SPACE STATION THERMAL CONTROL SURFACES

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FOREWORD

This interim report describes results of the first six months of a study on Contract NAS 8-32637, "Space Station Thermal Control Surfaces." The contract was initiated on 4 August 1977 as a 6-month study to assess the deficiencies between the state of the art in thermal-control surface technology and that which would be required for both a 25-kW power module and a 25-year-mission space station.

The Scope of Work of the contract has been modified to include additional emphasis on Task 1, "Requirements Analysis," and the period of performance will be extended for an additional eight months of effort. The final report is being deferred until the end of the extended period of performance.

This report covers the period of 4 August 1977 to 4 February 1978, and is submitted in two volumes. The literature search and survey portion of this study are contained in Volume II.

This study was performed by personnel of Aerojet ElectroSystems Company, for the Space Sciences Laboratory of NASA-Marshall Flight Center.

Study Manager for the program was Carl R. Maag. Principal contributors to the program were C. R. Maag, J. M. Millard, and M. T. Grenier. The NASA technical monitor for the study is Mr. Donald Wilkes. Mr. Rauol Lopez acted as technical advisor for the 25-kW power module. Both Messrs. Wilkes and Lopez made significant contributions to the study through enlightening discussions with the author. Their interest and assistance are greatly appreciated.

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Section 1

INTRODUCTION AND PROGRAM DESCRIPTION

1.1 INTRODUCTION

The U.S. space program goals for long-duration manned missions place particular demands on thermal-control systems. NASA's plans for space stations in low earth orbit (LEO) and geosynchronous earth orbit (GEO) will require performance from these systems far beyond their presently proven capabilities. These systems will be used in the integral and staging support of such important missions as space power generation, space industrialization, solar systems explorations, search for extraterrestrial intelligence, and global service systems operations. The importance of these efforts points up the need for assuring that the thermal-control technology will be available when the design of these stations is maturing.

NASA plans for a space power module to be operational in the 1980s. In order to provide energy for functions such as life support, space manufacturing, experimentation, and communications, as well as power transmission to other space vehicles and stations, this first-generation space power station would have to rely upon existing technology to meet schedule restraints. Operation would be relatively simple, with a solar array (perhaps in the 20 to 100 kW class) providing energy as electricity directly, or in stored form available through docking. Operations would be in LEO, and might involve a fleet of power platforms. Fixed, over-sized radiators would probably be used for thermal control on these stations.

In the 1990s, advanced space power stations in the 100s of kilowatts range could be realized. Power-generation systems in these stations would probably include very large solar arrays, or, possibly, solar thermal techniques with rotating machinery using the Brayton cycle. The thermal-control systems might be implemented with radiators having long-life coatings or panels that could be easily replaced when required. Toward the end of the century, as more long-term (25 years) habitats become feasible, thermal-control technology will have to make corresponding advancements.

1.2 PROGRAM DESCRIPTION

1.2.1 Objectives

This study program will develop plans which are based on the present thermal-control technology, and which will assure that this vital field keeps pace with the other space program elements. The plans provide for the development, as they are required, of thermal-control surfaces meeting the full range of expected environments. Good systems management and funding constraints, however, dictate that the number of different future thermal-control systems be kept to a minimum. This goal can be accomplished if the plans promote commonality between systems, and flexibility to accommodate variations in payload design. The approach undertaken to meet the objectives was to perform three technical tasks: requirements analysis, technology assessment, and program planning.

1.2.2 Program Tasks

a. Task 1 -- Requirements Analysis

This task has three objectives: (1) to define the thermal-control-surface requirements for both space station and 25-kW power module, (2) to analyze the missions, and (3) to determine the thermal-control-surface technology needed to satisfy both sets of requirements.

Utilizing mission planning documents, the radiator design and thermal-control-surface requirements will be analyzed, taking into consideration parameters such as thermal-coating degradation, vehicle attitude, self eclipsing, variation in solar constant, albedo, and earth emission. After determining the requirements for realistic environmental control, a technology roadmap will be developed which satisfies these requirements.

b. Task 2 -- Technology Assessment

This task also has three objectives (1) to perform a literature/industry survey on thermal-control surfaces, (2) to compare current technology with the requirements developed in Task 1, and (3) to determine what technology advancements are required for both the space station and the 25-kW power module.

Both a literature search and an industry survey will be conducted. The literature search will include a comprehensive review of the relevant literature published after 1 January 1964, and will be conducted using the most up-to-date techniques. The literature search will be for material identifying and defining thermal-coatings research and development, contamination control, and in-orbit servicing under a space environment. Primary concentration will be on programs proposed for NASA missions, although, as time permits, the experiences of other Federal Government Agencies (in particular the Department of Defense) will be added for completeness.

To supplement the search, an industry survey will be conducted using two modes of data collection: (1) direct telephone contact, and (2) personal visits. The following sources of information will be contacted: (1) NASA centers, (2) principal investigators, (3) members of the academic and scientific community who have been major contributors and advisors on past NASA programs, and (4) other scientific and aerospace companies whose major business is supplying state-of-the-art thermal-control surfaces for spaceborne NASA missions. Within budget and schedule limits, decision makers at key installations in the Department of Defense will also be contacted to broaden the survey base and make it as comprehensive as possible.

In addition, the current state-of-the-art technologies of passive thermal-control surfaces will be compared to determine what additional technologies are required for the space station and (as a first priority) the 25-kW power module.

c. Task 3 -- Program Planning

Advanced development plans will be formulated that define new initiatives and/or program augmentations for development and testing areas required to provide the proper environmental control for the space station and the 25-kW power module.

Section 2

DETAILED PROGRESS REPORT

2.1 REQUIREMENTS ANALYSIS

The analysis portion of this study has dealt with defining, sizing, and evaluating active, thermal-control radiator systems for space stations in the low earth orbit (LEO) environment. This includes evaluation of their degraded performance with time and end of life (EOL) thermal considerations. The study has been multiphase in nature, following general proposed program directions and specific directives reached as a result of discussions with project office technical personnel and technical interchange meetings.

Initially, this study has resulted in a definition of heat-rejection requirements, geometry, orbital constraints, potential degradation effects, and environmental considerations. In addition, two computer programs have been developed which provide a preliminary design and evaluation tool for active radiator systems in LEO. One program was developed as a general program for space station analysis. The other program was specifically tailored to provide an analysis tool for the 25-kW power module. The power module program has been subsequently used in degradation (EOL) and radiator sizing analyses for the module.

This report will present the results of the study including general conclusions regarding space station active thermal-control radiator system environments and constraints, details of both computer programs developed including operation and listing, and the results of computer analyses performed.

2.1.1 Analysis

In the beginning of the study it was necessary to find a set of constraints to work within with respect to thermal orbital considerations such as dissipative heat loads, orientations, altitudes, inclinations, radiator geometry, degradation, and fluid systems. This would allow a meaningful direction to be taken with respect to actual radiator analysis. Researching References 1 through 5 provided the necessary insight to develop a general definition of thermal constraints and ranges on pertinent parameters. This would allow a realistic approach to analysis of space station active radiator requirements and environment. Before discussing these considerations, it should be noted that these initial findings provided the basis for the decision to develop analytical tasks such as computer programs instead of conducting a study of parameters affecting radiator design. Because of the number and range of parameters involved, such a study would be enormous. Insufficient detail would be provided for many parameters, making the results of little probable practical use. A rigorous computer program, however, could provide sufficient meaningful detail in any area of interest and would be of great practical use as an analytical tool.

2.1.2 Definition of Thermal Orbital Considerations

Based upon the researching of space station thermal-design considerations from previous studies, and AESC's experience in passive radiator design, it was felt that a set of general, active—radiator design constraints should be adopted, recommended, and utilized in development of the computer programs. Constraints or parameter ranges have been specified with respect to fluid control systems, altitude, orbit inclination, geometry, orientation, dissipative loads, and degradation. All constraints or ranges discussed below have been incorporated into the computer programs.

The fluid-control system chosen for the general space station and power module programs is the bypass type used on the STS and 25-kW power module (References 5 and 6). There are sufficient advantages to such a system, from a functional point of view, to merit its use as a general system approach to the flow problem. Figure 1 (Reference 6) presents a schematic of such a flow system.

Temperature control of the coolant is accomplished by simple bypass of the radiators. A flow-control valve diverts some of the hot flow from the

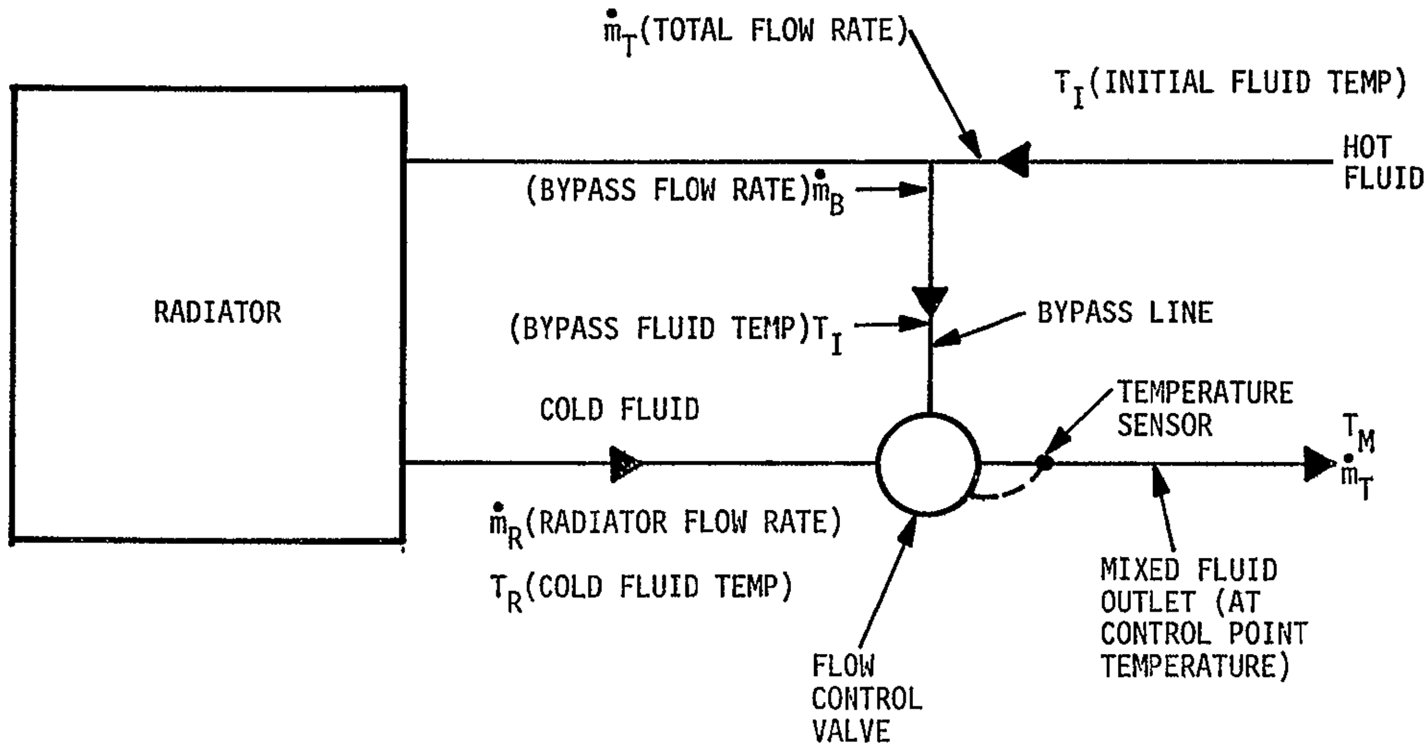


FIGURE 1 RADIATOR TEMPERATURE CONTROL SYSTEM

system to mix with cold flow returned from the radiators. The temperature of the mixed flow is monitored by an electronic controller which commands the valve to regulate the flow to maintain the desired mix temperature. Mathematically, the control concept is by conservation of mass and energy:

$$\dot{m}_T h_M = \dot{m}_R h_R + \dot{m}_B h_B \quad (1)$$

$$\dot{m}_T = \dot{m}_R + \dot{m}_B \quad (2)$$

$$h = \int Cp \; dT \quad (3)$$

Assuming Cp is a constant over the temperature range considered, the following relationship holds:

$$T_M = \frac{\dot{m}_R T_R + \dot{m}_B T_I}{\dot{m}_T} \quad (4)$$

where

T_I = initial hot-fluid temperature

T_R = radiator-outlet temperature

T_M = mixed-outlet temperature

$\dot{m}_R$ = radiator mass flow rate

$\dot{m}_B$ = bypass mass flow rate

$\dot{m}_T$ = total mass flow rate

h = fluid enthalpy

Cp = fluid specific heat

This type of system allows a T_M to be chosen and maintained to ensure there is no potential danger to the system by a varying outlet temperature, such as freezing of water vapor in critical components of the system. Also, the pump may be selected for a single operating speed, allowing it to operate with maximum efficiency at design speed. Choosing a T_M and T_I based upon environmental constraints, and knowing the required heat load to dissipate, the total mass flow rate can be determined for preliminary design from the expression:

$$D = \dot{m}_T \, C_p \, (T_I - T_M) \tag{5}$$

where

D = total heat load to be dissipated from fluid by radiator.

Such a system can operate and maintain a given T_M until radiator heat loads are such that the radiator outlet fluid temperature rises above the T_M value, thus stressing the importance on the degradation of solar absorptance (α_s) on radiator life.

Constraints on altitude and orbit inclination (beta angle) cannot be applied because of the variety of primary mission orbits considered for various tasks. All beta angles (β) between 0 and $\pm$ 90 degrees must be considered (even though most missions lie between $\pm$ 52°), and the limit on altitude is only restricted to LEO conditions. It was decided to consider altitudes between 100 and 1000 nautical miles. Although most planned mission orbits are between 200 and 300 nautical miles, some possible missions range to higher altitudes. This makes 1000 nautical miles a safe upper limit for possible missions and for LEO limitations, allowing use of mean orbital heat-load shape factors for external heat-load calculations.

The assumption made for LEO conditions is that mean orbital temperatures computed from mean orbital heat loads are representative of entire orbital temperatures because of the short orbital periods involved. This assumption would not be valid at synchronous orbits where orbital periods are far longer. At synchronous orbits, orbital variations become important and require transient solution techniques. Thus, assuming LEO conditions, steady-state solutions can be obtained and it is not necessary to imply thermal capacitance values for radiators.

The angle β refers to the inclination of the orbital plane from the solar vector. This angle should not be confused by the term "inclination," which usually refers to the inclined angle of the orbit with respect to the equator. The angle β will be used in this report as it relates most directly to external solar-heat loads.

In the space environment, use must be made of all required and available area which is thermally favorable for radiators. If area is available on module surfaces for radiators it should be used. In space station studies, extended-platform double-sided radiators are used for modules which do not have available surface area, or where the area is insufficient. When module area is sufficient to attach a radiator, one-sided wrap-around radiators are used for additional dissipation requirements (Reference 1). Thus, when station construction begins with just a power module, for example, extended radiators are used. When inhabited modules are added, additional dissipation is controlled by wrap-around radiators using the available module area.

From studies, it appears that this change from extended to wrap-around radiators may not occur until up to approximately 35 kW need to be dissipated. This "break point" in radiator design has been made a variable in the general space station computer program, but such high heat-load capabilities may be needed from extended radiators in space. Studies indicate total dissipative heat loads may exceed 100 kW for space power generating stations. Thus, radiator systems composed of extended and wrap-around radiators must be able to accommodate such total dissipative loads.

All such active radiator systems must be designed to handle not only required dissipative loads but also external heat loads. Under LEO conditions, earthshine (earth radiation) and albedo (solar flux reflected off the earth) must be considered in addition to direct solar input. All three of these external heat inputs are orientation dependent. Under LEO conditions, earthshine and albedo can be the dominant external heat inputs. Being dependent upon the radiator's view of the earth, care must be taken to orient radiators to minimize these inputs whenever possible. Orientations for radiators can often be used which minimize all three external heat inputs, or at least minimize earthshine and albedo without increasing direct solar inputs. Minimizing the combination of earthshine and albedo should be given priority under LEO conditions, over direct solar input if necessary, because of the relative magnitudes attainable at low altitudes. As an example, a flat, extendable radiator which looks directly at the earth in LEO conditions would be unable to operate properly within any realistic environmental temperature ranges because of earthshine input alone. Studies (Reference 5) conducted on the 25-kW power module have resulted in such conclusions already.

Orienting extendable flat radiators in the orbital plane tends to minimize all three external inputs at most probable β angles ($-52^{\circ} \leq \beta \leq 52^{\circ}$), and provides minimal earthshine and albedo for all β angles. Orienting cylindrical wrap-around radiators with the axis pointing toward the earth minimizes albedo and earthshine, while not accentuating direct solar input and provides a minimal solar input for a realistic orientation for most probable β angles. It is recommended that these orientations be used as optimal radiator orientations. They have been incorporated into both computer programs as the orientations used in computing mean external heat-input values.

The degradation of radiator surfaces because of radiation damage and potential contamination is of prime importance in radiator design. Degradation of a surface causes an increase in α_s with time while essentially leaving the emittance (ε) a constant. Thus, direct solar and albedo external heat inputs increase with time causing an ever increasing total heat load for the radiator to accommodate. As this process continues, an ever increasing percentage of coolant flow is diverted through the radiator in order to maintain the mix temperature. Once the external loads have increased to where the radiator has the total coolant flow through it, further degradation will cause a failure of the system to maintain the proper mix temperature. This point in time represents the end of life (EOL) condition, and the absorptance value associated with it determines the amount of degradation a radiator can withstand. The EOL limit on α_s which a radiator can accommodate depends largely on orientation and radiator area. The time on orbit to arrive at an EOL α_s value depends on the rate of degradation (change in absorptance per month).

Another consideration which must be taken into account is an upper limit α_s for which infinite radiator area is required to provide "in spec" cooling because of the high heat fluxes incident. This value is largely dependent upon the thermal requirements of the coolant loop and the orientation of the radiators; the external heat fluxes are largely a function of orientation. This value provides an upper limit to the EOL α_s acceptable for many orientations (α_s for infinite area may be 1.0 for some orientation, β combinations).

An EOL α_s value is the key parameter in radiator design as it determines the life of a radiator system and platform area required. The larger the EOL α_s, the larger the radiator required and the longer it will last. If the desired EOL α_s value turns out to be larger than the α_s value for infinite area, either the orientation must be changed or the task of refurbishing the radiator surface materials on-orbit must be considered.

The most difficult part of determining EOL is determining the rate of degradation. It is straightforward to determine an EOL α_s, but to determine EOL itself is dependent on the rate of degradation. Rates of α_s degradation may vary from 0.0015 (Reference 8) to over 0.01 $\Delta\alpha_s$/month (considered a safe upper limit value) depending on material, exposure to the space radiation environment and volatile condensible material (VCM) contaminants. Contamination is a major contributor to surface degradation.

Coarse estimates on rates of degradation, based upon low-contamination long-term satellite flight experience (Reference 8), can be made if no engine firings occur within the vicinity of the space station. However, a station which is STS tended adds to the analysis complexity by major contamination exposure caused by thruster plumes from the engines. These plumes can easily engulf a large space station. The best way to handle such a problem is to perform a complete contamination analysis on a space station. Such an analysis determines the contributing contaminants and computes their mass deposition rates on all station surfaces as a function of time, taking into account surface source emission, surface re-emission, and thruster plume and vent emission. These mass deposition rates can then be correlated with changes in α_s to determine rates of degradation on surfaces, particularly on radiators.

One of the functions of both computer programs is to provide a solution to the radiator-flow problem as a function of degradation. Changes in radiator and flow performance are computed as a function of time after launch, allowing EOL α_s values to be determined and EOL as a function of degradation rate. Values for α_s for infinite radiator area are also presented and checked against EOL α_s by the programs.

With the above definition of thermal parameters, a general space station computer program was developed to be used as a design tool for the preliminary design of active thermal-control radiators. In addition to this, a second program, similar in nature to the general program, was developed especially for the 25-kW power module to be used as a preliminary design and evaluation tool for its radiator system. These programs will be presented and discussed in detail later in this report. Using the 25-kW power module program, a study has been conducted to evaluate the EOL conditions for the present module configuration as a function of degradation rate and the area required to maintain proper thermal operation for five years.

2.1.3 Power Module EOL Degradation and Area Requirement Study

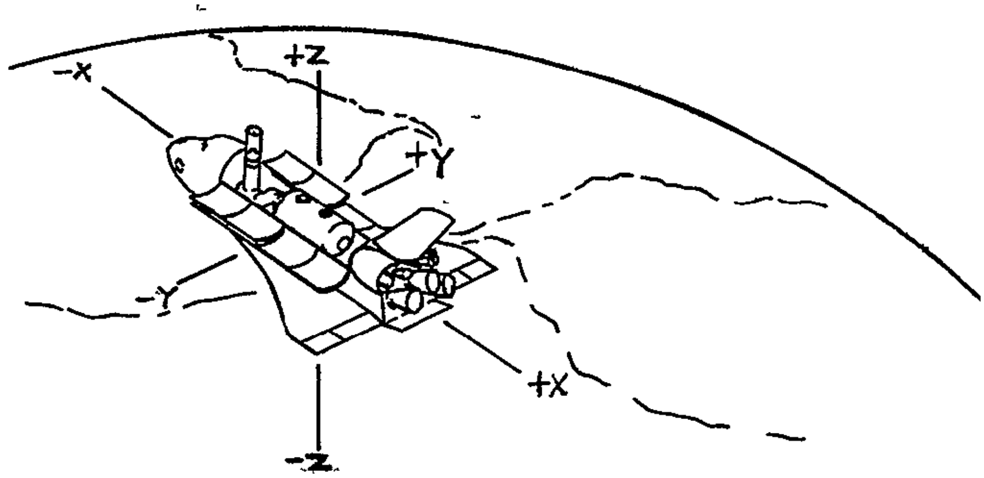
As a result of the technical interchange meeting and subsequent discussions with the project office technical personnel, a study has been performed to evaluate the EOL conditions for the present 25-kW power module configuration as a function of degradation rate (linear rate of α_s increasing with time). In addition, an evaluation of the area required to sustain "in spec" operating conditions for five years has been completed.

The study was conducted evaluating a white paint (initial $\alpha_s = 0.15$, $\varepsilon = 0.88$) and silvered Teflon (2 mil, initial $\alpha_s = 0.07$, $\varepsilon = 0.76$) as radiator materials. Orbital parameters chosen were those of primary mission, with $\beta = 78.5^o$ and altitude equal to 235 nautical miles. The radiator control system was to maintain a mix temperature of 40^oF, a mass flow rate of 3000 lbm/hr, and an inlet temperature of 95^oF while dissipating 12 kW as a heat load. It was assumed all four radiators were used, with a combined area of 634 ft^2. The coolant assumed was Freon 21, with a specific heat of 0.25 BTU/lbm-^oR (References 5 and 7). Tending by the STS was assumed to minimize heat rejection capability to space (view blockage) while increasing dissipation load to a worst case. Orientations considered were the ZPOP XLV (X local vertical) and the ZPOP YPSL (Y perpendicular to the sun line). These orientations were considered because they are the most favorable from a thermal standpoint and therefore would provide the longest EOL time on orbit.

Figure 2 provides a picture of the axis system of the STS and the STS orientations considered for this study, with the module attached. The term "POP" means perpendicular to the orbit plane.

Studies were conducted for rates of degradation ranging from 0.0015 $\Delta\alpha_s$/month to 0.01 $\Delta\alpha_s$/month as an upper bound, considering potential contamination effects.

The key results of the study are presented in Table 1.



STS AXIS SYSTEM

ZPOP XLV ORIENTATION

ZPOP YPSL ORIENTATION

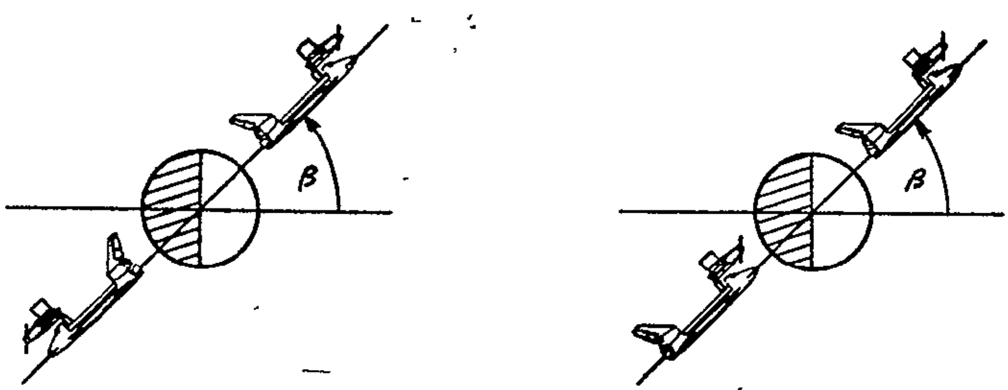


FIGURE 2 STS AXIS SYSTEM AND POWER MODULE PRIMARY ORIENTATIONS CONSIDERED

TABLE 1 POWER MODULE EOL DEGRADATION AND AREA REQUIREMENT STUDY RESULTS

Material	Orientation	Maximum Degradation Rate For Five Year Life ($\Delta\alpha_s$/Month)	α_s Value Requiring Infinite Radiator Platform Area
White Paint $\alpha_s = 0.15$ $\varepsilon = 0.88$	ZPOP XLV	0.0024	0.3780
	ZPOP YPSL	0.0019	0.3415
Silvered Teflon $\alpha_s = 0.07$ $\varepsilon = 0.76$	ZPOP XLV	0.0027	0.3264
	ZPOP YPSL	0.0023	0.2949

The results in the table are presented for the materials considered, the orientations, and the primary mission considerations discussed in the previous paragraphs. The α_s values presented are maximum values allowable. At these values infinite radiator area is required to keep the thermal-control system "in spec"; thus, they define an upper limit to EOL α_s values. These values are largely a function of orbit and orientation. The maximum degradation rates presented are the largest rates allowable to remain "in spec" for five years under the primary mission constraints presented.

Detailed plots of study results for area requirements and radiator lifetime for present area considerations as a function of degradation rate are presented in Figures 3 through 10. Figures 3 through 6, provide charts of radiator life as a function of degradation rate for the materials and orientations considered. Figures 7 through 10 present required radiator platform area for five-year operation (with primary mission constraints) as a function of α_s value at five years. It is clear from these plots that an upper limit α_s

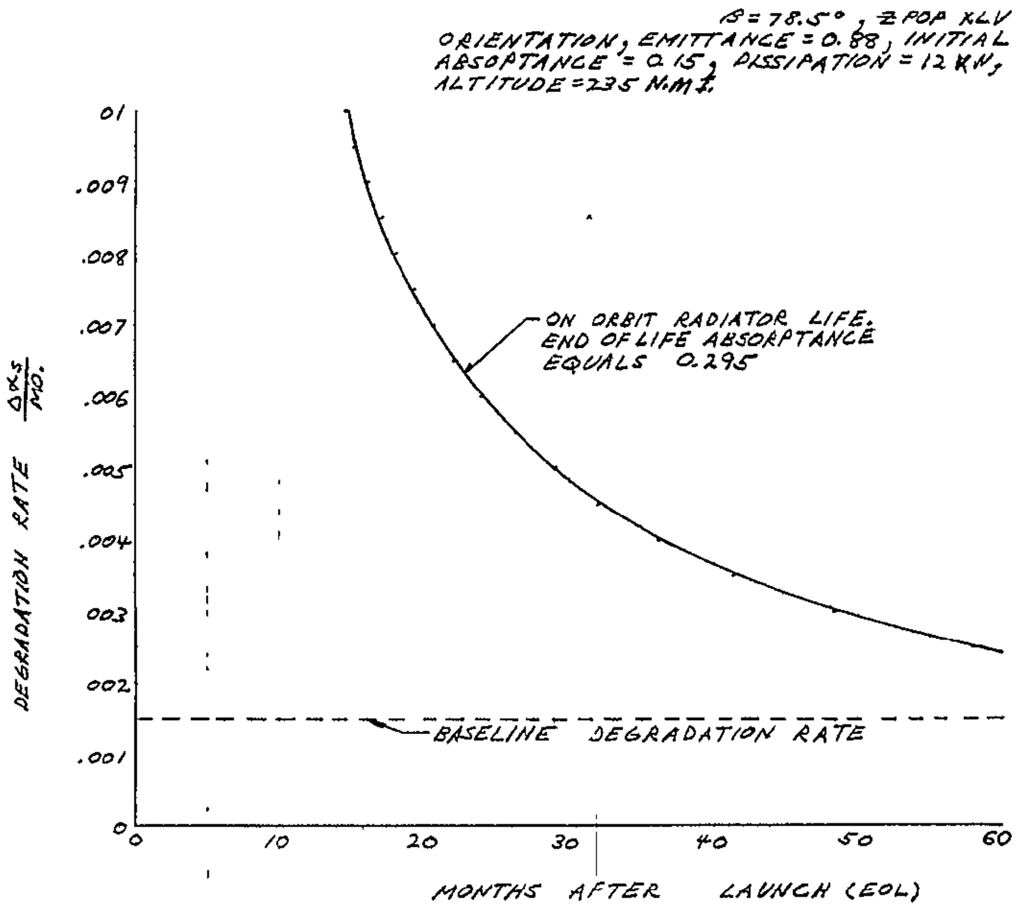


FIGURE 3 DEGRADATION RATE VERSUS LIFE ON ORBIT FOR WHITE PAINT

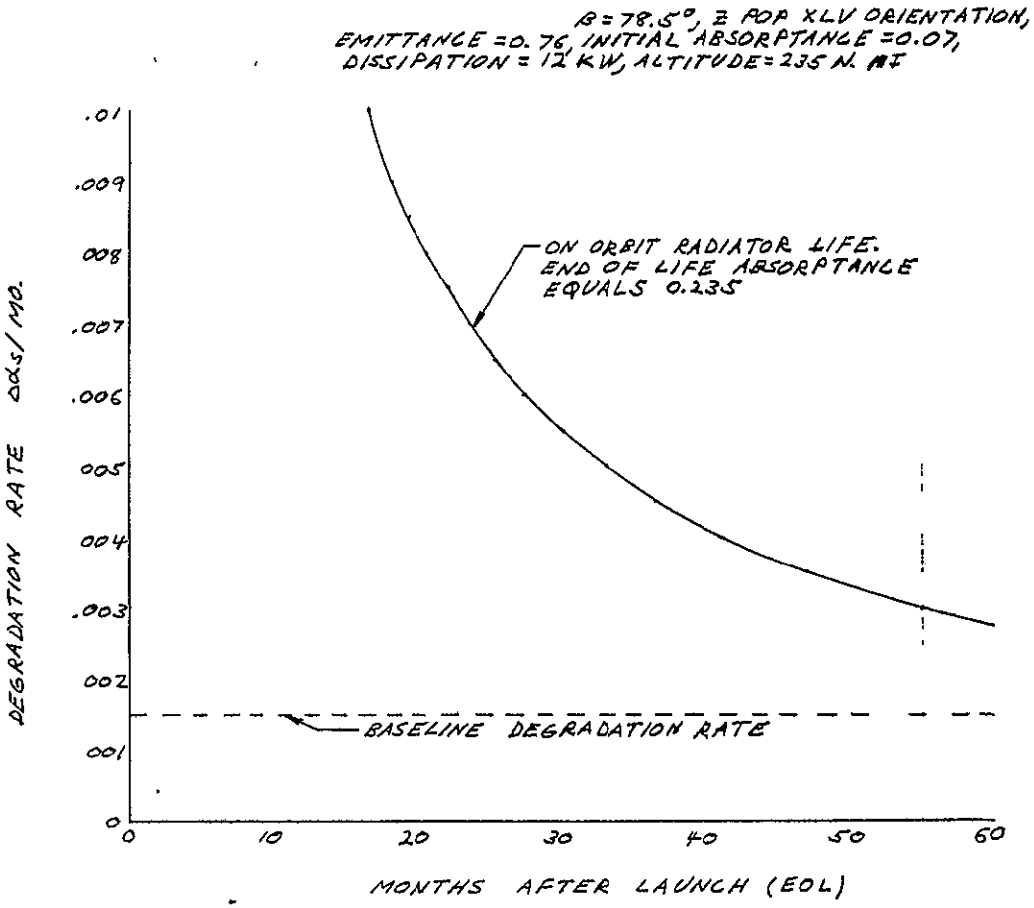


FIGURE 4 DEGRADATION RATE VERSUS LIFE ON ORBIT FOR SILVERED TEFLON

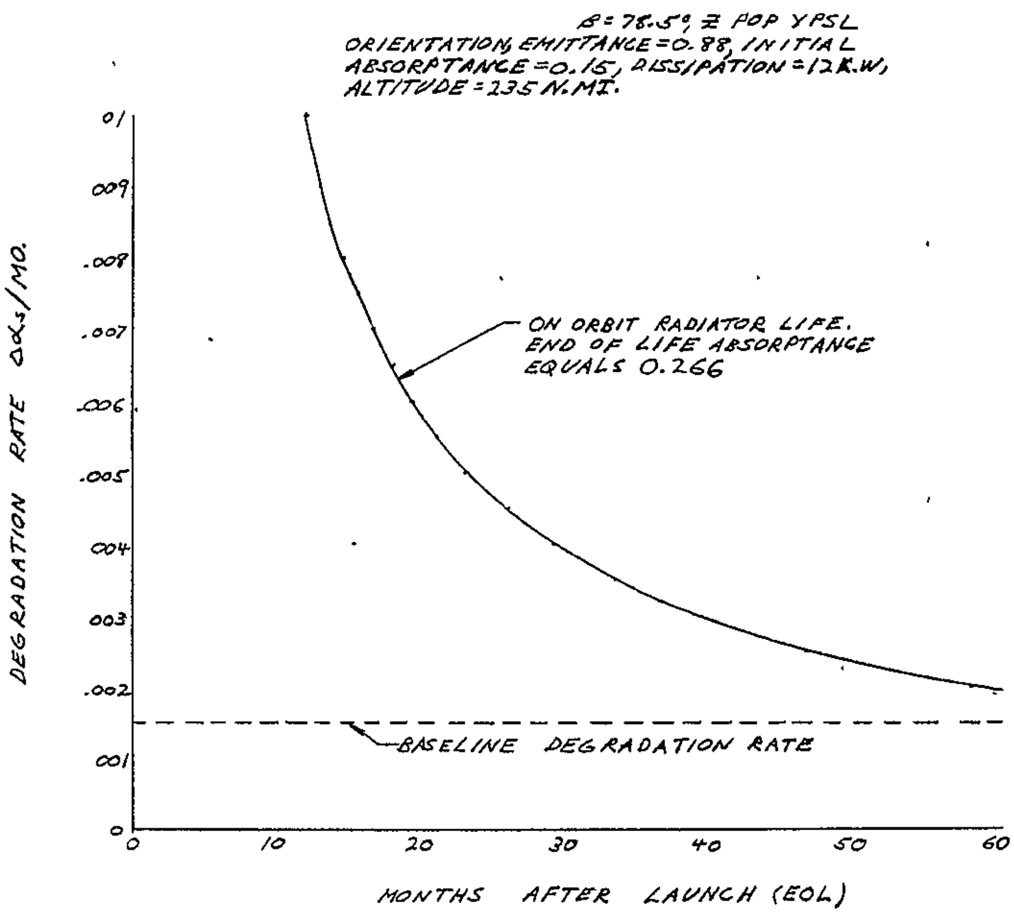


FIGURE 5 DEGRADATION RATE VERSUS LIFE ON ORBIT FOR WHITE PAINT

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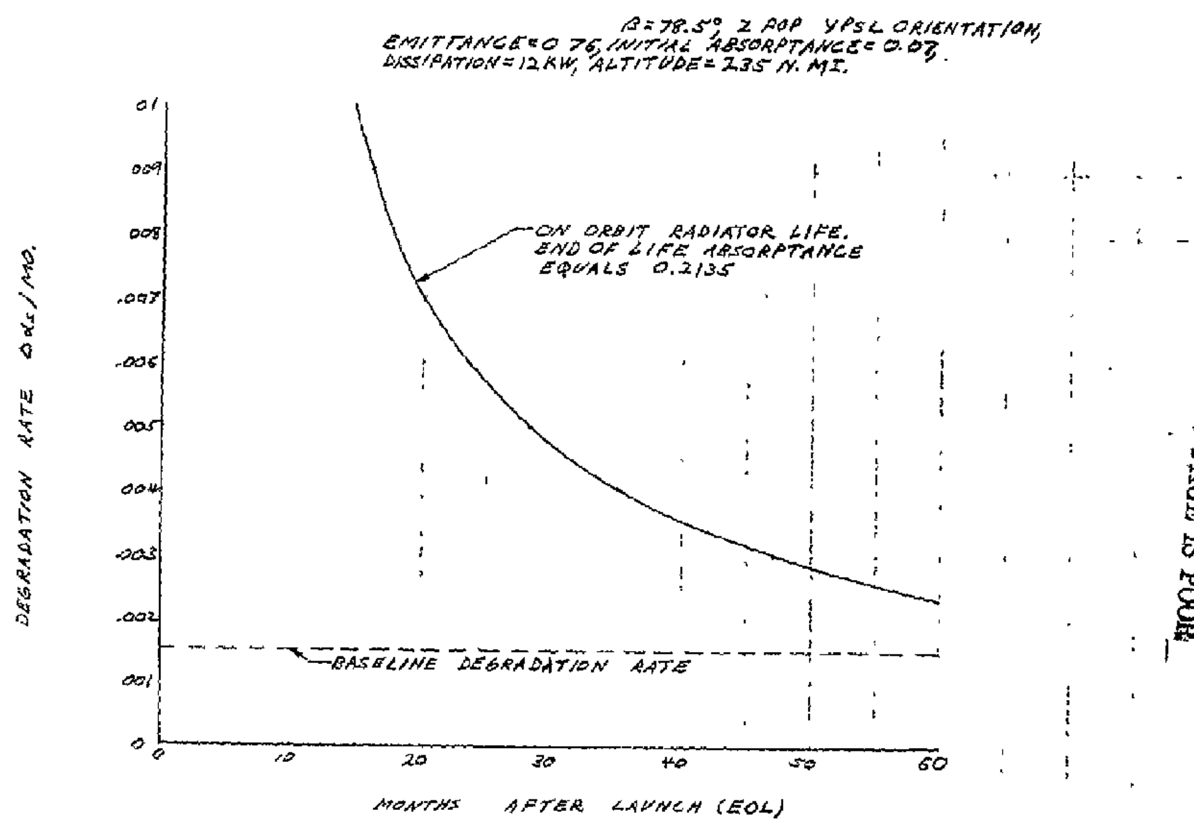

FIGURE 6 DEGRADATION RATE VERSUS LIFE ON ORBIT FOR SILVERED TEFLON

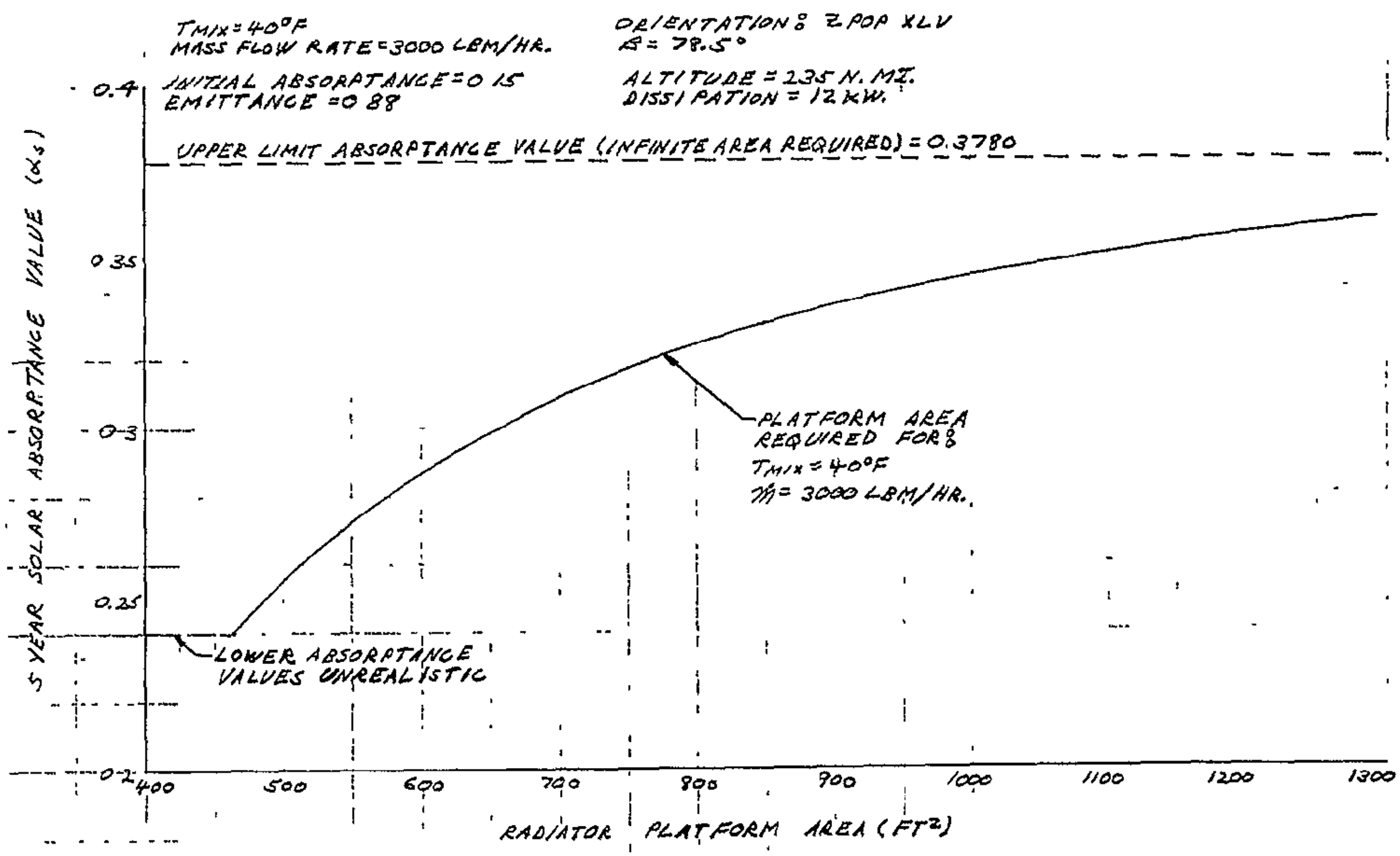

FIGURE 7 RADIATOR MINIMUM PLATFORM AREA REQUIREMENT VERSUS 5-YEAR SOLAR ABSORPTANCE VALUE FOR WHITE PAINT

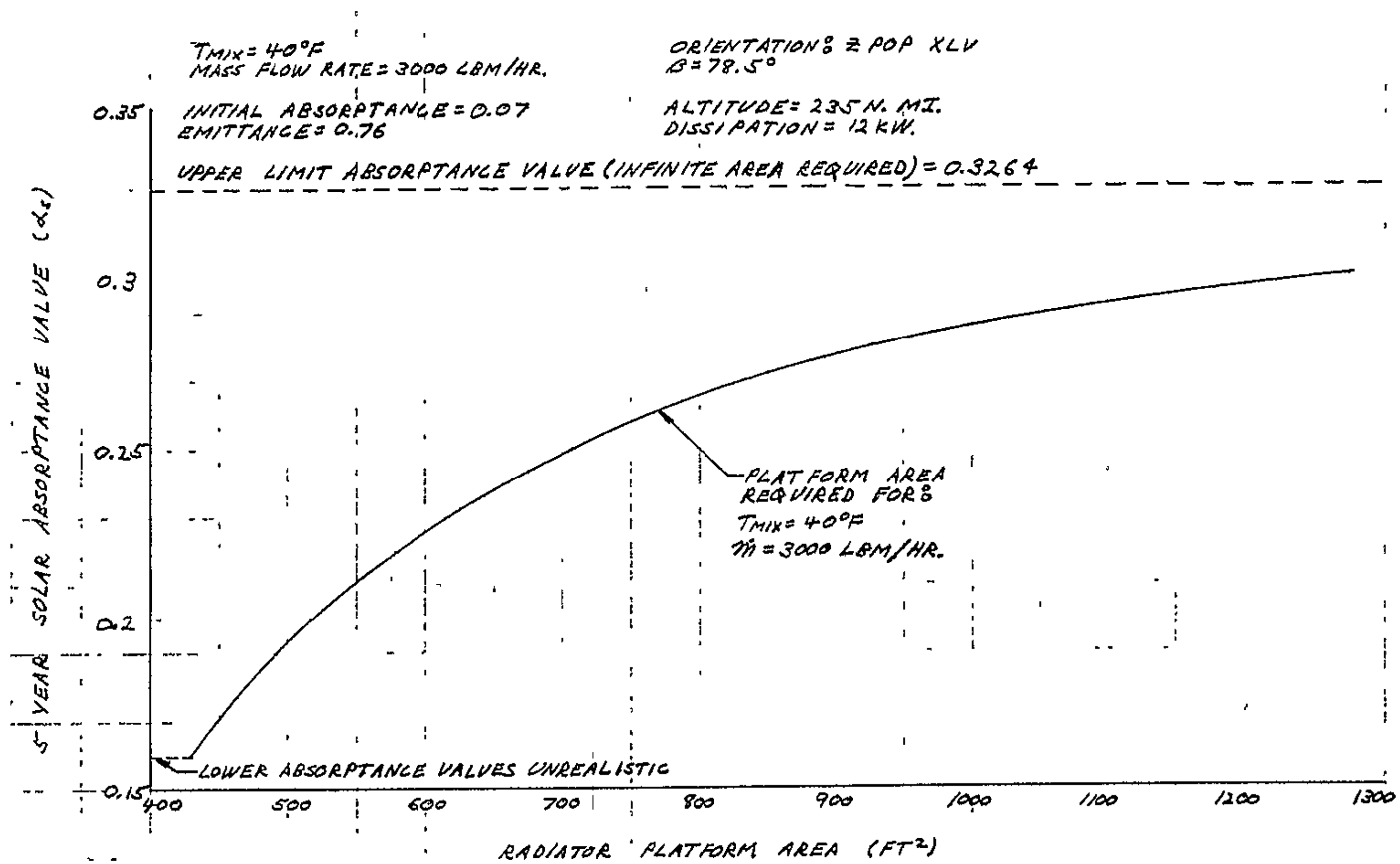

FIGURE 8 RADIATOR MINIMUM PLATFORM AREA REQUIREMENT VERSUS 5-YEAR SOLAR ABSORPTANCE VALUE FOR SILVERED TEFLON

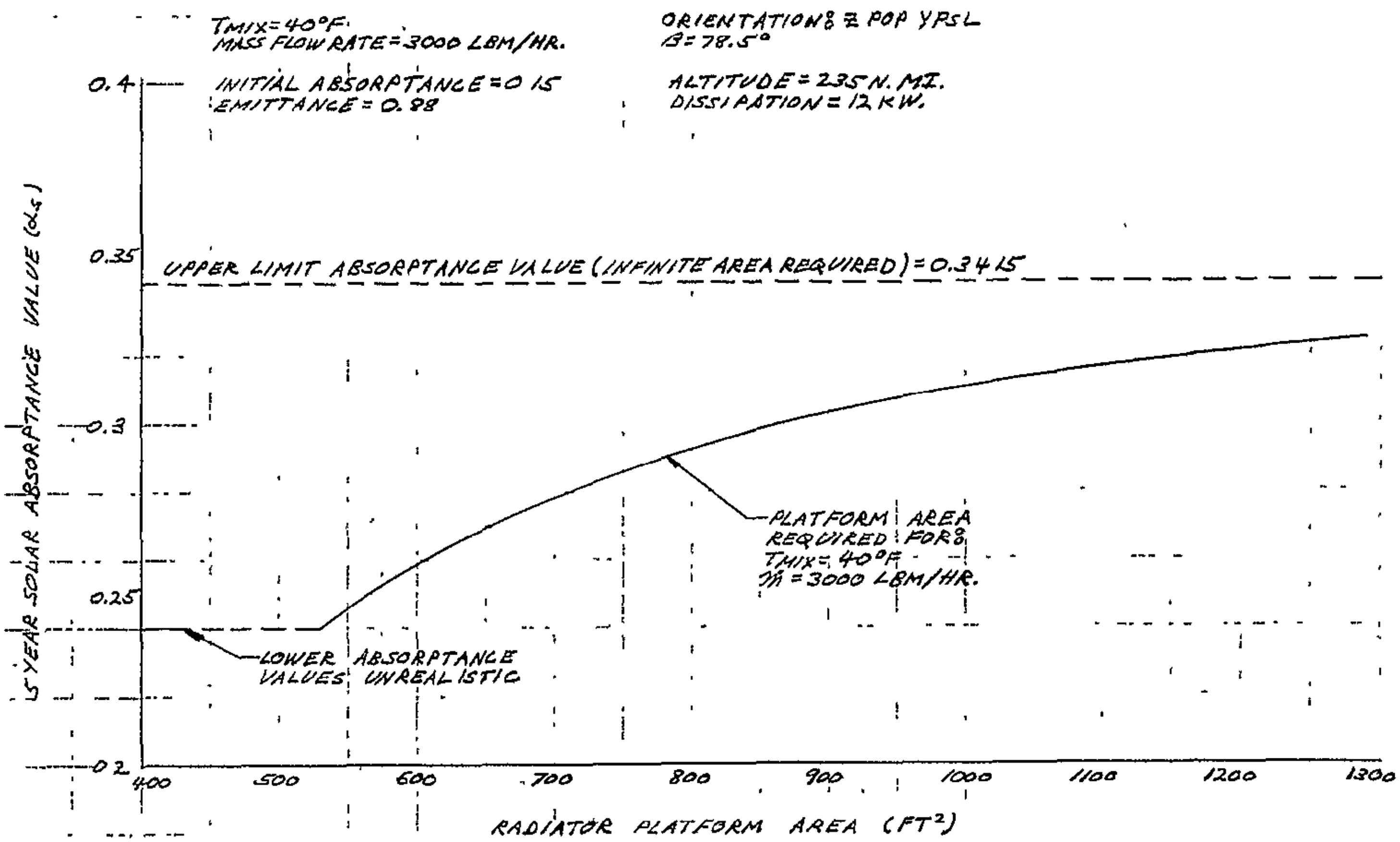

FIGURE 9 MINIMUM RADIATOR PLATFORM AREA REQUIRED VERSUS 5-YEAR SOLAR ABSORPTANCE VALUE FOR WHITE PAINT

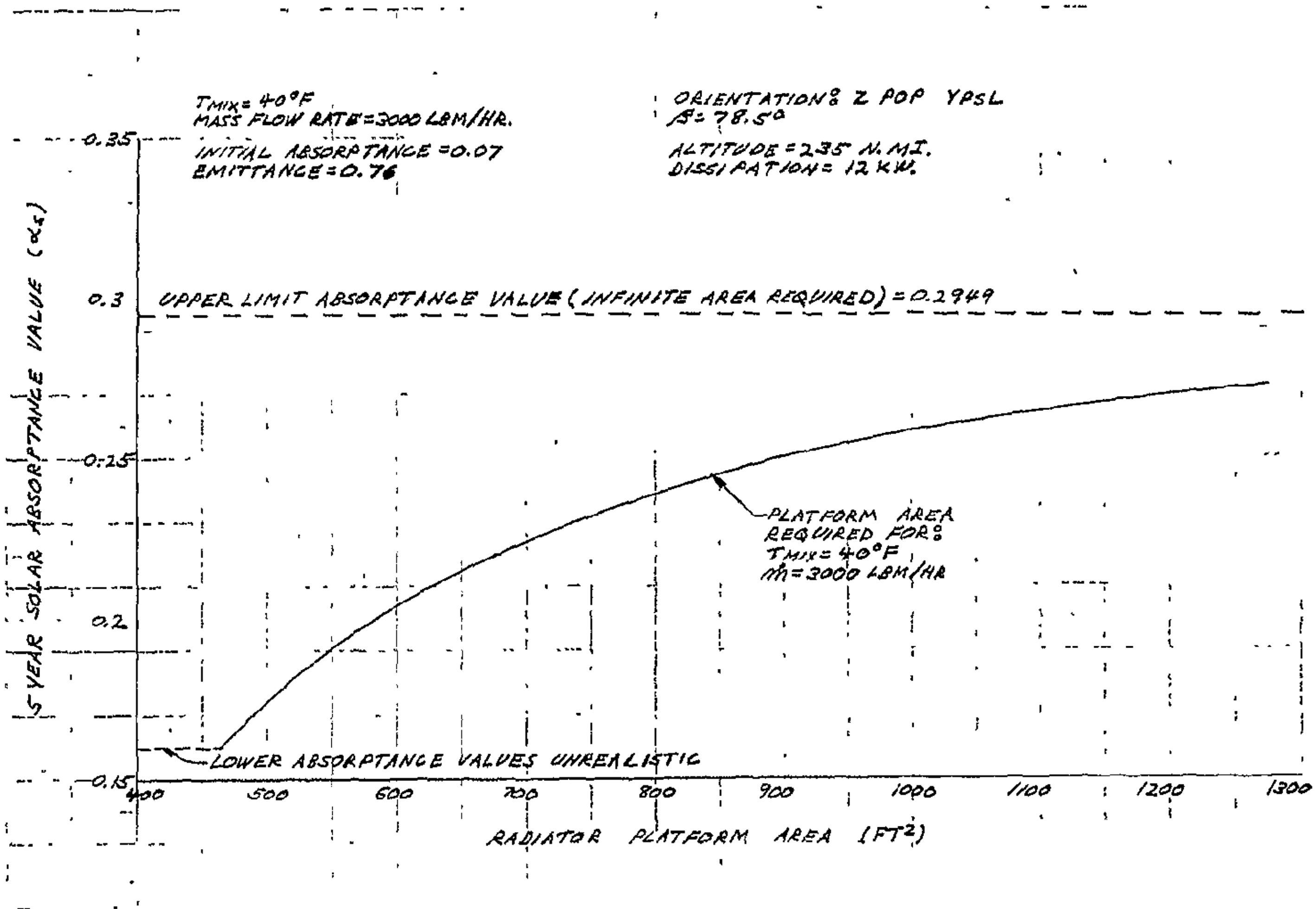

FIGURE 10 RADIATOR MINIMUM PLATFORM AREA REQUIREMENT VERSUS 5-YEAR SOLAR ABSORPTANCE VALUE FOR SILVERED TEFLON

value exists for which infinite area is inadequate because of the size of external loads. Thus, for a given orientation, there is a maximum α_s value for which the radiator can maintain proper operation because of the influence of direct solar and albedo heat loads.

Because of the low degradation rates (values below 0.0027 $\Delta\alpha_s$/month) required to provide five-year life with current area constraints, and the low maximum α_s values acceptable because of orientation constraints, it appears refurbishment will be required within the five-year period if current orbital considerations and orientations remain unchanged (even if increased area were provided).

The radiator orientations are favorable thermally, and only a movable radiator system could slightly improve their orientation. However, lowering the high β value for the primary mission could greatly increase the upper limit on maximum α_s for EOL conditions.

The only alternative to radiator refurbishment for a five-year module life appears to be a lowering of primary mission β angle. In order to provide data for such an alternative, a study has been conducted with the current constraints and present platform area for the system with primary mission orbit, as in the previously discussed study, with the exception of β being a variable. The same materials and orientations were considered. These results are presented in Figures 11 through 15.

Figures 11 through 14 show the life the present system can expect to have (remain "in spec") as a function of degradation rate and β angle. These charts show how, for a given rate of degradation, time until EOL increases as β is lowered; they also show what level of degradation can be sustained for five years as a function of β. Figure 15 shows how β affects the α_s value for the infinite radiator area requirement and how this α_s value, which provides an upper limit, increases as β decreases.

For an altitude of 235 nautical miles, eclipsing by the earth begins at approximately 69.5 degrees. The figures show that no significant

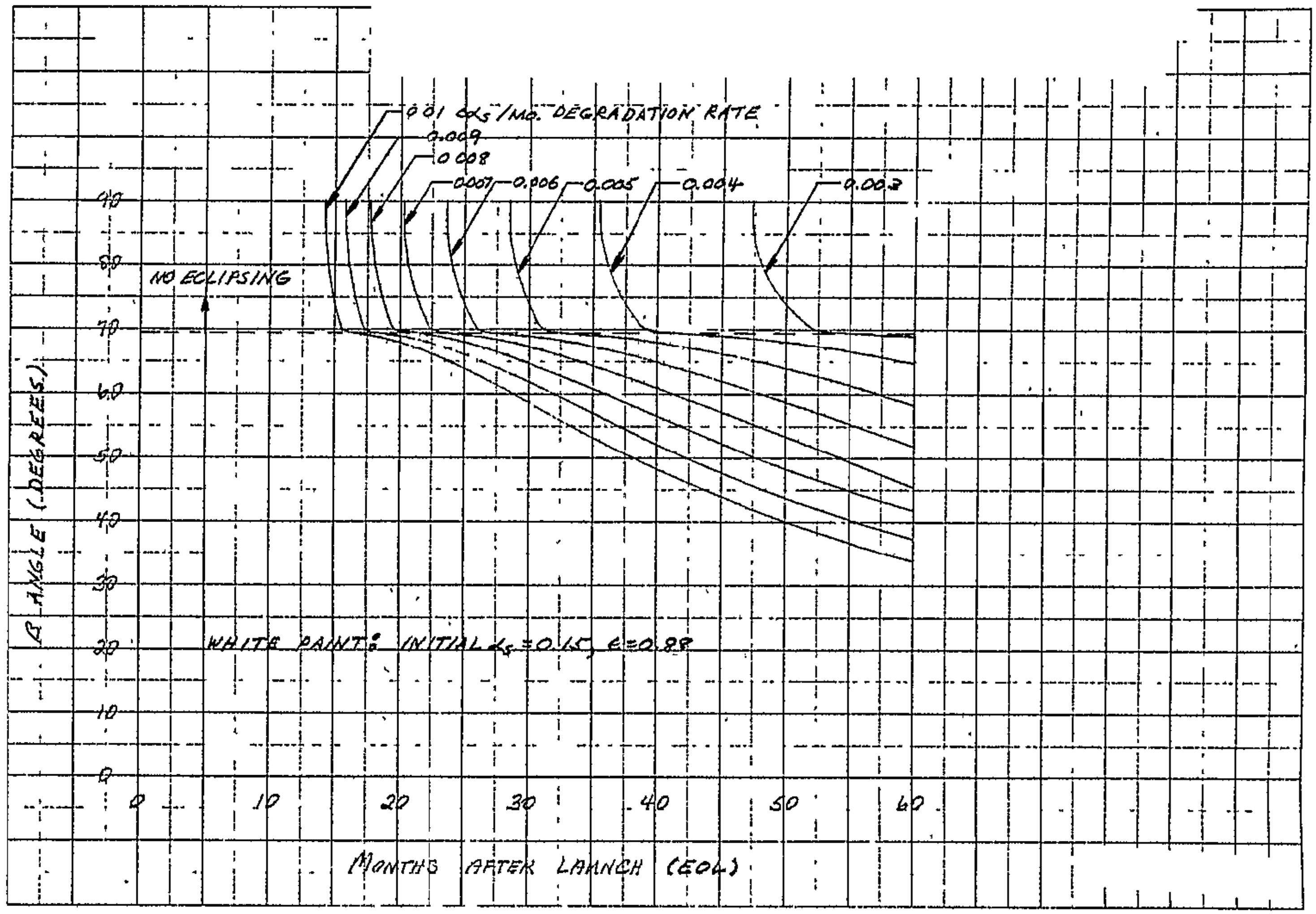

FIGURE 11 VARIATION IN SYSTEM LIFE WITH β ANGLE AS A FUNCTION OF DEGRADATION RATE FOR WHITE PAINT AT 235 NMI, ZPOP XLV ORIENTATION

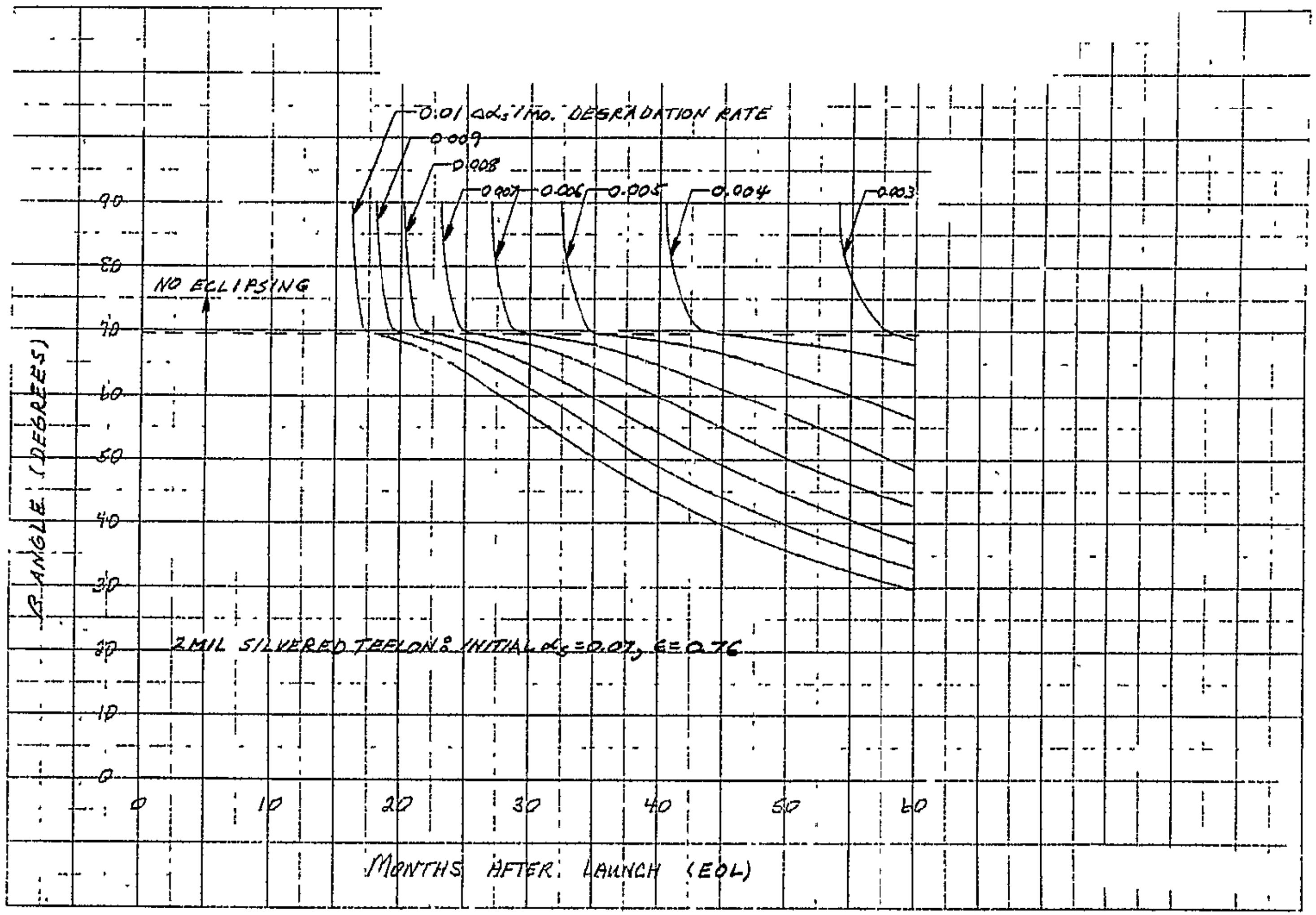

FIGURE 12 VARIATION IN SYSTEM LIFE WITH β ANGLE AS A FUNCTION OF DEGRADATION RATE FOR 2-MIL SILVERED TEFLON AT 235 NMI, ZPOP XLV ORIENTATION

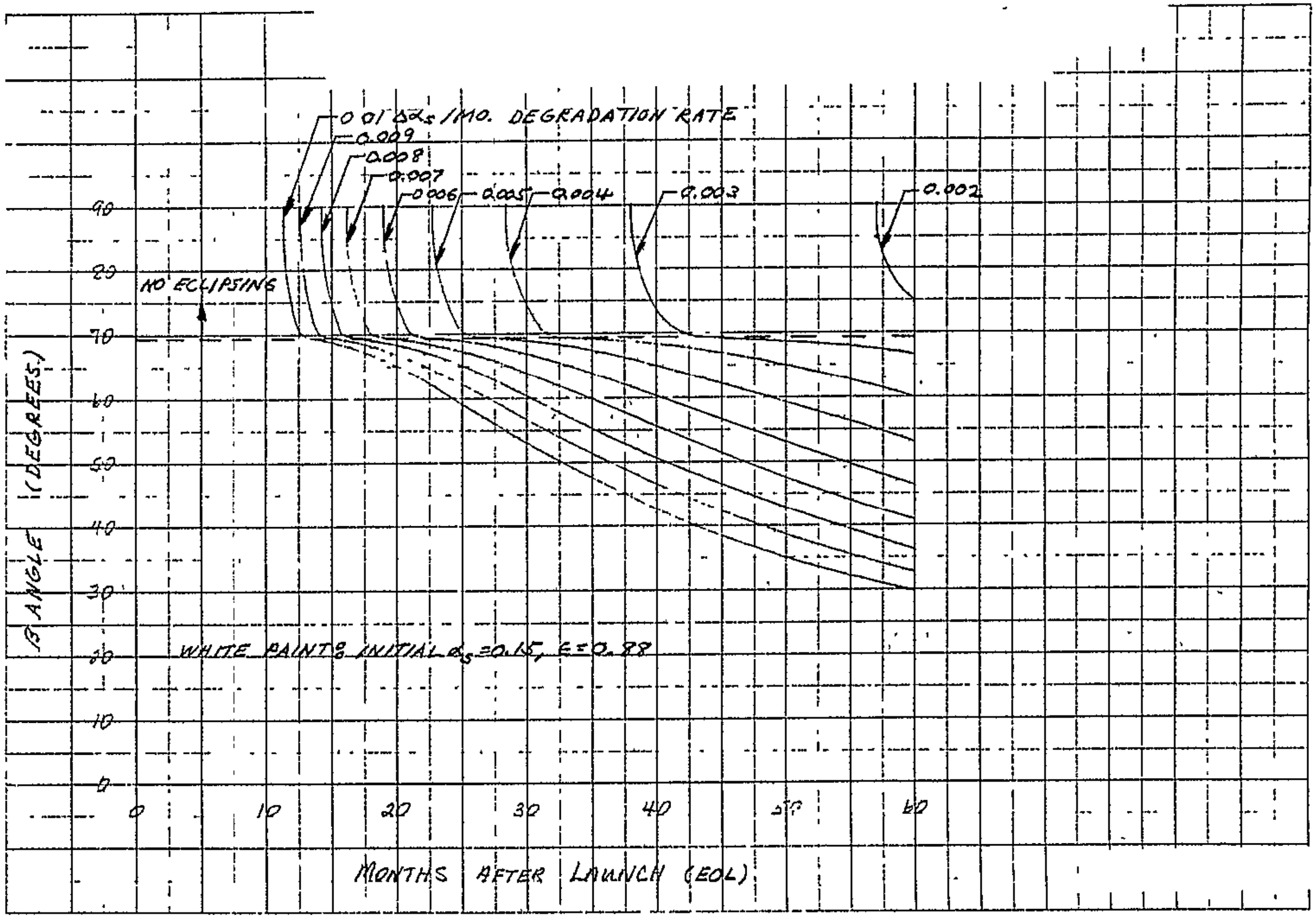

FIGURE 13 VARIATION IN SYSTEM LIFE WITH β ANGLE AS A FUNCTION OF DEGRADATION RATE FOR WHITE PAINT AT 235 NMI, ZPOP YPSL ORIENTATION

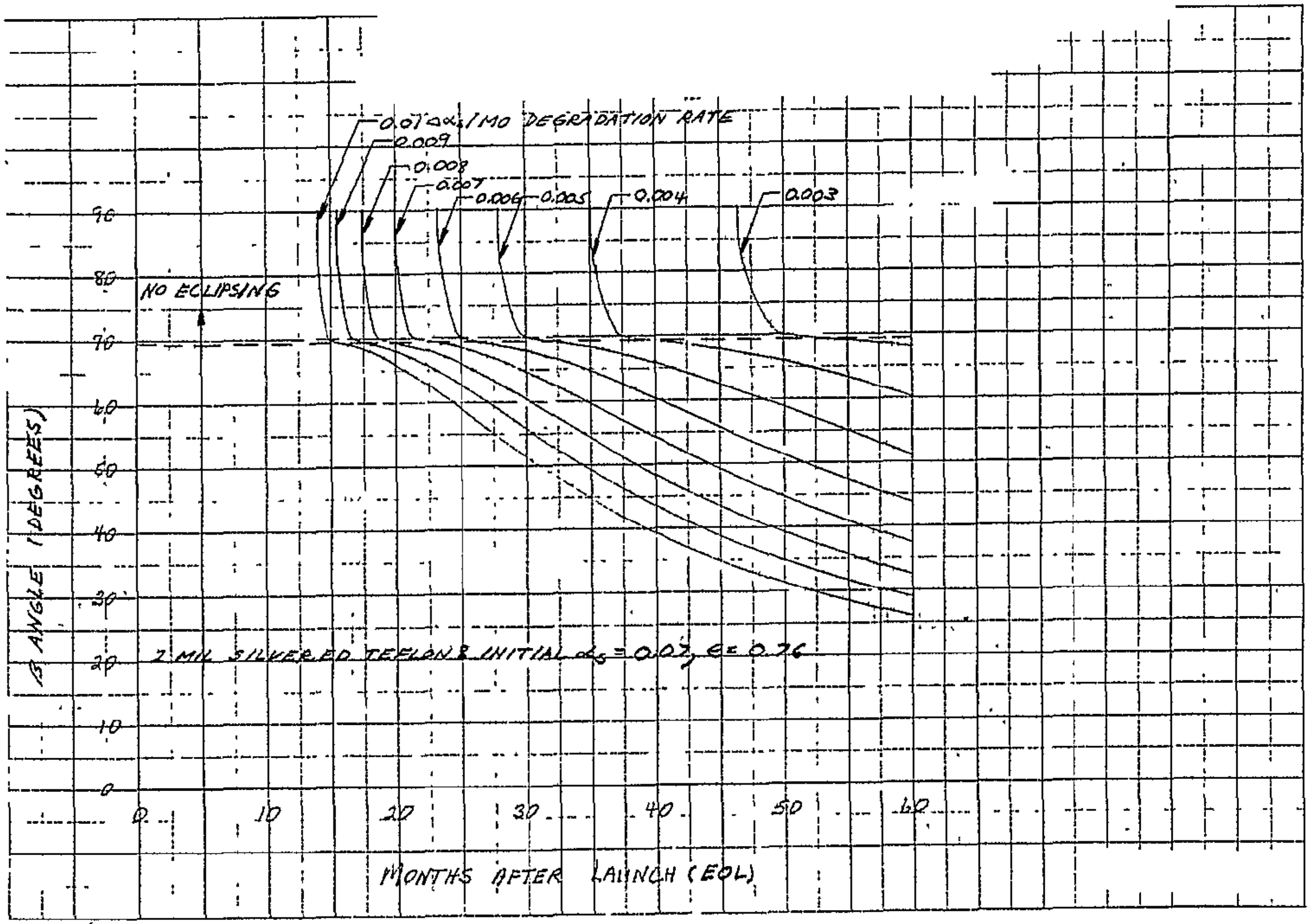

FIGURE 14 VARIATION IN SYSTEM LIFE WITH β ANGLE AS A FUNCTION OF DEGRADATION RATE FOR 2-MIL SILVERED TEFLON AT 235 NMI, ZPOP YPSL ORIENTATION

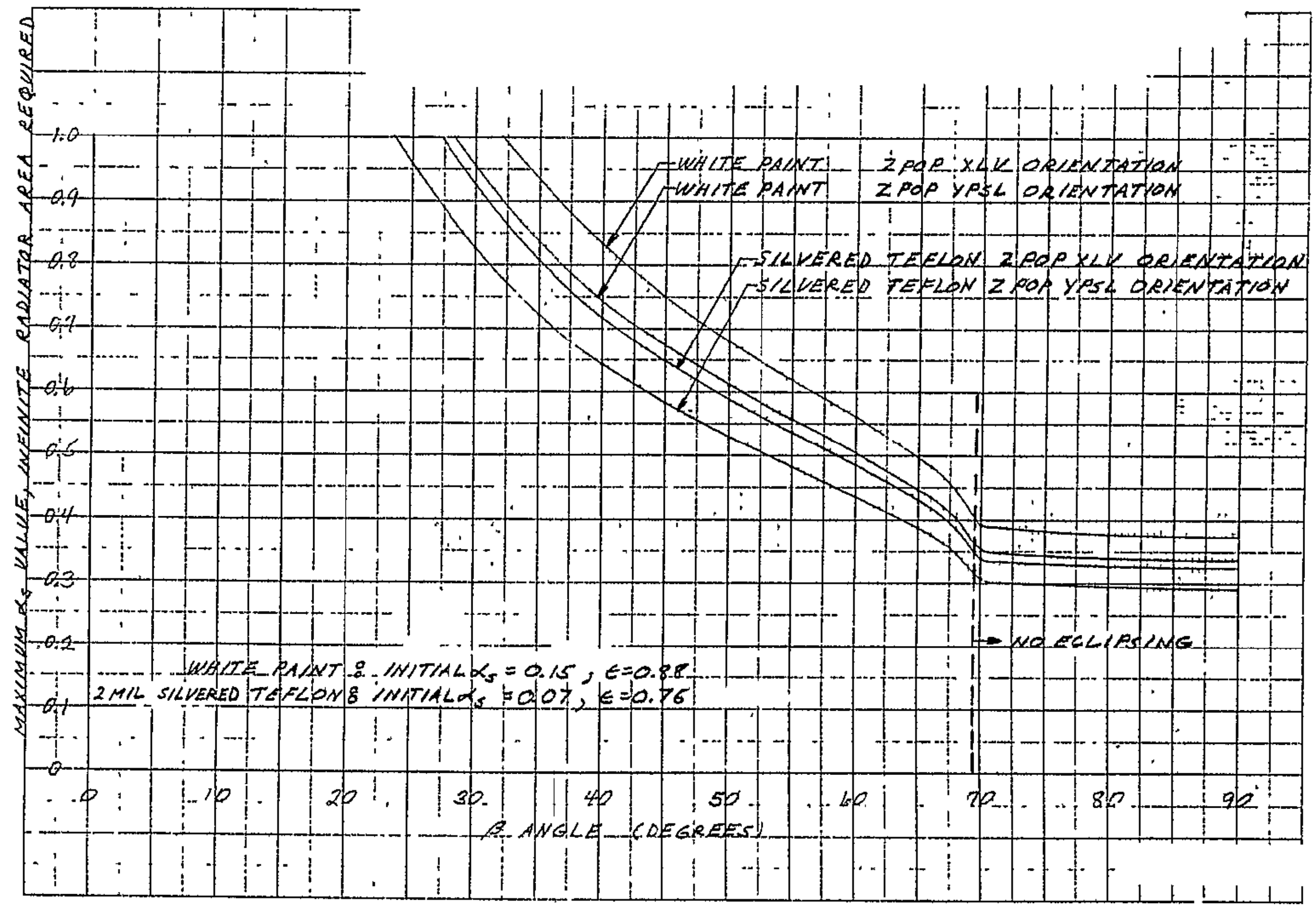

FIGURE 15 MAXIMUM ABSORPTANCE LIMIT FOR AREA SIZING AS A FUNCTION OF β ANGLE OF THE POWER MODULE, ALTITUDE = 235 NMI

increase in system life can be attained unless the β angle is lowered below this level. For reasonable degradation rates on the order of 0.005 $\Delta\alpha_s$/month as estimated (Skylab results from NASA/MSFC), and with the current system design, it appears mission β angle may have to be lowered to a value of ≈ 51 degrees to ensure five-year life at 235 nautical miles.

