

SRB CRITICAL ITEMS LIST

SUBSYSTEM: STRUCTURES AND MISCELLANEOUS ITEMS

ITEM NAME: SRB/MLP Holddown Components

PART NO.: 10183-0004 FM CODE: A03
10183-0005
10183-0006
10183-0007
10183-0102
10400-0943

CN 044

ITEM CODE: 60-04-04 REVISION: Basic

CRITICALITY CATEGORY: 1 REACTION TIME: Immediate

NO. REQUIRED: 24 DATE: March 1, 2002

CRITICAL PHASES: Final countdown SUPERCEDES: March 31, 1999

FMEA PAGE NO.: E-59 ANALYST: R. Vaughan/S. Parvathaneni

SHEET 1 OF 4 APPROVED: S. Parvathaneni

CN 044

FAILURE MODE AND CAUSES: Loss of pretension caused by:

- Improper Installation
- Yielding of improper material including aft skirt holddown post.
- Unusual Environments
- Inadequate dry film lubricant on the spherical surfaces

FAILURE EFFECT SUMMARY: Loss of mission, vehicle and crew caused by fire and explosion on the pad.

RATIONALE FOR RETENTION:

A. DESIGN

- The SRB holddown components secures the entire shuttle system to the mobile launch pad at a total of eight places. They consist of a holddown stud, aft skirt shoe, aft skirt shoe shim, three spherical washers and a holddown nut. (The frangible nut is covered in 60-04-03). All components are Inconel 718.
- 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). (Improper Material) CN 044
- 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). (Improper Materials)
- The spherical surface of the spherical bearing is coated with a dry film lubricant to preclude any galling or seizure.

- O The SRB holddown components are qualified for use by test and analysis as documented in USA SRBE COQ A-STR-7124.
- O Analysis shows that a minimum factor of safety of greater than +1.4 exists between the design of the holddown system and the maximum loads on these components due to the pretension operation. (Ref. BPC-ANAL-003-87). (BI-1858R1)
- O EM Lube Lock 1000X
 - 10753-0038 EM Lube Lock 1000 Lubricant
 - 10753-0039 EM Lube Lock 2006 Lubricant
 - 10PRC-0575 Procedure for Application for 1000X Dry Film Lubricant System on Inconel 718 Nickel Alloy
- O BOOSTERLUBE™
 - 10753-0068 BOOSTERLUBE™ Solid Film Lubricant
 - 10PRC-0647 Procedure for Application of 10753-0068 (BOOSTERLUBE™) Solid Film Lubricant on Inconel 718 Nickel Alloy
- O Lubrication tests were performed to determine the coefficient of friction, both static and dynamic, under applied pressures up to 110,000 PSI. (Inadequate Lubricant, Galling)

B. TESTING

- O Holddown Studs are proofloaded in accordance with 10PRC-0349. (Yielding of Improper Material)

C. INSPECTION

VENDOR RELATED INSPECTION

- O USA SRBE QAR verifies proper application of dry film lubricant and proper shipping protection in accordance with SIP 1453. (Inadequate Lubricant)
- O USA SRBE SIP 1453 controls the USA SRBE QAR inspection criteria at the vendor's facility. (Improper Material)
- O USA SRBE QAR verifies vendor traceability for Mill certifications of physical and chemical properties to meet the drawing requirements in accordance with SIP 1453. (Improper Material)
- O Vendor QA and USA SRBE QAR verifies that all nondestructive testing has been done to meet the drawing and specification requirements in accordance with SIP 1453. (Improper Material)
- O Vendor QA and USA SRBE QAR verifies that the heat treat data meets the specification requirements and verifies the heat treat charts in accordance with SIP 1453. (Improper Material)
- O Vendor QA and USA SRBE QAR verifies that the tensile test data meets the drawing requirements in accordance with SIP 1453. (Improper Material)
- O Holddown Stud Proofloading is performed per 10PRC-0349 and verified per SIP 1453. Exceeds Preloads, Thread Failure)
- O Critical Processes/Inspections:
 - o Heat treat operations are performed in accordance with AMS 5664. (Improper Material)
 - o Ultrasonic Inspection per MIL-STD-2154. (Improper Material)
 - o Eddy current inspections are performed in accordance with CONAM Inspection Procedure 70-ET-003. (Improper Material)

- o EM Lube Lock is performed per 10PRC-0575 and STP 624 or BOOSTERLUBE™ dry film lubricant application is per 10PRC-0647 and STP 644.

