

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Hydraulic Flex Lines

PART NO.: See Below

FM CODE: A02

ITEM CODE: 20-01-41

REVISION: Basic

CRITICALITY CATEGORY: 1

REACTION TIME: Seconds

NO. REQUIRED: See Parts List

DATE: March 1, 2001

CRITICAL PHASES: Final Countdown, Boost

SUPERCEDES: March 31, 2000

FMEA PAGE NO.: A-136

ANALYST: B. Snook/S. Parvathaneni

SHEET 1 OF 5

APPROVED: S. Parvathaneni

CN 042

CN 042

FAILURE MODE AND CAUSES: Rupture (System A and/or B) caused by:

- o Material defect
- o Manufacturing defect
- o Improper Installation

FAILURE EFFECT SUMMARY: Fire and explosion will lead to loss of mission, vehicle and crew.

REDUNDANCY SCREENS AND MEASUREMENTS: N/A

PART NUMBERS:

High Pressure Flex Lines

- 10200-0014-101 (Rock)
- Alt. 10200-0014-103
- 10200-0014-102 (Tilt)
- Alt. 10200-0014-104
- 10200-0015-101 (Tilt)
- Alt. 10200-0015-103
- 10200-0015-102 (Rock)
- Alt. 10200-0015-104
- 10200-0026-101
- Alt. 10200-0026-102
- 10200-0036-101 (Rock)
- Alt. 10200-0036-103
- 10200-0036-102 (Tilt)
- Alt. 10200-0036-104
- 10201-0010-101

Low Pressure Flex Lines

10200-0012-101
Alt. 10200-0012-102
10200-0013-101
Alt. 10200-0013-102
10200-0017-101 (Tilt)
Alt. 10200-0017-102
10200-0019-101 (Rock)
Alt. 10200-0019-103
10200-0019-102 (Tilt)
Alt. 10200-0019-104
10200-0024-101 (Rock)
Alt. 10200-0024-102
10201-0012-101

RATIONALE FOR RETENTION:

A. DESIGN

- o The flex lines are designed per the USA SRBE source control drawings 10209-0020, 0022 and 0023. The qualification of these tubes and lines is as per NASA TM-78258 and TM-82439. (All Failure Causes)
- o Dynatube fittings are titanium 6AL-4V and are attached to the hoses by mechanical swaging. (Material Defect and Manufacturing Defect)
- o All hydraulic lines of less than 1.5" diameter are designed for proof pressure two times operating pressure and burst pressure four times operating pressure. (Material Defect, Manufacturing Defect)
- o All hydraulic lines of 1.5" or greater diameter are designed for proof pressure 1.5 times operating pressure and burst pressure 2.5 times operating pressure. (Material Defect, Manufacturing Defect)
- o Fittings are lockwired per MS33540. (Improper Installation)
- o Fluid procurement is controlled per SE-S-0073. (Material Defects)
- o Tube assemblies are fabricated per 10PRC-0038 and flex assemblies per AM-B8510 and STP 303. This includes the preparation and inspection of tube/hose ends and fittings, assembly alignment checks and acceptance criteria of the assembled unit. (Manufacturing Defect)
- o Flex line consists of a fluoroflex-T teflon base inner tube, four high tensile stainless steel spiral wraps and an outer braid of 304 or 302 Cres. (Material Defect, Manufacturing Defects)
- o Normal operating pressure of the hydraulic system HP side is 3250 psig maximum with pressure relief at 3850 psig. (All Failure Causes)

- o Hydraulic fluid is MIL-H-83282 or MIL-PRF-83282 which was developed to reduce the potential of fire. (Material Defect)
- o The aft skirt is purged with GN2 prior to APU start up. This reduces the O2 concentration to less than four percent per OMRSD File II, Vol. 1, requirement number S00FM0.430. (All Failure Causes)
- o Operating pressure of the low pressure side is 65 psig. (All Failure Causes)
- o Tubing and Hoses were qualified for SRB application as reported in the Solid Rocket Booster TVC System verification test (V-2) TM-78258 (nominal) and TM-82439 (off-nominal). (All failure causes)

