SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :AUXILIARY POWER (APUS) FMEA NO 04-2 -MD12 -13 REV:02/26/88

ASSEMBLY :FUEL SUPPLY
P/N RI :ME276-0030-0017
P/N VENDOR:J.C. CARTER P/N 60870-3
QUANTITY :3
:1 PER FUEL TANK
:

CRIT. FUNC: 1R
CRIT. HDW: 3

VEHICLE EFFECTIVITY:	102 X	103 X	104 X

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

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

PREPARED BY:		APPROVED BY:	APPROVED BY (NASA):
DES	J R MUNROE	DES	SSM
REL	T R BOLTZ	REL	REL
QE	W J SMITH	QE	

ITEM:
COUPLING, GN2 FILL.

FUNCTION:
(1) TO PROVIDE INTERFACE BETWEEN GROUND SERVICING EQUIPMENT AND FUEL TANK FOR GN2 FILL AND VENT OPERATIONS. (2) TO MAINTAIN PROPER SEAL AFTER SERVICING.

FAILURE MODE:
EXTERNAL LEAKAGE

CAUSE(S):
SEAL FAILURES, PIECE PART FAILURE, CORROSION, CONTAMINATION.

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

(A) LOSS OF REDUNDANT SEALS THEN POSSIBLE LOSS OF ONE APU SYSTEM BEFORE MISSION COMPLETION.

(B) LOSS OF REDUNDANT SEALS THEN POSSIBLE LOSS OF SHAFT POWER TO ONE HYDRAULIC PUMP.

(C) ABORT DECISION IS REQUIRED, IF FAILURE OCCURS PRIOR TO ENTRY COMMITMENT.

(D) POSSIBLE LOSS CREW/VEHICLE IF BOTH CAP AND POPPET SEALS FAIL, AND (1) THE LEAKING GN2 CONTAINS HYDRAZINE FROM A DIAPHRAGM FAILURE OR (2) THE LEAKING SEALS CAUSE TOTAL LOSS OF GN2 PRESSURE (LOSS OF APU) AND A SECOND APU IS LOST.

(E) FUNCTIONAL CRITICALITY EFFECT - POSSIBLE LOSS CREW/VEHICLE IF BOTH CAP AND POPPET SEALS FAIL, AND (1) THE LEAKING GN2 CONTAINS HYDRAZINE FROM A DIAPHRAGM FAILURE OR (2) THE LEAKING SEALS CAUSE TOTAL LOSS OF GN2 PRESSURE (LOSS OF APU) AND A SECOND APU IS LOST. QD CAP SEALS ARE NOT CAPABLE OF CHECKOUT BECAUSE NO TEST PORT OR EQUIPMENT IS PROVIDED. NOT DETECTABLE INFLIGHT BECAUSE NO MEASUREMENT BETWEEN POPPET AND CAP SEALS EXISTS.

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

(A) DESIGN
THE COUPLING IS BASICALLY THE SAME DESIGN AS USED ON APOLLO CSM AND LE RCS FUEL AND OXIDIZER SYSTEMS, EXCEPT THE BODY THICKNESS IN THE TIG WE AREA HAS BEEN INCREASED 50% MORE ON THE SHUTTLE COUPLING ON THE END TH CONNECTS TO GROUND HALF. THE BODY MATERIAL AND END FITTING ARE 17-4 P WITH DYNATUBE MALE FITTING FOR ORBITER TUBING CONNECTION.

THE DISCONNECT IS CAPPED DURING FLIGHT AND HAS DUAL POPPET TEFZEL SEAL AS WELL AS TWO CONCENTRIC INDEPENDENT SEALING RIDGES ON THE TEFZEL CAP SEAL. THE DYNATUBE FITTING HAS DUAL SEALING SURFACES AND IS MADE OF 1 PH CRES HEAT TREATED TO 145 KSI TENSILE MINIMUM.

