

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : AFT - REACTION CONTROL FMEA NO 03-2A -202140-1 REV:04/14 81

|                                |                 |             |         |
|--------------------------------|-----------------|-------------|---------|
| 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 : 4                   | EFFECTIVITY:    | X           | X X     |
| : TWO REQ'D PER POD            | PHASE(S): PL LO | OO X DO     | LE      |

|              |           |                    |                     |    |    |
|--------------|-----------|--------------------|---------------------|----|----|
| PREPARED BY: |           | REDUNDANCY SCREEN: | A-                  | B- | C- |
| DES          | J LAZARUS | APPROVED BY:       | APPROVED BY (NASA): |    |    |
| REL          | R P DIEHL | REL                | <i>[Signature]</i>  |    |    |
| QE           | W J SMITH | QE                 | <i>[Signature]</i>  |    |    |

ITEM:  
VALVE, MANIFOLD ISOLATION, VERNIER THRUSTER, SOLENOID (28VDC) BI-STABLE (LATCHING) LV257/258 357/358

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 INADEQUATE FOR SMALL RATE ATTITUDE HOLD.

(D) NO EFFECT

DISPOSITION & RATIONALE:

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

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(A) DESIGN

SERIES SWITCHES (RPC'S) MINIMIZE POTENTIAL FOR INADVERT ACTUATION. PARALLEL SWITCHES (RPC'S) PROVIDE ELECT REDUND FOR THE OPENING SIG. AN INDUCT VOLTAGE SUPPRESSOR CIRCUIT IS PROVIDED IN THE ELECTRICAL SYSTEM TO PREVENT DAMAGE TO OTHER ON-LINE COMP. TO LIMIT THE POSSIBILITY OF THE ELECT SHORT POTENTIAL THE LEAD AND MAGNET WIRES ARE ENCAP BY POTTING AND A FIXTURE IS USED DURING ASSEMBLY TO ENSURE THAT INSULATION IS NOT DAMAGED BY THE EXIT NOTCH WHEN THE COIL SLEEVE IS PRESSED ONTO THE COIL.

MATERIALS ARE SELECTED THAT ARE COMPATIBLE WITH PROPELLANTS.

(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 PSI 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 BEFORE FIRST FLIGHT AND ON A CONTINGENCY BASIS. MANIFOLD ISOLATION VALVE LEAKAGE TEST THE 1ST, FLIGHT, THE 5TH FLIGHT AND EVERY 5 FLIGHTS THEREAFTER AND ON A CONTINGENCY BASIS. REDUNDANT CIRCUIT VERIFICATION O/P AND O/M EVERY FLIGHT. A REDUNDANT CIRCUIT VERIFICATION OF THE MOD/POD FOR THE FIRST FLIGHT, FIFTH FLIGHT AND EVERY FIVE FLIGHTS THEREAFTER AND ON A CONTINGENCY BASIS. VERNIER MANIFOLD ISOLATION VALVE RELIEF DEVICE CHECK OUT THE 5TH AND EVERY 5 FLIGHTS THEREAFTER AND ON A CONTINGENCY BASIS. INTERFACE VERIFICATION FOR THE ORB/POD AND ORB/MOD ON A CONTINGENCY BASIS.

(C) INSPECTION

RECEIVING INSPECTION

MATERIAL AND PROCESS CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS LEVEL TO 200 FOR MMH AND 200A FOR NTO IS VERIFIED BY INSPECTION. CORROSION PROTECTION IS VERIFIED BY INSPECTION. PARTS PASSIVATION IS VERIFIED BY INSPECTION.

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**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. COIL ASSEMBLY OF D.C. SOLENOID INSPECTION AT SUBASSEMBLY LEVEL IS VERIFIED BY INSPECTION. 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.

**CRITICAL PROCESSES**

WELDING PER S3012 AND SOLDERING PER NH5300.4 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 IS WITNESSED AND VERIFIED BY INSPECTION.

**HANDLING/PACKAGING**

PACKAGING IS VERIFIED BY INSPECTION.

**(D) FAILURE HISTORY**

CAR A6470:

DURING QUAL TESTING A FAILURE RESULTED FROM THE ACCUMULATION OF SELF GENERATED CONTAMINATION BETWEEN THE ARMATURE AND COIL FACE WHICH REDUCED THE MAGNETIC ATTRACTIVE FORCE HOLDING IT OPEN. CORRECTIVE ACTION WAS TO IMPROVE FINISH OF ARMATURE AND COIL POLE FACES, AND LUBRICATION PROCESSES.

**(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.