



GEORGE C. MARSHALL

**SPACE
FLIGHT
CENTER**

SA-513/SL-1
PM-MO-10-71

MAY 9, 1973

REVISION 5

PARTIAL REVISION

LAUNCH MISSION RULES INPUT DOCUMENT

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION



MSFC LAUNCH MISSION RULES

REV	CHANGE LOG						
	CONTROL NUMBER	KSC ITEM	PAGES	DESCRIPTION	REMARKS	LETTER TO KSC	
REVISION 4 3-26-73	WP-029	3-2722	I-100A	AM Thermal Control System Primary System Pressure	Added new rule and background data.	MO-MGR (73-10) 3/29/73	
			I-101	AM Figure 1	Revise AM Figure 1.	MO-MGR (73-10) 3/29/73	
			I-102	AM Figure 2	Revise AM Figure 2	MO-MGR (73-10) 3-29-73	
	SP-001	3-8000	I-110	Workshop GSE/ESE GN ₂ to ATM Canister	Approved rule moved from Section II.	N/A	
	EP-002	2-907	II-21 II-21.1	Azimuth Laying Theodolite Laying System	Pages deleted.	N/A	
	SP-001	3-8000	II-110	Workshop GSE/ESE GN ₂ to ATM Canister	Pages deleted.	N/A	
REVISION 5 5-9-73	1P-003	3-404	I-3.1	SV Upper Air Winds	Update upper air wind curve for May and June Launch	N/A	
	EP-007	2-927A	I-23A	Nose Cone Temperature	Revise upper limit and add alternate measurement	TBS	
	OP-024	3-218A	I-51A I-51A.1 I-51A.2 I-51A.3	OWS AM Ground Power ON	Pages Deleted (see page III - 20)	N/A	
	OP-009	3-219 thru 3-222	I-52	OWS Power Bus 1 & 2	Update Background Data	N/A	
MISSION SA-513/SL1		SECTION CHANGE LOG		STAGE/SUBSECTION	SYSTEM	DATE/CHANGE NO MAY 9, 1973 R5	P. GE xi

MSFC LAUNCH MISSION RULES

REV	CHANGE LOG					
	CONTROL NUMBER	KSC ITEM	PAGES	DESCRIPTION	REMARKS	LETTER TO KSC
	OP-003	3-400	I-57 I-57.2 I-57.3 I-57.4 I-57.5 I-57.6	OWS Stored Film	Revise Redline Maximum and Minimum and Notes. Update Background Data.	Magnafaxed 5-7-73 SL- EL
	OP-021	3-401	I-58 I-58.3 I-58.4 I-58.5 I-58.6	OWS Refrigeration Primary Circuits	Revise Redline Maximum and Minimum and Notes. <i>UPDATE BACKGROUND DATA.</i>	Magnafaxed 5-7-73 SL- EL
	OP-002	3-402	I-59	OWS Refrigeration Primary	Change Redline Maximum and Minimum <i>Limits</i>	Magnafaxed 5-7-73 SL- EL
	WP-014	3-2155	I-78.1	AM I&C Coax Switch Position	Update Background Data	N/A
	WP-003	3-2201 thru 3-2208	I-82.1 I-82.2	AM Battery	Update Background Data	N/A
	WP-016	3-2253 thru 3-2268	I-86 I-86.1 I-86.2 I-86.3	AM Battery Power	Revise Redline Maximum and Minimum. Update Background Data.	LDX SL- EL 5-8-73
	WP-004	3-2706	I-94 I-94.1 I-94.2 I-94.3	Am Mole Sieve	Revise Redline Notes. Update Background Data.	LDX SL- EL 5-8-73
MISSION SA-513/SL-1		SECTION CHANGE LOG		STAGE/SUBSECTION	SYSTEM	DATE/CHANGE NO MAY 9, 1973 R5
						PAGE xii

MSFC LAUNCH MISSION RULES

REV		CHANGE LOG								
REVISION 5 5-9-73	CONTROL NUMBER	KSC ITEM	PAGES	DESCRIPTION	REMARKS	LETTER TO KSC				
	WP-024	3-2709 3-2709A	I-95 I-95.1 I-95.2	AM Thermal Capacitor	Add Redline Rule for Secondary Loop. Revise Notes. Update Background Data.	LDX to SL-EI 5-8-73				
	WP-022	3-2711A	I-96 I-96.1 I-96.2 I-96.3	AM Primary and Secondary Cooland Control	Add Redline Rule for Secondary Loop. Revise Notes. Update Background Data.	LDX to SL-EI 5-8-73				
	WP-023	3-2712 3-2712A	I-97 I-97.1 I-97.2 I-97.3 I-97.4 I-97.5	AM Primary and Secondary Coolant Control Valves	Add Redline Rule for Secondary Loop. Revise Notes. Update Background Data.	LDX to SL-EI 5-8-73				
	WP-008	3-2715 3-2716	I-98.1	AM Thermal Control System Primary and Secondary Coolant Pumps	Update Background Data	LDX to SL-EI 5-8-73				
	WP-009	3-2717A	I-99 I-99.1 I-99.2 I-99.3	AM Primary and Secondary Loop Pump Pressure Differential	Add Redline Rule for Secondary Loop. Revise Notes. Update Background Data.	LDX to SL-EI 5-8-73				
	WP-028	3-2720	I-100 I-100.1 I-100.2 I-100.3 I-100.4	AM Primary and Secondary Loop Bypass Monitor.	Add Redline Rule for Secondary Loop. Revise Notes. Update Background Data.	LDX to SL-EI 5-8-73				
	MISSION		SECTION		STAGE/SUBSECTION		SYSTEM		DATE/CHANGE NO	
SA-513/SL-		CHANGE LOG						May 9, 1973 R5		xii'

MSFC LAUNCH MISSION RULES

REV

CHANGE LOG

CONTROL
NUMBER

KSC
ITEM

PAGES

DESCRIPTION

REMARKS

LETTER
TO KSC

I-104

AM Figure 4

Revise AM Figure 4

Trans-
mitted to
SL-EI
4-17-73

RP-011

3-6101A
3-6101B
3-6101C

I-108A
I-108A.1
I-108A.2
I-108A.3

ATM APCS Evacuation Valve
Position

Add New Rule and Background Data.

Trans-
mitted to
SL-EI
4-5-73

REVISION 5 5-9-73

W. G. Clarke

W. G. Clarke
Manager, Operations Engineering Office

MISSION

SECTION

STAGE/SUBSECTION

SYSTEM

DATE/CHANGE NO

PAGE

SA-513/SL-1

CHANGE LOG

MAY 9, 1973 R5

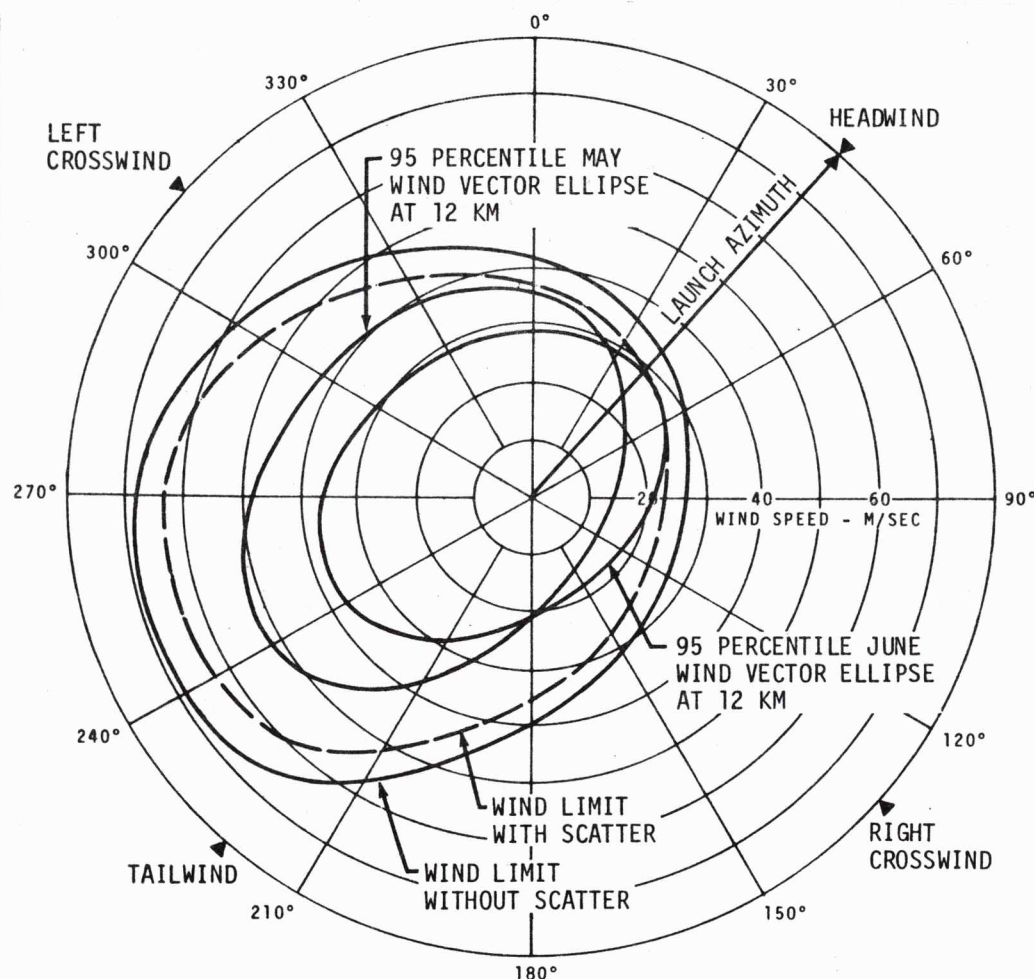
xiv

MSFC LAUNCH MONITORING RULE INPUT

REV	ITEM	SPACE VEHICLE UPPER AIR WIND RESTRICTIONS					
	1-404	<p>PRELAUNCH SIMULATIONS OF THE SPACE VEHICLE RESPONSE TO UPPER AIR WINDS AT TIME OF LAUNCH WILL BE PERFORMED AT MSFC BY AN MSFC/MSC WIND MONITORING TEAM USING WIND DATA PROVIDED BY KSC. A C-BAND RADAR WILL BE UTILIZED TO TRACK JIMSPHERE BALLOONS RELEASED FROM THE LAUNCH AREA TO OBTAIN UPPER AIR WIND DATA FROM L-48 HOURS TO T+10 MINUTES ON A SCHEDULE AGREED TO BY KSC, MSFC, AND MSC. RESULTS OF THE WIND SIMULATIONS WILL BE TRANSMITTED VIA DATAFAX TO THE LAUNCH OPERATIONS MANAGER (OR TEST SUPERVISOR IN HIS ABSENCE) AT THE LAUNCH CONTROL CENTER. REPORTS WILL BE AVAILABLE AND PROVIDED AS CONSIDERED APPROPRIATE STARTING AT L-24 HOURS WITH A GO/NO-GO RECOMMENDATION TRANSMITTED PRIOR TO START OF CRYOGENIC LOADING. IF THE WIND SIMULATIONS INDICATE THAT WIND CONDITIONS ARE MARGINAL FOR LAUNCH, THE WIND MONITORING TEAM WILL REPORT THAT "LAUNCH WINDS ARE MARGINAL FOR LAUNCH" UPON RECEIPT OF THIS REPORT, THE LAUNCH OPERATIONS MANAGER WILL PLACE A CONTINGENCY PLAN INTO EFFECT WHICH WILL PROVIDE FOR A NEW JIMSPHERE RELEASE EACH HOUR. THE CONTINGENCY PLAN WILL REMAIN IN EFFECT UNTIL LIFTOFF HAS OCCURRED, THE LAUNCH IS SCRUBBED, OR A SUBSEQUENT REPORT STATES THAT "LAUNCH WINDS ARE NO LONGER MARGINAL FOR LAUNCH." THE WIND MONITORING TEAM WILL PROVIDE A REPORT TO THE LAUNCH OPERATIONS MANAGER FOR EACH JIMSPHERE RELEASE UNDER THE CONTINGENCY PLAN.</p> <p>THE UPPER AIR WIND CHART ON PAGE I-3.1 PROVIDES GENERAL GUIDANCE AS TO WHEN SIMULATIONS ARE REQUIRED. VEHICLE LIMITS ARE NOT EXPLICITLY REFLECTED.</p>					
MISSION:		SECTION:		STAGE/SUBSECTION:		SYSTEM:	
SA-513/SL-1		SPACE VEHICLE		WEATHER RESTRICTIONS			
REMARKS: The C-Band radar/Jimsphere system data is used in vehicle flight simulation programs to determine the effect of the wind on the vehicle in flight. Tracking of the Jimsphere by the real time C-Band radar is required to provide the wind monitoring team at MSFC with data to determine as early as possible if marginal conditions will or will not exist at launch and make a Go/No-Go recommendation to the Launch Operations Manager.						REQUIRED BY:	
						AERO	
						CONTROL NUMBER:	
						513-1P-003	
CONCURRENCES						PAGE	REVISION
AERO:	ASTR:	ASTN:				.1	REV 5
	SL-EI # 2-6-73	PROG. ENG. OFFICE:	SAT-E ROB 4-16-73	MO-MGR:	WAC 4/16/73	DATE: MAY 9 1973	PAGE: I-3

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:



NOTE :

- CONTROL SYSTEM FROM MSFC MEMO S&E-ASTR-SD-93-71, DATED 3 SEPTEMBER 1971.
- AERODYNAMICS FROM MSFC MEMO S&E-AERO-71-1, DATED 6 JANUARY 1971.
- TRAJECTORY DATA FROM BOEING MEMO 5-9410-H-433, DATED 17 SEPTEMBER 1972.
- α - β LIMITS FROM MSFC MEMO S&E-ASTN-ADL (72-41) DATED 12 APRIL 1972.

SKYLAB WIND BIASED WIND SPEED LIMITS AT 12 KILOMETERS ALTITUDE

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	2-927A	12K20	TEMP. - NOSE CONE COMPARTMENT INDICATION				60°F	76°F	FROM START OF LMRD UNTIL T-24 HOURS
		12K24 (ALTERNATE)	TEMP, NOSECONE COMPARTMENT INDICATION				65°F	80°F	FROM T-24 HOURS UNTIL INITIATION OF AUTO SEQUENCE
MISSION:		SECTION:		STAGE/SUBSECTION:		SYSTEM:			
SA-513/SL-1		LAUNCH VEHICLE		FACILITY GSE		REDLINES AND CATEGORIES			
REMARKS: Nose cone purge is required to maintain nose cone enclosure cleanliness and ambient temperature, and provide inerting. Loss of purge could result in excessive temperatures in PS volume, as well as hazardous gas buildup. At T-24 hours, purge temperature is increased from 63+5°F to 75+5°F to obtain acceptable launch temperatures for the ATM rack electrical/mechanical equipment. ATM telemetry data is not available to monitor temperatures; therefore, the proper purge temperatures must be assured. Loss of the purge after T-24 hours could result in cold rack equipment launch temperatures and corresponding cold problems in orbit prior to activation of the ATM systems, i.e., APCS, I&C, etc.						REQUIRED BY: ASTN ATM			
						CONTROL NUMBER: 513-EP-007-R 5			
						PAGE		REVISION	
						.1, .2		REV 4	
AERO:		ASTR:		ASTN:		DATE:		PAGE:	
ATM <i>Call 3-12-73</i>				SAT-E <i>3/12/73</i>		MO-MGR: <i>3-13-73</i>		MAY 8 1973 I-23A	

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. System Description

Volume enclosed by payload shroud is purged via a nose cone purge in two separate phases. First phase begins with the air purge at roll out from VAB. It is continuous, up to 30 minutes prior to cryogenic loading. At that time purge is switched over to N₂ at 50 lb/min with 1.54 psi umbilical pressure which is then continued till liftoff. Required compartment temperature range is $75^{\circ} \pm 5^{\circ}\text{F}$.

2. Probable Cause of (LMR) Violation

Facility GSE failure.

3. Consequence of (LMR) Violation

Skylab launch with cold rack temperatures and corresponding cold equipment problems in orbit prior to ATM systems activation.

4. Backup Measurements and Nominal Values

N/A

5. Operational Tests

Facility air supply units (Nose Cone Purge GSE) are verified prior to hook-up.

6. Reliability/Redundancy Considerations

There are no secondary purges available. Reliability of the system is dependent upon proven, well tested, and checked out facility GSE.

7. Instrumentation Accuracy and Method of Redline Determination

Instrumentation Accuracy (Overall) is $\pm 1.3^{\circ}\text{F}$.

8. Other Information

None

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
<p>THIS PAGE INTENTIONALLY LEFT BLANK</p> <p>(In addition, delete page 51A.2)</p>									
MISSION:		SECTION:		STAGE/SUBSECTION:			SYSTEM:		
REMARKS:							REQUIRED BY:		
							CONTROL NUMBER:		
CONCURRENCES							PAGE		REVISION
AERO:		ASTR:		ASTN:		CSE:			
		PROG. ENG. OFFICE:		PROG. OFFICE:		MO-MGR:		DATE:	
								PAGE: I-51A	

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	3-219	M7002-440	VOLTAGE - PDCS, OWS BUS 1			1 of 2 M			WHILE BUSES ARE ENERGIZED EITHER BY GROUND OR INTERNAL POWER UNTIL INITIATION OF AUTOMATIC SEQUENCE.
		M7400-440 (ALT, UMB)	VOLTAGE - PDCS, OWS BUS 1				25 VDC *	30 VDC *	
	3-221	M7003-440	VOLTAGE - PDCS, OWS BUS 2			1 of 2 M			* OWS BUS 1 AND 2 VOLTAGE SHALL BE WITHIN -1.8/+1.2 VDC OF THE RESPECTIVE AM REG. BUS.
		M7401-440 (ALT, UMB)	VOLTAGE - PDCS, OWS BUS 2						
	3-220	M7004-440	CURRENT - PDCS, OWS BUS 1			M	NONE	30 AMPS	TRANSIENTS THAT OCCUR DURING LOAD SWITCHING AND POWER TRANSFER ARE NOT CONSIDERED REDLINE VIOLATIONS
	3-222	M7005-440	CURRENT - PDCS, OWS BUS 2			M	NONE	22 AMPS	

MISSION: SA-513/SL-1	SECTION: WORKSHOP	STAGE/SUBSECTION: OWS/POWER DISTRIBUTION AND CONTROL SYSTEM	SYSTEM: REDLINES AND CATEGORIES
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REMARKS: OWS Buses 1 and 2 are the main 28 VDC power buses for the OWS. They receive power from AM Reg. Bus 1 and 2 and distribute power to most OWS electrical loads. Monitoring the OWS Bus voltage levels with respect to the AM Reg. Bus levels will insure that the buses are supplied with power at the required voltage level from the AM and that no excessive voltage drop exists in the AM/OWS power feeder circuitry.

REQUIRED BY:
MDAC-WEST
ASTR

CONTROL NUMBER:
513-OP-009-R5

CONCURRENCES				PAGE		REVISION	
AERO:	ASTR:	ASTN:		.1, .2, .3, .4,		REV. 5	
	SW			.5		REV. 2	
	PROG. ENG. OFFICE:	PROG. OFFICE: (EI)	MO-MGR:	DATE:		PAGE:	
		#5-9-73	49c 5/9/73	MAY 9 1973		I-52	

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. System Description

OWS Buses 1 and 2 are the main 28 VDC power buses for the OWS. They receive power from Reg. Bus 1 and 2 in the AM and in turn distribute power to most other OWS electrical loads. Main power feeder from AM Reg. buses to OWS buses is divided in two groups, each containing nine parallel power paths. Each bus has twenty-seven conductors from the AM/OWS interface to the OWS Power Distribution Console, nine circuit breakers (one set of nine in OWS; other set of nine in AM), three relays with three power contacts each, and three interface connectors. (Ref. Figure 1)

2. Probable Cause of Redline Violations

- a. Open circuit between REG & OWS buses
- b. Excessive load on REG bus
- c. Excessive load on OWS bus
- d. Faulty power feeding REG bus

3. Consequences of Redline Violations

Consequence of violating either upper or lower redline limit for OWS bus voltages is possible loss of subsystem loads necessary for accomplishment of primary objectives. The consequence of violating redline limit for OWS Bus currents is excessive power consumption or possible opening of bus feeder circuit breakers if maximum current capability is exceeded.

