SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-1CB-0749-X

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
TRANSDUCER, ENGINE HELIUM SUPPLY TEMPERATURE, -300 TO +600 DEG F.
ME449-0156-0002(AFT) ROSEMOUNT
ME449-0010-0007(MID) RDF

■ QUANTITY OF LIKE ITEMS: 6
SIX

■ FUNCTION:
PROVIDES TEMPERATURE INDICATION OF THE HELIUM SUPPLY. USED TO PRECLUDE EXCEEDENCE OF STRUCTURAL TEMPERATURE LIMITS OF THE SUPPLY TANKS DURING SERVICING. ENSURES ADEQUATE HELIUM MASS TO MEET MISSION REQUIREMENTS (WHEN USED WITH HELIUM SUPPLY PRESSURE) AND TO VERIFY THAT THE ENGINE MINIMUM TEMPERATURE REQUIREMENTS FOR HELIUM ARE NOT VIOLATED. THERE ARE THREE TANKS FOR EACH ENGINE HELIUM SUPPLY. ONE 4.7 CUBIC FOOR (Cu Ft) TANK IS IN THE AFT FUSELAGE AND ONE 4.7 AND ONE 17.3 Cu Ft TANK ARE IN THE MID FUSELAGE. THERE IS ONE TRANSDUCER IN THE 4.7 Cu Ft AFT COMPARTMENT TANK AND ONE TRANSDUCER IN THE 17.3 Cu Ft TANK FOR BOTH OF THE MID FUSELAGE TANKS.

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-1CB-0749-02

REVISION# 2 89/08/23

SUBSYSTEM:

ITEM NAME: CRITICALITY OF THIS FAILURE MODE:1/1

■ FAILURE MODE:
RUPTURE/LEAKAGE OF 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: MID TANKS:
: V41T1152A
: V41T1252A
: V41T1352A
: .
: AFT TANKS:
: V41T1151A
: V41T1251A
: V41T1351A

- 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:
AFT TANKS (-0002):

THE TRANSDUCER USES A PLATINUM WIRE TEMPERATURE SENSING ELEMENT (POSITIVE COEFFICIENT OF RESISTANCE FOR TEMPERATURE). THE RESISTANCE CHANGES PROPORTIONALY WITH TEMPERATURE. THE UNIT IS POWERED AND MONITORED BY AN EXTERNAL SIGNAL CONDITIONER. THE PLATINUM SENSING WIRE IS WOUND AROUND A HOLLOW MANDREL TO PROVIDE A RAPID RESPONSE. THIS WIRE IS EXPOSED TO THE ENVIRONMENT BY OPENINGS IN THE OUTER STAINLESS STEEL SHEATH.

THE TRANSDUCER WHICH IS AN OPEN CONFIGURATION IS HERMETICALLY SEALED FROM THE SEALING FACE OF THE HEX NUT TO THE CONNECTOR WELD. THE PROBE IS CYLINDRICAL CONSISTING OF A ONE PIECE HEX NUT AND THREADED SECTION WHICH IS TIG WELDED TO THE HOLLOW MANDREL. THE PLATINUM SENSING WIRE IS COILED AROUND AND INSULATED FROM THE MANDREL BY PLASMA DEPOSITED ALUMINUM OXIDE (AL203). THE PLATINUM SENSING WIRE IS WELDED TO COPPER LEAD WIRES THAT ARE ATTACHED TO THE CONNECTOR PINS. THE PLATINUM

SENSING WIRE AND MANDREL IS CONTAINED WITHIN AN OUTER STAINLESS STEEL SHEATH THAT IS TIG WELDED TO THE THREADED PART AND ALSO AT THE TIP OF THE MANDREL.

RUPTURE/LEAKAGE OF THE TRANSDUCER IS PRECLUDED BY USE OF A PRIMARY AND SECONDARY BARRIER CONCEPT WHICH CONSISTS OF AN INNER AND OUTER WELDED STAINLESS STEEL HOUSING DESIGNED WITH A PROOF OF 4950 PSIA AND BURST OF 6750 PSIA. THE PROBE IS DESIGNED AND CONSTRUCTED TO WITHSTAND 6750 PSIA WITHOUT ANY STRUCTURAL FAILURE. STRUCTURAL ANALYSIS INDICATES A POSITIVE MARGIN OF SAFETY FOR ALL OPERATING CONDITIONS.

MID BODY TANKS (-0007):

THE TRANSDUCER USES A PLATINUM WIRE TEMPERATURE SENSING ELEMENT (POSITIVE COEFFICIENT OF RESISTANCE FOR TEMPERATURE). THE RESISTANCE CHANGES PROPORTIONALY WITH TEMPERATURE. THE UNIT IS POWERED AND MONITORED BY AN EXTERNAL SIGNAL CONDITIONER. THE PLATINUM SENSING WIRE IS WOUND AROUND A HOLLOW MANDREL TO PROVIDE A RAPID RESPONSE. THIS WIRE IS EXPOSED TO THE ENVIRONMENT BY OPENINGS IN THE OUTER STAINLESS STEEL SHEATH.

