

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ELECT POWER DIST & CONT FMEA NO 05-6 -2345A -1 REV:05/16/88

ASSEMBLY :MAIN DC DIST ASSY 1 ABORT: RTLS,TAL CRIT.FUNC: 1R
P/N RI :V070-764258 CRIT. HDW: 2
P/N VENDOR: VEHICLE 102 103 104
QUANTITY :1 EFFECTIVITY: X X X
:ONE, MAIN DC PHASE(S): PL LO X OO X DO X LS
:DISTR ASSY-1

REDUNDANCY SCREEN: A-PASS B-PASS C-PASS

PREPARED BY: APPROVED BY: APPROVED BY (NASA):
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ITEM:

SHUNT, DC AMMETER, (50MV, 500A) - FUEL CELL 1 RETURN LINE

FUNCTION:

SENSES LOAD CURRENT IN FUEL CELL 1 RETURN LINE AND PROVIDES PROPORTIONAL VOLTAGE TO THE AMMETER ELEMENT. 40V76A31R11

FAILURE MODE:

OPENS, OPEN ELEMENT

CAUSE(S):

PIECE PART FAILURE, CONTAMINATION, VIBRATION, MECHANICAL SHOCK, PROCESSING ANOMALY, THERMAL STRESS

EFFECT(S) ON:

(A)SUBSYSTEM (B)INTERFACES (C)MISSION (D)CREW/VEHICLE (E)FUNCTIONAL CRITICALITY EFFECT:

(A) LOSS OF MAIN DC BUS SOURCE FROM AFFECTED FUEL CELL.

(B) LOSS OF POWER TO AFFECTED BUS LOADS, ASSOCIATED INVERTERS AND 3 PHASE AC BUS SET. THE AFFECTED AFT RCS AC MOTOR VALVES CANNOT BE OPERATED FOR OMS/RCS INTERCONNECT OR CROSSFEED ALSO, NEITHER OF TWO SERIES HELIUM BLOWDOWN VALVES CAN BE OPENED. ALSO, DUE TO INTERRUPTION OF CIRCUIT PATH BETWEEN THE RETURN TERMINAL OF THE AFFECTED FUEL CELL POWER SECTION AND ORBITER STRUCTURE GROUND, A VOLTAGE DIFFERENCE MAY EXIST BETWEEN THE POWER SECTION RETURN AND FUEL CELL STRUCTURE. IF THIS CONDITION EXISTS, IT MAY RESULT IN CURRENT LEAKAGE THROUGH AN ELECTROLYTE FILM IN REACTANT PASSAGES LEADING TO HEATING AND POSSIBLE IGNITION OF INSULATOR PLATE OR FUEL CELL SEPARATOR PLATE MATERIALS.

(C) EARLY MISSION TERMINATION - LAND AT NEXT PRIMARY LANDING SITE OPPORTUNITY.

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EFFECT(S) ON (CONTINUED):

(A)SUBSYSTEM (B)INTERFACES (C)MISSION (D)CREW/VEHICLE (E)FUNCTIONAL CRITICALITY EFFECT:

(D) FIRST FAILURE - NO EFFECT. CRIT 1 FOR RTLS BECAUSE LOSS OF ANY AC BUS PRIOR TO OMS/RCS INTERCONNECT LEAVES RCS TANK ISOLATION VALVE OPEN DURING RTLS OMS PROPELLANT DUMP. SINCE DUMPING OMS PROPELLANTS THROUGH RCS JETS NORMALLY SUPPLIED FROM THE AFFECTED OPEN TANK ISOLATION VALVE WOULD RESULT IN DUMPING RCS PROPELLANTS ALONG WITH OMS PROPELLANTS, AND MANUALLY CLOSING THE ASSOCIATED MANIFOLD ISOLATION VALVES AFTER THE OMS PROPELLANT DUMP BEGINS WOULD RENDER THOSE RCS MANIFOLDS UNUSABLE FOR ET SEPARATION, "SMART INTERCONNECT" SOFTWARE (CR'S 59126H AND 89210B, EFFECTIVITY 01-8B, STS-26) PROTECTS AGAINST LOSS OF AFT RCS MANIFOLDS BY Deselecting THE AFFECTED RCS JETS FOR THE OMS PROPELLANT DUMP. DISABLING HALF OF THE AFT RCS JETS FOR OMS PROPELLANT DUMP REDUCES THE DUMP CAPABILITY AND MAY RESULT IN AN INCOMPLETE OMS RTLS PROPELLANT DUMP WITH A POSSIBLE VIOLATION OF LANDING CONSTRAINTS FOR WEIGHT AND/OR CENTER OF GRAVITY. ALSO CRIT 1 FOR RTLS AND TAL BECAUSE HELIUM BLOWDOWN VALVES CANNOT BE OPENED. BOTH HELIUM SUPPLY BLOWDOWN VALVES MUST OPEN, FAILURE TO OPEN EITHER SERIES VALVE AFTER MECO COULD PREVENT PURGE OF AFT FUSELAGE COMPARTMENT, LH2/LO2 UMBILICAL CAVITIES AND AFT OMS PODS, ALLOWING ACCUMULATION OF PROPELLANTS WITH POSSIBLE FIRE AND EXPLOSION RESULTING IN PROBABLE LOSS OF CREW AND VEHICLE (REF. 05-6J-2050-1, 03-1-0233-3).

(E) POSSIBLE LOSS OF CREW/VEHICLE DUE TO LOSS OF SECOND MAIN DC BUS, FUEL CELL/MAIN BUS CONTACTOR, OR CURRENT SHUNT DURING ASCENT OR ENTRY RESULTING IN UNDERVOLTAGE CONDITION TO CRITICAL LOADS. ALSO POSSIBLE LOSS OF CREW/VEHICLE AFTER SECOND FAILURE (LOSS OF ABILITY TO CLOSE REACTANT VALVES TO AFFECTED FUEL CELL) DUE TO FIRE AND/OR EXPLOSION IN THE AFFECTED FUEL CELL.

