THE UNIVERSITY OF MICHIGAN

INDUSTRY PROGRAM OF THE COLLEGE OF ENGINEERING

KINETICS OF THE PHASE TRANSFORMATION OF CALCIUM SULFATE IN AQUEOUS AND BRINE SOLUTIONS

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in the
University of Michigan
Department of Chemical and Metallurgical Engineering
1967

October, 1967

IP-790

ACKNOWLEDGEMENTS

It is a pleasure for the author to express his appreciation to the following individuals and organizations for their contributions to this research:

The late Dr. Kenneth F. Gordon who initially proposed the kinetic study.

Professor Wilbur C. Bigelow, chairman of the doctoral committee, for his assistance, encouragement, and guidance.

The other members of the doctoral committee, Professors Lawrence O. Brockway, Giuseppe Parravano, Robert D. Pehlke, and J. Louis York, for their interest, suggestions, and patience.

My brother and sister for their assistance in transcribing part of the data.

Messrs. Murry Player and Bernard Schorle, fellow graduate students, for their suggestions, criticisms, and assistance.

The Industry Program of the College of Engineering for their excellent work in the preparation of this dissertation.

The Office of Saline Water of the United States Department of the Interior for their financial support.

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NOMENCLATURE

A	Distance in the A direction defined in Figure 35, cm
A'	Cross-sectional area of capillary, cm^2
a	Activity
a	Thickness of hemihydrate needle, cm
a'	Thickness of dihydrate particle, cm
B	Distance in the B Direction defined in Figure 35, cm
b	Width of hemihydrate needle, cm
b'	Width of dihydrate particle, cm
b_o	Constant defined by Equation (K-1)
b_1	Constant defined by Equation (K-1)
C	Distance in the C direction defined in Figure 35, cm
c	Length of hemihydrate needle, cm
c'	Length of dihydrate particle, cm
D	Average crystal diameter, cm
D	Amount of dihydrate reacted, moles
D_o	Initial amount of dihydrate, moles
D_i	Constants used in Equations (62) to (69) where $i = 1, 2, \ldots, 12$
D'	Constant defined by Equation (Q-11)
D''	Constant defined by Equation (Q-10)
D'''	Constant defined by Equation (Q-9)
d	Distance, cm
E	Activation energy, Kcal/gm mole
f	Fugacity, mm Hg

f/p	Fugacity coefficient
ΔG	Total free energy change, ergs
ΔG^*	Free energy change for critical nucleus, ergs
$\Delta G^{\#}$	Free energy of activation, Kcal/gm mole
$\overline{\Delta G}$	Free energy change per molecule, ergs/molecule
$\Delta H^{\#}$	Enthalpy of activation, Kcal/gm mole
h	Height of liquid meniscus, cm
J	Constant defined by Equation (57)
K	Nucleation rate constant, $\min^{-1}$
K_1	Constant defined by Equation (Q-4)
K_2	Constant defined by Equation (Q-4)
k	General kinetic rate constant, $\min^{-1}$
m	Number of molecules per nucleus
m^*	Number of molecules per critical nucleus
Δm	Change in number of moles, gm moles
N	Number of nuclei
N_o	Total number of nuclei
N_o/p	Number of nuclei per dihydrate particle
N_f	Number of crystal fragments per sample
P	Pressure, mm Hg
P^o	Pressure of pure component, mm Hg
P/P^o	Vapor pressure ratio
R	Gas constant, 1.987 Kcal/gm mole/^oK
R_i	General term for any of the kinetic constants: K, U_B/a, U_B/b, U_A/a, or U_A/b, $\min^{-1}$
R_{io}	General term for any of the kinetic constants for the reaction in water

r	Radius, cm
S	Slope, min^{-1}
$\Delta S\#$	Entropy of activation, Kcal/gm mole/^{o}K
SS	Sign of the Slope, defined by Equation (79)
T	Temperature, °K or °F
t	Time of observation, min
U	Linear growth velocity, cm/min
U_A	Linear growth velocity in the A direction, cm/min
U_B	Linear growth velocity in the B direction, cm/min
U_C	Linear growth velocity in the C direction, cm/min
U_o	Linear growth velocity for reaction in water, cm/min
U/d	General kinetic growth constant, min^{-1}
U_A/a	Kinetic growth constant, min^{-1}
U_A/b	Kinetic growth constant, min^{-1}
U_B/a	Kinetic growth constant, min^{-1}
U_B/b	Kinetic growth constant, min^{-1}
U_C/c	Kinetic growth constant, min^{-1}
u	Impingement time, min
V	Volume, cc
V_f	Volume of one dihydrate crystal, cc
ΔV	Volume change, cc
ΔV_1	Volume change for dihydrate-hemihydrate reaction, cc
ΔV_2	Volume change for hemihydrate-anhydrite reaction, cc
$\bar{V}$	Molar volume, cc/gm mole
v	Volume of a hemihydrate needle, cc
v_m	Volume per molecule, cc/molecule

W	Constant
w	Impingement time, min
w_D	Weight of dihydrate, gm
X	Weight fraction
x	Nucleation time, min
x	Distance, cm
Y	Chlorinity, gm Cl^- per 1000 gm solution
y	Impingement time, min
Z	Pre-exponential factor, min^{-1}
z	Impingement time, min

Greek Letters

α	Fraction reacted
β	Number of successive events occuring in the formation of a nucleus
γ	Strain energy per unit area, $ergs/cm^2$
θ_1	First impingement time, $b/2U_B$, min
θ_2	Second impingement time, $(b/2)/(U_B - U_A/\sqrt{3})$, min
θ_3	Third impingement time, $a/2U_A$, min
θ_c	C direction impingement time, c/U_C , min
ν	Frequency of lattice vibration, cycles/min
ρ	Density, gm/cc
ρ_T	Density at temperature T, gm/cc
$\bar{\rho}$	Molar density, moles/cc
σ	Shape factor, cm^2
$\tau_{5\%}$	Time for 5% transformation, min
$(\tau_{5\%})_o$	Time for 5% transformation in water, min

Subscripts

A	Anhydrite
D	Dihydrate
H	Hemihydrate
W	Water
a	First part of reaction
c	Second part of reaction
c	Corrected t, h, or T values
e	Third part of reaction
g	Fourth part of reaction
o	observed
r	reaction
t	temperature
tot	total

ABSTRACT

Although evaporative processes presently provide the most economical means of recovering potable water from sea water, they are limited by calcium sulfate scale which forms on the heat transfer surfaces. This scale forms by the nucleation and growth of calcium sulfate dihydrate or hemihydrate from solution, usually followed by the dehydration of these phases to the hemihydrate or anhydrite phase. In order to understand this scaling process so that it can either be controlled or eliminated, the fundamental nature of both the formation and transformation processes must be known.

In this connection, an investigation has been made of the phase transformation of calcium sulfate dihydrate to hemihydrate and anhydrite at temperatures encountered in desalinization processes. This investigation was divided into two major parts: (1) studies of the time-temperature-transformation (TTT) relationships of the dihydrate-hemihydrate and the hemihydrate-anhydrite transformations and (2) a study of the kinetic mechanism of the dihydrate-hemihydrate transformation.

The TTT relationships for the dihydrate-hemihydrate and the hemihydrate-anhydrite transformationswere obtained from dilatometric measurements of the net volume change accompanying the transformation of 0.7 gram samples in water, in sodium chloride solutions containing from 0.5% to 21% NaCl, and in synthetic sea water, over the temperature range from 230° to 350°F. Initial dihydrate particle sizes ranged from one large crystal to a very fine powder. The different phases occurring were indentified by their X-ray powder diffraction patterns. A total of 63 experimental runs were made.

The dihydrate-hemihydrate transformation was found to be affected by three major variables: temperature, water activity, and initial dihydrate particle size. Both nucleation time and reaction time decreased with increasing temperature and decreasing water activity, indicating that both the nucleation and growth processes were accelerated by these changes. A minimum nucleation time was observed for particles about 0.01 inches long.

The hemihydrate-anhydrite transformation was affected in a similar manner by changes in temperature and water activity. Initial particle sizes were not varied in this study.

In the study of the transformation mechanism, the geometric details of the dihydrate-hemihydrate transformation were observed microscopically in a special cell designed to duplicate the conditions used in the dilatometer. Based on these observations, a simplified physical model was developed for the nucleation, growth, and impingement of hemihydrate needles with each other and the boundaries of the parent dihydrate crystals. Kinetic equations were derived for this model, and their kinetic rate constants were determined by fitting the equations to the rate data calculated from the dilatometric measurements. Empirical equations were derived for the variation of the kinetic constants with temperature and water activity. Using these empirical equations and the theoretical equations, time-temperature-transformation curves were calculated which compared favorably with the experimentally measured TTT values. This agreement helped to establish the validity of the theoretical equations and provided a means for interpolating and extrapolating the data obtained in this research.

I. INTRODUCTION

Although the formation of thermally insulating scale on boiler and heat exchanger surfaces has been a serious engineering problem for many years, it has recently become more serious with the growth of progress to recover potable water from the oceans and brackish inland water supplies. At present, scale formation is a major factor limiting the efficiency and increasing the cost of production of potable water by evaporative processes. While all salts dissolved in the feed water to an evaporator are potential scale formers if the evaporation is carried beyond the limit of their solubilities, calcium sulfate is particularly bothersome because of its inverted solubility characteristics. As shown in Figure 1, two of the three solid crystalline modifications of calcium sulfate occurring in aqueous solutions, $CaSO_4$ (anhydrite) and $CaSO_2 \cdot 1/2H_2O$ (hemihydate), exhibit this phenomenon over their entire range of solubilities, while $CaSO_2 \cdot 2H_2O$ (dihydrate) exhibits the normal behaviour of increasing solubility for temperatures below 100°F, and then exhibits inverted or decreasing solubility above 100°F. This decrease in solubility with an increase in temperature permits scale formation to occur on the heat transfer surface where a thin film of feed water can quickly become supersaturated causing scale to form, often before an appreciable amount of desalinated water is produced.

In general, this phenomenon of scale formation involves the nucleation of calcium sulfate, either within the solution itself (homogeneous nucleation) or on some other phase, for example, the heating surface of the evaporators (heterogeneous nucleation), followed by growth of one or more of the three principal phases of calcium sulfate which are

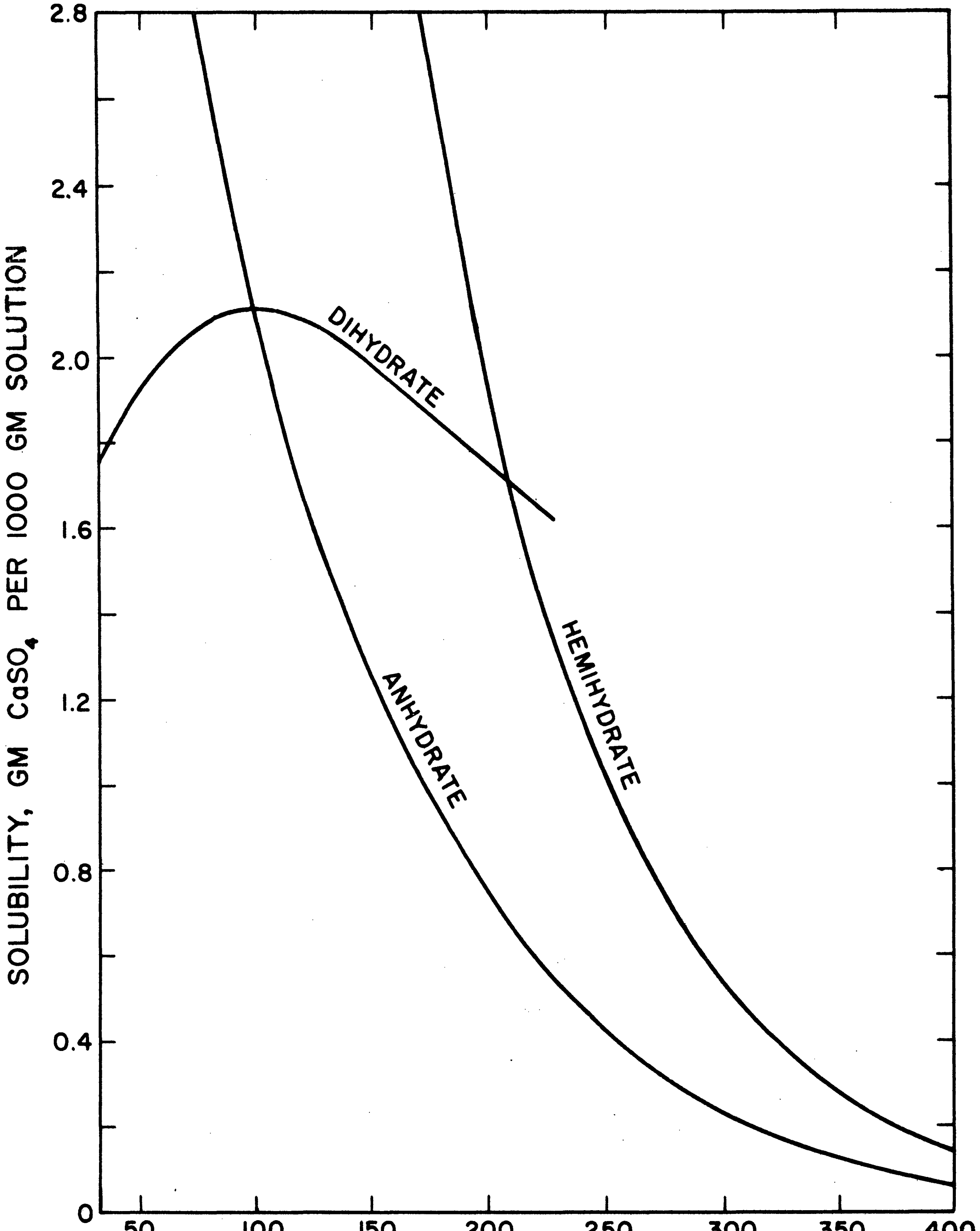


Figure 1. Solubilities of the Solid Phases in the Calcium Sulfate - Water System (Reference 69).

stable in aqueous solutions. Since both calcium sulfate hemihydrate and dihydrate are metastable over the range of conditions commonly encountered in evaporators, scale formation may subsequently involve the transformation of the dihydrate to the hemihydrate, or the hemihydrate to the anhydrite. The development of effective means of controlling calcium sulfate scale formation must ultimately involve the development of means of controlling these nucleation, growth, and transformation processes based on an understanding of the fundamental mechanisms involved.

The purpose of this investigation was to study the fundamental mechanism and the kinetics of the direct transformation of solid calcium sulfate dihydrate, $CaSO_4 \cdot 2H_2O$, to solid calcium sulfate hemihydrate, $CaSO_4 \cdot 1/2H_2O$, in water, in aqueous sodium chloride solutions, and in synthetic sea water concentrates at various temperatures. The net reaction for this transformation is represented by the following equation:

$$CaSO_4 \cdot 2H_2O(S) \rightarrow CaSO_4 \cdot 1/2H_2O(S) + 3/2H_2O(L) \qquad (1)$$

This reaction was chosen because the formation of calcium sulfate scale on heat exchanger surfaces necessarily causes an increase in temperature, due to its insulating properties, resulting in favorable temperature conditions for the above dehydration reaction to occur. Because the transformation reaction probably also starts at the heat exchanger surface where the temperature is highest, an understanding of the changes involved might provide a key for effective control or the removal of calcium sulfate scale.

The research on the dehydration of calcium sulfate dihydrate to hemihydrate was divided into two major parts: (1) studies of the time-temperature-transformation (TTT) relationships based entirely on observations of the volume change accompanying the reaction, and (2) the studies of the kinetic mechanism, using primarily microscopic observations. The use of optical grade selenite, $CaSO_4 \cdot 2H_2O$, for these observations rather than actual calcium sulfate scale, increased the utility of these studies by allowing the transformation occurring within the solid crystals to be photographed showing details of the transformation which otherwise could not have been obtained. Combining these visual details with TTT data made it possible to develop kinetic equations for the dehydration process which have both scientific and engineering applications.

II. REVIEW OF THE LITERATURE

Five solid phases have been identified in the calcium sulfate-water system: the dihydrate, $CaSO_4 \cdot 2H_2O$; the hemihydrate, $CaSO_4 \cdot 1/2H_2O$; soluble anhydrite, γ-$CaSO_4$; natural anhydrite, β-$CaSO_4$; and a high temperature form of anhydrite, α-$CaSO_4$. The transformations between these phases were observed by differential thermal analysis showing that the dihydrate to hemihydrate transformation occurs near 130°C,(6,48,73,79) that the hemihydrate to γ-$CaSO_4$ transformation occurs near 170°C,(6,48,73,79) and that the β-$CaSO_4$ transformation occurs near 1230°C.(36,38,60,62) The transformation between γ-$CaSO_4$ and β-$CaSO_4$, requiring considerably less energy, was not detected by differential thermal analysis but was observed in x-ray diffraction studies.(63,73)

X-ray powder diffraction patterns(82) have been reported for all but the α high temperature phase which is extremely unstable below 1230°C. These patterns are sufficiently distinctive to permit ready identification of the calcium sulfate phases, although the patterns for hemihydrate and γ-$CaSO_4$ are almost identical, making it difficult to distinguish them from each other unless: (1) care is taken to eliminate the possibility of hydration to hemihydrate, (2) the exposures are standardized, and (3) an x-ray camera capable of giving highly accurate d values is used.(73,99)

A. Time-Temperature-Transformation Studies.

In the $CaSO_4$ - water system, the hydrates can be dehydrated with the formation of either gaseous or liquid water depending on whether the reactants are heated in contact with air or are immersed in an aqueous solution. Three phase transformations have been detected when the solid phases were heated in contact with air, but only two were found when they were submerged in an aqueous solution, resulting in five different phase reactions describing the dehydration of calcium sulfate.

Examination of the time-temperature-transformation information available in the literature on the reactions occurring in air indicates that the vapor pressure of the water in the air has a marked effect in determining which dehydration reaction occurs. When samples of dihydrate were heated in a stream of air dried over phosphoric acid they dehydrated directly to soluble anhydrite (γ-$CaSO_4$) without any indication of the formation of hemihydrate appearing in the TTT data.(11,19,80) When samples were heated in a furnace where there was a minimum movement of the air around the sample, the dihydrate began to transform to hemihydrate which, in turn, began to transform to γ-$CaSO_4$ before the dihydrate was completely transformed to hemihydrate.(11) When samples of dihydrate were deliberately heated in a stream of moist air, only the transformation of the dihydrate to the hemihydrate was observed(12,39,54,80) probably due to termination of the observations before the second reaction had initiated. Other observations(55,98,99) yielding isobaric dehydration curves for the transformation of the dihydrate to hemihydrate, and the hemihydrate to γ-$CaSO_4$ (soluble anhydrite) showed that the reactions were reversible under these conditions and occurred in a sequential manner with the dihydrate transforming completely to the hemihydrate which in turn transformed to γ-$CaSO_4$. Since the vapor pressure of the water was not reported, except for the isobaric experiments, it was impossible to quantitatively describe its effect on the reaction. It can be pointed out, however, that the rate of dehydration of the hemihydrate to anhydrite becomes faster than the dehydration of the dihydrate to hemihydrate for some vapor pressures of water, causing the latter reaction to become the rate controlling step for the conversion of dihydrate to anhydrite.

Examination of the time-temperature-transformation studies available in the literature for the dehydration of the dihydrate while submerged in aqueous solutions indicated that the salts dissolved in the aqueous media had a marked effect on the reactions and on their mechanism. The detailed studies of Taperova and associates(87,88,89,90) showed that the concentration of phosphoric acid in the solution in which the phases were submerged determined what reaction would occur at a particular temperature. Using radioactive isotope techniques, Ketelaar and Heijmann(51) concluded that whenever one of the phase reactions observed by Taperova occurred, either by hydration or dehydration, it occurred through the solution, as indicated by a decrease in the radioactivity of the phosphoric acid solutions.

Ostroff(66) followed the dehydration of calcium sulfate dihydrate immersed in an aqueous solution containing sodium and magnesium chlorides at 90.5°C. Even though the free energy relationships indicated that the dihydrate should transform directly to anhydrite, he observed that the hemihydrate first formed completely, and then it transformed to natural anhydrite (β-$CaSO_4$). From this he concluded that the anhydrite could form from the dihydrate only when the conditions for the transformation of the dihydrate to the hemihydrate also existed.

Droste and Grim(24) followed the continuous change of calcium sulfate dihydrate to hemihydrate in an atmosphere of saturated steam by observing the change in intensity of x-rays diffracted from the (020) planes of dihydrate and hemihydrate crystals using an autoclave combined with conventional x-ray diffraction equipment. Their results showed that the transformation occurred by a solid-solid transformation, and provided no indication of any intermediate step or liquid phase occurring during the transformation.

The hydration of hemihydrate to dihydrate was studied in much detail by observing the setting of Plaster of Paris(18,19,71,72,100) which involves the crystallization of the dihydrate from a supersaturated solution.(20) Mechanistic studies on the hydration of anhydrite to dihydrate were also made showing that the initial particle size of the anhydrite(29) and the solution phase containing the reacting solids(16) affected the rate of reaction considerably.

Isolated values of the transition temperature for the dihydrate-hemihydrate and dihydrate-anhydrite equilibria were determined from the intersections of the respective solubility curves and by the direct observation of the effect of temperature on the overall rates of reaction. Using the intersection of solubility curves, for example, Partridge(69,70,75) found the temperature for the gypsum-anhydrite transition to be 37°C, and the gypsum-hemihydrate transition to be 98°C in water; Hill(41) found the temperature for the gypsum-anhydrite transition to be 42°C in water by extrapolating solubility data obtained in potassium sulfate solutions; and Posnjak(89) found the temperature of the gypsum-anhydrite transformation to be 30°C in sea water concentrated 4.8 times. Southard(50) obtained values of 100°C±1°C for the transition temperature between gypsum and hemihydrate in water, by measuring the volume change of selenite partially reacted to hemihydrate in a dilatometer, and by plotting the square root of the absolute value of the rate of volume change versus temperature, retaining the sign associated with the rate. He also determined the transition temperature of the same transformation to be 95°C±1°C in an ethanol-water solution in which the activity of the water was 0.94 (at 95°C).

Using free energy relationships and measured thermodynamic properties, Kelley and Southard(50) developed the following equation giving the transition temperature for the dihydrate-hemihydrate equilibrium as a function of the activity of the water in the solution:

$$RT \ln a^{3/2} = -856.0 - 50.99\, T \operatorname{Log}_{10} T + 0.0185\, T^2 + 126.41\, T \qquad (2)$$

On the other hand, Toriumi and Hara(94) calculated the temperatures for the dihydrate-hemihydrate and for the dihydrate-anhydrite transitions from the intersection of the solubility curves measured in sea water concentrated to various degrees, and correlated the values of the reciprocal of the equilibrium temperature with the logarithm of the vapor pressure ratio P/P^o. The correlating equations are:

$$\log_{10}(P/P^o) = -537.20/T + 1.4476 \qquad (3)$$

for the dihydrate to hemihydrate transformation, and

$$\log_{10}(P/P^o) = -373.64/T + 1.2010 \qquad (4)$$

for the dihydrate to anhydrite transformation, where P is the vapor pressure of the sea water, P^o is the vapor pressure of pure water at the same temperature, and T is the equilibrium temperature in degrees Kelvin.

MacDonald(57) examined the thermodynamic data existing in the literature on the equilibrium between calcium sulfate dihydrate and anhydrite and derived thermodynamic relationships for the effect of lithostatic pressure on the transforming solids and of hydrostatic pressure on the solution phases in pure water and saturated sodium chloride solutions. Using the available data measured at 40°C, he was able to determine that the relationship between the pressure of the system and the equilibrium temperature was approximately linear. When the system was only under a hydrostatic load, he calculated the slopes of the pressure versus temperature lines as 84.4 bars per degree centigrade for dilute calcium sulfate solutions and as 90.8 for saturated sodium chloride solutions. When the solid in the system was under a lithostatic pressure approximately 2.4 time the applied hydrostatic pressure, he calculated the slope of the pressure versus temperature lines as -39.45 for dilute calcium sulfate solutions and as -48.3 for saturated sodium chloride solutions.

B. Crystallographic Studies

Crystal structures have been reported in the literature for four phases of calcium sulfate: the dihydrate (selenite or gypsum) the hemihydrate (bassanite), soluble anhydrite (γ-$CaSO_4$), and natural anhydrite (β-$CaSO_4$). In addition, Kelley(50) has reported thermodynamic data which suggest the possibility of the existence of modifications of these phases although no confirming crystallographic data have been reported.

Studies of the crystal structure of calcium sulfate dihydrate by Onorato(64), Wooster(103), Gossner(21), Bragg(9), De Jong and

Bouman(22), and Strunz(84) have resulted in six different unit cells appearing in the literature, with each author choosing the b axis perpendicular to the planes of easiest cleavage, but six different sets of a and c axes. The relationships between these six different unit cells for calcium sulfate dihydrate are shown in Figure A-1 of Appendix A where the lattice is viewed perpendicular to the (010) cleavage planes.(10,22,23) The centers of the sulfate radicals and the calcium ions are represented by the intersection of the lines while the different unit cells are shown by heavy outlining.

According to De Jong and Bouman, calcium sulfate dihydrate has a monoclinic unit cell containing four molecules of $CaSO_4 \cdot 2H_2O$ with: $a = 5.68$, $b = 15.18$, $c = 6.29$ Å, and $\beta = 113°50'$. The locations of the individual atoms in the structure have been given by Wooster(103), Strunz,(84) and Wyckoff,(104,105,106) while investigations using proton magnetic resonance,(67) infrared spectroscopy,(2) and neutron diffraction(40) have accurately located the positions of the hydrogen atoms and have provided information on the nature of the bonding between the sulfate radicals and the water molecules.

When calcium sulfate dihydrate is viewed perpendicular to the (010) cleavage planes, the crystal transmits polarized light in four different directions which are 90 degrees apart, representing the α and γ optical axis of the crystal.(13) These axes are rotated 37°28' to the c axis of the morphological cell(27,78) which also is the c axis of the unit cell of De Jong and Bouman. These optical axes can be used, in conjunction with the predominant cleavage planes, to determine the orientation of the unit cells in the crystal fragments. Cleavage(68) occurs most easily between (010) planes yielding thin polished foliae, between (100) planes forming cleaved surfaces with conchoidial fractures (convex elevations and concave depressions), and between (011) planes resulting in a fibrous fracture plane parallel to (001) planes. The relationships of the cleavage planes to the crystallographic and optical axes are shown in Figure 2.

The crystal structure of calcium sulfate hemihydrate formed in solution has been studied by Onorato,(15) Gallitelli,(31) Caspari,(14,15) and Flörke.(30) The monoclinic structure proposed by Gallitelli was described by Flörke using a hexagonal unit cell having: a = 6.83, c = 5.25 Å and containing three molecules. Flörke also studied the structure of γ-$CaSO_4$ formed by dehydrating hemihydrate in air. He proposed a hexagonal structure similar to that of the hemihydrate except that the water molecules were missing. The dimensions of this hexagonal unit cell are: a = 6.99, c = 6.34 Å. It contains three molecules, and the locations of the atoms in the structure were also given by Flörke.

The crystal structure of anhydrite was studied by Wasastjerna (Reference 9,21) and Dickson and Binks(23) who determined the cell to be orthorhombic with a = 6.19, b = 6.94, and c = 6.94 Å and containing four $CaSO_4$ molecules. More recently Swanson, Fuyat, and Ugrinic(86) measured the following lattice constants: a = 6.238, b = 6.991, and c = 6.996 Å which were redesignated by Deer(21): a = 6.991, b = 6.996, and c = 6.238 Å. The locations of the individual atoms in the structure were reported by Wyckoff.(104,105)

The four phases resulting from the successive decomposition of calcium sulfate dihydrate to anhydrite are related by the preferential

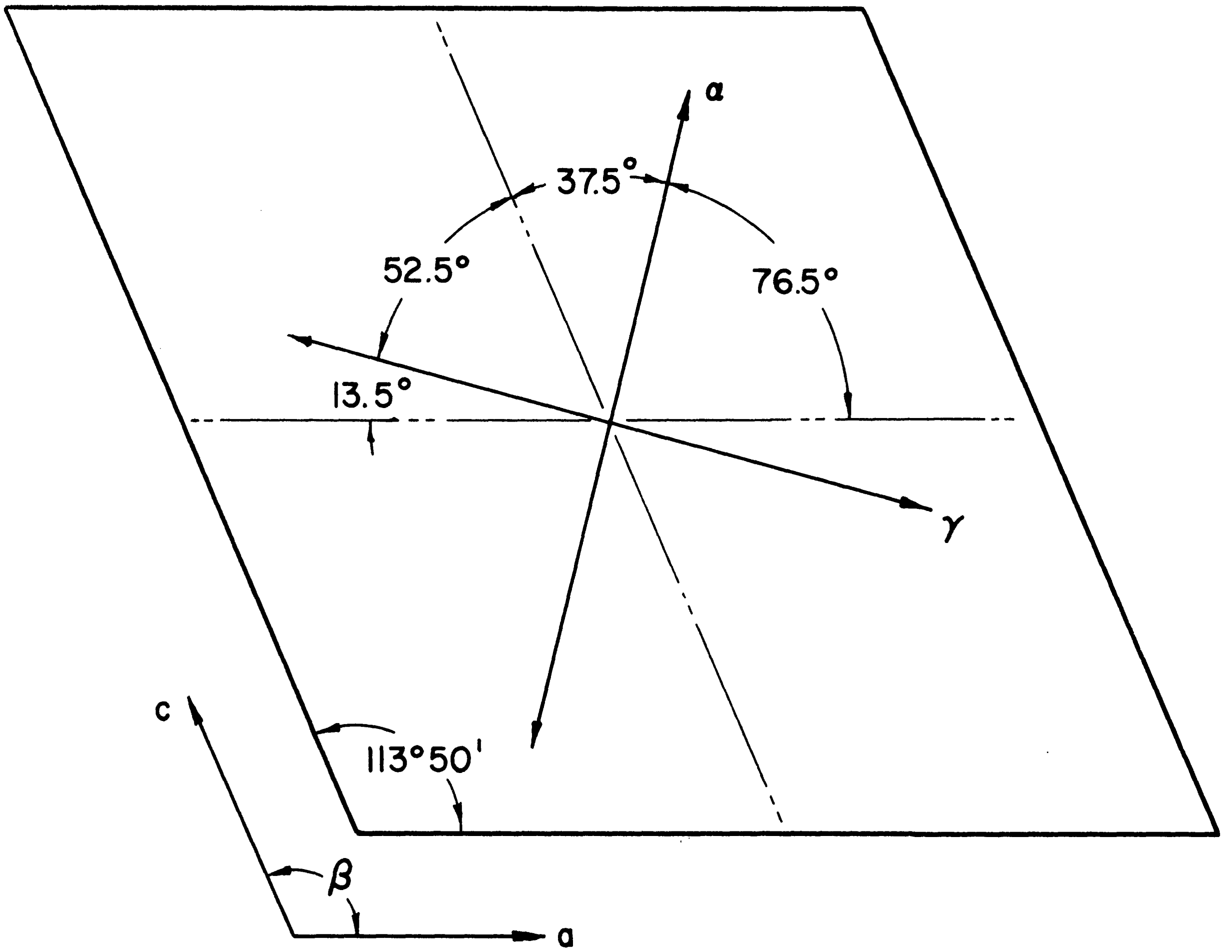


Figure 2. The Relationships Between the Crystallographic Axes a and c and the Optical Axes α and γ for Gypsum Viewed Perpendicular to Its (010) Cleavage Plane.

orientation of the forming crystals within the original crystal structure. Examination of these different structures shows that they are all related by a chain-like feature comprised of calcium and sulfate ions approximately 3.1 Å apart which is preserved in each structure during the decomposition along their c axes.(1,21,30,77) The a axes of the hemihydrate crystals tend to be randomly oriented with respect to the original dihydrate structure(77) whereas the a axes of the anhydrite, which formed from single crystals of hemihydrate, tend to form parallel to one of the a axes of the hemihydrate.(30)

The phase transformation of γ-$CaSO_4$ to β-$CaSO_4$ in air was studied by Posnjak(73) and Newman and Wells(63) who identified the phases by x-ray diffraction patterns. The β-$CaSO_4$ phase was first detected as a minor component in the γ-$CaSO_4$ which formed when samples of dihydrate were heated at 200°C for 670 hours. Samples heated above 450°C were subsequently found to be entirely composed of β-$CaSO_4$ which was also observed during the manufacture of Plaster of Paris.(101) The addition of liquid water to the samples during heating resulted in the formation of β-$CaSO_4$ at 170°C after the comparatively short time of one and one-half hours, indicating that γ-$CaSO_4$ is not stable in aqueous solutions. The results of these investigations are summarized in Table A-1 and Figure A-2 of Appendix A.

Grahmann(36) observed the high temperature form of calcium sulfate, α-$CaSO_4$, while studying binary phase equilibria. Masuda(60) also observed this transformation and reported a transition temperature of 1231°C. Gruver(38) observed this same transformation at 1230°C, and another at

1350°C involving the melting of an eutectic compound between calcium sulfate and calcium oxide.(62) The change in crystal structure at 1230°C is probably associated with a rotation of some of the sulfate ions, changing the structure from a low temperature barite (orthorhomibic) structure to a high temperature (cubic) structure resembling that of sodium chloride. This phenomenon has been observed in other compounds (i.e. $CsClO_4$, KBF_4, $KClO_4$, NH_4BF_4, NH_4ClO_4, $RbClO_4$, and $TlClO_4$) containing radicals of BF_4^- and ClO_4^- which have been shown by Magignac(76) to behave analogously to $SO_4^=$.

C. Summary

Investigations of the dehydration reactions in air led to the postulate that gypsum ($CaSO_4 \cdot 2H_2O$) first dehydrated to hemihydrate ($CaSO_4 \cdot 1/2H_2O$) which was further dehydrated to "soluble anhydrite" (γ-$CaSO_4$) which gradually transforms to natural anhydrite (β-$CaSO_4$) when heated above 170°C. Further heating of natural anhydrite results in another phase change to a high temperature form α-$CaSO_4$.

Investigations of the dehydration reactions occurring when the reactants were immersed in aqueous solutions showed that gypsum dehydrates to hemihydrate which in turn dehydrates to natural anhydrite without any indication of the formation of γ-$CaSO_4$. Studies of the reverse of this process show that the hemihydrate and natural anhydrite readily rehydrate through the solution phase to the dihydrate,(20) although much longer times are required for crystals of anhydrite. Investigations of the equilibrium conditions existing between the three stable phases in solution, primarily using solubility experiments, have established the transition temperature for the dihydrate-hemihydrate and the dihydrate-anhydrite equilibria in aqueous solutions by the intersection of the respective solubility curves. Determinations of the solubilities in sea water concentrates have shown that the respective solubilities change differently with increased concentrations of sea salts, resulting in a lowering of the equilibrium temperatures with increasing salt concentration. Rates of dehydration of the hydrated phases of calcium sulfate were reported in a few cases for the reactions occurring in salt and phosphoric acid solutions.

The information presented from the literature describes the general characteristics and properties of the calcium sulfate—water system that are needed to understand the physical and chemical changes occurring during the dehydration of calcium sulfate dihydrate. The only measurements of individual rates of dehydration applicable to accurate kinetic analysis are those of Budnikoff for the dehydration of dihydrate to hemihydrate in moist air. His experimental values are reproduced in Table A-2 of Appendix A. The remaining TTT measurements mentioned in the review were not observed at equal time intervals and, consequently, could not be analyzed without first smoothing the data. Some detailed kinetic studies on related solid-solid-vapor and solid-solid-liquid reactions were found, however, containing adequate theoretical treatments for their particular reactions. The following section of this dissertation presents some of these fundamental kinetic concepts which are applicable to the calcium sulfate—water system.

III. KINETIC THEORY FOR TRANSFORMATIONS IN SOLIDS

Determination of the reaction mechanism of solid-solid-gas or solid-solid-liquid reactions requires information on: (1) the rate of nucleation of the second phase within the first, (2) the shape of the forming nuclei and their growth geometry throughout the entire reaction, and (3) the pattern of any interferences occurring between the growing nuclei and the edges of the crystal or neighboring nuclei. In the literature, four different laws were used to describe nucleation rates: the exponential law, $dN/dx = KN_o \exp(-Kx)$; the linear law $dN/dx = KN_o$; the power law, $dN/dx = D\beta x^{\beta-1}$; and the law of instantaneous nucleation, $N = N_o$; where dN/dx is the rate of nucleation, K is the nucleation rate constant, x is time, N_o is the total number of nuclei, D is a constant, and β is the number of successive events occurring in the formation of a nucleus. The shapes of growing nuclei were successfully determined using microscopic observation revealing such shapes as: hexagons, rhombohedrons, squares, circles, and four pointed stars.(32,33) As these reactions progressed, the growing nuclei were observed to overlap making it necessary to modify the rate equation describing their growth to account for this interference. Both generalized and specific theories describing the combined effects of nucleation and a growth have been postulated in the literature attempting to adequately describe this complicated phenomenon.

A generalized method for developing a simple mathematical equation describing the overall kinetics of the transformations in solids which occur by nucleation and growth processes was described by Erofeev,(20,26,27,28) Mample,(58,59) and Avrami.(3,4,5) However, this generalized approach does not appear suitable for the present investigation, because it cannot easily incorporate information on the shape and growth patterns of the forming nuclei with information on the overall rate of nucleation and, therefore, is not particularly useful in developing and testing models of reaction mechanisms. Instead, kinetic equations have been developed specifically for this study, based on the experimentally observed characteristics of the nucleation and growth process. Previously successful studies, using this individualized approach, have served as encouraging guides in the present work: i.e. studies of the dehydration of calcium carbonate hexahydrate ($CaCO_3 \cdot 6H_2O$) in solutions;(8,47,93) of copper sulfate pentahydrate ($CuSO_4 \cdot 5H_2O$) in air;(46) and of potassium hydrogen oxalate hemihydrate ($KHC_2O_4 \cdot 1/2H_2O$) in air.(45)

From the most general, theoretical point of view, the decomposition of salt hydrates consists of the nucleation of a lower hydrate on, or within, the crystal of a higher hydrate, followed by the growth of the lower hydrate until the original crystal is completely transformed. When a nucleus of the lower hydrate first forms and starts to grow within the crystal lattice of the higher hydrate, the region of the parent lattice surrounding the growing nucleus is deformed due to the difference in molecular volume of the lower hydrate crystal forming and the original crystal. This deformation results in strain energy which must be considered in the determination of the minimum size for a stable nucleus. If the size of a particular nucleus is greater than the critical size determined by free energy requirements, the nucleus will grow; however, if it is less than the critical size, it will disappear.

The free energy change(33) associated with the formation of a nucleus within the lattice of a parent crystal is given by the following equation:

$$\Delta G = m\overline{\Delta G} + \sigma\gamma \qquad (5)$$

where: ΔG is the total free energy change,

m is the number of molecules in the nucleus,

$\overline{\Delta G}$ is the bulk free energy change per molecule,

σ is the shape factor, i.e. the external area of phase formed (this term is equal to $4\pi r^2$ for the simple case of a spherical nucleus), and

γ is the strain energy per unit interfacial area.

Upon substituting the values of the shape factor for a spherical nucleus into Equation (5), the result is:

$$\Delta G = m\overline{\Delta G} + \gamma 4\pi r^2 \qquad (6)$$

The r^2 term can be replaced by an equivalent term which is a function of m. If v_m is designated as the volume per molecule of product, then the number of molecules in a spherical nucleus is equal to the ratio of the volume of the nucleus $(4/3)\pi r^3$ to the volume per molecule v_m, i.e. $m = 4\pi r^3/3v_m$. Solving this expression for r^2 and substituting it into Equation (6), yields:

$$\Delta G = \overline{\Delta G}\, m + \gamma(36\pi v_m^2)^{1/3} m^{2/3} \qquad (7)$$

Incorporating the fact that $\overline{\Delta G}$ must be negative if the reaction is to occur spontaneously, the above equation becomes:

$$\Delta G = -|\overline{\Delta G}|m + \gamma(36\pi v_m^2)^{1/3} m^{2/3}, \qquad (8)$$

which is of the form:

$$\Delta G \quad = \quad - bm + am^{2/3} \qquad (9)$$

The strain energy γ, can be positive, negative, or zero depending on the particular structures involved. If γ is positive, $\Delta G = 0$ for $m = 0$ and for $m = (a/b)^3$, and has a maximum value for $m = m* = (2a/3b)^3$ $= (2\gamma/3|\overline{\Delta G}|)^3 36 v_m^2$, determined from the conditions that the slope is zero at a maximum, i.e, $\left.\frac{d\Delta G}{dm}\right|_{m=m*} = 0$. The value of the free energy for $m = m*$ is:

$$\Delta G* \quad = \quad 4a^3/27b^2 \quad = \quad m*|\overline{\Delta G}|/2.$$

If the strain energy γ is zero or negative, the equation for ΔG is zero for $m = 0$ and negative for all positive values of m, indicating that under these conditions a maximum size for a critical nucleus does not exist, provided Equation (10) takes into consideration all the applicable energy terms; therefore, the reaction occurs spontaneously after the first molecule decomposes.

In general nucleation occurs when local energy fluctuations provide the activation energy necessary to initiate the reaction at the potential nucleation site in the parent crystal. Assuming that the decomposition of a single molecule results ultimately in a stable nucleus, the probability of such a unimolecular reaction (33,35) is given by:

$$K \quad = \quad \nu\exp(- \Delta G^{\#}/RT) \qquad (10)$$

were: K is the nucleation rate constant,

ν is the frequency of lattice vibration,

$\Delta G^{\#}$ is the free energy of activation,

R is the gas constant, and

T is the absolute temperature.

Substituting the thermodynamic equation:

$$\Delta G^{\#} = \Delta H^{\#} - T \Delta S^{\#} \tag{11}$$

into Equation (15), gives:

$$K = \nu \exp(\Delta S^{\#}/R) \exp(-\Delta H^{\#}/RT) \tag{12}$$

which has the general form of the Arrhenius equation:

$$K = Z \exp(-E/RT). \tag{13}$$

The nucleation rate constant K can be determined in some instances by observing the change in the number of nuclei with time,(102) but in most cases it is determined indirectly by fitting the observed kinetic data to equations describing the combined effects of nucleation and growth.

Microscopic observations made on growing nuclei suggest that in most cases they grow at constant linear rates once they become visible,(33) allowing the volume transformed per nucleus $v(t,x)$ to be calculated as a function of time of nucleation x and the specific time of observation $x = t$. The total volume transformed $V(t)$ at any particular time $x = t$ is the integral of the product of the rate of nucleation dN/dx (i.e. the number of nuclei forming per minute) and the volume transformed per nucleus $v_a(x,t)$:

$$V(t) = \int_{x=0}^{x=t} \frac{dN}{dx} v_a(x,t)dx. \tag{14}$$

This equation satisfactorily describes the total volume transformed as a function of time until two nuclei grow into each another; thereafter, the equation as shown predicts more growth than actually occurs because actual growth no longer occurs in the direction of the interference. The interference of two nuclei therefore alters their individual growth patterns, previously described by $v_a(x,t)$, and requires a correction term $v_b(y,t)$ to be applied at the time of the interference $y = \Theta_1$. This gives the following equation for the volume transformed per nucleus:

$$v_2(x,t) = v_a(x,t) + v_b(y,t) \tag{15}$$

The first term describes the unrestricted growth of a nucleus while the second term describes the effect of the interference on the unrestricted growth after one nucleus intersects another nucleus or the edge of the parent crystal. After the first interference occurs, the remaining nuclei begin to intersect one another with the same rate of occurrence as they nucleated, i.e. nuclei which formed early in the reaction have a higher probability of intersecting neighboring nuclei or the sides of the parent crystal than nuclei which nucleated later simply because they have been in existence longer. Since the original rate of nucleation was described by $dN(x)/dx$, the rate of interference, or distribution of interference times, is given by the same function only starting at time Θ_1: i.e., by $dN(y-\Theta_1)/dy$. Upon incorporating these terms into Equation (14), the equation describing the total volume transformed as a function of time becomes:

$$V(t) = \int_{x=0}^{x=t} dN(x)/dx \quad v_a(x,t)dx + \int_{y=\Theta_1}^{y=t} dN(y-\Theta_1)/dy \; v_b(y,t)dy \tag{16}$$

The first integral represents the total volume that would be transformed by unrestricted growth while the second integral represents the interference volume correction which must be applied to the first integral so that the entire equation gives the correct value for the actual total volume transformed.

For example, Bradley, Colvin, and Hume(8) successfully used this method to describe the complete dehydration of calcium carbonate hexahydrate, $CaCO_3 \cdot 6H_2O$, which proceeds in a simple manner when flat crystals are used. Nucleation of these crystals was observed to occur almost entirely on the two opposite flat surfaces, so that as the transformation proceeded these two faces grew toward each other until they met at the center of the crystal. The rate of nucleation was found to follow the exponential law, $dN/dx = KN_o \exp(-Kx)$, and the rate of growth for each individual nucleus was given by $v_a(x,t) = 2AU(t-x)$, where A is the area of the growing crystal face and U is the linear rate of growth of the transforming interface, and t-x is the time of growth, i.e. the difference in time between observation x = t and nucleation x. After the two opposite growing faces of one crystal met each other at the center of the crystal, the contribution of the growth of that particular crystal to the total transformation process was ended. The following equation which contains the interference correction term $v_b(y,t) = -2AU(t-y)$, was used to describe the volume transformed as a function of time:

$$V(t) = \int_{x=0}^{x=t} KN_o \exp(-Kx) 2AU(t-x)\,dx - \int_{y=\theta_1}^{y=t} KN_o \exp(-K(y-\theta_1)) 2AU(t-y)\,dy \quad (17)$$

The growth of nuclei which have more complicated shapes can be restricted from growing in several directions by interference with neighboring nuclei or the sides of the parent crystals. In a case like this, the equation describing the unrestricted growth must be corrected each time a growing nucleus meets opposition, requiring two, three, or more correction terms depending on the geometry of the system.

As will be shown later in this dissertation, the transformation of calcium sulfate dihydrate to hemihydrate exhibits three different impingements, and the volume of the hemihydrate formed as a function of time for this process is:

$$V(t) = \int_{x=0}^{x=t} dN(x)/dx \; v_a(x,t)dx + \int_{y=\theta_1}^{y=t} dN(y-\theta_1)/dy \; v_c(y,t)dy$$
$$+ \int_{z=\theta_2}^{z=t} dN(z-\theta_2)/dz \; v_e(z,t)dz + \int_{w=\theta_3}^{w=t} dN(w-\theta_3)/dw \; v_g(w,t)dw. \qquad (18)$$

The particular analytical expressions for $V(t)$, $v_a(x,t)$, $v_c(y,t)$, $v_e(z,t)$ and $v_g(w,t)$ and for θ_1 , θ_2 , and θ_3 were derived from microscopic observations of the shapes and rates of growth of the hemihydrate phase within single crystals of the dihydrate phase. These observations, and the calculations based on them, are presented in Chapter V following the description of the work on the time-temperature-transformation characteristics of the reaction.

IV. STUDIES OF TIME-TEMPERATURE-TRANSFORMATION RELATIONSHIPS

These studies involve measurements of the overall rates of dehydration (1) of calcium sulfate dihydrate to hemihydrate and (2) of calcium sulfate hemihydrate to anhydrite, in water, in sodium chloride solutions, and in synthetic sea water concentrates. The reactions were followed by observing the change in the total volume of the system as a function of time in a glass dilatometer using special equipment which permitted automatic, simultaneous recording of the temperature and the height of the liquid meniscus in the dilatometer capillary at equal time intervals. The results of these studies are presented as time-temperature-transformation (TTT) curves showing the general effects of solution concentration, temperature, and initial particle size on the rates of the reactions.

A. Experimental Procedures

The essential features of the special glass dilatometer used in these experiments are shown in Figure 3. The reaction mixture was contained in the reaction bulb of the dilatometer which was a Pyrex glass tube about two inches long and 3/8 inch in diameter. The temperature of the reaction mixture was measured by means of a copper-constantan thermocouple made from 30 gauge wires which were sealed through a glass plug that fitted into the ground glass joint at the bottom of the reaction bulb. Changes in the volume of the reaction mixture were detected by measuring the changes in height of the liquid in a calibrated capillary tube which was connected to the reaction bulb by a second ground glass joint. These measurements were made relative to a metal scale which was firmly attached to the capillary.

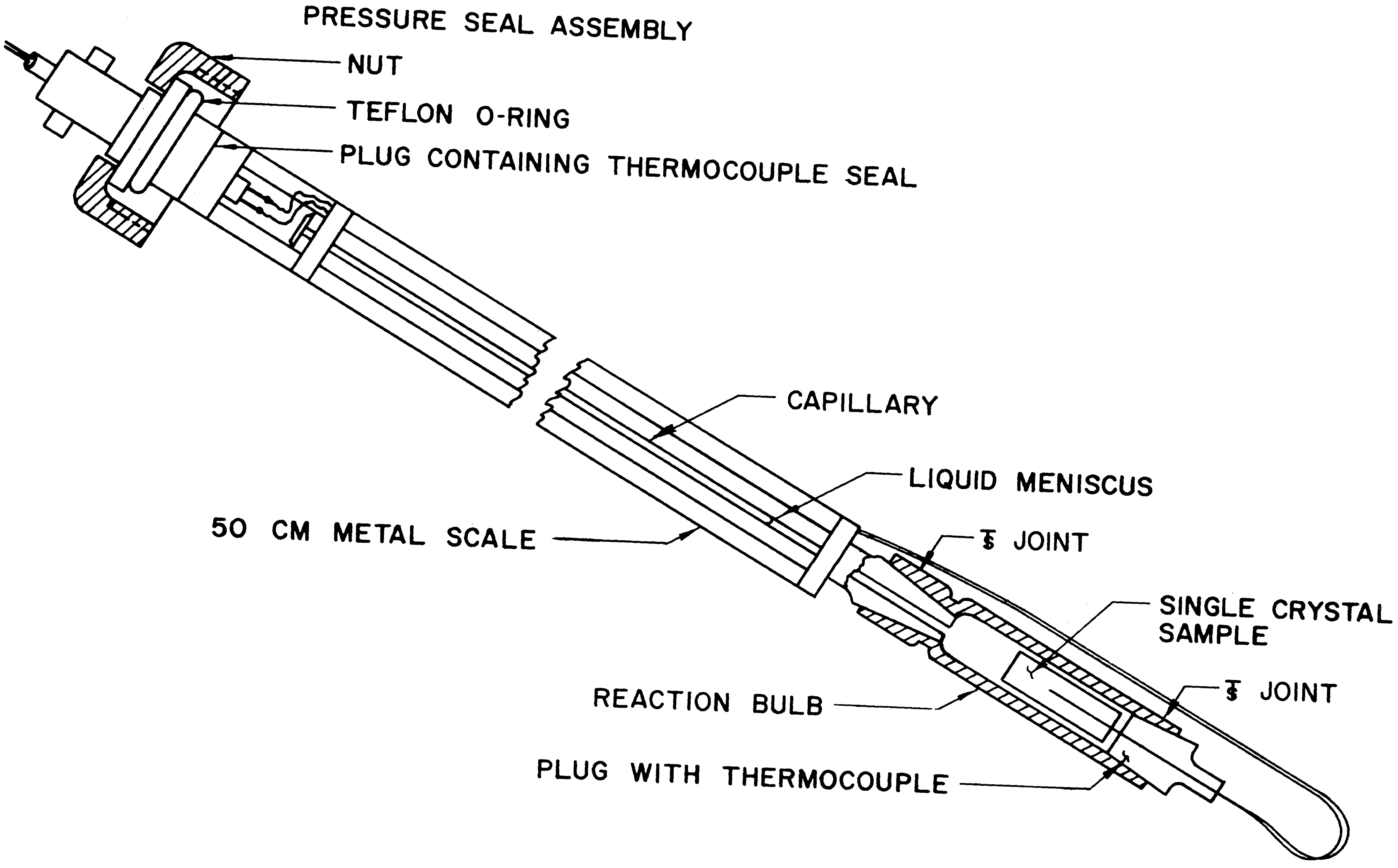


Figure 3. Construction of Dilatometer (Approximately Actual Size).

In preparing the dilatometer for use, the reaction mixture was loaded into the reaction bulb by first distributing a measured weight of crystals of calcium sulfate dihydrate around the thermocouple, and then injecting the solution into the bottom of the reaction bulb with a hypodermic syringe. Particular care was taken to displace all the entrained air between the crystals. Finally, a small volume of solution, determined by experience, was added to the capillary to adjust the initial location of the meniscus, a thin layer of silicone grease was applied to the ground glass joints, and the capillary, the reaction bulb, and the thermocouple plug were wired firmly together.

During use, the dilatometer was enclosed in a heavy-walled glass tube inside the insulated constant-temperature bath shown schematically in Figure 4. The desired reaction temperature was achieved by circulating the heated air inside the bath rapidly past the tube containing the dilatometer. The temperature of the air was maintained constant to ± 0.5°F by a sensitive bimetallic thermo-regulator. Nitrogen gas was introduced into the glass tube containing the dilatometer to prevent the solutions in the dilatometer from boiling. A constant pressure was obtained by a pressure regulating valve which maintained a constant minimum pressure and a back pressure regulating valve which maintained a maximum pressure by venting any excess pressure caused by the expansion of dilatometer and its contents. These two valves were set to operate within 2 psig of each other.

During an experimental run, the temperature indicated by the thermocouple within the reaction bulb was recorded at 5-second intervals by a recording potentiometer. The height of the liquid meniscus in the capillary tube was recorded simultaneously with every twelfth temperature reading (i.e. at one minute intervals) by photographing the position of the

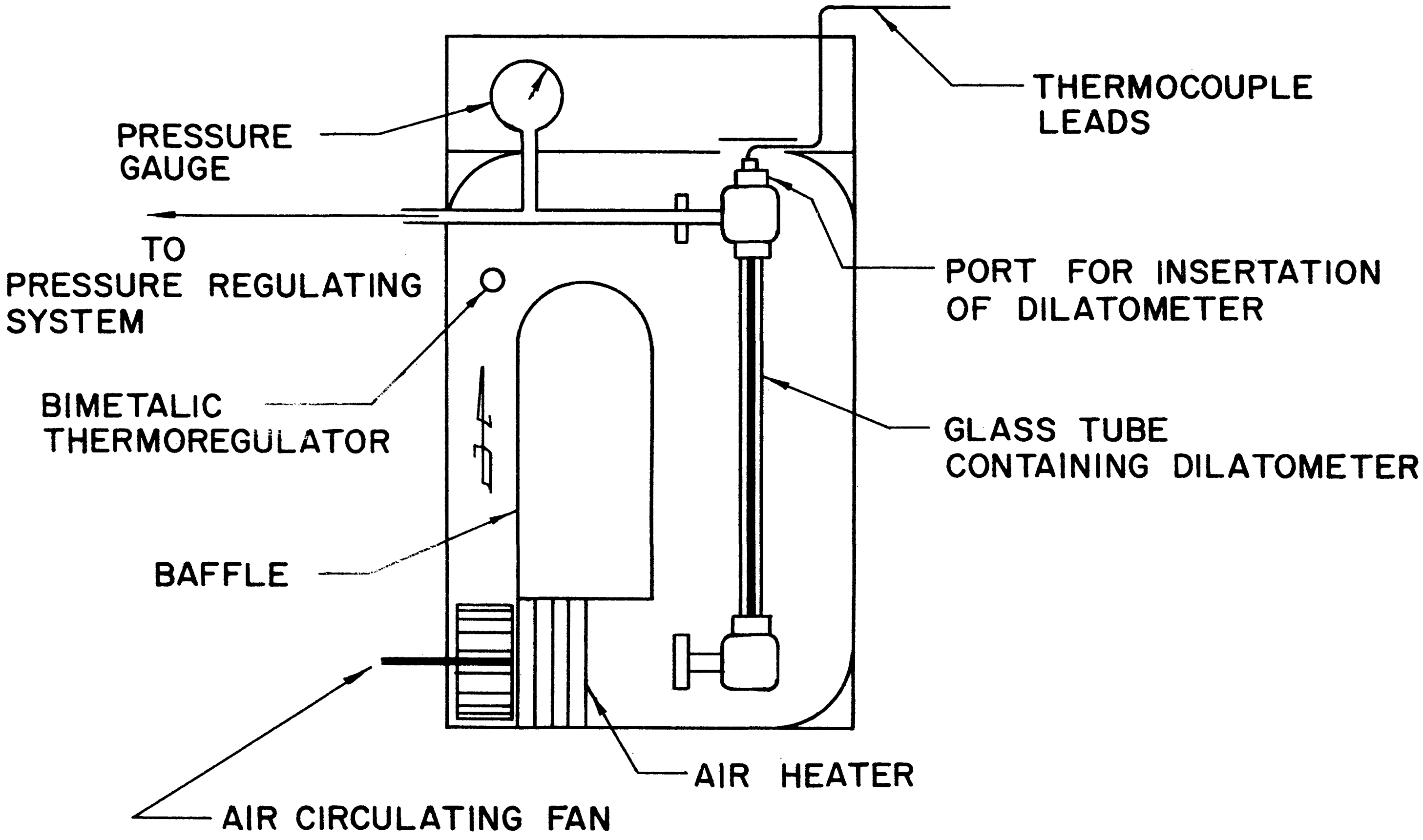


Figure 4. Schematic Drawing of Constant Temperature Bath and Pressurized Glass Tube for Containing the Dilatometer.

liquid meniscus against the metal scale, using a 16 mm movie camera whose shutter was operated, one frame at a time, by a solenoid actuated by a clock used in conjunction with the printing mechanism of the recording potentiometer. The height of the liquid meniscus was obtained by projecting the photographic image, frame by frame, on a screen and reading the position of the meniscus between the millimeter reference marks using a vernier scale of the type shown in Figure 5 which allowed interpolation of the data to $\pm$ 0.02 mm. The values of temperature were read to $\pm$ 0.2°F directly from the potentiometerer's chart using a 15X magnifying glass, and the corresponding values of time were determined from the chart speed of one-third inch per minute. The values of the observed time t_o, temperature T_o, and height of the liquid meniscus h_o determined by the above procedures are listed in Appendix U for all the experimental runs.

These observed data values were then punched on IBM cards and corrected on the IBM 7090 electronic digital computer using the thermocouple calibration given in Appendix B, the capillary calibration given in Appendix C, and the computer program given in Appendix D, giving values of corrected data: t_c, T_c, and h_c where $t_c = t_o$. A typical set of corrected values obtained from the observed data by this procedure for experimental run 62 is listed in Table I. These data were plotted in Figure 6 and 7 to show the general characteristics of the changes in the height of the meniscus and temperature during a typical reaction.

In order to obtain h_r, the height due to the reaction alone, from the corrected values of h_c, it was necessary to determine the height h_t caused by the rapid thermal volume expansion which occurred when the dilatometer and its contents at room temperature were inserted into the

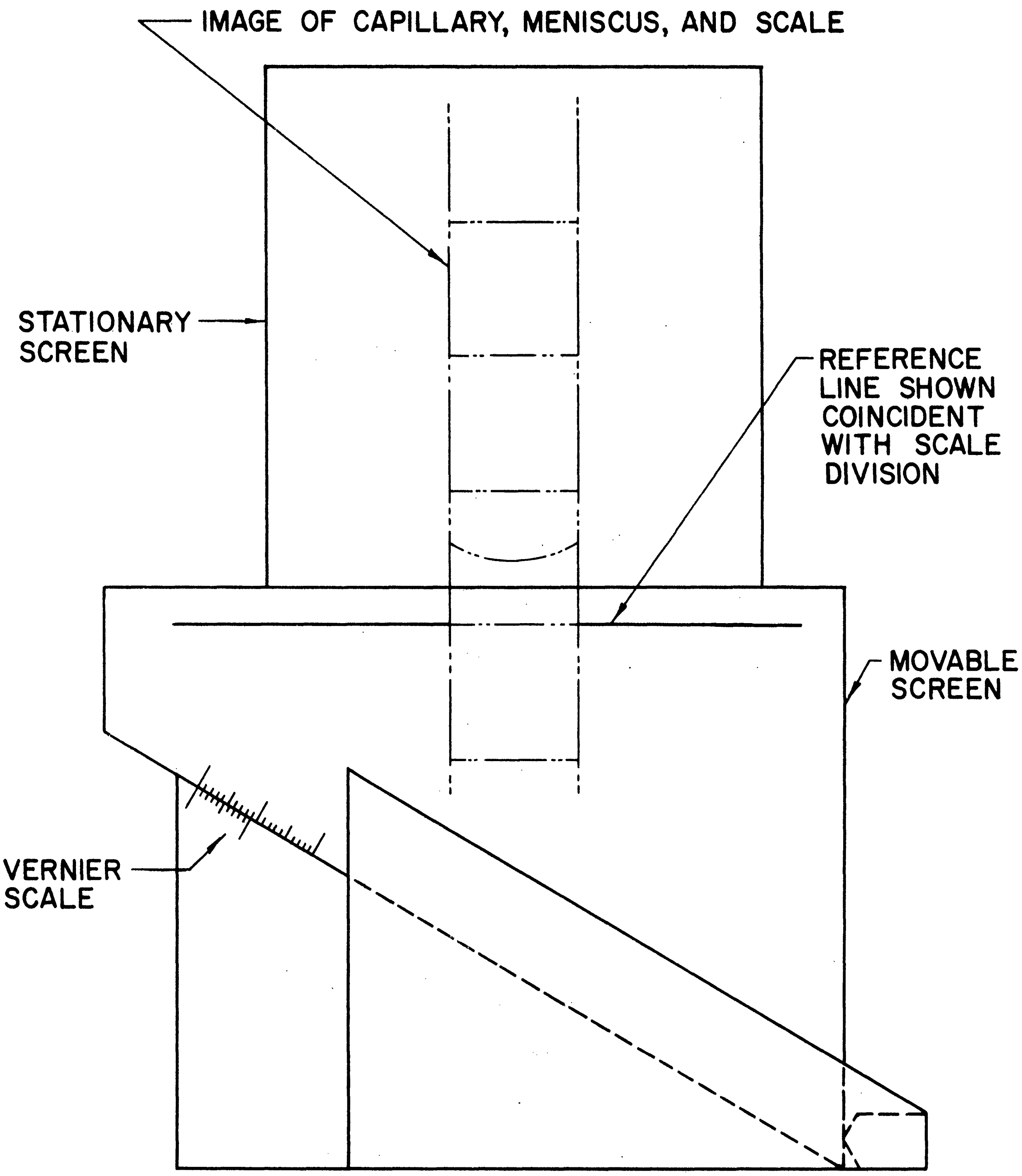


Figure 5. Vernier for Reading Position of Meniscus (Approximately One-Half Size).

TABLE I

CORRECTED EXPERIMENTAL DATA FROM RUN 62

Time min	Temp. °F	Height cm	Time min	Temp. °F	Height cm	Time min	Temp. °F	Height cm
.0	72.6	.000	165.0	244.8	32.597	330.0	244.9	38.374
5.0	199.6	24.084	170.0	244.8	32.824	335.0	244.9	38.415
10.0	231.6	28.470	175.0	244.7	33.055	340.0	244.9	38.442
15.0	240.7	29.811	180.0	244.7	33.287	345.0	244.8	38.469
20.0	243.7	30.195	185.0	244.7	33.512	350.0	244.9	38.501
25.0	244.7	30.308	190.0	244.6	33.740	355.0	244.8	38.525
30.0	245.1	30.348	195.0	244.6	33.965	360.0	244.9	38.541
35.0	245.0	30.363	200.0	244.6	34.206	365.0	244.8	38.558
40.0	245.1	30.367	205.0	244.6	34.441	370.0	244.9	38.572
45.0	245.0	30.371	210.0	244.6	34.682	375.0	244.9	38.586
50.0	245.1	30.371	215.0	244.6	34.927	380.0	245.0	38.601
55.0	245.0	30.377	220.0	244.6	35.164	385.0	244.9	38.605
60.0	245.1	30.386	225.0	244.6	35.407	390.0	245.0	38.616
65.0	245.0	30.395	230.0	244.6	35.641	394.0	244.9	38.623
70.0	245.1	30.408	235.0	244.6	35.880	400.0	245.0	38.624
75.0	245.0	30.424	240.0	244.6	36.119	405.0	244.9	38.634
80.0	245.1	30.445	245.0	244.6	36.331	410.0	244.9	38.638
85.0	245.0	30.469	250.0	244.6	36.544	415.0	244.9	38.645
90.0	245.1	30.512	255.0	244.6	36.735	420.0	244.9	38.648
95.0	245.0	30.554	260.0	244.6	36.916	425.0	244.9	38.653
100.0	245.1	30.611	265.0	244.7	37.070	430.0	245.0	38.660
105.0	245.0	30.681	270.0	244.7	37.234	435.0	244.9	38.660
110.0	245.0	30.764	275.0	244.7	37.389	440.0	245.0	38.664
115.0	245.0	30.863	280.0	244.7	37.537	445.0	244.9	38.664
120.0	245.0	30.978	285.0	244.7	37.676	450.0	244.9	38.672
125.0	245.0	31.102	290.0	244.7	37.792	455.0	244.9	38.674
130.0	244.9	31.241	295.0	244.7	37.898	460.0	244.9	38.676
135.0	244.9	31.396	300.0	244.7	38.000	465.0	244.9	38.676
140.0	244.9	31.563	305.0	244.7	38.082	470.0	244.9	38.679
145.0	244.8	31.744	310.0	244.8	38.164	475.0	245.0	38.680
150.0	244.8	31.940	315.0	244.8	38.222	480.0	244.9	38.679
155.0	244.8	32.152	320.0	244.8	38.272			
160.0	244.8	32.369	325.0	244.8	38.332			

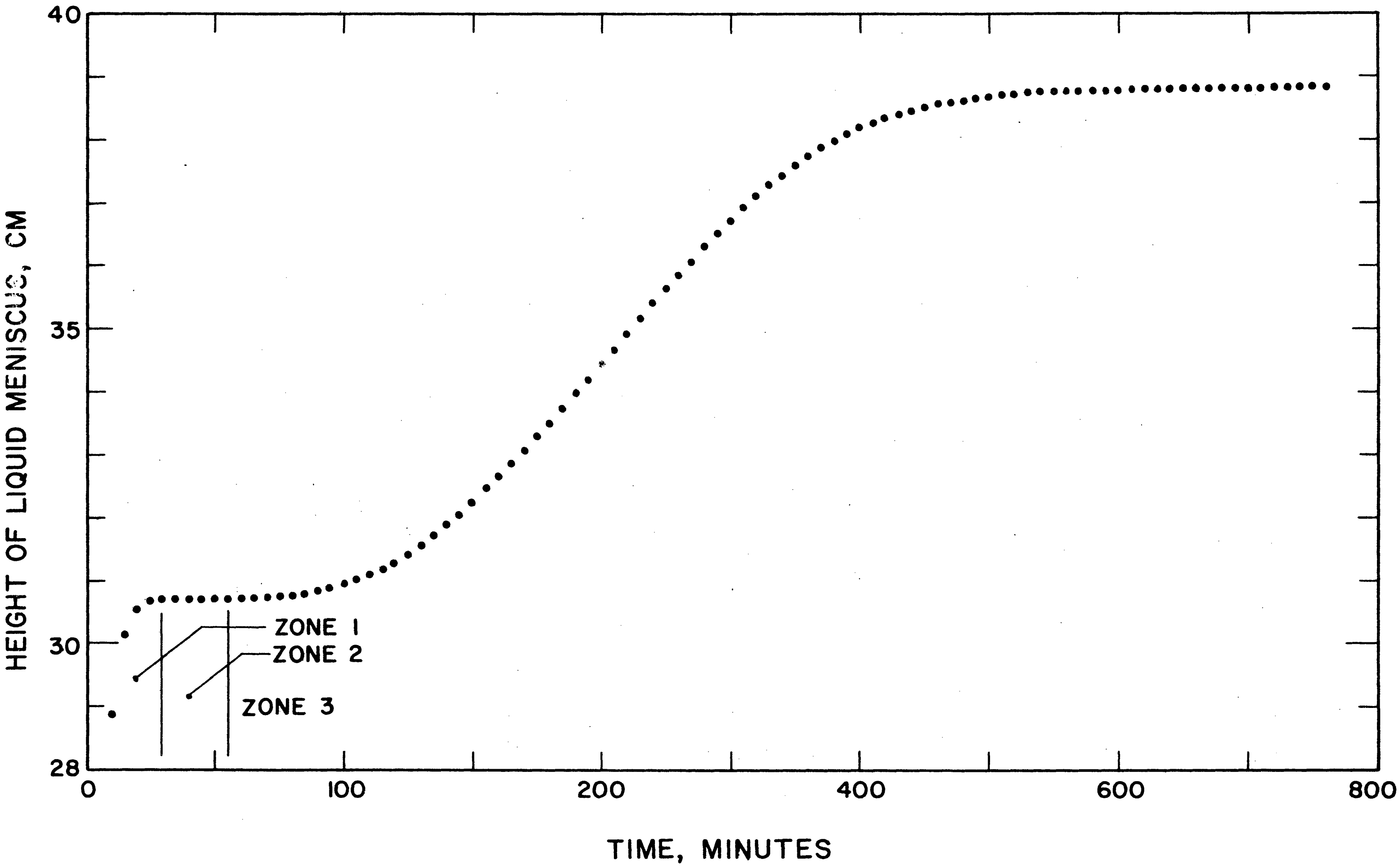


Figure 6. Values of Height of Liquid Meniscus in Dilatometer Capillary Versus Time for Run 62 for the Transformation of Calcium Sulfate Dihydrate to Hemihydrate in Water at 245°F.

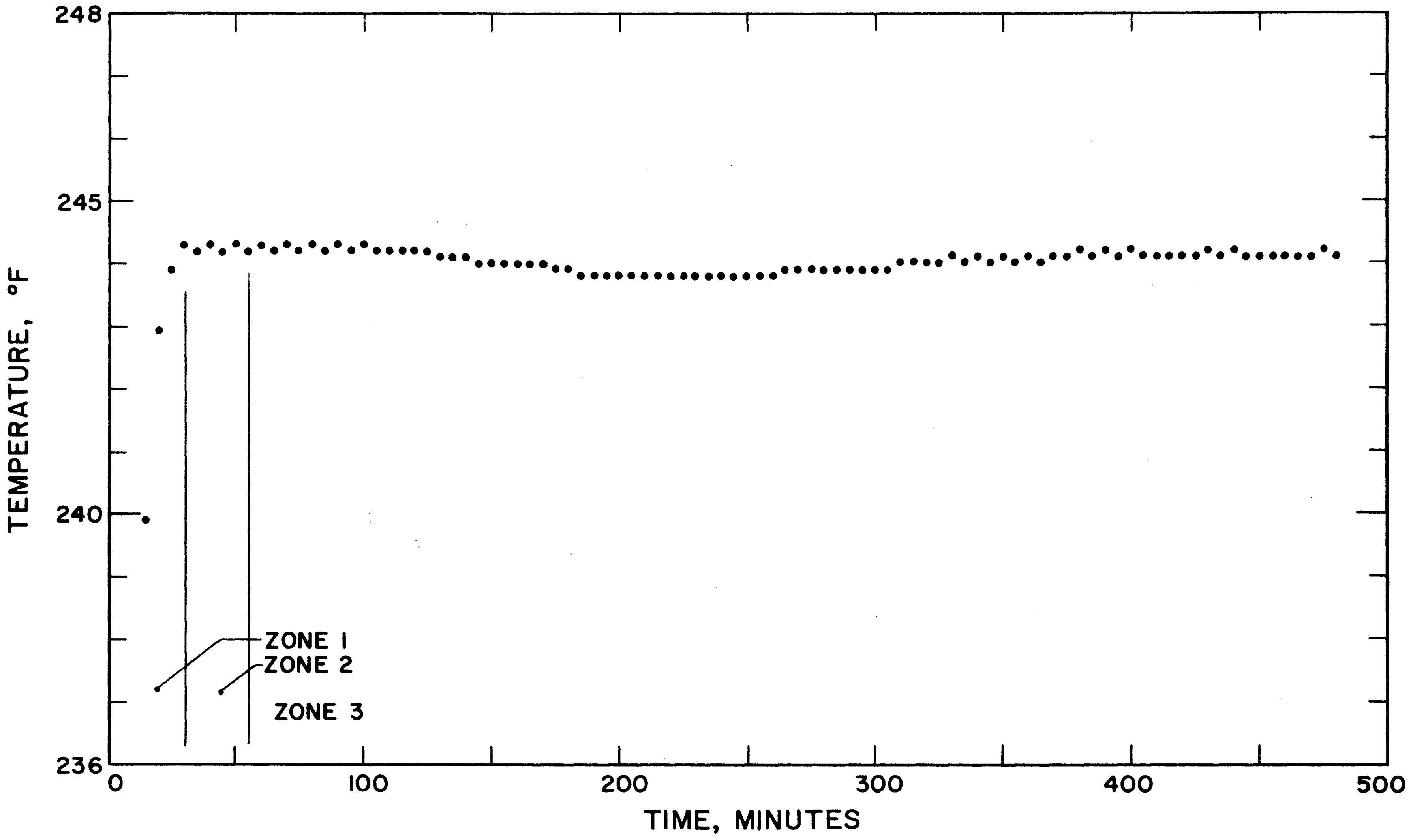


Figure 7. Values of Temperature Versus Time for Dilatometric Run 62 for the Transformation of Calcium Sulfate Dihydrate to Hemihydrate in Water at 245°F.

hot constant temperature bath at the beginning of an experimental run. This rapid expansion caused the height of the liquid column in the capillary to increase rapidly at first and then to approach asymptotically the value corresponding to the volume of the reaction mixture of crystals and solution at the bath temperature (Figure 6, Zone 1). The meniscus height then remained at this value until the dehydration reaction started (Figure 6, Zone 2), whereupon it again increased as the volume of the reaction mixture increased (Figure 6, Zone 3), finally reaching another steady state value at the end of the reaction.

The temperature of the reaction mixture inside the dilatometer followed a similar cycle, increasing asymptotically to the temperature of the bath (Figure 7, Zone 1), remaining constant until the dehydration reaction started (Figure 7, Zone 2), then decreasing slightly due to the absorption of heat from the reaction mixture by the endothermic reaction, and finally coming back to the bath temperature when the reaction was completed (Figure 7, Zone 3).

The change in height of the meniscus due to thermal effects h_t was calculated from an equation of the form:

$$h_t = A + B(T_c - T_{c_i}) + C(T_c - T_{c_i})^2 \qquad (19)$$

which is a power series relationship between the volume and the temperature of a liquid and solid system. In this equation, A, B, and C are constants determined for each run, T_c is the corrected temperature at the time of the measurement, and T_{c_i} is the initial corrected temperature at the start of the run (usually room temperature). The values of the constants were obtained by the method of least squares from the data taken before the reaction began, (i.e. during the period of Zone 1, Figure 6, before the change due to the reaction was detectable) when h_t was assumed equal to h_c. These values were substituted in Equation (19) and the values of h_t corresponding to the value of the temperature T_c were calculated for the remainder of the experimental run. Finally, the values due to the reaction were obtained as follows: $h_r = h_c - h_t$, and $T_r = T_c$, and $t_r = t_c - t_c*$, where t_c* is the time when the reaction began.

The accuracy of the method used in obtaining the values of h_t was evaluated using time-temperature-height values obtained from two experiments when the dilatometer was charged with water alone. Equation (19) was fitted to the height and temperature values for the first 25 minutes of each experiment obtaining values of the coefficients A, B, and C, by the method of least squares with each fit having a standard error estimate of less than 0.04 cm. Using these coefficients, values of height were calculated by Equation (19) and compared with of the corresponding experimental values for the remaining 95 minutes of each experiment. The calculated values corresponding to approximately 1% of the total height of reaction. This close agreement between the calculated and experimental values indicated that the method was more than satisfactory for determining the height change due to thermal expansion of the contents of the dilatometer during an experimental run.

The method of calculating h_r was also evaluated by comparing values of the total height of reaction $h_{r_{tot}}$ with the corresponding theoretical height values calculated from the physical properties of the individual phases to see if the experimental data behaved correctly with respect to changes in temperature and solution concentration. The theoretical values of $h_{r_{tot}}$ were calculated from published and experimentally measured densities of calcium sulfate dihydrate and hemihydrate measured at room temperature using the stoichiometric relationships as shown in Appendix L. The temperature dependence of values of $h_{r_{tot}}$ was assumed to be that of the water in the system alone since the densities of the solid phases as a function of temperature were not readily available and are small. The values of the total height of reaction $h_{r_{tot}}$ resulting from the experiments using water, 3.5% sodium chloride solutions, and normal synthetic sea water are listed in Appendix F and shown in Figures 8, 9 and 10, with the calculated least squares line drawn through the points. The dashed line also shown on each figure represents the temperature dependence of the theoretical values of $h_{r_{tot}}$ corresponding to the complete dehydration of calcium sulfate dihydrate to hemihydrate in water.

Examination of each figure shows (1) that the points lie very close to the least squaresline, (2) that the slopes of all the lines are very similar, and (3) that the actual values lie near, but below, the theoretical curve for all the data. The standard deviation of the values of $h_{r_{tot}}$ from the least squares line shown in each figure is 0.057 cm, 0.033 cm, and 0.081 cm, respectively, indicated good precision and reproducibility of the values. Likewise, the similarity in the values of slopesof 0.024 cm/°F, 0.014 cm/°F, and 0.019/°F, to each other, and to the theoretically determined slope of 0.020 cm/°F, show that the experimental values exhibit the necessary temperature dependence.

The small differences between the experimental values and the theoretical line are easily accounted for by examining the calculation

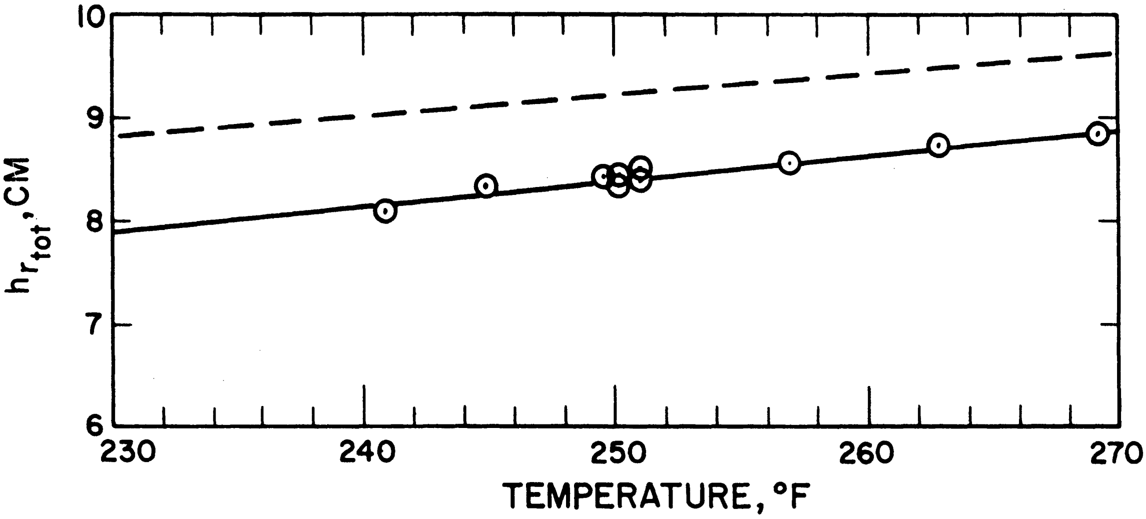


Figure 8. Total Change in Meniscus Height Due to Reaction Versus Temperature for Runs in Water.

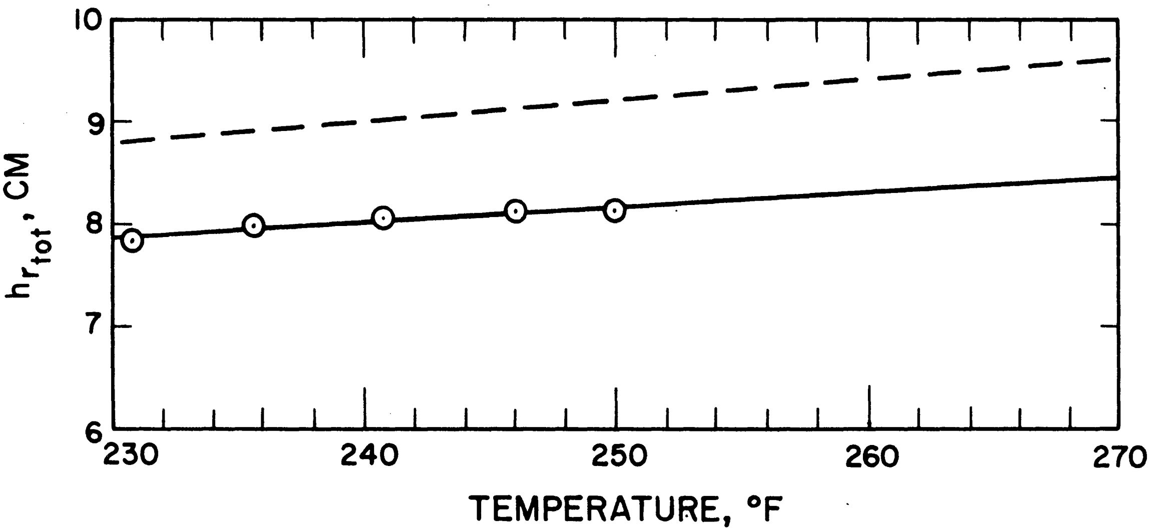


Figure 9. Total Change in Meniscus Height Due to Reaction Versus Temperature for Runs in 3.5% Sodium Chloride Solutions.

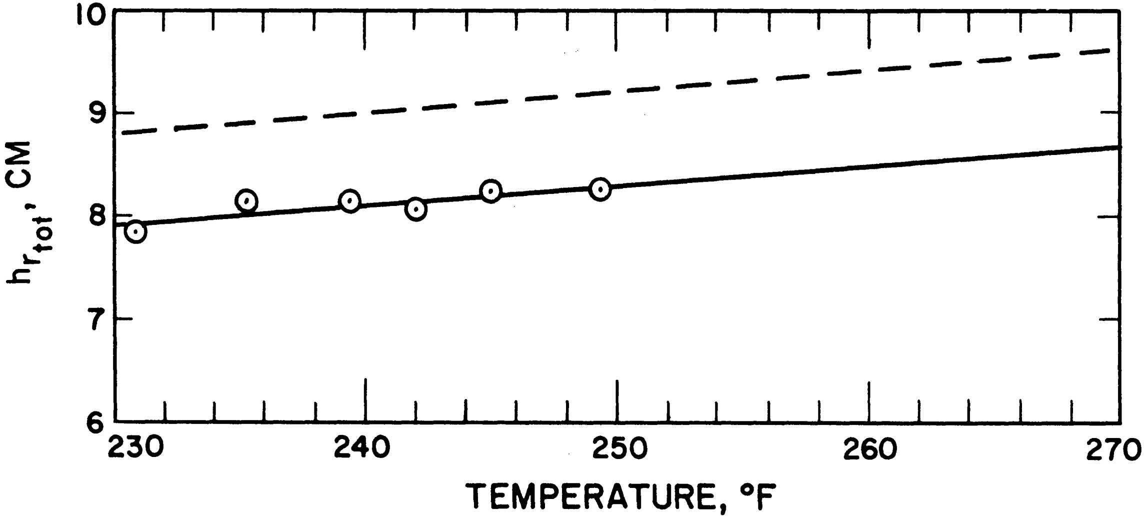


Figure 10. Total Change in Meniscus Height Due to Reaction Versus Temperature for Runs in Normal Synthetic Sea Water.

used to determine the line. The total volume change is the difference between the combined volumes of the hemihydrate and product water formed during the reaction and the original volume of the dihydrate before the reaction. Since the observed volume change is the small difference of three relatively large numbers, a relatively small error in one of the individual values would result in a large error in the final value. Such an error could result from the fact that the densities are not known to enough significant places or because the change in densities with temperature was not used. A calculated change of 1% in the values of one of the volumes used in the calculations resulted in a 10% change in the calculated value of the total height of reaction, and could easily account for the difference between the data and the theoretical line. Another very small portion of the difference can also be accounted for by considering the compressibility of the liquid in the system. Calculations showed that a value of 0.08 cm would be reasonable for the amount of liquid used at the temperature and pressure of the system. This amounts to 10% of the total discrepancy of 0.80 cm.

Two other hypothetical causes of the discrepancy, which were easily eliminated, are: (1) that the reaction did not go to completion and (2) that liquid was lost from the dilatometer by evaporation. The reactions were shown to have gone to completion by observing the height of the liquid meniscus as a function of time until the second reaction occurred, i.e. the transformation of calcium sulfate hemihydrate to anhydrite. Such observations showed that the height remained constant after the first reaction and stopped until the second reaction had begun, indicating that the first reaction had gone to completion. The fact that very little water was lost from the dilatometer by evaporation can be seen by examining the data given in Figure 8. Each run was made with the dilatometer pressurized at approximately 90 psig. Since the vapor pressure of the solution doubled over the temperature range investigated (i.e. 25.4 psia at 240°F to 41.8 psia at 270°F) under conditions of constant total pressure, the rate of evaporation through the capillary would probably be increased by both the pressure and the temperature effects. On the other hand, the 240°F run lasted approximately 30 hours while the 270°F run lasted only one and one-half hours. This twenty fold increase in the length of time should mask any change in rate of evaporation due to the 30°F increase in temperature and doubling of vapor pressure. Consequently, the run at 240°F should show a greater water loss than the higher temperature runs, resulting in an increased slope of the observed data. Since this was not observed, the loss of water by evaporation was assumed to be negligible.

Another characteristic of the total height of reaction $h_{r_{tot}}$, indicating the consistency between the theoretical and experimental data values, is shown in Figures 11 and 12 where values of $h_{r_{tot}}$ are plotted versus the percent dissolved solids in the solutions surrounding the reaction mixture for reactions run at approximately one constant temperature. The values of $h_{r_{tot}}$ decrease with increasing dissolved solids as predicted by the partial molal volume relationships for sodium chloride solutions, where small additions of pure water to any sodium chloride solution result in a final volume which is less than the sum of the two original uncombined volumes. This relationship is also shown in Figure 12 for synthetic sea water concentrates which should behave similarly since their constituent also is sodium chloride.

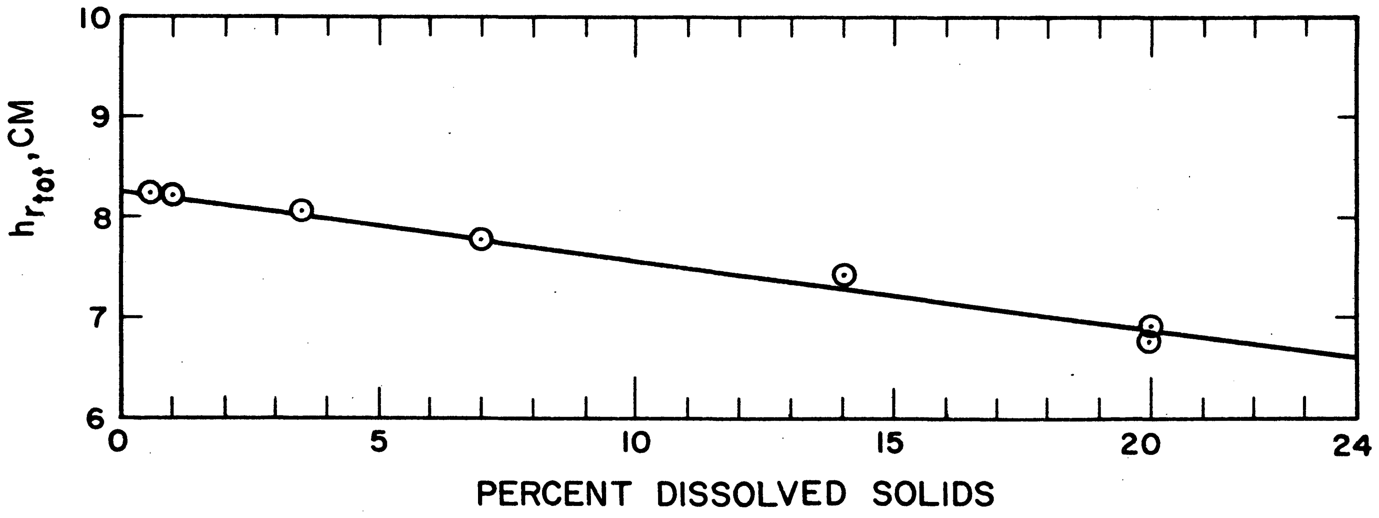


Figure 11. Total Change in Meniscus Height Due to Reaction Versus Sodium Chloride Solution Concentration.

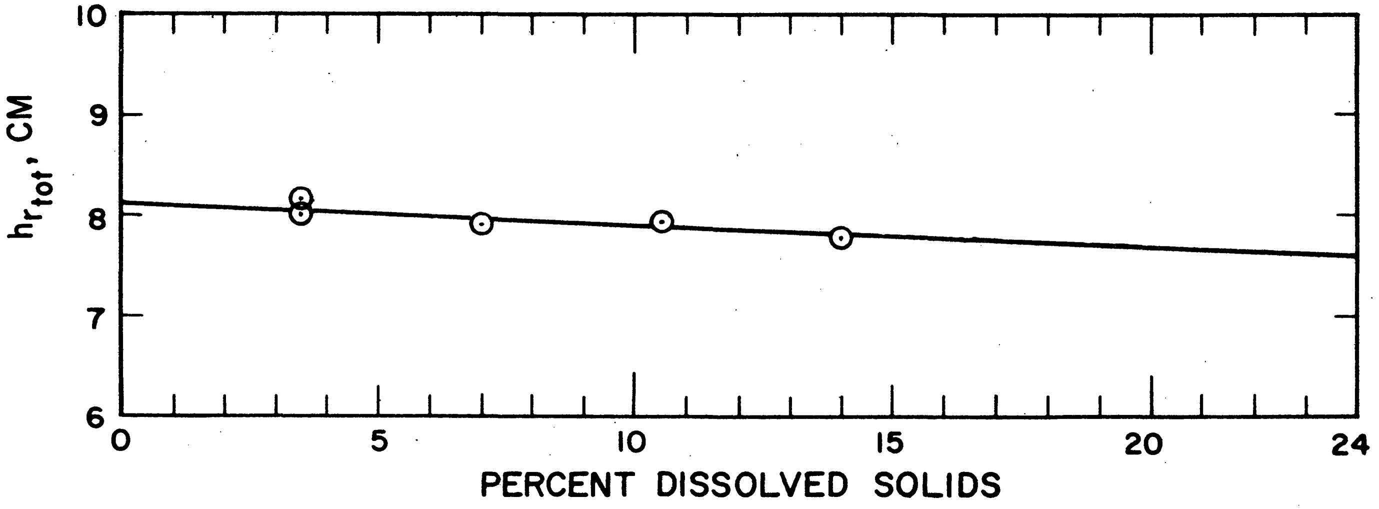


Figure 12. Total Change in Meniscus Height Due to Reaction Versus Synthetic Sea Water Concentration.

Since each value of h_r is directly proportional to the volume change during the reaction, which is proportional to the amount of calcium sulfate dihydrate reacted, h_r is proportional to the number of moles of dihydrate reacted or the number of moles of hemihydrate formed. A more convenient way of expressing the amount reacted for further analysis is obtained by normalizing the experimental results by dividing the number of moles of calcium sulfate dihydrate reacted D by the initial number of moles D_o, giving the fraction reacted, $\alpha = D/D_o$. In terms of the experimental data, D corresponds to height of reaction h_r, and D_o to the total height of reaction $h_{r_{tot}}$ after the reaction has gone to completion, or $\alpha = h_r/ h_{r_{tot}}$. Differentiation of these expressions gives the relationship between the different forms of the reaction rate;

$$\frac{d\alpha}{dt} = (1/D_o)\frac{dD}{dt} = (1/h_{r_{tot}})\frac{dh}{dt} . \qquad (20)$$

Since the experimental results consist of discrete values measured at uniform time intervals, it was necessary to use numerical methods to obtain values of the reaction rate $d\alpha/dt$ from the normalized data. This was accomplished by the following second order numerical differential approximation:

$$\frac{d\alpha}{dt}(t) = \frac{\Delta\alpha}{\Delta t} = \frac{\alpha_{t_{n+1}} - \alpha_{t_{n-1}}}{t_{n+1} - t_{n-1}} . \qquad (21)$$

The computer program given in Appendix E was used to calculate the normalized data $\alpha(t)$, $d\alpha/dt$, T, and t from the corrected data h_c, t_c, and T_c after first calculating values of h_t, h_r, t_r and T_r. Values of α, $d\alpha/dt$, and t, calculated for experimental run number 62 are listed in Table II and plotted as functions of time in Figure 13 and 14 to show the general characteristics of the normalized data obtained by these procedures. The remaining normalized data is given in Appendix T.

TABLE II

VALUES OF α AND $d\alpha/dt$ CALCULATED FOR EXPERIMENTAL RUN 62 ON THE TRANSFORMATION OF CALCIUM SULFATE DIHYDRATE TO HEMIHYDRATE AT 245°F IN WATER

Time, Min	α	$\frac{d\alpha}{dt}$, min^{-1}	Time, Min	α	$\frac{d\alpha}{dt}$, min^{-1}
0.	.00000	.00000	215.	.81023	.00365
5.	.00180	.00012	220.	.82991	.00383
10.	.00119	.00022	225.	.84852	.00364
15.	.00396	.00026	230.	.86628	.00344
20.	.00384	.00035	235.	.88297	.00306
25.	.00744	.00044	240.	.89689	.00266
30.	.00828	.00054	245.	.90961	.00250
35.	.01284	.00080	250.	.92186	.00221
40.	.01632	.00102	255.	.93170	.00180
45.	.02304	.00119	260.	.93986	.00151
50.	.02820	.00152	265.	.94683	.00130
55.	.03829	.00200	270.	.95283	.00132
60.	.04825	.00218	275.	.96003	.00106
65.	.06013	.00257	280.	.96339	.00100
70.	.07394	.00287	285.	.96999	.00082
75.	.08882	.00332	290.	.97155	.00065
80.	.10719	.00370	295.	.97647	.00071
85.	.12579	.00387	300.	.97863	.00067
90.	.14584	.00435	305.	.98320	.00048
95.	.16924	.00469	310.	.98344	.00040
100.	.19277	.00490	315.	.98716	.00037
105.	.21822	.00515	320.	.98716	.00017
110.	.24426	.00534	325.	.98884	.00018
115.	.27163	.00546	330.	.98896	.00023
120.	.29888	.00567	335.	.99112	.00018
125.	.32829	.00573	340.	.99076	.00022
130.	.35614	.00549	345.	.99328	.00010
135.	.38314	.00561	350.	.99172	.00013
140.	.41219	.00561	355.	.99460	.00034
145.	.43920	.00559	360.	.99508	.00013
150.	.46813	.00571	365.	.99592	.00012
155.	.49634	.00571	370.	.99628	.00010
160.	.52527	.00583	375.	.99688	-.00002
165.	.55467	.00579	380.	.99604	.00008
170.	.58312	.00576	385.	.99772	.00005
175.	.61229	.00573	390.	.99652	.00005
180.	.64039	.00568	395.	.99820	.00026
185.	.66907	.00574	400.	.99916	.00012
190.	.66775	.00541	405.	.99940	.00005
195.	.72320	.00510	410.	.99964	.00002
200.	.74877	.00485	415.	.99964	.00004
205.	.77170	.00447	420.	1.00000	.00000
210.	.79342	.00385			

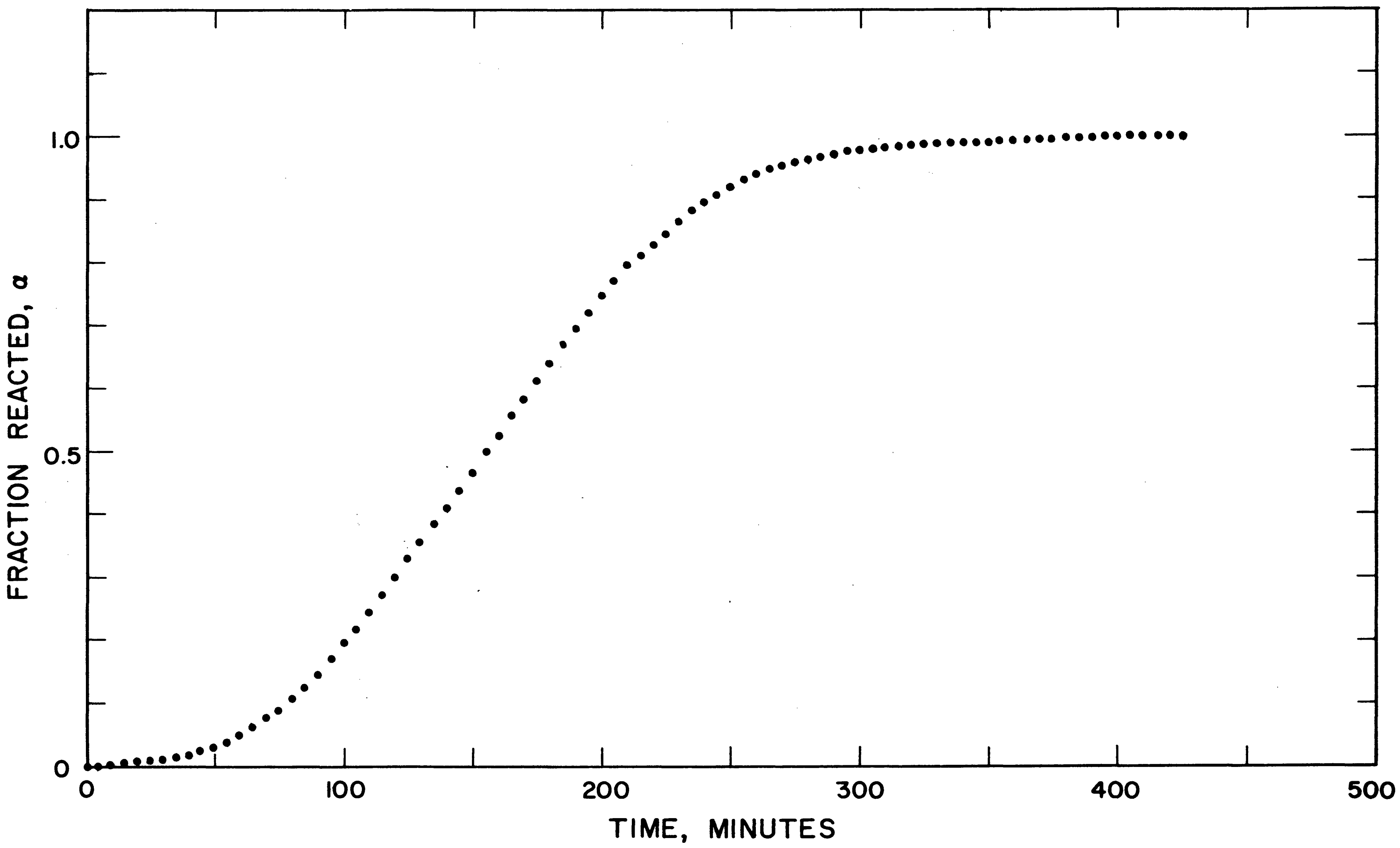


Figure 13. Fraction of Calcium Sulfate Dihydrate Transformed to Calcium Sulfate Hemihydrate in Water at 245°F During Run 62.

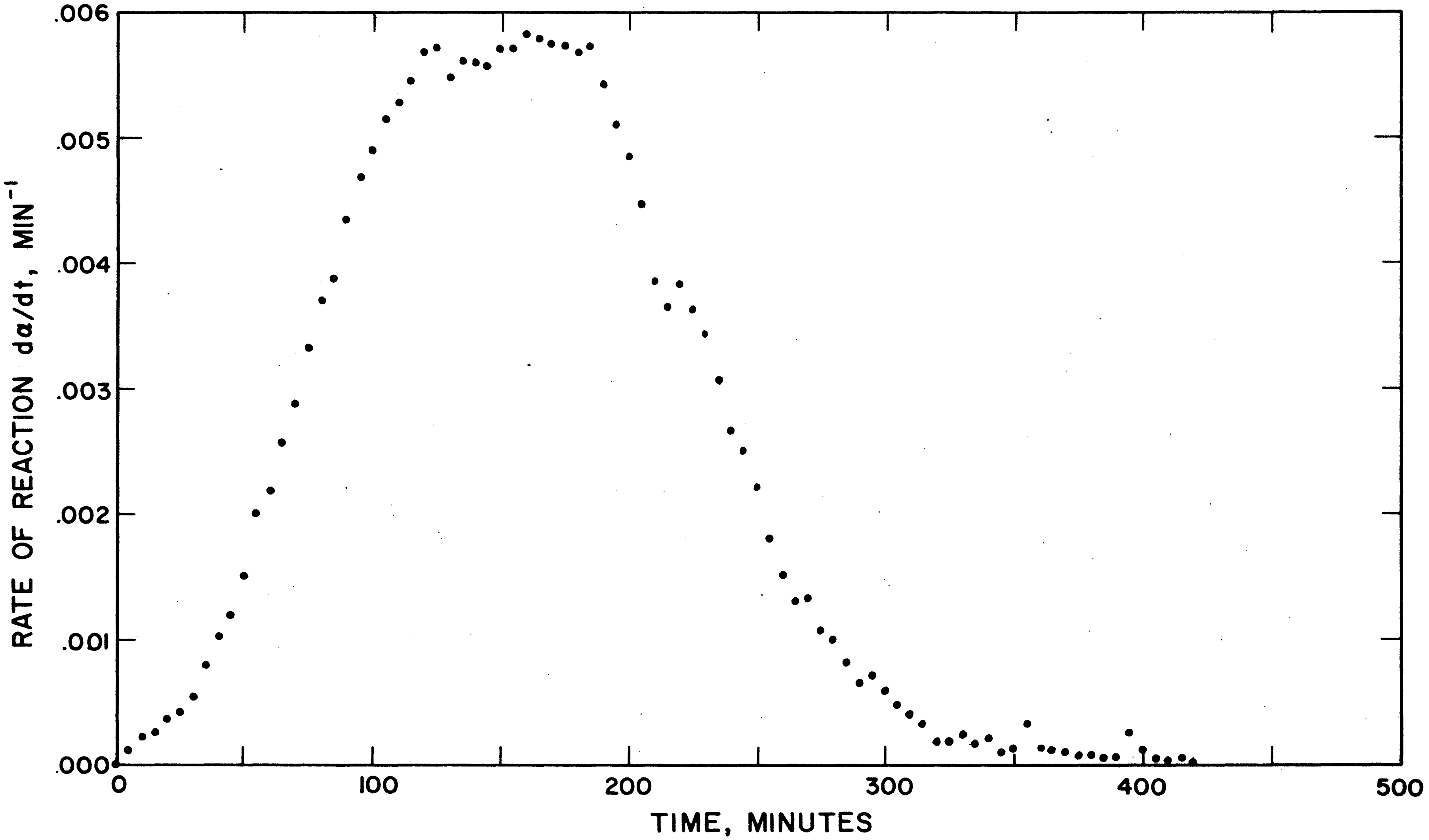


Figure 14. Variation of the Reaction Rate with Time for Run 62 for the Transformation of Calcium Sulfate Dihydrate in Water at 245°F.

B. Experimental Results

After all the data were transformed to the normalized form using the IBM 7090 computer, the values of time, temperature, and fraction transformed were read directly from the computer print out. For each experimental run, the temperature of the reaction and the time corresponding to 5%, 25%, 50%, 75%, and 95% transformation were punched on IBM cards to facilitate grouping of the data according to the parameters studied, as shown in Appendix G, to enumerate the effects of (1) temperature, (2) brine solution concentration, and (3) initial particle size. The results pertaining to the dehydration of calcium sulfate dihydrate to hemihydrate are presented first, followed by the results pertaining to the dehydration of hemihydrate to anhydrite.

1. Dehydration of Dihydrate to Hemihydrate

The chemical equation representing the dehydration of solid calcium sulfate dihydrate (selenite) to solid calcium sulfate hemihydrate when the solids are immersed in an aqueous solutions is:

$$CaSO_4 \cdot 2H_2O(S) \xrightarrow{\text{solution}} CaSO_4 \cdot 1/2H_2O(S) + 3/2H_2O(L). \qquad (22)$$

The TTT relationships for this reaction were studied over a range of temperatures from 230°F to 300°F in distilled water, and in solutions containing 0.0%, 0.5%, 1.0%, 3.5%, 7.0%, 14.0%, and 21.0% sodium chloride, and, 1.0, 2.0, 3.0, and 4.0 times the salt concentration in normal synthetic sea water according to the composition given in Appendix H. The dihydrate crystal particles used as starting materials were separated between 11 different screens having hole sizes shown in Appendix I. Particles obtained between screens having 0.0082 and 0.0069 inch openings were used for most of the experiments, with other particle sizes being used only in a series of experiments conducted to determine the effect of initial crystal particle size on the reaction. The phases occurring during the experiments were identified by their x-ray diffraction patterns as described in Appendix J.

a. Effect of Temperature. The effect of temperature over the range from 250°F to 265°F on the dehydration of calcium sulfate dihydrate to hemihydrate when the solids were in solutions of constant composition is shown by the time-temperature-transformation curves of Figures 15, 16, and 17, for solutions of water, 3.5% sodium chloride, and normal synthetic sea water, respectively. In all three cases, the TTT curves have the same general configuration consisting of five almost equally spaced and parallel curves exhibiting decreasing slope with increasing temperature. The times for a given percent transformation of calcium sulfate dihydrate to hemihydrate, when the solids were immersed in 3.5% sodium chloride solutions and in normal synthetic sea water solutions, are almost identical except that values of the times for the sea water experiments are slightly longer. Even though the values of time for a given percent transformation in water were measured over a slightly higher temperature range, they still exhibit the same general relationship with respect to time as do the values measured for the reaction in 3.5% sodium chloride solutions and in normal synthetic sea water over the lower temperature range.

The 50%-transformation curves from Figures 15, 16, and 17, were redrawn in Figure 18 showing primarily the effect of temperature on the TTT curves for the dehydration of calcium sulfate dihydrate to hemihydrate and, secondarily, the effect of the solute concentration on the

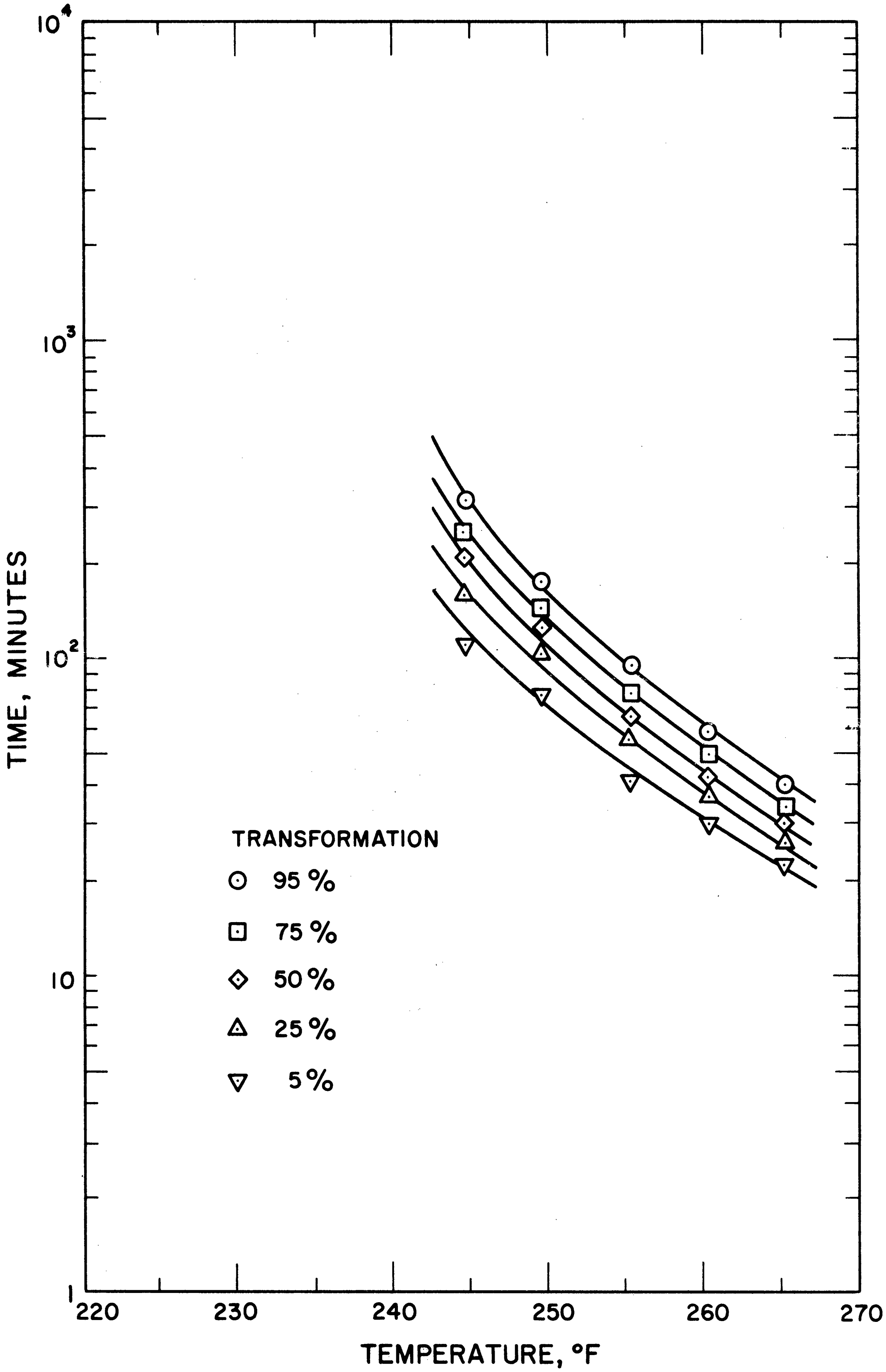


Figure 15. Time-Temperature-Transformation Curves for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in Water.

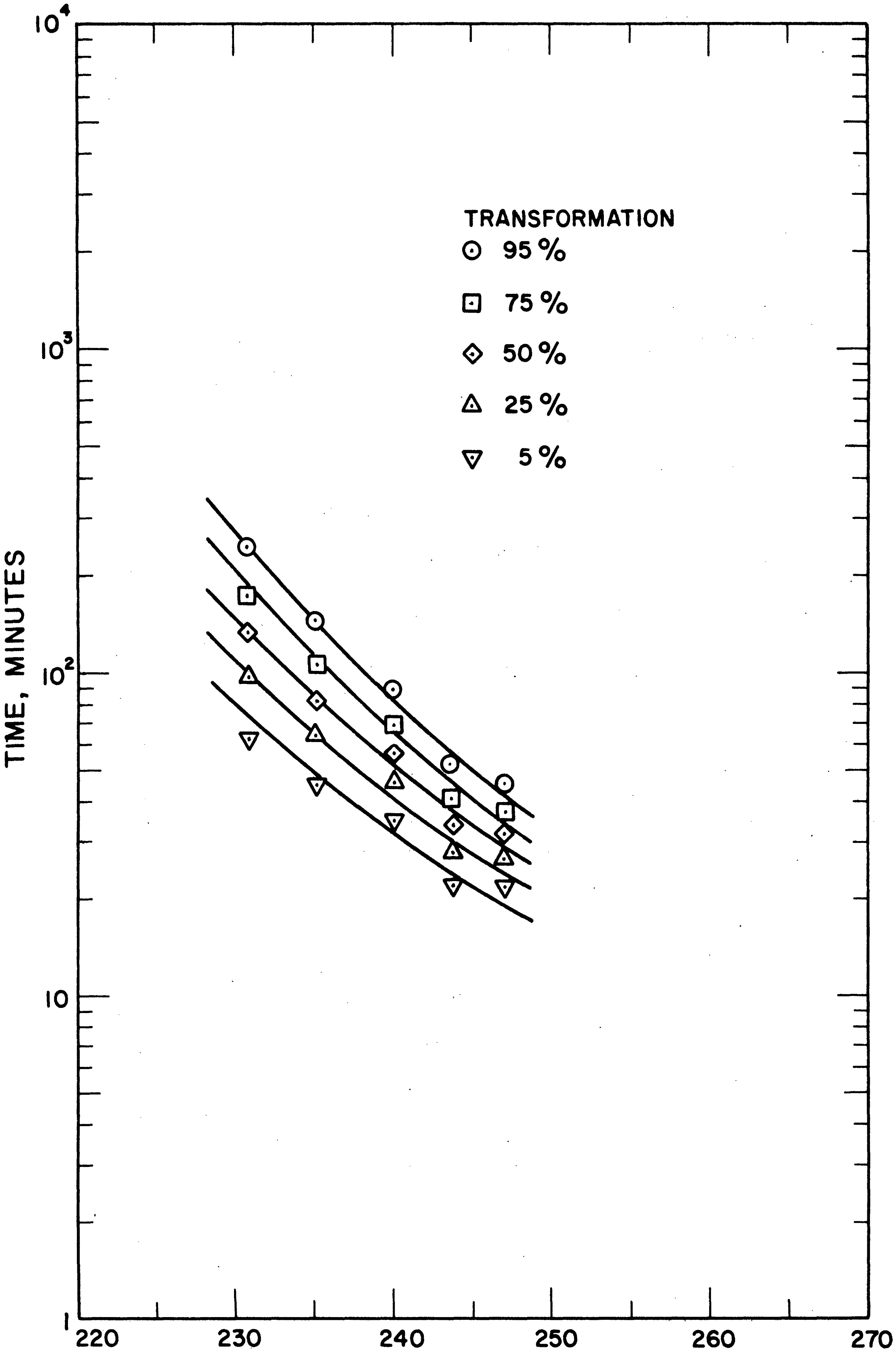


Figure 16. Time-Temperature-Transformation Curves for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in 3.5% Sodium Chloride Solution.

