

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 02-2B-A01-SW -X****SUBSYSTEM NAME: FLIGHT CONTROL - TVC ACTUATOR****REVISION: 2 07/18/94**

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: SSME TVC ACTUATOR	MC621-0015
SRU	: SWITCHING VALVE MOOG	A39300

**QUANTITY OF LIKE ITEMS: 6
ONE PER ACTUATOR****FUNCTION:**

AUTOMATICALLY PROVIDES POWER FROM EITHER OF TWO HYDRAULIC SYSTEMS. THE VALVE SENSES AN ACTIVE SYSTEM LOSS AND AUTOMATICALLY SWITCHES TO THE STANDBY SYSTEM. THE VALVE WILL RESET IF THE FAILED SYSTEM REGAINS ITS PROPER PRESSURE LEVEL. VALVE SPOOL POSITION IS PROVIDED.

FAILURE MODES EFFECTS ANALYSIS FMEA - CIL FAILURE MODE

NUMBER: 02-2B-A01-SW-04

REVISION#: 0 12/04/87

SUBSYSTEM NAME: FLIGHT CONTROL - TVC ACTUATOR

LRU: SSME TVC ACTUATOR

ITEM NAME: SWITCHING VALVE

CRITICALITY OF THIS

FAILURE MODE: 1R2

FAILURE MODE:

FAILS TO SWITCH TO STANDBY HYDRAULIC SYSTEM

MISSION PHASE: LO LIFT-OFF

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

CAUSE:

CONTAMINATION, JAMMED

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

- A) PASS
- B) N/A
- C) PASS

PASS/FAIL RATIONALE:

A)

B)

***B* SCREEN IS NOT APPLICABLE BECAUSE OF STANDBY REDUNDANCY.**

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF USE OF ONE STANDBY HYDRAULIC SYSTEM.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE
NUMBER: 02-2B-A01-SW-04**

(B) INTERFACING SUBSYSTEM(S):
NONE

(C) MISSION:
NONE

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

(E) FUNCTIONAL CRITICALITY EFFECTS:
FUNCTIONAL CRITICALITY EFFECTS - POSSIBLE LOSS OF MISSION, CREW/VEHICLE AFTER TWO FAILURES: LOSS OF ACTIVE HYDRAULIC SYSTEM AND FAILURE TO SWITCH TO STANDBY HYDRAULIC SYSTEM. ENGINE WILL LOCK IN LAST POSITION, RESULTING IN POSSIBLE ENGINE COLLISION. LOSS OF FUNCTION CAN RESULT IN LOSS OF VEHICLE CONTROL.

-DISPOSITION RATIONALE-

(A) DESIGN:
SPOOL AND SLEEVE ARE 440C MATERIAL, HARDENED AND LAPPED FOR A MATCHED SET. SPOOL IS GROOVED TO CLEAR SILTING. EACH HYDRAULIC SYSTEM HAS A 5 MICRON FILTER UPSTREAM OF ACTUATOR THAT PROTECTS THE SWITCHING VALVE FROM CONTAMINATION. FORCE DEVELOPED ON SWITCHING VALVE SPOOL IS IN EXCESS OF 500 POUNDS TO CLEAR CONTAMINATION.

(B) TEST:
QUALIFICATION: 20,000 SWITCHING CYCLES PERFORMED. ACTUATOR WAS VIBRATED TO FLIGHT LEVELS AND TESTED AT -65 AND 275 DEGREES F. 100,000 PRESSURE IMPULSE CYCLES AT EACH SUPPLY AND RETURN PORT, AT 230 DEGREES F. SUPPLY PORTS WERE CYCLED FROM 3,000 PSIG TO 4,500 PSIG TO 1,500 PSIG, BACK TO 3,000 PSIG EACH CYCLE; RETURN PORTS, FROM 750 PSIG TO 1,500 PSIG TO 0 PSIG, BACK TO 750 PSIG. VERIFIED THAT ALL PARTS WERE WITHIN ACCEPTABLE LIMITS DURING DISASSEMBLY AND INSPECTION AT COMPLETION OF QUALIFICATION.

ACCEPTANCE: FOUR SWITCHING VALVE CYCLES AT HIGH (MAIN PUMP) AND LOW (CIRCULATION PUMP) PRESSURES. PERFORMANCE TEST VERIFIES SWITCHING VALVE IS OPERATIONAL. FLUID FROM ACTUATOR IS VERIFIED TO MEET CLEANLINESS LEVEL 190 PER MA0110-301.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE

NUMBER: 02-2B-A01-SW-04

OMRSD: ACTUATOR SWITCHING VALVE CHECK, PERFORMED PRIOR TO EACH MISSION. HYDRAULIC FLUID SAMPLES ARE TAKEN AFTER EVERY FLIGHT AND VERIFIED TO BE WITHIN SPECIFIED CLEANLINESS LEVELS.

(C) INSPECTION:

RECEIVING INSPECTION

RAW MATERIAL CERTIFICATION ARE VERIFIED. SPECIAL MATERIAL REQUIREMENTS ARE IDENTIFIED IN CERTIFICATIONS.

NONDESTRUCTIVE EVALUATION

PIECE PARTS EVALUATED BY SELECTED PENETRANT, MAGNETIC PARTICLE, ULTRASONIC, AND RADIOGRAPHIC INSPECTIONS.

SPECIAL PROCESSES

CRITICAL/CLOSE TOLERANCE DIMENSIONS AND FINISHES ARE 100 PERCENT INSPECTED FOLLOWING MACHINING.

CONTAMINATION CONTROL

ASSEMBLY AREA CLEANLINESS IS VERIFIED BY CONTAMINATION CONTROL PLAN. COMPONENTS ARE PRECLEANED PRIOR TO ASSEMBLY. PARTS AND TOOLS/AIDS ARE CLEANED PRIOR TO ASSEMBLY. END ITEM FLUID SAMPLE IS VERIFIED PRIOR TO ACTUATOR DELIVERY.

TESTING

ROCKWELL DESIGN AND QUALITY PERSONNEL, WITH NASA PARTICIPATION, CONDUCT A DETAILED ACCEPTANCE REVIEW OF THE HARDWARE AT THE VENDOR'S FACILITY, PRIOR TO THE SHIPMENT OF EACH END ITEM COVERED BY CONTROL PLAN. ATP VERIFICATION IS MIP FOR RI QA REPRESENTATIVE.

(D) FAILURE HISTORY:

THERE IS NO HISTORY OF FAILURE FOR THIS FAILURE MODE.

(E) OPERATIONAL USE:

NONE

- APPROVALS -

EDITORIALLY APPROVED : FMEA/CIL COORDINATOR : *Stell*
 TECHNICAL APPROVAL : VIA APPROVAL FORM : 95-CIL-009_02-2B

ORIGINAL MODE DOCUMENT (REV 12/04/87) SIGNED BY

DESIGN ENGINEERING : N. LEVERT
 RELIABILITY ENGINEERING : C. NELSON
 QUALITY ENGINEERING : M. SAVALA
 NASA SUBSYSTEM MANAGER :

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE

NUMBER: 02-2B-A01-SW-04

NASA RELIABILITY :
NASA QUALITY ASSURANCE :