# SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ORBITAL MANEUVER FMEA NO 03-3 -1101 -1 REV: 3/30/88

ASSEMBLY :PRESSURIZATION SUBSYSTEM
P/N RI :MC621-0059 (SCHEMATIC)
P/N VENDOR:
QUANTITY :
:ONE SET PER EA POD
:

CRIT. FUNC: 1
CRIT. HDW: 1

| VEHICLE EFFECTIVITY: | 102 X | 103 X | 104 X |
|---|---|---|---|

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

REDUNDANCY SCREEN: A- B- C-

| PREPARED BY: | | APPROVED BY: | APPROVED BY (NASA): |
|---|---|---|---|
| DES | D W CARLSON | DES | SSM |
| REL | C M AKERS | REL | REL |
| QE | W J SMITH | QE | QE |

8-26-88

**ITEM:**
FEED LINE, HELIUM (INCLUDING MECHANICAL FITTINGS AND VALVE BODIES.)

**FUNCTION:**
5/8 X .058 304L S.S. LINES PROVIDE HELIUM FEED FROM THE HELIUM RESERVOIR TO THE REGULATOR INLET. A 3/4 X .020 304L SS LINE PROVIDES HELIUM FEED FROM THE REGULATOR OUTLET TO THE PROPELLANT STORAGE TANK. 1/4 X .020, 1/4 X .028, 3/8 X .035, 1/2 X .020 304L SS LINES FOR SERVICING, TEST AND CHECKOUT. MECHANICAL CONNECTORS INCLUDE SPECIAL HELIUM TANK CONNECTOR WITH DUAL SEALS (USED IN APOLLO), DYNATUBE FITTINGS AT HELIUM LINE/TANK CONNECTION, DUAL SEAL FITTINGS FOR PRESSURE/TEMPERATURE INSTRUMENTATION AND COMPONENT/VALVE BODY EXTERNAL LEAK SOURCES; AND INTERNAL BARRIERS FOR EXTERNAL LEAKAGE. VALVE BODIES FOR THE PRESSURIZATION SYSTEM INCLUDE COUPLINGS, TRANSDUCERS, GHE ISOLATION VALVE, PRESSURE REGULATOR, VAPOR ISOLATION VALVE, CHECK VALVE, RELIEF VALVE, AND MANUAL ISOLATION VALVE. ALL COMPONENT BODIES ARE CRES FORGINGS OR MACHINED FROM BILLETS.

**FAILURE MODE:**
STRUCTURAL FAILURE, RUPTURE, EXTERNAL LEAKAGE.

**CAUSE(S):**
MATERIAL DEFICIENCY, WELD DEFECT/CRACK, TEST/FABRICATION/INSTALLATION DAMAGE, SEAL OR BELLOWS FAILURE DUE TO MATERIAL, FAULTY ASSEMBLY, CORROSION, VIBRATION, MECHANICAL SHOCK OR EXCESS WEAR.

**EFFECT(S) ON:**
(A)SUBSYSTEM (B)INTERFACES (C)MISSION (D)CREW/VEHICLE

(A) LOSS OF SUBSYSTEM PRESSURIZATION.

(B) LOSS OF INTERFACE FUNCTION (INABILITY TO PRESSURIZE PROPELLANT TANK DUE TO HELIUM LOSS - POTENTIAL POD STRUCTURE & TPS DAMAGE).

(C) LAUNCH DELAY OR ABORT DECISION.

(D) POTENTIAL CREW/VEHICLE LOSS. LOSS OF HELIUM OVERBOARD MAY RESULT IN INABILITY TO UTILIZE PROPELLANT FOR DEORBIT. SUDDEN LOSS OF HELIUM MAY RESULT IN POD STRUCTURE OR TPS DAMAGE. POTENTIAL STRUCTURAL DAMAGE TO PROPELLANT TANK AND POD DURING LANDING DUE TO EXCESSIVE PROPELLANT WEIGHT.

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

(A) DESIGN
THE FACTOR OF SAFETY IS 4.0 FOR LINES < 1 1/2" DIAMETER. THE FACTOR OF SAFETY FOR VALVE BODIES IS 1.5 OR GREATER. THE WELDED CONSTRUCTION ELIMINATES JOINTS & POSSIBLE LEAK PATHS. THE ANNEALED AREA (DUE TO WELDING) IS BACKED BY A SLEEVE. FASTENING CLAMPS ALLOW FREEDOM OF MOVEMENT. TUBING BENDS ARE CONTROLLED BETWEEN FIXED POINTS TO FACILITATE INSTALLATION AND ACCOMMODATE VEHICLE GROWTH AND MOVEMENT. EXTERNAL PRESSURE SENSING ORIFICES ARE SIZED TO LIMIT ANY EXTERNAL LEAKAGE. LOCK WIRING IS USED ON ALL DYNATUBE FITTING.

(B) TEST

QUALIFICATION TESTS
TUBING INSTALLATION CERTIFICATION TESTS PERFORMED PER SD75-SH-0205 INCLUDED PRESSURE CYCLING AND FATIGUE FOR TYPICAL SHUTTLE LINES, JOINTS AND CLAMPING METHODS. ALSO QUALIFIED AS PART OF POD ASSEMBLY - VIBRO-ACOUSTIC TESTING AT JSC (131 EQUIVALENT MISSIONS).

