

SSME FA/CIL
REDUNDANCY SCREEN

Component Group: Propellant Valves
CIL Item: D210-03
Component: Fuel Bleed Valve
Part Number: RS498056
Failure Mode: Gross leakage.

Prepared: P. Lowrmore
Approved: T. Nguyen
Approval Date: 6/30/99
Change #: 1
Directive #: CGBD ME1-01-5226
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Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	High pressure to fuel interface; rupture of vehicle fuel bleed duct; overpressurization of aft compartment. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE: N/A.	1 ME-G7S

SSME FMEA/CIL
DESIGN

Component Group: Propellant Valves
CIL Item: D210-03
Component: Fuel Bleed Valve
Part Number: RS008056
Failure Mode: Gross leakage.

Prepared: P. Lowrincro
Approved: T. Nguyen
Approval Date: 8/30/99
Change #: 1
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Design / Document Reference

FAILURE CAUSE: A: Poppet or seat fractured/damaged.

THE FUEL BLEED VALVE (1), POPPET (2), AND BODY (3) (SEAT) ARE HEAT TREATED INCONEL 718. THE MATERIAL WAS SELECTED FOR ITS STRENGTH AND DUCTILITY AT CRYOGENIC TEMPERATURE. INCONEL 718 IS CORROSION RESISTANT, RESISTANT TO STRESS CORROSION CRACKING (4), AND IS RESISTANT TO HEE AT THE NEAR -400F OPERATING TEMPERATURE. THE SEALING FACES OF THE POPPET AND HOUSING ARE TUNGSTEN CARBIDE HARDFACE (2)(3). HARDFACE BONDING IS ENSURED BY THERMAL SHOCK TEST AND GRINDING (5).

(1) RS008056; (2) RS008282; (3) RS009507; (4) RSS-8582; (5) RA0609-016

FAILURE CAUSE: B: Weld 4 (retainer/poppet) failure.

THE RETAINER (1) AND POPPET (2) ARE HEAT TREATED INCONEL 718. THE MATERIAL WAS CHOSEN FOR ITS STRENGTH, DUCTILITY, WELDABILITY, AND RESISTANCE TO CORROSION AND STRESS CORROSION CRACKING (3), AND IS RESISTANT TO HEE AT THE NEAR -400F OPERATING TEMPERATURE. THE WELD IS A CLASS I A E B WELD (1). THE RETAINER BUTTS UP AGAINST A SHOULDER IN THE POPPET FOR ADDED SUPPORT (1).

(1) RS008286; (2) RS008282; (3) RSS-8582

FAILURE CAUSE: C: Contamination.

THE FUEL BLEED VALVE DETAIL PARTS, TEST FIXTURES, AND TEST FLUIDS MEET THE CLEAN REQUIREMENTS FOR LOX SERVICE PRIOR TO ASSEMBLY AND TEST (1)(2). THE PISTON ASSEMBLY HAS A TEFLON SLEEVE TO PREVENT METAL-TO-METAL RUBBING AND PARTICLE GENERATION (3). THE SURFACE FINISH OF THE TEFLON SLEEVE AND HOUSING PREVENT WEAR AND PARTICLE GENERATION (4). THE LARGE POPPET STROKE (.235 INCHES (2)) PREVENTS TRAPPING PARTICLES BETWEEN THE POPPET AND SEAT DURING FLOW.

(1) RS008056; (2) RL00034; (3) RS009503; (4) RS009507

FAILURE CAUSE: D: Stop screw loosens.

THE SCREWS ARE TORQUED INTO SELF-LOCKING HELI-COIL INSERTS. THE DRAWING SPECIFIES A MINIMUM RUNNING TORQUE AND THE FINAL TORQUE (1). THE VALVE IS OPEN ONLY DURING PROPELLANT CONDITIONING WHEN THERE ARE NO VIBRATION LOADS TO LOOSEN THE SCREWS. DURING ENGINE OPERATION, WHEN THE VALVE IS EXPOSED TO VIBRATION, THE VALVE IS CLOSED AND THE SCREW LOAD IS MINIMUM WHICH MINIMIZES THE CHANCE OF A SCREW LOOSENING.

