

SSME 1 A/CIL
REDUNDANCY SCREEN

Component Group: Ducts and Lines
CIL Item: K106-02
Part Number: R035533
Component: High Pressure Fuel Duct
FMEA Item: K106
Failure Mode: Fails to contain hydrogen.

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

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

SSME FMEA/CIL
DESIGN

Component Group: Ducts and Lines
CIL Item: K106-02
Part Number: R035533
Component: High Pressure Fuel Duct
FMEA Item: K106
Failure Mode: Fails to contain hydrogen.

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

Page: 1 of 1

Design / Document Reference

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

THE DUCT ASSEMBLY (1) IS MANUFACTURED UTILIZING 3 INCONEL 718 FORGINGS. INCONEL 718 WAS SELECTED FOR ITS STRENGTH, RESISTANCE TO STRESS CORROSION, CORROSION RESISTANCE, HIGH/LOW CYCLE FATIGUE CHARACTERISTICS, AND WELDABILITY (2). MATERIALS ARE SOLUTION HEAT TREATED TO DEVELOP FULL MATERIAL STRENGTH AND HARDNESS. HYDROGEN ENVIRONMENT EFFECTS ARE NOT A CONCERN DUE TO CRYOGENIC OPERATING TEMPERATURES (2). FLANGE SECTIONS INCORPORATE RADIUS JOINTS TO REDUCE STRESS CONCENTRATIONS. OFFSET LIMIT REQUIREMENTS ARE ESTABLISHED TO REDUCE STRESS CONCENTRATIONS AND IMPROVE WELD GEOMETRY. ALL SECTIONS ARE FORGED FOR STRENGTH. INSTALLATION IS CONTROLLED FOR ANGULARITY AND OFFSET (3). THE MINIMUM FACTORS OF SAFETY FOR THE DUCT MEET CEI REQUIREMENTS (4). LOW CYCLE AND HIGH CYCLE FATIGUE LIFE MEET CEI REQUIREMENTS (5). THE DUCT ASSEMBLY HAS COMPLETED CERTIFICATION TESTING BY ANALYSIS, SIMILARITY, LAB TESTING AND HOT FIRE (6). TABLE K106 LISTS THE NEW FMEA/CIL WELDS AND IDENTIFIES THE CRITICAL INITIAL FLAW SIZE DETECTABILITY AND ROOT SIDE INSPECTION. THESE WELDS HAVE BEEN ASSESSED AS ACCEPTABLE FOR FLIGHT (7).

(1) R035529; (2) RSS-8582; (3) RL01071; (4) RL00532, CP320R0003B; (5) RL00532, CP320R0003B; (6) VRS 392; (7) RSS-8756

**SSME FMI CIL
INSPECTION AND TEST**

Component Group: Ducts and Lines
 CIL Item: K106-02
 Part Number: R035533
 Component: High Pressure Fuel Duct
 FMEA Item: K106
 Failure Mode: Fails to contain hydrogen.

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

Page: 1 of 1

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	DUCT		R035529
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	R035529
		FORGINGS ARE ULTRASONIC INSPECTED PER DRAWING AND SPECIFICATION REQUIREMENTS.	RB0170-253 RB0170-153
		MACHINED DETAILS ARE PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116
	HEAT TREAT	HEAT TREAT IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RA0611-020 RB0170-253 RB0170-153
		ASSEMBLY INTEGRITY	THE FILLET RADII AT THE TRANSITION AREAS ARE VERIFIED PER DRAWING REQUIREMENTS.
	EXTERIOR SURFACE OF DUCT IS INSPECTED FOR SURFACE DEFECTS PER DRAWING AND SPECIFICATION REQUIREMENTS.		R035529
	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. WELDS CONFORM TO CLASS I REQUIREMENTS OF SPECIFICATION.	RL10011 RA0607-094 RA0115-116 RA0115-006 RA0115-001 RA0115-127
		ASSEMBLY INTEGRITY	THE DUCT ASSEMBLY IS PROOF PRESSURE TESTED PER DRAWING REQUIREMENTS.
	EXTERNAL SURFACES ARE LEAK TESTED PER DRAWING REQUIREMENTS AFTER PROOF PRESSURE TEST.		R035529
	FLIGHT FLOW TESTING	INTERNAL AND EXTERNAL SURFACES ARE PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS AFTER PROOF PRESSURE TEST.	RA0115-116
		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
WELD JOINTS

Component Group: Ducts and Lines
 CIL Item: K106
 Part Number: R035533
 Component: High Pressure Fuel Duct
 FMEA Item: K106

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

Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Access	Critical Initial Flaw Size Not Detectable		Comments
						HCF	LCF	
DUCT	R035529	1	GTAW	I				
DUCT	R035529	2	GTAW	I				