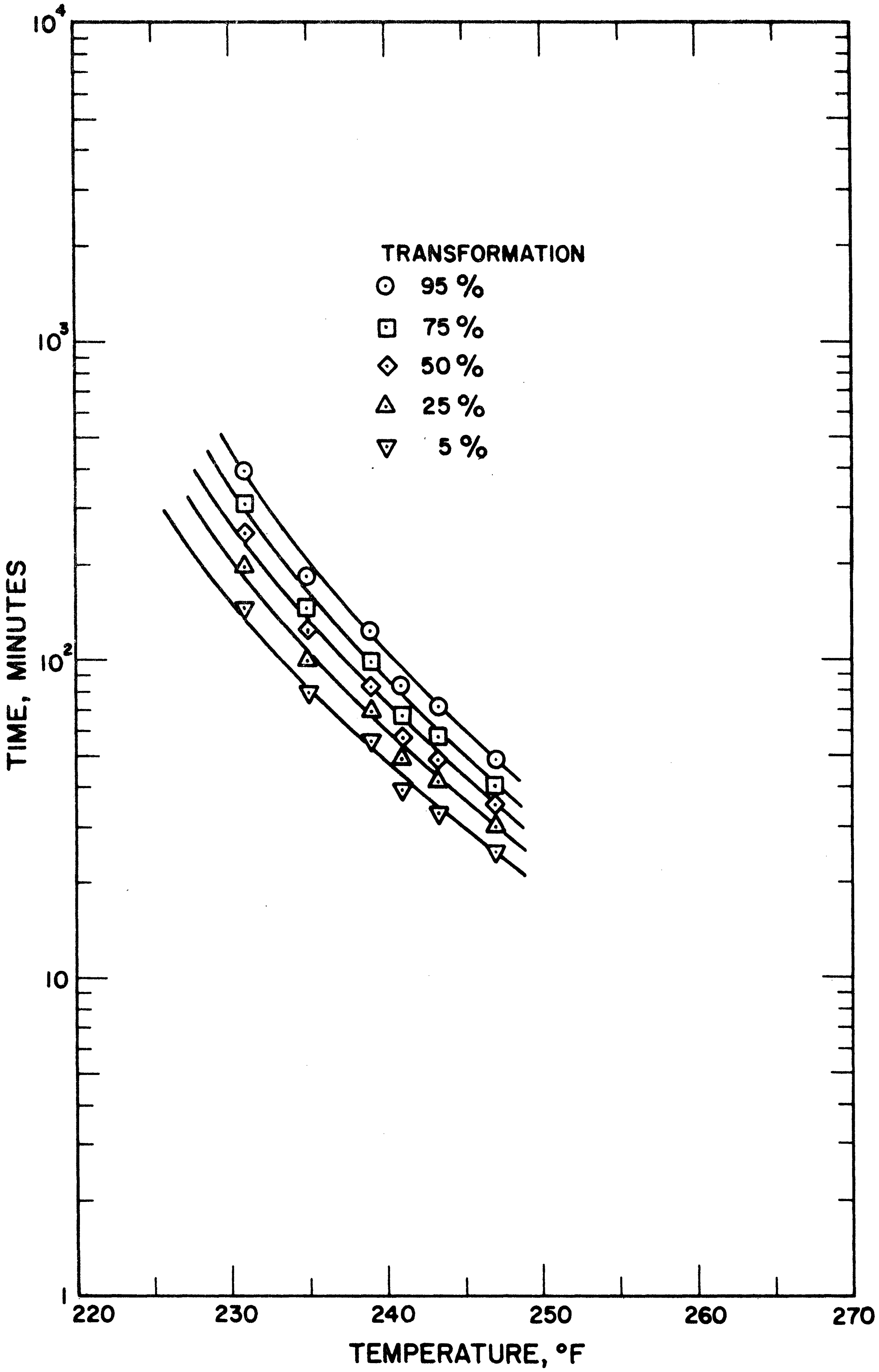


Figure 17. Time-Temperature-Transformation Curves for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in Synthetic Sea Water.

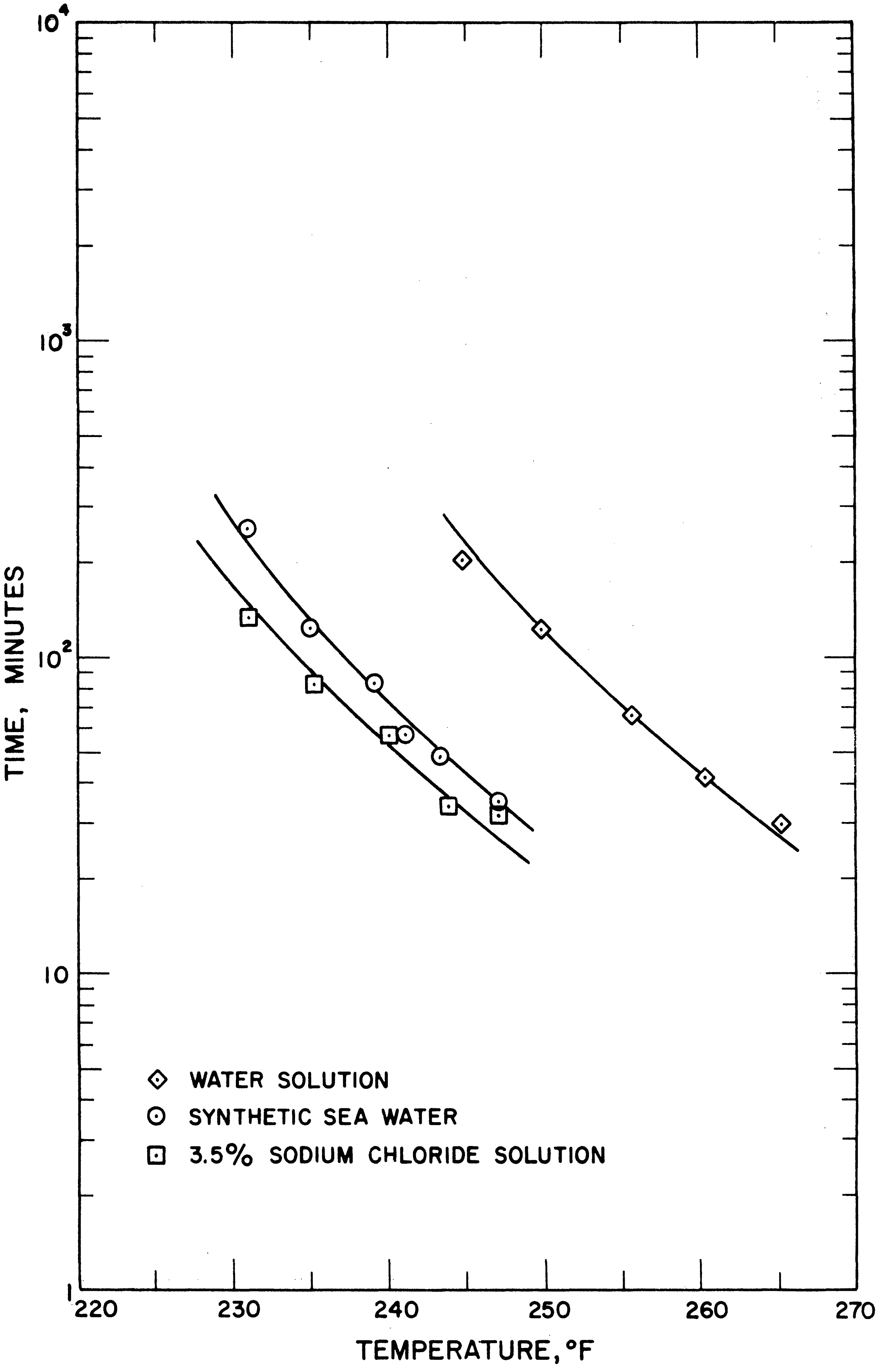


Figure 18. Time-Temperature-Transformation Curves for 50% Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in Water, in 3.5% Sodium Chloride Solution, and in Synthetic Sea Water.

reaction. For solutions of constant composition, the time for 50%-transformation decreases with increasing temperature, and for solutions of variable concentration, the time decreases at constant temperature as the concentration of dissolved solids increases. Since the overall rate of reaction is inversely proportional to the time of reaction, the overall rate of reaction increases with both increasing temperature for constant solution concentration and with increasing concentration of dissolved solids for the reaction occurring at a constant temperature.

Further observations were made on the dehydration of calcium sulfate dihydrate to hemihydrate over the temperature range 265°F to 300°F using the temperature response observed in the dilatometer rather than the volume change. The primary reaction under consideration at the time of these observations was the dehydration of calcium sulfate hemihydrate to anhydrite at temperature above 325°F, with the hemihydrate being formed in the dilatometer by the dehydration of the dihydrate. The first reaction occurred almost immediately and was completed long before the dilatometer and its contents reached the steady state temperature of the bath where the second reaction later occurred. The high rate of reaction encountered, as indicated by the temperature response for the dehydration of the dihydrate to the hemihydrate, as well as the transient temperature conditions, made it difficult to determine precisely the beginning and the ending of this reaction, except by graphical means, resulting in data with a high degree of scatter.

The results of these observations are shown in Figure 19, 20, and 21, for the reaction when the solids were immersed in water, in 3.5% sodium chloride solutions and in synthetic sea water, respectively. All the curves exhibit the same negative slopes as the previous data except the 5% curve for the reaction in 3.5% sodium chloride solutions

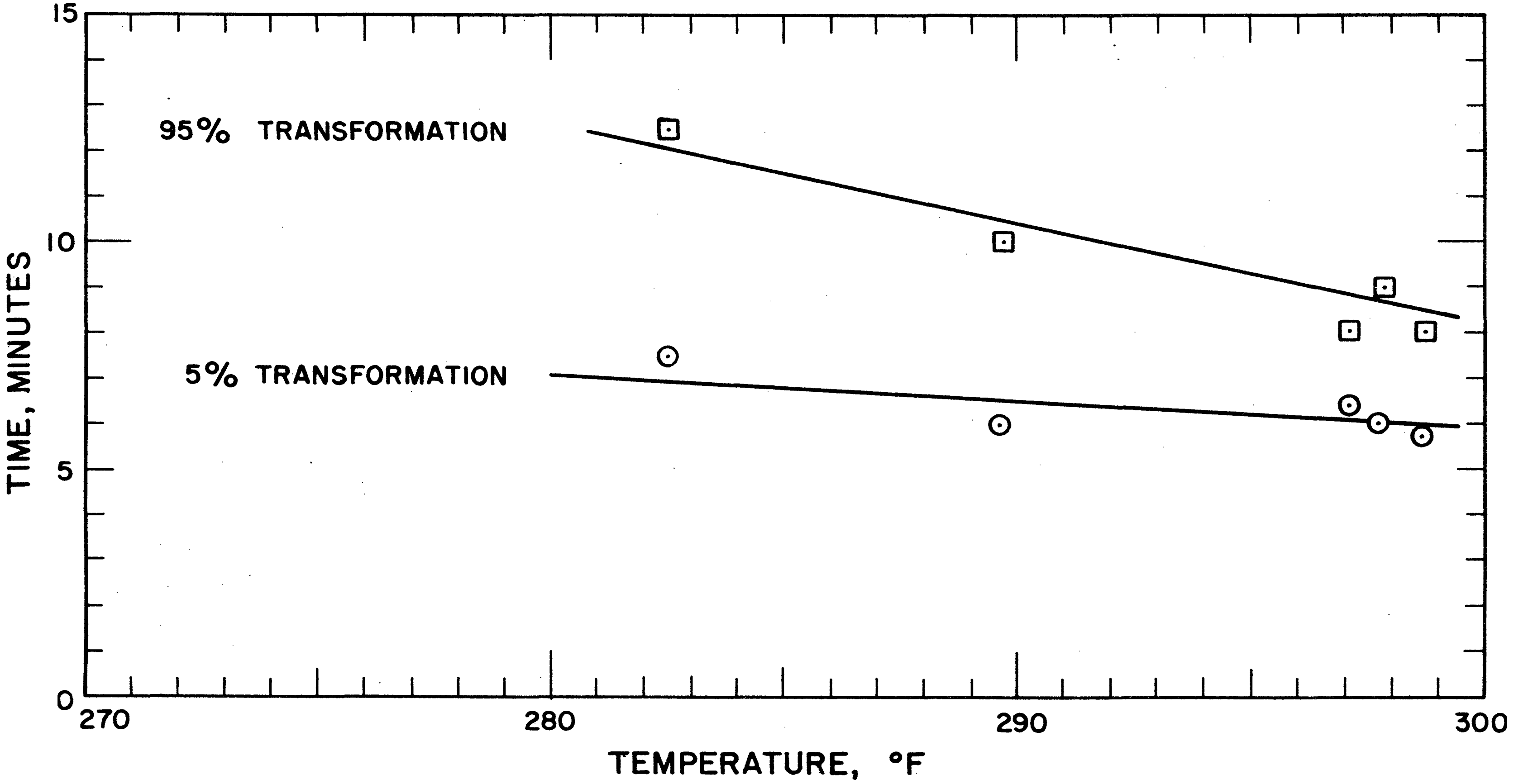


Figure 19. Estimated Time-Temperature-Transformation Curves for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in Water at High Temperatures.

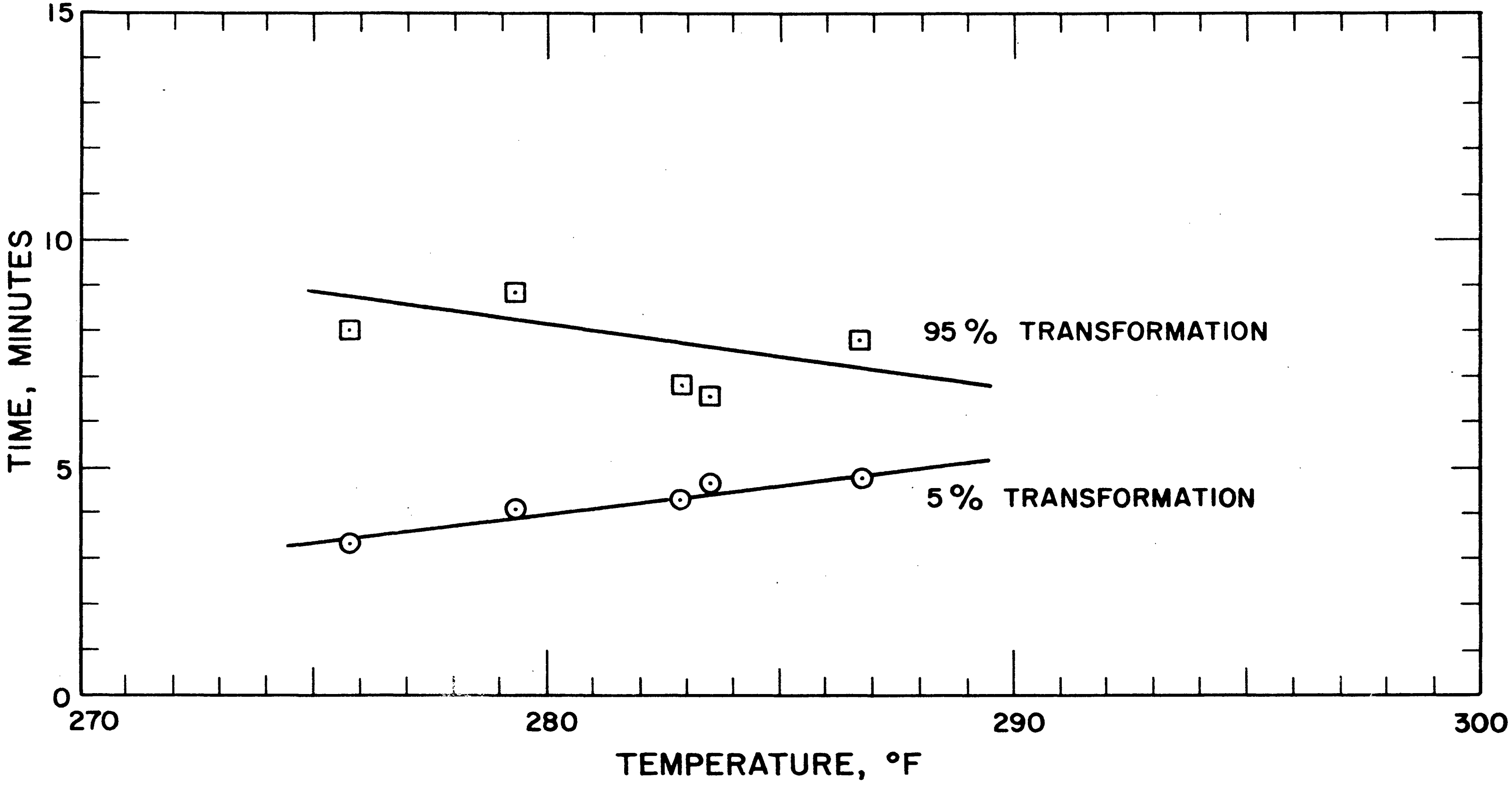


Figure 20. Estimated Time-Temperature-Transformation Curves for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in 3.5% Sodium Chloride Solution at High Temperature.

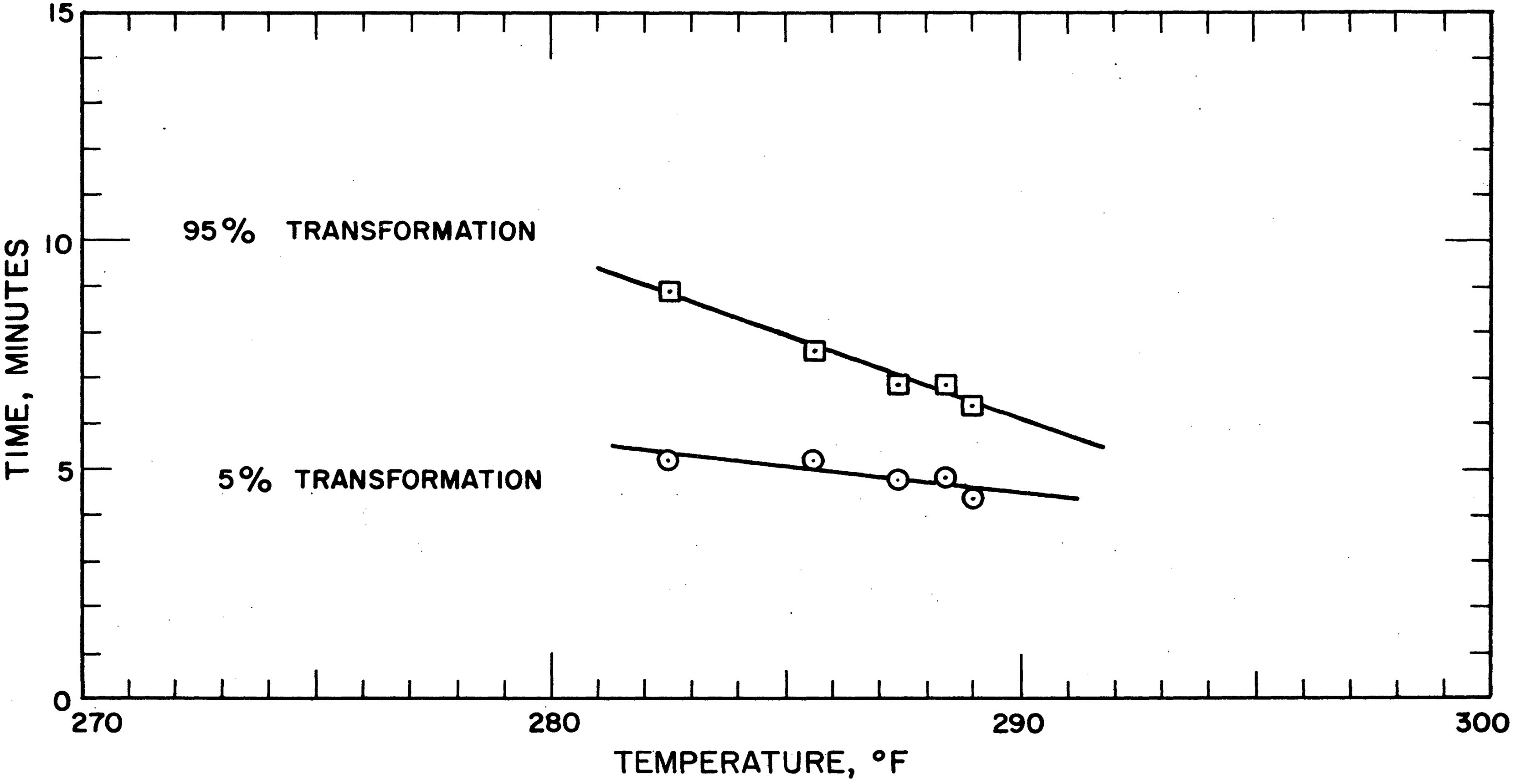


Figure 21. Estimated Time-Temperature-Transformation Curves for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in Normal Synthetic Sea Water at High Temperatures.

which exhibits a positive slope, and is probably in error due to the experimental uncertainties enumerated in the preceding paragraph.

Analysis of these curves shows that the overall rate of reaction continues to increase with increasing temperature for the reaction in solutions of constant concentration, and with increasing concentration of dissolved solids for conditions of constant temperature.

b. Effect of Concentration. The dehydration of calcium sulfate dihydrate to hemihydrate was observed at 240°F when the solids were immersed in aqueous solutions of sodium chloride and in synthetic sea water concentrates ranging in concentration from water (actually dilute calcium sulfate solutions) to solutions containing up to 21% dissolved solids. The effect of the solution concentration is shown in Figure 22 for aqueous sodium chloride solutions, and in Figure 23 for synthetic sea water concentrates. The three curves shown in Figure 22 for sodium chloride solutions, all have the same general shape. Each curve starts from the time value corresponding to the reaction occurring in water and decreases with increasing solution concentration, exhibiting a continuously decreasing negative slope. Likewise, the three curves for the synthetic sea water concentrates shown in Figure 23 exhibit the same general characteristics as those shown in Figure 22 after they were extrapolated to the value for pure water.

The data for the reaction in synthetic sea water concentrates and sodium chloride solutions fall on the same curves as shown in Figure 24 when the activities of the water in the solution surrounding the reacting solids were used rather than the weight percent dissolved solids. The individual data points for the sodium chloride solutions tend to lie

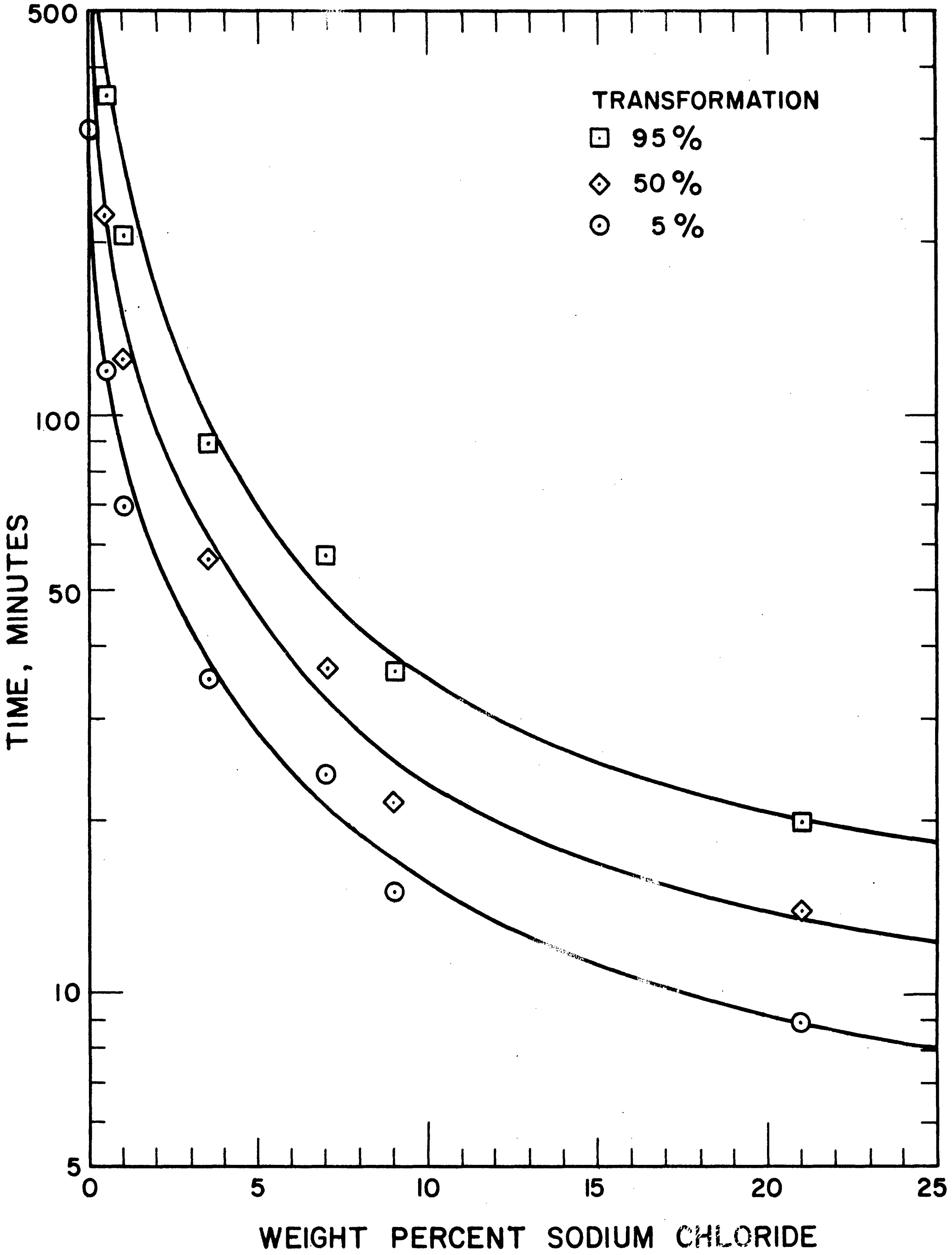


Figure 22. The Effect of the Concentration of Sodium Chloride Solutions on the Transformation Time for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate at 240°F.

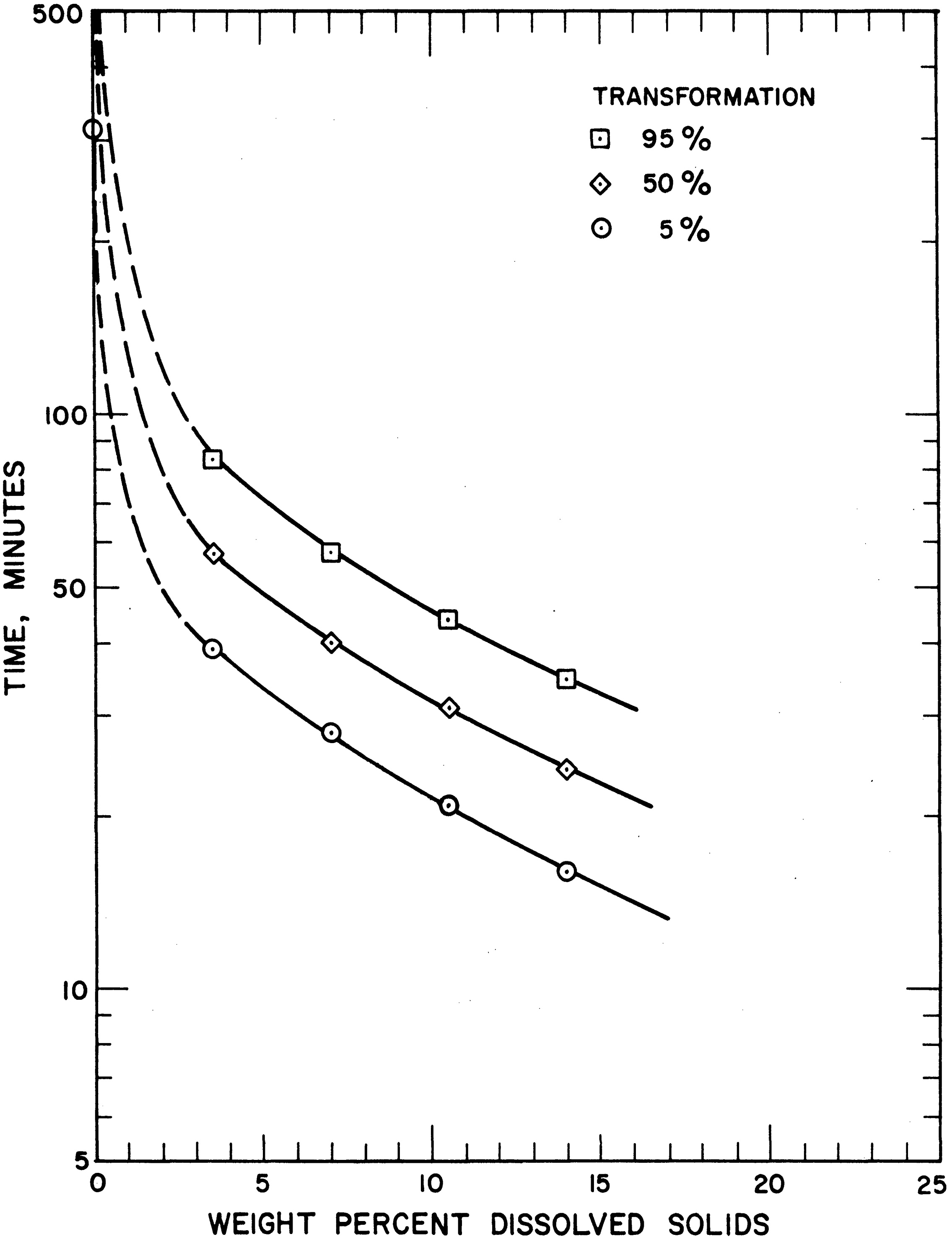


Figure 23. The Effect of Concentration of Synthetic Sea Water on the Transformation Time for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate at 240°F.

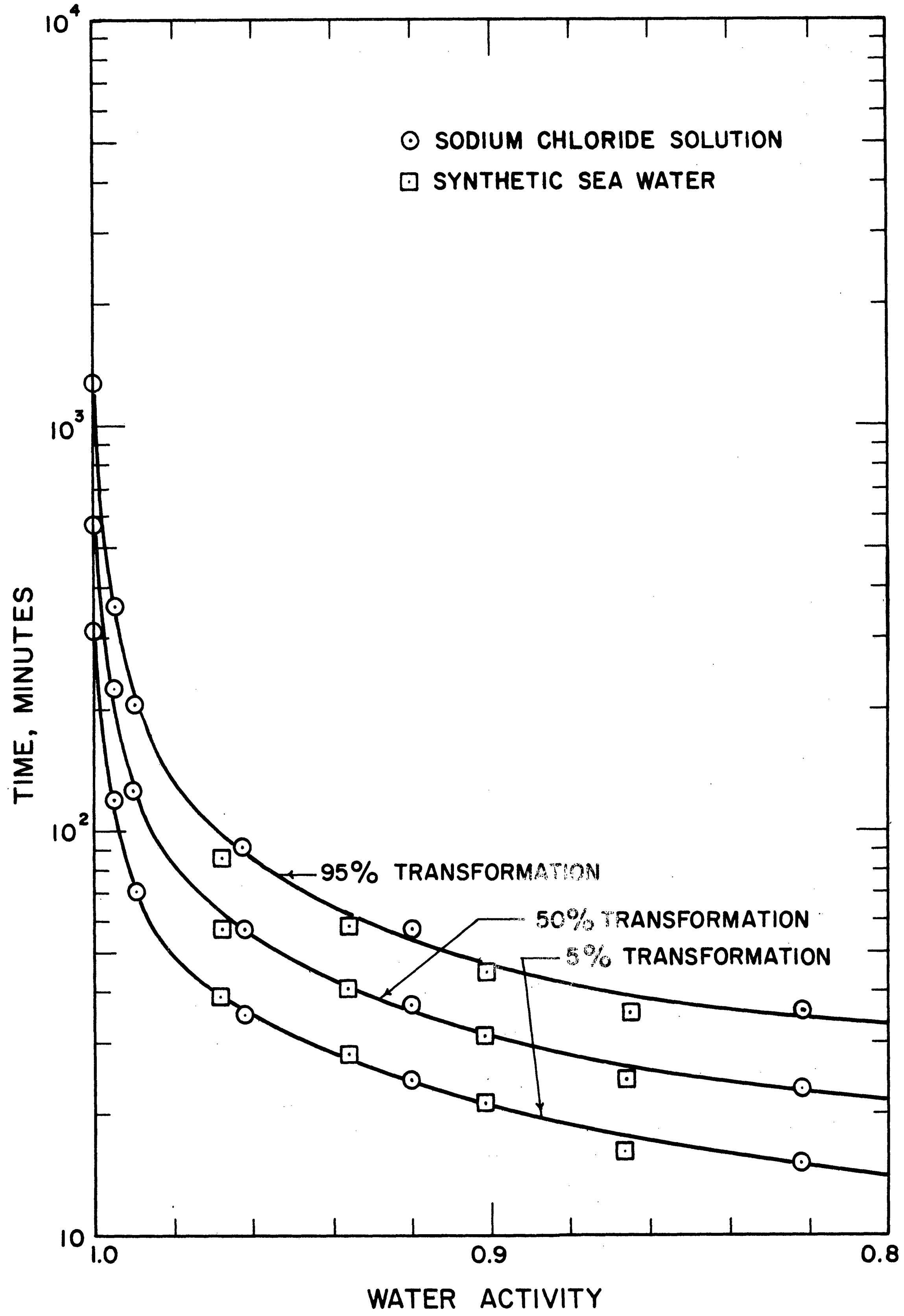


Figure 24. The Effect of the Activity of the Water in Solution on the Transformation Times for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate at 240°F.

slightly above the curves, and those for the synthetic sea water tend to lie slightly below. These small trends could be due to the normally expected scatter in the data or to some secondary effect, such as the presence of additional ions in the synthetic sea water, or to slight inaccuracies in the calculated activities for the water in either or both of the solutions. Examination of the free energy relationships for the transformation of calcium sulfate dihydrate to hemihydrate shows that only the activity of the product water should be affected by changes in the solution surrounding the solids since the activity of a pure solid is unity. Thus, besides temperature, the activity of the water in solution is a major variable for this reaction, as well as other dehydration reactions, possibly even for phase equilibria between hydrates and aqueous solutions.

The activity of the water in the solutions discussed above was calculated from the following relationships:

$$a = f/f^\circ = (f/p)P/(f/p)^\circ P^\circ = P/P^\circ \qquad (23)$$

where a is activity, f is fugacity, (f/p) is fugacity coefficient, and P is the vapor pressure of the solution. The variables represent the properties of the various brine solutions while the superscripted variables represent the properties of pure water. Values of the ratio P/P° for sodium chloride solutions were calculated from vapor pressure data given in the International Critical Tables.(97) The data were correlated by the method shown in Appendix K yielding the following relationships based on the method introduced by Cox:(43)

$$P/P^\circ = 1 - 0.643\ X \text{ for } 0 \leq X \leq 0.10 \qquad (24)$$

$$P/P^\circ = 0.962 - 2.93\ X^2 \text{ for } 0.10 \leq X \leq 0.25 \qquad (25)$$

where X is the weight fraction of dissolved solids. A similar relationship was available in the book "The Oceans"(85) for sea water with the vapor pressure ratio expressed in terms of chlorinity, where Y = the grams of chlorine (Cl^-) per 1000 grams of solution:

$$P/P^\circ = 1 - 0.000969\ Y\ . \qquad (26)$$

The effect of concentration on the overall rate of reaction can be obtained from the TTT curves shown in Figures 22, 23, and 24 by using the fact that the overall rate of reaction is inversely proportional to the total time of reaction, estimated by the time difference between the 5% and the 95% transformation curves. In both cases, the rate of reaction increases with increasing solution concentration or decreasing activity of the water in the solution. The increase occurs very quickly for small additions of sea water salts or sodium chloride to very dilute aqueous solutions and less quickly for concentrated solutions approaching saturation. The effect of concentration on the time required for initiation of the reaction can also be seen by using the 5% transformation curves as a first order estimate of the initiation time. In both types of solutions, the time for initiation decreases very quickly for small additions of solute when the solutions are dilute, but much less spectacularly as the solution concentration approaches saturation.

c. Effect of Initial Particle Size. The effect of initial particle size on the dehydration of calcium sulfate dihydrate to hemihydrate while the solids were immersed in water was studied under conditions of approximately constant temperature by varying the size of the dihydrate crystallites comprising the original sample. Crystal fragments were obtained between screens having; 0.0, 0.0021, 0.0029, 0.0035, 0.0041, 0.0058, 0.0069, 0.0082, 0.0116, 0.0138, and 0.0164 inch openings. As shown in Figure 25, a minimum time for the reaction occurred, for each curve of constant transformation for samples collected between screens having 0.0116 and 0.0082 inch openings indicating a maximum overall rate of reaction for initial particles of this size range.

This effect of initial particle size on the reaction indicates the possibility that two independent processes are occurring, one limiting the rate at the beginning of the transformation and the other at the end. As shown in the next chapter, the reaction occurs by nucleation of hemihydrate on the surface of the crystal with subsequent growth of the hemihydrate phase through the parent dihydrate crystal. When the reacting particles are large, the rate of nucleation is low due to the small surface area available for nucleation and the transformation results primarily by a large amount of growth of a few nuclei. On the other hand, when the reacting particles are small, the rate of nucleation is high due to the large surface area, but the transformation results primarily by a small amount of growth of a large number of nuclei. Thus, at one end of the spectrum, the rate of nucleation is controlling and at the other end growth rate is controlling, with a maximum rate existing some place in between. Consequently, the time for a given amount of reaction, which is inversely proportional to the rate of reaction, exhibits a minimum when plotted as a function of particle size as shown in Figure 25.

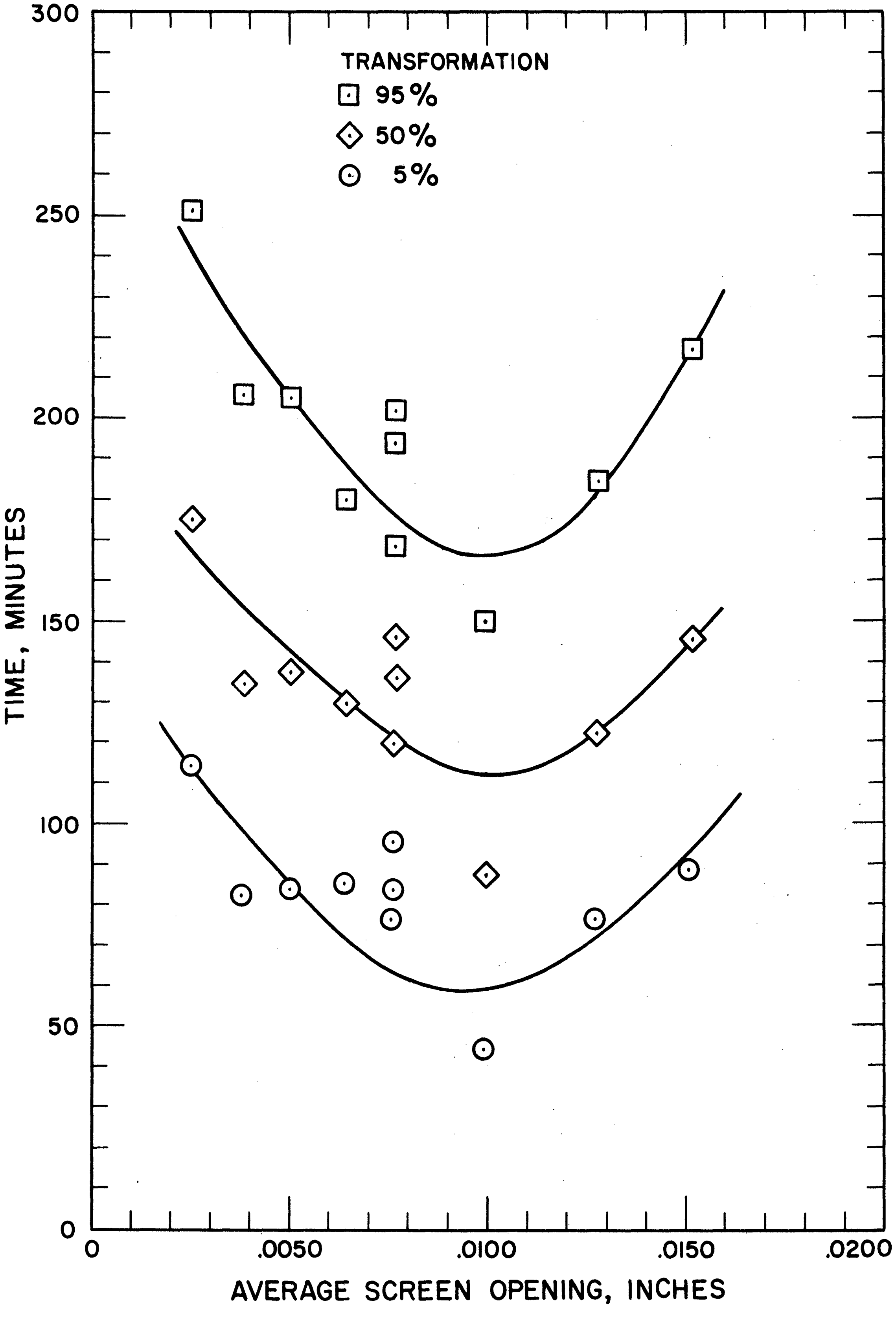


Figure 25. The Effect of Dihydrate Crystal Fragment Size as a Function of Screen Opening on the Transformation Time for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in Water at 250°F for Washed Samples.

Assuming that the overall rate of reaction is directly proportional to the maximum rate of reaction, then the values of the maximum rate of reaction should be inversely proportional to the total time for the reaction and should exhibit a maximum when plotted as a function of initial particle size. This characteristic is shown clearly in Figure 26 where the values of the smoothed maximum rate of reaction are plotted versus initial particle size, indicating a good degree of consistency between the different forms of the data obtained in these studies.

2. Transformation of Hemihydrate to Anhydrite

The chemical equation representing the dehydration of calcium sulfate hemihydrate to calcium sulfate anhydrite when the solids are immersed in aqueous solutions is:

$$CaSO_4 \cdot 1/2H_2O(S) \xrightarrow{\text{solution}} CaSO_4(S) + 1/2H_2O(L) \ . \qquad (27)$$

To study the TTT characteristics of this reaction, calcium sulfate hemihydrate was formed in the dilatometer reaction bulb at the beginning of each experimental run from a sample of dihydrate crystals separated between screens having 0.0116 and 0.0082 inch openings. Experimental runs were made at temperatures of about 325°, 340°, and 347°F in water, in 3.5% sodium chloride solution, and in synthetic sea water. The dilatometric procedures used for these runs were identical to those previously described except greater care was required in estimating the amount of solution to be added to the dilatometer to keep the meniscus within the length of the capillary during the entire experiment. This was necessary because three volume increases occurred: that due to the thermal expansion of the dilatometer's contents, that due to the dehydration of the

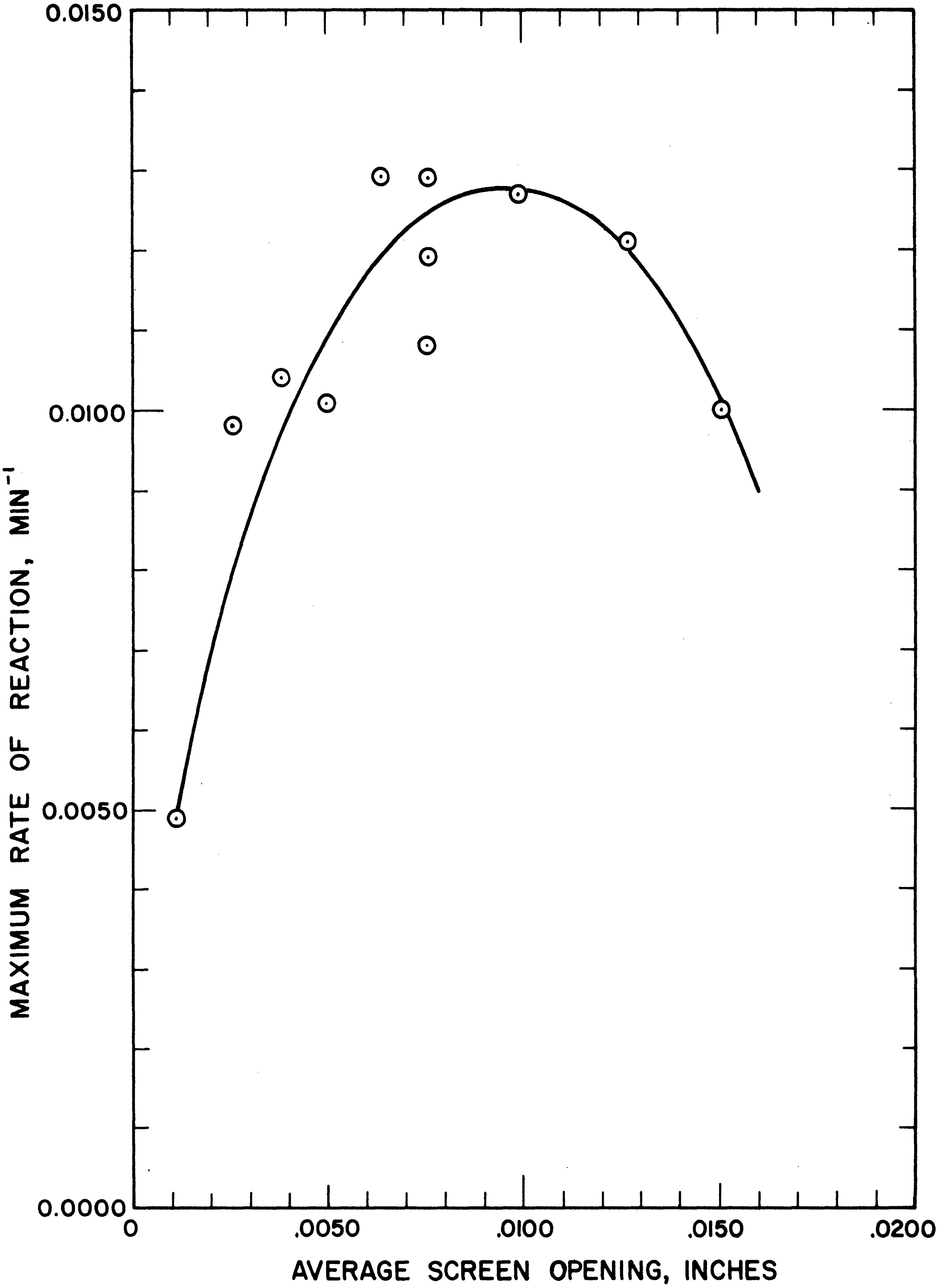


Figure 26. The Effect of Dihydrate Crystal Fragment Size as a Function of Screen Opening on the Maximum Rate of Reaction Observed During the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in Water at 250°F for Washed Samples.

dihydrate to the hemihydrate, and that due to the dehydration of the hemihydrate to the anhydrite.

The effect of temperature on the dehydration of calcium sulfate hemihydrate to anhydrite is shown in Figures 27, 28, and 29, for the reaction where the solids were immersed in water, in 3.5% sodium chloride solutions, and in synthetic sea water, respectively. Over the temperature range covered by these experiments, the TTT curves for water, sea water, and sodium chloride solutions are straight lines with negative slopes, except for the 5% transformation curve for water which has a positive slope, and is probably in error. Analysis of the shapes of the curves and their relative orientation shows that the overall rate of reaction for the dehydration of calcium sulfate hemihydrate to anhydrite increases with increasing temperature. Conversely, the time for reaction decreases with increasing temperature. The reaction is also accelerated by increasing the concentration of the solute in the solution containing the reaction mixture. The time required for a given fraction transformation at a given temperature is considerably longer in water than in normal synthetic sea water where it is only slightly longer than in the 3.5% sodium chloride solutions, as shown in Figure 30 where the 50% transformation curves for these three cases are presented together.

3. Comparison of Results

The relationship between the time-temperature-transformation results for the dehydration of calcium sulfate dihydrate to hemihydrate, and hemihydrate to anhydrite is shown graphically in Figure 31 where the 50% transformation curves are plotted for each reaction where the solids

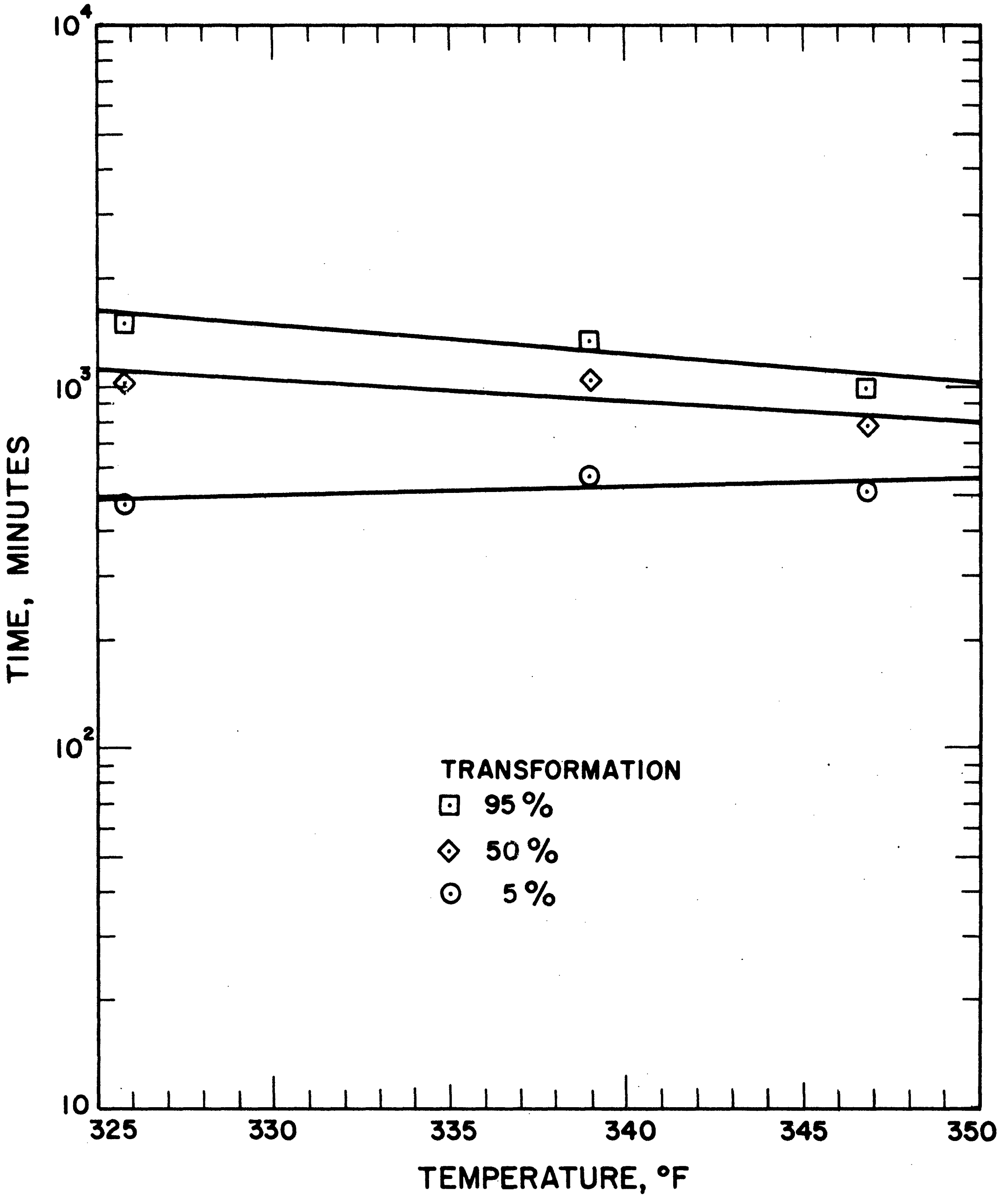


Figure 27. Time-Temperature-Transformation Curves for the Dehydration of Calcium Sulfate Hemihydrate to Anhydrite in Water.

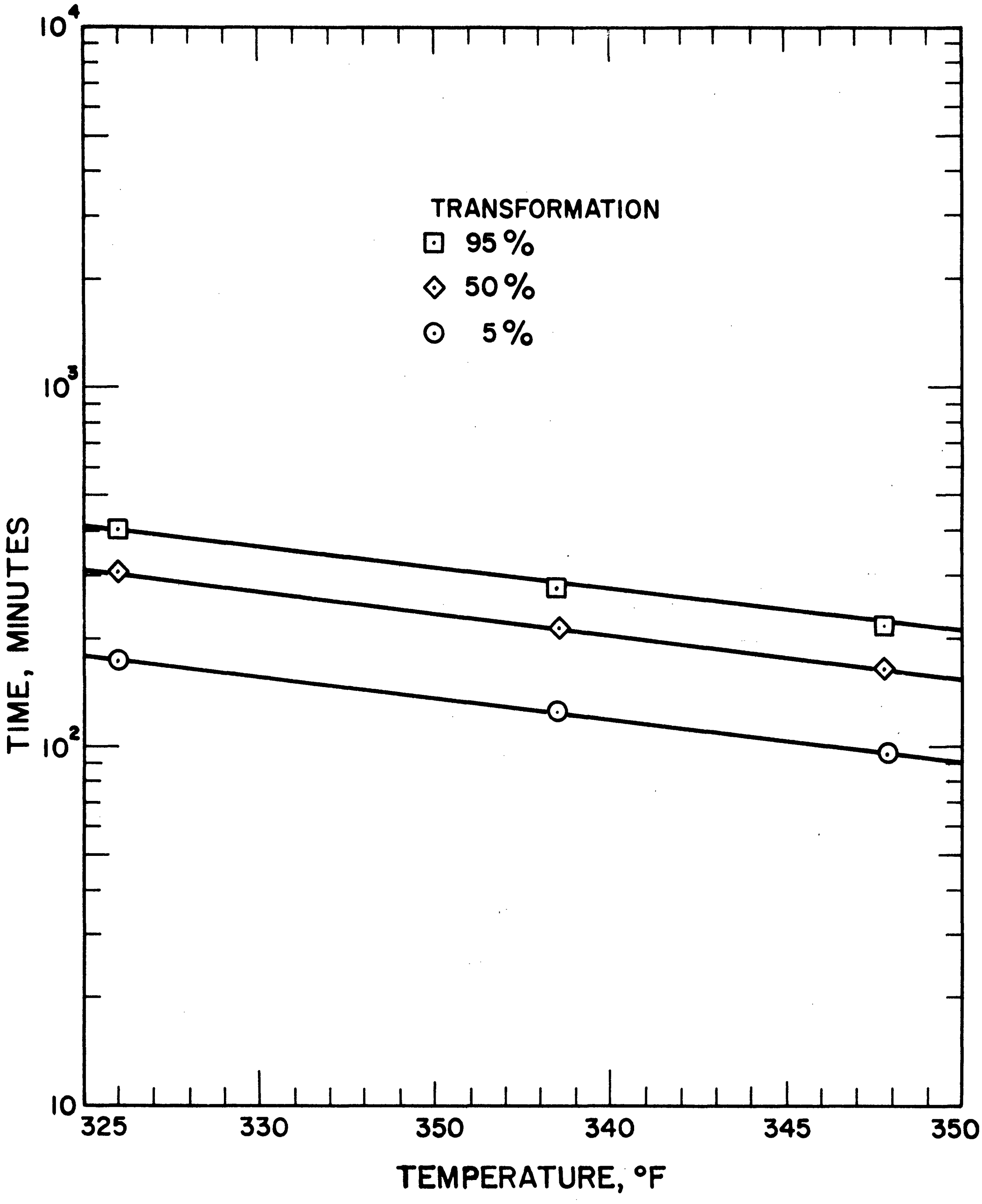


Figure 28. Time-Temperature-Transformation Curves for the Dehydration of Calcium Sulfate Hemihydrate to Anhydrite in 3.5% Sodium Chloride Solutions.

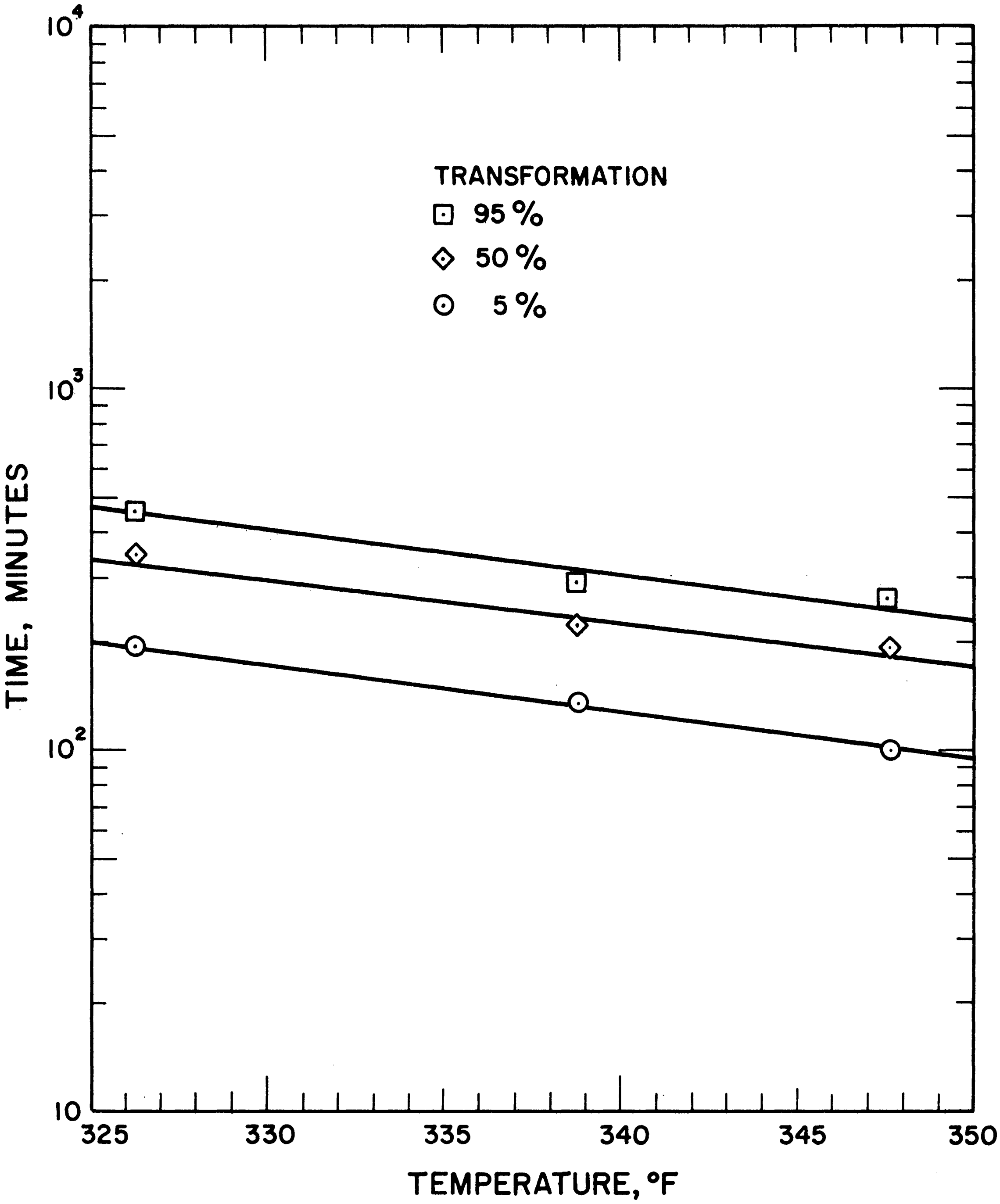


Figure 29. Time-Temperature-Transformation Curves for the Dehydration of Calcium Sulfate Hemihydrate to Anhydrite in Synthetic Sea Water.

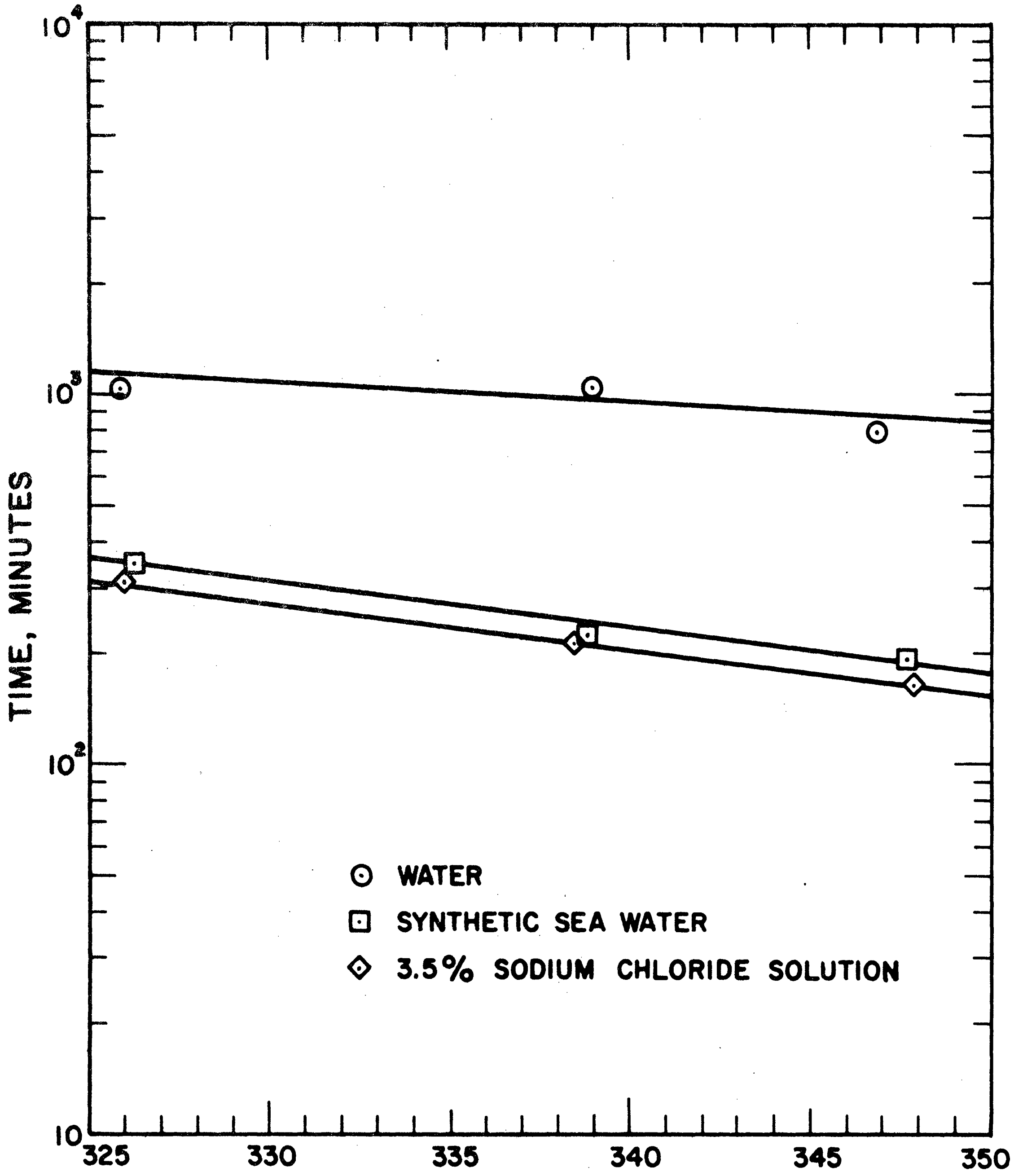


Figure 30. Time-Temperature- 50% Transformation Curves for the Dehydration of Calcium Sulfate Hemihydrate to Anhydrite in Water, in 3.5% Sodium Chloride Solution, and in Synthetic Sea Water.

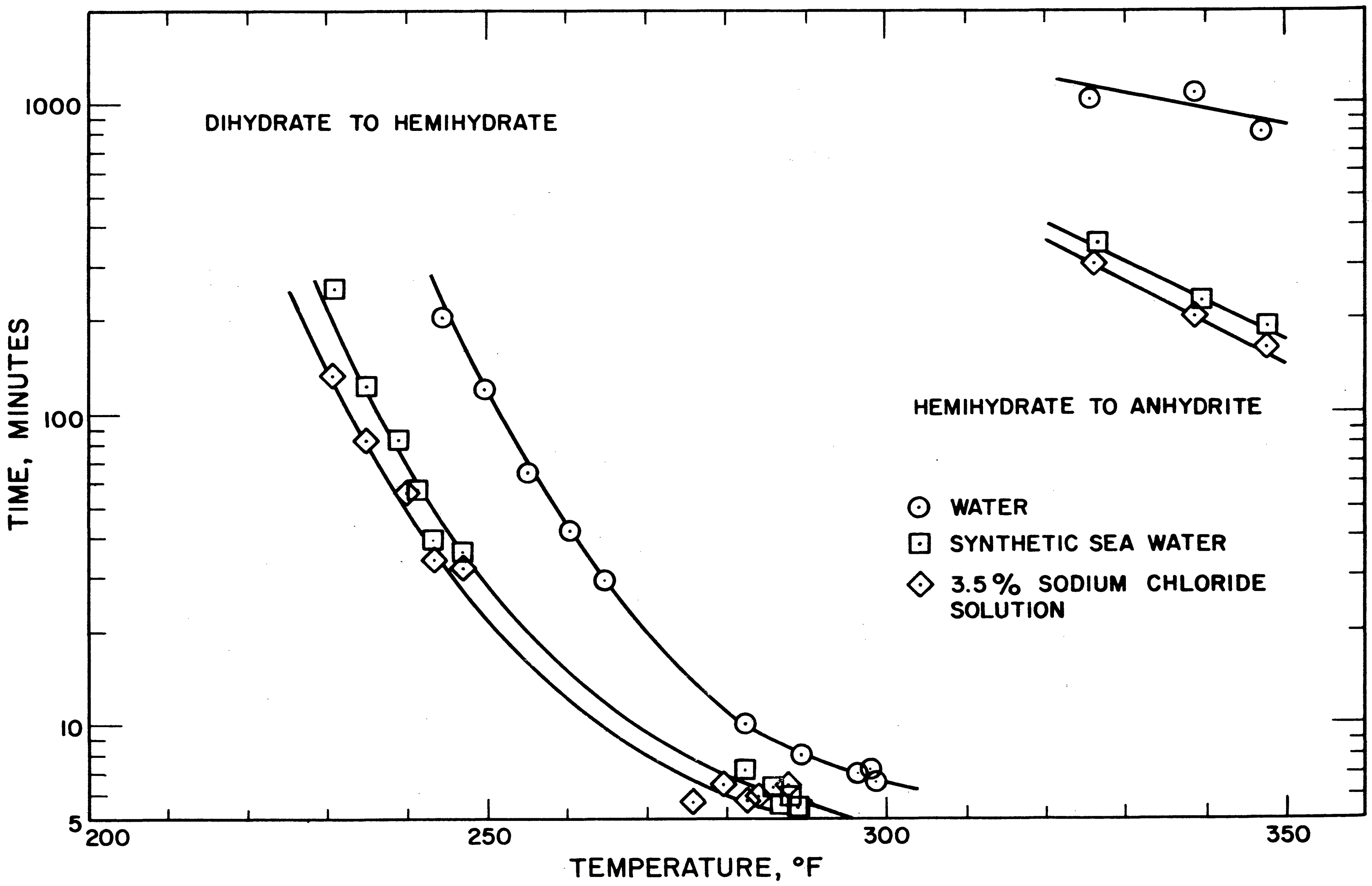


Figure 31. Summary of Time-Temperature-Transformation Results for 50% Dehydration.

were immersed in water, in 3.5% sodium chloride solutions, and in synthetic sea water. The 50% transformation curves for each reaction occupy the same relative positions to each other with respect to time: the reaction in water requiring considerably more time than the reaction in synthetic sea water which, in turn, requires slightly more time than reaction in 3.5% sodium chloride solution. The relative positions of the two sets of curves show that when the two reactions occur consecutively as under the conditions used here: the dehydration of the dihydrate to hemihydrate goes to completion before the dehydration of the hemihydrate to anhydrite starts.

V. DIHYDRATE TO HEMIHYDRATE TRANSFORMATION MECHANISM

While the time-temperature-transformation data describe the overall kinetics of the transformation processes, they do not fulfill the traditional objective of a kinetic investigation which is the derivation of an appropriate rate equation based on the mechanism of the reaction being studied. For this purpose information on the nature of the transformation mechanism is needed. It was found that this could be obtained for the dehydration of dihydrate to hemihydrate from microscopic observations of dihydrate crystals during the transformation process.

A. Experimental Procedures

These microscopic observations were carried out in a special cell designed to duplicate as nearly as possible the conditions of temperature and pressure used in the dilatometric experiments while permitting observation of the transforming crystals with an optical microscope. As shown in Figure 32, this reaction cell was formed by a neoprene rubber O-ring and two optically flat quartz disks which were clamped together by a set of brass spacers and flanges designed to support the cell on the stage of an inverted column optical metallograph and to conduct heat from an electric heater to the cell. The temperature of the reaction mixture inside the cell was recorded at 5-second intervals using the same recording potentiometer used in the dilatometric studies and a copper-constantan thermocouple made from 30 gauge wires inserted through the O-ring. The crystals were photographed simultaneously with the recording of the temperature at either one or five minute intervals, depending on the rate of transformation, using the synchronizing system previously described

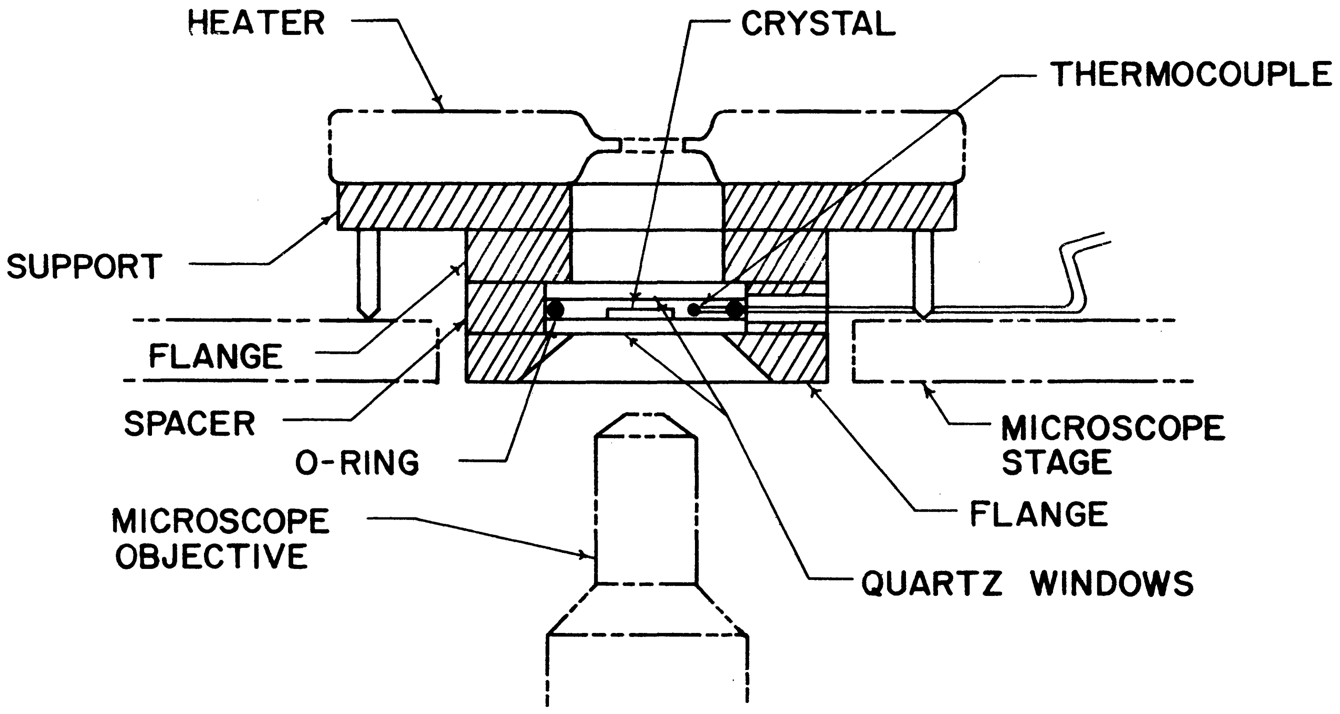


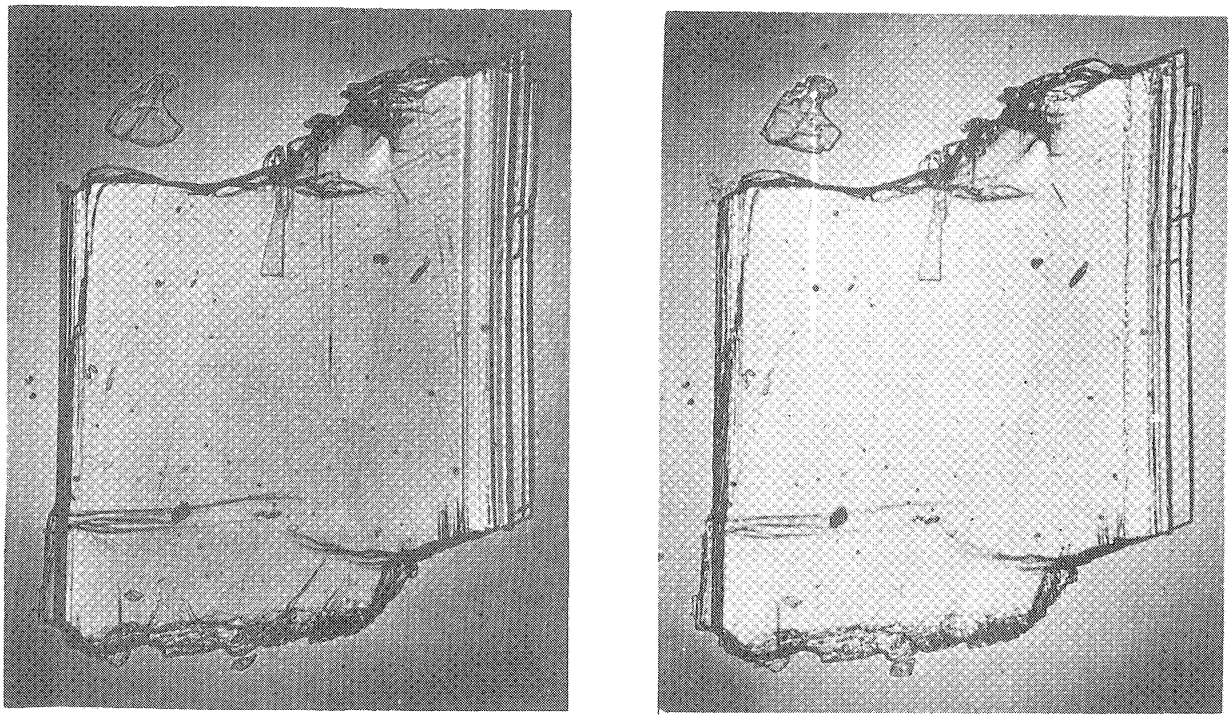
Figure 32. Reaction Cell Used for Microscopic Observations of Phase Transformation.

and a 35 mm through-the-lens reflex camera attached to the ocular tube of the metallograph. Polarized light was used to achieve maximum contrast and best delineation of the phases. Magnification was determined by means of a standard B & L metric stage micrometer slide. Temperatures were read directly from the chart of the recording potentiometer, using a 15X magnifying glass to facilitate interpolation, while the time intervals between photographs were determined from the known chart speed of one-third inch per minute.

B. Experimental Results

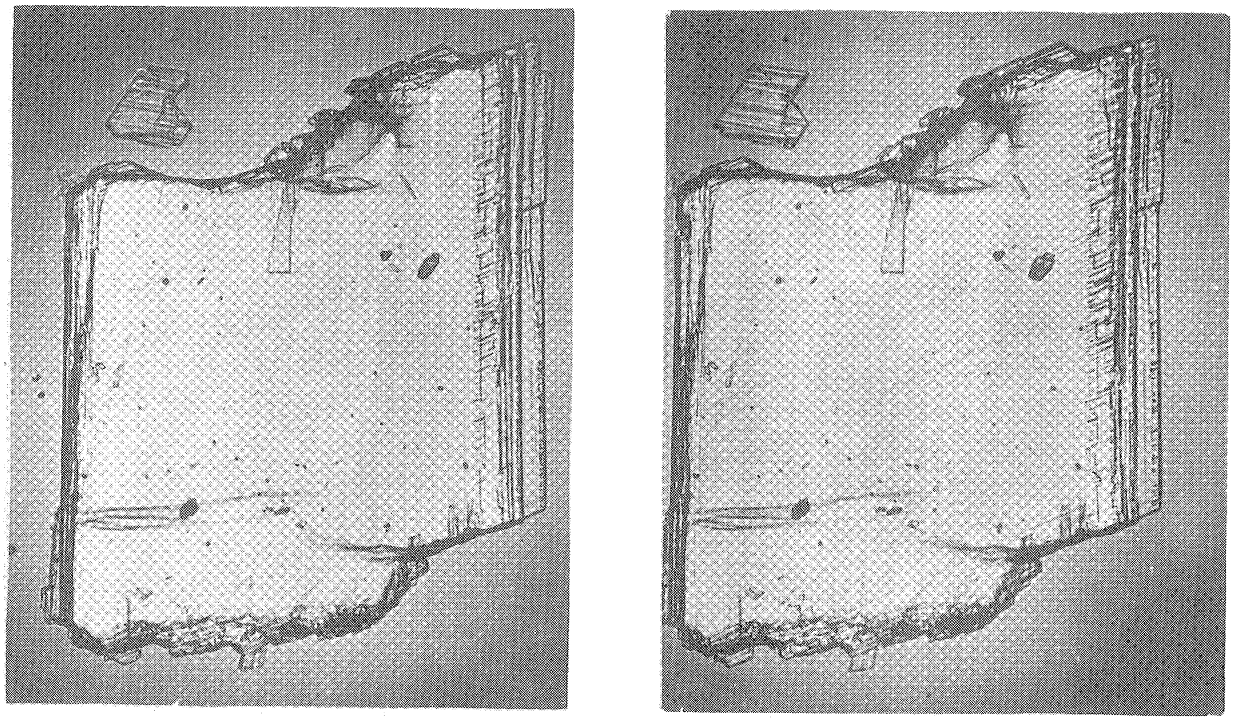
The general characteristics of the mechanism involved in the transformation of calcium sulfate dihydrate to hemihydrate were observed and photographed using thin rhombic crystals (approximately 1 x 1 x 0.05 mm in size) of optical grade selenite ($CaSO_4 \cdot 2H_2O$) which were similar to those used in the dilatometric experiments. A number of such crystals were sealed in the appropriate liquid medium in the reaction stage and heated quickly into the temperature range from 250°F to 275°F and photographed at appropriate time intervals. Because of their plate-like shapes they generally laid flat on the bottom of the chamber and could therefore be viewed only in a direction perpendicular to the (010) cleavage planes. Figure 33 consists of a series of micrographs showing the transformation of two crystals. In these micrographs the larger crystal is oriented with its (001) cleavage planes parallel to the vertical edges of the micrographs, and its (100) cleavage planes slightly skew to the top and bottom edges.

During the first 10 to 20 minutes, while the temperature of the reaction mixture increased rapidly, considerable material apparently



(a) Time 0 min, 74.4°F.

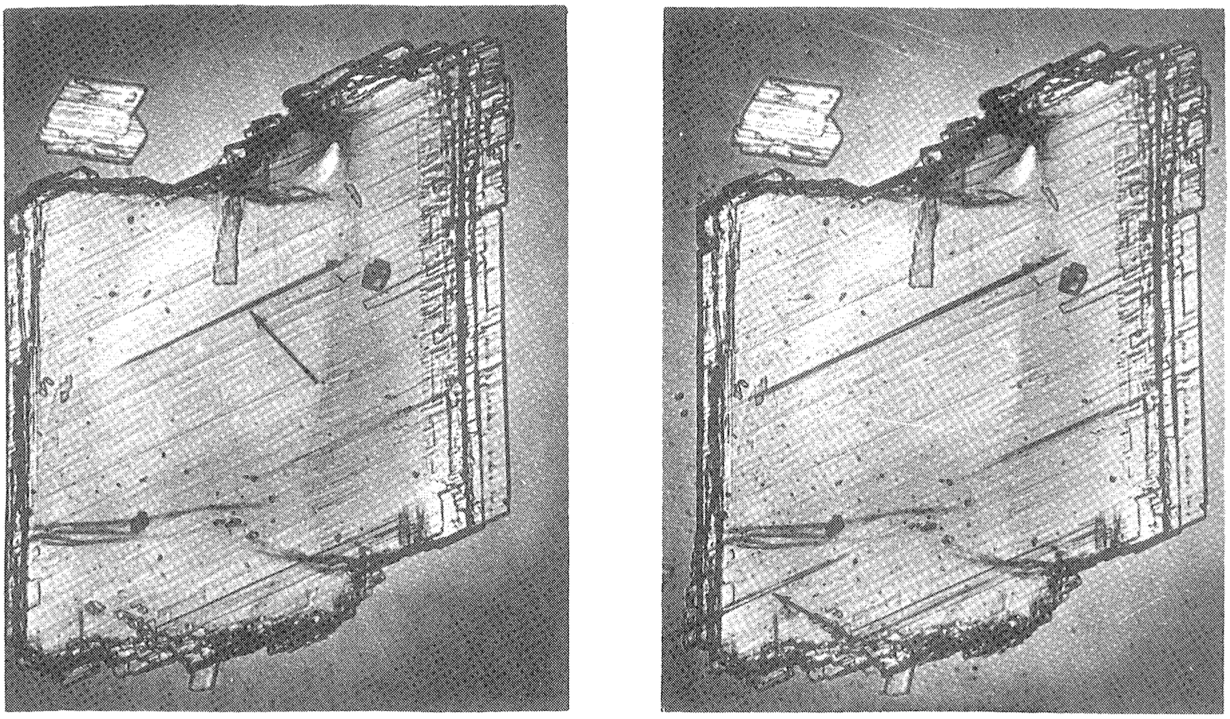
(b) Time 6 min, 213.8°F.



(c) Time 8 min, 238.4°F.

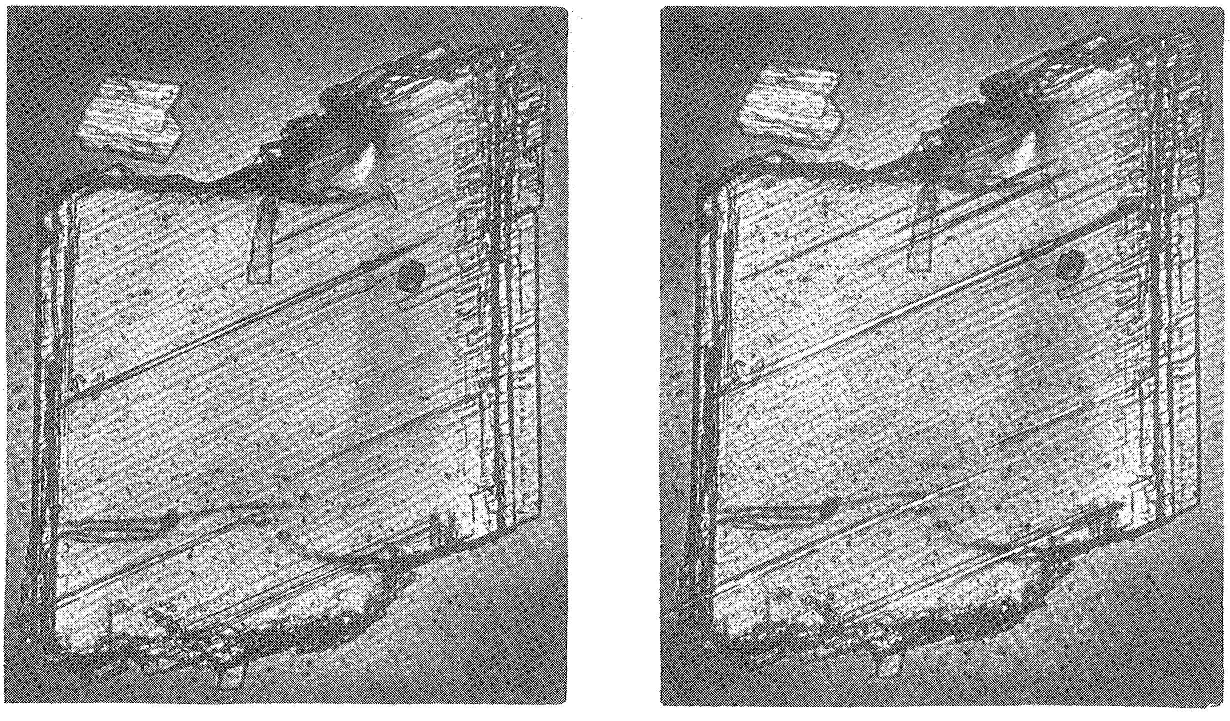
(d) Time 10 min, 247.5°F.

Figure 33. Sequence of Micrographs (85X) Showing the Transformation of a Single Crystal of Calcium Sulfate Dihydrate to Hemihydrate in Water.



(e) Time 26 min, 264.8°F.

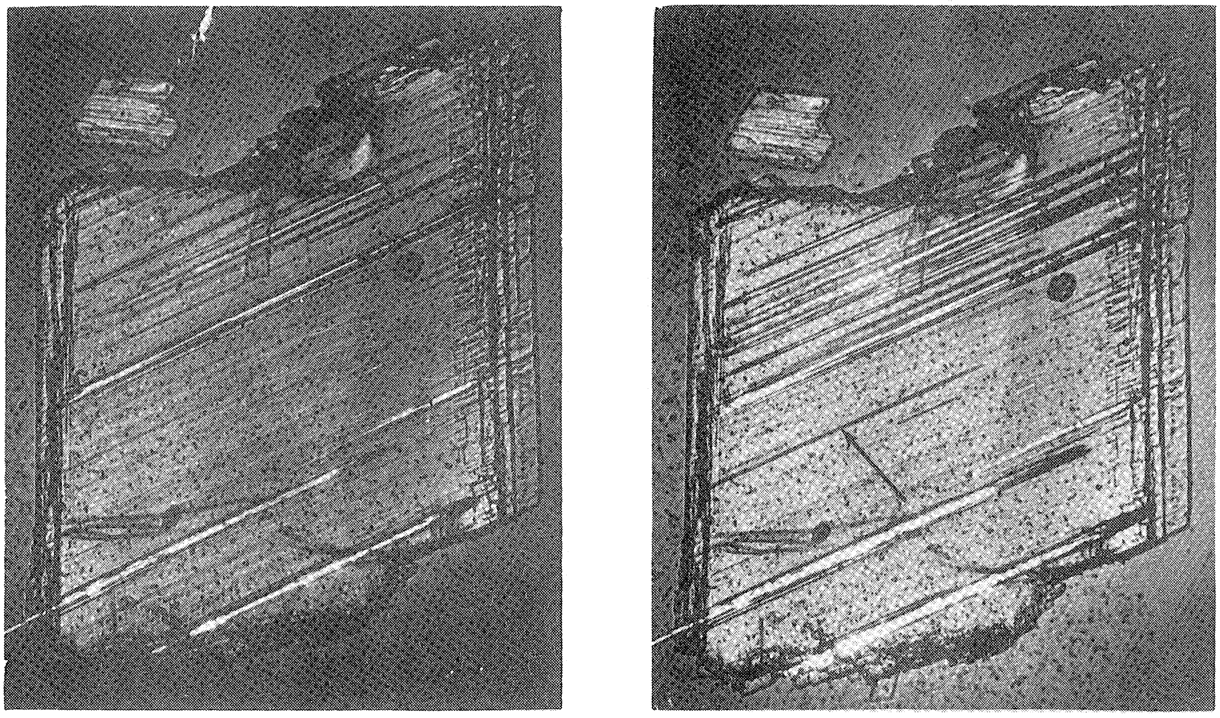
(f) Time 28 min, 265.6°F.



(g) Time 30 min, 266.5°F.

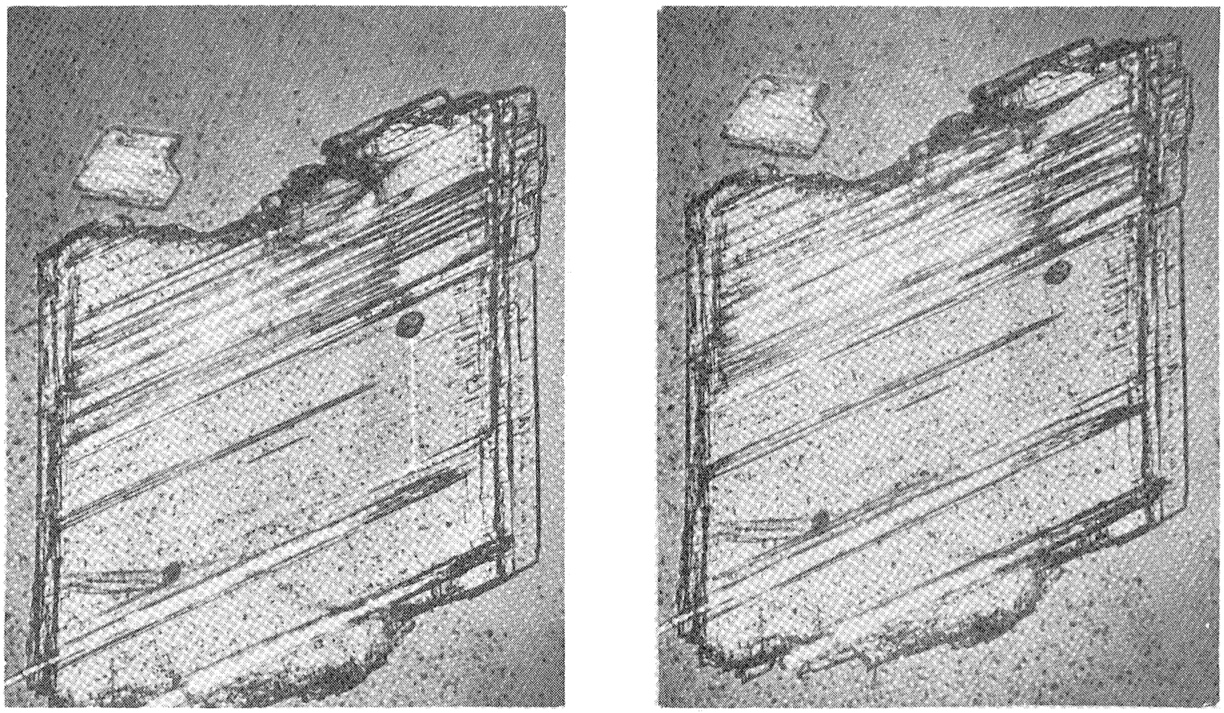
(h) Time 32 min, 267.5°F.

Figure 33 (CONT'D)



(i) Time 34 min, 268.4°F.

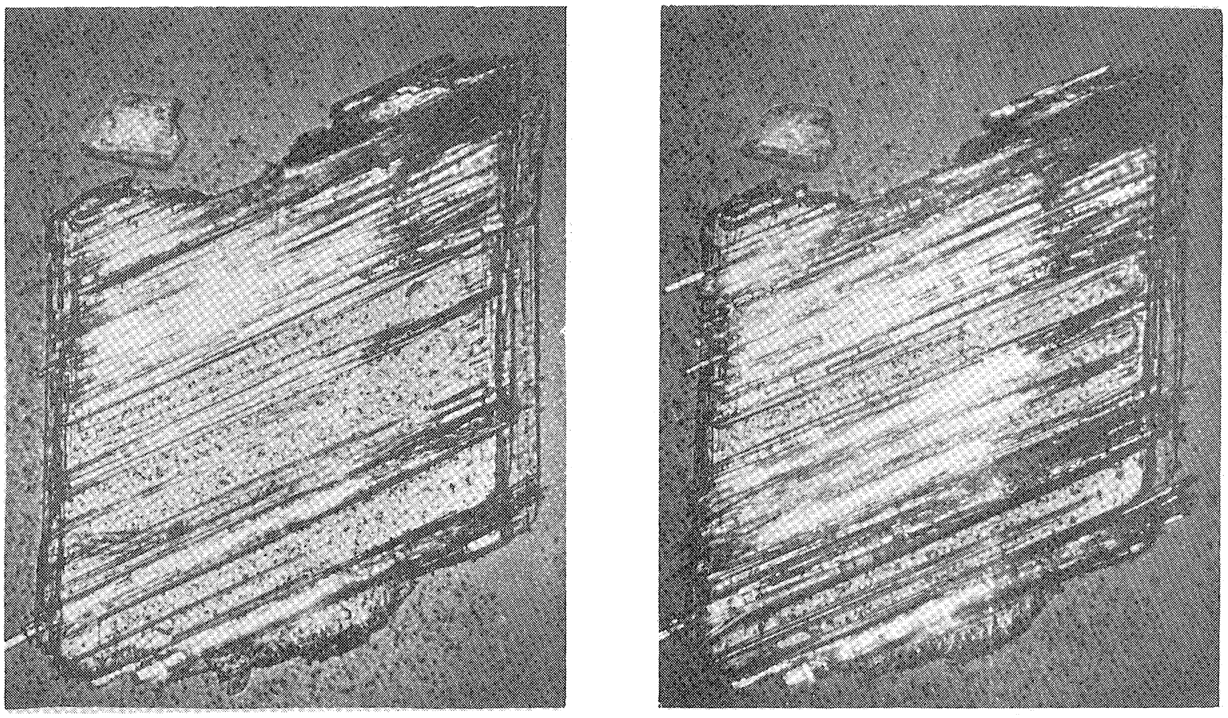
(j) Time 36 min, 269.0°F.



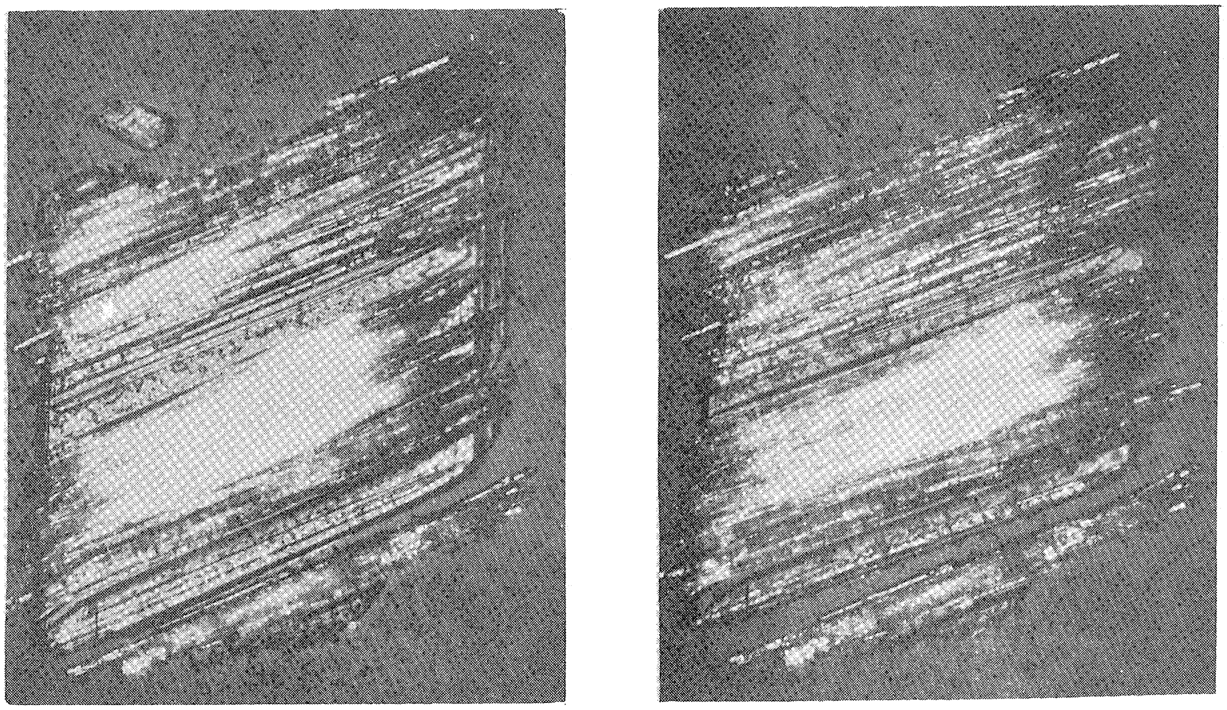
(k) Time 38 min, 269.8°F.

(l) Time 40 min, 270.3°F.

Figure 33 (CONT'D)



(m) Time 45 min, 271.8°F. (n) Time 50 min, 272.2°F.



(o) Time 55 min, 272.8°F. (p) Time 60 min, 273.2°F.

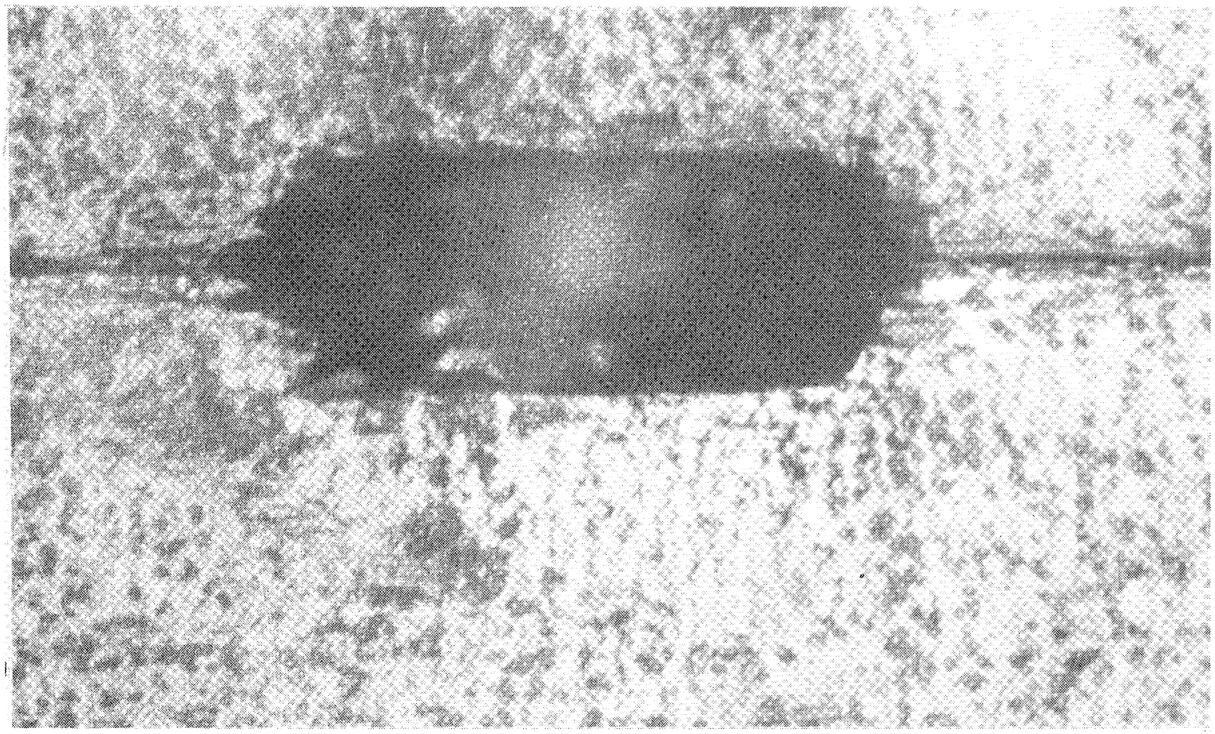
Figure 33 (CONT'D)

deposited from solution onto existing crystals, as evidenced by the marked growth of the smaller crystal, by the disappearance of the randomly oriented scratches and abrasions initially present on the surface of the larger crystal, and by subsequent development of striations parallel to the (100) cleavage planes of the larger crystal. The first hemihydrate nucleus developed in the upper central portion of the larger crystal after about 25 minutes and can be seen in micrograph 33c. Additional nuclei developed shortly thereafter at various locations throughout the larger crystal. These nuclei all appeared initially as thin black lines parallel to the (100) planes which grew very rapidly in length, usually penetrating a major portion of the distance through the crystal before developing appreciable width. They then slowly increased in width, appearing as white bands having sharp black outlines, and ultimately grew into one another, consuming the entire dihydrate crystal. After the transformation was substantially complete, the aggregate of hemihydrate crystals began to break into fragments.

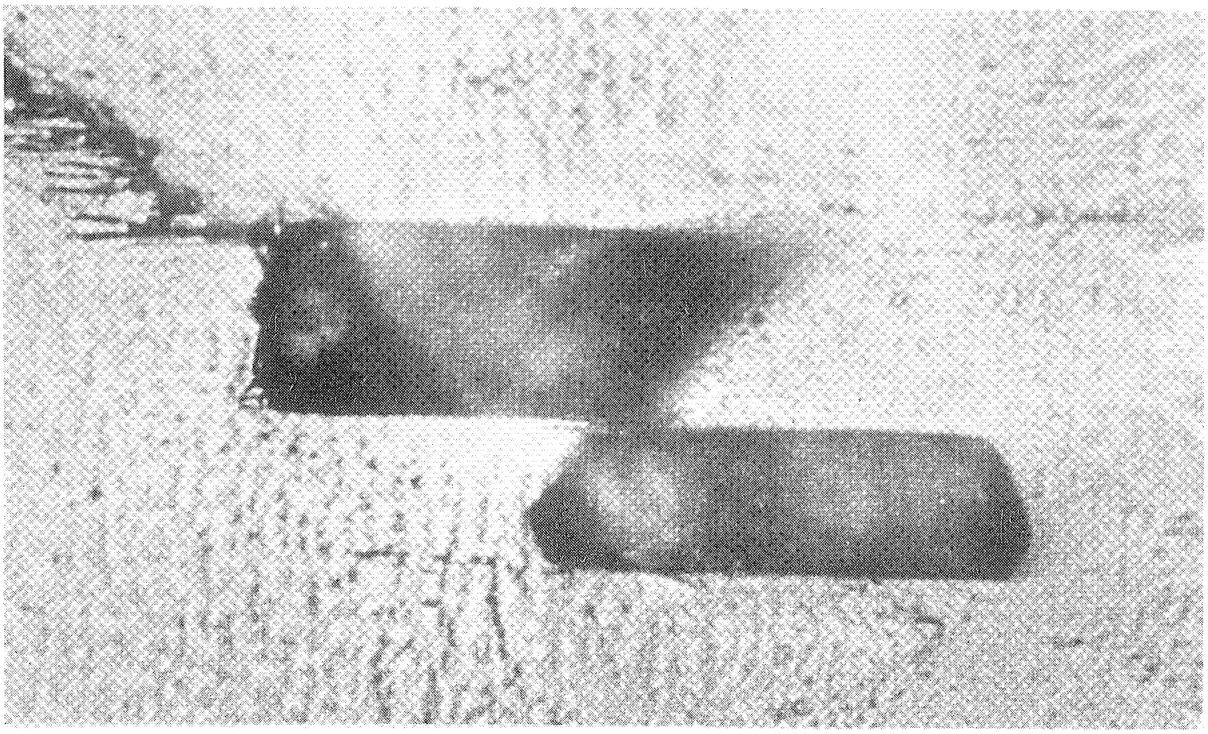
Evidence that the solution is involved to some extent in the transformation process was provided by the dissolution of the smaller crystal during the last 15 minutes. This crystal did not transform to hemihydrate but remained as dihydrate and apparently dissolved once the concentration of ions in solution began to decrease toward the concentration for equilibrium with the less soluble hemihydrate. The growth of some of the hemihydrate needles beyond the boundaries of the parent dihydrate crystal indicates the process of the precipitation of calcium and sulfate ions from the solution onto the hemihydrate phase.

The numerous tiny black flecks which appeared after about 20 minutes and increased in size and number throughout the remainder of the reaction are believed to be small hemihydrate crystals which nucleated either in the solution or from it onto the surface of the glass cover plate of the reactor. These processes involving transfer and precipitation of calcium and sulfate ions in solution appeared to constitute only a small fraction of the total transformation process, however, and it was concluded that the principal transformation mechanism consisted of the nucleation and growth of plate-like or needle-like hemihydrate crystals within the dihydrate crystals.

The cross-sectional shapes of hemihydrate needles were examined by observing the transformation process in large (about 1 x .3 x .3 cm) dihydrate cyrstals which had been cut and polished to produce a surface perpendicular to the axial direction of the hemihydrate needles (i.e. perpendicular to both the (100) and (010) planes of the dihydrate crystals). The initial cutting of this surface was done with a fine jewelers' saw using water as a lubricant. The crystals were then embedded in a 50-50 mixture of carnauba wax and rosin, the cut surface was carefully polished down to Linde-B grade alumina on metallographic wheels, after which the wax was removed by immersion in boiling water. The crystals were then placed in the microscope reaction stage with the polished surface resting on the bottom quartz plate, and the nucleation and growth of the hemihydrate needles was observed and photographed as described above. Typical micrographs are reproduced in Figure 34. As shown, most of the needles observed had cross sections which were elongated hexagons whose widths ranged from two to three times their thickness, and whose long edges were parallel to the (010) cleavage planes of the parent dihydrate crystals.

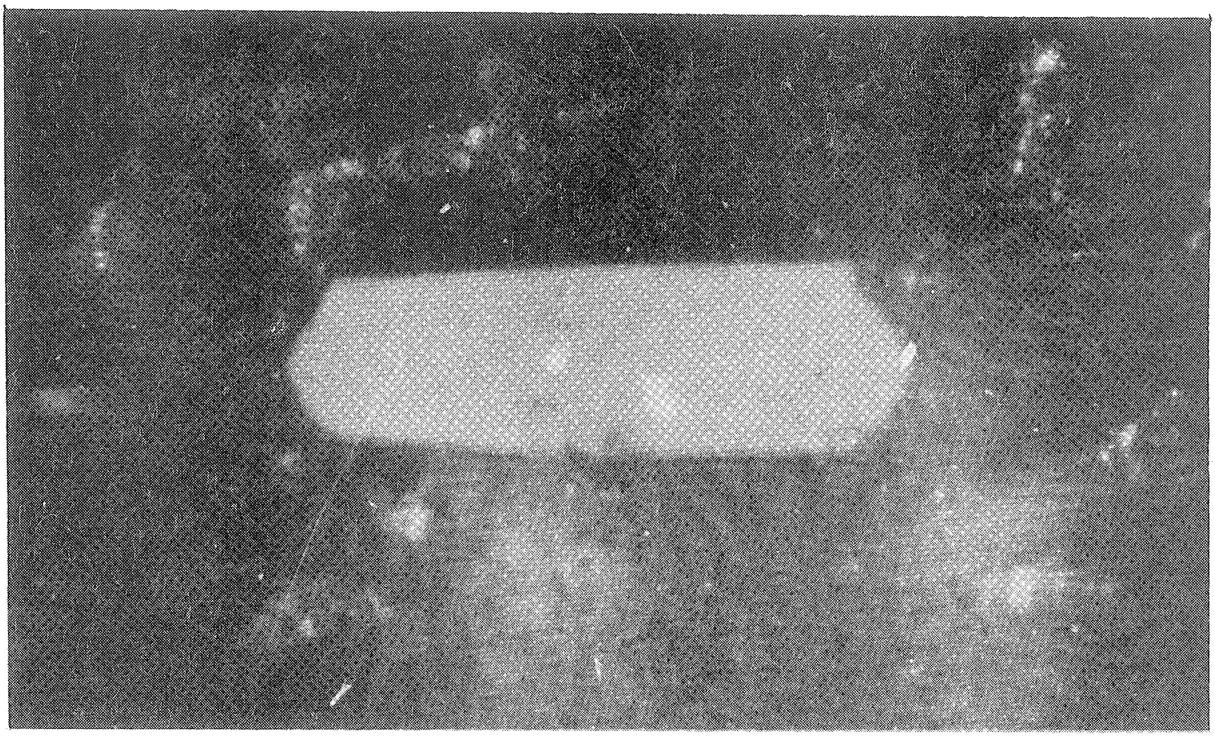


(a) Micrograph 2.01

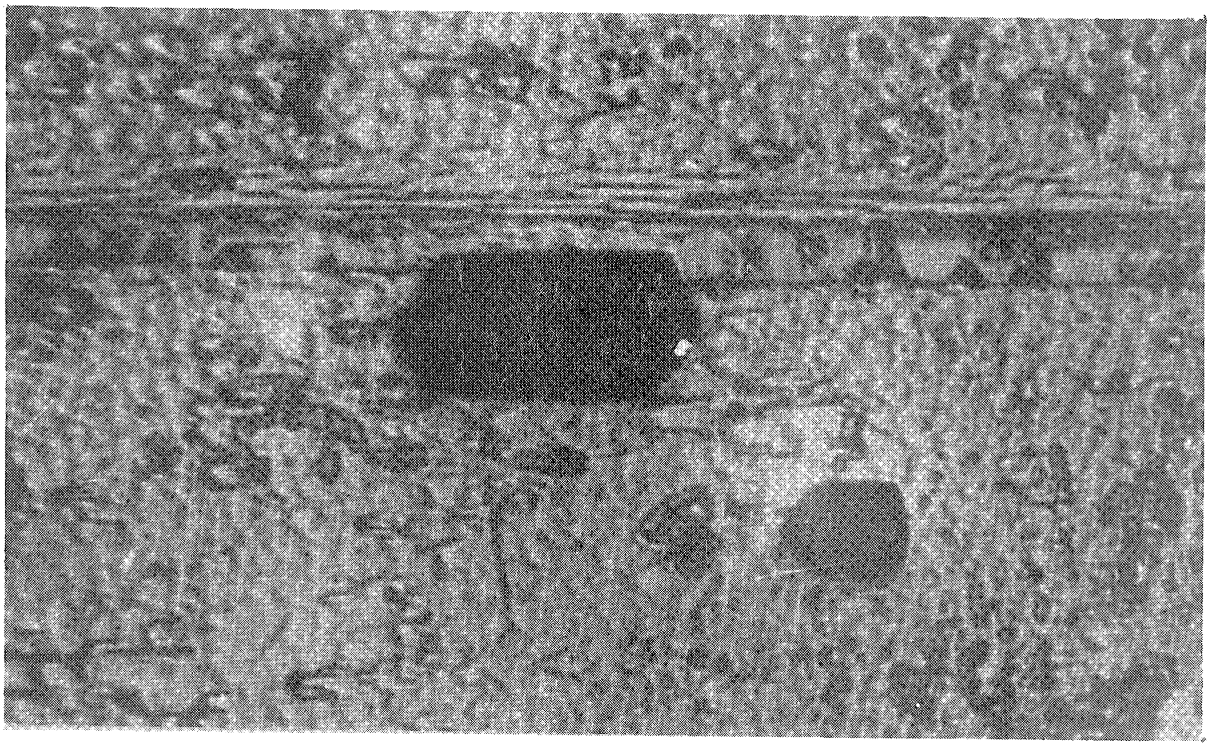


(b) Micrograph 3.03

Figure 34. Micrographs (480X) Showing the Cross Sections of Hemihydrate Needles in Large Crystals of Calcium Sulfate Dihydrate.

