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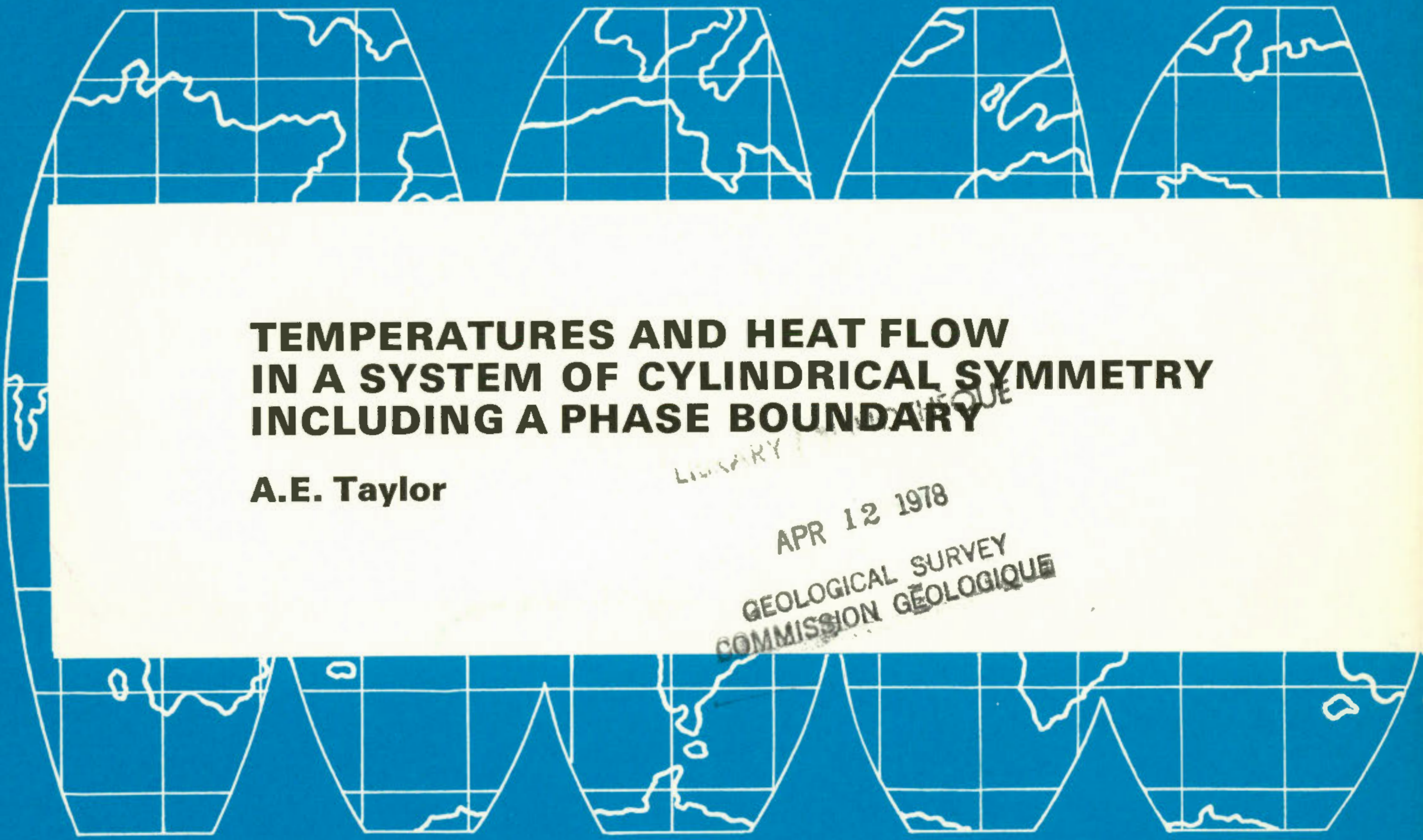

TEMPERATURES AND HEAT FLOW IN A SYSTEM OF CYLINDRICAL SYMMETRY INCLUDING A PHASE BOUNDARY

A.E. Taylor

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ABSTRACT

A numerical model has been developed to simulate the transient thermal regime arising from a cylindrically symmetric disturbance in a semi-infinite medium. Heat transfer by radial conduction only is considered and provision is made for a phase change involving latent heat to occur within the medium. The program has been used to produce a set of tables giving both temperatures at various distances from the source for a range of dimensionless times and the radial heat flow leaving the source region. Data are tabulated for cases with and without a phase change; in the case of a phase change, tables are given for a latent heat density of 30 MJ/m^3 and several source and initial temperatures. The source disturbance is considered to be either sustained indefinitely or to last for a finite period, after which cooling occurs.

The program finds application in such geophysical problems as the study of the disturbance to the geothermal regime resulting from the drilling of and production from petroleum wells, from buried pipelines and power cables and from underground tunnels. Using the tables, a hypothetical example is developed to illustrate the thermal disturbance arising from drilling a petroleum exploration well through permafrost.

RÉSUMÉ

Un modèle numérique a été développé afin de simuler le régime thermique transitoire qui résulte de la perturbation produite par une source cylindrique dans un milieu semi-infini. Le programme prend uniquement en considération la transmission de chaleur par conduction radiale et tient compte de la possibilité d'un changement de phase, impliquant une chaleur latente, dans le milieu. On a utilisé le programme pour produire une série de tables qui donnent, et les températures à plusieurs distances de la source pendant une période de temps, et le flux de chaleur radiale qui part de la source.

Les données sont classifiées pour des cas avec et sans changement de phase; dans le premier cas, des tables sont présentées pour une densité de chaleur latente de $30 MJ/m^3$, pour plusieurs températures de la source et plusieurs températures initiales du milieu. La perturbation est considérée, soit comme se prolongeant indéfiniment, soit comme continuant pendant une période définie et suivie d'un refroidissement.

Le programme peut être appliqué à des problèmes géophysiques tels que l'étude du bouleversement au régime géothermique découlant du forage et de l'exploitation des puits de pétrole, des pipelines et des lignes de transmission hydroélectrique enfouis, et des passages souterrains. En utilisant les tables, un exemple hypothétique est développé pour illustrer la perturbation thermique qui survient lors du forage d'un puits de pétrole d'exploration dans le pergélisol.

CONTENTS

1. INTRODUCTION

Knowledge of the transient thermal regime in problems involving cylindrical symmetry is important in many physical applications. The basic problem is represented by the heating and cooling of a large body by heat conduction from a cylinder imbedded internally. In this work, the solution finds application in geophysics in the study of the disturbance to the geothermal regime resulting from the drilling of and production from petroleum wells, from buried pipelines or power cables and from underground tunnels or drifts. A computer program, developed to simulate numerically these situations, has been designed to model the disturbed transient regime due to conduction where a phase change with latent heat is involved, such as in a permafrost environment or in a situation where freezing occurs around a chilled pipeline.

Section 2 reviews briefly a number of papers dealing with various aspects of the thermal regime in cylindrical systems which may be of interest in studying the geophysical applications cited. An overview of the theory is presented in section 3, and in more detail in Appendix A. Presentation of the data and the use of dimensionless parameters are described in section 4. Finally, Appendices C through F contain tables of calculated temperatures and heat flow.

Practical use of the data presented in this report is demonstrated in Appendix B by the study of the thermal regime of a petroleum exploration well in permafrost.

2. PREVIOUS STUDIES

The literature contains a number of solutions to the transient heat flow problem in cylindrical symmetry. Carslaw and Jaeger (1959) develop analytic solutions to many thermal problems in cylindrical geometry but rarely are these in closed form. Ingersoll et al. (1954) approximate analytic solutions for a wide variety of problems. Jaeger (1956) develops analytic solutions for temperatures within a region of single phase material surrounding a cylindrical source for times during a disturbance and for temperatures within the source region after the cessation of the disturbance. Such integral solutions are evaluated directly or through series expansions and tables are produced. Ritchie and Sakakura (1956) use asymptotic expansions to solve the heat conduction equation for various boundary conditions. Jessop (1963, 1966) calculates numerical values of the integrals in the heat flow equation for single phase media and produces tables from which heat flow from a cylindrical source for various times can be calculated.

A number of authors have studied the problem and its direct application to geophysical situations. Bullard (1947) calculates the dissipation time for the disturbance due to drilling a borehole. Lachenbruch and Brewer (1959) undertake a comprehensive analytic study of the dissipation of the temperature disturbance of a well drilled through permafrost, comparing with field results. Using graphical methods and comparing with field results, Cheremenski (1960a, b) shows that formation conductivity can be determined from disturbed temperatures if the heat input when drilling the wellbore is known. The disturbance due to rotary drilling of boreholes is studied analytically by Jaeger (1961) and compared to field data.

Recently, a number of papers have given results from computer-based numerical analysis studies of the disturbance due to drilling petroleum wells. Eickmeier et al. (1970) use a finite difference model to study the temperature disturbance within the formation due to production of warm oil through a wellbore. In application to a permafrost area, their model does not include provision for the latent heat of a phase change in the event of melting. Couch et al. (1970) study a similar problem and included latent heat for a phase change in permafrost environments. Lea et al. (1973) adapt the work of Ritchie et al. (1956) to develop a graphical procedure to predict the onset of permafrost melting in the surrounding formation and to estimate insulation requirements for production wells. In a recent work, Pui et al. (1975) describe a numerical simulator developed to study the thermal disturbance around a wellbore while drilling and they apply it to several particular cases.

In developing the present work, an attempt has been made to keep the model as general as possible to ensure broad applicability. The tabular data may be used to predict the transient thermal regime surrounding a cylindrical heat source, and the time for such disturbance to diminish. Provision is made for a change of phase of variable latent heat to occur outside the source region. The thermal regime is described through tables of temperatures within and outside the source region, and of the radial heat flow developed by the heat source.

The data are tabulated for a broad range of dimensionless parameters of time and radial distance for several values of latent heat density and source temperatures. This has led to a large number of tables; a smaller suite of tables has been selected and included here in Appendices C through F. The full set of tables (Taylor, 1978) is on Open File in the Library of the Earth Physics Branch.

3. THE METHOD

A numerical model has been developed to simulate the transient thermal regime arising from a cylindrically symmetric source disturbance in a semi-infinite medium. Heat transfer by radial conduction only is considered and provision is made for a phase change to occur within the medium. A description of the method will be given here, leaving the theory to Appendix A.

The finite difference calculus is used to solve the problem. This demands that partial derivatives in the heat conduction equation be replaced by their finite difference approximations. Alternately, an intuitive development of the solution is suggested by the symmetrical geometry and the need to divide the problem space into cells for numerical calculations.

Following the latter course, we segment the space surrounding the cylinder source into concentric shells of geometrically increasing radii, and consider only a pie-shaped sector of angle one radian (Fig. 1). Then we may solve for each cell in any small time Δt a conceptual equation

(Heat in)-(Heat out) = (Heat stored in cell as temperature change)

If Δt is chosen smaller than the thermal time constant of the problem, the temperature at any time t for a cell can be found by iterating over many increments of Δt. The temperatures of the cells will increase or decrease, depending on the nature of the source.

If a phase change occurs in any cell, the program holds the temperature of the cell at the melting or freezing point until heat equal to the latent heat capacity of the cell has been supplied (in melting) or taken away (in freezing). In such a case the conceptual equation for the cell becomes, temporarily,

(Heat in)-(Heat out) = (Heat contributing to latent heat)

until the right-hand side of the equation equals the latent heat capacity of the cell. Thereafter, the cell's temperature is allowed to change according to the previous equation. By applying this routine to all cells and iterating over time, the thermal regime of a system in response to any transient source can be described.

4. PROGRAM OUTPUT

The output of the program is in a variety of formats. Temperature arrays of all cells at any specified time can be printed. Alternately, following the format of Jaeger (1956), temperatures within the medium and source can be obtained as functions of dimensionless parameters of time and distance. Tables in Appendices C and E have been presented in this format.

Appendix C presents temperatures for the case in which a region initially at zero or a constant temperature is bounded internally by a cylindrical source held at a different fixed temperature for times $t > 0$. Such tables compare with Jaeger's (1956) Table I but cover the many additional cases involving a phase change. Frequently such a source is in practice short-lived, and temperature changes occurring within the source region as the system returns to undisturbed conditions are desired. Such data are presented in Appendix E in two formats. The first gives the variation of

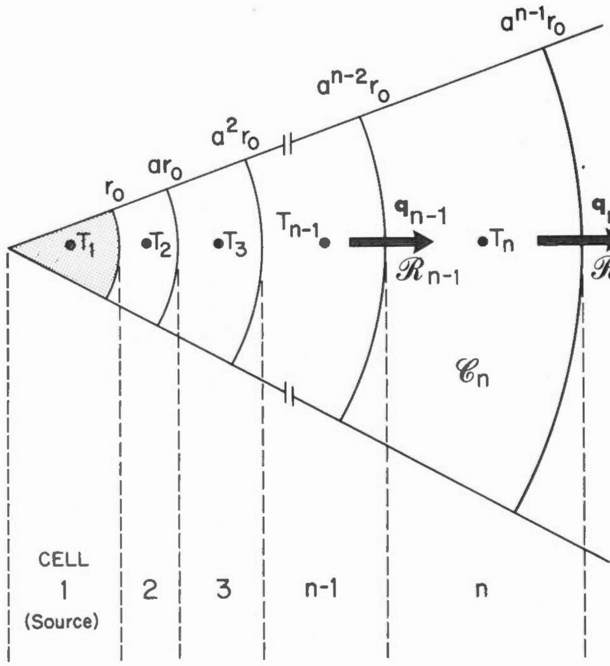

Figure 1.

Division of problem space and assignment of physical properties of cells in numerical solution (after Eickmeier et al., 1970).

temperature within the source and medium as a function of time before and after cessation of the disturbance, in tabular form identical to Appendix C. The second gives the temperatures within the source region at various times following the cessation of disturbance, and hence is comparable to Jaeger's Table II extended for the cases involving a phase change.

Appendices D and F contain tables of the radial heat flow as a function of dimensionless time for the various cases considered in Appendices C and E, respectively. The tabulated values have been normalized to give the heat flow from a source of one metre radius into a medium of one $Wm^{-1}K^{-1}$.

Output parameters may be subscripted to allow for a change of phase; subscript A refers to the phase of the undisturbed medium and B refers to the medium which has undergone a change of phase.

r = radial variable (m)
r_o = radius of cylindrical source (m)
k_A, k_B = thermal conductivity of the medium ($Wm^{-1}K^{-1}$)
c_A, c_B = specific heat ($Jkg^{-1}\ K^{-1}$)
ρ_A, ρ_B = density ($kg\ m^{-3}$)

$\alpha_A = \frac{k_A}{\rho_A c_A}$ = diffusivity in state A (m^2s^{-1})

Λ = latent heat of pore saturant (Jkg^{-1})
ρ_w = density of pore saturant ($kg\ m^{-3}$)
ϕ = ratio of pore saturant to total volume (porosity)
t = time(s)
t_o = duration of source disturbance(s)

Then for Appendices C, D, E and F

$$\tau = \frac{\alpha_A t}{r_o^2} \tag{4-1}$$

$$R = \frac{r}{r_o} \tag{4-2}$$

where τ and R are dimensionless, and the diffusivity of the undisturbed phase is used to calculate τ. In the computer-generated tables, τ is designated "TAU". The latent heat density of the medium is defined as

$$L = \Lambda \rho_w \phi \qquad (Jm^{-3}) \tag{4-3}$$

When the source lasts for a finite time t_o, as in Appendices E and F, temperatures are calculated for times $t > t_o$,

$$t = t_o + Nt_o \qquad (s) \tag{4-4}$$

where $N \geq 0$ and need not be an integer. Temperatures are presented in Appendix E for various N and t_o, where

$$\tau_o = \frac{\alpha_A t_o}{r_o^2} \tag{4-5}$$

Heat flow values tabulated in Appendices D and F have been normalized to give the heat flow $\omega(1,1)$ from a source of one metre radius into a medium of one $Wm^{-1}K^{-1}$. For a particular application, tabulated values must be multiplied by the conductivity of the medium immediately adjacent to the source region and divided by the radius, i.e.

$$\omega(r_o, k_A) = \omega(1,1) \bullet \frac{k_A}{r_o} \ (Wm^{-2}) \tag{4-6}$$

if the medium in contact with the source is in its original state, or

$$\omega(r_o, k_B) = \omega(1,1) \bullet \frac{k_B}{r_o} \ (Wm^{-2}) \tag{4-7}$$

if the medium adjacent to the source has undergone a change of phase. The phase status of the medium surrounding the source is indicated beside each entry in the tables as "A" or "B".

Only a single table covering the space and time frames desired is required in the single phase case, while a suite of tables is necessary to approximate the various two-phase cases. This arises from the inherent non-linearity of the solution in the latter case because of the latent heat.

In the single phase case, tables are provided only for the case of initial temperature 0^o and source temperature 1^o. Other initial temperature - source temperature pair solutions can be calculated using Duhamel's theorem (Carslaw and Jaeger, 1959, Ch. 1.14). These tables extend Jaeger's (1956) tables to some extent.

In the two phase case, tables are included for a variety of parameters. In all cases, the phase change temperature is assumed to be 0^oC. Tables are given for initial temperatures of -0.01^o, -5^o and -10^oC, for source temperatures of 10^o and 30^o and for a latent heat density of 30 megajoules per cubic metre. In a geophysical application, this latent heat represents a permafrost of about 9% porosity. Tables for other latent heat densities, source and initial temperatures are available in Taylor (1978).

Tables in the collection will rarely correspond to the latent heat density, source and initial temperatures required in a particular application. However, selecting tables whose parameters are closest to those of the problem will be satisfactory for many engineering applications. In the two-phase case, interpolations are not justified mathematically and are of varying accuracy. For engineering purposes, satisfactory estimates for temperatures and heat flow can be obtained when source temperatures and latent heat densities are interpolated linearly. The position of the phase change boundary and temperatures close to it are most in error for such interpolation. Generally, initial (geothermal) temperatures may not be interpolated. Use of and interpolation from the tables is discussed more fully in Appendix B.

Appendices C, D, E and F begin with a brief outline of the mathematical conditions underlying the tables and the dimensionless parameters employed. An index block is given on the bottom edge of each table to identify the latent heat density, the source and initial temperatures and the τ_o (= TAU_o) value.

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APPENDIX A. THEORY AND NUMERICAL FORMULATION

A.1 Introduction

An outline of the numerical solution to the problem is given in this section. A fuller treatment is documented in Taylor (1978). The finite difference formulation requires the problem space to be divided into cells. Temperatures are calculated for each cell using historic temperatures of it and of neighboring cells, and such cell parameters as thermal resistance and capacitance. These latter values are calculated from such basic physical properties as the density, thermal conductivity and specific heat of the materials comprising the system. Finally, a discussion of tests done on the program to test its stability and agreement with simple analytic solutions is presented.

A.2 Explicit finite difference formulation

In numerical calculation using the calculus of finite differences, the problem space is divided into cells. To take advantage of the cylindrical symmetry of this problem, a sector of angle one radian and unit depth is considered (Fig. 1, after Eickmeier et al., 1970). If the basic source radius is specified by r_o, cells outside the source can be generated by a factor a, where successive cell radii are ar_o, $a^2 r_o$, ..., $a^n r_o$.
A third dimension can be added to the problem by considering a stack of these sectors along the length of the cylinder. A list of symbols is given in Table 1.

The time-dependent heat conduction equation (Fourier's equation) governs the distribution of temperature T, in space and time t, in a medium whose diffusivity is α.

$$\nabla^2 T = \frac{1}{\alpha}\frac{\partial T}{\partial t} \qquad \text{(A-1)}$$

This equation may be solved using the finite difference calculus by replacing the partial derivatives by their finite difference approximations (Taylor, 1978).

Alternately, (A-1) can be reduced to a well-known conceptual equation which is somewhat easier to cast into a computer solution. Using expressions for diffusivity α and heat flux ω (heat flow per unit cross-sectional area),

$$\alpha = \frac{k}{\rho c} \qquad \text{(A-2)}$$

$$\omega = k\nabla T \qquad \text{(A-3)}$$

$$\nabla\cdot\omega = k\nabla^2 T \qquad \text{(A-4)}$$

(A-1) may be written

$$\nabla.\omega = \rho c\,\frac{\partial T}{\partial t} \qquad \text{(A-5)}$$

which is in the form of an equation of continuity. The divergence on the left-hand side represents the difference between heat fluxes into and out of the cell. This results in a change in temperature within the cell according to the right-hand side of the equation. Replacing the partial time derivative by its finite difference approximation yields

$$(\nabla.\omega)\Delta t = \rho c\Delta T \qquad \text{(A-6)}$$

that is, for a particular cell

(Heat in)-(Heat out) = (Heat stored in cell as temperature change) (A-7)

This equation may be applied over the time interval Δt to find the temperature change arising within the cell from the imbalance in heat flow $\nabla.\omega$, provided Δt is chosen smaller than the thermal time constant of the system. Then the temperature at any time t within a cell can be found by iterating over many increments of Δt and over all cells.

The temperatures of the cells will increase or decrease, depending on the nature of the source. If a phase change occurs in any cell, the program holds the temperature of the cell at the melting or freezing point until heat equal to the latent heat capacity of the cell has been supplied (in melting) or taken away (in freezing). In such a case, the conceptual equation for the cell becomes, temporarily,

(Heat in)-(Heat out) = (Heat contributing to latent heat budget)

(A-8)

until the right side equals the latent heat capacity of the cell. Thereafter, the cell's temperature is allowed to change according to (A-7).

The algebraic values of heat flow, and heat stored become very simple in the geometry and cell division described. Before proceeding to develop this solution, cell properties such as thermal resistance and capacitance must be calculated.

A.3 Cell Parameters

For computer solution of a problem it is necessary to solve (A-7) or (A-8) repeatedly for each cell. For such an iterative solution, it is convenient to use pre-calculated physical properties for each cell. For example, the heat capacity of a cell can be calculated from the specific heat and density of the material comprising the cell and the cell geometry. Likewise each cell will have a thermal resistance and a latent heat capacity. Such properties are simply calculated in this symmetric geometry from basic physical properties and the steady-state heat conduction equation,

$$\nabla^2 T = 0 \tag{A-9}$$

with a general solution (Ingersoll et al., 1954, p. 37)

$$T = A + B \ln r \tag{A-10}$$

where A and B are constants to be determined. A list of other symbols is given in Table 1. In calculating the heat flow from one cell to another, the temperature of these two adjacent cells will be known. For the nth and (n+1)th cells,

$$T = T_n \text{ at } r = r_n$$

$$T = T_{n+1} \text{ at } r = r_{n+1} = ar_n \tag{A-11}$$

Equation (A-11) is put in (A-10) and solved for A and B.

$$T = \frac{T_{n+1} \ln r_n - T_n \ln r_{n+1}}{\ln r_n - \ln r_{n+1}} + \frac{(T_{n+1} - T_n) \ln r}{\ln a} \tag{A-12}$$

which gives T as a general function of radius r. If r_n is taken as the radius of the cell boundary between the nth and (n+1)th cells, the radial heat flux across this cylindrical surface is

$$\omega_n = k_n \left.\frac{\partial T}{\partial r}\right|_{r = r_n} \tag{A-13}$$

and the heat flow is, per unit length of cylinder per radian,

$$q_n = \text{area x flux} = \frac{(2\pi r_n)(1)}{2\pi} \omega_n$$

$$= \frac{k_n (T_{n+1} - T_n)}{\ln a} \tag{A-14}$$

If a cell-to-cell thermal resistance $\mathscr{R}$ is defined as

$$\mathscr{R}_n = \frac{\ln a}{k_n} \tag{A-15}$$

the heat flow simplifies to

$$q_n = \frac{\Delta T_n}{\mathscr{R}_n} \tag{A-16}$$

Subscripts "n" denote properties of the nth cell (Fig. 1).

An imbalance of heat flowing into and out of a cell is the characteristic feature of the transient rather than the steady state heat conduction equation. This imbalance will result in a temperature change within a cell governed by its heat capacity. Alternately, in the permafrost case, the imbalance promotes the thawing or subsequent refreezing of the cell, to an extent governed by the latent heat capacity.

Both the heat capacity and the latent heat capacity depend on the volume of the cell. The heat capacity for the nth cell is

$$\mathscr{C}_n = \tfrac{1}{2} c_n \rho_n r_o^2 (a^{2n-2} - a^{2n-4}); \; n=2,3,\ldots \tag{A-17}$$

A latent heat density, L, may be defined from the latent heat Λ (J kg^{-1}) and density ρ_w (kg m^{-3}) of the pore saturant that occupies a fraction ϕ of the total volume.

$$L = \Lambda \rho_w \phi \tag{A-18}$$

with units of J m^{-3}. The latent heat capacity H_n of the nth cell is equal to the latent heat density times the cell volume.

$$H_n = \tfrac{1}{2} r_o^2 \, L \, (a^{2n-2} - a^{2n-4}); \; n=2,3,... \qquad (A-19)$$

The source can have physical properties different from the surrounding medium. In addition, its geometry is unique. Hence the values $\mathcal{R}_1$, $\mathcal{C}_1$ and H_1 are modified to reflect these differences.

A.4 Basic properties of the formation material

Bulk material properties, distinguished between the two phase states, can be used directly in the calculations. In geophysical applications, occasionally what is measured in the laboratory are the grain properties. The program accepts such values, calculating bulk properties from the grain properties, for a specified pore saturant. Discussion is simplified by working through a geophysical example, although it should be remembered that the model can accommodate any two-phase system.

For an example in permafrost terrain, the bulk density of the ground or rock is calculated from the grain density and the density of water or ice, depending on whether the material is in the unfrozen or frozen state.

$$\rho_u = \phi\rho_w + (1-\phi)\,\rho_g \text{ if unfrozen}$$

$$\rho_f = \phi\rho_i + (1-\phi)\,\rho_g \text{ if frozen} \qquad (A-20)$$

where ϕ is the ratio of pore volume (assumed saturated with water, either unfrozen or frozen) to total volume (porosity).

The bulk conductivity is calculated using a two component geometric model (Woodside and Messmer, 1961):

$$k_u = k_w^{\phi}\, k_g^{(1-\phi)} \text{ if unfrozen}$$

$$k_f = k_i^{\phi}\, k_g^{(1-\phi)} \text{ if frozen} \qquad (A-21)$$

assuming all porefluid is water if above the freezing temperature and all ice if below.

Bulk specific heats are calculated according to

$$c_u = \phi c_w + (1-\phi)\, c_g \text{ if unfrozen}$$

$$c_f = \phi c_i + (1-\phi)\, c_g \text{ if frozen} \qquad (A-22)$$

A.5 Computer Solution

Results from the previous two sections can now be used to cast the conceptual equations (A-7) and (A-8) in mathematical terms. Using (A-15), (A-16) and (A-17) for the nth cell,

$$(\text{Heat in}) = q_{n-1}\Delta t = \frac{T_{n-1} - T_n}{\mathcal{R}_{n-1}} \cdot \Delta t$$

$$(\text{Heat out}) = q_n \Delta t = \frac{T_n - T_{n+1}}{\mathcal{R}_n} \cdot \Delta t \qquad (A-23)$$

$$(\text{Heat stored}) = \mathcal{C}_n\,(T_n' - T_n)$$

and for a cell undergoing phase change,

$$\left(\begin{array}{l}\text{Heat contributing to}\\ \text{latent heat budget}\end{array}\right) = \Delta H_n \qquad (A-24)$$

For each iteration these values are calculated for all cells, but with (Heat in) = 0 for the source, n = 1. $\mathcal{R}$ and $\mathcal{C}$ in each case depend on whether the nth cell is frozen or unfrozen ((A-20), (A-21) and (A-22)). T_{n-1}, T_n, and T_{n+1} are average temperatures in the (n-1)th, nth and (n+1)th cells at the beginning of time Δt; and T_n' is the new temperature for the nth cell at the end of Δt.

Equation (A-7) is then solved for each cell. If an iteration predicts a new temperature of a cell passing through the freezing point, (A-8) is solved for succeeding iterations, holding the cell at its freezing point, until a cumulative total of ΔH_n values exceeds its latent heat capacity H_n (A-19). Thence the temperature of the cell in the new phase is permitted to change freely and iterations revert to using (A-7).

Substituting the expressions (A-23) in (A-7) and solving for T_n',

$$T_n' = \frac{\Delta t}{\mathcal{C}_n \mathcal{R}_{n-1}} T_{n-1} + \left[1 - \frac{\Delta t}{\mathcal{C}_n}\left(\frac{1}{\mathcal{R}_{n-1}} + \frac{1}{\mathcal{R}_n}\right)\right] T_n$$

$$+ \frac{\Delta t}{\mathcal{C}_n \mathcal{R}_n} T_{n+1}; \; n = 2, 3, ... \qquad (A-25)$$

which shows the explicit dependence of the finite difference solution on physical and geometric properties and previously calculated temperatures.

Subscript n=1 designates the source region. Initially the source temperature is maintained at selected values for a selected time but thereafter is allowed to change freely according to the heat capacity and thermal resistance of the source. Because of radial symmetry, "heat in" is zero for the wellbore cell.

$$T_1' = \left[1 - \frac{\Delta t}{\mathscr{C}_1 \mathscr{R}_1}\right] T_1 + \frac{\Delta t}{\mathscr{C}_1 \mathscr{R}_1} T_2 \qquad \text{(A-26)}$$

Inspection of (A-25) leads to a stability criterion. T_n must contribute to T_n' in a "non-negative" way (Eickmeier et al., 1970):

$$1 - \frac{\Delta t}{\mathscr{C}_n}\left[\frac{1}{\mathscr{R}_{n-1}} + \frac{1}{\mathscr{R}_n}\right] > 0$$

$$\text{(A-27)}$$

$$\Delta t < \frac{\mathscr{C}_n \mathscr{R}_{n-1} \mathscr{R}_n}{\mathscr{R}_{n-1} + \mathscr{R}_n}$$

This is essentially the same condition for the explicit method developed by Carnahan et al. (1969, ch. 7.10). In practice, Δt is chosen to satisfy this criterion for all possible property values that may be encountered ... for all cells, in both phase states.

The expression on the right is the thermal time constant of the system; hence response to a disturbance and ultimate decay is governed by this characteristic time.

A.6 Program testing

When a numerical technique is used to solve a problem, one must be sure that properties of stability, consistency and convergence are preserved. By convergence one means that the numerical solution tends towards the analytic solution as the space and time subdivisions tend to zero. Consistency implies that the method approximates the partial differential equation intended and not some other equation. Carnahan et al. (1969, Ch. 7) show that choosing the time step according to the stability condition (A-27) ensures these three conditions are satisfied for the numerical method used here.

Errors arise from the need to subdivide the problem space for a numerical solution, and as cells are made smaller, the calculated solution converges to the analytic solution. In this report, the maximum number of cells used and their size are chosen to keep the computing time within reason and to limit the error to a degree that may be tolerated in most applications.

Temperatures at the various dimensionless radii R are interpolated, using (A-12), from mean temperatures calculated by the program for the cells. In this report, several different tables are presented for the same physical input parameters; where such tables overlap, small differences in the solutions arise from having employed a finer space subdivision for the table involving smaller dimensionless times τ.

In the two-phase system, the particular cell undergoing phase change is equivalent to a local boundary condition that moves outwards from the source. As a consequence of the size of the cells and the large latent heat involved, this boundary is stationary over an appreciable time interval and a step-like character is imparted to the numerical solution. Figure 2 illustrates how plateaus in the heat flow are reflected in similar small steps in time for temperatures near the source. A strong correlation between these plateaus and the time interval required for a single cell to change phase is apparent.

Hence, the solution of the two-phase problem has some inherent sensitivity to choice of cell sizes. Examination of Figure 2 suggests that temperatures occasionally may be inaccurate to about 5% of the source-initial temperature difference but can be expected to improve at longer times. We must tolerate such variations as not compromising most applications.

Extensive testing of the program was carried out and comparisons were made, wherever possible, with analytic solutions. For the single phase case, Jaeger (1956) evaluates integral solutions for temperatures within a region surrounding a cylindrical source and within the source region after cessation of the disturbance. Jessop (1963, 1966) calculates the heat flow for the same geometry in the single phase case.

In the present work, temperatures calculated for the single phase case for the region outside the cylindrical source agree to within $0.005^{\circ}C$ of Jaeger's values and are generally within $0.001^{\circ}C$ (Jaeger, 1956, Table I). Computed temperatures within the source region after cessation of the disturbance agree to within $0.02^{\circ}C$ for short times and to within $0.005^{\circ}C$ at longer times (Jaeger, 1956, Table II).

Radial heat flow values calculated for the

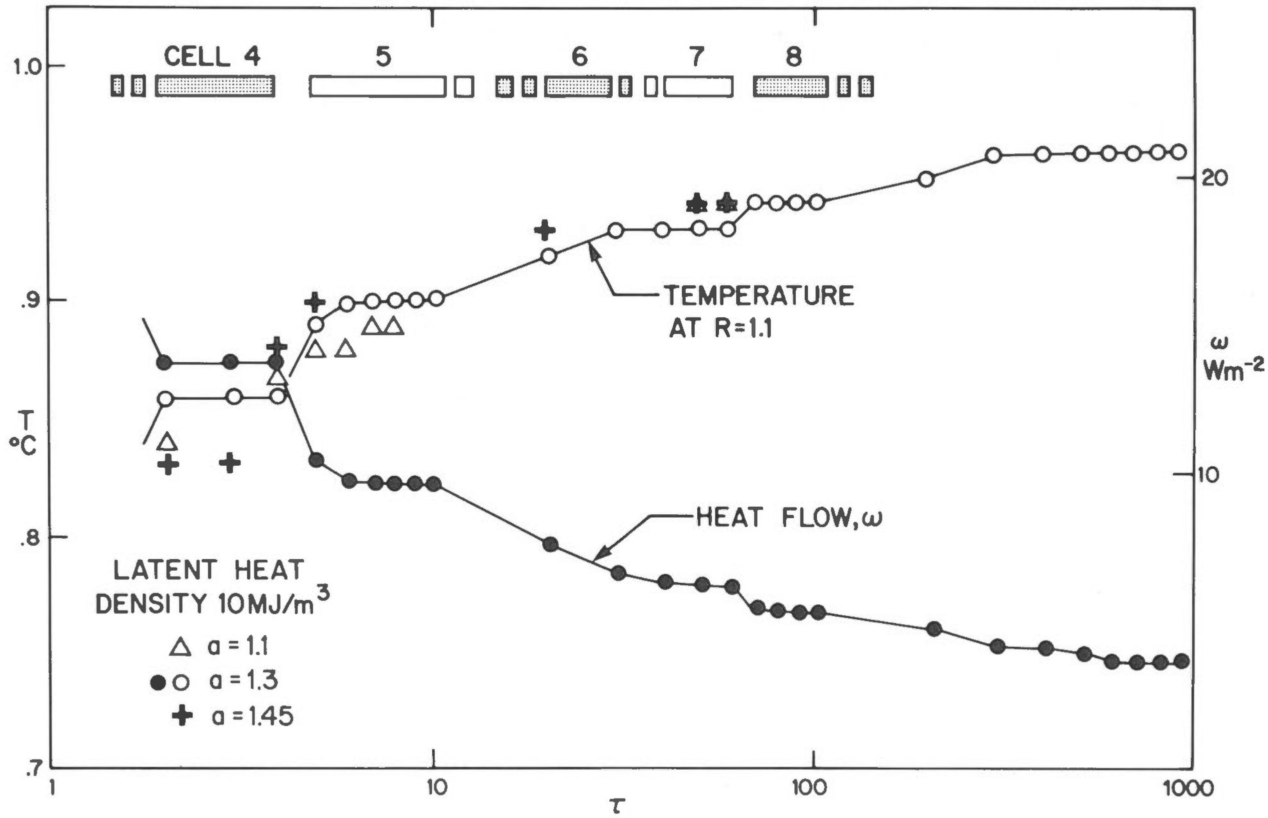

FIGURE 2.

Temperature and radial heat flow as a function of dimensionless time to illustrate effect of division of problem space (factor "a") on solution. Cells actively undergoing a phase change for a = 1.3 are shown along the top (section A.6).

single phase case were compared to values computed by Jessop (1963, 1966). Agreement is within 1.5%, improving to better than 0.5% at longer times.

Testing of the calculations tabulated in the present study in the two phase case is, however, less complete because the problem is non-linear and analytic solutions are available in only a few special cases. The position of the freezing boundary with time was calculated from an approximate analytic solution of Carslaw and Jaeger (1959, Ch. 11.6 (II)), for the case of a chilled pipe in water. The freezing front computed by this program occurred within 2.5% of the theoretical time for a number of radii (Table 2). The program calculates mean temperatures for a cell, and part of this error may be due to interpolating the radial position of the 0° isotherm within the actively freezing cell.

TABLE 1.

List of symbols used in theory, Appendix A.

r	radial distance in cylindrical coordinates (m)
r_o	source radius (m)
a	radial multiplier
T	temperature (°C)
t	time (s)
t_o	duration of source (s)
α	thermal diffusivity (m^2s^{-1})
k	thermal conductivity ($Wm^{-1}K^{-1}$)
c	specific heat ($J\ kg^{-1}K^{-1}$)
ρ	density ($kg\ m^{-3}$)
Λ	specific latent heat of pore saturant ($J\ kg^{-1}$)
L	latent heat density of medium (Jm^{-3})
ω	heat flux (Wm^{-2})
ϕ	porosity, volume fraction
g,w,i	subscripts denoting grain, water and ice properties
u,f	subscripts denoting unfrozen and frozen properties
A	subscript denoting medium in its original phase state
B	Subscript devoting medium of phase different from the original

Cell Properties:

n	subscript denoting nth cell
$\mathscr{R}_n$	thermal resistance from nth to (n + 1)th cell ($W^{-1}mK$)
$\mathscr{C}_n$	heat capacity of nth cell (JK^{-1})
H_n	latent heat capacity of nth cell (J)
q_n	heat flow out of nth cell (W)

APPENDIX B. USE OF TABULATED DATA

A brief description of the tabulated data is presented here to facilitate their use. First, the various tables will be surveyed to illustrate characteristics of the disturbed thermal regime, especially those features that arise because of a phase change. Second, a practical example of the use of the tables to model a hypothetical petroleum exploration well through permafrost will be worked through in detail. This example is chosen to require some interpolation from the tables; this will illustrate the technique and the errors that may arise.

