Bendix

Aerospace Systems Division

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LMS Qualification and Flight Acceptance T/V Test Summary and Thermal Design Final Report

This ATM summarizes the analytical and test results of the Lunar Mass Spectrometer thermal control system. The report is divided into three sections. The first section introduces the hardware and develops the mathematical thermal model of the experiment. The second section summarizes the Qualification and Flight Acceptance thermal vacuum testing program, and the third section presents the lunar surface predictions of the hardware.

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SUMMARY

The LMS maintains thermal control, within the -10 to +125°F operating temperature goals, by means of insulated surfaces and spectrally selective coatings during lunar day, and insulated surfaces and electronics and heater power dissipation during lunar night.

A 107 node thermal model was developed utilizing the Bendix thermal analyzer computer program which accounts for all modes of heat transfer including radiation and conduction. This model was used to optimize the thermal during the initial design phase, by considering such things as, spectrally selective coatings and radiator surfaces, radiator areas, and minimization of support structure heat leaks.

The Qualification and Flight Acceptance thermal vacuum tests are summarized including test setups and pertinent results. Detailed correlations studies are summarized and compared with the analytical model demonstrating the validity of the model in predicting the thermal response.

Lunar predictions are presented which are based on the test correlated thermal math model. These predictions include both a clean and dust covered model deployed equatorially and at a 20° latitude. A clean non-dust degraded experiment with 7.7 watts of power dissipation will operate within a -4/+110°F range for lunar night and noon, respectively. Degradation of all unprotected surfaces 100% results in an increase of lunar noon temperature to 117°F. An accumulation of 3% dust on the mirror surface can be tolerated before the +125°F operating goal is reached.

Deployment at a 20° latitude has the effect of decreasing the lunar noon temperature by 5°F.

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ILLUSTRATIONS (CONT.)

1.0 SCOPE

The purpose of this report is to document the development of the Lunar Mass Spectrometer Thermal Analysis, and the results and conclusions resulting from the thermal vacuum testing of the LMS Qualification and Flight models in the BxA thermal vacuum test chamber. This report is in three parts: Experiment Objectives and Thermal Analysis, Qualification and Flight Thermal Vacuum Testing, and Lunar Predictions.

SECTION I

EXPERIMENT OBJECTIVES AND THERMAL ANALYSES

This section summarizes the objectives of the LMS experiment and the development of the thermal model and analysis.

2.0 BACKGROUND AND PURPOSE

The Lunar Mass Spectrometer is basically a magnetic - deflection mass spectrometer designed to identify the constituents of the lunar surface atmosphere. It consists of two major subsystems, the electronics section and the gas analyzer section. The subsystems are joined to a common baseplate with each subsystem having its own fiberglass cover. The electronics subsystem is contained within a 40 layer thermal bag.

Thermal control is maintained by means of a second-surface mirrored radiator plate and internal power heat dissipation. This control will maintain the electronics heat sink between $-10^{\circ}F$ (lunar night) and $+125^{\circ}F$ (lunar noon). The gas analyzer subsystem contains no thermal control and is subject to the lunar temperature range of $-300^{\circ}F$ to $+250^{\circ}F$.

3.0 DESIGN SPECIFICATION REQUIREMENTS

3.1 Temperature Requirements

Design temperature goals per the LMS project group are as follows:

TABLE 3.1

RADIATOR PLATE TEMPERATURE

Operational Goals	Day	+125°F
	Night	-10°F
Survival	Night	-30°F

3.2 Power Requirement

Reference states that the LMS power requirement shall be less than the following:

TABLE 3.2

POWER

Operational	Day	13.8 Watts
	Night	12 Watts
Survival	Night	8 Watts

The actual power dissipation used for the purpose of thermal analysis of the Flight Model was, 7.7 watts within the electronics bag, and 1.69 watts on the analyzer baseplate.

4.0 THERMAL DESIGN AND ANALYSIS GOALS

4.1 Design Goals

4.1.1 Maintain the electronics within the specified limits of temperature and power.

- Provide means of dissipating electronics heat during lunar day
- Minimize the effects of solar heat
- Provide adequate temperature control during lunar night
- Minimize heat leaks
- Provide electronic components with good heat paths to the thermal plate

4.1.2 Provide thermal control to $\pm 25^{\circ}$ off equator deployment.

4.1.3 Minimize dust effect resulting from:

- Astronaut activity
- LM ascent

4.1.4 Minimize effects of time dependent degradation of thermal surfaces.

4.1.5 Provide astronaut activity and deployment constraints commensurate with good thermal control.

4.2 Thermal Analyses Goals

4.2.1 Determine heat leak or gain through:

- Cables
- Structural supports
- Experiment cover
- Masking

4.2.2 Determine thermal performance in a lunar environment.

4.2.3 Recommend thermal coatings.

4.2.4 Develop a thermal math model.

4.2.5 Utilize data obtained from the performance of DVT to design Qual. and Flight models.

4.2.6 Utilize data from the DVT and ALSEP system qualification and flight thermal - vacuum tests to verify the performance of lunar hardware.

5.0 ANALYTICAL THERMAL MODEL

5.1 Node Description

The thermal model of LMS (Figures 1, 2, and 3) was developed utilizing the Bendix Thermal Analyzer Computer Program. The model consists of 108 nodes representing various components of the LMS in addition to the lunar surface and space. These nodes and their physical significance are listed in Appendix A.

5.2 Thermal Resistances

There are 590 resistances in the LMS thermal model. These resistances represent all heat exchange, both through conduction and radiation, between all nodal surfaces of the experiment and the environment. These resistances, their interconnecting nodes, configuration factors, and surface areas are listed in Appendix A.

5.3 Solar Heating

The absorbed solar flux is simulated in model by apply equivalent heat to the surface node of the irradiated surface. Surfaces irradiated are mirror surfaces, masking, analyzer baseplate, and analyzer cover surfaces.

5.4 Lunar Surface Temperature

Variation of the lunar surface temperature as a function of deployment angle and solar angle was considered in the analysis. Temperatures of the surface as a function of these variables are indicated in Figure 4. During lunar night the lunar surface was taken as $-300^{\circ}F$.

5.5 Electronics Power

The power input to the LMS consists of operational electronics power, analyzer filament power, back-up resistor heater power, and standby survival power. These four inputs are handled as heat inputs to the appropriate electronics nodes in the thermal model.

The input power data of each model was obtained during LMS functional testing of Qual. and flight hardware. These functional tests were per Bendix TP 2347420 and 2368966.

LMS EXPERIMENTAL NODAL MODEL - THERMAL AND ANALYZER COVER ASSEMBLIES

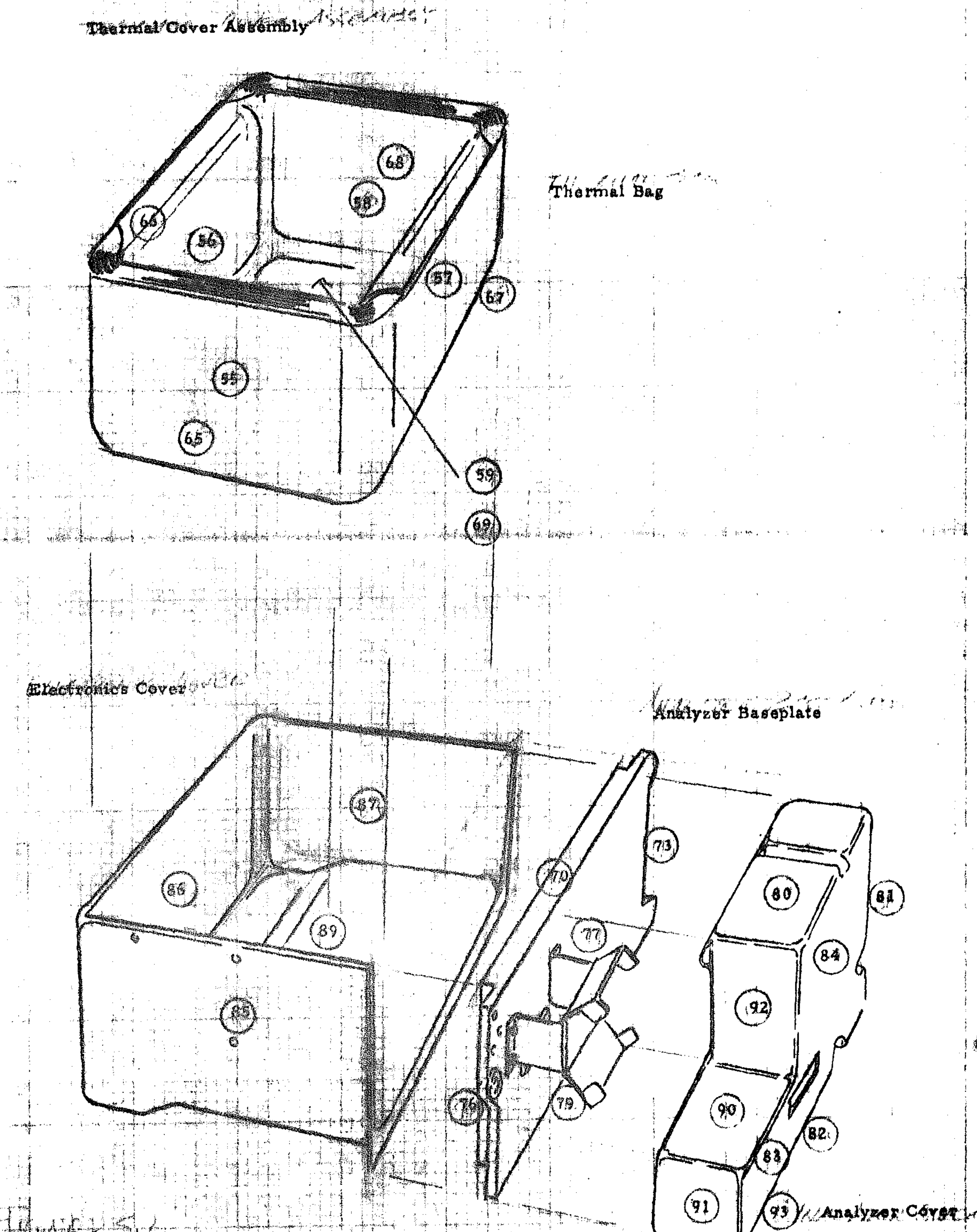
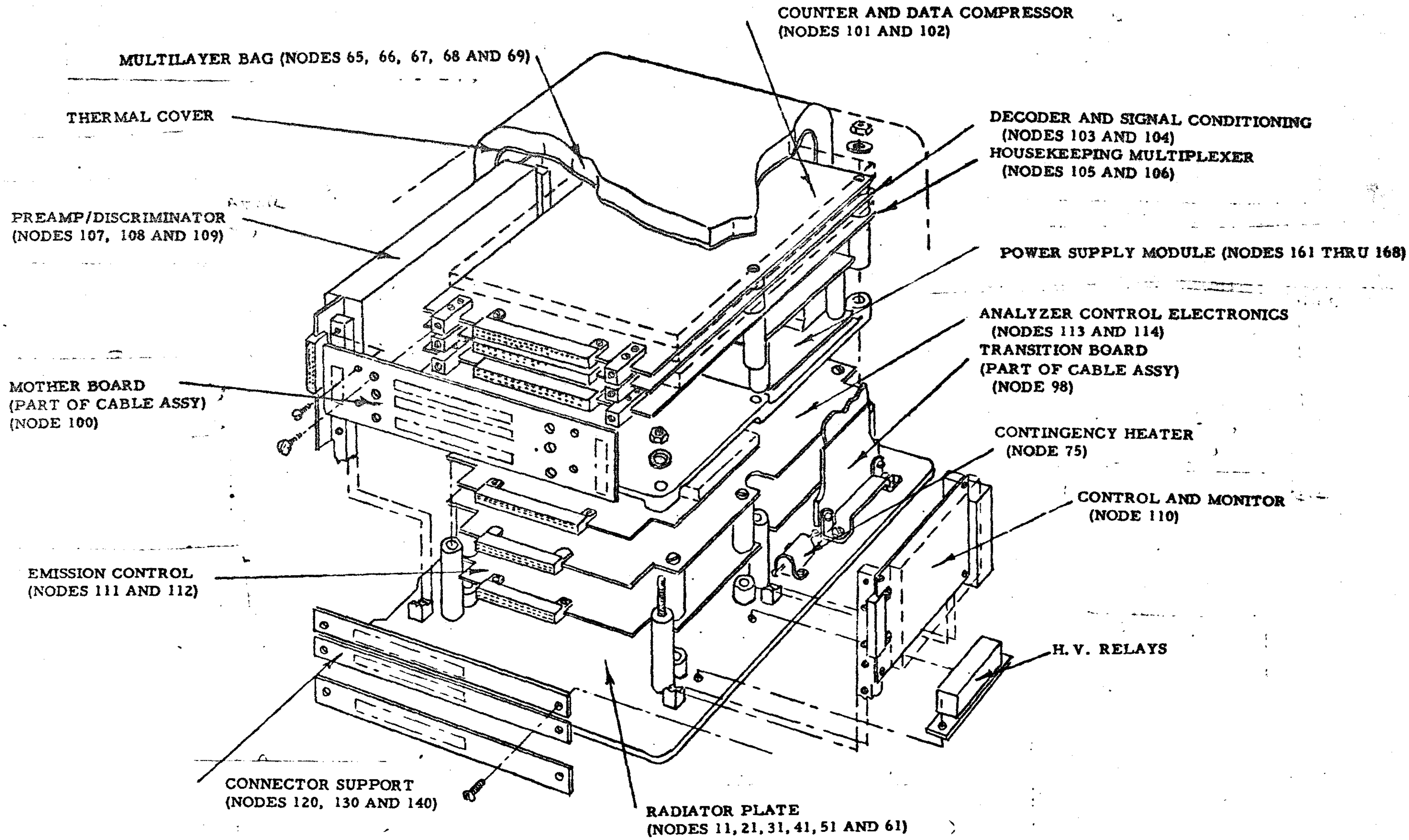


Figure 5.1

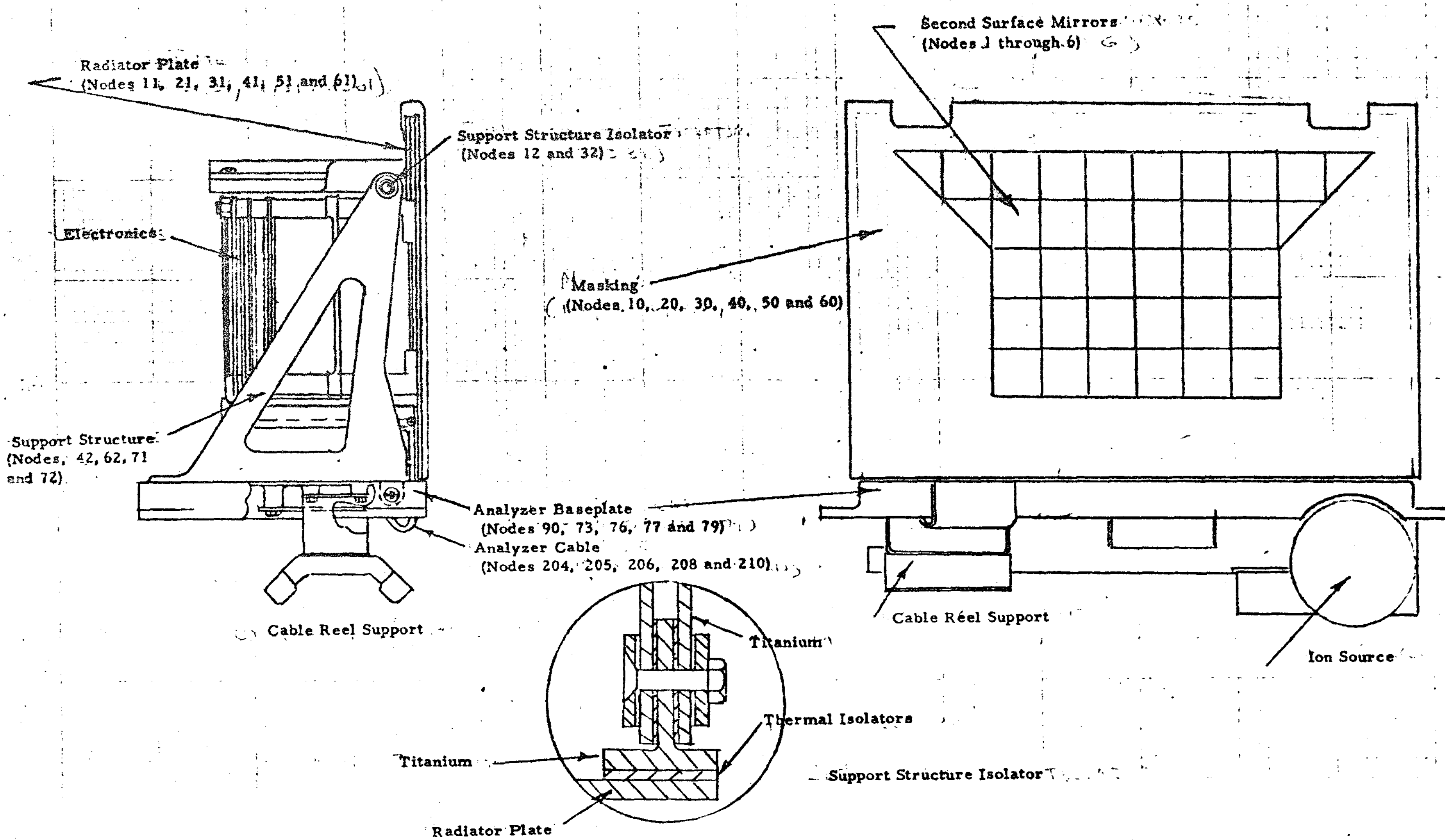
Figure 5.2



LUNAR MASS SPECTROMETER ELECTRONICS NODAL MODEL

Figure 5.3

LUNAR MASS SPECTROMETER RADIATOR PLATE AND ANALYZER ASSEMBLY



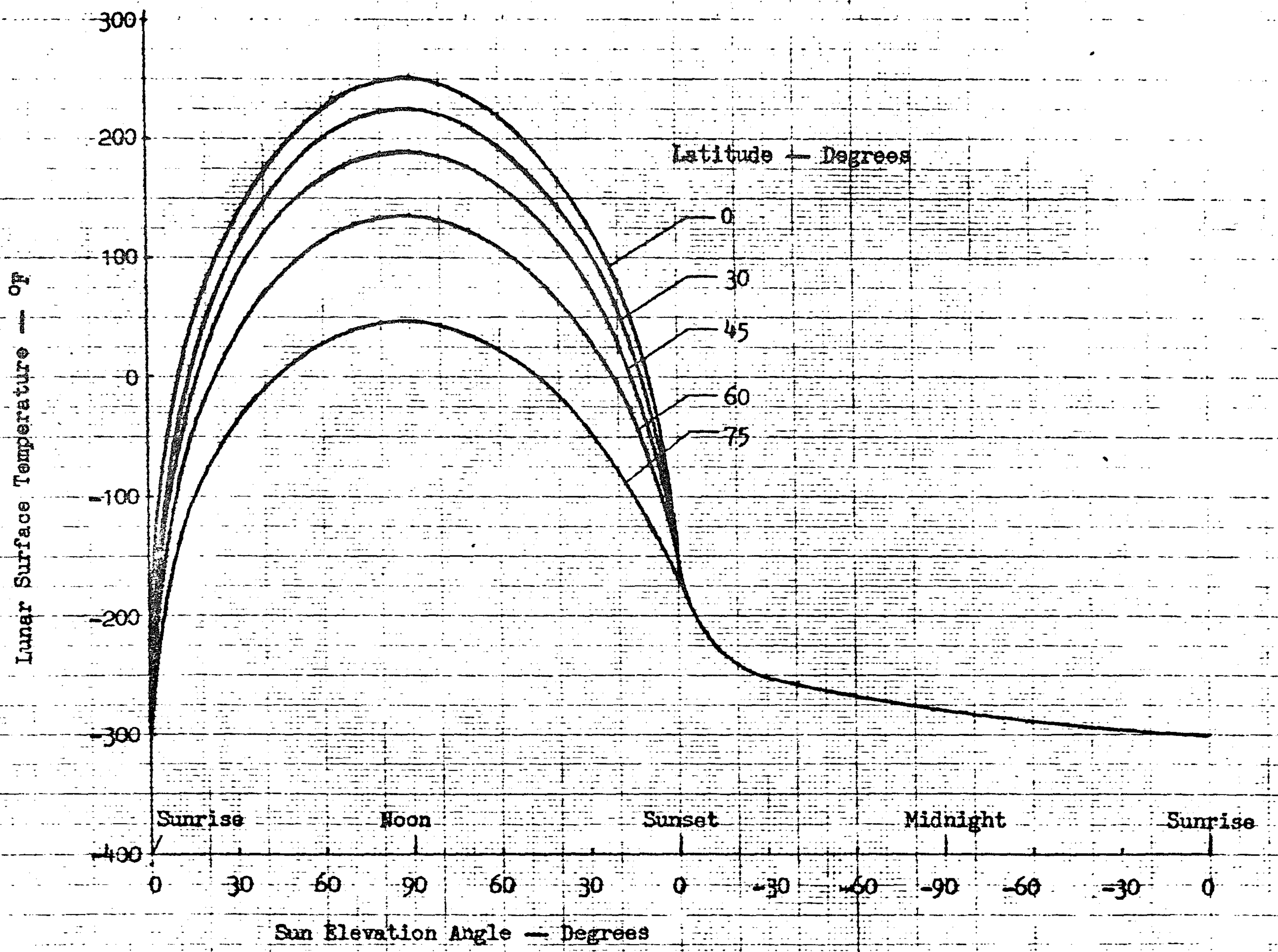


Figure 5.4 Lunar Surface Temperature vs Sun Angle and Latitude

5.6 Analyzer Support Structure

The analyzer baseplate is structurally mounted to the electronics radiator plate via two titanium support structures. These structures provide a direct path of heat leak through the multilayer bag to the baseplate, which is not thermally controlled. To minimize this as a problem, a thermal isolator (Figure 3) was designed employing a titanium clevis and fiber spacers. In addition, heat leak through the analyzer cover via radiation was minimized by aluminizing the analyzer cover.

5.7 Multilayer Bag and Masking

A multilayer bag was produced from 40 layers of double-sided aluminized 1/4 mil mylar and spacers. This bag completely encloses the electronics and is mounted to the underside of the radiator plate. The bag's thermal resistance was obtained from the Lockheed Acceptance Test Report TXA 2464. Heat leak through the bag was simulated in the model by means of an effective emittance, $\epsilon = 0.0047$.

The radiator plate masking is used to eliminate extraneous heat leak from the radiator plate edge and mounting hardware etc. In addition, the masking allows for changes in exposed radiator area to accommodate change in power dissipation without major design changes. This masking is made from 20 layers of double-sided aluminized 1/4 mil. mylar with spacers. It has an outer layer of aluminized teflon with teflon side out, resulting in an $\alpha/\epsilon = 0.20/0.69$. The effective internal emissivity is $\epsilon = 0.060$.

5.8 LMS Radiator Plate Thermal Coating Optical Properties

The radiator plate consists of a 0.060 inch thick plate of 2024-T6 aluminum coated with 60, 1 inch square second-surface mirrors. These mirrors are 1 inch square and 0.006 inch thick. The mirrors have optical properties per acceptance specification OCLI Spec. SI-100 stating, solar absorbance $\alpha = 0.050 \pm 0.005$, and hemispherical emissivity $\epsilon = 0.80 \pm 0.02$. The actual values used in the thermal model were $\alpha/\epsilon = 0.08/0.8$. The $\alpha = 0.08$ was used to accommodate the effect of the cracks between each mirror.

