

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0746 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 02/20/01

PART DATA

| | PART NAME | PART NUMBER |
|-----|---|------------------------------------|
| | VENDOR NAME | VENDOR NUMBER |
| LRU | : TRANSDUCER, PRESSURE SOLARTRON, STATHAM DIV. | ME449-0177-2577 PA8106-1M-22128 |

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

TRANSDUCER, GH2 PRESSURIZATION LINE PRESSURE, 0 TO 1000 PSIA.

REFERENCE DESIGNATORS: V41P1490A

QUANTITY OF LIKE ITEMS: 1

FUNCTION:

PROVIDES INDICATION OF GH2 DISCONNECT PRESSURE. LOCATED ON LINE CONNECTING DELTA PRESSURE TRANSDUCER (MT50) TO ET PRESSURIZATION MANIFOLD.

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NUMBER: 03-1-0746-02

REVISION#: 1 10/30/01

SUBSYSTEM NAME: MAIN PROPULSION

LRU: GH2 2" DISCONNECT PRESSURE TRANSDUCER

CRITICALITY OF THIS

ITEM NAME: GH2 2" DISCONNECT PRESSURE TRANSDUCER

FAILURE MODE: 1/1

FAILURE MODE:

RUPTURE/LEAKAGE OF THE TRANSDUCER BODY.

MISSION PHASE:

PL PRE-LAUNCH
LO LIFT-OFF

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:

MATERIAL DEFECT, FATIGUE

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:

GH2 AND/OR GHE LEAKAGE INTO THE AFT COMPARTMENT. POSSIBLE OVERPRESSURIZATION OF THE AFT COMPARTMENT AND FIRE/EXPLOSION HAZARD. GHE LEAKAGE FROM ANTI-ICING PURGE DETECTABLE ON GROUND USING HAZARDOUS GAS DETECTION SYSTEM (HGDS) PRIOR TO T-9 MINUTES.

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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 UTILIZES A STRAIN GAGE PRESSURE MONITORING CONCEPT. A BEAM WITH A STRAIN GAGE IS CONNECTED TO THE SENSING DIAPHRAGM WITH A LINKAGE PIN. THE DIAPHRAGM DEFLECTION DUE TO PRESSURE CHANGES IS TRANSMITTED TO THE BEAM THROUGH THE LINK PIN CAUSING BEAM DEFLECTION. THE STRAIN GAUGE WILL MEASURE THIS DEFLECTION.

LEAD WIRES CONNECT THE STRAIN GAUGE TO A STATIONARY YOKE (STAINLESS STEEL). NICKEL LEADS CONNECT THE STATIONARY YOKE TO THE FEEDTHROUGH CONNECTOR. MATERIALS AND PROCESSES USED ARE COMPATIBLE WITH THE ENVIRONMENTAL CONDITIONS. THE TRANSDUCER IS CAPABLE OF WITHSTANDING 1.5 TIMES MAXIMUM OPERATING PRESSURE WITHOUT CHANGING THE CALIBRATION.

RUPTURE/LEAKAGE OF THE TRANSDUCER IS PRECLUDED BY USE OF A PRIMARY AND SECONDARY BARRIER DESIGN CONCEPT. THE PRIMARY BARRIER UTILIZES WELDED INCONEL 718 COMPONENTS (THREADED FITTING AND DIAPHRAGM) AND IS DESIGNED FOR A PROOF PRESSURE OF 1.5 TIMES MAXIMUM OPERATING PRESSURE. 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 MINIMUM BURST PRESSURE OF 3 TIMES MAXIMUM OPERATING PRESSURE. STRUCTURAL ANALYSIS INDICATES A POSITIVE MARGIN OF SAFETY FOR ALL OPERATING CONDITIONS.

(B) TEST:
PRE-ATP

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THERMAL CYCLE

WITH POWER APPLIED, CYCLE BETWEEN -250 DEG F AND +350 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 1000 PSIA) TWICE EACH HOUR.

ATP

EXAMINATION OF PRODUCT

PROOF PRESSURE

PRIMARY AND SECONDARY BARRIER
1.5 TIMES MAXIMUM OPERATING PRESSURE

PERFORMANCE TESTS

INSULATION RESISTANCE

CALIBRATION

0, 20, 40, 60, 80, 100, 80, 60, 40, 20 AND 0 PERCENT OF FULL SCALE PRESSURE (1000 PSIA) AT -250 DEG F, +70 DEG F, AND +350 DEG F. RECORD ERROR DUE TO TEMPERATURE EFFECTS, LINEARITY, RESIDUAL IMBALANCE, REPEATABILITY, AND SENSITIVITY.

CERTIFICATION

BY SIMILARITY

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.

BY TEST

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.

BURST TEST

PRIMARY AND SECONDARY BARRIER
MINIMUM OF 3 TIMES MAXIMUM OPERATING PRESSURE

OMRSD

ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

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ALL RAW MATERIALS ARE VERIFIED BY INSPECTION FOR MATERIALS AND PROCESS CERTIFICATION.

CONTAMINATION CONTROL
CLEANLINESS LEVEL IS VERIFIED TO 100A. CORROSION PROTECTION IS 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 THE ASSEMBLY PROCESS.

CRITICAL PROCESSES
THE FOLLOWING ARE VERIFIED BY INSPECTION:

SOLDERING
HEAT TREATMENT
PARTS PASSIVATION
WELDING

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

HANDLING/PACKAGING SPECIAL
HANDLING PER DOCUMENTED INSTRUCTIONS IS VERIFIED BY INSPECTION TO PRECLUDE DAMAGE, SHOCK, AND CONTAMINATION DURING COMPONENT HANDLING, TRANSPORTING, AND 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 CAN BE TAKEN.

- 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 |

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NASA SR&QA

: ERICH BASS

:/S/ ERICH BASS