SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group:	Propellant Valves
CIL Item:	D210-04
Component:	Fuel Bleed Valve
Part Number:	RS008058
Failure Mode:	Erroneous position feedback signal.

Prepared:	P. Lowrimore
Approved:	T. Nguyen
Approval Date:	8/30/99
Change #:	1
Directive #:	CCBD ME3-01-5226
Page:	1 of 1

Phase	Failure / Effect Description	Criticality Hazard Reference
P 4 2	Erroneous signal not detected by controller results in loss of protection against failure of valve to close. Loss of vehicle due to orbiter duct rupture may result if FBV fails to close and is not detected. Redundancy Screens: SENSOR SYSTEM - VALVE SYSTEM: UNLIKE REDUNDANCY A. Pass - Redundant hardware items are capable of checkout during normal ground turnaround. B: Fail - Loss of a redundant hardware items is not detectable during flight. C: Pass - Loss of redundant hardware items could not result from a single credible event.	1R ME-07S

SSME FMEA/CIL
DESIGN

Component Group:	Propellant Valves	Prepared:	P. Lowrimore
CIL Item:	D210-04	Approved:	T. Nguyen
Component:	Fuel Bleed Valve	Approval Date:	6/30/99
Part Number:	RS008056	Change #:	1
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		Page:	1 of 1

Design / Document Reference

FAILURE CAUSE: A: Damaged armature.

THE ARMATURE IS MANUFACTURED FROM HY-MU 80 ALLOY BAR (1) COLD DRAWN AND MAGNETIC ANNEALED. MATERIAL IS SELECTED FOR ITS MAGNETIC PERMABILITY AND COERCIVE FORCE. THE HY-MU 80 ARMATURE MATERIAL CANNOT ADVERSELY AFFECT THE INDICATOR FEEDBACK SIGNAL UNLESS THE ARMATURE ITSELF IS DIMENSIONALLY DEFORMED OR OTHERWISE PHYSICALLY COMPROMISED AS DETECTABLE PER REQUIRED ACCEPTANCE TEST VERIFICATION SUCH AS OUTPUT CHANGE (2). THE HOUSING PROTECTS THE ARMATURE FROM THE OUTSIDE ELEMENTS. THE MINIMUM DIAMETRICAL CLEARANCE BETWEEN ARMATURE O.D. AND THE TRANSFORMER HOUSING BORE IS CONTROLLED (2). THE ARMATURE IS DRY-FILM LUBRICATED (2). THE ARMATURE EXTENSION IS HEAT TREATED INCONEL 718 (2). THE MATERIAL WAS SELECTED FOR ITS STRENGTH, DUCTILITY, AND WELDABILITY. THE ARMATURE EXTENSION MAY ALSO BE MANUFACTURED FROM INCONEL 625 BAR (2). THIS MATERIAL WAS SELECTED FOR ITS WELDABILITY, CORROSION RESISTANCE, CRYOGENIC TOUGHNESS, RESISTANCE TO STRESS CORROSION CRACKING, AND RESISTANCE TO INDUCED FERROMAGNETISM (3). THE EXTENSION IS KNURLED FOR A TIGHT FIT ON THE ARMATURE I.D. THE ARMATURE IS RETAINED BY AN E B. WELDED GUIDE ON THE END OF THE EXTENSION. THE LVDT ASSEMBLY IS LIFE LIMITED TO PREVENT FAILURE (4).

(1) MIL-N-14411, COMP 1; (2) RES1114; (3) RSS-8582; (4) DAR 1422

FAILURE CAUSE: B: Open or short circuit.
C: Change of internal resistance caused by moisture, corrosion, or contamination.

PARTS FOR THE CIRCUITS INVOLVED IN THIS FUNCTION HAVE BEEN SELECTED FROM THE MSFC CLASS S OR EQUIVALENT APPROVED PARTS SELECTION (1). ELECTRICAL CONNECTOR IS DESIGNED TO SEAL AGAINST MOISTURE/CONTAMINATION (2). RECEPTACLE PINS ARE NICKEL UNDERPLATED AND GOLD OVERPLATED TO PREVENT CORROSION (3). GLASS BEADS (4) FILL ALL CAVITIES AND PREVENT WIRE MOVEMENT. THE CAVITY IS EVACUATED AND BACK-FILLED WITH HELIUM. A TEFLON PLUG IS INSERTED IN THE ACCESS PASSAGEWAY AND A BALL IS RESISTANCE WELDED TO THE HOUSING ACCESS PORT. THE BALL RECESS IS POTTED (5) FLUSH WITH TOP OF FLANGE. THIS DESIGN PREVENTS MOISTURE/CONTAMINATION PROBLEMS (6). SOLDERING OF ELECTRICAL CONNECTIONS AND TERMINAL CONNECTIONS ARE CONTROLLED BY SPECIFICATION (7). PRIMARY AND SECONDARY COILS ARE DESIGNED SO THEY ARE INSULATED FROM EACH OTHER (8). THE FUEL AND OXIDIZER BLEED VALVES WITH THE POSITIONING INDICATOR ATTACHED HAS SUCCESSFULLY PASSED DESIGN VERIFICATION TESTING (9), WHICH INCLUDED PRESSURE CYCLING (10), AND VIBRATION TESTING (11).