5.9 Electronics to Analyzer Cable

The LMS cable consists of two sections. There exists a section between the electronics and the analyzer comprised of copper coax high voltage cables leading to high voltage filaments, and manganin wires leading to the interconnect board mounted on the analyzer baseplate. The ribbon cable which mates with the ALSEP central station also interfaces with the interconnect board. The thermal conductivity per foot used for the section between the electronics and analyzer was 0.0214 $\frac{\text{BTU-Ft.}}{\text{HR-}^\circ\text{F}}$. The 1-1/2 inch length between the radiator plate clip and the analyzer baseplate clip has a conductivity of 0.172 $\frac{\text{BTU}}{\text{HR}^\circ\text{F}}$.

5.10 Heat Leak Summary

Table 1 summarizes total heat leaks for nominal noon, night, and degraded noon with a mirror $\alpha = 0.10$ and 100% dust coverage on unprotected surfaces.

5.11 Design Parameter Study

The final LMS thermal design is influenced by variations in both internal power dissipation and final adjustment to the radiator masking size and associated radiator area. Figures 5 and 6 present the radiator plate temperature variation as a function of both radiator area and internal power dissipation for lunar noon and lunar night.

Figure 5.6

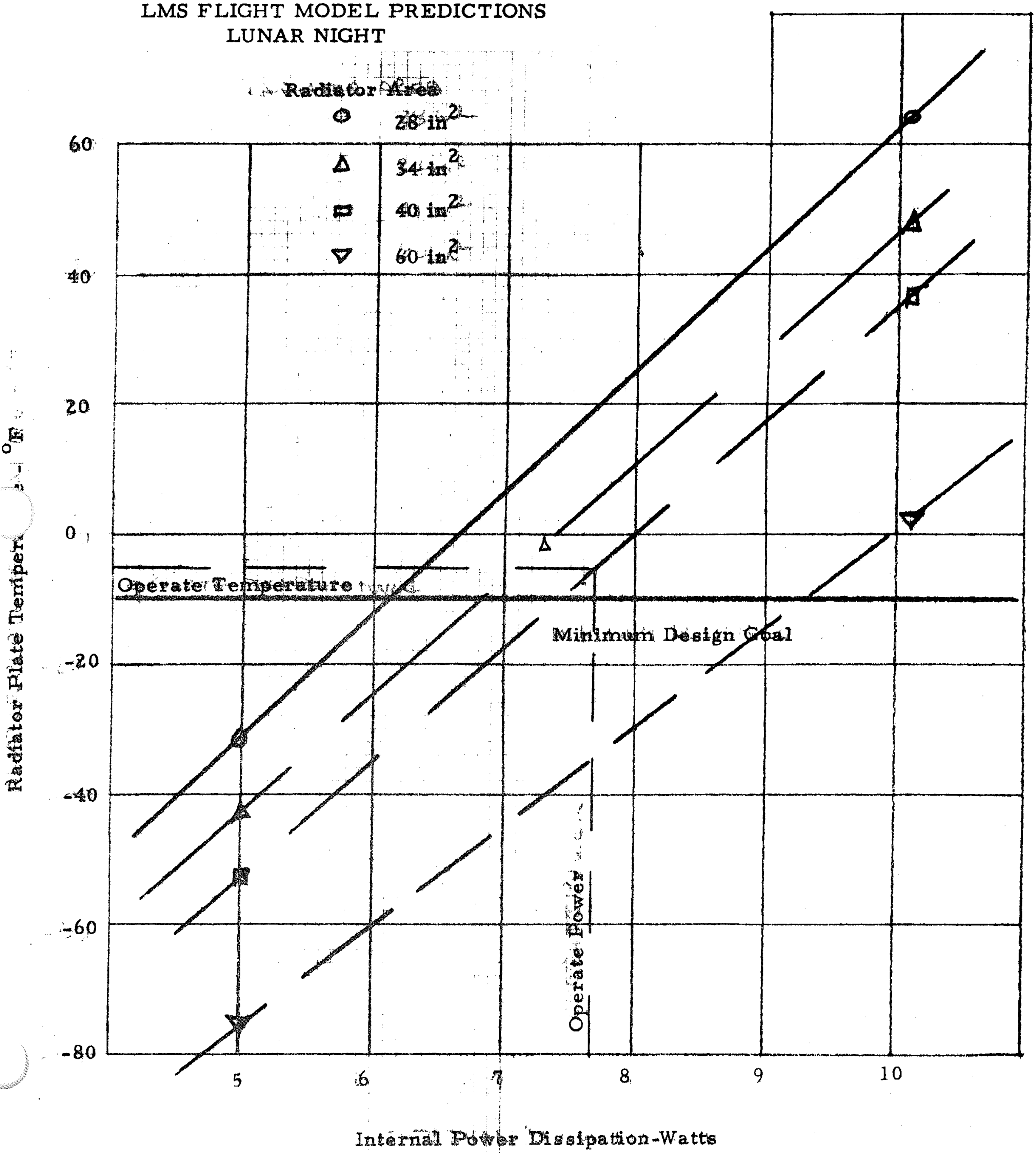

LMS FLIGHT MODEL PREDICTIONS
LUNAR NIGHT
Radiator Area
28 in²
34 in²
40 in²
60 in²
Operate Temperature
Minimum Design Goal
Operate Power
Radiator Plate Temper... - °F
60
40
20
0
-20
-40
-60
-80
5
6
7
8
9
10
Internal Power Dissipation-Watts

Figure 5.5

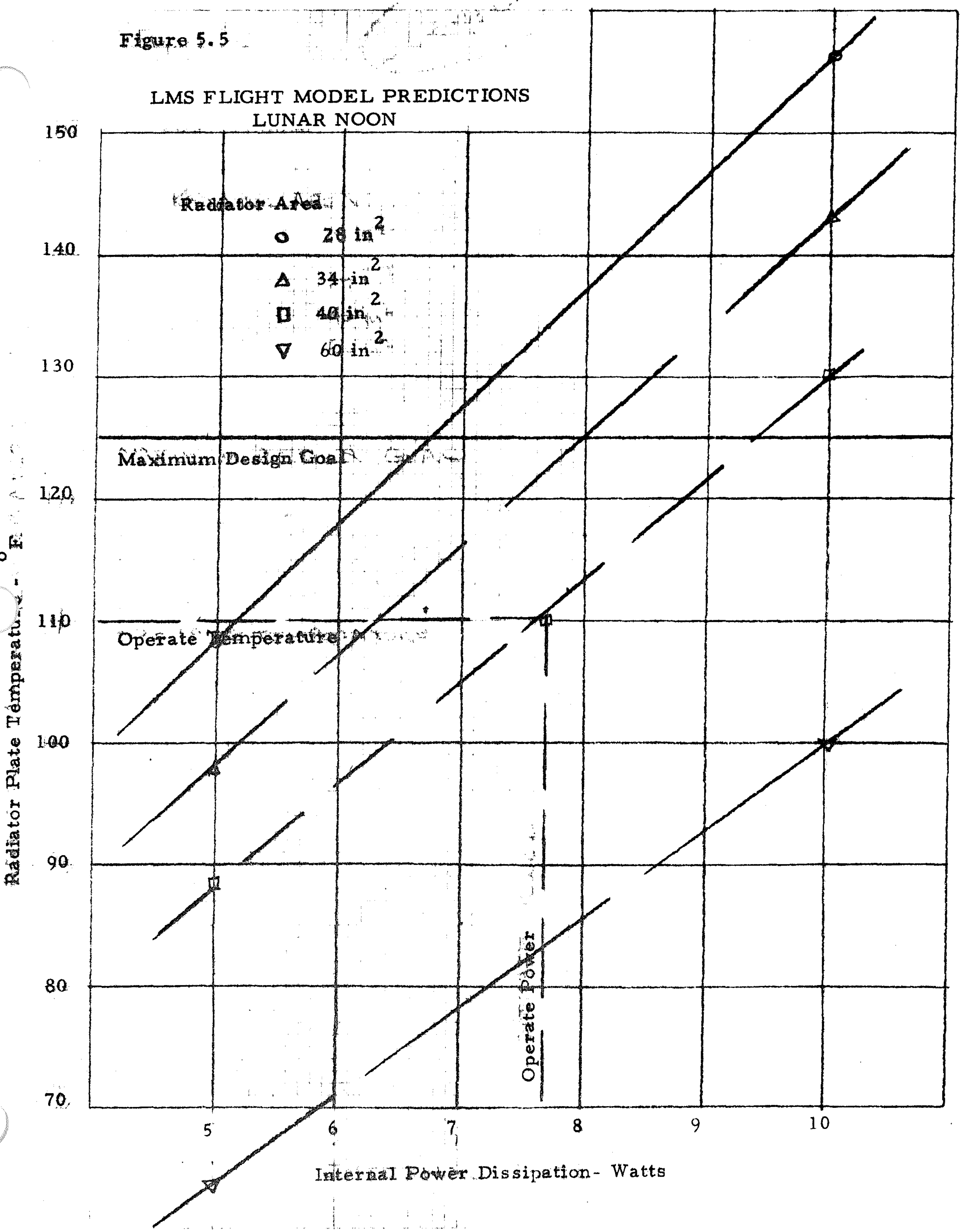

LMS FLIGHT MODEL PREDICTIONS
LUNAR NOON
Radiator Area
28 in^2
34 in^2
40 in^2
60 in^2
Maximum Design Goal
Operate Temperature
Operate Power
150
140
130
120
110
100
90
80
70
5
6
7
8
9
10
Radiator Plate Temperature - °F
Internal Power Dissipation- Watts

TABLE 5.1

LMS HEAT BALANCE SUMMARY

	Heat Leak (Watts)		
Path	Night	Noon	Degraded Noon
40 in^2 radiator	-4.430	-8.066	-8.615
Masking	-0.436	-0.283	-0.340
Isolator to Analyzer	-1.240	+0.470	+0.802
Thermal Bag	-0.0930	+0.160	+0.163
Electronic Cable	-1.075	+0.318	+0.540
Thermal Plate	-0.095	+0.088	+0.188
TOTAL	-7.36	-7.32	-7.36

SECTION II

QUAL AND FLIGHT THERMAL VACUUM TESTS

This section summarizes the Qual and Flight thermal vacuum test results and correlations.

6.0 BACKGROUND

The Lunar Mass Spectrometer Qualification Thermal Vacuum Tests were performed during the period of 20 May 1972 thru 7 June 1972. The Flight Acceptance tests were performed during the period 01 July 1972 thru 11 July 1972, both at the Bendix Aerospace Systems Division in Ann Arbor, Michigan. This report presents the thermal data obtained during those tests together with a correlation of the thermal mathematical model with experimental data. Also included is a brief description of the test installation.

7.0 TEST OBJECTIVES

The objectives of the LMS Qualification and Flight Acceptance Tests were to subject the LMS and integrated ALSEP to the lunar thermal/vacuum environment demonstrating the ability of the LMS design to withstand these extremes without loss of function.

8.0 DESCRIPTION OF TEST CONDITIONS AND TEST INSTALLATION

8.1 Thermal Test Conditions Qual Test and Flight Acceptance Test

The LMS Qualification test was correlated for three thermal test conditions. These conditions simulate the lunar noon and night phases of operating in addition to the Design Limit Condition which simulates a +280°F lunar surface and 1.25 solar load. (See Table 2)

The Flight Acceptance Test was correlated for the Acceptance Lunar Noon and Acceptance Night conditions. (See Table 3)

8.2 Thermal Vacuum Chamber

The test was conducted in the 20' x 27' thermal vacuum chamber in a vacuum greater than 1 X 10^{-5} Torr.

8.3 Lunar Surface Simulator

The lunar surface was simulated by a metal plate (5' x 5') with 8 inch vertical lips. The surface was horizontally mounted in the northwest section of the 20' x 27' chamber. The surface was coated with black paint to simulate the emittance of the lunar surface. Surface temperature was controlled by means of resistance heaters beneath the surface and vertical lips, and cooling coils beneath the surface.

8.4 Solar Simulation

Solar simulation was achieved by utilizing an array of quartz infrared electric heat lamps. These lamps are arranged in pairs and were directed through the center line of the experiment at right angles to the horizontal approximately 18 inches above the experiment surface. The intensity of radiation impingement was determined by measuring the intensity of radiation absorbed in a radiometer coated with a second surface mirror. The plot of this intensity for both Qual and Flight is indicated in Figures 5 and 6.

TABLE 8.1

QUALIFICATION TEST CONDITIONS

Condition	Description	Solar Intensity (Suns)	Lunar Surface Temperature (° F)	Power Dissipation (Watts)
1	Qual Lunar Noon	1.0	+250	7.36
2	Qual Lunar Night	--	-300	7.36
3	Design Limit Noon	1.25	+280	7.36

FLIGHT ACCEPTANCE TEST CONDITIONS

Condition	Description	Solar Intensity (Suns)	Lunar Surface Temperature (° F)	Power Dissipation (Watts)
1	Acceptance Noon	1.0	+250	7.70
2	Acceptance Night	--	-300	7.70

Figure 8.1

LMS LUNAR SURFACE
THERMOCOUPLE LOCATIONS

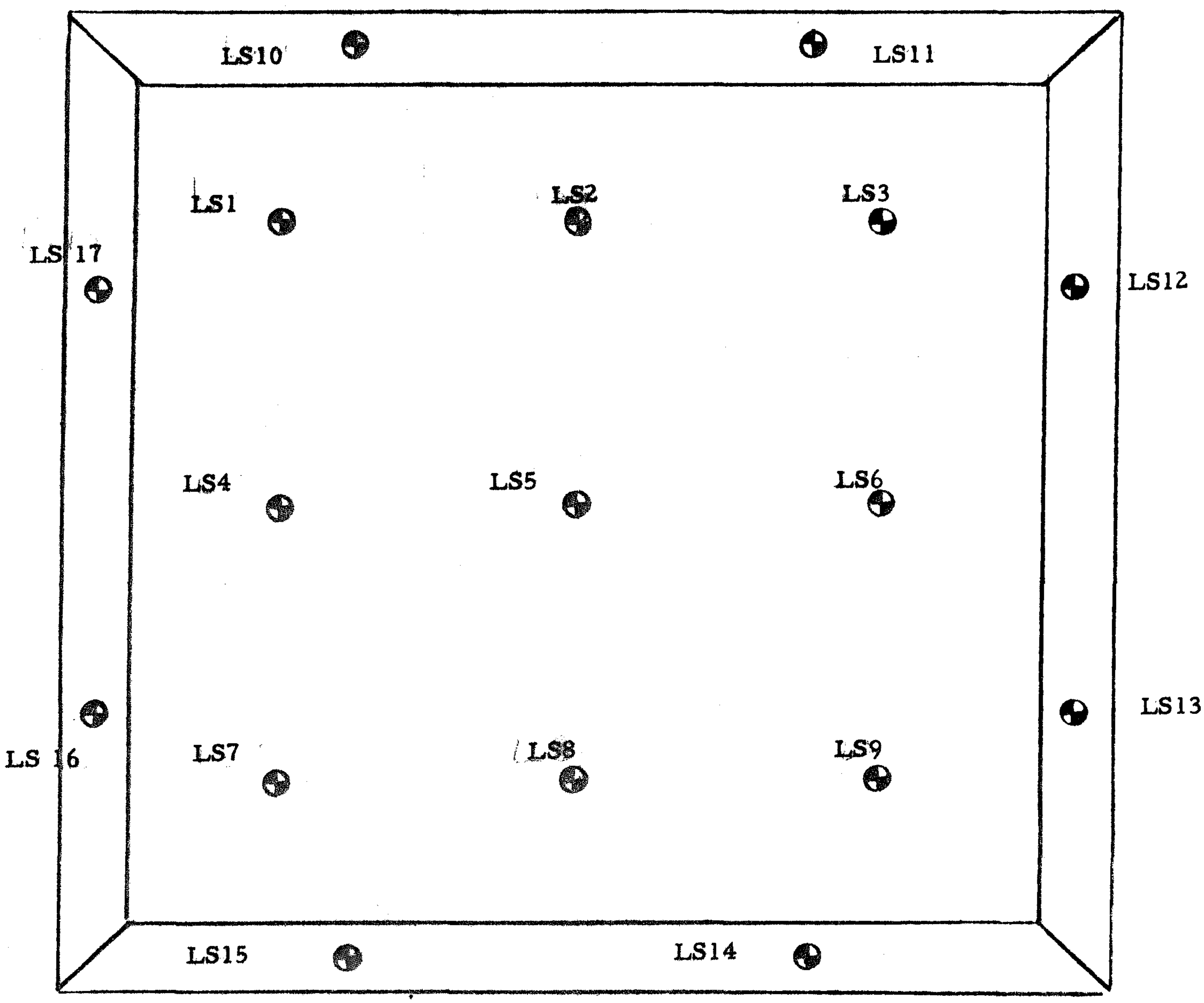


Figure 8.2

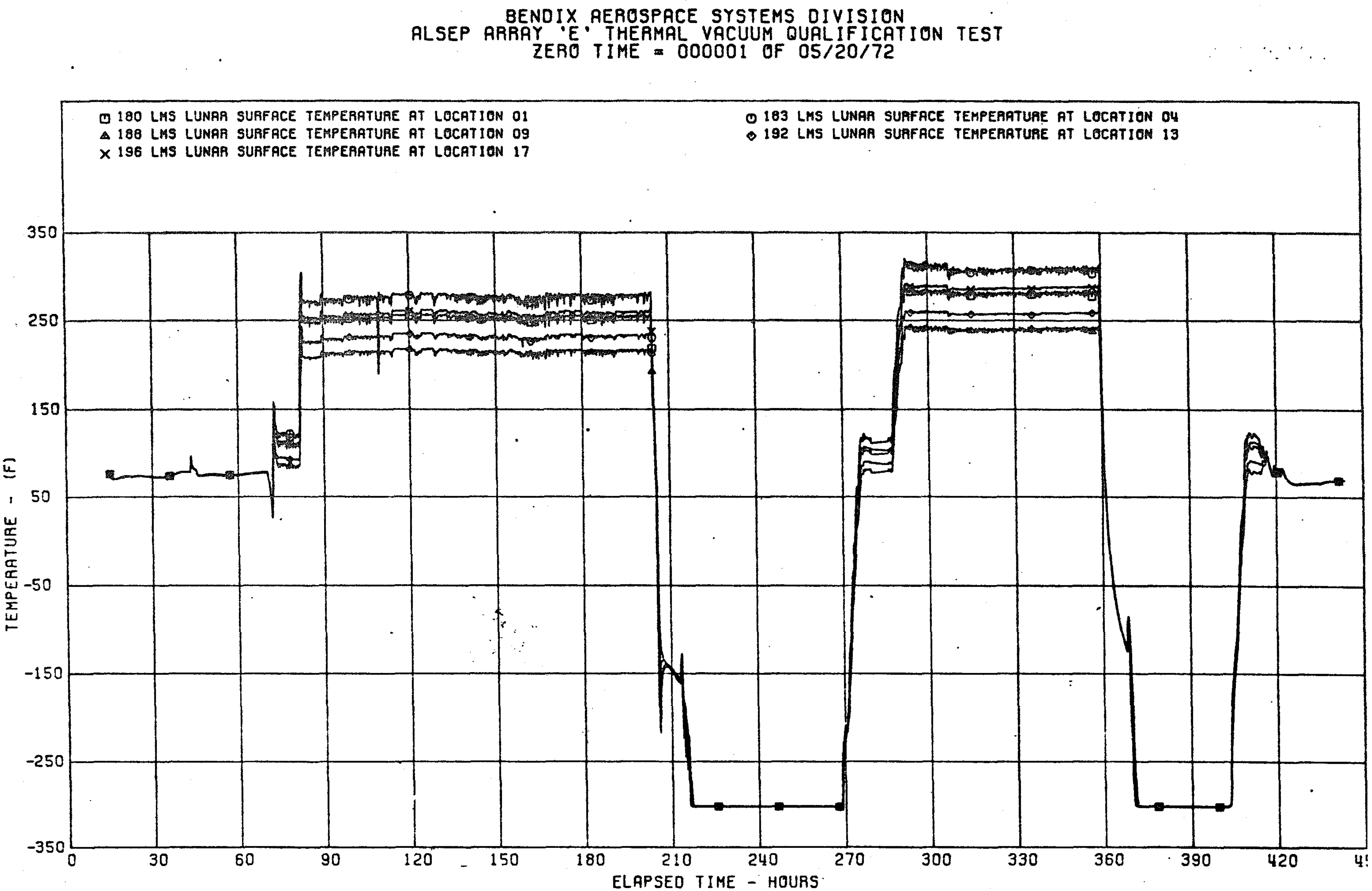

BENDIX AEROSPACE SYSTEMS DIVISION
ALSEP ARRAY 'E' THERMAL VACUUM QUALIFICATION TEST
ZERO TIME = 000001 OF 05/20/72
180 LMS LUNAR SURFACE TEMPERATURE AT LOCATION 01
188 LMS LUNAR SURFACE TEMPERATURE AT LOCATION 09
196 LMS LUNAR SURFACE TEMPERATURE AT LOCATION 17
183 LMS LUNAR SURFACE TEMPERATURE AT LOCATION 04
192 LMS LUNAR SURFACE TEMPERATURE AT LOCATION 13
TEMPERATURE - (F)
350
250
150
50
-50
-150
-250
-350
0
30
60
90
120
150
180
210
240
270
300
330
360
390
420
ELAPSED TIME - HOURS