ASSEMBLY/CHECKOUT RELATED INSPECTIONS

- O After each flight the aft skirt shoe and holddown stud washers are inspected for damage, corrosion, cuts, dents, gouges, cracks, and the solid film lubricant is removed and replaced. Inspection and repair criteria are contained in 10SPC-0131 (Refurbishment Engineering Specifications for Space Shuttle Solid Rocket Assembly Project). (Unusual Environments)
- O After each flight the holddown stud lower nut (10183-0004) is inspected as part of the refurbishment process. This includes visual inspection for defects and tread dimension in accordance with 10SPC-0131 (Refurbishment Engineering Specifications for Space Shuttle Solid Rocket Assembly Project).

PRELAUNCH CHECKOUT RELATED INSPECTIONS

- O Verify by visual inspection and record all discrepancies per OMRSD File V, Volume 1, requirement no. B08SB0.050. (Damaged Bearing Surfaces)
- O The holddown system is installed including verification of proper installation and torque by SPC Quality. Preload is verified per OMRSD File V, Vol. I, requirement no. B08HS0.033. Maximum stud load shall not exceed load application and cycle limits as defined in OMRSD File II, Vol. III, Table C00CB0.060.000. (Improper Installation)
- O Tension in four (4) Holddown Studs/Frangible Nuts on each SRB is verified at the Launch Pad prior to final ordnance connection per OMRSD File V, Vol. I, Requirement Number B08HS0.040. (Improper Material and Improper Installation)
- O Holddown Studs are inspected per OMRSD File V, Vol. I, Requirement number B08HS0.060 (Improper Material)
- O Verify thread condition on Frangible Nut and Holddown Stud per OMRSD File V, Vol. I, Requirement number B08HS0.060 (Thread Failure)
- O Verify that the support posts are in the proper position per OMRSD File V, Vol. I, requirement number B08SP0.010. (Excessive Preloads)
- O Measure and record the strains on each support post after mating the LH & RH Aft Booster Assembly per OMRSD File V, Vol. I, Requirement number B08SP0.020 (Excessive Preloads)
- O Verify Datum point locations of MLP/LP support posts per OMRSD File V, Vol. I, requirement number B08SP0.030 (Excessive Preloads)
- O USA SRBE 10SPC-0131 (Refurbishment Engineering Specifications for Space Shuttle Solid Rocket Booster) visually inspects all bearing surfaces for evidence of galling or breakdown of the lubrication system. (Galling, Inadequate Lubrication)
- 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.

F. WAIVERS

o BI-1858R2, 10-20-93, CCBD SB3-01-4715

o Requirement: 10CEI-0001 para. 3.3.6 requires "All Structural Elements shall be designed and analyzed to meet all structural requirements contained in MSFC-HDBK-505." MSFC-HDBK-505 para. H502 requires that hardware used on manned flight that is verified by analysis and static testing shall have a minimum safety factor of 1.1 on yield.

o Departure: The holddown studs for BI043 & Subs are subjected to a 1,218,000 pound to 1,228,000 pound proof load which reduces the safety factor on yield to 1.04.

o Rational: The requirement to proof load the holddown studs at this value (1,218,000 pound) assures that the studs will withstand at least 15 pretensioning cycles and 38 abort/lift-off cycles without failure. Not only does this assure the integrity of the studs during lift-off, it also assures the integrity of the studs during pretensioning which assures safety to the personnel installing the hardware