Accurate determination of the rates of degradation that will actually be encountered can only be achieved by a detailed contamination study. However, reasonable rough estimates of the degradation rates anticipated indicate the present 25-kW power module design for the thermal-control system cannot survive "in spec" for a five-year period (even with the most favorable orientations) without lowering the primary mission β angle considerably or refurbishing radiators on orbit at least once in the five-year period. With the present system and primary mission orbit, studies indicate proper operational system life will be approximately 2 to 2.5 years without refurbishment or orbit change required.

2.2 COMPUTER PROGRAM DEVELOPMENT

Two computer programs have been developed which provide a preliminary design and evaluation tool for active radiator systems in LEO. One program has been developed as a general program for space station analysis. The other program has been developed to provide an analysis tool for the 25-kW power module.

Both programs find the radiator-flow solution and evaluate external heat loads in the same way; however, the two programs are conceptually different. The general space station program is more in the nature of a preliminary design tool, while the power module program is more of an evaluation tool. For many purposes both programs could be used for the same task. However, the space station program has greater capability for sizing radiator platform areas and coolant flow rates along with the ability to size both flat extended and cylindrical wraparound radiators.

Both programs, as discussed in subsection 2.1, have been formatted according to the general orbital considerations:

a. The bypass thermal control system is the type of system both programs evaluate.

b. Both programs are limited to altitudes between 100 and 1000 nautical miles, with β angles ranging from 0 to $\pm$ 90 degrees.

c. Both programs are restricted to LEO conditions because of the assumption that orbital periods are sufficiently small to allow orbital mean temperatures to be indicative of temperatures over the entire orbit. This allows orbital mean external heat loads to be used and steady-state solutions to be determined. The problem of determining orbital transient solutions requiring specific thermal capacitance values for radiators is eliminated.

d. Both programs evaluate flat extended radiators oriented in the orbit plane, as this is an optimal configuration for a fixed system. In addition, the space station program evaluates cylindrical wrap-around module radiators oriented with the axis pointing toward the earth as that is the optimal configuration for such a fixed system. The flat radiators are double sided; thus, the area considered is platform area.

e. Both programs evaluate degraded performance with time on orbit. Rates of degradation may be input along with time on orbit and intervals over which solutions are obtained.

Both of these programs allow the parameters of altitude, orbit β angle, required fluid heat-load dissipation, and degradation rates to be selectively inputted as singular values or as ranges with specified intervals. This allows the user to evaluate a specific case of interest or generate an entire parametric study in a single run. Other inputs vary depending on which program is used.

2.2.1 General Space Station Program

The space station program was developed to be a preliminary design tool, with the major objectives being the determination of required coolant flow rate and radiator area for a prescribed EOL condition based upon degradation. In addition, the entire radiator-flow solution is determined for time increments from initial on-orbit conditions through EOL, providing a quantitative solution to the effects of degradation over the life of the system.

These solutions may be found for both flat extended radiators and cylindrical wrap-around module radiators. The input allows for the solution for each radiator type independently. The required fluid dissipation may be input in such a way that only one type of radiator need be considered or dissipation may be incremented such that flat radiators are sized up to a certain load (break point) after which all additional dissipation will be used to size cylindrical radiators. Thus, a particular radiator (of either type) may be sized, or a combination of independent radiators of both types may be sized for total heat loads for a large station with inhabited modules.

The known input parameters for the program relate a design philosophy. Internal environmental control defines an inlet temperature (T_I), outlet mix temperature (T_M) and a dissipation load (D) specifically or within very small ranges. Orbital β angles and altitude will be defined or ranges set. This information furnishes the required data input for sizing the coolant flow rate, providing the coolant specific heat is known. However, for area sizing, additional information must be determined on the maximum external heat fluxes the system can withstand. For this reason degradation knowledge is essential. A value for EOL α_s must be determined. The area sizing of the radiator, because of external loading, depends on this parameter.

For a given orientation, altitude, and β value, there is a maximum α_s value for which a given system (materials considered) can remain "in spec" even with infinite area. The program computes this value and compares it with an EOL α_s value computed from degradation rate, initial α_s value, and lifetime inputted. Should the EOL α_s be less, a lifetime solution to the flow problem will be computed and area sized. If the EOL α_s is larger, the solution will terminate with the appropriate message. The area will be sized using the computed EOL α_s, assuming the total mass flow rate of coolant is flowing through the radiator as the EOL limiting condition. This provides a minimum area required to meet the EOL condition. The program computes the complete radiator flow solution at specified time intervals (inputted) between initial on-orbit time and EOL (EOL time is specified as a design input and is used to calculate EOL α_s), showing quantitatively how degradation changes the system performance.

The program can thus be used to determine what EOL α_s values are acceptable under design conditions and what rates of degradation are implied to meet EOL lifetimes for given orientations. The program output provides information as to when programmed inputs do not provide a realistic solution. Thus, the necessary information to correlate orbital parameters with area and flow requirements (aiding in pump sizing) for realistic life on orbit for the system is provided.

When a solution is possible, the program provides inlet-fluid temperature, mean radiator temperature, radiator-outlet-fluid temperature, mass flow rate through the radiator, α_s, total solar heat input, total albedo heat input, and eta (η) as a function of time after launch, including EOL. Eta is defined as

$$\eta = \frac{T^4 - T_R^{\,4}}{T_I^{\,4} - T_R^{\,4}} \tag{6}$$

where

T = mean radiator temperature

In addition to these parameters, design parameters such as total mass flow rate, required area, EOL α_s, maximum α_s due to external loads, dissipation, earthshine heat input (not a function of α_s but rather ε, thus remaining constant), orbit parameters, and inlet and mix temperature conditions are printed out.

2.2.2 25-kW Power Module Program

The power module program has been designed to be an evaluation tool for the module active radiator system. This program solves the radiator-flow problem, but only for flat extendable radiators. While this program can be used for radiator sizing, a nominal area is input for which a coolant flow rate is sized in the same way as the space station program. Also, while this program does provide minimum area size for candidate EOL α_s (which it also computes), its purpose is to evaluate the change in radiator performance with time and show when actual EOL will occur and at what α_s.

In the space station program, the time period inputted was treated as the EOL value for design; in this program it is not. A portion of the program uses the input time to compute an area sizing and α_s for such a period of time (assumed candidate EOL); however, the area inputted does not necessarily correlate with the inputted time, nor does that time necessarily represent actual EOL in this program. This program computes the degraded system solution at intervals (user specified) until either the inputted time period runs out or the radiator reaches a temperature equal to the inlet fluid. After the actual EOL condition is reached (degradation has occurred until all the flow is required through the radiator), the solution continues providing an evaluation of system degradation "out of spec" and a measure of increased required flow rates and temperatures encountered past actual EOL as a function of time.

While the space station program reveals if a specified EOL solution is possible and, if so, what it is, this program reveals when actual EOL will occur and subsequent "out of spec" performance. The area sizing calculation is performed to show what area is required at the EOL radiator mass flow rate to sustain "in spec" operation for the time period inputted. This area enables a determination to be made if the nominal area inputted is oversized or undersized.

In addition, a maximum value for α_s is computed for which infinite radiator-area is required to remain "in spec." If the α_s computed over the time period inputted is greater than the infinite area α_s limit, then area cannot be computed and the situation is printed out.

For the degraded solution, the outputs printed (inlet fluid temperature, mean radiator temperature, radiator outlet fluid temperature, mass flow rate through radiator, α_s, total solar heat input, total albedo heat input and eta) are the same as those for the space station program.

In addition to these parameters, design parameters such as total mass flow rate, area sizing for time period α_s, α_s maximum for infinite area caused by external loads, dissipation, total earthshine heat input (constant), orbital parameters, and inlet and mix temperature conditions are output.

2.2.3 External Heat Inputs

External heat inputs include direct solar heat input, earthshine heat input and albedo heat input. Being in the LEO environment, all three of these inputs are significant, and orbital mean values may be used because of the short orbital periods involved.

Solar heat input may be defined as follows:

$$Q_s = SAF_s\alpha_s \tag{7}$$

where

S = solar flux (mean) incident on surface (442 BTU/hr-ft^2)

A = surface area (ft^2)

F_s = shape factor defined as $F_s = Q_s/SA\,\alpha_s$,
F_s is a measure of projected area normal to solar flux and can be represented by cos ϕ where ϕ is the angle between the solar vector and surface normal. The value of S presented is a mean value; it varies between 426 and 454 BTU/hr-ft^2.

The earthshine heat input, which is thermal radiation from the earth, may be defined as:

$$Q_E = EAF_E \, \varepsilon \tag{8}$$

E = earth thermal radiation flux incident on a surface (66.36 BTU/hr-ft^2)

ε = emittance of surface

F_E = shape factor defined as $F_E = Q_E/EA\,\varepsilon$; F_E is more complicated than F_s in that it not only accounts for projected surface area but also the distribution of incident radiation as earth emission cannot be considered collimated as solar flux can.

The albedo heat input is solar-flux incident on a surface which is reflected from the earth and may be defined as follows:

$$Q_A = Sa\,F_A\,A\,\alpha_s \tag{9}$$

where

a = reflectance of earth, has average value of 0.4

F_A = shape factor defined as: $F_A = Q_A/Sa\,A\,\alpha_s$, F_A is also more complicated than F_s in that it not only accounts for projected surface area but also the distribution of incident radiation.

The earthshine and albedo formulae for a cylinder replace the area with the product of diameter times length, and the shape factors are based upon this convention. In order to factor out or use area in these formulae for a cylinder, a factor of π must be used to compensate for the shape factor convention.

To provide straightforward use of the external input formulations, the shape factors must be formulated as functions of orbit position (θ = orbit angular position defined as zero at the subsolar point), β angle, and altitude. Restricting the flat radiator orientation to the plane or the orbit and the cylindrical radiator orientation to the axis pointing toward the earth, a simple set of formulations and assumptions may be applied.

With the orientations defined, data from Reference 9 was used to derive the F_E values as a function of altitude (being independent of β) for both types of radiators. These data were then curve-fitted into the following polynomial expressions:

Flat plate:

$$F_E = 0.4127579927 - AL\ (0.6963855121 \times 10^{-3}) + AL^2\ (0.6778353736 \times 10^{-6}) - AL^3\ (0.2684461542 \times 10^{-9}) \tag{10}$$

Cylinder:

$$F_E = 1.296533585 - AL\ (0.218701805 \times 10^{-2}) + AL^2\ (0.2127767402 \times 10^{-5}) - AL^3\ (0.8424327902 \times 10^{-9}) \tag{11}$$

where

AL = altitude (nmi)

These expressions are valid from 100 to 1000 nautical miles in altitude.

The only way to handle albedo F_A values in a fashion which is not unwieldy, is to devise a formulation which approximates the rigorous solution. The following common approximation was used:

$$F_A = F_E \cos(\psi) \tag{12}$$

where

ψ = The angle between a vector along the solar line and a vector pointing toward the center of the earth.

This approximation is very accurate (within a few percent) for orbital mean values and only becomes inaccurate when β is close to 90 degrees. However, at such β values the value for albedo is usually so small when compared with other inputs the discrepancy is negligible. In terms of θ and β the expression becomes

$$F_A = F_E \cos(\theta) \cos(\beta) \tag{13}$$

The direct solar F_S values obtain the following functional forms, being independent of altitude:

Flat Plate:

$$F_S = \sin(\beta) \tag{14}$$

Cylinder:

$$F_S = \frac{1}{\pi} (\sin (\cos^{-1} (\cos(\theta) \cos(\beta)))) \tag{15}$$

The orbital mean shape factor values are required; thus, the above equations must be numerically integrated over an entire orbit (θ) to determine mean values. For direct solar F_S values, shading caused by earth eclipsing must be considered. The following equation reveals the orbit position at which eclipsing starts as a function of β, altitude and radius of the earth [(R) = 3441 nautical miles]:

$$\theta = \left(\cos^{-1}\left[\frac{(R) \sin\left[\cos^{-1}\left(\frac{(AL+R) \sin\beta}{R}\right)\right]}{(AL+R) \cos\beta}\right] + \frac{\pi}{2}\right) \text{(radians)} \tag{16}$$

The above θ and its complement define the orbital range over which earth shading occurs, and F_S values must be zero for the integration over this interval.

Equations (10) through (16) are programmed and mathematically manipulated to generate orbital mean F_S, F_E, and F_A values which then may be used in conjunction with Equations (7) through (9) to generate the orbital mean external heat inputs. Figures 16 through 21 provide plots of the orbital mean shape factors for direct solar, earthshine, and albedo external heat inputs as a function of altitude and β angle. Figure 22, generated by Equation (16), shows the beginning of earth eclipsing as a function of β and altitude.

With the ability to compute external heat inputs in a concise, practical fashion, it is now necessary to present the solution technique for the radiator-flow problem.

2.2.4 Solution to the Radiator-Flow Problem

Analysis of a differential strip being perpendicular to the parallel flow through the radiator can yield a set of dimensionless equations. These equations reduce the solution of an on-orbit active-radiator problem to a simple computerized set of numerical calculations or even a simple graphical solution by hand. The following derivation develops the equations and the solution technique used in both computer programs to solve these equations.

Figure 23 shows a differential strip of a radiator with mathematical terms defining heat inputs and outputs. The derivation will be performed for a flat-plate radiator and the differences in terms will be presented for a cylindrical radiator. The assumptions made are that the radiator is in equilibrium and there is no conduction of heat along the radiator itself.

Considering heat loads into the differential strip, the heat caused by fluid entering becomes

$$\dot{m}_R \, CpT_X$$

where

T = Temperature.

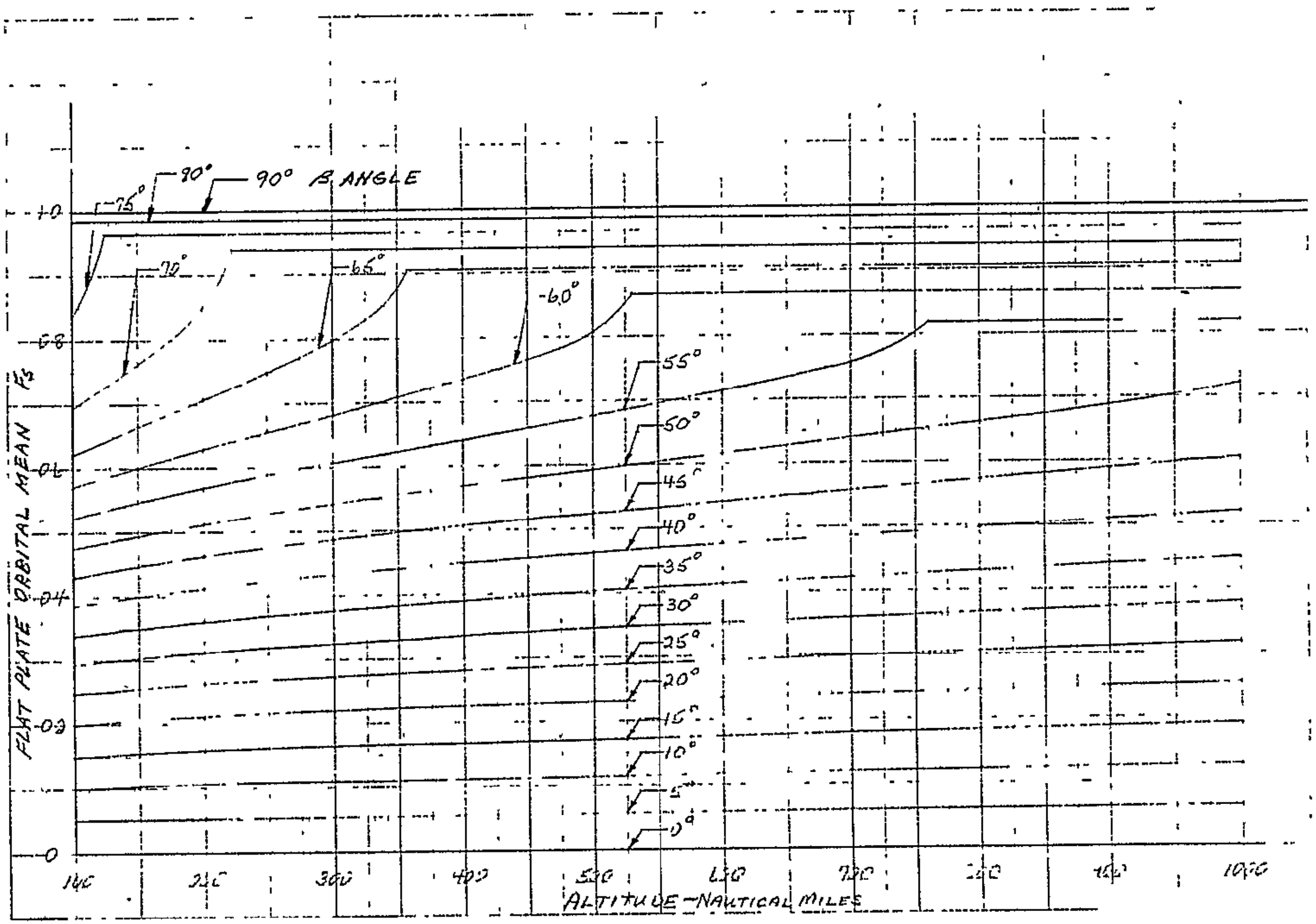

FIGURE 16 ORBITAL MEAN F_S AS A FUNCTION OF β ANGLE AND ALTITUDE FOR A FLAT PLATE RADIATOR IN ORBIT PLANE. VALUE IS FOR ONE SIDE OF THE RADIATOR

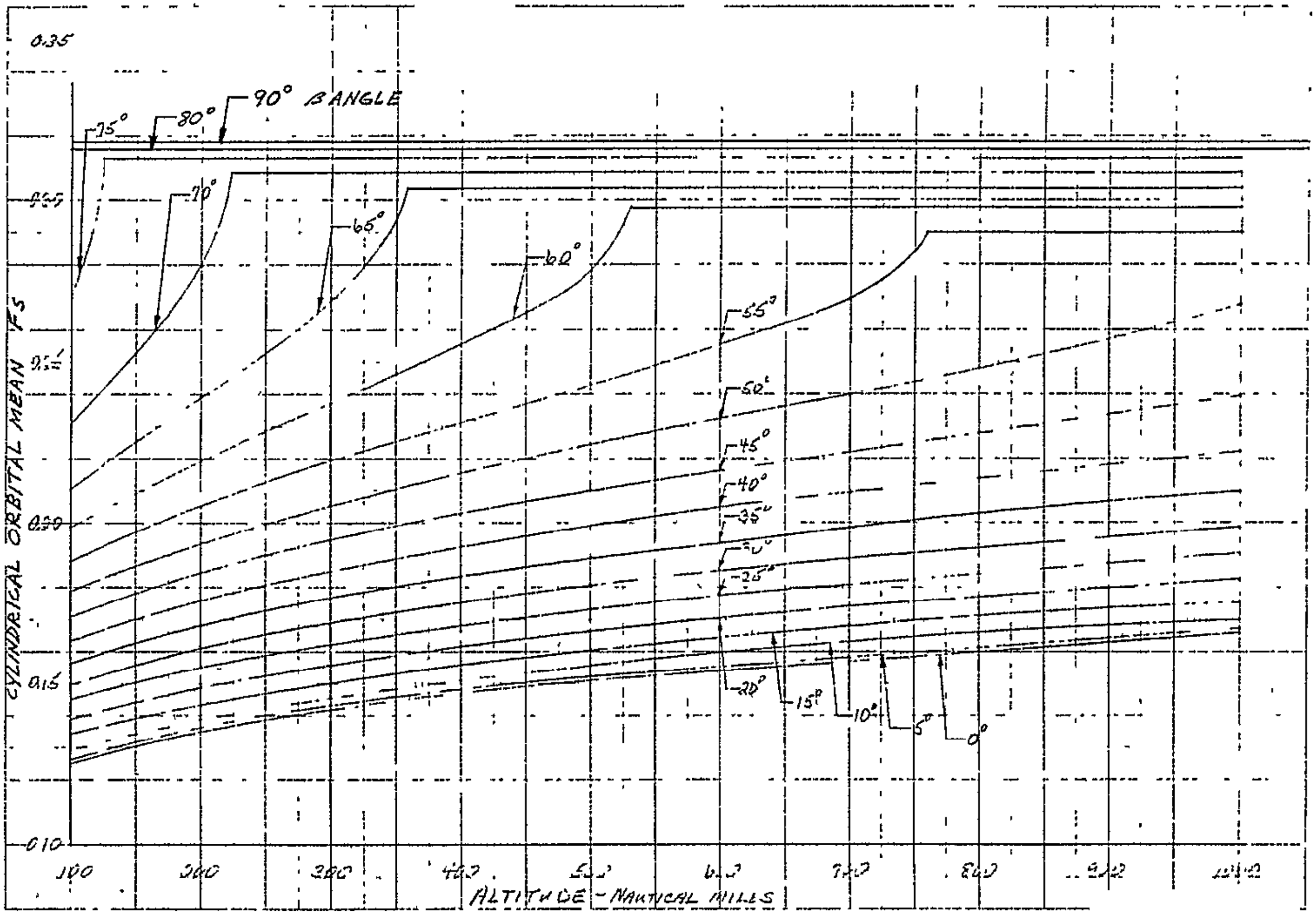

FIGURE 17 ORBITAL MEAN F_S AS A FUNCTION OF β ANGLE AND ALTITUDE FOR A CYLINDRICAL RADIATOR ORIENTED WITH AXIS POINTING TOWARD EARTH

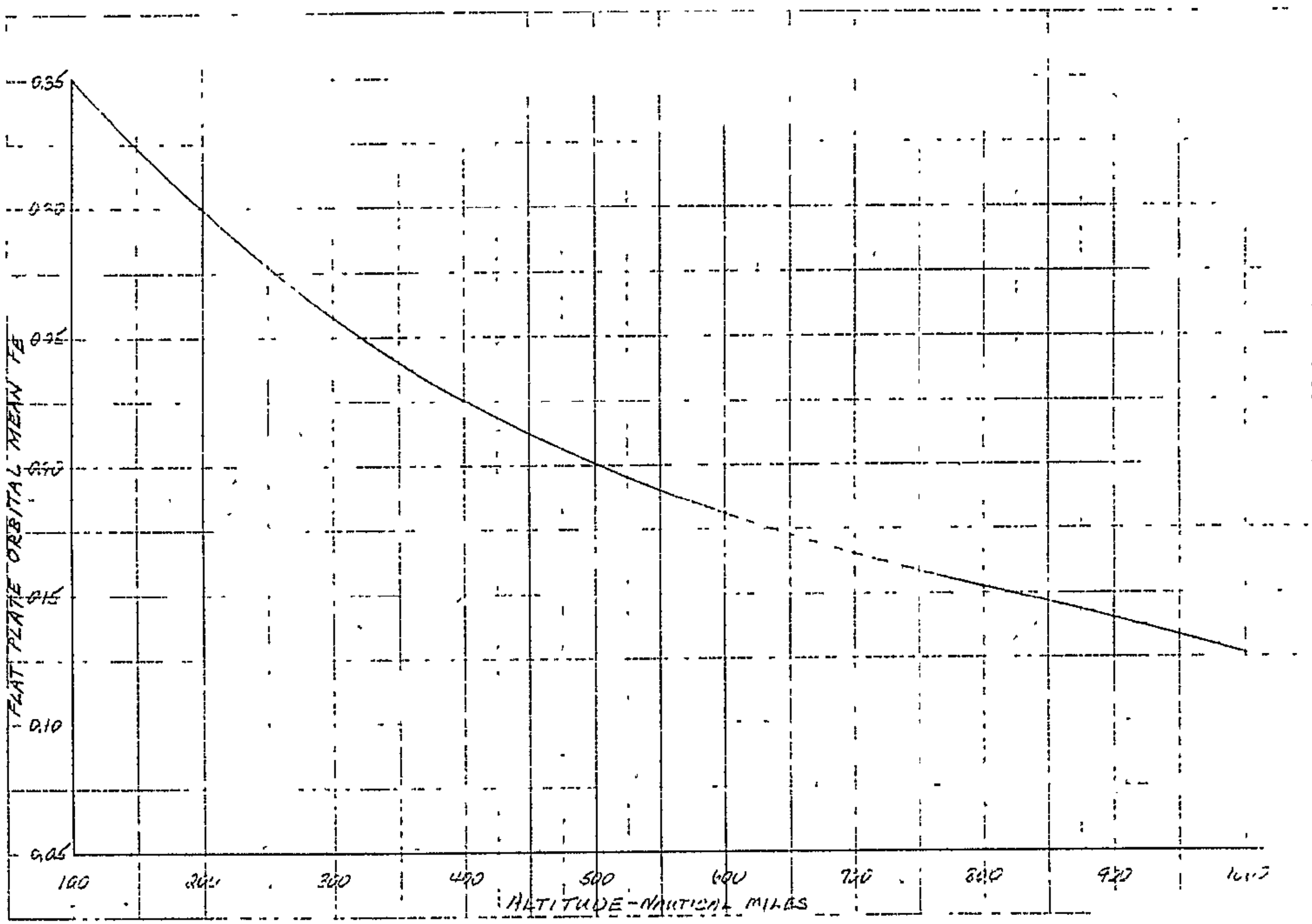

FIGURE 18 ORBITAL MEAN F_E AS A FUNCTION OF ALTITUDE FOR FLAT PLATE RADIATOR IN ORBIT PLANE

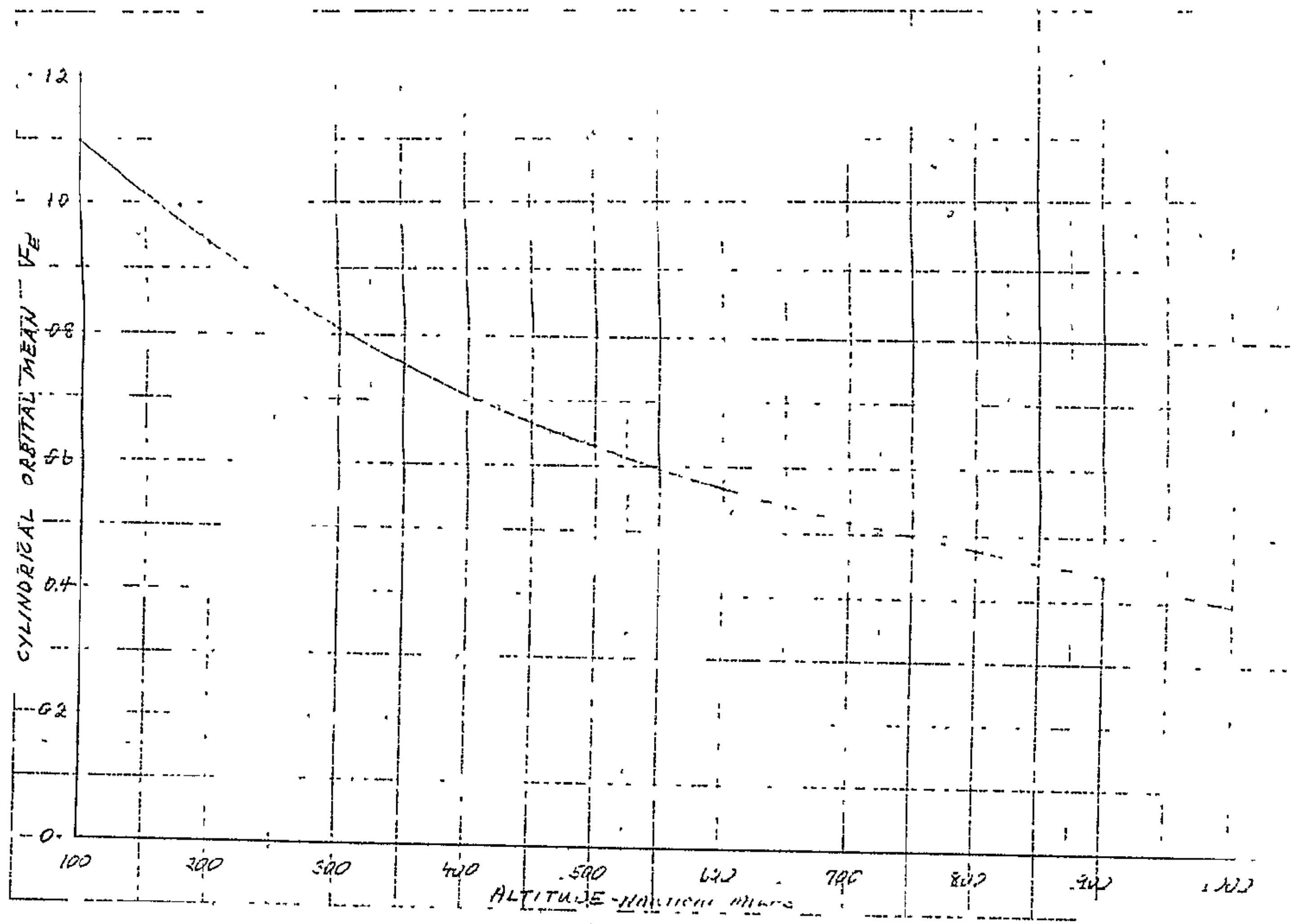

FIGURE 19 ORBITAL MEAN F_E AS A FUNCTION OF ALTITUDE FOR CYLINDRICAL RADIATOR ORIENTED WITH AXIS POINTING TOWARD EARTH

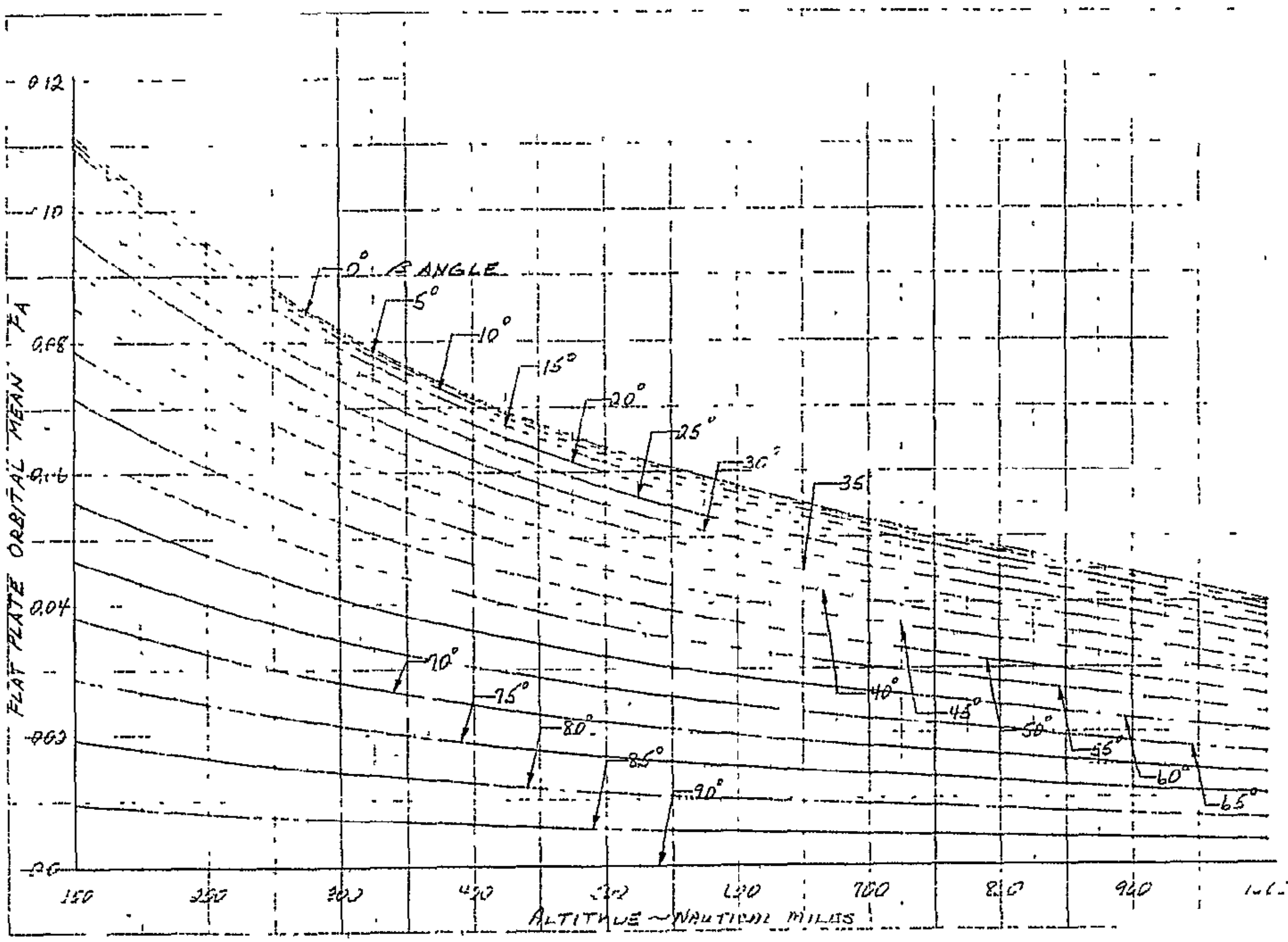

FIGURE 20 ORBITAL MEAN F_A AS A FUNCTION OF β ANGLE AND ALTITUDE FOR A FLAT PLATE RADIATOR IN THE ORBIT PLANE

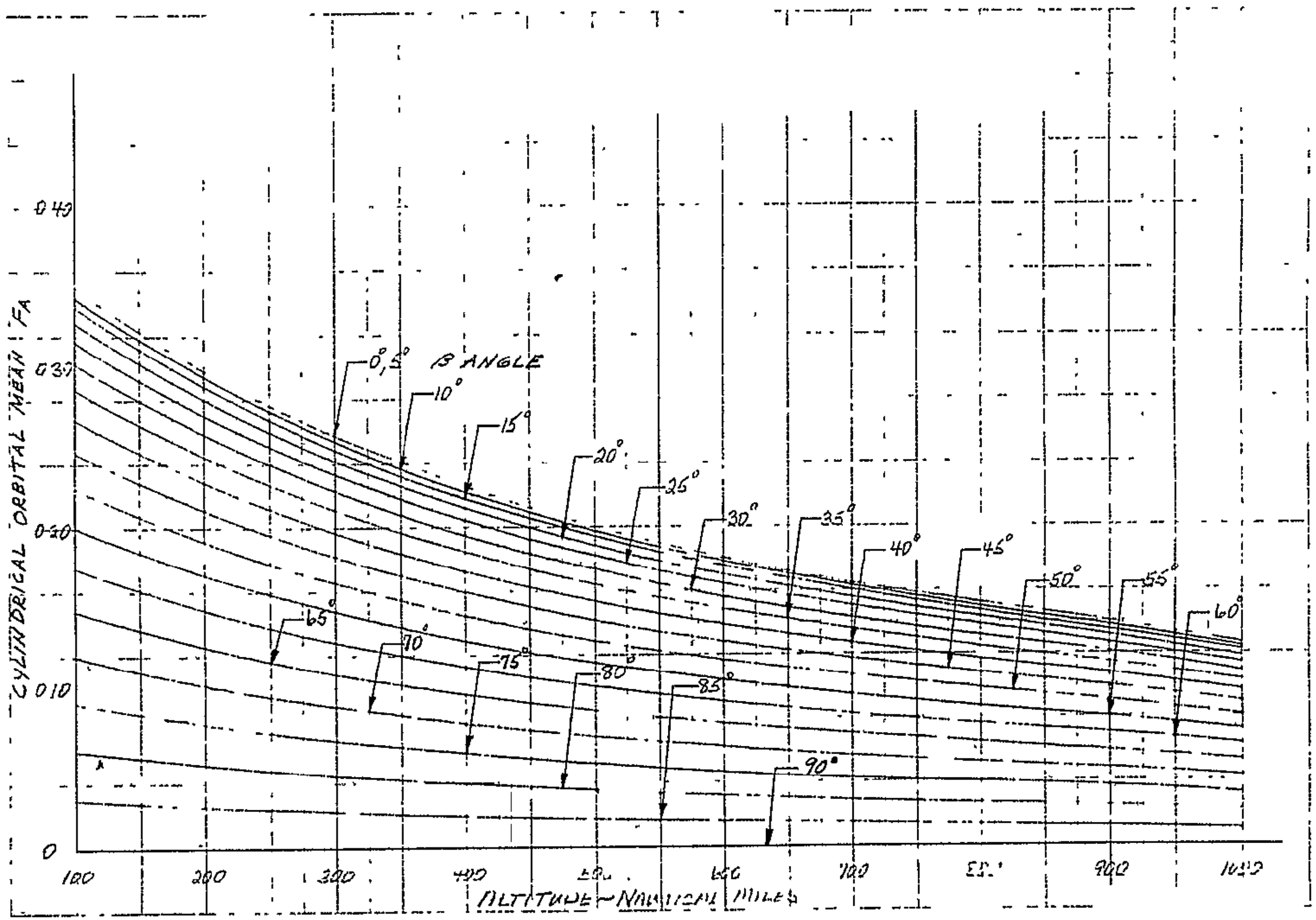

FIGURE 21 ORBITAL MEAN F_A AS A FUNCTION OF β ANGLE AND ALTITUDE FOR A CYLINDRICAL RADIATOR ORIENTED WITH AXIS POINTING TOWARD EARTH

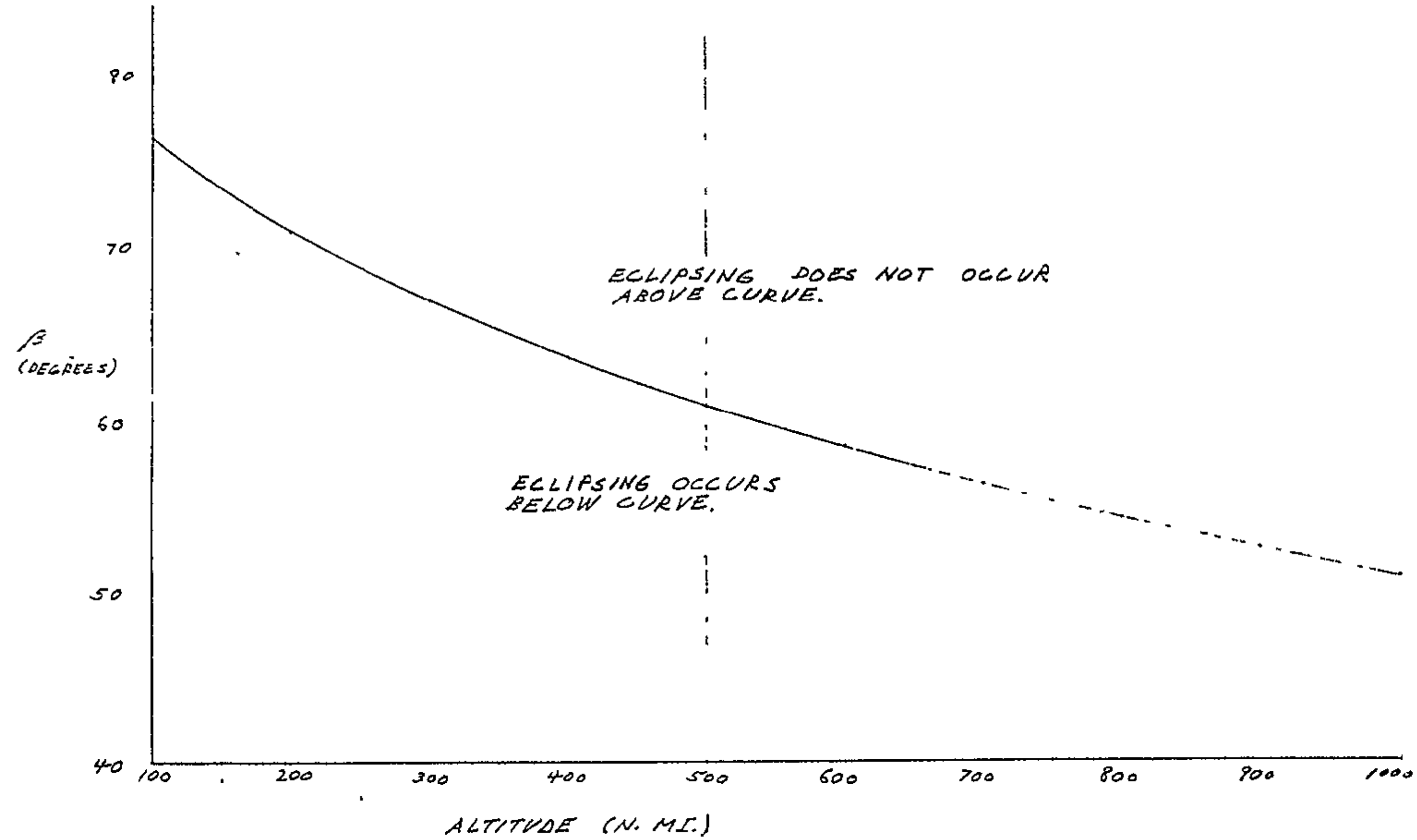

FIGURE 22 β VERSUS ALTITUDE FOR BEGINNING OF EARTH ECLIPSING

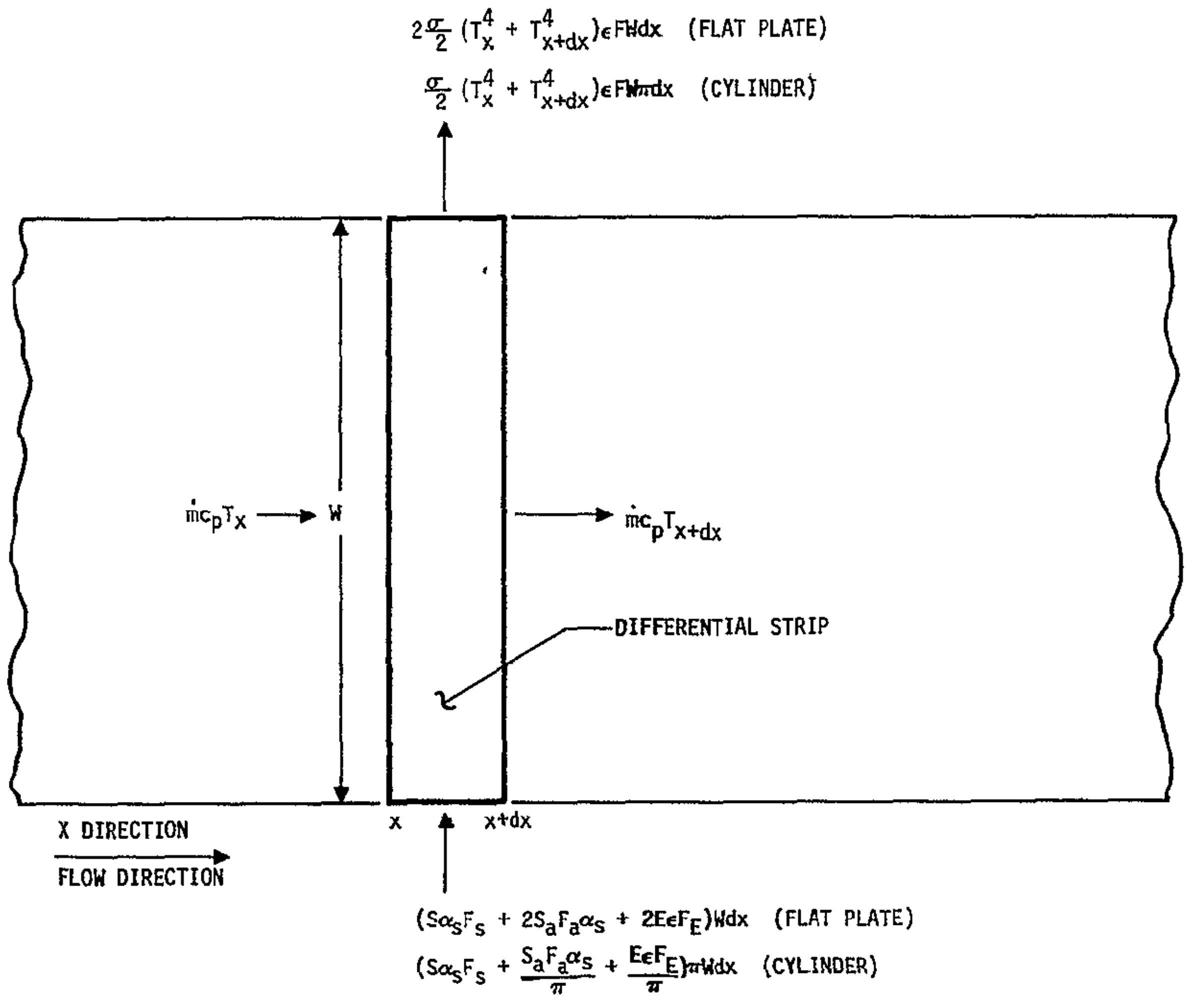

FIGURE 23 DEFINITION OF DIFFERENTIAL STRIP OF RADIATOR WITH HEAT FLOWS

Heat input caused by external loads becomes

$$(S\ \alpha_s F_S + 2SaF_A\ \alpha_s + 2E\ \varepsilon\ F_E + q_p)\ Wdx \qquad \text{(flat plate)}$$

$$(S\ \alpha_s F_S + \frac{SaF_A\ \alpha_s}{\pi} + \frac{E\ \varepsilon\ F_E}{\pi} + q_p)\ W\pi dx \qquad \text{(cylinder)}$$

where

W = radiator width for flat plate radiator and diameter for a cylindrical radiator

q_p = parasitic heat flux caused by radiation exchange with other surfaces.

Considering heat loads leaving the differential strip, the heat load due to the fluid becomes

$$\dot{m}_R\ CpT_{x+dx}$$

The heat load leaving the strip because of radiation to space becomes

$$2\sigma \left(\frac{T_x^{\ 4} + T_{x+dx}^4}{2}\right)\ \varepsilon\ FWdx \qquad \text{(flat plate)}$$

$$\sigma \left(\frac{T_x^{\ 4} + T_{x+dx}^4}{2}\right)\ \varepsilon\ FW\pi dx \qquad \text{(cylinder)}$$

where

σ = Stefan-Boltzmann constant (0.173×10^{-8} BTU/hr-ft^2-$^oR^4$)

F = view factor surface has to space.

For this analysis the q_p term will not be considered. It is not used in the computer programs because of the difficulty of computing such a term. In a more rigorous model, however, it could be used. The reader should note that it exists, although often negligible in value.

Summing the terms with the convention of heat out minus heat in gives for a flat plate:

$$\dot{m}_R Cp(T_{x+dx} - T_x) + 2\sigma\left(\frac{T_x^{4} + T_{x+dx}^{4}}{2}\right)\varepsilon\ FWdx - (S\ \alpha_s F_S + 2SaF_A\ \alpha_s + 2E\varepsilon F_E) = 0 \quad (17)$$

let

$$(S\ \alpha_s\ F_S + 2SaF_A\ \alpha_s + 2E\ \varepsilon\ F_E) = q_{EXT} \quad (18)$$

Rearranging Equation (17):

$$\frac{dT}{q_{EXT} - 2\sigma\ \varepsilon\ FT^4} = \frac{Wdx}{\dot{m}_R\ Cp} \quad (19)$$

Integrating:

$$\frac{Wdx}{\dot{m}_R\ Cp} = \frac{1}{(2\sigma\ \varepsilon\ F)^{1/4}}\left\{\frac{1}{4(q_{EXT})^{3/4}} \ln\left|\frac{(q_{EXT})^{1/4} + (2\sigma\ \varepsilon\ F)^{1/4}T}{(q_{EXT})^{1/4} - (2\sigma\ \varepsilon\ F)^{1/4}T}\right| + \frac{1}{2\ (q_{EXT})^{3/4}} \tan^{-1}\left[\frac{(2\sigma\ \varepsilon\ F)^{1/4}T}{(q_{EXT})^{1/4}}\right]\right\}\Bigg|_{T_I}^{T_R} \quad (20)$$

let

$$A = WX \qquad \text{(by definition)}$$

$$k = \left(\frac{2\sigma\ \varepsilon\ F}{q_{EXT}}\right)^{1/4} \qquad \text{(for a cylinder the factor of 2 would be missing)} \tag{21}$$

Substituting T_R, T_I and k and rearranging, the following equation is obtained:

$$\left(\frac{q_{EXT}A}{\dot{m}_R C p T_I}\right)(KT_I) = 1/4\left(\ln\left|\frac{1 + (KT_I)\left(\frac{T_R}{T_I}\right)}{1 - (KT_I)\left(\frac{T_R}{T_I}\right)}\right| - \ln\left|\frac{1 + (KT_I)}{1 - (KT_I)}\right|\right)$$

$$+ 1/2\left(\tan^{-1}\left[(KT_I)\left(\frac{T_R}{T_I}\right)\right] - \tan^{-1}\left[KT_I\right]\right) \tag{22}$$

The above equation relates external heat inputs to the radiator area and mass flow rate of coolant, and correlates these parameters with fluid temperatures. All of this is accomplished in terms of dimensionless parameters. Now the dissipation D must be related to these parameters through a second dimensionless expression. Relating D to the radiator flow, an equation similar to Equation (5) is obtained:

$$D = \dot{m}_R C p\ (T_I - T_R) \tag{23}$$

Dividing this expression by $q_{EXT}A$ and rearranging, the following expression is obtained:

$$\frac{D}{q_{EXT}A} = \left(\frac{\dot{m}_R C p T_I}{q_{EXT}A}\right)\left[1 - \frac{T_R}{T_I}\right] \tag{24}$$

This expression is the second required equation in terms of dimensionless parameters, and it now provides a relationship between D and the other flow parameters. Equation (22) is valid only for values of KT_R, which is represented by $\left[KT_I\left(\frac{T_R}{T_I}\right)\right]$, greater than 1.0; below this value it has regions of both no physical significance and a partial absorber instead of an efficient radiator.

Figure 24 displays a plot of Equations (22) and (24) as functions of KT_I and $D/q_{EXT}A$ for pertinent ranges of the parameters. These two dimensionless numbers can be computed from known parameters, yielding values for T_R/T_I and $\frac{\dot{m}_R CpT_I}{q_{EXT}A}$ from the graph. This gives an immediate solution to the flow problem. Thus, T_R may be determined and either $\dot{m}_R$ or A will be known, depending on the calculation, allowing the other to be immediately found. If the calculation is to size area, $\dot{m}_R$ will equal $\dot{m}_T$ and thus will be known as a worst-case EOL condition, allowing A to be found from the dimensionless parameter. If A is known, $\dot{m}_R$ may be found for a degraded condition from the dimensionless parameter.

For the special case of KT_R equal to 1.0, the area is infinite, this case allows calculation of the α_s maximum limit for which the system can remain "in spec" even with infinite area. Equating KT_R equal to 1.0, the following formulations are found:

$$\alpha_s = \frac{2\varepsilon\left(\sigma F T_R^{\ 4} - EF_E\right)}{S(F_S + 2aF_A)} \qquad \text{(flat plate)} \qquad (25)$$

$$\alpha_s = \frac{\varepsilon\left(\sigma F T_R^{\ 4} - \frac{EF_E}{\pi}\right)}{S\ (F_S + \frac{aFA}{\pi})} \qquad \text{(cylinder)} \qquad (26)$$

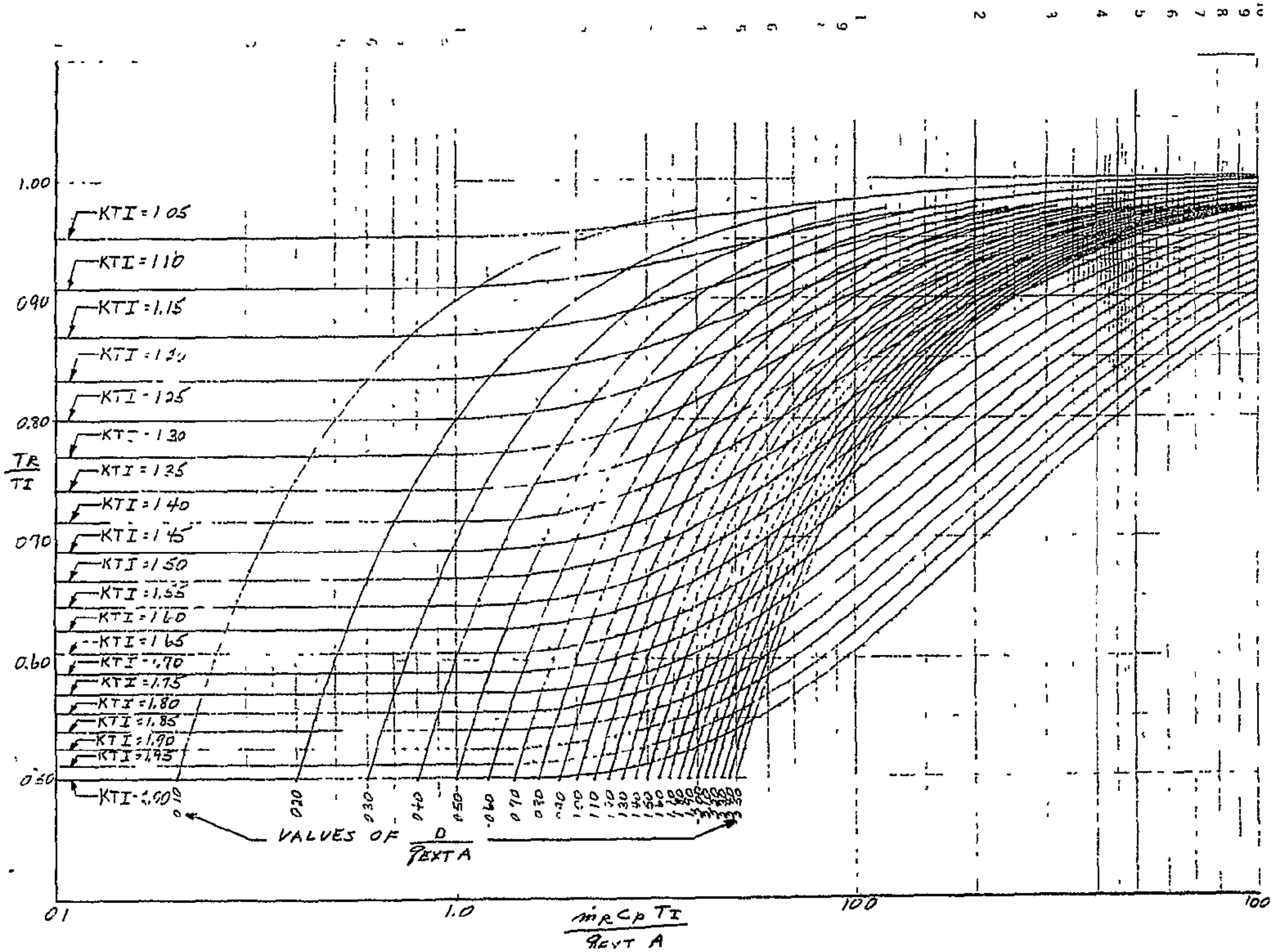

FIGURE 24 GRAPHICAL SOLUTION PLOT OF T_R/T_I AND $\frac{\dot{m}_R C_p T_I}{q_{EXT} A}$ AS A FUNCTION OF $D/q_{EXT}A$ AND KT_I

Using system-defined values such as temperatures and dissipation, and orbit definition relating β and altitude along with known constants, Figures 16 through 21 and Figure 23 may be used to graphically solve the radiator-flow problem in a concise fashion. The only parameter yet to be solved for is the mean temperature of the radiator. This can be solved by a simple heat balance. The equations for solution are as follows:

$$T = \left[\left(D + S\,\alpha_s\,F_S + 2\,Sa\,\alpha_s\,F_A + 2\,E\,\varepsilon\,F_E\right)/(2\sigma\varepsilon F)\right]^{1/4} \quad \text{(flat plate)} \tag{27}$$

$$T = \left[\left(D + S\,\alpha_s F_S + \frac{Sa\,\alpha_s\,F_A}{\pi} + \frac{E\,\varepsilon\,F_E}{\pi}\right)/(\sigma\,\varepsilon\,F)\right]^{1/4} \quad \text{(cylinder)} \tag{28}$$

where

T = mean radiator temperature.

The total solution to the radiator-flow problem has been programmed in both programs using the above equations. The numerical bi-section procedure is used to find the intersection of the family parameters KT_I and $D/q_{EXT}A$ to provide solutions to Equations (22) and (24) in a concise and accurate fashion. The number of iterations required are printed out with the solution under the heading "ITN."

The techniques embodied in the computer programs provide the basis for useful preliminary design tools with powerful and rigorous solution capacity, while still maintaining the ability for sufficient generality in terms of orbital and system requirements. All analyses performed in this study were performed with these programs.