Figure 8.3

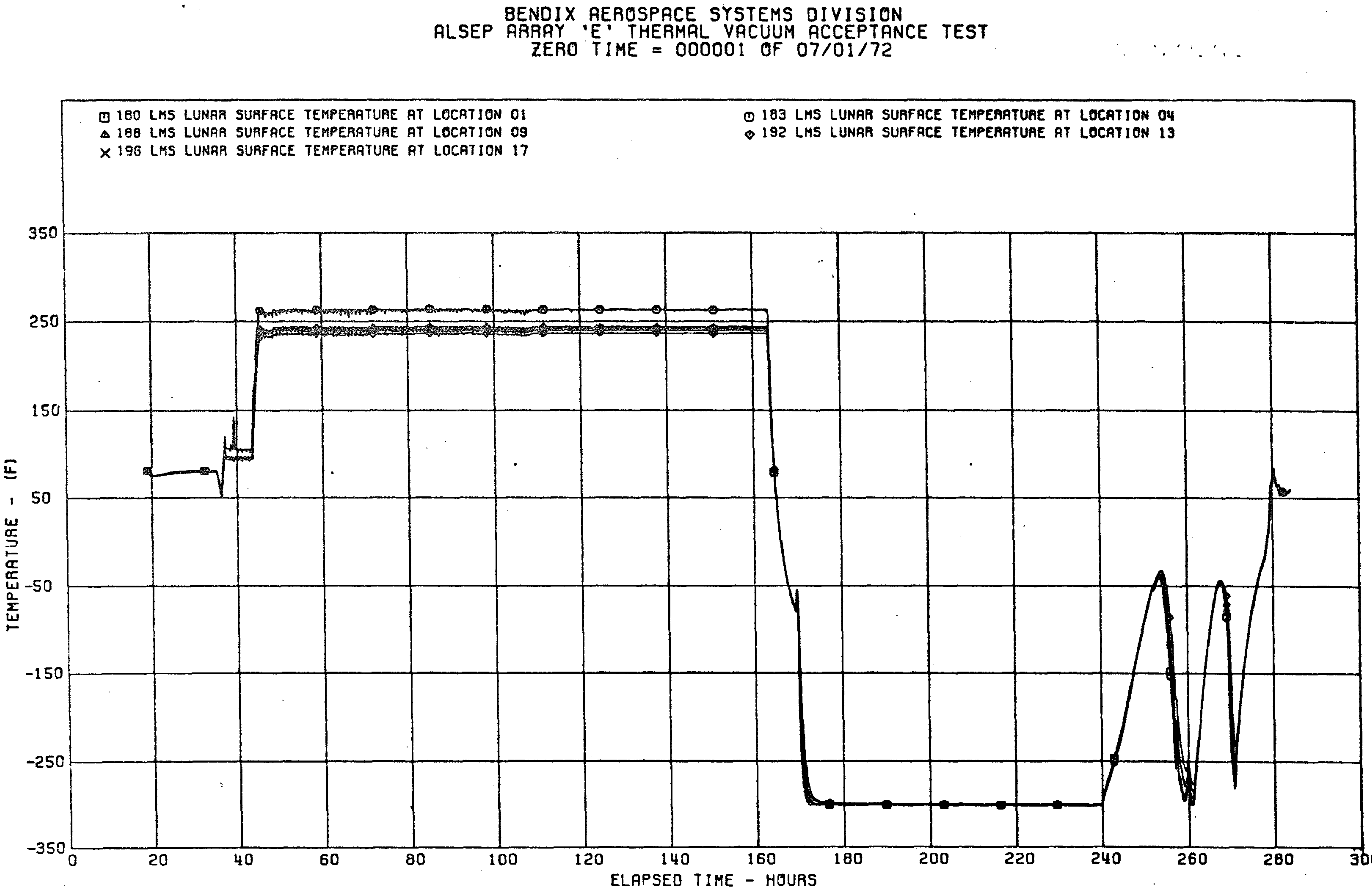

BENDIX AEROSPACE SYSTEMS DIVISION
ALSEP ARRAY 'E' THERMAL VACUUM ACCEPTANCE TEST
ZERO TIME = 000001 OF 07/01/72
180 LMS LUNAR SURFACE TEMPERATURE AT LOCATION 01
188 LMS LUNAR SURFACE TEMPERATURE AT LOCATION 09
196 LMS LUNAR SURFACE TEMPERATURE AT LOCATION 17
183 LMS LUNAR SURFACE TEMPERATURE AT LOCATION 04
192 LMS LUNAR SURFACE TEMPERATURE AT LOCATION 13
350
250
150
50
-50
-150
-250
-350
TEMPERATURE - (F)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
ELAPSED TIME - HOURS

Figure 8.4

BENDIX AEROSPACE SYSTEMS DIVISION
ALSEP ARRAY 'E' THERMAL VACUUM QUALIFICATION TEST
ZERO TIME = 000001 OF 05/20/72

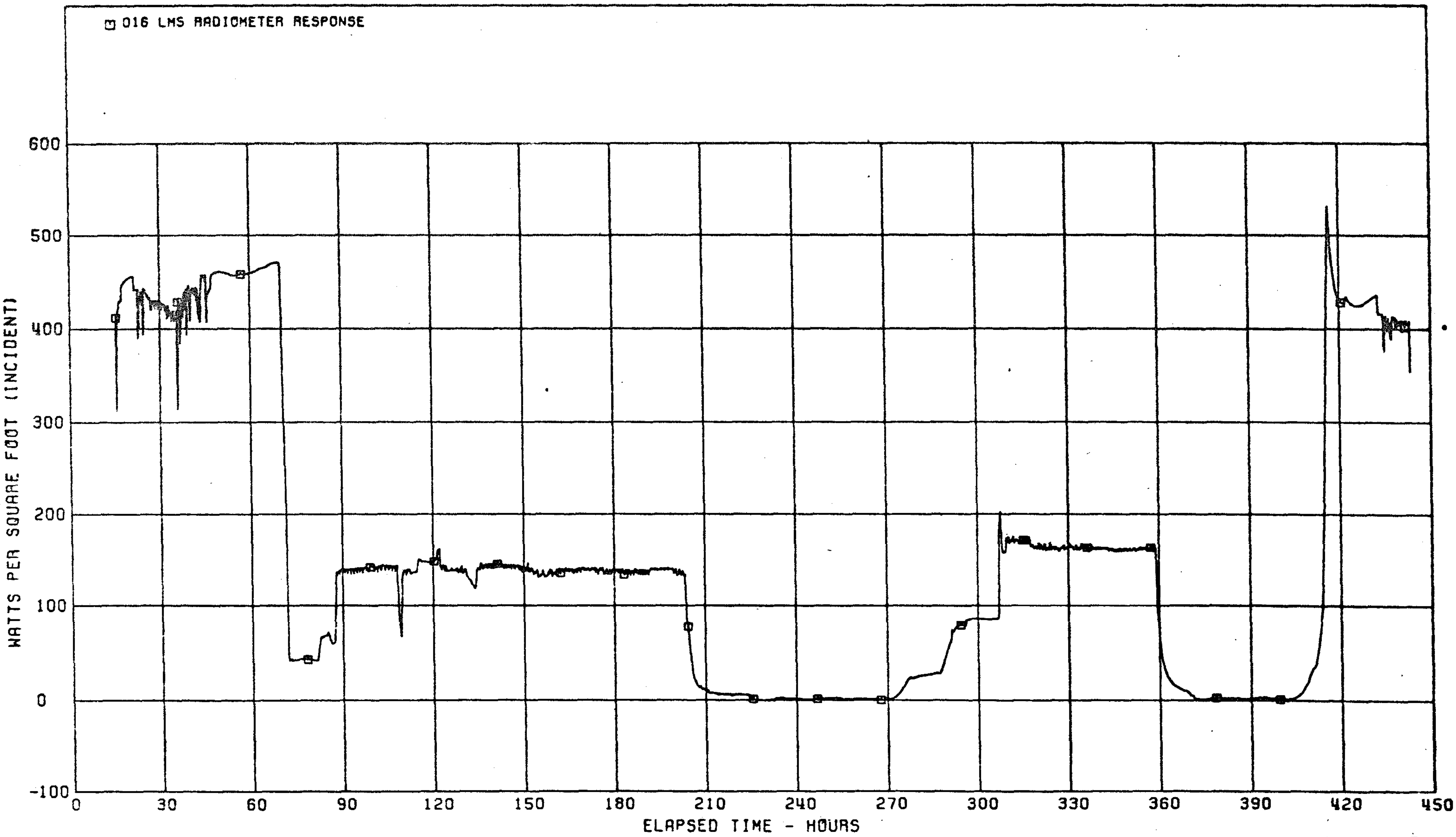
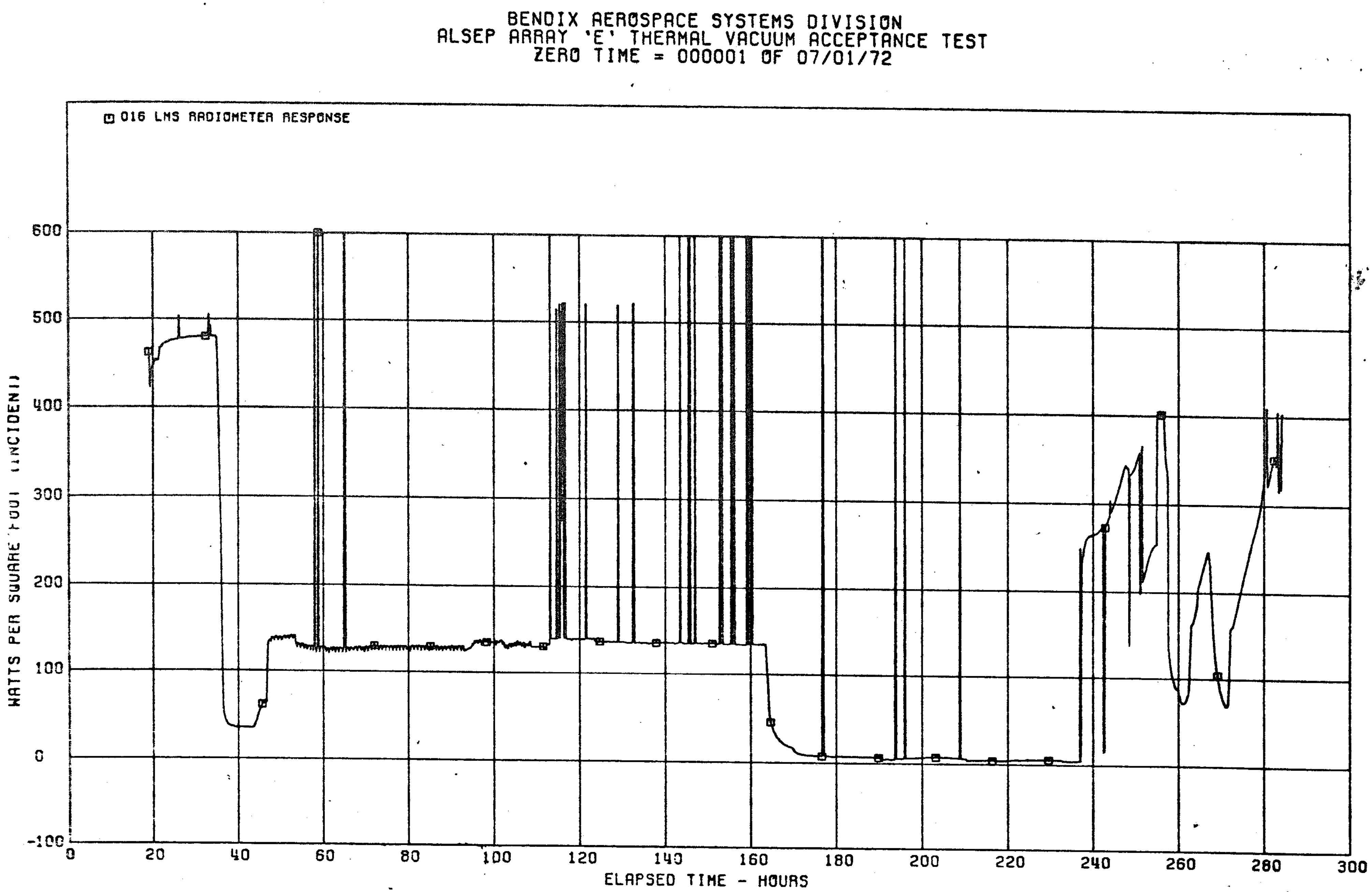
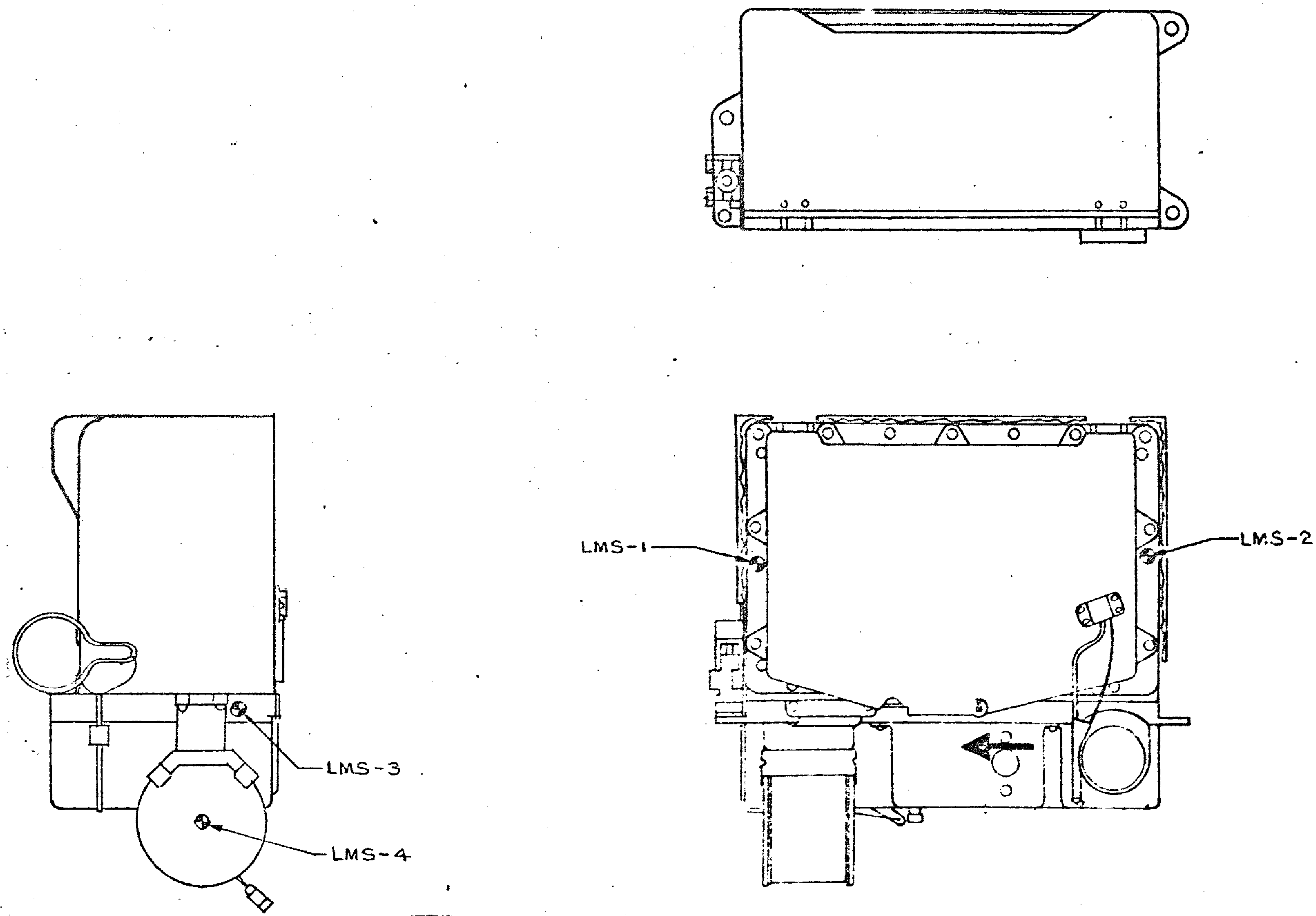


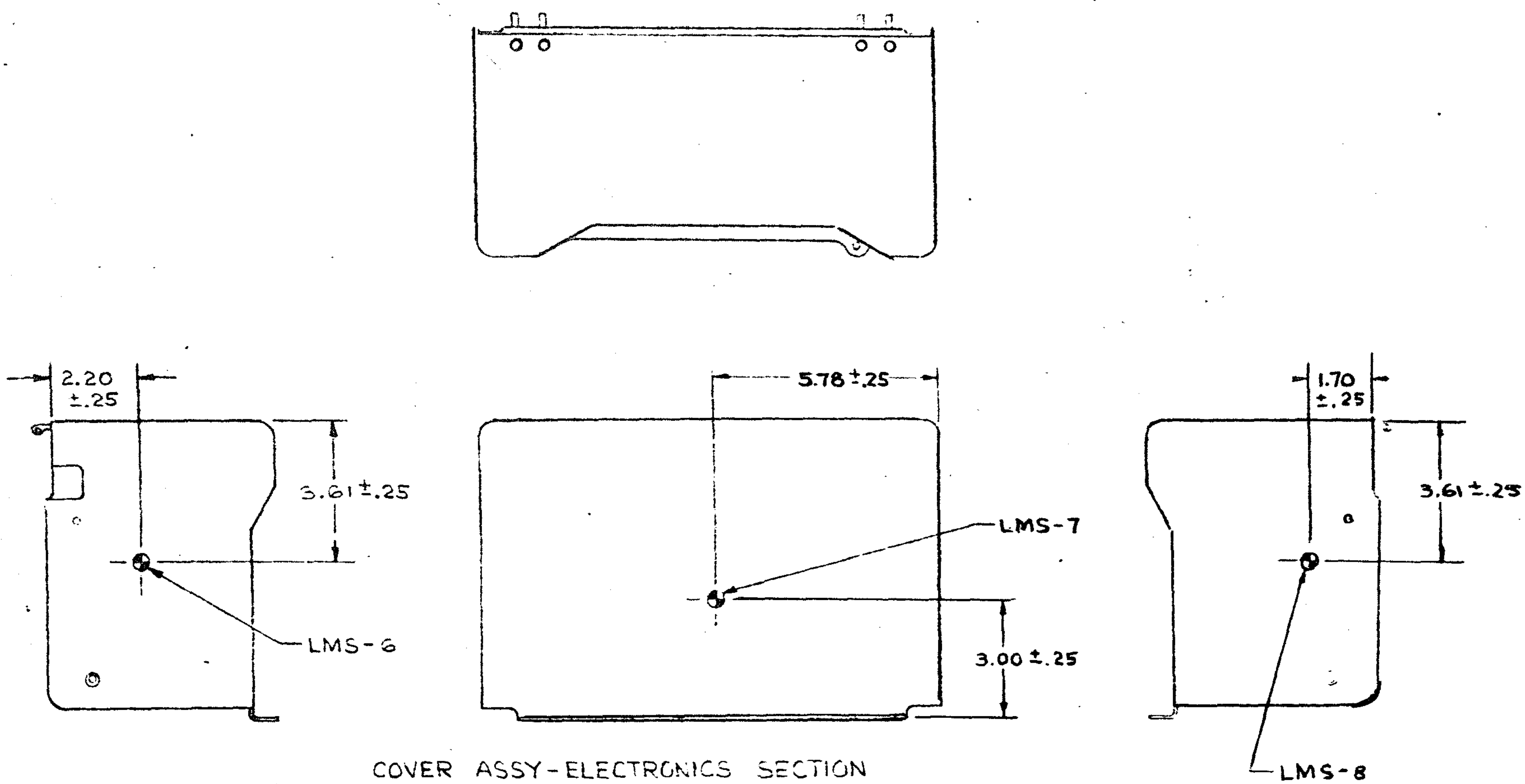
Figure 8.5


BENDIX AEROSPACE SYSTEMS DIVISION
ALSEP ARRAY 'E' THERMAL VACUUM ACCEPTANCE TEST
ZERO TIME = 000001 OF 07/01/72
016 LMS RADIOMETER RESPONSE
WATTS PER SQUARE FOOT (INCIDENT)
600
500
400
300
200
100
0
-100
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
ELAPSED TIME - HOURS



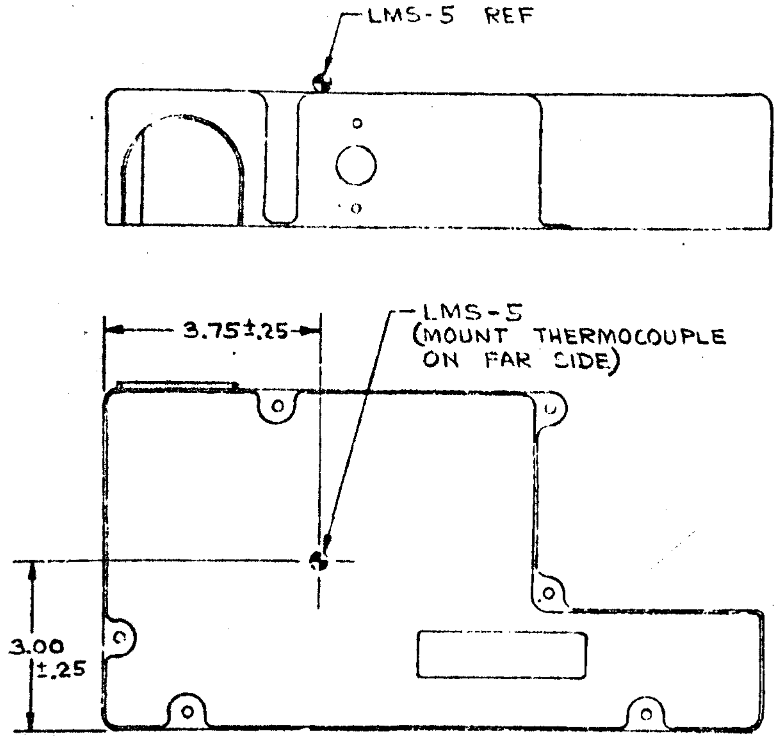
LUNAR MASS SPECTROMETER ASSY
REF DWG 2347400

Figure 8.7

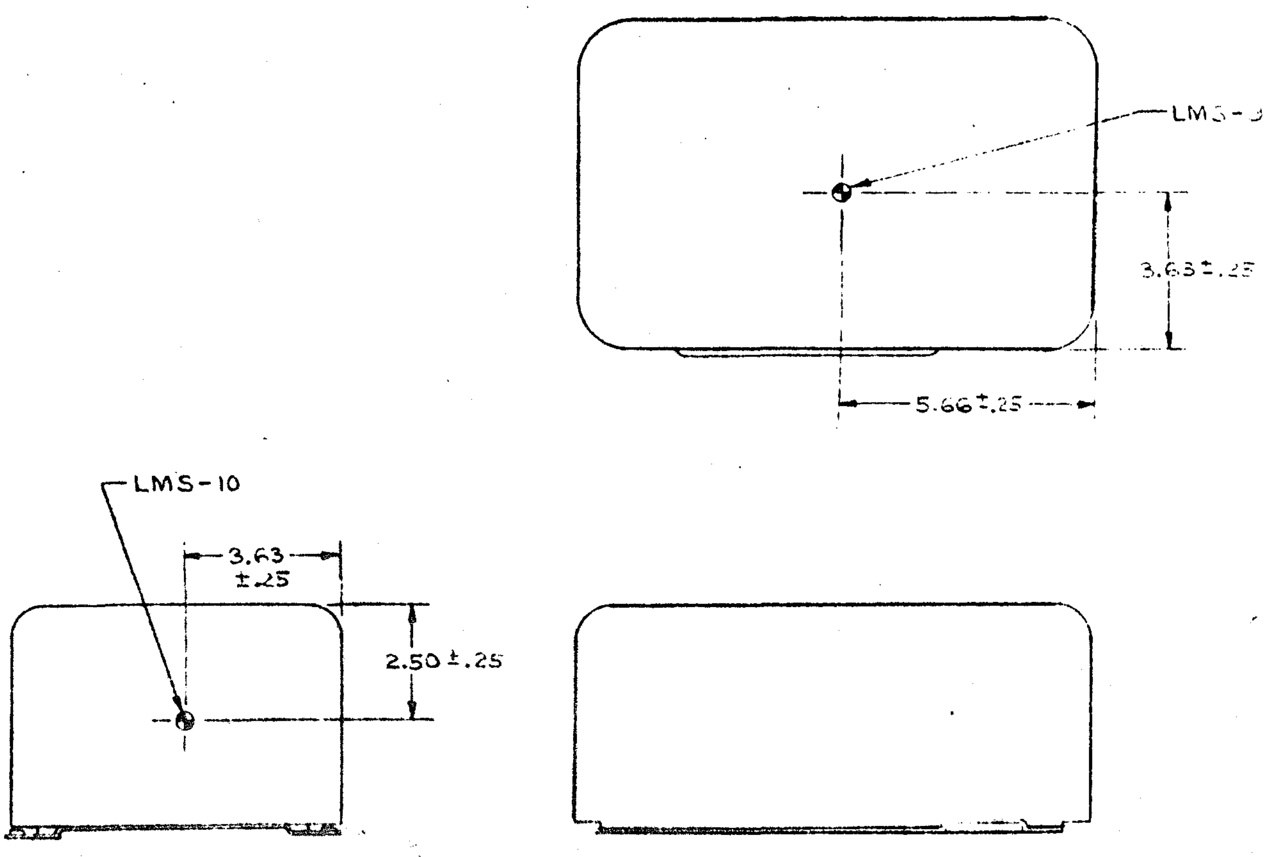


COVER ASSY-ELECTRONICS SECTION
REF DWG 2347675

Figure 8.8



COVER, ANALYZER
REF DWG 2347511



THERMAL COVER ASSY
REF DWG 2347510

8.5 Experiment Location

The LMS was centered on the 5' x 5' surface and placed on a 5 inch aluminum standoff. This standoff provided a more accurate view factor of the lunar surface. Figures 8.6 and 8.7 are photos of the deployed Qual and Flight models.

