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User's Manual for the NASA Lewis Ice Accretion/Heat Transfer Prediction Code with Electrothermal Deicer Input

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SUMMARY

A version of LEWICE has been developed that incorporates a recently developed electrothermal deicer code, developed at the University of Toledo by William B. Wright. This was accomplished, in essence, by replacing a subroutine in LEWICE, called EBAL, which balanced the energies at the ice surface, with a subroutine called UTICE. UTICE performs this same energy balance, as well as handles all the time-temperature transients below the ice surface, for all of the layers of a composite blade as well as the ice layer itself.

This new addition is set up in such a fashion that a user may specify any number of heaters, any heater chordwise length, and any heater gap desired. The heaters may be fired in unison, or they may be cycled with periods independent of each other. The heater intensity may also be varied. In addition, the user may specify any number of layers and thicknesses depthwise into the blade. Thus, the new addition has maximum flexibility in modeling virtually any electrothermal deicer installed into any airfoil.

It should be noted that the model simulates both shedding and runback. With the runback capability, it can simulate the anti-icing mode of heater performance, as well as detect icing downstream of the heaters due to runback in unprotected portions of the airfoil.

This version of LEWICE can be run in three modes. In mode 1, no conduction heat transfer is modeled (which would be equivalent to the original version of LEWICE). In mode 2, all heat transfer is considered to be caused by conduction, but no heaters are firing. In mode 3, conduction heat transfer where the heaters are engaged is modeled, with subsequent ice shedding.

When run in the first mode, there is virtually identical agreement with the original version of LEWICE in the prediction of accreted ice shapes. The code may be run in the second mode to determine the effects of conduction on the ice accretion process.

Work has been done in expanding the subroutines in LEWICE's PLOT3D routines to graph selected temperature distributions either depthwise at a specific chord location or chordwise at a specific depth. This would allow intermediate time-temperature results to be inspected at specific locations making use of existing capabilities and hardware with a minimum of new coding.

INTRODUCTION

The formation of ice on the exterior surfaces of aircraft can have a considerable effect on flight performance, as it increases drag and decreases lift. Thus, an aircraft must be designed with the equipment necessary for ice removal or prevention. Basically, aircraft ice protection systems can be classified as either anti-icing or de-icing.

The anti-icing principle involves the prevention of ice formation on the protected area at all times. Typical anti-icing methods make use of chemicals and/or the passage of hot bleed air through channels below the surface on which ice formation is to be prevented. In contrast, de-icing involves the periodic removal of accreted ice by mechanical or thermal means. For ice removal systems, attention must also be given to uniform removal of ice. Itagaki (reference 1) elaborates on the dangers of non-uniform shedding. Various de-icing methods have been investigated, including pneumatic boots, electro-expulsive, pneumatic impulse, and electrothermal, which are among the more common concepts.

The pneumatic boot is essentially an exterior "skin" which is laminated to the surface to be de-iced. The boot is a flexible, rubber-like material which, when inflated, breaks the ice off the surface. Boots are relatively simple and efficient, but require frequent maintenance to ensure reliability.

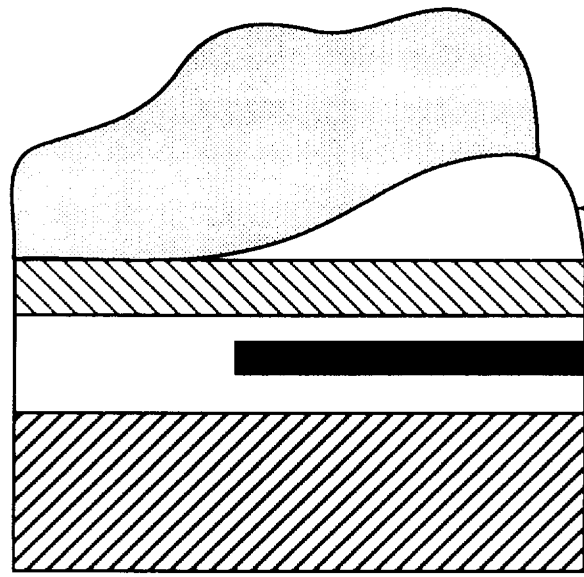
Electro-expulsive de-icers are a relatively new development that is beginning to find applications. In this system a series of electromagnets is pulsed in cycles, flexing a metal abrasion shield. The flexing of this shield cracks any surface ice, causing it to be easily shed by the aerodynamic forces acting on the surface.

Pneumatic impulse de-icers are also a relatively new development. The shedding mechanism here is the same as in the electro-expulsive system, except that the abrasion shield is flexed by a shock wave moving down a series of branching tubes, ultimately guiding the shock wave to the abrasion shield surface. The shock wave is generated by a pulse of high pressure air released by a quick action solenoid valve. This system should be finding applications in the near future.

Electrothermal de-icing consists of cyclic heating of discrete elements by electrothermal means. The energy requirements are significantly less for de-icing systems than they are for anti-icing systems. From experimental studies, Stallabrass (reference 2) concluded that the electrothermal method has the most advantages as a de-icing mechanism, although it does have some maintainability/reliability problems. Werner (reference 3) has also reported that the electrothermal de-icing technique is the most commonly used method, and that it has been applied to both fixed-wing and rotary-wing aircraft.

The objective of an electrothermal de-icing system is to raise the composite blade surface/ice interface temperature above the melting temperature of ice, resulting in a very thin interfacial layer of liquid which reduces the ice adhesion to the blade surface. Aerodynamic and/or centrifugal forces can then readily sweep the unmelted ice from the surface. A typical electrothermal de-icer pad is essentially a composite body consisting of (1) a metal substrate (the main structure of the aircraft blade), (2) an inner layer of insulation, (3) a heating element, (4) an outer layer of insulation, and (5) an abrasion shield. Depending upon the construction and application of a blade/ heater mat combination, there may be additional layers. In a thermal analysis of the composite construction any glue or adhesive bonding the layers together may itself be considered layer. Figure 1 depicts a two-dimensional cut-away view of the typical construction of an electrothermal de-icer pad, as well as a representative set of materials and thicknesses used for fabrication. The cross-section shown represents a view of the heater pad normal to the run of the heating elements.

The heating element usually employed in an electrothermal de-icer pad consists either of a woven mat of wires and glass fibers or of multiple strips of resistance ribbon. The gaps which exist between the individual rows of mats or ribbons can reduce the effectiveness of the heating pad's de-icing performance, causing nonuniform melting of the ice. The two insulation layers, which usually consist of a resin impregnated glass cloth, serve to provide electrical insulation for the



Layer	Material	Thickness Inches	Diffusivity ft^2/hr
Substrate	755-T6 Aluminum	0.087	1.65
Inner Insulation	Epoxy/Glass	0.050	0.0087
Heater	Nichrome	0.004	0.138
Outer Insulation	Epoxy/Glass	0.010	0.0087
Substrate	304 Stainless	0.012	0.15
Ice		0.250	0.0445

Figure 1 - Typical materials and construction of an electrothermal de-icer pad.

heating element. In order to direct more heat flow toward the ice layer, it is necessary to use a greater thickness for the inner insulation than for the outer insulation. The abrasion shield serves to protect the de-icer pad from rain erosion as well as dust/sand erosion, and to provide more uniform heating, thus minimizing cold spots above the heater gaps.

The ability to predict the performance of an electrothermal de-icer pad is essential to the design and subsequent fabrication of these units. To accomplish this, some method of determining the time-temperature history throughout the pad needs to be developed. Figure 2 provides a pictorial representation of an electrothermal heater section that is part of an airfoil, with some indication of the nature of the thermophysics involved. Clearly, the conduction of energy is three-dimensional, and occurs in a curved, composite body. The temperature plot to the right of the figure provides a qualitative representation of a typical temperature distribution. The temperature is highest at the heater center, drops rapidly under the heater (where the insulation is thickest) and less rapidly in the direction of the ice (where the insulation is the thinnest).

Development of an analytical model for such a problem is virtually impossible. A numerical model is more realizable, but even this is somewhat impractical, unless some simplifications are made to the geometry and the thermophysics. Figure 3 illustrates three alterations to the full de-icing problem, each having different degrees of problem simplification. The one dimensional model is the simplest. In this model, all layers are assumed to be planes infinite in extent. The temperature at a given location is assumed to be constant throughout the plane containing that point. It is generally assumed that the layers are in perfect thermal contact and that they have constant material properties. Stallabrass (reference 2) appears to have been the first to attempt a numerical solution of an electrothermal de-icing problem using a one-dimensional model. His numerical scheme used an explicit finite difference method. Results agreed well with approximate analytical solutions for relatively short real times into the problem. To account for the effect of the phase change on the temperature transients within the composite blade, the node at the ice-abrasion shield interface was held at the freezing temperature until the estimated heat flux into the control

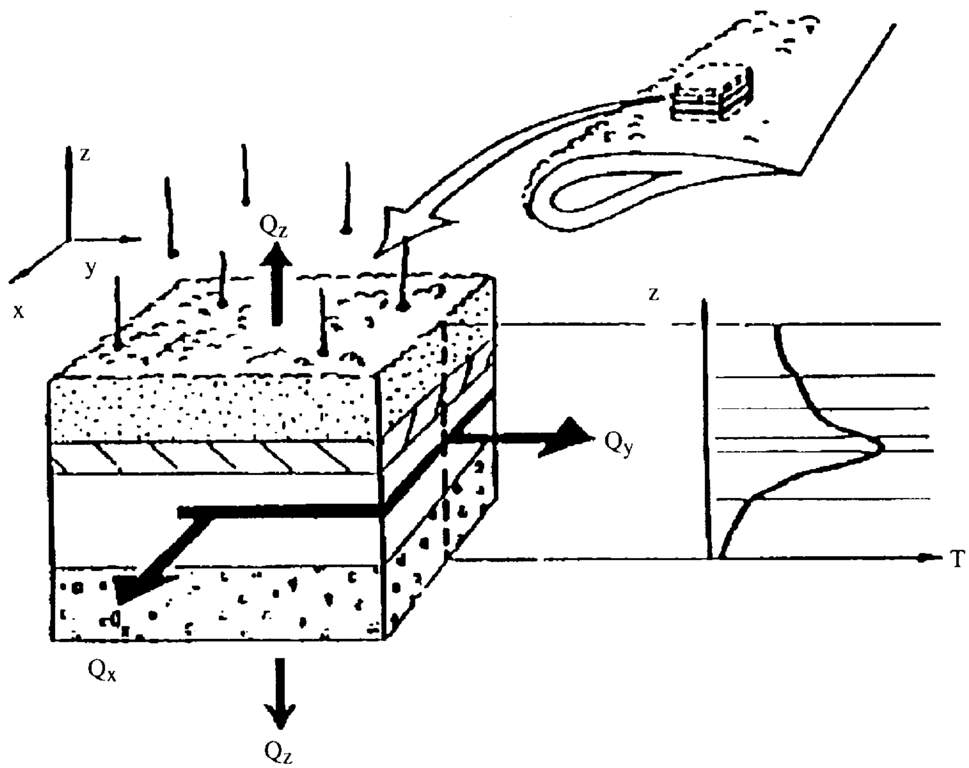


Figure 2.—Qualitative representation of the thermophysics involved in an electrothermal de-icer pad.

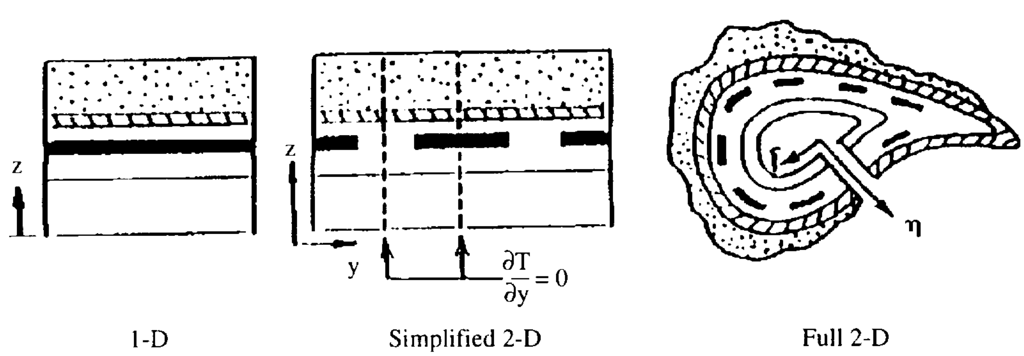


Figure 3.—Degrees of simplification to the true thermophysics of the de-icing problem.

volume containing the node was deemed sufficient to cause melting.

Baliga (reference 4) modelled the same problem by handling the phase change heat transfer using a high heat capacity formulation. Marano (reference 5) applied the so-called enthalpy method to model the phase change problem. Gent and Cansdale (reference 6) solved the same problem for conduction only (no phase change), and obtained nearly the same results as Marano for conduction only.

The two-dimensional problem, represented by the middle schematic in figure 3, was solved by Chao (reference 7) and DeWitt, et al. (reference 8). Chao's work was a direct extension of Marano's one-dimensional numerical formulation and procedures to two dimensions. Of fundamental importance, the effect of the heater gap width on deicing performance was studied numerically.

Leffel (reference 9) provided detailed experimental results of the thermal transients induced by an electrothermal de-icing unit on a UH1H helicopter rotor blade section. These experimental results were initially used to validate the codes developed by Chao and Marano. The experimental results revealed that when the layers of a blade are sufficiently thin, and the curvature sufficiently gradual, Marano's one-dimensional code yields excellent results over most of the blade. Furthermore, it was found that there are two regions of potentially substantial inaccuracies (depending on heater wattages, material properties, etc.). These are at the immediate edges of the heater banks, and in the region of large curvature at the leading edge of the blade that wraps around the nose block.

Masiulaniec (reference 10) and Huang (reference 11) have successfully modelled the full two-dimensional airfoil, reducing the possibilities of inaccuracies in the regions of high curvature. Masiulaniec used a body fitted coordinate transformation that mapped the airfoil into a series of connected, rectangular computational zones. A solution was obtained in this transformed domain, with the solution then being 'unmapped' into real coordinates. The computational times required for this procedure were prohibitive. Techniques to numerically accelerate the computations need to be applied before the code would be considered for use by the commercial sector. Huang has modeled the same problem but with a finite element approach to capture the curvilinear effects. This approach provides more reasonable computational times, although if a sufficient number of points are included to accurately simulate the heater gaps, this approach also becomes too slow for use in the commercial sector.

More recently, Wright (reference 12) has developed a model of the electrothermal deicer pad. Although his model is a rectangular one, which does not allow for the effect of a curvilinear geometry on the heat transfer, it is much more comprehensive than previous models in accounting for the physics affecting the transient temperature profiles. His algorithms numerically model the concurrent phenomena of two-dimensional transient heat transfer, ice accretion, and ice shedding which arise from the use of an electrothermal pad. An implicit alternating direction method was used to simultaneously solve the heat transfer and accretion equations occurring in a multilayered body covered with ice. In order to model the phase change between ice and water, the method of assumed states was used. This method assumes a state for each node and then calculates a solution based on those assumptions. If all these phase assumptions are correct, the solution is complete. If not, new assumptions are made as to the state of each control volume and the solution is recalculated. This is repeated until no more control volumes are changing phase. The use of this technique is first seen in the open literature in the work of Roelke (reference 13). This method allows the equations to be linearized such that a direct solution is possible. An iterative procedure is also required to find the correct phase at each node. It is Wright's model that forms the basis for the electrothermal heater upgrade to LEWICE, NASA Lewis's ice accretion code.

NOMENCLATURE

A	Area(ft)
C_D	Coefficient of drag (dimensionless)
C_e	Mass concentration of water in air at the edge of the boundary layer (lb/ft^3)
C_p	Heat capacity (BTU/lb°F)
C_s	Mass concentration of water in air at the surface (lb/ft^3)
D	Length of rotor arm (ft)
e	Evaporative pressure (psia)
F	Force per unit span (lbf/ft)
H	Enthalpy per unit volume (BTU/ft^3)
h	Heat transfer coefficient (BTU/ft^2-hr-°F)
h_m	Mass transfer coefficient (ft/hr)
k	Thermal conductivity (BTU/ft-hr-°F)
L	Lewis number (dimensionless)
L_f	Latent heat of fusion (BTU/lb)
L_v	Latent heat of vaporization (BTU/lb)
LWC	Liquid water content of air (lb/ft^3)
M	Mach number (dimensionless)

m	Mass (lb)
MW	Molecular weight (lb/mol)
N	Mass flux (lb/ft^2-hr)
N_f	Freezing fraction (dimensionless)
q"	Heat flux (BTU/ft2-hr)
q"'	Volumetric heat source (BTU/ft^3-hr)
R	Ideal gas constant (BTU/mol-°R)
R_{rb}	Mass flux of runback (lb/ft^2-hr)
R_w	Mass flux of impinging water (lb/ft^2-hr)
r	Recovery factor (dimensionless)
T	Temperature (°F)
t	Time (hr)
V	Velocity (ft/hr)
x	Parallel to the blade surface (ft)
y	Perpendicular to the blade surface (ft)

Greek Letters:

α	Thermal diffusivity (ft^2/hr)
β	Collection efficiency (dimensionless)

γ	Ratio of heat capacities Cp/Cv (dimensionless)
ρ	Density (lb/ft^3)
Ω	Rotor speed (rpm)

Subscripts

a	accretion
aero	aerodynamic
air	air
c	centrifugal
conv	convection
e	edge of boundary layer
evap	evaporation
fh	frictional heat
i	node number
ice	ice
in	amount going in
k	layer number
ke	kinetic energy
lat	latent heat

l	liquid phase
m	melt phase
nc	net amount of convection
new	new
o	total property
old	old
out	amount going out
r	melt range
rec	recovery property
s	surface
sol	solid phase
w	water
x	x-dependent
y	y-dependent
∞	free-stream property

FORMULATION AND DEVELOPMENT OF EQUATIONS

The previous electrothermal models that were discussed are accurate for the cases when de-icing occurs after the ice accretion process has occurred, with no further buildup of ice. They fail, however, to describe the phenomena of ice accretion during de-icing (or anti-icing), which represents the more realistic case that needs to be simulated. The discussion that follows explains how this additional physics is imbedded within the algorithms that numerically simulate the deicer.

Messinger (reference 14) appears to have been the first to develop a model for the prediction of ice accretion on airfoils. His model assumes steady-state, incompressible flow. Since then, Bragg (reference 15), Gent (reference 6) and Ruff and Berkowitz (reference 16) have updated this analysis to include two-dimensional, compressible flow. It is Ruff and Berkowitz's model that was contained within LEWICE prior to its upgrade with the electrothermal deicer. All of the above models consider the surface of the airfoil to be insulated. However, when an electrothermal device is activated during ice accretion, there is significant heat transfer throughout the blade and the ice. Clearly, there is a need to combine these two approaches such that the complete phenomena of icing can be modeled. The phenomena of ice accretion with heat sources would not be complete, however, without an analysis of how the ice is removed and an analysis of where it travels afterward. Again, much of the early work in ice adhesion was performed by Stallabrass (reference 2).

Recently, Scavuzzo (references 17 and 18) has developed a more advanced theoretical model for the prediction of ice shedding using a finite element analysis of the ice stresses. He also found expeimentally the relation of ice adhesion as a function of surface temperature. The method used in this work to predict shedding is based on Scavuzzo's experiments.

The solution method used in this study is an extension of the ADI method, which was shown by Wright (reference 19) to be the most efficient for the two-dimensional transient heat transfer in an electrothermal deicer pad. The ADI method is a direct solution method first developed by

Peaceman and Rachford (reference 20). However, a direct solution method requires a linear solution matrix.

There are two nonlinearities in the governing equations for this process. The first of these is the phase change of the water into ice. This nonlinearity occurs because during freezing (or melting), the enthalpy continues to change while the temperature remains constant. Since enthalpy is found in the governing equations for the ice, this non-linearity must be removed. This is performed by using the Method of Assumed States, developed by Schneider and Raw (reference 21).

Essentially, the Method of Assumed States eliminates the latent heat of the ice and replaces it with a very high heat capacity over a very small temperature range. Wright showed this temperature range to be, at most, 10^{-4} °F. By eliminating the latent heat, a linear relationship between enthalpy and temperature develops within each of the three phases: solid, liquid, and mush. A phase is assumed at each location and then the temperature profile is found. The phase of each control volume is then found and compared with the assumed phase. The second nonlinearity occurs at the ice accretion interface. There are two nonlinearities in the governing equation for this process. The first concerns the freezing fraction, which is the fraction of the impinging water which freezes. However, since the latent heat has already been replaced by a high heat capacity, the freezing fraction can be solved for in terms of the surface temperature.

The other nonlinearity in the ice accretion equation concerns the evaporation term. Within this term, there exists an evaporative pressure at the surface. The relationship between evaporative pressure and temperature is given by Antoine's equation, which is highly nonlinear. However, the magnitude of this heat loss term is small enough such that changes in the surface temperature at the accretion surface do not change the results drastically. Therefore, this term uses the temperature at the previous time step to determine the heat lost caused by evaporation.

In summary, the objective of this enhancement to LEWICE is to develop an efficient numerical model which combines all of the previous analysis in order to accurately predict ice accretion, ice shedding, and two-dimensional thermal transients in an electrothermal pad.

HEAT CONDUCTION AND PHASE CHANGE EQUATIONS

The following assumptions were made in the development of a mathematical model for heat conduction in a composite blade:

1. The thermal physical properties of the material composing each layer of the blade may be different, but do not depend on temperature.

2. Each layer is either isotropic or orthotropic, meaning that cross-derivative terms in the anisotropic heat equation are neglected, but that kx is not equal to ky.

3. There is perfect thermal contact between layers.

4. Curvature effects of the blade are not taken into account because the deicer thickness normal to the blade is thin compared to the effective blade thickness.

5. Thermal transients in the spanwise direction are ignored.

6. The ambient temperature and all heat transfer coefficients are constant with respect to time.

7. The density change due to melting is negligible, i.e., the effect of the volume contraction of the ice as it melts is neglected.

8. The phase change of the ice is assumed to occur over a small temperature interval near the true melting point rather than at the melting point itself.

With the above assumptions, the mathematical formulation for the problem of unsteady heat conduction in a chord-wise two-dimensional composite blade with electrothermal heating can be represented as:

$$(\rho C_p)_k \frac{\partial T}{\partial t} = k_{x,k} \frac{\partial^2 T}{\partial x^2} + k_{y,k} \frac{\partial^2 T}{\partial y^2} + q'''_k \qquad (1)$$

For the ice layer, the governing equation in terms of the enthalpy is given by

$$:\frac{\partial H}{\partial t} = k_{ice}\left(\frac{\partial^2 T}{\partial x^2}+\frac{\partial^2 T}{\partial y^2}\right) \tag{2}$$

In order to solve this problem, it is necessary to remove enthalpy from the governing equation above and replace it with temperature. The standard relationship between enthalpy and temperature is

$$H = \begin{bmatrix} (\rho C_p)_s T \\ (\rho C_p)_s T_{mp} < H < \rho_l C_{p_s} T_{mp} + \rho_l L_f \\ (\rho C_p)_s T_{mp} + \rho_l L_f + (\rho C_p)_l (T - T_{mp}) \end{bmatrix} \begin{bmatrix} T < T_{mp} \\ T_{mp} \\ T > T_{mp} \end{bmatrix} \tag{3}$$

However, this relationship is nonlinear, as there are multiple values for the enthalpy while the temperature remains at the melting temperature. The numerical method employed requires that a linear relationship exists, so that the coefficient matrix created can be easily inverted. To accomplish this, ice is assumed to melt over a very small temperature range near the melting temperature instead of at the melting temperature. The modified form of the enthalpy- temperature relationship is:

$$H = \begin{bmatrix} (\rho C_p)_s T \\ (\rho C_p)_s T_{mp} + \rho_l L_f \frac{(T - T_{mp})}{T_r} \\ (\rho C_p)_s T_{mp} + \rho_l L_f + (\rho C_p)_l (T - T_{mp} - T_r) \end{bmatrix} \begin{bmatrix} T < T_{mp} \\ T_{mp} < T < T_{mp} + T_r \\ T > T_{mp} + T_r \end{bmatrix} \tag{4}$$

It is convenient to define a specific heat capacity in this melt region, which is given by:

$$(C_p)_m = \frac{(\rho_l - \rho_s) C_{ps} T_{mp} + \rho_l L_f}{\rho_m T_r} \tag{5}$$

where ρ_m is the density of the region between solid and liquid, henceforth to be referred to as the ‘mush’ region. Therefore, the governing equation for the ice layer can be written as:

$$
\begin{bmatrix}
\frac{\partial}{\partial t}\rho C_{ps} T \\
\frac{\partial}{\partial t}\rho C_{Pm} T \\
\frac{\partial}{\partial t}\rho C_{Pl} T
\end{bmatrix}
= \frac{\partial}{\partial x} k_{ice} \frac{\partial T}{\partial x} + \frac{\partial}{\partial y} k_{ice} \frac{\partial T}{\partial y}
\begin{bmatrix}
0 \\
\left[(\rho C_p)_m - (\rho C_p)_s \right] T_{mp} \\
\left[(\rho C_p)_l - (\rho C_p)_s \right] T_{mp} + \left[(\rho C_p)_l - (\rho C_p)_m \right] T_r
\end{bmatrix}
\tag{6}
$$

where the top expression in each bracket is used for the solid phase, the middle expression is used for the mush phase, and the bottom expression is used for the liquid phase. As long as this range is small, the accuracy of the solution is not significantly altered. A melting range of 10^{-4} or smaller has proven to be necessary for this study. Since the temperature is not known prior to this calculation, the phase of the ice (solid, mush, or liquid) must first be assumed, the temperature calculated using the appropriate equation, and the phase checked at the end. This creates an iterative scheme to solve for the temperature within the composite body.

BOUNDARY CONDITIONS FOR THE COMPOSITE BODY

There are three types of boundary conditions used for the composite body. They are:

1. Interior interfaces between layers of the composite body.

2. Constant temperature outer boundary conditions.

3. Convection outer boundary conditions.

At interior interfaces, the temperatures and heat fluxes are continuous, i.e.:

$$T_{i,j})_{layer1} = T_{i,j})_{layer2} \tag{7}$$

$$-k_x \frac{\partial T}{\partial x})_{layer1} = -k_x \frac{\partial T}{\partial x})_{layer2} \tag{8}$$

$$-k_y \frac{\partial T}{\partial y})_{layer1} = -k_y \frac{\partial T}{\partial y})_{layer2} \tag{9}$$

where Equation (8) or Equation (9) is used depending upon whether the interface in question is in the x-direction or in the y-direction.

Constant temperature interfaces are given by:

$$T_{i,j})_{surface} = T_{\infty} \tag{10}$$

This type of boundary condition is rarely used for the simulation of a de-icer pad, but has been incorporated into the program which has been developed so that other heat transfer phenomena may be studied by the user.

Convection boundary conditions are given by:

$$-k_x \frac{\partial T}{\partial x})_{surface} = h(T_s - T_{\infty}) \tag{11}$$

$$-k_y \frac{\partial T}{\partial y})_{surface} = h(T_s - T_{\infty}) \tag{12}$$

Insulated boundary conditions are obtained by setting the heat transfer coefficient in the above equations to zero. There is another type of boundary condition used at the top surface of the ice, and it is derived in the next section.

ACCRETION BOUNDARY CONDITION

In a previous numerical model of a de-icer pad, Wright (reference 19), the outer boundary condition at the top surface of the ice was assumed to be given by Equation 12 of the previous section. However, this is not adequate when the actual physics of the flow at the exposed surface are considered. The new approach is a modified version of that used by Gent and Cansdale (reference 6). There are several assumptions which need to be made in the development of an improved icing boundary condition. These are listed below.

1. The terms in the energy equation which are considered important are:

   a. convection losses.

b. kinetic heating.

c. evaporative/sublimative cooling.

d. sensible heat gain/loss.

e. viscous losses.

f. latent heat gain.

All other terms are neglected.

2. Kinetic heating is adiabatic.

3. The Chilton-Colburn analogy is used to relate the mass loss caused by evaporation to a heat loss caused by evaporation.

4. Viscous dissipation is given by a 'recovery factor' as defined by Schlichting (reference 22).

5. Air is a perfect gas.

6. The Antoine equation is used to relate vapor pressure to static temperature. This implies that the molar volume of the liquid is negligible compared to that of the gas and that the heat of evaporation is independent of temperature.

7. Physical properties of air and water, except for air density, are independent of temperature.

8. Mass transfer is proportional to the concentration difference accross the boundary layer.

9. The ambient conditions of velocity and mass density are constants.

If dry air flows over the airfoil, the surface temperature would be increased beyond that of the ambient because of the compressible flow of air which strikes the surface of the blade, thereby imparting the kinetic energy of the air to the blade. Since this is presumed to be an adiabatic process, the local static temperature at the edge of the boundary layer would be given by:

$$T_e = \frac{T_o}{(1 + \frac{\gamma - 1}{2} M_e^2)} \tag{13}$$

Schlichting relates this temperature to the surface temperature through the 'recovery factor' r which is equal to $Pr^{1/3}$ for a turbulent boundary layer and $Pr^{1/2}$ for a laminar boundary layer. This is presumed to account for the viscous dissipation in the boundary layer. The final result is called the recovery temperature and is given by:

$$T_{rec} = \frac{T_o (1 + r\frac{\gamma - 1}{2} M_e^2)}{(1 + \frac{\gamma - 1}{2} M_e^2)} \tag{14}$$

where T_{rec} is the recovery temperature. The amount of energy increase owing to the combined effects of the frictional heating by air and the viscous dissipation of the boundary layer is normally placed in terms of a convective flux:

$$q''_{fh} = h (T_{rec} - T_\infty) \tag{15}$$

The convective flux is described by Newton's Law of Cooling:

$$q''_{conv} = h (T_s - T_\infty) \tag{16}$$

When convection is combined with frictional heating, Eqs. 15 and 16 may be united into a net convective flux which is given by:

$$q''_{nc} = h (T_s - T_{rec}) \tag{17}$$

An additional kinetic heating term is also present owing to the impact of the water droplets on the surface. This is given by:

$$q''_{ke} = \frac{R_w V_\infty^2}{2} \tag{18}$$

The heat loss caused by evaporation is determined by finding the mass transfer rate of water vapor leaving the surface of the blade and multiplying it by the heat of vaporization. Sublimation is handled in the same manner, but using the heat of sublimation. Since the latent heats of vaporization and sublimation are large, it takes only a small amount of mass to be removed by either process before a significant drop in surface temperature is realized. The driving force for this process is the concentration difference across the boundary layer, Cs-Ce, where the mass density, C, is given by:

$$C = \frac{e(MW)_w}{RT} \tag{19}$$

The evaporative mass flux of water vapor through the boundary layer can be described by:

$$N = h_m(C_s - C_e) \tag{20}$$

The heat loss is given by:

$$q''_{evap} = L_v N \tag{21}$$

Combining Eqs. 19 through 21, the evaporative heat loss can be written as:

$$q''_{evap} = \frac{L_v h_m (MW)_w}{R}\left(\frac{e_s}{T_s} - \frac{e_e}{T_e}\right) \tag{22}$$

The mass transfer coefficient can be replaced with the heat transfer coefficient via the Chilton-Colburn analogy between heat and mass transfer:

$$h_m = \frac{h}{(\rho C_p)_{air} L^{2/3}} \tag{23}$$

Replacing the density of air via the ideal gas law gives the net heat lost by evaporation as:

$$q''_{evap} = \frac{L_v h (MW)_w}{[P(MW)C_p]_{air} L^{2/3}}\left(e_s \frac{T_e}{T_s} - e_e\right) \tag{24}$$

The evaporative pressure at any location can be evaluated solely in terms of the local static temperature using Antoine's equation:

$$\log e_s = A - \frac{B}{T_s + C} \tag{25}$$

where A, B, and C are empirical constants. Since the temperature at the edge of the boundary layer is given by equation 13 and the evaporative pressure is given by equation 25, the only unknown in equation 24 is the surface temperature.

The sensible heat transfer and the latent heat transfer are determined by tracing the thermodynamic path the incoming liquid takes to get to the surface temperature. The exact form of these equations depends upon how much heat is available after the other heat losses/gains have been considered. If the surface temperature is below the freezing point, the sensible and latent heat terms needed are the heating of the supercooled liquid up to freezing, the freezing of the water into ice (latent heat), and the subsequent cooling to the surface temperature. These three terms can be expressed in equation form as:

$$q''_{sens1} = -R_w C_{pl} (T_m - T_\infty) \tag{26}$$

$$q''_{lat} = R_w L_f \tag{27}$$

$$q''_{sens2} = -R_w C_{ps} (T_s - T_m) \tag{28}$$

If the surface is at the freezing point and hence only part of the ice freezes, the terms are the heating of the supercooled liquid up to freezing and the partial freezing of the water into ice (latent heat). These terms can be described by:

$$q''_{sens3} = -R_w C_{pl} (T_m - T_\infty) \tag{29}$$

$$q''_{lat} = N_f R_w L_f \tag{30}$$

Since the assumption has been made that ice melts over a small temperature range, the freezing fraction can be written in terms of the surface temperature:

$$N_f = \frac{T_m + T_r - T_s}{T_r} \tag{31}$$

Hence, the latent heat term for this case can be written as:

$$q''_{lat} = \frac{(T_m + T_r - T_s) R_w L_f}{T_r} \tag{32}$$

If the surface temperature is above freezing, the sensible heat is given by:

$$q''_{sensl} = -R_w C_{pl} (T_s - T_\infty) \tag{33}$$

Additionally, there is a sensible heat transfer between the runback water and the region into which the water flows. This heat exchange is caused by the temperature distribution along the airfoil. These terms cannot be discounted, as they are quite significant for cases involving a considerable amount of runback. The form of the equations describing this sensible heat transfer is the same as those for the sensible heat terms above, but replacing R_w with the mass flux of runback water, R_{rb}, and the ambient temperature, T_∞, with the temperature of the runback water, T_{rb}.

The accretion boundary condition can be found by setting the heat flux at the outer surface equal to the sum of the heat fluxes described above. This can be written as:

$$-\left(k_y \frac{\partial T}{\partial s}\right)_s = q''_{nc} + q''_{evap} - q''_{ke} - q''_{lat} \pm q''_{sens} \tag{34}$$

Note that the heat flux is directed outward, such that a term which results in a heat gain at the surface has a negative sign and a term which results in a heat loss has a positive sign. Replacing the heat fluxes in the equation above with the expressions described earlier gives:

$$\left(-\left(k_y \frac{\partial T}{\partial s}\right)_s = h(T_s - T_{rec}) + \frac{L_v h (MW)_w}{[P (MW) C_p]_{air} L^{2/3}} \left(e_s \frac{T_e}{T_s} - e_e\right) - \frac{R_w V_\infty^2}{2}\right)$$
$$\begin{bmatrix} R_w C_{pl} (T_{mp} - T_\infty) + R_{rb} C_{pl} (T_{mp} - T_{rb}) - (R_w + R_{rb}) \left((L_f + C_{ps}) (T_m - T_s) \right) \\ R_w C_{pl} (T_{mp} - T_\infty) + R_{rb} C_{pl} (T_{mp} - T_{rb}) - (R_w + R_{rb}) \\ R_w C_{pl} (T_s - T_\infty) + R_{rb} C_{pl} (T_s - T_{rb}) - (R_w + R_{rb}) \end{bmatrix} \tag{35}$$

where the top expression in the brackets is used for the solid (ice) phase, the middle expression is used for the mush phase, and the bottom expression is used for the liquid (water) phase. As with the governing equations for conduction within the de-icer, the surface temperature is not known prior to this calculation, so that the Method of Assumed States must be used here as well.

ACCRETION MASS BALANCE

In the previous section, conservation of energy was applied at the top surface of the ice. This resulted in the derivation of an appropriate boundary condition for the heat conduction equation. In this section, conservation of mass will be applied to the same surface to determine the amount of ice which forms on the blade. The additional assumptions which have been made in this derivation are:

1. All of the incoming water which does not freeze will flow into the next control volume as runback water, hence the flow of surface water is not shear driven.

2. Runback water flows in the direction opposed to the aerodynamic stagnation point. Because of this, no runback water can flow into the control volume which contains the stagnation point .

3. Any runback water which the stagnation point control volume generates is equally divided into the two control volumes on each side of this point.

Because of the above assumptions, the mass balance must be applied to the stagnation point control volume first, as the amount of runback water present elsewhere is dependent upon the amount generated at the stagnation point. The general form of the mass balance in terms of the mass fluxes is:

$$R_w + R_{rb,\,in} = R_e + R_a + R_{rb,\,out} \qquad (36)$$

The mass flux of impinging water is given by:

$$R_w = \beta (LWC) V_\infty \qquad (37)$$

The collection efficiency given above is simply the fraction of water droplets in a volume of water which impinges upon the surface, meaning that the droplet strikes the surface and remains there and does not splatter. The collection efficiency can be obtained by correlations with the ambient conditions, or by a separate computer program which calculates the trajectory of the droplets in the air and determines if they will strike the surface and if so, if they will splatter or remain upon the surface.

The mass flux of evaporation is given by:

$$R_e = \frac{q''_{evap}}{L_e} \tag{38}$$

One of the purposes of equations in the previous section was to obtain the freezing fraction, N_f. This is the fraction of impinging water which freezes. Hence, the amount of runback water leaving the control volume is obtained by multiplying the total amount of incoming water by the fraction which does not freeze. Hence:

$$R_{rb,\,out} = (R_w - R_{rb,\,in})\,(1 - N_f) \tag{39}$$

The mass flux of runback water coming in, $R_{rb,in}$, is zero at the stagnation point and is calculated from the previous volume's mass balance elsewhere. This is why it is necessary to start the calculations at the stagnation point. The mass flux of ice accretion is obtained by solving equation 36 for R_a and substituting the above expressions to obtain:

$$R_a = (R_w - R_{rb,\,in})\,N_f - \frac{q''_{evap}}{L_e} \tag{40}$$

ICE SHEDDING

The assumptions made in the development of an ice shedding model are:

1. The flow is two-dimensional, that is, the aerodynamic force has x and y-components only.

2. The forces holding the ice to the surface are determined from the bonding strength of the ice.

3. The bonding strength is dependant only upon the temperature at the ice/blade interface.

4. The ice sheds as a whole and not in sections.

5. Each spanwise section acts independently of the other sections.

6. The ice will shed when the net average external forces exceed the net average force holding the ice to the surface.

The aerodynamic force is computed by the formula:

$$F_{aero} = \frac{\rho_{\infty} V_{\infty}^2 A}{2} \tag{41}$$

The equations relating bonding strength of the ice versus temperature were obtained by curve-fitting experimental data provided by J. R. Stallabrass. The computational domain takes the x-direction to be along the surface of the airfoil in the chordwise direction. The y-direction is normal to the airfoil, and the z-direction is along the surface of the airfoil in the spanwise direction.

ICE SHAPE TRANSFORMATION

This section describes how the ice shape is generated around the airfoil. The thickness of ice in the computational domain at each chordwise location is found by taking the mass flux of ice accretion, multiplying by the time step, and dividing by the ice density. The mass flux of ice accretion is found from equation (40): $R_a = (R_w - R_{rb,in}) N_f - \frac{q''_{evap}}{L_e}$

The thickness of ice normal to the surface is then:

$$y_{ice} = \left[(R_w + R_{rb,in}) N_f - \frac{q''_{evap}}{L_v} \right] \frac{\Delta t}{\rho_{ice}} \tag{42}$$

If, at every point in the domain, the normal to the surface of the blade is determined and the rectangular height of the ice is added to this, a good approximation of the ice shape on the blade is obtained. However, this process creates a larger mass of ice than was calculated in the rectangular coordinates, as shown in figures 4 through 6.

The dashed line represents the ice shape after transformation, and the shaded regions represent

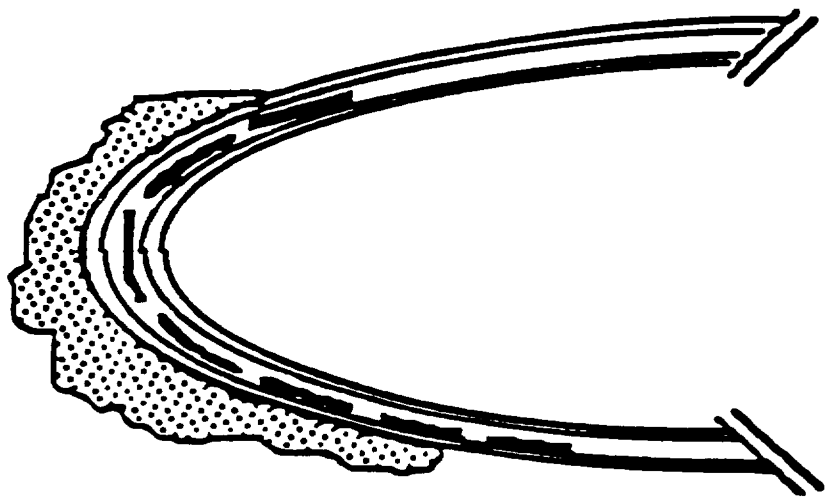


Figure 4 - Iced Airfoil equipped with electrothermal pads.

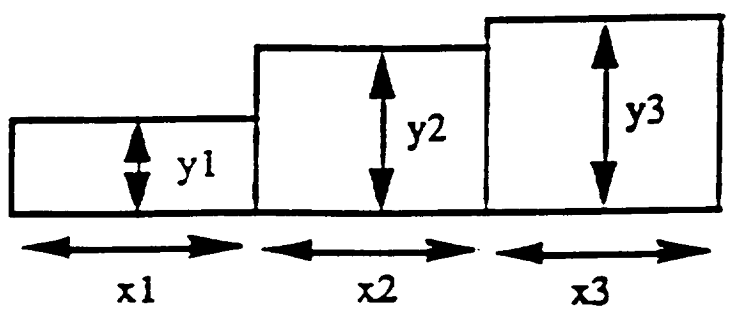


Figure 5 - Ice shape in rectangular coordinates.

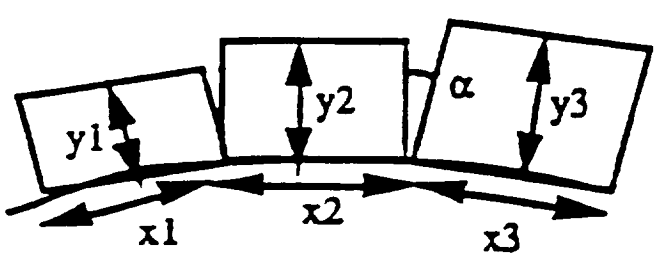


Figure 6 - Representation of ice shape on airfoil.

the extra area (and hence the extra mass) added by this method of forming the ice shape. This extra area can be represented by a triangle. The heights of the transformed rectangles are diminished such that the total area remains the same between the rectangular plane and the transformed plane. This is done mathematically by first computing the angle "α" between the rectangles. This is simply the difference between the angles formed by the sides of the adjacent rectangles and the horizontal. Then, the adjusted ice height, which is the one to be plotted normal to the blade surface, is given by

$$y_{i,new} = \frac{y_{i,old}(X_{i+1} - X_{i-1})}{(X_{i+1} - X_{i-1}) + y_{i-1}\sin\alpha} \tag{43}$$

Thus, the first nonzero block of ice will remain the same height, which is reasonable since this will be small, and the rest will be adjusted accordingly.

COMPARISON WITH PREVIOUS ACCRETION MODELS

In the previous section, a model was developed to simulate the phenomena occurring around an electrothermal deicer during icing conditions. Each of these phenomena must be verified using other numerical codes or, if possible, by the use of experimental data. The validity of the heat transfer model used has been previously established by Wright (reference 19). Therefore, this section will deal with validating the accretion and shedding routines.

The accretion results of this program were compared to two other numerical models. The first model was developed by the Royal Air Establishment (RAE) under Gent and Cansdale (reference 6). The other code, LEWICE, was developed by NASA Lewis Research Center. Results of this second model can be found in the LEWICE users manual.

The case selected for comparison with the RAE model was used because heat transfer data and collection efficiency data were available for this run. In their report, Gent and Cansdale provide sample curves of heat transfer coefficient, collection efficiency, and the ratio of static pressure over total pressure. These values were read off from the plots as input into the program.

These curves were valid for a NACA 0012 airfoil with a .415 m chord at these conditions: α=8°, M=0.4, and MVD=20 μm. There are nine runs in their paper under these conditions: for T_∞ = -15 °C, -10 °C, and -5 °C; and for LWC = 0.1, 0.3, and 0.5 g/m^3. The comparison plot for LWC = 0.5 g/m^3 and T_∞ = -10 °C is provided in figures 7 and 8. Other values produced similar results. As can be seen from these figures, the two programs produce very similar ice shapes. The minor differences which do exist are due to the inaccurate method in which the input data was provided. This theory is supported by the virtually identical agreement with the LEWICE code, for which more accurate input data was available.

For the comparison above, the current program was modified to use RAE's evaporation term. In the development of the governing equations, an alternative form of the heat lost due to evapo-

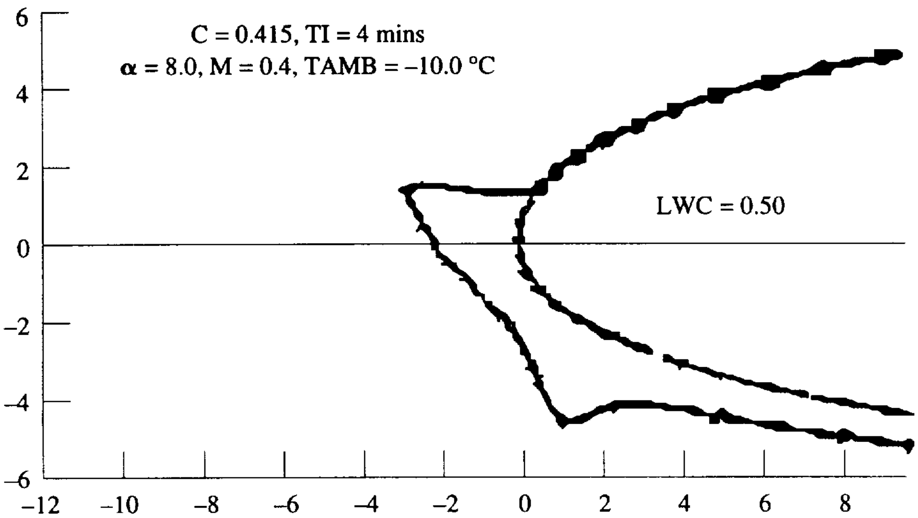


Figure 7.—RAE ice accretion prediction.

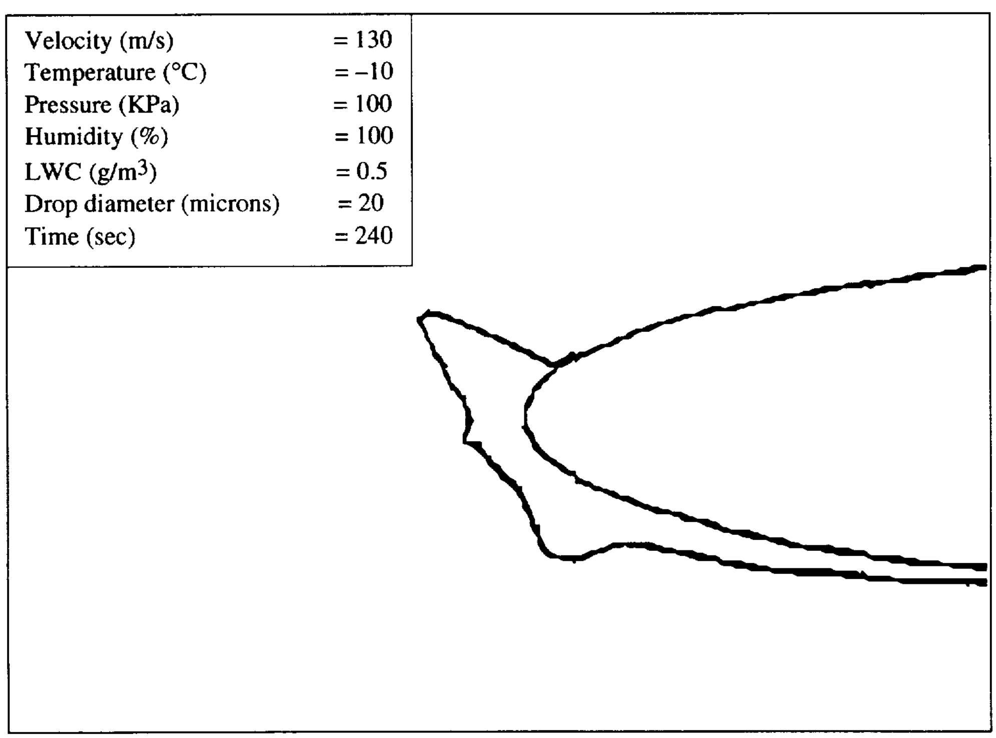


Figure 8.—Numerical ice accretion comparison on RAE case.

ration was produced. The RAE form was used in the previous comparison in order to show the equivalence of the accretion equations. Additionally, no conduction into the blade was allowed, nor was shedding allowed to occur. Again, this was done to show the prediction of the accretion model alone. Additional runs were produced to show the effects of the additional features within this program.

The same case as above was run using the new evaporation term and allowing conduction within the ice and airfoil. The airfoil properties are provided in Table I. As can be seen in figure 9, a much different ice shape is formed. As heat is lost into the airfoil, less of the impinging water runs back and the runback water which is produced travels a smaller distance before freezing. This results in the front horn appearing closer to the stagnation point.

The temperature and heat flux ($-k\partial T/\partial y$) within layer 3 at the stagnation point were plotted versus time for this case to show the effect of the ice accretion process on the blade. These plots are shown in figures 10 and 11. As can be seen from these plots, after an initial transient, the values are relatively constant. This effect can be seen in experimental data of ice accretion.

The current program was then compared to the original LEWICE code. The case used for comparison was example case 2 in the LEWICE users manual. This case was selected because it was a glaze ice accretion and was asymmetric. As can be seen from figures 12 and 13, excellent agreement is obtained between these two codes. This is due to the fact that the exact same heat transfer coefficients, static pressures, and collection efficiencies could be used for this comparison because, in both cases, these results were obtained from LEWICE's flow and trajectory modules. The experimental ice shape for these conditions is provided in figure 14 for comparison. Additionally, no conduction into the blade was allowed, nor was shedding allowed to occur. Again, this was done to show the prediction of the accretion model alone.

