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A THERMAL ANALYSIS OF THE "L" SYSTEM

INVESTIGATING THE PARAMETRIC TOLERANCES EFFECTING THE LENS TEMPERATURE

Final Report of [redacted]

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CONCLUSION

A tolerance study was accomplished in two phases:

PHASE I - Estimates were made by Vidya and LMSC on "Likely" extreme values of parameters. These were analyzed and predicted the lens temperature would be between 70 and 80^{o}F (if designed for 72^{o}F).

PHASE II - Then the most extreme surface property changes were assumed and, if combined with extremes of all other extreme parameters, the lens temperature would be between 60 and 90^{o}F.

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A nominal surface mosaic consisting of gold and white strips was found for L-4 which created a lens temperature of 72.1°F under nominal conditions of surface properties, duty cycle, and beta angle. Variations in these parameters disclosed that surface properties, under the rule that absorptivity and emissivity vary in the same direction, caused a variation in lens temperature of 2.9°F; the beta angle variation from 18° to 39° around a nominal of 29° caused the lens temperature to vary -1.5°F to +1.7° around the nominal; and the camera operating duty-cycle variation from zero to 12 minutes around a nominal of 4 minutes per pass caused the lens temperature to vary -1.5°F to 3.2°F around the nominal. When all of the warmest effects were combined into one run the lens temperature was found to be 79.7°F.

All of the lens-temperature variations obtained through this study up to this point could not explain the flight results received on previous units. Therefore, it was decided that more drastic extremes should be sought by allowing the surface properties to vary in a different manner. The new variations would allow the absorptivity of the surface finishes to go up while the emissivity went down or vice versa. With this new ground rule it was found that the effect on lens temperature due to surface properties alone was -7.7 to +12.6°F around the nominal. With this wider range of temperature variation due to surface properties the total band of lens temperature level, with all parametric variations studied in analysis superimposed, is expected to be approximately 60° to 90°F with a nominal of 72°F.

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TEMPERATURE TOLERANCE STUDY - PHASE I

1. INTRODUCTION

The purpose of this report is to present the results obtained in Phase I of the Lanyard System temperature tolerance study. This temperature tolerance study was requested in order to provide the anticipated bounds on the temperature level of critical components within the "L" System. Phase I of this study contained certain variables which are pertinent to the expected band of temperature levels; however, it is to be considered as limited in scope. In Phase I the parametric study was to include the following:

(1) the anticipated variation in beta angle around the nominal beta,

(2) the expected variation of the nominal value of the surface finishes as prescribed by tests performed on the ground by LMSC, and

(3) variations in camera operating duty cycle.

These variables do not completely define the possible range of temperature variations to be anticipated. Phase II of the tolerance study would complete the possible range of variations by including such variables as the external heating constants, altitude, and vehicle roll angle.

2. METHOD OF ATTACK

The thermal mathematical model of the Lanyard System has in the past been used to predict temperature distributions of the "L" System during flight. These flight predictions for past units have

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not agreed with flight results. Due to the limited thermal experimental results obtained because of program schedule pressures and other limitations, it has not been possible to upgrade the mathematical model such that more precise predictions can be made. There are two main deviations in the predictions from flight results; namely, (1) the levels predicted by the model are lower than the experimentally observed results, and (2) the temperature distribution within the package does not agree. It is not the purpose of this report to explain these deviations. However, the temperature level of the package is a function of the boundary conditions imposed on the mathematical model and therefore if these estimated conditions deviate, then predictions should be different from observed results. The results of this study will show how the temperature levels can vary as a function of certain boundary conditions. Regarding the deviations between flight results and predicted results in the temperature distribution, it is apparent that this is a flaw in the mathematical model. These errors, however, are small and to date it has not been possible to correct them. However, for purposes of this analysis, the effect of these small errors should be negligible.

In using the thermal mathematical model, the method of attack for the evaluation of the uncertainties is as follows:

(1) Through a series of computer runs a nominal exterior vehicle skin mosaic, composed of white paint and gold, would be sought which would give a nominal lens temperature of 70 - 75°F.

(2) Using the nominal mosaic pattern on the exterior skin the surface properties of the control surface finishes would be varied within the limits established by ground testing. These variations would be designed to seek out the expected lowest temperature given by these variations and the expected highest temperatures.

(3) With the nominal mosaic and nominal surface properties imposed the beta angle would be varied to the possible extremes.

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The purpose of this is to bracket the effect of beta angle variations in terms of the temperature level of the lens. For the L-4 mission this beta angle variation would be from 18° to 39° with a nominal beta of 29°.

(4) The duty cycle would be varied to two values distinctly different from the expected nominal flight program. These two values were to be chosen as (a) zero assuming that the system does not operate (similar to an L-2 condition); and (b) 12 minutes, the longest burst to be encountered on a mission.

(5) Two predictions were to be made, which would be combinations of the effective beta angle variation, and surface property variations.

For each of the above conditions the thermal mathematical model was used to predict temperature distributions throughout the system.

3. PRESENTATION OF RESULTS

A series of three runs with the computer program was made to determine which of the sets of vehicle skin mosaics furnished by LMSC would provide the desired temperature level on the lens. The mosaics provided for these three runs are tabulated in Figure 1 according to the adiabatic mean temperature level expected from these mosaics within the given section of the vehicle. The particular vehicle section is labeled A, B, or C with reference to the sketch shown in Figure 1. Each of the three mosaics were developed using the nominal values for the control surface properties shown tabulated in Figure 1. Also shown in Figure 1 are the variations assigned to these nominal values. These variations were used in some temperature predictions and the results will be presented in the following paragraphs.

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The three mosaics examined can be identified with computer run numbers 700, 701, and 702. Of these three runs it was found that Run 701 produced a lens temperature which was within the specified range. The lens temperature level produced by Run 701 was 72.1°F. The mosaic pattern which established this temperature level was taken as the nominal and was used throughout the rest of this tolerance study. In addition to the nominal paint pattern, the other parameters involved which establish nominal conditions will be found summarized in Table I corresponding to Run 701. These nominal conditions are the beta angle of 29°, nominal surface properties of the white and gold exterior surface finishes, and a nominal duty cycle of 4-minutes duration per orbit. Run 701 provided a complete temperature distribution throughout the system according to the nodal breakdown provided in the mathematical model. This nodal breakdown will be found in Figure 2. Corresponding to the nodes shown in Figure 2, Table II presents the time averaged temperatures over the tenth orbit for each node for Run 701. Since Table II in conjunction with Figure 2 becomes cumbersome to use when attempting to determine the temperatures of only a few nodes within the system, the temperatures of certain critical components have been extracted and are shown in Figure 3. From Figure 3 it can be seen that the lens barrel is at 72.1°F. There is approximately a 10° gradient axially along the lens and the inner tube is at an average temperature of approximately 69°F. This distribution is very similar to the distributions predicted for the previous units, L-1, L-2, and L-3.

For each run on the tolerance study the time average mean temperatures over the tenth orbit have been tabulated. From these tables the entire temperature distribution throughout the system may be obtained. In addition to these temperature tables, the temperatures of selected nodes have been extracted, as was done for Run 701, and placed on a figure similar to Figure 3. These will be found as Figures 4 through 14 of this report.

A summary of the conditions imposed in this tolerance study can

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be found in Table I along with the resulting time average lens temperature. From this table it will be seen that first of all, Runs 703 and 704 were made to show the effect of the beta angle variation. For these runs, 703 was for a beta angle of 18°, utilizing nominal surface properties and a nominal duty cycle, while Run 704 was for beta angle of 39°, again utilizing nominal conditions. Here it is seen that this resulted in a variation in the lens temperature of 3.2° or $\frac{-1.7^{\circ}F}{+1.5^{\circ}F}$ around the nominal temperature. The effect of the beta-angle variation upon the entire temperature distribution can be extracted from Tables III and IV, utilizing the complete nodal definition or a limited examination of the effect may be achieved from Figures 4 and 5.

In order to show the effect upon the payload temperature level and distribution caused by surface property variation, Runs 705, 706, and 707 were made. Run 705 produced the highest temperature level possible with the surface property variations allowable at the time when this run was made. When this run was made, similarly with 706 and 707, the basic ground rule was that if the absorptivity took a positive value of its tolerance limit then the emissivity must also include its positive tolerance value. Under this condition the highest alpha over epsilon ratio for the gold occurs when negative values of the tolerances were used. With white the highest value of the alpha over epsilon ratio occurs when positive values of its tolerance are used. Conversely, the lowest alpha over epsilon ratio for gold occurs when the positive tolerances are used and for white when the negative tolerances are used.

In order to determine the extreme temperatures to be experienced due to surface property variations it was desired to choose that combination of the gold and white properties which would cause the highest and lowest temperatures. It was assumed that the warmest predictions would be achieved when both the gold and white took on values for surface properties which caused each one to have the highest alpha over epsilon ratio. Similar for the cold case it was assumed

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that the lowest alpha over epsilon ratios for both the gold and white would cause the lowest temperatures. As shown by Table I, Runs 705 and 706 were set up on this basis with Run 705 being the expected warmest run and Run 706 the expected coldest.

Run 705 produced an apparent conformation of the basic assumption made, namely, that the highest alpha over epsilon ratio for both gold and white would produce the warmest temperature by producing a lens temperature 2.9^{o}F warmer than the nominal as shown in Table I. However, Run 706, which was expected to produce the coldest lens temperature gave a lens temperature which was also warmer than the nominal. Thus, an apparent ambiguity exists and an explanation for the peculiar phenomen is in order.

In order to determine how such a phenomenon could occur it was decided that the averaging process used to obtain the integrated surface properties over spatial spans around the skin should be examined. The method used to obtain the effective alpha and epsilon is given by the following equations:

$$\bar{a} = a_W F + a_G (1-F) \tag{1}$$

$$\bar{\epsilon} = \epsilon_W F + \epsilon_G (1-F) \tag{2}$$

Dividing Equation (1) by Equation (2) gives the following expression for the spatial average alpha over epsilon ratio as a function of the fraction of white paint on the surface:

$$\frac{\bar{a}}{\bar{\epsilon}} = \frac{a_W F + a_G (1-F)}{\epsilon_W F + \epsilon_G (1-F)} \tag{3}$$

Using this equation the alpha over epsilon variation as a function of the fraction of white paint was generated for the nominal

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surface conditions and for the expected coldest surface conditions (this condition was discussed previously, namely, the lowest alpha over epsilon ratio on both the gold and white). The results of this work is shown graphically in Figure 15. From this figure it is seen that the curve for the expected coldest surface crosses over the nominal case producing for a very large temperature range a surface with an alpha over epsilon ratio which is higher than the nominal. Thus, the ambiguity presented previously is explained since the integrated alpha over epsilon ratio can be higher even when individual constituents of the surface provide colder conditions.

In view of this unexpected result it was decided that the average alpha over epsilon ratio for each section of the vehicle, shown in Figure 1, should be computed as well as the average alpha over epsilon ratio for the entire payload for all combinations of the surface properties possible under the ground rules established earlier. The result of this analysis is shown in tabular form in Table XIV. Here it is seen that the expected high run, namely 705, does not produce the highest alpha over epsilon ratio for the entire payload. In fact, Run 706, which was the expected coldest run has a higher alpha over epsilon ratio for the entire payload than did Run 705. However, it has been experienced in the past and it was proven out herein that Section C of the payload has major control over the temperature of the lens cell and it will be seen from Table XIV that Run 705 has the highest alpha over epsilon ratio in that region. However, in the interests of proving this point and also insuring that the extreme in temperature excursions had been obtained, Run 707 was made. For Run 707, the alpha over epsilon ratio for the entire package was higher than it was for Run 705 (see Table XIV) but in Section C the alpha over epsilon ratio was lower. Runs 705 and 707 supported the conjecture that Section C isthe controlling factor for the lens temperature since Run 705 produced a lens temperature of 75.0°F while Run 707 produced 74.0°F.

Table XIV also shows that Run 701, the nominal case, should have

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produced the coldest temperature since not only does it have the lowest alpha over epsilon ratio in Section C, but has one of the lowest ratios for the entire package. This again adds support to the discussion, over average surface properties, provided previously and also shows that the fraction of white paint for each section of the payload is somewhere within the crossover region shown in Figure 15. In addition, Table XIV shows that the nominal condition establishes alpha over epsilon ratios for all sections which are as low as any combination of the surface properties available can produce.

In Table XIV, Cases 5 and 6 show ratios in Section C which are even higher than the warmest cases run. If the assumptions set forth and supported previously are correct then these two cases, namely 5 and 6, should produce lens temperatures warmer than Run 705. However, these two cases were not run to check this out, but from the magnitude of the increase in alpha over epsilon ratio a significant rise in lens temperature would not be expected. All other cases shown in Table XIV give alpha over epsilon ratios which would be expected to produce temperature levels intermediately between Run 705 and 701.

In order to achieve the limiting temperature levels, Runs 708 and 709 were made. These two runs are combinations of certain of the parameters all of which are in a direction which tend to raise the temperature level. Run 708 combines the hottest orbital condition, namely, a beta of 39° with the hottest surface properties which were used. This particular run included the nominal duty cycle. The resulting temperature of the lens cell was 76.5° which is a degree and a half above Run 705 which utilized the same surface properties and is 2.9° hotter than the Run 704 which was for the same beta angle. Run 709 is exactly the same as Run 708, but included a 12-minute duty cycle instead of the nominal 4-minute duty cycle in order to achieve the highest temperatures possible with the parametric variations available. The resulting average lens temperature came out to be 79.7° as shown in Table I.

