

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ORBITAL MANEUVER

FMEA NO 03-3 -4510 -1

REV:12/04/87

ASSEMBLY : ENGINE SUBSYSTEM
 P/N RI : MC621-0009
 P/N VENDOR: 1186070, 1186014, 1186042
 QUANTITY :
 : (2 SETS VEHICLE)
 :

ABORT:
 RTLS, TAL, ATD
 VEHICLE .102 .103 .104
 EFFECTIVITY: X X X
 PHASE(S): PL LO OO X DO X LS

PREPARED BY:
 DES V F ROZDOS
 REL C M AKERS
 QE W J SMITH

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

ITEM:

FEED LINES, GN2 PNEUMATIC ACTUATION FOR ENGINE BI-PROPELLANT VALVE.
 (INCLUDING COMPONENT BODIES AND MECHANICAL CONNECTIONS).

FUNCTION:

PROVIDE GN2 FEED FROM FILL COUPLING TO GN2 TANK ASSEMBLY. 1/4" DIA X .020 304L SS FROM FILL COUPLING TO ENGINE INTERFACE. 1/4" DIA X .020 TITANIUM ALLOY (3AL-2.5V) FROM ENGINE INTERFACE TO FILL VALVE. PROVIDE GN2 FEED FROM THE GN2 ACCUMULATOR TO THE CONTROL VALVES FOR ACTUATION OF THE ENGINE BI-PROP VALVE - 1/4 DIA X .020 TITANIUM ALLOY (3AL-2.5V). PROVIDE GN2 FEED TO PURGE VALVES - 1/4 DIA X .020 TITANIUM ALLOY (3AL-2.5V). FEED LINE FITTINGS INCLUDE MECHANICAL FITTINGS WITH DUAL-SEALS FOR PRESSURE TRANSDUCER INSTALLATION. VALVE BODIES INCLUDE REGULATOR, FILL VALVE, ISOLATION VALVE, PURGE VALVE, CONTROL VALVE, AND COUPLINGS.

FAILURE MODE:

STRUCTURAL FAILURE, RUPTURE, EXTERNAL LEAKAGE.

CAUSE(S):

MATERIAL DEFICIENCY, WELD DEFECT/CRACK, STRESS CORROSION, TEST/FAB/INSTALLATION DAMAGE, VIBRATION, MECHANICAL SHOCK.

EFFECT(S) ON:

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

(A) SUBSYSTEM DEGRADATION (LOSS OF PRESSURANT). IF FILL VENT VALVE ALSO LEAKS (FOR FILL LINE) OR ACCUMULATOR LINE LEAKS. LOSS OF ABILITY TO ACTUATE BI-PROP VALVE AND LOSS OF ENGINE.

(B) DEGRADATION OF INTERFACE FUNCTION - LOSS OF ONE ENGINE.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ORBITAL MANEUVER

FMEA NO 03-3 -4510 -1

REV:12/04/87

(C) POSSIBLE EARLY MISSION TERMINATION. REDLINE ADDITIONAL PROPELLANT FOR RCS BACKUP DEORBIT. NEXT PLS DEORBIT IF SUFFICIENT PROPELLANT NOT AVAILABLE.

(D) NO EFFECT - CRITICALITY 1 FOR ABORT - ONE ENGINE CANNOT DEplete PROPELLANT WITHIN TIME REQUIRED. REDUCED FLOWRATE DURING DUMP COULD CAUSE LANDING WEIGHT, C. G. PROBLEMS.

(E) FUNCTIONAL CRITICALITY EFFECT POSSIBLE LOSS OF CREW/VEHICLE, LOSS OF GN2 PRESSURANT THROUGH THE FEED LINE WOULD RESULT IN INABILITY TO ACTUATE THE BI-PROP VALVES WITH RESULTANT INABILITY TO DEORBIT ASSUMING FAILURE OF OTHER OMS ENGINE AND INADEQUATE PROPELLANT FOR RCS DE-ORBIT.

DISPOSITION & RATIONALE:

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

(A) DESIGN

THE FACTOR OF SAFETY FOR LINES IS 4.0 X MAXIMUM OPERATING PRESSURE (SYSTEM RELIEF). THE FACTOR OF SAFETY FOR VALVE BODIES IS 1.5 OR GREATER. REDUNDANT ENGINES ARE PROVIDED EITHER OF WHICH IS ADEQUATE FOR DE-ORBIT. FASTENING CLAMPS ALLOW FREEDOM OF MOVEMENT. TUBING BENDS ARE CONTROLLED BETWEEN FIXED POINTS TO FACILITATE INSTALLATION AND ACCOMMODATE VEHICLE GROWTH AND MOVEMENT.