4. Backup Measurements and Nominal Values

M0153-513 VOLT - REG BUS 1	26.9 to 29.7 VDC (Refer to Airlock Module Rule 513-WP-018)
M0154-513 VOLT - REG BUS 2	

5. Operational Tests Not Applicable6. Reliability/Redundancy Considerations

Both OWS buses must be operational at launch to insure refrigeration system redundancy and water tank heater operation. Remote switching capability does not exist to transfer loads from a failed to an operational bus. Liftoff with only one bus active and/or with unacceptable bus voltages or currents could compromise the achievement of mission objectives.

MSFC LAUNCH MISSION RULE BACKGROUND

The Critical Items applicable:

KSC LMR ITEM	CIL GP/CAT	CIL IDENT	FMEA IDENT	PART NUMBER/PART NAME	MEASUREMENT NUMBER	*	COMMENTS
	LCC-2	4-54	Elect 31-06	1B78543/Circuit Breaker Assy	M7400-M7403	Yes	
	LCC-2	4-57	Data 61.1-31	1B80813/Voltage Sensor		Yes	
	LCC-2	4-51	Elect 31-03	1B83224/Wiring Harness 440A1W1	M7400,M7002 , M7004	Yes	
	LCC-2	4-50	Elect 31-02	1B69384/Wiring Harness 436W1		Yes	
	LCC-2	4-52	Elect 31-04	1B69383/Wiring Harness 436W2	M7401,M7003 , M7005	Yes	
	LCC-2	4-53	Elect 31-05	1B83225/Wiring Harness 440A1W2		Yes	

* WILL FAILURE OF THIS COMPONENT CAUSE MEASUREMENT TO EXCEED REDLINE LIMIT?

MSFC LAUNCH MISSION RULE BACKGROUND

7. Instrumentation Accuracy and Method of Redline Value Determination

<u>Measurement</u>	<u>CRT</u>	<u>AR</u>	<u>Meter</u>
M7400-440	-	+1.19*	+1.82 VDC
M7002-440	+0.74	+1.26*	+1.89 VDC
M7004-440	+3.5	+5.32*	+7.7 AMP
M7401-440	-	+1.19*	+1.82 VDC
M7003-440	+0.74	+1.26*	+1.89 VDC
M7005-440	+3.5	+5.32*	+7.7 AMP

* PRIME MONITORING DEVICE

All OWS electrical modules have a design upper limit of 30 VDC. Since line drop to many of these modules is negligible, upper redline limit is 30 VDC. Lower limit was determined by operation of RS Pump Inverter which requires between 24 and 30 VDC for proper operation. Allowing for a one volt line drop between OWS bus and the inverter input brings the lower redline limit on the OWS bus to 25 VDC. The requirement that the voltage is within +1.2/-1.8 VDC of the respective AM Reg. Bus reflects a line drop of 0.6 VDC due to maximum loads of 30 AMPS (OWS Bus 1) and 22 AMPS (OWS Bus 2) and system accuracies of +1.2 VDC. The bus current redline values reflect the predicted current loads and system accuracies.

8. Other Information

- One volt peak-to-peak noise between 20 and 20K Hertz on steady-state voltage is allowed. Excursions less than 1 sec. duration to 22.0 V minimum and 34 V maximum are allowed.
- One half of the water tank heaters are enabled prior to OWS closeout in the VAB and subsequently will operate as required as a function of the water temperature.
- The Refrigeration System is turned on in the VAB before perishable food is installed in freezers and remains on through subsequent prelaunch operations until shortly before liftoff. Power will be supplied to the pump inverter from a separate ESE power supply via the RACS/RS bus for the majority of the countdown and the Refrigeration System will be transferred to OWS Bus 1 for a short period prior to the terminal count.
- Monitoring the OWS Bus 1 & 2 voltage redlines will insure that both buses are being supplied with power at the required voltage level from the AM and insure that no excessive voltage drop exists in the AM/OWS power feeder circuitry.

MSFC LAUNCH MISSION RULE BACKGROUND

The prime concern related to bus current-carrying capability is whether or not any of the main power feeder circuit breakers in the AM or in the OWS have been inadvertently tripped open. Each tripped feeder circuit breaker in the AM or in the OWS will cause a loss of 1/9 of the copper in the positive feeder line (the return line is assumed to remain intact since it does not involve any active components). Since there is no direct instrumentation of circuit breaker position, this information must be obtained by analyzing the voltage drop between the AM Regulated Buses and the corresponding OWS Bus as a function of load current. Detection of excessive voltage drop between these two points will serve to indicate an anomalous condition in the prime feeder circuitry, which could be caused by tripped circuit breakers or by other less probable circuit faults.

It will actually be difficult to detect an open circuit breaker(s) since (1) the voltage drops will be small at the levels of OWS bus current drawn during the launch countdown, and (2) the end-to-end measurement system inaccuracies are large enough to mask a change in voltage drop caused by open circuit breakers. Prelaunch checkout procedures will be utilized to reduce the theoretical measurement inaccuracy and by recording data from KSC integrated testing for various states of circuit breakers configuration at several incremental current levels. It will be possible to construct a profile for voltage drop vs load current (see Figure 2).

- e. The following is a summary of the predicted OWS bus loads during launch countdown:

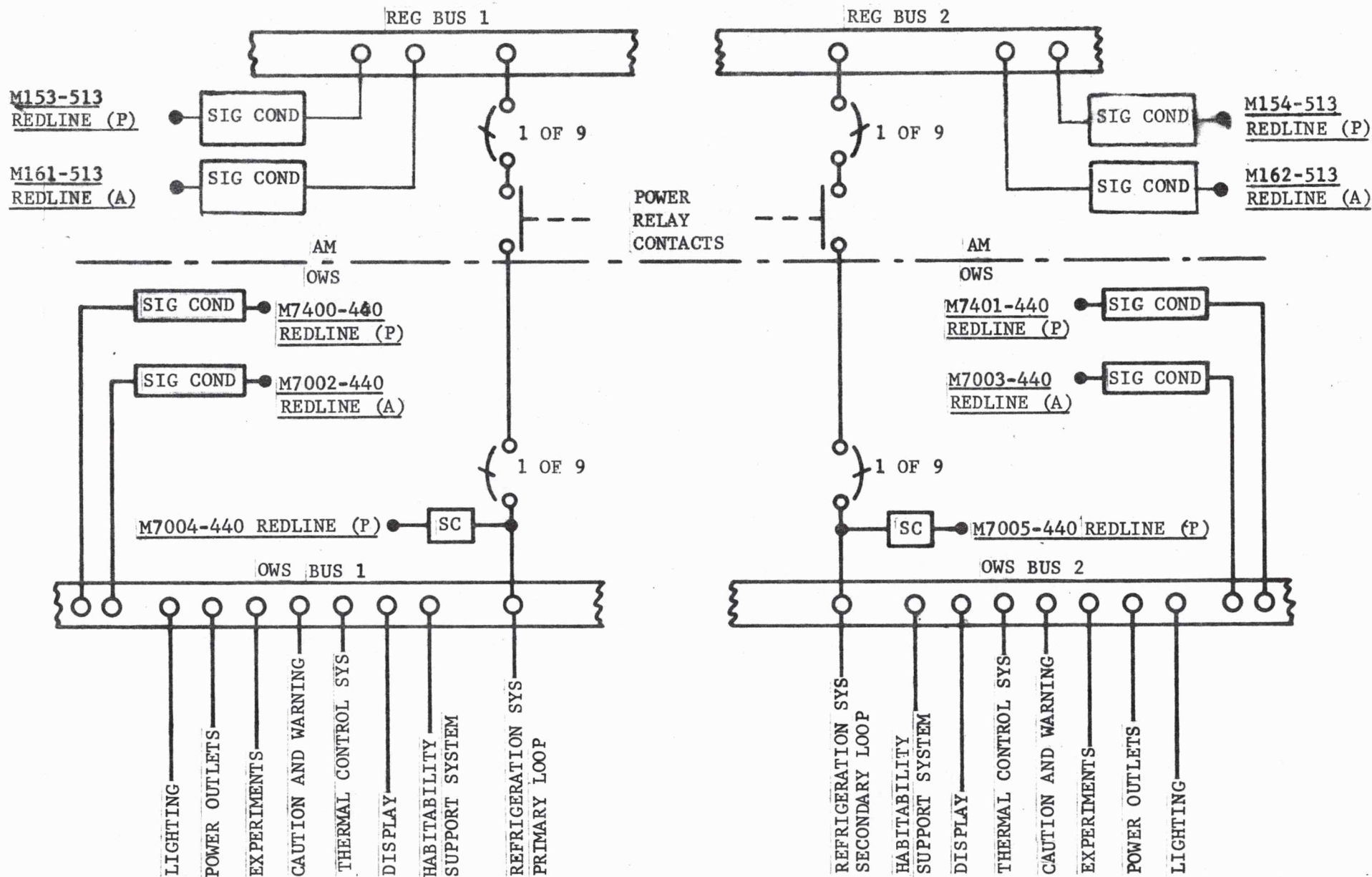
<u>Function</u>	<u>Bus #1</u>		<u>Bus #2</u>	
	Min	Max	Min	Max
Refrigeration Regenerator* Heater - 126 Watts	0	4.5	0	0
Refrigeration Logic Unit* - 33.6 Watts	1.2	1.2	1.2	1.2
Refrigeration Pump* Inverter	3.2	3.2	-	-
Metabolic Analyzer Ion Pump - 4 Watts	0.1	0.1	-	-
Water Container Heater 10 @ 95.5 Watts (5 per Bus)	0	17.1	0	17.1
TOTAL	4.5	26.1	1.2	18.3

*These loads are on the RACS/RS bus until T-20 hours.

9. System Schematic

Ref. Figure 1

MSFC LAUNCH MISSION RULE BACKGROUND



OWS SIMPLIFIED POWER DISTRIBUTION DIAGRAM

FIGURE 1

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	3-400	C7044-436	TEMP - TCS, FWD COMPT, NO. 6				42°F	63°F	FROM START OF LMRD UNTIL T-12 HOURS
						1 OF 2 M	* 55°F	63°F	FROM T-12 HRS. UNTIL T-11 MIN.
		C7042-436 (ALTERNATE)	TEMP - TCS, FWD COMPT, NO. 5				40°F	59°F	FROM START OF LMRD UNTIL T-12 HOURS
							51°F	59°F	FROM T-12 HRS. UNTIL T-11 MIN.
<p>*NOTE: RAMPING OF TEMP SHOULD START AT APPROX T-24 HRS TO ASSURE A MINIMUM OF 55°F AT T-12 HRS.</p>									
MISSION: SA-513/SL-1		SECTION: WORKSHOP		STAGE/SUBSECTION: OWS/GROUND THERMAL CONDITIONING SYSTEM			SYSTEM: REDLINES AND CATEGORIES		
REMARKS: Prelaunch temperature requirements for the OWS stored film in the film vault are to maintain temperature between 40°F and 50°F as much time as possible with allowable excursions to 65°F. 65°F is the maximum OWS internal environmental temperature which the refrigeration subsystem can tolerate during ground hold. A higher minimum temperature at T-12 hrs is required by the EREF tape requirement of 55°F minimum at launch (REF EDCR 2X0964).							REQUIRED BY: MDAC-WEST		
							CONTROL NUMBER: 513-OP-003-.R5		
CONCURRENCES							PAGE		REVISION
AERO:	ASTR:	ASTN:					.1	REV.4	
	SL-SW						.2, .3, .4, .5, .6	REV.5	
PROG. ENG. OFFICE:			PROG. OFFICE: (EI)		MO-MGR:	DATE:	PAGE:		
			H 5-9-73		49c 5/9/73	MAY 9 1973	I-57		

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. System Description

The ground thermal conditioning system provides on-pad temperature control to a maximum of 65°F and minimum of 40°F from the time of system activation in the VAB through launch minus 12 hours (55-65°F T-12 hours to launch). Circulation of conditioned dry gaseous nitrogen within the habitation area is effected by operation of one of two fans which force the nitrogen across heat exchangers providing the temperature conditioning. The heat exchangers and the two fans are located in the vehicle wardroom in the entertainment center. At least one circulating fan will be in operation from "Button Up" in the VAB until launch.

2. Probable Cause of Redline Violations

- a. Ground heat exchanger coolant temperature high/low.
- b. Fan failure.

3. Consequences of Redline Violations

Launch temperatures greater than 65°F could result in loss of temperature control in food freezers and shortened storage life of food. Temperatures less than 40°F violate the food and film ICD's. Temperature less than 55°F from T-12 hours until T-11 minutes violate the EREP tape to OWS ICD.

4. Backup Measurements and Nominal Values

C7408-436 FILM VAULT INT.

C7411-436 FOOD CONTAINER EXT.

47±5°F (until T-12 hours): 59±4°F (after T-12 hours)

5. Operational Tests

Not Applicable.

6. Reliability/Redundancy Considerations

All critical active functions are redundant.

- a. Two Heat Exchanger Fans,
- b. Two TCUs,
- c. Two Sets of Control Valves,

MSFC LAUNCH MISSION RULE BACKGROUND

The Critical Items applicable: _____

KSC LMR ITEM	CIL GP/CAT	CIL IDENT	FMEA IDENT	PART NUMBER/PART NAME	MEASUREMENT NUMBER	*	COMMENTS
	LCC-2	4-62	Ref 72	1A49958/Disconnect	C7043-C7044	Yes	

* WILL FAILURE OF THIS COMPONENT CAUSE MEASUREMENT TO EXCEED REDLINE LIMIT?

7. Instrumentation Accuracy and Method of Redline Value Determination

<u>MEASUREMENT</u>	<u>CRT</u>	<u>ACCURACY</u> <u>AR</u>	<u>METER</u>
C7044-436	+2.5°F*	+4.3°F	+6.5°F
C7042-436	-2.5°F*	-4.3°F	-6.5°F

*PRIME MONITORING DEVICE

Method of redline value determination - Red line is maximum value in ICD 65ICD9541, also maximum refrigeration system can tolerate at lift off without depleting max heat sink capacity. 40°F is minimum value in food and film ICD. 55°F is minimum requirement from T-12 hours until T-11 minutes to pre-condition EREP tapes prior to liftoff.

8. Other Information

The Ground Support Equipment (GSE) can be adjusted to bring the OWS internal temperature within the prescribed tolerance.

MSFC LAUNCH MISSION RULE BACKGROUND

8. Other Information (Cont'd)Effect of Ground Thermal Conditioning System (GTCS)
Unrepaired Failure * on Launch Day

GTCS LOSS	RESULTING IMPACT	ASSUMPTIONS
Anytime from 6 a.m. (EDT) through the launch window	Film temperature reaches 70° F. Ambient food temperature specification of 85° F not exceeded. The frozen food will exceed its specification limit of 0° F by 2° F.	<ul style="list-style-type: none"> a. GTCS fan de-energized when failure occurred. b. Controlled walls for 55 to 63° F prior to failure. c. For May launch. d. Refrigeration system (RS) ground cooling failure has not occurred.

* Since the resulting impacts represent some out of specification conditions, all effort should be made to maintain GTCS control. However, in the event that irreparable failures occur, the conditions given could be tolerated.

GTCS down time without recovery is indicated on Chart 1.

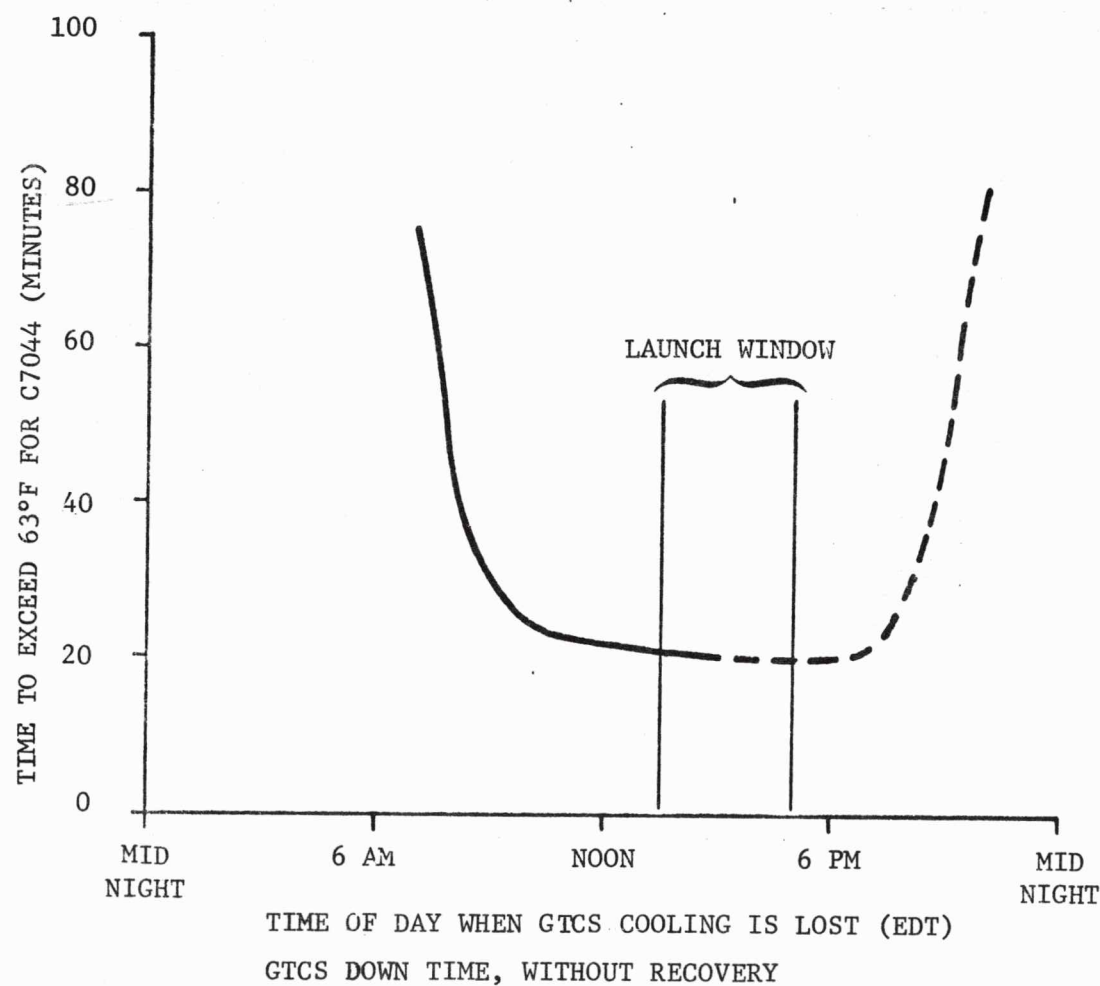
GTCS recovery time required is indicated on Chart 2.

GTCS "ON" requirements for various launch times as a function of GTCS failure times is indicated on Chart 3.