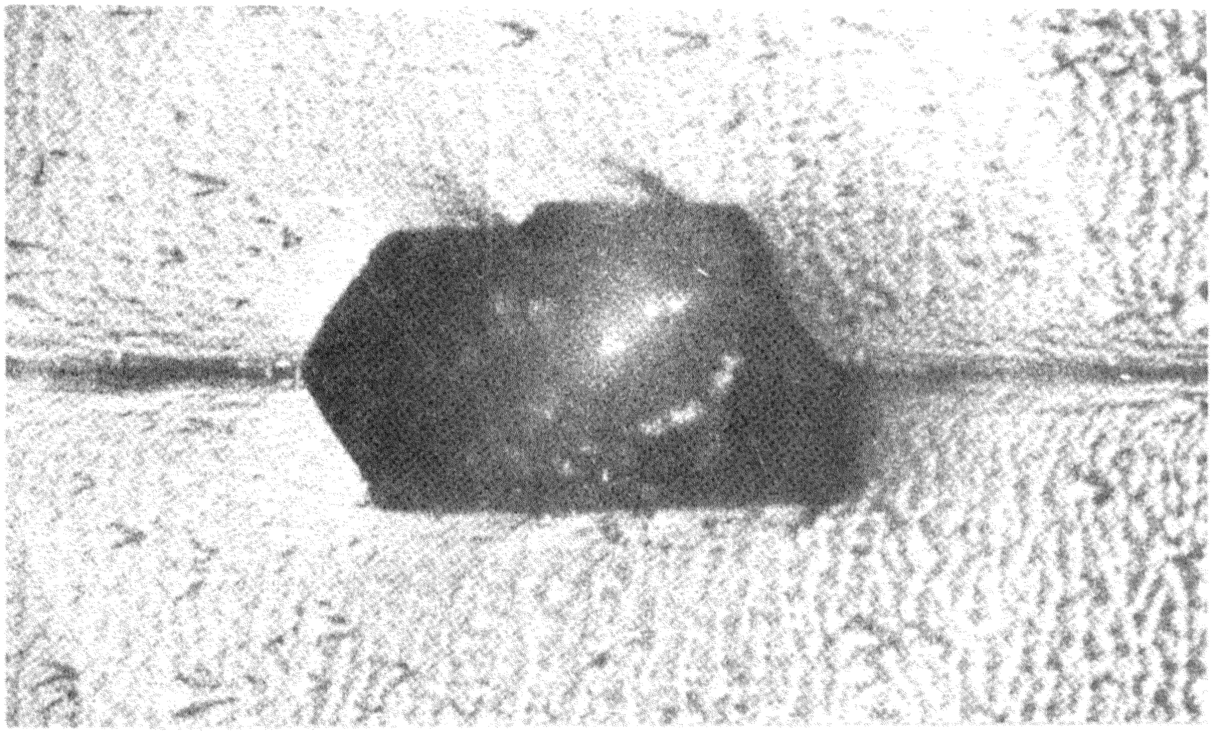


(c) Micrograph 13.03

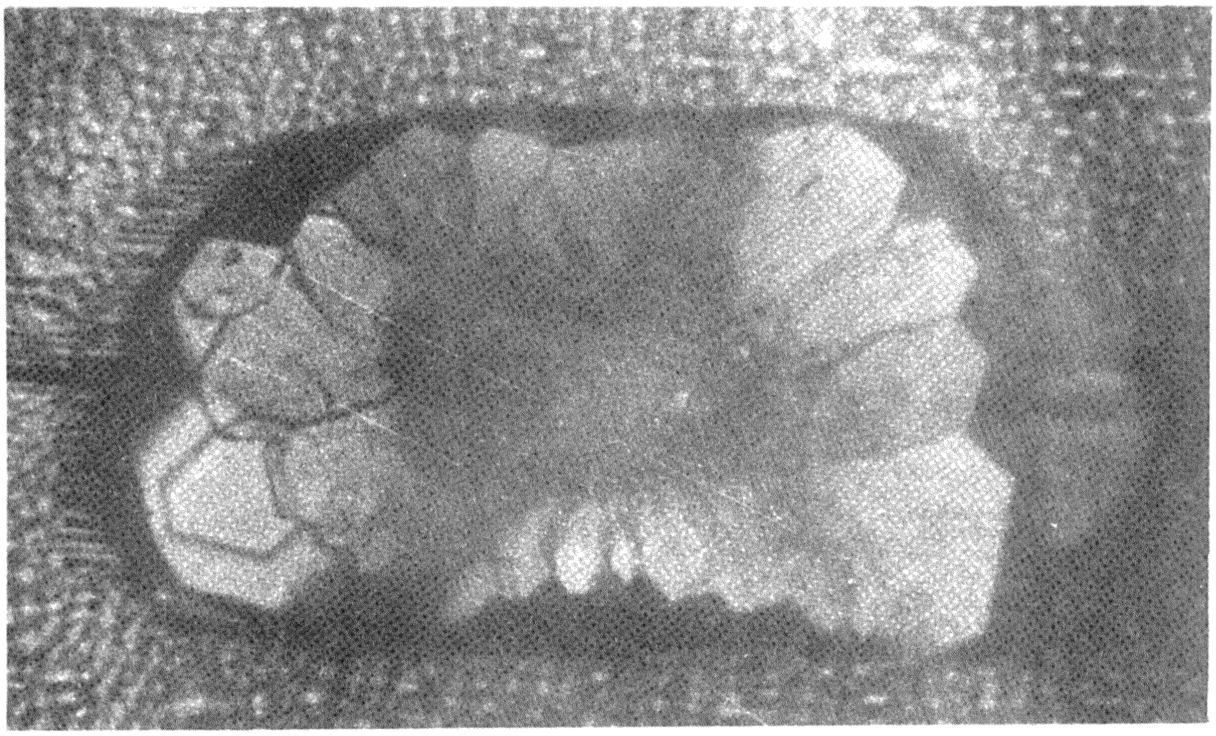


(d) Micrograph 12.03

Figure 34 (CONT'D)

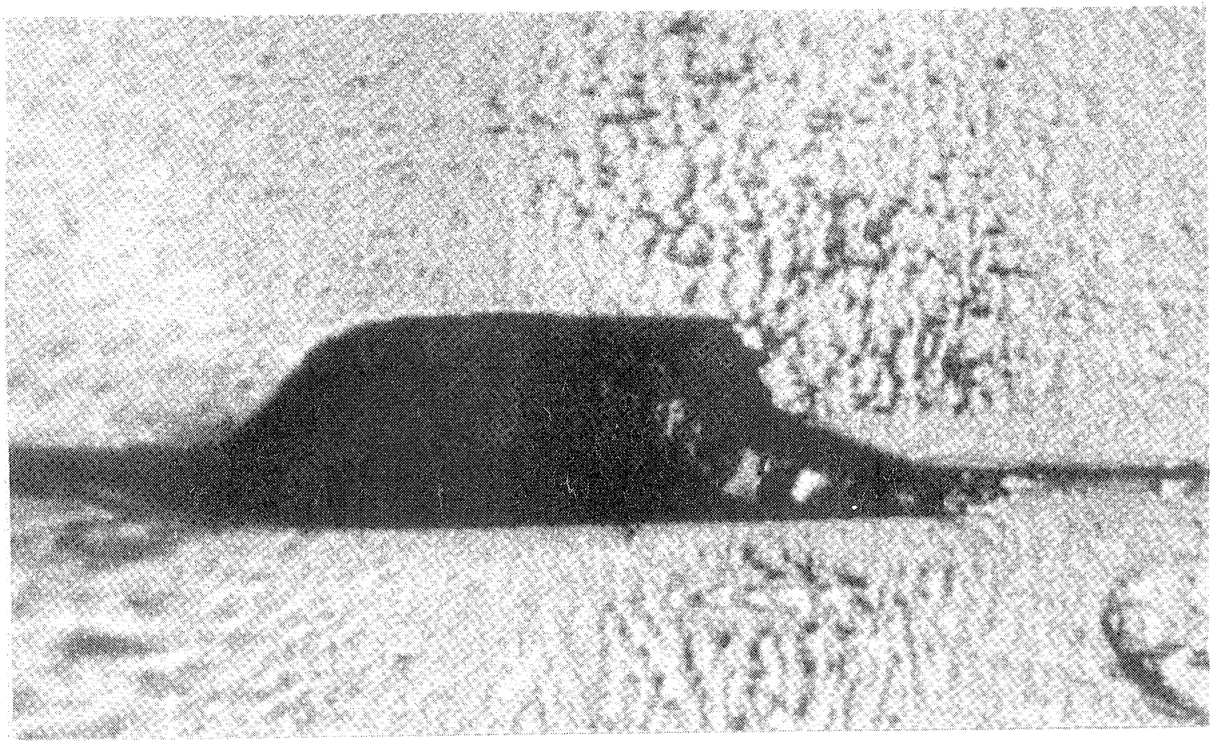


(e) Micrograph 1.03

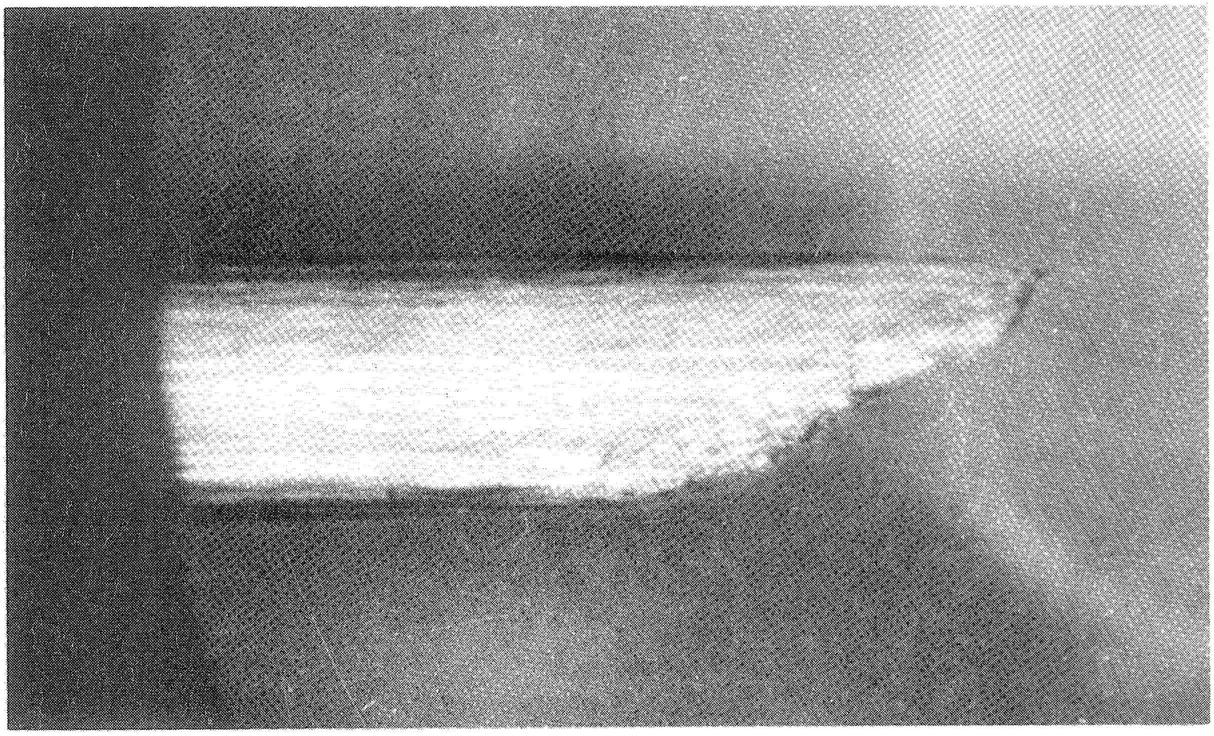


(f) Micrograph 1.22

Figure 34 (CONT'D)



(g) Micrograph 4.02



(h) Micrograph 10.02

Figure 34 (CONT'D)

In some cases the hexagonal shape was not fully developed; however, this was attributed to localized effects, particularly at the polished surface, and it was concluded that in general the hemihydrate phase consists of long needles with elongated hexagonal cross sections. The needles' axes appeared to run parallel to the direction defined by the intersection of the (100) and (010) cleavage planes of the dihydrate crystals and the long, cross-sectional direction was parallel to the (010) planes as shown schematically in Figure 35. This needle-like shape is consistent with the crystal sturcture of the hemihydrate phase and with the shapes of the hemihydrate crystals shown in Figure 36 which were observed in the solution near one of the large dihydrate crystals. In addition, the large crystal in Figure 34f appears to have developed a cross-sectional substructure of hexagonal units. It was also noted that a number of hemihydrate needles usually appeared side by side, with somewhat irregular spacings but apparently on the same (010) cleavage plane, even in the large dihydrate crystal. This appeared to be due to inherent imperfections or incipient cleavage of the particular planes, and would be expected to be more pronounced in the smaller dihydrate crystals used in the dilatometric experiments.

To provide a basis for subsequently developing a kinetic equation, the rates at which the hemihydrate needles grew in thickness U_A, width U_B, and length U_C, corresponding respectively to the rates of growth in the A, B, and C directions of Figure 35, were determined as a function of temperature from measurements of the dimensions of the growing needles in the sequential micrographs. The calculated values of 215 individual measurements are given in Appendix M and the average values are summarized in Table III and Figure 37. These results show that the

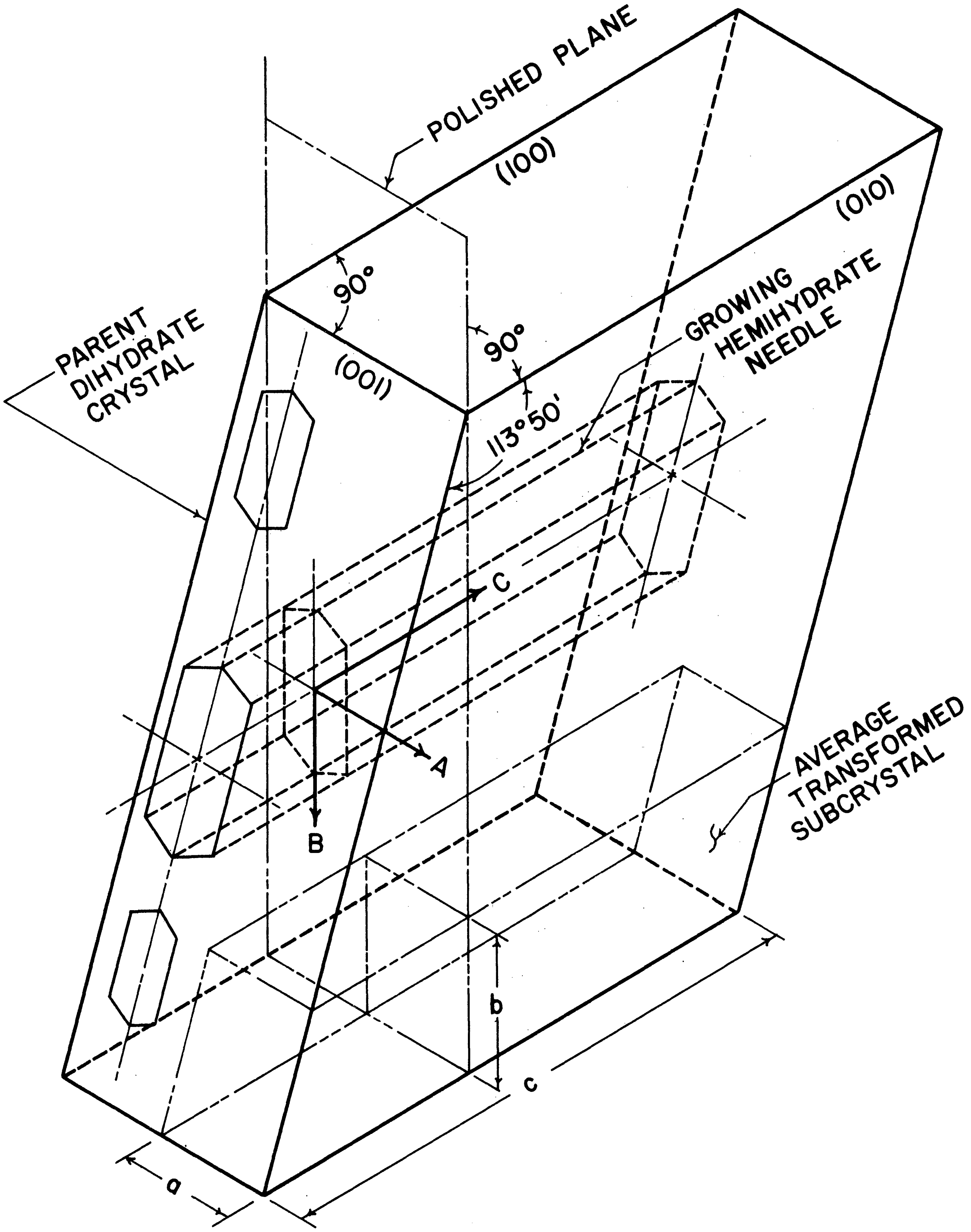


Figure 35. Parameters Used in Describing the Orientation and Growth of Hemihydrate Needles in the Parent Dihydrate Crystal.

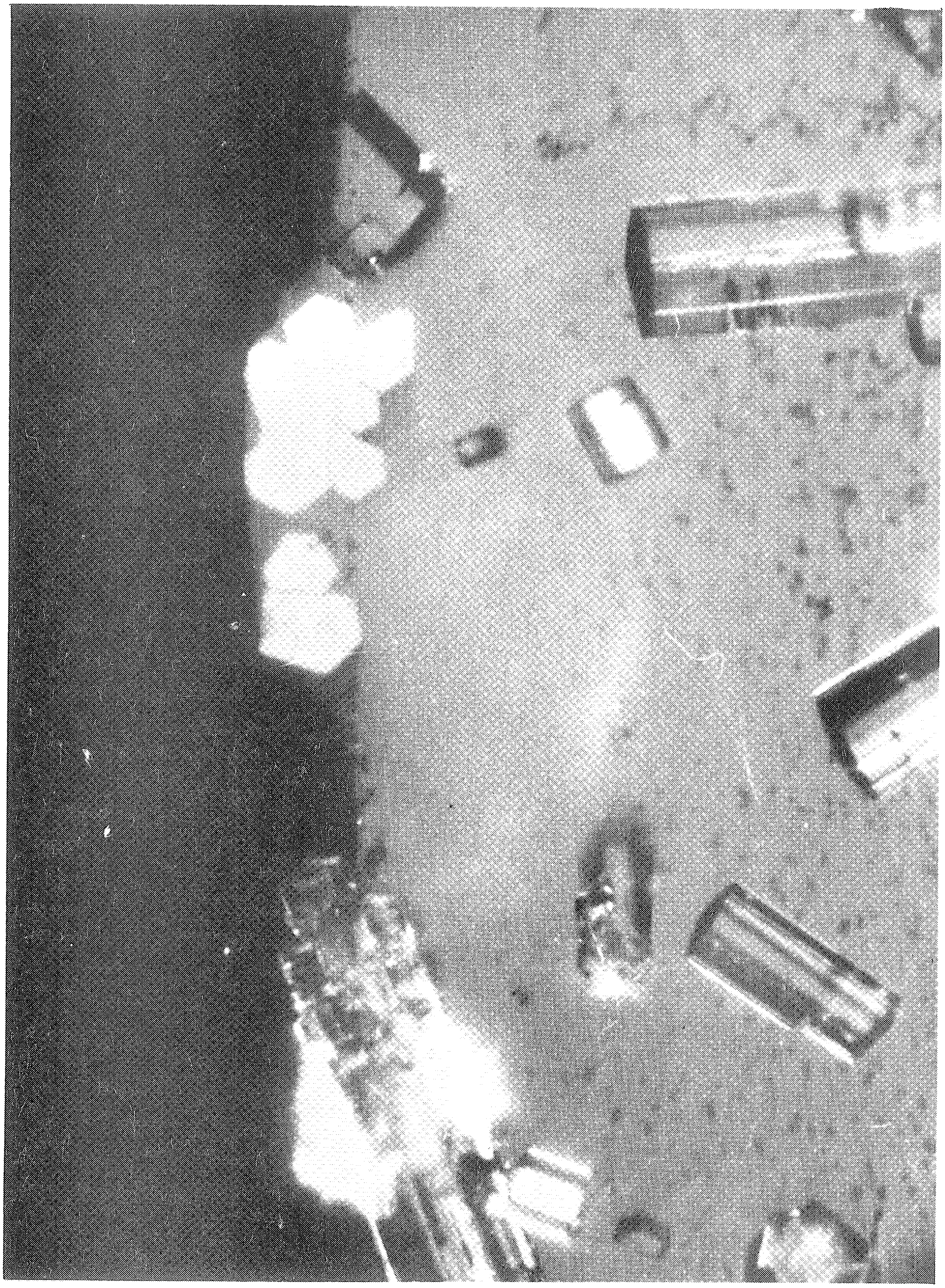


Figure 36. Hemihydrate Needles Observed in the Solution
Near a Large Calcium Sulfate Dihydrate Crystal.

TABLE III

VALUES OF AVERAGE LINEAR GROWTH RATES OF HEMIHYDRATE CRYSTALS WITHIN DIHYDRATE CRYSTALS IMMERSED IN WATER

Micro. No.	Direction Measured	Average Temp. °F	Average Rate cm/min	Reciprocal of Avg. Temp. $°K^{-1}$
3.	A	253.61	.00002	.0025235
3.	A	253.61	.00001	.0025235
4.	A	253.60	.00001	.0025235
12.	A	278.94	.0001	.0024369
12.	A	278.94	.0001	.0024369
13.	A	279.71	.00009	.0024344
3.	B	253.61	.000031	.0025235
3.	B	253.61	.000036	.0025235
8.	B	261.44	.000061	.0024961
9.	B	271.02	.00017	.0024634
10.	B	273.59	.00025	.0024547
11.	B	274.70	.00034	.0024510
12.	B	278.94	.00041	.0024369
12.	B	278.94	.00025	.0024369
13.	B	279.71	.00039	.0024344
14.	C	255.82	.00376	.0025157
6.	C	258.42	.00392	.0025066
7.	C	260.87	.00494	.0024980
8.	C	261.52	.00508	.0024958
9.	C	271.02	.00612	.0024634
10.	C	273.59	.00743	.0024547
11.	C	274.55	.00693	.0024515

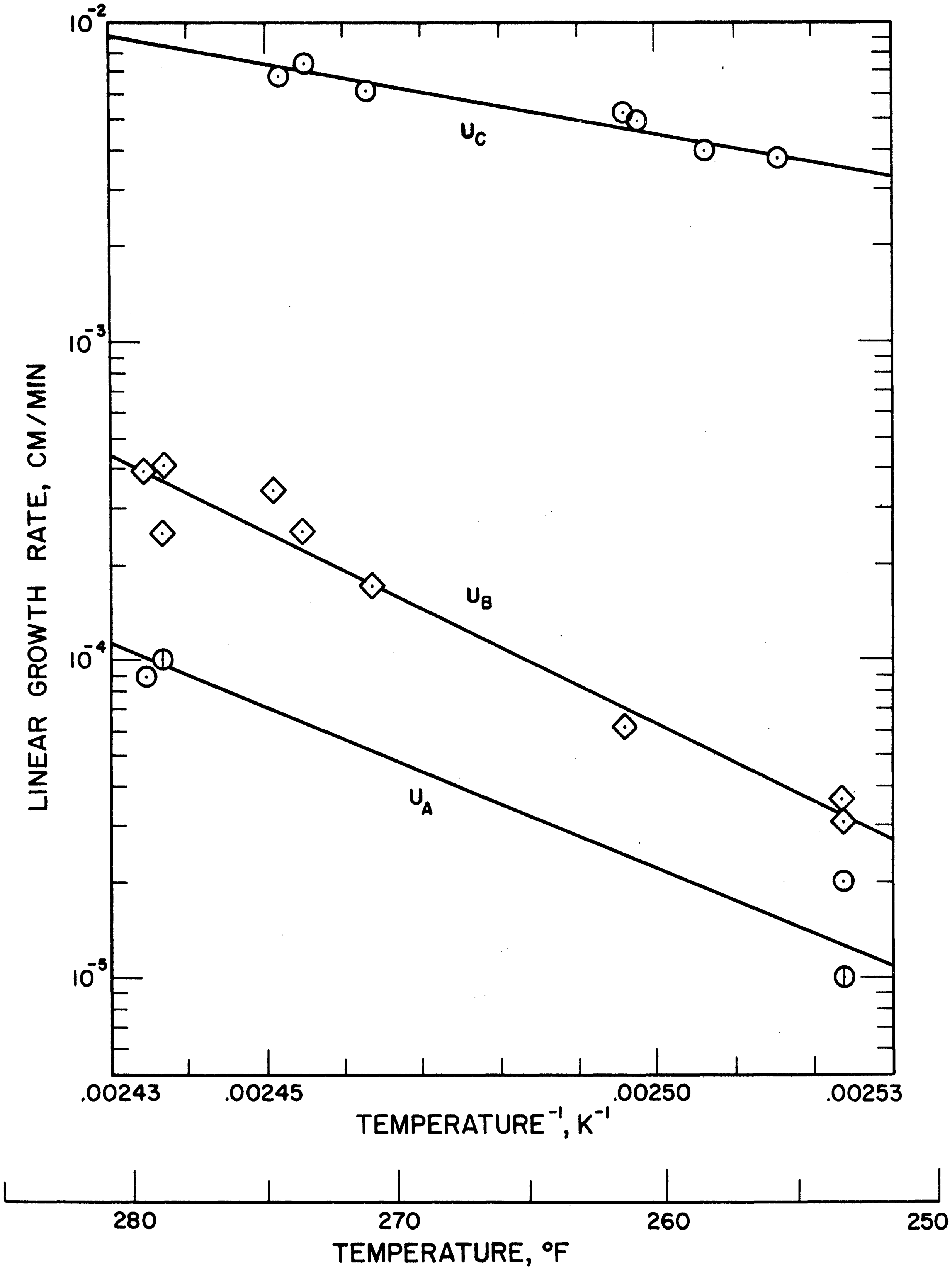


Figure 37. Arrhenius Plot for the Linear Growth Rates U_A, U_B, and U_C for the Transformation of Calcium Sulfate Dihydrate to Hemihydrate in Water.

rate of growth in width U_B was from 2 to 3 times greater than the rate of growth in thickness U_A, while the rate of growth in length U_C was from 20 to 120 times greater than U_B, depending on the temperature. Plots of the logarithms of the rates versus the reciprocal of the absolute temperature gave reasonably good straight lines as shown in Figure 37, indicating that the temperature dependence of the growth rates could be described by equations of the form $\ln U = \ln Z - E/RT$ or $U = Z\exp(-E/RT)$, in which the constants Z and E have approximately the values shown in Table IV.

TABLE IV

VALUES OF Z AND E
CORRESPONDING TO FIGURE 37

Rate, cm/min	Z, cm/min	E, Kcal/gm mole
U_A	3.97×10^{20}	46.2
U_B	1.17×10^{26}	55.4
U_C	1.65×10^{8}	19.3

By analogy, the Z's may be interpreted as pre-exponential factors and the E's as activation energies in classical Arrhenius equations for the respective growth processes.

C. Derivation of the Kinetic Equations

From these results it is possible to develop a model of the transformation mechanism which can be used as the basis for formulating the desired kinetic equations. To facilitate the mathematical analysis, it is convenient to highly idealize the model.

1. Model of the Transformation Mechanism

In the model adopted, the transformation process is considered to start with the formation of hemihydrate nuclei on the (001) cleavage planes of the dihydrate crystals. Based on the micrographs of Figure 33, and the relative values of U_A , U_B , and U_C , the nuclei are considered to propagate almost instantaneously through the entire lengths of the tiny dihydrate crystals along (010) cleavage planes before they attain appreciable thickness, so that negligible material is transformed by the time the growth in the C direction is completed. Instead, virtually all of the dihydrate phase is transformed by subsequent slower growth of the nuclei in the A and B directions, during which they develop as needles having elongated hexagonal cross sections with interfacial angles of 120°, as indicated in Figure 35. Since a large number of nuclei develop in each dihydrate crystal, this cross-sectional growth must terminate when they encounter one another or the edges of the dihydrate crystals. Because of the apparent tendency for numerous nuclei to form on the same (010) plane, and because U_B is several times greater than U_A , it is considered that these encounters occur first in the B direction. When the material surrounding the needles at the time of initial encounter is subsequently transformed, each needle will, in effect, have produced a hemihydrate subcrystal of rectangular cross section. Thus, a fully transformed dihydrate crystal is considered to consist of numerous hemihydrate subcrystals having average dimensions a , b , and c measured parallel to their A , B , and C axes, as indicated in Figure 35. The value of c will equal the average length of the hemihydrate crystals. The values of a and b will depend on the relative rates of nucleation and growth, and will therefore probably vary with temperature. Because the dihydrate crystals are considered to have idealized shapes with plane external faces, the volume of the average subcrystal will be simply $V = abc$.

2. Formulation of Equations

As indicated in the theoretical discussion, the total volume of hemihydrate formed can be expressed as a function of time by an equation of the form:

$$V(t) = \int_{x=0}^{x=t} dN/dx \quad v(x,t)dx \qquad (28)$$

where dN/dx is the nucleation rate and $v(x,t)$ is the volume of an individual hemihydrate needle. Since it is necessary to deal simultaneously with the nucleation process and a multi-stage growth process, several time variables are utilized. Times referring explicitly to the nucleation process are designated by the variable x which is assigned the value of zero at the instant the first nucleus forms. The overall time of reaction, or the "time of observation", is designated by the variable t which is defined such that $t = 0$ when $x = 0$. The period of growth for a particular needle at any instant of observation will thus be equal to $(t-x)$, the difference between the time of reaction at that instant and the time at which the needle nucleated, so that $v(x,t)$ will in general be an explicit function of $(t-x)$. Likewise, periods for the various stages of the growth process delineated by the impingement phenomenon are expressed as $(t-y)$, $(t-z)$, and $(t-w)$, where y , z , and w are time variables each assigned to a different growth stage and each being equal to zero when $t = 0$. Dividing Equation (28) by V_{tot} the total volume of hemidydrate formed upon completion of the reaction, gives the fraction transformed $\alpha = V(t)/V_{tot}$ which corresponds to the dilatometric data. Differentiation with respect to time then gives the desired kinetic equation for the rate of transformation $d\alpha/dt$. It is therefore now necessary to proceed to formulate expressions for these various functions, based on the theoretical model just described.

a. Rate of Nucleation. The experimental observations indicated that nucleation occurs predominately on the (001) cleavage planes which form two of the edges of each dihydrate crystal in the polycrystalline sample. Initially the rate of nucleation will be proportional to N_o , the total number of available nucleation sites, which will be proportional to the total area of such surfaces in the sample. After nucleation has started and N nuclei have formed, the rate will be proportional to (N_o-N) the number of nucleation sites still available at a given time x , or:

$$dN/dx = K(N_o - N) \tag{29}$$

where K is the nucleation rate constant. The rate of nucleation, expressed as an explicit function of time is obtained by separating the variables:

$$\int_{N=0}^{N=N} dN/(N_o-N) = K\int_{x=0}^{x=x} dx \tag{30}$$

and integrating to obtain:

$$-\left[\ln(N_o-N)\right]_{N=0}^{N=N} = K\left[x\right]_{x=0}^{x=x} \tag{31}$$

or

$$\ln(N_o - N)/N_o = -Kx . \tag{32}$$

Writing this in exponential form gives:

$$(N_o - N)/N_o = \exp(-Kx) \tag{33}$$

which yields:

$$N = N_o[1-\exp(-Kx)] . \tag{34}$$

Differentiation of this equation with respect to time gives the following desired expression relating nucleation rate and time:

$$dN/dx = N_oK \exp(-Kx) . \tag{35}$$

The validity of this equation can be examined by comparing it with Equation (29) which defines dN/dx , as the difference of two integer variables, N and N_o . Equation (35) which is continuous with respect to time, can be considered a valid approximation to Equation (34), if, and only if, the value of N_o is large, so that the time between successive values of N (i.e. N and $N+1$) is small for most values of N .

An analytic expression for the time between N and $N+1$ can be obtained by solving Equation (32) for $x(N)$ and for $x(N+1)$, and subtracting to obtain the corresponding difference in time:

$$\Delta x = x(N+1)-x(N) = (1/K)\ln [(N_o-N)/(N_o-N-1)]. \tag{36}$$

This shows that the change in time corresponding to a unit change in N depends on K , N_o , and N . Assuming that a time increment of one minute or less would provide a sufficiently accurate approximation of the discontinuous function by the continuous one, and choosing $K = 0.01$ min^{-1} , a value less than any reported to date, then the solution of Equation (36) is $N_o-N = 101$. Thus, for a sample containing less than 101 hemihydrate needles, the time between successive increments of N would be greater than the one minute chosen as the maximum acceptable time difference. For samples containing more than 101 needles, the equation would be valid $[(N_0-101)/N_0]$ 100% of the time. In these studies there was considerably more than one nucleus per original crystal, and there were approximately 211,000 initial crystals per sample as calculated in Appendix P; therefore, the above equation should be acceptable more than 99 percent of the time, which is more than sufficient.

b. Volume Transformed per Nucleus. Calculation of the volume transformed per nucleus, based on the assumed model, is considerably simplified by the instantaneous propagation of the nuclei in the C direction, since only the rates of growth in the A and B directions then need be considered the overall rate determining growth factors. Further simplification is achieved by choosing a symmetrical cross section for the growing hemihydrate needles and an idealized shape for the parent dihydrate crystals. Thus, the volume of a hemihydrate needle is equal simply to its length c multiplied by its cross-sectional area. This cross-sectional area is equal to $2A(2B) - 2A^2/\sqrt{3}$, where A and B are the dimensions of the needle in their respective axial directions, as defined in Figure 35, giving $v_a = 4\ ABc - 2A^2c/\sqrt{3}$. This can be made time dependent by substituting $U_A(t-x)$ for A, and $U_B(t-x)$ for B, giving:

$$v_a(x,t) = (2\ U_AU_B - U_A^2/\sqrt{3})2c(t-x)^2\ . \qquad (37)$$

The subscript "a" is affixed to this equation to call explicit attention to the fact that it accurately represents the volume of a growing needle only during the initial stages of growth prior to the time when impingement occurs. Thereafter, the expression for the volume transformed must be corrected. This can be done by considering growth in time to continue according to Equation (37) and subtracting from $v_a(x,t)$ the amount by which this continuously expanding hypothetical volume of the needle in question interpenetrates other needles.

c. Total Volume of Hemihydrate Transformed. Before making this correction for impingement, however, it is convenient to combine Equations (35) and (37), as indicated by Equation (28), to obtain a basic equation for the total volume of hemihydrate formed, as follows:

$$V_a(t) = W_a K \int_{x=0}^{x=t} \exp(-Kx)(t-x)^2 dx \qquad (38)$$

where $W_a = 2N_o c(2U_A U_B - U_A^2/\sqrt{3})$. This can be evaluated by two successive integrations by parts, using the standard relationship $\int u dv = uv - \int v du$. For the first integration $u = (t-x)^2$, $du = -2(t-x)dx$, $v = -(1/K)\exp(-Kx)$, and $dv = \exp(-Kx)dx$, giving:

$$\int u dv = -(1/K)(t-x)^2 \exp(-Kx) - (2/K) \int (t-x) \exp(-Kx)dx \ .$$

The integral in this equation can be evaluated by choosing $u = (t-x)$, $du = -dx$, $v = -(1/K)\exp(-Kx)$, and $dv = \exp(-Kx)dx$, giving as the final solution:

$$V_1(t) = V_a(t) = W_a[2/K^2 - 2t/K + t^2 - (2/K^2)\exp(-Kt)] \ . \qquad (39)$$

The physical significance of Equation (39) and its relationship to Equations (35) and (37) is illustrated schematically in Figure 38. Each curve k_i represents the growth curve described by Equation (37) for a particular nucleus which formed at time x_i and grew to a volume

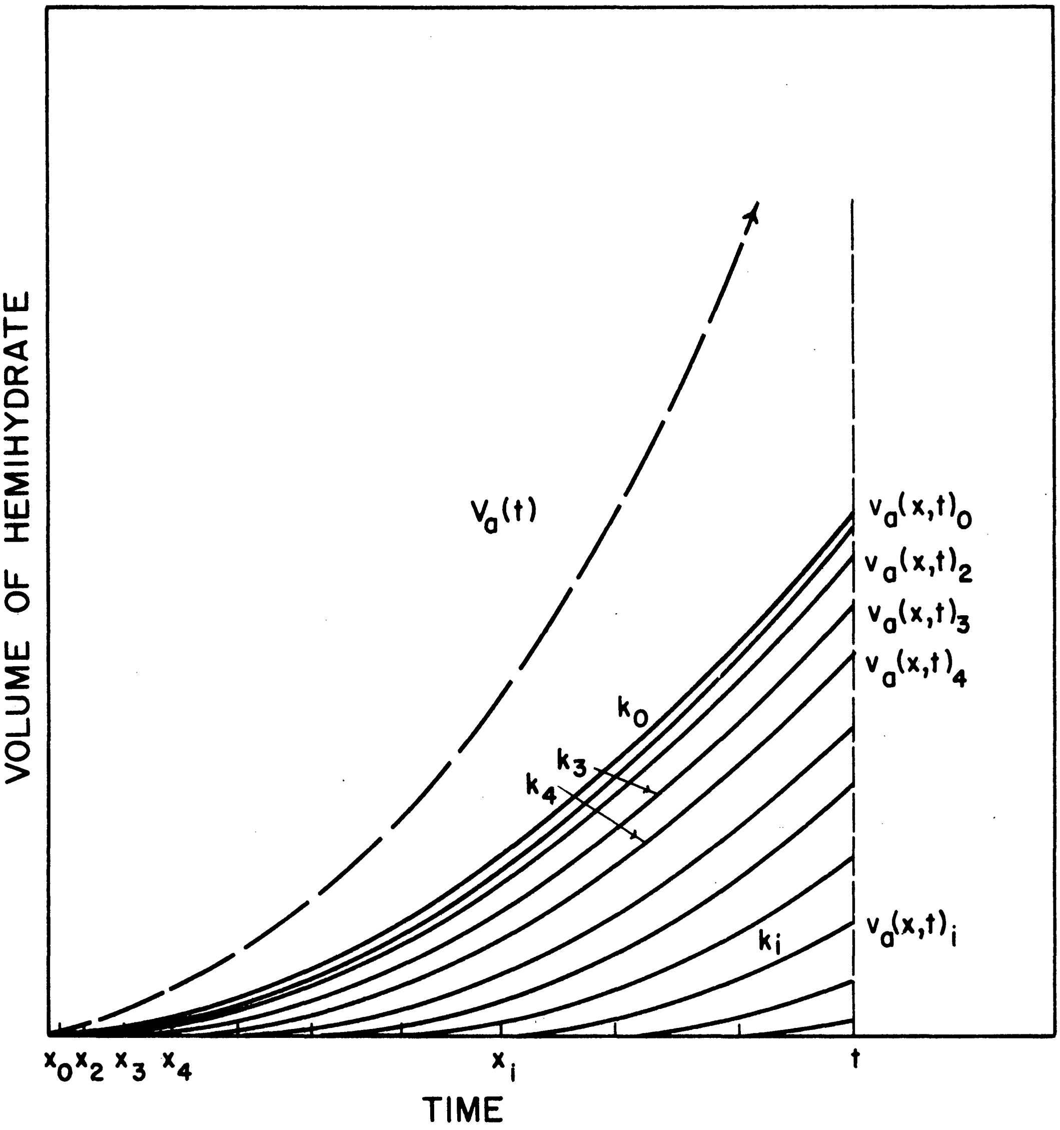
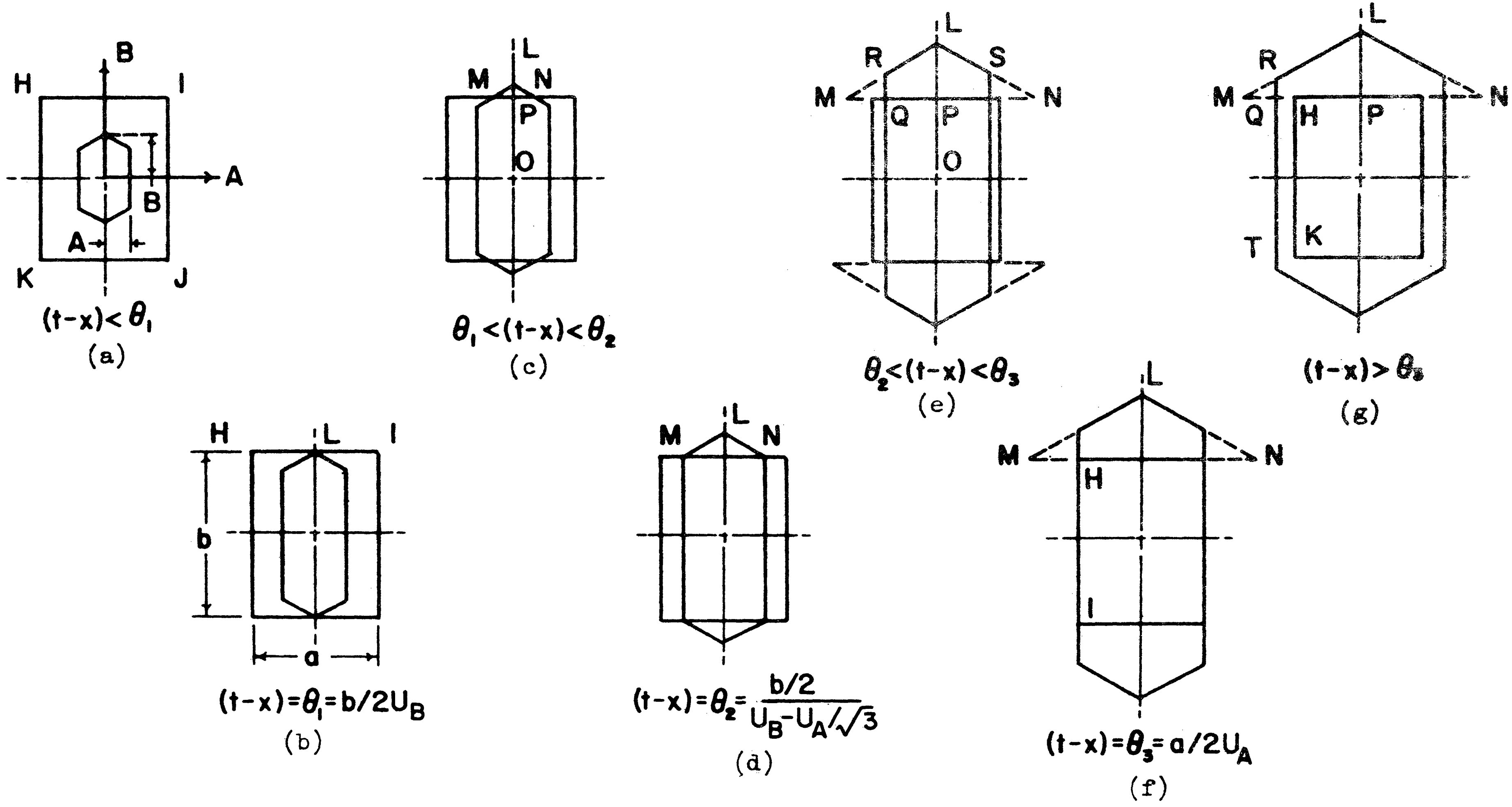


Figure 38. Schematic Representation of the Relationships Between the Functions dN/dx , $v_a(x,t)_i$, and $V_a(t)$.

v_i at the time of observation t. The variation in density of the x_i along the time axis represents the variation in nucleation rate with time, as given by Equation (35). The result of the integration is the sum of the v_i's which is equal to $V_a(t)$ for any value of t.

d. Correction for Impingement. As indicated above, Equations (37) and (39) do not include the necessary correction for impingement of the growing needles as they increase in size and number and ultimately consume the entire parent dihydrate crystal. This correction is relatively simple to accomplish using the concept of the average transformed subcrystal, since it amounts only to calculating the amount by which the growth volume described by Equation (39) extends beyond the volume of a coaxial average transformed subcrystal. These calculations can conveniently be carried out in three stages, corresponding to the stages of growth of the extended needle volume shown in Figures 39c, e, and g, where the cross section of a growing hexagonal needle is shown schematically in relation to the cross section of the average transformed subcrystal it will ultimately produce as its net contribution to the transformation.

Equation (39) will represent the actual volume of a growing needle only during the time when $B \leq b/2$ and $(t-x) \leq \Theta_1$, corresponding to Figure 39. According to the transformation model, impingement is considered most likely to occur first in the direction of the B axis when $(t-x) = \Theta_1 = b/2U_B$ and $B = b/2$, as indicated in Figure 39b. Thereafter it is necessary to subtract twice the volume corresponding to the triangle LMN of Figure 39c from $v_a(x,t)$. The area of triangle



$(t-x) < \theta_1$
(a)

$\theta_1 < (t-x) < \theta_2$
(c)

$\theta_2 < (t-x) < \theta_3$
(e)

$(t-x) > \theta_3$
(g)

$(t-x) = \theta_1 = b/2U_B$
(b)

$(t-x) = \theta_2 = \dfrac{b/2}{U_B - U_A/\sqrt{3}}$
(d)

$(t-x) = \theta_3 = a/2U_A$
(f)

Figure 39. The Relationships Between the Different Stages of the Impingement Process, the Geometry of a Growing Hemihydrate Needle, and the Transformed Hemihydrate Subcrystal.

LMN is equal to $(LP)(MN)/2 = (LP)2(LP)\cot(30°)/2 = (B-b/2)^2\sqrt{3}$, and the corresponding volume is $v_c = 2c\sqrt{3}\,(B-b/2)^2$. In order to make this equation time dependent, both B and b/2 must be expressed as functions of time. B represents the hypothetical total distance the needle would have grown in the B direction if impingement had not occurred, and as before is equal to $U_B(t-x)$. The term b/2 represents the actual distance of growth in the B direction up to the instant of impingement, and therefore can be expressed as $b/2 = U_B(y-x)$, where y is a new time variable referring explicitly to the initiation of the impingement and interpenetration process, i.e. $y = 0$ when $t = 0$. With these substitutions, the time dependent equation:

$$v_c(y,t) = 2c\sqrt{3}\,U_B^2(t-y)^2 \tag{40}$$

is obtained as the correction per hemihydrate needle. The correction $V_c(t)$ to be applied for the total volume of hemihydrate formed can be calculated by incorporating this expression into an equation of the form:

$$V_c(t) = \int_{y=\Theta_1}^{y=t} dN/dy\; v_c(y,t)dy \tag{41}$$

where dN/dy is the rate of impingement. Since the model uses idealized hemihydrate needles transforming idealized subcrystals, the rate of impingement is equal to the rate of nucleation, except that the impingement starts Θ_1 minutes later than the nucleation. Thus, $dN/dy = KN_0\exp[-K(y-\Theta_1)]$.

Substituting into Equation (41) gives:

$$V_c(t) = W_c \cdot K \int_{y=\Theta_1}^{y=t} \exp[-K(y-\Theta_1)](t-y)^2dy \tag{42}$$

where $W_c = 2\ cN_oU_B^2\sqrt{3}$. Integration by parts and evaluation, taking the lower limit of integration as $\Theta_1 = b/2U_B$, yields:

$$V_c(t) = W_c \{2/K^2 - 2(t-\Theta_1)/K + (t-\Theta_1)^2 - (2/K^2)\exp(-K(t-\Theta_1))\} \text{ for } t \geq \Theta_1 . \tag{43}$$

The physical significance of this equation and its relationship to the functions $v_c(y,t)$, dN/dy , and $V_a(t)$ are shown schematically in Figure 40. Each curve l_i represents the volume correction to be added to a particular nucleus which formed at x_i , experienced impingement at y_i , and was observed at time t . The variations in densities of the y_i along the time axis represent the variations in impingement rate with time. The result of the integration is the calculated sum of the $v_c(x,t)_i$ which is equal to $V_c(t)$ for any particular time t . The time of impingement for the needles which formed at time zero represents the limiting case where $y = \Theta_1$. The corrected volume incorporating this first correction is:

$$V_2(t) = V_a(t) - V_c(t) \text{ for } t \geq \Theta_1 . \tag{44}$$

To facilitate mathematical operations, it was convenient to calculate $V_c(t)$ for all $(t-x) \geq \Theta_1$. As shown in Figure 39, however, once $(t-x)$ becomes greater than Θ_2 , the triangle LMN becomes greater than that part of the cross-sectional area of the extended needle which is outside the average transformed volume by an amount corresponding to four times the volume associated with the triangle MQR , and the continued use of Equation (44) results in an over correction. It is therefore

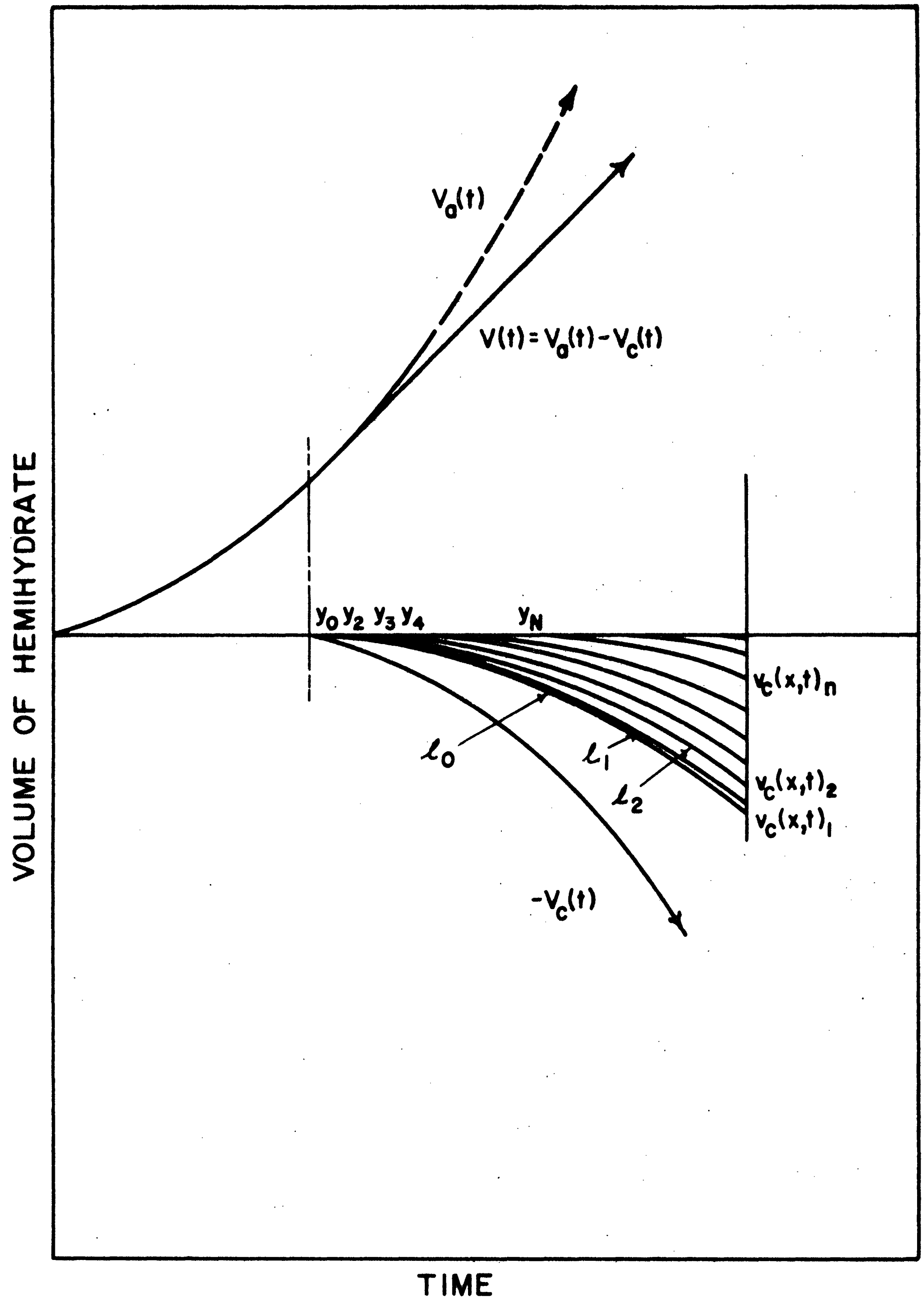


Figure 40. Schematic Representation of the Relationships Between the Functions dN/dy , $v_c(y,t)_i$, $V_c(t)$, $V_a(t)$, and $V(t)$.

convenient to correct for this condition by adding to Equation (44) a term $V_e(t)$ based on the volume given by 4c times the area of triangle MQR .

The area of triangle MQR is equal to $(MQ)(QR)/2 = (MQ)^2\tan(30°)/2 = (MQ)^2 \sqrt{3}/6 = (\sqrt{3}/6)\ [\sqrt{3}\ B-A-b\sqrt{3}/2]$, and the corresponding correction volume per needle is $v_e = 2c\sqrt{3}\ (B-A/\sqrt{3} - b/2)^2$. The time dependent form of v_e is obtained by substituting $U_B(t-x)$ for B and $U_A(t-x)$ for A , giving $v_e = 2c\sqrt{3}\ [(U_B - U_A/\sqrt{3})(t-x) - b/2]^2$. Since b/2 is a specific value of $B-A/\sqrt{3}$, it corresponds to $(U_B - U_A/\sqrt{3})(t-x)$ when t equals z , which is the time when the impingement process changed for the hemihydrate needle which nucleated at time x . The time dependent equation for the volume per needle now becomes:

$$v_e(z,t) = 2c\sqrt{3}\ (U_B - U_A/\sqrt{3})^2\ (t-z)^2 \ . \tag{45}$$

The corresponding expression for the total correction is:

$$V_e(t) = \int_{z=\Theta_2}^{z=t} dN/dz\ v_e(z,t)dz \ . \tag{46}$$

The rate of initiation of this change in the impingement process dN/dz will have the same form as the rate of nucleation but will start Θ_2 minutes later in time for each needle. It can therefore be expressed mathematically as $dN/dz = KN_0 \exp[-K(z-\Theta_2)]$. Substituting the values of dN/dz and the $v_e(z,t)$ into Equation (46) gives:

$$V_e(t) = W_e \cdot K \int_{z=\Theta_2}^{z=t} \exp\ [-K(z-\Theta_2)]\ (t-z)^2\ dz \tag{47}$$

where $W_e = 2c\ N_o(U_B - U_A/\sqrt{3})^2$. Integration by parts yields:

$$V_e(t) = W_e \{2/K^2 - 2(t-\Theta_2)/K + (t-\Theta_2)^2 - (2/K^2) \exp [-K(t-\Theta_2)]\} \tag{48}$$

where $\Theta_2 = (b/2)/(U_B - U_A/\sqrt{3})$. Adding this to Equation (44) gives:

$$V_3(t) = V_a(t) - V_c(t) + V_e(t) \text{ for } t \geq \Theta_2 \tag{49}$$

as the revised expression for the corrected volume.

Impingement occurs in the A direction when $(t-x) = \Theta_3 = a/2U_A$ and $A = a/2$, as indicated in Figure 39f. Thereafter, the total volume of hemihydrate calculated by Equation (49) will be too large by the amount corresponding to twice the volume associated with rectangle HKTQ of Figure 39g, and it is necessary to subtract this from Equation (49) to obtain the final corrected volume. The area of rectangle HKTQ is $(QH)(HK) = (A-a/2)(b)$, and the corresponding volume is $v_g = bc\ (A-a/2)$. This equation can be made time dependent by substituting $U_A(t-x)$ for A and $U_A(w-x)$ for a/2 , where w is the impingement time in the A direction, i.e., w = 0 when t = 0 . With these substitutions, the time dependent equation for the corrected volume per needle is:

$$v_g(w,t) = 2bc\ U_A(t-w) \ , \tag{50}$$

and the correction for this impingement $V_g(t)$, to be applied to the total volume of hemihydrate, can be calculated by:

$$V_g(t) = \int_{w=\Theta_3}^{w=t} dN/dw\ v_g(w,t)dw \tag{51}$$

where dN/dw is the rate of impingement. Again, because of the ideality of the model, this rate of impingement is equal to the rate of nucleation except that this stage of impingement starts $\Theta_3 = a/2U_A$ minutes later than the initial nucleation, giving $dN/dw = KN_0 \exp[-K(w-\Theta_3)]$. Substituting the values of $v_g(w,t)$ and dN/dw into Equation (51) gives

$$Vg(t) = W_g \cdot K \int_{w=\Theta_3}^{w=t} \exp[-K(w-\Theta_3)]\,(t-w)dw \qquad (52)$$

where $W_g = 2bcN_oU_A$. This equation can be integrated by parts using $u = t-w$, $du = -dw$, $v = -(1/K)\exp[-K(w-\Theta_3)]$, and $dv = \exp[-K(w-\Theta_3)]\,dw$, giving:

$$V_g(t) = W_g \left\{(t-\Theta_3) + (1/K)\,[\exp[-K(t-\Theta_3)] - 1]\right\} \qquad (53)$$

where $\Theta_3 = a/2U_A$. Subtracting this from Equation (49) gives the final expression for the total volume of hemihydrate formed:

$$V_4(t) = V_a(t) - V_c(t) + V_e(t) - V_g(t) \text{ for } t \geq \Theta_3 . \qquad (54)$$

These corrected values $V_1(t)$, $V_2(t)$, $V_3(t)$, and $V_4(t)$, for the total volume of hemihydrate formed during the various stages of the reaction, can be related directly to the net volume change observed in the dilatometer, and thereby used as a basis for developing theoretical equations for the fraction reacted α and the rate of reaction $d\alpha/dt$.

e. Fraction Reacted Equations. The net volume change ΔV_r measured in the dilatometer for reaction at constant temperature is the sum of the volume changes of the dihydrate ΔV_D, hemihydrate ΔV_H, and the product water ΔV_W:

$$\Delta V_r = \Delta V_D + \Delta V_H + \Delta V_W \qquad (55)$$

These individual volume changes are proportional to the respective changes in the number of moles Δm and the molar volumes $\bar{V}$ for each species: i.e. $\Delta V_D = \Delta m_D \bar{V}_D$, $\Delta V_H = \Delta m_H \bar{V}_H$, and $\Delta V_W = \Delta m_W \bar{V}_W$. From the stoichiometry of this reaction given by Equation (22), $\Delta m_D = -\Delta m_H$ and $\Delta m_W = 3/2\ \Delta m_H$. Upon substituting these into Equation (55), the equation for the net volume change becomes:

$$\Delta V_r = \Delta m_H(\bar{V}_H + 3/2\ \bar{V}_W - \bar{V}_D) . \tag{56}$$

The change in the number of moles of hemihydrate can now be represented by $\Delta m_H = \Delta V_H \bar{\rho}_H$, the product of the volume change and the molar density ($\bar{\rho}$ = moles/cc), giving:

$$\begin{aligned} \Delta V_r &= \Delta V_H[\bar{\rho}_H(\bar{V}_H + 3/2\ \bar{V}_W - \bar{V}_D)] \\ &= \Delta V_H\ J \end{aligned} \tag{57}$$

where J is a constant. Dividing this equation by the total net volume change upon completion of the reaction ΔV_{rtot} , noting that $\Delta V_{rtot} = J\Delta V_{Htot}$, gives:

$$\alpha(t) = \frac{\Delta V_r}{\Delta V_{rtot}} = \frac{\Delta V_H}{\Delta V_{Htot}} \tag{58}$$

where $\alpha(t)$ is the fraction reacted expressed as a function of time. Since ΔV_H starts from zero and increase as the reaction progresses, $\Delta V_H = V_H - 0$, and Equation (58) can be rewritten as:

$$\alpha(t) = \frac{\Delta V_r}{\Delta V_{rtot}} = \frac{V_H}{V_{Htot}} \tag{59}$$

where V_H is the value at any particular stage of the reaction. The calculated volume of hemihydrate V_H formed at any time t will be given by $V_1(t)$, $V_2(t)$, $V_3(t)$ and $V_4(t)$ for the respective stages of the reaction, and the total volume at completion of the reaction is $V_{Htot} = abc\ N_o$, therefore, the above equation can be written:

$$\alpha_i(t) \ \frac{\Delta V_r}{\Delta V_{rtot}} = \frac{V_i(t)}{abc\ N_o} \qquad (60)$$

where $i = 1, 2, 3, 4$ correspond to the four stages of the reaction. The volume changes detected in the dilatometer capillary are proportional to the height changes, since $\Delta V_r = A'\Delta h_r$ and $V_{rtot} = A'\Delta h_{rtot}$, where A' is the cross-sectional area of the capillary, therefore, the final form of the equation for $\alpha_i(t)$ is:

$$\alpha_i(t) = \frac{\Delta h_r}{\Delta h_{rtot}} = \frac{V_i(t)}{abc\ N_o} \ . \qquad (61)$$

Using this relationship, and the equations derived above for the $V_i(t)$, the following four theoretical equations describing the fraction of hemihydrate formed as a function of time are obtained:

$$\alpha_1(t) = D_1 + D_2 t + D_3 t^2 + D_4 \exp(-Kt) \text{ for } 0 \leq t \leq \Theta_1 \ , \qquad (62)$$

$$\alpha_2(t) = D_5 + D_6 t + D_7 t^2 + D_8 \exp(-Kt) \text{ for } \Theta_1 \leq t \leq \Theta_2 \ , \qquad (63)$$

$$\alpha_3(t) = D_9 + D_{10} t + D_{11} \exp(-Kt) \text{ for } \Theta_2 \leq t \leq \Theta_3 \ , \text{ and} \qquad (64)$$

$$\alpha_4(t) = 1 + D_{12} \exp(-Kt) \text{ for } t \geq \Theta_3 \ . \qquad (65)$$

Differentiation of these four equations with respect to time gives four differential equations for the rate of reaction:

$$d\alpha_1/dt = D_2 + 2D_3t - KD_4 \exp(-Kt) \text{ for } 0 \leq t \leq \Theta_1 , \quad (66)$$

$$d\alpha_2/dt = D_6 + 2D_7t - KD_8 \exp(-Kt) \text{ for } \Theta_1 \leq t \leq \Theta_2 , \quad (67)$$

$$d\alpha_3/dt = D_{10} - KD_{11} \exp(-Kt) \text{ for } \Theta_2 \leq t \leq \Theta_3 , \text{ and} \quad (68)$$

$$d\alpha_4/dt = -KD_{12} \exp(-Kt) \text{ for } t \geq \Theta_3 . \quad (69)$$

The constants appearing in the eight equations above are:

$$D_1 = (4/K^2)[2(U_A/a)(U_B/b)-(1/\sqrt{3})(U_A/a)(U_A/b)]$$

$$D_2 = -KD_1$$

$$D_3 = (K^2/2)D_1$$

$$D_4 = -D_1$$

$$D_5 = D_1 - (4\sqrt{3}/K^2)(U_B/b) - (2\sqrt{3}/K)(U_B/a) - (\sqrt{3}/2)(b/a)$$

$$D_6 = D_2 + (2\sqrt{3})(U_B/a) + (4\sqrt{3}/K)(U_B/a)(U_B/b)$$

$$D_7 = D_3 - (2/\sqrt{3})(U_B/a)(U_B/b)$$

$$D_8 = D_4 + (4\sqrt{3}/K^2)(U_B/a)(U_B/b) \exp(K\Theta_1)$$

$$D_9 = -(2/K)(U_A/a)$$

$$D_{10} = 2(U_A/a)$$

$$D_{11} = D_1[\exp(K\Theta_2)-1] + (4\sqrt{3}/K^2)(U_B/a)(U_B/b) [\exp(K\Theta_1) - \exp(K\Theta_2)]$$

$$D_{12} = D_{11} - (2/K)(U_A/a) \exp(K\Theta_3) .$$

3. Evaluation of Kinetic Constants

Equations (62-69) are the desired kinetic equations expressing the fraction transformed and the rate of transformation as functions of time. As written, these equations involve the twelve constants $D_1 \ldots D_i \ldots D_{12}$; however, these D_i's are functions only of the four kinetic growth constants (U_A/a), (U_B/b), (U_A/b), and (U_B/a), so the kinetic equations are actually functions only of these four growth constants, the nucleation rate constant K, and time t_0. To complete the derivation of the kinetic equations, it is now necessary to evaluate these kinetic constants.

a. Method. In many previous studies of the kinetics of transformations in solids, the coefficients D_i of the theoretical equations have been relatively simple functions of the kinetic rate constants, so that it has been possible to evaluate the rate constants from values of the coefficients D_i obtained by fitting the equations to the experimental data. This procedure could not be used in the present case, however, because of inaccuracies introduced by the complex mathematical manipulations which were involved as a result of the relatively complex nature of the rate equations themselves, and because the coefficients D_i are not simple functions of the desired kinetic constants. Instead, values of Θ_1, Θ_2, and Θ_3 were determined by fitting the rate equations to the experimental data and the four growth constants were calculated using the following relationships, derived from the expressions given for the limits of integration for Equations (42), (47), and (53):

$$U_A/a = 1/2\Theta_3 , \tag{70}$$

$$U_B/b = 1/2\Theta_1 , \tag{71}$$

$$U_A/b = \sqrt{3}(1/2\Theta_1) - \sqrt{3}(1/2\Theta_2) , \text{ and} \tag{72}$$

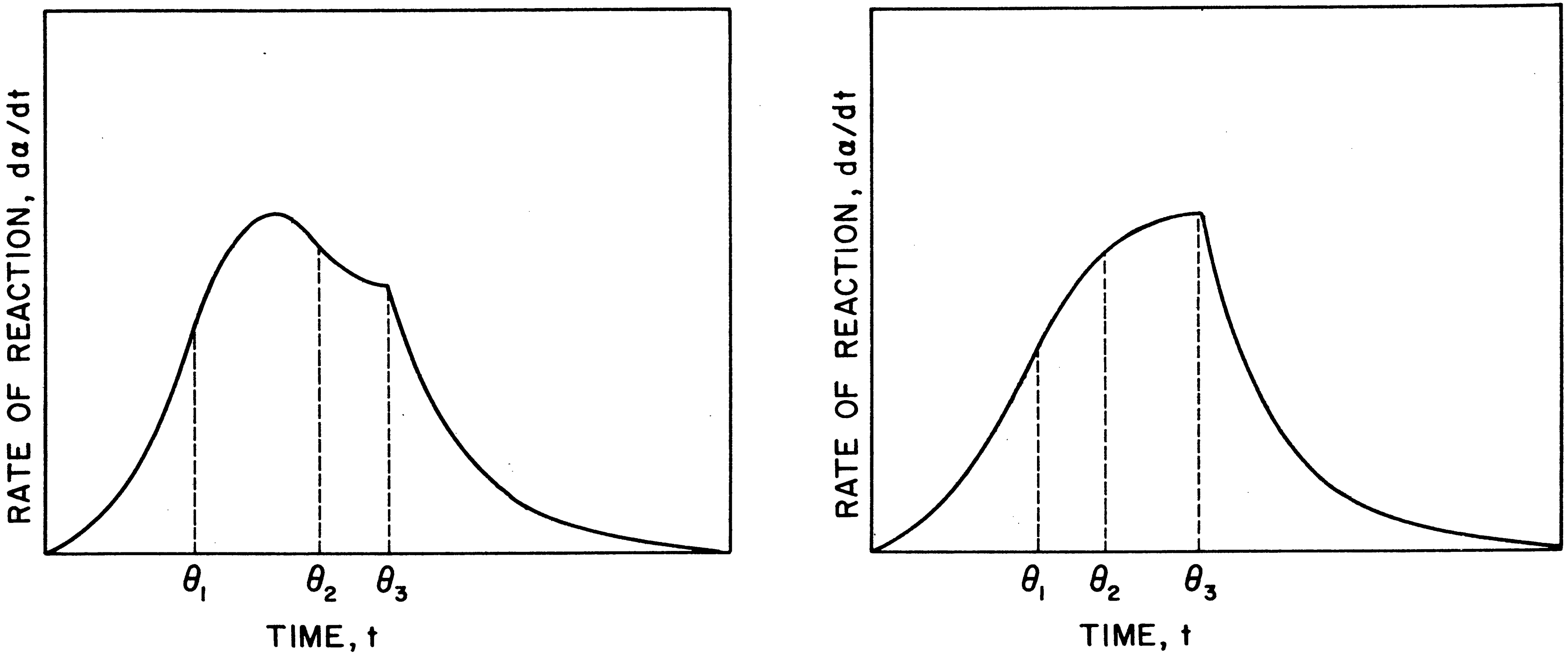
$$U_B/a = (U_A/a)(U_B/b)/(U_A/b) \quad . \tag{73}$$

On the basis of the model used in deriving the theoretical equations, curves of $d\alpha/dt$ versus time would be expected to show recognizable changes in slope at times equal approximately to Θ_1 and Θ_3 corresponding to the start of the initial and final stages of the impingement process, with possibly some distinctive change at an intermediate time corresponding approximately to Θ_2 . Rate curves were plotted for each of the 54 experimental runs, and the majority was found to have shapes of Type I shown in Figure 41(a) where the rate increases rapidly at first, goes through a maximum, decreases to a point of abrupt change in slope, and then decreases exponentially to zero. The curves for seven of the experimental runs (numbered 6, 16, 21, 40, 41, 45, and 52) had shapes of Type II shown in Figure 41(b) where the maximum value coincided with the abrupt change in slope preceding the final exponential decay. Run 33, which involved extreme experimental conditions, had a shape different from either of these types and will be discussed separately later. In each case, the time corresponding to the point of inflection following the initial rapid growth was taken as the initial estimate of Θ_1 , while the time corresponding to the point of discontinuity in slope preceding the final exponential decay was taken as the initial estimate of Θ_3 , as shown in Figure 41.

Calculation of values of the nucleation rate constant K was based on the equation:

$$d\alpha/dt = K(1 - \alpha) \text{ for } t \geq \Theta_3 \qquad (74)$$

obtained by combining Equations (65) and (69). This equation indicates that a plot of $d\alpha/dt$ versus $(1 - \alpha)$, for values measured as the reaction nears completion, should be a straight line which passes through the origin having a slope equal to K . A least squares fit of this equation to the data taken toward the end of each experimental run should therefore provide a reliable determination of the value of K , independent of the other rate constants. In making this least squares fit,



(a) Type I

(b) Type II

Figure 41. Types of Rate Curves Exhibited by Most Experimental Runs.

however, Equation (74) was modified as follows:

$$d\alpha/dt = K\,\Delta\alpha + K(1-\alpha) \qquad (75)$$

so that the least squares line was not required to go through the origin which would be somewhat arbitrarily defined by the last available experimental data point. This was considered desirable because there was no way of being sure that the reaction had been allowed to go until it was 100% complete in all experimental runs. Furthermore, the use of this more general equation would eliminate the effects of any undetermined systematic errors in the experimental measurements that might have tended to bias the experimental values slightly in one direction or another. The values of K and $\Delta\alpha$ calculated in this manner for the various experimental runs are listed in Table V. The fact that the $\Delta\alpha$ values are small in all cases indicates that all experimental runs were carried substantially to completion and that the data are substantially free from bias. This considerably enhances the confidence which can be placed in the previous calculations based on these data.

Estimation of values for Θ_2 was considerably more difficult than estimation of values of Θ_1 , Θ_3 , and K , primarily because there was no distinctive feature in either type of experimental rate curve that could be reliably associated with Θ_2 . Estimations of Θ_2 based only on visual inspection of the experimental rate curves often produced curves of the wrong type when used in Equations (66) to (69) to calculate a theoretical curve for comparison with the experimental data. Since the two types of rate curves differ fundamentally in the sign of their slope in the region of Θ_2 , an analysis of the factors governing the slope at Θ_2

was undertaken to attempt to develop some procedure to assist in estimating Θ_2 . Differentiating Equation (68) gives the desired slope as:

$$d^2\alpha/dt^2 = D_{11} K^2 \exp(-Kt) \, . \tag{76}$$

The coefficient D_{11} can be expressed in terms of Θ_1 , Θ_2 , and Θ_3 as follows:

$$\begin{aligned} D_{11} = {} & (2/\Theta_1\Theta_2)[\exp(K\Theta_2)-1] \\ & -(1/\Theta_1\Theta_2)(1-\Theta_1/\Theta_2)[\exp(K\Theta_2)-1] \\ & +(1/\Theta_1\Theta_3)[1/(1-\Theta_1/\Theta_2)][\exp(K\Theta_1)-\exp(K\Theta_2)]. \end{aligned} \tag{77}$$

Substituting this into Equation (76) and setting it equal to Θ_2 yields:

$$d^2\alpha/dt^2 = (K^2/\Theta_1\Theta_2)(SS) \tag{78}$$

where SS is the following collection of terms in $K\Theta_1$ and $K\Theta_2$ which determines the "Sign of the Slope" of the theoretical curve at Θ_2 :

$$\begin{aligned} SS = {} & (1 + K\Theta_1/K\Theta_2)[\exp(K\Theta_2)-1] \\ & + [\exp(K\Theta_1) - \exp(K\Theta_2)]/(1 - K\Theta_1/K\Theta_2). \end{aligned} \tag{79}$$

Values of SS were calculated for different combinations of $K\Theta_1$ and $K\Theta_2$, and the particular combinations for which $SS = 0$ were determined by graphical interpolation. As shown in Figure 42, these combinations define a line which separates a zone containing combinations of values which give curves of positive slope from a zone containing combinations which gives curves of negative slope. Furthermore, for constant Θ_1 and Θ_3, the values of the slope increase as the values of Θ_2 depart from the value at the line of zero slope. Combinations for which $\Theta_2 \leq \Theta_1$ define a third zone which has no physical meaning in the present problem. Thus,

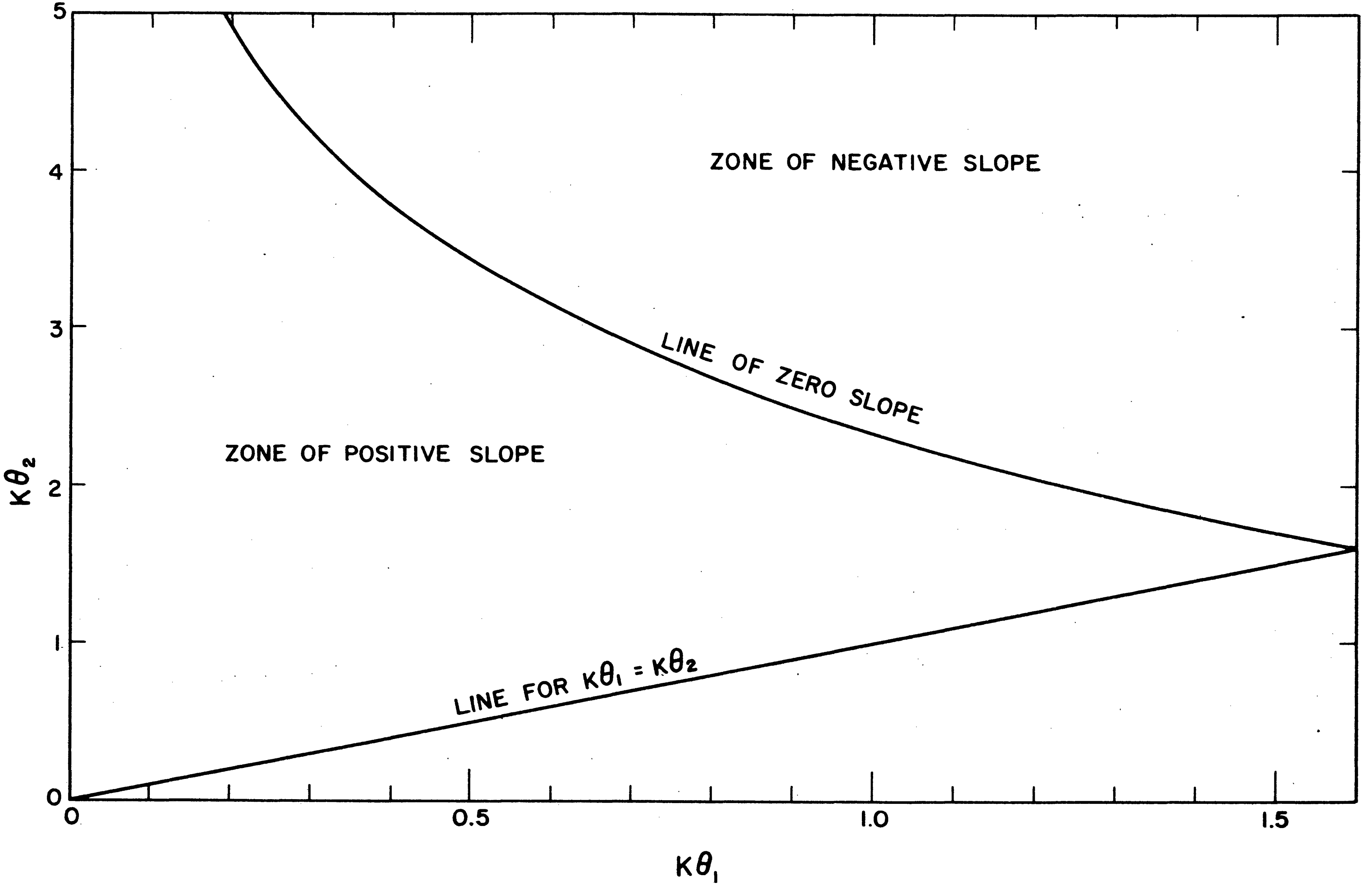


Figure 42. Graphical Solution for Equation (79).

once values of K , Θ_1 , and Θ_3 were estimated, it was possible to determine from Figure 42 the range of values of Θ_2 which would give a slope of the correct sign. It was then necessary to select, more or less by guess, a value in this range for use in the initial estimation of Θ_2 .

The values of Θ_1 , Θ_2 and Θ_3 estimated in this manner for each experimental curve were then substituted into Equations (70) to (73) to give values for the kinetic growth constants which, together with the calculated value of the nucleation rate constant K , were used in Equations (66) and (69) to obtain calculated values for the rate of reaction as a function of time. These calculated rate values were then plotted and compared with plots of the corresponding experimental values for each experimental run and the values of Θ_1 , Θ_2 , and Θ_3 were adjusted by trial and error until the smooth calculated rate curves fell approximately along the center of the slightly scattered distribution of plotted experimental values. These calculations were carried out on an IBM 7090 computer using the program given in Appendix N.

b. Numerical Values. This procedure was generally successful in providing an acceptable fit of the theoretical equations to the experimental data with a reasonable expenditure of time and effort (except in the case of experimental runs 6 and 33 which will be considered in detail later). Typical examples of the fit of the theoretical curves to the experimental data are shown in Figures 43 through 50, while the final values of Θ_1 , Θ_2 , and Θ_3 chosen for all runs, together with the values of the four growth rate constants (U_B/a) , (U_B/b) , (U_A/a) , and (U_A/b) calculated from them, are listed in Table V.

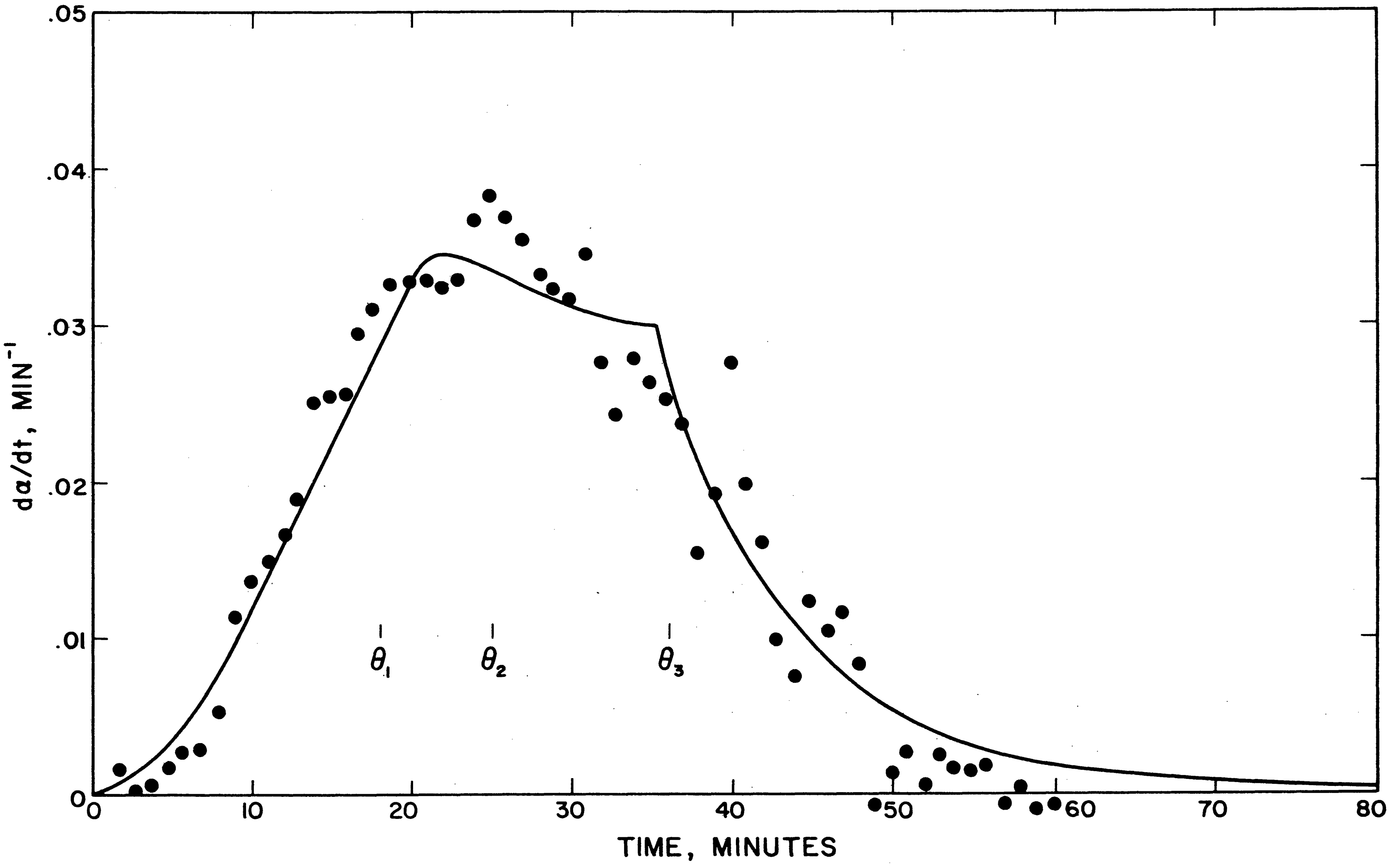


Figure 43. Fit of the Theoretical Curve to the Experimental Data for Run 10 for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in Water at 258°F.

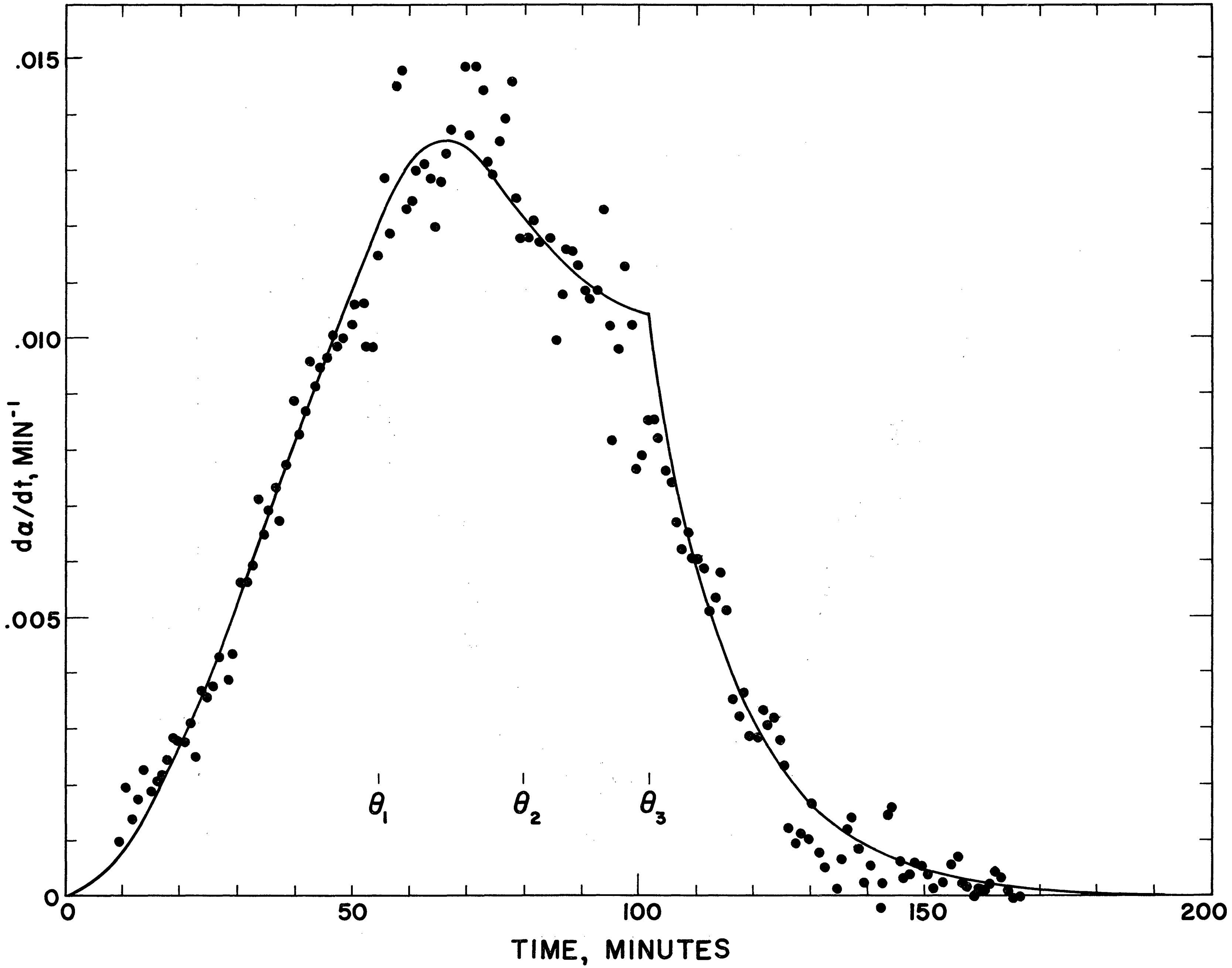


Figure 44. Fit of the Theoretical Curve to the Experimental Data for Run 20 for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in Water at 251°F.

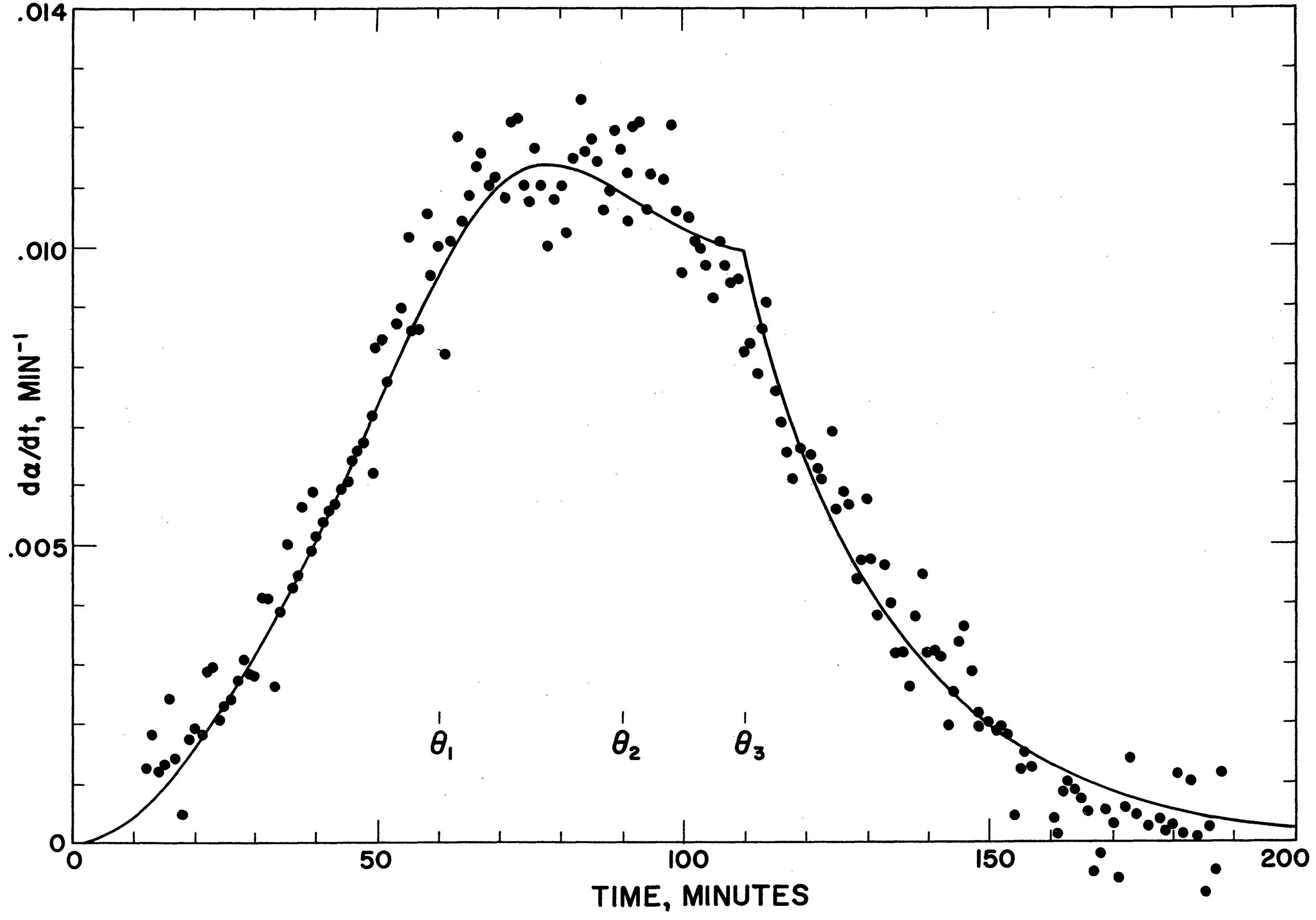


Figure 45. Fit of the Theoretical Curve to the Experimental Data for Run 30 for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in Water at 250°F.

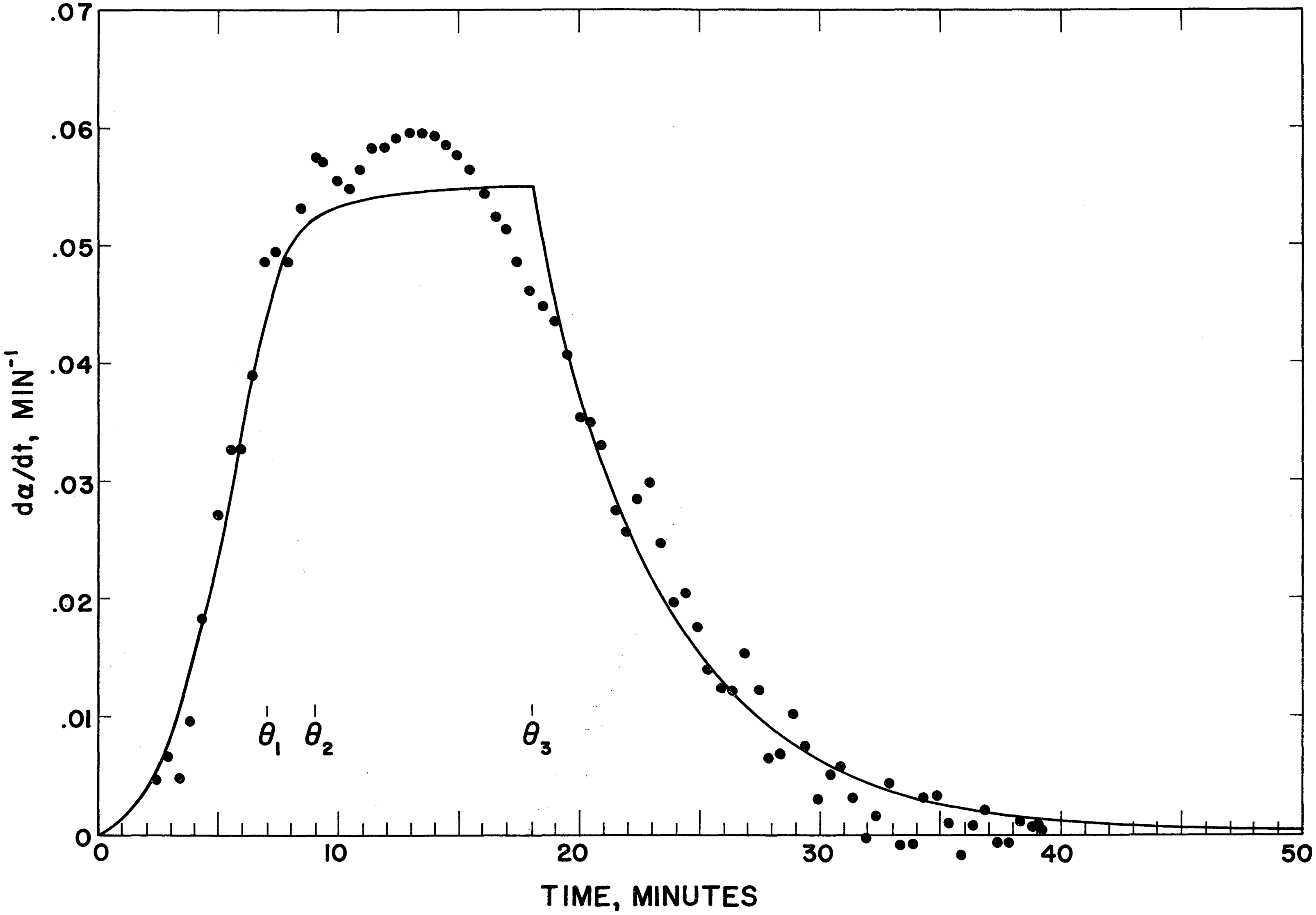


Figure 46. Fit of the Theoretical Curve to the Experimental Data for Run 40 for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in a 14% Sodium Chloride Solution at 237°F.

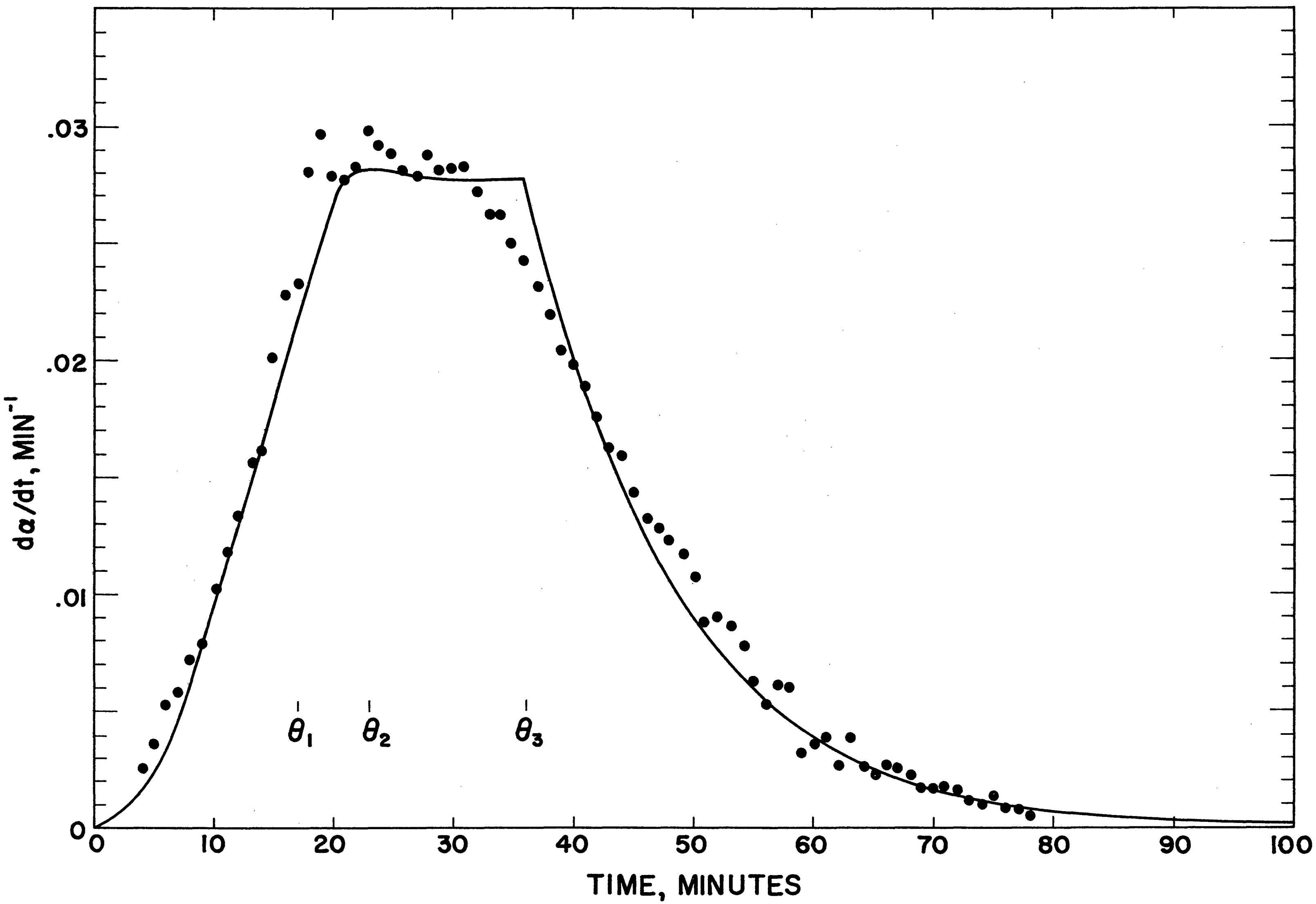


Figure 47. Fit of the Theoretical Curve to the Experimental Data for Run 50 for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in Normal Synthetic Sea Water at 240°F.

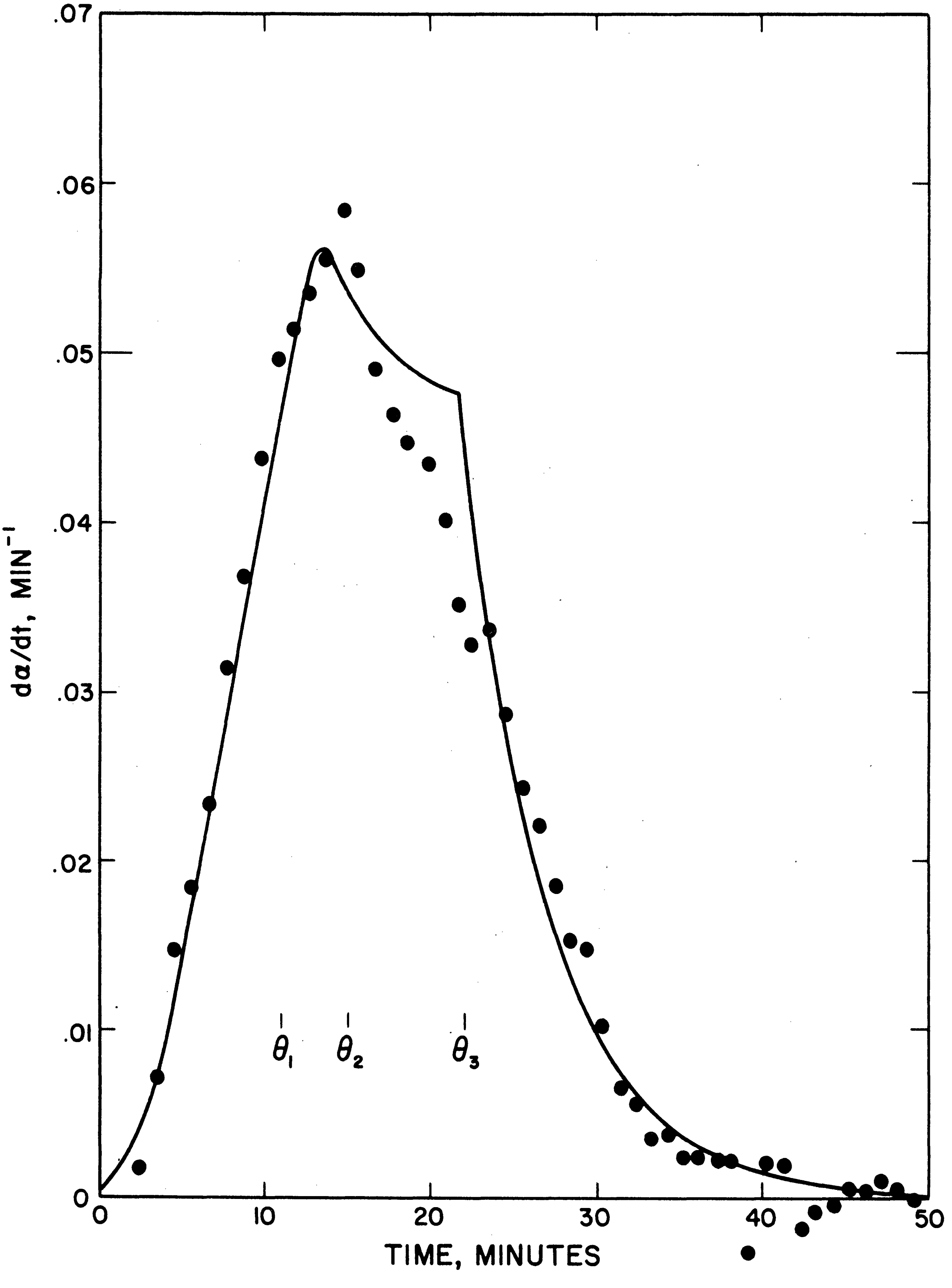


Figure 48. Fit of the Theoretical Curve to the Experimental Data for Run 60 for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in Normal Synthetic Sea Water at 247°F.

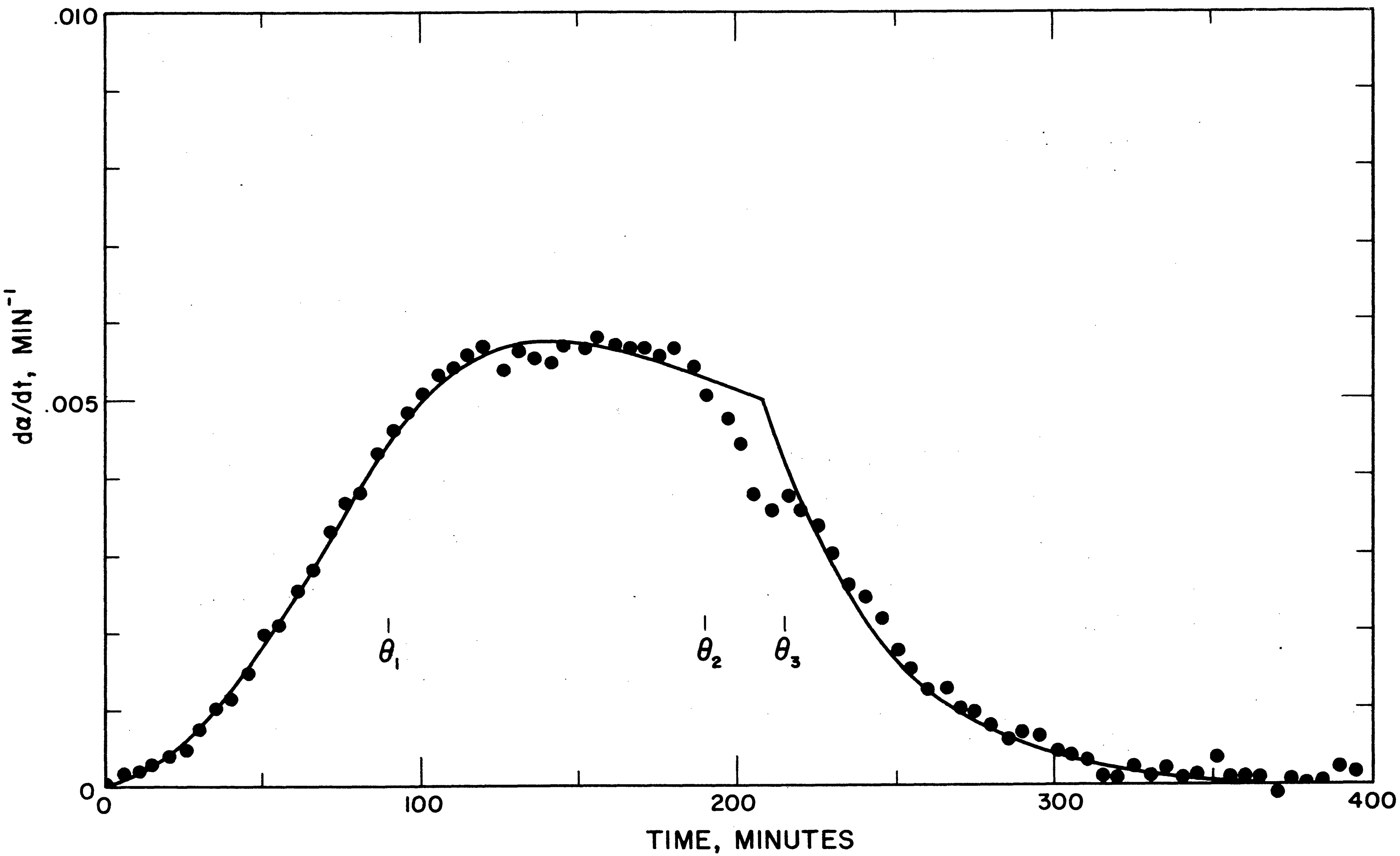


Figure 49. Fit of the Theoretical Curve to the Experimental Data for Run 62 for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in Water at 245°F.

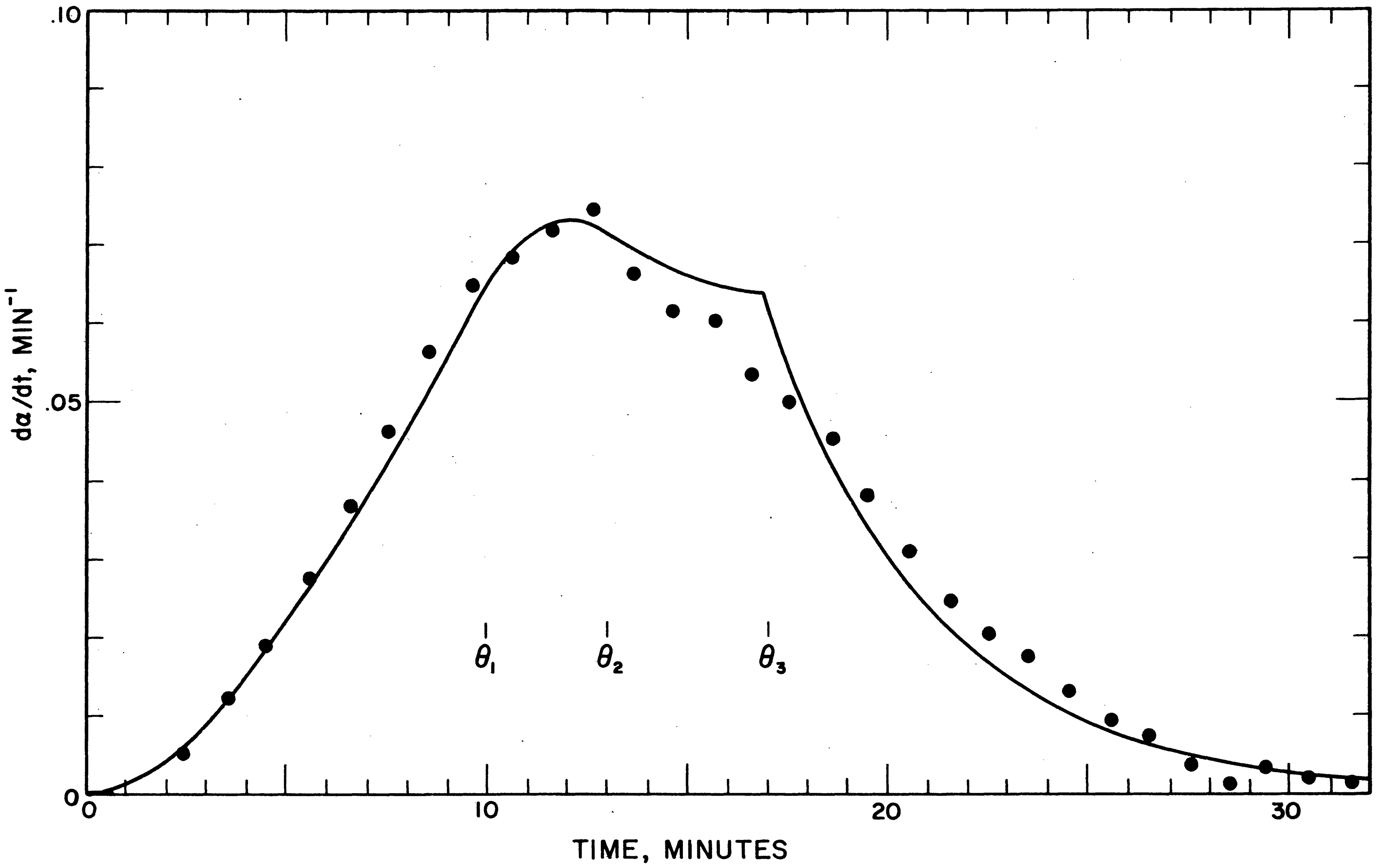


Figure 50. Fit of the Theoretical Curve to the Experimental Data for Run 64 for the Dehydration of Calcium Sulfate Dihydrate to Hemihydrate in Water at 265°F.

TABLE V

VALUES OF KINETIC CONSTANTS

Run No.	Temp. °F	Temp.$^{-1}$ °K^{-1}	$\Delta\alpha$	θ_1 Min	θ_2 Min	θ_3 Min	K Min^{-1}	U_B/a Min^{-1}	U_B/b Min^{-1}	U_A/a Min^{-1}	U_A/b Min^{-1}	P/P°
6	261.01	.0024976	.03045	--.-	--.-	--.-	.02489	.-----	.-----	.-----	.-----	1.000
7	258.00	.0025080	.00734	19.0	26.0	34.0	.09213	.03045	.02632	.01563	.01351	1.000
8	257.98	.0025081	.02233	18.0	26.0	34.0	.08164	.02759	.02778	.01471	.01480	1.000
9	258.96	.0025047	.01578	17.0	24.0	35.0	.1247	.02828	.02941	.01429	.01486	1.000
10	257.84	.0025086	.01867	18.0	25.0	35.0	.1181	.02946	.02778	.01429	.01347	1.000
11	258.90	.0025049	.01248	10.0	12.0	31.0	.1222	.05587	.05000	.01613	.01443	1.000
12	259.41	.0025031	.00579	17.0	23.0	34.0	.1786	.03255	.02941	.01471	.01329	1.000
13	259.79	.0025018	.00626	17.0	24.0	30.0	.1888	.03299	.02941	.01667	.01486	1.000
14	260.20	.0025004	.02746	10.0	25.0	29.0	.1271	.01659	.05000	.01724	.05196	1.000
15	258.73	.0025055	.00071	12.0	31.0	36.0	.1815	.01308	.04167	.01389	.04423	1.000
16	260.13	.0025006	.00356	5.0	6.0	38.0	.1542	.04558	.1000	.01316	.02887	1.000
19	251.07	.0025325	.00991	35.0	90.0	102.0	.05333	.00463	.01429	.00490	.01512	1.000
20	250.53	.0025344	.00115	55.0	80.0	102.0	.06573	.00906	.00906	.00490	.00492	1.000
21	251.03	.0025326	.00425	20.0	23.0	89.0	.06675	.02487	.02500	.00562	.00565	1.000
22	250.54	.0025344	.00627	45.0	60.0	90.0	.05531	.01283	.01111	.00556	.00481	1.000
23	250.53	.0025344	.01459	55.0	80.0	95.0	.04875	.00972	.00909	.00526	.00492	1.000
24	250.22	.0025355	.00541	65.0	90.0	105.0	.04420	.00990	.00769	.00476	.00370	1.000
25	250.34	.0025351	.00392	40.0	55.0	95.0	.03794	.01111	.01250	.00526	.00590	1.000
26	250.34	.0025351	-.00029	60.0	85.0	125.0	.04207	.00785	.00833	.00440	.00425	1.000
27	250.71	.0025338	.00872	60.0	80.0	105.0	.03923	.01100	.00833	.00476	.00361	1.000
28	249.83	.0025369	.00910	65.0	90.0	120.0	.03238	.00866	.00769	.00417	.00370	1.000
29	249.99	.0025364	.00952	45.0	95.0	110.0	.03131	.00499	.01111	.00455	.01013	1.000
30	249.96	.0025365	.01267	60.0	90.0	110.0	.04144	.00787	.00833	.00455	.00481	1.000
31	250.53	.0025344	.00706	55.0	75.0	100.0	.05424	.01083	.00909	.00500	.00420	1.000
32	250.73	.0025337	.01325	85.0	130.0	140.0	.02840	.00596	.00588	.00357	.00353	1.000
33	250.40	.0025349	.02498	--.-	--.-	--.-	.02498	.-----	.-----	.-----	.-----	1.000
34	250.11	.0025359	.02185	50.0	80.0	97.0	.04312	.00794	.01000	.00515	.00650	1.000
35	249.27	.0025389	.01135	80.0	105.0	133.0	.04611	.00912	.00625	.00376	.00258	1.000
36	247.03	.0025470	.00459	9.0	11.0	19.0	.1700	.08356	.05556	.02632	.01750	0.978
37	237.34	.0025824	.02565	3.5	4.5	9.5	.3633	.1367	.1429	.05263	.05499	0.831
38	240.01	.0025725	.00627	23.0	30.0	47.0	.07015	.02632	.02174	.01064	.00879	0.978
39	239.04	.0025761	-.00145	15.0	28.0	34.0	.1812	.01829	.03333	.01471	.02681	0.956
40	236.83	.0025843	.00955	7.0	9.0	18.0	.1861	.07217	.07143	.02778	.02749	0.903
41	230.29	.0026088	.01289	11.0	13.0	18.0	.1324	.1042	.04546	.02778	.01211	0.831
42	240.55	.0025705	-.00744	275.0	375.0	450.0	.00399	.00241	.00182	.00111	.00084	1.000
43	240.27	.0025716	.01262	70.0	95.0	125.0	.02616	.00878	.00714	.00400	.00326	0.994
44	240.67	.0025701	.02264	110.0	180.0	230.0	.01586	.00323	.00455	.00217	.00306	0.997
45	239.01	.0025762	.01299	20.0	25.0	50.0	.05540	.02887	.02500	.01000	.00866	0.982
47	239.49	.0025744	.00193	11.0	15.0	22.0	.2223	.04921	.04546	.02273	.02100	0.945
48	238.86	.0025768	.00982	9.0	13.0	17.0	.2062	.05519	.05556	.02941	.02961	0.926
49	240.04	.0025724	.02361	11.0	15.0	24.0	.1155	.04511	.04546	.02083	.02100	0.963
50	241.01	.0025689	.01379	17.0	23.0	36.0	.08124	.03074	.02941	.01389	.01329	0.982
51	235.03	.0025910	.01375	42.0	55.0	95.0	.03408	.01286	.01191	.00526	.00487	0.982
52	235.15	.0025905	.01586	45.0	60.0	80.0	.02975	.01443	.01111	.00625	.00481	0.978
53	230.93	.0026064	.01543	80.0	110.0	140.0	.01786	.00756	.00625	.00357	.00295	0.978
54	230.88	.0026065	.00969	100.0	130.0	240.0	.01640	.00521	.00550	.00208	.00200	0.982
55	243.74	.0025589	.00435	15.0	20.0	27.5	.1213	.04199	.03333	.01818	.01443	0.978
58	255.40	.0025172	.00098	30.0	40.0	55.0	.08280	.02100	.01667	.00909	.00722	1.000
59	249.08	.0025396	.00384	70.0	90.0	105.0	.05892	.01237	.00714	.00476	.00275	1.000
60	247.01	.0025470	-.00400	11.0	15.0	22.0	.1938	.04921	.04546	.02273	.02100	0.982
61	243.35	.0025603	.00395	16.0	22.0	34.0	.1026	.03113	.03125	.01471	.01476	0.982
62	244.73	.0025553	-.00018	90.0	190.0	210.0	.02654	.00261	.00556	.00238	.00506	1.000
63	260.44	.0024995	.00234	17.0	21.0	30.0	.1727	.05052	.02941	.01667	.00970	1.000
64	265.20	.0024831	.00001	10.0	13.0	17.0	.2417	.07358	.05000	.02941	.01999	1.000

In general the fit of the theoretical curves to the experimental data is good for values of $t \leq \Theta_1$ and $t \geq \Theta_3$ where the shapes of the theoretical curves are primarily dependent on the values of K, Θ_1, and Θ_3 which can be determined relatively easily and reliably. In the interval between $t = \Theta_1$ and $t = \Theta_3$ the fit is usually less satisfactory. Here the shapes of many of the experimental curves are not well defined, probably because this is the interval where the reaction rate is maximum so that all experimental measurements are more subject to random variations. In addition, both the numerical differentiation technique used in calculating the experimental rates and the numerical procedure used to calculate the shrinkage of volume of the system due to endothermic cooling, are least reliable in this region. The greatest possible cause of this discrepency is the fact that the theoretical curves were calculated assuming that the reaction occurred at a constant temperature, where in reality, the reaction temperature changed continuously with the rate of reaction because of the absorption of the endothermic heat of reaction by the solids. Thus, each reaction started and ended approximately at the temperature of the thermostat, but decreased to some minimum value as the reaction rate reached its maximum value. Since the calculated average temperature of the reaction lies between the temperature of the thermostat and the minimum observed temperature and since the theoretical curves were calculated on the basis of the average temperature and not on the basis of the changing temperature profile, the calculated rate curves should be necessarily slightly higher than the experimental data in the region where the rate of reaction is maximum and slightly lower than the experimental data near the beginning and end of each reaction.