2.2.5 External Heat Input Blockage Factors

Because there is no concise way of accounting for the parasitic load (q_p) absent in many of the equations (its value is often negligible) it has been neglected. However, the presence of other surfaces often causes blockage of external heat inputs, which cannot be neglected. Therefore, blockage factors which provide the degree of blockage (or passage) of direct solar, albedo, and earthshine inputs individually are inputs to both programs. There are values for each type of external input for the radiator and in the case of the space station program, values are input for both types of radiators independently. As an example, if a value of 0.6 is input for direct solar, this implies only 60 percent of the available direct solar input is incident on the radiator and 40 percent has been blocked by other surfaces. Values of 0.0 mean total blockage and values of 1.0 mean no blockage.

2.2.6 Program Inputs

The following card inputs are required. Use of the inputs in one or both of the programs is indicated alongside the card designation:

Card 1: (Both programs)

Parameter Name	Description	Field Columns	Format
NAL1	Lowest altitude considered (nmi)	1-10	I 10
NAL2	Highest altitude considered (nmi)	11-20	I 10
NAL3	Incremental altitude value for looping (nmi)	21-30	I 10

Card 2: (Both programs)

Parameter Name	Description	Field Columns	Format
NB1	Lowest β angle considered (degrees)	1-10	I 10
NB2	Highest β angle considered (degrees)	11-20	I 10
NB3	Incremental β value for looping (degrees)	21-30	I 10

Card 3: (Both programs except BREAK)

Parameter Name	Description	Field Columns	Format
ND1	Lowest value of dissipation (kW)	1-10	I 10
ND2	Highest value of dissipation (kW)	11-20	I 10
ND3	Incremental dissipation value for looping (kW)	21-30	I 10
BREAK (Space Station Program Only)	Dissipation value to change from flat to cylindrical radiators (kW)	31-40	F10.4

Card 4: (Module Program only)

Parameter Name	Description	Field Columns	Format
MDP	Time period over which solution is considered (months)	1-10	I 10
MODI	Time increment between solutions within MDP period (months)	11-20	I 10

Card 4: (Space Station Program Only)

Parameter Name	Description	Field Columns	Format
MDP	EOL time period for flat-plate radiator over which solution is considered (months)	1-10	I 10
MDC	EOL time period for cylindrical radiator over which solution is considered (months)	11-20	I 10
MODIP	Flat-plate radiator time increment between solutions within MDP period (months)	21-30	I 10
MODIC	Cylindrical radiator time increment between solutions within MDC period (months)	31-40	I 10

All following cards are inputs for either flat-plate radiators or cylindrical radiators and have an appropriate "P" or "C" in column one:

Card 5: (Both programs except PAREA)

Parameter Name	Description	Field Columns	Format
TEST	Alphanumeric P	1	A1
PTI	Flat-plate radiator inlet temperature (°F)	11-20	F10.4
PTM	Flat-plate radiator mix temperature (°F)	31-40	F10.4
PAREA (Module Program only)	Radiator platform area (ft^2)	51-60	F10.4

Card 6: (Space Station Program only)

Parameter Name	Description	Field Columns	Format
TEST	Alphanumeric C	1	A1
CTI	Cylindrical radiator inlet temperature (°F)	11-20	F10.4
CTM	Cylindrical radiator mix temperature (°F)	31-40	F10.4

Card 6: (Module Program), Card 7: (Space Station Program)

Parameter Name	Description	Field Columns	Format
TEST	Alphanumeric P	1	A1
PSHDS	Flat-plate radiator, direct solar blockage factor, range: 0-1.0	11-20	F10.4
PSHDE	Flat-plate radiator earthshine blockage factor, range: 0-1.0	31-40	F10.4
PSHDA	Flat-plate radiator albedo blockage factor, range: 0-1.0	51-60	F10.4

Card 7: (Module Program), Card 9: (Space Station Program)

Parameter Name	Description	Field Columns	Format
TEST	Alphanumeric P	1	A1
PSPACE	Flat-plate radiator view factor to space	11-20	F10.4
PCP	Flat-plate radiator coolant specific heat (BTU.lbm-^{o}R)	31-40	F10.4

Card 8: (Module Program), Card 11: (Space Station Program)

Parameter Name	Description	Field Columns	Format
TEST	Alphanumeric P	1	A1
PALPHA	Flat-plate radiator initial α_s value	11-20	F10.4
EMTP	Emittance of flat-plate radiator	31-40	F10.4
PDEG	Flat-plate radiator linear degradation rate ($\Delta\alpha_s$/Mo.)	51-60	F10.4

Card 8: (Space Station Program only)

Parameter Name	Description	Field Columns	Format
TEST	Alphanumeric C	1	A1
CSHDS	Cylindrical radiator direct solar blockage factor, range: 0-1.0	11-20	F10.4
CSHDE	Cylindrical radiator earthshine blockage factor, range: 0-1.0	31-40	F10.4
CSHDA	Cylindrical radiator albedo blockage factor, range: 0-1.0	51-60	F10.4

Card 10: (Space Station Program Only)

Parameter Name	Description	Field Columns	Format
TEST	Alphanumeric C	1	A1
CSPACE	Cylindrical radiator view factor to space	11-20	F10.4

Card 10: (Cont.)

Parameter Name	Description	Field Columns	Format
CCP	Cylindrical radiator coolant specific heat (BTU/lbm-^{o}R)	31-40	F10.4

Card 12: (Space Station Program only)

Parameter Name	Description	Field Columns	Format
TEST	Alphanumeric C	1	A1
CALPHA	Cylindrical radiator initial α_s value	11-20	F10.4
EMTC	Emittance of the cylindrical radiator	31-40	F10.4
CDEG	Cylindrical radiator linear degradation rate ($\Delta\alpha_s$/Mo.)		

The reason for the alphanumeric P and C designations is two-fold. First of all, it is to make the user aware of the input, as a mistaken input dealing with the radiator parameters could result in an excessive output of useless data and unnecessary waste of machine time. With their ability to vary parameters, these programs are capable of generating large quantities of printout requiring caution with input data. The other reason is concerned with the space station program only. Cards for the flat-plate and cylindrical radiators are inputted in alternating fashion: first a card for the flat-plate radiator, then a card for the cylindrical radiator. Such an identification procedure makes the user more aware and the data more easily identifiable.

The last card input in both programs deals with surface properties, α_s, ε, and degradation rate. As many of these cards as desired may be added on to generate a study over a range of property values or degradation rates. The program will perform calculations for all other inputs for each one of these cards until no more cards are found, at which time it will terminate the run. For the space station program, additional surface property cards must be inputted in pairs, one for the flat-plate radiator then one for the cylindrical radiator.

A special routine called "Readre" is called in the beginning of both programs. This routine allows a card to be reread off a unit 99 instead of the unit 5 card reader. The candidate P or C value is read by the card reader and then, if the proper designation is in column 1, the remaining values are read from unit 99. It is assumed another computer will have a similar routine; if not, little code change would be needed to illuminate the "Readre" routine. It is merely a programming convenience.

The power module program inputs consist of eight cards plus possible additional surface-property cards. The space station program inputs consist of 12 cards plus possible additional pairs of surface-property cards. With these inputs, as listed above, individual problems may be evaluated or entire parametric studies can be generated with a single run. Core allocation need only be 45 k for the power module program and 55 k for the space station program. No tape drives or disk storage are required. The program listings, along with sample inputs and outputs, will be presented in Appendixes A and B, respectively. Appendix C presents a sample case of the space station program.

2.3 TECHNOLOGY ASSESSMENT

While prediction of the effects of the space environment on thermal-control surfaces is a problem faced on all space programs, the associated data base is diffuse and must be applied with caution. The problem of predicting the effect of radiation interaction with materials in vacuum is complex and difficult to solve. Experimentally obtained data are limited because of inadequate simulation techniques. Flight experiments are the basis for the best engineering information available today on the effects of the space environment on thermal-control surfaces. However, such data are limited to the accuracy of temperature measurements, and may be significantly biased by unknown events that occurred prior to or during the mission (e.g., pre-orbit contamination, on-orbit contamination, electrostatic discharge damage, etc.).

2.3.1 Literature Search

AESC conducted a literature search and industry survey of thermal-control-surface technology and application. Particular attention was given to caveats and limitations affecting the application of the data to the use in the study.

The literature search identified the current state of the art in space-stable thermal-control surfaces where low-temperature thermal control is required. This search made use of the on-line computer capabilities of DIALOG, the system monitored by Lockheed Information Sciences Laboratory in Palo Alto, California. With DIALOG, all Government-sponsored work released to the public from the year 1964 to date can be searched with a high degree of specificity (NTIS data base). Other computer-search systems were used to screen the material published in over 7000 worldwide major scientific and technical journals from 1970 to date. The indexing done by the following data bases were searched: INSPEC (formerly Science Abstracts), COMPENDEX (Engineering Index), ISMEX, SCISEARCH, and CDA (Comprehensive Dissertation Abstracts).

The information data base of NASA was consulted as well. A search strategy was devised to provide the most logical and complete search for all parameters involved in the identification of space-stable thermal-control surfaces. In addition to on-line efforts, the latest NASA budget hearings were reviewed, the requirements posed by the current NASA 5-year plan were perused, and proceedings of symposia and conferences considering the problem, but not indexed conventionally, were reviewed.

The information available from appropriate information analysis centers (such as the Defense Documentation Center) was sought for classified literature. Only that portion of the search that was unclassified is presented in this report. Assistance was also sought from the Government-Industrial Data Exchange Program (GIDEP) at Corona, California.

Finally, pertinent information from other NASA facilities (such as Goddard, MSFC, etc.) that do not report all of their efforts through NASA's announcement publications, STAR (Scientific and Technical Aerospace Reports) was sought to assure completeness of the effort.

The entire literature search is presented as Volume II of this interim report.

2.3.2 Industry Survey

To supplement the literature search, AESC also conducted an industry survey. The results of that survey, along with the organization and responsible individuals, are presented in Appendix D. A sampling of the type of information requested from those agencies and industrial organization who participated was as follows:

- Do you agree with the findings of the literature search? That is, is it your opinion that (1) space-stable materials are available for low earth orbits, and (2) space-stable materials for geosynchronous orbits do not exist (i.e., for lifetimes greater than five (5) years).
- What type of programs do you envision will be needed to meet the requirements of long-term (25 years) missions.
- If a NASA center - do you plan to submit RTOP's in any of these areas?

The information in the Appendix is presented not in any preferential order, but as presented to the study manager in the survey.

2.3.3 Technology Assessment

A comparison was made between the current technology and the thermal-control-surface requirements for both the 25-kW power module and the space station, with more emphasis on the 25-kW power module. Table 2 lists those areas which were addressed by the study.

TABLE 2 TECHNOLOGY AREAS ASSESSED IN THE SSTCS STUDY

● Ground-based testing	● Electrostatic charging of spacecraft
⊙ In-orbit servicing	⊙ Contamination modeling and control techniques
⊙ Monitoring instrumentation	● Nuclear radiation effects
⊙ Contamination control and avoidance	● Simulation and testing improvements
⊙ New and improved materials	⊙ Safety
	⊙ Cost

2.3.3.1 The 25-kW Power Module

Based on the analyses of the missions and on the power module design, no new or improved thermal-control surface will be required. In examining both silvered Teflon (Ag/FEP) and one of the more stable white paints for LEO (i.e., zinc orthotitanate/potassium silicate) it was concluded that both materials would inherently survive the radiation environment for five years. Unfortunately, when used on the radiators, these thermal-control surfaces are easily subjected to contamination which will subsequently degrade their performance. The contamination environment to which this platform will be subjected will be the key lifetime limiting factor. If the radiators are to be fully extended for the mission duration, in addition to the approximate 4000 ft^2 of solar array adhesives, they will be exposed to the blast and subsequent impingement of both the STS Reaction Control System (RCS) and Vernier Control System (VCS). If this platform is to operate on a continual basis for a period of five years, it will require new or replacement radiators before EOL.

An overview of general spacecraft contamination concerns shown in Table 3 indicates that three key issues must be carefully evaluated in order to develop an effective contamination control system and management plan:

- Initial contamination budget - cleanliness level, including maintenance, handling, and other pertinent procedural factors.
- Material selection - outgassing, transport-deposition properties, preflight space conditioning being a possible means of contamination reduction.
- Configuration and subsystem designs - avoidance of contaminant fluxes, implementation of on-board contamination preventive measures.

Contamination procedures will require advancement in a number of areas to maintain higher level of cleanliness for this and future missions. Those areas of concern are indicated in Table 2 by ⊙ .

TABLE 3 GENERAL SPACECRAFT CONTAMINATION CONCERNS

- Deposition or Film Formation - Surface physical/ chemical property changes, optical and thermal performance degradation
- Plume Impingement or Particle Streams - Surface erosion, blast damage
- Particulate/Molecular Environments - Light scattering and absorption
- Radiation, Micrometeoroid Sputtering - Surface outgassing, contaminant flux trajectories

Since configuration changes or the implementation of on-board contamination preventive measures are required to meet mission lifetimes, it is recommended that the following be considered:

- Utilization of analytical models (and computer codes) for predicting contaminant flow fields, deposition-fluxes, and degradation rates, including gas-surface interactions, multispecies and multimolecular layer adsorption kinetics.
- Development of a methodology for an optimum cost-effective contamination-control solution for a 25-kW power module based on analytical tools, mission profiles, cost requirements, etc.

2.3.3.2 General Space Station

The assessment for the space station was partially completed during this first phase. The entire assessment will be completed during the follow-on portion. The comparison to date is in close agreement with the results of the industry survey.

The electrostatic charging of spacecraft from magnetospheric disturbances and on-board sources is of great concern for missions at or near geosynchronous attitude. Many spacecraft have experienced charge buildup in multilayer insulations and dielectric thermal-control surfaces. In addition, circuitry switching believed attributable to these sources has occurred on numerous occasions. High voltage with SEP, NEP, nuclear power, and large solar panels can provide strong charging sources on future missions. New or improved space-stable conductive, thermal-control surfaces are required.

Thermal-control surfaces are easily subjected to contamination which can subsequently degrade their performance. Extremely cold radiators required for cryogenic cooling can act as molecular sinks for any liquids or gases. Contamination of optics can degrade video coverage and G&C trackers. SEP, using mercury or cesium as a fuel, can deposit its exhaust products on nearby radiators, lowering their emittance, and thus their capability to reject heat from high-temperature power-conversion units. Hot plasma from NEP could contaminate and damage critical thermal-control surfaces.

Contamination procedures will require advancement in a number of areas to maintain higher levels of cleanliness for future missions. Cleaning procedures, such as using heaters to drive off contaminants, can be utilized. Active cleaning techniques (e.g., atomic-oxygen sputtering) to drive off vapor-deposited contaminants (e.g., mercury or cesium ions) should be considered. Monitoring techniques (QCMS), such as those used on present-day spacecraft, are also a must. The system costs of maintaining adequate contamination control will continue to expand if tight reins are not put on the subject from the conception of a mission.

The disposal of hazardous waste payloads by launches from earth to deep space may become feasible. Technology requirements to include nuclear radiation effects of thermal-control surfaces should be considered.

Improvements in simulation accuracy, speeding up the testing process, personnel safety, and overall system cost reductions are technology developments required to advance the state of the art in this field.

2.4 PROGRAM PLANNING

No effort was expended on this task during this period. This has been redirected to be completed during the follow-on effort.

Section 3

CONCLUDING REMARKS

This study has resulted in the definition of generalized-space-station active-thermal-control-radiation heat-rejection requirements: geometry, orbital constraints, potential degradation effects, and environmental considerations. In addition, two computer programs have been developed which provide a preliminary design and evaluation tool for active radiator systems in low earth orbit. One program was developed as a general program for space station analysis while the other program was specifically tailored to provide an analysis tool for the 25-kW power module. The power module program was extensively used for both the degradation at end-of-life and radiator sizing analyses for the module.

Results indicate that the present thermal-control system of the 25-kW power module design cannot survive "in spec" for a five-year period (even with the most favorable conditions) without lowering the primary mission β angle considerably, or without refurbishing or replacing the radiators at least once.

The literature search has indicated that space-stable, thermal-control surfaces exist today for extended low-earth-orbit (LEO) missions (contamination free). Unfortunately, the same cannot be said for geosynchronous altitude missions. Except for the costly silvered-quartz second-surface mirrors, low α/ε ratio thermal-control surfaces will not survive long-duration missions. Missions (contamination-free) at this altitude requiring low-cost low α/ε surfaces will most likely be forced to replace or refurbish surfaces after five years.

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APPENDIX A

Fortran Listings for Computer Programs

The Fortran listings of both computer programs are presented in this Appendix. The listing of the power module program will be presented first, followed directly by the listing for the general space station program.

OS/360 FORTRAN H

```
  COMPILER OPTIONS - NAME=  MAIN,OPT=00,LINECNT=55,SIZE=0000K,
                     SOURCE,EBCDIC,NOLIST,NODECK,LOAD,MAP,NOEDIT,ID,XREF
          C
          C       ******************************************************************
          C
          C       THIS PROGRAM IS DESIGNED TO EVALUATE RADIATOR PERFORMANCE WITHIN
          C       THE THERMAL CONTROL SYSTEM FOR THE 25 KW POWER MODULE PROGRAM.
          C       IT COMPUTES THE MEAN RADIATOR TEMPERATURE, REQUIRED MASS FLOW RATE
          C       AND EXIT FLUID TEMPERATURE FOR DOUBLE SIDED FLAT PLATE RADIATORS,
          C       THIS INCLUDES DEGRADED PERFORMANCE WITH TIME. IT IS ASSUMED PLANE
          C       OF RADIATORS IS IN ORBIT PLANE, EXTERNAL LOADS ARE COMPUTED IN
          C       THE PROGRAM INCLUDING DIRECT SOLAR, ALBEDO AND EARTHSHINE. SHAPE
          C       FACTOR TO SPACE AND EXTERNAL INPUT BLOCKAGE FACTORS MAY BE INPUT.
          C       PROGRAM MAY BE USED TO PARAMETRICALLY EVALUATE EFFECTS OF
          C       DEGRADATION, RADIATOR PERFORMANCE AND AREA SIZING FOR A VARIETY OF
          C       INPUT ORIENTATIONS, DISSIPATIONS, DEGRADATION RATES AND ALTITUDES
          C       FROM 100 TO 1000 NAUTICAL MILES. THIS PROGRAM IS FOR ' L E O '
          C       CONDITIONS ONLY ASSUMING ORBIT PERIODS SUFFICIENTLY SMALL TO USE
          C       MEAN ORBITAL EXTERNAL INPUT SHAPE FACTORS.
          C
          C       ******************************************************************
          C
 0002             DIMENSION X(2),DIFF(2)
 0003             DATA PLATE/'P   '/
 0004             CALL READRE
          C       ******************************************************************
          C       EARTH ORBITAL CONSTANTS.
          C       ******************************************************************
 0005             R=3441.0
 0006             S=442.4
 0007             A=0.4
 0008             E=66.36
 0009             SIGMA=0.173E-08
          C       ******************************************************************
          C       READ IN INPUT DATA FOR GENERAL ORBITAL CONSIDERATIONS.
          C       ******************************************************************
 0010             READ(5,200) NAL1,NAL2,NAL3
 0011         200 FORMAT (3I10)
 0012             READ(5,200) NB1,NB2,NB3
 0013             READ(5,200) ND1,ND2,ND3
 0014             READ(5,200) MDP,MODI
          C       ******************************************************************
          C       READ IN INPUT DATA FOR PLATE RADIATOR CONSIDERATIONS.
          C       ******************************************************************
 0015             READ(5,202) TEST
 0016         202 FORMAT (1A4)
 0017             IF(TEST.NE.PLATE) GO TO 203
 0019             READ(99,204) PTI,PTM,PAREA
 0020         204 FORMAT (10X,3(F10.4,10X))
 0021             PTI=PTI+459.67
 0022             PTM=PTM+459.67
 0023             READ(5,202) TEST
 0C               IF(TEST.NE.PLATE) GO TO 203
```

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR

```
      READ(99,204) PSHDS,PSHDE,PSHDA
      READ(5,202) TEST
      IF(TEST.NE.PLATE) GO TO 203
      READ(99,204) PSPACE,PCP
  250 READ(5,202,END=800) TEST
      IF(TEST.NE.PLATE) GO TO 203
      READ(99,204) PALPHA,EMTP,PDEG
C     ******************************************************************
C     PRINTOUT OF PERTINENT INPUTS.
C     ******************************************************************
      WRITE(6,20)
      WRITE(6,206)
  206 FORMAT(1X,'2 5 K W   P O W E R   M O D U L E   P R O G R A M .',//
     */)
      WRITE(6,207) NAL1,NAL2,NAL3
  207 FORMAT (1X,'ALTITUDE (N.MI.), LOWEST = ',I5,2X,'HIGHEST = ',I5,2X,
     *'INCREMENT = ',I5,/)
      WRITE(6,208) NB1,NB2,NB3
  208 FORMAT (1X,'ORBIT INCLINATION (DEG.), LOWEST = ',I5,2X,'HIGHEST =
     *',I5,2X,'INCREMENT = ',I5,/)
      WRITE(6,209) ND1,ND2,ND3
  209 FORMAT (1X,'DISSIPATION (KW.), LOWEST = ',I5,2X,'HIGHEST = ',I5,2X
     *,'INCREMENT = ',I5,/)
      WRITE(6,210) MDP,MODI
  210 FORMAT (1X,'MONTHS DEGRADATION FOR PLATE RADIATOR = ',I5,2X,'INCRE
     *MENT = ',I5,/)
      WRITE (6,211)
  211 FORMAT (1X,'SHADING COEFFICIENTS')
      WRITE(6,212) PSHDS,PSHDE,PSHDA
  212 FORMAT (1X,'PLATE, SOLAR = ',F10.8,2X,'EARTHSHINE = ',F10.8,2X,'AL
     *BEDO = ',F10.8,/)
      WRITE(6,214) PSPACE,PCP
  214 FORMAT (1X,'PLATE, SHAPE FACTOR TO SPACE = ',F10.8,2X,'FLUID CP =
     *',F10.4,2X,'BTU/LBM-R.',/)
      WRITE(6,216)
  216 FORMAT (1X,'RADIATOR MATERIAL PROPERTIES')
      WRITE(6,217) PALPHA,EMTP,PDEG
  217 FORMAT (1X,'PLATE, ABSORPTANCE = ',F10.5,2X,'EMITTANCE = ',F10.5,2
     *X,'MONTHLY CHANGE IN ABSORPTANCE = ',F10.6,/)
C     ******************************************************************
C     CONTROL LOOP FOR ALTITUDE VARIATION.
C     ******************************************************************
      DO 270 M=NAL1,NAL2,NAL3
      AL=1.0*M
C     ******************************************************************
C     CALCULATION OF EARTHSHINE SHAPE FACTORS FROM POLYNOMIAL FITS.
C     ******************************************************************
      FP=0.4127579927-AL*0.6963855121E-03+(AL**2)*0.6778353736E-06-(AL**
     *3)*0.2684461542E-09
      FP=FP*PSHDE
C     ******************************************************************
C     CONTROL LOOP FOR ORBIT INCLINATION VARIATION.
C     ******************************************************************
```

```
      DO 270 L=NB1,NB2,NB3
      B=1.0*L
      B=B*(3.141593/180.0)
C     ******************************************************************
C     CALCULATION OF ORBITAL MEAN FS AND FA VALUES.
C     ******************************************************************
      THETA=0.0
      PFS=0.0
      PFA=0.0
      DO 3 N=1,360
      THETA=THETA+1.0*(3.14159/180.0)
C     ******************************************************************
C     ALBEDO AND DIRECT SOLAR SHAPE FACTOR CALCULATIONS FOR FLAT
C     PLATE RADIATOR.
C     ******************************************************************
      FS=SIN(B)
      TEST=((AL+R)*SIN(B))/R
      IF(TEST.GT.1.0) GO TO 4
      SANGLE=ARCOS((R*SIN(ARCOS(((AL+R)*SIN(B))/R)))/((AL+R)*COS(B)))+90
     *.0*(3.14159/180.0)
      COMP=2.0*(3.14159)-SANGLE
      IF(THETA.GT.SANGLE.AND.THETA.LT.COMP) FS=0.0
    4 CONTINUE
      PFS=PFS+FS
      GAMMA=COS(THETA)*COS(B)
      FA=FP*GAMMA
      IF(FA.LT.0.0) FA=0.0
      PFA=PFA+FA
    3 CONTINUE
      PFSM=(PFS/360.0)*PSHDS
      PFAM=(PFA/360.0)*PSHDA
C     ******************************************************************
C     CONTROL LOOP FOR DISSIPATION VARIATION.
C     ******************************************************************
      DO 270 K=ND1,ND2,ND3
      DD=1.0*K
      D=DD*3.412*1000.0
C     ******************************************************************
C     COMPUTATION OF INITIAL ON ORBIT PARAMETERS FOR FLAT PLATE RADIATOR
C     ******************************************************************
      FLO=D/(PCP*(PTI-PTM))
      PERTH=2.0*E*EMTP*FP*PAREA
      PSOL=S*PALPHA*PFSM*PAREA
      PAL=2.0*A*S*PALPHA*PFAM*PAREA
C     ******************************************************************
C     PRINTOUT OF INITIAL ON ORBIT PARAMETERS FOR FLAT PLATE RADIATOR.
C     ******************************************************************
      WRITE(6,20)
   20 FORMAT (1H1)
      D1=D/(3.412*1000.0)
      WRITE(6,21)D,D1
   21 FORMAT (1X,'FLAT PLANE RADIATOR FOR CASE OF ',F8.1,1X,'BTU/HR. DIS
     *SIPATION = ',F5.1,1X,'KW.',/)
```

```
      PTI=PTI-459.67
      PTM=PTM-459.67
      WRITE(6,27) PTI,PTM,FLO
   27 FORMAT (1X,'TEMPERATURES (F), INLET = ',F7.2,' , MIX = ',F7.2,' ,
     *COOLANT FLOW RATE (LBM/HR) = ',F9.2,/)
      PTI=PTI+459.67
      PTM=PTM+459.67
      WRITE(6,22) PAREA
   22 FORMAT (1X,'PLATFORM AREA IN FT2 = ',F10.4,/)
      B=B*(180.0/3.14159)
      WRITE(6,35) B,AL
   35 FORMAT(1X,'ORBIT INCLINATION =',F5.1,1X,'DEGREES, ALTITUDE =',F7.1
     *,1X,'NAUTICAL MILES.',/)
      B=B*(3.14159/180.0)
      WRITE(6,51) PERTH,PSOL,PAL
   51 FORMAT (1X,'EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = ',F10.3,2
     *X,'SOLAR = ',F10.3,2X,'ALBEDO = ',F10.3,/)
      WRITE(6,28)
   28 FORMAT (1X,'EFFECT OF DEGRADATION',/)
      WRITE(6,29)
   29 FORMAT (1X,'     MONTH       INLET (F)         RAD (F)     OUTLET (F
     *)     MFR(LBM/HR)  ABSORPTANCE     SOL(BTU/HR)      AL(BTU/HR)       A
     *CA        ITN',/)
C     ******************************************************************
C     CALCULATION OF TEMPS. AND FLUID PARAMETERS WITH DEGRADATION
C     FOR FLAT PLATE RADIATOR.
C     SOLUTICN OF GOVERNING NCN-DIMENSIONAL EQUATIONS FOUND BY
C     BI-SECTION METHOD.
C     ******************************************************************
      DALPHA=PALPHA
      NMDP=MDP+1
      DO 400 J=1,NMDP,MODI
      PT4=(D+S*PAREA*PFSM*DALPHA+2.0*S*A*DALPHA*PFAM*PAREA+2.0*E*PAREA*E
     *MTP*FP)/(PAREA*PSPACE*EMTP*SIGMA*2.0)
      PT=PT4**0.25
      IF(PT.LT.PTI) GO TO 285
      WRITE(6,301)
  301 FORMAT (1X,'SOLUTION TERMINATED DUE TO RADIATOR MEAN TEMPERATURE B
     *EING GREATER THAN FLUID INLET TEMPERATCRE.',/)
      GO TO 265
  285 N=0
      QEXT=S*DALPHA*PFSM+2.0*S*A*DALPHA*PFAM+2.0*E*EMTP*FP
      PK=((2.0*SIGMA*EMTP*PSPACE)/QEXT)**0.25
      PTIK=PTI*PK
C     ******************************************************************
C     TEST TO SEE IF SOLUTION WITHIN PROPER RANGE OF PARAMETERS.
C     ******************************************************************
      XL=1.01/PTIK
      XR=0.999
      P1L=(0.25*ALOG(ABS((1.0+PTIK*XL)/(1.0-PTIK*XL)))-0.25*ALOG(ABS((1.
     *0+PTIK)/(1.0-PTIK)))+0.5*ATAN(PTIK*XL)-0.5*ATAN(PTIK))/PTIK
      P1L=1.0/P1L
      P2L=(D/(QEXT*PAREA))/(1.0-XL)
```

```
          DIFFL=P1L-P2L
          P1R=(0.25*ALOG(ABS((1.0+PTIK*XR)/(1.0-PTIK*XR)))-0.25*ALOG(ABS((1.
         *0+PTIK)/(1.0-PTIK)))+0.5*ATAN(PTIK*XR)-0.5*ATAN(PTIK))/PTIK
          P1R=1.C/P1R
          P2R=(D/(QEXT*PAREA))/(1.0-XR)
          DIFFR=P1R-P2R
          TEST=DIFFL*DIFFR
          IF(TEST.LT.0.0) GO TO 260
      220 WRITE(6,221)
      221 FORMAT (1X,'SOLUTION OUTSIDE TO/TI RANGE, SOLUTION TERMINATED.',/)
          GO TO 265
C     ******************************************************************
C         ITERATION PROCESS FOR SCLUTION.
C     ******************************************************************
      260 TEMP=XL
          X(1)=(XL+XR)/2.0
          X(2)=XR
      224 DO 222 NX=1,2
          P1=(0.25*ALOG(ABS((1.0+PTIK*X(NX))/(1.0-PTIK*X(NX))))-0.25*ALOG(AB
         *S((1.0+PTIK)/(1.0-PTIK)))+0.5*ATAN(PTIK*X(NX))-0.5*ATAN(PTIK))/PTI
         *K
          P1=1.0/P1
          P2=(D/(QEXT*PARFA))/(1.0-X(NX))
          DIFF(NX)=P1-P2
      222 CONTINLE
          TEST=DIFF(1)*DIFF(2)
          CRITRA=0.02
          DIF=(ABS(X(1)-X(2))/((X(1)+X(2))/2.0))*100.0
          N=N+1
          IF(DIF.LE.CRITRA) GO TO 240
          IF(TEST.GT.0.0) GO TO 225
          TEMP=X(1)
          X(1)=(X(1)+X(2))/2.0
          GO TO 224
      225 X(2)=X(1)
          X(1)=TEMP
          X(1)=(X(1)+X(2))/2.0
          GO TO 224
      240 T=(X(1)+X(2))/2.0
          P=(P1+P2)/2.0
C     ******************************************************************
C         COMPUTATION OF SOLUTION DIMENSIONAL VALUES.
C     ******************************************************************
          PTR=T*PTI
          PMRATE=P*((QEXT*PAREA)/(PCP*PTI))
          PADA=(PT**4-PTR**4)/(PTI**4-PTR**4)
          PDSOL=S*DALPHA*PFSM*PAREA
          PDAL=2.0*A*S*DALPHA*PFAM*PAREA
C     ******************************************************************
C         PRINTOUT OF DEGRADED CONDITIONS FOR FLAT PLATE RADIATOR.
C     ******************************************************************
          PTI=PTI-459.67
          PT=PT-459.67
```

```
      PTR=PTR-459.67
      NN=J-1
      WRITE(6,30) NN,PTI,PT,PTR,PMRATE,DALPHA,PDSOL,PDAL,PADA,N
   30 FORMAT (1X,I10,4(5X,F10.2),5X,F8.6,2(5X,F10.2),5X,F4.2,5X,I4)
      PTI=PTI+459.67
      PT=PT+459.67
      PTR=PTR+459.67
      DALPHA=DALPHA+PDEG*MODI
  400 CONTINUE
C     ************************************************************************
C     COMPUTE END OF LIFE SOLAR ABSORPTANCE VALUE AND REQUIRED RADIATOR
C     PLATFORM AREA TO REMAIN IN 'SPEC' WITH SUCH AN ABSORPTANCE.
C     ************************************************************************
  265 ALIFE=PALPHA+MDP*PDEG
      QLIFE=S*ALIFE*PFSM+2.0*S*A*ALIFE*PFAM+2.0*E*EMTP*FP
      PKLIFE=((2.0*SIGMA*EMTP*PSPACE)/QLIFE)**0.25
      PKPTM=PKLIFE*PTM
      PAAI=(2.0*EMTP*(SIGMA*PSPACE-((1.0/PTM)**4)*E*FP))/(S*(PFSM+2.0*A*
     *PFAM)*((1.0/PTM)**4))
      IF(PAAI.GT.1.0) PAAI=1.0
      IF(PKPTM.LE.1.0) GO TO 190
      PKTIL=PTI*PKLIFE
      XLIFE=PTM/PTI
      PL=(0.25*ALOG(ABS((1.0+PKTIL*XLIFE)/(1.0-PKTIL*XLIFE)))-0.25*ALOG(
     *ABS((1.0+PKTIL)/(1.0-PKTIL)))+0.5*ATAN(PKTIL*XLIFE)-0.5*ATAN(PKTIL
     *))/PKTIL
      AREA=PL*((FLO*PCP*PTI)/QLIFE)
C     ************************************************************************
C     PRINT ABSORPTANCE AND AREA VALUES.
C     ************************************************************************
      WRITE(6,281) AREA,MDP
  281 FORMAT (/,1X,'PLATFORM AREA REQUIRED TO REMAIN IN SPEC = ',F8.2,2X
     *,'FT2 FOR ',I3,2X,'MONTHS ON ORBIT.',/)
      WRITE(6,280) ALIFE,MDP,PDEG
  280 FORMAT (1X,'SOLAR ABSORPTANCE = ',F7.5,2X,'FOR ',I3,2X,'MONTHS OF
     *LIFE WITH A DEGRADATION RATE OF ',F8.6,2X,'CHANGE IN ABSORPTANCE P
     *ER MONTH.',/)
      WRITE(6,192) PAAI
  192 FORMAT (1X,'SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LO
     *ADS FOR SIZING RADIATOR AREA = ',F7.5,/)
      GO TO 270
  190 WRITE(6,191) PAAI
  191 FORMAT(/,1X,'EXTERNAL LOADS ARE TOO LARGE FOR INFINITE RADIATOR TO
     * REMAIN IN SPEC, SOLAR ABSORPTANCE VALUE FOR LIMIT = ',F7.5,/)
  270 CONTINUE
      GO TO 700
C     ************************************************************************
C     PROGRAM TERMINATION CONTROL.
C     ************************************************************************
  203 WRITE(6,219)
  219 FORMAT (1X,'MISTAKE MADE IN PLATE RADIATOR INPUT, PROGRAM TERMINAT
     *ED.')
  700 GO TO 250
  800 RETURN
      END
```

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                                           OS/360  FORTRAN H

  COMPILER OPTIONS - NAME=  MAIN,OPT=00,LINECNT=55,SIZE=0000K,
                         SOUPCE,EBCDIC,NOLIST,NODECK,LOAD,MAP,NOEDIT,ID,XREF
           C
           C      *****************************************************************
           C
           C      PROGRAM TO COMPUTE THE PLATFORM AREA REQUIRED FOR SPACE RADIATORS
           C      AND THEIR DEGRADED PERFORMANCE WITH TIME. IT IS ASSUMED FLAT
           C      EXTENDED RADIATORS WILL HANDLE DISSIPATION LOAD UP TO BREAK POINT
           C      AND THEN MODULE WRAP-AROUND ONE SIDED RADIATORS WILL HANDLE ALL
           C      ADDITIONAL DISSIPATION LOADS. IT IS ASSUMED FLAT RADIATORS ARE IN
           C      THE ORBIT PLANE AND WRAP-AROUND RADIATCRS ARE CYLINDRICAL IN SHAPE
           C      WITH END POINTING TOWARD THE EARTH. THIS PROGRAM IS FOR ' L E O '
           C      CONDITIONS ONLY AND ASSUMES ORBIT PERICDS SMALL ENOUGH TO USE
           C      ORBITAL MEAN EXTERNAL HEAT LOAD SHAPE FACTORS. THIS PROGRAM
           C      HANDLES DIRECT SOLAR, ALBEDO, AND EARTHSHINE INPUTS. ALTITUDE
           C      RANGE IS FROM 100 TO 1000 NAUTICAL MILES.
           C
           C      *****************************************************************
           C
 0002             DIMENSION X(2),DIFF(2)
 0003             DATA PLATE/'P   '/
 0004             DATA CYL/'C   '/
 0005             CALL READRE
           C      *****************************************************************
           C      EARTH ORBITAL CONSTANTS.
           C      *****************************************************************
 00               R=3441.C
 00               S=442.4
 0008             A=0.4
 0009             E=66.36
 0010             SIGMA=0.173E-08
           C      *****************************************************************
           C      READ IN INPUT DATA FOR GENERAL ORBITAL CONSIDERATIONS.
           C      *****************************************************************
 0011             READ(5,200) NAL1,NAL2,NAL3
 0012         200 FORMAT (3I10,F10.4)
 0013             READ(5,200) NB1,NB2,NB3
 0014             READ(5,200) ND1,ND2,ND3,BREAK
           C      *****************************************************************
           C      READ IN DATA FOR PLATE AND CYLINDRICAL RADIATOR CONSIDERATIONS.
           C      ' P ' STANDS FOR PLATE RADIATOR.
           C      ' C ' STANDS FOR CYLINDRICAL RADIATOR.
           C      *****************************************************************
 0015             READ(5,201) MDP,MDC,MODIP,MODIC
 0016         201 FORMAT (4I10)
 0017             READ(5,202) TEST
 0018         202 FORMAT (1A4)
 0019             IF(TEST.NE.PLATE) GO TO 203
 0021             READ(99,204) PTI,PTM
 0022         204 FORMAT (10X,3(F10.4,10X))
 0023             PTI=PTI+459.67
 0024             PTM=PTM+459.67
 00               READ(5,202) TEST
```

```
      IF(TEST.NE.CYL) GO TO 205
      READ(99,204) CTI,CTM
      CTI=CTI+459.67
      CTM=CTM+459.67
      READ(5,202) TEST
      IF(TEST.NE.PLATE) GO TO 203
      READ(99,204) PSHDS,PSHDE,PSHDA
      READ(5,202) TEST
      IF(TEST.NE.CYL) GO TO 205
      READ(99,204) CSHDS,CSHDE,CSHDA
      READ(5,202) TEST
      IF(TEST.NE.PLATE) GO TO 203
      READ(99,204) PSPACE,PCP
      READ(5,202) TEST
      IF(TEST.NE.CYL) GO TO 205
      READ(99,204) CSPACE,CCP
  750 READ(5,202,END=300) TEST
      IF(TEST.NE.PLATE) GO TO 203
      READ(99,204) PALPHA,EMTP,PDEG
      READ(5,202,END=300) TEST
      IF(TEST.NE.CYL) GO TO 205
      READ(99,204) CALPHA,EMTC,CDEG
C     ******************************************************************
C     PRINTOUT OF PERTINENT INPUTS.
C     ******************************************************************
      WRITE(6,20)
      WRITE(6,206)
  206 FORMAT(1X,'S P A C E   S T A T I O N   R A D I A T O R   P R O G R
     * A M',///)
      WRITE(6,207) NAL1,NAL2,NAL3
  207 FORMAT (1X,'ALTITUDE (N.MI.), LOWEST = ',I5,2X,'HIGHEST = ',I5,2X,
     *'INCREMENT = ',I5,/)
      WRITE(6,208) NB1,NB2,NB3
  208 FORMAT (1X,'ORBIT INCLINATION (DEG.), LOWEST = ',I5,2X,'HIGHEST =
     *',I5,2X,'INCREMENT = ',I5,/)
      WRITE(6,209) ND1,ND2,ND3,BREAK
  209 FORMAT (1X,'DISSIPATION (KW.), LOWEST = ',I5,2X,'HIGHEST = ',I5,2X
     *,'INCREMENT = ',I5,//,1X,'BREAK POINT FROM PLATE TO CYLINDRICAL RA
     *DIATORS (KW.) = ',F7.2,/)
      WRITE(6,210) MDP,MODIP,MDC,MODIC
  210 FORMAT (1X,'MONTHS DEGRADATION FOR FLAT PLATE RADIATOR  = ',I5,2X,
     *'INCREMENT = ',I5,/,1X,'MONTHS DEGRADATION FOR CYLINDRICAL RADIATO
     *R = ',I5,2X,'INCREMENT = ',I5,/)
      WRITE (6,211)
  211 FORMAT (1X,'SHADING COEFFICIENTS')
      WRITE(6,212) PSHDS,PSHDE,PSHDA
  212 FORMAT (1X,'PLATE, SOLAR = ',F10.8,2X,'EARTHSHINE = ',F10.8,2X,'AL
     *BEDO = ',F10.8)
      WRITE(6,213) CSHDS,CSHDE,CSHDA
  213 FORMAT (1X,'CYL. , SOLAR = ',F10.8,2X,'EARTHSHINE = ',F10.8,2X,'AL
     *BEDO = ',F10.8,/)
      WRITE(6,214) PSPACE,PCP
  214 FORMAT (1X,'PLATE, SHAPE FACTOR TO SPACE = ',F10.8,2X,'FLUID CP =
```

```
     *',F10.4,2X,'BTU/LBM-R.')
      WRITE(6,215) CSPACE,CCP
  215 FORMAT (1X,'CYL. , SHAPE FACTOR TO SPACE = ',F10.8,2X,'FLUID CP =
     *',F10.4,2X,'BTU/LBM-R.',/)
      WRITE(6,216)
  216 FORMAT (1X,'RADIATOR MATERIAL PROPERTIES')
      WRITE(6,217) PALPHA,EMTP,PDEG
  217 FORMAT (1X,'PLATE, ABSORPTANCE = ',F10.5,2X,'EMITTANCE = ',F10.5,2
     *X,'MONTHLY CHANGE IN ABSORPTANCE = ',F10.6)
      WRITE(6,218) CALPHA,EMTC,CDEG
  218 FORMAT (1X,'CYL. , ABSORPTANCE = ',F10.5,2X,'EMITTANCE = ',F10.5,2
     *X,'MONTHLY CHANGE IN ABSORPTANCE = ',F10.6,/,1H1)
C     ******************************************************************
C     CONTROL LOOP FOR ALTITUDE VARIATION.
C     ******************************************************************
      DO 270 M=NAL1,NAL2,NAL3
      AL=1.0*M
C     ******************************************************************
C     CALCULATION OF EARTHSHINE SHAPE FACTORS FROM POLYNOMIAL FITS.
C     ******************************************************************
      FP=0.4127579927-AL*0.6963855121E-03+(AL**2)*0.6778353736E-06-(AL**
     *3)*0.2684461542E-09
      FP=FP*PSHDE
      FC=1.296533585-AL*0.218701805E-02+(AL**2)*0.2127767402E-05-(AL**3)
     **0.8424327902E-09
      FC=FC*CSHDE
C     ******************************************************************
C     CONTROL LOOP FOR ORBIT INCLINATION VARIATION.
C     ******************************************************************
      DO 270 L=NB1,NB2,NB3
      B=1.0*L
      B=B*(3.141593/180.0)
C     ******************************************************************
C     CALCULATION OF ORBITAL MEAN FS AND FA VALUES.
C     ******************************************************************
      THETA=0.0
      PFS=0.0
      PFA=0.0
      CFS=0.0
      CFA=0.0
      DO 3 N=1,360
      THETA=THETA+1.0*(3.14159/180.0)
C     ******************************************************************
C     ALBEDO AND DIRECT SOLAR SHAPE FACTOR CALCULATIONS FOR FLAT
C     PLATE RADIATOR.
C     ******************************************************************
      FS=SIN(B)
      TEST=((AL+R)*SIN(B))/R
      IF(TEST.GT.1.0) GO TO 4
      SANGLE=ARCOS((R*SIN(ARCOS(((AL+R)*SIN(B))/R)))/((AL+R)*COS(B)))+90
     *.0*(3.14159/180.0)
      COMP=2.0*(3.14159)-SANGLE
      IF(THETA.GT.SANGLE.AND.THETA.LT.COMP) FS=0.0
```

```
    4 CONTINUE
      PFS=PFS+FS
      GAMMA=COS(THETA)*COS(B)
      FA=FP*GAMMA
      IF(FA.LT.0.0) FA=0.0
      PFA=PFA+FA
C     ***********************************************************************
C     ALBEDO AND DIRECT SOLAR SHAPE FACTOR CALCULATIONS FOR
C     CYLINDRICAL RADIATOR.
C     ***********************************************************************
      FS=(1.0/3.14159)*SIN(ARCOS(COS(THETA)*COS(B)))
      IF(TEST.GT.1.0) GO TO 50
      IF(THETA.GT.SANGLE.AND.THETA.LT.COMP) FS=0.0
   50 CFS=CFS+FS
      FA=FC*GAMMA
      IF(FA.LT.0.0) FA=0.0
      CFA=CFA+FA
    3 CONTINUE
      PFSM=(PFS/360.0)*PSHDS
      PFAM=(PFA/360.0)*PSHDA
      CFSM=(CFS/360.0)*CSHDS
      CFAM=(CFA/360.0)*CSHDA
C     ***********************************************************************
C     CONTROL LOOP FOR DISSIPATION VARIATION.
C     ***********************************************************************
      DO 270 K=ND1,ND2,ND3
      DD=1.0*K
      D=DD*3.412*1000.0
      IF(DD.GT.BREAK) GO TO 150
C     ***********************************************************************
C     COMPUTATION OF INITIAL ON ORBIT PARAMETERS FOR FLAT PLATE RADIATOR
C     AREA SIZED FOR MAXIMUM SOLAR ABSORPTANCE OVER TIME INTERVAL.
C     ***********************************************************************
      PAMAX=PALPHA+MDP*PDEG
      PAAI=(2.0*EMTP*(SIGMA*PSPACE-((1.0/PTM)**4)*E*FP))/(S*(PFSM+2.0*A*
     *PFAM)*((1.0/PTM)**4))
      IF(PAAI.GT.1.0) PAAI=1.0
      CHECK=0.0
      IF(PAMAX.EQ.PAAI.OR.PAMAX.GT.PAAI) CHECK=1.0
      IF(PAMAX.EQ.PAAI.OR.PAMAX.GT.PAAI) GO TO 400
      QLIFE=S*PAMAX*PFSM+2.0*S*A*PAMAX*PFAM+2.0*E*EMTP*FP
      PKLIFE=((2.0*SIGMA*EMTP*PSPACE)/QLIFE)**0.25
      PKPTM=PKLIFE*PTM
      PFLO=D/(PCP*(PTI-PTM))
      PKPTI=PKLIFE*PTI
      XLIFE=PTM/PTI
      PL=(0.25*ALOG(ABS((1.0+PKPTI*XLIFE)/(1.0-PKPTI*XLIFE)))-0.25*ALOG(
     *ABS((1.0+PKPTI)/(1.0-PKPTI)))+0.5*ATAN(PKPTI*XLIFE)-0.5*ATAN(PKPTI
     *))/PKPTI
      PAREA=PL*((PFLO*PCP*PTI)/QLIFE)
      PERTH=2.0*E*EMTP*FP*PAREA
      PSOL=S*PALPHA*PFSM*PAREA
      PAL=2.0*A*S*PALPHA*PFAM*PAREA
```

```
C      ******************************************************************
C      PRINTOUT OF INITIAL ON CRBIT PARAMETERS FOR FLAT PLATE RADIATOR.
C      ******************************************************************
   400 WRITE(6,20)
    20 FORMAT (1H1)
       D1=D/(3.414*1000.0)
       WRITE(6,21)D,D1
    21 FORMAT (1X,'FLAT PLANE RADIATOR FOR CASE OF ',F8.1,1X,'BTU/HR. DIS
      *SIPATICN = ',F5.1,1X,'KW.',/)
       B=B*(180.0/3.14159)
       WRITE(6,35) B,AL
    35 FORMAT(1X,'ORBIT INCLINATION =',F5.1,1X,'DEGREES, ALTITUDE =',F7.1
      *,1X,'NAUTICAL MILES.',/)
       B=B*(3.14159/180.0)
       IF(CHECK.EQ.1.0) GO TO 800
       PTI=PTI-459.67
       PTM=PTM-459.67
       WRITE(6,27) PTI,PTM
    27 FORMAT (1X,'TEMPERATURES, INLET = ',F7.2,' ,    MIX = ',F7.2,/)
       PTI=PTI+459.67
       PTM=PTM+459.67
       WRITE(6,22) PAREA
    22 FORMAT (1X,'PLATFORM AREA IN FT2 = ',F10.4,/)
       WRITE (6,23) PFLO
    23 FORMAT (1X,'COOLANT MASS FLOW RATE (LBM/HR.) = ',F12.4,/)
       WRITE(6,51) PERTH,PSOL,PAL
    51 FORMAT (1X,'INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = '
      *,F10.3,2X,'SOLAR = ',F10.3,2X,'ALBEDO = ',F10.3,/)
       WRITE(6,401) PAAI
   401 FORMAT (1X,'SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LO
      *ADS FOR SIZING RADIATOR AREA = ',F7.5,/)
       WRITE(6,402) PAMAX,MDP,PDEG
   402 FORMAT (1X,'MAXIMUM ABSORPTANCE VALUE = ',F7.5,2X,'FOR A PERIOD OF
      * ',I5,2X,'MONTHS AT A DEGRADATION RATE OF ',F7.5,2X,'DELTA ABSORPT
      *ANCE PER MONTH',///)
       GO TO 404
   800 WRITE(6,900)
   900 FORMAT(///)
       WRITE(6,403) PAAI
   403 FORMAT (1X,'MAXIMUM SOLAR ABSORPTANCE VALUE OVER INTERVAL EXCEEDS
      *',F7.5,2X,'WHICH IS UPPER LIMIT REQUIRING INFINITE RADIATOR AREA')
       GO TO 150
   404 WRITE(6,28)
    28 FORMAT (1X,'EFFECT OF DEGRADATION',/)
       WRITE(6,29)
    29 FORMAT (1X,'      MONTH       INLET (F)         RAD (F)      OUTLET (F
      *)    MFR(LBM/HR)  ABSORPTANCE     SOL(BTU/HR)      AL(BTU/HR)       A
      *DA        ITN',/)
C      ******************************************************************
C      CALCULATION OF TEMPS. AND FLUID PARAMETERS WITH DEGRADATION
C      FOR FLAT PLATE RADIATOR.
C      SOLUTICN OF GOVERNING NCN-DIMENSIONAL EQUATIONS FOUND BY
C      BI-SECTION METHOD.
```

```
C     ***********************************************************************
      DALPHA=PALPHA
      NMDP=MDP+1
      DO 26 J=1,NMDP,MODIP
      PT4=(D+S*PAREA*PFSM*DALPHA+2.0*S*A*DALPHA*PFAM*PAREA+2.0*E*PAREA*E
     *MTP*FP)/(PAREA*PSPACE*EMTP*SIGMA*2.0)
      PT=PT4**0.25
      IF(PT.LT.PTI) GO TO 285
      WRITE(6,301)
  301 FORMAT (1X,'SOLUTION TERMINATED DUE TO RADIATOR MEAN TEMPERATURE B
     *EING GREATER THAN FLUID INLET TEMPERATURE.',/)
      GO TO 150
  285 N=0
      QEXT=S*DALPHA*PFSM+2.0*S*A*DALPHA*PFAM+2.0*E*EMTP*FP
      PK=((2.0*SIGMA*EMTP*PSPACE)/QEXT)**0.25
      PTIK=PTI*PK
C     ***********************************************************************
C     TEST TO SEE IF SOLUTION WITHIN PROPER RANGE OF PARAMETERS.
C     ***********************************************************************
      XL=1.01/PTIK
      XR=0.999
      P1L=(0.25*ALOG(ABS((1.0+PTIK*XL)/(1.0-PTIK*XL)))-0.25*ALOG(ABS((1.
     *0+PTIK)/(1.0-PTIK)))+0.5*ATAN(PTIK*XL)-0.5*ATAN(PTIK))/PTIK
      P1L=1.0/P1L
      P2L=(D/(QEXT*PAREA))/(1.0-XL)
      DIFFL=P1L-P2L
      P1R=(0.25*ALOG(ABS((1.0+PTIK*XR)/(1.0-PTIK*XR)))-0.25*ALOG(ABS((1.
     *0+PTIK)/(1.0-PTIK)))+0.5*ATAN(PTIK*XR)-0.5*ATAN(PTIK))/PTIK
      P1R=1.0/P1R
      P2R=(D/(QEXT*PAREA))/(1.0-XR)
      DIFFR=P1R-P2R
      TEST=DIFFL*DIFFR
      IF(TEST.LT.0.0) GO TO 260
      WRITE(6,221)
  221 FORMAT (1X,'SOLUTION OUTSIDE TO/TI RANGE, SOLUTION TERMINATED.',/)
      GO TO 150
C     ***********************************************************************
C     ITERATION PROCESS FOR SOLUTION.
C     ***********************************************************************
  260 TEMP=XL
      X(1)=(XL+XR)/2.0
      X(2)=XR
  224 DO 222 NX=1,2
      P1=(0.25*ALOG(ABS((1.0+PTIK*X(NX))/(1.0-PTIK*X(NX))))-0.25*ALOG(AB
     *S((1.0+PTIK)/(1.0-PTIK)))+0.5*ATAN(PTIK*X(NX))-0.5*ATAN(PTIK))/PTI
     *K
      P1=1.0/P1
      P2=(D/(QEXT*PAREA))/(1.0-X(NX))
      DIFF(NX)=P1-P2
  222 CONTINUE
      TEST=DIFF(1)*DIFF(2)
      CRITRA=0.02
      DIF=(ABS(X(1)-X(2))/((X(1)+X(2))/2.0))*100.0
```

```
      N=N+1
      IF(DIF.LE.CRITRA) GO TO 240
      IF(TEST.GT.0.0) GO TO 225
      TEMP=X(1)
      X(1)=(X(1)+X(2))/2.0
      GO TO 224
  225 X(2)=X(1)
      X(1)=TEMP
      X(1)=(X(1)+X(2))/2.0
      GO TO 224
  240 T=(X(1)+X(2))/2.0
      P=(P1+P2)/2.0
C     ******************************************************************
C     COMPUTATION OF SOLUTION DIMENSIONAL VALUES.
C     ******************************************************************
      PTR=T*PTI
      PMRATE=P*((QEXT*PAREA)/(PCP*PTI))
      PADA=(PT**4-PTR**4)/(PTI**4-PTR**4)
      PDSOL=S*DALPHA*PFSM*PAREA
      PDAL=2.0*A*S*DALPHA*PFAM*PAREA
C     ******************************************************************
C     PRINTOUT OF DEGRADED CONDITIONS FOR FLAT PLATE RADIATOR.
C     ******************************************************************
      PTI=PTI-459.67
      PT=PT-459.67
      PTR=PTR-459.67
      NN=J-1
      WRITE(6,30) NN,PTI,PT,PTR,PMRATE,DALPHA,PDSOL,PDAL,PADA,N
   30 FORMAT (1X,I10,4(5X,F10.2),5X,F8.6,2(5X,F10.2),5X,F4.2,5X,I4)
      PTI=PTI+459.67
      PT=PT+459.67
      PTR=PTR+459.67
      DALPHA=DALPHA+PDEG*MODIP
   26 CONTINUE
C     ******************************************************************
C     CYLINDRICAL RADIATOR SIZING.
C     ******************************************************************
  150 CONTINUE
      DC=0.0
      IF(DD.LE.BREAK) GO TO 270
      IF(DD.GT.BREAK) DC=D-BREAK*3.412*1000.0
C     ******************************************************************
C     COMPUTATION OF INITIAL ON-ORBIT PARAMETERS FOR CYLINDRICAL
C     RADIATOR.
C     AREA SIZED FOR MAXIMUM SOLAR ABSORPTANCE OVER TIME INTERVAL.
C     ******************************************************************
      CAMAX =CALPHA+MDC*CDEG
      CAAI=(EMTC*(SIGMA*CSPACE*(CTM**4)-(1.0/3.14159)*E*FC))/(S*(CFSM+(1
     *.0/3.14159)*A*CFAM))
      IF(CAAI.GT.1.0) CAAI=1.0
      CHECK=C.0
      IF(CAMAX.EQ.CAAI.OR.CAMAX.GT.CAAI) CHECK=1.0
      IF(CAMAX.EQ.CAAI.OR.CAMAX.GT.CAAI) GO TO 450
```

```
      QLIFE=S*CAMAX*CFSM+(S*A*CAMAX*CFAM)/3.14159+(E*EMTC*FC)/3.14159
      CKLIFE=((SIGMA*EMTC*CSPACE)/QLIFE)**0.25
      CKCTM=CKLIFE*CTM
      CFLO=DC/(CCP*(CTI-CTM))
      CKCTI=CKLIFE*CTI
      XLIFE=CTM/CTI
      CL=(0.25*ALOG(ABS((1.0+CKCTI*XLIFE)/(1.0-CKCTI*XLIFE)))-0.25*ALOG(
     *ABS((1.0+CKCTI)/(1.0-CKCTI)))+0.5*ATAN(CKCTI*XLIFE)-0.5*ATAN(CKCTI
     *))/CKCTI
      CAREA=CL*((CFLO*CCP*CTI)/QLIFE)
      CERTH=(E*CAREA*EMTC*FC)/3.14159
      CSOL=S*CAREA*CFSM*CALPHA
      CAL=(S*A*CALPHA*CFAM*CAREA)/3.14159
C     ******************************************************************
C     PRINTOUT OF INITIAL ON-ORBIT PARAMETERS FOR CYLINDRICAL RADIATOR.
C     ******************************************************************
  450 WRITE(6,20)
      D1=DC/(3.414*1000.0)
      WRITE(6,60) DC,D1
   60 FORMAT (1X,'CYLINDRICAL RADIATOR FOR CASE OF ',F9.1,1X,'BTU/HR. DI
     *SSIPATION = ',F5.1,1X,'KW.',/)
      B=B*(180.0/3.14159)
      WRITE(6,35) B,AL
      B=B*(3.14159/180.0)
      IF(CHECK.EQ.1.0) GO TO 801
      CTI=CTI-459.67
      CTM=CTM-459.67
      WRITE(6,27) CTI,CTM
      CTI=CTI+459.67
      CTM=CTM+459.67
      WRITE(6,22) CAREA
      WRITE(6,23) CFLO
      WRITE(6,51) CERTH,CSOL,CAL
      WRITE(6,401) CAAI
      WRITE(6,402) CAMAX,MDC,CDEG
      GO TO 451
  801 WRITE(6,900)
      WRITE(6,403) CAAI
      GO TO 270
  451 WRITE(6,28)
      WRITE(6,29)
C     ******************************************************************
C     CALCULATION OF TEMPS. AND FLUID PARAMETERS WITH DEGRADATION
C     FOR CYLINDRICAL RADIATOR.
C     SOLUTION OF GOVERNING NON-DIMENSIONAL EQUATIONS FOUND BY
C     BI-SECTION METHOD.
C     ******************************************************************
      DALPHA=CALPHA
      NMDC=MDC+1
      DO 500 J=1,NMDC,MODIC
      CT4=(DC+S*CAREA*CFSM*DALPHA+(S*A*DALPHA*CFAM*CAREA)/3.14159+(E*CAR
     *EA*EMTC*FC)/3.14159)/(CAREA*CSPACE*EMTC*SIGMA)
      CT=CT4**0.25
```

```
      CTI=(DC/(CCP*CFLO))+CTM
      IF(CT.LT.CTI) GO TO 600
      WRITE(6,601)
  601 FORMAT (1X,'SOLUTION TERMINATED DUE TO RADIATOR MEAN TEMPERATURE B
     *EING GREATER THAN FLUID INLET TEMPERATURE.',/)
      GO TO 270
  600 N=0
      QEXT=S*DALPHA*CFSM+(S*A*DALPHA*CFAM)/3.14159+(E*EMTC*FC)/3.14159
      CK=((SIGMA*EMTC*CSPACE)/QEXT)**0.25
      CTIK=CTI*CK
C     ******************************************************************
C     TEST TO SEE IF SOLUTION WITHIN PROPER RANGE OF PARAMETERS.
C     ******************************************************************
      XL=1.01/CTIK
      XR=0.999
      C1L=(0.25*ALOG(ABS((1.0+CTIK*XL)/(1.0-CTIK*XL)))-0.25*ALOG(ABS((1.
     *0+CTIK)/(1.0-CTIK)))+0.5*ATAN(CTIK*XL)-0.5*ATAN(CTIK))/CTIK
      C1L=1.0/C1L
      C2L=(DC/(QEXT*CAREA))/(1.0-XL)
      DIFFL=C1L-C2L
      C1R=(0.25*ALOG(ABS((1.0+CTIK*XR)/(1.0-CTIK*XR)))-0.25*ALOG(ABS((1.
     *0+CTIK)/(1.0-CTIK)))+0.5*ATAN(CTIK*XR)-0.5*ATAN(CTIK))/CTIK
      C1R=1.0/C1R
      C2R=(DC/(QEXT*CAREA))/(1.0-XR)
      DIFFR=C1R-C2R
      TEST=DIFFL*DIFFR
      IF(TEST.LT.0.0) GO TO 660
      WRITE(6,621)
  621 FORMAT (1X,'SOLUTION OUTSIDE TO/TI RANGE, SOLUTION TERMINATED.',/)
      GO TO 270
C     ******************************************************************
C     ITERATION PROCESS FOR SOLUTION.
C     ******************************************************************
  660 TEMP=XL
      X(1)=(XL+XR)/2.0
      X(2)=XR
  624 DO 622 NX=1,2
      C1=(0.25*ALOG(ABS((1.0+CTIK*X(NX))/(1.0-CTIK*X(NX))))-0.25*ALOG(AB
     *S((1.0+CTIK)/(1.0-CTIK)))+0.5*ATAN(CTIK*X(NX))-0.5*ATAN(CTIK))/CTI
     *K
      C1=1.0/C1
      C2=(DC/(QEXT*CAREA))/(1.0-X(NX))
      DIFF(NX)=C1-C2
  622 CONTINUE
      TEST=DIFF(1)*DIFF(2)
      CRITRA=0.02
      DIF=(ABS(X(1)-X(2))/((X(1)+X(2))/2.0))*100.0
      N=N+1
      IF(DIF.LE.CRITRA) GO TO 640
      IF(TEST.GT.0.0) GO TO 625
      TEMP=X(1)
      X(1)=(X(1)+X(2))/2.0
      GO TO 624
```

```
  625 X(2)=X(1)
      X(1)=TEMP
      X(1)=(X(1)+X(2))/2.0
      GO TO 624
  640 T=(X(1)+X(2))/2.0
      C=(C1+C2)/2.0
C     ******************************************************************
C     COMPUTATION OF SOLUTION DIMENSIONAL VALUES.
C     ******************************************************************
      CTR=T*CTI
      CMRATE=C*((QEXT*CAREA)/(CCP*CTI))
      CADA=(CT**4-CTR**4)/(CTI**4-CTR**4)
      CDSOL=S*DALPHA*CFSM*CAREA
      CDAL=A*S*DALPHA*CFAM*CAREA/3.14159
C     ******************************************************************
C     PRINTOUT OF DEGRADED CONDITIONS FOR CYLINDRICAL RADIATOR.
C     ******************************************************************
      CTI=CTI-459.67
      CT=CT-459.67
      CTR=CTR-459.67
      NN=J-1
      WRITE(6,30) NN,CTI,CT,CTR,CMRATE,DALPHA,CDSOL,CDAL,CADA,N
      CTI=CTI+459.67
      CT=CT+459.67
      CTR=CTR+459.67
      DALPHA=DALPHA+CDEG*MODIC
  500 CONTINUE
  270 CONTINUE
      GO TO 750
C     ******************************************************************
C     PROGRAM TERMINATION CONTROL.
C     ******************************************************************
  203 WRITE(6,219)
  219 FORMAT (1X,'MISTAKE MADE IN PLATE RADIATOR INPUT, PROGRAM TERMINAT
     *ED.')
      GO TO 300
  205 WRITE(6,220)
  220 FORMAT (1X,'MISTAKE MADE IN CYLINDER RADIATOR INPUT, PROGRAM TERMI
     *NATED.')
  300 RETURN
      END
```

APPENDIX B

Sample Program Inputs and Outputs

A sample case will be presented for each program, showing inputs and program outputs. The purpose of this portion of the report is to familiarize the user with the input formats and format of the program outputs. The first case will deal with the power module program. Immediately following the program output, a case will be presented using the space station program. These sample cases are designed to not only have a high degree of realism but also to display the versatile capabilities of these programs in a reasonable fashion for example purposes.

The following case inputs will be used for a sample case of the power module program use:

1. Two altitudes will be considered; 235 and 270 nautical miles.

2. The β angle will be varied from a value of 10 degrees to a value of 90 degrees at 20-degree intervals.

3. The dissipation value will be held constant at 12 kW.

4. The total time duration will be 60 months (5 years), with the solution intervals of one month.

5. The fluid inlet and mix temperatures will be set at 94.6°F and 40°F, respectively. The radiator area will be set at a value of 634.2 ft^2.

6. All external-input blockage factors will be given a value of 0.9.

7. The view factor to space will be 0.91, and the specific heat of the coolant will be 0.25 Btu/lbm-$^{\circ}$R (Freon 21).

8. The initial α_s value will be 0.07, the emittance value will be 0.76, and the degradation rates will be varied from 0.003 to 0.009 $\Delta\alpha_s$/month at intervals of 0.003 $\Delta\alpha_s$/month.

The succeeding pages will present these inputs written out on a coding form, followed by the program output.

10 132 138 (REV 9/68)

AEROJET ELECTROSYSTEMS COMPANY

COMPUTING SCIENCES
80 COLUMN INPUT

DATE FEB. 78 PROGRAM NO. POWER MODULE PROGRAM PROGRAMMED BY 1.

INPUT FORMATS

1 FIRST CARD:
235 270 35 } FORMAT(3I10)
NAL1 NAL2 NAL3

2 SECOND CARD:
10 90 20 } FORMAT(3I10)
MB1 MB2 MB3

3 THIRD CARD:
121 12 1 } FORMAT(3I10)
MD1 MD2 MD3

4 FOURTH CARD:
60 1 } FORMAT(2I10)
MDA MODI

5 FIFTH CARD:
P 94.6 40.0 634.2 } FORMAT(A1, 9X, 3(F10.4,10X))
TEST PTI PTM PAREA

6 SIXTH CARD:
P 0.9 0.9 0.9 } FORMAT(A1, 9X, 3(F10.4,10X))
TEST PSHDS PSHDE PSHDA

STK NO. D-1 083

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR

10 132 198 (REV 5/68)

AEROJET ELECTROSYSTEMS COMPANY

COMPUTING SCIENCES
80 COLUMN INPUT

DATE FEB. 78   PROGRAM NO. POWER MODULE PROGRAM   PROGRAMMED BY   2

```
7 SEVENTH CARD:
P              0.91                      0.25   } FORMAT(A1, 9X, 2(F10.4, 10X))
TEST           PSPACE                    PCP

8 EIGHTH CARD:
P              0.07                      0.76                      0.003 } FORMAT(A1, 9X, 3(F10.4, 10X))
TEST           PALPHA                    EMTA                      PDEG

P              0.07                      0.76                      0.006 } ADDITIONAL SURFACE
P              0.07                      0.76                      0.009 } PROPERTY CARDS.
```

STK NO D-1-063

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR

2 5 K W   P O W E R   M O D U L E   P R O G R A M .

