

**SSME EA/CIL  
REDUNDANCY SCREEN**

Component Group: Igniters and Sensors  
 CIL Item: J312-02  
 Component: HPOTP Boost Stage Discharge Temp Transducer (O11.1.2)  
 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  
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Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	Loss of output signal; probe migration to OPOV or FPOV; fire from LOX impact or rubbing. Loss of vehicle. Redundancy Screens SINGLE POINT FAILURE N/A	I ME-C3S,M,A,C

SSME FMEA/CIL  
DESIGN

Component Group: Igniters and Sensors  
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Design / Document Reference

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

THE DRYOGENIC 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 ARE PRIMARY REASONS FOR SELECTING THIS MATERIAL (2). THE SENSOR PROBE MATERIAL MEETS STANDARD LOX COMPATIBILITY 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 J312 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 -241 DESIGN IS IDENTICAL TO THE -231 DESIGN WITH THE ADDITION OF A WORKMANSHIP SCREENING REQUIREMENT. THE RES7002-241 DESIGN HAS BEEN QUALIFIED BY SIMILARITY (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-3682-6 MSFC-SPEC-522; (3) RL10017; (4) DVS-SSME-203, RSS-8660 (5) RSS-203-11, (6) RSS-8758, (7) RSS-8660; (8) RL00532, CP320R0003B, RSS-8546

**SSME FM /CIL  
INSPECTION AND TEST**

Component Group: Igniters and Sensors  
 CIL Item: J312-02  
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 Part Number: RES7002  
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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
	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.	RC7002
	ASSEMBLY INTEGRITY	TRANSDUCERS ARE SUBJECTED TO A WORKMANSHIP SCREENING ACCEPTANCE TEST INCLUDING VIBRATION AND THERMAL CYCLING	RC7002
	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)	QMRSD V41AQ0.010 QMRSD 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 88RC09781.

Operational Use: Not Applicable.

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**SSME EA/CIL  
WELD JOINTS**

Component Group: Igniters and Sensors  
 CIL Item: J312  
 Component: HPOTP Boost Stage Discharge Temp Transducer (O11.1.2)  
 Part Number: RES7002

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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	
TEMPERATURE TRANSDUCER	RES7002	R2	GTAW	II	X			
TEMPERATURE TRANSDUCER	RES7002	R2A	GTAW	II	X			

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