Within Appendices C to F, tables are arranged in order of latent heat density, source and initial temperatures and τ_o, in the same sequence as these four parameters appear on the index block printed at the bottom of each table. In this discussion it will be convenient to refer to a particular table simply by these four parameters in the same order. The table to be discussed first, will, on this basis, be designated by (30, 10, -5, 100), representing a source disturbance lasting to time τ_o = 100 followed by cooling.

The temperature regime corresponding to these parameters is found in Appendix E, and the table of heat flow is located in Appendix F. Turning to the temperature data, one notes immediately that the area of the table with positive temperatures represents the extent of the thaw bulb in dimensionless radius and time. This area can be subdivided into an isothermal region, illustrating the considerable space and time span for which temperatures are held at the freezing temperature while latent heat is dispersed. In this case, refreezing is complete only after a time interval equivalent to about two periods of disturbance but a further five such periods elapse before temperatures cool to within 0.5°C of undisturbed conditions.

The corresponding table for heat flow shows an abrupt decrease in heat flow from the source region following the cessation of the disturbance. The very small values for times τ = 140 to 200 reflect the presence of the isothermal regime noted above. Once refreezing is complete, the heat flow increases and cooling to initial conditions continues.

Comparing these tables with others of different parameters illustrates features of a two-phase system. In the table (30, 10, -10, 100), the geothermal temperature is -10°C instead of -5° and the thaw bulb is smaller in size. Refreezing is much more rapid as well because of the larger radial temperature

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 334 MJ/M^3

TAU	R 1.000	1.300	1.350	1.400	1.450	1.500	1.550	1.600	1.700	1.800	2.000	2.050	2.150	2.300	2.400	2.700
.1770	-5.00	.00	.00	.00	.00	.00	.00	.01	.01	.01	.01	.01	.01	.01	.01	.01
.2446	-5.00	-.86	.00	.00	.00	.00	.00	.00	.01	.01	.01	.01	.01	.01	.01	.01
.3230	-5.00	-1.07	-.49	.00	.00	.00	.00	.00	.00	.01	.01	.01	.01	.01	.01	.01
.4144	-5.00	-1.17	-.76	-.36	.00	.00	.00	.00	.00	.00	.01	.01	.01	.01	.01	.01
.5178	-5.00	-1.95	-1.51	-1.08	-.50	.00	.00	.00	.00	.00	.01	.01	.01	.01	.01	.01
.6338	-5.00	-1.95	-1.51	-1.09	-.70	-.32	.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.7630	-5.00	-1.95	-1.51	-1.09	-.80	-.52	-.25	.00	.00	.00	.00	.00	.01	.01	.01	.01
1.0600	-5.00	-2.50	-2.14	-1.80	-1.46	-1.14	-.83	-.53	.00	.00	.00	.00	.00	.00	.01	.01
1.4140	-5.00	-2.89	-2.58	-2.29	-2.01	-1.73	-1.47	-1.21	-.70	.00	.00	.00	.00	.00	.00	.01
2.2940	-5.00	-3.17	-2.90	-2.65	-2.41	-2.17	-1.94	-1.72	-1.29	-.90	.00	.00	.00	.00	.00	.00
2.5510	-5.00	-3.17	-2.90	-2.65	-2.41	-2.17	-1.94	-1.72	-1.29	-.90	-.15	.00	.00	.00	.00	.00
3.1130	-5.00	-3.26	-3.01	-2.78	-2.55	-2.34	-2.13	-1.94	-1.57	-1.23	-.64	-.49	.00	.00	.00	.00
4.0700	-5.00	-3.38	-3.15	-2.93	-2.71	-2.50	-2.30	-2.10	-1.73	-1.38	-.73	-.58	-.33	.00	.00	.00
4.7990	-5.00	-3.55	-3.34	-3.14	-2.95	-2.76	-2.58	-2.41	-2.07	-1.76	-1.18	-1.04	-.78	-.34	.00	.00

TAU	R 1.000	1.340	1.343	1.346	1.348	1.350	1.490	1.493	1.496	1.498	1.500	2.270	2.280	2.290	2.295	2.300
.2440	-5.00	-.11	-.05	.00	.00	.00	.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.2446	-5.00	-.11	-.06	-.00	.00	.00	.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.2450	-5.00	-.12	-.06	-.01	.00	.00	.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.2500	-5.00	-.17	-.11	-.06	-.03	.00	.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.2510	-5.00	-.18	-.12	-.07	-.04	-.00	.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.2520	-5.00	-.19	-.13	-.08	-.05	-.01	.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.2540	-5.00	-.20	-.15	-.10	-.07	-.03	.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.5174	-5.00	-1.60	-1.57	-1.55	-1.53	-1.51	-.05	-.02	.00	.00	.00	.01	.01	.01	.01	.01
.5178	-5.00	-1.60	-1.57	-1.55	-1.53	-1.51	-.05	-.02	.00	.00	.00	.01	.01	.01	.01	.01
.5182	-5.00	-1.60	-1.57	-1.55	-1.53	-1.51	-.06	-.02	.00	.00	.00	.01	.01	.01	.01	.01
.5280	-5.00	-1.60	-1.57	-1.55	-1.53	-1.51	-.10	-.07	-.04	-.01	.00	.01	.01	.01	.01	.01
.5300	-5.00	-1.60	-1.57	-1.55	-1.53	-1.51	-.11	-.07	-.04	-.02	-.00	.01	.01	.01	.01	.01
.5350	-5.00	-1.60	-1.57	-1.55	-1.53	-1.51	-.13	-.10	-.06	-.04	-.02	.01	.01	.01	.01	.01
.5400	-5.00	-1.60	-1.57	-1.55	-1.53	-1.51	-.15	-.12	-.09	-.07	-.05	.01	.01	.01	.01	.01
4.0700	-5.00	-3.20	-3.18	-3.17	-3.16	-3.15	-2.54	-2.53	-2.52	-2.51	-2.50	-.05	-.03	-.01	.00	.00
4.1000	-5.00	-3.20	-3.18	-3.17	-3.16	-3.15	-2.54	-2.53	-2.52	-2.51	-2.50	-.06	-.04	-.02	-.00	.00
4.1300	-5.00	-3.20	-3.18	-3.17	-3.16	-3.15	-2.54	-2.53	-2.52	-2.51	-2.50	-.07	-.05	-.03	-.01	-.00
4.1600	-5.00	-3.20	-3.18	-3.17	-3.16	-3.15	-2.54	-2.53	-2.52	-2.51	-2.50	-.08	-.06	-.03	-.02	-.01
4.2000	-5.00	-3.20	-3.18	-3.17	-3.16	-3.15	-2.54	-2.53	-2.52	-2.51	-2.50	-.09	-.07	-.05	-.04	-.03
4.2500	-5.00	-3.20	-3.18	-3.17	-3.16	-3.15	-2.54	-2.53	-2.52	-2.51	-2.50	-.10	-.08	-.06	-.05	-.04
4.3000	-5.00	-3.20	-3.18	-3.17	-3.16	-3.15	-2.54	-2.53	-2.52	-2.51	-2.50	-.11	-.09	-.07	-.06	-.05

TABLE 2.

Position of phase change front for example of chilled source (-5°C) in water initially at +0.01°C. In upper table, successive radii-time pairs along diagonal satisfy approximate analytic formula for position of freeze front (see section A.6) e.g. front will be at R = 1.35 at time τ = 0.2446 in the analytic solution. The temperatures (°C) are from the numerical solution. More detail around three analytic solutions (boxed) is provided in the lower table, e.g. the numerical solution predicts the freeze front at time τ = 0.2446 to be between radius 1.346 and 1.348 (star) rather than at 1.350, or alternately it reaches τ = 1.350 later than τ = 0.2446 (arrow).

gradients and hence larger heat flow existing outside the thaw front.

The equivalent case where a change of phase is not involved may be determined from table (0, 1, 0, 100). The table of temperatures is adjusted to compare with the previous table (source 10^{o}, initial temperature $-5^{o}C$) by multiplying tabulated entries by the source-initial temperature difference (15) and subtracting 5^{o}. The corresponding heat flow table is obtained by multiplying entries by 15.

Figure 3 compares the temperature variation with time τ at several radii for this case and for (30, 10, -5, 100). The effect of latent heat in creating an isothermal regime at $0^{o}C$ for some distance from the source during freezeback is readily apparent. Comparison of the curves for the two cases at R = 2 and 4 shows that the outward propagation of a temperature disturbance is less in the case involving latent heat.

Heat flow for these cases is shown in Figure 4. The value during the disturbance is slightly greater in the case involving a phase change because of the larger radial gradients that develop between the source and the thaw front. The cooling profile in the two-phase case reflects the rapidly decreasing heat transfer from the source region as part of the formation becomes isothermal, and while latent heat is being dispersed outward from the thaw front. When freezeback is complete, the temperature and heat flow curves are quite similar in both cases.

Sample Problem

Practical use of the tables to predict the thermal regime in a geophysical example will now be demonstrated. Selecting tables whose parameters are closest to those needed in a particular application is usually satisfactory for engineering purposes; however some simple interpolating between tables will be done in this exercise to illustrate the errors that may arise. The example chosen is the simulation of

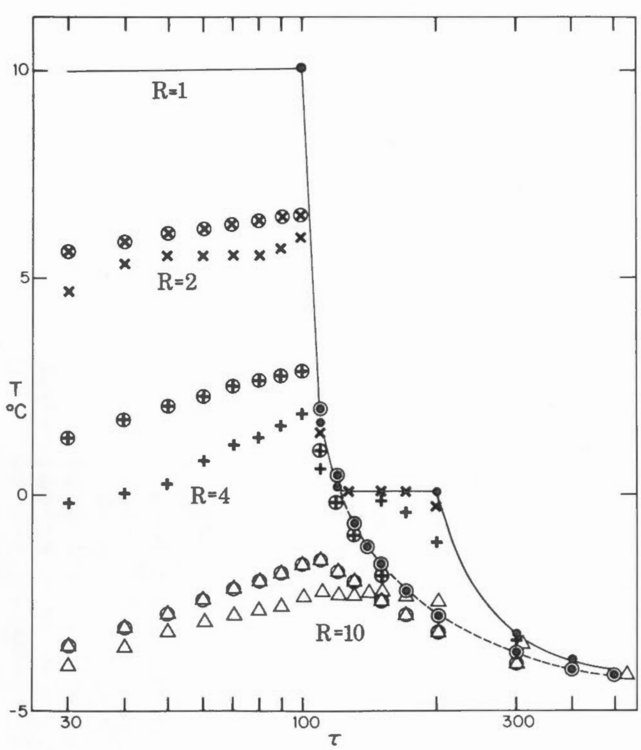

FIGURE 3.

Temperature variation with time at several radii R to compare response in the two-phase case (•, x, +, Δ) with that from the single phase case (circled symbols). (Appendix B).

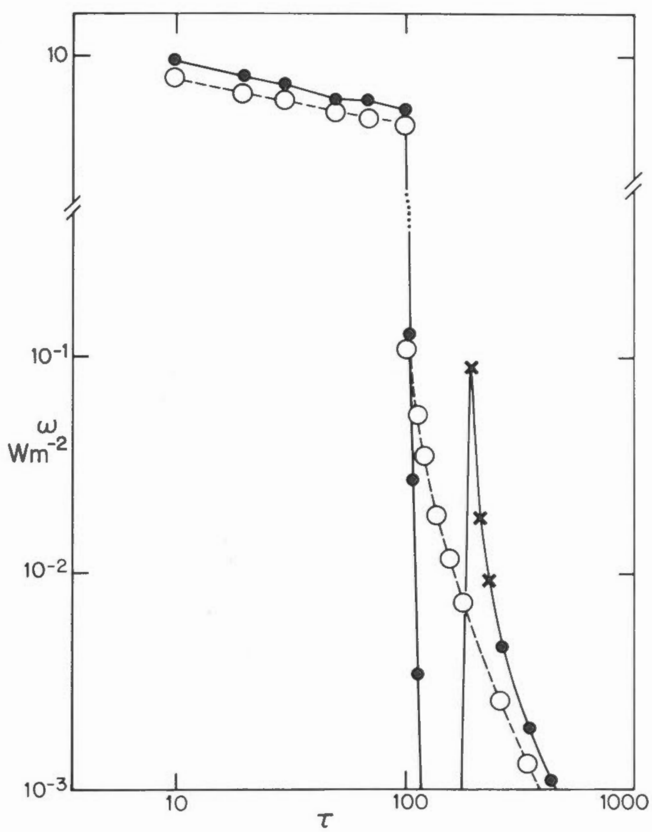

FIGURE 4.

Radial heat flow from the source for the two cases of Figure 3. • = two-phase; o = single phase; x = detail for two-phase case taken from a supplementary run. (Appendix B).

drilling a petroleum exploration well through sandstones in a permafrost region. The mean annual surface temperature for the location is assumed to be $-11^{o}C$, and the water saturated porosity is 9%. The wellbore, of diameter 0.34 m (13 5/8 inches) is drilled for 54 days using a circulation temperature of $20^{o}C$. The steps required to determine the thermal model will now be outlined.

B.1 Calculation of Physical Properties

To determine dimensionless time τ, properties of the formation material must be known. If physical property values for sandstone in both frozen and unfrozen states are known, these may be used; otherwise such may be calculated from the grain properties and the porosity according to section A.4. The latter course is followed in this example, and SI units are used throughout.

(i) Density

In practice it is sufficient to assume the density of ice and water are identical, 1000 kg m^{-3}. ρ_g = 2630 kg m^{-3} for sandstone and using (A-20) with ϕ = 0.09, ρ = 2483 kg m^{-3} for both frozen and unfrozen cases, approximately.

(ii) Conductivity

$k_w = 0.50\ Wm^{-1}K^{-1}$
$k_i = 2.25\ Wm^{-1}\ K^{-1}$
$k_g = 4.7\ Wm^{-1}\ K^{-1}$ for sandstone and using (A-21),

$k_u = 3.84\ Wm^{-1}K^{-1}$ (unfrozen)
$k_f = 4.40\ Wm^{-1}K^{-1}$ (frozen)

(iii) Specific Heat

$c_w = 4187\ Jkg^{-1}K^{-1}$
$c_i = 2090\ Jkg^{-1}K^{-1}$
$c_g = 837\ Jkg^{-1}K^{-1}$ for sandstone and using (A-22)

$c_u = 1138\ Jkg^{-1}K^{-1}$ (unfrozen)
$c_f = 950\ Jkg^{-1}K^{-1}$ (frozen)

B.2 Calculation of Dimensionless time

Section 4 describes the conversion of real times t to the dimensionless times τ used in the tables. Above the permafrost boundary, the formation normally is in a frozen state, so the diffusivity in this state is used to calculate τ, equation (4-1). In particular, the time τ_o equivalent to a real drilling time of t_o = 54 days is

$$\tau_o = \frac{\alpha_A t_o}{r_o^2} = \frac{k_f t_o}{\rho\, c_f\, r_o^2}$$

$$= \frac{4.40 \times 54 \times 86400}{2483 \times 950 \times 0.17^2} = 301$$

Below the permafrost base, the formation is always unfrozen, so the diffusivity of sandstone in the unfrozen state is used; hence,

$$\tau_o = \frac{3.84 \times 54 \times 86400}{2483 \times 1138 \times 0.17^2} = 219$$

B.3 Latent Heat Density

Below the permafrost base, a phase change will not occur in the problem being simulated, so the latent heat density is 0; within the normally frozen material, it is found using (4-3):

$\Lambda = 334{,}960\ Jkg^{-1}$ for water/ice

$$L = \Lambda \rho_w \phi = 334960 \times 10^3 \times 0.09$$

$$= 30 \times 10^6\ Jm^{-3}$$

This is the amount of heat which must be added, or removed, from a cubic metre of formation to change the state of all the porewater/ice.

B.4 Use of Temperature Tables

Tables in Appendices E and F may not be used directly in this case because interpolation will be required to accommodate a source temperature of $20^{o}C$ and, below the permafrost base, a τ_o of 219. Temperatures may be derived from tables in the first part of Appendix E for various radii using (4-1) and (4-2); or in the latter part of Appendix E, for the source region only using (4-4). Following the second approach, the tables required for the permafrost regime are (30, 10, x, 10-1000) and (30, 30, x, 10-1000) where x is -.01, -5, and -10, and where 10-1000 is the range of values found on a single table. Interpolation will not be needed for a τ_o of 301 as this is close to the tabulated value of 300 within this range. A simple linear interpolation between these tables is employed for the particular problem for source temperature $20^{o}C$ and for intermediate geotherms -7.5^{o} and $-2.5^{o}C$. Because the two-phase problem is inherently non-linear, interpolation must be understood to be done from necessity and is not justified mathematically.

Below the permafrost base, only one table is needed from the latter part of Appendix E: (0, 1, 0, 3-1000). For this single phase case, temperatures for other source temperatures or initial temperatures can be generated by superposition. For a geotherm of +5° and a 20°C source, entries in the above temperature table are multiplied by 15 and 5°C is added. Finally, a simple interpolation provides temperatures for a τ_o of 219.

The profiles resulting from these calculations are shown in Figure 5, for N = 0.1, 0.5, 1, and 5 (Equation (4-4)), corresponding to real times of 5.4, 27, 54, and 270 days after cessation of drilling.

The depth scale for the graph is obtained from the heat conduction equation (A-3), the surface temperature and the estimated terrestrial heat flux for the area. If we assume the latter to be about 0.07 Wm^{-2}, the depth ΔZ from the surface to the permafrost base can be calculated using the conductivity

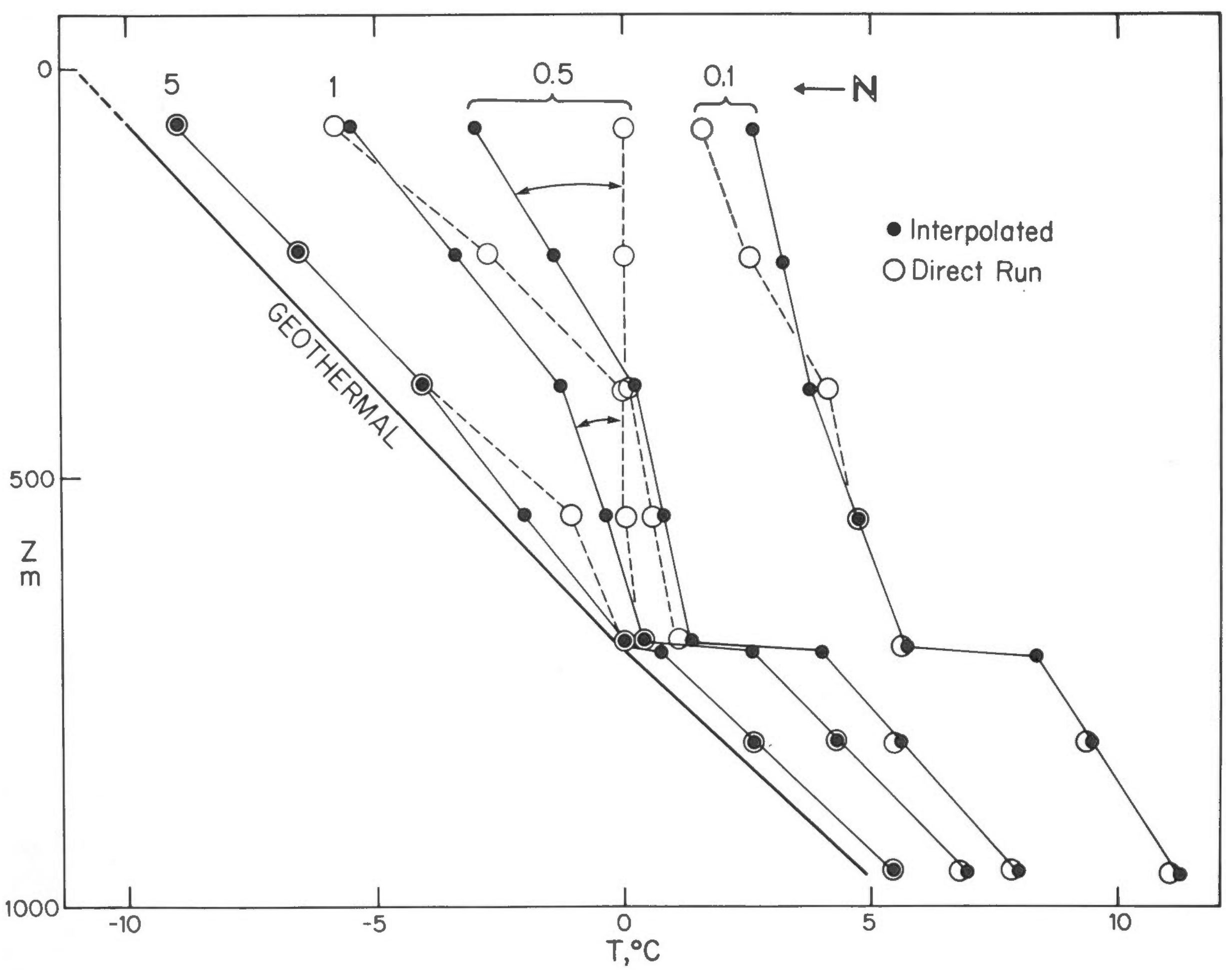

FIGURE 5.

Temperature profiles with depth derived from the tables for the petroleum exploration well simulated in Appendix B. N represents time in fractions of the drilling period following cessation of drilling. Temperatures interpolated from the tables are compared with those calculated directly by the computer program.

of frozen sandstone:

$$\omega = k_f \nabla T = k_f \frac{\Delta T}{\Delta Z}$$

$$\Delta Z = \frac{k_f}{\omega} \Delta T = \frac{4.4 \times 11}{0.07} = 691 \text{ m} \qquad \text{(A-3)}$$

The depth of the -10^o and -5^o geotherms can be calculated similarly. The depth of the $+5^o$ geotherm can be found from the unfrozen conductivity,

$$\Delta Z = 691 + \frac{3.84 \times 5}{0.07} = 965 \text{ m}$$

To compare with the interpolated values, temperatures were calculated directly by the computer program and plotted in Figure 5. The difference of the results at any one time illustrates the error that may arise from interpolating. As discussed in section A.6, the absolute errors in any table are quite small but simple interpolation between tables is not justified because of the non-linearity of the two-phase case. Interpolation errors, when expressed as a percent of the source-initial temperature difference, are generally smaller than 15% but may be large enough in magnitude to cast a different, and incorrect, interpretation on the results. This arises usually when interpolating near the phase boundary, when endpoints are on either side of the phase curve, or one point is at 0^oC. In Figure 5, the interpolated curve for N = 0.5 at the 10^oC geotherm is only 10% of the source-geothermal difference below the directly calculated temperature. However, the upper part of this profile suggests that freezing is complete when in fact it is not.

Only minor errors are encountered in superposition of solutions in normally unfrozen formation. Use of tables with geotherms of -0.01^o and 0^o (unfrozen) give an accurate indication of the response across the phase boundary.

B.5 Use of Heat Flow Tables

Tabulated heat flux values are normalized for a source of radius one metre and a formation conductivity of one $Wm^{-1}K^{-1}$, and thus cannot normally be used directly (see section 4). Continuing the same example, the radial heat flow will be calculated at several depths.

The heat flow tables are found in Appendix F. Interpolations must be done from these tables after the radius and conductivity factors are applied. Entries 'A' and 'B' beside each value in the tables denote the phase of the material into which the heat flux from the source is being conducted, 'A' referring to formation in its original state, and 'B' denoting medium which has changed phase.

In this example, below the permafrost the formation is always in its original, unfrozen state ('A') and the radial heat flow is obtained using the unfrozen conductivity and (4-6) with tables (0, 1, 0, 100) and (0, 1, 0, 300):

$$\omega(.17 \text{ m}, 3.84 \text{ Wm}^{-1}\text{K}^{-1})$$
$$= (\text{tabulated value}) \times \frac{3.84}{0.17} \text{ Wm}^{-2}$$

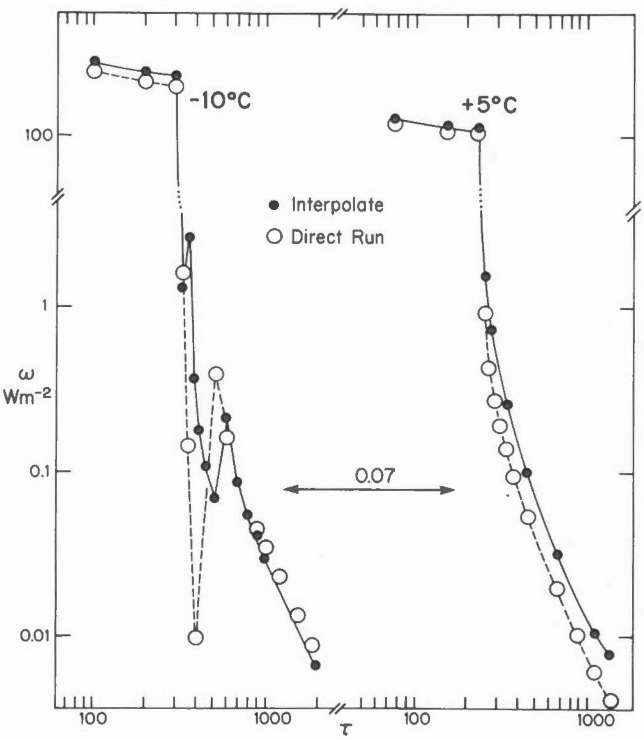

FIGURE 6.

Radial heat flux derived from the tables and compared with directly computed values for the petroleum well simulated in Appendix B. The geotherms -10^oC and 5^oC correspond to depths (Fig. 5). A typical terrestrial heat flow of 0.07 Wm^{-2} is shown for comparison.

This is the heat flow leaving the wellbore, for a source of 1^{o} and a geothermal of $0^{o}C$. For this example, the source-geothermal difference is 15^{o} and the heat flow above must be multiplied by 15. Thence a linear interpolation may be done to obtain heat flow values corresponding to $\tau_{o} = 219$.

Within the permafrost, table (30, 10, -10, 300) indicates that the wellbore is surrounded by some formation that has melted ('B' indicating a changed state) until after τ = 330; hence the heat flow to that time is, using (4-7),

$$\omega(.17\ m,\ 3.84\ Wm^{-1}K^{-1})$$

$$= (\text{tabulated value}) \times \frac{3.84}{0.17}\ Wm^{-2}$$

for a source of 10^{o}. After that time the formation has refrozen completely (the 'A' indicating the frozen, original state) and the heat flow is obtained from (4-6) using a conductivity of 4.40 $Wm^{-1}K^{-1}$. The values desired for a source of 20^{o} are estimated through interpolating these and similar results obtained from (30, 30, -10, 300).

If the interpolated heat flow for geotherms -10^{o} and $+5^{o}C$ are plotted, profiles as in Figure 6 result. Comparing the heat flows computed directly shows that the departure from data interpolated from tables is greatest for low heat flow values and that interpolated values do not accurately reflect the behaviour when temperatures approach an isothermal during freezeback. The magnitude of the terrestrial heat flux is shown for comparison.

APPENDIX C. TABLES OF TEMPERATURE VERSUS TIME FOR A SUSTAINED SOURCE

Consider a homogeneous medium at constant initial temperature, bounded internally by a cylinder of radius r_o and constant temperature at time t greater than zero. The thermal conductivity, specific heat and density of the medium are k_A, c_A and ρ_A respectively, where the subscript A denotes the phase of the medium in its undisturbed state.

For a system not undergoing a phase change, the initial temperature is 0^oC. For a system that will experience a phase change, cases are presented for initial temperatures of -0.01^o, -5^o , and -10^oC, and the phase change is assumed to occur at 0^oC. In all cases, the medium is initially in state A, compatible with the initial temperature, and the corresponding values k_A, c_A and ρ_A are used to calculate dimensionless time τ for all times. The latent heat density, L, is the heat required per cubic metre of medium to complete the change of state. It is defined (A-18) from the latent heat Λ (J kg^{-1}) and density ρw of pore saturant which occupies a fraction ϕ of the total volume.

Parameters:

$$\alpha_A = \frac{k_A}{c_A\rho_A} \qquad (m^2s)$$

$$\tau = \frac{\alpha_A t}{r_o^2}$$

$$R = \frac{r}{r_o}$$

$$L = \Lambda\rho_w\phi \qquad (Jm^{-3})$$

where r is the radial position within the medium from the center of the source cylinder.

The tables present temperatures in degrees Celsius within the medium at various values of dimensionless radii R and time τ. Index blocks along the lower edge of each table identify the parametric values used: latent heat density (MJ/m^3), source and initial temperatures (^oC).

TEMPERATURES IN RADIAL HEAT FLOW
****

TAU	R = 1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
.05	1.000	.717	.482	.302	.175	.094	.046	.021	.008	.003	.001	.000	.000	.000	.000	.000
.06	1.000	.739	.517	.342	.213	.124	.067	.034	.016	.007	.003	.001	.000	.000	.000	.000
.07	1.000	.755	.545	.375	.245	.152	.089	.049	.025	.012	.006	.003	.001	.000	.000	.000
.08	1.000	.766	.565	.399	.270	.174	.106	.062	.034	.017	.009	.004	.002	.001	.000	.000
.09	1.000	.778	.585	.424	.295	.197	.126	.077	.044	.024	.014	.007	.003	.002	.001	.000
.1	1.000	.787	.601	.445	.317	.218	.145	.092	.056	.032	.019	.010	.005	.003	.001	.001
.2	1.000	.837	.691	.563	.451	.355	.275	.209	.156	.113	.082	.058	.040	.027	.018	.011
.3	1.000	.860	.733	.620	.519	.430	.353	.286	.229	.180	.142	.110	.083	.063	.047	.034
.4	1.000	.873	.758	.655	.562	.479	.405	.339	.282	.232	.190	.155	.124	.098	.078	.060
.5	1.000	.883	.776	.680	.593	.514	.443	.380	.324	.273	.230	.193	.159	.131	.107	.086
.6	1.000	.890	.789	.698	.615	.540	.472	.411	.356	.306	.263	.224	.189	.159	.133	.110
.7	1.000	.895	.800	.713	.634	.561	.496	.436	.382	.333	.290	.250	.215	.184	.156	.131
.8	1.000	.899	.808	.724	.648	.579	.515	.457	.404	.356	.312	.273	.237	.205	.176	.150
.9	1.000	.903	.815	.734	.661	.593	.531	.474	.422	.375	.332	.292	.256	.223	.194	.167
1	1.000	.906	.821	.742	.671	.605	.545	.489	.438	.391	.348	.309	.272	.239	.209	.181

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
0	1	0	---

TEMPERATURES IN RADIAL HEAT FLOW

R

TAU	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
1	1.000	.907	.822	.745	.673	.607	.549	.494	.443	.394	.353	.317	.283	.250	.218	.188
2	1.000	.924	.855	.791	.732	.678	.628	.581	.537	.496	.458	.424	.392	.360	.331	.302
3	1.000	.932	.870	.813	.760	.711	.666	.623	.584	.546	.511	.479	.448	.419	.391	.364
4	1.000	.937	.879	.826	.777	.732	.690	.650	.613	.578	.545	.515	.486	.458	.432	.406
5	1.000	.940	.886	.836	.789	.746	.706	.669	.634	.600	.569	.540	.512	.485	.460	.435
6	1.000	.943	.891	.843	.798	.757	.719	.683	.649	.617	.587	.559	.532	.506	.482	.458
7	1.000	.945	.895	.848	.806	.766	.729	.694	.662	.631	.602	.574	.548	.523	.499	.477
8	1.000	.947	.898	.853	.812	.773	.737	.703	.672	.642	.613	.587	.561	.537	.514	.492
9	1.000	.948	.901	.857	.817	.779	.744	.711	.680	.651	.623	.597	.572	.549	.526	.504
10	1.000	.949	.903	.860	.821	.784	.750	.718	.688	.659	.632	.607	.582	.559	.537	.516
20	1.000	.956	.916	.879	.845	.813	.784	.756	.730	.705	.681	.659	.638	.618	.598	.580
30	1.000	.959	.922	.888	.857	.828	.800	.774	.750	.727	.705	.685	.665	.646	.628	.611
40	1.000	.962	.926	.894	.864	.837	.811	.786	.763	.741	.721	.701	.682	.665	.647	.631
50	1.000	.963	.929	.898	.870	.843	.818	.794	.772	.751	.732	.713	.695	.678	.661	.645
60	1.000	.964	.932	.901	.874	.848	.824	.801	.779	.759	.740	.722	.704	.688	.672	.656
70	1.000	.965	.933	.904	.877	.852	.828	.806	.785	.765	.747	.729	.712	.696	.680	.665
80	1.000	.966	.935	.906	.880	.855	.832	.810	.790	.770	.752	.735	.718	.702	.687	.672
90	1.000	.967	.936	.908	.882	.858	.835	.814	.794	.775	.757	.740	.723	.708	.693	.679
100	1.000	.967	.937	.909	.884	.860	.838	.817	.797	.779	.761	.744	.728	.713	.698	.684
200	1.000	.970	.943	.919	.896	.874	.854	.835	.818	.801	.785	.770	.755	.742	.728	.716
300	1.000	.972	.947	.923	.901	.881	.862	.845	.828	.812	.797	.783	.769	.756	.744	.732
400	1.000	.973	.949	.926	.905	.886	.868	.851	.834	.819	.805	.791	.778	.765	.753	.742
500	1.000	.974	.950	.928	.908	.889	.871	.855	.839	.824	.810	.797	.784	.772	.761	.749
600	1.000	.975	.951	.930	.910	.892	.874	.858	.843	.829	.815	.802	.789	.778	.766	.755
700	1.000	.975	.952	.931	.912	.894	.877	.861	.846	.832	.818	.806	.793	.782	.771	.760
800	1.000	.975	.953	.932	.913	.896	.879	.863	.849	.835	.821	.809	.797	.785	.774	.764
900	1.000	.976	.954	.933	.915	.897	.881	.865	.851	.837	.824	.812	.800	.789	.778	.767
1000	1.000	.976	.954	.934	.916	.898	.882	.867	.853	.839	.826	.814	.802	.791	.781	.770

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
0	1	0	---

TEMPERATURES IN RADIAL HEAT FLOW

TAU	R 1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
1	1.000	.353	.101	.022	.005	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
2	1.000	.458	.197	.074	.026	.008	.002	.001	.000	.000	.000	.000	.000	.000	.000	.000
3	1.000	.511	.258	.121	.054	.021	.007	.003	.001	.000	.000	.000	.000	.000	.000	.000
4	1.000	.545	.302	.159	.081	.038	.016	.007	.003	.001	.001	.000	.000	.000	.000	.000
5	1.000	.569	.334	.190	.105	.054	.025	.013	.006	.003	.001	.000	.000	.000	.000	.000
6	1.000	.587	.358	.215	.126	.070	.036	.020	.010	.005	.003	.001	.000	.000	.000	.000
7	1.000	.602	.379	.237	.145	.086	.047	.027	.014	.007	.004	.002	.001	.001	.000	.000
8	1.000	.613	.396	.255	.162	.100	.057	.035	.019	.010	.006	.003	.002	.001	.001	.000
9	1.000	.623	.411	.271	.177	.112	.068	.043	.024	.014	.009	.004	.002	.002	.001	.000
10	1.000	.632	.423	.285	.191	.125	.078	.050	.029	.018	.011	.005	.003	.002	.001	.000
20	1.000	.681	.498	.372	.279	.209	.154	.115	.082	.060	.043	.028	.021	.015	.010	.006
30	1.000	.705	.535	.416	.327	.258	.202	.160	.123	.096	.074	.055	.042	.033	.024	.016
40	1.000	.721	.558	.445	.359	.291	.236	.192	.155	.125	.101	.078	.063	.051	.039	.029
50	1.000	.732	.575	.466	.382	.316	.262	.217	.179	.149	.123	.099	.082	.067	.054	.042
60	1.000	.740	.588	.482	.400	.336	.282	.238	.200	.168	.142	.117	.099	.083	.068	.054
70	1.000	.747	.599	.495	.415	.351	.298	.255	.217	.185	.158	.133	.113	.096	.080	.066
80	1.000	.752	.608	.506	.428	.365	.312	.269	.231	.199	.172	.146	.126	.109	.092	.077
90	1.000	.757	.615	.515	.438	.376	.325	.281	.244	.212	.184	.159	.138	.120	.103	.087
100	1.000	.761	.621	.523	.447	.386	.335	.292	.255	.223	.195	.170	.149	.130	.113	.097
200	1.000	.785	.659	.570	.502	.446	.399	.359	.324	.293	.265	.240	.218	.199	.180	.163
300	1.000	.797	.678	.594	.529	.476	.432	.393	.360	.330	.303	.279	.257	.238	.219	.202
400	1.000	.805	.691	.610	.547	.496	.453	.416	.383	.355	.329	.305	.284	.264	.246	.229
500	1.000	.810	.700	.621	.560	.511	.469	.433	.401	.373	.347	.324	.303	.284	.266	.249
600	1.000	.815	.707	.630	.570	.522	.481	.446	.415	.387	.362	.339	.319	.300	.282	.266
700	1.000	.818	.712	.637	.579	.531	.491	.456	.426	.398	.374	.352	.331	.313	.295	.279
800	1.000	.821	.717	.643	.586	.539	.499	.465	.435	.408	.384	.362	.342	.323	.306	.290
900	1.000	.824	.721	.648	.592	.545	.506	.473	.443	.417	.393	.371	.351	.333	.316	.300
1000	1.000	.826	.725	.653	.597	.551	.513	.479	.450	.424	.400	.379	.359	.341	.324	.308

