

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**

NUMBER: 03-1-0721 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 02/20/2001

---

**PART DATA**

---

	<b>PART NAME</b>	<b>PART NUMBER</b>
	<b>VENDOR NAME</b>	<b>VENDOR NUMBER</b>
LRU	: TRANSDUCER, LH2 PRESSURE STATHAM	ME449-0179-0271 PA8105-100-22132

---

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**

TRANSDUCER, LH2 17 INCH FEEDLINE MANIFOLD DISCONNECT PRESSURE (V41P1433C).

REFERENCE DESIGNATORS: V41P1433C

QUANTITY OF LIKE ITEMS: 1

**FUNCTION:**

PROVIDES MEASUREMENT OF LH2 MANIFOLD PRESSURE. LOCATED NEAR 17" DISCONNECT. DATA IS USED FOR GROUND AND IN-FLIGHT MONITORING OF SYSTEM PERFORMANCE. HARD-WIRED TO ON-BOARD CAUTION AND WARNING SYSTEM.

**FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE**

**NUMBER: 03-1-0721-02**

**REVISION#: 1 10/30/01**

**SUBSYSTEM NAME:** MAIN PROPULSION

**LRU:** TRANSDUCER, LH2 PRESSURE

**ITEM NAME:** TRANSDUCER, LH2 17" FEEDLINE PRESSURE

**CRITICALITY OF THIS**

**FAILURE MODE:** 1/1

---

**FAILURE MODE:**

RUPTURE/LEAKAGE OF THE TRANSDUCER BODY DURING LOADING, ASCENT AND DUMP/INERT.

**MISSION PHASE:** PL PRE-LAUNCH  
LO LIFT-OFF

**VEHICLE/PAYLOAD/KIT EFFECTIVITY:** 102 COLUMBIA  
103 DISCOVERY  
104 ATLANTIS  
105 ENDEAVOUR

**CAUSE:**

FATIGUE, MATERIAL DEFECTS

**CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO**

---

**REDUNDANCY SCREEN** A) N/A  
B) N/A  
C) N/A

**PASS/FAIL RATIONALE:**

A)

B)

C)

---

**- FAILURE EFFECTS -**

---

**(A) SUBSYSTEM:**

LH2 LEAKAGE INTO THE AFT COMPARTMENT. GN2 PURGE OF THE AFT COMPARTMENT MAY LOWER THE GH2 CONCENTRATION, BUT THE FIRE/EXPLOSION HAZARD IS STILL PRESENT. POSSIBLE OVERPRESSURIZATION OF THE AFT COMPARTMENT. POSSIBLE LOSS OF ADJACENT CRITICAL FUNCTIONS DUE TO CRYO EXPOSURE. LEAKAGE DETECTABLE ON GROUND USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE  
NUMBER: 03-1-0721-02**

ALSO RESULTS IN POSSIBLE LOSS OF HELIUM SUPPLY DURING MANIFOLD  
REPRESSURIZATION CAUSING LOSS OF AFT COMPARTMENT PURGE.

**(B) INTERFACING SUBSYSTEM(S):**  
SAME AS A.

**(C) MISSION:**  
ON GROUND, VIOLATION OF HGDS LCC WILL RESULT IN LAUNCH SCRUB.

**(D) CREW, VEHICLE, AND ELEMENT(S):**  
POSSIBLE LOSS OF CREW/VEHICLE.

**(E) FUNCTIONAL CRITICALITY EFFECTS:**  
NONE.

---

**-DISPOSITION RATIONALE-**

---

**(A) DESIGN:**  
THE TRANSDUCER PRIMARY BARRIER UTILIZES WELDED INCONEL 718 COMPONENTS  
(THREADED FITTING AND DIAPHRAGM) AND IS DESIGNED FOR A PROOF PRESSURE OF 300  
PSIA. A 304L CASE ASSEMBLY, INCLUDING FEEDTHROUGH TERMINALS, IS WELDED TO THE  
THREADED FITTING TO PROVIDE A SECONDARY BARRIER. THE SECONDARY BARRIER IS  
DESIGNED FOR A BURST PRESSURE OF 2000 PSIA. STRUCTURAL ANALYSIS INDICATES A  
POSITIVE MARGIN OF SAFETY FOR ALL OPERATING CONDITIONS.

THE CASE ASSEMBLY IS EVACUATED, THEN SEALED BY WELDING A BALL INTO THE LEAK  
CHECK PORT.

**(B) TEST:**  
MANUFACTURING

    THERMAL CYCLE  
        WITH POWER APPLIED, CYCLE BETWEEN -273 DEG F AND -411 DEG F SIX  
        TIMES STAYING 2 HOURS AT EACH TEMPERATURE. DURING EACH 2 HOUR  
        PERIOD, CYCLE PRESSURE FROM 0 TO 75 PERCENT MINIMUM OF FULL  
        SCALE (FULL SCALE IS 0 TO 100 PSIA) TWICE EACH HOUR.