This not only made it extremely difficult to establish when a satisfactory fit of the theoretical curve to the experimental data had been achieved, but also contributed to the uncertainty in the determination of the values of Θ_2 which basically determined the shape of the theoretical curve in this interval. The extent to which the basic problems relating to measurements and corrections of the experimental data determined the ultimate outcome is perhaps indicated by the comparison of Figure 45 and 46. Figure 45 shows the results for run number 30 where very good agreement between the experimental and theoretical curves was achieved. In this case, the reaction was carried out under conditions for which the reaction rates were relatively slow and all the above problems would be at a minimum. Figure 46, on the other hand, shows the results for run number 40 which was carried out under conditions for which the reaction rates were high and the problems in the data handling were more serious. Here the fit of the theoretical curve to the experimental data is rather poor in the interval between $t = \Theta_1$ and $t = \Theta_3$.

c. Variations with Temperature and Concentration. From both the theoretical and the practical standpoints it would now be desirable to develop equations giving the kinetic constants as functions of temperature and solution concentration, since these equations would complete the theoretical description of the transformation and since they would be useful in extending the kinetic data somewhat beyond the limits of the measured values. Characteristically, kinetic rate constants vary exponentially with temperature according to the classical Arrhenius equation:

$$k = Z \exp(-E/RT) \tag{80}$$

where Z is the pre-exponential factor, which may be related to the entropy change as noted in connection with Equation (13), and E is the experimental activation energy. Written in logarithms this equation becomes:

$$\ln k = \ln Z - E/RT \; . \qquad (81)$$

Since $\ln k$ and $1/T$ are variable, the above equation is the equation for a straight line with a slope of $-E/R$ and intercept $\ln Z$. Figures 51, 52, and 53 show the least squares lines based on Equation (81) fitted to the calculated values for K, U_B/a, U_B/b, U_A/a, and U_A/b for the reaction occurring in water, in 3.5% sodium chloride solutions, and in normal synthetic sea water. The corresponding values of Z and E for K, U_B/a, U_B/b, U_A/a, and U_A/b are listed in Table VI. Except for the data for Run 42, the agreement between the least squares lines and the experimental data is sufficiently good to justify the use of the Arrhenius type equation for representing the temperature dependence of these rate constants over the temperature range involved. When the data from Run 42 were included, the dashed least squares line shown in Figure 51 was obtained. This line does not fit any of the data particularly well. When the data from Run 42 were omitted, however, the solid line was obtained which shows excellent agreement with all the data points except the omitted one from Run 42. On this basis it was concluded that the data for Run 42 are not consistent with data from the other runs in water. Other calculations, given later, provide an even stronger basis for this point of view; consequently, data for Run 42 were omitted from these and all subsequent theoretical calculations.

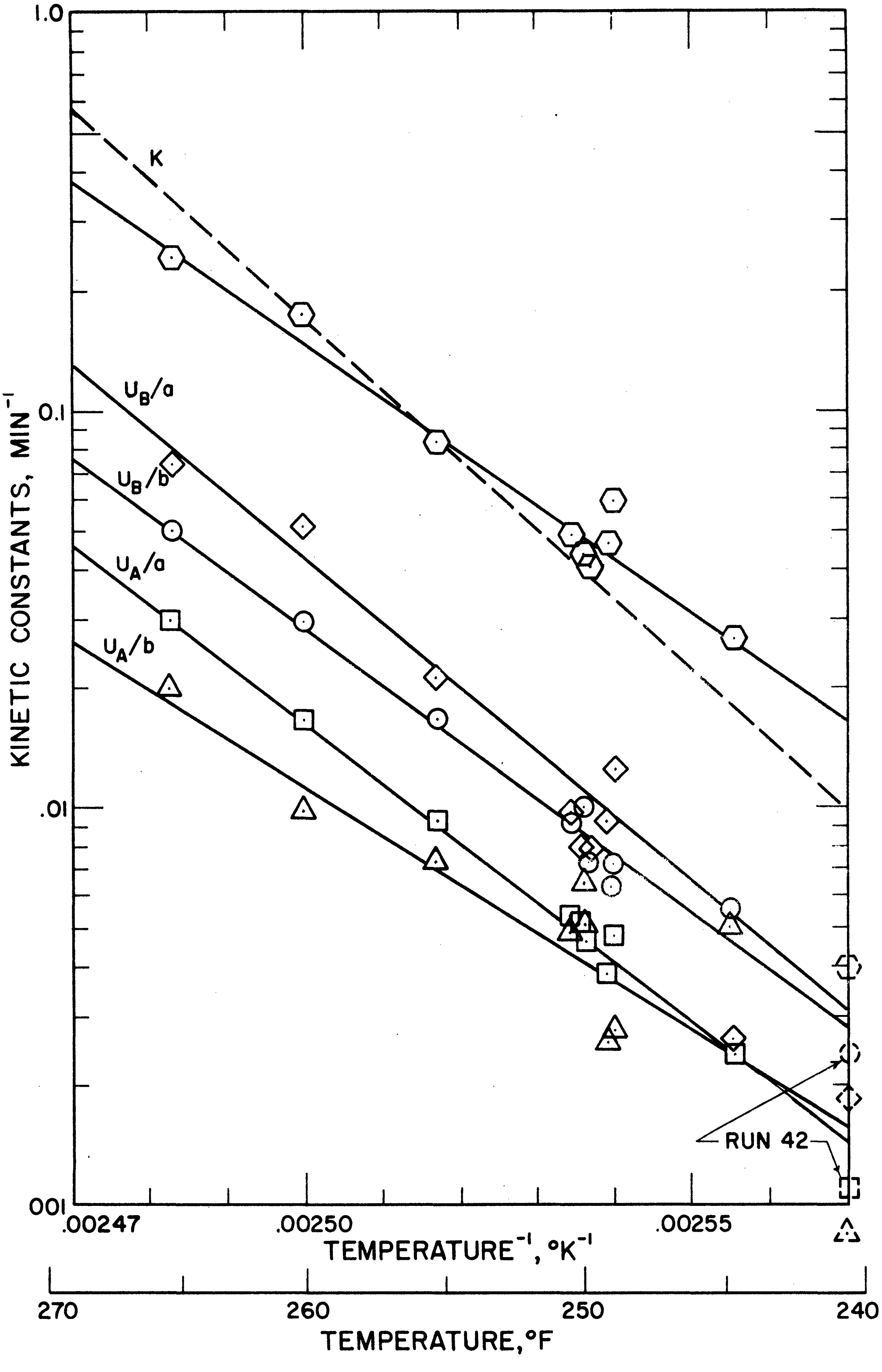


Figure 51. Arrhenius Plot of the Kinetic Constants K, U_B/a, U_B/b, U_A/a, and U_A/b for the Transformation of Calcium Sulfate Dihydrate to Hemihydrate in Water.

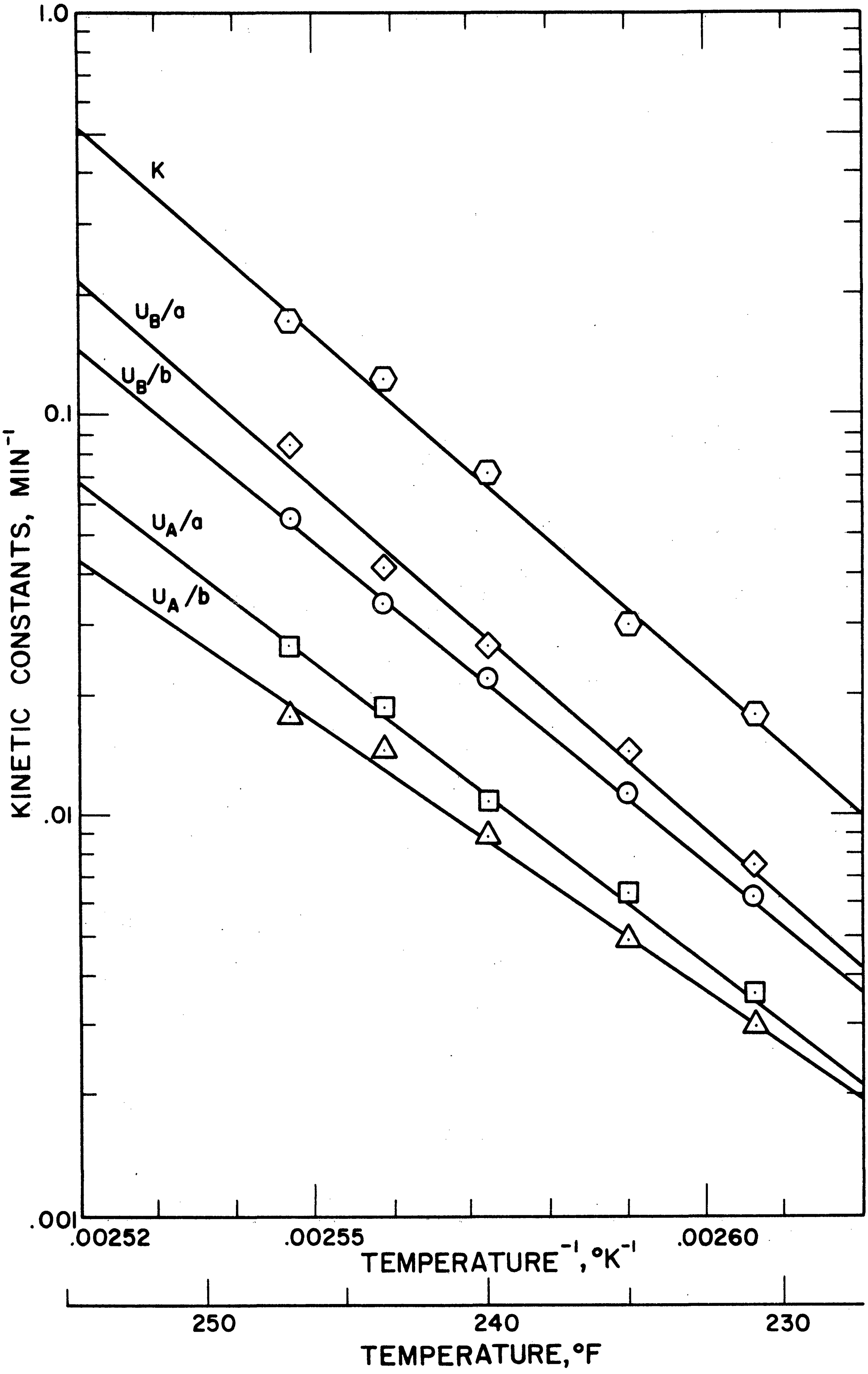


Figure 52. Arrhenius Plot of the Kinetic Constants K , U_B/a , U_B/b , U_A/a , and U_A/b for the Transformation of Calcium Sulfate Dihydrate to Hemihydrate in 3.5% Sodium Chloride Solutions.

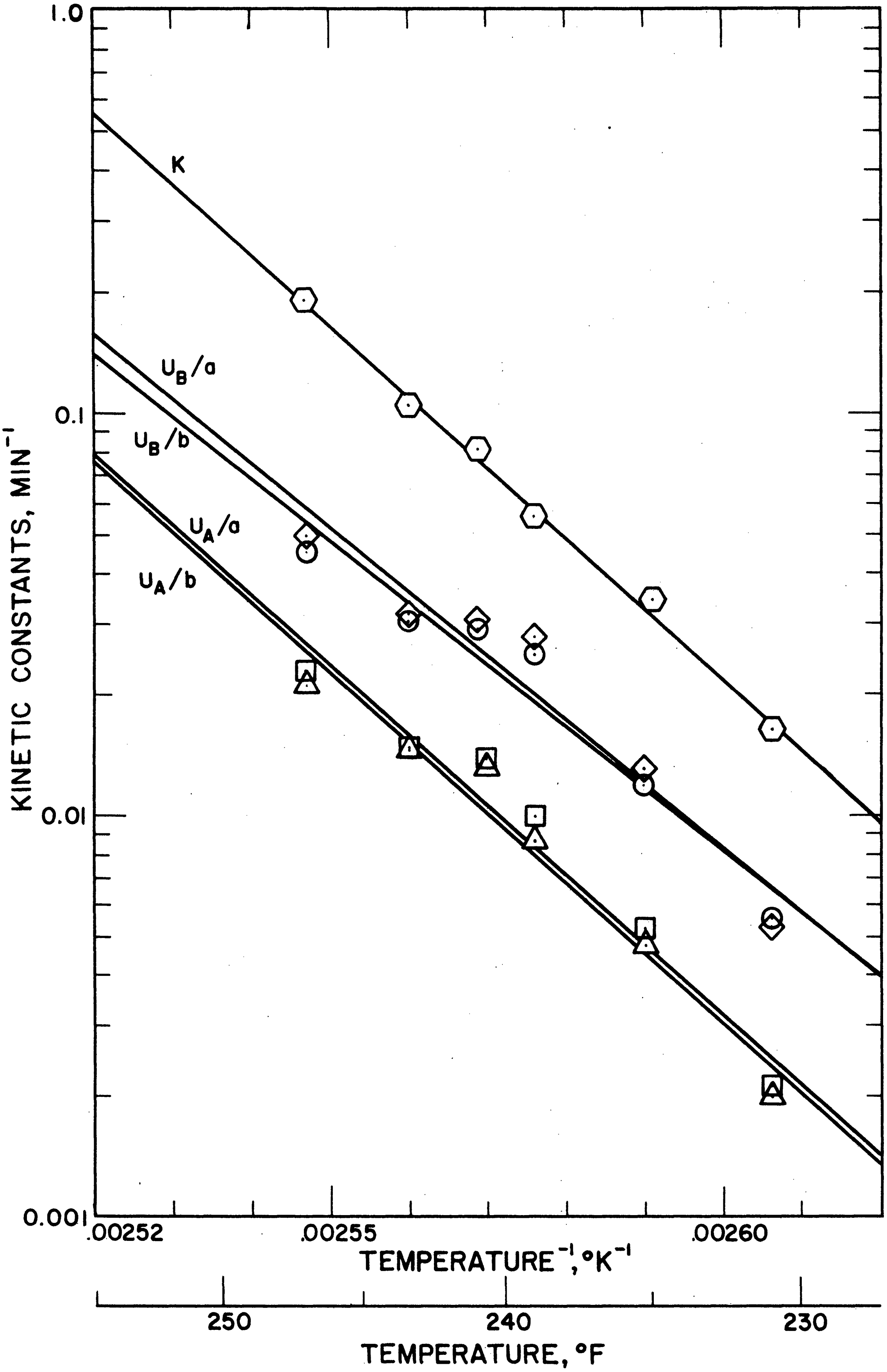


Figure 53. Arrhenius Plot of the Kinetic Constants K , U_B/a , U_B/b , U_A/a , and U_A/b for the Transformation of Calcium Sulfate Dihydrate to Hemihydrate in Normal Synthetic Sea Water.

TABLE VI

VALUES OF Z AND E CORRESPONDING TO FIGURES 51, 52 AND 53.

Rate Constant	Pre-Exponential Factor Z, min^{-1}	Activation Energy E, Kcal/gm mole
	Reaction Occurring in Water	
K	8.21×10^{32}	61.7
U_B/a	7.96×10^{41}	79.2
U_B/b	6.70×10^{33}	64.7
U_A/a	6.86×10^{35}	68.4
U_A/b	1.17×10^{29}	56.7
	Reaction Occurring in 3.5% Sodium Chloride Solutions	
K	7.93×10^{42}	78.4
U_B/a	2.51×10^{42}	78.2
U_B/b	1.00×10^{39}	72.3
U_A/a	3.35×10^{35}	66.7
U_A/b	1.37×10^{32}	60.8
	Reaction Occurring in Synthetic Sea Water	
K	1.07×10^{44}	80.4
U_B/a	1.14×10^{39}	72.4
U_B/b	5.02×10^{37}	70.0
U_A/a	1.41×10^{42}	78.5
U_A/b	1.68×10^{42}	78.7

An equation for the variation of the nucleation rate constant K with the concentration of salts added to the reaction solution was derived from the results of 20 experimental runs using starting solutions which contained from 0.5% to 21% sodium chloride and 1, 2, 3, and 4 times the concentrations of salts for normal sea water. These experimental runs were all carried out at the same nominal temperature of 240°F; however, the actual temperatures of the runs were not all the same because the cooling of the reaction mixture due to the endothermic nature of the reaction caused the reaction temperature to vary slightly both with the rate of reaction and with the solute concentration. Therefore, values corresponding to a constant temperature of 239.6°F were estimated for the more concentrated solutions from plots of the logarithm of K versus $1/T$, by extrapolating the experimental values for the high concentrations to the constant temperature of 239.6°F using lines having the same slopes as the line for the 3.5% sodium chloride data and for the normal synthetic sea water as shown in Figures 54 and 55, respectively. As shown in Figure 56, two straight lines are obtained when these values of K are plotted against the weight fraction of dissolved solids for these two types of solutions.

In seeking a more general relationship, it has been found that the data for both types of solutions fall on a common straight line when K is plotted versus $1-P/P^\circ$ as shown in Figure 57. Here P/P° is the ratio of the vapor pressure of water in the solution to that of pure water at the same temperature and is approximately equal to the activity of the water in the solution. The equation describing this relationship has the general form:

$$K = K_o + S(1-P/P^\circ) , \qquad (82)$$

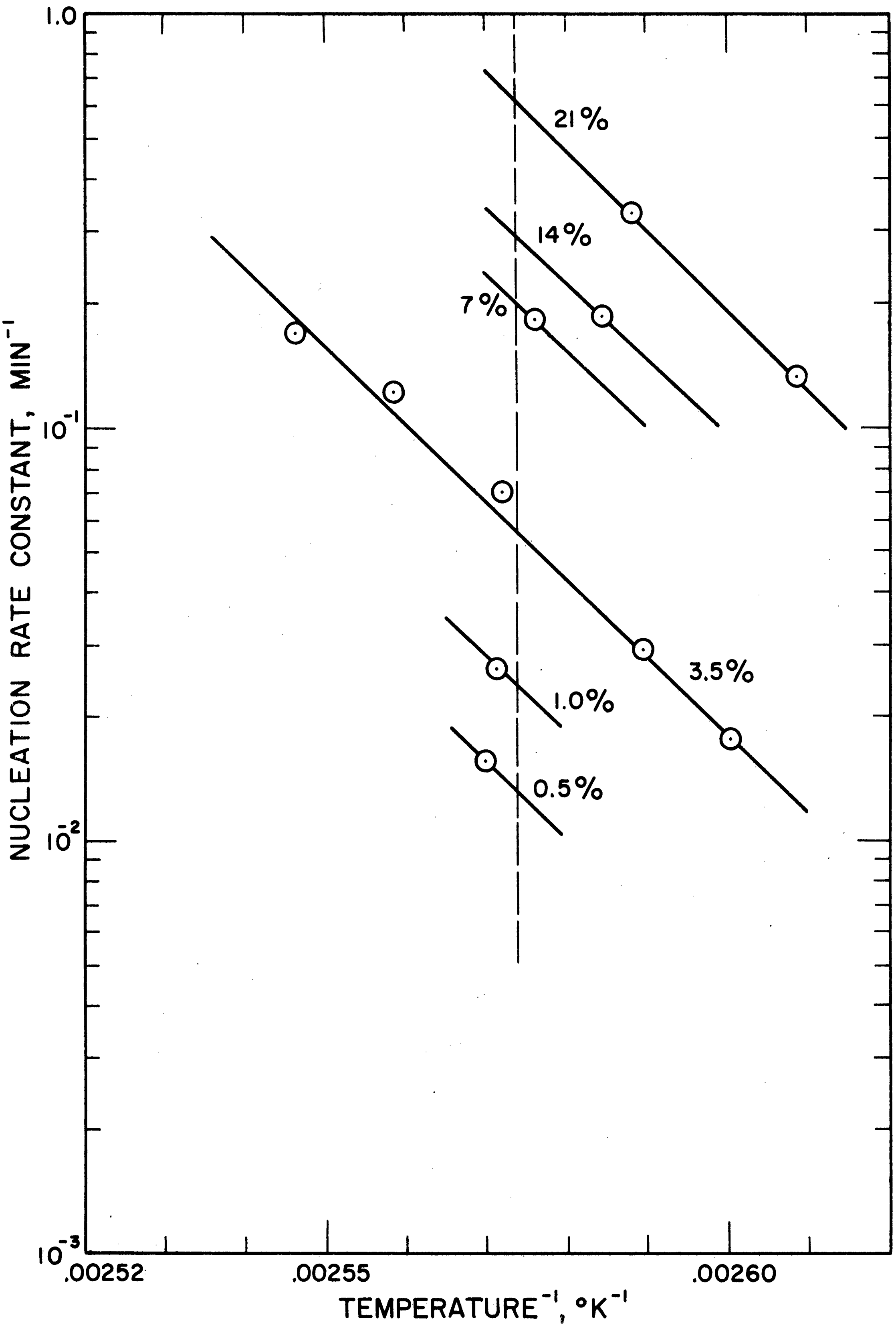


Figure 54. Extrapolation of Values of Nucleation Rate Constant K to the Constant Temperature of 239.6°F for Sodium Chloride Solutions.

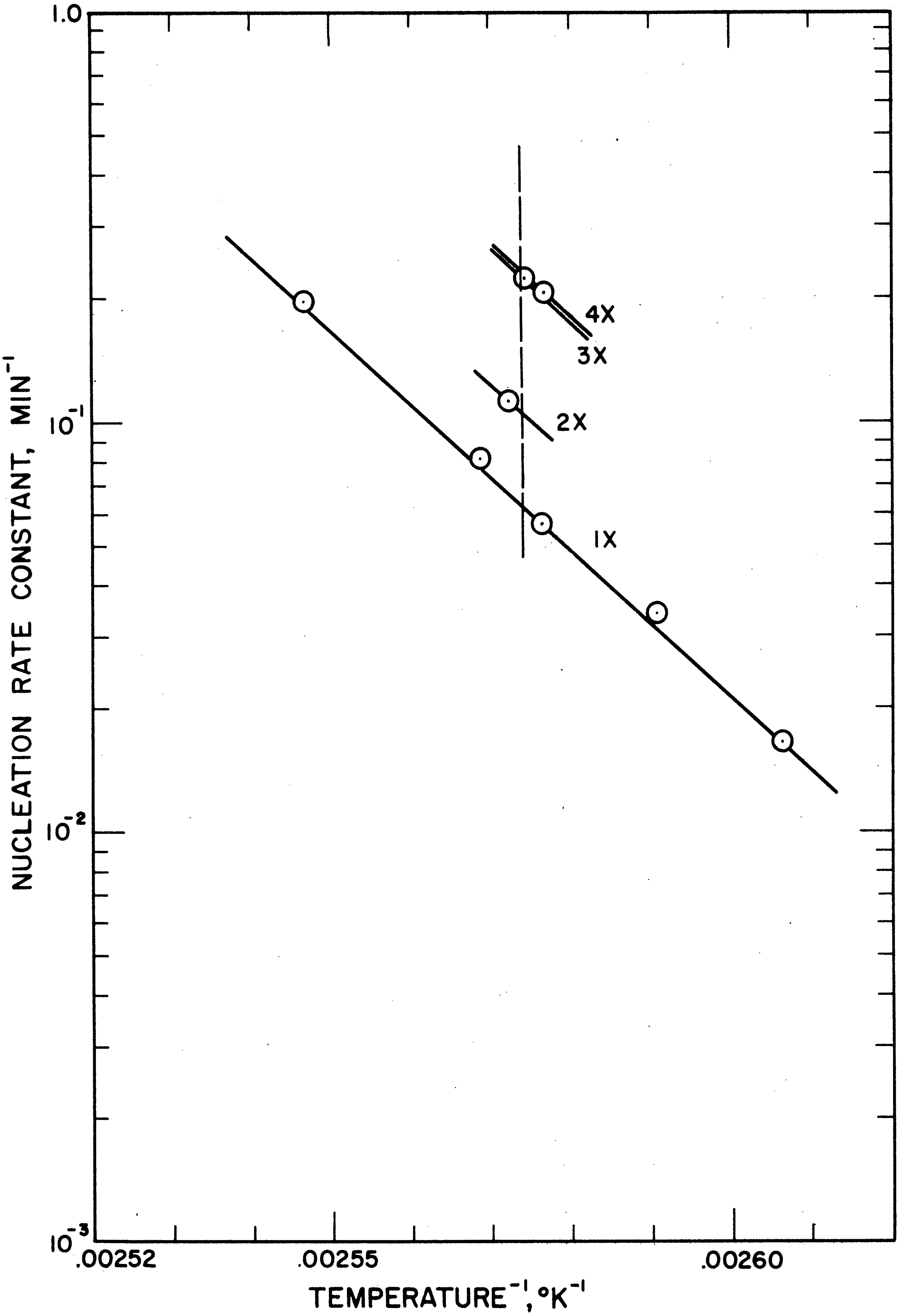


Figure 55. Extrapolation of Values of Nucleation Rate Constant K to the Constant Temperature of 239.6°F for Synthetic Sea Water Containing 1, 2, 3, and 4 Times the Salts of Normal Synthetic Sea Water.

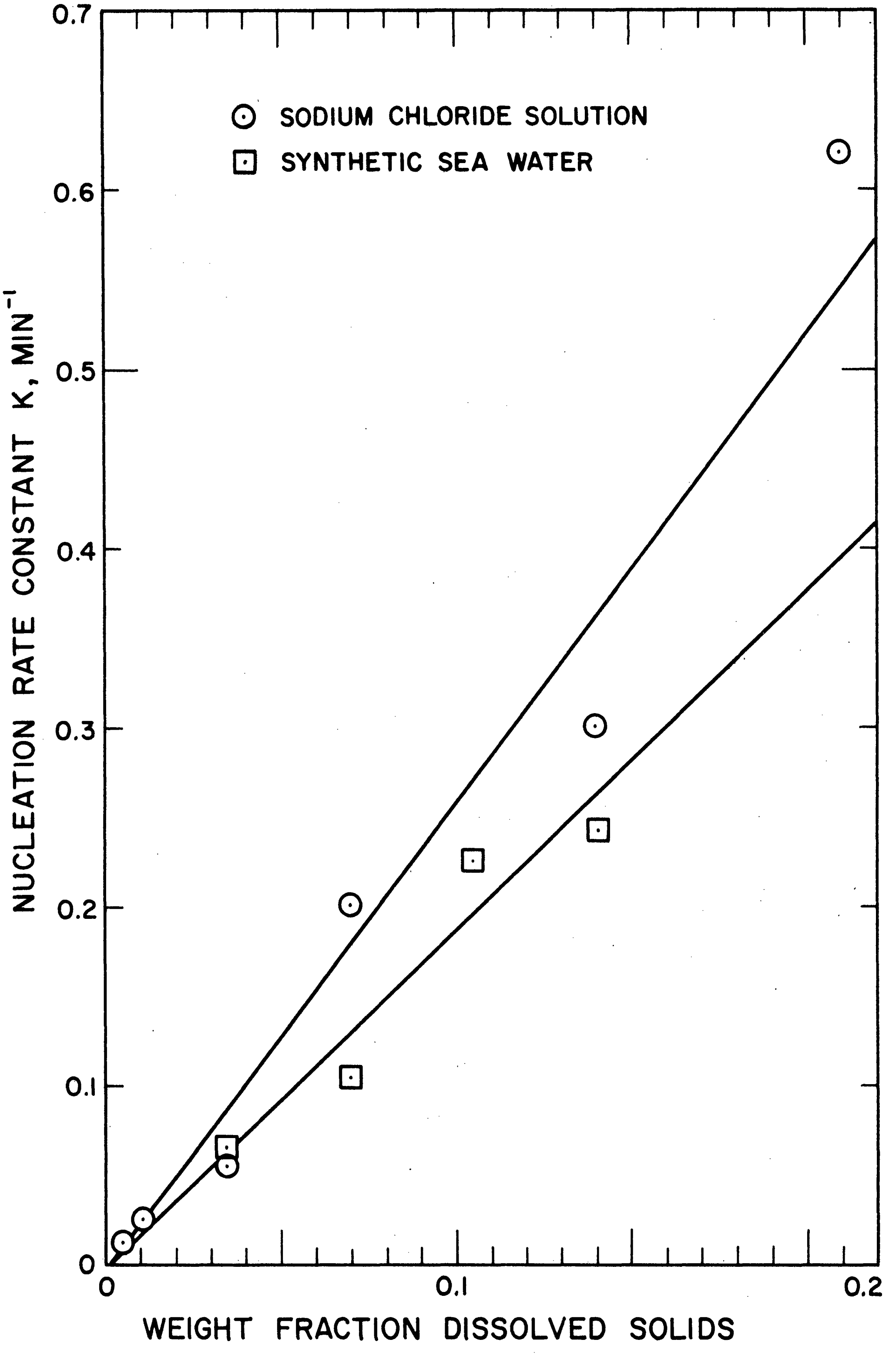


Figure 56. Plot of Smoothed Data from Figures 54 and 55 Showing the Effect of Dissolved Solids on the Nucleation Rate Constant K .

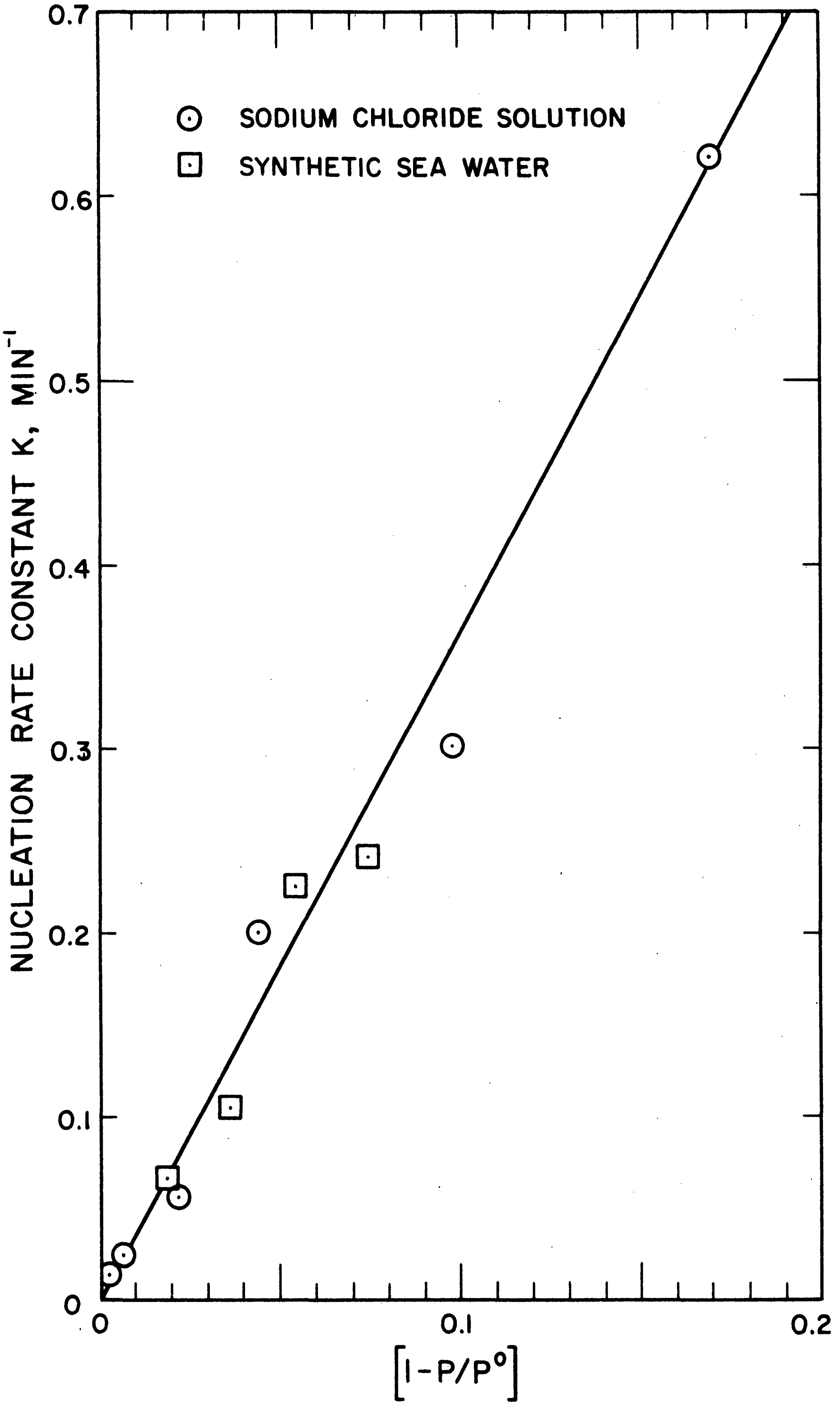


Figure 57. Plot of Smoothed Data from Figures 54 and 55 Showing the Effect of the Activity of the Water (P/P^o) in the Solution Surrounding the Reaction Mixture on the Nucleation Rate Constant K .

where K is the nucleation rate constant, S is the slope of the line, and K_o is the intercept having the value of the nucleation rate constant in water when $1-P/P°$ is zero. Since $1-P/P°$ is a dimensionless quantity, the term S should be similar in characteristics to K and K_o, and should also vary exponentially with temperature according to the Arrhenius equation. It should therefore be permissible to write:

$$S = (K-K_o)/(1-P/P°) = Z \exp(-E/RT) \text{ , or} \tag{83}$$

$$\ln (K-K_o)/(1-P/P°) = \ln Z - E/RT \text{ .} \tag{84}$$

These equations relate mathematically the nucleation rate constant K to both the temperature and the activity of the water in the solution. By analogy, it was assumed that equations of the form:

$$(R_i-R_{i_o})/(1-P/P°) = Z \exp(-E/RT) \text{ ,} \tag{85}$$

and

$$\ln (R_{i_o}-R_{i_o})/(1-P/P°) = \ln Z - E/RT \tag{86}$$

might be used to represent the variations of all the rate constants with temperature and the activity of the water in the solutions, where $R_i = K$, U_B/a, U_B/b, U_A/a, and U_A/b. Figure 58 shows that the experimental data exhibit satisfactory agreement with the least squares lines derived from these equations when the logarithm of $(R_i-R_{io})/(1-P/P°)$ is plotted versus $1/T$. The values of Z and E for the least squares line of Figure 58 are listed in Table VII.

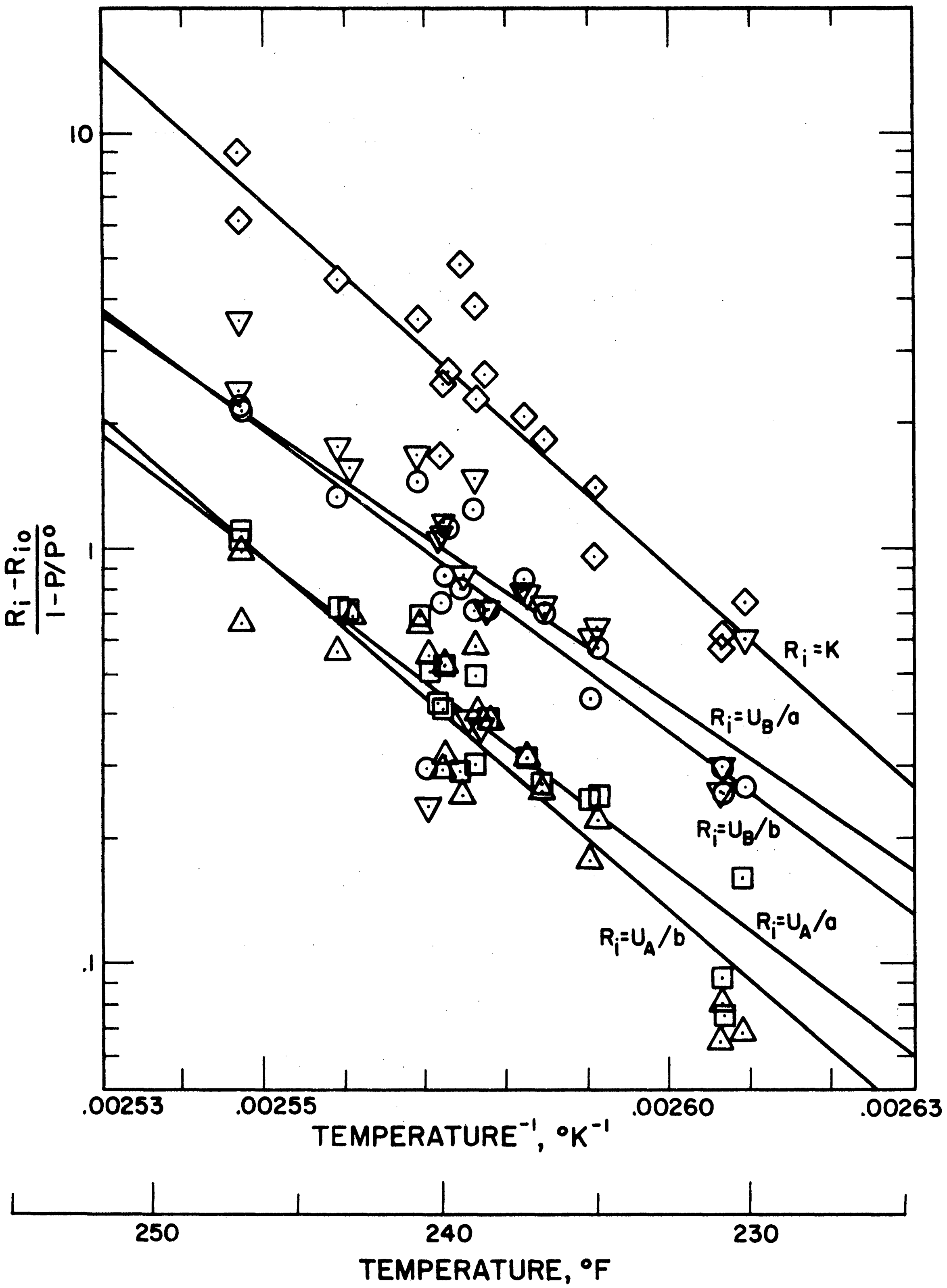


Figure 58. Least Squares Lines Correlating the Variations of the Kinetic Constants with both Temperature and Water Activity.

TABLE VII

VALUES OF Z AND E OF EQUATION (85) FOR THE LEAST SQUARES LINES SHOWN IN FIGURE 58.

Parameter, min^{-1}	Z, min^{-1}	E, Kcal/gm mole
$\frac{K-K}{(1-P/P^\circ)}$	7.85×10^{45}	80.8
$\frac{(U_B/a)-(U_B/a)_o}{(1-P/P^\circ)}$	1.01×10^{34}	60.5
$\frac{(U_B/b)-(U_B/b)_o}{(1-P/P^\circ)}$	5.73×10^{37}	67.2
$\frac{(U_A/a)-(U_A/a)_o}{(1-P/P^\circ)}$	3.67×10^{38}	69.2
$\frac{(U_A/b)-(U_A/b)_o}{(1-P/P^\circ)}$	2.08×10^{43}	77.8

4. Test of the Theoretical Equations

Having completed the derivations of the theoretical equations, it now becomes desirable to test their validity. For this purpose it would be preferable to compare values of α or $d\alpha/dt$ calculated from the theoretical equations with experimentally measured values not used in the evaluation of the constants of the theoretical equations. Unfortunately, unused experimental data of this kind are not available, and to obtain such data would be beyond the scope of this study. Therefore, the adopted test consists of comparing theoretically calculated TTT curves with the experimentally determined TTT values reported in the previous chapter. This is perhaps the best test that can be devised with the available data, because the experimental TTT values were obtained from the basic dilatometric data with a minimum of calculation and mathematical manipulation, while the theoretical TTT curves were based on equations whose constants were calculated from $d\alpha/dt$ values obtained by numerical differentiation of the basic data. Since these calculations could introduce considerable random variations, and other uncertainties, the experimental TTT values may be considered sufficiently independent of the calculated ones to serve as a basis for a test of the equations.

In order to compare the experimental TTT values with the TTT values calculated from the theoretical equations, a common time base must be established for the two sets of data since the time values for the experimental data were measured from the time the experimental run was started, whereas the time values for the theoretical equations were measured from the time the first nucleus appeared. The difference between these times is the induction time or nucleation time for the transformation, and addition of this value to the theoretically calculated time values will accomplish the desired time base correction. Ideally, values for the nucleation time could be determined from experimental TTT values for zero percent transformation. In practice, however, the zero percent TTT values are very difficult to evaluate, and more accurate results can be obtained using the 5 percent TTT values. The time base adjustment was therefore achieved by adding to the theoretically calculated transformation time values the difference between the 5 percent transformation time and those calculated theoretically. In order to make this correction effectively, a mathematical expression for the variation of the 5 percent transformation time $\tau_{5\%}$ with temperature was needed. For this purpose the following equation was used:

$$1/\tau_{5\%} = Z \exp(-E/RT) \quad . \tag{87}$$

Least squares lines based on this equation agree very satisfactorily with the experimental data as shown in Figure 59. The values of the constants Z and E for these lines are listed in Table VIII. The final TTT curves calculated from the theoretical rate equations, using the computer program given in Appendix O, are shown in Figures 60, 61, and 62 together with the experimentally determined TTT data points from Figures 15, 16, and 17 and estimates of the 5% and 95% TTT points at 270°F obtained by extrapolation of the curves of Figures 19, 20, and 21. Except for the case of Run 42 shown in Figure 60, the agreement between the theoretically calculated TTT curves and the experimental TTT data is excellent over the temperature range 230° to 250°F where the experimental values are considered to be reasonably accurate. In addition, the agreement of the theoretical curves with

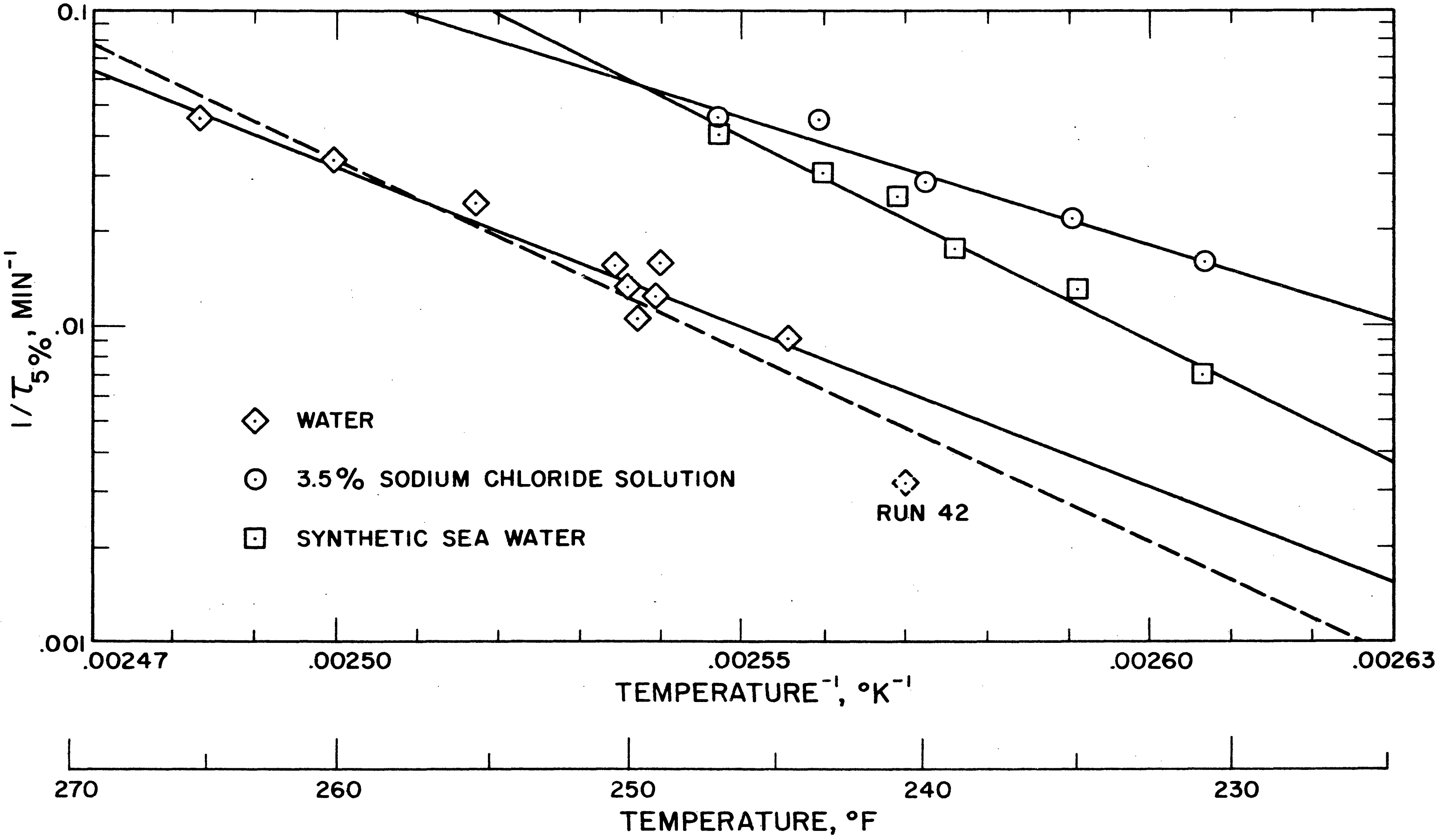


Figure 59. Least Squares Lines Based on the Arrhenius Equation Fitted to Time-Temperature-5% Transformation Data.

TABLE VIII

VALUES OF Z AND E CORRESPONDING TO FIGURE 59

Solution	Z, min^{-1}	E, Kcal/gm mole
Water	5.92×10^{23}	46.2
3.5% NaCl Solution	3.21×10^{19}	37.4
Synthetic Sea Water	4.42×10^{31}	59.3

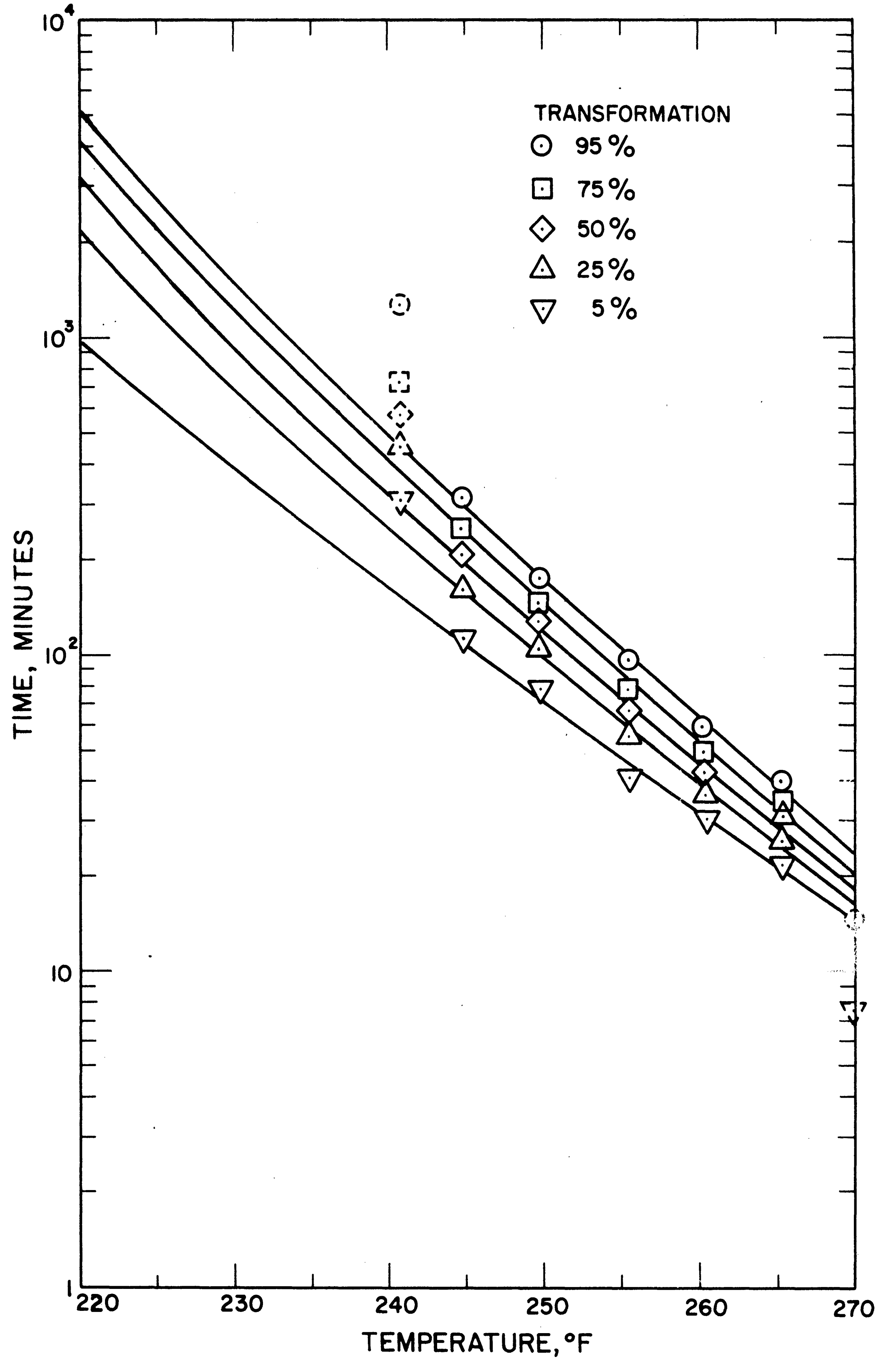


Figure 60. Comparison of TTT Curves Calculated from the Theoretical Equations with Experimentally Measured TTT Data for the Dihydrate-Hemihydrate Transformation in Water.

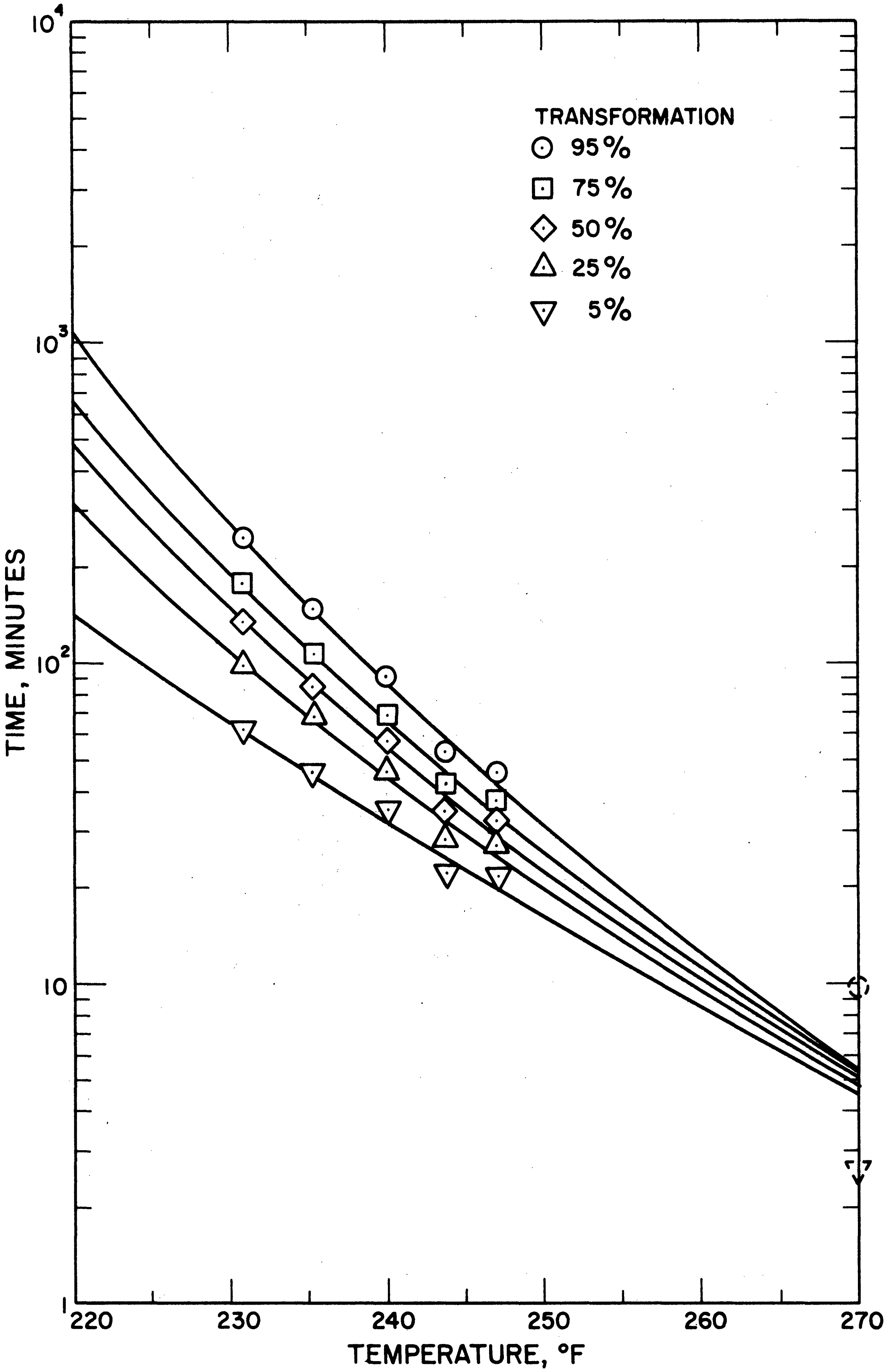


Figure 61. Comparison of TTT Curves Calculated from the Theoretical Equations with Experimentally Measured TTT Data for the Dihydrate-Hemihydrate Transformation in 3.5% Sodium Chloride Solution.

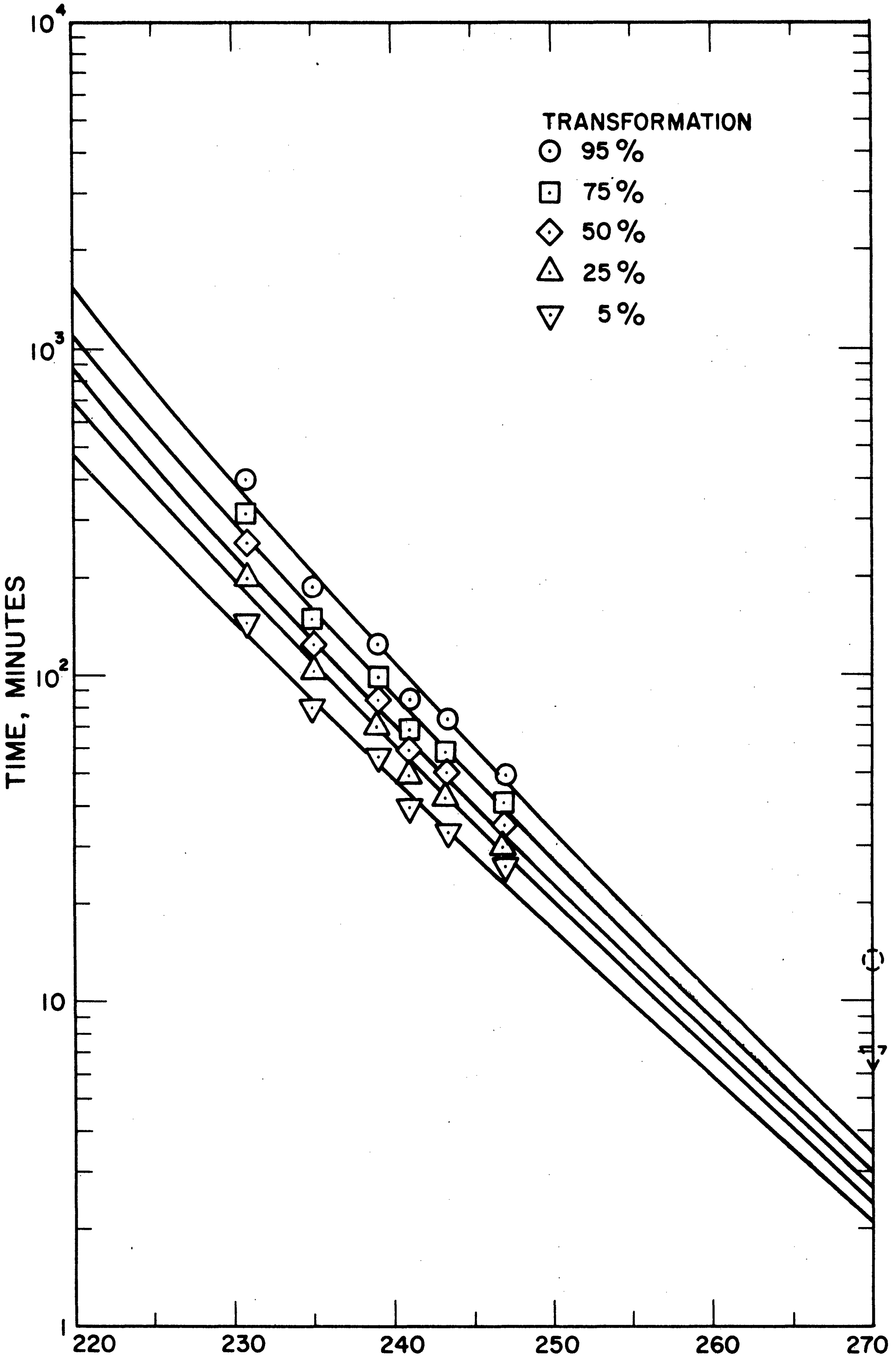


Figure 62. Comparison of TTT Curves Calculated from the Theoretical Equations with Experimentally Measured TTT Data for the Dihydrate-Hemihydrate Transformation in Normal Synthetic Sea Water.

the extrapolated experimental estimates at 270°F is quite acceptable, considering the large uncertainty associated with the experimental estimates at these temperatures.

The disagreement between the points for Run 42 and the theoretical curves is sufficient to cast doubt on the validity of the data from this run, and it is instructive to consider the basis for this in some detail because of the additional insight it provides concerning the role of various factors in the theoretical calculations. When the experimental TTT curves of Figure 15, 16, and 17 were first prepared, the rather sharp bend introduced by the points for Run 42 was noted and questioned but not considered particularly unusual because of the complex character of the system involved and because "C" or "S" shaped TTT curves are frequently encountered for solid transformations. The original experimental data were re-examined and the calculation of the TTT values was re-checked but no obvious mistakes were found. Some difficulty had been encountered with the thermocouple during the early part of the run, as indicated by the discontinuity in the potentiometer chart record which is reproduced in Figure 63; however, this difficulty had supposedly been taken care of, and the temperature values were subsequently assumed to be accurate. When Equation (87) was applied to the 5 percent transformation data for the reaction in water including the data from Run 42, the dashed least squares line shown in Figure 59 was obtained (with $Z = 4.25 \times 10^{28} \text{min}^{-1}$ and $E = 55.1$ Kcal/gm mole). Using this as the basis for the time correction, the theoretically calculated TTT curves shown in Figure 64 were obtained. The agreement between these curves and the experimental TTT data points was so much poorer than that for the

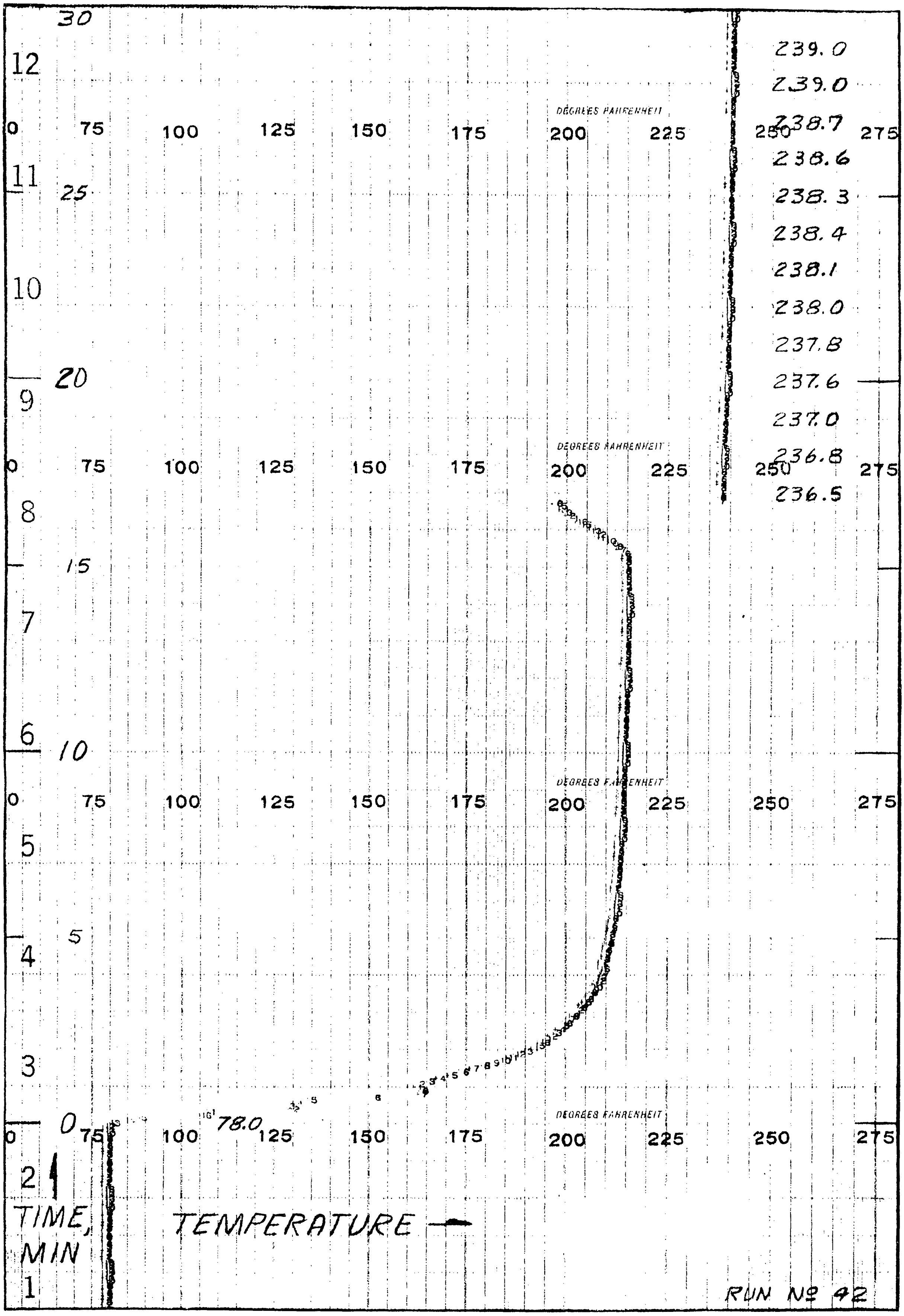


Figure 63. Initial Portion of the Potentiometric Chart for Run 42 Showing the Irratic Thermocouple Behavior at the Beginning of the Experiment.

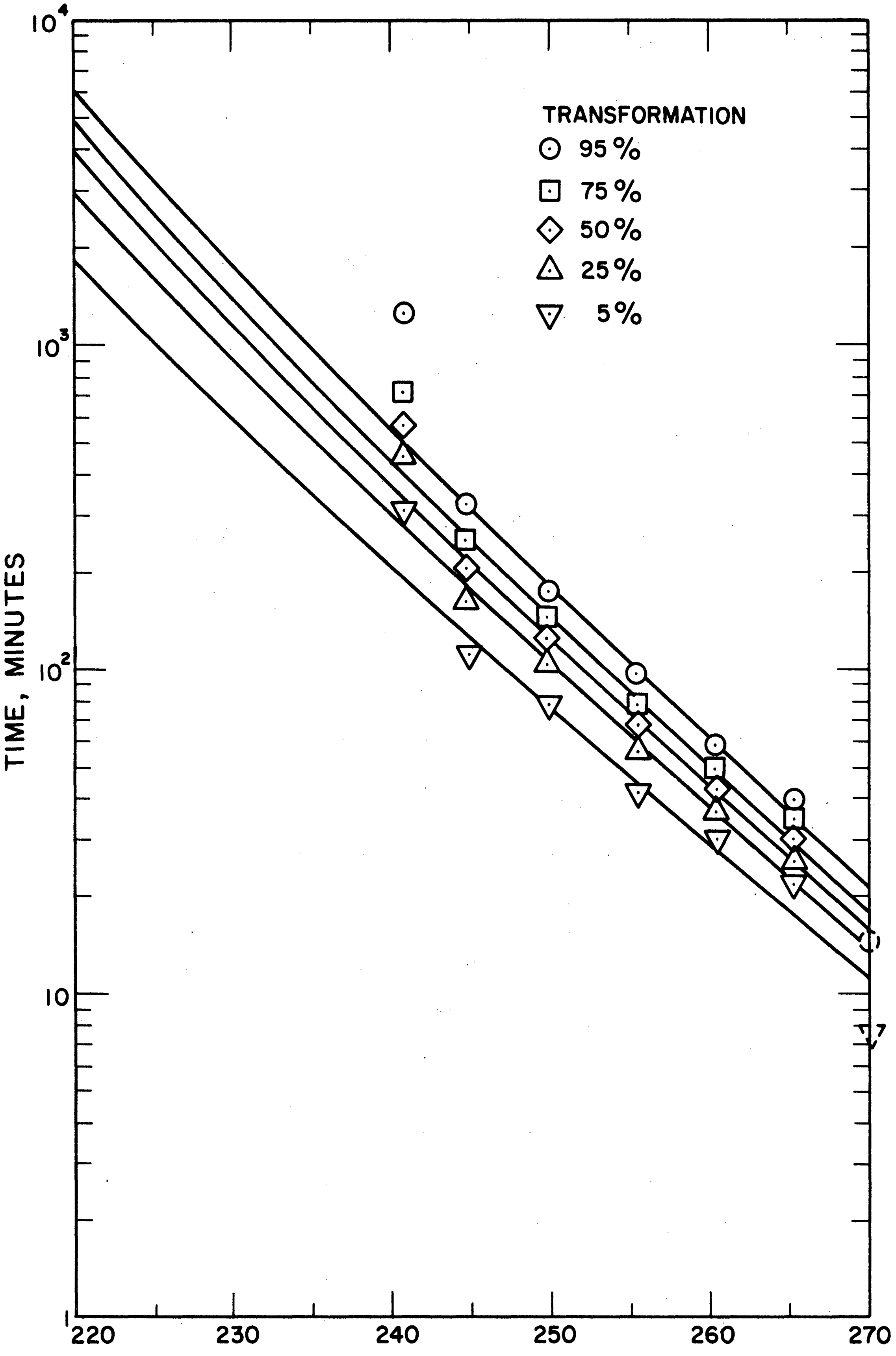


Figure 64. Comparison of TTT Curves Calculated from the Theoretical Equations with Experimentally Measured TTT Data for the Dihydrate-Hemihydrate Transformation in Water Using the Values for Run 42.

curves of Figures 61 and 62 that it was decided to disregard the data from Run 42 in these calculations, whereupon the curves shown in Figure 60 were obtained.

The reason for the apparent discrepancy between the data from Run 42 and the data from the other runs in water is not clear. It seems most likely that the trouble with the thermocouple was not fully eliminated and that the recorded temperature values are about 5°F too high. It is possible, however, that the reaction mechanism was different, since the reaction rates were the lowest encountered in the entire investigation due to the combined effects of the low reaction temperature and high activity value for water in the liquid of the reaction mixture (i.e. dilute calcium sulfate solution). Unfortunately, it has not been possible to repeat this run because the dilatometer has been dismantled for modification for use in another study. In any event, discarding the data from Run 42 seems justified from the practical point of view since it brings the theoretical curves into better agreement with the experimental data at the higher temperature which are of greatest importance in the operation of evaporators and heat exchangers. Thus, the theoretical curves are made potentially more useful for purposes of extrapolation.

Comparison of the TTT curves in Figure 60 with those in Figure 64 showsthe relative contributions of the various factors to the theoretical curves. In particular, it is evident that Equation (87), which relates temperature to the nucleation time for the transformation, establishes the time base for the theoretical curves and determines both the magnitude of the time values and the "slopes" of the curves.

Equations (62) to (65), which relate to the transformation mechanism, determine the spacing of the curves for different percent transformation relative to one another.

The use of Equations (62) to (65) has been restricted so far to calculation of TTT curves for the transformation of calcium sulfate dihydrate to hemihydrate in water, in 3.5% sodium chloride solutions, and in normal synthetic sea water. Ideally, it would be desirable to develop a means for making similar calculations for solutions of other compositions and concentrations. To do this, however, it is necessary to have an equation similar in function to Equation (87) but which gives the variation of $\tau_{5\%}$ with both temperature and solution composition. Only the following equation, selected by analogy with Equation (85), has been tried for this purpose to date:

$$[(1/\tau_{5\%})-(1/\tau_{5\%})_o]/[1-P/P°] = Z \exp(-E/RT) \; . \qquad (88)$$

The least squares line, based on this equation and calculated using all the $1/\tau_{5\%}$ values available for sodium chloride solutions and synthetic sea water concentrates and calculated $(1/\tau_{5\%})_o$ values for water, is shown in Figure 65 together with the points which indicate the individual calculated values for the variables of the equation. The values of the constants Z and E for this line are 4.40×10^{26} min^{-1} and 47.5 Kcal/gm mole, respectively. The agreement between the point values and the line is not considered especially good because of the considerable deviation of many of the points from the line, but particularly because points calculated from runs in the sodium chloride solutions and in the synthetic sea water concentrates appear to define separate least squares lines (shown dashed in Figure 65) rather than to be

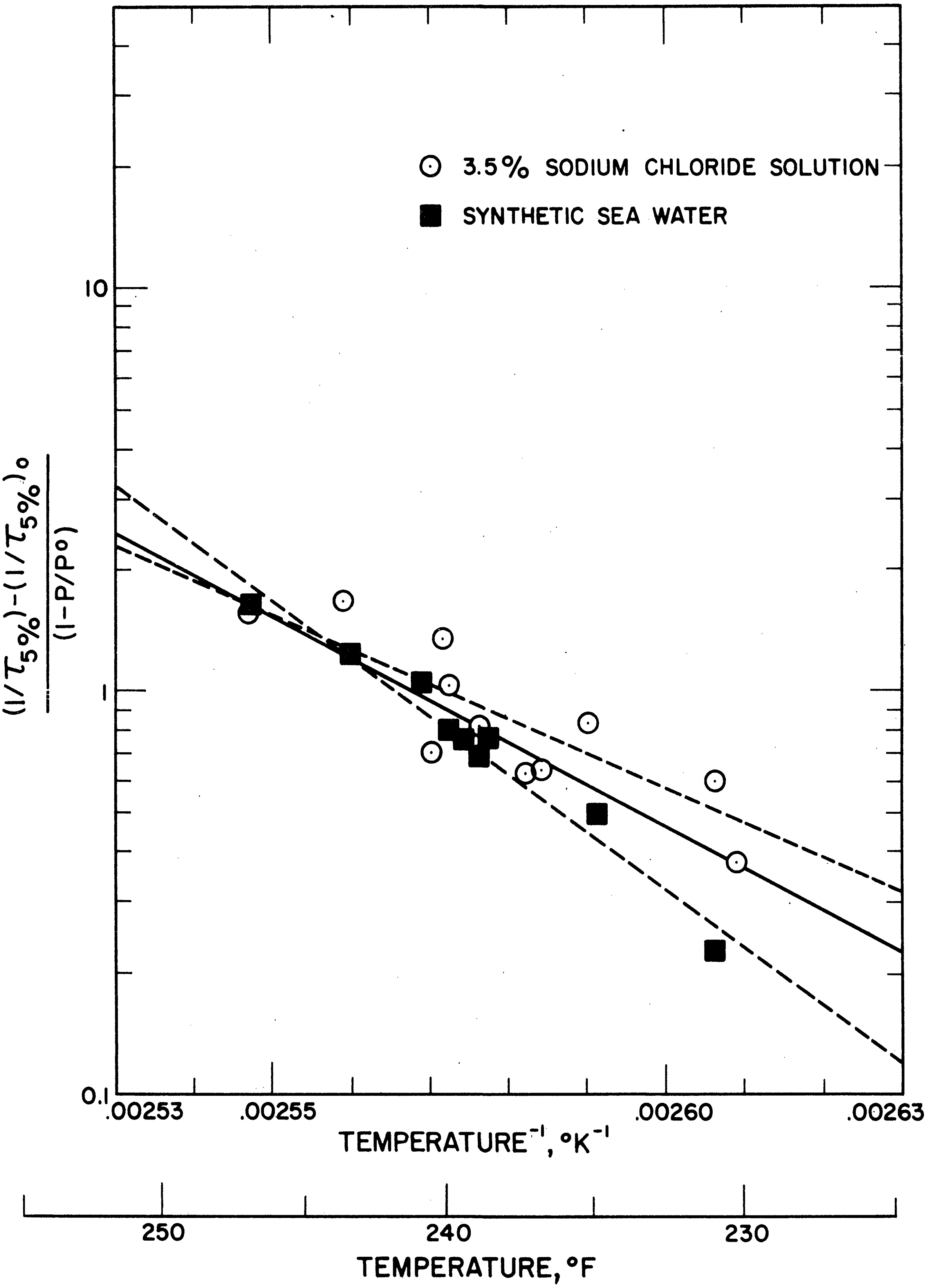


Figure 65. Least Squares Lines Based on the General Correlation Fitted to Time-Temperature-5% Transformation Data.

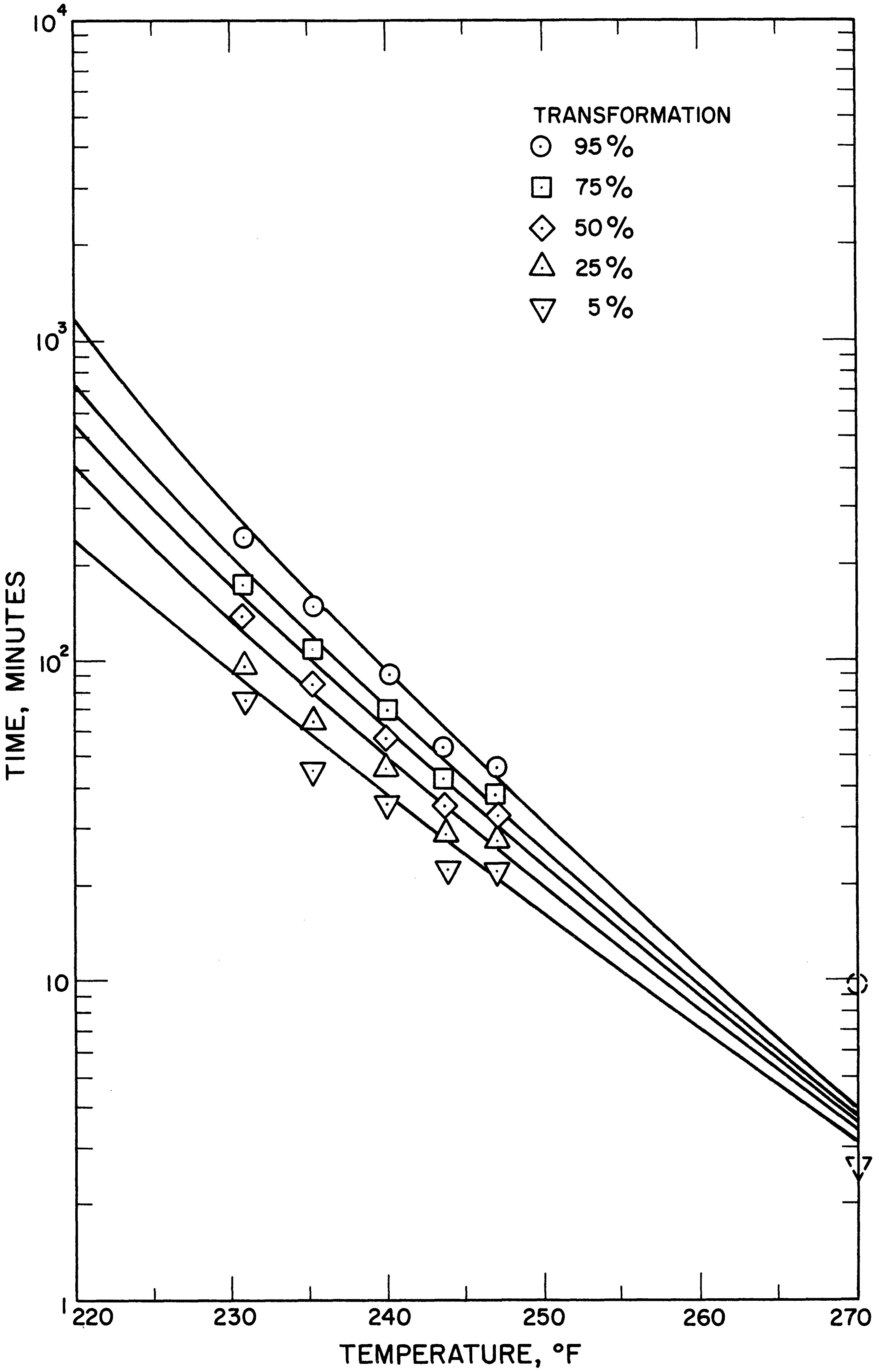


Figure 66. Comparison of TTT Curves Calculated from the Theoretical Equations with Experimentally Measured TTT Data for the Dihydrate-Hemihydrate Transformation in 3.5% Sodium Chloride Solutions Using Generalized Correlation for $1/\tau_{5\%}$.

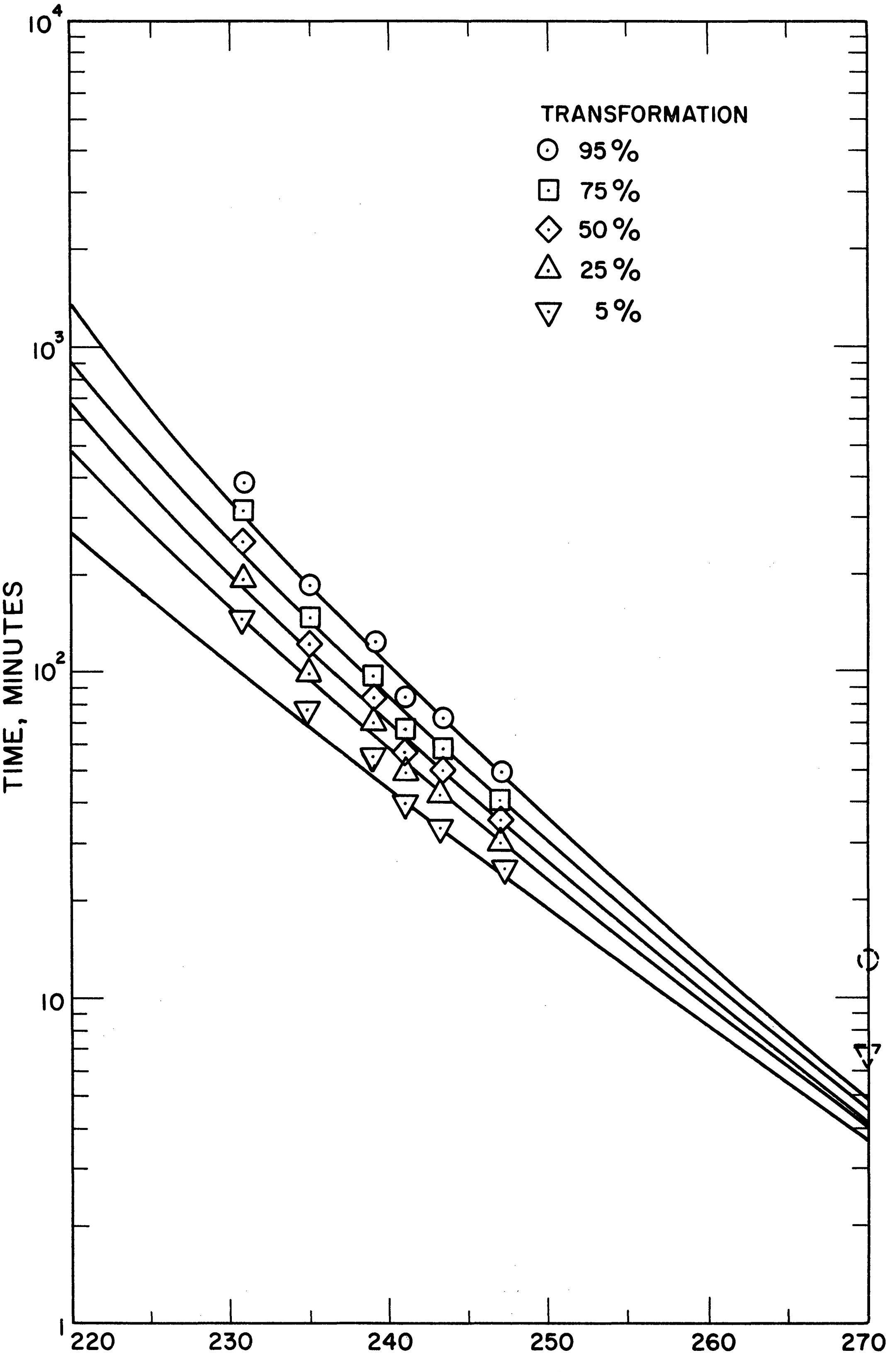


Figure 67. Comparison of TTT Curves Calculated from the Theoretical Equations with Experimentally Measured TTT Data for the Dihydrate-Hemihydrate Transformation in Normal Synthetic Sea Water Using Generalized Correlation for $1/\tau_{5\%}$.

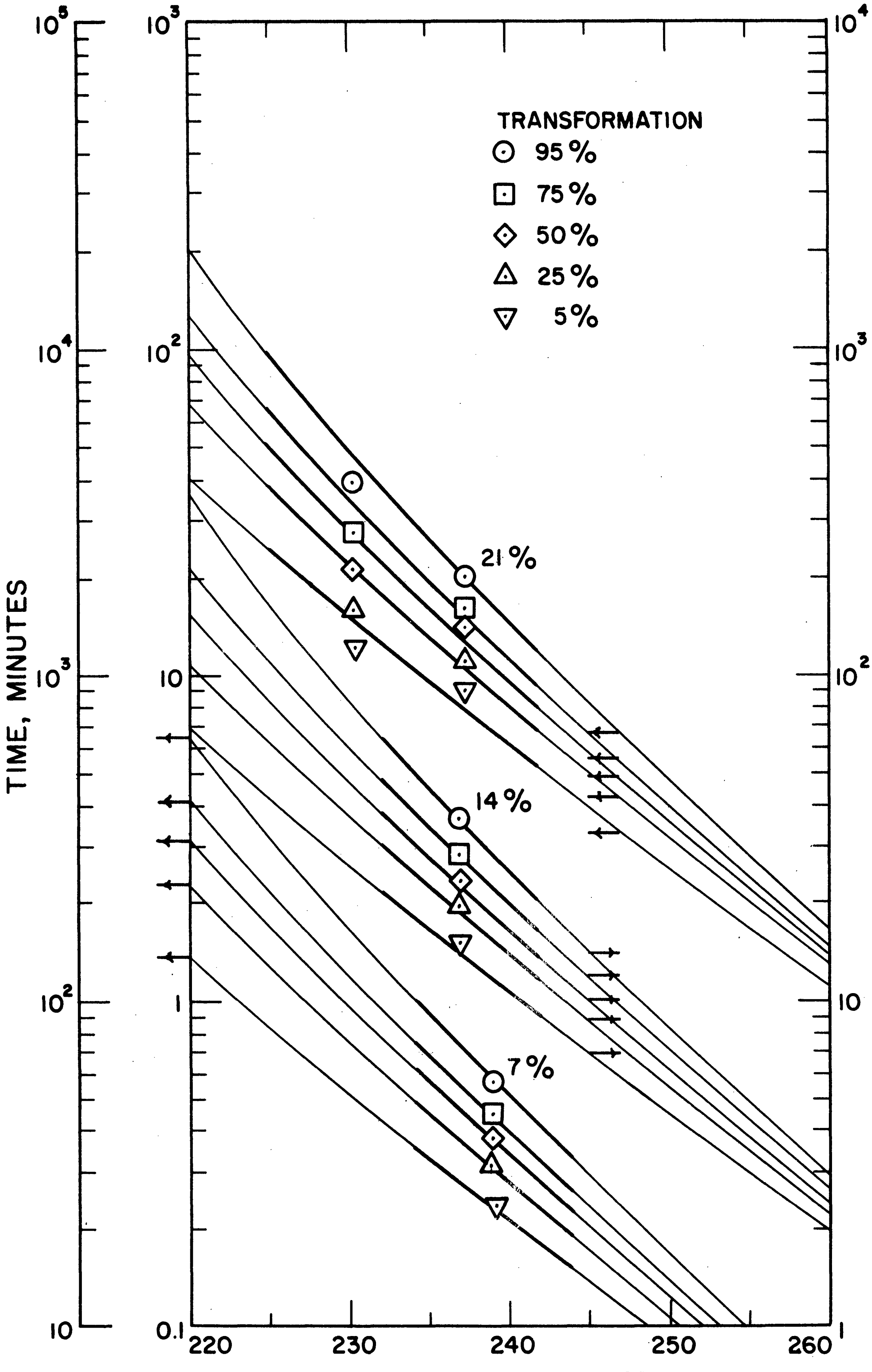


Figure 68. Comparison of TTT Curves Calculated from the Theoretical Equations with Experimentally Measured TTT Data for the Dihydrate-Hemihydrate Transformation in 7%, 14%, and 21% Sodium Chloride Solutions.

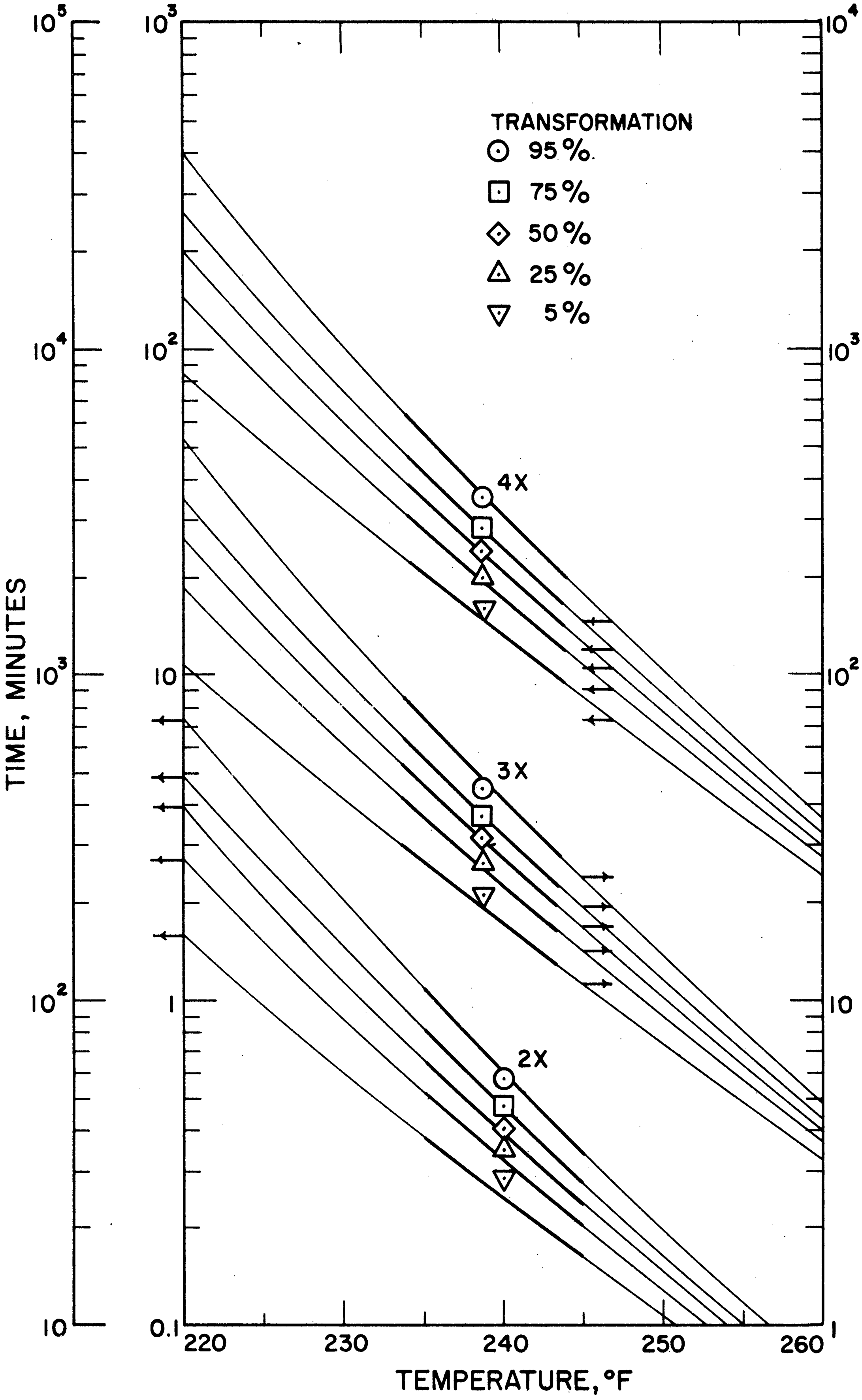


Figure 69. Comparison of TTT Curves Calculated from the Theoretical Equations with Experimentally Measured TTT Data for the Dihydrate-Hemihydrate Transformation in Synthetic Sea Water Containing 2, 3, and 4 Times the Salts of Normal Synthetic Sea Water.

distributed randomly around the least squares line obtained using the pooled data (shown solid in Figure 65).

TTT curves for the transformation in 3.5% sodium chloride solutions and in normal synthetic sea water, calculated from Equations (62) to (65), using $\tau_{5\%}$ values calculated from Equation (88) to establish the time base, are shown in Figures 66 and 67 together with the experimentally derived TTT values from Figures 16 and 17 and the estimated 5% and 95% TTT values at 270°F obtained from Figures 20 and 21. Although the agreement of these theoretically calculated TTT curves with the experimental results is not as good as before over the temperature range from 230° to 250°F, it is nonetheless acceptable, considering the overall complexity of the undertaking. On the other hand, the agreement between the extrapolated theoretical curves and the two extrapolated data points at 270°F is nearly as good as before. This suggests that the theoretical TTT curves in Figures 66 and 67 may be useful for estimating TTT values at higher temperatures for applications where high accuracy is not required. On this basis, the procedure was also applied to 7.0%, 14.0% and 21.0% sodium chloride solutions and to synthetic sea water concentrates of 2, 3, and 4 times that of normal synthetic sea water. Only limited experimental data are available for these solutions; however, the agreement between the theoretically calculated curves and the data points is generally good, as shown in Figures 68 and 69. The theoretical curves were calculated over the temperature range from 220° to 260°F, even though data were not available to test them over this entire range, providing "order of magnitude" values in a form readily available for comparison with future measurements.

VI. DISCUSSION

The dehydration of calcium sulfate dihydrate to hemihydrate occurs in aqueous and brine solutions by nucleation of hemihydrate needles on the surface of the dihydrate crystals followed by the growth of these needles through the dihydrate phase. Impingement between adjacent nuclei or between nuclei and the sides of the parent dihydrate crystal eventually terminates the reaction. Because the dihydrate phase is transformed by many hemihydrate needles, the rate of reaction measured dilatometrically represents the sum of the growth rates of all these needles. Consequently, changes in either their growth rates or growth patterns may change the total rate of the reaction. A practical meaning was added to these observations by postulating a model which describes the total rate of reaction as the sum of these individual growth rates, making it possible to understand the characteristics of the reaction from both microscopic and macroscopic points of view.

The special technique for synchronizing the recording of time, temperature, and liquid height in the capillary provided data suitable for numerical differentiation, resulting in rate values exhibiting a minimum of scatter and clearly indicating the detailed changes in the rate of reaction with time. Fitting the theoretical equations describing the postulated mechanism to this differentiated data yielded values for the kinetic constants contained in these equations for different conditions of temperature, solution composition, and initial dihydrate crystal size. From these observations, empirical equations were developed describing the effects of temperature and water activity on these kinetic constants, making it possible to calculate the values of the kinetic constants for the desired reaction conditions. Using these empirical correlations and the theoretical equations, TTT curves were calculated which passed through the experimental data points as accurately as those drawn by visual inspection, indicating the highly acceptable accuracy of these calculations. Comparison of the theoretical TTT values for 270°F with extrapolated experimental values obtained at higher temperatures showed good agreement indicating that extrapolation up to 270°F is reasonable.

A. Dihydrate-Hemihydrate Transformation

Changes in the characteristics of the dihydrate-hemihydrate transformation can be described in terms of three major variables: temperature, activity of the water in the solution surrounding the reacting solids, and the initial dihydrate particle size. Because of the close agreement between the theoretical curves and the experimental data, changes in the characteristics can be described in terms of either of these equally well. In the following discussion, the values used in the numerical examples were obtained from the theoretical curves.

1. Effect of Temperature

The overall rate of reaction increases rapidly with rising temperature because both the nucleation and growth processes increase with increasing temperature. The acceleration of the nucleation process over the temperature range 230° to 270°F is shown by the marked decrease in induction time for the reaction, estimated by the 5% transformation curves. For the reaction in water the induction time decreases from 400 to 15 minutes, in 3.5% sodium chloride solutions it decreases from 66 to 6 minutes, and in synthetic sea water it decreases from 150 to 2 minutes. Acceleration of the nucleation process is also shown by the rapid increase in the values of the nucleation rate constant with increasing temperature. Small changes in temperature result in large changes in the values of the nucleation rate constant because the slopes of the correlating lines are very steep as indicated by the high activation energies of 62, 78, and 80 Kcal/gm mole for the reaction in water, in 3.5% sodium chloride solutions, and in synthetic sea water, respectively.

The growth processes were also greatly accelerated by relatively small increases in temperature as shown by the changes in reaction time, estimated by the time difference between the 5% and the 95% transformation curves. Over the same temperature range (230° to 270°F) for the reaction in water, the reaction time decreases from 1200 to 10 minutes, in 3.5% sodium chloride solutions it decreases from 224 to 1 minute, and in normal synthetic sea water it decreases from 250 to 1 minute. Correspondingly, the kinetic growth constants also increase with increasing temperature very rapidly as indicated by the high experimental values obtained for their activation energies, i.e. between 56 and 80 Kcal/gm mole.

2. Effect of Water Activity

The overall rate of reaction also increases with decreasing activity of the water in the solution surrounding the solids. Both the nucleation and growth processes are accelerated by small changes in the water activity which was obtained by using different sodium chloride solutions and synthetic sea water concentrates at 240°F. The acceleration of the nucleation process is shown by the decrease in induction time from

170 to 6 minutes for a change in activity from 1.0 to 0.83, i.e. from water to 21% sodium chloride solution.. For this same change in activity, the nucleation rate constant increases by a factor of almost 40 from a value of 0.017 to a value of 0.62.

Likewise, the growth processes were also accelerated by relatively small changes in water activity, as indicated by the decrease in the reaction time from 350 to 10 minutes for the same activity change from 1.0 to 0.83. The kinetic growth constants also increase from relatively small values to relatively large ones for this change in activity. Thus, the overall rate of reaction increases because of the increase in the rates of nucleation and growth resulting from the decrease in water activity.

3. Effect of Initial Particle Size

For changes in initial dihydrate particle size, the overall rate of reaction does not appreciably change except when very large or very small particles are used, then the entire reaction mechanism also changes. This change in mechanism was observed experimentally in a large single crystal and in a fine powder sample. Each case is discussed in detail later. However, between these two extremes, the slight changes in the overall rate of reaction are due primarily to changes in the nucleation process, since all the kinetic growth constants remain approximately constant and independent of the initial dihydrate particle size. The induction times measured at 250°F seemingly go through a minimum value with changing particle size. They decrease from values near 120 minutes to a value near 60 minutes at the minimum as the particle sizes change from of 0.018 and 0.002 inches to the values at the minimum of 0.01 inches. On the other hand, the nucleation rate constant goes through a maximum for approximately this same particle size, increasing from values near 0.025 to a value near 0.05 at the maximum. Thus, the nucleation parameters change by a factor of two for these changes in particle size, while the growth parameters remain essentially constant, resulting in very little change in the overall rate of reaction.

B. Hemihydrate-Anhydrite Transformation

Although the characteristics of the dihydrate-hemihydrate transformation were studied in considerable detail, the hemihydrate-anhydrite reaction was examined only to confirm the stepwise transformation of calcium sulfate dihydrate to hemihydrate to anhydrite, in water, in 3.5% sodium chloride solutions, and in normal synthetic sea water. This reaction was observed only at three different temperatures for the three different solutions resulting in nine sets of data values. The effects of temperature and water activity on the hemihydrate-anhydrite transformation were estimated from the TTT curves drawn through these data values.

The increase in the overall rate of reaction observed for the hemihydrate-anhydrite reaction probably results from increases in both the nucleation and growth processes with rising temperature. The increase in the nucleation process is indicated by the decrease in the induction time. In water, the induction time decreases from 510 to 475 minutes, while in 3.5% sodium chloride solutions and in normal synthetic sea water, it decreases from 185 to 100 minutes over the temperature range 325° to 350°F. Based on the observed relationships between the behavior of the induction time and nucleation rate constant for the dihydrate-hemihydrate reaction, one can assume that the nucleation rate constant increases with temperature for this reaction. Judging from the rate of change of the induction time with temperature, one can also assume that the rate of nucleation is less sensitive to temperature changes for this reaction than for the first reaction. The growth rates, likewise, are assumed to increase with increasing temperature because the reaction time decreases with increasing temperature. For example, in water, the reaction time decreases from 1000 to 500 minutes, while in the two brine solutions, it decreases from 245 to 145 minutes.

The overall rate of reaction also increases with decreasing activity of water, again probably because of increases in both the nucleation and growth processes. These increases are indicated by the decreases in induction time from 490 to 190 minutes, and the decrease in the reaction time from 1100 to 250 minutes, for a decrease in activity form 1.0 to 0.98. From these time changes, it seems that the hemihydrate-anhydrite reaction is more sensitive to changes in activity of water than the dihydrate-hemihydrate reaction, but this can only be confirmed after a model has been successfully postulated and the functional relationships between the water activity and the rate constants have been established.

C. Reaction Model

The postulated reaction model for the dihydrate-hemihydrate transformation has been shown to describe adequately both the rate and TTT data over a fairly wide range of temperature and water activity. Certain aspects of the model which were presented earlier in the dissertation, but not discussed fully, are treated here along with some new aspects. In particular, the nature of the assumptions and possible refinements are examined along with a brief discussion on the rate controlling step of the mechanism. The correlations of the kinetic constants are examined showing their limitations and their range of applicability.

1. Basic Assumptions

The model for the reaction mechanism was highly idealized in order to obtain theoretical equations which describe the nucleation and growth phenomenon encountered in the dehydration of calcium sulfate dihydrate. The basic assumptions are: (1) that all the dihydrate crystals used in each sample have the same size and shape, (2) that nucleation of the hemihydrate phase occurs on the (001) cleavage planes of the dihydrate crystals with uniform spacing, (3) that all the hemihydrate needles grow with the same velocities U_A , U_B , and U_C in their respective directions, and (4) that impingement occurs simultaneously at the opposite sides of the transformed hemihydrate subcrystals. Starting with these assumptions, equations were developed which describe the experimental rate data reasonably well and the TTT data remarkably well. Based on this good agreement between the values calculated using the model and the experimental data, any modification of these assumptions, in an attempt to improve the model, can only be considered secondary refinements.

One such possible refinement would be to bring the configuration of the initial dihydrate particles into closer agreement with the assumption of uniform particle sizes by growing uniform crystals from solution. This change would probably decrease the scatter in the experimental data to some extent. Another possible refinement would be to assume a more complicated impingement process to characterize the transformation mechanism. This change could result in the addition of several adjustable parameters which could improve the fit of the experimental data between Θ_1 and Θ_3 .

2. Rate Controlling Process

When a reaction is composed of more than one process, it is valuable to know which process is the rate controlling one. In the dihydrate-hemihydrate reaction where both nucleation and growth processes occur, the rate controlling step was found to be the growth process where the hemihydrate interface moves through the dihydrate crystal, since the nucleation process is relatively quickly terminated. The movement of this interface can itself be limited by two processes occurring at the interface: the chemical reaction resulting in the formation of the hemihydrate phase containing an excess of water, and the diffusion of this excess water from this transition zone to the bulk solution. The chemical reaction step was found to be the rate controlling one by the elimination of the possibility that diffusion was controlling. This was accomplished by observing the rates of interfacial movements recorded in Appendix M. Since these rates are approximately constant and independent of the length of the hemihydrate needles, the diffusion process was eliminated because it predicts a decrease in rate with an increase in length of the hemihydrate needle.

It is still valuable, however, to compare the theoretical equations derived in Appendix Q for the chemical reaction:

$$\frac{(U/d) - (U/d)_o}{1-(P/P^\circ)^{3/2}} = Z \exp(-E/RT) \qquad (89)$$

and for diffusion:

$$\frac{(U/d) - (U/d)_o}{1-P/P^\circ} = \frac{Z}{x} \exp(-E/RT) \qquad (90)$$

with empirically derived Equation (85):

$$\frac{(U/d) - (U/d)_o}{1 - P/P^\circ} = Z \exp(-E/RT) \ .$$

The chemical reaction equation indicates that the P/P° term should be raised to the 3/2 power, and the diffusion equation indicates that a distance parameter x is needed. The interesting fact here is that the equation for the chemical reaction is the same as Equation (85) since the term $1-P/P^\circ$ is proportional to $1-(P/P^\circ)^{3/2}$ as long as $P/P^\circ \geq 0.6$. Consequently, it can not be said whether Equation (89) or (85) best describes the relationship between the water activity and the kinetic constants over the complete range of water activity, 0.0 to 1.0 . Since all the data available are for values of $P/P^\circ \geq 0.8$, the validity of the chemical reaction equation can neither be proven conclusively nor disproven until additional data becomes available. Obviously once this happens, the true relationship can be determined. Until this occurs, however, the empirical correlation given by Equation (85) will be used to describe the relationship between temperature and water activity for the kinetic constants.

3. Theoretical Equations

The theoretical equations were previously shown to describe the experimental rate data over the temperature range 230° to 270°F and over the water activity range of 1.0 to 0.83 for one set of particles separated between screens having 0.0082 and 0.0069 inch openings. The equations were also applied to experimental results obtained using 10 different initial particle sizes separated between 11 screens bracketed by screens having 0.0164 and 0.0021 inch openings. Whenever these equations are used to extrapolate the data beyond this limited range of experimental conditions, caution should be exercised.

a. Limitations. Six limitations must be considered whenever the equations describing the dihydrate-hemihydrate reaction mechanism are used: (1) the range of water activity, (2) the initial dihydrate particle size, (3) the accuracy of the $1/\tau_{5\%}$ correlation, (4) the mechanism change for large particles, (5) the mechanism change for small particles, and (6) the mechanism change caused by temperature changes.

(1) From the discussion on the rate controlling step, it is obvious that the theoretical equations can only be safely extrapolated to values of activity near 0.6, because beyond this point the form of the correlating equation is questionable. Since the limits of solubility of sodium chloride solutions and synthetic sea water concentrates occur for an activity near 0.7, this particular problem should not restrict the applicability of this equation to aqueous and brine solutions normally encountered in desalinization processes. However, this limitation will become important whenever the reaction occurs in aqueous solutions capable of having extremely low water activities, i.e. concentrated ethanol-water solutions.

(2) Another limitation on the application of these equations results from the fact that the effects of initial dihydrate particle size were never incorporated into the equations giving the nucleation rate constant and the induction times as functions of temperature and water activity. These equations are all based on measurements made using only one initial dihydrate particle size close to the size which gives a

maximum nucleation rate constant and a minimum induction time. Consequently, the results from this study exhibit almost the shortest possible induction times and the highest possible nucleation rates. Applying these results to processes where the dihydrate crystals may have different sizes under different experimental conditions may result in conservative estimates with respect to nucleation times, since the actual reactions would probably exhibit induction times greater than those calculated from these correlations.

(3) Another limitation also exists on the correlation of induction times. The correlation of $1/\tau_{5\%}$ with temperature and water activity was not considered as satisfactory as the other correlations because the data for sodium chloride solutions and synthetic sea water fell around two separate lines instead of around the one least squares line for all the data pooled together as shown in Figure 65. This correlation can be improved by the addition of another parameter which should bring the data into one straight line. One such parameter might be the supersaturation of the bulk solution with respect to the nucleating, hemihydrate phase, but this possibility could not be checked since the concentration of calcium sulfate was not known for all the solutions used.

(4) One of the more important factors limiting the range of applicability of the model is the assumption that the hemihydrate phase grows almost instantaneously through the dihydrate crystal in the C direction and that the remaining growth is two-dimensional, allowing the transformation to be described by a two-dimensional, mathematical model. This assumption is valid as long as the time for growth in the C direction is small and considerably less than θ_1. The time for growth

depends upon both the final hemihydrate crystal dimension c and on the rate of growth of the hemihydrate needle U_C , and it is defined as: $\Theta_c = c/U_C$. Whenever this assumption is no longer valid, growth can not be described by a two-dimensional model but must be described by a three-dimensional model. For such a case, the growth in the C direction must also be treated as a function of time. Such a treatment results in four possible, three-dimensional models, one applicable for each of the following conditions: $\Theta_c \leq \Theta_1$, $\Theta_1 \leq \Theta_c \leq \Theta_2$, $\Theta_2 \leq \Theta_c \leq \Theta_3$, and $\Theta_c \geq \Theta_3$.

Experimental evidence of this change in mechanism, where growth in the C direction is no longer instantaneous, is shown by the results of run 6 which represent the conditions where $\Theta_c \geq \Theta_3$. The theoretical equations for this special case were derived as shown in Appendix R and used to calculate the theoretical rate curve based on four impingement times: Θ_1 , Θ_2 , Θ_3 , and Θ_c . Figure 70 shows the experimental data points obtained for this run along with the smooth rate curve calculated using the three-dimensional model. The agreement is considered fairly good as a first estimate, since only a few estimates of the four impingement times were made. For the first 50 minutes of this reaction, the data values were probably masked by the thermal volume expansion because the reaction probably nucleated faster than usual because of the sawing technique used in shaping the initial crystal. Nevertheless, the overall agreement is considered satisfactory.

(5) Another important factor limiting the model is the assumption that all the initial dihydrate particles are parallelepipeds having the same size and shape. The inherent cleavage properties of the dihydrate crystals allow this assumption to remain valid for all but the smallest

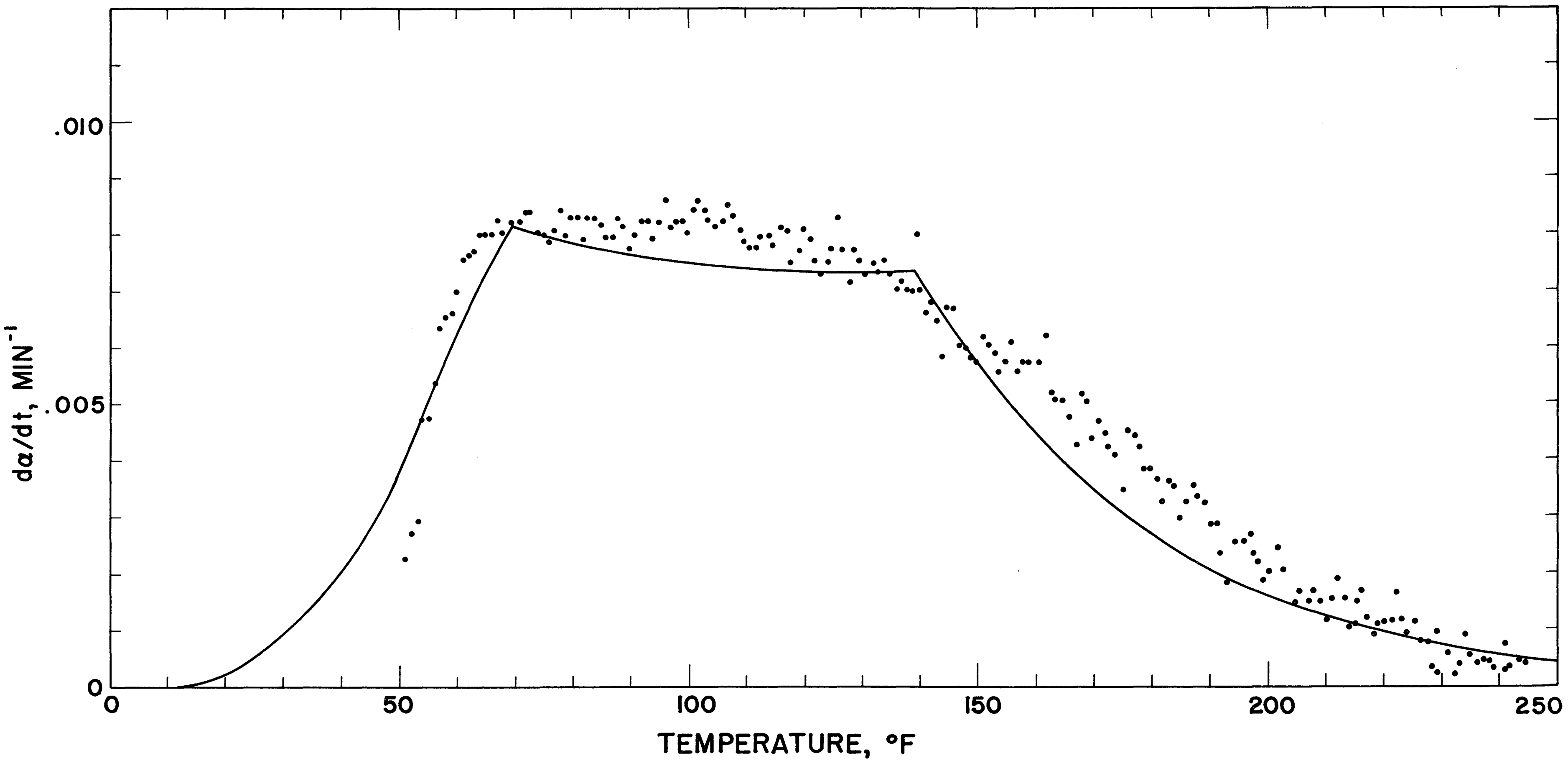


Figure 70. Fit of the Theoretical Curve, Calculated Using the Three-Dimensional Model, to the Experimental Data for Run 6 for the Dehydration of a single crystal of Calcium Sulfate Dihydrate to Hemihydrate in Water at 261°F.

particles, where crushing and grinding eventually results in particles having the shapes of polyhedrons or spheres with rough surfaces. As the particles become smaller and more nearly spherical in shape, the impingement process probably changes because of the increasing percentage of impingement between the hemihydrate needles and the spherical surface. This is accompanied, of course, by a decrease in the amount of impingement between adjacent nuclei because the number of nuclei per particle decreases as the particle size decreases. When this happens, the shape of the reaction rate-versus-time curves changes to the shape of one exhibiting a minimum between two maxima as shown in Figures 71 and 72 for runs 33 and 16, respectively.

(6) Changes in temperature for a constant initial particle size can also cause this same effect to occur. In this case, as the temperature decreases, the number of hemihydrate needles per particle also decreases resulting in more impingement between nuclei and the curved surface of the dihydrate particle, and less impingement between adjacent nuclei. Thus, the transformation mechanism can be changed by either grinding the particles small enough and reacting at one temperature, or by lowering the temperature while holding the particle size constant.

The conditions under which this phenomenon occurs are shown graphically in Figure 73 where the average particle diameters (estimated by the average screen size openings D) are plotted along with the values of the b dimension of the transformed hemihydrate subcrystal calculated in Appendix S. As the value of b approaches that of the average crystal diameter D , the change in reaction mechanism becomes more apparent as shown by the change in shape between runs 33 and 16, where the depth of

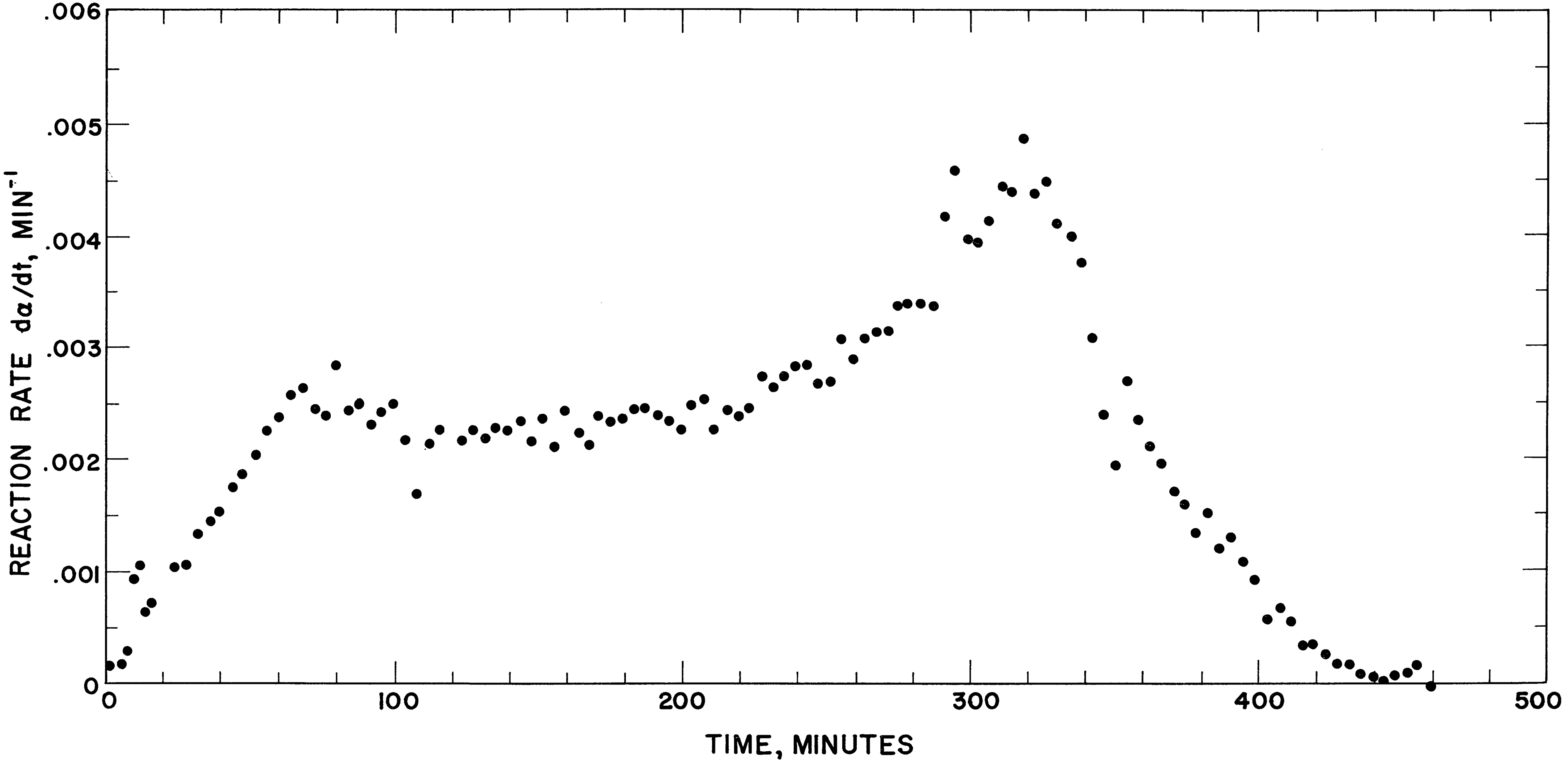


Figure 71. Variation in the Reaction Rate as a Function of Time for Run 33 on the Transformation of Calcium Sulfate Dihydrate to Hemihydrate in Water at 250°F Using Extremely Fine Dihydrate Particles.

