

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ORBITAL MANEUVER

FMEA NO 03-3 -1004 -3

REV: 3/30/88

ASSEMBLY : PRESSURIZATION SUBSYSTEM

P/N RI : MC621-0059

P/N VENDOR: 73P620002

QUANTITY : 4

: 2 PER POD

CRIT. FUNC: 2R

CRIT. HDW: 3

VEHICLE 102 103 104

EFFECTIVITY: X X X

PHASE(S): PL X LO X OO X DO X LS

PREPARED BY:

DES D W CARLSON

REL C M AKERS

QE W J SMITH

REDUNDANCY SCREEN: A-PASS B-FAIL C-PASS

APPROVED BY:

DES *[Signature]* APPROVED BY (NASA):

REL *[Signature]* SSM *[Signature]*

QE *[Signature]* REL *[Signature]* 26-88

ITEM:

REGULATOR, HELIUM PRESSURE, SERIES STAGES.

FUNCTION:

THE PRIMARY REGULATOR REDUCES AND REGULATES THE HELIUM SUPPLY PRESSURE (4800-460 PSI) TO THE REQ'D PROPELLANT TANK ULLAGE PRESSURE OF 257 (PLUS OR MINUS 5) PSI. THE SECONDARY REGULATOR OPERATES 7 PSI HIGHER IF PRIMARY REGULATOR FAILS. THE REGULATOR LOCKS-UP AT A PRESSURE OF 266 PSIG (SERIES STAGES AND PARALLEL FLOW PATHS ARE PROVIDED).

FAILURE MODE:

EXTERNAL LEAKAGE

CAUSE(S):

BELLOWS FAILURE DUE TO IMPROPERLY PROCESSED MATERIAL OR FAULTY ASSEMBLY.

EFFECT(S) ON:

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

(A) LOSS OF PRESSURANT (LIMITED BY RETAINER SEALS, CLOSE TOLERANCES BETWEEN INTERFACING ELEMENTS, AND THE ATMOSPHERIC SENSING ORIFICE.

(B) NO EFFECT (PRESSURANT LOSS LIMITED BY GHE ISOLATION VALVE AND CHECK VALVES).

(C) NO EFFECT.

(D) NO EFFECT.

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(E) FUNCTIONAL CRITICALITY EFFECT - POSSIBLE EARLY MISSION TERMINATION. FAILURE OF REDUNDANT ELEMENTS (GHE ISOLATION VALVE AND CHECK VALVES) MAY REQUIRE OPERATIONAL USE CHANGES AND POSSIBLE MISSION MODIFICATION INCLUDING USE OF PROPELLANT FROM LEAKING POD FIRST. THE MINOR LEAK RATE ANTICIPATED DUE TO A BELLOWS FAILURE WOULD PROBABLY NOT BE READILY DETECTABLE DURING MISSION USAGE. FAILURE (LEAKAGE) OF THE UNLIKE REDUNDANT ITEM (CHECK VALVE) WOULD ALSO NOT BE READILY DETECTABLE. LONG TERM LEAKAGE COULD RESULT IN A DETECTABLE DROP IN PROPELLANT TANK ULLAGE PRESSURE.

DISPOSITION & RATIONALE:

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

(A) DESIGN

THE SMALL SENSING ORIFICE IN THE REGULATOR CAP ALLOWS SENSING OF EXTERNAL PRESSURE TO CORRECT BETWEEN ATMOSPHERIC AND VACUUM PRESSURES. PRESSURE BELLOWS ARE UTILIZED TO LIMIT ANY POTENTIAL LEAKAGE. LEAKAGE THROUGH A FRACTURED BELLOWS IS RESTRICTED BY THE RETAINER SEALS, THE CLOSE TOLERANCES BETWEEN INTERFACING ELEMENTS AND THE ATMOSPHERIC SENSING ORIFICE. THE DOWNSTREAM CHECK VALVE PREVENTS LOSS OF ULLAGE PRESSURE FROM THE PROPELLANT TANK. THE UPSTREAM HELIUM ISOLATION VALVE CAN BE CLOSED AND IS NORMALLY CLOSED DURING NON-FIRING PERIODS TO PREVENT ANY CONTINUING PRESSURE LOSS. THE FACTOR OF SAFETY FOR PROOF PRESSURE IS 1.5 X MAX. WORKING PRESSURE.

(B) TEST

QUALIFICATION TEST

(3 UNITS -2 FAIRCHILD & 1 C.C.C.) - RANDOM VIBRATION, THERMAL CYCLES (-65 TO +150 DEGREE F.), ENDURANCE - 2100 FLOW CYCLES, 100 (MISSION EQUIVALENT) MISSION SIMULATIONS - PARALLEL OPERATIONS, BLOWDOWN, PROPELLANT COMPATIBILITY. ALSO QUALIFIED AS PART OF POD ASSY - VIBRO-ACOUSTIC TESTING AT JSC (131 EQUIVALENT MISSION DUTY CYCLES). APPROX. 7 YEARS EXPOSURE TO OPERATING ENVIRONMENT.

ACCEPTANCE TEST

EACH UNIT - PROOF PRESSURE, EXTERNAL LEAKAGE, SET POINT VERIFICATION. LOCK-UP PRESSURE, INTERNAL LEAKAGE. PERFORMANCE - SLAM START, FLOW LIMITER VERIFICATION, NORMAL REGULATION, LOW TEMPERATURE, CLEANLINESS, DRYING.

GROUND TURNAROUND

V43CBO.210 PERFORMS EXTERNAL LEAK CHECKS FOR FIRST FLIGHT AND CONTINGENCY.