The same case was then repeated for the first minute of accretion with the addition of conductive effects. As can be seen in figure 15, this ice shape is not much different from the previous

Table I - THERMAL PROPERTIES OF AIRFOIL

Layer	Thickness inches	Thermal Conductivity BTU/hr-ft^2-°F	Thermal Diffusivity ft^2/hr
Aluminum D-spar	0.087	102.	2.83
Epoxy/glass insulation	0.050	0.22	0.0087
Heater element	0.004	7.60	0.138
Epoxy/glass insulation	0.010	0.22	0.0087
Stainless steel abrasion shield	0.012	8.70	0.15

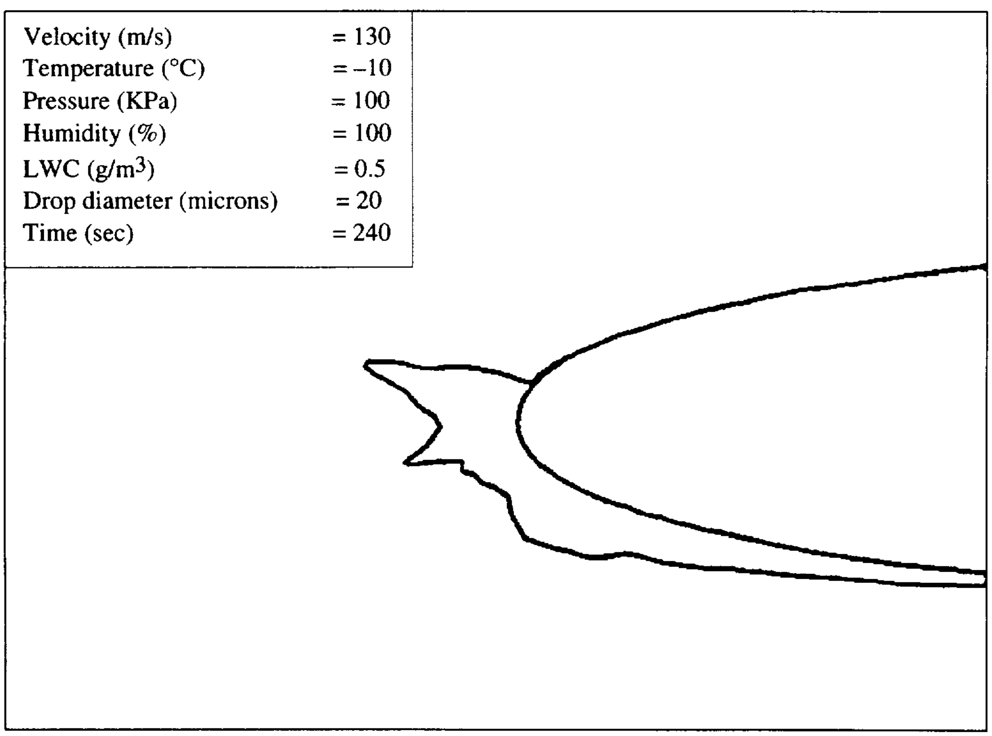


Figure 9.—Effects of conduction on RAE example case.

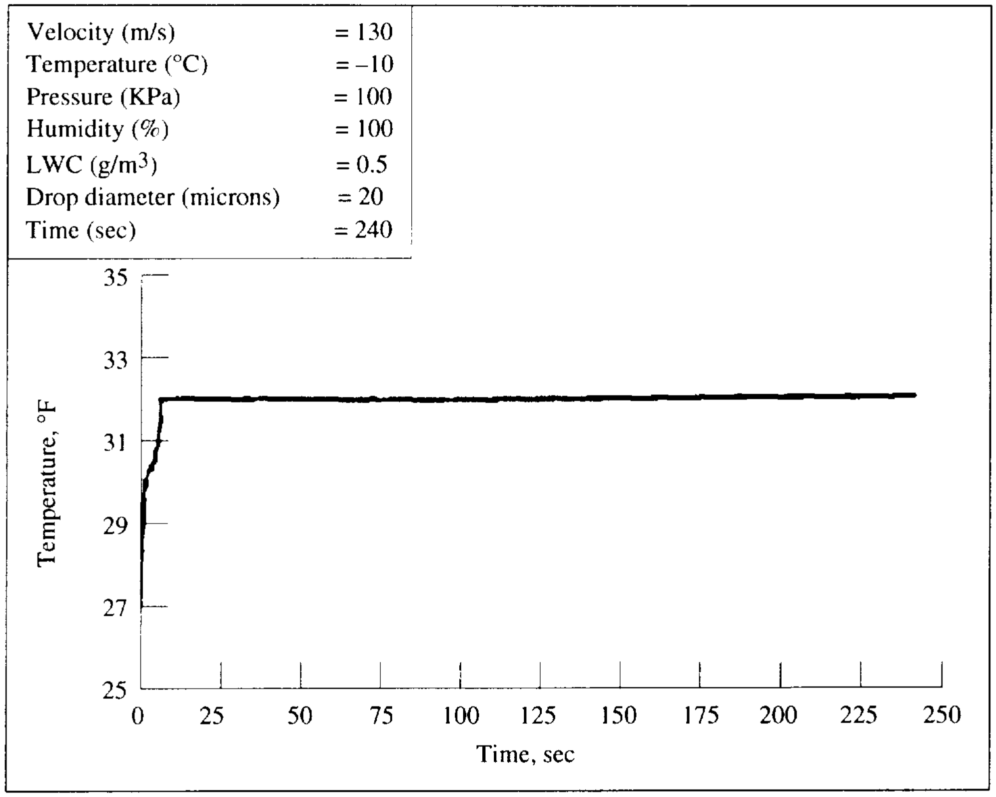


Figure 10.—Temperature of layer 3 at the stagnation point on RAE example case.

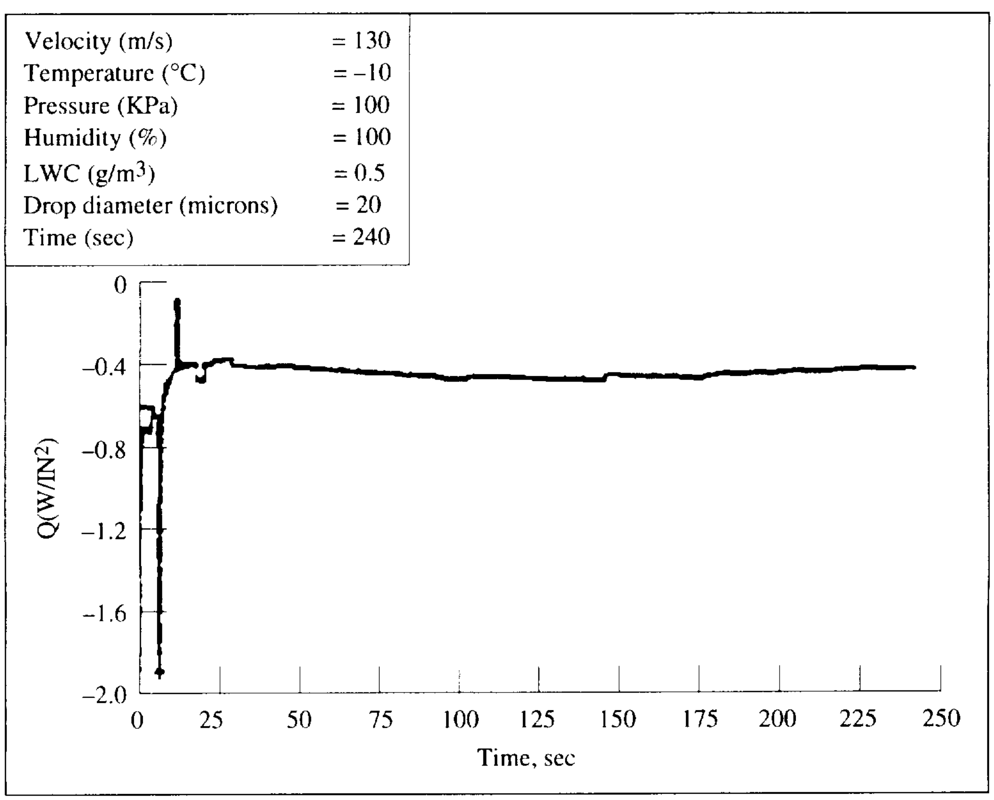


Figure 11.—Conductive flux through layer 3 at the stagnation point on RAE example case.

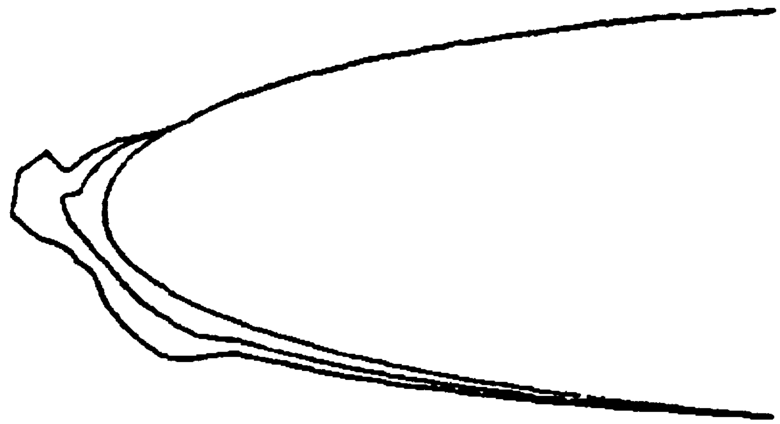


Figure 12.—LEWICE predicted ice accretion on example case 2.

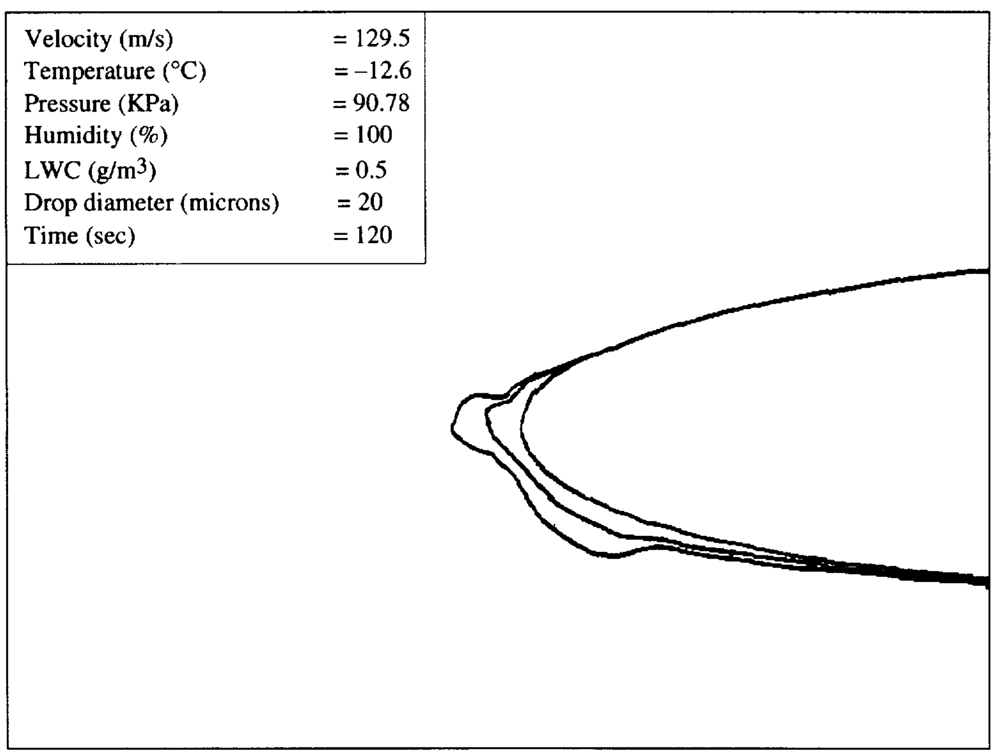


Figure 13.—Numerically predicted ice accretion on example case 2.

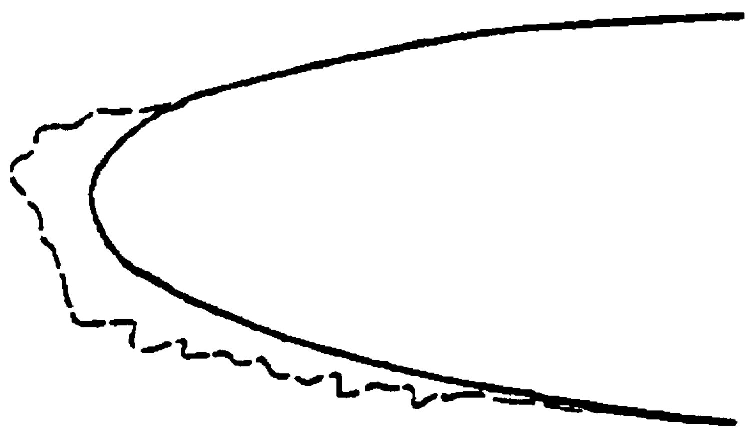


Figure 14.—Experimental ice accretion on example case 2.

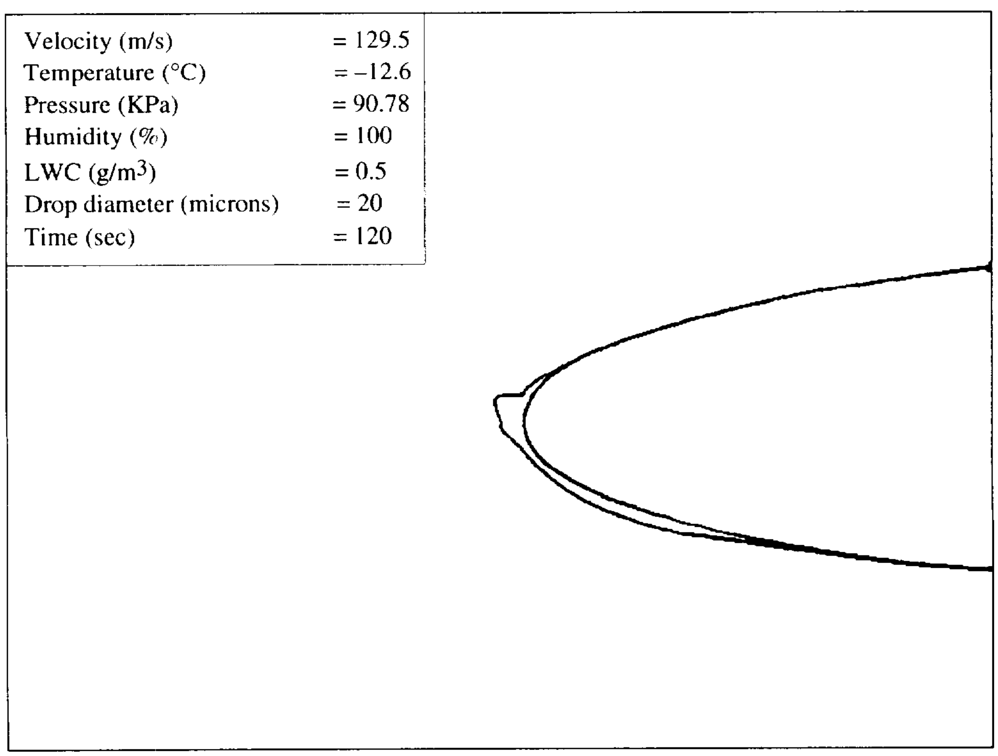


Figure 15.—Effects of conduction on example case 2.

cases, but if the flow code were to be updated for further accretion, the minor differences in the ice shape would be felt in the updated flow results. For this case, sample plots of temperature versus time and heat flux ($-k\partial T/\partial y$) in layer three versus time at the stagnation point are shown. These are provided in figures 16 and 17. As can be seen from the time-dependent plots, the heat flux oscillates initially. It is felt that this is caused by the lagging of the evaporation term one time step in the conduction algorithm. This is necessary in order to linearize the matrix equations such that ADI can determine the solution.

This case was again repeated, this time turning on three electrothermal heaters in the airfoil. The heaters were located in layer three and were distributed around the tip of the airfoil as shown in figure 18. All wattages were 30 W/in^2. The ice shape predicted in figure 19 is much different than the previous cases, but since shedding is not considered in this run, the ice remains on the surface. Besides some runback accretion on the lower surface, the only place where ice forms is at the location of the horn in the previous cases. This is due to the extremely high heat transfer coefficient predicted by LEWICE at this location. Again, the transient temperature and heat flux at the stagnation point heater are provided in figures 20 and 21.

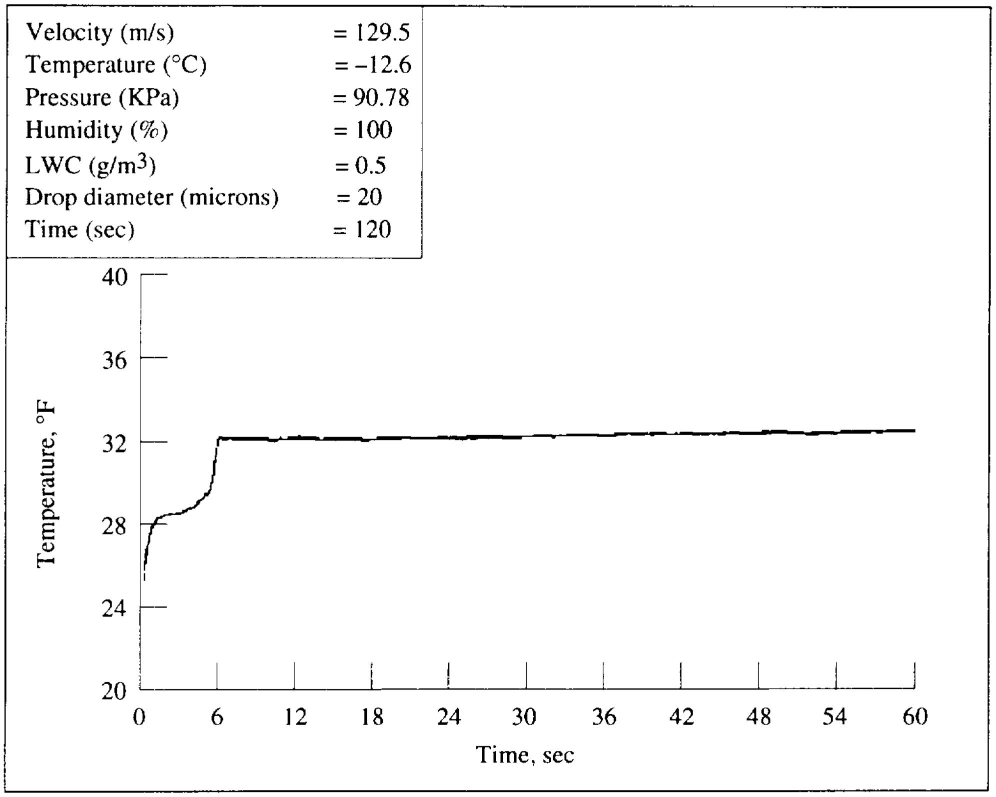


Figure 16.—Temperature of heater at the stagnation point on example case 2.

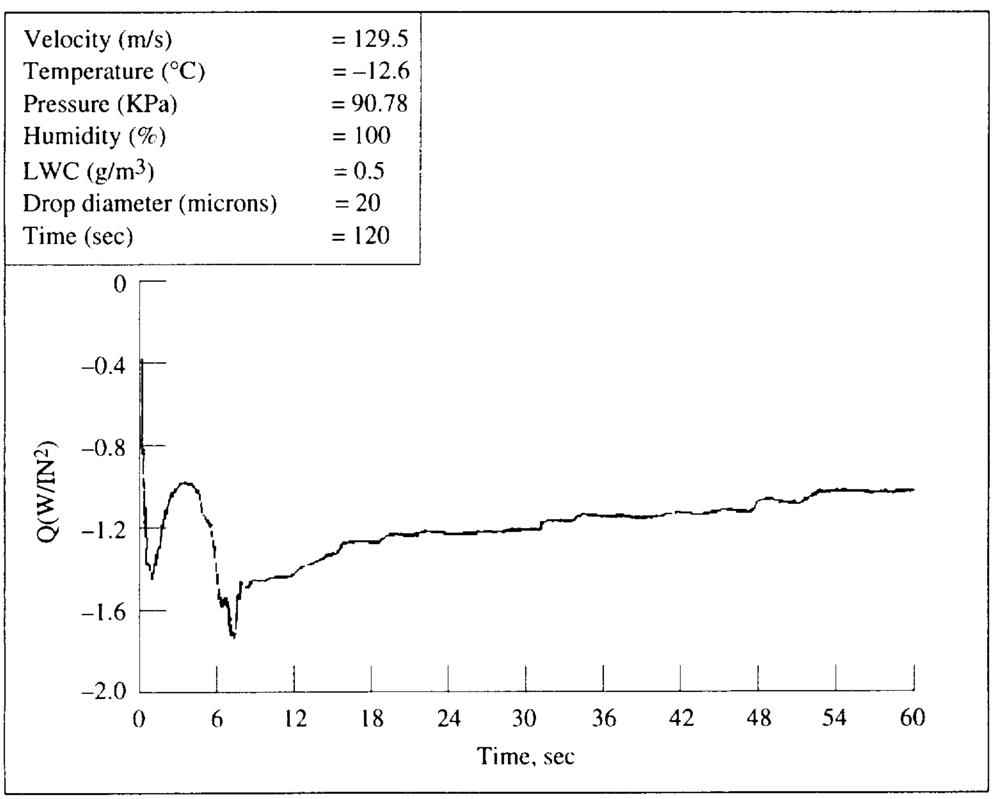


Figure 17.—Conductive flux through heater at the stagnation point on example case 2.

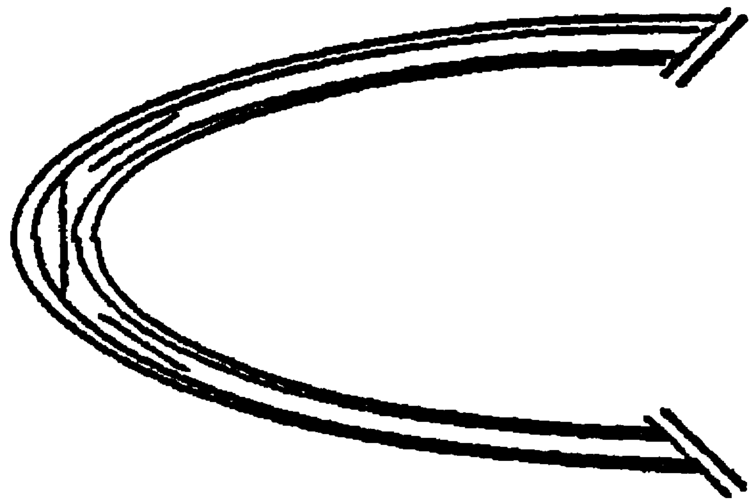


Figure 18.—Distribution of heaters on example case 2.

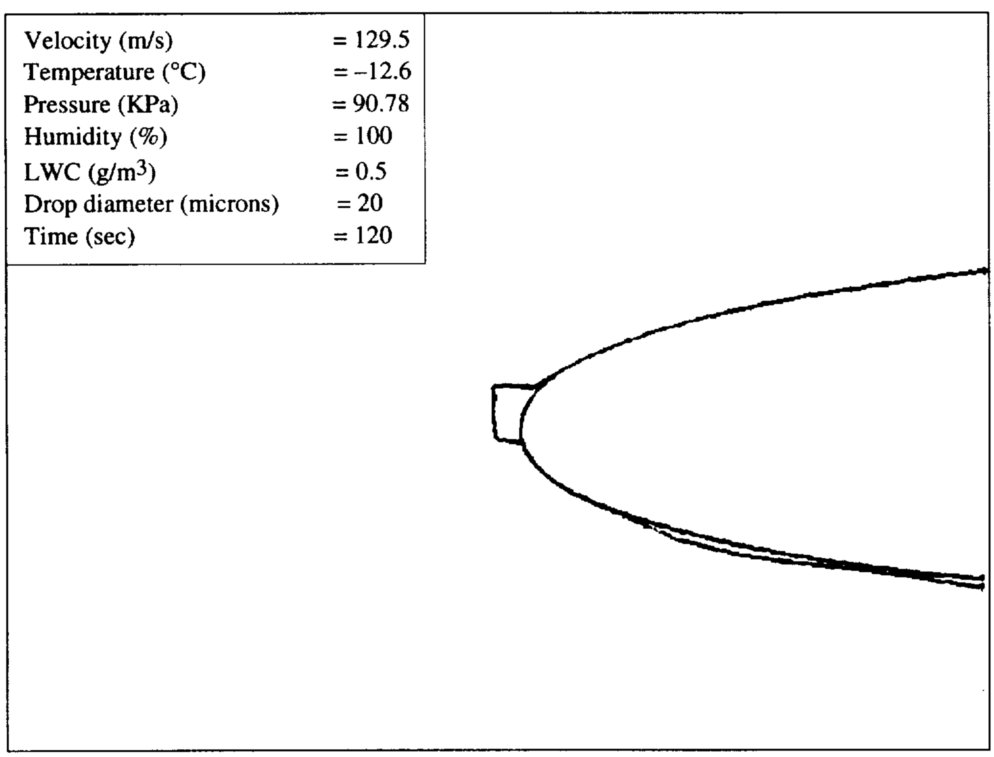


Figure 19.—Predicted ice shape with heat source on example case 2.

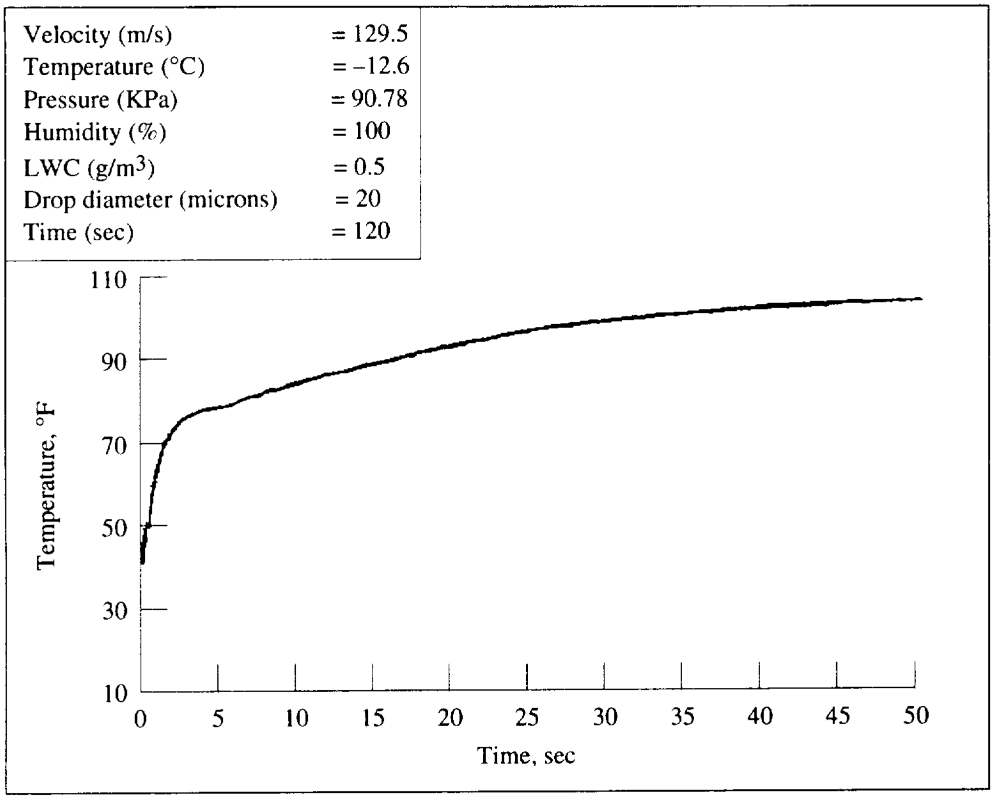


Figure 20.—Temperature of heater at the stagnation point on example case 2 with heat source.

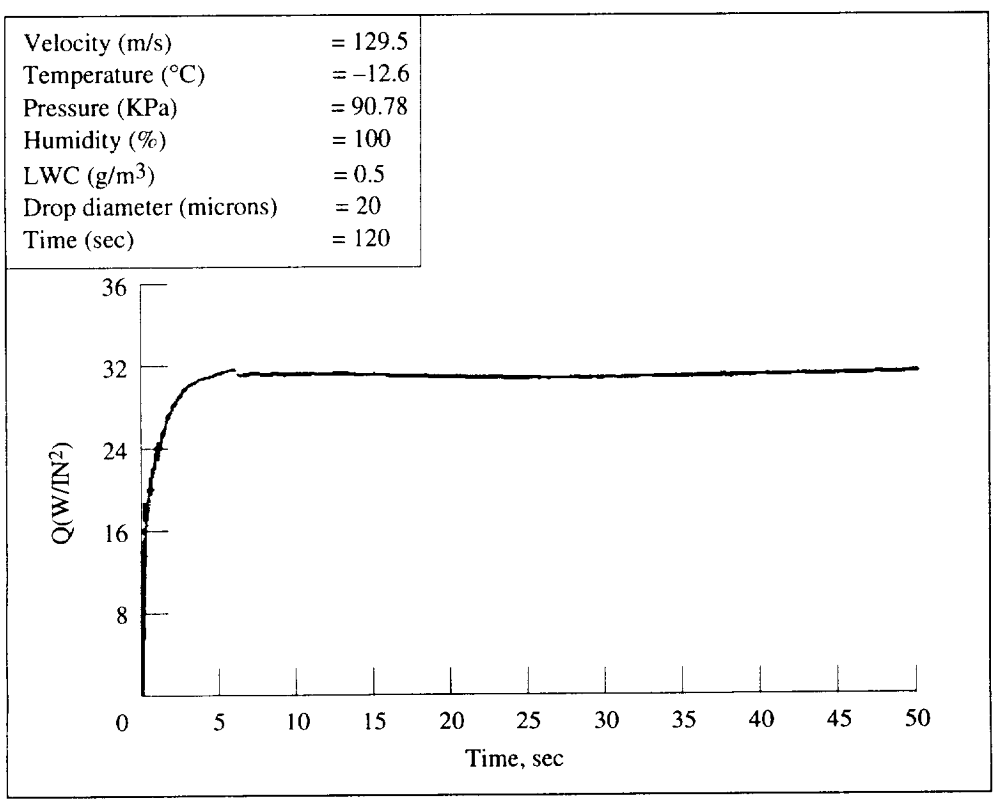


Figure 21.—Conductive flux through heater at the stagnation point on example case 2 with heat source.

COMPARISON WITH EXPERIMENTAL DATA

In order to further evaluate the code, a comparison was made with previously obtained experimental data from Leffel (reference 9). The particular data set chosen was selected because it was a case of cyclic heating and because the ice shed. The ice shape and thickness were known from an identical accretion run performed earlier. A thirteen layer electrothermal pad is modeled. Properties of this pad are provided in table II. Eight heaters are modeled at three different cycle times, as shown in figures 22 and 23. Figures 24 and 25 show the comparison between the experimental ice shape and the predicted ice shape for these conditions. Conduction was neglected during the 5 min. accretion process. Considering the many arbitrary variables which had to be provided to make this comparison, we feel that agreement is quite good. Figures 26 through 28 show the temperature-time comparisons for this case at position 7 in the heater and the ice-abrasion-shield interface. Experimental ice shedding occurred approximately 5 seconds after the heaters were turned on compared with the numerical prediction of 0.3 seconds. Since the correlation between bonding strength and surface temperature is accurate to within plus or minus 30 percent, this is a reasonable prediction. The CPU time for this run using a 177 X 70 grid for 300 seconds of accretion and 80 seconds of de-icing time on NASA's VM machine was 22 minutes, 27 seconds. This is an acceptable value considering the complexity of the problem, the large size of the mesh, and the long simulation time.

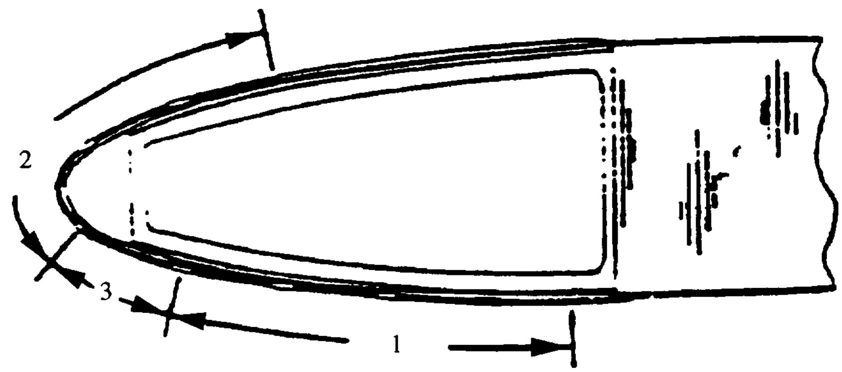


Figure 22.—Distribution of heaters on experimental case.

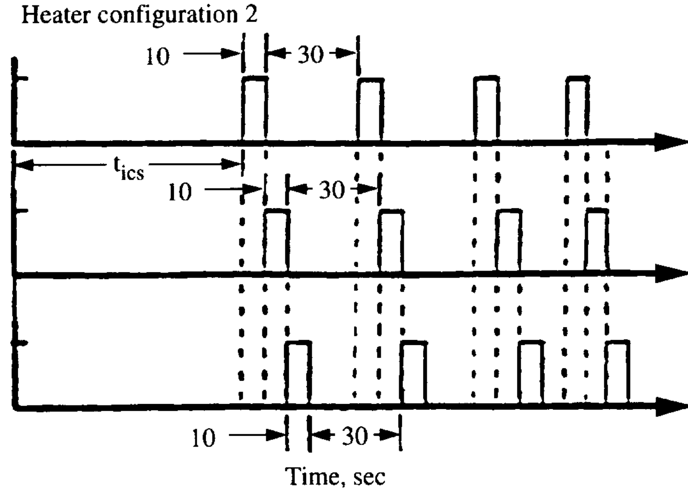


Figure 23.—Heater cycle times on experimental case.

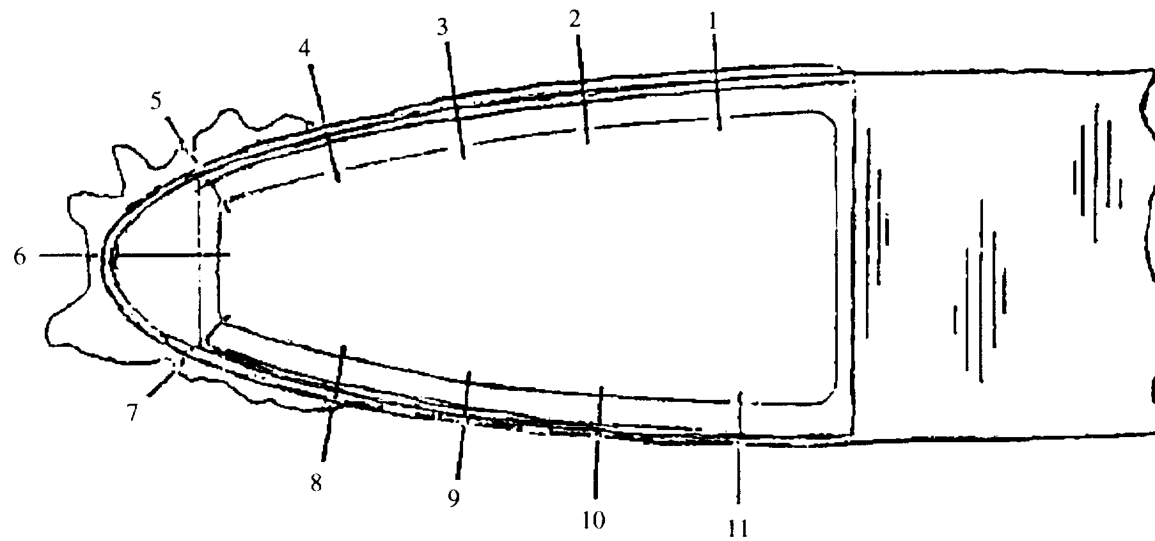


Figure 24.—Experimental ice accretion.

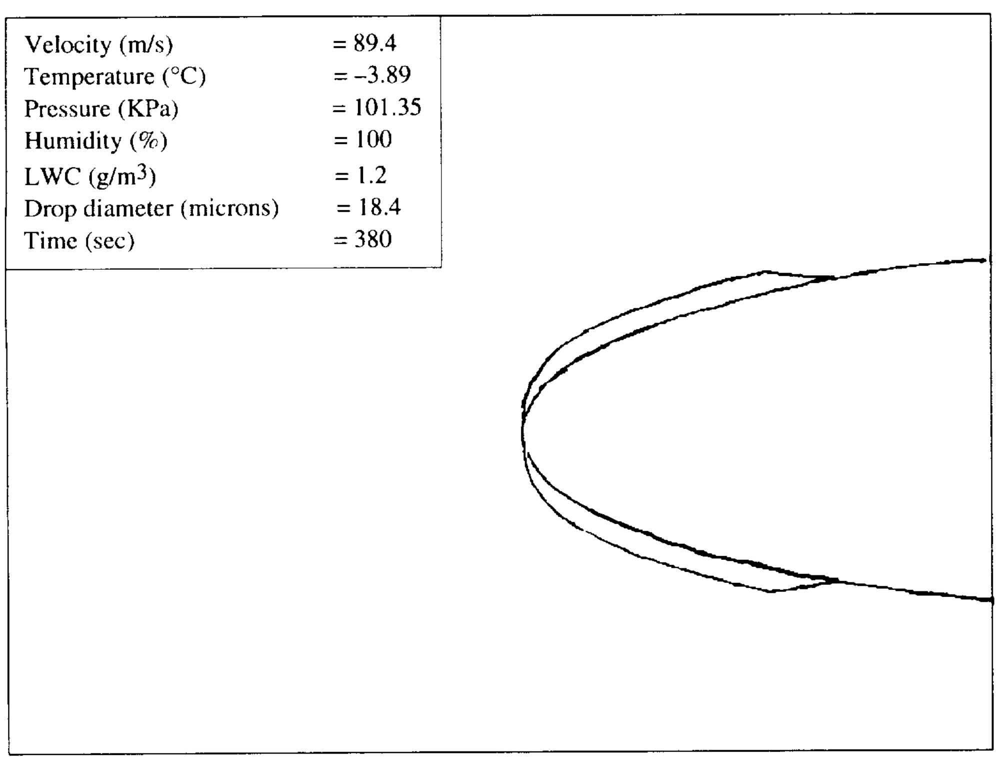


Figure 25.—Numerically predicted ice accretion.

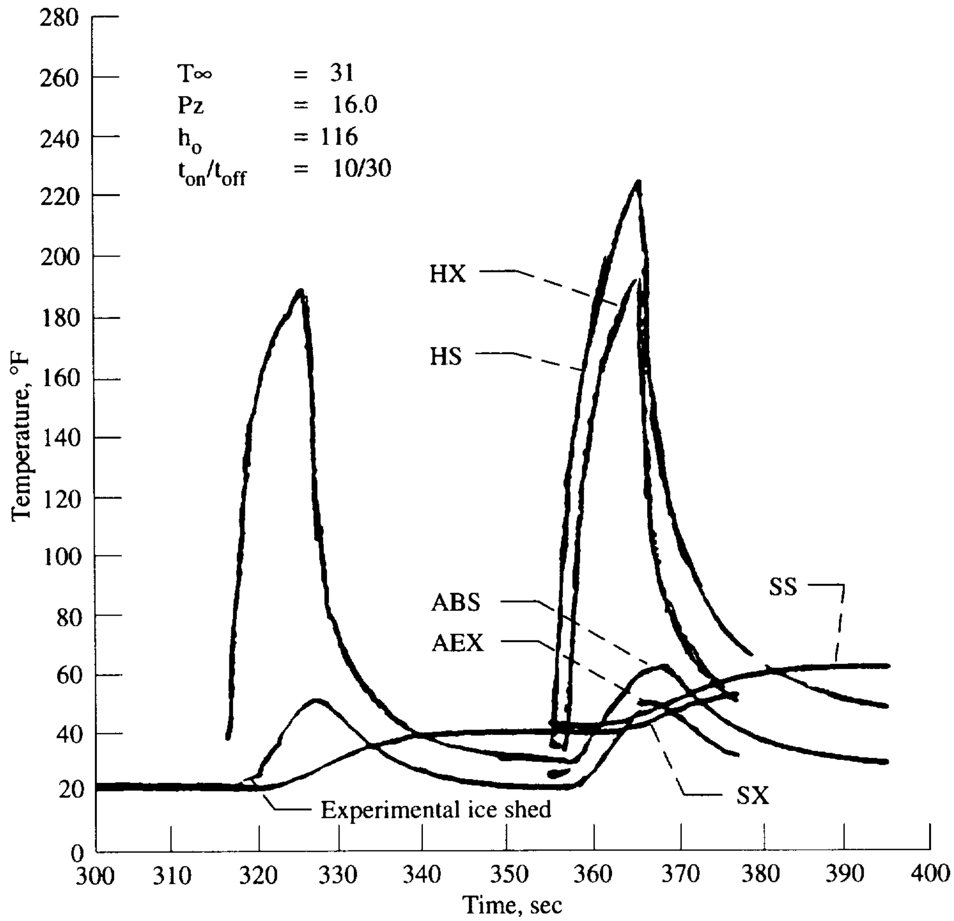


Figure 26.—Experimental temperature results at position 7.

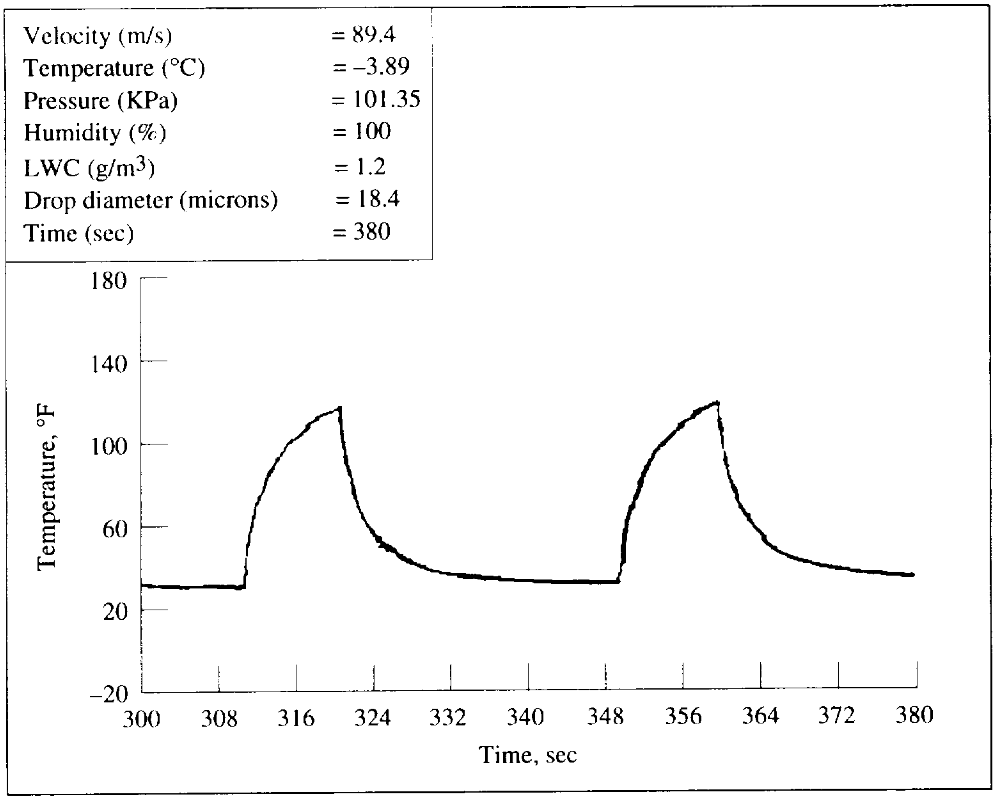


Figure 27.—Numerical prediction of heater temperature at position 7.

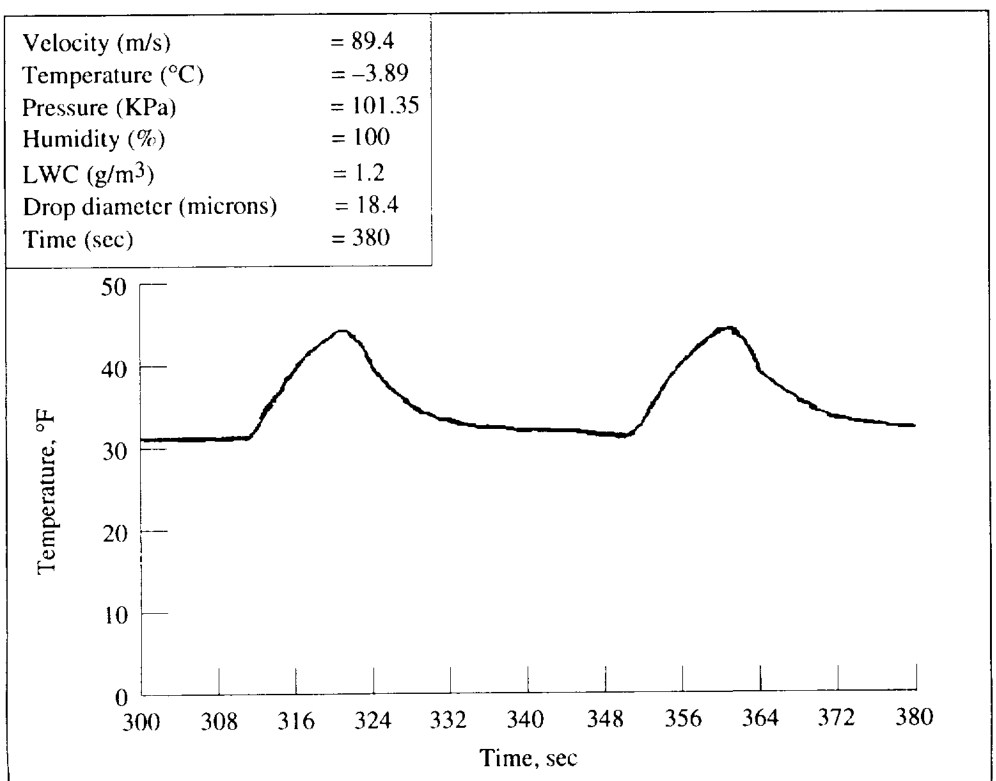


Figure 28.—Numerical prediction of ice/abrasion shield interface temperature at position 7.

Table II - PHYSICAL CONSTRUCTION AND PHYSICAL PROPERTIES OF MATERIALS USED IN THE HELICOPTER BLADE AND ELECTROTHERMAL DEICER

Layer	Nodes	Thickness, in	Thermal conductivity, BTU/hr-ft-°F	Thermal diffusivity ft2/hr
Abrasion shield stainless steel	6	0.030	8.7	0.15
Adhesive epoxy	4	0.0168	0.1	0.0058
Insulation epoxy/glass	4	0.0138	0.22	0.0087
Adhesive epoxy	4	0.0082	0.1	0.0058
Heater element copper	4	0.0065	60.0	1.15
Adhesive epoxy	4	0.0082	0.1	0.0058
Insulation epoxy/glass	4	0.0138	0.22	0.0087
Adhesive epoxy	2	0.0082	0.1	0.0058
Blade skin stainless steel	4	0.020	8.7	0.15
Film adhesive FM 1000	3	0.01	0.1	0.0058
Doubler aluminum	10	0.05	102.0	2.83
Film adhesive FM 1000	3	0.01	0.1	0.0058
Doubler aluminum	31	0.175	102.0	2.83

DEICER INPUT FILE AND VARIABLES

This section is intended to help the user work with the input data for both the electrothermal deicers and all the layers of the airfoil below the surface of the abrasion shield where the airfoil is embedded. By properly inputting values and 'tagging' the appropriate variables, a user may numerically 'construct' virtually any airfoil/heater configuration for simulation. Any number of layers may be specified, each having its own thickness and material properties. Even the adhesive bonding between two layers can be accounted for by treating the adhesive as a separate layer having its own thickness and properties.

The heaters themselves may be specified to have different lengths, gap widths, intensities, firing sequences, etc., as well as having a different number of heaters within the deicing blanket. Thus there is maximum flexibility in using the code to simulate most airfoils, heater configurations and designs, as well as the operating conditions of the heaters.

The data files and input variables needed to run LEWICE before this version with the electrothermal upgrade will not be repeated here, since there has been no change made to those files and variables or how they are used. The additional input needed to run this version of LEWICE has all been placed in a separate data file called DEICE DATA. A numerical 'toggle' can be engaged in this data set, essentially turning it off, thus allowing LEWICE to be run in its original form prior to the electrothermal upgrade. The data file DEICE DATA is broken up into five sections: "Data for the Composite Body" which reads in the layers, thicknesses, heater geometry and configuration, and material property data for the composite body; "Data for the Heater" which reads in power densities and cycle times; "Boundary Condition Data" which reads in any boundary or initial condition that needs to be input that is not passed through or is not computed in the unmodified version of LEWICE; "Ice Property Data" which reads in the physical properties of the ice, the initial ice shape if one exists, the ambient conditions; and "Time Step and Input/Output Parameters" which reads in the time steps, the simulation time, and the print/plot options for the program.

Please refer to the hard copy of DEICE DATA found at the end of this section when reading the remainder of this section. Note that there is some brief documentation of some of the more commonly used variables within the body of DEICE DATA that will aid in the editing of the data set for a new airfoil/heater geometry and/or new operating conditions. The text that follows provides a more detailed explanation of those variables with an explanation of the remaining variables, broken down by the five input sections.

VM System: Before running this version of LEWICE, a filedef needs to be assigned to DEICE DATA prior to the execution of the code, along with the original data set file. If the filedef is not assigned just prior to execution, then it must be placed in as part of the exec file, if an exec file is used to compile and run the program. The procedure to define filedefs is machine dependent, thus the user will have to determine how this is done on the CPU unit that is being used to execute the code.

DATA FOR THE COMPOSITE BODY

This version of LEWICE simulates the heat transfer in an airfoil by unwrapping it at the trailing edge and laying it flat on a two-dimensional rectangular plane. The y-direction is the direction normal to the airfoil surface and the x-direction is measured along the chord. The z-direction, along the span of the blade, is not modeled. This enhancement is not limited to the modeling of airfoils alone. As long as the assumption of a two-dimensional rectangular computational model remains valid, and accurate values of boundary conditions are computed or passed through by other subroutines, any component (engine inlet, windshield, etc.) can be modeled.

Using this information, the number of layers in the y-direction (L) is the number of different materials used in the construction of the deicer pad/airfoil. The number of sections in the x-direction (NX) is the number of heaters plus the number of heater gaps. Within each section (a particular heater or heater gap) the spacing between nodes is uniform. The grid spacing between individual sections, however, will not necessarily be the same. Additionally, a user can specify two or more grid spacings within a heater section by specifying two or more sub-sections within that section, each having the same thermal properties and watt densities, but having different lengths and different numbers of nodes. This feature can be used to place more grid points where the heater meets the gap to look at the large temperature gradient which exists there.

The next set of data specifies the physical properties of the deicer pad and the number of nodes within each layer. The units required for each property are given in the data file. Each line of data in this region represents a layer in the composite body. Therefore, the number of lines of physical property data must equal the number of layers specified by the variable L (the number of layers). If they are not equal, a run error will occur when the program tries to read in the set of comment statements that follow as data. The previous chapter provides an explanation of what the orthotropic factor is. For most materials, all values of this variable should be set equal to one. The limits on input are that the number of layers must be less than 30 and the sum of the nodes minus the number of layers plus 2 must be less than 190.

The next sub-section provides the physical properties and number of nodes for the heater layer. The thermal properties given here will be used only in the heater layer, which is specified in the next data section. Again, each line of data represents a region of constant nodal spacing. This means that each line provides data for a heater, or data for a gap. The number of lines in this region must be equal to the value of the variable NX (the number of sections in the layer containing the heaters). A run error will occur if the number of lines is different. The limits on input in the x-direction are the same as those for the y-direction given above.