9. System Schematic

None

MSFC LAUNCH MISSION RULE BACKGROUND

NOTES

1. ASSUMES C7044 AT 58°F WHEN COOLANT LOSS OCCURED
2. APPLICABLE FOR HOT MAY DAY
3. ASSUMES GTCS FAN IS TURNED OFF WHEN COOLANT LOSS OCCURED
4. 15°F HEAT EXCHANGER FLUID SUPPLY TEMPERATURE

CHART 1

MSFC LAUNCH MISSION RULE BACKGROUND

NOTES

1. ASSUMES C7044 AT 58°F WHEN COOLANT LOSS OCCURED
2. APPLICABLE FOR HOT MAY DAY
3. ASSUMES GTCS FAN IS TURNED OFF WHEN COOLANT LOSS OCCURED
4. 15°F HEAT EXCHANGER FLUID SUPPLY TEMPERATURE

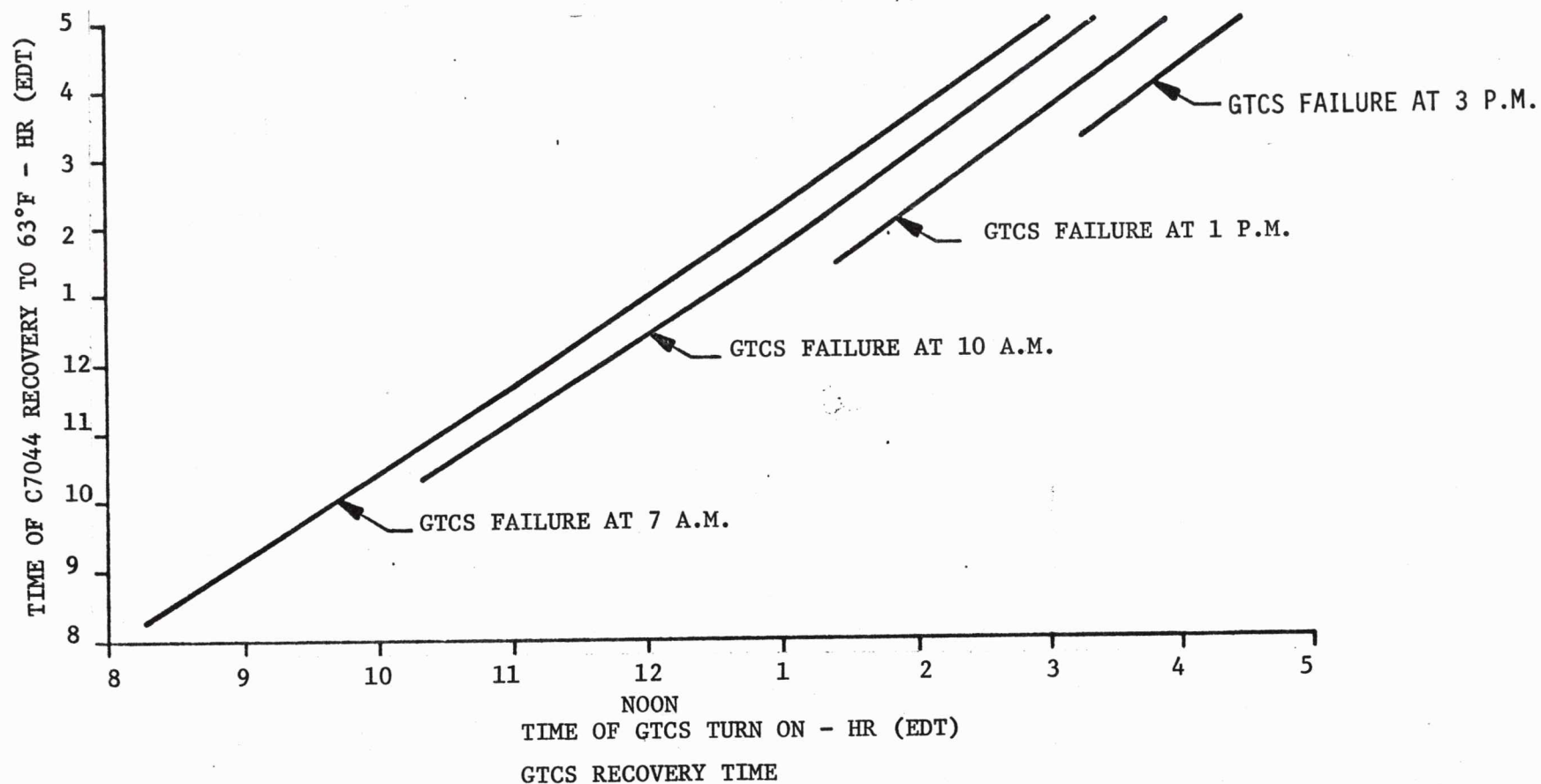
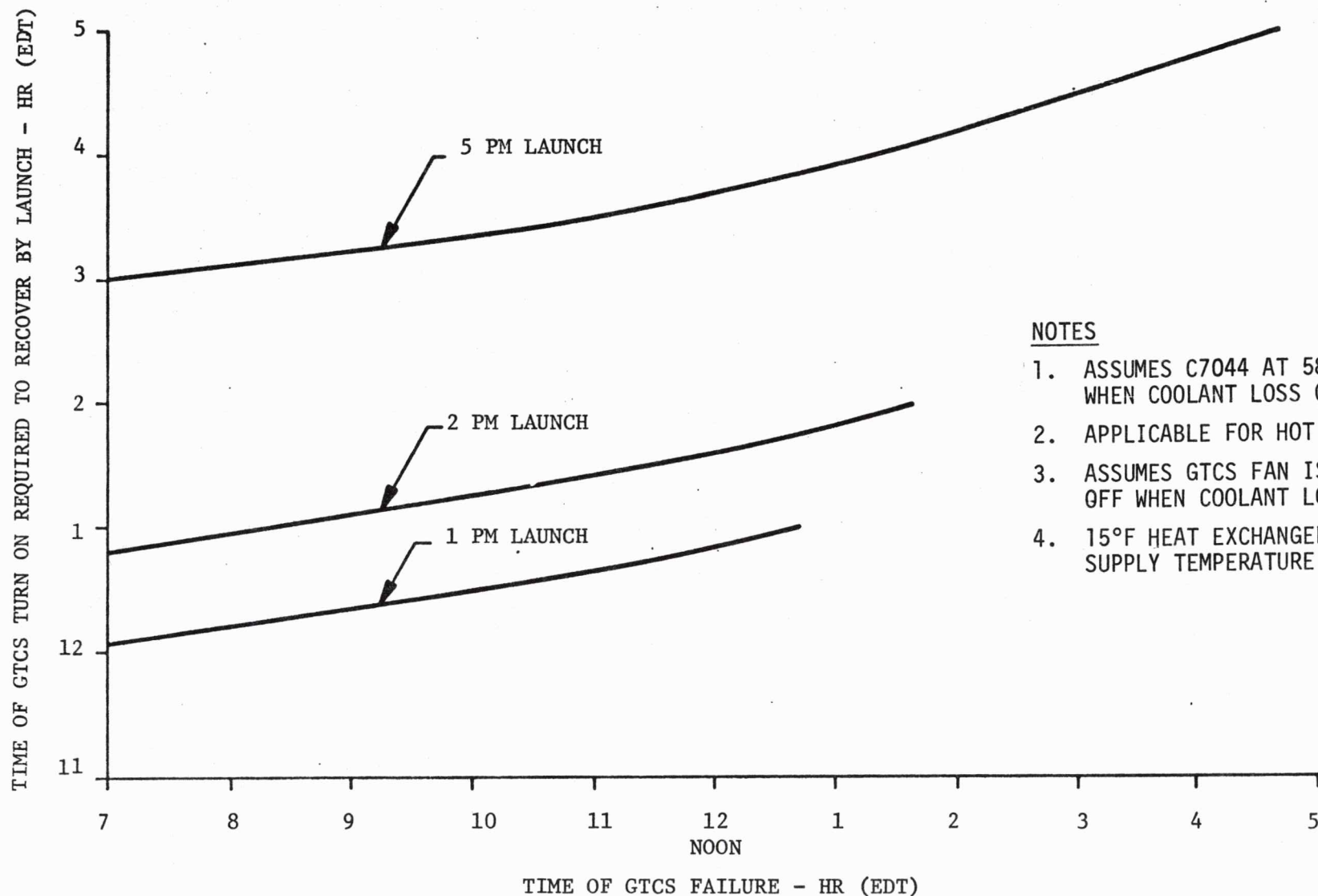


CHART 2

MSFC LAUNCH MISSION RULE BACKGROUND



NOTES

1. ASSUMES C7044 AT 58°F WHEN COOLANT LOSS OCCURED
2. APPLICABLE FOR HOT MAY DAY
3. ASSUMES GTCS FAN IS TURNED OFF WHEN COOLANT LOSS OCCURED
4. 15°F HEAT EXCHANGER FLUID SUPPLY TEMPERATURE

CHART 3. GTCS "ON" REQUIREMENTS FOR VARIOUS LAUNCH TIMES AS A FUNCTION OF GTCS FAILURE TIMES

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	3-401	C7115-403	TEMP-RS, PR CKT, T/C INL, COOL				-42°F	-24°F	FROM START OF LMRD UNTIL PRIMARY AND SECONDARY LOOP DISABLE (APPROX. T-5 MIN)
		K7326-403	EVENT-RS, PCR BYP VLV, RDTR MODE				*	*	* SYSTEM IN TOLERANCE WHEN COOLANT FLOW IS DIRECTED THROUGH THE GROUND HEAT EXCHANGERS.
		UC8162	TEMP, CCU SUPPLY			1 OF 2 M	-49°F	-27°F	FROM START OF LMRD UNTIL PRIMARY AND SECONDARY LOOP DISABLE (APPROX. T-5 MIN)
		UF8001 PLUS UF8011 (ALT)	FLOW RATE, WATER/GLYCOL FLOW RATE, WATER/GLYCOL				1.0 GPM	NONE	*(1) FOUR MEASUREMENTS REQUIRED.
MISSION: SA-513/SL-1		SECTION: WORKSHOP		STAGE/SUBSECTION: OWA/REFRIGERATION SYSTEM			SYSTEM: REDLINES AND CATEGORIES		
REMARKS: Verify proper prelaunch status and operation of the primary refrigeration loop and assure that thermal capacitor is completely frozen at launch. (Ref. 513-OP-002, page I-59) NOTE: Measurement C7115-403 is the primary redline.						REQUIRED BY: MDAC-WEST ASTR ASTN			
						CONTROL NUMBER: 513-OP-021-R5			
CONCURRENCES						PAGE		REVISION	
AERO:		ASTR:		ASTN: WCP Jm 5/8/73		CSE:		.1, .2	
		SL-SW 13						REV. 2	
								.3, .4, .5, .6	
								REV. 5	
		PROG. ENG. OFFICE:		PROG. OFFICE: (EI) #5-9-73		MO-MGR: WCP 5/9/73		DATE: MAY 9 1973	
								PAGE: I-58	

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. System Description

The refrigeration system contains a radiator bypass valve which directs coolant flow either through the radiator or the ground heat exchangers. During prelaunch operations, coolant flow is maintained continuously through the ground heat exchangers which provide proper coolant conditioning to maintain the thermal capacitor in a fully frozen state. The primary measurement indicates coolanol temperature in the primary loop between the ground heat exchangers and the thermal capacitors. Measurements within the redline values indicate the position of the radiator bypass valve in the bypass mode and sufficient cooling capacity from the ground heat exchangers.

2. Probable Cause of Redline Violation

- a. Valve failure
- b. Bypass valve controller malfunction
- c. GSE input command failure
- d. Insufficient cooling from the TCU

3. Consequences of Redline Violations

Consequence of a redline violation is that the thermal capacitor may not be in a fully frozen and chilled down condition at launch. This can result in insufficient cooling during the initial insertion/on-orbit operations and frozen food damage could result due to food temperatures exceeding 0°F. Loop switching could occur due to a freezer "HI" condition.

The long term impact is loss of the backup RS loop if the redline violation is due to a bypass valve or bypass valve controller failure.

4. Backup Measurements and Nominal ValuesNominal Range

C7701-A04 RS, CCU COOLANT OUTLET TEMP	-21°F to -43°F
K7412-436 EVENT-RS, PRIMARY CKT PUMP 1, ON	ON
D7002-436 PRESS-RS, PR LOOP, PUMP INLET	36 to 44 PSIA
D7001-436 PRESS-RS, PR LOOP, PUMP DELTA P	32 to 44 PSID
K7447-403 EVENT-RS, PLR BYP VLV, RDTR MODE	BYPASS MODE

5. Operation Tests

Not Applicable

MSFC LAUNCH MISSION RULE BACKGROUND

6. Reliability/Redundancy Considerations

A redline violation may indicate an onboard system failure which could ultimately result in loss of one of the two available RS loops, thereby eliminating loop redundancy and reducing RS reliability.

The Critical Items applicable:

KSC LMR ITEM	CIL GP/CAT	CIL IDENT	FMEA IDENT	PART NUMBER/PART NAME	MEASUREMENT NUMBER	*	COMMENTS
	LCC-2	4-65	Ref 120.01.01	1B82697/Refrigeration Bypass Controller	C7115,K7326	Yes	
	LCC-2	4-67	Ref 120.01.01- 10	1B79878-1/Solenoid Bypass Valve		Yes	
	LCC-2	4-75	Ref 120.01.04- 13	7541626/Quick Disconnect		Yes	
* WILL FAILURE OF THIS COMPONENT CAUSE MEASUREMENT TO EXCEED REDLINE LIMIT?							

7. Instrumentation Accuracy and Method of Redline Value Determination

a. <u>Measurement</u>	<u>CRT</u>	<u>AR</u>	<u>Meter</u>
C7115-403 (P)	+ 4.4*	+ 7.6	+ 11.3 °F

* Prime monitoring device

The method of redline value determination is to select temperatures which are sufficiently low to ensure a fully frozen and chilled thermal capacitor. Test data indicate that a coolanol temperature of -24°F, or colder, entering the thermal capacitor for a prolonged period of time will place the capacitor in the required "charged" condition. This upper value for measurement C7115-403 is a soft value and does not contain instrumentation error. The lower limit of -42°F is equal to the lower redline limit of -40°F for thermal capacitor outlet temperature (see reference 513-OP-002) less a 2°F temperature rise due to thermal control panel heat leak.

(Page I-59)

MSFC LAUNCH MISSION RULE BACKGROUND

- b. Instrumentation accuracy for the alternate measurement is not applicable since it is a bilevel measurement. Absence of signal indicates flow through the ground heat exchangers.

8. Other Information

The normal operating procedure for the Ground Temperature Control Unit as specified in TCRSC 1B83429 should preclude measurement C7115-403 from being out of redline limits.

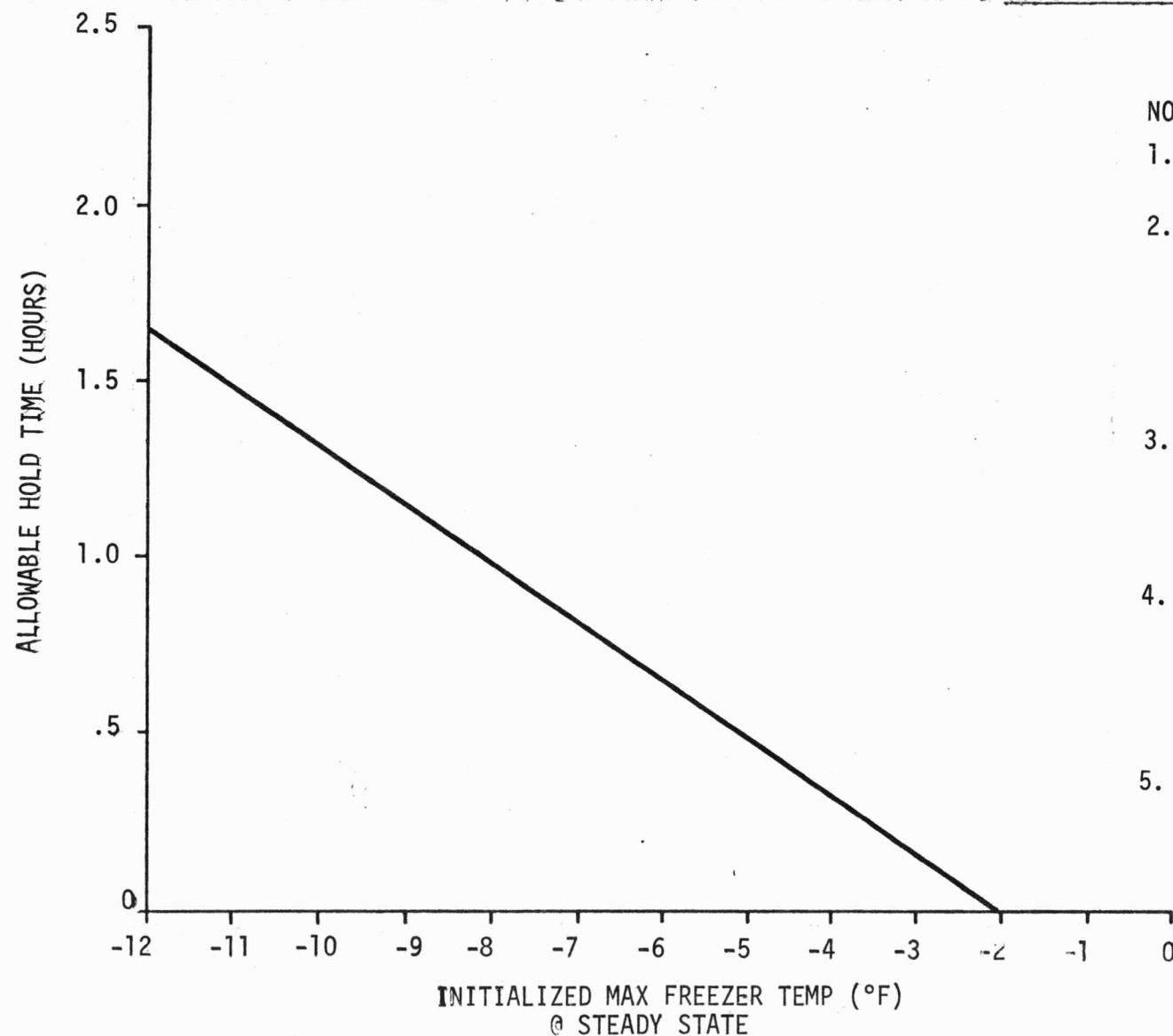
Hold times vs. Recovery times are indicated on Charts 1, 2 and 3.

9. System Schematic

Ref. Figures 1 & 2, 513-OP-002, Pages I-59.6 & I-59.7

MSFC LAUNCH MISSION RULE BACKGROUND

ALLOWABLE HOLD TIME (LOSS OF TCU) AS A FUNCTION OF MAX FREEZER TEMPERATURE TO PREVENT FOOD TEMPERATURE EXCEEDING 0° F. (ON BOARD PUMP OFF DURING HOLD) WITH RECOVERY REQUIRED.

