

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 02-2C-C01-SW-C -X

SUBSYSTEM NAME: FLIGHT CONTROL - ELEVON ACTUATOR

REVISION: 2

04/30/93

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	:ELEVON ACTUATOR	MC621-0014
SRU	:SWITCHING VALVE MOOG	A39490

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

QUANTITY OF LIKE ITEMS: 4
ONE PER ACTUATOR

FUNCTION:

AUTOMATICALLY PROVIDES POWER FROM ONE OF THREE HYDRAULIC SYSTEMS. THE VALVE SENSES AN ACTIVE SYSTEM LOSS AND AUTOMATICALLY SWITCHES TO A 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: 02-2C-C01-SW-C-03

REVISION#: 3 08/20/98

SUBSYSTEM NAME: FLIGHT CONTROL - ELEVON ACTUATOR

LRU: ELEVON ACTUATOR

ITEM NAME: SWITCHING VALVE

CRITICALITY OF THIS
FAILURE MODE: 1/1

FAILURE MODE:

EITHER SPOOL FAILS/JAMS IN INTERMEDIATE POSITION

MISSION PHASE:

LO	LIFT-OFF
DO	DE-ORBIT
LS	LANDING/SAFING

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) N/A
B) N/A
C) N/A

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF ELEVON ACTUATOR

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(B) INTERFACING SUBSYSTEM(S):
NONE

(C) MISSION:

POSSIBLE LOSS OF MISSION

PRE-LAUNCH - LAUNCH SCRUB IF FAILURE OCCURS PRIOR TO T-31 SECONDS. THE PROBLEM WOULD BE DISCOVERED DURING FLIGHT CONTROL AEROSURFACE PROFILE POSITION CHECK.

ASCENT - ELEVON MOVEMENT REQUIRED FOR WING LOAD RELIEF.

DESCENT - ELEVON MOVEMENT IS REQUIRED FOR PITCH/ROLL MOMENT MANEUVER FOR ENTRY APPROACH AND LANDING OPERATIONS.

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

LOSS OF CREW/VEHICLE IF ELEVON UNABLE TO RESPOND TO REQUIRED COMMANDS EITHER ON ASCENT OR ENTRY. PRELAUNCH CHECKOUT WILL ASCERTAIN CORRECT POSITION OF SWITCHING VALVES PRIOR TO LAUNCH. PRIOR TO DE-ORBIT, THE APU'S ARE STARTED SEQUENTIALLY, CAUSING THE SWITCHING VALVES TO CHANGE POSITION. IF A VALVE JAMS IN THE INTERMEDIATE POSITION, AN ELEVON ACTUATOR WOULD BE DISABLED.

(E) FUNCTIONAL CRITICALITY EFFECTS:

LOSS OF CREW/VEHICLE FOR FIRST FAILURE. NORMAL START UP SEQUENCE WILL CAUSE SWITCHING VALVES TO CHANGE POSITION. IF CONTAMINATION IS PRESENT, EITHER PRIMARY OR SECONDARY SPOOL CAN JAM IN AN INTERMEDIATE POSITION AND BLOCK SUPPLY OR RETURN PORTS. LOSS OF SUPPLY PRESSURE TO AND RETURN FROM AN ELEVON ACTUATOR CAN RESULT IN LOSS OF VEHICLE CONTROL ON ENTRY.

LOSS OF CREW/VEHICLE IF SWITCHING VALVE BLOCKS PRESSURE AND RETURN PORTS AFTER LOSS OF AN APU OR LOSS OF A HYDRAULIC SYSTEM (1R2).

-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.

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(B) TEST:

QUALIFICATION:

20,000 SWITCHING CYCLES PERFORMED ON THE ACTUATOR. ACTUATOR WAS VIBRATED TO FLIGHT LOADS. ACTUATOR WAS STABILIZED AT -65 DEG F FOR 3 HOURS AND THEN THE TEMPERATURE WAS ELEVATED TO THE OPERATING TEMPERATURE OF +60 DEG F AND FURTHER TESTING WAS CONDUCTED WITHIN THE OPERATING RANGE OF +60 DEG F TO +230 DEG F. 100,000 PRESSURE IMPULSE CYCLES AT EACH SUPPLY AND RETURN PORT, AT 225 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 QUALIFICATION.

ACCEPTANCE:

FOUR SWITCHING VALVE CYCLES AT HIGH (MAIN PUMP) AND LOW (CIRCULATION PUMP) PRESSURES. PERFORMANCE TESTS VERIFY THAT THE SWITCHING VALVE IS OPERATIONAL. FLUID FROM ACTUATOR IS VERIFIED TO MEET CLEANLINESS LEVEL 190 PER MA0110-301.

GROUND TURNAROUND TEST

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

RAW MATERIAL VERIFICATION 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.

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(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
TECHNICAL APPROVAL

: BNA
: VIA APPROVAL FORM

: J. Kemura 8-24-98
: 95-CIL-009_02-2C