

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : PURGE, VENT & DRAIN FMEA NO 01-5 -385001-1 REV:09/24/87

ASSEMBLY : ET/ORB DISCNCT PURGE SYS  
 F/N RI : V070-385020/070/030  
 F/N VENDOR:  
 QUANTITY : 2  
 : TWO RUNS

	VEHICLE	102	103	104	
EFFECTIVITY:	-X	X	X		
PHASE(S):	PL	X	LO	X	OO DO LS

PREPARED BY: DES F A FERRIS REL J S MULLEN  
 REDUNDANCY SCREEN: A-N/A B-N/A C-N/A  
 APPROVED BY: DESBY *[Signature]* APPROVED BY (NASA):  
 REL *[Signature]* SSM *[Signature]*  
 QE *[Signature]* REL *[Signature]*  
 QE *[Signature]*

ITEM:  
 PURGE MEDIA DISTRIBUTION

FUNCTION:  
 THE DISTRIBUTION SYSTEM, CONSISTING OF AN UMBILICAL DISCONNECT, TUBING, A MANIFOLD, AN ORIFICE & FLEX HOSES, PLUMBS THE PURGE MEDIA (GHE FOR LH2 SIDE - GN2 FOR LO2 SIDE) FROM T-O UMBILICAL PANELS TO THE FRANGIBLE NUT CANISTERS, DISCONNECT PLATE AND ELECTRICAL FEED THRU CAVITIES.

FAILURE MODE:  
 GROSS LEAKAGE/CLOGGED ORIFICE.

CAUSE(S):  
 TUBING/FLEX HOSE/MANIFOLD/DISCONNECT RUPTURE, CONTAMINATION.

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

(A) LOSS OF FUNCTION. LOSS OF PURGE AND POSITIVE PRESSURE IN PLATE GAP CAVITY MAY LEAD TO CRYO-PUMPING AND FORMATION OF LIQUID AIR/OXYGEN AND/OR ICE.

(B) NONE.

(C, D) POSSIBLE LOSS OF CREW/VEHICLE PRELAUNCH DUE TO EXPLOSIVE EFFECT OF RELEASING UNDILUTED GH2 FROM A DISCONNECT LEAK INTO THE ATMOSPHERE OR FORMATION OF AN EXPLOSIVE LIQUID AIR/HYDROGEN GAS ENVIRONMENT INTERNAL TO THE LH2 DISCONNECT. ALSO, POSSIBLE FORMATION OF ICE INTERNAL TO BOTH THE LH2 AND LO2 DISCONNECT FRANGIBLE NUT CANISTERS WHICH COULD PRECLUDE ET SEPARATION AND RESULT IN LOSS OF CREW/VEHICLE.

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

(A) DESIGN  
 THE SYSTEM USES DYNATUBE FLUID FITTINGS CAPABLE OF HIGH PRESSURE LOADING AND BRAZED JOINTS INSTEAD OF MECHANICAL FITTINGS WHERE POSSIBLE. THE STAINLESS STEEL TUBING IS CAPABLE OF 3000 PSID OPERATION AND THE MAXIMUM OPERATING PRESSURE IS 750 PSIG WHICH YIELDS A FACTOR OF SAFETY (F.O.S.)

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OF 4. THE MANIFOLD AND FLEX HOSE OPERATING PRESSURE IS 28 PSIG WHICH RESULTS IN A F.O.S. OF 64 FOR THE MANIFOLD AND A F.O.S OF 100 FOR THE FLEX HOSE. THE F.O.S. IS 25 BY ANALYSIS FOR THE ULTIMATE HOOP STRESS OF 5510 PSI FOR THE TUBING. THE F.O.S. IS 19 BY ANALYSIS FOR THE ULTIMATE DESIGN SHOCK LOAD OF 7204 PSI FOR THE TUBING. THE SYSTEM SONIC ORIFICES ARE 0.0960 AND 0.0747 INCH IN DIAMETER AND THE GROUND PURGE FLOWS THROUGH A 25 MICRON GSE FILTER.

