

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :AFT - REACTION CONTROL FMEA NO 03-2A -201020-1 REV:04/12,85

ASSEMBLY :PRESSURIZATION

P/N RI :MC284-0419

P/N VENDOR:738J5

QUANTITY :8

:TWO VALVES REQ'D FOR
:EACH HELIUM TANK

VEHICLE
EFFECTIVITY:
PHASE(S): PL LO X OC X DO X LS

CRIT. FUNC: 15
CRIT. HDW: 2
102 103 104
X X X
X

PREPARED BY:

DES J LAZARUS
REL R P DIEHL
QE W J SMITH

REDUNDANCY SCREEN: A-PASS B-PASS C-PASS
APPROVED BY: *[Signature]* APPROVED BY (NASA):
DES *[Signature]* SSM *[Signature]*
REL *[Signature]* REL *[Signature]*
QE *[Signature]* QE *[Signature]*

ITEM:

VALVE, D.C. SOLENOID OPERATED, HIGH PRESSURE. HELIUM (1/2") BI-STABLE.
(LATCHING - MAGNETIC & SPRING FORCE) LV 201/202/203/204/301/302/303/304.

FUNCTION:

UTILIZED TO CONTROL HELIUM PRESSURIZATION SYSTEM IN THE AFT MODULES. IN
THE OPEN POSITION A FLOW PATH IS PROVIDED FROM THE HELIUM SUPPLY TANK(S)
TO THE REGULATORS. TWO PARALLEL PATHS ARE PROVIDED FOR EACH PROPELLANT
TANK. TWO PATHS ARE NORMALLY OPEN FOR ASCENT AND ENTRY. ONE PATH IS
NORMALLY OPEN PER TANK ON ORBIT. THE OPEN VALVE MAY BE CLOSED AND THE
PARALLEL VALVE OPENED SUBSEQUENT TO A DOWNSTREAM FAILURE.

FAILURE MODE:

FAILS CLOSED

CAUSE(S):

VIBRATION, CONTINUOUS INADVERTENT CLOSING SIGNAL DUE TO SHORT CIRCUIT,
SHOCK, PIECE PART FAILURE, CONTAMINATION.

EFFECT(S) ON:

(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE

(A) LOSS OF REDUNDANT PRESSURIZATION PATH.

(B) NO EFFECT

(C) NO EFFECT

(D) NO EFFECT

(E) FUNCTIONAL CRITICALITY EFFECT - POSSIBLE CREW VEHICLE LOSS - FAILURE
OF REDUNDANT PARALLEL FLOW PATH WOULD RESULT IN INABILITY TO BURN OR
DEplete RCS PROPELLANT. POSSIBLE LOSS OF CONTROL DURING MATED
COAST/EXTERNAL TANK SEPARATION/ENTRY. FAILED CLOSED OF PARALLEL FLOW
PATHS MAY RESULT IN VEHICLE LOSS.

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DISPOSITION & RATIONALE:

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

(A) DESIGN

PARALLEL VALVES AND REDUNDANT POWER SOURCES ARE PROVIDED. ULLAGE PRESS IS ADEQ FOR PROP FEED WITH LESS THAN 35 PERCENT PROP REMAINING. ONE VALVE IS MAINTAINED IN THE LATCHED OPEN POSITION WITH NO POWER APPLIED ; THE OTHER IS LATCHED CLOSED.

A 100-MICRON FILTER IS PROVIDED TO LIMIT THE POSS OF CONTAM CAUSING LEAKAGE, JAMMING MOVING PARTS - OR PLUGGING PILOT CONTROL ORIFICES.

TO LIMIT THE ELECT SHORT POTENTIAL, 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. THE DESIGN FACTOR OF SAFETY IS 1.5 FOR PROOF PRESSURE AND 2.0 FOR BURST PRESSURE.

(B) TEST

TWO UNITS WERE USED IN THE QUALIFICATION TEST PROGRAM. THE TESTING INCLUDED RANDOM VIBRATION, SHOCK, ELECTRICAL POWER VARIATION, POSITION INDICATOR CONTACT RESISTANCE, LIFE CYCLE (2200 CYCLES), THERMAL (+20 TO +150 DEG F), DUTY HEAT RISE FOR SOLENOID TEMP, BURST (8000 PSIG), PROPELLANT EXPOSURE AND REVERSE DIFFERENTIAL PRESSURE TEST.

THE ACCEPTANCE TESTING INCLUDED EXAMINATION OF PRODUCT, PROOF PRESSURE (6000 PSIG), EXTERNAL LEAKAGE, DIELECTRIC STRENGTH, INSULATION RESISTANCE, BONDING, OPERATION, POWER DRAIN, PRESSURE DROP, POSITION INDICATOR CIRCUIT RESISTANCE AND INTERNAL LEAKAGE.