8.6 Thermocouple Locations

Ten thermocouples were designated to measure the Qualification model experiment temperatures. These are indicated in Figure 8.8 thru 8.10. There were no thermocouples attached to the Flight model. The temperature data obtained was housekeeping (HK-41) data via experiment thermistors. Thermocouple monitors located on the lunar surface simulator are indicated in Figure 10.

8.7 Experiment Models

8.7.1 Qual Model

Qual model consisted of the complete LMS experiment including dust cover. It had a radiator plate masked to 34 in^2 and dissipated 7.4 watts internal to the multilayer bag.

8.7.2 Flight Model

Flight model consisted of the complete LMS experiment including dust cover. Although the analyzer section was attached, analyzer power dissipation was removed to an analyzer simulator located on the lunar surface. This simulator temperature was maintained between 50 and 70° F. The model had a radiator plate masked to 40 in^2 and dissipated 7.7 watts internal to the multilayer bag.

Figure 8.9

QUAL MODEL T/V TEST SET UP

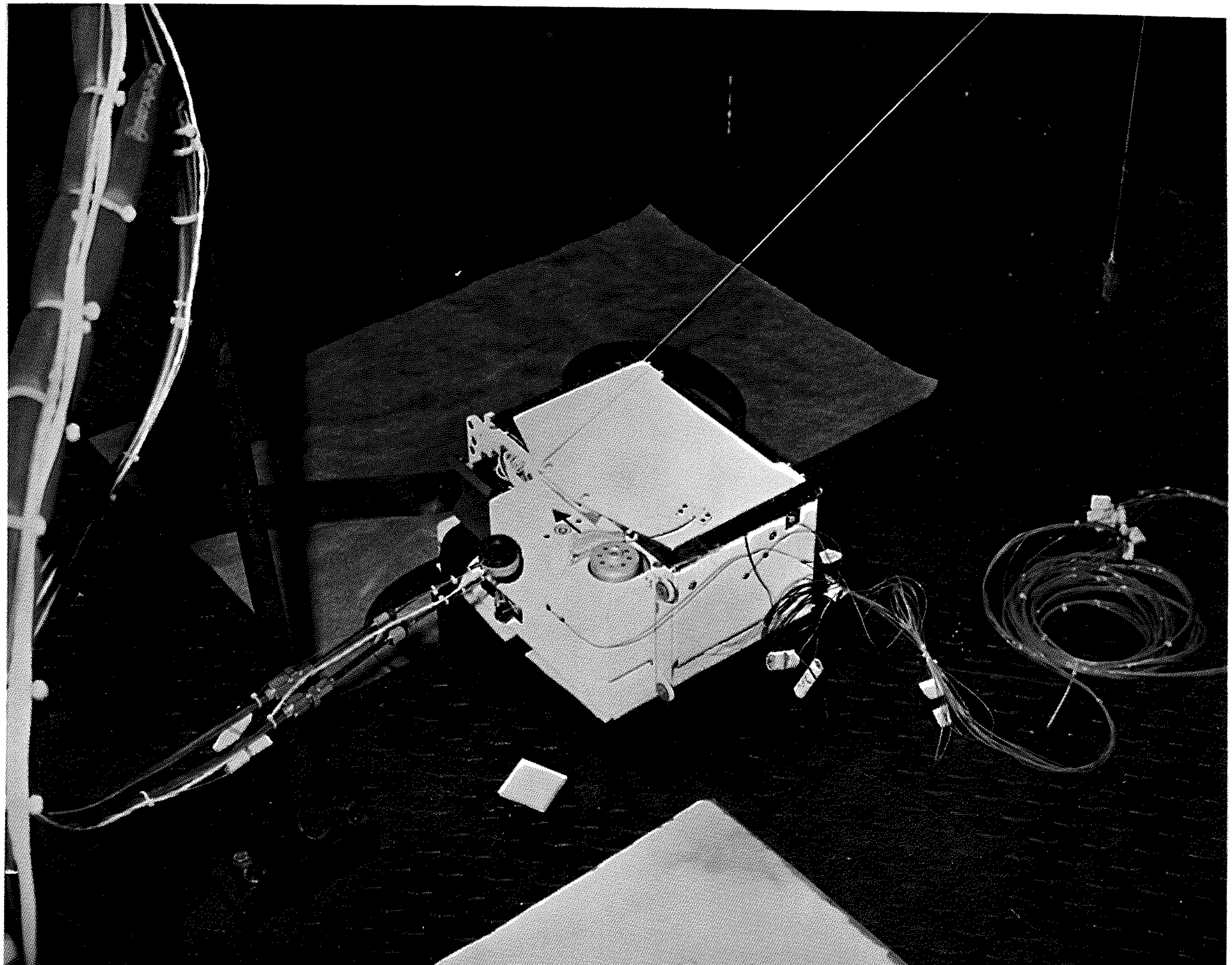
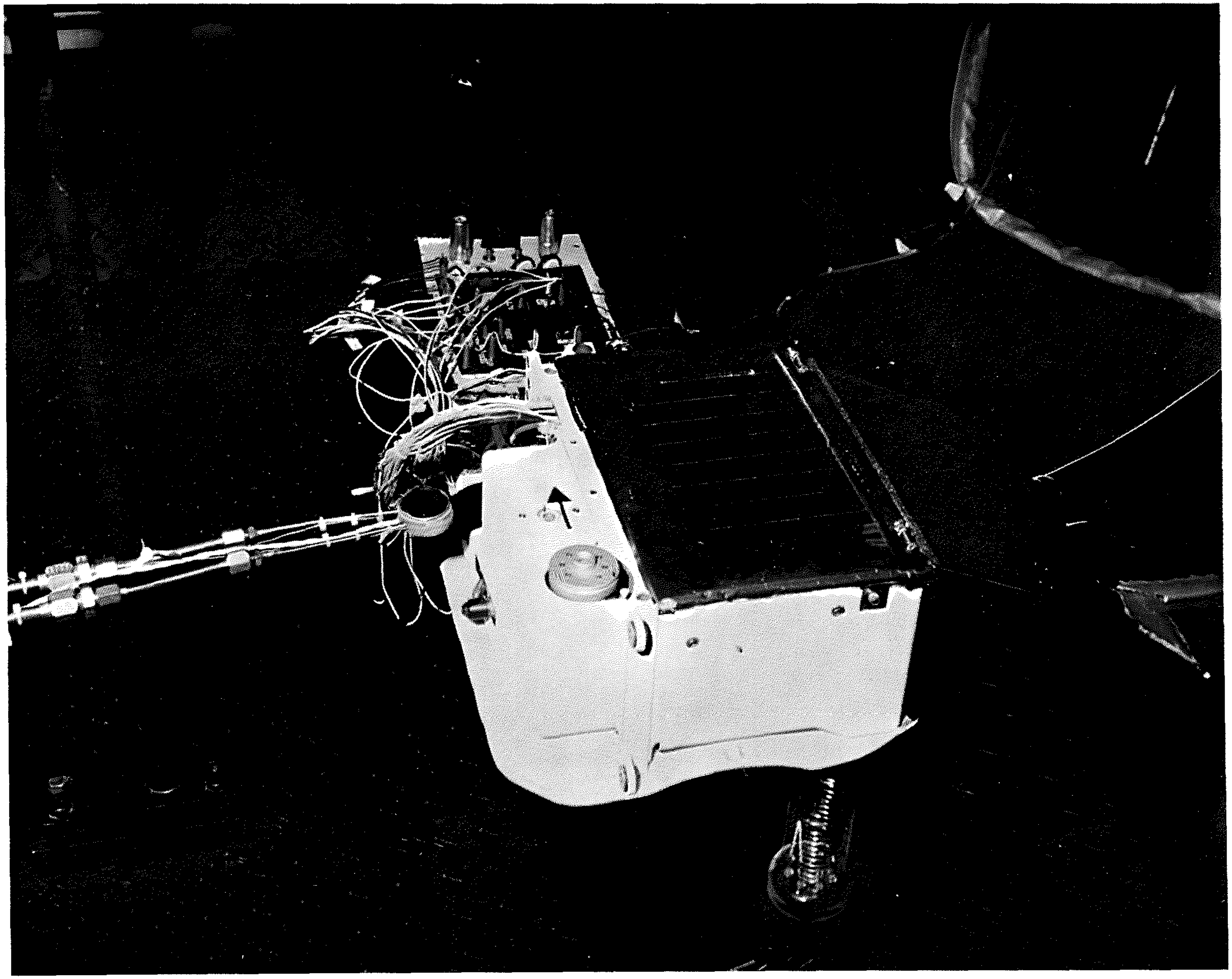


Figure 8.10

FLIGHT MODEL T/V TEST SETUP



9.0 RESULTS AND DISCUSSION

9.1 Graphical Summary of Results

9.1.1 Qualification Test

9.1.1.1 Radiator Plate - Analyzer Plate Events Plot (Figure 11)

This plot presents a chronological picture of the radiator plate and analyzer base plate temperature with the major events superimposed. Critical conditions from a thermal standpoint occur at lunar noon (189 hours) and lunar night (226 hours). The radiator plate/analyzer plate was 111/130°F and 0/-108°F for lunar noon and night respectively. The design limit noon condition, which occurred at 348 hours resulted in a radiator plate/analyzer baseplate temperature of +120/140°F.

9.1.1.2 LMS 01, 03, 04 and 05 (Figure 12).

This curve summarizes the radiator plate, analyzer baseplate and analyzer cover together with the cable reel temperatures. The analyzer cover ran +158/136/-200°F for design limit/lunar noon/night respectively. The cable reel lying on the lunar surface beneath a multilayer blanket attained +251/224/-289°F for the three conditions.

9.1.1.3 LMS 06, 07, 08, 09, 10 (Figure 13).

The plots in figure 13 include all the thermal cover and electronics cover thermocouples. Summarizing these data; the thermal cover end temperature was 145/124/-101°F for design limit/lunar noon/night respectively, the electronics cover ends were 117/96/-200°F and 165/143/-194°F, the thermal cover bottom was 203/184/-127°F, and the electronics cover bottom was 224/195/-230°F.

Figure 9.1

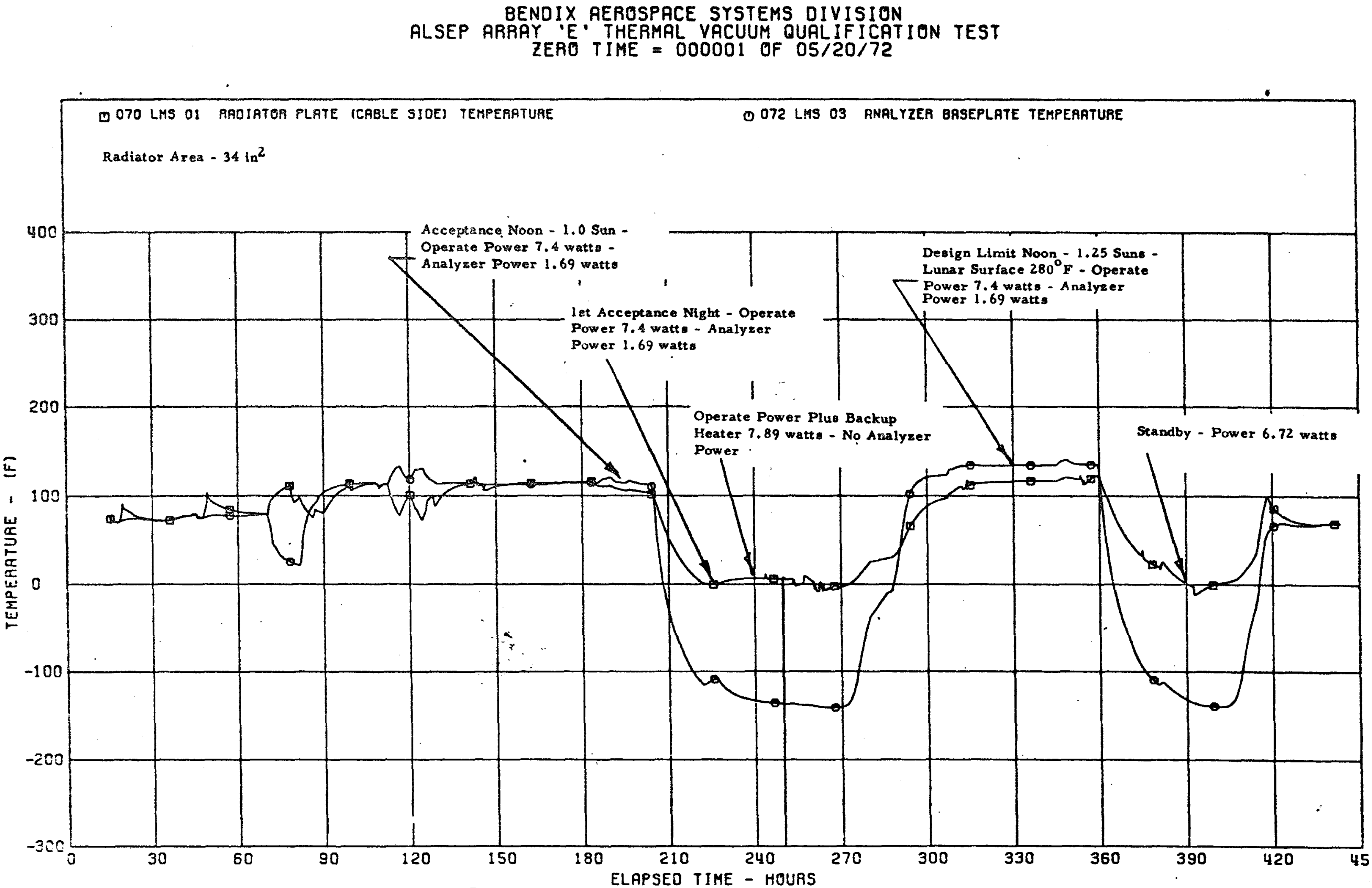

BENDIX AEROSPACE SYSTEMS DIVISION
ALSEP ARRAY 'E' THERMAL VACUUM QUALIFICATION TEST
ZERO TIME = 000001 OF 05/20/72
070 LMS 01 RADIATOR PLATE (CABLE SIDE) TEMPERATURE
072 LMS 03 ANALYZER BASEPLATE TEMPERATURE
Radiator Area - 34 in^2
Acceptance Noon - 1.0 Sun - Operate Power 7.4 watts - Analyzer Power 1.69 watts
1st Acceptance Night - Operate Power 7.4 watts - Analyzer Power 1.69 watts
Operate Power Plus Backup Heater 7.89 watts - No Analyzer Power
Design Limit Noon - 1.25 Suns - Lunar Surface 280°F - Operate Power 7.4 watts - Analyzer Power 1.69 watts
Standby - Power 6.72 watts
TEMPERATURE - (F)
400
300
200
100
0
-100
-200
-300
0
30
60
90
120
150
180
210
240
270
300
330
360
390
420
45
ELAPSED TIME - HOURS

Figure 9.2

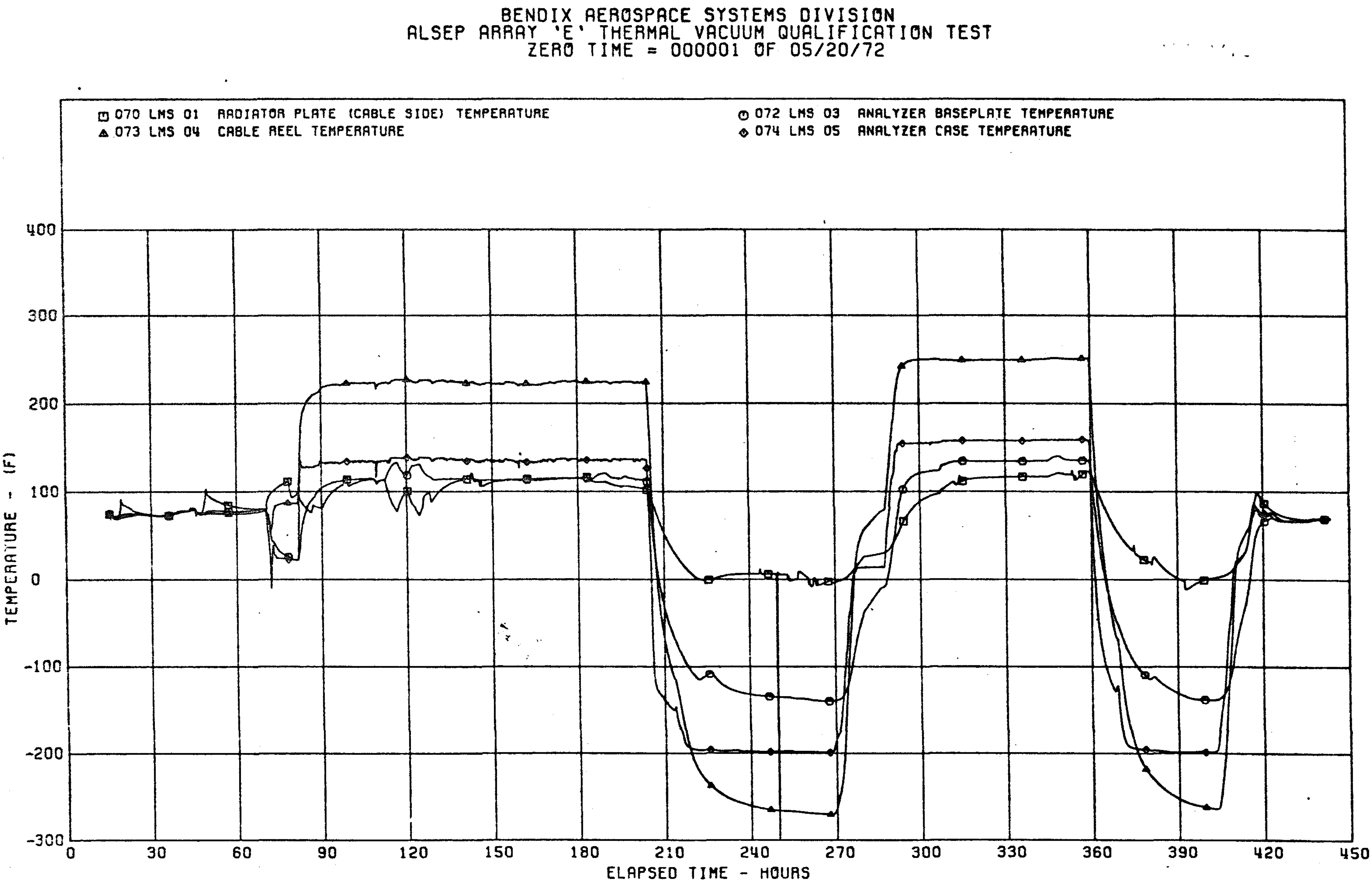
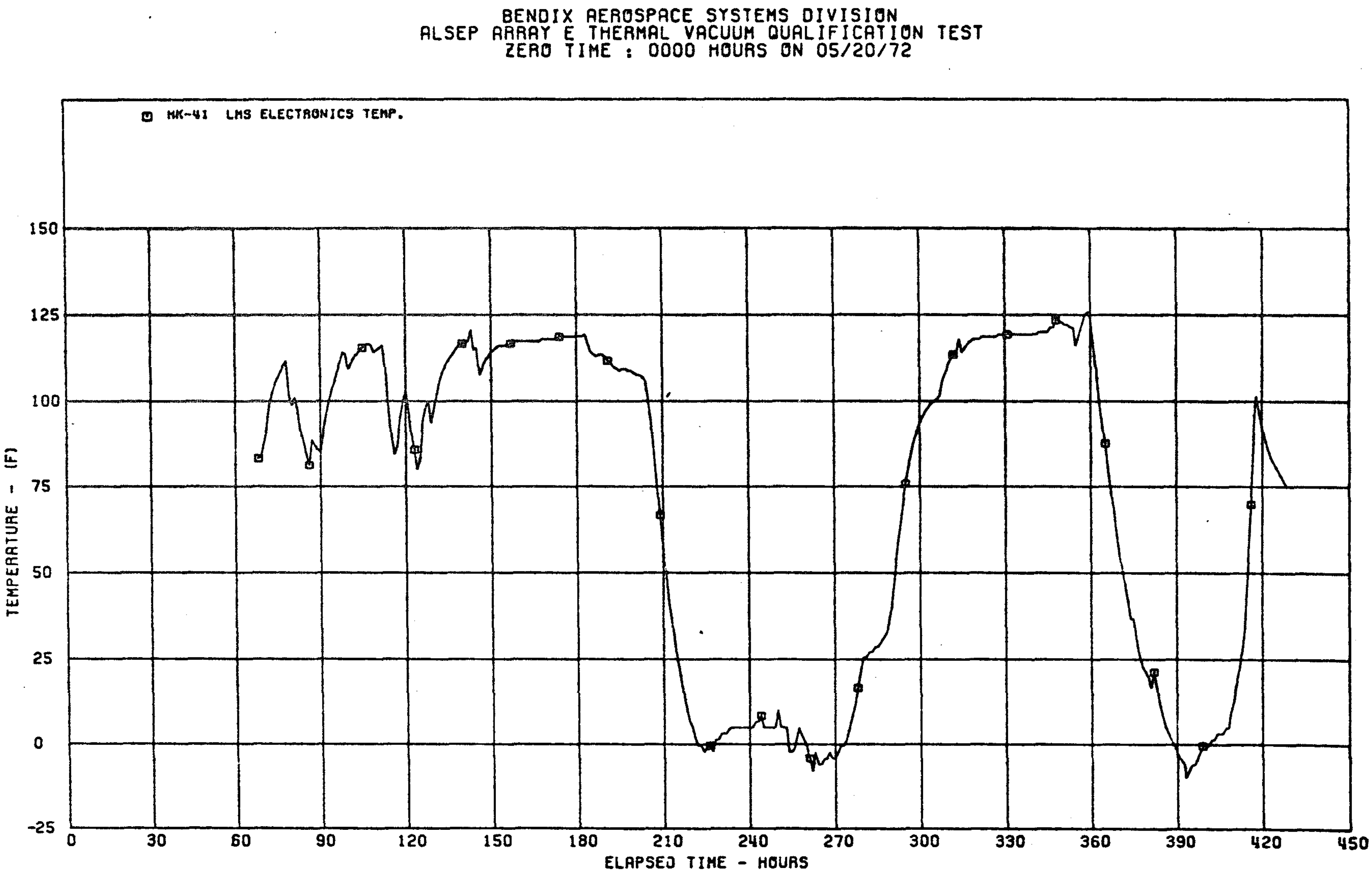
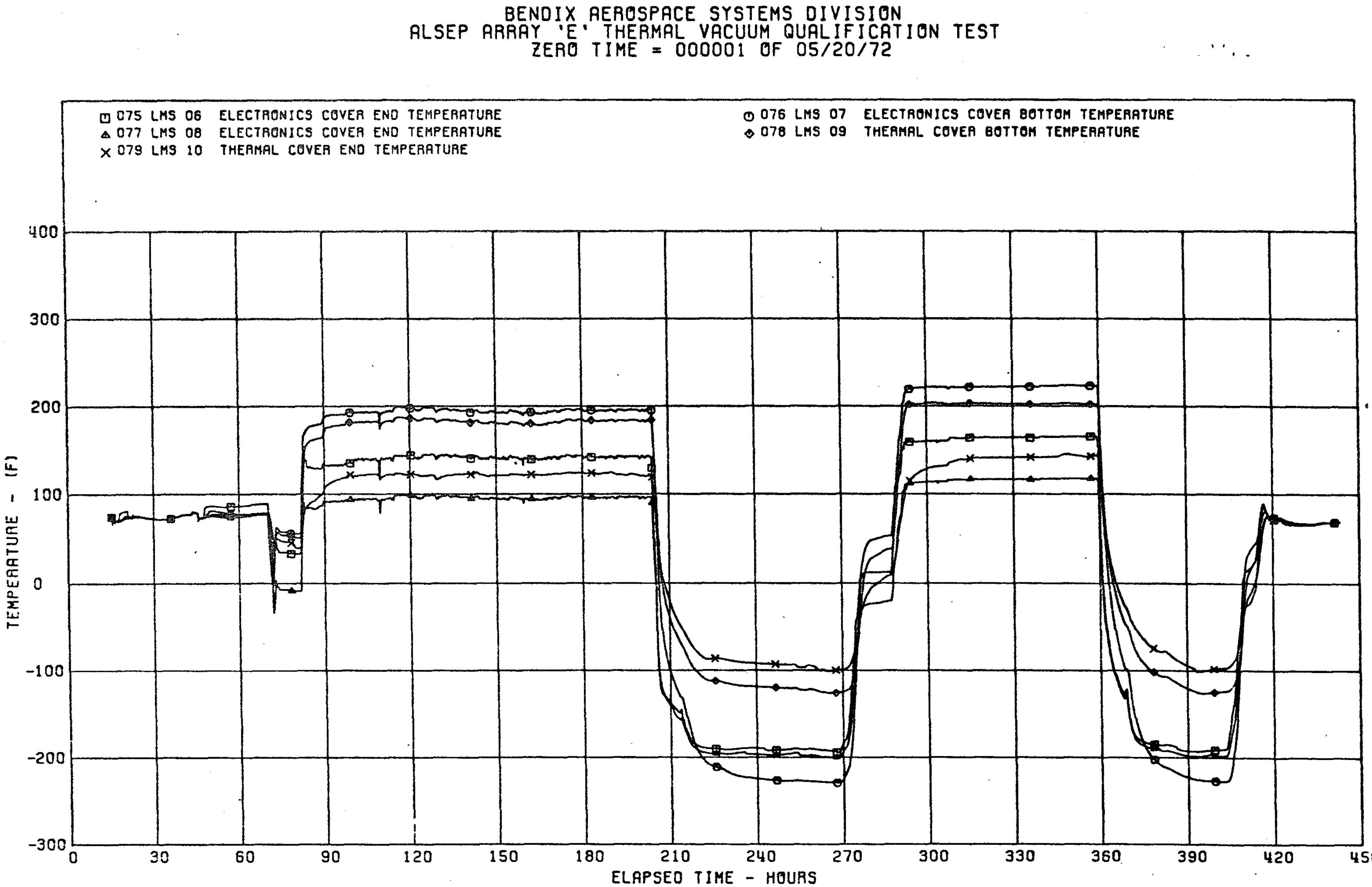

