PRINT DATE: 07/07/98

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER: 03-2A-201070 -X

SUBSYSTEM NAME: AFT REACTION CONTROL SYSTEM (RCS)
REVISION: 1 03/03/98

PART DATA

	PART NAME **VENDOR NAME**	**PART NUMBER** **VENDOR NUMBER**
	: PRESSURIZATION	
LRU	: DISCONNECT, QUICK FILL	MC276-0017-0402 75372000-0402
LRU	: DISCONNECT, QUICK FILL	MC276-0017-0403 75372000-0403
LRU	: DISCONNECT, QUICK FILL	MC276-0017-1412 75372000-0402
LRU	: DISCONNECT, QUICK FILL	MC276-0017-1413 75372000-0403

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
DISCONNECT, QUICK, FILL, HE (MD219, 220, 319, 320) (1/4") WITH SPRING LOADED POPPET AND STRUCTURAL END CAP.

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 4
1 PER PROPELLANT,
2 PER POD

FUNCTION:
PROVIDE HELIUM TANK FILL AND VENT POINT FOR GROUND SERVICING OPERATIONS AND LOADING. COUPLING IS ACCESSIBLE AT THE HELIUM SERVICING PANEL.

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NUMBER: 03-2A-201070- 01

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SUBSYSTEM NAME: AFT REACTION CONTROL SYSTEM (RCS)

LRU: DISCONNECT, QUICK FILL

ITEM NAME: DISCONNECT, QUICK FILL

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:

EXTERNAL LEAKAGE, POPPET FAILS OPEN, CAP LEAKS IN EXCESS OF ACCEPTABLE RATES

MISSION PHASE:

PL	PRE-LAUNCH
LO	LIFT-OFF
OO	ON-ORBIT
DO	DE-ORBIT
LS	LANDING/SAFING

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102	COLUMBIA
103	DISCOVERY
104	ATLANTIS
105	ENDEAVOUR

CAUSE:

SEALS DAMAGED OR DETERIORATED, CONTAMINATION, VIBRATION, MECHANICAL SHOCK, PIECE-PART STRUCTURAL FAILURE, IMPROPER USE, INADEQUATE MAINTENANCE OF GSE HALF, INADEQUATE LINE SUPPORT, SHAFT OR BORE BENT, OVERPRESSURE OF PANEL, EXCESS TORQUE

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

A) FAIL
B) FAIL
C) PASS

PASS/FAIL RATIONALE:

A)
CANNOT CHECK REDUNDANT SEALS WHEN CAP IS INSTALLED.

B)
REQUIRES BOTH SEALS TO LEAK ON-ORBIT BEFORE FAILURE IS DETECTABLE.

C)

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- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF REDUNDANT SEAL, LOSS OF SUB-SYSTEM PRESSURIZATION.

(B) INTERFACING SUBSYSTEM(S):
NO EFFECT

(C) MISSION:
NO EFFECT

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT

(E) FUNCTIONAL CRITICALITY EFFECTS:
POTENTIAL CREW/VEHICLE LOSS IF PROPELLANT CAN NOT BE UTILIZED OR DEPLETED DUE TO INABILITY TO REPRESSURIZE PROP TANKS AS A RESULT OF HELIUM LOSS. POSSIBLE DAMAGE TO POD STRUCTURE AND TPS IF CAP BLOWS OFF. 1R EFFECT ASSUMES LOSS OF ALL SEALS (POPPET AND CAP) BEFORE EFFECT IS MANIFESTED.

-DISPOSITION RATIONALE-

(A) DESIGN:
THE DESIGN SAFETY FACTORS ARE 1.5 FOR PROOF PRESSURE (DEMONSTRATED FOR EACH UNIT) AND 2.0 FOR BURST PRESSURE (BY ANALYSIS AND QUAL TEST). THREE SIZES (1/4", 1/2", 1") WERE CERTIFIED BY TEST.

A COMPLETE STRESS ANALYSIS WAS PERFORMED. GROUND HALF COUPLINGS AND LINES ARE SUPPORTED TO LIMIT ANY UNDUE STRESS ON THE COUPLING DURING SERVICE TO PREVENT DAMAGE TO SEALS AND WELD JOINTS. USE OF A CAP MINIMIZES THE LEAKAGE POTENTIAL BY PROVIDING A REDUNDANT SEAL.

THE DESIGN ALLOWS THE REPLACEMENT OF THE POPPET SEAL DURING MAINTENANCE PROCEDURES. A 10 MICRON FILTER IS INSTALLED IN THE GSE TO PREVENT FAILURES DUE TO CONTAMINATION.

(B) TEST:

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THE QUALIFICATION TEST PROGRAM INCLUDED THREE 1/4", THREE 1/2", AND TWO 1" UNITS. THE TESTING INCLUDED RANDOM VIBRATION (POPPET OPEN AND CAP ON), ENDURANCE (600 CYCLES COUPLED AND UNCOUPLED), THERMAL CYCLES (-30 TO +200 DEG F) FOR 1/2" AND 1" ONLY, BASIC AND BENCH HANDLING SHOCK FOR 1/2" AND 1", BENDING AND AXIAL LOADS (100 FT-LBS AND 100LBS) FOR 1/2" AND 1" ONLY, 2130 PSI BURST PRESSURE FOR 1/2" AND 1" ONLY, SURGE PRESSURE (190,000 CYCLES TO 1300 PSI) FOR 1/2" AND 1" ONLY, AND PROPELLANT COMPATIBILITY.