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In order to determine the effect of duty cycle variation alone, Runs 710 and 711 imposed the extremes on duty cycle only with all other parameters held at nominal conditions. The resulting effects upon lens temperature are shown in Table I where it is seen that with no power input into the package, except for the clock, namely Run 710, the temperature attained was 70.6° while with the extreme duty cycle of 12 minutes, Run 711, the temperature was 75.3°. This variation in duty cycle was selected because first of all, zero would be as little a duty cycle as one could impose and the 12-minute condition is the longest duty cycle expected during the next mission. Both of these conditions are more severe than is to be expected. The zero condition and the 12-minute duty cycle per orbit were both run for a total of ten orbits which would not occur in an operational unit. Therefore, both of these conditions are indicative of extremes and yet only a 4.7°F variation from one extreme to the other in the lens cell temperature was experienced. Tables X and XI present the complete results for Runs 710 and 711, respectively and Figures 11 and 12 present the results for selected nodes. If these results are compared to the nominal case, Run 701, Table II and Figure 3, the effect of duty cycle upon the entire unit may be evaluated.

From the results presented it is seen that the variations in lens temperature level are not very severe, with a minimum of 70.4°F and a maximum of 79.7°F. In fact, the results obtained from this study do not allow for excursions in temperature level which were present in the L-3 missions. It was therefore decided that more drastic extremes should be sought. In order to obtain more drastic extremes it was decided that the basic ground rule regarding surface properties should be changed. Originally, the rule was that both the absorptivity and theemissivity must vary in the same direction, either both positively or both negatively. By changing this ground rule to allow the absorptivity to vary in a positive direction while the emissivity varied in a negative direction, and vice versa, much larger extremes should be attained. To determine the effect of the

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new surface conditions two more runs, namely Runs 714 and 715 were made. These two runs held all parameters at the nominal values except for surface properties. Run 714 allowed the absorptivity of both the gold and white to vary to the positive value of the tolerance limit and the emissivity to vary to the negative value of the tolerance limit. Run 715 allowed just the opposite condition with both absorptivities varying to the negative extreme while the emissivity varied to the positive extreme. In Table I a summary of these conditions is shown along with the resulting effect upon lens cell temperature. The complete results of these two runs can be found in Tables XII and XIII and limited results can be found in Figures 13 and 14.

Run 714 gave the highest temperature level obtained thus far, namely 84.7°F and the run did not allow for any variations other than surface properties. If one can assume that the effect of beta angle and duty cycle are very nearly additive then effects shown previously may be superimposed upon Run 714 to determine the expected highest temperature when more than one effect is combined. Run 704 showed that a variation in beta angle to a warmer condition would cause the lens cell temperature to raise 1.5°F. Therefore, the expected lens temperature for the surface properties of Run 714 at a beta angle of 39° would be 86.2°F. If now the warm duty cycle effect is combined with these surface properties and a beta angle of 39° the expected temperature would be 89.4°F. Therefore, it can be conjectured that if all of the warmest parametric variations included in this study were combined into one prediction the upper limit on lens cell temperature would be approximately 90°F.

Run 715 produced the lowest temperature of all runs made, namely 64.4°F. If combination of the lowest duty cycle and coldest beta angle are made by conjecture as they were for the warmest case, then the expected coldest temperature would be 61.2°F. Therefore, by conjecture it appears that the operational band of temperatures to be expected due to all of the parameters studied herein is approximately 60 to 90°F.

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TOLERANCE STUDY SUMMARY

TABLE I

RUN No.	BETA ANGLE DEG	SURFACE PROPERTIES		DUTY CYCLE MIN.	REMARKS	AVE. LENS TEMP. °F
		GOLD α/ϵ =	WHITE α/ϵ =			
701	29	$\frac{.39}{.15}$ = 2.60	$\frac{.15}{.86}$ = .175	4	NOMINAL	72.1
703	18	$\frac{.39}{.15}$ = 2.60	$\frac{.15}{.86}$ = .175	4	BETA VARIATION	70.4
704	39	$\frac{.39}{.15}$ = 2.60	$\frac{.15}{.86}$ = .175	4	BETA VARIATION	73.6
705	29	$\frac{.39-.03}{.15-.03}$ = 3.00	$\frac{.15+.07}{.86+.02}$ = .250	4	SURF. PROP. VAR.	75.0
706	29	$\frac{.39+.07}{.15+.03}$ = 2.56	$\frac{.15-.03}{.86-.02}$ = .143	4	SURF. PROP. VAR.	73.9
707	29	$\frac{.39+.07}{.15+.03}$ = 2.56	$\frac{.15+.07}{.86+.02}$ = .250	4	SURF. PROP. VAR.	74.0
708	39	$\frac{.39-.03}{.15-.03}$ = 3.00	$\frac{.15+.07}{.86+.02}$ = .250	4	COMBINATION	76.5
709	39	$\frac{.39-.03}{.15-.03}$ = 3.00	$\frac{.15+.07}{.86+.02}$ = .250	12	COMBINATION	79.7
710	29	$\frac{.39}{.15}$ = 2.60	$\frac{.15}{.86}$ = .175	0	DUTY CYCLE VAR.	70.6
711	29	$\frac{.39}{.15}$ = 2.60	$\frac{.15}{.86}$ = .175	12	DUTY CYCLE VAR.	75.3
714	29	$\frac{.39+.07}{.15-.03}$ = 3.83	$\frac{.15+.07}{.86-.02}$ = .262	4	SURF. PROP. VAR.	84.7
715	29	$\frac{.39-.03}{.15+.03}$ = 2.00	$\frac{.15-.03}{.86+.02}$ = .136	4	SURF. PROP. VAR.	64.4

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TABLE II.

TIME AVERAGED TEMPERATURES
FOR THE TENTH ORBIT, RUN 701

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RUN #701

MEAN TEMPERATURES FOR CYCLE NO 10

1	530.58	2	531.95	3	529.61	4	530.18	5	531.52	6	543.54	7	519.01
8	515.12	9	526.99	10	540.20	11	541.38	12	546.59	13	549.91	14	526.37
15	502.68	16	499.12	17	518.97	18	530.81	19	532.16	20	529.80	21	537.79
22	514.23	23	500.80	24	500.20	25	514.11	26	523.68	27	520.03	28	517.57
29	523.36	30	523.25	31	524.04	32	521.56	33	525.20	34	526.29	35	523.48
36	521.56	37	524.97	38	525.47	39	528.66	40	528.62	41	528.68	42	528.63
43	526.97	44	526.97	45	527.33	46	527.20	47	523.96	48	521.58	49	525.04
50	526.27	51	524.42	52	529.00	53	525.67	54	523.65	55	524.00	56	525.64
57	523.70	58	526.63	59	526.36	60	526.29	61	525.12	62	523.57	63	524.85
64	524.11	65	524.18	66	524.32	67	523.77	68	523.78	69	524.14	70	523.40
71	523.45	72	531.32	73	525.60	74	524.88	75	526.81	76	527.13	77	526.95
78	527.01	79	527.10	80	522.90	81	560.37	82	524.28	83	529.63	84	529.44
85	529.64	86	529.48	87	532.10	88	531.30	89	532.81	90	532.62	91	531.36
92	528.89	93	521.49	94	527.33	95	530.53	96	529.91	97	529.20	98	529.95
99	529.35	100	530.25	101	529.39	102	530.03	103	530.42	104	533.18	105	531.81
106	531.49	107	533.75	108	534.33	109	535.48	110	522.54	111	520.38	112	537.42
113	528.60	114	528.21	115	528.71	116	528.40	117	527.91	118	527.22	119	528.03
120	526.82	121	538.12	122	529.38	123	530.04	124	530.33	125	530.86	126	527.77
127	530.02	128	532.41	129	532.89								

CONDITIONS

BETA ANGLE = 29°

DUTY CYCLE = 4 MIN

SURFACE PROPERTIES

GOLD $\frac{\alpha}{\epsilon} = \frac{.39}{.15}$

WHITE $\frac{\alpha}{\epsilon} = \frac{.15}{.86}$

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TABLE III.

TIME AVERAGED TEMPERATURES
FOR THE TENTH ORBIT, RUN 703

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RUN # 703

MEAN TEMPERATURES FOR CYCLE NO 10

1	528.03	2	529.87	3	527.40	4	527.44	5	527.98	6	546.22	7	530.04
8	515.99	9	526.11	10	537.32	11	530.63	12	526.53	13	539.41	14	532.43
15	523.38	16	506.43	17	522.06	18	528.87	19	518.25	20	506.00	21	523.80
22	519.27	23	517.95	24	508.53	25	519.25	26	522.82	27	508.32	28	498.73
29	511.98	30	521.90	31	523.19	32	522.01	33	522.83	34	521.63	35	522.73
36	521.92	37	522.81	38	521.22	39	526.70	40	526.65	41	526.71	42	526.66
43	525.26	44	525.34	45	525.49	46	525.21	47	523.04	48	522.01	49	522.64
50	521.67	51	523.83	52	526.49	53	523.46	54	522.41	55	523.15	56	524.11
57	523.37	58	525.19	59	524.71	60	524.41	61	522.15	62	522.49	63	523.39
64	522.68	65	522.30	66	522.47	67	522.66	68	522.69	69	522.98	70	522.29
71	522.18	72	529.74	73	524.14	74	523.60	75	525.10	76	525.31	77	525.06
78	525.25	79	525.48	80	521.70	81	559.57	82	522.68	83	527.44	84	527.22
85	527.46	86	527.24	87	530.38	88	529.73	89	531.52	90	531.23	91	529.82
92	527.07	93	518.94	94	524.44	95	528.11	96	527.42	97	526.63	98	527.47
99	526.67	100	527.85	101	527.08	102	527.50	103	527.37	104	531.01	105	529.29
106	528.89	107	531.22	108	531.00	109	534.91	110	522.62	111	517.22	112	527.33
113	526.58	114	526.21	115	526.57	116	526.23	117	526.04	118	525.24	119	526.05
120	525.13	121	527.93	122	527.03	123	527.48	124	527.29	125	528.65	126	526.49
127	526.83	128	527.61	129	531.12								

CONDITIONS

BETA ANGLE = 18°
DUTY CYCLE = 4 MIN

SURFACE PROPERTIES
GOLD α/ϵ = .39/.15
WHITE α/ϵ = .15/.86

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TABLE III

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TABLE IV

TIME AVERAGED TEMPERATURES FOR THE TENTH ORBIT, RUN 704

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RUN # 704

MEAN TEMPERATURES FOR CYCLE NO 10

1	532.30	2	533.38	3	531.30	4	532.31	5	534.38	6	539.32	7	510.21
8	513.95	9	527.02	10	541.68	11	551.30	12	562.25	13	557.24	14	518.91
15	486.54	16	492.92	17	515.83	18	531.74	19	545.56	20	548.60	21	547.54
22	508.95	23	489.42	24	495.12	25	513.06	26	525.17	27	531.45	28	532.95
29	531.61	30	525.16	31	525.13	32	521.77	33	527.73	34	530.66	35	524.57
36	522.00	37	527.43	38	529.59	39	530.51	40	530.47	41	530.53	42	530.49
43	528.78	44	528.73	45	529.26	46	529.25	47	525.12	48	521.81	49	527.61
50	530.58	51	525.72	52	531.75	53	528.18	54	525.40	55	525.48	56	527.70
57	524.68	58	528.38	59	528.27	60	528.39	61	528.22	62	525.18	63	526.87
64	526.02	65	526.48	66	526.59	67	525.46	68	525.48	69	525.86	70	525.05
71	525.20	72	533.42	73	527.63	74	526.79	75	528.65	76	529.06	77	528.96
78	528.90	79	528.90	80	524.51	81	561.67	82	526.43	83	531.50	84	531.34
85	531.53	86	531.40	87	533.59	88	532.72	89	533.95	90	533.82	91	532.67
92	530.43	93	523.62	94	529.62	95	532.49	96	531.88	97	531.27	98	531.99
99	531.50	100	532.13	101	531.23	102	532.09	103	532.90	104	534.87	105	533.79
106	533.54	107	535.65	108	536.96	109	535.17	110	522.19	111	522.70	112	545.52
113	530.44	114	530.09	115	530.66	116	530.43	117	525.74	118	529.26	119	529.96
120	528.66	121	532.18	122	531.25	123	532.10	124	532.79	125	532.53	126	528.78
127	532.64	128	536.32	129	533.91								

CONDITIONS

BETA ANGLE = 39°
DUTY CYCLE = 4 MIN

SURFACE PROPERTIES
GOLD α/ε = .39/.15
WHITE α/ε = .15/.86

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TABLE V

TIME AVERAGED TEMPERATURES FOR THE TENTH ORBIT, RUN 705

[redacted]

RUN # 705

MEAN TEMPERATURES FOR CYCLE NO 10

1	535.45	2	536.51	3	533.51	4	533.84	5	535.26	6	549.17	7	527.51
8	523.08	9	533.24	10	545.50	11	545.93	12	550.95	13	554.58	14	532.92
15	513.12	16	509.73	17	527.02	18	536.20	19	537.14	20	535.41	21	543.70
22	521.15	23	510.38	24	509.91	25	521.52	26	528.92	27	525.04	28	523.55
29	529.78	30	529.11	31	530.12	32	527.96	33	530.99	34	531.97	35	529.49
36	527.83	37	530.66	38	531.12	39	532.84	40	532.79	41	532.84	42	532.80
43	531.71	44	531.71	45	532.03	46	531.90	47	530.17	48	528.09	49	530.97
50	532.06	51	530.24	52	534.55	53	531.22	54	529.44	55	529.73	56	531.27
57	529.17	58	531.74	59	531.43	60	531.36	61	530.60	62	529.41	63	530.55
64	529.75	65	529.91	66	530.01	67	529.54	68	529.58	69	529.85	70	529.21
71	529.27	72	536.86	73	531.24	74	530.57	75	531.60	76	531.88	77	531.76
78	531.80	79	531.93	80	528.84	81	564.62	82	529.94	83	533.54	84	533.30
85	533.48	86	533.33	87	534.98	88	534.28	89	535.05	90	534.88	91	533.72
92	531.49	93	524.53	94	531.12	95	534.26	96	533.94	97	533.08	98	533.77
99	533.21	100	534.33	101	533.34	102	533.83	103	534.29	104	535.96	105	535.13
106	534.93	107	537.50	108	538.26	109	541.07	110	528.61	111	523.39	112	541.82
113	532.91	114	532.58	115	532.90	116	532.75	117	532.40	118	532.00	119	532.49