```
ALTITUDE (N.MI.), LOWEST =   235  HIGHEST =   270  INCREMENT =    35

ORBIT INCLINATION (DEG.), LOWEST =    10  HIGHEST =    90  INCREMENT =    20

DISSIPATION (KW.), LOWEST =   12  HIGHEST =    12  INCREMENT =     1

MONTHS DEGRADATION FOR PLATE RADIATOR =    60  INCREMENT =     1

SHADING COEFFICIENTS
PLATE, SOLAR = 0.85999998  EARTHSHINE = 0.89999998  ALBEDO = 0.99999998

PLATE, SHAPE FACTOR TO SPACE = 0.90999997  FLUID CP =     0.2500  BTU/LBM-R.

RADIATOR MATERIAL PROPERTIES
PLATE, ABSORPTANCE =    0.07000  EMITTANCE =    0.76000  MONTHLY CHANGE IN ABSORPTANCE =   0.003000
```

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INL 1 = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 734.2000

ORBIT INCLINATION = 19.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 16296.418 SOLAR = 1884.240 ALBEDO = 1129.185

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-13.29	-76.04	959.84	0.070000	1884.24	1129.18	0.25	15
1	94.60	-13.05	-75.65	962.00	0.073000	1964.99	1177.58	0.25	15
2	94.60	-12.81	-75.27	964.15	0.076000	2045.74	1225.97	0.25	15
3	94.60	-12.57	-74.89	966.31	0.079000	2126.50	1274.36	0.25	15
4	94.60	-12.33	-74.50	968.60	0.082000	2207.25	1322.76	0.25	15
5	94.60	-12.10	-74.13	970.73	0.085000	2288.00	1371.15	0.25	15
6	94.60	-11.86	-73.75	972.87	0.088000	2368.75	1419.54	0.25	15
7	94.60	-11.62	-73.37	975.14	0.091000	2449.50	1467.94	0.25	15
8	94.60	-11.39	-73.00	977.25	0.094000	2530.26	1516.33	0.25	15
9	94.60	-11.15	-72.61	979.51	0.097000	2611.01	1564.72	0.25	15
10	94.60	-10.92	-72.25	981.62	0.100000	2691.76	1613.11	0.25	15
11	94.60	-10.68	-71.87	983.87	0.103000	2772.51	1661.51	0.25	15
12	94.60	-10.45	-71.49	986.12	0.106000	2853.27	1709.90	0.25	15
13	94.60	-10.21	-71.12	988.35	0.108999	2934.02	1758.29	0.25	15
14	94.60	-9.98	-70.75	990.59	0.111999	3014.77	1806.69	0.25	15
15	94.60	-9.74	-70.37	992.82	0.114999	3095.52	1855.08	0.25	15
16	94.60	-9.51	-70.00	995.04	0.117999	3176.28	1903.47	0.25	15
17	94.60	-9.28	-69.64	997.25	0.120999	3257.03	1951.87	0.25	15
18	94.60	-9.04	-69.27	999.47	0.123999	3337.78	2000.26	0.25	15
19	94.60	-8.81	-68.91	1001.69	0.126999	3418.53	2048.65	0.25	15
20	94.60	-8.58	-68.53	1004.03	0.129999	3499.28	2097.05	0.25	15
21	94.60	-8.35	-68.17	1006.23	0.132999	3580.04	2145.44	0.25	15
22	94.60	-8.12	-67.80	1008.58	0.135999	3660.79	2193.83	0.25	15
23	94.60	-7.89	-67.44	1010.77	0.138999	3741.54	2242.22	0.25	15
24	94.60	-7.65	-67.07	1013.11	0.141999	3822.29	2290.62	0.25	15
25	94.60	-7.43	-66.71	1015.29	0.144999	3903.04	2339.01	0.25	15
26	94.60	-7.20	-66.35	1017.62	0.147999	3983.80	2387.40	0.26	15
27	94.60	-6.97	-65.98	1019.95	0.150999	4064.55	2435.80	0.26	15
28	94.60	-6.74	-65.62	1022.27	0.153999	4145.30	2484.19	0.26	15
29	94.60	-6.51	-65.26	1024.59	0.156999	4226.05	2532.58	0.26	15
30	94.60	-6.28	-64.90	1026.90	0.159999	4306.81	2580.98	0.26	15
31	94.60	-6.05	-64.54	1029.22	0.162999	4387.55	2629.37	0.26	15
32	94.60	-5.82	-64.18	1031.52	0.165999	4468.31	2677.76	0.26	15
33	94.60	-5.60	-63.83	1033.83	0.168999	4549.06	2726.16	0.26	15
34	94.60	-5.37	-63.47	1036.13	0.171999	4629.81	2774.55	0.26	15
35	94.60	-5.14	-63.12	1038.42	0.174999	4710.56	2822.94	0.26	15
36	94.60	-4.92	-62.76	1040.87	0.177999	4791.32	2871.33	0.26	15
37	94.60	-4.69	-62.41	1043.17	0.180999	4872.07	2919.73	0.26	15
38	94.60	-4.46	-62.06	1045.46	0.183999	4952.82	2968.12	0.26	15
39	94.60	-4.24	-61.70	1047.90	0.186998	5033.57	3016.51	0.26	15
40	94.60	-4.01	-61.34	1050.34	0.189998	5114.32	3064.91	0.26	15
41	94.60	-3.79	-61.00	1052.61	0.192998	5195.08	3113.30	0.26	15
42	94.60	-3.57	-60.64	1055.05	0.195998	5275.83	3161.69	0.26	15
43	94.60	-3.34	-60.29	1057.49	0.198998	5356.58	3210.08	0.26	15
44	94.60	-3.12	-59.95	1059.75	0.201998	5437.33	3258.48	0.26	15
45	94.60	-2.89	-59.60	1062.17	0.204998	5518.09	3306.87	0.26	15

46	94.60	-2.67	-59.25	1064.61	0.207998	5598.84	3355.26	0.26	15
47	94.60	-2.45	-58.90	1067.02	0.210998	5679.59	3403.66	0.26	15
48	94.60	-2.23	-58.55	1069.44	0.213998	5760.34	3452.05	0.26	15
49	94.60	-2.00	-58.21	1071.86	0.216998	5841.09	3500.44	0.26	15
50	94.60	-1.78	-57.86	1074.27	0.219998	5921.85	3548.84	0.26	15
51	94.60	-1.56	-57.52	1076.68	0.222998	6002.60	3597.23	0.26	15
52	94.60	-1.34	-57.18	1079.10	0.225998	6083.35	3645.62	0.26	15
53	94.60	-1.12	-56.82	1081.67	0.228998	6164.10	3694.02	0.26	15
54	94.60	-0.90	-56.48	1084.07	0.231998	6244.86	3742.41	0.26	15
55	94.60	-0.68	-56.15	1086.47	0.234998	6325.61	3790.80	0.26	15
56	94.60	-0.46	-55.80	1089.04	0.237998	6406.36	3839.19	0.26	15
57	94.60	-0.24	-55.46	1091.44	0.240998	6487.11	3887.59	0.26	15
58	94.60	-0.02	-55.12	1094.00	0.243998	6567.86	3935.98	0.26	15
59	94.60	0.20	-54.78	1096.40	0.246998	6648.62	3984.37	0.26	15
60	94.60	0.42	-54.44	1098.96	0.249998	6729.37	4032.77	0.26	15

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 293.67 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.25000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.003000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 1.00000

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 30.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 16296.418 SOLAR = 5572.672 ALBEDO = 992.988

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-6.85	-65.81	1021.05	0.070000	5572.67	992.99	0.26	15
1	94.60	-6.35	-65.01	1026.18	0.073000	5811.50	1035.54	0.26	15
2	94.60	-5.85	-64.24	1031.15	0.076000	6050.32	1078.10	0.26	15
3	94.60	-5.36	-63.46	1036.25	0.079000	6289.14	1120.66	0.26	15
4	94.60	-4.87	-62.68	1041.33	0.082000	6527.97	1163.21	0.26	15
5	94.60	-4.37	-61.91	1046.56	0.085000	6766.80	1205.77	0.26	15
6	94.60	-3.88	-61.15	1051.61	0.088000	7005.63	1248.32	0.26	15
7	94.60	-3.39	-60.38	1056.81	0.091000	7244.45	1290.88	0.26	15
8	94.60	-2.91	-59.62	1062.00	0.094000	7483.28	1333.44	0.26	15
9	94.60	-2.42	-58.86	1067.33	0.097000	7722.10	1375.99	0.26	15
10	94.60	-1.94	-58.11	1072.50	0.100000	7960.93	1418.55	0.26	15
11	94.60	-1.46	-57.36	1077.81	0.103000	8199.75	1461.11	0.26	15
12	94.60	-0.97	-56.60	1083.28	0.106000	8438.58	1503.66	0.26	15
13	94.60	-0.49	-55.86	1088.57	0.108999	8677.41	1546.22	0.26	15
14	94.60	-0.02	-55.11	1094.03	0.111999	8916.23	1588.77	0.26	15
15	94.60	0.46	-54.38	1099.31	0.114999	9155.05	1631.33	0.26	15
16	94.60	0.94	-53.64	1104.91	0.117999	9393.88	1673.89	0.27	15
17	94.60	1.41	-52.91	1110.34	0.120999	9632.71	1716.44	0.27	15
18	94.60	1.88	-52.17	1115.92	0.123999	9871.54	1759.00	0.27	15
19	94.60	2.35	-51.46	1121.35	0.126999	10110.36	1801.55	0.27	15
20	94.60	2.82	-50.73	1126.92	0.129999	10349.18	1844.11	0.27	15
21	94.60	3.29	-50.00	1132.67	0.132999	10588.01	1886.67	0.27	15
22	94.60	3.76	-49.29	1138.25	0.135999	10826.83	1929.22	0.27	15
23	94.60	4.22	-48.57	1143.99	0.138999	11065.66	1971.78	0.27	15
24	94.60	4.68	-47.86	1149.72	0.141999	11304.48	2014.33	0.27	15
25	94.60	5.15	-47.15	1155.46	0.144999	11543.32	2056.89	0.27	15
26	94.60	5.61	-46.45	1161.20	0.147999	11782.14	2099.45	0.27	15
27	94.60	6.07	-45.74	1167.11	0.150999	12020.96	2142.00	0.27	15
28	94.60	6.52	-45.03	1173.02	0.153999	12259.79	2184.56	0.27	15
29	94.60	6.98	-44.33	1178.93	0.156999	12498.61	2227.12	0.27	15
30	94.60	7.44	-43.64	1184.84	0.159999	12737.45	2269.67	0.27	15
31	94.60	7.89	-42.95	1190.76	0.162999	12976.27	2312.23	0.27	15
32	94.60	8.34	-42.25	1196.85	0.165999	13215.09	2354.78	0.28	15
33	94.60	8.79	-41.57	1202.77	0.168999	13453.92	2397.34	0.28	15
34	94.60	9.24	-40.88	1209.88	0.171999	13692.74	2439.90	0.28	15
35	94.60	9.69	-40.19	1215.16	0.174999	13931.57	2482.45	0.28	15
36	94.60	10.14	-39.51	1221.27	0.177999	14170.39	2525.01	0.28	15
37	94.60	10.59	-38.83	1227.57	0.180999	14409.23	2567.56	0.28	15
38	94.60	11.03	-38.16	1233.69	0.183999	14648.05	2610.12	0.28	15
39	94.60	11.48	-37.48	1240.00	0.186998	14886.87	2652.68	0.28	15
40	94.60	11.92	-36.81	1246.32	0.189998	15125.70	2695.23	0.28	15
41	94.60	12.36	-36.14	1252.82	0.192998	15364.52	2737.79	0.28	15
42	94.60	12.80	-35.47	1259.15	0.195998	15603.35	2780.34	0.28	15
43	94.60	13.24	-34.80	1265.68	0.198998	15842.18	2822.90	0.28	15
44	94.60	13.68	-34.14	1272.21	0.201998	16081.00	2865.46	0.28	15
45	94.60	14.11	-33.48	1278.76	0.204998	16319.83	2908.01	0.28	15

46	94.60	14.55	-32.83	1285.31	0.207998	16558.65	2950.57	0.28	15
47	94.60	14.98	-32.16	1292.06	0.210998	16797.48	2993.13	0.28	15
48	94.60	15.42	-31.51	1298.83	0.213998	17036.30	3035.68	0.29	15
49	94.60	15.85	-30.86	1305.42	0.216998	17275.13	3078.24	0.29	15
50	94.60	16.28	-30.21	1312.21	0.219998	17513.96	3120.79	0.29	15
51	94.60	16.71	-29.56	1319.20	0.222998	17752.78	3163.35	0.29	15
52	94.60	17.14	-28.92	1326.02	0.225998	17991.61	3205.91	0.29	15
53	94.60	17.56	-28.27	1333.03	0.228998	18230.43	3248.46	0.29	15
54	94.60	17.99	-27.62	1340.07	0.231998	18469.26	3291.02	0.29	15
55	94.60	18.41	-26.98	1347.13	0.234998	18708.08	3333.57	0.29	15
56	94.60	18.84	-26.35	1354.20	0.237998	18946.91	3376.13	0.29	15
57	94.60	19.26	-25.72	1361.29	0.240998	19185.74	3418.69	0.29	15
58	94.60	19.68	-25.08	1368.58	0.243998	19424.56	3461.24	0.29	15
59	94.60	20.10	-24.45	1375.71	0.246998	19663.39	3503.80	0.29	15
60	94.60	20.52	-23.82	1383.04	0.249998	19902.21	3546.36	0.29	15

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 344.53 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.25000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.003000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.83483

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATICN = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 50.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 16296.418 SOLAR = 9290.223 ALBEDO = 737.028

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFP (LBM/HR)	ABSORPTANCE	SOL (BTU/HR)	AL (BTU/HR)	ADA	ITN
0	94.60	-0.83	-56.38	1084.75	0.070000	9290.22	737.03	0.26	15
1	94.60	-0.10	-55.25	1093.02	0.073000	9688.37	768.61	0.26	15
2	94.60	0.63	-54.11	1101.42	0.076000	10086.51	800.20	0.26	15
3	94.60	1.35	-53.00	1109.65	0.079000	10484.66	831.79	0.27	15
4	94.60	2.07	-51.88	1118.19	0.082000	10882.80	863.37	0.27	15
5	94.60	2.79	-50.77	1126.73	0.085000	11280.95	894.96	0.27	15
6	94.60	3.51	-49.67	1135.25	0.088000	11679.09	926.55	0.27	15
7	94.60	4.22	-48.58	1143.94	0.091000	12077.24	958.13	0.27	15
8	94.60	4.92	-47.49	1152.62	0.094000	12475.40	989.72	0.27	15
9	94.60	5.63	-46.41	1161.48	0.097000	12873.54	1021.31	0.27	15
10	94.60	6.33	-45.33	1170.51	0.100000	13271.69	1052.89	0.27	15
11	94.60	7.03	-44.26	1179.53	0.103000	13669.84	1084.48	0.27	15
12	94.60	7.72	-43.20	1188.56	0.106000	14067.98	1116.07	0.27	15
13	94.60	8.41	-42.14	1197.78	0.108999	14466.14	1147.65	0.28	15
14	94.60	9.10	-41.09	1207.00	0.111999	14864.28	1179.24	0.28	15
15	94.60	9.79	-40.05	1216.41	0.114999	15262.43	1210.83	0.28	15
16	94.60	10.47	-39.01	1225.83	0.117999	15660.57	1242.41	0.28	15
17	94.60	11.15	-37.97	1235.44	0.120999	16058.72	1274.00	0.28	15
18	94.60	11.83	-36.95	1245.08	0.123999	16456.87	1305.59	0.28	15
19	94.60	12.50	-35.92	1254.91	0.126999	16855.01	1337.17	0.28	15
20	94.60	13.17	-34.90	1264.76	0.129999	17253.16	1368.76	0.28	15
21	94.60	13.84	-33.90	1274.63	0.132999	17651.31	1400.34	0.28	15
22	94.60	14.51	-32.89	1284.72	0.135999	18049.46	1431.93	0.28	15
23	94.60	15.17	-31.89	1294.82	0.138999	18447.61	1463.52	0.28	15
24	94.60	15.83	-30.89	1305.15	0.141999	18845.75	1495.10	0.29	15
25	94.60	16.49	-29.90	1315.50	0.144999	19243.89	1526.69	0.29	15
26	94.60	17.14	-28.91	1326.08	0.147999	19642.04	1558.28	0.29	15
27	94.60	17.79	-27.93	1336.69	0.150999	20040.20	1589.86	0.29	15
28	94.60	18.44	-26.95	1347.52	0.153999	20438.34	1621.45	0.29	15
29	94.60	19.09	-25.97	1358.40	0.156999	20836.49	1653.04	0.29	15
30	94.60	19.73	-25.01	1369.31	0.159999	21234.64	1684.62	0.29	15
31	94.60	20.37	-24.04	1380.46	0.162999	21632.78	1716.21	0.29	15
32	94.60	21.01	-23.08	1391.85	0.165999	22030.93	1747.80	0.29	15
33	94.60	21.65	-22.13	1403.10	0.168999	22429.08	1779.38	0.29	15
34	94.60	22.28	-21.17	1414.80	0.171999	22827.23	1810.97	0.30	15
35	94.60	22.91	-20.23	1426.33	0.174999	23225.38	1842.56	0.30	14
36	94.60	23.54	-19.28	1438.32	0.177999	23623.52	1874.14	0.30	14
37	94.60	24.17	-18.34	1450.37	0.180999	24021.67	1905.73	0.30	14
38	94.60	24.79	-17.40	1462.47	0.183999	24419.81	1937.32	0.30	14
39	94.60	25.41	-16.48	1474.64	0.186998	24817.96	1968.90	0.30	14
40	94.60	26.03	-15.56	1486.86	0.189998	25216.11	2000.49	0.30	14
41	94.60	26.65	-14.63	1499.57	0.192998	25614.26	2032.08	0.30	14
42	94.60	27.26	-13.71	1512.33	0.195998	26012.41	2063.66	0.30	14
43	94.60	27.87	-12.79	1525.18	0.198998	26410.55	2095.25	0.30	14
44	94.60	28.48	-11.89	1538.08	0.201998	26808.70	2126.83	0.31	14
45	94.60	29.09	-10.97	1551.49	0.204998	27206.85	2158.42	0.31	14

46	94.60	29.70	-10.07	1564.98	0.207998	27605.00	2190.01	0.31	14
47	94.60	30.30	-9.17	1578.54	0.210998	28003.14	2221.59	0.31	14
48	94.60	30.90	-8.27	1592.17	0.213998	28401.29	2253.18	0.31	14
49	94.60	31.50	-7.39	1605.90	0.216998	28799.44	2284.77	0.31	14
50	94.60	32.10	-6.49	1620.16	0.219998	29197.58	2316.35	0.31	14
51	94.60	32.69	-5.61	1634.50	0.222998	29595.73	2347.94	0.31	14
52	94.60	33.28	-4.71	1649.38	0.225998	29993.88	2379.53	0.31	14
53	94.60	33.87	-3.84	1663.90	0.228998	30392.02	2411.11	0.32	14
54	94.60	34.46	-2.96	1678.98	0.231998	30790.18	2442.70	0.32	14
55	94.60	35.04	-2.08	1694.15	0.234998	31188.32	2474.29	0.32	14
56	94.60	35.63	-1.21	1709.45	0.237998	31586.47	2505.87	0.32	14
57	94.60	36.21	-0.34	1725.29	0.240998	31984.61	2537.46	0.32	14
58	94.60	36.79	0.51	1740.79	0.243998	32382.77	2569.05	0.32	14
59	94.60	37.37	1.39	1757.33	0.246998	32780.91	2600.63	0.32	14
60	94.60	37.94	2.25	1773.54	0.249998	33179.06	2632.22	0.32	14

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 415.45 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.25000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.003000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.54663

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 70.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 16296.418 SOLAR = 16608.746 ALBEDO = 392.166

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	10.63	-38.77	1228.08	0.070000	16608.75	392.17	0.28	15
1	94.60	11.78	-37.02	1244.38	0.073000	17320.54	408.97	0.28	15
2	94.60	12.92	-35.29	1260.92	0.076000	18032.33	425.78	0.28	15
3	94.60	14.05	-33.57	1277.88	0.079000	18744.12	442.59	0.28	15
4	94.60	15.18	-31.88	1294.91	0.082000	19455.92	459.39	0.28	15
5	94.60	16.29	-30.18	1312.60	0.085000	20167.71	476.20	0.29	15
6	94.60	17.40	-28.51	1330.36	0.088000	20879.52	493.01	0.29	15
7	94.60	18.50	-26.85	1348.61	0.091000	21591.30	509.81	0.29	15
8	94.60	19.60	-25.21	1366.97	0.094000	22303.11	526.62	0.29	15
9	94.60	20.68	-23.57	1386.03	0.097000	23014.90	543.43	0.29	15
10	94.60	21.76	-21.95	1405.23	0.100000	23726.69	560.23	0.29	15
11	94.60	22.84	-20.34	1425.16	0.103000	24438.48	577.04	0.30	14
12	94.60	23.90	-18.75	1445.05	0.106000	25150.28	593.85	0.30	14
13	94.60	24.96	-17.16	1465.49	0.108999	25862.07	610.66	0.30	14
14	94.60	26.01	-15.59	1486.51	0.111999	26573.87	627.46	0.30	14
15	94.60	27.05	-14.03	1507.73	0.114999	27285.66	644.27	0.30	14
16	94.60	28.09	-12.48	1529.55	0.117999	27997.46	661.08	0.31	14
17	94.60	29.12	-10.93	1552.00	0.120999	28709.25	677.88	0.31	14
18	94.60	30.15	-9.39	1575.09	0.123999	29421.05	694.69	0.31	14
19	94.60	31.16	-7.87	1598.44	0.126999	30132.84	711.50	0.31	14
20	94.60	32.18	-6.38	1622.02	0.129999	30844.63	728.30	0.31	14
21	94.60	33.18	-4.87	1646.73	0.132999	31556.43	745.11	0.31	14
22	94.60	34.18	-3.38	1671.73	0.135999	32268.22	761.92	0.32	14
23	94.60	35.18	-1.89	1697.46	0.138999	32980.02	778.72	0.32	14
24	94.60	36.16	-0.41	1723.96	0.141999	33691.81	795.53	0.32	14
25	94.60	37.15	1.05	1750.77	0.144999	34403.61	812.34	0.32	14
26	94.60	38.12	2.50	1778.39	0.147999	35115.41	829.14	0.32	14
27	94.60	39.09	3.95	1806.84	0.150999	35827.20	845.95	0.33	14
28	94.60	40.06	5.40	1836.13	0.153999	36538.99	862.76	0.33	14
29	94.60	41.01	6.84	1866.34	0.156999	37250.79	879.57	0.33	14
30	94.60	41.97	8.26	1896.93	0.159999	37962.58	896.37	0.33	14
31	94.60	42.92	9.69	1928.98	0.162999	38674.38	913.18	0.33	14
32	94.60	43.86	11.10	1961.49	0.165999	39386.17	929.99	0.34	14
33	94.60	44.80	12.50	1994.99	0.168999	40097.97	946.79	0.34	14
34	94.60	45.73	13.90	2029.55	0.171999	40809.76	963.60	0.34	14
35	94.60	46.66	15.31	2065.69	0.174999	41521.55	980.41	0.34	14
36	94.60	47.58	16.69	2102.43	0.177999	42233.34	997.21	0.34	14
37	94.60	48.49	18.07	2140.32	0.180999	42945.14	1014.02	0.35	14
38	94.60	49.41	19.45	2179.41	0.183999	43656.94	1030.83	0.35	14
39	94.60	50.31	20.81	2219.70	0.186998	44368.74	1047.63	0.35	14
40	94.60	51.22	22.18	2261.91	0.189998	45080.53	1064.44	0.35	14
41	94.60	52.11	23.54	2304.85	0.192998	45792.33	1081.25	0.35	14
42	94.60	53.01	24.90	2349.84	0.195998	46504.12	1098.06	0.36	14
43	94.60	53.90	26.25	2396.24	0.198998	47215.91	1114.86	0.36	14
44	94.60	54.78	27.59	2444.19	0.201998	47927.70	1131.67	0.36	14
45	94.60	55.66	28.94	2494.41	0.204998	48639.50	1148.48	0.36	14

46	94.60	56.53	30.27	2546.26	0.207998	49351.29	1165.28	0.36	14
47	94.60	57.41	31.60	2599.89	0.210998	50063.09	1182.09	0.37	14
48	94.60	58.27	32.93	2656.03	0.213998	50774.89	1198.90	0.37	14
49	94.60	59.13	34.27	2714.83	0.216998	51486.68	1215.70	0.37	14
50	94.60	59.99	35.59	2775.70	0.219998	52198.48	1232.51	0.37	14
51	94.60	60.84	36.91	2839.45	0.222998	52910.27	1249.32	0.38	14
52	94.60	61.69	38.23	2905.53	0.225998	53622.06	1266.12	0.38	14
53	94.60	62.54	39.54	2974.77	0.228998	54333.85	1282.93	0.38	14
54	94.60	63.38	40.85	3047.36	0.231998	55045.65	1299.74	0.38	14
55	94.60	64.21	42.17	3124.39	0.234998	55757.45	1316.55	0.38	13
56	94.60	65.05	43.47	3203.45	0.237998	56469.25	1333.35	0.39	13
57	94.60	65.88	44.76	3286.54	0.240998	57181.04	1350.16	0.39	13
58	94.60	66.70	46.07	3375.59	0.243998	57892.84	1366.97	0.39	13
59	94.60	67.52	47.38	3469.24	0.246998	58604.63	1383.77	0.39	13
60	94.60	68.34	48.67	3565.83	0.249998	59316.42	1400.58	0.40	13

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 732.25 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.25000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.003000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.32241

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 90.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 16296.418 SOLAR = 17675.902 ALBEDO = 0.000

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	11.69	-37.16	1243.07	0.070000	17675.90	0.00	0.28	15
1	94.60	12.88	-35.35	1260.39	0.073000	18433.43	0.00	0.28	15
2	94.60	14.06	-33.56	1277.97	0.076000	19190.95	0.00	0.28	15
3	94.60	15.23	-31.80	1295.81	0.079000	19948.48	0.00	0.28	15
4	94.60	16.39	-30.05	1313.93	0.082000	20706.01	0.00	0.29	15
5	94.60	17.54	-28.31	1332.52	0.085000	21463.55	0.00	0.29	15
6	94.60	18.68	-26.58	1351.60	0.088000	22221.07	0.00	0.29	15
7	94.60	19.82	-24.87	1370.99	0.091000	22978.60	0.00	0.29	15
8	94.60	20.95	-23.17	1390.73	0.094000	23736.13	0.00	0.29	15
9	94.60	22.07	-21.49	1410.80	0.097000	24493.66	0.00	0.30	15
10	94.60	23.18	-19.82	1431.62	0.100000	25251.18	0.00	0.30	14
11	94.60	24.28	-18.16	1452.61	0.103000	26008.72	0.00	0.30	14
12	94.60	25.38	-16.53	1473.77	0.106000	26766.25	0.00	0.30	14
13	94.60	26.47	-14.89	1495.94	0.108999	27523.78	0.00	0.30	14
14	94.60	27.55	-13.28	1518.32	0.111999	28281.30	0.00	0.30	14
15	94.60	28.63	-11.67	1541.33	0.114999	29038.83	0.00	0.31	14
16	94.60	29.70	-10.06	1565.01	0.117999	29796.36	0.00	0.31	14
17	94.60	30.76	-8.48	1588.93	0.120999	30553.90	0.00	0.31	14
18	94.60	31.81	-6.91	1613.53	0.123999	31311.43	0.00	0.31	14
19	94.60	32.86	-5.34	1638.86	0.126999	32068.95	0.00	0.31	14
20	94.60	33.90	-3.78	1664.93	0.129999	32826.47	0.00	0.32	14
21	94.60	34.94	-2.24	1691.29	0.132999	33584.01	0.00	0.32	14
22	94.60	35.97	-0.71	1718.45	0.135999	34341.54	0.00	0.32	14
23	94.60	36.99	0.81	1746.39	0.138999	35099.07	0.00	0.32	14
24	94.60	38.00	2.33	1775.18	0.141999	35856.59	0.00	0.32	14
25	94.60	39.01	3.85	1804.81	0.144999	36614.13	0.00	0.33	14
26	94.60	40.02	5.34	1834.86	0.147999	37371.66	0.00	0.33	14
27	94.60	41.01	6.84	1866.30	0.150999	38129.18	0.00	0.33	14
28	94.60	42.00	8.31	1878.70	0.153999	38886.71	0.00	0.33	14
29	94.60	42.99	9.80	1931.57	0.156999	39644.25	0.00	0.33	14
30	94.60	43.97	11.26	1965.42	0.159999	40401.77	0.00	0.34	14
31	94.60	44.94	12.72	2000.35	0.162999	41159.30	0.00	0.34	14
32	94.60	45.91	14.18	2036.86	0.165999	41916.82	0.00	0.34	14
33	94.60	46.87	15.63	2074.01	0.168999	42674.36	0.00	0.34	14
34	94.60	47.83	17.07	2112.83	0.171999	43431.89	0.00	0.34	14
35	94.60	48.78	18.50	2152.33	0.174999	44189.42	0.00	0.35	14
36	94.60	49.73	19.93	2193.64	0.177999	44946.95	0.00	0.35	14
37	94.60	50.67	21.36	2236.28	0.180999	45704.48	0.00	0.35	14
38	94.60	51.61	22.77	2280.29	0.183999	46462.00	0.00	0.35	14
39	94.60	52.54	24.19	2326.35	0.186998	47219.53	0.00	0.35	14
40	94.60	53.47	25.59	2373.30	0.189998	47977.07	0.00	0.36	14
41	94.60	54.39	27.00	2423.03	0.192998	48734.60	0.00	0.36	14
42	94.60	55.30	28.39	2473.79	0.195998	49492.13	0.00	0.36	14
43	94.60	56.22	29.78	2526.91	0.198998	50249.65	0.00	0.36	14
44	94.60	57.12	31.18	2582.52	0.201998	51007.18	0.00	0.37	14
45	94.60	58.02	32.56	2640.04	0.204998	51764.71	0.00	0.37	14

46	94.60	58.92	33.94	2700.28	0.207998	57522.25	0.00	0.37	14
47	94.60	59.81	35.31	2762.63	0.210998	53279.77	0.00	0.37	14
48	94.60	60.70	36.68	2827.96	0.213998	54037.30	0.00	0.37	14
49	94.60	61.58	38.05	2896.43	0.216998	54794.82	0.00	0.38	14
50	94.60	62.46	39.42	2968.15	0.219998	55552.36	0.00	0.38	14
51	94.60	63.34	40.78	3043.47	0.222998	56309.89	0.00	0.38	14
52	94.60	64.21	42.14	3122.43	0.225998	57067.42	0.00	0.38	13
53	94.60	65.07	43.51	3206.17	0.228998	57824.94	0.00	0.39	13
54	94.60	65.93	44.87	3294.18	0.231998	58582.48	0.00	0.39	13
55	94.60	66.79	46.21	3384.83	0.234998	59340.00	0.00	0.39	13
56	94.60	67.64	47.56	3482.00	0.237998	60097.53	0.00	0.39	13
57	94.60	68.49	48.92	3586.17	0.240998	60855.06	0.00	0.40	13
58	94.60	69.34	50.26	3694.05	0.243998	61612.60	0.00	0.40	13
59	94.60	70.18	51.63	3811.86	0.246998	62370.12	0.00	0.40	13
60	94.60	71.02	52.96	3934.13	0.249998	63127.65	0.00	0.40	13

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 795.32 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.25000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.003000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.31010

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 10.0 DEGREES, ALTITUDE = 270.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 15479.301 SOLAR = 1918.344 ALBEDO = 1072.563

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-14.85	-78.54	945.97	0.070000	1918.34	1072.56	0.25	15
1	94.60	-14.61	-78.16	948.01	0.073000	2000.56	1118.53	0.25	15
2	94.60	-14.37	-77.77	950.20	0.076000	2082.77	1164.50	0.25	15
3	94.60	-14.13	-77.40	952.22	0.079000	2164.99	1210.46	0.25	15
4	94.60	-13.89	-77.01	954.39	0.082000	2247.20	1256.43	0.25	15
5	94.60	-13.66	-76.63	956.54	0.085000	2329.41	1302.40	0.25	15
6	94.60	-13.42	-76.24	958.70	0.088000	2411.63	1348.36	0.25	15
7	94.60	-13.18	-75.86	960.84	0.091000	2493.84	1394.33	0.25	15
8	94.60	-12.94	-75.48	962.98	0.094000	2576.05	1440.29	0.25	15
9	94.60	-12.71	-75.11	965.11	0.097000	2658.27	1486.26	0.25	15
10	94.60	-12.47	-74.73	967.23	0.100000	2740.48	1532.23	0.25	15
11	94.60	-12.24	-74.34	969.50	0.103000	2822.70	1578.19	0.25	15
12	94.60	-12.00	-73.97	971.61	0.106000	2904.91	1624.16	0.25	15
13	94.60	-11.77	-73.60	973.71	0.108999	2987.12	1670.13	0.25	15
14	94.60	-11.53	-73.22	975.96	0.111999	3069.34	1716.09	0.25	15
15	94.60	-11.30	-72.85	978.05	0.114999	3151.55	1762.06	0.25	15
16	94.60	-11.06	-72.48	980.29	0.117999	3233.76	1808.03	0.25	15
17	94.60	-10.83	-72.10	982.53	0.120999	3315.98	1853.99	0.25	15
18	94.60	-10.60	-71.73	984.75	0.123999	3398.19	1899.96	0.25	15
19	94.60	-10.36	-71.37	986.83	0.126999	3480.41	1945.92	0.25	15
20	94.60	-10.13	-71.00	989.04	0.129999	3562.62	1991.89	0.25	15
21	94.60	-9.90	-70.63	991.25	0.132999	3644.83	2037.86	0.25	15
22	94.60	-9.67	-70.26	993.46	0.135999	3727.05	2083.82	0.25	15
23	94.60	-9.43	-69.88	995.81	0.138999	3809.26	2129.79	0.25	15
24	94.60	-9.20	-69.52	998.01	0.141999	3891.47	2175.76	0.25	15
25	94.60	-8.97	-69.15	1000.20	0.144999	3973.69	2221.72	0.25	15
26	94.60	-8.74	-68.79	1002.38	0.147999	4055.90	2267.69	0.25	15
27	94.60	-8.51	-68.42	1004.71	0.150999	4138.11	2313.66	0.25	15
28	94.60	-8.28	-68.06	1006.89	0.153999	4220.33	2359.62	0.25	15
29	94.60	-8.05	-67.69	1009.22	0.156999	4302.54	2405.59	0.25	15
30	94.60	-7.82	-67.34	1011.39	0.159999	4384.75	2451.56	0.25	15
31	94.60	-7.59	-66.97	1013.70	0.162999	4466.97	2497.52	0.25	15
32	94.60	-7.36	-66.61	1016.01	0.165999	4549.18	2543.49	0.26	15
33	94.60	-7.14	-66.26	1018.17	0.168999	4631.39	2589.45	0.26	15
34	94.60	-6.91	-65.90	1020.47	0.171999	4713.61	2635.42	0.26	15
35	94.60	-6.68	-65.54	1022.77	0.174999	4795.82	2681.39	0.26	15
36	94.60	-6.46	-65.18	1025.07	0.177999	4878.04	2727.35	0.26	15
37	94.60	-6.23	-64.82	1027.36	0.180999	4960.25	2773.32	0.26	15
38	94.60	-6.00	-64.47	1029.65	0.183999	5042.46	2819.29	0.26	15
39	94.60	-5.78	-64.11	1031.94	0.186998	5124.68	2865.25	0.26	15
40	94.60	-5.55	-63.76	1034.22	0.189998	5206.89	2911.22	0.26	15
41	94.60	-5.33	-63.40	1036.66	0.192998	5289.11	2957.19	0.26	15
42	94.60	-5.10	-63.05	1038.93	0.195998	5371.32	3003.15	0.26	15
43	94.60	-4.88	-62.70	1041.21	0.198998	5453.53	3049.12	0.26	15
44	94.60	-4.65	-62.34	1043.64	0.201998	5535.75	3095.08	0.26	15
45	94.60	-4.43	-62.00	1045.90	0.204998	5617.96	3141.05	0.26	15

46	94.60	-4.20	-61.64	1048.32	0.207998	5700.18	3187.02	0.26	15
47	94.60	-3.98	-61.30	1050.59	0.210998	5782.39	3232.98	0.26	15
48	94.60	-3.76	-60.94	1053.00	0.213998	5864.60	3278.95	0.26	15
49	94.60	-3.54	-60.59	1055.41	0.216998	5946.82	3324.92	0.26	15
50	94.60	-3.31	-60.25	1057.66	0.219998	6029.03	3370.88	0.26	15
51	94.60	-3.09	-59.90	1060.07	0.222998	6111.24	3416.85	0.26	15
52	94.60	-2.87	-59.56	1062.48	0.225998	6193.46	3462.82	0.26	15
53	94.60	-2.65	-59.21	1064.89	0.228998	6275.67	3508.78	0.26	15
54	94.60	-2.43	-58.86	1067.29	0.231998	6357.88	3554.75	0.26	15
55	94.60	-2.21	-58.52	1069.68	0.234998	6440.10	3600.72	0.26	15
56	94.60	-1.99	-58.18	1072.08	0.237998	6522.31	3646.68	0.26	15
57	94.60	-1.77	-57.84	1074.47	0.240998	6604.52	3692.65	0.26	15
58	94.60	-1.55	-57.49	1076.86	0.243998	6686.74	3738.61	0.26	15
59	94.60	-1.33	-57.16	1079.25	0.246998	6768.95	3784.58	0.26	15
60	94.60	-1.11	-56.81	1081.80	0.249998	6851.17	3830.55	0.26	15

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 290.65 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.25000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.003000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 1.00000

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 30.0 DEGREES, ALTITUDE = 270.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 15479.301 SOLAR = 5670.867 ALBEDO = 943.200

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-8.22	-67.97	1007.48	0.070000	5670.87	943.20	0.25	15
1	94.60	-7.71	-67.16	1012.56	0.073000	5913.90	983.62	0.25	15
2	94.60	-7.21	-66.37	1017.46	0.076000	6156.93	1024.04	0.26	15
3	94.60	-6.71	-65.58	1022.49	0.079000	6399.97	1064.47	0.26	15
4	94.60	-6.20	-64.78	1027.67	0.082000	6643.00	1104.89	0.26	15
5	94.60	-5.70	-64.00	1032.67	0.085000	6886.04	1145.31	0.26	15
6	94.60	-5.20	-63.22	1037.82	0.088000	7129.07	1185.73	0.26	15
7	94.60	-4.71	-62.44	1042.94	0.091000	7372.11	1226.16	0.26	15
8	94.60	-4.21	-61.66	1048.20	0.094000	7615.14	1266.58	0.26	15
9	94.60	-3.72	-60.89	1053.30	0.097000	7858.17	1307.00	0.26	15
10	94.60	-3.23	-60.12	1058.55	0.100000	8101.21	1347.42	0.26	15
11	94.60	-2.74	-59.35	1063.93	0.103000	8344.24	1387.85	0.26	15
12	94.60	-2.25	-58.59	1069.15	0.106000	8587.28	1428.27	0.26	15
13	94.60	-1.76	-57.83	1074.50	0.108999	8830.31	1468.69	0.26	15
14	94.60	-1.28	-57.07	1079.87	0.111999	9073.34	1509.11	0.26	15
15	94.60	-0.79	-56.32	1085.21	0.114999	9316.38	1549.54	0.26	15
16	94.60	-0.31	-55.57	1090.71	0.117999	9559.41	1589.96	0.26	15
17	94.60	0.17	-54.83	1096.03	0.120999	9802.45	1630.38	0.26	15
18	94.60	0.65	-54.09	1101.52	0.123999	10045.48	1670.80	0.26	15
19	94.60	1.13	-53.34	1107.16	0.126999	10288.51	1711.22	0.27	15
20	94.60	1.61	-52.61	1112.63	0.129999	10531.54	1751.65	0.27	15
21	94.60	2.08	-51.87	1118.27	0.132999	10774.57	1792.07	0.27	15
22	94.60	2.55	-51.15	1123.72	0.135999	11017.62	1832.49	0.27	15
23	94.60	3.03	-50.41	1129.51	0.138999	11260.65	1872.91	0.27	15
24	94.60	3.50	-49.69	1135.14	0.141999	11503.68	1913.34	0.27	15
25	94.60	3.97	-48.96	1140.92	0.144999	11746.72	1953.76	0.27	15
26	94.60	4.43	-48.25	1146.54	0.147999	11989.75	1994.18	0.27	15
27	94.60	4.90	-47.53	1152.31	0.150999	12232.78	2034.60	0.27	15
28	94.60	5.36	-46.81	1158.26	0.153999	12475.81	2075.03	0.27	15
29	94.60	5.83	-46.10	1164.04	0.156999	12718.86	2115.45	0.27	15
30	94.60	6.29	-45.39	1170.00	0.159999	12961.89	2155.87	0.27	15
31	94.60	6.75	-44.68	1175.95	0.162999	13204.92	2196.29	0.27	15
32	94.60	7.21	-43.98	1181.91	0.165999	13447.96	2236.72	0.27	15
33	94.60	7.67	-43.28	1187.87	0.168999	13690.99	2277.14	0.27	15
34	94.60	8.13	-42.59	1193.82	0.171999	13934.02	2317.56	0.27	15
35	94.60	8.58	-41.89	1199.97	0.174999	14177.05	2357.98	0.28	15
36	94.60	9.04	-41.20	1206.11	0.177999	14420.09	2398.41	0.28	15
37	94.60	9.49	-40.51	1212.26	0.180999	14663.13	2438.83	0.28	15
38	94.60	9.94	-39.82	1218.41	0.183999	14906.16	2479.25	0.28	15
39	94.60	10.39	-39.13	1224.75	0.186998	15149.20	2519.67	0.28	15
40	94.60	10.84	-38.46	1230.91	0.189998	15392.23	2560.09	0.28	15
41	94.60	11.29	-37.77	1237.26	0.192998	15635.26	2600.52	0.28	15
42	94.60	11.73	-37.10	1243.62	0.195998	15878.30	2640.94	0.28	15
43	94.60	12.18	-36.41	1250.16	0.198998	16121.33	2681.36	0.28	15
44	94.60	12.62	-35.74	1256.54	0.201998	16364.36	2721.78	0.28	15
45	94.60	13.07	-35.07	1263.10	0.204998	16607.40	2762.21	0.28	15

46	94.60	13.51	-34.40	1269.68	0.207998	16850.43	2807.63	0.28	15
47	94.60	13.95	-33.73	1276.26	0.210998	17093.46	2843.05	0.28	15
48	94.60	14.39	-33.07	1282.86	0.213998	17336.50	2883.47	0.28	15
49	94.60	14.82	-32.40	1289.65	0.216998	17579.54	2923.90	0.28	15
50	94.60	15.26	-31.75	1296.26	0.219998	17822.57	2964.32	0.29	15
51	94.60	15.69	-31.09	1303.08	0.222998	18065.60	3004.74	0.29	15
52	94.60	16.13	-30.44	1309.92	0.225998	18308.64	3045.16	0.29	15
53	94.60	16.56	-29.78	1316.76	0.228998	18551.67	3085.59	0.29	15
54	94.60	16.99	-29.13	1323.80	0.231998	18794.70	3126.01	0.29	15
55	94.60	17.42	-28.48	1330.67	0.234998	19037.75	3166.43	0.29	15
56	94.60	17.85	-27.83	1337.75	0.237998	19280.78	3206.85	0.29	15
57	94.60	18.28	-27.19	1344.85	0.240998	19523.81	3247.27	0.29	15
58	94.60	18.71	-26.54	1351.96	0.243998	19766.84	3287.70	0.29	15
59	94.60	19.13	-25.91	1359.08	0.246998	20009.88	3328.12	0.29	15
60	94.60	19.56	-25.26	1366.42	0.249998	20252.91	3368.54	0.29	15

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 341.51 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.25000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.003000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.83737

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 50.0 DEGREES, ALTITUDE = 270.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 15479.301 SOLAR = 9440.668 ALBEDO = 700.074

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-2.03	-58.26	1071.48	0.070000	9440.67	700.07	0.26	15
1	94.60	-1.29	-57.09	1079.71	0.073000	9845.27	730.08	0.26	15
2	94.60	-0.55	-55.94	1087.93	0.076000	10249.85	760.08	0.26	15
3	94.60	0.19	-54.80	1096.28	0.079000	10654.44	790.08	0.26	15
4	94.60	0.92	-53.65	1104.79	0.082000	11059.04	820.08	0.27	15
5	94.60	1.66	-52.52	1113.28	0.085000	11463.64	850.09	0.27	15
6	94.60	2.38	-51.41	1121.76	0.088000	11868.23	880.09	0.27	15
7	94.60	3.11	-50.29	1130.39	0.091000	12272.82	910.09	0.27	15
8	94.60	3.83	-49.18	1139.18	0.094000	12677.43	940.10	0.27	15
9	94.60	4.55	-48.07	1147.97	0.097000	13082.02	970.10	0.27	15
10	94.60	5.26	-46.97	1156.92	0.100000	13486.62	1000.10	0.27	15
11	94.60	5.97	-45.88	1165.87	0.103000	13891.21	1030.10	0.27	15
12	94.60	6.68	-44.80	1175.00	0.106000	14295.81	1060.11	0.27	15
13	94.60	7.38	-43.72	1184.14	0.108999	14700.40	1090.11	0.27	15
14	94.60	8.08	-42.65	1193.28	0.111999	15104.99	1120.11	0.27	15
15	94.60	8.78	-41.59	1202.59	0.114999	15509.59	1150.11	0.28	15
16	94.60	9.48	-40.53	1212.10	0.117999	15914.19	1180.12	0.28	15
17	94.60	10.17	-39.47	1221.61	0.120999	16318.78	1210.12	0.28	15
18	94.60	10.86	-38.42	1231.33	0.123999	16723.38	1240.12	0.28	15
19	94.60	11.54	-37.38	1241.06	0.126999	17127.97	1270.13	0.28	15
20	94.60	12.23	-36.34	1250.80	0.129999	17532.57	1300.13	0.28	15
21	94.60	12.90	-35.31	1260.74	0.132999	17937.16	1330.13	0.28	15
22	94.60	13.58	-34.29	1270.72	0.135999	18341.76	1360.14	0.28	15
23	94.60	14.25	-33.27	1280.89	0.138999	18746.35	1390.14	0.28	15
24	94.60	14.93	-32.25	1291.09	0.141999	19150.95	1420.14	0.28	15
25	94.60	15.59	-31.24	1301.51	0.144999	19555.55	1450.14	0.29	15
26	94.60	16.26	-30.24	1311.96	0.147999	19960.14	1480.15	0.29	15
27	94.60	16.92	-29.23	1322.63	0.150999	20364.73	1510.15	0.29	15
28	94.60	17.58	-28.24	1333.33	0.153999	20769.32	1540.15	0.29	15
29	94.60	18.24	-27.24	1344.27	0.156999	21173.92	1570.15	0.29	15
30	94.60	18.89	-26.27	1355.03	0.159999	21578.52	1600.16	0.29	15
31	94.60	19.55	-25.28	1366.24	0.162999	21983.11	1630.16	0.29	15
32	94.60	20.20	-24.30	1377.49	0.165999	22387.70	1660.16	0.29	15
33	94.60	20.84	-23.33	1388.78	0.168999	22792.30	1690.17	0.29	15
34	94.60	21.49	-22.37	1400.31	0.171999	23196.89	1720.17	0.29	15
35	94.60	22.13	-21.40	1411.89	0.174999	23601.50	1750.17	0.30	15
36	94.60	22.77	-20.44	1423.72	0.177999	24006.09	1780.17	0.30	15
37	94.60	23.40	-19.48	1435.82	0.180999	24410.69	1810.18	0.30	14
38	94.60	24.04	-18.55	1447.55	0.183999	24815.28	1840.18	0.30	14
39	94.60	24.67	-17.60	1459.76	0.186998	25219.88	1870.18	0.30	14
40	94.60	25.30	-16.64	1472.43	0.189998	25624.47	1900.19	0.30	14
41	94.60	25.92	-15.71	1484.75	0.192998	26029.07	1930.19	0.30	14
42	94.60	26.55	-14.78	1497.56	0.195998	26433.66	1960.19	0.30	14
43	94.60	27.17	-13.84	1510.44	0.198998	26838.25	1990.19	0.30	14
44	94.60	27.79	-12.92	1523.38	0.201998	27242.85	2020.20	0.30	14
45	94.60	28.41	-12.01	1536.38	0.204998	27647.44	2050.20	0.31	14

46	94.60	29.02	-11.08	1549.89	0.207998	28052.04	2080.20	0.31	14
47	94.60	29.63	-10.16	1563.48	0.210998	28456.63	2110.20	0.31	14
48	94.60	30.24	-9.25	1577.15	0.213998	28861.23	2140.21	0.31	14
49	94.60	30.85	-8.35	1590.90	0.216998	29265.82	2170.21	0.31	14
50	94.60	31.46	-7.44	1605.18	0.219998	29670.43	2200.21	0.31	14
51	94.60	32.06	-6.54	1619.54	0.222998	30075.02	2230.22	0.31	14
52	94.60	32.66	-5.64	1633.98	0.225998	30479.61	2260.22	0.31	14
53	94.60	33.26	-4.75	1648.53	0.228998	30884.21	2290.22	0.31	14
54	94.60	33.86	-3.86	1663.63	0.231998	31288.80	2320.22	0.32	14
55	94.60	34.45	-2.97	1678.83	0.234998	31693.40	2350.23	0.32	14
56	94.60	35.04	-2.09	1694.12	0.237998	32097.99	2380.23	0.32	14
57	94.60	35.63	-1.21	1709.52	0.240998	32502.58	2410.23	0.32	14
58	94.60	36.22	-0.33	1725.50	0.243998	32907.18	2440.24	0.32	14
59	94.60	36.81	0.55	1741.59	0.246998	33311.77	2470.24	0.32	14
60	94.60	37.39	1.42	1757.79	0.249998	33716.37	2500.24	0.32	14

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 412.59 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.25000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.003000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.54616

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 70.0 DEGREES, ALTITUDE = 270.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 15479.301 SOLAR = 16608.746 ALBEDO = 372.502

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL (BTU/HR)	AL (BTU/HR)	ADA	ITN
0	94.60	9.29	-40.79	1209.72	0.070000	16608.75	372.50	0.28	15
1	94.60	10.45	-39.04	1225.59	0.073000	17320.54	388.47	0.28	15
2	94.60	11.60	-37.29	1241.88	0.076000	18032.33	404.43	0.28	15
3	94.60	12.74	-35.56	1258.38	0.079000	18744.12	420.39	0.28	15
4	94.60	13.88	-33.84	1275.14	0.082000	19455.92	436.36	0.28	15
5	94.60	15.00	-32.14	1292.32	0.085000	20167.71	452.32	0.28	15
6	94.60	16.12	-30.45	1309.79	0.088000	20879.52	468.29	0.29	15
7	94.60	17.23	-28.78	1327.52	0.091000	21591.30	484.25	0.29	15
8	94.60	18.33	-27.11	1345.74	0.094000	22303.11	500.22	0.29	15
9	94.60	19.42	-25.47	1364.05	0.097000	23014.90	516.18	0.29	15
10	94.60	20.51	-23.83	1382.89	0.100000	23726.69	532.14	0.29	15
11	94.60	21.59	-22.22	1402.04	0.103000	24438.48	548.11	0.29	15
12	94.60	22.66	-20.60	1421.73	0.106000	25150.28	564.07	0.30	14
13	94.60	23.73	-19.00	1441.97	0.108999	25862.07	580.04	0.30	14
14	94.60	24.78	-17.41	1462.38	0.111999	26573.87	596.00	0.30	14
15	94.60	25.83	-15.85	1482.95	0.114999	27285.66	611.96	0.30	14
16	94.60	26.88	-14.29	1504.10	0.117999	27997.46	627.93	0.30	14
17	94.60	27.92	-12.74	1525.88	0.120999	28709.25	643.89	0.31	14
18	94.60	28.95	-11.19	1548.26	0.123999	29421.05	659.86	0.31	14
19	94.60	29.97	-9.67	1570.88	0.126999	30132.84	675.82	0.31	14
20	94.60	30.99	-8.14	1594.15	0.129999	30844.63	691.79	0.31	14
21	94.60	32.00	-6.63	1618.10	0.132999	31556.43	707.75	0.31	14
22	94.60	33.01	-5.13	1642.32	0.135999	32268.22	723.71	0.31	14
23	94.60	34.01	-3.64	1667.25	0.138999	32980.02	739.68	0.32	14
24	94.60	35.00	-2.15	1692.91	0.141999	33691.81	755.64	0.32	14
25	94.60	35.99	-0.67	1719.31	0.144999	34403.61	771.61	0.32	14
26	94.60	36.97	0.79	1746.05	0.147999	35115.41	787.57	0.32	14
27	94.60	37.95	2.25	1773.61	0.150999	35827.20	803.53	0.32	14
28	94.60	38.92	3.70	1801.96	0.153999	36538.99	819.50	0.33	14
29	94.60	39.88	5.13	1830.69	0.156999	37250.79	835.46	0.33	14
30	94.60	40.84	6.58	1860.78	0.159999	37962.58	851.43	0.33	14
31	94.60	41.79	8.00	1891.28	0.162999	38674.38	867.39	0.33	14
32	94.60	42.74	9.42	1922.71	0.165999	39386.17	883.35	0.33	14
33	94.60	43.68	10.83	1955.10	0.168999	40097.97	899.32	0.33	14
34	94.60	44.62	12.25	1989.03	0.171999	40809.76	915.28	0.34	14
35	94.60	45.55	13.64	2022.93	0.174999	41521.55	931.25	0.34	14
36	94.60	46.48	15.03	2058.41	0.177999	42233.34	947.21	0.34	14
37	94.60	47.40	16.42	2095.00	0.180999	42945.14	963.18	0.34	14
38	94.60	48.32	17.80	2132.74	0.183999	43656.94	979.14	0.34	14
39	94.60	49.23	19.18	2171.69	0.186998	44368.74	995.10	0.35	14
40	94.60	50.14	20.55	2211.83	0.189998	45080.53	1011.07	0.35	14
41	94.60	51.04	21.91	2253.26	0.192998	45792.33	1027.03	0.35	14
42	94.60	51.94	23.28	2296.63	0.195998	46504.12	1043.00	0.35	14
43	94.60	52.83	24.63	2340.80	0.198998	47215.91	1058.96	0.36	14
44	94.60	53.72	25.98	2387.03	0.201998	47927.70	1074.93	0.36	14
45	94.60	54.60	27.33	2434.76	0.204998	48639.50	1090.89	0.36	14

46	94.60	55.48	28.67	2484.11	0.207998	49351.29	1106.85	0.36	14
47	94.60	56.36	30.01	2535.75	0.210998	50063.09	1122.82	0.36	14
48	94.60	57.23	31.34	2589.10	0.213998	50774.89	1138.78	0.37	14
49	94.60	58.09	32.66	2644.31	0.216998	51486.68	1154.75	0.37	14
50	94.60	58.95	33.99	2702.10	0.219998	52198.48	1170.71	0.37	14
51	94.60	59.81	35.31	2762.63	0.222998	52910.27	1186.67	0.37	14
52	94.60	60.67	36.63	2825.28	0.225998	53622.06	1202.64	0.37	14
53	94.60	61.51	37.95	2890.97	0.228998	54333.85	1218.60	0.38	14
54	94.60	62.36	39.26	2959.83	0.231998	55045.65	1234.57	0.38	14
55	94.60	63.20	40.57	3031.23	0.234998	55757.45	1250.53	0.38	14
56	94.60	64.04	41.89	3107.68	0.237998	56469.25	1266.50	0.38	13
57	94.60	64.87	43.19	3186.32	0.240998	57181.04	1282.46	0.39	13
58	94.60	65.70	44.49	3268.83	0.243998	57892.84	1298.42	0.39	13
59	94.60	66.52	45.79	3355.59	0.246998	58604.63	1314.39	0.39	13
60	94.60	67.34	47.10	3448.52	0.249998	59316.42	1330.35	0.39	13

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 711.81 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.25000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.003000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.32615

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 90.0 DEGREES, ALTITUDE = 270.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 15479.301 SOLAR = 17675.902 ALBEDO = 0.000

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	10.40	-39.12	1224.89	0.070000	17675.90	0.00	0.28	15
1	94.60	11.60	-37.29	1241.80	0.073000	18433.43	0.00	0.28	15
2	94.60	12.79	-35.49	1258.94	0.076000	19190.95	0.00	0.28	15
3	94.60	13.96	-33.71	1276.52	0.079000	19948.48	0.00	0.28	15
4	94.60	15.13	-31.94	1294.35	0.082000	20706.01	0.00	0.28	15
5	94.60	16.30	-30.18	1312.65	0.085000	21463.55	0.00	0.29	15
6	94.60	17.45	-28.44	1331.22	0.088000	22221.07	0.00	0.29	15
7	94.60	18.59	-26.71	1350.12	0.091000	22978.60	0.00	0.29	15
8	94.60	19.73	-25.01	1369.31	0.094000	23736.13	0.00	0.29	15
9	94.60	20.86	-23.31	1389.03	0.097000	24493.66	0.00	0.29	15
10	94.60	21.98	-21.62	1409.28	0.100000	25251.18	0.00	0.30	15
11	94.60	23.09	-19.95	1429.88	0.103000	26008.72	0.00	0.30	14
12	94.60	24.20	-18.30	1450.86	0.106000	26766.25	0.00	0.30	14
13	94.60	25.30	-16.65	1472.41	0.108999	27523.78	0.00	0.30	14
14	94.60	26.39	-15.02	1494.16	0.111999	28281.30	0.00	0.30	14
15	94.60	27.47	-13.40	1516.52	0.114999	29038.83	0.00	0.30	14
16	94.60	28.55	-11.79	1539.53	0.117999	29796.36	0.00	0.31	14
17	94.60	29.61	-10.19	1563.19	0.120999	30553.90	0.00	0.31	14
18	94.60	30.68	-8.61	1587.08	0.123999	31311.43	0.00	0.31	14
19	94.60	31.73	-7.03	1611.66	0.126999	32068.95	0.00	0.31	14
20	94.60	32.78	-5.46	1636.97	0.129999	32826.47	0.00	0.31	14
21	94.60	33.82	-3.91	1662.58	0.132999	33584.01	0.00	0.32	14
22	94.60	34.86	-2.36	1689.36	0.135999	34341.54	0.00	0.32	14
23	94.60	35.88	-0.83	1716.49	0.138999	35099.07	0.00	0.32	14
24	94.60	36.91	0.70	1744.42	0.141999	35856.59	0.00	0.32	14
25	94.60	37.92	2.21	1772.70	0.144999	36614.13	0.00	0.32	14
26	94.60	38.93	3.72	1802.29	0.147999	37371.66	0.00	0.33	14
27	94.60	39.94	5.23	1832.80	0.150999	38129.18	0.00	0.33	14
28	94.60	40.93	6.72	1863.71	0.153999	38886.71	0.00	0.33	14
29	94.60	41.93	8.20	1895.57	0.156999	39644.25	0.00	0.33	14
30	94.60	42.91	9.68	1928.91	0.159999	40401.77	0.00	0.33	14
31	94.60	43.89	11.15	1962.73	0.162999	41159.30	0.00	0.34	14
32	94.60	44.87	12.61	1997.61	0.165999	41916.82	0.00	0.34	14
33	94.60	45.84	14.07	2034.08	0.168999	42674.36	0.00	0.34	14
34	94.60	46.80	15.52	2071.14	0.171999	43431.89	0.00	0.34	14
35	94.60	47.76	16.95	2109.41	0.174999	44189.42	0.00	0.34	14
36	94.60	48.71	18.39	2149.40	0.177999	44946.95	0.00	0.35	14
37	94.60	49.66	19.82	2190.09	0.180999	45704.48	0.00	0.35	14
38	94.60	50.60	21.24	2232.67	0.183999	46462.00	0.00	0.35	14
39	94.60	51.54	22.66	2276.61	0.186998	47219.53	0.00	0.35	14
40	94.60	52.47	24.08	2322.58	0.189998	47977.07	0.00	0.35	14
41	94.60	53.39	25.49	2370.09	0.192998	48734.60	0.00	0.36	14
42	94.60	54.31	26.88	2418.47	0.195998	49492.13	0.00	0.36	14
43	94.60	55.23	28.28	2469.81	0.198998	50249.65	0.00	0.36	14
44	94.60	56.14	29.68	2522.81	0.201998	51007.18	0.00	0.36	14
45	94.60	57.05	31.06	2577.70	0.204998	51764.71	0.00	0.37	14

46	94.60	57.95	32.44	2635.12	0.207998	52522.25	0.00	0.37	14
47	94.60	58.85	33.83	2695.23	0.210998	53279.77	0.00	0.37	14
48	94.60	59.74	35.20	2757.45	0.213998	54037.30	0.00	0.37	14
49	94.60	60.63	36.57	2822.63	0.216998	54794.82	0.00	0.37	14
50	94.60	61.51	37.95	2890.97	0.219998	55552.36	0.00	0.38	14
51	94.60	62.39	39.31	2962.60	0.222998	56309.89	0.00	0.38	14
52	94.60	63.27	40.68	3037.69	0.225998	57067.42	0.00	0.38	14
53	94.60	64.14	42.04	3116.54	0.228998	57824.94	0.00	0.38	13
54	94.60	65.01	43.41	3200.13	0.231998	58582.48	0.00	0.39	13
55	94.60	65.87	44.75	3286.17	0.234998	59340.00	0.00	0.39	13
56	94.60	66.72	46.11	3378.38	0.237998	60097.53	0.00	0.39	13
57	94.60	67.58	47.46	3475.33	0.240998	60855.06	0.00	0.39	13
58	94.60	68.43	48.81	3577.45	0.243998	61612.60	0.00	0.40	13
59	94.60	69.27	50.17	3686.90	0.246998	62370.12	0.00	0.40	13
60	94.60	70.11	51.52	3802.44	0.249998	63127.65	0.00	0.40	13

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 772.57 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.25000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.003000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.31333

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2 5 K W   P O W E R   M O D U L E   P R O G R A M .

ALTITUDE (N.MI.), LOWEST =   235  HIGHEST =   270  INCREMENT =    35

ORBIT INCLINATION (DEG.), LOWEST =    10  HIGHEST =    90  INCREMENT =    20

DISSIPATION (KW.), LOWEST =    12  HIGHEST =    12  INCREMENT =     1

MONTHS DEGRADATION FOR PLATE RADIATOR =    60  INCREMENT =     1

SHADING COEFFICIENTS
PLATE, SOLAR = 0.89999998  EARTHSHINE = 0.89999998  ALBEDO = 0.89999998

PLATE, SHAPE FACTOR TO SPACE = 0.90999997  FLUID CP =     0.2500  BTU/LBM-R.

RADIATOR MATERIAL PROPERTIES
PLATE, ABSORPTANCE =     0.07000  EMITTANCE =   0.76000  MONTHLY CHANGE IN ABSORPTANCE =   0.006000
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FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 10.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 16296.418 SOLAR = 1884.240 ALBEDO = 1129.185

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-13.29	-76.04	959.84	0.070000	1884.24	1129.18	0.25	15
1	94.60	-12.81	-75.27	964.15	0.076000	2045.75	1225.97	0.25	15
2	94.60	-12.33	-74.50	968.60	0.082000	2207.25	1322.76	0.25	15
3	94.60	-11.86	-73.75	972.87	0.088000	2368.76	1419.55	0.25	15
4	94.60	-11.39	-73.00	977.25	0.094000	2530.26	1516.33	0.25	15
5	94.60	-10.92	-72.25	981.62	0.100000	2691.77	1613.12	0.25	15
6	94.60	-10.44	-71.49	986.12	0.106000	2853.28	1709.91	0.25	15
7	94.60	-9.98	-70.75	990.59	0.112000	3014.78	1806.69	0.25	15
8	94.60	-9.51	-70.00	995.04	0.118000	3176.29	1903.48	0.25	15
9	94.60	-9.04	-69.27	999.47	0.124000	3337.79	2000.27	0.25	15
10	94.60	-8.58	-68.53	1004.03	0.130000	3499.30	2097.05	0.25	15
11	94.60	-8.12	-67.80	1008.58	0.136000	3660.81	2193.84	0.25	15
12	94.60	-7.65	-67.07	1013.11	0.142000	3822.31	2290.63	0.25	15
13	94.60	-7.20	-66.35	1017.62	0.148000	3983.82	2387.42	0.26	15
14	94.60	-6.74	-65.62	1022.27	0.154000	4145.32	2484.20	0.26	15
15	94.60	-6.28	-64.90	1026.90	0.160000	4306.83	2580.99	0.26	15
16	94.60	-5.82	-64.18	1031.52	0.166000	4468.33	2677.78	0.26	15
17	94.60	-5.37	-63.47	1036.13	0.172000	4629.84	2774.56	0.26	15
18	94.60	-4.92	-62.76	1040.87	0.178000	4791.34	2871.35	0.26	15
19	94.60	-4.46	-62.05	1045.61	0.184000	4952.85	2968.14	0.26	15
20	94.60	-4.01	-61.34	1050.34	0.190000	5114.36	3064.93	0.26	15
21	94.60	-3.57	-60.64	1055.05	0.196000	5275.86	3161.71	0.26	15
22	94.60	-3.12	-59.95	1059.75	0.202000	5437.37	3258.50	0.26	15
23	94.60	-2.67	-59.25	1064.61	0.208000	5598.88	3355.29	0.26	15
24	94.60	-2.23	-58.55	1069.44	0.214000	5760.38	3452.07	0.26	15
25	94.60	-1.78	-57.86	1074.27	0.220000	5921.89	3548.86	0.26	15
26	94.60	-1.34	-57.18	1079.10	0.226000	6083.39	3645.65	0.26	15
27	94.60	-0.90	-56.48	1084.08	0.232000	6244.90	3742.43	0.26	15
28	94.60	-0.46	-55.80	1089.04	0.237999	6406.41	3839.22	0.26	15
29	94.60	-0.02	-55.12	1094.00	0.243999	6567.91	3936.01	0.26	15
30	94.60	0.42	-54.44	1098.96	0.249999	6729.42	4032.80	0.26	15
31	94.60	0.85	-53.77	1103.91	0.255999	6890.92	4129.58	0.27	15
32	94.60	1.29	-53.09	1109.02	0.261999	7052.43	4226.37	0.27	15
33	94.60	1.72	-52.43	1113.96	0.267999	7213.93	4323.15	0.27	15