THE FLIGHT HALF QD AND CAP ARE A MATCHED SET. ANY VIOLATION OF THIS WOULD RAISE THE CRITICALITY TO 1/1. (SERVICE PANEL SEALS WILL RELIEVE.

(B) TEST
THE COUPLING WAS TESTED TO BURST OF 2,100 PSIG (F.S. = 6) DURING CERTIFICATION FOR APOLLO RCS USE. SIMILAR COUPLINGS HAVE BEEN TESTED 295 DEG F, 270 PSIG, AND VIBRATED AT 0.7 G2/HZ.

DYNATUBES WERE QUALIFIED BY RESISTOFLEX FOR 200,000 IMPULSE CYCLES UP T 4,500 PSIG AT 400 DEG F TO -65 DEG F, 12,000 PSI BURST PLUS SINE VIBRA AT +/- 0.41 G TO +/- 10 G FOR 3 HR (20 MIN SWEEPS FROM 5 TO 2,000 CPS).

540 PSIG PROOF AND GN2 LEAKAGE TESTS ARE PERFORMED AT COUPLING SUPPLIER WITH CAPS ON AND OFF. THE PROOF AND GN2 LEAKAGE (AT OPEN POS) TESTS AR REPEATED AFTER INSTALLATION IN THE ORBITER APU SYSTEM. MAXIMUM ALLOWAB LEAKAGE OF 5 X 10-3 SCC/SEC APPLIES TO POPPET. THE DYNATUBES ARE ALIGN AND TORQUED TO MINIMUM 180 IN- LB PER MA0102-306.

OMRSD: POSTFLIGHT SYSTEM INSPECTION, FUEL TANK SERVICING AND QD CAP VISUAL CHECKS ARE PERFORMED EVERY FLOW.

(C) INSPECTION

RECEIVING INSPECTION
MATERIAL AND PROCESSES CERTIFICATIONS ARE VERIFIED.

CONTAMINATION CONTROL
CLEANLINESS TO LEVEL 100 IS VERIFIED BY INSPECTION. PARTS PASSIVATION AND OTHER CORROSION PROTECTION REQUIREMENTS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
MANUFACTURING, ASSEMBLY, AND INSTALLATION REQUIREMENTS ARE VERIFIED BY INSPECTION. DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION

NONDESTRUCTIVE EVALUATION
LEAK TEST IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES
TIG WELDING AND HEAT TREATING ARE VERIFIED BY INSPECTION.

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

HANDLING/PACKAGING
HANDLING, PACKAGING, STORAGE, AND SHIPPING PROCEDURES ARE VERIFIED.

(D) FAILURE HISTORY
SEVEN, LEAKAGE FAILURES DOCUMENTED IN CAR AC1697, ON THIS AND FUEL COUPLINGS (3 CASES OF POPPET/CAP LEAKS - STS 3, 4, 5, FLIGHT LEAKAGE AND 4 CASES OF POPPET LEAKAGE). DR/CAR's AC1697, AC3298, AC4175, AC9478, AD0686, 03F017, AND 04F009.

CORRECTIVE ACTION IS TO PROVIDE SAMPLING AT THE GSE/VEHICLE INTERFACE FOR THE FIRST THREE FLIGHTS TO ASSURE THAT THE GSE FILTERS ARE INTACT AND NO CONTAMINATION IS BEING INTRODUCED INTO THE SYSTEM.

ALSO, THE GSE FILTERS ARE BEING CHANGED TO REMOVABLE ELEMENT INSTEAD OF FIXED ELEMENT FILTERS TO FACILITATE BETTER CLEANING AND DRYING OF THE GSE ASSEMBLY.

NO VEHICLE/MISSION THREATENING LEAKS HAVE BEEN EXPERIENCED.

(E) OPERATIONAL USE
IF LEAKAGE IS DETECTED BY THE GROUND CREW, THE WORST CASE (FUEL LEAKAGE) IS ASSUMED AND THE CREW HAS OPTION TO RUN APU TO DEPLETION.