The sum of the lengths of the heaters and the gaps represents the distance along the surface of the airfoil starting at the bottom of the tail, going around the stagnation point and back to the tail. However, this distance may not be known to the user. Because of this, the actual lengths of these end segments are determined by the program, which computes the actual distance around the airfoil using the coordinates of the clean airfoil. The program then lengthens or shortens the end segments so that the sum of the individual segments is equal to the distance around the airfoil. In the printed output of the data, the program will list the actual lengths of the end segments that were used.

DATA FOR THE HEATER

There are three methods used by the program to model a heat source. The method used is selected by the user by inputting a value for the variable IH from 1 to 3. For a value of IH=1, the program will not use any heat source terms and will ignore the rest of the data input from this section. This has previously been used only for debugging purposes, but the capability remains to use this option.

For a value of IH=2, the program will assume that the heater is a point heater, i.e., it has a zero thickness. In this case the heat source is not applied in the energy equation, but at the boundary between two adjoining layers in the deicer pad. This option was provided because the heater thickness is very thin. However, previous studies using this assumption (reference 5) have shown that using this option will overpredict the temperature in the deicer pad because there is no heater material for the source to have to diffuse through. For this case the user must supply values for the variables L1 and L2 which represent the layers between which the heater resides. The value of L1 must be one less than the value of L2. The variable IJ below this is not used if IH=2.

For a value of IH=3, the program will treat the heater as a volumetric heat source within one of the layers of the deicer. This is the option most often used and is the form of the heat source used in the governing equations presented in the previous chapter. For this case the user must supply a value for the variable IJ, which represents the layer in the y-direction that the heater is in. The program counts the bottom layer of the deicer as layer 1. This will be the first layer listed in the composite body data file. The variables L1 and L2 are not used by the program if IH=3.

For either IH=2 or IH=3, there are five options which can be specified to determine the style of heater to be modeled. This option is specified by the variable IHQ. For a value of IHQ=1, all heaters remain on at their specified wattages for the entire simulation. The on/off times and lag times provided below this value are ignored for IHQ=1. This option has been used to determine the maximum amount of heating a particular configuration can provide.

For a value of IHQ=2 the heaters are on at their specified wattages for the amount of time given by the variable TON, then are off for the amount of time specified by the variable TOFF. The cycle then repeats for the duration of the simulation. The variable TLAG, the lag time, is used to turn the heaters off for a specified period of time before the cycle begins. This allows for ice accretion to take place for a period of time before the first heater turns on. After TLAG seconds have expired, that heater will turn on and begin its cycle. After this time, the value of TLAG is no longer used. Note that all sections, including the heater gaps, will have a wattage assigned to them. For a heater gap, the wattage will be zero. For a wattage of zero, the on time, off time, and lag time are not used, since there is no heater in that section to turn on and off.

For a value of IH=3, the heater will cycle as described above, but initially the heater wattage will be zero and will increase in a linear fashion to the wattage provided after TON seconds. The heater then turns off for TOFF seconds. For a value of IHQ=4, the heater will start at the given wattage, but will oscillate around that value in a sinusoidal manner for the duration of the on time, then it will turn off. These heater options were provided in previous deicer models developed at the University of Toledo, but have never been used by the code developer except to verify that the options work as designed. If you wish to design a deicer which operates in this fashion, you are sure to welcome the options to numerically model it using this program.

BOUNDARY CONDITION DATA

Because the computational field is two-dimensional, there are four boundary conditions which need to be specified. These are assigned by the variables ICB1, ICB2, ICB3, and ICB4. A value of 1 for any of these parameters will denote a constant temperature boundary condition at that surface. A value of 2 for any of these parameters will denote a convective ($q = h \Delta T$) boundary. A value of 3 will denote an accretion boundary, and can only be used at the top surface of the grid where icing occurs. Convective boundaries are normally used at the other three surfaces.

The variable IBC2 defines the boundary condition to be used at the top surface of the ice and can have three values whereas the other surfaces can have only two. A value of 3 for IBC3 denotes the accretion boundary where kinetic heating, evaporation, latent heat, and sensible heat transfer occur as well as convection.

IBC1 is used for the bottom of the deicer, which is in the interior of the airfoil. This boundary is normally assumed to be insulated (h1=0) or to have a free convection boundary (h1 approximately = to 1 through 10). ICB3 is at the left boundary and ICB4 is at the right boundary. Both of these boundaries are normally considered to be insulated for the deicer pad. Since the entire airfoil is being modeled, both of these boundaries occur at the tail end of the airfoil and any boundary condition other than an insulated boundary at both surfaces would not be realistic.

The variables TX1, TX2, TX3, and TX4 provide the temperature at which the respective boundary will be held constant if a constant boundary condition is used. These values are ignored if a convective boundary is used. TG1, TG3, TG4, H1, H3, and H4 provide the ambient temperature and heat transfer coefficient at the bottom, left, and right sides, respectively. These values are ignored if a constant boundary condition is used. One application for using different boundary conditions and various ambient temperatures is for code verification with known solutions to heat transfer problems. The heat transfer coefficients at the top surface are passed to the program from LEWICE via a COMMON bloc. The ambient temperature at the top surface is also passed through by LEWICE.

Embedded within the boundary condition data section are several 'toggles' that determine if the program will consider certain special features. The toggle ICOND is used to control heat conduction into the airfoil during the icing period before the heaters are turned on. If ICOND=1, conduction will be neglected during icing and if ICOND=2, conduction will always be considered. This feature has two very important purposes. First, it is used to compare ice shapes generated with this version of LEWICE to those generated by the original LEWICE, and with the RAE's ice accretion code, neither of which considers conduction within the blade. Second, it is used to greatly reduce the computational time of the code.

With no heat source in the blade, the effects of conduction on the ice shape are small for many cases. The effect of conduction is seen in the resulting temperature profile around the blade. By neglecting conduction, the ice accretion energy balance at the top surface possesses no terms that change with time, other than those which are provided by LEWICE's flow/trajectory codes. Therefore, the solution to the temperature profile and the amount of ice accretion at each node is easily obtained, whereas if conduction is considered, it is a transient process. For example, if the flow code is updated every minute, and the time step of the conduction algorithm is 0.1 second, this represents a difference of having to perform 600 calculations if the conduction algorithm is considered versus only once if it is neglected.

The next variable, INIT, determines the temperature distribution to be used at time=0.0 for the simulation. If INIT=1, all of the temperatures are set equal to the ambient temperature. This option has been used for comparison with previous deicer programs which can only specify a constant initial temperature. If INIT=2, the temperature distribution in the deicer is set equal to the recovery temperature distribution. This is the surface temperature distribution the blade would obtain in dry conditions, that is, only kinetic heating and convective losses are considered. This is the most widely used option, as this most accurately models the actual temperature distribution in the blade when accretion starts. If INIT=3, the temperature distribution in the deicer is set equal to the accretion temperature distribution. This temperature distribution is obtained by solving the energy equation assuming no conduction. This option has been used to study the effects of conduction into or out of the blade, and whether this conduction is significant or not.

The next variable, ISH, determines if shedding of the ice is to be considered. Again, for comparison with previous programs in this area which do not model shedding, this feature needs to be turned off. If shedding is not considered, the blade information is not used except in the contribution of the speed to the kinetic heating term. For ISH=1, shedding is not considered, and for ISH=2, shedding of the ice is considered.

ICE PROPERTY DATA

The first variable, IG, determines whether or not a change of phase will occur in the top layer of the grid. In a normal deicing run, the ice is the top layer of the composite body and is the only layer which can undergo phase change from solid to liquid. However, this option, IG=1, can be used to study the thermal behavior of a deicer pad under non-icing conditions. That is, there are only layers of metal, insulation, adhesive, etc., and there is no ice layer. Physical property data for ice and water in this section is ignored if there is no phase change. For IG=1, phase change in the top layer is not considered. For IG=2, phase change is considered in the top layer.

The next set of data provides physical property data for the ice and air. Most of these are self explanatory. The melting range, TR, is the temperature range over which icing occurs. Due to the numerical methods employed by the program, this range needs to exist and must be equal to or less than 10-4.

The next set of data provides the initial ice shape for the airfoil. This option is a throwback to the era in which the University of Toledo deicing codes did not calculate the amount of ice accretion, but used this option to specify the ice shape. Still, if the user wishes to start the simulation with something other than a clean airfoil, this capability still exists within the program and is useful in comparing the results of this code to previous deicer programs. The variable NP specifies the number of points the user wishes to input in the variable ice shape. The x-value (XP) and y-value (YP) correspond to the x-y coordinates of the ice on the rectangular grid. The program will then linearly interpolate between each point to generate a variable ice shape to start the simulation. When a clean airfoil is desired at the start of a run, one needs to make sure that all values of YP are set to zero.

The actual thickness of the top layer of the simulation is specified with this input. The value specified in 'Data for the Composite Body' is only used for the purpose of determining the 'delta y' in the top layer. This is true even when the user specifies the top layer to be something other than ice. For example, if the user wishes to model just the deicer pad with no ice formation and no phase change potential, the thickness in this input should be set equal to the thickness of the top layer of the deicer pad. The last set of data in this section specifies the rotor speed and location. This information is used in shedding the ice and in the kinetic heating term in the energy balance. If a rotor is not being modeled, simply specify RPM=0.

TIME STEP AND INPUT/OUTPUT PARAMETERS

The first part of this section specifies the time step to be used by the conduction algorithm. Note that the same time step does not have to be used for the entire simulation. This option was provided so that a smaller time step could be used to better resolve certain phenomena. For example, if experimental shedding data were available using a high speed camera and the shedding time could be determined to a hundredth of a second or even a thousandth of a second, the time step of the program could be lowered in this time interval to compare with these values. Each of the first two time steps (DTAUI, DTAUM) specified are used for the number of time steps given below it (NISP, NMSP). The last time step (DTAUF) is used for the remainder of the simulation.

The next input variable sets the maximum number of input iterations for the phase change calculation. The program assumes a phase (solid, mush, liquid) for each node, then calculates the temperature profile in the grid based on that assumption. The program then checks each phase to determine if that assumption was correct. If any of the assumptions were incorrect, new assumptions are made based on the predicted temperatures and a new temperature profile is calculated. If JCOUNT iterations are reached, the program will use the last temperature profile calculated and continue with the simulation. The program will also print out to the main output file the number of iterations used at any time step where it had to use more than 3 iterations. If several of the time steps require JCOUNT iterations, the results of the program will be suspect and the user will be provided with an error message.

The next variable, NPRT, provides the number of time steps at which the x-y coordinates of the ice shape will be printed out. This output is provided in addition to the ice shape output that LEWICE provides. Place the four digit integer of the time step that you wish below the four X's in the comment statement. The number of time steps provided must be equal to the value of NPRT. Note that the program asks for time step, and not the time. This requires the user to take the time at which you desire printout and divide by the time step provided above. For example, if the user wants to print out the coordinates of the iced airfoil after two minutes (120 seconds), take 120 seconds and divide by the time step for the conduction algorithm, which is usually 0.1 sec, which will result in a value of 1200 for the desired time step.

The last series of input data specifies the times and location when and where the user wishes printed output of the temperatures. These values are also the default plot options which will be used if the user wishes to plot the output. This is much more convenient than inputting all of this information at the terminal. There are five types of printed output that the user can specify. Currently, only one type of printed output can be specified per run. However, other types of output can be specified for plotting purposes.

There are five types of temperature output which can be specified by the user. All five have been used for one purpose or another. The variable IOTYPE selects the type of output the user wants. The variable NPTS specifies how many points are to printed out. There must be NPTS number of lines of input data following this statement. For IOTYPE=1, the program will print time in the first column and temperature in each of the following columns. Each column of temperatures is a user specified point in the grid. This type of output is comparable to the type of output generated by a thermocouple.

The format to specify which point to print out has been designed so that users can input information they know rather than information that has to be calculated. For IOTYPE=1, the left column of integers specifies the section number in the x-direction where the requested point is located and the right column of integers specifies the layer number in the y-direction of the requested point. The left column of characters specifies where within that section (left (L), middle (M), right (R)) the user wishes output. Similarly, the right column of characters specifies where within the requested section (bottom (B), middle (M), top (T)) the user wishes output. Hence the user does not have to count nodes to be able to print out a certain point.

As an example, consider a heater mat with 11 heaters. Assume that there is a small gap between each heater. For 11 heaters there will be 12 gaps. The large unheated section from the tail point at the bottom surface to the edge of the first heater counts as a gap, albeit a large one, as does the large unheated section from the edge of the eleventh heater to the tail point on the upper surface. If the user wants to print out the time-temperature history of the node at the top of the sixth heater, in the middle of that heater, the following procedure is used. First, the user notes that in the gap-heater-gap setup used in the data file, heater five is the tenth section in the simulation (always count sections starting at the left of the grid and composite body layers from the bottom). Let's say that the heating element in this pad is the ninth layer in composite counting up from the bottom. Therefore, the user would identify this point with the designation 0012 M 0009 T in the proper format as seen in the example data file. This will print out the time-temperature history of the node in the middle of section 12 and at the top of layer 9. This is easier than adding nodes to find that this may be node 40 in the x-direction and node 37 in the y-direction. Each successive point desired is determined in the same manner. Note that due to the formatted output, the program will print zero's in the remainder of the columns where there is no data and that if more than 10 points are specified, points 11 through 20 will be printed below the results for points 1 through 10.

For IOTYPE=2, the program will print the distance along the chord, measuring from the stagnation point, in the leftmost column and temperature in the remaining columns. This shows the variation of temperature with respect to chord distance at specified times and y-values. This type of output is comparable to the parameter plots used by LEWICE, which plots temperature, heat transfer coefficient, and so forth, as a function of distance along the airfoil. The left column of integers specifies the time step at which printout is needed and the right column specifies the layer in the y-direction. The left column of characters is not used for this print option and the right column of characters again pinpoints where within the layer the output is needed.

For example, if the user wishes to print out the ice-abrasion shield interface temperature after 10 seconds, the following procedure is used. First, 10 seconds is divided by the time step, usually 0.1, seconds to obtain 100. If the abrasion shield layer is 13 and the ice layer is 14, the user may specify this interface as either the top of layer 13 or the bottom of layer 14. Therefore, the data input for this would be 0100 T 0013 T. Note that although the left character is not used, the formatting of the input requires that it remain there. The selection of a 'T' is purely arbitrary.

For IOTYPE=3, the program will print the distance normal to the surface of the airfoil (y-direction) as measured from the substrate in the first column and temperatures in the remaining columns. This shows how the temperature varies in the y-direction at a selected chord and time. The left column of integers is used for the time step of the output and the right column is used for the section number in the x-direction, counting from the left boundary (the bottom of the tail). Note that the section number in the x-direction is in a different location than for IOTYPE=1. This is because the left column is used primarily to hold the time step. The left column is used for the section number only for IOTYPE=1, where both the section number and layer number need to be specified. The left column of characters is not used for this print type, and the right column of characters contains information on the location within the section where the printout is requested.

For example, if the user wants to print out the temperature distribution at the stagnation point after 10 seconds, the following procedure would be used. First, the time step of 100 would be calculated in the same manner as it was for IOTYPE=2. Then, the user determines that the stagnation point is in the middle of section 12, as performed for IOTYPE=1. Therefore the format of the input data for this case would be 0100 T 0012 M. Again note that the left character is provided even though it is not used by the program.

For IOTYPE=4, all data is provided at every time step in the simulation. This has been used for debugging purposes only, and it is not recommended to the user. The program will print the distance in the y-direction in the leftmost column, then will print the first 10 temperatures starting from the left side of the grid in the remaining columns. If there are more than 10 nodes in the x-direction, the program will repeat the above formatting for nodes 11 through 20, and so on. The time of the simulation to that point will precede the temperatures. For this type of output, all of the data in the four columns below IOTYPE is ignored, but for formatting purposes, the number of lines of input in this section must be the same as the value of NPTS.

For IOTYPE=5, all of the grid points are again printed, but only at the time steps provided in the left column of the input data. The other columns are not needed for this print type, but must remain because of the input format for this section. The format of the output is the same as for IOTYPE=4. This is the same type of output provided for earlier University of Toledo codes and has been kept so that direct comparisons of temperatures can be made between the temperature results of this program and the previous results.

OUTPUT FILES LOCATED WITHIN SUBROUTINE UTICE

There are twelve different output files for the subroutine UTICE, which is the root computational module for the electrothermal upgrade of LEWICE. The output of UTICE is put into various files so that the user can more easily find the necessary output without having to traverse through much unneeded information. The output is printed in column form, so that most PC graphics software can more easily read the information in for plotting purposes. These output data files are provided in the order of the variables IO1 through IO12 in subroutine UTICE, which define the file numbers for outputting the data.

The first output file is called UTICE OUTPUT. Output going to this file is identified in the program by the variable IO1. This file contains the echo of the input data. This is helpful so that the user can check that the correct information was input. This file also prints out the ice shape using the rectangular computational grid. A zero will indicate no ice, a value of 9 will indicate the ice-abrasion shield interface, a value of 1 indicates an interior ice node, and the values 2 through 8 indicate an ice-ambient interface. By viewing this output, a user can get an idea of what the ice shape looks like.

This file also contains the number of phase iterations the program used at any particular time step. This information is printed only when the number of iterations used is greater than or equal to 3. This is useful in pinpointing when most of the ice is changing into liquid, and to make sure that the limit of iterations is not being reached. If the limit on the number of phase iterations (normally 20) is being reached several times during a run, the output may not be accurate.

The next output file, XY DATA, contains the x-y coordinates of the iced airfoil at the time steps given by the input variable ITIME. Output going to this file is identified in the program by the variable IO2. This file is the result of a mapping routine in UTICE, and not the result of LEWICE's mapping routine. There may be a difference between the two shapes because UTICE will always grow ice normal to the clean airfoil, whereas LEWICE will grow ice normal to the ice shape at the previous time step.

The next two data files, HTC DATA1 and HTC DATA2, contain the x-coordinates and y-coordinates of the airfoil, the collection efficiencies, the static pressures at the edge of the boundary layer, and the heat transfer coefficients around the airfoil. Output going to these files is identified in the program by the variables IO3 and IO4. HTC DATA1 prints out this information using the grid in UTICE, and HTC DATA2 prints out this information using the grid in LEWICE. This was performed so that the user can compare the values that LEWICE generates with the values that UTICE uses. These values, after using the proper unit conversions, will be the same if there are no bugs in the program. These two files have been instrumental in locating the bugs which did exist and which were eliminated. The LEWICE output is in metric units, and the UTICE output is in English units.

The next output file, FORCE DATA, contains the results of the shedding routine. Output going to this file is identified in the program by the variable IO5. The first column is time, the second column is the adhesion force holding the ice on, and columns 3 through 5 are the components of the sum of the external forces in the 'z', 'x', and 'y' directions, respectively. These are found from the components of the aerodynamic force. The external force increases linearly with the mass of accreted ice, so this will increase with time. The adhesion force is dependent upon the bonding strength, which in turn is assumed to be solely a function of the temperature at the ice-abrasion shield interface. This will vary during the course of a run, especially when the deicer is firing.

The next output file, TEMPS DATA, contains the printed output of the nodal temperatures in the format specified by the user. Output going to this file is identified in the program by the variable IO6. The formatting is performed using the IOTYPE variable in the INOUT DATA input file and by the columns of integers and characters below IOTYPE. The first column in this output file will be the independent variable x, y, or t and the other columns will be the specified temperatures.

The next output file, ACCRET TEMPS, contains the printed output of the temperature and enthalpy at the ice-ambient surface assuming no conduction into the blade. Output going to this file is identified in the program by the variable IO7. This information is generated by solving the accretion energy balance at each nodal location. The first column will contain the distance from the stagnation point, in inches. The second column is the temperature at that location in degrees Fahrenheit, and the third column is the enthalpy at that location in units of BTU's per cubic foot. For those cases in which conduction into the blade has been neglected (using the input variable ICOND) and no heaters are fired, this file contains the actual temperatures at each location.

The next output file, YPN DATA, contains the amount of ice accretion at each node in the rectangular computational grid. Output going to this file is identified in the program by the variable IO8. The first column will contain the distance from the stagnation point in inches. The second column contains the amount of ice at that location. This file, along with the output file DICE DATA, was also useful in debugging the program. It is also useful for finding the maximum amount of ice accretion on the airfoil. This information is printed using the nodal locations used by DEICE.

The next data file, QENER DATA, contains the printed output of the terms in the accretion energy balance. Output going to this file is identified in the program by the variable IO9. These terms are calculated assuming no conduction into the airfoil. The first column contains the distance from the stagnation point in inches. The second column contains the amount of heat lost due to convection in watts per square meter. This set of units was used so that comparisons could be made between the relative importance of the heater wattage to these values. The third column contains the amount of heat gained from kinetic heating with the air. The fourth column contains the additional amount of kinetic heat gain due to the impinging water droplets. The fifth column is the amount of heat lost due to evaporation. The sixth column contains the sensible and latent heat transfer from the impinging supercooled water droplets. The seventh column contains the sensible and latent heat transfer from the water which enters this node from the previous node. For cases where there is a large amount of runback, this term will be larger than the previous value. The last column contains the sum of the previously described heat fluxes, and since conservation of energy applies, this value should always be very close to zero. This was done to check the program to see if indeed energy is conserved by the calculation.

The next output file, QPART DATA, contains the heat fluxes in the energy balance including conduction. Output going to this file is identified in the program by the variable IO10. The output format is the same as the previous data file, except for the last two. The next-to-the-last column is the heat flux due to conduction in the y-direction, and the last column is the sum of the heat fluxes, including conduction. If the last column is not zero, this represents the heat flux due to conduction in the x-direction.

The next output file, DICE DATA, contains the incremental amount of ice which will be added to the LEWICE ice shape once UTICE has completed a time-set of computations. Output going to this file is identified in the program by the variable IO11. The first column is the distance from the stagnation point in meters. The second column contains the amount of ice accretion, in meters, which is to be added in that time step. This is the same information which is printed in the file YPN DATA, except the information in DICE DATA is printed using the nodal spacing used in LEWICE. Again, a comparison of the values between these two output files can be made to check the interaction between the two programs.

The final output file, MASS DATA, contains the mass fluxes of each term in the accretion mass balance. Output going to this file is identified in the program by the variable IO12. The format of this output is the same as that found in the usual LEWICE output file EXAMPLE1 OUTPUT. The first column is the distance from the stagnation point in meters. The second column contains the heat flux through the ice-abrasion shield interface due to conduction. This is the same value as the conduction heat flux in the previous output file. This was included in this file to make the output have the same format as the usual LEWICE output. The third column contains the mass flux impinging at that location in kilograms per square meter. The fourth column contains the mass flux entering the control volume due to runback. The fifth column contains the mass flux lost due to evaporation. The sixth column contains the total mass flux entering the control volume, which is the sum of columns three and four. Finally, the last column contains the net mass flux remaining in the control volume, which is determined by subtracting column five from column six.

INTERACTIVE INPUT AND OUTPUT

In addition to the interactive input/output that the original version of LEWICE required, there are additional interactive requirements in the upgraded version. This is intended primarily as a convenience, since the interactive information asked for is mainly either a verification of input data, or for variables that may or may not be desired, depending upon the object/intent of that particular run. Only the added interactive requirements will be discussed here.

After asking for the standard LEWICE input, the program will access the subroutine WINPUT, which allows the user to check the input file before S24Y, the LEWICE flow module, is executed. In this subroutine, the user will be asked two questions. The first one will ask if the data printed on the screen is satisfactory, meaning that this is the data the user wishes to input. If the answer is no, the program will stop running and will prompt you to make the necessary changes in the input data file. In this manner, the user can see what data the program is reading in, so that the user knows that everything has been input in the required format. Before this feature was added, it was disappointing to see LEWICE complete the flow and trajectory modules only to come across an input error in the deicer module such that the run had to be manually stopped.

The second question asks the user if the rest of the data within that section should be viewed. Initially, it is useful to view all of the input information to familiarize the user with the data being input. The user is prompted for the answers to these two questions in each section of the data file. Later on, it is helpful to skip over these sections which have not been changed, so that the terminal input by the user is minimized.

At the start of routine UTICE in LEWICE, the subroutine SETTYP is accessed. SETTYP determines the type of plot options that the user wants. This routine will not be accessed unless the user selects parameter plots in the LEWICE plot options. This routine will then ask you to select from 10 plot options and up to 3 ways to plot those options. Only temperatures can be plotted as a function of y-direction, because this is the only one of the 10 which is a function of the y-direction.

Time dependent plots are limited to temperature, the total heat flux, and the runback mass flux because the others either did not depend upon time or provided no new information.

If a plot type is selected by the user which is the same as the type selected in the input data file using the variable IOTYPE, the user will be asked if these options are to be used for plotting as well. When specifying plot options, it is not necessary to respecify the values in the input data file INOUT DATA. If the option selected is not the default option, the program will prompt the user for the same type of input as the input data file asks for, namely layer numbers and positions, and time steps for output. If the plot style is different from the default value, the program will simply prompt the user for data to be input. The user is encouraged to use the default options, as this saves a significant amount of tedious inputting of values at the terminal. Care must be taken to input the data in the requested format. Inputting the data in the incorrect format may cause the program to plot nonexistent points.

The selection of the plot options is performed separately from the actual plotting of the data, so that the program only has to store those values which need to be plotted. This was done not to save on computational time, but to save on virtual memory space by allowing the arrays needed for the plotting routines to have a smaller value. This was necessary because the program does require a lot of virtual memory to store all of the information it generates. This program has been run on the University of Toledo's VAX system, so there should be no difficulty with installation of this upgrade to LEWICE on another VAX or larger system with a FORTRAN compiler. The prompts for the actual plotting of the data, such as the minima and maxima for the plot, are the same as for the existing LEWICE parameter plots. In addition, the program will give you the plot number and style immediately prior to plotting so that the user may keep track of which plot is being presented. Enter '0' and press RETURN to get rid of this message and to see the plot.

Provided in the next few pages are a sample of the screen messages and typical interactive input/output in a normally executed run for LEWICE with the electrothermal upgrade.

Sample Screen Messages and Typical Interactive Input/Output in a Normally Executed LEWICE Run with the Electrothermal Upgrade

