

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : FWD - REACTION CONTROL FMEA NO' 03-2F -102170-1 REV: 04/08, 88

ASSEMBLY : PROPELLANT FEED CRIT. FUNC: 2
P/N RI : MC284-0420-0011/-0012 CRIT. HDW: 2
P/N VENDOR: 73895-0031/-0032 VEHICLE 102 103 104
QUANTITY : 2 EFFECTIVITY: X X X
: ONE REQ'D PER PROPELLANT PHASE(S): PL LO OO X DO LS

PREPARED BY: J LAZARUS DES APPROVED BY: K. Di. Paul REDUNDANCY SCREEN: A- B- C-
REL R P DIEHL REL R.P. Diehl APPROVED BY (NASA):
QE W J SMITH QE W.J. Smith SSM R. J. Korman
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ITEM:
VALVE, MANIFOLD ISOLATION, VERNIER THRUSTER, SOLENOID (28VDC) BI-STABLE (LATCHING) (LV157,158).

FUNCTION:
TO PROVIDE VERNIER THRUSTER ISOLATION: 1) PRIOR TO SYSTEM ACTIVATION AND 2) IN THE EVENT OF A RUNAWAY THRUSTER OR MANIFOLD LEAK.

FAILURE MODE:
FAILS CLOSED, FAILS TO OPEN, RESTRICTED FLOW.

CAUSE(S):
IMPROPER ELECTRICAL SIGNAL (CONTINUOUS SHORT) OR LOW MAGNETIC FORCE FROM LATCHING MAGNET, MECH SHOCK, VIB., CONTAM (AIR GAP), CORROSION, MATERIAL DEFECT, ELECTRICAL FAILURE.

EFFECT(S) ON:
(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE
(A) LOSS OF FUNCTION (VERNIER THRUSTER).
(B) DEGRADATION OF INTERFACE SUBSYSTEM-PAYLOAD MANIPULATION.
(C) POSSIBLE EARLY MISSION TERMINATION. PRIMARY THRUSTERS ARE INADEQUATE FOR SMALL RATE ATTITUDE HOLD.
(D) NO EFFECT

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

(A) DESIGN
SERIES SWITCHES (RPC'S) MINIMIZE POTENTIAL FOR INADVER ACTUATION.
PARALLEL SWITCHES (RPC'S) PROVIDE ELECT REDUN FOR THE OPENING SIG. AN INDUCT VOLTAGE SUPRES CIRCUIT IS PROV IN THE ELECTRICAL SYSTEM TO PREVENT DAMAGE TO OTHER ON-LINE COMPONENTS.
TO LIMIT THE POSSIBILITY OF THE ELECT SHORT POTENT, THE LEAD AND MAGNET WIRES ARE ENCAP BY POTTING AND A FIXTURE IS USED DURING ASSEMBLY TO ENSURE THAT INSUL IS NOT DAMAGED BY THE EXIT NOTCH WHEN THE COIL SLEEVE IS PRESSED ONTO THE COIL. MATERIALS ARE COMPATIBLE WITH PROPELLANTS.

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(B) TEST

TWO UNITS WERE USED FOR QUAL TESTS. QUAL PRESSURE SURGE TESTS WERE CONDUCTED ON THE VALVE TO SIMULATE THE EFFECT OF MULTIPLE PRIMARY THRUSTER SHUTDOWNS. THE TEST CONSISTED OF 95,000 PRESSURE CYCLES WHICH REPRESENTS A SCATTER FACTOR OF 4.0 ABOVE THE 50 MISSION LIMITED LIFE OF THE VALVE. THE SURGE CYCLES WERE AT VARIOUS MIN/MAX PRESSURES FROM 0 MIN TO 1000 MAX PSIG.

A QUAL BURST TEST WAS CONDUCTED AT 2000 PSIG FOR ONE MINUTE WHICH IS TWO TIMES THE MAX OPERATIONAL PRESSURE. THERE WAS NO EVIDENCE OF RUPTURE OR FRACTURE.

