FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER:03-1-0145 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 3 07/25/00

PART DATA

	PART NAME / **VENDOR NAME**	**PART NUMBER** / **VENDOR NUMBER**
LRU	:HIGH PRESSURE GHE FILTER WINTEC	ME286-0056-0001 24228-626

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
FILTER (FL5), HIGH PRESSURE HELIUM, PNEUMATIC HELIUM SUPPLY SYSTEM (0.375 INCH DIA).

REFERENCE DESIGNATORS: FL5

QUANTITY OF LIKE ITEMS: 1

FUNCTION:
THE FILTER TRAPS CONTAMINATION THAT MAY BE PRESENT IN HELIUM FROM THE GROUND SUPPORT EQUIPMENT SUPPLY AND/OR THE PNEUMATIC HELIUM TANK PRIOR TO FLOW THROUGH THE ISOLATION SOLENOID VALVES (LV7,8) AND INTO THE PNEUMATIC SUPPLY DISTRIBUTION SYSTEM.

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REVISION#: 2 07/25/00

SUBSYSTEM NAME: MAIN PROPULSION
LRU: GHE FILTER
ITEM NAME: MPS PNEU GHE SUPPLY FILTER (FL5)

CRITICALITY OF THIS FAILURE MODE: 1/1

FAILURE MODE:
RUPTURE/LEAKAGE

MISSION PHASE:

PL	PRE-LAUNCH
LO	LIFT-OFF
DO	DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102	COLUMBIA
103	DISCOVERY
104	ATLANTIS
105	ENDEAVOUR

CAUSE:
MATERIAL DEFECT, FATIGUE, INTERFACE SEAL DAMAGE.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

A) N/A
B) N/A
C) N/A

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
DURING ASCENT, THE PNEUMATIC HELIUM SUPPLY WILL BE LOST. ESCAPING HELIUM MAY OVERPRESSURIZE THE AFT COMPARTMENT.

WHEN THE CROSSOVER VALVE (LV10) OPENS AT MECO, THE PNEUMATIC HELIUM DISTRIBUTION SYSTEM WILL BE FED FROM THE LEFT ENGINE HELIUM SUPPLY. WHEN THE

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ENGINE 1 AND 3 INTERCONNECT "OUT" VALVES OPEN AT MECO PLUS 20 SECONDS, THE ENGINE 1 AND 3 HELIUM SUPPLIES WILL LEAK THROUGH THE FAILED LINE.

STORED HELIUM PRESSURE IN THE ACCUMULATOR LEG AND SUPPLEMENTAL HELIUM FROM LV10 SHOULD BE ADEQUATE TO OPERATE THE LO2 PREVALVES AT MECO. LOSS OF HELIUM MAY PREVENT OPERATION OF VALVES FOR MPS DUMP.

PURGE OF AFT COMPARTMENT AND LH2/LO2 SYSTEMS WOULD DEPEND SOLELY ON THE LEFT ENGINE HELIUM SYSTEM RESIDUALS, RESULTING IN INADEQUATE ABORT PURGE, INCOMPLETE PROPELLANT DUMP, AND INGESTION OF CONTAMINATION.

DURING ENTRY, VENT DOORS ARE CLOSED TO PREVENT INGESTION OF RCS AND APU GASES. RUPTURE DURING THE TIME PERIOD THAT THE VENT DOORS ARE CLOSED MAY RESULT IN OVERPRESSURIZATION OF AFT COMPARTMENT. VENT DOORS ARE OPENED WHEN VEHICLE VELOCITY DROPS BELOW 2400 FT/SEC.

PRIOR TO LIFTOFF, EXCESSIVE HELIUM LEAKAGE MAY BE DETECTABLE USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

(B) INTERFACING SUBSYSTEM(S):
SAME AS A.

(C) MISSION:
ON GROUND, POSSIBLE LAUNCH SCRUB DUE TO LCC VIOLATION.

(D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:
NONE.

-DISPOSITION RATIONALE-

(A) DESIGN:
THE FILTER IS A 25 MICRON ABSOLUTE "OFF-THE-SHELF" ITEM. ITS ELEMENT IS OF ALL STAINLESS STEEL WELDED CONSTRUCTION. IT CONSISTS OF A PLEATED TWILLED DOUBLE DUTCH WIRE ELEMENT, A SUPPORT TUBE, AN END CAP, A FITTING AND TWO TEFLON O-RINGS.

