SSME FEA/CIL
REDUNDANCY SCREEN

Component Group:	Igniters and Sensors
CIL Item:	J211-02
Component:	Hydraulic Supply Pressure Transducer (H3.1)
Part Number:	RE2233/RES7001
Failure Mode:	Leakage into sensor housing.

Prepared:	M. Oliver
Approved:	T. Nguyen
Approval Date:	3/30/99
Change #:	2
Directive #:	CCBD ME3-01-4994
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Phase	Failure / Effect Description	Criticality Hazard Reference
M 4 1	Sensor housing failure. Hydraulic fluid leakage into aft compartment. Loss of hydraulic pressure results in hydraulic lockup. Mission abort may result when hydraulic lockup occurs during Max Q throttling.	1R ME-E1P,S,A,M,C D
	Redundancy Screens SINGLE POINT FAILURE: N/A.	

SSME FMEA/CIL
DESIGN

Component Group:	Igniters and Sensors	Prepared:	M. Oliver
CIL Item:	J211-02	Approved:	T. Nguyen
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Design / Document Reference

FAILURE CAUSE: ALL CAUSES

STATHAM:

THE PRESSURE CAVITY AND EXTERNAL CASE ARE MANUFACTURED FROM INCONEL 718. THIS MATERIAL WAS SELECTED FOR ITS STRENGTH, TENSION MODULUS, WELDABILITY, CORROSION RESISTANCE AND RESISTANCE TO STRESS CORROSION CRACKING (1). THE DESIGN CRITERIA FOR THE PRESSURE CAVITY REQUIRES THE UNIT TO 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 (2).

EATON:

THE DIAPHRAGM AND A PORTION OF THE ISOLATOR ASSEMBLY ARE MANUFACTURED FROM A-286. STRENGTH, DUCTILITY, ELASTIC MODULUS, RESISTANCE TO CORROSION, AND RESISTANCE TO HYDROGEN ENVIRONMENT EMBRITTLEMENT EFFECTS ARE THE PRIMARY REASONS FOR SELECTING A-286 (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). DESIGN CRITERIA FOR BURST AND PROOF PRESSURE REQUIREMENTS ARE IDENTICAL IN BOTH DESIGNS (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 J211 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).

(1) RSS-8582; (2) RC7007; (3) DVS-SSME-203, RSS-8660. (4) RSS-203-13 RSS-203-14; (5) RSS-8548, CP320R0003B; (6) RL00532, CP320R0003B; (7) VRS-0550

SSME FMEA/CIL
INSPECTION AND TEST

Component Group: Igniters and Sensors
CIL Item: J211-02
Component: Hydraulic Supply Pressure Transducer (H3,1)
Part Number: RE2233/RES7001
Failure Mode: Leakage into sensor housing.

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Approved: T. Nguyen
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Failure Causes	Significant Characteristics	Inspection(s) / Test(s)	Document Reference
ALL CAUSES	SINGLE PICKUP, DUAL OUTPUT, PRESSURE TRANSDUCER		RE2233 / RES7007
	MATERIAL INTEGRITY	MATERIAL INTEGRITY IS VERIFIED PER SPECIFICATION REQUIREMENTS.	RC7007
	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.	
		TRANSDUCERS ARE SUBJECTED TO A WORKMANSHIP SCREENING ACCEPTANCE TEST INCLUDING VIBRATION, THERMAL CYCLING AND FUNCTIONAL TESTS.	
	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	SENSORS ARE VISUALLY INSPECTED.	OMRSD V41BU0.030
		SENSOR OPERATION IS VERIFIED EVERY MISSION FLOW BY SUCCESSFUL COMPLETION OF THE CONTROLLER SENSOR ELECTRICAL CHECKOUT. (LAST TEST)	OMRSD V41AQ0.010 OMRSD S0CFA0.213

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: 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.

SSME/CIL
FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE

Component Group: Igniters and Sensors
Item Name: Hydraulic Supply Pressure Transducer (H3.1)
Item Number: J211
Part Number: RE2233/RES7001

Prepared: M. Oliver
Approved: T. Nguyen
Approval Date: 3/30/99
Change #: 3
Directive #: CCBD ME3-01-4984

Base Line Rationale	Variance	Change Rationale	Variant Dash Number
J211 - 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-0550).	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).	RES7001-72,82 RE2233--071
J211 - 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.	RES7007-72 -82 RE2233-071

SSME EA/CIL
WELD JOINTS

Component Group: Igniters and Sensors
CIL Item: J211
Component: Hydraulic Supply Pressure Transducer (H3.1)
Part Number: RE2233/RES7001

Prepared: M. Oliver
Approved: T. Nguyen
Approval Date: 3/30/99
Change #: 1
Directive #: CCBD ME3-01-4994
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Component	Basic Part Number	Weld Number	Weld Type	Class	Root Side Not Access	Critical Initial Flaw Size Not Detectable HCF	LCF	Comments
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			
PRESSURE TRANSDUCER	67456	S-2	GTAW	II	X	X		
PRESSURE TRANSDUCER	64458	S-3	EBW	II	X			
PRESSURE TRANSDUCER	64458	S-4	EBW	II	X			
PRESSURE TRANSDUCER	67463	S-5	EBW	II	X			
PRESSURE TRANSDUCER	67463	S-6	EBW	II	X			