BENDIX AEROSPACE SYSTEMS DIVISION
ALSEP ARRAY 'E' THERMAL VACUUM QUALIFICATION TEST
ZERO TIME = 000001 OF 05/20/72
070 LMS 01 RADIATOR PLATE (CABLE SIDE) TEMPERATURE
073 LMS 04 CABLE REEL TEMPERATURE
072 LMS 03 ANALYZER BASEPLATE TEMPERATURE
074 LMS 05 ANALYZER CASE TEMPERATURE
400
300
200
100
0
-100
-200
-300
TEMPERATURE - (F)
0
30
60
90
120
150
180
210
240
270
300
330
360
390
420
450
ELAPSED TIME - HOURS

Figure 9.2 a


BENDIX AEROSPACE SYSTEMS DIVISION
ALSEP ARRAY E THERMAL VACUUM QUALIFICATION TEST
ZERO TIME : 0000 HOURS ON 05/20/72
HK-41 LMS ELECTRONICS TEMP.
TEMPERATURE - (F)
150
125
100
75
50
25
0
-25
0
30
60
90
120
150
180
210
240
270
300
330
360
390
420
450
ELAPSED TIME - HOURS

igure 9.3


BENDIX AEROSPACE SYSTEMS DIVISION
ALSEP ARRAY 'E' THERMAL VACUUM QUALIFICATION TEST
ZERO TIME = 000001 OF 05/20/72
075 LMS 06 ELECTRONICS COVER END TEMPERATURE
077 LMS 08 ELECTRONICS COVER END TEMPERATURE
079 LMS 10 THERMAL COVER END TEMPERATURE
076 LMS 07 ELECTRONICS COVER BOTTOM TEMPERATURE
078 LMS 09 THERMAL COVER BOTTOM TEMPERATURE
400
300
200
100
0
-100
-200
-300
TEMPERATURE - (F)
0
30
60
90
120
150
180
210
240
270
300
330
360
390
420
450
ELAPSED TIME - HOURS

9.1.2 Flight Test

9.1.2.1 Radiator Plate Internal Thermistor HK-41 (Figure 14)

This plot presents a chronological picture of the radiator plate thermistor with the major events superimposed. Critical conditions from a thermal standpoint occur at lunar noon (154 hours) and lunar night (210 hours). The radiator plate and analyzer baseplate represented by housekeeping data read during the tests were, 111/140°F during lunar noon, and -11/-120°F during lunar night.

9.1.2.2 Analyzer Simulator Temperature (Figure 15)

This plot indicates the temperature maintained in the analyzer simulator box which was located on the lunar surface but removed from the LMS experiment.

9.2 Factors Affecting Correlation of Test Data and Analysis

9.2.1 View Factors

Table 4 tabulates the experiment to chamber view factors of the experiment critical surfaces. Locating the experiment on a 5 inch aluminum standoff provides an accurate view factor of all surfaces except the edge of the masking which has negligible effect.

9.2.2 Effects of Infrared Solar Simulation

Because the percentage of heat absorbed by the mirrored surface is greater under infrared irradiation then solar irradiation, the heat load on the mirrored surfaces is simulated by measuring one sun equivalent heat load on a mirrored surface radiometer. In simulating the mirror heat load, the heat loads on the S-13-G white coating, and the aluminized teflon are under simulated. The extent of the undersimulation is tabulated in Table 5. These loads have the effect of decreasing the equilibrium temperature 3°F from the lunar noon predicted temperature.

9.2.3 Effect of Flight Test Analyzer Simulator

Qual Model dissipated 1.69 watts of power in the analyzer baseplate which forms one side of the electronics cover. Dissipation of this power

TABLE 9.1

CONFIGURATION FACTORS

QUAL AND FLIGHT T/V TEST

Item	Test		Actual		% Error
	Lunar Surface	Cold Wall	Lunar Surface	Cold Wall	
Mirrors	0.0	1.0	0.0	1.0	0.0
Masking Top	0.0	1.0	0.0	1.0	0.0
Masking Edge	0.452	0.548	0.50	0.50	9.5
Electronic's Cover	0.50	0.50	0.50	0.50	0.0
Analyzer Cover	0.50	0.50	0.50	0.50	0.0

TABLE 9.2

SOLAR SIMULATION ON QUAL AND FLIGHT THERMAL SURFACES

Condition	Surface Solar Load (Suns)		
	Second Surface Mirror	S-13-G	Aluminized Teflon Masking
Design Limit Noon	1.25	0.472	0.431
Acceptance Noon	1.0	0.378	0.345

Figure 9.4

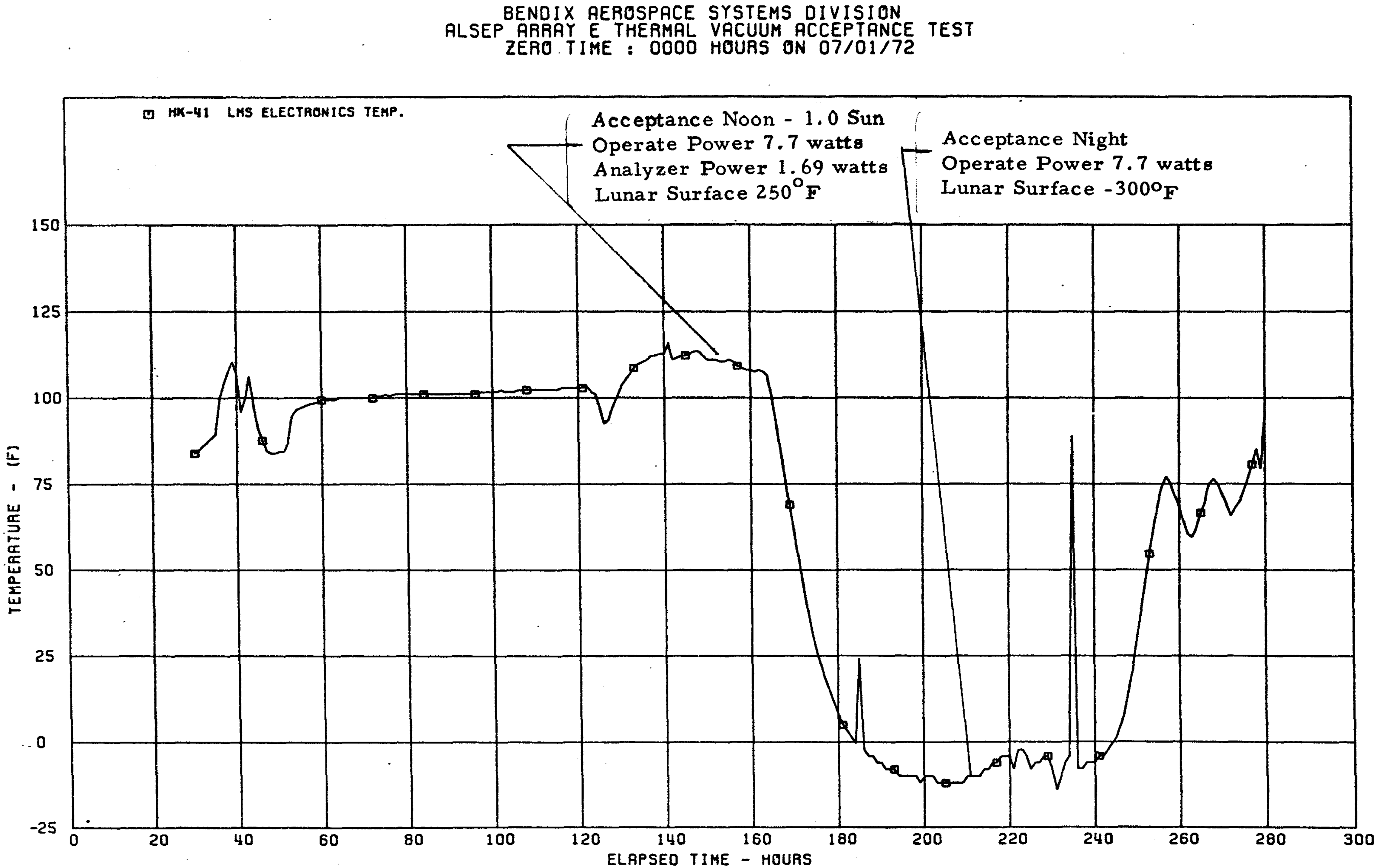
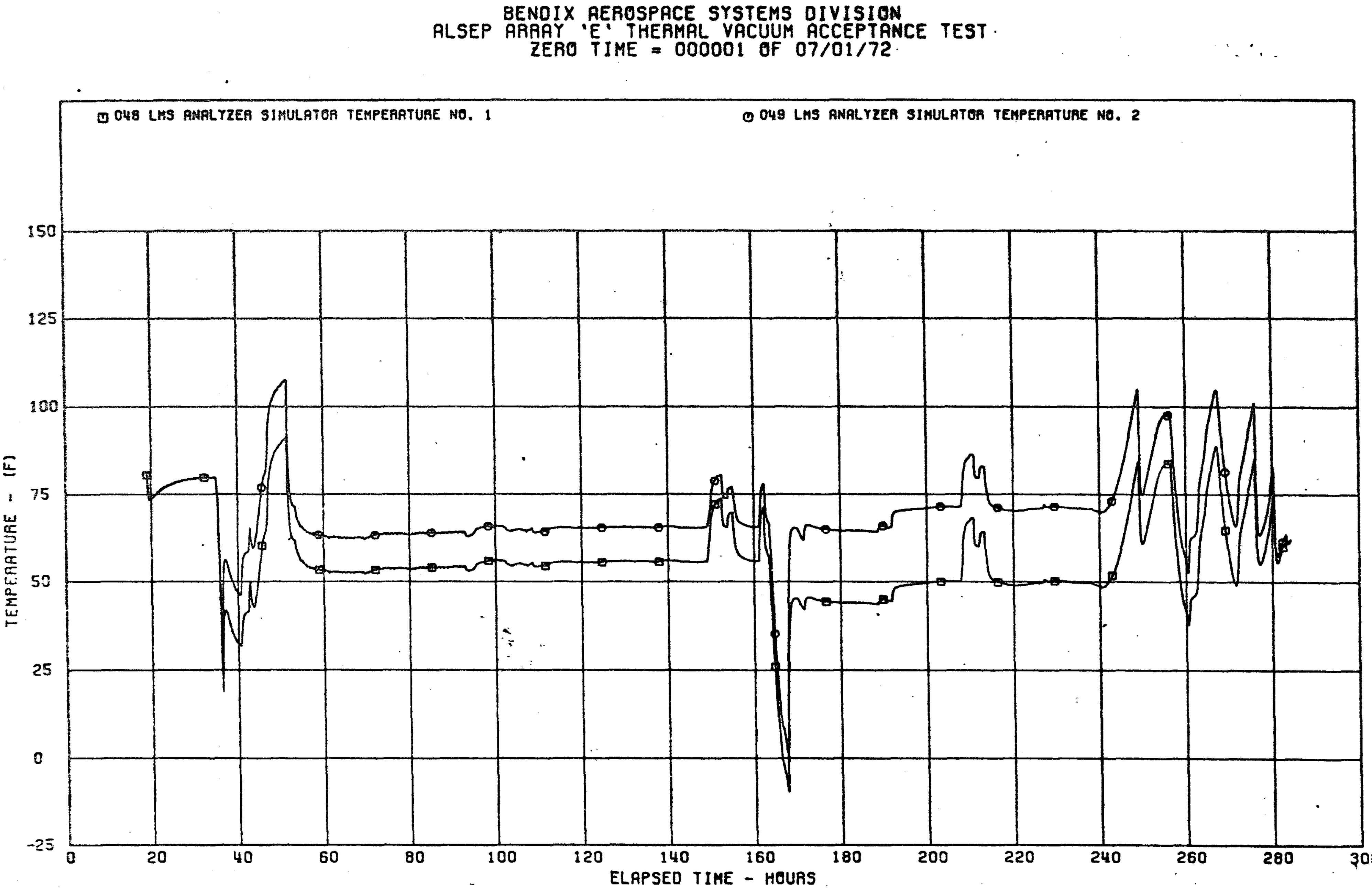

BENDIX AEROSPACE SYSTEMS DIVISION
ALSEP ARRAY E THERMAL VACUUM ACCEPTANCE TEST
ZERO TIME : 0000 HOURS ON 07/01/72
HK-41 LMS ELECTRONICS TEMP.
Acceptance Noon - 1.0 Sun
Operate Power 7.7 watts
Analyzer Power 1.69 watts
Lunar Surface 250°F
Acceptance Night
Operate Power 7.7 watts
Lunar Surface -300°F
150
125
100
75
50
25
0
-25
TEMPERATURE - (F)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
ELAPSED TIME - HOURS

Figure 9.5


BENDIX AEROSPACE SYSTEMS DIVISION
ALSEP ARRAY 'E' THERMAL VACUUM ACCEPTANCE TEST
ZERO TIME = 000001 OF 07/01/72
048 LMS ANALYZER SIMULATOR TEMPERATURE NO. 1
049 LMS ANALYZER SIMULATOR TEMPERATURE NO. 2
TEMPERATURE - (F)
150
125
100
75
50
25
0
-25
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
ELAPSED TIME - HOURS

resulted in a baseplate temperature 42°F warmer than no power dissipation. During the Flight lunar night operating mode, this dissipation took place in a simulator removed from the experiment. Removing this dissipation and the associated colder baseplate results in a radiator plate 10°F colder than with the actual baseplate.

9.3 Comparison of Data and Correlated Temperatures

Tables 6 and 7 include the test temperatures of critical modes for both Qual and Flight tests. Radiator plate temperatures were correlated to within 3°F for all conditions. The Flight Test radiator plate temperature was not actual data, but was extrapolated from Qual data of the radiator plate thermocouple and HK-41 thermistor. This temperature difference was +6°F during lunar noon and +3°F during lunar night.

TABLE 9.3

LUNAR MASS SPECTROMETER QUALIFICATION THERMAL VACUUM TEST DATA AND CORRELATION

	Test Condition					
	Design Limit Noon		Acceptance Noon		Qual Night	
Location	Test Data	Analytical Data	Test Data	Analytical Data	Test Data	Analytical Data
Radiator Plate	120°F	117°F	111°F	109°F	0°F	0°F
HK-41 Radiator Plate Internal	127°	123°	117°	115°	3°	3°
Analyzer Baseplate	140°	152°	121°	129°	-108° [1]	- 99°
Analyzer Cover	158°	153°	136°	129°	-200°	-230°
Electronics Cover End	165°	152°	143°	129°	-194° [1]	-252°
Electronics Cover End	117° [2]	151°	96° [2]	129°	-200° [1]	-258°
Thermal Cover End	145°	151°	124°	127°	-101° [1]	-191°
Electronics Cover Bottom	224° [3]	279°	184° [3]	249°	-230°	-269°
Thermal Cover Bottom	203° [3]	272°	184° [3]	243°	-127° [1]	-204°

[1] These temperatures were still changing at a rate of 3°F/hr or greater.

[2] T/C 08 ran consistently low, T/C 06 is more representative of the cover end temperature.

[3] The cover bottom was resting on an aluminum box standoff.

TABLE 9.4

LUNAR MASS SPECTROMETER FLIGHT
ACCEPTANCE THERMAL VACUUM TEST DATA AND CORRELATION

	Test Condition			
	Acceptance Noon		Acceptance Night	
Location	Test Data	Analytical Data	Test Data	Analytical Data
HK-41 Radiator Plate Internal	111°F	108°F	- 11°F	-11°F
Radiator Plate (1)	105°	102°	- 14°	- 14° (2)
Analyzer Baseplate	140°	129°	-120°	-131°

(1) This temperature was not an actual test point - it was extrapolated from the radiator plate to HK-41 temperature gradient of Qual T/V.

(2) An analyzer simulator was utilized eliminating 1.69 watts of power dissipation on the analyzer baseplate - expected temperature with analyzer dissipation will be $-4^{\circ}F$.

SECTION III

LUNAR PREDICTIONS

This section summarizes the lunar surface analysis of the correlated thermal model.

10.0 LUNAR PREDICTIONS

10.1 Nominal Operation of LMS with Clean Thermal Surfaces

The operating temperatures of the 40 $in.^2$ radiator plate of an LMS dissipating 7.7 watts internally is 110°F during lunar noon and -4°F during lunar night. This assumes all surfaces are clean and non-degraded. The radiator plate temperature during the survival mode dissipating 8 watts is -17 °F.

Figure 16 indicates the day/night operating temperature of a nominal experiment as a function of power dissipation and radiator area.

10.2 Degraded or Dust Covered Radiator and Cover Surfaces

Figure 17 indicates the radiator temperature as a function of solar angle for various degraded surfaces. These plots assume the sun is incident on the side of the analyzer cover. The first plot indicates temperatures of an experiment with all surfaces totally dust covered with the exception of those initially covered by the dust cover. The parametric studies include various states of mirror/radiator plate degradation from the nominal $\alpha = 0.08$ to $\alpha = 0.3$. Dust coverages (percent areas covered) corresponding to these α's are indicated in Figure 18. For example an $\alpha = 0.3$ is comparable to 22.5% dust coverage of mirrors and masking.

The second series of plot indicates the effects of radiator surface degradation assuming all other surfaces clean of dust.

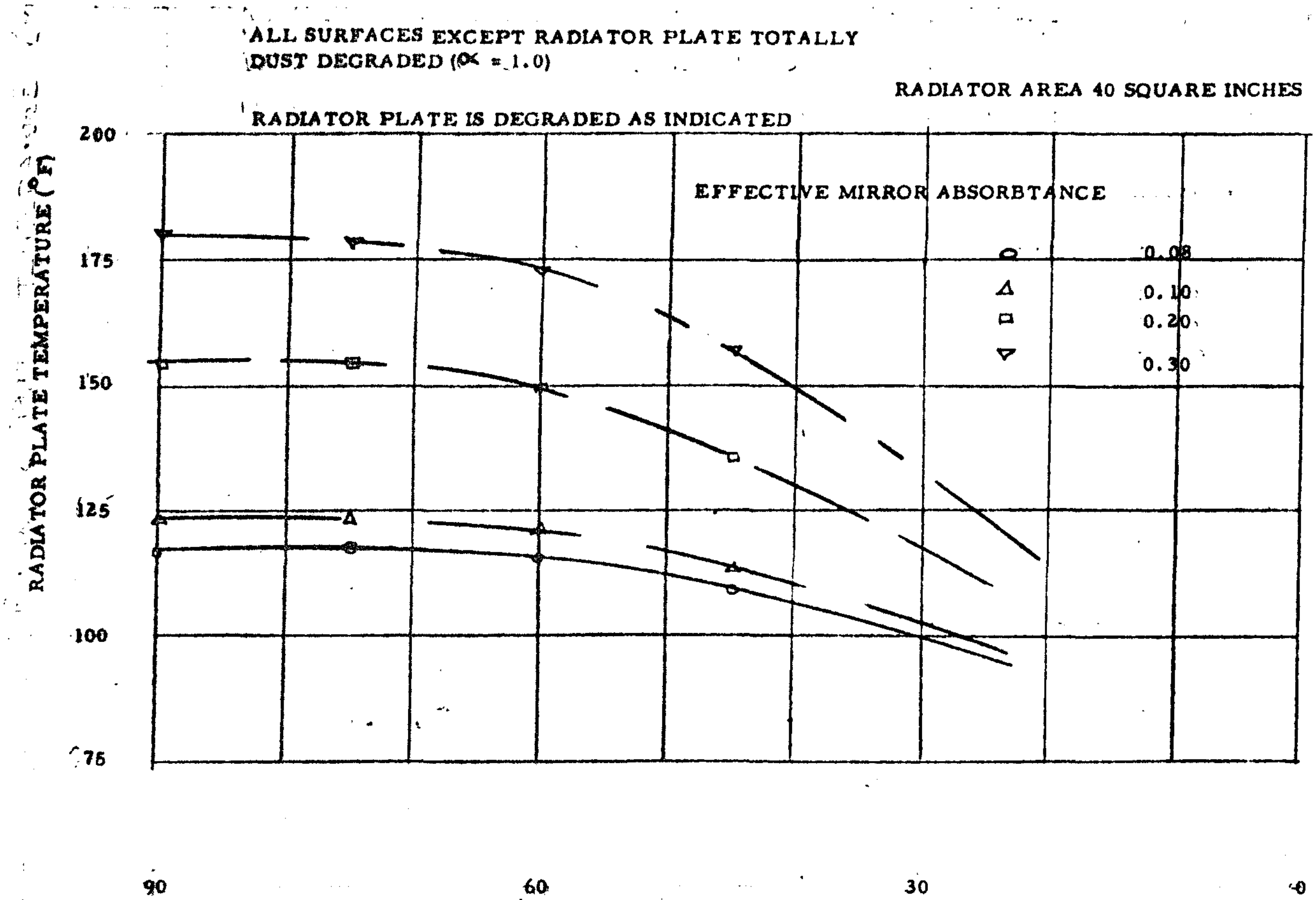
Using +125°F as maximum allowable radiator temperature, a "clean" experiment could have its mirror degraded from $\alpha = 0.08$ to $\alpha = 0.133$ before exceeding the allowable temperature. An experiment with non-protected surfaces 100% dust covered could have mirror degradation from $\alpha = 0.08$ to $\alpha = 0.105$ before exceeding the +125°F allowable temperature limit.