THE MATERIALS USED IN THE DESIGN AND FABRICATION OF THE HELIUM FILTER ASSEMBLY ARE THE HEAD (304L), SUMP AND TWO TUBES (21-6-9 CRES). THERE HAS BEEN NO FAILURE HISTORY FOR THE MATERIALS USED IN ENVIRONMENTS SIMILAR TO THE REQUIREMENTS OUTLINED IN ME286-0056.

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THE FILTER HAS TWO POTENTIAL LEAK PATHS: THE TUBE/HEAD INTERFACE AND THE SUMP/HEAD INTERFACE. THE TUBES ARE THREADED INTO THE HEAD AND TORQUED TO 25 FT-LBS BEFORE BEING TIG WELDED TO THE HEAD. THE SUMP/HEAD INTERFACE IS DOUBLE SEALED. ITS PRIMARY SEAL IS A LEAD- COATED, A286 CRES K-SEAL. THE SECONDARY SEAL IS A TEFLON O-RING.

THE FILTER ASSEMBLY IS PROOF PRESSURE TESTED AT TWO TIMES ITS OPERATING PRESSURE DURING ATP AND CERTIFICATION TESTING. IT WAS BURST PRESSURE TESTED AT FOUR TIMES ITS OPERATING PRESSURE DURING CERTIFICATION TESTING.

(B) TEST:
ATP

EXAMINATION OF PRODUCT

BUBBLE POINT TEST (GREATER THAN 8.28 INCHES WATER)

PROOF PRESSURE TEST (9000 PSIG)

LEAKAGE (0 TO 4500 PSIG)

CLEANLINESS (100A)

CERTIFICATION

RANDOM VIBRATION (DRY AND UNPRESSURIZED)
14 MINUTES IN X AND Y AXIS, 20 TO 2000 HZ, 22.3 GRMS
34 MINUTES IN X AND Y AXIS, 20 TO 2000 HZ, 20.2 GRMS

TRANSIENT VIBRATION (DRY AND UNPRESSURIZED)
IN X AND Y AXIS, 5 TO 35 HZ +/- 0.25 G PEAK

FLOW CAPACITY (464 SCFM (0.08 LBS/SEC) GHE AT 970 PSIG, +70 DEG F)
CLEAN FLOW (20 PSID MAX)
2 GRAMS OF AC COARSE DUST (20 PSID MAX)

ELEMENT BUBBLE POINT TEST (GREATER THAN 8.28 INCH WATER)
PROOF PRESSURE TEST (9000 PSIG)

EXTERNAL LEAKAGE (4500 PSIG)
AMBIENT (+70 DEG F)
LOW TEMP (-160 TO -200 DEG F)
HIGH TEMP (+160 DEG F)

LEAKAGE/THERMAL (970 PSIG)
+100 TO +350 TO +150 DEG F (1X10-4 SCC/SEC MAX LEAK RATE DURING CYCLE) LEAKAGE CHECKED CONTINUOUSLY

ELEMENT PRESSURE

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PLUG FILTER ELEMENT WITH A SLURRY OF AC COARSE DUST
PRESSURIZED TO 1125 PSID
CLEAN ELEMENT
ELEMENT BUBBLE POINT TEST

LIFE AND ENVIRONMENT REQUIREMENTS DEMONSTRATED BY ANALYSIS

BURST PRESSURE TEST (18,200 PSIG)

GROUND TURNAROUND TEST
ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:
RECEIVING INSPECTION
INSPECTION OF ALL CRITICAL DIMENSIONS. INCOMING MATERIALS ARE VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION.

CONTAMINATION CONTROL
FILTERS ARE MAINTAINED TO CLEANLINESS LEVEL 100A. AFTER BUBBLE POINT TEST AND PRIOR TO PACKAGING, FILTERS ARE DRIED IN VACUUM OVEN.