QUAL TESTING ALSO INCLUDED RANDOM VIBRATION (48 MIN/AXIS), BASIC DESIGN SHOCK, LIFE CYCLE (2000 CYCLES), THERMAL CYCLES, BELLOWS LEAKAGE, DUTY CYCLES, PROPELLANT COMPATIBILITY, ELECTRICAL POWER VARIATION, AND POSITION INDICATOR CONTACT RESISTANCE.

ACCEPTANCE TESTING INCLUDED PROOF PRESSURE (1130 PSIG), EXTERNAL LEAKAGE DIELECTRIC STRENGTH, INSULATION RESISTANCE, OPERATION, POWER DRAIN, PRESSURE DROP, POSITION INDICATOR CIRCUIT RESISTANCE, INTERNAL LEAKAGE, AND CLEANLINESS.

OMRSD PERFORMS THE FOLLOWING: ISOLATION VALVE ELECTRICAL VERIFICATION OF MOD/POD THE FIRST FLIGHT AND ON A CONTINGENCY BASIS. VERNIER MANIFOLD ISOLATION VALVE LEAKAGE THE 5TH AND EVERY 5 FLIGHTS THEREAFTER. THE REDUNDANT CIRCUIT VERIFICATION EVERY FLIGHT BEGINNING WITH THE SECOND FLIGHT. TALKBACK AND ELECTRICAL INTEGRITY IS ALSO VERIFIED. A REDUNDANT CIRCUIT VERIFICATION OF THE MOD/POD FOR THE FIRST FLIGHT, FIFTH FLIGHT AND EVERY FLIGHT THEREAFTER AND ON A CONTINGENCY BASIS THEREAFTER. INTERFACE VERIFICATION OF THE MOD/POD AND ORBITER ON A CONTINGENCY BASIS. VERNIER MANIFOLD ISOLATION VALVE RELIEF DEVICE CHECK OUT THE 5TH AND EVERY 5 FLIGHTS THEREAFTER AND ON A CONTINGENCY BASIS.

(C) INSPECTION

RECEIVING INSPECTION

MATERIAL AND PROCESS CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS AND PASSIVATION IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

OPERATING VOLTAGES AND LATCH FORCES ARE VERIFIED BY INSPECTION. ALL DETAIL PARTS ARE INSPECTED UNDER 40X MAGNIFICATION FOR FINISH, BURRS, DAMAGE, AND CONTAMINATION PRIOR TO ASSEMBLY. D.C. SOLENOID COIL IS VERIFIED BY INSPECTION AT THE SUBASSEMBLY LEVEL FOR DAMAGE, INSULATION RESISTANCE, DIELECTRIC STRENGTH, AND POLARITY. SPRING LOAD TEST IS VERIFIED BY INSPECTION. SEALS ARE VISUALLY INSPECTED PRIOR TO INSTALLATION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

PENETRANT INSPECTION OF WELDS IS VERIFIED BY INSPECTION.

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CRITICAL PROCESSES

WELDING PER S3012 AND SOLDERING PER NHBS300.4 ARE VERIFIED BY INSPECTION. WELDS ARE VERIFIED BY VISUAL INSPECTION AND BY WELD SAMPLES WHICH ARE CHECKED FOR WELD PENETRATION.

TESTING

INSPECTION VERIFIES PROOF PRESSURE TEST OF WELDS. ATP PER 73895ATP1 IS WITNESSED AND VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING IS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

DURING QUAL TEST, FAILURE RESULTED FROM THE ACCUMULATION OF SELF GENERATED CONTAMINATION BETWEEN THE ARMATURE AND COIL FACE WHICH REDUCED THE MAGNET FORCE HOLDING IT OPEN. CORRECTIVE ACTION WAS TO IMPROVE FINISH OF ARMATURE AND COIL POLE FACES AND LUBRICATION PROCESSES. (CAR A6470)

(E) OPERATIONAL USE

IN THE EVENT OF THE LOSS OF THE VERNIER THRUSTER FUNCTION THE PRIMARY THRUSTERS MAY BE USED FOR THE VERNIER FUNCTION. SOME MISSION OBJECTIVES MAY NOT BE MET DUE TO INCREASED USE OF PROPELLANT.