10.3 Lunar Noon Non-Operating Conditions

10.3.1 Dust Cover On

The equilibrium temperatures of the LMS with dust cover intact

LUNAR MASS SPECTROMETER RADIATOR TEMPERATURE AS A FUNCTION OF SOLAR ANGLE



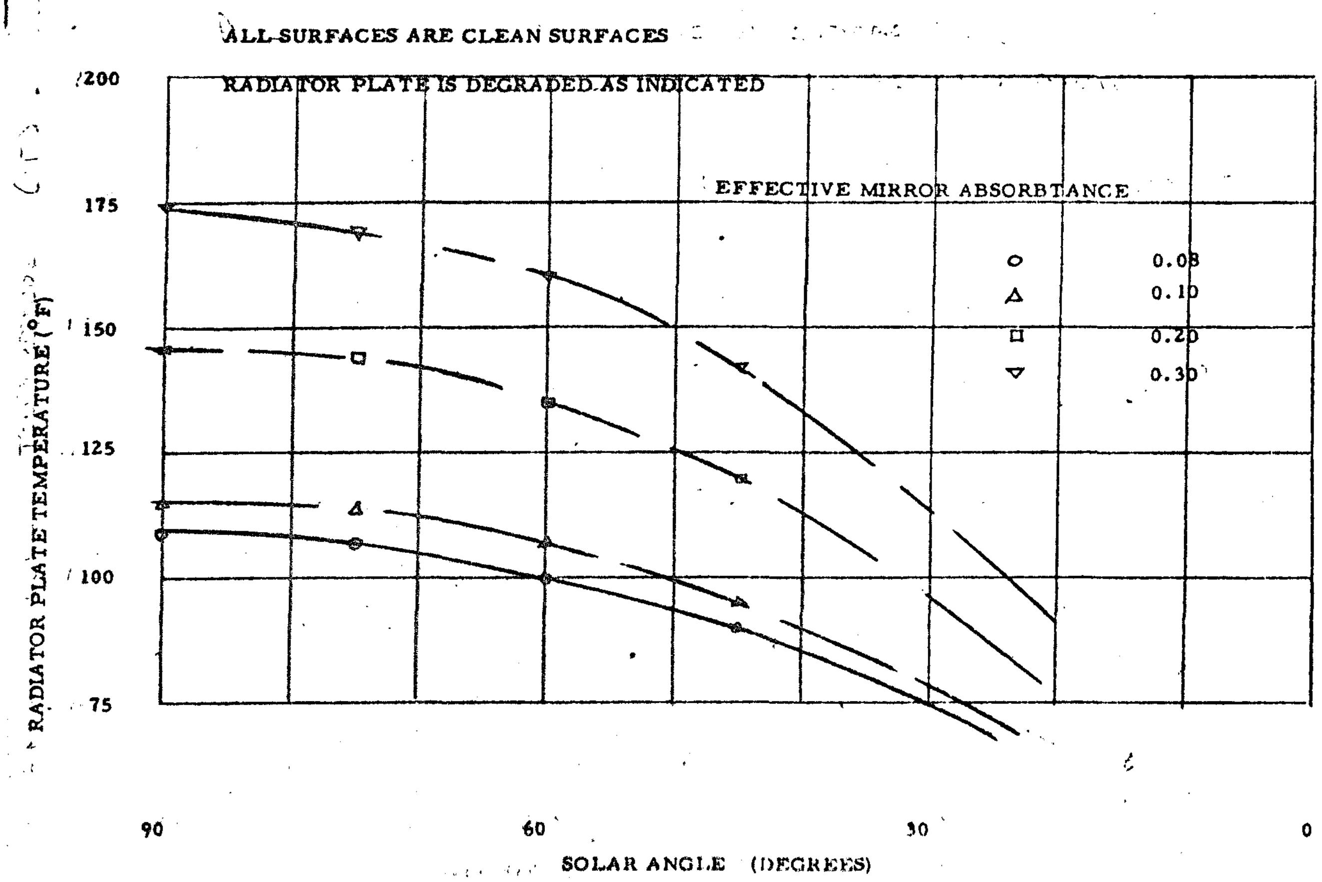
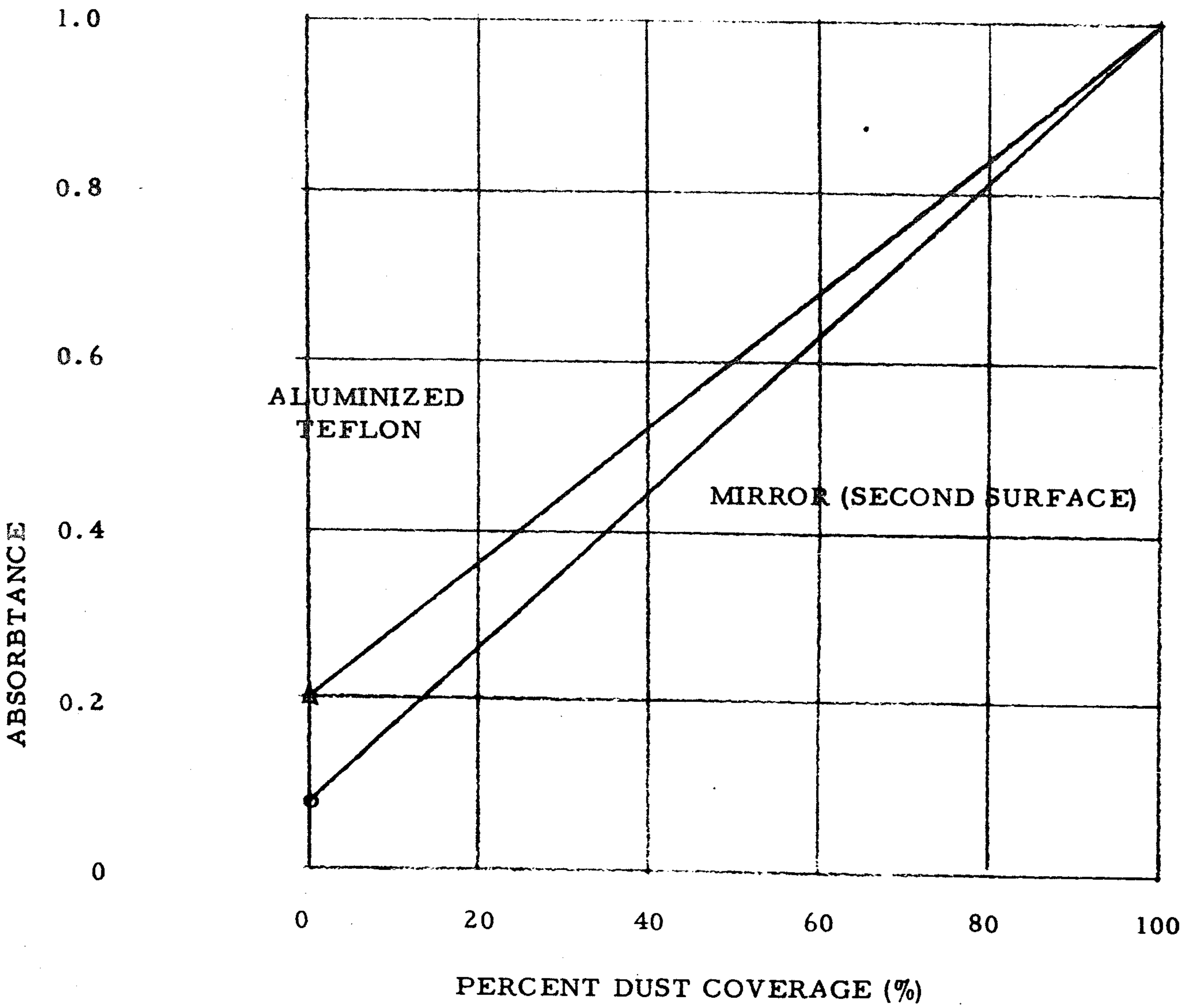


Figure 10.1

EFFECTS OF DUST ON THE SOLAR ABSORBTANCE OF THE LMS RADIATOR COATINGS

Figure 10.2



S

are; for clean surfaces the radiator plate will attain +107°F, for dust cover and all surfaces 100% dust covered the radiator plate will attain a +228°F temperature.

10.3.2 Radiator Exposed - no Power Dissipation (Lunar Noon)

A nominally clean experiment at equilibrium, with no internal power dissipation, will attain an +27°F radiator plate temperature at lunar noon.

10.3.3 Deployment at a 20° Latitude

Deployment of the LMS at a 20° latitude has the effect of decreasing the lunar noon operating temperature from +110°F to 105°F. This results from the combination of the lunar surface decrease in temperature and the sun no longer normal to the radiator plate.

REFERENCES

1) AL 900132 "Performance and Design Requirements for Lunar Mass Spectrometer Experiment Subsystem for ALSEP Package System" Bendix Aerospace Systems Div.

2) TP 2365582 "ALSEP Array E Deployed System Design Limit Thermal Vacuum Test Procedure", Bendix Aerospace Systems Div.

3) TP 2365575 "ALSEP Array E Flight System Deployed Thermal Vacuum Test Procedure", Bendix Aerospace Systems Div.

4) ATM-1097 "Lunar Mass Spectrometer Design Verification Thermal Vacuum Test", Bendix Aerospace Systems Div.

5) LED-520-1F "Design Criteria and Environments for the LM", Grumman Aircraft Engineering Corp.

APPENDIX A

THERMAL MODEL NODES

1	Second Surface Mirror
2	Second Surface Mirror
3	Second Surface Mirror
4	Second Surface Mirror
5	Second Surface Mirror
6	Second Surface Mirror
10	Masking
11	Radiator Plate
12	Support Structure Isolator
20	Masking
21	Radiator Plate
28	L-Shaped Clip
30	Masking
31	Radiator Plate
32	Support Structure Isolator
40	Masking
41	Radiator Plate
42	Support Structure
50	Masking
51	Radiator Plate
55	Thermal Cover
56	Thermal Cover
57	Thermal Cover
58	Thermal Cover
59	Thermal Cover
60	Masking
61	Radiator Plate
62	Support Structure
63	High Voltage Power Supply Support
64	High Voltage Power Supply Support
65	Thermal Bag
66	Thermal Bag
67	Thermal Bag
68	Thermal Bag
69	Thermal Bag
70	Baseplate
71	Support Structure
72	Support Structure
73	Baseplate
74	Ribbon Cable
75	Backup Heater
76	Baseplate
77	Baseplate
78	L-Shaped Clip
79	Baseplate
80	Analyzer Cover
81	Analyzer Cover
82	Analyzer Cover
83	Analyzer Cover
84	Analyzer Cover
85	Electronics Cover
86	Electronics Cover
87	Electronics Cover
88	Dust Cover
89	Electronics Cover
90	Analyzer Cover
91	Analyzer Cover
92	Analyzer Cover
93	Analyzer Cover
98	Connector
100	Mother Board
101	Data Compressor Board
102	Data Compressor Board
103	Signal Conditioner Board
104	Signal Conditioner Board
105	Housekeeping Multiplexer Board
106	Housekeeping Multiplexer Board
107	Preamp/Discriminator Board
108	Preamp/Discriminator Board
109	Preamp/Discriminator Board
110	Control and Monitor Board
111	Emission Control Board
112	Emission Control Board
113	Programmed Sweep High Voltage Board

APPENDIX A (CONT.)

114 Programmed Sweep High Voltage Board
115 Low Voltage Power Supply
116 High Voltage Power Supply Base
117 Flat Ribbon Cable
118 Flat Ribbon Cable
119 Flat Ribbon Cable
120 Mother Board
121 Interconnect Board
122 Interconnect Board
127 Analyzer Connector
128 Relay Mount
129 Analyzer Wire Connector
130 Mother Board
131 Relay Mount
140 Mother Board
143 Aluminum Card Support
144 Aluminum Card Support
161 High Voltage Power Supply
162 High Voltage Power Supply
163 High Voltage Power Supply
164 High Voltage Power Supply
165 High Voltage Power Supply
166 High Voltage Power Supply
167 High Voltage Power Supply
168 High Voltage Power Supply
199 Lunar Surface
200 Space
201 Radiator Plate Cable Clip
202 Analyzer Plate Cable Clip
204 Analyzer Cable
206 Analyzer Cable
208 Analyzer Cable
210 Analyzer Cable

Appendix B

-0 -0 -0 -0 -0 NODE DATA

Node				Initial Temperature	Table Number (Heat Input)		Product of (Absorptance & Absorbing Area)
1	0	0	.1000E+01	.7500E+02	5	-0	.3610E+00
2	0	0	.1000E+01	.7500E+02	5	-0	.8670E+00
3	0	0	.1000E+01	.7500E+02	5	-0	.3610E+00
4	0	0	.1000E+01	.7500E+02	5	-0	.2166E+00
5	0	0	.1000E+01	.7500E+02	5	-0	.8663E+00
6	0	0	.1000E+01	.7500E+02	5	-0	.2166E+00
10	0	0	.1000E+01	.7500E+02	7	-0	.1633E+01
11	0	0	.1000E+01	.7500E+02	0	0	0.
12	0	0	.1000E+01	.7500E+02	0	0	0.
20	0	0	.1000E+01	.7500E+02	7	-0	.5410E+00
21	0	0	.1000E+01	.7500E+02	0	0	0.
28	0	0	.1000E+01	.7500E+02	0	0	0.
30	0	0	.1000E+01	.7500E+02	7	-0	.1633E+01
31	0	0	.1000E+01	.7500E+02	0	0	0.
32	0	0	.1000E+01	.7500E+02	0	0	0.
40	0	0	.1000E+01	.7500E+02	7	-0	.1990E+01
41	0	0	.1000E+01	.7500E+02	0	0	0.
42	0	0	.1000E+01	.7500E+02	0	0	0.
50	0	0	.1000E+01	.7500E+02	7	-0	.5408E+00
51	0	0	.1000E+01	.7500E+02	0	0	0.
55	0	0	.1000E+01	.7500E+02	0	0	0.
56	0	0	.1000E+01	.7500E+02	0	0	0.
57	0	0	.1000E+01	.7500E+02	0	0	0.
58	0	0	.1000E+01	.7500E+02	0	0	0.
59	0	0	.1000E+01	.7500E+02	0	0	0.
60	0	0	.1000E+01	.7500E+02	7	-0	.1990E+01
61	0	0	.1000E+01	.7500E+02	0	0	0.
62	0	0	.1000E+01	.7500E+02	0	0	0.
65	0	0	.1000E+01	.7500E+02	0	0	0.
66	0	0	.1000E+01	.7500E+02	0	0	0.
67	0	0	.1000E+01	.7500E+02	0	0	0.
68	0	0	.1000E+01	.7500E+02	0	0	0.
69	0	0	.1000E+01	.7500E+02	0	0	0.
70	0	0	.1000E+01	.7500E+02	2	-0	.1960E+01
71	0	0	.1000E+01	.7500E+02	0	0	0.
72	0	0	.1000E+01	.7500E+02	0	0	0.
73	0	0	.1000E+01	.7500E+02	0	0	0.
74	0	0	.1000E+01	.7500E+02	0	0	0.

75	0	0	.1000E+01	.7500E+02	0	0	0.
76	0	0	.1000E+01	.7500E+02	0	0	0.
77	0	0	.1000E+01	.7500E+02	6	-0	.3810E+01
78	0	0	.1000E+01	.7500E+02	0	0	0.
79	0	0	.1000E+01	.7500E+02	0	0	0.
80	0	0	.1000E+01	.7500E+02	2	-0	.4050E+01
81	0	0	.1000E+01	.7500E+02	0	0	0.
82	0	0	.1000E+01	.7500E+02	0	0	0.
83	0	0	.1000E+01	.7500E+02	6	-0	.1920E+01
84	0	0	.1000E+01	.7500E+02	6	-0	.1000E+02
85	0	0	.1000E+01	.7500E+02	0	0	0.
86	0	0	.1000E+01	.7500E+02	0	0	0.
87	0	0	.1000E+01	.7500E+02	0	0	0.
88	0	0	.1000E+01	.7500E+02	2	-0	.1262E+02
89	0	0	.1000E+01	.7500E+02	0	0	0.
90	0	0	.1000E+01	.7500E+02	2	-0	.2180E+01
91	0	0	.1000E+01	.7500E+02	0	0	0.
92	0	0	.1000E+01	.7500E+02	0	0	0.
93	0	0	.1000E+01	.7500E+02	0	0	0.
98	0	0	.1000E+01	.7500E+02	0	0	0.
100	0	0	.1000E+01	.7500E+02	0	0	0.
101	0	0	.1000E+01	.7500E+02	1	-0	.4700E+00
102	0	0	.1000E+01	.7500E+02	1	-0	.4700E+00
103	0	0	.1000E+01	.7500E+02	1	-0	.2120E+00
104	0	0	.1000E+01	.7500E+02	0	0	0.
105	0	0	.1000E+01	.7500E+02	1	-0	.2070E+00
106	0	0	.1000E+01	.7500E+02	1	-0	.2080E+00
107	0	0	.1000E+01	.7500E+02	1	-0	.3400E+00
108	0	0	.1000E+01	.7500E+02	1	-0	.3300E+00
109	0	0	.1000E+01	.7500E+02	1	-0	.3300E+00
110	0	0	.1000E+01	.7500E+02	1	-0	.3900E-01
111	0	0	.1000E+01	.7500E+02	1	-0	.1200E+01
112	0	0	.1000E+01	.7500E+02	1	-0	.8600E+00
113	0	0	.1000E+01	.7500E+02	1	-0	.2300E+00
114	0	0	.1000E+01	.7500E+02	1	-0	.6000E+00
115	0	0	.1000E+01	.7500E+02	1	-0	.1070E+01
116	0	0	.1000E+01	.7500E+02	0	0	0.
117	0	0	.1000E+01	.7500E+02	0	0	0.
118	0	0	.1000E+01	.7500E+02	0	0	0.
119	0	0	.1000E+01	.7500E+02	0	0	0.
120	0	0	.1000E+01	.7500E+02	0	0	0.
121	0	0	.1000E+01	.7500E+02	0	0	0.
122	0	0	.1000E+01	.7500E+02	0	0	0.
127	0	0	.1000E+01	.7500E+02	0	0	0.
128	0	0	.1000E+01	.7500E+02	0	0	0.
129	0	0	.1000E+01	.7500E+02	0	0	0.
130	0	0	.1000E+01	.7500E+02	0	0	0.
131	0	0	.1000E+01	.7500E+02	0	0	0.
135	0	0	.1000E+01	.7500E+02	0	0	0.
140	0	0	.1000E+01	.7500E+02	0	0	0.
143	0	0	.1000E+01	.7500E+02	0	0	0.

144	0	0	.1000E+01	.7500E+02	0	0	0.
161	0	0	.1000E+01	.7500E+02	0	0	0.
162	0	0	.1000E+01	.7500E+02	0	0	0.
163	0	0	.1000E+01	.7500E+02	0	0	0.
164	0	0	.1000E+01	.7500E+02	0	0	0.
165	0	0	.1000E+01	.7500E+02	1	-0	.1770E+00
166	0	0	.1000E+01	.7500E+02	1	-0	.3400E-01
167	0	0	.1000E+01	.7500E+02	1	-0	.7000E-02
168	0	0	.1000E+01	.7500E+02	1	-0	.1500E+00
199	0	0	-.1000E+01	.2500E+03	0	0	0.
200	0	0	-.1000E+01	-.3000E+03	0	0	0.
201	0	0	.1000E+01	.7500E+02	0	0	0.
202	0	0	.1000E+01	.7500E+02	0	0	0.
204	0	0	.1000E+01	.7500E+02	0	0	0.
206	0	0	.1000E+01	.7500E+02	0	0	0.
208	0	0	.1000E+01	.7500E+02	0	0	0.
210	0	0	.1000E+01	.7500E+02	0	0	0.
211	0	0	.1000E+01	.7500E+02	4	-0	.1650E+01

MOORE BUSINESS FORMS INC 22

Resistor Number	Connecting Nodes		Radiation Area		Configuration Factor				
-0	-0		-0 -0 -0		RESISTOR DATA				
1	1	2	.2854E+01	0.	0.	0.	0	0	0.
2	1	6	.2448E+01	0.	0.	0.	0	0	0.
3	2	5	.1836E+01	0.	0.	0.	0	0	0.
4	2	3	.2854E+01	0.	0.	0.	0	0	0.
5	5	4	.2854E+01	0.	0.	0.	0	0	0.
6	5	6	.2854E+01	0.	0.	0.	0	0	0.
7	3	4	.2448E+01	0.	0.	0.	0	0	0.
8	5	51	.2360E+00	0.	0.	0.	0	0	0.
9	2	21	.4170E+00	0.	0.	0.	0	0	0.
10	1	11	.2480E+00	0.	0.	0.	0	0	0.
11	3	31	.2480E+00	0.	0.	0.	0	0	0.
12	4	41	.1700E+01	0.	0.	0.	0	0	0.
13	6	61	.1700E+01	0.	0.	0.	0	0	0.
15	50	51	.4890E+03	0.	0.	0.	0	0	0.
19	20	21	.4810E+03	0.	0.	0.	0	0	0.
23	10	11	.1590E+03	0.	0.	0.	0	0	0.
27	30	31	.1590E+03	0.	0.	0.	0	0	0.
31	40	41	.1330E+03	0.	0.	0.	0	0	0.
35	60	61	.1330E+03	0.	0.	0.	0	0	0.
38	11	21	.2000E+01	0.	0.	0.	0	0	0.
39	21	31	.2000E+01	0.	0.	0.	0	0	0.
40	41	51	.2000E+01	0.	0.	0.	0	0	0.
41	51	61	.2000E+01	0.	0.	0.	0	0	0.
42	11	61	.1715E+01	0.	0.	0.	0	0	0.
43	31	41	.1715E+01	0.	0.	0.	0	0	0.
44	21	51	.1336E+01	0.	0.	0.	0	0	0.
45	31	32	.5372E+02	0.	0.	0.	0	0	0.
46	11	12	.5372E+02	0.	0.	0.	0	0	0.
47	32	42	.3430E+03	0.	0.	0.	0	0	0.
48	12	62	.3430E+03	0.	0.	0.	0	0	0.
49	32	72	.4040E+03	0.	0.	0.	0	0	0.

