SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group: Igniters and Sensors
CIL Item: J313-02
Component: MCC Oxidizer Injection Temperature Transducer (O8.3)
Part Number: RES7002
Failure Mode: Structural failure of probe.

Prepared: M. Oliver
Approved: T. Nguyen
Approval Date: 3/30/99
Change #: 1
Directive #: CCBD ME3-01-4994
Page: 1 of 1

Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	Fire from LOX impact or rubbing (see Mode 1 for effects of erroneous output signal). Loss of vehicle.	1
	Redundancy Screens: SINGLE POINT FAILURE: N/A	ME-C3S,M,A,C

SSME EA/CIL DESIGN

Component Group: Igniters and Sensors
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Component: MCC Oxidizer Injection Temperature Transducer (08.3)
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Design / Document Reference

FAILURE CAUSE: A: Probe weld or parent material failure.

THE CRYOGENIC TEMPERATURE TRANSDUCER, FRONT HOUSING, SHIELD, AND END CAP ARE MADE FROM INCONEL 625 (1). TENSILE STRENGTH, RESISTANCE TO GENERAL CORROSION, WELDABILITY TO 300 SERIES CRES, AND RESISTANCE TO STRESS CORROSION CRACKING REQUIREMENTS (3). THE SHIELD IS GAS TUNGSTEN ARC WELDED TO THE FRONT HOUSING. WELDING IS CONTROLLED BY SPECIFICATION (1). THIS END ITEM UNIT IS A VENDOR SUPPLIED ITEM, DRAWING SPECIFICATIONS AND MANUFACTURING PROCESSES ARE CONTROLLED BY ROCKETDYNE (1). ALL SENSOR DESIGNS ARE SUBJECTED TO A CRITICAL DESIGN REVIEW. ANY DESIGN CHANGES ARE RE-REVIEWED (1). THE RES7002-231 TRANSDUCER DESIGN HAS PASSED DESIGN VERIFICATION TESTING (4), INCLUDING THERMAL CYCLING AND VIBRATION TESTING (5). TABLE J313 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 (6). THE -223 DESIGN IS IDENTICAL TO THE -231 DESIGN WITH THE EXCEPTION OF ELEMENT ICE POINT RESISTANCE AND CONNECTOR ORIENTATION. THE RES7002-223 DESIGN HAS BEEN QUALIFIED BY SIMILARITY TO THE -231 DESIGN (7). HIGH CYCLE AND LOW CYCLE FATIGUE LIFE, AS WELL AS THE MINIMUM FACTORS OF SAFETY FOR THE TEMPERATURE TRANSDUCER, MEET CEI REQUIREMENTS (8).

(1) RES7002; (2) RSS 8582-6, (3) RL10017; (4) DVS-SSME-203, RSS-8660; (5) RSS-203-11. (6) RSS-8756; (7) RSS-8660; (8) RL00532, CP32DR0003B, RSS-8546

SSME FMEA/CIL
INSPECTION AND TEST

Component Group: Igniters and Sensors
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Page: 1 of 1

Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	TEMPERATURE TRANSDUCER		RES7002
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RC7002
	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	TRANSDUCERS ARE SUBJECTED TO A WORKMANSHIP SCREENING ACCEPTANCE TEST INCLUDING VIBRATION AND THERMAL CYCLING	
	HOT FIRE ACCEPTANCE TESTING (GREEN RUN)	SENSOR OPERATION IS VERIFIED THROUGH HOT FIRE ACCEPTANCE 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	SENSOR OPERATION IS VERIFIED EVERY MISSION FLOW BY SUCCESSFUL COMPLETION OF THE CONTROLLER SENSOR ELECTRICAL CHECKOUT. (LAST TEST)	OMRSD V41AQ0.010 OMRSD S00FA0.213

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: Igniters and Sensors
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Page: 1 of 1

Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Access	Critical Initial Flaw Size Not Detectable HCF	Critical Initial Flaw Size Not Detectable LCF	Comments
TEMPERATURE TRANSDUCER	RES7002	R2	GTAW	II	X			
TEMPERATURE TRANSDUCER	RES7002	R2A	GTAW	II	X			