

SSME EA/CIL
REDUNDANCY SCREEN

Component Group: Igniters and Sensors
CIL Item: J215-02
Component: Emergency Shutdown Pressure Transducer (P2,3)
Part Number: RE2233/RES7001
Failure Mode: Leakage into sensor housing.

Prepared: M. Oliver
Approved: T. Nguyen
Approval Date: 3/30/98
Change #: 2
Directive #: CCBD ME3-01-4994
Page: 1 of 1

| Phase | Failure / Effect Description | Critically Hazard Reference |
|------------|--|-----------------------------|
| SMC 4.1 | Leakage results in housing failure. Overpressurization of aft compartment. Loss of vehicle. Redundancy Screens: SINGLE POINT FAILURE: N/A | 1 ME-G10C,D |

SSME FMEA/CIL
DESIGN

Component Group: Igniters and Sensors
CIL Item: J225-02
Component: Emergency Shutdown Pressure Transducer (P2.3)
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

Page: 1 of 1

Design / Document Reference

FAILURE CAUSE: ALL CAUSES

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 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). 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 REQUIREMENTS (6). TABLE J225 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 LISTED IN THE WELD ASSESSMENT (7). SENSORS FROM ENGINE 2010 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-8660; (4) RSS-203-13, RSS-203-14; (5) RSS-854E, CP320R0003B; (6) RL00532, CP320R0003B; (7) VRS-0550

**SSME FA /CIL
INSPECTION AND TEST**

Component Group: Igniters and Sensors
 CIL Item: J225-02
 Component: Emergency Shutdown Pressure Transducer (P2.3)
 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
 Page: 1 of 1

| Failure Causes | Significant Characteristics | Inspection(s) / Test(s) | Document Reference |
|----------------|---|--|--|
| ALL CAUSES | 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. 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. | RI 00461 |
| | 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 122B |
| | 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 V41BU0.020 OMRSD V41AQ0.010 OMRSD 500FA0.213 |

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 MEA/CIL
FIELD CONFIGURATION VARIANCES FROM CIL RATIONALE

Component Group: Igniters and Sensors
 Item Name: Emergency Shutdown Pressure Transducer (P2.3)
 Item Number: J225
 Part Number: RE2233/RES7001

Prepared: M. Oliver
 Approved: T. Nguyen
 Approval Date: 3/30/99
 Change #: 2
 Directive #: CCBD ME1-01-4994

Page: 1 of 1

| Base Line Rationale | Variance | Change Rationale | Variant Dash Number |
|--|---|---|---------------------------------|
| J225 - 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) | RES7001-207,227 RE2233-021 |
| J225 - 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 | RES7001-217, -237 RE2233-021 |

**SSME EA/CIL
WELD JOINTS**

Component Group: Igniters and Sensors
 CIL Item: J225
 Component: Emergency Shutdown Pressure Transducer (P2.3)
 Part Number: RE2233/RES7001

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

| 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 | | | |