FILE: MANUAL NWK A VM/SP CONVERSATIONAL MONITOR SYSTEM

```
Ready; T=0.01/0.06 08:34:29
iceb example1
DMKTDK355I DASD is being cleared
DASD 300 DEFINED 0030 CYL
DMSACP723I C (500) R/O
DMSLIO740I Execution begins...
TIME =  0.

ENTER DESIRED ICING TIME (SEC), (F10.1)
380.

ARE NEW PLOT OPTIONS DESIRED? (Y/N)
y

AVAILABLE PLOT OPTIONS
  0 - NO PLOTS
  1 - PARAMETER PLOTS ONLY
  2 - TRAJECTORY PLOTS ONLY
  3 - PARAMETER AND TRAJECTORY PLOTS
ENTER PLOT OPTION (I1)
1
THIS QUESTION WILL SKIP ALL ERROR CHECKING OF INPUT.
DO YOU WISH TO SEE ALL THE DATA IN THIS SECTION?
ANSWER Y OR N.
y

TOTAL NUMBER OF LAYERS                    L= 14
NUMBER OF HEATER SECTIONS                 NX= 23
IS THE INPUT DATA SATISFACTORY? ANSWER Y OR N.
y
COMPOSITE BODY DATA
DO YOU WISH TO SEE ALL THE DATA IN THIS SECTION?
ANSWER Y OR N.
y
# NODES    LENGTH(IN)       CONDUCTIVITY        DIFFUSIVITY     KY/KX
                           (BTU/FT*HR*F)        FT**2/HR
 5          0.07500       102.000000          2.830000
 3          0.01000         0.100000          0.005800
 5          0.05000       102.000000          2.830000
 3          0.01000         0.100000          0.005800
 4          0.02000         8.700000          0.150000
 2          0.00820         0.100000          0.005800
 4          0.01380         0.220000          0.008700
 4          0.00820         0.100000          0.005800
 4          0.00650        60.000000          1.150000
 4          0.00820         0.100000          0.005800
 4          0.01380         0.220000          0.008700
 4          0.00820         0.100000          0.005800
 6          0.03000         8.700000          0.150000
21          0.25000         1.290000          0.044600
     # NODES     LENGTH(IN)        CONDUCTIVITY        DIFFUSIVITY
                                  (BTU/FT*HR*F)        FT**2/HR
       8          5.50000           0.100000            0.005800
       4          1.00000          60.000000            1.150000
       3          0.06100           0.100000            0.005800
```

```
 4     1.00000     60.000000     1.150000
 3     0.06100      0.100000     0.005800
 8     1.00000     60.000000     1.150000
 3     0.06100      0.100000     0.005800
14     1.00000     60.000000     1.150000
 3     0.06100      0.100000     0.005800
26     1.00000     60.000000     1.150000
 3     0.06100      0.100000     0.005800
41     1.00000     60.000000     1.150000
 3     0.06100      0.100000     0.005800
26     1.00000     60.000000     1.150000
 3     0.06100      0.100000     0.005800
14     1.00000     60.000000     1.150000
 3     0.06100      0.100000     0.005800
 8     1.00000     60.000000     1.150000
 3     0.06100      0.100000     0.005800
 4     1.00000     60.000000     1.150000
 3     0.06100      0.100000     0.005800
 4     1.00000     60.000000     1.150000
 8     6.50000      0.100000     0.005800
IS THE INPUT DATA SATISFACTORY? ANSWER Y OR N.
n
PLEASE CHANGE THE FILE DEICE3 DATA
TO REFLECT THE PROPER DATA AND RERUN THE CASE.
IT IS NOT NECESSARY TO RECOMPILE.
DASD 500  DETACHED


LEWICE IS NOW COMPLETE. REMEMBER TO ERASE THE RESTART FILE.
Ready; T=0.47/0.95 08:37:03
hardcopy off  manual nwk
```

```
Ready; T=0.02/0.07 15:33:40
iceb exampiel
DASD is being cleared
DASD 300 DEFINED 0030 CYL
195 replaces G (195)
C (500) R/O
Execution begins...
TIME =  0.

ENTER DESIRED ICING TIME (SEC), (F10.1)
250.

ARE NEW PLOT OPTIONS DESIRED? (Y/N)
y

AVAILABLE PLOT OPTIONS
  0 - NO PLOTS
  1 - PARAMETER PLOTS ONLY
  2 - TRAJECTORY PLOTS ONLY
  3 - PARAMETER AND TRAJECTORY PLOTS
ENTER PLOT OPTION (I1)
1
THIS QUESTION WILL SKIP ALL ERROR CHECKING OF INPUT.
DO YOU WISH TO SEE ALL THE DATA IN THIS SECTION?
ANSWER Y OR N.
y

TOTAL NUMBER OF LAYERS                    L= 14
NUMBER OF HEATER SECTIONS                 NX= 23
IS THE INPUT DATA SATISFACTORY? ANSWER Y OR N.
y
COMPOSITE BODY DATA
DO YOU WISH TO SEE ALL THE DATA IN THIS SECTION?
ANSWER Y OR N.
y
# NODES    LENGTH(IN)       CONDUCTIVITY         DIFFUSIVITY     KY/KX
                          (BTU/FT*HR*F)        FT**2/HR
 5          0.07500       102.000000           2.830000
 3          0.01000         0.100000           0.005800
 5          0.05000       102.000000           2.830000
 3          0.01000         0.100000           0.005800
 4          0.02000         8.700000           0.150000
 2          0.00820         0.100000           0.005800
 4          0.01380         0.220000           0.008700
 4          0.00820         0.100000           0.005800
 4          0.00650        60.000000           1.150000
 4          0.00820         0.100000           0.005800
 4          0.01380         0.220000           0.008700
 4          0.00820         0.100000           0.005800
 6          0.03000         8.700000           0.150000
21          0.25000         1.290000           0.044600
     # NODES      LENGTH(IN)         CONDUCTIVITY         DIFFUSIVITY
                                    (BTU/FT*HR*F)        FT**2/HR
      8           6.50000              0.100000            0.005800
      4           1.00000             60.000000            1.150000
```

```
        3          0.06100            0.100000          0.005800
        4          1.00000           60.000000          1.150000
        3          0.06100            0.100000          0.005800
        8          1.00000           60.000000          1.150000
        3          0.06100            0.100000          0.005800
       14          1.00000           60.000000          1.150000
        3          0.06100            0.100000          0.005800
       26          1.00000           60.000000          1.150000
        3          0.06100            0.100000          0.005800
       41          1.00000           60.000000          1.150000
        3          0.06100            0.100000          0.005800
       26          1.00000           60.000000          1.150000
        3          0.06100            0.100000          0.005800
       14          1.00000           60.000000          1.150000
        3          0.06100            0.100000          0.005800
        8          1.00000           60.000000          1.150000
        3          0.06100            0.100000          0.005800
        4          1.00000           60.000000          1.150000
        3          0.06100            0.100000          0.005800
        4          1.00000           60.000000          1.150000
        8          6.50000            0.100000          0.005800
IS THE INPUT DATA SATISFACTORY? ANSWER Y OR N.
y
INTERNAL HEAT GENERATION IN SLAB NUMBER          JJ=  9
                                BETWEEN NODE    NO1= 24
                                   AND NODE     NO2= 27
HEATER DATA
DO YOU WISH TO SEE ALL THE DATA IN THIS SECTION?
ANSWER Y OR N.
y

     1          30.00000          5.00000        60.00000        120.00000

     2          30.00000         60.00000        60.00000        120.00000

     3          30.00000          5.00000        60.00000        120.00000

STEP FUNCTION HEAT INPUT IN WATTS/IN*IN
IS THE INPUT DATA SATISFACTORY? ANSWER Y OR N.
y

FULL ACCRETION BALANCE IS USED AT TOP SURFACE


COMPOSITE BODY TEMPERATURES ARE INITIALIZED

O THE ACCRETION BALANCE TEMPERATURE PROFILE


CONDUCTION INTO THE BLADE IS NOT CONSIDERED BEFORE THE HEATER(S) TURN ON.

SHEDDING OF ICE IS CONSIDERED

IS THE INPUT DATA SATISFACTORY? ANSWER Y OR N.
y
```

```
PHYSICAL PROPERTY DATA
DO YOU WISH TO SEE ALL THE DATA IN THIS SECTION?
ANSWER Y OR N.
y


CONVECTION OCCURS       AT  J=1
          AMBIENT TEMPERAT URE      TG1=      9.400000DEG.F
          HEAT TRANSFER COEFF.      H1 =       1.000000B.T.U/HR.FT.FT.DEG.F
INSULATED BOUNDARY CONDITION ON LEFT SIDE.

INSULATED BOUNDARY CONDITION ON RIGHT SIDE.



THE PHASE CHANGE IN THE ICE LAYER IS CONSIDERED

LATENT HEAT OF ICE                         HLAM =   143.399994B.T.U./LB
THERMAL CONDUCTIVITY OF WATER              AKL  =     0.320000B.T.U./HR.FT.DEG.F
DENSITY OF WATER                           DEL  =    62.399994LB/CU.FT
SPECIFIC HEAT * DENSITY OF WATER           CPL  =    62.212799B.T.U./CU.FT.DEG.F
DENSITY OF ICE                             DES  =    57.399994LB/CU.FT.
THE MELTING TEMPERATURE                    TMP  =    32.000000DEG.F

ICE MELTING RANGE                          TR   =     0.000010DEG.F
HEAT OF VAPORIZATION                      HVAP =  1075.159910 BTU/LB
HEAT CAPACITY OF AIR                     CPAIR =     0.250000 BTU/LB*DEG F
NUMBER OF POINTS IN ICE SHAPE APPROXIMATION  NP =  2
      X-COORDINATE XP =   0.00000        Y-COORDINATE YP =   0.00000
      X-COORDINATE XP =  30.37717        Y-COORDINATE YP =   0.00000
AMBIENT TEMPERATURE,TINF =    9.320 DEG. F
LIQUID WATER CONTENT,LWC =    0.5000 G/M**3
AMBIENT VELOCITY,VINF =  424.737549 FT/S
DROPLET DIAMETER,DROP =   20.0000 MICRONS
AMBIENT PRESSURE,PINF =   13.161913 PSI
ANGLE OF ATTACK,ALPHA =   0.000 DEG
IS THE INPUT DATA SATISFACTORY? ANSWER Y OR N.
y
TIME STEP AND DEFAULT PLOT OPTIONS
DO YOU WISH TO SEE ALL THE DATA IN THIS SECTION?
ANSWER Y OR N.
y

INITIAL TIME STEP                               DTAUI =     0.100000SECS
                          FOR TIME STEPS NISP   = 10
INTERMIDIATE TIME STEP                          DTAUM =     0.100000SECS
                           FOR TIME STEPS NMSP  =100
FINAL TIME STEP                                 DTAUF =     0.100000SECS
NUMBER OF SECONDS IN THE SIMULATION         TIMEOUT =      250.0000 SEC
MAXIMUM NUMBER OF ITERATIONS FOR PHASE ROUTINE  JCOUNT =  20


X-Y COORDINATES OF THE ICE SHAPE WILL BE PRINTED OUT
AT THE FOLLOWING TIME STEPS
         1200
```

```
        1800
        2400
        2500
X-LAYER  WHERE(L-M-R)  Y-LAYER  WHERE(B-M-T)

   8        M             9        T
   8        M            13        T
  10        M             9        T
  10        M            13        T
  12        M             9        T
  12        M            13        T
  14        M             9        T
  14        M            13        T
  16        M             9        T
  16        M            13        T
IS THE INPUT DATA SATISFACTORY? ANSWER Y OR N.
y

THE POTENTIAL FLOW FIELD IS NOW BEING CALCULATED

     XO          YO                         XP        YP        S         DT

    UPPER SURFACE LIMIT          LOWER SURFACE LIMIT
     YOU           SU           YOL           SL
  0.1114E-01    0.4066E-01   -0.1115E-01   -0.4093E-01


        AVAILABLE PLOT OPTIONS
          0  -  NO PLOTS
          1  -  TEMPERATURE
          2  -  HEAT FLUX DUE TO CONVECTION
          3  -  HEAT FLUX DUE TO KINETIC HEATING
          4  -  HEAT FLUX DUE TO EVAPORATION
          5  -  HEAT FLUX DUE TO SENSIBLE HEAT
          6  -  HEAT FLUX DUE TO LATENT HEAT
          7  -  NET HEAT FLUX AT SURFACE
          8  -  IMPINGING MASS FLUX
          9  -  MASS FLUX DUE TO EVAPORATION
          10 -  MASS FLUX DUE TO RUNBACK
  ENTER OPTION NUMBER (I2)
01

        SECONDARY PLOT OPTIONS
          THE Y-DIRECTION IS NORMAL TO THE BLADE SURFACE
          0  -  NO PLOTS
          1  -  TIME DEPENDANT PLOTS AT A SPECIFIED X,Y LOCATION
          2  -  CHORD DEPENDANT PLOTS AT A SPECIFIED Y AND TIME
          3  -  Y-DEPENDANT PLOTS AT A SPECIFIED CHORD AND TIME
  ENTER OPTION NUMBER (I2)
03
THE VALUE OF IOTYP IS NOT EQUAL TO THE DEFAULT VALUE
GIVEN IN THE INPUT DATA SET (DEICE3 DATA).
IF THE VALUE INPUT HERE IS GOING TO BE USED MORE OFTEN,
IT IS STRONGLY RECOMMENDED THAT YOU CHANGE THE DEFAULT VALUE.
```

```
THERE ARE 2500 TIMESTEPS IN THE SIMULATION

HERE ARE 23 SECTIONS IN THE X-DIRECTION
HEATER   1 IS IN SECTION  10
HEATER   2 IS IN SECTION  12
HEATER   3 IS IN SECTION  14

INPUT THE LAYER IN THE X-DIRECTION THAT YOU WISH TO PLOT
FORMAT I2
12
INPUT WHICH POINT (LEFT [L], MIDDLE [M], OR RIGHT[R]) YOU WISH TO PLOT
FORMAT A1
m

INPUT THE TIME STEP AT WHICH YOU WANT THE DATA PLOTTED
FORMAT I5
2400
DO YOU WISH TO INPUT ANOTHER PAIR OF POINTS? (Y OR N)
n

         SECONDARY PLOT OPTIONS
           THE Y-DIRECTION IS NORMAL TO THE BLADE SURFACE
           0  -  NO PLOTS
           1  -  TIME DEPENDANT PLOTS AT A SPECIFIED X,Y LOCATION
           2  -  CHORD DEPENDANT PLOTS AT A SPECIFIED Y AND TIME
           3  -  Y-DEPENDANT PLOTS AT A SPECIFIED CHORD AND TIME
  ENTER OPTION NUMBER (I2)
00

         AVAILABLE PLOT OPTIONS
           0  -  NO PLOTS
           1  -  TEMPERATURE
           2  -  HEAT FLUX DUE TO CONVECTION
           3  -  HEAT FLUX DUE TO KINETIC HEATING
           4  -  HEAT FLUX DUE TO EVAPORATION
           5  -  HEAT FLUX DUE TO SENSIBLE HEAT
           6  -  HEAT FLUX DUE TO LATENT HEAT
           7  -  NET HEAT FLUX AT SURFACE
           8  -  IMPINGING MASS FLUX
           9  -  MASS FLUX DUE TO EVAPORATION
           10 -  MASS FLUX DUE TO RUNBACK
  ENTER OPTION NUMBER (I2)
00

         SECONDARY PLOT OPTIONS
           THE Y-DIRECTION IS NORMAL TO THE BLADE SURFACE
           0  -  NO PLOTS
           1  -  TIME DEPENDANT PLOTS AT A SPECIFIED X,Y LOCATION
           2  -  CHORD DEPENDANT PLOTS AT A SPECIFIED Y AND TIME
           3  -  Y-DEPENDANT PLOTS AT A SPECIFIED CHORD AND TIME
  ENTER OPTION NUMBER (I2)
00
TIME =     120.00 SEC
TIME =     122.00 SEC
TIME =     124.00 SEC
```

```
TIME =     126.00 SEC
TIME =     128.00 SEC
TIME =     130.00 SEC
TIME =     132.00 SEC
TIME =     134.00 SEC
TIME =     136.00 SEC
TIME =     138.00 SEC
TIME =     140.00 SEC
TIME =     142.00 SEC
TIME =     144.00 SEC
TIME =     146.00 SEC
TIME =     148.00 SEC
TIME =     150.00 SEC
TIME =     152.00 SEC
TIME =     154.00 SEC
TIME =     156.00 SEC
TIME =     158.00 SEC
TIME =     160.00 SEC
TIME =     162.00 SEC
TIME =     164.00 SEC
TIME =     166.00 SEC
TIME =     168.00 SEC
TIME =     170.00 SEC
TIME =     172.00 SEC
TIME =     174.00 SEC
TIME =     176.00 SEC
TIME =     178.00 SEC
TIME =     180.00 SEC
TIME =     182.00 SEC
TIME =     184.00 SEC
TIME =     186.00 SEC
TIME =     188.00 SEC
TIME =     190.00 SEC
TIME =     192.00 SEC
TIME =     194.00 SEC
TIME =     196.00 SEC
TIME =     198.00 SEC
TIME =     200.00 SEC
TIME =     202.00 SEC
TIME =     204.00 SEC
TIME =     206.00 SEC
TIME =     208.00 SEC
TIME =     210.00 SEC
TIME =     212.00 SEC
TIME =     214.00 SEC
TIME =     216.00 SEC
TIME =     218.00 SEC
TIME =     220.00 SEC
TIME =     222.00 SEC
TIME =     224.00 SEC
TIME =     226.00 SEC
TIME =     228.00 SEC
TIME =     230.00 SEC
TIME =     232.00 SEC
TIME =     234.00 SEC
```

```
TIME =    236.00 SEC
TIME =    238.00 SEC
TIME =    240.00 SEC
TIME =    242.00 SEC
TIME =    244.00 SEC
TIME =    246.00 SEC
TIME =    248.00 SEC
TIME =    250.00 SEC
DEICER OUTPUT PLOT NUMBER   1 TYPE #   1
ENTER 0 AND HIT RETURN TO CONTINUE
0
Graphics device NOT assigned.
ENTER desired device name or HELP HELP.
CEGDIN100R DEFAULT to CANCEL.
b77b1t
Device B77B1T attached.
```

```
PLOT #   1 OF VARIABLE =   1 DEP. VARIABLE #   1
 MAXIMUM VALUES: TIME (S)        0.25000E+03 T (F)          0.83724E+02

 MINIMUM VALUES: TIME (S)        0.00000E+00 T (F)          0.00000E+00

 ENTER MAXIMUM X-AXIS VALUE.
300.
 ENTER MINIMUM X-AXIS VALUE.
0.
 ENTER MAXIMUM Y-AXIS VALUE.
300.
 ENTER MINIMUM Y-AXIS VALUE.
0.
 IF YOU WOULD LIKE A DIFFERENT SCALE, ENTER 1.
 IF NOT, ENTER 0.
10
PLOT #   2 OF VARIABLE =   1 DEP. VARIABLE #   1
 MAXIMUM VALUES: TIME (S)        0.25000E+03 T (F)          0.83724E+02

 MINIMUM VALUES: TIME (S)        0.00000E+00 T (F)          0.00000E+00

 ENTER MAXIMUM X-AXIS VALUE.
300.
 ENTER MINIMUM X-AXIS VALUE.
0.
 ENTER MAXIMUM Y-AXIS VALUE.
300.
 ENTER MINIMUM Y-AXIS VALUE.
0.
```

```
 IF YOU WOULD LIKE A DIFFERENT SCALE, ENTER 1.
 IF NOT, ENTER 0.
0
PLOT #    1 OF VARIABLE #    1 DEP. VARIABLE #    1
 MAXIMUM VALUES: TIME (S)        0.25000E+03 T (F)              0.16628E+03

 MINIMUM VALUES: TIME (S)        0.00000E+00 T (F)              0.00000E+00

 ENTER MAXIMUM X-AXIS VALUE.
300.
 ENTER MINIMUM X-AXIS VALUE.
0.
 ENTER MAXIMUM Y-AXIS VALUE.
300.
 ENTER MINIMUM Y-AXIS VALUE.
0.
 IF YOU WOULD LIKE A DIFFERENT SCALE, ENTER 1.
 IF NOT, ENTER 0.
0
PLOT #    1 OF VARIABLE #    1 DEP. VARIABLE #    1
 MAXIMUM VALUES: TIME (S)        0.25000E+03 T (F)              0.37921E-02

 MINIMUM VALUES: TIME (S)        0.00000E+00 T (F)              0.00000E+00

 ENTER MAXIMUM X-AXIS VALUE.
300.
 ENTER MINIMUM X-AXIS VALUE.
0.
 ENTER MAXIMUM Y-AXIS VALUE.
300.
 ENTER MINIMUM Y-AXIS VALUE.
0.
 IF YOU WOULD LIKE A DIFFERENT SCALE, ENTER 1.
 IF NOT, ENTER 0.
0.
PLOT #    1 OF VARIABLE #    1 DEP. VARIABLE #    1
 MAXIMUM VALUES: TIME (S)        0.25000E+03 T (F)              0.27000E+02

 MINIMUM VALUES: TIME (S)        0.00000E+00 T (F)              0.00000E+00

 ENTER MAXIMUM X-AXIS VALUE.
300.
 ENTER MINIMUM X-AXIS VALUE.
0.
 ENTER MAXIMUM Y-AXIS VALUE.
300.
 ENTER MINIMUM Y-AXIS VALUE.
0.
 IF YOU WOULD LIKE A DIFFERENT SCALE, ENTER 1.
 IF NOT, ENTER 0.
0.
PLOT #    1 OF VARIABLE #    1 DEP. VARIABLE #    1
 MAXIMUM VALUES: TIME (S)        0.25000E+03 T (F)              0.23046E-02

 MINIMUM VALUES: TIME (S)        0.00000E+00 T (F)              0.00000E-00
```

```
 ENTER MAXIMUM X-AXIS VALUE.
300.
 ENTER MINIMUM X-AXIS VALUE.
0.
 ENTER MAXIMUM Y-AXIS VALUE.
300.
 ENTER MINIMUM Y-AXIS VALUE.
0.
 IF YOU WOULD LIKE A DIFFERENT SCALE, ENTER 1.
 IF NOT, ENTER 0.
0.
DEICER OUTPUT PLOT NUMBER   2 TYPE #   1
ENTER 0 AND HIT RETURN TO CONTINUE
0


  NACA 0012  : EXAMPLE 1         : TIME= 250.000 SEC

 ICING CONDITION:

      STATIC TEMPERATURE (C)            260.55
      STATIC PRESSURE (PA)            90748.00
      VELOCITY (M/S)                    129.46
      LWC (G/M**3)                        0.50
      DROPLET DIAMETER (MICRONS)         20.00


 ICE ACCRETION DATA:

      STAGNATION POINT                     70
      TRANSITION POINTS (LOWER,UPPER)      68       71
      ICING LIMITS (LOWER,UPPER)           42       98
      NUMBER OF POINTS                    139
      NUMBER OF SEGMENTS ADDED              0

        AVAILABLE PLOT OPTIONS
          0  -  NO PLOTS
          1  -  ICED GEOMETRY
          2  -  YO VS S
          3  -  BETA VS S
          4  -  VE VS S
          5  -  TE VS S
          6  -  PE VS S
          7  -  TSURF VS S
          8  -  HTC VS S
          9  -  XK VS S
          10 -  ICE DENSITY VS S
          11 -  FFRAC VS S
  ENTER OPTION NUMBER (I2)
01

ENTER PERCENT OF GEOMETRY TO BE PLOTTED (F10.0)
15.
```

```
        AVAILABLE PLOT OPTIONS
          0  -  NO PLOTS
          1  -  ICED GEOMETRY
          2  -  YO VS S
          3  -  BETA VS S
          4  -  VE VS S
          5  -  TE VS S
          6  -  PE VS S
          7  -  TSURF VS S
          8  -  HTC VS S
          9  -  XK VS S
          10 -  ICE DENSITY VS S
          11 -  FFRAC VS S
 ENTER OPTION NUMBER (I2)
08
 MAXIMUM VALUES: S=    0.54419,  HTC    1236.27612
 MINIMUM VALUES: S=   -0.54361,  HTC       0.00000

 ENTER MAXIMUM X-AXIS VALUE.
0.2
 ENTER MINIMUM X-AXIS VALUE.
-0.2
 ENTER MAXIMUM Y-AXIS VALUE.
1300.
 ENTER MINIMUM Y-AXIS VALUE.
0.
ENTER 1 IF EXPERIMENTAL DATA IS TO BE PLOTTED
IF NOT, ENTER 0
0
 IF YOU WOULD LIKE A DIFFERENT SCALE, ENTER 1.
 IF NOT, ENTER 0.
0

        AVAILABLE PLOT OPTIONS
          0  -  NO PLOTS
          1  -  ICED GEOMETRY
          2  -  YO VS S
          3  -  BETA VS S
          4  -  VE VS S
          5  -  TE VS S
          6  -  PE VS S
          7  -  TSURF VS S
          8  -  HTC VS S
          9  -  XK VS S
          10 -  ICE DENSITY VS S
          11 -  FFRAC VS S
 ENTER OPTION NUMBER (I2)
03
 MAXIMUM VALUES: S=    0.54419, BETA       0.64460
 MINIMUM VALUES: S=   -0.54361, BETA       0.00000

 ENTER MAXIMUM X-AXIS VALUE.
0.2
 ENTER MINIMUM X-AXIS VALUE.
-0.2
```

```
 ENTER MAXIMUM Y-AXIS VALUE.
1.0
 ENTER MINIMUM Y-AXIS VALUE.
0.0
ENTER 1 IF EXPERIMENTAL DATA IS TO BE PLOTTED
IF NOT, ENTER 0

 IF YOU WOULD LIKE A DIFFERENT SCALE, ENTER 1.
 IF NOT, ENTER 0.
0

         AVAILABLE PLOT OPTIONS
           0  -  NO PLOTS
           1  -  ICED GEOMETRY
           2  -  YO VS S
           3  -  BETA VS S
           4  -  VE VS S
           5  -  TE VS S
           6  -  PE VS S
           7  -  TSURF VS S
           8  -  HTC VS S
           9  -  XK VS S
           10 -  ICE DENSITY VS S
           11 -  FFRAC VS S
  ENTER OPTION NUMBER (I2)
00

 TIME STEP COMPLETE: TIME=  250.000

 ICING TIME INPUT HAS BEEN REACHED

 PROGRAM OPTIONS
   1 - CONTINUE ICING, USE PREVIOUS FLOW FIELD
   2 - CONTINUE ICING, CALCULATE NEW FLOW FIELD
   3 - TERMINATE PROGRAM
3

 MESSAGE SUMMARY: MESSAGE NUMBER - COUNT

                                209     511  OR OVER
PRT FILE 0411  TO  LRCG3D   COPY 001   NOHOLD
Device DISCONNECTED from VM/GRAPH3D.
DASD 500  DETACHED


17:49:43


MSG FROM LRCG3D  : GRAPH3D PLOT SENT TO B77B1_TALARIS


LEWICE IS NOW COMPLETE. REMEMBER TO ERASE THE RESTART FILE.
Ready; T=549.76/1168.92 17:49:49
hardcopy off manual exampl
```

```
NACA 0012  : EXAMPLE 1
&S24Y
ILIFT= 1
IPARA= 1
IFIRST= 3
ISECND= 3
IPVOR= 1
INCLT= 0
CLT= 0.0
ICHORD= 0
CCL= 0.0
IND= 1
ISOL= 0
IPRINT= 0
IFLLL= 1
&END
  1.0000000   0.9899999   0.9800000   0.9700000   0.9500000   0.9250000  6 0 3
  0.9000000   0.8750000   0.8500000   0.8250000   0.8000000   0.7750000  6 0 3
  0.7500000   0.7250000   0.7000000   0.6750000   0.6500000   0.6250000  6 0 3
  0.6000000   0.5750000   0.5500000   0.5250000   0.5000000   0.4750000  6 0 3
  0.4500000   0.4250000   0.4000000   0.3750000   0.3500000   0.3250000  6 0 3
  0.3000000   0.2750000   0.2500000   0.2250000   0.2000000   0.1750000  6 0 3
  0.1500000   0.1250000   0.1000000   0.0900000   0.0800000   0.0700000  6 0 3
  0.0600000   0.0500000   0.0450000   0.0400000   0.0350000   0.0300000  6 0 3
  0.0250000   0.0200000   0.0150000   0.0100000   0.0075000   0.0050000  6 0 3
  0.0037500   0.0025000   0.0022500   0.0020000   0.0017500   0.0015000  6 0 3
  0.0012500   0.0010000   0.0008750   0.0007500   0.0006250   0.0005000  6 0 3
  0.0003750   0.0002500   0.0001250   0.0000000   0.0001250   0.0002500  6 0 3
  0.0003750   0.0005000   0.0006250   0.0007500   0.0008750   0.0010000  6 0 3
  0.0012500   0.0015000   0.0017500   0.0020000   0.0022500   0.0025000  6 0 3
  0.0037500   0.0050000   0.0075000   0.0100000   0.0150000   0.0200000  6 0 3
  0.0250000   0.0300000   0.0350000   0.0400000   0.0450000   0.0500000  6 0 3
  0.0600000   0.0700000   0.0800000   0.0900000   0.1000000   0.1250000  6 0 3
  0.1500000   0.1750000   0.2000000   0.2250000   0.2500000   0.2750000  6 0 3
  0.3000000   0.3250000   0.3500000   0.3750000   0.4000000   0.4250000  6 0 3
  0.4500000   0.4750000   0.5000000   0.5250000   0.5500000   0.5750000  6 0 3
  0.6000000   0.6250000   0.6500000   0.6750000   0.7000000   0.7250000  6 0 3
  0.7500000   0.7750000   0.8000000   0.8250000   0.8500000   0.8750000  6 0 3
  0.9000000   0.9250000   0.9500000   0.9700000   0.9800000   0.9899999  6 0 3
  1.0000000   0.0000000   0.0000000   0.0000000   0.0000000   0.0000000  1 1 3
  0.0000000  -0.0018740  -0.0036110  -0.0052390  -0.0082510  -0.0117000  6 0 4
 -0.0149080  -0.0179530  -0.0208880  -0.0237390  -0.0265150  -0.0292210  6 0 4
 -0.0318550  -0.0344110  -0.0368870  -0.0392810  -0.0415850  -0.0437950  6 0 4
 -0.0459040  -0.0479060  -0.0497930  -0.0515600  -0.0531980  -0.0546980  6 0 4
 -0.0560510  -0.0572430  -0.0582620  -0.0590900  -0.0597070  -0.0600940  6 0 4
 -0.0602260  -0.0600760  -0.0596120  -0.0587940  -0.0575700  -0.0558790  6 0 4
 -0.0536360  -0.0507320  -0.0470040  -0.0452280  -0.0432520  -0.0410380  6 0 4
 -0.0385350  -0.0356740  -0.0340820  -0.0323620  -0.0304960  -0.0284620  6 0 4
 -0.0262300  -0.0237260  -0.0207970  -0.0172480  -0.0150780  -0.0123860  6 0 4
 -0.0106990  -0.0086200  -0.0081360  -0.0076230  -0.0070750  -0.0064850  6 0 4
 -0.0058470  -0.0051460  -0.0047660  -0.0043630  -0.0039310  -0.0034620  6 0 4
 -0.0029450  -0.0023560  -0.0016320   0.0000000   0.0016320   0.0023560  6 0 4
  0.0029450   0.0034620   0.0039310   0.0043630   0.0047660   0.0051460  6 0 4
  0.0058470   0.0064850   0.0070750   0.0076230   0.0081360   0.0086200  6 0 4
  0.0106990   0.0123860   0.0150780   0.0172480   0.0207970   0.0237260  6 0 4
```

```
  0.0262300   0.0284620   0.0304960   0.0323620   0.0340820   0.0356740  6 0 4
  0.0385350   0.0410380   0.0432520   0.0452280   0.0470040   0.0507320  6 0 4
  0.0536360   0.0558790   0.0575700   0.0587940   0.0596120   0.0600760  6 0 4
  0.0602260   0.0600940   0.0597070   0.0590900   0.0582620   0.0572430  6 0 4
  0.0560510   0.0546980   0.0531980   0.0515600   0.0497930   0.0479060  6 0 4
  0.0459040   0.0437950   0.0415850   0.0392810   0.0368870   0.0344110  6 0 4
  0.0318550   0.0292210   0.0265150   0.0237390   0.0208880   0.0179530  6 0 4
  0.0149080   0.0117000   0.0082510   0.0052390   0.0036110   0.0018740  6 0 4
  0.0000000   0.0000000   0.0000000   0.0000000   0.0000000   0.0000000  1 1 4
&TRAJ1
GEPS= 0.4999999E-04
DSHIFT= 0.20E-02
VEPS= 0.9999999E-03
LCMB= 0
LCMP= 0
LEQM= 1
LSYM= 0
LYOR= 1
LXOR= 1
NBDY= 1
NEQ= 4
NPL= 15
NSEAR= 50
NSI- 1
TIMSTP= 0.9999999E-03
&END
&TRAJ2
CHORD= 0.5334
G= 0.0
PIT= 0.0
PITDOT= 0.0
PRATK= 0.0
XORC= -4.0
XSTOP= 0.50
YOLIM= 0.9999999E-04
YOMAX= 0.50E-01
YOMIN= -0.50E-01
YORC= 0.9999996E-01
&END
&DIST
FLWC= 1.0, 9*0.0
DPD= 20.0, 9*0.0
CFP= 1.0, 9*0.0
&END
&ICE
VINF= 129.46000000
LWC= 0.500
TAMB= 260.5500
PAMB= 90748.000
RH= 100.0
DPMM= 20.0
XKINIT= 0.00035
SEGTOL= 1.50
&END
```

```
---------------------------------------------------------------------
                 DATA    FOR    THE    COMPOSITE    BODY
---------------------------------------------------------------------
    THIS IS THE FIRST OF FIVE DATA FILES USED FOR PROGRAM NASAUT.
    BODY - HEAT - BOUND - PROP - INOUT DATA FILES ARE CURRENTLY USED.
      COMMENTS:
    LAYERS IN THE Y-DIRECTION MAKE UP THE DIFFERENT MATERIALS IN THE
DEICER - ABRASION SHIELD, INSULATION, HEATER, ETC.
    SECTIONS IN THE X-DIRECTION ALLOW FOR DIFFERENT PHYSICAL PROPERTIES
ONLY IN THE HEATER LAYER, I.E., HEATER-GAP-HEATER. NODAL STRUCTURE
(DX) IS USED IN EVERY LAYER.
    MAKE SURE THE NUMBER OF LAYERS (VALUE OF L) EQUALS THE NUMBER OF
LINES OF DATA PROVIDED. THE SAME GOES FOR THE NUMBER OF HEATER SECTIONS.
    IF ICE IS CONSIDERED, IT IS THE TOP LAYER. THE LENGTH (THICKNESS) OF
THE TOP LAYER GIVEN HERE IS USED ONLY TO DETERMINE DY IN THE ICE LAYER.
THE ACTUAL THICKNESS OF THE ICE IS GIVEN INITALLY IN THE PROP DATA FILE.
ICE THICKNESS DURING THE SIMULATION IS GIVEN BY THE ACCRETION ALGORITHM.
    LIMITS ON INPUT: 190 NODES IN Y-DIRECTION (ACTUAL NODES USED =
NUMBER INPUT - NUMBER OF LAYERS + 2). LIMIT OF 29 LAYERS IN Y-DIRECTION
LIMIT OF 190 NODES IN X-DIRECTION (NO DOUBLE COUNTING AS ABOVE). LIMIT
OF 29 SECTIONS IN X-DIRECTION (TOTAL OF HEATERS + GAPS).
---------------------------------------------------------------------
TOTAL NUMBER OF LAYERS IN THE Y-DIRECTION              L= 014
TOTAL NUMBER OF HEATER SECTIONS IN THE X-DIRECTION    NX= 023
DATA FOR EACH LAYER:
----------------
 # OF       LENGTH          CONDUCTIVITY          DIFFUSIVITY
 NODES       (IN)           (BTU/FT*HR*F)         (FT**2/HR)
 05 ALM   0000.07500       000102.000000          000002.830000
 03 ADH   0000.01000       000000.100000          000000.005800
 05 ALM   0000.05000       000102.000000          000002.830000
 03 ADH   0000.01000       000000.100000          000000.005800
 04 STL   0000.02000       000008.700000          000000.150000
 02 ADH   0000.00820       000000.100000          000000.005800
 04 INS   0000.01380       000000.220000          000000.008700
 04 ADH   0000.00820       000000.100000          000000.005800
 04 HTR   0000.00650       000060.000000          000001.150000
 04 ADH   0000.00820       000000.100000          000000.005800
 04 INS   0000.01380       000000.220000          000000.008700
 04 ADH   0000.00820       000000.100000          000000.005800
 06 STL   0000.03000       000008.700000          000000.150000
 21 ICE   0000.25000       000001.290000          000000.044600
DATA FOR EACH HEATER/GAP SECTION:
--------------------------------
     # OF        LENGTH            CONDUCTIVITY          DIFFUSIVITY
     NODES        (IN)             (BTU/FT*HR*F)          (FT**2/HR)
G     08       0006.50000          000000.100000         000000.005800
H 1   04       0001.00000          000060.000000         000001.150000
G     03       0000.06100          000000.100000         000000.005800
H 2   04       0001.00000          000060.000000         000001.150000
G     03       0000.06100          000000.100000         000000.005800
H 3   08       0001.00000          000060.000000         000001.150000
G     03       0000.06100          000000.100000         000000.005800
H 4   14       0001.00000          000060.000000         000001.150000
G     03       0000.06100          000000.100000         000000.005800
```

```
H 5     26     0001.00000     000060.000000     000001.150000
G       03     0000.06100     000000.100000     000000.005800
H 6     41     0001.00000     000060.000000     000001.150000
G       03     0000.06100     000000.100000     000000.005800
H 7     26     0001.00000     000060.000000     000001.150000
G       03     0000.06100     000000.100000     000000.005800
H 8     14     0001.00000     000060.000000     000001.150000
G       03     0000.06100     000000.100000     000000.005800
H 9     08     0001.00000     000060.000000     000001.150000
G       03     0000.06100     000000.100000     000000.005800
H 10    04     0001.00000     000060.000000     000001.150000
G       03     0000.06100     000000.100000     000000.005800
H 11    04     0001.00000     000060.000000     000001.150000
G       08     0006.50000     000000.100000     000000.005800
---------------------------------------------------------------------
                     DATA   FOR   THE   HEATER
---------------------------------------------------------------------
    THIS IS THE SECOND OF FIVE DATA FILES USED FOR THE PROGRAM DEICE3.
    BODY - HEAT - BOUND - PROP - INOUT DATA FILES ARE CURRENTLY USED.
       COMMENTS:
        IF NO HEAT SOURCE IS PRESENT                        IH  = 1
        IF POINT HEAT SOURCE IS PRESENT                     IH  = 2
        IF INTERNAL HEAT GENERATION IN A SLAB OCCURS        IH  = 3
        IF CONSTANT HEAT INPUT IS USED                      IHQ = 1
        IF STEP FUNCTION HEAT INPUT IS USED                 IHQ = 2
        IF RAMP FUNCTION HEAT INPUT IS USED                 IHQ = 3
        IF SINE FUNCTION HEAT INPUT IS USED                 IHQ = 4
---------------------------------------------------------------------
   IF USING A POINT HEAT SOURCE, THE VALUE OF IJ IS NOT USED. IF USING A
FINITE THICKNESS HEATER, THE VALUES L1 AND L2 ARE NOT USED BY THE
PROGRAM. THE LINE MUST NOT BE DELETED, HOWEVER, DUE TO FORMATTING.
   MAKE SURE THE NUMBER OF LINES OF HEATER POWER DENSITIES EQUALS THE
NUMBER OF HEATER SECTIONS GIVEN IN BODY DATA FILE. ALSO BE SURE THAT THE
WATTAGES ARE IN A HEATER SECTION, NOT IN A GAP.
   LAG TIME IS THE AMOUNT OF TIME, STARTING FROM THE BEGINNING OF THE
SIMULATION, BEFORE THAT HEATER BEGINS ITS CYCLE. THE HEATER WILL THEN BE
ON FOR THE DURATION OF THE ON TIME, THEN WILL TURN OFF FOR THE AMOUNT
GIVEN IN THE OFF SECTION, AND THEN WILL TURN ON AGAIN.  LAG TIME ALLOWS
FOR ICE ACCRETION BEFORE THE HEATER CYCLES BEGIN. USE THIS OPTION WHEN
YOU WANT THE PROGRAM TO START AT A POINT WHERE ICE HAS ALREADY FORMED ON
THE BLADE.
   IF IH = 1, THERE ARE NO HEATERS AND THE PROGRAM WILL DISALLOW ANY
POWER DENSITIES INPUT.
---------------------------------------------------------------------
TYPE OF HEAT SOURCE                                      IH= 003
FOR IH=2  POINT HEAT SOURCE          BETWEEN SLAB        L1= 009
                                         AND  SLAB        L2= 010
FOR IH=3  INTERNAL HEAT GENERATION IN SLAB               IJ= 009
TYPE OF HEAT SOURCE USED                                IHQ= 002
 HEATER DENSITY  TIME ON      TIME OFF     LAG TIME
 (WATTS/IN**2)    (SEC)        (SEC)        (SEC)
  00000.0000     0010.00      0000.00      0000.00         G
  00000.0000     0020.00      0040.00      0130.00         H 1
  00000.0000     0010.00      0000.00      0000.00         G
  00000.0000     0020.00      0040.00      0128.00         H 2
```

```
 00000.0000     0010.00     0000.00     0000.00      G
 00000.0000     0020.00     0040.00     0126.00      H 3
 00000.0000     0010.00     0000.00     0000.00      G
 00000.0000     0020.00     0040.00     0124.00      H 4
 00000.0000     0010.00     0000.00     0000.00      G
 00030.0000     0005.00     0060.00     0120.00      H 5
 00000.0000     0010.00     0000.00     0000.00      G
 00030.0000     0060.00     0060.00     0120.00      H 6
 00000.0000     0010.00     0000.00     0000.00      G
 00030.0000     0005.00     0060.00     0120.00      H 7
 00000.0000     0010.00     0000.00     0000.00      G
 00000.0000     0020.00     0040.00     0124.00      H 8
 00000.0000     0010.00     0000.00     0000.00      G
 00000.0000     0020.00     0040.00     0126.00      H 9
 00000.0000     0010.00     0000.00     0000.00      G
 00000.0000     0020.00     0040.00     0128.00      H 10
 00000.0000     0010.00     0000.00     0000.00      G
 00000.0000     0020.00     0040.00     0130.00      H 11
 00000.0000     0010.00     0000.00     0000.00      G
------------------------------------------------------------------
                  BOUNDARY   CONDITION   DATA
------------------------------------------------------------------
   THIS IS THE THIRD OF FIVE DATA FILES USED FOR PROGRAM DEICE3.
   BODY - HEAT - BOUND - PROP - INOUT DATA FILES ARE CURRENTLY USED
      COMMENTS:
       FOR CONSTANT TEMPERATURE BOUNDARY CONDITIONS AT J=1 IBC1=1
        "    "         "         "         "     AT J=M IBC2=1
        "    "         "         "         "     AT I=1 IBC3=1
        "    "         "         "         "     AT I=N IBC4=1
        "  CONVECTION BOUNDARY CONDITIONS         AT J=1 IBC1=2
        "    "         "         "               AT J=M IBC2=2
        "    "         "         "               AT I=1 IBC3=2
        "    "         "         "               AT I=N IBC4=2
        "  ACCRETION BOUNDARY CONDITION           AT J=M IBC2=3
   BOUNDARY CONDITIONS FOR A DEICER ARE NORMALLY INSULATED ON THE LEFT
AND RIGHT SIDES, INSULATED (OR LOW H VALUE) AT THE BOTTOM, AND A
VARIABLE H AT THE TOP SURFACE, I.E., ALL SIDES HAVE CONVECTION BOUNDARY.
   OTHER OPTIONS ARE GIVEN IF THE USER WISHES TO INVESTIGATE OTHER TWO
DIMENSIONAL HEAT TRANSFER PHENOMENA NOT INVOLVING A DEICER.
       IF CONDUCTION IS CONSIDERED ICOND=2
       IF CONDUCTION IS NOT CONSIDERED ICOND=1
       IF SHEDDING IS CONSIDERED ISH=2
       IF SHEDDING IS NOT CONSIDERED ISH=1
------------------------------------------------------------------
BOUNDARY AND INITIAL CONDITIONS:
-----------------------------
TYPE OF BOUNDARY CONDITION              AT J=1 IBC1= 2
                                        AT J=M IBC2= 3
                                        AT I=1 IBC3= 2
                                        AT I=N IBC4= 2
  IBC1=1, CONSTANT TEMPERATURE  AT J=1  TX1 = 000010.000000 DEG.F
  IBC2=1,       "        "      AT J=M  TX2 = 000010.000000 DEG.F
  IBC3=1,       "        "      AT I=1  TX3 = 000010.000000 DEG.F
  IBC4=1,       "        "      AT I=N  TX4 = 000010.000000 DEG.F
   CONVECTION DATA FOR BOTTOM. LEFT, AND SIDE BOUNDARIES
```

```
  IBC1=2, AMBIENT  TEMPERATURE  AT J=1  TG1 = 000009.400000 DEG.F
  IBC3=2,    "          "       AT I=1  TG3 = 000005.000000 DEG.F
  IBC4=2,    "          "       AT I=N  TG4 = 000005.000000 DEG.F
        HEAT TRANSFER COEFF.    AT J=1   H1 = 000001.000000 BTU/H.F.FT2
          "     "      "        AT I=1   H3 = 000000.000000 BTU/H.F.FT2
          "     "      "        AT I=N   H4 = 000000.000000 BTU/H.F.FT2
    IS CONDUCTION USED DURING TLAG?  1=NO. 2=YES.   ICOND = 1
INITIALIZE BLADE TEMPS TO WHICH VALUES (SEE ABOVE)    INIT = 3
IS SHEDDING CONSIDERED?         1=NO 2=YES            ISH = 2
--------------------------------------------------------------------
                     ICE   PROPERTY   DATA
--------------------------------------------------------------------
   THIS IS THE FOURTH OF FIVE DATA FILES USED IN THE PROGRAM DEICE3.
   BODY - HEAT - BOUND - PROP - INOUT DATA FILES ARE CURRENTLY USED.
      COMMENTS:
       IF PHASE CHANGE IS CONSIDERED IG=2
       IF PHASE CHANGE IS NOT CONSIDERED IG=1
    PROGRAM ASSUMES THAT IF ICE IS PRESENT, IT IS THE TOP LAYER. SOME
PHYSICAL PROPERTIES OF ICE ARE TAKEN FROM THE DATA GIVEN IN BODY DATA
FILE FOR THE TOP LAYER.
    INITIAL ICE SHAPE CAN BE INPUT HERE. IT IS RECOMMENDED THAT YOU LET
 THE PROGRAM DETERMINE THE ICE SHAPE (USE LAG TIME IN HEATER) AND LEAVE
 THIS AT ZERO. ALWAYS PUT IN AT LEAST 2 POINTS FOR INITIAL ICE SHAPE.
    SET VALUE OF INIT = 1 IF YOU WANT THE BLADE TO BE INITIALIZED TO
 THE AMBIENT TEMPERATURE. SET VALUE OF INIT = 2 IF YOU WANT THE BLADE TO
 BE INITIALIZED TO THE RECOVERY TEMPERATURE, WHICH IS THE AMBIENT
 TEMPERATURE + KINETIC HEATING -BOUNDARY LAYER LOSSES. SET VALUE OF
 INIT = 3 IF YOU WANT THE BLADE TO BE INITIALIZED TO THE ACCRETION
 TEMPERATURE ASSUMING NO HEAT TRANSFER INTO THE BLADE.
--------------------------------------------------------------------
IS PHASE CHANGE CONSIDERED? IF YES, IG=2. IF NO, IG=1.  IG = 2
LATENT HEAT OF ICE                    HLAM = 000143.400000 B.T.U./LB
  "    CONDUCTIVITY "    "            AKL  = 000000.320000 B.T.U./HR.FT.F
DENSITY OF WATER                      DEL  = 000062.400000 LB./CU.FT
SPECIFIC HEAT*DENSITY OF WATER        CPL  = 000062.212800 B.T.U./CU.FT'F
DENSITY OF ICE                        DES  = 000057.400000 LB./CU.FT
THE MELTING TEMPERATURE               TMP  = 000032.000000 DEG.'F.
THE MELTING RANGE IS ( < 1. E-5 )     TR   = 00.0000100000 DEG.'F.
HEAT OF VAPORIZATION                  HVAP = 001075.160000 B.T.U./LB
HEAT CAPACITY OF AIR                 CPAIR = 000000.250000 B.T.U./LB 'F.
NUMBER OF POINTS FOR INITIAL ICE SHAPE        NP = 002
X-VALUE   0000.00000  Y-VALUE 0000.00000
          0030.37716          0000.00000
--------------------------------------------------------------------
            TIME   STEP   AND   INPUT/OUTPUT   PARAMETERS
--------------------------------------------------------------------
   THIS IS THE LAST OF FIVE DATA FILES USED FOR THE PROGRAM DEICE3.
   BODY - HEAT - BOUND - PROP - INOUT DATA FILES ARE CURRENTLY USED.
      COMMENTS:
   TIME STEP FOR A PROBLEM WHERE THE UNSTEADY-STATE SOLUTION IS WANTED
SHOULD NOT BE GREATER THAN 0.1 SEC. IF A STEADY-STATE PROBLEM IS BEING
SOLVED USING THIS PROGRAM, LARGER TIME STEPS MAY BE UTILIZED.
   VARIABLE TIME STEPS CAN BE USED TO STUDY PHENOMENA WHICH ARE KNOWN
TO OCCUR DURING A SPECIFIC PERIOD. IT HAS BEEN USED TO DETERMINE EXACT
TIME OF INITIAL MELTING AND SHEDDING, BUT IT IS NOT NECESSARY TO DO THIS
```

```
    BECAUSE OF THE NUMERICAL METHOD USED, THE PROGRAM NEEDS TO ASSUME
THE PHASE OF THE ICE/WATER (SOLID, MUSH, LIQUID) AT EACH NODE AND TO
CHECK THIS AGAINST THE SOLUTION MATRIX. 10 ITERATIONS (OR LESS) HAVE
BEEN SUFFICIENT IN THE PAST. EXTREMELY COMPLEX PROBLEMS MAY REQUIRE MORE
    YOU WILL KNOW IF YOU NEED MORE ITERATIONS.
    NUMBER OF POINTS TO BE OUTPUT IS NEGLECTED IF IOTYPE = 4.
    POSITION DATA (X OR Y LAYER) IS IGNORED IF IOTYPE = 5.
    VALUES ARE NEEDED FOR FORMATTING. HOWEVER, FOR IOTYPE = 4, YOU CAN
INPUT NPTS = 0 IF YOU WISH.
    LIMITS ON INPUT: VALUE OF NPRT = 50 (HENCE LIMIT ON TEMP. LOCATIONS
AND TIMES YOU CAN SPECIFY); VALUE OF NPTS = 50 (LIMIT OF NUMBER OF ICE
PROFILES PRINTED OUT).
    FOR IOTYPE = 1, THE LEFT NUMBER INPUT IS THE X-SECTION NUMBER YOU
WANT PRINTED OUT. THE CHARACTER NEXT TO IT DESIGNATES WHETHER YOU WANT
THE LEFT (L), MIDDLE (M), OR RIGHT (R) NODE OF THIS SECTION. THE RIGHT
NUMBER IS THE Y-LAYER YOU WANT PRINTED OUT AND THE CHARACTER NEXT TO IT
IS FOR THE BOTTOM (B), MIDDLE (M), OR TOP (T) NODE OF THIS LAYER.
    FOR IOTYPE = 2 OR = 3, THE LEFT NUMBER IS THE TIME STEP AT WHICH
OUTPUT IS GIVEN. FOR IOTYPE = 2, THE RIGHT VALUE IS THE Y-LAYER OF THE
NODES TO BE OUTPUT AND FOR IOTYPE = 3, IT IS THE X-SECTION OF THE NODES
OUTPUT. THE LEFT CHARACTER IS IGNORED, AND THE RIGHT ONE IS DESCRIBED
ABOVE FOR EACH TYPE (X OR Y).
    FOR IOTYPE = 4, EVERYTHING IS PRINTED OUT, SO THE PROGRAM WILL
IGNORE ITEMS INPUT. I RECOMMEND LEAVING SOMETHING THERE SO THAT YOU
DON'T FORGET THE FORMATTING OF THE DATA FOR OTHER TYPES OF OUTPUT.
    FOR IOTYPE = 5, EVERYTHING BUT THE LEFT NUMBER IS IGNORED. THE LEFT
VALUE IS THE TIME STEP AT WHICH YOU WANT THE OUTPUT.
    THE FORMAT FOR THE NPRT VALUES IS THE SAME AS THAT FOR IOTYPE = 5.
-----------------------------------------------------------------------
INITIAL TIME STEP                          DTAUI = 000000.100000 SECS.
                    FOR TIME STEPS         NISP  = 0010
INTERMIDIATE TIME STEP                     DTAUM = 000000.100000 SECS.
                    FOR TIME STEPS         NMSP  = 0100
FINAL TIME STEP                            DTAUF = 000000.100000 SECS.
 NUMBER OF PHASE CHANGE ITERATIONS        JCOUNT = 020
NUMBER OF ICE SHAPES TO BE OUTPUT       NPRT = 004
PUT VALUE XXXX IN SPOTS MARKED BY X'S
          1200
          1800
          2400
          2500

IF IOTYPE = 1, PRINTS T(TIME) AT X1,Y1: X2,Y2; ETC.
IF IOTYPE = 2, PRINTS T(X) AT TIME1,Y1: TIME2,Y2; ETC.
IF IOTYPE = 3, PRINTS T(Y) AT X1,TIME1: X2,TIME2; ETC.
IF IOTYPE = 4, PRINTS ALL NODES AT ALL TIMESTEPS
IF IOTYPE = 5, PRINTS T(X,Y) AT TIME1, TIME2; ETC.

TYPE OF OUTPUT REQUESTED                        IOTYPE = 001
NUMBER OF POINTS TO BE OUTPUT                     NPTS = 010
          0008  M          0009  T
          0008  M          0013  T
          0010  M          0009  T
          0010  M          0013  T
          0012  M          0009  T
```

0012	M	0013	T
0014	M	0009	T
0014	M	0013	T
0016	M	0009	T
0016	M	0013	T

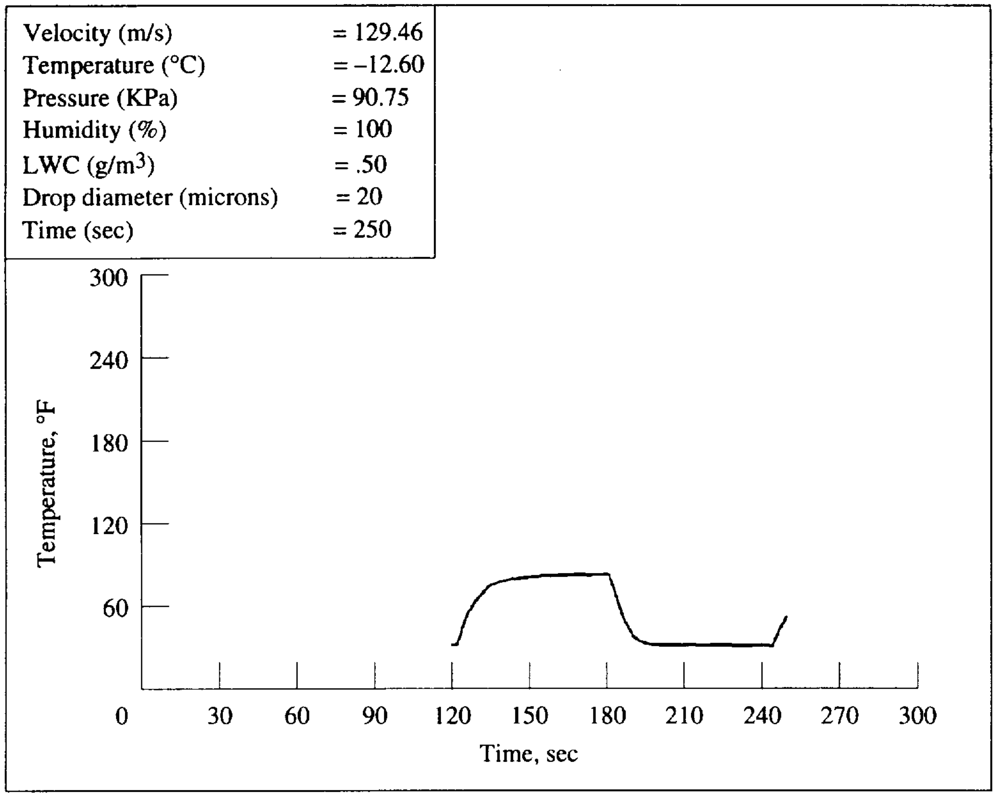


Figure 29.—Heater temperature for position 5.

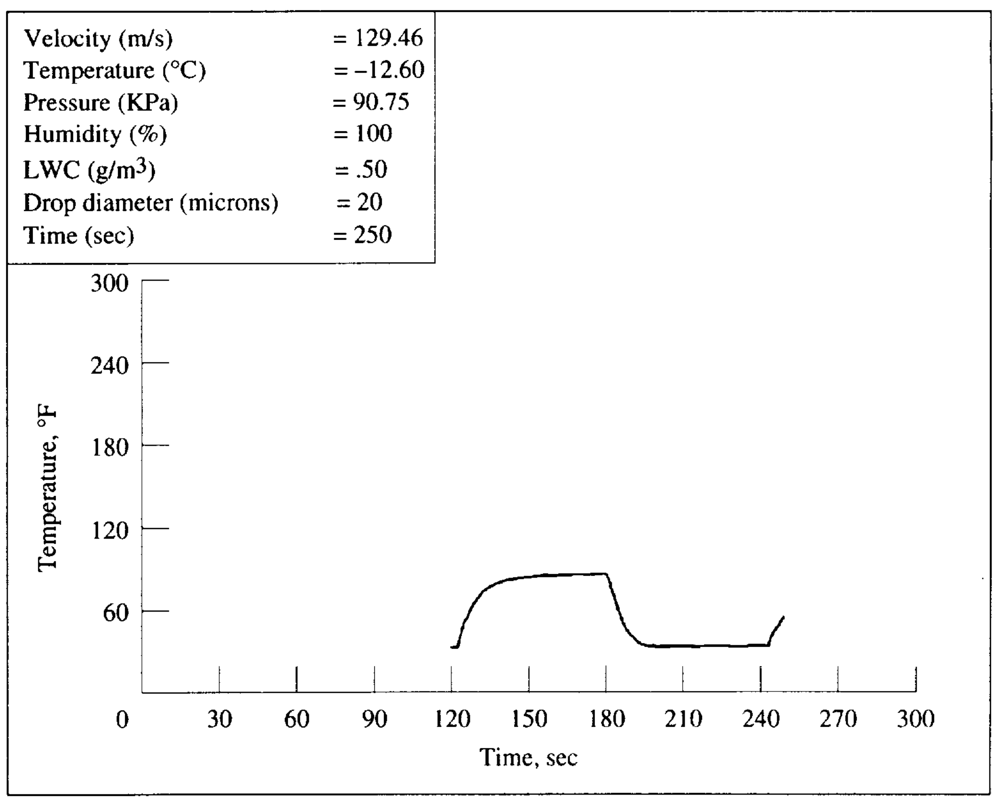


Figure 30.—Heater temperature for position 7.

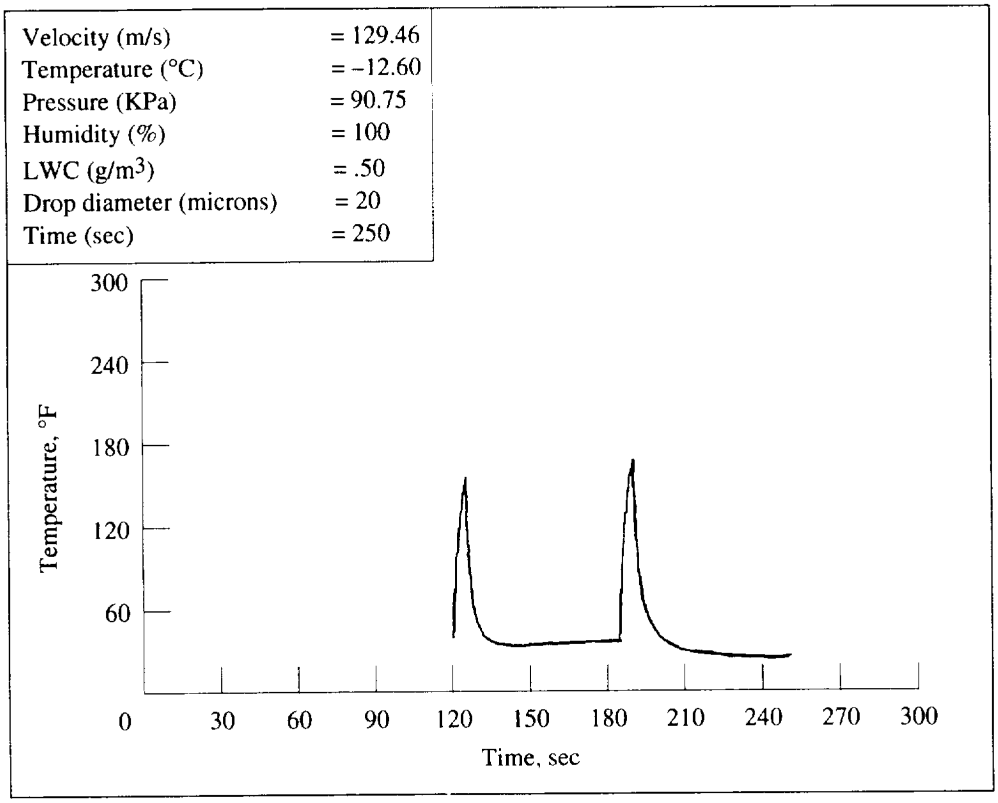


Figure 31.—Heater temperature for position 6.

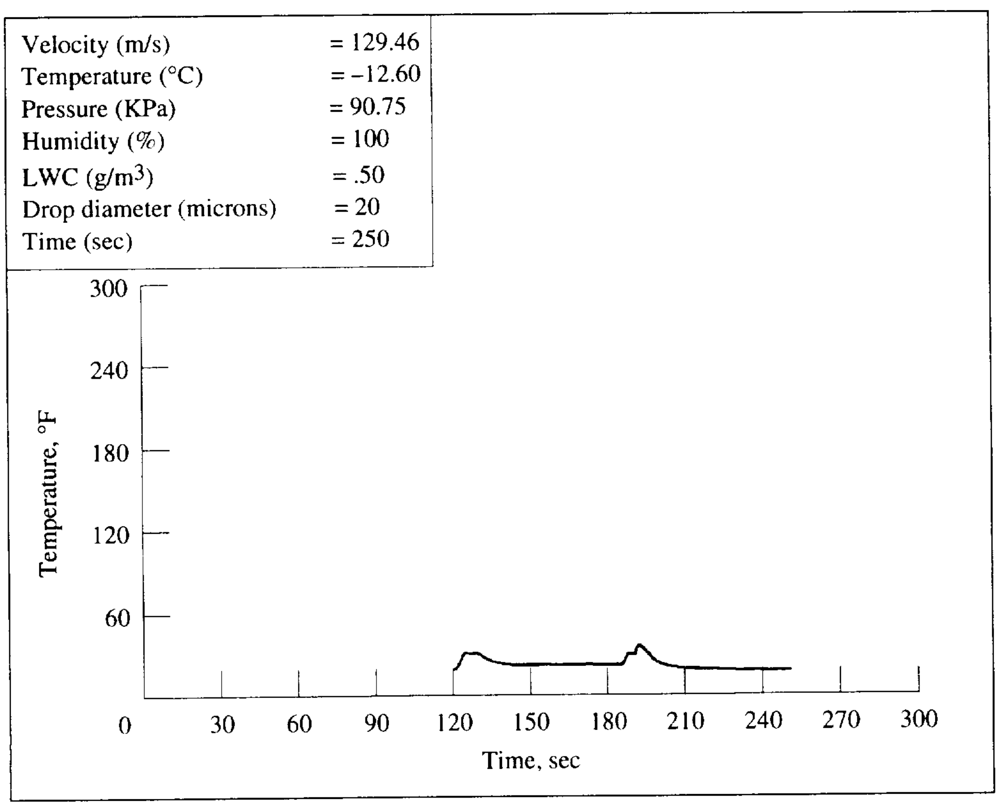


Figure 32.—Abrasion shield temperature for position 6.

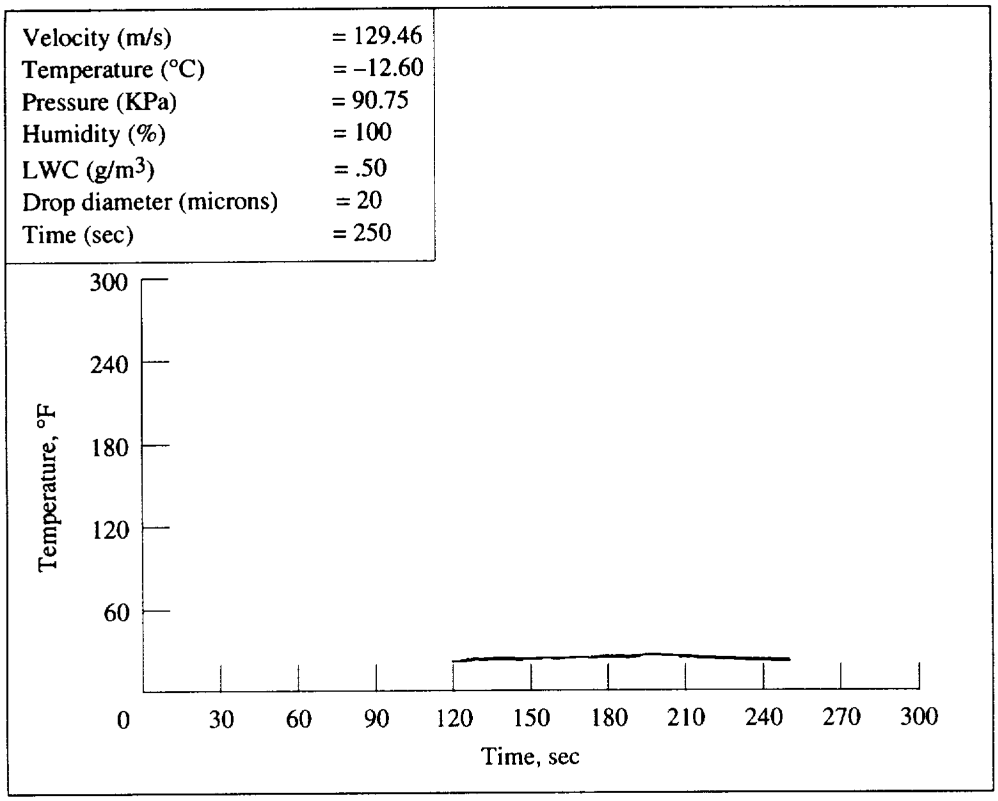


Figure 33.—Abrasion shield temperature for position 5.

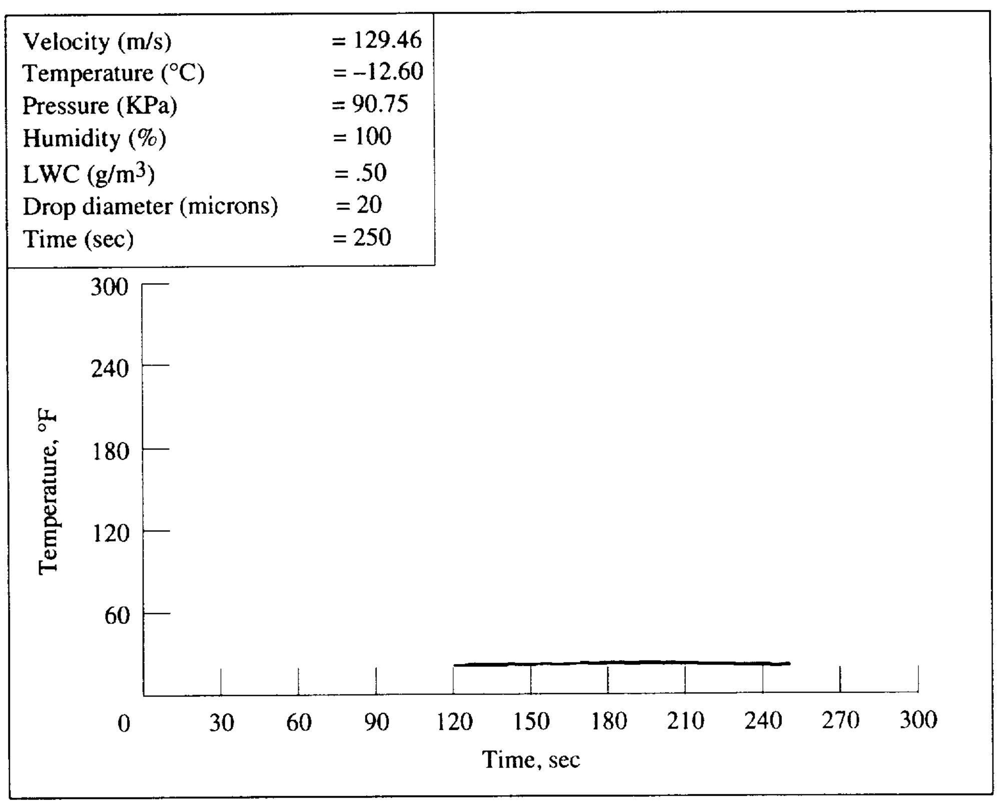


Figure 34.—Abrasion shield temperature for position 7.

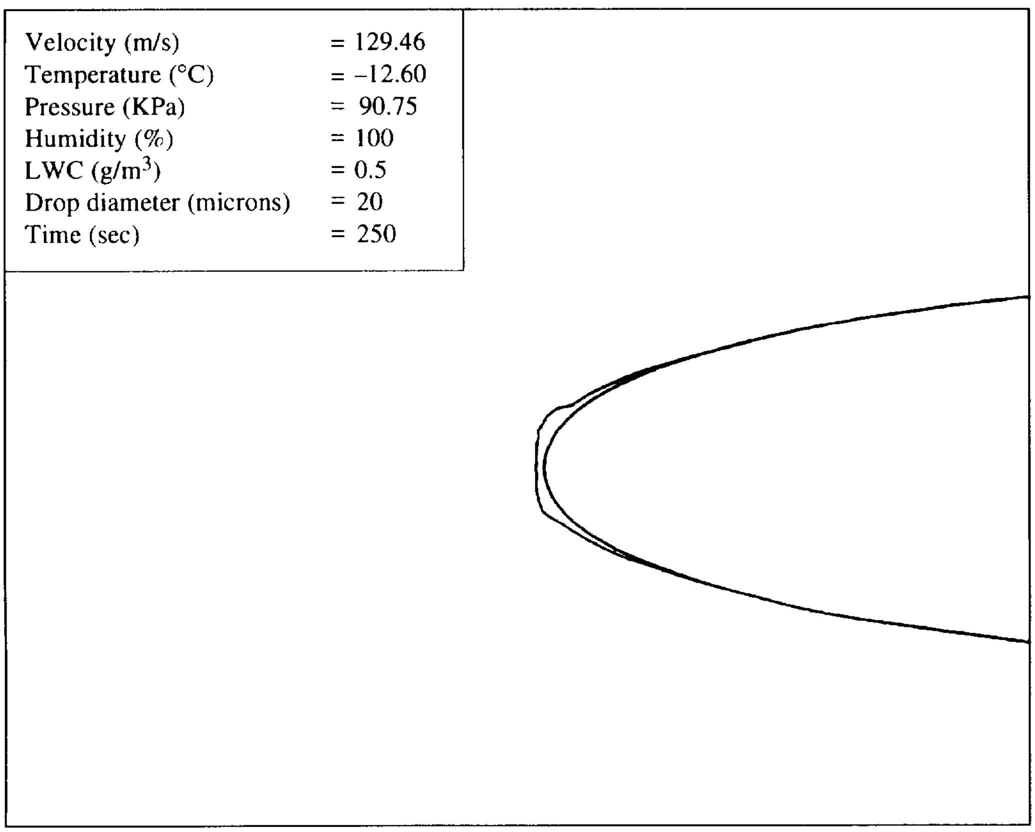


Figure 35.—Ice shape for example case.

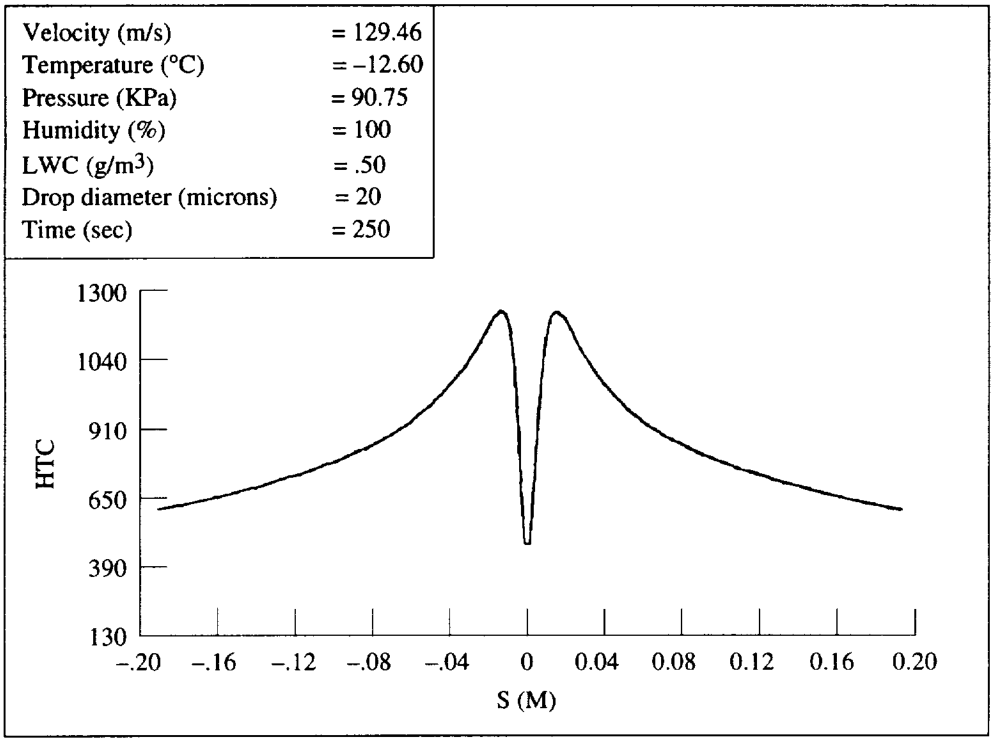


Figure 36.—Heat transfer coefficient for example case.

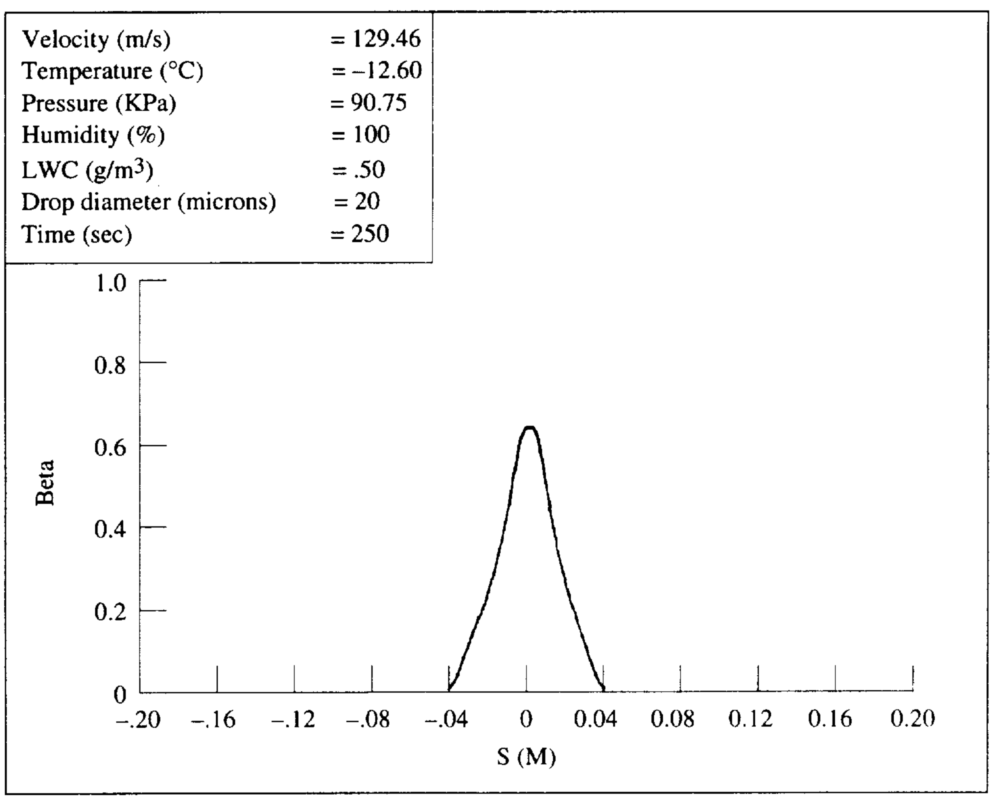


Figure 37.—Collection efficiency for example case.