DISPOSITION & RATIONALE:

(A)DESIGN (B)TEST (C)INSPECTION (D)FAILURE HISTORY (E)OPERATIONAL USE

(A,B,C,D) DISPOSITION AND RATIONALE

(A) DESIGN

THE DC AMMETER SHUNT IS A LIGHTWEIGHT, EXTERNAL-INSTRUMENT-TYPE DEVICE PROVIDING A 50 MV OUTPUT AT ITS 500 AMPERE CURRENT RATING. THE SUPPLIER'S (WESTON) CONFIGURATION IS MODIFIED BY REMOVING THE SHUNT BASEPLATE AND MOUNTING THE SHUNT DIRECTLY ON THE MAIN DC DISTRIBUTION AND CONTROL ASSEMBLY (MDCA) BASEPLATE.

(B) TEST

QUALIFICATION/CERTIFICATION

CERTIFICATION TESTING AND ANALYSIS ARE COMPLETED AND APPROVED. QUALIFIED TO MIL-5-61B. CERTIFICATION TESTS INCLUDE:

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(B) TEST (CONTINUED)

TEST	CAUSE CONTROL					
	a	b	c	d	e	f
CAUSES	a Piece part failure		d Mechanical shock			
	b Contamination		e Processing anomaly			
	c Vibration		f Thermal stress			
VISUAL AND MECHANICAL EXAMINATION		X			X	
VOLTAGE DROP		X			X	
DIELECTRIC WITHSTANDING VOLTAGE		X			X	
SUSTAINED LOAD		X			X	
OVERLOAD CYCLING	X				X	
MECHANICAL SHOCK	X			X		X

QUALIFICATION/CERTIFICATION TEST PERFORMED AT THE NEXT ASSEMBLY LEVEL (NDCA) INCLUDE:

TEST	CAUSE CONTROL					
	a	b	c	d	e	f
CAUSES	a Piece part failure		d Mechanical shock			
	b Contamination		e Processing anomaly			
	c Vibration		f Thermal stress			
ACCEPTANCE	X	X	X		X	X
QUAL/ACCEPTANCE (QAVT AT 0.067 g ² /HZ)	X		X		X	
RANDOM VIBRATION (0.023 g ² /HZ, 84 MIN)	X		X		X	
THERMAL VACUUM (75 TO 165 °P, 6 CYCLES FOR 72 HOURS TOTAL)						X
DESIGN SHOCK (20G, 3 DROPS/AXIS)				X		
VISUAL EXAMINATION	X	X			X	

ACCEPTANCE AND SCREENING

ALL PRODUCTION UNITS ARE SUBJECTED TO 100% SCREENING TESTS WHICH INCLUDE:

TEST	CAUSE CONTROL					
	a	b	c	d	e	f
VISUAL AND MECHANICAL EXAMINATION		X			X	
CALIBRATION OF RESISTANCE					X	

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(B) TEST (CONTINUED)

ACCEPTANCE TEST AT THE NEXT ASSEMBLY (MAIN DC DISTRIBUTION AND CONTROL ASSEMBLY):

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

GROUND TURNAROUND TEST

VERIFY ACTIVATION OF ORBITER MAIN DC BUS A FROM THE MAIN BUS A GROUND SUPPLY. COMMAND THE ORBITER MAIN DC BUS A "ON", AND MONITOR THE STIMULI COMMANDS, DISCRETE EVENTS, AND BUS VOLTAGE. TEST IS PERFORMED FOR ALL FLIGHTS.

(C) INSPECTION

RECEIVING INSPECTION (FAILURE CAUSE b,e)

RECEIVING INSPECTION PERFORMS VISUAL AND DIMENSIONAL EXAMINATIONS OF INCOMING PARTS. RAW MATERIAL CERTIFICATIONS ARE OBTAINED AND VERIFIED BY RECEIVING INSPECTION.

CONTAMINATION CONTROL (FAILURE CAUSE b)

PARTS ARE ASSEMBLED IN A LAMINAR FLOW MODULE WITHIN A CONTROLLED WORK AREA.

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

ASSEMBLY AND INSTALLATION OPERATIONS ARE MONITORED AND VERIFIED BY INSPECTION.

CRITICAL PROCESSES (FAILURE CAUSE b,e)

CRITICAL PROCESSES AND CERTIFICATIONS ARE MONITORED AND VERIFIED BY INSPECTION. THE CRITICAL PROCESS IS SOLDERING.

TESTING

SCREENING TESTS ARE MONITORED AND VERIFIED BY INSPECTION. THE SCREENING TESTS PERFORMED ARE A VISUAL AND MECHANICAL EXAMINATION AND A CALIBRATION OF RESISTANCE.

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(C) INSPECTION (CONTINUED)

HANDLING/PACKAGING (FAILURE CAUSE c,d)

PACKAGING IS PERFORMED PER APPLICABLE REQUIREMENTS AND VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

THERE IS EXTENSIVE PRIOR PROGRAM HISTORY (APOLLO, SKYLAB). NO GENERIC FAILURE MODES EXIST.

(E) OPERATIONAL USE

FOR FUEL CELL ELECTRICAL SOURCE LOSS, POWER CAN BE RESTORED WITH A MAIN BUS TIE TO ANOTHER MAIN BUS. PRESENT FLIGHT RULES DO NOT PERMIT BUS TIEING TO A DEAD BUS UNTIL AFTER SRB SEPARATION. ONBOARD PROCEDURES MANAGE POWER FOR LOSS OF ONE FUEL CELL/MAIN DC BUS.