

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0720 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 02/20/01

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: TRANSDUCER, LH2 ENG INLET PRES STATHAM	ME449-0179-0272

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
TRANSDUCER, LH2 ENGINE INLET PRESSURE

REFERENCE DESIGNATORS: V41P1100C
V41P1200C
V41P1300C

QUANTITY OF LIKE ITEMS: 3
ONE PER ENGINE

FUNCTION:
MEASURES LH2 ENGINE FEEDLINE PRESSURE NEAR THE ENGINE INLET.

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ITEM NAME: TRANSDUCER, LH2 ENG INLET PRESS

CRITICALITY OF THIS

FAILURE MODE: 1R2

FAILURE MODE:

ERRONEOUS INDICATION - SHIFTS HIGH

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
PAD	PAD ABORT

REDUNDANCY SCREEN

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

PASS/FAIL RATIONALE:

A)

B)

FAILS B SCREEN SINCE TRANSDUCER SHIFTS MAY NOT BE READILY DISTINGUISHABLE FROM EXPECTED OUTPUT.

C)

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(A) SUBSYSTEM:

NO EFFECT FIRST FAILURE.

RECIRC PUMP FUNCTION IS VERIFIED USING THE SSME LPFTP OUTLET PRESSURE MEASUREMENT.

CRIT 1/1 FOR INTACT ABORT SINCE PRESSURE TRANSDUCER IS USED AS CUE FOR CREW TO MANUALLY INHIBIT LH2 PREVALVE OPENING DURING DUMP IN CASE OF AN UNCONTAINED SSME FAILURE.

(B) INTERFACING SUBSYSTEM(S):

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 - ASCENT

- 1) LH2 INLET PRESSURE TRANSDUCER SHIFTS HIGH (GREATER THAN OR EQUAL TO 30 PSIA WHICH IS FLIGHT RULE CUE PRESSURE).
- 2) UNCONTAINED SSME SHUTDOWN. ASSUMES SSME DAMAGE ONLY TO THE EFFECT THAT ISOLATION OF THE SSME WOULD PREVENT CATASTROPHIC FAILURE.

RESULTS IN FAILURE OF CREW TO ISOLATE THE DAMAGED SSME BY INHIBITING OPENING OF THE ASSOCIATED LH2 PREVALVE. FIRE/EXPLOSION HAZARD IN AFT COMPARTMENT. 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 ATTACHED TO THE SENSING DIAPHRAGM. ANNEALED GOLD LEADS FROM THE BEAM TO TRANSITION PINS ARE UTILIZED. BOTH THE PINS AND GOLD LEADS ARE CONFORMAL COATED WITH PARALENE. MATERIALS AND PROCESSES USED ARE COMPATIBLE WITH THE ENVIRONMENTAL CONDITIONS. THE TRANSDUCER IS CAPABLE OF WITHSTANDING 150 PSIA WITHOUT CHANGING THE CALIBRATION.

THE CASE ASSEMBLY, INCLUDING THE FEED THROUGH TERMINALS, IS EVACUATED, THEN SEALED BY WELDING A BALL INTO THE LEAK CHECK PORT. PRIOR TO SEALING, A SPECIFIC AMOUNT OF HELIUM IS PLACED INTO THE ASSEMBLY FOR THE PURPOSE OF

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LEAK CHECKING THE WELDS, FEED THROUGH PINS, AND BALL SEAL. THE STRAIN GAGE BRIDGE IS ELECTRICALLY OFFSET TO COMPENSATE FOR THE HELIUM PRESSURE IN THE ASSEMBLY.

(B) TEST:
ATP

EXAMINATION OF PRODUCT

THERMAL CYCLE

WITH POWER APPLIED, CYCLE BETWEEN -273 DEG F AND -411 DEG F SIX TIMES STAYING 2 HOURS AT EACH TEMPERATURE. DURING EACH 2 HOUR PERIOD, CYCLE PRESSURE FROM 0 PSIG TO 75 PSIA TWICE EACH HOUR.

PERFORMANCE TESTS

INSULATION RESISTANCE

CALIBRATION

0, 20, 40, 60, 80, 100, 80, 60, 40, 20 AND 0 PSIA AT -273 DEG F, -320 DEG F AND AT -411 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

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INSPECTION VERIFIES REQUIRED PROCEDURES/SHOP PRACTICES ARE UTILIZED FOR CONTAMINATION CONTROL. CLEANLINESS LEVEL 400 IS MAINTAINED AND 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 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.

NONDESTRUCTIVE EVALUATION

HELIUM LEAK TEST IS 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:

GROUND: GROUND OPERATIONS SAFING PROCEDURES CONTAIN SAFING SEQUENCE OF EVENTS FOR MAJOR LEAKS IN THE HYDROGEN 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/ ERICH BASS

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