FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER:05-1-FC1042 -X

SUBSYSTEM NAME: GUIDANCE, NAVIGATION, & CONTROL
REVISION: 0 02/09/88

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
	:AFT FUSELAGE	
LRU	:RATE GYRO ASSEMBLY (RGA)	MC493-0015-0010
LRU	:RATE GYRO ASSEMBLY (RGA)	MC493-0015-0011

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
ORBITER RATE GYRO ASSEMBLY (RGA) RGA, NO'S. 1, 2, 3 AND 4.

REFERENCE DESIGNATORS: 50V79A12
50V79A13
40V79A14
40V79A40

QUANTITY OF LIKE ITEMS: 4
FOUR REQUIRED

FUNCTION:
PROVIDES ANALOG OUTPUTS PROPORTIONAL TO THE ANGULAR RATES ABOUT THE PITCH, ROLL AND YAW INPUT AXES, THREE TEST SIGNALS, SPIN MOTOR ROTATION DETECTOR (SMRD), TO INDICATE SYNC. SPEED OF SPIN MOTOR AND THREE STATUS SIGNALS TO INDICATE GYRO/ELECTRONICS INTEGRITY.

FAILURE MODES EFFECTS ANALYSIS FMEA – CIL FAILURE MODE
NUMBER: 05-1-FC1042-02

REVISION#: 1 01/22/96
SUBSYSTEM NAME: GUIDANCE, NAVIGATION, & CONTROL
LRU: RATE GYRO ASSEMBLY (RGA) CRITICALITY OF THIS
ITEM NAME: RATE GYRO ASSEMBLY (RGA) FAILURE MODE: 1R2

FAILURE MODE:
ERRONEOUS OUTPUT. THIS IS ONLY TRUE FOR SOFT FAILURES BELOW REDUNDANCY MANAGEMENT TRIP LEVEL.

MISSION PHASE: DO DE-ORBIT

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

CAUSE:
VIBRATION, TEMPERATURE, PIECE-PART FAILURE, MISHANDLING/ABUSE, 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 THE ERRONEOUS OUTPUT MAY BE BELOW THE REDUNDANCY MANAGEMENT TRIP LEVEL.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
NO EFFECT FOR FIRST FAILURE. REDUNDANCY MANAGEMENT (IMVS) ENABLES CONTINUED FLIGHT CONTROL OPERATION.

(B) INTERFACING SUBSYSTEM(S):
SAME AS (A)

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(C) MISSION:
NO EFFECT FOR FIRST FAILURE. POSSIBLE VEHICLE LOSS DUE TO LOSS OF CONTROL (EXCESS FUEL USAGE) ON SECOND FAILURE, DUE TO INABILITY OF SOFTWARE TO ISOLATE FAILURES DURING ENTRY/AERODYNAMIC FLIGHT. WORST CASE EFFECT IS TWO UNDETECTED FAILURES OF THE SAME POLARITY AND MAGNITUDE.

(D) CREW, VEHICLE, AND ELEMENT(S):
SAME AS (C)

(E) FUNCTIONAL CRITICALITY EFFECTS:
CRITICALITY 1R BECAUSE LOSS OF RATE FEEDBACK INFORMATION MAY CAUSE LOSS OF VEHICLE.

-DISPOSITION RATIONALE-

(A) DESIGN:
ALL ELECTRICAL, ELECTRONIC, AND ELECTROMECHANICAL (EEE) PIECE PARTS WHICH MAKE UP THE RGA, 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 GYROSCOPE WHICH IS A MAJOR PART OF THE RGA, WAS QUALIFIED AND CERTIFIED TO HAVE A DEMONSTRATED LIFE WITHOUT FAILURE OF 158,000 HOURS. THE RGA AS AN ASSEMBLY HAS A CERTIFIED LIFE OF 8,000 HOURS (100 MISSIONS) EQUIVALENT TO TEN YEARS.

THE RGA 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 RGA INCORPORATES A SPIN MOTOR ROTATION DETECTOR (SMRD) CIRCUIT, TO INDICATE PROPER SYNC SPEED OF THE GYROSCOPE SPIN MOTOR. CIRCUIT INTEGRITY DETERMINATION IS ALSO PROVIDED THROUGH EXTERNALLY APPLIED STIMULI AS A MEASUREMENT OF LOOP RESPONSE.

(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. INTEGRATED/SUBSYSTEM VERIFICATION IS PERFORMED DURING TURNAROUND. FUNCTIONAL TEST IS MONITORED TO VERIFY STATUS SIGNALS INDICATING GYRO/ELECTRONICS INTEGRITY.

(C) INSPECTION:
RECEIVING INSPECTION
PRINTED WIRING BOARD (PWB) EXAMINATIONS AT 7X BY SOURCE AND RECEIVING INSPECTION. INCOMING INSPECTION OF CASTING INCLUDES X-RAY EXAMINATIONS.

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QUALITY CONTROL INSPECTION OF PARTS IS CONDUCTED AT RECEIVING INSPECTION AND KITTING.

CONTAMINATION CONTROL
CLASS 100,000 LEVEL CLEAN ROOM AND IONIZED WORK STATIONS ARE MAINTAINED AND VERIFIED 100% BY INSPECTION.

NONDESTRUCTIVE EVALUATION
RADIOGRAPHS, TEST COUPONS, M&P CERTIFICATIONS NON-DESTRUCTIVE TEST (NDT) CERTIFICATIONS, AND CHEMICAL AND METALLURGICAL RECORDS ARE MAINTAINED. WELDING/BRAZING EQUIPMENT/MATERIAL CERTIFIED BY QUALITY ENGINEERING.

ASSEMBLY/INSTALLATION
IN-LINE INSPECTION OF SOLDERING AND CONFORMAL COATING IS PERFORMED. INSPECTION VERIFIES APPLICATION OF ADHESIVES. ATP IS OBSERVED AND VERIFIED BY RI AND NORTHROP QUALITY CONTROL, INCLUDING AVT, ATT, LEAK AND SHOCK TESTS. DIMENSIONAL CHECKS ARE VERIFIED AND RECORDED BY INSPECTION. TORQUE VERIFICATION BY INSPECTION.

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

CRITICAL PROCESSES
WAVE SOLDERING, WELDING, BRAZING AND CONTAMINATION CONTROLS ARE VERIFIED BY INSPECTION.

HANDLING/PACKAGING
THE USE OF PLASTIC AND PADDED PWB CONTAINERS, ALONG WITH TOTE BOXES AND ANTI-STATIC BAGS, IS VERIFIED BY INSPECTION. THE PACKING AND PACKAGING REQUIREMENTS ARE SATISFIED BY USE OF SPECIAL QUALIFIED CONTAINERS FOR IN-PLANT TRANSPORTATION AND SHIPPING.

(D) FAILURE HISTORY:
THERE HAVE BEEN NO ACCEPTANCE TEST, QUALIFICATION TEST, FIELD OR FLIGHT FAILURES ASSOCIATED WITH THIS FAILURE MODE.

(E) OPERATIONAL USE:
NONE

- APPROVALS -

EDITORIALLY APPROVED	: RI	: 1/24/96
EDITORIALLY APPROVED	: JSC	: 2-1-96
TECHNICAL APPROVAL	: APPROVAL FORM	: 95-CIL-004-RI