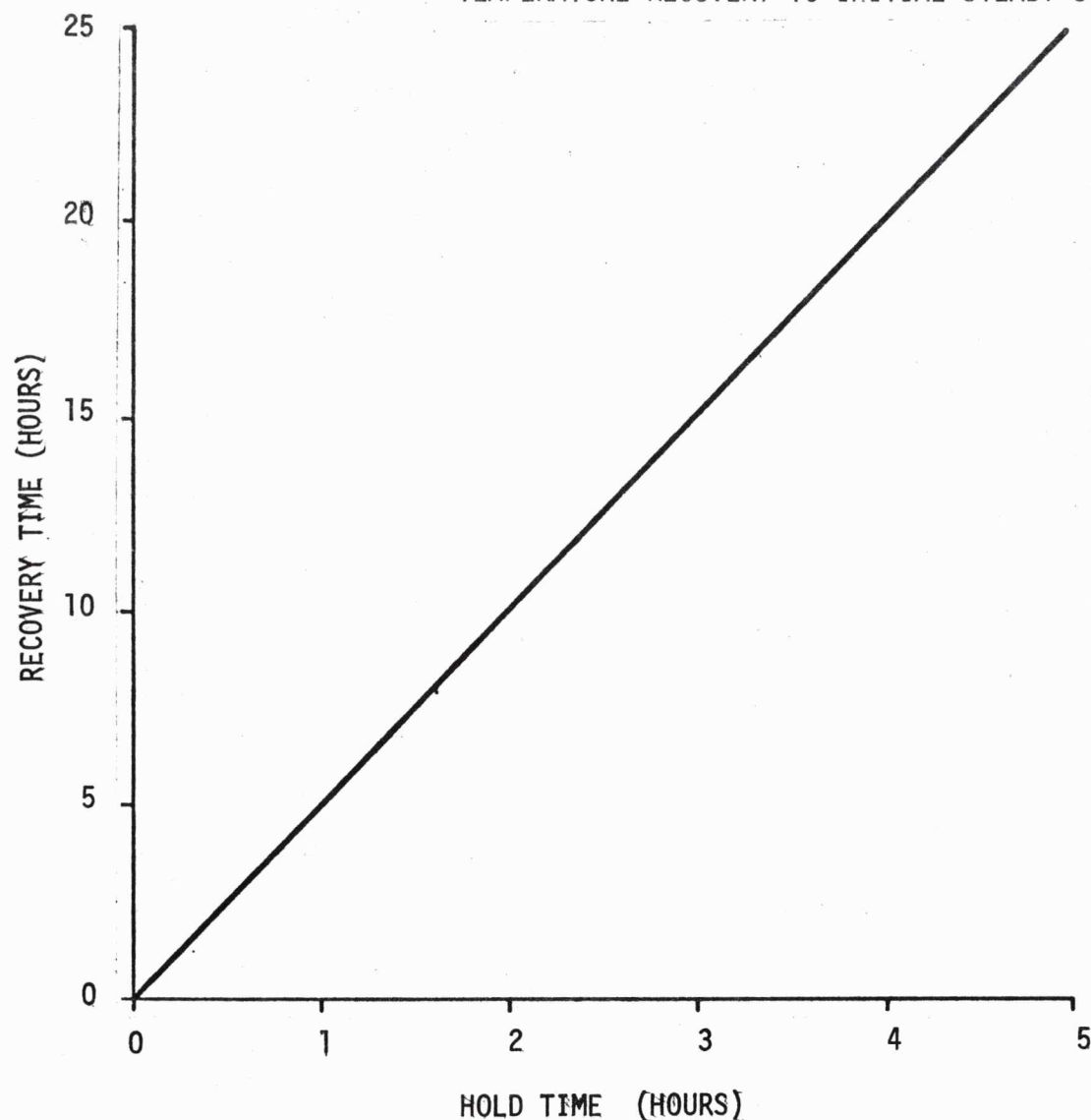


NOTES

1. ALLOWS FOR FOOD TEMPERATURE OVERSHOOT AFTER TCU RESTART.
2. CURVE BASED ON TM SENSOR (C7281 OR C7282 OR C7283) REACHING -2°F. SUBSEQUENT ACTUAL FOOD TEMPERATURE OVERSHOOT WILL NOT EXCEED 0°F. IF TCU RESTART ON OR BEFORE TM SENSOR = -2°F.
3. THIS CURVE NOT VALID FOR HOLD PRIOR TO LIFT-OFF WITHOUT RECOVERY. SEE CHART 2 FOR REQUIRED RECOVERY TO ACHIEVE INITIAL CONDITIONS.
4. IF FREEZER TEMPERATURES REACH 0°F & TCU CANNOT RESTART, START ONBOARD PUMP TO UTILIZE CAPACITOR TO PROVIDE TEMPORARY THERMAL CONTROL FOOD MAY EXCEED 0°F IN THIS MODE.
5. TCU AND PUMPS MUST BE RESTARTED AT OR BEFORE HOLD TIME EXCEEDED.

CHART 1

MSFC LAUNCH MISSION RULE BACKGROUND

REQUIRED RECOVERY TIME VS HOLD TIME TO ACHIEVE FOOD
TEMPERATURE RECOVERY TO INITIAL STEADY STATE CONDITIONS

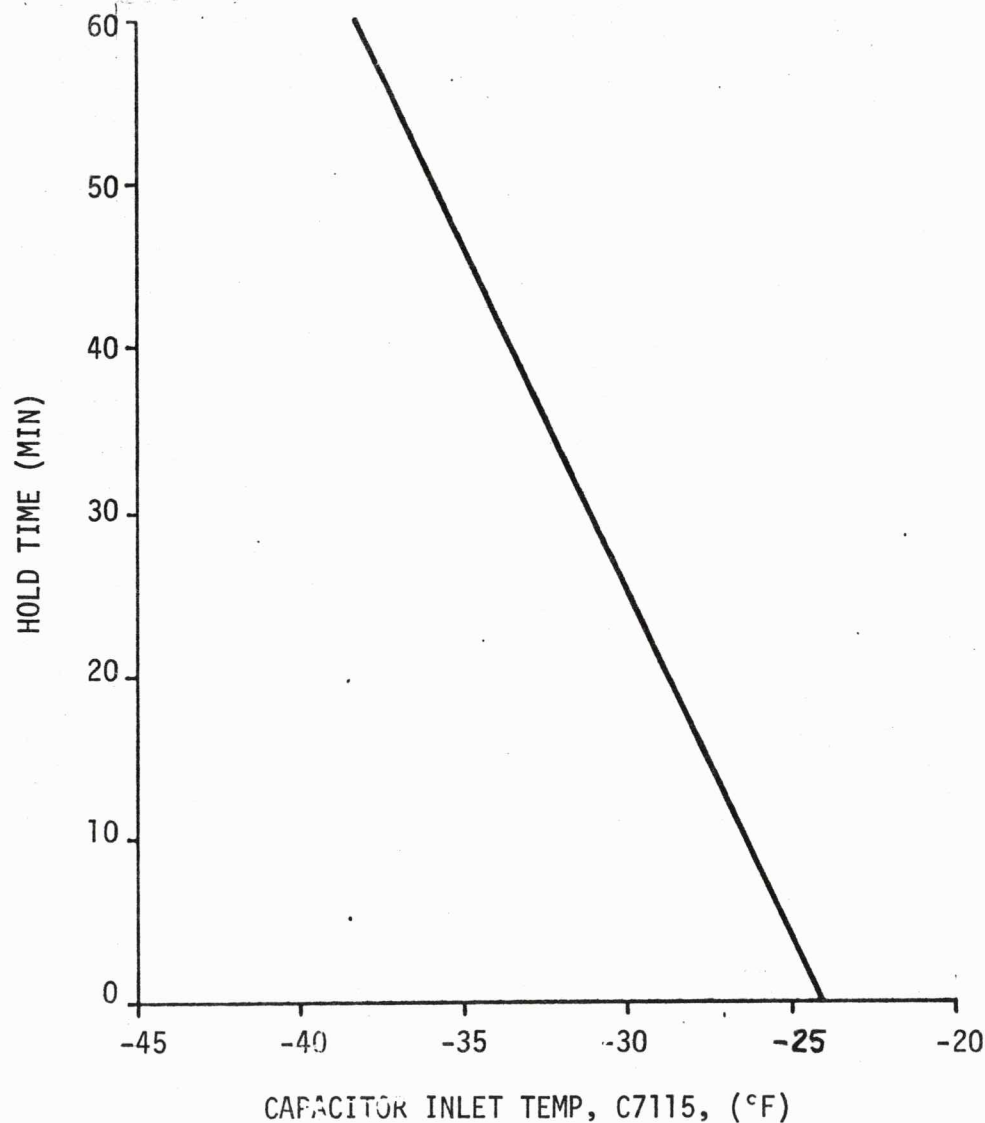
NOTES

1. TCU PERFORMANCE (TEMP & FLOW RATE) EQUAL BEFORE AND AFTER HOLD.
2. FLIGHT SENSORS IN FREEZERS WILL RECOVER TWICE AS FAST AS THE ACTUAL FOOD.
3. SEE CHART 1 FOR ALLOWANCE HOLD TIMES.

CHART 2

MSFC LAUNCH MISSION RULE BACKGROUND

MAXIMUM RS/TCU HOLD TIMES FOR PRE-LAUNCH WITH
NO RECOVERY REQUIRED PRIOR TO LIFT-OFF.



NOTE

1. INSTRUMENTATION TOLERANCE INCL.
2. PUMPS OFF (ON BOARD) DURING HOLD
3. ALL SYSTEM TEMPS @ STEADY STATE PRIOR TO HOLD.
4. ALLOWS FOR FOOD TEMPERATURE RISE DURING INSERTION.

CHART 3

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	3-402	C7279-403	TEMP - RS, PRI CKT, FREEZER THERMAL CONT VALVE COOLANT OUT			1 OF 2 M	-40°F	-20°F	FROM START OF LMRD UNTIL PRIMARY AND SECONDARY LOOP DISABLE (APPROX. T-5 MIN.)
		C7402-403 (ALT, UMB)	TEMP - RS, PRI CKT, FREEZER THERMAL CONT VALVE COOLANT OUT						
	3-403	C7296-436	TEMP - RS, PRI CKT CHILL THERM CONT VALVE COOLANT OUT			1 OF 2 M	+35.3°F	+42.8°F	FROM START OF LMRD UNTIL PRIMARY AND SECONDARY LOOP DISABLE (APPROX. T-5 MIN.)
		C7404-436 (ALT, UMB)	TEMP - RS, PRI CKT CHILL THERM CONT VALVE COOLANT OUT						

MISSION:	SECTION:	STAGE/SUBSECTION:	SYSTEM:
SA-513/SL-1	WORKSHOP	OWS/REFRIGERATION SYSTEM	REDLINES AND CATEGORIES

REMARKS:	REQUIRED BY:
Verify proper prelaunch status and operation of primary refrigeration loop. Assure that thermal conditioning of OWS refrigeration system freezer, storage, and chiller compartments is maintained within acceptable limits during prelaunch operations. (Ref. 513-OP-008, Page I-62)	MDAC-WEST ASTN
	CONTROL NUMBER:
	513-OP-002-R5

CONCURRENCES					PAGE	REVISION
AERO:	ASTR:	ASTN:		CSE:	.1, .2, .3, .4, .5, .7	REV 2
	SL-SW <i>LB</i>	<i>WEP JA 5/8/73</i>			.6	REV 3
		PROG. ENG. OFFICE:	PROG. OFFICE: (EI)	MO-MGR:	DATE: MAY 9 1973	PAGE: I-59
			<i>#5-9-73</i>	<i>WAC 5/9/73</i>		

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. System Description

The Refrigeration System (RS) is a low-temperature thermal control system that utilizes coolanol-15 in a closed loop to provide for freezing of food and urine and for chilling of food, urine, and potable water. Temperature control is provided in the range of +42°F to -20°F. Two coolant loops (primary and secondary) are provided in the RS, with the secondary loop being a backup in the event of primary loop failure. The two loops are essentially identical and independent of each other except for common utilization of the radiator, ground cooling heat exchanger, and thermal capacitor in the heat rejection portion of the loop. These components have separate primary and secondary coolant paths as do the freezers, chillers, regenerator HX and regenerative heater located in the inner portion of the loop. Each loop of the RS contains automatic failure logic that will switch pumps on receipt of a low pump differential pressure signal, or switch loops due to low pump accumulator level or logic unit power supply voltage out of band. The primary loop also contains logic to switch to the secondary loop for high wardroom freezer inlet temperature, or low chiller inlet temperature.

For on-orbit operation, heat gained in the freezers, chillers and associated plumbing is rejected to space by the radiator with supplemental heat rejection capability provided by the thermal capacitor (charged with undecane wax) located downstream of the radiator. During the LMRD effectivity period, normal operation of the RS will be on the primary loop with the radiator bypass valve in the bypass position. Heat gained will be rejected to a GSE ground cooling cart via the ground cooling heat exchangers.

2. Probable Cause of Redline Violations

a. Causes of high side violations of measurements C7279-403 and C7402-403:

1. Pump failure.
2. Radiator bypass valve failed in radiator mode.
3. Ground cooling heat exchanger TCU coolant temperature high.
4. Insufficient chilldown time.
5. Excessive heat leak.

b. Causes of low side violations of measurements C7279-403 and C7402-403:

1. Ground cooling heat exchanger TCU coolant temperature low.

c. Causes of high side violations of measurements C7296-436 and C7404-436:

1. Chiller control valve malfunction.

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD ACTION NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	3-2155	K374-512	POSITION - COAX SWITCH 2W OR 10W			M	*	*	COMMIT AT END OF FINAL TRANSMITTER TEST (APPROX. T-19 HRS.) *SYSTEM IN TOLERANCE IF 2 WATT XMTR SELECTED. DISREGARD WHEN 10 WATT XMTR IS BEING TESTED
MISSION:		SECTION:		STAGE/SUBSECTION:			SYSTEM:		
AS-513/SL-1		WORKSHOP		AM/I&C SYSTEM			REDLINES AND CATEGORIES		
REMARKS: Should the 10-watt transmitter be selected for launch, telemetry transmission may be impaired at certain altitudes.							REQUIRED BY:		
							MDAC-EAST ASTN		
							CONTROL NUMBER:		
							513-WP-014-R1		
CONCURRENCES							PAGE	REVISION	
AERO:		ASTR:		ASTN:					
		AL/MDA							
		PROG. ENG. OFFICE:		PROG. OFFICE: (EI)		MO-MGR:		DATE:	
				#4-25-73		4/25/73		MAY 8 1973	
							PAGE: I-78		

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. System Description

AM Data Transmission and Antenna Subsystem provides RF transmission capability to STDN during prelaunch, launch and orbit for real time and delayed time data and delayed time voice, in both stabilized and unstabilized vehicle attitudes. Airlock telemetry data is transmitted to STDN by means of four telemetry transmitters consisting of three 10-watt units and one 2-watt unit. 2-watt transmitter is used during launch phase of SL-1. 10-watt transmitters are used during orbit phases of mission. See Figure 1 for system diagram.

2. Probable Cause of Redline Violations

- a. Relay malfunction
- b. Human error

3. Consequence of a Redline Violation

When used with the 10-watt transmitter the quadriplexer is subject to a corona discharge at certain ambient pressures down to .07 MMHg, which will reflect the transmitter output power. Although no permanent damage would be sustained by either the transmitter or quadriplexer, telemetry transmission would be impaired until the corona was extinguished.

4. Backup Measurements and Nominal Values - See Paragraph 55. Operational Tests - During the final transmitter test the DCS command S195 will be sent for the last time selecting the 2-watt transmitter for operation for the remainder of the countdown and for launch. When the command is sent, observe that received signal strength decreases to insure 2-watt transmitter was actually selected. The above assumes sufficient attenuation is inserted in RF link to take receiver out of saturation.6. Reliability/Redundancy Considerations - None.7. Instrumentation Accuracy and Method of Redline Value Determination - The discrete measurement verifying coax switch position in combination with change in signal strength is used rather than a continuous signal strength indication. Atmospheric conditions, antenna orientation/location, etc., make continuous signal strength monitoring an unreliable method for determining whether the 2-watt or 10-watt is transmitting at a given time. With the above method, there is no accuracy problem.8. Other Information - None

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	3-2201	C101-524	TEMP, BATTERY 1 INTERNAL			M	26°F	100°F	FROM START OF LMRD UNTIL INITIATION OF AUTOMATIC SEQUENCE SEE AM FIG. 3 (PG. I-103)
	3-2202	C102-524	TEMP, BATTERY 2 INTERNAL			M	26°F	100°F	
	3-2203	C103-524	TEMP, BATTERY 3 INTERNAL			M	26°F	100°F	
	3-2204	C104-524	TEMP, BATTERY 4 INTERNAL			M	26°F	100°F	
	3-2205	C105-525	TEMP, BATTERY 5 INTERNAL			M	26°F	100°F	
	3-2206	C106-525	TEMP, BATTERY 6 INTERNAL			M	26°F	100°F	
	3-2207	C107-525	TEMP, BATTERY 7 INTERNAL			M	26°F	100°F	
	3-2208	C108-525	TEMP, BATTERY 8 INTERNAL			M	26°F	100°F	
MISSION:		SECTION:		STAGE/SUBSECTION:		SYSTEM:			
SA-513/SL-1		WORKSHOP		AM/ELECTRICAL POWER SYSTEM		REDLINES AND CATEGORIES			
REMARKS: AM battery temperatures are controlled by active TCS during prelaunch operations to assure battery electrical performance within acceptable limits. Battery degradation and/or loss occurs at high operating temperatures. (Ref. 513-WP-016, Page I-86)						REQUIRED BY:			
						MDAC-EAST ASTR			
						CONTROL NUMBER:			
						513-WP-003 - R 2			
CONCURRENCES						PAGE		REVISION	
						.1, .2		REV. 5	
						.3		REV. 3	
AERO:		ASTR:		ASTN: <i>swl</i>		CSE:		DATE:	
				<i>X-15</i> 5/7/73 AL/MDA <i>mb</i> 5/8/73 PROG. ENG. OFFICE:		MO-MGR: <i>WAC</i> 5/9/73		MAY 9 1973	
				PROG. OFFICE: (EI) <i>#5-973</i>				PAGE 1-82	

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. System Description

- a. Ref. 513-WP-016, Page I-86, Para. 1a.
- b. OWS solar array is divided into eight electrically identical parts called solar array groups, each of which feeds a power conditioning group (PCG) composed of battery charger, battery, and voltage regulator. The function of each PCG is to provide conditioned power to using equipment and to recharge nickel-cadmium batteries during orbital daylight period. Battery charger output voltage is limited as a function of battery temperature and available power. Temperature compensation of charger voltage is provided to prevent hydrogen generation within battery and to restrict oxygen generation rate to that level which can be recombined within battery without venting. Two thermistors installed within each battery provide temperature sensing to the battery charger for this function. An additional thermistor within each battery provides battery temperature for telemetry purposes. Each battery is mounted with base of the case in contact with a cold-plate, through which coolant is circulated to remove battery generated heat. For diagram ref. Fig. 1, 513-WP-016 and Fig. 1, 513-WP-023 on Pages I-86 and I-97 respectively.

During the LMRD effectivity period, each battery will be charged and discharged, with resulting heat removed by active coolant system to maintain control of battery temperature.

2. Probable Cause of Redline Violations

- a. Excessive battery charge/overcharge due to battery charger malfunction (maximum limit violation).
- b. Malfunction of ground cooling system (maximum limit violation - all batteries). Refer to 513-WP-022, Page I-96.
- c. Malfunction of active coolant system (maximum or minimum limit violation - all batteries). Refer to 513-WP-022, Page I-96.

3. Consequences of Redline Violations

An overtemperature condition will reduce battery cycle life; therefore, depending on the extent of degradation, energy storage capability of the affected battery or batteries in the latter portions of the mission may be reduced. If the violation is the result of a charger malfunction, the charger and affected battery may be unusable, reducing system energy storage capability as long as the malfunction persists. An undertemperature condition will result in lower than normal battery charge rates, however, no adverse effect on the batteries will result.

4. Backup Measurements and Nominal ValuesPrimary Coolant Loop:

C233-505 TEMP, PRI LOOP - BAT MOD 1 OUTLET

C235-505 TEMP, PRI LOOP - BAT MOD 2 OUTLET

Nominal Values:

37 to 90°F.

Comparative temperatures of coolant in the active loop entering and leaving battery module coldplates provide battery coolant status.

MSFC LAUNCH MISSION RULE BACKGROUND

4. Backup Measurements and Nominal Values (Contd)

C273-534 TEMP, PRI CLNT CTL VLV - CVPC OUT 1
 C275-534 TEMP, PRI CLNT CTL VLV - CVPC OUT 2

Nominal Values:
 34 to 70°F

Ref: 513-WP-022

M133-524
 thru

M136-524 VOLT, BATTERY 1 THRU 8
 and VOLTAGE

M137-525
 thru
 M140-525

Nominal Values:
 37.3 to 46.9 VDC

Battery voltage level is an indication of the battery temperature when the battery is maintained in the voltage limited charge mode. If the voltage is fairly steady and is between the stated limits, then the battery temperature is in the acceptable range.

Secondary Coolant Loop:

C234-505 TEMP, SEC LOOP - BAT MOD 1 OUTLET
 C236-505 TEMP, SEC LOOP - BAT MOD 2 OUTLET

Nominal Values: :
 37 to 90°F.

Comparative temperatures of coolant in the active loop entering and leaving battery module coldplates provide battery coolant status.

