INTRODUCTION TO APPENDIX C

10/28/87

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 (FMEA'S) 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 CONDUCT, INADVERTANTLY OPENS, FAILS TO TRANSFER						
(a) Piece Part Failure	X	X	X	X	X	X
(b) Contamination	X	X	X	X	X	X
(c) Vibration	X	X	X	X	X	X
(d) Mechanical Shock	X	X	X	X	X	X
(e) Processing Anomaly	X	X	X	X	X	X
(f) Thermal Stress	X	X	X	X	X	X
CLOSED, FAILS TO OPEN, PREMATURELY CLOSES, SHORTS CONTACT-TO-CONTACT						
(a) Piece Part Failure	X	X	X	X	X	X
(b) Contamination	X	X	X	X		X
(c) Vibration	X	X	X	X	X	X
(d) Mechanical Shock	X	X	X	X	X	X
(e) Processing Anomaly	X	X	X	X	X	X
(f) Thermal Stress	X	X	X	X	X	X
SHORT TO STRUCTURE (GROUND)						
(a) Piece Part Failure	X	X	X	X	X	
(c) Vibration	X	X	X	X	X	
(d) Mechanical Shock	X	X	X	X	X	
(e) Processing Anomaly	X	X	X	X	X	
SHORT POLE-TO-POLE						
(a) Piece Part Failure	X	X	X	X		
(c) Vibration	X	X	X	X		
(d) Mechanical Shock	X	X	X	X		
(e) Processing Anomaly	X	X	X	X		

11/03/87

APPENDIX C ITEM 5 - GENERAL PURPOSE CONTACTOR
MC455-0134-0001 & -0003 LATCHING 125A
-0002 & -0004 NON-LATCHING 125A

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

(A) DESIGN

THESE CONTACTORS ARE HOUSED WITHIN A HERMETICALLY-SEALED, ALL WELDED METAL CASE. THE CONTACTOR UTILIZES SILVER ALLOY CONTACTS AND IS DESIGNED TO THE REQUIREMENTS OF MIL-R-6106.

DESIGN EVOLUTION

COMPONENT HISTORY AND DESIGN EVOLUTION; THE BASIC DESIGN BUILT TO MIL-R-6106 HAS HAD EXTENSIVE PROGRAM HISTORY (COMMERCIAL-L1011, DC10; MILITARY-F4; NASA-SATURN AND SKYLAB). DURING QUAL TESTING THE -0001 CONFIGURATION CONTACTS TACK WELDED CLOSED DURING THE 2,000TH CYCLE OF A 50,000 CYCLE LIFE TEST (SEE CAR A7931- 010). CORRECTIVE ACTION RESULTED IN -0003 AND -0004 CONFIGURATIONS FEATURING IMPROVED CONTACT MATERIAL (MALLORY G12, SILVER TUNGSTEN CARBIDE) AND DELTA QUAL TESTING.

(B) TEST

QUALIFICATION/CERTIFICATION TEST AND ANALYSIS IS COMPLETE. CERTIPICATION TEST INCLUDE:

TEST	CAUSE CONTROL					
	a	b	c	d	e	f
FUNCTIONAL AND PERFORMANCE	X	X			X	
ELECTROMAGNETIC INTERFERENCE (EMI)						
QUAL ACCEPTANCE VIBRATION TEST (QAVT)			X			
OVERLOAD	X				X	
TERMINAL STRENGTH	X				X	
INSULATION RESISTANCE (IR)		X			X	
DIELECTRIC WITHSTANDING VOLTAGE (DWV)		X			X	
LEAKAGE		X			X	
FLIGHT VIBRATION (0.15 g^2/HZ)	X		X			
THERMAL-VACUUM (5 CYCLES, -65 AND +165 ^{o}F)	X					X
TRANSIENT SURGE (40 VDC) AND SPIKES (77 VDC)					X	
CYCLE LIFE CYCLING TEST (35000 CYCLE)	X				X	

