SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group:	Ducts and Lines	**Prepared:**	D. Early
CIL Item:	K110-02	**Approved:**	T. Nguyen
Part Number:	RS007168	**Approval Date:**	7/25/00
Component:	Fuel Bleed Duct	**Change #:**	1
FMEA Item:	K110	**Directive #:**	CCBD ME3-01-5638
Failure Mode:	Fails to contain hydrogen.	**Page:**	1 of 1

Phase	Failure / Effect Description	Criticality Hazard Reference
PSMCD 4.1	Fuel leak into aft compartment. Overpressurization of aft compartment. Possible fire or detonation. Loss of vehicle.	1 ME-D3P,D, ME-D3S,A,M,C
	Redundancy Screens: SINGLE POINT FAILURE: N/A	

SSME FMEA/CIL
DESIGN

Component Group:	**Ducts and Lines**	**Prepared:**	**D. Early**
CIL Item:	**K110-02**	**Approved:**	**T. Nguyen**
Part Number:	**RS007168**	**Approval Date:**	**7/25/00**
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Design / Document Reference

FAILURE CAUSE: A: Parent material failure or weld failure.

THE DUCT ASSEMBLY (1) IS MANUFACTURED UTILIZING INCONEL 718 MATERIAL FOR THE FLANGE, VALVE HOUSING AND INTERMEDIATE DUCT SUPPORT. THE REMAINDER OF THE ASSEMBLY IS ARMCO 21-6-9 TUBING, BAR, AND SHEET. ARMCO 21-6-9 WAS SELECTED FOR ITS STRENGTH AT CRYOGENIC TEMPERATURES, ITS CORROSION RESISTANCE, AND RESISTANCE TO STRESS CORROSION CRACKING (2). HYDROGEN ENVIRONMENT DOES NOT HAVE A SIGNIFICANT EFFECT ON ARMCO 21-6-9. INCONEL 718 WAS SELECTED FOR ITS STRENGTH, RESISTANCE TO STRESS CORROSION, CORROSION RESISTANCE, HIGH/LOW CYCLE FATIGUE CHARACTERISTICS, AND WELDABILITY (2). MATERIALS ARE HEAT TREATED TO DEVELOP FULL MATERIAL STRENGTH AND HARDNESS (2). HYDROGEN ENVIRONMENT EFFECTS ARE NOT A PROBLEM DUE TO THE OPERATING ENVIRONMENT. FLANGE SECTIONS INCORPORATE RADIUS JOINTS TO REDUCE STRESS CONCENTRATIONS. OFFSET LIMIT REQUIREMENTS ARE ESTABLISHED TO REDUCE STRESS CONCENTRATIONS AND IMPROVE WELD GEOMETRY. TUBING STOCK IS DRAWN TO MAINTAIN SURFACE REGULARITY. INSTALLATION IS CONTROLLED FOR ANGULARITY AND OFFSET PER SPECIFICATION REQUIREMENTS (3). AN ACTIVE CORROSION INHIBITOR IS APPLIED TO THE EXTERNAL SURFACES OF THE UNINSULATED DUCT FOR ADDED CORROSION RESISTANCE (4). THE MINIMUM FACTORS OF SAFETY FOR THE DUCT MEET CEI REQUIREMENTS (5). HIGH AND LOW CYCLE FATIGUE LIFE MEET CEI REQUIREMENTS (6), EXCEPT ALL DUCTS THAT ARE HIGH CYCLE FATIGUE LIFE LIMITED FOR ELECTROCHEM ETCH LIFE CONCERNS (10). THE DUCT ASSEMBLY HAS COMPLETED PRESSURE CYCLING AND ULTIMATE PRESSURE DVS TESTING (7). THE DUCT ASSEMBLY PARENT MATERIALS WERE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH, SINCE THEY ARE NOT FRACTURE CRITICAL PARTS (8). TABLE K110 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 (9).

(1) RS007169; (2) RSS-8582; (3) I.L. 0216-8066; (4) RS007168, RA1608-008, RB0125-009; (5) RSS-8546, CP320R0003B; (6) RL00532, CP320R0003B; (7) RSS-511-43; (8) NASA TASK 117; (9) RSS-8756, MCR 0964; (10) DAR 2736

SSME FM. CIL
INSPECTION AND TEST

Component Group:	Ducts and Lines	**Prepared:**	D. Early
CIL Item:	K110-02	**Approved:**	T. Nguyen
Part Number:	RS007168	**Approval Date:**	7/25/00
Component:	Fuel Bleed Duct	**Change #:**	1
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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	DUCT DUCT		RS007168 RS007169
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	RS007169
		DETAILS ARE PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116
	HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0611-020
	WELD INTEGRITY	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 RA0607-094 RA0115-116 RA0115-006 RA1115-001 RA0115-127
		AN ACTIVE CORROSION INHIBITOR COATING IS VERIFIED PER SPECIFICATION AND DRAWING REQUIREMENTS.	RS007168 RA1608-008
	ASSEMBLY INTEGRITY	EXTERIOR SURFACE OF DUCT IS INSPECTED FOR SURFACE DEFECTS PER DRAWING AND SPECIFICATION REQUIREMENTS.	RS007169 RA0102-003
		THE ASSEMBLY IS PROOF PRESSURE TESTED PER DRAWING REQUIREMENTS.	RS007169
		WELDS ARE PENETRANT INSPECTED AFTER PROOF PRESSURE TEST PER SPECIFICATION REQUIREMENTS.	RA0115-116
	FLIGHT FLOW TESTING	THE EXTERNAL SURFACE IS VISUALLY INSPECTED PRIOR TO EACH LAUNCH.	OMRSD V41BU0.030
		A HELIUM SIGNATURE LEAK TEST IS PERFORMED PRIOR TO EACH LAUNCH. (LAST TEST)	OMRSD S00000.950

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
FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE

Component Group: Ducts and Lines
Item Name: Fuel Bleed Duct
Item Number: K110
Part Number: RS007168

Prepared: D. Early
Approved: T. Nguyen
Approval Date: 7/25/00
Change #: 1
Directive #: CCBD ME3-01-5638

Base Line Rationale	Variance	Change Rationale	Variant Dash Number
1. K110-02 APPLICATION OF CORROSION INHIBITOR.	ACTIVE CORROSION INHIBITOR IS NOT APPLIED.	USE AS IS RATIONALE: (1) DUCTS ARE LOW-SHELF TIME CONFIGURATION REDUCING THE POSSIBILITIES OF CORROSION. (2) DUCTS ARE LIFE LIMITED BY MAJOR WAIVER, DAR 2081.	RS007168-091

SSME :A/CIL
WELD JOINTS

Component Group: Ducts and Lines
CIL Item: K110
Part Number: RS007168
Component: Fuel Bleed Duct
FMEA Item: K110

Prepared: D. Early
Approved: T. Nguyen
Approval Date: 7/25/00
Change #: 1
Directive #: CCBD ME3-01-5638

Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Accessible	Critical Initial Flaw Size Not Detectable HCF	Critical Initial Flaw Size Not Detectable LCF	Comments
DUCT	RS007169	1	GTAW	I	X			
DUCT	RS007169	4	GTAW	I	X	X		
DUCT	RS007169	8	GTAW	I	X	X		
DUCT	RS007169	9	GTAW	I		X		
DUCT	RS007169	10	GTAW	I	X	X	X	