

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : FWD - REACTION CONTROL FMEA NO 03-2F -102170-3 REV:04/09/88

ASSEMBLY : PROPELLANT FEED	CRIT. FUNC:	1
P/N RI : MC284-0420-0011,-0012	CRIT. HDW:	1
P/N VENDOR: 73895-0031,-0032	VEHICLE	102 103 104
QUANTITY : 2	EFFECTIVITY:	X X X
: ONE PER PROPELLANT	PHASE(S):	PL X LO X CO X DO X LS X

PREPARED BY:	DES	J LAZARUS	DES	APPROVED BY:	REL	R P DIEHL	REL	W J SMITH	QE	REDUNDANCY SCREEN:	A-	B-	C-	APPROVED BY (NASA)
DES	REL	QE	DES	REL	QE	SSM	REL	QE						

ITEM:
VALVE, MANIFOLD ISOLATION, VERNIER THRUSTER, SOLENOID (28 VDC) BI-STABLE (LATCHING) LV 157/158.

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:
BELLOWS LEAK, STRUCTURAL FAILURE, EXTERNAL LEAK.

CAUSE(S):
MATERIAL DEFECT, WELD DEFECT, PIECE-PART FAILURE, SURGE PRESSURE, FATIGUE.

EFFECT(S) ON:

- (A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE
- (A) SUBSYSTEM DEGRADATION, LOSS OF PROPELLANT.
- (B) POTENTIAL CORROSION DAMAGE IN THE POD AND/OR ADVERSE AFFECT ON TPS.
- (C) POSSIBLE LOSS OF MISSION DUE TO INABILITY TO USE VERNIER THRUSTERS.
- (D) POSSIBLE LOSS OF CREW/VEHICLE IF LEAK RESULTS IN EXCESSIVE LOSS OF PROPELLANT OR EXPLOSIVE HAZARD. OVERPRESSURIZATION OF THE POD MAY OCCUR. LINE RUPTURES BELOW TANK ISO VALVE ARE NOT ISOLATABLE IN ALL INSTANCES DUE TO LIMITED TIME REQ'D TO REACT.

DISPOSITION & RATIONALE:

- (A) DESIGN (B) TEST (C) INSPECTION (D) FAILURE HISTORY (E) OPERATIONAL USE
- (A) DESIGN
BELLOWS IS FABRICATED USING AM350 CRES (0.007 THICK) WELDED CONVOLUTES. THE DESIGN SAFETY FACTOR IS 2X MAX OPERATING SURGE PRESSURE AND IS PROCF TESTED TO 1500 PSIG. MATERIALS ARE SELECTED THAT ARE COMPATIBLE WITH PROPELLANTS.

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(B) TEST

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 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. MANIFOLD ISOLATION VALVE LEAKAGE CHECKS THE 5TH AND EVERY 5 FLIGHTS THEREAFTER. VERNIER MANIFOLD ISOLATION VALVE RELIEF DEVICE CHECKOUT THE 5TH AND EVERY 5 FLIGHTS THEREAFTER AND ON A CONTINGENCY BASIS. THE MANIFOLD ISOLATION OPERATION 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 AND EVERY FIVE FLIGHTS THEREAFTER AND ON A CONTINGENCY BASIS. PROPELLANT LOADING FOR EVERY MISSION.

(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. CLEANING OF DETAIL PARTS 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. LAPPING OF THE POPPET AND SLEEVE SURFACES AND INSPECTION AT 40X MAGNIFICATION.

NONDESTRUCTIVE EVALUATION

PENETRANT INSPECTION OF WELDS IS VERIFIED BY INSPECTION.

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CRITICAL PROCESSES

WELDING PER S3012 AND SOLDERING PER NHB5300.4 ARE VERIFIED BY INSPECTION. WELDS ARE VERIFIED BY VISUAL INSPECTION AND BY WELD SAMPLES WHICH ARE CHECKED FOR WELD PENETRATION.

TESTING

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

HANDLING/PACKAGING

PACKAGING IS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

NO FAILURE HISTORY. DEVELOPMENT TEST AND ANALYSIS SHOWED A PRESSURE SURGE FATIGUE PROBLEM WHICH WAS RESOLVED BY REDUCING THE LIFE OF THE VALVE TO 50 MISSIONS.

(E) OPERATIONAL USE

A LEAK CAN BE ISOLATED BY CLOSING THE UPSTREAM ISOLATION VALVE. SWITCH TO GPC POSITION IF ERRONEOUS SWITCH POSITION IS DETECTED.