

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE  
NUMBER:05-1-FC6542 -X

SUBSYSTEM NAME: GUIDANCE, NAVIGATION, & CONTROL

REVISION: 0 04/11/94

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PART DATA

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	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	:ATVC HONEYWELL INC	MC621-0043-6541

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EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
ASCENT THRUST VECTOR CONTROLLER (ATVC), NO'S 1, 2, 3, 4

REFERENCE DESIGNATORS: 54V79A1  
55V79A2  
56V79A3  
56V79A21

QUANTITY OF LIKE ITEMS: 4  
FOUR

FUNCTION:  
PROVIDES ELECTRICAL OUTPUT DRIVE SIGNALS FOR ONE OF FOUR REDUNDANT CHANNELS OF THE SRB AND SSME TVC ACTUATORS. PROVIDES AUTONOMOUS MONITORING OF SECONDARY DELTA PRESSURE, EQUALIZATION, AND FAILURE ISOLATION COMMANDS FOR 10 TVC ACTUATORS.

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

NUMBER: 05-1-FC6542-01

REVISION#: 1 01/22/96

SUBSYSTEM NAME: GUIDANCE, NAVIGATION, &amp; CONTROL

LRU: ASCENT THRUST VECTOR CONT

ITEM NAME: ASCENT THRUST VECTOR CONT

CRITICALITY OF THIS

FAILURE MODE: 1R2

FAILURE MODE:  
LOSS OF OUTPUT

MISSION PHASE: LO LIFT-OFF

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

## CAUSE:

TEMPERATURE, MISHANDLING/ABUSE, VIBRATION, PIECE-PART FAILURE,  
CONTAMINATION, THERMAL SHOCK AND MECHANICAL SHOCK

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN	A) PASS
	B) FAIL
	C) PASS

## PASS/FAIL RATIONALE:

A)

B)

FAILS B SCREEN BECAUSE LOSS OF OUTPUT (NULL FAILURES) WILL NOT GENERATE  
SUFFICIENT PRESSURE TO USE THE FAULT DETECTION AND ISOLATION CAPABILITY.

C)

**- FAILURE EFFECTS -****(A) SUBSYSTEM:**

NO EFFECT FOR FIRST FAILURE, REMAINING 3 CHANNELS ARE UTILIZED.

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

NO EFFECT FOR FIRST FAILURE, LOSS OF ONE OF FOUR ATVC'S.

**(C) MISSION:**

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NO EFFECT FOR FIRST FAILURE.

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

NO EFFECT FOR FIRST FAILURE. VEHICLE LOSS AFTER A SECOND UNDETECTED FAILURE DUE TO A TWO ON TWO FORCE FIGHT CONDITION.

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

CRITICALITY 1R BECAUSE LOSS OF MPS AND SRB THRUST VECTOR CONTROL MAY CAUSE LOSS OF VEHICLE.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

ALL ELECTRICAL, ELECTRONIC, AND ELECTROMECHANICAL (EEE) PIECE PARTS WHICH MAKE UP THE ATVC ARE CONTROLLED TO THE ORBITER PROJECT PARTS LIST (OPPL) REQUIREMENTS OF MF0004-400. PASSIVE EEE PARTS AND ELECTRICAL CONNECTORS ARE MILITARY QUALIFIED AND 100% SCREENED TO OPPL REQUIREMENTS. MICROCIRCUITS ARE QUALIFIED TO MIL-M-38510 AND SCREENED TO MIL-S-883, LEVEL B. SEMICONDUCTOR DEVICES ARE JANTXV LEVEL. CIRCUIT DESIGN LIMITS WORST CASE JUNCTION TEMPERATURES TO 95°C AND ELECTRICAL STRESSES TO 50% OF RATED CAPABILITY FOR ALL PARTS. THE ATVC AS AN ASSEMBLY HAS A CERTIFIED LIFE OF 10,000 HOURS (100 MISSIONS) EQUIVALENT TO TEN YEARS.

THE ATVC IS DESIGNED AS A HERMETICALLY SEALED UNIT TO PREVENT OR ELIMINATE THE ENVIRONMENTAL EFFECTS OF RAIN, SAND, DUST, AS WELL AS MOISTURE. INTERNAL COMPONENTS ARE CONFORMAL COATED TO ELIMINATE THE ADVERSE EFFECTS OF MOISTURE, PRESSURE, AND/OR TEMPERATURE VARIATIONS IN ADDITION TO SHORT CIRCUIT PROTECTION. THE ATVC ALSO INCORPORATES A FAULT DETECTION CIRCUIT TO ISOLATED DRIVER OF FAILED CHANNEL, THEREBY ELIMINATING ITS EFFECT ON THE SYSTEM.