(1) RS008056

FAILURE CAUSE: E: Piston seizure or binding.

THE BLEED VALVE PISTON (1) IS GUIDED BY A TEFLON SLEEVE. THE SLEEVE PREVENTS METAL-TO-METAL RUBBING BETWEEN THE PISTON AND THE HOUSING (2) AND METALLIC PARTICLE GENERATION. THE TEFLON ALSO REDUCES FRICTION. THE TEFLON IS COMPATIBLE WITH ITS EXPOSURE MEDIA, AND CAUSES NO PROBLEM WHEN IN INTIMATE CONTACT WITH METALLIC COMPONENTS (3). IN THE EVENT THAT METAL PARTICLES FROM ANOTHER SOURCE GET INTO THE PISTON-HOUSING INTERFACE, THE PARTICLES BECOME IMBEDDED IN THE TEFLON SLEEVE. THIS ALSO PREVENTS GALLING BETWEEN THE PISTON AND HOUSING AND PREVENTS BINDING OR SEIZURE. THE SURFACE FINISHES OF THE HOUSING (2) AND PISTON (1) ASSEMBLY ARE SELECTED TO PREVENT EXCESSIVE WEAR. ALL INTERNAL COMPONENTS ARE CLEANED TO PROPELLANT SERVICE REQUIREMENTS (4). THE VALVE IS ASSEMBLED IN A CONTAMINATION CONTROLLED ENVIRONMENT (5).

(1) RS009503; (2) RSD09507; (3) RSS-8582; (4) RL10001; (5) RQ0711-600

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FAILURE CAUSE: ALL CAUSES

HIGH CYCLE AND LOW CYCLE FATIGUE LIFE OF THE BLEED VALVE MEETS CEI REQUIREMENTS (1). THE MINIMUM FACTORS OF SAFETY FOR THE BLEED VALVE MEET CEI REQUIREMENTS (2). THE FBV COMPONENTS WERE CLEARED FOR FRACTURE MECHANICS/INDE FLAW GROWTH, SINCE THEY ARE NOT FRACTURE CRITICAL PARTS (3). TABLE D210 LISTS ALL THE FMEA/CIL WELDS AND IDENTIFIES THOSE WELDS IN WHICH THE CRITICAL INITIAL FLAW SIZE IS NOT DETECTABLE, AND THOSE WELDS IN WHICH THE ROOT SIDE IS NOT ACCESSIBLE FOR INSPECTION. THESE WELDS HAVE BEEN ASSESSED AS ACCEPTABLE FOR FLIGHT BY RISK ASSESSMENT (4). THE BLEED VALVE HAS COMPLETED DESIGN VERIFICATION TESTING (5), INCLUDING VIBRATION (6), AND ENDURANCE TESTING (7).

(1) RL03532, CP320R0003B; (2) RSS-8546, CP320R0003B; (3) NASA TASK 117; (4) RSS-8756; (5) DVS-55ME-516; (6) RSS-516-21; (7) RSS-516-17

**SSME FMEA/CIL
INSPECTION AND TEST**

Component Group: Propellant Valves
 CL Item: D2f0-03
 Component: Fuel Bleed Valve
 Part Number: RS008058
 Failure Mode: Gross leakage.