FILE: MASS DATA A VM/SP CONVERSATIONAL MONITOR SYSTEM

2	-0.21419E+02	-0.24654E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
3	-0.19188E+02	-0.15423E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
4	-0.16958E+02	-0.14972E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
5	-0.14727E+02	-0.14966E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
6	-0.12497E+02	-0.14979E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
7	-0.10266E+02	-0.14624E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
8	-0.80355E+01	-0.13145E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
9	-0.58050E+01	-0.93198E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
10	-0.54717E+01	-0.43924E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
11	-0.51383E+01	0.14209E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
12	-0.48050E+01	0.75586E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
13	-0.47745E+01	0.11848E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
14	-0.47440E+01	0.16325E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
15	-0.44107E+01	0.23889E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
16	-0.40773E+01	0.30123E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
17	-0.37440E+01	0.36054E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
18	-0.37135E+01	0.40387E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
19	-0.36830E+01	0.45148E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
20	-0.35401E+01	0.51101E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
21	-0.33973E+01	0.56500E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
22	-0.32544E+01	0.61633E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
23	-0.31116E+01	0.66521E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
24	-0.29687E+01	0.71134E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
25	-0.28259E+01	0.75403E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
26	-0.26830E+01	0.79224E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
27	-0.26525E+01	0.82157E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
28	-0.26220E+01	0.85861E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
29	-0.25451E+01	0.90303E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
30	-0.24682E+01	0.94073E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
31	-0.23912E+01	0.97561E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
32	-0.23143E+01	0.10073E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
33	-0.22374E+01	0.10342E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
34	-0.21605E+01	0.10544E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
35	-0.20835E+01	0.10652E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
36	-0.20066E+01	0.10623E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
37	-0.19297E+01	0.10376E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
38	-0.18528E+01	0.97413E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
39	-0.17758E+01	0.84164E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
40	-0.16989E+01	0.58715E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
41	-0.16220E+01	0.11539E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
42	-0.15915E+01	-0.72402E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
43	-0.15610E+01	-0.16552E+00	0.00000E+00	0.00000E+00	0.62661E-07	0.00000E+00	
44	-0.15210E+01	-0.25345E+00	0.00000E+00	0.00000E+00	0.33178E-06	0.00000E+00	
45	-0.14810E+01	0.91577E+00	0.68631E-06	0.00000E+00	0.68631E-06	0.68631E-06	
46	-0.14410E+01	0.85582E+00	0.11507E-05	0.00000E+00	0.10948E-05	0.11507E-05	
47	-0.14010E+01	0.73281E+00	0.17299E-05	0.00000E+00	0.10903E-05	0.17299E-05	
48	-0.13610E+01	0.63353E+00	0.24289E-05	0.00000E+00	0.10992E-05	0.24289E-05	
49	-0.13210E+01	0.55388E+00	0.32419E-05	0.00000E+00	0.11188E-05	0.32419E-05	
50	-0.12810E+01	0.49207E+00	0.41217E-05	0.00000E+00	0.11462E-05	0.41217E-05	
51	-0.12410E+01	0.44917E+00	0.50111E-05	0.00000E+00	0.11791E-05	0.50111E-05	
52	-0.12010E+01	0.41856E-00	0.58759E-05	0.00000E+00	0.12167E-05	0.58759E-05	
53	-0.11610E+01	0.27615E+00	0.67263E-05	0.00000E+00	0.12555E-05	0.67263E-05	
54	-0.11210E+01	0.34679E+00	0.75770E-05	0.00000E+00	0.12839E-05	0.75770E-05	
55	-0.10810E+01	0.36184E+00	0.84354E-05	0.00000E+00	0.13261E-05	0.84354E-05	
56	-0.10410E+01	0.37527E-00	0.93002E-05	0.00000E+00	0.13720E-05	0.93002E-05	

57	-0.10010E+01	0.39760E+00	0.10170E-04	0.00000E+00	0.14209E-05	0.10170E-04
58	-0.96100E+00	0.43178E+00	0.11039E-04	0.00000E+00	0.14734E-05	0.11039E-04
59	-0.92100E+00	0.47510E+00	0.11899E-04	0.00000E+00	0.15312E-05	0.11899E-04
60	-0.88100E+00	0.48901E+00	0.12748E-04	0.00000E+00	0.15777E-05	0.12748E-04
61	-0.84100E+00	0.57232E+00	0.13609E-04	0.00000E+00	0.16388E-05	0.13609E-04
62	-0.80100E+00	0.67093E+00	0.14517E-04	0.00000E+00	0.17097E-05	0.14517E-04
63	-0.76100E+00	0.78851E+00	0.15506E-04	0.00000E+00	0.17895E-05	0.15506E-04
64	-0.72100E+00	0.92785E+00	0.16599E-04	0.00000E+00	0.18802E-05	0.16599E-04
65	-0.68100E+00	0.10834E+01	0.17816E-04	0.00000E+00	0.19857E-05	0.17816E-04
66	-0.64100E+00	0.12246E+01	0.19157E-04	0.00000E+00	0.20409E-05	0.19157E-04
67	-0.60100E+00	0.14248E+01	0.20534E-04	0.00000E+00	0.21812E-05	0.20534E-04
68	-0.56100E+00	0.17725E+01	0.21841E-04	0.00000E+00	0.23257E-05	0.21841E-04
69	-0.53050E+00	0.28107E+01	0.17346E-04	0.00000E+00	0.18888E-05	0.17346E-04
70	-0.50000E+00	0.13586E+02	0.18033E-04	0.00000E+00	0.18657E-05	0.18033E-04
71	-0.47500E+00	0.74369E+01	0.15283E-04	0.00000E+00	0.16083E-05	0.15283E-04
72	-0.45000E+00	0.88954E+01	0.15857E-04	0.00000E+00	0.16431E-05	0.15857E-04
73	-0.42500E+00	0.10350E+02	0.16537E-04	0.00000E+00	0.16590E-05	0.16537E-04
74	-0.40000E+00	0.11289E+02	0.17317E-04	0.00000E+00	0.16695E-05	0.17317E-04
75	-0.37500E+00	0.11935E+02	0.18123E-04	0.00000E+00	0.15913E-05	0.18123E-04
76	-0.35000E+00	0.12365E+02	0.18874E-04	0.00000E+00	0.16614E-05	0.18874E-04
77	-0.32500E+00	0.12597E+02	0.19591E-04	0.87211E-05	0.17376E-05	0.28312E-04
78	-0.30000E+00	0.12725E+02	0.20393E-04	0.26962E-04	0.19120E-05	0.47355E-04
79	-0.27500E+00	0.12930E+02	0.21399E-04	0.36308E-04	0.18157E-05	0.57707E-04
80	-0.25000E+00	0.13218E+02	0.22448E-04	0.38600E-04	0.17053E-05	0.61047E-04
81	-0.22500E+00	0.13464E+02	0.23076E-04	0.39946E-04	0.16401E-05	0.63022E-04
82	-0.20000E+00	0.12198E+02	0.23546E-04	0.45405E-04	0.15796E-05	0.68952E-04
83	-0.17500E+00	0.10067E+02	0.24475E-04	0.42699E-04	0.14408E-05	0.67174E-04
84	-0.15000E+00	0.89549E+01	0.25328E-04	0.41664E-04	0.13063E-05	0.66992E-04
85	-0.12500E+00	0.87703E+01	0.25634E-04	0.34868E-04	0.11685E-05	0.60502E-04
86	-0.10000E+00	0.88701E+01	0.25965E-04	0.28391E-04	0.10469E-05	0.54357E-04
87	-0.75000E-01	0.90751E+01	0.26439E-04	0.18158E-04	0.91558E-06	0.44598E-04
88	-0.50000E-01	0.93930E+01	0.26479E-04	0.64299E-05	0.80811E-06	0.32909E-04
89	-0.25000E-01	0.96650E+01	0.26491E-04	0.00000E+00	0.81166E-06	0.26491E-04
90	0.00000E+00	0.94287E+01	0.26463E-04	0.64299E-05	0.80623E-06	0.32892E-04
91	0.25000E-01	0.90473E+01	0.26438E-04	0.18537E-04	0.79480E-06	0.44975E-04
92	0.50000E-01	0.87957E+01	0.26396E-04	0.31274E-04	0.85985E-06	0.57670E-04
93	0.75000E-01	0.86461E+01	0.26157E-04	0.42330E-04	0.96683E-06	0.68486E-04
94	0.10000E+00	0.85783E+01	0.25824E-04	0.52756E-04	0.10947E-05	0.78580E-04
95	0.12500E+00	0.87124E+01	0.25429E-04	0.56854E-04	0.12477E-05	0.82282E-04
96	0.15000E+00	0.94885E+01	0.24915E-04	0.58821E-04	0.13773E-05	0.83736E-04
97	0.17500E+00	0.12137E+02	0.24059E-04	0.62605E-04	0.15036E-05	0.86665E-04
98	0.20000E+00	0.13632E+02	0.22013E-04	0.58585E-04	0.17693E-05	0.80597E-04
99	0.22500E+00	0.13384E+02	0.21359E-04	0.43136E-04	0.18455E-05	0.64495E-04
100	0.25000E+00	0.13147E+02	0.20717E-04	0.38637E-04	0.18824E-05	0.59354E-04
101	0.27500E+00	0.13245E+02	0.19268E-04	0.29891E-04	0.17568E-05	0.49159E-04
102	0.30000E+00	0.13237E+02	0.18025E-04	0.00000E+00	0.14772E-05	0.18025E-04
103	0.32500E+00	0.13092E+02	0.17298E-04	0.00000E+00	0.15990E-05	0.17298E-04
104	0.35000E+00	0.12827E+02	0.16738E-04	0.00000E+00	0.16697E-05	0.16738E-04
105	0.37500E+00	0.12432E+02	0.15990E-04	0.00000E+00	0.16383E-05	0.15990E-04
106	0.40000E+00	0.11835E+02	0.14989E-04	0.00000E+00	0.15794E-05	0.14989E-04
107	0.42500E+00	0.10917E+02	0.13956E-04	0.00000E+00	0.16906E-05	0.13956E-04
108	0.45000E+00	0.94804E+01	0.13103E-04	0.00000E+00	0.16690E-05	0.13103E-04
109	0.47500E+00	0.78319E+01	0.12465E-04	0.00000E+00	0.16356E-05	0.12465E-04
110	0.50000E+00	0.24394E+02	0.11983E-04	0.00000E+00	0.15665E-05	0.11983E-04
111	0.53050E+00	0.45384E+01	0.14051E-04	0.00000E+00	0.18204E-05	0.14051E-04

112	0.56100E+00	0.27150E+01	0.13519E-04	0.00000E+00	0.16902E-05	0.13519E-04	0.
113	0.60100E+00	0.20780E+01	0.16682E-04	0.00000E+00	0.21653E-05	0.16682E-04	0.
114	0.64100E+00	0.16782E+01	0.15549E-04	0.00000E+00	0.20066E-05	0.15549E-04	0.
115	0.68100E+00	0.13742E+01	0.14466E-04	0.00000E+00	0.18746E-05	0.14466E-04	0.
116	0.72100E+00	0.11311E+01	0.13531E-04	0.00000E+00	0.17638E-05	0.13531E-04	0.
117	0.76100E+00	0.94147E+00	0.12705E-04	0.00000E+00	0.16699E-05	0.12705E-04	0.
118	0.80100E+00	0.85457E+00	0.11906E-04	0.00000E+00	0.16186E-05	0.11906E-04	0.
119	0.84100E+00	0.73161E+00	0.11075E-04	0.00000E+00	0.15405E-05	0.11075E-04	0.
120	0.88100E+00	0.63400E+00	0.10218E-04	0.00000E+00	0.14731E-05	0.10218E-04	0.
121	0.92100E+00	0.56146E+00	0.93586E-05	0.00000E+00	0.14134E-05	0.93586E-05	0.
122	0.96100E+00	0.50032E+00	0.85100E-05	0.00000E+00	0.13602E-05	0.85100E-05	0.
123	0.10010E+01	0.40254E+00	0.76665E-05	0.00000E+00	0.13214E-05	0.76665E-05	0.
124	0.10410E+01	0.50558E+00	0.68189E-05	0.00000E+00	0.12801E-05	0.68189E-05	0.
125	0.10810E+01	0.50090E+00	0.59666E-05	0.00000E+00	0.12349E-05	0.59666E-05	0.
126	0.11210E+01	0.50632E+00	0.51220E-05	0.00000E+00	0.11953E-05	0.51220E-05	0
127	0.11610E+01	0.52795E+00	0.42972E-05	0.00000E+00	0.11610E-05	0.42972E-05	0
128	0.12010E+01	0.57027E+00	0.34740E-05	0.00000E+00	0.11319E-05	0.34740E-05	0
129	0.12410E+01	0.64320E+00	0.26055E-05	0.00000E+00	0.11079E-05	0.26055E-05	0
130	0.12810E+01	0.75760E+00	0.16590E-05	0.00000E+00	0.10897E-05	0.16590E-05	0
131	0.13210E+01	0.90888E+00	0.73517E-06	0.00000E+00	0.73517E-06	0.73517E-06	0
132	0.13610E+01	0.10171E+01	0.42900E-08	0.00000E+00	0.42900E-08	0.42900E-08	0
133	0.14010E+01	-0.13366E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
134	0.14410E+01	-0.12440E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
135	0.14810E+01	-0.63182E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
136	0.15210E+01	-0.14955E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
137	0.15610E+01	0.33317E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
138	0.15915E+01	0.42719E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
139	0.16220E+01	0.69190E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
140	0.16989E+01	0.95464E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
141	0.17758E+01	0.10878E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
142	0.18528E+01	0.11507E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
143	0.19297E+01	0.11739E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
144	0.20066E+01	0.11746E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
145	0.20835E+01	0.11623E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	C
146	0.21605E+01	0.11420E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	C
147	0.22374E+01	0.11161E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	C
148	0.23143E+01	0.10861E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	C
149	0.23912E+01	0.10530E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	C
150	0.24682E+01	0.10176E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
151	0.25451E+01	0.98000E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
152	0.26220E+01	0.94013E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
153	0.26525E+01	0.89693E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
154	0.26830E+01	0.86194E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
155	0.28259E+01	0.82766E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
156	0.29687E+01	0.78550E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
157	0.31116E+01	0.74045E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
158	0.32544E+01	0.69301E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
159	0.33973E+01	0.64349E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
160	0.35401E+01	0.59207E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
161	0.36830E+01	0.53878E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
162	0.37135E+01	0.49380E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
163	0.37440E+01	0.45317E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
164	0.40773E+01	0.38557E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
165	0.44107E+01	0.32456E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
166	0.47440E+01	0.26165E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	

167	0.47745E+01	0.21938E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
168	0.48050E+01	0.17876E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
169	0.51383E+01	0.10716E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
170	0.54717E+01	0.52964E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
171	0.58050E+01	0.23320E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
172	0.80355E+01	-0.96367E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
173	0.10266E+02	-0.13300E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
174	0.12497E+02	-0.14425E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
175	0.14727E+02	-0.14548E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
176	0.16958E+02	-0.14329E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
177	0.19188E+02	-0.14361E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
178	0.21419E+02	-0.28086E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.

FILE: DICE DATA A VM/SP CONVERSATIONAL MONITOR SYSTEM

0.000000000000E+00	0.000000000000E+00
0.213658763380E+00	0.000000000000E+00
0.426801559342E+00	0.000000000000E+00
0.639564639659E+00	0.000000000000E+00
0.106430232933E+01	0.000000000000E+00
0.159427463898E+01	0.000000000000E+00
0.212357888963E+01	0.000000000000E+00
0.265245839848E+01	0.000000000000E+00
0.318106364380E+01	0.000000000000E+00
0.370946839810E+01	0.000000000000E+00
0.423769466110E+01	0.000000000000E+00
0.476576076594E+01	0.000000000000E+00
0.529366627263E+01	0.000000000000E+00
0.582140267458E+01	0.000000000000E+00
0.634897319844E+01	0.000000000000E+00
0.687637447091E+01	0.000000000000E+00
0.740359886540E+01	0.000000000000E+00
0.793064579526E+01	0.000000000000E+00
0.845751027388E+01	0.000000000000E+00
0.898419288792E+01	0.000000000000E+00
0.951068586414E+01	0.000000000000E+00
0.100369952158E+02	0.000000000000E+00
0.105631205029E+02	0.000000000000E+00
0.110890642187E+02	0.000000000000E+00
0.116148320833E+02	0.000000000000E+00
0.121404282031E+02	0.000000000000E+00
0.126658660714E+02	0.000000000000E+00
0.131911536081E+02	0.000000000000E+00
0.137163131063E+02	0.000000000000E+00
0.142413756589E+02	0.000000000000E+00
0.147663826255E+02	0.000000000000E+00
0.152913939920E+02	0.000000000000E+00
0.158164839710E+02	0.000000000000E+00
0.163417646144E+02	0.000000000000E+00
0.168673931472E+02	0.000000000000E+00
0.173935923535E+02	0.000000000000E+00
0.179207030826E+02	0.000000000000E+00
0.184492327955E+02	0.000000000000E+00
0.189800355223E+02	0.000000000000E+00
0.191933226366E+02	0.000000000000E+00
0.194073829687E+02	0.000000000000E+00
0.196224680490E+02	0.100524566000E-07
0.198389463001E+02	0.453962514000E-06
0.200573718221E+02	0.887504721000E-04
0.201675656894E+02	0.215322201000E-03
0.202786047320E+02	0.337043544000E-03
0.203906784961E+02	0.464335317000E-03
0.205040340112E+02	0.600579893000E-03
0.206190210186E+02	0.746608945000E-03
0.207364521062E+02	0.939490972000E-03
0.208581417033E+02	0.119158090000E-02
0.209869034585E+02	0.142938644000E-02
0.210564222489E+02	0.160364690000E-02
0.211335722384E+02	0.289047882000E-02
0.211776646186E+02	0.232472713000E-02

0.212286073720E+02	0.235507265000E-02
0.212400472133E+02	0.221005408000E-02
0.212520313467E+02	0.210260693000E-02
0.212646802300E+02	0.203932263000E-02
0.212781366324E+02	0.196106965000E-02
0.212925265299E+02	0.185003551000E-02
0.213081556640E+02	0.172521011000E-02
0.213165563599E+02	0.166754425000E-02
0.213254170814E+02	0.161967170000E-02
0.213348612133E+02	0.157313119000E-02
0.213450540448E+02	0.150693906000E-02
0.213562238575E+02	0.140628195000E-02
0.213688683317E+02	0.130496640000E-02
0.213842972681E+02	0.126235583000E-02
0.214186696557E+02	0.129296002000E-02
0.214530420432E+02	0.134247215000E-02
0.214684709796E+02	0.143570313000E-02
0.214811154538E+02	0.150468177000E-02
0.214922852665E+02	0.156887877000E-02
0.215024780980E+02	0.164282508000E-02
0.215119222299E+02	0.172157097000E-02
0.215207829514E+02	0.179782789000E-02
0.215291836473E+02	0.186827569000E-02
0.215448127815E+02	0.199275836000E-02
0.215592026790E+02	0.208739378000E-02
0.215726590813E+02	0.211706711000E-02
0.215853079646E+02	0.216788147000E-02
0.215972920980E+02	0.247450126000E-02
0.216087319394E+02	0.297235418000E-02
0.216596746927E+02	0.232414692000E-02
0.217037670729E+02	0.354407728000E-02
0.217809170625E+02	0.145220268000E-02
0.218504358528E+02	0.118785352000E-02
0.219791976080E+02	0.996353570000E-03
0.221008872051E+02	0.752129825000E-03
0.222183182928E+02	0.600256957000E-03
0.223333053001E+02	0.456815818000E-03
0.224466608153E+02	0.320933061000E-03
0.225587345793E+02	0.189257669000E-03
0.226697736219E+02	0.590182026000E-04
0.227799674892E+02	0.000000000000E+00
0.229983930112E+02	0.281359007000E-05
0.232148712623E+02	0.470211532000E-07
0.234299563426E+02	0.000000000000E+00
0.236440166748E+02	0.000000000000E+00
0.238573037891E+02	0.000000000000E+00
0.243881065159E+02	0.000000000000E+00
0.249166362287E+02	0.000000000000E+00
0.254437469578E+02	0.000000000000E+00
0.259699461641E+02	0.000000000000E+00
0.264955746969E+02	0.000000000000E+00
0.270208553403E+02	0.000000000000E+00
0.275459453193E+02	0.000000000000E+00
0.280709566858E+02	0.000000000000E+00
0.285959636524E+02	0.000000000000E+00

0.291210262050E+02	0.000000000000E+00
0.296461857032E+02	0.000000000000E+00
0.301714732399E+02	0.000000000000E+00
0.306969111082E+02	0.000000000000E+00
0.312225072281E+02	0.000000000000E+00
0.317482750926E+02	0.000000000000E+00
0.322742188084E+02	0.000000000000E+00
0.328003440955E+02	0.000000000000E+00
0.333266534472E+02	0.000000000000E+00
0.338531464234E+02	0.000000000000E+00
0.343798290374E+02	0.000000000000E+00
0.349066935161E+02	0.000000000000E+00
0.354337404459E+02	0.000000000000E+00
0.359609648404E+02	0.000000000000E+00
0.364883661129E+02	0.000000000000E+00
0.370159366367E+02	0.000000000000E+00
0.375436730387E+02	0.000000000000E+00
0.380715785454E+02	0.000000000000E+00
0.385996446502E+02	0.000000000000E+00
0.391278709132E+02	0.000000000000E+00
0.396562756675E+02	0.000000000000E+00
0.401848809128E+02	0.000000000000E+00
0.407137604217E+02	0.000000000000E+00
0.412430646723E+02	0.000000000000E+00
0.417730369820E+02	0.000000000000E+00
0.421977746717E+02	0.000000000000E+00
0.424105377520E+02	0.000000000000E+00
0.426236805479E+02	0.000000000000E+00

FILE: HTC DATA2 A VM/SP CONVERSATIONAL MONITOR SYSTEM

0.53340E+00	0.00000E+00	0.00000E+00	0.94528E+05	0.00000E+00
0.52807E+00	-0.99959E-03	0.00000E+00	0.93085E+05	0.33257E+03
0.52273E+00	-0.19261E-02	0.00000E+00	0.92501E+05	0.35195E+03
0.51740E+00	-0.27945E-02	0.00000E+00	0.91961E+05	0.36999E+03
0.50673E+00	-0.44011E-02	0.00000E+00	0.91466E+05	0.38681E+03
0.49339E+00	-0.62408E-02	0.00000E+00	0.91115E+05	0.39923E+03
0.48006E+00	-0.79519E-02	0.00000E+00	0.90863E+05	0.40860E+03
0.46672E+00	-0.95761E-02	0.00000E+00	0.90654E+05	0.41668E+03
0.45339E+00	-0.11142E-01	0.00000E+00	0.90463E+05	0.42434E+03
0.44005E+00	-0.12662E-01	0.00000E+00	0.90281E+05	0.43181E+03
0.42672E+00	-0.14143E-01	0.00000E+00	0.90105E+05	0.43925E+03
0.41338E+00	-0.15586E-01	0.00000E+00	0.89932E+05	0.44674E+03
0.40005E+00	-0.16991E-01	0.00000E+00	0.89763E+05	0.45424E+03
0.38671E+00	-0.18355E-01	0.00000E+00	0.89599E+05	0.46175E+03
0.37338E+00	-0.19676E-01	0.00000E+00	0.89437E+05	0.46942E+03
0.36004E+00	-0.20952E-01	0.00000E+00	0.89276E+05	0.47725E+03
0.34671E+00	-0.22181E-01	0.00000E+00	0.89117E+05	0.48524E+03
0.33337E+00	-0.23360E-01	0.00000E+00	0.88959E+05	0.49344E+03
0.32004E+00	-0.24485E-01	0.00000E+00	0.88802E+05	0.50188E+03
0.30670E+00	-0.25553E-01	0.00000E+00	0.88646E+05	0.51060E+03
0.29337E+00	-0.26560E-01	0.00000E+00	0.88491E+05	0.51962E+03
0.28003E+00	-0.27502E-01	0.00000E+00	0.88335E+05	0.52908E+03
0.26670E+00	-0.28376E-01	0.00000E+00	0.88178E+05	0.53896E+03
0.25336E+00	-0.29176E-01	0.00000E+00	0.88019E+05	0.54941E+03
0.24003E+00	-0.29898E-01	0.00000E+00	0.87859E+05	0.56048E+03
0.22670E+00	-0.30533E-01	0.00000E+00	0.87697E+05	0.57223E+03
0.21336E+00	-0.31077E-01	0.00000E+00	0.87532E+05	0.58482E+03
0.20002E+00	-0.31519E-01	0.00000E+00	0.87370E+05	0.59823E+03
0.18669E+00	-0.31848E-01	0.00000E+00	0.87208E+05	0.61262E+03
0.17335E+00	-0.32054E-01	0.00000E+00	0.87049E+05	0.62818E+03
0.16002E+00	-0.32125E-01	0.00000E+00	0.86893E+05	0.64508E+03
0.14668E+00	-0.32045E-01	0.00000E+00	0.86742E+05	0.66365E+03
0.13335E+00	-0.31797E-01	0.00000E+00	0.86597E+05	0.68429E+03
0.12001E+00	-0.31361E-01	0.00000E+00	0.86463E+05	0.70739E+03
0.10668E+00	-0.30708E-01	0.00000E+00	0.86346E+05	0.73363E+03
0.93345E-01	-0.29806E-01	0.00000E+00	0.86256E+05	0.76394E+03
0.80010E-01	-0.28609E-01	0.00000E+00	0.86207E+05	0.79977E+03
0.66675E-01	-0.27060E-01	0.00000E+00	0.86222E+05	0.84362E+03
0.53340E-01	-0.25072E-01	0.00000E+00	0.86289E+05	0.88156E+03
0.48006E-01	-0.24125E-01	0.00000E+00	0.86350E+05	0.90769E+03
0.42672E-01	-0.23071E-01	0.00000E+00	0.86451E+05	0.93724E+03
0.37338E-01	-0.21890E-01	0.00000E+00	0.86617E+05	0.97066E+03
0.32004E-01	-0.20555E-01	0.00000E+00	0.86890E+05	0.10080E+04
0.26670E-01	-0.19029E-01	0.36846E-01	0.87197E+05	0.10389E+04
0.24003E-01	-0.18179E-01	0.72813E-01	0.87462E+05	0.10614E+04
0.21336E-01	-0.17262E-01	0.10903E+00	0.87792E+05	0.10855E+04
0.18669E-01	-0.16267E-01	0.14571E+00	0.88194E+05	0.11122E+04
0.16002E-01	-0.15182E-01	0.18299E+00	0.88677E+05	0.11436E+04
0.13335E-01	-0.13991E-01	0.22123E+00	0.89290E+05	0.11801E+04
0.10668E-01	-0.12655E-01	0.27031E+00	0.90202E+05	0.12137E+04
0.80010E-02	-0.11093E-01	0.33232E+00	0.91577E+05	0.12363E+04
0.53340E-02	-0.92001E-02	0.39755E+00	0.93134E+05	0.12260E+04
0.40005E-02	-0.80426E-02	0.45049E+00	0.94644E+05	0.11809E+04
0.26670E-02	-0.66067E-02	0.51003E+00	0.96128E+05	0.10989E+04
0.20002E-02	-0.57068E-02	0.55315E+00	0.97340E+05	0.10040E+04

0.13335E-02	-0.45979E-02	0.58051E+00	0.98116E+05	0.92716E+03
0.12001E-02	-0.43397E-02	0.59210E+00	0.98429E+05	0.88705E+03
0.10668E-02	-0.40661E-02	0.60299E+00	0.98714E+05	0.85121E+03
0.93345E-03	-0.37738E-02	0.61453E+00	0.99002E+05	0.81178E+03
0.80010E-03	-0.34591E-02	0.61789E+00	0.99292E+05	0.76835E+03
0.66675E-03	-0.31188E-02	0.62325E+00	0.99578E+05	0.72199E+03
0.53340E-03	-0.27449E-02	0.62761E+00	0.99793E+05	0.68355E+03
0.46672E-03	-0.25422E-02	0.63085E+00	0.99942E+05	0.65425E+03
0.40005E-03	-0.23272E-02	0.63420E+00	0.10008E+06	0.62528E+03
0.33337E-03	-0.20968E-02	0.63780E+00	0.10023E+06	0.59510E+03
0.26670E-03	-0.18466E-02	0.64381E+00	0.10036E+06	0.56432E+03
0.20003E-03	-0.15709E-02	0.64399E+00	0.10050E+06	0.53413E+03
0.13335E-03	-0.12567E-02	0.64421E+00	0.10064E+06	0.50297E+03
0.66675E-04	-0.87051E-03	0.64460E+00	0.10080E+06	0.50297E+03
0.00000E+00	0.00000E+00	0.64380E+00	0.10080E+06	0.50297E+03
0.66675E-04	0.87051E-03	0.64278E+00	0.10064E+06	0.50297E+03
0.13335E-03	0.12567E-02	0.64218E+00	0.10050E+06	0.53413E+03
0.20003E-03	0.15709E-02	0.64173E+00	0.10036E+06	0.56432E+03
0.26670E-03	0.18466E-02	0.63692E+00	0.10023E+06	0.59510E+03
0.33337E-03	0.20968E-02	0.63356E+00	0.10008E+06	0.62528E+03
0.40005E-03	0.23272E-02	0.63045E+00	0.99942E+05	0.65425E+03
0.46672E-03	0.25422E-02	0.62744E+00	0.99793E+05	0.68355E+03
0.53340E-03	0.27449E-02	0.62338E+00	0.99578E+05	0.72199E+03
0.66675E-03	0.31188E-02	0.61839E+00	0.99292E+05	0.76826E+03
0.80010E-03	0.34591E-02	0.61371E+00	0.99002E+05	0.81179E+03
0.93345E-03	0.37738E-02	0.60237E+00	0.98713E+05	0.85130E+03
0.10668E-02	0.40661E-02	0.59167E+00	0.98429E+05	0.88705E+03
0.12001E-02	0.43397E-02	0.58029E+00	0.98116E+05	0.92716E+03
0.13335E-02	0.45979E-02	0.55340E+00	0.97340E+05	0.10040E+04
0.20002E-02	0.57068E-02	0.51257E+00	0.96128E+05	0.10989E+04
0.26670E-02	0.66067E-02	0.45467E+00	0.94644E+05	0.11809E+04
0.40005E-02	0.80426E-02	0.39931E+00	0.93134E+05	0.12260E+04
0.53340E-02	0.92001E-02	0.33332E+00	0.91577E+05	0.12362E+04
0.80010E-02	0.11093E-01	0.26976E+00	0.90202E+05	0.12137E+04
0.10668E-01	0.12655E-01	0.21949E+00	0.89291E+05	0.11801E+04
0.13335E-01	0.13991E-01	0.18146E+00	0.88677E+05	0.11436E+04
0.16002E-01	0.15182E-01	0.14437E+00	0.88195E+05	0.11122E+04
0.18669E-01	0.16267E-01	0.10789E+00	0.87792E+05	0.10855E+04
0.21336E-01	0.17262E-01	0.71863E-01	0.87462E+05	0.10614E+04
0.24003E-01	0.18179E-01	0.36087E-01	0.87197E+05	0.10389E+04
0.26670E-01	0.19029E-01	0.00000E+00	0.86890E+05	0.10080E+04
0.32004E-01	0.20555E-01	0.00000E+00	0.86617E+05	0.97065E+03
0.37338E-01	0.21890E-01	0.00000E+00	0.86451E+05	0.93725E+03
0.42672E-01	0.23071E-01	0.00000E+00	0.86350E+05	0.90768E+03
0.48006E-01	0.24125E-01	0.00000E+00	0.86289E+05	0.88157E+03
0.53340E-01	0.25072E-01	0.00000E+00	0.86222E+05	0.84362E+03
0.66675E-01	0.27060E-01	0.00000E+00	0.86207E+05	0.79977E+03
0.80010E-01	0.28609E-01	0.00000E+00	0.86256E+05	0.76394E+03
0.93345E-01	0.29806E-01	0.00000E+00	0.86346E+05	0.73364E+03
0.10668E+00	0.30708E-01	0.00000E+00	0.86463E+05	0.70739E+03
0.12001E+00	0.31361E-01	0.00000E+00	0.86597E+05	0.68429E+03
0.13335E+00	0.31797E-01	0.00000E+00	0.86742E+05	0.66365E+03
0.14668E+00	0.32045E-01	0.00000E+00	0.86893E+05	0.64508E+03
0.16002E+00	0.32125E-01	0.00000E+00	0.87049E+05	0.62818E+03
0.17335E-00	0.32054E-01	0.00000E+00	0.87208E+05	0.61263E+03

0.18669E+00	0.31848E-01	0.00000E+00	0.87370E+05	0.59823E+03
0.20002E+00	0.31519E-01	0.00000E+00	0.87532E+05	0.58482E+03
0.21336E+00	0.31077E-01	0.00000E+00	0.87697E+05	0.57223E+03
0.22670E+00	0.30533E-01	0.00000E+00	0.87859E+05	0.56048E+03
0.24003E+00	0.29898E-01	0.00000E+00	0.88019E+05	0.54941E+03
0.25336E+00	0.29176E-01	0.00000E+00	0.88178E+05	0.53896E+03
0.26670E+00	0.28376E-01	0.00000E+00	0.88335E+05	0.52908E+03
0.28003E+00	0.27502E-01	0.00000E+00	0.88491E+05	0.51962E+03
0.29337E+00	0.26560E-01	0.00000E+00	0.88646E+05	0.51060E+03
0.30670E+00	0.25553E-01	0.00000E+00	0.88802E+05	0.50188E+03
0.32004E+00	0.24485E-01	0.00000E+00	0.88959E+05	0.49344E+03
0.33337E+00	0.23360E-01	0.00000E+00	0.89117E+05	0.48524E+03
0.34671E+00	0.22181E-01	0.00000E+00	0.89276E+05	0.47725E+03
0.36004E+00	0.20952E-01	0.00000E+00	0.89437E+05	0.46942E+03
0.37338E+00	0.19676E-01	0.00000E+00	0.89599E+05	0.46175E+03
0.38671E+00	0.18355E-01	0.00000E+00	0.89763E+05	0.45424E+03
0.40005E+00	0.16991E-01	0.00000E+00	0.89932E+05	0.44673E+03
0.41338E+00	0.15586E-01	0.00000E+00	0.90105E+05	0.43924E+03
0.42672E+00	0.14143E-01	0.00000E+00	0.90281E+05	0.43180E+03
0.44005E+00	0.12662E-01	0.00000E+00	0.90463E+05	0.42433E+03
0.45339E+00	0.11142E-01	0.00000E+00	0.90654E+05	0.41667E+03
0.46672E+00	0.95761E-02	0.00000E+00	0.90863E+05	0.40859E+03
0.48006E+00	0.79519E-02	0.00000E+00	0.91115E+05	0.39922E+03
0.49339E+00	0.62408E-02	0.00000E+00	0.91466E+05	0.38681E+03
0.50673E+00	0.44011E-02	0.00000E+00	0.91961E+05	0.36999E+03
0.51740E+00	0.27945E-02	0.00000E+00	0.92501E+05	0.35195E+03
0.52273E+00	0.19261E-02	0.00000E+00	0.93085E+05	0.33258E+03
0.52807E+00	0.99959E-03	0.00000E+00	0.94528E+05	0.28421E+03
0.53340E+00	0.00000E+00	0.00000E+00	0.90748E+05	0.00000E+00

FILE: XY DATA A VM/SP CONVERSATIONAL MONITOR SYSTEM

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4.45336373	-1.22251264
4.42290092	-1.22099942
4.39243966	-1.21945531
4.05964263	-1.20050210
3.72710276	-1.17746893
3.39490633	-1.14990196
3.36453128	-1.14713608
3.33416014	-1.14432769
3.19196146	-1.13059597
3.04986066	-1.11588127
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1.45018911	-0.85711833
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1.20332896	-0.79383156
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0.92911722	-0.73143478
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0.30074993	-0.53883886
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2.48271458	1.04605085
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2.76600613	1.08328257
2.90787067	1.10013021
3.04986066	1.11588127
3.19196146	1.13059597
3.33416014	1.14432769
3.36453128	1.14713608
3.39490633	1.14990196
3.72710276	1.17746893
4.05964263	1.20050210
4.39243966	1.21945531
4.42290092	1.22099942
4.45336373	1.22251264
4.78638001	1.23710023
5.11952640	1.24831620
5.45276231	1.25644559
7.68307923	1.24616059
9.91154523	1.15226143
12.13690611	1.00119134
14.35897929	0.80748978
16.57796232	0.58102690
18.79386813	0.32622788
20.78999862	0.03935400

FILE: QCOND DATA A VM/SP CONVERSATIONAL MONITOR SYSTEM

120.000000	28.121052	21.367600	21.300049
120.000000	28.121052	21.367600	21.300049
120.000000	28.121052	21.367600	21.300049
120.000000	28.121052	21.367600	21.300049
120.000000	28.121052	21.367600	21.300049
120.100000	28.121052	21.367600	21.300049
120.300000	27.420975	21.367600	21.300049
120.500000	27.465296	21.367476	21.300171
120.700000	26.802170	21.367258	21.300387
120.900000	26.007167	21.366947	21.300693
121.100000	24.922612	21.366544	21.301085
121.300000	23.637499	21.366047	21.301562
121.500000	22.169093	21.365456	21.302117
121.700000	20.550830	21.364766	21.302753
121.900000	18.783002	21.363977	21.303463
122.100000	16.945013	21.363086	21.304249
122.300000	15.074730	21.362091	21.305110
122.500000	13.184268	21.360992	21.306043
122.700000	11.289676	21.359792	21.307046
122.900000	9.406904	21.358492	21.308115
123.100000	7.542440	21.357092	21.309248
123.300000	5.708895	21.355593	21.310444
123.500000	3.912621	21.353997	21.311700
123.700000	2.319036	21.352306	21.313014
123.900000	1.120082	21.350519	21.314385
124.100000	0.097874	16.299288	9.390358
124.300000	0.003948	16.453816	9.228278
124.500000	0.000024	16.691092	9.014641
124.700000	0.000022	16.257770	8.512870
124.900000	0.000020	16.500753	8.354727
125.100000	0.000020	16.514771	7.985393
125.300000	0.000018	16.138804	7.545214
125.500000	0.000018	16.187686	7.274086
125.700000	0.000017	15.897216	6.894794
125.900000	0.000016	16.017724	6.708210
126.100000	0.000016	16.170473	6.545222
126.300000	0.000015	15.915463	6.251596
126.500000	0.000846	17.004931	6.440756
126.700000	0.025547	16.618781	6.088180
126.900000	0.072183	16.713365	5.872242
127.100000	0.158362	16.949671	5.557934
127.300000	0.286040	17.633826	5.287026
127.500000	0.064034	15.942989	4.263140
127.700000	0.135165	14.044385	3.328428
127.900000	0.351915	12.326458	3.440093
128.100000	0.312251	6.900503	1.796592
128.300000	0.051299	6.846734	2.013605
128.500000	0.008607	5.377879	1.529749
128.700000	0.021179	7.042710	2.033737
128.900000	0.021798	7.601113	2.283861
129.100000	0.044585	11.858595	3.704484
129.300000	0.103079	15.637320	4.877648
129.500000	0.159474	15.679019	4.835949
129.700000	0.224809	15.722147	4.792821
129.900000	0.305069	16.095156	5.127225

130.100000	0.395811	16.655199	5.274594
130.300000	0.527916	18.299236	5.752795
130.500000	0.623316	18.323967	5.728065
130.700000	0.719304	18.350335	5.701696
130.900000	0.816506	18.377114	5.674917
131.100000	0.940129	18.946448	5.812996
131.300000	1.040703	18.976000	5.783444
131.500000	1.140182	19.006458	5.752986
131.700000	1.238805	19.037544	5.721900
131.900000	1.372149	19.614416	5.852440
132.100000	1.468597	19.648208	5.818648
132.300000	1.561966	19.682783	5.784074
132.500000	1.652102	19.718065	5.748792
132.700000	1.739064	19.754195	5.712661
132.900000	1.822320	19.791049	5.675808
133.100000	1.901918	19.828761	5.638095
133.300000	1.971969	19.867226	5.599631
133.500000	1.991179	19.342078	5.417366
133.700000	2.070345	19.365377	5.394067
133.900000	2.207270	19.391415	5.368029
134.100000	2.301330	19.417371	5.342073
134.300000	2.396378	19.444019	5.315425
134.500000	2.408244	18.901190	5.150841
134.700000	2.491075	18.913653	5.138378
134.900000	2.569493	18.928739	5.123292
135.100000	2.646979	18.942790	5.109241
135.300000	2.720217	18.957393	5.094638
135.500000	2.874780	19.529787	5.229657
135.700000	2.946392	19.544921	5.214523
135.900000	3.016103	19.559849	5.199595
136.100000	3.082093	19.574864	5.184580
136.300000	3.146239	19.589748	5.169696
136.500000	3.206752	19.604640	5.154804
136.700000	3.265183	19.619418	5.140026
136.900000	3.320931	19.634163	5.125281
137.100000	3.272456	19.084771	4.967260
137.300000	3.316550	19.091636	4.960395
137.500000	3.360781	19.098653	4.953379
137.700000	3.403470	19.105817	4.946214
137.900000	3.444719	19.112949	4.939082
138.100000	3.483770	19.120091	4.931941
138.300000	3.521199	19.127183	4.924848
138.500000	3.437777	18.566517	4.778101
138.700000	3.469498	18.566791	4.777827
138.900000	3.501075	18.568105	4.776513
139.100000	3.530578	18.568890	4.775729
139.300000	3.666129	19.132634	4.919397
139.500000	3.696103	19.133658	4.918373
139.700000	3.723715	19.134746	4.917285
139.900000	3.751573	19.135798	4.916233
140.100000	3.777776	19.136915	4.915116
140.300000	3.803949	19.138012	4.914019
140.500000	3.828782	19.139162	4.912869
140.700000	3.853454	19.140305	4.911727
140.900000	3.877021	19.141492	4.910539

141.100000	3.900364	19.142681	4.909350
141.300000	3.922786	19.143910	4.908121
141.500000	3.944960	19.145148	4.906883
141.700000	3.966364	19.146423	4.905608
141.900000	3.987519	19.147712	4.904319
142.100000	4.008027	19.149036	4.902995
142.300000	4.028299	19.150379	4.901652
142.500000	4.048027	19.151756	4.900275
142.700000	4.067538	19.153155	4.898876
142.900000	4.086594	19.154588	4.897443
143.100000	4.105458	19.156045	4.895986
143.300000	4.123941	19.157537	4.894495
143.500000	4.142257	19.159054	4.892977
143.700000	4.160259	19.160605	4.891426
143.900000	4.178119	19.162185	4.889846
144.100000	4.195720	19.163798	4.888233
144.300000	4.213206	19.165441	4.886590
144.500000	4.230483	19.167118	4.884913
144.700000	4.247669	19.168825	4.883206
144.900000	4.264689	19.170566	4.881465
145.100000	4.281641	19.172339	4.879692
145.300000	4.298466	19.174146	4.877885
145.500000	4.315242	19.175985	4.876046
145.700000	4.331926	19.177858	4.874173
145.900000	4.348581	19.179764	4.872267
146.100000	4.365173	19.181704	4.870327
146.300000	4.381754	19.183677	4.868355
146.500000	4.398298	19.185683	4.866348
146.700000	4.414846	19.187723	4.864308
146.900000	4.431381	19.189797	4.862234
147.100000	4.447935	19.191904	4.860127
147.300000	4.464496	19.194045	4.857986
147.500000	4.481087	19.196220	4.855811
147.700000	4.497705	19.198428	4.853603
147.900000	4.514364	19.200669	4.851362
148.100000	4.531065	19.202944	4.849088
148.300000	4.547818	19.205251	4.846780
148.500000	4.564627	19.207592	4.844439
148.700000	4.581496	19.209966	4.842065
148.900000	4.598433	19.212373	4.839659
149.100000	4.615438	19.214812	4.837219
149.300000	4.632522	19.217284	4.834747
149.500000	4.649681	19.219788	4.832243
149.700000	4.666927	19.222325	4.829707
149.900000	4.684255	19.224893	4.827138
150.100000	4.701678	19.227493	4.824538
150.300000	4.719187	19.230125	4.821906
150.500000	4.736799	19.232789	4.819242
150.700000	4.754501	19.235484	4.816547
150.900000	4.772312	19.238210	4.813822
151.100000	4.790217	19.240966	4.811065
151.300000	4.808236	19.243754	4.808278
151.500000	4.826352	19.246571	4.805460
151.700000	4.844586	19.249419	4.802612
151.900000	4.862921	19.252297	4.799734

152.100000	4.881376	19.255205	4.796826
152.300000	4.899935	19.258142	4.793889
152.500000	4.918617	19.261109	4.790922
152.700000	4.937404	19.264105	4.787926
152.900000	4.956317	19.267129	4.784902
153.100000	4.975338	19.270182	4.781849
153.300000	4.994486	19.273264	4.778768
153.500000	5.013742	19.276373	4.775658
153.700000	5.033128	19.279510	4.772521
153.900000	5.052622	19.282676	4.769356
154.100000	5.072247	19.285868	4.766163
154.300000	5.091983	19.289088	4.762944
154.500000	5.111849	19.292334	4.759697
154.700000	5.131826	19.295607	4.756424
154.900000	5.151934	19.298907	4.753124
155.100000	5.172154	19.302233	4.749799
155.300000	5.192504	19.305584	4.746447
155.500000	5.212967	19.308962	4.743069
155.700000	5.233561	19.312365	4.739666
155.900000	5.254267	19.315793	4.736238
156.100000	5.275104	19.319246	4.732785
156.300000	5.296053	19.322724	4.729307
156.500000	5.317132	19.326227	4.725805
156.700000	5.338323	19.329753	4.722278
156.900000	5.359645	19.333304	4.718727
157.100000	5.381078	19.336879	4.715152
157.300000	5.402640	19.340477	4.711554
157.500000	5.424314	19.344099	4.707932
157.700000	5.446117	19.347744	4.704287
157.900000	5.468030	19.351411	4.700620
158.100000	5.478011	19.355102	4.696929
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158.500000	5.414464	19.362578	4.689454
158.700000	5.364334	18.796478	4.548141
158.900000	4.488049	19.189920	4.862111
159.100000	4.541136	19.194292	4.857739
159.300000	4.575130	19.197156	4.854875
159.500000	4.596492	19.199418	4.852613
159.700000	4.617886	19.201854	4.850178
159.900000	4.635854	19.204296	4.847736
160.100000	4.652065	19.206796	4.845235
160.300000	4.665981	19.209390	4.842641
160.500000	4.677779	19.212089	4.839942
160.700000	4.686871	19.214929	4.837102
160.900000	4.692822	19.217914	4.834117
161.100000	4.684928	19.221083	4.830948
161.300000	4.699845	19.224444	4.827587
161.500000	4.716037	19.228055	4.823976
161.700000	4.736269	19.231942	4.820089
161.900000	4.757069	19.235893	4.816138
162.100000	4.779158	19.239925	4.812106
162.300000	4.801703	19.244003	4.808028
162.500000	4.824905	19.248129	4.803903
162.700000	4.848457	19.252289	4.799742
162.900000	4.872425	19.256483	4.795548

163.100000	4.896664	19.260707	4.791324
163.300000	4.921205	19.264957	4.787074
163.500000	4.945962	19.269233	4.782798
163.700000	4.970959	19.273532	4.778499
163.900000	4.996131	19.277855	4.774177
164.100000	5.021507	19.282197	4.769834
164.300000	5.047031	19.286562	4.765470
164.500000	5.072734	19.290945	4.761086
164.700000	5.098565	19.295348	4.756684
164.900000	5.124558	19.299769	4.752263
165.100000	5.150664	19.304208	4.747823
165.300000	5.176919	19.308665	4.743366
165.500000	5.166342	18.744587	4.600032
165.700000	4.048023	19.167422	4.884610
165.900000	4.099990	19.172280	4.879752
166.100000	4.131772	19.175688	4.876344
166.300000	4.150278	19.178596	4.873435
166.500000	4.172330	19.181660	4.870371
166.700000	4.190897	19.184644	4.867387
166.900000	4.209715	19.187628	4.864404
167.100000	4.227052	19.190590	4.861441
167.300000	4.244542	19.193559	4.858472
167.500000	4.261280	19.196527	4.855504
167.700000	4.278155	19.199506	4.852525
167.900000	4.294627	19.202494	4.849537
168.100000	4.311250	19.205498	4.846533
168.300000	4.327664	19.208517	4.843514
168.500000	4.344249	19.211556	4.840475
168.700000	4.360747	19.214616	4.837415
168.900000	4.377430	19.217701	4.834330
169.100000	4.394105	19.220812	4.831219
169.300000	4.410971	19.223953	4.828078
169.500000	4.427872	19.227127	4.824904
169.700000	4.444953	19.230338	4.821694
169.900000	4.462075	19.233589	4.818443
170.100000	4.479330	19.236884	4.815147
170.300000	4.496580	19.240229	4.811802
170.500000	4.513859	19.243629	4.808403
170.700000	4.531005	19.247089	4.804942
170.900000	4.547975	19.250616	4.801415
171.100000	4.564552	19.254218	4.797813
171.300000	4.580586	19.257902	4.794129
171.500000	4.595756	19.261679	4.790352
171.700000	4.609753	19.265556	4.786475
171.900000	4.622083	19.269548	4.782484
172.100000	4.632198	19.273664	4.778367
172.300000	4.620242	19.277920	4.774112
172.500000	4.587694	19.282317	4.769714
172.700000	4.565191	19.286950	4.765081
172.900000	4.484516	18.721963	4.622656
173.100000	3.735398	19.113545	4.938487
173.300000	3.794901	19.119379	4.932652
173.500000	3.833228	19.123598	4.928433
173.700000	3.856151	19.127231	4.924800
173.900000	3.875748	19.131049	4.920982

