SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group: Propellant Valves
CIL Item: D220-05
Component: Oxidizer Bleed Valve
Part Number: RS008056
Failure Mode: Piece part structural failure.

Prepared: P. Lowrimore
Approved: T. Nguyen
Approval Date: 6/30/99
Change #: 1
Directive #: CCBD ME3-01-5226

Phase	Failure / Effect Description	Criticality Hazard Reference
PD 4.1	Fire from LOX impact or rubbing. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE: *N/A.*	† ME-C3P,D. ME-C3P,A

SSME FMEA/CIL
DESIGN

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Design / Document Reference

FAILURE CAUSE: A: Internal structural failure of: Poppet, Retainer.

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). THE POPPET AND RETAINER ARE JOINED WITH A CLASS 1A E.B. WELD (4). THE RETAINER BUTTS-UP AGAINST A SHOULDER IN THE POPPET FOR ADDED SUPPORT (1). THE SEALING FACE OF THE POPPET IS TUNGSTEN CARBIDE HARDFACED (2). HARDFACE BONDING IS ENSURED BY THERMAL SHOCK TEST AND GRINDING (5). BOTH INCONEL 718 AND THE TUNGSTEN CARBIDE HARDFACING MEET LOX COMPATIBILITY REQUIREMENTS (3). THE HEAT SHRINKABLE TEFLON SLEEVE ON THE PISTON HAS AN APPROVED MATERIAL USAGE AGREEMENT (6). HIGH CYCLE AND LOW CYCLE FATIGUE LIFE OF THE BLEED VALVE MEETS CEI REQUIREMENTS (7). THE MINIMUM FACTORS OF SAFETY FOR THE BLEED VALVE MEET CEI REQUIREMENTS (8). THE OBV COMPONENTS WERE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH, SINCE THEY ARE NOT FRACTURE CRITICAL PARTS (9). TABLE D220 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 BE RISK ASSESSMENT (10). THE BLEED VALVE HAS COMPLETED DESIGN VERIFICATION TESTING (11), INCLUDING VIBRATION (12), AND ENDURANCE TESTING (13).

(1) RS008286; (2) RS008282; (3) RSS-8582; (4) RS008056; (5) RA0609-015; (6) RB0130-100; (7) RL00532, CP320R0003B; (8) RSS-8546, CP320R0003B; (9) NASA TASK 117; (10) RSS-8756; (11) DVS-SSME-516; (12) RSS-516-21; (13) RSS-516-17

SSME FMEA/CIL
INSPECTION AND TEST

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	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 RA0611-020
		HARDFACING IS VERIFIED PER DRAWING AND SPECIFICATION REQUIREMENTS. - ADHESION IS VERIFIED BY THERMAL SHOCK TEST PER SPECIFICATION - COATING INTEGRITY IS VERIFIED BY DYE PENETRANT INSPECTION PER SPECIFICATION.	RS008282 RA1609-049 RA0115-116
	WELD INTEGRITY	WELD SAMPLES MADE PRIOR TO PRODUCTION WELD VERIFY E.B. WELD PARAMETERS.	RA0607-094
		ALL WELDS ARE INSPECTED TO DRAWING AND SPECIFICATION REQUIREMENTS PER WELD CLASS INSPECTIONS INCLUDE: VISUAL, DIMENSIONAL, PENETRANT, RADIOGRAPHIC, ULTRASONIC, AND FILLER MATERIAL, AS APPLICABLE.	RL10011 RA1609-049 RA0115-116 RA0115-006 RA0115-127 RA1115-001
	ASSEMBLY INTEGRITY	VALVE FUNCTIONAL TESTS VERIFY PART INTEGRITY.	RL00034
		OBV SEAT LEAKAGE TESTS VERIFY POPPET INTEGRITY PRIOR TO EACH FLIGHT. (LAST TEST)	OMRSD V41BQ0.141

Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)
Reference: NASA letter SA21/88/308 and Rocketdyne letter 88RC09761.

Operational Use: Not Applicable.

SSME FMEA/CIL
WELD JOINTS

Component Group: Propellant Valves
CIL Item: D22D
Component: Oxidizer Bleed Valve
Part Number: RS008056

Prepared: P. Lowrimore
Approved: T. Nguyen
Approval Date: 6/30/99
Change #: 1
Directive #: CCBD ME3-01-5225
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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
OXIDIZER BLEED VALVE	RS008056	1	EBW	II	X	X	X	
OXIDIZER BLEED VALVE	RS008056	2	EBW	II	X			
OXIDIZER BLEED VALVE	RS008056	4	EBW	1A	X			
BELLOWS	RS008285	3,4	GTAW	II	X	X		

SSME FMEA/CIL
FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE

Component Group: Propellant Valves
Item Name: Oxidizer Bleed Valve
Item Number: D220
Part Number: RS008056

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Base Line Rationale	Variance	Change Rationale	Variant Dash Number
1. D220-04 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 TENDENCY. USE AS IS RATIONALE: 1. ENGINEERING ANALYSIS HAS DETERMINED THAT ALL ARMATURE EXTENSIONS FABRICATED FROM INCO 718 WILL NOT EXPERIENCE LOW ENOUGH TEMPERATURES ON OXIDIZER BLEED VALVES TO INDUCE FERROMAGNETIVITY AND ARE THEREFORE ACCEPTABLE FOR USE. (ECP 1088)	-021, -041, -051, -061, -071, -101