

FAILURE MODES EFFECTS ANALYSIS FMEA - CIL FAILURE MODE

NUMBER: 05-1-FC3242-04

REVISION#: 1 01/03/96

SUBSYSTEM NAME: GUIDANCE, NAVIGATION, & CONTROL

LRU: SPEED BRAKE THRUST CONTROL

ITEM NAME: SPEED BRAKE THRUST CONTROL

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:

LOSS OF OUTPUT (TWO OR MORE CHANNELS)

MISSION PHASE: LO LIFT-OFF

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

CAUSE:

PHYSICAL JAMMING DUE TO VIBRATION, MECHANICAL SHOCK, MISHANDLING/ABUSE, PIECE PART STRUCTURAL FAILURE OR CONTAMINATION.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? YES

TAL TRANS-ATLANTIC LANDING

REDUNDANCY SCREEN

- A) PASS
- B) PASS
- C) PASS

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

NO EFFECT IN AUTO. LOSS OF MANUAL MAIN ENGINE THROTTLING CAPABILITY DURING FLIGHT ASCENT (PILOT'S STATION FAILURE ONLY).

(B) INTERFACING SUBSYSTEM(S):

SAME AS (A)

(C) MISSION:

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FIRST FAILURE (PILOT'S SBTC T/O SWITCH ANOMALY) - NO EFFECT. SECOND FAILURE (AUTO THROTTLE ANOMALY COUPLED WITH FIRST FAILURE) RESULTS IN LOSS OF CAPABILITY TO THROTTLE MAIN ENGINE. FLIGHT SOFTWARE ONLY ACCEPTS INPUT COMMANDS FROM PILOT'S SBTC.

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

**(E) FUNCTIONAL CRITICALITY EFFECTS:**  
CRIT 1 FOR TAL BECAUSE LOSS OF MANUAL ENGINE THROTTLING MAY RESULT IN LOSS OF CREW/VEHICLE; ENGINES REQUIRED TO BE THROTTLED BACK TO PROVIDE TIME FOR OMS PROPELLANT DUMPING. CRIT 1R BECAUSE LOSS OF MAIN ENGINE THROTTLING CAPABILITY MAY CAUSE LOSS OF CREW/VEHICLE.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**  
THE ELECTROMECHANICAL DESIGN HAS A CERTIFIED OPERATIONAL LIFE OF 23,500 HOURS. THE QUALIFIED CYCLIC LIFE OF THE TAKEOVER SWITCH (ON/OFF) WAS CERTIFIED FOR 5,000 ACTUATION EQUIVALENT TO 100 MISSION. ANALYSIS OF THE LOAD BEARING MECHANISMS INDICATE A YIELD LIMIT OF AT LEAST 1.4 TIMES THE OPERATIONAL DESIGN LOAD. UNIT IS COMPLETELY ENCLOSED TO PREVENT DEBRIS FROM ENTERING AND JAMMING MECHANISM.

ALL ELECTRICAL, ELECTRONIC AND ELECTROMECHANICAL (EEE) PIECE PARTS WHICH MAKE UP THE SBTC ARE CONTROLLED TO THE ORBITER PROJECT PARTS LIST (OPPL) REQUIREMENTS OR MF0004-400. PASSIVE EEE PARTS AND ELECTRICAL CONNECTORS ARE MILITARY QUALIFIED AND 100% SCREENED TO OPPL REQUIREMENTS. MICRO-CIRCUITS ARE QUALIFIED TO MIL-M-38510 AND SCREENED TO MIL-S-883, LEVEL B. SEMI-CONDUCTOR DEVICES ARE JANTXV LEVEL. CIRCUIT DESIGN LIMITS WORST CASE JUNCTION TEMPERATURES TO 95 DEG C AND ELECTRICAL STRESSES TO 50% OF RATED CAPABILITY FOR ALL PARTS.

**(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, WAS COMPLETED TO CERTIFY DESIGN. INTEGRATED/SUBSYSTEM VERIFICATION IS PERFORMED DURING TURNAROUND. FUNCTIONAL TEST OF SPEED BRAKE THRUST CONTROL IS MONITORED TO VERIFY OPERATION WITHIN SPECIFICATION.

**(C) INSPECTION:**  
RECEIVING INSPECTION  
INCOMING MATERIAL IS VERIFIED BY RECEIVING INSPECTION.

CONTAMINATION CONTROL  
HARDWARE AND FACILITY CONTAMINATION CONTROL MONITORED BY INSPECTION.  
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. TORQUING (ACCEPT/REJECT) VERIFIED BY INSPECTION. MECHANICAL RIGGING AND TORQUING ARE VERIFIED 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 MET BY USE OF SPECIAL QUALIFIED CONTAINERS FOR IN-PLANT TRANSPORTATION AND SHIPPING.

(D) FAILURE HISTORY:  
NO PHYSICAL JAMMING OF TAKEOVER SWITCH OR PIECE PART FAILURES HAVE OCCURRED DURING DEVELOPMENT, QUALIFICATION, ACCEPTANCE, FIELD TESTING, AND FLIGHT OPERATIONS.

(E) OPERATIONAL USE:  
NONE

- APPROVALS -

EDITORIALLY APPROVED	: RI	: <u>                    </u>
EDITORIALLY APPROVED	: JSC	: <u>                    </u>
TECHNICAL APPROVAL	: APPROVAL FORM	: <u>                    </u>
		: 95-CIL-001-R1