34	94.60	2.16	-51.76	1119.06	0.273999	7375.44	4419.94	0.27	15
35	94.60	2.59	-51.09	1124.16	0.279999	7536.95	4516.73	0.27	15
36	94.60	3.02	-50.42	1129.43	0.285999	7698.45	4613.52	0.27	15
37	94.60	3.45	-49.76	1134.52	0.291999	7859.96	4710.30	0.27	15
38	94.60	3.87	-49.10	1139.76	0.297999	8021.46	4807.09	0.27	15
39	94.60	4.30	-48.44	1145.03	0.303999	8182.97	4903.88	0.27	15
40	94.60	4.73	-47.79	1150.27	0.309999	8344.48	5000.66	0.27	15
41	94.60	5.15	-47.14	1155.53	0.315999	8505.98	5097.45	0.27	15
42	94.60	5.57	-46.50	1160.79	0.321999	8667.49	5194.24	0.27	15
43	94.60	6.00	-45.84	1166.21	0.327999	8828.99	5291.02	0.27	15
44	94.60	6.42	-45.20	1171.63	0.333999	8990.50	5387.81	0.27	15
45	94.60	6.84	-44.55	1177.06	0.339999	9152.00	5484.60	0.27	15

46	94.60	7.25	-43.91	1182.49	0.345999	9313.51	5581.39	0.27	15
47	94.60	7.67	-43.28	1187.92	0.351999	9475.02	5678.17	0.27	15
48	94.60	8.09	-42.65	1193.34	0.357999	9636.52	5774.96	0.27	15
49	94.60	8.50	-42.01	1198.95	0.363999	9798.03	5871.75	0.28	15
50	94.60	8.92	-41.37	1204.57	0.369999	9959.54	5968.54	0.28	15
51	94.60	9.33	-40.74	1210.19	0.375999	10121.04	6065.32	0.28	15
52	94.60	9.74	-40.12	1215.80	0.381999	10282.54	6162.11	0.28	15
53	94.60	10.15	-39.49	1221.43	0.387999	10444.05	6258.89	0.28	15
54	94.60	10.56	-38.87	1227.06	0.393999	10605.55	6355.68	0.28	15
55	94.60	10.97	-38.25	1232.88	0.399999	10767.05	6452.47	0.28	15
56	94.60	11.38	-37.63	1238.70	0.405999	10928.57	6549.26	0.28	15
57	94.60	11.79	-37.01	1244.52	0.411999	11090.07	6646.04	0.28	15
58	94.60	12.19	-36.39	1250.34	0.417999	11251.58	6742.83	0.28	15
59	94.60	12.60	-35.78	1256.19	0.423999	11413.08	6839.62	0.28	15
60	94.60	13.00	-35.17	1262.04	0.429999	11574.59	6936.41	0.28	15

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 322.72 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.43000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.006000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 1.00000

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 30.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 16296.418 SOLAR = 5572.672 ALBEDO = 992.988

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-6.85	-65.81	1021.05	0.070000	5572.67	992.99	0.26	15
1	94.60	-5.85	-64.24	1031.15	0.076000	6050.33	1078.10	0.26	15
2	94.60	-4.87	-62.68	1041.33	0.082000	6527.98	1163.21	0.26	15
3	94.60	-3.88	-61.15	1051.61	0.088000	7005.64	1248.33	0.26	15
4	94.60	-2.91	-59.62	1062.00	0.094000	7483.30	1333.44	0.26	15
5	94.60	-1.94	-58.11	1072.50	0.100000	7960.95	1418.55	0.26	15
6	94.60	-0.97	-56.60	1083.28	0.106000	8438.61	1503.67	0.26	15
7	94.60	-0.02	-55.11	1094.03	0.112000	8916.27	1588.78	0.26	15
8	94.60	0.94	-53.64	1104.91	0.118000	9393.92	1673.89	0.27	15
9	94.60	1.88	-52.17	1115.93	0.124000	9871.58	1759.01	0.27	15
10	94.60	2.82	-50.73	1126.93	0.130000	10349.23	1844.12	0.27	15
11	94.60	3.76	-49.29	1138.25	0.136000	10826.89	1929.23	0.27	15
12	94.60	4.68	-47.86	1149.73	0.142000	11304.54	2014.35	0.27	15
13	94.60	5.61	-46.45	1161.20	0.148000	11782.20	2099.46	0.27	15
14	94.60	6.52	-45.03	1173.02	0.154000	12259.86	2184.57	0.27	15
15	94.60	7.44	-43.64	1184.84	0.160000	12737.51	2269.68	0.27	15
16	94.60	8.34	-42.25	1196.85	0.166000	13215.16	2354.80	0.28	15
17	94.60	9.24	-40.88	1208.88	0.172000	13692.83	2439.91	0.28	15
18	94.60	10.14	-39.51	1221.27	0.178000	14170.48	2525.02	0.28	15
19	94.60	11.03	-38.16	1233.70	0.184000	14648.13	2610.14	0.28	15
20	94.60	11.92	-36.81	1246.32	0.190000	15125.80	2695.25	0.28	15
21	94.60	12.80	-35.47	1259.15	0.196000	15603.45	2780.36	0.28	15
22	94.60	13.68	-34.14	1272.22	0.202000	16081.10	2865.48	0.28	15
23	94.60	14.55	-32.82	1285.31	0.208000	16558.76	2950.59	0.28	15
24	94.60	15.42	-31.51	1298.84	0.214000	17036.42	3035.70	0.29	15
25	94.60	16.28	-30.21	1312.21	0.220000	17514.07	3120.82	0.29	15
26	94.60	17.14	-28.92	1326.02	0.226000	17991.73	3205.93	0.29	15
27	94.60	17.99	-27.63	1339.89	0.232000	18469.39	3291.04	0.29	15
28	94.60	18.84	-26.35	1354.20	0.237999	18947.04	3376.15	0.29	15
29	94.60	19.68	-25.08	1368.60	0.243999	19424.70	3461.27	0.29	15
30	94.60	20.52	-23.82	1383.04	0.249999	19902.36	3546.38	0.29	15
31	94.60	21.36	-22.56	1397.97	0.255999	20380.01	3631.49	0.29	15
32	94.60	22.19	-21.32	1412.97	0.261999	20857.67	3716.61	0.30	15
33	94.60	23.01	-20.08	1428.26	0.267999	21335.32	3801.72	0.30	14
34	94.60	23.83	-18.83	1444.04	0.273999	21812.98	3886.83	0.30	14
35	94.60	24.65	-17.62	1459.53	0.279999	22290.64	3971.95	0.30	14
36	94.60	25.47	-16.40	1475.51	0.285999	22768.30	4057.06	0.30	14
37	94.60	26.28	-15.18	1492.01	0.291999	23245.95	4142.17	0.30	14
38	94.60	27.08	-13.97	1508.62	0.297999	23723.61	4227.29	0.30	14
39	94.60	27.89	-12.78	1525.36	0.303999	24201.27	4312.39	0.31	14
40	94.60	28.68	-11.58	1542.63	0.309999	24678.92	4397.51	0.31	14
41	94.60	29.48	-10.40	1560.03	0.315999	25156.58	4482.62	0.31	14
42	94.60	30.27	-9.22	1577.57	0.321999	25634.23	4567.73	0.31	14
43	94.60	31.05	-8.05	1595.68	0.327999	26111.89	4652.85	0.31	14
44	94.60	31.84	-6.88	1613.92	0.333999	26589.55	4737.96	0.31	14
45	94.60	32.62	-5.71	1632.76	0.339999	27067.20	4823.07	0.31	14

46	94.60	33.39	-4.56	1651.76	0.345999	27544.86	4908.19	0.31	14
47	94.60	34.16	-3.40	1671.37	0.351999	28022.51	4993.30	0.32	14
48	94.60	34.93	-2.25	1691.17	0.357999	28500.17	5078.41	0.32	14
49	94.60	35.70	-1.12	1711.12	0.363999	28977.82	5163.53	0.32	14
50	94.60	36.46	0.02	1731.74	0.369999	29455.49	5248.64	0.32	14
51	94.60	37.21	1.16	1753.02	0.375999	29933.14	5333.75	0.32	14
52	94.60	37.97	2.28	1774.01	0.381999	30410.79	5418.87	0.32	14
53	94.60	38.72	3.41	1796.16	0.387999	30888.46	5503.98	0.32	14
54	94.60	39.46	4.51	1818.06	0.393999	31366.11	5589.09	0.33	14
55	94.60	40.21	5.64	1841.16	0.399999	31843.76	5674.21	0.33	14
56	94.60	40.95	6.73	1864.01	0.405999	32321.43	5759.32	0.33	14
57	94.60	41.69	7.85	1888.10	0.411999	32799.08	5844.43	0.33	14
58	94.60	42.42	8.94	1911.92	0.417999	33276.73	5929.54	0.33	14
59	94.60	43.15	10.04	1937.05	0.423999	33754.39	6014.66	0.33	14
60	94.60	43.88	11.13	1962.45	0.429999	34232.05	6099.77	0.34	14

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 449.69 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.43000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.006000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.83483

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 50.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 16296.418 SOLAR = 9290.223 ALBEDO = 737.028

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-0.83	-56.38	1084.75	0.070000	9290.22	737.03	0.26	15
1	94.60	0.63	-54.12	1101.26	0.076000	10086.52	800.20	0.26	15
2	94.60	2.07	-51.88	1118.19	0.082000	10882.82	863.38	0.27	15
3	94.60	3.51	-49.67	1135.25	0.088000	11679.13	926.55	0.27	15
4	94.60	4.92	-47.49	1152.62	0.094000	12475.43	989.72	0.27	15
5	94.60	6.33	-45.33	1170.51	0.100000	13271.73	1052.90	0.27	15
6	94.60	7.72	-43.20	1188.56	0.106000	14068.03	1116.07	0.27	15
7	94.60	9.10	-41.09	1207.00	0.112000	14864.33	1179.24	0.28	15
8	94.60	10.47	-39.01	1225.83	0.118000	15660.63	1242.42	0.28	15
9	94.60	11.83	-36.95	1245.08	0.124000	16456.94	1305.59	0.28	15
10	94.60	13.17	-34.90	1264.77	0.130000	17253.25	1368.76	0.29	15
11	94.60	14.51	-32.89	1284.72	0.136000	18049.55	1431.94	0.28	15
12	94.60	15.83	-30.89	1305.15	0.142000	18845.85	1495.11	0.29	15
13	94.60	17.14	-28.91	1326.08	0.148000	19642.15	1558.29	0.29	15
14	94.60	18.44	-26.95	1347.52	0.154000	20438.45	1621.46	0.29	15
15	94.60	19.73	-25.01	1369.32	0.160000	21234.75	1684.63	0.29	15
16	94.60	21.01	-23.08	1391.86	0.166000	22031.05	1747.81	0.29	15
17	94.60	22.28	-21.18	1414.59	0.172000	22827.36	1810.98	0.30	15
18	94.60	23.54	-19.28	1438.32	0.178000	23623.66	1874.15	0.30	14
19	94.60	24.79	-17.40	1462.48	0.184000	24419.97	1937.33	0.30	14
20	94.60	26.03	-15.56	1486.86	0.190000	25216.27	2000.50	0.30	14
21	94.60	27.26	-13.71	1512.34	0.196000	26012.57	2063.68	0.30	14
22	94.60	28.48	-11.89	1538.09	0.202000	26808.87	2126.85	0.31	14
23	94.60	29.70	-10.07	1564.98	0.208000	27605.17	2190.02	0.31	14
24	94.60	30.90	-8.27	1592.18	0.214000	28401.48	2253.20	0.31	14
25	94.60	32.10	-6.49	1620.16	0.220000	29197.79	2316.37	0.31	14
26	94.60	33.28	-4.71	1649.38	0.226000	29994.09	2379.54	0.31	14
27	94.60	34.46	-2.96	1678.99	0.232000	30790.39	2442.72	0.32	14
28	94.60	35.63	-1.21	1709.45	0.237999	31586.69	2505.89	0.32	14
29	94.60	36.79	0.51	1740.79	0.243999	32382.99	2569.06	0.32	14
30	94.60	37.94	2.25	1773.54	0.249999	33179.29	2632.24	0.32	14
31	94.60	39.09	3.95	1806.77	0.255999	33975.59	2695.41	0.33	14
32	94.60	40.22	5.66	1841.50	0.261999	34771.89	2758.59	0.33	14
33	94.60	41.35	7.35	1877.27	0.267999	35568.21	2821.76	0.33	14
34	94.60	42.48	9.03	1914.10	0.273999	36364.51	2884.93	0.33	14
35	94.60	43.59	10.70	1952.11	0.279999	37160.81	2948.11	0.33	14
36	94.60	44.70	12.36	1991.78	0.285999	37957.11	3011.28	0.34	14
37	94.60	45.80	14.00	2032.17	0.291999	38753.41	3074.45	0.34	14
38	94.60	46.89	15.66	2074.92	0.297999	39549.71	3137.63	0.34	14
39	94.60	47.98	17.29	2118.47	0.303999	40346.02	3200.80	0.34	14
40	94.60	49.05	18.91	2164.00	0.309999	41142.32	3263.98	0.35	14
41	94.60	50.13	20.54	2211.55	0.315999	41938.62	3327.15	0.35	14
42	94.60	51.19	22.15	2260.70	0.321999	42734.92	3390.32	0.35	14
43	94.60	52.25	23.75	2312.05	0.327999	43531.23	3453.50	0.35	14
44	94.60	53.30	25.35	2365.17	0.333999	44327.53	3516.67	0.36	14
45	94.60	54.35	26.94	2420.69	0.339999	45123.83	3579.84	0.36	14

46	94.60	55.39	28.52	2478.82	0.345999	45920.14	3643.02	0.36	14
47	94.60	56.42	30.10	2539.62	0.351999	46716.44	3706.19	0.36	14
48	94.60	57.45	31.68	2603.26	0.357999	47512.75	3769.36	0.37	14
49	94.60	58.47	33.24	2669.20	0.363999	48309.05	3832.54	0.37	14
50	94.60	59.48	34.80	2739.01	0.369999	49105.35	3895.71	0.37	14
51	94.60	60.49	36.37	2812.86	0.375999	49901.65	3958.89	0.37	14
52	94.60	61.50	37.92	2889.60	0.381999	50697.95	4022.06	0.38	14
53	94.60	62.49	39.47	2970.90	0.387999	51494.25	4085.23	0.38	14
54	94.60	63.48	41.02	3056.97	0.393999	52290.55	4148.41	0.38	14
55	94.60	64.47	42.56	3147.47	0.399999	53086.86	4211.58	0.39	13
56	94.60	65.45	44.10	3243.45	0.405999	53883.16	4274.75	0.39	13
57	94.60	66.43	45.65	3346.21	0.411999	54679.47	4337.93	0.39	13
58	94.60	67.40	47.18	3454.52	0.417999	55475.77	4401.10	0.39	13
59	94.60	68.36	48.70	3568.66	0.423999	56272.07	4464.27	0.40	13
60	94.60	69.32	50.24	3693.16	0.429999	57068.38	4527.45	0.40	13

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 753.86 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.43000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.006000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.54663

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 70.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 16296.418 SOLAR = 16608.746 ALBEDO = 392.166

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	10.63	-38.77	1228.08	0.070000	16608.75	392.17	0.28	15
1	94.60	12.92	-35.29	1260.92	0.076000	18032.35	425.78	0.28	15
2	94.60	15.18	-31.88	1294.91	0.082000	19455.95	459.39	0.28	15
3	94.60	17.40	-28.51	1330.36	0.088000	20879.55	493.01	0.29	15
4	94.60	19.60	-25.20	1367.17	0.094000	22303.16	526.62	0.29	15
5	94.60	21.76	-21.95	1405.23	0.100000	23726.77	560.24	0.29	15
6	94.60	23.90	-18.75	1445.05	0.106000	25150.37	593.85	0.30	14
7	94.60	26.01	-15.59	1486.51	0.112000	26573.97	627.46	0.30	14
8	94.60	28.09	-12.48	1529.55	0.118000	27997.57	661.08	0.31	14
9	94.60	30.15	-9.39	1575.09	0.124000	29421.18	694.69	0.31	14
10	94.60	32.18	-6.38	1622.02	0.130000	30844.79	728.31	0.31	14
11	94.60	34.18	-3.38	1671.73	0.136000	32268.39	761.92	0.32	14
12	94.60	36.16	-0.41	1723.96	0.142000	33691.99	795.53	0.32	14
13	94.60	38.12	2.52	1778.87	0.148000	35115.59	829.15	0.32	14
14	94.60	40.06	5.40	1836.15	0.154000	36539.19	862.76	0.33	14
15	94.60	41.97	8.26	1896.94	0.160000	37962.79	896.38	0.33	14
16	94.60	43.86	11.10	1961.49	0.166000	39386.39	929.99	0.34	14
17	94.60	45.73	13.90	2029.55	0.172000	40810.00	963.61	0.34	14
18	94.60	47.58	16.69	2102.44	0.178000	42233.60	997.22	0.34	14
19	94.60	49.41	19.45	2179.41	0.184000	43657.21	1030.83	0.35	14
20	94.60	51.22	22.19	2261.91	0.190000	45080.81	1064.45	0.35	14
21	94.60	53.01	24.90	2349.85	0.196000	46504.41	1098.06	0.36	14
22	94.60	54.78	27.59	2444.20	0.202000	47928.01	1131.68	0.36	14
23	94.60	56.53	30.27	2546.26	0.208000	49351.61	1165.29	0.36	14
24	94.60	58.27	32.93	2656.04	0.214000	50775.23	1198.90	0.37	14
25	94.60	59.99	35.59	2775.73	0.220000	52198.83	1232.52	0.37	14
26	94.60	61.69	38.23	2905.54	0.226000	53622.43	1266.13	0.38	14
27	94.60	63.38	40.85	3047.37	0.232000	55046.03	1299.75	0.38	14
28	94.60	65.05	43.47	3203.52	0.237999	56469.64	1333.36	0.39	13
29	94.60	66.70	46.07	3375.60	0.243999	57893.24	1366.98	0.39	13
30	94.60	68.34	48.67	3565.84	0.249999	59316.84	1400.59	0.40	13
31	94.60	69.96	51.27	3780.65	0.255999	60740.45	1434.20	0.40	13
32	94.60	71.57	53.85	4019.66	0.261999	62164.05	1467.82	0.41	13
33	94.60	73.17	56.45	4293.69	0.267999	63587.66	1501.43	0.41	13
34	94.60	74.75	59.04	4606.88	0.273999	65011.26	1535.05	0.42	13
35	94.60	76.31	61.64	4969.51	0.279999	66434.81	1568.66	0.42	13
36	94.60	77.86	64.22	5392.58	0.285999	67858.44	1602.27	0.43	13
37	94.60	79.40	66.83	5897.71	0.291999	69282.06	1635.89	0.43	13
38	94.60	80.93	69.43	6507.84	0.297999	70705.63	1669.50	0.44	13
39	94.60	82.44	72.05	7265.21	0.303999	72129.25	1703.12	0.45	13
40	94.60	83.94	74.68	8223.76	0.309999	73552.88	1736.73	0.45	13
41	94.60	85.43	77.32	9482.61	0.315999	74976.44	1770.34	0.46	13
42	94.60	86.91	79.98	11206.01	0.321999	76400.06	1803.96	0.46	13
43	94.60	88.37	82.66	13716.65	0.327999	77823.69	1837.57	0.47	13
44	94.60	89.82	85.36	17740.49	0.333999	79247.25	1871.19	0.48	13
45	94.60	91.26	88.10	25219.91	0.339999	80670.88	1904.80	0.48	12

46	94.60	92.69	90.85	43773.72	0.345999	82094.50	1938.42	0.49	12
47	94.60	94.11	93.65	173728.63	0.351999	83518.06	1972.03	0.49	12

SOLUTION TERMINATED DUE TO RADIATOR MEAN TEMPERATURE BEING GREATER THAN FLUID INLET TEMPERATURE.

EXTERNAL LOADS ARE TOO LARGE FOR INFINITE RADIATOR TO REMAIN IN SPEC, SOLAR ABSORPTANCE VALUE FOR LIMIT = 0.32241

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 90.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 16296.418 SOLAR = 17675.902 ALBEDO = 0.000

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	11.69	-37.16	1243.07	0.070000	17675.90	0.00	0.28	15
1	94.60	14.06	-33.56	1277.97	0.076000	19190.97	0.00	0.28	15
2	94.60	16.39	-30.05	1313.93	0.082000	20706.04	0.00	0.29	15
3	94.60	18.68	-26.58	1351.60	0.088000	22221.11	0.00	0.29	15
4	94.60	20.95	-23.17	1390.73	0.094000	23736.19	0.00	0.29	15
5	94.60	23.18	-19.82	1431.62	0.100000	25251.27	0.00	0.30	14
6	94.60	25.38	-16.53	1473.77	0.106000	26766.34	0.00	0.30	14
7	94.60	27.55	-13.28	1518.32	0.112000	28281.41	0.00	0.30	14
8	94.60	29.70	-10.06	1565.02	0.118000	29796.48	0.00	0.31	14
9	94.60	31.81	-6.91	1613.53	0.124000	31311.56	0.00	0.31	14
10	94.60	33.90	-3.78	1664.94	0.130000	32826.63	0.00	0.32	14
11	94.60	35.97	-0.71	1718.45	0.136000	34341.71	0.00	0.32	14
12	94.60	38.00	2.33	1775.18	0.142000	35856.78	0.00	0.32	14
13	94.60	40.02	5.34	1834.86	0.148000	37371.85	0.00	0.33	14
14	94.60	42.01	8.31	1898.20	0.154000	38886.93	0.00	0.33	14
15	94.60	43.97	11.26	1965.43	0.160000	40402.00	0.00	0.34	14
16	94.60	45.91	14.19	2036.89	0.166000	41917.07	0.00	0.34	14
17	94.60	47.83	17.07	2112.83	0.172000	43432.15	0.00	0.34	14
18	94.60	49.73	19.93	2193.65	0.178000	44947.21	0.00	0.35	14
19	94.60	51.61	22.77	2280.30	0.184000	46462.30	0.00	0.35	14
20	94.60	53.47	25.59	2373.31	0.190000	47977.37	0.00	0.36	14
21	94.60	55.30	28.39	2473.80	0.196000	49492.43	0.00	0.36	14
22	94.60	57.12	31.18	2582.53	0.202000	51007.52	0.00	0.37	14
23	94.60	58.92	33.94	2700.29	0.208000	52522.59	0.00	0.37	14
24	94.60	60.70	36.68	2827.96	0.214000	54037.66	0.00	0.37	14
25	94.60	62.46	39.42	2968.20	0.220000	55552.73	0.00	0.39	14
26	94.60	64.21	42.14	3122.44	0.226000	57067.80	0.00	0.38	13
27	94.60	65.93	44.87	3294.18	0.232000	58582.88	0.00	0.39	13
28	94.60	67.65	47.56	3482.07	0.237999	60097.96	0.00	0.39	13
29	94.60	69.34	50.26	3694.11	0.243999	61613.03	0.00	0.40	13
30	94.60	71.02	52.96	3934.14	0.249999	63128.10	0.00	0.40	13
31	94.60	72.68	55.66	4207.01	0.255999	64643.17	0.00	0.41	13
32	94.60	74.33	58.35	4518.65	0.261999	66158.19	0.00	0.42	13
33	94.60	75.96	61.05	4882.27	0.267999	67673.31	0.00	0.42	13
34	94.60	77.57	63.75	5309.60	0.273999	69188.38	0.00	0.43	13
35	94.60	79.18	66.44	5816.57	0.279999	70703.44	0.00	0.43	13
36	94.60	80.76	69.15	6437.38	0.285999	72218.50	0.00	0.44	13
37	94.60	82.34	71.88	7208.94	0.291999	73733.56	0.00	0.44	13
38	94.60	83.90	74.61	8193.94	0.297999	75248.69	0.00	0.45	13
39	94.60	85.45	77.34	9492.75	0.303999	76763.75	0.00	0.46	13
40	94.60	86.98	80.12	11311.71	0.309999	78278.81	0.00	0.46	13
41	94.60	88.50	82.91	14009.30	0.315999	79793.88	0.00	0.47	13
42	94.60	90.01	85.72	18451.46	0.321999	81308.94	0.00	0.48	13
43	94.60	91.51	88.56	27164.57	0.327999	82824.00	0.00	0.48	12
44	94.60	92.99	91.43	51678.84	0.333999	84339.13	0.00	0.49	12

SOLUTION OUTSIDE TO/TI RANGE, SOLUTION TERMINATED.

EXTERNAL LOADS ARE TOO LARGE FOR INFINITE RADIATOR TO REMAIN IN SPEC, SOLAR ABSORPTANCE VALUE FOR LIMIT = 0.31010

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 10.0 DEGREES, ALTITUDE = 270.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 15479.301 SOLAR = 1918.344 ALBEDO = 1072.563

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-14.85	-78.54	945.97	0.070000	1918.34	1072.56	0.25	15
1	94.60	-14.37	-77.77	950.20	0.076000	2082.77	1164.50	0.25	15
2	94.60	-13.89	-77.01	954.39	0.082000	2247.20	1256.43	0.25	15
3	94.60	-13.42	-76.24	958.70	0.088000	2411.63	1348.36	0.25	15
4	94.60	-12.94	-75.48	962.98	0.094000	2576.06	1440.30	0.25	15
5	94.60	-12.47	-74.73	967.23	0.100000	2740.49	1532.23	0.25	15
6	94.60	-12.00	-73.97	971.61	0.106000	2904.92	1624.17	0.25	15
7	94.60	-11.53	-73.22	975.96	0.112000	3069.35	1716.10	0.25	15
8	94.60	-11.06	-72.48	980.29	0.118000	3233.78	1808.03	0.25	15
9	94.60	-10.60	-71.73	984.75	0.124000	3398.21	1899.97	0.25	15
10	94.60	-10.13	-71.00	989.04	0.130000	3562.64	1991.90	0.25	15
11	94.60	-9.66	-70.26	993.46	0.136000	3727.06	2083.83	0.25	15
12	94.60	-9.20	-69.52	998.01	0.142000	3891.49	2175.77	0.25	15
13	94.60	-8.74	-68.79	1002.38	0.148000	4055.92	2267.70	0.25	15
14	94.60	-8.28	-68.06	1006.89	0.154000	4220.35	2359.64	0.25	15
15	94.60	-7.82	-67.34	1011.39	0.160000	4384.78	2451.57	0.25	15
16	94.60	-7.36	-66.61	1016.01	0.166000	4549.21	2543.50	0.26	15
17	94.60	-6.91	-65.90	1020.48	0.172000	4713.64	2635.44	0.26	15
18	94.60	-6.45	-65.18	1025.07	0.178000	4878.07	2727.37	0.26	15
19	94.60	-6.00	-64.47	1029.65	0.184000	5042.50	2819.30	0.26	15
20	94.60	-5.55	-63.76	1034.22	0.190000	5206.93	2911.24	0.26	15
21	94.60	-5.10	-63.05	1038.93	0.196000	5371.36	3003.17	0.26	15
22	94.60	-4.65	-62.34	1043.64	0.202000	5535.78	3095.10	0.26	15
23	94.60	-4.20	-61.64	1048.32	0.208000	5700.21	3187.04	0.26	15
24	94.60	-3.76	-60.94	1053.00	0.214000	5864.64	3278.97	0.26	15
25	94.60	-3.31	-60.25	1057.67	0.220000	6029.07	3370.91	0.26	15
26	94.60	-2.87	-59.56	1062.48	0.226000	6193.50	3462.84	0.26	15
27	94.60	-2.43	-58.86	1067.29	0.232000	6357.93	3554.77	0.26	15
28	94.60	-1.99	-58.18	1072.08	0.237999	6522.36	3646.71	0.26	15
29	94.60	-1.55	-57.49	1076.87	0.243999	6686.79	3738.64	0.26	15
30	94.60	-1.11	-56.81	1081.80	0.249999	6851.21	3830.57	0.26	15
31	94.60	-0.67	-56.13	1086.58	0.255999	7015.64	3922.51	0.26	15
32	94.60	-0.23	-55.45	1091.50	0.261999	7180.07	4014.44	0.26	15
33	94.60	0.20	-54.78	1096.41	0.267999	7344.50	4106.38	0.26	15
34	94.60	0.64	-54.11	1101.33	0.273999	7508.93	4198.31	0.26	15
35	94.60	1.07	-53.44	1106.40	0.279999	7673.36	4290.24	0.27	15
36	94.60	1.50	-52.77	1111.47	0.285999	7837.79	4382.18	0.27	15
37	94.60	1.93	-52.11	1116.37	0.291999	8002.22	4474.11	0.27	15
38	94.60	2.36	-51.45	1121.43	0.297999	8166.65	4566.04	0.27	15
39	94.60	2.78	-50.78	1126.64	0.303999	8331.08	4657.98	0.27	15
40	94.60	3.21	-50.13	1131.70	0.309999	8495.51	4749.91	0.27	15
41	94.60	3.64	-49.47	1136.92	0.315999	8659.94	4841.84	0.27	15
42	94.60	4.06	-48.82	1141.96	0.321999	8824.36	4933.78	0.27	15
43	94.60	4.48	-48.17	1147.18	0.327999	8988.79	5025.71	0.27	15
44	94.60	4.91	-47.52	1152.39	0.333999	9153.22	5117.64	0.27	15
45	94.60	5.33	-46.87	1157.77	0.339999	9317.65	5209.58	0.27	15

46	94.60	5.74	-46.23	1162.98	0.345999	9482.08	5301.51	0.27	15
47	94.60	6.16	-45.59	1168.37	0.351999	9646.51	5393.45	0.27	15
48	94.60	6.58	-44.94	1173.75	0.357999	9810.94	5485.38	0.27	15
49	94.60	7.00	-44.31	1179.13	0.363999	9975.37	5577.31	0.27	15
50	94.60	7.41	-43.67	1184.52	0.369999	10139.80	5669.25	0.27	15
51	94.60	7.82	-43.04	1189.91	0.375999	10304.22	5761.18	0.27	15
52	94.60	8.24	-42.42	1195.31	0.381999	10468.65	5853.12	0.28	15
53	94.60	8.65	-41.79	1200.87	0.387999	10633.09	5945.05	0.28	15
54	94.60	9.06	-41.16	1206.45	0.393999	10797.51	6036.98	0.28	15
55	94.60	9.47	-40.53	1212.03	0.399999	10961.94	6128.92	0.28	15
56	94.60	9.88	-39.91	1217.61	0.405999	11126.37	6220.85	0.28	15
57	94.60	10.29	-39.30	1223.19	0.411999	11290.80	6312.79	0.28	15
58	94.60	10.69	-38.67	1228.96	0.417999	11455.23	6404.72	0.28	15
59	94.60	11.10	-38.05	1234.74	0.423999	11619.66	6496.65	0.28	15
60	94.60	11.50	-37.45	1240.34	0.429999	11784.08	6588.59	0.28	15

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 318.82 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.43000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.006000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 1.00000

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 30.0 DEGREES, ALTITUDE = 270.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 15479.301 SOLAR = 5670.867 ALBEDO = 943.200

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-8.22	-67.97	1007.48	0.070000	5670.87	943.20	0.25	15
1	94.60	-7.21	-66.37	1017.46	0.076000	6156.94	1024.05	0.26	15
2	94.60	-6.20	-64.78	1027.67	0.082000	6643.01	1104.89	0.26	15
3	94.60	-5.20	-63.22	1037.82	0.088000	7129.08	1185.74	0.26	15
4	94.60	-4.21	-61.66	1048.20	0.094000	7615.16	1266.58	0.26	15
5	94.60	-3.23	-60.12	1058.55	0.100000	8101.23	1347.43	0.26	15
6	94.60	-2.25	-58.59	1069.15	0.106000	8587.30	1428.27	0.26	15
7	94.60	-1.28	-57.07	1079.87	0.112000	9073.38	1509.12	0.26	15
8	94.60	-0.31	-55.57	1090.71	0.118000	9559.45	1589.96	0.26	15
9	94.60	0.65	-54.09	1101.52	0.124000	10045.52	1670.81	0.26	15
10	94.60	1.61	-52.61	1112.63	0.130000	10531.59	1751.66	0.27	15
11	94.60	2.55	-51.14	1123.89	0.136000	11017.66	1832.50	0.27	15
12	94.60	3.50	-49.69	1135.14	0.142000	11503.74	1913.35	0.27	15
13	94.60	4.43	-48.25	1146.54	0.148000	11989.81	1994.19	0.27	15
14	94.60	5.36	-46.81	1158.27	0.154000	12475.89	2075.04	0.27	15
15	94.60	6.29	-45.39	1170.00	0.160000	12961.96	2155.88	0.27	15
16	94.60	7.21	-43.98	1181.91	0.166000	13448.04	2236.73	0.27	15
17	94.60	8.13	-42.59	1193.83	0.172000	13934.11	2317.57	0.27	15
18	94.60	9.04	-41.20	1206.11	0.178000	14420.18	2398.42	0.28	15
19	94.60	9.94	-39.82	1218.41	0.184000	14906.25	2479.26	0.28	15
20	94.60	10.84	-38.44	1231.09	0.190000	15392.32	2560.11	0.28	15
21	94.60	11.73	-37.08	1243.81	0.196000	15878.39	2640.96	0.28	15
22	94.60	12.62	-35.74	1256.54	0.202000	16364.47	2721.80	0.28	15
23	94.60	13.51	-34.40	1269.68	0.208000	16850.54	2802.65	0.28	15
24	94.60	14.39	-33.07	1282.86	0.214000	17336.61	2883.49	0.28	15
25	94.60	15.26	-31.75	1296.27	0.220000	17822.68	2964.34	0.29	15
26	94.60	16.13	-30.43	1309.92	0.226000	18308.77	3045.18	0.29	15
27	94.60	16.99	-29.13	1323.80	0.232000	18794.84	3126.03	0.29	15
28	94.60	17.85	-27.83	1337.76	0.237999	19280.91	3206.88	0.29	15
29	94.60	18.71	-26.54	1351.96	0.243999	19766.98	3287.72	0.29	15
30	94.60	19.56	-25.26	1366.42	0.249999	20253.05	3368.57	0.29	15
31	94.60	20.41	-23.99	1381.15	0.255999	20739.13	3449.41	0.29	15
32	94.60	21.25	-22.73	1395.96	0.261999	21225.20	3530.26	0.29	15
33	94.60	22.09	-21.47	1411.05	0.267999	21711.27	3611.10	0.30	15
34	94.60	22.92	-20.22	1426.42	0.273999	22197.34	3691.95	0.30	14
35	94.60	23.75	-18.97	1442.29	0.279999	22683.42	3772.79	0.30	14
36	94.60	24.57	-17.75	1457.84	0.285999	23169.49	3853.64	0.30	14
37	94.60	25.39	-16.50	1474.32	0.291999	23655.56	3934.48	0.30	14
38	94.60	26.21	-15.29	1490.50	0.297999	24141.64	4015.33	0.30	14
39	94.60	27.02	-14.07	1507.20	0.303999	24627.71	4096.17	0.30	14
40	94.60	27.83	-12.87	1524.00	0.309999	25113.79	4177.02	0.30	14
41	94.60	28.63	-11.66	1541.36	0.315999	25599.86	4257.86	0.31	14
42	94.60	29.43	-10.47	1558.87	0.321999	26085.93	4338.71	0.31	14
43	94.60	30.23	-9.27	1576.92	0.327999	26572.00	4419.55	0.31	14
44	94.60	31.02	-8.09	1595.13	0.333999	27058.08	4500.40	0.31	14
45	94.60	31.81	-6.92	1613.46	0.339999	27544.15	4581.25	0.31	14

46	94.60	32.59	-5.74	1632.40	0.345999	28030.22	4662.09	0.31	14
47	94.60	33.37	-4.58	1651.49	0.351999	28516.29	4742.94	0.31	14
48	94.60	34.15	-3.41	1671.21	0.357999	29002.38	4823.79	0.32	14
49	94.60	34.93	-2.26	1691.10	0.363999	29488.45	4904.63	0.32	14
50	94.60	35.70	-1.12	1711.17	0.369999	29974.52	4985.48	0.32	14
51	94.60	36.46	0.03	1731.89	0.375999	30460.59	5066.32	0.32	14
52	94.60	37.23	1.18	1753.26	0.381999	30946.66	5147.17	0.32	14
53	94.60	37.99	2.31	1774.84	0.387999	31432.74	5228.01	0.32	14
54	94.60	38.74	3.44	1796.64	0.393999	31918.81	5308.86	0.32	14
55	94.60	39.49	4.56	1819.14	0.399999	32404.88	5389.70	0.33	14
56	94.60	40.24	5.68	1841.87	0.405999	32890.95	5470.55	0.33	14
57	94.60	40.99	6.80	1865.33	0.411999	33377.04	5551.39	0.33	14
58	94.60	41.73	7.91	1889.53	0.417999	33863.11	5632.24	0.33	14
59	94.60	42.47	9.02	1914.00	0.423999	34349.18	5713.09	0.33	14
60	94.60	43.21	10.12	1938.73	0.429999	34835.25	5793.93	0.33	14

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 445.46 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.43000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.006000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.83737

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 50.0 DEGREES, ALTITUDE = 270.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 15479.301 SOLAR = 9440.668 ALBEDO = 700.074

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-2.03	-58.26	1071.48	0.070000	9440.67	700.07	0.26	15
1	94.60	-0.55	-55.94	1087.93	0.076000	10249.86	760.08	0.26	15
2	94.60	0.92	-53.65	1104.79	0.082000	11059.06	820.09	0.27	15
3	94.60	2.38	-51.41	1121.76	0.088000	11868.25	880.09	0.27	15
4	94.60	3.83	-49.18	1139.18	0.094000	12677.46	940.10	0.27	15
5	94.60	5.26	-46.97	1156.92	0.100000	13486.66	1000.10	0.27	15
6	94.60	6.68	-44.80	1175.00	0.106000	14295.86	1060.11	0.27	15
7	94.60	8.08	-42.65	1193.28	0.112000	15105.05	1120.12	0.27	15
8	94.60	9.48	-40.52	1212.10	0.118000	15914.25	1180.12	0.28	15
9	94.60	10.86	-38.42	1231.33	0.124000	16723.45	1240.13	0.28	15
10	94.60	12.23	-36.34	1250.89	0.130000	17532.65	1300.14	0.28	15
11	94.60	13.58	-34.29	1270.72	0.136000	18341.84	1360.14	0.28	15
12	94.60	14.93	-32.25	1291.09	0.142000	19151.04	1420.15	0.28	15
13	94.60	16.26	-30.24	1311.96	0.148000	19960.23	1480.15	0.29	15
14	94.60	17.58	-28.24	1333.34	0.154000	20769.45	1540.16	0.29	15
15	94.60	18.89	-26.27	1355.04	0.160000	21578.64	1600.17	0.29	15
16	94.60	20.20	-24.30	1377.49	0.166000	22387.84	1660.17	0.29	15
17	94.60	21.49	-22.37	1400.31	0.172000	23197.03	1720.18	0.29	15
18	94.60	22.77	-20.44	1423.73	0.178000	24006.23	1780.18	0.30	15
19	94.60	24.04	-18.55	1447.56	0.184000	24815.43	1840.19	0.30	14
20	94.60	25.30	-16.64	1472.43	0.190000	25624.63	1900.20	0.30	14
21	94.60	26.55	-14.78	1497.56	0.196000	26433.82	1960.20	0.30	14
22	94.60	27.79	-12.92	1523.38	0.202000	27243.03	2020.21	0.30	14
23	94.60	29.02	-11.08	1549.90	0.208000	28052.22	2080.22	0.31	14
24	94.60	30.24	-9.25	1577.15	0.214000	28861.43	2140.22	0.31	14
25	94.60	31.46	-7.44	1605.18	0.220000	29670.62	2200.23	0.31	14
26	94.60	32.66	-5.64	1633.99	0.226000	30479.82	2260.23	0.31	14
27	94.60	33.86	-3.86	1663.63	0.232000	31289.01	2320.24	0.32	14
28	94.60	35.04	-2.08	1694.13	0.237999	32098.22	2380.25	0.32	14
29	94.60	36.22	-0.33	1725.50	0.243999	32907.41	2440.25	0.32	14
30	94.60	37.39	1.42	1757.80	0.249999	33716.61	2500.26	0.32	14
31	94.60	38.55	3.15	1791.06	0.255999	34525.80	2560.27	0.32	14
32	94.60	39.71	4.89	1825.78	0.261999	35335.01	2620.27	0.33	14
33	94.60	40.85	6.59	1861.06	0.267999	36144.21	2680.28	0.33	14
34	94.60	41.99	8.30	1897.91	0.273999	36953.41	2740.28	0.33	14
35	94.60	43.12	9.99	1935.89	0.279999	37762.60	2800.29	0.33	14
36	94.60	44.24	11.67	1975.05	0.285999	38571.80	2860.30	0.34	14
37	94.60	45.36	13.35	2015.95	0.291999	39381.00	2920.30	0.34	14
38	94.60	46.47	15.02	2058.12	0.297999	40190.20	2980.31	0.34	14
39	94.60	47.57	16.67	2101.65	0.303999	40999.39	3040.31	0.34	14
40	94.60	48.66	18.32	2147.10	0.309999	41808.60	3100.32	0.35	14
41	94.60	49.75	19.97	2194.66	0.315999	42617.79	3160.33	0.35	14
42	94.60	50.83	21.60	2243.72	0.321999	43426.99	3220.33	0.35	14
43	94.60	51.90	23.22	2294.47	0.327999	44236.19	3280.34	0.35	14
44	94.60	52.97	24.83	2347.52	0.333999	45045.39	3340.35	0.36	14
45	94.60	54.03	26.45	2403.58	0.339999	45854.58	3400.35	0.36	14

46	94.60	55.08	28.05	2460.98	0.345999	46663.79	3460.36	0.36	14
47	94.60	56.13	29.65	2521.69	0.351999	47472.98	3520.36	0.36	14
48	94.60	57.17	31.24	2585.22	0.357999	48282.18	3580.37	0.37	14
49	94.60	58.20	32.83	2651.75	0.363999	49091.38	3640.38	0.37	14
50	94.60	59.23	34.41	2721.45	0.369999	49900.58	3700.38	0.37	14
51	94.60	60.25	35.99	2794.51	0.375999	50709.78	3760.39	0.37	14
52	94.60	61.27	37.57	2871.85	0.381999	51518.98	3820.40	0.38	14
53	94.60	62.28	39.13	2952.97	0.387999	52328.17	3880.40	0.38	14
54	94.60	63.28	40.69	3038.15	0.393999	53137.37	3940.41	0.38	14
55	94.60	64.28	42.27	3130.11	0.399999	53946.56	4000.41	0.38	13
56	94.6C	65.27	43.82	3225.93	0.405999	54755.77	4060.42	0.39	13
57	94.60	66.26	45.36	3326.79	0.411999	55564.96	4120.43	0.39	13
58	94.60	67.24	46.93	3436.69	0.417999	56374.17	4180.43	0.39	13
59	94.6C	68.22	48.47	3550.69	0.423999	57183.36	4240.44	0.40	13
60	94.60	69.19	50.03	3674.96	0.429999	57992.56	4300.44	0.40	13

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 750.83 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.43000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.006000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.54616

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 70.0 DEGREES, ALTITUDE = 270.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 15479.301 SOLAR = 16608.746 ALBEDO = 372.502

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	9.29	-40.79	1209.72	0.070000	16608.75	372.50	0.28	15
1	94.60	11.60	-37.29	1241.88	0.076000	18032.35	404.43	0.28	15
2	94.60	13.88	-33.84	1275.14	0.082000	19455.95	436.36	0.28	15
3	94.60	16.12	-30.45	1309.79	0.088000	20879.55	468.29	0.29	15
4	94.60	18.33	-27.11	1345.74	0.094000	22303.16	500.22	0.29	15
5	94.60	20.51	-23.83	1382.89	0.100000	23726.77	532.15	0.29	15
6	94.60	22.66	-20.60	1421.73	0.106000	25150.37	564.07	0.30	14
7	94.60	24.78	-17.41	1462.38	0.112000	26573.97	596.00	0.30	14
8	94.60	26.88	-14.29	1504.10	0.118000	27997.57	627.93	0.30	14
9	94.60	28.95	-11.19	1548.26	0.124000	29421.18	659.86	0.31	14
10	94.60	30.99	-8.14	1594.15	0.130000	30844.79	691.79	0.31	14
11	94.60	33.01	-5.13	1642.33	0.136000	32268.39	723.72	0.31	14
12	94.60	35.00	-2.15	1692.91	0.142000	33691.99	755.65	0.32	14
13	94.60	36.97	0.79	1746.05	0.148000	35115.59	787.57	0.32	14
14	94.60	38.92	3.70	1801.96	0.154000	36539.19	819.50	0.33	14
15	94.60	40.84	6.58	1860.78	0.160000	37962.79	851.43	0.33	14
16	94.60	42.74	9.42	1922.73	0.166000	39386.39	883.36	0.33	14
17	94.60	44.62	12.25	1989.03	0.172000	40810.00	915.29	0.34	14
18	94.60	46.48	15.03	2058.42	0.178000	42233.60	947.22	0.34	14
19	94.60	48.32	17.80	2132.76	0.184000	43657.21	979.15	0.34	14
20	94.60	50.14	20.55	2211.85	0.190000	45080.81	1011.07	0.35	14
21	94.60	51.94	23.28	2296.64	0.196000	46504.41	1043.00	0.35	14
22	94.60	53.72	25.98	2387.03	0.202000	47928.01	1074.93	0.36	14
23	94.60	55.48	28.67	2484.12	0.208000	49351.61	1106.86	0.36	14
24	94.60	57.23	31.34	2589.10	0.214000	50775.23	1138.79	0.37	14
25	94.60	58.96	33.99	2702.11	0.220000	52198.83	1170.72	0.37	14
26	94.60	60.67	36.63	2825.29	0.226000	53622.43	1202.65	0.37	14
27	94.60	62.36	39.26	2959.83	0.232000	55046.03	1234.58	0.38	14
28	94.60	64.04	41.89	3107.67	0.237999	56469.64	1266.50	0.39	13
29	94.60	65.70	44.49	3268.84	0.243999	57893.24	1298.43	0.39	13
30	94.60	67.34	47.10	3448.55	0.249999	59316.84	1330.36	0.39	13
31	94.60	68.98	49.69	3647.27	0.255999	60740.45	1362.29	0.40	13
32	94.60	70.59	52.27	3869.89	0.261999	62164.05	1394.22	0.40	13
33	94.60	72.19	54.86	4122.39	0.267999	63587.66	1426.15	0.41	13
34	94.60	73.78	57.45	4409.93	0.273999	65011.26	1458.08	0.41	13
35	94.60	75.35	60.04	4739.15	0.279999	66434.81	1490.00	0.42	13
36	94.60	76.91	62.63	5124.35	0.285999	67858.44	1521.93	0.42	13
37	94.60	78.45	65.22	5575.19	0.291999	69282.06	1553.86	0.43	13
38	94.60	79.99	67.81	6115.35	0.297999	70705.63	1585.79	0.44	13
39	94.60	81.51	70.42	6775.44	0.303999	72129.25	1617.72	0.44	13
40	94.60	83.01	73.05	7600.34	0.309999	73552.88	1649.65	0.45	13
41	94.60	84.50	75.67	8653.19	0.315999	74976.44	1681.58	0.45	13
42	94.60	85.99	78.32	10060.54	0.321999	76400.06	1713.51	0.46	13
43	94.60	87.46	80.98	12030.25	0.327999	77823.69	1745.43	0.47	13
44	94.60	88.92	83.67	14990.16	0.333999	79247.25	1777.36	0.47	13
45	94.60	90.36	86.39	19967.31	0.339999	80670.88	1809.29	0.48	12

46	94.60	91.80	89.11	29884.21	0.345999	82094.50	1841.22	0.49	12
47	94.60	93.22	91.88	60416.76	0.351999	83518.06	1873.15	0.49	12

SOLUTION TERMINATED DUE TO RADIATOR MEAN TEMPERATURE BEING GREATER THAN FLUID INLET TEMPERATURE.

EXTERNAL LOADS ARE TOO LARGE FOR INFINITE RADIATOR TO REMAIN IN SPEC, SOLAR ABSORPTANCE VALUE FOR LIMIT = 0.32615

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 90.0 DEGREES, ALTITUDE = 270.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 15479.301 SOLAR = 17675.902 ALBEDO = 0.000

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	10.40	-39.12	1224.89	0.070000	17675.90	0.00	0.28	15
1	94.60	12.79	-35.49	1258.94	0.076000	19190.97	0.00	0.28	15
2	94.60	15.13	-31.94	1294.35	0.082000	20706.04	0.00	0.28	15
3	94.60	17.45	-28.44	1331.23	0.088000	22221.11	0.00	0.29	15
4	94.60	19.73	-25.01	1369.31	0.094000	23736.19	0.00	0.29	15
5	94.60	21.98	-21.62	1409.28	0.100000	25251.27	0.00	0.30	15
6	94.60	24.20	-18.30	1450.86	0.106000	26766.34	0.00	0.30	14
7	94.60	26.39	-15.02	1494.17	0.112000	28281.41	0.00	0.30	14
8	94.60	28.55	-11.79	1539.53	0.118000	29796.48	0.00	0.31	14
9	94.60	30.68	-8.61	1587.08	0.124000	31311.56	0.00	0.31	14
10	94.60	32.78	-5.46	1636.98	0.130000	32826.63	0.00	0.31	14
11	94.60	34.86	-2.36	1689.37	0.136000	34341.71	0.00	0.32	14
12	94.60	36.91	0.70	1744.42	0.142000	35856.78	0.00	0.32	14
13	94.60	38.93	3.72	1802.30	0.148000	37371.85	0.00	0.33	14
14	94.60	40.93	6.72	1863.72	0.154000	38886.93	0.00	0.33	14
15	94.60	42.91	9.68	1928.91	0.160000	40402.00	0.00	0.33	14
16	94.60	44.87	12.61	1997.61	0.166000	41917.07	0.00	0.34	14
17	94.60	46.80	15.52	2071.16	0.172000	43432.15	0.00	0.34	14
18	94.60	48.71	18.40	2149.40	0.178000	44947.21	0.00	0.35	14
19	94.60	50.60	21.24	2232.67	0.184000	46462.30	0.00	0.35	14
20	94.60	52.47	24.08	2322.53	0.190000	47977.37	0.00	0.35	14
21	94.60	54.31	26.89	2419.14	0.196000	49492.43	0.00	0.36	14
22	94.60	56.14	29.68	2522.82	0.202000	51007.52	0.00	0.36	14
23	94.60	57.95	32.44	2635.13	0.208000	52522.59	0.00	0.37	14
24	94.60	59.74	35.20	2757.46	0.214000	54037.66	0.00	0.37	14
25	94.60	61.51	37.95	2890.93	0.220000	55552.73	0.00	0.38	14
26	94.60	63.27	40.68	3037.70	0.226000	57067.80	0.00	0.38	14
27	94.60	65.01	43.41	3200.13	0.232000	58582.88	0.00	0.39	13
28	94.60	66.73	46.11	3378.39	0.237999	60097.96	0.00	0.39	13
29	94.60	68.43	48.81	3577.48	0.243999	61613.03	0.00	0.40	13
30	94.60	70.11	51.50	3800.44	0.249999	63128.10	0.00	0.40	13
31	94.60	71.78	54.21	4055.32	0.255999	64643.17	0.00	0.41	13
32	94.60	73.44	56.91	4345.85	0.261999	66158.19	0.00	0.41	13
33	94.60	75.08	59.59	4678.44	0.267999	67673.31	0.00	0.42	13
34	94.60	76.70	62.28	5067.59	0.273999	69188.38	0.00	0.42	13
35	94.60	78.31	64.98	5530.11	0.279999	70703.44	0.00	0.43	13
36	94.60	79.91	67.68	6085.36	0.285999	72218.50	0.00	0.44	13
37	94.60	81.49	70.40	6769.52	0.291999	73733.56	0.00	0.44	13
38	94.60	83.06	73.12	7627.52	0.297999	75248.69	0.00	0.45	13
39	94.60	84.61	75.86	8741.20	0.303999	76763.75	0.00	0.45	13
40	94.60	86.16	78.62	10250.27	0.309999	78278.81	0.00	0.46	13
41	94.60	87.68	81.40	12414.90	0.315999	79793.88	0.00	0.47	13
42	94.60	89.20	84.19	15742.51	0.321999	81308.94	0.00	0.47	13
43	94.60	90.70	87.03	21648.23	0.327999	82824.00	0.00	0.48	12
44	94.60	92.19	89.87	34698.21	0.333999	84339.13	0.00	0.49	12
45	94.60	93.67	92.78	90302.00	0.339999	85854.19	0.00	0.49	12

SOLUTION TERMINATED DUE TO RADIATOR MEAN TEMPERATURE BEING GREATER THAN FLUID INLET TEMPERATURE.

EXTERNAL LOADS ARE TOO LARGE FOR INFINITE RADIATOR TO REMAIN IN SPEC, SOLAR ABSORPTANCE VALUE FOR LIMIT = 0.31333

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2 5 K W   P O W E R   M O D U L E   P R O G R A M.


ALTITUDE (N.MI.), LOWEST =   235  HIGHEST =   270  INCREMENT =    35

ORBIT INCLINATION (DEG.), LOWEST =    10  HIGHEST =    90  INCREMENT =    20

DISSIPATION (KW.), LOWEST =    12  HIGHEST =    12  INCREMENT =     1

MONTHS DEGRADATION FOR PLATE RADIATOR =    60  INCREMENT =     1

SHADING COEFFICIENTS
PLATE, SOLAR = 0.89999998  EARTHSHINE = 0.89999998  ALBEDO = 0.89999998

PLATE, SHAPE FACTOR TO SPACE = 0.90999997  FLUID CP =     0.2500  BTU/LBM-R.

RADIATOR MATERIAL PROPERTIES
PLATE, ABSORPTANCE =    0.07000  EMITTANCE =    0.76000  MONTHLY CHANGE IN ABSORPTANCE =  0.009000
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FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 10.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 16296.418 SOLAR = 1884.240 ALBEDO = 1129.185

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-13.29	-76.04	959.84	0.070000	1884.24	1129.18	0.25	15
1	94.60	-12.57	-74.89	966.31	0.079000	2126.50	1274.36	0.25	15
2	94.60	-11.86	-73.75	972.87	0.088000	2368.76	1419.54	0.25	15
3	94.60	-11.15	-72.61	979.51	0.097000	2611.01	1564.72	0.25	15
4	94.60	-10.44	-71.49	986.12	0.106000	2853.27	1709.90	0.25	15
5	94.60	-9.74	-70.37	992.82	0.115000	3095.53	1855.08	0.25	15
6	94.60	-9.04	-69.27	999.47	0.124000	3337.79	2000.26	0.25	15
7	94.60	-8.35	-68.17	1006.23	0.133000	3580.05	2145.44	0.25	15
8	94.60	-7.65	-67.07	1013.11	0.142000	3822.30	2290.63	0.25	15
9	94.60	-6.97	-65.98	1019.95	0.150999	4064.56	2435.80	0.26	15
10	94.60	-6.28	-64.90	1026.90	0.159999	4306.82	2580.99	0.26	15
11	94.60	-5.60	-63.83	1033.83	0.168999	4549.08	2726.17	0.26	15
12	94.60	-4.92	-62.76	1040.87	0.177999	4791.34	2871.34	0.26	15
13	94.60	-4.24	-61.70	1047.90	0.186999	5033.59	3016.53	0.26	15
14	94.60	-3.57	-60.64	1055.05	0.195999	5275.85	3161.71	0.26	15
15	94.60	-2.89	-59.60	1062.18	0.204999	5518.11	3306.89	0.26	15
16	94.60	-2.23	-58.55	1069.44	0.213999	5760.37	3452.07	0.26	15
17	94.60	-1.56	-57.52	1076.68	0.222999	6002.63	3597.25	0.26	15
18	94.60	-0.90	-56.48	1084.07	0.231999	6244.88	3742.43	0.26	15
19	94.60	-0.24	-55.46	1091.44	0.240999	6487.14	3887.61	0.26	15
20	94.60	0.42	-54.44	1098.96	0.249999	6729.40	4032.79	0.26	15
21	94.60	1.07	-53.43	1106.47	0.258999	6971.66	4177.96	0.27	15
22	94.60	1.72	-52.43	1113.96	0.267999	7213.92	4323.14	0.27	15
23	94.60	2.37	-51.42	1121.61	0.276999	7456.18	4468.32	0.27	15
24	94.60	3.02	-50.42	1129.42	0.285999	7698.43	4613.50	0.27	15
25	94.60	3.66	-49.44	1137.05	0.294999	7940.69	4758.68	0.27	15
26	94.60	4.30	-48.44	1145.03	0.303999	8182.95	4903.86	0.27	15
27	94.60	4.94	-47.47	1152.82	0.312998	8425.21	5049.04	0.27	15
28	94.60	5.57	-46.50	1160.79	0.321998	8667.46	5194.22	0.27	15
29	94.60	6.21	-45.52	1168.92	0.330998	8909.72	5339.41	0.27	15
30	94.60	6.84	-44.55	1177.06	0.339998	9151.98	5484.59	0.27	15
31	94.60	7.46	-43.59	1185.20	0.348998	9394.24	5629.77	0.27	15
32	94.60	8.09	-42.65	1193.34	0.357998	9636.50	5774.95	0.27	15
33	94.60	8.71	-41.69	1201.67	0.366998	9878.75	5920.13	0.28	15
34	94.60	9.33	-40.74	1210.18	0.375998	10121.01	6065.30	0.28	15
35	94.60	9.95	-39.81	1218.52	0.384998	10363.27	6210.48	0.28	15
36	94.60	10.56	-38.87	1227.06	0.393998	10605.52	6355.66	0.28	15
37	94.60	11.18	-37.94	1235.78	0.402998	10847.78	6500.84	0.28	15
38	94.60	11.79	-37.01	1244.52	0.411998	11090.04	6646.03	0.28	15
39	94.60	12.39	-36.09	1253.27	0.420998	11332.30	6791.21	0.28	15
40	94.60	13.00	-35.17	1262.04	0.429998	11574.55	6936.39	0.28	15
41	94.60	13.60	-34.26	1271.01	0.438998	11816.81	7081.57	0.28	15
42	94.60	14.20	-33.34	1280.18	0.447998	12059.08	7226.75	0.28	15
43	94.60	14.80	-32.44	1289.19	0.456998	12301.34	7371.93	0.28	15
44	94.60	15.40	-31.54	1298.40	0.465998	12543.59	7517.11	0.29	15
45	94.60	15.99	-30.64	1307.82	0.474997	12785.85	7662.29	0.29	15

46	94.60	16.59	-29.75	1317.09	0.483997	13028.11	7807.46	0.29	15
47	94.60	17.17	-28.85	1326.75	0.492997	13270.36	7952.64	0.29	15
48	94.60	17.76	-27.97	1336.26	0.501997	13512.62	8097.83	0.29	15
49	94.60	18.35	-27.09	1345.99	0.510997	13754.88	8243.01	0.29	15
50	94.60	18.93	-26.21	1355.75	0.519997	13997.13	8388.19	0.29	15
51	94.60	19.51	-25.34	1365.53	0.528997	14239.40	8533.37	0.29	15
52	94.60	20.09	-24.47	1375.55	0.537997	14481.66	8678.55	0.29	15
53	94.60	20.67	-23.60	1385.61	0.546997	14723.91	8823.73	0.29	15
54	94.60	21.24	-22.73	1395.88	0.555997	14966.17	8968.91	0.29	15
55	94.60	21.82	-21.87	1406.21	0.564997	15208.43	9114.09	0.30	15
56	94.60	22.39	-21.01	1416.78	0.573997	15450.69	9259.27	0.30	14
57	94.60	22.96	-20.16	1427.38	0.582997	15692.93	9404.45	0.30	14
58	94.60	23.52	-19.31	1438.03	0.591997	15935.19	9549.63	0.30	14
59	94.60	24.09	-18.46	1448.72	0.600997	16177.46	9694.81	0.30	14
60	94.60	24.65	-17.63	1459.46	0.609997	16419.71	9839.99	0.30	14

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 358.37 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.61000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.009000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS. FOR SIZING RADIATOR AREA = 1.00000

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 30.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 16296.418 SOLAR = 5572.672 ALBEDO = 992.988

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-6.85	-65.81	1021.05	0.070000	5572.67	992.99	0.26	15
1	94.60	-5.36	-63.46	1036.25	0.079000	6289.15	1120.66	0.26	15
2	94.60	-3.88	-61.15	1051.61	0.088000	7005.64	1248.33	0.26	15
3	94.60	-2.42	-58.86	1067.34	0.097000	7722.12	1376.00	0.26	15
4	94.60	-0.97	-56.60	1083.28	0.106000	8438.60	1503.66	0.26	15
5	94.60	0.46	-54.38	1099.31	0.115000	9155.09	1631.33	0.26	15
6	94.60	1.88	-52.17	1115.93	0.124000	9871.56	1759.00	0.27	15
7	94.60	3.29	-50.00	1132.67	0.133000	10598.04	1886.67	0.27	15
8	94.60	4.68	-47.86	1149.73	0.142000	11304.52	2014.34	0.27	15
9	94.60	6.07	-45.74	1167.11	0.150999	12021.01	2142.01	0.27	15
10	94.60	7.44	-43.64	1184.84	0.159999	12737.48	2269.68	0.27	15
11	94.60	8.79	-41.57	1202.77	0.168999	13453.97	2397.35	0.28	15
12	94.60	10.14	-39.51	1221.27	0.177999	14170.45	2525.02	0.28	15
13	94.60	11.48	-37.48	1240.00	0.186999	14886.94	2652.69	0.28	15
14	94.60	12.80	-35.47	1259.15	0.195999	15603.42	2780.36	0.28	15
15	94.60	14.11	-33.48	1278.76	0.204999	16319.89	2908.03	0.28	15
16	94.60	15.42	-31.52	1298.64	0.213999	17036.38	3035.70	0.29	15
17	94.60	16.71	-29.56	1319.20	0.222999	17752.86	3163.36	0.29	15
18	94.60	17.99	-27.63	1339.89	0.231999	18469.35	3291.03	0.29	15
19	94.60	19.26	-25.72	1361.29	0.240999	19185.82	3418.70	0.29	15
20	94.60	20.52	-23.82	1383.04	0.249999	19902.31	3546.37	0.29	15
21	94.60	21.77	-21.94	1405.36	0.258999	20618.79	3674.04	0.29	15
22	94.60	23.01	-20.08	1428.26	0.267999	21335.28	3801.71	0.30	14
23	94.60	24.24	-18.23	1451.58	0.276999	22051.75	3929.38	0.30	14
24	94.60	25.47	-16.40	1475.51	0.285999	22768.24	4057.05	0.30	14
25	94.60	26.68	-14.59	1500.09	0.294999	23484.72	4184.71	0.30	14
26	94.60	27.89	-12.78	1525.36	0.303999	24201.20	4312.39	0.31	14
27	94.60	29.08	-10.99	1551.32	0.312998	24917.68	4440.05	0.31	14
28	94.60	30.27	-9.22	1577.57	0.321998	25634.16	4567.72	0.31	14
29	94.60	31.45	-7.45	1605.00	0.330998	26350.65	4695.39	0.31	14
30	94.60	32.62	-5.71	1632.76	0.339998	27067.13	4823.06	0.31	14
31	94.60	33.78	-3.99	1661.32	0.348998	27783.61	4950.73	0.32	14
32	94.60	34.93	-2.25	1691.17	0.357998	28500.09	5078.40	0.32	14
33	94.60	36.08	-0.55	1721.39	0.366998	29216.58	5206.07	0.32	14
34	94.60	37.21	1.16	1753.01	0.375998	29933.06	5333.74	0.32	14
35	94.60	38.34	2.84	1785.05	0.384998	30649.54	5461.41	0.32	14
36	94.60	39.46	4.51	1818.06	0.393998	31366.02	5589.08	0.33	14
37	94.60	40.58	6.19	1852.56	0.402998	32082.51	5716.75	0.33	14
38	94.60	41.69	7.85	1888.08	0.411998	32798.99	5844.42	0.33	14
39	94.60	42.79	9.50	1924.70	0.420998	33515.46	5972.09	0.33	14
40	94.60	43.88	11.13	1962.45	0.429998	34231.95	6099.75	0.34	14
41	94.60	44.96	12.76	2001.34	0.438998	34948.43	6227.42	0.34	14
42	94.60	46.04	14.37	2041.46	0.447998	35664.92	6355.09	0.34	14
43	94.60	47.11	15.98	2083.38	0.456998	36381.39	6482.76	0.34	14
44	94.60	48.18	17.60	2127.20	0.465998	37097.88	6610.43	0.34	14
45	94.60	49.24	19.19	2171.86	0.474997	37814.36	6738.10	0.35	14

46	94.60	50.29	20.77	2218.50	0.483997	38530.85	6865.77	0.35	14
47	94.60	51.34	22.36	2267.33	0.492997	39247.33	6993.44	0.35	14
48	94.60	52.37	23.93	2317.74	0.501997	39963.81	7121.11	0.35	14
49	94.60	53.41	25.50	2370.45	0.510997	40680.29	7248.78	0.36	14
50	94.60	54.43	27.07	2425.58	0.519997	41396.78	7376.45	0.36	14
51	94.60	55.45	28.62	2482.63	0.528997	42113.26	7504.12	0.36	14
52	94.60	56.47	30.17	2542.30	0.537997	42829.73	7631.79	0.36	14
53	94.60	57.48	31.72	2604.80	0.546997	43546.22	7759.45	0.37	14
54	94.60	58.48	33.26	2670.21	0.555997	44262.71	7887.13	0.37	14
55	94.60	59.48	34.79	2738.73	0.564997	44979.18	8014.79	0.37	14
56	94.60	60.47	36.32	2810.54	0.573997	45695.66	8142.46	0.37	14
57	94.60	61.45	37.86	2886.55	0.582997	46412.11	8270.13	0.38	14
58	94.60	62.43	39.38	2966.29	0.591997	47128.61	8397.80	0.38	14
59	94.60	63.41	40.90	3050.05	0.600997	47845.12	8525.47	0.38	14
60	94.60	64.38	42.41	3138.79	0.609997	48561.57	8653.14	0.38	13

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 658.32 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.61000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.009000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.83483

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 50.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 16296.418 SOLAR = 9290.223 ALBEDO = 737.028

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-0.83	-56.38	1084.75	0.070000	9290.22	737.03	0.26	15
1	94.60	1.35	-53.00	1109.65	0.079000	10484.67	831.79	0.27	15
2	94.60	3.51	-49.67	1135.25	0.088000	11679.11	926.55	0.27	15
3	94.60	5.63	-46.41	1161.48	0.097000	12873.56	1021.31	0.27	15
4	94.60	7.72	-43.20	1188.56	0.106000	14068.01	1116.07	0.27	15
5	94.60	9.79	-40.05	1216.41	0.115000	15262.46	1210.83	0.28	15
6	94.60	11.83	-36.95	1245.08	0.124000	16456.91	1305.59	0.28	15
