

INTRODUCTION TO APPENDIX C

- ITEM 1 - HYBRID RELAY MC455-0135
- ITEM 2 - GENERAL PURPOSE RELAY MC455-0129
- ITEM 3 - LATCHING RELAY MC455-0128
- ITEM 4 - RELAY MODULE MC455-0131
- ITEM 5 - GENERAL PURPOSE CONTACTOR MC455-0134
- ITEM 6 - POWER CONTACTOR MC455-0126

THE FOLLOWING TABLE LISTS FAILURE MODES AND CAUSES WHICH WERE CONSIDERED IN DERIVING THE FAILURE MODES AND EFFECTS ANALYSIS (PARA 5) FOR THE ITEMS LISTED ABOVE:

FAILURE MODE / Failure Cause	HYBRID RELAY	GEN PURP RELAY	LATCHING RELAY	RELAY MODULE	GEN PURP CONTACTOR	POWER CONTACTOR
OPEN, FAILS TO CONTACT, INADEQUATELY OFFERS, FAILS TO TRANSFER (a) Piece Part Failure (b) Contamination (c) Vibration (d) Mechanical Shock (e) Processing Anomaly (f) Thermal Stress	X X X X X X	X X X X X X	X X X X X X	X X X X X X	X X X X X	X X X X X
CLOSED, FAILS TO OPEN, PREMATURELY CLOSSES, SHORTS CONTACT-TO-CONTACT (a) Piece Part Failure (b) Contamination (c) Vibration (d) Mechanical Shock (e) Processing Anomaly (f) Thermal Stress	X X X X X X	X X X X X X	X X X X X X	X X X X X X	X X X X	X X X X X
SHORT TO STRUCTURE (GROUND) (a) Piece Part Failure (c) Vibration (d) Mechanical Shock (e) Processing Anomaly	X X X X	X X X X	X X X X	X X X X	X X X X	
SHORT POLE-TO-POLE (a) Piece Part Failure (c) Vibration (d) Mechanical Shock (e) Processing Anomaly	X X X X	X X X X	X X X X	X X X X		

11/03/87

APPENDIX C ITEM 4 - RELAY MODULE

ME455-0131-1002/-1003

ME455-0131-0002/-0003

DISPOSITION & RATIONALE:

(A) DESIGN, (B) TEST, (C) INSPECTION, (D) FAILURE HISTORY:

(A) DESIGN

THE RELAY MODULE IS AN ENVIRONMENTALLY SEALED METAL CASE, WHICH CONTAINS TWO 40M37496 HERMETICALLY-SEALED RELAYS, TWO JANTXVIN4944 DIODES MOUNTED ON AN INTERNAL TERMINAL BOARD AND AN INTEGRATED WIRING TERMINATING SYSTEM (IWTS) CONNECTOR. THE -0002 AND -0003 USED IN OV-102 HAVE SOLDER POT TERMINALS INSTEAD OF THE IWTS CONNECTOR. THE OV-102 APPLICATIONS HAVE AN ADDED MOUNTING BRACKET STIFFENER WHICH IS INHERENT IN RELAYS FOR SUBSEQUENT BUILDS (LXXX). THE RELAY MODULE WAS DESIGNED TO MEET THE REQUIREMENTS OF THE ROCKWELL INTERNATIONAL SPECIFICATION ME455-0131. THE APPLICATION OF THE COMPONENTS ARE ANALYZED TO ASSURE COMPLIANCE WITH THE 25% DERATING CRITERIA OF THE ORBITER PROJECT PARTS LIST (OPPL).

(B) TEST

QUALIFICATION/CERTIFICATION

QUALIFICATION/CERTIFICATION TESTING- THE 40M RELAYS AND THE DIODES WERE CERTIFIED TO THEIR APPLICABLE SPECIFICATIONS, 40M37496F AND MIL-S-19500/359 RESPECTIVELY. THE IWTS CONNECTOR WAS CERTIFIED AS PART OF THE PUSHBUTTON SWITCH ASSEMBLY.

THE RELAY MODULE WAS TESTED AND CERTIFIED AS PART OF THE MID POWER CONTROL ASSEMBLY AND THE MOTOR CONTROL ASSEMBLY WHICH WERE SUBJECTED TO THE FOLLOWING:

TEST	CAUSE CONTROL					
	a	b	c	d	e	f
VIBRATION	X		X		X	
THERMAL VACUUM	X				X	
CORROSIVE CONTAMINATION		X			X	X
MECHANICAL SHOCK TESTS	X			X	X	

11/03/87

APPENDIX C ITEM 4 CONT'D

ACCEPTANCE AND SCREENING

ALL RELAY MODULES ARE SUBJECTED TO ACCEPTANCE AND SCREENING TESTS WHICH INCLUDE:

TEST	CAUSE CONTROL					
	a	b	c	d	e	f
VISUAL					X	
DIELECTRIC STRENGTH (DWV AT 500 Vrms)					X	
INSULATION RESISTANCE (IR)					X	
ACCEPTANCE THERMAL (20 TO 120 °F)	X					X
PIND (RELAYS ONLY)		X			X	

ACCEPTANCE TEST AT THE NEXT ASSEMBLY:

TEST	CAUSE CONTROL					
	a	b	c	d	e	f
FUNCTIONAL	X	X			X	
CONTINUITY		X			X	
INSULATION RESISTANCE		X			X	
VIBRATION (POWER CONTROL ASSEMBLIES TESTED AT 0.04 g <sup>2</sup> /HZ)	X		X			

(C) INSPECTION

RECEIVING INSPECTION (FAILURE CAUSE a,b)

PERFORMS VISUAL AND DIMENSIONAL EXAMINATION OF ALL INCOMING PARTS. CERTIFICATION RECORDS AND TEST REPORTS ARE MAINTAINED CERTIFYING MATERIALS AND PHYSICAL PROPERTIES.