APPENDIX C ITEM 5 CONT'D

ALL CONTACTORS ARE SUBJECTED TO ACCEPTANCE TESTS WHICH INCLUDE PERFORMANCE AND SCREENING:

TEST	CAUSE CONTROL					
	a	b	c	d	e	f
INSULATION RESISTANCE (IR)		X			X	
DIELECTRIC WITHSTANDING VOLTAGE (DMV)		X			X	
LEAKAGE (FINE, $1X10^{-8}$ ATM SEC AND GROSS)		X			X	
VISUAL					X	
RUN-IN (500 CYCLES MINIMUM)	X				X	
ACCEPTANCE VIBRATION TEST (AVT)	X		X			
RADIOGRAPHIC INSPECTION		X			X	

ACCEPTANCE TEST AT THE NEXT ASSEMBLY:

TEST	CAUSE CONTROL					
	a	b	c	d	e	f
FUNCTIONAL	X				X	
CONTINUITY		X			X	
INSULATION RESISTANCE		X			X	
VIBRATION (0.04 g^2/HZ)	X		X			

(C) INSPECTION

RECEIVING INSPECTION (FAILURE CAUSE a,b)

VERIFIES CONTACTOR GLASS HEADER. ALL RAW MATERIALS VERIFIED BY INSPECTION TO COMPLY WITH MATERIAL REQUIREMENTS THROUGH SUPPLIER CERTIFICATIONS AND/OR COUPON ANALYSIS. CORROSION-PROTECTED MATERIALS ARE VERIFIED BY SUPPLIER CERTIFICATIONS AND INSPECTIONS.

APPENDIX C ITEM 5 CONT'D

CONTAMINATION CONTROL (FAILURE CAUSE b)

INSPECTION VERIFIES ULTRASONIC AND AIR BLAST CLEANING.

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

DETAILED INSPECTIONS PERFORMED ON ALL PARTS PRIOR TO NEXT ASSEMBLY; ALL CRITICAL MEASUREMENTS AND ADJUSTMENTS VERIFIED BY INSPECTION. TORQUE VERIFICATION ACCOMPLISHED ON FASTENERS.

NONDESTRUCTIVE EVALUATION (NDE) (FAILURE CAUSE a,b,e)

RADIOGRAPHIC INSPECTION PERFORMED FOR EVIDENCE OF LOOSE PARTS AND ASSEMBLY ANOMALIES.

CRITICAL PROCESSES (FAILURE CAUSE a,b,e)

ALL CRITICAL PROCESSES INCLUDING SOLDERING, WELDING, PLATING, AND BRAZING, ARE MONITORED AND VERIFIED BY INSPECTION.

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

ACCEPTANCE TEST OBSERVED AND VERIFIED BY QUALITY CONTROL (QC), INCLUDING VIBRATION.

HANDLING/PACKAGING (FAILURE CAUSE c,d)

PARTS PACKAGED AND PROTECTED ARE VERIFIED BY INSPECTION TO APPLICABLE REQUIREMENTS.

(D) FAILURE HISTORY

FAILURE MODE: OUT OF TOLERANCE COIL RESISTANCE

CAR'S AD1440 AND AD1453
DURING LRU ACCEPTANCE TESTING, A SHIFT IN COIL RESISTANCE WAS ATTRIBUTED TO THE COIL ASSEMBLY PROCESS, WHICH CAUSED A STEERING DIODE TO FAIL SHORTED.

THE SUPPLIER RESPECIFIED THE COIL ASSEMBLY PROCESS AND INSTITUTED SPECIAL SCREEN TESTS DURING ACCEPTANCE TO PRECLUDE THIS FAILURE MODE.

APPENDIX C ITEM 5 CONT'D

PREPARED BY:		APPROVED BY:	APPROVED BY (NASA):
DESIGN	I. CHASE	DES I.K. Chase	SSM W.C. Stone 11/3/87
RELIABILITY	M. HOVE	REL M. Hove (11-3-87)	REL Robert D. McPherson
QUALITY	J. COURSEN	QE Glenn for M. Hove	QE [illegible]