7	94.60	13.84	-33.89	1274.64	0.133000	17651.36	1400.35	0.28	15
8	94.60	15.83	-30.89	1305.15	0.142000	18845.82	1495.11	0.29	15
9	94.60	17.79	-27.93	1336.70	0.150999	20040.27	1589.87	0.29	15
10	94.60	19.73	-25.01	1369.32	0.159999	21234.71	1684.63	0.29	15
11	94.60	21.65	-22.13	1403.10	0.168999	22429.17	1779.39	0.29	15
12	94.60	23.54	-19.28	1438.32	0.177999	23623.62	1874.15	0.30	14
13	94.60	25.41	-16.48	1474.65	0.186999	24818.07	1968.91	0.30	14
14	94.60	27.26	-13.71	1512.33	0.195999	26012.51	2063.67	0.30	14
15	94.60	29.09	-10.97	1551.49	0.204999	27206.96	2158.43	0.31	14
16	94.60	30.90	-8.27	1592.18	0.213999	28401.42	2253.19	0.31	14
17	94.60	32.69	-5.61	1634.50	0.222999	29595.86	2347.95	0.31	14
18	94.60	34.46	-2.96	1678.99	0.231999	30790.32	2442.71	0.32	14
19	94.60	36.21	-0.34	1725.30	0.240999	31984.77	2537.47	0.32	14
20	94.60	37.94	2.25	1773.54	0.249999	33179.21	2632.23	0.32	14
21	94.60	39.66	4.81	1824.31	0.258999	34373.66	2726.99	0.33	14
22	94.60	41.35	7.35	1877.26	0.267999	35568.12	2821.75	0.33	14
23	94.60	43.03	9.87	1933.03	0.276999	36762.57	2916.51	0.33	14
24	94.60	44.70	12.36	1991.78	0.285999	37957.02	3011.27	0.34	14
25	94.60	46.34	14.83	2053.18	0.294999	39151.46	3106.03	0.34	14
26	94.60	47.98	17.29	2118.47	0.303999	40345.92	3200.79	0.34	14
27	94.60	49.59	19.72	2187.38	0.312998	41540.37	3295.55	0.35	14
28	94.60	51.19	22.15	2260.70	0.321998	42734.81	3390.31	0.35	14
29	94.60	52.78	24.55	2338.16	0.330998	43929.27	3485.07	0.35	14
30	94.60	54.35	26.94	2420.69	0.339998	45123.72	3579.83	0.36	14
31	94.60	55.91	29.31	2508.68	0.348998	46318.16	3674.59	0.36	14
32	94.60	57.45	31.68	2603.26	0.357998	47512.61	3769.35	0.37	14
33	94.60	58.98	34.03	2704.24	0.366998	48707.06	3864.11	0.37	14
34	94.60	60.49	36.37	2812.86	0.375998	49901.52	3958.87	0.37	14
35	94.60	62.00	38.70	2929.92	0.384998	51095.96	4053.64	0.38	14
36	94.60	63.48	41.02	3056.97	0.393998	52290.42	4148.39	0.38	14
37	94.60	64.96	43.33	3195.03	0.402998	53484.87	4243.15	0.39	13
38	94.60	66.43	45.65	3346.21	0.411998	54679.32	4337.91	0.39	13
39	94.60	67.88	47.94	3511.05	0.420998	55873.76	4432.68	0.40	13
40	94.60	69.32	50.24	3693.16	0.429998	57068.22	4527.43	0.40	13
41	94.60	70.75	52.54	3894.84	0.438998	58262.67	4622.20	0.40	13
42	94.60	72.17	54.83	4118.72	0.447998	59457.11	4716.96	0.41	13
43	94.60	73.57	57.12	4370.74	0.456998	60651.56	4811.71	0.41	13
44	94.60	74.97	59.41	4655.23	0.465998	61846.02	4906.48	0.42	13
45	94.60	76.35	61.70	4978.17	0.474997	63040.46	5001.23	0.42	13

46	94.60	77.73	64.00	5352.93	0.483997	64234.91	5096.00	0.43	13
47	94.60	79.09	66.30	5787.55	0.492997	65429.37	5190.76	0.43	13
48	94.60	80.44	68.60	6299.63	0.501997	66623.81	5285.52	0.44	13
49	94.60	81.78	70.91	6914.22	0.510997	67818.25	5380.28	0.44	13
50	94.60	83.12	73.23	7667.06	0.519997	69012.69	5475.04	0.45	13
51	94.60	84.44	75.56	8604.96	0.528997	70207.13	5569.80	0.45	13
52	94.60	85.75	77.90	9808.36	0.537997	71401.56	5664.56	0.46	13
53	94.60	87.06	80.25	11418.93	0.546997	72596.06	5759.32	0.46	13
54	94.60	88.35	82.63	13684.31	0.555997	73790.50	5854.08	0.47	13
55	94.60	89.64	85.02	17097.27	0.564997	74984.94	5948.84	0.48	13
56	94.60	90.92	87.42	22813.83	0.573997	76179.38	6043.60	0.48	12
57	94.60	92.18	89.85	34538.61	0.582997	77373.75	6138.36	0.49	12
58	94.60	93.44	92.34	72494.25	0.591997	78568.25	6233.12	0.49	12

SOLUTION TERMINATED DUE TO RADIATOR MEAN TEMPERATURE BEING GREATER THAN FLUID INLET TEMPERATURE.

EXTERNAL LOADS ARE TOO LARGE FOR INFINITE RADIATOR TO REMAIN IN SPEC, SOLAR ABSORPTANCE VALUE FOR LIMIT = 0.54663

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 70.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 16296.418 SOLAR = 16608.746 ALBEDO = 392.166

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	10.63	-38.77	1228.08	0.070000	16608.75	392.17	0.28	15
1	94.60	14.05	-33.57	1277.88	0.079000	18744.14	442.59	0.28	15
2	94.60	17.40	-28.51	1330.36	0.088000	20879.54	493.01	0.29	15
3	94.60	20.68	-23.57	1386.04	0.097000	23014.94	543.43	0.29	15
4	94.60	23.90	-18.75	1445.05	0.106000	25150.33	593.85	0.30	14
5	94.60	27.05	-14.03	1507.73	0.115000	27285.73	644.27	0.30	14
6	94.60	30.15	-9.39	1575.09	0.124000	29421.13	694.69	0.31	14
7	94.60	33.18	-4.87	1646.73	0.133000	31556.53	745.11	0.31	14
8	94.60	36.16	-0.41	1723.96	0.142000	33691.93	795.53	0.32	14
9	94.60	39.09	3.95	1806.84	0.150999	35827.33	845.95	0.33	14
10	94.60	41.97	8.26	1896.94	0.159999	37962.72	896.38	0.33	14
11	94.60	44.80	12.50	1994.99	0.168999	40098.13	946.80	0.34	14
12	94.60	47.58	16.69	2102.43	0.177999	42233.52	997.22	0.34	14
13	94.60	50.31	20.81	2219.71	0.186999	44368.92	1047.64	0.35	14
14	94.60	53.01	24.90	2349.84	0.195999	46504.31	1098.06	0.36	14
15	94.60	55.66	28.94	2494.41	0.204999	48639.71	1148.48	0.36	14
16	94.60	58.27	32.93	2656.03	0.213999	50775.11	1198.90	0.37	14
17	94.60	60.84	36.90	2838.71	0.222999	52910.51	1249.32	0.38	14
18	94.60	63.38	40.85	3047.37	0.231999	55045.91	1299.74	0.38	14
19	94.60	65.88	44.76	3286.55	0.240999	57181.30	1350.17	0.39	13
20	94.60	68.34	48.67	3565.83	0.249999	59316.71	1400.59	0.40	13
21	94.60	70.77	52.56	3895.87	0.258999	61452.10	1451.01	0.40	13
22	94.60	73.16	56.45	4293.69	0.267999	63587.50	1501.43	0.41	13
23	94.60	75.53	60.34	4781.02	0.276999	65722.88	1551.85	0.42	13
24	94.60	77.86	64.22	5392.57	0.285999	67858.25	1602.27	0.43	13
25	94.60	80.17	68.12	6186.50	0.294999	69993.69	1652.69	0.44	13
26	94.60	82.44	72.05	7265.20	0.303999	72129.06	1703.11	0.45	13
27	94.60	84.69	76.00	8805.24	0.312998	74264.44	1753.53	0.45	13
28	94.60	86.91	79.98	11206.00	0.321998	76399.88	1803.95	0.46	13
29	94.60	89.10	84.01	15465.26	0.330998	78535.25	1854.38	0.47	13
30	94.60	91.26	88.10	25219.90	0.339998	80670.63	1904.80	0.48	12
31	94.60	93.40	92.25	69963.81	0.348998	82806.06	1955.22	0.49	12

SOLUTION TERMINATED DUE TO RADIATOR MEAN TEMPERATURE BEING GREATER THAN FLUID INLET TEMPERATURE.

EXTERNAL LOADS ARE TOO LARGE FOR INFINITE RADIATOR TO REMAIN IN SPEC, SOLAR ABSORPTANCE VALUE FOR LIMIT = 0.32241

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = . 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 90.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 16296.418 SOLAR = 17675.902 ALBEDO = 0.000

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	11.69	-37.16	1243.07	0.070000	17675.9C	0.00	0.28	15
1	94.60	15.23	-31.80	1295.81	0.079000	19948.50	0.00	0.28	15
2	94.60	18.68	-26.58	1351.60	0.088000	22221.10	0.00	0.29	15
3	94.60	22.07	-21.49	1410.80	0.097000	24493.71	0.00	0.30	15
4	94.60	25.38	-16.53	1473.77	0.106000	26766.30	0.00	0.30	14
5	94.60	28.63	-11.67	1541.33	0.115000	29038.51	0.00	0.31	14
6	94.60	31.81	-6.91	1613.53	0.124000	31311.51	0.00	0.31	14
7	94.60	34.94	-2.24	1691.29	0.133000	33584.12	0.00	0.32	14
8	94.60	38.00	2.33	1775.18	0.142000	35856.72	0.00	0.32	14
9	94.60	41.01	6.84	1866.30	0.150999	38129.32	0.00	0.33	14
10	94.6C	43.97	11.26	1965.42	0.159999	40401.92	0.00	0.34	14
11	94.60	46.87	15.63	2074.01	0.168999	42674.52	0.00	0.34	14
12	94.60	49.73	19.93	2193.65	0.177999	44947.13	0.00	0.35	14
13	94.60	52.54	24.19	2326.35	0.186999	47219.73	0.00	0.35	14
14	94.60	55.30	28.39	2473.80	0.195999	49492.34	0.00	0.36	14
15	94.60	58.02	32.56	2640.05	0.204999	51764.93	0.00	0.37	14
16	94.60	60.70	36.68	2827.96	0.213999	54037.54	0.00	0.37	14
17	94.60	63.34	40.78	3043.47	0.222999	56310.14	0.00	0.38	14
18	94.60	65.93	44.87	3294.18	0.231999	58582.75	0.00	0.39	13
19	94.60	68.49	48.92	3586.18	0.240999	60855.34	0.00	0.40	13
20	94.60	71.02	52.96	3934.14	0.249999	63127.96	0.00	0.40	13
21	94.60	73.50	57.00	4356.87	0.258999	65400.55	0.00	0.41	13
22	94.60	75.96	61.05	4882.27	0.267999	67673.13	0.00	0.42	13
23	94.60	78.38	65.09	5551.94	0.276999	69945.75	0.00	0.43	13
24	94.60	80.76	69.15	6437.37	0.285999	72218.31	0.00	0.44	13
25	94.60	83.12	73.24	7667.39	0.294999	74490.94	0.00	0.45	13
26	94.60	85.45	77.36	9500.35	0.303999	76753.56	0.00	0.46	13
27	94.60	87.74	81.51	12511.56	0.312998	79036.13	0.00	0.47	13
28	94.60	90.01	85.71	18426.59	0.321998	81308.75	0.00	0.48	13
29	94.60	92.25	89.98	35530.74	0.330998	83581.38	0.00	0.49	12

SOLUTION OUTSIDE TO/TI RANGE, SOLUTION TERMINATED.

EXTERNAL LOADS ARE TOO LARGE FOR INFINITE RADIATOR TO REMAIN IN SPEC, SOLAR ABSORPTANCE VALUE FOR LIMIT = 0.31010

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 10.0 DEGREES, ALTITUDE = 270.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 15479.301 SOLAR = 1918.344 ALBEDO = 1072.563

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSOPPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-14.85	-78.54	945.97	0.070000	1918.34	1072.56	0.25	15
1	94.60	-14.13	-77.40	952.22	0.079000	2164.99	1210.46	0.25	15
2	94.60	-13.42	-76.24	958.70	0.088000	2411.63	1348.36	0.25	15
3	94.60	-12.71	-75.11	965.11	0.097000	2658.27	1486.26	0.25	15
4	94.60	-12.00	-73.97	971.61	0.106000	2904.92	1624.16	0.25	15
5	94.60	-11.30	-72.85	978.05	0.115000	3151.56	1762.06	0.25	15
6	94.60	-10.60	-71.73	984.75	0.124000	3398.20	1899.96	0.25	15
7	94.60	-9.90	-70.63	991.25	0.133000	3644.84	2037.86	0.25	15
8	94.60	-9.20	-69.52	998.01	0.142000	3891.49	2175.76	0.25	15
9	94.60	-8.51	-68.42	1004.72	0.150999	4138.13	2313.66	0.25	15
10	94.60	-7.82	-67.34	1011.39	0.159999	4384.77	2451.56	0.25	15
11	94.60	-7.14	-66.26	1018.17	0.168999	4631.41	2589.46	0.26	15
12	94.60	-6.45	-65.18	1025.07	0.177999	4878.05	2727.36	0.26	15
13	94.60	-5.78	-64.11	1031.94	0.186999	5124.70	2865.26	0.26	15
14	94.60	-5.10	-63.05	1038.93	0.195999	5371.34	3003.16	0.26	15
15	94.60	-4.43	-62.00	1045.90	0.204999	5617.98	3141.06	0.26	15
16	94.60	-3.76	-60.94	1053.00	0.213999	5864.63	3278.96	0.26	15
17	94.60	-3.09	-59.90	1060.07	0.222999	6111.27	3416.86	0.26	15
18	94.60	-2.43	-58.86	1067.29	0.231999	6357.91	3554.77	0.26	15
19	94.60	-1.77	-57.84	1074.47	0.240999	6604.55	3692.67	0.26	15
20	94.60	-1.11	-56.81	1081.80	0.249999	6851.20	3830.57	0.26	15
21	94.60	-0.45	-55.79	1089.12	0.258999	7097.84	3968.47	0.26	15
22	94.60	0.20	-54.78	1096.41	0.267999	7344.48	4106.36	0.26	15
23	94.60	0.85	-53.77	1103.86	0.276999	7591.13	4244.27	0.27	15
24	94.60	1.50	-52.77	1111.47	0.285999	7837.77	4382.16	0.27	15
25	94.60	2.14	-51.78	1118.89	0.294999	8084.41	4520.06	0.27	15
26	94.60	2.78	-50.78	1126.64	0.303999	8331.05	4657.96	0.27	15
27	94.60	3.42	-49.80	1134.22	0.312998	8577.70	4795.86	0.27	15
28	94.60	4.06	-48.82	1141.96	0.321998	8824.34	4933.77	0.27	15
29	94.60	4.70	-47.84	1149.86	0.330998	9070.98	5071.66	0.27	15
30	94.60	5.33	-46.87	1157.77	0.339998	9317.63	5209.57	0.27	15
31	94.60	5.95	-45.91	1165.67	0.348998	9564.27	5347.46	0.27	15
32	94.60	6.58	-44.94	1173.75	0.357998	9810.91	5485.37	0.27	15
33	94.60	7.20	-43.99	1181.83	0.366998	10057.55	5623.27	0.27	15
34	94.60	7.82	-43.04	1189.91	0.375998	10304.20	5761.16	0.27	15
35	94.60	8.44	-42.10	1198.18	0.384998	10550.84	5899.07	0.28	15
36	94.60	9.06	-41.16	1206.45	0.393998	10797.48	6036.96	0.28	15
37	94.60	9.67	-40.22	1214.90	0.402998	11044.12	6174.87	0.28	15
38	94.60	10.29	-39.30	1223.19	0.411998	11290.76	6312.77	0.28	15
39	94.60	10.90	-38.36	1231.85	0.420998	11537.41	6450.67	0.28	15
40	94.60	11.50	-37.45	1240.34	0.429998	11784.05	6588.57	0.28	15
41	94.60	12.11	-36.53	1249.02	0.438998	12030.70	6726.47	0.28	15
42	94.60	12.71	-35.61	1257.89	0.447998	12277.34	6864.37	0.28	15
43	94.60	13.31	-34.71	1266.61	0.456998	12523.98	7002.27	0.28	15
44	94.60	13.91	-33.79	1275.71	0.465998	12770.63	7140.17	0.28	15
45	94.60	14.50	-32.89	1284.66	0.474997	13017.27	7278.07	0.28	15

46	94.60	15.09	-32.00	1293.79	0.483997	13263.91	7415.97	0.28	15
47	94.60	15.69	-31.10	1302.96	0.492997	13510.55	7553.87	0.29	15
48	94.60	16.27	-30.22	1312.15	0.501997	13757.19	7691.77	0.29	15
49	94.60	16.86	-29.33	1321.54	0.510997	14003.84	7829.67	0.29	15
50	94.60	17.44	-28.45	1330.98	0.519997	14250.48	7967.57	0.29	15
51	94.60	18.03	-27.57	1340.63	0.528997	14497.12	8105.47	0.29	15
52	94.60	18.61	-26.70	1350.30	0.537997	14743.76	8243.37	0.29	15
53	94.60	19.19	-25.83	1360.01	0.546997	14990.40	8381.27	0.29	15
54	94.60	19.76	-24.96	1369.94	0.555997	15237.05	8519.17	0.29	15
55	94.60	20.33	-24.09	1379.91	0.564997	15483.70	8657.07	0.29	15
56	94.60	20.91	-23.24	1389.91	0.573997	15730.34	8794.97	0.29	15
57	94.60	21.48	-22.38	1400.15	0.582997	15976.97	8932.87	0.29	15
58	94.60	22.04	-21.53	1410.42	0.591997	16223.62	9070.77	0.30	15
59	94.60	22.61	-20.67	1420.95	0.600997	16470.27	9208.67	0.30	14
60	94.60	23.17	-19.83	1431.51	0.609997	16716.90	9346.57	0.30	14

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 353.25 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.61000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.009000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 1.00000

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 30.0 DEGREES, ALTITUDE = 270.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 15479.301 SOLAR = 5670.867 ALBEDO = 943.200

..EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-8.22	-67.97	1007.48	0.070000	5670.87	943.20	0.25	15
1	94.60	-6.71	-65.58	1022.49	0.079000	6399.97	1064.47	0.26	15
2	94.60	-5.20	-63.22	1037.82	0.088000	7129.08	1185.74	0.26	15
3	94.60	-3.72	-60.89	1053.30	0.097000	7858.19	1307.00	0.26	15
4	94.60	-2.25	-58.59	1069.15	0.106000	8587.29	1428.27	0.26	15
5	94.60	-0.79	-56.32	1085.21	0.115000	9316.40	1549.54	0.26	15
6	94.60	0.65	-54.09	1101.52	0.124000	10045.51	1670.81	0.26	15
7	94.60	2.08	-51.87	1118.27	0.133000	10774.61	1792.08	0.27	15
8	94.60	3.50	-49.69	1135.14	0.142000	11503.72	1913.34	0.27	15
9	94.60	4.90	-47.53	1152.31	0.150999	12232.83	2034.61	0.27	15
10	94.60	6.29	-45.39	1170.00	0.159999	12961.93	2155.88	0.27	15
11	94.60	7.67	-43.28	1187.87	0.168999	13691.05	2277.15	0.27	15
12	94.60	9.04	-41.20	1206.11	0.177999	14420.15	2398.42	0.28	15
13	94.60	10.39	-39.13	1224.75	0.186999	15149.25	2519.68	0.28	15
14	94.60	11.73	-37.10	1243.62	0.195999	15878.37	2640.95	0.28	15
15	94.60	13.07	-35.07	1263.11	0.204999	16607.47	2762.22	0.28	15
16	94.60	14.39	-33.07	1282.86	0.213999	17336.57	2883.49	0.28	15
17	94.60	15.69	-31.09	1303.09	0.222999	18065.69	3004.75	0.29	15
18	94.60	16.99	-29.13	1323.80	0.231999	18794.79	3126.02	0.29	15
19	94.60	18.28	-27.19	1344.85	0.240999	19523.89	3247.29	0.29	15
20	94.60	19.56	-25.26	1366.42	0.249999	20253.01	3368.56	0.29	15
21	94.60	20.83	-23.36	1388.54	0.258999	20982.11	3489.83	0.29	15
22	94.60	22.09	-21.47	1411.05	0.267999	21711.22	3611.09	0.30	15
23	94.60	23.33	-19.59	1434.34	0.276999	22440.33	3732.36	0.30	14
24	94.60	24.57	-17.73	1458.25	0.285999	23169.43	3853.63	0.30	14
25	94.60	25.80	-15.89	1482.40	0.294999	23898.54	3974.90	0.30	14
26	94.60	27.02	-14.07	1507.20	0.303999	24627.65	4096.16	0.30	14
27	94.60	28.23	-12.27	1532.68	0.312998	25356.76	4217.43	0.31	14
28	94.60	29.43	-10.47	1558.87	0.321998	26085.86	4338.70	0.31	14
29	94.60	30.63	-8.69	1585.78	0.330998	26814.98	4459.97	0.31	14
30	94.60	31.81	-6.92	1613.46	0.339998	27544.08	4581.23	0.31	14
31	94.60	32.99	-5.16	1641.93	0.348998	28273.18	4702.50	0.31	14
32	94.60	34.15	-3.41	1671.21	0.357998	29002.30	4823.77	0.32	14
33	94.60	35.31	-1.68	1701.34	0.366998	29731.40	4945.04	0.32	14
34	94.60	36.46	0.03	1731.89	0.375998	30460.50	5066.30	0.32	14
35	94.60	37.61	1.74	1763.77	0.384998	31189.62	5187.57	0.32	14
36	94.60	38.74	3.44	1796.64	0.393998	31918.72	5308.84	0.32	14
37	94.60	39.87	5.12	1830.46	0.402998	32647.84	5430.11	0.33	14
38	94.60	40.99	6.79	1865.32	0.411998	33376.94	5551.38	0.33	14
39	94.60	42.10	8.47	1901.72	0.420998	34106.04	5672.65	0.33	14
40	94.60	43.21	10.12	1938.73	0.429998	34835.16	5793.91	0.33	14
41	94.60	44.30	11.77	1977.41	0.438998	35564.26	5915.18	0.34	14
42	94.60	45.40	13.41	2017.29	0.447998	36293.37	6036.45	0.34	14
43	94.60	46.48	15.03	2058.41	0.456998	37022.48	6157.72	0.34	14
44	94.60	47.56	16.66	2101.39	0.465998	37751.58	6278.98	0.34	14
45	94.60	48.63	18.27	2145.71	0.474997	38480.69	6400.25	0.35	14

46	94.60	49.69	19.88	2192.07	0.483997	39209.80	6521.52	0.35	14
47	94.60	50.75	21.47	2239.93	0.492997	39938.91	6642.79	0.35	14
48	94.60	51.80	23.06	2289.36	0.501997	40668.01	6764.06	0.35	14
49	94.60	52.84	24.65	2341.67	0.510997	41397.12	6885.32	0.35	14
50	94.60	53.88	26.22	2395.13	0.519997	42126.23	7006.59	0.36	14
51	94.60	54.91	27.79	2451.65	0.528997	42855.33	7127.86	0.36	14
52	94.60	55.93	29.35	2510.19	0.537997	43584.43	7249.13	0.36	14
53	94.60	56.95	30.92	2572.09	0.546997	44313.55	7370.40	0.37	14
54	94.60	57.97	32.47	2636.20	0.555997	45042.65	7491.66	0.37	14
55	94.60	58.97	34.02	2703.40	0.564997	45771.77	7612.93	0.37	14
56	94.60	59.97	35.56	2774.46	0.573997	46500.87	7734.20	0.37	14
57	94.60	60.97	37.11	2848.98	0.582997	47229.93	7855.47	0.38	14
58	94.60	61.96	38.64	2927.13	0.591997	47959.07	7976.74	0.38	14
59	94.60	62.94	40.17	3009.12	0.600997	48688.19	8098.00	0.38	14
60	94.60	63.92	41.71	3096.85	0.609997	49417.27	8219.27	0.38	13

PLATFORM AREA REQUIRED TO REMAIN IN SPEC = 650.98 FT2 FOR 60 MONTHS ON ORBIT.

SOLAR ABSORPTANCE = 0.61000 FOR 60 MONTHS OF LIFE WITH A DEGRADATION RATE OF 0.009000 CHANGE IN ABSORPTANCE PER MONTH.

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.83737

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 50.0 DEGREES, ALTITUDE = 270.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 15479.301 SOLAR = 9440.668 ALBEDO = 700.074

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-2.03	-58.26	1071.48	0.070000	9440.67	700.07	0.26	15
1	94.60	0.19	-54.80	1096.28	0.079000	10654.45	790.08	0.26	15
2	94.60	2.38	-51.41	1121.76	0.088000	11868.25	880.09	0.27	15
3	94.60	4.55	-48.07	1147.97	0.097000	13082.05	970.10	0.27	15
4	94.60	6.68	-44.80	1175.00	0.106000	14295.84	1060.11	0.27	15
5	94.60	8.78	-41.59	1202.59	0.115000	15509.63	1150.12	0.28	15
6	94.60	10.86	-38.42	1231.33	0.124000	16723.42	1240.13	0.28	15
7	94.60	12.90	-35.31	1260.74	0.133000	17937.21	1330.14	0.28	15
8	94.60	14.93	-32.25	1291.09	0.142000	19151.00	1420.15	0.28	15
9	94.60	16.92	-29.23	1322.63	0.150999	20364.81	1510.15	0.29	15
10	94.60	18.89	-26.27	1355.04	0.159999	21578.60	1600.16	0.29	15
11	94.60	20.84	-23.33	1388.78	0.168999	22792.39	1690.17	0.29	15
12	94.60	22.77	-20.44	1423.73	0.177999	24006.18	1780.18	0.30	15
13	94.60	24.67	-17.60	1459.77	0.186999	25219.98	1870.19	0.30	14
14	94.60	26.55	-14.78	1497.56	0.195999	26433.77	1960.20	0.30	14
15	94.60	28.41	-12.01	1536.38	0.204999	27647.56	2050.21	0.31	14
16	94.60	30.24	-9.25	1577.15	0.213999	28861.36	2140.22	0.31	14
17	94.60	32.06	-6.54	1619.54	0.222999	30075.15	2230.23	0.31	14
18	94.60	33.86	-3.86	1663.63	0.231999	31288.95	2320.23	0.32	14
19	94.60	35.63	-1.21	1709.53	0.240999	32502.73	2410.24	0.32	14
20	94.60	37.39	1.42	1757.79	0.249999	33716.54	2500.25	0.32	14
21	94.60	39.13	4.02	1808.11	0.258999	34930.33	2590.26	0.33	14
22	94.60	40.85	6.59	1861.06	0.267999	36144.12	2680.27	0.33	14
23	94.60	42.56	9.15	1916.81	0.276999	37357.91	2770.28	0.33	14
24	94.60	44.24	11.67	1975.05	0.285999	38571.70	2860.29	0.34	14
25	94.60	45.91	14.19	2036.92	0.294999	39785.50	2950.30	0.34	14
26	94.60	47.57	16.67	2101.65	0.303999	40999.29	3040.31	0.34	14
27	94.60	49.21	19.14	2170.48	0.312998	42213.09	3130.32	0.35	14
28	94.60	50.83	21.60	2243.72	0.321998	43426.88	3220.32	0.35	14
29	94.60	52.43	24.03	2321.13	0.330998	44640.68	3310.33	0.35	14
30	94.60	54.03	26.45	2403.58	0.339998	45854.46	3400.34	0.36	14
31	94.60	55.60	28.84	2490.82	0.348998	47068.26	3490.35	0.36	14
32	94.60	57.17	31.24	2585.22	0.357998	48282.05	3580.36	0.37	14
33	94.60	58.71	33.62	2686.03	0.366998	49495.84	3670.37	0.37	14
34	94.60	60.25	35.99	2794.51	0.375998	50709.64	3760.38	0.37	14
35	94.60	61.77	38.34	2911.35	0.384998	51923.43	3850.39	0.38	14
36	94.60	63.28	40.69	3038.14	0.393998	53137.23	3940.40	0.38	14
37	94.60	64.78	43.05	3177.60	0.402998	54351.02	4030.41	0.39	13
38	94.60	66.26	45.36	3326.79	0.411998	55564.81	4120.41	0.39	13
39	94.60	67.73	47.70	3493.12	0.420998	56778.60	4210.42	0.39	13
40	94.60	69.19	50.03	3674.96	0.429998	57992.41	4300.43	0.40	13
41	94.60	70.63	52.34	3876.28	0.438998	59206.20	4390.44	0.40	13
42	94.60	72.07	54.67	4101.98	0.447998	60419.99	4480.45	0.41	13
43	94.60	73.49	56.98	4353.68	0.456998	61633.78	4570.46	0.41	13
44	94.60	74.90	59.30	4640.44	0.465998	62847.57	4660.46	0.42	13
45	94.60	76.30	61.61	4965.93	0.474997	64061.36	4750.48	0.42	13

46	94.60	77.69	63.93	5340.74	0.483997	65275.16	4840.48	0.43	13
47	94.60	79.07	66.25	5778.84	0.492997	66488.94	4930.49	0.43	13
48	94.60	80.44	68.60	6299.36	0.501997	67702.75	5020.50	0.44	13
49	94.60	81.80	70.93	6920.07	0.510997	68916.50	5110.51	0.44	13
50	94.60	83.14	73.27	7680.89	0.519997	70130.31	5200.52	0.45	13
51	94.60	84.48	75.63	8636.88	0.528997	71344.13	5290.53	0.45	13
52	94.60	85.81	78.00	9865.92	0.537997	72557.88	5380.54	0.46	13
53	94.60	87.13	80.39	11526.89	0.546997	73771.69	5470.55	0.46	13
54	94.60	88.44	82.78	13862.10	0.555997	74985.50	5560.55	0.47	13
55	94.60	89.74	85.20	17426.58	0.564997	76199.25	5650.57	0.48	13
56	94.60	91.03	87.65	23592.15	0.573997	77413.06	5740.57	0.48	12
57	94.60	92.31	90.12	36569.33	0.582997	78626.81	5830.58	0.49	12
58	94.60	93.58	92.58	81269.63	0.591997	79840.63	5920.59	0.50	12

SOLUTION TERMINATED DUE TO RADIATOR MEAN TEMPERATURE BEING GREATER THAN FLUID INLET TEMPERATURE.

EXTERNAL LOADS ARE TOO LARGE FOR INFINITE RADIATOR TO REMAIN IN SPEC, SOLAR ABSORPTANCE VALUE FOR LIMIT = 0.54616

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 70.0 DEGREES, ALTITUDE = 270.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 15479.301 SOLAR = 16608.746 ALBEDO = 372.502

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	9.29	-40.79	1209.72	0.070000	16608.75	372.50	0.28	15
1	94.60	12.74	-35.56	1258.38	0.079000	18744.14	420.39	0.28	15
2	94.60	16.12	-30.45	1309.79	0.088000	20879.54	468.29	0.29	15
3	94.60	19.42	-25.47	1364.05	0.097000	23014.94	516.18	0.29	15
4	94.60	22.66	-20.60	1421.73	0.106000	25150.33	564.07	0.30	14
5	94.60	25.83	-15.85	1482.95	0.115000	27285.73	611.97	0.30	14
6	94.60	28.95	-11.19	1548.26	0.124000	29421.13	659.86	0.31	14
7	94.60	32.00	-6.63	1618.11	0.133000	31556.53	707.75	0.31	14
8	94.60	35.00	-2.15	1692.91	0.142000	33691.93	755.64	0.32	14
9	94.60	37.95	2.25	1773.61	0.150999	35827.33	803.54	0.32	14
10	94.60	40.84	6.58	1860.78	0.159999	37962.72	851.43	0.33	14
11	94.60	43.68	10.84	1955.63	0.168999	40098.13	899.32	0.33	14
12	94.60	46.48	15.03	2058.42	0.177999	42233.52	947.22	0.34	14
13	94.60	49.23	19.18	2171.69	0.186999	44368.92	995.11	0.35	14
14	94.60	51.94	23.28	2296.63	0.195999	46504.31	1043.00	0.35	14
15	94.60	54.60	27.33	2434.79	0.204999	48639.71	1090.89	0.36	14
16	94.60	57.23	31.34	2589.10	0.213999	50775.11	1138.79	0.37	14
17	94.60	59.81	35.31	2762.63	0.222999	52910.51	1186.68	0.37	14
18	94.60	62.36	39.26	2959.83	0.231999	55045.91	1234.57	0.38	14
19	94.60	64.87	43.19	3186.33	0.240999	57181.30	1282.47	0.39	13
20	94.60	67.34	47.10	3448.52	0.249999	59316.71	1330.36	0.39	13
21	94.60	69.78	50.98	3755.64	0.258999	61452.10	1378.25	0.40	13
22	94.60	72.19	54.86	4122.39	0.267999	63587.50	1426.14	0.41	13
23	94.60	74.56	58.75	4569.55	0.276999	65722.88	1474.04	0.42	13
24	94.60	76.91	62.63	5124.34	0.285999	67858.25	1521.93	0.42	13
25	94.60	79.22	66.53	5834.91	0.294999	69993.69	1569.82	0.43	13
26	94.60	81.51	70.42	6775.43	0.303999	72129.06	1617.72	0.44	13
27	94.60	83.76	74.36	8092.43	0.312998	74264.44	1665.61	0.45	13
28	94.60	85.99	78.32	10060.50	0.321998	76399.88	1713.50	0.46	13
29	94.60	88.19	82.33	13354.98	0.330998	78535.25	1761.39	0.47	13
30	94.60	90.36	86.39	19967.29	0.339998	80670.63	1809.29	0.48	12
31	94.60	92.51	90.49	39874.75	0.348998	82806.06	1857.18	0.49	12

SOLUTION TERMINATED DUE TO RADIATOR MEAN TEMPERATURE BEING GREATER THAN FLUID INLET TEMPERATURE.

EXTERNAL LOADS ARE TOO LARGE FOR INFINITE RADIATOR TO REMAIN IN SPEC, SOLAR ABSORPTANCE VALUE FOR LIMIT = 0.32615

FLAT PLANE RADIATOR FOR CASE OF 40944.0 BTU/HR. DISSIPATION = 12.0 KW.

TEMPERATURES (F), INLET = 94.60 , MIX = 40.00 , COOLANT FLOW RATE (LBM/HR) = 2999.57

PLATFORM AREA IN FT2 = 634.2000

ORBIT INCLINATION = 90.0 DEGREES, ALTITUDE = 270.0 NAUTICAL MILES.

EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 15479.301 SOLAR = 17675.902 ALBEDO = 0.000

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	10.40	-39.12	1224.89	0.070000	17675.90	0.00	0.28	15
1	94.60	13.96	-33.71	1276.52	0.079000	19948.50	0.00	0.28	15
2	94.60	17.45	-28.44	1331.23	0.088000	22221.10	0.00	0.29	15
3	94.60	20.86	-23.31	1389.03	0.097000	24493.71	0.00	0.29	15
4	94.60	24.20	-18.30	1450.86	0.106000	26766.30	0.00	0.30	14
5	94.60	27.47	-13.40	1516.53	0.115000	29038.91	0.00	0.30	14
6	94.60	30.68	-8.61	1587.08	0.124000	31311.51	0.00	0.31	14
7	94.60	33.82	-3.91	1662.58	0.133000	33584.12	0.00	0.32	14
8	94.60	36.91	0.70	1744.42	0.142000	35856.72	0.00	0.32	14
9	94.60	39.94	5.23	1832.80	0.150999	38129.32	0.00	0.33	14
10	94.60	42.91	9.68	1928.91	0.159999	40401.92	0.00	0.33	14
11	94.60	45.84	14.07	2034.08	0.168999	42674.52	0.00	0.34	14
12	94.60	48.71	18.40	2149.40	0.177999	44947.13	0.00	0.35	14
13	94.60	51.54	22.66	2276.61	0.186999	47219.73	0.00	0.35	14
14	94.60	54.31	26.89	2419.14	0.195999	49492.34	0.00	0.36	14
15	94.60	57.05	31.06	2577.70	0.204999	51764.93	0.00	0.37	14
16	94.60	59.74	35.20	2757.45	0.213999	54037.54	0.00	0.37	14
17	94.60	62.39	39.31	2962.60	0.222999	56310.14	0.00	0.38	14
18	94.60	65.01	43.41	3200.13	0.231999	58582.75	0.00	0.39	13
19	94.60	67.58	47.46	3475.33	0.240999	60855.34	0.00	0.39	13
20	94.60	70.11	51.50	3800.43	0.249999	63127.96	0.00	0.40	13
21	94.60	72.61	55.55	4194.11	0.258999	65400.55	0.00	0.41	13
22	94.60	75.08	59.59	4678.43	0.267999	67673.13	0.00	0.42	13
23	94.60	77.51	63.63	5288.96	0.276999	69945.75	0.00	0.43	13
24	94.60	79.91	67.68	6085.36	0.285999	72218.31	0.00	0.44	13
25	94.60	82.28	71.76	7172.55	0.294999	74490.94	0.00	0.44	13
26	94.60	84.61	75.86	8741.18	0.303999	76763.56	0.00	0.45	13
27	94.60	86.92	80.01	11228.96	0.312998	79036.13	0.00	0.46	13
28	94.60	89.20	84.19	15742.49	0.321998	81308.75	0.00	0.47	13
29	94.60	91.45	88.45	26654.24	0.330998	83581.38	0.00	0.48	12
30	94.60	93.67	92.78	90301.88	0.339998	85853.94	0.00	0.49	12

SOLUTION TERMINATED DUE TO RADIATOR MEAN TEMPERATURE BEING GREATER THAN FLUID INLET TEMPERATURE.

EXTERNAL LOADS ARE TOO LARGE FOR INFINITE RADIATOR TO REMAIN IN SPEC, SOLAR ABSORPTANCE VALUE FOR LIMIT = 0.31333

APPENDIX C

Space Station Program Sample Case

A sample case of the general space station program inputs and outputs will be presented. The following inputs will be used as a sample case of the program use:

1. A single altitude of 235 nautical miles will be considered.

2. The β angle will be varied from a value of 10 degrees to a value of 90 degrees at 20-degree intervals.

3. The dissipation value will range from 35 kW to a total station value of 70 kW at intervals of 35 kW. The break point between flat-plate and cylindrical radiators will be 35 kW.

4. The total time duration will be 60 months (5 years), with solution intervals of one month. These values will be used for both flat-plate and cylindrical radiators.

5. The fluid inlet and mix temperatures will be set at 94.6°F and 40°F, respectively. These values will be used for both flat-plate and cylindrical radiators.

6. All external-input blockage factors for the flat-plate radiators will be given a value of 0.9, while all those for the cylindrical radiators will be given a value of 0.8.

7. The view factor to space for the flat-plate radiators will be given a value of 0.9, while for the cylindrical radiators the value will be 0.8. The specific heat for the coolant of both radiator systems will be specified as 0.25 BTU/lbm-$^{\circ}$R (Freon 21).

8. The initial α_s value will be 0.07, the emittance value will be 0.76, and the degradation rates will be varied from 0.003 to 0.009 $\Delta\alpha_s$/month at intervals of 0.003 $\Delta\alpha_s$/month. These values will be used for both flat-plate and cylindrical radiators.

For many radiator parameters, the same values have been given to both types of radiators. This does not need to be the case. The program is capable of handling all radiator parameters for each type of radiator independently, as some of the parameter differences already indicate.

The succeeding pages will present these inputs written on a coding form, followed by the program output.

IO 132 130 (REV 5/68)

AEROJET ELECTROSYSTEMS COMPANY

COMPUTING SCIENCES
80 COLUMN INPUT

DATE FEB. 78 PROGRAM NO. SPACE STATION PROGRAM PROGRAMMED BY 1.

INPUT FORMATS

1 FIRST CARD:
235 235 1 } FORMAT(3I10)
NAL1 NAL2 NAL3

2 SECOND CARD:
10 90 20 } FORMAT(3I10)
NB1 NB2 NB3

3 THIRD CARD:
35 105 35 35.0 } FORMAT(3I10, F10.4)
MD1 MD2 MD3 BREAK

4 FOURTH CARD:
60 60 1 1 } FORMAT(4I10)
MDP MDC MODIA MODIC

5 FIFTH CARD:
P 94.6 40.0 } FORMAT(A1, 9X, 2(F10.4, 10X))
TEST PTI PTM

6 SIXTH CARD:
C 94.6 40.0 } FORMAT(A1, 9X, 2(F10.4, 10X))
TEST CTI CTM

STK. NO D 1-083

AEROJET ELECTROSYSTEMS COMPANY

COMPUTING SCIENCES 80 COLUMN INPUT

DATE FEB. 78 PROGRAM NO. SPACE STATION PROGRAM PROGRAMMED BY 2.

7 SEVENTH CARD:
P 0.9 0.9 0.9 } FORMAT (A1, 9X, 3(F10.4, 10X))
TEST PSHDS PSHDE PSHDA

8 EIGHTH CARD:
C 0.8 0.8 0.8 } FORMAT (A1, 9X, 3(F10.4, 10X))
TEST CSHDS CSHDE CSHDA

9 NINTH CARD:
P 0.9 0.25 } FORMAT (A1, 9X, 2(F10.4, 10X))
TEST PSPACE PCP

10 TENTH CARD:
C 0.8 0.25 } FORMAT (A1, 9X, 2(F10.4, 10X))
TEST CSPACE CCP

11 ELEVENTH CARD:
P 0.07 0.76 0.003 } FORMAT (A1, 9X, 3(F10.4, 10X))
TEST PALPHA EMTP PDEG

12 TWELFTH CARD:
C 0.07 0.76 0.003 } FORMAT (A1, 9X, 3(F10.4, 10X))
TEST CALPHA EMTC CDEG

P 0.07 0.76 0.006
C 0.07 0.76 0.006 } ADDITIONAL SURFACE
P 0.07 0.76 0.009 } PROPERTY CARDS
C 0.07 0.76 0.009

STK. NO D-1 063

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR.

S P A C E   S T A T I O N   R A D I A T O R   P R O G R A M

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ALTITUDE (N.MI.), LOWEST =   235  HIGHEST =   235  INCREMENT =     1

ORBIT  INCLINATION (DEG.), LOWEST =    10  HIGHEST =    90  INCREMENT =    20

DISSIPATION (KW.), LOWEST =    35  HIGHEST =    70  INCREMENT =    35

BREAK POINT FROM PLATE TO CYLINDRICAL RADIATORS (KW.) =   35.00

MONTHS DEGRADATION FOR FLAT PLATE RADIATOR  =    60  INCREMENT =     1
MONTHS DEGRADATION FOR CYLINDRICAL RADIATOR =    60  INCREMENT =     1

SHADING COEFFICIENTS
PLATE, SOLAR = 0.89999998  EARTHSHINE = 0.89999998  ALBEDO = 0.89999998
CYL. , SOLAR = 0.79999995  EARTHSHINE = 0.79999995  ALBEDO = 0.79999995

PLATE, SHAPE FACTOR TO SPACE = 0.89999998  FLUID CP =     0.2500  BTU/LBM-R.
CYL. , SHAPE FACTOR TO SPACE = 0.79999995  FLUID CP =     0.2500  BTU/LBM-R.

RADIATOR MATERIAL PROPERTIES
PLATE, ABSORPTANCE =    0.07000  EMITTANCE =    0.76000  MONTHLY CHANGE IN ABSORPTANCE =   0.003000
CYL. , ABSORPTANCE =    0.07000  EMITTANCE =    0.76000  MONTHLY CHANGE IN ABSORPTANCE =   0.003000
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FLAT PLANE RADIATOR FOR CASE OF 119419.9 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 10.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 869.0938

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7344

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 22332.258 SOLAR = 2582.122 ALBEDO = 1547.410

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 1.00000

MAXIMUM ABSORPTANCE VALUE = 0.25000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00300 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	56.39	23.74	6745.17	0.070000	2582.12	1547.41	0.41	12
1	94.60	56.55	23.92	6761.34	0.073000	2692.78	1613.73	0.41	12
2	94.60	56.70	24.21	6789.38	0.076000	2803.44	1680.04	0.41	12
3	94.60	56.86	24.50	6817.44	0.079000	2914.10	1746.36	0.41	12
4	94.60	57.01	24.79	6845.62	0.082000	3024.77	1812.68	0.41	12
5	94.60	57.17	25.07	6873.85	0.085000	3135.43	1878.99	0.41	12
6	94.60	57.33	25.36	6902.15	0.088000	3246.09	1945.31	0.41	12
7	94.60	57.48	25.64	6930.55	0.091000	3356.75	2011.63	0.41	12
8	94.60	57.64	25.92	6958.98	0.094000	3467.41	2077.94	0.41	12
9	94.60	57.79	26.20	6987.49	0.097000	3578.07	2144.26	0.41	12
10	94.60	57.95	26.48	7016.05	0.100000	3688.73	2210.58	0.41	12
11	94.60	58.10	26.75	7044.75	0.103000	3799.39	2276.89	0.41	12
12	94.60	58.26	27.03	7073.45	0.106000	3910.05	2343.21	0.41	12
13	94.60	58.41	27.30	7102.26	0.108999	4020.71	2409.53	0.41	12
14	94.60	58.57	27.58	7131.07	0.111999	4131.38	2475.84	0.41	12
15	94.60	58.72	27.85	7160.05	0.114999	4242.04	2542.16	0.42	12
16	94.60	58.88	28.12	7189.09	0.117999	4352.70	2608.48	0.42	12
17	94.60	59.03	28.39	7218.14	0.120999	4463.36	2674.79	0.42	12
18	94.60	59.18	28.65	7247.38	0.123999	4574.02	2741.11	0.42	12
19	94.60	59.34	28.92	7276.58	0.126999	4684.68	2807.43	0.42	12
20	94.60	59.49	29.19	7305.87	0.129999	4795.34	2873.74	0.42	12
21	94.60	59.64	29.45	7335.34	0.132999	4906.00	2940.06	0.42	12
22	94.60	59.80	29.71	7364.79	0.135999	5016.66	3006.38	0.42	12
23	94.60	59.95	30.07	7407.64	0.138999	5127.32	3072.69	0.42	12
24	94.60	60.11	30.33	7437.35	0.141999	5237.98	3139.01	0.42	12
25	94.60	60.26	30.67	7480.61	0.144999	5348.64	3205.33	0.42	11
26	94.60	60.41	30.83	7497.05	0.147999	5459.30	3271.65	0.42	11
27	94.60	60.56	31.18	7540.59	0.150999	5569.96	3337.96	0.42	11
28	94.60	60.72	31.34	7557.01	0.153999	5680.63	3404.28	0.42	11
29	94.60	60.87	31.69	7600.80	0.156999	5791.29	3470.60	0.42	11
30	94.60	61.02	32.04	7644.95	0.159999	5901.95	3536.91	0.42	11
31	94.60	61.17	32.19	7661.46	0.162999	6012.61	3603.23	0.42	11
32	94.60	61.33	32.54	7705.91	0.165999	6123.27	3669.55	0.42	11
33	94.60	61.48	32.69	7722.43	0.168999	6233.93	3735.86	0.42	11
34	94.60	61.63	33.04	7767.21	0.171999	6344.59	3802.18	0.42	11
35	94.60	61.78	33.38	7812.18	0.174999	6455.25	3868.50	0.42	11
36	94.60	61.93	33.53	7828.79	0.177999	6565.91	3934.81	0.42	11
37	94.60	62.09	33.87	7874.13	0.180999	6676.58	4001.13	0.42	11

38	94.60	62.24	34.21	7919.75	0.183999	6787.24	4067.45	0.42	11
39	94.60	62.39	34.36	7936.51	0.186998	6897.90	4133.76	0.42	11
40	94.60	62.54	34.69	7982.41	0.189998	7008.56	4200.08	0.42	11
41	94.60	62.69	35.03	8028.64	0.192998	7119.22	4266.39	0.42	11
42	94.60	62.84	35.17	8045.38	0.195998	7229.88	4332.71	0.42	11
43	94.60	62.99	35.50	8091.98	0.198998	7340.54	4399.03	0.42	11
44	94.60	63.14	35.83	8138.86	0.201998	7451.20	4465.35	0.42	11
45	94.60	63.29	35.98	8155.70	0.204998	7561.87	4531.66	0.42	11
46	94.60	63.44	36.30	8202.91	0.207998	7672.53	4597.98	0.42	11
47	94.60	63.59	36.63	8250.36	0.210998	7783.19	4664.30	0.42	11
48	94.60	63.74	36.77	8267.40	0.213998	7893.85	4730.61	0.43	11
49	94.60	63.89	37.09	8315.17	0.216998	8004.51	4796.93	0.43	11
50	94.60	64.04	37.42	8363.35	0.219998	8115.17	4863.25	0.43	11
51	94.60	64.19	37.55	8380.41	0.222998	8225.83	4929.56	0.43	11
52	94.60	64.34	37.87	8428.93	0.225998	8336.49	4995.88	0.43	11
53	94.60	64.49	38.19	8477.74	0.228998	8447.15	5062.20	0.43	11
54	94.60	64.64	38.51	8526.91	0.231998	8557.81	5128.51	0.43	11
55	94.60	64.79	38.64	8544.14	0.234998	8668.48	5194.83	0.43	11
56	94.60	64.94	38.96	8593.68	0.237998	8779.14	5261.14	0.43	11
57	94.60	65.09	39.27	8643.46	0.240998	8889.80	5327.46	0.43	11
58	94.60	65.24	39.58	8693.61	0.243998	9000.46	5393.78	0.43	11
59	94.60	65.39	39.71	8711.03	0.246998	9111.12	5460.10	0.43	11
60	94.60	65.53	40.02	8761.53	0.249998	9221.78	5526.41	0.43	11

CYLINDRICAL RADIATOR FOR CASE OF 119420.0 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 10.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 2235.2898

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7383

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 25525.395 SOLAR = 7802.242 ALBEDO = 1572.152

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.90378

MAXIMUM ABSORPTANCE VALUE = 0.25000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00300 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	[illegible]A	ITN
0	94.60	46.49	7.48	5485.17	0.070000	7802.24	1572.15	0.39	12
1	94.60	46.81	8.01	5518.29	0.073000	8136.62	1639.53	0.39	12
2	94.60	47.14	8.64	5559.42	0.076000	8471.00	1706.91	0.39	12
3	94.60	47.47	9.16	5592.68	0.079000	8805.37	1774.28	0.39	12
4	94.60	47.80	9.77	5634.08	0.082000	9139.75	1841.66	0.39	12
5	94.60	48.12	10.29	5667.47	0.085000	9474.13	1909.04	0.39	12
6	94.60	48.45	10.89	5709.12	0.088000	9808.51	1976.41	0.39	12
7	94.60	48.78	11.39	5742.67	0.091000	10142.88	2043.79	0.39	12
8	94.60	49.10	11.99	5784.63	0.094000	10477.27	2111.17	0.39	12
9	94.60	49.43	12.65	5835.20	0.097000	10811.64	2178.54	0.39	11
10	94.60	49.75	13.23	5877.57	0.100000	11146.02	2245.92	0.39	11
11	94.60	50.07	13.63	5903.00	0.103000	11480.39	2313.30	0.39	11
12	94.60	50.39	14.20	5945.54	0.106000	11814.77	2380.68	0.39	11
13	94.60	50.71	14.77	5988.36	0.108999	12149.15	2448.05	0.39	11
14	94.60	51.04	15.34	6031.32	0.111999	12483.53	2515.43	0.39	11
15	94.60	51.36	15.90	6074.45	0.114999	12817.91	2582.81	0.39	11
16	94.60	51.68	16.46	6117.79	0.117999	13152.29	2650.18	0.39	11
17	94.60	52.00	17.01	6161.37	0.120999	13486.66	2717.56	0.40	11
18	94.60	52.31	17.56	6205.12	0.123999	13821.04	2784.94	0.40	11
19	94.60	52.63	18.10	6249.07	0.126999	14155.42	2852.32	0.40	11
20	94.60	52.95	18.64	6293.26	0.129999	14489.79	2919.69	0.40	11
21	94.60	53.27	19.17	6337.60	0.132999	14824.17	2987.07	0.40	11
22	94.60	53.58	19.71	6382.19	0.135999	15158.55	3054.45	0.40	11
23	94.60	53.90	20.41	6445.84	0.138999	15492.93	3121.82	0.40	11
24	94.60	54.21	20.93	6491.02	0.141999	15827.30	3189.20	0.40	11
25	94.60	54.53	21.45	6536.43	0.144999	16161.68	3256.58	0.40	11
26	94.60	54.84	21.96	6582.04	0.147999	16496.06	3323.96	0.40	11
27	94.60	55.16	22.47	6627.84	0.150999	16830.44	3391.33	0.40	11
28	94.60	55.47	22.98	6673.88	0.153999	17164.82	3458.71	0.40	11
29	94.60	55.78	23.65	6740.10	0.156999	17499.20	3526.09	0.40	11
30	94.60	56.09	24.15	6786.82	0.159999	17833.57	3593.46	0.40	11
31	94.60	56.40	24.64	6833.72	0.162999	18167.95	3660.84	0.40	11
32	94.60	56.71	25.13	6880.91	0.165999	18502.32	3728.22	0.41	11
33	94.60	57.02	25.79	6949.00	0.168999	18836.71	3795.59	0.41	11
34	94.60	57.33	26.27	6996.81	0.171999	19171.08	3862.97	0.41	11
35	94.60	57.64	26.75	7044.89	0.174999	19505.46	3930.35	0.41	11
36	94.60	57.95	27.39	7114.59	0.177999	19839.84	3997.73	0.41	11
37	94.60	58.26	27.86	7163.35	0.180999	20174.21	4065.11	0.41	11

38	94.60	58.56	28.50	7234.16	0.183999	20508.59	4132.48	0.41	11
39	94.60	58.87	28.96	7283.64	0.186998	20842.97	4199.86	0.41	11
40	94.60	59.18	29.42	7333.43	0.189998	21177.35	4267.23	0.41	11
41	94.60	59.48	30.04	7405.83	0.192998	21511.73	4334.61	0.41	11
42	94.60	59.79	30.49	7456.33	0.195998	21846.11	4401.99	0.41	11
43	94.60	60.09	31.10	7530.02	0.198998	22180.48	4469.36	0.41	11
44	94.60	60.40	31.55	7581.27	0.201998	22514.86	4536.74	0.41	11
45	94.60	60.70	32.15	7656.24	0.204998	22849.24	4604.12	0.41	11
46	94.60	61.00	32.75	7731.96	0.207998	23183.62	4671.50	0.41	11
47	94.60	61.31	33.19	7784.45	0.210998	23517.99	4738.97	0.41	11
48	94.60	61.61	33.78	7861.52	0.213998	23852.37	4806.25	0.41	11
49	94.60	61.91	34.21	7914.84	0.216998	24186.75	4873.63	0.42	11
50	94.60	62.21	34.79	7993.30	0.219998	24521.13	4941.00	0.42	11
51	94.60	62.51	35.36	8072.52	0.222998	24855.50	5008.38	0.42	11
52	94.60	62.81	35.78	8127.23	0.225998	25189.88	5075.76	0.42	11
53	94.60	63.11	36.35	8207.88	0.228998	25524.26	5143.14	0.42	11
54	94.60	63.41	36.92	8289.50	0.231998	25858.64	5210.52	0.42	11
55	94.60	63.71	37.48	8371.89	0.234998	26193.02	5277.89	0.42	11
56	94.60	64.00	37.89	8428.61	0.237998	26527.39	5345.27	0.42	11
57	94.60	64.30	38.44	8512.62	0.240998	26861.77	5412.64	0.42	11
58	94.60	64.60	38.99	8597.51	0.243998	27196.15	5480.02	0.42	11
59	94.60	64.89	39.54	8683.47	0.246998	27530.53	5547.40	0.42	11
60	94.60	65.19	40.08	8770.36	0.249998	27864.90	5614.78	0.42	11

FLAT PLANE RADIATOR FOR CASE OF 119419.9 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 30.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 1022.2290

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7344

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 26267.227 SOLAR = 8982.254 ALBEDO = 1600.539

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.82375

MAXIMUM ABSORPTANCE VALUE = 0.25000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00300 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	44.47	4.28	5290.64	0.070000	8982.25	1600.54	0.38	12
1	94.60	44.83	4.97	5331.98	0.073000	9367.20	1669.13	0.38	12
2	94.60	45.20	5.55	5365.99	0.076000	9752.15	1737.73	0.38	12
3	94.60	45.56	6.22	5407.59	0.079000	10137.10	1806.32	0.38	12
4	94.60	45.92	6.79	5441.73	0.082000	10522.05	1874.91	0.38	12
5	94.60	46.29	7.45	5483.56	0.085000	10907.00	1943.51	0.38	12
6	94.60	46.65	8.10	5525.55	0.088000	11291.95	2012.10	0.38	12
7	94.60	47.01	8.73	5567.75	0.091000	11676.89	2080.69	0.38	11
8	94.60	47.37	9.37	5610.06	0.094000	12061.85	2149.29	0.38	11
9	94.60	47.73	10.00	5652.58	0.097000	12446.80	2217.88	0.39	11
10	94.60	48.09	10.63	5695.22	0.100000	12831.75	2286.47	0.39	11
11	94.60	48.44	11.26	5738.09	0.103000	13216.69	2355.07	0.39	11
12	94.60	48.80	11.69	5764.94	0.106000	13601.64	2423.66	0.39	11
13	94.60	49.16	12.31	5808.03	0.108999	13986.59	2492.26	0.39	11
14	94.60	49.51	12.92	5851.30	0.111999	14371.54	2560.85	0.39	11
15	94.60	49.87	13.70	5911.32	0.114999	14756.49	2629.44	0.39	11
16	94.60	50.22	14.30	5955.11	0.117999	15141.44	2698.04	0.39	11
17	94.60	50.57	14.89	5999.09	0.120999	15526.39	2766.63	0.39	11
18	94.60	50.93	15.48	6043.25	0.123999	15911.34	2835.22	0.39	11
19	94.60	51.28	16.06	6087.61	0.126999	16296.29	2903.82	0.39	11
20	94.60	51.63	16.64	6132.19	0.129999	16681.22	2972.41	0.39	11
21	94.60	51.98	17.21	6176.98	0.132999	17066.18	3041.00	0.39	11
22	94.60	52.33	17.78	6221.97	0.135999	17451.13	3109.60	0.39	11
23	94.60	52.68	18.51	6284.95	0.138999	17836.08	3178.19	0.39	11
24	94.60	53.03	19.07	6330.54	0.141999	18221.02	3246.79	0.40	11
25	94.60	53.37	19.63	6376.32	0.144999	18605.98	3315.38	0.40	11
26	94.60	53.72	20.18	6422.34	0.147999	18990.93	3383.97	0.40	11
27	94.60	54.06	20.89	6487.05	0.150999	19375.87	3452.57	0.40	11
28	94.60	54.41	21.43	6533.62	0.153999	19760.82	3521.16	0.40	11
29	94.60	54.75	21.96	6580.51	0.156999	20145.77	3589.75	0.40	11
30	94.60	55.10	22.66	6646.62	0.159999	20530.73	3658.35	0.40	11
31	94.60	55.44	23.19	6694.09	0.162999	20915.67	3726.94	0.40	11
32	94.60	55.78	23.87	6761.19	0.165999	21300.61	3795.53	0.40	11
33	94.60	56.13	24.39	6809.35	0.168999	21685.57	3864.13	0.40	11
34	94.60	56.47	25.07	6877.54	0.171999	22070.51	3932.72	0.40	11
35	94.60	56.81	25.58	6926.37	0.174999	22455.47	4001.32	0.40	11
36	94.60	57.15	26.24	6995.74	0.177999	22840.41	4069.91	0.40	11
37	94.60	57.49	26.74	7045.18	0.180999	23225.37	4138.50	0.40	11

38	94.60	57.83	27.40	7115.60	0.183999	23610.31	4207.10	0.41	11
39	94.60	58.16	27.89	7165.84	0.186998	23995.25	4275.69	0.41	11
40	94.60	58.50	28.54	7237.37	0.189998	24380.21	4344.28	0.41	11
41	94.60	58.84	29.02	7288.32	0.192998	24765.16	4412.88	0.41	11
42	94.60	59.17	29.66	7361.11	0.195998	25150.11	4481.47	0.41	11
43	94.60	59.51	30.29	7434.66	0.198998	25535.05	4550.06	0.41	11
44	94.60	59.84	30.91	7508.96	0.201998	25920.00	4618.66	0.41	11
45	94.60	60.18	31.38	7561.59	0.204998	26304.96	4687.25	0.41	11
46	94.60	60.51	32.00	7637.09	0.207998	26689.90	4755.84	0.41	11
47	94.60	60.84	32.61	7713.48	0.210998	27074.86	4824.44	0.41	11
48	94.60	61.17	33.22	7790.66	0.213998	27459.80	4893.03	0.41	11
49	94.60	61.51	33.67	7845.11	0.216998	27844.74	4961.63	0.41	11
50	94.60	61.84	34.27	7923.53	0.219999	28229.70	5030.22	0.41	11
51	94.60	62.17	34.86	8002.89	0.222998	28614.64	5098.81	0.41	11
52	94.60	62.50	35.45	8083.10	0.225998	28999.60	5167.41	0.42	11
53	94.60	62.83	36.04	8164.16	0.228998	29384.54	5236.00	0.42	11
54	94.60	63.16	36.62	8246.08	0.231998	29769.50	5304.59	0.42	11
55	94.60	63.48	37.19	8328.98	0.234998	30154.45	5373.19	0.42	11
56	94.60	63.81	37.77	8412.75	0.237998	30539.40	5441.78	0.42	11
57	94.60	64.14	38.33	8497.46	0.240998	30924.34	5510.38	0.42	11
58	94.60	64.46	38.90	8583.04	0.243998	31309.29	5578.97	0.42	11
59	94.60	64.79	39.45	8669.67	0.246998	31694.25	5647.56	0.42	11
60	94.60	65.11	40.01	8757.21	0.249998	32079.19	5716.16	0.42	11

CYLINDRICAL RADIATOR FOR CASE OF 119420.0 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 30.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 2310.7188

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7383

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 26386.742 SOLAR = 9354.074 ALBEDO = 1429.176

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.81222

MAXIMUM ABSORPTANCE VALUE = 0.25000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00300 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	44.14	3.86	5267.55	0.070000	9354.07	1429.18	0.38	12
1	94.60	44.51	4.46	5301.68	0.073000	9754.96	1490.43	0.38	12
2	94.60	44.88	5.05	5335.83	0.076000	10155.84	1551.68	0.38	12
3	94.60	45.25	5.73	5377.43	0.079000	10556.72	1612.93	0.38	12
4	94.60	45.62	6.31	5411.72	0.082000	10957.61	1674.18	0.38	12
5	94.60	45.99	6.97	5453.57	0.085000	11358.49	1735.42	0.38	12
6	94.60	46.35	7.64	5495.62	0.088000	11759.38	1796.67	0.38	12
7	94.60	46.72	8.17	5530.14	0.091000	12160.26	1857.92	0.38	11
8	94.60	47.09	8.82	5572.46	0.094000	12561.14	1919.17	0.38	11
9	94.60	47.45	9.47	5614.93	0.097000	12962.03	1980.42	0.39	11
10	94.60	47.82	10.11	5657.56	0.100000	13362.91	2041.67	0.39	11
11	94.60	48.18	10.74	5700.41	0.103000	13763.79	2102.92	0.39	11
12	94.60	48.54	11.36	5743.39	0.106000	14164.68	2164.17	0.39	11
13	94.60	48.90	11.99	5786.61	0.108999	14565.57	2225.42	0.39	11
14	94.60	49.26	12.60	5829.93	0.111999	14966.45	2286.67	0.39	11
15	94.60	49.63	13.21	5873.50	0.114999	15367.33	2347.92	0.39	11
16	94.60	49.99	13.82	5917.25	0.117999	15768.22	2409.17	0.39	11
17	94.60	50.34	14.42	5961.19	0.120999	16169.10	2470.42	0.39	11
18	94.60	50.70	15.01	6005.36	0.123999	16569.98	2531.67	0.39	11
19	94.60	51.06	15.78	6066.69	0.126999	16970.87	2592.92	0.39	11
20	94.60	51.41	16.36	6111.38	0.129999	17371.75	2654.17	0.39	11
21	94.60	51.77	16.94	6156.22	0.132999	17772.64	2715.42	0.39	11
22	94.60	52.12	17.51	6201.36	0.135999	18173.52	2776.67	0.39	11
23	94.60	52.48	18.08	6246.64	0.138999	18574.40	2837.92	0.40	11
24	94.60	52.83	18.82	6309.96	0.141999	18975.29	2899.17	0.39	11
25	94.60	53.19	19.38	6355.88	0.144999	19376.17	2960.42	0.40	11
26	94.60	53.54	19.93	6401.97	0.147999	19777.05	3021.67	0.40	11
27	94.60	53.89	20.65	6466.59	0.150999	20177.94	3082.92	0.40	11
28	94.60	54.24	21.19	6513.33	0.153999	20578.82	3144.17	0.40	11
29	94.60	54.59	21.74	6560.30	0.156999	20979.71	3205.42	0.40	11
30	94.60	54.94	22.44	6626.31	0.159999	21380.59	3266.66	0.40	11
31	94.60	55.29	22.97	6673.96	0.162999	21781.48	3327.91	0.40	11
32	94.60	55.64	23.66	6741.06	0.165999	22182.36	3389.16	0.40	11
33	94.60	55.98	24.18	6789.26	0.168999	22583.25	3450.41	0.40	11
34	94.60	56.33	24.86	6857.41	0.171999	22984.13	3511.66	0.40	11
35	94.60	56.67	25.38	6906.30	0.174999	23385.01	3572.91	0.40	11
36	94.60	57.02	26.05	6975.60	0.177999	23785.89	3634.16	0.40	11
37	94.60	57.36	26.55	7025.19	0.180999	24186.78	3695.41	0.40	11

38	94.60	57.71	27.21	7095.48	0.183999	24587.67	3756.66	0.40	11
39	94.60	58.05	27.71	7145.89	0.186998	24988.55	3817.91	0.41	11
40	94.60	58.39	28.36	7217.38	0.189998	25389.43	3879.16	0.41	11
