FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 02-6-A16 -X

SUBSYSTEM NAME: HYDRAULICS

REVISION: 1 07/24/98

PART DATA

	PART NAME / **VENDOR NAME**	**PART NUMBER** / **VENDOR NUMBER**
LRU	: ACCUMULATOR, HYDRAULIC PARKER	MC621-0035

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
ACCUMULATOR, SSME, HYDRAULIC

REFERENCE DESIGNATORS: 50V58AU5
50V58AU7
50V58AU9

QUANTITY OF LIKE ITEMS: 3
ONE IN EACH POWER SYSTEM RETURN LINE AT SSME/HYDRAULIC INTERFACE

FUNCTION:
SUPPRESS HYDRAULIC TRANSIENT PRESSURES IN THE RETURN LINE FROM THE SSME PROPELLANT CONTROL VALVE TO A LEVEL COMPATIBLE WITH THE SSME SYSTEM REQUIREMENTS. ASSEMBLY INCLUDES A PRESSURE GAGE FOR GROUND OPERATIONS, A GAS FILL VALVE FOR CHARGING AND A GN2 PRESSURE TRANSDUCER FOR PRELAUNCH OPERATIONS. THE ACCUMULATOR IS PRESSURIZED TO LESS THAN 100 PSI IN THIS APPLICATION.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE
NUMBER: 02-6-A16-03

REVISION#: 1 07/24/98

SUBSYSTEM NAME: HYDRAULICS
LRU: ACCUMULATOR, HYDRAULIC
ITEM NAME: ACCUMULATOR, HYDRAULIC

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:
CYLINDER RUPTURE

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:
MATERIAL DEFECT, FATIGUE

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:

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 02-6-A16- 03

LOSS OF ONE OF THREE HYDRAULIC SYSTEMS. LOSS OF VEHICLE'S HYDRAULIC SYSTEM REDUNDANCY.

(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 REDUNDANT 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. HYDRAULIC FLUID ON TPS SCREED MAY CAUSE DEGRADED TPS BONDS

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

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

(E) FUNCTIONAL CRITICALITY EFFECTS:
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:
BURST FACTOR OF 4. MATERIAL IS 4130 STEEL, HEAT TREATED 150 TO 170 KSI. PROVIDES GOOD PHYSICAL PROPERTIES FOR HIGH ALLOWABLE STRESS. ALLOWABLE STRESS IS 190 KSI. THE ACTUAL CALCULATED CYLINDER HOOP STRESS (BURST 6,000 PSI) IS 90 KSI. THE MARGIN OF SAFETY IS 1.1. CYLINDER DESIGN AVOIDS STRESS RISERS AND SUDDEN CHANGES IN SECTION IN CRITICAL AREAS.

(B) TEST:
QUALIFICATION:

- OPERATIONAL LIFE CYCLING - WITH PRECHARGE AT 70 DEG F AND 45 PSIG, PERFORM 50,000 PRESSURE IMPULSE CYCLES FROM 50 PSIG MAXIMUM TO 1,000

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 02-6-A16- 03

MINIMUM. PASS/FAIL CRITERIA: NO EXTERNAL LEAKAGE AND SUBSEQUENT PASSAGE OF PERFORMANCE RECORD TEST.
- BURST TEST - 6,000 PSI AT 275 DEG F. PASS/FAIL CRITERIA: NO EVIDENCE OF EXTERNAL LEAKAGE OR RUPTURE.
- RUPTURE TEST - INCREASE TO 7,000 PSI.

ACCEPTANCE:
- EXAMINATION OF PRODUCT - WEIGHT, WORKMANSHIP, FINISH, DIMENSIONS, AND CONSTRUCTION.
- PROOF PRESSURE 3,000 PSI (CONTAINER). 2250 PSIG (PISTON). PASS/FAIL CRITERIA: NO LEAKAGE OR DEFORMATION.
- PERFORMANCE RECORD TEST:
  - OPERATIONAL TEST - 5 CYCLES FROM 10 PSIG MAXIMUM TO 50 PSIG MINIMUM FLUID PRESSURE WITH A 45 PSIG GN2 PRE CHARGE. THEN INTRODUCE 75 PSIG MAXIMUM FLUID PRESSURE AND VERIFY PISTON MOVES.
  - STATIC LEAKAGE TEST - 45 PSIG PRE CHARGE AT 70 DEG F AND 75 PSIG FLUID PRESSURE. PASS/FAIL CRITERIA: NO HYDRAULILC LEAKAGE (ONE DROP PER HOUR MAXIMUM AT VENT PORT). ZERO EXTERNAL GN2 LEAKAGE BY BUBBLE TEST IN A 5 MINUTE PERIOD (3 SCC PER HOUR MAXIMUM AT VENT PORT).
  - DYNAMIC LEAKAGE TEST - 0 TO 47 PSIG GN2 PRE CHARGE AND 55 PSIG MAXIMUM TO 75 PSIG MINIMUM FLUID PRESSURE. PASS/FAIL CRITERIA: GN2 - 6 SCC/20 CYCLES. HYDRAULICS - 2 DROPS/20 CYCLES.

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

(C) INSPECTION:
RECEIVING INSPECTION
RAW MATERIAL PURCHASES ARE MADE ONLY FROM MATERIAL APPROVED BY ROCKWELL. TEST REPORTS AND MATERIAL CERTIFICATIONS ARE MAINTAINED CERTIFYING MATERIAL AND PHYSICAL PROPERTIES.

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

CRITICAL PROCESSES
HEAT TREATMENT IS VERIFIED BY INSPECTION.

NDE
MAGNETIC PARTICLE INSPECTION IS PERFORMED AND RESULTS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
PARTS PROTECTION DURING FABRICATION OPERATION IS VERIFIED BY INSPECTION.
MANUFACTURING/ASSEMBLY PROCESSES ARE VERIFIED BY INSPECTION

TESTING

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 02-6-A16-03

PROOF PRESSURE TESTS ARE PERFORMED AS PART OF THE ACCEPTANCE TEST PROCEDURE AND ARE VERIFIED BY INSPECTION

HANDLING/PACKAGING
INSPECTION VERIFIES PACKAGING PRIOR TO SHIPMENT.

(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; RAPID LEAK RATE WOULD DEPLETE SYSTEM BEFORE ACTION COULD BE TAKEN.

- APPROVALS -

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