CONDITIONS

BETA ANGLE = 29°

DUTY CYCLE = 4 MIN

SURFACE PROPERTIES

GOLD α/ε = .39-.03/.15-.03

WHITE α/ε = .15+.07/.86+.02

SECRET

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TABLE VI.
TIME AVERAGED TEMPERATURES
FOR THE TENTH ORBIT, RUN 706

[redacted]

RUN # 706

MEAN TEMPERATURES FOR CYCLE NO 10

1	533.98	2	535.21	3	531.83	4	532.39	5	534.18	6	549.54	7	519.80
8	515.20	9	528.78	10	543.81	11	545.79	12	553.31	13	557.17	14	533.31
15	502.43	16	497.49	17	520.22	18	534.56	19	537.47	20	537.06	21	546.68
22	520.18	23	501.56	24	499.58	25	515.53	26	526.72	27	524.88	28	523.68
29	530.98	30	526.55	31	527.81	32	524.32	33	528.54	34	530.42	35	527.15
36	524.33	37	528.23	38	529.42	39	531.18	40	531.13	41	531.18	42	531.14
43	529.78	44	529.69	45	530.09	46	530.02	47	527.80	48	524.45	49	528.46
50	530.48	51	527.35	52	532.45	53	529.02	54	526.98	55	527.01	56	528.80
57	526.34	58	529.50	59	529.28	60	529.28	61	528.62	62	526.96	63	528.06
64	527.28	65	527.56	66	527.67	67	526.92	68	526.91	69	527.27	70	526.72
71	526.84	72	534.43	73	528.73	74	527.97	75	529.63	76	529.91	77	529.80
78	529.81	79	529.88	80	526.43	81	562.81	82	527.46	83	532.07	84	531.82
85	532.00	86	531.87	87	533.86	88	533.10	89	534.17	90	534.00	91	532.80
92	530.49	93	523.38	94	529.75	95	532.89	96	532.54	97	531.65	98	532.33
99	531.83	100	532.91	101	531.74	102	532.37	103	533.02	104	534.94	105	533.92
106	533.68	107	535.81	108	536.67	109	539.89	110	524.28	111	522.52	112	542.28
113	531.22	114	530.79	115	531.22	116	531.04	117	530.60	118	530.05	119	530.64
120	529.59	121	533.03	122	531.74	123	532.37	124	532.91	125	534.90	126	531.07
127	533.67	128	536.74	129	536.67								

CONDITIONS
BETA ANGLE = 29°
DUTY CYCLE = 1 MIN

SURFACE PROPERTIES
GOLD α/ε = .39+.07/.15+.03
WHITE α/ε = .15−.03/.86−.02

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TABLE VII
TIME AVERAGED TEMPERATURES FOR THE TENTH ORBIT, RUN 707

[redacted]

RUN # 707

MEAN TEMPERATURES FOR CYCLE NO 10

1	533.64	2	535.24	3	531.42	4	531.75	5	533.80	6	550.50	7	519.76
8	514.41	9	525.28	10	541.84	11	540.22	12	554.49	13	559.13	14	536.99
15	503.88	16	498.27	17	520.61	18	535.38	19	539.28	20	542.38	21	552.65
22	524.98	23	503.93	24	501.14	25	516.91	26	528.68	27	528.28	28	529.98
29	537.80	30	529.01	31	530.23	32	526.16	33	530.39	34	532.96	35	529.67
36	526.31	37	530.22	38	532.06	39	531.90	40	531.85	41	531.90	42	531.87
43	531.09	44	530.95	45	531.35	46	531.34	47	530.27	48	526.34	49	530.38
50	533.06	51	529.49	52	534.96	53	531.41	54	529.43	55	529.15	56	531.05
57	528.25	58	531.18	59	530.98	60	531.04	61	531.04	62	529.48	63	530.37
64	529.54	65	530.02	66	530.07	67	529.20	68	529.18	69	529.50	70	529.18
71	529.35	72	536.65	73	530.96	74	530.18	75	531.01	76	531.24	77	531.24
78	531.20	79	531.27	80	529.04	81	564.42	82	529.77	83	532.32	84	532.05
85	532.27	86	532.11	87	534.01	88	533.47	89	534.34	90	534.09	91	532.80
92	530.34	93	522.75	94	529.33	95	532.78	96	532.39	97	531.46	98	532.26
99	531.66	100	532.86	101	531.54	102	532.14	103	532.84	104	534.60	105	533.55
106	533.30	107	534.97	108	535.37	109	540.26	110	523.40	111	521.89	112	542.06
113	531.91	114	531.53	115	531.78	116	531.78	117	531.59	118	531.41	119	531.54
120	530.89	121	532.97	122	531.50	123	532.11	124	532.70	125	535.77	126	531.60
127	534.01	128	537.58	129	536.81								

CONDITIONS

BETA ANGLE = 29°

DUTY CYCLE = 4 MIN

SURFACE PROPERTIES

GOLD α/ε = .39±.07/.15±.03

WHITE α/ε = .15±.07/.86±.02

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TABLE VIII
TIME AVERAGED TEMPERATURES
FOR THE TENTH ORBIT, RUN 708

[redacted]

RUN # 708

MEAN TEMPERATURES FOR CYCLE NO 10

1	537.28	2	538.04	3	535.26	4	536.02	5	538.17	6	545.37	7	519.59
8	522.21	9	533.50	10	547.17	11	555.62	12	566.43	13	561.87	14	525.70
15	497.61	16	503.46	17	523.73	18	537.14	19	550.45	20	554.41	21	553.52
22	515.74	23	498.38	24	503.81	25	518.44	26	529.74	27	536.31	28	539.18
29	538.07	30	530.74	31	531.08	32	527.97	33	533.33	34	536.21	35	530.41
36	528.00	37	532.89	38	535.09	39	534.62	40	534.58	41	534.62	42	534.59
43	533.39	44	533.33	45	533.82	46	533.83	47	531.20	48	528.13	49	533.35
50	536.25	51	531.22	52	537.11	53	533.52	54	530.94	55	530.92	56	533.04
57	529.89	58	533.29	59	533.15	60	533.29	61	533.52	62	530.75	63	532.26
64	531.40	65	531.96	66	532.03	67	530.95	68	530.98	69	531.29	70	530.59
71	530.76	72	538.67	73	532.96	74	532.15	75	533.30	76	533.67	77	533.62
78	533.55	79	533.58	80	530.22	81	565.44	82	531.78	83	535.40	84	535.18
85	535.35	86	535.25	87	536.47	88	535.69	89	536.18	90	536.09	91	535.05
92	533.05	93	526.69	94	533.45	95	536.25	96	535.95	97	535.18	98	535.82
99	535.40	100	536.26	101	535.22	102	535.90	103	536.80	104	537.69	105	537.16
106	537.03	107	539.46	108	540.95	109	541.02	110	528.48	111	525.75	112	549.85
113	534.70	114	534.38	115	534.80	116	534.71	117	534.14	118	533.91	119	534.29
120	533.33	121	536.35	122	535.22	123	535.9[illegible]	124	536.67	125	538.50	126	535.30
127	538.35	128	541.90	129	539.25								

CONDITIONS

BETA ANGLE = 39°

DUTY CYCLE = 4 MIN

SURFACE PROPERTIES

GOLD α/ε = .39-.03/.15-.03

WHITE α/ε = .15+.07/.86+.02

SECRET

[redacted]

TABLE IX
TIME AVERAGED TEMPERATURES
FOR THE TENTH ORBIT, RUN 709

[redacted]

RUN # 709
MEAN TEMPERATURES FOR CYCLE NO 10

1	539.39	2	541.35	3	539.32	4	544.97	5	542.18	6	546.78	7	521.41
8	524.32	9	536.26	10	549.06	11	557.46	12	567.66	13	563.12	14	527.21
15	499.83	16	505.89	17	526.04	18	538.97	19	551.92	20	555.49	21	554.63
22	517.82	23	501.23	24	506.93	25	521.42	26	532.24	27	538.33	28	540.83
29	539.74	30	537.85	31	535.84	32	533.03	33	538.42	34	540.96	35	535.73
36	533.80	37	538.88	38	540.61	39	539.61	40	539.59	41	539.70	42	539.60
43	538.98	44	539.10	45	539.56	46	539.52	47	535.84	48	533.02	49	538.27
50	540.86	51	540.30	52	550.87	53	542.07	54	537.95	55	538.52	56	542.32
57	535.77	58	541.04	59	540.09	60	539.98	61	539.78	62	538.07	63	541.18
64	538.56	65	539.47	66	539.47	67	538.46	68	538.61	69	538.87	70	537.40
71	537.53	72	556.34	73	542.07	74	540.55	75	539.09	76	539.66	77	539.73
78	539.75	79	540.23	80	536.30	81	568.17	82	546.92	83	539.90	84	539.70
85	540.28	86	539.75	87	539.70	88	539.17	89	538.69	90	538.56	91	537.51
92	535.59	93	529.08	94	536.93	95	541.61	96	540.06	97	539.30	98	541.29
99	539.51	100	540.48	101	539.47	102	542.52	103	541.02	104	540.47	105	540.55
106	540.57	107	554.96	108	556.54	109	542.77	110	530.67	111	527.47	112	551.56
113	539.69	114	539.74	115	540.50	116	539.93	117	539.55	118	540.35	119	540.12
120	539.41	121	540.45	122	539.41	123	542.61	124	540.83	125	540.95	126	537.59
127	541.15	128	544.32	129	541.42								

CONDITIONS
BETA ANGLE = 39°
DUTY CYCLE = 12 MIN

SURFACE PROPERTIES
GOLD α/ε = .39-.03/.15-.03
WHITE α/ε = .15+.07/.86+.02

[redacted]

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TABLE X
TIME AVERAGED TEMPERATURES FOR THE TENTH ORBIT, RUN 710

[redacted]

RUN # 710

MEAN TEMPERATURES FOR CYCLE NO 10

1	529.53	2	530.20	3	527.38	4	525.05	5	529.36	6	542.90	7	518.19
8	514.13	9	525.67	10	539.33	11	540.47	12	545.96	13	549.30	14	525.82
15	501.90	16	498.25	17	518.14	18	530.14	19	531.58	20	529.35	21	537.35
22	513.48	23	499.82	24	499.13	25	513.10	26	522.84	27	519.28	28	516.93
29	522.72	30	520.59	31	522.13	32	519.57	33	523.20	34	524.37	35	521.34
36	519.27	37	522.69	38	523.24	39	526.30	40	526.25	41	526.27	42	526.27
43	524.48	44	524.38	45	524.80	46	524.66	47	522.13	48	519.70	49	523.16
50	524.44	51	520.27	52	521.68	53	521.72	54	520.77	55	520.76	56	521.57
57	521.39	58	523.00	59	523.24	60	523.33	61	522.57	62	520.57	63	521.45
64	521.28	65	521.24	66	521.33	67	520.80	68	520.70	69	521.04	70	520.63
71	520.70	72	521.87	73	521.72	74	521.41	75	524.23	76	524.47	77	524.22
78	524.20	79	524.03	80	520.50	81	559.42	82	521.56	83	527.37	84	527.17
85	527.13	86	527.22	87	530.55	88	529.66	89	531.62	90	531.43	91	530.17
92	527.65	93	520.30	94	525.50	95	527.57	96	527.72	97	527.02	98	526.97
99	527.17	100	528.00	101	527.11	102	526.36	103	528.19	104	531.65	105	529.96
106	529.56	107	524.42	108	526.17	109	534.64	110	521.48	111	519.53	112	536.57
113	526.19	114	525.62	115	525.86	116	525.90	117	525.37	118	524.19	119	525.23
120	524.06	121	528.14	122	527.13	123	526.31	124	528.12	125	529.77	126	526.61
127	528.75	128	531.32	129	531.81								

CONDITIONS

BETA ANGLE = 29°

DUTY CYCLE = 0 MIN

SURFACE PROPERTIES

GOLD α/ε = .39/.15

WHITE α/ε = .15/.86

SECRET

[redacted]

TABLE XI
TIME AVERAGED TEMPERATURES FOR THE TENTH ORBIT, RUN 711

[redacted]

RUN # 711

MEAN TEMPERATURES FOR CYCLE NO 10

1	532.62	2	535.24	3	533.67	4	539.28	5	535.55	6	544.83	7	520.64
8	517.09	9	529.62	10	541.96	11	543.19	12	547.84	13	551.13	14	527.75
15	504.64	16	501.28	17	521.05	18	532.51	19	533.61	20	530.93	21	538.91
22	516.18	23	503.38	24	503.04	25	516.86	26	526.07	27	522.06	28	519.29
29	525.04	30	530.47	31	528.82	32	526.59	33	530.33	34	531.12	35	528.83
36	527.36	37	531.03	38	531.10	39	533.67	40	533.65	41	533.77	42	533.65
43	532.60	44	532.78	45	533.11	46	532.94	47	528.61	48	526.45	49	529.99
50	530.96	51	533.61	52	543.04	53	534.39	54	530.77	55	531.71	56	535.10
57	529.56	58	534.47	59	533.38	60	533.06	61	531.48	62	531.01	63	533.92
64	531.35	65	531.82	66	531.89	67	531.37	68	531.52	69	531.82	70	530.31
71	530.31	72	549.32	73	534.88	74	533.44	75	532.65	76	533.16	77	533.11
78	533.27	79	533.81	80	529.03	81	563.02	82	539.82	83	534.13	84	533.95
85	534.58	86	533.99	87	535.28	88	534.73	89	535.25	90	535.03	91	533.76
92	531.36	93	523.83	94	530.80	95	535.92	96	534.03	97	533.34	98	535.47
99	533.47	100	534.48	101	533.66	102	536.72	103	534.66	104	535.96	105	535.22
106	535.05	107	549.44	108	550.17	109	537.13	110	524.62	111	522.06	112	539.12
113	533.61	114	533.61	115	534.45	116	533.66	117	533.35	118	533.74	119	533.91
120	532.95	121	534.43	122	533.59	123	536.82	124	534.51	125	533.25	126	530.29
127	532.77	128	534.81	129	534.99								