CN 042

B. TESTING

- o Individual hose assemblies are hydrostatically proof tested per 10REQ-0021, para. 2.3.3.5. (Material Defect)
- o Individual hose assemblies are helium leak tested per 10REQ-0021, para. 2.3.3.6. (Material Defect and Manufacturing Defect)
- o Hydraulic circuit fluid leak test is performed per 10REQ-0021, para. 2.3.12.2 prior to hotfire. (All Failure Causes)
- o Functional test is performed during hotfire operations per 10REQ-0021, para. 2.3.11, 2.3.15, and 2.3.16 respectively for: (All Failure Causes)
 - Low speed spin
 - High speed spin
 - Hotfire
- o Prelaunch hydraulic system leak test is performed per OMRSD File V, Vol. 1, Requirement Number B42HP0.020. (All Failure Causes)
- o Helium leak test to less than 1×10^{-4} sccs is performed per 10REQ-0021, para. 2.3.3.3. (All Failure Causes)

C. INSPECTION**VENDOR RELATED INSPECTIONS**

- o Inspections of sealing surfaces by USA SRBE PQAR per SIP 1260. (Manufacturing Defect)
- o Critical processes/inspections
 - Swaging per STP 303

KSC RELATED INSPECTIONS

- o Individual hose assemblies are inspected for the requirements of 10PRC-0038 per 10REQ-0021, para. 2.3.0. (All Failure Causes)

- o Hydrostatic test is verified per 10REQ-0021, para. 2.3.3.5. (All Failure Causes)
- o Individual hose assemblies helium leak test verifies acceptable leakage per 10REQ-0021, para. 2.3.3.6. (Material Defect and Manufacturing Defect)
- o In skirt tube/hose installation torque and lockwire is witnessed per 10REQ-0021, para. 2.1.4. (Manufacturing Defects)
- o Assembly torque is verified per 10REQ-0021, para. 2.1.4. (Manufacturing Defect and Improper Installation)
- o Lockwire is verified per 10REQ-0021, para. 2.1.4. (Manufacturing Defects)
- o Hydraulic system helium leak test is verified per 10REQ-0021, para. 2.3.3.3. (All Failure Causes)
- o Hydraulic circuit fluid leak test is verified per 10REQ-0021, para. 2.3.12.2 prior to hotfire. (All Failure Causes)
- o Performance of visual leak check of hydraulic circuit (system) joints per 10REQ-0021, para. 2.3.12.2. (All failure causes)
- o Proper function of TVC system is verified during hotfire per 10REQ-0021, para. 2.3.16 (includes verification of rock and tilt reservoirs between 50 and 90 percent. (All Failure Causes)
- o TVC system is inspected for external leaks per 10REQ-0021, para. 2.3.11.3, 2.3.15.5, and 2.3.16.4 respectively, following low speed GN2spin, high speed GN2 spin and post hotfire inspection.
- o Prelaunch hydraulic leak test is witnessed per OMRSD File V, Vol. 1, Requirement Number B42HPO.020.
- o Hydraulic fluid is verified for cleanliness and composition (purity and particulate count) prior to introduction on board the flight hardware per 10REQ-0021, para. 2.3.2.6 and during prelaunch per OMRSD File V, Vol. I, requirement number B42HPO.010. (Material Defects)
- o Verification of hydraulic fluid (effluent) sampled for moisture and dissolved air content per OMRSD File V, Vol. I, requirement number B42HPO.011 and .070 respectively. (Material Defects)

D. FAILURE HISTORY

Criticality Category 1:

- o No SRB Failure History for this Failure Mode.

E. OPERATIONAL USE

- o Not applicable to this failure mode.

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