SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-1CB-0741-X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION : 2 89/08/23

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU :	TRANSDUCER	ME449-0177-8179

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
TRANSDUCER, ENGINE HELIUM SUPPLY PRESSURE

QUANTITY OF LIKE ITEMS: 3
THREE
ONE PER ENGINE He SUPPLY

FUNCTION:
PROVIDES PRESSURE INDICATION FOR MPS ENGINE HELIUM SUPPLY. ALSO USED BY THE BACK-UP FLIGHT SOFTWARE (BFS) TO DETERMINE IF THERE IS EXCESSIVE HELIUM USAGE/LEAKAGE ON THAT ENGINE SYSTEM. LOCATED ON THE LINE BETWEEN THE SUPPLY TANK AND THE SUPPLY ISOLATION CHECK VALVES (CV25,26,36,37,41,42).

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-1CB-0741-02

REVISION# 2 89/08/23

SUBSYSTEM: MAIN PROPULSION
LRU :TRANSDUCER
ITEM NAME: TRANSDUCER

CRITICALITY OF THIS FAILURE MODE:1/1

FAILURE MODE:
RUPTURE/LEAKAGE OF THE TRANSDUCER BODY.

MISSION PHASE:
PL PRELAUNCH
LO LIFT-OFF
DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA
: 103 DISCOVERY
: 104 ATLANTIS

CAUSE:
MATERIAL DEFECT, FATIGUE.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? N

REDUNDANCY SCREEN A) N/A
B) N/A
C) N/A

PASS/FAIL RATIONALE:
A)

B)

C)

MASTER MEAS. LIST NUMBERS: V41P1150C
: V41P1250C
: V41P1350C

- FAILURE EFFECTS -

(A) SUBSYSTEM:
DURING ASCENT, HELIUM SUPPLY TO ONE ENGINE WILL BE LOST. ESCAPING HELIUM MAY OVERPRESSURIZE THE AFT COMPARTMENT.

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.

PRIOR TO T-9 MINUTES, 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:

- DISPOSITION RATIONALE -

(A) DESIGN:
THE TRANSDUCER UTILIZES A STRAIN GAGE PRESSURE MONITORING CONCEPT. A BEAM WITH A STRAIN GAGE (MOUNTED AND COATED WITH A CERAMIC MATERIAL) 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.

THE LINKAGE PIN HAS TWO PIECES THAT ARE WELDED TOGETHER. ONE PIECE IS CONNECTED TO THE BEAM AND THE SECOND IS CONNECTED TO THE DIAPHRAGM. STRAIN GAUGE LEAD WIRES CONNECT THE STRAIN GAUGE TO A STATIONARY YOKE (STAINLESS STEEL). GOLD LEADS CONNECT THE STATIONARY YOKE TO THE FEEDTHROUGH CONNECTOR AND ARE CONFORMAL COATED WITH PARALENE. 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.

■ (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 5000 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 (5000 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
DV41AZ0.110 ORB/MPS HIGH PRESS GHe SYSTEM FLIGHT DECAY TEST (EVERY FLT)
V41AZ0.110 ORBITER MPS SSME HELIUM HIGH PRESSURE DECAY TEST (PRIOR TO FIRST REFLIGHT OF EACH VEHICLE)
V41AZ0.140 ORBITER/MPS SSME HELIUM HIGH DELTA PRESSURE DECAY (I5)
V41AZ0.150 FLIGHT PRESSURIZATION ISOLATION TEST (EVERY FLIGHT)
V41AZ0.160 SSME LOW PRESSURE GHe CHECK VALVE ISOLATION TEST (I5)
V41AZ0.190 COMPONENT WELDED JOINTS LEAK CHECK (I10)
V41BC0.100 2-WAY SOLENOID VALVE LEAK TEST - HIGH PRESSURE (EVERY FLIGHT)
V41BG0.010 PR1-4, 7-9 PNEUMATIC SSME REGULATOR LOCK-UP TEST (EVERY FLT)
V41BG0.080 PR1-3,7-9 SSME HELIUM REGULATOR FUNCTION TEST (EVERY FLIGHT)
V41BU0.010 MPS COMPONENTS VISUAL INSPECTION (EVERY FLIGHT)

(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.

NONDESTRUCTIVE EVALUATION
HELIUM LEAK TEST IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING
SPECIAL HANDLING PER DOCUMENTED INSTRUCTIONS IS VERIFIED BY INSPECTION

PRINT DATE: 08/24/89

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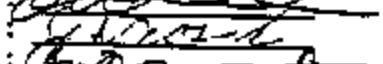
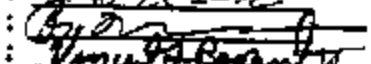
TO PRECLUDE DAMAGE, SHOCK, AND CONTAMINATION DURING COMPONENT HANDLING, TRANSPORTING, AND PACKAGING BETWEEN WORK STATIONS.

(D) FAILURE HISTORY:
THERE HAVE BEEN NO ACCEPTANCE TEST, QUALIFICATION TEST, FIELD OR FLIGHT FAILURES ASSOCIATED WITH THIS FAILURE MODE.

(E) OPERATIONAL USE:
NO CREW ACTION CAN BE TAKEN.

- APPROVALS -

RELIABILITY ENGINEERING	L. H. FINEBERG	
DESIGN ENGINEERING	J. E. OSLUND	
QUALITY ENGINEERING	R. WILLIAMS	
NASA RELIABILITY		
NASA SUBSYSTEM MANAGER		
NASA QUALITY ASSURANCE