CONDITIONS

BETA ANGLE = 29°
DUTY CYCLE = 12 MIN

SURFACE PROPERTIES
GOLD α/ϵ = .39/.15
WHITE α/ϵ = .15/.86

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[redacted]

TABLE XII
TIME AVERAGED TEMPERATURES
FOR THE TENTH ORBIT, RUN 714

[redacted]

RUN # 714

MEAN TEMPERATURES FOR CYCLE NO 10

1	551.85	2	552.51	3	545.73	4	545.29	5	547.99	6	573.94	7	546.69
8	538.86	9	546.85	10	563.27	11	559.67	12	572.87	13	578.85	14	561.43
15	535.53	16	528.78	17	547.08	18	556.43	19	559.05	20	559.93	21	572.77
22	547.52	23	532.79	24	529.59	25	541.02	26	546.98	27	545.29	28	546.23
29	556.53	30	548.26	31	550.59	32	547.17	33	550.10	34	552.14	35	549.62
36	546.82	37	549.47	38	550.92	39	546.68	40	546.62	41	546.62	42	546.63
43	547.41	44	547.28	45	547.58	46	547.55	47	551.01	48	547.73	49	550.52
50	552.63	51	548.67	52	553.33	53	549.83	54	548.52	55	548.11	56	549.75
57	546.50	58	548.47	59	548.15	60	548.23	61	549.27	62	548.72	63	549.25
64	548.22	65	548.93	66	548.85	67	548.27	68	548.30	69	548.39	70	548.31
71	548.50	72	555.06	73	549.66	74	549.05	75	547.46	76	547.60	77	547.73
78	547.66	79	547.83	80	548.55	81	579.41	82	548.55	83	546.52	84	546.05
85	546.18	86	546.10	87	544.66	88	544.37	89	542.66	90	542.54	91	541.65
92	540.08	93	534.21	94	543.42	95	546.58	96	547.35	97	545.76	98	546.25
99	545.95	100	548.03	101	546.00	102	546.07	103	547.25	104	545.01	105	545.93
106	546.13	107	548.67	108	550.01	109	561.61	110	543.84	111	533.39	112	559.73
113	547.24	114	546.89	115	546.69	116	547.14	117	547.32	118	547.83	119	547.02
120	547.46	121	548.28	122	545.90	123	546.00	124	547.04	125	556.96	126	553.00
127	554.47	128	557.90	129	556.21								

CONDITIONS

BETA ANGLE = 29°
DUTY CYCLE = 1 MIN

SURFACE PROPERTIES
GOLD α/ϵ = .39+.07/.15-.03
WHITE α/ϵ = .15+.07/.86-.02

[redacted]

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TABLE XIII

TIME AVERAGED TEMPERATURES

FOR THE TENTH ORBIT, RUN 715

[redacted]

RUN # 715

MEAN TEMPERATURES FOR CYCLE NO

1	516.69	2	519.33	3	518.89	4	519.63	5	520.54	6	529.46	7	501.36
8	498.33	9	509.09	10	522.53	11	521.22	12	529.30	13	532.62	14	505.65
15	481.72	16	480.14	17	501.40	18	515.16	19	515.70	20	512.36	21	517.73
22	494.37	23	480.87	24	481.90	25	497.90	26	509.94	27	505.40	28	501.01
29	504.10	30	508.58	31	508.26	32	506.13	33	510.26	34	510.96	35	508.00
36	506.46	37	510.39	38	510.46	39	517.64	40	517.61	41	517.70	42	517.62
43	514.73	44	514.80	45	515.19	46	515.01	47	507.88	48	505.84	49	509.75
50	510.63	51	510.19	52	514.81	53	511.54	54	509.09	55	509.84	56	511.52
57	510.56	58	513.74	59	513.49	60	513.36	61	510.98	62	508.85	63	510.54
64	509.96	65	509.65	66	509.93	67	509.36	68	509.37	69	509.89	70	508.82
71	508.79	72	517.42	73	511.52	74	510.73	75	514.46	76	514.87	77	514.58
78	514.70	79	514.75	80	507.80	81	549.48	82	510.15	83	519.04	84	518.98
85	519.26	86	519.02	87	524.41	88	523.47	89	526.93	90	526.57	91	524.98
92	521.72	93	512.65	94	516.51	95	520.20	96	518.67	97	518.39	98	519.41
99	518.52	100	518.95	101	518.54	102	519.44	103	519.42	104	525.32	105	522.43
106	521.76	107	523.10	108	522.53	109	520.41	110	507.67	111	511.31	112	521.99
113	517.16	114	516.73	115	517.53	116	516.87	117	516.17	118	514.85	119	516.46
120	514.42	121	518.91	122	518.56	123	519.46	124	519.38	125	514.80	126	511.72
127	514.05	128	516.29	129	518.58								

CONDITIONS

BETA ANGLE = 29°

DUTY CYCLE = 1 MIN

SURFACE PROPERTIES

GOLD α/ϵ = .39-.03/.15+.03

WHITE α/ϵ = .15-.03/.86+.02

[redacted]

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[redacted]

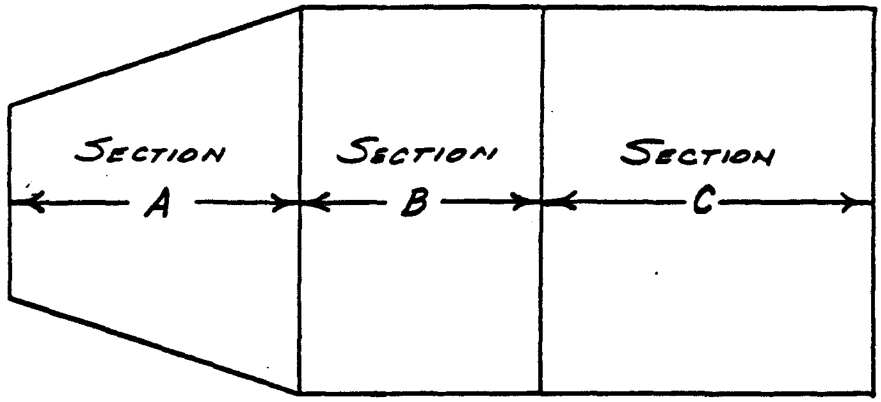
TABLE XIV

SPATIAL AVERAGED ALPHA OVER EPSILON RATIO'S FOR THE PAYLOAD

CASE	WHITE	GOLD	SECTION (A)	SECTION (B)	SECTION (C)	OVERALL	REMARKS	RUN NO.
I	$\frac{\alpha}{\epsilon} = \frac{.15}{.86} = .174$	$\frac{\alpha}{\epsilon} = \frac{.39}{.15} = 2.60$	1.747	1.408	1.176	1.433	NOM WHITE NOM GOLD	701
II	$\frac{\alpha}{\epsilon} = \frac{.12}{.84} = .143$	$\frac{\alpha}{\epsilon} = \frac{.46}{.18} = 2.55$	1.816	1.494	1.261	1.518	LOW WHITE LOW GOLD	706
III	$\frac{\alpha}{\epsilon} = \frac{.22}{.88} = .250$	$\frac{\alpha}{\epsilon} = \frac{.36}{.18} = 3.00$	1.873	1.480	1.226	1.508	HIGH WHITE HIGH GOLD	705
IV	$\frac{\alpha}{\epsilon} = \frac{.22}{.88} = .250$	$\frac{\alpha}{\epsilon} = \frac{.46}{.18} = 2.55$	1.826	1.514	1.292	1.538	HIGH WHITE LOW GOLD	707
V	$\frac{\alpha}{\epsilon} = \frac{.12}{.84} = .143$	$\frac{\alpha}{\epsilon} = \frac{.36}{.12} = 3.00$	1.861	1.459	1.187	1.483	LOW WHITE HIGH GOLD	
VI	$\frac{\alpha}{\epsilon} = \frac{.15}{.86} = .174$	$\frac{\alpha}{\epsilon} = \frac{.36}{.12} = 3.00$	1.858	1.454	1.192	1.483	NOM WHITE HIGH GOLD	
VII	$\frac{\alpha}{\epsilon} = \frac{.15}{.86} = .174$	$\frac{\alpha}{\epsilon} = \frac{.46}{.18} = 2.55$	1.814	1.494	1.264	1.518	NOM WHITE LOW GOLD	
VIII	$\frac{\alpha}{\epsilon} = \frac{.22}{.88} = .250$	$\frac{\alpha}{\epsilon} = \frac{.39}{.15} = 2.60$	1.761	1.432	1.207	1.456	HIGH WHITE NOM GOLD	
IX	$\frac{\alpha}{\epsilon} = \frac{.12}{.84} = .143$	$\frac{\alpha}{\epsilon} = \frac{.39}{.15} = 2.60$	1.749	1.407	1.171	1.432	LOW WHITE NOM GOLD	

[redacted]

[redacted]



PAYLOAD MOSAIC SECTIONS

CONTROL SURFACE OPTICAL PROPERTIES

MATERAL	PROPERTY	NOMINAL VALUE	VARIATION
VACUUM DEPOSITED GOLD	ABSORPTIVITY	.39	+.07 -.03
	EMISSIVITY	.15	+.03 -.03
WHITE SILICON ELASTOMER	ABSORPTIVITY	.15	+.07 -.03
	EMISSIVITY	.86	+.02 -.02

MOSAIC IDENTIFICATION

RUN NO.	SECT.	IDEAL SECT AVE TEMP.	REMARKS
700	A	45	FOUND TO CAUSE EXCESSIVE LENS TEMPERATURE
	B	60	
	C	90	
701	A	40	FOUND TO GIVE A LENS TEMP. OF 72.1°F TAKEN AS NOMINAL
	B	55	
	C	85	
702	A	50	FOUND TO CAUSE EXCESSIVE LENS TEMPERATURE
	B	65	
	C	95	

FIGURE 1. – PAYLOAD CONTROL SURFACE DESCRIPTION

[redacted]

[redacted]

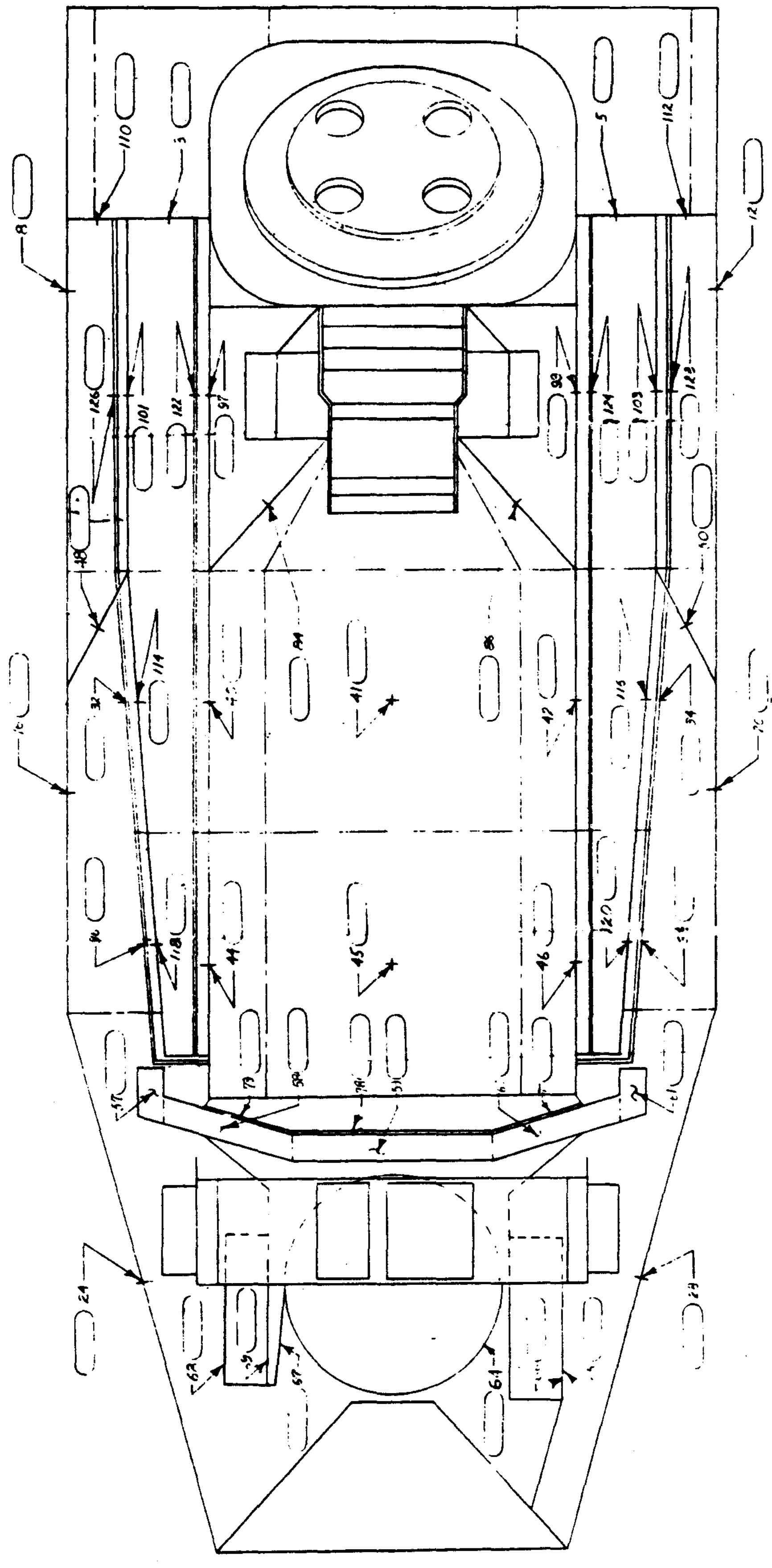


FIGURE 2 - NODAL BREAKDOWN OF L SYSTEM, TOP VIEW

[redacted]