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
0	1	0	---

TEMPERATURES IN RADIAL HEAT FLOW
****

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R = 1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
1	10.00	8.55	7.23	6.02	4.90	3.85	2.88	1.98	1.12	.31	-.00	-.00	-.00	-.00	-.00	-.00
2	10.00	8.82	7.76	6.80	5.91	5.08	4.38	3.72	3.11	2.52	1.87	1.18	.52	-.00	-.00	-.00
3	10.00	8.96	8.02	7.15	6.34	5.60	4.90	4.25	3.63	3.05	2.52	2.03	1.57	1.13	.71	.30
4	10.00	8.97	8.03	7.17	6.37	5.62	4.93	4.27	3.66	3.08	2.63	2.29	1.97	1.66	1.37	1.08
5	10.00	9.10	8.28	7.53	6.84	6.20	5.62	5.07	4.56	4.08	3.64	3.25	2.88	2.52	2.18	1.85
6	10.00	9.17	8.42	7.72	7.08	6.48	5.93	5.41	4.92	4.46	4.03	3.62	3.23	2.87	2.51	2.17
7	10.00	9.19	8.45	7.77	7.15	6.56	6.02	5.50	5.02	4.56	4.13	3.72	3.33	2.96	2.61	2.26
8	10.00	9.20	8.46	7.79	7.16	6.58	6.04	5.53	5.05	4.59	4.16	3.75	3.36	2.99	2.63	2.29
9	10.00	9.20	8.47	7.79	7.17	6.59	6.05	5.54	5.05	4.60	4.17	3.76	3.37	2.99	2.64	2.29
10	10.00	9.21	8.49	7.83	7.22	6.65	6.12	5.63	5.17	4.73	4.33	3.96	3.61	3.27	2.94	2.63
20	10.00	9.34	8.74	8.19	7.68	7.21	6.76	6.34	5.95	5.58	5.22	4.89	4.57	4.26	3.97	3.69
30	10.00	9.44	8.92	8.45	8.01	7.60	7.22	6.86	6.53	6.21	5.91	5.62	5.34	5.08	4.83	4.59
40	10.00	9.44	8.94	8.47	8.04	7.63	7.26	6.90	6.57	6.25	5.95	5.67	5.40	5.14	4.89	4.65
50	10.00	9.49	9.02	8.59	8.19	7.81	7.47	7.14	6.84	6.55	6.27	6.01	5.76	5.53	5.30	5.08
60	10.00	9.51	9.07	8.66	8.28	7.92	7.59	7.28	6.99	6.71	6.45	6.20	5.96	5.74	5.52	5.31
70	10.00	9.52	9.08	8.67	8.29	7.94	7.62	7.31	7.02	6.75	6.49	6.24	6.00	5.78	5.56	5.35
80	10.00	9.52	9.08	8.67	8.30	7.95	7.62	7.31	7.02	6.75	6.49	6.24	6.01	5.78	5.57	5.36
90	10.00	9.53	9.09	8.69	8.33	7.98	7.66	7.36	7.08	6.81	6.56	6.32	6.09	5.87	5.66	5.45
100	10.00	9.55	9.14	8.77	8.42	8.10	7.79	7.51	7.24	6.99	6.75	6.52	6.30	6.10	5.90	5.71
200	10.00	9.61	9.25	8.92	8.61	8.33	8.06	7.81	7.58	7.35	7.14	6.94	6.75	6.57	6.39	6.22
300	10.00	9.62	9.27	8.95	8.65	8.38	8.12	7.88	7.65	7.43	7.23	7.03	6.85	6.67	6.50	6.34
400	10.00	9.65	9.33	9.04	8.76	8.51	8.27	8.05	7.84	7.64	7.45	7.27	7.10	6.94	6.78	6.63
500	10.00	9.65	9.34	9.05	8.78	8.53	8.30	8.08	7.87	7.68	7.49	7.31	7.14	6.98	6.83	6.68
600	10.00	9.66	9.34	9.05	8.78	8.53	8.30	8.08	7.87	7.68	7.49	7.32	7.15	6.99	6.83	6.68
700	10.00	9.68	9.38	9.11	8.86	8.62	8.40	8.20	8.00	7.82	7.65	7.48	7.32	7.17	7.03	6.89
800	10.00	9.68	9.39	9.13	8.88	8.65	8.44	8.24	8.05	7.87	7.70	7.53	7.38	7.23	7.09	6.95
900	10.00	9.68	9.40	9.13	8.89	8.66	8.44	8.24	8.06	7.88	7.71	7.55	7.39	7.24	7.10	6.97
1000	10.00	9.68	9.40	9.13	8.89	8.66	8.45	8.25	8.06	7.88	7.71	7.55	7.39	7.25	7.11	6.97

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-.01	---

TEMPERATURES IN RADIAL HEAT FLOW
****

LATENT HEAT DENSITY, 30 MJ/M^3

R

TAU	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
1	10.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
2	10.00	1.87	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
3	10.00	2.52	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
4	10.00	2.63	.10	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
5	10.00	3.64	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
6	10.00	4.03	.44	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
7	10.00	4.13	.81	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
8	10.00	4.16	1.04	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
9	10.00	4.17	1.18	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
10	10.00	4.33	1.48	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
20	10.00	5.22	2.43	.87	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
30	10.00	5.91	3.53	1.86	.52	-.00	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
40	10.00	5.95	3.59	1.91	.87	.11	-.00	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01
50	10.00	6.27	4.13	2.67	1.61	.59	-.00	-.00	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01
60	10.00	6.45	4.38	2.93	1.81	.87	.03	-.00	-.00	-.00	-.00	-.01	-.01	-.01	-.01	-.01
70	10.00	6.49	4.43	2.97	1.85	.98	.32	-.00	-.00	-.00	-.00	-.01	-.01	-.01	-.01	-.01
80	10.00	6.49	4.44	2.98	1.85	1.04	.48	-.00	-.00	-.00	-.00	-.00	-.01	-.01	-.01	-.01
90	10.00	6.56	4.57	3.19	2.19	1.44	.86	.18	-.00	-.00	-.00	-.00	-.00	-.01	-.01	-.01
100	10.00	6.75	4.86	3.55	2.56	1.78	1.14	.40	-.00	-.00	-.00	-.00	-.00	-.00	-.01	-.01
200	10.00	7.14	5.48	4.30	3.40	2.67	2.07	1.56	1.11	.62	.12	-.00	-.00	-.00	-.00	-.00
300	10.00	7.23	5.61	4.46	3.56	2.83	2.22	1.68	1.21	.87	.59	.34	.11	-.00	-.00	-.00
400	10.00	7.45	5.97	4.91	4.10	3.43	2.87	2.40	1.97	1.60	1.27	.96	.62	.30	-.00	-.00
500	10.00	7.49	6.02	4.98	4.17	3.51	2.95	2.47	2.04	1.66	1.32	1.00	.75	.52	.31	.11
600	10.00	7.49	6.03	4.98	4.18	3.52	2.97	2.49	2.07	1.71	1.38	1.09	.85	.64	.45	.27
700	10.00	7.65	6.27	5.29	4.54	3.93	3.41	2.97	2.58	2.24	1.93	1.65	1.40	1.17	.96	.74
800	10.00	7.70	6.35	5.39	4.65	4.05	3.54	3.10	2.71	2.36	2.05	1.76	1.50	1.26	1.03	.82
900	10.00	7.71	6.36	5.41	4.68	4.07	3.56	3.12	2.73	2.38	2.07	1.78	1.52	1.27	1.05	.84
1000	10.00	7.71	6.37	5.42	4.68	4.08	3.57	3.13	2.74	2.39	2.07	1.79	1.52	1.28	1.05	.84

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-.01	---

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
1	10.00	8.07	6.38	4.89	3.51	2.22	1.02	-.05	-.57	-1.06	-1.48	-1.86	-2.22	-2.56	-2.88	-3.20
2	10.00	8.56	7.25	6.05	4.93	3.88	2.70	1.58	.53	-.15	-.45	-.74	-1.01	-1.27	-1.52	-1.76
3	10.00	8.57	7.26	6.05	4.94	3.91	3.21	2.55	1.93	1.34	.78	.25	-.22	-.63	-1.02	-1.40
4	10.00	8.82	7.75	6.77	5.87	5.02	4.17	3.37	2.62	1.91	1.24	.59	-.00	-.16	-.30	-.44
5	10.00	8.95	7.99	7.11	6.30	5.54	4.85	4.19	3.58	2.99	2.19	1.23	.31	-.13	-.32	-.51
6	10.00	8.97	8.03	7.17	6.37	5.62	4.92	4.27	3.65	3.07	2.41	1.70	1.02	.38	-.08	-.27
7	10.00	8.97	8.03	7.17	6.37	5.63	4.93	4.27	3.66	3.07	2.51	1.97	1.45	.95	.48	.03
8	10.00	8.97	8.03	7.17	6.37	5.63	4.93	4.27	3.66	3.07	2.57	2.12	1.70	1.29	.91	.53
9	10.00	8.97	8.03	7.17	6.37	5.63	4.93	4.27	3.66	3.07	2.61	2.23	1.87	1.52	1.19	.87
10	10.00	9.01	8.10	7.27	6.51	5.79	5.15	4.54	3.97	3.42	2.96	2.55	2.17	1.80	1.45	1.11
20	10.00	9.20	8.47	7.79	7.17	6.59	6.05	5.54	5.06	4.60	4.17	3.76	3.37	3.00	2.64	2.30
30	10.00	9.29	8.64	8.05	7.50	6.98	6.50	6.06	5.63	5.23	4.86	4.50	4.16	3.84	3.53	3.23
40	10.00	9.34	8.74	8.19	7.68	7.20	6.76	6.34	5.95	5.58	5.22	4.89	4.57	4.26	3.97	3.68
50	10.00	9.34	8.74	8.19	7.68	7.21	6.76	6.34	5.95	5.58	5.22	4.89	4.57	4.26	3.97	3.69
60	10.00	9.34	8.74	8.19	7.68	7.21	6.76	6.34	5.95	5.58	5.22	4.89	4.57	4.26	3.97	3.69
70	10.00	9.40	8.84	8.34	7.87	7.43	7.02	6.64	6.28	5.94	5.61	5.31	5.01	4.74	4.47	4.21
80	10.00	9.43	8.90	8.42	7.98	7.56	7.17	6.81	6.47	6.14	5.83	5.54	5.26	5.00	4.74	4.50
90	10.00	9.44	8.93	8.47	8.03	7.63	7.25	6.90	6.56	6.25	5.95	5.66	5.39	5.13	4.88	4.64
100	10.00	9.44	8.94	8.47	8.04	7.63	7.26	6.90	6.57	6.25	5.96	5.67	5.40	5.14	4.89	4.65
200	10.00	9.51	9.07	8.66	8.29	7.93	7.61	7.30	7.01	6.73	6.47	6.22	5.98	5.76	5.54	5.33
300	10.00	9.52	9.08	8.67	8.30	7.95	7.62	7.32	7.03	6.75	6.49	6.25	6.01	5.79	5.57	5.36
400	10.00	9.56	9.15	8.78	8.44	8.12	7.82	7.54	7.27	7.02	6.78	6.55	6.34	6.13	5.94	5.75
500	10.00	9.57	9.19	8.83	8.50	8.19	7.90	7.63	7.37	7.13	6.90	6.69	6.48	6.28	6.09	5.91
600	10.00	9.57	9.19	8.83	8.50	8.19	7.90	7.63	7.37	7.13	6.90	6.69	6.48	6.28	6.09	5.91
700	10.00	9.57	9.19	8.83	8.50	8.19	7.90	7.63	7.37	7.13	6.90	6.69	6.48	6.28	6.09	5.91
800	10.00	9.59	9.22	8.87	8.55	8.26	7.98	7.72	7.47	7.24	7.02	6.81	6.61	6.42	6.24	6.06
900	10.00	9.61	9.25	8.91	8.61	8.32	8.05	7.80	7.57	7.34	7.13	6.93	6.74	6.55	6.38	6.21
1000	10.00	9.61	9.26	8.94	8.63	8.36	8.09	7.85	7.62	7.40	7.19	6.99	6.80	6.62	6.45	6.28

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-5.0	---

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

R

TAU	1.0	3.0	4.0	5.0	7.0	10.0	12.0	15.0	20.0	25.0	30.0	40.0	50.0	60.0	70.0	100.0
1	10.00	-4.03	-4.78	-4.95	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
2	10.00	-2.87	-4.21	-4.72	-4.98	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
3	10.00	-2.42	-3.75	-4.44	-4.92	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
4	10.00	-1.70	-3.34	-4.17	-4.84	-4.99	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
5	10.00	-1.34	-2.88	-3.87	-4.73	-4.97	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
6	10.00	-1.11	-2.59	-3.61	-4.62	-4.95	-4.99	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
7	10.00	-.93	-2.40	-3.40	-4.49	-4.92	-4.98	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
8	10.00	-.76	-2.27	-3.24	-4.37	-4.89	-4.97	-4.99	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
9	10.00	-.55	-2.16	-3.11	-4.26	-4.85	-4.96	-4.99	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
10	10.00	-.36	-2.01	-2.99	-4.16	-4.81	-4.94	-4.99	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
20	10.00	.84	-.87	-1.87	-3.25	-4.33	-4.69	-4.89	-4.99	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
30	10.00	1.75	-.17	-1.14	-2.72	-3.93	-4.39	-4.74	-4.95	-4.99	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
40	10.00	2.43	-.07	-.82	-2.18	-3.54	-4.10	-4.56	-4.89	-4.97	-4.99	-5.00	-5.00	-5.00	-5.00	-5.00
50	10.00	2.43	.52	-.61	-1.97	-3.26	-3.84	-4.38	-4.81	-4.94	-4.98	-5.00	-5.00	-5.00	-5.00	-5.00
60	10.00	2.43	.85	-.31	-1.83	-3.07	-3.65	-4.22	-4.72	-4.90	-4.97	-5.00	-5.00	-5.00	-5.00	-5.00
70	10.00	3.08	1.23	-.11	-1.48	-2.87	-3.48	-4.08	-4.63	-4.86	-4.95	-4.99	-5.00	-5.00	-5.00	-5.00
80	10.00	3.42	1.40	-.01	-1.12	-2.62	-3.28	-3.93	-4.55	-4.81	-4.92	-4.99	-5.00	-5.00	-5.00	-5.00
90	10.00	3.58	1.90	-.03	-1.01	-2.41	-3.09	-3.78	-4.46	-4.76	-4.90	-4.98	-5.00	-5.00	-5.00	-5.00
100	10.00	3.59	1.91	.26	-.94	-2.28	-2.94	-3.65	-4.37	-4.71	-4.87	-4.98	-5.00	-5.00	-5.00	-5.00
200	10.00	4.41	2.95	1.83	-.27	-1.28	-1.98	-2.78	-3.67	-4.20	-4.53	-4.85	-4.96	-4.99	-5.00	-5.00
300	10.00	4.44	2.99	1.86	.37	-1.05	-1.64	-2.34	-3.20	-3.79	-4.26	-4.67	-4.87	-4.96	-4.98	-5.00
400	10.00	4.90	3.57	2.54	.82	-.45	-1.14	-1.93	-2.87	-3.50	-3.94	-4.49	-4.77	-4.91	-4.96	-5.00
500	10.00	5.09	3.81	2.81	1.31	-.41	-.85	-1.59	-2.53	-3.20	-3.69	-4.32	-4.66	-4.85	-4.92	-5.00
600	10.00	5.09	3.81	2.81	1.31	-.23	-.78	-1.47	-2.35	-3.00	-3.49	-4.16	-4.55	-4.78	-4.88	-4.99
700	10.00	5.09	3.81	2.81	1.31	.05	-.71	-1.39	-2.23	-2.86	-3.34	-4.02	-4.44	-4.70	-4.83	-4.98
800	10.00	5.28	4.05	3.10	1.68	.24	-.45	-1.19	-2.10	-2.74	-3.22	-3.91	-4.34	-4.63	-4.78	-4.97
900	10.00	5.45	4.26	3.34	1.96	.28	-.19	-.92	-1.87	-2.55	-3.07	-3.80	-4.25	-4.56	-4.73	-4.96
1000	10.00	5.54	4.38	3.48	2.12	.30	-.03	-.73	-1.69	-2.39	-2.92	-3.68	-4.16	-4.49	-4.68	-4.95

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	10	-5.0	---

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
1	10.00	7.63	5.38	3.23	1.23	-.30	-1.13	-1.91	-2.65	-3.35	-3.99	-4.59	-5.16	-5.70	-6.22	-6.72
2	10.00	8.22	6.57	5.03	3.61	2.29	1.05	-.07	-.75	-1.39	-2.02	-2.65	-3.25	-3.82	-4.37	-4.89
3	10.00	8.46	6.89	5.28	3.79	2.40	1.10	-.01	-.12	-.22	-.62	-1.24	-1.82	-2.38	-2.92	-3.43
4	10.00	8.57	7.26	6.05	4.94	3.87	2.35	.93	-.14	-.57	-.98	-1.36	-1.73	-2.09	-2.42	-2.75
5	10.00	8.57	7.26	6.05	4.94	3.90	2.89	1.95	1.06	.22	-.35	-.81	-1.25	-1.67	-2.07	-2.45
6	10.00	8.57	7.26	6.05	4.94	3.91	3.16	2.46	1.80	1.18	.59	.02	-.58	-1.16	-1.71	-2.24
7	10.00	8.67	7.46	6.36	5.33	4.39	3.64	2.95	2.29	1.67	1.08	.52	-.02	-.65	-1.26	-1.84
8	10.00	8.78	7.66	6.64	5.78	4.81	4.00	3.24	2.51	1.83	1.19	.57	-.01	-.45	-.88	-1.28
9	10.00	8.83	7.76	6.78	5.88	5.03	4.18	3.38	2.63	1.91	1.24	.59	-.01	-.32	-.62	-.91
10	10.00	8.87	7.83	6.88	6.00	5.18	4.30	3.48	2.71	1.97	1.28	.61	-.01	-.22	-.43	-.63
20	10.00	8.97	8.03	7.17	6.37	5.63	4.93	4.27	3.66	3.07	2.56	2.09	1.65	1.22	.81	.42
30	10.00	9.10	8.29	7.53	6.84	6.19	5.58	5.01	4.48	3.97	3.48	3.00	2.55	2.12	1.70	1.30
40	10.00	9.16	8.39	7.68	7.03	6.42	5.85	5.32	4.81	4.34	3.83	3.30	2.80	2.33	1.87	1.43
50	10.00	9.20	8.47	7.79	7.17	6.59	6.05	5.54	5.05	4.60	4.17	3.76	3.37	2.99	2.64	2.29
60	10.00	9.20	8.47	7.79	7.17	6.59	6.05	5.54	5.06	4.60	4.17	3.76	3.37	3.00	2.64	2.30
70	10.00	9.20	8.47	7.79	7.17	6.59	6.05	5.54	5.06	4.60	4.17	3.76	3.37	3.00	2.64	2.30
80	10.00	9.24	8.55	7.91	7.32	6.78	6.26	5.78	5.33	4.90	4.49	4.11	3.74	3.39	3.05	2.73
90	10.00	9.27	8.60	7.99	7.42	6.89	6.39	5.93	5.49	5.07	4.68	4.31	3.95	3.61	3.29	2.97
100	10.00	9.28	8.63	8.03	7.47	6.95	6.47	6.01	5.58	5.18	4.79	4.43	4.08	3.75	3.43	3.12
200	10.00	9.34	8.74	8.19	7.68	7.21	6.76	6.34	5.95	5.58	5.22	4.89	4.57	4.26	3.97	3.69
300	10.00	9.40	8.85	8.34	7.87	7.43	7.02	6.64	6.28	5.93	5.61	5.30	5.01	4.72	4.46	4.20
400	10.00	9.42	8.89	8.40	7.95	7.53	7.14	6.77	6.42	6.09	5.78	5.48	5.20	4.93	4.67	4.42
500	10.00	9.44	8.92	8.45	8.01	7.60	7.22	6.86	6.52	6.20	5.90	5.61	5.34	5.07	4.82	4.58
600	10.00	9.44	8.94	8.47	8.04	7.63	7.26	6.90	6.57	6.26	5.96	5.67	5.40	5.14	4.89	4.65
700	10.00	9.46	8.96	8.50	8.08	7.69	7.32	6.97	6.65	6.34	6.04	5.77	5.50	5.25	5.01	4.77
800	10.00	9.47	8.99	8.54	8.13	7.75	7.39	7.06	6.74	6.44	6.15	5.88	5.62	5.38	5.14	4.92
900	10.00	9.48	9.00	8.57	8.16	7.78	7.43	7.10	6.79	6.49	6.21	5.94	5.69	5.45	5.22	4.99
1000	10.00	9.49	9.02	8.58	8.18	7.81	7.46	7.14	6.83	6.54	6.26	6.00	5.74	5.50	5.28	5.05

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	10	-10.0	---

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R: 1.0	3.0	4.0	5.0	7.0	10.0	12.0	15.0	20.0	25.0	30.0	40.0	50.0	60.0	70.0	100.0
1	10.00	-8.25	-9.61	-9.92	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
2	10.00	-6.69	-8.76	-9.56	-9.96	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
3	10.00	-5.40	-7.91	-9.08	-9.87	-9.99	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
4	10.00	-4.58	-7.16	-8.58	-9.73	-9.98	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
5	10.00	-4.16	-6.64	-8.15	-9.56	-9.96	-9.99	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
6	10.00	-3.89	-6.27	-7.80	-9.37	-9.92	-9.98	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
7	10.00	-3.56	-5.95	-7.50	-9.18	-9.87	-9.97	-9.99	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
8	10.00	-3.05	-5.59	-7.21	-9.00	-9.82	-9.95	-9.99	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
9	10.00	-2.65	-5.23	-6.92	-8.82	-9.76	-9.93	-9.99	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
10	10.00	-2.32	-4.91	-6.64	-8.64	-9.69	-9.91	-9.98	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
20	10.00	-1.19	-3.42	-5.02	-7.23	-8.93	-9.50	-9.83	-9.98	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
30	10.00	-.33	-2.45	-4.11	-6.40	-8.30	-9.03	-9.58	-9.92	-9.98	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
40	10.00	-.11	-1.77	-3.39	-5.70	-7.74	-8.59	-9.31	-9.82	-9.95	-9.99	-10.00	-10.00	-10.00	-10.00	-10.00
50	10.00	-.15	-1.52	-2.92	-5.18	-7.28	-8.20	-9.03	-9.70	-9.90	-9.97	-10.00	-10.00	-10.00	-10.00	-10.00
60	10.00	.60	-1.32	-2.72	-4.85	-6.92	-7.86	-8.77	-9.56	-9.84	-9.95	-9.99	-10.00	-10.00	-10.00	-10.00
70	10.00	1.10	-1.04	-2.58	-4.62	-6.64	-7.58	-8.54	-9.42	-9.77	-9.92	-9.99	-10.00	-10.00	-10.00	-10.00
80	10.00	1.47	-.68	-2.30	-4.39	-6.41	-7.35	-8.33	-9.29	-9.70	-9.88	-9.98	-10.00	-10.00	-10.00	-10.00
90	10.00	1.60	-.51	-1.97	-4.10	-6.17	-7.13	-8.14	-9.15	-9.62	-9.84	-9.97	-10.00	-10.00	-10.00	-10.00
100	10.00	1.68	-.39	-1.75	-3.85	-5.94	-6.92	-7.96	-9.02	-9.54	-9.79	-9.96	-9.99	-10.00	-10.00	-10.00
200	10.00	2.43	.52	-.83	-2.70	-4.61	-5.57	-6.68	-7.97	-8.77	-9.27	-9.76	-9.93	-9.99	-9.99	-10.00
300	10.00	3.04	1.21	-.18	-1.99	-3.90	-4.85	-5.96	-7.30	-8.19	-8.79	-9.50	-9.80	-9.94	-9.97	-10.00
400	10.00	3.31	1.35	-.08	-1.54	-3.39	-4.32	-5.43	-6.78	-7.72	-8.39	-9.23	-9.65	-9.87	-9.93	-10.00
500	10.00	3.50	1.45	-.01	-1.22	-3.03	-3.94	-5.03	-6.38	-7.35	-8.65	-8.98	-9.48	-9.77	-9.88	-9.99
600	10.00	3.59	1.91	.58	-1.12	-2.83	-3.70	-4.76	-6.08	-7.04	-7.77	-8.75	-9.32	-9.67	-9.82	-9.99
700	10.00	3.73	2.10	1.02	-.88	-2.68	-3.54	-4.57	-5.86	-6.81	-7.54	-8.55	-9.17	-9.56	-9.75	-9.97
800	10.00	3.90	2.31	1.15	-.67	-2.42	-3.28	-4.33	-5.63	-6.60	-7.33	-8.37	-9.02	-9.45	-9.67	-9.96
900	10.00	4.00	2.43	1.22	-.55	-2.24	-3.10	-4.13	-5.43	-6.40	-7.14	-8.20	-8.89	-9.34	-9.60	-9.94
1000	10.00	4.07	2.52	1.28	-.44	-2.09	-2.94	-3.96	-5.26	-6.22	-6.97	-8.05	-8.76	-9.24	-9.52	-9.92

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	10	-10.0	---

TEMPERATURES IN RADIAL HEAT FLOW
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LATENT HEAT DENSITY, 30 MJ/M^3

R

TAU	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
4	30.00	27.54	25.30	23.24	21.33	19.56	17.91	16.37	14.91	13.53	12.25	11.05	9.90	8.81	7.76	6.76
5	30.00	27.68	25.57	23.63	21.84	20.17	18.65	17.22	15.87	14.60	13.43	12.36	11.34	10.36	9.43	8.53
6	30.00	27.83	25.86	24.05	22.37	20.81	19.37	18.02	16.75	15.55	14.43	13.40	12.41	11.46	10.56	9.69
7	30.00	27.93	26.03	24.30	22.69	21.19	19.80	18.50	17.27	16.10	15.02	13.99	13.02	12.09	11.20	10.34
8	30.00	27.97	26.13	24.43	22.85	21.39	20.03	18.75	17.54	16.40	15.32	14.31	13.34	12.41	11.53	10.68
9	30.00	28.00	26.18	24.51	22.95	21.51	20.17	18.91	17.72	16.59	15.53	14.54	13.59	12.68	11.81	10.97
10	30.00	28.05	26.28	24.65	23.14	21.73	20.43	19.21	18.05	16.96	15.94	14.99	14.08	13.21	12.37	11.58
20	30.00	28.34	26.83	25.44	24.15	22.95	21.84	20.79	19.80	18.86	17.98	17.15	16.35	15.59	14.87	14.17
30	30.00	28.51	27.15	25.90	24.74	23.66	22.65	21.71	20.81	19.97	19.17	18.41	17.69	17.00	16.34	15.70
40	30.00	28.57	27.26	26.06	24.95	23.91	22.95	22.04	21.18	20.37	19.61	18.88	18.19	17.53	16.89	16.29
50	30.00	28.65	27.43	26.30	25.25	24.28	23.37	22.52	21.71	20.95	20.23	19.54	18.89	18.27	17.67	17.10
60	30.00	28.70	27.50	26.41	25.40	24.45	23.57	22.74	21.96	21.22	20.52	19.85	19.22	18.61	18.03	17.47
70	30.00	28.71	27.54	26.46	25.46	24.53	23.66	22.84	22.07	21.34	20.65	19.99	19.36	18.76	18.19	17.64
80	30.00	28.75	27.61	26.56	25.59	24.68	23.84	23.05	22.30	21.59	20.92	20.28	19.68	19.09	18.54	18.01
90	30.00	28.79	27.68	26.67	25.73	24.85	24.03	23.26	22.54	21.85	21.20	20.58	20.00	19.43	18.89	18.38
100	30.00	28.82	27.73	26.74	25.82	24.96	24.16	23.41	22.70	22.03	21.39	20.79	20.21	19.66	19.13	18.62
200	30.00	28.94	27.98	27.09	26.27	25.50	24.79	24.12	23.48	22.88	22.31	21.77	21.26	20.76	20.29	19.84
300	30.00	29.00	28.09	27.26	26.48	25.76	25.08	24.45	23.85	23.29	22.75	22.24	21.75	21.29	20.84	20.42
400	30.00	29.04	28.17	27.37	26.63	25.93	25.29	24.68	24.11	23.56	23.05	22.56	22.09	21.65	21.22	20.81
500	30.00	29.07	28.21	27.43	26.70	26.03	25.40	24.80	24.24	23.71	23.21	22.73	22.28	21.84	21.43	21.03
600	30.00	29.10	28.28	27.53	26.83	26.18	25.57	25.00	24.47	23.96	23.47	23.01	22.58	22.16	21.76	21.37
700	30.00	29.12	28.31	27.58	26.89	26.25	25.66	25.10	24.57	24.07	23.59	23.14	22.71	22.30	21.91	21.53
800	30.00	29.13	28.33	27.59	26.91	26.28	25.69	25.13	24.61	24.11	23.64	23.20	22.77	22.36	21.97	21.60
900	30.00	29.14	28.35	27.63	26.96	26.33	25.75	25.20	24.68	24.20	23.73	23.29	22.87	22.47	22.08	21.71
1000	30.00	29.16	28.39	27.68	27.03	26.42	25.85	25.31	24.81	24.33	23.88	23.45	23.04	22.64	22.27	21.91

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	30	-.01	---

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
1	30.00	5.21	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
2	30.00	8.70	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
3	30.00	11.43	2.11	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
4	30.00	12.25	2.88	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
5	30.00	13.43	5.13	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
6	30.00	14.43	6.15	.72	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
7	30.00	15.02	6.70	1.74	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
8	30.00	15.32	6.97	2.40	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
9	30.00	15.53	7.44	2.61	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
10	30.00	15.94	8.25	3.65	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
20	30.00	17.98	11.15	6.63	3.62	1.12	-.00	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01
30	30.00	19.17	12.89	8.52	5.23	2.82	1.08	-.00	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01
40	30.00	19.61	13.61	9.49	6.49	4.25	2.53	.76	-.00	-.00	-.00	-.00	-.01	-.01	-.01	-.01
50	30.00	20.23	14.56	10.61	7.65	5.31	3.40	1.78	.37	-.00	-.00	-.00	-.00	-.01	-.01	-.01
60	30.00	20.52	14.99	11.10	8.12	5.72	3.72	2.32	1.19	.17	-.00	-.00	-.00	-.01	-.01	-.01
70	30.00	20.65	15.19	11.36	8.44	6.14	4.27	2.88	1.71	.67	-.00	-.00	-.00	-.00	-.00	-.01
80	30.00	20.92	15.64	11.96	9.18	7.00	5.22	3.83	2.63	1.40	.18	-.00	-.00	-.00	-.00	-.00
90	30.00	21.20	16.08	12.49	9.76	7.59	5.80	4.33	3.05	1.86	.75	-.00	-.00	-.00	-.00	-.00
100	30.00	21.39	16.37	12.84	10.13	7.95	6.14	4.62	3.29	2.17	1.19	.30	-.00	-.00	-.00	-.00
200	30.00	22.31	17.82	14.64	12.19	10.20	8.52	7.09	5.83	4.72	3.73	2.82	2.10	1.47	.87	.32
300	30.00	22.75	18.51	15.52	13.21	11.34	9.77	8.44	7.27	6.26	5.36	4.54	3.83	3.18	2.58	2.00
400	30.00	23.05	18.98	16.10	13.87	12.05	10.51	9.19	8.02	6.98	6.05	5.20	4.42	3.70	3.03	2.43
500	30.00	23.21	19.24	16.43	14.26	12.50	11.01	9.75	8.63	7.66	6.79	5.99	5.30	4.67	4.08	3.54
600	30.00	23.47	19.66	16.95	14.86	13.16	11.72	10.48	9.39	8.43	7.57	6.78	6.07	5.41	4.81	4.24
700	30.00	23.59	19.85	17.19	15.13	13.45	12.03	10.81	9.73	8.76	7.90	7.10	6.38	5.72	5.10	4.52
800	30.00	23.64	19.92	17.29	15.24	13.57	12.16	10.94	9.86	8.90	8.03	7.24	6.52	5.85	5.22	4.64
900	30.00	23.73	20.07	17.47	15.46	13.82	12.44	11.25	10.20	9.28	8.44	7.69	7.01	6.38	5.80	5.26
1000	30.00	23.88	20.30	17.76	15.80	14.20	12.84	11.68	10.66	9.75	8.93	8.18	7.51	6.89	6.32	5.78

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	30	-.01	---

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

R

TAU	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
1	30.00	25.69	21.79	18.22	14.92	11.90	9.88	7.99	6.21	4.53	2.93	1.41	-.02	-.72	-1.38	-2.02
2	30.00	26.80	23.89	21.22	18.75	16.45	14.36	12.40	10.55	8.80	7.14	5.57	4.07	2.64	1.27	-.01
3	30.00	26.97	24.22	21.71	19.37	17.21	15.27	13.44	11.73	10.10	8.72	7.53	6.39	5.30	4.26	3.26
4	30.00	27.36	24.95	22.75	20.71	18.81	17.09	15.48	13.95	12.51	11.21	10.02	8.89	7.80	6.76	5.77
5	30.00	27.53	25.27	23.20	21.28	19.50	17.85	16.30	14.83	13.45	12.15	10.94	9.77	8.67	7.60	6.58
6	30.00	27.58	25.37	23.33	21.45	19.70	18.06	16.53	15.08	13.71	12.42	11.19	10.02	8.90	7.83	6.80
7	30.00	27.62	25.44	23.44	21.59	19.87	18.29	16.79	15.39	14.06	12.83	11.68	10.59	9.55	8.55	7.59
8	30.00	27.74	25.67	23.78	22.03	20.39	18.89	17.48	16.16	14.90	13.74	12.66	11.63	10.64	9.70	8.80
9	30.00	27.85	25.68	24.08	22.41	20.86	19.43	18.08	16.81	15.61	14.50	13.46	12.47	11.52	10.61	9.74
10	30.00	27.93	26.04	24.30	22.70	21.20	19.62	18.51	17.29	16.12	15.04	14.01	13.04	12.11	11.22	10.36
20	30.00	28.22	26.59	25.10	23.71	22.42	21.22	20.10	19.04	18.03	17.09	16.20	15.35	14.53	13.75	13.01
30	30.00	28.33	26.80	25.39	24.09	22.88	21.75	20.69	19.68	18.73	17.83	16.98	16.16	15.38	14.64	13.92
40	30.00	28.45	27.03	25.72	24.51	23.39	22.34	21.36	20.43	19.55	18.72	17.93	17.18	16.47	15.78	15.12
50	30.00	28.53	27.19	25.96	24.82	23.75	22.76	21.83	20.95	20.11	19.33	18.58	17.86	17.18	16.53	15.90
60	30.00	28.55	27.22	26.01	24.88	23.83	22.85	21.92	21.05	20.23	19.45	18.71	18.00	17.32	16.68	16.06
70	30.00	28.57	27.26	26.06	24.95	23.91	22.95	22.04	21.18	20.37	19.60	18.88	18.18	17.52	16.88	16.27
80	30.00	28.63	27.39	26.24	25.18	24.19	23.26	22.40	21.58	20.80	20.07	19.37	18.71	18.08	17.47	16.89
90	30.00	28.68	27.48	26.37	25.35	24.39	23.50	22.67	21.88	21.13	20.42	19.75	19.11	18.50	17.91	17.35
100	30.00	28.71	27.53	26.44	25.43	24.50	23.62	22.80	22.02	21.29	20.59	19.93	19.30	18.70	18.12	17.57
200	30.00	28.85	27.79	26.82	25.93	25.09	24.31	23.58	22.88	22.23	21.61	21.02	20.46	19.92	19.40	18.91
300	30.00	28.89	27.89	26.96	26.10	25.30	24.55	23.85	23.18	22.56	21.96	21.40	20.86	20.34	19.85	19.38
400	30.00	28.96	28.01	27.14	26.33	25.57	24.87	24.21	23.58	22.99	22.43	21.90	21.39	20.91	20.44	20.00
500	30.00	28.96	28.02	27.15	26.35	25.60	24.90	24.24	23.62	23.03	22.47	21.94	21.44	20.95	20.49	20.05
600	30.00	29.01	28.10	27.26	26.49	25.77	25.10	24.47	23.87	23.31	22.77	22.26	21.78	21.31	20.87	20.44
700	30.00	29.04	28.17	27.36	26.62	25.93	25.28	24.67	24.09	23.55	23.03	22.54	22.08	21.63	21.20	20.79
800	30.00	29.05	28.19	27.39	26.65	25.97	25.33	24.72	24.16	23.62	23.11	22.62	22.16	21.72	21.30	20.89
900	30.00	29.05	28.19	27.40	26.66	25.98	25.34	24.74	24.17	23.63	23.12	22.64	22.18	21.74	21.31	20.91
1000	30.00	29.06	28.19	27.40	26.66	25.98	25.34	24.74	24.17	23.64	23.13	22.65	22.19	21.74	21.32	20.92

