

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Hydraulic Rigid Lines and Fittings

PART NO.: See Below

FM CODE: A02

ITEM CODE: 20-01-40

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-132

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SHEET 1 OF 7

APPROVED: S. Parvathaneni

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

- o Material defect
- o Manufacturing defect

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

REDUNDANCY SCREENS AND MEASUREMENTS: N/A

PART NUMBERS:

High Pressure Rigid Lines

- 10200-0002-101 (Tilt)
- 10200-0005-101
- Alt. 10200-0005-106
- 10200-0005-103 (Tilt)
- Alt. 10200-0005-107
- 10200-0005-104 (Rock)
- Alt. 10200-0005-108
- 10200-0007-101
- Alt. 10200-0007-106
- 10200-0008-101
- Alt. 10200-0008-102
- 10200-0009-101 (Rock)
- Alt. 10200-0009-108
- 10200-0009-102 (Rock)
- Alt. 10200-0009-109

- 10200-0009-103 (Tilt)

Alt. 10200-0009-110
10200-0009-104 (Tilt)
Alt. 10200-0009-111
10200-0009-105 (Tilt)
Alt. 10200-0009-112
10200-0009-106 (Rock)
Alt. 10200-0009-113
10200-0009-107 (Rock)
Alt. 10200-0009-114
10200-0070-101 (Tilt)
Alt. 10200-0070-102
10200-0072-101 (Rock)
Alt. 10200-0072-103
10200-0072-102 (Tilt)
Alt. 10200-0072-104
10201-0003-102
10201-0008-101
10201-0009-101

High Pressure Fittings

Tee

10209-0091-801
Alt. 10209-0151-801

Elbow

10209-0062-801
(Alt. 10209-0166)
Alt. 10209-0127-801
(Alt. 10209-0167)
10209-0065-801 (2)
10209-0128-801
10209-0130-801
10209-0067-801 (3)
Alt. 10209-0132-801
10209-0070-801
Alt. 10209-0135-801
10209-0103-801 (Tilt)
Alt. 10209-0155-801

Connector

10209-0027-801
10209-0032-801

Low Pressure Rigid Lines

10200-0006-101 (Rock)
Alt. 10200-0006-103
10200-0006-102 (Tilt)
Alt. 10200-0006-104
10200-0007-102 (Rock)
Alt. 10200-0007-107

10200-0007-103 (Tilt)
Alt. 10200-0007-108
10200-0007-104 (Rock)
Alt. 10200-0007-109
10200-0007-105 (Tilt)
Alt. 10200-0007-110
10200-0010-101 (Tilt)
10200-0010-102 (Rock)
10201-0005-102
10201-0007-101
10201-0008-102
Alt. 10201-0008-104
10201-0081-101
10201-0081-102

Low Pressure Fittings

Elbow

10209-0168
10209-0063-801
10209-0064-801 (Tilt)
(Alt. 10209-0164)
Alt. 10209-0129-801
(Alt. 10209-0165)
10209-0066-801
Alt. 10209-0131-801
10209-0067-801
Alt. 10209-0132-801
10209-0070-801
Alt. 10209-0135-801
10209-0072-801 (2)
Alt. 10209-0136-801
10209-0100-801
10209-0154-801

Tee

10209-0104-801
Alt. 10209-0156-801
10209-0105-801

Connectors

10209-0029-801
10209-0035-801

RATIONALE FOR RETENTION:

A. DESIGN

- o The Rigid Lines are designed per MSFC specification 13A10047 and qualified per NASA TM-78258 and TM-82439. (All Failure Causes)
- o Fluid procurement is controlled per SE-S-0073. (Material Defects)

- o 0.375 inch and larger lines are titanium 3AL-2.5V fully annealed, seamless and subjected to one hundred percent ultrasonic inspection. (Material Defect, Manufacturing Defects)
- o 0.250 lines are 304 stainless steel. These tubes are not reused. (Material Defect)
- o Dynatube fittings are titanium 6AL-4V and are attached to the tubing by mechanical internal swaging. (Manufacturing Defect, Material Defects)
- o All high pressure hydraulic lines are designed for proof pressure two times operating pressure and burst pressure four times operating pressure. (All Failure Causes)
- o Hydraulic fluid is MIL-H-83282 or MIL-PRF-83282 which was developed to reduce fire potential. (All Failure Causes)
- o Tube hose assemblies are fabricated per 10PRC-0038. This includes preparation and inspection of tube/hose ends and fittings, assembly alignment checks and acceptance criteria of the assembled unit. (Manufacturing Defect)
- o The high pressure hydraulic system includes a relief valve set to open between 3650 and 3850 psig. This is below the tubing burst pressure. (All Failure Causes)
- o The aft skirt area 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 Tubing and fittings 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)