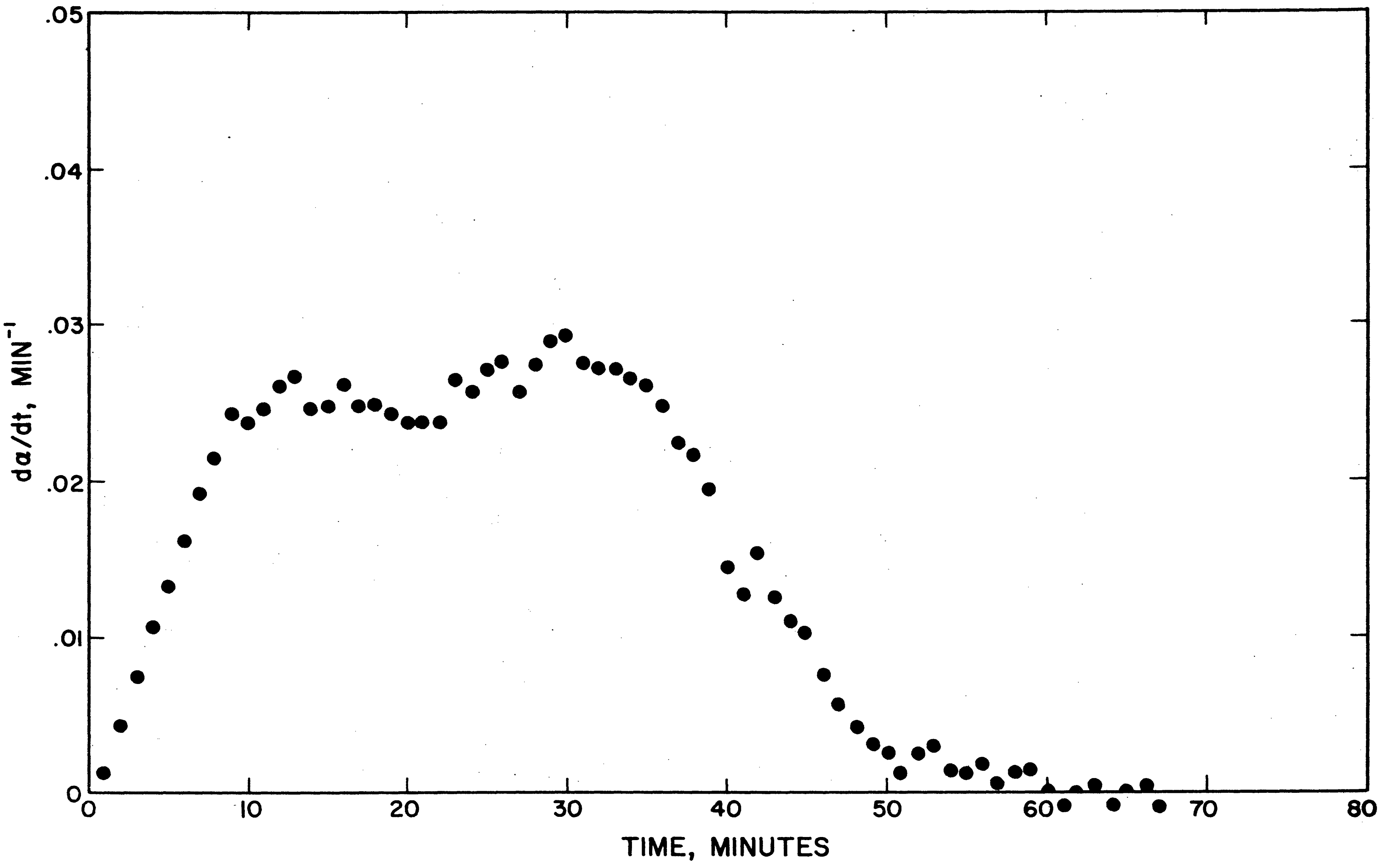


Figure 72. Variation in the Reaction Rate as a Function of Time for Run 16 on the Transformation of Calcium Sulfate Dihydrate to Hemihydrate in Water at 260°F Using Extremely Fine Dihydrate Particles.

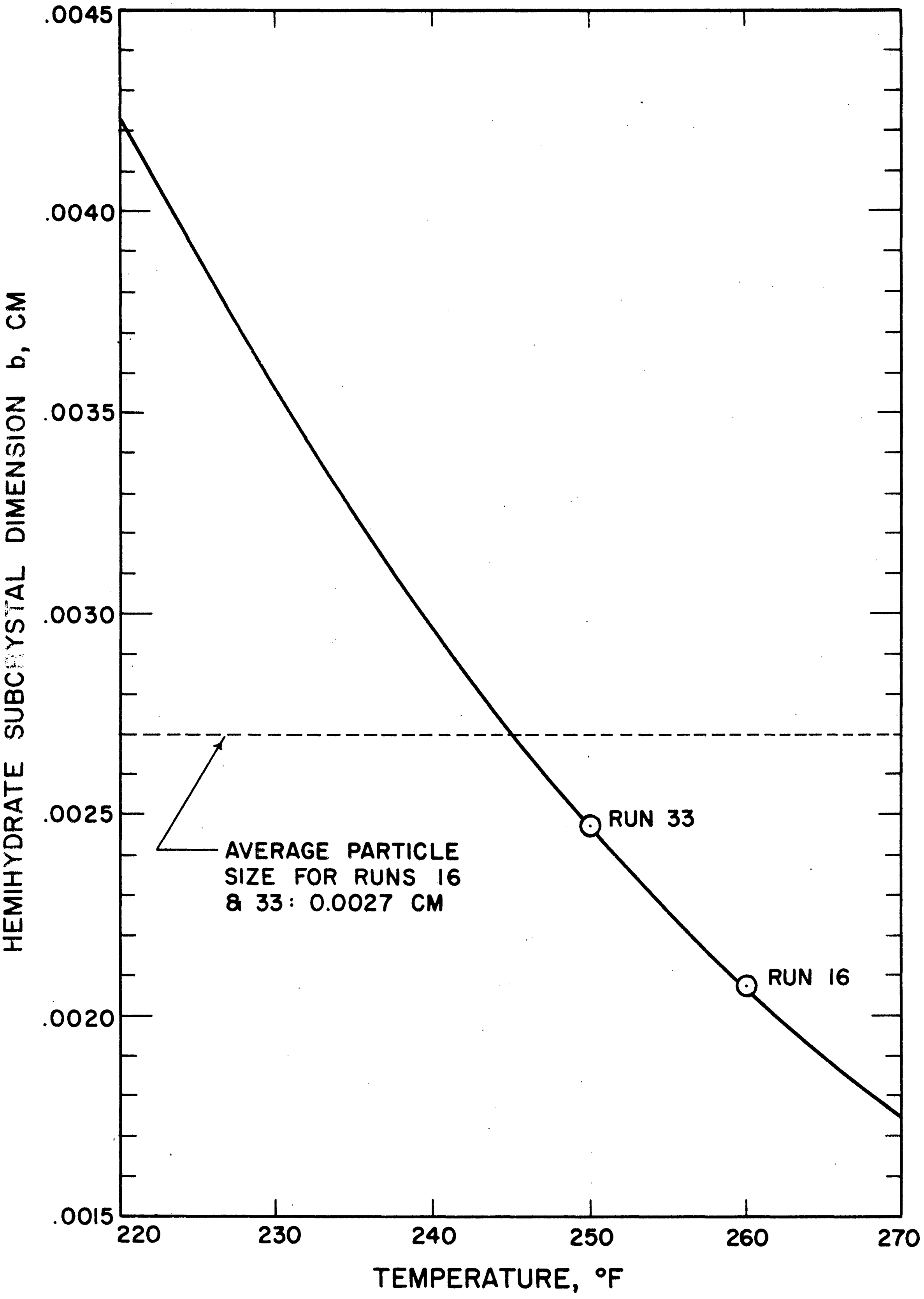


Figure 73. Relationship Between Values of the b Dimension of the Hemihydrate Subcrystals as a Function of Temperature and the Average Particle Size for Runs 16 and 33.

the minimum increases with decreasing temperature. For a reaction at still lower temperatures, this change should become even more apparent. This was confirmed by the characteristic shapes of the rate curves observed by Budnikoff(12) for the dehydration in air at 225°F of samples of powdered selenite, shown in Figures A-3 and A-4 of Appendix A.

b. *Range of Applicability.* The theoretical equations derived from the postulated reaction mechanism should be applicable over the temperature range 230° to 270°F, and over the water activity range 0.6 to 1.0, provided the initial particles meet the following conditions: First, the particles must be small enough so that the time of growth in the C direction is almost instantaneous: i.e., $0 \simeq c/U_C \ll \Theta_1$. Second, the crystal must be large enough so that each particle is approximately a parallelepiped transformed by several hemihydrate needles: i.e., $b \ll D$.

D. Applicability of Results

The aim of most engineering research is to obtain numerical results which can be applied to industrial processes. Before the TTT results obtained in this study can be applied directly to the calcium sulfate scale problem, some means of classifying the crystal size and shapes in industrial dihydrate scale must be obtained. Some estimate must also be obtained of the effects of impurities entrained in the scale on the rate of reaction and on the impingement process. Since the proposed model accurately describes the rate of transformation in irregularly shaped dihydrate crystal fragments, it is believed that the model will also be able to describe the transformation in actual calcium sulfate scale.

The time-temperature-transformation results reported in this dissertation should be especially useful in the design and evaluation of certain phases of many desalinization processes. Information previously available for this purpose, on the calcium sulfate-water system, consists primarily of the values of transition temperatures which only indicate if the phase transformation can occur or not, whereas the TTT relationships presented here show not only whether or not the reaction will occur, but also the extent to which it will occur for different combinations of time and temperature.

In particular, the TTT relationships should be useful in the evaluation of phase equilibrium and solubility data previously reported on the calcium sulfate-water system. When the data of different investigators were plotted on a single figure, there was so much scatter that it was difficult to determine the exact solubility curves(81). One possible explanation for this is that the time required to reach equilibrium exceeded the induction time for a phase change. Once such a phase change was initiated, the concentration of the dissolved solids in the solution would change due to the transport phenomenon in which the more stable phase would dissolve and the less stable phase would precipitate resulting in a concentration gradient existing in the solution. Samples taken under such conditions would, undoubtedly, have a concentration between the two solubility values depending upon the relative rates of solution and dissolution. It is in fact possible that the time required to reach equilibrium could be longer than the time necessary for the initiation of the transformation, whereupon the true values of the solubility could not be measured.

The TTT relationships should also be useful in the evaluation of desalinization processes using seeding techniques to prevent scale formation. In general, such processes involve the addition of small, solid, seed crystals to the feed water of evaporators in hopes that the scale will form on the seeds in preference to the heat transfer surface. In the past, successful operation of pilot plants using seeding techniques did not always result in successful designs of full size plants using the same techniques. This might have been caused by the transformation of the seed crystals due to longer exposure or higher temperatures in the larger evaporators compared to the pilot size units in which the processes were originally developed.

Furthermore, these TTT relationships may also be useful in developing descaling processes especially where the scale which forms can be dehydrated to another phase under the prevailing operating conditions. When such conditions are encountered, a knowledge of the physical and chemical properties of each phase will determine which phase would be easier to remove. Using this information along with the TTT relationships, the necessary operating conditions can be determined to optimize the descaling operation.

For example, in the calcium sulfate - water system, the hemihydrate phase might be easier to chemically attack since the dehydration of the dihydrate to the hemihydrate results in the formation of hemihydrate crystals fragmented by small cracks. Thus, it might be possible to chemically attack the hemihydrate scale formed from dihydrate scale by first allowing the heat transfer surface to become dry, vaporizing the water in these cracks and crevasses,and then to apply some cold chemical which will be pulled into the cracks by the condensing vapor, thereby increasing the surface area and facilitating the chemical removal of the scale.

E. Areas of Possible Future Research

During the writing of this dissertation, several areas for possible future research became apparent. These are enumerated below for reference as seven possible future studies:

(1) Studies on the dihydrate-hemihydrate transformation in aqueous solutions over the range of water activity, 0.0 to 0.8.

(2) Studies on the dihydrate-hemihydrate transformation in air over the range of water activity, 0.0 to 1.0, along with a comparison with the results of the first study.

(3) Studies on the effects of changing the length of dihydrate crystals on the four possible, three-dimensional, reaction models.

(4) Studies on the effects of extremely small particle sizes on the dihydrate-hemihydrate transformation.

(5) Studies on the velocities of the dihydrate-hemihydrate interface for the reaction in air and in aqueous solutions over the range of water activity, 0.0 to 1.0.

(6) Studies on the heterogeneous nucleation of calcium sulface hemihydrate on, or within, crystals of dihydrate from solutions supersaturated with respect to calcium sulfate hemihydrate.

(7) Studies on the hemihydrate-anhydrite transformation in air and in aqueous and brine solutions to determine the effects of temperature, water activity, and initial particle size and configuration on the reaction mechanism.

VII. SUMMARY

Presently, evaporative processes are the most feasible means of recovering potable water from sea water, but these processes are limited by calcium sulfate scale which forms on the heat transfer surfaces. This scale forms by the nucleation and growth of calcium sulfate dihydrate, hemihydrate, or anhydrite from solution, usually followed by the dehydration to the anhydrite phase whenever possible. In order to understand this scaling process, so that it can be either controlled or eliminated, both the fundamental steps of its formation and transformation must be known. The purpose of this investigation was primarily to study the dihydrate-hemihydrate transformation in detail as one part of the whole problem.

This research was divided into two major studies: (1) the studies of the time-temperature-transformation (TTT) relationships of the dihydrate-hemihydrate and the hemihydrate-anhydrite transformations and (2) studies of the kinetic mechanism of the dihydrate-hemihydrate transformation. In the TTT studies, the reactions were followed dilatometrically by observing the change in total volume of the system, as a function of time, in a special glass dilatometer while simultaneously recording the temperature and height of the liquid meniscus in the dilatometer capillary at equal time intervals. In the mechanism studies, the dihydrate-hemihydrate transformation was observed microscopically in a special cell designed to duplicate the conditions encountered in the dilatometer.

The dihydrate-hemihydrate transformation was observed in 0.0%, 0.5%, 1.0%, 3.5%, 7.0%, 14.0%, and 21.0% sodium chloride solutions and in solutions containing 1.0, 2.0, 3.0, and 4.0 times the salt concentration of normal synthetic sea water over a temperature range 230° to 270°F. All the experiments were made using dihydrate crystal fragments separated between screens having 0.0082 and 0.0069 inch openings, except for those used to study the effect of changing the initial particle size. The particles used in these experiments ranged from one large crystal to a fine powder.

The hemihydrate-anhydrite transformation was observed in water, in 3.5% sodium chloride solutions, and in normal synthetic sea water over a temperature range 325° to 350°F using dihydrate particles separated between screens having 0.0116 and 0.0082 inch openings, which were first reacted to hemihydrate in the dilatometer, then to anhydrite.

The phases occurring in all the experiments under different steady state conditions were verified from their x-ray powder diffraction patterns.

The TTT curves obtained show that both the induction times and the reaction times for both reactions decrease with increasing temperature or decreasing water activity, indicating that the overall rate of reaction increases from both of these changes. Changes in the initial dihydrate particle size were shown to affect only the induction time and the nucleation rate constant for the dihydrate-hemihydrate transformation, resulting in a minimum induction time and a maximum nucleation rate constant being observed for particles of about 0.01 inches in length.

The studies on the transformation mechanism, describing the microscopic observations, the measurements, and the calculations, resulted in a solid state reaction mechanism for the dihydrate-hemihydrate transformation in aqueous solutions.

The transformation was observed by photographing the growing hemihydrate phase within single crystals of optical grade selenite at equal time intervals while simultaneously recording the temperature of the system on a recording potentiometer. The micrographs obtained show the configuration and orientation of the forming hemihydrate phase to the known cleavage planes of selenite, and measurements on the micrographs gave values of the rates of transformation in three different directions within the dihydrate crystals as functions of temperature.

Based on these observations, a mathematical model was derived which describes the nucleation, growth, and impingement of growing hemihydrate needles with each other and the boundaries of the parent dihydrate crystals during the transformation process. Using this model, the values of the kinetic constants appearing in the equations describing the rate of reaction were obtained by fitting the smooth curves generated using these equations to the experimental rate values using a trial-and-error procedure.

The dependence of these rate constants on temperature was successfully described using the Arrhenius equation, and their dependence on both temperature and water activity was described using Equation (85):

$$(R_i - R_{io})/(1 - P/P^o) = Z \exp(-E/RT) \ .$$

Using this correlation and the equations describing the reaction mechanism, time-temperature-transformation curves were calculated which compared favorably with the experimentally measured TTT values, establishing the validity of the model, and providing a means of interpolating and extrapolating the data obtained in this research.

The time-temperature-transformation results obtained in this investigation should be useful in evaluating phase equilibrium and solubility data presented in the literature on the calcium sulfate - water system in terms of possible transformations, and in the evaluation of processes using calcium sulfate seed crystals for preferential nucleation sites, by providing information on the stability and transformation characteristics of these crystals in aqueous or brine solutions.

APPENDICES

APPENDIX A

RESULTS IN THE LITERATURE

Some of the important results encountered in the literature are presented briefly in this appendix. The relationship between the six different unit cells of gypsum reported are shown in Figure A-1. This diagram was extremely valuable in understanding the crystallographic data when the authors were discussing the same phenomenon using different unit cell designations.

The results of the investigations of Newman and Wells(63) on the transformation of γ-$CaSO_4$ to β-$CaSO_4$ are presented in Figure A-2 and Table A-1 showing the time-temperature-transformation zone for this reaction. Their results show the extreme instability of γ-$CaSO_4$ in the presence of water and, consequently, also show that the transformation of dihydrate to hemihydrate in aqueous solutions is followed by the dehydration of the hemihydrate to natural anhydrite without the formation of "soluble anhydrite".

The experimental data of Budnikoff(12) on the dehydration of gypsum flakes in air are presented in detail in Table A-2. Since his experimental observations were reported at equal time intervals, they were analyzed using the methods described in this text. The data were converted into the dimensionless α form by dividing the percent transformation by the total theoretical percent transformation, i.e. 15.69. The rate of reaction $d\alpha/dt$ was obtained using Equation (26). The rate data are shown plotted in Figures A-3 and A-4.

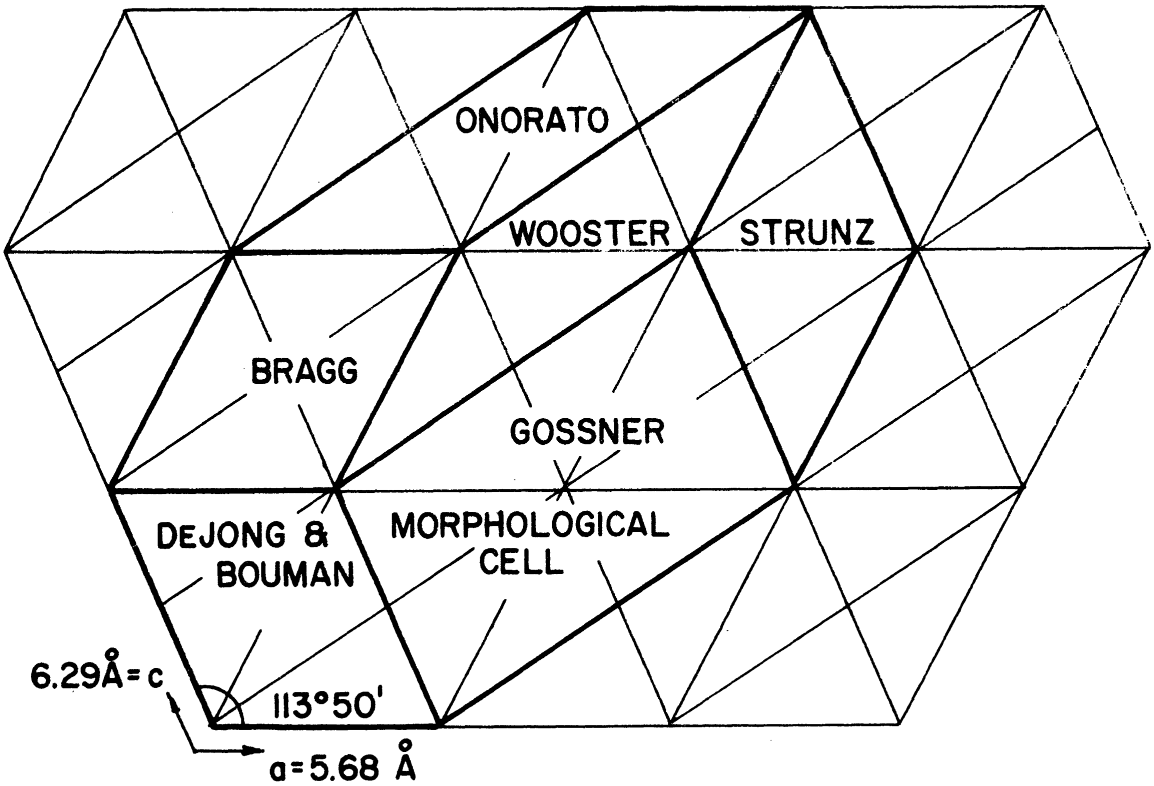


Figure A-1. Relationships Between the Different Unit Cells Reported in the Literature for Gypsum Viewed Perpendicular to the (010) Cleavage Plane (After Deer, Howie, and Zussman (21)).

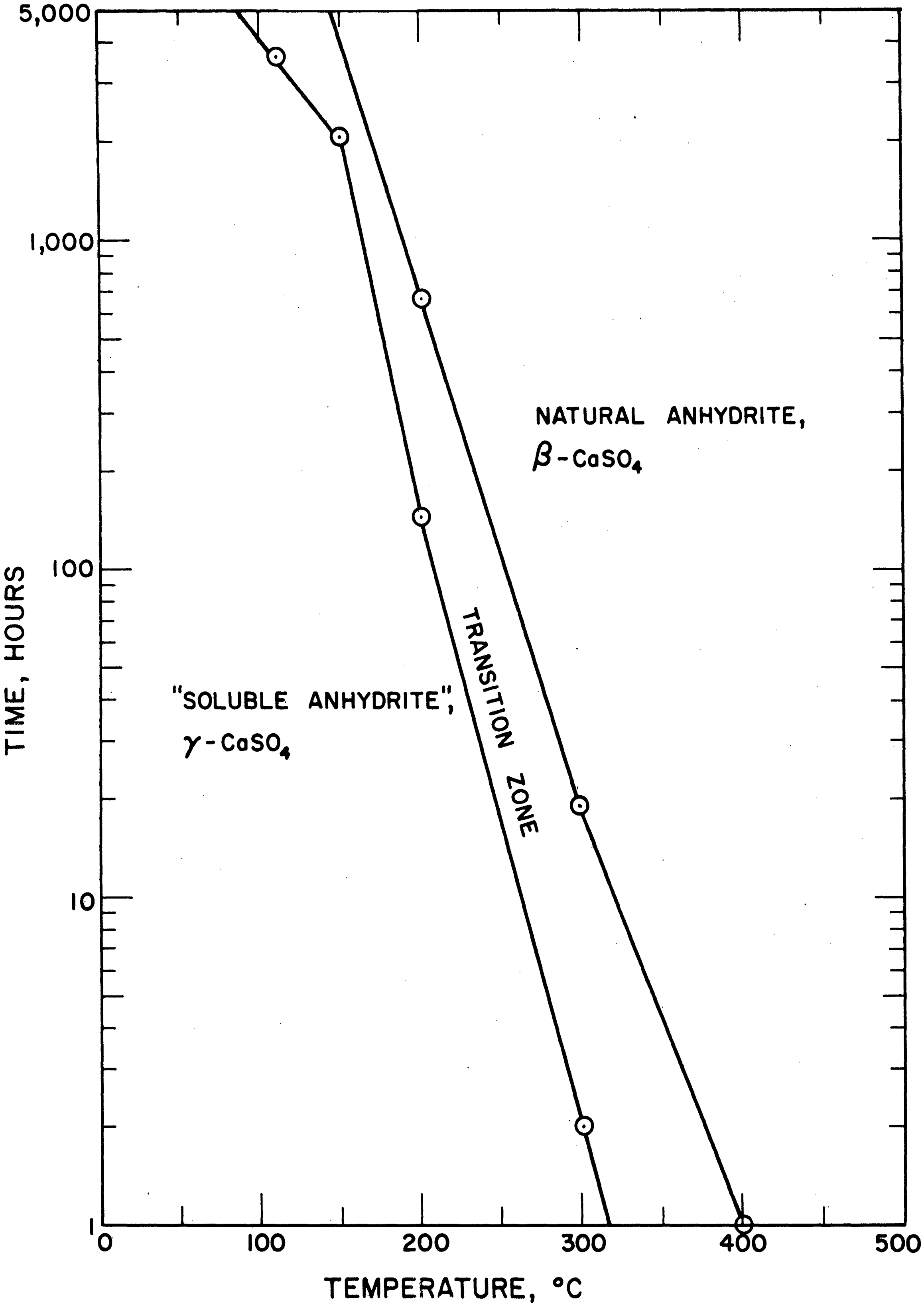


Figure A-2. Time-Temperature-Transformation Relationships for the Phase Transformation of α - $CaSO_4$ to β - $CaSO_4$ Determined by Newman and Wells Using X-ray Methods.

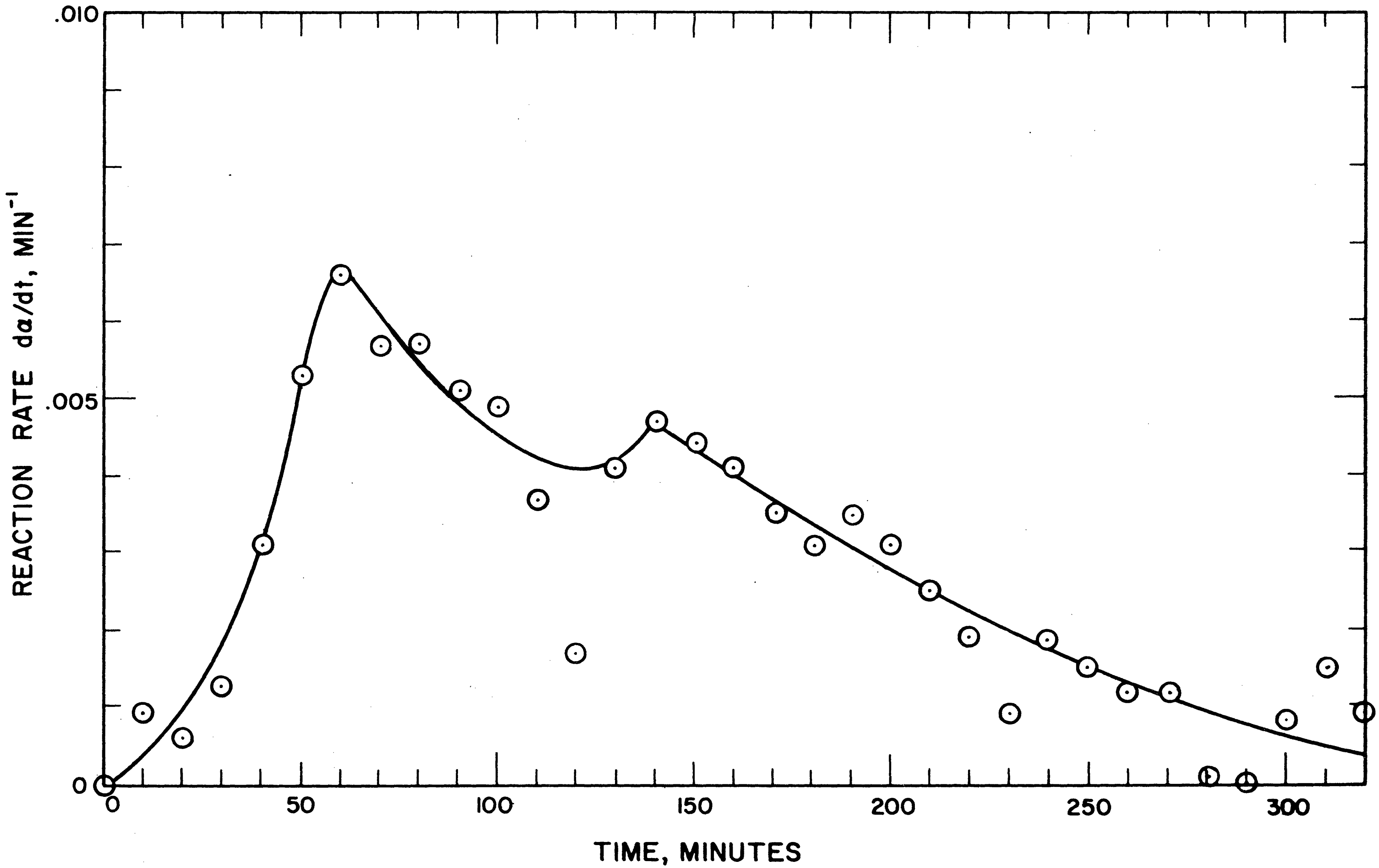


Figure A-3. Variation in the Reaction Rate as a Function of Time Observed by Budnikoff for the Transformation of Calcium Sulfate Dihydrate (Coated with Sodium Chloride) to Hemihydrate in Air at 107°C.

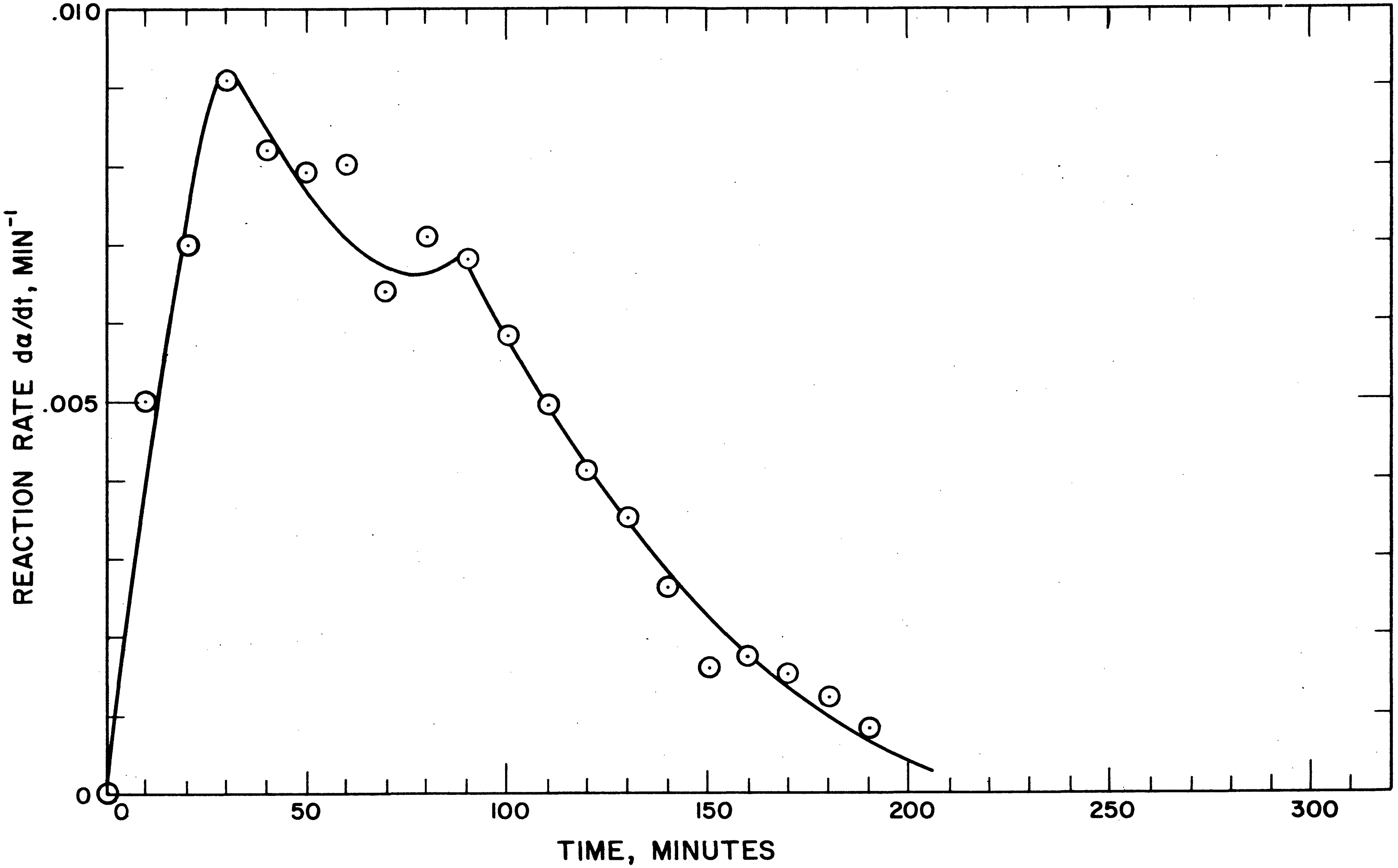


Figure A-4. Variation in the Reaction Rate as a Function of Time Observed by Budnikoff for the Transformation of Calcium Sulfate Dihydrate to Hemihydrate in Air at 107°C.

TABLE A-1

X-RAY DATA BY NEWMAN AND WELLS

Temp., °C	Time Hours	Phase Identified
110	3,670	SA
150	170	SA
	624	SA
	2,080	SA
200	3	SA
	145	SA
	670	SA & NA
300	2	SA
	19	SA & NA
	48	SA & NA
	115	NA
400	1/2	SA & NA
425	1	SA & NA
	114	NA
450	1	NA
500	1/2	NA
625	1	NA
	114	NA
900	1	NA
	114	NA
1,100	4	NA
1,225	2	NA
Reaction in Presence of Liquid Water		
170	1 1/2	NA
210	44	NA

SA = "Soluble Anhydrite", γ - $CaSO_4$

NA = "Natural Anhydrite", β - $CaSO_4$

TABLE A-2

EXPERIMENTAL RESULTS OF BUDNIKOFF

The Dehydration in air at 107°C of:

	Gypsum and 5% NaCl			Gypsum		
Time, min	Percent Wt. Loss	α	$d\alpha/dt$, min^{-1}	Percent Wt. Loss	α	$d\alpha/dt$, min^{-1}
0	0.00	.0000	.0000	0.00	.0000	.0000
10	0.20	.0127	.0009	0.58	.0369	.0050
20	0.30	.0191	.0006	1.60	.1019	.0070
30	0.40	.0254	.0013	2.78	.1771	.0091
40	0.72	.0458	.0031	4.48	.2855	.0082
50	1.40	.0892	.0053	5.38	.3428	.0079
60	2.40	.1529	.0066	6.96	.4435	.0080
70	3.50	.2230	.0057	7.90	.5035	.0064
80	4.20	.2676	.0057	8.98	.5723	.0071
90	5.30	.3377	.0051	10.14	.6462	.0068
100	5.82	.3709	.0049	11.14	.7100	.0058
110	6.86	.4372	.0037	11.98	.7635	.0049
120	7.00	.4461	.0017	12.68	.8081	.0041
130	7.40	.4716	.0041	13.28	.8463	.0035
140	8.30	.5289	.0047	13.78	.8782	.0026
150	8.90	.5672	.0044	14.12	.8999	.0016
160	9.70	.6182	.0041	14.30	.9114	.0017
170	10.20	.6500	.0035	14.68	.9356	.0015
180	10.80	.6883	.0031	14.78	.9420	.0012
190	11.20	.7138	.0035	15.06	.9498	.0008
200	11.90	.7584	.0031	15.04	.9685	.----
210	12.20	.7775	.0025			
220	12.70	.8094	.0019			
230	12.80	.8158	.0009			
240	13.00	.8285	.0019			
250	13.40	.8540	.0015			
260	13.50	.8604	.0012			
270	13.80	.8795	.0012			
280	13.90	.8856	.0001			
290	13.84	.8820	.0000			
300	13.90	.8859	.0008			
310	14.10	.8986	.0015			
320	14.40	.9177	.0009			
330	14.40	.9177	.0003			
340	14.50	.9241	.----			

APPENDIX B

THERMOCOUPLE CALIBRATIONS

The copper-constantan thermocouples used in the dilatometric and microscopic experiments were calibrated by inserting the four inches of available thermocouple wire with the glass plug attached into the vapor of gently refluxing pure ethanol, and pure water, and into solidifying sodium sulfate decahydrate ($Na_2SO_4 \cdot 10H_2O$), and the values of the temperature indicated by the thermocouples were automatically printed on the chart paper of the recording potentiometer used in the experiments. The values of the reference temperatures were determined from the published reference values using the standard barometric corrections for water.(42) A barometric correction for ethanol based on the following equation was obtained by fitting the vapor pressure data given in Table B-1(42,97) using the method of least squares:

$$T_{act} = 78.26 + 0.03396(P-760) - 0.00001846(P-760)^2 \qquad (B-1)$$

Here, T_{act} is the boiling point in degrees centigrade corresponding to the barometric pressure P in millimeters of mercury.

Linear calibration equations for the three thermocouples used were obtained from the values of the recorded and reference temperatures given in Table B-2 by the method of least squares. The equation for thermocouple No. 1, which was used in dilatometric experiments number 5 through 55, was:

$$T_{act} = - 1.520 + 1.010\ T_{rec} \qquad (B-2)$$

The equation for thermocouple No. 2, which was used in dilatometric experiments 56 through 76, was:

$$T_{act} = -1.380 + 1.009\, T_{rec}$$

and the equation for thermocouple No. 3, which was used in the microscopic experiments, was:

$$T_{act} = -3.11 + 1.015\, T_{rec}$$

where T_{act} is the reference temperature (T_{act} was set equal to the given reference temperature when determining the coefficients appearing in these equations) and T_{rec} is the recorded temperature.

When the data given in Table B-2 was correlated it had a standard error estimate of 0.34°F, 0.18°F, and 0.20°F, respectively. The absolute accuracy of the recording potentiometer was reported as ± 0.030 mv, corresponding to a probable error of ± 1.4°F at 50°F and of ± 1.0°F at 350°F. Therefore the thermocouple calibration was well within the accuracy of the instruments.

TABLE B-1

VAPOR PRESSURE DATA FOR ETHANOL(24,97)

Temperature °C	Pressure mm of Hg
70.00	542.5
77.26	750.0
78.26	760.0
79.26	770.0
80.00	812.6
85.00	986.3

TABLE B-2

DATA OBTAINED CALIBRATING THERMOCOUPLES

Reference Temp., °F	Recorded Temp., °F	Reference Temp., °F	Recorded Temp., °F	Reference Temp. °F	Recorded Temp., °F
Data for Thermocouple No. 1.					
90.29	90.10	171.88	171.10	210.66	209.50
90.29	90.20	171.51	171.25	210.65	209.50
90.29	90.40	171.20	171.10	210.80	209.90
90.29	90.60	171.19	171.45	210.83	210.00
90.29	91.10	171.15	171.45	210.84	210.30
90.29	90.70	171.39	171.40	210.55	209.50
90.29	90.95	171.48	171.55	210.53	210.00
90.29	90.60	171.64	171.55	210.18	209.60
90.29	91.35	171.69	171.80	210.17	210.15
90.29	91.00	171.73	171.80	210.14	209.70
90.29	91.00	172.07	172.00	210.41	209.90
90.29	91.00	171.63	171.45	210.49	210.00
90.29	91.00	171.61	171.00	210.67	209.95
90.29	91.00	171.65	171.20	210.73	210.00
90.29	91.00	171.66	171.55	210.76	210.10
90.29	90.95	171.67	171.70	211.13	210.15
90.29	90.50	171.68	171.40	210.75	209.95
90.29	90.50	171.72	171.90	210.64	209.45
90.29	90.90	171.71	171.70	210.70	209.70
90.29	90.80				
Data for Thermocouple No. 2.					
90.29	90.80	171.15	171.10	211.09	210.60
90.29	91.00	171.43	171.20	210.30	209.70
90.29	90.90	171.42	171.60	210.11	209.40
90.29	90.60	171.56	171.75	210.42	209.90
90.29	90.70	171.53	171.60	210.63	210.00
		171.45	171.30	210.59	210.00
				210.51	209.95
Data for Thermocouple No. 3.					
90.29	91.90	171.31	171.90	210.38	210.10
90.29	91.95	171.22	171.95	210.32	210.00
90.29	91.95	171.12	171.95	210.20	210.10

APPENDIX C

CALIBRATION OF DILATOMETER CAPILLARY

The capillary tube, with attached metal scale used in the dilatometric experiments, was calibrated by injecting equal volumes of deionized water into the capillary using a micrometer syringe (calibrated by weighing mercury displacements to give 0.1975±0.0003 ml/1000 scale divisions). The height after each injection was read against the metal scale with a precision cathetometer under conditions of constant temperature and atmospheric pressure. During the calibration 70 equal volume increments of 0.001975 ml each were infected into the capillary giving a total observed height change of 45.515 cm corresponding to 0.650 cm per increment, and an average cross-sectional area of 0.0030375 cm^2, calculated by dividing the total volume added by the total height change observed. The difference between the values read from the metal scale attached to the capillary and the reference values calculated by successive additions of the value 0.650 cm to the first scale reading of 0.110 cm was calculated for each value of the observed height as the correction at that point. The corrections needed for the intermediate points were determined by a linear interpolation between the measured values using the computer program given in Appendix D and the calibration corrections shown in Table C-1.

TABLE C-1

CALIBRATION FOR CAPILLARY USED IN THE DILATOMETRIC EXPERIMENTS.

Height, cm	Correction, cm	Height, cm	Correction, cm
0.110	0.000	23.518	-0.347
0.735	0.025	24.168	-0.377
1.440	-0.030	24.818	-0.392
2.105	-0.044	25.468	-0.397
2.770	-0.059	26.119	-0.371
3.435	-0.074	26.769	-0.356
4.095	-0.084	27.805	-0.386
4.775	-0.114	28.455	-0.386
5.430	-0.118	29.090	-0.371
6.085	-0.123	29.710	-0.340
7.400	-0.133	30.340	-0.320
8.090	-0.138	31.000	-0.330
8.725	-0.177	31.645	-0.325
6.745	-0.162	32.280	-0.310
9.400	-0.187	32.885	-0.264
10.055	-0.192	33.505	-0.234
10.700	-0.187	34.175	-0.254
11.385	-0.221	34.820	-0.249
12.035	-0.221	35.465	-0.243
12.680	-0.216	36.085	-0.213
13.330	-0.216	36.705	-0.183
13.985	-0.221	37.390	-0.218
14.660	-0.245	38.025	-0.203
15.315	-0.250	38.665	-0.192
15.965	-0.250	39.270	-0.147
16.160	-0.245	39.885	-0.112
17.270	-0.254	40.555	-0.123
17.940	-0.274	41.210	-0.137
18.610	-0.294	41.850	-0.126
19.270	-0.304	42.450	-0.076
19.915	-0.299	43.060	-0.036
20.570	-0.303	43.725	-0.051
21.255	-0.338	44.370	-0.045
21.915	-0.348	45.020	-0.045
22.570	-0.353	45.625	-0.000
23.210	-0.345		

APPENDIX D

COMPUTER PROGRAM USED TO MAKE TEMPERATURE AND HEIGHT CORRECTIONS FOR THE CAPILLARY USED IN THE DILATOMETRIC EXPERIMENTS

```
           DIMENSION C(100), L(100), H(600), T(600)
           INTEGER N,F,K,J,I,START,NUMBER,C0,C1,C2,C3,C4,C5,
          1E,B,A,FACTOR,D
           READ FORMAT CONST, N
           READ FORMAT LENGTH, L(0)...L(N)
           READ FORMAT CORR, C(0)...C(N)
           PRINT COMMENT $1$
           THROUGH THREE, FOR K=0,1,K.G.N
THREE      PRINT RESULTS L(K), C(K)
BEGIN      READ FORMAT RUNNO, NUMBER
           READ FORMAT PR, D
           READ FORMAT CONTRL,C0,C1,C2,C3,C4,C5
           READ FORMAT CON,F,E,B,A
           READ FORMAT HEIGHT, H(0)...H(F)
           READ FORMAT TEMP, T(0)...T(F)
           START=1
           THROUGH FOUR, FOR J=0,1,J.G.F
           THROUGH FIVE, FOR K=START,1,K.G.N
FIVE       WHENEVER H(J).GE.L(K-1) .AND. H(J).L.L(K),
          1TRANSFER TO CAL
CAL        H(J)=H(J)+(H(J)-L(K-1))/(L(K)-L(K-1))*
          1(C(K)-C(K-1))+C(K-1)
FOUR       START=K
           WHENEVER K .G. 1, START=K-1
           THROUGH SIX, FOR I=0,10,I.G.F
SIX        PUNCH FORMAT HCARD, H(I), H(I+1), H(I+2), H(I+3),
          1H(I+4), H(I+5), H(I+6), H(I+7), H(I+8), H(I+9)
           WHENEVER NUMBER .G. 55, TRANSFER TO GO
           THROUGH SEVEN, FOR J=0,1,J.G.F
SEVEN      T(J)=-1.5246773+1.0103362*T(J)
           TRANSFER TO NINE
GO         THROUGH EIGHT, FOR J=0,1,J.G.F
EIGHT      T(J)=-1.3804684+1.0089389*T(J)
NINE       THROUGH TEN, FOR I=0,10,I.G.F
TEN        PUNCH FORMAT TCARD, T(I), T(I+1), T(I+2), T(I+3),
          1T(I+4), T(I+5), T(I+6), T(I+7), T(I+8), T(I+9)
           TRANSFER TO BEGIN
           VECTOR VALUES CONST=$ I5*$
           VECTOR VALUES CORR=$7F10.3*$
           VECTOR VALUES LENGTH=$7F10.3*$
           VECTOR VALUES RUNNO=$I5*$
           VECTOR VALUES PR=$I5*$
           VECTOR VALUES CONTRL=$6I5*$
           VECTOR VALUES CON=$3I5,F5.2*$
           VECTOR VALUES HEIGHT=$10F7.3*$
           VECTOR VALUES TEMP=$10F7.1*$
           VECTOR VALUES HCARD=$10F7.3*$
           VECTOR VALUES TCARD=$10F7.1*$
           END OF PROGRAM
```

APPENDIX E

COMPUTER PROGRAMS USED TO CALCULATE NORMALIZED DATA FROM CORRECTED TIME-TEMPERATURE-HEIGHT DATA FOR THE DIHYDRATE-HEMIHYDRATE AND THE HEMIHYDRATE-ANHYDRITE TRANSFORMATIONS

```
           R
           R PROGRAM FOR THE DIHYDRATE-HEMIHYDRATE TRANS.
           R
            DIMENSION V(600), T(600), Z(600), X(600), Y(600),
           1ALPHAA(600), ZCAL(600), ALPHA(600), TIME1(600), T
           1IME2(600), RATE(600), XX(600), D(600), DLIM(600),
           1S(60), TIME(600), USED(600), VHT(600), VEST(600),
           1DELV(600), SS(60), ERROR(600), DELT(600), THT(600
           1), PERCDV(600), SSS(60), CHECK(600), VRXN(600), T
           1WT(600), WEIGHT(600), OBSNO(600), DRATE(600), DD(
           1 600), VDELT(600), BETA(600), BETAA(600), DBETA(6
           100)
            INTEGER B, F, I, J, K, L, N, START, STOP, LIMIT,
           1CONSI, CONSJ, TMX, TMAX, TFINAL, USED, C, E, M,
           1CONTRL, A, NP1, ITER, ITMAX, STARTP, STOPP, TLIN,
           1LINT, TADU, TBDU, LIM, G, H, P, TT, CC0, CC1, CC2
           1, CC3, CC4, CC5, NORXN
            STATEMENT LABEL S, SS, SSS
           R
BEGIN       READ FORMAT RUNNO, NUMBER
            READ FORMAT PH, P
            READ FORMAT CNTRL,CC0,CC1,CC2,CC3,CC4,CC5
            READ FORMAT CONST,F,A,B,DELTAT
            READ FORMAT VOLUME, V(0)...V(F)
            READ FORMAT TEMP, T(0)...T(F)
            EXECUTE FTRAP.
            THROUGH IT0, FOR J=0,1, J .G. F
            OBSNO(J)=J+1.
            TIME1(J)=J*DELTAT
            TIME2(J)=TIME1(J)*TIME1(J)
IT0         TIME(J)=J*DELTAT
            C=0
            LIMIT=14
            TEMPMX=0
            THROUGH IT6, FOR I=0,1,I.G.F/2
            WHENEVER T(I) .G. TEMPMX
            TEMPMX=T(I)
            C=I
IT6         END OF CONDITIONAL
            LIM=30./DELTAT
            WHENEVER LIM .G. (F-1)/2, LIM=(F-1)/2
            THROUGH IT1, FOR J=B,1,J.G.LIM+LIM
IT1         VEST(J)=V(J+1)-V(J)
            VMIN=.ABS.(VEST(LIM))
```

```
           G=LIM
           THROUGH IT4, FOR J=B,1,J.G.LIM
           WHENEVER .ABS.(VEST(J)) .L. VMIN
           VMIN=VEST(J)
           G=J
IT4        END OF CONDITIONAL
           L=3
S(3)       CONTINUE
           CONTRL=2
           THROUGH IT5, FOR J=B,1,J.G.LIM+LIM
           ARG=VEST(J)
           WHENEVER ARG .LE. 0., ARG=1.
           Z(J)=ELOG.(ARG)
           X(J)=TIME(J)
           Y(J)=1.
IT5        ZCAL(J)=Z(J)
           START=B
           STOP=G-5
           STARTP=B
           STOPP=LIM+LIM
           WHENEVER CONTRL .E. 1, TRANSFER TO CALC
           PRINT FORMAT TITLE, NUMBER
           PRINT FORMAT NAME3
           TRANSFER TO CALC
S(4)       CONTINUE
           H=LIM
           THROUGH IT8, FOR J=A,1,J.G.LIM+LIM
           WHENEVER Z(J).G.ZCAL(J)+.25 .AND.
          1Z(J+1).G.ZCAL(J+1)+.25
           H=J
           TRANSFER TO IT9
IT8        END OF CONDITIONAL
IT9        CONTINUE
           PRINT RESULTS C, G, H
           WHENEVER H .L. 25 .AND. H .G. 20
           H=H+(25-H)
           OR WHENEVER H .LE. 20
           H=H+5
           END OF CONDITIONAL
           PRINT RESULTS H
           WHENEVER H .L. C, C=H
           PRINT RESULTS C
           SUMX=0.
           SUMX2=0.
           SUMX3=0.
           SUMX4=0.
           SUMY=0.
           SUMXY=0.
           SUMX2Y=0.
           N=0
           NORXN=C-5
           WHENEVER CCO .E. 10, NORXN=CC1
           THROUGH SQUIGL, FOR J=B,1,J.G. NORXN
           X(J)=T(J)-T(0)
```

```
              XX(J)=X(J)*X(J)
              Y(J)=V(J)
              SUMX=SUMX+X(J)
              SUMY=SUMY+Y(J)
              SUMXY=SUMXY+X(J)*Y(J)
              SUMX2=SUMX2+XX(J)
              SUMX3=SUMX3+XX(J)*X(J)
              SUMX2Y=SUMX2Y+XX(J)*Y(J)
              SUMX4=SUMX4+XX(J)*XX(J)
SQUIGL        N=N+1
              A1=N
              A2=SUMX
              A3=SUMX2
              B1=SUMX
              B2=SUMX2
              B3=SUMX3
              C1=SUMX2
              C2=SUMX3
              C3=SUMX4
              D1=SUMY
              D2=SUMXY
              D3=SUMX2Y
              R2=A2/A1
              R3=A3/A1
              E2=B2-B1*R2
              F2=C2-C1*R2
              G2=D2-D1*R2
              E3=B3-B1*R3
              F3=C3-C1*R3
              G3=D3-D1*R3
              Z1=(G2-G3*E2/E3)/(F2-F3*E2/E3)
              ZBAR=Z1
              Y1=(G2-F2*Z1)/E2
              Y2=(G3-F3*Z1)/E3
              YBAR=(Y1+Y2)/2.
              X1=(D1-B1*Y1-C1*Z1)/A1
              X2=(D2-B2*Y1-C2*Z1)/A2
              X3=(D3-B3*Y1-C3*Z1)/A3
              X4=(D1-B1*Y2-C1*Z1)/A1
              X5=(D2-B2*Y2-C2*Z1)/A2
              X6=(D3-B3*Y2-C3*Z1)/A3
              XBAR=(X1+X2+X3+X4+X5+X6)/6.
              PRINT FORMAT TITLE, NUMBER
              PRINT RESULTS Z1
              PRINT RESULTS ZBAR
              PRINT RESULTS Y1, Y2
              PRINT RESULTS YBAR
              PRINT RESULTS X1, X2, X3
              PRINT RESULTS X4, X5, X6
              PRINT RESULTS XBAR
              N=0
              SUMDD=0.
              THROUGH IT10, FOR J=B,1,J.G. NORXN
              TFUNCT=T(J)-T(0)
```

```
          Z(J)=XBAR+YBAR*TFUNCT+ZBAR*TFUNCT*TFUNCT
          D(J)=V(J)-Z(J)
          SUMDD=SUMDD+D(J)*D(J)
          PERCDV(J)=(V(J)-Z(J))/V(J)*100.
IT10      N=N+1
          STDERE=SQRT.(SUMDD/N)
          PRINT FORMAT TITLE, NUMBER
          PRINT FORMAT NAME1
          THROUGH IT12, FOR J=B,1,J.G. NORXN
IT12      PRINT FORMAT ABLE, V(J), Z(J), D(J), PERCDV(J)
          PRINT RESULTS STDERE
          THROUGH IT13, FOR J=B-1,-1,J.L.0
          TFUNCT=T(J)-T(0)
IT13      V(J)=XBAR+YBAR*TFUNCT+ZBAR*TFUNCT*TFUNCT
          THROUGH N11, FOR I=0,1,I.G.F
          TFUNCT=T(I)-T(0)
          VHT(I)=XBAR+YBAR*TFUNCT+ZBAR*TFUNCT*TFUNCT
          VRXN(I)=V(I)-VHT(I)
N11       CONTINUE
          MXDELV=0.
          THROUGH S8A, FOR I=C,1,I.G. F
          WHENEVER VRXN(I) .G. MXDELV
          MXDELV=VRXN(I)
          E=I
S8A       END OF CONDITIONAL
          THROUGH N2, FOR I=0,1, I .G. F
          ALPHAA(I)=VRXN(I)/VRXN(E)
N2        CONTINUE
          THROUGH N3, FOR I=F,-1,VRXN(I) .LE. 0.00099999999
N3        CONTINUE
          CONSI=I
          I=0
          THROUGH N4, FOR J=0,1, I .G. F
          I=CONSI+J
N4        ALPHA(J)=ALPHAA(I)
          ALPHA(J-1)=1.
          ALPHA(J)=1.
          ALPHA(0)=0
          I=0
          THROUGH N5, FOR J=1,1, I .G. F
          I=CONSI+J
N5        RATE(J)=(ALPHA(J+1)-ALPHA(J-1))/(2*DELTAT)
          RATE(0)=ALPHA(1)/(2*DELTAT)
          I=0
          THROUGH N5A, FOR J=1,1,I.G.F
          I=CONSI+J
N5A       DRATE(J)=(RATE(J+1)-RATE(J-1))/(2.*DELTAT)
          DRATE(0)=RATE(1)/(2.*DELTAT)
          RATE(J-1)=0.
          RATE(J)=0.
          TIME1(0)=0
          TIME2(0)=0
          I=0
          THROUGH S8, FOR J=1,1,I.G.F-1
```

```
            I=CONSI+J
            WEIGHT(J)=(ALPHA(J+1)-ALPHA(J-1))/2.
            TWT(J)=T(I)*WEIGHT(J)
S8          CONTINUE
            WEIGHT(0)=ALPHA(1)/2.
            WEIGHT(F)=(ALPHA(F)-ALPHA(F-1))/2.
            TWT(0)=T(CONSI)*WEIGHT(0)
            TWT(F)=T(CONSI+F)*WEIGHT(F)
            SUMA=0
            SUMT=0
            THROUGH IT11, FOR J=1,1, ALPHA(J) .G. 0.999995
            I=CONSI+J
            SUMT=SUMT+WEIGHT(J)*T(I)
            SUMA=SUMA+WEIGHT(J)
IT11        CONTINUE
            WEIGHT(J)=(ALPHA(J)-ALPHA(J-1))/2.
            TWT(J)=T(CONSI+J)*WEIGHT(J)
            TRXNAV=(SUMT+WEIGHT(0)*T(CONSI)+WEIGHT(J)*
           1T(CONSI+J))/(SUMA+WEIGHT(0)+WEIGHT(J))
            PRINT FORMAT TITLE, NUMBER
            PRINT FORMAT NAME2
            I=0
            THROUGH IT3, FOR J=0,1, I .G. E
            I=CONSI+J
            PRINT FORMAT ANSB, OBSNO(J), TIME(J), ALPHA(J),
           1RATE(J), DRATE(J), T(I), NUMBER
IT3         CONTINUE
            PRINT RESULTS TRXNAV
            PRINT FORMAT TITLE, NUMBER
            PRINT FORMAT NAME8
            THROUGH IT2, FOR I=0,1, I .G. F
IT2         PRINT FORMAT ANSO, TIME(I), T(I), V(I), VHT(I),
           1VRXN(I), ALPHAA(I)
            WHENEVER P .NE. 1, TRANSFER TO BEGIN
            I=0
            THROUGH IT7, FOR J=0,1,I.G.E
            I=CONSI+J
            PUNCH FORMAT CARD, OBSNO(J), TIME(J), ALPHA(J),
           1RATE(J), T(I), NUMBER
IT7         CONTINUE
            TRANSFER TO BEGIN
CALC        CONTINUE
            THROUGH ONE, FOR J=0,1, J .G. F
            USED(J)=8
ONE         D(J)=0
            DLIM(0)=0
            SUMZ=0
            THROUGH ONEA, FOR J=START,1, J .G. STOP
ONEA        SUMZ=SUMZ+.ABS.(Z(J))
            DLIM(1)=SUMZ
            DIF=1.
            THROUGH TWO, FOR K=1,1, DIF .L.  .00001
            N=0
            SUMXX=0
```

```
           SUMXY=0
           SUMYY=0
           SUMXZ=0
           SUMYZ=0
           THROUGH THREE, FOR J=START,1, J.G. STOP
           USED(J)=0
           WHENEVER D(J) .LE. DLIM(K)
           USED(J)=1
           N=N+1
           SUMXX=SUMXX+X(J)*X(J)
           SUMXY=SUMXY+X(J)*Y(J)
           SUMYY=SUMYY+Y(J)*Y(J)
           SUMXZ=SUMXZ+X(J)*Z(J)
           SUMYZ=SUMYZ+Y(J)*Z(J)
THREE      END OF CONDITIONAL
           BCONST=(SUMXZ*SUMXY-SUMYZ*SUMXX)/(SUMXY*SUMXY-
          1SUMYY*SUMXX)
           SUMDD=0
           THROUGH FOUR, FOR J=0,1,J.G.STOPP
           ZCAL(J)=ACONST*X(J)+BCONST*Y(J)
           D(J)=.ABS.(ZCAL(J)-Z(J))
           DD(J)=Z(J)-ZCAL(J)
           WHENEVER USED(J) .E. 1
           SUMDD=SUMDD+D(J)*D(J)
FOUR       END OF CONDITUONAL
           THROUGH FOURA, FOR J=STARTP,1, J .G. STOPP
FOURA      PERCDV(J)=(Z(J)-ZCAL(J))/ZCAL(J)*100.
           STDERE=SQRT.(SUMDD/N)
           DLIM(K+1)=2*STDERE
           DIF=.ABS.(DLIM(K+1)-DLIM(K))
           WHENEVER CONTRL .G. 0
           DIF=0
TWO        END OF CONDITIONAL
           WHENEVER CONTRL .E. 1, TRANSFER TO SS(L)
           THROUGH FIVE, FOR J=STARTP,1, J .G. STOPP
FIVE       PRINT FORMAT ANS, TIME(J), Z(J), ZCAL(J), X(J),
          1Y(J), DD(J), USED(J)
           VECTOR VALUES ANS=$1H ,F10.2,5F20.5,I9*$
           PRINT RESULTS START
           PRINT RESULTS STOP
           PRINT RESULTS ACONST
           PRINT RESULTS BCONST
           PRINT RESULTS STDERE
           PRINT RESULTS DLIM(K)
           PRINT RESULTS DIF
          R
           WHENEVER L .L. LIMIT
           L=L+1
           TRANSFER TO S(L)
           END OF CONDITIONAL
           TRANSFER TO BEGIN
          R
           VECTOR VALUES RUNNO=$I5*$
           VECTOR VALUES PH=$I5*$
```

```
 VECTOR VALUES CNTRL=$6I5*$
 VECTOR VALUES CONST=$3I5,F5.2*$
 VECTOR VALUES VOLUME=$10F7.5*$
 VECTOR VALUES TEMP=$10F7.2*$
 VECTOR VALUES TITLE=$1H1,S4,23HEXPERIMENTAL RUN N
1UMBER,S1,7H.......,I5*$
 VECTOR VALUES ANSB=$1H ,F10.0,F10.2,3F10.5,F10.2,
1S5,I5*$
 VECTOR VALUES ANSO=$1H ,2F10.2,3F10.3, F10.5*$
 VECTOR VALUES ABLE=$1H ,4F20.3*$
 VECTOR VALUES CARD=$F10.0,F10.2,2F10.5,F10.2,S5,I
15*$
R
 VECTOR VALUES NAME1=$1H ,S14,6HHEIGHT,S10,10HCAL
1HEIGHT,S5,15HDEV FROM HEIGHT,S9,11HPERCENT DEV*$
 VECTOR VALUES NAME3=$1H ,S6,4HTIME,S10,10HELOG(DE
1LV),S16,4HZCAL,S16,4HTIME,S18,2HY=,S12,8HDEV ZCAL
1,S4,5HUSED=*$
 VECTOR VALUES NAME2=$1H ,S4,6HOBS NO,S6,4HTIME,S5
1,5HALPHA,S6,4HRATE,S5,5HDRATE,S6,4HTEMP,S4,6HNUMB
1ER*$
 VECTOR VALUES NAME8=$1H ,S6,4HTIME,S6,4HTEMP,S7,3
1HVOL,S7,3HVHT,S6,4HVRXN,S4,6HALPHAA*$
R
 END OF PROGRAM
```

```
          R
          R PROGRAM FOR THE HEMIHYDRATE-ANHYDRITE TRANS.
          R
           DIMENSION H(500), T(500), TIME(500), ALPHAA(500),
          1RATE(500), TIMEA(500), OBSNO(500), ALPHA(500),
          1PERCTD(500), X(500), Y(500), Z(500), D(500)
           INTEGER J, START, STOP, ZERO, END, F
BEGIN      READ FORMAT RUNNO, NUMBER
           READ FORMAT CONST, F, DELTAT, TRANSL, START, STOP
           READ FORMAT HVAR, H(0)...H(F)
           READ FORMAT TVAR, T(0)...T(F)
           THROUGH FIVE, FOR J=0,1,J.G.F
           TIME(J)=(DELTAT*J+TRANSL)/100.
           X(J)=(T(J)-T(0))/100.
FIVE       Y(J)=X(J)*X(J)
           TIME(0)=0.
           N=0.
           SUMW=0.
           SUMX=0.
           SUMY=0.
           SUMZ=0.
           SUMWX=0.
           SUMWY=0.
           SUMWZ=0.
           SUMXX=0.
           SUMXY=0.
           SUMXZ=0.
           SUMYY=0.
           SUMYZ=0.
           SUMZZ=0.
           THROUGH SIX, FOR J=START,1,J.G.STOP
           SUMW=SUMW+H(J)
           SUMX=SUMX+X(J)
           SUMY=SUMY+Y(J)
           SUMZ=SUMZ+TIME(J)
           SUMWX=SUMWX+H(J)*X(J)
           SUMWY=SUMWY+H(J)*Y(J)
           SUMWZ=SUMWZ+H(J)*TIME(J)
           SUMXX=SUMXX+X(J)*X(J)
           SUMXY=SUMXY+X(J)*Y(J)
           SUMXZ=SUMXZ+X(J)*TIME(J)
           SUMYY=SUMYY+Y(J)*Y(J)
           SUMYZ=SUMYZ+Y(J)*TIME(J)
           SUMZZ=SUMZZ+TIME(J)*TIME(J)
SIX        N=N+1.
           A1=N*SUMXZ-SUMX*SUMZ
           B1=SUMX*SUMXZ-SUMXX-SUMZ
           C1=SUMY*SUMXZ-SUMXY*SUMZ
           D1=SUMW*SUMXZ-SUMWX*SUMZ
```

```
           A2=N*SUMYZ-SUMY*SUMZ
           B2=SUMX*SUMYZ-SUMXY*SUMZ
           C2=SUMY*SUMYZ-SUMYY*SUMZ
           D2=SUMW*SUMYZ-SUMWY*SUMZ
           A3=N*SUMZZ-SUMZ*SUMZ
           B3=SUMX*SUMZZ-SUMXZ*SUMZ
           C3=SUMY*SUMZZ-SUMYZ*SUMZ
           D3=SUMW*SUMZZ-SUMWZ*SUMZ
           E1=A1*C2-A2*C1
           F1=B1*C2-B2*C1
           G1=D1*C2-D2*C1
           E2=A1*C3-A3*C1
           F2=B1*C3-B3*C1
           G2=D1*C3-D3*C1
           AA=(G1*F2-G2*F1)/(E1*F2-E2*F1)
           BB=(G1-AA*E1)/F1
           CC=(D1-AA*A1-BB*B1)/C1
           DD=(SUMW-AA*N-BB*SUMX-CC*SUMY)/SUMZ
           THROUGH SEVEN, FOR J=0,1,J.G.F
           Z(J)=AA+BB*X(J)+CC*Y(J)+DD*TIME(J)
           D(J)=H(J)-Z(J)
SEVEN      PERCTD(J)=(D(J)/Z(J))*100.
           SUMDD=0.
           N=0.
           THROUGH EIGHT, FOR J=START,1,J.G.STOP
           N=N+1.
EIGHT      SUMDD=SUMDD+D(J)*D(J)
           STDERE=SQRT.(SUMDD/N)
           PRINT FORMAT TITLE, NUMBER
           PRINT FORMAT NAME
           THROUGH FOURTN, FOR J=START,1,J.G.STOP
FOURTN     PRINT FORMAT ANS, H(J), Z(J), D(J), PERCTD(J)
           PRINT RESULTS STDERE
           PRINT RESULTS AA, BB, CC, DD
           PRINT RESULTS A1, B1, C1, D1
           PRINT RESULTS A2, B2, C2, D2
           PRINT RESULTS A3, B3, C3, D3
           PRINT RESULTS E1, F1, G1
           PRINT RESULTS E2, F2, G2
           PRINT RESULTS START
           PRINT RESULTS STOP
           THROUGH NINE, FOR J=F,-1,J.LE. START
NINE       WHENEVER D(J) .LE. 0., TRANSFER TO TEN
TEN        ZERO=J
           MAX=0.
           THROUGH ELEVEN, FOR J=ZERO,1,J.G.F
           WHENEVER D(J) .G. MAX
           MAX=D(J)
           END=J
ELEVEN     END OF CONDITIONAL
           THROUGH TWELVE, FOR J=0,1,J.G.F
           TIME(J)=DELTAT*J+TRANSL
           ALPHAA(J)=D(J)/MAX
TWELVE     ALPHA(J)=ALPHAA(J)
```

```
           TIME(0)=0.
           ALPHA(ZERO)=0.
           ALPHA(END+1)=1.
           ALPHA(ZERO-1)=0.
           SUMAT=0.
           SUMA=0.
           THROUGH THIRTN, FOR J=ZERO,1,J.G.END
           TIMEA(J)=(J-ZERO)*DELTAT
           OBSNO(J)=(J-ZERO)*1.+1.
           RATE(J)=(ALPHA(J+1)-ALPHA(J-1))/(2.*DELTAT)
           SUMA=SUMA+RATE(J)*DELTAT
           SUMAT=SUMAT+RATE(J)*T(J)*DELTAT
THIRTN     CONTINUE
           TRXNAV=SUMAT/SUMA
           PRINT FORMAT TITLE, NUMBER
           PRINT FORMAT NAME1
           THROUGH FIFTN, FOR J=ZERO,1,J.G.END
FIFTN      PRINT FORMAT ANS1, OBSNO(J), TIMEA(J), ALPHA(J),
          1RATE(J), T(J), NUMBER
           PRINT RESULTS TRXNAV
           PRINT FORMAT TITLE, NUMBER
           PRINT FORMAT NAME2
           THROUGH SIXTN, FOR J=0,1,J.G.F
SIXTN      PRINT FORMAT ANS2, TIME(J), T(J), H(J), Z(J),
          1D(J), ALPHAA(J)
           THROUGH SEVNTN, FOR J=ZERO,1,J.G.END
SEVNTN     PUNCH FORMAT CARD, OBSNO(J), TIMEA(J), ALPHA(J),
          1RATE(J), T(J), NUMBER
           TRANSFER TO BEGIN
           VECTOR VALUES RUNNO=$I5*$
           VECTOR VALUES CONST=$I5,F5.2,F5.1,2I5*$
           VECTOR VALUES HVAR=$10F7.3*$
           VECTOR VALUES TVAR=$10F7.1*$
           VECTOR VALUES TITLE=$1H1,17HEXPERIMENTAL RUN,
          114HNUMBER .......,I5//*$
           VECTOR VALUES NAME=$1H ,S14,6HHEIGHT,S10, 4HCAL ,
          16HHEIGHT,S5,15HDEV FROM HEIGHT,S9, 8HPERCENT ,
          13HDEV//*$
           VECTOR VALUES ANS=$1H ,4F20.3*$
           VECTOR VALUES NAME1=$1H ,S4,6HOBS NO,S6,4HTIME,
          1S5,5HALPHA,S6,4HRATE,S6,4HTEMP,S4,6HNUMBER*$
          14HRATE,S6,4HTEMP,S4,6HNUMBER*$
           VECTOR VALUES ANS1=$1H ,F10.0,F10.1,2F10.5,F10.1,
          1I10*$
           VECTOR VALUES NAME2=$1H ,S6,4HTIME,S6,4HTEMP,S4,
          16HEIGHT,
          16HHEIGHT,S6,4HHCAL,S6,4HHRXN,S4,6HALPHAA//*$
           VECTOR VALUES ANS2=$1H ,2F10.1,3F10.3,F10.5*$
           VECTOR VALUES CARD=$F10.0,F10.1,2F10.5,F10.1,I10*$
           END OF PROGRAM
```

APPENDIX F

SUMMARY OF EXPERIMENTAL CONDITIONS

RUN NO.	SOLID WT.,GM	CRYSTAL DIA.,IN	** SOLUTION CON.	PRESS PSIG	TEMP °F	HEIGHT CM
	DEHYDRATION OF CALCIUM SULFATE DIHYDRATE TO HEMIHYDRATE					
1-5	PRELIMINARY RUNS NOT ANALYZED					
6	1.010	SING.CRYST.	DIW	59.0	261.3	12.789
7	.630	.0195-.0138	DIW	95.*	259.8	7.735
8	.770	.0138-.0116	DIW	95.*	259.4	9.095
9	.720	.0116-.0082	DIW	95.*	260.3	7.902
10	.705	.0082-.0069	DIW	95.*	259.3	8.079
11	.700	.0069-.0058	DIW	95.*	261.0	7.736
12	.700	.0058-.0041	DIW	94.0	261.2	7.87
13	.700	.0041-.0035	DIW	93.*	261.3	5.897
14	.700	.0035-.0029	DIW	93.*	261.7	6.954
15	.700	.0029-.0021	DIW	92.0	260.4	7.894
16	.700	.0021-.0000	DIW	90.0	261.4	7.702
17	PHOTOGRAPHIC HEIGHT READINGS INCOMPLETE					
18	PHOTOGRAPHIC HEIGHT READINGS INCOMPLETE					
19	.700	.0041-.0035	DIW	90.0	251.1	8.575
20	.700	.0058-.0041	DIW	87.*	250.9	8.528
21	.700	.0035-.0029	DIW	87.*	251.3	8.414
22	.700	.0069-.0058	DIW	87.*	250.9	8.360
23	.700	.0082-.0069	DIW	87.*	251.0	8.393
24	.700	.0116-.0082	DIW	87.*	250.4	8.479
25	.700	.0116-.0082	DIW	87.*	251.0	8.506
26	.700	.0058-.0041	DIW	87.*	250.9	8.279
27	.700	.0138-.0116	DIW	87.*	251.0	8.405
28	.700	.0164-.0138	DIW	87.0	250.3	8.384
29	.700	.0041-.0035	DIW	87.*	249.8	8.037
30	.700	.0082-.0069	DIW	87.0	250.4	8.337
31	.700	.0069-.0058	DIW	97.0	251.0	8.440
32	.700	.0029-.0021	DIW	97.*	250.5	8.243
33	.700	.0021-.0000	DIW	97.5	250.3	8.222
34	.700	.0082-.0069	DIW	87.3	250.3	8.434
35	.700	.0082-.0069	DIW	86.0	249.7	8.368
36	.700	.0082-.0069	3.5% NaCl	86.*	249.9	8.148
37	.700	.0082-.0069	21.0% NaCl	86.0	245.0	6.729
38	.700	.0082-.0069	3.5% NaCl	86.*	240.8	8.060
39	.700	.0082-.0069	7.0% NaCl	85.0	241.5	7.778
40	.700	.0082-.0069	14.0% NaCl	85.*	241.1	7.417
41	.700	.0082-.0069	21.0% NaCl	85.*	236.0	6.948
42	.700	.0082-.0069	DIW	85.*	240.9	8.102
43	.700	.0082-.0069	1.0% NaCl	85.*	239.9	8.220

RUN NO.	SOLID WT.,GM	CRYSTAL DIA.,IN	SOLUTION CON.	PRESS PSIG	TEMP OF	HEIGHT CM
44	.700	.0082-.0069	0.5% NaCl	85.*	240.5	8.238
45	.700	.0082-.0069	1X SSW	85.0	239.4	8.139
46		PHOTOGRAPHIC DATA NOT READABLE				
47	.700	.0082-.0069	3X SSW	89.*	242.0	7.943
48	.700	.0082-.0069	4X SSW	88.*	242.5	7.794
49	.700	.0082-.0069	2X SSW	87.0	242.1	7.923
50	.700	.0082-.0069	1X SSW	87.0	242.0	8.083
51	.700	.0082-.0069	1X SSW	86.*	235.3	8.134
52	.700	.0082-.0069	3.5% NaCl	85.0	235.7	7.997
53	.700	.0082-.0069	3.5% NaCl	85.0	230.9	7.888
54	.700	.0082-.0069	1X SSW	85.0	231.0	7.867
55	.700	.0082-.0069	3.5% NaCl	85.0	246.1	8.162
56	CHECK RUN ON THERMAL VOLUME EXPANSION CORRELATION					
57	CHECK RUN ON THERMAL VOLUME EXPANSION CORRELATION					
58	.700	.0082-.0069	DIW	90.0	256.9	8.566
59	.700	.0082-.0069	DIW	90.0	249.6	8.426
60	.700	.0082-.0069	1X SSW	89.0	249.4	8.261
61	.700	.0082-.0069	1X SSW	87.5*	245.0	8.244
62	.700	.0082-.0069	DIW	86.0	244.9	8.331
63	.700	.0082-.0069	DIW	87.0	262.8	8.723
64	.700	.0082-.0069	DIW	89.0	269.3	8.823
DEHYDRATION OF CALCIUM SULFATE HEMIHYDRATE TO ANHYDRITE						
65	.700	.0116-.0082	DIW	155.0	TERMINATED	
66	.700	.0116-.0082	DIW	205.0	325.5	3.044
67	.700	.0116-.0082	3.5% NaCl	200.*	TERMINATED	
68	.700	.0116-.0082	1X SSW	200.*	326.2	3.279
69	.700	.0116-.0082	3.5% NaCl	200.*	326.1	3.416
70	.700	.0116-.0082	3.5% NaCl	200.*	338.5	3.434
71	.700	.0116-.0082	1X SSW	200.0	338.8	3.412
72A	.700	.0116-.0082	DIW	200.*	TERMINATED	
72	.700	.0116-.0082	DIW	200.*	339.1	3.453
73A	.700	.0116-.0082	3.5% NaCl	200.*	TERMINATED	
73	.700	.0116-.0082	3.5% NaCl	200.*	347.9	3.658
74A	.700	.0116-.0082	1X SSW	200.*	TERMINATED	
74B	.700	.0116-.0082	1X SSW	200.*	TERMINATED	
75	.700	.0116-.0082	1X SSW	171.0	347.6	3.617
76	.700	.0116-.0082	DIW	200.*	346.8	3.379

* PRESSURE VALUES DETERMINED BY INTERPOLATION.

** CONCENTRATION FOR SODIUM CHLORIDE SOLUTIONS ARE IN WEIGHT PERCENT. CONCENTRATIONS FOR SYNTHETIC SEA WATER CONCENTRATES ARE EXPRESSED AS A CONCENTRATION FACTOR WHICH IS THE RATIO OF THE WEIGHT PERCENT DISSOLVED SOLIDS IN SOLUTION TO THE WEIGHT PERCENT DISSOLVED SOLIDS IN NORMAL SYNTHETIC SEA WATER.

APPENDIX G

SUMMARY OF ALL THE TIME-TEMPERATURE-TRANSFORMATION RELATIONSHIPS

All the time-temperature-transformation relationships determined during the dilatometric studies are summarized in five different tables in this appendix. Tables G-1 through G-4 contain the results for the dehydration of calcium sulfate dihydrate to hemihydrate and Table G-5 contains the results for the dehydration of calcium sulfate hemihydrate to anhydrite. Tables G-1, G-2, and G-5 show the results for the reactions where the solids were immersed in water, 3.5% sodium chloride solutions, and in synthetic sea water. Table G-3 shows the effect of changing solution concentration on the relationships, and Table G-4 shows the effect of changes in initial particle size on the relationships for the dehydration of calcium sulfate dihydrate to hemihydrate.

TABLE G-1

TIME-TEMPERATURE-TRANSFORMATION RESULTS FOR THE DEHYDRATION OF CALCIUM SULFATE DIHYDRATE TO HEMIHYDRATE SHOWING THE EFFECT OF THE CONCENTRATION OF THE SOLUTION IN WHICH THE SOLIDS WERE IMMERSED ON THE TRANSFORMATION

RUN NO.	TEMP. °F	SOLUTION CON.	TIME IN MIN FOR PERCENT REACTED 5	25	50	75	95
		RESULTS FOR SODIUM CHLORIDE SOLUTIONS					
		*					
42	240.6	0.0	310	450	570	720	1280
44	240.7	0.5	119	174	224	278	354
43	240.3	1.0	70	98	123	155	206
38	240.0	3.5	35	46	57	69	90
39	239.0	7.0	24	31	37	45	57
40	236.8	14.0	15	19	23	28	36
41	23.04	21.0	12	16	21	27	39
37	237.3	21.0	9	11	14	16	20
		RESULTS FOR SYNTHETIC SEA WATER CONCENTRATES					
		**					
42	240.6	0.0	310	450	570	720	1280
50	241.0	1.0	39	49	57	67	84
49	240.0	2.0	28	34	40	47	57
47	239.5	3.0	21	26	31	36	44
48	238.9	4.0	16	20	24	28	35

* WEIGHT PERCENT DISSOLVED SOLIDS

** CONCENTRATION FACTOR = (WEIGHT PERCENT DISSOLVED SOLIDS / WEIGHT PERCENT DISSOLVED SOLIDS IN NORMAL SYNTHETIC SEA WATER)

TABLE G-2

TIME-TEMPERATURE-TRANSFORMATION RESULTS FOR THE DEHYDRATION OF CALCIUM SULFATE DIHYDRATE TO HEMIHYDRATE WHERE THE SOLIDS WERE IMMERSED IN AQUEOUS SOLUTIONS AT TEMPERATURES BELOW 270 °F

RUN NO.	TEMP. °F	* Δ-TIME MIN	TIME IN MIN FOR PERCENT REACTED 5	25	50	75	95
			RESULTS FOR WATER				
64	265.2	1	22	26	30	34	40
63	260.4	1	30	37	42	49	59
58	255.4	1	41	55	66	77	95
23	250.5	1	66	91	111	130	158
34	250.1	1	76	100	119	139	168
30	250.0	1	95	124	146	169	202
35	249.3	1	83	112	136	162	194
59	249.1	1	63	87	107	127	155
62	244.7	5	110	160	205	250	320
42	240.6	10	310	450	570	720	1280
23-59	249.8	AVE. VALUES	77	103	124	145	175
			RESULTS FOR 3.5 PERCENT SODIUM CHLORIDE SOLUTIONS				
36	247.0	1	22	27	32	37	46
55	243.7		22	28	34	42	53
38	240.0	1	35	46	57	69	90
52	235.1	1	45	64	83	107	149
53	230.9	1	63	97	133	175	249
			RESULTS FOR NORMAL SYNTHETIC SEA WATER				
60	247.0	1	25	30	35	40	49
61	243.3	1	33	42	49	58	72
50	241.0	1	39	49	57	67	84
45	239.0	1	56	70	83	99	124
51	235.0	1	78	101	123	148	187
54	230.9	1	147	197	251	310	398

* TIME INTERVAL BETWEEN DATA POINTS

TABLE G-3

TIME-TEMPERATURE-TRANSFORMATION RESULTS FOR THE DEHYDRATION CALCIUM SULFATE HEMIHYDRATE TO ANHYDRITE WHERE THE SOLIDS WERE IMMERSED IN AQUEOUS SOLUTIONS

RUN NO.	TEMP. OF	* Δ-TIME MIN	TIME IN MIN FOR PERCENT REACTED 5	25	50	75	95
			RESULTS FOR WATER				
66	325.8	10	474	774	1034	1264	1504
72	339.0	10	574	894	1054	1184	1334
76	346.8	10	510	680	790	880	1000
			RESULTS FOR 3.5 PERCENT SODIUM CHLORIDE SOLUTIONS				
69	326.0	5	175	250	310	360	400
70	338.5	5	125	175	215	250	280
73	347.8	5	95	135	165	195	220
			RESULTS FOR NORMAL SYNTHETIC SEA WATER				
68	326.3	5	195	275	350	415	460
71	338.8	5	135	180	225	265	295
75	347.7	5	100	145	195	240	265

* TIME INTERVAL BETWEEN DATA POINTS

TABLE G-4

TIME-TEMPERATURE-TRANSFORMATION RESULTS FOR THE DEHYDRATION OF CALCIUM SULFATE DIHYDRATE TO HEMIHYDRATE WHERE THE SOLIDS WERE IMMERSED IN AQUEOUS SOLUTIONS AT TEMPERATURES ABOVE 275°F

RUN NO.	TEMP. °F	* Δ-TIME MIN	TIME IN MIN FOR PERCENT REACTED 5	25	50	75	95
			RESULTS FOR WATER				
65	282.5	0.1	7.5	-.-	-.-	-.-	12.5
66	289.6	0.1	6.0	-.-	-.-	-.-	10.0
72A	297.1	0.1	6.2	-.-	-.-	-.-	8.0
72	297.8	0.1	6.0	-.-	-.-	-.-	9.0
76	298.7	0.1	5.7	-.-	-.-	-.-	8.0
			RESULTS FOR 3.5 PERCENT SODIUM CHLORIDE SOLUTIONS				
67	275.8	0.1	3.3	-.-	-.-	-.-	8.0
69	279.3	0.1	4.1	-.-	-.-	-.-	8.9
70	286.7	0.1	4.8	-.-	-.-	-.-	7.8
73A	282.9	0.1	4.3	-.-	-.-	-.-	6.8
73	283.5	0.1	4.7	-.-	-.-	-.-	6.6
			RESULTS FOR NORMAL SYNTHETIC SEA WATER				
68	282.5	0.1	5.2	-.-	-.-	-.-	8.9
71	285.6	0.1	5.2	-.-	-.-	-.-	7.6
74A	289.0	0.1	4.4	-.-	-.-	-.-	6.4
74B	288.4	0.1	4.8	-.-	-.-	-.-	6.9
75	287.4	0.1	4.8	-.-	-.-	-.-	6.9

* TIME INTERVAL BETWEEN READINGS

TABLE G-5

TIME-TEMPERATURE TRANSFORMATION RESULTS FOR THE DEHYDRATION OF CALCIUM SULFATE DIHYDRATE TO HEMIHYDRATE SHOWING THE EFFECT OF THE INITIAL DIHYDRATE CRYSTAL FRAGMENT SIZE ON THE REACTION WHERE THE SOLIDS WERE IMMERSED IN WATER

RUN	TEMP.	SCREEN	TIME IN MIN FOR PERCENT REACTED				
NO.	°F	OPENING, IN	5	25	50	75	95
UNWASHED CRYSTALS RUN AT APPROXIMATELY 260°F							
6	261.0	SING. CRY.	33	58	88	123	171
7	258.0	.0195.-0138	28	36	43	52	67
8	258.0	.0138.-0116	23	31	39	49	63
9	259.0	.0116.-0082	31	39	46	54	66
10	257.8	.0082.-0069	29	37	44	52	63
11	258.9	.0069.-0058	32	39	47	54	65
12	259.4	.0058.-0041	35	42	48	55	64
13	259.8	.0041.-0035	32	40	45	51	59
14	260.2	.0035.-0029	29	36	42	49	58
15	258.7	.0029.-0021	34	41	49	57	67
16	260.1	.0021.-0000	33	42	52	61	72
UNWASHED CRYSTALS RUN AT APPROXIMATELY 250°F							
24	250.2	.0116.-0082	61	90	112	133	167
23	250.5	.0082.-0069	66	91	111	130	158
22	250.5	.0069.-0058	60	84	103	123	149
20	250.5	.0058.-0041	65	90	109	129	156
19	251.1	.0041.-0035	71	92	114	136	165
21	251.0	.0035.-0029	61	80	103	124	150
WASHED CRYSTALS RUN AT APPROXIMATELY 250°F							
28	249.8	.0164.-0138	89	121	145	173	217
27	250.7	.0138.-0116	76	101	122	147	184
25	250.3	.0116.-0082	44	66	87	111	150
30	250.0	.0082.-0069	95	124	146	169	202
34	250.1	.0082.-0069	76	100	119	139	168
35	249.3	.0082.-0069	83	112	136	162	194
31	250.5	.0069.-0058	85	110	130	151	180
26	250.3	.0058.-0041	83	111	137	164	205
29	250.0	.0041.-0035	82	109	134	161	205
32	250.7	.0029.-0021	114	147	175	204	251
33	250.4	.0021.-0000	205	292	398	470	529

APPENDIX H

COMPOSITION OF SYNTHETIC SEA WATER

The composition of the normal synthetic sea water used during these studies was given by Lyman and Fleming(56) in 1940 and is quoted below in Table H-1 from the "Oceans"(85),p. 185. It contains all the major inorganic salts of real sea water and has a chlorinity of 19%. The three synthetic sea water concentrates used during these studies contained dissolved solids of 2, 3, and 4 times that given below for normal synthetic sea water.

TABLE H-1

COMPOSITION OF NORMAL SYNTHETIC SEA WATER

Compound	Mass, grams
NaCl	23.476
$MgCl_2$	4.981
Na_2SO_4	3.981
$CaCl_2$	1.102
KCl	0.664
$NaHCO_3$	0.192
KBr	0.096
H_3BO_3	0.026
$SrCl_2$	0.024
NaF	0.003
H_2O	965.519
Total Weight	1000.000

APPENDIX I

CLASSIFICATION OF INITIAL PARTICLE SIZES

The solid samples of optical grade selenite used in the dilatometric experiments were composed of small rhombic crystal fragments obtained by crushing and grinding larger crystals with a mortar and pestle, then classifying the product into different size distributions using 11 Tyler Standard Screens, shaken mechanically for two minutes. The pertinent screen data are shown in Table I-1.

A portion of each dry sample classified was washed several times in deionized water to remove all the adhering powder from the crystal fragments by forming a suspension of the fine particles and separating them from the bulk crystal fragments by decanting the liquid. This washing procedure was continued until the supernatant liquid was clear. The slurry of usable crystal fragments was dried over night at 100°F, cooled, and stored for use in the dilatometric experiments.

TABLE I-1

CRYSTAL CLASSIFICATION INFORMATION

Tyler Standard Screen Data				
Mesh	Opening, mm	Opening, Inches	Limited Screen Openings, Inches	Average Opening, Inches
32	.495	.0195		
			.0195-.0164	.0180
35	.417	.0164		
			.0164-.0138	.0151
42	.351	.0138		
			.0138-.0116	.0127
48	.295	.0116		
60	.246	.0097	.0116-.0082	.0099
65	.208	.0082		
			.0082-.0069	.0076
80	.175	.0069		
			.0069-.0058	.0064
100	.147	.0058		
115	.124	.0049	.0058-.0041	.0050
150	.104	.0041		
			.0041-.0035	.0038
170	.088	.0035		
			.0035-.0029	.0032
200	.074	.0029		
250	.062	.0024	.0029-.0021	.0025
270	.053	.0021		
			.0021-.0000	.0011

APPENDIX J

PHASE INDENTIFICATION USING X-RAY POWDER DIFFRACTION PATTERNS

The dihydrate, hemihydrate, and anhydrite phases occurring in the dilatometer under the different steady state conditions encountered during the experimental runs were identified using powder x-ray diffraction patterns. Samples were removed from the dilatometer before either of the two reactions studied became detectable and after each one had gone to completion. The samples were dried in air over night at 100°F, cooled in a desiccator, and a small portion was finely ground, mixed with "Duco" cement, and formed into small cylinders for use in the x-ray camera. Exposures were made in a 114.7 mm diameter Straumanis powder camera using $Cu(K_{\alpha})$ radiation for 8 hours at 40 KV and 15 MA with a piece of thin nickel foil placed over the film to reduce the background. The phases identified by these x-ray powder diffraction patterns corresponded to those predicted by the chemical equations describing each reaction, confirming the hypothesis that calcium sulfate hemihydrate dehydrates to calcium sulfate hemihydrate which in turn dehydrates to calcuim sulfate anhydrite in that particular sequential manner under non-equilibrium conditions encountered when the solids were immersed and heated in water, 3.5% sodium chloride solutions, and in synthetic sea water.

The detailed results of this study are summarized in Table J-1. From the four of the x-ray powder diffraction patterns shown in Figures J-1, J-2, J-3, and J-4, values of the interplaner distances d were measured for calcium sulfate dihydrate, hemihydrate, and anhydrite, and for sodium chloride, and compared with the published reference values in Tables J-2, J-3, J-4 and J-5, respectively. The remaining x-ray powder diffraction patterns were identified by physically superimposing one film upon the other since the patterns are unmistakeably different.

Comparison of the x-ray powder diffraction patterns from each of the three different phases revealed that none of the strongest lines occurring in any one of the phases occurred in either of the other phases, indicating that the reactions were observed at steady state conditions either before or after the reactions had occurred.

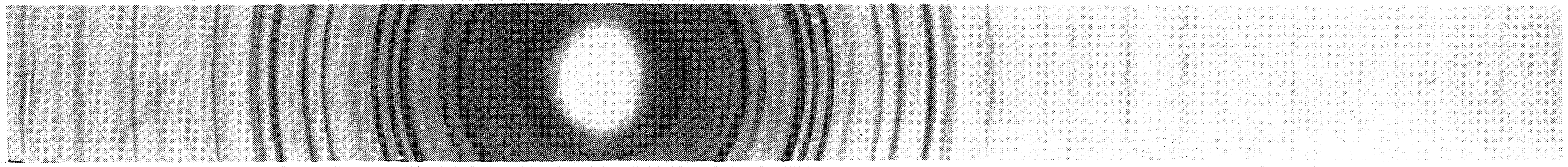


Figure J-1. X-ray Powder Diffraction Pattern for Calcium Sulfate Dihydrate.

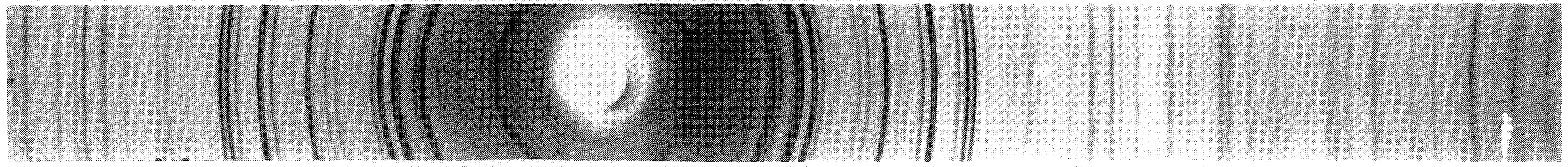


Figure J-2. X-ray Powder Diffraction Pattern for Calcium Sulfate Hemihydrate.

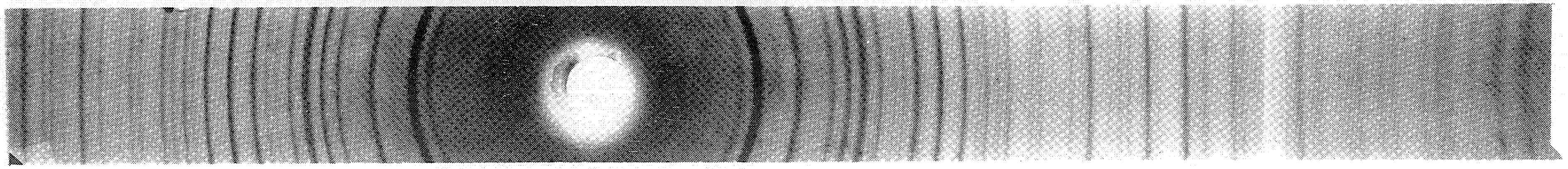


Figure J-3. X-ray Powder Diffraction Pattern for Calcium Sulfate Anhydrite.

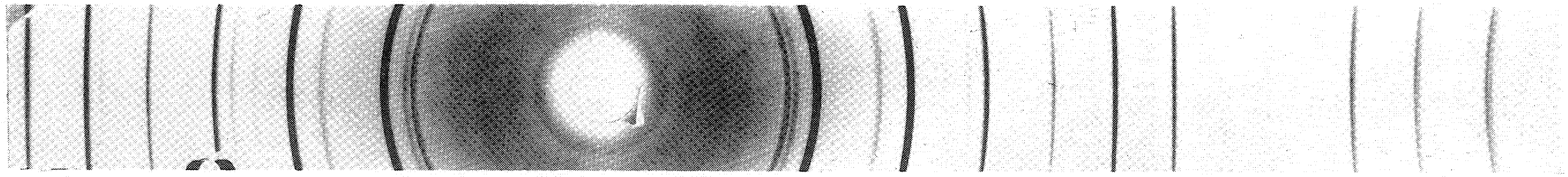


Figure J-4. X-ray Powder Diffraction Pattern for C. P. Sodium Chloride.

TABLE J-1

RESULTS OF STUDIES OF THE X-RAY POWDER DIFFRACTION PATTERNS

X-ray No.	Run No.	Starting Material	Solution	Temp., °F	Removal of X-ray samples from dilatometer in relationship to the reactions detected by a volume increase as shown below: Dihydrate to Hemihydrate	Hemihydrate to Anhydrite	Phase Identified by X-ray Diffraction Patterns
1	All	Selenite	Water	-----	Before	Before	Dihydrate
1A*	All	Selenite	Water	-----	Before	Before	Dihydrate
2	28	Selenite	Water	250.3	After	Before	Hemihydrate
2A*	28	Selenite	Water	250.3	After	Before	Hemihydrate
3	65	Selenite	Water	~310.	After	After	Anhydrite
4	66	Selenite	Water	325.5	After	After	Anhydrite
5*	--	NaCl	-----	-----	-----	-----	NaCl
6*	72	Selenite	Water	339.1	After	After	Anhydrite
7	72A	Selenite	Water	~337.	After	Before	Hemihydrate
8	76	Selenite	Water	346.8	After	After	Anhydrite
9	36	Selenite	3-1/2% NaCl	349.9	After	Before	Hemihydrate
10	73	Selenite	3-1/2% NaCl	347.9	After	After	Anhydrite
11	73A	Selenite	3-1/2% NaCl	~346.	After	Before	Hemihydrate
12	60	Selenite	Sea Water	249.4	After	Before	Hemihydrate
13	--	Selenite	Air	~250.	After	------	Hemihydrate
14	74A	Selenite	Sea Water	>350.	After	Before	Hemihydrate
15	74B	Selenite	Sea Water	~346.	After	After	Anhydrite

* Measured values of interplaner distances d are shown for these samples.

TABLE J-2

COMPARISON OF X-RAY DIFFRACTION DATA FROM CALCIUM SULFATE DIHYDRATE (SELENITE) WITH DATA REPORTED FOR $CaSO_4 \cdot 2H_2O$ ON ASTM CARD NUMBER 6-0046 AND 6-0047(82).

$CaSO_4 \cdot 2H_2O$		Sample of Starting Material, Selenite	
d(Å)	I/I_1	d(Å)	I/I_1
7.56	100	7.63	VS
4.27	51	4.27	VS
3.79	21	3.80	M
3.163	3	3.149	VW
3.059	57	3.056	VS
2.867	27	2.861	S
2.786	5		
2.697	28	2.670	S
2.591	4		
2.530	1		
2.495	6		
2.450	4		
2.400	4		
2.216	6	2.211	M
2.139	1		
2.080	10	2.078	M
2.073	8		
1.990	4		
1.953	2		
1.898	16	1.895	M
1.879	10	1.877	M
1.864	4		
1.843	1		
1.812	10	1.809	W
1.796	4		
1.778	10	1.784	W
1.711	1		
1.684	1		
1.664	4		
1.645	2		
etc.			

VS = very strong
S = strong
M = medium
W = weak
VW = very weak

TABLE J-3

COMPARISON OF X-RAY DIFFRACTION DATA FROM CALCIUM SULFATE HEMIHYDRATE FORMED FROM DIHYDRATE IN WATER WITH THE DATA REPORTED FOR $CaSO_4 \cdot 1/2H_2O$ ON ASTM CARD NUMBER 2-0675.(82)

Standard $CaSO_4 \cdot 1/2H_2O$		Sample Formed in Dilatometric Run	
d(Å)	I/I_1	d(Å)	I/I_1
5.98	90	6.020	S
4.35	20	4.333	VW
3.45	80	3.480	S
2.98	100	2.997	VS
2.78	100	2.812	S
2.69	30	2.713	VW
2.33	40	2.343	VW
2.26	20	2.263	VW
2.20	20		
2.12	80	2.136	M
1.99	30		
1.89	60	1.908	W
1.84	90	1.846	S
1.72	40	1.729	W
1.69	80	1.692	M
1.65	60	1.662	M
1.60	20		
1.53	30		
1.47	40		
1.44	30		

VS = very strong
S = strong
M = medium
W = weak
VW = very weak

TABLE J-1

RESULTS OF STUDIES OF THE X-RAY POWDER DIFFRACTION PATTERNS

X-ray No.	Run No.	Starting Material	Solution	Temp., °F	Removal of X-ray samples from dilatometer in relationship to the reactions detected by a volume increase as shown below: Dihydrate to Hemihydrate	Hemihydrate to Anhydrite	Phase Identified by X-ray Diffraction Patterns
1	All	Selenite	Water	-----	Before	Before	Dihydrate
1A*	All	Selenite	Water	-----	Before	Before	Dihydrate
2	28	Selenite	Water	250.3	After	Before	Hemihydrate
2A*	28	Selenite	Water	250.3	After	Before	Hemihydrate
3	65	Selenite	Water	~310.	After	After	Anhydrite
4	66	Selenite	Water	325.5	After	After	Anhydrite
5*	--	NaCl	-----	-----	-----	-----	NaCl
6*	72	Selenite	Water	339.1	After	After	Anhydrite
7	72A	Selenite	Water	~337.	After	Before	Hemihydrate
8	76	Selenite	Water	346.8	After	After	Anhydrite
9	36	Selenite	3-1/2% NaCl	349.9	After	Before	Hemihydrate
10	73	Selenite	3-1/2% NaCl	347.9	After	After	Anhydrite
11	73A	Selenite	3-1/2% NaCl	~346.	After	Before	Hemihydrate
12	60	Selenite	Sea Water	249.4	After	Before	Hemihydrate
13	--	Selenite	Air	~250.	After	------	Hemihydrate
14	74A	Selenite	Sea Water	> 350.	After	Before	Hemihydrate
15	74B	Selenite	Sea Water	~ 346.	After	After	Anhydrite

* Measured values of interplaner distances d are shown for these samples.

TABLE J-2

COMPARISON OF X-RAY DIFFRACTION DATA FROM CALCIUM SULFATE DIHYDRATE (SELENITE) WITH DATA REPORTED FOR $CaSO_4 \cdot 2H_2O$ ON ASTM CARD NUMBER 6-0046 AND 6-0047(82).

$CaSO_4 \cdot 2H_2O$		Sample of Starting Material, Selenite	
d(Å)	I/I_1	d(Å)	I/I_1
7.56	100	7.63	VS
4.27	51	4.27	VS
3.79	21	3.80	M
3.163	3	3.149	VW
3.059	57	3.056	VS
2.867	27	2.861	S
2.786	5		
2.697	28	2.670	S
2.591	4		
2.530	1		
2.495	6		
2.450	4		
2.400	4		
2.216	6	2.211	M
2.139	1		
2.080	10	2.078	M
2.073	8		
1.990	4		
1.953	2		
1.898	16	1.895	M
1.879	10	1.877	M
1.864	4		
1.843	1		
1.812	10	1.809	W
1.796	4		
1.778	10	1.784	W
1.711	1		
1.684	1		
1.664	4		
1.645	2		

etc.

VS = very strong
S = strong
M = medium
W = weak
VW = very weak

TABLE J-3

COMPARISON OF X-RAY DIFFRACTION DATA FROM CALCIUM SULFATE HEMIHYDRATE FORMED FROM DIHYDRATE IN WATER WITH THE DATA REPORTED FOR $CaSO_4.1/2H_2O$ ON ASTM CARD NUMBER 2-0675.(82)

Standard $CaSO_4 \cdot 1/2H_2O$ ·		Sample Formed in Dilatometric Run	
d(Å)	I/I_1	d(Å)	I/I_1
5.98	90	6.020	S
4.35	20	4.333	VW
3.45	80	3.480	S
2.98	100	2.997	VS
2.78	100	2.812	S
2.69	30	2.713	VW
2.33	40	2.343	VW
2.26	20	2.263	VW
2.20	20		
2.12	80	2.136	M
1.99	30		
1.89	60	1.908	W
1.84	90	1.846	S
1.72	40	1.729	W
1.69	80	1.692	M
1.65	60	1.662	M
1.60	20		
1.53	30		
1.47	40		
1.44	30		

VS = very strong
S = strong
M = medium
W = weak
VW = very weak

TABLE J-4

COMPARISON OF X-RAY DIFFRACTION DATA FROM CALCIUM SULFATE ANHYDRITE FORMED FROM HEMIHYDRATE IN WATER WITH THE DATA REPORTED FOR CALCIUM SULFATE, $CaSO_4$, ANHYDRITE ON ASTM CARD NUMBER 6-0226.(82)

Standard $CaSO_4$		Sample Formed During Dilatometric Run	
d(Å)	I/I_1	d(Å)	I/I_1
3.87	6	3.88	VW
3.498	100	3.502	VS
3.118	3		
2.849	33	2.840	M
2.797	4		
2.473	8	2.469	W
2.328	22	2.330	M
2.208	20	2.192	M
2.183	8		
2.086	9	2.076	W
1.993	6	1.990	VW
1.938	4	1.932	VW
1.869	15	1.865	M
1.852	4		
1.749	11	1.747	M
1.748	10		
1.648	14	1.645	M
1.594	3	1.591	VW
1.564	5	1.561	VW
1.525	4	1.521	VW
1.515	1		
1.490	5	1.488	W
1.424	33	1.423	W
1.418	1		
1.398	3	1.396	W
1.396	2		
1.365	1		
1.319	4	1.318	W
1.296	2		
1.277	5	1.275	W

VS = very strong
S = strong
M = medium

W = weak
VW = very weak

TABLE J-5

COMPARISON OF X-RAY DIFFRACTION DATA FROM C.P. SODIUM CHLORIDE WITH DATA REPORTED FOR NaCl ON ASTM CARD NUMBER 5-0628.(82)

Standard NaCl		C.P. Sodium Chloride	
d(Å)	I/I_1	d(Å)	I/I_1
3.258	13	3.25	M
		3.10	M
2.821	100	2.80	VS
		2.20	M
1.994	55	1.98	VS
		1.80	VW
1.701	2	1.69	W
1.628	15	1.62	S
1.410	6	1.405	M
		1.390	VVW
1.294	1	1.290	W
1.261	11	1.256	S
1.1515	7	1.148	S
1.0855	1	1.082	VW
0.9969	2	1.040	VVW
0.9533	1	0.952	W
0.9401	3	0.938	M
0.8917	4	0.890	M
0.8601	1	0.860	VVW
0.8503	3	0.850	M
		0.848	M
		0.834	VVW
0.8141	2	0.814	W
		0.812	W

VS = Very Strong
S = Strong
M = Medium
W = Weak
VW = Very Weak
VVW = Very Very Weak

APPENDIX K

VAPOR PRESSURE RATIOS FOR SODIUM CHLORIDE SOLUTIONS

Values of the vapor pressure ratio P/P°, i.e. the ratio of the vapor pressure of sodium chloride solutions P to the vapor pressure of pure water P° at identical temperatures, were calculated from the vapor pressure data given in the International Critical Tables(49,97) using the method introduced by Cox.(17) The linear relationship between the logarithm of the vapor pressure of pure water for the same temperature was determined by the method of least squares using Equation K-1 yielding the coefficients shown in Table K-1 for different values of the weight fraction of sodium chloride X in the solution:

$$\ln P = \ln b_o(X) + b_1 \ln P^\circ \qquad \text{(K-1)}$$

where b_o and b_1 are constants. The value of b_1 was found almost equal to unity and consequently the data were correlated again forcing $b_1=1$ resulting in the following relationship.

$$\ln (P/P^\circ) = \ln b_o(X) \text{ or } P/P^\circ = b_o(X) \; . \qquad \text{(K-2)}$$

The values of $b_o(X)$ obtained using this squation for solutions having different values of X are shown in Table K-2.

Values of the function $b_o(X)$ for values of X different from those shown in Table K-2 were calculated using the following interpolation formulas determined by a least squares fit of the data:

$$b_o(X) = 1.000 - 0.643X \quad \text{for} \quad 0.0 \leq X \leq 0.10 \qquad \text{(K-3)}$$

$$b_o(X) = 0.962 - 2.93X^2 \quad \text{for} \quad 0.10 \leq X \leq 0.25 \qquad \text{(K-4)}$$

Thus, the vapor pressure ratios for all sodium chloride solutions can be determined as a function of the amount of dissolved solid up to 25% solution.

TABLE K-1

COEFFICIENTS OF EQUATION (K-1)

X	ln b_o (X)	b_1
.000	.000000	1.000000
.025	-.013438	.999613
.050	-.035468	1.000607
.075	-.041760	.998586
.100	-.064684	.999357
.125	-.086805	.999633
.150	-.112222	1.000094
.175	-.138777	1.000135
.200	-.184505	1.002890
.225	-.221218	1.003168
.250	-.273199	1.005370

TABLE K-2

COEFFICIENTS OF EQUATION (K-2)

X	ln b_o (X)	b_o (X)
.000	.000000	1.000000
.025	-.015208	.984907
.050	-.032694	.967835
.075	-.048219	.952925
.100	-.067612	.934623
.125	-.088484	.915318
.150	-.111794	.89423
.175	-.138161	.87096
.200	-.171302	.84257
.225	-.206747	.81323
.250	-.248668	.77984

The vapor pressure ratios calculated using Equations (K-3) and (K-4) for the six different sodium chloride solutions used in these studies are shown in Table K-3. For comparison, the vapor pressure ratios calculated by Equation (26) for synthetic sea water concentrates are also shown in this table.

TABLE K-3

VAPOR PRESSURE RATIOS

Sodium Chloride Solutions

Weight Fraction, X	Vapor Pressure Ratio P/P°
.005	0.997
.010	0.994
.035	0.978
.070	0.956
.140	0.903
.210	0.831

Synthetic Sea Water Concentrates

Chlorinity, Y	Vapor Pressure Ratio P/P°
19	0.982
38	0.963
57	0.945
76	0.926

APPENDIX L

VOLUME CHANGES IN THE CALCIUM SULFATE - WATER SYSTEM

The two dehydration reactions observed in the calcium sulfate - water system can be represented by the following equations:

$$CaSO_4 \cdot 2H_2O(S) \xrightarrow{\Delta V_1} CaSO_4 \cdot 1/2\ H_2O(S) + 3/2\ H_2O(L) \tag{L-1}$$

$$CaSO_4 \cdot 1/2\ H_2O(S) \xrightarrow{\Delta V_2} CaSO_4(S) + 1/2\ H_2O(L)\ . \tag{L-2}$$

Assuming that the densities of the solids remain constant with changes in temperature, the total volume change occurring with each reaction was calculated using the physical constants listed in Table L-1 and the following equations:

$$\Delta V_1 = V_H + V_{3/2W} - V_D \tag{L-3}$$

$$\Delta V_2 = V_A + V_{1/2W} - V_H \tag{L-4}$$

where V_D, V_H, V_A, and V_{xW} represent the volume of the dihydrate, hemihydrate, anhydrite, and water phases, respectively. For a 0.7 gram sample of dihydrate, the volumes at 4°C are: $V_D = 0.3017$, $V_H = 0.2130$, $V_A = 0.1870$, $V_{3/2W} = 0.1100$, $V_{1/2W} = 0.0367$, $\Delta V_1 = 0.0213$, and $\Delta V_2 = 0.0107$ cc. When the volume changes are desired as a function of temperature, only the volume of water must be calculated as a function of temperature using:

$$V(T)_{3/2W} = 0.1100\ \rho_{4^\circ}/\rho_T \tag{L-5}$$

$$V(T)_{1/2W} = 0.0367\ \rho_{4^\circ}/\rho_T\ . \tag{L-6}$$

The results of the calculations using these equations are summarized in Table L-2 where the changes in the values are listed as a function of temperature. The theoretical height changes which should be observed in the dilatometer capillary for each reaction are also listed in the last two columns of this table. These values were calculated by dividing the volume change for each reaction by the average cross-sectional area of the capillary, 0.0030375 cm^2.

TABLE L-1

VALUES OF THE PHYSICAL CONSTANTS FOR CALCIUM SULFATE

Compound	$CaSO_4 \cdot 2H_2O$	$CaSO_4 \cdot 1/2\ H_2O$	$CaSO_4$	H_2O
Molecular Weight	172.18	145.15	136.15	18.02
Density gm/cc	2.32	2.75	2.96 (2.9)	1.000 4°C

Values found in Reference 7, 19, 42, and 61.

TABLE L-2

HEIGHT AND VOLUME VALUES

Temp., °F	Water Density, gm/cc	$V_{3/2W}$, cc	$V_{1/2W}$, cc	ΔV_1, cc	ΔV_2, cc	Δh_1, cm	Δh_2, cm
39.2	1.0000	0.1100	0.0367	0.0213	0.0107	7.01	3.52
212.0	0.9584	0.1148	0.0383	0.0261	0.0123	8.59	4.05
230.0	0.9510	0.1157	0.0385	0.0270	0.0126	8.89	4.15
248.0	0.9434	0.1166	0.0389	0.0279	0.0129	9.19	4.25
266.0	0.9352	0.1176	0.0392	0.0289	0.0132	9.51	4.35
284.0	0.9264	0.1187	0.0396	0.0300	0.0136	9.88	4.48

APPENDIX M

RESULTS FROM MICROSCOPIC OBSERVATIONS

The dimensions of the growing hemihydrate needles were measured in three different directions on micrographs made from the 35 mm negatives taken during the microscopic observations. Using the known magnifications along with the measured lengths, the rates of growth were calculated using the computer program given in Table M-2. Table M-1 contains the dimensions measured and the temperature of the reaction listed according to micrograph number. Values of average temperature, rate, and reciprocal absolute temperature calculated from adjacent micrographs are shown along with the average values of temperature, rate, and reciprocal absolute temperature for each series of measurements. Micrographs numbered 6 and 14 represent 197X magnifications and the remaining ones 477.5X.