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	30	-5.0	---

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R = 1.0	3.0	4.0	5.0	7.0	10.0	12.0	15.0	20.0	25.0	30.0	40.0	50.0	60.0	70.0	100.0
1	30.00	-3.39	-4.62	-4.92	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
2	30.00	-1.57	-3.64	-4.52	-4.96	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
3	30.00	-.47	-2.90	-4.08	-4.87	-4.99	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
4	30.00	-.13	-2.04	-3.45	-4.72	-4.98	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
5	30.00	2.05	-1.54	-3.04	-4.53	-4.95	-4.99	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
6	30.00	3.38	-1.11	-2.77	-4.34	-4.92	-4.98	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
7	30.00	4.07	-.68	-2.40	-4.15	-4.87	-4.97	-4.99	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
8	30.00	4.74	-.18	-1.78	-3.94	-4.81	-4.95	-4.99	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
9	30.00	6.17	-.34	-1.67	-3.70	-4.74	-4.93	-4.98	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
10	30.00	6.71	-.07	-1.41	-3.48	-4.67	-4.90	-4.98	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
20	30.00	9.79	4.96	-.06	-1.87	-3.83	-4.46	-4.81	-4.98	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
30	30.00	10.73	5.70	2.64	-1.19	-3.16	-3.94	-4.54	-4.91	-4.98	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
40	30.00	12.24	7.81	4.62	-.52	-2.38	-3.43	-4.23	-4.80	-4.94	-4.99	-5.00	-5.00	-5.00	-5.00	-5.00
50	30.00	13.11	8.74	5.40	.06	-1.95	-2.95	-3.90	-4.66	-4.89	-4.97	-5.00	-5.00	-5.00	-5.00	-5.00
60	30.00	13.28	8.92	5.54	1.33	-1.75	-2.68	-3.64	-4.51	-4.83	-4.94	-4.99	-5.00	-5.00	-5.00	-5.00
70	30.00	13.57	9.38	6.26	1.92	-1.23	-2.38	-3.41	-4.37	-4.75	-4.91	-4.99	-5.00	-5.00	-5.00	-5.00
80	30.00	14.31	10.30	7.29	3.04	-.99	-1.88	-3.09	-4.21	-4.67	-4.87	-4.98	-5.00	-5.00	-5.00	-5.00
90	30.00	14.65	10.94	7.96	3.61	-.74	-1.58	-2.81	-4.04	-4.58	-4.82	-4.97	-5.00	-5.00	-5.00	-5.00
100	30.00	15.10	11.23	8.24	3.80	-.51	-1.43	-2.61	-3.87	-4.48	-4.77	-4.96	-4.99	-5.00	-5.00	-5.00
200	30.00	16.71	13.23	10.55	6.52	2.20	-.10	-1.16	-2.60	-3.56	-4.15	-4.73	-4.92	-4.98	-4.99	-5.00
300	30.00	17.27	13.96	11.41	7.63	3.73	1.61	-.17	-1.76	-2.89	-3.62	-4.42	-4.78	-4.93	-4.97	-5.00
400	30.00	18.01	14.87	12.44	8.78	4.93	2.97	.35	-1.20	-2.27	-3.07	-4.08	-4.59	-4.84	-4.92	-5.00
500	30.00	18.07	14.95	12.52	8.87	5.00	3.02	1.31	-.93	-2.02	-2.77	-3.60	-4.39	-4.73	-4.66	-4.99
600	30.00	18.55	15.55	13.24	9.78	6.21	4.43	1.98	-.11	-1.33	-2.31	-3.54	-4.21	-4.61	-4.79	-4.98
700	30.00	18.96	16.07	13.84	10.48	6.95	5.16	3.01	-.23	-1.11	-1.93	-3.23	-4.00	-4.48	-4.70	-4.97
800	30.00	19.08	16.22	14.00	10.66	7.13	5.32	3.12	.22	-.93	-1.77	-3.01	-3.81	-4.34	-4.61	-4.95
900	30.00	19.10	16.25	14.03	10.70	7.16	5.35	3.14	.78	-.75	-1.66	-2.86	-3.66	-4.21	-4.52	-4.93
1000	30.00	19.11	16.26	14.05	10.73	7.22	5.45	3.34	1.12	-.51	-1.52	-2.73	-3.53	-4.09	-4.43	-4.91

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	30	-5.0	---

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R = 1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
1	30.00	25.62	21.64	18.00	14.62	11.47	8.34	5.41	2.64	.03	-.87	-1.70	-2.50	-3.25	-3.98	-4.68
2	30.00	26.39	23.12	20.14	17.37	14.80	12.29	9.94	7.73	5.63	3.64	1.75	-.01	-.39	-.75	-1.10
3	30.00	26.87	24.01	21.39	18.96	16.70	14.61	12.64	10.79	9.04	7.27	5.51	3.82	2.21	.67	-.30
4	30.00	26.91	24.10	21.51	19.11	16.88	14.82	12.88	11.06	9.33	7.97	6.88	5.84	4.84	3.89	2.98
5	30.00	27.18	24.62	22.26	20.08	18.06	16.22	14.49	12.85	11.31	9.87	8.52	7.23	6.00	4.82	3.69
6	30.00	27.38	25.00	22.81	20.78	18.90	17.17	15.54	14.01	12.56	11.06	9.55	8.10	6.72	5.40	4.14
7	30.00	27.52	25.26	23.18	21.26	19.47	17.82	16.26	14.79	13.41	12.11	10.90	9.73	8.63	7.56	6.55
8	30.00	27.57	25.36	23.33	21.44	19.69	18.05	16.52	15.07	13.70	12.40	11.18	10.01	8.89	7.82	6.79
9	30.00	27.59	25.39	23.37	21.49	19.75	18.12	16.59	15.14	13.78	12.48	11.25	10.08	8.96	7.89	6.86
10	30.00	27.59	25.40	23.38	21.51	19.77	18.14	16.61	15.16	13.80	12.51	11.28	10.10	8.98	7.91	6.88
20	30.00	28.02	26.22	24.56	23.02	21.59	20.26	19.00	17.81	16.69	15.63	14.62	13.66	12.74	11.86	11.02
30	30.00	28.17	26.50	24.97	23.54	22.22	20.99	19.83	18.74	17.70	16.73	15.81	14.93	14.09	13.28	12.51
40	30.00	28.31	26.77	25.35	24.04	22.82	21.68	20.61	19.60	18.64	17.73	16.87	16.05	15.27	14.52	13.80
50	30.00	28.33	26.81	25.41	24.11	22.90	21.77	20.71	19.71	18.76	17.86	17.01	16.19	15.42	14.67	13.96
60	30.00	28.37	26.89	25.53	24.26	23.09	21.99	20.96	19.98	19.06	18.19	17.37	16.58	15.83	15.11	14.42
70	30.00	28.46	27.05	25.76	24.56	23.44	22.40	21.42	20.49	19.62	18.79	18.01	17.26	16.54	15.86	15.20
80	30.00	28.51	27.15	25.90	24.74	23.66	22.65	21.71	20.82	19.97	19.17	18.41	17.69	17.00	16.33	15.70
90	30.00	28.54	27.21	25.99	24.86	23.81	22.82	21.89	21.02	20.20	19.41	18.67	17.96	17.28	16.63	16.01
100	30.00	28.55	27.23	26.01	24.89	23.84	22.86	21.94	21.07	20.25	19.47	18.72	18.02	17.34	16.70	16.08
200	30.00	28.72	27.55	26.48	25.48	24.55	23.69	22.87	22.10	21.38	20.69	20.03	19.41	18.81	18.24	17.69
300	30.00	28.78	27.66	26.64	25.69	24.81	23.98	23.20	22.47	21.78	21.12	20.50	19.90	19.33	18.79	18.27
400	30.00	28.85	27.80	26.84	25.94	25.11	24.33	23.60	22.91	22.26	21.64	21.05	20.49	19.96	19.44	18.95
500	30.00	28.86	27.81	26.85	25.96	25.14	24.36	23.63	22.95	22.30	21.69	21.10	20.54	20.01	19.50	19.01
600	30.00	28.89	27.87	26.94	26.08	25.27	24.52	23.81	23.15	22.51	21.92	21.35	20.81	20.29	19.79	19.32
700	30.00	28.93	27.95	27.05	26.22	25.44	24.71	24.03	23.39	22.78	22.21	21.66	21.13	20.63	20.16	19.70
800	30.00	28.95	28.00	27.12	26.30	25.55	24.84	24.17	23.54	22.95	22.39	21.85	21.34	20.85	20.38	19.94
900	30.00	28.96	28.02	27.15	26.34	25.59	24.89	24.24	23.61	23.03	22.47	21.94	21.43	20.95	20.49	20.05
1000	30.00	28.97	28.02	27.15	26.35	25.60	24.90	24.24	23.62	23.03	22.47	21.95	21.44	20.96	20.50	20.05

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-10.0	---

TEMPERATURES IN RADIAL HEAT FLOW
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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	3.0	4.0	5.0	7.0	10.0	12.0	15.0	20.0	25.0	30.0	40.0	50.0	60.0	70.0	100.0
1	30.00	-7.14	-9.37	-9.87	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
2	30.00	-4.29	-7.95	-9.28	-9.94	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
3	30.00	-2.77	-6.49	-8.45	-9.79	-9.99	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
4	30.00	-1.17	-5.64	-7.74	-9.55	-9.97	-9.99	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
5	30.00	-.58	-4.56	-7.06	-9.29	-9.93	-9.99	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
6	30.00	-.09	-3.44	-6.30	-8.98	-9.87	-9.97	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
7	30.00	-.04	-3.05	-5.62	-8.64	-9.79	-9.95	-9.99	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
8	30.00	1.89	-2.60	-5.20	-8.31	-9.70	-9.92	-9.98	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
9	30.00	3.02	-2.16	-4.89	-8.01	-9.60	-9.89	-9.98	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
10	30.00	3.66	-1.59	-4.64	-7.74	-9.48	-9.84	-9.96	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
20	30.00	7.26	1.40	-1.74	-5.33	-8.20	-9.16	-9.71	-9.96	-9.99	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
30	30.00	9.14	3.65	-.26	-3.84	-7.15	-8.38	-9.30	-9.86	-9.97	-9.99	-10.00	-10.00	-10.00	-10.00	-10.00
40	30.00	10.61	5.61	.49	-2.63	-6.09	-7.59	-8.82	-9.70	-9.91	-9.98	-10.00	-10.00	-10.00	-10.00	-10.00
50	30.00	10.76	5.73	2.39	-2.12	-5.46	-6.95	-8.35	-9.49	-9.84	-9.95	-10.00	-10.00	-10.00	-10.00	-10.00
60	30.00	11.38	6.68	3.31	-1.34	-4.94	-6.47	-7.95	-9.26	-9.73	-9.91	-9.99	-10.00	-10.00	-10.00	-10.00
70	30.00	12.29	7.76	3.97	-.54	-4.20	-5.91	-7.54	-9.03	-9.62	-9.86	-9.98	-10.00	-10.00	-10.00	-10.00
80	30.00	12.88	8.47	5.15	-.77	-3.54	-5.35	-7.13	-8.79	-9.50	-9.80	-9.97	-10.00	-10.00	-10.00	-10.00
90	30.00	13.23	8.87	5.50	-.36	-3.20	-4.92	-6.74	-8.55	-9.36	-9.73	-9.96	-9.99	-10.00	-10.00	-10.00
100	30.00	13.31	8.94	5.56	.39	-3.00	-4.64	-6.44	-8.31	-9.22	-9.65	-9.94	-9.99	-10.00	-10.00	-10.00
200	30.00	15.24	11.38	8.39	3.90	-.91	-2.23	-4.15	-6.44	-7.87	-8.74	-9.59	-9.88	-9.98	-9.99	-10.00
300	30.00	15.94	12.28	9.46	5.26	.74	-.93	-2.95	-5.34	-6.88	-7.92	-9.13	-9.66	-9.90	-9.95	-10.00
400	30.00	16.75	13.29	10.61	6.58	1.85	-.54	-1.93	-4.23	-5.95	-7.16	-8.65	-9.39	-9.77	-9.89	-10.00
500	30.00	16.82	13.37	10.69	6.66	2.53	.76	-1.46	-3.77	-5.38	-6.59	-8.20	-9.10	-9.60	-9.79	-9.99
600	30.00	17.19	13.85	11.27	7.40	3.42	1.48	-.78	-3.22	-4.91	-6.16	-7.83	-8.82	-9.42	-9.68	-9.97
700	30.00	17.65	14.42	11.92	8.17	4.12	1.78	-.29	-2.50	-4.31	-5.65	-7.47	-8.55	-9.23	-9.56	-9.96
800	30.00	17.94	14.78	12.34	8.67	4.84	2.90	-.43	-2.05	-3.79	-5.18	-7.10	-8.28	-9.04	-9.43	-9.93
900	30.00	18.06	14.94	12.52	8.86	4.99	3.02	-.03	-1.85	-3.51	-4.84	-6.78	-8.02	-8.84	-9.29	-9.90
1000	30.00	18.07	14.95	12.53	8.87	5.00	3.02	.78	-1.69	-3.33	-4.62	-6.52	-7.78	-8.66	-9.16	-9.86

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	30	-10.0	---

APPENDIX D. TABLES OF HEAT FLOW VERSUS TIME FOR A SUSTAINED SOURCE

These tables present normalized values $\omega(1,1)$ of the heat flow from a source of radius one metre into a medium of conductivity one $Wm^{-1} K^{-1}$ for the cases given in Appendix C. The dimensionless time τ is calculated, as in Appendix C, from the diffusivity α_A of the medium in its original, or undisturbed state, A. For a particular application, tabulated values must be multiplied by the conductivity ($Wm^{-1}K^{-1}$) of the medium immediately adjacent to the source and divided by the radius (m), i.e.

$$\omega(r_o,k_A) = \omega(1,1) \times \frac{k_A}{r_o} \quad (Wm^{-2}) \tag{4-6}$$

if the medium in contact with the source at that time is in its original state, or

$$\omega(r_o,k_B) = \omega(1,1) \times \frac{k_B}{r_o} \quad (Wm^{-2}) \tag{4-7}$$

if the medium adjacent to the source has undergone a change of phase. The phase status of the medium in contact with the source is indicated beside each entry in the tables as "A" (undisturbed, original state) or "B" (changed phase). The notation ".AAAE+aa" is interpreted to mean ".AAA x 10^{+aa}", and a "*" replaces any value smaller than 10^{-10} Wm^{-2}.

Index blocks along the lower edge of each table identify the parametric values used: latent heat density (MJ/m^3), source and initial temperatures (^oC), and duration of source τ_o.

HEAT FLOW IN RADIAL SYMMETRY

TAU	HEAT FLOW		TAU	HEAT FLOW	TAU	HEAT FLOW
.05	.304E+01	(A)				
.06	.280E+01	(A)				
.07	.262E+01	(A)				
.08	.248E+01	(A)				
.09	.236E+01	(A)				
.10	.226E+01	(A)				
.20	.172E+01	(A)				
.30	.148E+01	(A)				
.40	.134E+01	(A)				
.50	.124E+01	(A)				
.60	.116E+01	(A)				
.70	.111E+01	(A)				
.80	.105E+01	(A)				
.90	.101E+01	(A)				
1.00	.987E+00	(A)				
2.00	.802E+00	(A)				
3.00	.717E+00	(A)				
4.00	.664E+00	(A)				
5.00	.628E+00	(A)				
6.00	.600E+00	(A)				
7.00	.578E+00	(A)				
8.00	.561E+00	(A)				
9.00	.546E+00	(A)				
10.00	.533E+00	(A)				
20.00	.460E+00	(A)				
30.00	.425E+00	(A)				
40.00	.404E+00	(A)				
50.00	.387E+00	(A)				
60.00	.375E+00	(A)				
70.00	.366E+00	(A)				
80.00	.358E+00	(A)				
90.00	.351E+00	(A)				
100.00	.345E+00	(A)				
200.00	.310E+00	(A)				
300.00	.293E+00	(A)				
400.00	.282E+00	(A)				
500.00	.274E+00	(A)				
600.00	.267E+00	(A)				
700.00	.262E+00	(A)				
800.00	.258E+00	(A)				
900.00	.254E+00	(A)				
1000.00	.251E+00	(A)				

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU$_o$	LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU$_o$	LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU$_o$
0	1	0.0	---								

HEAT FLOW IN RADIAL SYMMETRY

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	HEAT FLOW	TAU	HEAT FLOW	TAU	HEAT FLOW
1.00	.152E+02 (B)	1.00	.209E+02 (B)	1.00	.249E+02 (B)
2.00	.125E+02 (B)	2.00	.151E+02 (B)	2.00	.188E+02 (B)
3.00	.109E+02 (B)	3.00	.151E+02 (B)	3.00	.162E+02 (B)
4.00	.108E+02 (B)	4.00	.124E+02 (B)	4.00	.151E+02 (B)
5.00	.949E+01 (B)	5.00	.110E+02 (B)	5.00	.151E+02 (B)
6.00	.872E+01 (B)	6.00	.108E+02 (B)	6.00	.151E+02 (B)
7.00	.849E+01 (B)	7.00	.108E+02 (B)	7.00	.140E+02 (B)
8.00	.844E+01 (B)	8.00	.108E+02 (B)	8.00	.128E+02 (B)
9.00	.843E+01 (B)	9.00	.108E+02 (B)	9.00	.123E+02 (B)
10.00	.830E+01 (B)	10.00	.105E+02 (B)	10.00	.119E+02 (B)
20.00	.690E+01 (B)	20.00	.842E+01 (B)	20.00	.108E+02 (B)
30.00	.592E+01 (B)	30.00	.746E+01 (B)	30.00	.941E+01 (B)
40.00	.585E+01 (B)	40.00	.690E+01 (B)	40.00	.884E+01 (B)
50.00	.540E+01 (B)	50.00	.690E+01 (B)	50.00	.842E+01 (B)
60.00	.512E+01 (B)	60.00	.690E+01 (B)	60.00	.842E+01 (B)
70.00	.507E+01 (B)	70.00	.635E+01 (B)	70.00	.842E+01 (B)
80.00	.506E+01 (B)	80.00	.602E+01 (B)	80.00	.797E+01 (B)
90.00	.498E+01 (B)	90.00	.585E+01 (B)	90.00	.768E+01 (B)
100.00	.470E+01 (B)	100.00	.584E+01 (B)	100.00	.752E+01 (B)
200.00	.413E+01 (B)	200.00	.510E+01 (B)	200.00	.690E+01 (B)
300.00	.400E+01 (B)	300.00	.506E+01 (B)	300.00	.635E+01 (B)
400.00	.368E+01 (B)	400.00	.465E+01 (B)	400.00	.610E+01 (B)
500.00	.363E+01 (B)	500.00	.448E+01 (B)	500.00	.592E+01 (B)
600.00	.362E+01 (B)	600.00	.448E+01 (B)	600.00	.584E+01 (B)
700.00	.340E+01 (B)	700.00	.448E+01 (B)	700.00	.571E+01 (B)
800.00	.333E+01 (B)	800.00	.430E+01 (B)	800.00	.555E+01 (B)
900.00	.332E+01 (B)	900.00	.414E+01 (B)	900.00	.547E+01 (B)
1000.00	.330E+01 (B)	1000.00	.406E+01 (B)	1000.00	.540E+01 (B)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	10	-.01	---

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	10	-5.0	---

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	10	-10.0	---

HEAT FLOW IN RADIAL SYMMETRY

****

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	HEAT FLOW	TAU	HEAT FLOW	TAU	HEAT FLOW
1.00	.395E+02 (B)	1.00	.454E+02 (B)	1.00	.461E+02 (B)
2.00	.323E+02 (B)	2.00	.337E+02 (B)	2.00	.382E+02 (B)
3.00	.274E+02 (B)	3.00	.319E+02 (B)	3.00	.329E+02 (B)
4.00	.258E+02 (B)	4.00	.278E+02 (B)	4.00	.324E+02 (B)
5.00	.244E+02 (B)	5.00	.259E+02 (B)	5.00	.297E+02 (B)
6.00	.228E+02 (B)	6.00	.254E+02 (B)	6.00	.276E+02 (B)
7.00	.218E+02 (B)	7.00	.251E+02 (B)	7.00	.261E+02 (B)
8.00	.213E+02 (B)	8.00	.238E+02 (B)	8.00	.254E+02 (B)
9.00	.209E+02 (B)	9.00	.227E+02 (B)	9.00	.253E+02 (B)
10.00	.204E+02 (B)	10.00	.218E+02 (B)	10.00	.253E+02 (B)
20.00	.175E+02 (B)	20.00	.187E+02 (B)	20.00	.207E+02 (B)
30.00	.157E+02 (B)	30.00	.176E+02 (B)	30.00	.192E+02 (B)
40.00	.151E+02 (B)	40.00	.163E+02 (B)	40.00	.177E+02 (B)
50.00	.141E+02 (B)	50.00	.155E+02 (B)	50.00	.176E+02 (B)
60.00	.137E+02 (B)	60.00	.152E+02 (B)	60.00	.171E+02 (B)
70.00	.135E+02 (B)	70.00	.151E+02 (B)	70.00	.162E+02 (B)
80.00	.131E+02 (B)	80.00	.143E+02 (B)	80.00	.157E+02 (B)
90.00	.127E+02 (B)	90.00	.138E+02 (B)	90.00	.153E+02 (B)
100.00	.124E+02 (B)	100.00	.136E+02 (B)	100.00	.152E+02 (B)
200.00	.111E+02 (B)	200.00	.121E+02 (B)	200.00	.135E+02 (B)
300.00	.105E+02 (B)	300.00	.116E+02 (B)	300.00	.128E+02 (B)
400.00	.100E+02 (B)	400.00	.109E+02 (B)	400.00	.121E+02 (B)
500.00	.980E+01 (B)	500.00	.109E+02 (B)	500.00	.120E+02 (B)
600.00	.943E+01 (B)	600.00	.104E+02 (B)	600.00	.117E+02 (B)
700.00	.925E+01 (B)	700.00	.101E+02 (B)	700.00	.113E+02 (B)
800.00	.918E+01 (B)	800.00	.995E+01 (B)	800.00	.110E+02 (B)
900.00	.905E+01 (B)	900.00	.993E+01 (B)	900.00	.109E+02 (B)
1000.00	.884E+01 (B)	1000.00	.993E+01 (B)	1000.00	.109E+02 (B)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-.01	---

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-5.0	---

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-10.0	---

APPENDIX E. TABLES OF TEMPERATURE VERSUS TIME FOR A SOURCE OF FINITE DURATION

Consider a homogeneous medium at constant initial temperature, bounded internally by a cylinder of radius r_o held at constant temperature for time $0 < t \leq t_o$. For time $t > t_o$, the source cylinder and the medium relax to initial conditions. The thermal conductivity, specific heat and density of the medium are k_A, c_A and ρ_A, respectively, where the subscript A denotes the phase of the medium in its undisturbed state.

For a system not undergoing a phase change, the initial temperature is 0^oC. For a system that will experience a phase change, cases are presented for initial temperatures of -0.01^o, -5^o, and -10^oC, and the phase change is assumed to occur at 0^oC. In all cases, the medium is initially in state A, compatible with the initial temperature, and the corresponding values of k_A, c_A and ρ_A are used to calculate dimensionless time τ. The latent heat density, L, is the heat required per cubic metre of medium to complete the change of state. It is defined (A-18) from the latent heat Λ (J kg^{-1}) and density ρ_w (kg m^{-3}) of pore saturant which occupies a fraction ϕ of the total volume.

Parameters:

$$\alpha_A = \frac{k_A}{c_A \rho_A} \qquad (m^2 s)$$

$$\tau = \frac{\alpha_A t}{r_o^2}$$

$$\tau_o = \frac{\alpha_A t_o}{r_o^2}$$

$$R = \frac{r}{r_o}$$

$$L = \Lambda \rho_w \phi \qquad (Jm-3)$$

where r is the radial position within the medium from the center of the source cylinder.

Two tabular formats are used; the first presents temperatures in degrees Celsius within the medium at various values of dimensionless radii R and time τ, for various values of source time τ_o. The source temperature is shown under R = 1. The second format is a concise summary of temperatures within the source region following cessation of source disturbance for time

$$t = t_o + Nt_o; \; N \geq 0$$

where N need not be an integer. The source temperature in the second type is shown under N = 0.

Index blocks along the lower edge of each table identify the parametric values used: latent heat density (MJ/m^3), source and initial temperatures (^oC), and duration of source τ_o.

TEMPERATURES IN RADIAL HEAT FLOW

TAU	R = 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
1	1.000	.906	.821	.743	.672	.607	.353	.098	.018	.003	.000	.000	.000	.000	.000	.000
2	1.000	.924	.854	.791	.732	.678	.459	.196	.071	.023	.002	.000	.000	.000	.000	.000
3	1.000	.932	.870	.812	.760	.711	.511	.258	.119	.051	.006	.000	.000	.000	.000	.000
3.3	.797	.775	.746	.720	.690	.660	.510	.272	.131	.059	.009	.000	.000	.000	.000	.000
3.6	.680	.666	.647	.630	.609	.589	.481	.280	.143	.068	.011	.000	.000	.000	.000	.000
3.9	.602	.591	.577	.564	.549	.534	.450	.280	.152	.075	.014	.001	.000	.000	.000	.000
4.2	.542	.534	.523	.513	.500	.488	.421	.277	.158	.082	.017	.001	.000	.000	.000	.000
4.5	.494	.488	.479	.470	.460	.451	.395	.271	.163	.088	.019	.001	.000	.000	.000	.000
5.1	.422	.417	.411	.405	.398	.391	.350	.256	.166	.097	.025	.002	.000	.000	.000	.000
6	.347	.344	.339	.335	.331	.326	.299	.232	.164	.105	.034	.004	.000	.000	.000	.000
7	.290	.288	.285	.282	.279	.276	.257	.208	.156	.108	.041	.006	.000	.000	.000	.000
8	.250	.249	.247	.245	.242	.240	.225	.189	.148	.107	.046	.008	.000	.000	.000	.000
9	.220	.219	.217	.215	.214	.212	.201	.172	.139	.105	.050	.011	.000	.000	.000	.000
10	.196	.195	.194	.193	.191	.190	.181	.158	.130	.102	.053	.013	.001	.000	.000	.000
20	.095	.095	.094	.094	.094	.093	.091	.086	.078	.069	.051	.026	.006	.001	.000	.000
30	.063	.063	.062	.062	.062	.062	.061	.059	.055	.051	.042	.027	.009	.002	.002	.001
40	.047	.047	.047	.047	.047	.046	.046	.044	.043	.040	.034	.025	.011	.004	.003	.003
50	.037	.037	.037	.037	.037	.037	.037	.036	.035	.033	.029	.023	.012	.005	.004	.004
60	.031	.031	.031	.031	.031	.031	.031	.030	.029	.028	.025	.020	.012	.006	.005	.004
70	.027	.027	.027	.027	.026	.026	.026	.026	.025	.024	.022	.019	.012	.006	.005	.005
80	.023	.023	.023	.023	.023	.023	.023	.023	.022	.022	.020	.017	.011	.006	.005	.005
90	.021	.021	.021	.021	.021	.021	.020	.020	.020	.019	.018	.016	.011	.006	.005	.005
100	.019	.019	.018	.018	.018	.018	.018	.018	.018	.017	.016	.014	.010	.006	.005	.005
200	.008	.008	.008	.008	.008	.008	.008	.008	.008	.008	.008	.007	.005	.004	.003	.003
300	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.003	.002	.002	.001

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
0	1	0.0	3

TEMPERATURES IN RADIAL HEAT FLOW

****

TAU	R = 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
1	1.000	.907	.822	.745	.673	.607	.353	.101	.023	.005	.000	.000	.000	.000	.000	.000
2	1.000	.924	.855	.791	.732	.678	.459	.197	.074	.026	.002	.000	.000	.000	.000	.000
3	1.000	.932	.870	.813	.760	.711	.511	.258	.121	.054	.007	.000	.000	.000	.000	.000
4	1.000	.937	.879	.826	.777	.732	.546	.302	.159	.081	.016	.001	.000	.000	.000	.000
5	1.000	.940	.886	.836	.789	.746	.569	.334	.190	.105	.025	.003	.000	.000	.000	.000
6	1.000	.943	.891	.843	.798	.757	.587	.359	.215	.126	.036	.005	.000	.000	.000	.000
7	1.000	.945	.895	.849	.806	.766	.602	.379	.237	.145	.047	.007	.000	.000	.000	.000
8	1.000	.947	.898	.853	.812	.773	.613	.396	.255	.162	.058	.010	.001	.000	.000	.000
9	1.000	.948	.901	.857	.817	.779	.623	.411	.271	.177	.068	.014	.001	.000	.000	.000
10	1.000	.949	.903	.860	.821	.764	.632	.423	.285	.190	.078	.018	.001	.000	.000	.000
11	.679	.671	.661	.649	.639	.629	.562	.418	.295	.203	.087	.022	.002	.000	.000	.000
12	.551	.546	.540	.534	.528	.522	.482	.387	.291	.209	.096	.026	.002	.000	.000	.000
13	.471	.467	.464	.459	.455	.451	.424	.354	.279	.209	.103	.030	.003	.000	.000	.000
14	.412	.410	.407	.404	.401	.398	.378	.325	.265	.205	.108	.034	.004	.000	.000	.000
15	.369	.368	.365	.363	.360	.358	.342	.300	.251	.199	.112	.038	.005	.000	.000	.000
16	.335	.334	.332	.330	.328	.326	.313	.278	.237	.193	.114	.042	.005	.001	.000	.000
17	.307	.306	.305	.303	.301	.300	.289	.260	.225	.186	.115	.045	.006	.001	.000	.000
18	.283	.282	.281	.280	.278	.277	.268	.243	.213	.179	.115	.047	.007	.001	.000	.000
19	.264	.263	.262	.260	.259	.258	.250	.229	.202	.172	.114	.050	.008	.001	.000	.000
20	.247	.246	.245	.244	.243	.242	.235	.216	.193	.166	.113	.052	.009	.001	.000	.000
30	.150	.150	.150	.149	.149	.149	.146	.139	.130	.119	.095	.058	.018	.004	.000	.000
40	.108	.108	.108	.108	.108	.108	.106	.103	.098	.092	.078	.055	.023	.007	.001	.000
50	.085	.085	.085	.085	.085	.084	.084	.081	.078	.075	.066	.050	.025	.010	.001	.000
60	.070	.070	.070	.070	.070	.069	.069	.067	.065	.063	.057	.045	.026	.012	.002	.000
70	.059	.059	.059	.059	.059	.059	.059	.058	.056	.054	.050	.041	.025	.013	.003	.000
80	.052	.052	.051	.051	.051	.051	.051	.050	.049	.048	.044	.037	.025	.014	.003	.000
90	.046	.046	.046	.045	.045	.045	.045	.045	.044	.043	.040	.034	.024	.014	.004	.000
100	.041	.041	.041	.041	.041	.041	.041	.040	.039	.038	.036	.032	.023	.014	.004	.000
200	.020	.020	.020	.020	.020	.020	.020	.020	.020	.019	.019	.018	.015	.012	.006	.001
300	.013	.013	.013	.013	.013	.013	.013	.013	.013	.013	.013	.012	.011	.010	.006	.002
400	.010	.010	.010	.010	.010	.010	.010	.010	.010	.010	.010	.009	.009	.008	.006	.002
500	.008	.008	.008	.008	.008	.008	.008	.008	.008	.008	.008	.008	.007	.007	.005	.002
600	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.006	.006	.006	.006	.005	.002
700	.006	.006	.006	.006	.006	.006	.006	.006	.006	.006	.006	.005	.005	.005	.004	.002
800	.005	.005	.005	.005	.005	.005	.005	.005	.005	.005	.005	.005	.005	.004	.004	.002
900	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.003	.002
1000	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.003	.002

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
0	1	0.0	10

TEMPERATURES IN RADIAL HEAT FLOW

R

TAU	1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
10	1.000	.949	.903	.860	.821	.784	.633	.424	.287	.191	.081	.019	.002	.000	.000	.000
20	1.000	.956	.916	.879	.845	.814	.682	.498	.373	.280	.156	.062	.012	.002	.000	.000
30	1.000	.960	.923	.889	.857	.828	.706	.535	.417	.328	.204	.098	.026	.006	.000	.000
33	.563	.561	.558	.554	.549	.546	.521	.461	.392	.326	.214	.107	.031	.008	.001	.000
36	.442	.440	.439	.437	.435	.433	.420	.387	.345	.300	.213	.114	.035	.010	.001	.000
39	.370	.369	.368	.367	.366	.364	.356	.334	.305	.273	.205	.118	.040	.011	.001	.000
42	.321	.321	.320	.319	.318	.317	.311	.295	.273	.249	.195	.120	.044	.013	.001	.000
45	.286	.285	.285	.284	.283	.282	.278	.265	.248	.229	.185	.119	.047	.015	.002	.000
51	.234	.234	.234	.233	.233	.232	.229	.221	.210	.197	.165	.115	.051	.019	.002	.000
60	.186	.186	.186	.185	.185	.185	.183	.178	.171	.162	.142	.107	.055	.024	.004	.000
70	.152	.152	.152	.151	.151	.151	.150	.147	.142	.136	.122	.097	.056	.027	.005	.000
80	.129	.129	.128	.128	.128	.128	.127	.125	.121	.117	.107	.088	.055	.030	.006	.000
90	.112	.112	.112	.111	.111	.111	.111	.109	.106	.103	.095	.080	.053	.031	.008	.000
100	.099	.099	.099	.098	.098	.098	.098	.096	.094	.092	.086	.074	.051	.032	.009	.000
200	.046	.046	.046	.046	.046	.046	.046	.045	.045	.044	.043	.040	.034	.027	.014	.002
300	.030	.030	.030	.030	.030	.030	.030	.030	.029	.029	.029	.027	.025	.021	.014	.003
400	.022	.022	.022	.022	.022	.022	.022	.022	.022	.022	.021	.021	.019	.017	.012	.004
500	.018	.018	.018	.018	.018	.018	.018	.018	.017	.017	.017	.017	.016	.014	.011	.005
600	.015	.015	.015	.015	.015	.015	.015	.015	.015	.014	.014	.014	.013	.012	.010	.005
700	.012	.012	.012	.012	.012	.012	.012	.012	.012	.012	.012	.012	.012	.011	.009	.005
800	.011	.011	.011	.011	.011	.011	.011	.011	.011	.011	.011	.011	.010	.010	.008	.005
900	.010	.010	.010	.010	.010	.010	.010	.010	.010	.010	.010	.009	.009	.009	.007	.005
1000	.009	.009	.009	.009	.009	.009	.009	.009	.009	.009	.009	.008	.008	.008	.007	.005
2000	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.003
3000	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003	.002

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
0	1	0.0	30

TEMPERATURES IN RADIAL HEAT FLOW

TAU	R = 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
10	1.000	.949	.903	.860	.821	.784	.633	.424	.287	.191	.081	.019	.002	.000	.000	.000
20	1.000	.956	.916	.879	.845	.814	.682	.498	.373	.280	.156	.062	.012	.002	.000	.000
30	1.000	.960	.923	.889	.857	.828	.706	.535	.417	.328	.204	.098	.026	.006	.000	.000
40	1.000	.962	.927	.894	.864	.837	.721	.559	.446	.360	.238	.127	.042	.012	.001	.000
50	1.000	.963	.929	.898	.870	.843	.732	.576	.466	.383	.263	.150	.056	.019	.002	.000
60	1.000	.964	.932	.902	.874	.848	.740	.589	.482	.401	.283	.170	.070	.027	.004	.000
70	1.000	.965	.933	.904	.877	.852	.747	.599	.495	.416	.299	.186	.083	.035	.006	.000
80	1.000	.966	.935	.906	.880	.855	.752	.608	.506	.428	.313	.200	.094	.042	.008	.000
90	1.000	.967	.936	.908	.882	.858	.757	.615	.515	.439	.325	.213	.105	.049	.010	.000
100	1.000	.967	.937	.910	.884	.860	.761	.622	.523	.448	.336	.224	.114	.057	.013	.000
110	.459	.458	.457	.456	.455	.454	.447	.429	.405	.377	.316	.228	.123	.063	.015	.000
120	.352	.351	.351	.351	.350	.349	.346	.337	.325	.310	.274	.215	.127	.069	.018	.001
130	.292	.292	.292	.291	.291	.291	.289	.283	.275	.265	.241	.198	.126	.073	.021	.001
140	.252	.252	.252	.252	.252	.251	.250	.246	.240	.233	.215	.182	.124	.076	.023	.001
150	.223	.223	.223	.223	.222	.222	.221	.218	.214	.208	.195	.169	.120	.077	.026	.001
170	.182	.182	.182	.182	.182	.182	.181	.179	.176	.173	.164	.146	.111	.076	.029	.002
200	.144	.144	.144	.144	.144	.144	.143	.142	.140	.138	.132	.121	.098	.073	.033	.003
300	.086	.086	.086	.086	.086	.086	.085	.085	.084	.084	.082	.078	.068	.057	.035	.008
400	.061	.061	.061	.061	.061	.061	.061	.061	.061	.060	.059	.057	.052	.046	.032	.011
500	.048	.048	.048	.048	.048	.048	.048	.047	.047	.047	.046	.045	.042	.038	.029	.012
600	.039	.039	.039	.039	.039	.039	.039	.039	.039	.039	.038	.037	.035	.033	.026	.013
700	.033	.033	.033	.033	.033	.033	.033	.033	.033	.033	.032	.032	.030	.028	.023	.013
800	.029	.029	.029	.029	.029	.029	.029	.029	.029	.028	.028	.028	.027	.025	.021	.013
900	.025	.025	.025	.025	.025	.025	.025	.025	.025	.025	.025	.025	.024	.023	.019	.012
1000	.023	.023	.023	.023	.023	.023	.023	.023	.023	.023	.022	.022	.021	.020	.018	.012
2000	.011	.011	.011	.011	.011	.011	.011	.011	.011	.011	.011	.011	.011	.011	.010	.008
3000	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.006
4000	.005	.005	.005	.005	.005	.005	.005	.005	.005	.005	.005	.005	.005	.005	.005	.005
5000	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
0	1	0.0	100

TEMPERATURES IN RADIAL HEAT FLOW

R

TAU	1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
100	1.000	.967	.937	.910	.884	.860	.761	.622	.523	.448	.336	.224	.114	.057	.013	.000
200	1.000	.970	.943	.919	.896	.874	.785	.660	.571	.502	.399	.293	.181	.112	.041	.003
300	1.000	.972	.947	.923	.902	.881	.797	.679	.595	.530	.432	.331	.220	.149	.067	.010
330	.386	.385	.385	.385	.385	.384	.382	.377	.369	.360	.336	.293	.218	.155	.073	.012
360	.294	.293	.293	.293	.293	.293	.292	.289	.286	.261	.269	.246	.199	.152	.078	.015
390	.243	.243	.243	.243	.242	.242	.242	.240	.238	.235	.227	.212	.179	.144	.081	.017
420	.209	.209	.209	.209	.209	.209	.208	.207	.206	.203	.198	.187	.163	.135	.081	.020
450	.184	.184	.184	.184	.184	.184	.184	.183	.182	.180	.176	.168	.149	.126	.080	.022
510	.150	.150	.150	.150	.150	.150	.150	.149	.149	.148	.145	.139	.127	.111	.077	.025
600	.118	.118	.118	.118	.118	.118	.118	.118	.117	.117	.115	.112	.104	.094	.070	.029
700	.096	.096	.096	.096	.096	.096	.096	.096	.095	.095	.094	.092	.087	.080	.063	.031
800	.081	.081	.081	.081	.081	.081	.081	.081	.081	.080	.080	.078	.074	.069	.057	.031
900	.070	.070	.070	.070	.070	.070	.070	.070	.070	.070	.069	.068	.065	.061	.052	.031
1000	.062	.062	.062	.062	.062	.062	.062	.062	.062	.061	.061	.060	.058	.055	.047	.030
2000	.028	.028	.028	.028	.028	.028	.028	.028	.028	.028	.028	.028	.028	.027	.025	.020
3000	.019	.018	.018	.018	.018	.018	.018	.018	.018	.018	.018	.018	.018	.018	.017	.015
4000	.014	.014	.014	.014	.014	.014	.014	.014	.014	.014	.014	.014	.014	.013	.013	.012
5000	.011	.011	.011	.011	.011	.011	.011	.011	.011	.011	.011	.011	.011	.011	.010	.010
6000	.009	.009	.009	.009	.009	.009	.009	.009	.009	.009	.009	.009	.009	.009	.009	.008

