

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0744 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 02/21/01

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: TRANSDUCER, PRESSURE STATHAM	ME449-0177-2179 PA8103-1M-22125

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

TRANSDUCER, PNEUMATIC SYSTEM REGULATOR OUTLET PRESSURE, 0 TO 1000 PSIA.

REFERENCE DESIGNATORS: V41P1605A

QUANTITY OF LIKE ITEMS: 1

FUNCTION:

PROVIDES INDICATION OF MPS PNEUMATIC SYSTEM REGULATED HELIUM OUTLET PRESSURE. LOCATED BETWEEN THE REGULATOR (PR4) AND THE CHECK VALVE (CV8).

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REVISION#: 1 10/30/01

SUBSYSTEM NAME: MAIN PROPULSION

LRU: PNEUMATIC REG OUTLET PRESS TRANSDUCER

CRITICALITY OF THIS

ITEM NAME: PNEUMATIC REG OUTLET PRESS TRANSDUCER

FAILURE MODE: 1/1

FAILURE MODE:

RUPTURE/LEAKAGE OF THE TRANSDUCER BODY.

MISSION PHASE:

LO LIFT-OFF
DO DE-ORBIT

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:

DURING ASCENT, THE PNEUMATIC HELIUM SUPPLY WILL BE LOST. ESCAPING HELIUM MAY OVERPRESSURIZE THE AFT COMPARTMENT.

WHEN THE CROSSOVER VALVE (LV10) OPENS AT MECO, THE PNEUMATIC HELIUM DISTRIBUTION SYSTEM WILL BE FED FROM THE LEFT ENGINE HELIUM SUPPLY. WHEN THE

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INTERCONNECT E1 AND E3 "OUT" VALVES OPEN AT MECO PLUS 20 SECONDS, THE ENGINE HELIUM SUPPLIES WILL LEAK THROUGH THE FAILED LINE.

STORED HELIUM PRESSURE IN THE ACCUMULATOR LEG SHOULD BE ADEQUATE TO OPERATE THE LO2 PREVALVES AT MECO. LOSS OF HELIUM MAY PREVENT OPERATION OF VALVES FOR MPS DUMP.

PURGE OF AFT COMPARTMENT AND LH2/LO2 SYSTEMS WOULD DEPEND SOLELY ON THE LEFT ENGINE HELIUM SYSTEM RESIDUALS.

DURING ENTRY, VENT DOORS ARE CLOSED TO PREVENT INGESTION OF RCS AND APU GASES. RUPTURE DURING THE TIME PERIOD THAT THE VENT DOORS ARE CLOSED MAY RESULT IN OVERPRESSURIZATION OF AFT COMPARTMENT. VENT DOORS ARE OPENED WHEN VEHICLE VELOCITY DROPS BELOW 2400 FT/SEC.

EXCESSIVE HELIUM LEAKAGE WILL BE DETECTABLE USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

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

(C) MISSION:
ON GROUND, POSSIBLE LAUNCH SCRUB DUE TO LCC VIOLATION.

(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

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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**

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

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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.

(E) OPERATIONAL USE:

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PNEUMATIC TANK, REGULATOR, AND ACCUMULATOR PRESSURE ARE ON S/M ALERT FDA SYSTEM AND THE BFS SYSTEM SUMMARY DISPLAY. THIS ALLOWS THE FLIGHT CREW TO RESPOND TO A PNEUMATIC HELIUM SYSTEM LEAK INDEPENDENT OF GROUND CONTROL.

- 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 MULSER
USA SAM	: MIKE SNYDER	:/S/ MIKE SNYDER
USA ORBITER ELEMENT	: SUZANNE LITTLE	:/S/ SUZANNE LITTLE
NASA SR&QA	: ERICH BASS	:/S/ ERICH BASS