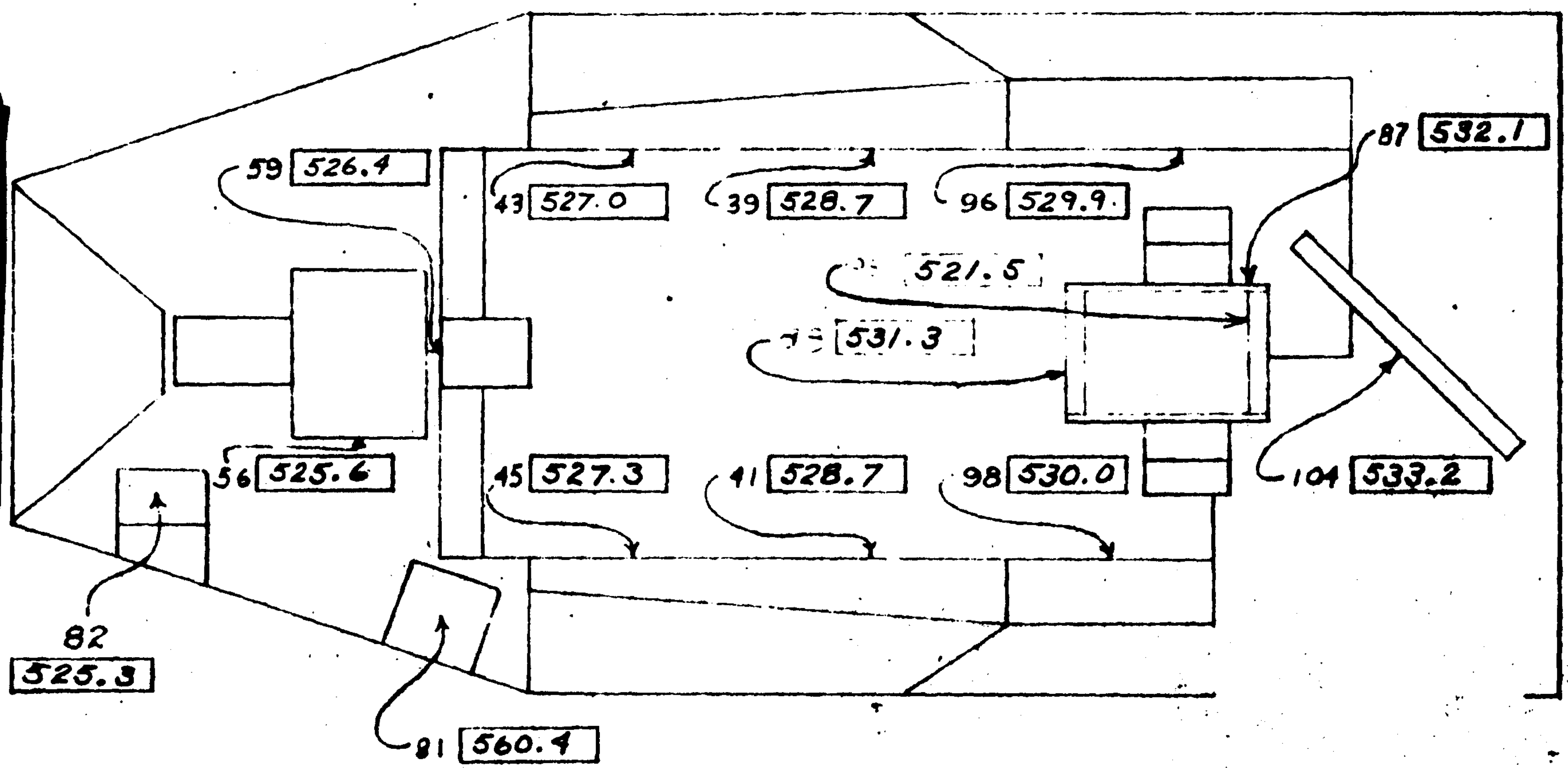
SECRET

RUN 701
BETA ANGLE = 29°
DUTY CYCLE = 4 MIN
SURFACE PROPERTIES

GOLD $\frac{\alpha}{\epsilon} = \frac{.39}{.15}$

WHITE $\frac{\alpha}{\epsilon} = \frac{.15}{.86}$

[redacted]



[redacted]

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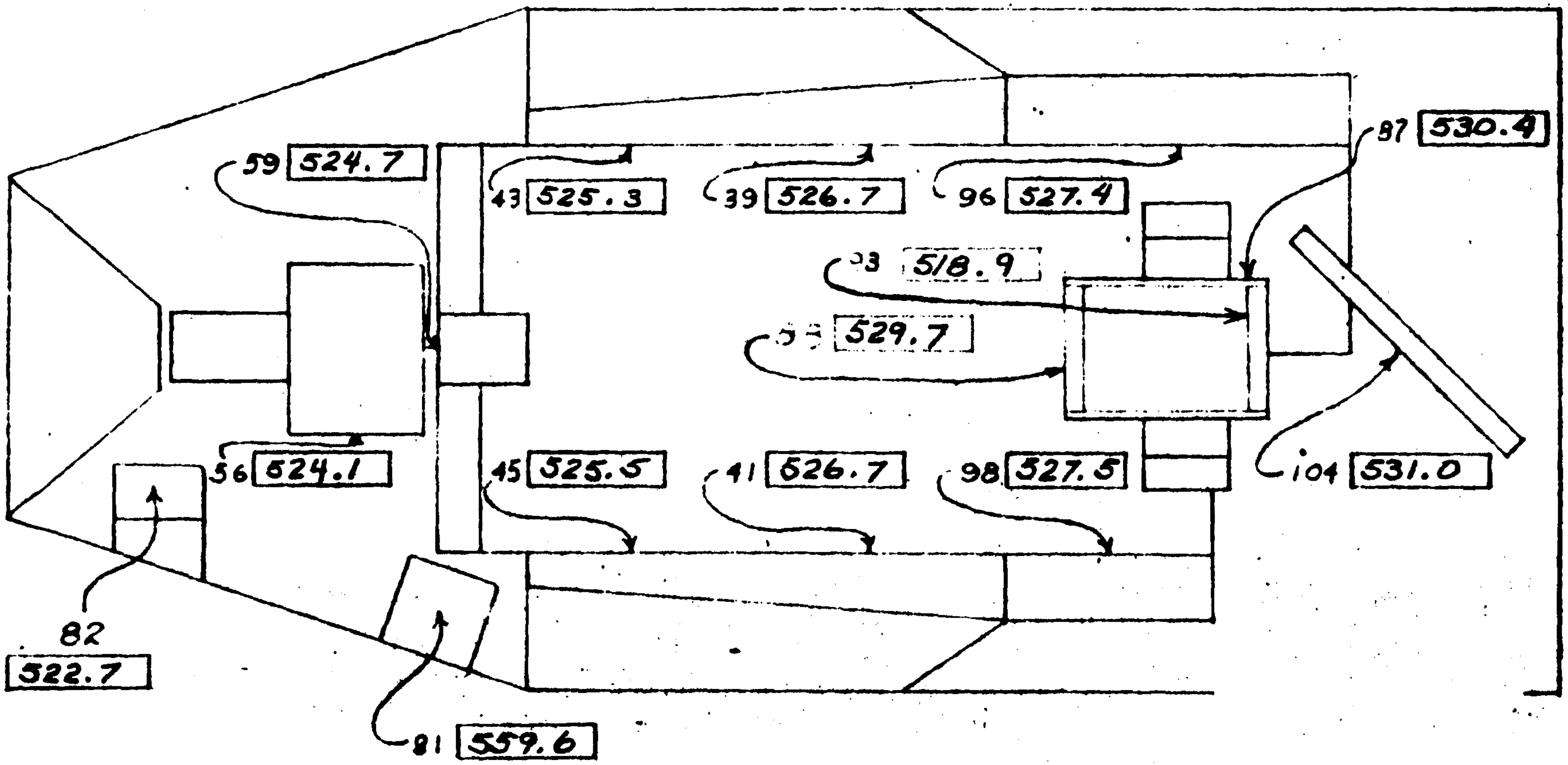
FIGURE 3 PREDICTED TEMPERATURE DISTRIBUTION SCHEMATIC OF SELECTED NODES

RUN 703
BETA ANGLE = 18°
DUTY CYCLE = 4 MIN
SURFACE PROPERTIES

GOLD $\frac{\alpha}{\epsilon} = \frac{.39}{.15}$

WHITE $\frac{\alpha}{\epsilon} = \frac{.15}{.86}$

[redacted]



[redacted]

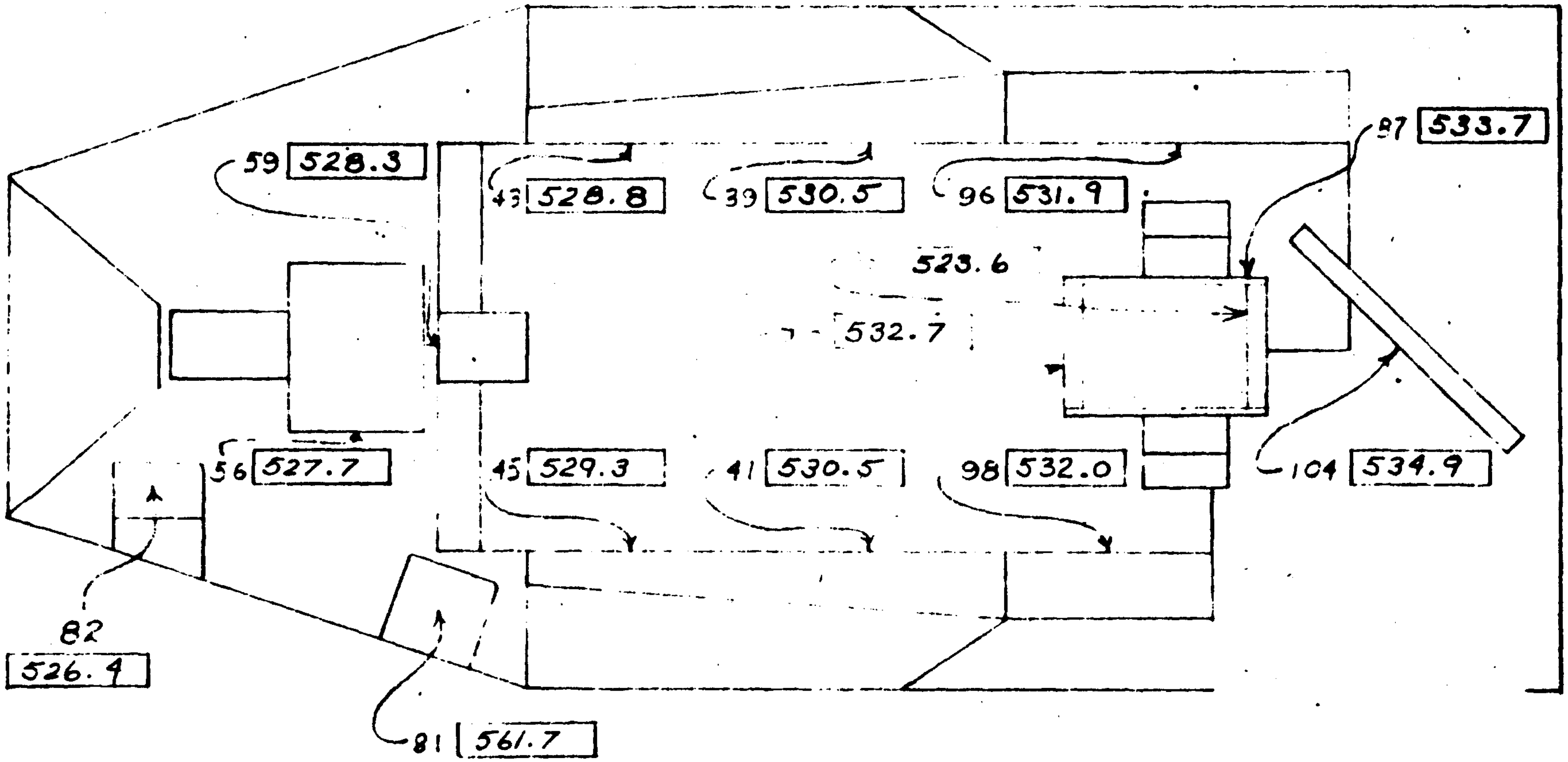
FIGURE 1 PREDICTED TEMPERATURE DISTRIBUTION SCHEMATIC OF SELECTED NODES

RUN 704
BETA ANGLE = 39°
DUTY CYCLE = 4 MIN
SURFACE PROPERTIES

GOLD $\frac{\alpha}{\epsilon} = \frac{.39}{.15}$

WHITE $\frac{\alpha}{\epsilon} = \frac{.15}{.86}$

[redacted]



[redacted]

