

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : FWD - REACTION CONTROL FMEA NO 03-2F -121317-1 REV:12/01/87

ASSEMBLY : VERNIER THRUSTER
P/N RI : MC467-0029
P/N VENDOR: 234874
QUANTITY : 2
: 1 PER THRUSTER

Table with columns: VEHICLE, EFFECTIVITY, PHASE(S), CRIT. FUNC, CRIT. HDW. Values include 102, 103, 104, X, X, X, PL, LO, OO, X, DO, LS.

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REDUNDANCY SCREEN: A- B- C-
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ITEM:
HEATER, RESISTANCE TYPE 27 VOLT, 10 WATTS-VERNIER.

FUNCTION:

ONE HEATER ELEMENT IS UTILIZED PER THRUSTER TO PREVENT PROP FREEZING AND POT SUBSEQ EFFECTS SUCH AS IGN PRESS SPIKES CAUSING STRUCT DAMAGE TO THE THRUSTER. THE HEATER ELEM IS NICHROME V WIRE AND THE SENSOR ELEM IS PURE PLATINUM WIRE. THE HEATER ASS'Y IS CONTAINED IN A METAL HOUSING BOLTED ON THE BACK FACE OF THE INJ. TEMP SENSING IS REMOTE FROM THE HEATER AND FEEDS THE SIGNAL INTO A SOLID STATE CONTROLLER FOR HEATER SWITCHING. THE HEATER IS ON AT 145+/- 5F AND OFF AT 189+/- 10F.

FAILURE MODE:

FAILS OPEN (OFF), PRECLUDING HEATING OF VALVES/INJECTOR.

CAUSE(S):

OVER-TEMP DUE TO EXCESS POWER INPUT, VIBRATION, SHOCK, FAB DEF, ASS'Y DAMAGE, THERMAL STRAIN, DIELECTRIC FAIL, MOISTURE.

EFFECT(S) ON:

- (A)SUBSYSTEM (B)INTERFACES (C)MISSION (D)CREW/VEHICLE
(A) LOSS OF FUNCTION (VERNIER THRUSTERS)-LOSS OF SINGLE (-2) VERNIER THRUSTER CAUSES LOSS (SHUTDOWN) OF VERNIER CONTROL.
(B) NO EFFECT
(C) MISSION MODIFICATION DUE TO LOSS OF VERNIER CONTROL. PRIMARY THRUSTER USAGE RESULTS IN HIGHER PROPELLANT CONSUMPTION. SOME MISSION OBJECTIVES MAY NOT BE MET.
(D) NO EFFECT.

DISPOSITION & RATIONALE:

(A)DESIGN (B)TEST (C)INSPECTION (D)FAILURE HISTORY (E)OPERATIONAL USE

(A) DESIGN

THE HEATER ELEMENT IS NICHROME V WIRE AND THE SENSOR ELEMENT IS PURE PLATINUM WIRE. THE HEATER ASSY IS CONTAINED IN A SEALED METAL HOUSING BOLTED ON THE BACK FACE OF THE INJECTOR

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(B) TEST

QUAL TEST INCLUDED ROUGH HANDLING, VIB (34 MIN/AXIS), FORWARD AND REVERSE INTERNAL LEAKAGE, EXT LEAKAGE, ABNORMAL OPERATION, ACCELERATED LIFE DUTY CYCLE, PROPELLANT COMPATIBILITY, BURST, HEATER OUT IGNITION, NOZZLE THERMAL TRANSIENT, MISSION DUTY CYCLE.

ACCEPTANCE TESTING INCLUDES PROOF PRESSURE OF THE NOZZLE (150 PSIG), EXTERNAL LEAKAGE, CLEANLINESS, THRUSTER PERFORMANCE. QUAL TESTS UTILIZED THREE UNITS.

OMRSD PERFORMS THE FOLLOWING: THRUSTER HEATER VERIFICATION FOR THE FIRST FLIGHT AND ON A CONTINGENCY BASIS THEREAFTER. FUNCTIONAL CHECK OUT FOR THE FIRST, FIFTH AND EVERY FIFTH FLIGHT THEREAFTER. REDUNDANT CIRCUIT VERIFICATION FOR THE SECOND FLIGHT AND EVERY FLIGHT THEREAFTER. A VERNIER THRUSTER HEATER VERIFICATION ON THE SECOND FLIGHT AND EVERY FLIGHT THEREAFTER.

(C) INSPECTION

- RECEIVING INSPECTION

INSPECTION VERIFIES RAW MATERIAL AND PHYSICAL PROPERTIES.

CONTAMINATION CONTROL

CLEANLINESS AND CORROSION PROTECTION ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

VISUAL INSPECTION OF DIMENSIONS IS VERIFIED BY INSPECTION. ELECTRICAL COMPONENTS ARE TESTED FOR INSULATION RESISTANCE AND DIELECTRIC STRENGTH AND VERIFIED BY INSPECTION. MANUFACTURING, ASSEMBLY, AND INSTALLATION OPERATIONS ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

INSPECTION VERIFIES PENETRANT INSPECTION OF THE EXTERNAL ENCLOSURE, INCLUDING BRAZES AND EXTERNAL WELDS.

CRITICAL PROCESSES

INSPECTION VERIFIES WELDING AND BRAZING ARE TO TAYCO SPECIFICATION REQUIREMENTS. INSPECTION VISUALLY INSPECTS WELDS AND BRAZES. THE INTER-ELEMENT WELD IS ALSO GIVEN CONTINUITY CHECK AND A SAMPLE WELD IS PULL TESTED. EXTERNAL WELDS AND BRAZES ARE ALSO VERIFIED BY ATP HELIUM LEAK TEST.

TESTING

ATP IS WITNESSED AND VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING, HANDLING, AND STORAGE ENVIRONMENTS ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

THERE HAVE BEEN NO FAILURES DURING TEST OR DURING FLIGHT ON VERNIER THRUSTERS. THERE HAVE BEEN TWO FAILED OFF HEATER FAILURES DUE TO MANUFACTURING PROBLEMS ON THE PRIMARY THRUSTERS WHICH ARE OF SIMILAR DESIGN. CORRECTIVE ACTION WAS TO CHANGE SUPPLIERS.

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(E) OPERATIONAL USE

IN THE EVENT OF LOSS OFF VERNIER THRUSTER CAPABILITY, THE PRIMARY THRUSTERS CAN BE USED FOR THE VERNIER FUNCTION. SOME MISSION OBJECTIVES MAY NOT BE MET DUE TO INCREASED RATE OF PROPELLANT CONSUMPTION ON PRIMARY THRUSTERS.