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B. TESTING

- o Helium is verified for cleanliness and composition (purity and particulate count) prior to introduction on-board the flight hardware per 10REQ-0021, para. 2.3.2.5. (Material Defect)
- o Hydraulic tubing assemblies and fittings are refurbished per 10SPC-0131 para. I. (Manufacturing Defects)
- o Individual tube assemblies are hydrostatically proof tested per 10REQ-0021, para. 2.3.3.5. (All Failure Causes)
- o Individual tube assemblies are helium leak tested per 10REQ-0021, para. 2.3.3.6. (Material Defect and Manufacturing Defect)
- o Installed tube assemblies are helium leak tested per 10REQ-0021, para. 2.3.3.3. (Material Defect and Manufacturing Defect)

- o Hydraulic circuit fluid leak test is performed per 10REQ-0021, para. 2.3.12.2 prior to hotfire. (Material Defect and Manufacturing Defect)
- o Low pressure hydraulic lines are hydrostatically proof tested to 1600 psig and high pressure lines are tested to 7200 psig. (Manufacturing Defect)
- o Prelaunch hydraulic system leak test is performed per OMRSD File V, Vol. 1, Requirement Number B42HP0.020. (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 Evacuation/removal of hydraulic fluid from the tube between the low pressure relief valve (within hydraulic manifold) and the hydraulic service panel is performed following high speed GN2 spin per 10REQ-0021, para. 2.3.15.5, hotfire per 10REQ-0021, para. 2.3.16.4. (All Failure Causes)
- 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 operations per OMRSD File V, Vol. 1, Requirement Number B42HPO.010. (Material Defect)
- o The above referenced OMRSD testing is performed every flight.

C. INSPECTION

I. VENDOR RELATED INSPECTIONS

- o Inspections of sealing surfaces per USA SRBE PQAR SIP 1260.(Manufacturing Defect)
- o Critical processes/inspections:
 - Swaging per 10PRC-0038
 - Tube Bending per 10PRC-0038
 - Tube End Flaring per 10PRC-0038
 - Annealing per MIL-H-81200

II. KSC RELATED REFURBISHMENT INSPECTION

- o Visual inspection of tube assemblies will be performed per 10SPC-0131, para. II. (All Failure Causes)
- o Functional testing of tube assemblies will be performed per 10SPC-0131, paragraph IV.

All manual tests will be witnessed by Quality or verified for those instances when controlled software is utilized and a test report is generated. (All Failure Causes)

III. KSC RELATED ASSEMBLY AND OPERATIONS INSPECTIONS

- o Helium cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board flight hardware per 10REQ-0021, para. 2.3.2.5. (Material Defect)
- o Individual tube 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 tube 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 Defect)
- o Hydraulic system helium leak test is witnessed/verified per 10REQ-0021, para. 2.3.3.3. (Material Defect and Manufacturing Defect)
- o Hydraulic circuit fluid leak test is witnessed/verified per 10REQ-0021, para. 2.3.12.2 prior to hotfire. (All Failure Causes)
- o Verification 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 demonstrated during Hotfire operations per 10REQ-0021, para. 2.3.11, 2.3.15, and 2.3.16 respectively for: (All Failure Causes)
 - Low speed GN2 spin
 - High speed GN2 spin
 - Hotfire (Includes verification of rock and tilt reservoirs between 50 and 90 percent)
- o Inspections for leaks, rubbing and discoloration are conducted per 10REQ-0021, para. 2.3.11.3 and 2.3.15.5 respectively following low speed GN2 spin and high speed GN2 spin. (All Failure Causes)
- o Post hotfire inspection and leak check per 10REQ-0021, para. 2.3.16.4. (All Failure Causes)
- o Prelaunch hydraulic system leak test is witnessed/verified per OMRSD File V, Vol. 1, Requirement Number B42HP0.020. (All Failure Causes)

- o Hydraulic fluid cleanliness and composition (purity and particulate count) are verified prior to introduction on-board the flight hardware per 10REQ-0021, para. 2.3.2.6 and during prelaunch operations per OMRSD File V, Vol. 1, Requirement Number B42HP0.010. (Material Defect)
- o Verification of hydraulic fluid (effluent) sampled for moisture per OMRSD File V, Vol. I, requirement number B42HP0.011. (Material Defects)
- o Helium cleanliness and composition (purity and particulate count) are verified prior to introduction to on board flight hardware per 10REQ-0021, para. 2.3.2.5. (Material Defects)

D. FAILURE HISTORY

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

E. OPERATIONAL USE

- o Not applicable to this failure mode.