SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :MAIN PROPULSION FMEA NO 03-1 -0723 -1 REV:05/04/88F

ASSEMBLY :STATHAM
P/N RI :ME449-0179-0173
P/N VENDOR:PA 8105-300-22131
QUANTITY :1
:ONE
:

CRIT. FUNC: 1R
CRIT. HDW: 3

VEHICLE EFFECTIVITY:	102	103	104
	X	X	X

PHASE(S): PL LO X OO DO LS

REDUNDANCY SCREEN: A-PASS B-FAIL C-PASS

PREPARED BY:		APPROVED BY:		APPROVED BY (NASA):	
DES	J E OSLUND	DES		SSM	
REL	L H FINEBERG	REL		REL	
QE	D R STOICA	QE		QE	

ITEM:
TRANSDUCER, LO2 17 INCH FEEDLINE MANIFOLD DISCONNECT PRESSURE (V41P1533C).

FUNCTION:
PROVIDES MEASUREMENT OF LO2 MANIFOLD PRESSURE. LOCATED NEAR 17" DISCONNECT. DATA IS USED FOR GROUND AND IN-FLIGHT MONITORING OF SYSTEM PERFORMANCE. HARD-WIRED TO ON-BOARD CAUTION AND WARNING SYSTEM.

FAILURE MODE:
ERRONEOUS OUTPUT (READS LOW) POST-MECO.

CAUSE(S):
PIECE PART STRUCTURAL FAILURE, CONTAMINATION.

EFFECT(S) ON:
(A)SUBSYSTEM (B)INTERFACES (C)MISSION (D)CREW/VEHICLE

(A,B) INCORRECT LO2 MANIFOLD PRESSURE INPUT TO CAUTION AND WARNING (C&W) SYSTEM (AUDIBLE ALARM 249 PSIA). NO EFFECT, NORMAL PRESSURE BUILDUP IS NOT SUFFICENT TO CAUSE THE LO2 MANIFOLD RELIEF SYSTEM TO OPERATE.

FAILS SCREEN B BECAUSE ERRONEOUS LOW INDICATIONS CANNOT BE DISTINGUISHED FROM NORMAL LOW SYSTEM PRESSURE AFTER SUCCESSFUL DUMP AND VACUUM INERT.

(C,D) NO EFFECT.

(E) FUNCTIONAL CRITICALITY EFFECT

1R3, 5 SUCCESS PATHS. TIME FRAME - POST DUMP.

1) LO2 TRANSDUCER FAILS - ERRONEOUS READING (LOW).
2) LO2 RELIEF SYSTEM FAILS TO RELIEVE.
3,4,5) ALL 3 LO2 PREVALVES FAIL TO OPEN/REMAIN OPEN.

TRANSDUCER FAILURE WOULD RESULT IN NO C&W ALERT TO PROMPT IMMEDIATE VACUUM INERTING. PRESSURE BUILDUP DUE TO LO2 DUMP AND RELIEF SYSTEM FAILURES WILL CAUSE LO2 MANIFOLD RUPTURE RESULTING IN LEAKAGE OF LO2 INTO THE AFT COMPARTMENT. POSSIBLE AFT COMPARTMENT OVERPRESSURIZATION AND FIRE/EXPLOSION HAZARD. POSSIBLE LOSS OF ADJACENT CRITICAL COMPONENTS DUE TO CRYOGENIC EXPOSURE. POSSIBLE LOSS OF CREW/VEHICLE.

DISPOSITION & RATIONALE:
(A) DESIGN (B) TEST (C) INSPECTION (D) FAILURE HISTORY (E) OPERATIONAL USE

(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 450 PSIA WITHOUT CHANGING THE CALIBRATION.

THE CASE ASSEMBLY, INCLUDING THE FEEDTHROUGH 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 LEAK CHECKING THE WELDS, FEEDTHROUGH 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 -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 FULL SCALE (FULL SCALE IS 0 TO 300 PSIA) TWICE EACH HOUR.

PERFORMANCE TESTS

INSULATION RESISTANCE

CALIBRATION
0, 20, 40, 60, 80, 100, 80, 60, 40, 20, AND 0 PERCENT FULL SCALE AT -147 DEG F, -225 DEG F AND AT -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
V41AKO.010 ORB MOUNTED SENSOR FUNCTION TEST (CONTINGENCY)

(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
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
DURING OV-104 VEHICLE TESTING AT KSC, THE LO2 MANIFOLD PRESSURE TRANSDUCER INDICATED A READING OF APPROXIMATELY 85 PSIA. THE CORRECT PRESSURE INDICATION SHOULD HAVE BEEN APPROXIMATELY 8 PSIA. SUPPLIER FAILURE ANALYSIS INDICATED EXCESSIVE NEGATIVE ZERO BALANCE OUTPUT AND HIGH RESISTANCE SHORTS FROM CONNECTOR PINS TO TRANSDUCER CASE. RESISTANCE RETURNED TO NORMAL AFTER CONNECTOR WAS REMOVED. CAUSE OF FAILURE WAS THEREFORE NOT DETERMINED (REFERENCE CAR AD3021).

(E) OPERATIONAL USE
NO CREW ACTION WILL BE TAKEN BECAUSE TRANSDUCER FAILURE WILL MASK PRESSURE RISE. THE LO2 FILL/DRAIN VALVES COULD BE OPENED TO ALLEVIATE THE PRESSURE BUILDUP IF THE LO2 MANIFOLD PRESSURE TRANSDUCER IS SUSPECTED TO BE MALFUNCTIONING.