

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**

NUMBER: 05-6BA-2584B-IM -X

SUBSYSTEM NAME: EPD&amp;C - LANDING GEAR CONTROL

REVISION: 0

08/22/00

**PART DATA**

	<b>PART NAME</b>	<b>PART NUMBER</b>
	<b>VENDOR NAME</b>	<b>VENDOR NUMBER</b>
LRU	: FWD PCA 1	VO70-763320
SRU	: RELAY, LATCHING	MC455-0128-0001

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**

RELAY, LATCHING, LANDING GEAR DOWN CONTROL CIRCUIT (4P2P)

REFERENCE DESIGNATORS: 81V76A22K8

QUANTITY OF LIKE ITEMS: 1

ONE, FPCA-1

**FUNCTION:**

THE TWO SERIES DOWN RELAYS (K6 AND K8) WITH ONE ARM RELAY (K7) ACTUATES THE CIRCUIT FOR THE LANDING GEAR EXTEND VALVE 1. PROTECTION AGAINST PREMATURES AND REDUNDANCY PROVIDED WITHIN LANDING GEAR CIRCUITS. COMMON RESET TO ALL LANDING GEAR DOWN AND ARM RELAYS.

**FAILURE MODES EFFECTS ANALYSIS FMEA – CIL FAILURE MODE**

**NUMBER: 05-6BA-2584B-IM-02**

**REVISION#: 0 09/22/00**

**SUBSYSTEM NAME: EPD&C - LANDING GEAR CONTROL**

**LRU: FWD PCA 1**

**ITEM NAME: RELAY, LATCHING, K8**

**CRITICALITY OF THIS FAILURE MODE: 1R2**

**FAILURE MODE:**

CLOSED, PREMATURELY CLOSSES (TO SET POSITION), SHORT TO STRUCTURE (GROUND), SHORTS CONTACT-TO-CONTACT (TO SET POSITION)

**MISSION PHASE: LS LANDING/SAFING**

**VEHICLE/PAYLOAD/KIT EFFECTIVITY:**

- 102 COLUMBIA
  - 103 DISCOVERY
  - 104 ATLANTIS
  - 105 ENDEAVOUR
- EFFECTIVE AFTER LANDING GEAR MOD -  
(K6 RELAY CHANGED TO DOWN FUNCTION)

**CAUSE:**

FOR CLOSED, PREMATURELY CLOSSES (TO SET POSITION), SHORTS CONTACT-TO-CONTACT (TO SET POSITION): PIECE PART FAILURE, CONTAMINATION, VIBRATION, MECHANICAL SHOCK, PROCESSING ANOMALY, THERMAL STRESS.  
FOR SHORT TO STRUCTURE (GROUND): PIECE PART FAILURE, VIBRATION, MECHANICAL SHOCK, PROCESSING ANOMALY.

**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 STATUS OF A SINGLE RELAY CONTACT PREMATURELY CLOSING TO THE SET POSITION OR SHORTING TO STRUCTURE (GROUND) FOR THE LANDING GEAR EXTEND VALVE 1 COMMAND CIRCUIT STATUS CANNOT BE MONITORED IN FLIGHT.

C)

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**- FAILURE EFFECTS -**

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**(A) SUBSYSTEM:**

FIRST FAILURE – LOSS OF ONE OF TWO SERIES DOWN RELAYS TO PREVENT A SINGLE INADVERTENT HYDRAULIC DOWN COMMAND OF THE LANDING GEARS.

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

FIRST FAILURE – LOSS OF ONE OF TWO SERIES DOWN RELAYS TO PREVENT A SINGLE INADVERTENT HYDRAULIC DOWN COMMAND OF THE LANDING GEARS.

**(C) MISSION:**

FIRST FAILURE - NO EFFECT

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

FIRST FAILURE – NO EFFECT

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

CASE 1: SHORTS CONTACT-TO-CONTACT (TO SET POSITION), SHORT TO STRUCTURE (GROUND); CRITICALITY 1R2, PFP

POSSIBLE LOSS OF CREW/VEHICLE DUE TO THE FOLLOWING SCENARIO:

1. K8 (DOWN) RELAY SHORTS CONTACT-TO-CONTACT (TO SET POSITION) OR SHORT TO STRUCTURE (GROUND).
2. K6 (DOWN) RELAY SHORTS CONTACT-TO-CONTACT (TO SET POSITION). LANDING GEARS WILL BE EXTENDED AS SOON AS ARM SWITCH IS ACTIVATED BECAUSE BOTH DOWN RELAYS (NORMALLY CLOSED BY DOWN SWITCH) HAVE FAILED SHORTS CONTACT-TO-CONTACT (TO SET POSITION). THIS MAY OCCUR AT A TIME WHEN THERE IS A LIGHT VEHICLE, STRONG HEAD WIND AND LOW ENERGY WHICH COULD LAND VEHICLE SHORT OF RUNWAY AND MAY CAUSE VEHICLE DAMAGE RESULTING IN POSSIBLE LOSS OF CREW/VEHICLE.