(1) 85M03928; (2) RES1232; (3) MSFC-SPEC-250; (4) MIL-G-9954, SIZE 12; (5) MSFC-SPEC-222; (6) 2-6149-2; (7) MSFC-SPEC-276; (8) 4-6149; (9) DVS-SSME-516; (10) RSS-516-17; (11) RSS-516-20

SSME FMEA/CIL
INSPECTION AND TEST

Component Group: Propellant Valves
CIL Item: D210-04
Component: Fuel Bleed Valve
Part Number: RS008056
Failure Mode: Erroneous position feedback signal.

Prepared: P. Lowrimore
Approved: T. Nguyen
Approval Date: 6/30/99
Change #: 1
Directive #: CCBD ME3-01-5225

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	POSITION INDICATOR		RES1114
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	
		ARMATURE DRY-FILM LUBRICATION IS INSPECTED PER SPECIFICATION AND DRAWING REQUIREMENTS.	RB0140-017 RES1114
		DIAMETRICAL CLEARANCE BETWEEN ARMATURE AND TRANSFORMER BORE IS INSPECTED PER DRAWING REQUIREMENTS.	RES1114
B, C	POSITION INDICATOR		RES1114
	PLATING INTEGRITY	THE PLATING IS VERIFIED PER SPECIFICATION REQUIREMENTS.	
	SOLDERING INTEGRITY	ELECTRICAL SOLDERING IS INSPECTED PER SPECIFICATION REQUIREMENTS.	
	ASSEMBLY CLEANLINESS	CLEANLINESS IS VERIFIED DURING ASSEMBLY AND TESTING PER SPECIFICATION REQUIREMENTS.	RL10001 RES1114
	ASSEMBLY INTEGRITY	EACH TRANSDUCER IS EXAMINED FOR QUALITY OF WORKMANSHIP PER SPECIFICATION REQUIREMENTS.	RES1114
		THE FOLLOWING TESTS ARE PERFORMED DURING MANUFACTURING AND ACCEPTANCE TESTING - INSULATION RESISTANCE BETWEEN COILS AND CASE. - DIELECTRIC WITHSTANDING VOLTAGE TEST TO VERIFY CURRENT LEAKAGE IS WITHIN SPECIFICATION REQUIREMENTS. - STROKE DEFLECTION TESTS TO VERIFY PROPER DISPLACEMENT, OUTPUT VOLTAGE, AND PHASING. - SCALE FACTOR AND LINEARITY TEST. - LOW TEMPERATURE FUNCTIONAL TEST. - HELIUM BACK FILL AND LEAK TEST.	
	WELD INTEGRITY	ALL WELDS ARE INSPECTED TO DRAWING AND SPECIFICATION REQUIREMENTS.	RL10011 RA0507-034

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
ALL CAUSES	PRE-FLIGHT CHECKOUT	POSITION INDICATOR OPERATION IS VERIFIED DURING EACH FLIGHT FLOW BY THE FOLLOWING TESTS: (LAST TEST) - FLIGHT READINESS TEST. - CONTROLLER POWER UP. - SENSOR CHECKOUT. - PNEUMATIC CHECKOUT MODULE LOAD AND EXECUTE. - PRE-CRYO LOADING CONFIGURATION VERIFICATION.	OMRSD S00FA0.211 OMRSD S00FA0.213 OMRSD S00FA0.213 OMRSD S00FA0.213 OMRSD S00FA0.213

Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)
Reference: NASA letter SA21/88/308 and Rocketdyne letter 88RC09751.

Operational Use: Not Applicable.

SSME FEA/CIL
WELD JOINTS

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

Prepared: P. Lowrimore
Approved: T. Nguyen
Approval Date: 6/30/98
Change #: 1
Directive #: CCBD ME3-01-5226

Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Access	Critical Initial Flaw Size Not Detectable HCF	Critical Initial Flaw Size Not Detectable LCF	Comments
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			

SSME FMEA/CIL
FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE

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

Prepared: P. Lowrimore
Approved: T. Nguyen
Approval Date: 6/30/99
Change #: 1
Directive #: CCBD ME3-01-5228

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