

**SSME FMEA/CIL
REDUNDANCY SCREEN**

Component Group: Pneumatic Controls
 CIL Item: C300-06
 Component: Helium Precharge Valve
 Part Number: RS01D180
 Failure Mode: Failure to contain helium pressurant.

Prepared: P. Lowmore
 Approved: T. Nguyen
 Approval Date: 6/2/99
 Change #: 1
 Directive #: CCBD ME3-01-5213
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| Phase | Failure / Effect Description | Criticality Hazard Reference |
|-----------|---|------------------------------------|
| SM 4.1 | HPV body fails to contain helium pressurant, high flowrate of helium reduces supply pressure to PCA. HPOTP intermediate seal purge pressure diminishes. High helium flowrate causes overpressurization of aft compartment. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE: N/A | 1 ME-C15, ME-C16 |
| PS 4.1 | HPV body fails to contain helium pressurant, high flowrate reduces supply pressure to PCA. HPOTP intermediate seal purge pressure diminishes. Controller monitors HPOTP intermediate seal purge pressure sensor and detects out-of-limit condition. Engine ready is inhibited. Launch delay. Loss of vehicle due to HPOTP fire may result if loss of helium to HPOTP IMSL purge is not detected. Redundancy Screens: PNEUMATIC SYSTEM - SENSOR SYSTEM: UNLIKE REDUNDANCY A: Pass - Redundant hardware items are capable of checkout during normal ground turnaround. B: Pass - Loss of a redundant hardware items is detectable during flight. C: Fail - Loss of redundant hardware items could result from a single credible event | 1R ME-C15, ME-G3P, ME-G3A |
| C 4.1 | HPV body or check valve body fails to contain helium pressurant. HPV fails to supply helium pressurant for Pogo shutdown. Loss of Pogo shutdown charge during MECO, at zero G condition and minimum NPSP shutdown will result in cavitation/overspeed of HPOTP and/or HPOTP. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE: N/A | 1 ME-C1C, ME-C1A, ME-G10C |

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SSME EA/CIL
DESIGN

Component Group: Pneumatic Controls
CIL Item: C300-06
Component: Helium Precharge Valve
Part Number: RS010180
Failure Mode: Failure to contain helium pressurant.

Prepared: P. Lowmore
Approved: T. Nguyen
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Design / Document Reference

FAILURE CAUSE: A: Structural failure (parent metal) of: Helium precharge valve housing.
B: Structural failure (parent metal) of: Helium precharge solenoid housing.

INCONEL 718 IS USED TO MANUFACTURE THE HELIUM PRECHARGE VALVE HOUSING (1). IT HAS HIGH STRENGTH AND RELATIVELY LOW THERMAL EXPANSION-CONTRACTION CHARACTERISTICS. RELATIVELY LOW THERMAL EXPANSION-CONTRACTION CHARACTERISTICS PROVIDE BETTER TOLERANCE CONTROL AND LOWER INDUCED STRESS FROM INTIMATE CONTACT WITH DISSIMILAR METALS. IT IS CORROSION RESISTANT AND EXHIBITS HIGH STRESS CORROSION CRACKING RESISTANCE. INCONEL 718 ALSO POSSESSES A COMPARATIVELY HIGH MODULUS OF ELASTICITY (2). THE SOLENOID VALVE HOUSING (3) IS MADE FROM 7075-T651 ALUMINUM ALLOY. LIGHTWEIGHT, HIGH STRENGTH, AND TENSILE YIELD (2) ARE THE PRIMARY REASONS FOR USING THIS ALLOY. PROTECTION FROM GENERAL CORROSION AND GALVANIC CORROSION AT DISSIMILAR METAL CONTACT AREAS IS PROVIDED BY ANODIZING THE ALUMINUM ALLOY (4). HIGH CYCLE AND LOW CYCLE FATIGUE LIFE, AS WELL AS THE MINIMUM FACTORS OF SAFETY FOR THE HELIUM PRECHARGE VALVE, MEET CEI REQUIREMENTS (7), EXCEPT FOR PROOF PRESSURE FACTOR WHICH IS ACCEPTED PER MAJOR WAIVER (8). THE HPV WAS CLEARED FOR FRACTURE MECHANICS/INDE FLAW GROWTH SINCE IT CONTAINS NO FRACTURE CRITICAL PARTS (9). THE ASSEMBLY HAS COMPLETED DESIGN VERIFICATION TESTING (5), INCLUDING VIBRATION AND ENDURANCE TESTING (6). A EXAMINATION OF ENGINE 2010 HPV SHOWED NO EVIDENCE OF DEGRADATION OR WEAR OF THE DETAIL PARTS. THE VALVE ACCUMULATED OVER 13,300 SECONDS AND 43 STARTS. THE CONTROLLER MONITOR SYSTEM IS COMPRISED OF REDUNDANT SENSOR ELECTRONICS, REDUNDANT HARNESSSES, AND REDUNDANT CONTROLLER CHANNELS (10).