C274-534 TEMP, SEC CLNT CTL VLV - CVSC OUT 1
 C276-534 TEMP, SEC CLNT CTL VLV - CVSC OUT 2

Nominal Values:
 34 to 70°F

Ref: 513-WP-022

5. Operational Tests

None

6. Reliability/Redundancy Considerations

Eight (8) nickel-cadmium batteries are provided in the AM EPS. Battery overtemperature conditions could result in a reduction of cycle life capability of the affected batteries which could ultimately result in loss of the affected batteries and a reduction of available power.

The Critical Items applicable:

KSC LMR ITEM	CIL GP/CAT	CIL IDENT	FMEA IDENT	PART NUMBER/PART NAME	MEASUREMENT NUMBER	*	COMMENTS
	LCC-II	pg 29	EPS 1.1.17	61B769006/Battery Charger	C101-C108	Yes	

*Will failure of this component cause measurement to exceed redline limit?

MSFC LAUNCH MISSION RULE BACKGROUND

7. Instrumentation Accuracy and Method of Redline Value Determination

Instrumentation Accuracy: +2.9, -5.3 (Range 26 to 100°F) (CRT)

Method of Redline Value Determination: Analysis of previous AM battery subcontractor testing has indicated desirability of maintaining nickel-cadmium battery temperature and at absolute levels of approximately room temperature (75°F). Maximum limit is beyond normal operating range using ground coolant system, but below automatic cut-off point setting of battery chargers. Minimum limit is well below normal operating range and was widened by the amount of instrumentation accuracy.

8. Other Information

Each battery charger contains control circuitry to limit battery charge current to 0.5 AMP max. in the event battery temperature reaches 120 + 0, - 12°F.

9. System Schematic

Ref. Fig. 1, 513-WP-023 & Fig. 1, 513-WP-016 on Pages I-97 and I-71 respectively.

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
3-2253	M133-524		VOLT, BATTERY 1 VOLTAGE			M	SEE AM FIG 3&4	SEE AM FIG 3	SEE AM FIG. 3 & 4 (PGS. I-103, 104)
3-2254	M134-524		VOLT, BATTERY 2 VOLTAGE			M			
3-2255	M135-524		VOLT, BATTERY 3 VOLTAGE			M			
3-2256	M136-524		VOLT, BATTERY 4 VOLTAGE			M			
3-2257	M137-525		VOLT, BATTERY 5 VOLTAGE			M			
3-2258	M138-525		VOLT, BATTERY 6 VOLTAGE			M			
3-2259	M139-525		VOLT, BATTERY 7 VOLTAGE			M			
3-2260	M140-525		VOLT, BATTERY 8 VOLTAGE			M			
3-2261	M141-524		VOLT, BATTERY 1 CURRENT			M	NONE	SEE AM FIG 4	SEE AM FIG 4, (PG. I-104)
3-2262	M142-524		VOLT, BATTERY 2 CURRENT			M			
3-2263	M143-524		VOLT, BATTERY 3 CURRENT			M			
3-2264	M144-524		VOLT, BATTERY 4 CURRENT			M			
3-2265	M145-525		VOLT, BATTERY 5 CURRENT			M			
3-2266	M146-525		VOLT, BATTERY 6 CURRENT			M			
3-2267	M147-525		VOLT, BATTERY 7 CURRENT			M			
3-2268	M148-525		VOLT, BATTERY 8 CURRENT			M			
MISSION: SA-513/SL-1				SECTION: WORKSHOP		STAGE/SUBSECTION: AM/ELECTRICAL POWER SYSTEM		SYSTEM: REDLINES AND CATEGORIES	
REMARKS: AM batteries (8) are required to power AM/MDA/OWS loads from transfer to internal power (prelaunch) through launch. Each AM battery must be at nearly full SOC during final prelaunch periods to provide maximum total battery energy for initial OWS SAS activation, plus contingency backup activation command time, and during orbital night periods. (Ref. 513-WP-003 and -017 on Pages I-82 and I-85 respectively.)						REQUIRED BY: MDAC-EAST ASTR			
						CONTROL NUMBER: 513-WP-016- R5			
						PAGE		REVISION	
						.4, .5		REV.3	
						.1, .2, .3,		REV.5	
AERO:		ASTR: <i>4-23-73</i>		ASTN:		AL/MDA <i>22</i> <i>5/4/73</i>		PROG. ENG. OFFICE:	
						PROG. OFFICE: (EI) <i>HS-9-73</i>		MO-MGR: <i>WRE 5/9/73</i>	
						DATE: MAY 9 1973		AGE: I-86	

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. System Description

- a. AM EPS is designed to accept power from a solar array mounted on OWS (during flight) or from external power (during prelaunch operations) and to condition this power for application to AM EPS buses and nickel-cadmium batteries. Nickel-cadmium batteries are utilized to provide power to loads during the orbital night period, launch period, and during prelaunch periods when external power is not applied.
- b. OWS solar array is divided into eight electrically identical parts called solar array groups, each of which feeds a power conditioning group (PCG), composed of battery charger, battery, and voltage regulator. Function of each PCG is to provide conditioned power to loads and to recharge the nickel-cadmium batteries during orbital daylight periods. Each battery charger contains two ampere-hour integrator circuits, (primary and secondary), each of which computes an approximate value for battery state of charge, with the selected circuit providing a control signal to reduce charging to low levels upon reaching full charge conditions. The state of charge measurement of each ampere-hour integrator circuit is continuously provided to the AM telemetry subsystem. Temperature compensation is provided for each ampere-hour integrator circuit to account for variation in battery charging efficiency as temperature of the battery changes. Each battery contains 30 series connected cells. During LMRD effectivity period, each battery will be charged and discharged, with apparent SOC monitored and charging controlled (in part) by ampere-hour integrator circuits. Battery voltage will also be monitored to provide an indication of battery performance under both charge and discharge conditions. For diagram, refer to Figure 1.

2. Probable Cause of Redline Violations

Minimum SOC Limit Violations (SOC, CN 513-WP-017 on Page I-85) (Note: Maximum SOC Limit Violations - N/A)

- a. Excessive battery discharge due to loss of external power (all eight batteries).
- b. Excessive battery discharge due to battery discharge due to battery charger malfunction (one battery).
- c. Malfunction of ampere-hour integrator circuit selected to control battery charging (one battery).

Maximum Voltage Limit Violations (Charge Cycle, AM Fig. 3) (Note: Minimum Limit Violations during charge cycle - N/A)

- a. Excessive charging voltage resulting from a charger malfunction.

Minimum Voltage Limit Violations (Discharge Cycle, AM Fig. 4) (Note: Maximum Limit Violations during discharge cycles N/A)

- a. Excessive load impressed on the battery.
- b. Loss of individual cell outputs.
- c. Low battery state of charge.

MSFC LAUNCH MISSION RULE BACKGROUND

Unexpected Increase in Battery Current (Discharge Cycle, AM Fig. 4)

- a. Although there is no redline value for maximum battery current, an unexpected increase may be caused by a malfunction in the EPS or load equipment and therefore should be investigated.

3. Consequences of Redline Violations

Violation of the minimum limit for state-of-charge would reduce the stored energy available for initial OWS SAS activation, plus contingency backup activation command time, and during orbital night periods. Violations of the maximum voltage limit of AM Figure 3 would require bypass of the affected battery and charger combination, which would reduce energy storage capacity by one-eighth. Violation of the minimum voltage limit of AM Figure 4 may also result in loss of one-eighth of AM energy storage capacity.

4. Backup Measurements and Nominal Values

For primary and secondary state-of-charge:

M141-524] VOLT, BATTERY 1 thru 8 CURRENT] Nominal Values: 0 to 15A
thru		
M144-524		
and		
M145-525		
thru		
M148-525		

A gross indication of battery SOC during discharge can be obtained by integration of the current time plot:

Iah = Integrated current in amp-hrs

$$SOC = (1 - \frac{Iah}{33}) 100\%$$

For battery voltage:

M117-524] VOLT, BATTERY 1 thru 8 PRI SOC] Nominal Values: 95 to 100%
thru		
M120-524		
and		
M121-525		
thru		
M124-525		

To substantiate reason for low voltage indication.

M125-524] VOLT, BATTERY 1 thru 8 SEC SOC
thru	
M128-524	
and	
M129-525	
thru	
M132-525	

MSFC LAUNCH MISSION RULE BACKGROUND

M101-524
thru
M104-524

M105-525
thru
M108-525

VOLT, SAS ARRAY
GROUP 1 THRU 8

Nominal Values:

Array voltage will be
approximately one volt
less than battery voltage
(discharge cycle only).

5. Operational Tests

None

6. Reliability/Redundancy Considerations

The AM EPS is designed to operate as essentially eight paralleled subsystems, each of which uses one battery for energy storage. Loss of battery or battery charger before launch would reduce system capability to sustain launch electrical loads as well as orbital loads thereafter.

The Critical Items applicable:

KSC LMR ITEM	CIL GP/CAT	CIL IDENT	FMEA IDENT	PART NUMBER/PART NAME	MEASUREMENT NUMBER	*	COMMENTS
	LCC-II	pg 29	EPS 1.1.01	61B769004/Battery	M117-M140	Yes	
	LCC-II	pg 29	EPS 1.1.09	61B769005/Regulator	M141-M148	No	
	LCC-II	pg 29	EPS 1.1.17	61B769006/Charger	M117-M140	Yes	

* WILL FAILURE OF THIS COMPONENT CAUSE MEASUREMENT TO EXCEED REDLINE LIMIT?

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES	
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM		
	3-2706	C217-541	TEMP, MOLE SIEVE B - CHX PRI INLET			1 of 2 M	43°F *	51°F *	FROM SYSTEM ACTIVATION AND TEMPERATURE STABILIZATION UNTIL INITIATION OF AUTOMATIC SEQUENCE.	
		C209-542 (ALT)	TEMP, MOLE SIEVE A - CHX PRI INLET							
	3-2706A	C218-541	TEMP, MOLE SIEVE B - CHX SEC INLET			1 of 2 M	43°F *	51°F *		FROM SYSTEM ACTIVATION AND TEMPERATURE STABILIZATION UNTIL TERMINATION OF SECONDARY COOLANT LOOP FLOW. (APPROX. T-5 HOURS)
		C210-542 (ALT)	TEMP, MOLE SIEVE A - CHX SEC INLET							
MISSION:		SECTION:		STAGE/SUBSECTION:		SYSTEM:				
SA-513/SL-1		WORKSHOP		AM/THERMAL CONTROL SYSTEM		REDLINES AND CATEGORIES				
REMARKS:						REQUIRED BY:				
Temperatures are monitored to assure that coolant is supplied to the condensing heat exchanger at the desired temperature. (Ref. 513-WP-008, -009, -022, and -023, pages I-98, I-99, I-96 and I-97 respectively.						MDAC-EAST				
						CONTROL NUMBER:				
						513-WP-004-R5				
CONCURRENCES						PAGE		REVISION		
AERO:	ASTR:	ASTN:		CSE:	.1, .2, .3		REV. 5			
		AL/MDA 5/8/73								
		PROG. ENG. OFFICE:	PROG. OFFICE: (EI)	MO-MGR:	DATE:	MAY 9 1973		PAGE:		
			# 5-9-73	Whe 5/9/73				I-94		

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. System Description

Ref. 513-WP-023, page I-97.

2. Probable Causes of Redline Violations

Maximum limit violations:

- a. Coolant temperature control valve malfunction.
- b. Premature switching of radiator bypass selector valve - should be detectable by discrete measurement K209-515 for the primary coolant loop and K210-515 for the secondary coolant loop. (Ref. 513-WP-028, page I-100).
- c. Malfunction of ground cooling system.
- d. Motor/pump unit malfunction - Should be detected by the observer monitoring pump ΔP and coolant flow (Ref. 513-WP-009, page I-99.)

Minimum limit violations:

- a. Coolant temperature control valve CVPB or CVSB malfunction.
- b. Failure of control valve CVPA or CVSA to hold minimum temperature limit. (Ref. 513-WP-023, I-97)

3. Consequences of Redline Violations

A violation of minimum limit could result in excessive cooling or equipment in modules downstream of coolant control, valve. Violation of maximum limit would lead to possible overheating of equipment downstream of coolant control valve CVPB or CVSB. Violation of either limit would alter moisture removal capability of CHX and thus, prevent maintenance of desired dew point with present operational plans. Extreme violations could cause equipment damage. CHX does not remove moisture until system activation in orbit, however.

4. Backup Measurements and Nominal Values

Primary Coolant Loop:

C244-515 TEMP - THERMAL CAPACITOR - PRIMARY OUTLET
C265-517 TEMP - THERMAL CAPACITOR 2 PRIMARY INLET]

A temperature higher than +40°F prior to T-30 minutes or +18°F after T-30 minutes would indicate a failure of the ground cooling system or premature switching of the radiator bypass selector valve.

C283-534 TEMP - PRIMARY COOLANT CONTROL VALVE CVPA OUTLET 1 (Ref. 513-WP-023, page I-97)

MSFC LAUNCH MISSION RULE BACKGROUND

4. Backup Measurements and Nominal Values (Contd)

Primary Coolant Loop:

K209-515 EVENT, PRI RAD BYPASS MONITOR - ONE = BYPASS Value of ONE until Bypass Mode is switched at T-9:25 min.

Secondary Coolant Loop:

C245-515 TEMP - THERMAL CAPACITOR - SECONDARY OUTLET A temperature higher than +40°F prior to T-5 hours would indicate a failure of the ground cooling system or premature switching of the radiator bypass selector valve.

C284-534 TEMP - SECONDARY COOLANT CONTROL VALVE CVSA OUTLET 1 (Ref. 513-WP-023, page I-97)

K210-515 EVENT, SEC RAD BYPASS MONITOR - ONE = BYPASS Value of ONE until valve switching during sec. loop deactivation at approximately T-5 hrs.

LMRs 513-WP-008 and 513-WP-009 covering pump inlet pressure, pump differential pressure and coolant flow may provide additional information. (See pages I-98 and I-99 respectively)

5. Operational Tests Not Applicable6. Reliability/Redundancy Considerations

Exceeding redline limits can be an indication that any one of several failures may have occurred which could ultimately result in complete operational loss of one of the two coolant loops thereby eliminating loop redundancy. Such an event would decrease the coolant system reliability.

The Critical Items applicable:

KSC LMR ITEM	CIL GP/CAT	CIL IDENT	FMEA IDENT	PART NUMBER/PART NAME	MEASUREMENT NUMBER	*	COMMENTS
	LCC-II	pg 21	ECS 4.1.37	61C830096-9/Temperature Control Valve -47°F	*(1) C217, C218 C210, C209	Yes	*(1) Item to be included in Rev C of CIL (ECP 971)

* WILL FAILURE OF THIS COMPONENT CAUSE MEASUREMENT TO EXCEED REDLINE LIMIT?

MSFC LAUNCH MISSION RULE BACKGROUND

7. Instrumentation Accuracy and Method of Redline Value Determination

Instrumentation accuracy: +1.0, -1.9 (Range 42 to 52)°F (CRT)

Method of redline value determination: The coolant temperature control valves CVPB and CVSB are adjusted prior to installation to maintain valve outlet coolant temperature between 45°F and 49°F. The correct outlet temperature is obtained by proportional mixing of hot and cold incoming coolant. In a normally operating valve, the flow of hot coolant into the valve will be completely blocked (except for allowable internal leakage) if the outlet temperature rises to 49°F and the flow of cold coolant completely blocked if the outlet temperature drops to 45°F. The given redline limits were based on these valve characteristics for the expected coolant temperature distribution, instrumentation accuracy noted above and an allowance for heat leak into coolant lines between the valve and the sensors.

8. Other Information None

9. System Schematic Ref. Fig. 1, 513-WP-023, page I-97.4.

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD ACTION NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
3-2709	C262-517		TEMP, THERMAL CAP. SKIN 1						FROM SYSTEM TEMPERATURE STABILIZATION UNTIL TERMINATION OF GROUND COOLING (APPROX. T-10 MINUTES)
	C263-517		TEMP, THERMAL CAP. SKIN 2						
	C264-517		TEMP, THERMAL CAP. SKIN 3					40°F *(2)	
	C265-517		TEMP, THERMAL CAP. 2 PRI INLET			-1 of 2 M	NONE	18°F *(3)	
	C244-515 (ALT)		TEMP, THERMAL CAP. PRI OUTLET						
3-2709A	C245-515		TEMP, THERMAL CAP, SEC OUTLET			M	NONE	40°F	*ALL THREE MEASUREMENTS REQUIRED *(1) BOTH MEASUREMENTS REQUIRED WHILE PRI LOOP IS ACTIVE *(2) PRIOR TO T-30 MIN. *(3) AFTER T-30 MIN. FROM SYSTEM TEMPERATURE STABILIZATION UNTIL TERMINATION OF SEC. COOLANT LOOP FLOW (APPROX. T - 5 HOURS)

MISSION:
SA-513/SL-1SECTION:
WORKSHOPSTAGE/SUBSECTION:
AM/THERMAL CONTROLSYSTEM:
REDLINES AND CATEGORIES

REMARKS:

From start of LMRID until T-30 minutes this rule provides assurance that coldplated AM equipment will be maintained at acceptable temperatures. From T-30 minutes until launch, this rule provides assurance that the AM thermal capacitors are charged prior to launch.

REQUIRED BY:

MDAC-EAST

CONTROL NUMBER:

513-WP-024-R5

CONCURRENCES			
AERO:	ASTR:	ASTN: <i>JWL</i>	CSE:
		<i>JL/MDA</i>	
		<i>5/8/73</i>	
		PROG. ENG. OFFICE:	PROG. OFFICE: (EI)
		<i>5-9-73</i>	MO-MGR: <i>5/9/73</i>

PAGE	REVISION
.1, .2	REV. 5
DATE: MAY 9 1973	PAGE: 1-95

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. System Description

Ref. 513-WP-023, page I-97.

2. Probable Causes of Redline Violations

Maximum limit violations:

- a. Malfunction of ground cooling system.
- b. Motor/pump unit malfunction in primary loop or secondary loop.
- c. Premature switching of primary or secondary radiator bypass selector valve.
- d. Excessive heat leak into capacitor module or coolant primary or secondary inlet/outlet line due to damaged insulation.

Minimum limit violations:

- a. Ground coolant supply temperature too low.

3. Consequences of Redline Violations

A violation of the maximum limit of 40°F (prior to T-30 minutes) may result in overheating of AM coldplated equipment.

Violation of maximum limit of +18°F after T-30 minutes would decrease the coldplated equipment cooling available prior to radiator activation/cool-down due to a less than fully charged capacitor module.

4. Backup Measurements and Nominal Values

None

5. Operational Tests

Not applicable

MSFC LAUNCH MISSION RULE BACKGROUND

6. Reliability/Redundancy Considerations

Exceeding redline limits may indicate that any one of several failures has occurred. The failure could result in ineffective operation of the coolant system and overheating of equipment and could ultimately result in complete operations loss of one of the two coolant loops thereby eliminating loop redundancy.

7. Instrumentation Accuracy and Method of Redline Determination

Instrumentation accuracy: C244-515, +1, -2.2 (Range -20 to +20)°F (CFT), -2.53°F C262-517 thru C265-517
+ .9, -1.3 (Range -20 to +20)°F; C245-515, +1, -2.2 (Range -20 to +20)°F

The maximum redline limit of +40°F (Prior to T-30 minutes) was based on assuring adequate cooling of the AM battery modules while allowing some margin should the ambient FTC temperature be abnormally high. The maximum limit of +18°F for the primary loop after T-30 minutes is based on a requirement to freeze the capacitors for launch. Should the ambient KSC temperature be abnormally high, supplemental cooling will be introduced at a point in the count such that at T-30 minutes the capacitors will be frozen. Although the capacitors freeze at approximately +22°F, the redline limit was set at +18°F to allow for instrumentation inaccuracy and the location of temperature sensors attached to the capacitor skin.

8. Other Information

No problem with violations of the minimum temperature limit (-120°F) is anticipated based on the present ground cooling system capabilities.

9. System Schematic

Ref. Figure 1, 513-WP-023, page I-97.4.