OMRSD PERFORMS THE FOLLOWING: AN ISOLATION VALVE ELECTRICAL VERIFICATION OF MOD/POD FOR THE FIRST FLIGHT AND THEREAFTER ON A CONTINGENCY BASIS. A HELIUM ISOLATION VALVE LEAK TEST EVERY FLIGHT AND ON A CONTINGENCY BASIS.

A PRESSURE DECAY TEST OF THE HIGH PRESSURE HELIUM SYSTEM EVERY FLIGHT. MOISTURE CONTENT VERIFICATION THE FIRST FLIGHT AND THEREAFTER ON A CONTINGENCY BASIS. HELIUM SAMPLING AFTER EVERY 3 FLIGHTS AND ON A CONTINGENCY BASIS. HELIUM SYSTEM ACTIVATION FOR EACH FLIGHT. HELIUM SERVICING TO FLIGHT LOADS FOR EACH FLIGHT. CIRCUIT VERIFICATION ON THE MOD/POD THE FIRST FLIGHT, THE FIFTH FLIGHT AND EVERY FIVE FLIGHTS THEREAFTER AND ON A CONTINGENCY BASIS. CIRCUIT VERIFICATION THE SECOND FLIGHT AND EVERY FLIGHT. INTERFACE VERIFICATION OF THE ORB/POD ON A CONTINGENCY BASIS. A REGULATOR RESPONSE TEST EVERY FLIGHT AND 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 VRFIFIED 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. ALL CAPSULE ASSEMBLY OF BELLEVILLE AND BELLOWS LOAD TESTED AT SUBASSEMBLY LEVEL AND 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 NHB5300.4 ARE VERIFIED BY INSPECTION. WELDS ARE VERIFIED BY VISUAL INSPECTION AND BY WELD SAMPLES CHECKED FOR WELD PENETRATION.

TESTING

INSPECTION VERIFIES PROOF PRESSURE TEST OF WELDS. ATP PER 73835 ATP1.1. WITNESSED AND VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING IS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

CAR AC9173:

DURING THE AA MOD OF OV-102 THERE WAS NO INDICATION OF VALVE OPEN BUT THERE WAS A SLOW PRESSURE RISE INDICATING THAT THE PILOT STAGE WAS OPENING DURING CHECKOUT USING GSE. THE CAUSE OF THE FAILURE WAS EXCESSIVE LEAKAGE PAST THE TEFLON WIPER SEALS AROUND THE MAIN POPPET DUE TO WEARING OF THE THREE NYLON WIPER SEALS. AFTER SEVERAL ACTUATIONS THE VALVE BEGAN TO OPERATE CORRECTLY. IT WAS CONCLUDED THAT THE VALVE WOULD OPEN (ALTHOUGH SLIGHTLY SLOWER) IN NORMAL SYSTEM OPERATION BECAUSE THE DOWNSTREAM PRESSURE WILL BUILD UP RAPIDLY WHEN IT IS IN A CLOSED RCS SYSTEM AND ASSIST IN OPENING THE MAIN POPPET. NO CORRECTIVE ACTION WAS WARRANTED AS THE DELAYED OPENING OF THE MAIN POPPET IS ACCEPTABLE AND NOT DETRIMENTAL TO THE SYSTEM.

CAR A9774:

DURING QUALIFICATION TESTING VALVES FAILED TO OPEN AT 18 VDC. ALTHOUGH CONTAMINATION WAS SUSPECTED AS A CAUSE IT WAS NOT PROVED. CAR AB10-6 (WSTF) IS ANOTHER CASE WHERE THE VALVE FAILED TO REMAIN OPEN AND CONTAMINATION IN PLUNGER BORE WAS DISCOVERED. CORRECTIVE ACTION - THE SUPPLIER IMPROVED VISUAL INSPECTION WITH FIBER OPTICS ESPECIALLY IN HARD TO INSPECT AREA (BOTTOM OF BORES) AND ASSURED THAT THE FINAL STABILIZED OPENING VOLTAGE WAS BETWEEN 8 - 16 VOLTS WITH EMPHASIS ON MID RANGE.

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CAR ABS858 (QUAL) AND AC0977 (WSTF):
DURING QUALIFICATION AND TEST AT WSTF THE VALVE FAILED CLOSED AT HIGH
FLOW RATE OF 800 SCFM WHICH SIMULATES A FAILED OPEN REGULATOR CONDITION.
NO CORRECTIVE ACTION WAS TAKEN FOR THIS CONDITION AS THE DELTA PRESSURE
CAUSED BY THE HIGH FLOW RATE CAN OVERCOME THE FRICTION AND MAGNETIC
LATCHING FORCE. VALVE CLOSURE HELPS TO ALLEVIATE FAILURE BY SHUTTING OFF
PRESSURE SOURCE. VALVE CAN BE REOPENED AFTER HIGH FLOW STOPS.

(E) OPERATIONAL USE
USE PARALLEL FLOW PATH. USE EXISTING ULLAGE PRESSURE OR CROSSFEED IF
BOTH VALVES FAIL.