**(B) TEST:**

ACCEPTANCE TESTING, WHICH INCLUDES ACCEPTANCE THERMAL TESTING (ATT) AND ACCEPTANCE VIBRATION TESTING (AVT), IS PERFORMED ON EACH UNIT. QUALIFICATION TESTING, INCLUDING VIBRATION, SHOCK, TEMPERATURE, HAS BEEN SUCCESSFULLY COMPLETED TO CERTIFY DESIGN. INTEGRATED/SUBSYSTEM VERIFICATION IS PERFORMED DURING TURNAROUND. FUNCTIONAL TEST IS MONITORED TO VERIFY THAT OUTPUT OF ATVC IS WITHIN SPEC FOR CONTROLLING MPS AND SRB.

**(C) INSPECTION:**

RECEIVING INSPECTION  
INCOMING MATERIAL IS VERIFIED BY RECEIVING INSPECTION.

CONTAMINATION CONTROL  
FINAL ASSEMBLY AND REWORK PERFORMED IN A CLEAN ROOM.

ASSEMBLY/INSTALLATION

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QUALITY PLANNING ENSURES ALL DRAWING AND PROCUREMENT REQUIREMENTS ARE PUT INTO IN-PROCESS WORK TICKETS. ALL ASSEMBLY BENCHES ARE EQUIPPED WITH GROUNDING STRAPS AND BENCH COVERS. TORQUING VERIFICATION BY INSPECTION.

**NONDESTRUCTIVE EVALUATION**  
RADIOGRAPHIC ANALYSIS, ULTRASONIC TESTING, DYE PENETRANT AND MAGNETIC PARTICLE ANALYSIS VERIFIED BY INSPECTION.

**CRITICAL PROCESSES**  
POTTING, BONDING, FUSION WELDING, SOLDERING AND MATERIAL CLEANING VERIFIED BY INSPECTION.

**TESTING**  
ENVIRONMENTAL ACCEPTANCE TESTING IS OBSERVED AND VERIFIED BY QUALITY CONTROL.

**HANDLING/PACKAGING**  
THE PACKING AND PACKAGING REQUIREMENTS ARE SATISFIED BY USE OF SPECIAL QUALIFIED CONTAINERS FOR IN-PLANT TRANSPORTATION AND SHIPPING. RETURNED AND ACCEPTED GOODS ARE STORED IN A BONDED AREA.

**(D) FAILURE HISTORY:**  
AC2784 (FIELD) MAIN ENGINE 2 PITCH TVC CIRCUIT FAILED SPURIOUSLY. AN SRU LEVEL FAILURE ANALYSIS ISOLATED THE FAILURE TO AN LM108A COMPARATOR WHICH HAD AN ERRATIC OUTPUT. HONEYWELL FAILURE HISTORY SHOWED ONE OTHER FAILURE DUE TO AN LM108A COMPARATOR. THEY WERE CONSIDERED AN ISOLATED CASE AND THERE WAS NO CORRECTIVE ACTION.

AC3716 (FIELD) THE YAW ENGINE DID NOT EXHIBIT A NEGATIVE DRIVE OUTPUT. THE FAILURE WAS ISOLATED TO AN ITT DIODE WHICH WAS THEN REMOVED. ALTHOUGH THIS WAS THE SECOND ITT DIODE FAILURE OF THE SAME LOT DATE CODE, THEY INDICATED A RELATIVELY SMALL FAILURE RATE. THEREFORE NO CORRECTIVE ACTION OTHER THAN REPLACEMENT WAS TAKEN FOLLOWING THE PIND TESTING WHICH WAS IMPLEMENTED FOLLOWING THE FIRST DIODE FAILURE OCCURRENCE.

**(E) OPERATIONAL USE:**  
NONE

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**- APPROVALS -**

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EDITORIALLY APPROVED	: RI	: <u>Jim D. 1/25/96</u>
EDITORIALLY APPROVED	: JSC	: <u>John S. 2-1-96</u>
TECHNICAL APPROVAL	: APPROVAL FORM	: 95-CIL-004-RI