

SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group: Igniters and Sensors
 QIL Item: J311-03
 Component: MFV Hydraulic Temperature Transducer (M12.1)
 Part Number: RES7002
 Failure Mode: Leakage into sensor housing.

Prepared: M. Oliver
 Approved: T. Nguyen
 Approval Date: 3/30/99
 Change #: 1
 Directive #: CCBD ME3-01-4994
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Phase	Failure / Effect Description	Criticality Hazard Reference
M 4.1	Hydraulic fluid in alt compartment. Loss of return flow to reservoir. External leakage will eventually result in low reservoir level, loss of hydraulic pressure, engine hydraulic lockup. Loss of mission may result when hydraulic lockup occurs during Max Q throttling. Redundancy Screens. SINGLE POINT FAILURE: N/A.	1R ME-E1P,S,A,M,C,D

SSME EA/CIL
DESIGN

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Design / Document Reference

FAILURE CAUSE: A: Parent material or braze failure.

THE CRYOGENIC TEMPERATURE SENSOR PROBE HOUSING IS MADE FROM INCONEL 625. INCONEL 625 WAS SELECTED FOR ITS TENSILE STRENGTH, RESISTANCE TO GENERAL CORROSION, WELDABILITY TO 300 SERIES CRES, AND RESISTANCE TO STRESS CORROSION CRACKING (1), (2). THE REAR HOUSING IS MANUFACTURED FROM 321 CRES. THIS MATERIAL WAS SELECTED FOR ITS STRENGTH, WELDABILITY, CORROSION RESISTANCE, AND RESISTANCE TO STRESS CORROSION CRACKING (1), (2). HYDROGEN ENVIRONMENT EFFECTS ARE NOT CONSIDERED A PROBLEM UNDER THESE CONDITIONS OF USE (1). THE SHIELD IS GAS TUNGSTEN ARC WELDED TO THE PROBE HOUSING (3). PROCESSES USED FOR INTERNAL PROBE BRAZING AND HOUSING WELDING ARE CONTROLLED BY SPECIFICATION (3).

THE SENSORS ARE A VENDOR ITEM. DRAWING SPECIFICATION AND MANUFACTURING PROCESSES ARE CONTROLLED BY ROCKETDYNE (3). ALL SENSOR DESIGNS ARE SUBJECTED TO A CRITICAL DESIGN REVIEW. ANY DESIGN CHANGES ARE RE-REVIEWED (3). SENSORS HAVE COMPLETED DESIGN VERIFICATION TESTING (4), INCLUDING VIBRATION TESTING (5). THE MINIMUM FACTORS OF SAFETY MEET CEI REQUIREMENTS (6). THE SENSORS WERE ANALYZED FOR HIGH CYCLE FATIGUE AND LOW CYCLE FATIGUE, ALL REQUIREMENTS WERE MET (7).

(1) RSS-8662; (2) MSFC-SPEC-622; (3) RC7002; (4) DVS-SSME-203, RSS-8660; (5) RSS-203-11; (6) RSS-8546, CP320R0003B; (7) RL00532, CP320R0003B

**SSME FMEA/CIL
INSPECTION AND TEST**

Component Group: Igniters and Sensors
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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	TEMPERATURE TRANSDUCER		RES7002
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RC7002
	BRAZE INTEGRITY	BRAZING IS INSPECTED PER SPECIFICATION REQUIREMENTS.	
	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.	
	ASSEMBLY INTEGRITY	AFTER THE CASE IS WELDED, HELIUM LEAK TESTS ARE PERFORMED TO VERIFY HERMETIC SEAL. ALL VENDOR INSPECTION AND TEST CRITERIA IS UNDER ROCKETDYNE APPROVAL AND CONTROL. TRANSDUCERS ARE SUBJECTED TO A WORKMANSHIP SCREENING ACCEPTANCE TEST INCLUDING VIBRATION AND THERMAL CYCLE.	
	HOT FIRE AND ACCEPTANCE TESTING (GREEN RUN)	SENSOR OPERATION IS VERIFIED THROUGH HOT FIRE TESTING.	RL00461
	DATA REVIEW	ALL CONTROLLER DATA FROM THE PREVIOUS FLIGHT OR HOT FIRE IS REVIEWED. ANY ANOMALOUS CONDITION NOTED REQUIRES FURTHER TESTING OR HARDWARE REPLACEMENT PRIOR TO THE NEXT FLIGHT.	MSFC PLN 1228
	PRE-FLIGHT CHECKOUT	SENSORS ARE VISUALLY INSPECTED. SENSOR OPERATION IS VERIFIED EVERY MISSION FLOW BY SUCCESSFUL COMPLETION OF THE CONTROLLER SENSOR ELECTRICAL CHECKOUT. (LAST TEST)	OMRSD V41BU0.030 OMRSD V41AQ0.010 OMRSD 500FA0.213

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

Operational Use: FAILURE MODE CAN BE DETECTED IN REALTIME BY THE FLIGHT CONTROL TEAM WHO WILL EVALUATE EFFECTS UPON VEHICLE PERFORMANCE AND ABORT CAPABILITY. BASED ON THIS EVALUATION THE APPROPRIATE ABORT MODE OR SYSTEM CONFIGURATION WILL BE SELECTED. FAILURE DETECTION CUES AND ASSOCIATED SSME PERFORMANCE DATA HAVE BEEN COORDINATED BETWEEN THE ENGINEERING AND FLIGHT OPERATIONS ORGANIZATIONS WITH THE RESPONSES DOCUMENTED IN MISSION FLIGHT RULES.