174.100000	3.888346	19.134984	4.917047
174.300000	3.895071	19.139066	4.912966
174.500000	3.899437	19.143379	4.908652
174.700000	3.920306	19.147917	4.904114
174.900000	3.943141	19.152739	4.899292
175.100000	3.968891	19.157743	4.894288
175.300000	3.995303	19.162826	4.889206
175.500000	4.022824	19.167955	4.884077
175.700000	4.050706	19.173134	4.878897
175.900000	4.079260	19.178337	4.873694
176.100000	4.108012	19.183576	4.868455
176.300000	4.137262	19.188830	4.863201
176.500000	4.166612	19.194112	4.857919
176.700000	4.196371	19.199406	4.852626
176.900000	4.226170	19.204722	4.847309
177.100000	4.256325	19.210048	4.841983
177.300000	4.286482	19.215393	4.836638
177.500000	4.316959	19.220747	4.831284
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177.900000	4.378160	19.231496	4.820535
178.100000	4.408871	19.236890	4.815141
178.300000	4.439852	19.242291	4.809740
178.500000	4.470789	19.247706	4.804325
178.700000	4.501979	19.253127	4.798904
178.900000	4.533120	19.258562	4.793469
179.100000	4.564498	19.264003	4.788028
179.300000	4.595827	19.269457	4.782575
179.500000	4.627379	19.274916	4.777115
179.700000	4.658883	19.280387	4.771644
179.900000	4.690598	19.285865	4.766166
180.100000	4.722267	19.291353	4.760678
180.300000	4.754178	19.296847	4.755184
180.500000	4.783847	19.302194	4.749837
180.700000	4.812128	19.307405	4.744626
180.900000	4.834972	19.312238	4.739793
181.100000	4.850794	19.316476	4.735555
181.300000	4.859525	19.320158	4.731873
181.500000	4.865096	19.323341	4.728691
181.700000	4.868033	19.326121	4.725910
181.900000	4.871547	19.328498	4.723533
182.100000	4.875041	19.330518	4.721514
182.300000	4.880776	19.332142	4.719889
182.500000	4.887363	19.333382	4.718649
182.700000	4.896335	19.334189	4.717842
182.900000	4.905932	19.334561	4.717470
183.100000	4.917183	19.334452	4.717579
183.300000	4.917723	19.333858	4.718173
183.500000	4.883972	19.332734	4.719297
183.700000	4.847658	19.331129	4.720902
183.900000	3.867002	19.029933	5.022099
184.100000	3.138638	19.232497	5.526947
184.300000	3.309829	19.780659	5.686197
184.500000	3.362388	19.781662	5.685194
184.700000	3.432120	20.108473	6.065796
184.900000	3.502561	20.111722	6.062548

185.100000	3.596239	20.416042	6.465640
185.300000	3.628726	20.420983	6.460698
185.500000	3.675905	20.423323	6.458359
185.700000	3.633448	20.425333	6.456349
185.900000	3.545405	20.707232	6.881863
186.100000	3.312904	20.712589	6.876506
186.300000	3.025793	20.718161	6.870933
186.500000	2.602564	20.193989	6.687693
186.700000	2.214025	20.203227	6.678454
186.900000	1.751233	19.683117	6.491152
187.100000	1.354171	19.698145	6.476124
187.300000	0.984211	19.717355	6.456915
187.500000	0.695274	18.358993	6.491685
187.700000	0.414000	18.371359	6.471320
187.900000	0.195424	17.447711	6.116200
188.100000	0.072350	16.767352	5.935826
188.300000	0.012090	16.821574	5.906171
188.500000	0.000025	17.130783	6.158927
188.700000	0.000024	17.194825	6.095805
188.900000	0.000023	17.556795	6.329532
189.100000	0.000022	17.653754	6.232344
189.300000	0.000021	17.773119	6.112398
189.500000	0.000020	17.259251	6.025997
189.700000	0.000018	16.938181	5.747105
189.900000	0.000023	12.484294	6.032846
190.100000	0.000022	12.364137	6.131626
190.300000	0.000021	12.032134	5.924808
190.500000	0.000019	11.134379	5.748437
190.700000	0.042831	10.538761	5.685589
190.900000	0.040189	8.964004	5.066673
191.100000	0.068510	7.433529	4.407434
191.300000	0.078367	4.945553	2.955829
191.500000	0.096065	4.223810	2.691707
191.700000	0.126769	4.420319	2.955353
191.900000	0.184040	4.593123	3.244221
192.100000	0.238843	4.774685	3.525772
192.300000	0.293050	4.787216	3.515881
192.500000	0.361179	4.944116	3.824157
192.700000	0.088669	5.557279	4.157061
192.900000	0.108610	5.574337	4.144843
193.100000	0.229058	5.746991	4.468362
193.300000	0.166773	6.162711	4.794327
193.500000	0.210135	6.257108	5.058099
193.700000	0.041507	6.736137	6.024881
193.900000	0.059222	6.826761	6.317105
194.100000	0.182566	6.865537	6.297437
194.300000	0.287456	7.477525	7.593736
194.500000	0.281008	8.251510	8.297276
194.700000	0.317567	8.696651	8.829427
194.900000	0.516033	9.352524	9.646111
195.100000	0.685235	10.047255	10.424370
195.300000	0.855883	10.960286	11.477847
195.500000	1.226692	11.847595	12.561539
195.700000	1.551070	12.729162	13.651177
195.900000	2.105070	13.833076	15.011095

196.100000	2.746077	15.172242	16.629568
196.300000	3.666048	17.432320	19.291480
196.500000	4.364199	18.309152	20.409335
196.700000	5.308749	20.098482	22.576276
196.900000	5.947319	20.506018	23.186643
197.100000	6.634425	21.144422	24.054705
197.300000	7.135022	21.102494	24.128055
197.500000	7.579921	21.068371	24.191106
197.700000	8.029234	21.040761	24.245662
197.900000	8.448849	21.018419	24.293136
198.100000	8.851823	21.000774	24.334381
198.300000	9.223775	20.986696	24.370609
198.500000	9.697269	20.975681	24.402468
198.700000	10.131864	20.967272	24.430523
198.900000	10.500245	20.961069	24.455273
199.100000	11.008180	20.956770	24.477144
199.300000	11.550451	20.953982	24.496569
199.500000	12.211224	20.952530	24.513795
199.700000	12.980415	20.952293	24.529002
199.900000	13.869926	20.953183	24.542342
200.100000	14.631737	20.955033	24.553992
200.300000	15.373872	20.957743	24.564145
200.500000	15.981164	20.961205	24.572954
200.700000	16.557542	20.965357	24.580538
200.900000	17.057288	20.970123	24.587012
201.100000	17.529660	20.975452	24.592463
201.300000	17.951171	20.981288	24.596977
201.500000	18.349736	20.987600	24.600616
201.700000	18.713003	20.994345	24.603442
201.900000	19.056869	21.001499	24.605506
202.100000	19.556084	21.009030	24.606858
202.300000	19.920000	21.016916	24.607538
202.500000	20.271674	21.025128	24.607578
202.700000	20.834036	21.262287	24.874477
202.900000	21.161548	21.271326	24.873270
203.100000	21.448450	21.280616	24.871536
203.300000	21.713523	21.290195	24.869278
203.500000	21.961598	21.300028	24.866534
203.700000	22.194357	21.310101	24.863332
203.900000	22.414022	21.320396	24.859701
204.100000	22.655204	21.330896	24.855667
204.300000	22.952984	21.341601	24.851239
204.500000	23.245819	21.352491	24.846443
204.700000	23.451655	21.363556	24.841300
204.900000	23.642415	21.374776	24.835833
205.100000	23.794097	21.386138	24.830062
205.300000	23.944712	21.397650	24.823992
205.500000	24.089465	21.409297	24.817639
205.700000	24.234068	21.421070	24.811018
205.900000	24.376590	21.432853	24.804250
206.100000	24.497026	21.444642	24.797347
206.300000	24.619575	21.456438	24.790307
206.500000	24.736342	21.468241	24.783140
206.700000	24.846344	21.480050	24.775841
206.900000	24.993598	21.491877	24.768412

207.100000	25.146786	21.503709	24.760873
207.300000	25.259899	21.515515	24.753257
207.500000	25.370522	21.527278	24.745586
207.700000	25.471411	21.539003	24.737859
207.900000	25.597338	21.550733	24.730037
208.100000	25.695504	21.562455	24.722137
208.300000	25.775610	21.574165	24.714169
208.500000	25.854557	21.585851	24.706144
208.700000	25.926584	21.597504	24.698074
208.900000	26.004658	21.609115	24.689971
209.100000	26.072278	21.620671	24.681850
209.300000	26.137702	21.632164	24.673718
209.500000	26.199141	21.643590	24.665585
209.700000	26.264426	21.654946	24.657461
209.900000	26.329363	21.666215	24.649360
210.100000	26.388489	21.677392	24.641288
210.300000	26.440732	21.688471	24.633251
210.500000	26.491289	21.699452	24.625254
210.700000	26.540571	21.710328	24.617302
210.900000	26.584121	21.721106	24.609396
211.100000	26.625332	21.731785	24.601538
211.300000	26.670328	21.742363	24.593727
211.500000	26.717675	21.752823	24.585981
211.700000	26.790431	21.763163	24.578305
211.900000	26.886469	21.773390	24.570692
212.100000	26.984832	21.783509	24.563139
212.300000	27.073676	21.793396	24.555768
212.500000	27.152573	21.803050	24.548588
212.700000	27.227447	21.812479	24.541588
212.900000	27.296839	21.821702	24.534749
213.100000	27.364682	21.830730	24.528063
213.300000	27.429510	21.839571	24.521521
213.500000	27.533690	21.848242	24.515109
213.700000	27.605050	21.856758	24.508813
213.900000	27.671587	21.865176	24.502576
214.100000	27.727863	21.873499	24.496400
214.300000	27.780882	21.881722	24.490289
214.500000	27.831765	21.889835	24.484255
214.700000	27.882693	21.897838	24.478297
214.900000	27.952517	21.905662	24.472484
215.100000	28.040472	21.913323	24.466801
215.300000	28.123449	21.920827	24.461241
215.500000	28.186392	21.928233	24.455750
215.700000	28.235774	21.935545	24.450326
215.900000	28.284392	21.942765	24.444964
216.100000	28.329063	21.949893	24.439664
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216.500000	28.402616	21.963861	24.429273
216.700000	28.432806	21.970716	24.424167
216.900000	28.460561	21.977487	24.419120
217.100000	28.488068	21.984175	24.414131
217.300000	28.515885	21.990779	24.409201
217.500000	28.552913	21.997308	24.404326
217.700000	28.596143	22.003727	24.399535
217.900000	28.667227	22.010036	24.394829

218.100000	28.740419	22.016242	24.390202
218.300000	28.795712	22.022348	24.385652
218.500000	28.843295	22.028272	24.381261
218.700000	28.883251	22.034030	24.377016
218.900000	28.923419	22.039629	24.372909
219.100000	28.958711	22.045079	24.368928
219.300000	28.997661	22.050392	24.365065
219.500000	29.037107	22.055573	24.361313
219.700000	29.075696	22.060630	24.357666
219.900000	29.116040	22.065572	24.354109
220.100000	29.194633	22.070409	24.350638
220.300000	29.246290	22.075147	24.347246
220.500000	29.293557	22.079793	24.343929
220.700000	29.333653	22.084354	24.340682
220.900000	29.372850	22.088838	24.337494
221.100000	29.410909	22.093251	24.334362
221.300000	29.450323	22.097631	24.331246
221.500000	29.485465	22.101976	24.328148
221.700000	29.517949	22.106278	24.325077
221.900000	29.548744	22.110562	24.322009
222.100000	29.581853	22.114825	24.318948
222.300000	29.617970	22.119062	24.315898
222.500000	29.654578	22.123268	24.312864
222.700000	29.690434	22.127396	24.309896
222.900000	29.723804	22.131447	24.306990
223.100000	29.759293	22.135414	24.304156
223.300000	29.800322	22.139294	24.301394
223.500000	29.842532	22.143126	24.298666
223.700000	29.883649	22.146910	24.295971
223.900000	29.922364	22.150650	24.293307
224.100000	29.961808	22.154319	24.290701
224.300000	30.026694	22.157921	24.288148
224.500000	30.072859	22.161432	24.285677
224.700000	30.115839	22.164855	24.283281
224.900000	30.154921	22.168198	24.280953
225.100000	30.192701	22.171465	24.278690
225.300000	30.229081	22.174662	24.276486
225.500000	30.270021	22.177792	24.274337
225.700000	30.312500	22.180859	24.272240
225.900000	30.350839	22.183867	24.270190
226.100000	30.387583	22.186824	24.268181
226.300000	30.427237	22.189731	24.266208
226.500000	30.466156	22.192594	24.264269
226.700000	30.503306	22.195413	24.262363
226.900000	30.564097	22.198194	24.260486
227.100000	30.606241	22.200947	24.258626
227.300000	30.643870	22.203674	24.256783
227.500000	30.677196	22.206375	24.254958
227.700000	30.725419	22.209053	24.253147
227.900000	30.788927	22.211704	24.251353
228.100000	30.846820	22.214326	24.249580
228.300000	30.896116	22.216910	24.247834
228.500000	30.941805	22.219460	24.246115
228.700000	30.983186	22.221998	24.244397
228.900000	31.022620	22.224513	24.242695

229.100000	31.057829	22.227002	24.241009
229.300000	31.089839	22.229446	24.239361
229.500000	31.136282	22.231848	24.237747
229.700000	31.188401	22.234211	24.236164
229.900000	31.231949	22.236537	24.234609
230.100000	31.272606	22.238828	24.233083
230.300000	31.308925	22.241087	24.231581
230.500000	31.370862	22.243315	24.230103
230.700000	31.406374	22.245476	24.228684
230.900000	31.444901	22.247574	24.227321
231.100000	31.477671	22.249610	24.226011
231.300000	31.512570	22.251595	24.224744
231.500000	31.555363	22.253558	24.223492
231.700000	31.609983	22.255498	24.222255
231.900000	31.656102	22.257416	24.221033
232.100000	31.697419	22.259313	24.219826
232.300000	31.733988	22.261172	24.218651
232.500000	31.767201	22.262995	24.217506
232.700000	31.797648	22.264782	24.216390
232.900000	31.826112	22.266536	24.215302
233.100000	31.864601	22.268261	24.214234
233.300000	31.930971	22.269958	24.213190
233.500000	31.968452	22.271622	24.212174
233.700000	32.005258	22.273255	24.211182
233.900000	32.033612	22.274859	24.210214
234.100000	32.060641	22.276436	24.209267
234.300000	32.084388	22.277989	24.208341
234.500000	32.108579	22.279521	24.207430
234.700000	32.130843	22.281037	24.206529
234.900000	32.153128	22.282536	24.205640
235.100000	32.173864	22.284019	24.204761
235.300000	32.192690	22.285485	24.203893
235.500000	32.209959	22.286935	24.203037
235.700000	32.234201	22.288373	24.202188
235.900000	32.278171	22.289790	24.201354
236.100000	32.309121	22.291185	24.200538
236.300000	32.341240	22.292566	24.199731
236.500000	32.368514	22.293935	24.198931
236.700000	32.396066	22.295291	24.198139
236.900000	32.420989	22.296637	24.197353
237.100000	32.445289	22.297972	24.196572
237.300000	32.467262	22.299306	24.195788
237.500000	32.486289	22.300636	24.195003
237.700000	32.502863	22.301964	24.194217
237.900000	32.519358	22.303288	24.193430
238.100000	32.534710	22.304609	24.192642
238.300000	32.548972	22.305926	24.191854
238.500000	32.568448	22.307207	24.191097
238.700000	32.598542	22.308448	24.190375
238.900000	32.615481	22.309651	24.189688
239.100000	32.633723	22.310817	24.189032
239.300000	32.648542	22.311955	24.188401
239.500000	32.676858	22.313085	24.187773
239.700000	32.720461	22.314207	24.187149
239.900000	32.767608	22.315320	24.186530

240.100000	32.815601	22.316407	24.185932
240.300000	32.838178	22.317478	24.185346
240.500000	32.777329	22.318534	24.184770
240.700000	32.468621	22.319576	24.184205
240.900000	31.792524	22.320604	24.183651
241.100000	30.839463	22.321618	24.183108
241.300000	29.729088	22.322612	24.182582
241.500000	28.553106	22.323582	24.182079
241.700000	27.388393	22.324527	24.181599
241.900000	26.299174	22.325446	24.181143
242.100000	25.341165	22.326343	24.180711
242.300000	24.529391	22.327216	24.180303
242.500000	23.837136	22.328058	24.179926
242.700000	23.253555	22.328876	24.179573
242.900000	22.765748	22.329671	24.179243
243.100000	22.357889	22.330443	24.178936
243.300000	22.009054	22.331186	24.178653
243.500000	21.717626	22.331903	24.178394
243.700000	21.458404	22.332595	24.178155
243.900000	21.219079	22.333268	24.177932
244.100000	21.005431	22.333925	24.177716
244.300000	20.816985	22.334570	24.177506
244.500000	20.643355	22.335195	24.177308
244.700000	20.479506	22.335802	24.177117
244.900000	20.322715	22.336394	24.176933
245.100000	20.172964	22.336974	24.176753
245.300000	20.033647	22.337540	24.176580
245.500000	19.900704	22.338094	24.176412
245.700000	19.772874	22.338608	24.176276
245.900000	19.648613	22.339087	24.176169
246.100000	19.526893	22.339532	24.176085
246.300000	19.406463	22.339945	24.176027
246.500000	19.283401	22.340331	24.175990
246.700000	19.167534	22.340688	24.175975
246.900000	19.058263	22.341018	24.175981
247.100000	18.944969	22.341323	24.176008
247.300000	18.827908	22.341604	24.176054
247.500000	18.722104	22.341849	24.176130
247.700000	18.618146	22.342074	24.176221
247.900000	18.487041	22.342285	24.176322
248.100000	18.359608	22.342480	24.176435
248.300000	18.255651	22.342651	24.176563
248.500000	18.152572	22.342804	24.176702
248.700000	18.054740	22.342943	24.176848
248.900000	17.925218	22.343068	24.177001
249.100000	17.823044	22.343183	24.177160
249.300000	17.685924	22.343289	24.177323
249.500000	17.551192	22.343382	24.177495
249.700000	17.447109	22.343463	24.177671
249.900000	17.342462	22.343534	24.177853

FILE: TEMPS DATA A VM/SP CONVERSATIONAL MONITOR SYSTEM

120.00000000	21.63	21.63	20.26	20.26	32.00	32.00	19.78
120.00000000	21.63	21.63	20.26	20.26	32.00	32.00	19.78
120.00000000	21.63	21.63	20.26	20.26	32.00	32.00	19.78
120.00000000	21.63	21.63	20.26	20.26	32.00	32.00	19.78
120.00000000	21.63	21.63	20.26	20.26	32.00	32.00	19.78
120.20000000	21.63	21.63	39.31	20.26	51.04	32.00	38.84
120.40000000	21.63	21.63	51.91	20.29	63.60	32.00	51.47
120.60000000	21.63	21.63	62.58	20.39	74.18	32.00	62.18
120.80000000	21.63	21.63	71.31	20.58	82.83	32.00	70.95
121.00000000	21.63	21.63	79.13	20.88	90.56	32.00	78.80
121.20000000	21.63	21.63	86.03	21.28	97.38	32.00	85.73
121.40000000	21.63	21.63	92.36	21.77	103.63	32.00	92.08
121.60000000	21.62	21.63	98.12	22.33	109.29	32.00	97.86
121.80000000	21.62	21.63	103.46	22.95	114.51	32.00	103.21
122.00000000	21.62	21.63	108.38	23.63	119.31	32.00	108.16
122.20000000	21.62	21.63	112.97	24.35	123.75	32.00	112.76
122.40000000	21.61	21.63	117.25	25.11	127.85	32.00	117.05
122.60000000	21.61	21.63	121.25	25.89	131.65	32.00	121.06
122.80000000	21.61	21.63	125.00	26.68	135.19	32.00	124.82
123.00000000	21.62	21.63	128.52	27.50	138.49	33.91	128.36
123.20000000	21.62	21.63	131.85	28.32	141.59	34.31	131.69
123.40000000	21.62	21.63	134.98	29.14	144.50	35.73	134.84
123.60000000	21.63	21.63	137.95	29.97	147.26	36.70	137.82
123.80000000	21.64	21.63	140.76	30.81	149.87	37.60	140.64
124.00000000	21.64	21.63	143.44	31.81	152.35	39.43	143.33
124.20000000	21.66	21.63	145.98	32.00	154.71	40.61	145.88
124.40000000	21.67	21.63	148.40	32.00	156.97	42.11	148.31
124.60000000	21.68	21.63	150.70	32.00	159.13	43.23	150.63
124.80000000	21.70	21.63	152.88	32.00	161.20	44.55	152.83
125.00000000	21.72	21.63	154.94	32.00	163.19	45.62	154.92
125.20000000	21.74	21.63	137.72	32.00	165.11	46.81	137.73
125.40000000	21.76	21.63	126.63	32.00	166.95	47.83	126.68
125.60000000	21.79	21.63	117.09	32.00	168.72	48.92	117.19
125.80000000	21.81	21.64	109.21	32.00	170.43	49.88	109.38
126.00000000	21.84	21.64	102.18	32.00	172.08	50.90	102.42
126.20000000	21.87	21.64	96.02	32.00	173.67	51.80	96.32
126.40000000	21.90	21.65	90.54	32.00	175.21	52.75	90.91
126.60000000	21.93	21.65	85.62	32.00	176.69	53.60	86.05
126.80000000	21.96	21.65	81.24	32.00	178.14	54.49	81.74
127.00000000	21.99	21.66	77.24	32.00	179.53	55.30	77.80
127.20000000	22.02	21.66	73.69	32.00	180.88	56.13	74.31
127.40000000	22.06	21.67	70.42	32.00	182.19	56.89	71.11
127.60000000	22.09	21.68	67.53	32.00	183.47	57.67	68.27
127.80000000	22.12	21.68	64.85	32.00	184.71	58.40	65.65
128.00000000	22.15	21.69	62.47	32.25	185.91	59.13	63.32
128.20000000	22.18	21.70	60.26	32.25	187.08	59.81	61.17
128.40000000	22.22	21.70	58.30	32.24	188.22	60.50	59.25
128.60000000	22.25	21.71	56.47	32.15	189.32	61.15	57.47
128.80000000	22.28	21.72	54.85	32.04	190.39	61.80	55.88
129.00000000	22.31	21.73	53.32	31.89	191.44	62.41	54.39
129.20000000	22.34	21.73	51.96	31.73	192.46	63.02	53.05
129.40000000	22.36	21.74	50.67	31.57	193.44	63.59	51.79
129.60000000	22.39	21.75	49.51	31.31	194.41	64.17	50.66
129.80000000	22.42	21.76	48.41	31.01	195.34	64.71	49.58
130.00000000	22.45	21.77	47.42	30.75	196.25	65.26	48.60

130.20000000	22.47	21.77	46.47	30.48	197.13	65.77	47.67
130.40000000	22.50	21.78	45.60	30.20	197.99	66.28	46.83
130.60000000	22.52	21.79	44.77	29.94	198.82	66.76	46.02
130.80000000	22.55	21.80	44.02	29.67	199.64	67.25	45.28
131.00000000	22.57	21.80	43.29	29.42	200.43	67.70	44.58
131.20000000	22.60	21.81	42.63	29.16	201.20	68.15	43.93
131.40000000	22.62	21.82	41.99	28.92	201.94	68.59	43.31
131.60000000	22.64	21.83	41.40	28.68	202.67	69.01	42.74
131.80000000	22.66	21.83	40.84	28.45	203.37	69.42	42.18
132.00000000	22.68	21.84	40.32	28.22	204.05	69.82	41.68
132.20000000	22.70	21.85	39.81	28.01	204.72	70.20	41.19
132.40000000	22.72	21.85	39.35	27.80	205.36	70.58	40.74
132.60000000	22.74	21.86	38.90	27.59	205.99	70.94	40.31
132.80000000	22.76	21.87	38.49	27.40	206.60	71.30	39.91
133.00000000	22.78	21.87	38.09	27.21	207.19	71.63	39.52
133.20000000	22.79	21.88	37.72	27.03	207.77	71.97	39.17
133.40000000	22.81	21.88	37.36	26.86	208.32	72.29	38.82
133.60000000	22.82	21.89	37.03	26.69	208.87	72.60	38.51
133.80000000	22.84	21.90	36.71	26.53	209.39	72.91	38.20
134.00000000	22.85	21.90	36.42	26.38	209.90	73.20	37.92
134.20000000	22.87	21.91	36.13	26.23	210.40	73.49	37.64
134.40000000	22.88	21.91	35.87	26.09	210.88	73.76	37.39
134.60000000	22.90	21.91	35.61	25.95	211.35	74.03	37.14
134.80000000	22.91	21.92	35.37	25.82	211.80	74.29	36.92
135.00000000	22.92	21.92	35.14	25.70	212.24	74.54	36.70
135.20000000	22.93	21.93	34.93	25.58	212.67	74.79	36.49
135.40000000	22.94	21.93	34.72	25.47	213.09	75.03	36.30
135.60000000	22.96	21.93	34.53	25.36	213.49	75.26	36.12
135.80000000	22.97	21.94	34.35	25.26	213.88	75.48	35.94
136.00000000	22.98	21.94	34.18	25.16	214.27	75.70	35.78
136.20000000	22.99	21.94	34.02	25.07	214.63	75.91	35.62
136.40000000	23.00	21.95	33.86	24.98	215.00	76.12	35.48
136.60000000	23.01	21.95	33.72	24.90	215.34	76.31	35.34
136.80000000	23.02	21.95	33.58	24.82	215.69	76.51	35.21
137.00000000	23.03	21.96	33.45	24.74	216.01	76.69	35.09
137.20000000	23.03	21.96	33.33	24.66	216.34	76.87	34.98
137.40000000	23.04	21.96	33.21	24.59	216.65	77.05	34.87
137.60000000	23.05	21.96	33.10	24.53	216.95	77.22	34.77
137.80000000	23.06	21.97	33.00	24.46	217.24	77.39	34.67
138.00000000	23.07	21.97	32.90	24.40	217.53	77.55	34.59
138.20000000	23.08	21.97	32.81	24.34	217.81	77.70	34.50
138.40000000	23.08	21.97	32.72	24.28	218.08	77.85	34.43
138.60000000	23.09	21.98	32.64	24.23	218.34	78.00	34.35
138.80000000	23.10	21.98	32.57	24.18	218.60	78.14	34.28
139.00000000	23.11	21.98	32.49	24.13	218.85	78.28	34.22
139.20000000	23.11	21.98	32.43	24.09	219.09	78.42	34.16
139.40000000	23.12	21.98	32.36	24.04	219.32	78.55	34.10
139.60000000	23.13	21.99	32.31	24.00	219.56	78.67	34.05
139.80000000	23.13	21.99	32.25	23.96	219.78	78.80	34.01
140.00000000	23.14	21.99	32.20	23.93	220.00	78.92	33.96
140.20000000	23.15	21.99	32.15	23.89	220.21	79.03	33.92
140.40000000	23.16	21.99	32.11	23.86	220.41	79.15	33.88
140.60000000	23.16	21.99	32.07	23.83	220.61	79.26	33.85
140.80000000	23.17	21.99	32.03	23.80	220.81	79.36	33.82
141.00000000	23.18	22.00	31.99	23.77	221.00	79.47	33.79

141.20000000	23.18	22.00	31.96	23.74	221.18	79.57	33.76
141.40000000	23.19	22.00	31.93	23.71	221.36	79.66	33.74
141.60000000	23.20	22.00	31.90	23.69	221.54	79.76	33.71
141.80000000	23.20	22.00	31.88	23.67	221.71	79.85	33.69
142.00000000	23.21	22.00	31.86	23.65	221.88	79.94	33.68
142.20000000	23.22	22.00	31.84	23.63	222.04	80.03	33.66
142.40000000	23.22	22.01	31.82	23.61	222.20	80.11	33.65
142.60000000	23.23	22.01	31.80	23.59	222.35	80.19	33.63
142.80000000	23.24	22.01	31.79	23.57	222.50	80.27	33.62
143.00000000	23.24	22.01	31.77	23.55	222.65	80.35	33.62
143.20000000	23.25	22.01	31.76	23.54	222.79	80.43	33.61
143.40000000	23.26	22.01	31.75	23.53	222.93	80.50	33.60
143.60000000	23.26	22.01	31.74	23.51	223.07	80.57	33.60
143.80000000	23.27	22.01	31.74	23.50	223.20	80.64	33.60
144.00000000	23.28	22.02	31.73	23.49	223.33	80.71	33.59
144.20000000	23.28	22.02	31.73	23.48	223.45	80.78	33.59
144.40000000	23.29	22.02	31.73	23.47	223.58	80.84	33.59
144.60000000	23.30	22.02	31.72	23.46	223.70	80.90	33.60
144.80000000	23.30	22.02	31.72	23.45	223.82	80.96	33.60
145.00000000	23.31	22.02	31.73	23.44	223.93	81.02	33.60
145.20000000	23.32	22.02	31.73	23.43	224.04	81.08	33.61
145.40000000	23.32	22.03	31.73	23.43	224.15	81.14	33.62
145.60000000	23.33	22.03	31.73	23.42	224.26	81.19	33.62
145.80000000	23.34	22.03	31.74	23.41	224.36	81.24	33.63
146.00000000	23.35	22.03	31.74	23.41	224.47	81.30	33.64
146.20000000	23.35	22.03	31.75	23.40	224.57	81.35	33.65
146.40000000	23.36	22.03	31.76	23.40	224.67	81.40	33.66
146.60000000	23.37	22.03	31.76	23.39	224.76	81.44	33.67
146.80000000	23.38	22.03	31.77	23.39	224.85	81.49	33.68
147.00000000	23.38	22.04	31.78	23.39	224.94	81.54	33.69
147.20000000	23.39	22.04	31.79	23.38	225.04	81.58	33.70
147.40000000	23.40	22.04	31.80	23.38	225.12	81.62	33.71
147.60000000	23.40	22.04	31.81	23.38	225.21	81.67	33.73
147.80000000	23.41	22.04	31.82	23.38	225.29	81.71	33.74
148.00000000	23.42	22.04	31.83	23.38	225.37	81.75	33.76
148.20000000	23.43	22.05	31.85	23.37	225.45	81.79	33.77
148.40000000	23.44	22.05	31.86	23.37	225.53	81.82	33.78
148.60000000	23.44	22.05	31.87	23.37	225.61	81.86	33.80
148.80000000	23.45	22.05	31.88	23.37	225.69	81.90	33.82
149.00000000	23.46	22.05	31.90	23.37	225.76	81.93	33.83
149.20000000	23.47	22.05	31.91	23.37	225.83	81.97	33.85
149.40000000	23.47	22.05	31.93	23.37	225.90	82.00	33.86
149.60000000	23.48	22.06	31.94	23.37	225.97	82.03	33.88
149.80000000	23.49	22.06	31.96	23.37	226.04	82.07	33.90
150.00000000	23.50	22.06	31.97	23.37	226.11	82.10	33.91
150.20000000	23.51	22.06	31.99	23.37	226.17	82.13	33.93
150.40000000	23.52	22.06	32.00	23.38	226.24	82.16	33.95
150.60000000	23.52	22.06	32.02	23.38	226.30	82.19	33.97
150.80000000	23.53	22.07	32.03	23.38	226.36	82.22	33.98
151.00000000	23.54	22.07	32.05	23.38	226.42	82.24	34.00
151.20000000	23.55	22.07	32.06	23.38	226.48	82.27	34.02
151.40000000	23.56	22.07	32.08	23.38	226.54	82.30	34.04
151.60000000	23.56	22.07	32.10	23.39	226.60	82.32	34.06
151.80000000	23.57	22.07	32.11	23.39	226.65	82.35	34.07
152.00000000	23.58	22.08	32.13	23.39	226.71	82.38	34.09

152.20000000	23.59	22.08	32.15	23.39	226.76	82.40	34.11
152.40000000	23.60	22.08	32.16	23.39	226.82	82.42	34.13
152.60000000	23.61	22.08	32.18	23.40	226.87	82.45	34.15
152.80000000	23.61	22.08	32.20	23.40	226.92	82.47	34.17
153.00000000	23.62	22.09	32.21	23.40	226.97	82.49	34.18
153.20000000	23.63	22.09	32.23	23.40	227.02	82.52	34.20
153.40000000	23.64	22.09	32.25	23.41	227.07	82.54	34.22
153.60000000	23.65	22.09	32.27	23.41	227.12	82.56	34.24
153.80000000	23.66	22.09	32.28	23.41	227.16	82.58	34.26
154.00000000	23.67	22.10	32.30	23.42	227.21	82.60	34.28
154.20000000	23.67	22.10	32.32	23.42	227.25	82.62	34.30
154.40000000	23.68	22.10	32.34	23.42	227.30	82.64	34.31
154.60000000	23.69	22.10	32.35	23.42	227.34	82.66	34.33
154.80000000	23.70	22.10	32.37	23.43	227.39	82.68	34.35
155.00000000	23.71	22.10	32.39	23.43	227.43	82.69	34.37
155.20000000	23.72	22.11	32.40	23.43	227.47	82.71	34.39
155.40000000	23.73	22.11	32.42	23.44	227.51	82.73	34.41
155.60000000	23.73	22.11	32.44	23.44	227.55	82.75	34.42
155.80000000	23.74	22.11	32.46	23.44	227.59	82.76	34.44
156.00000000	23.75	22.11	32.47	23.45	227.63	82.78	34.46
156.20000000	23.76	22.12	32.49	23.45	227.67	82.80	34.48
156.40000000	23.77	22.12	32.51	23.45	227.71	82.81	34.50
156.60000000	23.78	22.12	32.52	23.46	227.75	82.83	34.52
156.80000000	23.79	22.12	32.54	23.46	227.79	82.85	34.53
157.00000000	23.79	22.12	32.56	23.46	227.82	82.86	34.55
157.20000000	23.80	22.13	32.58	23.47	227.86	82.88	34.57
157.40000000	23.81	22.13	32.59	23.47	227.89	82.89	34.59
157.60000000	23.82	22.13	32.61	23.47	227.93	82.90	34.61
157.80000000	23.83	22.13	32.63	23.48	227.96	82.92	34.62
158.00000000	23.84	22.13	32.64	23.48	228.00	82.93	34.64
158.20000000	23.85	22.14	32.66	23.49	228.03	82.95	34.66
158.40000000	23.85	22.14	32.68	23.49	228.06	82.96	34.68
158.60000000	23.86	22.14	32.69	23.49	228.09	82.97	34.69
158.80000000	23.87	22.14	32.71	23.50	228.13	82.99	34.71
159.00000000	23.88	22.15	32.73	23.50	228.16	83.00	34.73
159.20000000	23.89	22.15	32.74	23.50	228.19	83.01	34.74
159.40000000	23.90	22.15	32.76	23.51	228.22	83.02	34.76
159.60000000	23.91	22.15	32.78	23.51	228.25	83.04	34.78
159.80000000	23.91	22.15	32.79	23.52	228.28	83.05	34.80
160.00000000	23.92	22.16	32.81	23.52	228.31	83.06	34.81
160.20000000	23.93	22.16	32.82	23.52	228.34	83.07	34.83
160.40000000	23.94	22.16	32.84	23.53	228.37	83.08	34.85
160.60000000	23.95	22.16	32.85	23.53	228.40	83.09	34.86
160.80000000	23.96	22.16	32.87	23.53	228.43	83.11	34.88
161.00000000	23.97	22.17	32.88	23.53	228.45	83.12	34.90
161.20000000	23.97	22.17	32.90	23.54	228.48	83.13	34.91
161.40000000	23.98	22.17	32.91	23.54	228.51	83.14	34.93
161.60000000	23.99	22.17	32.93	23.54	228.54	83.15	34.94
161.80000000	24.00	22.17	32.94	23.54	228.56	83.16	34.96
162.00000000	24.01	22.18	32.96	23.55	228.59	83.17	34.98
162.20000000	24.02	22.18	32.97	23.55	228.61	83.18	34.99
162.40000000	24.02	22.18	32.99	23.55	228.64	83.19	35.01
162.60000000	24.03	22.18	33.00	23.56	228.66	83.20	35.02
162.80000000	24.04	22.18	33.02	23.56	228.69	83.21	35.04
163.00000000	24.05	22.19	33.03	23.56	228.71	83.22	35.05

163.20000000	24.06	22.19	33.05	23.57	228.74	83.23	35.07
163.40000000	24.07	22.19	33.06	23.57	228.76	83.24	35.08
163.60000000	24.07	22.19	33.08	23.57	228.79	83.24	35.10
163.80000000	24.08	22.19	33.09	23.58	228.81	83.25	35.11
164.00000000	24.09	22.20	33.11	23.58	228.84	83.26	35.13
164.20000000	24.10	22.20	33.12	23.58	228.86	83.27	35.14
164.40000000	24.11	22.20	33.14	23.59	228.88	83.28	35.16
164.60000000	24.11	22.20	33.15	23.59	228.90	83.29	35.17
164.80000000	24.12	22.20	33.16	23.59	228.93	83.30	35.19
165.00000000	24.13	22.21	33.18	23.60	228.95	83.30	35.20
165.20000000	24.14	22.21	33.19	23.60	228.97	83.31	35.22
165.40000000	24.15	22.21	33.21	23.60	228.99	83.32	35.23
165.60000000	24.15	22.21	33.22	23.61	229.01	83.33	35.25
165.80000000	24.16	22.21	33.24	23.61	229.03	83.34	35.26
166.00000000	24.17	22.22	33.25	23.61	229.05	83.34	35.27
166.20000000	24.18	22.22	33.26	23.62	229.07	83.35	35.29
166.40000000	24.19	22.22	33.28	23.62	229.10	83.36	35.30
166.60000000	24.19	22.22	33.29	23.62	229.11	83.37	35.31
166.80000000	24.20	22.22	33.30	23.63	229.14	83.37	35.33
167.00000000	24.21	22.23	33.32	23.63	229.15	83.38	35.34
167.20000000	24.22	22.23	33.33	23.63	229.18	83.39	35.35
167.40000000	24.23	22.23	33.34	23.64	229.19	83.40	35.36
167.60000000	24.23	22.23	33.36	23.64	229.21	83.40	35.37
167.80000000	24.24	22.23	33.37	23.64	229.23	83.41	35.38
168.00000000	24.25	22.24	33.38	23.65	229.25	83.42	35.40
168.20000000	24.26	22.24	33.40	23.65	229.27	83.42	35.41
168.40000000	24.26	22.24	33.41	23.65	229.29	83.43	35.42
168.60000000	24.27	22.24	33.42	23.66	229.31	83.44	35.43
168.80000000	24.28	22.24	33.43	23.66	229.33	83.44	35.44
169.00000000	24.29	22.25	33.45	23.66	229.34	83.45	35.45
169.20000000	24.29	22.25	33.46	23.67	229.36	83.46	35.46
169.40000000	24.30	22.25	33.47	23.67	229.38	83.46	35.47
169.60000000	24.31	22.25	33.48	23.67	229.40	83.47	35.48
169.80000000	24.32	22.25	33.50	23.67	229.41	83.48	35.50
170.00000000	24.32	22.26	33.51	23.68	229.43	83.48	35.51
170.20000000	24.33	22.26	33.52	23.68	229.45	83.49	35.52
170.40000000	24.34	22.26	33.53	23.68	229.46	83.49	35.53
170.60000000	24.35	22.26	33.54	23.69	229.48	83.50	35.54
170.80000000	24.35	22.26	33.56	23.69	229.50	83.51	35.55
171.00000000	24.36	22.27	33.57	23.69	229.51	83.51	35.56
171.20000000	24.37	22.27	33.58	23.69	229.53	83.52	35.57
171.40000000	24.37	22.27	33.59	23.70	229.54	83.52	35.58
171.60000000	24.38	22.27	33.60	23.70	229.56	83.53	35.60
171.80000000	24.39	22.27	33.61	23.70	229.58	83.53	35.61
172.00000000	24.40	22.27	33.63	23.71	229.59	83.54	35.62
172.20000000	24.40	22.28	33.64	23.71	229.61	83.55	35.63
172.40000000	24.41	22.28	33.65	23.71	229.62	83.55	35.64
172.60000000	24.42	22.28	33.66	23.71	229.64	83.56	35.65
172.80000000	24.42	22.28	33.67	23.72	229.66	83.56	35.6
173.00000000	24.43	22.28	33.68	23.72	229.67	83.57	35.68
173.20000000	24.44	22.29	33.69	23.72	229.68	83.57	35.6
173.40000000	24.44	22.29	33.70	23.72	229.70	83.58	35.70
173.60000000	24.45	22.29	33.71	23.73	229.71	83.58	35.7
173.80000000	24.46	22.29	33.73	23.73	229.73	83.59	35.7
174.00000000	24.47	22.29	33.74	23.73	229.74	83.59	35.7

174.20000000	24.47	22.29	33.75	23.74	229.76	83.60	35.75
174.40000000	24.48	22.30	33.76	23.74	229.77	83.60	35.76
174.60000000	24.49	22.30	33.77	23.74	229.78	83.61	35.78
174.80000000	24.49	22.30	33.78	23.74	229.80	83.61	35.79
175.00000000	24.50	22.30	33.79	23.74	229.81	83.62	35.80
175.20000000	24.51	22.30	33.80	23.75	229.83	83.62	35.81
175.40000000	24.51	22.30	33.81	23.75	229.84	83.63	35.82
175.60000000	24.52	22.31	33.82	23.75	229.85	83.63	35.83
175.80000000	24.53	22.31	33.83	23.75	229.87	83.64	35.85
176.00000000	24.53	22.31	33.84	23.75	229.88	83.64	35.86
176.20000000	24.54	22.31	33.85	23.76	229.89	83.64	35.87
176.40000000	24.54	22.31	33.86	23.76	229.91	83.65	35.88
176.60000000	24.55	22.32	33.86	23.76	229.92	83.65	35.89
176.80000000	24.56	22.32	33.87	23.76	229.93	83.66	35.90
177.00000000	24.56	22.32	33.88	23.76	229.94	83.66	35.91
177.20000000	24.57	22.32	33.89	23.77	229.96	83.67	35.92
177.40000000	24.58	22.32	33.90	23.77	229.97	83.67	35.93
177.60000000	24.58	22.32	33.91	23.77	229.98	83.68	35.94
177.80000000	24.59	22.33	33.92	23.77	229.99	83.68	35.95
178.00000000	24.60	22.33	33.93	23.78	230.01	83.68	35.96
178.20000000	24.60	22.33	33.94	23.78	230.02	83.69	35.97
178.40000000	24.61	22.33	33.95	23.78	230.03	83.69	35.98
178.60000000	24.61	22.33	33.96	23.78	230.04	83.70	35.99
178.80000000	24.62	22.33	33.97	23.79	230.06	83.70	36.00
179.00000000	24.63	22.33	33.98	23.79	230.07	83.70	36.01
179.20000000	24.63	22.34	33.99	23.79	230.08	83.71	36.02
179.40000000	24.64	22.34	34.00	23.79	230.09	83.71	36.03
179.60000000	24.64	22.34	34.01	23.79	230.10	83.72	36.04
179.80000000	24.65	22.34	34.02	23.80	230.11	83.72	36.05
180.00000000	24.66	22.34	34.02	23.80	230.12	83.72	36.06
180.20000000	24.66	22.34	34.03	23.80	210.94	83.72	36.07
180.40000000	24.67	22.35	34.04	23.80	197.96	83.69	36.08
180.60000000	24.67	22.35	34.05	23.81	186.48	83.58	36.09
180.80000000	24.68	22.35	34.06	23.81	176.70	83.33	36.09
181.00000000	24.69	22.35	34.07	23.81	167.73	82.93	36.10
181.20000000	24.69	22.35	34.07	23.81	159.75	82.37	36.10
181.40000000	24.70	22.35	34.08	23.81	152.49	81.66	36.10
181.60000000	24.70	22.35	34.08	23.82	145.90	80.84	36.10
181.80000000	24.71	22.36	34.08	23.82	139.87	79.90	36.09
182.00000000	24.71	22.36	34.08	23.82	134.33	78.87	36.08
182.20000000	24.72	22.36	34.07	23.82	129.25	77.76	36.06
182.40000000	24.73	22.36	34.06	23.82	124.53	76.59	36.04
182.60000000	24.73	22.36	34.05	23.82	120.18	75.37	36.01
182.80000000	24.74	22.36	34.03	23.83	116.13	74.12	35.97
183.00000000	24.74	22.37	34.01	23.83	112.36	72.84	35.94
183.20000000	24.75	22.37	33.99	23.83	108.83	71.55	35.89
183.40000000	24.75	22.37	33.97	23.83	105.54	70.25	35.85
183.60000000	24.76	22.37	33.94	23.83	102.44	68.95	35.80
183.80000000	24.76	22.37	33.91	23.83	99.54	67.66	35.74
184.00000000	24.77	22.37	33.87	23.83	96.79	66.38	35.68
184.20000000	24.77	22.37	33.83	23.83	94.20	65.12	35.62
184.40000000	24.78	22.38	33.79	23.82	91.75	63.87	35.56
184.60000000	24.78	22.38	33.75	23.82	89.42	62.65	35.49
184.80000000	24.79	22.38	33.71	23.82	87.21	61.45	35.42
185.00000000	24.79	22.38	33.66	23.82	85.11	60.28	35.34

185.20000000	24.80	22.38	52.67	23.82	83.11	59.13	54.32
185.40000000	24.80	22.38	65.23	23.84	81.20	58.02	66.83
185.60000000	24.81	22.38	75.83	23.93	79.38	56.94	77.39
185.80000000	24.81	22.38	84.50	24.12	77.64	55.88	86.01
186.00000000	24.82	22.39	92.24	24.45	75.97	54.86	93.70
186.20000000	24.82	22.39	99.07	24.88	74.37	53.87	100.47
186.40000000	24.83	22.39	105.31	25.42	72.85	52.91	106.66
186.60000000	24.83	22.39	110.99	26.04	71.39	51.98	112.29
186.80000000	24.84	22.39	116.23	26.72	69.99	51.07	117.49
187.00000000	24.85	22.39	121.06	27.47	68.65	50.20	122.28
187.20000000	24.85	22.39	125.56	28.25	67.36	49.36	126.74
187.40000000	24.86	22.40	129.74	29.07	66.13	48.55	130.88
187.60000000	24.87	22.40	133.64	29.91	64.95	47.76	134.75
187.80000000	24.87	22.40	137.29	30.73	63.83	47.00	138.37
188.00000000	24.88	22.40	140.72	31.63	62.75	46.27	141.77
188.20000000	24.89	22.40	143.94	32.00	61.72	45.56	144.96
188.40000000	24.91	22.40	146.98	32.00	60.73	44.88	147.96
188.60000000	24.92	22.40	149.83	32.00	59.79	44.23	150.78
188.80000000	24.93	22.41	152.50	32.00	58.88	43.60	153.43
189.00000000	24.95	22.41	155.02	32.00	58.02	42.99	155.92
189.20000000	24.96	22.41	157.38	32.00	57.20	42.40	158.25
189.40000000	24.98	22.41	159.59	32.00	56.41	41.84	160.44
189.60000000	25.00	22.41	161.67	32.00	55.66	41.30	162.50
189.80000000	25.02	22.42	163.63	32.00	54.95	40.78	164.44
190.00000000	25.04	22.42	165.47	32.00	54.26	40.28	166.28
190.20000000	25.07	22.42	148.03	32.00	53.61	39.80	148.84
190.40000000	25.09	22.43	136.73	32.00	52.99	39.33	137.55
190.60000000	25.12	22.43	126.97	32.00	52.40	38.89	127.81
190.80000000	25.14	22.43	118.87	32.00	51.84	38.47	119.74
191.00000000	25.17	22.44	111.62	32.00	51.30	38.06	112.53
191.20000000	25.20	22.44	105.25	33.50	50.79	37.67	106.20
191.40000000	25.23	22.45	99.59	34.38	50.30	37.29	100.59
191.60000000	25.26	22.45	94.51	35.16	49.83	36.94	95.58
191.80000000	25.29	22.46	90.01	35.74	49.38	36.59	91.14
192.00000000	25.31	22.46	85.93	36.15	48.95	36.26	87.10
192.20000000	25.34	22.47	82.31	36.42	48.54	35.95	83.52
192.40000000	25.37	22.48	79.00	36.56	48.14	35.65	80.23
192.60000000	25.40	22.48	76.05	36.59	47.75	35.37	77.30
192.80000000	25.43	22.49	73.32	36.55	47.38	35.09	74.58
193.00000000	25.46	22.50	70.89	36.43	47.03	34.83	72.15
193.20000000	25.49	22.51	68.61	36.26	46.68	34.58	69.87
193.40000000	25.51	22.51	66.57	36.03	46.35	34.35	67.82
193.60000000	25.54	22.52	64.65	35.78	46.03	34.12	65.89
193.80000000	25.56	22.53	62.91	35.49	45.72	33.91	64.14
194.00000000	25.59	22.54	61.27	35.19	45.42	33.71	62.48
194.20000000	25.61	22.55	59.77	34.87	45.13	33.51	60.97
194.40000000	25.63	22.55	58.35	34.54	44.85	33.33	59.53
194.60000000	25.65	22.56	57.04	34.20	44.58	33.16	58.21
194.80000000	25.67	22.57	55.80	33.87	44.32	33.00	56.95
195.00000000	25.69	22.58	54.65	33.53	44.06	32.85	55.79
195.20000000	25.71	22.58	53.55	33.20	43.82	32.71	54.67
195.40000000	25.73	22.59	52.53	32.86	43.58	32.58	53.63
195.60000000	25.75	22.60	51.55	32.54	43.35	32.46	52.63
195.80000000	25.76	22.61	50.65	32.22	43.12	32.34	51.71
196.00000000	25.78	22.61	49.77	31.92	42.91	32.24	50.81