TABLE M-1

DATA FROM MICROSCOPIC STUDIES

MICRO. NO.	LENGTH CM	TEMP. °F	AVE.TEMP. °F	RATE CM/MIN	TEMP.$^{-1}$ °K^{-1}
DETERMINATION OF LINEAR GROWTH VELOCITY, U_A					
1.01	3.55	251.20	251.45	.0000314	.0025320
1.02	3.70	251.71	251.86	.0000209	.0025302
1.03	3.80	252.01	252.37	.0000147	.0025291
1.04	3.87	252.72	252.82	.0000147	.0025266
1.05	3.94	252.93	253.08	.0000377	.0025259
1.06	4.12	253.23	253.38	.0000168	.0025248
1.07	4.20	253.53	253.64	.0000209	.0025237
1.08	4.30	253.74	253.84	.0000209	.0025230
1.09	4.40	253.94	254.09	.0000105	.0025223
1.10	4.45	254.25	254.19	.0000209	.0025212
1.11	4.55	254.14	254.14	.0000209	.0025216
1.12	4.65	254.14	254.14	.0000168	.0025216
1.13	4.73	254.14	254.09	.0000147	.0025216
1.14	4.80	254.04	254.04	.0000209	.0025220
1.15	4.90	254.04	254.04	.0000209	.0025220
1.16	5.00	254.04	253.99	.0000209	.0025220
1.17	5.10	253.94	253.94	.0000314	.0025223
1.18	5.25	253.94	253.84	.0000419	.0025223
1.19	5.45	253.74	253.74	.0000733	.0025230
1.20	5.80	253.74	253.64	.0000419	.0025230
1.21	6.00	253.53	253.53	.0000628	.0025237
1.22	6.30	253.53			
.....AVERAGE VALUES.....			253.52	.0000274	.0025238
DETERMINATION OF LINEAR GROWTH VELOCITY, U_A					
2.01	2.90	255.36	256.02	.0000524	.0025173
2.02	3.15	256.68	256.78	.0000524	.0025127
2.03	3.40	256.88	257.04	.0000796	.0025119
2.04	3.78	257.19	257.39	.0000565	.0025109
2.05	4.05	257.60	256.63	.0000733	.0025095
2.06	4.40	255.67	254.30	.0000524	.0025162
2.07	4.65	252.93	252.93	.0000524	.0025259
2.08	4.90	252.93	253.33	.0000628	.0025259
2.09	5.20	253.74	254.30	.0000628	.0025230
2.10	5.50	254.85	255.16	.0000419	.0025191
2.11	5.70	255.46	255.36	.0000984	.0025169
2.12	6.17	255.26	255.06	.0000796	.0025177
2.13	6.55	254.85	254.50	.0000524	.0025191
2.14	6.80	254.14	253.89	.0000628	.0025216
2.15	7.10	253.64			
.....AVERAGE VALUES.....			255.19	.0000628	.0025179

TABLE M-1 (CONT'D)

MICRO. NO.	LENGTH CM	TEMP. °F	AVE.TEMP. °F	RATE CM/MIN	TEMP.$^{-1}$ °K^{-1}
DETERMINATION OF LINEAR GROWTH VELOCITY, U_A					
3.01	1.75	253.84	253.64	.0000105	.0025227
3.02	1.80	253.43	253.43	.0000105	.0025241
3.03	1.85	253.43	253.53	.0000105	.0025241
3.04	1.90	253.64	253.69	.0000314	.0025234
3.05	2.05	253.74	253.74	.0000314	.0025230
3.06	2.20	253.74			
.....AVERAGE VALUES.....			253.61	.0000188	.0025235
DETERMINATION OF LINEAR GROWTH VELOCITY, U_A					
3.01	2.30	253.84	253.64	.0000105	.0025227
3.02	2.35	253.43	253.43	.0000209	.0025241
3.03	2.45	253.43	253.53	.0000105	.0025241
3.04	2.50	253.64	253.69	.0000105	.0025234
3.05	2.55	253.74	253.74	.0000105	.0025230
3.06	2.60	253.74			
.....AVERAGE VALUES.....			253.61	.0000126	.0025235
DETERMINATION OF LINEAR GROWTH VELOCITY, U_B					
3.01	6.25	253.84	253.64	.0000314	.0025227
3.02	6.40	253.43	253.43	.0000209	.0025241
3.03	6.50	253.43	253.53	.0000209	.0025241
3.04	6.60	253.64	253.69	.0000314	.0025234
3.05	6.75	253.74	253.74	.0000524	.0025230
3.06	7.00	253.74			
.....AVERAGE VALUES.....			253.61	.0000314	.0025235
DETERMINATION OF LINEAR GROWTH VELOCITY, U_B					
3.01	4.75	253.84	253.64	.0000314	.0025227
3.02	4.90	253.43	253.43	.0000419	.0025241
3.03	5.10	253.43	253.53	.0000209	.0025241
3.04	5.20	253.64	253.69	.0000419	.0025234
3.05	5.40	253.74	253.74	.0000419	.0025230
3.06	5.60	253.74			
.....AVERAGE VALUES.....			253.61	.0000356	.0025235
DETERMINATION OF LINEAR GROWTH VELOCITY, U_A					
4.01	2.55	253.43	253.43	.0000105	.0025241
4.02	2.60	253.43	253.53	.0000105	.0025241
4.03	2.65	253.64	253.69	.0000105	.0025234
4.04	2.70	253.74	253.74	.0000105	.0025230
4.05	2.75	253.74			
.....AVERAGE VALUES.....			253.60	.0000105	.0025235

TABLE M-1 (CONT'D)

MICRO. NO.	LENGTH CM	TEMP. °F	AVE.TEMP. °F	RATE CM/MIN	TEMP.$^{-1}$ °K^{-1}
DETERMINATION OF LINEAR GROWTH VELOCITY, U_C					
6.01	9.05	258.00	257.95	.0053299	.0025080
6.02	11.15	257.90	257.90	.0038071	.0025084
6.03	12.65	257.90	258.15	.0032995	.0025084
6.04	13.95	258.41	258.46	.0040609	.0025066
6.05	15.55	258.51	258.61	.0031726	.0025063
6.06	16.80	258.71	258.81	.0035533	.0025056
6.07	18.20	258.92	259.02	.0041878	.0025049
6.08	19.85	259.12			
.....AVERAGE VALUES.....			258.42	.0039159	.0025066
DETERMINATION OF LINEAR GROWTH VELOCITY, U_C					
7.01	12.60	260.03	260.29	.0047120	.0025010
7.02	14.85	260.54	260.64	.0042932	.0024992
7.03	16.90	260.74	260.79	.0043979	.0024985
7.04	19.00	260.84	260.84	.0062827	.0024981
7.05	22.00	260.84	260.95	.0050262	.0024981
7.06	24.40	261.05	261.15	.0069110	.0024974
7.07	27.70	261.25	261.45	.0029319	.0024967
7.08	29.10	261.66			
.....AVERAGE VALUES.....			260.87	.0049364	.0024980
DETERMINATION OF LINEAR GROWTH VELOCITY, U_C					
8.01	5.90	261.86	261.81	.0056545	.0024946
8.02	8.60	261.76	261.76	.0050262	.0024950
8.03	11.00	261.76	261.76	.0047120	.0024950
8.04	13.25	261.76	261.66	.0047120	.0024950
8.05	15.50	261.56	261.45	.0053403	.0024957
8.06	18.05	261.35	261.25	.0052356	.0024964
8.07	20.55	261.15	261.15	.0050262	.0024971
8.08	22.95	261.15	261.35	.0049215	.0024971
8.09	25.30	261.56			
.....AVERAGE VALUES.....			261.52	.0050785	.0024958
DETERMINATION OF LINEAR GROWTH VELOCITY, U_B					
8.01	1.75	261.76	261.76	.0000524	.0024950
8.02	1.80	261.76	261.66	.0000524	.0024950
8.03	1.85	261.56	261.45	.0000314	.0024957
8.04	1.88	261.35	261.25	.0000733	.0024964
8.05	1.95	261.15	261.15	.0000733	.0024971
8.06	2.02	261.15	261.35	.0000838	.0024971
8.07	2.10	261.56			
.....AVERAGE VALUES.....			261.44	.0000611	.0024961

TABLE M-1 (CONT'D)

DETERMINATION OF LINEAR GROWTH VELOCITY, U_C

MICRO. NO.	LENGTH CM	TEMP. °F	AVE.TEMP. °F	RATE CM/MIN	TEMP.$^{-1}$ °K^{-1}
9.01	6.90	269.58	269.78	.0062199	.0024682
9.02	9.87	269.98	270.13	.0059267	.0024669
9.03	12.70	270.29	270.59	.0058639	.0024658
9.04	15.50	270.90	271.00	.0064293	.0024638
9.05	18.57	271.10	271.50	.0065550	.0024631
9.06	21.70	271.91	271.96	.0062408	.0024604
9.07	24.68	272.01	272.16	.0056126	.0024600
9.08	27.36	272.32			
.....AVERAGE VALUES.....			271.02	.0061212	.0024634

DETERMINATION OF LINEAR GROWTH VELOCITY, U_B

MICRO. NO.	LENGTH CM	TEMP. °F	AVE.TEMP. °F	RATE CM/MIN	TEMP.$^{-1}$ °K^{-1}
9.01	1.95	269.58	269.78	.0001047	.0024682
9.02	2.05	269.98	270.13	.0002304	.0024669
9.03	2.27	270.29	270.59	.0001361	.0024658
9.04	2.40	270.90	271.00	.0002094	.0024638
9.05	2.60	271.10	271.50	.0002094	.0024631
9.06	2.80	271.91	271.96	.0001571	.0024604
9.07	2.95	272.01	272.16	.0001571	.0024600
9.08	3.10	272.32			
.....AVERAGE VALUES.....			271.02	.0001720	.0024634

DETERMINATION OF LINEAR GROWTH VELOCITY, U_C

MICRO. NO.	LENGTH CM	TEMP. °F	AVE.TEMP. °F	RATE CM/MIN	TEMP.$^{-1}$ °K^{-1}
10.01	7.77	272.62	272.87	.0071204	.0024580
10.02	11.17	273.13	273.08	.0070995	.0024563
10.03	14.56	273.03	273.43	.0071623	.0024566
10.04	17.98	273.84	273.94	.0075602	.0024539
10.05	21.59	274.04	274.09	.0077906	.0024532
10.06	25.31	274.14	274.14	.0078325	.0024529
10.07	29.05	274.14			
.....AVERAGE VALUES.....			273.59	.0074276	.0024547

DETERMINATION OF LINEAR GROWTH VELOCITY, U_B

MICRO. NO.	LENGTH CM	TEMP. °F	AVE.TEMP. °F	RATE CM/MIN	TEMP.$^{-1}$ °K^{-1}
10.01	2.95	272.62	272.87	.0003141	.0024580
10.02	3.25	273.13	273.08	.0002618	.0024563
10.03	3.50	273.03	273.43	.0002932	.0024566
10.04	3.78	273.84	273.94	.0002827	.0024539
10.05	4.05	274.04	274.09	.0001152	.0024532
10.06	4.16	274.14	274.14	.0002513	.0024529
10.07	4.40	274.14			
.....AVERAGE VALUES.....			273.59	.0002531	.0024547

TABLE M-1 (CONT'D)

MICRO. NO.	LENGTH CM	TEMP. °F	AVE.TEMP. °F	RATE CM/MIN	TEMP.$^{-1}$ °K^{-1}
DETERMINATION OF LINEAR GROWTH VELOCITY, U_C					
11.01	11.76	274.55	274.45	.0062827	.0024515
11.02	14.76	274.35	274.65	.0075812	.0024522
11.03	18.38	274.96			
.....AVERAGE VALUES.....			274.55	.0069319	.0024515
DETERMINATION OF LINEAR GROWTH VELOCITY, U_B					
11.01	4.25	274.55	274.45	.0002618	.0024515
11.02	4.50	274.35	274.65	.0003141	.0024522
11.03	4.80	274.96	275.01	.0004398	.0024502
11.04	5.22	275.06			
.....AVERAGE VALUES.....			274.70	.0003386	.0024510
DETERMINATION OF LINEAR GROWTH VELOCITY, U_A					
12.01	1.72	277.60	277.54	.0000419	.0024414
12.02	1.76	277.49	277.54	.0000628	.0024417
12.03	1.82	277.60	277.85	.0000838	.0024414
12.04	1.90	278.10	278.15	.0002094	.0024397
12.05	2.10	278.20	278.61	.0000838	.0024394
12.06	2.18	279.02	279.07	.0001047	.0024367
12.07	2.28	279.12	279.27	.0002304	.0024364
12.08	2.50	279.42	279.47	.0002618	.0024354
12.09	2.75	279.52	279.88	.0001571	.0024350
12.10	2.90	280.24	280.34	.0001675	.0024327
12.11	3.06	280.44	280.64	.0002304	.0024320
12.12	3.28	280.84			
.....AVERAGE VALUES.....			278.94	.0001485	.0024369
DETERMINATION OF LINEAR GROWTH VELOCITY, U_B					
12.01	3.22	277.60	277.54	.0001885	.0024414
12.02	3.40	277.49	277.54	.0004607	.0024417
12.03	3.84	277.60	277.85	.0003770	.0024414
12.04	4.20	278.10	278.15	.0002723	.0024397
12.05	4.46	278.20	278.61	.0003351	.0024394
12.06	4.78	279.02	279.07	.0004398	.0024367
12.07	5.20	279.12	279.27	.0005236	.0024364
12.08	5.70	279.42	279.47	.0003770	.0024354
12.09	6.06	279.52	279.88	.0004607	.0024350
12.10	6.50	280.24	280.34	.0005026	.0024327
12.11	6.98	280.44	280.64	.0005445	.0024320
12.12	7.50	280.84			
.....AVERAGE VALUES.....			278.94	.0004074	.0024369

TABLE M-1 (CONT'D)

MICRO. NO.	LENGTH CM	TEMP. OF	AVE.TEMP. OF	RATE CM/MIN	TEMP.$^{-1}$ OK^{-1}
DETERMINATION OF LINEAR GROWTH VELOCITY, U_A					
12.01	1.05	277.60	277.54	.0000524	.0024414
12.02	1.10	277.49	277.54	.0001047	.0024417
12.03	1.20	277.60	277.85	.0001047	.0024414
12.04	1.30	278.10	278.15	.0001047	.0024397
12.05	1.40	278.20	278.61	.0000209	.0024394
12.06	1.42	279.02	279.07	.0001361	.0024367
12.07	1.55	279.12	279.27	.0000733	.0024364
12.08	1.62	279.42	279.47	.0001675	.0024354
12.09	1.78	279.52	279.88	.0001466	.0024350
12.10	1.92	280.24	280.34	.0001885	.0024327
12.11	2.10	280.44	280.64	.0002094	.0024320
12.12	2.30	280.84			
.....AVERAGE VALUES.....			278.94	.0001190	.0024369
DETERMINATION OF LINEAR GROWTH VELOCITY, U_B					
12.01	1.40	277.60	277.54	.0000838	.0024414
12.02	1.48	277.49	277.54	.0001257	.0024417
12.03	1.60	277.60	277.85	.0001152	.0024414
12.04	1.71	278.10	278.15	.0001466	.0024397
12.05	1.85	278.20	278.61	.0002094	.0024394
12.06	2.05	279.02	279.07	.0001780	.0024367
12.07	2.22	279.12	279.27	.0002408	.0024364
12.08	2.45	279.42	279.47	.0003665	.0024354
12.09	2.80	279.52	279.88	.0004188	.0024350
12.10	3.20	280.24	280.34	.0003141	.0024327
12.11	3.50	280.44	280.64	.0005236	.0024320
12.12	4.00	280.84			
.....AVERAGE VALUES.....			278.94	.0002475	.0024369
DETERMINATION OF LINEAR GROWTH VELOCITY, U_A					
13.01	2.27	280.13	280.13	.0000628	.0024330
13.02	2.33	280.13	279.98	.0000733	.0024330
13.03	2.40	279.83	279.83	.0000942	.0024340
13.04	2.49	279.83	279.63	.0000942	.0024340
13.05	2.58	279.42	279.42	.0000628	.0024354
13.06	2.64	279.42	279.27	.0001675	.0024354
13.07	2.80	279.12			
.....AVERAGE VALUES.....			279.71	.0000925	.0024344

TABLE M-1 (CONT'D)

MICRO. NO.	LENGTH CM	TEMP. °F	AVE.TEMP. °F	RATE CM/MIN	TEMP.$^{-1}$ °K^{-1}
DETERMINATION OF LINEAR GROWTH VELOCITY, U_B					
13.01	7.22	280.13	280.13	.0003979	.0024330
13.02	7.60	280.13	279.98	.0003665	.0024330
13.03	7.95	279.83	279.83	.0004607	.0024340
13.04	8.39	279.83	279.63	.0003560	.0024340
13.05	8.73	279.42	279.42	.0004712	.0024354
13.06	9.18	279.42	279.27	.0002618	.0024354
13.07	9.43	279.12			
.....AVERAGE VALUES.....			279.71	.0003857	.0024344
DETERMINATION OF LINEAR GROWTH VELOCITY, U_C					
14.01	13.55	256.07	256.07	.0039086	.0025148
14.02	14.32	256.07	256.07	.0046193	.0025148
14.03	15.23	256.07	255.97	.0044670	.0025148
14.04	16.11	255.87	255.87	.0047716	.0025155
14.05	17.05	255.87	255.87	.0038071	.0025155
14.06	17.80	255.87	255.87	.0035533	.0025155
14.07	18.50	255.87	255.82	.0036548	.0025155
14.08	19.22	255.77	255.72	.0038071	.0025159
14.09	19.97	255.67	255.72	.0028426	.0025162
14.10	20.53	255.77	255.77	.0031472	.0025159
14.11	21.15	255.77	255.77	.0030457	.0025159
14.12	21.75	255.77	255.77	.0035533	.0025159
14.13	22.45	255.77	255.72	.0032995	.0025159
14.14	23.10	255.67	255.72	.0040609	.0025162
14.15	23.90	255.77	255.77	.0043655	.0025159
14.16	24.76	255.77	255.77	.0042640	.0025159
14.17	25.60	255.77	255.72	.0026904	.0025159
14.18	26.13	255.67			
.....AVERAGE VALUES.....			255.82	.0037563	.0025157

TABLE M-2

COMPUTER PROGRAM USED TO CALCULATE LINEAR RATES OF GROWTH FROM MICROSCOPIC DATA

```
          DIMENSION TAG(10), T(40), TAVE(40), L(40),
         1RATE(40), RT(40)
          INTEGER I, J, F, S
BEGIN     READ FORMAT CONST, RUN, F, S, DELTAT, MAG
          READ FORMAT LABLE, TAG(1)...TAG(S)
          READ FORMAT TEMP, T(1)...T(F)
          THROUGH ONE, FOR J=1,1,J.G.F
          T(J)=-3.1140346+1.0152246*T(J)
ONE       RT(J)=1.8/(T(J)+459.69)
          SUMT=0.
          N=0.
          THROUGH TWO, FOR J=1,1,J.G.F-1
          TAVE(J)=(T(J+1)+T(J))/2.
          SUMT=SUMT+TAVE(J)
TWO       N=N+1.
          AVTEMP=SUMT/N
          RECPTK=1.8/(AVTEMP+459.69)
          THROUGH THREE, FOR I=1,1,I.G.S
          READ FORMAT LENGTH, L(1)...L(F)
          SUMR=0.
          N=0.
          THROUGH FOUR, FOR J=1,1,J.G.F-1
          RATE(J)=TAG(I)*(L(J+1)-L(J))/DELTAT/MAG
          SUMR=SUMR+RATE(J)
FOUR      N=N+1.
          AVRATE=SUMR/N
          LNAVR=ELOG.(AVRATE)
          PRINT FORMAT NAME
          THROUGH FIVE, FOR J=1,1,J.G.F
          K=0.01*J
          PRINT FORMAT ANS, RUN, K, L(J), T(J), TAVE(J),
         1RATE(J), RT(J)
FIVE      CONTINUE
          PRINT RESULTS AVTEMP, AVRATE
          PRINT RESULTS RECPTK, LNAVR
          THROUGH SIX, FOR J=1,1,J.G.F
          K=0.01*J
SIX       PUNCH FORMAT CARD1, RUN, K, L(J), T(J), TAVE(J),
         1RATE(J), RT(J)
          PUNCH FORMAT CARD2, AVTEMP, AVRATE, RECPTK
THREE     CONTINUE
          TRANSFER TO BEGIN
          VECTOR VALUES CONST=$F5.2,2I5,2F5.1*$
          VECTOR VALUES LABLE=$10F5.0*$
          VECTOR VALUES TEMP=$10F7.1*$
          VECTOR VALUES LENGTH=$10F7.2*$
          VECTOR VALUES NAME=$1H1,S2,7HRUN NO.,S3,6HLENGHT,
         1S6,4HTEMP,S2,8HAVE TEMP,S9,4HRATE,S3,8HREC TEMP,
         12H K*$
```

TABLE M-2 (CONT'D)

```
 VECTOR VALUES ANS=$1H0,F6.0,F3.2,F9.2,2F10.2,
12F13.7*$
 VECTOR VALUES CARD1=$F2.0,F3.2,F9.2,2F10.2,
12F13.7*$
 VECTOR VALUES CARD2=$S24,F10.2,2F13.7*$
 END OF PROGRAM
```

APPENDIX N

COMPUTER PROGRAM USED TO CALCULATE FRACTION REACTED AND RATE OF REACTION VALUES AS FUNCTIONS OF TIME USING THE MODEL

```
           R
           RW=UADA, X=UBUB, Y=UADB, Z=UBDA
           R
            INTEGER T1, T2, T3, J, END
            DIMENSION ALPHA(1000), RATE(1000), TIME(1000)
BEGIN       READ FORMAT DATA, N, K, E, F, G, CONTRL, DELTAT
            ROOT3=SQRT.(3.)
            W=1./(2.*G)
            X=1./(2.*E)
            Y=(X-1./(2.F))*ROOT3
            Z=W*X/Y
            WW=1./W
            XX=1./X
            YY=1./Y
            ZZ=1./Z
            A=4.*W*X-2./ROOT3*W*Y
            B=-2.*ROOT3*X*Z
            C=2.*ROOT3*(Z*X-2./ROOT3*X*W+1./3.000*W*Y)
            D=-2.*W
            T1=1./(2.*X)/DELTAT
            T2=1./(2.*X-2./ROOT3*Y)/DELTAT
            T3=1./(2.*W)/DELTAT
            TF1=1./(2.*X)
            TF2=1./(2.*X-2./RR
            TF2=1./(2.*X-2./ROOT3*Y)
            TF3=1./(2.*W)
            END=10./K+T3
            PRINT COMMENT $1$
            PRINT RESULTS N, TF1, TF2, TF3
            PRINT RESULTS END, T1, T2, T3
            PRINT RESULTS A, B, C, D
            PRINT RESULTS W, X, Y, Z
            PRINT RESULTS WW, XX, YY, ZZ
            WHENEVER TF1 .G. TF2 .OR. TF1 .G. TF3 .OR.
           1TF2 .G. TF3
            TRANSFER TO BEGIN
            END OF CONDITIONAL
            THROUGH ONE, FOR J=0,5,J.G.T1
            T=J*DELTAT
            TIME(J)=T
            ARG1=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
            DARG1=2.*T-2./K*(1.-EXP.(-K*T))
            RATE(J)=A*DARG1
ONE         ALPHA(J)=A*ARG1
            THROUGH TWO, FOR J=T1+1,1,J.G. T2
            T=J*DELTAT
            TIME(J)=T
            ARG1=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
            DARG1=2.*T-2./K*(1.-EXP.(-K*T))
```

```
          T=J*DELTAT-TF1
          ARG2=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
          DARG2=2.*T-2./K*(1.-RXP.(-K*T))
          RATE(J)=A*DARG1+B*DARG2
TWO       ALPHA(J)=A*ARG1+B*ARG2
          THROUGH THREE, FOR J=T2+1,1,J.G. T3
          T=J*DELTAT
          TIME(J)=T
          ARG1=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
          DARG1=2.*T-2./K*(1.-EXP.(-K*T))
          T=J*DELTAT-TF1
          ARG2=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
          DARG2=2.*T-2./K*(1,-RXP.(-K*T))
          T=J*DELTAT-TF2
          ARG3=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
          DARG3=2.*T-2./K*(1.-EXP.(-K*T))
          RATE(J)=A*DARG1+B*DARG2+C*DARG3
TWO       ALPHA(J)=A*ARG1+B*ARG2+C*ARG3
          THROUGH FOUR, FOR J=T3+1,5,J.G. END .OR.
         1ALPHA(J-10) .G. 0.99999
          T=J*DELTAT
          TIME(J)=T
          ARG1=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
          DARG1=2.*T-2./K*(1.-EXP.(-K*T))
          T=J*DELTAT-TF1
          DARG2=2.*T-2./K*(1.-RXP.(-K*T))
          ARG2=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
          T=J*DELTAT-TF2
          ARG3=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
          DARG3=2.*T-2./K*(1.-EXP.(-K*T))
          T=J*DELTAT-TF3
          ARG4=T+(EXP.(-K*T)-1.)/K
          DARG4=1.-EXP.(-K*T)
          RATE(J)=A*DARG1+B*DARG2+C*DARG3+D*DARG4
FOUR      ALPHA(J)=A*ARG1+B*ARG2+C*ARG3+D*ARG4
          PRINT FORMAT NAME
          THROUGH FIVE, FOR J=0,5,J.G. T1
          PRINT FORMAT ANS, J, ALPHA(J), RATE(J), TIME(J)
          THROUGH SIX, FOR J=T1+1,1,J.G. T3
SIX       PRINT FORMAT ANS, J, ALPHA(J), RATE(J), TIME(J)
          THROUGH SEVEN, FOR J=T3+1,5,J.G. END .OR.
         1ALPHA(J-10) .G. 0.99999
SEVEN     PRINT FORMAT ANS, J, ALPHA(J), RATE(J), TIME(J)
          TRANSFER TO BEGIN
          VECTOR VALUES DATA=$F2.0,F11.5/S10,3F10.0/I1,
         1F9.2*$
          VECTOR VALUES NAME=$1H0,S7,2HNO,S5,5HALPHA,S6,
         14HRATE*$
          VECTOR VALUES ANS=$1H ,U9,2F10.5,F10.1*$
          END OF PROGRAM
```

APPENDIX O

COMPUTER PROGRAM USED TO CALCULATE T-T-T DATA FROM THEORETICAL EQUATIONS

```
              INTEGER T1, T2, T3, J, END, T4
             1,I,H,N, M
              DIMENSION ALPHA(3000), RATE(3000),TIME(3000)
             1, CHECK(10), RLTIME(3000)
BEGIN         PRINT COMMENT $1$
              READ AND PRINT DATA
              ROOT3=SQRT.(3.)
              CHECK(0)=0.05
              CHECK(1)=0.25
              CHECK(2)=0.50
              CHECK(3)=0.75
              CHECK(4)=0.95
              DELTAT=10.
              THROUGH LOOP, FOR H=0,1, H .G. 10
              TEMP=220.+5.*H
              TK=(TEMP-32)/1.8+273.16
              RECTK=1./TK
              WHENEVER N .E. 1
              THATA=1./(EXP.(65.919412-27714.276/TK))
              TRANSFER TO GO
              END OF CONDITIONAL
              WHENEVER N .E. 2
              THATA=1./(EXP.(44.914749-18815.948/TK))
              TRANSFER TO GO
              END OF CONDITIONAL
              WHENEVER N .E. 3
              THATA=1./(EXP.(72.867142-29835.423/TK))
              TRANSFER TO GO
              END OF CONDITIONAL
              WHENEVER N .E. 4
              THATA=1./(EXP.(54.737652-23270.542/TK))
              TRANSFER TO GO
              END OF CONDITIONAL
              THATA=1./(EXP.(54.737652-23270.542/TK)+(1.-ACT)*
             1EXP.(61.349550-23884.856/TK))
GO            K=EXP.(75.837088-31093.767/TK)+(1.-ACT)*
             1EXP.(105.67753-40687.348/TK)
              UBDB=EXP.(77.883003-32579.302/TK)+(1.-ACT)*
             1EXP.(86.941237-33827.652/TK)
              UADA=EXP.(81.935544-34415.472/TK)+(1.-ACT)*
             1EXP.(88.798765-34844.749/TK)
              ARG=EXP.(89.521356-37331.503/TK)+(1.-ACT)*
             1EXP.(85.559312-33397.799/TJ)
              UADB=(UBDB-ARG)*SQRT.(3.)
              UBDA=UBDB*UADA/UADB
              W=UADA
              X=UBDB
              Y=UADB
              Z=UBDA
```

```
            WW=1./W
            XX=1./X
            YY=1./Y
            ZZ=1./Z
            A=4.*W*X-2./ROOT3*W*Y
            B=-2.*ROOT3*X*Z
            C=2.*ROOT3*(Z*X-2./ROOT3*X*W+1./3.000*W*Y)
            D=-2.*W
            T1=1./(2.*X)/DELTAT
            T2=1./(2.*X-2./ROOT3*Y)/DELTAT
            T3=1./(2.*W)/DELTAT
            TF1=1./(2.*X)
            TF2=1./(2.*X-2./ROOT3*Y)
            TF3=1./(2.*W)
            END=2998
            PRINT RESULTS TEMP, TK, RECTK
            PRINT RESULTS THATA, K, ARG
            PRINT RESULTS UBDA, UBDB, UADA, UADB
            PRINT FORMAT NAME
            I=0
            THROUGH ONE, FOR J=0,1,J.G.T1
            T=J*DELTAT
            TIME(J)=T
            ARG1=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
            DARG1=2.*T-2./K*(1.-EXP.(-K*T))
            RATE(J)=A*DARG1
            ALPHA(J)=A*ARG1
            WHENEVER I .E. 0 .AND. ALPHA(J) .GE. CHECK(I)
            M=J
            ARG1=ALPHA(M)-0.05
            ARG2=0.05-ALPHA(M-1)
            WHENEVER ARG1 .G. ARG2, M=M-1
            END OF CONDITIONAL
            WHENEVER ALPHA(J) .GE. CHECK(I)
            RLTIME(J)=TIME(J)+THATA-TIME(M)
            RLTIME(J-1)=TIME(J-1)+THATA-TIME(M)
            PRINT FORMAT ANS, I, J, TIME(J), ALPHA(J),
           1RATE(J), RLTIME(J)
            PRINT FORMAT ANS, I, J-1, TIME(J-1), ALPHA(J-1),
           1RATE(J-1), RLTIME(J-1)
            I=I+1
ONE         END OF CONDITIONAL
            THROUGH TWO, FOR J=T1+1,1,J.G. T2
            T=J*DELTAT
            TIME(J)=T
            ARG1=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
            DARG1=2.*T-2./K*(1.-EXP.(-K*T))
            T=J*DELTAT-TF1
            ARG2=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
            DARG2=2.*T-2./K*(1.-EXP.(-K*T))
            RATE(J)=A*DARG1+B*DARG2
            ALPHA(J)=A*ARG1+B*ARG2
            WHENEVER ALPHA(J) .GE. CHECK(I)
            RLTIME(J)=TIME(J)+THATA-TIME(M)
```

```
           RLTIME(J-1)=TIME(J-1)+THATA-TIME(M)
           PRINT FORMAT ANS, I, J, TIME(J), ALPHA(J),
          1RATE(J), RLTIME(J)
           PRINT FORMAT ANS, I, J-1, TIME(J-1), ALPHA(J-1),
          1RATE(J-1), RLTIME(J-1)
           I=I+1
TWO        END OF CONDITIONAL
           THROUGH THREE, FOR J=T2+1,1,J.G. T3
           T=J*DELTAT
           TIME(J)=T
           ARG1=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
           DARG1=2.*T-2./K*(1.-EXP.(-K*T))
           T=J*DELTAT-TF1
           ARG2=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
           DARG2=2.*T-2./K*(1.-EXP.(-K*T))
           T=J*DELTAT-TF2
           ARG3=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
           DARG3=2.*T-2./K*(1.-EXP.(-K*T))
           RATE(J)=A*DARG1+B*DARG2+C*DARG3
           ALPHA(J)=A*ARG1+B*ARG2+C*ARG3
           WHENEVER ALPHA(J) .GE. CHECK(I)
           RLTIME(J)=TIME(J)+THATA-TIME(M)
           RLTIME(J-1)=TIME(J-1)+THATA-TIME(M)
           PRINT FORMAT ANS, I, J, TIME(J), ALPHA(J),
          1RATE(J), RLTIME(J)
           PRINT FORMAT ANS, I, J-1, TIME(J-1), ALPHA(J-1),
          1RATE(J-1), RLTIME(J-1)
           I=I+1
THREE      END OF CONDITIONAL
           THROUGH FOUR, FOR J=T3+1,1,J.G. END
           T=J*DELTAT
           TIME(J)=T
           ARG1=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
           DARG1=2.*T-2./K*(1.-EXP.(-K*T))
           T=J*DELTAT-TF1
           DARG2=2.*T-2./K*(1.-EXP.(-K*T))
           ARG2=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
           T=J*DELTAT-TF2
           ARG3=T*T-2./K*(T+1./K*(EXP.(-K*T)-1.))
           DARG3=2.*T-2./K*(1.-EXP.(-K*T))
           T=J*DELTAT-TF3
           ARG4=T+(EXP.(-K*T)-1.)/K
           DARG4=1.-EXP.(-K*T)
           RATE(J)=A*DARG1+B*DARG2+C*DARG3+D*DARG4
           ALPHA(J)=A*ARG1+B*ARG2+C*ARG3+D*ARG4
           WHENEVER ALPHA(J) .GE. CHECK(I)
           RLTIME(J)=TIME(J)+THATA-TIME(M)
           RLTIME(J-1)=TIME(J-1)+THATA-TIME(M)
           PRINT FORMAT ANS, I, J, TIME(J), ALPHA(J),
          1RATE(J), RLTIME(J)
           PRINT FORMAT ANS, I, J-1, TIME(J-1), ALPHA(J-1),
          1RATE(J-1), RLTIME(J-1)
           I=I+1
           WHENEVER I .GE. 5, TRANSFER TO OUT
```

```
FOUR       END OF CONDITIONAL
OUT        CONTINUE
           WHENEVER RATE(T2) .GE. 0.0005, DELTAT=5.
           WHENEVER RATE(T2) .GE. 0.001, DELTAT=1.
           WHENEVER RATE(T2) .GE. 0.010, DELTAT=0.1
           WHENEVER RATE(T2) .GE. 0.100, DELTAT=0.01
LOOP       CONTINUE
           TRANSFER TO BEGIN
           VECTOR VALUES NAME=$1HO,S8,1HI,S9,1HJ,S6,4HTIME,
          1S5,5HALPHA,S6,4HRATE,S4,6HRLTIME*$
           VECTOR VALUES ANS=$1H ,I9,I10,F10.1,2F10.5,F10.1*$
           END OF PROGRAM
```

APPENDIX P

MEASUREMENTS OF DIHYDRATE CRYSTAL DIMENSIONS

The average configuration and dimensions of the dihydrate crystal fragments used in the dilatometric experiments were measured from micrographs made at known magnifications on crystal fragments separated between screens having 0.0069 and 0.0082 inch openings. The fragments were thin, flat plates resulting from cleavage between (010) cleavage planes having outlines of a parallelogram with interior angles of 66° and 114°. The outlines of most of the crystals approached the shape of perfect parallelograms exhibiting small chips and protrusions along their edges when examined microscopically. Micrographs were made showing the thickness as well as the length and width of the crystal fragments allowing the measurements of their dimensions to be made directly from the micrographs. Two clear plastic scales glued together at 114° were used in measuring the lengths of the edges of the crystal fragments shown in one set of micrographs while the thicknesses were measured on another set of micrographs. The values obtained by these measurements are shown in Tables P-1 and P-2, resulting in crystal fragments having an average thickness of $a' = 4.1 \times 10^{-3}$ cm, and average parallelogram edges of $c' = 1.50 \times 10^{-2}$ and $b' = 2.54 \times 10^{-2}$ cm.

Examination of ten crystal fragments using polarized light showed that the optical axes were inclined approximately 37 1/2° to the shortest sides of seven of the ten crystals fragments examined indicating that the shortest sides of the crystals were probably formed by (100) cleavage planes and that the longest sides were probably formed by (001) cleavage planes. Combining this information with the measurements on the average crystal sizes just given, the shortest length of $c' = 1.50 \times 10^{-2}$ cm most probably corresponds to the average length of the (100) cleavage planes and the longest length of $b' = 2.54 \times 10^{-2}$ cm to the average length of the (001) cleavage plane length.

The average number of dihydrate crystal fragments in a 0.7 gram sample was calculated by dividing the total volume of dihydrate by the volume of one of these crystal fragments. The volume of an average crystal fragment is: $V_f = a'b'c' \sin(66°10') = 1.43 \times 10^{-6}\ \text{cm}^3$, using the values of a', b', and c' just calculated. Division of the total volume of dihydrate V_D, where $V_D = w_D/\rho_D = 0.7 \times 2.32 = 0.213\ \text{cm}^3$, by V_f gives the number of crystal fragments per sample, $N_f = V_D/V_f = 211,000$.

TABLE P-1

THICKNESS OF CRYSTAL FRAGMENTS

Micro. No.	Thickness cm at 480X	Micro. No.	Thickness cm at 480X
16.01	2.0	16.23	1.1
16.02	1.6	16.24	2.0
16.03	1.4	16.25	1.3
16.04	1.7	16.26	1.3
16.05	1.9	16.27	1.3
16.06	3.6	16.28	1.4
16.07	2.0	16.29	1.2
16.08	1.5	16.30	1.4
16.09	1.4	16.31	0.7
16.10	3.4	16.32	0.8
16.11	4.0	16.33	2.4
16.12	0.9	16.34	1.3
16.13	2.8	16.35	1.9
16.14	1.6	16.36	0.9
16.14	2.3	16.37	2.1
16.15	2.2	16.38	1.9
16.16	2.2	16.39	1.1
16.17	2.9		
16.18	1.9	15.30	1.7
16.19	2.4	15.31	3.0
16.20	2.1	15.32	4.7
16.21	2.5	15.33	1.9
16.22	2.7		

Sum of Thicknesses 86.4 cm @ 480X

Average Thickness 1.96 cm @ 480X

Actual Average Thickness 4.1×10^{-3} cm

TABLE P-2

LENGTHS AND WIDTHS OF CRYSTAL FRAGMENTS

Micro. No.	Longest Dimension cm @ 305X	Shortest Dimension cm @ 305X
15.01	5.8	5.1
15.02	6.0	3.9
15.03	8.2	5.4
15.04	8.1	4.8
15.05	8.6	4.5
15.06	6.0	5.2
15.07	6.8	4.9
15.08	6.3	5.4
15.08	4.1	3.5
15.09	6.3	5.4
15.10	7.0	4.2
15.10	7.5	4.5
15.11	8.6	4.4
15.12	6.6	4.1
15.13	6.5	4.1
15.14	6.2	3.1
15.14	7.7	4.6
15.15	8.0	4.5
15.16	7.1	3.0
15.17	7.6	4.1
15.18	7.1	2.9
15.19	9.4	5.9
15.20	9.5	4.4
15.21	7.5	5.0
15.22	9.1	6.6
15.23	9.2	3.3
15.24	7.4	5.2
15.25	5.5	2.8
15.26	7.5	7.5
15.27	7.8	4.5
15.28	10.6	5.2
15.29	15.0	5.5
15.30	14.0	3.5
15.31	5.4	4.3
Sum of Lengths	263.2 cm @ 305X	155.3 cm @ 305X
Average Length	7.74 cm @ 305X	4.57 cm @ 305X
Actual Length	2.54×10^{-2} cm	1.50×10^{-2} cm

APPENDIX Q

DERIVATIONS OF THE CHEMICAL REACTION AND THE DIFFUSION EQUATIONS

The movement of the dihydrate-hemihydrate interface is caused by two processes occurring at the interface: the chemical reaction resulting in the formation of the hemihydrate phase containing an excess of water, i.e.:

$$CaSO_4 \cdot 2H_2O \rightarrow CaSO_4 \cdot 1/2\ H_2O + 3/2\ H_2O \ , \qquad (Q\text{-}1)$$

and the diffusion of the excess water from the interface to the bulk solution.

The chemical reaction occurring at the interface can be described mathematically by:

$$dm_H/dt = K_1'\ a_D - K_2'\ a_H\ a_W^{3/2} \qquad (Q\text{-}2)$$

where m_H is the mass of hemihydrate formed, K_1' and K_2' are reaction rate constants, and a_D, a_H, and a_W are the activities of the dihydrate, hemihydrate, and water phases, respectively. Since the activity of a pure solid is unity, Equation (Q-2) reduces to:

$$dm_H/dt = K_1' - K_2'\ a_W^{3/2} \ . \qquad (Q\text{-}3)$$

For a constant cross-sectional area, the rate of mass transformation is proportional to the velocity of the moving interface:

$$U = K_1 - K_2\ a_W^{3/2} \qquad (Q\text{-}4)$$

and using pure water for the bulk solution results in:

$$U_o = K_1 - K_2 \; . \tag{Q-5}$$

Subtracting Equation (Q-5) from Equation (Q-4) yields:

$$U - U_o = K_2 \, (1 - a_W{}^{3/2}) \tag{Q-6}$$

where K_2 traditionally is assumed to have an Arrhenius temperature dependence resulting in:

$$\frac{U - U_o}{1 - a_W{}^{3/2}} = Z'\exp(-E/RT) \tag{Q-7}$$

which can be made similar to Equation (85) by division of both sides by some arbitrary constant d and substituting P/P^o for a_W :

$$\frac{(U/d) - (U/d)_o}{1 - (P/P^o)^{3/2}} = Z \exp(-E/RT) \; . \tag{Q-8}$$

The diffusion of water through the hemihydrate crystal can likewise be described by:

$$dm_W = - \frac{D'''}{x} (a\# - a) \; dt \tag{Q-9}$$

where m_W is the mass of water flowing, $(a\# - a)$ is the difference in activities between the interface and the bulk solution, x is the length of the diffusion path, D''' is a constant, and t is time. Since the mass of hemihydrate formed is proportional to the mass of water removed, Equation (Q-9) is equivalent to:

$$dm_H = \frac{D''}{x} (a\# - a)\, dt \qquad (Q\text{-}10)$$

and for a constant cross-sectional area, where the change in mass is proportional to the distance the interface moves, this equation becomes:

$$dx = \frac{D'}{x} (a\# - a)\, dt \qquad (Q\text{-}11)$$

or:

$$U = dx/dt = \frac{D'}{x}(a\# - a) \ . \qquad (Q\text{-}12)$$

For constant values of x, the difference in velocities of two interfaces resulting from the use of two different bulk solutions can be represented by the following equation:

$$U - U_o = \frac{D'}{x} (a_o - a) \qquad (Q\text{-}13)$$

where U_o and $a_o = 1$ represent the values obtained for pure water and U and $a = P/P^o$ represent the values in any salt solution. Since the coefficient D' usually exhibits an Arrhenius temperature dependence, the above equation takes on a form similar to that of Equation (85) after division by an arbritrary length d :

$$\frac{(U/d) - (U/d)_o}{(1 - P/P^o)} = \frac{Z}{x} \exp(-E/RT) \ . \qquad (Q\text{-}14)$$

APPENDIX R

THREE-DIMENSIONAL MODEL

The equations for the three-dimensional model were derived directly from the two-dimensional model using the following substitution for c: $c = U_C(t-x)$, assuming that the growth in the C direction terminated after Θ_3 minutes by impingement with another needle and that the cross sections of the hemihydrate needles are approximately uniform over their entire length. Thus, each needle eventually transforms a volume equal to abc . After the first impingement, the term $(t - x)$ must be expressed as functions of the variables being used: y , z , and w . This is easily accomplished by noting that Θ_1 is the value of the time difference between nucleation at time x and impingement at the time y: $\Theta_1 = y - x$, or $(t - x) = (t - y) + \Theta_1$ for $\Theta_1 \leq y \leq \Theta_2$. Similarly, $(t - x) = (t - z) + \Theta_2$ for $\Theta_2 \leq z \leq \Theta_3$, and $(t - x) = (t - w) + \Theta_3$ for $\Theta_3 \leq w \leq \Theta_c$. After impingement occurs in the C direction, a new term must be added for the final correction.

The volume transformed by one hemihydrate needle growing in three-dimensions is:

$$v_a(x,t) = 2(2U_AU_B - U_A^2/\sqrt{3})\ U_C\ (t-x)^3\ . \qquad \text{(R-1)}$$

The total volume transformed by many such needles is:

$$V_a'(t) = \int_{x=0}^{x=t} dN/dx\ v_a(x,t)dx \qquad \text{(R-2)}$$

where $dN/dx = K\ N_o \exp(-K\ x)$. When $t = \Theta_1 = b/2U_B$, the first impingement occurs requiring the subtraction of the following volume:

$$v_c(x,y,t) = 2\sqrt{3}\ U_B^2\ U_C\ (t-y)^2\ (t-x)\ . \qquad \text{(R-3)}$$

Since the term $(t-x)$ is equal to $(t-y) + \Theta_1$ for values of $\Theta_1 \leq y \leq \Theta_2$, the correction volume for the first impingement becomes:

$$v_c(y,t) = 2\sqrt{3}\, U_B^2 U_C [(t-y)^3 + \Theta_1(t-y)^2] \qquad (R\text{-}4)$$

and, consequently, the total volume correction for the first impingement is:

$$V_c'(t) = \int_{y=\Theta_1}^{y=t} dN/dy\; v_c(y,t)dy \qquad (R\text{-}5)$$

where $dN/dy = K\, N_o \exp[-K(y-\Theta_1)]$. After $t = \Theta_2 = b/[2(U_B - U_A/\sqrt{3})]$, the second impingement occurs requiring a volume addition term. This addition for a single hemihydrate needle is:

$$v_e(z,t) = 2\sqrt{3}\, (U_B - U_A/\sqrt{3})^2 U_C [(t-z)^3 + \Theta_2(t-z)^2] \qquad (R\text{-}6)$$

corresponding to a total volume correction of:

$$V_e'(t) = \int_{z=\Theta_2}^{z=t} dN/dz\; v_e(z,t)dz \qquad (R\text{-}7)$$

where $dN/dz = K\, N_o \exp[-K(z-\Theta_2)]$. After $t = \Theta_3 = a/2U_A$, the correction for impingement for a single needle is:

$$v_g(w,t) = 2\, b\, U_A U_C [(t-w)^2 + \Theta_3(t-w)] \qquad (R\text{-}8)$$

corresponding to a total volume correction:

$$V_g'(t) = \int_{w=\Theta_3}^{w=t} dN/dw\; v_g(w,t)dw \qquad (R\text{-}9)$$

where $dN/dw = K\, N_o \exp[-K(w-\Theta_3)]$. After $t = \Theta_c = c/U_C$, the final correction for impingement of a single needle is:

$$v_i(u,t) = a\, b\, U_C(t-u) \qquad (R\text{-}10)$$

corresponding to a total volume correction:

$$V_i'(t) = \int_{u = \Theta_c}^{u = t} dN/du \; v_i(u,t)du \qquad \text{(R-11)}$$

where $dN/du = K\,N_o \exp[-K(u-\Theta_c)]$. Thus, the total volume for $t > \Theta_c$ can be expressed as:

$$V'(t) = V_a'(t) - V_c'(t) + V_e'(t) - V_g'(t) - V_i'(t) \,. \qquad \text{(R-12)}$$

Division of the above equation by the total volume of hemihydrate formed $abcN_o$ gives the fraction reacted as a function of time:

$$\alpha(t) = V'(t)/abcN_o \qquad \text{(R-13)}$$

and differentiation of this equation gives the equation for the rate of reaction:

$$d\alpha/dt = (1/abcN_o)\; d[V'(t)]/dt \,. \qquad \text{(R-14)}$$

Values of $d\alpha/dt$ were calculated on the IBM 7090 computer using the program shown in Table R-1. The program uses Equations (R-13) and (R-14) directly without calculating explicitly the coefficients of the time terms.

TABLE R-1

COMPUTER PROGRAM FOR THREE-DIMENSIONAL MODEL

```
               R
               R W=UADA, X=UBDB, Y=UADB, Z=UBDA, U=UCDC
               R
                INTEGER T1, T2, T3, J, END, T4
                DIMENSION ALPHA(1000), RATE(1000),TIME(1000)
BEGIN           READ FORMAT DATA,N,K,E,F,G,H,CONTRL,DELTAT
                ROOT3=SQRT.(3.)
                W=1./(2.*G)
                X=1./(2.*E)
                Y=(X-1./(2.*F))*ROOT3
                Z=W*X/Y
                U=1./H
                WW=1./W
                XX=1./X
                YY=1./Y
                ZZ=1./Z
                UU=1./U
                A=4.*W*X-2./ROOT3*W*Y
                B=-2.*ROOT3*X*Z
                C=2.*ROOT3*(Z*X-2./ROOT3*X*W+1./3.000*W*Y)
                D=-2.*W
                A=A*U
                B=B*U
                C=C*U
                D=D*U
                DD=-U
                T1=1./(2.*X)/DELTAT/5.
                T2=1./(2.*X-2./ROOT3*Y)/DELTAT/5.
                T3=1./(2.*W)/DELTAT/5.
                T4=1./U/DELTAT/5.
                TF1=1./(2.*X)
                TF2=1./(2.*X-2./ROOT3*Y)
                TF3=1./(2.*W)
                TF4=1./U
                END=(10./K+T3)/5.
                PRINT COMMENT $1$
                PRINT RESULTS N, TF1, TF2, TF3
                PRINT RESULTS TF4
                PRINT RESULTS END, T1, T2, T3
                PRINT RESULTS T4
                PRINT RESULTS A, B, C, D
                PRINT RESULTS DD
                PRINT RESULTS W, X, Y, Z
                PRINT RESULTS U
                PRINT RESULTS WW, XX, YY, ZZ
                PRINT RESULTS UU
                THROUGH ONE, FOR J=0,1,J.G. T1
                T=5.*J*DELTAT
                TIME(J)=T
```

TABLE R-1 (CONT'D)

```
           ARG1=T*T*T-3./K*(T*T-2./K*(T-1./K*(1.-EXP.(-K*T))))
           DARG1=3.*T*T-3./K*(2.*T-2./K*(1.-EXP.(-K*T)))
           RATE(J)=A*DARG1
ONE        ALPHA(J)=A*ARG1
           THROUGH TWO, FOR J=T1+1,1,J.G. T2
           T=5.*J*DELTAT
           TIME(J)=T
           ARG1=T*T*T-3./K*(T*T-2./K*(T-1./K*(1.-EXP.(-K*T))))
           DARG1=3.*T*T-3./K*(2.*T-2./K*(1.-EXP.(-K*T)))
           T=5.*J*DELTAT-TF1
           ARG2=T*T*T-3./K*(T*T-2./K*(T-1./K*(1.-EXP.(-K*T))))
           DARG2=3.*T*T-3./K*(2.*T-2./K*(1.-EXP.(-K*T)))
           ARG3=T*T-2./K*(T-1./K*(1.-EXP.(-K*T)))
           DARG3=2.*T-2./K*(1.-EXP.(-K*T))
           RATE(J)=A*DARG1+B*(DARG2+TF1*DARG3)
TWO        ALPHA(J)=A*ARG1+B*(ARG2+TF1*ARG3)
           THROUGH THREE, FOR J=T2+1,1,J.G. T3
           T=5.*J*DELTAT
           TIME(J)=T
           ARG1=T*T*T-3./K*(T*T-2./K*(T-1./K*(1.-EXP.(-K*T))))
           DARG1=3.*T*T-3./K*(2.*T-2./K*(1.-EXP.(-K*T)))
           T=5.*J*DELTAT-TF1
           ARG2=T*T*T-3./K*(T*T-2./K*(T-1./K*(1.-EXP.(-K*T))))
           DARG2=3.*T*T-3./K*(2.*T-2./K*(1.-EXP.(-K*T)))
           ARG3=T*T-2./K*(T-1./K*(1.-EXP.(-K*T)))
           DARG3=2.*T-2./K*(1.-EXP.(-K*T))
           T=5.*J*DELTAT-TF2
           ARG4=T*T*T-3./K*(T*T-2./K*(T-1./K*(1.-EXP.(-K*T))))
           DARG4=3.*T*T-3./K*(2.*T-2./K*(1.-EXP.(-K*T)))
           ARG5=T*T-2./K*(T-1./K*(1.-EXP.(-K*T)))
           DARG5=2.*T-2./K*(1.-EXP.(-K*T))
           RATE(J)=A*DARG1+B*(DARG2+TF1*DARG3)+C*(DARG4+TF2*
          1DARG5)
THREE      ALPHA(J)=A*ARG1+B*(ARG2+TF1*ARG3)+C*(ARG4+TF2*ARG5)
           THROUGH FOUR, FOR J=T3+1,1, J .G. T4
           T=5.*J*DELTAT
           TIME(J)=T
           ARG1=T*T*T-3./K*(T*T-2./K*(T-1./K*(1.-EXP.(-K*T))))
           DARG1=3.*T*T-3./K*(2.*T-2./K*(1.-EXP.(-K*T)))
           T=5.*J*DELTAT-TF1
           ARG2=T*T*T-3./K*(T*T-2./K*(T-1./K*(1.-EXP.(-K*T))))
           DARG2=3.*T*T-3./K*(2.*T-2./K*(1.-EXP.(-K*T)))
           ARG3=T*T-2./K*(T-1./K*(1.-EXP.(-K*T)))
           DARG3=2.*T-2./K*(1.-EXP.(-K*T))
           T=5.*J*DELTAT-TF2
           ARG4=T*T*T-3./K*(T*T-2./K*(T-1./K*(1.-EXP.(-K*T))))
           DARG4=3.*T*T-3./K*(2.*T-2./K*(1.-EXP.(-K*T)))
           ARG5=T*T-2./K*(T-1./K*(1.-EXP.(-K*T)))
           DARG5=2.*T-2./K*(1.-EXP.(-K*T))
           T=5.*J*DELTAT-TF3
           ARG6=T*T-2./K*(T-1./K*(1.-EXP.(-K*T)))
```

TABLE R-1 (CONT'D)

```
           DARG6=2.*T-2./K*(1.-EXP.(-K*T))
           ARG7=T-1./K*(1.-EXP.(-K*T))
           DARG7=1.-EXP.(-K*T)
           RATE(J)=A*DARG1+B*(DARG2+TF1*DARG3)+C*(DARG4+TF2*
          1DARG5)
          1+D*(DARG6+TF3*DARG7)
FOUR       ALPHA(J)=A*ARG1+B*(ARG2+TF1*ARG3)+C*(ARG4+TF2*ARG5)
          1+D*(ARG6+TF3*ARG7)
           THROUGH SIX, FOR J=T4+1,1,J .G. END .OR.
          1ALPHA(J-10) .G. 0.99999
           T=5.*J*DELTAT
           TIME(J)=T
           ARG1=T*T*T-3./K*(T*T-2./K*(T-1./K*(1.-EXP.(-K*T))))
           DARG1=3.*T*T-3./K*(2.*T-2./K*(1.-EXP.(-K*T)))
           T=5.*J*DELTAT-TF1
           ARG2=T*T*T-3./K*(T*T-2./K*(T-1./K*(1.-EXP.(-K*T))))
           DARG2=3.*T*T-3./K*(2.*T-2./K*(1.-EXP.(-K*T)))
           ARG3=T*T-2./K*(T-1./K*(1.-EXP.(-K*T)))
           DARG3=2.*T-2./K*(1.-EXP.(-K*T))
           T=5.*J*DELTAT-TF2
           ARG4=T*T*T-3./K*(T*T-2./K*(T-1./K*(1.-EXP.(-K*T))))
           DARG4=3.*T*T-3./K*(2.*T-2./K*(1.-EXP.(-K*T)))
           ARG5=T*T-2./K*(T-1./K*(1.-EXP.(-K*T)))
           DARG5=2.*T-2./K*(1.-EXP.(-K*T))
           T=5.*J*DELTAT-TF3
           ARG6=T*T-2./K*(T-1./K*(1.-EXP.(-K*T)))
           DARG6=2.*T-2./K*(1.-EXP.(-K*T))
           ARG7=T-1./K*(1.-EXP.(-K*T))
           DARG7=1.-EXP.(-K*T)
           T=5.*J*DELTAT-TF4
           ARG8=T-1./K*(1.-EXP.(-K*T))
           DARG8=1.-EXP.(-K*T)
           RATE(J)=A*DARG1+B*(DARG2+TF1*DARG3)+C*(DARG4+TF2*
          1DARG5)
          1+D*(DARG6+TF3*DARG7)+DD*DARG8
SIX        ALPHA(J)=A*ARG1+B*(ARG2+TF1*ARG3)+C*(ARG4+TF2*ARG5)
          1+D*(ARG6+TF3*ARG7)+DD*ARG8
           PRINT FORMAT NAME
           THROUGH FIVE, FOR J=0,1,J.G. END .OR. ALPHA(J-10)
          1 .G. 0.99999
FIVE       PRINT FORMAT ANS, J,ALPHA(J),RATE(J),TIME(J)
           TRANSFER TO BEGIN
           VECTOR VALUES DATA=$F2.0,F11.5/S10,4F10.0/I1,F9.2*$
           VECTOR VALUES NAME=$1H0, S7,2HNO,S5,5HALPHA,
          1S6,4HRATE*$
           VECTOR VALUES ANS=$1H ,I9,2F10.5,F10.1*$
           END OF PROGRAM
```

APPENDIX S

DIMENSIONS OF THE HEMIHYDRATE SUBCRYSTALS AS FUNCTIONS OF TEMPERATURE

The dimensions of the hemihydrate needles were calculated as functions of temperature from the values of the kinetic growth constants U_B/a , U_B/b , U_A/a , and U_A/b using the values of U_A and U_B measured directly in large single crystals of dihydrate. Since the temperature dependences for these six terms are known, the temperature dependence for a and b can be calculated directly from these relationships by dividing the equations describing the temperature dependence of U_A and U_B by the equations describing the temperature dependence for the kinetic growth constants. This results in four equations, two describing the temperature dependence of a , and two describing the temperature dependence of b , all having the form of the Arrhenius equation. Averaging the coefficients of the two equations for a , and the two equations for b yields:

$$a = 3.89 \times 10^{-16} \exp(11{,}571/T) \qquad \text{(S-1)}$$

$$b = 7.82 \times 10^{-9} \exp(4{,}993/T) \qquad \text{(S-2)}$$

where T is the absolute temperature in degrees Kelvin. Values calculated using these equations are given in Table S-1.

It should be pointed out that the temperature dependence for a and b probably is the result of the temperature dependence of the nucleation phenomenon which determines the density of the nuclei on the surface of the crystal and, consequently, determines the values of a and b . As the reaction temperature increases, the total number of nucleation sites also increases due to the increase in molecular vibrations and the size of the hemihydrate subcrystals decreases accordingly, since the surface area remains constant. The number of nuclei per initial dihydrate particle can be calculated from the values of a and b previously calculated using the following relationship:

$$V_H = a\ b\ c\ N_{o/p}\ N_f$$

where a , b , and, are the average dimensions of the hemihydrate subcrystal, V_H is the final volume of hemihydrate formed, N_f is the number of dihydrate particles per sample, and $N_{o/p}$ is the number of nuclei per dihydrate particle. For the 0.7 gram samples used in these experiments, $V_H = 0.2130$ cc, c = 0.015 cm, and $N_f = 211{,}000$ particle/sample (See Appendices L and P), and the equation for $N_{o/p}$ is:

$$N_{o/p} = 2.21 \times 10^{19} \exp(-16{,}564/T) \qquad \text{(S-4)}$$

where T is the absolute temperature in degrees Kelvin. Values of $N_{o/p}$ calculated at several temperatures are shown in Table S-2.

TABLE S-1

DIMENSIONS OF HEMIHYDRATE SUBCRYSTALS

Temp., °F	a, cm	b, cm
220	0.00786	0.00423
230	0.00504	0.00357
240	0.00328	0.00296
250	0.00215	0.00247
260	0.00143	0.00207
270	0.00096	0.00175

TABLE S-2

NUMBER OF NUCLEI PER DIHYDRATE PARTICLE

Temp., °F	N_o/p, Nuclei per Particle
220	1.98
230	3.74
240	6.93
250	12.7
260	22.7
270	70.1

APPENDIX T

NORMALIZED DATA

NORMALIZED DATA FROM RUN 6

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00018	260.20
1.00	.00037	.00229	260.40
2.00	.00459	.00278	260.40
3.00	.00592	.00293	260.70
4.00	.01045	.00477	260.80
5.00	.01545	.00477	260.90
6.00	.01999	.00539	261.00
7.00	.02624	.00641	261.00
8.00	.03281	.00657	261.00
9.00	.03938	.00661	261.00
10.00	.04603	.00704	261.00
11.00	.05346	.00755	261.00
12.00	.06112	.00762	261.00
13.00	.06870	.00770	261.00
14.00	.07652	.00801	261.00
15.00	.08473	.00801	261.00
16.00	.09255	.00805	261.00
17.00	.10084	.00829	261.00
18.00	.10913	.00805	261.00
19.00	.11695	.00805	261.00
20.00	.12524	.00829	261.00
21.00	.13353	.00829	261.00
22.00	.14182	.00841	261.00
23.00	.15034	.00841	261.00
24.00	.15863	.00809	261.00
25.00	.16653	.00801	261.00
26.00	.17466	.00790	261.00
27.00	.18232	.00809	261.00
28.00	.19084	.00848	261.00
29.00	.19929	.00801	261.00
30.00	.20687	.00833	261.00
31.00	.21594	.00833	261.00
32.00	.22353	.00798	261.00
33.00	.23190	.00833	261.00
34.00	.24018	.00833	261.00
35.00	.24855	.00817	261.00
36.00	.25653	.00798	261.00
37.00	.26450	.00798	261.00
38.00	.27248	.00833	261.00
39.00	.28116	.00813	261.00
40.00	.28874	.00778	261.00
41.00	.29672	.00801	261.00
42.00	.30477	.00829	261.00
43.00	.31330	.00829	261.00
44.00	.32135	.00790	261.00
45.00	.32909	.00829	261.00
46.00	.33793	.00864	261.00
47.00	.34637	.00817	261.00
48.00	.35427	.00825	261.00
49.00	.36287	.00825	261.00

NORMALIZED DATA FROM RUN 6 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.37077	.00809	261.00
51.00	.37906	.00848	261.00
52.00	.38774	.00868	261.00
53.00	.39642	.00845	261.00
54.00	.40463	.00829	261.00
55.00	.41299	.00813	261.00
56.00	.42089	.00825	261.00
57.00	.42949	.00856	261.00
58.00	.43802	.00833	261.00
59.00	.44615	.00805	261.00
60.00	.45413	.00790	261.00
61.00	.46194	.00778	261.00
62.00	.46969	.00778	261.00
63.00	.47751	.00798	261.00
64.00	.48564	.00798	261.00
65.00	.49346	.00782	261.00
66.00	.50128	.00813	261.00
67.00	.50972	.00809	261.00
68.00	.51746	.00751	261.00
69.00	.52474	.00770	261.00
70.00	.53287	.00809	261.00
71.00	.54092	.00790	261.00
72.00	.54866	.00755	261.00
73.00	.55601	.00735	261.00
74.00	.56336	.00755	261.00
75.00	.57110	.00774	261.00
76.00	.57885	.00833	261.00
77.00	.58776	.00778	261.00
78.00	.59441	.00719	261.00
79.00	.60215	.00786	261.00
80.00	.61012	.00755	261.00
81.00	.61724	.00731	261.00
82.00	.62475	.00755	261.00
83.00	.63233	.00735	261.00
84.00	.63945	.00755	261.00
85.00	.64742	.00735	261.00
86.00	.65415	.00704	261.00
87.00	.66150	.00719	261.00
88.00	.66854	.00700	261.00
89.00	.67549	.00700	261.00
90.00	.68253	.00700	261.00
91.00	.68949	.00661	261.00
92.00	.69575	.00680	261.00
93.00	.70310	.00649	261.00
94.00	.70873	.00583	261.00
95.00	.71475	.00672	261.00
96.00	.72218	.00672	261.00
97.00	.72820	.00598	261.00
98.00	.73414	.00598	261.00
99.00	.74016	.00579	261.00

NORMALIZED DATA FROM RUN 6 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.74571	.00579	261.00
101.00	.75173	.00622	261.00
102.00	.75815	.00606	261.00
103.00	.76385	.00590	261.00
104.00	.76995	.00555	261.00
105.00	.77496	.00575	261.00
106.00	.78145	.00610	261.00
107.00	.78716	.00555	261.00
108.00	.79255	.00575	261.00
109.00	.79865	.00571	261.00
110.00	.80397	.00461	261.00
111.00	.80788	.00575	261.00
112.00	.81546	.00622	261.00
113.00	.82031	.00512	261.00
114.00	.82571	.00504	261.00
115.00	.83040	.00504	261.00
116.00	.83579	.00485	261.00
117.00	.84009	.00426	261.00
118.00	.84432	.00516	261.00
119.00	.85042	.00504	261.00
120.00	.85440	.00438	261.00
121.00	.85917	.00465	261.00
122.00	.86371	.00450	261.00
123.00	.86817	.00528	261.00
124.00	.87427	.00407	261.00
125.00	.87630	.00348	261.00
126.00	.88123	.00450	261.00
127.00	.88529	.00446	261.00
128.00	.89014	.00426	261.00
129.00	.89381	.00387	261.00
130.00	.89788	.00387	261.00
131.00	.90156	.00368	261.00
132.00	.90523	.00325	261.00
133.00	.90805	.00364	261.00
134.00	.91250	.00352	261.00
135.00	.91508	.00297	261.00
136.00	.91845	.00328	261.00
137.00	.92165	.00258	261.00
138.00	.92361	.00238	261.10
139.00	.92642	.00321	261.10
140.00	.93002	.00282	261.10
141.00	.93205	.00282	261.10
142.00	.93565	.00235	261.10
143.00	.93674	.00180	261.20
144.00	.93924	.00223	261.10
145.00	.94120	.00258	261.20
146.00	.94441	.00258	261.10
147.00	.94636	.00262	261.20
148.00	.94964	.00238	261.10
149.00	.95113	.00219	261.20

NORMALIZED DATA FROM RUN 6 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
150.00	.95402	.00184	261.10
151.00	.95480	.00199	261.20
152.00	.95801	.00246	261.10
153.00	.95973	.00203	261.20
154.00	.96208	.00149	261.10
155.00	.96270	.00145	261.20
156.00	.96497	.00168	261.20
157.00	.96606	.00149	261.20
158.00	.96794	.00168	261.20
159.00	.96943	.00149	261.20
160.00	.97091	.00113	261.20
161.00	.97169	.00152	261.20
162.00	.97396	.00188	261.20
163.00	.97545	.00149	261.20
164.00	.97693	.00109	261.20
165.00	.97764	.00149	261.20
166.00	.97991	.00168	261.20
167.00	.98100	.00113	261.20
168.00	.98217	.00094	261.20
169.00	.98288	.00109	261.20
170.00	.98436	.00113	261.20
171.00	.98514	.00113	261.20
172.00	.98663	.00168	261.20
173.00	.98851	.00113	261.20
174.00	.98890	.00094	261.20
175.00	.99038	.00109	261.20
176.00	.99109	.00074	261.20
177.00	.99187	.00078	261.20
178.00	.99265	.00031	261.20
179.00	.99249	.00090	261.30
180.00	.99445	.00074	261.20
181.00	.99398	.00059	261.30
182.00	.99562	.00016	261.20
183.00	.99429	.00031	261.40
184.00	.99625	.00094	261.30
185.00	.99617	.00055	261.40
186.00	.99734	.00035	261.30
187.00	.99687	.00039	261.40
188.00	.99812	.00039	261.30
189.00	.99765	.00027	261.40
190.00	.99867	.00027	261.30
191.00	.99820	.00027	261.40
192.00	.99922	.00027	261.30
193.00	.99875	.00039	261.40
194.00	1.00000	.00039	261.30

NORMALIZED DATA FROM RUN 7

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00184	259.20
1.00	.00368	.00578	259.30
2.00	.01157	.00847	259.30
3.00	.02062	.01092	259.30
4.00	.03342	.01280	259.30
5.00	.04622	.01635	259.30
6.00	.06611	.02048	259.20
7.00	.08718	.02068	259.10
8.00	.10747	.02281	259.10
9.00	.13280	.02681	259.00
10.00	.16109	.02893	258.80
11.00	.19067	.03312	258.60
12.00	.22733	.03410	258.20
13.00	.25886	.03250	258.10
14.00	.29233	.03353	258.00
15.00	.32593	.03328	257.90
16.00	.35890	.03502	257.90
17.00	.39597	.03849	257.70
18.00	.43589	.03791	257.50
19.00	.47179	.03572	257.30
20.00	.50733	.03399	257.20
21.00	.53978	.03161	257.20
22.00	.57055	.02961	257.20
23.00	.59899	.02844	257.20
24.00	.62743	.02780	257.20
25.00	.65458	.02715	257.20
26.00	.68173	.02683	257.20
27.00	.70824	.02566	257.20
28.00	.73306	.02431	257.20
29.00	.75685	.02289	257.20
30.00	.77884	.01891	257.30
31.00	.79467	.01775	257.60
32.00	.81434	.01915	257.70
33.00	.83297	.01631	257.80
34.00	.84696	.01463	258.00
35.00	.86223	.01539	258.10
36.00	.87775	.01545	258.10
37.00	.89313	.01467	258.10
38.00	.90710	.01087	258.10
39.00	.91488	.00868	258.30
40.00	.92446	.00797	258.40
41.00	.93083	.00694	258.60
42.00	.93834	.00847	258.70
43.00	.94778	.00731	258.70
44.00	.95296	.00345	258.80
45.00	.95468	.00403	259.10
46.00	.96101	.00601	259.10
47.00	.96670	.00478	259.10
48.00	.97058	.00202	259.10
49.00	.97073	.00202	259.30

NORMALIZED DATA FROM RUN 7 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.97461	.00324	259.30
51.00	.97721	.00291	259.40
52.00	.98044	.00291	259.40
53.00	.98302	.00284	259.40
54.00	.98613	.00194	259.40
55.00	.98691	.00123	259.50
56.00	.98859	.00065	259.50
57.00	.98822	.00046	259.60
58.00	.98951	-.00018	259.60
59.00	.98785	.00104	259.80
60.00	.99159	.00162	259.70
61.00	.99108	.00129	259.80
62.00	.99417	.00123	259.70
63.00	.99354	.00091	259.80
64.00	.99598	.00245	259.70
65.00	.99843	.00162	259.60
66.00	.99921	-.00018	259.70
67.00	.99806	-.00058	259.80
68.00	.99806	.00032	259.80
69.00	.99871	.00032	259.80
70.00	.99871	.00065	259.80
71.00	1.00000	-.00115	259.80

NORMALIZED DATA FROM RUN 8

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00027	257.30
1.00	.00055	.00426	257.90
2.00	.00852	.00740	258.10
3.00	.01535	.00857	258.40
4.00	.02566	.01073	258.50
5.00	.03681	.01315	258.70
6.00	.05195	.01630	258.80
7.00	.06940	.01890	258.90
8.00	.08974	.02150	258.90
9.00	.11239	.02315	258.90
10.00	.13603	.02474	258.90
11.00	.16187	.03083	258.90
12.00	.19769	.03175	258.30
13.00	.22536	.03043	258.40
14.00	.25855	.03166	258.10
15.00	.28868	.03097	258.10
16.00	.32048	.03086	258.00
17.00	.35039	.03150	258.00
18.00	.38349	.02994	257.60
19.00	.41027	.02951	257.80
20.00	.44251	.03053	257.70
21.00	.47132	.02966	257.70
22.00	.50183	.02981	257.50
23.00	.53094	.02881	257.60
24.00	.55945	.02815	257.50
25.00	.58724	.02842	257.60
26.00	.61629	.02844	257.50
27.00	.64411	.02723	257.50
28.00	.67075	.02540	257.40
29.00	.69491	.02437	257.50
30.00	.71949	.02206	257.30
31.00	.73903	.02044	257.40
32.00	.76036	.01983	257.40
33.00	.77870	.01974	257.50
34.00	.79984	.01942	257.40
35.00	.81754	.01776	257.40
36.00	.83535	.01535	257.40
37.00	.84824	.01537	257.70
38.00	.86608	.01427	257.60
39.00	.87677	.01205	257.90
40.00	.89019	.01212	257.90
41.00	.90101	.01108	258.10
42.00	.91234	.01198	258.10
43.00	.92498	.01155	258.10
44.00	.93543	.00860	258.10
45.00	.94219	.00739	258.30
46.00	.95021	.00679	258.30
47.00	.95576	.00624	258.50
48.00	.96269	.00629	258.50
49.00	.96834	.00515	258.70

NORMALIZED DATA FROM RUN 8 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.97299	.00276	258.60
51.00	.97385	.00364	259.00
52.00	.98026	.00394	258.90
53.00	.98174	.00250	259.10
54.00	.98526	.00346	259.10
55.00	.98866	.00224	259.10
56.00	.98973	.00167	259.20
57.00	.99201	.00231	259.30
58.00	.99435	.00046	259.20
59.00	.99293	.00114	259.50
60.00	.99662	.00115	259.30
61.00	.99524	.00115	259.50
62.00	.99893	-.00009	259.30
63.00	.99506	.00053	259.70
64.00	1.00000	.00026	259.40

NORMALIZED DATA FROM RUN 9

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00008	260.10
1.00	.00015	.00113	260.20
2.00	.00225	.00182	260.30
3.00	.00379	.00097	260.50
4.00	.00419	.00457	260.70
5.00	.01292	.00810	260.70
6.00	.02039	.00873	260.70
7.00	.03039	.01211	260.70
8.00	.04462	.01304	260.60
9.00	.05646	.01559	260.70
10.00	.07580	.01913	260.50
11.00	.09471	.02223	260.40
12.00	.12025	.02321	260.20
13.00	.14113	.02293	260.20
14.00	.16611	.02794	260.10
15.00	.19702	.03379	259.80
16.00	.23370	.03264	259.30
17.00	.26230	.03061	259.30
18.00	.29492	.03162	259.10
19.00	.32554	.03358	259.10
20.00	.36208	.03421	258.90
21.00	.39397	.03640	258.90
22.00	.43489	.03621	258.50
23.00	.46640	.03518	258.50
24.00	.50524	.03505	258.20
25.00	.53650	.03063	258.20
26.00	.56649	.03025	258.20
27.00	.59699	.03082	258.20
28.00	.62813	.02923	258.20
29.00	.65546	.02936	258.20
30.00	.68685	.02949	258.20
31.00	.71444	.02702	258.20
32.00	.74089	.02658	258.20
33.00	.76759	.02620	258.20
34.00	.79328	.02506	258.20
35.00	.81770	.02310	258.20
36.00	.83947	.02042	258.20
37.00	.85854	.01991	258.30
38.00	.87930	.01896	258.30
39.00	.89647	.01563	258.40
40.00	.91056	.01200	258.60
41.00	.92047	.01139	258.80
42.00	.93334	.01076	258.90
43.00	.94198	.01040	259.10
44.00	.95413	.01088	259.10
45.00	.96375	.00884	259.10
46.00	.97181	.00658	259.20
47.00	.97690	.00565	259.40
48.00	.98310	.00423	259.40
49.00	.98537	.00339	259.70

NORMALIZED DATA FROM RUN 9 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.98987	.00186	259.80
51.00	.98909	.00098	260.10
52.00	.99183	.00257	260.20
53.00	.99423	.00225	260.20
54.00	.99633	.00140	260.30
55.00	.99704	.00184	260.40
56.00	1.00000	.00099	260.30

NORMALIZED DATA FROM RUN 10

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00157	258.10
1.00	.00314	.00009	258.10
2.00	.00018	.00044	258.40
3.00	.00401	.00192	258.40
4.00	.00402	.00254	258.80
5.00	.00910	.00297	258.80
6.00	.00997	.00508	259.10
7.00	.01925	.01133	259.10
8.00	.03262	.01368	259.10
9.00	.04661	.01498	259.10
10.00	.06258	.01696	259.10
11.00	.08053	.01888	259.10
12.00	.10033	.02525	259.10
13.00	.13103	.02556	259.00
14.00	.15145	.02562	258.90
15.00	.18227	.02977	258.70
16.00	.21099	.03119	258.60
17.00	.24465	.03243	258.30
18.00	.27584	.03280	258.20
19.00	.31025	.03280	258.00
20.00	.34144	.03262	258.00
21.00	.37548	.03299	257.90
22.00	.40742	.03694	257.90
23.00	.44937	.03818	257.50
24.00	.48378	.03676	257.50
25.00	.52289	.03534	257.20
26.00	.55446	.03311	257.30
27.00	.58912	.03218	257.20
28.00	.61883	.03175	257.30
29.00	.65262	.03453	257.10
30.00	.68789	.02736	257.10
31.00	.70733	.02426	257.10
32.00	.73642	.02785	257.10
33.00	.76303	.02624	257.10
34.00	.78890	.02525	257.10
35.00	.81354	.02364	257.10
36.00	.83619	.01634	257.10
37.00	.84621	.01907	257.10
38.00	.87432	.02754	257.30
39.00	.90130	.01993	257.10
40.00	.91418	.01609	257.30
41.00	.93349	.00985	257.30
42.00	.93387	.00787	257.90
43.00	.94922	.01232	257.80
44.00	.95851	.01052	258.00
45.00	.97027	.01182	258.00
46.00	.98216	.00836	258.20
47.00	.98698	-.00030	258.10
48.00	.98155	.00155	258.70
49.00	.99009	.00285	258.60

NORMALIZED DATA FROM RUN 10 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.98725	.00099	259.00
51.00	.99207	.00254	259.00
52.00	.99232	.00192	259.10
53.00	.99591	.00142	259.10
54.00	.99517	.00192	259.30
55.00	.99975	-.00043	259.20
56.00	.99431	.00012	259.50
57.00	1.00000	-.00099	259.30

NORMALIZED DATA FROM RUN 11

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00313	260.70
1.00	.00626	.00895	260.70
2.00	.01789	.01286	260.70
3.00	.03199	.01654	260.70
4.00	.05098	.01906	260.50
5.00	.07010	.02210	260.40
6.00	.09517	.02430	260.20
7.00	.11870	.02669	260.20
8.00	.14855	.02985	260.00
9.00	.17839	.03339	259.80
10.00	.21532	.03333	259.30
11.00	.24505	.03179	259.30
12.00	.27890	.03147	259.10
13.00	.30799	.03147	259.10
14.00	.34184	.03192	258.90
15.00	.37183	.03565	258.90
16.00	.41314	.03656	258.40
17.00	.44495	.03258	258.50
18.00	.47829	.03412	258.40
19.00	.51319	.03489	258.30
20.00	.54808	.03406	258.20
21.00	.58130	.03412	258.20
22.00	.61632	.03270	258.10
23.00	.64670	.03148	258.10
24.00	.67928	.03096	258.10
25.00	.70862	.02883	258.10
26.00	.73693	.02754	258.10
27.00	.76369	.02547	258.10
28.00	.78787	.02501	258.10
29.00	.81372	.02527	258.10
30.00	.83841	.02282	258.10
31.00	.85935	.02037	258.10
32.00	.87916	.01857	258.30
33.00	.89649	.01489	258.40
34.00	.90894	.01237	258.70
35.00	.92124	.01320	258.90
36.00	.93535	.01313	259.00
37.00	.94751	.01139	259.10
38.00	.95812	.00868	259.20
39.00	.96486	.00623	259.40
40.00	.97057	.00436	259.70
41.00	.97357	.00409	260.00
42.00	.97875	.00582	260.10
43.00	.98522	.00537	260.20
44.00	.98949	.00240	260.20
45.00	.99002	.00362	260.40
46.00	.99673	.00259	260.30
47.00	.99519	.00149	260.50
48.00	.99971	.00117	260.40
49.00	.99752	-.00025	260.60

NORMALIZED DATA FROM RUN 11 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.99921	.00026	260.70
51.00	.99805	.00013	260.80
52.00	.99947	.00013	260.80
53.00	.99832	-.00019	260.90
54.00	.99909	.00020	260.90
55.00	.99871	.00013	261.00
56.00	.99935	.00065	261.00
57.00	1.00000	.00032	261.00

NORMALIZED DATA FROM RUN 12

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00016	261.20
1.00	.00033	.00461	261.20
2.00	.00922	.00978	261.20
3.00	.01989	.01226	261.20
4.00	.03373	.01546	261.20
5.00	.05082	.01769	261.10
6.00	.06911	.02061	261.10
7.00	.09203	.02385	261.00
8.00	.11680	.02959	261.00
9.00	.15122	.03410	260.60
10.00	.18501	.03448	260.40
11.00	.22018	.03476	260.20
12.00	.25454	.03606	260.10
13.00	.29231	.03723	259.80
14.00	.32900	.03660	259.60
15.00	.36551	.04059	259.50
16.00	.41019	.04180	259.10
17.00	.44910	.03870	259.00
18.00	.48759	.04031	259.00
19.00	.52973	.04038	258.80
20.00	.56834	.03959	258.80
21.00	.60891	.04091	258.70
22.00	.65016	.03977	258.50
23.00	.68844	.03442	258.40
24.00	.71900	.03283	258.50
25.00	.75411	.03317	258.40
26.00	.78535	.03004	258.40
27.00	.81418	.02779	258.40
28.00	.84093	.02618	258.50
29.00	.86653	.02389	258.60
30.00	.88871	.01961	258.70
31.00	.90575	.01783	258.90
32.00	.92436	.01754	259.00
33.00	.94082	.01544	259.10
34.00	.95524	.01341	259.20
35.00	.96764	.00935	259.30
36.00	.97394	.00703	259.60
37.00	.98170	.00538	259.80
38.00	.98470	.00394	260.10
39.00	.98959	.00521	260.20
40.00	.99512	.00419	260.30
41.00	.99798	.00076	260.40
42.00	.99664	-.00063	260.70
43.00	.99671	.00070	260.80
44.00	.99804	.00032	260.90
45.00	.99734	.00035	261.00
46.00	.99874	.00035	261.00
47.00	.99803	-.00064	261.10
48.00	.99746	.00003	261.20
49.00	.99809	.00064	261.20

NORMALIZED DATA FROM RUN 12 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.99873	.00032	261.20
51.00	.99873	.00032	261.20
52.00	.99936	.00032	261.20
53.00	.99936	.00032	261.20
54.00	1.00000	.00032	261.20

NORMALIZED DATA FROM RUN 13

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00123	261.10
1.00	.00246	.00250	261.10
2.00	.00499	.00567	261.20
3.00	.01381	.00967	261.20
4.00	.02432	.01136	261.20
5.00	.03653	.01306	261.20
6.00	.05044	.01399	261.20
7.00	.06451	.01560	261.20
8.00	.08164	.01899	261.20
9.00	.10249	.02520	261.20
10.00	.13203	.03047	261.00
11.00	.16344	.03276	260.70
12.00	.19755	.03352	260.40
13.00	.23047	.03282	260.20
14.00	.26320	.03596	260.20
15.00	.30238	.04436	260.00
16.00	.35192	.04851	259.60
17.00	.39941	.04638	259.30
18.00	.44469	.04545	259.20
19.00	.49030	.04511	259.10
20.00	.53490	.04460	259.10
21.00	.57950	.04544	259.10
22.00	.62579	.04417	259.10
23.00	.66784	.04205	259.10
24.00	.70989	.04087	259.10
25.00	.74957	.03739	259.10
26.00	.78467	.03595	259.10
27.00	.82147	.03425	259.10
28.00	.85318	.02857	259.10
29.00	.87861	.02365	259.30
30.00	.90048	.02017	259.50
31.00	.91895	.01609	259.70
32.00	.93266	.01397	260.00
33.00	.94689	.01295	260.20
34.00	.95857	.00998	260.40
35.00	.96686	.00735	260.60
36.00	.97328	.00515	260.80
37.00	.97715	.00456	261.00
38.00	.98240	.00584	261.10
39.00	.98884	.00406	261.10
40.00	.99052	.00271	261.20
41.00	.99425	.00348	261.20
42.00	.99747	.00109	261.20
43.00	.99644	.00033	261.30
44.00	.99813	.00178	261.30
45.00	1.00000	.00025	261.30

NORMALIZED DATA FROM RUN 14

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00129	261.20
1.00	.00257	.00278	261.20
2.00	.00555	.00587	261.30
3.00	.01432	.00947	261.30
4.00	.02449	.01170	261.40
5.00	.03772	.01610	261.40
6.00	.05670	.02020	261.40
7.00	.07813	.02360	261.40
8.00	.10391	.02794	261.30
9.00	.13400	.02921	261.20
10.00	.16233	.03081	261.20
11.00	.19563	.03303	261.00
12.00	.22839	.03684	260.70
13.00	.26930	.03912	260.50
14.00	.30662	.03665	260.30
15.00	.34260	.03489	260.20
16.00	.37639	.03663	260.20
17.00	.41586	.03757	260.00
18.00	.45152	.04128	260.00
19.00	.49842	.04293	259.50
20.00	.53739	.03818	259.50
21.00	.57478	.03710	259.50
22.00	.61159	.03755	259.50
23.00	.64987	.03647	259.40
24.00	.68452	.03453	259.40
25.00	.71892	.03374	259.30
26.00	.75199	.03163	259.30
27.00	.78219	.02822	259.30
28.00	.80844	.02488	259.50
29.00	.83196	.02411	259.70
30.00	.85666	.02303	259.80
31.00	.87801	.01992	260.00
32.00	.89649	.01988	260.20
33.00	.91777	.01889	260.20
34.00	.93427	.01731	260.30
35.00	.95239	.00892	260.30
36.00	.95212	.00555	261.00
37.00	.96348	.01062	261.00
38.00	.97337	.00873	261.10
39.00	.98095	.00681	261.20
40.00	.98698	.00645	261.20
41.00	.99385	.00384	261.30
42.00	.98467	.00226	261.40
43.00	.99836	.00226	261.50
44.00	.99918	.00082	261.60
45.00	1.00000	-.00107	261.70

NORMALIZED DATA FROM RUN 15

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00259	260.00
1.00	.00518	.00593	260.00
2.00	.01185	.00891	260.10
3.00	.02300	.01292	260.10
4.00	.03769	.01533	260.10
5.00	.05365	.01786	260.10
6.00	.07341	.02061	260.10
7.00	.09487	.02244	260.00
8.00	.11830	.02419	260.00
9.00	.14326	.02552	260.00
10.00	.16935	.03252	260.00
11.00	.20830	.03476	259.30
12.00	.23887	.03051	259.20
13.00	.26931	.03146	259.10
14.00	.30178	.03158	259.00
15.00	.33248	.03139	258.90
16.00	.36457	.03603	258.80
17.00	.40455	.03500	258.30
18.00	.43457	.03143	258.30
19.00	.46742	.03285	258.20
20.00	.50026	.03264	258.10
21.00	.53269	.03249	258.10
22.00	.56525	.03293	258.10
23.00	.59856	.03300	258.10
24.00	.63124	.03346	258.10
25.00	.66548	.03300	258.00
26.00	.69724	.03186	258.10
27.00	.72920	.02983	258.00
28.00	.75690	.02926	258.10
29.00	.78772	.02825	258.00
30.00	.81339	.02584	258.10
31.00	.83940	.02362	258.00
32.00	.86064	.02392	258.10
33.00	.88724	.02134	258.10
34.00	.90333	.01638	258.10
35.00	.92001	.01548	258.20
36.00	.93429	.01280	258.30
37.00	.94561	.00912	258.50
38.00	.95254	.00851	258.90
39.00	.96263	.00914	259.00
40.00	.97082	.00821	259.10
41.00	.97905	.00817	259.10
42.00	.98716	.00477	259.10
43.00	.98859	.00019	259.30
44.00	.98753	.00078	259.70
45.00	.99015	.00107	259.80
46.00	.98967	.00044	260.00
47.00	.99102	.00071	260.10
48.00	.99110	.00215	260.20
49.00	.99533	.00184	260.10

NORMALIZED DATA FROM RUN 15 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.99477	.00036	260.20
51.00	.99604	.00063	260.20
52.00	.99604	.00032	260.20
53.00	.99667	-.00040	260.20
54.00	.99523	.00032	260.30
55.00	.99731	-.00015	260.20
56.00	.99493	.00036	260.40
57.00	.99802	.00095	260.30
58.00	.99683	-.00028	260.40
59.00	.99747	.00004	260.40
60.00	.99691	.00063	260.50
61.00	.99873	.00154	260.40
62.00	1.00000	.00063	260.40

NORMALIZED DATA FROM RUN 16

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00121	261.20
1.00	.00242	.00445	261.20
2.00	.00891	.00773	261.20
3.00	.01787	.01078	261.20
4.00	.03046	.01350	261.20
5.00	.04487	.01623	261.20
6.00	.06292	.01915	261.20
7.00	.08318	.02142	261.20
8.00	.10577	.02414	261.20
9.00	.13146	.02382	261.10
10.00	.15340	.02478	261.10
11.00	.18102	.02601	260.90
12.00	.20543	.02672	260.90
13.00	.23445	.02485	260.60
14.00	.25513	.02492	260.80
15.00	.28428	.02626	260.50
16.00	.30765	.02497	260.50
17.00	.33422	.02471	260.30
18.00	.35708	.02414	260.30
19.00	.38250	.02388	260.20
20.00	.40483	.02388	260.20
21.00	.43026	.02388	260.10
22.00	.45259	.02658	260.10
23.00	.48341	.02563	259.80
24.00	.50385	.02710	260.00
25.00	.53760	.02755	259.50
26.00	.55895	.02577	259.70
27.00	.58915	.02738	259.50
28.00	.61372	.02904	259.60
29.00	.64723	.02937	259.20
30.00	.67245	.02746	259.30
31.00	.70215	.02733	259.20
32.00	.72711	.02720	259.30
33.00	.75655	.02681	259.20
34.00	.78073	.02616	259.30
35.00	.80888	.02486	259.20
36.00	.83046	.02254	259.30
37.00	.85396	.02183	259.30
38.00	.87412	.01976	259.40
39.00	.89349	.01430	259.50
40.00	.90271	.01299	260.00
41.00	.91946	.01514	260.00
42.00	.93299	.01262	260.10
43.00	.94470	.01106	260.20
44.00	.95511	.01014	260.30
45.00	.96498	.00762	260.30
46.00	.97035	.00575	260.50
47.00	.97647	.00419	260.60
48.00	.97872	.00321	260.80
49.00	.98290	.00263	260.90

NORMALIZED DATA FROM RUN 16 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.98398	.00146	261.10
51.00	.98581	.00274	261.20
52.00	.98945	.00305	261.20
53.00	.99191	.00150	261.20
54.00	.99245	.00150	261.30
55.00	.99492	.00188	261.30
56.00	.99622	.00097	261.30
57.00	.99687	.00130	261.30
58.00	.99881	.00156	261.30
59.00	.99998	.00020	261.30
60.00	.99922	-.00032	261.40
61.00	.99935	.00006	261.40
62.00	.99935	.00013	261.40
63.00	.99961	-.00064	261.40
64.00	.99807	.00019	261.50
65.00	1.00000	.00032	261.40

NORMALIZED DATA FROM RUN 19

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00106	251.70
1.00	.00211	.00093	251.60
2.00	.00186	.00187	251.70
3.00	.00585	.00268	251.60
4.00	.00722	.00297	251.70
5.00	.01179	.00292	251.60
6.00	.01305	.00409	251.70
7.00	.01998	.00350	251.50
8.00	.02005	.00385	251.70
9.00	.02768	.00431	251.50
10.00	.02868	.00466	251.70
11.00	.03701	.00548	251.50
12.00	.03964	.00571	251.70
13.00	.04844	.00571	251.50
14.00	.05107	.00713	251.70
15.00	.06269	.00753	251.40
16.00	.06614	.00711	251.60
17.00	.07691	.00764	251.40
18.00	.08141	.00793	251.60
19.00	.09277	.00722	251.40
20.00	.09585	.00845	251.70
21.00	.10968	.00940	251.40
22.00	.11465	.00969	251.60
23.00	.12906	.00987	251.30
24.00	.13438	.00981	251.50
25.00	.14868	.01062	251.20
26.00	.15563	.00908	251.40
27.00	.16685	.01086	251.30
28.00	.17734	.01044	251.30
29.00	.18772	.01050	251.30
30.00	.19833	.01032	251.30
31.00	.20836	.01073	251.30
32.00	.21979	.01273	251.30
33.00	.23383	.01144	251.10
34.00	.24267	.01050	251.20
35.00	.25482	.01067	251.10
36.00	.26401	.01079	251.20
37.00	.27640	.01167	251.10
38.00	.28736	.01114	251.10
39.00	.29867	.01037	251.10
40.00	.30809	.01096	251.20
41.00	.32059	.01138	251.10
42.00	.33086	.01015	251.10
43.00	.34088	.01061	251.10
44.00	.35208	.01185	251.10
45.00	.36458	.01090	251.00
46.00	.37389	.01079	251.10
47.00	.38615	.01085	251.00
48.00	.39558	.01160	251.10
49.00	.40936	.01249	251.00

NORMALIZED DATA FROM RUN 19 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.42056	.01214	251.00
51.00	.43364	.01178	250.90
52.00	.44411	.01172	251.00
53.00	.45708	.01266	250.90
54.00	.46944	.01189	250.90
55.00	.48087	.01160	250.90
56.00	.49265	.01184	250.90
57.00	.50454	.01166	250.90
58.00	.51597	.01172	250.90
59.00	.52798	.01113	250.90
60.00	.53822	.01166	251.00
61.00	.55130	.01189	250.90
62.00	.56201	.01224	251.00
63.00	.57579	.01201	250.90
64.00	.58603	.01178	251.00
65.00	.59935	.01178	250.90
66.00	.60959	.01172	251.00
67.00	.62279	.01214	250.90
68.00	.63387	.01160	250.90
69.00	.64600	.01143	250.90
70.00	.65673	.01185	250.90
71.00	.66969	.01137	250.80
72.00	.67947	.01125	250.90
73.00	.69220	.01079	250.80
74.00	.70104	.01132	250.90
75.00	.71484	.01038	250.70
76.00	.72180	.00926	250.90
77.00	.73336	.01009	250.80
78.00	.74197	.00926	250.90
79.00	.75188	.00980	250.90
80.00	.76156	.00986	250.90
81.00	.77161	.00933	250.80
82.00	.78022	.00968	250.90
83.00	.79097	.00939	250.80
84.00	.79900	.00815	250.90
85.00	.80728	.00869	250.90
86.00	.81637	.00957	250.90
87.00	.82642	.00822	250.80
88.00	.83282	.00845	250.90
89.00	.84333	.00787	250.80
90.00	.84856	.00817	250.90
91.00	.85968	.00775	250.70
92.00	.86407	.00717	250.90
93.00	.87402	.00688	250.70
94.00	.87783	.00617	250.90
95.00	.88636	.00671	250.80
96.00	.89124	.00530	250.90
97.00	.89695	.00606	250.90
98.00	.90337	.00524	250.90
99.00	.90743	.00495	251.00

NORMALIZED DATA FROM RUN 19 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.91326	.00660	251.00
101.00	.92063	.00531	250.90
102.00	.92387	.00419	251.00
103.00	.92900	.00501	251.00
104.00	.93390	.00426	251.00
105.00	.93752	.00420	251.00
106.00	.94230	.00461	251.00
107.00	.94673	.00367	251.00
108.00	.94964	.00379	251.00
109.00	.95431	.00325	251.00
110.00	.95615	.00267	251.10
111.00	.95965	.00332	251.10
112.00	.96280	.00292	251.10
113.00	.96548	.00268	251.10
114.00	.96816	.00297	251.10
115.00	.97143	.00251	251.10
116.00	.97318	.00204	251.10
117.00	.97551	.00110	251.10
118.00	.97537	.00233	251.20
119.00	.98018	.00304	251.10
120.00	.98146	.00140	251.10
121.00	.98297	.00140	251.10
122.00	.98426	.00122	251.10
123.00	.98542	.00057	251.10
124.00	.98540	.00034	251.20
125.00	.98610	.00117	251.20
126.00	.98773	.00199	251.20
127.00	.99009	.00176	251.10
128.00	.99125	.00105	251.10
129.00	.99219	.00111	251.10
130.00	.99347	.00087	251.10
131.00	.99394	.00064	251.10
132.00	.99475	.00047	251.10
133.00	.99487	.00023	251.10
134.00	.99522	.00064	251.10
135.00	.99615	.00064	251.10
136.00	.99650	.00052	251.10
137.00	.99720	.00070	251.10
138.00	.99790	.00023	251.10
139.00	.99767	.00035	251.10
140.00	.99860	.00047	251.10
141.00	.99860	.00000	251.10
142.00	.99860	.00023	251.10
143.00	.99907	.00058	251.10
144.00	.99977	.00047	251.10
145.00	1.00000	-.00065	251.10

NORMALIZED DATA FROM RUN 20

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00102	250.90
1.00	.00204	.00202	250.90
2.00	.00403	.00147	250.90
3.00	.00497	.00182	250.90
4.00	.00767	.00235	250.90
5.00	.00966	.00199	250.90
6.00	.01165	.00217	250.90
7.00	.01400	.00229	250.90
8.00	.01623	.00252	250.90
9.00	.01904	.00293	250.90
10.00	.02209	.00287	250.90
11.00	.02479	.00281	250.90
12.00	.02772	.00311	250.90
13.00	.03100	.00257	250.90
14.00	.03286	.00375	251.00
15.00	.03850	.00464	250.90
16.00	.04214	.00381	250.90
17.00	.04613	.00440	250.90
18.00	.05093	.00469	250.90
19.00	.05551	.00398	250.90
20.00	.05889	.00439	251.00
21.00	.06428	.00569	251.00
22.00	.07026	.00569	251.00
23.00	.07566	.00598	251.00
24.00	.08222	.00722	251.00
25.00	.09010	.00651	250.90
26.00	.09524	.00698	251.00
27.00	.10405	.00739	250.90
28.00	.11001	.00679	251.00
29.00	.11764	.00780	251.00
30.00	.12561	.00898	251.00
31.00	.13559	.00833	250.90
32.00	.14226	.00874	251.00
33.00	.15306	.00968	250.90
34.00	.16162	.00920	250.90
35.00	.17147	.00950	250.90
36.00	.18062	.00967	250.90
37.00	.19082	.01008	250.90
38.00	.20079	.00991	250.90
39.00	.21064	.01003	250.90
40.00	.22084	.01032	250.90
41.00	.23127	.01067	250.90
42.00	.24218	.01167	250.90
43.00	.25462	.01090	250.80
44.00	.26399	.01090	250.90
45.00	.27643	.01155	250.80
46.00	.28709	.01296	250.90
47.00	.30236	.01190	250.70
48.00	.31089	.01450	250.90
49.00	.33137	.01480	250.40

NORMALIZED DATA FROM RUN 20 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.34048	.01237	250.60
51.00	.35611	.01249	250.40
52.00	.36546	.01307	250.60
53.00	.38225	.01313	250.40
54.00	.39172	.01290	250.60
55.00	.40805	.01201	250.40
56.00	.41575	.01284	250.70
57.00	.43373	.01337	250.40
58.00	.44248	.01378	250.70
59.00	.46128	.01661	250.40
60.00	.47571	.01490	250.40
61.00	.49108	.01366	250.30
62.00	.50303	.01490	250.40
63.00	.52088	.01449	250.20
64.00	.53200	.01319	250.30
65.00	.54726	.01295	250.20
66.00	.55790	.01360	250.40
67.00	.57446	.01396	250.20
68.00	.58582	.01461	250.30
69.00	.60369	.01255	250.00
70.00	.61092	.01184	250.30
71.00	.62737	.01184	250.00
72.00	.63460	.01214	250.30
73.00	.65164	.01173	250.00
74.00	.65805	.01173	250.30
75.00	.67509	.01184	250.00
76.00	.68174	.00995	250.30
77.00	.69500	.01084	250.20
78.00	.70342	.01167	250.40
79.00	.71834	.01161	250.20
80.00	.72663	.01137	250.40
81.00	.74108	.01090	250.20
82.00	.74844	.01079	250.40
83.00	.76266	.01085	250.20
84.00	.77014	.01232	250.40
85.00	.78731	.01026	250.00
86.00	.79066	.00819	250.40
87.00	.80370	.00985	250.20
88.00	.81035	.01133	250.40
89.00	.82635	.01027	250.00
90.00	.83089	.00767	250.30
91.00	.84169	.00791	250.20
92.00	.84670	.00856	250.40
93.00	.85881	.00856	250.20
94.00	.86382	.00821	250.40
95.00	.87522	.00762	250.20
96.00	.87907	.00745	250.40
97.00	.89012	.00674	250.20
98.00	.89254	.00627	250.50
99.00	.90265	.00657	250.30

NORMALIZED DATA FROM RUN 20 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.90567	.00610	250.50
101.00	.91484	.00604	250.30
102.00	.91775	.00586	250.50
103.00	.92657	.00510	250.30
104.00	.92795	.00534	250.50
105.00	.93724	.00580	250.30
106.00	.93956	.00516	250.50
107.00	.94756	.00357	250.30
108.00	.94669	.00322	250.60
109.00	.95399	.00369	250.40
110.00	.95408	.00287	250.60
111.00	.95972	.00287	250.50
112.00	.95981	.00340	250.70
113.00	.96652	.00311	250.50
114.00	.96603	.00317	250.70
115.00	.97286	.00281	250.50
116.00	.97165	.00235	250.70
117.00	.97755	.00128	250.50
118.00	.97422	.00099	250.80
119.00	.97953	.00116	250.60
120.00	.97655	.00105	250.90
121.00	.98162	.00170	250.70
122.00	.97995	.00081	250.90
123.00	.98325	.00058	250.80
124.00	.98111	.00017	251.00
125.00	.98358	.00070	250.90
126.00	.98251	.00123	251.00
127.00	.98605	.00147	250.90
128.00	.98544	.00088	251.00
129.00	.98781	.00106	250.90
130.00	.98756	.00023	251.00
131.00	.98826	.00059	251.00
132.00	.98873	.00047	251.00
133.00	.98920	.00024	251.00
134.00	.98824	.00153	251.10
135.00	.99226	.00159	250.90
136.00	.99142	.00064	251.00
137.00	.99355	.00035	250.90
138.00	.99213	.00047	251.00
139.00	.99449	.00064	250.90
140.00	.99342	.00059	251.00
141.00	.99566	.00035	250.90
142.00	.99412	.00012	251.00
143.00	.99590	.00023	250.90
144.00	.99459	.00023	251.00
145.00	.99637	.00059	250.90
146.00	.99576	.00070	251.00
147.00	.99777	.00023	250.90
148.00	.99623	.00018	251.00
149.00	.99812	.00006	250.90

NORMALIZED DATA FROM RUN 20 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
150.00	.99635	.00012	251.00
151.00	.99836	.00012	250.90
152.00	.99658	.00023	251.00
153.00	.99883	.00047	250.90
154.00	.99752	.00023	251.00
155.00	.99930	.00012	250.90
156.00	.99776	.00000	251.00
157.00	.99930	.00000	250.90
158.00	.99776	-.00012	251.00
159.00	.99906	-.00012	250.90
160.00	.99752	-.00083	251.00
161.00	.99740	.00000	251.00
162.00	.99752	.00012	251.00
163.00	.99764	.00029	251.00
164.00	.99811	.00100	251.00
165.00	.99965	.00089	250.90
166.00	.99988	.00012	250.90
167.00	.99988	.00006	250.90
168.00	1.00000	.00006	250.90

NORMALIZED DATA FROM RUN 21

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00097	251.20
1.00	.00194	.00234	251.20
2.00	.00468	.00273	251.20
3.00	.00741	.00297	251.20
4.00	.01062	.00345	251.20
5.00	.01430	.00404	251.20
6.00	.01870	.00475	251.20
7.00	.02381	.00541	251.20
8.00	.02952	.00582	251.20
9.00	.03546	.00618	251.20
10.00	.04188	.00689	251.20
11.00	.04925	.00743	251.20
12.00	.05674	.00784	251.20
13.00	.06494	.00856	251.20
14.00	.07385	.01003	251.20
15.00	.08499	.01039	251.10
16.00	.09462	.00951	251.10
17.00	.10401	.00975	251.10
18.00	.11411	.01034	251.10
19.00	.12469	.01082	251.10
20.00	.13574	.01105	251.10
21.00	.14680	.01105	251.10
22.00	.15785	.01111	251.10
23.00	.16902	.01111	251.10
24.00	.18008	.01105	251.10
25.00	.19113	.01105	251.10
26.00	.20218	.01105	251.10
27.00	.21324	.01141	251.10
28.00	.22500	.01123	251.10
29.00	.23570	.01105	251.10
30.00	.24711	.01199	251.10
31.00	.25968	.01199	251.00
32.00	.27109	.01117	251.00
33.00	.28203	.01105	251.00
34.00	.29320	.01070	251.00
35.00	.30342	.01076	251.00
36.00	.31471	.01099	251.00
37.00	.32541	.01082	251.00
38.00	.33634	.01111	251.00
39.00	.34763	.01064	251.00
40.00	.35762	.01040	251.00
41.00	.36843	.01018	251.00
42.00	.37797	.01111	251.10
43.00	.39066	.01105	251.00
44.00	.40008	.01135	251.10
45.00	.41336	.01165	251.00
46.00	.42337	.01141	251.10
47.00	.43618	.01241	251.00
48.00	.44819	.01159	251.00
49.00	.45936	.01147	251.00

NORMALIZED DATA FROM RUN 21 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. ^{o}F
50.00	.47112	.01177	251.00
51.00	.48289	.01147	251.00
52.00	.49406	.01165	251.00
53.00	.50619	.01101	251.00
54.00	.51608	.01183	251.10
55.00	.52984	.01206	251.00
56.00	.54021	.01171	251.10
57.00	.55325	.01211	251.00
58.00	.56443	.01141	251.00
59.00	.57607	.01117	251.00
60.00	.58677	.01223	251.00
61.00	.60053	.01246	250.90
62.00	.61170	.01129	250.90
63.00	.62311	.01129	250.90
64.00	.63428	.01177	250.90
65.00	.64664	.01194	250.90
66.00	.65817	.01177	250.90
67.00	.67018	.01159	250.90
68.00	.68135	.01123	250.90
69.00	.69264	.01165	250.90
70.00	.70465	.01153	250.90
71.00	.71570	.01111	250.90
72.00	.72687	.01147	250.90
73.00	.73864	.01141	250.90
74.00	.74969	.01006	250.90
75.00	.75875	.01082	251.00
76.00	.77132	.01058	250.90
77.00	.77991	.00946	251.00
78.00	.79025	.01016	251.00
79.00	.80024	.01092	251.00
80.00	.81209	.01022	250.90
81.00	.82068	.00911	251.00
82.00	.83031	.00945	251.00
83.00	.83958	.00979	251.00
84.00	.84989	.00885	250.90
85.00	.85729	.00862	251.00
86.00	.86712	.00790	250.90
87.00	.87309	.00814	251.00
88.00	.88340	.00761	250.90
89.00	.88831	.00643	251.00
90.00	.89627	.00755	251.00
91.00	.90340	.00672	251.00
92.00	.90970	.00542	251.00
93.00	.91425	.00600	251.10
94.00	.92171	.00600	251.00
95.00	.92625	.00576	251.10
96.00	.93323	.00481	251.00
97.00	.93588	.00475	251.10
98.00	.94274	.00458	251.00
99.00	.94503	.00340	251.10

NORMALIZED DATA FROM RUN 21 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. ^{o}F
100.00	.94955	.00428	251.10
101.00	.95359	.00368	251.10
102.00	.95692	.00279	251.10
103.00	.95917	.00327	251.10
104.00	.96345	.00392	251.10
105.00	.96702	.00291	251.10
106.00	.96928	.00232	251.10
107.00	.97165	.00285	251.10
108.00	.97498	.00250	251.10
109.00	.97665	.00190	251.10
110.00	.97879	.00144	251.10
111.00	.97953	.00178	251.20
112.00	.98235	.00236	251.10
113.00	.98425	.00190	251.10
114.00	.98615	.00085	251.10
115.00	.98595	.00143	251.20
116.00	.98901	.00143	251.10
117.00	.98880	.00101	251.20
118.00	.99103	.00171	251.10
119.00	.99222	.00089	251.10
120.00	.99281	.00065	251.10
121.00	.99352	.00083	251.10
122.00	.99447	.00053	251.10
123.00	.99459	.00018	251.10
124.00	.99483	.00107	251.10
125.00	.99673	.00131	251.10
126.00	.99745	-.00028	251.10
127.00	.99617	-.00016	251.20
128.00	.99712	.00071	251.20
129.00	.99759	.00042	251.20
130.00	.99795	-.00022	251.20
131.00	.99715	.00077	251.30
132.00	.99950	.00042	251.20
133.00	.99798	-.00076	251.30
134.00	.99798	-.00070	251.30
135.00	.99658	.00018	251.40
136.00	.99834	.00012	251.30
137.00	.99682	.00030	251.40
138.00	.99893	.00030	251.30
139.00	.99741	.00030	251.40
140.00	.99952	.00024	251.30
141.00	.99789	.00018	251.40
142.00	.99988	.00024	251.30
143.00	.99836	.00006	251.40
144.00	1.00000	.00000	251.30

NORMALIZED DATA FROM RUN 22

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. ^{o}F
.00	.00000	.00088	251.10
1.00	.00176	.00166	251.10
2.00	.00332	.00221	251.10
3.00	.00619	.00269	251.10
4.00	.00870	.00395	251.10
5.00	.01408	.00371	251.10
6.00	.01611	.00209	251.10
7.00	.01827	.00329	251.10
8.00	.02269	.00433	251.10
9.00	.02692	.00233	251.00
10.00	.02736	.00183	251.10
11.00	.03059	.00329	251.10
12.00	.03394	.00305	251.10
13.00	.03669	.00305	251.10
14.00	.04004	.00365	251.10
15.00	.04398	.00407	251.10
16.00	.04817	.00413	251.10
17.00	.05224	.00407	251.10
18.00	.05630	.00431	251.10
19.00	.06085	.00490	251.10
20.00	.06611	.00532	251.10
21.00	.07149	.00532	251.10
22.00	.07676	.00586	251.10
23.00	.08322	.00628	251.10
24.00	.08932	.00640	251.10
25.00	.09601	.00676	251.10
26.00	.10283	.00652	251.10
27.00	.10905	.00712	251.10
28.00	.11707	.00881	251.10
29.00	.12668	.00929	251.00
30.00	.13565	.00849	251.00
31.00	.14366	.00849	251.00
32.00	.15263	.00885	251.00
33.00	.16137	.00909	251.00
34.00	.17082	.00987	251.00
35.00	.18110	.01029	251.00
36.00	.19139	.01082	251.00
37.00	.20275	.01035	251.00
38.00	.21208	.01136	251.00
39.00	.22548	.01226	251.00
40.00	.23660	.01154	251.00
41.00	.24856	.01226	251.00
42.00	.26112	.01342	251.00
43.00	.27540	.01324	250.90
44.00	.28760	.01208	250.90
45.00	.29956	.01336	250.90
46.00	.31432	.01378	250.80
47.00	.32711	.01286	250.80
48.00	.34003	.01446	250.80
49.00	.35603	.01410	250.60

NORMALIZED DATA FROM RUN 22 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. ^{o}F
50.00	.36823	.01348	250.60
51.00	.38298	.01422	250.50
52.00	.39666	.01244	250.40
53.00	.40786	.01078	250.50
54.00	.41822	.01250	250.60
55.00	.43286	.01366	250.50
56.00	.44554	.01390	250.50
57.00	.46065	.01390	250.40
58.00	.47333	.01402	250.40
59.00	.48868	.01396	250.30
60.00	.50124	.01286	250.30
61.00	.51440	.01328	250.30
62.00	.52779	.01316	250.30
63.00	.54071	.01298	250.30
64.00	.55375	.01407	250.30
65.00	.56886	.01310	250.20
66.00	.57994	.01304	250.30
67.00	.59494	.01310	250.20
68.00	.60614	.01298	250.30
69.00	.62089	.01310	250.20
70.00	.63233	.01481	250.30
71.00	.65052	.01316	250.00
72.00	.65865	.01138	250.30
73.00	.67328	.01256	250.20
74.00	.68377	.01244	250.30
75.00	.69816	.01220	250.20
76.00	.70817	.01244	250.30
77.00	.72304	.01214	250.20
78.00	.73245	.01142	250.30
79.00	.74588	.01118	250.20
80.00	.75481	.01176	250.30
81.00	.76941	.01073	250.00
82.00	.77627	.00815	250.20
83.00	.78571	.00883	250.20
84.00	.79393	.01176	250.30
85.00	.80924	.00939	250.00
86.00	.81271	.00843	250.30
87.00	.82610	.01113	250.00
88.00	.83496	.00927	250.00
89.00	.84464	.00726	250.00
90.00	.84947	.00843	250.20
91.00	.86151	.00746	250.00
92.00	.86438	.00600	250.30
93.00	.87351	.00863	250.20
94.00	.88164	.00760	250.20
95.00	.88870	.00638	250.20
96.00	.89440	.00718	250.30
97.00	.90305	.00738	250.20
98.00	.90915	.00628	250.20
99.00	.91561	.00604	250.20

NORMALIZED DATA FROM RUN 22 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. ^{o}F
100.00	.92123	.00752	250.20
101.00	.93064	.00728	250.00
102.00	.93579	.00407	250.00
103.00	.93878	.00478	250.00
104.00	.94536	.00355	250.00
105.00	.94587	.00179	250.20
106.00	.94894	.00399	250.30
107.00	.95385	.00153	250.30
108.00	.95201	.00209	250.40
109.00	.95803	.00419	250.30
110.00	.96038	.00341	250.40
111.00	.96485	.00299	250.30
112.00	.96636	.00353	250.40
113.00	.97191	.00305	250.30
114.00	.97246	.00221	250.40
115.00	.97633	.00233	250.30
116.00	.97713	.00159	250.40
117.00	.97952	-.00006	250.40
118.00	.97700	.00085	250.70
119.00	.98123	.00129	250.60
120.00	.97959	-.00004	250.80
121.00	.98114	.00167	250.80
122.00	.98294	.00155	250.80
123.00	.98425	.00046	250.80
124.00	.98385	.00126	250.90
125.00	.98677	.00114	250.80
126.00	.98613	.00161	250.90
127.00	.99000	.00167	250.80
128.00	.98947	.00084	250.90
129.00	.99167	.00042	250.80
130.00	.99031	-.00038	250.90
131.00	.99091	.00084	250.90
132.00	.99199	.00102	250.90
133.00	.99294	.00072	250.90
134.00	.99342	.00042	250.90
135.00	.99378	.00036	250.90
136.00	.99414	.00140	250.90
137.00	.99657	.00072	250.80
138.00	.99557	-.00032	250.90
139.00	.99593	.00078	250.90
140.00	.99713	.00066	250.90
141.00	.99725	.00036	250.90
142.00	.99785	.00006	250.90
143.00	.99737	-.00110	250.90
144.00	.99565	.00036	251.00
145.00	.99809	.00018	250.90
146.00	.99601	.00036	251.00
147.00	.99880	.00128	250.90
148.00	.99856	-.00018	250.90
149.00	.99845	-.00086	250.90

