

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0722 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 02/20/01

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	:TRANSDUCER, LO2 PRESSURE GOULD-MSD	ME449-0179-0173 PA8105-300-22131

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

TRANSDUCER, LO2 ENGINE INLET PRESSURE

REFERENCE DESIGNATORS: V41P1130C
V41P1230C
V41P1330C

QUANTITY OF LIKE ITEMS: 3
ONE PER ENGINE

FUNCTION:

MEASURES LO2 ENGINE FEEDLINE PRESSURE NEAR THE ENGINE INLET. PRESSURE DATA IS USED FOR POST FLIGHT DATA ANALYSIS.

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REVISION#: 2 02/08/02

SUBSYSTEM NAME: MAIN PROPULSION

LRU: TRANSDUCER, LO2 PRESSURE

ITEM NAME: TRANSDUCER, LO2 PRESSURE

CRITICALITY OF THIS

FAILURE MODE: 1R2

FAILURE MODE:

ERRONEOUS INDICATION

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? YES

RTLS	RETURN TO LAUNCH SITE
TAL	TRANS-ATLANTIC LANDING
AOA	ABORT ONCE AROUND
ATO	ABORT TO ORBIT

REDUNDANCY SCREEN

- A) PASS
- B) FAIL
- C) PASS

PASS/FAIL RATIONALE:

A)

B)

FAILS B SCREEN BECAUSE SIGNAL FROM FAILED TRANSDUCER IS INDISTINGUISHABLE FROM A PROPERLY FUNCTIONING TRANSDUCER.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

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THIS TRANSDUCER IS USED AS A MCC CUE FOR THE CREW TO INHIBIT DUMP THROUGH AN SSME SHUTDOWN PRE-MECO, IN CASE OF UNCONTAINED ENGINE DAMAGE. FAILURE TO ISOLATE RESULTS IN LOSS OF CREW/VEHICLE.

(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:

1R2 2 SUCCESS PATHS. TIME FRAME - POST MECO

- 1) UNCONTAINED ENGINE DAMAGE THAT SHUTS DOWN ENGINE PRE-MECO. THIS ASSUMES THAT THE SSME IS DAMAGED ONLY TO THE EXTENT THAT ISOLATION OF THE DAMAGE WILL SAVE THE SYSTEM.
- 2) PRESSURE TRANSDUCER FAILS WITHIN OPERATING LIMITS (≥ 40 PSIA)

CREW FAILS TO ISOLATE SSME BY CLOSING LO2 PREVALVE DURING PROPELLANT DUMP PER FLIGHT RULE. RESULTS IN FIRE/EXPLOSION IN AFT COMPARTMENT AND LOSS OF CREW/VEHICLE.

-DISPOSITION RATIONALE-

(A) DESIGN:

THE TRANSDUCER PRIMARY BARRIER UTILIZES WELDED INCONEL 718 COMPONENTS (THREADED FITTING AND DIAPHRAGM) AND IS DESIGNED FOR A PROOF PRESSURE OF 900 PSIA. 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 BURST PRESSURE OF 2000 PSIA. STRUCTURAL ANALYSIS INDICATES A POSITIVE MARGIN OF SAFETY FOR ALL OPERATING CONDITIONS.

THE CASE ASSEMBLY IS EVACUATED, THEN SEALED BY WELDING A BALL INTO THE LEAK CHECK PORT.

(B) TEST:

MANUFACTURING

THERMAL CYCLE

WITH POWER APPLIED, CYCLE BETWEEN -147 DEG F AND -297 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 300 PSIA) TWICE EACH HOUR.

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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 -147 DEG F, -225 DEG F, AND -297 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.

OMRSD

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 800A 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:

FLIGHT: NO CREW ACTION CAN BE TAKEN.

GROUND: GROUND OPERATIONS SAFING PROCEDURES CONTAIN SAFING SEQUENCE OF EVENTS FOR MAJOR LEAKS IN THE OXYGEN SYSTEM.

- APPROVALS -

S&R ENGINEERING	: W.P. MUSTY	:/S/ W. P. MUSTY
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/ ERIC BASS