Prepared: P. Lowrimore
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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	BLEED VALVE POPPET BODY		RS008058 RS008282 RS009507
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS	RS008282 RS009507
		HARDFACING IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS	RS008282 RS009507
		- ADHESION IS VERIFIED BY THERMAL SHOCK TEST PER SPECIFICATION, - COATING INTEGRITY IS VERIFIED BY DYE PENETRANT INSPECTION PER SPECIFICATION, HEAT TREAT IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RA1609-049 RA0115-116 RS008282 RS009507
B	POPPET RETAINER		RS008282 RS008286
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	RS008282 RS008286
		HEAT TREAT IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS008282 RS008286 RA0511-020
	WELD INTEGRITY	WELD SAMPLES MADE PRIOR TO PRODUCTION WELD VERIFY E.B. WELD PARAMETERS. ALL WELDS ARE INSPECTED TO DRAWING AND SPECIFICATION REQUIREMENTS PER WELD CLASS. INSPECTIONS INCLUDE: VISUAL, DIMENSIONAL, PENETRANT, RADIOGRAPHIC, ULTRASONIC, AND FILLER MATERIAL, AS APPLICABLE.	RA0507-094 RL10011 RA0507-094 RA0115-116 RA0115-006 RA0115-127 RA1115-001
C, E	POPPET BODY		RS008282 RS009507
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	
	CLEANLINESS REQUIREMENTS	COMPONENTS ARE CLEANED FOR OXYGEN/FUEL SERVICE PER SPECIFICATION REQUIREMENTS.	RS008282 RS009507 RL10001

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Component: Propellant Valves
 CIL Item: 0210-03
 Component: Fuel Bleed Valve
 Part Number: R5008056
 Failure Mode: Gross leakage.

Prepared: P. Lowrin
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 Approval Date: 6/30/99
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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
D	STOP SCREW RUNNING TORQUE	RUNNING TORQUE OF THE STOP SCREW IS VERIFIED DURING ASSEMBLY.	RS008056
ALL CAUSES	ASSEMBLY INTEGRITY	SURFACE FINISH OF THE POPPET OD AND THE BODY BORE ARE INSPECTED PER DRAWING REQUIREMENTS. ASSEMBLY AND FUNCTIONAL TEST VERIFY VALVE OPERATION AND COMPONENT INTEGRITY FBV SEAT LEAKAGE TEST PRIOR TO EACH FLIGHT VERIFIES POPPET AND SEAT INTEGRITY. (LAST TEST)	HS008282 RS009507 RL00034 QMRSD V41BQ0.030

Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (FRAMS/PRACA)
 Reference: NASA letter SA21/88/308 and Rocketdyne letter 88RC09761.
 Operational Use: Not Applicable.

**SSME FA/CIL
WELD JOINTS**

Component Group: Propellant Valves
 CIL Item: D210
 Component: Fuel Bleed Valve
 Part Number: RS008056

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Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Access	Critical Initial Flaw Size Not Detectable		Comments
						HCF	LCF	
FUEL BLEED VALVE	RS008056	1	EBW	II	X	X	X	
FUEL BLEED VALVE	RS008056	2	EBW	II	X			
FUEL BLEED VALVE	RS008056	4	EBW	1A	X			

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SSME FMEA/CIL
FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE

Component Group: Propellant Valves
 Item Name: Fuel Bleed Valve
 Item Number: D210
 Part Number: RS000056

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Base Line Rationale	Variance	Change Rationale	Variant Dash Number
1. D210-04 ARMATURE EXTENSION MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS (INCONEL 625, ECP 1088).	SOME ARMATURE EXTENSIONS ARE FABRICATED FROM INCONEL 718.	INCONEL 718 CAN BECOME FERROMAGNETIC AT LIQUID HYDROGEN TEMPERATURES RESULTING IN ERRONEOUS POSITION FEEDBACK SIGNAL. INCONEL 625 DOES NOT EXHIBIT THIS FERROMAGNETIC TENDENCY. USE AS IS RATIONALE: 1. ALL INCO 718 MATERIAL LOTS USED FOR FLIGHT ARMATURE EXTENSIONS HAVE BEEN SAMPLE TESTED. ARMATURE EXTENSIONS FABRICATED FROM LOTS OF INCO 718 WHICH HAVE EXHIBITED HIGH SUSCEPTABILITY TO LOW TEMPERATURE INDUCED FERROMAGNETIVITY HAVE BEEN IDENTIFIED AND ARE PROHIBITED FROM USE ON FUEL BLEED VALVES PER DAR 2251. (UCR A003781)	-021, -041, -051, -061, -071, -101