

**SSME FMEA/CIL**  
**REDUNDANCY SCREEN**

Component Group: Igniters and Sensors  
 CIL Item: J208-02  
 Component: HPFTP Discharge Pressure Transducers (F4.1), HPOTP Discharge Pressure Transducers (O6.1)  
 Part Number: RE2233/RES7001  
 Failure Mode: Leakage into sensor housing.

Prepared: M. Oliver  
 Approved: T. Nguyen  
 Approval Date: 3/30/99  
 Change #: 4  
 Directive #: CCBO MES-01-4994  
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Phase	Failure / Effect Description	Criticality Hazard Reference
SMC 4.1	Leakage results in Focusing failure. Overpressurization of aft compartment. Loss of vehicle  Redundancy Screens: SINGLE POINT FAILURE: N/A	1 ME-C3S,A,M,C, ME-C3S,A,M,C

SSME EA/CIL  
DESIGN

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Design / Document Reference

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FAILURE CAUSE: A: Parent material or weld failure in pressure-containing cavity.

THE DIAPHRAGM AND A PORTION OF THE ISOLATOR ASSEMBLY ARE MANUFACTURED FROM A-288. STRENGTH, DUCTILITY, ELASTIC MODULUS, RESISTANCE TO CORROSION, AND RESISTANCE TO HYDROGEN ENVIRONMENT EFFECTS ARE THE PRIMARY REASONS FOR SELECTING A-288 (1). THE REMAINDER OF THE ISOLATOR ASSEMBLY, PRESSURE CAVITY, AND EXTERNAL CASE ARE MANUFACTURED FROM 304L CRES. THIS MATERIAL WAS SELECTED FOR ITS STRENGTH, WELDABILITY, CORROSION RESISTANCE, AND RESISTANCE TO STRESS CORROSION CRACKING (1). THE DESIGN CRITERIA FOR THE PRESSURE REFERENCE CAVITY REQUIRES THE UNIT BE CAPABLE OF WITHSTANDING 1.5 TIMES THE FULL SCALE PRESSURE, WITHOUT COMPONENT DAMAGE. (2) DESIGN REQUIRES BURST PRESSURE TO BE 3 TIMES FULL SCALE PRESSURE, TO A MAXIMUM VALUE OF 20,000 LBS. (2).

THE SENSORS ARE A VENDOR ITEM. DRAWING SPECIFICATIONS AND MANUFACTURING PROCESSES ARE CONTROLLED BY ROCKETDYNE (2). WELD CONTROLS INCLUDE WELD PREPARATION, CLEANLINESS, OPERATOR CERTIFICATION, AND WELD PARAMETERS (2). ALL SENSOR DESIGNS ARE SUBJECTED TO A CRITICAL DESIGN REVIEW. ANY DESIGN CHANGES ARE RE-REVIEWED (2). THE SENSORS HAVE COMPLETED DESIGN VERIFICATION TESTING (3), INCLUDING VIBRATION TESTING (4). THE MINIMUM FACTORS OF SAFETY MEET CEI REQUIREMENTS (5). THE SENSORS WERE ANALYZED FOR HIGH CYCLE FATIGUE AND LOW CYCLE FATIGUE LIFE AND MEET CEI REQUIREMENTS (6). TABLE J208 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 AND DETERMINED TO HAVE IMPROVED ULTIMATE AND YIELD STRENGTHS, ENDURANCE LIMITS AND FRACTURE TOUGHNESS OVER THOSE WELDS LIST IN THE WELD ASSESSMENT (7). SENSORS FROM ENGINE 3010 (EATON) WERE RE-SUBJECTED TO ACCEPTANCE TESTING. ALL SENSORS MET ACCEPTANCE CRITERIA FOR THIS FAILURE MODE.

(1) RSS-8582; (2) RC7001; (3) DVS-SSME-203, RSS-8550; (4) RSS-203-13, RSS-203-14; (5) RSS-8546, CP320R0003B; (6) RL00532, CP320R0003B; (7) VRS-0550

**SSME FMEA/CIL  
INSPECTION AND TEST**

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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
A	SINGLE PICKUP, DUAL OUTPUT, PRESSURE TRANSDUCER		RE2233 / RES7001
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RC7001
	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 PROOF PRESSURE TESTED PER SPECIFICATION REQUIREMENTS VACUUM CASE IS LEAK CHECKED TO VERIFY SEAL PER SPECIFICATION REQUIREMENTS. 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.	
	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.	M/SFC 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 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

SSM EA/CIL  
**FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE**

Component Group: Igniters and Sensors  
 Item Name: HPFTP Discharge Pressure Transducers (F4.1), HPOTP Discharge Pressure Transducers (O6.1)  
 Item Number: J208  
 Part Number: RE2233/RES7001

Prepared: M. Oliver  
 Approved: T. Nguyen  
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Base Line Rationale	Variance	Change Rationale	Variant Dash Number
J208 - These welds have been assessed and determined to have improved ultimate and yield strengths, endurance limits and fracture toughness over those welds listed in the weld assessment (VRS-055C)	Welds were assessed as acceptable for flight by risk assessment (RSS-8756).	New design eliminates one weld and increases overall component strength. USE AS IS RATIONALE: Welded assemblies meet all CEI requirements (RSS-8756).	RES7001-219,239 RE2233-061
J208 - New design improves producibility, inspectability and reliability of the transducer. New design reduces the risk of the introduction of conductive contamination.	An internal vacuum case is used for zero pressure reference point	New design eliminates internal vacuum case and reduces potential for conductive contamination. USE AS IS rationale: Functionality of zero pressure reference is maintained.	RES7001-219, -239 RE2233-061

**SSME FMEA/CIL**  
**WELD JOINTS**

Component Group: Igniters and Sensors  
 CIL Item: J208  
 Component: HPFTP Discharge Pressure Transducers (F4.1), HPOTP Discharge Pressure Transducers (D6.1)  
 Part Number: RE2233/RES7001

Prepared: M. Oliver  
 Approved: T. Nguyen  
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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	
PRESSURE TRANSDUCER	RE2233/RES7001							
PRESSURE TRANSDUCER	JKR1900	CCC-1	EBW	II	X	X	X	
PRESSURE TRANSDUCER	JLD1900	CCC-2	EBW	II	X	X	X	
PRESSURE TRANSDUCER	JVA1900	CCC-5	EBW	II	X			