50	12	71	.4040E+03	0.	0.	0.	0	0	0.
51	42	72	.2420E+03	0.	0.	0.	0	0	0.
52	62	71	.2420E+03	0.	0.	0.	0	0	0.
53	41	42	.4724E+02	0.	0.	0.	0	0	0.
54	61	62	.4893E+02	0.	0.	0.	0	0	0.
55	73	42	.6398E+02	0.	0.	0.	0	0	0.
56	76	62	.6398E+02	0.	0.	0.	0	0	0.
57	77	42	.8603E+01	0.	0.	0.	0	0	0.
58	77	62	.8603E+01	0.	0.	0.	0	0	0.
59	77	72	.8603E+01	0.	0.	0.	0	0	0.
60	77	71	.8603E+01	0.	0.	0.	0	0	0.
61	77	73	.1410E+01	0.	0.	0.	0	0	0.
62	77	76	.1410E+01	0.	0.	0.	0	0	0.
63	77	70	.4000E+00	0.	0.	0.	0	0	0.
64	77	79	.4000E+00	0.	0.	0.	0	0	0.
65	73	70	.1604E+02	0.	0.	0.	0	0	0.
66	76	70	.1604E+02	0.	0.	0.	0	0	0.
67	73	79	.1604E+02	0.	0.	0.	0	0	0.
68	76	79	.1604E+02	0.	0.	0.	0	0	0.
69	89	77	.4570E+03	0.	0.	0.	0	0	0.
70	87	32	.2128E+04	0.	0.	0.	0	0	0.
71	85	12	.2138E+04	0.	0.	0.	0	0	0.
72	87	42	.2134E+04	0.	0.	0.	0	0	0.
73	85	62	.2134E+04	0.	0.	0.	0	0	0.
74	87	86	.2390E+04	0.	0.	0.	0	0	0.
75	85	86	.2390E+04	0.	0.	0.	0	0	0.
76	86	89	.1036E+04	0.	0.	0.	0	0	0.
77	87	89	.1685E+04	0.	0.	0.	0	0	0.
78	85	89	.1595E+04	0.	0.	0.	0	0	0.
79	88	86	.1061E+04	0.	0.	0.	0	0	0.
80	80	84	.1494E+04	0.	0.	0.	0	0	0.
81	82	84	.1494E+04	0.	0.	0.	0	0	0.
82	81	84	.2235E+04	0.	0.	0.	0	0	0.
83	83	84	.7220E+04	0.	0.	0.	0	0	0.
84	90	83	.1511E+04	0.	0.	0.	0	0	0.
85	93	83	.1511E+04	0.	0.	0.	0	0	0.
86	91	83	.4065E+04	0.	0.	0.	0	0	0.
87	92	84	.3482E+04	0.	0.	0.	0	0	0.
88	80	81	.7683E+04	0.	0.	0.	0	0	0.
89	81	82	.7683E+04	0.	0.	0.	0	0	0.
90	82	93	.6550E+04	0.	0.	0.	0	0	0.
91	91	90	.4565E+04	0.	0.	0.	0	0	0.
92	91	93	.4565E+04	0.	0.	0.	0	0	0.
93	90	92	.4521E+04	0.	0.	0.	0	0	0.
94	92	80	.6478E+04	0.	0.	0.	0	0	0.
95	93	77	.1851E+04	0.	0.	0.	0	0	0.
96	82	77	.1494E+04	0.	0.	0.	0	0	0.
97	80	77	.1494E+04	0.	0.	0.	0	0	0.
98	81	77	.1606E+04	0.	0.	0.	0	0	0.
99	92	77	.1361E+04	0.	0.	0.	0	0	0.
100	90	77	.1852E+04	0.	0.	0.	0	0	0.

101	11	55	.1025E+04	0.	0.	0.	0	0	0.
102	31	58	.1025E+04	0.	0.	0.	0	0	0.
103	61	55	.1025E+04	0.	0.	0.	0	0	0.
104	41	58	.1025E+04	0.	0.	0.	0	0	0.
105	61	57	.1357E+04	0.	0.	0.	0	0	0.
106	11	56	.6896E+03	0.	0.	0.	0	0	0.
107	31	56	.6896E+03	0.	0.	0.	0	0	0.
108	41	57	.6696E+03	0.	0.	0.	0	0	0.
109	21	56	.3748E+03	0.	0.	0.	0	0	0.
110	51	57	.3748E+03	0.	0.	0.	0	0	0.
111	56	59	.5540E+03	0.	0.	0.	0	0	0.
112	57	59	.5540E+03	0.	0.	0.	0	0	0.
113	55	59	.1231E+04	0.	0.	0.	0	0	0.
114	58	59	.1231E+04	0.	0.	0.	0	0	0.
115	55	56	.2548E+04	0.	0.	0.	0	0	0.
116	56	58	.2704E+04	0.	0.	0.	0	0	0.
117	58	57	.2500E+04	0.	0.	0.	0	0	0.
118	57	55	.2343E+04	0.	0.	0.	0	0	0.
120	55	65	.4700E-02	.1675E-11	.2080E+00	0.	0	0	0.
121	58	68	.4700E-02	.1675E-11	.2080E+00	0.	0	0	0.
122	56	66	.4700E-02	.2802E-11	.3480E+00	0.	0	0	0.
123	57	67	.4700E-02	.2802E-11	.3480E+00	0.	0	0	0.
124	59	69	.4700E-02	.3357E-11	.4170E+00	0.	0	0	0.
129	110	51	.7120E+02	0.	0.	0.	0	0	0.
130	110	51	.6960E+02	0.	0.	0.	0	0	0.
131	110	41	.2474E+03	0.	0.	0.	0	0	0.
132	110	41	.2506E+03	0.	0.	0.	0	0	0.
140	107	108	.2220E+01	0.	0.	0.	0	0	0.
141	108	109	.1858E+01	0.	0.	0.	0	0	0.
142	109	11	.3418E+01	0.	0.	0.	0	0	0.
143	102	61	.5961E+02	0.	0.	0.	0	0	0.
144	102	11	.5961E+02	0.	0.	0.	0	0	0.
145	102	51	.5941E+02	0.	0.	0.	0	0	0.
146	102	21	.5941E+02	0.	0.	0.	0	0	0.
147	101	21	.6501E+02	0.	0.	0.	0	0	0.
148	101	51	.6501E+02	0.	0.	0.	0	0	0.
149	101	121	.8984E+02	0.	0.	0.	0	0	0.
150	101	122	.8984E+02	0.	0.	0.	0	0	0.
151	101	100	.3533E+03	0.	0.	0.	0	0	0.
152	100	121	.1056E+04	0.	0.	0.	0	0	0.
153	100	122	.1056E+04	0.	0.	0.	0	0	0.
154	121	31	.5400E+01	0.	0.	0.	0	0	0.
155	122	41	.5400E+01	0.	0.	0.	0	0	0.
156	104	61	.5304E+02	0.	0.	0.	0	0	0.
157	104	11	.5304E+02	0.	0.	0.	0	0	0.
158	104	51	.5279E+02	0.	0.	0.	0	0	0.
159	104	21	.5279E+02	0.	0.	0.	0	0	0.
160	103	21	.7984E+02	0.	0.	0.	0	0	0.
161	103	51	.7984E+02	0.	0.	0.	0	0	0.
162	103	121	.7028E+02	0.	0.	0.	0	0	0.
163	103	122	.7028E+02	0.	0.	0.	0	0	0.

164	103	100	.2286E+03	0.	0.	0.	0	0	0.
165	106	61	.5673E+02	0.	0.	0.	0	0	0.
166	106	11	.5673E+02	0.	0.	0.	0	0	0.
167	106	51	.5648E+02	0.	0.	0.	0	0	0.
168	106	21	.5648E+02	0.	0.	0.	0	0	0.
169	105	21	.5798E+02	0.	0.	0.	0	0	0.
170	105	51	.5798E+02	0.	0.	0.	0	0	0.
171	105	121	.7046E+02	0.	0.	0.	0	0	0.
172	105	122	.7046E+02	0.	0.	0.	0	0	0.
173	116	61	.8320E+01	0.	0.	0.	0	0	0.
174	116	11	.8320E+01	0.	0.	0.	0	0	0.
175	116	51	.8080E+01	0.	0.	0.	0	0	0.
176	116	21	.8080E+01	0.	0.	0.	0	0	0.
177	115	21	.8060E+01	0.	0.	0.	0	0	0.
178	115	51	.8060E+01	0.	0.	0.	0	0	0.
179	115	31	.7640E+01	0.	0.	0.	0	0	0.
180	115	41	.7640E+01	0.	0.	0.	0	0	0.
181	161	51	.5273E+02	0.	0.	0.	0	0	0.
182	164	21	.5273E+02	0.	0.	0.	0	0	0.
183	162	61	.5325E+02	0.	0.	0.	0	0	0.
184	163	11	.5354E+02	0.	0.	0.	0	0	0.
185	165	51	.2304E+02	0.	0.	0.	0	0	0.
186	168	21	.2304E+02	0.	0.	0.	0	0	0.
187	166	61	.2328E+02	0.	0.	0.	0	0	0.
188	167	11	.2328E+02	0.	0.	0.	0	0	0.
189	161	162	.3930E+04	0.	0.	0.	0	0	0.
190	164	163	.3930E+04	0.	0.	0.	0	0	0.
191	165	166	.3930E+04	0.	0.	0.	0	0	0.
192	168	167	.3930E+04	0.	0.	0.	0	0	0.
193	161	164	.5650E+04	0.	0.	0.	0	0	0.
194	162	163	.5650E+04	0.	0.	0.	0	0	0.
195	165	168	.5650E+04	0.	0.	0.	0	0	0.
196	166	167	.5650E+04	0.	0.	0.	0	0	0.
198	61	144	.1212E+02	0.	0.	0.	0	0	0.
199	11	144	.1212E+02	0.	0.	0.	0	0	0.
200	21	144	.1183E+02	0.	0.	0.	0	0	0.
201	51	144	.1183E+02	0.	0.	0.	0	0	0.
202	51	143	.1198E+02	0.	0.	0.	0	0	0.
203	21	143	.1198E+02	0.	0.	0.	0	0	0.
204	31	143	.1198E+02	0.	0.	0.	0	0	0.
205	41	143	.1198E+02	0.	0.	0.	0	0	0.
206	114	61	.6238E+02	0.	0.	0.	0	0	0.
207	114	11	.6238E+02	0.	0.	0.	0	0	0.
208	114	51	.6280E+02	0.	0.	0.	0	0	0.
209	114	21	.6280E+02	0.	0.	0.	0	0	0.
210	113	21	.5560E+02	0.	0.	0.	0	0	0.
211	113	51	.1081E+03	0.	0.	0.	0	0	0.
212	113	31	.5560E+02	0.	0.	0.	0	0	0.
213	113	41	.1081E+03	0.	0.	0.	0	0	0.
214	112	61	.3666E+03	0.	0.	0.	0	0	0.
215	112	11	.2536E+03	0.	0.	0.	0	0	0.

216	112	51	.3673E+03	0.	0.	0.	0	0	0.
217	112	21	.2546E+03	0.	0.	0.	0	0	0.
218	111	21	.3380E+02	0.	0.	0.	0	0	0.
219	111	31	.6450E+02	0.	0.	0.	0	0	0.
220	111	41	.6450E+02	0.	0.	0.	0	0	0.
221	111	51	.6450E+02	0.	0.	0.	0	0	0.
223	98	61	.4010E+03	0.	0.	0.	0	0	0.
224	127	77	.1479E+04	0.	0.	0.	0	0	0.
225	51	128	.3273E+04	0.	0.	0.	0	0	0.
227	129	77	.3888E+01	0.	0.	0.	0	0	0.
228	41	131	.1617E+04	0.	0.	0.	0	0	0.
229	51	131	.1617E+04	0.	0.	0.	0	0	0.
233	51	128	.3274E+04	0.	0.	0.	0	0	0.
244	1	200	.8000E+00	.4755E-10	.3470E-01	0.	0	0	0.
245	2	200	.8000E+00	.1142E-09	.8330E-01	0.	0	0	0.
246	3	200	.8000E+00	.4755E-10	.3470E-01	0.	0	0	0.
247	4	200	.8000E+00	.2850E-10	.2080E-01	0.	0	0	0.
248	5	200	.8000E+00	.1142E-09	.8330E-01	0.	0	0	0.
249	6	200	.8000E+00	.2850E-10	.2080E-01	0.	0	0	0.
250	10	200	.6900E+00	.7328E-10	.6200E-01	0.	0	0	0.
251	20	200	.6900E+00	.2458E-10	.2080E-01	0.	0	0	0.
252	30	200	.6900E+00	.7423E-10	.6280E-01	0.	0	0	0.
253	40	200	.6900E+00	.9066E-10	.7670E-01	0.	0	0	0.
254	50	200	.6900E+00	.2458E-10	.2080E-01	0.	0	0	0.
255	60	200	.6900E+00	.9066E-10	.7670E-01	0.	0	0	0.
260	89	199	.7460E+00	.6965E-09	.5450E+00	0.	0	0	0.
261	70	200	.9000E+00	.9296E-10	.6030E-01	0.	0	0	0.
264	80	200	.9000E+00	.1916E-09	.1243E+00	0.	0	0	0.
271	89	69	.4830E-01	.3980E-10	.4810E+00	0.	0	0	0.
272	86	66	.4930E-01	.3218E-10	.3810E+00	0.	0	0	0.
273	85	65	.4830E-01	.2118E-10	.2560E+00	0.	0	0	0.
274	87	68	.4830E-01	.2118E-10	.2560E+00	0.	0	0	0.
275	67	77	.9380E-01	.7729E-10	.4810E+00	0.	0	0	0.
276	41	111	.6680E+00	.4314E-10	.3770E-01	0.	0	0	0.
277	31	111	.6680E+00	.4314E-10	.3770E-01	0.	0	0	0.
278	11	112	.6680E+00	.4314E-10	.3770E-01	0.	0	0	0.
279	61	112	.6680E+00	.4314E-10	.3770E-01	0.	0	0	0.
280	51	111	.6730E+00	.3286E-10	.2850E-01	0.	0	0	0.
281	21	111	.6730E+00	.3286E-10	.2850E-01	0.	0	0	0.
282	21	112	.6770E+00	.3305E-10	.2850E-01	0.	0	0	0.
283	111	58	.1495E-02	.2553E-13	.9970E-02	0.	0	0	0.
284	112	55	.1495E-02	.2553E-13	.9970E-02	0.	0	0	0.
285	111	55	.1495E-02	.2041E-13	.7970E-02	0.	0	0	0.
286	112	58	.1495E-02	.2041E-13	.7970E-02	0.	0	0	0.
287	111	56	.1495E-02	.2925E-13	.1142E-01	0.	0	0	0.
288	111	57	.1495E-02	.2925E-13	.1142E-01	0.	0	0	0.
289	112	57	.1495E-02	.2925E-13	.1142E-01	0.	0	0	0.
290	112	56	.1495E-02	.2925E-13	.1142E-01	0.	0	0	0.
291	111	113	.6911E+00	.1432E-09	.1210E+00	0.	0	0	0.
292	111	58	.3980E-02	.1943E-12	.2850E-01	0.	0	0	0.
293	111	55	.3980E-02	.1943E-12	.2850E-01	0.	0	0	0.

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294	111	57	.1990E-02	.5618E-13	.1648E-01	0.	0	0	0.
295	111	110	.3280E-01	.9260E-12	.1648E-01	0.	0	0	0.
296	111	107	.4950E-02	.2001E-12	.2360E-01	0.	0	0	0.
297	111	108	.2970E-02	.7311E-13	.1437E-01	0.	0	0	0.
298	112	114	.6902E+00	.1604E-09	.1357E+00	0.	0	0	0.
299	112	58	.3980E-02	.1943E-12	.2850E-01	0.	0	0	0.
300	112	55	.3980E-02	.2427E-12	.3560E-01	0.	0	0	0.
301	112	109	.7920E-02	.2347E-12	.1730E-01	0.	0	0	0.
302	112	57	.3980E-02	.2127E-12	.3120E-01	0.	0	0	0.
303	112	74	.8200E-02	.2676E-12	.1905E-01	0.	0	0	0.
304	113	58	.3980E-02	.1943E-12	.2850E-01	0.	0	0	0.
305	113	107	.1950E-02	.7883E-13	.2360E-01	0.	0	0	0.
306	113	108	.1170E-02	.2880E-13	.1437E-01	0.	0	0	0.
307	113	55	.2560E-02	.1250E-12	.2850E-01	0.	0	0	0.
308	113	57	.1280E-02	.3613E-13	.1648E-01	0.	0	0	0.
309	113	110	.2390E-02	.6747E-13	.1648E-01	0.	0	0	0.
310	114	109	.3120E-02	.9246E-13	.1730E-01	0.	0	0	0.
311	114	55	.2560E-02	.1561E-12	.3560E-01	0.	0	0	0.
312	114	74	.1960E-02	.6396E-13	.1905E-01	0.	0	0	0.
313	114	57	.3980E-02	.2127E-12	.3120E-01	0.	0	0	0.
314	114	58	.3980E-02	.1943E-12	.2850E-01	0.	0	0	0.
316	113	117	.2150E-01	.2729E-12	.7410E-02	0.	0	0	0.
317	113	107	.1980E-02	.2076E-13	.6120E-02	0.	0	0	0.
318	113	108	.9900E-03	.6326E-14	.3730E-02	0.	0	0	0.
319	113	55	.1495E-02	.1898E-13	.7410E-02	0.	0	0	0.
320	113	110	.2458E-01	.3608E-12	.8570E-02	0.	0	0	0.
321	115	117	.2150E-01	.2729E-12	.7410E-02	0.	0	0	0.
322	115	107	.1980E-02	.2076E-13	.6120E-02	0.	0	0	0.
323	115	108	.9900E-03	.6326E-14	.3730E-02	0.	0	0	0.
324	115	55	.1495E-02	.1898E-13	.7410E-02	0.	0	0	0.
325	115	110	.2458E-01	.3608E-12	.8570E-02	0.	0	0	0.
327	114	55	.1495E-02	.2371E-13	.9260E-02	0.	0	0	0.
328	114	109	.2970E-02	.4360E-13	.8570E-02	0.	0	0	0.
329	114	117	.2150E-01	.2729E-12	.7410E-02	0.	0	0	0.
330	114	57	.1495E-02	.2722E-13	.1063E-01	0.	0	0	0.
331	114	74	.3075E-02	.2381E-13	.4520E-02	0.	0	0	0.
332	116	55	.1035E-02	.1642E-13	.9260E-02	0.	0	0	0.
333	116	109	.1580E-02	.2320E-13	.8570E-02	0.	0	0	0.
334	116	58	.1035E-02	.1314E-13	.7410E-02	0.	0	0	0.
335	116	57	.3735E-02	.2598E-13	.4060E-02	0.	0	0	0.
336	116	74	.1090E-02	.8440E-14	.4520E-02	0.	0	0	0.
337	115	105	.4520E+00	.1045E-09	.1350E+00	0.	0	0	0.
338	115	58	.2760E-02	.1683E-13	.3560E-02	0.	0	0	0.
339	115	107	.3690E-02	.1858E-13	.2940E-02	0.	0	0	0.
340	115	108	.2110E-02	.6506E-14	.1800E-02	0.	0	0	0.
341	115	55	.3790E-02	.2311E-13	.3560E-02	0.	0	0	0.
342	115	110	.1090E-01	.7693E-13	.4120E-02	0.	0	0	0.
343	105	58	.3980E-01	.2427E-12	.3560E-02	0.	0	0	0.
344	105	107	.6930E-02	.3490E-13	.2940E-02	0.	0	0	0.
345	105	108	.3960E-02	.1221E-13	.1800E-02	0.	0	0	0.
346	105	55	.5480E-02	.3342E-13	.3560E-02	0.	0	0	0.

347	105	110	.9000E-01	.6352E-12	.4120E-02	0.	0	0	0.
349	116	58	.2760E-02	.1683E-13	.3560E-02	0.	0	0	0.
350	116	109	.9500E-01	.6005E-12	.3690E-02	0.	0	0	0.
351	116	55	.7860E+00	.4793E-11	.3560E-02	0.	0	0	0.
352	116	74	.3450E+00	.1152E-11	.1950E-02	0.	0	0	0.
353	116	57	.2390E-01	.7124E-13	.1740E-02	0.	0	0	0.
354	106	58	.3980E-02	.2427E-14	.3560E-03	0.	0	0	0.
355	106	109	.9900E-03	.6258E-15	.3690E-03	0.	0	0	0.
356	106	55	.4980E-03	.3037E-15	.3560E-03	0.	0	0	0.
357	106	74	.5020E-02	.1677E-14	.1950E-03	0.	0	0	0.
358	106	57	.1495E-03	.4456E-16	.1740E-03	0.	0	0	0.
359	105	103	.6410E+00	.1482E-09	.1350E+00	0.	0	0	0.
360	105	100	.2385E-02	.4184E-13	.1024E-01	0.	0	0	0.
361	105	107	.1170E-02	.1698E-13	.8470E-02	0.	0	0	0.
362	105	108	.3896E-03	.3450E-14	.5170E-02	0.	0	0	0.
363	105	55	.1280E-02	.2245E-13	.1024E-01	0.	0	0	0.
364	105	110	.2385E-02	.4845E-13	.1186E-01	0.	0	0	0.
365	103	100	.3275E-01	.5745E-12	.1024E-01	0.	0	0	0.
366	103	107	.2970E-02	.4309E-13	.8470E-02	0.	0	0	0.
367	103	108	.9900E-03	.8768E-14	.5170E-02	0.	0	0	0.
368	103	55	.1990E-02	.3491E-13	.1024E-01	0.	0	0	0.
369	103	110	.3275E-01	.6654E-12	.1186E-01	0.	0	0	0.
370	106	104	.6400E+00	.1250E-09	.1140E+00	0.	0	0	0.
371	106	100	.2385E-02	.4184E-13	.1024E-01	0.	0	0	0.
372	106	109	.1560E-02	.2838E-13	.1062E-01	0.	0	0	0.
373	106	55	.1280E-02	.2807E-13	.1280E-01	0.	0	0	0.
374	106	74	.1180E-02	.1136E-13	.5620E-02	0.	0	0	0.
375	106	57	.3980E-02	.7022E-13	.1030E-01	0.	0	0	0.
376	104	100	.3275E-01	.5745E-12	.1024E-01	0.	0	0	0.
377	104	109	.3960E-02	.8045E-13	.1186E-01	0.	0	0	0.
378	104	55	.1990E-02	.4363E-13	.1280E-01	0.	0	0	0.
379	104	74	.1435E-01	.1381E-12	.5620E-02	0.	0	0	0.
380	104	57	.1987E-02	.3506E-13	.1030E-01	0.	0	0	0.
381	103	101	.6410E+00	.1482E-09	.1350E+00	0.	0	0	0.
382	103	100	.1790E-02	.2444E-13	.7970E-02	0.	0	0	0.
383	103	107	.7800E-03	.8805E-14	.6590E-02	0.	0	0	0.
384	103	108	.3900E-03	.2686E-14	.4020E-02	0.	0	0	0.
385	103	55	.9600E-03	.1311E-13	.7970E-02	0.	0	0	0.
386	103	110	.1790E-02	.2830E-13	.9230E-02	0.	0	0	0.
387	101	100	.2460E-01	.3359E-12	.7970E-02	0.	0	0	0.
388	101	107	.1980E-02	.2235E-13	.6590E-02	0.	0	0	0.
389	101	108	.9900E-03	.6817E-14	.4020E-02	0.	0	0	0.
390	101	55	.1495E-02	.2041E-13	.7970E-02	0.	0	0	0.
391	101	110	.2460E-01	.3890E-12	.9230E-02	0.	0	0	0.
392	104	102	.6400E+00	.1250E-09	.1140E+00	0.	0	0	0.
393	104	100	.1790E-02	.2444E-13	.7970E-02	0.	0	0	0.
394	104	109	.1170E-02	.1655E-13	.8260E-02	0.	0	0	0.
395	104	55	.9600E-03	.1638E-13	.9960E-02	0.	0	0	0.
396	104	74	.8850E-03	.6625E-14	.4370E-02	0.	0	0	0.
397	104	57	.1980E-02	.2724E-13	.8030E-02	0.	0	0	0.
398	102	100	.2460E-01	.3359E-12	.7970E-02	0.	0	0	0.