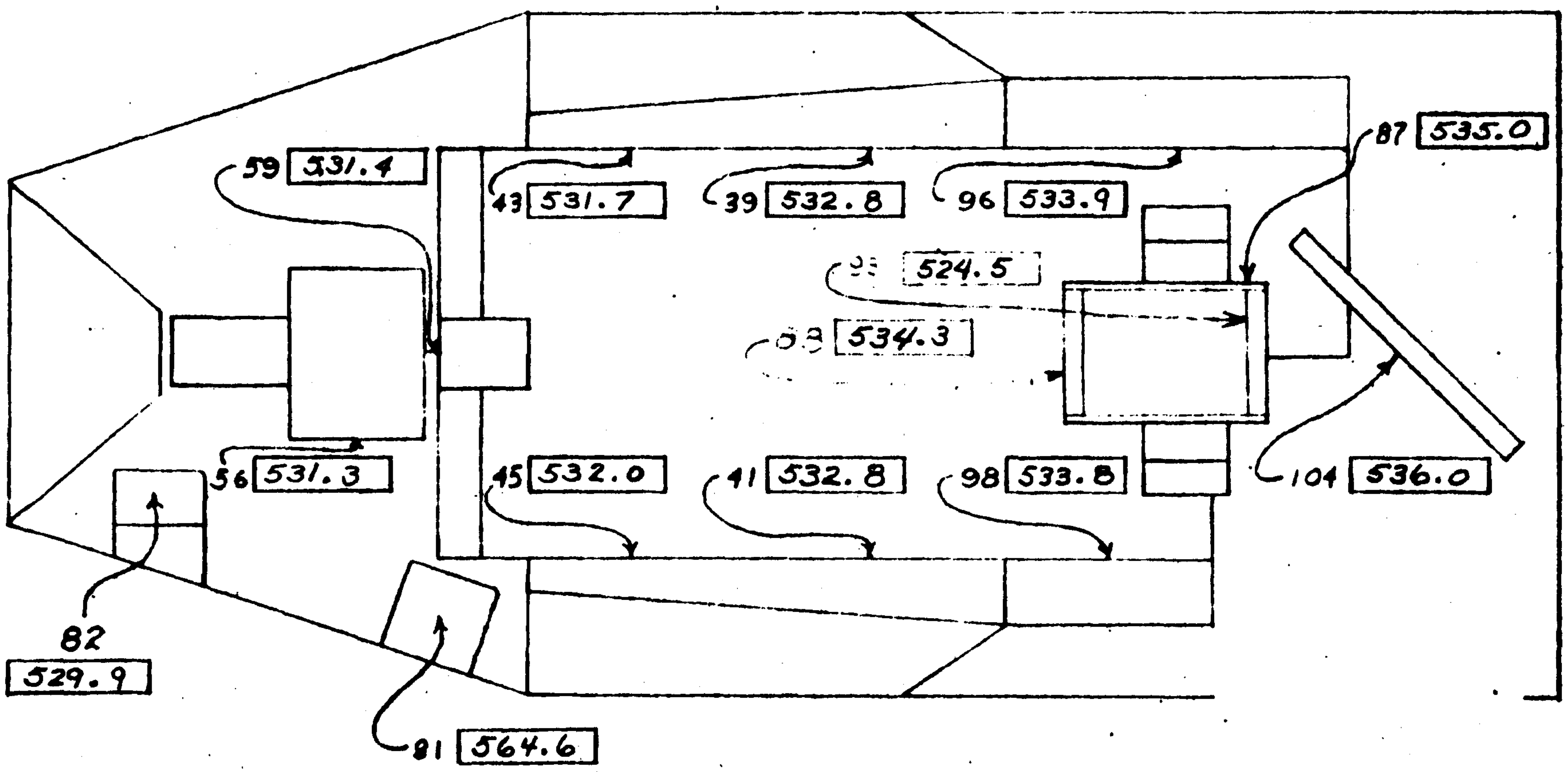
FIGURE 5 PREDICTED TEMPERATURE DISTRIBUTION SCHEMATIC OF SELECTED NODES

Run 705
Beta Angle = 29°
Duty Cycle = 4 min
Surface Properties

Gold $\frac{\alpha}{\epsilon} = \frac{.39 - .03}{.15 - .03}$

White $\frac{\alpha}{\epsilon} = \frac{.15 + .07}{.86 + .02}$

[redacted]



[redacted]

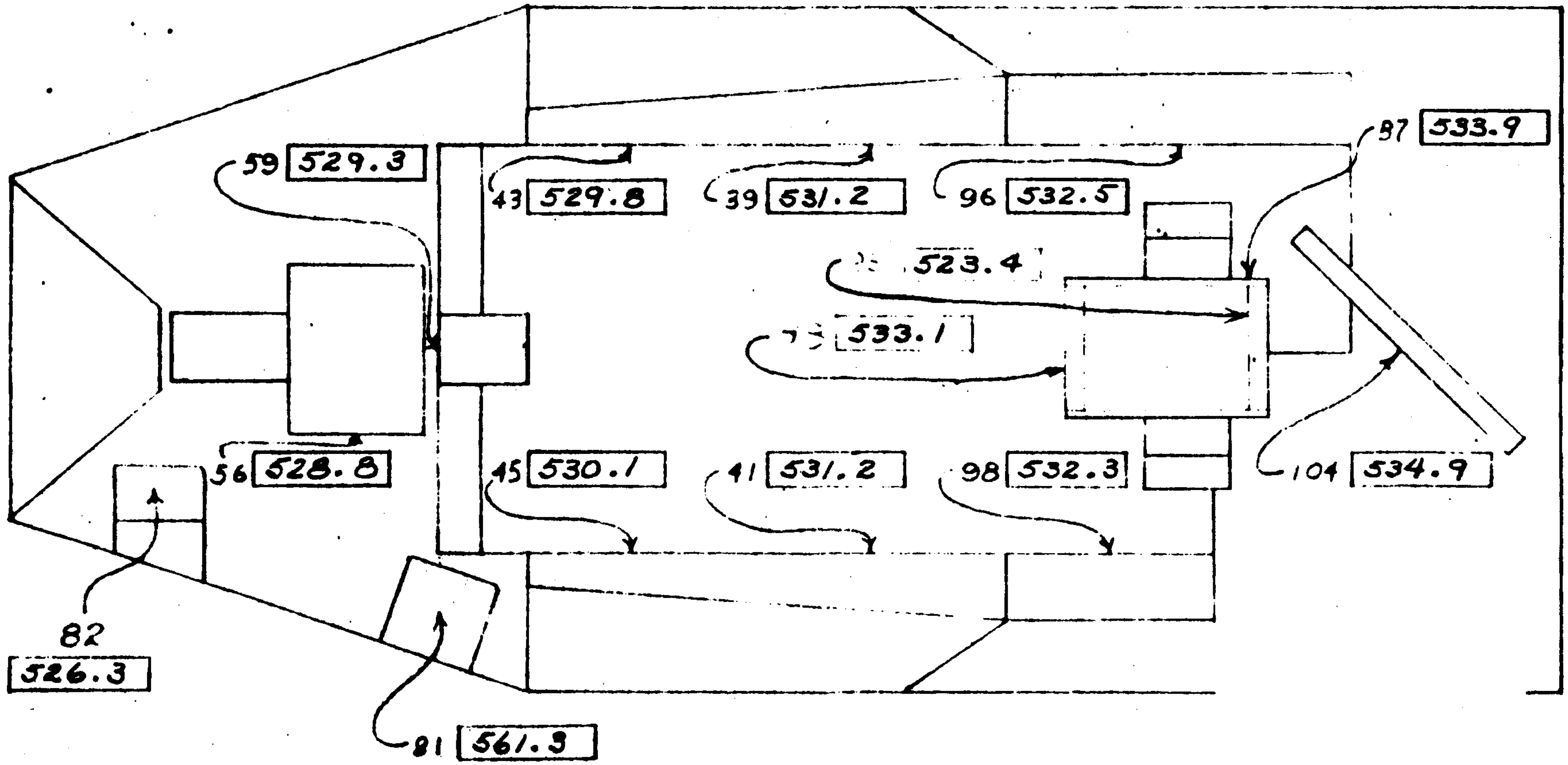
Figure 6 Predicted Temperature Distribution Schematic of Selected Nodes

[redacted]

RUN 706
BETA ANGLE = 29°
DUTY CYCLE = 4 MIN
SURFACE PROPERTIES

GOLD $\frac{\alpha}{\epsilon} = \frac{.39+.07}{.15+.03}$

WHITE $\frac{\alpha}{\epsilon} = \frac{.15-.03}{.86-.02}$



[redacted]

FIGURE 7 PREDICTED TEMPERATURE DISTRIBUTION SCHEMATIC OF SELECTED NODES

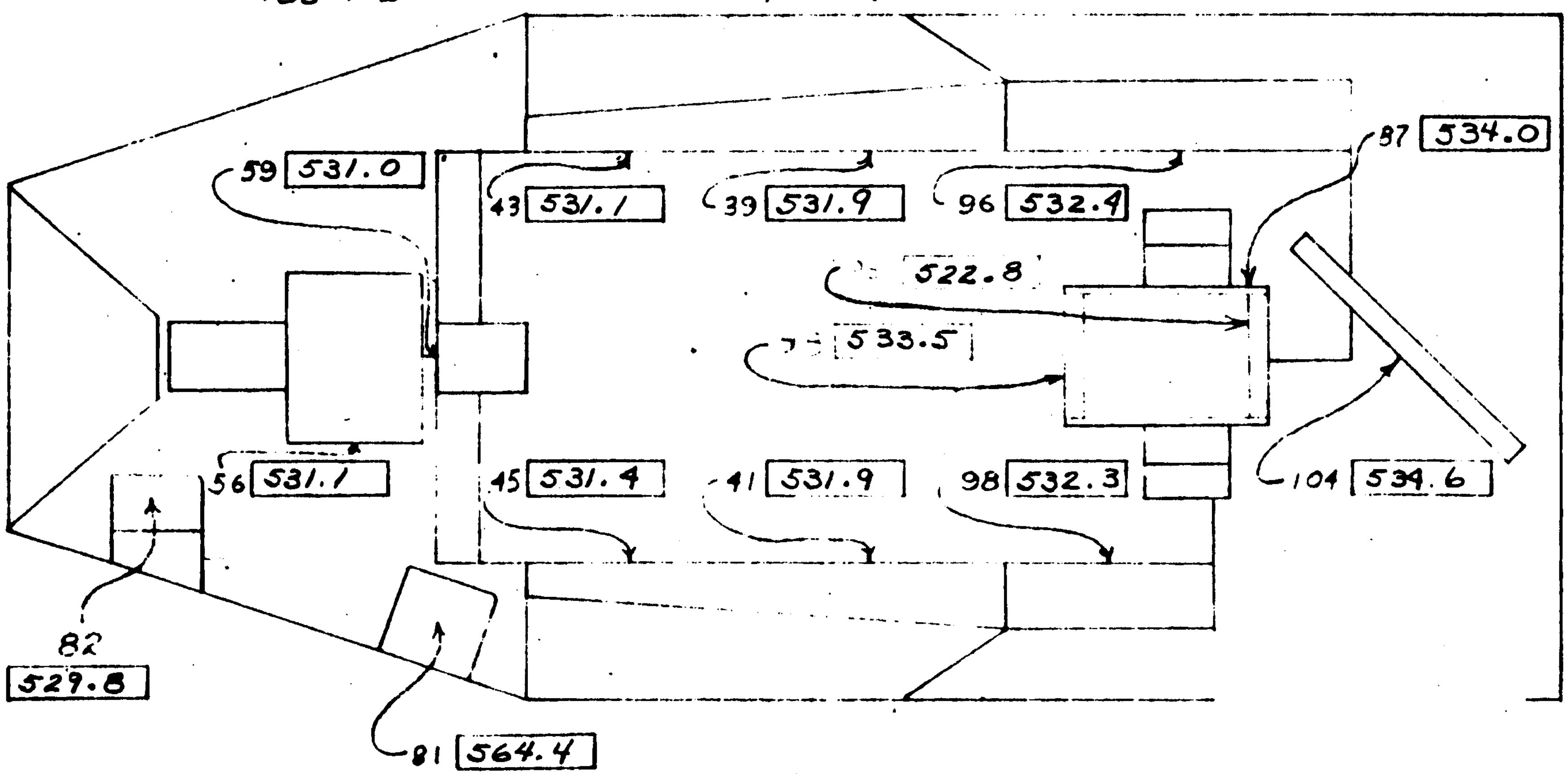
SECRET

RUN 707
BETA ANGLE = 29°
DUTY CYCLE = 4 MIN
SURFACE PROPERTIES

GOLD $\frac{\alpha}{\epsilon} = \frac{.39+.07}{.15+.03}$

WHITE $\frac{\alpha}{\epsilon} = \frac{.15+.07}{.86+.02}$

[redacted]



[redacted]

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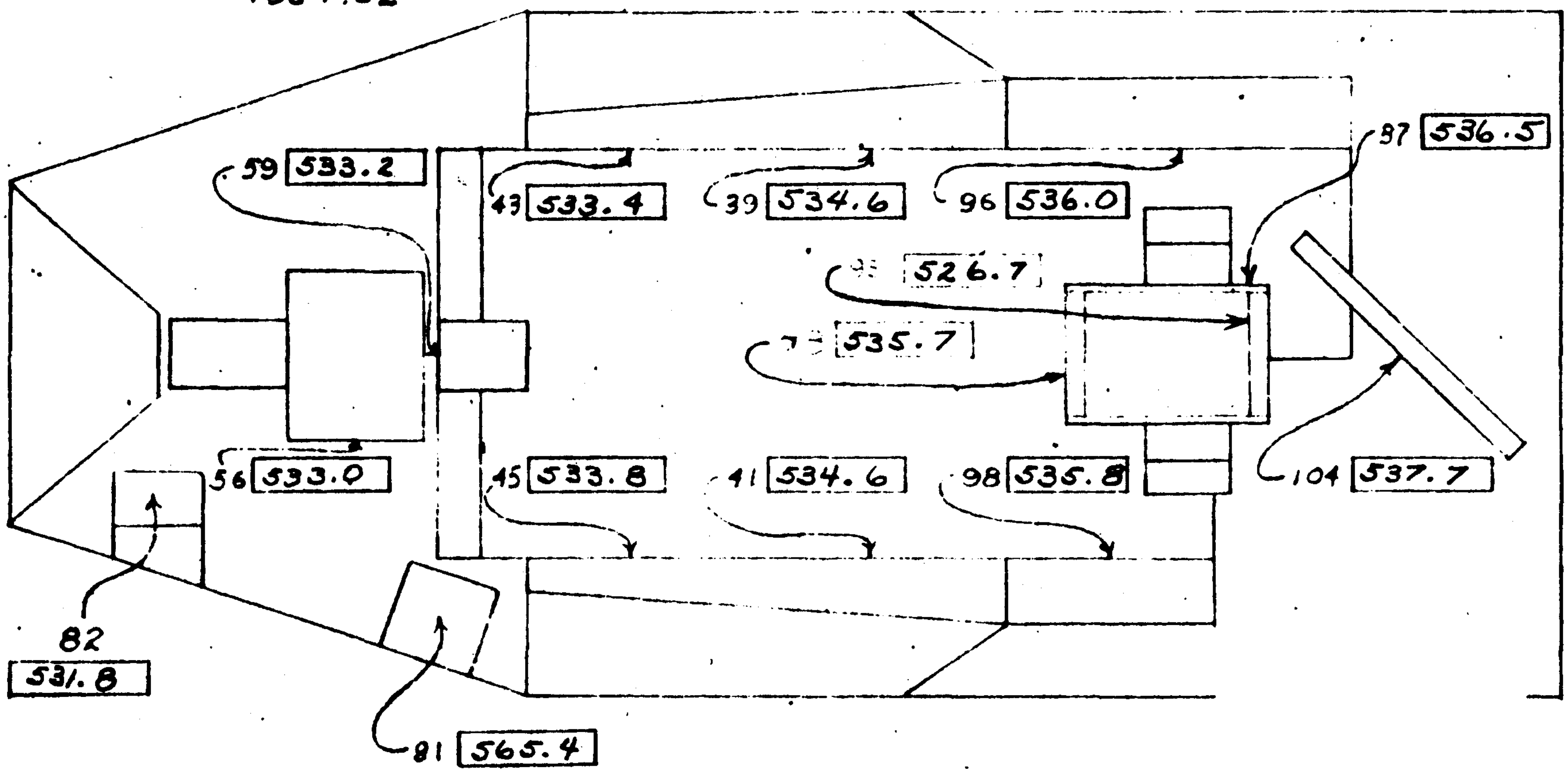
FIGURE 8 PREDICTED TEMPERATURE DISTRIBUTION SCHEMATIC OF SELECTED NODES