CASE 2: CLOSED, PREMATURELY CLOSES (TO SET POSITION); CRITICALITY 1R2, PFP

POSSIBLE LOSS OF CREW/VEHICLE DUE TO THE FOLLOWING SCENARIO:

- 1., 2. K8 (DOWN) AND K6 (DOWN) RELAYS FAIL CLOSED AFTER ARM SWITCH ACTIVATION AT TWO THOUSAND FEET ALTITUDE. LANDING GEARS WILL BE EXTENDED BECAUSE BOTH DOWN RELAYS (NORMALLY CLOSED BY DOWN SWITCH) HAVE FAILED CLOSED. THIS MAY OCCUR AT A TIME WHEN THERE IS A LIGHT VEHICLE, STRONG HEAD WIND AND LOW ENERGY WHICH COULD LAND VEHICLE SHORT OF RUNWAY AND MAY CAUSE VEHICLE DAMAGE RESULTING IN POSSIBLE LOSS OF CREW/VEHICLE.

CASE 3: CLOSED, PREMATURELY CLOSES (TO SET POSITION); CRITICALITY 1R3, PPP

POSSIBLE LOSS OF CREW/VEHICLE DUE TO THE FOLLOWING SCENARIO:

1. K8 (DOWN) (OR K6 (DOWN)) RELAY FAILS CLOSED PRIOR TO ARM SWITCH ACTIVATION AT TWO THOUSAND FEET ALTITUDE.
2. K6 (DOWN) (OR K8 (DOWN)) RELAY FAILS CLOSED PRIOR TO ARM SWITCH ACTIVATION AT TWO THOUSAND FEET ALTITUDE.

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3. ARM SWITCH ACTIVATION.  
IF DOWN RELAY (K8 OR K6) FAILS CLOSED PRIOR TO ARM SWITCH ACTIVATION AT TWO THOUSAND FEET ALTITUDE, CREW CAN DETECT FAILURE AND DELAY "ARM" UNTIL IT IS SAFE TO DEPLOY LANDING GEAR. THIS IS A CRIT 1R3, PPP SCENARIO PRIOR TO ARM SWITCH ACTIVATION.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

REFER TO APPENDIX C, ITEM NO.3 - LATCHING RELAY

**(B) TEST:**

REFER TO APPENDIX C, ITEM NO. 3 - LATCHING RELAY

**GROUND TURNAROUND TEST**

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

**(C) INSPECTION:**

REFER TO APPENDIX C, ITEM NO. 3 - LATCHING RELAY

**(D) FAILURE HISTORY:**

CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND TURNAROUND PROCESSING CAN BE FOUND IN THE PRACA DATABASE.

**(E) OPERATIONAL USE:**

CASE 1: SHORTS CONTACT-TO-CONTACT (TO SET POSITION), SHORT TO STRUCTURE (GROUND); CRITICALITY 1R2, PFP

1. NONE.

CASE 2: PREMATURELY CLOSES (TO SET POSITION); CRITICALITY 1R2, PPP

1. GEAR NORMALLY ARMED AT TWO THOUSAND FEET ALTITUDE WHICH ASSURES MAKING RUNWAY THRESHOLD EXCEPT FOR THE WORST CASE COMBINATION OF LIGHT WEIGHT VEHICLE, STRONG HEAD WIND AND LOW ON ENERGY. CREW TRAINS IN SHUTTLE TRAINING AIRCRAFT AT TWO THOUSAND FEET ALTITUDE TO MAKE ADJUSTMENTS TO COMPENSATE FOR INADVERTENT GEAR EXTENSION. IF DOWN RELAY FAILS CLOSED PRIOR TO ARM SWITCH ACTIVATION, CREW WILL DELAY "ARM" UNTIL IT IS SAFE TO DEPLOY LANDING GEAR. CREW WILL SEE "DOWN" PBI LIGHT ON AND GROUND WILL SEE THE ASSOCIATED TELEMETRY MEASUREMENT ON WHEN DOWN RELAY FAILS.

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- APPROVALS -

S & R ENGINEERING	: M. D. DUMETZ / G. T. TATE:	<i>M. Dumetz</i>
S & R ENGINEERING ITM	: P. A. STENGER	<i>P. A. Stenger 9/29/00</i>
DESIGN ENGINEERING	: J. L. PECK	<i>J. L. Peck 9/27/00</i>
EPD&C SUBSYSTEM MANAGER:	R. L. PHAN	<i>R. L. Phan 9/28/00</i>
SR&QA	:	<i>Libbey 4/27/00</i>
NASA DCE	:	<i>Z. F. ... for S. ... 28 sig 00</i>
MOD	:	<i>G. ...</i>
USA SAM	:	
USA ORBITER ELEMENT	:	

PAGE: 5

PRINT DATE: 09/22/00

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EPD&C SUBSYSTEM MANAGER:	R. L. PHAN	<i>R. Phan 9/28/00</i>
SR&QA	:	<i>[Signature] 9/28/00</i>
NASA DCE	:	<i>[Signature] For S. Morris 28 Sep 00</i>
MOD	:	<i>[Signature]</i>
USA SAM	:	
USA ORBITER ELEMENT	:	<i>Suzanne Lende 9/28/00</i>

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S & R ENGINEERING ITM	:	P. A. STENGER	: <i>P. Stenger 9/19/00</i>
DESIGN ENGINEERING	:	J. L. PECK	: <i>J. Peck 9/27/00</i>
EPD&C SUBSYSTEM MANAGER:	:	R. L. PHAN	: <i>R. Phan 9/28/00</i>
SR&QA	:		: <i>[Signature] 9/21/00</i>
NASA DCE	:		: <i>Z. Phelan for J. Numa 28 sep 00</i>
MOD	:		: <i>[Signature]</i>
USA SAM	:		: <i>[Signature]</i>
USA ORBITER ELEMENT	:		: <i>[Signature] 10/3/00</i>