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PRINT DATE: 08/28/89

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-1CB-0750-X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION : 2 89/08/23

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	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU :	TRANSDUCER, HE PNEU SUP TEMP	ME449-0156-0002

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EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
TRANSDUCER, PNEUMATIC HELIUM SUPPLY TEMP, -300 TO +600 DEG F.

QUANTITY OF LIKE ITEMS: 1  
ONE

FUNCTION:  
PROVIDES TEMPERATURE INDICATION OF THE HELIUM SUPPLY. USED TO PRECLUDE EXCEEDENCE OF STRUCTURAL TEMPERATURE LIMITS OF THE SUPPLY TANK 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. THE TRANSDUCER IS LOCATED IN THE 4.7 CUBIC FOOT PNEUMATIC HELIUM SUPPLY TANK WHICH IS LOCATED IN THE AFT FUSELAGE.

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SHUTTLE CRITICAL ITEMS LIST - ORBITER

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SUBSYSTEM: MAIN PROPULSION  
LRM : TRANSDUCER, HE PNEU SUP TEMP  
ITEM NAME: TRANSDUCER, HE PNEU SUP TEMP

CRITICALITY OF THIS  
FAILURE MODE: 1/1

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FAILURE MODE:  
RUPTURE/LEAKAGE OF THE TRANSDUCER BODY.

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

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

CAUSE:  
MATERIAL DEFECT, FATIGUE.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? N

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

PASS/FAIL RATIONALE:

A)

B)

C)

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MASTER MEAS. LIST NUMBERS: V41T1601A

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- FAILURE EFFECTS -  
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(A) SUBSYSTEM:

DURING ASCENT, THE PNEUMATIC HELIUM SUPPLY WILL BE LOST. ESCAPING  
HELIUM MAY OVERPRESSURIZE THE AFT COMPARTMENT.

WHEN THE CROSSOVER VALVE (LV10) OPENS AT MECO, THE PNEUMATIC HELIUM  
DISTRIBUTION SYSTEM WILL BE FED FROM THE LEFT ENGINE HELIUM SUPPLY.  
WHEN THE INTERCONNECT "OUT" VALVES OPEN AT MECO PLUS 20 SECONDS, THE

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ENGINE HELIUM SUPPLIES WILL LEAK THROUGH THE FAILED LINE.

STORED HELIUM PRESSURE IN THE ACCUMULATOR LEG AND SUPPLEMENTAL HELIUM FROM LV10 SHOULD BE ADEQUATE TO OPERATE THE LO2 PREVALVES AT MECO. LOSS OF HELIUM MAY PREVENT OPERATION OF VALVES FOR MPS DUMP.

PURGE OF AFT COMPARTMENT AND LH2/LO2 SYSTEMS WOULD DEPEND SOLELY ON THE LEFT ENGINE HELIUM SYSTEM RESIDUALS, RESULTING IN INADEQUATE ABORT PURGE, INCOMPLETE PROPELLANT DUMP, AND INGESTION OF CONTAMINATION.

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 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:

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- DISPOSITION RATIONALE -  
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(A) DESIGN:  
THE TRANSDUCER USES A PLATINUM WIRE TEMPERATURE SENSING ELEMENT (POSITIVE COEFFICIENT OF RESISTANCE FOR TEMPERATURE). THE RESISTANCE CHANGES PROPORTIONALLY 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 (AL2O3). THE PLATINUM SENSING WIRE IS WELDED TO COPPER LEAD WIRES THAT ARE ATTACHED TO THE CONNECTOR PINS. THE PLATINUM

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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.

■ (B) TEST:  
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.

## OMRSD

DV41AZO.110 ORB/MPS HIGH PRESS GHe SYSTEM FLIGHT DECAY TEST (EVERY FLT)  
V41AZO.110 ORBITER MPS SSME HELIUM HIGH PRESSURE DECAY TEST (PRIOR TO FIRST REFLIGHT OF EACH VEHICLE)  
V41AZO.150 FLIGHT PRESSURIZATION ISOLATION TEST (EVERY FLIGHT)  
V41AZO.190 COMPONENT WELDED JOINTS LEAK CHECK (I10)  
V41BCO.100 2-WAY SOLENOID VALVE LEAK TEST - HIGH PRESSURE (EVERY FLIGHT)

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V41BGO.010 PR1-4, 7-9 PNEUMATIC SSME REGULATOR LOCK-UP TEST (EVERY FLT)  
V41BGO.090 PR4 PNEUMATIC HELIUM REGULATOR FUNCTION TEST (EVERY FLIGHT)  
V41BUO.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:

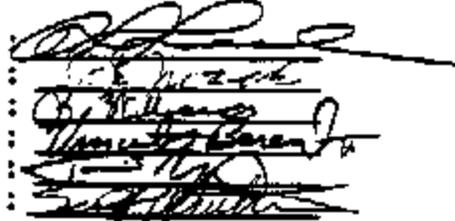
NO CREW ACTION CAN BE TAKEN.

EFFECTIVE FOR OI-80 SOFTWARE, CR 893978 "MPS PNEUMATIC SYSTEM FDA AND DISPLAY - BFS" ADDS PNEUMATIC TANK, REGULATOR, AND ACCUMULATOR PRESSURE TO THE S/M ALERT FGA SYSTEM AND ADDS THE 3 PRESSURE MEASUREMENTS TO THE BFS SYSTEM SUMMARY DISPLAY. THIS ALLOWS THE FLIGHT CREW TO RESPOND TO A PNEUMATIC HELIUM SYSTEM LEAK INDEPENDENT

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OF GROUND CONTROL.

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

  
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