41	94.60	58.73	29.00	7289.62	0.192998	25790.32	3940.41	0.41	11
42	94.60	59.07	29.49	7341.13	0.195998	26191.20	4001.66	0.41	11
43	94.60	59.42	30.12	7414.58	0.198998	26592.08	4062.91	0.41	11
44	94.60	59.75	30.75	7488.80	0.201998	26992.96	4124.16	0.41	11
45	94.60	60.09	31.38	7563.71	0.204998	27393.86	4185.41	0.41	11
46	94.60	60.43	31.84	7617.00	0.207998	27794.74	4246.66	0.41	11
47	94.60	60.77	32.46	7693.23	0.210998	28195.62	4307.91	0.41	11
48	94.60	61.10	33.07	7770.30	0.213998	28596.50	4369.16	0.41	11
49	94.60	61.44	33.68	7848.17	0.216998	28997.39	4430.41	0.41	11
50	94.60	61.78	34.28	7926.96	0.219998	29398.27	4491.66	0.41	11
51	94.60	62.11	34.87	8006.48	0.222998	29799.16	4552.91	0.41	11
52	94.60	62.45	35.47	8086.88	0.225998	30200.04	4614.16	0.41	11
53	94.60	62.78	36.05	8168.14	0.228998	30600.92	4675.41	0.42	11
54	94.60	63.11	36.49	8225.36	0.231998	31001.81	4736.66	0.42	11
55	94.60	63.45	37.21	8333.46	0.234998	31402.69	4797.91	0.42	11
56	94.60	63.78	37.79	8417.41	0.237998	31803.57	4859.16	0.42	11
57	94.60	64.11	38.36	8502.26	0.240998	32204.46	4920.40	0.42	11
58	94.60	64.44	38.92	8588.19	0.243998	32605.34	4981.65	0.42	11
59	94.60	64.77	39.48	8674.98	0.246998	33006.23	5042.90	0.42	11
60	94.60	65.10	40.04	8762.77	0.249998	33407.11	5104.15	0.42	11

FLAT PLANE RADIATOR FOR CASE OF 119419.9 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 50.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 1237.2051

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7344

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 31791.258 SOLAR = 18123.480 ALBEDO = 1437.803

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.53938

MAXIMUM ABSORPTANCE VALUE = 0.25000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00300 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	31.76	-14.33	4387.49	0.070000	18123.48	1437.80	0.34	12
1	94.60	32.36	-13.37	4425.78	0.073000	18900.19	1499.42	0.35	12
2	94.60	32.96	-12.43	4464.17	0.076000	19676.89	1561.04	0.35	12
3	94.60	33.56	-11.43	4507.95	0.079000	20453.60	1622.66	0.35	11
4	94.60	34.15	-10.41	4551.89	0.082000	21230.31	1684.28	0.35	11
5	94.60	34.75	-9.42	4596.01	0.085000	22007.02	1745.90	0.35	11
6	94.60	35.34	-8.43	4640.23	0.088000	22783.73	1807.52	0.35	11
7	94.60	35.93	-7.45	4684.68	0.091000	23560.43	1869.14	0.35	11
8	94.60	36.51	-6.49	4729.26	0.094000	24337.16	1930.76	0.35	11
9	94.60	37.10	-5.54	4774.02	0.097000	25113.87	1992.38	0.35	11
10	94.60	37.68	-4.60	4818.97	0.100000	25890.57	2054.00	0.36	11
11	94.60	38.26	-3.67	4864.07	0.103000	26667.29	2115.62	0.36	11
12	94.60	38.84	-2.75	4909.39	0.106000	27443.99	2177.24	0.36	11
13	94.60	39.42	-1.67	4966.73	0.108999	28220.72	2238.86	0.36	11
14	94.60	39.99	-0.77	5012.52	0.111999	28997.43	2300.48	0.36	11
15	94.60	40.57	0.12	5058.54	0.114999	29774.13	2362.09	0.36	11
16	94.60	41.14	1.16	5116.92	0.117999	30550.84	2423.71	0.36	11
17	94.60	41.70	2.02	5163.47	0.120999	31327.55	2485.33	0.36	11
18	94.60	42.27	3.04	5222.69	0.123999	32104.26	2546.95	0.36	11
19	94.60	42.84	3.89	5269.77	0.126999	32880.96	2608.57	0.36	11
20	94.60	43.40	4.89	5329.79	0.129999	33657.67	2670.19	0.37	11
21	94.60	43.96	5.72	5377.48	0.132999	34434.40	2731.81	0.37	11
22	94.60	44.52	6.69	5438.36	0.135999	35211.11	2793.43	0.37	11
23	94.60	45.08	7.66	5499.75	0.138999	35987.82	2855.05	0.37	11
24	94.60	45.64	8.46	5548.36	0.141999	36764.52	2916.67	0.37	11
25	94.60	46.19	9.41	5610.64	0.144999	37541.23	2978.29	0.37	11
26	94.60	46.74	10.34	5673.50	0.147999	38317.94	3039.91	0.37	11
27	94.60	47.29	11.27	5736.86	0.150999	39094.67	3101.53	0.37	11
28	94.60	47.84	12.18	5800.80	0.153999	39871.38	3163.15	0.37	11
29	94.60	48.39	13.09	5865.33	0.156999	40648.08	3224.77	0.38	11
30	94.60	48.93	13.98	5930.43	0.159999	41424.79	3286.38	0.38	11
31	94.60	49.47	14.87	5996.11	0.162999	42201.50	3348.00	0.38	11
32	94.60	50.02	15.75	6062.37	0.165999	42978.21	3409.62	0.38	11
33	94.60	50.56	16.62	6129.22	0.168999	43754.93	3471.24	0.38	11
34	94.60	51.09	17.48	6196.77	0.171999	44531.64	3532.86	0.38	11
35	94.60	51.63	18.47	6280.07	0.174999	45308.35	3594.48	0.38	11
36	94.60	52.16	19.31	6349.02	0.177999	46085.05	3656.10	0.38	11
37	94.60	52.70	20.14	6418.64	0.180999	46861.77	3717.72	0.38	11

38	94.60	53.23	21.10	6504.67	0.183999	47638.47	3779.34	0.39	11
39	94.60	53.76	21.92	6575.83	0.186998	48415.18	3840.96	0.39	11
40	94.60	54.29	22.86	6663.89	0.189998	49191.89	3902.58	0.39	11
41	94.60	54.81	23.66	6736.62	0.192998	49968.61	3964.20	0.39	11
42	94.60	55.34	24.58	6826.82	0.195998	50745.32	4025.82	0.39	11
43	94.60	55.86	25.49	6918.12	0.198998	51522.03	4087.44	0.39	11
44	94.60	56.38	26.39	7010.71	0.201998	52298.74	4149.05	0.39	11
45	94.60	56.90	27.16	7087.02	0.204998	53075.46	4210.67	0.39	11
46	94.60	57.42	28.04	7181.86	0.207998	53852.17	4272.29	0.39	11
47	94.60	57.94	28.92	7277.94	0.210998	54628.88	4333.91	0.40	11
48	94.60	58.45	29.79	7375.37	0.213998	55405.59	4395.53	0.40	11
49	94.60	58.97	30.64	7474.20	0.216998	56182.30	4457.15	0.40	11
50	94.60	59.48	31.49	7574.34	0.219998	56959.00	4518.77	0.40	11
51	94.60	59.99	32.33	7675.93	0.222999	57735.71	4580.39	0.40	11
52	94.60	60.50	33.29	7798.57	0.225998	58512.42	4642.01	0.40	11
53	94.60	61.01	34.11	7903.36	0.228998	59289.13	4703.63	0.40	11
54	94.60	61.51	34.92	8009.67	0.231998	60065.86	4765.25	0.40	11
55	94.60	62.02	35.85	8138.29	0.234998	60842.56	4826.87	0.40	11
56	94.60	62.52	36.64	8248.11	0.237998	61619.27	4888.49	0.41	11
57	94.60	63.02	37.55	8380.97	0.240998	62395.98	4950.11	0.41	11
58	94.60	63.52	38.32	8494.39	0.243998	63172.71	5011.73	0.41	11
59	94.60	64.02	39.21	8631.84	0.246998	63949.41	5073.34	0.41	11
60	94.60	64.52	39.97	8749.04	0.249998	64726.12	5134.96	0.41	11

CYLINDRICAL RADIATOR FOR CASE OF 119420.0 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 50.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 2437.1335

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7383

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 27830.301 SOLAR = 12019.160 ALBEDO = 1118.801

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.70311

MAXIMUM ABSORPTANCE VALUE = 0.25000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00300 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	40.46	-1.76	4959.81	0.070000	12019.16	1118.80	0.37	12
1	94.60	40.90	-1.06	4995.29	0.073000	12534.26	1166.75	0.37	12
2	94.60	41.34	-0.28	5037.42	0.076000	13049.36	1214.70	0.37	12
3	94.60	41.77	0.41	5072.99	0.079000	13564.46	1262.65	0.37	12
4	94.60	42.21	1.18	5115.36	0.082000	14079.57	1310.59	0.37	12
5	94.60	42.64	1.91	5157.86	0.085000	14594.67	1358.54	0.37	11
6	94.60	43.08	2.67	5200.52	0.088000	15109.77	1406.49	0.37	11
7	94.60	43.51	3.41	5243.34	0.091000	15624.87	1454.44	0.37	11
8	94.60	43.94	4.15	5286.33	0.094000	16139.97	1502.39	0.38	11
9	94.60	44.37	4.88	5329.47	0.097000	16655.07	1550.33	0.38	11
10	94.60	44.80	5.61	5372.78	0.100000	17170.17	1598.28	0.38	11
11	94.60	45.22	6.32	5416.30	0.103000	17685.27	1646.23	0.39	11
12	94.60	45.65	7.03	5459.95	0.106000	18200.37	1694.18	0.38	11
13	94.60	46.07	7.74	5503.80	0.108999	18715.47	1742.12	0.38	11
14	94.60	46.50	8.43	5547.82	0.111999	19230.57	1790.07	0.38	11
15	94.60	46.92	9.12	5592.05	0.114999	19745.67	1839.02	0.38	11
16	94.60	47.34	9.81	5636.44	0.117999	20260.78	1885.97	0.38	11
17	94.60	47.76	10.65	5696.06	0.120999	20775.88	1933.92	0.38	11
18	94.60	48.18	11.32	5741.01	0.123999	21290.98	1981.86	0.38	11
19	94.60	48.60	11.99	5786.16	0.126999	21806.07	2029.81	0.38	11
20	94.60	49.02	12.81	5846.99	0.129999	22321.17	2077.76	0.38	11
21	94.60	49.44	13.46	5892.66	0.132999	22836.28	2125.71	0.39	11
22	94.60	49.85	14.11	5938.54	0.135999	23351.38	2173.66	0.39	11
23	94.60	50.27	14.91	6000.60	0.138999	23866.48	2221.60	0.39	11
24	94.60	50.68	15.54	6047.05	0.141999	24381.58	2269.55	0.39	11
25	94.60	51.09	16.33	6109.99	0.144999	24896.68	2317.50	0.39	11
26	94.60	51.50	16.95	6157.04	0.147999	25411.78	2365.45	0.39	11
27	94.60	51.92	17.73	6220.93	0.150999	25926.88	2413.40	0.39	11
28	94.60	52.32	18.34	6268.60	0.153999	26441.98	2461.34	0.39	11
29	94.60	52.73	19.10	6333.49	0.156999	26957.09	2509.29	0.39	11
30	94.60	53.14	19.70	6381.71	0.159999	27472.18	2557.24	0.39	11
31	94.60	53.55	20.45	6447.61	0.162999	27987.28	2605.19	0.39	11
32	94.60	53.95	21.19	6514.07	0.165999	28502.38	2653.14	0.39	11
33	94.60	54.36	21.77	6563.41	0.168999	29017.49	2701.08	0.40	11
34	94.60	54.76	22.50	6630.91	0.171999	29532.59	2749.03	0.40	11
35	94.60	55.17	23.23	6699.06	0.174999	30047.69	2796.98	0.40	11
36	94.60	55.57	23.95	6767.81	0.177999	30562.79	2844.93	0.40	11
37	94.60	55.97	24.50	6818.65	0.180999	31077.89	2892.88	0.40	11

38	94.60	56.37	25.21	6888.61	0.183999	31592.99	2940.83	0.40	11
39	94.60	56.77	25.91	6959.14	0.186998	32108.09	2988.77	0.40	11
40	94.60	57.16	26.60	7030.44	0.189998	32623.19	3036.72	0.40	11
41	94.60	57.56	27.29	7102.39	0.192998	33138.29	3084.67	0.40	11
42	94.60	57.96	27.97	7175.09	0.195998	33653.39	3132.62	0.40	11
43	94.60	58.35	28.65	7248.45	0.198998	34168.49	3180.56	0.40	11
44	94.60	58.75	29.32	7322.65	0.201998	34683.59	3228.51	0.40	11
45	94.60	59.14	29.98	7397.48	0.204998	35198.70	3276.46	0.41	11
46	94.60	59.53	30.64	7473.20	0.207998	35713.80	3324.41	0.41	11
47	94.60	59.93	31.29	7549.62	0.210998	36228.89	3372.36	0.41	11
48	94.60	60.32	32.08	7648.20	0.213998	36743.99	3420.31	0.41	11
49	94.60	60.71	32.72	7726.47	0.216998	37259.09	3468.25	0.41	11
50	94.60	61.10	33.36	7805.59	0.219998	37774.20	3516.20	0.41	11
51	94.60	61.48	33.99	7885.52	0.222998	38289.30	3564.15	0.41	11
52	94.60	61.87	34.75	7988.94	0.225998	38804.39	3612.10	0.41	11
53	94.60	62.26	35.37	8070.81	0.228998	39319.49	3660.05	0.41	11
54	94.60	62.64	36.12	8177.00	0.231998	39834.58	3707.99	0.41	11
55	94.60	63.03	36.73	8260.95	0.234998	40349.70	3755.94	0.41	11
56	94.60	63.41	37.33	8345.91	0.237998	40864.79	3803.89	0.42	11
57	94.60	63.80	38.06	8456.17	0.240998	41379.88	3851.84	0.42	11
58	94.60	64.18	38.65	8543.23	0.243998	41895.00	3899.79	0.42	11
59	94.60	64.56	39.37	8656.52	0.246998	42410.09	3947.73	0.42	11
60	94.60	64.94	40.08	8771.52	0.249998	42925.17	3995.68	0.42	11

FLAT PLANE RADIATOR FOR CASE OF 119419.9 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 70.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 2221.4934

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7344

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 57083.559 SOLAR = 58177.594 ALBEDO = 1373.690

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.31813

MAXIMUM ABSORPTANCE VALUE = 0.25000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00300 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	0.65	-48.79	3333.02	0.070000	58177.59	1373.69	0.25	11
1	94.60	1.89	-46.94	3376.81	0.073000	60670.88	1432.56	0.25	11
2	94.60	3.12	-45.13	3420.72	0.076000	63164.16	1491.43	0.25	11
3	94.60	4.34	-43.35	3464.74	0.079000	65657.44	1550.30	0.25	11
4	94.60	5.55	-41.59	3508.90	0.082000	68150.75	1609.18	0.26	11
5	94.60	6.75	-39.71	3562.17	0.085000	70644.00	1668.05	0.26	11
6	94.60	7.94	-38.00	3606.75	0.088000	73137.31	1726.92	0.26	11
7	94.60	9.12	-36.32	3651.49	0.091000	75630.63	1785.79	0.26	11
8	94.60	10.29	-34.67	3696.43	0.094000	78123.94	1844.66	0.26	11
9	94.60	11.46	-32.89	3750.87	0.097000	80617.19	1903.53	0.26	11
10	94.60	12.62	-31.28	3796.30	0.100000	83110.50	1962.41	0.26	11
11	94.60	13.76	-29.55	3851.45	0.103000	85603.75	2021.28	0.27	11
12	94.60	14.90	-27.85	3907.01	0.106000	88097.06	2080.15	0.27	11
13	94.60	16.03	-26.31	3953.37	0.108999	90590.38	2139.02	0.27	11
14	94.60	17.16	-24.65	4009.71	0.111999	93083.69	2197.89	0.27	11
15	94.60	18.27	-23.02	4066.50	0.114999	95576.94	2256.76	0.27	11
16	94.60	19.38	-21.40	4123.78	0.117999	98070.25	2315.64	0.27	11
17	94.60	20.48	-19.94	4171.52	0.120999	100563.56	2374.51	0.28	11
18	94.60	21.57	-18.37	4229.71	0.123999	103056.81	2433.38	0.28	11
19	94.60	22.66	-16.69	4298.58	0.126999	105550.13	2492.25	0.28	11
20	94.60	23.74	-15.16	4357.90	0.129999	108043.44	2551.12	0.28	11
21	94.60	24.81	-13.65	4417.73	0.132999	110536.75	2609.99	0.28	11
22	94.60	25.87	-12.16	4478.18	0.135999	113030.00	2668.87	0.29	11
23	94.60	26.93	-10.68	4539.15	0.138999	115523.31	2727.74	0.29	11
24	94.60	27.98	-9.10	4611.43	0.141999	118016.63	2786.61	0.29	11
25	94.60	29.02	-7.67	4673.75	0.144999	120509.94	2845.48	0.29	11
26	94.60	30.06	-6.13	4747.60	0.147999	123003.19	2904.35	0.29	11
27	94.60	31.09	-4.73	4811.32	0.150999	125496.50	2963.23	0.29	11
28	94.60	32.11	-3.23	4886.78	0.153999	127989.75	3022.10	0.30	11
29	94.60	33.13	-1.75	4963.16	0.156999	130483.06	3080.97	0.30	11
30	94.60	34.14	-0.28	5040.48	0.159999	132976.38	3139.84	0.30	11
31	94.60	35.14	1.16	5118.72	0.162999	135469.69	3198.71	0.30	11
32	94.60	36.14	2.59	5197.96	0.165999	137962.94	3257.58	0.30	11
33	94.60	37.14	4.00	5278.23	0.168999	140456.25	3316.45	0.31	11
34	94.60	38.12	5.39	5359.49	0.171999	142949.56	3375.33	0.31	11
35	94.60	39.10	6.77	5441.86	0.174999	145442.81	3434.20	0.31	11
36	94.60	40.08	8.23	5537.33	0.177999	147936.13	3493.07	0.31	11
37	94.60	41.05	9.57	5622.03	0.180999	150429.44	3551.94	0.31	11

38	94.60	42.01	10.99	5720.22	0.183999	152922.75	3610.81	0.31	11
39	94.60	42.97	12.30	5807.38	0.186998	155416.06	3669.68	0.32	11
40	94.60	43.92	13.69	5908.36	0.189998	157909.31	3728.56	0.32	11
41	94.60	44.87	15.04	6010.95	0.192998	160402.63	3787.43	0.32	10
42	94.60	45.81	16.49	6128.07	0.195998	162895.94	3846.30	0.32	10
43	94.60	46.75	17.74	6220.86	0.198998	165389.19	3905.17	0.33	10
44	94.60	47.68	19.15	6341.68	0.201998	167882.50	3964.04	0.33	10
45	94.60	48.61	20.55	6464.57	0.204998	170375.81	4022.91	0.33	10
46	94.60	49.53	21.75	6562.18	0.207998	172869.06	4081.79	0.33	10
47	94.60	50.45	23.11	6689.06	0.210998	175362.38	4140.66	0.33	10
48	94.60	51.36	24.45	6818.22	0.213998	177855.69	4199.53	0.34	10
49	94.60	52.26	25.77	6949.67	0.216998	180348.94	4258.40	0.34	10
50	94.60	53.17	27.08	7083.61	0.219998	182842.25	4317.27	0.34	10
51	94.60	54.06	28.37	7220.14	0.222998	185335.56	4376.14	0.34	10
52	94.60	54.96	29.64	7359.14	0.225998	187828.81	4435.02	0.35	10
53	94.60	55.85	31.06	7531.32	0.228998	190322.13	4493.89	0.35	10
54	94.60	56.73	32.30	7676.28	0.231998	192815.44	4552.76	0.35	10
55	94.60	57.61	33.67	7855.69	0.234998	195308.75	4611.63	0.35	10
56	94.60	58.48	34.87	8006.91	0.237998	197802.06	4670.50	0.35	10
57	94.60	59.35	36.21	8194.04	0.240998	200295.31	4729.37	0.36	10
58	94.60	60.22	37.53	8385.71	0.243998	202788.63	4788.24	0.36	10
59	94.60	61.08	38.83	8581.82	0.246998	205281.94	4847.12	0.36	10
60	94.60	61.94	40.10	8782.71	0.249998	207775.19	4905.99	0.36	10

CYLINDRICAL RADIATOR FOR CASE OF 119420.0 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 70.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 3012.9309

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7383

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 34405.496 SOLAR = 23048.375 ALBEDO = 735.951

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.48015

MAXIMUM ABSORPTANCE VALUE = 0.25000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00300 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	26.88	-20.92	4136.38	0.070000	23048.38	735.95	0.33	12
1	94.60	27.58	-19.81	4176.13	0.073000	24036.15	767.49	0.33	12
2	94.60	28.27	-18.57	4225.70	0.076000	25023.93	799.03	0.33	11
3	94.60	28.97	-17.57	4260.73	0.079000	26011.70	830.57	0.33	11
4	94.60	29.65	-16.42	4305.69	0.082000	26999.48	862.11	0.34	11
5	94.60	30.34	-15.28	4350.77	0.085000	27987.25	893.65	0.34	11
6	94.60	31.02	-14.16	4396.06	0.088000	28975.03	925.19	0.34	11
7	94.60	31.70	-13.05	4441.50	0.091000	29962.80	956.73	0.34	11
8	94.60	32.38	-11.95	4487.16	0.094000	30950.58	988.27	0.34	11
9	94.60	33.05	-10.87	4532.96	0.097000	31938.36	1019.81	0.34	11
10	94.60	33.72	-9.80	4578.96	0.100000	32926.13	1051.35	0.34	11
11	94.60	34.39	-8.75	4625.18	0.103000	33913.90	1082.89	0.34	11
12	94.60	35.05	-7.71	4671.63	0.106000	34901.68	1114.43	0.35	11
13	94.60	35.72	-6.52	4729.07	0.108999	35889.46	1145.98	0.35	11
14	94.60	36.38	-5.50	4776.01	0.111999	36877.23	1177.52	0.35	11
15	94.60	37.03	-4.50	4823.19	0.114999	37865.00	1209.06	0.35	11
16	94.60	37.69	-3.35	4881.74	0.117999	38852.79	1240.60	0.35	11
17	94.60	38.34	-2.36	4929.49	0.120999	39840.56	1272.14	0.35	11
18	94.60	38.99	-1.24	4988.85	0.123999	40828.33	1303.68	0.35	11
19	94.60	39.64	-0.28	5037.20	0.126999	41816.10	1335.22	0.35	11
20	94.60	40.28	0.81	5097.42	0.129999	42803.88	1366.76	0.35	11
21	94.60	40.93	1.90	5158.14	0.132999	43791.66	1398.30	0.36	11
22	94.60	41.57	2.82	5207.48	0.135999	44779.43	1429.84	0.36	11
23	94.60	42.20	3.88	5269.13	0.138999	45767.20	1461.38	0.36	11
24	94.60	42.84	4.93	5331.26	0.141999	46754.98	1492.92	0.36	11
25	94.60	43.47	5.97	5393.99	0.144999	47742.76	1524.46	0.36	11
26	94.60	44.10	7.00	5457.23	0.147999	48730.53	1556.00	0.36	11
27	94.60	44.73	8.01	5521.04	0.150999	49718.28	1587.54	0.36	11
28	94.60	45.35	9.01	5585.41	0.153999	50706.07	1619.08	0.36	11
29	94.60	45.98	10.01	5650.43	0.156999	51693.86	1650.62	0.37	11
30	94.60	46.60	10.99	5715.98	0.159999	52681.60	1682.16	0.37	11
31	94.60	47.21	12.09	5795.42	0.162999	53669.39	1713.70	0.37	11
32	94.60	47.83	13.05	5862.37	0.165999	54657.14	1745.24	0.37	11
33	94.60	48.45	14.00	5929.95	0.168999	55644.93	1776.78	0.37	11
34	94.60	49.06	15.07	6011.98	0.171999	56632.72	1808.32	0.37	11
35	94.60	49.67	16.00	6080.97	0.174999	57620.51	1839.86	0.37	11
36	94.60	50.27	17.04	6164.82	0.177999	58608.25	1871.40	0.37	11
37	94.60	50.88	17.95	6235.38	0.180999	59596.04	1902.94	0.38	11

38	94.60	51.48	18.98	6321.18	0.183999	60583.84	1934.48	0.38	11
39	94.60	52.08	19.99	6408.08	0.186998	61571.58	1966.02	0.38	11
40	94.60	52.68	20.99	6496.13	0.189998	62559.37	1997.56	0.38	11
41	94.60	53.28	21.86	6569.99	0.192998	63547.16	2029.11	0.38	11
42	94.60	53.87	22.84	6660.17	0.195998	64534.90	2060.64	0.38	11
43	94.60	54.47	23.81	6751.38	0.198998	65522.70	2092.19	0.38	11
44	94.60	55.06	24.77	6843.93	0.201998	66510.44	2123.73	0.38	11
45	94.60	55.65	25.84	6953.87	0.204998	67498.19	2155.27	0.39	11
46	94.60	56.23	26.78	7049.14	0.207998	68486.00	2186.81	0.39	11
47	94.60	56.82	27.71	7145.72	0.210998	69473.75	2218.35	0.39	11
48	94.60	57.40	28.62	7243.59	0.213998	70461.50	2249.89	0.39	11
49	94.60	57.98	29.65	7360.19	0.216998	71449.31	2281.43	0.39	11
50	94.60	58.56	30.54	7461.12	0.219998	72437.13	2312.97	0.39	11
51	94.60	59.14	31.54	7581.36	0.222998	73424.88	2344.51	0.39	11
52	94.60	59.71	32.53	7703.72	0.225998	74412.63	2376.05	0.39	11
53	94.60	60.29	33.40	7809.48	0.228998	75400.44	2407.59	0.40	11
54	94.60	60.85	34.37	7935.77	0.231998	76388.19	2439.13	0.40	11
55	94.60	61.42	35.32	8064.41	0.234998	77375.94	2470.67	0.40	11
56	94.60	61.99	36.27	8195.26	0.237998	78363.75	2502.21	0.40	11
57	94.60	62.56	37.20	8328.48	0.240998	79351.50	2533.75	0.40	11
58	94.60	63.12	38.13	8464.07	0.243998	80339.31	2565.29	0.40	11
59	94.60	63.68	39.04	8602.22	0.246998	81327.06	2596.83	0.40	11
60	94.60	64.24	40.05	8764.37	0.249998	82314.81	2628.37	0.41	11

FLAT PLANE RADIATOR FOR CASE OF 119419.9 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 90.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 2423.2144

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7344

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 62266.984 SOLAR = 67537.813 ALBEDO = 0.001

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.30598

MAXIMUM ABSORPTANCE VALUE = 0.25000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00300 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-3.09	-51.51	3272.21	0.070000	67537.81	0.00	0.24	11
1	94.60	-1.77	-49.56	3317.39	0.073000	70432.25	0.00	0.24	11
2	94.60	-0.46	-47.65	3362.73	0.076000	73326.69	0.00	0.24	11
3	94.60	0.84	-45.76	3408.24	0.079000	76221.13	0.00	0.24	11
4	94.60	2.12	-43.91	3453.88	0.082000	79115.56	0.00	0.24	11
5	94.60	3.40	-42.08	3499.75	0.085000	82010.06	0.00	0.24	11
6	94.60	4.66	-40.28	3545.82	0.088000	84904.44	0.00	0.25	11
7	94.60	5.92	-38.51	3592.07	0.091000	87798.88	0.00	0.25	11
8	94.60	7.16	-36.76	3638.55	0.094000	90693.38	0.00	0.25	11
9	94.60	8.40	-34.90	3695.03	0.097000	93587.81	0.00	0.25	11
10	94.60	9.62	-33.20	3742.14	0.100000	96482.19	0.00	0.25	11
11	94.60	10.84	-31.52	3789.50	0.103000	99376.69	0.00	0.25	11
12	94.60	12.05	-29.74	3847.16	0.106000	102271.13	0.00	0.25	11
13	94.60	13.25	-28.11	3895.18	0.108999	105165.56	0.00	0.26	11
14	94.60	14.43	-26.37	3953.76	0.111999	108060.00	0.00	0.26	11
15	94.60	15.61	-24.78	4002.54	0.114999	110954.44	0.00	0.26	11
16	94.60	16.78	-23.09	4062.02	0.117999	113848.88	0.00	0.26	11
17	94.60	17.95	-21.42	4122.06	0.120999	116743.38	0.00	0.26	11
18	94.60	19.10	-19.77	4182.67	0.123999	119637.81	0.00	0.27	11
19	94.60	20.25	-18.14	4243.90	0.126999	122532.19	0.00	0.27	11
20	94.60	21.38	-16.66	4294.88	0.129999	125426.63	0.00	0.27	11
21	94.60	22.51	-15.07	4357.21	0.132999	128321.13	0.00	0.27	11
22	94.60	23.63	-13.50	4420.10	0.135999	131215.56	0.00	0.27	11
23	94.60	24.75	-11.84	4494.70	0.138999	134110.00	0.00	0.27	11
24	94.60	25.85	-10.31	4559.06	0.141999	137004.44	0.00	0.28	11
25	94.60	26.95	-8.80	4624.07	0.144999	139898.88	0.00	0.28	11
26	94.60	28.05	-7.30	4689.79	0.147999	142793.31	0.00	0.28	11
27	94.60	29.13	-5.72	4767.69	0.150999	145687.75	0.00	0.28	11
28	94.60	30.20	-4.26	4835.02	0.153999	148582.19	0.00	0.28	11
29	94.60	31.27	-2.72	4914.71	0.156999	151476.69	0.00	0.29	11
30	94.60	32.34	-1.30	4983.75	0.159999	154371.13	0.00	0.29	11
31	94.60	33.39	0.22	5065.37	0.162999	157265.50	0.00	0.29	11
32	94.60	34.44	1.71	5148.12	0.165999	160159.94	0.00	0.29	11
33	94.60	35.49	3.18	5231.93	0.168999	163054.44	0.00	0.29	11
34	94.60	36.52	4.63	5316.83	0.171999	165948.88	0.00	0.30	11
35	94.60	37.55	6.07	5402.92	0.174999	168843.31	0.00	0.30	11
36	94.60	38.57	7.49	5490.22	0.177999	171737.75	0.00	0.30	11
37	94.60	39.59	8.90	5578.74	0.180999	174632.19	0.00	0.30	11

38	94.60	40.60	10.29	5668.48	0.183999	177526.63	0.00	0.30	11
39	94.60	41.61	11.82	5785.25	0.186998	180421.06	0.00	0.31	10
40	94.60	42.61	13.17	5877.85	0.189998	183315.50	0.00	0.31	10
41	94.60	43.60	14.51	5971.93	0.192998	186210.00	0.00	0.31	10
42	94.60	44.59	16.01	6094.00	0.195998	189104.44	0.00	0.31	10
43	94.60	45.57	17.32	6191.12	0.198998	191998.88	0.00	0.31	10
44	94.60	46.54	18.61	6289.83	0.201998	194893.25	0.00	0.32	10
45	94.60	47.51	20.06	6417.56	0.204998	197787.75	0.00	0.32	10
46	94.60	48.48	21.48	6547.64	0.207998	200682.19	0.00	0.32	10
47	94.60	49.44	22.73	6651.71	0.210998	203576.63	0.00	0.32	10
48	94.60	50.39	24.12	6786.23	0.213998	206471.06	0.00	0.33	10
49	94.60	51.34	25.49	6923.08	0.216998	209365.50	0.00	0.33	10
50	94.60	52.28	26.85	7062.56	0.219998	212259.94	0.00	0.33	10
51	94.60	53.22	28.19	7204.74	0.222998	215154.44	0.00	0.33	10
52	94.60	54.15	29.51	7349.71	0.225998	218048.88	0.00	0.34	10
53	94.60	55.08	30.81	7497.48	0.228998	220943.25	0.00	0.34	10
54	94.60	56.00	32.10	7648.26	0.231998	223837.75	0.00	0.34	10
55	94.60	56.92	33.51	7833.77	0.234998	226732.19	0.00	0.34	10
56	94.60	57.83	34.76	7991.36	0.237998	229626.63	0.00	0.35	10
57	94.60	58.74	36.14	8184.98	0.240998	232521.06	0.00	0.35	10
58	94.60	59.64	37.35	8349.61	0.243998	235415.50	0.00	0.35	10
59	94.60	60.54	38.69	8552.02	0.246998	238309.94	0.00	0.35	10
60	94.60	61.43	40.01	8759.39	0.249998	241204.38	0.00	0.36	10

CYLINDRICAL RADIATOR FOR CASE OF 119420.0 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 90.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 3010.4883

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7383

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 34377.602 SOLAR = 23739.750 ALBEDO = 0.001

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.48066

MAXIMUM ABSORPTANCE VALUE = 0.25000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00300 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	26.93	-20.86	4138.64	0.070000	23739.76	0.00	0.33	12
1	94.60	27.63	-19.75	4178.38	0.073000	24757.16	0.00	0.33	12
2	94.60	28.32	-18.59	4223.04	0.076000	25774.57	0.00	0.33	11
3	94.60	29.01	-17.43	4267.88	0.079000	26791.97	0.00	0.33	11
4	94.60	29.70	-16.28	4312.86	0.082000	27809.38	0.00	0.34	11
5	94.60	30.38	-15.31	4347.96	0.085000	28826.79	0.00	0.34	11
6	94.60	31.06	-14.19	4393.15	0.088000	29844.19	0.00	0.34	11
7	94.60	31.74	-13.08	4438.55	0.091000	30861.59	0.00	0.34	11
8	94.60	32.42	-11.99	4484.13	0.094000	31879.01	0.00	0.34	11
9	94.60	33.09	-10.91	4529.90	0.097000	32896.41	0.00	0.34	11
10	94.60	33.76	-9.84	4575.86	0.100000	33913.81	0.00	0.34	11
11	94.60	34.43	-8.62	4632.62	0.103000	34931.21	0.00	0.34	11
12	94.60	35.09	-7.58	4679.07	0.106000	35948.63	0.00	0.34	11
13	94.60	35.75	-6.55	4725.75	0.108999	36966.03	0.00	0.35	11
14	94.60	36.41	-5.53	4772.63	0.111999	37983.44	0.00	0.35	11
15	94.60	37.07	-4.37	4830.77	0.114999	39000.84	0.00	0.35	11
16	94.60	37.72	-3.38	4878.23	0.117999	40018.25	0.00	0.35	11
17	94.60	38.37	-2.25	4937.19	0.120999	41035.66	0.00	0.35	11
18	94.60	39.02	-1.28	4985.23	0.123999	42053.06	0.00	0.35	11
19	94.60	39.67	-0.17	5045.00	0.126999	43070.46	0.00	0.35	11
20	94.60	40.31	0.78	5093.64	0.129999	44087.87	0.00	0.35	11
21	94.60	40.96	1.86	5154.33	0.132999	45105.28	0.00	0.36	11
22	94.60	41.59	2.93	5215.46	0.135999	46122.68	0.00	0.36	11
23	94.60	42.23	3.99	5277.14	0.138999	47140.08	0.00	0.36	11
24	94.60	42.87	5.04	5339.42	0.141999	48157.49	0.00	0.36	11
25	94.60	43.50	5.93	5389.80	0.144999	49174.88	0.00	0.36	11
26	94.60	44.13	6.96	5452.99	0.147999	50192.27	0.00	0.36	11
27	94.60	44.75	7.97	5516.73	0.150999	51209.67	0.00	0.36	11
28	94.60	45.38	8.97	5581.05	0.153999	52227.07	0.00	0.36	11
29	94.60	46.00	10.10	5658.88	0.156999	53244.52	0.00	0.37	11
30	94.60	46.62	11.08	5724.52	0.159999	54261.92	0.00	0.37	11
31	94.60	47.24	12.05	5790.75	0.162999	55279.32	0.00	0.37	11
32	94.60	47.85	13.01	5857.63	0.165999	56296.72	0.00	0.37	11
33	94.60	48.47	14.09	5938.71	0.168999	57314.12	0.00	0.37	11
34	94.60	49.08	15.03	6007.01	0.171999	58331.52	0.00	0.37	11
35	94.60	49.69	16.09	6089.92	0.174999	59348.91	0.00	0.37	11
36	94.60	50.29	17.00	6159.71	0.177999	60366.32	0.00	0.37	11
37	94.60	50.90	18.04	6244.52	0.180999	61383.76	0.00	0.38	11

38	94.60	51.50	19.06	6330.43	0.183999	62401.16	0.00	0.38	11
39	94.60	52.10	19.95	6402.65	0.186998	63418.56	0.00	0.38	11
40	94.60	52.70	20.95	6490.55	0.189998	64435.56	0.00	0.38	11
41	94.60	53.30	21.94	6579.64	0.192998	65453.36	0.00	0.38	11
42	94.60	53.89	22.92	6669.81	0.195998	66470.75	0.00	0.38	11
43	94.60	54.48	23.89	6761.25	0.198998	67488.13	0.00	0.38	11
44	94.60	55.07	24.85	6853.84	0.201999	68505.50	0.00	0.38	11
45	94.60	55.66	25.80	6947.76	0.204998	69523.00	0.00	0.39	11
46	94.60	56.24	26.74	7042.91	0.207998	70540.38	0.00	0.39	11
47	94.60	56.83	27.78	7156.08	0.210998	71557.75	0.00	0.39	11
48	94.60	57.41	28.70	7254.13	0.213998	72575.19	0.00	0.39	11
49	94.60	57.99	29.60	7353.52	0.216998	73592.56	0.00	0.39	11
50	94.60	58.57	30.62	7471.91	0.219998	74610.00	0.00	0.39	11
51	94.60	59.15	31.50	7574.40	0.222998	75627.38	0.00	0.39	11
52	94.60	59.72	32.49	7696.58	0.225998	76644.81	0.00	0.39	11
53	94.60	60.29	33.47	7820.95	0.228998	77662.19	0.00	0.40	11
54	94.60	60.86	34.44	7947.46	0.231998	78679.63	0.00	0.40	11
55	94.60	61.43	35.28	8056.77	0.234998	79697.00	0.00	0.40	11
56	94.60	62.00	36.23	8187.46	0.237998	80714.44	0.00	0.40	11
57	94.60	62.56	37.16	8320.51	0.240998	81731.81	0.00	0.40	11
58	94.60	63.13	38.19	8476.61	0.243998	82749.25	0.00	0.40	11
59	94.60	63.69	39.11	8615.00	0.246998	83766.69	0.00	0.40	11
60	94.60	64.25	40.01	8755.86	0.249998	84784.06	0.00	0.41	11

S P A C E   S T A T I O N   R A D I A T O R   P R O G R A M

ALTITUDE (N.MI.), LOWEST = 235 HIGHEST = 235 INCREMENT = 1

ORBIT INCLINATION (DEG.), LOWEST = 10 HIGHEST = 90 INCREMENT = 20

DISSIPATION (KW.), LOWEST = 35 HIGHEST = 70 INCREMENT = 35

BREAK POINT FROM PLATE TO CYLINDRICAL RADIATORS (KW.) = 35.00

MONTHS DEGRADATION FOR FLAT PLATE RADIATOR = 60 INCREMENT = 1
MONTHS DEGRADATION FOR CYLINDRICAL RADIATOR = 60 INCREMENT = 1

SHADING COEFFICIENTS
PLATE, SOLAR = 0.89999998 EARTHSHINE = 0.89999998 ALBEDO = 0.89999998
CYL. , SOLAR = 0.79999995 EARTHSHINE = 0.79999995 ALBEDO = 0.79999995

PLATE, SHAPE FACTOR TO SPACE = 0.89999998 FLUID CP = 0.2500 BTU/LBM-R.
CYL. , SHAPE FACTOR TO SPACE = 0.79999995 FLUID CP = 0.2500 BTU/LBM-R.

RADIATOR MATERIAL PROPERTIES
PLATE, ABSORPTANCE = 0.07000 EMITTANCE = 0.76000 MONTHLY CHANGE IN ABSORPTANCE = 0.006000
CYL. , ABSORPTANCE = 0.07000 EMITTANCE = 0.76000 MONTHLY CHANGE IN ABSORPTANCE = 0.006000

FLAT PLANE RADIATOR FOR CASE OF 119419.9 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 10.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 956.4446

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7344

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 24576.828 SOLAR = 2841.646 ALBEDO = 1702.937

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 1.00000

MAXIMUM ABSORPTANCE VALUE = 0.43000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00600 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	46.46	7.05	5458.63	0.070000	2841.65	1702.94	0.39	12
1	94.60	46.79	7.62	5493.88	0.076000	3085.21	1848.90	0.39	12
2	94.60	47.12	8.18	5529.16	0.082000	3328.78	1994.87	0.39	12
3	94.60	47.45	8.73	5564.45	0.088000	3572.35	2140.83	0.39	12
4	94.60	47.78	9.38	5608.20	0.094000	3815.92	2286.80	0.39	12
5	94.60	48.11	9.92	5643.66	0.100000	4059.49	2432.76	0.39	12
6	94.60	48.44	10.46	5679.08	0.106000	4303.06	2578.73	0.39	12
7	94.60	48.77	11.09	5723.20	0.112000	4546.63	2724.70	0.39	12
8	94.60	49.10	11.62	5758.81	0.118000	4790.20	2870.66	0.39	12
9	94.60	49.42	12.24	5803.22	0.124000	5033.77	3016.63	0.39	12
10	94.60	49.75	12.76	5838.92	0.130000	5277.34	3162.59	0.39	12
11	94.60	50.07	13.37	5883.55	0.136000	5520.90	3308.56	0.39	12
12	94.60	50.40	13.87	5919.45	0.142000	5764.47	3454.53	0.39	12
13	94.60	50.72	14.47	5964.42	0.148000	6008.04	3600.49	0.40	12
14	94.60	51.04	15.07	6009.58	0.154000	6251.61	3746.46	0.40	12
15	94.60	51.37	15.56	6045.70	0.160000	6495.18	3892.42	0.40	12
16	94.60	51.69	16.14	6091.19	0.166000	6738.75	4038.39	0.40	12
17	94.60	52.01	16.72	6136.82	0.172000	6982.32	4184.35	0.40	12
18	94.60	52.33	17.37	6192.09	0.178000	7225.89	4330.32	0.40	11
19	94.60	52.65	17.94	6238.23	0.184000	7469.46	4476.28	0.40	11
20	94.60	52.97	18.31	6265.46	0.190000	7713.02	4622.25	0.40	11
21	94.60	53.29	18.87	6311.88	0.196000	7956.59	4768.21	0.40	11
22	94.60	53.61	19.43	6358.51	0.202000	8200.16	4914.18	0.40	11
23	94.60	53.93	19.98	6405.30	0.208000	8443.73	5060.14	0.40	11
24	94.60	54.24	20.71	6472.19	0.214000	8687.30	5206.11	0.40	11
25	94.60	54.56	21.25	6519.64	0.220000	8930.87	5352.08	0.40	11
26	94.60	54.88	21.78	6567.32	0.226000	9174.44	5498.04	0.40	11
27	94.60	55.19	22.32	6615.22	0.232000	9418.01	5644.01	0.40	11
28	94.60	55.51	22.84	6663.36	0.237999	9661.58	5789.97	0.40	11
29	94.60	55.82	23.37	6711.73	0.243999	9905.14	5935.94	0.40	11
30	94.60	56.13	23.89	6760.37	0.249999	10148.71	6081.91	0.41	11
31	94.60	56.45	24.40	6809.26	0.255999	10392.29	6227.87	0.41	11
32	94.60	56.76	25.09	6879.70	0.261999	10635.85	6373.84	0.41	11
33	94.60	57.07	25.59	6929.27	0.267999	10879.42	6519.80	0.41	11
34	94.60	57.39	26.10	6979.06	0.273999	11122.99	6665.77	0.41	11
35	94.60	57.70	26.59	7029.16	0.279999	11366.56	6811.73	0.41	11
36	94.60	58.01	27.26	7101.70	0.285999	11610.13	6957.70	0.41	11
37	94.60	58.32	27.75	7152.46	0.291999	11853.70	7103.66	0.41	11

38	94.60	58.63	28.24	7203.57	0.297999	12097.27	7249.63	0.41	11
39	94.60	58.93	28.89	7277.83	0.303999	12340.84	7395.60	0.41	11
40	94.60	59.24	29.37	7329.59	0.309999	12584.41	7541.56	0.41	11
41	94.60	59.55	29.84	7381.74	0.315999	12827.97	7687.53	0.41	11
42	94.60	59.86	30.48	7457.72	0.321999	13071.54	7833.49	0.41	11
43	94.60	60.16	30.95	7510.62	0.327999	13315.11	7979.46	0.41	11
44	94.60	60.47	31.58	7587.98	0.333999	13558.68	8125.43	0.41	11
45	94.60	60.78	32.04	7641.71	0.339999	13802.25	8271.39	0.42	11
46	94.60	61.08	32.66	7720.39	0.345999	14045.82	8417.36	0.42	11
47	94.60	61.38	33.11	7774.92	0.351999	14289.39	8563.32	0.42	11
48	94.60	61.69	33.72	7855.03	0.357999	14532.96	8709.29	0.42	11
49	94.60	61.99	34.16	7910.36	0.363999	14776.53	8855.25	0.42	11
50	94.60	62.29	34.77	7992.00	0.369999	15020.09	9001.22	0.42	11
51	94.60	62.60	35.20	8048.24	0.375999	15263.66	9147.18	0.42	11
52	94.60	62.90	35.80	8131.37	0.381999	15507.23	9293.15	0.42	11
53	94.60	63.20	36.39	8215.35	0.387999	15750.80	9439.12	0.42	11
54	94.60	63.50	36.82	8273.09	0.393999	15994.36	9585.08	0.42	11
55	94.60	63.80	37.40	8358.64	0.399999	16237.93	9731.05	0.42	11
56	94.60	64.10	37.98	8445.25	0.405999	16481.50	9877.01	0.42	11
57	94.60	64.40	38.39	8504.57	0.411999	16725.07	10022.98	0.42	11
58	94.60	64.70	38.96	8592.83	0.417999	16968.64	10168.95	0.42	11
59	94.60	65.00	39.53	8682.07	0.423999	17212.21	10314.91	0.42	11
60	94.60	65.29	40.09	8772.32	0.429999	17455.78	10460.88	0.42	11

CYLINDRICAL RADIATOR FOR CASE OF 119420.0 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 10.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 2829.7825

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7383

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 32314.078 SOLAR = 9877.309 ALBEDO = 1990.278

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.90378

MAXIMUM ABSORPTANCE VALUE = 0.43000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00600 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	24.52	-26.02	3961.63	0.070000	9877.31	1990.28	0.33	12
1	94.60	25.28	-24.72	4005.65	0.076000	10723.93	2160.87	0.33	12
2	94.60	26.02	-23.54	4044.75	0.082000	11570.56	2331.47	0.33	12
3	94.60	26.77	-22.28	4088.68	0.088000	12417.18	2502.06	0.34	12
4	94.60	27.51	-21.05	4132.58	0.094000	13263.81	2672.66	0.34	12
5	94.60	28.25	-19.83	4176.48	0.100000	14110.43	2843.25	0.34	12
6	94.60	28.98	-18.64	4220.39	0.106000	14957.05	3013.84	0.34	12
7	94.60	29.71	-17.46	4264.34	0.112000	15803.68	3184.44	0.34	12
8	94.60	30.44	-16.30	4308.30	0.118000	16650.30	3355.04	0.34	12
9	94.60	31.16	-15.07	4357.47	0.124000	17496.93	3525.63	0.34	12
10	94.60	31.88	-13.79	4412.06	0.130000	18343.55	3696.22	0.34	11
11	94.60	32.60	-12.77	4451.02	0.136000	19190.18	3866.82	0.35	11
12	94.60	33.31	-11.59	4500.61	0.142000	20036.80	4037.41	0.35	11
13	94.60	34.03	-10.42	4550.38	0.148000	20883.42	4208.01	0.35	11
14	94.60	34.73	-9.10	4611.24	0.154000	21730.05	4378.61	0.35	11
15	94.60	35.44	-7.97	4661.47	0.160000	22576.68	4549.20	0.35	11
16	94.60	36.14	-6.86	4711.93	0.166000	23423.30	4719.79	0.35	11
17	94.60	36.84	-5.76	4762.56	0.172000	24269.93	4890.39	0.35	11
18	94.60	37.54	-4.51	4824.83	0.178000	25116.55	5060.98	0.35	11
19	94.60	38.23	-3.44	4876.03	0.184000	25963.18	5231.58	0.36	11
20	94.60	38.92	-2.38	4927.51	0.190000	26809.80	5402.17	0.36	11
21	94.60	39.61	-1.18	4990.93	0.196000	27656.42	5572.77	0.36	11
22	94.60	40.30	0.01	5054.87	0.202000	28503.04	5743.36	0.36	11
23	94.60	40.98	1.02	5107.27	0.208000	29349.67	5913.96	0.36	11
24	94.60	41.66	2.18	5172.14	0.214000	30196.30	6084.55	0.36	11
25	94.60	42.33	3.32	5237.55	0.220000	31042.92	6255.15	0.36	11
26	94.60	43.01	4.45	5303.55	0.226000	31889.55	6425.74	0.36	11
27	94.60	43.68	5.56	5370.07	0.232000	32736.17	6596.34	0.36	11
28	94.60	44.35	6.66	5437.21	0.237999	33582.80	6766.93	0.37	11
29	94.60	45.01	7.74	5504.90	0.243999	34429.42	6937.53	0.37	11
30	94.60	45.68	8.81	5573.27	0.249999	35276.04	7108.12	0.37	11
31	94.60	46.34	9.87	5642.21	0.255999	36122.67	7278.71	0.37	11
32	94.60	47.00	10.92	5711.78	0.261999	36969.29	7449.31	0.37	11
33	94.60	47.65	12.10	5795.75	0.267999	37815.92	7619.91	0.37	11
34	94.60	48.31	13.11	5866.80	0.273999	38662.54	7790.50	0.37	11
35	94.60	48.96	14.12	5938.56	0.279999	39509.16	7961.09	0.38	11
36	94.60	49.60	15.26	6025.28	0.285999	40355.79	8131.69	0.38	11
37	94.60	50.25	16.38	6113.13	0.291999	41202.41	8302.29	0.38	11

38	94.60	50.89	17.35	6187.38	0.297999	42049.04	8472.88	0.38	11
39	94.60	51.53	18.44	6277.29	0.303999	42895.66	8643.48	0.38	11
40	94.60	52.17	19.52	6368.43	0.309999	43742.29	8814.07	0.38	11
41	94.60	52.81	20.59	6460.80	0.315999	44588.91	8984.66	0.38	11
42	94.60	53.44	21.65	6554.39	0.321999	45435.50	9155.26	0.38	11
43	94.60	54.07	22.69	6649.21	0.327999	46282.16	9325.86	0.39	11
44	94.60	54.70	23.72	6745.39	0.333999	47128.77	9496.45	0.39	11
45	94.60	55.33	24.74	6842.86	0.339999	47975.38	9667.04	0.39	11
46	94.60	55.95	25.74	6941.71	0.345999	48821.99	9837.64	0.39	11
47	94.60	56.58	26.73	7041.91	0.351999	49668.65	10008.23	0.39	11
48	94.60	57.19	27.84	7161.02	0.357999	50515.26	10178.83	0.39	11
49	94.60	57.81	28.81	7264.33	0.363999	51361.87	10349.42	0.39	11
50	94.60	58.43	29.89	7387.39	0.369999	52208.53	10520.02	0.40	11
51	94.60	59.04	30.95	7512.58	0.375999	53055.14	10690.61	0.40	11
52	94.60	59.65	31.89	7621.13	0.381999	53901.75	10861.71	0.40	11
53	94.60	60.26	32.93	7750.53	0.387999	54748.41	11031.80	0.40	11
54	94.60	60.87	33.95	7882.26	0.393999	55595.02	11202.40	0.40	11
55	94.60	61.47	34.97	8016.50	0.399999	56441.63	11372.99	0.40	11
56	94.60	62.08	35.97	8153.20	0.405999	57288.24	11543.59	0.40	11
57	94.60	62.67	36.96	8292.46	0.411999	58134.89	11714.18	0.41	11
58	94.60	63.27	38.06	8455.92	0.417999	58981.51	11884.78	0.41	11
59	94.60	63.87	39.02	8601.06	0.423999	59828.12	12055.37	0.41	11
60	94.60	64.47	39.97	8748.99	0.429999	60674.77	12225.96	0.41	11

FLAT PLANE RADIATOR FOR CASE OF 119419.9 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 30.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 1341.6475

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7344

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 34475.012 SOLAR = 11788.965 ALBEDO = 2100.663

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.82375

MAXIMUM ABSORPTANCE VALUE = 0.43000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00600 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	AOA	ITN
0	94.60	19.78	-32.42	3762.50	0.070000	11788.96	2100.66	0.32	12
1	94.60	20.63	-31.05	3803.52	0.076000	12799.45	2280.72	0.32	12
2	94.60	21.47	-29.70	3844.43	0.082000	13809.92	2460.78	0.32	12
3	94.60	22.31	-28.28	3889.77	0.088000	14820.40	2640.83	0.32	12
4	94.60	23.15	-26.97	3930.52	0.094000	15830.89	2820.89	0.33	12
5	94.60	23.98	-25.60	3975.84	0.100000	16841.37	3000.94	0.33	12
6	94.60	24.81	-24.25	4021.15	0.106000	17851.84	3181.00	0.33	12
7	94.60	25.63	-22.92	4066.53	0.112000	18862.32	3361.06	0.33	12
8	94.60	26.45	-21.61	4111.89	0.118000	19872.80	3541.11	0.33	12
9	94.60	27.26	-20.23	4162.14	0.124000	20883.29	3721.17	0.33	12
10	94.60	28.07	-18.99	4207.70	0.130000	21893.75	3901.23	0.33	11
11	94.60	28.88	-17.65	4258.23	0.136000	22904.24	4081.28	0.33	11
12	94.60	29.68	-16.34	4308.91	0.142000	23914.71	4261.34	0.34	11
13	94.60	30.48	-15.04	4359.84	0.148000	24925.19	4441.39	0.34	11
14	94.60	31.27	-13.77	4410.93	0.154000	25935.68	4621.45	0.34	11
15	94.60	32.06	-12.51	4462.24	0.160000	26946.16	4801.51	0.34	11
16	94.60	32.85	-11.27	4513.75	0.166000	27956.63	4981.56	0.34	11
17	94.60	33.63	-9.89	4575.98	0.172000	28967.13	5161.62	0.34	11
18	94.60	34.41	-8.69	4628.05	0.178000	29977.60	5341.68	0.34	11
19	94.60	35.18	-7.34	4691.12	0.184000	30988.07	5521.73	0.34	11
20	94.60	35.95	-6.17	4743.80	0.190000	31998.56	5701.79	0.35	11
21	94.60	36.72	-4.86	4807.74	0.196000	33009.04	5881.84	0.35	11
22	94.60	37.49	-3.73	4861.07	0.202000	34019.51	6061.90	0.35	11
23	94.60	38.25	-2.45	4925.94	0.208000	35029.98	6241.96	0.35	11
24	94.60	39.01	-1.19	4991.34	0.214000	36040.48	6422.01	0.35	11
25	94.60	39.76	0.05	5057.34	0.220000	37050.95	6602.07	0.35	11
26	94.60	40.51	1.12	5112.19	0.226000	38061.45	6782.13	0.36	11
27	94.60	41.26	2.48	5191.02	0.232000	39071.97	6962.18	0.36	11
28	94.60	42.00	3.67	5258.77	0.237999	40082.39	7142.24	0.36	11
29	94.60	42.74	4.85	5327.12	0.243999	41092.89	7322.30	0.36	11
30	94.60	43.48	6.01	5396.12	0.249999	42103.36	7502.35	0.36	11
31	94.60	44.21	7.16	5465.73	0.255999	43113.83	7682.41	0.36	11
32	94.60	44.95	8.43	5548.70	0.261999	44124.32	7862.46	0.36	11
33	94.60	45.67	9.54	5619.82	0.267999	45134.80	8042.52	0.36	11
34	94.60	46.40	10.78	5704.64	0.273999	46145.27	8222.58	0.37	11
35	94.60	47.12	11.87	5777.30	0.279999	47155.77	8402.63	0.37	11
36	94.60	47.84	13.08	5864.10	0.285999	48166.24	8582.69	0.37	11
37	94.60	48.55	14.27	5952.06	0.291999	49176.71	8762.75	0.37	11

38	94.60	49.27	15.45	6041.07	0.297999	50187.21	8942.80	0.37	11
39	94.60	49.98	16.48	6117.31	0.303999	51197.68	9122.86	0.37	11
40	94.60	50.68	17.76	6222.76	0.309999	52208.15	9302.92	0.37	11
41	94.60	51.39	18.89	6315.43	0.315999	53218.65	9482.97	0.38	11
42	94.60	52.09	20.01	6409.33	0.321999	54229.12	9663.03	0.38	11
43	94.60	52.79	21.11	6504.53	0.327999	55239.59	9843.09	0.38	11
44	94.60	53.48	22.20	6601.03	0.333999	56250.09	10073.14	0.38	11
45	94.60	54.17	23.40	6714.44	0.339999	57260.56	10203.20	0.38	11
46	94.60	54.86	24.46	6813.85	0.345999	58271.04	10383.25	0.38	11
47	94.60	55.55	25.63	6930.89	0.351999	59281.51	10563.31	0.39	11
48	94.60	56.23	26.79	7049.86	0.357999	60292.00	10743.37	0.39	11
49	94.60	56.91	27.93	7170.97	0.363999	61302.47	10923.42	0.39	11
50	94.60	57.59	29.05	7294.16	0.369999	62312.97	11103.48	0.39	11
51	94.60	58.27	30.16	7419.56	0.375999	63323.44	11283.54	0.39	11
52	94.60	58.94	31.25	7547.25	0.381999	64333.91	11463.59	0.39	11
53	94.60	59.61	32.34	7677.21	0.387999	65344.41	11643.65	0.39	11
54	94.60	60.28	33.40	7809.46	0.393999	66354.88	11823.71	0.40	11
55	94.60	60.95	34.56	7963.27	0.399999	67365.31	12003.76	0.40	11
56	94.60	61.61	35.60	8100.92	0.405999	68375.81	12183.82	0.40	11
57	94.60	62.27	36.74	8261.04	0.411999	69386.31	12363.88	0.40	11
58	94.60	62.93	37.85	8424.73	0.417999	70396.75	12543.93	0.40	11
59	94.60	63.58	38.96	8592.09	0.423999	71407.25	12723.99	0.40	11
60	94.60	64.24	40.04	8763.29	0.429999	72417.75	12904.04	0.41	11

CYLINDRICAL RADIATOR FOR CASE OF 119420.0 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 30.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 3051.5093

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7383

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 34846.035 SOLAR = 12352.883 ALBEDO = 1887.353

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.81222

MAXIMUM ABSORPTANCE VALUE = 0.43000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00600 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	19.00	-33.46	3732.14	0.070000	12352.89	1887.35	0.32	12
1	94.60	19.87	-32.05	3773.43	0.076000	13411.70	2049.13	0.32	12
2	94.60	20.73	-30.68	3814.62	0.082000	14470.52	2210.90	0.32	12
3	94.60	21.58	-29.32	3855.71	0.088000	15529.33	2372.67	0.32	12
4	94.60	22.43	-27.89	3901.25	0.094000	16588.15	2534.44	0.32	12
5	94.60	23.28	-26.49	3946.78	0.100000	17646.97	2696.22	0.32	12
6	94.60	24.12	-25.12	3992.35	0.106000	18705.78	2857.99	0.33	12
7	94.60	24.96	-23.76	4037.94	0.112000	19764.60	3019.76	0.33	12
8	94.60	25.79	-22.43	4083.56	0.118000	20823.41	3181.54	0.33	12
9	94.60	26.62	-21.12	4129.25	0.124000	21882.23	3343.31	0.33	12
10	94.60	27.44	-19.68	4184.63	0.130000	22941.05	3505.08	0.33	11
11	94.60	28.26	-18.49	4225.69	0.136000	23999.86	3666.85	0.33	11
12	94.60	29.08	-17.16	4276.54	0.142000	25058.68	3828.63	0.33	11
13	94.60	29.89	-15.84	4327.57	0.148000	26117.49	3990.40	0.34	11
14	94.60	30.70	-14.54	4378.85	0.154000	27176.32	4152.17	0.34	11
15	94.60	31.50	-13.26	4430.29	0.160000	28235.13	4313.95	0.34	11
16	94.60	32.31	-11.84	4492.25	0.166000	29293.95	4475.71	0.34	11
17	94.60	33.10	-10.60	4544.26	0.172000	30352.76	4637.49	0.34	11
18	94.60	33.89	-9.38	4596.52	0.178000	31411.57	4799.26	0.34	11
19	94.60	34.68	-8.01	4659.62	0.184000	32470.40	4961.04	0.34	11
20	94.60	35.47	-6.82	4712.51	0.190000	33529.21	5122.81	0.34	11
21	94.60	36.25	-5.49	4776.52	0.196000	34588.03	5284.58	0.35	11
22	94.60	37.03	-4.34	4830.03	0.202000	35646.84	5446.35	0.35	11
23	94.60	37.80	-3.05	4894.94	0.208000	36705.66	5608.13	0.35	11
24	94.60	38.57	-1.77	4960.41	0.214000	37764.48	5769.90	0.35	11
25	94.60	39.34	-0.52	5026.48	0.220000	38823.29	5931.67	0.35	11
26	94.60	40.10	0.72	5093.10	0.226000	39882.11	6093.45	0.35	11
27	94.60	40.86	1.95	5160.34	0.232000	40940.92	6255.22	0.35	11
28	94.60	41.62	3.16	5228.17	0.237999	41999.74	6416.99	0.36	11
29	94.60	42.37	4.35	5296.61	0.243999	43058.56	6578.77	0.36	11
30	94.60	43.12	5.52	5365.68	0.249999	44117.37	6740.54	0.36	11
31	94.60	43.87	6.83	5447.76	0.255999	45176.19	6902.31	0.36	11
32	94.60	44.61	7.97	5518.32	0.261999	46235.00	7064.08	0.36	11
33	94.60	45.35	9.10	5589.52	0.267999	47293.82	7225.86	0.36	11
34	94.60	46.09	10.36	5674.31	0.273999	48352.64	7387.63	0.36	11
35	94.60	46.82	11.59	5760.20	0.279999	49411.44	7549.40	0.37	11
36	94.60	47.55	12.68	5833.86	0.285999	50470.27	7711.17	0.37	11
37	94.60	48.28	13.88	5921.75	0.291999	51529.05	7872.95	0.37	11

38	94.60	49.00	15.07	6010.74	0.297999	52587.88	8034.72	0.37	11
39	94.60	49.72	16.25	6100.98	0.303999	53646.70	8196.49	0.37	11
40	94.60	50.44	17.41	6192.41	0.309999	54705.53	8358.27	0.37	11
41	94.60	51.16	18.55	6285.04	0.315999	55764.31	8520.04	0.38	11
42	94.60	51.86	19.68	6378.92	0.321999	56823.14	8681.81	0.38	11
43	94.60	52.57	20.92	6488.99	0.327999	57881.96	8843.58	0.38	11
44	94.60	53.28	22.02	6585.70	0.333999	58940.79	9005.36	0.38	11
45	94.60	53.98	23.23	6699.18	0.339999	59999.57	9167.13	0.38	11
46	94.60	54.68	24.30	6798.84	0.345999	61058.40	9328.90	0.38	11
47	94.60	55.38	25.48	6915.91	0.351999	62117.23	9490.68	0.38	11
48	94.60	56.08	26.64	7035.02	0.357999	63176.05	9652.45	0.39	11
49	94.60	56.77	27.79	7156.22	0.363999	64234.88	9814.22	0.39	11
50	94.60	57.45	28.92	7279.56	0.369999	65293.66	9975.99	0.39	11
51	94.60	58.14	30.03	7404.98	0.375999	66352.44	10137.77	0.39	11
52	94.60	58.83	31.14	7532.80	0.381999	67411.31	10299.54	0.39	11
53	94.60	59.51	32.22	7662.82	0.387999	68470.13	10461.31	0.39	11
54	94.60	60.18	33.41	7813.72	0.393999	69528.88	10623.08	0.39	11
55	94.60	60.86	34.47	7948.93	0.399999	70587.75	10784.86	0.40	11
56	94.60	61.53	35.62	8106.00	0.405999	71646.56	10946.63	0.40	11
57	94.60	62.20	36.76	8266.52	0.411999	72705.38	11108.40	0.40	11
58	94.60	62.87	37.77	8410.21	0.417999	73764.19	11270.18	0.40	11
59	94.60	63.53	38.88	8577.54	0.423999	74823.00	11431.95	0.40	11
60	94.60	64.20	40.08	8769.88	0.429999	75881.81	11593.72	0.40	11

FLAT PLANE RADIATOR FOR CASE OF 119419.9 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 50.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 2290.4822

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7344

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 58856.297 SOLAR = 33552.648 ALBEDO = 2661.856

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.53938

MAXIMUM ABSORPTANCE VALUE = 0.43000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00600 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-13.67	-69.14	2918.33	0.070000	33552.65	2661.86	0.23	12
1	94.60	-12.06	-66.72	2961.91	0.076000	36428.58	2890.01	0.23	12
2	94.60	-10.48	-64.27	3009.28	0.082000	39304.50	3118.17	0.23	12
3	94.60	-8.90	-61.96	3052.43	0.088000	42180.43	3346.33	0.23	12
4	94.60	-7.35	-59.62	3099.55	0.094000	45056.36	3574.49	0.24	12
5	94.60	-5.81	-57.32	3146.59	0.100000	47932.29	3802.65	0.24	12
6	94.60	-4.29	-55.07	3193.60	0.106000	50808.22	4030.81	0.24	12
