

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0743 -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, ENGINE REGULATOR OUTLET PRESSURE, 0 TO 1000 PSIA.

REFERENCE DESIGNATORS: (LEG A: V41P1154A, V41P1254A, V41P1354A)
(LEG B: V41P1153A, V41P1253A, V41P1353A)

QUANTITY OF LIKE ITEMS: 6
TWO PER ENGINE LEG

FUNCTION:

PROVIDES INDICATION FOR MPS ENGINE REGULATED HELIUM OUTLET PRESSURE.
LOCATED IN THE LINE BETWEEN THE REGULATOR (PR1,2,3,7,8,9) AND THE CHECK VALVE
(CV5,6,7,29,40,45).

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 03-1-0743-02

REVISION#: 1 10/30/01

SUBSYSTEM NAME: MAIN PROPULSION

LRU: SSME SUPPLY REG OUT PRESS TRANSDUCER

CRITICALITY OF THIS

ITEM NAME: SSME SUPPLY REG OUT PRESS TRANSDUCER

FAILURE MODE: 1/1

FAILURE MODE:

RUPTURE/LEAKAGE OF THE TRANSDUCER BODY.

MISSION PHASE:

PL PRE-LAUNCH
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:

GHE LEAKAGE INTO THE AFT COMPARTMENT. POSSIBLE OVERPRESSURIZATION OF THE AFT COMPARTMENT. LEAKAGE DETECTABLE ON GROUND USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

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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 THE AFT COMPARTMENT. VENT DOORS ARE OPENED WHEN VEHICLE VELOCITY DROPS BELOW 2400 FT/SEC.

ALSO RESULTS IN POSSIBLE LOSS OF HELIUM SUPPLY 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.

GOLD 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.

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(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

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.

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(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:

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

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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