FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER: 02-6-E08 -X

SUBSYSTEM NAME: HYDRAULICS

REVISION: 1 07/24/98

PART DATA

	PART NAME / **VENDOR NAME**	**PART NUMBER** / **VENDOR NUMBER**
LRU	: FILTER MODULE PUROLATOR	MC621-0026

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
FILTER MODULE

REFERENCE DESIGNATORS: 50V58FL6
50V58FL7
50V58FL8

QUANTITY OF LIKE ITEMS: 3
ONE IN EACH HYDRAULIC POWER SYSTEM

FUNCTION:
PROVIDES FILTRATION CAPABILITY FOR THE HYDRAULIC POWER SUPPLY LINE, RETURN LINE AND MAIN PUMP CASE DRAIN. ALSO CONTAINS THE MAIN SYSTEM RELIEF VALVE AND PROVISIONS FOR MOUNTING THE SYSTEM SUPPLY PRESSURE TRANSDUCERS. INCORPORATES CHECK VALVE IN LINE WITH SERVICING DISCONNECT (02-6-E02) TO LIMIT FLUID LOSS AND ISOLATE SYSTEM PRESSURE DURING CONNECT/DISCONNECT PROCEDURE.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE
NUMBER: 02-6-E08-02

REVISION#: 1 07/24/98

SUBSYSTEM NAME: HYDRAULICS
LRU: FILTER MODULE
ITEM NAME: FILTER MODULE

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:
CLOGGED, SUPPLY LINE FILTER

MISSION PHASE: LO LIFT-OFF
DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:
102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:
EXCESSIVE ACCUMULATION OF CONTAMINANTS, COLLAPSED ELEMENT

CRITICALITY 1/1 DURING INTACT ABORT ONLY? YES
RTLS RETURN TO LAUNCH SITE

REDUNDANCY SCREEN
A) PASS
B) PASS
C) PASS

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF ONE HYDRAULIC POWER SYSTEM. LOW SYSTEM PRESSURE DUE TO HIGH RESTRICTION ACROSS FILTER CAUSES SWITCHING VALVES TO SWITCH.

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(B) INTERFACING SUBSYSTEM(S):
LOSS OF HYDRAULIC POWER FOR ENGINE VALVE CONTROL FOR ONE ENGINE RESULTING IN LOSS OF ONE SSME THRUST CONTROL. HOWEVER, ENGINE VALVES WILL LOCK IN POSITION AND ENGINE CONTINUES TO OPERATE. LOSS OF REDUNDANT HYDRAULIC POWER SYSTEM FOR FOUR TVC ACTUATORS. LOSS OF NOSE WHEEL STEERING AND HYDRAULIC LANDING GEAR DEPLOYMENT CAPABILITY IF SYSTEM ONE IS LOST. LOSS OF ONE OF THREE HYDRAULIC POWER SYSTEMS TO FLIGHT CONTROL SURFACES AND BRAKES. LOSS OF ONE OF THREE ET UMBILICAL RETRACT ACTUATORS FOR EACH UMBILICAL PLATE.

(C) MISSION:
ABORT DECISION OR POSSIBLE EARLY MISSION TERMINATION.

(D) CREW, VEHICLE, AND ELEMENT(S):
NONE

(E) FUNCTIONAL CRITICALITY EFFECTS:
POSSIBLE LOSS OF CREW/VEHICLE WITH TWO FAILURES: THIS FAILURE, PLUS LOSS OF SECOND HYDRAULIC SYSTEM. CRITICALITY 1 FOR SSME INDUCED RTLS.

-DISPOSITION RATIONALE-

(A) DESIGN:
ONE OF SUPPLIERS PROPRIETARY LINE OF FILTERS, DESIGNED IN ACCORDANCE WITH REQUIREMENTS OF MIL-F-8815 (GENERAL SPECIFICATION FOR FILTER AND FILTER ELEMENTS, FLUID PRESSURE, HYDRAULIC LINE). ELEMENT SIZED FOR 100 MISSIONS AT WORST CASE SYSTEM ALLOWABLE CONTAMINATION LEVEL. THE CYLINDRICAL CONVOLUTED 6 LAYER OUTER FILTER ELEMENT CONTAINS INNER AND OUTER STAINLESS STEEL SUPPORT SCREENS. THIS COMPOSITE ELEMENT IS MOUNTED ON THE OUTSIDE OF A PERFORATED WIRE-WOUND THIN WALL STAINLESS STEEL CYLINDER RESULTING IN A RIGID ASSEMBLY CAPABLE OF WITHSTANDING A DIFFERENTIAL PRESSURE, FROM OUTSIDE TO INSIDE, OF 1.5 TIMES THE NORMAL SYSTEM PRESSURE.

(B) TEST:
QUALIFICATION:
- ELEMENT COLLAPSE TEST - TESTED AT 275 DEG F, 4,500 PSID AND 6 GPM ACCORDING TO MIL-F-8815 PARAGRAPH 4.7.2.6

- FLOW FATIGUE TEST - 36,100 CYCLES AT VARIOUS PRESSURE DROPS AND 275 DEG F ELEMENTS LOADED WITH A-C FINE DUST PASS/FAIL CRITERIA: NO EVIDENCE OF DAMAGE.

