

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE  
NUMBER: 02-6-C05 -X**

**SUBSYSTEM NAME: HYDRAULICS**

**REVISION: 07/24/98**

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**PART DATA**

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<b>PART NAME</b>	<b>PART NUMBER</b>
<b>VENDOR NAME</b>	<b>VENDOR NUMBER</b>
LRU : ACTUATOR, UMBILICAL RETRACTOR PARKER BERTEA	MC287-0050

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
ACTUATOR, UMBILICAL RETRACTOR**

**REFERENCE DESIGNATORS:** 50V58AC11  
50V58AC12  
50V58AC13  
50V58AC14  
50V58AC15  
50V58AC16

**QUANTITY OF LIKE ITEMS: 6**  
THREE ACTUATORS ATTACHED TO EACH OF 2 UMBILICALS

**FUNCTION:**

THREE ACTUATORS CONNECTED TO EACH ORBITER UMBILICAL HALF PROVIDE MEANS FOR DAMPING OF COMPRESSIVE LOAD DURING RETRACTION OF THE PROPELLANT LINE VALVE CLUSTER INTO THE ORBITER IMMEDIATELY PRIOR TO ORBITER/EXTERNAL TANK SEPARATION. ACTUATOR ASSIST IN RETRACTION DURING FINAL PORTION OF STROKE. EACH ACTUATOR OF EACH UMBILICAL IS POWERED BY A DIFFERENT ONE OF THE THREE HYDRAULIC POWER SYSTEMS.

## FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

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SUBSYSTEM NAME: HYDRAULICS

LRU: ACTUATOR, UMBILICAL RETRACTOR

ITEM NAME: ACTUATOR, UMBILICAL RETRACTOR

CRITICALITY OF THIS

FAILURE MODE: 1R2

## FAILURE MODE:

CYLINDER RUPTURE

## MISSION PHASE:

LO LIFT-OFF

DO DE-ORBIT

## VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102 COLUMBIA

103 DISCOVERY

104 ATLANTIS

105 ENDEAVOUR

## CAUSE:

MATERIAL DEFECT

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

## REDUNDANCY SCREEN

A) PASS

B) PASS

C) PASS

## PASS/FAIL RATIONALE:

A)

B)

C)

## - FAILURE EFFECTS -

## (A) SUBSYSTEM:

LOSS OF ONE OF THREE HYDRAULIC SYSTEMS LOSS OF VEHICLE'S HYDRAULIC SYSTEM REDUNDANCY HYDRAULIC SYSTEM ONLY COMMUNICATES WITH ACTUATOR CYLINDER DURING RETRACTION LEAKAGE OF HYDRAULIC FLUID THROUGH RUPTURED CYLINDER COULD NOT OCCUR UNTIL RETRACTION IS INITIATED AT MECO. CYLINDER

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FAILURE WOULD HAVE TO DAMAGE BOTH ISOLATING SOLENOID AND CYLINDER UPON SOLENOID ACTIVATION TO LOSE A HYDRAULIC SYSTEM.

**(B) INTERFACING SUBSYSTEM(S):**

LOSS OF ONE OF THREE ET UMBILICAL RETRACT ACTUATORS FOR EACH UMBILICAL PLATE. LOSS OF NOSE WHEEL STEERING AND HYDRAULIC LANDING GEAR DEPLOYMENT CAPABILITY IF SYSTEM ONE IS LOST. LOSS OF ONE OF THREE HYDRAULIC POWER SYSTEM TO FLIGHT CONTROL SURFACES AND BRAKES. HYDRAULIC FLUID ON TPS SCREED MAY CAUSE DEGRADED TPS BONDS.

**(C) MISSION:**

NONE

**(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/LOSS OF SECOND UMBILICAL ACTUATOR/LOSS OF PYROTECHNIC BACKUP, IF FIRST FAILURE IS SYSTEM ONE.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

BURST FACTOR OF 2.5. CYLINDER IS 7075-T73 ALUMINUM WHICH PROVIDES GOOD PHYSICAL PROPERTIES FOR HIGH ALLOWABLE STRESS. ALLOWABLE STRESS IS 40,000 PSI AT 275 DEGREES F. ACTUAL CALCULATED CYLINDER HOOP STRESS (BURST) IS 39,084 PSI. THE MARGIN OF SAFETY IS 0.029. CYLINDER DESIGN AVOIDS STRESS RISERS AND SUDDEN CHANGES IN SECTION IN CRITICAL AREAS.