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	3-2711	C273-534	TEMP - PRIMARY COOLANT CONTROL VALVE CVPC OUTLET 1			1 of 2 M	* 34°F	* 70°F	FROM SYSTEM ACTIVATION AND TEMPERATURE STABILIZATION UNTIL T -30 MIN.
		C275-534 (ALT)	TEMP - PRIMARY COOLANT CONTROL VALVE CVPC OUTLET 2				* 34°F	* 44°F	FROM T -30 MIN UNTIL INITIATION OF AUTO SEQUENCE.
	3-2711A	C274-534	TEMP - SECONDARY COOLANT CONTROL VALVE CVSC OUTLET 1			1 of 2 M	* 34°F	* 70°F	FROM SYSTEM ACTIVATION AND TEMPERATURE STABILIZATION UNTIL TERMINATION OF SECONDARY COOLANT LOOP FLOW. (APPROX. T-5 HOURS)
		C276-534 (ALT)	TEMP - SECONDARY COOLANT CONTROL VALVE CVSC OUTLET 2						*MOMENTARY DEVIATIONS WHEN HEAT LOAD OR TEMPERATURE OF COOLING SOURCE VARIES RAPIDLY ARE NOT CONSIDERED VIOLATIONS.
MISSION:		SECTION:		STAGE/SUBSECTION:			SYSTEM:		
SA-513/SL-1		WORKSHOP		AM/THERMAL CONTROL SYSTEM			REDLINES AND CATEGORIES		
REMARKS:							REQUIRED BY:		
The CVPC and CVSC outlet temperatures are monitored to assure that the coolant temperature is adequate for cooling of battery and electronics modules. Only the Primary loop will be active for launch. The Secondary loop will be deactivated at approximately T-5 hours.							MDAC-EAST		
(Ref. 513-WP-004, -008, -009, and -023, pages I-94, I-98, I-99 and I-97).							CONTROL NUMBER:		
							513-WP-022-R5		
CONCURRENCES							PAGE		REVISION
AERO:	ASTR:	ASTN:		CSE:		.1,.2,.3		REV. 5	
		AL/MDA							
		5/8/73							
PROG. ENG. OFFICE:		PROG. OFFICE:	MO-MGR:	DATE:	PAGE:				
		#5-9-73 (EI)	WAC 5/9/73	MAY 9 1973				I-96	

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. System Description and Diagram

Ref. 513-WP-023, page I-97.

2. Probable Causes of Redline Violations

Maximum limit violations:

- a. Coolant temperature control valve malfunction.
- b. Premature switching of radiator bypass selector valve - should be detectable by discrete measurement K209-515, for the primary coolant loop and K210-515 for the secondary coolant loop.
(Ref. 513-WP-028, page I-100).
- c. Malfunction of ground cooling system.
- d. Motor/pump unit malfunction - Should be detected by the observer monitoring pump ΔP and coolant flow
(Ref. 513-WP-009, page I-99).

Minimum limit violations:

- a. Coolant temperature control valve malfunction.
- b. Failure of control valve CVPB (CVSB) and CVPA (CVSA) or CVPB (CVSB) alone to hold minimum primary (secondary) temperature limits. Failure of control valve CVPB (CVSB) and CVPA (CVSA) should be detected by the observer monitoring redlines in 513-WP-004 and 513-WP-023, respectively.

3. Consequences of Redline Violations

A violation of maximum limit could have a detrimental effect upon electrical equipment downstream by not providing adequate cooling. (Ref: 513-WP-003, page I-82)

A violation of the minimum limit could result in excessive cooling of equipment in modules downstream of coolant control valve. (Ref: 513-WP-003, page I-82)

4. Backup Measurements and Nominal Values

Primary Coolant Loop:

C244-515 TEMP, THERMAL CAPACITOR
 PRIMARY OUTLET

Nominal Values: A temperature higher than +40°F prior to T -30 minutes or +18°F after T-30 minutes would indicate a failure of the ground cooling system, or premature switching of the radiator bypass selector valve.

MSFC LAUNCH MISSION RULE BACKGROUND

4. Backup Measurements and Nominal Values (contd)

C279-534	TEMP, PRI ATM COOLANT MODULE OUTLET	} Nominal Values:	>45°F	Indication that coolant temperatures entering the control valve are in the correct range following completion of thermal capacitor charging (no later than T-30 minutes).
C277-534	TEMP, PRI COOLANT CONTROL VALVE CVPC INLET		<42°F	
K209-515	EVENT, PRI RAD BYPASS MONITOR, ONE = BYPASS			Value of ONE until Bypass Mode is switched at T-9:25 minutes.

Secondary Coolant Loop:

C245-515	TEMP, THERMAL CAPACITOR SECONDARY OUTLET			A temperature higher than +40 °F prior to T-5 hours would indicate a failure of the ground cooling system, or premature switching of the secondary radiator bypass valve.
K210-515	EVENT, SEC RAD BYPASS MONITOR, ONE = BYPASS			Value of ONE until secondary loop is turned off (approx. T-5 hours).

5. Operational Tests

Not Applicable.

6. Reliability/Redundancy Considerations

Exceeding redline limits can be an indication that any one of several failures may have occurred which could ultimately result in complete operational loss of one of the two coolant loops thereby eliminating loop redundancy. Such an event would decrease the coolant system reliability.

MSFC LAUNCH MISSION RULE BACKGROUND

The Critical Items applicable:

KSC LMR ITEM	CIL GP/CAT	CIL IDENT	FMEA IDENT	PART NUMBER/PART NAME	MEASUREMENT NUMBER	*	COMMENTS
	LCC-II	pg 32	ECS 4.1.06	52-83700-491/40°F Temp Control Valve	C273, C275 C274, C276	Yes	

* WILL FAILURE OF THIS COMPONENT CAUSE MEASUREMENT TO EXCEED REDLINE LIMIT?

7. Instrumentation Accuracy and Method of Redline Value Determination

Instrumentation accuracy: +1.3, -1.7 (Range 33°F to 45°F)(CRT)

Method of redline value determination: The coolant temperature control valves CVPC and CVSC are adjusted prior to installation to maintain valve outlet coolant temperature between 36°F and 42°F. The correct outlet temperature is obtained by proportional mixing of hot and cold incoming coolant. In a normal operating valve, the flow of hot coolant into the valve will be completely blocked (except for allowable internal leakage) if the outlet temperature rises to 42°F and the flow of cold coolant completely blocked if the outlet temperature drops to 36°F. The given redline limits for the period from T-30 minutes until launch were based on these valve characteristics together with noted instrumentation accuracy and an allowance for heat leak into coolant lines between the valve and the sensors. During the period prior to T-30 minutes, the valve cold inlet ports may be supplied with coolant higher than 42°F and thus be unable to maintain the 36°F to 42°F range. The higher temperature is acceptable as long as it remains below 70°F, a limit based on maintaining the downstream battery modules at acceptable temperatures.

8. Other Information

None.

9. System Schematic Ref. Fig. 1, 513-WP-023, Page I-97.4

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	3-2712	C283-534	TEMP - PRIMARY COOLANT CONTROL VALVE CVPA OUTLET 1			-1 of 2 M	43°F *,* (1)	51°F * (1) * (2)	FROM SYSTEM ACTIVATION AND TEMPERATURE STABILIZATION UNTIL INITIATION OF AUTO SEQUENCE (T-3 MIN. 7 SEC). *IN THE CASE OF A VIOLATION OF THE MINIMUM REDLINE LIMIT, CARE SHOULD BE EXERCISED TO PREVENT FREEZING OF THE EVA/IVA SUIT COOLANT. THE PRIMARY LOOP SHOULD BE DEACTIVATED, AND THE SECONDARY LOOP ACTIVATED, IF NECESSARY. *(1)MOMENTARY DEVIATIONS WHEN HEAT LOAD OR TEMPERATURE OF COOLING SOURCE VARIES RAPIDLY ARE NOT CONSIDERED VIOLATIONS. *(2)MAXIMUM REDLINE APPLICABLE ONLY AFTER T-30 MIN.
		C285-534 (ALTERNATE)	TEMP - PRI RGN HX IN-S/B CLNT MOD						
MISSION:		SECTION:		STAGE/SUBSECTION:			SYSTEM:		
SA-513/SL-1		WORKSHOP		AM/THERMAL CONTROL SYSTEM			REDLINES AND CATEGORIES		
REMARKS:							REQUIRED BY:		
The CVPA and CVSA outlet temperatures are monitored to assure adequate cooling of battery modules and satisfactory temperature control for moisture removal in the condensing heat exchanger. For related data see CN 513-WP-004, -008, -009, and -022, Pages I-94, I-98, I-99, I-96).							MDAC-EAST		
							CONTROL NUMBER:		
							513-WP-023-R5		
CONCURRENCES							PAGE		REVISION
AERO:	ASTR:	ASTN: <i>JWL</i>		CSE:	1., 2., 3., 4., 5.		REV. 5		
		<i>J. Steven</i>							
		AL/MDA <i>5/8/73</i>							
PROG. ENG. OFFICE:		PROG. OFFICE: (EI)		MO-MGR:	DATE: MAY 9 1973	PAGE: I-97			
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MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	3-2712A	C284-534	TEMP - SECONDARY COOLANT CONTROL VALVE CVSA OUTLET 1			1 of 2 M	43°F *,* (1)	NONE	FROM SYSTEM ACTIVATION AND TEMPERATURE STABILIZATION UNTIL SECONDARY LOOP TURN OFF (APPROX. T-5 HOURS)
		C286-534 (ALT)	TEMP - SEC RGN HX IN-S/B CLNT MOD						<p>*IN THE CASE OF A VIOLATION OF THE MINIMUM REDLINE LIMIT, CARE SHOULD BE EXERCISED TO PREVENT FREEZING OF THE EVA/IVA SUIT COOLANT. THE PRIMARY LOOP SHOULD BE DEACTIVATED, AND THE SECONDARY LOOP ACTIVATED, IF NECESSARY.</p> <p>*(1) MOMENTARY DEVIATIONS WHEN HEAT LOAD OR TEMPERATURE OF COOLING SOURCE VARIES RAPIDLY ARE NOT CONSIDERED VIOLATIONS.</p>
MISSION:		SECTION:		STAGE/SUBSECTION:		SYSTEM:			
SA-513/SL-1		WORKSHOP		AM/THERMAL CONTROL SYSTEM		REDLINES AND CATEGORIES			

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. System Description

Two independent, redundant coolant loops (primary and secondary) are provided. There are two pump packages, one for each loop containing three coolant pump/motor units. Three power supplies are provided for the three pump/motor units of each loop to convert spacecraft supplied DC power to the AC power required by the pump motors. During normal operation, one pump is operated in each loop, with each pump powered by a separate inverter. For a contingency mode after loss of one coolant loop, two pumps are operated in the remaining loop, with both pumps powered by a single inverter. Pump and inverter selection is provided by onboard switches and also DCS command. Inverter No. 1 powers pumps A and/or B, inverter No. 2 powers pumps B and/or C, and inverter No. 3 powers pumps C and/or A. Reservoirs are provided to maintain pump inlet pressure.

The coolant loops provide temperature control for ECS equipment, coldplated electrical/electronic equipment, and the ATM C&D panel/EREP heat exchanger. ECS equipment consists of suit cooling heat exchangers, condensing heat exchangers, cabin heat exchangers for OWS and AM/MDA, and an oxygen heat exchanger. The coldplated equipment includes three tape recorders, two battery modules, six electronic modules and two coolant pump inverter coldplates. All coldplated equipment except the pump inverters contain parallel coolant passages to permit passage of both primary and secondary coolant. Figure 1 is a system diagram illustrating measurement sensor locations.

During the LMRD effectivity period one or both loops may be activated and heat is dissipated to a ground coolant cart through a ground cooling heat exchanger installed in a bypass line around the radiator. Flow through the ground cooling heat exchanger is controlled by the radiator bypass selector valves which are in the bypass position until approximately T -5 hours, at which time the secondary loop is switched to the normal position and deactivated via DCS command. At T -9:25 minutes, the primary loop is switched to the normal position via DCS command. In orbit, heat is rejected to space by a radiator. Radiator performance is supplemented by a thermal capacitor (charged with tridecane wax) located downstream of the radiator. The capacitor stores heat while the vehicle is on the hot side of the orbit and rejects the heat on the cold side.

MSFC LAUNCH MISSION RULE BACKGROUND

2. Probable Causes of Redline Violations

Maximum limit violations:

- a. Coolant temperature control valve malfunction.
- b. Premature activation of radiator bypass selector valve - Should be detected by discrete measurement K209-515 for the primary coolant loop and K210-515 for the secondary coolant loop.
(Ref 513-WP-028, Page I-100)
- c. Malfunction of ground cooling system.
- d. Motor/pump unit malfunction - Should be detected by the observer monitoring pump ΔP and coolant flow.
(Ref. 513-WP-009, Page I-99)

Minimum limit violations:

Coolant temperature control valve malfunction.

3. Consequences of Redline Violations

A violation of the minimum limit in the primary (secondary) loop may prevent coolant temperature control valve CVPB (CVSB) from maintaining satisfactory temperature control for moisture removal in the condensing heat exchanger and thus prevent maintenance of the desired dew point with present operational plans. A gross violation of minimum limit could result in freezing of the EVA/IVA suit coolant. A violation of the maximum limit could reduce cooling of battery modules to an unacceptably low level.

4. Backup Measurements and Nominal Values

Primary Coolant Loop:

C244-515 TEMP, THERMAL CAPACITOR,
PRI OUTLET

C265-517 TEMP-THERMAL CAP 2 PRI INLET

K209-515 EVENT, PRI RAD BYPASS
MONITOR. ONE = BYPASS

Nominal Values: $\leq +18^{\circ}\text{F}$ A value higher than 40°F prior to T-30 minutes or a value higher than 18°F after T-30 minutes would indicate a failure of the ground cooling system or premature switching of the radiator bypass selector valve.

Value of ONE until Bypass Mode is switched at T -5 minutes.

MSFC LAUNCH MISSION RULE BACKGROUND

Secondary Coolant Loop:

C245-515

TEMP, THERMAL CAPACITOR,

SEC. OUTLET

Nominal Values: $\leq +40^{\circ}\text{F}$

A value higher than 40°F prior to secondary loop deactivation would indicate a failure of the ground cooling system or premature switching of the radiator bypass selector valve.

K210-515

EVENT, SEC RAD BYPASS

MONITOR. ONE = BYPASS

Value of ONE until secondary loop turned off at approximately T -5 hours.

4. Backup Measurements and Nominal Values (Continued)

LMRs 513-WP-008 and 513-WP-009 covering pump inlet pressure, pump differential pressure and coolant flow provide additional information.

5. Not Applicable

6. Reliability/Redundancy Consideration

Exceeding redline limits can be an indication that any one of several failures may have occurred which could ultimately result in complete operational loss of one of the two coolant loops thereby eliminating loop redundancy. Such an event would decrease the coolant system reliability.

MSFC LAUNCH MISSION RULE BACKGROUND

The Critical Items applicable:

KSC LMR ITEM	CIL GP/CAT	CIL IDENT	FMEA IDENT	PART NUMBER/PART NAME	MEASUREMENT NUMBER	*	COMMENTS
	LCC-II	pg 24	ECS 4.1.37	61C830096-11/Temp Control Valve -47°F	C283,C285 C284, C286	Yes	

* WILL FAILURE OF THIS COMPONENT CAUSE MEASUREMENT TO EXCEED REDLINE LIMIT?

7. Instrumentation Accuracy and Method of Redline Value Determination

- a. Instrumentation accuracy: +0.3, -1.0 (Range 42 to 52)° F (CRT)
- b. Method of redline value determination: The coolant temperature control valves CVPA and CVSA adjusted prior to installation to maintain valve outlet coolant temperature between 45°F and 49°F. The correct outlet temperature is obtained by proportional mixing of hot and cold incoming coolant. In a normally operating valve, the flow of hot coolant into the valve will be completely blocked (except for allowable internal leakage) if the outlet temperature rises to 49°F and the flow of cold coolant completely blocked if the outlet temperature drops to 45°F. The given redline limits were based on these valve characteristics together with noted instrumentation accuracy and an allowance for heat leak into coolant lines between the valve and the sensors.

8. Other Information

None.

9. System Schematic

See Fig. 1.

MSFC LAUNCH MISSION RULE BACKGROUND

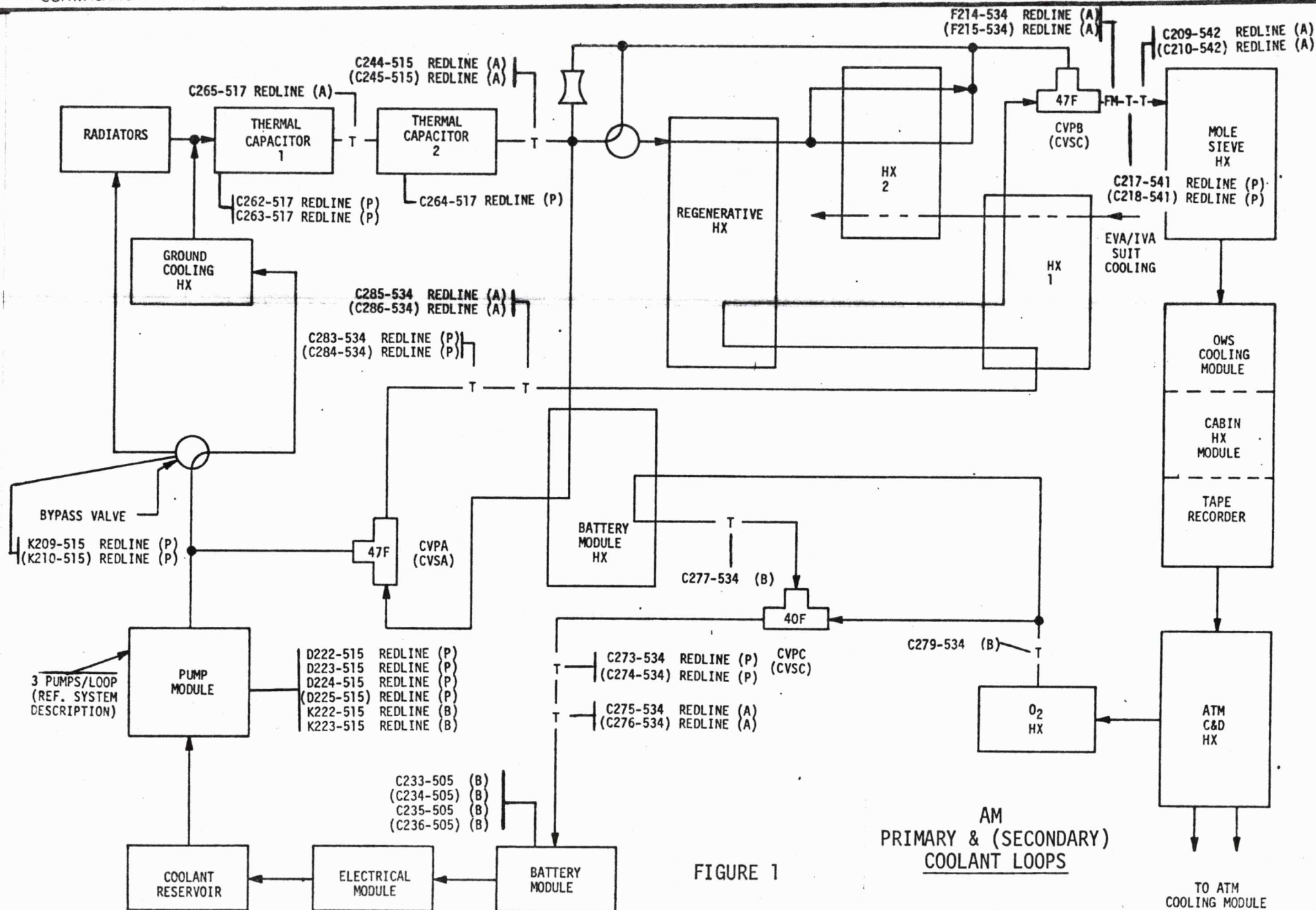


FIGURE 1

AM
PRIMARY & (SECONDARY)
COOLANT LOOPSTO ATM
COOLING

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD ACTION NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	3-2715	D222-515	PRESSURE - PRI COOLANT PUMP INLET			M	25 PSIA	NONE	FROM START OF LMRD UNTIL INITIATION OF AUTOMATIC SEQUENCE.
	3-2716	D223-515	PRESSURE - SEC COOLANT PUMP INLET			M	25 PSIA	NONE	
MISSION:		SECTION:		STAGE/SUBSECTION:		SYSTEM:			
SA-513/SL-1		WORKSHOP		AM/THERMAL CONTROL SYSTEM		REDLINES AND CATEGORIES			
REMARKS: Required to verify that adequate coolant is available in the reservoir. (Ref. 513-WP-004, -009, -022, and -023)						REQUIRED BY:			
						MDAC-EAST			
						CONTROL NUMBER:			
						513-WP-008-R3			
CONCURRENCES						PAGE		REVISION	
AERO:	ASTR:	ASTN:		CSE:		.2		REV. 3	
		AL/MDA 5/8/73				.1		REV. 5	
		PROG. ENG. OFFICE:	PROG. OFFICE: (EI)	MO-MGR:		DATE: MAY 9 1973		PAGE: T-98	
			#5-9-73	4/28 5/4/73					

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. System Description

Ref. 513-WP-023.