ACCEPTANCE TESTS
ALL WELDS X-RAY INSPECTED. PROOF PRESSURE AND LEAK TESTS PERFORMED DURING ACCEPTANCE. ALL MACHININGS DYE-PENETRANT INSPECTED.

GROUND TURNAROUND
V43CB0.210 PERFORMS FIRST FLIGHT AND CONTINGENCY EXTERNAL LEAK CHECKS.
V43CB0.220 PERFORMS EACH FLIGHT PRESSURE DECAY CHECKS OF HIGH PRESSURE HELIUM SYSTEM.
V43CB0.221 PERFORMS PRESSURE DECAY CHECKS OF LOW PRESSURE HELIUM SYSTEM EVERY FLIGHT.
V43CB0.213 PERFORMS MECHANICAL JOINT LEAKAGE TEST EVERY FIFTH FLIGHT.
V43CE0.030 PERFORMS SUBSYSTEM INSPECTION EVERY FIFTH FLIGHT.
V43CF0.020 PERFORMS HELIUM SERVICING TO FLIGHT LOAD EVERY FLIGHT.
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. RECORDS AND TEST REPORTS CERTIFYING PHYSICAL PROPERTIES ARE VERIFIED BY INSPECTION.

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CONTAMINATION CONTROL
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 INSPECTIONS PERFORMED DURING FABRICATION AND ASSEMBLY ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
RADIOGRAPHIC INSPECTION OF WELDS IS VERIFIED BY INSPECTION. ALL COMPONENT BODIES ARE VERIFIED BY PENETRANT INSPECTION.

CRITICAL PROCESSES
THE WELDING PROCESS AND VERIFICATION THAT WELDS MEET SPECIFICATION REQUIREMENTS ARE VERIFIED BY INSPECTION.

TESTING
TEST EQUIPMENT AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION. ACCEPTANCE TEST IS VERIFIED BY INSPECTION.

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

(D) FAILURE HISTORY
WELD JOINT LEAKAGE AT TEST POINT COUPLING ON THE OV-102 RH OMS POD WAS FOUND DURING PRE STS-9 CHECKOUT FOLLOWING REGULATOR REPLACEMENT IN THE HMF. THE OMRSD WAS REVISED TO INSURE THAT THE LINE SEGMENT IS PRESSURIZED WHEN LEAK CHECKS ARE PERFORMED.

CAR AC0058 RECORDS A STRUCTURAL FAILURE OF THE TUBE STUB AT THE TRANSITION RADIUS TO THE OMS TEST POINT COUPLING DOWNSTREAM OF THE REGULATOR FOLLOWING THE 100 MISSION ACOUSTIC TEST AT JSC. THE LINE PARTED COMPLETELY. THE CRACK INITIATED AT A TOOL MARK IN THE MACHINED RADIUS. THE FAILURE OCCURRED DURING ADDITIONAL TESTING AFTER COMPLETION OF THE 100 MISSION TEST. E.O. NO.21 TO MDAC DRAWING NO.73A62000 PROVIDE. ADDITIONAL SUPPORT FOR THE TUBE AND COUPLING.

CAR AB4724, AB5888, AB6494 AND AC1153 RECORD LEAKAGES OF DYNATUBE FITTINGS DURING ACOUSTIC TEST AND ASSEMBLY TEST. ML0310-0001 WAS REVISED TO ALLOW LOOSENING OF LINE CLAMPS TO ALLOW FITTING ALIGNMENT AND VERIFICATION OF ZERO PRE-LOAD. ALL FITTINGS WERE RECHECKED AND RETORQUED AS REQUIRED.

CAR AB7620 RECORDS INCOMPLETE WELD PENETRATION DETECTED ON TUBE WELDS ON THE OV-102 OMS POD AT KSC. THE POD WELDS WERE INSPECTED AND WELD JOINTS X-RAYS REVIEWED. DISCREPANT WELDS WERE SUBJECT TO MR ACTION AND REWELDING ACCOMPLISHED AS REQUIRED. A RADIOGRAPHIC AUDIT OF OTHER SYSTEMS AND SUPPLIER WAS CONDUCTED AND QCAN'S (QUALITY ASSURANCE CORRECTIVE ACTION NOTICES) GENERATED.

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CAR AB0049 RECORDS A BREAK IN THE HOUSING WALL DUE TO MACHINING. THIS WAS CORRECTED BY WELD REPAIR AND DRAWING CHANGE.

CAR 09F033 ALSO RECORDS POOR WELD PENETRATION ON THE BODY WELD JOINT OF LEAR SIEGLER COUPLING ON THE OV-102 STS-9 APU. BASED ON THE 1.56 SAFETY FACTOR, PROOF PRESSURE OF 7500 PSIG, STRESS ANALYSIS, LIFE ANALYSIS, AND INSPECTIONS PERFORMED, THE OMS COUPLINGS MEET SERVICE AND LIFE REQUIREMENTS.

(E) OPERATIONAL USE

OPERATE TWO ENGINES FROM LEAKING POD TO MAXIMIZE HELIUM UTILIZATION AND INCREASE ULLAGE VOLUME TO 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 LESS THAN 30% PROPELLANT.