V43CBO.221 PERFORMS PRESSURE DECAY CHECKS OF LOW PRESSURE HELIUM SYSTEM EVERY FLIGHT.

V43CFO.020 PERFORMS HELIUM SERVICING TO FLIGHT LOAD EVERY FLIGHT.

V43CBO.030 PERFORMS REGULATOR LEAK AND FUNCTIONAL TEST EVERY FLIGHT.

V43CBO.040 PERFORMS REGULATOR HIGH PRESSURE LEAK AND FUNCTIONAL TEST FOR THE FIRST FLIGHT.

V43CBO.050 PERFORMS REGULATOR LOW PRESSURE LEAK AND FUNCTIONAL TEST FOR THE FIRST FLIGHT AND CONTINGENCY.

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V43CFO.025 PERFORMS HELIUM SYSTEM ACTIVATION EVERY FLIGHT.
ULLAGE PRESSURES MONITORED DURING MISSION TO VERIFY PROPER REGULATOR PERFORMANCE.
ON-ORBIT BURNS ARE PERFORMED WITH SINGLE (ALTERNATE) REGULATOR LEGS TO VERIFY INDIVIDUAL REGULATORS.
HELIUM USAGE EACH FLIGHT IS MONITORED FOR DETECTION OF ABNORMAL CONSUMPTION RATE.
HELIUM TANK PRESSURE AND TEMPERATURE MONITORED EACH FLIGHT FOR LEAKAGE.

(C) INSPECTION

RECEIVING INSPECTION
MATERIALS AND PROCESSES CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
COMPONENTS ARE CLEANED PRIOR TO ASSEMBLY. CLEANLINESS TO LEVEL 100A AND CORROSION PROTECTION PROVISIONS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
MANUFACTURING, ASSEMBLY AND INSTALLATION PROCEDURES ARE VERIFIED BY INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. DIMENSIONAL AND VISUAL INSPECTION THROUGHOUT FABRICATION AND ASSEMBLY IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
PENETRANT AND RADIOGRAPHIC INSPECTION OF WELDS ARE VERIFIED BY INSPECTION. INSPECTION ALSO VERIFIES PENETRANT INSPECTION OF THE MAIN BELLOWS WELDS, AND THE HOUSING FORGINGS AT THE FORGING LEVEL.

CRITICAL PROCESSES
SURFACE COATING AND PLATING PROCESSES ARE VERIFIED BY INSPECTION. THE WELDING PROCESS AND VERIFICATION THAT WELDS MEET SPECIFICATION REQUIREMENTS ARE VERIFIED BY INSPECTION. ADDITIONAL DETAILS OF CRITICAL PROCESS INSPECTIONS ARE LISTED BELOW:

- (1) INSPECTION VISUALLY INSPECTS THE TIG (TUNGSTEN INERT GAS) WELDS WITHIN THE PILOT ACTUATOR ASSEMBLY AND WITHIN THE PILOT POPPET ASSEMBLY. ADDITIONAL TIG WELD INSPECTIONS INCLUDE THE WELDS THAT JOIN THE TUBING, BOTTOM CAPS, AND THE MAIN BELLOWS TO THE BODY. INSPECTION ALSO VERIFIES THE EB (ELECTRON BEAM) WELDS OF THE PILOT ACTUATOR BELLOWS INTO THE PILOT ACTUATOR ASSEMBLY. THE PROOF PRESSURE TEST/LEAK TEST PROVIDES FURTHER VERIFICATION OF WELDS INTEGRITY.
- (2) INSPECTION VERIFIES HEAT TREATMENT OF THE DETAIL PARTS, INCLUDING THE HOUSING FORGING TO DRAWING REQUIREMENTS.
- (3) THE FORGING SUPPLIER CERTIFIES THAT THE HOUSING FORGING MEET THE REQUIREMENTS OF MIL-F-.7190, AMENDMENT 1, GRADE A TESTING OF EACH FORGING LOT FOR CHEMISTRY, AFTER HEAT TREATMENT HARDNESS AND TENSILE STRENGTH IS VERIFIED BY INSPECTION.
- (4) INSPECTION VERIFIES THAT BELLEVILLE WASHERS ARE CADMIUM PLATED TO DRAWING REQUIREMENTS.

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TESTING

TEST EQUIPMENT AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION.
ACCEPTANCE TEST IS VERIFIED BY INSPECTION. (INCLUDES FUNCTIONAL AND
EXTERNAL LEAKAGE TESTS).

HANDLING/PACKAGING

HANDLING, PACKAGING, STORAGE AND SHIPPING REQUIREMENTS ARE VERIFIED BY
INSPECTION.

(D) FAILURE HISTORY

NO FAILURES ON DELIVERED HARDWARE.

(E) OPERATIONAL USE

NO ACTION FOR FIRST FAILURE - NOT DETECTABLE. FOR SUBSEQUENT FAILURE
CLOSE HELIUM ISOLATION VALVE TO REGULATOR THAT IS LEAKING. (LEAKAGE MAY
STILL OCCUR DUE TO BACK FLOW). OPERATE TWO ENGINES FROM FAILED POD TO
MAXIMIZE HELIUM AVAILABLE FROM LEAKING POD AND TO INCREASE ULLAGE VOLUME
AND MAXIMIZE BLOWDOWN. ULLAGE BLOWDOWN ADEQUATE FOR DEORBIT (IF LEAKAGE
IS UPSTREAM OF CHECK VALVES) AFTER OMS-2 FOR TYPICAL MISSIONS (APPROX.
60% ULLAGE REQUIRED FOR MAX BLOWDOWN). TYPICAL DEORBIT BURN REQUIRES LES
THAN 30% PROPELLANT.