2. Probable Causes of Redline Violations

Maximum limit violations

- a. Excessive coolant in system.
- b. Excessive coolant temperature resulting in excessive coolant expansion (See 513-WP-022).

Minimum limit violations

- a. Coolant leakage.
- b. Leak of Freon pressurant in reservoir.
- c. Malfunction of coolant control valve CVPC or CVSC causing coolant temperature to be lower than specified resulting in excessive coolant contraction (See 513-WP-022).

3. Consequences of Redline Violations

Minimum redline limit violation would render the affected loop unusable and, if undetected, operating electronic equipment could be overheated and damaged. An upper limit violation caused by a coolant overfill could result in sufficiently high pressures to rupture a cooling system component.

4. Backup Measurements and Nominal Values

K222-515 EVENT, PRI COOLANT
 RESERVOIR LOW

K223-515 EVENT, SEC COOLANT
 RESERVOIR LOW

Nominal Value: OFF

ON indicates almost total loss of reserve coolant.
Pump ΔP will not be affected until coolant loss
is greater than that indicated by these measurements.

5. Operational Tests

Not Applicable.

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	3-2717	D224-515	PRESS, PRI COOLANT PUMP DIFF			1 of 2 M	20 PSID	70 PSID	FROM SYSTEM ACTIVATION UNTIL INITIATION OF AUTOMATIC SEQUENCE. *ONE PUMP OPERATION. TRANSIENTS WILL OCCUR DURING VALVE SWITCHING
		F214-534 (ALT)	FLOW, PRI COOLANT CONTROL VALVE CVPB OUT				*	*	
MISSION:		SECTION:		STAGE/SUBSECTION:			SYSTEM:		
SA-513/SL-1		WORKSHOP		AM/THERMAL CONTROL SYSTEM			REDLINES AND CATEGORIES		
REMARKS:							REQUIRED BY:		
Provides indication of primary and secondary coolant loop flow and verification of primary and secondary pump performance.							MDAC-EAST ASTN		
(Ref. 513-WP-004, -008, -022, and -023 on Pages I-94, I-98, I-96, and I-97.)							CONTROL NUMBER:		
							513-WP-009-R3		
CONCURRENCES							PAGE		REVISION
AERO:	ASTR:	ASTN:		CSE:		.1, .2, .3		REV. 5	
		ASTN: <i>Stevens</i> JL/MDA <i>5/8/73</i>							
PROG. ENG. OFFICE:				PROG. OFFICE: (EI)	MO-MGR:	DATE: MAY 9 1973		PAGE: I-99	
				<i>5-9-73</i>	<i>led/8/73 5/9/73</i>				

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	3-2717A	D225-515 F215-534 (ALT)	PRESS, SEC COOLANT PUMP DIFF FLOW, SEC COOLANT CONTROL VALVE CVSB OUT			- 1 of 2 M	20 PSID * 238 LB/HR	70 PSID * NONE	FROM SYSTEM ACTIVATION UNTIL TERMINATION OF SECONDARY COOLANT LOOP FLOW (APPROX. T -5 HOURS) *ONE PUMP OPERATION. TRANSIENTS WILL OCCUR DURING VALVE SWITCHING
MISSION: SA-513/SL-1		SECTION: WORKSHOP		STAGE/SUBSECTION: AM/THERMAL CONTROL SYSTEM			SYSTEM: REDLINES AND CATEGORIES		

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. System Description and Diagram

Ref. 513-WP-023, Page I-97.

2. Probable Cause of Redline Violations

Maximum limit violations

- a. Pump inverter malfunction
- b. Operation of more than one pump in a coolant loop.

Minimum limit violations

- a. Pump malfunction.
- b. Pump inverter malfunction.
- c. Excessive coolant leak (should be detected first by observing redline measurements in 513-WP-008, Page I-98).
- d. Pump off.

3. Consequences of Redline Violations

Over-stress conditions that could follow a maximum limit violation may weaken or damage system. Reduced heat removal capability that would follow a minimum limit violation of either the primary or alternate redlines would eventually result in damage to dependent equipment. The given probable causes can result in partial or total loss of affected loop capability or reduction in loop reliability.

4. Backup Measurements

None.

5. Operational Tests

Not Applicable.

6. Reliability/Redundancy Considerations

A redline violation introduces the possibility of subsequent total loss of the affected primary coolant loop thereby eliminating loop redundancy. Loss of one pump will reduce the affected coolant loop reliability.

MSFC LAUNCH MISSION RULE BACKGROUND

The Critical Items applicable:

KSC LMR ITEM	CIL GP/CAT	CIL IDENT	FMEA IDENT	PART NUMBER/PART NAME	MEASUREMENT NUMBER	*	COMMENTS
	LCC-II	pg 32	ECS 4.1.03	61B85009/Pwr Inv, Cool Pump	D224, D225	Yes	
	LCC-II	pg 32	ECS 4.1.01	52-83700-833/Cool Pump, Dual	D224, D225 F214, F215	Yes	

* WILL FAILURE OF THIS COMPONENT CAUSE MEASUREMENT TO EXCEED REDLINE LIMIT?

7. Instrumentation Accuracy and Method of Redline Value Determination

Instrumentation accuracy: D224-515, (D225-515), +7 PSI F214-534, (F215-534) +7.2 lb/hr. (Based on 20-100% F.S. Range)
 Method of redline value determination: The given redline limits were estimated from pump performance curves and were verified during spacecraft systems tests. The maximum redline of 70 PSID considers a maximum pump differential pressure of 63 PSID for stabilized one-pump operation with the radiator bypass valve in the NORMAL position and allows for +7 PSI instrumentation inaccuracy. The minimum redline of 20 PSID is based on a minimum differential pressure of 27 PSID for stabilized one-pump operation with the radiator bypass valve in the BYPASS position and allows for -7 PSI instrumentation inaccuracy. For the alternate measurement, the minimum redline of 238 lb/hr considers a minimum design flow rate of 230 lb/hr for one-pump operation and allows for +7.2 lb/hr instrumentation inaccuracy.

8. Other Information

None.

9. System Schematic

Ref. Fig. 1, 513-WP-023, Page I-97.4

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES		
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM			
	3-2720	K209-515	PRIMARY RADIATOR BYPASS MONITOR.			M	*	*	* FROM START OF LMRD UNTIL T-10 MIN SYSTEM IN TOLERANCE WHEN BYPASS MONITOR IS DIRECTED TO GSE * (1) FROM T-10 MIN, UNTIL INITIATION OF AUTO SEQ. (T-3 MIN 7 SEC) SYSTEM IN TOLERANCE WHEN BYPASS MONITOR IS DIRECTED TO RADIATOR. AT LEAST A 4 PSID INCREASE IN D224 IS REQUIRED COINCIDENT WITH THE BYPASS VALVE CYCLING TO INSURE THE BYPASS VALVE HAS MOVED TO RADIATOR POSITION.		
MISSION: SA-513/SL-1		SECTION: WORKSHOP		STAGE/SUBSECTION: AM/TCS			SYSTEM: REDLINES AND CATEGORIES				
REMARKS: Provide verification that coolant system radiator bypass valves are in the proper position.							REQUIRED BY: MDAC-East				
							CONTROL NUMBER: 513-WP-028-R5				
CONCURRENCES							PAGE		REVISION		
AERO:		ASTR:		ASTN: <i>JKStewen</i>				.1, .2, .3		REV. 5	
				AL/MDA <i>5/8/73</i>							
		PROG. ENG. OFFICE:		PROG. OFFICE: (EI)		MO-MGR:		DATE: MAY 9 1973		PAGE: I-100	
				#5-9-73		<i>une 5/9/73</i>					

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	3-2721	K210-515	SECONDARY RADIATOR BYPASS MONITOR			M	*	*	FROM START OF LMRD UNTIL SECONDARY LOOP TURN-OFF (APPROX. T-5 HRS)
									SYSTEM IN TOLERANCE WHEN BYPASS MONITOR IS DIRECTED TO BYPASS
							*(1)	*(1)	*(1) FROM SECONDARY LOOP TURN-OFF (APPROX. T-5 HRS) UNTIL INITIATION OF AUTO SEQUENCE (T-3 MIN 7 SEC)
									SYSTEM IN TOLERANCE WHEN BYPASS MONITOR IS DIRECTED TO RADIATOR. AT LEAST A 4 PSID INCREASE IN D225 IS REQUIRED COINCIDENT WITH THE BYPASS VALVE CYCLING TO INSURE THE BYPASS VALVE HAS MOVED TO RADIATOR POSITION.
MISSION: SA-513/SL-1		SECTION: WORKSHOP		STAGE/SUBSECTION: AM/TCS			SYSTEM: REDLINES AND CATEGORIES		

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. SYSTEM DESCRIPTION

Ref. 513-WP-023, Page I-97.

2. PROBABLE CAUSES OF REDLINE VIOLATIONS

- a. Premature switching of radiator bypass valve.
- b. Failure of command system to properly position the valve.
- c. Valve malfunction.

3. CONSEQUENCES OF REDLINE VIOLATIONS

Violation of the redline limit for K210-515 prior to primary loop turn on will prematurely terminate ground cooling of the AM coolant system. Violation of the redline limit for K209-515 after secondary loop turn off and prior to T-10 minutes will prematurely terminate ground cooling of the AM coolant system. If ground cooling is prematurely terminated, excessive coolant temperatures could be obtained with possible overheating of coldplate mounted equipment or lift-off could occur with thermal capacitors which are partially or completely discharged (Ref. 513-WP-024). A violation after T-10 minutes will result in loss of heat rejection capability of the primary coolant loop via the radiator during orbital operation unless the valve can be manually positioned by the crew during cluster activation. (See Page I-95.)

Violation of the redline limit for K210-515 will result in loss of heat rejection capability of the secondary coolant loop via the radiator during orbital operation.

Failure of pump differential pressure to increase at least 4 PSID in either loop after switching command is sent is a positive indication that the related valve did not operate to the radiator position even though the appropriate discrete (K209 or K210) may be indicating that it has. (Note: In the case of one of the discrettes indicating a valve has assumed the radiator position without the occurrence of a corresponding increase of differential pressure, crew operation of the onboard switch is not likely to cause valve operation.)

4. BACKUP MEASUREMENTS AND NOMINAL VALUES

Primary and Secondary Loop: C262-517 TEMP, THERMAL CAP. 1 SKIN 1 A temperature increase will occur following premature switching of primary radiator bypass valve.
C263-517 TEMP, THERMAL CAP. 1 SKIN 2

5. OPERATIONAL TESTS

None

MSFC LAUNCH MISSION RULE BACKGROUND

6. RELIABILITY/REDUNDANCY CONSIDERATIONS

Exceeding redline limits may indicate that any one of several failures has occurred. The failure could result in ineffective operation of the coolant system and overheating of equipment and could ultimately result in complete operational loss of one of the two coolant loops thereby eliminating loop redundancy.

7. INSTRUMENTATION ACCURACY AND METHOD OF REDLINE DETERMINATION

Not applicable to the discrete measurements.

The requirement given for the increase in pump differential pressure when the bypass valve is switched is based on CDDT and spacecraft tests and analyses. The D224 and D225 instrumentation inaccuracy of ± 7 PSID is not considered applicable since the requirement is expressed in terms of a delta rather than an absolute measurement. Test experience indicates that an increase in stabilized differential pressure greater than 4 PSI will be obtained as a result of switching the radiator bypass valve to the normal (radiator) position.

8. OTHER INFORMATION

None

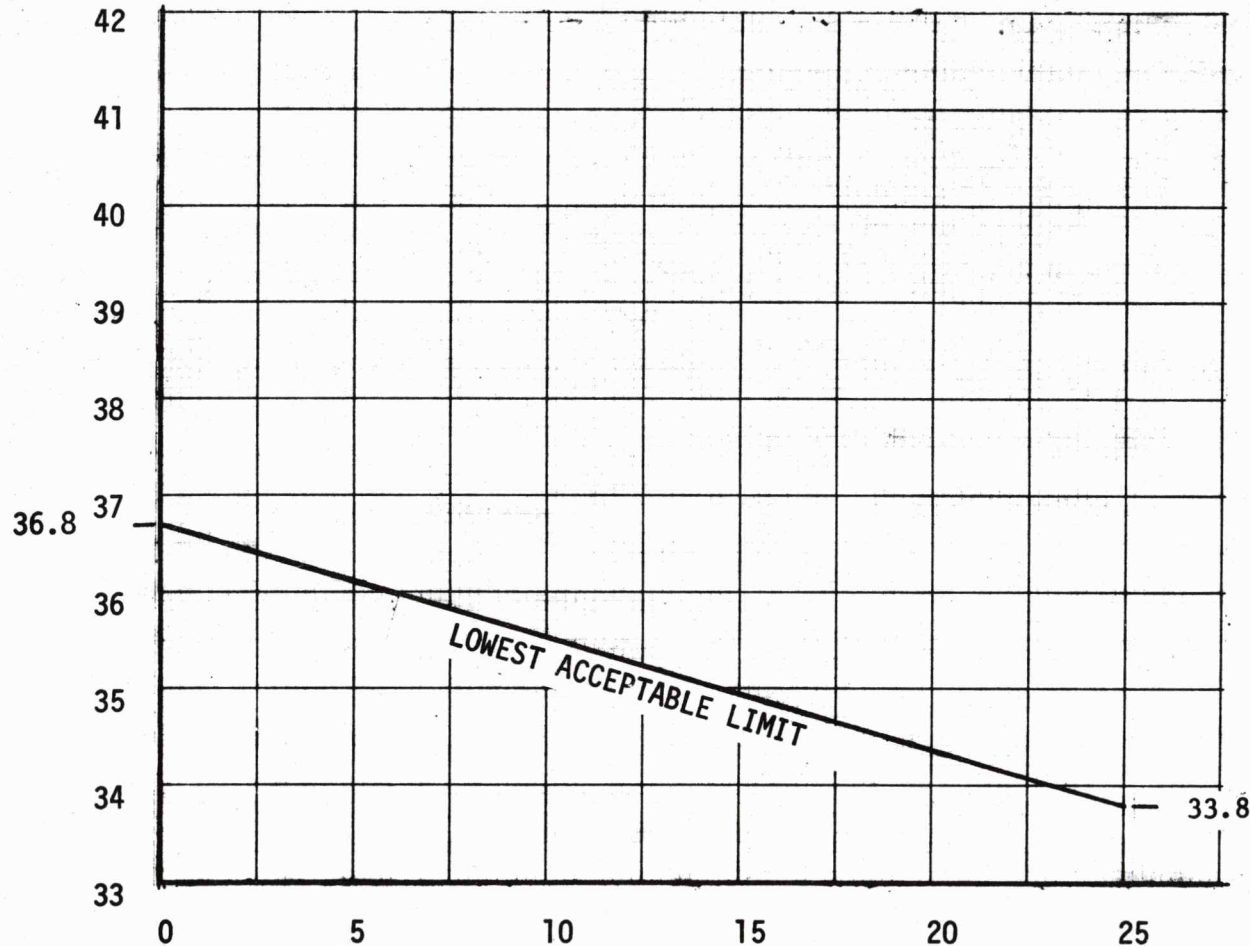
9. SYSTEM SCHEMATIC

Ref. Figure 1, 513-WP-023, Page I-97.4

MSFC LAUNCH MISSION RULES

REV	DESCRIPTION
-----	-------------

INTERNAL POWER ENVELOPE AM BATTERIES 1 THRU 8



TIME PERIOD:

ANY TIME AN AM BATTERY IS DISCHARGING WITH AVERAGE PRELAUNCH LOADS UNTIL INITIATION OF AUTO SEQUENCE

NOTE:

CURRENT GREATER THAN 25 AMPS IS NOT CONSIDERED A REDLINE VIOLATION BUT WILL SOON CAUSE AN SOC REDLINE VIOLATION & MAY INDICATE A MALFUNCTION IN EITHER THE EPS OR USING EQUIPMENT

(3-2253 THRU 3-2260)
VOLT, BATTERY 1-8 VOLTAGE
M133-524 THRU M140-525

(3-2261 THRU 3-2268) VOLT, BATTERY 1-8 CURRENT, M141-524 THRU M148-525 (AMPS)

MISSION	SECTION	STAGE/SUBSECTION	SYSTEM	DATE/CHANGE NO	PAGE
SA-513/ SL-1	WORKSHOP	AM/EPS	AM FIGURE 4	R5	I-104

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	3-6101A	DP7033 (ACE)	POSITION, EVACUATION VALVE OPEN CMG 1			M	*	*	FROM START OF LMRD UNTIL INITIATION OF AUTO SEQUENCE
	3-6101B	DP7034 (ACE)	POSITION, EVACUATION VALVE OPEN CMG 2			M	*	*	*SYSTEM IN TOLERANCE IF INDICATION IS OFF
	3-6101C	DP7035 (ACE)	POSITION, EVACUATION VALVE OPEN CMG 3			M	*	*	

MISSION:	SECTION:	STAGE/SUBSECTION:	SYSTEM:
SA-513/SL-1	WORKSHOP	ATM/APCS	REDLINES AND CATEGORY

REMARKS: Insure energy is not applied to ATM APCS Buses +7D12 & +7D22. The evacuation valve positions will indicate OPEN if either of the subject busses have been inadvertently powered. Assessment of the cause will have to be performed and corrective action taken.	REQUIRED BY: QUAL-PF ASTR-S ATM (APCS) Mr. Igou
	CONTROL NUMBER: 513-RP-011-R 5
	PAGE .1, .2, .3,

CONCURRENCES				PAGE	REVISION
AERO:	ASTR: 4/3/73 E.F. nail	ASTN:	QUAL 3-4-73 Hall		REV 5
ATM 4/4-73					
PROG. ENG. OFFICE:		PROG. OFFICE: (EI)	MO-MGR:	DATE: MAY 9 1973	PAGE: I-108A

MSFC LAUNCH MISSION RULE BACKGROUND

SYSTEM BACKGROUND DATA:

1. System Description

The ATM/APCS sub-buses +7D12 and +7D22 are the sources of input DC power to the Attitude and Pointing Control System components. The on/off status of these sub-buses can be controlled from the IU through the SWS switch selector, from the AMDCS, and from ATM switch selector number one. The APCS sub-buses can be energized from these control sources anytime the ATM +7D11 and +7D21 main buses are energized; these buses are energized for approximately 70 hours during the countdown and are still on at liftoff. Electrical closeout of the APCS in the VAB latches (sets) the power input relays for the primary ATMD, the Acq. S.S., and the 3 CMG's so that these components are powered up in flight by the "APCS on" commands from the IU. The 9 rack rate gyros are configured in a similar manner during countdown. Any command to the APCS sub-buses during countdown will prematurely power up the APCS components that are latched to +7D12 and +7D22. The status of these buses can be monitored by observing the status of the three CMG evacuation valve open indications since electrical closeout provides a path from the sub-buses through the CMGIA and CMG to the umbilical measuring system. An additional monitor point is available until T-9 minutes when the deadface relays open; this monitor point is a direct readout of the sub-buses.

