

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 02-6-E06 -X**

SUBSYSTEM NAME: HYDRAULICS

REVISION: 1 07/24/98

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	.PUMP, APU DRIVEN MAIN HYD ABEX	MC281-0029

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
PUMP, APU DRIVEN MAIN HYDRAULIC**

REFERENCE DESIGNATORS: 50V58PP4
50V58PP5
50V58PP6

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

FUNCTION:
PROVIDE HYDRAULIC POWER FOR HYDRAULIC SUBSYSTEM WITH PROVISION FOR
ELECTRICAL DEPRESSURIZATION.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 02-6-E06-05

REVISION#: 1 07/24/98

SUBSYSTEM NAME: HYDRAULICS

LRU: PUMP, APU DRIVEN MAIN HYD

ITEM NAME: PUMP, APU DRIVEN MAIN HYD

CRITICALITY OF THIS FAILURE MODE: 1/1

FAILURE MODE:

EXCESSIVE SUSTAINED OUTPUT

MISSION PHASE: LC LIFT-OFF

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

CAUSE:

COMPENSATING PISTON OR STROKING PISTON JAMMED, HANGER BEARING FAILURE, CONTAMINATION

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:

SYSTEM PRESSURE MAINTAINED AT MAIN RELIEF VALVE PRESSURE SUSTAINED HIGH PRESSURE INCREASE WILL INPUT HEAT TO HYDRAULIC SYSTEM AND ENGINES.

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HIGH SYSTEM PRESSURE WILL RESULT IN LOSS OF CONTROL OF ENGINE PROPELLANT CONTROL VALVE ACTUATORS DUE TO SPOOL/SLEEVE BINDING. ENGINE CANNOT RESPOND TO SHUTDOWN COMMAND. VALVES COULD FREE FLOAT. BINDING OF SHUTTLE VALVE SPOOL COULD PREVENT ADMITTING PNEUMATIC PRESSURE TO THE CLOSING PISTON IN EACH VALVE, PREVENTING PNEUMATIC SHUTDOWN CAPABILITY. POTENTIAL FOR UNCONTAINED ENGINE DAMAGE.

(C) MISSION:

POSSIBLE LOSS OF CREW/VEHICLE IF CATASTROPHIC FUEL MIXTURE IS REACHED (FAILURE IS DETECTABLE BY CREW OR GROUND BY EXCESSIVE HYDRAULIC PRESSURE AND/OR HIGH RESERVOIR FLUID TEMPERATURE.)

(D) CREW, VEHICLE, AND ELEMENT(S):

SAME AS (C).

-DISPOSITION RATIONALE-

(A) DESIGN:

ROTATING GROUP INCLUDING BEARINGS, DRIVE SHAFT, HANGER, COMPENSATOR SPOOL AND SLEEVE SIMILAR TO F-14 PUMP. DESIGN LIFE IS 750 HOURS. BEARINGS APPLIED LOADS ARE SMALL PERCENTAGE OF RATINGS. DRIVE SHAFT FAILS WITHIN 3.5 PERCENT OF DESIGN TORQUE. THE COMPENSATOR VALVE SLEEVE AND SPOOL ARE STEEL HARDENED AND LAPPED FOR MATCHED SET. THE DEPRESSURIZATION STROKING PISTONS ARE STEEL. SPRINGS ARE DESIGNED TO LOW STRESS. SOLENOID COIL IS HERMETICALLY SEALED.

(B) TEST:**QUALIFICATION:**

- ENDURANCE CYCLING TEST - 750 HOURS OF OPERATION AT VARYING FLOW RATES. 33% OF TEST AT 240 DEG F, 67% OF TEST AT 192 DEG F.
- OPERATING PROOF PRESSURE TEST - TESTED AT 240 DEG F, AT 125% RATED SPEED, 125% RATED DISCHARGE PRESSURE (AT NO FLOW), 10 CYCLES PER MINUTE FOR 5 MINUTES. PASS/FAIL CRITERIA: SHAFT SEAL LEAKAGE SHALL NOT EXCEED 5 CC/HR
- NON-OPERATING PROOF PRESSURE TEST - TESTED AT 275 DEG F, 160 PSIG TO INLET (CASE DRAIN AND OUTLET PORTS PLUGGED); 300 PSIG TO CASE DRAIN (OTHER PORTS OPEN); AND 4500 PSIG TO OUTLET (OTHER PORTS OPEN AND SHAFT RESTRAINED)/ PASS/FAIL CRITERIA: NO EXTERNAL LEAKAGE OR PERMANENT SET.

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- BURST TEST - TESTED AT 275 DEG F, 7,500 PSIG PRESSURE 320 PSIG RETURN AND 500 PSIG CASE DRAIN. PASS/FAIL CRITERIA: PUMP SHALL NOT RUPTURE.
- ENDURANCE CYCLING TEST (SOLENOID) - 50,000 ENERGIZE/DE-ENERGIZE CYCLES. TESTED AT 100 DEG F, 32 VDC, 3918 RPM PUMP SPEED, 66.3 GPM, AND 2950 PSIG OUTLET PRESSURE. PASS/FAIL/CRITERIA: SUBSEQUENT PASSAGE OF ELECTRICAL POWER TEST.