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_Q
0	1	0.0	300

TEMPERATURES IN RADIAL HEAT FLOW

TAU	R: 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
100	1.000	.967	.937	.910	.884	.860	.761	.622	.523	.448	.336	.224	.114	.057	.013	.000
200	1.000	.970	.943	.919	.896	.874	.785	.660	.571	.502	.399	.293	.181	.112	.041	.003
300	1.000	.972	.947	.923	.902	.881	.797	.679	.595	.530	.432	.331	.220	.149	.067	.010
400	1.000	.973	.949	.926	.905	.886	.805	.691	.610	.547	.454	.355	.247	.175	.088	.018
500	1.000	.974	.950	.928	.908	.889	.811	.700	.621	.561	.469	.373	.267	.195	.106	.027
600	1.000	.975	.951	.930	.910	.892	.815	.707	.630	.571	.461	.387	.283	.212	.121	.036
700	1.000	.975	.952	.931	.912	.894	.819	.712	.637	.579	.491	.399	.296	.225	.134	.044
800	1.000	.975	.953	.932	.913	.896	.822	.717	.643	.586	.500	.409	.307	.237	.145	.052
900	1.000	.976	.954	.933	.915	.897	.824	.721	.648	.592	.507	.417	.316	.247	.155	.060
1000	1.000	.976	.954	.934	.916	.898	.826	.725	.653	.597	.513	.424	.325	.256	.164	.066
1100	.326	.326	.326	.326	.325	.325	.325	.323	.321	.319	.312	.298	.268	.234	.166	.073
1200	.247	.247	.247	.247	.247	.247	.246	.246	.245	.244	.240	.234	.218	.199	.154	.077
1300	.204	.204	.204	.204	.204	.204	.203	.203	.202	.202	.200	.195	.185	.173	.141	.079
1400	.175	.175	.175	.175	.175	.175	.175	.175	.174	.174	.172	.169	.162	.153	.129	.078
1500	.154	.154	.154	.154	.154	.154	.154	.154	.154	.153	.152	.150	.144	.137	.119	.077
1600	.138	.138	.138	.138	.138	.138	.138	.138	.138	.137	.137	.135	.130	.125	.110	.075
1700	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	.124	.123	.119	.114	.102	.072
1800	.115	.115	.115	.115	.115	.115	.115	.115	.115	.114	.114	.113	.110	.106	.095	.069
1900	.106	.106	.106	.106	.106	.106	.106	.106	.106	.106	.105	.104	.102	.098	.089	.067
2000	.099	.099	.099	.099	.099	.099	.099	.099	.098	.098	.098	.097	.095	.092	.084	.064
3000	.058	.058	.058	.058	.058	.058	.058	.058	.058	.058	.058	.058	.057	.056	.053	.046
4000	.042	.042	.042	.042	.042	.042	.042	.042	.042	.042	.041	.041	.041	.040	.039	.035
5000	.032	.032	.032	.032	.032	.032	.032	.032	.032	.032	.032	.032	.032	.032	.031	.028
6000	.026	.026	.026	.026	.026	.026	.026	.026	.026	.026	.026	.026	.026	.026	.025	.024

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
0	1	0.0	1800

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

TAU \ R	1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
1	10.00	8.21	6.57	5.25	4.03	2.90	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
2	10.00	8.87	7.84	6.90	6.02	5.21	1.65	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
3	10.00	8.89	7.87	6.93	6.06	5.26	2.39	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
4	10.00	8.99	8.07	7.24	6.48	5.76	3.07	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01
5	10.00	9.14	8.36	7.64	6.98	6.36	3.88	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01
6	10.00	9.18	8.44	7.76	7.12	6.53	4.10	.41	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01
7	10.00	9.20	8.46	7.79	7.16	6.58	4.16	.81	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01
8	10.00	9.20	8.47	7.80	7.17	6.59	4.18	1.08	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01
9	10.00	9.20	8.47	7.80	7.18	6.60	4.18	1.27	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01
10	10.00	9.20	8.47	7.80	7.18	6.60	4.18	1.41	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01
11	5.40	5.28	5.17	4.95	4.76	4.57	3.47	1.42	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01
12	3.71	3.65	3.60	3.49	3.39	3.30	2.73	1.48	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01
13	2.80	2.76	2.73	2.66	2.60	2.55	2.18	1.31	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01
14	2.20	2.18	2.15	2.11	2.06	2.02	1.76	1.10	.04	-.00	-.01	-.01	-.01	-.01	-.01	-.01
15	1.76	1.75	1.73	1.69	1.66	1.63	1.43	.91	.07	-.00	-.01	-.01	-.01	-.01	-.01	-.01
16	1.43	1.41	1.40	1.37	1.34	1.32	1.16	.74	.08	-.00	-.01	-.01	-.01	-.01	-.01	-.01
17	1.17	1.16	1.14	1.12	1.10	1.08	.95	.61	.08	-.00	-.01	-.01	-.01	-.01	-.01	-.01
18	.95	.94	.93	.91	.89	.88	.77	.50	.07	-.00	-.00	-.01	-.01	-.01	-.01	-.01
19	.77	.76	.75	.74	.73	.71	.63	.40	.07	-.00	-.00	-.01	-.01	-.01	-.01	-.01
20	.62	.62	.61	.60	.59	.58	.51	.33	.06	-.00	-.00	-.01	-.01	-.01	-.01	-.01
30	.08	.08	.08	.08	.07	.07	.06	.04	.01	-.00	-.00	-.01	-.01	-.01	-.01	-.01
40	.01	.01	.01	.01	.01	.01	.01	.01	.00	-.00	-.00	-.01	-.01	-.01	-.01	-.01
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01	-.01	-.01	-.01
60	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01	-.01	-.01	-.01
70	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01	-.01	-.01	-.01
80	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01	-.01	-.01	-.01
90	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01	-.01	-.01	-.01
100	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01	-.01	-.01	-.01
200	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01	-.01
300	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01	-.01
400	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01	-.01
500	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01	-.01
600	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01	-.01
700	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.00	-.01	-.01	-.01
800	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.00	-.01	-.01	-.01
900	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.00	-.01	-.01	-.01
1000	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.00	-.01	-.01	-.01

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-.01	10

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R = 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
10	10.00	9.20	8.47	7.80	7.18	6.60	4.18	1.41	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01
20	10.00	9.37	8.80	8.28	7.79	7.34	5.45	2.80	1.01	-.00	-.00	-.01	-.01	-.01	-.01	-.01
30	10.00	9.40	8.85	8.35	7.89	7.46	5.67	3.26	1.76	.55	-.00	-.01	-.01	-.01	-.01	-.01
33	4.39	4.36	4.33	4.26	4.20	4.14	3.76	2.84	1.85	.77	-.00	-.01	-.01	-.01	-.01	-.01
36	2.91	2.89	2.88	2.84	2.81	2.78	2.59	2.09	1.47	.71	-.00	-.01	-.01	-.01	-.01	-.01
39	2.07	2.06	2.05	2.03	2.01	1.99	1.87	1.54	1.10	.56	-.00	-.01	-.01	-.01	-.01	-.01
42	1.51	1.50	1.49	1.48	1.46	1.45	1.36	1.13	.81	.43	-.00	-.00	-.01	-.01	-.01	-.01
45	1.10	1.10	1.09	1.08	1.07	1.06	1.00	.82	.60	.32	-.00	-.00	-.01	-.01	-.01	-.01
51	.59	.59	.59	.58	.58	.57	.54	.44	.32	.18	-.00	-.00	-.01	-.01	-.01	-.01
60	.23	.23	.23	.23	.23	.22	.21	.17	.13	.07	-.00	-.00	-.01	-.01	-.01	-.01
70	.08	.08	.08	.08	.08	.08	.08	.06	.05	.03	-.00	-.00	-.01	-.01	-.01	-.01
80	.03	.03	.03	.03	.03	.03	.03	.02	.02	.01	-.00	-.00	-.01	-.01	-.01	-.01
90	.01	.01	.01	.01	.01	.01	.01	.01	.01	.00	-.00	-.00	-.01	-.01	-.01	-.01
100	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01	-.01	-.01
200	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01	-.01	-.01
300	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01
400	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01
500	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01
600	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01
700	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01
800	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01
900	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01
1000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01
2000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.00	-.01	-.01
3000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.00	-.01	-.01

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-.01	30

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
10	10.00	9.20	8.47	7.80	7.18	6.60	4.18	1.41	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01
20	10.00	9.37	8.80	8.28	7.79	7.34	5.45	2.80	1.01	-.00	-.00	-.01	-.01	-.01	-.01	-.01
30	10.00	9.40	8.85	8.35	7.89	7.46	5.67	3.26	1.76	.55	-.00	-.01	-.01	-.01	-.01	-.01
40	10.00	9.48	9.00	8.56	8.16	7.78	6.21	4.01	2.48	1.20	-.00	-.01	-.01	-.01	-.01	-.01
50	10.00	9.49	9.02	8.53	8.19	7.82	6.27	4.10	2.56	1.39	-.00	-.00	-.01	-.01	-.01	-.01
60	10.00	9.49	9.02	8.59	8.20	7.83	6.28	4.11	2.56	1.47	.10	-.00	-.01	-.01	-.01	-.01
70	10.00	9.49	9.03	8.60	8.20	7.84	6.30	4.17	2.70	1.65	.28	-.00	-.01	-.01	-.01	-.01
80	10.00	9.53	9.11	8.71	8.35	8.01	6.60	4.64	3.30	2.30	.71	-.00	-.01	-.01	-.01	-.01
90	10.00	9.55	9.15	8.77	8.43	8.10	6.76	4.87	3.55	2.54	.93	-.00	-.01	-.01	-.01	-.01
100	10.00	9.56	9.16	8.79	8.45	8.14	6.82	4.96	3.65	2.63	1.06	-.00	-.01	-.01	-.01	-.01
110	3.34	3.33	3.32	3.30	3.29	3.27	3.16	2.84	2.42	1.95	.93	-.00	-.01	-.01	-.01	-.01
120	1.91	1.90	1.90	1.89	1.88	1.87	1.82	1.66	1.44	1.18	.60	-.00	-.00	-.01	-.01	-.01
130	1.13	1.13	1.12	1.12	1.11	1.11	1.07	.98	.85	.70	.36	-.00	-.00	-.01	-.01	-.01
140	.67	.67	.67	.66	.66	.66	.64	.58	.51	.42	.22	-.00	-.00	-.01	-.01	-.01
150	.40	.40	.40	.39	.39	.39	.38	.35	.30	.25	.13	-.00	-.00	-.01	-.01	-.01
170	.14	.14	.14	.14	.14	.14	.13	.12	.11	.09	.05	-.00	-.00	-.01	-.01	-.01
200	.03	.03	.03	.03	.03	.03	.03	.03	.02	.02	.01	-.00	-.00	-.01	-.01	-.01
300	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01	-.01
400	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01	-.01
500	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
600	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
700	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
800	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
900	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
1000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
2000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
3000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
4000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
5000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-.01	100

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU \ R	1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
100	10.00	9.56	9.16	8.79	8.45	8.14	6.82	4.96	3.65	2.63	1.06	-.00	-.01	-.01	-.01	-.01
200	10.00	9.61	9.25	8.93	8.62	8.34	7.17	5.52	4.35	3.46	2.15	.63	-.00	-.01	-.01	-.01
300	10.00	9.62	9.28	8.97	8.67	8.40	7.27	5.67	4.54	3.66	2.33	.99	-.00	-.00	-.01	-.01
330	2.22	2.22	2.22	2.21	2.21	2.20	2.16	2.07	1.92	1.75	1.33	.67	-.00	-.00	-.01	-.01
360	.99	.99	.99	.98	.98	.98	.96	.92	.86	.79	.61	.31	-.00	-.00	-.01	-.01
390	.45	.45	.45	.44	.44	.44	.44	.42	.39	.36	.27	.14	-.00	-.00	-.01	-.01
420	.20	.20	.20	.20	.20	.20	.20	.19	.18	.16	.12	.06	-.00	-.00	-.01	-.01
450	.09	.09	.09	.09	.09	.09	.09	.09	.08	.07	.06	.03	-.00	-.00	-.01	-.01
510	.02	.02	.02	.02	.02	.02	.02	.02	.02	.01	.01	.01	-.00	-.00	-.01	-.01
600	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01
700	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01
800	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01
900	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01
1000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01
2000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01
3000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01
4000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01
5000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01
6000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	10	-.01	300

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
100	10.00	9.56	9.16	8.79	8.45	8.14	6.82	4.96	3.65	2.63	1.06	-.00	-.01	-.01	-.01	-.01
200	10.00	9.61	9.25	8.93	8.62	8.34	7.17	5.52	4.35	3.46	2.15	.63	-.00	-.01	-.01	-.01
300	10.00	9.62	9.28	8.97	8.67	8.40	7.27	5.67	4.54	3.66	2.33	.99	-.00	-.00	-.01	-.01
400	10.00	9.64	9.30	9.00	8.72	8.45	7.36	5.82	4.73	3.90	2.68	1.49	.00	-.00	-.01	-.01
500	10.00	9.66	9.36	9.08	8.82	8.57	7.56	6.14	5.13	4.34	3.17	1.93	.38	-.00	-.01	-.01
600	10.00	9.67	9.36	9.09	8.83	8.59	7.59	6.17	5.17	4.39	3.22	1.98	.59	-.00	-.00	-.01
700	10.00	9.67	9.37	9.09	8.83	8.59	7.59	6.18	5.18	4.40	3.23	1.99	.69	-.00	-.00	-.01
800	10.00	9.67	9.37	9.09	8.83	8.59	7.59	6.18	5.18	4.40	3.23	1.99	.75	.05	-.00	-.01
900	10.00	9.68	9.39	9.12	8.87	8.64	7.67	6.31	5.35	4.60	3.50	2.36	1.18	.22	-.00	-.01
1000	10.00	9.69	9.42	9.16	8.92	8.70	7.78	6.48	5.56	4.85	3.78	2.67	1.44	.40	-.00	-.01
1100	1.92	1.92	1.92	1.92	1.92	1.91	1.91	1.88	1.85	1.80	1.69	1.46	.98	.37	-.00	-.01
1200	.94	.94	.94	.94	.94	.94	.93	.92	.91	.89	.84	.73	.50	.21	-.00	-.01
1300	.47	.47	.47	.47	.47	.47	.47	.46	.46	.45	.42	.37	.25	.11	-.00	-.01
1400	.24	.24	.24	.24	.24	.24	.24	.23	.23	.22	.21	.19	.13	.06	-.00	-.01
1500	.12	.12	.12	.12	.12	.12	.12	.12	.12	.11	.11	.09	.06	.03	-.00	-.01
1600	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06	.05	.05	.03	.01	-.00	-.01
1700	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.02	.02	.01	-.00	-.01
1800	.02	.02	.02	.02	.02	.02	.02	.02	.01	.01	.01	.01	.01	.00	-.00	-.01
1900	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.00	.00	-.00	-.01
2000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.01
3000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.01
4000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.01
5000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.01
6000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.01

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-.01	1000

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

TAU \ R	1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
1	10.00	8.16	6.49	4.65	2.94	1.36	-1.53	-3.92	-4.73	-4.96	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
2	10.00	8.39	6.92	5.79	4.75	3.77	-.19	-3.09	-4.23	-4.74	-4.97	-5.00	-5.00	-5.00	-5.00	-5.00
3	10.00	8.79	7.68	6.43	5.27	4.19	-.01	-2.01	-3.64	-4.45	-4.91	-4.99	-5.00	-5.00	-5.00	-5.00
4	10.00	8.88	7.86	6.93	6.06	5.25	.74	-1.72	-3.16	-4.11	-4.82	-4.98	-5.00	-5.00	-5.00	-5.00
5	10.00	8.89	7.87	6.93	6.07	5.26	1.61	-1.43	-2.87	-3.83	-4.70	-4.96	-5.00	-5.00	-5.00	-5.00
6	10.00	8.89	7.87	6.93	6.07	5.26	2.09	-1.21	-2.67	-3.62	-4.58	-4.94	-5.00	-5.00	-5.00	-5.00
7	10.00	8.89	7.87	6.93	6.07	5.26	2.39	-.97	-2.52	-3.45	-4.46	-4.91	-4.99	-5.00	-5.00	-5.00
8	10.00	8.90	7.90	6.99	6.14	5.36	2.62	-.74	-2.39	-3.31	-4.35	-4.87	-4.99	-5.00	-5.00	-5.00
9	10.00	9.02	8.13	7.32	6.57	5.87	3.04	-.51	-2.08	-3.14	-4.25	-4.83	-4.99	-5.00	-5.00	-5.00
10	10.00	9.09	8.26	7.50	6.79	6.14	3.26	-.30	-1.76	-2.92	-4.14	-4.79	-4.98	-5.00	-5.00	-5.00
11	4.87	4.73	4.61	4.37	4.14	3.94	2.32	-.18	-1.51	-2.70	-4.03	-4.75	-4.97	-5.00	-5.00	-5.00
12	2.89	2.81	2.74	2.61	2.48	2.36	1.40	-.23	-1.46	-2.55	-3.91	-4.70	-4.97	-5.00	-5.00	-5.00
13	1.67	1.62	1.58	1.49	1.40	1.32	.77	-.35	-1.54	-2.49	-3.81	-4.65	-4.96	-5.00	-5.00	-5.00
14	.82	.79	.75	.69	.63	.57	.31	-.49	-1.67	-2.49	-3.73	-4.60	-4.95	-4.99	-5.00	-5.00
15	.33	.31	.30	.27	.25	.22	.12	-.60	-1.74	-2.51	-3.67	-4.55	-4.94	-4.99	-5.00	-5.00
16	.13	.12	.12	.11	.10	.09	.04	-.68	-1.76	-2.52	-3.62	-4.51	-4.92	-4.99	-5.00	-5.00
17	.05	.05	.05	.04	.04	.04	.02	-.74	-1.77	-2.51	-3.58	-4.47	-4.91	-4.99	-5.00	-5.00
18	.02	.02	.02	.02	.02	.01	.01	-.79	-1.76	-2.50	-3.55	-4.43	-4.90	-4.99	-5.00	-5.00
19	.01	.01	.01	.01	.01	.01	.00	-.83	-1.75	-2.48	-3.52	-4.40	-4.89	-4.98	-5.00	-5.00
20	.00	.00	.00	.00	.00	.00	.00	-.85	-1.74	-2.46	-3.49	-4.36	-4.87	-4.98	-5.00	-5.00
30	.00	.00	.00	-.09	-.23	-.35	-.65	-1.55	-2.11	-2.58	-3.35	-4.13	-4.74	-4.94	-5.00	-5.00
40	-2.44	-2.44	-2.45	-2.46	-2.47	-2.47	-2.52	-2.66	-2.83	-3.03	-3.46	-4.04	-4.64	-4.89	-4.99	-5.00
50	-3.19	-3.19	-3.20	-3.20	-3.20	-3.21	-3.23	-3.29	-3.37	-3.47	-3.71	-4.08	-4.58	-4.84	-4.98	-5.00
60	-3.58	-3.59	-3.59	-3.59	-3.59	-3.59	-3.61	-3.64	-3.69	-3.75	-3.90	-4.16	-4.55	-4.80	-4.97	-5.00
70	-3.83	-3.83	-3.83	-3.83	-3.84	-3.84	-3.85	-3.87	-3.91	-3.95	-4.05	-4.24	-4.55	-4.77	-4.96	-5.00
80	-4.00	-4.00	-4.00	-4.01	-4.01	-4.01	-4.01	-4.03	-4.06	-4.09	-4.16	-4.31	-4.56	-4.76	-4.94	-5.00
90	-4.13	-4.13	-4.13	-4.13	-4.13	-4.13	-4.14	-4.15	-4.17	-4.19	-4.25	-4.37	-4.57	-4.75	-4.93	-5.00
100	-4.23	-4.23	-4.23	-4.23	-4.23	-4.23	-4.23	-4.25	-4.26	-4.28	-4.33	-4.42	-4.59	-4.74	-4.93	-5.00
200	-4.64	-4.64	-4.64	-4.64	-4.64	-4.64	-4.64	-4.64	-4.64	-4.65	-4.66	-4.68	-4.73	-4.78	-4.89	-4.98

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	10	-5.0	10

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
10	10.00	9.09	8.26	7.50	6.79	6.14	3.26	-.30	-1.76	-2.92	-4.14	-4.79	-4.98	-5.00	-5.00	-5.00
20	10.00	9.20	8.47	7.80	7.18	6.60	4.18	.76	-.88	-1.85	-3.21	-4.30	-4.87	-4.98	-5.00	-5.00
30	10.00	9.26	8.59	7.97	7.39	6.86	4.66	1.73	-.22	-1.34	-2.77	-3.92	-4.70	-4.93	-5.00	-5.00
33	3.05	3.00	2.96	2.88	2.80	2.72	2.25	.97	-.17	-1.13	-2.59	-3.81	-4.66	-4.91	-4.99	-5.00
36	1.16	1.14	1.12	1.08	1.04	1.00	.76	.30	-.23	-1.31	-2.51	-3.71	-4.60	-4.89	-4.99	-5.00
39	.33	.32	.32	.30	.29	.28	.21	.07	-.40	-1.38	-2.50	-3.64	-4.55	-4.87	-4.99	-5.00
42	.09	.09	.09	.08	.08	.08	.06	.02	-.54	-1.38	-2.46	-3.58	-4.51	-4.85	-4.99	-5.00
45	.03	.02	.02	.02	.02	.02	.02	.00	-.64	-1.37	-2.45	-3.53	-4.46	-4.83	-4.98	-5.00
51	.00	.00	.00	.00	.00	.00	.00	-.15	-.77	-1.33	-2.39	-3.44	-4.38	-4.78	-4.97	-5.00
60	.00	.00	.00	.00	.00	.00	.00	-.56	-1.18	-1.68	-2.48	-3.36	-4.28	-4.71	-4.96	-5.00
70	.00	.00	.00	.00	.00	.00	-.34	-.99	-1.49	-1.90	-2.57	-3.34	-4.19	-4.64	-4.94	-5.00
80	-1.22	-1.23	-1.24	-1.26	-1.28	-1.29	-1.38	-1.61	-1.89	-2.17	-2.70	-3.36	-4.14	-4.59	-4.92	-5.00
90	-2.32	-2.32	-2.32	-2.33	-2.33	-2.34	-2.37	-2.44	-2.55	-2.67	-2.96	-3.44	-4.11	-4.54	-4.90	-5.00
100	-2.81	-2.81	-2.81	-2.82	-2.82	-2.82	-2.84	-2.89	-2.95	-3.03	-3.22	-3.56	-4.10	-4.50	-4.88	-5.00
200	-4.15	-4.15	-4.15	-4.15	-4.15	-4.15	-4.15	-4.16	-4.17	-4.18	-4.20	-4.26	-4.39	-4.53	-4.77	-4.97
300	-4.46	-4.46	-4.46	-4.46	-4.46	-4.46	-4.46	-4.47	-4.47	-4.47	-4.49	-4.51	-4.56	-4.63	-4.76	-4.94
400	-4.61	-4.61	-4.61	-4.61	-4.61	-4.61	-4.61	-4.61	-4.61	-4.61	-4.62	-4.63	-4.66	-4.70	-4.79	-4.93
500	-4.69	-4.69	-4.69	-4.69	-4.69	-4.69	-4.69	-4.69	-4.69	-4.69	-4.70	-4.71	-4.72	-4.75	-4.81	-4.92
600	-4.74	-4.74	-4.74	-4.74	-4.74	-4.74	-4.74	-4.74	-4.75	-4.75	-4.75	-4.75	-4.77	-4.78	-4.83	-4.91

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-5.0	30

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

R

TAU	1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
10	10.00	9.09	8.26	7.50	6.79	6.14	3.26	-.30	-1.76	-2.92	-4.14	-4.79	-4.98	-5.00	-5.00	-5.00
20	10.00	9.20	8.47	7.80	7.18	6.60	4.18	.76	-.88	-1.85	-3.21	-4.30	-4.87	-4.98	-5.00	-5.00
30	10.00	9.26	8.59	7.97	7.39	6.86	4.66	1.73	-.22	-1.34	-2.77	-3.92	-4.70	-4.93	-5.00	-5.00
40	10.00	9.35	8.76	8.22	7.71	7.24	5.30	2.12	-.01	-.47	-2.12	-3.53	-4.53	-4.86	-4.99	-5.00
50	10.00	9.38	8.81	8.28	7.80	7.35	5.46	2.81	.21	-.65	-1.80	-3.20	-4.34	-4.76	-4.98	-5.00
60	10.00	9.38	8.81	8.28	7.80	7.35	5.46	2.81	.77	-.43	-1.65	-2.98	-4.17	-4.69	-4.96	-5.00
70	10.00	9.38	8.81	8.28	7.80	7.35	5.46	2.81	1.07	-.16	-1.56	-2.82	-4.02	-4.60	-4.94	-5.00
80	10.00	9.38	8.81	8.28	7.80	7.35	5.46	2.81	1.26	.18	-1.48	-2.70	-3.90	-4.51	-4.91	-5.00
90	10.00	9.40	8.85	8.35	7.88	7.45	5.65	3.15	1.56	.38	-1.29	-2.59	-3.79	-4.42	-4.88	-5.00
100	10.00	9.44	8.93	8.45	8.02	7.61	5.92	3.55	1.82	.45	-.93	-2.37	-3.68	-4.35	-4.85	-5.00
110	1.64	1.63	1.61	1.59	1.57	1.55	1.42	1.05	.57	.14	-.99	-2.23	-3.56	-4.26	-4.82	-5.00
120	.24	.24	.24	.23	.23	.23	.20	.13	.06	.01	-1.20	-2.27	-3.47	-4.19	-4.79	-4.99
130	.03	.03	.03	.03	.03	.03	.03	.02	.01	-.18	-1.22	-2.27	-3.42	-4.12	-4.76	-4.99
140	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.39	-1.22	-2.25	-3.37	-4.07	-4.72	-4.99
150	.00	.00	.00	.00	.00	.00	.00	.00	-.13	-.63	-1.31	-2.23	-3.33	-4.02	-4.69	-4.98
170	.00	.00	.00	.00	.00	.00	.00	-.05	-.48	-.87	-1.58	-2.36	-3.30	-3.94	-4.63	-4.98
200	.00	.00	.00	.00	.00	-.03	-.29	-.76	-1.14	-1.45	-1.94	-2.53	-3.31	-3.87	-4.56	-4.96
300	-3.31	-3.31	-3.31	-3.31	-3.31	-3.31	-3.32	-3.33	-3.34	-3.36	-3.41	-3.51	-3.73	-3.98	-4.43	-4.90
400	-3.87	-3.87	-3.87	-3.88	-3.88	-3.88	-3.88	-3.88	-3.89	-3.90	-3.92	-3.96	-4.06	-4.19	-4.46	-4.84
500	-4.15	-4.15	-4.15	-4.15	-4.15	-4.15	-4.15	-4.15	-4.16	-4.16	-4.17	-4.20	-4.26	-4.33	-4.51	-4.81
600	-4.32	-4.32	-4.32	-4.32	-4.32	-4.32	-4.32	-4.32	-4.32	-4.32	-4.33	-4.35	-4.39	-4.44	-4.56	-4.79
700	-4.43	-4.43	-4.43	-4.43	-4.43	-4.43	-4.43	-4.43	-4.43	-4.43	-4.44	-4.45	-4.48	-4.51	-4.60	-4.79
800	-4.51	-4.51	-4.51	-4.51	-4.51	-4.51	-4.51	-4.51	-4.51	-4.51	-4.51	-4.52	-4.54	-4.57	-4.64	-4.79
900	-4.57	-4.57	-4.57	-4.57	-4.57	-4.57	-4.57	-4.57	-4.57	-4.57	-4.57	-4.58	-4.60	-4.62	-4.67	-4.80
1000	-4.61	-4.61	-4.61	-4.61	-4.61	-4.61	-4.61	-4.62	-4.62	-4.62	-4.62	-4.62	-4.64	-4.65	-4.70	-4.81

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	10	-5.0	100

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
100	10.00	9.44	8.93	8.45	8.02	7.61	5.92	3.55	1.82	.45	-.93	-2.37	-3.68	-4.35	-4.85	-5.00
200	10.00	9.49	9.02	8.59	8.20	7.83	6.28	4.11	2.57	1.39	-.23	-1.48	-2.80	-3.63	-4.50	-4.96
300	10.00	9.54	9.11	8.72	8.36	8.03	6.63	4.66	3.27	2.16	.38	-.85	-2.31	-3.21	-4.20	-4.88
330	.60	.60	.60	.59	.59	.58	.55	.46	.33	.22	.03	-1.10	-2.24	-3.09	-4.11	-4.85
360	.03	.03	.03	.03	.03	.03	.02	.02	.01	.01	-.14	-1.17	-2.27	-3.05	-4.04	-4.82
390	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.41	-1.18	-2.26	-3.01	-3.98	-4.79
420	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.04	-.76	-1.43	-2.31	-2.99	-3.93	-4.76
450	.00	.00	.00	.00	.00	.00	.00	.00	-.03	-.32	-.82	-1.54	-2.38	-3.00	-3.89	-4.73
510	.00	.00	.00	.00	.00	.00	-.03	-.40	-.69	-.95	-1.39	-1.89	-2.54	-3.06	-3.84	-4.67
600	-2.45	-2.45	-2.45	-2.45	-2.45	-2.45	-2.45	-2.47	-2.49	-2.51	-2.57	-2.69	-2.96	-3.26	-3.84	-4.60
700	-3.14	-3.14	-3.14	-3.14	-3.14	-3.14	-3.14	-3.15	-3.16	-3.17	-3.19	-3.25	-3.38	-3.55	-3.92	-4.55
800	-3.50	-3.50	-3.50	-3.50	-3.50	-3.51	-3.51	-3.51	-3.51	-3.52	-3.54	-3.57	-3.66	-3.76	-4.02	-4.52
900	-3.74	-3.74	-3.74	-3.74	-3.74	-3.74	-3.74	-3.75	-3.75	-3.75	-3.77	-3.79	-3.85	-3.93	-4.12	-4.52
1000	-3.91	-3.91	-3.91	-3.91	-3.91	-3.91	-3.91	-3.92	-3.92	-3.92	-3.93	-3.95	-3.99	-4.05	-4.20	-4.53
2000	-4.56	-4.56	-4.56	-4.56	-4.56	-4.56	-4.56	-4.56	-4.56	-4.56	-4.56	-4.56	-4.57	-4.59	-4.62	-4.72

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	10	-5.0	300

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R = 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
100	10.00	9.44	8.93	8.45	8.02	7.61	5.92	3.55	1.82	.45	-.93	-2.37	-3.68	-4.35	-4.85	-5.00
200	10.00	9.49	9.02	8.59	8.20	7.83	6.28	4.11	2.57	1.39	-.23	-1.48	-2.80	-3.63	-4.50	-4.96
300	10.00	9.54	9.11	8.72	8.36	8.03	6.63	4.66	3.27	2.16	.38	-.85	-2.31	-3.21	-4.20	-4.88
400	10.00	9.57	9.17	8.80	8.47	8.15	6.84	5.00	3.69	2.68	.78	-.65	-1.81	-2.77	-3.91	-4.78
500	10.00	9.57	9.17	8.81	8.47	8.16	6.85	5.01	3.70	2.69	1.07	-.45	-1.63	-2.53	-3.67	-4.67
600	10.00	9.57	9.17	8.81	8.47	8.16	6.85	5.01	3.70	2.69	1.20	-.21	-1.53	-2.38	-3.49	-4.56
700	10.00	9.57	9.17	8.81	8.47	8.16	6.85	5.01	3.70	2.69	1.27	.13	-1.46	-2.27	-3.36	-4.45
800	10.00	9.59	9.22	8.88	8.57	8.28	7.05	5.33	4.11	3.17	1.74	.22	-1.14	-2.07	-3.22	-4.36
900	10.00	9.61	9.25	8.92	8.61	8.33	7.14	5.47	4.28	3.36	1.93	.25	-.90	-1.84	-3.06	-4.27
1000	10.00	9.61	9.26	8.94	8.64	8.36	7.19	5.55	4.39	3.48	2.05	.26	-.72	-1.67	-2.91	-4.18
1100	.09	.09	.09	.09	.09	.09	.09	.08	.07	.06	.03	.00	-1.13	-1.80	-2.84	-4.10
1200	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.37	-1.19	-1.87	-2.84	-4.03
1300	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.16	-.75	-1.47	-2.01	-2.86	-3.98
1400	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.17	-.56	-1.08	-1.68	-2.15	-2.91	-3.95
1500	.00	.00	.00	.00	.00	.00	-.11	-.43	-.65	-.82	-1.11	-1.46	-1.93	-2.32	-2.97	-3.93
1600	-1.97	-1.97	-1.97	-1.97	-1.97	-1.97	-1.97	-1.98	-2.00	-2.01	-2.06	-2.14	-2.34	-2.57	-3.07	-3.92
1700	-2.50	-2.50	-2.50	-2.50	-2.50	-2.50	-2.50	-2.51	-2.52	-2.52	-2.55	-2.60	-2.71	-2.86	-3.22	-3.94
1800	-2.83	-2.83	-2.83	-2.83	-2.83	-2.83	-2.83	-2.84	-2.84	-2.85	-2.86	-2.90	-2.98	-3.09	-3.36	-3.97
1900	-3.07	-3.07	-3.07	-3.07	-3.07	-3.07	-3.07	-3.07	-3.08	-3.08	-3.09	-3.12	-3.18	-3.27	-3.49	-4.01
2000	-3.26	-3.26	-3.26	-3.26	-3.26	-3.26	-3.26	-3.26	-3.26	-3.27	-3.28	-3.30	-3.35	-3.42	-3.60	-4.05
3000	-4.18	-4.18	-4.18	-4.18	-4.18	-4.18	-4.18	-4.18	-4.18	-4.19	-4.19	-4.20	-4.21	-4.24	-4.30	-4.48
4000	-4.57	-4.57	-4.57	-4.57	-4.57	-4.57	-4.57	-4.57	-4.57	-4.57	-4.58	-4.58	-4.59	-4.60	-4.63	-4.72

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-5.0	1000

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
1	10.00	7.17	4.58	2.20	-.00	-.32	-3.58	-8.28	-9.58	-9.93	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
2	10.00	8.16	6.49	4.53	2.72	1.04	-2.42	-6.51	-8.60	-9.55	-9.96	-10.00	-10.00	-10.00	-10.00	-10.00
3	10.00	8.16	6.49	5.33	4.26	3.27	-.93	-5.66	-7.86	-9.07	-9.85	-9.99	-10.00	-10.00	-10.00	-10.00
4	10.00	8.51	7.15	5.99	4.91	3.90	-.27	-4.91	-7.28	-8.63	-9.70	-9.97	-10.00	-10.00	-10.00	-10.00
5	10.00	8.65	7.41	6.20	5.08	4.04	-.17	-4.12	-6.68	-8.21	-9.53	-9.94	-10.00	-10.00	-10.00	-10.00
6	10.00	8.72	7.56	6.32	5.18	4.12	-.11	-3.53	-6.15	-7.80	-9.34	-9.90	-10.00	-10.00	-10.00	-10.00
7	10.00	8.78	7.66	6.41	5.25	4.17	-.06	-3.07	-5.71	-7.42	-9.14	-9.85	-9.99	-10.00	-10.00	-10.00
8	10.00	8.82	7.74	6.47	5.30	4.22	-.03	-2.69	-5.33	-7.08	-8.94	-9.79	-9.99	-10.00	-10.00	-10.00
9	10.00	8.85	7.80	6.84	5.96	5.13	-.12	-2.70	-5.00	-6.78	-8.74	-9.73	-9.98	-10.00	-10.00	-10.00
10	10.00	8.88	7.87	6.93	6.06	5.26	.16	-2.50	-4.75	-6.51	-8.55	-9.66	-9.97	-10.00	-10.00	-10.00
11	3.59	3.42	3.27	2.98	2.70	2.45	.07	-2.38	-4.55	-6.29	-8.37	-9.58	-9.96	-10.00	-10.00	-10.00
12	1.26	1.16	1.07	.90	.73	.58	-.12	-2.49	-4.50	-6.11	-8.21	-9.50	-9.94	-10.00	-10.00	-10.00
13	.14	.12	.11	.09	.07	.05	-.54	-2.94	-4.65	-6.06	-8.07	-9.42	-9.93	-9.99	-10.00	-10.00
14	.01	.01	.01	.01	.00	.00	-1.00	-3.10	-4.74	-6.05	-7.96	-9.35	-9.91	-9.99	-10.00	-10.00
15	.00	.00	.00	.00	-.02	-.27	-1.31	-3.19	-4.78	-6.04	-7.87	-9.28	-9.89	-9.99	-10.00	-10.00
16	.00	.00	.00	-.26	-.53	-.79	-1.86	-3.50	-4.89	-6.04	-7.80	-9.21	-9.88	-9.99	-10.00	-10.00
17	-.30	-.44	-.57	-.77	-.96	-1.13	-2.06	-3.68	-4.99	-6.07	-7.74	-9.15	-9.86	-9.98	-10.00	-10.00
18	-2.06	-2.12	-2.17	-2.26	-2.35	-2.42	-2.90	-3.99	-5.12	-6.11	-7.70	-9.09	-9.84	-9.98	-10.00	-10.00
19	-3.02	-3.06	-3.10	-3.16	-3.21	-3.26	-3.59	-4.39	-5.31	-6.18	-7.66	-9.03	-9.82	-9.97	-10.00	-10.00
20	-3.70	-3.73	-3.76	-3.80	-3.85	-3.89	-4.14	-4.77	-5.53	-6.28	-7.65	-8.99	-9.80	-9.97	-10.00	-10.00
30	-6.57	-6.57	-6.58	-6.59	-6.60	-6.61	-6.68	-6.85	-7.08	-7.35	-7.94	-8.78	-9.61	-9.90	-9.99	-10.00
40	-7.59	-7.59	-7.59	-7.60	-7.60	-7.61	-7.64	-7.72	-7.84	-7.98	-8.31	-8.83	-9.51	-9.83	-9.98	-10.00
50	-8.13	-8.14	-8.14	-8.14	-8.14	-8.15	-8.17	-8.22	-8.29	-8.37	-8.58	-8.93	-9.46	-9.78	-9.97	-10.00
60	-8.48	-8.48	-8.48	-8.48	-8.48	-8.49	-8.50	-8.53	-8.58	-8.64	-8.78	-9.04	-9.45	-9.74	-9.96	-10.00
70	-8.71	-8.71	-8.72	-8.72	-8.72	-8.72	-8.73	-8.75	-8.79	-8.83	-8.93	-9.12	-9.46	-9.71	-9.94	-10.00
80	-8.89	-8.89	-8.89	-8.89	-8.89	-8.89	-8.90	-8.92	-8.94	-8.97	-9.05	-9.20	-9.48	-9.70	-9.93	-10.00
90	-9.02	-9.02	-9.02	-9.02	-9.02	-9.02	-9.03	-9.04	-9.06	-9.08	-9.15	-9.27	-9.50	-9.69	-9.92	-10.00
100	-9.12	-9.12	-9.12	-9.12	-9.12	-9.12	-9.13	-9.14	-9.16	-9.18	-9.23	-9.32	-9.52	-9.69	-9.91	-10.00
200	-9.57	-9.57	-9.57	-9.57	-9.57	-9.57	-9.57	-9.58	-9.58	-9.59	-9.60	-9.62	-9.68	-9.74	-9.86	-9.98

