

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**NUMBER: 03-1-0742 -X****SUBSYSTEM NAME:** MAIN PROPULSION**REVISION:** 2 08/23/89

PART DATA

PART NAME	PART NUMBER
VENDOR NAME	VENDOR NUMBER
LRU : TRANSDUCER STATHAM	ME449-0177-8179

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

TRANSDUCER, PNEUMATIC HELIUM SUPPLY PRESSURE, 0 TO 5000 PSIA.

REFERENCE DESIGNATORS: V41P1600A**QUANTITY OF LIKE ITEMS:** 1**FUNCTION:**

PROVIDES PRESSURE INDICATION FOR MPS PNEUMATIC VALVE SUPPLY. LOCATED IN PNEUMATIC HELIUM LINE UPSTREAM OF THE HELIUM FILTER (FL5).

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REVISION#: 1 10/30/01

SUBSYSTEM NAME: MAIN PROPULSION

LRU: GHE PNEUMATIC SUPPLY TRANSDUCER

ITEM NAME: GHE PNEUMATIC SUPPLY TRANSDUCER

CRITICALITY OF THIS

FAILURE MODE: 1R2

FAILURE MODE:

ERRONEOUS OUTPUT (READS HIGH).

MISSION PHASE:

PL PRE-LAUNCH

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) PASS

C) PASS

PASS/FAIL RATIONALE:

A)

B)

PASSES B SCREEN BECAUSE FAILURE TO INDICATE PNEUMATIC SUPPLY DECAY DURING MECO INTERCONNECT WILL BE READILY DETECTABLE

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

NO EFFECT. RESULTS IN LOSS OF CONTINUOUS PRESSURE MONITORING CAPABILITY FOR PNEUMATIC HELIUM SUPPLY.

(B) INTERFACING SUBSYSTEM(S):

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SAME AS A.

(C) MISSION:

FIRST FAILURE - NO EFFECT.

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

SAME AS C.

(E) FUNCTIONAL CRITICALITY EFFECTS:

1R/2 2 SUCCESS PATHS. TIME FRAME - MECO.

- 1) TRANSDUCER ERRONEOUSLY INDICATES HIGH.
- 2) PNEUMATIC ACCUMULATOR LEG LEAKS.

SUPPLY PRESSURE DECAY WOULD NORMALLY BE THE INITIAL CUE IDENTIFYING A PNEUMATIC ACCUMULATOR LEG LEAK. IF THE LEAK RATE IS SUCH THAT SUPPLY PRESSURE WOULD HAVE IDENTIFIED THE LEAK IN TIME TO MANUALLY INTERCONNECT THE ENGINE 2 SUPPLY THROUGH THE LV10 CROSSOVER VALVE, AND THE REGULATOR OUT AND ACCUMULATOR PRESSURES DO NOT INDICATE THE LEAK IN TIME, THEN PNEUMATIC PRESSURE WILL NOT BE AVAILABLE TO CLOSE THE LO2 PREVALVES AT MECO.

LOSS OF PNEUMATIC ACTUATION HELIUM RESULTS IN LO2 PREVALVE FAILING TO CLOSE AND INABILITY TO MAINTAIN INJECTED HELIUM AND LO2 PRESSURE TO THE HIGH PRESSURE OXYGEN TURBOPUMP TO PREVENT PUMP OVERSPEED AND CAVITATION AT MECO. RESULTS IN UNCONTAINED ENGINE DAMAGE, AFT COMPARTMENT OVERPRESSURIZATION, AND FIRE/EXPLOSION HAZARD. AT MECO, THE ENGINE 2 HELIUM SUPPLY IS SWITCHED IN TO THE PNEUMATIC VALVE SYSTEM (VIA LV10) AS A BACKUP, BY SOFTWARE COMMAND, WHICH WILL NOT ACTUATE THE LO2 PREVALVES CLOSED IN CASE OF LARGE ACCUMULATOR PRESSURE LOSS. 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 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.

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THE CASE ASSEMBLY, INCLUDING THE FEEDTHROUGH TERMINALS, IS THEN EVACUATED AND SEALED BY WELDING A BALL INTO THE LEAK CHECK PORT. THE INTERNAL VACUUM IS USED AS A REFERENCE CONDITION FOR PSIA TRANSDUCERS.

ERRONEOUS OUTPUT (HIGH OR LOW) IS THE RESULT OF THE TRANSDUCER FALSELY INDICATING A PRESSURE HIGHER OR LOWER THAN THE ACTUAL PRESSURE BUT STILL WITHIN THE OPERATING PRESSURE RANGE. ERRONEOUS OUTPUT (LOW) CAN BE CAUSED BY DIAPHRAGM LEAKAGE OR EXTERNAL LEAKAGE INTO THE VACUUM CASE. ERRONEOUS OUTPUT (HIGH OR LOW) CAN BE CAUSED BY STRAIN GAUGE OR CIRCUIT FAILURE WITHIN THE TRANSDUCER.

**(B) TEST:
PRE-ATP**

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 5000 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 (5000 PSIA) AT -250 DEG F, +70 DEG F, AND +350 DEG F. RECORD ERROR DUE TO TEMPERATURE EFFECTS, LINEARITY, RESIDUAL IMBALANCE, REPEATABILITY, AND SENSITIVITY.

THE TRANSDUCERS ARE RE-CALIBRATED PERIODICALLY PER THE OMRSD REQUIREMENTS.

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.

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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

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.

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(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
NASA SR&QA	: ERICH BASS	:/S/ ERICH BASS