

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ORBITAL MANEUVER FMEA NO 03-3 -1002 -1 REV: 12/03/87

ASSEMBLY : PRESSURIZATION SUBSYSTEM

CRIT. FUNC: 1R

P/N RI : MC276-0017

CRIT. HDW: 2

P/N VENDOR:

VEHICLE 102 103 104

QUANTITY : 2

EFFECTIVITY: X

: ONE PER POD

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

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

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

ITEM:

COUPLING HELIUM FILL (MD415, 515).

FUNCTION:

HELIUM TANK IS FILLED OR VENTED FROM THIS COUPLING WHICH IS A SERVICE CONNECTION ACCESSIBLE AT THE HELIUM SERVICING PANEL. THE AIRBORNE HALF COUPLING (AHC) CONSISTS OF A SPRING LOADED POPPET, POPPET SEAL, AND FILTER. THE POPPET IS OPENED BY THE GROUND HALF COUPLING (GHC). POPPET AND CLOSED BY SPRING FORCE UPON DISENGAGEMENT. THE FLIGHT CAP INSTALLED PRIOR TO FLIGHT PROVIDES AN ADDITIONAL SEAL.

FAILURE MODE:

EXTERNAL LEAKAGE (SEAL LEAKAGE)

CAUSE(S):

CONTAMINATION, EXCESS OR IMPROPER USE, SEAL DAMAGE, NO GHC LINE SUPPORT-SHAFT OR BORE BENT, RETAINING NUT LOOSENS NEGATING CAP SEAL REDUNDANCY, VIBRATION.

EFFECT(S) ON:

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

(A) LOSS OF REDUNDANCY FOR EXTERNAL LEAKAGE. NO EFFECT UNLESS REDUNDANT SEALS LEAK.

(B) NO EFFECT.

(C) LAUNCH DELAY IF DETECTED DURING SERVICING. POSSIBLE MISSION MODIFICATION OR ABORT DECISION.

(D) NO EFFECT.

(E) FUNCTIONAL CRITICALITY EFFECT - EXCESSIVE HELIUM LEAKAGE ACROSS REDUNDANT SEALS DEPLETES HELIUM REQUIRED FOR PROPELLANT FEED. POSSIBLE

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DAMAGE TO STRUCTURE OR TPS OF SERVICE PANEL CLOSE-OUT (DUE TO POD OVERPRESSURE). POTENTIAL CREW/VEHICLE LOSS IF PROPELLANT CANNOT BE UTILIZED FOR DEORBIT OR DEPLETED. POTENTIAL TANK RUPTURE AT LANDING DUE TO EXCESSIVE PROPELLANT WEIGHT. CAP SEAL CANNOT BE VERIFIED AFTER INSTALLATION. NO INSTRUMENTATION AVAILABLE FOR DETECTION OF FAILURE OF CAP OR COUPLING SEAL IN FLIGHT.

DISPOSITION & RATIONALE:

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

(A) DESIGN

FACTOR OF SAFETY (BURST) IS 2.0 X WORKING PRESSURE. PROOF PRESSURE OF 1.5 IS DEMONSTRATED ON EACH UNIT. GROUND HALF COUPLINGS AND LINES ARE ADEQUATELY SUPPORTED TO LIMIT STRESS ON THE COUPLING DURING SERVICE AND PREVENT DAMAGE TO SEALS AND WELD JOINTS. A SAFETY FEATURE DURING SERVICING AND PRIOR TO REMOVAL OF THE END CAP IS A PROVISION WHEREBY ANY LEAKAGE PAST THE AIRBORNE POPPET SEAL CAN BE VENTED OVERBOARD BY ROTATING A BLEED SCREW. COMPLETE STRESS ANALYSIS HAS BEEN CONDUCTED. CAP MINIMIZES LEAKAGE POTENTIAL AND PROVIDES A REDUNDANT SEAL.