ATP

    EXAMINATION OF PRODUCT

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE  
NUMBER: 03-1-0721-02**

PERFORMANCE TESTS

INSULATION RESISTANCE

CALIBRATION

0, 20, 40, 60, 80, 100, 80, 60, 40, 20 AND 0 PERCENT OF FULL SCALE PRESSURE AT -273 DEG F, -320 DEG F, AND -411 DEG F. RECORD ERROR DUE TO TEMPERATURE EFFECTS, LINEARITY, RESIDUAL IMBALANCE, REPEATABILITY, SENSITIVITY, AND VIBRATION.

CERTIFICATION

THE TRANSDUCER WAS CERTIFIED BY SIMILARITY, DESIGN ANALYSIS, AND TESTING, AND IS SIMILAR IN DESIGN AND CONSTRUCTION TO TRANSDUCERS CERTIFIED BY BELL AEROSYSTEMS, MCDONNELL DOUGLAS, GENERAL ELECTRIC, AND MARTIN MARIETTA. THE PREVIOUS TEST LIMITS EXCEEDED ORBITER SPECIFICATION REQUIREMENTS. OFF-LIMITS VIBRATION TESTING WAS SUCCESSFULLY PERFORMED WITH NASA DESIGN AND RELIABILITY CONCURRENCE ON AN ME449-0179-0173 TRANSDUCER AFTER REDESIGN FOR THE HIGHER VIBRATION ENVIRONMENT EXPERIENCED BY SOME MPS PRESSURE TRANSDUCERS.

A QUALIFICATION UNIT WAS TESTED TO 2,000 PSI WITHOUT RUPTURING OR LEAKING. THE SECONDARY BARRIER WAS TESTED TO 30,000 PSI WITHOUT RUPTURING OR LEAKING.

OMRSD

ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

**(C) INSPECTION:**

RECEIVING INSPECTION

RECEIVING INSPECTION PERFORMS VISUAL AND DIMENSIONAL EXAMINATION OF ALL INCOMING PARTS. CERTIFICATION RECORDS/TEST REPORTS ARE MAINTAINED CERTIFYING MATERIALS AND PHYSICAL PROPERTIES. CORROSION PROTECTION FINISH IS CHECKED IN ACCORDANCE WITH REQUIREMENT.

CONTAMINATION CONTROL

INSPECTION VERIFIES REQUIRED PROCEDURES/SHOP PRACTICES ARE UTILIZED FOR CONTAMINATION CONTROL. CLEANLINESS LEVEL 400 IS MAINTAINED AND VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

PARTS ARE INSPECTED VISUALLY, DIMENSIONALLY AND INCREMENTALLY PER REQUIREMENTS. TOOL CALIBRATION IS VERIFIED BY INSPECTION. MANDATORY INSPECTION POINTS ARE INCLUDED IN ASSEMBLY PROCESS.

CRITICAL PROCESSES

WELDING IS MONITORED AND VERIFIED BY INSPECTION. SOLDERING, HEAT TREATING, AND PASSIVATING ARE ALSO VERIFIED BY INSPECTION.

TESTING

ATP, INCLUDING PROOF PRESSURE TEST, IS OBSERVED AND VERIFIED BY INSPECTION.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE  
NUMBER: 03-1-0721-02**

**HANDLING/PACKAGING**

PACKAGING AND PROTECTION ARE VERIFIED BY INSPECTION TO APPLICABLE REQUIREMENTS. SPECIAL HANDLING PER DOCUMENTED INSTRUCTIONS IS VERIFIED, TO PRECLUDE DAMAGE, SHOCK, AND CONTAMINATION DURING COMPONENT HANDLING/TRANSPORTING/PACKAGING BETWEEN WORK STATIONS.

**(D) FAILURE HISTORY:**

CURRENT DATA ON TEST FAILURE, FLIGHT FAILURE, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATABASE.

**(E) OPERATIONAL USE:**

FLIGHT: NO CREW ACTION CAN BE TAKEN.

GROUND: GROUND OPERATIONS SAFING PROCEDURES CONTAIN SAFING SEQUENCE OF EVENTS FOR MAJOR LEAKS IN THE HYDROGEN SYSTEM.

---

**- APPROVALS -**

---

S&R ENGINEERING	: L. DANG	:/S/ L. DANG
S&R ENGINEERING ITM	: P. A. STENGER-NGUYEN	:/S/ P. A. STENGER-NGUYEN
DESIGN ENGINEERING	: HERB WOLFSON	:/S/ HERB WOLFSON
MPS SUBSYSTEM MGR.	: TIM REITH	:/S/ TIM REITH
INSTRUMENTATION	: BILL MCKEE	:/S/ BILL MCKEE
MOD	: JEFF MUSLER	:/S/ JEFF MUSLER
USA SAM	: MIKE SNYDER	:/S/ MIKE SNYDER
USA ORBITER ELEMENT	: SUZANNE LITTLE	:/S/ SUZANNE LITTLE
NASA SR&QA	: ERICH BASS	:/S/ ERICH BASS