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-10.0	10

TEMPERATURES IN RADIAL HEAT FLOW
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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
10	10.00	8.88	7.87	6.93	6.06	5.26	.16	-2.50	-4.75	-6.51	-8.55	-9.66	-9.97	-10.00	-10.00	-10.00
20	10.00	9.00	8.08	7.24	6.47	5.74	2.94	-.97	-3.50	-5.14	-7.27	-8.91	-9.79	-9.97	-10.00	-10.00
30	10.00	9.11	8.30	7.55	6.86	6.22	3.33	-.41	-2.34	-4.02	-6.32	-8.26	-9.53	-9.89	-9.99	-10.00
33	1.40	1.34	1.29	1.18	1.07	.98	.53	-.76	-2.64	-3.97	-6.12	-8.08	-9.45	-9.86	-9.99	-10.00
36	.09	.08	.08	.07	.07	.06	.02	-1.32	-2.89	-4.13	-6.05	-7.93	-9.37	-9.83	-9.99	-10.00
39	.00	.00	.00	.00	.00	.00	-.28	-1.87	-3.10	-4.19	-6.00	-7.82	-9.29	-9.80	-9.98	-10.00
42	.00	.00	.00	.00	-.01	-.16	-.90	-2.28	-3.45	-4.42	-6.02	-7.73	-9.21	-9.76	-9.98	-10.00
45	-.91	-.98	-1.04	-1.14	-1.23	-1.32	-1.81	-2.85	-3.81	-4.64	-6.07	-7.67	-9.14	-9.72	-9.97	-10.00
51	-3.98	-3.99	-4.00	-4.02	-4.04	-4.06	-4.18	-4.48	-4.89	-5.33	-6.30	-7.62	-9.02	-9.65	-9.96	-10.00
60	-5.58	-5.59	-5.60	-5.61	-5.61	-5.62	-5.68	-5.82	-6.02	-6.26	-6.82	-7.72	-8.91	-9.55	-9.93	-10.00
70	-6.52	-6.53	-6.53	-6.53	-6.54	-6.54	-6.58	-6.66	-6.78	-6.93	-7.29	-7.91	-8.86	-9.46	-9.91	-10.00
80	-7.12	-7.12	-7.12	-7.12	-7.13	-7.13	-7.15	-7.21	-7.29	-7.39	-7.64	-8.09	-8.85	-9.40	-9.88	-10.00
90	-7.53	-7.53	-7.53	-7.53	-7.54	-7.54	-7.55	-7.60	-7.66	-7.73	-7.92	-8.26	-8.88	-9.37	-9.85	-10.00
100	-7.83	-7.84	-7.84	-7.84	-7.84	-7.84	-7.85	-7.89	-7.93	-7.99	-8.13	-8.41	-8.92	-9.35	-9.82	-10.00
200	-9.02	-9.03	-9.03	-9.03	-9.03	-9.03	-9.03	-9.04	-9.04	-9.06	-9.09	-9.15	-9.28	-9.44	-9.71	-9.96
300	-9.37	-9.37	-9.37	-9.37	-9.37	-9.37	-9.37	-9.37	-9.38	-9.38	-9.40	-9.42	-9.48	-9.56	-9.72	-9.93
400	-9.53	-9.53	-9.53	-9.53	-9.53	-9.53	-9.53	-9.54	-9.54	-9.54	-9.55	-9.56	-9.60	-9.64	-9.74	-9.91
500	-9.63	-9.63	-9.63	-9.63	-9.63	-9.63	-9.63	-9.63	-9.63	-9.63	-9.64	-9.65	-9.67	-9.70	-9.77	-9.90
600	-9.69	-9.69	-9.69	-9.69	-9.69	-9.69	-9.69	-9.69	-9.70	-9.70	-9.70	-9.71	-9.72	-9.74	-9.79	-9.89

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-10.0	30

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

R

TAU	1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
10	10.00	8.88	7.87	6.93	6.06	5.26	.16	-2.50	-4.75	-6.51	-8.55	-9.66	-9.97	-10.00	-10.00	-10.00
20	10.00	9.00	8.08	7.24	6.47	5.74	2.94	-.97	-3.50	-5.14	-7.27	-8.91	-9.79	-9.97	-10.00	-10.00
30	10.00	9.11	8.30	7.55	6.86	6.22	3.33	-.41	-2.34	-4.02	-6.32	-8.26	-9.53	-9.89	-9.99	-10.00
40	10.00	9.16	8.39	7.69	7.03	6.43	3.50	-.13	-1.71	-3.34	-5.64	-7.70	-9.25	-9.78	-9.98	-10.00
50	10.00	9.20	8.47	7.80	7.18	6.60	4.18	-.31	-1.67	-2.89	-5.13	-7.24	-8.98	-9.65	-9.96	-10.00
60	10.00	9.20	8.47	7.80	7.18	6.60	4.18	.37	-1.39	-2.70	-4.82	-6.89	-8.72	-9.51	-9.93	-10.00
70	10.00	9.20	8.47	7.80	7.18	6.60	4.18	1.06	-1.03	-2.57	-4.59	-6.61	-8.49	-9.37	-9.90	-10.00
80	10.00	9.20	8.47	7.80	7.18	6.60	4.20	1.44	-.44	-2.47	-4.42	-6.39	-8.29	-9.23	-9.86	-10.00
90	10.00	9.26	8.59	7.97	7.40	6.87	4.65	1.71	-.34	-2.05	-4.15	-6.18	-8.11	-9.10	-9.82	-10.00
100	10.00	9.28	8.63	8.03	7.47	6.95	4.79	1.80	-.28	-1.79	-3.88	-5.95	-7.93	-8.98	-9.77	-9.99
110	.17	.17	.16	.16	.15	.15	.11	.03	-.96	-2.16	-3.92	-5.80	-7.77	-8.85	-9.72	-9.99
120	.00	.00	.00	.00	.00	.00	.00	-.86	-1.86	-2.70	-4.08	-5.75	-7.64	-8.74	-9.67	-9.99
130	.00	.00	.00	-.13	-.29	-.44	-1.04	-1.92	-2.65	-3.29	-4.42	-5.83	-7.56	-8.64	-9.62	-9.99
140	-3.32	-3.33	-3.34	-3.35	-3.36	-3.37	-3.44	-3.64	-3.90	-4.21	-4.91	-6.00	-7.52	-8.56	-9.57	-9.98
150	-4.52	-4.53	-4.53	-4.54	-4.55	-4.55	-4.59	-4.70	-4.85	-5.03	-5.48	-6.26	-7.54	-8.50	-9.52	-9.98
170	-5.80	-5.80	-5.80	-5.81	-5.81	-5.81	-5.83	-5.89	-5.97	-6.07	-6.31	-6.79	-7.67	-8.46	-9.44	-9.96
200	-6.81	-6.81	-6.81	-6.82	-6.82	-6.82	-6.83	-6.86	-6.90	-6.96	-7.09	-7.37	-7.93	-8.50	-9.35	-9.94
300	-8.18	-8.18	-8.18	-8.18	-8.18	-8.18	-8.19	-8.19	-8.21	-8.22	-8.27	-8.36	-8.56	-8.80	-9.29	-9.85
400	-8.72	-8.72	-8.72	-8.72	-8.72	-8.72	-8.72	-8.72	-8.73	-8.74	-8.76	-8.81	-8.91	-9.04	-9.34	-9.79
500	-9.01	-9.01	-9.01	-9.01	-9.01	-9.01	-9.01	-9.01	-9.01	-9.02	-9.03	-9.06	-9.13	-9.21	-9.40	-9.76
600	-9.19	-9.19	-9.19	-9.19	-9.19	-9.19	-9.19	-9.19	-9.19	-9.20	-9.21	-9.23	-9.27	-9.33	-9.47	-9.74
700	-9.31	-9.32	-9.32	-9.32	-9.32	-9.32	-9.32	-9.32	-9.32	-9.32	-9.33	-9.34	-9.37	-9.41	-9.52	-9.74
800	-9.41	-9.41	-9.41	-9.41	-9.41	-9.41	-9.41	-9.41	-9.41	-9.41	-9.42	-9.43	-9.45	-9.48	-9.56	-9.74
900	-9.48	-9.48	-9.48	-9.48	-9.48	-9.48	-9.48	-9.48	-9.48	-9.48	-9.48	-9.49	-9.51	-9.54	-9.60	-9.75
1000	-9.53	-9.53	-9.53	-9.53	-9.53	-9.53	-9.53	-9.53	-9.54	-9.54	-9.54	-9.55	-9.56	-9.58	-9.63	-9.76

LATENT HEAT DENSITY	TEMPERATURE		TAU_o
	SOURCE	INITIAL	
30	10	-10.0	100

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R: 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
100	10.00	9.28	8.63	8.03	7.47	6.95	4.79	1.80	-.28	-1.79	-3.88	-5.95	-7.93	-8.98	-9.77	-9.99
200	10.00	9.36	8.77	8.23	7.74	7.27	5.34	2.14	-.03	-.59	-2.53	-4.53	-6.64	-7.93	-9.25	-9.94
300	10.00	9.38	8.81	8.28	7.80	7.35	5.46	2.81	1.14	-.10	-2.14	-3.95	-5.94	-7.25	-8.77	-9.82
330	.00	.00	.00	.00	.00	.00	.00	.00	-.65	-1.40	-2.59	-4.01	-5.83	-7.11	-8.64	-9.78
360	-1.19	-1.21	-1.23	-1.26	-1.28	-1.31	-1.46	-1.84	-2.27	-2.68	-3.46	-4.49	-5.92	-7.04	-8.53	-9.73
390	-4.24	-4.24	-4.24	-4.25	-4.25	-4.25	-4.27	-4.33	-4.41	-4.51	-4.77	-5.25	-6.19	-7.09	-8.46	-9.68
420	-5.29	-5.30	-5.30	-5.30	-5.30	-5.30	-5.31	-5.35	-5.39	-5.45	-5.60	-5.91	-6.54	-7.22	-8.42	-9.64
450	-5.96	-5.96	-5.96	-5.96	-5.96	-5.96	-5.97	-5.99	-6.03	-6.07	-6.17	-6.39	-6.86	-7.39	-8.41	-9.59
510	-6.80	-6.80	-6.80	-6.80	-6.80	-6.80	-6.81	-6.82	-6.84	-6.86	-6.93	-7.05	-7.35	-7.70	-8.45	-9.51
600	-7.53	-7.53	-7.53	-7.53	-7.53	-7.53	-7.53	-7.54	-7.55	-7.56	-7.60	-7.68	-7.85	-8.07	-8.58	-9.44
700	-8.02	-8.02	-8.02	-8.02	-8.02	-8.02	-8.02	-8.02	-8.03	-8.04	-8.06	-8.11	-8.22	-8.37	-8.72	-9.40
800	-8.34	-8.34	-8.34	-8.34	-8.34	-8.34	-8.34	-8.34	-8.35	-8.35	-8.37	-8.40	-8.48	-8.59	-8.85	-9.39
900	-8.57	-8.57	-8.57	-8.57	-8.57	-8.57	-8.57	-8.57	-8.58	-8.58	-8.59	-8.62	-8.68	-8.76	-8.95	-9.40
1000	-8.74	-8.74	-8.74	-8.74	-8.74	-8.74	-8.74	-8.75	-8.75	-8.75	-8.76	-8.78	-8.83	-8.89	-9.05	-9.41
2000	-9.47	-9.47	-9.47	-9.47	-9.47	-9.47	-9.47	-9.47	-9.47	-9.47	-9.47	-9.47	-9.49	-9.50	-9.54	-9.66

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	10	-10.0	300

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
100	10.00	9.28	8.63	8.03	7.47	6.95	4.79	1.80	-.28	-1.79	-3.88	-5.95	-7.93	-8.98	-9.77	-9.99
200	10.00	9.36	8.77	8.23	7.74	7.27	5.34	2.14	-.03	-.59	-2.53	-4.53	-6.64	-7.93	-9.25	-9.94
300	10.00	9.38	8.81	8.28	7.80	7.35	5.46	2.81	1.14	-.10	-2.14	-3.95	-5.94	-7.25	-8.77	-9.82
400	10.00	9.42	8.89	8.49	7.95	7.53	5.79	3.32	1.66	.41	-1.60	-3.45	-5.46	-6.79	-8.38	-9.67
500	10.00	9.44	8.93	8.45	8.02	7.61	5.92	3.53	1.80	.44	-1.26	-3.06	-5.05	-6.39	-8.05	-9.50
600	10.00	9.45	8.95	8.49	8.06	7.67	6.01	3.68	1.89	.47	-1.00	-2.77	-4.74	-6.07	-7.77	-9.34
700	10.00	9.46	8.97	8.52	8.10	7.71	6.08	3.79	1.97	.49	-.80	-2.54	-4.48	-5.81	-7.52	-9.19
800	10.00	9.47	8.99	8.54	8.13	7.75	6.15	3.89	2.04	.50	-.63	-2.35	-4.26	-5.58	-7.30	-9.04
900	10.00	9.48	9.00	8.56	8.15	7.78	6.20	3.98	2.09	.51	-.49	-2.18	-4.08	-5.39	-7.11	-8.90
1000	10.00	9.49	9.02	8.59	8.19	7.82	6.28	4.11	2.56	.92	-.78	-2.04	-3.92	-5.22	-6.95	-8.78
1100	.00	-.00	-.09	-.17	-.25	-.32	-.66	-1.20	-1.60	-1.95	-2.54	-3.31	-4.41	-5.36	-6.85	-8.66
1200	-4.69	-4.69	-4.70	-4.70	-4.70	-4.70	-4.71	-4.72	-4.75	-4.78	-4.87	-5.05	-5.46	-5.94	-6.97	-8.57
1300	-5.78	-5.79	-5.79	-5.79	-5.79	-5.79	-5.79	-5.80	-5.82	-5.83	-5.88	-5.98	-6.21	-6.51	-7.21	-8.53
1400	-6.44	-6.44	-6.44	-6.44	-6.44	-6.44	-6.45	-6.45	-6.46	-6.47	-6.51	-6.57	-6.73	-6.94	-7.45	-8.53
1500	-6.90	-6.90	-6.90	-6.90	-6.90	-6.90	-6.91	-6.91	-6.92	-6.93	-6.95	-7.00	-7.12	-7.27	-7.67	-8.57
1600	-7.25	-7.25	-7.25	-7.25	-7.25	-7.25	-7.25	-7.26	-7.26	-7.27	-7.29	-7.33	-7.42	-7.54	-7.86	-8.62
1700	-7.53	-7.53	-7.53	-7.53	-7.53	-7.53	-7.53	-7.53	-7.54	-7.54	-7.56	-7.59	-7.66	-7.76	-8.03	-8.69
1800	-7.75	-7.75	-7.75	-7.75	-7.75	-7.75	-7.76	-7.76	-7.76	-7.77	-7.78	-7.80	-7.87	-7.95	-8.18	-8.75
1900	-7.94	-7.94	-7.94	-7.94	-7.94	-7.94	-7.95	-7.95	-7.95	-7.95	-7.97	-7.99	-8.04	-8.11	-8.31	-8.82
2000	-8.11	-8.11	-8.11	-8.11	-8.11	-8.11	-8.11	-8.11	-8.11	-8.12	-8.13	-8.15	-8.19	-8.26	-8.43	-8.88
3000	-9.06	-9.06	-9.06	-9.06	-9.06	-9.06	-9.06	-9.06	-9.06	-9.07	-9.07	-9.08	-9.10	-9.12	-9.19	-9.40
4000	-9.51	-9.51	-9.51	-9.51	-9.51	-9.51	-9.51	-9.51	-9.51	-9.51	-9.51	-9.51	-9.52	-9.54	-9.58	-9.68

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	10	-10.0	1000

TEMPERATURES IN RADIAL HEAT FLOW
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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
1	30.00	26.38	23.07	20.13	17.40	14.87	5.30	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
2	30.00	26.96	24.19	21.71	19.41	17.27	9.20	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01
3	30.00	27.42	25.06	22.92	20.93	19.09	11.63	2.18	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01
4	30.00	27.55	25.32	23.26	21.37	19.60	12.30	4.02	-.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01
5	30.00	27.65	25.50	23.53	21.72	20.03	13.19	4.73	-.00	-.00	-.01	-.01	-.01	-.01	-.01	-.01
6	30.00	27.81	25.81	23.99	22.30	20.73	14.36	6.25	.59	-.00	-.01	-.01	-.01	-.01	-.01	-.01
7	30.00	27.94	26.05	24.33	22.73	21.24	15.16	7.13	1.67	-.00	-.01	-.01	-.01	-.01	-.01	-.01
8	30.00	28.01	26.20	24.53	22.99	21.56	15.65	7.65	2.52	-.00	-.01	-.01	-.01	-.01	-.01	-.01
9	30.00	28.06	26.29	24.66	23.15	21.75	15.95	7.97	3.15	-.00	-.01	-.01	-.01	-.01	-.01	-.01
10	30.00	28.09	26.34	24.74	23.25	21.87	16.13	8.15	3.60	.46	-.01	-.01	-.01	-.01	-.01	-.01
11	18.97	18.67	18.39	17.84	17.34	16.87	13.99	7.91	2.87	.16	-.00	-.01	-.01	-.01	-.01	-.01
12	14.39	14.21	14.05	13.73	13.43	13.15	11.36	7.23	3.52	.81	-.00	-.01	-.01	-.01	-.01	-.01
13	11.51	11.39	11.28	11.06	10.86	10.67	9.46	6.56	3.74	1.21	-.00	-.01	-.01	-.01	-.01	-.01
14	9.53	9.44	9.37	9.21	9.07	8.94	8.07	5.93	3.70	1.44	-.00	-.01	-.01	-.01	-.01	-.01
15	8.10	8.03	7.98	7.86	7.75	7.65	7.00	5.36	3.53	1.54	-.00	-.01	-.01	-.01	-.01	-.01
16	7.01	6.96	6.91	6.82	6.74	6.66	6.15	4.83	3.29	1.56	-.00	-.01	-.01	-.01	-.01	-.01
17	6.19	6.15	6.11	6.04	5.97	5.90	5.48	4.38	3.05	1.52	-.00	-.01	-.01	-.01	-.01	-.01
18	5.47	5.44	5.41	5.35	5.29	5.24	4.89	3.95	2.79	1.45	-.00	-.01	-.01	-.01	-.01	-.01
19	4.87	4.84	4.82	4.77	4.72	4.67	4.37	3.56	2.54	1.36	-.00	-.01	-.01	-.01	-.01	-.01
20	4.36	4.33	4.31	4.27	4.22	4.18	3.92	3.21	2.30	1.26	-.00	-.01	-.01	-.01	-.01	-.01
30	1.52	1.51	1.51	1.49	1.48	1.46	1.38	1.14	.83	.49	-.00	-.01	-.01	-.01	-.01	-.01
40	.54	.54	.54	.53	.53	.52	.49	.41	.29	.18	-.00	-.00	-.01	-.01	-.01	-.01
50	.19	.19	.19	.19	.19	.19	.17	.14	.10	.06	-.00	-.00	-.01	-.01	-.01	-.01
60	.07	.07	.07	.07	.07	.07	.06	.05	.04	.02	-.00	-.00	-.01	-.01	-.01	-.01
70	.02	.02	.02	.02	.02	.02	.02	.02	.01	.01	-.00	-.00	-.01	-.01	-.01	-.01
80	.01	.01	.01	.01	.01	.01	.01	.01	.00	.00	-.00	-.00	-.01	-.01	-.01	-.01
90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01	-.01	-.01
100	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01	-.01	-.01
200	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01	-.01	-.01
300	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01
400	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01
500	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01
600	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01
700	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01
800	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01
900	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01	-.01
1000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.00	-.01	-.01

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-.01	10

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
10	30.00	28.09	26.34	24.74	23.25	21.87	16.13	8.15	3.60	.46	-.01	-.01	-.01	-.01	-.01	-.01
20	30.00	28.39	26.92	25.57	24.33	23.16	18.33	11.63	7.07	3.70	-.00	-.01	-.01	-.01	-.01	-.01
30	30.00	28.47	27.07	25.79	24.60	23.49	18.88	12.47	8.11	5.00	.95	-.00	-.01	-.01	-.01	-.01
33	15.23	15.13	15.04	14.85	14.67	14.51	13.46	10.84	7.99	5.53	1.53	-.00	-.01	-.01	-.01	-.01
36	11.02	10.97	10.92	10.83	10.74	10.66	10.12	8.71	6.97	5.25	1.85	-.00	-.01	-.01	-.01	-.01
39	8.66	8.63	8.60	8.54	8.48	8.43	8.09	7.16	5.96	4.69	1.92	-.00	-.01	-.01	-.01	-.01
42	7.08	7.05	7.03	6.99	6.95	6.91	6.67	5.99	5.09	4.09	1.82	-.00	-.01	-.01	-.01	-.01
45	5.90	5.88	5.87	5.84	5.81	5.78	5.59	5.06	4.34	3.53	1.66	-.00	-.01	-.01	-.01	-.01
51	4.24	4.23	4.21	4.19	4.17	4.15	4.03	3.67	3.18	2.61	1.29	-.00	-.01	-.01	-.01	-.01
60	2.63	2.62	2.61	2.60	2.59	2.58	2.50	2.28	1.98	1.63	.84	-.00	-.01	-.01	-.01	-.01
70	1.56	1.55	1.55	1.54	1.54	1.53	1.48	1.36	1.18	.97	.51	-.00	-.01	-.01	-.01	-.01
80	.92	.92	.92	.91	.91	.91	.88	.80	.70	.57	.30	-.00	-.01	-.01	-.01	-.01
90	.55	.55	.55	.54	.54	.54	.52	.48	.41	.34	.18	-.00	-.01	-.01	-.01	-.01
100	.33	.33	.32	.32	.32	.32	.31	.28	.25	.20	.11	-.00	-.00	-.01	-.01	-.01
200	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01	-.01
300	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01	-.01	-.01
400	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
500	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
600	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
700	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
800	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
900	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
1000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
2000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01
3000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.00	-.01	-.01

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	30	-.01	30

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

R

TAU	1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
10	30.00	28.09	26.34	24.74	23.25	21.87	16.13	8.15	3.60	.46	-.01	-.01	-.01	-.01	-.01	-.01
20	30.00	28.39	26.92	25.57	24.33	23.16	18.33	11.63	7.07	3.70	-.00	-.01	-.01	-.01	-.01	-.01
30	30.00	28.47	27.07	25.79	24.60	23.49	18.88	12.47	8.11	5.00	.95	-.00	-.01	-.01	-.01	-.01
40	30.00	28.60	27.32	26.14	25.05	24.04	19.82	13.94	9.91	6.91	2.55	-.00	-.01	-.01	-.01	-.01
50	30.00	28.66	27.44	26.32	25.28	24.31	20.28	14.62	10.66	7.64	3.32	-.00	-.01	-.01	-.01	-.01
60	30.00	28.69	27.49	26.39	25.36	24.41	20.45	14.88	10.94	7.91	3.69	.30	-.01	-.01	-.01	-.01
70	30.00	28.70	27.52	26.43	25.42	24.49	20.58	15.10	11.26	8.37	4.34	.67	-.00	-.01	-.01	-.01
80	30.00	28.75	27.61	26.56	25.59	24.69	20.92	15.65	11.98	9.21	5.32	1.37	-.00	-.01	-.01	-.01
90	30.00	28.79	27.69	26.68	25.74	24.87	21.23	16.13	12.56	9.85	5.94	1.91	-.00	-.01	-.01	-.01
100	30.00	28.82	27.75	26.76	25.84	24.99	21.44	16.45	12.94	10.26	6.33	2.32	-.00	-.01	-.01	-.01
110	12.22	12.19	12.16	12.11	12.07	12.02	11.72	10.91	9.81	8.59	5.99	2.52	-.00	-.01	-.01	-.01
120	8.47	8.45	8.44	8.42	8.39	8.37	8.22	7.79	7.19	6.49	4.83	2.28	-.00	-.01	-.01	-.01
130	6.28	6.27	6.27	6.25	6.23	6.22	6.12	5.84	5.43	4.95	3.76	1.87	-.00	-.01	-.01	-.01
140	4.76	4.75	4.75	4.74	4.72	4.71	4.64	4.44	4.14	3.78	2.90	1.48	-.00	-.01	-.01	-.01
150	3.64	3.64	3.63	3.62	3.61	3.60	3.55	3.40	3.17	2.90	2.23	1.16	-.00	-.00	-.01	-.01
170	2.14	2.14	2.13	2.13	2.12	2.12	2.09	2.00	1.87	1.71	1.31	.69	-.00	-.00	-.01	-.01
200	1.03	1.03	1.03	1.03	1.02	1.02	1.01	.98	.93	.87	.73	.50	-.00	-.00	-.01	-.01
300	.23	.23	.23	.23	.23	.23	.23	.22	.22	.21	.18	.14	.00	-.00	-.01	-.01
400	.06	.06	.06	.06	.06	.06	.06	.06	.06	.05	.05	.04	.00	-.00	-.01	-.01
500	.02	.02	.02	.02	.02	.02	.02	.02	.01	.01	.01	.01	.00	-.00	-.00	-.01
600	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01
700	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01
800	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01
900	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01
1000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01
2000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01
3000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01
4000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01
5000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.00	-.01

LATENT HEAT DENSITY	TEMPERATURE		TAU_c
	SOURCE	INITIAL	
30	30	-.01	100

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
100	30.00	28.82	27.75	26.76	25.84	24.99	21.44	16.45	12.94	10.26	6.33	2.32	-.00	-.01	-.01	-.01
200	30.00	28.94	27.98	27.09	26.27	25.51	22.32	17.84	14.68	12.25	8.66	5.06	.91	-.00	-.01	-.01
300	30.00	29.00	28.08	27.24	26.46	25.74	22.72	18.46	15.44	13.09	9.57	5.87	2.17	.02	-.01	-.01
330	9.31	9.30	9.29	9.27	9.26	9.25	9.15	8.89	8.51	8.06	6.93	4.97	1.99	.16	-.00	-.01
360	5.95	5.95	5.94	5.94	5.93	5.92	5.88	5.76	5.59	5.38	4.84	3.84	2.12	.39	-.00	-.01
390	4.28	4.27	4.27	4.27	4.26	4.26	4.24	4.17	4.07	3.95	3.65	3.05	1.91	.49	-.00	-.01
420	3.28	3.27	3.27	3.27	3.27	3.27	3.25	3.21	3.14	3.07	2.86	2.45	1.62	.49	-.00	-.01
450	2.59	2.59	2.59	2.59	2.59	2.59	2.57	2.54	2.50	2.44	2.29	1.99	1.34	.45	-.00	-.01
510	1.69	1.69	1.69	1.68	1.68	1.68	1.68	1.66	1.63	1.59	1.50	1.31	.90	.34	-.00	-.01
600	.91	.91	.90	.90	.90	.90	.90	.89	.87	.86	.81	.71	.48	.20	-.00	-.01
700	.46	.46	.46	.46	.45	.45	.45	.45	.44	.43	.41	.36	.24	.10	-.00	-.01
800	.23	.23	.23	.23	.23	.23	.23	.23	.22	.22	.20	.18	.12	.05	-.00	-.01
900	.12	.12	.12	.12	.12	.12	.11	.11	.11	.11	.10	.09	.06	.03	-.00	-.01
1000	.06	.06	.06	.06	.06	.06	.06	.06	.06	.05	.05	.05	.03	.01	-.00	-.01
2000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.01
3000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.01
4000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.01
5000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.01
6000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00	-.01

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	30	-.01	300

TEMPERATURES IN RADIAL HEAT FLOW
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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
100	30.00	28.82	27.75	26.76	25.84	24.99	21.44	16.45	12.94	10.26	6.33	2.32	-.00	-.01	-.01	-.01
200	30.00	28.94	27.98	27.09	26.27	25.51	22.32	17.84	14.68	12.25	8.66	5.06	.91	-.00	-.01	-.01
300	30.00	29.00	28.08	27.24	26.46	25.74	22.72	18.46	15.44	13.09	9.57	5.87	2.17	.02	-.01	-.01
400	30.00	29.04	28.16	27.36	26.61	25.92	23.02	18.94	16.06	13.84	10.52	7.12	3.59	.95	-.00	-.01
500	30.00	29.08	28.25	27.48	26.77	26.11	23.34	19.45	16.70	14.56	11.36	8.01	4.32	1.74	-.00	-.01
600	30.00	29.10	28.28	27.52	26.83	26.18	23.46	19.64	16.93	14.82	11.66	8.32	4.56	2.14	-.00	-.01
700	30.00	29.11	28.29	27.54	26.85	26.20	23.50	19.70	17.00	14.91	11.76	8.43	4.66	2.07	-.00	-.01
800	30.00	29.12	28.32	27.58	26.90	26.26	23.61	19.87	17.22	15.17	12.10	8.89	5.41	3.18	-.00	-.01
900	30.00	29.15	28.37	27.65	26.99	26.37	23.80	20.17	17.60	15.61	12.62	9.50	6.07	3.79	.34	-.01
1000	30.00	29.17	28.40	27.70	27.05	26.45	23.93	20.38	17.87	15.92	12.99	9.91	6.48	4.15	.75	-.00
1100	7.82	7.82	7.81	7.81	7.81	7.80	7.78	7.71	7.62	7.50	7.19	6.56	5.21	3.75	.99	-.00
1200	5.04	5.04	5.04	5.04	5.04	5.03	5.02	4.99	4.94	4.89	4.73	4.41	3.67	2.77	.90	-.00
1300	3.48	3.48	3.48	3.47	3.47	3.47	3.47	3.44	3.42	3.38	3.28	3.07	2.58	1.97	.70	-.00
1400	2.44	2.44	2.44	2.44	2.43	2.43	2.43	2.41	2.39	2.37	2.30	2.16	1.82	1.39	.52	-.00
1500	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.70	1.69	1.67	1.62	1.52	1.28	.98	.37	-.00
1600	1.21	1.21	1.21	1.21	1.21	1.21	1.20	1.20	1.19	1.17	1.14	1.07	.90	.69	.27	-.00
1700	.85	.85	.85	.85	.85	.85	.85	.84	.84	.83	.80	.75	.64	.49	.19	-.00
1800	.60	.60	.60	.60	.60	.60	.60	.59	.59	.58	.57	.53	.45	.34	.14	-.00
1900	.42	.42	.42	.42	.42	.42	.42	.42	.42	.41	.40	.37	.32	.24	.10	-.00
2000	.30	.30	.30	.30	.30	.30	.30	.30	.29	.29	.28	.26	.22	.17	.07	-.00
3000	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.00	-.00
4000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00
5000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00
6000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.00

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	30	-.01	1000

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
1	30.00	25.94	22.23	18.60	15.25	12.12	-.02	-2.99	-4.54	-4.93	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
2	30.00	26.64	23.57	20.76	18.15	15.72	7.23	-1.51	-3.66	-4.54	-4.95	-5.00	-5.00	-5.00	-5.00	-5.00
3	30.00	27.04	24.34	21.90	19.65	17.55	9.09	-.47	-2.61	-4.05	-4.65	-4.99	-5.00	-5.00	-5.00	-5.00
4	30.00	27.40	25.03	22.87	20.88	19.02	11.53	-.25	-2.10	-3.40	-4.68	-4.97	-5.00	-5.00	-5.00	-5.00
5	30.00	27.55	25.31	23.25	21.35	19.58	12.27	1.89	-1.54	-2.99	-4.47	-4.94	-5.00	-5.00	-5.00	-5.00
6	30.00	27.59	25.38	23.36	21.48	19.73	12.47	3.55	-1.00	-2.73	-4.27	-4.89	-4.99	-5.00	-5.00	-5.00
7	30.00	27.60	25.40	23.39	21.52	19.79	12.59	4.31	-.46	-2.52	-4.10	-4.64	-4.99	-5.00	-5.00	-5.00
8	30.00	27.69	25.58	23.65	21.86	20.20	13.41	4.86	-.32	-2.00	-3.92	-4.78	-4.98	-5.00	-5.00	-5.00
9	30.00	27.81	25.81	23.97	22.28	20.70	14.25	5.37	-.16	-1.37	-3.68	-4.71	-4.98	-5.00	-5.00	-5.00
10	30.00	27.90	25.99	24.24	22.62	21.11	14.91	5.77	-.01	-.76	-3.41	-4.64	-4.97	-5.00	-5.00	-5.00
11	18.13	17.81	17.53	16.96	16.44	15.95	13.01	7.01	-.07	-1.33	-3.16	-4.55	-4.95	-5.00	-5.00	-5.00
12	13.48	13.30	13.14	12.81	12.51	12.23	10.45	6.26	.52	-1.13	-2.97	-4.46	-4.94	-4.99	-5.00	-5.00
13	10.56	10.44	10.33	10.10	9.89	9.70	8.43	5.28	.88	-.97	-2.82	-4.36	-4.92	-4.99	-5.00	-5.00
14	8.46	8.36	8.28	8.11	7.95	7.80	6.83	4.35	.94	-.66	-2.70	-4.28	-4.91	-4.99	-5.00	-5.00
15	6.83	6.75	6.69	6.55	6.43	6.31	5.54	3.55	.86	-.79	-2.60	-4.19	-4.89	-4.99	-5.00	-5.00
16	5.53	5.47	5.42	5.31	5.21	5.12	4.50	2.89	.73	-.74	-2.51	-4.11	-4.86	-4.98	-5.00	-5.00
17	4.54	4.49	4.45	4.36	4.27	4.20	3.69	2.38	.61	-.72	-2.44	-4.04	-4.84	-4.98	-5.00	-5.00
18	3.68	3.65	3.61	3.54	3.47	3.41	3.00	1.93	.48	-.71	-2.38	-3.98	-4.82	-4.98	-5.00	-5.00
19	2.99	2.96	2.93	2.87	2.82	2.77	2.44	1.57	.36	-.71	-2.32	-3.91	-4.80	-4.97	-5.00	-5.00
20	2.43	2.40	2.38	2.33	2.29	2.25	1.98	1.28	.27	-.72	-2.27	-3.85	-4.77	-4.96	-5.00	-5.00
30	.20	.20	.19	.18	.18	.17	.13	.05	-.25	-1.09	-2.15	-3.44	-4.54	-4.89	-4.99	-5.00
40	.00	.00	.00	.00	.00	.00	.00	.00	-.64	-1.26	-2.27	-3.34	-4.37	-4.80	-4.98	-5.00
50	.00	.00	.00	.00	.00	.00	.00	-.43	-1.06	-1.53	-2.33	-3.27	-4.24	-4.71	-4.96	-5.00
60	.00	.00	.00	.00	.00	.00	-.14	-.84	-1.31	-1.72	-2.44	-3.26	-4.16	-4.64	-4.94	-5.00
70	.00	.00	-.05	-.14	-.23	-.31	-.67	-1.22	-1.63	-1.98	-2.57	-3.28	-4.10	-4.57	-4.92	-5.00
80	-1.93	-1.94	-1.94	-1.95	-1.96	-1.96	-2.00	-2.11	-2.25	-2.41	-2.78	-3.33	-4.06	-4.52	-4.90	-5.00
90	-2.57	-2.57	-2.57	-2.58	-2.58	-2.58	-2.61	-2.66	-2.74	-2.83	-3.06	-3.44	-4.05	-4.48	-4.67	-5.00
100	-2.95	-2.95	-2.95	-2.95	-2.95	-2.96	-2.97	-3.01	-3.06	-3.12	-3.28	-3.57	-4.07	-4.46	-4.85	-5.00
200	-4.14	-4.14	-4.14	-4.14	-4.14	-4.14	-4.14	-4.15	-4.16	-4.17	-4.19	-4.25	-4.37	-4.51	-4.75	-4.97
300	-4.45	-4.45	-4.45	-4.45	-4.45	-4.45	-4.45	-4.45	-4.45	-4.46	-4.47	-4.49	-4.55	-4.61	-4.75	-4.94
400	-4.59	-4.59	-4.59	-4.59	-4.59	-4.59	-4.59	-4.59	-4.60	-4.60	-4.61	-4.62	-4.65	-4.69	-4.78	-4.92
500	-4.68	-4.68	-4.68	-4.68	-4.68	-4.68	-4.68	-4.68	-4.68	-4.68	-4.69	-4.69	-4.71	-4.74	-4.80	-4.91