THE TRANSDUCER WHICH IS AN OPEN CONFIGURATION IS HERMETICALLY SEALED FROM THE SEALING FACE OF THE HEX NUT TO THE CONNECTOR WELD. THE PROBE IS CYLINORICAL CONSISTING OF A ONE PIECE HEX NUT AND THREADED SECTION WHICH IS TIG WELDED TO THE HOLLOW MANDREL. THE PLATINUM SENSING WIRE IS COILED AROUND AND INSULATED FROM THE MANDREL BY PLASMA DEPOSITED ALUMINUM OXIDE (AL203). THE PLATINUM SENSING WIRE IS WELDED TO COPPER LEAD WIRES THAT ARE ATTACHED TO THE CONNECTOR PINS. THE PLATINUM SENSING WIRE AND MANDREL IS CONTAINED WITHIN AN OUTER STAINLESS STEEL SHEATH THAT IS TIG WELDED TO THE THREADED PART AND ALSO AT THE TIP OF THE MANDREL.

RUPTURE/LEAKAGE OF THE TRANSDUCER IS PRECLUDED BY USE OF A PRIMARY AND SECONDARY BARRIER CONCEPT WHICH CONSISTS OF AN INNER AND OUTER WELDED STAINLESS STEEL HOUSING DESIGNED WITH A PROOF OF 1.5 AND MINIMUM BURST OF 3.0. THE PROBE IS DESIGNED AND CONSTRUCTED TO WITHSTAND 10,000 PSIA WITHOUT ANY STRUCTURAL FAILURE.

■ (B) TEST:
AFT TANKS (-0002):

ATP

EXAMINATION OF PRODUCT

TIME CONSTANT TEST
RESPOND TO 63% OF A 50 DEG F STEP CHANGE IN LESS THAN 1 SECOND

SELF HEATING TEST
DISSIPATE 0.010 WATTS IN ROOM TEMPERATURE WATER MOVING AT 3 FEET/SEC
SELF HEATING ERROR NOT TO EXCEED +/- 0.5 DEG F

PROOF PRESSURE
PRIMARY AND SECONDARY BARRIER:
4950 PSIA

INSULATION RESISTANCE TEST

CALIBRATION
CALIBRATED AT 4 POINTS (-320, +32, +212, +600 DEG F)

CERTIFICATION

BY SIMILARITY

THE TRANSDUCER WAS CERTIFIED BY SIMILARITY TO THE SATURN S-II TRANSDUCERS (ME449-0009-0002) PROCURED BY ROCKWELL INTERNATIONAL. THE PREVIOUS TEST LIMITS EXCEEDED ORBITER SPECIFICATION REQUIREMENTS.

MID BODY TANKS (-0007):

ATP

EXAMINATION OF PRODUCT

LEAKAGE TEST (1x10-10 SCC/SEC MAXIMUM)
ONE ATMOSPHERIC DIFFERENTIAL FROM THE SEALING FACE OF THE HEX TO THE PROBE TIP.

HIGH PRESSURE
PROBE INLET: 10,000 PSIA

RESISTANCE TEST (+32 DEG F)
SENSING ELEMENT RESISTANCE

INSULATION RESISTANCE TEST

CALIBRATION
CALIBRATED AT 5 POINTS (-452, -320, +32, +212, +450 DEG F)

CERTIFICATION

CERTIFIED BY SIMILARITY TO ME449-0010-0008 TRANSDUCER WHOSE DESIGN REQUIREMENTS ARE MORE STRINGENT. ME449-0010-0008 WAS SUBJECTED TO THE FOLLOWING TESTS:

THERMAL SHOCK
10 CYCLES FROM +75 TO -320 DEG F

RANDOM VIBRATION TEST
13.3 HOURS OF RANDOM VIBRATION AT +75 DEG F IN EACH OF THE 2 AXES. CONTINUOUSLY MONITORED AND RECORDED

BURST
PRIMARY BARRIER: 22,000 PSI FROM SEALING FACE OF HEX TO PROBE TIP

OMRSD
OV41AZ0.110 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
INCOMING MATERIALS ARE VERIFIED FOR MATERIALS AND PROCESS CERTIFICATION.

CONTAMINATION CONTROL
CLEANLINESS LEVEL 100A IS MAINTAINED AND VERIFIED IN ACCORDANCE WITH APPLICABLE REQUIREMENTS. CORROSION PROTECTION IS VERIFIED IN ACCORDANCE WITH APPLICABLE REQUIREMENTS.

ASSEMBLY/INSTALLATION
PARTS ARE INSPECTED VISUALLY, DIMENSIONALLY, AND INCREMENTALLY PER REQUIREMENTS. TORQUE APPLICATION AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION. MANDATORY INSPECTION POINTS ARE INCLUDED IN THE ASSEMBLY PROCESS.

CRITICAL PROCESSES
WELDING, SOLDERING, HEAT TREATMENT, AND PARTS PASSIVATION ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
HELIUM LEAK TEST IS VERIFIED BY INSPECTION.

TESTING
ATP AND PROOF PRESSURE TESTS ARE 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:
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		