCormick Selph (TMcS) ICS 660377 or **Pacific Scientific MP2-502480-1.** | |
- o Lot Acceptance Test. X-ray film is examined by certified vendor personnel and verified by USA SRBE personnel.
Groove determination, ultimate load test, proof load test, stress corrosion test and magnetic particle inspection on housing are witnessed one hundred percent. Stress corrosion test is monitored by USA SRBE PQAR during the 30 day test. (AllFailure Causes)
 - USA SRBE Quality Assurance
USA SRBE Source Inspection Plan (SIP) 1120.
 - Contractor Quality Assurance
Hi-Shear Corporation acceptance test procedure 9362801-1101 or Teledyne McCormick Selph ATP 822141 or **Pacific Scientific MCD2-502480-1.** | |
- 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 or **Pacific Scientific ATP2-502480-1** (DefectiveMaterial)
 - Ultrasonic Inspection per MIL-STD-2154 (Defective Material)
 - Heat treatment per HSC 9362801-888 or TMcS Manufacturing and Quality Specifications 620153, 620154, 620155 or **Pacific Scientific MCD2-502480-1**. (Improper Heat Treat)
 - Magnetic Particle Inspection per ASTM-E-1444 and HSC 9362801-888(Cracked Fracture Groove and Defective Material)
 - Nickel Plating per HSC 9362786-1445 or TMcS 620156 or **Pacific Scientific MCD2-502480-1**. (Corrosion)
 - Housing Groove determination per HSC 9362801-888 or TMcS Manufacturing and Quality Specification 620153 or **Pacific Scientific MCD2-502480-1**. (Improper Fracture Groove)

KSC RELATED INSPECTION

- o Receiving Inspection
 - Visually inspected for gouges, chips, filings, cracks and corrosion by SPC Quality Assurance per OMRSD File V, Vol. I requirement no. B000FL.005. (Corrosion, Cracked Fracture Groove)
 - 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 struts is witnessed by USA SRBE Quality per 10REQ-0021 para. 4.3.1. (Corrosion)

D. FAILURE HISTORY

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

E. OPERATIONAL USE

- o Not applicable to this failure mode.