(B) TEST

THE ET/ORBITER PURGE SYSTEM TUBING IS CERTIFIED BY SIMILARITY TO THE WINDOW CAVITY CONDITIONING AND DRAIN SYSTEMS. THE WCC AND DRAIN SYSTEM TUBING WAS SUBJECTED TO THE EQUIVALENT OF 400 MISSION EXPOSURE OF RANDOM VIBRATION AT A MORE SEVERE LEVEL THAN THE ET/ORB SYSTEM DESIGN REQUIREMENT (ACCELERATION SPECTRAL DENSITY OF 3.0 G SQ/HZ TESTED VS. 0.5 G SQ/HZ REQUIRED). PRIOR TO THE FIRST FLIGHT, THE FOLLOWING TESTS WERE PERFORMED FOR THE PORTION OF THE SYSTEM UPSTREAM OF THE MANIFOLD - FLOW VERIFICATION AT 100 PSIG, PROOF PRESSURE AT 1125 PSIG AND A LEAK TEST AT 750 PSIG. PRIOR TO THE FIRST FLIGHT, THE FOLLOWING SYSTEM TESTS WERE PERFORMED (WITH THE MANIFOLD AND DOWNSTREAM HARDWARE INSTALLED) - FLOW VERIFICATION AT 100 PSIG, PROOF PRESSURE AT 250 PSIG AND A LEAK TEST AT 200 PSIG. DURING EACH TURNAROUND, THE SYSTEM UNDERGOES LEAKAGE AND FLOW VERIFICATION TESTS WITH THE FRANGIBLE NUT CANISTERS, ET/ORBITER PLATES, ELECTRICAL FEED-THROUGH CONNECTED PER THE OMRSD. AFTER THE ORBITER IS MATED TO THE ET, A TEST IS RUN TO INCREASE THE PURGE FLOW RATE TO ACHIEVE A SET PRESSURE IN THE PLATE GAP CAVITY PER FILE II OF THE OMRSD. THE ET/ORB DISCONNECT PURGE SYSTEM IS CERTIFIED UNDER CR14-385070-001.

(C) INSPECTION

RECEIVING INSPECTION

MATERIAL AND PROCESS CERTIFICATION OF HARDWARE AND RAW MATERIAL VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CORROSION PROTECTION PROVISIONS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

INSPECTION VERIFIES TUBE ALIGNMENT AND INSTALLATION OF SEALS AND FLUID FITTINGS WITH THREADED FASTENERS IN ACCORDANCE WITH THREAD LUBRICANT TORQUING AND LOCKWIRE REQUIREMENTS.

NONDESTRUCTIVE EVALUATION

RADIOGRAPHIC INSPECTION OF BRAZED TUBE JOINTS.

CRITICAL PROCESSES

TUBE BRAZING PROCESS VERIFIED BY INSPECTION.

HANDLING AND PACKAGING

PACKAGING AND PROTECTION REQUIREMENTS ARE VERIFIED BY INSPECTION. TESTING - LEAK AND FUNCTIONAL TESTS ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

NO FAILURES WERE EXPERIENCED AT NSTL OR DURING SEPARATION SYSTEM TESTS. ONE FLEX HOSE ON OV-102 WAS VISUALLY DISCOVERED TO BE FAILED (LEAKAGE).

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THE CAUSE OF THE FAILURE WAS DETERMINED BY FRACTOGRAPHIC EVIDENCE TO BE LOW CYCLE, HIGH STRESS FATIGUE. A FAILURE DUE TO MISSION VIBRATION OR FUNCTIONAL ENVIRONMENT EXPOSURE WOULD HAVE RESULTED IN HIGH CYCLE, LOW STRESS FATIGUE. THE OV-102 FAILURE WAS DISCOVERED AFTER THE EXTENSIVE AA MOD AND WAS DETERMINED TO BE A RESULT OF GROUND MISHANDLING. THE FLEX HOSE IS LOCATED IN A HIGH TRAFFIC AREA OF THE AFT FUSELAGE. FLEX HOSES ON OV-102 AND ALL OTHER VEHICLES WERE X-RAYED FOR SIMILAR FAILURES AND NO EVIDENCE OF FATIGUE WAS FOUND. THE FAILURE WOULD HAVE BEEN IDENTIFIED DURING PRESSURE DECAY AND FLOW VERIFICATION TESTS IF IT HAD NOT BEEN DETECTED VISUALLY. THE FLEX HOSE IS EXAMINED DURING THE OMRSD V30 ZONAL INSPECTION.

(E) OPERATIONAL USE

NO CORRECTIVE ACTION IS POSSIBLE.