[redacted]

RUN 708
BETA ANGLE = 39°
DUTY CYCLE = 4 MIN
SURFACE PROPERTIES

GOLD $\frac{\alpha}{\epsilon} = \frac{.39-.03}{.15-.03}$

WHITE $\frac{\alpha}{\epsilon} = \frac{.15+.07}{.86+.02}$



[redacted]

FIGURE 9 PREDICTED TEMPERATURE DISTRIBUTION SCHEMATIC OF SELECTED NODES

[redacted]

RUN 7.09
BETA ANGLE = 39°
DUTY CYCLE = 12 MIN
SURFACE PROPERTIES

GOLD $\frac{\alpha}{\epsilon} = \frac{.39 - .03}{.15 - .03}$

WHITE $\frac{\alpha}{\epsilon} = \frac{.15 + .07}{.86 + .02}$

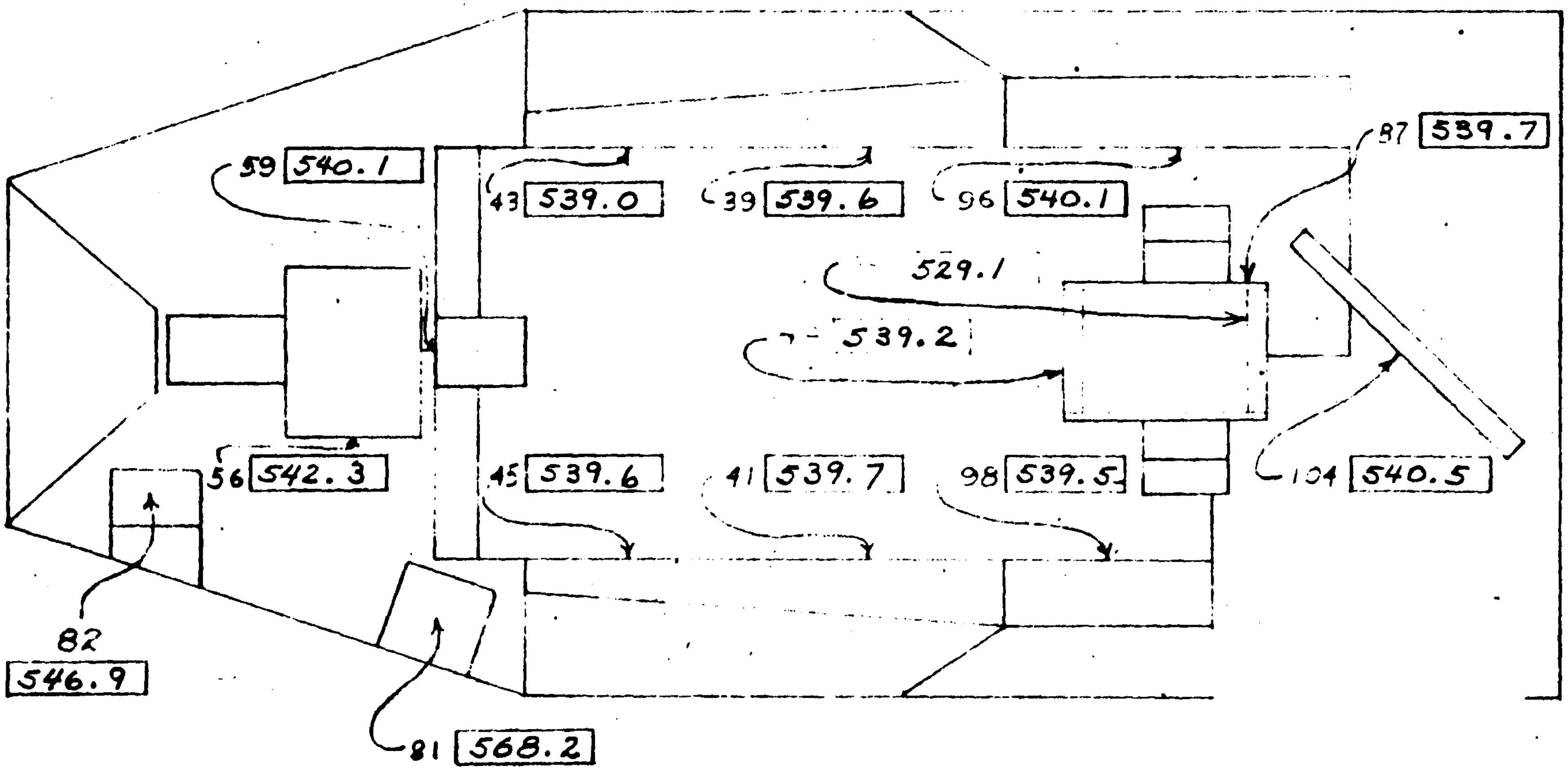


FIGURE 10 PREDICTED TEMPERATURE DISTRIBUTION SCHEMATIC OF SELECTED NODES

[redacted]

[redacted]

RUN · 710
BETA ANGLE = 29°
DUTY CYCLE = 0 MIN
SURFACE PROPERTIES

GOLD $\frac{\alpha}{\epsilon} = \frac{.39}{.15}$

WHITE $\frac{\alpha}{\epsilon} = \frac{.15}{.86}$

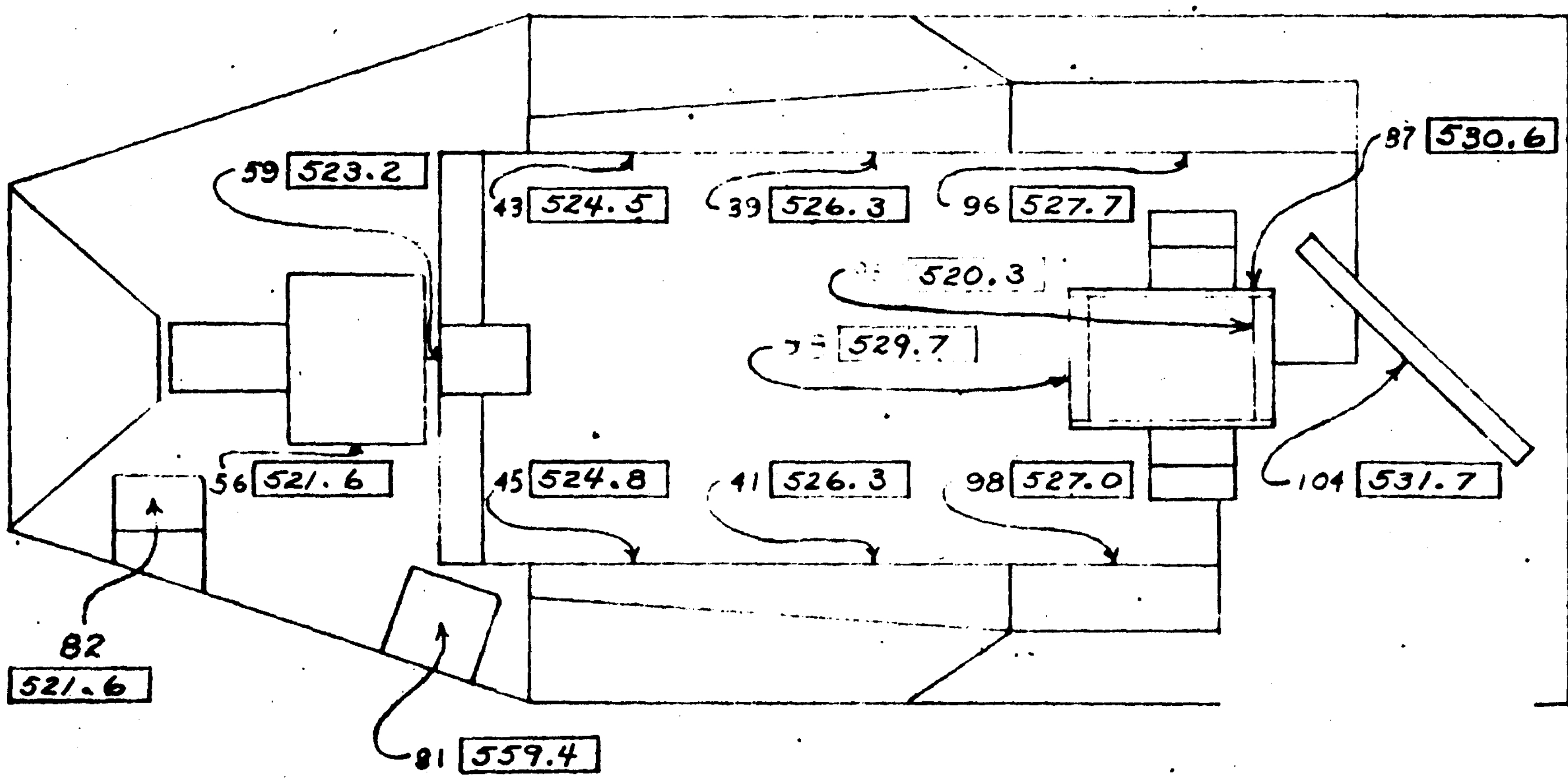


FIGURE 11 PREDICTED TEMPERATURE DISTRIBUTION SCHEMATIC OF SELECTED NODES

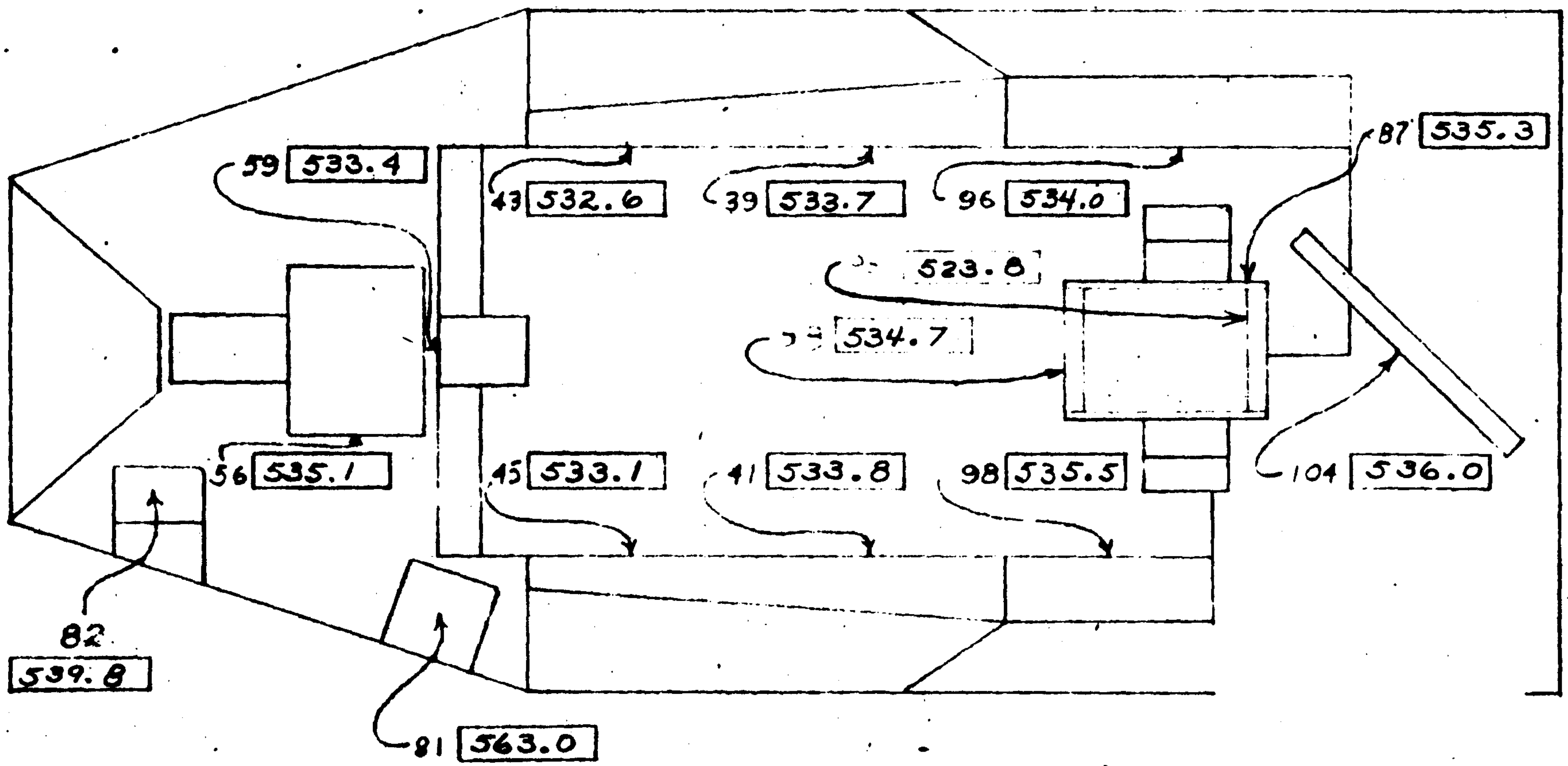
[redacted]