CONTAMINATION CONTROL (FAILURE CAUSE b)

QUALITY CONTROL (QC) VERIFIES THAT APPROPRIATE PROCEDURES AND SHOP PRACTICES ARE UTILIZED FOR CONTAMINATION CONTROL. CLEANLINESS OF RELAY ASSEMBLIES, PRIOR TO HERMETIC SEALING, IS

11/03/87

APPENDIX C ITEM 4 CONT'D

SUBJECT TO QC SURVEILLANCE AND DATA REVIEW AT THE SUBCONTRACTOR LEVEL (TELEDYNE RELAY).

ASSEMBLY/INSTALLATION (FAILURE CAUSE a,b,e)

DETAILED INSPECTION IS PERFORMED ON ALL PARTS PRIOR TO NEXT ASSEMBLY. HERMETIC SEALING AND BACKFILLING OPERATIONS ARE SUBJECT TO QC SURVEILLANCE AND DATA REVIEW AT THE SUBCONTRACTOR LEVEL (TELEDYNE RELAY).

CRITICAL PROCESSES (FAILURE CAUSE a,b,e)

ALL CRITICAL PROCESSES INCLUDING SOLDERING ARE MONITORED AND VERIFIED BY INSPECTION.

TESTING (FAILURE CAUSE a,b,c,e,f)

ALL PARTS OF THE ACCEPTANCE TEST ARE OBSERVED AND VERIFIED BY QC.

HANDLING/PACKAGING (FAILURE CAUSE c,d)

IN-PROCESS OPERATIONS ARE VERIFIED BY QC TO PROTECT PARTS AND PRECLUDE MISHANDLING. PARTS ARE PACKAGED, PROTECTED, AND VERIFIED BY INSPECTION TO APPLICABLE REQUIREMENTS AT THE SUPPLIER.

(D) FAILURE HISTORY

THERE HAVE BEEN A TOTAL OF FOUR FAILURES:

FAILURE MODE: INSULATION RESISTANCE BREAKDOWN

CAR'S AC1038 AND AC8010

TWO OF THE FAILURES WERE INSULATION RESISTANCE BREAKDOWN BETWEEN A COIL CIRCUIT AND RELAY CONTACT CIRCUIT VIA TERMINAL NO. 5. THESE CONDITIONS WERE BOTH CAUSED BY COLD FLOW OF A TEFLON SLEEVE ON THE STEERING DIODE LEAD. THE CORRECTIVE ACTION INITIATED IN JANUARY OF 1982 WAS TO REQUIRE WRAPPING OF THE TEFLON SLEEVE AS WELL AS THE DIODE BODY WITH KAPTON TAPE. ADDITIONALLY THE DIODE LEAD ROUTING MUST BE WITHIN A SPECIFIC LOCATION.

11/02/87 (3:27pm)

APPENDIX C ITEM 4 CONT'D

FAILURE MODE: OPEN, FAILS TO CONDUCT, INADVERTENTLY OPENS, FAILS TO TRANSFER

CAR'S AC3724 AND AD0479

TWO OTHER FAILURES WERE ASSOCIATED WITH INTERMITTENT CONTINUITY THROUGH THE RELAY CONTACT CIRCUITS. ONE WAS ISOLATED TO A MARGINAL SOLDER JOINT AND THE OTHER WAS ATTRIBUTED TO LACK OF SOLDER ON A TERMINAL BOARD JOINT. THE SUPPLIER REVISED HIS RELAY ASSEMBLY CIRCUIT BOARD DRAWING TO CLARIFY THE SOLDERING REQUIREMENTS, THIS WAS ACCOMPLISHED IN MAY OF 1986.

THREE OF THE ABOVE FAILURES WERE DETECTED AT THE NEXT ASSEMBLY LEVEL PRE-ACCEPTANCE OR ACCEPTANCE TESTS. ONLY ONE OF THESE WAS DETECTED AT THE VEHICLE LEVEL (CAR AD0479) AND IT WAS ON A DISPLAYS AND CONTROLS PANEL. THESE PANELS ARE NOT SUBJECTED TO AN ACCEPTANCE VIBRATION TEST WHICH NORMALLY WOULD DETECT PROBLEMS OF THIS NATURE.

PREPARED BY:

DESIGN I. CHASE  
RELIABILITY M. HOVE  
QUALITY J. COURSEN

APPROVED BY:

DES *I. Chase*  
REL *M. Hove*  
QE *J. Coursen*

APPROVED BY (NASA):

SSM *B. C. Stang 11/2/87*  
REL *D. W. ... M. E. Peterson*  
QE *...*