ACCEPTANCE TESTING INCLUDES EXAMINATION OF PRODUCT, 1420 PSIG GHE PROOF PRESSURE, LEAKAGE, OPERATION, CLEANLINESS AND TESTING OF THE CAP AS A SEPARATE ASSEMBLY.

THE UNIT ALSO QUALIFIED AS PART OF THE POD ASSY IN THE VIBRO-ACOUSTIC TEST AT JSC. THE HOT FIRE TESTING AT WSTF SUBJECTED THE UNIT TO 24 EQUIVALENT MISSION DUTY CYCLES AND APPROX 7 YEARS PROPELLANT EXPOSURE. THE ACCEPTANCE TEST INCLUDES PROOF PRESSURE, FUNCTIONAL TESTS, EXTERNAL LEAKAGE TESTS CONDUCTED BEFORE AND AFTER OPERATING CYCLES, AND CLEANLINESS AND DRYING. THE CAP IS TESTED AS AN ASSEMBLY.

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD. THE OMRSD DATA PROVIDED BELOW IS NO LONGER BEING KEPT UP-TO-DATE. IF THERE IS ANY DISCREPANCY BETWEEN THE GROUND TESTING DATA PROVIDED BELOW AND THE OMRSD, THE OMRSD IS THE MORE ACCURATE SOURCE OF THE DATA.

OMRSD PERFORMS THE FOLLOWING: LEAK CHECKS ON THE QD HIGH PRESSURE COUPLING EVERY FIVE MISSIONS AND WHENEVER THE COUPLING IS USED. PRESSURE DECAY CHECKS ON THE HIGH PRESSURE HELIUM SYSTEM FOR EACH FLIGHT. HELIUM SYSTEM ACTIVATION FOR EACH FLIGHT. HELIUM SERVICING TO FLIGHT LOAD EVERY FLIGHT. A LEAK CHECK OF THE CAP SEAL THE FIRST FLIGHT AND WHENEVER THE COUPLING IS USED DURING TURNAROUND. (EACH FLIGHT). AN EXTERNAL LEAKAGE VERIFICATION OF THE SYSTEM FOR THE FIRST FLIGHT AND ON A CONTINGENCY BASIS THEREAFTER. HELIUM SYSTEM SAMPLE EVERY THREE MISSIONS AND ON A CONTINGENCY BASIS. CANNOT CHECK REDUNDANT SEALS WHEN CAP IS ASSEMBLED.

(C) INSPECTION:
RECEIVING INSPECTION
TEST REPORTS AND MATERIAL CERTIFICATIONS CERTIFYING MATERIALS AND PHYSICAL PROPERTIES ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
CLEANLINESS LEVEL OF 100A IS VERIFIED BY INSPECTION. CORROSION PROTECTION IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
DISCONNECT IS VISUALLY INSPECTED FOR SURFACE DEFECTS. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. MANUFACTURING PROCESSES, INSTALLATION AND ASSEMBLY OPERATIONS ARE VERIFIED BY INSPECTION. SEALS ARE INSPECTED PER SNP 915. INSPECTION VERIFIES BRAYCOTE IS APPLIED TO THREADS, SEALS, AND SLIDING SURFACES.

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NONDESTRUCTIVE EVALUATION
PENETRANT INSPECTION OF BODY ASSEMBLY TIG WELD AND 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 1A, GRADE C, IS VERIFIED BY INSPECTION.

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

TESTING
ATP PER ATP75372002 IS WITNESSED AND VERIFIED BY INSPECTION. TEST EQUIPMENT AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION.

HANDLING/PACKAGING
PACKAGING, HANDLING, AND STORAGE ENVIRONMENT PROCEDURES ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:
CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE. THE FAILURE HISTORY DATA PROVIDED BELOW IS NO LONGER BEING KEPT UP-TO-DATE

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. 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.

CAR AB7343: (ATP) 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: (ATP)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.

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CAR AB5018: (KSC)CAP MALFUNCTION OCCURRED BECAUSE OF IMPROPER SPRING INSTALLATION. CORRECTIVE ACTION - REDESIGN MCR 6284R1. ALL CAPS HAVE BEEN RETRO-FITTED WITH THIS REDESIGN.

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.

(E) OPERATIONAL USE:
A CONTINGENCY PROCEDURE IS TO CLOSE THE HELIUM ISO VALVE FOR LARGE LEAKS RESULTING FROM DUAL SEAL FAILURE. AT THIS POINT FEED THE FAILED RCS SYSTEM FROM THE OTHER POD IN CROSSFEED. ENOUGH PROPELLANT MAY BE LEFT TO PROVIDE FOR A NORMAL ENTRY. DUMP TO MAX BLOWDOWN IF LEAKAGE RATE PERMITS.

IF FAILURE OCCURS PRIOR TO ET SEP, BLOWDOWN IS AVAILABLE FOR A NOMINAL ET SEP IF NO DISPERSIONS OCCUR. ENOUGH PROPELLANT WOULD BE REMAINING IN OTHER POD'S SYSTEM TO PERFORM NORMAL ENTRY. CROSS -FEED MAY BE USED FOR ET SEP IF TIME PERMITS.

- APPROVALS -

PAE MANAGER	: D. MIKULA	D.F. Mikula 08JUL98
PRODUCT ASSURANCE ENGR	: L. DANG	Carl Dang 08 July 98
DESIGN ENGINEERING	: E. VERA	David J Perry for Ed. Vera 7-7-98
BOEING SUBSYSTEM MANAGER	: D. PERRY	David J Perry 7-7-98
JSC MOD	: B. LUNNEY	Bruce Lunney 8-3-98