(B) TEST

QUALIFICATION TESTS

(3 UNITS) - RANDOM VIBRATION - 48 MINUTES EACH AXIS (100 MISSION EQUIVALENT). SHOCK-BENCH AND OPERATIONAL USE. THERMAL- (+210 TO -30 DEG F.). ENDURANCE - 600 FUNCTIONAL CYCLES, 800 PRESSURE CYCLES. BENDING AND AXIAL LOADS - 50FT-LB, 50 LBS. BURST TEST - 10000 PSI. ALSO QUALIFIED AS PART OF POD ASSEMBLY - VIBRO-ACOUSTIC TESTING AT JSC (131 EQUIVALENT MISSIONS). HOT-FIRE TEST PROGRAM AT NSTF (24 EQUIVALENT MISSIONS).

ACCEPTANCE TEST

EACH UNIT - PROOF PRESSURE, FUNCTIONAL TESTS, INTERNAL AND EXTERNAL LEAKAGE TESTS PERFORMED BEFORE AND AFTER OPERATING CYCLES.

GROUND TURNAROUND

V43CBO.210 PERFORMS FIRST FLIGHT EXTERNAL LEAK CHECKS.
V43CBO.220 PERFORMS EACH FLIGHT PRESSURE DECAY CHECKS OF HIGH PRESSURE HELIUM SYSTEM.
V43CBO.200 AND V43CBO.206 REQUIRES LEAK CHECK FOR EACH COUPLING AND CAP EVERY FIFTH FLIGHT.
V43CFO.020 PERFORMS LEAK CHECK ON EACH COUPLING BEFORE GSE IS DISCONNECTED.
HELIUM TANK PRESSURE AND TEMPERATURE MONITORED EACH FLIGHT FOR LEAKAGE.

(C) INSPECTION

RECEIVING INSPECTION

MATERIALS AND PROCESSES CERTIFICATIONS ARE VERIFIED BY INSPECTION. INCLUDING RESISTANCE WELDING OF 75372011 A.H.C. FILTER ASSEMBLY PER MIL-W-6858, HEAT TREATMENT OF 6A1-4V TITANIUM NUT AND RETAINER SEAL, HEAT-TREATMENT OF 15-5PH CRES POPPET AND BODY TO CONDITION H1150 PER MIL-H-6875, AND PASSIVATION PER QQ-P-635.

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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. SEALS ARE VERIFIED PER SNP915. MANUFACTURING VERIFIES BRAYCOTE IS APPLIED TO SEALS, THREADS AND SLIDING SURFACES.

CRITICAL PROCESS

THE TIG WELD OF THE 75372019 BODY ASSEMBLY PER MIL-W-8611 AND THE RESISTANCE WELD OF THE 75372011 A.H.C. FILTER ASSEMBLY ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

PENETRANT INSPECTION OF THE BODY ASSEMBLY TIG WELD AND THE FLANGE CASTING PER MIL-I-6866 TYPE I METHOD B IS VERIFIED BY INSPECTION. RADIOGRAPHIC INSPECTION OF THE FLANGE CASTING PER MIL-C-6021, CLASS IA GRADE C, IS VERIFIED BY INSPECTION.

TESTING

TEST EQUIPMENT AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION. ACCEPTANCE TEST PER APP75372002, INCLUDING FUNCTIONAL INTEGRITY OF COUPLING, IS VERIFIED BY INSPECTION. ACCEPTANCE TEST OF THE 75372011 A.H.C. FILTER ASSEMBLY, INCLUDING BUBBLE POINT TEST, EXAMINATION OF PRODUCT, AND VERIFICATION OF CLEANLINESS IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

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

(D) FAILURE HISTORY

CAR AB3799: (QUAL)

ONE UNIT BECAME DISENGAGED FROM THE CAP DUE TO UNDERSIZED LATCHING GROOVE THAT ESCAPED QUAL MR ACTION.