NORMALIZED DATA FROM RUN 22 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. ^{o}F
150.00	.99685	.00006	251.00
151.00	.99856	.00048	250.90
152.00	.99780	.00042	251.00
153.00	.99940	.00012	250.90
154.00	.99804	.00030	251.00
155.00	1.00000	-.00050	250.90

NORMALIZED DATA FROM RUN 23

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00064	250.90
1.00	.00127	.00183	250.90
2.00	.00365	.00238	250.90
3.00	.00604	.00226	250.90
4.00	.00818	.00328	250.90
5.00	.01259	.00286	250.80
6.00	.01390	.00208	250.90
7.00	.01676	.00274	250.90
8.00	.01938	.00298	250.90
9.00	.02272	.00328	250.90
10.00	.02594	.00429	250.90
11.00	.03130	.00346	250.80
12.00	.03285	.00340	250.90
13.00	.03809	.00399	250.80
14.00	.04083	.00310	250.90
15.00	.04428	.00381	250.90
16.00	.04846	.00423	250.90
17.00	.05274	.00453	250.90
18.00	.05751	.00441	250.90
19.00	.06156	.00447	250.90
20.00	.06645	.00542	250.90
21.00	.07240	.00596	250.90
22.00	.07836	.00590	250.90
23.00	.08420	.00560	250.90
24.00	.08956	.00620	250.90
25.00	.09659	.00691	250.90
26.00	.10338	.00810	250.90
27.00	.11280	.00804	250.80
28.00	.11947	.00625	250.80
29.00	.12531	.00786	250.90
30.00	.13520	.00828	250.80
31.00	.14187	.00756	250.90
32.00	.15033	.00906	250.90
33.00	.15998	.01001	250.90
34.00	.17035	.01114	250.80
35.00	.18227	.01019	250.70
36.00	.19073	.01037	250.80
37.00	.20300	.01108	250.60
38.00	.21289	.01054	250.70
39.00	.22409	.01204	250.70
40.00	.23696	.01341	250.60
41.00	.25090	.01245	250.50
42.00	.26187	.01162	250.50
43.00	.27414	.01233	250.50
44.00	.28653	.01227	250.50
45.00	.29868	.01215	250.50
46.00	.31084	.01275	250.50
47.00	.32418	.01305	250.50
48.00	.33693	.01281	250.50
49.00	.34980	.01311	250.50

NORMALIZED DATA FROM RUN 23 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.36315	.01299	250.50
51.00	.37578	.01281	250.50
52.00	.38876	.01221	250.50
53.00	.40020	.01287	250.60
54.00	.41450	.01370	250.50
55.00	.42761	.01311	250.50
56.00	.44071	.01263	250.50
57.00	.45287	.01358	250.60
58.00	.46788	.01340	250.50
59.00	.47967	.01245	250.60
60.00	.49278	.01317	250.60
61.00	.50601	.01436	250.60
62.00	.52150	.01442	250.50
63.00	.53484	.01340	250.50
64.00	.54831	.01400	250.50
65.00	.56285	.01448	250.40
66.00	.57727	.01305	250.30
67.00	.58894	.01227	250.40
68.00	.60181	.01352	250.40
69.00	.61599	.01424	250.30
70.00	.63029	.01358	250.30
71.00	.64316	.01281	250.30
72.00	.65591	.01257	250.30
73.00	.66830	.01269	250.30
74.00	.68128	.01263	250.30
75.00	.69356	.01215	250.30
76.00	.70559	.01186	250.30
77.00	.71727	.01168	250.30
78.00	.72895	.01144	250.30
79.00	.74015	.01078	250.30
80.00	.75051	.01174	250.30
81.00	.76362	.01066	250.20
82.00	.77184	.00798	250.30
83.00	.77958	.00929	250.40
84.00	.79043	.00935	250.30
85.00	.79829	.00941	250.40
86.00	.80925	.00971	250.30
87.00	.81771	.00858	250.30
88.00	.82641	.00757	250.30
89.00	.83284	.00804	250.40
90.00	.84250	.00834	250.30
91.00	.84953	.00804	250.40
92.00	.85858	.00745	250.30
93.00	.86442	.00763	250.40
94.00	.87383	.00834	250.30
95.00	.88110	.00679	250.30
96.00	.88742	.00590	250.30
97.00	.89290	.00667	250.40
98.00	.90076	.00643	250.30
99.00	.90577	.00530	250.40

NORMALIZED DATA FROM RUN 23 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.91137	.00566	250.40
101.00	.91709	.00578	250.40
102.00	.92292	.00459	250.40
103.00	.92626	.00483	250.50
104.00	.93258	.00536	250.40
105.00	.93698	.00465	250.40
106.00	.94187	.00494	250.40
107.00	.94687	.00447	250.40
108.00	.95081	.00393	250.40
109.00	.95474	.00411	250.40
110.00	.95903	.00304	250.40
111.00	.96081	.00268	250.50
112.00	.96439	.00250	250.50
113.00	.96581	.00125	250.60
114.00	.96688	.00125	250.70
115.00	.96831	.00232	250.80
116.00	.97153	.00196	250.80
117.00	.97224	.00155	250.90
118.00	.97462	.00238	250.90
119.00	.97701	.00232	250.90
120.00	.97927	.00191	250.90
121.00	.98082	.00191	250.90
122.00	.98308	.00220	250.90
123.00	.98523	.00179	250.90
124.00	.98666	.00036	250.90
125.00	.98594	.00042	251.00
126.00	.98749	.00155	251.00
127.00	.98904	.00227	251.00
128.00	.99202	.00155	250.90
129.00	.99214	.00053	251.00
130.00	.99309	.00095	251.00
131.00	.99404	.00083	251.00
132.00	.99476	.00066	251.00
133.00	.99535	.00161	251.00
134.00	.99798	.00089	250.90
135.00	.99714	-.00012	251.00
136.00	.99774	.00054	251.00
137.00	.99821	.00048	251.00
138.00	.99869	.00042	251.00
139.00	.99905	.00036	251.00
140.00	.99940	-.00042	251.00
141.00	.99821	.00018	251.10
142.00	.99976	.00078	251.00
143.00	.99976	.00000	251.00
144.00	.99976	-.00078	251.00
145.00	.99821	.00012	251.10
146.00	1.00000	.00090	251.00

NORMALIZED DATA FROM RUN 24

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00307	250.80
1.00	.00615	.00297	250.60
2.00	.00593	.00307	250.80
3.00	.01228	.00324	250.60
4.00	.01242	.00336	250.80
5.00	.01900	.00230	250.60
6.00	.01703	.00389	250.90
7.00	.02677	.00523	250.50
8.00	.02749	.00295	250.60
9.00	.03267	.00236	250.50
10.00	.03222	.00336	250.70
11.00	.03939	.00318	250.50
12.00	.03859	.00295	250.70
13.00	.04529	.00313	250.50
14.00	.04484	.00336	250.70
15.00	.05201	.00360	250.50
16.00	.05203	.00260	250.70
17.00	.05721	.00354	250.60
18.00	.05911	.00459	250.70
19.00	.06640	.00483	250.50
20.00	.06877	.00442	250.60
21.00	.07525	.00249	250.50
22.00	.07375	.00442	250.80
23.00	.08409	.00589	250.50
24.00	.08553	.00507	250.70
25.00	.09424	.00531	250.50
26.00	.09614	.00537	250.70
27.00	.10497	.00654	250.50
28.00	.10922	.00596	250.60
29.00	.11688	.00561	250.50
30.00	.12044	.00514	250.70
31.00	.12716	.00578	250.70
32.00	.13201	.00690	250.80
33.00	.14096	.00801	250.70
34.00	.14804	.00831	250.70
35.00	.15758	.00761	250.60
36.00	.16325	.00890	250.70
37.00	.17538	.00879	250.50
38.00	.18082	.00879	250.70
39.00	.19295	.01096	250.50
40.00	.20274	.01161	250.50
41.00	.21616	.01084	250.30
42.00	.22443	.00991	250.40
43.00	.23598	.00979	250.30
44.00	.24401	.01044	250.40
45.00	.25685	.01050	250.30
46.00	.26500	.01067	250.40
47.00	.27820	.01120	250.30
48.00	.28741	.01132	250.40
49.00	.30084	.01156	250.30

NORMALIZED DATA FROM RUN 24 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.31052	.01138	250.40
51.00	.32360	.01250	250.30
52.00	.33552	.01208	250.30
53.00	.34777	.01144	250.20
54.00	.35840	.01320	250.30
55.00	.37416	.01120	250.00
56.00	.38080	.01150	250.30
57.00	.39716	.01208	250.00
58.00	.40497	.01150	250.20
59.00	.42016	.01203	250.00
60.00	.42903	.01232	250.20
61.00	.44481	.01215	250.00
62.00	.45333	.01209	250.20
63.00	.46898	.01238	250.00
64.00	.47809	.01221	250.20
65.00	.49340	.01209	250.00
66.00	.50227	.01232	250.20
67.00	.51805	.01156	250.00
68.00	.52540	.01244	250.30
69.00	.54293	.01350	250.00
70.00	.55239	.01256	250.20
71.00	.56805	.01244	250.00
72.00	.57728	.01221	250.20
73.00	.59247	.01384	250.00
74.00	.60497	.01221	250.00
75.00	.61688	.01185	250.00
76.00	.62867	.01197	250.00
77.00	.64082	.01138	250.00
78.00	.65144	.01126	250.00
79.00	.66335	.01179	250.00
80.00	.67503	.01126	250.00
81.00	.68588	.01103	250.00
82.00	.69708	.01161	250.00
83.00	.70910	.01056	249.90
84.00	.71819	.00968	250.00
85.00	.72845	.00985	250.00
86.00	.73789	.00932	250.00
87.00	.74709	.00932	250.00
88.00	.75652	.00926	250.00
89.00	.76560	.00867	250.00
90.00	.77386	.00849	250.00
91.00	.78259	.00867	250.00
92.00	.79120	.00907	250.00
93.00	.80073	.00872	249.90
94.00	.80864	.00826	249.90
95.00	.81725	.00837	249.90
96.00	.82538	.00755	249.90
97.00	.83234	.00725	249.90
98.00	.83989	.00749	249.90
99.00	.84732	.00602	249.90

NORMALIZED DATA FROM RUN 24 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.85193	.00573	250.00
101.00	.85878	.00666	250.00
102.00	.86526	.00649	250.00
103.00	.87175	.00637	250.00
104.00	.87800	.00619	250.00
105.00	.88413	.00578	250.00
106.00	.88956	.00548	250.00
107.00	.89510	.00543	250.00
108.00	.90041	.00519	250.00
109.00	.90548	.00525	250.00
110.00	.91090	.00489	250.00
111.00	.91527	.00436	250.00
112.00	.91963	.00454	250.00
113.00	.92435	.00436	250.00
114.00	.92836	.00401	250.00
115.00	.93237	.00401	250.00
116.00	.93638	.00377	250.00
117.00	.93992	.00336	250.00
118.00	.94310	.00324	250.00
119.00	.94640	.00301	250.00
120.00	.94912	.00137	250.00
121.00	.94914	.00125	250.20
122.00	.95162	.00178	250.20
123.00	.95269	.00231	250.30
124.00	.95623	.00289	250.30
125.00	.95847	.00160	250.30
126.00	.95943	.00259	250.40
127.00	.96366	.00254	250.30
128.00	.96450	.00230	250.40
129.00	.96826	.00183	250.30
130.00	.96816	.00189	250.40
131.00	.97204	.00183	250.30
132.00	.97181	.00200	250.40
133.00	.97605	.00300	250.30
134.00	.97782	.00159	250.30
135.00	.97923	.00147	250.30
136.00	.98076	.00130	250.30
137.00	.98183	.00136	250.30
138.00	.98348	.00130	250.30
139.00	.98442	.00094	250.30
140.00	.98536	.00118	250.30
141.00	.98678	.00094	250.30
142.00	.98725	-.00005	250.30
143.00	.98667	.00001	250.40
144.00	.98726	.00083	250.40
145.00	.98832	.00088	250.40
146.00	.98903	.00088	250.40
147.00	.99009	.00083	250.40
148.00	.99068	.00059	250.40
149.00	.99127	.00059	250.40

NORMALIZED DATA FROM RUN 24 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
150.00	.99186	.00053	250.40
151.00	.99233	.00065	250.40
152.00	.99316	.00077	250.40
153.00	.99387	.00065	250.40
154.00	.99446	.00053	250.40
155.00	.99493	.00053	250.40
156.00	.99552	.00029	250.40
157.00	.99552	-.00052	250.40
158.00	.99447	-.00035	250.50
159.00	.99482	-.00035	250.50
160.00	.99377	.00029	250.60
161.00	.99541	.00029	250.50
162.00	.99436	-.00035	250.60
163.00	.99472	.00035	250.60
164.00	.99507	.00106	250.60
165.00	.99683	-.00006	250.50
166.00	.99495	.00018	250.60
167.00	.99718	.00006	250.50
168.00	.99507	-.00006	250.60
169.00	.99706	.00012	250.50
170.00	.99531	.00006	250.60
171.00	.99718	.00000	250.50
172.00	.99531	-.00082	250.60
173.00	.99554	.00018	250.60
174.00	.99566	-.00006	250.60
175.00	.99542	-.00006	250.60
176.00	.99554	.00029	250.60
177.00	.99601	.00024	250.60
178.00	.99601	.00018	250.60
179.00	.99637	.00012	250.60
180.00	.99625	.00076	250.60
181.00	.99789	.00012	250.50
182.00	.99648	.00018	250.60
183.00	.99824	.00094	250.50
184.00	.99836	.00088	250.50
185.00	1.00000	.00000	250.40

NORMALIZED DATA FROM RUN 25

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00007	250.90
1.00	.00014	.00048	250.90
2.00	.00096	.00194	251.00
3.00	.00402	.00288	251.00
4.00	.00672	.00217	251.00
5.00	.00836	.00217	251.10
6.00	.01107	.00359	251.10
7.00	.01554	.00417	251.10
8.00	.01942	.00417	251.10
9.00	.02388	.00464	251.10
10.00	.02870	.00494	251.10
11.00	.03376	.00523	251.10
12.00	.03917	.00553	251.10
13.00	.04481	.00582	251.10
14.00	.05080	.00600	251.10
15.00	.05680	.00688	251.10
16.00	.06456	.00782	251.00
17.00	.07244	.00741	251.00
18.00	.07938	.00717	250.90
19.00	.08679	.00729	250.90
20.00	.09396	.00770	250.90
21.00	.10219	.00917	250.90
22.00	.11230	.00829	250.80
23.00	.11876	.00858	250.90
24.00	.12946	.00970	250.80
25.00	.13816	.00911	250.80
26.00	.14769	.00935	250.80
27.00	.15686	.01205	250.80
28.00	.17179	.01111	250.50
29.00	.17908	.01017	250.60
30.00	.19213	.00993	250.40
31.00	.19895	.01052	250.60
32.00	.21318	.00988	250.30
33.00	.21870	.01023	250.60
34.00	.23363	.01017	250.30
35.00	.23904	.00982	250.60
36.00	.25327	.01170	250.40
37.00	.26243	.01123	250.50
38.00	.27572	.01170	250.30
39.00	.28583	.01152	250.40
40.00	.29876	.01140	250.30
41.00	.30864	.01234	250.40
42.00	.32345	.01258	250.20
43.00	.33380	.01181	250.30
44.00	.34708	.01040	250.20
45.00	.35460	.01317	250.40
46.00	.37342	.01199	250.00
47.00	.37859	.01170	250.40
48.00	.39681	.01270	250.00
49.00	.40398	.01352	250.30

NORMALIZED DATA FROM RUN 25 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.42385	.01446	249.80
51.00	.43290	.01146	250.00
52.00	.44678	.01234	249.90
53.00	.45759	.01193	250.00
54.00	.47064	.01170	249.90
55.00	.48099	.01193	250.00
56.00	.49451	.01193	249.90
57.00	.50485	.01228	250.00
58.00	.51908	.01117	249.80
59.00	.52719	.01152	250.00
60.00	.54212	.01140	249.80
61.00	.54999	.01134	250.00
62.00	.56481	.01117	249.80
63.00	.57233	.01076	250.00
64.00	.58632	.01052	249.80
65.00	.59337	.01035	250.00
66.00	.60701	.01005	249.80
67.00	.61348	.00988	250.00
68.00	.62676	.00993	249.80
69.00	.63335	.01023	250.00
70.00	.64722	.01005	249.80
71.00	.65345	.00976	250.00
72.00	.66673	.00982	249.80
73.00	.67308	.00958	250.00
74.00	.68590	.00917	249.80
75.00	.69142	.00935	250.00
76.00	.70459	.00935	249.80
77.00	.71011	.00893	250.00
78.00	.72246	.00982	249.80
79.00	.72975	.00870	249.90
80.00	.73986	.00764	249.80
81.00	.74503	.00846	250.00
82.00	.75678	.00852	249.80
83.00	.76208	.00805	250.00
84.00	.77289	.00605	249.80
85.00	.77418	.00611	250.20
86.00	.78512	.00770	250.00
87.00	.78958	.00747	250.20
88.00	.80005	.00747	250.00
89.00	.80451	.00752	250.20
90.00	.81510	.00670	250.00
91.00	.81792	.00564	250.30
92.00	.82638	.00694	250.20
93.00	.83179	.00617	250.30
94.00	.83872	.00517	250.30
95.00	.84213	.00570	250.50
96.00	.85013	.00605	250.40
97.00	.85424	.00705	250.50
98.00	.86423	.00576	250.30
99.00	.86576	.00594	250.60

NORMALIZED DATA FROM RUN 25 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.87611	.00529	250.30
101.00	.87634	.00382	250.60
102.00	.88375	.00335	250.50
103.00	.88303	.00464	250.80
104.00	.89303	.00494	250.50
105.00	.89291	.00494	250.80
106.00	.90291	.00559	250.50
107.00	.90408	.00441	250.70
108.00	.91173	.00270	250.50
109.00	.90948	.00353	250.90
110.00	.91878	.00388	250.60
111.00	.91724	.00359	250.90
112.00	.92595	.00394	250.60
113.00	.92512	.00211	250.90
114.00	.93018	.00347	250.80
115.00	.93205	.00429	250.90
116.00	.93876	.00300	250.70
117.00	.93805	.00276	250.90
118.00	.94429	.00317	250.70
119.00	.94440	.00312	250.90
120.00	.95052	.00288	250.70
121.00	.95016	.00182	250.90
122.00	.95416	.00212	250.80
123.00	.95439	.00117	250.90
124.00	.95651	.00223	250.90
125.00	.95886	.00212	250.90
126.00	.96074	.00141	250.90
127.00	.96167	.00212	251.00
128.00	.96497	.00159	250.90
129.00	.96485	.00165	251.00
130.00	.96826	.00170	250.90
131.00	.96826	.00165	251.00
132.00	.97155	.00141	250.90
133.00	.97108	.00153	251.00
134.00	.97461	.00141	250.90
135.00	.97390	.00129	251.00
136.00	.97720	.00135	250.90
137.00	.97661	.00123	251.00
138.00	.97967	.00141	250.90
139.00	.97943	.00029	251.00
140.00	.98025	.00035	251.00
141.00	.98013	.00118	251.10
142.00	.98260	.00082	251.00
143.00	.98177	.00094	251.10
144.00	.98448	.00076	251.00
145.00	.98330	-.00035	251.10
146.00	.98377	.00082	251.10
147.00	.98495	.00076	251.10
148.00	.98530	.00047	251.10
149.00	.98589	.00065	251.10

NORMALIZED DATA FROM RUN 25 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
150.00	.98659	.00071	251.10
151.00	.98730	.00059	251.10
152.00	.98777	.00065	251.10
153.00	.98859	.00059	251.10
154.00	.98895	.00041	251.10
155.00	.98942	.00153	251.10
156.00	.99201	.00053	251.00
157.00	.99047	-.00053	251.10
158.00	.99094	-.00047	251.10
159.00	.98953	.00053	251.20
160.00	.99200	.00135	251.10
161.00	.99224	.00029	251.10
162.00	.99259	.00041	251.10
163.00	.99306	.00024	251.10
164.00	.99306	.00024	251.10
165.00	.99353	.00035	251.10
166.00	.99377	.00018	251.10
167.00	.99388	.00018	251.10
168.00	.99412	.00012	251.10
169.00	.99412	.00012	251.10
170.00	.99435	.00018	251.10
171.00	.99447	.00006	251.10
172.00	.99447	.00006	251.10
173.00	.99459	.00012	251.10
174.00	.99471	.00041	251.10
175.00	.99541	.00041	251.10
176.00	.99553	.00018	251.10
177.00	.99576	.00018	251.10
178.00	.99588	.00012	251.10
179.00	.99600	.00082	251.10
180.00	.99753	.00000	251.00
181.00	.99600	-.00071	251.10
182.00	.99612	.00006	251.10
183.00	.99612	.00000	251.10
184.00	.99612	.00006	251.10
185.00	.99623	.00006	251.10
186.00	.99623	.00012	251.10
187.00	.99647	.00106	251.10
188.00	.99835	.00029	251.00
189.00	.99706	.00006	251.10
190.00	.99847	-.00012	251.00
191.00	.99682	.00018	251.10
192.00	.99882	.00018	251.00
193.00	.99717	.00006	251.10
194.00	.99894	.00006	251.00
195.00	.99729	.00006	251.10
196.00	.99906	.00000	251.00
197.00	.99729	-.00012	251.10
198.00	.99882	.00082	251.00
199.00	.99894	.00006	251.00

NORMALIZED DATA FROM RUN 25 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
200.00	.99894	-.00088	251.00
201.00	.99717	.00000	251.10
202.00	.99894	.00018	251.00
203.00	.99753	.00029	251.10
204.00	.99953	.00018	251.00
205.00	.99788	.00000	251.10
206.00	.99953	.00006	251.00
207.00	.99800	.00006	251.10
208.00	.99965	.00000	251.00
209.00	.99800	.00006	251.10
210.00	.99976	.00094	251.00
211.00	.99988	.00012	251.00
212.00	1.00000	-.00006	251.00

NORMALIZED DATA FROM RUN 26

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00044	251.00
1.00	.00088	.00053	250.80
2.00	.00106	.00181	250.90
3.00	.00450	.00082	250.80
4.00	.00269	.00251	251.00
5.00	.00951	.00368	250.70
6.00	.01006	.00311	250.80
7.00	.01573	.00223	250.60
8.00	.01453	.00248	250.80
9.00	.02068	.00260	250.60
10.00	.01972	.00190	250.80
11.00	.02449	.00220	250.70
12.00	.02413	.00396	250.90
13.00	.03240	.00314	250.60
14.00	.03041	.00356	250.90
15.00	.03953	.00486	250.60
16.00	.04013	.00323	250.80
17.00	.04599	.00347	250.70
18.00	.04708	.00462	250.90
19.00	.05523	.00510	250.60
20.00	.05729	.00556	250.80
21.00	.06634	.00519	250.60
22.00	.06767	.00601	250.80
23.00	.07836	.00625	250.50
24.00	.08017	.00574	250.70
25.00	.08984	.00604	250.50
26.00	.09225	.00604	250.70
27.00	.10191	.00628	250.50
28.00	.10482	.00640	250.70
29.00	.11472	.00565	250.50
30.00	.11611	.00652	250.80
31.00	.12776	.00752	250.50
32.00	.13115	.00689	250.70
33.00	.14153	.00713	250.50
34.00	.14540	.00713	250.70
35.00	.15579	.00803	250.50
36.00	.16147	.00785	250.70
37.00	.17149	.00676	250.50
38.00	.17500	.00770	250.70
39.00	.18689	.00867	250.40
40.00	.19233	.00882	250.60
41.00	.20452	.00852	250.40
42.00	.20936	.00933	250.60
43.00	.22318	.00951	250.30
44.00	.22838	.00864	250.50
45.00	.24046	.00876	250.30
46.00	.24590	.00993	250.50
47.00	.26033	.00993	250.20
48.00	.26577	.00831	250.40
49.00	.27694	.00924	250.30

NORMALIZED DATA FROM RUN 26 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.28425	.00906	250.40
51.00	.29506	.00936	250.30
52.00	.30297	.00960	250.40
53.00	.31426	.00948	250.30
54.00	.32193	.01048	250.40
55.00	.33522	.00954	250.20
56.00	.34102	.00873	250.40
57.00	.35267	.00984	250.30
58.00	.36071	.00984	250.40
59.00	.37236	.00990	250.30
60.00	.38052	.01015	250.40
61.00	.39265	.01081	250.30
62.00	.40214	.01096	250.40
63.00	.41458	.01042	250.20
64.00	.42297	.00939	250.30
65.00	.43336	.00909	250.30
66.00	.44115	.00966	250.40
67.00	.45269	.01003	250.30
68.00	.46121	.01009	250.40
69.00	.47286	.00997	250.30
70.00	.48114	.01003	250.40
71.00	.49291	.00997	250.30
72.00	.50107	.01084	250.40
73.00	.51459	.01003	250.20
74.00	.52112	.01159	250.40
75.00	.53778	.01322	250.00
76.00	.54756	.01042	250.00
77.00	.55861	.00930	249.90
78.00	.56616	.00942	250.00
79.00	.57745	.00966	249.90
80.00	.58549	.00954	250.00
81.00	.59654	.00912	249.90
82.00	.60373	.00936	250.00
83.00	.61526	.00997	249.90
84.00	.62366	.00930	250.00
85.00	.63386	.00888	249.90
86.00	.64141	.00855	250.00
87.00	.65096	.00761	250.00
88.00	.65664	.00906	250.20
89.00	.66908	.00906	250.00
90.00	.67476	.00930	250.20
91.00	.68768	.00918	250.00
92.00	.69312	.00888	250.20
93.00	.70543	.00906	250.00
94.00	.71124	.00894	250.20
95.00	.72331	.00839	250.00
96.00	.72803	.00827	250.20
97.00	.73986	.00821	250.00
98.00	.74446	.00821	250.20
99.00	.75629	.00815	250.00

NORMALIZED DATA FROM RUN 26 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.76076	.00803	250.20
101.00	.77235	.00809	250.00
102.00	.77695	.00803	250.20
103.00	.78842	.00680	250.00
104.00	.79054	.00580	250.30
105.00	.80002	.00767	250.20
106.00	.80588	.00743	250.30
107.00	.81488	.00731	250.20
108.00	.82050	.00713	250.30
109.00	.82913	.00676	250.20
110.00	.83403	.00845	250.30
111.00	.84603	.00728	250.00
112.00	.84858	.00441	250.20
113.00	.85486	.00616	250.20
114.00	.86090	.00785	250.20
115.00	.87055	.00592	250.00
116.00	.87274	.00550	250.20
117.00	.88155	.00480	250.00
118.00	.88234	.00351	250.30
119.00	.88856	.00495	250.20
120.00	.89225	.00507	250.30
121.00	.89871	.00477	250.20
122.00	.90179	.00326	250.30
123.00	.90523	.00266	250.40
124.00	.90711	.00393	250.50
125.00	.91309	.00305	250.40
126.00	.91321	.00263	250.60
127.00	.91834	.00362	250.50
128.00	.92046	.00362	250.60
129.00	.92559	.00320	250.50
130.00	.92686	.00332	250.60
131.00	.93223	.00332	250.50
132.00	.93350	.00190	250.60
133.00	.93604	.00172	250.60
134.00	.93695	.00353	250.70
135.00	.94310	.00341	250.50
136.00	.94377	.00172	250.60
137.00	.94655	.00166	250.60
138.00	.94709	.00036	250.70
139.00	.94727	.00112	250.80
140.00	.94933	.00242	250.80
141.00	.95211	.00223	250.80
142.00	.95380	.00263	250.80
143.00	.95736	.00269	250.70
144.00	.95917	.00163	250.70
145.00	.96062	.00245	250.70
146.00	.96406	.00245	250.60
147.00	.96551	.00145	250.60
148.00	.96696	.00115	250.60
149.00	.96781	.00103	250.60

NORMALIZED DATA FROM RUN 26 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
150.00	.96902	.00238	250.60
151.00	.97258	.00245	250.50
152.00	.97391	.00103	250.50
153.00	.97463	.00015	250.50
154.00	.97421	.00039	250.60
155.00	.97542	.00103	250.60
156.00	.97626	.00097	250.60
157.00	.97735	.00079	250.60
158.00	.97783	.00054	250.60
159.00	.97844	.00103	250.60
160.00	.97989	.00066	250.60
161.00	.97977	-.00075	250.60
162.00	.97838	.00027	250.70
163.00	.98031	.00226	250.70
164.00	.98291	.00091	250.60
165.00	.98212	.00079	250.70
166.00	.98448	.00148	250.60
167.00	.98508	.00060	250.60
168.00	.98568	.00048	250.60
169.00	.98605	-.00021	250.60
170.00	.98526	.00066	250.70
171.00	.98738	.00160	250.60
172.00	.98846	.00066	250.60
173.00	.98870	.00036	250.60
174.00	.98919	-.00033	250.60
175.00	.98804	.00054	250.70
176.00	.99027	-.00039	250.60
177.00	.98726	-.00027	250.80
178.00	.98973	.00242	250.70
179.00	.99209	.00054	250.60
180.00	.99082	-.00057	250.70
181.00	.99094	.00030	250.70
182.00	.99142	.00118	250.70
183.00	.99329	.00124	250.60
184.00	.99390	.00054	250.60
185.00	.99438	.00048	250.60
186.00	.99486	.00042	250.60
187.00	.99523	.00036	250.60
188.00	.99559	.00042	250.60
189.00	.99607	.00036	250.60
190.00	.99631	.00024	250.60
191.00	.99656	.00024	250.60
192.00	.99680	-.00063	250.60
193.00	.99529	-.00151	250.70
194.00	.99378	-.00145	250.80
195.00	.99239	-.00133	250.90
196.00	.99112	.00060	251.00
197.00	.99360	.00136	250.90
198.00	.99384	.00024	250.90
199.00	.99408	.00042	250.90

NORMALIZED DATA FROM RUN 26 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
200.00	.99469	.00042	250.90
201.00	.99493	-.00057	250.90
202.00	.99354	.00024	251.00
203.00	.99541	.00118	250.90
204.00	.99589	.00024	250.90
205.00	.99589	.00006	250.90
206.00	.99601	-.00006	250.90
207.00	.99577	-.00006	250.90
208.00	.99589	.00012	250.90
209.00	.99601	-.00063	250.90
210.00	.99462	.00042	251.00
211.00	.99686	.00136	250.90
212.00	.99734	.00012	250.90
213.00	.99710	-.00076	250.90
214.00	.99583	.00030	251.00
215.00	.99770	.00018	250.90
216.00	.99619	.00024	251.00
217.00	.99819	.00124	250.90
218.00	.99867	.00030	250.90
219.00	.99879	.00012	250.90
220.00	.99891	.00012	250.90
221.00	.99903	.00018	250.90
222.00	.99928	.00012	250.90
223.00	.99928	.00018	250.90
224.00	.99964	.00018	250.90
225.00	.99964	.00018	250.90
226.00	1.00000	-.00051	250.90

NORMALIZED DATA FROM RUN 27

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00144	251.30
1.00	.00288	.00133	251.20
2.00	.00266	.00161	251.30
3.00	.00609	.00178	251.20
4.00	.00623	.00202	251.30
5.00	.01014	.00202	251.20
6.00	.01028	.00202	251.30
7.00	.01419	.00226	251.20
8.00	.01480	.00238	251.30
9.00	.01894	.00262	251.20
10.00	.02003	.00268	251.30
11.00	.02430	.00291	251.20
12.00	.02586	.00263	251.30
13.00	.02955	.00369	251.30
14.00	.03324	.00357	251.30
15.00	.03669	.00387	251.30
16.00	.04097	.00422	251.30
17.00	.04514	.00434	251.30
18.00	.04966	.00564	251.30
19.00	.05642	.00482	251.20
20.00	.05930	.00576	251.30
21.00	.06794	.00694	251.10
22.00	.07318	.00547	251.10
23.00	.07889	.00595	251.10
24.00	.08508	.00743	251.10
25.00	.09374	.00660	251.00
26.00	.09828	.00631	251.10
27.00	.10636	.00672	251.00
28.00	.11173	.00744	251.10
29.00	.12123	.00661	251.00
30.00	.12495	.00732	251.20
31.00	.13586	.00850	251.00
32.00	.14195	.00756	251.10
33.00	.15097	.00785	251.00
34.00	.15765	.00857	251.10
35.00	.16811	.00951	251.00
36.00	.17667	.00957	251.00
37.00	.18724	.00916	250.90
38.00	.19499	.00910	251.00
39.00	.20545	.00934	250.90
40.00	.21367	.00970	251.00
41.00	.22484	.01052	250.90
42.00	.23471	.01011	250.90
43.00	.24506	.01059	250.90
44.00	.25589	.01141	250.90
45.00	.26789	.01023	250.80
46.00	.27636	.01135	250.90
47.00	.29059	.01101	250.70
48.00	.29837	.01089	250.90
49.00	.31237	.01035	250.70

NORMALIZED DATA FROM RUN 27 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.31907	.01142	250.90
51.00	.33521	.01202	250.70
52.00	.34310	.01078	250.90
53.00	.35677	.01166	250.80
54.00	.36642	.01437	250.90
55.00	.38550	.01378	250.50
56.00	.39399	.01308	250.70
57.00	.41165	.01320	250.40
58.00	.42038	.01225	250.60
59.00	.43616	.01225	250.40
60.00	.44489	.01214	250.60
61.00	.46043	.01302	250.40
62.00	.47092	.01202	250.50
63.00	.48447	.01196	250.40
64.00	.49484	.01190	250.50
65.00	.50826	.01084	250.40
66.00	.51651	.01266	250.60
67.00	.53358	.01201	250.30
68.00	.54053	.00983	250.50
69.00	.55323	.00971	250.40
70.00	.55994	.01053	250.60
71.00	.57429	.01053	250.40
72.00	.58100	.01041	250.60
73.00	.59511	.01029	250.40
74.00	.60158	.01011	250.60
75.00	.61534	.01035	250.40
76.00	.62228	.01023	250.60
77.00	.63581	.01105	250.40
78.00	.64439	.01041	250.50
79.00	.65663	.01029	250.40
80.00	.66498	.00988	250.50
81.00	.67638	.00940	250.40
82.00	.68377	.00964	250.50
83.00	.69565	.00988	250.40
84.00	.70353	.00940	250.50
85.00	.71445	.00822	250.40
86.00	.71997	.00892	250.60
87.00	.73230	.00786	250.40
88.00	.73569	.00869	250.70
89.00	.74967	.00845	250.40
90.00	.75259	.00845	250.70
91.00	.76656	.00951	250.40
92.00	.77160	.00839	250.60
93.00	.78334	.00827	250.40
94.00	.78814	.00815	250.60
95.00	.79964	.00885	250.40
96.00	.80585	.00785	250.50
97.00	.81534	.00844	250.40
98.00	.82272	.00726	250.40
99.00	.82986	.00644	250.40

NORMALIZED DATA FROM RUN 27 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.83559	.00702	250.50
101.00	.84390	.00666	250.40
102.00	.84892	.00666	250.50
103.00	.85722	.00542	250.40
104.00	.85976	.00513	250.60
105.00	.86748	.00607	250.50
106.00	.87190	.00660	250.60
107.00	.88068	.00572	250.50
108.00	.88334	.00547	250.70
109.00	.89163	.00488	250.50
110.00	.89310	.00406	250.70
111.00	.89974	.00476	250.60
112.00	.90262	.00564	250.70
113.00	.91102	.00558	250.50
114.00	.91378	.00340	250.60
115.00	.91783	.00216	250.60
116.00	.91810	.00293	250.80
117.00	.92368	.00369	250.70
118.00	.92548	.00293	250.80
119.00	.92953	.00369	250.80
120.00	.93286	.00327	250.80
121.00	.93607	.00327	250.80
122.00	.93940	.00309	250.80
123.00	.94226	.00209	250.80
124.00	.94359	.00315	250.90
125.00	.94856	.00297	250.80
126.00	.94953	.00162	250.90
127.00	.95179	.00244	250.90
128.00	.95441	.00338	250.90
129.00	.95856	.00244	250.80
130.00	.95929	.00150	250.90
131.00	.96155	.00202	250.90
132.00	.96334	.00184	250.90
133.00	.96524	.00120	250.90
134.00	.96573	.00120	251.00
135.00	.96764	.00190	251.00
136.00	.96954	.00178	251.00
137.00	.97121	.00173	251.00
138.00	.97299	.00243	251.00
139.00	.97607	.00155	250.90
140.00	.97609	.00072	251.00
141.00	.97751	.00213	251.00
142.00	.98035	.00213	250.90
143.00	.98178	.00049	250.90
144.00	.98132	.00043	251.00
145.00	.98263	.00119	251.00
146.00	.98370	.00101	251.00
147.00	.98465	.00113	251.00
148.00	.98596	.00189	251.00
149.00	.98844	.00077	250.90

NORMALIZED DATA FROM RUN 27 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
150.00	.98751	.00077	251.00
151.00	.98999	.00089	250.90
152.00	.98929	.00077	251.00
153.00	.99153	.00166	250.90
154.00	.99260	.00077	250.90
155.00	.99308	-.00035	250.90
156.00	.99191	.00065	251.00
157.00	.99439	.00166	250.90
158.00	.99522	.00089	250.90
159.00	.99617	-.00041	250.90
160.00	.99441	-.00059	251.00
161.00	.99500	-.00035	251.00
162.00	.99371	-.00059	251.10
163.00	.99383	.00018	251.10
164.00	.99407	.00042	251.10
165.00	.99466	.00030	251.10
166.00	.99466	.00000	251.10
167.00	.99466	.00018	251.10
168.00	.99502	.00118	251.10
169.00	.99703	.00042	251.00
170.00	.99585	.00030	251.10
171.00	.99762	.00036	251.00
172.00	.99657	.00042	251.10
173.00	.99845	.00000	251.00
174.00	.99657	-.00070	251.10
175.00	.99704	.00030	251.10
176.00	.99716	.00012	251.10
177.00	.99728	.00024	251.10
178.00	.99764	.00018	251.10
179.00	.99764	.00006	251.10
180.00	.99776	.00100	251.10
181.00	.99964	.00012	251.00
182.00	.99800	.00018	251.10
183.00	1.00000	.00012	251.00

NORMALIZED DATA FROM RUN 28

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00059	250.40
1.00	.00118	.00020	250.20
2.00	.00040	.00101	250.30
3.00	.00321	.00101	250.20
4.00	.00243	.00107	250.30
5.00	.00536	.00125	250.20
6.00	.00494	.00107	250.30
7.00	.00750	.00113	250.20
8.00	.00720	.00310	250.30
9.00	.01371	.00039	250.00
10.00	.00797	-.00030	250.40
11.00	.01311	.00167	250.20
12.00	.01131	.00167	250.40
13.00	.01645	.00185	250.20
14.00	.01501	.00098	250.40
15.00	.01841	.00029	250.30
16.00	.01560	.00128	250.60
17.00	.02097	.00221	250.40
18.00	.02001	.00274	250.60
19.00	.02646	.00256	250.40
20.00	.02514	.00227	250.60
21.00	.03099	.00245	250.40
22.00	.03003	.00268	250.60
23.00	.03636	.00379	250.40
24.00	.03761	.00298	250.50
25.00	.04232	.00316	250.40
26.00	.04393	.00322	250.50
27.00	.04876	.00340	250.40
28.00	.05073	.00433	250.50
29.00	.05741	.00370	250.30
30.00	.05812	.00388	250.50
31.00	.06517	.00295	250.30
32.00	.06402	.00307	250.60
33.00	.07131	.00423	250.40
34.00	.07249	.00459	250.60
35.00	.08049	.00447	250.40
36.00	.08143	.00540	250.60
37.00	.09129	.00483	250.30
38.00	.09109	.00507	250.60
39.00	.10143	.00606	250.30
40.00	.10321	.00572	250.50
41.00	.11288	.00671	250.30
42.00	.11663	.00689	250.40
43.00	.12665	.00707	250.20
44.00	.13077	.00811	250.30
45.00	.14288	.00656	250.00
46.00	.14389	.00644	250.30
47.00	.15576	.00668	250.00
48.00	.15724	.00686	250.30
49.00	.16948	.00734	250.00

NORMALIZED DATA FROM RUN 28 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.17191	.00763	250.30
51.00	.18474	.00757	250.00
52.00	.18706	.00751	250.30
53.00	.19977	.00775	250.00
54.00	.20257	.00862	250.30
55.00	.21701	.01083	249.90
56.00	.22422	.00010	250.00
57.00	.21720	-.00014	250.90
58.00	.22394	.00865	251.00
59.00	.23450	.01744	250.90
60.00	.25881	.01848	250.00
61.00	.27146	.00993	249.80
62.00	.27867	.00993	249.90
63.00	.29132	.00942	249.70
64.00	.29752	.00966	249.90
65.00	.31064	.01065	249.70
66.00	.31881	.01071	249.80
67.00	.33205	.01071	249.60
68.00	.34022	.00990	249.70
69.00	.35185	.00903	249.60
70.00	.35829	.00990	249.80
71.00	.37165	.00996	249.60
72.00	.37820	.00990	249.80
73.00	.39145	.01106	249.60
74.00	.40033	.01008	249.70
75.00	.41160	.01002	249.60
76.00	.42037	.01088	249.70
77.00	.43337	.00960	249.50
78.00	.43957	.00966	249.70
79.00	.45269	.00960	249.50
80.00	.45877	.00948	249.70
81.00	.47166	.00948	249.50
82.00	.47774	.00984	249.70
83.00	.49134	.00930	249.50
84.00	.49634	.00906	249.70
85.00	.50946	.00984	249.50
86.00	.51602	.00868	249.70
87.00	.52682	.00948	249.60
88.00	.53499	.01070	249.70
89.00	.54823	.00954	249.50
90.00	.55407	.00930	249.70
91.00	.56683	.00838	249.50
92.00	.57082	.00930	249.80
93.00	.58544	.01023	249.50
94.00	.59128	.01011	249.70
95.00	.60566	.00900	249.40
96.00	.60929	.00912	249.70
97.00	.62390	.00975	249.40
98.00	.62879	.00871	249.60
99.00	.64132	.00993	249.40

NORMALIZED DATA FROM RUN 28 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.64865	.00889	249.50
101.00	.65909	.00853	249.40
102.00	.66571	.00865	249.50
103.00	.67638	.00883	249.40
104.00	.68336	.00871	249.50
105.00	.69380	.00877	249.40
106.00	.70089	.00784	249.50
107.00	.70948	.00859	249.50
108.00	.71807	.00933	249.50
109.00	.72815	.00787	249.40
110.00	.73381	.00799	249.50
111.00	.74413	.00817	249.40
112.00	.75015	.00704	249.50
113.00	.75820	.00844	249.40
114.00	.76703	.00799	249.40
115.00	.77418	.00710	249.40
116.00	.78122	.00734	249.40
117.00	.78885	.00617	249.40
118.00	.79356	.00626	249.50
119.00	.80138	.00650	249.40
120.00	.80656	.00587	249.50
121.00	.81312	.00644	249.50
122.00	.81945	.00626	249.50
123.00	.82565	.00608	249.50
124.00	.83161	.00572	249.50
125.00	.83710	.00432	249.50
126.00	.84026	.00537	249.60
127.00	.84783	.00635	249.50
128.00	.85296	.00531	249.50
129.00	.85845	.00489	249.50
130.00	.86274	.00459	249.50
131.00	.86763	.00414	249.50
132.00	.87103	.00408	249.60
133.00	.87580	.00477	249.60
134.00	.88057	.00459	249.60
135.00	.88498	.00355	249.60
136.00	.88767	.00244	249.70
137.00	.88987	.00325	249.80
138.00	.89416	.00411	249.80
139.00	.89810	.00411	249.80
140.00	.90239	.00406	249.80
141.00	.90621	.00203	249.80
142.00	.90644	.00307	250.00
143.00	.91235	.00468	249.90
144.00	.91581	.00340	249.90
145.00	.91915	.00253	249.90
146.00	.92088	.00310	250.00
147.00	.92535	.00286	249.90
148.00	.92660	.00310	250.00
149.00	.93155	.00340	249.90

NORMALIZED DATA FROM RUN 28 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
150.00	.93340	.00322	250.00
151.00	.93799	.00274	249.90
152.00	.93888	.00256	250.00
153.00	.94312	.00274	249.90
154.00	.94437	.00280	250.00
155.00	.94873	.00262	249.90
156.00	.94962	.00128	250.00
157.00	.95129	.00030	250.00
158.00	.95021	.00047	250.20
159.00	.95224	.00122	250.20
160.00	.95265	.00209	250.30
161.00	.95641	.00260	250.20
162.00	.95784	.00191	250.20
163.00	.96023	.00221	250.20
164.00	.96226	.00185	250.20
165.00	.96392	.00092	250.20
166.00	.96410	.00161	250.30
167.00	.96715	.00236	250.20
168.00	.96881	.00155	250.20
169.00	.97025	.00155	250.20
170.00	.97192	.00161	250.20
171.00	.97347	.00328	250.20
172.00	.97848	.00161	250.00
173.00	.97669	-.00024	250.20
174.00	.97800	.00137	250.20
175.00	.97943	.00316	250.20
176.00	.98433	.00125	250.00
177.00	.98193	-.00066	250.20
178.00	.98301	.00101	250.20
179.00	.98396	.00101	250.20
180.00	.98504	.00083	250.20
181.00	.98563	.00078	250.20
182.00	.98659	.00101	250.20
183.00	.98766	.00107	250.20
184.00	.98873	.00101	250.20
185.00	.98969	.00072	250.20
186.00	.99016	-.00021	250.20
187.00	.98927	-.00015	250.30
188.00	.98986	.00054	250.30
189.00	.99034	-.00027	250.30
190.00	.98932	-.00021	250.40
191.00	.98992	.00048	250.40
192.00	.99028	.00054	250.40
193.00	.99099	-.00021	250.40
194.00	.98985	.00060	250.50
195.00	.99218	.00060	250.40
196.00	.99105	.00060	250.50
197.00	.99338	.00030	250.40
198.00	.99164	.00018	250.50
199.00	.99373	.00111	250.40

NORMALIZED DATA FROM RUN 28 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
200.00	.99385	.00030	250.40
201.00	.99433	-.00039	250.40
202.00	.99307	.00054	250.50
203.00	.99540	.00122	250.40
204.00	.99552	.00030	250.40
205.00	.99600	.00036	250.40
206.00	.99624	.00000	250.40
207.00	.99600	.00006	250.40
208.00	.99636	.00036	250.40
209.00	.99672	.00024	250.40
210.00	.99684	.00000	250.40
211.00	.99672	-.00087	250.40
212.00	.99510	.00012	250.50
213.00	.99695	.00012	250.40
214.00	.99534	.00024	250.50
215.00	.99743	.00111	250.40
216.00	.99755	.00006	250.40
217.00	.99755	.00006	250.40
218.00	.99767	.00006	250.40
219.00	.99767	.00006	250.40
220.00	.99779	.00105	250.40
221.00	.99976	.00111	250.30
222.00	1.00000	.00006	250.30

NORMALIZED DATA FROM RUN 29

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00162	250.60
1.00	.00324	.00044	250.50
2.00	.00088	.00124	250.70
3.00	.00573	.00156	250.50
4.00	.00399	.00093	250.70
5.00	.00760	.00193	250.60
6.00	.00785	.00199	250.70
7.00	.01158	.00187	250.60
8.00	.01158	.00205	250.70
9.00	.01569	.00305	250.60
10.00	.01768	.00286	250.60
11.00	.02141	.00168	250.50
12.00	.02104	.00280	250.70
13.00	.02701	.00261	250.50
14.00	.02626	.00193	250.70
15.00	.03087	.00311	250.60
16.00	.03249	.00305	250.70
17.00	.03696	.00299	250.60
18.00	.03846	.00367	250.70
19.00	.04430	.00305	250.60
20.00	.04456	.00473	250.80
21.00	.05376	.00404	250.50
22.00	.05264	.00330	250.80
23.00	.06036	.00547	250.60
24.00	.06359	.00566	250.70
25.00	.07168	.00417	250.50
26.00	.07193	.00523	250.80
27.00	.08213	.00535	250.50
28.00	.08263	.00634	250.80
29.00	.09482	.00666	250.40
30.00	.09594	.00610	250.70
31.00	.10701	.00591	250.40
32.00	.10776	.00715	250.70
33.00	.12132	.00746	250.30
34.00	.12269	.00691	250.60
35.00	.13513	.00896	250.30
36.00	.14061	.00728	250.40
37.00	.14969	.00740	250.30
38.00	.15541	.00715	250.40
39.00	.16400	.00722	250.30
40.00	.16985	.00809	250.40
41.00	.18017	.00827	250.30
42.00	.18640	.00815	250.40
43.00	.19647	.00852	250.30
44.00	.20344	.00964	250.40
45.00	.21576	.00977	250.20
46.00	.22298	.01082	250.30
47.00	.23740	.01182	250.00
48.00	.24661	.01039	250.00
49.00	.25818	.00977	249.90

NORMALIZED DATA FROM RUN '29 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.26614	.01076	250.00
51.00	.27970	.00977	249.80
52.00	.28568	.00902	250.00
53.00	.29774	.01014	249.90
54.00	.30596	.00989	250.00
55.00	.31753	.00977	249.90
56.00	.32549	.00977	250.00
57.00	.33706	.01008	249.90
58.00	.34565	.01039	250.00
59.00	.35784	.01020	249.90
60.00	.36606	.01002	250.00
61.00	.37787	.00989	249.90
62.00	.38584	.01002	250.00
63.00	.39791	.00989	249.90
64.00	.40562	.00952	250.00
65.00	.41694	.00964	249.90
66.00	.42491	.01113	250.00
67.00	.43921	.01144	249.70
68.00	.44780	.01101	249.80
69.00	.46123	.01008	249.60
70.00	.46796	.00915	249.80
71.00	.47952	.00983	249.70
72.00	.48762	.00983	249.80
73.00	.49918	.01020	249.70
74.00	.50802	.01027	249.80
75.00	.51971	.01002	249.70
76.00	.52805	.00971	249.80
77.00	.53912	.00977	249.70
78.00	.54759	.01014	249.80
79.00	.55941	.00958	249.70
80.00	.56675	.00958	249.80
81.00	.57857	.00983	249.70
82.00	.58641	.00964	249.80
83.00	.59785	.01057	249.70
84.00	.60756	.01008	249.70
85.00	.61801	.00921	249.60
86.00	.62597	.00828	249.70
87.00	.63456	.00840	249.70
88.00	.64277	.00952	249.80
89.00	.65360	.00927	249.70
90.00	.66131	.00908	249.80
91.00	.67176	.00883	249.70
92.00	.67898	.00896	249.80
93.00	.68968	.00871	249.70
94.00	.69640	.00784	249.80
95.00	.70536	.00784	249.70
96.00	.71208	.00834	249.90
97.00	.72203	.00790	249.80
98.00	.72788	.00747	249.90
99.00	.73696	.01033	249.80

NORMALIZED DATA FROM RUN 29 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.74854	.00902	249.90
101.00	.75501	.00666	249.80
102.00	.76185	.00715	249.80
103.00	.76931	.00728	249.80
104.00	.77641	.00715	249.80
105.00	.78362	.00585	249.80
106.00	.78811	.00635	249.90
107.00	.79632	.00647	249.80
108.00	.80105	.00610	249.90
109.00	.80851	.00579	249.80
110.00	.81262	.00579	249.90
111.00	.82008	.00572	249.80
112.00	.82407	.00572	249.90
113.00	.83153	.00547	249.80
114.00	.83501	.00523	249.90
115.00	.84198	.00473	249.80
116.00	.84447	.00498	250.00
117.00	.85193	.00516	249.80
118.00	.85480	.00479	249.90
119.00	.86151	.00485	249.80
120.00	.86450	.00491	249.90
121.00	.87134	.00585	249.80
122.00	.87620	.00448	249.80
123.00	.88030	.00417	249.80
124.00	.88453	.00435	249.80
125.00	.88901	.00442	249.80
126.00	.89337	.00404	249.80
127.00	.89710	.00286	249.80
128.00	.89909	.00392	249.90
129.00	.90494	.00473	249.80
130.00	.90855	.00355	249.80
131.00	.91203	.00361	249.80
132.00	.91576	.00355	249.80
133.00	.91912	.00342	249.80
134.00	.92261	.00336	249.80
135.00	.92584	.00305	249.80
136.00	.92870	.00386	249.80
137.00	.93355	.00305	249.70
138.00	.93480	.00299	249.80
139.00	.93953	.00292	249.70
140.00	.94065	.00174	249.80
141.00	.94301	.00249	249.80
142.00	.94563	.00255	249.80
143.00	.94811	.00205	249.80
144.00	.94973	.00187	249.80
145.00	.95185	.00243	249.80
146.00	.95458	.00230	249.80
147.00	.95645	.00112	249.80
148.00	.95683	.00112	249.90
149.00	.95869	.00118	249.90

NORMALIZED DATA FROM RUN 29 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
150.00	.95919	.00087	250.00
151.00	.96044	.00162	250.00
152.00	.96243	.00255	250.00
153.00	.96554	.00162	249.90
154.00	.96566	.00174	250.00
155.00	.96902	.00156	249.90
156.00	.96878	.00069	250.00
157.00	.97039	.00174	250.00
158.00	.97226	.00168	250.00
159.00	.97375	.00131	250.00
160.00	.97487	.00112	250.00
161.00	.97599	.00112	250.00
162.00	.97711	.00112	250.00
163.00	.97823	.00093	250.00
164.00	.97898	.00118	250.00
165.00	.98060	.00112	250.00
166.00	.98122	.00075	250.00
167.00	.98209	.00075	250.00
168.00	.98271	.00081	250.00
169.00	.98371	.00106	250.00
170.00	.98483	.00087	250.00
171.00	.98545	.00068	250.00
172.00	.98619	.00062	250.00
173.00	.98669	.00068	250.00
174.00	.98756	.00075	250.00
175.00	.98819	.00050	250.00
176.00	.98856	-.00143	250.00
177.00	.98533	.00044	250.20
178.00	.98943	.00230	250.00
179.00	.98993	.00037	250.00
180.00	.99018	-.00137	250.00
181.00	.98720	.00025	250.20
182.00	.99067	.00025	250.00
183.00	.98769	-.00143	250.20
184.00	.98782	.00025	250.20
185.00	.98819	.00031	250.20
186.00	.98844	.00019	250.20
187.00	.98856	.00037	250.20
188.00	.98919	.00031	250.20
189.00	.98919	.00193	250.20
190.00	.99304	.00193	250.00
191.00	.99304	.00012	250.00
192.00	.99329	.00000	250.00
193.00	.99304	.00006	250.00
194.00	.99341	.00031	250.00
195.00	.99366	.00012	250.00
196.00	.99366	.00006	250.00
197.00	.99378	.00019	250.00
198.00	.99403	.00025	250.00
199.00	.99428	.00037	250.00

NORMALIZED DATA FROM RUN 29 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
200.00	.99478	.00031	250.00
201.00	.99490	.00006	250.00
202.00	.99490	.00006	250.00
203.00	.99503	.00012	250.00
204.00	.99515	.00019	250.00
205.00	.99540	.00025	250.00
206.00	.99565	.00019	250.00
207.00	.99578	.00006	250.00
208.00	.99578	.00106	250.00
209.00	.99789	.00106	249.90
210.00	.99789	.00093	249.90
211.00	.99975	.00019	249.80
212.00	.99826	.00012	249.90
213.00	1.00000	.00000	249.80

NORMALIZED DATA FROM RUN 30

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00113	250.70
1.00	.00225	.00185	250.60
2.00	.00369	.00126	250.60
3.00	.00477	.00132	250.60
4.00	.00633	.00244	250.60
5.00	.00965	.00144	250.50
6.00	.00921	.00050	250.60
7.00	.01065	.00174	250.60
8.00	.01269	.00192	250.60
9.00	.01449	.00186	250.60
10.00	.01641	.00292	250.60
11.00	.02033	.00298	250.50
12.00	.02237	.00210	250.50
13.00	.02453	.00234	250.50
14.00	.02705	.00246	250.50
15.00	.02945	.00276	250.50
16.00	.03256	.00312	250.50
17.00	.03568	.00288	250.50
18.00	.03832	.00282	250.50
19.00	.04132	.00418	250.50
20.00	.04668	.00418	250.40
21.00	.04968	.00266	250.40
22.00	.05199	.00390	250.50
23.00	.05748	.00508	250.40
24.00	.06215	.00432	250.40
25.00	.06611	.00450	250.40
26.00	.07115	.00568	250.40
27.00	.07747	.00492	250.30
28.00	.08098	.00416	250.40
29.00	.08578	.00540	250.40
30.00	.09178	.00564	250.40
31.00	.09706	.00570	250.40
32.00	.10317	.00600	250.40
33.00	.10905	.00606	250.40
34.00	.11529	.00642	250.40
35.00	.12189	.00760	250.40
36.00	.13049	.00672	250.30
37.00	.13532	.00620	250.40
38.00	.14288	.00832	250.40
39.00	.15196	.00850	250.30
40.00	.15987	.00780	250.30
41.00	.16755	.00874	250.30
42.00	.17735	.00904	250.20
43.00	.18562	.01022	250.20
44.00	.19778	.00864	250.00
45.00	.20289	.00864	250.20
46.00	.21505	.01064	250.00
47.00	.22417	.00954	250.00
48.00	.23412	.01002	250.00
49.00	.24420	.00825	250.00

NORMALIZED DATA FROM RUN 30 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.25063	.01020	250.20
51.00	.26459	.01190	250.00
52.00	.27443	.01050	250.00
53.00	.28558	.01091	250.00
54.00	.29626	.01138	250.00
55.00	.30833	.01162	249.90
56.00	.31949	.01103	249.90
57.00	.33040	.01121	249.90
58.00	.34192	.01103	249.90
59.00	.35247	.01085	249.90
60.00	.36363	.01215	249.90
61.00	.37678	.01221	249.80
62.00	.38806	.01109	249.80
63.00	.39897	.01080	249.80
64.00	.40965	.01173	249.80
65.00	.42244	.01109	249.70
66.00	.43184	.01004	249.80
67.00	.44251	.01085	249.80
68.00	.45355	.01109	249.80
69.00	.46470	.01027	249.80
70.00	.47409	.01157	249.90
71.00	.48785	.01251	249.80
72.00	.49912	.01163	249.80
73.00	.51112	.01187	249.80
74.00	.52287	.01145	249.80
75.00	.53403	.01063	249.80
76.00	.54414	.01097	249.90
77.00	.55598	.01198	249.80
78.00	.56809	.01169	249.80
79.00	.57937	.01045	249.80
80.00	.58900	.01209	249.90
81.00	.60356	.01215	249.70
82.00	.61331	.01069	249.80
83.00	.62495	.01121	249.80
84.00	.63574	.01103	249.80
85.00	.64702	.01115	249.80
86.00	.65805	.01209	249.80
87.00	.67121	.01068	249.70
88.00	.67940	.00962	249.80
89.00	.69044	.01056	249.80
90.00	.70051	.01014	249.80
91.00	.71071	.01002	249.80
92.00	.72054	.00972	249.80
93.00	.73014	.00920	249.80
94.00	.73893	.01014	249.90
95.00	.75041	.00972	249.80
96.00	.75836	.00942	249.90
97.00	.76924	.00946	249.80
98.00	.77728	.00828	249.80
99.00	.78579	.00840	249.80

NORMALIZED DATA FROM RUN 30 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.79407	.00792	249.80
101.00	.80162	.00868	249.80
102.00	.81142	.00910	249.70
103.00	.81982	.00762	249.70
104.00	.82665	.00708	249.70
105.00	.83397	.00656	249.70
106.00	.83977	.00614	249.80
107.00	.84624	.00666	249.80
108.00	.85308	.00654	249.80
109.00	.85932	.00654	249.80
110.00	.86615	.00630	249.80
111.00	.87191	.00618	249.80
112.00	.87851	.00694	249.80
113.00	.88579	.00564	249.70
114.00	.88978	.00582	249.80
115.00	.89742	.00570	249.70
116.00	.90118	.00446	249.80
117.00	.90634	.00480	249.80
118.00	.91077	.00586	249.80
119.00	.91805	.00480	249.70
120.00	.92037	.00374	249.80
121.00	.92553	.00468	249.80
122.00	.92972	.00402	249.80
123.00	.93356	.00320	249.80
124.00	.93612	.00320	249.90
125.00	.93996	.00266	249.90
126.00	.94144	.00384	250.00
127.00	.94764	.00454	249.90
128.00	.95051	.00324	249.90
129.00	.95411	.00324	249.90
130.00	.95699	.00318	249.90
131.00	.96047	.00200	249.90
132.00	.96099	.00258	250.00
133.00	.96563	.00340	249.90
134.00	.96779	.00366	249.90
135.00	.97294	.00290	249.90
136.00	.97358	.00216	250.00
137.00	.97726	.00198	249.90
138.00	.97754	.00204	250.00
139.00	.98134	.00192	249.90
140.00	.98138	.00198	250.00
141.00	.98530	.00186	249.90
142.00	.98510	.00044	250.00
143.00	.98618	.00120	250.00
144.00	.98750	.00150	250.00
145.00	.98917	.00132	250.00
146.00	.99013	-.00080	250.00
147.00	.98757	-.00150	250.20
148.00	.98713	.00044	250.30
149.00	.98845	.00020	250.30

NORMALIZED DATA FROM RUN 30 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
150.00	.98753	.00090	250.40
151.00	.99025	.00102	250.30
152.00	.98956	.00096	250.40
153.00	.99217	.00078	250.30
154.00	.99112	.00054	250.40
155.00	.99325	-.00034	250.30
156.00	.99044	-.00016	250.50
157.00	.99292	.00060	250.40
158.00	.99164	.00036	250.50
159.00	.99364	-.00040	250.40
160.00	.99084	.00066	250.60
161.00	.99496	.00142	250.40
162.00	.99368	.00048	250.50
163.00	.99592	-.00046	250.40
164.00	.99276	.00030	250.60
165.00	.99652	.00030	250.40
166.00	.99336	.00036	250.60
167.00	.99724	.00024	250.40
168.00	.99384	.00030	250.60
169.00	.99784	.00118	250.40
170.00	.99620	.00012	250.50
171.00	.99808	.00106	250.40
172.00	.99832	.00018	250.40
173.00	.99844	-.00070	250.40
174.00	.99692	.00030	250.50
175.00	.99904	-.00046	250.40
176.00	.99599	.00048	250.60
177.00	1.00000	.00118	250.40

NORMALIZED DATA FROM RUN 31

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00022	251.00
1.00	.00044	.00093	251.00
2.00	.00186	.00160	251.00
3.00	.00364	.00154	251.00
4.00	.00494	.00172	251.00
5.00	.00707	.00136	251.00
6.00	.00767	.00160	251.00
7.00	.01027	.00219	251.00
8.00	.01205	.00190	251.00
9.00	.01407	.00122	251.00
10.00	.01449	.00152	251.10
11.00	.01710	.00261	251.10
12.00	.01971	.00261	251.10
13.00	.02231	.00278	251.10
14.00	.02528	.00284	251.10
15.00	.02800	.00235	251.10
16.00	.02997	.00247	251.20
17.00	.03293	.00405	251.20
18.00	.03807	.00379	251.10
19.00	.04052	.00421	251.20
20.00	.04649	.00530	251.10
21.00	.05111	.00379	251.10
22.00	.05407	.00474	251.10
23.00	.06059	.00648	251.10
24.00	.06703	.00589	251.00
25.00	.07236	.00551	251.00
26.00	.07805	.00587	251.00
27.00	.08409	.00598	251.00
28.00	.09002	.00622	251.00
29.00	.09653	.00658	251.00
30.00	.10317	.00687	251.00
31.00	.11028	.00711	251.00
32.00	.11739	.00741	251.00
33.00	.12509	.00782	251.00
34.00	.13303	.00800	251.00
35.00	.14108	.00835	251.00
36.00	.14973	.00877	251.00
37.00	.15862	.00871	251.00
38.00	.16715	.00912	251.00
39.00	.17687	.01027	251.00
40.00	.18769	.01009	250.90
41.00	.19705	.00954	250.90
42.00	.20677	.00978	250.90
43.00	.21660	.01001	250.90
44.00	.22679	.01025	250.90
45.00	.23710	.01049	250.90
46.00	.24777	.01043	250.90
47.00	.25796	.01049	250.90
48.00	.26874	.01243	250.90
49.00	.28281	.01334	250.70

NORMALIZED DATA FROM RUN 31 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
50.00	.29541	.01187	250.60
51.00	.30655	.01120	250.60
52.00	.31781	.01070	250.60
53.00	.32795	.01126	250.70
54.00	.34032	.01229	250.60
55.00	.35252	.01203	250.60
56.00	.36437	.01185	250.60
57.00	.37622	.01276	250.60
58.00	.38989	.01306	250.50
59.00	.40233	.01335	250.50
60.00	.41659	.01420	250.40
61.00	.43073	.01341	250.30
62.00	.44341	.01274	250.30
63.00	.45621	.01268	250.30
64.00	.46877	.01256	250.30
65.00	.48133	.01268	250.30
66.00	.49412	.01286	250.30
67.00	.50704	.01280	250.30
68.00	.51972	.01292	250.30
69.00	.53287	.01333	250.30
70.00	.54638	.01333	250.30
71.00	.55953	.01315	250.30
72.00	.57268	.01268	250.30
73.00	.58489	.01244	250.30
74.00	.59756	.01274	250.30
75.00	.61036	.01341	250.30
76.00	.62438	.01244	250.20
77.00	.63524	.01153	250.30
78.00	.64745	.01167	250.30
79.00	.65858	.01155	250.30
80.00	.67055	.01143	250.30
81.00	.68145	.01193	250.30
82.00	.69441	.01126	250.20
83.00	.70396	.00993	250.30
84.00	.71427	.01110	250.30
85.00	.72616	.01128	250.20
86.00	.73683	.01049	250.20
87.00	.74714	.01025	250.20
88.00	.75733	.01195	250.20
89.00	.77103	.01189	250.00
90.00	.78111	.00813	250.00
91.00	.78730	.00790	250.20
92.00	.79690	.01082	250.20
93.00	.80895	.00889	250.00
94.00	.81467	.00918	250.20
95.00	.82732	.00901	250.00
96.00	.83268	.00871	250.20
97.00	.84473	.01017	250.00
98.00	.85303	.00806	250.00
99.00	.86085	.00794	250.00

NORMALIZED DATA FROM RUN 31 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
100.00	.86890	.00571	250.00
101.00	.87226	.00541	250.20
102.00	.87972	.00887	250.20
103.00	.89000	.00632	250.00
104.00	.89236	.00438	250.30
105.00	.89876	.00555	250.30
106.00	.90346	.00549	250.40
107.00	.90974	.00616	250.40
108.00	.91578	.00496	250.40
109.00	.91965	.00575	250.50
110.00	.92727	.00600	250.40
111.00	.93166	.00474	250.40
112.00	.93675	.00492	250.40
113.00	.94149	.00468	250.40
114.00	.94611	.00359	250.40
115.00	.94868	.00245	250.50
116.00	.95100	.00233	250.60
117.00	.95333	.00306	250.70
118.00	.95712	.00276	250.70
119.00	.95885	.00247	250.80
120.00	.96205	.00235	250.80
121.00	.96355	.00193	250.90
122.00	.96592	.00255	250.90
123.00	.96865	.00284	250.90
124.00	.97161	.00243	250.90
125.00	.97350	.00213	250.90
126.00	.97587	.00190	250.90
127.00	.97729	.00154	250.90
128.00	.97895	.00166	250.90
129.00	.98061	.00178	250.90
130.00	.98251	.00160	250.90
131.00	.98381	.00142	250.90
132.00	.98535	.00087	250.90
133.00	.98554	.00098	251.00
134.00	.98732	.00130	251.00
135.00	.98815	.00089	251.00
136.00	.98910	.00101	251.00
137.00	.99017	.00101	251.00
138.00	.99111	.00089	251.00
139.00	.99194	.00083	251.00
140.00	.99277	-.00008	251.00
141.00	.99178	-.00014	251.10
142.00	.99249	.00065	251.10
143.00	.99308	.00071	251.10
144.00	.99391	.00059	251.10
145.00	.99427	.00036	251.10
146.00	.99462	.00065	251.10
147.00	.99557	.00053	251.10
148.00	.99569	.00030	251.10
149.00	.99616	.00121	251.10

NORMALIZED DATA FROM RUN 31 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
150.00	.99810	.00018	251.00
151.00	.99652	.00018	251.10
152.00	.99846	.00103	251.00
153.00	.99858	-.00061	251.00
154.00	.99723	-.00032	251.10
155.00	.99794	.00133	251.10
156.00	.99988	.00103	251.00
157.00	1.00000	-.00056	251.00

NORMALIZED DATA FROM RUN 32

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00178	251.10
1.00	.00357	.00281	251.00
2.00	.00563	.00200	251.00
3.00	.00757	.00200	251.00
4.00	.00963	.00212	251.00
5.00	.01181	.00255	251.00
6.00	.01473	.00291	251.00
7.00	.01764	.00273	251.00
8.00	.02019	.00279	251.00
9.00	.02322	.00315	251.00
10.00	.02649	.00411	251.00
11.00	.03144	.00417	250.90
12.00	.03484	.00334	250.90
13.00	.03811	.00274	250.90
14.00	.04032	.00292	251.00
15.00	.04396	.00388	251.00
16.00	.04809	.00419	251.00
17.00	.05233	.00443	251.00
18.00	.05694	.00437	251.00
19.00	.06107	.00461	251.00
20.00	.06616	.00581	251.00
21.00	.07269	.00569	250.90
22.00	.07754	.00479	250.90
23.00	.08227	.00426	250.90
24.00	.08606	.00546	251.00
25.00	.09319	.00528	250.90
26.00	.09661	.00564	251.00
27.00	.10447	.00594	250.90
28.00	.10850	.00594	251.00
29.00	.11636	.00588	250.90
30.00	.12027	.00613	251.00
31.00	.12861	.00564	250.90
32.00	.13155	.00564	251.00
33.00	.13989	.00708	250.90
34.00	.14572	.00619	250.90
35.00	.15227	.00649	250.90
36.00	.15870	.00637	250.90
37.00	.16500	.00655	250.90
38.00	.17180	.00679	250.90
39.00	.17859	.00685	250.90
40.00	.18551	.00679	250.90
41.00	.19218	.00643	250.90
42.00	.19837	.00698	250.90
43.00	.20613	.00746	250.90
44.00	.21329	.00728	250.90
45.00	.22069	.00728	250.90
46.00	.22784	.00752	250.90
47.00	.23573	.00770	250.90
48.00	.24325	.00758	250.90
49.00	.25089	.00782	250.90

NORMALIZED DATA FROM RUN 32 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
50.00	.25890	.00795	250.90
51.00	.26678	.00801	250.90
52.00	.27491	.00902	250.90
53.00	.28483	.00825	250.80
54.00	.29141	.00837	250.90
55.00	.30157	.00933	250.80
56.00	.31007	.00873	250.80
57.00	.31904	.00849	250.80
58.00	.32705	.00933	250.80
59.00	.33770	.00957	250.70
60.00	.34619	.00867	250.70
61.00	.35505	.00892	250.70
62.00	.36402	.00904	250.70
63.00	.37312	.00922	250.70
64.00	.38246	.01036	250.70
65.00	.39384	.01036	250.60
66.00	.40318	.00940	250.60
67.00	.41264	.00946	250.60
68.00	.42211	.00850	250.60
69.00	.42965	.00881	250.70
70.00	.43972	.00899	250.70
71.00	.44763	.00934	250.80
72.00	.45840	.00922	250.70
73.00	.46607	.00863	250.80
74.00	.47565	.01018	250.80
75.00	.48643	.00904	250.70
76.00	.49373	.00850	250.80
77.00	.50343	.00977	250.80
78.00	.51326	.00958	250.80
79.00	.52260	.01000	250.80
80.00	.53325	.00951	250.70
81.00	.54162	.00843	250.70
82.00	.55011	.00939	250.70
83.00	.56040	.00957	250.60
84.00	.56925	.00957	250.60
85.00	.57954	.00951	250.50
86.00	.58827	.00831	250.50
87.00	.59616	.00819	250.50
88.00	.60465	.00957	250.50
89.00	.61530	.00945	250.40
90.00	.62355	.00735	250.40
91.00	.63000	.00747	250.50
92.00	.63850	.00849	250.50
93.00	.64699	.00837	250.50
94.00	.65524	.00915	250.50
95.00	.66528	.00890	250.40
96.00	.67304	.00795	250.40
97.00	.68117	.00705	250.40
98.00	.68714	.00776	250.50
99.00	.69670	.00866	250.40

NORMALIZED DATA FROM RUN 32 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
100.00	.70446	.00789	250.40
101.00	.71247	.00801	250.40
102.00	.72047	.00728	250.40
103.00	.72702	.00734	250.40
104.00	.73515	.00776	250.40
105.00	.74255	.00716	250.40
106.00	.74947	.00673	250.40
107.00	.75602	.00578	250.40
108.00	.76102	.00643	250.50
109.00	.76888	.00685	250.40
110.00	.77473	.00644	250.50
111.00	.78176	.00565	250.50
112.00	.78604	.00637	250.60
113.00	.79450	.00649	250.50
114.00	.79902	.00643	250.60
115.00	.80736	.00631	250.50
116.00	.81163	.00678	250.60
117.00	.82092	.00576	250.40
118.00	.82316	.00487	250.60
119.00	.83065	.00546	250.50
120.00	.83407	.00540	250.60
121.00	.84145	.00546	250.50
122.00	.84499	.00474	250.60
123.00	.85094	.00456	250.60
124.00	.85412	.00402	250.70
125.00	.85897	.00396	250.70
126.00	.86203	.00396	250.80
127.00	.86688	.00383	250.80
128.00	.86970	.00359	250.90
129.00	.87406	.00431	250.90
130.00	.87831	.00437	250.90
131.00	.88280	.00431	250.90
132.00	.88692	.00406	250.90
133.00	.89092	.00400	250.90
134.00	.89493	.00472	250.90
135.00	.90036	.00454	250.80
136.00	.90400	.00286	250.80
137.00	.90609	.00280	250.90
138.00	.90961	.00328	250.90
139.00	.91264	.00309	250.90
140.00	.91579	.00309	250.90
141.00	.91883	.00297	250.90
142.00	.92174	.00279	250.90
143.00	.92441	.00291	250.90
144.00	.92756	.00291	250.90
145.00	.93023	.00243	250.90
146.00	.93241	.00249	250.90
147.00	.93520	.00285	250.90
148.00	.93811	.00218	250.90
149.00	.93957	.00200	250.90

NORMALIZED DATA FROM RUN 32 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
150.00	.94212	.00237	250.90
151.00	.94430	.00230	250.90
152.00	.94673	.00296	250.90
153.00	.95022	.00260	250.80
154.00	.95192	.00194	250.80
155.00	.95410	.00194	250.80
156.00	.95580	.00176	250.80
157.00	.95762	.00182	250.80
158.00	.95944	.00164	250.80
159.00	.96090	.00176	250.80
160.00	.96296	.00349	250.80
161.00	.96788	.00146	250.60
162.00	.96587	.00062	250.80
163.00	.96912	.00133	250.70
164.00	.96854	.00127	250.80
165.00	.97167	.00307	250.70
166.00	.97467	.00115	250.60
167.00	.97397	.00013	250.70
168.00	.97494	.00211	250.70
169.00	.97819	.00109	250.60
170.00	.97713	.00001	250.70
171.00	.97822	.00026	250.70
172.00	.97764	.00205	250.80
173.00	.98232	.00091	250.60
174.00	.97946	.00001	250.80
175.00	.98234	.00187	250.70
176.00	.98319	.00079	250.70
177.00	.98392	-.00017	250.70
178.00	.98285	.00055	250.80
179.00	.98501	.00138	250.70
180.00	.98562	.00061	250.70
181.00	.98622	.00085	250.70
182.00	.98732	.00055	250.70
183.00	.98732	.00030	250.70
184.00	.98792	.00061	250.70
185.00	.98853	-.00047	250.70
186.00	.98698	.00036	250.80
187.00	.98926	.00049	250.70
188.00	.98795	.00042	250.80
189.00	.99011	.00055	250.70
190.00	.98904	.00049	250.80
191.00	.99108	-.00059	250.70
192.00	.98785	.00030	250.90
193.00	.99168	.00114	250.70
194.00	.99013	.00036	250.80
195.00	.99241	.00042	250.70
196.00	.99098	.00042	250.80
197.00	.99326	-.00053	250.70
198.00	.98991	-.00072	250.90
199.00	.99183	.00108	250.80

NORMALIZED DATA FROM RUN 32 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
200.00	.99207	.00042	250.80
201.00	.99268	-.00053	250.80
202.00	.99101	.00012	250.90
203.00	.99292	.00006	250.80
204.00	.99113	.00090	250.90
205.00	.99472	.00012	250.70
206.00	.99137	.00024	250.90
207.00	.99520	.00114	250.70
208.00	.99365	.00024	250.80
209.00	.99569	-.00078	250.70
210.00	.99210	.00000	250.90
211.00	.99569	.00090	250.70
212.00	.99389	.00000	250.80
213.00	.99569	.00096	250.70
214.00	.99581	.00006	250.70
215.00	.99581	-.00084	250.70
216.00	.99413	.00012	250.80
217.00	.99605	.00108	250.70
218.00	.99629	.00198	250.70
219.00	1.00000	.00185	250.50

NORMALIZED DATA FROM RUN 33

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00013	250.60
2.00	.00051	.00016	250.50
4.00	.00063	.00015	250.50
6.00	.00111	.00015	250.50
8.00	.00124	.00030	250.50
10.00	.00233	.00093	250.50
12.00	.00496	.00102	250.40
14.00	.00642	.00061	250.40
16.00	.00739	.00070	250.40
18.00	.00922	.00085	250.40
20.00	.01080	.00067	250.40
22.00	.01189	.00088	250.40
24.00	.01432	.00103	250.40
26.00	.01603	.00103	250.40
28.00	.01846	.00106	250.40
30.00	.02028	.00116	250.40
32.00	.02308	.00131	250.40
34.00	.02551	.00131	250.40
36.00	.02831	.00146	250.40
38.00	.03135	.00146	250.40
40.00	.03415	.00152	250.40
42.00	.03743	.00176	250.40
44.00	.04120	.00176	250.40
46.00	.04449	.00173	250.40
48.00	.04813	.00185	250.40
50.00	.05190	.00198	250.40
52.00	.05604	.00204	250.40
54.00	.06005	.00213	250.40
56.00	.06455	.00225	250.40
58.00	.06905	.00219	250.40
60.00	.07331	.00237	250.40
62.00	.07854	.00252	250.40
64.00	.08340	.00258	250.40
66.00	.08888	.00274	250.40
68.00	.09435	.00261	250.40
70.00	.09934	.00246	250.40
72.00	.10420	.00243	250.40
74.00	.10907	.00249	250.40
76.00	.11417	.00240	250.40
78.00	.11867	.00274	250.40
80.00	.12512	.00286	250.40
82.00	.13011	.00249	250.40
84.00	.13509	.00243	250.40
86.00	.13984	.00237	250.40
88.00	.14458	.00249	250.40
90.00	.14981	.00249	250.40
92.00	.15455	.00231	250.40
94.00	.15905	.00249	250.40
96.00	.16452	.00240	250.40
98.00	.16866	.00231	250.40

NORMALIZED DATA FROM RUN 33 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.17377	.00249	250.40
102.00	.17863	.00219	250.40
104.00	.18252	.00216	250.40
106.00	.18727	.00219	250.40
108.00	.19128	.00168	250.40
110.00	.19400	.00174	250.50
112.00	.19826	.00213	250.50
114.00	.20252	.00213	250.50
116.00	.20677	.00225	250.50
118.00	.21152	.00216	250.50
120.00	.21541	.00189	250.50
122.00	.21906	.00198	250.50
124.00	.22331	.00216	250.50
126.00	.22769	.00231	250.50
128.00	.23256	.00225	250.50
130.00	.23669	.00204	250.50
132.00	.24070	.00219	250.50
134.00	.24545	.00237	250.50
136.00	.25019	.00225	250.50
138.00	.25445	.00222	250.50
140.00	.25907	.00222	250.50
142.00	.26333	.00216	250.50
144.00	.26770	.00231	250.50
146.00	.27257	.00243	250.50
148.00	.27743	.00216	250.50
150.00	.28120	.00219	250.50
152.00	.28619	.00237	250.50
154.00	.29069	.00234	250.50
156.00	.29555	.00210	250.50
158.00	.29908	.00225	250.50
160.00	.30455	.00243	250.50
162.00	.30881	.00216	250.50
164.00	.31319	.00222	250.50
166.00	.31769	.00225	250.50
168.00	.32219	.00210	250.50
170.00	.32608	.00243	250.50
172.00	.33192	.00237	250.50
174.00	.33557	.00219	250.50
176.00	.34068	.00231	250.50
178.00	.34481	.00222	250.50
180.00	.34955	.00234	250.50
182.00	.35418	.00225	250.50
184.00	.35855	.00243	250.50
186.00	.36390	.00261	250.50
188.00	.36901	.00243	250.50
190.00	.37363	.00243	250.50
192.00	.37874	.00237	250.50
194.00	.38312	.00231	250.50
196.00	.38799	.00234	250.50
198.00	.39249	.00219	250.50

NORMALIZED DATA FROM RUN 33 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
200.00	.39674	.00225	250.50
202.00	.40149	.00246	250.50
204.00	.40659	.00246	250.50
206.00	.41134	.00246	250.50
208.00	.41644	.00252	250.50
210.00	.42143	.00234	250.50
212.00	.42581	.00225	250.50
214.00	.43043	.00240	250.50
216.00	.43542	.00243	250.50
218.00	.44016	.00240	250.50
220.00	.44502	.00237	250.50
222.00	.44965	.00240	250.50
224.00	.45463	.00243	250.50
226.00	.45938	.00243	250.50
228.00	.46436	.00271	250.50
230.00	.47020	.00277	250.50
232.00	.47543	.00261	250.50
234.00	.48066	.00268	250.50
236.00	.48613	.00271	250.50
238.00	.49148	.00280	250.50
240.00	.49732	.00280	250.50
242.00	.50267	.00265	250.50
244.00	.50790	.00280	250.50
246.00	.51386	.00274	250.50
248.00	.51885	.00265	250.50
250.00	.52444	.00289	250.50
252.00	.53040	.00268	250.50
254.00	.53514	.00261	250.50
256.00	.54086	.00307	250.50
258.00	.54743	.00316	250.50
260.00	.55351	.00289	250.50
262.00	.55898	.00286	250.50
264.00	.56494	.00307	250.50
266.00	.57127	.00316	250.50
268.00	.57759	.00313	250.50
270.00	.58379	.00313	250.50
272.00	.59012	.00313	250.50
274.00	.59632	.00319	250.50
276.00	.60289	.00337	250.50
278.00	.60982	.00325	250.50
280.00	.61590	.00337	250.50
282.00	.62332	.00347	250.50
284.00	.62976	.00337	250.50
286.00	.63682	.00368	250.50
288.00	.64448	.00365	250.50
290.00	.65141	.00362	250.50
292.00	.65895	.00415	250.50
294.00	.66803	.00463	250.40
296.00	.67747	.00457	250.30
298.00	.68630	.00403	250.20

NORMALIZED DATA FROM RUN 33 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
300.00	.69359	.00395	250.20
302.00	.70211	.00401	250.20
304.00	.70965	.00392	250.20
306.00	.71780	.00410	250.20
308.00	.72607	.00410	250.20
310.00	.73421	.00423	250.20
312.00	.74297	.00441	250.20
314.00	.75185	.00438	250.20
316.00	.76048	.00438	250.20
318.00	.76936	.00468	250.20
320.00	.77921	.00486	250.20
322.00	.78882	.00462	250.20
324.00	.79770	.00444	250.20
326.00	.80658	.00450	250.20
328.00	.81570	.00447	250.20
330.00	.82446	.00432	250.20
332.00	.83297	.00407	250.20
334.00	.84075	.00401	250.20
336.00	.84902	.00398	250.20
338.00	.85669	.00374	250.20
340.00	.86398	.00374	250.20
342.00	.87164	.00339	250.20
344.00	.87753	.00305	250.30
346.00	.88385	.00331	250.30
348.00	.89079	.00337	250.30
350.00	.89735	.00313	250.30
352.00	.90331	.00292	250.30
354.00	.90903	.00283	250.30
356.00	.91462	.00268	250.30
358.00	.91973	.00249	250.30
360.00	.92460	.00234	250.30
362.00	.92910	.00204	250.30
364.00	.93274	.00210	250.30
366.00	.93749	.00213	250.30
368.00	.94126	.00192	250.30
370.00	.94515	.00182	250.30
372.00	.94856	.00170	250.30
374.00	.95196	.00170	250.30
376.00	.95537	.00158	250.30
378.00	.95828	.00140	250.30
380.00	.96096	.00131	250.30
382.00	.96351	.00131	250.30
384.00	.96619	.00149	250.30
386.00	.96947	.00134	250.30
388.00	.97154	.00119	250.30
390.00	.97422	.00128	250.30
392.00	.97665	.00125	250.30
394.00	.97920	.00116	250.30
396.00	.98127	.00103	250.30
398.00	.98334	.00091	250.30

NORMALIZED DATA FROM RUN 33 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
400.00	.98492	.00088	250.30
402.00	.98687	.00076	250.30
404.00	.98796	.00055	250.30
406.00	.98905	.00061	250.30
408.00	.99039	.00067	250.30
410.00	.99173	.00052	250.30
412.00	.99246	.00052	250.30
414.00	.99380	.00046	250.30
416.00	.99428	.00033	250.30
418.00	.99514	.00043	250.30
420.00	.99599	.00033	250.30
422.00	.99647	.00033	250.30
424.00	.99732	.00024	250.30
426.00	.99745	.00006	250.30
428.00	.99757	.00015	250.30
430.00	.99805	.00021	250.30
432.00	.99842	.00015	250.30
434.00	.99866	.00009	250.30
436.00	.99878	.00006	250.30
438.00	.99891	.00003	250.30
440.00	.99891	.00003	250.30
442.00	.99903	.00000	250.30
444.00	.99891	.00000	250.30
446.00	.99903	.00003	250.30
448.00	.99903	.00003	250.30
450.00	.99915	.00009	250.30
452.00	.99939	.00009	250.30
454.00	.99951	.00009	250.30
456.00	.99976	.00012	250.30
458.00	1.00000	.00006	250.30

NORMALIZED DATA FROM RUN 34

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00099	250.60
1.00	.00198	.00164	250.60
2.00	.00328	.00178	250.60
3.00	.00553	.00225	250.60
4.00	.00779	.00213	250.60
5.00	.00980	.00207	250.60
6.00	.01193	.00219	250.60
7.00	.01419	.00302	250.60
8.00	.01798	.00332	250.60
9.00	.02083	.00296	250.60
10.00	.02391	.00332	250.60
11.00	.02747	.00350	250.60
12.00	.03091	.00368	250.60
13.00	.03482	.00427	250.60
14.00	.03944	.00456	250.60
15.00	.04395	.00451	250.60
16.00	.04845	.00474	250.60
17.00	.05343	.00534	250.60
18.00	.05912	.00557	250.60
19.00	.06458	.00557	250.60
20.00	.07027	.00611	250.60
21.00	.07679	.00640	250.60
22.00	.08307	.00658	250.60
23.00	.08995	.00664	250.60
24.00	.09635	.00676	250.60
25.00	.10347	.00771	250.60
26.00	.11177	.00824	250.60
27.00	.11995	.00830	250.60
28.00	.12836	.00830	250.60
29.00	.13654	.00854	250.60
30.00	.14544	.00889	250.60
31.00	.15433	.00919	250.60
32.00	.16381	.00949	250.60
33.00	.17330	.00984	250.60
34.00	.18350	.01172	250.60
35.00	.19675	.01214	250.40
36.00	.20777	.01103	250.40
37.00	.21880	.01097	250.40
38.00	.22971	.01097	250.40
39.00	.24073	.01126	250.40
40.00	.25224	.01180	250.40
41.00	.26433	.01197	250.40
42.00	.27619	.01321	250.40
43.00	.29075	.01339	250.30
44.00	.30297	.01503	250.30
45.00	.32082	.01533	250.00
46.00	.33363	.01286	250.00
47.00	.34655	.01298	250.00
48.00	.35959	.01275	250.00
49.00	.37204	.01275	250.00

NORMALIZED DATA FROM RUN 34 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.38508	.01304	250.00
51.00	.39813	.01269	250.00
52.00	.41046	.01357	250.00
53.00	.42526	.01339	249.90
54.00	.43723	.01239	249.90
55.00	.45004	.01280	249.90
56.00	.46284	.01251	249.90
57.00	.47506	.01292	249.90
58.00	.48869	.01328	249.90
59.00	.50161	.01304	249.90
60.00	.51478	.01304	249.90
61.00	.52770	.01286	249.90
62.00	.54050	.01280	249.90
63.00	.55331	.01316	249.90
64.00	.56682	.01322	249.90
65.00	.57975	.01251	249.90
66.00	.59184	.01239	249.90
67.00	.60453	.01263	249.90
68.00	.61710	.01215	249.90
69.00	.62883	.01227	249.90
70.00	.64164	.01275	249.90
71.00	.65432	.01251	249.90
72.00	.66666	.01186	249.90
73.00	.67804	.01162	249.90
74.00	.68989	.01168	249.90
75.00	.70139	.01180	249.90
76.00	.71349	.01144	249.90
77.00	.72428	.01061	249.90
78.00	.73471	.01073	249.90
79.00	.74574	.01079	249.90
80.00	.75629	.01049	249.90
81.00	.76672	.01008	249.90
82.00	.77644	.00978	249.90
83.00	.78629	.00966	249.90
84.00	.79577	.00943	249.90
85.00	.80514	.00889	249.90
86.00	.81356	.00848	249.90
87.00	.82209	.00848	249.90
88.00	.83051	.00830	249.90
89.00	.83869	.00806	249.90
90.00	.84663	.00771	249.90
91.00	.85410	.00747	249.90
92.00	.86157	.00723	249.90
93.00	.86857	.00717	249.90
94.00	.87592	.00682	249.90
95.00	.88220	.00646	249.90
96.00	.88884	.00676	249.90
97.00	.89572	.00622	249.90
98.00	.90129	.00581	249.90
99.00	.90734	.00599	249.90

NORMALIZED DATA FROM RUN 34 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.91327	.00563	249.90
101.00	.91860	.00516	249.90
102.00	.92358	.00498	249.90
103.00	.92856	.00486	249.90
104.00	.93330	.00486	249.90
105.00	.93828	.00462	249.90
106.00	.94255	.00415	249.90
107.00	.94658	.00409	249.90
108.00	.95073	.00409	249.90
109.00	.95476	.00385	249.90
110.00	.95844	.00373	249.90
111.00	.96223	.00226	249.90
112.00	.96296	.00196	250.00
113.00	.96616	.00320	250.00
114.00	.96936	.00285	250.00
115.00	.97185	.00261	250.00
116.00	.97458	.00261	250.00
117.00	.97707	.00231	250.00
118.00	.97920	.00196	250.00
119.00	.98098	.00184	250.00
120.00	.98288	.00184	250.00
121.00	.98466	.00202	250.00
122.00	.98691	.00178	250.00
123.00	.98822	.00160	250.00
124.00	.99011	.00172	250.00
125.00	.99165	.00130	250.00
126.00	.99272	.00136	250.00
127.00	.99438	-.00152	250.00
128.00	.98968	-.00170	250.30
129.00	.99099	.00095	250.30
130.00	.99158	.00089	250.30
131.00	.99277	.00101	250.30
132.00	.99360	.00089	250.30
133.00	.99455	.00059	250.30
134.00	.99478	.00059	250.30
135.00	.99573	.00083	250.30
136.00	.99644	.00077	250.30
137.00	.99727	.00053	250.30
138.00	.99751	.00053	250.30
139.00	.99834	.00041	250.30
140.00	.99834	.00024	250.30
141.00	.99881	.00071	250.30
142.00	.99976	.00059	250.30
143.00	1.00000	-.00064	250.30

NORMALIZED DATA FROM RUN 35

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00204	249.90
1.00	.00407	.00281	249.80
2.00	.00562	.00167	249.80
3.00	.00742	.00203	249.80
4.00	.00969	.00227	249.80
5.00	.01196	.00239	249.80
6.00	.01447	.00251	249.80
7.00	.01698	.00281	249.80
8.00	.02008	.00293	249.80
9.00	.02283	.00293	249.80
10.00	.02594	.00323	249.80
11.00	.02929	.00353	249.80
12.00	.03299	.00364	249.80
13.00	.03658	.00376	249.80
14.00	.04052	.00406	249.80
15.00	.04470	.00424	249.80
16.00	.04901	.00436	249.80
17.00	.05343	.00448	249.80
18.00	.05797	.00478	249.80
19.00	.06299	.00514	249.80
20.00	.06825	.00520	249.80
21.00	.07338	.00590	249.80
22.00	.08004	.00590	249.70
23.00	.08518	.00532	249.70
24.00	.09068	.00580	249.70
25.00	.09677	.00615	249.70
26.00	.10299	.00615	249.70
27.00	.10908	.00703	249.70
28.00	.11705	.00727	249.60
29.00	.12363	.00687	249.60
30.00	.13080	.00711	249.60
31.00	.13785	.00681	249.60
32.00	.14442	.00769	249.60
33.00	.15323	.00811	249.50
34.00	.16064	.00735	249.50
35.00	.16793	.00735	249.50
36.00	.17534	.00759	249.50
37.00	.18310	.00771	249.50
38.00	.19075	.00771	249.50
39.00	.19852	.00813	249.50
40.00	.20700	.00825	249.50
41.00	.21501	.00819	249.50
42.00	.22338	.00843	249.50
43.00	.23186	.00860	249.50
44.00	.24059	.00890	249.50
45.00	.24967	.00890	249.50
46.00	.25839	.00920	249.50
47.00	.26807	.00920	249.50
48.00	.27680	.00914	249.50
49.00	.28636	.00968	249.50

NORMALIZED DATA FROM RUN 35 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.29616	.00956	249.50
51.00	.30548	.00962	249.50
52.00	.31540	.00986	249.50
53.00	.32520	.01050	249.50
54.00	.33639	.01104	249.40
55.00	.34727	.00998	249.40
56.00	.35635	.00968	249.40
57.00	.36663	.01062	249.40
58.00	.37759	.01092	249.30
59.00	.38846	.01070	249.30
60.00	.39898	.01076	249.30
61.00	.40997	.01076	249.30
62.00	.42049	.01076	249.30
63.00	.43148	.01070	249.30
64.00	.44188	.01082	249.30
65.00	.45311	.01187	249.30
66.00	.46563	.01127	249.20
67.00	.47566	.01052	249.20
68.00	.48666	.01076	249.20
69.00	.49717	.01110	249.20
70.00	.50885	.01127	249.10
71.00	.51972	.01034	249.10
72.00	.52952	.01098	249.10
73.00	.54168	.01145	249.00
74.00	.55243	.01010	249.00
75.00	.56187	.00968	249.00
76.00	.57179	.00980	249.00
77.00	.58147	.00980	249.00
78.00	.59139	.00962	249.00
79.00	.60071	.00968	249.00
80.00	.61075	.00974	249.00
81.00	.62019	.00974	249.00
82.00	.63023	.00962	249.00
83.00	.63943	.00980	249.00
84.00	.64983	.00998	249.00
85.00	.65939	.00956	249.00
86.00	.66895	.00938	249.00
87.00	.67815	.00932	249.00
88.00	.68759	.00908	249.00
89.00	.69632	.00926	249.00
90.00	.70612	.00956	249.00
91.00	.71544	.00932	249.00
92.00	.72476	.00932	249.00
93.00	.73408	.00902	249.00
94.00	.74280	.00878	249.00
95.00	.75165	.00878	249.00
96.00	.76037	.00866	249.00
97.00	.76898	.00854	249.00
98.00	.77746	.00848	249.00
99.00	.78595	.00860	249.00

NORMALIZED DATA FROM RUN 35 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
100.00	.79467	.00843	249.00
101.00	.80280	.00771	249.00
102.00	.81009	.00777	249.00
103.00	.81833	.00795	249.00
104.00	.82598	.00723	249.00
105.00	.83279	.00711	249.00
106.00	.84020	.00759	249.00
107.00	.84797	.00723	249.00
108.00	.85466	.00675	249.00
109.00	.86147	.00669	249.00
110.00	.86805	.00645	249.00
111.00	.87438	.00609	249.00
112.00	.88024	.00609	249.00
113.00	.88657	.00609	249.00
114.00	.89243	.00586	249.00
115.00	.89828	.00538	249.00
116.00	.90318	.00532	249.00
117.00	.90892	.00544	249.00
118.00	.91406	.00496	249.00
119.00	.91884	.00472	249.00
120.00	.92350	.00448	249.00
121.00	.92780	.00454	249.00
122.00	.93258	.00448	249.00
123.00	.93676	.00406	249.00
124.00	.94071	.00400	249.00
125.00	.94477	.00370	249.00
126.00	.94812	.00293	249.00
127.00	.95063	.00265	249.00
128.00	.95341	.00301	249.10
129.00	.95664	.00305	249.10
130.00	.95951	.00299	249.10
131.00	.96261	.00293	249.10
132.00	.96536	.00217	249.10
133.00	.96695	.00187	249.20
134.00	.96910	.00257	249.20
135.00	.97209	.00251	249.20
136.00	.97412	.00215	249.20
137.00	.97639	.00221	249.20
138.00	.97855	.00109	249.20
139.00	.97858	.00127	249.30
140.00	.98109	.00203	249.30
141.00	.98265	.00131	249.30
142.00	.98372	.00143	249.30
143.00	.98551	.00173	249.30
144.00	.98719	.00091	249.30
145.00	.98734	.00068	249.40
146.00	.98854	.00114	249.40
147.00	.98961	.00125	249.40
148.00	.99105	.00137	249.40
149.00	.99236	.00125	249.40

NORMALIZED DATA FROM RUN 35 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
150.00	.99356	.00026	249.40
151.00	.99288	.00020	249.50
152.00	.99395	.00060	249.50
153.00	.99407	.00042	249.50
154.00	.99479	.00084	249.50
155.00	.99575	.00090	249.50
156.00	.99658	.00008	249.50
157.00	.99590	.00014	249.60
158.00	.99686	.00060	249.60
159.00	.99710	.00030	249.60
160.00	.99745	-.00052	249.60
161.00	.99606	-.00022	249.70
162.00	.99701	.00066	249.70
163.00	.99737	.00042	249.70
164.00	.99785	.00036	249.70
165.00	.99809	.00030	249.70
166.00	.99845	.00042	249.70
167.00	.99892	.00042	249.70
168.00	.99928	.00018	249.70
169.00	.99928	.00030	249.70
170.00	.99988	.00030	249.70
171.00	.99988	.00006	249.70
172.00	1.00000	.00006	249.70

NORMALIZED DATA FROM RUN 36

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00081	247.00
1.00	.00162	.00172	247.30
2.00	.00345	.00643	247.90
3.00	.01449	.01091	248.00
4.00	.02528	.01546	248.30
5.00	.04541	.02191	248.30
6.00	.06909	.02608	248.30
7.00	.09757	.03253	248.30
8.00	.13414	.04162	248.20
9.00	.18080	.04775	247.80
10.00	.22965	.05401	247.60
11.00	.28882	.05523	247.00
12.00	.34012	.05455	247.00
13.00	.39792	.05584	246.70
14.00	.45180	.05412	246.60
15.00	.50617	.05081	246.30
16.00	.55342	.04780	246.30
17.00	.60177	.04682	246.20
18.00	.64706	.04424	246.20
19.00	.69026	.04234	246.20
20.00	.73174	.04044	246.20
21.00	.77114	.03700	246.20
22.00	.80575	.03400	246.30
23.00	.83913	.02866	246.30
24.00	.86307	.02301	246.70
25.00	.88516	.02154	246.90
26.00	.90615	.01902	247.00
27.00	.92321	.01319	247.20
28.00	.93253	.01227	247.70
29.00	.94774	.01276	247.80
30.00	.95804	.00950	248.00
31.00	.96675	.00735	248.20
32.00	.97275	.00656	248.50
33.00	.97986	.00471	248.60
34.00	.98217	.00416	248.90
35.00	.98819	.00503	248.90
36.00	.99223	.00331	249.00
37.00	.99480	.00239	249.10
38.00	.99700	.00196	249.20
39.00	.99871	.00042	249.30
40.00	.99783	-.00050	249.50
41.00	.99770	-.00001	249.60
42.00	.99781	-.00007	249.70
43.00	.99756	-.00044	249.80
44.00	.99693	.00006	249.90
45.00	.99767	.00068	249.90
46.00	.99828	.00055	249.90
47.00	.99877	.00049	249.90
48.00	.99926	.00037	249.90
49.00	.99951	.00025	249.90
50.00	.99975	.00025	249.90
51.00	1.00000	-.00080	249.90

NORMALIZED DATA FROM RUN 37

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00797	228.00
.50	.00797	.01775	230.10
1.00	.01775	.03254	232.10
1.50	.04051	.06244	233.50
2.00	.08018	.08128	234.20
2.50	.12179	.09324	235.00
3.00	.17342	.10474	235.40
3.50	.22653	.11139	235.80
4.00	.28481	.11937	236.00
4.50	.34590	.11451	236.10
5.00	.39932	.10814	236.60
5.50	.45404	.10854	236.90
6.00	.50786	.10720	237.10
6.50	.56124	.10438	237.40
7.00	.61224	.10036	237.70
7.50	.66160	.09369	238.00
8.00	.70593	.09159	238.50
8.50	.75319	.08742	238.70
9.00	.79334	.07820	239.10
9.50	.83140	.06928	239.40
10.00	.86262	.05605	239.90
10.50	.88745	.04861	240.50
11.00	.91123	.04473	241.00
11.50	.93218	.03892	241.50
12.00	.95015	.03058	242.00
12.50	.96275	.02491	242.60
13.00	.97506	.01999	243.10
13.50	.98274	.01403	243.70
14.00	.98909	.01090	244.20
14.50	.99364	.01091	244.70
15.00	1.00000	.00509	245.00

NORMALIZED DATA FROM RUN 38

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00016	240.80
1.00	.00033	.00252	240.80
2.00	.00504	.00376	240.80
3.00	.00785	.00457	240.90
4.00	.01418	.00639	240.90
5.00	.02063	.00689	240.90
6.00	.02795	.00806	240.90
7.00	.03676	.00912	240.90
8.00	.04619	.01042	240.90
9.00	.05760	.01185	240.90
10.00	.06989	.01290	240.90
11.00	.08341	.01510	240.90
12.00	.10009	.01754	240.80
13.00	.11850	.01823	240.70
14.00	.13654	.01984	240.60
15.00	.15818	.02247	240.50
16.00	.18147	.02348	240.30
17.00	.20514	.02327	240.10
18.00	.22802	.02248	240.00
19.00	.25010	.02304	240.00
20.00	.27410	.02409	239.90
21.00	.29829	.02370	239.90
22.00	.32149	.02453	239.90
23.00	.34735	.02478	239.80
24.00	.37105	.02357	239.80
25.00	.39450	.02345	239.80
26.00	.41795	.02333	239.80
27.00	.44115	.02264	239.80
28.00	.46323	.02329	239.80
29.00	.48772	.02291	239.70
30.00	.50906	.02217	239.70
31.00	.53206	.02236	239.60
32.00	.55377	.02103	239.60
33.00	.57412	.02091	239.60
34.00	.59559	.02078	239.60
35.00	.61569	.02016	239.60
36.00	.63591	.02010	239.60
37.00	.65589	.01917	239.60
38.00	.67425	.01867	239.60
39.00	.69323	.01867	239.60
40.00	.71160	.01836	239.60
41.00	.72996	.01805	239.60
42.00	.74770	.01642	239.60
43.00	.76279	.01518	239.70
44.00	.77806	.01551	239.70
45.00	.79381	.01520	239.70
46.00	.80845	.01458	239.70
47.00	.82297	.01319	239.70
48.00	.83484	.01207	239.80
49.00	.84712	.01148	239.80

NORMALIZED DATA FROM RUN 38 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
50.00	.85779	.01061	239.80
51.00	.86834	.00984	239.80
52.00	.87747	.00922	239.90
53.00	.88678	.00943	239.90
54.00	.89633	.00906	239.90
55.00	.90489	.00761	239.90
56.00	.91155	.00641	240.00
57.00	.91770	.00711	240.10
58.00	.92577	.00726	240.10
59.00	.93222	.00658	240.10
60.00	.93892	.00556	240.10
61.00	.94334	.00442	240.20
62.00	.94776	.00291	240.30
63.00	.94915	.00355	240.50
64.00	.95486	.00509	240.50
65.00	.95933	.00351	240.50
66.00	.96188	.00262	240.60
67.00	.96456	.00289	240.70
68.00	.96767	.00329	240.70
69.00	.97114	.00347	240.70
70.00	.97461	.00246	240.70
71.00	.97605	.00165	240.80
72.00	.97791	.00217	240.80
73.00	.98040	.00217	240.80
74.00	.98226	.00174	240.80
75.00	.98387	.00199	240.80
76.00	.98623	.00066	240.80
77.00	.98519	.00041	240.90
78.00	.98705	.00161	240.90
79.00	.98841	.00124	240.90
80.00	.98953	.00099	240.90
81.00	.99040	.00099	240.90
82.00	.99151	.00093	240.90
83.00	.99226	.00112	240.90
84.00	.99375	.00074	240.90
85.00	.99375	.00037	240.90
86.00	.99449	.00081	240.90
87.00	.99536	.00031	240.90
88.00	.99511	.00031	240.90
89.00	.99598	.00043	240.90
90.00	.99598	.00031	240.90
91.00	.99660	.00043	240.90
92.00	.99685	.00019	240.90
93.00	.99697	.00025	240.90
94.00	.99734	.00012	240.90
95.00	.99722	.00012	240.90
96.00	.99759	.00114	240.90
97.00	.99950	.00089	240.80
98.00	.99938	.00019	240.80
99.00	.99988	.00025	240.80
100.00	.99988	.00000	240.80
101.00	.99988	.00006	240.80
102.00	1.00000	-.00031	240.80

NORMALIZED DATA FROM RUN 39

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00052	238.70
1.00	.00104	.00355	239.10
2.00	.00710	.00574	239.30
3.00	.01251	.00657	239.60
4.00	.02024	.01010	239.80
5.00	.03271	.01466	239.90
6.00	.04956	.01787	239.90
7.00	.06846	.02096	239.90
8.00	.09147	.02424	239.90
9.00	.11693	.02629	239.90
10.00	.14406	.03072	239.90
11.00	.17837	.03323	239.60
12.00	.21052	.03471	239.60
13.00	.24779	.03830	239.40
14.00	.28712	.03939	239.10
15.00	.32657	.03805	238.90
16.00	.36322	.03786	238.90
17.00	.40230	.03953	238.80
18.00	.44228	.03934	238.70
19.00	.48097	.03940	238.60
20.00	.52107	.03921	238.50
21.00	.55938	.03696	238.40
22.00	.59500	.03504	238.40
23.00	.62945	.03253	238.40
24.00	.66005	.03009	238.40
25.00	.68963	.02893	238.40
26.00	.71791	.02829	238.40
27.00	.74620	.02636	238.40
28.00	.77064	.02463	238.50
29.00	.79545	.02366	238.50
30.00	.81796	.02142	238.60
31.00	.83828	.01891	238.70
32.00	.85579	.01852	238.90
33.00	.87533	.01807	238.90
34.00	.89192	.01576	239.00
35.00	.90684	.01332	239.10
36.00	.91856	.01184	239.30
37.00	.93052	.01215	239.40
38.00	.94286	.01003	239.40
39.00	.95059	.00740	239.60
40.00	.95767	.00695	239.80
41.00	.96449	.00637	239.90
42.00	.97041	.00553	240.00
43.00	.97555	.00450	240.10
44.00	.97941	.00489	240.20
45.00	.98533	.00258	240.20
46.00	.98457	.00078	240.50
47.00	.98688	.00199	240.60
48.00	.98856	.00251	240.70
49.00	.99190	.00180	240.70

NORMALIZED DATA FROM RUN 39 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
50.00	.99216	.00052	240.80
51.00	.99293	.00052	240.90
52.00	.99319	.00096	241.00
53.00	.99486	.00154	241.00
54.00	.99627	.00122	241.00
55.00	.99730	.00090	241.00
56.00	.99807	.00096	241.00
57.00	.99923	.00006	241.00
58.00	.99820	-.00019	241.10
59.00	.99884	.00013	241.10
60.00	.99846	.00019	241.10
61.00	.99923	.00058	241.10
62.00	.99962	.00032	241.10
63.00	.99987	.00013	241.10
64.00	.99987	-.00064	241.10
65.00	.99859	-.00058	241.20
66.00	.99872	.00045	241.20
67.00	.99949	-.00045	241.20
68.00	.99782	-.00090	241.30
69.00	.99769	.00019	241.30
70.00	.99820	.00039	241.30
71.00	.99846	-.00071	241.30
72.00	.99679	-.00064	241.40
73.00	.99717	-.00064	241.40
74.00	.99550	-.00109	241.50
75.00	.99499	-.00006	241.50
76.00	.99537	.00026	241.50
77.00	.99550	.00006	241.50
78.00	.99550	-.00026	241.50
79.00	.99499	-.00006	241.50
80.00	.99537	.00019	241.50
81.00	.99537	.00051	241.50
82.00	.99640	.00064	241.50
83.00	.99666	.00026	241.50
84.00	.99691	.00039	241.50
85.00	.99743	.00077	241.50
86.00	.99846	.00045	241.50
87.00	.99833	-.00013	241.50
88.00	.99820	-.00006	241.50
89.00	.99820	.00026	241.50
90.00	.99871	.00064	241.50
91.00	.99949	.00051	241.50
92.00	.99974	.00000	241.50
93.00	.99949	.00006	241.50
94.00	.99987	.00013	241.50
95.00	.99974	-.00006	241.50
96.00	.99974	-.00006	241.50
97.00	.99961	.00013	241.50
98.00	1.00000	-.00058	241.50

NORMALIZED DATA FROM RUN 40

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00451	232.70
.50	.00451	.00646	233.30
1.00	.00646	.00465	234.20
1.50	.00916	.00959	235.00
2.00	.01606	.01864	235.60
2.50	.02779	.02720	235.90
3.00	.04326	.03263	236.10
3.50	.06043	.03299	236.20
4.00	.07625	.03915	236.60
4.50	.09958	.04881	236.60
5.00	.12506	.04953	236.60
5.50	.14911	.04890	236.70
6.00	.17396	.05353	236.80
6.50	.20263	.05775	236.70
7.00	.23171	.05739	236.60
7.50	.26003	.05569	236.60
8.00	.28740	.05501	236.60
8.50	.31504	.05690	236.60
9.00	.34430	.05852	236.60
9.50	.37356	.05865	236.60
10.00	.40295	.05906	236.60
10.50	.43261	.05946	236.60
11.00	.46241	.05973	236.60
11.50	.49234	.05960	236.60
12.00	.52201	.05879	236.60
12.50	.55113	.05798	236.60
13.00	.57998	.05676	236.60
13.50	.60789	.05488	236.60
14.00	.63486	.05285	236.60
14.50	.66075	.05151	236.60
15.00	.68637	.04840	236.60
15.50	.70915	.04625	236.60
16.00	.73261	.04517	236.60
16.50	.75432	.04355	236.60
17.00	.77616	.04076	236.60
17.50	.79509	.03546	236.70
18.00	.81163	.03501	236.90
18.50	.83010	.03312	236.90
19.00	.84475	.02741	237.10
19.50	.85751	.02583	237.30
20.00	.87058	.02844	237.60
20.50	.88595	.02980	237.60
21.00	.90038	.02476	237.60
21.50	.91071	.01985	237.80
22.00	.92023	.02062	238.00
22.50	.93133	.01769	238.10
23.00	.93792	.01409	238.40
23.50	.94542	.01233	238.60
24.00	.95026	.01229	238.90
24.50	.95771	.01554	239.00

NORMALIZED DATA FROM RUN 40 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
25.00	.96580	.01221	239.00
25.50	.96992	.00666	239.20
26.00	.97247	.00689	239.50
26.50	.97682	.01028	239.60
27.00	.98275	.00762	239.60
27.50	.98444	.00298	239.80
28.00	.98573	.00520	240.00
28.50	.98964	.00597	240.00
29.00	.99170	.00317	240.10
29.50	.99281	-.00013	240.20
30.00	.99157	.00118	240.50
30.50	.99400	.00445	240.50
31.00	.99602	-.00097	240.50
31.50	.99302	-.00097	240.80
32.00	.99504	.00324	240.80
32.50	.99626	.00324	240.80
33.00	.99828	.00098	240.80
33.50	.99724	-.00168	240.90
34.00	.99660	.00084	241.00
34.50	.99808	.00216	241.00
35.00	.99875	-.00037	241.00
35.50	.99771	-.00037	241.10
36.00	.99838	.00148	241.10
36.50	.99919	.00081	241.10
37.00	.99919	.00081	241.10
37.50	1.00000	-.00078	241.10

