

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE
NUMBER: 05-5-B32-1 -X**

**SUBSYSTEM NAME: DATA PROCESSING SYSTEM (DPS)
REVISION: 8 04/09/96**

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
	: FLIGHT DECK	
LRU	: ROTATION HAND CONTROL (RHC)	MC621-0043-3047

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
SWITCH, BACKUP FLIGHT SYSTEM (BFS) ENGAGE, ROTATIONAL HAND CONTROLLER
(RHC), COMMANDER'S, PILOTS**

REFERENCE DESIGNATORS:

**QUANTITY OF LIKE ITEMS: 2
TWO**

**FUNCTION:
PROVIDES THE CAPABILITY FOR THE CREW TO ENGAGE BFS**

FAILURE MODES EFFECTS ANALYSIS FMEA - CIL FAILURE MODE

NUMBER: 05-5-B32-1-01

REVISION#: 8 04/09/96

SUBSYSTEM NAME: DATA PROCESSING SYSTEM (DPS)

LRU: ROTATION HAND CONTROL

CRITICALITY OF THIS

ITEM NAME: ROTATION HAND CONTROL

FAILURE MODE: 1R3

FAILURE MODE:

NO OUTPUT IN ONE OR MORE OF ITS 3 CHANNELS.

MISSION PHASE:

LO LIFT-OFF

DO DE-ORBIT

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

CAUSE:

PIECE PART ELECTRICAL/STRUCTURAL FAILURE, VIBRATION, MECHANICAL SHOCK, JAMMING, CONTAMINATION.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN	A) PASS
	B) FAIL
	C) PASS

PASS/FAIL RATIONALE:

A)

B)

FAILS SCREEN B BECAUSE SWITCH CHANNELS ARE NOT INSTRUMENTED, AND FAILURE CAN NOT BE DETECTED UNTIL BFS ENGAGE IS ATTEMPTED.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF BFS ENGAGE CAPABILITY FROM ONE OF TWO REDUNDANT FORWARD STATION RHC'S.

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(B) INTERFACING SUBSYSTEM(S):

LOSS OF BFS ENGAGE CAPABILITY FROM ONE OF TWO REDUNDANT FORWARD STATION RHC'S.

(C) MISSION:

NO EFFECT.

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

NO EFFECT FIRST FAILURE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

CRITICALITY 1R3 BECAUSE OF THE FOLLOWING REASON:

NO EFFECT FIRST FAILURE (LOSS OF ONE OR MORE CHANNELS OF ONE BFS SWITCH). NORMAL OPERATIONS CALL FOR CREW TO ENGAGE BOTH BFS SWITCHES SIMULTANEOUSLY, HENCE BFS WILL BE ENGAGED BY REDUNDANCY OF SWITCHES. SECOND FAILURE IS LOSS OF ONE OR MORE CHANNELS IN SECOND BFS SWITCH (BFS CAN NOT BE ENGAGE). THIRD FAILURE IS LOSS OF THE PRIMARY FLIGHT SYSTEM WHICH RESULTS IN LOSS OF VEHICLE/CREW.

-DISPOSITION RATIONALE-

(A) DESIGN:

ALL ELECTRICAL, ELECTRONIC, AND ELECTROMECHANIC (EEE) PIECE PARTS WHICH MAKE UP THE RHC ARE CONTROLLED TO THE ORBITER PROJECT PARTS LIST (OPPL) REQUIREMENTS OF MFD004-400. 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-STD-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 ELECTROMECHANICAL DESIGN HAS A CERTIFIED OPERATIONAL LIFE OF 23,500 HOURS. THE QUALIFIED CYCLIC LIFE FOR THE MAJOR AXES (ROLL, PITCH) IS CERTIFIED FOR 75,000 ACTUATIONS AND 50,000 ACTUATIONS FOR THE YAW AXIS. THE COMMUNICATION AND TRIM SWITCH DESIGNS HAVE A DEMONSTRATED AND CERTIFIED CYCLIC LIFE OF 10,000 ACTUATIONS PER EACH OPERATIONAL ENVELOPE. THE BFS ENGAGE SWITCH BY COMPARISON HAS A DEMONSTRATED AND CERTIFIED CYCLIC LIFE OF 5,000 ON/OFF ACTUATIONS. THE MINIMUM LEVELS OF PREDICTED YIELDING RELATIVE TO MECHANICAL WITHSTANDING STRENGTH WERE DESIGNED WITH A 1.4 STRUCTURAL FACTOR FOR SAFETY MARGIN. FOR ADDED ASSURANCE RELATIVE TO JAMMING, EACH OF THE NULL RETENTION SPRINGS ARE TIED THROUGH COIL CENTER, TO PREVENT A JAMMING CONDITION

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SHOULD ONE BREAK. THE FLIGHT CERTIFIED DESIGN INCLUDES A NEWLY CERTIFIED CONFIGURATION OF THE FLEX CABLE, WHICH HAS A DEMONSTRATED QUALIFICATION CYCLIC LIFE AS NOTED ABOVE FOR IMPROVED RELIABILITY WITH REGARD TO CYCLIC FATIGUE. THE QUALIFICATION REQUIREMENTS TO CERTIFY THIS DESIGN INCLUDED TWO LIFE CYCLE TESTS FOR A CONSERVATIVE MEASURE. THIS APPROACH WAS FELT NECESSARY, SINCE FOR THE BFS ENGAGE SWITCH, A THREE OF THREE CHANNEL OUTPUT SIGNAL IS NECESSARY TO ENGAGE THE BFS SYSTEM.

(B) TEST:

ACCEPTANCE TESTING WHICH INCLUDES ACCEPTANCE THERMAL TESTING (ATT), ACCEPTANCE VIBRATION TESTING (AVT), IS PERFORMED ON EACH UNIT.

QUALIFICATION TESTING, INCLUDING VIBRATION, SHOCK, TEMPERATURE, HAS BEEN SUCCESSFULLY COMPLETED TO CERTIFY DESIGN. INTEGRATED AND SUBSYSTEM VERIFICATION IS PERFORMED AT PALMDALE.

GROUND TURNAROUND TEST: ALL TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

INCOMING MATERIAL IS VERIFIED BY RECEIVING INSPECTION AND CERTIFICATION CONFORMANCE IS REVIEWED.

CONTAMINATION CONTROL

FINAL ASSEMBLY AND REWORK PERFORMED IN A CLEAN ROOM.

NONDESTRUCTIVE EVALUATION

NON DESTRUCTIVE TEST (NDT) CERTIFICATIONS AND RECORDS ARE MAINTAINED AND PROCESSES ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

TORQUING (ACCEPT/REJECT) VERIFICATION BY INSPECTION MECHANICAL RIGGING AND TORQUING ARE VERIFIED BY INSPECTION.

CRITICAL PROCESSES

CRITICAL PROCESSES ARE MONITORED BY QUALITY ENGINEERING.

TESTING

ACCEPTANCE TESTING IS OBSERVED AND VERIFIED BY QUALITY CONTROL, INCLUDING AVT, ATT, INSULATION RESISTANCE, DIELECTRIC STRENGTH, LEAK, AND SHOCK TEST.

HANDLING/PACKAGING

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

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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 DATABASE

(E) OPERATIONAL USE:
RECOMMENDED CREW PROCEDURE IS TO ENGAGE BOTH FORWARD RHC-BFS SWITCHES SIMULTANEOUSLY.

- APPROVALS -

EDITORIALLY APPROVED : RI
EDITORIALLY APPROVED : JSC
TECHNICAL APPROVAL : VIA APPROVAL FORM

J. L. Progen
Tom Shaver 5-2-96
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