**(B) TEST:**

**QUALIFICATION:**

- ENDURANCE CYCLING - 1,500 FULL STROKE CYCLES, 1,000 AT 0 DEGREES F AND 500 AT 160 DEGREES F WITH SIMULATED LOADS AND VELOCITIES APPLIED. PASS/FAIL CRITERIA: PASSAGE OF SUBSEQUENT PERFORMANCE RECORD TEST

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- IMPULSE CYCLING, 50,000 CYCLES, 3,000-4,500-3,000 PSI AT SUPPLY PORT AND 750-1,500-750 PSI AT RETURN PORT. RATE OF 2.0 HZ. PASS/FAIL CRITERIA: PASSAGE OF SUBSEQUENT PERFORMANCE RECORD TEST
- PERFORMANCE RECORD TEST - INCLUDES APPLIED FORCE/ACTUATOR PISTON VELOCITY TEST, FREE FLOAT, RETRACT AND EXTEND
- BURST TEST - 7,500 PSI AT BOTH PORTS. AT 275 DEG F. PASS/FAIL CRITERIA: NO EVIDENCE OF EXTERNAL LEAKAGE OR RUPTURE
- RUPTURE TEST - INCREASE TO RUPTURE OR 125 PERCENT OF BURST PRESSURE (7,500 PSI)

**ACCEPTANCE:**

- EXAMINATION OF PRODUCT - WEIGHT, WORKMANSHIP FINISH, DIMENSIONS, AND CONSTRUCTION
- PROOF PRESSURE - 4,500 PSI FOR TWO MINUTES AT 275 DEG F AND REPEATED AT AMBIENT TEMPERATURE AT BOTH PORTS FOR TWO CYCLES EACH. PASS/FAIL CRITERIA: NO EXTERNAL LEAKAGE OR PERMANENT DEFORMATION.
- PERFORMANCE RECORD TEST - INCLUDES APPLIED FORCE/ACTUATOR PISTON VELOCITY TEST, FREE FLOAT, RETRACT AND EXTEND.

**GROUND TURNAROUND TEST**

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

**(C) INSPECTION:**

**RECEIVING INSPECTION**

RECORDS AND TEST REPORTS ARE MAINTAINED CERTIFYING MATERIAL AND PHYSICAL PROPERTIES (RAW MATERIAL, ANNEALING, AND ULTRASONIC INSPECTION).

**CONTAMINATION CONTROL**

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

**CRITICAL PROCESSES**

HEAT TREATMENT AND ANODIZATION PROCESSES ARE VERIFIED BY INSPECTION.

**NDE**

PENETRANT PROCESS IS VERIFIED BY INSPECTION.

**ASSEMBLY/INSTALLATION**

EXAMINATION TESTS PERFORMED TO VERIFY THAT ALL QUALITY ASSURANCE DOCUMENTATION IS COMPLETE, VISUALLY INSPECT ASSEMBLY TO ASSURE COMPLIANCE WITH 261600 DRAWING, AND VERIFY THAT NO OBVIOUS DEFECTS ARE EVIDENT. FINAL INSPECTION OF ALL DIMENSIONS IS PERFORMED. MANIFOLD BLANK IS INSPECTED TO LAYOUT PATTERN AND DRAWING. MANIFOLD IS NUMERICAL CONTROL MACHINE INSPECTED TO DRAWING PRIOR TO ANODIZE (THREADS ARE INSPECTED), CYLINDER HONED TO DETAILED INSTRUCTIONS ON OPERATIONS SHEETS AND VERIFIED BY INSPECTION. STRICT COMPLIANCE WITH MACHINING SPECIFICATION (BMF 5115) AND CORROSION CONTROL PLAN (BMF 5110) REQUIRED AND VERIFIED BY INSPECTION.

**TESTING**

ATP IS VERIFIED BY INSPECTION.

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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 WOULD DEplete HYDRAULIC SYSTEM BEFORE ACTION COULD BE TAKEN.

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- APPROVALS -

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EDITORIALLY APPROVED  
TECHNICAL APPROVAL

· BNA  
· VIA APPROVAL FORM

· J. Kumura T-30-95  
· 95-CIL-009\_02-6