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PRINT DATE: 08/11/94

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE
NUMBER: 02-2C-C01-SP-X

SUBSYSTEM NAME: FLIGHT CONTROL MECHANISM-ELEVON ACTUATOR
REVISION: 0 03/25/94

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: ELEVON ACTUATOR	MC-621-0014
SRU	: SEC DIFF PRESSURE TRANSDUCER MOOG INC.	A23171-1

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
SECONDARY DIFFERENTIAL PRESSURE TRANSDUCER

REFERENCE DESIGNATORS: 6558AC7
6558AC8
60V58AC9
60V58AC10

QUANTITY OF LIKE ITEMS: 16
4 TRANSDUCERS PER ACTUATOR

TYPICAL:

LEFT OUTBOARD --- 6558AC7
LEFT INBOARD --- 6558AC8

RIGHT OUTBOARD --- 60V58AC9
RIGHT INBOARD --- 60V58AC10

FUNCTION:

THE ELEVON ACTUATORS (4 EACH) PROVIDE FORCE & CONTROL FOR POSITIONING THE ELEVON SURFACES.

THE ELEVON ACTUATOR SECONDARY DIFFERENTIAL PRESSURE TRANSDUCERS SERVE TWO PURPOSES (1) FDI - AUTOBYPASS IF PRESSURE EXCEEDS 2025 PSID (TRIP LEVEL) AND (2) EQUALIZATION - BALANCES PRESSURE VARIANCES BETWEEN 4 CHANNELS. THESE SIGNALS PROVIDE A CLOSED LOOP OPERATION THROUGH INTERFACE WITH THE AVIONIC FLIGHT CONTROL SYSTEM.

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE
NUMBER: 02-2C-C01-SP-01

REVISION# 1 08/11/94

SUBSYSTEM NAME: FLIGHT CONTROL MECHANISM-ELEVON ACTUATOR
LRU: ELEVON ACTUATOR
ITEM NAME: SEC DIFF PRESSURE TRANSDUCER

CRITICALITY OF THIS
FAILURE MODE: 1R2

FAILURE MODE:

TRANSDUCER STUCK AT PRESSURE ABOVE EQUALIZATION DEADBAND AND BELOW TRIP (BYPASS) LEVEL.

MISSION PHASE:

LO LIFT-OFF
DO DE-ORBIT

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

CAUSE:

STRUCTURE FAILURE, PARTICLE CONTAMINATION, GALLING, CORE DEBONDING

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) PASS
B) FAIL
C) PASS

PASS/FAIL RATIONALE:

A)

B)

"S" SCREEN FAIL SINCE THIS FAILURE MODE CONDITION CONSISTS OF THE POSSIBILITY OF THE TRANSDUCER BECOMING STUCK AT A PRESSURE ABOVE EQUALIZATION DEADBAND AND BELOW TRIP (BYPASS) LEVEL. THIS RESULTS IN THE EQUALIZATION LOGIC DRIVING THE SECONDARY DELTA PRESSURE OUTPUT IN THE OPPOSITE DIRECTION. THE NEXT HARDOVER FAILURE IN THE SAME DIRECTION WILL CREATE A TWO ON TWO FORCE FIGHT AND LOSS OF ACTUATOR.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
NONE

(B) INTERFACING SUBSYSTEM(S):
THIS FAILURE MODE WILL PROVIDE ERRONEOUS OUTPUT TO THE AVIONICS SUBSYSTEM.

(C) MISSION:

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE
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FAILURE CAN RESULT IN MINIMUM DURATION FLIGHT (MDF)

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT FOR ONE FAILURE

(E) FUNCTIONAL CRITICALITY EFFECTS:
POSSIBLE LOSS OF CREW/VEHICLE AFTER SECOND UNDETECTED FAILURE. LOSS OF
FUNCTION CAN RESULT IN LOSS OF VEHICLE CONTROL.

-DISPOSITION RATIONALE-

(A) DESIGN:

THE TRANSDUCER PISTON IS MADE FROM 316 CRES, CHROME PLATED ON BEARING SURFACES TO PREVENT GALLING. HYDRAULIC FLUID ENTERING THE TRANSDUCER IS FILTERED BY A (5 MICRON) HYDRAULIC SYSTEM FILTER TO PREVENT STICTION, DUE TO PARTICLE CONTAMINATION. ALL PARTS ARE CLEANED PRIOR TO ASSEMBLY.

(B) TEST:

QUALIFICATION:

ENDURANCE CYCLING- 400 MISSION DUTY CYCLES UNDER LOAD AT MAXIMUM TEMPERATURE OF 250 DEGREES F. ACTUATOR WAS VIBRATED AT FLIGHT LEVELS AND TESTED AT -65 AND 250 DEGREES 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. PERFORMANCE RECORD TESTS CONDUCTED AT 35 AND 225 DEGREES F FOLLOWING ENDURANCE TESTING. VERIFIED THAT ALL PARTS WERE WITHIN ACCEPTABLE LIMITS DURING DISASSEMBLY AND INSPECTION AT COMPLETION OF QUALIFICATION.

ACCEPTANCE:

PERFORMANCE TESTS VERIFY DIFFERENTIAL PRESSURE TRANSDUCERS ARE OPERATIONAL.

GROUND TURNAROUND TEST

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION- RAW MATERIAL CERTIFICATIONS ARE VERIFIED. SPECIAL MATERIAL REQUIREMENTS ARE IDENTIFIED IN CERTIFICATIONS. END FITTING IS MANUFACTURED BY MOOG AND SUPPLIED TO TRANSDUCER VENDOR..

NONDESTRUCTIVE EVALUATION: NONE PERFORMED

CRITICAL PROCESSES-VENDOR'S SOLDERING AND TIG WELDING PROCESSES ARE CONTROLLED BY MOOG. ALSO CLEANING AND BONDING PROCESSES ARE CONTROLLED BY MOOG.

SPECIAL PROCESSES-TRANSDUCER VENDOR COIL DESIGN AND MANUFACTURING PLANNERS ARE CONTROLLED BY MOOG

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ASSEMBLY/INSTALLATION-SAFETY WIRING AND TORQUING OPERATIONS ARE PERFORMED AND VERIFIED BY MANDATORY INSPECTIONS. SPECIALLY DESIGNED ASSEMBLY TOOLS/FIXTURES ARE REQUIRED BY ASSEMBLY DOCUMENTATION. CRIMP CONNECTIONS OF TRANSDUCER LEADS TO ELECTRICAL CONNECTORS ARE PERFORMED BY SPECIALLY TRAINED/CERTIFIED TECHNICIANS.

TESTING- ATP WITNESSED BY ROCKWELL QUALITY AND DCAS. TRANSDUCER ATP PERFORMED AT COMPONENT LEVEL AND AT ACTUATOR LEVEL. 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.

(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 DATABASE.

(E) OPERATIONAL USE:

PER STANDARD FCS CHANNEL MANAGEMENT (FLIGHT RULE 8-52), FAILED AND UNBYPASSED PORTS WILL BE ISOLATED WITH CREW ACTION TO EITHER TURN OFF THE AFFECTED FCS CHANNEL OR MANUALLY BYPASS THE AFFECTED PORT.

- APPROVALS -

EDITORIALLY APPROVED : RI
EDITORIALLY APPROVED : JSC
TECHNICALLY APPROVAL : VIA CR

[Signature]
Malcolm C. Jackson 11-3-94
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