ACCEPTANCE:
- EXAMINATION OF PRODUCT - WEIGHT, WORKMANSHIP FINISH, DIMENSIONS, AND CONSTRUCTION.
- CLEAN ELEMENT PRESSURE DROP TEST - TESTED AT 95 DEG F, SUPPLY AND RETURN ELEMENT 65 GPM AND CASE DRAIN 5 GPM. PASS/FAIL CRITERIA: SUPPLY ELEMENT 37 PSID MAXIMUM, RETURN ELEMENT 15 PSID MAXIMUM, CASE DRAIN 3.5 PSID MAXIMUM.
- PERFORMANCE RECORD TEST.
    - DIFFERENTIAL PRESSURE INDICATOR TEST - 60 PSIG TO 80 PSIG TO 0 PSIG. EACH SECTION BLOCKED. PASS/FAIL CRITERIA. INDICATOR SHALL NOT ACTUATE AT LESS THAN 60 PSIG, INDICATOR SHALL ACTUATE FULLY AND LOCK AT 80 PSIG AND INDICATOR SHALL REMAIN IN ACTUATED POSITION AT 0 PSIG.
    - CRACKING PRESSURE TEST - INCREASE INLET PRESSURE IN FREE FLOW DIRECTION TO 2 CC/MIN OR GREATER. PASS/FAIL CRITERIA: VALVE SHALL OPEN AT NOT LESS THAN 2 PSIG AND NO GREATER THAN 8 PSIG.
- MODULE PRESSURE DROP TEST - 0 DEG F, 3,150 PSIG SUPPLY WITH 46 PSID, 1,500 PSIG RETURN WITH 15 PSID. PASS/FAIL CRITERIA: FLOW RATE SHALL BE 4 GPM MINIMUM.
- RATED FLOW TEST - 105 DEG F, 3,150 PSIG SUPPLY WITH 65 GPM, 1,500 PSIG RETURN WITH 65 GPM AND 1,500 PSIG CASE DRAIN WITH 5 GPM. PASS/FAIL CRITERIA: PRESSURE DROP SHALL NOT EXCEED 81 PSID SUPPLY, 33 PSID RETURN, AND 32 PSID CASE DRAIN.
- CLEANLINESS TEST - LEVEL 190 PER MA0110-301.

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

(C) INSPECTION:
RECEIVING INSPECTION
RECEIVING/SHIPPING INSPECTION VERIFIES MATERIAL CERTIFICATIONS. MATERIAL IS VERIFIED BY PHYSICAL-CHEMICAL RECORDS AT RECEIVING INSPECTION.

CONTAMINATION CONTROL
CLEANLINESS AND CONTAMINATION LEVELS ARE VERIFIED BY INSPECTION (LEVEL 190 PER MAO110-301).

ASSEMBLY/INSTALLATION
MANUFACTURING/ASSEMBLY PROCESSES ARE VERIFIED BY INSPECTION.

CRITICAL PROCESSES
HEAT TREATING AND DRY FILM LUBE (VITROLUBE) ARE VERIFIED BY INSPECTION

TESTING

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FLOW, DIFFERENTIAL AND PRESSURE DROP TEST PARAMETERS ARE VERIFIED BY INSPECTION

HANDLING/PACKAGING
HANDLING AND PACKAGING REQUIREMENTS 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

(AB4388-010) (1981) ON SYSTEM NUMBER 3, ON THE FCHL TEST ARTICLE ALL FILTER MODULES WERE FOUND TO CONTAIN A PURPLISH BLACK SUBSTANCE WHICH ALSO COATED THE UPSTREAM SIDE OF THE FILTER ELEMENTS. IN ALL CASES THE DELTA P INDICATORS WERE EXTENDED INDICATING HIGH DELTA P. IT WAS OBSERVED THAT THE BYPASS VALVES PERFORMED AS REQUIRED. IT WAS DETERMINED THAT THE CAUSE WAS EXCESSIVE FREON TF ENTERING THE SYSTEM DURING GENERAL CLEANUP OF THE SYSTEM EQUIPMENT. THE COMBINATION OF EXCESSIVE FREON, WATER, AND ELEVATED HYDRAULIC TEMPERATURES LED TO A CHEMICAL REACTION WHICH CREATED THE SOLID PRODUCT OBSERVED. USE OF FREON TF HAS BEEN DISCONTINUED FOR USE AS A CLEANUP MATERIAL.

(E) OPERATIONAL USE:
TAKE MAIN PUMP TO LOW PRESSURE TO ALLOW SWITCHING VALVES TO CYCLE IF NECESSARY.

- APPROVALS -

EDITORIALLY APPROVED	: BNA	: J. Kimura 7-30-98
TECHNICAL APPROVAL	: VIA APPROVAL FORM	: 95-CIL-009_02-6