ACCEPTANCE:

- EXAMINATION OF PRODUCT - WEIGHT, WORKMANSHIP, FINISH, DIMENSIONS, AND CONSTRUCTION. PRESSURE, DEPRESSURIZED START, PRESSURIZATION.
- COIL PERFORMANCE TEST - COIL ENERGIZED AT 32 VDC FOR 1 HR. PASS/FAIL CRITERIA: OPERATING CURRENT SHALL NOT EXCEED 1.5 AMPS.
- ELECTRICAL POWER TEST - TESTED AT 100 DEG F, 3000 PSIG FOR ENERGIZING, 750 PSIG FOR DE-ENERGIZING, FOR 6 CYCLES AT VARYING VOLTAGES UP TO 32 VDC. PASS/FAIL CRITERIA: STEADY-STATE CURRENT SHALL NOT EXCEED 1.5 AMPS.
- BREAK-IN RUN TEST - TESTED AT 100 DEG F, 2950 PSIG PRESSURE, 55-75 PSIG RETURN FOR 18 HRS (3 HRS AT 30-75% OF RATED SPEED, 15 HRS AT 80-100% RATED SPEED, 3918 RPM, AND 66.3 GPM). PASS/FAIL CRITERIA: NO EVIDENCE OF MALFUNCTION.
- OPERATING PROOF AND OVERSPEED TEST - TESTED AT 240 DEG F, 300 PSIG TO CASE DRAIN, 220 PSIG RETURN, 4898 RPM, AND 3875 PSIG PRESSURE AT NO FLOW. LOAD CYCLE IS IMPOSED FROM 3875-3550 PSIG AT 85.4 GPM FOR 500 CYCLES. REPEATED FROM 3875-2000 PSIG FOR 500 CYCLES. PASS/FAIL CRITERIA: NO EXTERNAL LEAKAGE OR MALFUNCTION. SHAFT SEAL LEAKAGE SHALL NOT EXCEED 5 CC/HR.
- CALIBRATION TEST - TESTED AT 240 DEG F AT VARYING SPEEDS, FLOW RATES, AND DISCHARGE PRESSURES. PASS/FAIL CRITERIA: OVERALL EFFICIENCY SHALL BE GREATER THAN 85%.
- DEPRESSURIZED START TEST - DEPRESSURIZED START-UP TO VERIFY 500-1000 PSIG DISCHARGE PRESSURE AT RATED SPEED AND 0, 2, AND 5 GPM.
- PRESSURIZATION TEST - WITH PUMP RUNNING AT RATED SPEED AND NO FLOW IN DEPRESS MODE, PRESSURIZE PUMP TO OPERATING PRESSURE, THEN DEPRESSURIZE PUMP. PASS/FAIL CRITERIA: PRESSURIZATION/DEPRESSURIZATION RESPONSE TIME SHALL NOT EXCEED 1 SECOND.
- CLEANLINESS TEST - LEVEL 190 PER MA0110-301.

GROUND TURNAROUND TEST

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:**RECEIVING INSPECTION**

MATERIAL CERTIFICATION AND PROCESS CERTIFICATION ARE IMPOSED AND VERIFIED BY INSPECTION. BEARING-ROLLER, DATA PACKAGE REVIEWED. STROKING PISTON DATA PAK IS REVIEWED AND VISUAL EXAMINATION IS PERFORMED BY RECEIVING INSPECTION. SLEEVE-COMPENSATOR AND SPOOL COMPENSATOR DATA PAKS ARE REVIEWED AND A VISUAL INSPECTION IS PERFORMED BY RECEIVING INSPECTION. THE RATE SPRING AND COMPENSATOR SPRING DATA PAKS ARE REVIEWED AND A VISUAL INSPECTION IS PERFORMED BY RECEIVING INSPECTION.

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CONTAMINATION CONTROL
CLEANLINESS LEVEL OF 190 PER MAO110-301 IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES
HEAT TREATMENT PROCESS IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
MAGNETIC PARTICLE INSPECTION AND DYE PENETRANT PROCESS ARE PERFORMED
AND VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
HARDNESS CHECK OF EXTERNAL DRIVE SHAFT IS PERFORMED. PROCESSING
SEQUENCE OF EXTERNAL DRIVE SHAFT IS VERIFIED BY INSPECTION. INSPECTION OF
ALL FOUR PLACE DIMENSIONS. MACHINE FINISHES ARE VERIFIED BY INSPECTION. ALL
TRUE DIMENSIONS ARE VERIFIED BY INSPECTION. SOLENOID DATA PACKAGE IS
REVIEWED AND SOME DIMENSIONAL INSPECTIONS ARE PERFORMED.

TESTING
ATP IS VERIFIED BY INSPECTION

HANDLING/PACKAGING
HANDLING AND PACKAGING REQUIREMENTS 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.

(E) OPERATIONAL USE:
NONE

- APPROVALS -

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