CORRECTIVE ACTION WAS TO MAKE THE SUPPLIER QUALITY PERSONNEL AWARE OF THIS PROBLEM, AND THE SUPPLIER REP. INSPECTED ALL OV102 UNITS AND VERIFIED PROPER ENGAGEMENTS. ALL OTHER UNITS VERIFIED IN LINE.

CAR AB4431: (QUAL)

LEAKAGE OF A COUPLING AND CAP OCCURRED BECAUSE OF PARTICLES OF TEFLON CONTAMINATION. TEFLON ORIGINATED FROM GROUND HALF COUPLING. CORRECTIVE ACTION - NO CORRECTIVE ACTION WAS TAKEN AT THE SUPPLIER. DURING SERVICING LEAKAGE IS CHECKED BEFORE AND AFTER CONNECTING GROUND HALF.

CAR AB4181: (QUAL)

LEAKAGE OF A COUPLING AND CAP OCCURRED BECAUSE OF INCORRECT INSTALLATION OF AN OMNI SEAL.

CORRECTIVE ACTION REVISED PLANNING AND ADDED AN INSPECTION CHECK.

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CAR AB7343: (ATF)

COUPLING LEAKAGE OCCURRED DUE TO PITTED SURFACE.
CORRECTIVE ACTION INCORPORATED INSPECTION CHECK WITH 10X MAGNIFICATION VIEWER AND ASSEMBLY CONTAMINATION CONTROL PROCEDURES WERE INSTITUTED.

CAR A9508: (ATF)

CAP LOCKING FINGERS DID NOT RELOCATE BECAUSE OF AN UNDERSIZED RETAINING RING. CAP BLEED SCREW LEAK OCCURRED BECAUSE OF CONTAMINATION. CAP MALFUNCTION OCCURRED BECAUSE OF IMPROPER SPRING INSTALLATION. CORRECTIVE ACTION WAS TO CHECK ALL RINGS IN STORES. ASSEMBLY PERSONNEL WERE CAUTIONED.

CAR AB5018: (KSC)

CAP MALFUNCTION OCCURRED BECAUSE OF IMPROPER SPRING INSTALLATION. CORRECTIVE ACTION - REDESIGN MCR 6284R1.

CAR AB9513:

A SEAL LEAKAGE FAILURE AT KSC WAS CAUSED BY CONTAMINATION. CORRECTIVE ACTION - ASSEMBLY CONTAMINATION CONTROL PROCEDURES WERE INSTITUTED INCLUDING SEQUENCED ASSEMBLY, WELD SEQUENCES, FLUSH AT HIGHEST LINE ASSEMBLY LEVEL (REF EO 11 TO DWG NO.73A6200060). OMI V1061 WAS REVISED TO REQUIRE INSPECTION PRIOR TO COUPLING.

FOUR ACCEPTANCE TEST FAILURES ARE RECORDED FOR THE LEAKAGE MODE ATTRIBUTED TO CONTAMINATION, DAMAGED SEALS OR SEAL RETENTION GROOVE (REF. AB9745, AC1963, ACC080 AND AC3973). CONTAMINATION CONTROL AND ASSEMBLY PROVISIONS INCLUDED RINSE OF INTERFACE SEALS PRIOR TO TEST, VISUAL INSPECTION, AND USE OF A TOOL TO AID SEAL INSTALLATION.

(E) OPERATIONAL USE

OPERATE TWO ENGINES FROM PRESSURANT IN FAILED POD TO INCREASE ULLAGE VOLUME AND MAXIMIZE BLOWDOWN. ULLAGE BLOWDOWN ADEQUATE FOR DEORBIT AFTER OMS-2 FOR TYPICAL MISSIONS (APPROXIMATELY 60% ULLAGE REQUIRED FOR MAX BLOWDOWN). THE TYPICAL DEORBIT BURN REQUIRES LESS THAN 30% PROPELLANT.