SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :FWD - REACTION CONTROL FMEA NO 03-2F -101010-1 REV:12/03/8

ASSEMBLY :PRESSURIZATION
P/N RI :MC282-0082-0031/-0032
P/N VENDOR:BLD-S09040-1/-2
QUANTITY :2
:ONE REQ'D PER EACH
:PROPELLANT TANK

CRIT. FUNC: 1
CRIT. HDW: 1

VEHICLE EFFECTIVITY:	102	103	10
	X	X	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	J. LAZARUS	DES	SSM
REL	R P DIEHL	REL	REL
QE	W J SMITH	QE	QE

ITEM:
TANK HELIUM STORAGE, FILAMENT WOUND (TK101,TK102).

FUNCTION:
TO STORE HELIUM AT A MAX WORKING PRESSURE OF 4000 PSI FOR PRESSURIZATION OF THE FWD RCS MODULE'S PROPELLANT SUPPLY SYSTEM. TANK CONSISTS OF DOUBLE MELT TI LINER WITH DUPONT KEVLAR 49 FIBER AND EPOXY RESIN BONDING OVERWRAP. O.D. IS 18.71 IN. VOLUME IS 3008 CU. IN.

FAILURE MODE:
RUPTURE, EXTERNAL LEAK RUPTURE - LARGE CRACK WHICH PROPAGATES AROUND TANK IMMEDIATELY. LEAKAGE - FRACTURE WHICH DOES NOT PROPAGATE TO RUPTURE.

CAUSE(S):
MAT'L DEF, LINER DEF, FAULTY FAB, EPOXY CURE INADEQ, TEST/HANDL DAM, SHOCK, VIB, INADVER OVERPRESS (GND), STRESS CORROSION.

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

(A) LOSS OF FUNCTION/SUBSYSTEM

(B) LOSS OF INTERFACE FUNCTION - INABILITY TO DEPLETE/UTILIZE PROP, POSSIBLE DAMAGE TO POD STRUCTURE, TPS AND PROPELLANT LINES.

(C) POTENTIAL LOSS OF MISSION-EARLY MISSION TERMINATION DECISION DEPENDENT ON EXTENT OF DAMAGE.

(D) POSSIBLE LOSS OF CREW VEHICLE IF RATE OF LEAK EXCEEDS POD VENT CAPABILITY CAUSING DAMAGE TO POD STRUCT & THERMAL PROTECTION SYSTEM.

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

(A) DESIGN
FILAMENT WOUND TANKS ARE DESIGNED TO LEAK BEFORE RUPTURE WHICH LIMITS FAILURE PROPAGATION DUE TO SHRAPNEL.

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KEVLAR 49 FIBER HAS A TENSILE STRENGTH OF 500 KSI ALLOWING LIGHT WEIGHT WITH GREAT STRENGTH. INCREASED STRAIN CAPABILITY IS PROVIDED BY THE COMPRESSIVE LOAD ON A UNPRESSURIZED LINER.

VENT DOORS ARE OPEN ON ORBIT AND WILL RELIEVE ANY PRESSURE BUILD-UP DUE TO LEAKAGE. THE F.S. (BURST) IS 1.5 X WORKING PRESS.

(B)TEST

TWO UNITS WERE USED IN THE QUALIFICATION TEST PROGRAM AND INCLUDED ATP, PRESSURE CYCLES (1000 CYCLES WHICH IS 4X ANTICIPATED OPERATING LIFE), LEAKAGE, PRESSURE HOLD (CREEP), DYNAMIC LOADING AT MAX OPERATING PRESSURE, RADIOGRAPHIC INSPECTION, BURST/RUPTURE PRESSURE.

THE ACCEPTANCE TESTING INCLUDED EXAMINATION OF PRODUCT, LEAKAGE/PROOF PRESSURE AND RADIOGRAPHIC INSPECTION.

OMRSD PERFORMS THE FOLLOWING: A PRESSURE DECAY TEST ON THE HIGH PRESSURE HELIUM SYSTEM FOR EACH FLIGHT. A FIRST FLIGHT EXTERNAL LEAK CHECK AND ALSO WHEN COMPONENTS ARE REMOVED AND REPLACED. HELIUM SYSTEM SERVICING TO FLIGHT LOAD FOR EACH FLIGHT. SUBSYSTEM INSPECTION THE FIFTH FLIGHT AND EVERY FIVE FLIGHTS THEREAFTER AND ON A CONTINGENCY BASIS. HELIUM SYSTEM ACTIVATION FOR EVERY FLIGHT. HELIUM QUALITY IS VERIFIED PER SE-S-0073. OBTAINS A HELIUM SAMPLE EVERY THIRD MISSION AND ON A CONTINGENCY BASIS.

