

SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group: Block 1 Ducts and Lines
CIL Item: K640-01
Part Number: R039301
Component: MCC Drying Purge Manifold (ATD Configured Engine)
FMEA Item: K640
Failure Mode: Fails to contain hydrogen.

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

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Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	Hydrogen leakage into aft compartment. Aft compartment overpressurized. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE: N/A	1 ME-FD3S,A,M,C

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DESIGN

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Design / Document Reference

FAILURE CAUSE: A: Parent material failure of manifold.
B: Parent material failure of plate.

THE LINE ASSEMBLY (1) AND PLATE (2) ARE MANUFACTURED UTILIZING INCONEL 625 TUBE AND BAR. INCONEL 625 WAS SELECTED FOR ITS WELDABILITY, FORMABILITY, RESISTANCE TO STRESS CORROSION CRACKING, AND CORROSION RESISTANCE (3). INCONEL 625 IS NOT SIGNIFICANTLY EFFECTED BY HYDROGEN IN THIS ENVIRONMENT (3). INCONEL 625 POSSESSES THE REQUIRED STRENGTH WITHOUT REQUIRING HEAT TREAT. A STIFFENER IS INCORPORATED ACROSS THE PLATE TO PREVENT FLANGE DISTORTION UNDER PRESSURE. THE STIFFENER INCORPORATES RADIUS TO PREVENT STRESS RISERS. FLANGE AND ADAPTER 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. MINIMUM FACTORS OF SAFETY FOR THE MANIFOLD AND PLATE MEET CEI REQUIREMENTS (4). HIGH AND LOW CYCLE FATIGUE LIFE MEET CEI REQUIREMENTS (5). THE MANIFOLD AND PLATE HAVE COMPLETED CERTIFICATION TESTING BY ANALYSIS, SIMILARITY AND HOT FIRE TESTING (6). THE LINE ASSEMBLY PARENT MATERIALS WERE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH, SINCE THEY ARE NOT FRACTURE CRITICAL PARTS (7).

(1) R039301; (2) R039332; (3) RSS-8582; (4) CP320R0003B; (5) RL00532, CP320R0003B; (6) VRS-0507; (7) NASA TASK 117

**SSME FI /CIL
INSPECTION AND TEST**

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A, B	MANIFOLD PLATE		R039301 R039332
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	R039301 R039332
		MANIFOLD AND PLATE ARE PENETRANT INSPECTED PER SPECIFICATION REQUIREMENTS.	RA0115-116
		THE PLATE STIFFENER RADII ARE INSPECTED PER DRAWING REQUIREMENTS.	R039332
	FLIGHT FLOW TESTING	THE EXTERNAL SURFACE IS VISUALLY INSPECTED PRIOR TO EACH LAUNCH.	OMRSD V41BU0.030
	THE PLATE AND SEAL ARE LEAK CHECKED EACH FLIGHT.	OMRSD V41GEN.565	
	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
REDUNDANCY SCREEN

Component Group: Block 1 Ducts and Lines
CIL Item: K652-01
Part Number: R0018031
Component: Remote Mount FPB Pc Transducer Line (Phase II+)
FMEA Item: K652
Failure Mode: Fails to contain hot gas.

Prepared: D. Early
Approved: T. Nguyen
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Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	Hydrogen rich hot-gas leakage into aft compartment and overpressurization of the aft compartment. Extensive engine damage. Erosion of Pc port. Loss of vehicle.	1 ME-FD3S,A,M,C
Redundancy Screens: SINGLE POINT FAILURE: N/A		

SSM FMEA/CIL
DESIGN

Component Group: Block 1 Ducts and Lines
CIL Item: K652-01
Part Number: R0018031
Component: Remote Mount FPB Pc Transducer Line (Phase II+)
FMEA Item: K652
Failure Mode: Fails to contain hot gas.

Prepared: D. Early
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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 BAR. 321 CRES TUBING WAS SELECTED FOR 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. INCONEL 625 IS NOT SIGNIFICANTLY EFFECTED BY HYDROGEN IN THIS ENVIRONMENT (2). MOUNT AND SUPPORT SECTIONS INCORPORATE RADIUS JOINTS TO REDUCE STRESS CONCENTRATIONS. OFFSET LIMIT REQUIREMENTS ARE ESTABLISHED TO REDUCED STRESS CONCENTRATIONS AND IMPROVE WELD GEOMETRY. TUBING STOCK IS DRAWN TO MAINTAIN SURFACE REGULARITY. MINIMUM FACTORS OF SAFETY FOR THE LINE MEET CEI REQUIREMENTS (3). HIGH AND LOW CYCLE FATIGUE LIFE MEET CEI REQUIREMENTS (4). THE LINE ASSEMBLY HAS COMPLETED CERTIFICATION TESTING BY ANALYSIS, SIMILARITY AND HOT FIRE TESTING (5). THE LINE ASSEMBLY PARENT MATERIALS WERE CLEARED FOR FRACTURE MECHANICS/NDE FLAW GROWTH, SINCE THEY ARE NOT FRACTURE CRITICAL PARTS (6). TABLE K652 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 (7).

(1) R0018031; (2) RSS-8582; (3) CP320R0003B; (4) RL00532, CP320R0003B; (5) VRS-0487; (6) NASA TASK 117; (7) RSS-8756

SSME FMEA/CIL
INSPECTION AND TEST

Component Group: Block 1 Ducts and Lines
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 FMEA Item: K652
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A	MOUNT		R0018031
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS.	R0018031
		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			
ASSEMBLY INTEGRITY	THE ASSEMBLY IS PROOF PRESSURE TESTED PER DRAWING REQUIREMENTS.	RA0115-006	
FLIGHT FLOW TESTING	THE EXTERNAL SURFACE IS VISUALLY INSPECTED PRIOR TO EACH LAUNCH.	RA1115-001	
	A HELIUM SIGNATURE LEAK TEST IS PERFORMED PRIOR TO EACH LAUNCH. (LAST TEST)	RA0115-127	

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.