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	30	-5.0	10

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
10	30.00	27.90	25.99	24.24	22.62	21.11	14.91	5.77	-.01	-.76	-3.41	-4.64	-4.97	-5.00	-5.00	-5.00
20	30.00	28.13	26.43	24.86	23.41	22.06	16.44	8.66	4.16	1.02	-2.19	-3.85	-4.77	-4.96	-5.00	-5.00
30	30.00	28.39	26.91	25.56	24.31	23.14	18.30	11.57	7.00	2.77	-1.14	-2.94	-4.47	-4.88	-4.99	-5.00
33	14.44	14.33	14.23	14.03	13.84	13.67	12.53	9.70	6.53	3.16	-.92	-2.75	-4.37	-4.85	-4.99	-5.00
36	9.81	9.76	9.70	9.60	9.50	9.40	8.79	7.14	5.07	2.75	-.75	-2.61	-4.27	-4.81	-4.99	-5.00
39	7.04	7.00	6.97	6.90	6.83	6.77	6.36	5.24	3.77	2.13	-.64	-2.50	-4.18	-4.77	-4.98	-5.00
42	5.13	5.10	5.08	5.03	4.98	4.94	4.64	3.84	2.77	1.59	-.58	-2.40	-4.09	-4.73	-4.97	-5.00
45	3.75	3.73	3.71	3.68	3.64	3.61	3.40	2.81	2.03	1.16	-.57	-2.32	-4.01	-4.69	-4.97	-5.00
51	2.02	2.01	2.00	1.98	1.96	1.95	1.83	1.52	1.10	.61	-.61	-2.20	-3.87	-4.60	-4.95	-5.00
60	.80	.79	.79	.78	.77	.77	.72	.60	.43	.21	-.72	-2.06	-3.70	-4.48	-4.93	-5.00
70	.25	.25	.25	.24	.24	.24	.21	.14	.07	.02	-.89	-2.04	-3.54	-4.36	-4.89	-5.00
80	.03	.03	.03	.03	.03	.03	.03	.02	.01	.00	-1.15	-2.19	-3.47	-4.25	-4.85	-5.00
90	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.26	-1.20	-2.23	-3.43	-4.18	-4.82	-5.00
100	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.44	-1.21	-2.24	-3.39	-4.12	-4.78	-4.99
200	-2.58	-2.58	-2.58	-2.59	-2.59	-2.59	-2.60	-2.62	-2.66	-2.71	-2.83	-3.06	-3.50	-3.91	-4.52	-4.95
300	-3.66	-3.66	-3.66	-3.66	-3.66	-3.66	-3.66	-3.67	-3.68	-3.69	-3.73	-3.79	-3.94	-4.12	-4.47	-4.89
400	-4.05	-4.05	-4.05	-4.05	-4.05	-4.05	-4.06	-4.06	-4.06	-4.07	-4.09	-4.12	-4.20	-4.29	-4.51	-4.84
500	-4.27	-4.27	-4.27	-4.27	-4.27	-4.27	-4.27	-4.27	-4.27	-4.28	-4.29	-4.31	-4.35	-4.41	-4.56	-4.82
600	-4.40	-4.40	-4.40	-4.40	-4.40	-4.40	-4.40	-4.40	-4.40	-4.41	-4.41	-4.43	-4.46	-4.50	-4.60	-4.81
700	-4.49	-4.49	-4.49	-4.49	-4.49	-4.49	-4.49	-4.49	-4.50	-4.50	-4.50	-4.51	-4.53	-4.57	-4.64	-4.81
800	-4.56	-4.56	-4.56	-4.56	-4.56	-4.56	-4.56	-4.56	-4.56	-4.56	-4.57	-4.57	-4.59	-4.62	-4.68	-4.81
900	-4.61	-4.61	-4.61	-4.61	-4.61	-4.61	-4.61	-4.61	-4.61	-4.61	-4.62	-4.62	-4.64	-4.66	-4.70	-4.82
1000	-4.65	-4.65	-4.65	-4.65	-4.65	-4.65	-4.65	-4.65	-4.65	-4.66	-4.66	-4.66	-4.67	-4.69	-4.73	-4.82

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-5.0	30

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
10	30.00	27.90	25.99	24.24	22.62	21.11	14.91	5.77	-.01	-.76	-3.41	-4.64	-4.97	-5.00	-5.00	-5.00
20	30.00	28.13	26.43	24.86	23.41	22.06	16.44	8.66	4.16	1.02	-2.19	-3.85	-4.77	-4.96	-5.00	-5.00
30	30.00	28.39	26.91	25.56	24.31	23.14	18.30	11.57	7.00	2.77	-1.14	-2.94	-4.47	-4.88	-4.99	-5.00
40	30.00	28.46	27.05	25.75	24.55	23.44	18.79	12.24	7.62	4.13	-.37	-2.46	-4.15	-4.76	-4.98	-5.00
50	30.00	28.47	27.06	25.78	24.58	23.47	18.84	12.32	7.72	4.55	.81	-2.21	-3.90	-4.62	-4.96	-5.00
60	30.00	28.54	27.21	25.98	24.65	23.79	19.40	13.28	9.06	5.85	1.04	-1.42	-3.61	-4.47	-4.93	-5.00
70	30.00	28.62	27.35	26.19	25.12	24.12	19.95	14.13	10.08	7.05	1.85	-1.32	-3.24	-4.30	-4.89	-5.00
80	30.00	28.67	27.45	26.33	25.30	24.33	20.31	14.67	10.71	7.69	2.70	-1.01	-2.96	-4.12	-4.84	-5.00
90	30.00	28.69	27.49	26.39	25.37	24.42	20.46	14.89	10.96	7.92	3.21	-.75	-2.77	-3.95	-4.79	-5.00
100	30.00	28.70	27.51	26.41	25.40	24.45	20.52	14.98	11.05	8.01	3.51	-.47	-2.62	-3.81	-4.74	-4.99
110	10.11	10.08	10.05	9.99	9.93	9.88	9.54	8.59	7.32	5.91	3.04	-.16	-2.51	-3.69	-4.68	-4.99
120	5.78	5.76	5.75	5.72	5.69	5.67	5.49	5.01	4.34	3.57	1.93	.02	-2.41	-3.58	-4.62	-4.99
130	3.42	3.41	3.40	3.38	3.37	3.35	3.25	2.97	2.58	2.12	1.15	.02	-2.33	-3.49	-4.57	-4.98
140	2.02	2.02	2.01	2.00	1.99	1.98	1.93	1.76	1.53	1.26	.68	-.04	-2.27	-3.40	-4.52	-4.98
150	1.20	1.20	1.20	1.19	1.18	1.18	1.14	1.05	.91	.75	.40	-.15	-2.21	-3.33	-4.46	-4.97
170	.42	.42	.42	.42	.42	.41	.40	.37	.32	.26	.13	-.38	-2.11	-3.20	-4.37	-4.96
200	.09	.09	.09	.09	.09	.09	.08	.08	.07	.06	.02	-.62	-1.99	-3.05	-4.24	-4.93
300	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.47	-1.17	-2.19	-2.95	-3.96	-4.82
400	.00	.00	.00	.00	.00	.00	.00	-.28	-.62	-.89	-1.31	-1.82	-2.49	-3.03	-3.85	-4.71
500	-2.43	-2.43	-2.43	-2.44	-2.44	-2.44	-2.44	-2.45	-2.47	-2.50	-2.56	-2.68	-2.95	-3.25	-3.84	-4.62
600	-3.13	-3.13	-3.13	-3.14	-3.14	-3.14	-3.14	-3.14	-3.15	-3.16	-3.19	-3.25	-3.38	-3.55	-3.93	-4.56
700	-3.51	-3.51	-3.51	-3.51	-3.51	-3.51	-3.51	-3.51	-3.52	-3.52	-3.54	-3.58	-3.66	-3.77	-4.03	-4.53
800	-3.75	-3.75	-3.75	-3.75	-3.75	-3.75	-3.75	-3.75	-3.75	-3.76	-3.77	-3.80	-3.86	-3.93	-4.13	-4.53
900	-3.92	-3.92	-3.92	-3.92	-3.92	-3.92	-3.92	-3.92	-3.92	-3.93	-3.94	-3.96	-4.00	-4.06	-4.21	-4.54
1000	-4.05	-4.05	-4.05	-4.05	-4.05	-4.05	-4.05	-4.05	-4.05	-4.06	-4.06	-4.08	-4.11	-4.16	-4.28	-4.55
2000	-4.59	-4.59	-4.59	-4.59	-4.59	-4.59	-4.59	-4.59	-4.59	-4.59	-4.60	-4.60	-4.61	-4.62	-4.65	-4.74

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	30	-5.0	100

TEMPERATURES IN RADIAL HEAT FLOW
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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
100	30.00	28.70	27.51	26.41	25.40	24.45	20.52	14.98	11.05	8.01	3.51	-.47	-2.62	-3.81	-4.74	-4.99
200	30.00	28.86	27.81	26.85	25.96	25.14	21.69	16.83	13.39	10.74	6.78	2.16	-1.18	-2.50	-4.11	-4.93
300	30.00	28.87	27.84	26.90	26.02	25.21	21.80	17.01	13.61	10.98	7.01	3.20	-.13	-2.02	-3.61	-4.79
330	6.97	6.96	6.95	6.94	6.92	6.91	6.81	6.54	6.16	5.71	4.59	2.68	-.10	-1.69	-3.47	-4.74
360	3.67	3.67	3.66	3.66	3.65	3.64	3.60	3.49	3.32	3.11	2.58	1.57	-.09	-1.56	-3.33	-4.69
390	2.00	2.00	1.99	1.99	1.99	1.98	1.96	1.89	1.79	1.66	1.34	.77	-.10	-1.62	-3.22	-4.64
420	.97	.96	.96	.96	.96	.96	.94	.90	.84	.77	.60	.31	-.20	-1.67	-3.16	-4.58
450	.44	.44	.44	.44	.44	.43	.43	.41	.38	.35	.27	.14	-.35	-1.67	-3.11	-4.53
510	.09	.09	.09	.09	.09	.09	.09	.08	.08	.07	.06	.03	-.57	-1.64	-3.02	-4.44
600	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.00	-.76	-1.57	-2.91	-4.31
700	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.17	-1.15	-1.84	-2.89	-4.20
800	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.59	-1.30	-1.92	-2.90	-4.11
900	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.31	-.80	-1.55	-2.10	-2.94	-4.06
1000	.00	.00	.00	.00	.00	.00	.00	.00	-.21	-.46	-.64	-1.27	-1.82	-2.27	-3.00	-4.02
2000	-3.85	-3.85	-3.85	-3.85	-3.85	-3.85	-3.85	-3.85	-3.85	-3.85	-3.86	-3.87	-3.90	-3.93	-4.03	-4.30
3000	-4.42	-4.42	-4.42	-4.42	-4.42	-4.42	-4.42	-4.42	-4.42	-4.42	-4.42	-4.43	-4.44	-4.45	-4.50	-4.62

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	30	-5.0	300

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

R

TAU	1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
100	30.00	28.70	27.51	26.41	25.40	24.45	20.52	14.98	11.05	8.01	3.51	-.47	-2.62	-3.81	-4.74	-4.99
200	30.00	28.86	27.81	26.85	25.96	25.14	21.69	16.83	13.39	10.74	6.78	2.16	-1.18	-2.50	-4.11	-4.93
300	30.00	28.87	27.84	26.90	26.02	25.21	21.80	17.01	13.61	10.98	7.01	3.20	-.13	-2.02	-3.61	-4.79
400	30.00	28.96	28.01	27.14	26.33	25.57	22.43	18.01	14.88	12.47	8.87	5.18	-.06	-1.26	-3.03	-4.61
500	30.00	29.00	28.09	27.25	26.47	25.74	22.72	18.47	15.45	13.11	9.59	5.68	1.23	-.81	-2.60	-4.41
600	30.00	29.00	28.10	27.26	26.49	25.76	22.76	18.53	15.52	13.19	9.68	5.96	1.96	-.39	-2.37	-4.21
700	30.00	29.01	28.10	27.26	26.49	25.77	22.76	18.53	15.53	13.20	9.69	5.97	2.29	.23	-2.22	-4.04
800	30.00	29.03	28.15	27.34	26.59	25.89	22.97	18.87	15.96	13.71	10.35	6.65	3.00	.30	-1.78	-3.88
900	30.00	29.07	28.21	27.43	26.71	26.03	23.21	19.24	16.43	14.26	10.99	7.58	3.50	.36	-1.30	-3.70
1000	30.00	29.09	28.26	27.49	26.79	26.13	23.38	19.51	16.77	14.65	11.45	8.10	4.39	.90	-1.30	-3.50
1100	5.82	5.82	5.82	5.81	5.81	5.81	5.78	5.71	5.60	5.47	5.13	4.44	2.98	.96	-1.15	-3.33
1200	2.85	2.85	2.85	2.85	2.85	2.85	2.83	2.80	2.76	2.70	2.54	2.23	1.52	.48	-1.10	-3.19
1300	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.41	1.39	1.36	1.28	1.12	.77	.17	-1.09	-3.09
1400	.68	.68	.68	.68	.68	.68	.68	.67	.65	.63	.58	.46	.22	.02	-1.19	-3.01
1500	.19	.19	.19	.19	.19	.19	.19	.19	.18	.17	.15	.12	.05	-.01	-1.39	-3.01
1600	.05	.05	.05	.05	.05	.05	.05	.05	.05	.05	.04	.03	.01	-.18	-1.47	-3.02
1700	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.00	-.34	-1.51	-3.04
1800	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.46	-1.53	-3.05
1900	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.56	-1.54	-3.06
2000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.13	-.81	-1.68	-3.07
3000	-1.77	-1.77	-1.77	-1.77	-1.77	-1.77	-1.78	-1.78	-1.79	-1.80	-1.83	-1.90	-2.05	-2.23	-2.65	-3.47
4000	-3.63	-3.63	-3.63	-3.63	-3.63	-3.63	-3.63	-3.63	-3.63	-3.63	-3.64	-3.65	-3.68	-3.72	-3.83	-4.13
5000	-4.28	-4.28	-4.28	-4.28	-4.28	-4.28	-4.28	-4.28	-4.28	-4.29	-4.29	-4.29	-4.31	-4.33	-4.38	-4.54
6000	-4.62	-4.62	-4.62	-4.62	-4.62	-4.62	-4.62	-4.62	-4.62	-4.62	-4.62	-4.63	-4.63	-4.65	-4.67	-4.76

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	30	-5.0	1000

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

R

TAU	1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
1	30.00	25.27	20.96	17.54	14.37	11.42	-.47	-7.40	-9.33	-9.89	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
2	30.00	26.54	23.39	20.52	17.87	15.40	2.59	-4.54	-7.66	-9.27	-9.93	-10.00	-10.00	-10.00	-10.00	-10.00
3	30.00	26.65	23.60	20.79	18.19	15.77	7.35	-2.50	-6.57	-8.48	-9.75	-9.98	-10.00	-10.00	-10.00	-10.00
4	30.00	26.96	24.18	21.67	19.34	17.18	8.78	-1.50	-5.50	-7.78	-9.51	-9.95	-10.00	-10.00	-10.00	-10.00
5	30.00	27.25	24.74	22.45	20.33	18.36	9.74	-.66	-4.23	-6.98	-9.22	-9.91	-10.00	-10.00	-10.00	-10.00
6	30.00	27.42	25.07	22.92	20.92	19.07	10.33	-.00	-3.11	-6.16	-8.88	-9.84	-9.99	-10.00	-10.00	-10.00
7	30.00	27.54	25.30	23.24	21.34	19.56	12.25	-.25	-3.22	-5.53	-8.52	-9.75	-9.99	-10.00	-10.00	-10.00
8	30.00	27.58	25.38	23.35	21.48	19.73	12.47	1.58	-2.65	-5.12	-8.19	-9.65	-9.98	-10.00	-10.00	-10.00
9	30.00	27.60	25.40	23.38	21.52	19.78	12.53	3.01	-2.07	-4.82	-7.89	-9.54	-9.96	-10.00	-10.00	-10.00
10	30.00	27.60	25.41	23.39	21.53	19.79	12.54	3.89	-1.37	-4.59	-7.63	-9.42	-9.95	-10.00	-10.00	-10.00
11	16.08	15.70	15.35	14.66	14.02	13.43	9.82	3.72	-.80	-4.39	-7.40	-9.30	-9.93	-9.99	-10.00	-10.00
12	10.46	10.26	10.07	9.69	9.34	9.01	6.96	2.80	-.72	-4.06	-7.19	-9.19	-9.91	-9.99	-10.00	-10.00
13	7.17	7.04	6.92	6.68	6.45	6.24	4.89	1.99	-.68	-3.86	-6.98	-9.07	-9.88	-9.99	-10.00	-10.00
14	4.96	4.86	4.78	4.60	4.44	4.29	3.31	1.32	-.67	-3.81	-6.80	-8.96	-9.86	-9.98	-10.00	-10.00
15	3.33	3.26	3.20	3.07	2.95	2.84	2.13	.80	-.85	-3.79	-6.65	-8.84	-9.83	-9.98	-10.00	-10.00
16	2.19	2.14	2.10	2.01	1.93	1.86	1.39	.48	-1.12	-3.74	-6.53	-8.74	-9.80	-9.98	-10.00	-10.00
17	1.46	1.43	1.40	1.34	1.29	1.24	.92	.29	-1.37	-3.68	-6.43	-8.64	-9.77	-9.97	-10.00	-10.00
18	.95	.93	.91	.88	.84	.81	.60	.15	-1.58	-3.61	-6.33	-8.55	-9.74	-9.96	-10.00	-10.00
19	.62	.61	.60	.57	.55	.53	.39	.07	-1.75	-3.56	-6.23	-8.46	-9.71	-9.96	-10.00	-10.00
20	.41	.40	.39	.37	.36	.34	.26	.01	-1.89	-3.50	-6.14	-8.38	-9.67	-9.95	-10.00	-10.00
30	.00	.00	.00	.00	.00	.00	-.72	-2.15	-3.31	-4.30	-5.98	-7.82	-9.35	-9.84	-9.99	-10.00
40	-3.93	-3.94	-3.96	-3.98	-4.00	-4.02	-4.14	-4.45	-4.87	-5.33	-6.32	-7.68	-9.11	-9.71	-9.97	-10.00
50	-5.70	-5.71	-5.71	-5.72	-5.73	-5.74	-5.79	-5.93	-6.13	-6.36	-6.90	-7.79	-8.97	-9.60	-9.95	-10.00
60	-6.62	-6.62	-6.63	-6.63	-6.64	-6.64	-6.67	-6.76	-6.88	-7.02	-7.37	-7.98	-8.91	-9.51	-9.92	-10.00
70	-7.20	-7.20	-7.21	-7.21	-7.21	-7.22	-7.24	-7.29	-7.38	-7.47	-7.72	-8.16	-8.91	-9.45	-9.89	-10.00
80	-7.61	-7.61	-7.61	-7.61	-7.62	-7.62	-7.63	-7.68	-7.74	-7.81	-7.99	-8.33	-8.93	-9.41	-9.86	-10.00
90	-7.91	-7.91	-7.91	-7.91	-7.92	-7.92	-7.93	-7.96	-8.01	-8.06	-8.20	-8.47	-8.97	-9.39	-9.84	-10.00
100	-8.14	-8.14	-8.14	-8.15	-8.15	-8.15	-8.16	-8.18	-8.22	-8.26	-8.37	-8.59	-9.01	-9.38	-9.82	-9.99
200	-9.12	-9.12	-9.12	-9.12	-9.12	-9.12	-9.12	-9.13	-9.14	-9.15	-9.17	-9.23	-9.34	-9.48	-9.73	-9.96
300	-9.42	-9.42	-9.42	-9.42	-9.42	-9.42	-9.42	-9.43	-9.43	-9.43	-9.44	-9.47	-9.52	-9.59	-9.73	-9.93
400	-9.57	-9.57	-9.57	-9.57	-9.57	-9.57	-9.57	-9.57	-9.57	-9.58	-9.58	-9.60	-9.63	-9.67	-9.76	-9.91
500	-9.66	-9.66	-9.66	-9.66	-9.66	-9.66	-9.66	-9.66	-9.66	-9.66	-9.67	-9.67	-9.69	-9.72	-9.78	-9.90

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	30	-10.0	10

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R: 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
10	30.00	27.60	25.41	23.39	21.53	19.79	12.54	3.89	-1.37	-4.59	-7.63	-9.42	-9.95	-10.00	-10.00	-10.00
20	30.00	28.07	26.30	24.68	23.18	21.78	15.99	8.00	-.16	-2.07	-5.07	-8.13	-9.65	-9.95	-10.00	-10.00
30	30.00	28.13	26.42	24.85	23.39	22.04	16.39	8.43	3.73	.44	-4.04	-7.06	-9.20	-9.82	-9.99	-10.00
33	11.66	11.52	11.40	11.16	10.94	10.73	9.37	5.99	3.05	.75	-3.88	-6.84	-9.07	-9.77	-9.98	-10.00
36	6.31	6.25	6.20	6.08	5.97	5.88	5.22	3.50	1.82	.45	-3.68	-6.63	-8.94	-9.71	-9.98	-10.00
39	3.49	3.45	3.42	3.35	3.29	3.23	2.85	1.84	.92	.19	-3.61	-6.46	-8.81	-9.66	-9.97	-10.00
42	1.88	1.86	1.84	1.80	1.77	1.74	1.53	.99	.45	.02	-3.52	-6.32	-8.70	-9.60	-9.96	-10.00
45	1.01	1.00	.99	.97	.95	.93	.82	.53	.21	-.49	-3.44	-6.19	-8.58	-9.54	-9.95	-10.00
51	.29	.29	.29	.28	.28	.27	.24	.15	-.06	-1.28	-3.30	-5.96	-8.38	-9.42	-9.93	-10.00
60	.01	.01	.01	.01	.01	.01	.01	.00	-1.02	-2.06	-3.82	-5.87	-8.13	-9.25	-9.89	-10.00
70	.00	.00	.00	.00	.00	.00	.00	-.95	-1.93	-2.78	-4.20	-5.92	-7.95	-9.08	-9.84	-10.00
80	.00	-.00	-.01	-.18	-.35	-.50	-1.15	-2.10	-2.83	-3.47	-4.60	-6.05	-7.85	-8.94	-9.79	-10.00
90	-3.65	-3.66	-3.67	-3.68	-3.69	-3.70	-3.77	-3.95	-4.20	-4.48	-5.16	-6.24	-7.80	-8.84	-9.74	-9.99
100	-4.80	-4.80	-4.81	-4.81	-4.82	-4.83	-4.87	-4.97	-5.12	-5.30	-5.74	-6.52	-7.81	-8.76	-9.68	-9.99
200	-7.93	-7.93	-7.93	-7.93	-7.93	-7.93	-7.94	-7.95	-7.98	-8.00	-8.07	-8.21	-8.51	-8.84	-9.42	-9.93
300	-8.69	-8.69	-8.69	-8.69	-8.69	-8.69	-8.69	-8.70	-8.71	-8.72	-8.74	-8.80	-8.93	-9.09	-9.42	-9.86
400	-9.04	-9.04	-9.04	-9.04	-9.04	-9.04	-9.04	-9.04	-9.05	-9.05	-9.07	-9.10	-9.17	-9.26	-9.47	-9.82
500	-9.24	-9.24	-9.24	-9.24	-9.24	-9.24	-9.24	-9.24	-9.25	-9.25	-9.26	-9.28	-9.33	-9.39	-9.53	-9.80
600	-9.37	-9.37	-9.37	-9.37	-9.37	-9.37	-9.37	-9.37	-9.38	-9.38	-9.39	-9.40	-9.43	-9.47	-9.58	-9.79
700	-9.47	-9.47	-9.47	-9.47	-9.47	-9.47	-9.47	-9.47	-9.47	-9.47	-9.48	-9.48	-9.51	-9.54	-9.62	-9.79
800	-9.53	-9.53	-9.53	-9.53	-9.53	-9.53	-9.54	-9.54	-9.54	-9.54	-9.54	-9.55	-9.57	-9.59	-9.65	-9.79
900	-9.59	-9.59	-9.59	-9.59	-9.59	-9.59	-9.59	-9.59	-9.59	-9.59	-9.59	-9.60	-9.61	-9.63	-9.68	-9.80
1000	-9.63	-9.63	-9.63	-9.63	-9.63	-9.63	-9.63	-9.63	-9.63	-9.63	-9.64	-9.64	-9.65	-9.67	-9.71	-9.81

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	30	-10.0	30

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R: 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
10	30.00	27.60	25.41	23.39	21.53	19.79	12.54	3.89	-1.37	-4.59	-7.63	-9.42	-9.95	-10.00	-10.00	-10.00
20	30.00	28.07	26.30	24.68	23.18	21.78	15.99	8.00	-.16	-2.07	-5.07	-8.13	-9.65	-9.95	-10.00	-10.00
30	30.00	28.13	26.42	24.85	23.39	22.04	16.39	8.43	3.73	.44	-4.04	-7.06	-9.20	-9.82	-9.99	-10.00
40	30.00	28.27	26.68	25.23	23.88	22.63	17.42	10.19	5.15	1.27	-2.71	-6.22	-8.76	-9.64	-9.97	-10.00
50	30.00	28.38	26.90	25.53	24.27	23.10	18.22	11.39	5.93	1.46	-1.39	-5.27	-8.28	-9.42	-9.93	-10.00
60	30.00	28.45	27.03	25.72	24.52	23.39	18.71	12.14	7.53	3.12	-1.65	-4.53	-7.80	-9.18	-9.89	-10.00
70	30.00	28.46	27.06	25.77	24.58	23.47	18.83	12.30	7.68	3.95	-1.00	-4.14	-7.39	-8.92	-9.83	-10.00
80	30.00	28.47	27.07	25.78	24.59	23.48	18.85	12.32	7.69	4.33	-.13	-3.89	-7.06	-8.68	-9.76	-10.00
90	30.00	28.47	27.07	25.78	24.59	23.48	18.85	12.33	7.71	4.54	.81	-3.70	-6.80	-8.47	-9.69	-9.99
100	30.00	28.51	27.16	25.91	24.76	23.68	19.21	12.94	8.58	5.38	.96	-3.18	-6.53	-8.27	-9.61	-9.99
110	7.87	7.84	7.81	7.75	7.69	7.64	7.28	6.32	5.02	3.57	.64	-2.77	-6.22	-8.06	-9.53	-9.99
120	3.53	3.52	3.50	3.47	3.45	3.42	3.25	2.78	2.12	1.44	.26	-2.93	-6.00	-7.86	-9.44	-9.98
130	1.33	1.33	1.32	1.31	1.29	1.28	1.21	1.00	.72	.46	.03	-3.06	-5.90	-7.70	-9.36	-9.98
140	.47	.47	.47	.46	.46	.46	.43	.35	.26	.15	-.56	-3.05	-5.81	-7.57	-9.27	-9.97
150	.17	.17	.17	.17	.16	.16	.15	.13	.09	.04	-1.07	-3.02	-5.72	-7.45	-9.19	-9.96
170	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.45	-1.65	-3.53	-5.70	-7.28	-9.04	-9.94
200	.00	.00	.00	.00	.00	.00	.00	-.54	-1.26	-1.83	-2.81	-4.08	-5.82	-7.17	-8.86	-9.90
300	-5.85	-5.85	-5.85	-5.85	-5.85	-5.85	-5.86	-5.89	-5.93	-5.97	-6.09	-6.34	-6.88	-7.48	-8.59	-9.74
400	-7.22	-7.22	-7.22	-7.22	-7.22	-7.22	-7.23	-7.24	-7.25	-7.27	-7.33	-7.44	-7.68	-7.99	-8.65	-9.60
500	-7.89	-7.89	-7.89	-7.90	-7.90	-7.90	-7.90	-7.90	-7.91	-7.92	-7.95	-8.02	-8.16	-8.35	-8.77	-9.52
600	-8.30	-8.30	-8.30	-8.30	-8.30	-8.30	-8.30	-8.31	-8.31	-8.32	-8.34	-8.38	-8.48	-8.60	-8.90	-9.48
700	-8.58	-8.58	-8.58	-8.58	-8.58	-8.58	-8.58	-8.58	-8.58	-8.59	-8.60	-8.63	-8.70	-8.79	-9.01	-9.48
800	-8.77	-8.77	-8.77	-8.77	-8.77	-8.77	-8.77	-8.78	-8.78	-8.78	-8.79	-8.81	-8.87	-8.93	-9.10	-9.48
900	-8.92	-8.92	-8.92	-8.92	-8.92	-8.92	-8.92	-8.93	-8.93	-8.93	-8.94	-8.95	-8.99	-9.05	-9.18	-9.50
1000	-9.04	-9.04	-9.04	-9.04	-9.04	-9.04	-9.04	-9.04	-9.04	-9.05	-9.05	-9.07	-9.10	-9.14	-9.25	-9.52
2000	-9.57	-9.57	-9.57	-9.57	-9.57	-9.57	-9.57	-9.57	-9.57	-9.57	-9.58	-9.58	-9.59	-9.60	-9.64	-9.73

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	30	-10.0	100

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R = 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
100	30.00	28.51	27.16	25.91	24.76	23.68	19.21	12.94	8.58	5.38	.96	-3.18	-6.53	-8.27	-9.61	-9.99
200	30.00	28.70	27.51	26.42	25.41	24.47	20.55	15.02	11.10	8.06	3.50	-.81	-4.22	-6.39	-8.69	-9.89
300	30.00	28.78	27.67	26.65	25.71	24.83	21.16	16.00	12.35	9.54	5.29	.68	-2.88	-5.28	-7.90	-9.69
330	5.25	5.24	5.23	5.21	5.19	5.18	5.07	4.77	4.35	3.84	2.52	.32	-2.68	-4.95	-7.66	-9.61
360	1.49	1.48	1.48	1.47	1.46	1.46	1.42	1.30	1.13	.93	.51	.04	-3.04	-4.91	-7.47	-9.53
390	.31	.31	.31	.31	.31	.31	.30	.27	.24	.19	.10	-.62	-3.13	-4.92	-7.34	-9.45
420	.06	.06	.06	.06	.06	.06	.06	.05	.04	.03	.01	-.96	-3.14	-4.88	-7.23	-9.37
450	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.32	-1.75	-3.53	-4.97	-7.14	-9.30
510	.00	.00	.00	.00	.00	.00	.00	.00	-.20	-.77	-1.52	-2.56	-4.01	-5.20	-7.06	-9.15
600	-3.53	-3.53	-3.54	-3.54	-3.54	-3.54	-3.56	-3.59	-3.65	-3.71	-3.88	-4.21	-4.91	-5.67	-7.09	-8.97
700	-5.35	-5.35	-5.35	-5.35	-5.35	-5.35	-5.35	-5.37	-5.39	-5.42	-5.49	-5.63	-5.96	-6.37	-7.30	-8.85
800	-6.26	-6.26	-6.26	-6.26	-6.26	-6.26	-6.27	-6.27	-6.29	-6.30	-6.34	-6.43	-6.64	-6.91	-7.55	-8.79
900	-6.85	-6.85	-6.85	-6.85	-6.85	-6.85	-6.86	-6.86	-6.87	-6.88	-6.91	-6.97	-7.12	-7.31	-7.78	-8.78
1000	-7.28	-7.28	-7.28	-7.28	-7.28	-7.28	-7.28	-7.28	-7.29	-7.30	-7.32	-7.36	-7.47	-7.62	-7.99	-8.81
2000	-8.89	-8.89	-8.89	-8.89	-8.89	-8.89	-8.89	-8.89	-8.89	-8.89	-8.89	-8.90	-8.93	-8.96	-9.05	-9.30
3000	-9.42	-9.42	-9.42	-9.42	-9.42	-9.42	-9.42	-9.42	-9.42	-9.43	-9.43	-9.43	-9.44	-9.46	-9.50	-9.63

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	30	-10.0	300

TEMPERATURES IN RADIAL HEAT FLOW

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	R 1.0	1.1	1.2	1.3	1.4	1.5	2.0	3.0	4.0	5.0	7.0	10.0	15.0	20.0	30.0	50.0
100	30.00	28.51	27.16	25.91	24.76	23.68	19.21	12.94	8.58	5.38	.96	-3.18	-6.53	-8.27	-9.61	-9.99
200	30.00	28.70	27.51	26.42	25.41	24.47	20.55	15.02	11.10	8.06	3.50	-.81	-4.22	-6.39	-8.69	-9.89
300	30.00	28.78	27.67	26.65	25.71	24.83	21.16	16.00	12.35	9.54	5.29	.68	-2.88	-5.28	-7.90	-9.69
400	30.00	28.85	27.80	26.84	25.95	25.11	21.65	16.77	13.31	10.64	6.66	1.29	-2.11	-4.12	-7.12	-9.42
500	30.00	28.87	27.84	26.90	26.02	25.21	21.80	17.01	13.61	10.97	6.99	2.64	-1.47	-3.60	-6.51	-9.13
600	30.00	28.87	27.84	26.90	26.02	25.21	21.81	17.01	13.61	10.97	7.00	3.09	-.59	-3.33	-6.11	-8.84
700	30.00	28.91	27.91	27.00	26.15	25.36	22.07	17.43	14.15	11.61	7.82	3.94	-.16	-2.77	-5.74	-8.58
800	30.00	28.94	27.98	27.10	26.28	25.51	22.33	17.84	14.66	12.20	8.51	4.54	-.10	-2.11	-5.28	-8.33
900	30.00	28.97	28.02	27.16	26.35	25.61	22.49	18.10	14.98	12.57	8.95	4.93	-.05	-1.60	-4.85	-8.08
1000	30.00	28.98	28.06	27.20	26.41	25.68	22.61	18.29	15.22	12.85	9.28	5.22	-.01	-1.17	-4.46	-7.84
1100	2.98	2.98	2.97	2.97	2.97	2.96	2.93	2.85	2.74	2.59	2.22	1.41	-.08	-1.64	-4.29	-7.61
1200	.28	.28	.28	.28	.28	.28	.27	.26	.24	.22	.17	.08	-.69	-2.30	-4.48	-7.44
1300	.02	.02	.02	.02	.02	.02	.02	.02	.01	.01	.01	.00	-1.29	-2.48	-4.57	-7.34
1400	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.66	-1.90	-3.02	-4.77	-7.28
1500	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.02	-.81	-1.56	-2.58	-3.47	-4.98	-7.26
1600	-.38	-.40	-.42	-.45	-.47	-.50	-.65	-.96	-1.25	-1.50	-1.92	-2.46	-3.24	-3.94	-5.21	-7.27
1700	-3.52	-3.52	-3.52	-3.52	-3.52	-3.52	-3.53	-3.54	-3.57	-3.59	-3.66	-3.81	-4.14	-4.56	-5.51	-7.32
1800	-4.45	-4.45	-4.45	-4.45	-4.45	-4.46	-4.46	-4.47	-4.48	-4.50	-4.54	-4.63	-4.85	-5.14	-5.85	-7.39
1900	-5.09	-5.09	-5.09	-5.09	-5.09	-5.09	-5.09	-5.10	-5.11	-5.12	-5.15	-5.22	-5.39	-5.61	-6.17	-7.49
2000	-5.58	-5.58	-5.58	-5.58	-5.58	-5.58	-5.58	-5.59	-5.59	-5.60	-5.63	-5.68	-5.82	-5.99	-6.46	-7.60
3000	-7.93	-7.93	-7.93	-7.93	-7.93	-7.93	-7.93	-7.93	-7.93	-7.93	-7.94	-7.96	-8.00	-8.46	-8.22	-8.68
4000	-8.91	-8.91	-8.91	-8.91	-8.91	-8.91	-8.91	-8.92	-8.92	-8.92	-8.92	-8.93	-8.95	-8.98	-9.07	-9.30
5000	-9.43	-9.43	-9.43	-9.43	-9.43	-9.43	-9.43	-9.43	-9.43	-9.43	-9.43	-9.44	-9.45	-9.46	-9.51	-9.63
6000	-9.70	-9.70	-9.70	-9.70	-9.70	-9.70	-9.70	-9.70	-9.70	-9.70	-9.70	-9.70	-9.71	-9.72	-9.74	-9.80

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	30	-10.0	1000

TEMPERATURES IN RADIAL HEAT FLOW

TAU_o \ N	0.0	.1	.2	.3	.4	.5	.7	1.0	2.0	3.0	4.0	5.0	10.0	20.0	50.0	100.0
3	1.000	.791	.680	.602	.542	.493	.421	.346	.220	.161	.128	.106	.057	.030	.012	.004
10	1.000	.674	.548	.467	.411	.367	.306	.245	.150	.108	.085	.070	.037	.019	.008	.004
30	1.000	.563	.440	.369	.321	.264	.234	.186	.111	.080	.062	.051	.027	.014	.006	.003
100	1.000	.459	.352	.292	.252	.223	.182	.144	.086	.061	.048	.039	.021	.011	.004	
300	1.000	.385	.293	.243	.209	.184	.150	.118	.070	.050	.039	.032	.017	.009		
1000	1.000	.326	.247	.204	.175	.154	.125	.099	.058	.042	.032	.026				

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
0	1	0.00	3-1000

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

TAU_o	N: 0.0	.1	.2	.3	.4	.5	.7	1.0	2.0	3.0	4.0	5.0	10.0	20.0	50.0	100.0
10	10.00	5.40	3.71	2.80	2.20	1.75	1.16	.61	.08	.01	.00	.00	.00	.00	.00	.00
30	10.00	4.36	2.89	2.06	1.50	1.10	.59	.23	.01	.00	.00	.00	.00	.00	.00	.00
100	10.00	3.33	1.90	1.12	.67	.40	.14	.03	.00	.00	.00	.00	.00	.00	.00	
300	10.00	2.22	.99	.45	.20	.09	.02	.00	.00	.00	.00	.00	.00	.00		
1000	10.00	1.92	.94	.47	.24	.12	.03	.00	.00	.00	.00	.00				