(C)INSPECTION

RECEIVING INSPECTION
MATERIAL CERTIFICATION IS VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
CLEANLINESS TO LEVEL 100 IS VERIFIED BY INSPECTION

ASSEMBLY/INSTALLATION
MICRO-EXAMINATION AND CHEM-ETCH INSPECTION FOR ALPHA SEGREGATION IS VERIFIED BY INSPECTION. PRESSURIZATION CYCLE HISTORY LOG AND SCHEDULE IS VERIFIED BY INSPECTION. TESTING OF FORGINGS AND WELD SCHEDULES OF VESSELS IS VERIFIED BY INSPECTION. DRYNESS IS VERIFIED BY INSPECTION. PARTS PROTECTION, MANUFACTURING PROCESSES, FINISHES, ASSEMBLY AND INSTALLATION PER SHOP TRAVELER IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
SPECIAL NDE PENETRANT INSPECTION AND X-RAY INSPECTION OF LINER IS VERIFIED. X-RAY INSPECTION OF VESSEL IS VERIFIED. NDE (PENETRANT LEVEL 7) IS PERFORMED BEFORE AND AFTER VESSEL WELDING.

CRITICAL PROCESSES
WELDING, KEVLAR WRAPPING AND EPOXY CURE PROCESSES ARE VERIFIED BY INSPECTION.

TESTING
ATP IS WITNESSED AND VERIFIED BY INSPECTION.
MECHANICAL PROPERTIES AND CHEMICAL ANALYSIS FOR O2, N2 AND H2 CONTENT OF HEMISPHERES AFTER FINAL HEAT TREATMENT IS VERIFIED BY INSPECTION.

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HANDLING/PACKAGING
PACKAGING IS VERIFIED BY INSPECTION.

(D)FAILURE HISTORY
NO RCS FAILURES OF THIS TYPE.

CAR'S AB8282, A9902 (OMS), AC0968 (ARPCS) AND AB8397 (MPS):
TWO OMS TANKS OF THIS TYPE FAILED DURING THE PROOF SIZING OPERATIONS CONDUCTED EARLY IN THE PROGRAM. ONE ARPCS TANK FAILED IN A SIMILAR MANNER. TWO MPS TANKS WERE FOUND CRACKED DURING POST PROOF PRESSURE X-RAY. THE PROOF PRESSURE SIZING AND SUBSEQUENT X-RAY OPERATION IS US AS A SUCCESSFUL TOOL TO REJECT TANKS WITH DEFECTS THAT COULD PROPAGATE TO LEAKAGE WITHIN 1000 CYCLE USEFUL LIFE.

CAR'S A8669 AND A7806: (QUAL)
TWO ARPCS GN2 TANKS LEAKED DURING AND AFTER VIBRATION. INVESTIGATION SHOWED THAT FIXTURE LOADING CONDITIONS DURING VIBRATION TESTING CAUSED EXTREMELY SEVERE STRESS TO THE TANK MOUNTING STRUTS. EXAMINATION OF T FAILED TANKS SUPPORTED THIS CONCLUSION. CERTIFICATION WAS ACHIEVED WI ONE FULLY CERTIFIED TANK AND SIMILARITY TO OTHER CERTIFIED FILAMENT OVERWRAPPED VESSELS.

(E)OPERATIONAL USE
PERFORM MATED COAST RATE DAMPING WITH AFT RCS. IF LEAK RATE SUPPORTS, DUMP PROPELLANT IN LEAKING SYSTEM TO MAXIMIZE CAPABILITY. REDLINE ADDITIONAL PROPELLANT IN AFT RCS FOR TAIL ONLY ATTITUDE CONTROL.

POSSIBLE MISSION IMPACT - LOSS OF VERNIER RCS AND INCREASED AFT RCS PROPELLANT REQUIREMENTS MAY RESULT IN EARLY MISSION TERMINATION.