(B) TEST

QUALIFICATION TESTS

ROCKWELL PERFORMED TUBING CERTIFICATION TESTS PER "ORBITER TUBING VERIFICATION PLAN" (SD 75-SH-0205). THIS TESTING INCLUDED PRESSURE CYCLING AND FATIGUE FOR TYPICAL SHUTTLE LINES AND JOINTS. QUALIFICATION TESTS INCLUDED THERMAL CYCLES (-23 TO +150 DEG F) AND VIBRATION TESTING AT ENGINE LEVEL. ALSO QUALIFIED AS PART OF ENGINE ASSEMBLY - 138 FIRINGS AT ENGINE LEVEL; 498 ENGINE FIRINGS AT POD LEVEL AT WSTF.

ACCEPTANCE TESTS

EXAMINATION OF PRODUCT, WELD EVALUATION. LEAKAGE TESTS ARE PERFORMED IN PROCESS FOR TUBING SECTIONS. OPTICAL INSPECTIONS ARE PERFORMED IN ADDITION TO X-RAY AND DYE PENETRANT. LEAKAGE TESTS ARE ALSO PERFORMED AFTER INSTALLATION INTO THE SYSTEM AND WELDS ARE SUBJECTED TO NDE.

GROUND TURNAROUND

V43CBO.210 PERFORMS FIRST FLIGHT LEAK TEST.
V43CBO.280 PERFORMS PRESSURE DECAY OF GN2 SYSTEM EACH FLIGHT.
V43CBO.213 PERFORMS MECHANICAL JOINT LEAKAGE EVERY 5TH FLIGHT.
V43CBO.275 PERFORMS PRESSURE DECAY TEST DOWNSTREAM OF ENGINE VALVE EVERY 5TH FLIGHT.
V43CFO.030 PERFORMS PNEUMATIC SYSTEM GN2 SERVICING EVERY FLIGHT.
SOOPJO.040 PERFORMS POST ACTUATION PNEUMATIC LEAK/ FUNCTIONAL TEST

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ORBITAL MANEUVER FMEA NO 03-3 -4510 -1 REV:12/04/87

EVERY FLIGHT.

GN2 TANK AND ACCUMULATOR PRESSURE ARE MONITORED EACH FLIGHT FOR INDICATIONS OF LEAKAGE.

(C) INSPECTION

RECEIVING INSPECTION

MATERIALS AND PROCESSES CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS TO LEVEL 200 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 DURING FABRICATION IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

PENETRANT AND RADIOGRAPHIC INSPECTION OF WELDS ARE VERIFIED BY 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

CAR AC3348 RECORDS GN2 LEAKAGE (STS-4) AT GN2 TANK PRESSURE TRANSDUCER SEAL. REFERENCE CAR AC3348. INSTALLATION PROCEDURE WAS MODIFIED TO INSURE PROPER BOSS-FLANGE GAP AND INSTALLATION TORQUE. GAPS AND TORQUES VERIFIED FOR TRANSDUCERS ON ALL ENGINES.

CAR AB6278 RECORDS AN OCCURRENCE OF LEAKAGE ON THE GN2 FILL LINE (PN1186070) FITTING. THIS WAS CAUSED BY SCRATCHES ON THE DYNATUBE SEALING SURFACES RESULTING FROM INSTALLATION DAMAGE (ASSOCIATED WITH SPECIAL REPAIR (RETROFIT) OPERATIONS). ONLY REMEDIAL ACTION WAS TAKEN SINCE FAILURE WAS CONSIDERED AN ISOLATED OCCURRENCE.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ORBITAL MANEUVER

FMEA NO 03-3 -4510 -1

REV:12/04/87

(E) OPERATIONAL USE

FAILURE MAY BE DIFFICULT TO DIAGNOSE. FOR LEAKAGE UPSTREAM OF CHECK VALVE SAVE REMAINING ENGINE START FOR DEORBIT BURN. IF ACCUMULATOR PRESSURE LOST COMPLETE MISSION REQUIREMENTS. USING CROSSFEED FOR PROPELLANT UTILIZATION. REDLINE ADDITIONAL PROPELLANT FOR RCS BACKUP DEORBIT. NEXT PLS DEORBIT IF PROPELLANT FOR RCS BACKUP NOT AVAILABLE. POSSIBLE MISSION IMPACT. DECREASED PROPELLANT AVAILABLE FROM OMS TO RCS THROUGH INTERCONNECT FOR ON-ORBIT OPERATION.