

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**NUMBER: 03-1-0721 -X****SUBSYSTEM NAME:** MAIN PROPULSION**REVISION:** 1 02/20/2001

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
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 -- NON-CIL FAILURE MODE

NUMBER: 03-1-0721-01

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: 1R3

FAILURE MODE:

ERRONEOUS INDICATION (READS LOW) POST MECO

MISSION PHASE: LO LIFT-OFF

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

CAUSE:

PIECE-PART STRUCTURAL FAILURE, CONTAMINATION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

PASS/FAIL RATIONALE:

A)

B)

PRESSURE INDICATION IS STANDBY REDUNDANT TO RTLS DUMP VALVES FAILING TO OPEN. FAILURE IS NOT DETECTABLE SINCE ERRONEOUS LOW INDICATIONS CANNOT BE DISTINGUISHED FROM NORMAL LOW SYSTEM PRESSURE AFTER SUCCESSFUL DUMP AND VACUUM INERT.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

INCORRECT LH2 MANIFOLD PRESSURE INPUT. ERRONEOUS OUTPUT WILL DISABLE AUTO LH2 DUMP DURING OPS 1. LOSS OF INPUT TO CAUTION AND WARNING (C&W) SYSTEM

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(AUDIBLE ALARM AT 65 PSIA). NO EFFECT, NORMAL PRESSURE BUILDUP IN LH2 MANIFOLD WILL BE RELIEVED BY THE LH2 RELIEF SYSTEM.

(B) INTERFACING SUBSYSTEM(S):

SAME AS A.

(C) MISSION:

NO EFFECT, FIRST FAILURE

(D) CREW, VEHICLE, AND ELEMENT(S):

SAME AS C.

(E) FUNCTIONAL CRITICALITY EFFECTS:

1R/3, 3 SUCCESS PATHS. TIME FRAME: POST MECO TO DUMP START

- 1) LH2 TRANSDUCER FAILS (ERRONEOUS READING BETWEEN 0 AND 60 PSIA).
- 2) LH2 RTLS DUMP VALVE (PV17 OR 18) FAILS TO OPEN/REMAIN OPEN.
- 3) LH2 RELIEF SYSTEM (PV8/RV6) FAILS TO RELIEVE.

TRANSDUCER FAILURE WOULD RESULT IN LOSS OF AUTO DUMP CAPABILITY AND C&W ALERT TO PROMPT IMMEDIATE MANUAL MPS DUMP INITIATION. PRESSURE BUILDUP DUE TO RELIEF SYSTEM AND RTLS DUMP VALVE FAILURES WILL CAUSE LH2 MANIFOLD RUPTURE RESULTING IN LEAKAGE OF LH2 INTO THE AFT COMPARTMENT. POSSIBLE AFT COMPARTMENT OVERPRESSURIZATION AND FIRE/EXPLOSION HAZARD. POSSIBLE LOSS OF CRITICAL ADJACENT COMPONENTS DUE TO CRYOGENIC EXPOSURE.

POSSIBLE LOSS OF CREW/VEHICLE.

-DISPOSITION RATIONALE-

(A) DESIGN:

THE TRANSDUCER UTILIZES A STRAIN GAGE PRESSURE MONITORING CONCEPT. A BEAM WITH A STRAIN GAGE IS ATTACHED TO THE SENSING DIAPHRAGM. ANNEALED GOLD LEADS FROM THE BEAM TO TRANSITION PINS ARE UTILIZED. MATERIALS AND PROCESSES USED ARE COMPATIBLE WITH THE ENVIRONMENTAL CONDITIONS. THE TRANSDUCER IS CAPABLE OF WITHSTANDING 150 PSIA WITHOUT CHANGING THE CALIBRATION.

THE CASE ASSEMBLY, INCLUDING THE FEEDTHROUGH TERMINALS, IS EVACUATED, THEN SEALED BY WELDING A BALL INTO THE LEAK CHECK PORT. THE DEVICE PROVIDES DUAL BARRIERS TO PREVENT EXTERNAL LEAKAGE.

(B) TEST:

MANUFACTURING

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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

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.

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

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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.

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:

NO CREW ACTION WILL BE TAKEN BECAUSE TRANSDUCER FAILURE WILL MASK PRESSURE RISE. DUMP COULD BE STARTED ASAP IF LH2 MANIFOLD PRESSURE TRANSDUCER IS SUSPECTED TO BE MALFUNCTIONING.

- 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