196.20000000	25.79	22.62	48.95	31.59	42.70	32.15	49.98
196.40000000	25.81	22.63	48.16	30.76	42.49	32.08	49.17
196.60000000	25.82	22.63	47.43	30.47	42.30	32.01	48.41
196.80000000	25.83	22.64	46.70	29.80	42.10	31.97	47.68
197.00000000	25.84	22.64	46.02	29.48	41.92	32.00	46.98
197.20000000	25.85	22.65	45.34	28.96	41.74	32.00	46.30
197.40000000	25.86	22.65	44.69	28.64	41.57	32.00	45.64
197.60000000	25.86	22.66	44.06	28.21	41.40	32.00	45.00
197.80000000	25.87	22.66	43.46	27.92	41.23	32.00	44.39
198.00000000	25.88	22.67	42.87	27.56	41.08	32.00	43.79
198.20000000	25.88	22.67	42.31	27.29	40.92	32.00	43.21
198.40000000	25.88	22.68	41.76	26.99	40.77	32.00	42.65
198.60000000	25.89	22.68	41.24	26.75	40.62	32.00	42.12
198.80000000	25.89	22.68	40.73	26.48	40.48	32.00	41.60
199.00000000	25.89	22.68	40.25	26.26	40.33	32.00	41.11
199.20000000	25.89	22.69	39.78	26.03	40.20	32.00	40.63
199.40000000	25.89	22.69	39.34	25.84	40.06	32.00	40.17
199.60000000	25.89	22.69	38.90	25.63	39.92	32.00	39.73
199.80000000	25.89	22.69	38.49	25.46	39.79	32.00	39.31
200.00000000	25.89	22.70	38.09	25.28	39.66	32.00	38.89
200.20000000	25.88	22.70	37.71	25.13	39.53	32.00	38.50
200.40000000	25.88	22.70	37.34	24.97	39.40	32.00	38.12
200.60000000	25.87	22.70	36.98	24.83	39.28	32.00	37.76
200.80000000	25.87	22.70	36.64	24.68	39.15	32.00	37.41
201.00000000	25.86	22.70	36.31	24.56	39.02	32.00	37.07
201.20000000	25.85	22.70	35.99	24.43	38.90	32.00	36.74
201.40000000	25.85	22.70	35.69	24.32	38.77	32.00	36.43
201.60000000	25.84	22.70	35.40	24.20	38.65	32.00	36.12
201.80000000	25.83	22.70	35.11	24.10	38.52	32.00	35.83
202.00000000	25.82	22.70	34.84	23.99	38.40	32.00	35.55
202.20000000	25.81	22.70	34.58	23.90	38.27	32.00	35.27
202.40000000	25.80	22.70	34.32	23.81	38.15	32.00	35.01
202.60000000	25.79	22.70	34.08	23.72	38.03	32.00	34.75
202.80000000	25.78	22.69	33.84	23.64	37.91	32.00	34.50
203.00000000	25.77	22.69	33.61	23.56	37.79	32.00	34.26
203.20000000	25.76	22.69	33.39	23.48	37.67	32.00	34.02
203.40000000	25.75	22.69	33.17	23.41	37.55	32.00	33.80
203.60000000	25.74	22.69	32.96	23.34	37.43	32.00	33.58
203.80000000	25.72	22.69	32.77	23.27	37.32	32.00	33.36
204.00000000	25.71	22.68	32.57	23.21	37.20	32.00	33.16
204.20000000	25.70	22.68	32.38	23.15	37.09	32.00	32.96
204.40000000	25.68	22.68	32.20	23.09	36.98	32.00	32.76
204.60000000	25.67	22.68	32.03	23.04	36.87	32.00	32.57
204.80000000	25.66	22.67	31.85	22.98	36.76	32.00	32.39
205.00000000	25.64	22.67	31.69	22.93	36.65	32.00	32.21
205.20000000	25.63	22.67	31.53	22.88	36.54	32.00	32.03
205.40000000	25.61	22.66	31.37	22.83	36.44	32.00	31.86
205.60000000	25.60	22.66	31.22	22.79	36.33	32.00	31.70
205.80000000	25.59	22.66	31.07	22.74	36.23	32.00	31.54
206.00000000	25.57	22.66	30.93	22.70	36.13	32.00	31.38
206.20000000	25.56	22.65	30.79	22.66	36.03	32.00	31.23
206.40000000	25.54	22.65	30.66	22.62	35.93	32.00	31.09
206.60000000	25.52	22.64	30.53	22.58	35.83	32.00	30.94
206.80000000	25.51	22.64	30.40	22.55	35.73	32.00	30.81
207.00000000	25.49	22.64	30.28	22.51	35.64	32.00	30.67

207.20000000	25.48	22.63	30.16	22.48	35.55	32.00	30.54
207.40000000	25.46	22.63	30.04	22.44	35.46	32.00	30.41
207.60000000	25.45	22.63	29.93	22.41	35.36	32.00	30.29
207.80000000	25.43	22.62	29.81	22.38	35.28	32.00	30.16
208.00000000	25.41	22.62	29.71	22.35	35.19	32.00	30.04
208.20000000	25.40	22.62	29.60	22.32	35.10	32.00	29.93
208.40000000	25.38	22.61	29.50	22.30	35.01	32.00	29.82
208.60000000	25.36	22.61	29.40	22.27	34.93	32.00	29.71
208.80000000	25.35	22.60	29.30	22.24	34.85	32.00	29.60
209.00000000	25.33	22.60	29.20	22.22	34.76	32.00	29.49
209.20000000	25.31	22.60	29.11	22.19	34.68	32.00	29.39
209.40000000	25.30	22.59	29.02	22.17	34.60	32.00	29.29
209.60000000	25.28	22.59	28.93	22.15	34.53	32.00	29.19
209.80000000	25.27	22.58	28.84	22.12	34.45	32.00	29.10
210.00000000	25.25	22.58	28.76	22.10	34.37	32.00	29.01
210.20000000	25.23	22.58	28.67	22.08	34.30	32.00	28.91
210.40000000	25.22	22.57	28.59	22.06	34.22	32.00	28.83
210.60000000	25.20	22.57	28.51	22.04	34.15	32.00	28.74
210.80000000	25.18	22.56	28.43	22.02	34.08	32.00	28.65
211.00000000	25.16	22.56	28.36	22.00	34.01	32.00	28.57
211.20000000	25.15	22.55	28.28	21.98	33.94	32.00	28.49
211.40000000	25.13	22.55	28.21	21.96	33.87	32.00	28.41
211.60000000	25.11	22.55	28.14	21.95	33.80	32.00	28.33
211.80000000	25.10	22.54	28.07	21.93	33.73	32.00	28.25
212.00000000	25.08	22.54	28.00	21.91	33.67	32.00	28.18
212.20000000	25.06	22.53	27.93	21.90	33.60	32.00	28.10
212.40000000	25.05	22.53	27.87	21.88	33.54	32.00	28.03
212.60000000	25.03	22.53	27.80	21.87	33.47	32.00	27.96
212.80000000	25.01	22.52	27.74	21.85	33.41	32.00	27.89
213.00000000	25.00	22.52	27.68	21.84	33.35	32.00	27.82
213.20000000	24.98	22.51	27.61	21.82	33.29	32.00	27.76
213.40000000	24.96	22.51	27.55	21.81	33.22	32.00	27.69
213.60000000	24.95	22.50	27.50	21.79	33.16	32.00	27.63
213.80000000	24.93	22.50	27.44	21.78	33.11	32.00	27.56
214.00000000	24.92	22.50	27.38	21.77	33.05	32.00	27.50
214.20000000	24.90	22.49	27.32	21.75	32.99	32.00	27.44
214.40000000	24.88	22.49	27.27	21.74	32.93	32.00	27.38
214.60000000	24.87	22.48	27.22	21.73	32.87	32.00	27.32
214.80000000	24.85	22.48	27.16	21.72	32.82	32.00	27.26
215.00000000	24.83	22.47	27.11	21.71	32.76	32.00	27.21
215.20000000	24.82	22.47	27.06	21.69	32.71	32.00	27.1
215.40000000	24.80	22.47	27.01	21.68	32.66	32.00	27.1
215.60000000	24.78	22.46	26.96	21.67	32.60	32.00	27.0
215.80000000	24.77	22.46	26.91	21.66	32.55	32.00	26.9
216.00000000	24.75	22.45	26.86	21.65	32.50	32.00	26.9
216.20000000	24.74	22.45	26.81	21.64	32.45	32.00	26.8
216.40000000	24.72	22.45	26.77	21.63	32.39	32.00	26.8
216.60000000	24.70	22.44	26.72	21.62	32.34	32.00	26.7
216.80000000	24.69	22.44	26.67	21.61	32.29	32.00	26.7
217.00000000	24.67	22.43	26.63	21.60	32.25	32.00	26.6
217.20000000	24.66	22.43	26.59	21.59	32.20	32.00	26.6
217.40000000	24.64	22.43	26.54	21.58	32.15	32.00	26.5
217.60000000	24.63	22.42	26.50	21.57	32.10	32.00	26.5
217.80000000	24.61	22.42	26.46	21.56	32.06	32.00	26.5
218.00000000	24.59	22.41	26.42	21.55	32.01	32.00	26.4

218.20000000	24.58	22.41	26.37	21.55	31.96	32.00	26.41
218.40000000	24.56	22.41	26.33	21.54	31.92	32.00	26.37
218.60000000	24.55	22.40	26.29	21.53	31.87	32.00	26.32
218.80000000	24.53	22.40	26.25	21.52	31.83	32.00	26.28
219.00000000	24.52	22.39	26.22	21.51	31.79	32.00	26.24
219.20000000	24.50	22.39	26.18	21.50	31.74	32.00	26.20
219.40000000	24.49	22.39	26.14	21.50	31.70	32.00	26.16
219.60000000	24.47	22.38	26.10	21.49	31.66	32.00	26.12
219.80000000	24.46	22.38	26.06	21.48	31.62	32.00	26.08
220.00000000	24.44	22.37	26.03	21.47	31.58	32.00	26.04
220.20000000	24.43	22.37	25.99	21.47	31.53	32.00	26.00
220.40000000	24.41	22.37	25.96	21.46	31.49	32.00	25.96
220.60000000	24.40	22.36	25.92	21.45	31.45	32.00	25.92
220.80000000	24.38	22.36	25.89	21.45	31.41	32.00	25.89
221.00000000	24.37	22.35	25.85	21.44	31.38	32.00	25.85
221.20000000	24.35	22.35	25.82	21.43	31.34	32.00	25.81
221.40000000	24.34	22.35	25.78	21.43	31.30	32.00	25.78
221.60000000	24.32	22.34	25.75	21.42	31.26	32.00	25.74
221.80000000	24.31	22.34	25.72	21.41	31.22	32.00	25.71
222.00000000	24.30	22.34	25.69	21.41	31.19	32.00	25.67
222.20000000	24.28	22.33	25.65	21.40	31.15	32.00	25.64
222.40000000	24.27	22.33	25.62	21.39	31.11	32.00	25.61
222.60000000	24.25	22.32	25.59	21.39	31.08	32.00	25.57
222.80000000	24.24	22.32	25.56	21.38	31.04	32.00	25.54
223.00000000	24.22	22.32	25.53	21.38	31.01	32.00	25.51
223.20000000	24.21	22.31	25.50	21.37	30.97	32.00	25.47
223.40000000	24.20	22.31	25.47	21.36	30.94	32.00	25.44
223.60000000	24.18	22.31	25.44	21.36	30.90	32.00	25.41
223.80000000	24.17	22.30	25.41	21.35	30.87	32.00	25.38
224.00000000	24.15	22.30	25.38	21.35	30.84	32.00	25.35
224.20000000	24.14	22.29	25.35	21.34	30.80	32.00	25.32
224.40000000	24.13	22.29	25.32	21.34	30.77	32.00	25.29
224.60000000	24.11	22.29	25.30	21.33	30.74	32.00	25.26
224.80000000	24.10	22.28	25.27	21.33	30.71	32.00	25.23
225.00000000	24.09	22.28	25.24	21.32	30.67	32.00	25.20
225.20000000	24.07	22.28	25.21	21.32	30.64	32.00	25.17
225.40000000	24.06	22.27	25.19	21.31	30.61	32.00	25.14
225.60000000	24.05	22.27	25.16	21.31	30.58	32.00	25.11
225.80000000	24.03	22.27	25.13	21.30	30.55	32.00	25.09
226.00000000	24.02	22.26	25.11	21.30	30.52	32.00	25.06
226.20000000	24.01	22.26	25.08	21.29	30.49	32.00	25.03
226.40000000	23.99	22.26	25.06	21.29	30.46	32.00	25.00
226.60000000	23.98	22.25	25.03	21.29	30.43	32.00	24.98
226.80000000	23.97	22.25	25.01	21.28	30.40	32.00	24.95
227.00000000	23.96	22.25	24.98	21.28	30.37	32.00	24.92
227.20000000	23.94	22.24	24.96	21.27	30.34	32.00	24.90
227.40000000	23.93	22.24	24.93	21.27	30.31	32.00	24.87
227.60000000	23.92	22.24	24.91	21.26	30.29	32.00	24.85
227.80000000	23.90	22.23	24.88	21.26	30.26	32.00	24.82
228.00000000	23.89	22.23	24.86	21.26	30.23	32.00	24.80
228.20000000	23.88	22.23	24.84	21.25	30.20	32.00	24.7
228.40000000	23.87	22.22	24.81	21.25	30.17	32.00	24.7
228.60000000	23.85	22.22	24.79	21.25	30.15	32.00	24.7
228.80000000	23.84	22.22	24.77	21.24	30.12	32.00	24.7
229.00000000	23.83	22.21	24.75	21.24	30.09	32.00	24.6

229.20000000	23.82	22.21	24.72	21.23	30.07	32.00	24.65
229.40000000	23.81	22.21	24.70	21.23	30.04	32.00	24.63
229.60000000	23.79	22.20	24.68	21.23	30.01	32.00	24.60
229.80000000	23.78	22.20	24.66	21.22	29.99	32.00	24.58
230.00000000	23.77	22.20	24.64	21.22	29.96	32.00	24.56
230.20000000	23.76	22.19	24.61	21.22	29.94	32.00	24.53
230.40000000	23.75	22.19	24.59	21.21	29.91	32.00	24.51
230.60000000	23.73	22.19	24.57	21.21	29.89	32.00	24.49
230.80000000	23.72	22.18	24.55	21.21	29.86	32.00	24.47
231.00000000	23.71	22.18	24.53	21.21	29.84	32.00	24.45
231.20000000	23.70	22.18	24.51	21.20	29.81	32.00	24.42
231.40000000	23.69	22.18	24.49	21.20	29.79	32.00	24.40
231.60000000	23.68	22.17	24.47	21.20	29.76	32.00	24.38
231.80000000	23.67	22.17	24.45	21.19	29.74	32.00	24.36
232.00000000	23.65	22.17	24.43	21.19	29.72	32.00	24.34
232.20000000	23.64	22.16	24.41	21.19	29.69	32.00	24.32
232.40000000	23.63	22.16	24.39	21.18	29.67	32.00	24.30
232.60000000	23.62	22.16	24.37	21.18	29.65	32.00	24.28
232.80000000	23.61	22.15	24.35	21.18	29.62	32.00	24.26
233.00000000	23.60	22.15	24.33	21.17	29.60	32.00	24.24
233.20000000	23.59	22.15	24.31	21.17	29.58	32.00	24.22
233.40000000	23.58	22.15	24.30	21.17	29.56	32.00	24.20
233.60000000	23.56	22.14	24.28	21.16	29.54	32.00	24.18
233.80000000	23.55	22.14	24.26	21.16	29.51	32.00	24.16
234.00000000	23.54	22.14	24.24	21.16	29.49	32.00	24.14
234.20000000	23.53	22.13	24.22	21.16	29.47	32.00	24.12
234.40000000	23.52	22.13	24.20	21.16	29.45	32.00	24.10
234.60000000	23.51	22.13	24.19	21.16	29.43	32.00	24.08
234.80000000	23.50	22.13	24.17	21.16	29.41	32.00	24.06
235.00000000	23.49	22.12	24.15	21.16	29.38	32.00	24.05
235.20000000	23.48	22.12	24.13	21.15	29.36	32.00	24.03
235.40000000	23.47	22.12	24.12	21.15	29.34	32.00	24.01
235.60000000	23.46	22.11	24.10	21.15	29.32	32.00	23.99
235.80000000	23.45	22.11	24.08	21.15	29.30	32.00	23.97
236.00000000	23.44	22.11	24.07	21.14	29.28	32.00	23.96
236.20000000	23.43	22.11	24.05	21.14	29.26	32.00	23.94
236.40000000	23.42	22.10	24.03	21.14	29.24	32.00	23.92
236.60000000	23.41	22.10	24.02	21.13	29.22	32.00	23.90
236.80000000	23.40	22.10	24.00	21.13	29.21	32.00	23.8
237.00000000	23.39	22.10	23.98	21.13	29.19	32.00	23.8
237.20000000	23.38	22.09	23.97	21.13	29.17	32.00	23.8
237.40000000	23.37	22.09	23.95	21.12	29.15	32.00	23.8
237.60000000	23.36	22.09	23.93	21.12	29.13	32.00	23.8
237.80000000	23.35	22.09	23.92	21.12	29.11	32.00	23.8
238.00000000	23.34	22.08	23.90	21.11	29.09	32.00	23.7
238.20000000	23.33	22.08	23.89	21.11	29.08	32.00	23.7
238.40000000	23.32	22.08	23.87	21.13	29.06	32.00	23.7
238.60000000	23.31	22.08	23.86	21.13	29.04	32.00	23.7
238.80000000	23.30	22.07	23.84	21.13	29.02	32.00	23.7
239.00000000	23.29	22.07	23.83	21.13	29.00	32.00	23.7
239.20000000	23.28	22.07	23.81	21.12	28.99	32.00	23.6
239.40000000	23.27	22.06	23.80	21.12	28.97	32.00	23.6
239.60000000	23.26	22.06	23.78	21.12	28.95	32.00	23.6
239.80000000	23.25	22.06	23.77	21.12	28.94	32.00	23.6
240.00000000	23.24	22.06	23.75	21.12	28.92	32.00	23.6

240.20000000	23.23	22.06	23.74	21.11	47.97	32.00	23.62
240.40000000	23.23	22.05	23.72	21.11	60.56	32.00	23.60
240.60000000	23.22	22.05	23.71	21.11	71.21	32.00	23.59
240.80000000	23.21	22.05	23.70	21.11	79.94	32.00	23.57
241.00000000	23.20	22.05	23.68	21.10	87.75	32.00	23.56
241.20000000	23.19	22.04	23.67	21.10	94.63	32.00	23.55
241.40000000	23.18	22.04	23.66	21.10	100.94	32.00	23.53
241.60000000	23.17	22.04	23.64	21.10	106.67	32.00	23.52
241.80000000	23.16	22.04	23.63	21.10	111.96	32.00	23.51
242.00000000	23.15	22.03	23.62	21.09	116.82	32.00	23.51
242.20000000	23.14	22.03	23.61	21.09	121.33	32.00	23.50
242.40000000	23.14	22.03	23.61	21.09	125.51	32.00	23.50
242.60000000	23.13	22.03	23.60	21.09	129.39	32.00	23.50
242.80000000	23.12	22.02	23.60	21.08	133.00	32.00	23.50
243.00000000	23.11	22.02	23.59	21.08	136.37	32.00	23.51
243.20000000	23.10	22.02	23.59	21.08	139.51	32.00	23.52
243.40000000	23.09	22.02	23.59	21.08	142.45	32.00	23.53
243.60000000	23.09	22.02	23.60	21.08	145.20	32.00	23.54
243.80000000	23.08	22.01	23.60	21.07	147.78	32.00	23.56
244.00000000	23.07	22.01	23.61	21.07	150.21	32.00	23.59
244.20000000	23.06	22.01	23.62	21.07	152.48	32.00	23.61
244.40000000	23.05	22.01	23.63	21.07	154.63	32.00	23.64
244.60000000	23.04	22.00	23.65	21.07	156.65	33.54	23.67
244.80000000	23.04	22.00	23.67	21.07	158.55	34.64	23.71
245.00000000	23.03	22.00	23.69	21.07	160.38	35.65	23.74
245.20000000	23.02	22.00	23.71	21.07	162.12	36.50	23.78
245.40000000	23.01	22.00	23.73	21.07	163.78	37.40	23.83
245.60000000	23.00	21.99	23.76	21.07	165.38	38.21	23.87
245.80000000	23.00	21.99	23.78	21.07	166.93	39.02	23.92
246.00000000	22.99	21.99	23.81	21.08	168.44	39.74	23.97
246.20000000	22.98	21.99	23.85	21.08	169.89	40.44	24.03
246.40000000	22.97	21.99	23.88	21.08	171.30	41.09	24.08
246.60000000	22.97	21.98	23.91	21.09	172.66	41.71	24.14
246.80000000	22.96	21.98	23.95	21.09	173.98	42.29	24.20
247.00000000	22.95	21.98	23.99	21.09	175.25	42.86	24.26
247.20000000	22.94	21.98	24.03	21.10	176.48	43.40	24.32
247.40000000	22.94	21.98	24.07	21.10	177.66	43.94	24.38
247.60000000	22.93	21.97	24.11	21.11	178.80	44.49	24.45
247.80000000	22.92	21.97	24.16	21.11	179.91	45.02	24.51
248.00000000	22.91	21.97	24.20	21.12	180.97	45.56	24.58
248.20000000	22.91	21.97	24.25	21.13	182.00	46.10	24.65
248.40000000	22.90	21.97	24.29	21.13	183.00	46.65	24.71
248.60000000	22.89	21.96	24.34	21.14	183.96	47.31	24.78
248.80000000	22.89	21.96	24.39	21.15	184.90	48.07	24.85
249.00000000	22.88	21.96	24.44	21.16	185.81	48.84	24.92
249.20000000	22.88	21.96	24.49	21.16	186.69	49.61	25.00
249.40000000	22.87	21.96	24.54	21.17	187.55	50.43	25.0
249.60000000	22.86	21.95	24.59	21.18	188.40	51.21	25.1
249.80000000	22.86	21.95	24.65	21.19	189.22	51.96	25.2
250.00000000	22.85	21.95	24.70	21.20	190.03	52.67	25.2

FILE: WRIGHT OUTPUT A VM/SP CONVERSATIONAL MONITOR SYSTEM

```
TOTAL NUMBER OF SLABS                                    L= 14
NUMBER OF LAYERS IN HEATER                              NX= 23
TOTAL NUMBER OF NODES IN THE Y-DIRECTION                 M= 60
TOTAL NUMBER OF NODES IN THE X-DIRECTION                 N=177
TOTAL LENGTH OF COMPOSITE SLAB IN THE Y-DIRECTION    TLEN1=     0.511900INCHES
TOTAL LENGTH OF THE GRID IN THE X-DIRECTION          TLEN2=    24.610000INCHES
-------------------------------
```

# OF	LENGTH	CONDUCTIVITY	DIFFUSIVITY
5	0.07500	102.000000	2.830000
3	0.01000	0.100000	0.005800
5	0.05000	102.000000	2.830000
3	0.01000	0.100000	0.005800
4	0.02000	8.700000	0.150000
2	0.00820	0.100000	0.005800
4	0.01380	0.220000	0.008700
4	0.00820	0.100000	0.005800
4	0.00650	60.000000	1.150000
4	0.00820	0.100000	0.005800
4	0.01380	0.220000	0.008700
4	0.00820	0.100000	0.005800
6	0.03000	8.700000	0.150000
21	0.25000	1.290000	0.044600

DATA FOR THE HEATER

8	15.61367	0.100000	0.005800
4	1.00000	60.000000	1.150000
3	0.06100	0.100000	0.005800
4	1.00000	60.000000	1.150000
3	0.06100	0.100000	0.005800
8	1.00000	60.000000	1.150000
3	0.06100	0.100000	0.005800
14	1.00000	60.000000	1.150000
3	0.06100	0.100000	0.005800
26	1.00000	60.000000	1.150000
3	0.06100	0.100000	0.005800
41	1.00000	60.000000	1.150000
3	0.06100	0.100000	0.005800
26	1.00000	60.000000	1.150000
3	0.06100	0.100000	0.005800
14	1.00000	60.000000	1.150000
3	0.06100	0.100000	0.005800
8	1.00000	60.000000	1.150000
3	0.06100	0.100000	0.005800
4	1.00000	60.000000	1.150000
3	0.06100	0.100000	0.005800
4	1.00000	60.000000	1.150000
8	15.61367	0.100000	0.005800

```
INTERNAL HEAT GENERATION IN SLAB NUMBER          IJ=  9
                                BETWEEN NODE    NO1= 24
                                    AND NODE    NO2= 27

   1        30.00000        5.00000        60.00000        120.00000

HEATER  1 STARTS AT NODE IN X-DIRECTION     NODEG =  43
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```
 HEATER  1 ENDS AT NODE IN X-DIRECTION     NODG =  67

    2          30.00000           60.00000         60.00000         120.00000

 HEATER  2 STARTS AT NODE IN X-DIRECTION    NODEG =  70
 HEATER  2 ENDS AT NODE IN X-DIRECTION    NODG = 109

    3          30.00000           5.00000          60.00000         120.00000

 HEATER  3 STARTS AT NODE IN X-DIRECTION    NODEG = 112
 HEATER  3 ENDS AT NODE IN X-DIRECTION    NODG = 136

STEP FUNCTION HEAT INPUT IN WATTS/IN*IN


CONVECTION OCCURS       AT  J=1
         AMBIENT TEMPERAT URE      TG1=      9.400000DEG.F
         HEAT TRANSFER COEFF.      H1 =        1.000000B.T.U/HR.FT.FT.DEG.F
INSULATED BOUNDARY CONDITION ON LEFT SIDE.

INSULATED BOUNDARY CONDITION ON RIGHT SIDE.


FULL ACCRETION BALANCE IS USED AT TOP SURFACE


 X-COORDINATE Y-COORDINATE  BETA         PRESSURE     HTC

COMPOSITE BODY TEMPERATURES ARE INITIALIZED TO THE ACCRETION BALANCE TEMPERATURE PROFILE


CONDUCTION INTO THE BLADE IS NOT CONSIDERED BEFORE THE HEATER(S) TURN ON.

SHEDDING OF ICE IS CONSIDERED



THE PHASE CHANGE IN THE ICE LAYER IS CONSIDERED

LATENT HEAT OF ICE                        HLAM =   143.400000B.T.U./LB
THERMAL CONDUCTIVITY OF WATER             AKL  =     0.320000B.T.U./HR.FT.DEG.F
DENSITY OF WATER                          DEL  =    62.400000LB/CU.FT
SPECIFIC HEAT * DENSITY OF WATER          CPL  =    62.212800B.T.U./CU.FT.DEG.F
DENSITY OF ICE                            DES  =    57.400000LB/CU.FT.
THE MELTING TEMPERATURE                   TMP  =    32.000000DEG.F

ICE MELTING RANGE                         TR   =     0.000010DEG.F
HEAT OF VAPORIZATION                    HVAP =   1075.160000 BTU/LB
HEAT CAPACITY OF AIR                    CPAIR =      0.250000 BTU/LB*DEG F
NUMBER OF POINTS IN ICE SHAPE APPROXIMATION  NP =  2
     X-COORDINATE XP =   0.00000       Y-COORDINATE YP =    0.00000
     X-COORDINATE XP =  24.61000       Y-COORDINATE YP =    0.00000
AMBIENT TEMPERATURE,TINF =    9.320 DEG. F
LIQUID WATER CONTENT,LWC =    0.5000 G/M**3
AMBIENT VELOCITY,VINF =  424.737591 FT/S
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DROPLET DIAMETER,DROP =     20.0000 MICRONS
AMBIENT PRESSURE,PINF =     13.161907 PSI
ANGLE OF ATTACK,ALPHA =     0.000 DEG

INITIAL TIME STEP                                  DTAUI =      0.100000SECS
                                FOR TIME STEPS NISP    = 10
INTERMIDIATE TIME STEP                             DTAUM =      0.100000SECS
                                 FOR TIME STEPS NMSP   =100
FINAL TIME STEP                                    DTAUF =      0.100000SECS
NUMBER OF SECONDS IN THE SIMULATION      TIMEOUT =      250.0000 SEC
MAXIMUM NUMBER OF ITERATIONS FOR PHASE ROUTINE  JCOUNT =  20


X-Y COORDINATES OF THE ICE SHAPE WILL BE PRINTED OUT AT THE FOLLOWING TIME STEPS
         1200
         1800
         2400
         2500
X-LAYER  WHERE(L-M-R)  Y-LAYER  WHERE(B-M-T)

    8       M             9       T
    8       M            13       T
   10       M             9       T
   10       M            13       T
   12       M             9       T
   12       M            13       T
   14       M             9       T
   14       M            13       T
   16       M             9       T
   16       M            13       T

ICE LAYER MATRIX.  CHANGE FORMAT 780 SO THAT BOTTOM ROW IS ALL NINES.
THIS REPRESENTS THE ICE SHAPE IN RECTANGULAR COORDINATES
0 = AIR, 1 = INTERIOR ICE NODE, 2-8 = ICE-AIR BOUNDARY NODE
9 = ICE-METAL (OR AIR-METAL) BOUNDARY NODE

999999999999999999999999999999999999999999999999999999999999999999999999999999
999999999999999999999999999999999999999999999999999999999999999999999999999999
999999999999999999
 MASS OF ICE/UNIT SPAN COMING IN EACH TIME STEP =    8.764176601 *10**(-5) LB/FT
  3 ITERATIONS WERE REQUIRED AT TIME =  122.300
  3 ITERATIONS WERE REQUIRED AT TIME =  123.900
  3 ITERATIONS WERE REQUIRED AT TIME =  184.700
  3 ITERATIONS WERE REQUIRED AT TIME =  245.200
  3 ITERATIONS WERE REQUIRED AT TIME =  245.400
  3 ITERATIONS WERE REQUIRED AT TIME =  245.600
  3 ITERATIONS WERE REQUIRED AT TIME =  249.100
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00000000000000000705160000000000000000000000000000000000000000000000000000000000
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00000000000000000000000000000000000000000000000000000000000000000000000000003112
26000000000000005121140000000000000000000000000000000000000000000000000000000000
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11260000000000521111400000000000000000000000000000000000000000000000000000000000
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11112600000005111111160000000000000000000000000000000000000000000000000000000000
0000000000000000000
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11111122222221111111111226000000000000000000000000000000000000000000000000000000
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11111111111111111111111111222226000000000000000000000000000000000000000000000000
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11111111111111111111111111111111112222600000000000000000000000000000000000000000
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00000000000000000000000000000000000000000000000000000005222222211111111111111111
11111111111111111111111111111111111111222226000000000000000000000000000000000000
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11111111111111111111111111111111111111111111222222222222260000000000000000000000
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99999999999999999999999999999999999999999999999999999999999999999999999999999999
9999999999999999999
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FILE: EXAMPLE1 OUTPUT A VM/SP CONVERSATIONAL MONITOR SYSTEM

1
0 UNTRANSFORMED COORDINATE DATA FOR BODY ID = 1,

I	X(I)	Y(I)	I	X(I)
1	1.0000000	0.0000000	51	0.0150000
2	0.9899999	-0.0018740	52	0.0100000
3	0.9800000	-0.0036110	53	0.0075000
4	0.9700000	-0.0052390	54	0.0050000
5	0.9500000	-0.0082510	55	0.0037500
6	0.9250000	-0.0117000	56	0.0025000
7	0.9000000	-0.0149080	57	0.0022500
8	0.8750000	-0.0179530	58	0.0020000
9	0.8500000	-0.0208880	59	0.0017500
10	0.8250000	-0.0237390	60	0.0015000
11	0.8000000	-0.0265150	61	0.0012500
12	0.7750000	-0.0292210	62	0.0010000
13	0.7500000	-0.0318550	63	0.0008750
14	0.7250000	-0.0344110	64	0.0007500
15	0.7000000	-0.0368870	65	0.0006250
16	0.6750000	-0.0392810	66	0.0005000
17	0.6500000	-0.0415850	67	0.0003750
18	0.6250000	-0.0437950	68	0.0002500
19	0.6000000	-0.0459040	69	0.0001250
20	0.5750000	-0.0479060	70	0.0000000
21	0.5500000	-0.0497930	71	0.0001250
22	0.5250000	-0.0515600	72	0.0002500
23	0.5000000	-0.0531980	73	0.000375
24	0.4750000	-0.0546980	74	0.000500
25	0.4500000	-0.0560510	75	0.000625
26	0.4250000	-0.0572430	76	0.000750
27	0.4000000	-0.0582620	77	0.000875
28	0.3750000	-0.0590900	78	0.001000
29	0.3500000	-0.0597070	79	0.001250
30	0.3250000	-0.0600940	80	0.001500
31	0.3000000	-0.0602260	81	0.001750
32	0.2750000	-0.0600760	82	0.002000
33	0.2500000	-0.0596120	83	0.002250
34	0.2250000	-0.0587940	84	0.002500
35	0.2000000	-0.0575700	85	0.003750
36	0.1750000	-0.0558790	86	0.005000
37	0.1500000	-0.0536360	87	0.007500
38	0.1250000	-0.0507320	88	0.01000
39	0.1000000	-0.0470040	89	0.01500
40	0.0900000	-0.0452280	90	0.02000
41	0.0800000	-0.0432520	91	0.02500
42	0.0700000	-0.0410380	92	0.03000
43	0.0600000	-0.0385350	93	0.03500
44	0.0500000	-0.0356740	94	0.04000
45	0.0450000	-0.0340820	95	0.04500
46	0.0400000	-0.0323620	96	0.05000
47	0.0350000	-0.0304960	97	0.06000
48	0.0300000	-0.0284620	98	0.07000
49	0.0250000	-0.0262300	99	0.08000
50	0.0200000	-0.0237260	100	0.09000

0 UNTRANSFORMED COORDINATE DATA FOR BODY ID = 1,

I	X(I)	Y(I)	I	X(I)
101	0.1000000	0.0470040	121	0.6000000
102	0.1250000	0.0507320	122	0.6250000
103	0.1500000	0.0536360	123	0.6500000
104	0.1750000	0.0558790	124	0.6750000
105	0.2000000	0.0575700	125	0.7000000
106	0.2250000	0.0587940	126	0.7250000
107	0.2500000	0.0596120	127	0.7500000
108	0.2750000	0.0600760	128	0.7750000
109	0.3000000	0.0602260	129	0.8000000
110	0.3250000	0.0600940	130	0.8250000
111	0.3500000	0.0597070	131	0.8500000
112	0.3750000	0.0590900	132	0.8750000
113	0.4000000	0.0582620	133	0.9000000
114	0.4250000	0.0572430	134	0.9250000
115	0.4500000	0.0560510	135	0.9500000
116	0.4750000	0.0546980	136	0.9700000
117	0.5000000	0.0531980	137	0.9800000
118	0.5250000	0.0515600	138	0.9899999
119	0.5500000	0.0497930	139	1.0000000
120	0.5750000	0.0479060		

1 DOUGLAS AIRCRAFT COMPANY TWO-DIMENSIONAL POTENTIAL FLOW PROGRAM

OCOMBINED FLOW

OALPHA = 0.000000 ALPHA 0 = -0.000010 NO. OF BODIES 1

0 CL = -0.000001 CHORD = 1.000000 TOTAL ELEMENTS 138

OBODY ID = 1 NO. OF ELEMENTS 138

0 I	X	Y	S	VT	CP
1	0.9950030	-0.0009536	0.0024939	-0.8268568	0.3163079
2	0.9850022	-0.0027573	0.0074755	-0.8886779	0.2102516
3	0.9750018	-0.0044365	0.0124468	-0.9189485	0.1555337
4	0.9600045	-0.0067781	0.0198878	-0.9451057	0.1067752
5	0.9375049	-0.0100112	0.0310313	-0.9680865	0.0628085
6	0.9125030	-0.0133284	0.0433953	-0.9839662	0.0318105
7	0.8875018	-0.0164470	0.0557466	-0.9951778	0.0096211
8	0.8625011	-0.0194324	0.0680896	-1.0043850	-0.0087891
9	0.8375007	-0.0223233	0.0804271	-1.0128345	-0.0258331
10	0.8125010	-0.0251359	0.0927601	-1.0208492	-0.0421324
11	0.7875008	-0.0278768	0.1050892	-1.0285645	-0.0579443
12	0.7625008	-0.0305473	0.1174145	-1.0361195	-0.0735426
13	0.7375007	-0.0331427	0.1297361	-1.0434093	-0.0887022
14	0.7125006	-0.0356590	0.1420537	-1.0504131	-0.1033669
15	0.6875010	-0.0380946	0.1543673	-1.0573273	-0.1179409
16	0.6625009	-0.0404444	0.1666770	-1.0641356	-0.1323843
17	0.6375008	-0.0427021	0.1789826	-1.0707989	-0.1466093
18	0.6125008	-0.0448624	0.1912839	-1.0773830	-0.1607542
19	0.5875007	-0.0469188	0.2035809	-1.0838785	-0.1747923
20	0.5625011	-0.0488641	0.2158736	-1.0902729	-0.1886950
21	0.5375010	-0.0506920	0.2281620	-1.0966110	-0.2025557
22	0.5125009	-0.0523956	0.2404461	-1.1029644	-0.2165298
23	0.4875010	-0.0539657	0.2527259	-1.1092901	-0.2305241
24	0.4625010	-0.0553936	0.2650015	-1.1156693	-0.2447176
25	0.4375010	-0.0566678	0.2772731	-1.1220808	-0.2590647
26	0.4125009	-0.0577752	0.2895408	-1.1285248	-0.2735682

27	0.3875008	-0.0587010	0.3018049	-1.1350374	-0.2883091
28	0.3625007	-0.0594260	0.3140658	-1.1414566	-0.3029222
29	0.3375004	-0.0599308	0.3263240	-1.1477957	-0.3174343
30	0.3125001	-0.0601935	0.3385806	-1.1540527	-0.3318377
31	0.2874997	-0.0601882	0.3508365	-1.1601448	-0.3459358
32	0.2624992	-0.0598856	0.3630934	-1.1660824	-0.3597479
33	0.2374985	-0.0592503	0.3753535	-1.1718359	-0.3731985
34	0.2124973	-0.0582363	0.3876199	-1.1771927	-0.3857822
35	0.1874957	-0.0567876	0.3998970	-1.1819983	-0.3971195
36	0.1624932	-0.0548323	0.4121915	-1.1859293	-0.4064274
37	0.1374894	-0.0522749	0.4245133	-1.1885767	-0.4127140
38	0.1124833	-0.0489800	0.4368784	-1.1891909	-0.4141741
39	0.0949960	-0.0461379	0.4455639	-1.1883068	-0.4120722
40	0.0849948	-0.0442662	0.4505519	-1.1872902	-0.4096575
41	0.0749931	-0.0421762	0.4555610	-1.1851130	-0.4044924

1 DOUGLAS AIRCRAFT COMPANY TWO-DIMENSIONAL POTENTIAL FLOW PROGRAM

0COMBINED FLOW

0ALPHA = 0.000000 ALPHA 0 = -0.000010 NO. OF BODIES 1

0 CL = -0.000001 CHORD = 1.000000 TOTAL ELEMENTS 138

0BODY ID = 1 NO. OF ELEMENTS 138

0 I	X	Y	S	VT	CP
42	0.0649905	-0.0398243	0.4605984	-1.1808882	-0.3944960
43	0.0549870	-0.0371499	0.4656748	-1.1729183	-0.3757372
44	0.0474957	-0.0348913	0.4695106	-1.1636896	-0.3541727
45	0.0424947	-0.0332373	0.4720929	-1.1553192	-0.3347616
46	0.0374936	-0.0314462	0.4746971	-1.1443930	-0.3096352
47	0.0324921	-0.0294985	0.4773283	-1.1306772	-0.2784309
48	0.0274893	-0.0273701	0.4799936	-1.1155014	-0.2443428
49	0.0224832	-0.0250116	0.4827065	-1.0984278	-0.2065430
50	0.0174724	-0.0223086	0.4854980	-1.0677691	-0.1401300
51	0.0124526	-0.0190892	0.4884223	-1.0151653	-0.0305605
52	0.0087273	-0.0161891	0.4907375	-0.9530599	0.0916770
53	0.0062075	-0.0137715	0.4924502	-0.8769054	0.2310369
54	0.0043571	-0.0115558	0.4938660	-0.7800955	0.3914510
55	0.0030979	-0.0096758	0.4949756	-0.6789739	0.5389946
56	0.0023736	-0.0083787	0.4957039	-0.6001760	0.6397888
57	0.0021234	-0.0078803	0.4959773	-0.5699757	0.6751277
58	0.0018732	-0.0073498	0.4962648	-0.5368442	0.7117984
59	0.0016230	-0.0067808	0.4965695	-0.4998917	0.7501083
60	0.0013727	-0.0061669	0.4968945	-0.4601265	0.7882836
61	0.0011222	-0.0054975	0.4972448	-0.4157826	0.8271249
62	0.0009367	-0.0049563	0.4975253	-0.3790886	0.8562919
63	0 0008116	-0.0045648	0.4977267	-0.3526645	0.8756278
64	0.0006864	-0.0041473	0.4979404	-0.3240116	0.8950166
65	0.0005612	-0.0036968	0.4981695	-0.2925074	0.9144395
66	0.0004359	-0.0032039	0.4984189	-0.2576435	0.9336199
67	0.0003101	-0.0026510	0.4986968	-0.2174374	0.9527210
68	0.0001830	-0.0019948	0.4990245	-0.1691893	0.9713750
69	0.0000337	-0.0008182	0.4996060	-0.0722345	0.9947822
70	0.0000337	0.0008182	0.5004090	0.0722346	0.9947822
71	0.0001830	0.0019948	0.5009906	0.1691884	0.9713753
72	0.0003101	0.0026510	0.5013182	0.2174363	0.9527215
73	0.0004359	0.0032039	0.5015962	0.2576425	0.9336204
74	0.0005612	0.0036968	0.5018455	0.2925056	0.9144405
75	0.0006864	0.0041473	0.5020747	0.3240096	0.8950178

76	0.0008116	0.0045648	0.5022883	0.3526618	0.8756297
77	0.0009367	0.0049563	0.5024897	0.3790872	0.8562930
78	0.0011222	0.0054975	0.5027702	0.4157806	0.8271265
79	0.0013727	0.0061669	0.5031205	0.4601249	0.7882851
80	0.0016230	0.0067808	0.5034456	0.4998900	0.7501100
81	0.0018732	0.0073498	0.5037503	0.5368431	0.7117995
82	0.0021234	0.0078803	0.5040377	0.5699748	0.6751287

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1 DOUGLAS AIRCRAFT COMPANY TWO-DIMENSIONAL POTENTIAL FLOW PROGRAM
0COMBINED FLOW
0ALPHA =   0.000000     ALPHA 0 =  -0.000010     NO. OF BODIES       1
0 CL   =  -0.000001     CHORD =     1.000000     TOTAL ELEMENTS    138
0BODY ID =  1           NO. OF ELEMENTS  138
```

0 I	X	Y	S	VT	CP
83	0.0023736	0.0083787	0.5043111	0.6001753	0.6397897
84	0.0030979	0.0096758	0.5050395	0.6789737	0.5389948
85	0.0043571	0.0115558	0.5061491	0.7800954	0.3914512
86	0.0062075	0.0137715	0.5075648	0.8769064	0.2310352
87	0.0087273	0.0161891	0.5092775	0.9530599	0.0916770
88	0.0124526	0.0190892	0.5115927	1.0151653	-0.0305605
89	0.0174724	0.0223086	0.5145170	1.0677700	-0.1401320
90	0.0224832	0.0250116	0.5173085	1.0984278	-0.2065430
91	0.0274893	0.0273701	0.5200214	1.1155024	-0.2443447
92	0.0324921	0.0294985	0.5226867	1.1306782	-0.2784328
93	0.0374935	0.0314462	0.5253180	1.1443930	-0.3096352
94	0.0424947	0.0332373	0.5279222	1.1553192	-0.3347616
95	0.0474957	0.0348913	0.5305044	1.1636896	-0.3541727
96	0.0549870	0.0371499	0.5343402	1.1729183	-0.3757372
97	0.0649905	0.0398243	0.5394166	1.1808882	-0.3944960
98	0.0749931	0.0421762	0.5444540	1.1851130	-0.4044924
99	0.0849948	0.0442662	0.5494631	1.1872892	-0.4096556
100	0.0949960	0.0461379	0.5544512	1.1883059	-0.4120703
101	0.1124833	0.0489800	0.5631366	1.1891890	-0.4141703
102	0.1374894	0.0522749	0.5755017	1.1885757	-0.4127121
103	0.1624932	0.0548323	0.5878236	1.1859283	-0.4064255
104	0.1874957	0.0567876	0.6001180	1.1819973	-0.3971176
105	0.2124973	0.0582363	0.6123952	1.1771927	-0.3857822
106	0.2374985	0.0592503	0.6246616	1.1718359	-0.3731985
107	0.2624992	0.0598856	0.6369216	1.1660814	-0.3597450
108	0.2874997	0.0601882	0.6491785	1.1601439	-0.3459330
109	0.3125001	0.0601935	0.6614344	1.1540527	-0.3318377
110	0.3375004	0.0599308	0.6736910	1.1477957	-0.3174343
111	0.3625007	0.0594260	0.6859493	1.1414576	-0.3029251
112	0.3875008	0.0587010	0.6982101	1.1350374	-0.2883091
113	0.4125009	0.0577752	0.7104742	1.1285248	-0.2735682
114	0.4375010	0.0566678	0.7227419	1.1220808	-0.2590647
115	0.4625010	0.0553936	0.7350135	1.1156702	-0.2447195
116	0.4875010	0.0539657	0.7472891	1.1092901	-0.2305241
117	0.5125009	0.0523956	0.7595669	1.1029644	-0.2165298
118	0.5375010	0.0506920	0.7718530	1.0966110	-0.2025557
119	0.5625011	0.0488641	0.7841414	1.0902729	-0.1886950
120	0.5875007	0.0469188	0.7964341	1.0838785	-0.1747923
121	0.6125008	0.0448624	0.8087311	1.0773830	-0.1607542
122	0.6375008	0.0427021	0.8210325	1.0707989	-0.1466093
123	0.6625009	0.0404444	0.8333380	1.0641346	-0.1323824

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1 DOUGLAS AIRCRAFT COMPANY TWO-DIMENSIONAL POTENTIAL FLOW PROGRAM
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0COMBINED  FLOW
0ALPHA =    0.000000          ALPHA 0 =  -0.000010         NO.  OF  BODIES   1
0  CL   =  -0.000001            CHORD =   1.000000         TOTAL  ELEMENTS  138
0BODY ID =  1                   NO. OF ELEMENTS  138
0  I          X              Y              S              VT             CP
 124      0.6875010      0.0380946      0.8456477      1.0573263      -0.1179380
 125      0.7125006      0.0356590      0.8579614      1.0504122      -0.1033649
 126      0.7375007      0.0331427      0.8702790      1.0434084      -0.0887003
 127      0.7625008      0.0305473      0.8826005      1.0361185      -0.0735407
 128      0.7875008      0.0278768      0.8949258      1.0285645      -0.0579443
 129      0.8125010      0.0251359      0.9072549      1.0208492      -0.0421324
 130      0.8375007      0.0223233      0.9195880      1.0128345      -0.0258331
 131      0.8625011      0.0194324      0.9319254      1.0043850      -0.0087891
 132      0.8875018      0.0164470      0.9442685      0.9951773       0.0096221
 133      0.9125030      0.0133284      0.9566197      0.9839657       0.0318115
 134      0.9375049      0.0100112      0.9689837      0.9680861       0.0628093
 135      0.9600045      0.0067781      0.9801271      0.9451054       0.1067759
 136      0.9750018      0.0044365      0.9875680      0.9189482       0.1555341
 137      0.9850022      0.0027573      0.9925392      0.8886767       0.2102538
 138      0.9950030      0.0009536      0.9975207      0.8268554       0.3163102
0INTEGRATED VALUES
0CY =      0.00000      CX =     0.00010
0CL =      0.00000      CD =     0.00010      CM =      0.00000
0PARABOLIC INTEGRATION
0INTEGRATED VALUES
0CY =      0.00000      CX =     0.00014
0CL =      0.00000      CD =     0.00014      CM =      0.00000
0TOTAL CM =     0.00000
0TOTAL CM =     0.00000      (PARABOLIC)
1

  THE PARTICLES ARE RELEASED FROM X = -2.23860E+00
  WHICH IS OBTAINED AT THE    1 LOOP OF   50 LOOPS

  GEOMETRY CHARACTERISTICS:

         LEADING EDGE (X,Y)          -2.0000E-03     0.0000E+00
         TRAILING EDGE (X,Y)          5.3540E-01     0.0000E+00
         THICKNESS                    6.8249E-02
         CHORD                        5.3300E-01
         ANGLE OF ATTACK              0.0000E+00

         UPPER BOUNDARY               3.7537E-02
         LOWER BOUNDARY              -3.7537E-02

  PARTICLE TRAJECTORY DATA:


  THE PARTICLES ARE RELEASED IN EQUILIBRIUM WITH THE AIR


  PARTICLE    INITIAL    INITIAL   PARTICLE    PITCH      PIT       GRAVT     ERROR
  DIAMETER      VX         VY        AOA       ANGLE      DOT       CONST     CRITERIA
  (MICRONS)   (M/S)      (M/S)    (DEGREES)  (DEGREES) (DEG/SEC)  (M/S**2)
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20.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00E-05

THE PARTICLES OF SIZE 20.00 MICRONS CONTAIN 1.0000 OF THE TOTAL MASS

X0	Y0		XP	YP	S	DT
-2.2385998	0.0266500	OUT OF RANGE	0.0484457	0.0380774		4.0962E-05
-2.2385998	-0.0266500	OUT OF RANGE	0.0477284	-0.0379399		4.4922E-05

YOMAX= 2.6650E-02 YOMIN= -2.6650E-02

-2.2385998	0.0000000	HIT BODY AT	-0.0019999	-0.0000014	-0.0000014	1.1018E-05
-2.2385998	0.0133250	OUT OF RANGE	0.1107253	0.0388240		7.6590E-05
-2.2385998	0.0066625	HIT BODY AT	0.0036130	0.0088118	0.0120186	9.3000E-06
-2.2385998	0.0099937	HIT BODY AT	0.0148293	0.0150130	0.0251191	1.5189E-05
-2.2385998	0.0116594	OUT OF RANGE	0.1079729	0.0376250		6.8192E-05
-2.2385998	0.0108266	HIT BODY AT	0.0215766	0.0175715	0.0323731	1.6960E-05
-2.2385998	0.0112430	OUT OF RANGE	0.1121140	0.0381168		7.0951E-05
-2.2385998	0.0110348	HIT BODY AT	0.0247283	0.0186010	0.0356948	2.0998E-05
-2.2385998	0.0111389	HIT BODY AT	0.0294927	0.0199897	0.0406632	2.4890E-05
-2.2385998	0.0111909	OUT OF RANGE	0.1106844	0.0378739		7.5113E-05
-2.2385998	-0.0077556	HIT BODY AT	0.0061026	-0.0105433	-0.0151490	1.3812E-05
-2.2385998	-0.0172028	OUT OF RANGE	0.0944566	-0.0385269		5.5636E-05
-2.2385998	-0.0124792	OUT OF RANGE	0.1101912	-0.0383226		5.7317E-05
-2.2385998	-0.0101174	HIT BODY AT	0.0155774	-0.0153250	-0.0259473	1.7198E-05
-2.2385998	-0.0112983	OUT OF RANGE	0.1176085	-0.0389536		7.4692E-05
-2.2385998	-0.0107078	HIT BODY AT	0.0201960	-0.0170917	-0.0309036	2.1912E-05
-2.2385998	-0.0110030	HIT BODY AT	0.0244180	-0.0185044	-0.0353698	1.6749E-05
-2.2385998	-0.0111507	HIT BODY AT	0.0297521	-0.0200632	-0.0409328	2.4138E-05
-2.2385998	-0.0112245	OUT OF RANGE	0.1155867	-0.0386387		7.9871E-05

UPPER SURFACE LIMIT		LOWER SURFACE LIMIT	
YOU	SU	YOL	SL
0.1114E-01	0.4066E-01	-0.1115E-01	-0.4093E-01

-2.2385998	0.0100244	HIT BODY AT	0.0150027	0.0150884	0.0253082	1.5329E-05
-2.2385998	0.0085915	HIT BODY AT	0.0085559	0.0120096	0.0180842	1.3082E-05
-2.2385998	0.0071586	HIT BODY AT	0.0046330	0.0095470	0.0133735	1.2935E-05
-2.2385998	0.0057257	HIT BODY AT	0.0019866	0.0074326	0.0097591	8.4159E-06
-2.2385998	0.0042928	HIT BODY AT	0.0001727	0.0054606	0.0068696	9.6150E-06
-2.2385998	0.0028599	HIT BODY AT	-0.0009905	0.0035846	0.0044574	7.9854E-06
-2.2385998	0.0014270	HIT BODY AT	-0.0016913	0.0017790	0.0022144	8.9035E-06
-2.2385998	-0.0000059	HIT BODY AT	-0.0019995	-0.0000060	-0.0000060	3.8970E-06
-2.2385998	-0.0014388	HIT BODY AT	-0.0016871	-0.0017937	-0.0022296	1.0054E-05
-2.2385998	-0.0028717	HIT BODY AT	-0.0009906	-0.0035846	-0.0044573	9.2337E-06
-2.2385998	-0.0043046	HIT BODY AT	0.0001824	-0.0054754	-0.0068872	9.8511E-06
-2.2385998	-0.0057375	HIT BODY AT	0.0019971	-0.0074428	-0.0097737	8.9501E-06
-2.2385998	-0.0071704	HIT BODY AT	0.0047205	-0.0096063	-0.0134793	9.6757E-06
-2.2385998	-0.0086033	HIT BODY AT	0.0085990	-0.0120337	-0.0181335	1.1835E-05
-2.2385998	-0.0100362	HIT BODY AT	0.0150662	-0.0151160	-0.0253774	1.5338E-05