7	94.60	-2.78	-52.86	3240.59	0.112000	53684.15	4258.96	0.24	12
8	94.60	-1.28	-50.64	3291.94	0.118000	56560.08	4487.13	0.24	11
9	94.60	0.19	-48.44	3343.40	0.124000	59436.05	4715.28	0.25	11
10	94.60	1.66	-46.28	3395.04	0.130000	62311.98	4943.44	0.25	11
11	94.60	3.11	-44.16	3446.85	0.136000	65187.91	5171.60	0.25	11
12	94.60	4.55	-42.08	3498.83	0.142000	68063.81	5399.76	0.25	11
13	94.60	5.97	-40.04	3551.07	0.148000	70939.75	5627.92	0.25	11
14	94.60	7.38	-38.03	3603.55	0.154000	73815.69	5856.07	0.25	11
15	94.60	8.78	-35.91	3665.65	0.160000	76691.56	6084.23	0.26	11
16	94.60	10.17	-33.96	3718.77	0.166000	79567.50	6312.39	0.26	11
17	94.60	11.54	-31.91	3781.74	0.172000	82443.44	6540.55	0.26	11
18	94.60	12.91	-30.03	3835.64	0.178000	85319.38	6768.71	0.26	11
19	94.60	14.26	-28.05	3899.59	0.184000	88195.38	6996.87	0.26	11
20	94.60	15.60	-26.09	3964.11	0.190000	91071.25	7225.03	0.27	11
21	94.60	16.92	-24.30	4019.33	0.196000	93947.19	7453.19	0.27	11
22	94.60	18.24	-22.40	4084.97	0.202000	96823.13	7681.34	0.27	11
23	94.60	19.55	-20.54	4151.32	0.208000	99699.06	7909.50	0.27	11
24	94.60	20.84	-18.70	4218.26	0.214000	102575.00	8137.66	0.27	11
25	94.60	22.13	-16.89	4285.93	0.220000	105450.94	8365.82	0.28	11
26	94.60	23.40	-14.98	4364.74	0.226000	108326.88	8593.98	0.28	11
27	94.60	24.67	-13.22	4433.97	0.232000	111202.81	8822.14	0.28	11
28	94.60	25.92	-11.37	4514.71	0.237999	114078.75	9050.30	0.28	11
29	94.60	27.17	-9.66	4585.61	0.243999	116954.69	9278.46	0.28	11
30	94.60	28.40	-7.86	4668.27	0.249999	119830.63	9506.61	0.29	11
31	94.60	29.63	-6.20	4740.98	0.255999	122706.56	9734.77	0.29	11
32	94.60	30.85	-4.45	4825.79	0.261999	125582.44	9962.93	0.29	11
33	94.60	32.06	-2.73	4911.69	0.267999	128458.44	10191.09	0.29	11
34	94.60	33.26	-1.03	4998.86	0.273999	131334.38	10419.25	0.30	11
35	94.60	34.45	0.65	5087.21	0.279999	134210.31	10647.41	0.30	11
36	94.60	35.63	2.30	5176.84	0.285999	137086.19	10875.57	0.30	11
37	94.60	36.80	4.03	5279.60	0.291999	139962.13	11103.72	0.30	11

38	94.60	37.97	5.64	5372.05	0.297999	142838.06	11331.88	0.30	11
39	94.60	39.13	7.32	5478.02	0.303999	145714.00	11560.04	0.31	11
40	94.60	40.28	8.98	5585.80	0.309999	148589.94	11788.20	0.31	11
41	94.60	41.42	10.62	5695.28	0.315999	151465.88	12016.36	0.31	11
42	94.60	42.55	12.23	5806.68	0.321999	154341.81	12244.52	0.31	11
43	94.60	43.68	13.89	5932.73	0.327999	157217.75	12472.68	0.32	10
44	94.60	44.80	15.37	6035.30	0.333999	160093.69	12700.84	0.32	10
45	94.60	45.91	17.01	6165.80	0.339999	162969.63	12928.99	0.32	10
46	94.60	47.01	18.62	6298.76	0.345999	165845.56	13157.15	0.32	10
47	94.60	48.11	20.21	6434.42	0.351999	168721.50	13385.31	0.33	10
48	94.60	49.20	21.78	6572.72	0.357999	171597.44	13613.47	0.33	10
49	94.60	50.28	23.32	6713.77	0.363999	174473.38	13841.63	0.33	10
50	94.60	51.36	24.84	6857.73	0.369999	177349.31	14069.79	0.33	10
51	94.60	52.43	26.34	7004.64	0.375999	180225.25	14297.95	0.34	10
52	94.60	53.49	27.97	7184.11	0.381999	183101.13	14526.10	0.34	10
53	94.60	54.55	29.42	7337.81	0.387999	185977.06	14754.26	0.34	10
54	94.60	55.60	31.01	7525.41	0.393999	188853.00	14982.42	0.34	10
55	94.60	56.64	32.57	7717.71	0.399999	191728.94	15210.58	0.35	10
56	94.60	57.68	33.95	7882.89	0.405999	194604.88	15438.74	0.35	10
57	94.60	58.71	35.47	8084.27	0.411999	197480.81	15666.90	0.35	10
58	94.60	59.73	37.10	8324.32	0.417999	200356.75	15895.05	0.35	10
59	94.60	60.75	38.56	8537.02	0.423999	203232.69	16123.21	0.36	10
60	94.60	61.76	39.99	8755.53	0.429999	206108.63	16351.37	0.36	10

CYLINDRICAL RADIATOR FOR CASE OF 119420.0 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 50.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 3473.1714

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7383

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 39661.117 SOLAR = 17128.566 ALBEDO = 1594.408

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.70311

MAXIMUM ABSORPTANCE VALUE = 0.43000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00600 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	10.03	-44.81	3428.33	0.070000	17128.57	1594.41	0.29	12
1	94.60	11.08	-43.16	3468.65	0.076000	18596.73	1731.07	0.30	12
2	94.60	12.13	-41.45	3512.83	0.082000	20064.89	1867.73	0.30	12
3	94.60	13.17	-39.77	3556.89	0.088000	21533.05	2004.40	0.30	12
4	94.60	14.21	-38.13	3600.91	0.094000	23001.21	2141.06	0.30	12
5	94.60	15.24	-36.51	3644.81	0.100000	24469.37	2277.72	0.30	12
6	94.60	16.26	-34.93	3688.73	0.106000	25937.53	2414.39	0.30	12
7	94.60	17.27	-33.28	3736.85	0.112000	27405.69	2551.05	0.30	12
8	94.60	18.28	-31.67	3785.02	0.118000	28873.84	2687.71	0.31	12
9	94.60	19.29	-30.02	38[illegible]7.63	0.124000	30342.01	2824.38	0.31	11
10	94.60	20.28	-28.54	3881.68	0.130000	31810.17	2961.04	0.31	11
11	94.60	21.27	-26.92	3934.58	0.136000	33278.33	3097.70	0.31	11
12	94.60	22.26	-25.33	3987.68	0.142000	34746.48	3234.37	0.31	11
13	94.60	23.24	-23.92	4031.98	0.148000	36214.64	3371.03	0.31	11
14	94.60	24.21	-22.38	4085.49	0.154000	37682.81	3507.69	0.32	11
15	94.60	25.17	-20.86	4139.21	0.160000	39150.97	3644.36	0.32	11
16	94.60	26.13	-19.36	4193.27	0.166000	40619.13	3781.02	0.32	11
17	94.60	27.09	-17.74	4257.02	0.172000	42087.29	3917.68	0.32	11
18	94.60	28.04	-16.29	4311.70	0.178000	43555.44	4054.35	0.32	11
19	94.60	28.98	-14.86	4366.73	0.184000	45023.61	4191.01	0.32	11
20	94.60	29.92	-13.30	4431.85	0.190000	46491.77	4327.67	0.32	11
21	94.60	30.86	-11.92	4487.58	0.196000	47959.93	4464.34	0.33	11
22	94.60	31.78	-10.40	4553.71	0.202000	49428.09	4601.00	0.33	11
23	94.60	32.71	-9.06	4610.25	0.208000	50896.24	4737.66	0.33	11
24	94.60	33.62	-7.59	4677.47	0.214000	52364.41	4874.32	0.33	11
25	94.60	34.53	-6.14	4745.26	0.220000	53832.57	5010.99	0.33	11
26	94.60	35.44	-4.71	4813.71	0.226000	55300.72	5147.65	0.33	11
27	94.60	36.34	-3.30	4882.82	0.232000	56768.88	5284.32	0.34	11
28	94.60	37.24	-1.91	4952.63	0.237999	58237.04	5420.98	0.34	11
29	94.60	38.14	-0.55	5023.07	0.243999	59705.20	5557.64	0.34	11
30	94.60	39.02	0.94	5105.35	0.249999	61173.36	5694.30	0.34	11
31	94.60	39.91	2.27	5177.39	0.255999	62641.52	5830.97	0.34	11
32	94.60	40.78	3.58	5250.14	0.261999	64109.68	5967.63	0.35	11
33	94.60	41.66	5.01	5335.26	0.267999	65577.81	6104.30	0.35	11
34	94.60	42.53	6.41	5421.44	0.273999	67045.94	6240.96	0.35	11
35	94.60	43.39	7.67	5496.85	0.279999	68514.13	6377.62	0.35	11
36	94.60	44.25	9.03	5585.18	0.285999	69982.31	6514.29	0.35	11
37	94.60	45.11	10.38	5674.64	0.291999	71450.44	6650.95	0.35	11

38	94.60	45.96	11.71	5765.30	0.297999	72918.63	6787.61	0.36	
39	94.60	46.81	13.14	5869.99	0.303999	74386.75	6924.28	0.36	
40	94.60	47.65	14.43	5963.36	0.309999	75854.94	7060.94	0.36	11
41	94.60	48.49	15.71	6058.10	0.315999	77323.06	7197.60	0.36	11
42	94.60	49.32	17.08	6167.45	0.321999	78791.25	7334.27	0.36	11
43	94.60	50.16	18.32	6265.03	0.327999	80259.38	7470.93	0.36	11
44	94.60	50.98	19.66	6377.80	0.333999	81727.56	7607.59	0.37	11
45	94.60	51.81	20.98	6492.57	0.339999	83195.69	7744.25	0.37	11
46	94.60	52.62	22.27	6609.22	0.345999	84663.88	7880.92	0.37	11
47	94.60	53.44	23.55	6727.89	0.351999	86132.06	8017.58	0.37	11
48	94.60	54.25	24.82	6848.66	0.357999	87600.19	8154.25	0.37	11
49	94.60	55.06	26.17	6986.75	0.363999	89068.38	8290.91	0.37	11
50	94.60	55.86	27.40	7112.05	0.369999	90536.50	8427.57	0.38	11
51	94.60	56.66	28.71	7255.48	0.375999	92004.69	8564.23	0.38	11
52	94.60	57.46	30.00	7401.89	0.381999	93472.81	8700.90	0.38	11
53	94.60	58.25	31.28	7551.38	0.387999	94941.00	8837.56	0.38	11
54	94.60	59.04	32.54	7704.03	0.393999	96409.13	8974.23	0.38	11
55	94.60	59.82	33.78	7859.82	0.399999	97877.31	9110.89	0.39	11
56	94.60	60.60	34.97	8019.06	0.405999	99345.44	9247.55	0.39	10
57	94.60	61.38	36.27	8199.97	0.411999	100813.63	9384.21	0.39	10
58	94.60	62.16	37.55	8385.34	0.417999	102281.81	9520.88	0.39	10
59	94.60	62.93	38.81	8575.38	0.423999	103749.94	9657.54	0.39	10
60	94.60	63.70	40.05	8770.14	0.429999	105218.13	9794.20	0.40	10

FLAT PLANE RADIATOR FOR CASE OF 119419.9 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 70.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

MAXIMUM SOLAR ABSORPTANCE VALUE OVER INTERVAL EXCEEDS 0.31813 WHICH IS UPPER LIMIT REQUIRING INFINITE RADIATOR AREA

CYLINDRICAL RADIATOR FOR CASE OF 119420.0 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 70.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 7214.0000

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7383

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 82378.688 SOLAR = 55185.797 ALBEDO = 1762.122

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.48015

MAXIMUM ABSORPTANCE VALUE = 0.43000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00600 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-29.95	-80.17	2734.10	0.070000	55185.80	1762.12	0.18	12
1	94.60	-27.94	-77.27	2780.93	0.076000	59916.00	1913.16	0.18	12
2	94.60	-25.95	-74.44	2827.51	0.082000	64646.19	2064.20	0.18	12
3	94.60	-23.99	-71.67	2873.88	0.088000	69376.38	2215.24	0.19	12
4	94.60	-22.06	-68.89	2925.71	0.094000	74106.56	2366.27	0.19	12
5	94.60	-20.16	-66.24	2971.88	0.100000	78836.75	2517.31	0.19	12
6	94.60	-18.27	-63.58	3023.72	0.106000	83566.94	2668.35	0.19	12
7	94.60	-16.41	-60.99	3075.67	0.112000	88297.19	2819.39	0.19	11
8	94.60	-14.58	-58.51	3121.81	0.118000	93027.38	2970.43	0.19	11
9	94.60	-12.77	-55.93	3180.02	0.124000	97757.56	3121.47	0.20	11
10	94.60	-10.98	-53.55	3226.42	0.130000	102487.75	3272.50	0.20	11
11	94.60	-9.21	-51.06	3285.24	0.136000	107217.94	3423.54	0.20	11
12	94.60	-7.46	-48.63	3344.43	0.142000	111948.13	3574.58	0.20	11
13	94.60	-5.73	-46.37	3391.48	0.148000	116678.31	3725.62	0.20	11
14	94.60	-4.02	-44.02	3451.47	0.154000	121408.50	3876.66	0.21	11
15	94.60	-2.33	-41.71	3511.97	0.160000	126138.75	4027.70	0.21	11
16	94.60	-0.66	-39.44	3572.96	0.166000	130868.88	4178.73	0.21	11
17	94.60	1.00	-37.20	3634.53	0.172000	135599.06	4329.77	0.21	11
18	94.60	2.63	-35.14	3683.41	0.178000	140329.31	4480.81	0.21	11
19	94.60	4.25	-32.97	3746.04	0.184000	145059.56	4631.85	0.22	11
20	94.60	5.85	-30.84	3809.35	0.190000	149789.75	4782.89	0.22	11
21	94.60	7.44	-28.62	3886.94	0.196000	154519.88	4933.93	0.22	11
22	94.60	9.01	-26.55	3951.77	0.202000	159250.13	5084.97	0.22	11
23	94.60	10.57	-24.52	4017.30	0.208000	163980.31	5236.01	0.22	11
24	94.60	12.10	-22.51	4083.64	0.214000	168710.56	5387.04	0.22	11
25	94.60	13.63	-20.54	4150.80	0.220000	173440.69	5538.08	0.23	11
26	94.60	15.14	-18.47	4232.97	0.226000	178170.88	5689.12	0.23	11
27	94.60	16.63	-16.55	4302.00	0.232000	182901.13	5840.16	0.23	11
28	94.60	18.12	-14.55	4386.31	0.237999	187631.31	5991.20	0.23	11
29	94.60	19.58	-12.68	4457.34	0.243999	192361.44	6142.24	0.24	11
30	94.60	21.04	-10.73	4543.96	0.249999	197091.69	6293.28	0.24	11
31	94.60	22.48	-8.91	4617.26	0.255999	201821.88	6444.32	0.24	11
32	94.60	23.91	-7.01	4706.33	0.261999	206552.13	6595.36	0.24	11
33	94.60	25.32	-5.14	4796.81	0.267999	211282.38	6746.39	0.24	11
34	94.60	26.73	-3.29	4888.56	0.273999	216012.44	6897.43	0.25	11
35	94.60	28.12	-1.47	4981.93	0.279999	220742.69	7048.47	0.25	11
36	94.60	29.50	0.33	5076.71	0.285999	225472.94	7199.51	0.25	11
37	94.60	30.87	2.10	5173.17	0.291999	233203.00	7350.55	0.25	11

38	94.60	32.22	3.93	5286.38	0.297999	234933.25	7501.59	0.26	10
39	94.60	33.57	5.57	5370.94	0.303999	239663.50	7652.63	0.26	10
40	94.60	34.90	7.37	5488.06	0.309999	244393.69	7803.66	0.26	10
41	94.60	36.23	9.14	5606.97	0.315999	249123.94	7954.70	0.26	10
42	94.60	37.54	10.89	5728.20	0.321999	253854.06	8105.74	0.27	10
43	94.60	38.84	12.45	5820.20	0.327999	258584.25	8256.78	0.27	10
44	94.60	40.14	14.16	5945.77	0.333999	263314.50	8407.82	0.27	10
45	94.60	41.42	15.85	6073.71	0.339999	268044.69	8558.86	0.28	10
46	94.60	42.69	17.52	6204.29	0.345999	272774.81	8709.89	0.28	10
47	94.60	43.96	19.16	6337.33	0.351999	277505.06	8860.93	0.28	10
48	94.60	45.21	20.93	6505.93	0.357999	282235.25	9011.97	0.28	10
49	94.60	46.46	22.53	6645.01	0.363999	286965.50	9163.01	0.29	10
50	94.60	47.69	24.11	6787.21	0.369999	291695.75	9314.05	0.29	10
51	94.60	48.92	25.82	6965.93	0.375999	296425.88	9465.09	0.29	10
52	94.60	50.14	27.35	7114.86	0.381999	301156.06	9616.13	0.30	10
53	94.60	51.35	29.01	7301.43	0.387999	305886.31	9767.16	0.30	10
54	94.60	52.55	30.51	7458.05	0.393999	310616.50	9918.20	0.30	10
55	94.60	53.74	32.12	7653.21	0.399999	315346.63	10069.24	0.31	10
56	94.60	54.93	33.71	7853.20	0.405999	320076.88	10220.28	0.31	10
57	94.60	56.10	35.28	8058.42	0.411999	324807.06	10371.32	0.31	10
58	94.60	57.27	36.94	8304.76	0.417999	329537.31	10522.36	0.32	10
59	94.60	58.43	38.46	8521.51	0.423999	334267.56	10673.40	0.32	10
60	94.60	59.58	40.07	8781.23	0.429999	338997.63	10824.43	0.32	10

FLAT PLANE RADIATOR FOR CASE OF 119419.9 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 90.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

MAXIMUM SOLAR ABSORPTANCE VALUE OVER INTERVAL EXCEEDS 0.30598 WHICH IS UPPER LIMIT REQUIRING INFINITE RADIATOR AREA

CYLINDRICAL RADIATOR FOR CASE OF 119420.0 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 90.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 7183.5469

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7383

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 82030.938 SOLAR = 56647.188 ALBEDO = 0.002

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.48066

MAXIMUM ABSORPTANCE VALUE = 0.43000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00600 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-29.76	-80.04	2738.15	0.070000	56647.19	0.00	0.18	12
1	94.60	-27.76	-77.14	2785.00	0.076000	61502.64	0.00	0.18	12
2	94.60	-25.78	-74.31	2831.56	0.082000	66358.06	0.00	0.19	12
3	94.60	-23.82	-71.55	2877.97	0.088000	71213.50	0.00	0.19	12
4	94.60	-21.90	-68.85	2924.19	0.094000	76069.00	0.00	0.19	12
5	94.60	-19.99	-66.13	2975.96	0.100000	80924.44	0.00	0.19	12
6	94.60	-18.12	-63.55	3022.01	0.106000	85779.94	0.00	0.19	12
7	94.60	-16.26	-60.89	3079.73	0.112000	90635.38	0.00	0.19	11
8	94.60	-14.43	-58.41	3125.88	0.118000	95490.81	0.00	0.20	11
9	94.60	-12.62	-55.84	3184.02	0.124000	100346.31	0.00	0.20	11
10	94.60	-10.83	-53.46	3230.39	0.130000	105201.75	0.00	0.20	11
11	94.60	-9.07	-50.98	3289.15	0.136000	110057.19	0.00	0.20	11
12	94.60	-7.32	-48.69	3335.86	0.142000	114912.69	0.00	0.20	11
13	94.60	-5.59	-46.39	3395.31	0.148000	119768.13	0.00	0.20	11
14	94.60	-3.89	-43.95	3455.21	0.154000	124623.56	0.00	0.21	11
15	94.60	-2.20	-41.64	3515.61	0.160000	129479.00	0.00	0.21	11
16	94.60	-0.53	-39.50	3563.61	0.166000	134334.44	0.00	0.21	11
17	94.60	1.12	-37.27	3624.95	0.172000	139189.94	0.00	0.21	11
18	94.60	2.75	-35.07	3686.87	0.178000	144045.31	0.00	0.21	11
19	94.60	4.37	-32.91	3749.42	0.184000	148900.81	0.00	0.22	11
20	94.60	5.97	-30.78	3812.62	0.190000	153756.31	0.00	0.22	11
21	94.60	7.55	-28.69	3876.44	0.196000	158611.81	0.00	0.22	11
22	94.60	9.12	-26.50	3954.71	0.202000	163467.19	0.00	0.22	11
23	94.60	10.67	-24.47	4020.17	0.208000	168322.69	0.00	0.22	11
24	94.60	12.21	-22.47	4086.36	0.214000	173178.19	0.00	0.23	11
25	94.60	13.73	-20.50	4153.43	0.220000	178033.56	0.01	0.23	11
26	94.60	15.23	-18.44	4235.30	0.226000	182889.06	0.01	0.23	11
27	94.60	16.73	-16.52	4304.25	0.232000	187744.56	0.01	0.23	11
28	94.60	18.21	-14.52	4388.33	0.237999	192600.06	0.01	0.23	11
29	94.60	19.67	-12.65	4459.21	0.243999	197455.44	0.01	0.24	11
30	94.60	21.12	-10.71	4545.58	0.249999	202310.94	0.01	0.24	11
31	94.60	22.56	-8.89	4618.69	0.255999	207166.44	0.01	0.24	11
32	94.60	23.99	-6.99	4707.54	0.261999	212021.81	0.01	0.24	11
33	94.60	25.40	-5.12	4797.68	0.267999	216877.31	0.01	0.25	11
34	94.60	26.80	-3.28	4889.29	0.273999	221732.81	0.01	0.25	11
35	94.60	28.19	-1.46	4982.30	0.279999	226588.19	0.01	0.25	11
36	94.60	29.57	0.34	5076.86	0.285999	231443.69	0.01	0.25	11
37	94.60	30.94	2.11	5173.02	0.291999	236299.19	0.01	0.25	11

38	94.60	32.29	3.84	5270.82	0.297999	241154.63	0.01	0.26	10
39	94.60	33.64	5.66	5385.57	0.303999	246010.06	0.01	0.26	10
40	94.60	34.97	7.46	5502.28	0.309999	250865.50	0.01	0.26	10
41	94.60	36.29	9.05	5590.23	0.315999	255721.00	0.01	0.27	10
42	94.60	37.60	10.80	5710.87	0.321999	260576.38	0.01	0.27	10
43	94.60	38.90	12.53	5833.79	0.327999	265431.88	0.01	0.27	10
44	94.60	40.19	14.24	5959.01	0.333999	270287.38	0.01	0.27	10
45	94.60	41.48	15.92	6086.69	0.339999	275142.75	0.01	0.28	10
46	94.60	42.75	17.58	6217.02	0.345999	279998.25	0.01	0.28	10
47	94.60	44.01	19.22	6349.84	0.351999	284853.75	0.01	0.28	10
48	94.60	45.26	20.84	6485.53	0.357999	289709.25	0.01	0.28	10
49	94.60	46.51	22.44	6624.02	0.363999	294564.63	0.01	0.29	10
50	94.60	47.74	24.17	6798.55	0.369999	299420.13	0.01	0.29	10
51	94.60	48.97	25.72	6943.71	0.375999	304275.63	0.01	0.29	10
52	94.60	50.18	27.40	7125.49	0.381999	309131.13	0.01	0.30	10
53	94.60	51.39	28.92	7277.70	0.387999	313986.50	0.01	0.30	10
54	94.60	52.59	30.55	7467.77	0.393999	318842.00	0.01	0.30	10
55	94.60	53.78	32.16	7662.57	0.399999	323697.38	0.01	0.31	10
56	94.60	54.96	33.74	7862.09	0.405999	328552.88	0.01	0.31	10
57	94.60	56.14	35.31	8066.87	0.411999	333408.38	0.01	0.31	10
58	94.60	57.30	36.85	8276.82	0.417999	338263.88	0.01	0.32	10
59	94.60	58.46	38.49	8528.96	0.423999	343119.25	0.01	0.32	10
60	94.60	59.61	39.98	8751.07	0.429999	347974.75	0.01	0.32	10

S P A C E   S T A T I O N   R A D I A T O R   P R O G R A M

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ALTITUDE (N.MI.), LOWEST =   235  HIGHEST =   235  INCREMENT =     1

ORBIT INCLINATION (DEG.), LOWEST =     10  HIGHEST =     90  INCREMENT =     20

DISSIPATION (KW.), LOWEST =     35  HIGHEST =     70  INCREMENT =     35

BREAK POINT FROM PLATE TO CYLINDRICAL RADIATORS (KW.) =   35.00

MONTHS DEGRADATION FOR FLAT PLATE RADIATOR  =    60  INCREMENT =     1
MONTHS DEGRADATION FOR CYLINDRICAL RADIATOR =    60  INCREMENT =     1

SHADING COEFFICIENTS
PLATE, SOLAR = 0.89999998  EARTHSHINE = 0.89999998  ALBEDO = 0.89999998
CYL. , SOLAR = 0.79999995  EARTHSHINE = 0.79999995  ALBEDO = 0.79999995

PLATE, SHAPE FACTOR TO SPACE = 0.89999998  FLUID CP =     0.2500  BTU/LBM-R.
CYL. , SHAPE FACTOR TO SPACE = 0.79999995  FLUID CP =     0.2500  BTU/LBM-R.

RADIATOR MATERIAL PROPERTIES
PLATE, ABSORPTANCE =    0.07000  EMITTANCE =    0.76000  MONTHLY CHANGE IN ABSORPTANCE =   0.009000
CYL. , ABSORPTANCE =    0.07000  EMITTANCE =    0.76000  MONTHLY CHANGE IN ABSORPTANCE =   0.009000
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FLAT PLANE RADIATOR FOR CASE OF 119419.9 BTU/HR. DESSIPATION = 35.0 KW.

ORBIT INCLINATION = 10.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 1064.0527

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7344

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 27341.930 SOLAR = 3161.355 ALBEDO = 1894.532

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 1.00000

MAXIMUM ABSORPTANCE VALUE = 0.61000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00900 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	35.84	-9.84	4576.23	0.070000	3161.35	1894.53	0.36	12
1	94.60	36.37	-9.02	4611.43	0.079000	3567.81	2138.11	0.36	12
2	94.60	36.90	-8.10	4652.71	0.088000	3974.27	2381.69	0.36	12
3	94.60	37.43	-7.20	4694.00	0.097000	4380.73	2625.28	0.36	12
4	94.60	37.95	-6.31	4735.25	0.106000	4787.18	2868.86	0.37	12
5	94.60	38.48	-5.44	4776.50	0.115000	5193.64	3112.44	0.37	12
6	94.60	39.00	-4.48	4824.16	0.124000	5600.10	3356.02	0.37	12
7	94.60	39.52	-3.62	4865.44	0.133000	6006.55	3599.60	0.37	12
8	94.60	40.03	-2.78	4906.73	0.142000	6413.01	3843.18	0.37	12
9	94.60	40.55	-1.86	4954.63	0.150999	6819.47	4086.76	0.37	12
10	94.60	41.06	-1.04	4995.97	0.159999	7225.93	4330.34	0.37	12
11	94.60	41.58	-0.14	5044.11	0.168999	7632.39	4573.93	0.37	12
12	94.60	42.09	0.75	5092.39	0.177999	8038.84	4817.50	0.37	12
13	94.60	42.60	1.63	5140.80	0.186999	8445.30	5061.09	0.37	12
14	94.60	43.11	2.50	5189.37	0.195999	8851.76	5304.67	0.37	12
15	94.60	43.62	3.36	5238.13	0.204999	9258.21	5548.25	0.38	12
16	94.60	44.12	4.28	5294.13	0.213999	9664.68	5791.83	0.38	11
17	94.60	44.63	5.11	5343.27	0.222999	10071.13	6035.41	0.38	11
18	94.60	45.13	5.94	5392.63	0.231999	10477.59	6278.99	0.38	11
19	94.60	45.63	6.76	5442.12	0.240999	10884.05	6522.57	0.38	11
20	94.60	46.13	7.57	5491.84	0.249999	11290.50	6766.16	0.38	11
21	94.60	46.63	8.54	5556.65	0.258999	11696.96	7009.74	0.38	11
22	94.60	47.12	9.33	5606.91	0.267999	12103.42	7253.32	0.38	11
23	94.60	47.62	10.11	5657.42	0.276999	12509.88	7496.90	0.38	11
24	94.60	48.11	11.06	5723.47	0.285999	12916.34	7740.48	0.38	11
25	94.60	48.60	11.82	5774.49	0.294999	13322.79	7984.06	0.39	11
26	94.60	49.09	12.74	5841.51	0.303999	13729.25	8227.64	0.39	11
27	94.60	49.58	13.49	5893.17	0.312998	14135.71	8471.23	0.39	11
28	94.60	50.07	14.39	5961.14	0.321998	14542.16	8714.80	0.39	11
29	94.60	50.56	15.12	6013.43	0.330998	14948.62	8958.39	0.39	11
30	94.60	51.04	16.00	6082.46	0.339998	15355.08	9201.97	0.39	11
31	94.60	51.53	16.88	6152.08	0.348998	15761.54	9445.55	0.39	11
32	94.60	52.01	17.58	6205.47	0.357998	16168.00	9689.13	0.39	11
33	94.60	52.49	18.44	6276.17	0.366998	16574.45	9932.71	0.39	11
34	94.60	52.97	19.29	6347.55	0.375998	16980.91	10176.29	0.39	11
35	94.60	53.45	20.13	6419.55	0.384998	17387.36	10419.88	0.39	11
36	94.60	53.93	20.96	6492.31	0.393998	17793.82	10663.46	0.40	11
37	94.60	54.40	21.78	6565.74	0.402998	18200.27	10907.04	0.40	11

38	94.60	54.87	22.59	6639.86	0.411998	18606.73	11150.62	0.40	11
39	94.60	55.35	23.40	6714.71	0.420998	19013.19	11394.20	0.40	11
40	94.60	55.82	24.19	6790.35	0.429998	19419.64	11637.78	0.40	11
41	94.60	56.29	24.98	6866.66	0.438998	19826.10	11881.36	0.40	11
42	94.60	56.76	25.76	6943.78	0.447998	20232.57	12124.95	0.40	11
43	94.60	57.23	26.53	7021.66	0.456998	20639.03	12368.53	0.40	11
44	94.60	57.70	27.44	7120.21	0.465998	21045.48	12612.11	0.40	11
45	94.60	58.16	28.20	7199.98	0.474997	21451.94	12855.69	0.40	11
46	94.60	58.62	28.95	7280.55	0.483997	21858.39	13099.27	0.41	11
47	94.60	59.09	29.83	7382.84	0.492997	22264.85	13342.85	0.41	11
48	94.60	59.55	30.57	7465.36	0.501997	22671.30	13586.43	0.41	11
49	94.60	60.01	31.44	7570.29	0.510997	23077.76	13830.02	0.41	11
50	94.60	60.47	32.15	7654.91	0.519997	23484.22	14073.59	0.41	11
51	94.60	60.93	33.00	7762.68	0.528997	23890.69	14317.18	0.41	11
52	94.60	61.38	33.71	7849.43	0.537997	24297.14	14560.76	0.41	11
53	94.60	61.84	34.54	7960.04	0.546997	24703.60	14804.34	0.41	11
54	94.60	62.29	35.37	8072.42	0.555997	25110.06	15047.92	0.41	11
55	94.60	62.75	36.19	8186.56	0.564997	25516.52	15291.50	0.41	11
56	94.60	63.20	36.86	8278.13	0.573997	25922.97	15535.08	0.42	11
57	94.60	63.65	37.66	8395.47	0.582997	26329.41	15778.66	0.42	11
58	94.60	64.10	38.45	8514.63	0.591997	26735.87	16022.25	0.42	11
59	94.60	64.55	39.24	8635.74	0.600997	27142.34	16265.83	0.42	11
60	94.60	65.00	40.02	8758.78	0.609997	27548.79	16509.41	0.42	11

CYLINDRICAL RADIATOR FOR CASE OF 119420.0 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 10.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 3895.9941

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7383

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 44489.445 SOLAR = 13598.902 ALBEDO = 2740.180

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.90378

MAXIMUM ABSORPTANCE VALUE = 0.61000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00900 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-1.71	-60.20	3086.92	0.070000	13598.90	2740.18	0.27	12
1	94.60	-0.38	-58.09	3129.60	0.079000	15347.32	3092.49	0.27	12
2	94.60	0.93	-56.03	3171.90	0.088000	17095.75	3444.79	0.27	12
3	94.60	2.24	-53.93	3217.65	0.097000	18844.16	3797.10	0.27	12
4	94.60	3.53	-51.87	3263.16	0.106000	20592.58	4149.40	0.28	12
5	94.60	4.82	-49.86	3308.48	0.115000	22341.00	4501.71	0.28	12
6	94.60	6.09	-47.89	3353.61	0.124000	24089.42	4854.02	0.28	12
7	94.60	7.35	-45.88	3402.53	0.133000	25837.85	5206.32	0.28	12
8	94.60	8.61	-43.99	3447.43	0.142000	27586.26	5558.63	0.28	12
9	94.60	9.85	-42.06	3496.25	0.150999	29334.69	5910.94	0.28	12
10	94.60	11.08	-40.07	3549.15	0.159999	31083.11	6263.24	0.29	12
11	94.60	12.31	-38.24	3598.03	0.168999	32831.53	6615.55	0.29	11
12	94.60	13.52	-36.24	3655.29	0.177999	34579.95	6967.86	0.29	11
13	94.60	14.73	-34.45	3704.38	0.186999	36328.38	7320.16	0.29	11
14	94.60	15.92	-32.53	3762.06	0.195999	38076.79	7672.47	0.29	11
15	94.60	17.11	-30.81	3811.39	0.204999	39825.21	8024.78	0.29	11
16	94.60	18.29	-28.96	3869.58	0.213999	41573.63	8377.09	0.30	11
17	94.60	19.46	-27.14	3928.08	0.222999	43322.05	8729.39	0.30	11
18	94.60	20.62	-25.35	3986.93	0.231999	45070.47	9081.79	0.30	11
19	94.60	21.77	-23.59	4046.14	0.240999	46818.89	9434.01	0.30	11
20	94.60	22.92	-21.86	4105.69	0.249999	48567.32	9786.31	0.30	11
21	94.60	24.05	-20.15	4165.69	0.258999	50315.73	10138.62	0.31	11
22	94.60	25.18	-18.48	4226.05	0.267999	52064.16	10490.93	0.31	11
23	94.60	26.30	-16.69	4296.35	0.276999	53812.57	10843.23	0.31	11
24	94.60	27.41	-15.06	4357.72	0.285999	55560.99	11195.54	0.31	11
25	94.60	28.52	-13.33	4429.27	0.294999	57309.41	11547.85	0.31	11
26	94.60	29.62	-11.62	4501.56	0.303999	59057.83	11900.15	0.31	11
27	94.60	30.71	-9.94	4574.59	0.312998	60806.26	12252.46	0.32	11
28	94.60	31.79	-8.28	4648.38	0.321998	62554.67	12604.77	0.32	11
29	94.60	32.87	-6.65	4722.98	0.330998	64303.04	12957.07	0.32	11
30	94.60	33.94	-5.05	4798.39	0.339998	66051.44	13309.38	0.32	11
31	94.60	35.00	-3.47	4874.63	0.348998	67799.88	13661.69	0.32	11
32	94.60	36.05	-1.91	4951.72	0.357998	69548.31	14013.99	0.33	11
33	94.60	37.10	-0.25	5040.55	0.366998	71296.75	14366.30	0.33	11
34	94.60	38.14	1.39	5130.58	0.375998	73045.19	14718.61	0.33	11
35	94.60	39.18	2.87	5210.66	0.384998	74793.56	15070.91	0.33	11
36	94.60	40.21	4.46	5303.05	0.393998	76541.94	15423.22	0.33	11
37	94.60	41.23	6.02	5396.75	0.402998	78290.38	15775.53	0.34	11

38	94.60	42.25	7.57	5491.85	0.411998	80038.81	16177.83	0.34	11
39	94.60	43.26	9.08	5588.28	0.420998	81787.25	16480.14	0.34	11
40	94.60	44.26	10.69	5698.23	0.429998	83535.69	16832.45	0.34	11
41	94.60	45.26	12.16	5797.72	0.438998	85284.13	17184.75	0.34	11
42	94.60	46.25	13.72	5911.20	0.447998	87032.50	17537.06	0.35	11
43	94.60	47.24	15.26	6026.71	0.456998	88780.94	17889.37	0.35	11
44	94.60	48.22	16.66	6131.28	0.465998	90529.31	18241.68	0.35	11
45	94.60	49.20	18.26	6263.81	0.474997	92277.75	18593.98	0.35	11
46	94.60	50.17	19.73	6385.50	0.483997	94026.19	18946.29	0.35	11
47	94.60	51.13	21.17	6509.48	0.492997	95774.63	19298.60	0.36	11
48	94.60	52.09	22.70	6649.69	0.501997	97523.06	19650.90	0.36	11
49	94.60	53.04	24.10	6778.44	0.510997	99271.44	20003.21	0.36	11
50	94.60	53.99	25.58	6924.27	0.519997	101019.88	20355.50	0.36	11
51	94.60	54.94	27.11	7087.92	0.528997	102768.31	20707.82	0.37	10
52	94.60	55.87	28.63	7255.52	0.537997	104516.69	21060.10	0.37	10
53	94.60	56.81	29.95	7395.92	0.546997	106265.13	21412.41	0.37	10
54	94.60	57.73	31.43	7570.81	0.555997	108013.56	21764.72	0.37	10
55	94.60	58.66	32.88	7750.00	0.564997	109761.94	22117.03	0.37	10
56	94.60	59.57	34.31	7933.62	0.573997	111510.38	22469.34	0.38	10
57	94.60	60.49	35.72	8121.77	0.582997	113258.69	22821.65	0.38	10
58	94.60	61.40	37.28	8350.11	0.591997	115007.19	23173.94	0.38	10
59	94.60	62.30	38.64	8548.91	0.600997	116755.69	23526.25	0.38	10
60	94.60	63.20	39.98	8752.86	0.609997	118504.06	23878.56	0.39	10

FLAT PLANE RADIATOR FOR CASE OF 119419.9 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 30.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 1987.7583

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7344

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 51077.496 SOLAR = 17466.297 ALBEDO = 3112.301

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.82375

MAXIMUM ABSORPTANCE VALUE = 0.61000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00900 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-10.74	-69.72	2909.26	0.070000	17466.30	3112.30	0.25	12
1	94.60	-9.20	-67.34	2951.08	0.079000	19711.95	3512.45	0.25	12
2	94.60	-7.67	-64.94	2996.13	0.088000	21957.61	3912.60	0.25	12
3	94.60	-6.15	-62.59	3040.87	0.097000	24203.25	4312.75	0.25	12
4	94.60	-4.65	-60.30	3085.25	0.106000	26448.91	4712.90	0.25	12
5	94.60	-3.16	-57.97	3133.22	0.115000	28694.56	5113.05	0.25	12
6	94.60	-1.69	-55.79	3177.11	0.124000	30940.21	5513.20	0.26	12
7	94.60	-0.24	-53.56	3224.75	0.133000	33185.85	5913.35	0.26	12
8	94.60	1.21	-51.30	3276.26	0.142000	35431.51	6313.50	0.26	12
9	94.60	2.64	-49.17	3323.78	0.150999	37677.17	6713.65	0.26	12
10	94.60	4.05	-47.00	3375.30	0.159999	39922.80	7113.30	0.26	12
11	94.60	5.46	-44.89	3426.89	0.168999	42168.46	7513.96	0.27	11
12	94.60	6.85	-42.81	3478.59	0.177999	44414.13	7914.11	0.27	11
13	94.60	8.22	-40.76	3530.39	0.186999	46659.79	8314.25	0.27	11
14	94.60	9.59	-38.60	3590.87	0.195999	48905.45	8714.41	0.27	11
15	94.60	10.95	-36.63	3643.07	0.204999	51151.08	9114.55	0.27	11
16	94.60	12.29	-34.54	3704.19	0.213999	53396.74	9514.71	0.27	11
17	94.60	13.62	-32.64	3756.85	0.222999	55642.40	9914.86	0.28	11
18	94.60	14.94	-30.63	3818.67	0.231999	57988.06	10315.01	0.28	11
19	94.60	16.25	-28.65	3880.95	0.240999	60133.69	10715.16	0.28	11
20	94.60	17.55	-26.85	3934.58	0.249999	62379.35	11115.31	0.28	11
21	94.60	18.84	-24.93	3997.70	0.258999	64625.01	11515.46	0.28	11
22	94.60	20.12	-22.91	4070.70	0.267999	66870.63	11915.61	0.29	11
23	94.60	21.39	-21.06	4134.99	0.276999	69116.25	12315.76	0.29	11
24	94.60	22.64	-19.24	4199.81	0.285999	71361.94	12715.91	0.29	11
25	94.60	23.89	-17.45	4265.25	0.294999	73607.63	13116.06	0.29	11
26	94.60	25.13	-15.55	4341.09	0.303999	75853.25	13516.21	0.29	11
27	94.60	26.36	-13.82	4407.83	0.312998	78098.88	13916.36	0.30	11
28	94.60	27.58	-11.98	4485.28	0.321998	80344.56	14316.52	0.30	11
29	94.60	28.79	-10.17	4563.64	0.330998	82590.19	14716.66	0.30	11
30	94.60	29.99	-8.39	4642.98	0.339998	84835.88	15116.82	0.30	11
31	94.60	31.19	-6.64	4723.24	0.348998	87081.50	15516.96	0.30	11
32	94.60	32.37	-4.91	4804.54	0.357998	89327.19	15917.12	0.31	11
33	94.60	33.55	-3.21	4886.87	0.366998	91572.81	16317.27	0.31	11
34	94.60	34.71	-1.42	4981.11	0.375998	93818.50	16717.42	0.31	11
35	94.60	35.88	0.23	5065.76	0.384998	96064.13	17117.57	0.31	11
36	94.60	37.03	1.97	5162.68	0.393998	98309.75	17517.72	0.32	11
37	94.60	38.17	3.57	5249.74	0.402998	100555.44	17917.87	0.32	11

38	94.60	39.30	5.25	5349.49	0.411998	102801.13	18318.02	0.32	11
39	94.60	40.43	6.92	5450.83	0.420998	105046.75	18718.17	0.32	11
40	94.60	41.55	8.55	5553.74	0.429998	107292.38	19118.32	0.32	11
41	94.60	42.67	10.27	5670.37	0.438998	109538.06	19518.47	0.33	11
42	94.60	43.77	11.86	5776.87	0.447998	111783.69	19918.63	0.33	11
43	94.60	44.87	13.52	5897.46	0.456998	114029.31	20318.78	0.33	11
44	94.60	45.96	15.06	6007.70	0.465998	116275.00	20718.93	0.33	11
45	94.60	47.04	16.67	6132.63	0.474997	118520.69	21119.08	0.34	11
46	94.60	48.12	18.26	6259.89	0.483997	120766.31	21519.23	0.34	11
47	94.60	49.19	20.00	6416.22	0.492997	123012.00	21919.38	0.34	10
48	94.60	50.26	21.54	6548.98	0.501997	125257.63	22319.53	0.34	10
49	94.60	51.31	23.05	6684.21	0.510997	127503.25	22719.68	0.35	10
50	94.60	52.36	24.73	6850.44	0.519997	129748.94	23119.83	0.35	10
51	94.60	53.41	26.19	6991.63	0.528997	131994.63	23519.98	0.35	10
52	94.60	54.45	27.81	7165.11	0.537997	134240.25	23920.13	0.35	10
53	94.60	55.48	29.24	7312.82	0.546997	136485.88	24320.28	0.36	10
54	94.60	56.50	30.80	7494.20	0.555997	138731.56	24720.43	0.36	10
55	94.60	57.52	32.35	7680.02	0.564997	140977.19	25120.58	0.36	10
56	94.60	58.54	33.86	7870.57	0.573997	143222.81	25520.73	0.36	10
57	94.60	59.54	35.52	8098.82	0.582997	145468.38	25920.88	0.37	10
58	94.60	60.54	36.98	8300.08	0.591997	147714.13	26321.04	0.37	10
59	94.60	61.54	38.57	8541.27	0.600997	149959.81	26721.18	0.37	10
60	94.60	62.53	39.98	8754.14	0.609997	152205.38	27121.34	0.38	10

CYLINDRICAL RADIATOR FOR CASE OF 119420.0 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 30.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 4583.0586

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7383

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 52335.234 SOLAR = 18552.781 ALBEDO = 2834.615

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.81222

MAXIMUM ABSORPTANCE VALUE = 0.61000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00900 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-12.27	-71.27	2881.36	0.070000	18552.79	2834.61	0.24	12
1	94.60	-10.69	-68.83	2923.59	0.079000	20938.13	3199.06	0.24	12
2	94.60	-9.12	-66.37	2969.06	0.088000	23323.48	3563.51	0.25	12
3	94.60	-7.57	-63.97	3014.19	0.097000	25708.82	3927.96	0.25	12
4	94.60	-6.04	-61.62	3059.00	0.106000	28094.16	4292.41	0.25	12
5	94.60	-4.52	-59.24	3107.39	0.115000	30479.51	4656.86	0.25	12
6	94.60	-3.01	-57.01	3151.73	0.124000	32864.85	5021.30	0.25	12
7	94.60	-1.52	-54.73	3199.80	0.133000	35250.20	5385.75	0.25	12
8	94.60	-0.04	-52.51	3247.79	0.142000	37635.54	5750.20	0.26	12
9	94.60	1.42	-50.25	3299.74	0.150999	40020.89	6114.65	0.26	12
10	94.60	2.87	-48.12	3347.65	0.159999	42406.23	6479.09	0.26	12
11	94.60	4.30	-45.96	3399.70	0.168999	44791.58	6843.54	0.26	11
12	94.60	5.72	-43.84	3451.84	0.177999	47176.92	7208.00	0.26	11
13	94.60	7.13	-41.59	3512.58	0.186999	49562.27	7572.44	0.27	11
14	94.60	8.52	-39.54	3565.10	0.195999	51947.61	7936.89	0.27	11
15	94.60	9.91	-37.53	3617.78	0.204999	54332.95	8301.34	0.27	11
16	94.60	11.28	-35.41	3679.44	0.213999	56718.30	8665.79	0.27	11
17	94.60	12.64	-33.47	3732.63	0.222999	59103.64	9030.23	0.27	11
18	94.60	13.99	-31.42	3795.04	0.231999	61488.99	9394.68	0.27	11
19	94.60	15.32	-29.55	3848.84	0.240999	63874.33	9759.13	0.28	11
20	94.60	16.65	-27.57	3912.11	0.249999	66259.63	10123.58	0.28	11
21	94.60	17.96	-25.62	3975.83	0.258999	68645.00	10488.03	0.28	11
22	94.60	19.27	-23.70	4040.16	0.267999	71030.38	10852.48	0.28	11
23	94.60	20.56	-21.82	4104.98	0.276999	73415.63	11216.93	0.29	11
24	94.60	21.84	-19.83	4180.00	0.285999	75801.00	11581.37	0.29	11
25	94.60	23.11	-18.01	4246.15	0.294999	78186.31	11945.87	0.29	11
26	94.60	24.38	-16.21	4312.88	0.303999	80571.69	12310.27	0.29	11
27	94.60	25.63	-14.31	4390.25	0.312998	82957.06	12674.72	0.29	11
28	94.60	26.87	-12.57	4458.47	0.321998	85342.38	13039.17	0.30	11
29	94.60	28.10	-10.74	4537.52	0.330998	87727.75	13403.62	0.30	11
30	94.60	29.33	-8.93	4617.62	0.339998	90113.06	13768.07	0.30	11
31	94.60	30.54	-7.14	4698.66	0.348998	92498.44	14132.51	0.30	11
32	94.60	31.75	-5.39	4780.75	0.357998	94883.75	14496.96	0.30	11
33	94.60	32.95	-3.66	4863.91	0.366998	97269.13	14861.41	0.31	11
34	94.60	34.14	-1.84	4959.05	0.375998	99654.44	15225.86	0.31	11
35	94.60	35.32	-0.17	5044.59	0.384998	102039.81	15590.31	0.31	11
36	94.60	36.49	1.60	5142.45	0.393998	104425.13	15954.75	0.31	11
37	94.60	37.65	3.22	5230.47	0.402998	106810.50	16319.21	0.31	11

38	94.60	38.81	4.93	5331.21	0.411998	109195.81	16683.65	0.32	11
39	94.60	39.95	6.62	5433.61	0.420998	111581.19	17048.10	0.32	11
40	94.60	41.09	8.28	5537.61	0.429998	113966.50	17412.55	0.32	11
41	94.60	42.23	9.91	5643.30	0.438998	116351.88	17777.00	0.32	11
42	94.60	43.35	11.63	5762.99	0.447998	118737.19	18141.45	0.33	11
43	94.60	44.46	13.21	5872.40	0.456998	121122.56	18505.89	0.33	11
44	94.60	45.58	14.87	5996.37	0.465998	123507.88	18870.34	0.33	11
45	94.60	46.68	16.51	6122.59	0.474997	125893.25	19234.79	0.33	11
46	94.60	47.77	18.19	6264.24	0.483997	128278.56	19599.24	0.34	10
47	94.60	48.86	19.78	6395.66	0.492997	130663.94	19963.69	0.34	10
48	94.60	49.94	21.34	6529.55	0.501997	133049.31	20328.14	0.34	10
49	94.60	51.01	22.87	6666.07	0.510997	135434.63	20692.59	0.34	10
50	94.60	52.08	24.56	6833.47	0.519997	137820.00	21057.02	0.35	10
51	94.60	53.14	26.05	6976.13	0.528997	140205.31	21421.48	0.35	10
52	94.60	54.20	27.69	7150.93	0.537997	142590.69	21785.93	0.35	10
53	94.60	55.24	29.30	7330.06	0.546997	144976.00	22150.37	0.35	10
54	94.60	56.29	30.71	7482.97	0.555997	147361.38	22514.82	0.36	10
55	94.60	57.32	32.27	7670.22	0.564997	149746.69	22879.26	0.36	10
56	94.60	58.35	33.80	7862.39	0.573997	152132.06	23243.71	0.36	10
57	94.60	59.37	35.47	8092.18	0.582997	154517.19	23608.15	0.36	10
58	94.60	60.39	36.95	8295.00	0.591997	156902.69	23972.62	0.37	10
59	94.60	61.40	38.55	8537.77	0.600997	159288.06	24337.04	0.37	10
60	94.60	62.41	39.98	8752.53	0.609997	161673.38	24701.49	0.37	10

FLAT PLANE RADIATOR FOR CASE OF 119419.9 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 50.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

MAXIMUM SOLAR ABSORPTANCE VALUE OVER INTERVAL EXCEEDS 0.53938 WHICH IS UPPER LIMIT REQUIRING INFINITE RADIATOR AREA

CYLINDRICAL RADIATOR FOR CASE OF 119420.0 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 50.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

TEMPERATURES, INLET = 94.60 , MIX = 40.00

PLATFORM AREA IN FT2 = 6441.8164

COOLANT MASS FLOW RATE (LBM/HR.) = 8748.7383

INITIAL EXTERNAL HEAT INPUTS (BTU/HR.), EARTHSHINE = 73560.875 SOLAR = 31768.980 ALBEDO = 2957.209

SOLAR ABSORPTANCE VALUE FOR UPPER LIMIT OF EXTERNAL LOADS FOR SIZING RADIATOR AREA = 0.70311

MAXIMUM ABSORPTANCE VALUE = 0.61000 FOR A PERIOD OF 60 MONTHS AT A DEGRADATION RATE OF 0.00900 DELTA ABSORPTANCE PER MONTH

EFFECT OF DEGRADATION

MONTH	INLET (F)	RAD (F)	OUTLET (F)	MFR(LBM/HR)	ABSORPTANCE	SOL(BTU/HR)	AL(BTU/HR)	ADA	ITN
0	94.60	-31.51	-87.09	2631.83	0.070000	31768.98	2957.21	0.19	12
1	94.60	-29.43	-83.98	2677.97	0.079000	35853.54	3337.42	0.19	12
2	94.60	-27.38	-80.95	2723.54	0.088000	39938.11	3717.63	0.19	12
3	94.60	-25.35	-78.01	2768.57	0.097000	44022.66	4097.83	0.20	12
4	94.60	-23.35	-75.06	2817.85	0.106000	48107.21	4478.05	0.20	12
5	94.60	-21.38	-72.18	2866.85	0.115000	52191.78	4858.26	0.20	12
6	94.60	-19.44	-69.38	2915.64	0.124000	56276.33	5238.46	0.20	12
7	94.60	-17.52	-66.64	2964.24	0.133000	60360.91	5618.68	0.20	12
8	94.60	-15.63	-63.88	3017.67	0.142000	64445.46	5998.89	0.21	12
9	94.60	-13.76	-61.27	3066.10	0.150999	68530.00	6379.10	0.21	12
10	94.60	-11.91	-58.57	3124.72	0.159999	72614.56	6759.30	0.21	11
11	94.60	-10.09	-56.06	3173.20	0.168999	76699.13	7139.52	0.21	11
12	94.60	-8.29	-53.46	3232.18	0.177999	80783.69	7519.73	0.21	11
13	94.60	-6.50	-51.06	3280.86	0.186999	84868.25	7899.94	0.21	11
14	94.60	-4.74	-48.55	3340.41	0.195999	88952.81	8280.15	0.22	11
15	94.60	-3.01	-46.10	3400.31	0.204999	93037.31	8660.36	0.22	11
16	94.60	-1.29	-43.69	3460.65	0.213999	97121.94	9040.57	0.22	11
17	94.60	0.42	-41.32	3521.40	0.222999	101206.44	9420.78	0.22	11
18	94.60	2.10	-39.00	3582.63	0.231999	105291.00	9800.99	0.22	11
19	94.60	3.76	-36.72	3644.37	0.240999	109375.50	10181.20	0.23	11
20	94.60	5.41	-34.48	3706.68	0.249999	113460.13	10561.41	0.23	11
21	94.60	7.04	-32.28	3769.51	0.258999	117544.63	10941.62	0.23	11
22	94.60	8.65	-30.11	3832.97	0.267999	121629.25	11321.83	0.23	11
23	94.60	10.24	-27.85	3908.90	0.276999	125713.81	11702.04	0.23	11
24	94.60	11.82	-25.75	3973.79	0.285999	129798.31	12082.25	0.24	11
25	94.60	13.39	-23.69	4039.39	0.294999	133882.94	12462.46	0.24	11
26	94.60	14.94	-21.53	4117.88	0.303999	137967.44	12842.67	0.24	11
27	94.60	16.47	-19.41	4197.43	0.312998	142052.06	13222.88	0.24	11
28	94.60	17.99	-17.45	4265.60	0.321998	146136.56	13603.09	0.25	11
29	94.60	19.49	-15.39	4347.18	0.330998	150221.13	13983.30	0.25	11
30	94.60	20.98	-13.36	4429.85	0.339998	154305.75	14363.52	0.25	11
31	94.60	22.46	-11.37	4513.63	0.348998	158390.25	14743.72	0.25	11
32	94.60	23.92	-9.40	4598.68	0.357998	162474.75	15123.93	0.26	11
33	94.60	25.37	-7.47	4685.05	0.366998	166559.38	15504.14	0.26	11
34	94.60	26.81	-5.56	4772.73	0.375998	170643.94	15884.35	0.26	11
35	94.60	28.24	-3.57	4874.88	0.384998	174728.56	16264.57	0.26	11
36	94.60	29.65	-1.72	4965.38	0.393998	178813.06	16644.77	0.26	11
37	94.60	31.05	0.11	5057.45	0.402998	182897.56	17024.99	0.27	11

38	94.60	32.44	2.01	5164.48	0.411998	186982.19	17405.20	0.27	11
39	94.60	33.81	3.89	5273.39	0.420998	191066.75	17735.41	0.27	11
40	94.60	35.18	5.73	5384.20	0.429998	195151.38	18165.62	0.27	11
41	94.60	36.53	7.53	5497.01	0.438998	199235.88	18545.82	0.28	10
42	94.60	37.87	9.33	5611.95	0.447998	203320.38	18926.04	0.28	10
43	94.60	39.21	11.10	5728.97	0.456998	207405.00	19306.25	0.28	10
44	94.60	40.53	12.84	5848.27	0.465998	211489.56	19686.46	0.29	10
45	94.60	41.84	14.74	5998.72	0.474997	215574.06	20066.67	0.29	10
46	94.60	43.14	16.43	6123.13	0.483997	219658.69	20446.88	0.29	10
47	94.60	44.43	18.11	6250.03	0.492997	223743.19	20827.09	0.29	10
48	94.60	45.71	19.92	6409.41	0.501997	227827.81	21207.30	0.30	10
49	94.60	46.98	21.54	6542.06	0.510997	231912.31	21587.50	0.30	10
50	94.60	48.24	23.30	6708.24	0.519997	235996.98	21967.70	0.30	10
51	94.60	49.50	25.03	6878.05	0.528997	240081.50	22347.92	0.31	10
52	94.60	50.74	26.74	7051.85	0.537997	244166.00	22728.13	0.31	10
53	94.60	51.98	28.42	7229.86	0.546997	248250.50	23108.35	0.31	10
54	94.60	53.20	30.07	7412.06	0.555997	252335.13	23488.55	0.32	10
55	94.60	54.42	31.70	7598.94	0.564997	256419.69	23868.77	0.32	10
56	94.60	55.63	33.44	7823.65	0.573997	260504.31	24248.97	0.32	10
57	94.60	56.83	35.15	8054.61	0.582997	264588.63	24629.17	0.33	10
58	94.60	58.02	36.70	8257.61	0.591997	268673.25	25009.39	0.33	10
59	94.60	59.20	38.35	8501.04	0.600997	272757.94	25389.60	0.33	10
60	94.60	60.38	39.98	8751.76	0.609997	276842.38	25769.82	0.34	10

FLAT PLANE RADIATOR FOR CASE OF 115419.9 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 70.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

MAXIMUM SOLAR ABSORPTANCE VALUE OVER INTERVAL EXCEEDS 0.31813 WHICH IS UPPER LIMIT REQUIRING INFINITE RADIATOR AREA

CYLINDRICAL RADIATOR FOR CASE OF 119420.0 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 70.0 DEGREES, ALTITUDE = 235.1 NAUTICAL MILES.

MAXIMUM SOLAR ABSORPTANCE VALUE OVER INTERVAL EXCEEDS 0.48015 WHICH IS UPPER LIMIT REQUIRING INFINITE RADIATOR AREA

FLAT PLANE RADIATOR FOR CASE OF 115419.9 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 90.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

MAXIMUM SOLAR ABSORPTANCE VALUE OVER INTERVAL EXCEEDS 0.30598 WHICH IS UPPER LIMIT REQUIRING INFINITE RADIATOR AREA

CYLINDRICAL RADIATOR FOR CASE OF 119420.0 BTU/HR. DISSIPATION = 35.0 KW.

ORBIT INCLINATION = 90.0 DEGREES, ALTITUDE = 235.0 NAUTICAL MILES.

MAXIMUM SOLAR ABSORPTANCE VALUE OVER INTERVAL EXCEEDS 0.48066 WHICH IS UPPER LIMIT REQUIRING INFINITE RADIATOR AREA

APPENDIX D

Industry Search Results

NASA/GSFC*

Goddard Space Center has expressed an interest in the general area of thermal-control surfaces for large space structures. They feel studies should be initiated in the following areas:

- Reapplication of coatings in space (paints, polymers)
- Development of techniques to liquify helium in space
- Development of techniques to clean radiators in space
- Development of an 80°K-5 watt cryoradiator
- Development of electrostatic methods to attract contamination to noncritical surfaces
- Development of a 75 to 100°K mechanical cooler
- Ionization of waste disposal - collection somewhere else
- Development of space-stable conductive coatings for geosynchronous orbits
- Development of accelerated testing philosophy to predict 30-year lifetimes
- Development of techniques to coat large structures with thin films in orbit

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*Participating individuals and organization

- Mr. Jack Triolo - Thermal Design Branch
- Dr. Alan Sherman - Thermal Design Branch
- Mr. James Heaney - Optics Branch

NASA/JSC*

Johnson Space Center has an active interest in general areas of thermal-control surfaces for long-term missions. They have submitted a RTOP on the subject of repair and replacement of radiators in space. They are soliciting information from government agencies and industry on state-of-the-art synchronous altitude space simulation facilities. They feel studies should be initiated in the following areas:

- Develop techniques to coat structures with thin films in orbit; e.g., SPS
- Develop structural composites [(polymides, polyesters, graphite epoxies) (1-5 mil)] useful as thermal-control surfaces
- Develop techniques to monitor optical properties/mechanical properties
- Develop techniques to maintain pointing accuracy of reflectors as a function of changes in optical/radiative properties
- Develop accelerated testing philosophy to predict 30-year lifetime
- Develop ultra-low outgassing materials
- Develop docking techniques to prevent thruster plume impingement

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*Participating individuals and organization

- Mr. Stephen Jacobs - Materials Technology Branch
- Dr. Lubert Leger - Materials Technology Branch

NASA/LaRC*

Langley Research Center is extremely interested in this subject. They are deeply involved in the large-area space-structures program and feel studies should be performed in the following disciplines:

- Develop techniques to monitor the optical/mechanical properties of materials in space
- Develop testing philosophies to predict 30-year lifetimes on materials
- Develop low outgassing materials
- Develop techniques to repair or replace materials in space

*Participating individuals and organization

- Mr. Wayne Slemp - Materials Application Branch

NASA/LeRC*

Lewis Research Center offered the following suggestions:

- Develop techniques to monitor the optical/radiative/ mechanical properties of thermal surfaces in orbit
- Develop charge-control materials (e.g., thermal coatings, etc.)
- Develop an accelerated testing philosophy for predicting 30-year lifetimes
- Develop lightweight, high-temperature MLI
- Determine effects of ion engines on materials

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*Participating individuals and organization

- Mr. Frank Berkopec - Electrical Systems Branch
- Mr. George Smolak - Flight Project Branch

AFML/WPAFB*

The Air Force Materials Laboratory has initiated programs in the development of extended-life satellite materials. They are of the opinion that programs of this nature must be undertaken for long-term future missions to be successful.

- Develop low outgassing conductive adhesives
- Develop charge-control materials (i.e., thermal coatings, insulation, solar cell coverslides)
- Investigate mass transport properties and effects of contaminants

*Participating individuals and organizations

- Dr. William Lehn - Materials and Elastomers Branch

IIT Research Institute

IITRI feels NASA should initiate studies in the following areas:

- Develop techniques to clean radiators in space
- Develop methods to monitor optical properties and contamination on optical surfaces
- Develop techniques to refurbish surfaces in orbit
- Develop techniques to reapply coatings in space (paints, etc.)
- Develop new low outgassing conductive adhesives
- Develop new low outgassing materials

*Participating individuals and organizations

- Mr. Jack Gilligan - Polymer Chemistry Research
- Mr. Yoshiro Harada - Mechanics of Materials Division