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	10	-.01	10-1000

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	N: 0.0	.1	.2	.3	.4	.5	.7	1.0	2.0	3.0	4.0	5.0	10.0	20.0
10	10.00	4.87	2.89	1.67	.82	.31	.05	.00	.00	-2.45	-3.20	-3.59	-4.31	-4.65
30	10.00	3.00	1.14	.32	.09	.03	.00	.00	-2.33	-3.36	-3.79	-4.03	-4.52	-4.76
100	10.00	1.63	.24	.03	.00	.00	.00	.00	-3.31	-3.88	4.15	-4.32	-4.65	
300	10.00	.60	.03	.00	.00	.00	.00	-2.45	-3.74	-4.14	-4.35	-4.49		
1000	10.00	.09	.00	.00	.00	.00	-2.50	-3.26	-4.18	-4.57				

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-5.0	10-1000

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

TAU_O	N: 0.0	.1	.2	.3	.4	.5	.7	1.0	2.0	3.0	4.0	5.0	10.0	20.0
10	10.00	3.59	1.26	.14	.01	.00	-.44	-3.76	-6.58	-7.60	-8.14	-8.48	-9.21	-9.59
30	10.00	1.34	.08	.00	.00	-.98	-4.00	-5.60	-7.53	-8.27	-8.66	-8.91	-9.43	-9.71
100	10.00	.17	.00	.00	-3.33	-4.53	-5.80	-6.81	-8.18	-8.72	-9.01	-9.19	-9.58	
300	10.00	.00	-1.23	-4.24	-5.30	-5.96	-6.80	-7.53	-8.57	-8.99	-9.23	-9.39		
1000	10.00	.00	-4.70	-5.79	-6.44	-6.90	-7.53	-8.11	-9.06	-9.51				

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	10	-10.0	10-1000

TEMPERATURES IN RADIAL HEAT FLOW

LATENT HEAT DENSITY, 30 MJ/M^3

TAU_0 \ N	0.0	.1	.2	.3	.4	.5	.7	1.0	2.0	3.0	4.0	5.0	10.0	20.0	50.0	100.0
10	30.00	18.97	14.39	11.51	9.53	8.03	6.15	4.31	1.51	.53	.19	.07	.00	.00	.00	.00
30	30.00	15.13	10.97	8.63	7.05	5.88	4.21	2.61	.54	.11	.02	.00	.00	.00	.00	.00
100	30.00	12.19	8.45	6.27	4.75	3.63	2.13	1.03	.23	.06	.02	.00	.00	.00	.00	
300	30.00	9.29	5.94	4.27	3.27	2.59	1.68	.90	.12	.01	.00	.00	.00	.00		
1000	30.00	7.81	5.04	3.47	2.43	1.71	.85	.30	.01	.00	.00	.00				

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	30	-.01	10-1000

TEMPERATURES IN RADIAL HEAT FLOW

****

LATENT HEAT DENSITY, 30 MJ/M^3

N

TAU	0.0	.1	.2	.3	.4	.5	.7	1.0	2.0	3.0	4.0	5.0	10.0	
10	30.00	18.13	13.48	10.56	8.46	6.76	4.49	2.38	.19	.00	.00	.00	-3.22	
30	30.00	14.33	9.76	7.00	5.10	3.73	2.00	.79	.00	.00	.00	-1.99	-3.81	-4.43
100	30.00	10.08	5.76	3.40	2.02	1.20	.42	.09	.00	.00	-2.44	-3.14	-4.15	-4.62
300	30.00	6.95	3.66	1.99	.96	.44	.09	.01	.00	-2.29	-3.22	-3.65	-4.52	
1000	30.00	5.81	2.85	1.43	.68	.19	.01	.00	-1.77	-3.63	-4.28	-4.62		

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	30	-5.0	10-1000

TEMPERATURES IN RADIAL HEAT FLOW

****

LATENT HEAT DENSITY, 30 MJ/M^3

N

TAU_O	0.0	.1	.2	.3	.4	.5	.7	1.0	2.0	3.0	4.0	5.0	10.0	
10	30.00	16.08	10.46	7.17	4.96	3.26	1.43	.39	.00	-3.97	-5.73	-6.63	-8.33	
30	30.00	11.53	6.25	3.45	1.86	1.00	.29	.01	-3.67	-6.08	-7.08	-7.66	-8.82	-9.40
100	30.00	7.84	3.52	1.32	.47	.17	.00	.00	-5.85	-7.22	-7.90	-8.30	-9.14	-9.60
300	30.00	5.23	1.48	.31	.06	.00	.00	-3.54	-6.85	-7.85	-8.38	-8.71	-9.52	
1000	30.00	2.97	.28	.02	.00	.00	-3.53	-5.58	-7.93	-8.91	-9.43	-9.70		

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-10.0	10-1000

APPENDIX F. TABLES OF HEAT FLOW VERSUS TIME FOR A SOURCE OF FINITE DURATION

These tables present normalized values ω (1,1) of the heat flow from a source of radius one metre into a medium of conductivity one $Wm^{-1} K^{-1}$ for the cases given in Appendix E. The dimensionless time τ is calculated, as in Appendix E, from the diffusivity α_A of the medium in its original, or undisturbed state, A. For a particular application, tabulated values must be multiplied by the conductivity ($Wm^{-1}K^{-1}$) of the medium immediately adjacent to the source and divided by the radius (m), i.e.

$$\dot{\omega}(r_o,k_A) = \omega(1,1) \times \frac{k_A}{r_o} \quad (Wm^{-2}) \qquad (4\text{-}6)$$

if the medium in contact with the source at that time is in its original state, or

$$\omega(r_o,k_B) = \omega(1,1) \times \frac{k_B}{r_o} \quad (Wm^{-2}) \qquad (4\text{-}7)$$

if the medium adjacent to the source has undergone a change of phase. The phase status of the medium in contact with the source is indicated beside each entry in the tables as "A" (undisturbed, original state) or "B" (changed phase). The notation ".AAAE+aa" is interpreted to mean ".AAA x 10^{+aa}", and a "*" replaces any value smaller than 10^{-10} Wm^{-2}.

Index blocks along the lower edge of each table identify the parametric values used: latent heat density (MJ/m^3), source and initial temperatures (^oC), and duration of source τ_o.

HEAT FLOW IN RADIAL SYMMETRY

TAU	HEAT FLOW
1.00	.986E+00 (A)
2.00	.800E+00 (A)
3.00	.717E+00 (A)
3.30	.240E+00 (A)
3.60	.154E+00 (A)
3.90	.114E+00 (A)
4.20	.892E-01 (A)
4.50	.726E-01 (A)
5.10	.514E-01 (A)
6.00	.339E-01 (A)
7.00	.234E-01 (A)
8.00	.173E-01 (A)
9.00	.133E-01 (A)
10.00	.106E-01 (A)
20.00	.245E-02 (A)
30.00	.107E-02 (A)
40.00	.593E-03 (A)
50.00	.378E-03 (A)
60.00	.262E-03 (A)
70.00	.191E-03 (A)
80.00	.146E-03 (A)
90.00	.116E-03 (A)
100.00	.948E-04 (A)
200.00	.291E-04 (A)
300.00	.142E-04 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
0	1	0.0	3

TAU	HEAT FLOW
1.00	.988E+00 (A)
2.00	.802E+00 (A)
3.00	.717E+00 (A)
4.00	.663E+00 (A)
5.00	.628E+00 (A)
6.00	.600E+00 (A)
7.00	.578E+00 (A)
8.00	.561E+00 (A)
9.00	.546E+00 (A)
10.00	.533E+00 (A)
11.00	.879E-01 (A)
12.00	.494E-01 (A)
13.00	.335E-01 (A)
14.00	.246E-01 (A)
15.00	.192E-01 (A)
16.00	.155E-01 (A)
17.00	.129E-01 (A)
18.00	.108E-01 (A)
19.00	.927E-02 (A)
20.00	.804E-02 (A)
30.00	.291E-02 (A)
40.00	.151E-02 (A)
50.00	.919E-03 (A)
60.00	.620E-03 (A)
70.00	.447E-03 (A)
80.00	.338E-03 (A)
90.00	.264E-03 (A)
100.00	.212E-03 (A)
200.00	.510E-04 (A)
300.00	.224E-04 (A)
400.00	.126E-04 (A)
500.00	.799E-05 (A)
600.00	.554E-05 (A)
700.00	.406E-05 (A)
800.00	.311E-05 (A)
900.00	.246E-05 (A)
1000.00	.199E-05 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
0	1	0.0	10

TAU	HEAT FLOW
10.00	.532E+00 (A)
20.00	.460E+00 (A)
30.00	.425E+00 (A)
33.00	.292E-01 (A)
36.00	.150E-01 (A)
39.00	.962E-02 (A)
42.00	.690E-02 (A)
45.00	.529E-02 (A)
51.00	.343E-02 (A)
60.00	.210E-02 (A)
70.00	.138E-02 (A)
80.00	.983E-03 (A)
90.00	.737E-03 (A)
100.00	.573E-03 (A)
200.00	.122E-03 (A)
300.00	.519E-04 (A)
400.00	.286E-04 (A)
500.00	.181E-04 (A)
600.00	.124E-04 (A)
700.00	.908E-05 (A)
800.00	.691E-05 (A)
900.00	.545E-05 (A)
1000.00	.440E-05 (A)
2000.00	.109E-05 (A)
3000.00	.481E-06 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
0	1	0.0	30

HEAT FLOW IN RADIAL SYMMETRY

TAU	HEAT FLOW
10.00	.532E+00 (A)
20.00	.460E+00 (A)
30.00	.425E+00 (A)
40.00	.403E+00 (A)
50.00	.387E+00 (A)
60.00	.374E+00 (A)
70.00	.365E+00 (A)
80.00	.358E+00 (A)
90.00	.350E+00 (A)
100.00	.344E+00 (A)
110.00	.781E-02 (A)
120.00	.377E-02 (A)
130.00	.237E-02 (A)
140.00	.168E-02 (A)
150.00	.128E-02 (A)
170.00	.821E-03 (A)
200.00	.498E-03 (A)
300.00	.172E-03 (A)
400.00	.870E-04 (A)
500.00	.526E-04 (A)
600.00	.353E-04 (A)
700.00	.253E-04 (A)
800.00	.190E-04 (A)
900.00	.149E-04 (A)
1000.00	.119E-04 (A)
2000.00	.283E-05 (A)
3000.00	.124E-05 (A)
4000.00	.692E-06 (A)
5000.00	.441E-06 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
0	1	0.0	100

TAU	HEAT FLOW
100.00	.344E+00 (A)
200.00	.310E+00 (A)
300.00	.293E+00 (A)
330.00	.227E-02 (A)
360.00	.107E-02 (A)
390.00	.671E-03 (A)
420.00	.474E-03 (A)
450.00	.357E-03 (A)
510.00	.228E-03 (A)
600.00	.138E-03 (A)
700.00	.896E-04 (A)
800.00	.632E-04 (A)
900.00	.471E-04 (A)
1000.00	.365E-04 (A)
2000.00	.766E-05 (A)
3000.00	.323E-05 (A)
4000.00	.178E-05 (A)
5000.00	.112E-05 (A)
6000.00	.770E-06 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
0	1	0.0	300

TAU	HEAT FLOW
100.00	.344E+00 (A)
200.00	.310E+00 (A)
300.00	.293E+00 (A)
400.00	.281E+00 (A)
500.00	.273E+00 (A)
600.00	.267E+00 (A)
700.00	.262E+00 (A)
800.00	.257E+00 (A)
900.00	.253E+00 (A)
1000.00	.250E+00 (A)
1100.00	.586E-03 (A)
1200.00	.274E-03 (A)
1300.00	.171E-03 (A)
1400.00	.120E-03 (A)
1500.00	.904E-04 (A)
1600.00	.711E-04 (A)
1700.00	.576E-04 (A)
1800.00	.479E-04 (A)
1900.00	.405E-04 (A)
2000.00	.347E-04 (A)
3000.00	.118E-04 (A)
4000.00	.595E-05 (A)
5000.00	.359E-05 (A)
6000.00	.240E-05 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
0	1	0.0	1000

HEAT FLOW IN RADIAL SYMMETRY

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	HEAT FLOW
1.00	.192E+02 (B)
2.00	.119E+02 (B)
3.00	.117E+02 (B)
7.00	.107E+02 (B)
5.00	.906E+01 (B)
6.00	.858E+01 (B)
7.00	.845E+01 (B)
8.00	.841E+01 (B)
9.00	.840E+01 (B)
10.00	.840E+01 (B)
11.00	.132E+01 (B)
12.00	.638E+00 (B)
13.00	.386E+00 (B)
14.00	.271E+00 (B)
15.00	.205E+00 (B)
16.00	.162E+00 (B)
17.00	.131E+00 (B)
18.00	.106E+00 (B)
19.00	.859E-01 (B)
20.00	.697E-01 (B)
30.00	.872E-02 (B)
40.00	.110E-02 (B)
50.00	.140E-03 (B)
60.00	.174E-04 (B)
70.00	.221E-05 (B)
80.00	.276E-06 (B)
90.00	.349E-07 (B)
100.00	.441E-08 (B)
200.00	* (B)
300.00	* (B)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	10	-.01	10

TAU	HEAT FLOW
10.00	.840E+01 (B)
20.00	.656E+01 (B)
30.00	.629E+01 (B)
33.00	.388E+00 (B)
36.00	.187E+00 (B)
39.00	.120E+00 (B)
42.00	.846E-01 (B)
45.00	.613E-01 (B)
51.00	.329E-01 (B)
60.00	.129E-01 (B)
70.00	.462E-02 (B)
80.00	.164E-02 (B)
90.00	.582E-03 (B)
100.00	.208E-03 (B)
200.00	.671E-08 (B)
300.00	* (B)
400.00	* (B)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	10	-.01	30

TAU	HEAT FLOW
10.00	.840E+01 (B)
20.00	.656E+01 (B)
30.00	.629E+01 (B)
40.00	.547E+01 (B)
50.00	.537E+01 (B)
60.00	.537E+01 (B)
70.00	.535E+01 (B)
80.00	.491E+01 (B)
90.00	.468E+01 (B)
100.00	.459E+01 (B)
110.00	.111E+00 (B)
120.00	.546E-01 (B)
130.00	.317E-01 (B)
140.00	.187E-01 (B)
150.00	.111E-01 (B)
170.00	.391E-02 (B)
200.00	.818E-03 (B)
300.00	.442E-05 (B)
400.00	.240E-07 (B)
500.00	.129E-09 (B)
600.00	* (B)
700.00	* (B)
800.00	* (B)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	10	-.01	100

HEAT FLOW IN RADIAL SYMMETRY

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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	HEAT FLOW	
100.00	.459E+01	(B)
200.00	.409E+01	(B)
300.00	.395E+01	(B)
330.00	.336E-01	(B)
360.00	.141E-01	(B)
390.00	.633E-02	(B)
420.00	.286E-02	(B)
450.00	.129E-02	(B)
510.00	.264E-03	(B)
600.00	.244E-04	(B)
700.00	.173E-05	(B)
800.00	.122E-06	(B)
900.00	.865E-08	(B)
1000.00	.613E-09	(B)
2000.00	*	(B)

TAU	HEAT FLOW	
100.00	.459E+01	(B)
200.00	.409E+01	(B)
300.00	.395E+01	(B)
400.00	.382E+01	(B)
500.00	.353E+01	(B)
600.00	.349E+01	(B)
700.00	.347E+01	(B)
800.00	.347E+01	(B)
900.00	.336E+01	(B)
1000.00	.321E+01	(B)
1100.00	.787E-02	(B)
1200.00	.349E-02	(B)
1300.00	.173E-02	(3)
1400.00	.874E-03	(B)
1500.00	.440E-03	(B)
1600.00	.222E-03	(B)
1700.00	.111E-03	(B)
1800.00	.562E-04	(B)
1900.00	.282E-04	(3)
2000.00	.142E-04	(B)
3000.00	.149E-07	(B)
4000.00	*	(3)
5000.00	*	(B)
6000.00	*	(B)

TAU	HEAT FLOW

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-.01	300

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-.01	1000

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0

HEAT FLOW IN RADIAL SYMMETRY

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	HEAT FLOW
1.00	.192E+02 (B)
2.00	.174E+02 (B)
3.00	.128E+02 (B)
4.00	.117E+02 (B)
5.00	.117E+02 (B)
6.00	.117E+02 (B)
7.00	.117E+02 (B)
8.00	.116E+02 (B)
9.00	.103E+02 (B)
10.00	.959E+01 (B)
11.00	.147E+01 (B)
12.00	.803E+00 (B)
13.00	.536E+00 (B)
14.00	.390E+00 (B)
15.00	.167E+00 (B)
16.00	.660E-01 (B)
17.00	.274E-01 (B)
18.00	.108E-01 (B)
19.00	.429E-02 (B)
20.00	.171E-02 (B)
30.00	* (B)
40.00	.616E-01 (A)
50.00	.272E-01 (A)
60.00	.161E-01 (A)
70.00	.108E-01 (A)
80.00	.778E-02 (A)
90.00	.589E-02 (A)
100.00	.462E-02 (A)
200.00	.102E-02 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	10	-5.0	10

TAU	HEAT FLOW
10.00	.959E+01 (B)
20.00	.840E+01 (B)
30.00	.777E+01 (B)
33.00	.490E+00 (B)
36.00	.236E+00 (B)
39.00	.759E-01 (B)
42.00	.212E-01 (B)
45.00	.587E-02 (B)
51.00	.464E-03 (B)
60.00	.391E-06 (B)
70.00	* (B)
80.00	.116E+00 (A)
90.00	.345E-01 (A)
100.00	.204E-01 (A)
200.00	.268E-02 (A)
300.00	.105E-02 (A)
400.00	.563E-03 (A)
500.00	.349E-03 (A)
600.00	.238E-03 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	10	-5.0	30

TAU	HEAT FLOW
10.00	.959E+01 (B)
20.00	.840E+01 (B)
30.00	.777E+01 (B)
40.00	.681E+01 (B)
50.00	.655E+01 (B)
60.00	.655E+01 (B)
70.00	.655E+01 (B)
80.00	.655E+01 (B)
90.00	.629E+01 (B)
100.00	.590E+01 (B)
110.00	.131E+00 (B)
120.00	.272E-01 (B)
130.00	.344E-02 (B)
140.00	.429E-03 (B)
150.00	.712E-04 (B)
170.00	.144E-07 (B)
200.00	* (B)
300.00	.470E-02 (A)
400.00	.196E-02 (A)
500.00	.110E-02 (A)
600.00	.708E-03 (A)
700.00	.496E-03 (A)
800.00	.367E-03 (A)
900.00	.283E-03 (A)
1000.00	.226E-03 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	10	-5.0	100

HEAT FLOW IN RADIAL SYMMETRY
****

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	HEAT FLOW	
100.00	.590E+01	(B)
200.00	.536E+01	(B)
300.00	.487E+01	(B)
330.00	.328E-01	(B)
360.00	.151E-02	(B)
390.00	.682E-04	(B)
420.00	.768E-06	(B)
450.00	.154E-08	(B)
510.00	*	(B)
600.00	.565E-02	(A)
700.00	.251E-02	(A)
800.00	.153E-02	(A)
900.00	.106E-02	(A)
1000.00	.780E-03	(A)
2000.00	.165E-03	(A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-5.0	300

TAU	HEAT FLOW	
100.00	.590E+01	(B)
200.00	.536E+01	(B)
300.00	.487E+01	(B)
400.00	.455E+01	(B)
500.00	.454E+01	(B)
600.00	.454E+01	(B)
700.00	.454E+01	(B)
800.00	.426E+01	(B)
900.00	.413E+01	(B)
1000.00	.405E+01	(B)
1100.00	.256E-02	(B)
1200.00	.138E-04	(B)
1300.00	.390E-08	(B)
1400.00	*	(B)
1500.00	*	(B)
1600.00	.398E-02	(A)
1700.00	.211E-02	(A)
1800.00	.147E-02	(A)
1900.00	.112E-02	(A)
2000.00	.903E-03	(A)
3000.00	.289E-03	(A)
4000.00	.146E-03	(A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	10	-5.0	1000

TAU	HEAT FLOW

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0

HEAT FLOW IN RADIAL SYMMETRY

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	HEAT FLOW
1.00	.228E+02 (B)
2.00	.192E+02 (B)
3.00	.192E+02 (B)
4.00	.158E+02 (B)
5.00	.142E+02 (B)
6.00	.135E+02 (B)
7.00	.128E+02 (B)
8.00	.124E+02 (B)
9.00	.121E+02 (B)
10.00	.117E+02 (B)
11.00	.182E+01 (B)
12.00	.102E+01 (B)
13.00	.181E+00 (B)
14.00	.172E-01 (B)
15.00	.413E-02 (B)
16.00	.223E-08 (B)
17.00	.167E+01 (A)
18.00	.642E+00 (A)
19.00	.422E+00 (A)
20.00	.317E+00 (A)
30.00	.789E-01 (A)
40.00	.380E-01 (A)
50.00	.225E-01 (A)
60.00	.149E-01 (A)
70.00	.106E-01 (A)
80.00	.795E-02 (A)
90.00	.618E-02 (A)
100.00	.495E-02 (A)
200.00	.117E-02 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	10	-10.0	10

TAU	HEAT FLOW
10.00	.117E+02 (B)
20.00	.105E+02 (B)
30.00	.933E+01 (B)
33.00	.641E+00 (B)
36.00	.446E-01 (B)
39.00	.205E-02 (B)
42.00	.809E-05 (B)
45.00	.726E+00 (A)
51.00	.142E+00 (A)
60.00	.656E-01 (A)
70.00	.386E-01 (A)
80.00	.259E-01 (A)
90.00	.188E-01 (A)
100.00	.143E-01 (A)
200.00	.284E-02 (A)
300.00	.119E-02 (A)
400.00	.646E-03 (A)
500.00	.407E-03 (A)
600.00	.280E-03 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	10	-10.0	30

TAU	HEAT FLOW
10.00	.117E+02 (B)
20.00	.105E+02 (B)
30.00	.933E+01 (B)
40.00	.882E+01 (B)
50.00	.840E+01 (B)
60.00	.840E+01 (B)
70.00	.840E+01 (B)
80.00	.838E+01 (B)
90.00	.773E+01 (B)
100.00	.753E+01 (B)
110.00	.392E-01 (B)
120.00	.110E-03 (B)
130.00	* (B)
140.00	.690E-01 (A)
150.00	.461E-01 (A)
170.00	.246E-01 (A)
200.00	.133E-01 (A)
300.00	.407E-02 (A)
400.00	.201E-02 (A)
500.00	.119E-02 (A)
600.00	.795E-03 (A)
700.00	.566E-03 (A)
800.00	.425E-03 (A)
900.00	.331E-03 (A)
1000.00	.266E-03 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_o
30	10	-10.0	100

HEAT FLOW IN RADIAL SYMMETRY
****

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	HEAT FLOW	TAU	HEAT FLOW	TAU	HEAT FLOW
100.00	.753E+01 (B)	100.00	.753E+01 (B)		
200.00	.673E+01 (B)	200.00	.673E+01 (B)		
300.00	.655E+01 (B)	300.00	.655E+01 (B)		
330.00	.458E-03 (B)	400.00	.608E+01 (B)		
360.00	.203E+00 (A)	500.00	.590E+01 (B)		
390.00	.252E-01 (A)	600.00	.576E+01 (B)		
420.00	.143E-01 (A)	700.00	.565E+01 (B)		
450.00	.980E-02 (A)	800.00	.556E+01 (B)		
510.00	.573E-02 (A)	900.00	.549E+01 (B)		
600.00	.327E-02 (A)	1000.00	.537E+01 (B)		
700.00	.207E-02 (A)	1100.00	* (B)		
800.00	.143E-02 (A)	1200.00	.803E-02 (A)		
900.00	.106E-02 (A)	1300.00	.431E-02 (A)		
1000.00	.816E-03 (A)	1400.00	.287E-02 (A)		
2000.00	.196E-03 (A)	1500.00	.210E-02 (A)		
		1600.00	.164E-02 (A)		
		1700.00	.133E-02 (A)		
		1800.00	.110E-02 (A)		
		1900.00	.939E-03 (A)		
		2000.00	.815E-03 (A)		
		3000.00	.326E-03 (A)		
		4000.00	.168E-03 (A)		

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O	LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O	LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	10	-10.0	300	30	10	-10.0	1000				

HEAT FLOW IN RADIAL SYMMETRY

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	HEAT FLOW
1.00	.386E+02 (B)
2.00	.323E+02 (B)
3.00	.272E+02 (B)
4.00	.258E+02 (B)
5.00	.247E+02 (B)
6.00	.231E+02 (B)
7.00	.217E+02 (B)
8.00	.209E+02 (B)
9.00	.204E+02 (B)
10.00	.201E+02 (B)
11.00	.329E+01 (B)
12.00	.190E+01 (B)
13.00	.127E+01 (B)
14.00	.895E+00 (B)
15.00	.664E+00 (B)
16.00	.515E+00 (B)
17.00	.419E+00 (B)
18.00	.349E+00 (B)
19.00	.297E+00 (B)
20.00	.258E+00 (B)
30.00	.845E-01 (B)
40.00	.300E-01 (B)
50.00	.107E-01 (B)
60.00	.379E-02 (B)
70.00	.136E-02 (B)
80.00	.479E-03 (B)
90.00	.171E-03 (B)
100.00	.609E-04 (B)
200.00	.196E-08 (B)
300.00	* (B)
400.00	* (B)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-.01	10

TAU	HEAT FLOW
10.00	.201E+02 (B)
20.00	.169E+02 (B)
30.00	.160E+02 (B)
33.00	.108E+01 (B)
36.00	.535E+00 (B)
39.00	.336E+00 (B)
42.00	.240E+00 (B)
45.00	.183E+00 (B)
51.00	.122E+00 (B)
60.00	.738E-01 (B)
70.00	.436E-01 (B)
80.00	.259E-01 (B)
90.00	.154E-01 (B)
100.00	.912E-02 (B)
200.00	.494E-04 (B)
300.00	.267E-06 (B)
400.00	.145E-08 (B)
500.00	* (B)
600.00	* (B)
700.00	* (B)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-.01	30

TAU	HEAT FLOW
10.00	.201E+02 (B)
20.00	.169E+02 (B)
30.00	.160E+02 (B)
40.00	.147E+02 (B)
50.00	.141E+02 (B)
60.00	.138E+02 (B)
70.00	.136E+02 (B)
80.00	.131E+02 (B)
90.00	.127E+02 (B)
100.00	.124E+02 (B)
110.00	.290E+00 (B)
120.00	.145E+00 (B)
130.00	.956E-01 (B)
140.00	.692E-01 (B)
150.00	.521E-01 (B)
170.00	.304E-01 (B)
200.00	.112E-01 (B)
300.00	.168E-02 (B)
400.00	.436E-03 (B)
500.00	.113E-03 (B)
600.00	.295E-04 (B)
700.00	.767E-05 (B)
800.00	.200E-05 (B)
900.00	.518E-06 (B)
1000.00	.135E-06 (B)
2000.00	* (B)
3000.00	* (B)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-.01	100

HEAT FLOW IN RADIAL SYMMETRY

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	HEAT FLOW
100.00	.124E+02 (B)
200.00	.111E+02 (B)
300.00	.105E+02 (B)
330.00	.894E-01 (B)
360.00	.401E-01 (B)
390.00	.223E-01 (B)
420.00	.144E-01 (B)
450.00	.104E-01 (B)
510.00	.631E-02 (B)
600.00	.333E-02 (B)
700.00	.168E-02 (B)
800.00	.844E-03 (B)
900.00	.424E-03 (B)
1000.00	.214E-03 (B)
2000.00	.223E-06 (B)
3000.00	.233E-09 (B)
4000.00	* (B)
5000.00	* (B)
6000.00	* (B)

TAU	HEAT FLOW
100.00	.124E+02 (B)
200.00	.111E+02 (B)
300.00	.105E+02 (B)
400.00	.101E+02 (B)
500.00	.960E+01 (B)
600.00	.944E+01 (B)
700.00	.937E+01 (B)
800.00	.923E+01 (B)
900.00	.895E+01 (B)
1000.00	.876E+01 (B)
1100.00	.218E-01 (B)
1200.00	.105E-01 (B)
1300.00	.671E-02 (B)
1400.00	.460E-02 (B)
1500.00	.322E-02 (B)
1600.00	.227E-02 (B)
1700.00	.159E-02 (B)
1800.00	.112E-02 (B)
1900.00	.792E-03 (B)
2000.00	.558E-03 (B)
3000.00	.169E-04 (B)
4000.00	.510E-06 (B)
5000.00	.154E-07 (B)
6000.00	.465E-09 (B)

TAU	HEAT FLOW

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-.01	300

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-.01	1000

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O

HEAT FLOW IN RADIAL SYMMETRY

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	HEAT FLOW
1.00	.438E+02 (B)
2.00	.353E+02 (B)
3.00	.313E+02 (B)
4.00	.274E+02 (B)
5.00	.258E+02 (B)
6.00	.254E+02 (B)
7.00	.253E+02 (B)
8.00	.244E+02 (B)
9.00	.231E+02 (B)
10.00	.221E+02 (B)
11.00	.342E+01 (B)
12.00	.190E+01 (B)
13.00	.131E+01 (B)
14.00	.986E+00 (B)
15.00	.776E+00 (B)
16.00	.622E+00 (B)
17.00	.508E+00 (B)
18.00	.412E+00 (B)
19.00	.333E+00 (B)
20.00	.271E+00 (B)
30.00	.456E-01 (B)
40.00	.659E-03 (B)
50.00	.219E-05 (B)
60.00	* (B)
70.00	* (B)
80.00	.484E-01 (A)
90.00	.247E-01 (A)
100.00	.164E-01 (A)
200.00	.259E-02 (A)
300.00	.105E-02 (A)
400.00	.571E-03 (A)
500.00	.357E-03 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-5.0	10

TAU	HEAT FLOW
10.00	.221E+02 (B)
20.00	.196E+02 (B)
30.00	.169E+02 (B)
33.00	.116E+01 (B)
36.00	.609E+00 (B)
39.00	.404E+00 (B)
42.00	.287E+00 (B)
45.00	.209E+00 (B)
51.00	.112E+00 (B)
60.00	.441E-01 (B)
70.00	.253E-01 (B)
80.00	.362E-02 (B)
90.00	.456E-03 (B)
100.00	.578E-04 (B)
200.00	.117E-01 (A)
300.00	.302E-02 (A)
400.00	.147E-02 (A)
500.00	.875E-03 (A)
600.00	.582E-03 (A)
700.00	.416E-03 (A)
800.00	.313E-03 (A)
900.00	.245E-03 (A)
1000.00	.197E-03 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-5.0	30

TAU	HEAT FLOW
10.00	.221E+02 (B)
20.00	.196E+02 (B)
30.00	.169E+02 (B)
40.00	.162E+02 (B)
50.00	.162E+02 (B)
60.00	.154E+02 (B)
70.00	.145E+02 (B)
80.00	.140E+02 (B)
90.00	.137E+02 (B)
100.00	.137E+02 (B)
110.00	.333E+00 (B)
120.00	.165E+00 (B)
130.00	.958E-01 (B)
140.00	.565E-01 (B)
150.00	.336E-01 (B)
170.00	.118E-01 (B)
200.00	.247E-02 (B)
300.00	.768E-06 (B)
400.00	* (B)
500.00	.571E-02 (A)
600.00	.254E-02 (A)
700.00	.155E-02 (A)
800.00	.107E-02 (A)
900.00	.103E-02 (A)
1000.00	.608E-03 (A)
2000.00	.149E-03 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-5.0	100

HEAT FLOW IN RADIAL SYMMETRY

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	HEAT FLOW
100.00	.137E+02 (B)
200.00	.120E+02 (B)
300.00	.118E+02 (B)
330.00	.910E-01 (B)
360.00	.391E-01 (B)
390.00	.231E-01 (B)
420.00	.135E-01 (B)
450.00	.622E-02 (B)
510.00	.127E-02 (B)
600.00	.117E-03 (B)
700.00	.222E-05 (B)
800.00	.135E-07 (B)
900.00	* (B)
1000.00	* (B)
2000.00	.462E-03 (A)
3000.00	.201E-03 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-5.0	300

TAU	HEAT FLOW
100.00	.137E+02 (B)
200.00	.120E+02 (B)
300.00	.118E+02 (B)
400.00	.109E+02 (B)
500.00	.105E+02 (B)
600.00	.104E+02 (B)
700.00	.104E+02 (B)
800.00	.101E+02 (B)
900.00	.979E+01 (B)
1000.00	.955E+01 (B)
1100.00	.238E-01 (B)
1200.00	.106E-01 (B)
1300.00	.527E-02 (B)
1400.00	.355E-02 (B)
1500.00	.140E-02 (B)
1600.00	.364E-03 (B)
1700.00	.946E-04 (B)
1800.00	.246E-04 (B)
1900.00	.640E-05 (B)
2000.00	.150E-05 (B)
3000.00	.286E-02 (A)
4000.00	.492E-03 (A)
5000.00	.245E-03 (A)
6000.00	.129E-03 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O
30	30	-5.0	1000

TAU	HEAT FLOW

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_O

HEAT FLOW IN RADIAL SYMMETRY

LATENT HEAT DENSITY, 30 MJ/M^3

TAU	HEAT FLOW
1.00	.513E+02 (B)
2.00	.365E+02 (B)
3.00	.351E+02 (B)
4.00	.321E+02 (B)
5.00	.290E+02 (B)
6.00	.272E+02 (B)
7.00	.259E+02 (B)
8.00	.254E+02 (B)
9.00	.253E+02 (B)
10.00	.253E+02 (B)
11.00	.417E+01 (B)
12.00	.223E+01 (B)
13.00	.142E+01 (B)
14.00	.101E+01 (B)
15.00	.745E+00 (B)
16.00	.501E+00 (B)
17.00	.336E+00 (B)
18.00	.219E+00 (B)
19.00	.144E+00 (B)
20.00	.933E-01 (B)
30.00	.214E-05 (B)
40.00	.147E+00 (A)
50.00	.636E-01 (A)
60.00	.378E-01 (A)
70.00	.254E-01 (A)
80.00	.184E-01 (A)
90.00	.140E-01 (A)
100.00	.110E-01 (A)
200.00	.246E-02 (A)
300.00	.106E-02 (A)
400.00	.587E-03 (A)
500.00	.372E-03 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU$_0$
30	30	-10.0	10

TAU	HEAT FLOW
10.00	.253E+02 (B)
20.00	.203E+02 (B)
30.00	.196E+02 (B)
33.00	.140E+01 (B)
36.00	.656E+00 (B)
39.00	.382E+00 (B)
42.00	.209E+00 (B)
45.00	.112E+00 (B)
51.00	.326E-01 (B)
60.00	.222E-02 (B)
70.00	.308E-05 (B)
80.00	* (B)
90.00	.820E-01 (A)
100.00	.472E-01 (A)
200.00	.642E-02 (A)
300.00	.254E-02 (A)
400.00	.136E-02 (A)
500.00	.851E-03 (A)
600.00	.581E-03 (A)
700.00	.422E-03 (A)
800.00	.320E-03 (A)
900.00	.252E-03 (A)
1000.00	.204E-03 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU$_0$
30	30	-10.0	30

TAU	HEAT FLOW
10.00	.253E+02 (B)
20.00	.203E+02 (B)
30.00	.196E+02 (B)
40.00	.182E+02 (B)
50.00	.171E+02 (B)
60.00	.163E+02 (B)
70.00	.162E+02 (B)
80.00	.162E+02 (B)
90.00	.162E+02 (B)
100.00	.156E+02 (B)
110.00	.345E+00 (B)
120.00	.163E+00 (B)
130.00	.736E-01 (B)
140.00	.263E-01 (B)
150.00	.935E-02 (B)
170.00	.504E-03 (B)
200.00	.345E-08 (B)
300.00	.114E-01 (A)
400.00	.478E-02 (A)
500.00	.270E-02 (A)
600.00	.174E-02 (A)
700.00	.122E-02 (A)
800.00	.907E-03 (A)
900.00	.701E-03 (A)
1000.00	.560E-03 (A)
2000.00	.154E-03 (A)

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU$_0$
30	30	-10.0	100

HEAT FLOW IN RADIAL SYMMETRY
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LATENT HEAT DENSITY, 30 MJ/M^3

TAU	HEAT FLOW
100.00	.156E+02 (B)
200.00	.136E+02 (B)
300.00	.128E+02 (B)
330.00	.101E+00 (B)
360.00	.406E-01 (B)
390.00	.873E-02 (B)
420.00	.214E-02 (B)
450.00	.181E-03 (B)
510.00	.136E-07 (B)
600.00	.161E-01 (A)
700.00	.630E-02 (A)
800.00	.380E-02 (A)
900.00	.262E-02 (A)
1000.00	.194E-02 (A)
2000.00	.413E-03 (A)
3000.00	.197E-03 (A)

TAU	HEAT FLOW
100.00	.156E+02 (B)
200.00	.136E+02 (B)
300.00	.128E+02 (B)
400.00	.121E+02 (B)
500.00	.118E+02 (B)
600.00	.118E+02 (B)
700.00	.114E+02 (B)
800.00	.111E+02 (B)
900.00	.108E+02 (B)
1000.00	.107E+02 (B)
1100.00	.263E-01 (B)
1200.00	.399E-02 (B)
1300.00	.450E-03 (B)
1400.00	.273E-05 (B)
1500.00	* (B)
1600.00	.210E+00 (A)
1700.00	.642E-02 (A)
1800.00	.397E-02 (A)
1900.00	.293E-02 (A)
2000.00	.232E-02 (A)
3000.00	.732E-03 (A)
4000.00	.370E-03 (A)
5000.00	.195E-03 (A)
6000.00	.103E-03 (A)

TAU	HEAT FLOW

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	30	-10.0	300

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0
30	30	-10.0	1000

LATENT HEAT DENSITY	TEMPERATURE SOURCE	TEMPERATURE INITIAL	TAU_0