[redacted]

RUN 711
BETA ANGLE = 29°
DUTY CYCLE = 12 MIN
SURFACE PROPERTIES

GOLD $\frac{\alpha}{\epsilon} = \frac{.39}{.15}$

WHITE $\frac{\alpha}{\epsilon} = \frac{.15}{.86}$



[redacted]

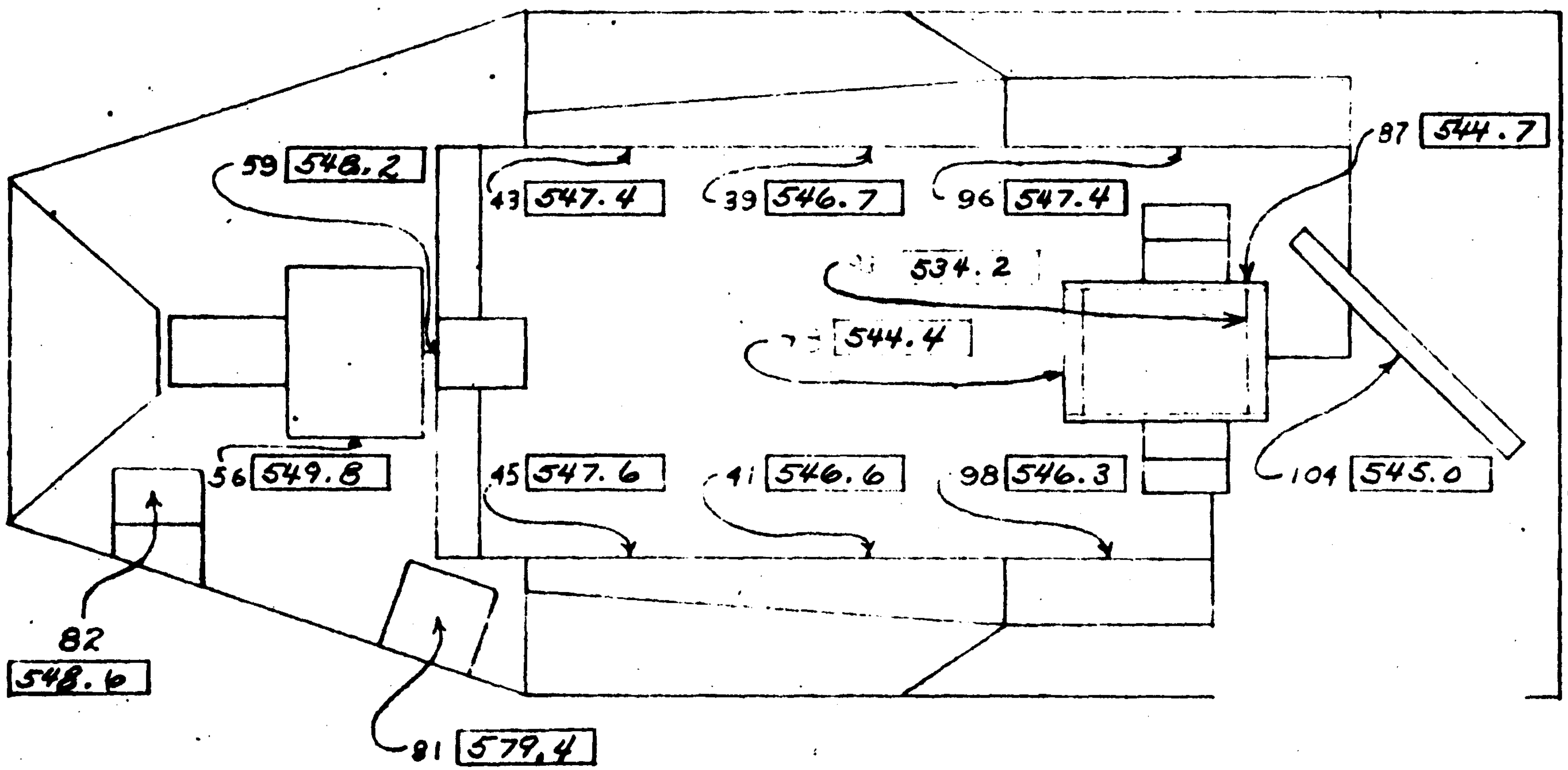
FIGURE 12 PREDICTED TEMPERATURE DISTRIBUTION SCHEMATIC OF SELECTED NODES

[redacted]

RUN 714
BETA ANGLE = 29°
DUTY CYCLE = 4 MIN
SURFACE PROPERTIES

GOLD $\frac{\alpha}{\epsilon} = \frac{.39+.07}{.15-.03}$

WHITE $\frac{\alpha}{\epsilon} = \frac{.15+.07}{.86-.02}$



[redacted]

FIGURE 13 PREDICTED TEMPERATURE DISTRIBUTION SCHEMATIC OF SELECTED NODES

[redacted]

RUN 7/5
BETA ANGLE = 29°
DUTY CYCLE = 4 MIN
SURFACE PROPERTIES

GOLD $\frac{\alpha}{\epsilon} = \frac{.39 - .03}{.15 + .03}$

WHITE $\frac{\alpha}{\epsilon} = \frac{.15 - .03}{.86 + .02}$

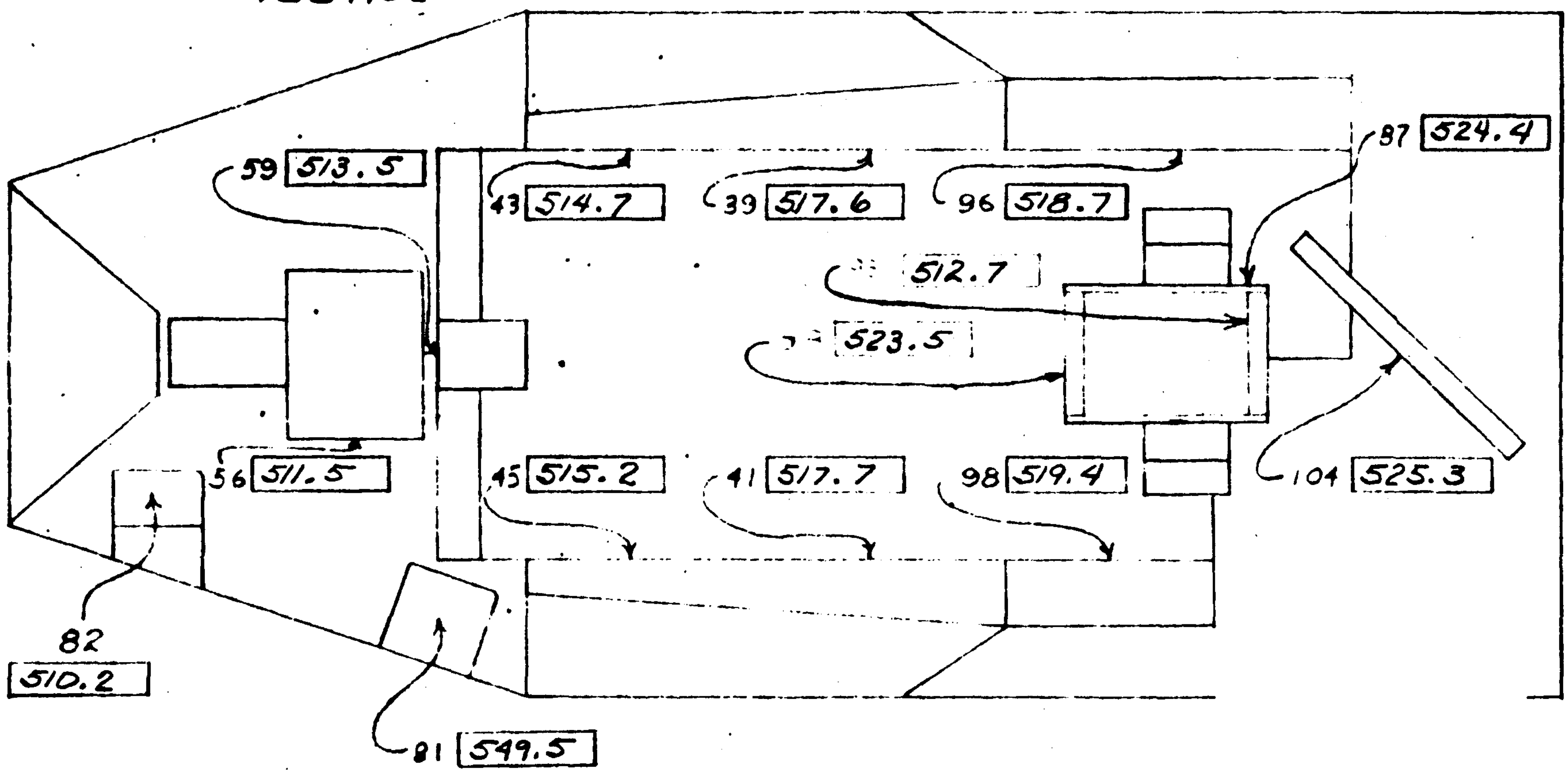


FIGURE 14 PREDICTED TEMPERATURE DISTRIBUTION SCHEMATIC OF SELECTED NODES

[redacted]

[redacted]

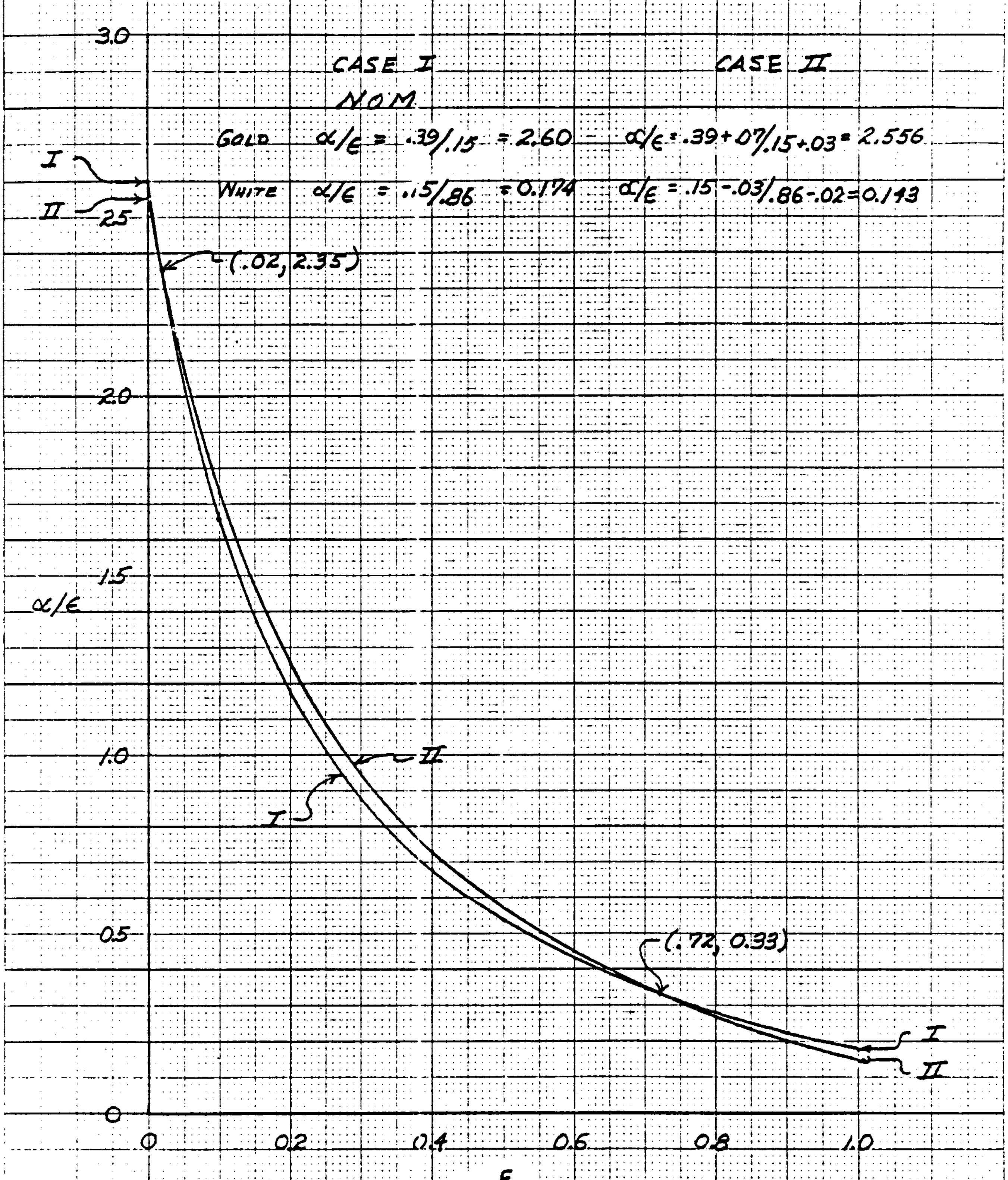


FIG. 15 COMPOSITE ABSORPTIVITY TO EMISSIVITY RATIO VERSUS THE FRACTION OF WHITE PAINT

[redacted]