Y0 VS S DATA FOR DROPLET DIAMETER= 20.00000 MICRONS
17 POINTS HAVE BEEN CALCULATED

I S Y0

1	0.040663	0.011139
2	0.025308	0.010024
3	0.018084	0.008591
4	0.013374	0.007159
5	0.009759	0.005726
6	0.006870	0.004293
7	0.004457	0.002860
8	0.002214	0.001427
9	-0.000006	-0.000006
10	-0.002230	-0.001439
11	-0.004457	-0.002872
12	-0.006887	-0.004305
13	-0.009774	-0.005737
14	-0.013479	-0.007170
15	-0.018134	-0.008603
16	-0.025377	-0.010036
17	-0.040933	-0.011151

CALCULATED LOCAL COLLECTION EFFICIENCY FOR DROPLET DIAMETER= 20.00000 MICRONS

SEG	S	BETA
1	-0.545895	0.000000
2	-0.539384	0.000000
3	-0.533950	0.000000
4	-0.525830	0.000000
5	-0.513684	0.000000
6	-0.500213	0.000000
7	-0.486761	0.000000
8	-0.473321	0.000000
9	-0.459890	0.000000
10	-0.446465	0.000000
11	-0.433045	0.000000
12	-0.419628	0.000000
13	-0.406216	0.000000
14	-0.392807	0.000000
15	-0.379402	0.000000
16	-0.366002	0.000000
17	-0.352605	0.000000
18	-0.339212	0.000000
19	-0.325824	0.000000
20	-0.312439	0.000000
21	-0.299059	0.000000
22	-0.285683	0.000000
23	-0.272311	0.000000
24	-0.258942	0.000000
25	-0.245577	0.000000
26	-0.232215	0.000000
27	-0.218856	0.000000
28	-0.205498	0.000000
29	-0.192142	0.000000
30	-0.178786	0.000000
31	-0.165428	0.000000
32	-0.152066	0.000000
33	-0.138698	0.000000

34	-0.125319	0.000000
35	-0.111923	0.000000
36	-0.098502	0.000000
37	-0.085042	0.000000
38	-0.071535	0.000000
39	-0.062032	0.000000
40	-0.056554	0.000000
41	-0.051058	0.000000
42	-0.045521	0.000000
43	-0.039941	0.000000
44	-0.035710	0.036846
45	-0.032844	0.072813
46	-0.029959	0.109033
47	-0.027037	0.145709
48	-0.024067	0.182994
49	-0.021020	0.221230
50	-0.017851	0.270309
51	-0.014517	0.332322
52	-0.011802	0.397545
53	-0.009728	0.450488
54	-0.007975	0.510033
55	-0.006590	0.553147
56	-0.005676	0.580513
57	-0.005290	0.592095
58	-0.004926	0.602992
59	-0.004541	0.614535
60	-0.004131	0.617890
61	-0.003697	0.623249
62	-0.003343	0.627614
63	-0.003081	0.630852
64	-0.002810	0.634196
65	-0.002518	0.637801
66	-0.002198	0.643813
67	-0.001836	0.643985
68	-0.001363	0.644210
69	-0.000542	0.644599
70	0.000542	0.643803
71	0.001363	0.642776
72	0.001836	0.642185
73	0.002198	0.641731
74	0.002518	0.636916
75	0.002810	0.633562
76	0.003081	0.630451
77	0.003343	0.627439
78	0.003697	0.623379
79	0.004131	0.618394
80	0.004541	0.613712
81	0.004926	0.602371
82	0.005290	0.591665
83	0.005676	0.580286
84	0.006590	0.553399
85	0.007975	0.512574
86	0.009728	0.454673
87	0.011802	0.399306
88	0.014517	0.333322

89	0.017851	0.269760
90	0.021020	0.219492
91	0.024067	0.181459
92	0.027037	0.144372
93	0.029959	0.107891
94	0.032844	0.071863
95	0.035710	0.036087
96	0.039941	0.000000
97	0.045521	0.000000
98	0.051058	0.000000
99	0.056554	0.000000
100	0.062032	0.000000
101	0.071535	0.000000
102	0.085042	0.000000
103	0.098502	0.000000
104	0.111923	0.000000
105	0.125319	0.000000
106	0.138698	0.000000
107	0.152066	0.000000
108	0.165428	0.000000
109	0.178786	0.000000
110	0.192142	0.000000
111	0.205498	0.000000
112	0.218856	0.000000
113	0.232215	0.000000
114	0.245577	0.000000
115	0.258942	0.000000
116	0.272311	0.000000
117	0.285683	0.000000
118	0.299059	0.000000
119	0.312439	0.000000
120	0.325824	0.000000
121	0.339212	0.000000
122	0.352605	0.000000
123	0.366002	0.000000
124	0.379402	0.000000
125	0.392807	0.000000
126	0.406216	0.000000
127	0.419628	0.000000
128	0.433045	0.000000
129	0.446465	0.000000
130	0.459890	0.000000
131	0.473321	0.000000
132	0.486761	0.000000
133	0.500213	0.000000
134	0.513684	0.000000
135	0.525830	0.000000
136	C.533950	0.000000
137	0.539384	0.000000
138	0.545895	0.000000

1 SEG	S	QCOND	MDOTC	MDOTRI	MDOTE	MDOTTI
2	-0.21419E+02	-0.24654E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	-0.19188E+02	-0.15423E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
4	-0.16958E+02	-0.14972E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	-0.14727E-02	-0.14966E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E-00

6	-0.12497E+02	-0.14979E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
7	-0.10266E+02	-0.14624E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
8	-0.80355E+01	-0.13145E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
9	-0.58050E+01	-0.93198E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
10	-0.54717E+01	-0.43924E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
11	-0.51383E+01	0.14209E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
12	-0.48050E+01	0.75586E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
13	-0.47745E+01	0.11848E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
14	-0.47440E+01	0.16325E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
15	-0.44107E+01	0.23889E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
16	-0.40773E+01	0.30123E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
17	-0.37440E+01	0.36054E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
18	-0.37135E+01	0.40387E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
19	-0.36830E+01	0.45148E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
20	-0.35401E+01	0.51101E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
21	-0.33973E+01	0.56500E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
22	-0.32544E+01	0.61633E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
23	-0.31116E+01	0.66521E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
24	-0.29687E+01	0.71134E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
25	-0.28259E+01	0.75403E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
26	-0.26830E+01	0.79224E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
27	-0.26525E+01	0.82157E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.
28	-0.26220E+01	0.85861E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
29	-0.25451E+01	0.90303E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
30	-0.24682E+01	0.94073E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
31	-0.23912E+01	0.97561E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
32	-0.23143E+01	0.10073E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
33	-0.22374E+01	0.10342E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
34	-0.21605E+01	0.10544E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
35	-0.20835E+01	0.10652E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
36	-0.20066E+01	0.10623E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
37	-0.19297E+01	0.10376E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
38	-0.18528E+01	0.97413E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
39	-0.17758E+01	0.84164E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
40	-0.16989E+01	0.58715E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
41	-0.16220E+01	0.11539E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
42	-0.15915E+01	-0.72402E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
43	-0.15610E+01	-0.16552E+00	0.00000E+00	0.00000E+00	0.62661E-07	0.00000E+00	-0
44	-0.15210E+01	-0.25345E+00	0.00000E+00	0.00000E+00	0.33178E-06	0.00000E+00	-0
45	-0.14810E+01	0.91577E+00	0.68631E-06	0.00000E+00	0.68631E-06	0.68631E-06	0
46	-0.14410E+01	0.85582E+00	0.11507E-05	0.00000E+00	0.10948E-05	0.11507E-05	0
47	-0.14010E+01	0.73281E+00	0.17299E-05	0.00000E+00	0.10903E-05	0.17299E-05	0
48	-0.13610E+01	0.63353E+00	0.24289E-05	0.00000E+00	0.10992E-05	0.24289E-05	
49	-0.13210E+01	0.55388E+00	0.32419E-05	0.00000E+00	0.11188E-05	0.32419E-05	
50	-0.12810E+01	0.49207E+00	0.41217E-05	0.00000E+00	0.11462E-05	0.41217E-05	
51	-0.12410E+01	0.44917E+00	0.50111E-05	0.00000E+00	0.11791E-05	0.50111E-05	
52	-0.12010E+01	0.41856E+00	0.58759E-05	0.00000E+00	0.12167E-05	0.58759E-05	
53	-0.11610E+01	0.27615E+00	0.67263E-05	0.00000E+00	0.12555E-05	0.67263E-05	
54	-0.11210E+01	0.34679E+00	0.75770E-05	0.00000E+00	0.12839E-05	0.75770E-05	
55	-0.10810E+01	0.36184E+00	0.84354E-05	0.00000E+00	0.13261E-05	0.84354E-05	
56	-0.10410E+01	0.37527E+00	0.93002E-05	0.00000E+00	0.13720E-05	0.93002E-05	
57	-0.10010E+01	0.39760E+00	0.10170E-04	0.00000E+00	0.14209E-05	0.10170E-04	
58	-0.96100E+00	0.43178E+00	0.11039E-04	0.00000E+00	0.14734E-05	0.11039E-04	
59	-0.92100E+00	0.47510E+00	0.11899E-04	0.00000E+00	0.15312E-05	0.11899E-04	
60	-0.88100E+00	0.48901E+00	0.12748E-04	0.00000E+00	0.15777E-05	0.12748E-04	

61	-0.84100E+00	0.57232E+00	0.13609E-04	0.00000E+00	0.16388E-05	0.13609E-04	0
62	-0.80100E+00	0.67093E+00	0.14517E-04	0.00000E+00	0.17097E-05	0.14517E-04	0
63	-0.76100E+00	0.78851E+00	0.15506E-04	0.00000E+00	0.17895E-05	0.15506E-04	0
64	-0.72100E+00	0.92785E+00	0.16599E-04	0.00000E+00	0.18802E-05	0.16599E-04	0
65	-0.68100E+00	0.10834E+01	0.17816E-04	0.00000E+00	0.19857E-05	0.17816E-04	0
66	-0.64100E+00	0.12246E+01	0.19157E-04	0.00000E+00	0.20409E-05	0.19157E-04	0
67	-0.60100E+00	0.14248E+01	0.20534E-04	0.00000E+00	0.21812E-05	0.20534E-04	0
68	-0.56100E+00	0.17725E+01	0.21841E-04	0.00000E+00	0.23257E-05	0.21841E-04	0
69	-0.53050E+00	0.28107E+01	0.17346E-04	0.00000E+00	0.18888E-05	0.17346E-04	0
70	-0.50000E+00	0.13586E+02	0.18033E-04	0.00000E+00	0.18657E-05	0.18033E-04	0
71	-0.47500E+00	0.74369E+01	0.15283E-04	0.00000E+00	0.16083E-05	0.15283E-04	0
72	-0.45000E+00	0.88954E+01	0.15857E-04	0.00000E+00	0.16431E-05	0.15857E-04	0
73	-0.42500E+00	0.10350E+02	0.16537E-04	0.00000E+00	0.16590E-05	0.16537E-04	0
74	-0.40000E+00	0.11289E+02	0.17317E-04	0.00000E+00	0.16695E-05	0.17317E-04	[illegible]
75	-0.37500E+00	0.11935E+02	0.18123E-04	0.00000E+00	0.15913E-05	0.18123E-04	[illegible]
76	-0.35000E+00	0.12365E+02	0.18874E-04	0.00000E+00	0.16614E-05	0.18874E-04	[illegible]
77	-0.32500E+00	0.12597E+02	0.19591E-04	0.87211E-05	0.17376E-05	0.28312E-04	[illegible]
78	-0.30000E+00	0.12725E+02	0.20393E-04	0.26962E-04	0.19120E-05	0.47355E-04	[illegible]
79	-0.27500E+00	0.12930E+02	0.21399E-04	0.36308E-04	0.18157E-05	0.57707E-04	[illegible]
80	-0.25000E+00	0.13218E+02	0.22448E-04	0.38600E-04	0.17053E-05	0.61047E-04	[illegible]
81	-0.22500E+00	0.13464E+02	0.23076E-04	0.39946E-04	0.16401E-05	0.63022E-04	[illegible]
82	-0.20000E+00	0.12198E+02	0.23546E-04	0.45405E-04	0.15796E-05	0.68952E-04	[illegible]
83	-0.17500E+00	0.10067E+02	0.24475E-04	0.42699E-04	0.14408E-05	0.67174E-04	[illegible]
84	-0.15000E+00	0.89549E+01	0.25328E-04	0.41664E-04	0.13063E-05	0.66992E-04	[illegible]
85	-0.12500E+00	0.87703E+01	0.25634E-04	0.34868E-04	0.11685E-05	0.60502E-04	[illegible]
86	-0.10000E+00	0.88701E+01	0.25965E-04	0.28391E-04	0.10469E-05	0.54357E-04	[illegible]
87	-0.75000E-01	0.90751E+01	0.26439E-04	0.18158E-04	0.91558E-06	0.44598E-04	
88	-0.50000E-01	0.93930E+01	0.26479E-04	0.64299E-05	0.80811E-06	0.32909E-04	
89	-0.25000E-01	0.96650E+01	0.26491E-04	0.00000E+00	0.81166E-06	0.26491E-04	
90	0.00000E+00	0.94287E+01	0.26463E-04	0.64299E-05	0.80623E-06	0.32892E-04	
91	0.25000E-01	0.90473E+01	0.26438E-04	0.18537E-04	0.79480E-06	0.44975E-04	
92	0.50000E-01	0.87957E+01	0.26396E-04	0.31274E-04	0.85985E-06	0.57670E-04	
93	0.75000E-01	0.86461E+01	0.26157E-04	0.42330E-04	0.96683E-06	0.68486E-04	
94	0.10000E+00	0.85783E+01	0.25824E-04	0.52756E-04	0.10947E-05	0.78580E-04	
95	0.12500E+00	0.87124E+01	0.25429E-04	0.56854E-04	0.12477E-05	0.82282E-04	
96	0.15000E+00	0.94885E+01	0.24915E-04	0.58821E-04	0.13773E-05	0.83736E-04	
97	0.17500E+00	0.12137E+02	0.24059E-04	0.62605E-04	0.15036E-05	0.86665E-04	
98	0.20000E+00	0.13632E+02	0.22013E-04	0.58585E-04	0.17693E-05	0.80597E-04	
99	0.22500E+00	0.13384E+02	0.21359E-04	0.43136E-04	0.18455E-05	0.64495E-04	
100	0.25000E+00	0.13147E+02	0.20717E-04	0.38637E-04	0.18824E-05	0.59354E-04	
101	0.27500E+00	0.13245E+02	0.19268E-04	0.29891E-04	0.17568E-05	0.49159E-04	
102	0.30000E+00	0.13237E+02	0.18025E-04	0.00000E+00	0.14772E-05	0.18025E-04	
103	0.32500E+00	0.13092E+02	0.17298E-04	0.00000E+00	0.15990E-05	0.17298E-04	
104	0.35000E+00	0.12827E+02	0.16738E-04	0.00000E+00	0.16697E-05	0.16738E-04	
105	0.37500E+00	0.12432E+02	0.15990E-04	0.00000E+00	0.16383E-05	0.15990E-04	
106	0.40000E+00	0.11835E+02	0.14989E-04	0.00000E+00	0.15794E-05	0.14989E-04	
107	0.42500E+00	0.10917E+02	0.13956E-04	0.00000E+00	0.16906E-05	0.13956E-04	
108	0.45000E+00	0.94804E+01	0.13103E-04	0.00000E+00	0.16690E-05	0.13103E-04	
109	0.47500E+00	0.78319E+01	0.12465E-04	0.00000E+00	0.16356E-05	0.12465E-04	
110	0.50000E+00	0.24394E+02	0.11983E-04	0.00000E+00	0.15665E-05	0.11983E-04	
111	0.53050E+00	0.45384E+01	0.14051E-04	0.00000E+00	0.18204E-05	0.14051E-04	
112	0.56100E+00	0.27150E+01	0.13519E-04	0.00000E+00	0.16902E-05	0.13519E-04	
113	0.60100E+00	0.20780E+01	0.16682E-04	0.00000E+00	0.21653E-05	0.16682E-04	
114	0.64100E+00	0.16782E+01	0.15549E-04	0.00000E+00	0.20066E-05	0.15549E-04	
115	0.68100E+00	0.13742E+01	0.14466E-04	0.00000E+00	0.18746E-05	0.14466E-04	

116	0.72100E+00	0.11311E+01	0.13531E-04	0.00000E+00	0.17638E-05	0.13531E-04	0.
117	0.76100E+00	0.94147E+00	0.12705E-04	0.00000E+00	0.16699E-05	0.12705E-04	0.
118	0.80100E+00	0.85457E+00	0.11906E-04	0.00000E+00	0.16186E-05	0.11906E-04	0
119	0.84100E+00	0.73161E+00	0.11075E-04	0.00000E+00	0.15405E-05	0.11075E-04	0
120	0.88100E+00	0.63400E+00	0.10218E-04	0.00000E+00	0.14731E-05	0.10218E-04	0.
121	0.92100E+00	0.56146E+00	0.93586E-05	0.00000E+00	0.14134E-05	0.93586E-05	0
122	0.96100E+00	0.50032E+00	0.85100E-05	0.00000E+00	0.13602E-05	0.85100E-05	0
123	0.10010E+01	0.40254E+00	0.76665E-05	0.00000E+00	0.13214E-05	0.76665E-05	0
124	0.10410E+01	0.50558E+00	0.68189E-05	0.00000E+00	0.12801E-05	0.68189E-05	0
125	0.10810E+01	0.50090E+00	0.59666E-05	0.00000E+00	0.12349E-05	0.59666E-05	0
126	0.11210E+01	0.50632E+00	0.51220E-05	0.00000E+00	0.11953E-05	0.51220E-05	0
127	0.11610E+01	0.52795E+00	0.42972E-05	0.00000E+00	0.11610E-05	0.42972E-05	0
128	0.12010E+01	0.57027E+00	0.34740E-05	0.00000E+00	0.11319E-05	0.34740E-05	0
129	0.12410E+01	0.64320E+00	0.26055E-05	0.00000E+00	0.11079E-05	0.26055E-05	0
130	0.12810E+01	0.75760E+00	0.16590E-05	0.00000E+00	0.10897E-05	0.16590E-05	0
131	0.13210E+01	0.90888E+00	0.73517E-06	0.00000E+00	0.73517E-06	0.73517E-06	0
132	0.13610E+01	0.10171E+01	0.42900E-08	0.00000E+00	0.42900E-08	0.42900E-08	0
133	0.14010E+01	-0.13366E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
134	0.14410E+01	-0.12440E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
135	0.14810E+01	-0.63182E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
136	0.15210E+01	-0.14955E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
137	0.15610E+01	0.33317E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
138	0.15915E+01	0.42719E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
139	0.16220E+01	0.69190E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
140	0.16989E+01	0.95464E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
141	0.17758E+01	0.10878E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
142	0.18528E+01	0.11507E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
143	0.19297E+01	0.11739E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
144	0.20066E+01	0.11746E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
145	0.20835E+01	0.11623E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
146	0.21605E+01	0.11420E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
147	0.22374E+01	0.11161E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
148	0.23143E+01	0.10861E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
149	0.23912E+01	0.10530E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
150	0.24682E+01	0.10176E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
151	0.25451E+01	0.98000E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
152	0.26220E+01	0.94013E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
153	0.26525E+01	0.89693E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	(
154	0.26830E+01	0.86194E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
155	0.28259E+01	0.82766E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
156	0.29687E+01	0.78550E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
157	0.31116E+01	0.74045E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
158	0.32544E+01	0.69301E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
159	0.33973E+01	0.64349E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
160	0.35401E+01	0.59207E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
161	0.36830E+01	0.53878E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
162	0.37135E+01	0.49380E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
163	0.37440E+01	0.45317E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
164	0.40773E+01	0.38557E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
165	0.44107E+01	0.32456E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
166	0.47440E+01	0.26165E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
167	0.47745E+01	0.21938E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
168	0.48050E+01	0.17876E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
169	0.51383E+01	0.10716E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	
170	0.54717E+01	0.52964E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	

171	0.58050E+01	0.23320E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
172	0.80355E+01	-0.96367E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
173	0.10266E+02	-0.13300E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
174	0.12497E+02	-0.14425E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
175	0.14727E+02	-0.14548E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
176	0.16958E+02	-0.14329E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
177	0.19188E+02	-0.14361E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0
178	0.21419E+02	-0.28086E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0

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NACA 0012 : EXAMPLE 1 : TIME= 250.000 SEC

ICING CONDITION:

STATIC TEMPERATURE (C)	260.55
STATIC PRESSURE (PA)	90748.00
VELOCITY (M/S)	129.46
LWC (G/M**3)	0.50
DROPLET DIAMETER (MICRONS)	20.00

ICE ACCRETION DATA:

STAGNATION POINT	70	
TRANSITION POINTS (LOWER,UPPER)	68	71
ICING LIMITS (LOWER,UPPER)	42	98
NUMBER OF POINTS	139	
NUMBER OF SEGMENTS ADDED	0	

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SEG	X	Y	S	VE	TE	PRESS
1	0.53340E+00	0.00000E+00	-0.54361E+00	0.10304E+03	0.26361E+03	0.94528E+05
2	0.52807E+00	-0.99959E-03	-0.53819E+00	0.11376E+03	0.26245E+03	0.93085E+05
3	0.52273E+00	-0.19261E-02	-0.53278E+00	0.11785E+03	0.26198E+03	0.92501E+05
4	0.51740E+00	-0.27945E-02	-0.52468E+00	0.12153E+03	0.26154E+03	0.91961E+05
5	0.50673E+00	-0.44011E-02	-0.51256E+00	0.12482E+03	0.26114E+03	0.91466E+05
6	0.49339E+00	-0.62408E-02	-0.49910E+00	0.12711E+03	0.26085E+03	0.91115E+05
7	0.48006E+00	-0.79519E-02	-0.48566E+00	0.12873E+03	0.26064E+03	0.90863E+05
8	0.46672E+00	-0.95761E-02	-0.47223E+00	0.13006E+03	0.26047E+03	0.90654E+05
9	0.45339E+00	-0.11142E-01	-0.45881E+00	0.13127E+03	0.26032E+03	0.90463E+05
10	0.44005E+00	-0.12662E-01	-0.44539E+00	0.13241E+03	0.26017E+03	0.90281E+05
11	0.42672E+00	-0.14143E-01	-0.43198E+00	0.13350E+03	0.26002E+03	0.90105E+05
12	0.41338E+00	-0.15586E-01	-0.41856E+00	0.13458E+03	0.25988E+03	0.89932E+05
13	0.40005E+00	-0.16991E-01	-0.40516E+00	0.13561E+03	0.25974E+03	0.89763E+05
14	0.38671E+00	-0.18355E-01	-0.39176E+00	0.13661E+03	0.25960E+03	0.89599E+05
15	0.37338E+00	-0.19676E-01	-0.37836E+00	0.13760E+03	0.25947E+03	0.89437E+05
16	0.36004E+00	-0.20952E-01	-0.36496E+00	0.13857E+03	0.25933E+03	0.89276E+05
17	0.34671E+00	-0.22181E-01	-0.35157E+00	0.13952E+03	0.25920E+03	0.89117E+05
18	0.33337E+00	-0.23360E-01	-0.33819E+00	0.14047E+03	0.25907E+03	0.88959E+05
19	0.32004E+00	-0.24485E-01	-0.32481E+00	0.14140E+03	0.25894E+03	0.88802E+05
20	0.30670E+00	-0.25553E-01	-0.31143E+00	0.14232E+03	0.25881E+03	0.88646E+05
21	0.29337E+00	-0.26560E-01	-0.29806E+00	0.14323E+03	0.25868E+03	0.88491E+05
22	0.28003E+00	-0.27502E-01	-0.28470E+00	0.14414E+03	0.25855E+03	0.88335E+05
23	0.26670E+00	-0.28376E-01	-0.27134E+00	0.14505E+03	0.25842E+03	0.88178E+05
24	0.25336E+00	-0.29176E-01	-0.25798E+00	0.14597E+03	0.25829E+03	0.88019E+05
25	0.24003E+00	-0.29898E-01	-0.24463E+00	0.14690E+03	0.25815E+03	0.87859E+05
26	0.22670E+00	-0.30533E-01	-0.23128E+00	0.14782E+03	0.25802E+03	0.87697E+05
27	0.21336E+00	-0.31077E-01	-0.21794E+00	0.14876E+03	0.25788E+03	0.87532E+05

28	0.20002E+00	-0.31519E-01	-0.20460E+00	0.14968E+03	0.25774E+03	0.87370E+05	C
29	0.18669E+00	-0.31848E-01	-0.19126E+00	0.15060E+03	0.25760E+03	0.87208E+05	C
30	0.17335E+00	-0.32054E-01	-0.17792E+00	0.15149E+03	0.25747E+03	0.87049E+05	C
31	0.16002E+00	-0.32125E-01	-0.16459E+00	0.15236E+03	0.25734E+03	0.86893E+05	C
32	0.14668E+00	-0.32045E-01	-0.15125E+00	0.15320E+03	0.25721E+03	0.86742E+05	C
33	0.13335E+00	-0.31797E-01	-0.13791E+00	0.15401E+03	0.25709E+03	0.86597E+05	C
34	0.12001E+00	-0.31361E-01	-0.12456E+00	0.15475E+03	0.25697E+03	0.86463E+05	C
35	0.10668E+00	-0.30708E-01	-0.11121E+00	0.15539E+03	0.25687E+03	0.86346E+05	C
36	0.93345E-01	-0.29806E-01	-0.97829E-01	0.15589E+03	0.25680E+03	0.86256E+05	C
37	0.80010E-01	-0.28609E-01	-0.84422E-01	0.15616E+03	0.25676E+03	0.86207E+05	C
38	0.66675E-01	-0.27060E-01	-0.70969E-01	0.15607E+03	0.25677E+03	0.86222E+05	C
39	0.53340E-01	-0.25072E-01	-0.61519E-01	0.15571E+03	0.25683E+03	0.86289E+05	C
40	0.48006E-01	-0.24125E-01	-0.56092E-01	0.15537E+03	0.25688E+03	0.86350E+05	C
41	0.42672E-01	-0.23071E-01	-0.50642E-01	0.15482E+03	0.25696E+03	0.86451E+05	C
42	0.37338E-01	-0.21890E-01	-0.45161E-01	0.15390E+03	0.25710E+03	0.86617E+05	C
43	0.32004E-01	-0.20555E-01	-0.39637E-01	0.15238E+03	0.25734E+03	0.86890E+05	C
44	0.26656E-01	-0.19071E-01	-0.35460E-01	0.15066E+03	0.25759E+03	0.87197E+05	C
45	0.23955E-01	-0.18323E-01	-0.32644E-01	0.14916E+03	0.25782E+03	0.87462E+05	C
46	0.21242E-01	-0.17522E-01	-0.29800E-01	0.14728E+03	0.25810E+03	0.87792E+05	C
47	0.18523E-01	-0.16640E-01	-0.26922E-01	0.14496E+03	0.25843E+03	0.88194E+05	C
48	0.15792E-01	-0.15671E-01	-0.24000E-01	0.14214E+03	0.25884E+03	0.88677E+05	C
49	0.13045E-01	-0.14599E-01	-0.21010E-01	0.13848E+03	0.25935E+03	0.89290E+05	C
50	0.10263E-01	-0.13395E-01	-0.17906E-01	0.13290E+03	0.26010E+03	0.90202E+05	C
51	0.74187E-02	-0.11984E-01	-0.14624E-01	0.12408E+03	0.26123E+03	0.91577E+05	C
52	0.45207E-02	-0.10226E-01	-0.11968E-01	0.11341E+03	0.26249E+03	0.93134E+05	C
53	0.29445E-02	-0.91280E-02	-0.98517E-02	0.10214E+03	0.26370E+03	0.94644E+05	C
54	0.91825E-03	-0.80127E-02	-0.80110E-02	0.89836E+02	0.26487E+03	0.96128E+05	C
55	-0.15713E-03	-0.71662E-02	-0.65608E-02	0.78490E+02	0.26582E+03	0.97340E+05	C
56	-0.70888E-03	-0.57372E-02	-0.55973E-02	0.70342E+02	0.26643E+03	0.98116E+05	C
57	-0.83941E-03	-0.53642E-02	-0.52096E-02	0.66781E+02	0.26667E+03	0.98429E+05	C
58	-0.88302E-03	-0.49865E-02	-0.48262E-02	0.63387E+02	0.26689E+03	0.98714E+05	C
59	-0.96188E-03	-0.46080E-02	-0.44311E-02	0.59759E+02	0.26711E+03	0.99002E+05	C
60	-0.10517E-02	-0.42147E-02	-0.40132E-02	0.55877E+02	0.26733E+03	0.99292E+05	C
61	-0.11175E-02	-0.37873E-02	-0.35650E-02	0.51770E+02	0.26755E+03	0.99578E+05	C
62	-0.11573E-02	-0.33251E-02	-0.31999E-02	0.48464E+02	0.26772E+03	0.99793E+05	C
63	-0.11490E-02	-0.30587E-02	-0.29363E-02	0.46041E+02	0.26783E+03	0.99942E+05	C
64	-0.11742E-02	-0.27993E-02	-0.26677E-02	0.43592E+02	0.26794E+03	0.10008E+06	C
65	-0.12046E-02	-0.25245E-02	-0.23800E-02	0.41027E+02	0.26805E+03	0.10023E+06	C
66	-0.12257E-02	-0.22263E-02	-0.20643E-02	0.38341E+02	0.26816E+03	0.10036E+06	C
67	-0.12202E-02	-0.18939E-02	-0.17076E-02	0.35515E+02	0.26826E+03	0.10050E+06	C
68	-0.11974E-02	-0.15137E-02	-0.12752E-02	0.32283E+02	0.26837E+03	0.10064E+06	C
69	-0.12056E-02	-0.10297E-02	-0.51657E-03	0.28425E+02	0.26849E+03	0.10080E+06	C
70	-0.12739E-02	0.11688E-05	0.51675E-03	0.28425E+02	0.26849E+03	0.10080E+06	C
71	-0.12394E-02	0.10341E-02	0.12765E-02	0.32283E+02	0.26837E+03	0.10064E+06	C
72	-0.12303E-02	0.15199E-02	0.17078E-02	0.35515E+02	0.26826E+03	0.10050E+06	C
73	-0.12335E-02	0.18967E-02	0.20607E-02	0.38341E+02	0.26816E+03	0.10036E+06	
74	-0.12226E-02	0.22255E-02	0.23760E-02	0.41027E+02	0.26805E-03	0.10023E+06	
75	-0.12136E-02	0.25271E-02	0.26687E-02	0.43592E+02	0.26794E+03	0.10008E+06	
76	-0.12111E-02	0.28105E-02	0.29441E-02	0.46041E+02	0.26783E+03	0.99942E+05	
77	-0.12093E-02	0.30781E-02	0.32087E-02	0.48464E+02	0.26772E-03	0.99793E+05	
78	-0.12004E-02	0.33396E-02	0.35697E-02	0.51770E+02	0.26755E-03	0.99578E+05	
79	-0.11408E-02	0.37961E-02	0.40184E-02	0.55872E+02	0.26733E-03	0.99292E+05	
80	-0.10886E-02	0.42298E-02	0.44381E-02	0.59759E+02	0.26711E-03	0.99002E+05	
81	-0.99058E-03	0.46204E-02	0.48291E-02	0.63391E+02	0.26689E-03	0.98713E+05	
82	-0.87064E-03	0.49803E-02	0.52199E-02	0.66781E+02	0.26667E-03	0.98429E+05	

83	-0.87351E-03	0.53824E-02	0.57078E-02	0.70342E+02	0.26643E+03	0.98116E+05	0.
84	-0.10395E-02	0.59315E-02	0.67384E-02	0.78490E+02	0.26582E+03	0.97340E+05	0.
85	-0.20713E-03	0.71645E-02	0.82251E-02	0.89836E+02	0.26487E+03	0.96128E+05	0.
86	0.43484E-03	0.85044E-02	0.10072E-01	0.10214E+03	0.26370E+03	0.94644E+05	0.
87	0.22261E-02	0.97968E-02	0.12341E-01	0.11341E+03	0.26249E+03	0.93134E+05	0.
88	0.45143E-02	0.10233E-01	0.15202E-01	0.12408E+03	0.26123E+03	0.91577E+05	0
89	0.74054E-02	0.12007E-01	0.18486E-01	0.13290E+03	0.26010E+03	0.90202E+05	0
90	0.10248E-01	0.13422E-01	0.21591E-01	0.13848E+03	0.25935E+03	0.89291E+05	0
91	0.13044E-01	0.14601E-01	0.24583E-01	0.14214E+03	0.25884E+03	0.88677E+05	0.
92	0.15794E-01	0.15667E-01	0.27506E-01	0.14496E+03	0.25843E+03	0.88195E+05	0.
93	0.18527E-01	0.16628E-01	0.30384E-01	0.14728E+03	0.25810E+03	0.87792E+05	0.
94	0.21249E-01	0.17502E-01	0.33227E-01	0.14916E+03	0.25782E+03	0.87462E+05	0.
95	0.23963E-01	0.18297E-01	0.36043E-01	0.15066E+03	0.25760E+03	0.87197E+05	0.
96	0.26661E-01	0.19057E-01	0.40219E-01	0.15238E+03	0.25734E+03	0.86890E+05	0.
97	0.32004E-01	0.20556E-01	0.45743E-01	0.15390E+03	0.25710E+03	0.86617E+05	0
98	0.37338E-01	0.21891E-01	0.51223E-01	0.15482E+03	0.25696E+03	0.86451E+05	0
99	0.42672E-01	0.23071E-01	0.56674E-01	0.15537E+03	0.25688E+03	0.86350E+05	0
100	0.48006E-01	0.24125E-01	0.62101E-01	0.15571E+03	0.25683E+03	0.86289E+05	0
101	0.53340E-01	0.25072E-01	0.71551E-01	0.15607E+03	0.25677E+03	0.86222E+05	0
102	0.66675E-01	0.27060E-01	0.85004E-01	0.15616E+03	0.25676E+03	0.86207E+05	0
103	0.80010E-01	0.28609E-01	0.98411E-01	0.15589E+03	0.25680E+03	0.86256E+05	0
104	0.93345E-01	0.29806E-01	0.11179E+00	0.15539E+03	0.25687E+03	0.86346E+05	0
105	0.10668E+00	0.30708E-01	0.12515E+00	0.15475E+03	0.25697E+03	0.86463E+05	0
106	0.12001E+00	0.31361E-01	0.13849E+00	0.15401E+03	0.25709E+03	0.86597E+05	0
107	0.13335E+00	0.31797E-01	0.15183E+00	0.15320E+03	0.25721E+03	0.86742E+05	0
108	0.14668E+00	0.32045E-01	0.16517E+00	0.15236E+03	0.25734E+03	0.86893E+05	0
109	0.16002E+00	0.32125E-01	0.17850E+00	0.15149E+03	0.25747E+03	0.87049E+05	0
110	0.17335E+00	0.32054E-01	0.19184E+00	0.15060E+03	0.25760E+03	0.87208E+05	0
111	0.18669E+00	0.31848E-01	0.20518E+00	0.14968E+03	0.25774E+03	0.87370E+05	0
112	0.20002E+00	0.31519E-01	0.21852E+00	0.14876E+03	0.25788E+03	0.87532E+05	0
113	0.21336E+00	0.31077E-01	0.23186E+00	0.14782E+03	0.25802E+03	0.87697E+05	0
114	0.22670E+00	0.30533E-01	0.24521E+00	0.14690E+03	0.25815E+03	0.87859E+05	0
115	0.24003E+00	0.29898E-01	0.25856E+00	0.14597E+03	0.25829E+03	0.88019E+05	0
116	0.25336E+00	0.29176E-01	0.27192E+00	0.14505E+03	0.25842E+03	0.88178E+05	0
117	0.26670E+00	0.28376E-01	0.28528E+00	0.14414E+03	0.25855E+03	0.88335E+05	0
118	0.28003E+00	0.27502E-01	0.29865E+00	0.14323E+03	0.25868E+03	0.88491E+05	0
119	0.29337E+00	0.26560E-01	0.31202E+00	0.14232E+03	0.25881E+03	0.88646E+05	0
120	0.30670E+00	0.25553E-01	0.32539E+00	0.14140E+03	0.25894E+03	0.88802E+05	0
121	0.32004E+00	0.24485E-01	0.33877E+00	0.14047E+03	0.25907E+03	0.88959E+05	0
122	0.33337E+00	0.23360E-01	0.35216E+00	0.13952E+03	0.25920E+03	0.89117E+05	0
123	0.34671E+00	0.22181E-01	0.36555E+00	0.13857E+03	0.25933E+03	0.89276E+05	0
124	0.36004E+00	0.20952E-01	0.37894E+00	0.13760E+03	0.25947E+03	0.89437E+05	0
125	0.37338E+00	0.19676E-01	0.39234E+00	0.13661E+03	0.25960E+03	0.89599E+05	0
126	0.38671E+00	0.18355E-01	0.40574E+00	0.13561E+03	0.25974E+03	0.89763E+05	0
127	0.40005E+00	0.16991E-01	0.41915E+00	0.13457E+03	0.25988E+03	0.89932E+05	0
128	0.41338E+00	0.15586E-01	0.43256E+00	0.13350E+03	0.26002E+03	0.90105E+05	0
129	0.42672E+00	0.14143E-01	0.44597E+00	0.13240E+03	0.26017E+03	0.90281E+05	0
130	0.44005E+00	0.12662E-01	0.45939E+00	0.13126E+03	0.26032E+03	0.90463E+05	0
131	0.45339E+00	0.11142E-01	0.47282E+00	0.13005E+03	0.26047E+03	0.90654E+05	0
132	0.46672E+00	0.95761E-02	0.48625E+00	0.12873E+03	0.26064E+03	0.90863E+05	
133	0.48006E+00	0.79519E-02	0.49968E+00	0.12710E+03	0.26085E+03	0.91115E+05	
134	0.49339E+00	0.62408E-02	0.51314E+00	0.12482E+03	0.26114E+03	0.91466E+05	
135	0.50673E+00	0.44011E-02	0.52526E+00	0.12153E+03	0.26154E+03	0.91961E+05	
136	0.51740E+00	0.27945E-02	0.53336E+00	0.11785E+03	0.26198E+03	0.92501E+05	
137	0.52273E+00	0.19261E-02	0.53877E+00	0.11376E+03	0.26245E+03	0.93085E+05	

138	0.52807E+00	0.99959E-03	0.54419E+00	0.10304E+03	0.26361E+03	0.94528E+05	0
139	0.53340E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.90748E+05	0
1 SEG	S	HTC	XK	BETA	FFRAC	RI	
1	-0.54361E+00	0.00000E+00	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	0
2	-0.53819E+00	0.33257E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	0
3	-0.53278E+00	0.35195E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	0
4	-0.52468E+00	0.36999E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	C
5	-0.51256E+00	0.38681E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	0
6	-0.49910E+00	0.39923E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	C
7	-0.48566E+00	0.40860E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	C
8	-0.47223E+00	0.41668E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	(
9	-0.45881E+00	0.42434E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	(
10	-0.44539E+00	0.43181E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	(
11	-0.43198E+00	0.43925E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	(
12	-0.41856E+00	0.44674E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	(
13	-0.40516E+00	0.45424E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	(
14	-0.39176E+00	0.46175E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	(
15	-0.37836E+00	0.46942E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	(
16	-0.36496E+00	0.47725E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
17	-0.35157E+00	0.48524E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
18	-0.33819E+00	0.49344E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
19	-0.32481E+00	0.50188E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
20	-0.31143E+00	0.51060E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
21	-0.29806E+00	0.51962E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	'
22	-0.28470E+00	0.52908E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
23	-0.27134E+00	0.53896E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
24	-0.25798E+00	0.54941E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
25	-0.24463E+00	0.56048E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
26	-0.23128E+00	0.57223E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
27	-0.21794E+00	0.58482E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
28	-0.20460E+00	0.59823E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
29	-0.19126E+00	0.61262E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
30	-0.17792E+00	0.62818E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
31	-0.16459E+00	0.64508E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	(
32	-0.15125E+00	0.66365E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	(
33	-0.13791E+00	0.68429E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	(
34	-0.12456E+00	0.70739E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	(
35	-0.11121E+00	0.73363E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	(
36	-0.97829E-01	0.76394E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
37	-0.84422E-01	0.79977E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
38	-0.70969E-01	0.84362E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
39	-0.61519E-01	0.88156E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
40	-0.56092E-01	0.90769E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
41	-0.50642E-01	0.93724E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
42	-0.45161E-01	0.97066E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
43	-0.39637E-01	0.10080E+04	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01	
44	-0.35460E-01	0.10389E+04	0.35000E-03	0.36846E-01	0.10000E+01	0.10000E+01	
45	-0.32644E-01	0.10514E+04	0.35000E-03	0.72813E-01	0.10000E+01	0.10000E+01	
46	-0.29800E-01	0.10855E+04	0.35000E-03	0.10903E+00	0.10000E+01	0.10000E+01	
47	-0.26922E-01	0.11122E+04	0.35000E-03	0.14571E+00	0.10000E+01	0.10000E+01	
48	-0.24000E-01	0.11436E+04	0.35000E-03	0.18299E+00	0.10000E+01	0.10000E+01	
49	-0.21010E-01	0.11801E+04	0.35000E-03	0.22123E+00	0.10000E+01	0.10000E+01	
50	-0.17906E-01	0.12137E+04	0.35000E-03	0.27031E+00	0.10000E+01	0.10000E+01	
51	-0.14624E-01	0.12363E+04	0.35000E-03	0.33232E+00	0.10000E+01	0.10000E+01	
52	-0.11968E-01	0.12260E+04	0.35000E-03	0.39755E+00	0.10000E+01	0.10000E+01	

53	-0.98517E-02	0.11809E+04	0.35000E-03	0.45049E+00	0.99682E+00	0.10000E+01
54	-0.80110E-02	0.10989E+04	0.35000E-03	0.51003E+00	0.63919E+00	0.10000E+01
55	-0.65608E-02	0.10040E+04	0.35000E-03	0.55315E+00	0.38742E+00	0.10000E+01
56	-0.55973E-02	0.92716E+03	0.35000E-03	0.58051E+00	0.38283E+00	0.10000E+01
57	-0.52096E-02	0.88705E+03	0.35000E-03	0.59210E+00	0.33200E+00	0.10000E+01
58	-0.48262E-02	0.85121E+03	0.35000E-03	0.60299E+00	0.32936E+00	0.10000E+01
59	-0.44311E-02	0.81178E+03	0.35000E-03	0.61453E+00	0.35917E+00	0.10000E+01
60	-0.40132E-02	0.76835E+03	0.35000E-03	0.61789E+00	0.34738E+00	0.10000E+01
61	-0.35650E-02	0.72199E+03	0.35000E-03	0.62325E+00	0.31216E+00	0.10000E+01
62	-0.31999E-02	0.68355E+03	0.35000E-03	0.62761E+00	0.33452E+00	0.10000E+01
63	-0.29363E-02	0.65425E+03	0.35000E-03	0.63085E+00	0.35510E+00	0.10000E+01
64	-0.26677E-02	0.62528E+03	0.35000E-03	0.63420E+00	0.36255E+00	0.10000E+01
65	-0.23800E-02	0.59510E+03	0.35000E-03	0.63780E+00	0.35994E+00	0.10000E+01
66	-0.20643E-02	0.56432E+03	0.35000E-03	0.64381E+00	0.36543E+00	0.10000E+01
67	-0.17076E-02	0.53413E+03	0.35000E-03	0.64399E+00	0.39686E+00	0.10000E+01
68	-0.12752E-02	0.50297E+03	0.35000E-03	0.64421E+00	0.44907E+00	0.10000E+01
69	-0.51657E-03	0.50297E+03	0.35000E-03	0.64460E+00	0.50305E+00	0.10000E+01
70	0.51675E-03	0.50297E+03	0.35000E-03	0.64380E+00	0.43645E+00	0.10000E+01
71	0.12765E-02	0.50297E+03	0.35000E-03	0.64278E+00	0.28318E+00	0.10000E+01
72	0.17078E-02	0.53413E+03	0.35000E-03	0.64218E+00	0.26629E+00	0.10000E+01
73	0.20607E-02	0.56432E+03	0.35000E-03	0.64173E+00	0.24279E+00	0.10000E+01
74	0.23760E-02	0.59510E+03	0.35000E-03	0.63692E+00	0.22965E+00	0.10000E+01
75	0.26687E-02	0.62528E+03	0.35000E-03	0.63356E+00	0.23991E+00	0.10000E+01
76	0.29441E-02	0.65425E+03	0.35000E-03	0.63045E+00	0.26148E+00	0.10000E+01
77	0.32087E-02	0.68355E+03	0.35000E-03	0.62744E+00	0.28025E+00	0.10000E+01
78	0.35697E-02	0.72199E+03	0.35000E-03	0.62338E+00	0.28961E+00	0.10000E+01
79	0.40184E-02	0.76826E+03	0.35000E-03	0.61839E+00	0.28369E+00	0.10000E+01
80	0.44381E-02	0.81179E+03	0.35000E-03	0.61371E+00	0.26032E+00	0.10000E+01
81	0.48291E-02	0.85130E+03	0.35000E-03	0.60237E+00	0.25398E+00	0.10000E+01
82	0.52199E-02	0.88705E+03	0.35000E-03	0.59167E+00	0.28320E+00	0.10000E+01
83	0.57078E-02	0.92716E+03	0.35000E-03	0.58029E+00	0.34705E+00	0.10000E+01
84	0.67384E-02	0.10040E+04	0.35000E-03	0.55340E+00	0.42388E+00	0.10000E+01
85	0.82251E-02	0.10989E+04	0.35000E-03	0.51257E+00	0.40270E+00	0.10000E+01
86	0.10072E-01	0.11809E+04	0.35000E-03	0.45467E+00	0.10000E+01	0.10000E+01
87	0.12341E-01	0.12260E+04	0.35000E-03	0.39931E+00	0.99908E+00	0.10000E+01
88	0.15202E-01	0.12362E+04	0.35000E-03	0.33332E+00	0.10000E+01	0.10000E+01
89	0.18486E-01	0.12137E+04	0.35000E-03	0.26976E+00	0.10000E+01	0.10000E+01
90	0.21591E-01	0.11801E+04	0.35000E-03	0.21949E+00	0.10000E+01	0.10000E+01
91	0.24583E-01	0.11436E+04	0.35000E-03	0.18146E+00	0.10000E+01	0.10000E+01
92	0.27506E-01	0.11122E+04	0.35000E-03	0.14437E+00	0.10000E+01	0.10000E+01
93	0.30384E-01	0.10855E+04	0.35000E-03	0.10789E+00	0.10000E+01	0.10000E+01
94	0.33227E-01	0.10614E+04	0.35000E-03	0.71863E-01	0.10000E+01	0.10000E+01
95	0.36043E-01	0.10389E+04	0.35000E-03	0.36087E-01	0.10000E+01	0.10000E+0!
96	0.40219E-01	0.10080E+04	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+0
97	0.45743E-01	0.97065E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+0
98	0.51223E-01	0.93725E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+0
99	0.56674E-01	0.90768E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+0
100	0.62101E-01	0.88157E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+0
101	0.71551E-01	0.84362E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+0
102	0.85004E-01	0.79977E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+0
103	0.98411E-01	0.76394E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+0
104	0.11179E+00	0.73364E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+0
105	0.12515E+00	0.70739E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+0
106	0.13849E+00	0.68429E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+(
107	0.15183E+00	0.66365E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+(

108	0.16517E+00	0.64508E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
109	0.17850E+00	0.62818E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
110	0.19184E+00	0.61263E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
111	0.20518E+00	0.59823E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
112	0.21852E+00	0.58482E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
113	0.23186E+00	0.57223E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
114	0.24521E+00	0.56048E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
115	0.25856E+00	0.54941E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
116	0.27192E+00	0.53896E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
117	0.28528E+00	0.52908E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
118	0.29865E+00	0.51962E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
119	0.31202E+00	0.51060E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
120	0.32539E+00	0.50188E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
121	0.33877E+00	0.49344E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
122	0.35216E+00	0.48524E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
123	0.36555E+00	0.47725E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
124	0.37894E+00	0.46942E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
125	0.39234E+00	0.46175E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
126	0.40574E+00	0.45424E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
127	0.41915E+00	0.44673E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
128	0.43256E+00	0.43924E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
129	0.44597E+00	0.43180E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
130	0.45939E+00	0.42433E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
131	0.47282E+00	0.41667E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
132	0.48625E+00	0.40859E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
133	0.49968E+00	0.39922E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
134	0.51314E+00	0.38681E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
135	0.52526E+00	0.36999E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
136	0.53336E+00	0.35195E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
137	0.53877E+00	0.33258E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01
138	0.54419E+00	0.28421E+03	0.35000E-03	0.00000E+00	0.10000E+01	0.10000E+01

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13. ABSTRACT ***(Maximum 200 words)***

A version of LEWICE has been developed that incorporates a recently developed electrothermal deicer code, developed at the University of Toledo by William B. Wright. This was accomplished, in essence, by replacing a subroutine in LEWICE, called EBAL, which balanced the energies at the ice surface, with a subroutine called UTICE. UTICE performs this same energy balance, as well as handles all the time-temperature transients below the ice surface, for all of the layers of a composite blade as well as the ice layer itself. This new addition is set up in such a fashion that a user may specify any number of heaters, any heater chordwise length, and any heater gap desired. The heaters may be fired in unison, or they may be cycled with periods independent of each other. The heater intensity may also be varied. In addition, the user may specify any number of layers and thicknesses depthwise into the blade. Thus, the new addition has maximum flexibility in modeling virtually any electrothermal deicer installed into any airfoil. It should be noted that the model simulates both shedding and runback. With the runback capability, it can simulate the anti-icing mode of heater performance, as well as detect icing downstream of the heaters due to runback in unprotected portions of the airfoil. This version of LEWICE can be run in three modes. In mode 1, no conduction heat transfer is modeled (which would be equivalent to the original version of LEWICE). In mode 2, all heat transfer is considered due to conduction, but no heaters are firing. In mode 3, conduction heat transfer where the heaters are engaged is modeled, with subsequent ice shedding. When run in the first mode, there is virtually identical agreement with the original version of LEWICE in the prediction of accreted ice shapes. The code may be run in the second mode to determine the effects of conduction on the ice accretion process.

14. SUBJECT TERMS

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