(1) RS010181; (2) RSS-8582-6, (3) RS010359; (4) RA1809-003; (5) DVS-SSME-517; (6) RSS-517-53, RSS-517-51; (7) RL00532, CP020R0003B, RSS-8546; (8) DAR 2233; (9) NASA TASK 117; (10) CP406R0002 PT 1 3.2.3.6.4

**SSME FMEA/CIL
INSPECTION AND TEST**

Component Group: Pneumatic Controls
 CIL Item: C300-05
 Component: Helium Precharge Valve
 Part Number: RS010180
 Failure Mode: Failure to contain helium pressurant.

Prepared: P. Lowmore
 Approved: T. Nguyen
 Approval Date: 8/2/99
 Change #: 1
 Directive #: CCB0 ME3-01-5213
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| Failure Causes | Significant Characteristics | Inspection(s) / Test(s) | Document Reference |
|----------------|---|---|--|
| ALL CAUSES | HELIUM PRECHARGE VALVE ASSEMBLY HOUSING, HELIUM PRECHARGE VALVE SOLENOID VALVE SOLENOID | MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS. THE HEAT TREAT IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS | RS010180 |
| | | | RS010181 |
| | | | RS010311 RS010359 |
| | MATERIAL INTEGRITY | HOUSING ASSEMBLIES ARE PENETRANT INSPECTED AFTER FINISH MACHINING AND HEAT TREATMENT. ANODIZE OF SOLENOID IS VERIFIED PER DRAWING REQUIREMENTS. | RS010181 RS010359 |
| | | | RS010181 RS010359 RA0511-020 RA0111-025 RA0115-118 |
| | | | RS010359 |
| | PROOF TESTING | HPV ASSEMBLY LESS SOLENOID VALVE IS PROOF TESTED SOLENOID VALVE IS PROOF PRESSURE TESTED | RS010180 RL00459 |
| | | | RS010341 RL00226 RL00459 |
| | ASSEMBLY INTEGRITY | THE HPV ASSEMBLY IS VERIFIED DURING ACCEPTANCE TESTING. | |
| | PRE-FLIGHT CHECKOUT | FLIGHT READINESS TEST, INCLUDING PNEUMATIC SHUTDOWN IS PERFORMED EACH FLIGHT. FLIGHT READINESS TESTS AND VALVE CYCLE VERIFICATION ARE PERFORMED EACH FLIGHT. AFT CLOSEOUT INSPECTION IS PERFORMED PRIOR TO FLIGHT HPV OPERATION IS VERIFIED DURING PNEUMATIC CHECKOUT PRIOR TO CRYO LOADING. (LAST TEST) | GMRSD V41AS0 03C GMRSD S00FAC.211 GMRSD V41AS0.030 GMRSD V41BU0 070 GMRSD S00FAC 213 |

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Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)
 Reference: NASA letter S421/88/308 and Rockaldyne letter 80RC09761
 Operational Use: Not Applicable.