399	102	109	.2970E-02	.4202E-13	.8260E-02	0.	0	0	0.
400	102	55	.1495E-02	.2551E-13	.9960E-02	0.	0	0	0.
401	102	74	.1077E-01	.8062E-13	.4370E-02	0.	0	0	0.
402	102	57	.1980E-02	.2724E-13	.8030E-02	0.	0	0	0.
403	101	118	.5460E+00	.4630E-10	.4950E-01	0.	0	0	0.
404	101	59	.1300E+00	.3006E-10	.1350E+00	0.	0	0	0.
405	101	117	.4310E-01	.5884E-12	.7970E-02	0.	0	0	0.
406	101	58	.1920E-02	.2394E-13	.7280E-02	0.	0	0	0.
407	101	107	.1560E-02	.1761E-13	.6590E-02	0.	0	0	0.
408	101	108	.7800E-03	.5371E-14	.4020E-02	0.	0	0	0.
409	101	56	.9600E-03	.1122E-13	.6820E-02	0.	0	0	0.
410	101	55	.1920E-02	.5460E-13	.1660E-01	0.	0	0	0.
411	101	110	.1790E-02	.2714E-13	.8850E-02	0.	0	0	0.
412	101	57	.9600E-03	.1122E-13	.6820E-02	0.	0	0	0.
413	102	119	.5460E+00	.3451E-10	.3690E-01	0.	0	0	0.
414	102	59	.1430E+00	.2964E-10	.1210E+00	0.	0	0	0.
415	102	117	.2160E-01	.2949E-12	.7970E-02	0.	0	0	0.
416	102	58	.9600E-03	.1197E-13	.7280E-02	0.	0	0	0.
417	102	109	.1170E-02	.1657E-13	.8270E-02	0.	0	0	0.
418	102	56	.9600E-03	.8486E-13	.5160E-01	0.	0	0	0.
419	102	55	.1920E-02	.6249E-13	.1900E-01	0.	0	0	0.
420	102	74	.1435E-01	.4916E-13	.2000E-02	0.	0	0	0.
421	102	57	.1280E-02	.2960E-13	.1350E-01	0.	0	0	0.
422	118	59	.4340E-01	.1740E-10	.2340E+00	0.	0	0	0.
423	118	58	.1480E-02	.1848E-13	.7290E-02	0.	0	0	0.
424	118	57	.1480E-02	.1732E-13	.6830E-02	0.	0	0	0.
425	118	55	.1480E-02	.1848E-13	.7290E-02	0.	0	0	0.
426	118	56	.1480E-02	.1732E-13	.6830E-02	0.	0	0	0.
427	119	59	.4340E-01	.1740E-10	.2340E+00	0.	0	0	0.
428	119	55	.1480E-02	.1848E-13	.7290E-02	0.	0	0	0.
429	119	56	.1480E-02	.1732E-13	.6830E-02	0.	0	0	0.
430	119	58	.1480E-02	.1848E-13	.7290E-02	0.	0	0	0.
431	119	57	.1480E-02	.1732E-13	.6830E-02	0.	0	0	0.
432	117	58	.4340E-01	.4981E-11	.6700E-01	0.	0	0	0.
433	117	31	.1460E-02	.1303E-13	.5210E-02	0.	0	0	0.
434	117	41	.1460E-02	.1303E-13	.5210E-02	0.	0	0	0.
435	117	59	.1480E-02	.2637E-13	.1040E-01	0.	0	0	0.
436	117	56	.1480E-02	.1927E-13	.7600E-02	0.	0	0	0.
437	117	57	.1480E-02	.1927E-13	.7600E-02	0.	0	0	0.
438	110	57	.1335E+00	.2344E-10	.1025E+00	0.	0	0	0.
439	110	59	.1480E-02	.2502E-13	.9870E-02	0.	0	0	0.
440	110	58	.1480E-02	.1787E-13	.7050E-02	0.	0	0	0.
441	110	55	.1480E-02	.1787E-13	.7050E-02	0.	0	0	0.
442	110	41	.1485E-02	.1656E-13	.6510E-02	0.	0	0	0.
443	110	51	.1485E-02	.1101E-13	.4330E-02	0.	0	0	0.
444	74	57	.2760E-01	.1641E-11	.3470E-01	0.	0	0	0.
445	74	59	.2460E-02	.2284E-13	.5420E-02	0.	0	0	0.
446	74	55	.8380E-02	.2491E-12	.1735E-01	0.	0	0	0.
447	74	58	.8380E-02	.2491E-12	.1735E-01	0.	0	0	0.
448	74	61	.4870E-02	.4522E-13	.5420E-02	0.	0	0	0.
449	109	56	.7450E-01	.9227E-11	.7230E-01	0.	0	0	0.

450	109	55	.1035E-02	.1183E-13	.6670E-02	0.	0	0	0.
451	109	59	.1050E+00	.1556E-11	.8650E-02	0.	0	0	0.
452	109	58	.1035E-02	.1183E-13	.6670E-02	0.	0	0	0.
453	109	11	.7810E-03	.3184E-14	.2380E-02	0.	0	0	0.
454	109	21	.7810E-03	.3184E-14	.2380E-02	0.	0	0	0.
455	108	56	.8090E-01	.7539E-11	.5440E-01	0.	0	0	0.
456	108	59	.1050E+00	.1678E-11	.9330E-02	0.	0	0	0.
457	108	55	.1035E-02	.1183E-13	.6670E-02	0.	0	0	0.
458	108	58	.1035E-02	.1183E-13	.6670E-02	0.	0	0	0.
459	108	21	.1580E-02	.9581E-14	.3540E-02	0.	0	0	0.
460	107	56	.6625E-01	.1141E-10	.1005E+00	0.	0	0	0.
461	107	31	.1035E-02	.1046E-13	.5900E-02	0.	0	0	0.
462	107	58	.1035E-02	.1183E-13	.6670E-02	0.	0	0	0.
463	107	59	.1030E+00	.2405E-11	.1363E-01	0.	0	0	0.
464	107	55	.1035E-02	.1183E-13	.6670E-02	0.	0	0	0.
467	28	21	.8382E+02	0.	0.	0.	0	0	0.
468	28	51	.8382E+02	0.	0.	0.	0	0	0.
469	78	51	.9112E+02	0.	0.	0.	0	0	0.
470	78	61	.9132E+02	0.	0.	0.	0	0	0.
471	117	118	.3172E+04	0.	0.	0.	0	0	0.
472	118	119	.2045E+03	0.	0.	0.	0	0	0.
473	119	74	.1324E+03	0.	0.	0.	0	0	0.
474	117	100	.1337E+04	0.	0.	0.	0	0	0.
475	74	98	.8530E+02	0.	0.	0.	0	0	0.
477	79	199	.9000E+00	.9296E-10	.6030E-01	0.	0	0	0.
478	82	199	.9000E+00	.1896E-09	.1230E+00	0.	0	0	0.
479	93	199	.9000E+00	.1016E-09	.6590E-01	0.	0	0	0.
502	110	122	.2399E+03	0.	0.	0.	0	0	0.
503	55	56	.3420E-01	.1599E-11	.2730E-01	0.	0	0	0.
504	55	57	.4170E-01	.1950E-11	.2730E-01	0.	0	0	0.
506	105	100	.9673E+02	0.	0.	0.	0	0	0.
518	51	112	.6770E+00	.3305E-10	.2850E-01	0.	0	0	0.
519	41	120	.7347E+04	0.	0.	0.	0	0	0.
520	31	120	.7347E+04	0.	0.	0.	0	0	0.
521	31	130	.7347E+04	0.	0.	0.	0	0	0.
522	41	130	.7347E+04	0.	0.	0.	0	0	0.
523	31	140	.7347E+04	0.	0.	0.	0	0	0.
524	41	140	.7347E+04	0.	0.	0.	0	0	0.
525	115	120	.1600E+04	0.	0.	0.	0	0	0.
526	113	130	.9114E+03	0.	0.	0.	0	0	0.
527	111	140	.9114E+03	0.	0.	0.	0	0	0.
528	113	143	.6500E+00	.9386E-10	.8430E-01	0.	0	0	0.
529	114	144	.6500E+00	.1253E-09	.1125E+00	0.	0	0	0.
530	115	143	.6500E+00	.1217E-09	.1093E+00	0.	0	0	0.
531	116	144	.1068E+00	.1829E-10	.1000E+00	0.	0	0	0.
532	59	55	.3290E-01	.2313E-11	.4104E-01	0.	0	0	0.
533	59	56	.4410E-01	.1737E-11	.2300E-01	0.	0	0	0.
534	59	57	.4180E-01	.2835E-11	.3960E-01	0.	0	0	0.
535	59	58	.4570E-01	.9652E-12	.1233E-01	0.	0	0	0.
536	11	59	.3440E-01	.7513E-12	.1275E-01	0.	0	0	0.
537	21	59	.3440E-01	.4909E-12	.8330E-02	0.	0	0	0.

538	31	59	.3440E-01	.8279E-12	.1405E-01	0.	0	0	0.
539	41	59	.3440E-01	.6995E-12	.1187E-01	0.	0	0	0.
540	51	59	.3440E-01	.8044E-12	.1365E-01	0.	0	0	0.
541	61	59	.3440E-01	.1208E-11	.2050E-01	0.	0	0	0.
550	75	51	.1714E+01	0.	0.	0.	0	0	0.
575	161	106	.7670E+00	.3403E-10	.2590E-01	0.	0	0	0.
576	162	106	.7680E+00	.3388E-10	.2575E-01	0.	0	0	0.
577	163	106	.7680E+00	.3388E-10	.2575E-01	0.	0	0	0.
578	164	106	.7670E+00	.3403E-10	.2590E-01	0.	0	0	0.
579	165	116	.7180E+00	.3186E-10	.2590E-01	0.	0	0	0.
580	166	116	.7190E+00	.3171E-10	.2575E-01	0.	0	0	0.
581	167	116	.7190E+00	.3171E-10	.2575E-01	0.	0	0	0.
582	168	116	.7180E+00	.3186E-10	.2590E-01	0.	0	0	0.
583	161	165	.5140E+00	.2280E-10	.2590E-01	0.	0	0	0.
584	161	166	.4320E+00	.1917E-10	.2590E-01	0.	0	0	0.
585	161	167	.4110E+00	.1823E-10	.2590E-01	0.	0	0	0.
586	161	168	.4280E+00	.1899E-10	.2590E-01	0.	0	0	0.
587	162	165	.4320E+00	.1906E-10	.2575E-01	0.	0	0	0.
588	162	166	.5140E+00	.2267E-10	.2575E-01	0.	0	0	0.
589	162	167	.4280E+00	.1888E-10	.2575E-01	0.	0	0	0.
590	162	168	.4110E+00	.1813E-10	.2575E-01	0.	0	0	0.
591	163	165	.4110E+00	.1813E-10	.2575E-01	0.	0	0	0.
592	163	166	.4280E+00	.1888E-10	.2575E-01	0.	0	0	0.
593	163	167	.5140E+00	.2267E-10	.2575E-01	0.	0	0	0.
594	163	168	.4320E+00	.1906E-10	.2575E-01	0.	0	0	0.
595	164	165	.4280E+00	.1899E-10	.2590E-01	0.	0	0	0.
596	164	166	.4110E+00	.1823E-10	.2590E-01	0.	0	0	0.
597	164	167	.4320E+00	.1917E-10	.2590E-01	0.	0	0	0.
598	164	168	.5140E+00	.2280E-10	.2590E-01	0.	0	0	0.
600	10	199	.1850E+00	.4453E-11	.1405E-01	0.	0	0	0.
601	20	199	.1850E+00	.2640E-11	.8330E-02	0.	0	0	0.
602	30	199	.1850E+00	.4453E-11	.1405E-01	0.	0	0	0.
603	40	199	.1850E+00	.4453E-11	.1405E-01	0.	0	0	0.
604	50	199	.1850E+00	.2640E-11	.8330E-02	0.	0	0	0.
605	60	199	.1850E+00	.4453E-11	.1405E-01	0.	0	0	0.
606	10	200	.3040E+00	.7317E-11	.1405E-01	0.	0	0	0.
607	20	200	.3040E+00	.4338E-11	.8330E-02	0.	0	0	0.
608	30	200	.3040E+00	.7317E-11	.1405E-01	0.	0	0	0.
609	40	200	.3040E+00	.7317E-11	.1405E-01	0.	0	0	0.
610	50	200	.3040E+00	.4338E-11	.8330E-02	0.	0	0	0.
611	60	200	.3040E+00	.7317E-11	.1405E-01	0.	0	0	0.
612	85	199	.4220E+00	.1851E-09	.2560E+00	0.	0	0	0.
613	85	200	.4740E+00	.2079E-09	.2560E+00	0.	0	0	0.
614	86	199	.4830E+00	.3938E-09	.4760E+00	0.	0	0	0.
615	86	88	.3250E+00	.2650E-09	.4760E+00	0.	0	0	0.
616	86	200	.5200E-01	.4240E-10	.4760E+00	0.	0	0	0.
617	87	199	.4220E+00	.1851E-09	.2560E+00	0.	0	0	0.
618	87	200	.4740E+00	.2079E-09	.2560E+00	0.	0	0	0.
619	88	199	.4330E+00	.3723E-09	.5020E+00	0.	0	0	0.
620	88	200	.9430E-01	.8109E-10	.5020E+00	0.	0	0	0.
621	73	199	.4220E+00	.2263E-10	.3130E-01	0.	0	0	0.

622	73	200	.4740E+00	.2541E-10	.3130E-01	0.	0	0	0.
623	76	199	.4220E+00	.2263E-10	.3130E-01	0.	0	0	0.
624	76	200	.4740E+00	.2541E-10	.3130E-01	0.	0	0	0.
625	81	199	.4220E+00	.7142E-10	.9880E-01	0.	0	0	0.
626	81	200	.4740E+00	.8022E-10	.9880E-01	0.	0	0	0.
627	83	199	.5060E+00	.5270E-10	.6080E-01	0.	0	0	0.
628	83	200	.3790E+00	.3947E-10	.6080E-01	0.	0	0	0.
629	84	199	.4220E+00	.2277E-09	.3150E+00	0.	0	0	0.
630	84	200	.4740E+00	.2558E-09	.3150E+00	0.	0	0	0.
631	91	199	.5060E+00	.2921E-10	.3370E-01	0.	0	0	0.
632	91	200	.3790E+00	.2188E-10	.3370E-01	0.	0	0	0.
633	90	200	.9000E+00	.4193E-10	.2720E-01	0.	0	0	0.
634	90	135	.7180E+00	.4920E-10	.4000E-01	0.	0	0	0.
635	135	200	.7800E+00	.5345E-10	.4000E-01	0.	0	0	0.
636	92	199	.4220E+00	.4793E-10	.6630E-01	0.	0	0	0.
637	92	200	.4740E+00	.5383E-10	.6630E-01	0.	0	0	0.
638	88	199	.6650E-02	.5719E-11	.5020E+00	0.	0	0	0.
639	88	200	.1540E+00	.1324E-09	.5020E+00	0.	0	0	0.
641	11	199	.1705E+05	0.	0.	0.	0	0	0.
642	41	199	.1705E+05	0.	0.	0.	0	0	0.
669	85	199	.2083E+04	0.	0.	0.	0	0	0.
670	86	199	.1043E+04	0.	0.	0.	0	0	0.
671	87	199	.2083E+04	0.	0.	0.	0	0	0.
672	77	199	.1705E+05	0.	0.	0.	0	0	0.
673	89	199	.2084E+04	0.	0.	0.	0	0	0.
674	89	199	.2084E+04	0.	0.	0.	0	0	0.
675	82	199	.2771E+04	0.	0.	0.	0	0	0.
676	82	199	.2771E+04	0.	0.	0.	0	0	0.
701	112	61	.3240E+02	0.	0.	0.	0	0	0.
702	111	61	.1005E+04	0.	0.	0.	0	0	0.
703	131	61	.3830E+04	0.	0.	0.	0	0	0.
704	128	61	.2310E+04	0.	0.	0.	0	0	0.
705	166	61	.3060E+04	0.	0.	0.	0	0	0.
706	167	61	.2675E+04	0.	0.	0.	0	0	0.
707	102	61	.1031E+05	0.	0.	0.	0	0	0.
708	21	61	.8570E+04	0.	0.	0.	0	0	0.
709	166	61	.3257E+04	0.	0.	0.	0	0	0.
710	107	61	.1180E+03	0.	0.	0.	0	0	0.
711	108	61	.1620E+03	0.	0.	0.	0	0	0.
712	109	61	.2060E+03	0.	0.	0.	0	0	0.
713	127	206	.1414E+03	0.	0.	0.	0	0	0.
714	77	81	.9800E-01	.9401E-11	.5600E-01	0.	0	0	0.
715	77	82	.1230F+00	.1180E-10	.5600E-01	0.	0	0	0.
716	77	83	.5900E-01	.5660E-11	.5600E-01	0.	0	0	0.
717	77	84	.2820E+00	.2705E-10	.5600E-01	0.	0	0	0.
718	77	90	.6700E-01	.6427E-11	.5600E-01	0.	0	0	0.
719	77	91	.3400E-01	.3262E-11	.5600E-01	0.	0	0	0.
720	77	92	.6980E-01	.6696E-11	.5600E-01	0.	0	0	0.
721	77	200	.1198E+00	.8106E-10	.3950E+00	0.	0	0	0.
722	77	199	.1198E+00	.5007E-10	.2440F+00	0.	0	0	0.
723	77	90	.1198E+00	.2791E-10	.1360E+00	0.	0	0	0.

724	77	92	.1198E+00	.2791E-10	.1360E+00	0.	0	0	0.
726	77	200	.1600E-01	.1370E-10	.5000E+00	0.	0	0	0.
727	77	199	.1600E-01	.1370E-10	.5000E+00	0.	0	0	0.
728	65	11	.1040E-01	.3919E-12	.2200E-01	0.	0	0	0.
729	65	61	.1040E-01	.3919E-12	.2200E-01	0.	0	0	0.
730	68	31	.1040E-01	.3919E-12	.2200E-01	0.	0	0	0.
731	68	41	.1040E-01	.3919E-12	.2200E-01	0.	0	0	0.
732	85	11	.1040E-01	.3919E-12	.2200E-01	0.	0	0	0.
733	85	61	.1040E-01	.3919E-12	.2200E-01	0.	0	0	0.
734	87	31	.1040E-01	.3919E-12	.2200E-01	0.	0	0	0.
735	87	41	.1040E-01	.3919E-12	.2200E-01	0.	0	0	0.
736	206	202	.1414E+03	0.	0.	0.	0	0	0.
737	202	70	.2000E+02	0.	0.	0.	0	0	0.
739	77	206	.2080E-01	.1425E-10	.4000E+00	0.	0	0	0.
740	200	206	.2080E-01	.1603E-10	.4500E+00	0.	0	0	0.
741	202	208	.9068E+01	0.	0.	0.	0	0	0.
743	208	210	.2317E+02	0.	0.	0.	0	0	0.
744	208	77	.3940E-01	.2700E-10	.4000E+00	0.	0	0	0.
745	208	200	.3940E-01	.1687E-10	.2500E+00	0.	0	0	0.
746	208	199	.3940E-01	.1687E-10	.2500E+00	0.	0	0	0.
748	210	77	.1410E+02	0.	0.	0.	0	0	0.
749	210	77	.6130E-01	.4305E-10	.4100E+00	0.	0	0	0.
750	210	84	.6130E-01	.4305E-10	.4100E+00	0.	0	0	0.
751	61	201	.1193E+02	0.	0.	0.	0	0	0.
752	201	204	.2920E+01	0.	0.	0.	0	0	0.
753	204	202	.2920E+01	0.	0.	0.	0	0	0.
755	61	204	.2560E-01	.1973E-10	.4500E+00	0.	0	0	0.
756	57	204	.2560E-01	.1973E-10	.4500E+00	0.	0	0	0.
757	201	98	.3887E+01	0.	0.	0.	0	0	0.
758	77	85	.2010E-01	.1394E-10	.4050E+00	0.	0	0	0.
759	77	200	.2010E-01	.7747E-11	.2250E+00	0.	0	0	0.
760	77	199	.2010E-01	.7747E-11	.2250E+00	0.	0	0	0.
761	77	199	.2010E-01	.1549E-10	.4500E+00	0.	0	0	0.
762	77	200	.2010E-01	.1549E-10	.4500E+00	0.	0	0	0.
763	77	87	.1170E-01	.8117E-11	.4050E+00	0.	0	0	0.
764	77	81	.1170E-01	.8117E-11	.4050E+00	0.	0	0	0.
765	77	200	.1170E-01	.9019E-11	.4500E+00	0.	0	0	0.
766	77	199	.1170E-01	.9019E-11	.4500E+00	0.	0	0	0.
767	70	41	.2700E-02	.3978E-11	.8600E+00	0.	0	0	0.
768	70	51	.2700E-02	.3978E-11	.8600E+00	0.	0	0	0.
769	70	61	.2700E-02	.3978E-11	.8600E+00	0.	0	0	0.
770	88	200	.9000E+00	.6429E-09	.4170E+00	0.	0	0	0.
777	211	77	.8430E+00	0.	0.	0.	0	0	0.
778	211	77	.7310E-01	.1064E-09	.8500E+00	0.	0	0	0.
779	211	200	.2180E-01	.3174E-10	.8500E+00	0.	0	0	0.
780	211	200	.2098E-01	.1527E-10	.4250E+00	0.	0	0	0.
781	211	199	.2098E-01	.1527E-10	.4250E+00	0.	0	0	0.
782	77	93	.6590E-01	.6322E-11	.5600E-01	0.	0	0	0.
783	77	80	.1230F+00	.1160F-10	.5600E-01	0.	0	0	0.
-0	-0		-0	-0	-0				

8	1	9	-0.	FUNCTION 8 DATA					
	2	57							
	2	67							
	2	101							
	2	102							
	2	111							
	2	112							
	2	115							
	4	101							
-1	-0	-0	0.0						
9	1	1	-0.	FUNCTION 9 DATA					
			-0.	.1000E+01	.1000E-01	.2000E+02-0.	-0.		
-1	-0	-0	-0.						
-1	-0	-0	-0.						
-0	-0		102	-0	-0	-0	-0		
1	0	4	-0.	.3610E+01					
-1	-0	-0	0.						
2	0	4	-0.	.3413E+01					
-1	-0	-0	0.						
3	0	4	-0.	.1000E-03					
-1	-0	-0	0.						
4	0	4	-0.	.3413E+01					
-1	-0	-0	0.						
5	0	4	-0.	.3414E+01					
-1	-0	-0	0.						
6	0	4	-0.	.1000E-03					
-1	-0	-0	0.						
7	0	4	-0.	.3413E+01					
-1	-0	-0	0.						
-1	-0	-0	-0.						