ASSEMBLY/INSTALLATION
SURFACE FINISHES ARE VERIFIED ON FILTER COMPONENTS SUCH AS END CAP, FITTING, SUMP, AND TUBE. INSPECTION VERIFIES TORQUE APPLICATION TO SUMP IS IN ACCORDANCE WITH REQUIREMENT. LUBRICATION OF SUMP THREADS AND IDENTIFICATION MARKINGS ARE VERIFIED BY INSPECTION.

CRITICAL PROCESSES
PART PASSIVATION IS VERIFIED ON FILTER COMPONENTS SUCH AS TUBE, SUMP, END CAP AND FITTING BY INSPECTION. TIG WELDS OF END CAP TO THE ELEMENT ASSEMBLY ARE VERIFIED BY INSPECTION. FILTER MARKING PROCESS BY CHEM-ETCH IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
HELIUM LEAK DETECTION IS CONDUCTED TO DETECT ANY POSSIBLE LEAKAGE IN THE ASSEMBLY.

TESTING
ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING
EACH FILTER OR FILTER ELEMENT END ITEM AND ITS SUPPORTING DOCUMENTATION ARE VISUALLY CHECKED PRIOR TO SHIPMENT. FILTERS ARE FIRST PRE-PACKAGED TO ASSURE MAINTENANCE OF CLEANLINESS LEVEL. PACKAGING MATERIALS AND METHODS ARE UTILIZED IN ACCORDANCE WITH REQUIREMENTS.

(D) FAILURE HISTORY:
SEVERAL CASES OF EXTERNAL LEAKAGE WERE NOTED DURING CHECKOUT AT THE VENDOR (CAR'S A5560 AND A5561). A TEFLON COATED SEAL LEAKED DUE TO BODY

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INTERFERENCE DURING ASSEMBLY. THE TEFLON COATED SEAL WAS REPLACED WITH A GOLD PLATED, HARRISON K-SEAL.

DURING PROOF PRESSURE TESTING OF THE HELIUM PANEL AT DOWNEY, THE REQUIRED PRESSURE OF 4400 PSIG COULD NOT BE OBTAINED DUE TO EXTERNAL LEAKAGE OF THE FILTER (REFERENCE CAR AB8915). FAILURE ANALYSIS SHOWED THAT THE TEFLON "O" RING SEAL IN THE HEAD ASSEMBLY WAS SHEARED OFF. THE "O" RING GROOVE WAS 0.052 INCH UNDERSIZE ON THE DIAMETER CAUSING THE "O" RING TO PROTRUDE OUT OF THE GROOVE 0.026 INCH. WHEN THE SUMP WAS INSERTED INTO THE HEAD ASSEMBLY AND TIGHTENED, THE "O" RING WAS SHEARED. THE HEAD ASSEMBLY IS MACHINED BY AN OUTSIDE VENDOR. CORRECTIVE ACTION WAS TO INSTITUTE 100% DIMENSIONAL INSPECTION DURING RECEIVING.

CURRENT DATA ON TEST FAILURE, FLIGHT FAILURE, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATABASE.

(E) OPERATIONAL USE:
PNEUMATIC TANK, REGULATOR, AND ACCUMULATOR PRESSURE ARE ON S/M ALERT FDA SYSTEM AND THE BFS SYSTEM SUMMARY DISPLAY. THIS ALLOWS THE FLIGHT CREW TO RESPOND TO A PNEUMATIC HELIUM SYSTEM LEAK INDEPENDENT OF GROUND CONTROL.

- APPROVALS -

S&R ENGINEERING	: W.P. MUSTY	:/S/ W. P. MUSTY
S&R ENGINEERING ITM	: P. A. STENGER-NGUYEN	:/S/ P. A. STENGER-NGUYEN
DESIGN ENGINEERING	: CHARLES EBERHART	:/S/ CHARLES EBERHART
MPS SUBSYSTEM MGR.	: TIM REITH	:/S/ TIM REITH
MOD	: JEFF MUSLER	:/S/ JEFF MUSLER
USA SAM	: MIKE SNYDER	:/S/ MIKE SNYDER
USA ORBITER ELEMENT	: SUZANNE LITTLE	:/S/ SUZANNE LITTLE
NASA SR&QA	: BILL PRINCE	:/S/ BILL PRINCE