2. Probable Cause of Redline Violations

- a. Inadvertent ATM switch selector number one command.
- b. Inadvertent IU command.
- c. Inadvertent AM DCS command, local or from MCC Houston.
- d. Failure in control networks.

3. Consequences of Redline Violations

- a. If the APCS sub-buses are powered up during the countdown, this would indicate that an erroneous command has been issued by one of the control sources or that a failure has occurred in the control networks. The results of such a premature command would be:
 - 1) The ATM Batteries would be loaded with approximately 40 amperes from T-71 Hours until T-7 Minutes. After T-7 Minutes the ATM Batteries would be loaded with approximately 50 amperes. On orbit battery reserve could be reduced below an acceptable level, depending upon the time of malfunction.
 - 2) The ATM DC, WCIU, CMG, CMG Inverter Assemblies, Acquisition Sun Sensors, and Rack Rate Gyros would be operated with no method of monitoring their performance or temperature. These components and the ATM batteries could operate above their specified ranges and be damaged.

MSFC LAUNCH MISSION RULE BACKGROUND

4. Backup Measurements and Nominal Values

Measurements:

Nominal Value:

Remarks:

*BP7033, Voltage, Bus +7D12

0.0 to 2.0 VDC

*Inactive after deadface relays
open at T-9 minutes.

*BP7034, Voltage, Bus +7D22

0.0 to 2.0 VDC

5. Operational Test (Other Method of System Validation)

None

6. Reliability/Redundancy Considerations

The APCS sub-buses can be turned on from three sources. Any of the commands will power up both +7D12 and +7D22; separate command is available from ATM switch selector number one and to turn the buses off one at a time.

The Critical Items applicable: TBD

KSC LMR ITEM	CIL GP/CAT	CIL IDENT	FMEA IDENT	PART NUMBER/PART NAME	MEASUREMENT NUMBER	*	COMMENTS

* WILL FAILURE OF THIS COMPONENT CAUSE MEASUREMENT TO EXCEED REDLINE LIMIT?

7. Instrumentation Accuracy and Method of Redline Value Determination

These measurements are discrete indications.

The position of latching relays and CMG valve switches after electrical closeout in the VAB is such that the +7D12 and +7D22 bus voltages are available on the above measurements until plug eject. These three measurements are on red event lights in the ATM control room.

8. Other Information

None.

MSFC LAUNCH MISSION RULE BACKGROUND

9. System Schematic

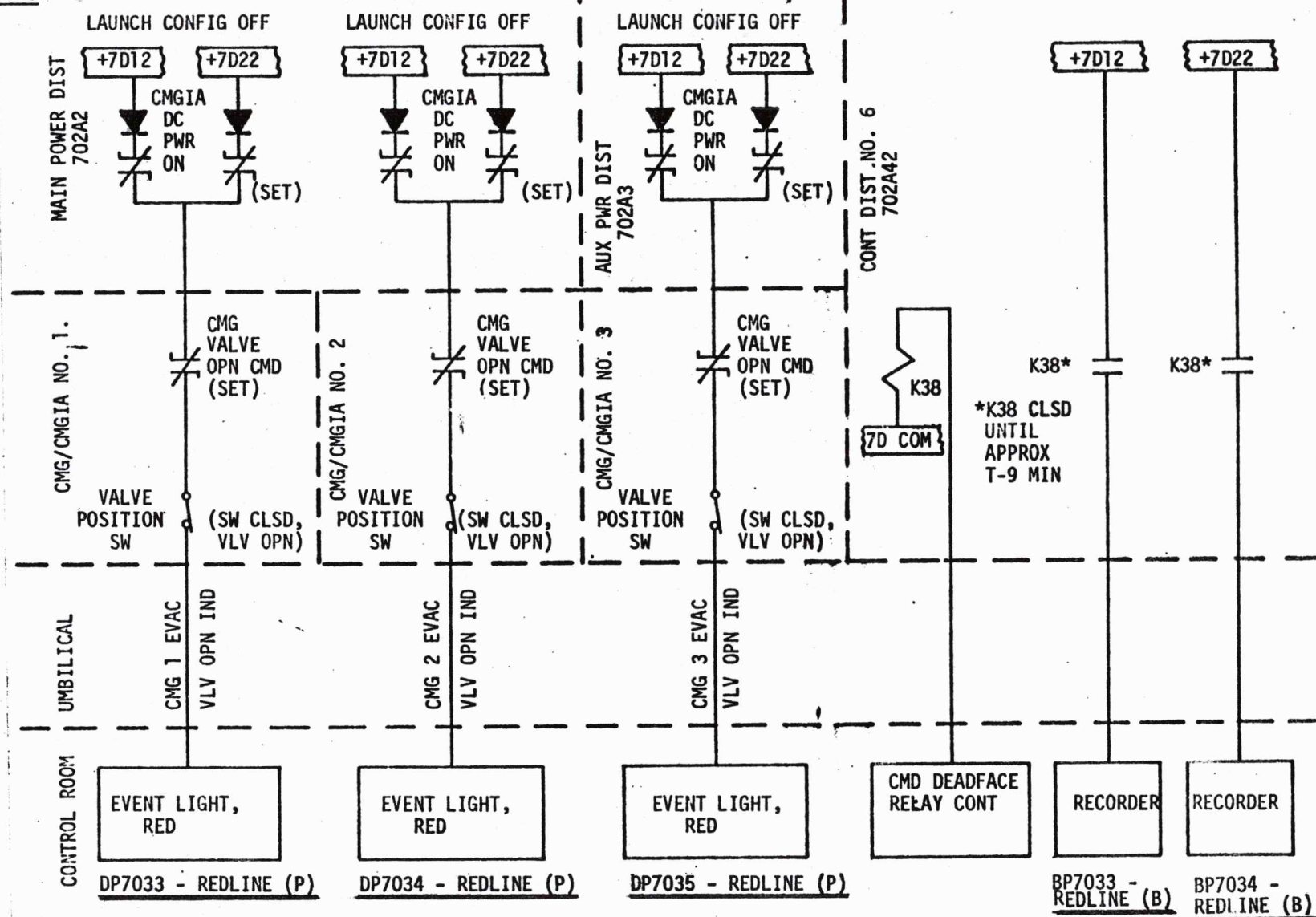


FIGURE 1.

APCS SUB-BUS MONITOR VIA CMG EVACUATION VALVE OPEN INDICATION

MSFC LAUNCH MISSION RULES

REV

INDEX

SECTION III DISAPPROVED LAUNCH MISSION RULES

KSC Item Number(s)	Control Number	Rule Description	Page Number
2-431	RP-010 *(4)	VOLTAGE, BUS 7D11	THESE DISAPPROVED RULES ARE RETAINED IN THE MO-E FILES
	*	ATM FIGURE 1	
	*(1)	ATM FIGURE 2	
	*(2)	ATM FIGURE 3	
	*(3)	ATM FIGURE 4	
	*(4)	ATM FIGURE 5	
	OP-011	TEMP - GTCS, FOOD CONTAINER EXT.	
	BP-004	S-II LOX DEPLETION SENSORS 1-5 OPEN	
	OP-012	EVENT, RS, PRI LOOP RAD BYPASS VLV, BYPASS MODE	
	OP-018	EVENT, MS, TENS STRAPS SECURED	
3-2106 thru 3-2109	WP-007	VOLT, INSTR BUSES A	III-18
3-611 thru 3-616	OP-015	EVENT, TACS THRUSTERS	III-19
3-218A	OP-024	EVENT - AM GND PWR ENABLE ON	III-20
	OP-025	EVENT - RS, RADIATOR PROTECTIVE SHIELD JETTISON AND RTN SW RLYS IF MODE ON	III-21
	OP-026	EVENT - OWS, ATM SAW PRI AND SEC AND A & B	III-22
	OP-027	EVENT - OWS SAW SECTION AND FAIRING DEPL RLY RST	III-23
	OP-028	EVENT - OWS MS RLY RST ON & H/A SOL VNT VLV CLOSE OFF	III-24

MISSION
SA-513/SL-

SECTION

III

STAGE/SUBSECTION

SYSTEM

DATE/CHANGE NO

MAY 9 1973 R5

PAGE

II-111

MSFC LAUNCH MISSION RULES

REV

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SECTION III DISAPPROVED LAUNCH MISSION RULES

KSC Item Number(s)	Control Number	Rule Description	Page Number
	OP-029	EVENT, ATM DEPLOYMENT ASSEMBLY RELAYS RST ON	III-25
	OP-030	EVENT - PAYLOAD SHROUD RELAYS RST ON	III-26

MISSION SA-513/ SL-1	SECTION III	STAGE/SUBSECTION	SYSTEM	DATE/CHANGE NO MAY 9 1973 R5	PAGE III-iv
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MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
	3-218A	K7428-411 (UMB)	EVENT-AM GND PWR ENABLE ON			M	*	*	<p>FROM TRANSFER TO INTERNAL POWER (APPROX. T-15 MIN.) UNTIL INITIATION OF AUTOMATIC SEQUENCE.</p> <p>*SYSTEM IN TOLERANCE IF ENABLE INDICATION OFF.</p>
<div style="border: 2px solid black; padding: 10px; transform: rotate(-10deg); margin: 20px auto; width: 80%;"> <p style="text-align: center;">DISAPPROVED RULE</p> <p>This rule has been disapproved by SL-EI. The rule is not considered to be a mandatory requirement.</p> <p>Rev 5</p> <p>Date MAY 9 1973</p> </div>									
MISSION:		SECTION:		STAGE/SUBSECTION:			SYSTEM:		
SA-513/SL-1		WORKSHOP		OWS/POWER DISTRIBUTION AND CONTROL SYSTEM			REDLINES AND CATEGORIES		
REMARKS:							REQUIRED BY:		
<p>This measurement verifies that the OWS SAS power buses are electrically isolated from the OWS umbilical. A change in output of K7428 from +28 VDC to 0 VDC at execution of Airlock Module Ground Power Enable Off command (launch minus 15 minutes) indicates that the OWS umbilical deadfacing circuitry is in launch configuration.</p>							MDAC-West		
							CONTROL NUMBER:		
							513-OP-024-R4		
							PAGE		REVISION
							.1, .2, .3		REV 4
AERO:			ASTR: 3-13-73		ASTN:		SW		
			<i>adp</i>				RWM 3/13/73		
			PROG. ENG. OFFICE:		PROG. OFFICE: EI		MO-MGR:		
					# 3-28-73		WJG 3/28/73		
							DATE: MAY 9 1973		PAGE: III-20

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
		K7444-404 (UMB)	EVENT - RS, RADIATOR PROTECTIVE SHIELD JETTISON AND RTN SW RLYS IF MODE ON			M	*	*	FROM RS TRANSFER TO INTERNAL (T-20 HOURS) UNTIL RS DISABLE (APPROX. T-5 MINUTES) * SYSTEM IN TOLERANCE IF INDICATION ON
<div style="border: 2px solid black; padding: 10px; transform: rotate(-10deg); margin: 20px auto; width: 80%;"> <p style="text-align: center;">DISAPPROVED RULE</p> <p style="text-align: center;">This rule has been disapproved by SL-EI. The rule is not considered to be a mandatory requirement.</p> <p style="text-align: center;">Rev 5</p> <p style="text-align: right;">Date MAY 9 1973</p> </div>									
MISSION:		SECTION:		STAGE/SUBSECTION:			SYSTEM:		
SA-513/SL-1		WORKSHOP		OWS/REFRIGERATION SYSTEM			REDLINES AND CATEGORIES		
REMARKS: Monitor this indication for proper liftoff configuration to preclude launching with either certain premature jettison of RS Shield, possible loss of RS secondary loop, or reduction in RS secondary loop power and/or return wiring.							REQUIRED BY: MDAC-WEST		
							CONTROL NUMBER: 513-OP-025-R5		
							PAGE		REVISION
AERO:		ASTR: 3-12-73 <i>[Signature]</i>		ASTN:		SW RW 3/13/73			
		PROG. ENG. OFFICE:		PROG. OFFICE: EI		MO-MGR:	DATE: MAY 9 1973		PAGE: III-21

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
		K7651-411 (UMB)	EVENT - OWS, ATM SAW PRI AND SEC AND A & B			M	*	*	VERIFY PRIOR TO PAD CLEAR AND AT INITIATION OF AUTO SEQ. *SYSTEM IN TOLERANCE IF RELAYS RESET INDICATION ON
<div style="border: 2px solid black; padding: 10px; transform: rotate(-10deg); margin: 20px auto; width: 80%;"> <p style="text-align: center;">DISAPPROVED RULE</p> <p>This rule has been disapproved by SL-EI. The rule is not considered to be a mandatory requirement.</p> <p style="text-align: center;">Rev 5</p> <p style="text-align: right;">Date MAY 9 1973</p> </div>									
MISSION:		SECTION:		STAGE/SUBSECTION:		SYSTEM:			
SA-513/SL-1		WORKSHOP		OWS/ATM DEPLOYMENT		REDLINES AND CATEGORIES			
REMARKS: This measurement verifies proper liftoff configuration of OWS relays controlled by the OWS switch selector for ATM EBW System A & B Arm and ATM Solar Wings Deploy to preclude launching with one or more "reset" commands continuously applied to ATM circuitry.						REQUIRED BY: MDAC-West			
						CONTROL NUMBER: 513-OP-026-R5			
CONCURRENCES						PAGE		REVISION	
AERO:	ASTN:	ASTN:		SW					
				RWM 3/13/73					
		PROG. ENG. OFFICE:		PROG. OFFICE: EI		MO-MGR:		DATE: MAY 9 1973	
								PAGE: III-22	

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
		K7653-411 (UMB)	EVENT - OWS SAW SECTION AND FAIRING DEPL RLY RST			M	*	*	VERIFY PRIOR TO PAD CLEAR AND AT INITIATION OF AUTO SEQ. *SYSTEM IN TOLERANCE IF RELAYS RESET INDICATION ON
<div style="border: 2px solid black; padding: 10px; transform: rotate(-5deg); margin: 20px auto; width: 80%;"> <p style="text-align: center;"><u>DISAPPROVED RULE</u></p> <p style="text-align: center;">This rule has been disapproved by SL-EI. The rule is not considered to be a mandatory requirement.</p> <p style="text-align: center;">Rev 5</p> <p style="text-align: right;">Date MAY 9 1973</p> </div>									
MISSION: SA-513/SL-1		SECTION: WORKSHOP		STAGE/SUBSECTION: OWS/POWER DISTRIBUTION AND CONTROL SYSTEM			SYSTEM: REDLINES AND CATEGORIES		
REMARKS: Monitor this indication for proper liftoff configuration to preclude launching with one of the two SAS Wing Section or Beam Fairing deployment systems failed or inoperative due to relay configuration.							REQUIRED BY: MDAC-West		
							CONTROL NUMBER: 513-OP-027-R5		
							PAGE		REVISION
AERO:		ASTR: 3-13-73 <i>[Signature]</i>		ASTN:		SW RUM 3/13/73			
		PROG. ENG. OFFICE:		PROG. OFFICE: EI		MO-MGR:		DATE: MAY 9 1973	
								PAGE: III-23	

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
		K7656-411 (UMB)	EVENT-OWS MS RLY RST ON & H/A SOL VNT VLV CLOSE OFF			M	*	*	VERIFY PRIOR TO PAD CLEAR AND AT INITIATION OF AUTO SEQ. *SYSTEM IN TOLERANCE IF INDICATION ON
<div style="border: 2px solid black; padding: 10px; transform: rotate(-10deg); margin: 20px auto; width: 80%;"> <p style="text-align: center;">DISAPPROVED RULE</p> <p style="text-align: center;">This rule has been disapproved by SL-EI. The rule is not considered to be a mandatory requirement.</p> <p style="text-align: center;">Rev 5</p> <p style="text-align: right;">Date MAY 9 1973</p> </div>									
MISSION:		SECTION:		STAGE/SUBSECTION:			SYSTEM:		
SA-513/SL-1		WORKSHOP		OWS/METEOROID SHIELD			REDLINES AND CATEGORIES		
REMARKS:							REQUIRED BY:		
Monitor this indication for proper liftoff configuration to preclude launching with one of the two Meteoroid Shield deployment EBW systems failed or inoperative due to relay configuration.							MDAC-WEST		
							CONTROL NUMBER:		
							513-OP-028-R5		
CONCURRENCES							PAGE		REVISION
AERO:	ASTR:	ASTN:	SW						
	3-13-73		RW/ml 3/13/73						
PROG. ENG. OFFICE:				PROG. OFFICE: EI		MO-MGR:	DATE: MAY 9 1973		PAGE: III-24

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
		K7657-411 (UMB)	EVENT, ATM DEPLOYMENT ASSEMBLY RELAYS RST ON			M	*	*	VERIFY PRIOR TO PAD CLEAR AND AT INITIATION OF AUTO SEQ. *SYSTEM IN TOLERANCE IF RELAYS RESET INDICATION ON
<div style="border: 2px solid black; padding: 10px; transform: rotate(-10deg); margin: 20px auto; width: 80%;"> <p style="text-align: center;">DISAPPROVED RULE</p> <p>This rule has been disapproved by SL-EI. The rule is not considered to be a mandatory requirement.</p> <p style="text-align: center;">Rev 5 Date MAY '9 1973</p> </div>									
MISSION:		SECTION:		STAGE/SUBSECTION:			SYSTEM:		
SA-513/SL-1		WORKSHOP		OWS/ATM DEPLOYMENT			REDLINES AND CATEGORIES		
REMARKS: Monitor this indication for proper liftoff configuration to preclude launching with one or both of the ATM DA primary deployment systems failed or inoperative due to relay configuration.							REQUIRED BY:		
							MDAC-West		
							CONTROL NUMBER:		
							513-OP-029-R5		
							PAGE	REVISION	
CONCURRENCES									
AERO:	ASTR: 3-13-73	ASTN:	SW						
			REWHL 3/13/73						
PROG. ENG. OFFICE:							PROG. OFFICE: EI		MO-MGR:
							DATE: MAY 9 1973		PAGE: III-25

MSFC LAUNCH MISSION RULE INPUT

REV	ITEM	MEAS/TM NO.	DESCRIPTION	CATEGORY			REDLINE VALUES		TIME PERIOD/ACTION/NOTES
				FLT CONT	ENG DATA	PRE-LAUNCH	MINIMUM	MAXIMUM	
		K7658-411	EVENT - PAYLOAD SHROUD RELAYS RST ON			M	*	*	<p>VERIFY PRIOR TO PAD CLEAR AND AT INITIATION OF AUTO SEQ.</p> <p>*SYSTEM IN TOLERANCE IF RELAYS RESET INDICATION ON</p>
<div style="border: 2px solid black; padding: 10px; transform: rotate(-10deg); margin: 20px auto; width: 80%;"> <p align="center">DISAPPROVED RULE</p> <p>This rule has been disapproved by SL-EI. The rule is not considered to be a mandatory requirement.</p> <p>Rev 5</p> <p>Date MAY 9 1973</p> </div>									
MISSION:		SECTION:		STAGE/SUBSECTION:		SYSTEM:			
SA-513/SL-1		WORKSHOP		OWS/PAYLOAD SHROUD DEPLOYMENT		REDLINES AND CATEGORIES			
REMARKS: Monitor this indication for proper liftoff configuration to preclude launching with one or both of the primary PS jettison EBW systems failed or inoperative due to relay configuration.						REQUIRED BY: MDAC-West			
						CONTROL NUMBER: 513-OP-030-R5			
CONCURRENCES						PAGE		REVISION	
AERO:		ASTR: 3-13-73		ASTN:		SW			
		APR 20 1973				RW m 3/13/73			
				PROG. ENG. OFFICE:		PROG. OFFICE: EI		MO-MGR:	
						DATE: MAY 9 1973		PAGE: III-26	