

SSME FMEA/CIL
INSPECTION AND TEST

Component Group: Ducts and Lines
 CIL Item: K512-01
 Part Number: RS007171
 Component: MFVA Emergency Shutdown Control Line
 FMEA Item: K512, K513
 Failure Mode: Fails to contain helium.

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

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	LINE FLANGE TEE ELBOW		RS007171 RS007147 RS007149 RS007237
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	RS007171 RS007147 RS007149 RS007237
		DETAILS ARE PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116
	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
	ASSEMBLY INTEGRITY	THE ASSEMBLY IS PROOF PRESSURE TESTED PER DRAWING REQUIREMENTS.	RS007171
FLIGHT FLOW TESTING	THE EXTERNAL SURFACE IS VISUALLY INSPECTED PRIOR TO EACH LAUNCH. FRT VERIFIES PROPELLANT VALVE PNEUMATIC OPERATION PRIOR TO EACH FLIGHT. (LAST TEST)	OMRSD V41BU0.030 OMRSD S00FA0.211	

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.

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DESIGN

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Design / Document Reference

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

THE LINE ASSEMBLY (1) IS MANUFACTURED UTILIZING 321 CRES TUBE AND INCONEL 625. 321 CRES TUBING WAS SELECTED BECAUSE OF ITS STRENGTH, FABRICABILITY, GENERAL CORROSION RESISTANCE, AND STRESS CORROSION RESISTANCE (2). INCONEL 625 WAS SELECTED FOR ITS WELDABILITY, FORMABILITY, RESISTANCE TO STRESS CORROSION CRACKING, AND CORROSION RESISTANCE (2). INCONEL 625 POSSESSES THE REQUIRED STRENGTH WITHOUT REQUIRING HEAT TREAT. FLANGE, TEE, AND ELBOW 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). MINIMUM FACTORS OF SAFETY FOR THE LINE MEET CEI REQUIREMENTS (4). HIGH AND LOW CYCLE FATIGUE LIFE MEET CEI REQUIREMENTS (5). THE LINE ASSEMBLY HAS COMPLETED PRESSURE CYCLING AND ULTIMATE PRESSURE DVS TESTING (6). THE LINE ASSEMBLY PARENT MATERIAL WAS CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH, SINCE THEY ARE NOT FRACTURE CRITICAL PARTS (7). TABLE K512 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 (8).

(1) RS007171; (2) RSS-8582; (3) RA1102-006; (4) RSS-8546, CP320R0003B; (5) RL00532, CP320R0003B; (6) RSS-511-43; (7) NASA TASK 117; (8) RSS-8756

**SSME FMEA/CIL
REDUNDANCY SCREEN**

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Phase	Failure / Effect Description	Criticality Hazard Reference
P 4.1	Helium leakage into aft compartment. Helium pressurant is not applied to closing piston of main fuel valve actuator (MFVA). MFV may drift causing propellant leakage. MFV leakage results in fire, open air detonation, and overpressure condition. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE: N/A	1 ME-A1P, ME-A2P, ME-A2A
C 4.2	Helium leakage into aft compartment. MFV and CCV fail to close; fuel flow continues until vehicle closure of prevalves; post shutdown fire, open air detonation, and overpressure condition when premature shutdown occurs on the launch pad. Loss of vehicle Redundancy Screens: ACTUATOR SYSTEM - PNEUMATIC SYSTEM: UNLIKE REDUNDANCY	1R ME-A1A
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.		

SSME I .A/CIL
WELD JOINTS

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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	
LINE	RS007171	1-7	GTAW	I	X	X		