NORMALIZED DATA FROM RUN 41

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00076	156.10
.50	.00076	.00441	165.60
1.00	.00441	.00144	173.70
1.50	.00220	-.00177	181.20
2.00	.00264	.00163	187.40
2.50	.00384	.00542	193.00
3.00	.00806	.00448	197.80
3.50	.00832	.00676	202.30
4.00	.01483	.00403	205.80
4.50	.01235	.00039	209.40
5.00	.01522	.00612	212.30
5.50	.01847	-.00053	214.70
6.00	.01468	-.00554	217.30
6.50	.01293	.00364	219.50
7.00	.01833	.00141	221.00
7.50	.01433	.00088	222.90
8.00	.01921	.00504	224.10
8.50	.01937	.01161	225.60
9.00	.03081	.01355	226.20
9.50	.03292	.01873	227.50
10.00	.04954	.03197	227.90
10.50	.06489	.03814	228.50
11.00	.08768	.04374	228.70
11.50	.10863	.04829	229.10
12.00	.13597	.05306	229.20
12.50	.16169	.05426	229.40
13.00	.19022	.05306	229.40
13.50	.21475	.05116	229.70
14.00	.24139	.05461	229.80
14.50	.26936	.05447	229.80
15.00	.29586	.05356	229.90
15.50	.32292	.05454	230.00
16.00	.35040	.05426	230.10
16.50	.37717	.05328	230.20
17.00	.40367	.04870	230.30
17.50	.42588	.04920	230.70
18.00	.45287	.05265	230.70
18.50	.47853	.05399	230.80
19.00	.50687	.05209	230.70
19.50	.53063	.04922	230.90
20.00	.55608	.04930	230.90
20.50	.57992	.04734	231.00
21.00	.60342	.04594	231.00
21.50	.62586	.04376	231.10
22.00	.64719	.03857	231.20
22.50	.66443	.03549	231.50
23.00	.68268	.03691	231.60
23.50	.70134	.03487	231.70
24.00	.71755	.03537	231.90
24.50	.73671	.03573	231.90

NORMALIZED DATA FROM RUN 41 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
25.00	.75328	.03187	232.00
25.50	.76858	.02913	232.10
26.00	.78241	.02857	232.30
26.50	.79716	.02907	232.40
27.00	.81148	.02444	232.50
27.50	.82159	.02326	232.80
28.00	.83474	.02538	232.80
28.50	.84697	.02306	232.90
29.00	.85780	.02110	233.00
29.50	.86807	.01970	233.10
30.00	.87750	.01844	233.20
30.50	.88651	.01598	233.30
31.00	.89348	.01254	233.50
31.50	.89906	.01360	233.70
32.00	.90709	.01438	233.80
32.50	.91344	.01340	233.90
33.00	.92049	.01215	234.00
33.50	.92559	.01103	234.10
34.00	.93152	.00885	234.20
34.50	.93443	.00801	234.40
35.00	.93953	.00879	234.50
35.50	.94322	.00669	234.60
36.00	.94622	.00585	234.70
36.50	.94907	.00571	234.80
37.00	.95193	.00459	234.90
37.50	.95366	.00551	235.00
38.00	.95744	.00481	235.00
38.50	.95848	.00355	235.10
39.00	.96099	.00235	235.10
39.50	.96083	.00397	235.30
40.00	.96497	.00448	235.20
40.50	.96530	.00350	235.30
41.00	.96846	.00392	235.20
41.50	.96922	.00081	235.30
42.00	.96928	-.00193	235.40
42.50	.96729	-.00003	235.60
43.00	.96925	-.00101	235.60
43.50	.96629	-.00156	235.80
44.00	.96769	.00062	235.80
44.50	.96690	.00006	235.90
45.00	.96774	.00020	235.90
45.50	.96710	-.00171	236.00
46.00	.96604	-.00022	236.10
46.50	.96688	.00274	236.10
47.00	.96878	.00070	236.00
47.50	.96758	-.00050	236.10
48.00	.96828	.00028	236.10
48.50	.96786	.00056	236.10
49.00	.96884	.00112	236.10
49.50	.96898	.00042	236.10

NORMALIZED DATA FROM RUN 41 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
50.00	.96926	.00056	236.10
50.50	.96954	.00028	236.10
51.00	.96954	.00000	236.10
51.50	.96954	.00014	236.10
52.00	.96968	.00042	236.10
52.50	.96996	.00056	236.10
53.00	.97024	.00000	236.10
53.50	.96996	.00000	236.10
54.00	.97024	.00014	236.10
54.50	.97010	.00162	236.10
55.00	.97186	.00042	236.00
55.50	.97051	-.00162	236.10
56.00	.97024	.02949	236.10
56.50	1.00000	.00162	234.10

NORMALIZED DATA FROM RUN 42

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.000110	240.80
10.00	.00110	.000086	240.70
20.00	.00172	.000058	240.70
30.00	.00226	.000051	240.80
40.00	.00275	-.000022	240.80
50.00	.00182	.000016	240.90
60.00	.00306	.000111	240.90
70.00	.00404	.000182	240.90
80.00	.00670	.000256	240.80
90.00	.00917	.000235	240.80
100.00	.01139	.000240	240.80
110.00	.01398	.000278	240.80
120.00	.01695	.000346	240.80
130.00	.02090	.000395	240.80
140.00	.02485	.000420	240.80
150.00	.02929	.000549	240.80
160.00	.03583	.000679	240.80
170.00	.04287	.000740	240.80
180.00	.05064	.000740	240.80
190.00	.05768	.000852	241.00
200.00	.06767	.001067	241.00
210.00	.07903	.001173	241.00
220.00	.09113	.001253	241.00
230.00	.10409	.001333	241.00
240.00	.11779	.001462	241.00
250.00	.13334	.001506	240.80
260.00	.14791	.001555	240.80
270.00	.16445	.001653	240.80
280.00	.18098	.001653	240.80
290.00	.19752	.001741	240.80
300.00	.21579	.001864	240.80
310.00	.23480	.001925	240.80
320.00	.25430	.001901	240.80
330.00	.27282	.001966	240.80
340.00	.29363	.002028	240.70
350.00	.31338	.002045	240.70
360.00	.33453	.002179	240.50
370.00	.35695	.002108	240.30
380.00	.37670	.002036	240.30
390.00	.39768	.002141	240.20
400.00	.41952	.002123	240.20
410.00	.44014	.002055	240.20
420.00	.46062	.002080	240.20
430.00	.48173	.002105	240.20
440.00	.50271	.002062	240.20
450.00	.52296	.002024	240.20
460.00	.54320	.002011	240.20
470.00	.56319	.002036	240.20
480.00	.58393	.002018	240.20
490.00	.60356	.001877	240.20

NORMALIZED DATA FROM RUN 42 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
500.00	.62146	.001827	240.30
510.00	.64010	.001777	240.30
520.00	.65701	.001551	240.30
530.00	.67113	.001539	240.50
540.00	.68779	.001568	240.50
550.00	.70248	.001421	240.50
560.00	.71621	.001353	240.60
570.00	.72954	.001352	240.60
580.00	.74324	.001309	240.60
590.00	.75571	.001185	240.60
600.00	.76694	.001035	240.60
610.00	.77641	.001181	240.50
620.00	.79056	.001220	240.30
630.00	.80081	.000987	240.30
640.00	.81031	.000870	240.30
650.00	.81821	.000771	240.30
660.00	.82574	.000728	240.30
670.00	.83278	.000558	240.30
680.00	.83689	.000514	240.50
690.00	.84306	.000617	240.50
700.00	.84923	.000352	240.50
710.00	.85010	.000291	240.80
720.00	.85504	.000445	240.80
730.00	.85899	.000497	240.80
740.00	.86498	.000575	240.70
750.00	.87050	.000461	240.60
760.00	.87420	.000405	240.60
770.00	.87861	.000400	240.50
780.00	.88219	.000334	240.50
790.00	.88528	.000339	240.50
800.00	.88898	.000466	240.50
810.00	.89461	.000423	240.30
820.00	.89745	.000272	240.30
830.00	.90005	.000107	240.30
840.00	.89959	.000053	240.50
850.00	.90111	.000169	240.60
860.00	.90296	.000150	240.60
870.00	.90411	.000157	240.70
880.00	.90609	.000197	240.70
890.00	.90806	.000257	240.70
900.00	.91123	.000245	240.60
910.00	.91296	.000173	240.60
920.00	.91469	.000144	240.60
930.00	.91584	.000156	240.70
940.00	.91781	.000166	240.70
950.00	.91917	.000179	240.70
960.00	.92139	.000238	240.70
970.00	.92394	.000226	240.60
980.00	.92592	.000167	240.60
990.00	.92728	.000093	240.60

NORMALIZED DATA FROM RUN 42 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
1000.00	.92777	.000058	240.60
1010.00	.92843	.000119	240.70
1020.00	.93016	.000142	240.70
1030.00	.93127	.000135	240.70
1040.00	.93287	.000179	240.70
1050.00	.93485	.000130	240.70
1060.00	.93546	.000070	240.70
1070.00	.93625	.000095	240.80
1080.00	.93736	.000186	240.80
1090.00	.93996	.000204	240.80
1100.00	.94144	.000117	240.80
1110.00	.94230	.000124	240.80
1120.00	.94391	.000244	240.80
1130.00	.94719	.000257	240.70
1140.00	.94904	.000161	240.70
1150.00	.95040	.000192	240.70
1160.00	.95287	.000222	240.70
1170.00	.95484	.000107	240.70
1180.00	.95501	.000061	240.80
1190.00	.95606	.000127	240.90
1200.00	.95754	.000089	240.90
1210.00	.95785	.000083	241.00
1220.00	.95921	.000155	241.00
1230.00	.96094	.000155	241.00
1240.00	.96230	.000185	241.00
1250.00	.96464	.000203	241.00
1260.00	.96637	.000179	241.00
1270.00	.96822	.000172	241.00
1280.00	.96982	.000155	241.00
1290.00	.97131	.000173	241.00
1300.00	.97328	.000216	241.00
1310.00	.97563	.000210	241.00
1320.00	.97748	.000197	241.00
1330.00	.97958	.000172	241.00
1340.00	.98093	.000130	241.00
1350.00	.98217	.000118	241.00
1360.00	.98328	.000142	241.00
1370.00	.98501	.000161	241.00
1380.00	.98649	.000135	241.00
1390.00	.98772	.000130	241.00
1400.00	.98908	.000124	241.00
1410.00	.99019	.000087	241.00
1420.00	.99081	.000055	241.00
1430.00	.99130	.000074	241.00
1440.00	.99229	.000142	241.00
1450.00	.99414	.000124	241.00
1460.00	.99476	.000133	241.00
1470.00	.99679	.000107	240.90
1480.00	.99691	.000018	240.90
1490.00	.99716	-.000021	240.90

NORMALIZED DATA FROM RUN 42 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
1500.00	.99649	.000003	241.00
1510.00	.99723	.000049	241.00
1520.00	.99747	.000031	241.00
1530.00	.99784	.000031	241.00
1540.00	.99809	.000077	241.00
1550.00	.99938	.000096	240.90
1560.00	1.00000	.000031	240.90

NORMALIZED DATA FROM RUN 43

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00066	240.70
1.00	.00132	.00145	240.70
2.00	.00290	.00170	240.70
3.00	.00473	.00158	240.70
4.00	.00607	.00176	240.70
5.00	.00826	.00219	240.70
6.00	.01045	.00255	240.70
7.00	.01337	.00336	240.70
8.00	.01716	.00312	240.60
9.00	.01960	.00336	240.60
10.00	.02388	.00385	240.50
11.00	.02729	.00347	240.50
12.00	.03082	.00341	240.50
13.00	.03410	.00353	240.50
14.00	.03787	.00371	240.50
15.00	.04152	.00401	240.50
16.00	.04590	.00408	240.50
17.00	.04968	.00414	240.50
18.00	.05418	.00462	240.50
19.00	.05892	.00493	240.50
20.00	.06403	.00523	240.50
21.00	.06938	.00493	240.50
22.00	.07389	.00511	240.50
23.00	.07960	.00578	240.50
24.00	.08544	.00572	240.50
25.00	.09104	.00627	240.50
26.00	.09797	.00675	240.50
27.00	.10454	.00651	240.50
28.00	.11099	.00657	240.50
29.00	.11768	.00657	240.50
30.00	.12413	.00687	240.50
31.00	.13143	.00712	240.50
32.00	.13837	.00724	240.50
33.00	.14591	.00724	240.50
34.00	.15284	.00742	240.50
35.00	.16075	.00773	240.50
36.00	.16829	.00797	240.50
37.00	.17669	.00827	240.50
38.00	.18484	.00815	240.50
39.00	.19299	.00827	240.50
40.00	.20139	.00839	240.50
41.00	.20978	.01049	240.50
42.00	.22237	.01055	240.30
43.00	.23088	.00900	240.30
44.00	.24037	.00931	240.30
45.00	.24950	.01017	240.30
46.00	.26071	.01035	240.20
47.00	.27020	.00925	240.20
48.00	.27921	.00943	240.20
49.00	.28906	.00992	240.20

NORMALIZED DATA FROM RUN 43 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
50.00	.29904	.00998	240.20
51.00	.30901	.00979	240.20
52.00	.31862	.00973	240.20
53.00	.32848	.01010	240.20
54.00	.33882	.01034	240.20
55.00	.34916	.01004	240.20
56.00	.35889	.00979	240.20
57.00	.36875	.01034	240.20
58.00	.37958	.01046	240.20
59.00	.38967	.01090	240.20
60.00	.40138	.01072	240.10
61.00	.41111	.01022	240.10
62.00	.42182	.01071	240.10
63.00	.43252	.01022	240.10
64.00	.44226	.00992	240.10
65.00	.45236	.00992	240.10
66.00	.46209	.00992	240.10
67.00	.47219	.01004	240.10
68.00	.48216	.00973	240.10
69.00	.49165	.00949	240.10
70.00	.50114	.00961	240.10
71.00	.51087	.00937	240.10
72.00	.51988	.00802	240.10
73.00	.52691	.00783	240.20
74.00	.53555	.00833	240.20
75.00	.54358	.00839	240.20
76.00	.55234	.00852	240.20
77.00	.56061	.00858	240.20
78.00	.56949	.00882	240.20
79.00	.57825	.00765	240.20
80.00	.58479	.00759	240.30
81.00	.59343	.00809	240.30
82.00	.60097	.00803	240.30
83.00	.60949	.00821	240.30
84.00	.61740	.00827	240.30
85.00	.62604	.00858	240.30
86.00	.63455	.00797	240.30
87.00	.64197	.00742	240.30
88.00	.64939	.00791	240.30
89.00	.65779	.00766	240.30
90.00	.66472	.00736	240.30
91.00	.67251	.00754	240.30
92.00	.67981	.00748	240.30
93.00	.68747	.00773	240.30
94.00	.69526	.00724	240.30
95.00	.70195	.00675	240.30
96.00	.70876	.00681	240.30
97.00	.71558	.00620	240.30
98.00	.72117	.00627	240.30
99.00	.72811	.00724	240.30

NORMALIZED DATA FROM RUN 43 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
100.00	.73565	.00700	240.30
101.00	.74210	.00681	240.30
102.00	.74928	.00712	240.30
103.00	.75633	.00750	240.30
104.00	.76427	.00737	240.20
105.00	.77108	.00639	240.20
106.00	.77704	.00627	240.20
107.00	.78361	.00602	240.20
108.00	.78909	.00566	240.20
109.00	.79493	.00578	240.20
110.00	.80064	.00584	240.20
111.00	.80661	.00602	240.20
112.00	.81269	.00572	240.20
113.00	.81804	.00541	240.20
114.00	.82352	.00523	240.20
115.00	.82850	.00505	240.20
116.00	.83361	.00462	240.20
117.00	.83775	.00468	240.20
118.00	.84298	.00487	240.20
119.00	.84748	.00487	240.20
120.00	.85272	.00511	240.20
121.00	.85770	.00487	240.20
122.00	.86245	.00450	240.20
123.00	.86671	.00462	240.20
124.00	.87169	.00444	240.20
125.00	.87559	.00359	240.20
126.00	.87887	.00347	240.20
127.00	.88252	.00389	240.20
128.00	.88666	.00395	240.20
129.00	.89043	.00377	240.20
130.00	.89420	.00365	240.20
131.00	.89773	.00359	240.20
132.00	.90138	.00316	240.20
133.00	.90406	.00292	240.20
134.00	.90722	.00304	240.20
135.00	.91014	.00274	240.20
136.00	.91269	.00268	240.20
137.00	.91549	.00262	240.20
138.00	.91793	.00249	240.20
139.00	.92048	.00255	240.20
140.00	.92304	.00219	240.20
141.00	.92486	.00225	240.20
142.00	.92754	.00243	240.20
143.00	.92973	.00225	240.20
144.00	.93204	.00207	240.20
145.00	.93386	.00225	240.20
146.00	.93654	.00225	240.20
147.00	.93836	.00195	240.20
148.00	.94043	.00207	240.20
149.00	.94250	.00189	240.20

NORMALIZED DATA FROM RUN 43 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
150.00	.94420	.00182	240.20
151.00	.94615	.00195	240.20
152.00	.94810	.00164	240.20
153.00	.94944	.00146	240.20
154.00	.95102	.00176	240.20
155.00	.95296	.00263	240.20
156.00	.95627	.00239	240.10
157.00	.95773	.00152	240.10
158.00	.95932	.00140	240.10
159.00	.96053	.00152	240.10
160.00	.96236	.00146	240.10
161.00	.96345	.00122	240.10
162.00	.96479	.00116	240.10
163.00	.96576	.00109	240.10
164.00	.96698	.00134	240.10
165.00	.96844	.00103	240.10
166.00	.96905	.00079	240.10
167.00	.97002	.00122	240.10
168.00	.97148	.00109	240.10
169.00	.97221	.00085	240.10
170.00	.97319	.00091	240.10
171.00	.97404	.00091	240.10
172.00	.97501	.00091	240.10
173.00	.97586	.00091	240.10
174.00	.97683	.00085	240.10
175.00	.97756	.00079	240.10
176.00	.97842	.00079	240.10
177.00	.97915	.00067	240.10
178.00	.97975	.00073	240.10
179.00	.98061	.00055	240.10
180.00	.98085	.00061	240.10
181.00	.98182	.00061	240.10
182.00	.98207	.00049	240.10
183.00	.98280	.00061	240.10
184.00	.98328	.00055	240.10
185.00	.98389	.00049	240.10
186.00	.98426	.00067	240.10
187.00	.98523	.00067	240.10
188.00	.98559	.00061	240.10
189.00	.98645	.00264	240.10
190.00	.99088	.00221	239.90
191.00	.99088	.00030	239.90
192.00	.99148	.00030	239.90
193.00	.99148	.00024	239.90
194.00	.99197	.00024	239.90
195.00	.99197	.00043	239.90
196.00	.99282	.00043	239.90
197.00	.99282	.00049	239.90
198.00	.99380	.00055	239.90
199.00	.99392	.00018	239.90

NORMALIZED DATA FROM RUN 43 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
200.00	.99416	.00012	239.90
201.00	.99416	.00000	239.90
202.00	.99416	.00018	239.90
203.00	.99453	.00024	239.90
204.00	.99465	.00024	239.90
205.00	.99501	.00036	239.90
206.00	.99538	.00024	239.90
207.00	.99550	.00018	239.90
208.00	.99574	.00030	239.90
209.00	.99611	.00036	239.90
210.00	.99647	.00030	239.90
211.00	.99672	.00043	239.90
212.00	.99732	.00024	239.90
213.00	.99720	.00006	239.90
214.00	.99745	.00024	239.90
215.00	.99769	.00030	239.90
216.00	.99805	.00000	239.90
217.00	.99769	-.00006	239.90
218.00	.99793	.00018	239.90
219.00	.99805	.00030	239.90
220.00	.99854	.00024	239.90
221.00	.99854	.00018	239.90
222.00	.99891	.00043	239.90
223.00	.99939	.00036	239.90
224.00	.99963	.00012	239.90
225.00	.99963	.00012	239.90
226.00	.99988	-.00006	239.90
227.00	.99951	-.00012	239.90
228.00	.99963	.00006	239.90
229.00	.99963	.00018	239.90
230.00	1.00000	-.00068	239.90

NORMALIZED DATA FROM RUN 44

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00034	240.90
2.00	.00137	.00147	240.90
4.00	.00589	.00232	240.90
6.00	.01067	.00251	240.90
8.00	.01594	.00264	240.90
10.00	.02122	.00267	240.90
12.00	.02662	.00280	240.90
14.00	.03240	.00295	240.90
16.00	.03844	.00298	240.90
18.00	.04434	.00295	240.90
20.00	.05025	.00324	240.90
22.00	.05728	.00352	240.90
24.00	.06432	.00358	240.90
26.00	.07161	.00368	240.90
28.00	.07902	.00364	240.90
30.00	.08618	.00377	240.90
32.00	.09410	.00390	240.90
34.00	.10177	.00383	240.90
36.00	.10943	.00402	240.90
38.00	.11785	.00424	240.90
40.00	.12639	.00440	240.90
42.00	.13544	.00446	240.90
44.00	.14424	.00462	240.90
46.00	.15391	.00481	240.90
48.00	.16346	.00477	240.90
50.00	.17301	.00490	240.90
52.00	.18306	.00487	240.90
54.00	.19249	.00481	240.90
56.00	.20229	.00490	240.90
58.00	.21209	.00499	240.90
60.00	.22227	.00506	240.90
62.00	.23232	.00493	240.90
64.00	.24199	.00499	240.90
66.00	.25230	.00515	240.90
68.00	.26260	.00515	240.90
70.00	.27291	.00528	240.90
72.00	.28371	.00518	240.90
74.00	.29364	.00506	240.90
76.00	.30394	.00490	240.90
78.00	.31324	.00487	240.90
80.00	.32342	.00506	240.90
82.00	.33347	.00493	240.90
84.00	.34315	.00493	240.90
86.00	.35320	.00493	240.90
88.00	.36287	.00506	240.90
90.00	.37343	.00515	240.90
92.00	.38348	.00512	240.90
94.00	.39391	.00518	240.90
96.00	.40421	.00534	240.90
98.00	.41527	.00518	240.90

NORMALIZED DATA FROM RUN 44 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
100.00	.42495	.00549	240.90
102.00	.43724	.00574	240.80
104.00	.44793	.00518	240.80
106.00	.45798	.00531	240.80
108.00	.46916	.00540	240.80
110.00	.47959	.00521	240.80
112.00	.49002	.00518	240.80
114.00	.50032	.00525	240.80
116.00	.51100	.00521	240.80
118.00	.52118	.00512	240.80
120.00	.53148	.00521	240.80
122.00	.54204	.00525	240.80
124.00	.55247	.00562	240.80
126.00	.56452	.00527	240.70
128.00	.57356	.00487	240.70
130.00	.58399	.00512	240.70
132.00	.59404	.00499	240.70
134.00	.60397	.00543	240.70
136.00	.61577	.00546	240.60
138.00	.62582	.00527	240.60
140.00	.63686	.00505	240.50
142.00	.64603	.00481	240.50
144.00	.65609	.00477	240.50
146.00	.66513	.00421	240.50
148.00	.67294	.00428	240.60
150.00	.68224	.00462	240.60
152.00	.69141	.00446	240.60
154.00	.70008	.00408	240.60
156.00	.70775	.00399	240.60
158.00	.71604	.00443	240.60
160.00	.72545	.00443	240.50
162.00	.73374	.00390	240.50
164.00	.74103	.00368	240.50
166.00	.74844	.00374	240.50
168.00	.75598	.00371	240.50
170.00	.76327	.00358	240.50
172.00	.77031	.00346	240.50
174.00	.77709	.00333	240.50
176.00	.78362	.00352	240.50
178.00	.79116	.00352	240.50
180.00	.79770	.00411	240.50
182.00	.80759	.00454	240.30
184.00	.81587	.00367	240.20
186.00	.82228	.00311	240.20
188.00	.82831	.00314	240.20
190.00	.83484	.00298	240.20
192.00	.84025	.00298	240.20
194.00	.84678	.00305	240.20
196.00	.85244	.00280	240.20
198.00	.85796	.00276	240.20

NORMALIZED DATA FROM RUN 44 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
200.00	.86349	.00261	240.20
202.00	.86839	.00270	240.20
204.00	.87430	.00286	240.20
206.00	.87983	.00258	240.20
208.00	.88460	.00242	240.20
210.00	.88950	.00239	240.20
212.00	.89415	.00242	240.20
214.00	.89918	.00232	240.20
216.00	.90345	.00210	240.20
218.00	.90760	.00201	240.20
220.00	.91149	.00217	240.20
222.00	.91627	.00210	240.20
224.00	.91991	.00192	240.20
226.00	.92393	.00182	240.20
228.00	.92720	.00176	240.20
230.00	.93097	.00179	240.20
232.00	.93436	.00166	240.20
234.00	.93763	.00160	240.20
236.00	.94077	.00154	240.20
238.00	.94379	.00154	240.20
240.00	.94693	.00151	240.20
242.00	.94982	.00148	240.20
244.00	.95283	.00141	240.20
246.00	.95547	.00135	240.20
248.00	.95824	.00148	240.20
250.00	.96138	.00123	240.20
252.00	.96314	.00107	240.20
254.00	.96565	.00113	240.20
256.00	.96766	.00094	240.20
258.00	.96942	.00091	240.20
260.00	.97130	.00094	240.20
262.00	.97319	.00094	240.20
264.00	.97507	.00094	240.20
266.00	.97696	.00091	240.20
268.00	.97872	.00091	240.20
270.00	.98060	.00079	240.20
272.00	.98186	.00063	240.20
274.00	.98311	.00069	240.20
276.00	.98462	.00079	240.20
278.00	.98626	.00069	240.20
280.00	.98739	.00063	240.20
282.00	.98877	.00044	240.20
284.00	.98915	.00044	240.20
286.00	.99053	.00053	240.20
288.00	.99128	.00038	240.20
290.00	.99204	.00041	240.20
292.00	.99292	.00057	240.20
294.00	.99430	.00050	240.20
296.00	.99493	.00038	240.20
298.00	.99581	.00044	240.20

NORMALIZED DATA FROM RUN 44 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
300.00	.99669	.00038	240.20
302.00	.99731	.00022	240.20
304.00	.99757	.00013	240.20
306.00	.99782	-.00025	240.20
308.00	.99658	-.00025	240.30
310.00	.99683	.00022	240.30
312.00	.99746	-.00059	240.30
314.00	.99447	-.00078	240.50
316.00	.99435	.00006	240.50
318.00	.99472	.00031	240.50
320.00	.99560	.00035	240.50
322.00	.99610	.00013	240.50
324.00	.99610	.00025	240.50
326.00	.99711	.00031	240.50
328.00	.99736	.00013	240.50
330.00	.99761	.00013	240.50
332.00	.99786	.00019	240.50
334.00	.99837	.00035	240.50
336.00	.99925	.00025	240.50
338.00	.99937	.00013	240.50
340.00	.99975	.00009	240.50
342.00	.99975	.00006	240.50
344.00	.99789	.00018	240.20
346.00	.99813	.00012	240.20
348.00	.99838	-.00024	240.20
350.00	.99718	-.00024	240.30
352.00	.99742	.00018	240.30
354.00	.99791	-.00060	240.30
356.00	.99502	-.00075	240.50
358.00	.99490	.00006	240.50
360.00	.99527	.00027	240.50
362.00	.99599	.00030	240.50
364.00	.99648	.00012	240.50
366.00	.99648	.00024	240.50
368.00	.99745	.00027	240.50
370.00	.99757	.00009	240.50
372.00	.99782	.00012	240.50
374.00	.99806	.00018	240.50
376.00	.99854	.00030	240.50
378.00	.99927	.00021	240.50
380.00	.99939	.00012	240.50
382.00	.99976	.00009	240.50
384.00	.99979	.00006	240.50
386.00	1.00000	-.00042	240.50

NORMALIZED DATA FROM RUN 45

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00056	240.10
1.00	.00111	.00185	240.10
2.00	.00369	.00360	240.10
3.00	.00831	.00384	240.00
4.00	.01138	.00283	240.00
5.00	.01396	.00477	240.00
6.00	.02092	.00587	239.90
7.00	.02571	.00408	239.90
8.00	.02908	.00525	240.00
9.00	.03620	.00670	240.00
10.00	.04247	.00765	240.00
11.00	.05151	.00876	239.90
12.00	.05999	.00897	239.90
13.00	.06945	.00977	239.90
14.00	.07952	.01069	239.90
15.00	.09082	.01124	239.90
16.00	.10201	.01275	239.90
17.00	.11633	.01327	239.80
18.00	.12854	.01626	239.90
19.00	.14886	.01771	239.50
20.00	.16397	.01798	239.50
21.00	.18482	.01705	239.20
22.00	.19807	.01742	239.40
23.00	.21966	.01838	239.10
24.00	.23482	.01828	239.20
25.00	.25622	.02038	239.00
26.00	.27558	.01896	238.90
27.00	.29413	.01812	238.90
28.00	.31182	.01782	238.90
29.00	.32976	.01788	238.90
30.00	.34757	.01902	238.90
31.00	.36779	.01831	238.80
32.00	.38419	.01831	238.90
33.00	.40441	.01874	238.80
34.00	.42166	.01898	238.90
35.00	.44237	.01843	238.80
36.00	.45852	.01914	238.90
37.00	.48065	.01957	238.70
38.00	.49766	.01979	238.80
39.00	.52022	.01775	238.50
40.00	.53317	.01735	238.80
41.00	.55493	.01939	238.60
42.00	.57194	.01831	238.70
43.00	.59154	.01757	238.60
44.00	.60708	.01816	238.70
45.00	.62785	.01600	238.50
46.00	.63907	.01628	238.80
47.00	.66041	.01597	238.50
48.00	.67102	.01286	238.80
49.00	.68613	.01736	238.80

NORMALIZED DATA FROM RUN 45 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.70575	.01626	238.50
51.00	.71865	.01136	238.50
52.00	.72846	.01136	238.70
53.00	.74136	.01241	238.70
54.00	.75328	.01210	238.70
55.00	.76557	.01133	238.70
56.00	.77594	.01192	238.80
57.00	.78940	.01232	238.70
58.00	.80058	.01106	238.70
59.00	.81152	.01010	238.70
60.00	.82079	.00973	238.80
61.00	.83099	.00912	238.80
62.00	.83903	.00977	238.90
63.00	.85052	.01029	238.80
64.00	.85961	.00897	238.80
65.00	.86846	.00777	238.80
66.00	.87515	.00780	238.90
67.00	.88406	.00768	238.80
68.00	.89051	.00697	238.90
69.00	.89800	.00694	238.90
70.00	.90439	.00663	238.90
71.00	.91127	.00651	238.90
72.00	.91741	.00608	238.90
73.00	.92343	.00577	238.90
74.00	.92896	.00571	238.90
75.00	.93486	.00522	238.90
76.00	.93941	.00479	238.90
77.00	.94444	.00396	238.90
78.00	.94732	.00359	239.00
79.00	.95162	.00448	239.00
80.00	.95629	.00405	239.00
81.00	.95973	.00338	239.00
82.00	.96305	.00350	239.00
83.00	.96674	.00267	239.00
84.00	.96839	.00236	239.10
85.00	.97146	.00224	239.10
86.00	.97286	.00187	239.20
87.00	.97520	.00095	239.20
88.00	.97476	.00162	239.30
89.00	.97845	.00199	239.30
90.00	.97874	.00107	239.40
91.00	.98059	.00268	239.40
92.00	.98410	.00280	239.30
93.00	.98619	.00178	239.30
94.00	.98766	.00147	239.30
95.00	.98914	.00218	239.30
96.00	.99203	.00154	239.20
97.00	.99221	.00058	239.30
98.00	.99319	.00092	239.30
99.00	.99405	.00015	239.30

NORMALIZED DATA FROM RUN 45 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.99349	.00098	239.40
101.00	.99602	.00169	239.30
102.00	.99688	.00080	239.30
103.00	.99761	-.00022	239.30
104.00	.99644	.00037	239.40
105.00	.99835	.00120	239.30
106.00	.99884	-.00028	239.30
107.00	.99779	-.00040	239.40
108.00	.99803	.00025	239.40
109.00	.99828	.00037	239.40
110.00	.99877	.00043	239.40
111.00	.99914	-.00053	239.40
112.00	.99772	.00018	239.50
113.00	.99951	.00114	239.40
114.00	1.00000	.00025	239.40

NORMALIZED DATA FROM RUN 47

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00024	238.20
1.00	.00047	.00041	238.90
2.00	.00082	.00566	239.70
3.00	.01180	.01017	239.90
4.00	.02115	.01158	240.30
5.00	.03497	.01861	240.60
6.00	.05838	.02433	240.60
7.00	.08363	.02752	240.70
8.00	.11341	.03439	240.80
9.00	.15242	.04125	240.60
10.00	.19591	.04831	240.50
11.00	.24905	.05218	240.00
12.00	.30026	.05416	239.80
13.00	.35737	.05761	239.40
14.00	.41548	.05552	239.00
15.00	.46840	.05158	238.90
16.00	.51863	.04903	238.90
17.00	.56647	.04721	238.90
18.00	.61305	.04726	238.90
19.00	.66099	.04581	238.70
20.00	.70467	.04205	238.70
21.00	.74508	.04003	238.70
22.00	.78473	.03718	238.70
23.00	.81943	.03378	238.80
24.00	.85229	.03063	238.80
25.00	.88069	.02714	238.90
26.00	.90657	.02277	239.00
27.00	.92624	.01556	239.20
28.00	.93769	.01298	239.70
29.00	.95219	.01221	239.90
30.00	.96210	.00825	240.20
31.00	.96869	.00551	240.60
32.00	.97312	.00694	241.00
33.00	.98257	.00778	241.00
34.00	.98868	.00313	241.10
35.00	.98883	.00241	241.50
36.00	.99349	.00199	241.50
37.00	.99281	-.00033	241.80
38.00	.99282	.00126	242.00
39.00	.99534	.00161	242.00
40.00	.99604	.00233	242.10
41.00	1.00000	.00091	242.00

NORMALIZED DATA FROM RUN 48

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00833	237.80
.50	.00833	.00911	238.00
1.00	.00911	.00904	238.70
1.50	.01737	.01682	239.00
2.00	.02593	.02537	239.40
2.50	.04274	.03605	239.40
3.00	.06198	.03977	239.40
3.50	.08251	.04278	239.40
4.00	.10476	.04753	239.50
4.50	.13004	.05235	239.50
5.00	.15711	.05633	239.50
5.50	.18636	.05979	239.50
6.00	.21690	.06307	239.50
6.50	.24943	.06597	239.40
7.00	.28287	.06860	239.30
7.50	.31804	.06996	239.10
8.00	.35282	.06906	238.90
8.50	.38710	.06732	238.70
9.00	.42014	.06384	238.60
9.50	.45094	.06171	238.60
10.00	.48186	.06539	238.60
10.50	.51633	.06668	238.30
11.00	.54853	.06332	238.30
11.50	.57965	.06063	238.20
12.00	.60916	.06211	238.20
12.50	.64176	.06173	238.00
13.00	.67089	.05722	238.00
13.50	.69899	.05479	238.00
14.00	.72568	.05196	238.00
14.50	.75095	.04927	238.00
15.00	.77494	.04573	238.00
15.50	.79668	.04053	238.10
16.00	.81547	.03868	238.20
16.50	.83536	.03553	238.20
17.00	.85100	.03064	238.40
17.50	.86600	.02774	238.60
18.00	.87874	.02929	238.90
18.50	.89529	.03098	238.90
19.00	.90972	.02467	239.00
19.50	.91997	.01778	239.20
20.00	.92750	.01863	239.60
20.50	.93859	.02115	239.70
21.00	.94866	.01736	239.80
21.50	.95595	.00962	240.00
22.00	.95828	.01079	240.50
22.50	.96674	.01332	240.50
23.00	.97160	.00907	240.70
23.50	.97581	.00889	240.90
24.00	.98048	.00747	241.00
24.50	.98329	.00593	241.20

NORMALIZED DATA FROM RUN 48 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
25.00	.98642	.00452	241.30
25.50	.98781	.00155	241.50
26.00	.98796	.00201	241.80
26.50	.98981	.00544	241.90
27.00	.99340	.00429	241.90
27.50	.99410	.00164	242.00
28.00	.99505	.00262	242.10
28.50	.99672	.00121	242.10
29.00	.99625	-.00074	242.20
29.50	.99597	-.00087	242.40
30.00	.99538	.00069	242.50
30.50	.99666	.00205	242.50
31.00	.99743	.00167	242.50
31.50	.99833	.00115	242.50
32.00	.99859	.00167	242.50
32.50	1.00000	.00018	242.50

NORMALIZED DATA FROM RUN 49

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00229	241.90
1.00	.00457	.00503	241.90
2.00	.01006	.00748	242.00
3.00	.01953	.01054	242.00
4.00	.03114	.01313	242.00
5.00	.04578	.01647	242.00
6.00	.06408	.02237	242.00
7.00	.09053	.02774	241.70
8.00	.11956	.03304	241.50
9.00	.15660	.03610	241.00
10.00	.19175	.03878	240.90
11.00	.23416	.04203	240.50
12.00	.27581	.04423	240.30
13.00	.32263	.04332	239.90
14.00	.36244	.04300	239.80
15.00	.40863	.04322	239.40
16.00	.44889	.04149	239.40
17.00	.49161	.04162	239.30
18.00	.53212	.04250	239.30
19.00	.57661	.04256	239.00
20.00	.61725	.04080	239.00
21.00	.65820	.03947	238.90
22.00	.69619	.03616	238.90
23.00	.73052	.03212	238.90
24.00	.76044	.02935	239.10
25.00	.78921	.02566	239.10
26.00	.81175	.02335	239.40
27.00	.83592	.02159	239.50
28.00	.85492	.02080	239.80
29.00	.87751	.02007	239.80
30.00	.89506	.01805	240.00
31.00	.91361	.01411	240.00
32.00	.92327	.01143	240.50
33.00	.93646	.01111	240.60
34.00	.94549	.01044	240.90
35.00	.95735	.00966	240.90
36.00	.96480	.00760	241.10
37.00	.97256	.00640	241.20
38.00	.97761	.00612	241.40
39.00	.98480	.00296	241.40
40.00	.98353	.00246	241.80
41.00	.98972	.00347	241.80
42.00	.99047	.00214	242.00
43.00	.99401	.00341	242.00
44.00	.99729	.00278	242.00
45.00	.99956	.00136	242.00
46.00	1.00000	.00006	242.10

NORMALIZED DATA FROM RUN 50

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00123	241.90
1.00	.00246	.00370	241.90
2.00	.00741	.00520	241.90
3.00	.01285	.00588	241.90
4.00	.01916	.00724	241.90
5.00	.02732	.00792	241.90
6.00	.03499	.01002	241.90
7.00	.04736	.01188	241.90
8.00	.05875	.01330	241.90
9.00	.07396	.01553	241.90
10.00	.08980	.01602	241.90
11.00	.10600	.02011	241.90
12.00	.13001	.02277	241.70
13.00	.15154	.02332	241.70
14.00	.17666	.02803	241.50
15.00	.20760	.02973	241.10
16.00	.23612	.02787	241.00
17.00	.26334	.02765	241.00
18.00	.29142	.02839	241.00
19.00	.32012	.02985	241.00
20.00	.35111	.02917	240.90
21.00	.37845	.02849	240.90
22.00	.40808	.02811	240.80
23.00	.43468	.02780	240.80
24.00	.46369	.02873	240.70
25.00	.49215	.02821	240.70
26.00	.52011	.02830	240.70
27.00	.54875	.02852	240.60
28.00	.57714	.02719	240.50
29.00	.60312	.02616	240.50
30.00	.62947	.02604	240.50
31.00	.65520	.02499	240.50
32.00	.67945	.02412	240.50
33.00	.70345	.02301	240.50
34.00	.72547	.02177	240.50
35.00	.74700	.02091	240.50
36.00	.76728	.01961	240.50
37.00	.78621	.01738	240.50
38.00	.80205	.01617	240.50
39.00	.81856	.01599	240.60
40.00	.83403	.01413	240.60
41.00	.84683	.01311	240.70
42.00	.86025	.01274	240.80
43.00	.87231	.01234	240.90
44.00	.88493	.01206	240.90
45.00	.89643	.01055	240.90
46.00	.90602	.00884	241.00
47.00	.91412	.00888	241.10
48.00	.92377	.00863	241.10
49.00	.93137	.00782	241.20

NORMALIZED DATA FROM RUN 50 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
50.00	.93942	.00618	241.20
51.00	.94374	.00504	241.40
52.00	.94949	.00603	241.50
53.00	.95580	.00600	241.50
54.00	.96149	.00312	241.50
55.00	.96203	.00355	241.80
56.00	.96859	.00380	241.80
57.00	.96963	.00263	241.90
58.00	.97384	.00390	241.90
59.00	.97743	.00256	241.90
60.00	.97897	.00232	242.00
61.00	.98206	.00272	242.00
62.00	.98441	.00254	242.00
63.00	.98713	.00229	242.00
64.00	.98899	.00173	242.00
65.00	.99060	.00173	242.00
66.00	.99245	.00186	242.00
67.00	.99431	.00167	242.00
68.00	.99579	.00111	242.00
69.00	.99654	.00111	242.00
70.00	.99802	.00148	242.00
71.00	.99951	.00099	242.00
72.00	1.00000	-.00087	242.00

NORMALIZED DATA FROM RUN 51

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00017	235.90
1.00	.00034	.00085	235.90
2.00	.00170	.00123	235.90
3.00	.00280	.00154	235.90
4.00	.00477	.00203	235.90
5.00	.00686	.00184	235.90
6.00	.00846	.00209	235.90
7.00	.01104	.00252	235.90
8.00	.01350	.00270	235.90
9.00	.01645	.00264	235.90
10.00	.01879	.00277	235.90
11.00	.02198	.00320	235.90
12.00	.02518	.00332	235.90
13.00	.02862	.00350	235.90
14.00	.03219	.00393	235.90
15.00	.03649	.00436	235.90
16.00	.04092	.00461	235.90
17.00	.04571	.00467	235.90
18.00	.05026	.00510	235.90
19.00	.05591	.00547	235.90
20.00	.06120	.00638	235.90
21.00	.06866	.00765	235.80
22.00	.07650	.00783	235.70
23.00	.08433	.00748	235.60
24.00	.09146	.00785	235.60
25.00	.10003	.00810	235.50
26.00	.10765	.00756	235.50
27.00	.11515	.00775	235.50
28.00	.12314	.00908	235.50
29.00	.13331	.00939	235.40
30.00	.14192	.00818	235.40
31.00	.14966	.00861	235.40
32.00	.15913	.00922	235.40
33.00	.16810	.00928	235.40
34.00	.17769	.00977	235.40
35.00	.18765	.00990	235.40
36.00	.19748	.01062	235.40
37.00	.20888	.01098	235.30
38.00	.21945	.01129	235.30
39.00	.23147	.01111	235.20
40.00	.24167	.01051	235.20
41.00	.25249	.01082	235.20
42.00	.26331	.01160	235.20
43.00	.27569	.01238	235.10
44.00	.28807	.01244	235.00
45.00	.30057	.01172	234.90
46.00	.31151	.01094	234.90
47.00	.32245	.01125	234.90
48.00	.33401	.01100	234.90
49.00	.34446	.01100	234.90

NORMALIZED DATA FROM RUN 51 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.35602	.01106	234.90
51.00	.36659	.01094	234.90
52.00	.37790	.01113	234.90
53.00	.38884	.01119	234.90
54.00	.40027	.01125	234.90
55.00	.41134	.01119	234.90
56.00	.42265	.01106	234.90
57.00	.43347	.01131	234.90
58.00	.44527	.01131	234.90
59.00	.45609	.01094	234.90
60.00	.46715	.01113	234.90
61.00	.47834	.01106	234.90
62.00	.48928	.01191	234.90
63.00	.50216	.01197	234.80
64.00	.51322	.01113	234.80
65.00	.52441	.01076	234.80
66.00	.53473	.01051	234.80
67.00	.54543	.01057	234.80
68.00	.55588	.01063	234.80
69.00	.56670	.01070	234.80
70.00	.57727	.01076	234.80
71.00	.58821	.01094	234.80
72.00	.59915	.01082	234.80
73.00	.60985	.01076	234.80
74.00	.62067	.01057	234.80
75.00	.63100	.01027	234.80
76.00	.64120	.01033	234.80
77.00	.65165	.01002	234.80
78.00	.66124	.00971	234.80
79.00	.67107	.00990	234.80
80.00	.68103	.00947	234.80
81.00	.69001	.00910	234.80
82.00	.69923	.00940	234.80
83.00	.70882	.00922	234.80
84.00	.71767	.00867	234.80
85.00	.72615	.00848	234.80
86.00	.73463	.00811	234.80
87.00	.74238	.00781	234.80
88.00	.75025	.00762	234.80
89.00	.75762	.00842	234.80
90.00	.76709	.00781	234.80
91.00	.77324	.00652	234.80
92.00	.78012	.00701	234.80
93.00	.78725	.00688	234.80
94.00	.79389	.00676	234.80
95.00	.80078	.00664	234.80
96.00	.80717	.00664	234.80
97.00	.81405	.00670	234.80
98.00	.82057	.00652	234.80
99.00	.82709	.00652	234.80

NORMALIZED DATA FROM RUN 51 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.83360	.00627	234.80
101.00	.83963	.00609	234.80
102.00	.84577	.00602	234.80
103.00	.85167	.00578	234.80
104.00	.85733	.00559	234.80
105.00	.86286	.00547	234.80
106.00	.86827	.00529	234.80
107.00	.87343	.00516	234.80
108.00	.87860	.00516	234.80
109.00	.88376	.00486	234.80
110.00	.88831	.00486	234.80
111.00	.89347	.00424	234.80
112.00	.89679	.00443	234.80
113.00	.90232	.00498	234.80
114.00	.90675	.00418	234.80
115.00	.91068	.00381	234.80
116.00	.91437	.00393	234.80
117.00	.91855	.00430	234.80
118.00	.92298	.00400	234.80
119.00	.92654	.00357	234.80
120.00	.93011	.00350	234.80
121.00	.93355	.00326	234.80
122.00	.93663	.00235	234.80
123.00	.93826	.00235	234.90
124.00	.94133	.00307	234.90
125.00	.94441	.00295	234.90
126.00	.94723	.00283	234.90
127.00	.95006	.00270	234.90
128.00	.95264	.00258	234.90
129.00	.95523	.00270	234.90
130.00	.95805	.00246	234.90
131.00	.96014	.00234	234.90
132.00	.96273	.00227	234.90
133.00	.96469	.00215	234.90
134.00	.96703	.00221	234.90
135.00	.96912	.00191	234.90
136.00	.97084	.00197	234.90
137.00	.97305	.00197	234.90
138.00	.97477	.00119	234.90
139.00	.97543	.00100	235.00
140.00	.97678	.00148	235.00
141.00	.97838	.00166	235.00
142.00	.98010	.00076	235.00
143.00	.97989	.00069	235.10
144.00	.98149	.00117	235.10
145.00	.98222	.00111	235.10
146.00	.98370	.00063	235.10
147.00	.98349	.00045	235.20
148.00	.98460	.00117	235.20
149.00	.98583	.00123	235.20

NORMALIZED DATA FROM RUN 51 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
150.00	.98705	.00104	235.20
151.00	.98792	.00080	235.20
152.00	.98865	.00080	235.20
153.00	.98951	.00098	235.20
154.00	.99062	.00033	235.20
155.00	.99016	.00020	235.30
156.00	.99103	.00068	235.30
157.00	.99152	.00049	235.30
158.00	.99201	.00031	235.30
159.00	.99213	.00037	235.30
160.00	.99275	.00068	235.30
161.00	.99348	.00049	235.30
162.00	.99373	.00025	235.30
163.00	.99398	.00043	235.30
164.00	.99459	.00049	235.30
165.00	.99496	.00043	235.30
166.00	.99545	.00043	235.30
167.00	.99582	.00037	235.30
168.00	.99619	.00012	235.30
169.00	.99607	.00049	235.30
170.00	.99717	-.00584	235.30
171.00	.98439	.00006	235.30
172.00	.99730	.00658	235.30
173.00	.99754	.00037	235.30
174.00	.99803	.00031	235.30
175.00	.99816	.00025	235.30
176.00	.99852	.00006	235.30
177.00	.99828	-.00645	235.30
178.00	.98562	-.00621	235.30
179.00	.98586	.00658	235.30
180.00	.99877	.00670	235.30
181.00	.99926	.00025	235.30
182.00	.99926	.00031	235.30
183.00	.99988	.00037	235.30
184.00	1.00000	-.00072	235.30

NORMALIZED DATA FROM'RUN 52

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00045	235.80
1.00	.00091	.00189	235.80
2.00	.00378	.00313	235.80
3.00	.00716	.00369	235.80
4.00	.01116	.00406	235.80
5.00	.01529	.00356	235.80
6.00	.01829	.00456	235.80
7.00	.02441	.00569	235.80
8.00	.02967	.00550	235.80
9.00	.03542	.00569	235.80
10.00	.04104	.00625	235.80
11.00	.04792	.00706	235.80
12.00	.05517	.00725	235.80
13.00	.06243	.00757	235.80
14.00	.07030	.00838	235.80
15.00	.07918	.00875	235.80
16.00	.08781	.00907	235.80
17.00	.09731	.00969	235.80
18.00	.10719	.01000	235.80
19.00	.11732	.01207	235.80
20.00	.13133	.01232	235.60
21.00	.14195	.01263	235.60
22.00	.15658	.01288	235.40
23.00	.16771	.01144	235.40
24.00	.17947	.01163	235.40
25.00	.19097	.01175	235.40
26.00	.20297	.01200	235.40
27.00	.21498	.01175	235.40
28.00	.22648	.01232	235.40
29.00	.23961	.01275	235.40
30.00	.25199	.01300	235.40
31.00	.26562	.01363	235.30
32.00	.27925	.01388	235.20
33.00	.29338	.01344	235.10
34.00	.30613	.01244	235.10
35.00	.31826	.01250	235.10
36.00	.33114	.01282	235.10
37.00	.34389	.01369	235.10
38.00	.35852	.01369	235.00
39.00	.37128	.01313	235.00
40.00	.38478	.01375	235.00
41.00	.39878	.01338	234.90
42.00	.41154	.01294	234.90
43.00	.42467	.01275	234.90
44.00	.43705	.01263	234.90
45.00	.44993	.01275	234.90
46.00	.46256	.01275	234.90
47.00	.47544	.01257	234.90
48.00	.48769	.01244	234.90
49.00	.50032	.01269	234.90

NORMALIZED DATA FROM RUN 52 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.51307	.01219	234.90
51.00	.52470	.01219	234.90
52.00	.53746	.01238	234.90
53.00	.54946	.01194	234.90
54.00	.56134	.01188	234.90
55.00	.57322	.01150	234.90
56.00	.58435	.01144	234.90
57.00	.59610	.01132	234.90
58.00	.60698	.01082	234.90
59.00	.61773	.01069	234.90
60.00	.62836	.01063	234.90
61.00	.63899	.01069	234.90
62.00	.64975	.01032	234.90
63.00	.65962	.00957	234.90
64.00	.66888	.00925	234.90
65.00	.67813	.00950	234.90
66.00	.68788	.00932	234.90
67.00	.69676	.00882	234.90
68.00	.70551	.00882	234.90
69.00	.71439	.00857	234.90
70.00	.72265	.00832	234.90
71.00	.73102	.00838	234.90
72.00	.73940	.00832	234.90
73.00	.74765	.00813	234.90
74.00	.75566	.00813	234.90
75.00	.76391	.00800	234.90
76.00	.77166	.00750	234.90
77.00	.77891	.00732	234.90
78.00	.78629	.00719	234.90
79.00	.79329	.00694	234.90
80.00	.80017	.00725	234.90
81.00	.80780	.00656	234.90
82.00	.81330	.00594	234.90
83.00	.81968	.00625	234.90
84.00	.82581	.00663	234.90
85.00	.83293	.00631	234.90
86.00	.83844	.00569	234.90
87.00	.84431	.00575	234.90
88.00	.84994	.00569	234.90
89.00	.85569	.00569	234.90
90.00	.86132	.00531	234.90
91.00	.86632	.00475	234.90
92.00	.87082	.00469	234.90
93.00	.87570	.00481	234.90
94.00	.88045	.00463	234.90
95.00	.88495	.00481	234.90
96.00	.89008	.00494	234.90
97.00	.89483	.00456	234.90
98.00	.89921	.00425	234.90
99.00	.90333	.00400	234.90

NORMALIZED DATA FROM RUN 52 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.90721	.00388	234.90
101.00	.91109	.00406	234.90
102.00	.91534	.00306	234.90
103.00	.91721	.00288	235.00
104.00	.92109	.00356	235.00
105.00	.92434	.00331	235.00
106.00	.92772	.00175	235.00
107.00	.92785	.00188	235.20
108.00	.93147	.00350	235.20
109.00	.93485	.00325	235.20
110.00	.93798	.00300	235.20
111.00	.94085	.00200	235.20
112.00	.94198	.00188	235.30
113.00	.94460	.00269	235.30
114.00	.94735	.00256	235.30
115.00	.94973	.00244	235.30
116.00	.95223	.00244	235.30
117.00	.95461	.00238	235.30
118.00	.95698	.00206	235.30
119.00	.95873	.00200	235.30
120.00	.96098	.00213	235.30
121.00	.96299	.00194	235.30
122.00	.96486	.00181	235.30
123.00	.96661	.00175	235.30
124.00	.96836	.00181	235.30
125.00	.97024	.00100	235.30
126.00	.97036	.00100	235.40
127.00	.97224	.00150	235.40
128.00	.97336	.00131	235.40
129.00	.97487	.00156	235.40
130.00	.97649	.00150	235.40
131.00	.97787	.00131	235.40
132.00	.97912	.00138	235.40
133.00	.98062	.00125	235.40
134.00	.98162	.00088	235.40
135.00	.98237	.00094	235.40
136.00	.98349	.00113	235.40
137.00	.98462	.00106	235.40
138.00	.98562	-.00075	235.40
139.00	.98312	-.00062	235.60
140.00	.98437	.00119	235.60
141.00	.98550	.00081	235.60
142.00	.98600	.00044	235.60
143.00	.98637	.00063	235.60
144.00	.98725	.00081	235.60
145.00	.98800	.00075	235.60
146.00	.98875	.00063	235.60
147.00	.98925	.00044	235.60
148.00	.98962	.00056	235.60
149.00	.99037	.00056	235.60

NORMALIZED DATA FROM RUN 52 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
150.00	.99075	.00056	235.60
151.00	.99150	-.00006	235.60
152.00	.99062	.00013	235.70
153.00	.99175	.00069	235.70
154.00	.99200	.00006	235.70
155.00	.99187	.00025	235.70
156.00	.99250	.00056	235.70
157.00	.99300	.00031	235.70
158.00	.99312	.00025	235.70
159.00	.99350	.00050	235.70
160.00	.99412	.00038	235.70
161.00	.99425	.00031	235.70
162.00	.99475	.00063	235.70
163.00	.99550	.00025	235.70
164.00	.99525	.00025	235.70
165.00	.99600	.00088	235.70
166.00	.99700	.00019	235.70
167.00	.99637	-.00006	235.70
168.00	.99687	.00050	235.70
169.00	.99737	.00031	235.70
170.00	.99750	.00006	235.70
171.00	.99750	.00013	235.70
172.00	.99775	.00013	235.70
173.00	.99775	.00050	235.70
174.00	.99875	.00019	235.70
175.00	.99812	-.00006	235.70
176.00	.99862	.00025	235.70
177.00	.99862	-.00013	235.70
178.00	.99837	.00019	235.70
179.00	.99900	.00031	235.70
180.00	.99900	.00006	235.70
181.00	.99912	.00013	235.70
182.00	.99925	.00025	235.70
183.00	.99962	.00031	235.70
184.00	.99987	.00019	235.70
185.00	1.00000	.00000	235.70

NORMALIZED DATA FROM RUN 53

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00011	230.90
1.00	.00021	.00061	230.90
2.00	.00123	.00076	230.90
3.00	.00173	.00076	230.90
4.00	.00275	.00127	230.90
5.00	.00427	.00120	230.90
6.00	.00516	.00032	230.90
7.00	.00491	.00051	231.00
8.00	.00618	.00139	231.00
9.00	.00770	.00165	231.00
10.00	.00948	.00158	231.00
11.00	.01087	.00152	231.00
12.00	.01252	.00190	231.00
13.00	.01468	.00222	231.00
14.00	.01696	.00241	231.00
15.00	.01949	.00222	231.00
16.00	.02140	.00216	231.00
17.00	.02380	.00273	231.00
18.00	.02685	.00273	231.00
19.00	.02926	.00216	231.00
20.00	.03116	.00317	231.00
21.00	.03560	.00393	231.00
22.00	.03902	.00323	231.00
23.00	.04206	.00330	231.00
24.00	.04561	.00380	231.00
25.00	.04967	.00374	231.00
26.00	.05309	.00374	231.00
27.00	.05715	.00412	231.00
28.00	.06133	.00431	231.00
29.00	.06577	.00450	231.00
30.00	.07033	.00450	231.00
31.00	.07477	.00463	231.00
32.00	.07959	.00520	231.00
33.00	.08517	.00526	231.00
34.00	.09011	.00475	231.00
35.00	.09467	.00507	231.00
36.00	.10025	.00532	231.00
37.00	.10532	.00551	231.00
38.00	.11128	.00596	231.00
39.00	.11724	.00590	231.00
40.00	.12307	.00545	231.00
41.00	.12814	.00590	231.00
42.00	.13486	.00640	231.00
43.00	.14095	.00602	231.00
44.00	.14691	.00615	231.00
45.00	.15325	.00615	231.00
46.00	.15921	.00634	231.00
47.00	.16593	.00685	231.00
48.00	.17290	.00716	231.00
49.00	.18025	.00697	231.00

NORMALIZED DATA FROM RUN 53 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.18684	.00647	231.00
51.00	.19318	.00672	231.00
52.00	.20028	.00742	231.00
53.00	.20802	.00735	231.00
54.00	.21499	.00666	231.00
55.00	.22133	.00697	231.00
56.00	.22893	.00729	231.00
57.00	.23591	.00735	231.00
58.00	.24364	.00754	231.00
59.00	.25099	.00754	231.00
60.00	.25873	.00735	231.00
61.00	.26570	.00704	231.00
62.00	.27280	.00697	231.00
63.00	.27965	.00716	231.00
64.00	.28713	.00748	231.00
65.00	.29461	.00723	231.00
66.00	.30158	.00735	231.00
67.00	.30931	.00754	231.00
68.00	.31667	.00735	231.00
69.00	.32402	.00735	231.00
70.00	.33137	.00704	231.00
71.00	.33809	.00659	231.00
72.00	.34456	.00710	231.00
73.00	.35229	.00710	231.00
74.00	.35876	.00672	231.00
75.00	.36573	.00685	231.00
76.00	.37245	.00678	231.00
77.00	.37930	.00672	231.00
78.00	.38589	.00697	231.00
79.00	.39324	.00691	231.00
80.00	.39971	.00691	231.00
81.00	.40706	.00691	231.00
82.00	.41353	.00685	231.00
83.00	.42075	.00710	231.00
84.00	.42773	.00716	231.00
85.00	.43508	.00691	231.00
86.00	.44155	.00666	231.00
87.00	.44839	.00697	231.00
88.00	.45549	.00678	231.00
89.00	.46196	.00666	231.00
90.00	.46880	.00672	231.00
91.00	.47540	.00659	231.00
92.00	.48199	.00659	231.00
93.00	.48858	.00647	231.00
94.00	.49492	.00678	231.00
95.00	.50215	.00710	231.00
96.00	.50912	.00697	231.00
97.00	.51609	.00653	231.00
98.00	.52218	.00647	231.00
99.00	.52902	.00678	231.00

NORMALIZED DATA FROM RUN 53 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.53574	.00678	231.00
101.00	.54259	.00666	231.00
102.00	.54905	.00647	231.00
103.00	.55552	.00602	231.00
104.00	.56110	.00690	231.00
105.00	.56933	.00735	230.90
106.00	.57579	.00628	230.90
107.00	.58188	.00628	230.90
108.00	.58835	.00602	230.90
109.00	.59392	.00609	230.90
110.00	.60052	.00640	230.90
111.00	.60673	.00609	230.90
112.00	.61269	.00609	230.90
113.00	.61890	.00628	230.90
114.00	.62524	.00609	230.90
115.00	.63107	.00583	230.90
116.00	.63690	.00545	230.90
117.00	.64197	.00571	230.90
118.00	.64831	.00571	230.90
119.00	.65338	.00551	230.90
120.00	.65934	.00590	230.90
121.00	.66517	.00564	230.90
122.00	.67063	.00627	230.90
123.00	.67771	.00640	230.80
124.00	.68342	.00551	230.80
125.00	.68874	.00520	230.80
126.00	.69381	.00526	230.80
127.00	.69927	.00545	230.80
128.00	.70472	.00513	230.80
129.00	.70953	.00482	230.80
130.00	.71435	.00520	230.80
131.00	.71993	.00526	230.80
132.00	.72488	.00475	230.80
133.00	.72944	.00463	230.80
134.00	.73413	.00475	230.80
135.00	.73895	.00501	230.80
136.00	.74415	.00488	230.80
137.00	.74871	.00456	230.80
138.00	.75327	.00444	230.80
139.00	.75758	.00444	230.80
140.00	.76215	.00437	230.80
141.00	.76633	.00425	230.80
142.00	.77064	.00406	230.80
143.00	.77445	.00374	230.80
144.00	.77812	.00393	230.80
145.00	.78231	.00418	230.80
146.00	.78649	.00380	230.80
147.00	.78991	.00387	230.80
148.00	.79422	.00418	230.80
149.00	.79828	.00380	230.80

NORMALIZED DATA FROM RUN 53 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
150.00	.80183	.00361	230.80
151.00	.80551	.00387	230.80
152.00	.80956	.00374	230.80
153.00	.81299	.00323	230.80
154.00	.81603	.00311	230.80
155.00	.81920	.00336	230.80
156.00	.82275	.00361	230.80
157.00	.82643	.00342	230.80
158.00	.82960	.00342	230.80
159.00	.83327	.00342	230.80
160.00	.83644	.00336	230.80
161.00	.83999	.00330	230.80
162.00	.84303	.00330	230.80
163.00	.84658	.00342	230.80
164.00	.84988	.00323	230.80
165.00	.85305	.00317	230.80
166.00	.85622	.00317	230.80
167.00	.85939	.00317	230.80
168.00	.86256	.00298	230.80
169.00	.86535	.00260	230.80
170.00	.86776	.00285	230.80
171.00	.87105	.00304	230.80
172.00	.87384	.00279	230.80
173.00	.87663	.00266	230.80
174.00	.87917	.00254	230.80
175.00	.88170	.00254	230.80
176.00	.88424	.00260	230.80
177.00	.88690	.00260	230.80
178.00	.88944	.00247	230.80
179.00	.89184	.00241	230.80
180.00	.89425	.00228	230.80
181.00	.89641	.00228	230.80
182.00	.89882	.00235	230.80
183.00	.90110	.00222	230.80
184.00	.90325	.00222	230.80
185.00	.90554	.00235	230.80
186.00	.90795	.00228	230.80
187.00	.91010	.00209	230.80
188.00	.91213	.00203	230.80
189.00	.91416	.00216	230.80
190.00	.91644	.00209	230.80
191.00	.91834	.00177	230.80
192.00	.91999	.00197	230.80
193.00	.92227	.00177	230.80
194.00	.92354	.00209	230.80
195.00	.92646	.00203	230.80
196.00	.92760	.00165	230.80
197.00	.92975	.00184	230.80
198.00	.93127	.00177	230.80
199.00	.93330	.00184	230.80

NORMALIZED DATA FROM RUN 53 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
200.00	.93495	.00152	230.80
201.00	.93634	.00177	230.80
202.00	.93850	.00171	230.80
203.00	.93977	.00095	230.80
204.00	.94040	.00114	230.80
205.00	.94205	.00158	230.80
206.00	.94357	.00139	230.80
207.00	.94484	.00133	230.80
208.00	.94623	.00171	230.80
209.00	.94826	.00133	230.80
210.00	.94890	.00133	230.80
211.00	.95092	.00146	230.80
212.00	.95181	.00139	230.80
213.00	.95371	.00152	230.80
214.00	.95485	.00120	230.80
215.00	.95612	.00133	230.80
216.00	.95752	.00120	230.80
217.00	.95853	.00120	230.80
218.00	.95993	.00114	230.80
219.00	.96081	.00108	230.80
220.00	.96208	.00120	230.80
221.00	.96322	.00108	230.80
222.00	.96424	.00095	230.80
223.00	.96512	.00095	230.80
224.00	.96614	.00032	230.80
225.00	.96577	.00032	230.90
226.00	.96678	.00101	230.90
227.00	.96780	.00095	230.90
228.00	.96869	.00089	230.90
229.00	.96957	.00095	230.90
230.00	.97059	.00101	230.90
231.00	.97160	.00089	230.90
232.00	.97236	.00089	230.90
233.00	.97338	.00095	230.90
234.00	.97426	.00095	230.90
235.00	.97528	.00070	230.90
236.00	.97566	.00063	230.90
237.00	.97655	.00076	230.90
238.00	.97718	.00051	230.90
239.00	.97756	.00057	230.90
240.00	.97832	.00057	230.90
241.00	.97870	.00057	230.90
242.00	.97946	.00082	230.90
243.00	.98035	.00089	230.90
244.00	.98124	.00070	230.90
245.00	.98174	.00044	230.90
246.00	.98212	.00044	230.90
247.00	.98263	.00051	230.90
248.00	.98314	.00063	230.90
249.00	.98390	.00051	230.90

NORMALIZED DATA FROM RUN 53 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
250.00	.98415	.00057	230.90
251.00	.98504	.00070	230.90
252.00	.98555	.00038	230.90
253.00	.98580	.00032	230.90
254.00	.98618	.00044	230.90
255.00	.98669	.00038	230.90
256.00	.98694	.00032	230.90
257.00	.98732	.00032	230.90
258.00	.98758	.00032	230.90
259.00	.98796	.00025	230.90
260.00	.98808	.00032	230.90
261.00	.98859	.00025	230.90
262.00	.98859	.00032	230.90
263.00	.98922	.00032	230.90
264.00	.98922	.00032	230.90
265.00	.98986	.00057	230.90
266.00	.99036	.00038	230.90
267.00	.99062	.00038	230.90
268.00	.99113	.00038	230.90
269.00	.99138	.00044	230.90
270.00	.99201	.00044	230.90
271.00	.99227	.00019	230.90
272.00	.99239	.00025	230.90
273.00	.99277	.00044	230.90
274.00	.99328	.00057	230.90
275.00	.99391	.00038	230.90
276.00	.99404	.00019	230.90
277.00	.99429	.00032	230.90
278.00	.99468	.00025	230.90
279.00	.99480	.00013	230.90
280.00	.99493	.00019	230.90
281.00	.99518	.00025	230.90
282.00	.99544	.00032	230.90
283.00	.99582	.00032	230.90
284.00	.99607	.00013	230.90
285.00	.99607	.00025	230.90
286.00	.99658	.00025	230.90
287.00	.99658	.00006	230.90
288.00	.99670	.00025	230.90
289.00	.99708	.00044	230.90
290.00	.99759	.00051	230.90
291.00	.99810	.00006	230.90
292.00	.99772	-.00019	230.90
293.00	.99772	.00000	230.90
294.00	.99772	.00013	230.90
295.00	.99797	.00025	230.90
296.00	.99823	.00006	230.90
297.00	.99810	.00000	230.90
298.00	.99823	.00013	230.90
299.00	.99835	.00006	230.90

NORMALIZED DATA FROM RUN 53 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
300.00	.99835	.00006	230.90
301.00	.99848	.00013	230.90
302.00	.99861	.00019	230.90
303.00	.99886	.00019	230.90
304.00	.99899	.00006	230.90
305.00	.99899	.00013	230.90
306.00	.99924	.00038	230.90
307.00	.99975	.00013	230.90
308.00	.99949	.00000	230.90
309.00	.99975	.00019	230.90
310.00	.99987	.00013	230.90
311.00	1.00000	-.00069	230.90

NORMALIZED DATA FROM RUN 54

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00044	230.90
1.00	.00088	.00082	230.90
2.00	.00165	.00102	230.90
3.00	.00292	.00127	230.90
4.00	.00419	.00121	230.90
5.00	.00533	.00133	230.90
6.00	.00686	.00133	230.90
7.00	.00800	.00127	230.90
8.00	.00940	.00102	230.90
9.00	.01004	.00089	230.90
10.00	.01118	.00146	230.90
11.00	.01296	.00178	230.90
12.00	.01474	.00159	230.90
13.00	.01614	.00159	230.90
14.00	.01792	.00172	230.90
15.00	.01957	.00165	230.90
16.00	.02122	.00184	230.90
17.00	.02325	.00197	230.90
18.00	.02516	.00197	230.90
19.00	.02720	.00216	230.90
20.00	.02948	.00216	230.90
21.00	.03152	.00210	230.90
22.00	.03368	.00210	230.90
23.00	.03571	.00229	230.90
24.00	.03825	.00242	230.90
25.00	.04054	.00235	230.90
26.00	.04296	.00261	230.90
27.00	.04575	.00254	230.90
28.00	.04804	.00254	230.90
29.00	.05084	.00267	230.90
30.00	.05338	.00299	230.90
31.00	.05681	.00292	230.90
32.00	.05923	.00261	230.90
33.00	.06202	.00324	230.90
34.00	.06571	.00318	230.90
35.00	.06838	.00235	230.90
36.00	.07041	.00235	230.90
37.00	.07308	.00324	230.90
38.00	.07690	.00343	230.90
39.00	.07995	.00330	230.90
40.00	.08351	.00362	230.90
41.00	.08719	.00343	230.90
42.00	.09037	.00343	230.90
43.00	.09406	.00350	230.90
44.00	.09736	.00350	230.90
45.00	.10105	.00375	230.90
46.00	.10486	.00369	230.90
47.00	.10842	.00375	230.90
48.00	.11236	.00375	230.90
49.00	.11592	.00362	230.90

NORMALIZED DATA FROM RUN 54 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.11961	.00400	230.90
51.00	.12393	.00413	230.90
52.00	.12787	.00432	230.90
53.00	.13257	.00400	230.90
54.00	.13588	.00413	230.90
55.00	.14083	.00445	230.90
56.00	.14478	.00388	230.90
57.00	.14859	.00426	230.90
58.00	.15329	.00432	230.90
59.00	.15723	.00400	230.90
60.00	.16130	.00419	230.90
61.00	.16562	.00419	230.90
62.00	.16969	.00413	230.90
63.00	.17388	.00419	230.90
64.00	.17808	.00400	230.90
65.00	.18189	.00495	230.90
66.00	.18799	.00464	230.80
67.00	.19117	.00464	230.90
68.00	.19726	.00419	230.80
69.00	.19956	.00331	230.90
70.00	.20388	.00464	230.90
71.00	.20884	.00521	230.90
72.00	.21430	.00445	230.80
73.00	.21774	.00375	230.90
74.00	.22181	.00439	230.90
75.00	.22651	.00445	230.90
76.00	.23070	.00439	230.90
77.00	.23528	.00572	230.90
78.00	.24214	.00496	230.80
79.00	.24519	.00337	230.90
80.00	.24888	.00432	230.90
81.00	.25384	.00407	230.90
82.00	.25702	.00477	230.90
83.00	.26337	.00540	230.90
84.00	.26782	.00470	230.90
85.00	.27278	.00477	230.90
86.00	.27735	.00483	230.90
87.00	.28244	.00458	230.90
88.00	.28651	.00432	230.90
89.00	.29108	.00458	230.90
90.00	.29566	.00470	230.90
91.00	.30049	.00483	230.90
92.00	.30532	.00483	230.90
93.00	.31015	.00470	230.90
94.00	.31473	.00477	230.90
95.00	.31968	.00464	230.90
96.00	.32400	.00464	230.90
97.00	.32896	.00565	230.90
98.00	.33531	.00464	230.80
99.00	.33824	.00477	230.90

NORMALIZED DATA FROM RUN 54 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
100.00	.34484	.00464	230.80
101.00	.34752	.00426	230.90
102.00	.35336	.00464	230.80
103.00	.35680	.00489	230.90
104.00	.36315	.00458	230.80
105.00	.36595	.00432	230.90
106.00	.37179	.00439	230.80
107.00	.37472	.00439	230.90
108.00	.38056	.00458	230.80
109.00	.38387	.00464	230.90
110.00	.38984	.00451	230.80
111.00	.39290	.00483	230.90
112.00	.39950	.00470	230.80
113.00	.40231	.00483	230.90
114.00	.40916	.00496	230.80
115.00	.41222	.00445	230.90
116.00	.41806	.00432	230.80
117.00	.42086	.00451	230.90
118.00	.42708	.00445	230.80
119.00	.42976	.00445	230.90
120.00	.43598	.00470	230.80
121.00	.43917	.00477	230.90
122.00	.44552	.00451	230.80
123.00	.44819	.00426	230.90
124.00	.45403	.00445	230.80
125.00	.45709	.00451	230.90
126.00	.46306	.00451	230.80
127.00	.46612	.00451	230.90
128.00	.47208	.00439	230.80
129.00	.47489	.00439	230.90
130.00	.48085	.00451	230.80
131.00	.48391	.00451	230.90
132.00	.48988	.00464	230.80
133.00	.49319	.00470	230.90
134.00	.49929	.00445	230.80
135.00	.50209	.00458	230.90
136.00	.50844	.00426	230.80
137.00	.51061	.00445	230.90
138.00	.51734	.00483	230.80
139.00	.52027	.00477	230.90
140.00	.52687	.00470	230.80
141.00	.52967	.00445	230.90
142.00	.53577	.00445	230.80
143.00	.53857	.00477	230.90
144.00	.54530	.00470	230.80
145.00	.54798	.00413	230.90
146.00	.55356	.00419	230.80
147.00	.55637	.00502	230.90
148.00	.56360	.00458	230.80
149.00	.56552	.00407	230.90

NORMALIZED DATA FROM RUN 54 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
150.00	.57174	.00458	230.80
151.00	.57467	.00464	230.90
152.00	.58102	.00451	230.80
153.00	.58370	.00426	230.90
154.00	.58954	.00458	230.80
155.00	.59285	.00458	230.90
156.00	.59869	.00451	230.80
157.00	.60187	.00458	230.90
158.00	.60784	.00445	230.80
159.00	.61077	.00419	230.90
160.00	.61623	.00407	230.80
161.00	.61891	.00445	230.90
162.00	.62513	.00426	230.80
163.00	.62742	.00426	230.90
164.00	.63364	.00439	230.80
165.00	.63619	.00419	230.90
166.00	.64203	.00413	230.80
167.00	.64446	.00439	230.90
168.00	.65080	.00445	230.80
169.00	.65335	.00413	230.90
170.00	.65907	.00419	230.80
171.00	.66174	.00439	230.90
172.00	.66784	.00394	230.80
173.00	.66963	.00388	230.90
174.00	.67559	.00394	230.80
175.00	.67751	.00413	230.90
176.00	.68385	.00477	230.80
177.00	.68704	.00426	230.90
178.00	.69237	.00388	230.80
179.00	.69479	.00407	230.90
180.00	.70051	.00413	230.80
181.00	.70306	.00394	230.90
182.00	.70839	.00407	230.80
183.00	.71119	.00432	230.90
184.00	.71703	.00400	230.80
185.00	.71920	.00388	230.90
186.00	.72478	.00388	230.80
187.00	.72695	.00375	230.90
188.00	.73228	.00388	230.80
189.00	.73471	.00400	230.90
190.00	.74029	.00388	230.80
191.00	.74246	.00375	230.90
192.00	.74779	.00407	230.80
193.00	.75060	.00375	230.90
194.00	.75529	.00350	230.80
195.00	.75759	.00369	230.90
196.00	.76266	.00362	230.80
197.00	.76483	.00356	230.90
198.00	.76978	.00369	230.80
199.00	.77221	.00394	230.90

NORMALIZED DATA FROM RUN 54 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
200.00	.77766	.00337	230.80
201.00	.77894	.00330	230.90
202.00	.78427	.00356	230.80
203.00	.78606	.00337	230.90
204.00	.79101	.00311	230.80
205.00	.79229	.00337	230.90
206.00	.79775	.00362	230.80
207.00	.79953	.00324	230.90
208.00	.80423	.00324	230.80
209.00	.80602	.00330	230.90
210.00	.81084	.00324	230.80
211.00	.81250	.00350	230.90
212.00	.81783	.00311	230.80
213.00	.81873	.00280	230.90
214.00	.82342	.00311	230.80
215.00	.82496	.00305	230.90
216.00	.82952	.00267	230.80
217.00	.83030	.00273	230.90
218.00	.83499	.00299	230.80
219.00	.83627	.00191	230.90
220.00	.83881	.00254	230.90
221.00	.84135	.00248	230.90
222.00	.84377	.00242	230.90
223.00	.84619	.00261	230.90
224.00	.84898	.00261	230.90
225.00	.85140	.00330	230.90
226.00	.85558	.00248	230.80
227.00	.85635	.00159	230.90
228.00	.85877	.00242	230.90
229.00	.86118	.00324	230.90
230.00	.86524	.00242	230.80
231.00	.86601	.00248	230.90
232.00	.87020	.00222	230.80
233.00	.87046	.00134	230.90
234.00	.87288	.00261	230.90
235.00	.87568	.00248	230.90
236.00	.87784	.00197	230.90
237.00	.87962	.00216	230.90
238.00	.88216	.00261	230.90
239.00	.88483	.00235	230.90
240.00	.88686	.00191	230.90
241.00	.88864	.00247	230.90
242.00	.89181	.00172	230.80
243.00	.89207	.00172	230.90
244.00	.89524	.00191	230.80
245.00	.89589	.00134	230.90
246.00	.89792	.00178	230.90
247.00	.89945	.00254	230.90
248.00	.90300	.00197	230.80
249.00	.90339	.00197	230.90

NORMALIZED DATA FROM RUN 54 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
250.00	.90694	.00197	230.80
251.00	.90733	.00197	230.90
252.00	.91088	.00165	230.80
253.00	.91063	.00083	230.90
254.00	.91254	.00172	230.90
255.00	.91406	.00153	230.90
256.00	.91559	.00172	230.90
257.00	.91750	.00191	230.90
258.00	.91940	.00172	230.90
259.00	.92093	.00165	230.90
260.00	.92271	.00172	230.90
261.00	.92436	.00140	230.90
262.00	.92550	.00133	230.90
263.00	.92703	.00165	230.90
264.00	.92881	.00165	230.90
265.00	.93033	.00140	230.90
266.00	.93161	.00127	230.90
267.00	.93288	.00172	230.90
268.00	.93504	.00089	230.90
269.00	.93466	.00045	231.00
270.00	.93593	.00159	231.00
271.00	.93784	.00146	231.00
272.00	.93886	.00133	231.00
273.00	.94051	.00153	231.00
274.00	.94191	.00108	231.00
275.00	.94267	.00102	231.00
276.00	.94394	.00127	231.00
277.00	.94521	.00114	231.00
278.00	.94623	.00108	231.00
279.00	.94738	.00114	231.00
280.00	.94852	.00114	231.00
281.00	.94966	.00108	231.00
282.00	.95068	.00089	231.00
283.00	.95144	.00095	231.00
284.00	.95259	.00102	231.00
285.00	.95348	.00102	231.00
286.00	.95462	.00102	231.00
287.00	.95551	.00095	231.00
288.00	.95653	.00102	231.00
289.00	.95754	.00114	231.00
290.00	.95882	.00114	231.00
291.00	.95983	.00064	231.00
292.00	.96009	.00044	231.00
293.00	.96072	.00083	231.00
294.00	.96174	.00089	231.00
295.00	.96250	.00070	231.00
296.00	.96314	.00083	231.00
297.00	.96415	.00095	231.00
298.00	.96504	.00089	231.00
299.00	.96593	.00083	231.00

NORMALIZED DATA FROM RUN 54 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
300.00	.96670	.00083	231.00
301.00	.96759	.00089	231.00
302.00	.96848	.00070	231.00
303.00	.96898	.00083	231.00
304.00	.97013	.00089	231.00
305.00	.97076	.00057	231.00
306.00	.97127	.00064	231.00
307.00	.97204	.00089	231.00
308.00	.97305	.00070	231.00
309.00	.97343	.00057	231.00
310.00	.97420	.00089	231.00
311.00	.97521	.00083	231.00
312.00	.97585	.00057	231.00
313.00	.97636	.00044	231.00
314.00	.97674	.00051	231.00
315.00	.97737	.00070	231.00
316.00	.97814	.00064	231.00
317.00	.97864	.00038	231.00
318.00	.97890	.00032	231.00
319.00	.97928	.00057	231.00
320.00	.98004	.00051	231.00
321.00	.98030	.00057	231.00
322.00	.98119	.00051	231.00
323.00	.98131	.00032	231.00
324.00	.98182	.00057	231.00
325.00	.98246	.00051	231.00
326.00	.98284	.00032	231.00
327.00	.98309	.00038	231.00
328.00	.98360	.00044	231.00
329.00	.98398	.00025	231.00
330.00	.98411	.00013	231.00
331.00	.98424	.00032	231.00
332.00	.98475	.00064	231.00
333.00	.98551	.00064	231.00
334.00	.98602	.00044	231.00
335.00	.98640	.00038	231.00
336.00	.98678	.00044	231.00
337.00	.98729	.00038	231.00
338.00	.98754	.00032	231.00
339.00	.98792	.00025	231.00
340.00	.98805	.00025	231.00
341.00	.98843	.00038	231.00
342.00	.98881	.00032	231.00
343.00	.98907	.00032	231.00
344.00	.98945	.00038	231.00
345.00	.98983	.00032	231.00
346.00	.99009	.00025	231.00
347.00	.99034	.00019	231.00
348.00	.99047	.00019	231.00
349.00	.99072	.00013	231.00

NORMALIZED DATA FROM RUN 54 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
350.00	.99072	.00019	231.00
351.00	.99110	.00051	231.00
352.00	.99174	.00038	231.00
353.00	.99186	.00013	231.00
354.00	.99199	.00025	231.00
355.00	.99237	.00025	231.00
356.00	.99250	.00013	231.00
357.00	.99263	.00013	231.00
358.00	.99275	.00032	231.00
359.00	.99326	.00038	231.00
360.00	.99352	.00013	231.00
361.00	.99352	.00013	231.00
362.00	.99377	.00032	231.00
363.00	.99415	.00019	231.00
364.00	.99415	.00013	231.00
365.00	.99441	.00019	231.00
366.00	.99453	.00019	231.00
367.00	.99479	.00038	231.00
368.00	.99530	.00025	231.00
369.00	.99530	.00006	231.00
370.00	.99542	.00013	231.00
371.00	.99555	.00006	231.00
372.00	.99555	.00013	231.00
373.00	.99581	.00025	231.00
374.00	.99606	.00013	231.00
375.00	.99606	.00019	231.00
376.00	.99644	.00019	231.00
377.00	.99644	.00006	231.00
378.00	.99657	.00013	231.00
379.00	.99670	.00013	231.00
380.00	.99682	.00019	231.00
381.00	.99708	.00000	231.00
382.00	.99682	-.00006	231.00
383.00	.99695	.00019	231.00
384.00	.99720	.00013	231.00
385.00	.99720	.00006	231.00
386.00	.99733	.00019	231.00
387.00	.99758	.00019	231.00
388.00	.99771	.00013	231.00
389.00	.99784	.00006	231.00
390.00	.99784	.00013	231.00
391.00	.99809	.00019	231.00
392.00	.99822	.00006	231.00
393.00	.99822	.00006	231.00
394.00	.99835	.00032	231.00
395.00	.99886	.00038	231.00
396.00	.99911	.00019	231.00
397.00	.99924	.00006	231.00
398.00	.99924	.00006	231.00
399.00	.99936	.00006	231.00

NORMALIZED DATA FROM RUN 54 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
400.00	.99936	.00006	231.00
401.00	.99949	.00006	231.00
402.00	.99949	.00006	231.00
403.00	.99962	.00013	231.00
404.00	.99975	.00000	231.00
405.00	.99962	-.00013	231.00
406.00	.99949	.00019	231.00
407.00	1.00000	.00006	231.00

NORMALIZED DATA FROM RUN 55

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00777	244.40
.50	.00777	.01259	244.30
1.00	.01259	.00654	244.40
1.50	.01431	.00907	244.70
2.00	.02166	.01699	244.70
2.50	.03130	.01821	244.60
3.00	.03988	.01609	244.60
3.50	.04739	.01781	244.70
4.00	.05768	.02201	244.70
4.50	.06940	.02311	244.60
5.00	.08080	.02365	244.60
5.50	.09305	.02475	244.60
6.00	.10554	.02573	244.60
6.50	.11878	.02695	244.60
7.00	.13250	.03022	244.60
7.50	.14899	.03193	244.50
8.00	.16443	.03557	244.50
8.50	.18456	.03883	244.30
9.00	.20326	.03801	244.20
9.50	.22257	.03924	244.10
10.00	.24250	.04177	244.00
10.50	.26434	.04095	243.80
11.00	.28345	.03847	243.80
11.50	.30281	.04063	243.80
12.00	.32408	.04409	243.70
12.50	.34690	.04470	243.50
13.00	.36878	.04315	243.40
13.50	.39005	.04173	243.30
14.00	.41051	.04222	243.30
14.50	.43227	.04149	243.20
15.00	.45200	.03920	243.20
15.50	.47148	.03884	243.20
16.00	.49084	.03965	243.20
16.50	.51113	.03737	243.10
17.00	.52820	.03675	243.20
17.50	.54788	.03565	243.10
18.00	.56385	.03504	243.20
18.50	.58292	.03862	243.10
19.00	.60247	.03492	243.00
19.50	.61784	.03276	243.10
20.00	.63523	.03430	243.10
20.50	.65214	.03332	243.10
21.00	.66856	.03426	243.10
21.50	.68640	.03222	243.00
22.00	.70078	.02957	243.10
22.50	.71597	.03002	243.10
23.00	.73079	.03002	243.10
23.50	.74599	.02810	243.10
24.00	.75890	.02774	243.20
24.50	.77372	.02904	243.20

NORMALIZED DATA FROM RUN 55 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
25.00	.78793	.02732	243.20
25.50	.80104	.02516	243.20
26.00	.81310	.02215	243.30
26.50	.82319	.02450	243.40
27.00	.83760	.02426	243.30
27.50	.84745	.02100	243.40
28.00	.85860	.01847	243.40
28.50	.86592	.01619	243.60
29.00	.87478	.01867	243.70
29.50	.88458	.01720	243.70
30.00	.89198	.01251	243.80
30.50	.89709	.01344	244.00
31.00	.90542	.01401	244.00
31.50	.91110	.01148	244.10
32.00	.91691	.01160	244.20
32.50	.92271	.01266	244.30
33.00	.92957	.01107	244.30
33.50	.93378	.01033	244.40
34.00	.93990	.00687	244.40
34.50	.94064	.00984	244.70
35.00	.94975	.01282	244.50
35.50	.95346	.00646	244.60
36.00	.95620	.00405	244.70
36.50	.95751	.00776	244.90
37.00	.96396	.00715	244.80
37.50	.96466	.00270	245.00
38.00	.96666	.00400	245.10
38.50	.96866	.00543	245.20
39.00	.97209	.00674	245.20
39.50	.97540	.00506	245.20
40.00	.97715	.00314	245.30
40.50	.97854	.00384	245.40
41.00	.98099	.00466	245.40
41.50	.98319	.00273	245.40
42.00	.98372	-.00074	245.50
42.50	.98245	.00212	245.70
43.00	.98585	.00237	245.60
43.50	.98482	.00081	245.80
44.00	.98666	.00151	245.80
44.50	.98633	.00257	245.90
45.00	.98923	.00425	245.80
45.50	.99058	.00257	245.80
46.00	.99180	.00257	245.80
46.50	.99315	.00208	245.80
47.00	.99388	.00004	245.80
47.50	.99319	-.00152	245.90
48.00	.99237	-.00176	246.00
48.50	.99142	.00135	246.10
49.00	.99371	.00159	246.00
49.50	.99302	-.00176	246.10

NORMALIZED DATA FROM RUN 55 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.99195	-.00009	246.20
50.50	.99293	.00290	246.20
51.00	.99485	.00061	246.10
51.50	.99354	-.00070	246.20
52.00	.99416	.00086	246.20
52.50	.99440	.00229	246.20
53.00	.99645	.00241	246.10
53.50	.99681	-.00082	246.10
54.00	.99563	.00074	246.20
54.50	.99755	.00025	246.10
55.00	.99587	.00025	246.20
55.50	.99779	.00049	246.10
56.00	.99636	.00037	246.20
56.50	.99816	.00049	246.10
57.00	.99685	.00061	246.20
57.50	.99877	.00012	246.10
58.00	.99697	.00012	246.20
58.50	.99890	.00025	246.10
59.00	.99722	.00012	246.20
59.50	.99902	.00049	246.10
60.00	.99771	.00037	246.20
60.50	.99939	.00180	246.10
61.00	.99951	.00000	246.10
61.50	.99939	-.00131	246.10
62.00	.99820	.00025	246.20
62.50	.99963	-.00012	246.10
63.00	.99808	.00025	246.20
63.50	.99988	.00012	246.10
64.00	.99820	-.00336	246.20
64.50	.99652	.00025	246.30
65.00	.99844	.00348	246.20
65.50	1.00000	-.00168	246.10

NORMALIZED DATA FROM RUN 58

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00071	256.90
1.00	.00142	.00199	256.90
2.00	.00399	.00274	256.90
3.00	.00690	.00398	256.90
4.00	.01195	.00379	256.80
5.00	.01449	.00438	256.90
6.00	.02070	.00455	256.80
7.00	.02360	.00608	256.90
8.00	.03286	.00784	256.70
9.00	.03928	.00665	256.70
10.00	.04617	.00730	256.70
11.00	.05388	.00994	256.70
12.00	.06606	.01011	256.50
13.00	.07409	.01246	256.60
14.00	.09099	.01316	256.20
15.00	.10042	.01250	256.30
16.00	.11599	.01384	256.10
17.00	.12811	.01484	256.20
18.00	.14566	.01665	256.00
19.00	.16142	.01853	256.00
20.00	.18272	.01882	255.70
21.00	.19907	.01781	255.70
22.00	.21835	.01786	255.60
23.00	.23479	.01939	255.70
24.00	.25712	.02009	255.50
25.00	.27497	.02180	255.60
26.00	.30072	.02132	255.20
27.00	.31761	.02037	255.40
28.00	.34146	.02237	255.20
29.00	.36235	.02331	255.20
30.00	.38807	.02241	255.00
31.00	.40718	.02341	255.20
32.00	.43490	.02541	254.90
33.00	.45801	.02335	254.90
34.00	.48159	.02270	254.90
35.00	.50341	.02500	255.00
36.00	.53159	.02552	254.70
37.00	.55445	.02422	254.80
38.00	.58003	.02399	254.70
39.00	.60243	.02335	254.80
40.00	.62673	.02318	254.70
41.00	.64879	.02300	254.70
42.00	.67274	.02001	254.60
43.00	.68882	.01861	254.80
44.00	.70996	.01815	254.70
45.00	.72511	.01815	254.90
46.00	.74625	.01891	254.80
47.00	.76293	.01727	254.90
48.00	.78079	.01609	254.90
49.00	.79512	.01563	255.10

NORMALIZED DATA FROM RUN 58 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
50.00	.81205	.01534	255.10
51.00	.82581	.01518	255.20
52.00	.84240	.01323	255.10
53.00	.85227	.01324	255.40
54.00	.86888	.01142	255.20
55.00	.87512	.01132	255.60
56.00	.89151	.01144	255.30
57.00	.89800	.01003	255.60
58.00	.91158	.00892	255.40
59.00	.91584	.00686	255.70
60.00	.92530	.00899	255.70
61.00	.93382	.00717	255.70
62.00	.93964	.00499	255.80
63.00	.94380	.00648	256.00
64.00	.95260	.00595	255.80
65.00	.95571	.00413	256.00
66.00	.96085	.00408	256.00
67.00	.96386	.00361	256.10
68.00	.96807	.00143	256.10
69.00	.96672	.00090	256.40
70.00	.96987	.00208	256.40
71.00	.97088	.00350	256.60
72.00	.97688	.00251	256.40
73.00	.97590	.00233	256.60
74.00	.98155	.00157	256.40
75.00	.97903	-.00021	256.70
76.00	.98113	.00228	256.70
77.00	.98358	.00281	256.70
78.00	.98676	.00134	256.60
79.00	.98627	.00028	256.70
80.00	.98732	.00123	256.70
81.00	.98872	.00217	256.70
82.00	.99166	-.00043	256.60
83.00	.98786	-.00078	256.90
84.00	.99010	.00064	256.80
85.00	.98914	.00093	256.90
86.00	.99197	.00070	256.80
87.00	.99054	.00047	256.90
88.00	.99290	.00058	256.80
89.00	.99171	.00053	256.90
90.00	.99395	.00058	256.80
91.00	.99288	.00041	256.90
92.00	.99477	.00035	256.80
93.00	.99358	.00064	256.90
94.00	.99605	.00064	256.80
95.00	.99486	.00023	256.90
96.00	.99652	-.00006	256.80
97.00	.99475	-.00006	256.90
98.00	.99640	.00029	256.80
99.00	.99533	-.00030	256.90

NORMALIZED DATA FROM RUN 58 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. F
100.00	.99580	.00035	256.90
101.00	.99603	.00006	256.90
102.00	.99591	.00000	256.90
103.00	.99603	.00029	256.90
104.00	.99650	.00023	256.90
105.00	.99650	.00018	256.90
106.00	.99685	.00035	256.90
107.00	.99720	.00012	256.90
108.00	.99708	.00006	256.90
109.00	.99732	.00023	256.90
110.00	.99755	.00018	256.90
111.00	.99767	.00000	256.90
112.00	.99755	.00006	256.90
113.00	.99778	.00023	256.90
114.00	.99802	.00006	256.90
115.00	.99790	.00000	256.90
116.00	.99802	.00018	256.90
117.00	.99825	.00018	256.90
118.00	.99837	.00012	256.90
119.00	.99848	.00012	256.90
120.00	.99860	.00012	256.90
121.00	.99872	.00023	256.90
122.00	.99907	.00018	256.90
123.00	.99907	-.00012	256.90
124.00	.99883	.00006	256.90
125.00	.99918	.00023	256.90
126.00	.99930	.00023	256.90
127.00	.99965	.00018	256.90
128.00	.99965	-.00006	256.90
129.00	.99953	.00012	256.90
130.00	.99988	.00006	256.90
131.00	.99965	.00006	256.90
132.00	1.00000	.00006	256.90

NORMALIZED DATA FROM RUN 59

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00081	250.10
1.00	.00163	.00141	250.00
2.00	.00281	.00318	250.00
3.00	.00799	.00213	249.80
4.00	.00706	.00160	249.90
5.00	.01120	.00278	249.80
6.00	.01262	.00260	249.80
7.00	.01640	.00208	249.70
8.00	.01677	.00120	249.80
9.00	.01879	.00225	249.80
10.00	.02128	.00355	249.80
11.00	.02589	.00373	249.70
12.00	.02874	.00285	249.70
13.00	.03159	.00209	249.70
14.00	.03292	.00338	249.80
15.00	.03835	.00350	249.70
16.00	.03992	.00274	249.80
17.00	.04383	.00409	249.80
18.00	.04811	.00668	249.80
19.00	.05720	.00586	249.60
20.00	.05983	.00469	249.70
21.00	.06658	.00598	249.60
22.00	.07180	.00552	249.60
23.00	.07761	.00605	249.60
24.00	.08390	.00741	249.60
25.00	.09242	.00747	249.50
26.00	.09883	.00647	249.50
27.00	.10536	.00589	249.50
28.00	.11061	.00618	249.60
29.00	.11773	.00736	249.60
30.00	.12532	.00795	249.60
31.00	.13363	.00813	249.60
32.00	.14158	.01024	249.60
33.00	.15411	.01042	249.40
34.00	.16242	.00966	249.40
35.00	.17344	.01019	249.30
36.00	.18281	.00885	249.30
37.00	.19114	.00792	249.40
38.00	.19864	.01019	249.50
39.00	.21153	.01220	249.30
40.00	.22304	.01110	249.30
41.00	.23373	.01092	249.30
42.00	.24488	.01180	249.30
43.00	.25732	.01285	249.20
44.00	.27058	.01327	249.10
45.00	.28385	.01245	249.00
46.00	.29548	.01093	249.00
47.00	.30571	.01017	249.10
48.00	.31583	.01216	249.20
49.00	.33004	.01286	249.10

NORMALIZED DATA FROM RUN 59 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
50.00	.34156	.01304	249.10
51.00	.35613	.01364	249.00
52.00	.36883	.01475	249.00
53.00	.38563	.01481	248.80
54.00	.39844	.01112	248.80
55.00	.40787	.01206	249.00
56.00	.42256	.01469	248.90
57.00	.43725	.01230	248.80
58.00	.44716	.01359	249.00
59.00	.46443	.01470	248.80
60.00	.47656	.01383	248.90
61.00	.49208	.01441	248.80
62.00	.50537	.01329	248.80
63.00	.51867	.01184	248.80
64.00	.52905	.01160	249.00
65.00	.54186	.01481	249.00
66.00	.55866	.01429	248.80
67.00	.57044	.01329	248.90
68.00	.58525	.01363	248.80
69.00	.59771	.01246	248.80
70.00	.61017	.01439	248.80
71.00	.62649	.01234	248.60
72.00	.63485	.01111	248.80
73.00	.64871	.01163	248.70
74.00	.65812	.01181	248.80
75.00	.67233	.01252	248.70
76.00	.68316	.01199	248.80
77.00	.69630	.01169	248.70
78.00	.70654	.01081	248.80
79.00	.71793	.01133	248.80
80.00	.72921	.01139	248.80
81.00	.74072	.01127	248.80
82.00	.75176	.01086	248.80
83.00	.76244	.01062	248.80
84.00	.77300	.01044	248.80
85.00	.78332	.01021	248.80
86.00	.79341	.00997	248.80
87.00	.80326	.00961	248.80
88.00	.81264	.00838	248.80
89.00	.82002	.00850	248.90
90.00	.82964	.00920	248.90
91.00	.83842	.00825	248.90
92.00	.84613	.00855	248.90
93.00	.85551	.00878	248.90
94.00	.86370	.00825	248.90
95.00	.87201	.00684	248.90
96.00	.87737	.00648	249.00
97.00	.88497	.00760	249.00
98.00	.89256	.00700	249.00
99.00	.89897	.00653	249.00

NORMALIZED DATA FROM RUN 59 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
100.00	.90562	.00647	249.00
101.00	.91191	.00629	249.00
102.00	.91820	.00587	249.00
103.00	.92366	.00522	249.00
104.00	.92864	.00522	249.00
105.00	.93410	.00423	249.00
106.00	.93710	.00399	249.10
107.00	.94208	.00287	249.10
108.00	.94284	.00240	249.30
109.00	.94688	.00404	249.30
110.00	.95091	.00386	249.30
111.00	.95459	.00344	249.30
112.00	.95780	.00326	249.30
113.00	.96112	.00326	249.30
114.00	.96432	.00297	249.30
115.00	.96705	.00291	249.30
116.00	.97014	.00273	249.30
117.00	.97251	.00237	249.30
118.00	.97489	.00237	249.30
119.00	.97726	.00225	249.30
120.00	.97940	.00160	249.30
121.00	.98046	.00108	249.30
122.00	.98156	.00161	249.40
123.00	.98369	.00166	249.40
124.00	.98488	.00131	249.40
125.00	.98630	.00043	249.40
126.00	.98573	.00031	249.50
127.00	.98692	.00131	249.50
128.00	.98835	.00025	249.50
129.00	.98742	.00001	249.60
130.00	.98837	.00095	249.60
131.00	.98932	.00083	249.60
132.00	.99003	.00095	249.60
133.00	.99122	.00083	249.60
134.00	.99169	.00059	249.60
135.00	.99240	.00059	249.60
136.00	.99288	.00053	249.60
137.00	.99347	.00089	249.60
138.00	.99466	.00059	249.60
139.00	.99466	.00012	249.60
140.00	.99490	.00036	249.60
141.00	.99537	.00024	249.60
142.00	.99537	.00012	249.60
143.00	.99561	.00042	249.60
144.00	.99620	.00065	249.60
145.00	.99691	.00042	249.60
146.00	.99703	.00012	249.60
147.00	.99715	.00012	249.60
148.00	.99727	.00024	249.60
149.00	.99763	.00036	249.60

NORMALIZED DATA FROM RUN 59 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
150.00	.99798	.00012	249.60
151.00	.99786	.00006	249.60
152.00	.99810	.00012	249.60
153.00	.99810	.00006	249.60
154.00	.99822	.00024	249.60
155.00	.99858	.00018	249.60
156.00	.99858	.00012	249.60
157.00	.99881	.00024	249.60
158.00	.99905	.00018	249.60
159.00	.99917	.00006	249.60
160.00	.99917	.00006	249.60
161.00	.99929	.00012	249.60
162.00	.99941	.00030	249.60
163.00	.99988	.00024	249.60
164.00	.99988	.00000	249.60
165.00	.99988	.00000	249.60
166.00	.99988	.00006	249.60
167.00	1.00000	-.00006	249.60

NORMALIZED DATA FROM RUN 60

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00168	248.60
1.00	.00335	.00706	248.90
2.00	.01413	.01476	248.90
3.00	.03288	.01834	248.70
4.00	.05080	.02318	248.80
5.00	.07923	.03109	248.60
6.00	.11299	.03689	248.40
7.00	.15302	.04353	248.00
8.00	.20006	.04927	247.60
9.00	.25156	.05110	247.20
10.00	.30225	.05316	247.00
11.00	.35788	.05533	246.70
12.00	.41292	.05809	246.50
13.00	.47407	.05485	246.00
14.00	.52263	.04891	246.10
15.00	.57188	.04648	246.00
16.00	.61560	.04461	246.10
17.00	.66109	.04316	246.00
18.00	.70191	.04002	246.10
19.00	.74113	.03448	246.10
20.00	.77087	.03291	246.50
21.00	.80695	.03372	246.50
22.00	.83832	.02842	246.60
23.00	.86378	.02413	246.80
24.00	.88657	.02224	247.00
25.00	.90826	.01843	247.10
26.00	.92344	.01522	247.40
27.00	.93870	.01496	247.50
28.00	.95335	.01032	247.50
29.00	.95934	.00676	247.90
30.00	.96686	.00596	248.10
31.00	.97125	.00348	248.40
32.00	.97382	.00371	248.70
33.00	.97867	.00261	248.80
34.00	.97905	.00249	249.10
35.00	.98365	.00442	249.10
36.00	.98788	.00254	249.10
37.00	.98873	-.00036	249.20
38.00	.98717	.00224	249.40
39.00	.99321	.00206	249.20
40.00	.99128	-.00127	249.40
41.00	.99068	-.00072	249.50
42.00	.98984	.00000	249.60
43.00	.99068	.00097	249.60
44.00	.99177	.00061	249.60
45.00	.99189	.00115	249.60
46.00	.99407	.00109	249.50
47.00	.99407	.00006	249.50
48.00	.99419	-.00054	249.50
49.00	.99298	-.00030	249.60

NORMALIZED DATA FROM RUN 60 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
50.00	.99359	.00036	249.60
51.00	.99371	.00006	249.60
52.00	.99371	.00018	249.60
53.00	.99407	.00006	249.60
54.00	.99383	-.00012	249.60
55.00	.99383	-.00157	249.60
56.00	.99069	.00036	249.80
57.00	.99456	.00018	249.60
58.00	.99105	.00018	249.80
59.00	.99492	.00200	249.60
60.00	.99504	.00024	249.60
61.00	.99540	.00018	249.60
62.00	.99540	.00000	249.60
63.00	.99540	.00000	249.60
64.00	.99540	.00012	249.60
65.00	.99565	.00036	249.60
66.00	.99613	.00018	249.60
67.00	.99601	.00000	249.60
68.00	.99613	.00097	249.60
69.00	.99794	-.00091	249.50
70.00	.99432	-.00091	249.70
71.00	.99613	.00097	249.60
72.00	.99625	.00097	249.60
73.00	.99807	.00000	249.50
74.00	.99625	-.00091	249.60
75.00	.99625	.00000	249.60
76.00	.99625	.00091	249.60
77.00	.99807	-.00091	249.50
78.00	.99444	.00097	249.70
79.00	1.00000	.00097	249.40

NORMALIZED DATA FROM RUN 61

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00186	245.10
1.00	.00372	.00308	245.00
2.00	.00616	.00352	245.10
3.00	.01077	.00534	245.10
4.00	.01683	.00661	245.10
5.00	.02399	.00807	245.10
6.00	.03297	.00970	245.10
7.00	.04340	.01423	245.10
8.00	.06143	.01714	244.80
9.00	.07767	.01751	244.70
10.00	.09646	.02000	244.60
11.00	.11767	.02477	244.50
12.00	.14599	.02785	244.10
13.00	.17338	.02745	243.90
14.00	.20089	.02999	243.80
15.00	.23335	.03132	243.50
16.00	.26353	.03296	243.40
17.00	.29926	.03490	243.10
18.00	.33332	.03376	243.00
19.00	.36678	.03352	242.90
20.00	.40036	.03358	242.80
21.00	.43394	.03352	242.70
22.00	.46740	.03201	242.60
23.00	.49797	.03057	242.60
24.00	.52854	.03002	242.60
25.00	.55802	.02978	242.60
26.00	.58810	.02882	242.60
27.00	.61566	.02863	242.70
28.00	.64536	.02886	242.60
29.00	.67338	.02735	242.60
30.00	.70007	.02567	242.60
31.00	.72471	.02410	242.70
32.00	.74827	.02445	242.80
33.00	.77362	.02384	242.80
34.00	.79594	.02010	242.80
35.00	.81382	.01853	243.00
36.00	.83300	.01845	243.10
37.00	.85071	.01543	243.10
38.00	.86386	.01440	243.30
39.00	.87950	.01420	243.30
40.00	.89226	.01167	243.40
41.00	.90285	.01058	243.60
42.00	.91342	.01045	243.70
43.00	.92375	.00954	243.80
44.00	.93251	.00833	243.90
45.00	.94041	.00748	244.00
46.00	.94746	.00777	244.10
47.00	.95595	.00657	244.10
48.00	.96059	.00457	244.30
49.00	.96510	.00426	244.40

NORMALIZED DATA FROM RUN 61 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
50.00	.96912	.00450	244.50
51.00	.97409	.00371	244.50
52.00	.97653	.00250	244.60
53.00	.97909	.00304	244.70
54.00	.98261	.00315	244.70
55.00	.98540	.00189	244.70
56.00	.98639	.00152	244.80
57.00	.98845	.00134	244.80
58.00	.98907	.00086	244.90
59.00	.99016	.00158	244.90
60.00	.99222	.00164	244.90
61.00	.99344	-.00023	244.90
62.00	.99176	-.00029	245.10
63.00	.99286	-.00059	245.10
64.00	.99058	.00037	245.30
65.00	.99360	.00109	245.20
66.00	.99276	.00145	245.30
67.00	.99650	.00049	245.10
68.00	.99373	.00145	245.30
69.00	.99939	.00205	245.00
70.00	.99783	-.00066	245.10
71.00	.99807	.00018	245.10
72.00	.99819	-.00084	245.10
73.00	.99639	-.00265	245.20
74.00	.99289	.00012	245.40
75.00	.99663	.00259	245.20
76.00	.99807	.00169	245.10
77.00	1.00000	-.00060	245.00

NORMALIZED DATA FROM RUN 62

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00018	245.10
5.00	.00180	.00012	245.00
10.00	.00119	.00022	245.10
15.00	.00396	.00026	245.00
20.00	.00384	.00035	245.10
25.00	.00744	.00044	245.00
30.00	.00828	.00054	245.10
35.00	.01284	.00080	245.00
40.00	.01632	.00102	245.10
45.00	.02304	.00119	245.00
50.00	.02820	.00152	245.10
55.00	.03829	.00200	245.00
60.00	.04825	.00218	245.00
65.00	.06013	.00257	245.00
70.00	.07394	.00287	245.00
75.00	.08882	.00332	245.00
80.00	.10719	.00370	244.90
85.00	.12579	.00387	244.90
90.00	.14584	.00435	244.90
95.00	.16924	.00469	244.80
100.00	.19277	.00490	244.80
105.00	.21822	.00515	244.80
110.00	.24426	.00534	244.80
115.00	.27163	.00546	244.80
120.00	.29888	.00567	244.80
125.00	.32829	.00573	244.70
130.00	.35614	.00549	244.70
135.00	.38314	.00561	244.70
140.00	.41219	.00561	244.60
145.00	.43920	.00559	244.60
150.00	.46813	.00571	244.60
155.00	.49634	.00571	244.60
160.00	.52527	.00583	244.60
165.00	.55467	.00579	244.60
170.00	.58312	.00576	244.60
175.00	.61229	.00573	244.60
180.00	.64038	.00568	244.60
185.00	.66907	.00574	244.60
190.00	.69775	.00541	244.60
195.00	.72320	.00510	244.60
200.00	.74877	.00485	244.60
205.00	.77170	.00447	244.60
210.00	.79342	.00385	244.60
215.00	.81023	.00365	244.70
220.00	.82991	.00383	244.70
225.00	.84852	.00364	244.70
230.00	.86628	.00344	244.70
235.00	.88297	.00306	244.70
240.00	.89689	.00266	244.70
245.00	.90961	.00250	244.70

NORMALIZED DATA FROM RUN 62 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
250.00	.92186	.00221	244.70
255.00	.93170	.00180	244.70
260.00	.93986	.00151	244.80
265.00	.94683	.00130	244.80
270.00	.95283	.00132	244.80
275.00	.96003	.00106	244.80
280.00	.96339	.00100	244.90
285.00	.96999	.00082	244.80
290.00	.97155	.00065	244.90
295.00	.97647	.00071	244.80
300.00	.97863	.00067	244.90
305.00	.98320	.00048	244.80
310.00	.98344	.00040	244.90
315.00	.98716	.00037	244.80
320.00	.98716	.00017	244.90
325.00	.98884	.00018	244.90
330.00	.98896	.00023	245.00
335.00	.99112	.00018	244.90
340.00	.99076	.00022	245.00
345.00	.99328	.00010	244.90
350.00	.99172	.00013	245.00
355.00	.99460	.00034	244.90
360.00	.99508	.00013	244.90
365.00	.99592	.00012	244.90
370.00	.99628	.00010	244.90
375.00	.99688	-.00002	244.90
380.00	.99604	.00008	245.00
385.00	.99772	.00005	244.90
390.00	.99652	.00005	245.00
395.00	.99820	.00026	244.90
400.00	.99916	.00012	244.90
405.00	.99940	.00005	244.90
410.00	.99964	.00002	244.90
415.00	.99964	.00004	244.90
420.00	1.00000	-.00012	244.90

NORMALIZED DATA FROM RUN 63

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00365	262.80
1.00	.00731	.00632	262.60
2.00	.01264	.00880	262.70
3.00	.02491	.01069	262.50
4.00	.03402	.01298	262.60
5.00	.05088	.01663	262.40
6.00	.06727	.02138	262.40
7.00	.09364	.02605	262.00
8.00	.11938	.02960	261.90
9.00	.15285	.03364	261.50
10.00	.18667	.03668	261.30
11.00	.22621	.03874	260.90
12.00	.26414	.04040	260.70
13.00	.30700	.04123	260.30
14.00	.34660	.04218	260.20
15.00	.39135	.04344	259.90
16.00	.43347	.04475	259.80
17.00	.48085	.04384	259.50
18.00	.52116	.04307	259.60
19.00	.56700	.04267	259.40
20.00	.60650	.04241	259.50
21.00	.65182	.03958	259.20
22.00	.68565	.03423	259.40
23.00	.72028	.03234	259.40
24.00	.75033	.03213	259.60
25.00	.78454	.02982	259.50
26.00	.80996	.02616	259.80
27.00	.83685	.02415	259.90
28.00	.85825	.02308	260.20
29.00	.88302	.01970	260.20
30.00	.89766	.01712	260.70
31.00	.91727	.01709	260.70
32.00	.93183	.01442	260.90
33.00	.94611	.01053	261.00
34.00	.95289	.00892	261.40
35.00	.96395	.00826	261.50
36.00	.96940	.00614	261.80
37.00	.97622	.00482	261.90
38.00	.97903	.00433	262.20
39.00	.98488	.00461	262.20
40.00	.98826	.00292	262.30
41.00	.99072	.00057	262.40
42.00	.98940	-.00012	262.70
43.00	.99048	.00258	262.80
44.00	.99456	.00267	262.70
45.00	.99582	-.00006	262.70
46.00	.99444	-.00017	262.90
47.00	.99547	.00014	262.90
48.00	.99472	.00158	263.00
49.00	.99862	-.00081	262.80
50.00	.99311	.00069	263.20
51.00	1.00000	.00184	262.80

NORMALIZED DATA FROM RUN 64

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00046	267.30
1.00	.00092	.00498	267.70
2.00	.00996	.01217	267.90
3.00	.02526	.01808	267.90
4.00	.04612	.02740	267.90
5.00	.08007	.03677	267.50
6.00	.11966	.04601	267.20
7.00	.17209	.05668	266.60
8.00	.23301	.06488	266.00
9.00	.30185	.06843	265.30
10.00	.36988	.07221	264.90
11.00	.44628	.07459	264.30
12.00	.51905	.06693	263.90
13.00	.58014	.06126	263.80
14.00	.64158	.06069	263.70
15.00	.70153	.05373	263.60
16.00	.74903	.04959	264.00
17.00	.80071	.04511	264.00
18.00	.83925	.03797	264.40
19.00	.87665	.03070	264.60
20.00	.90066	.02418	265.20
21.00	.92501	.02083	265.50
22.00	.94232	.01777	266.00
23.00	.96055	.01305	266.20
24.00	.96843	.00959	266.80
25.00	.97974	.00761	267.00
26.00	.98364	.00323	267.50
27.00	.98619	.00181	267.90
28.00	.98726	.00365	268.30
29.00	.99350	.00206	268.30
30.00	.99139	.00150	268.70
31.00	.99651	.00243	268.60
32.00	.99624	.00037	268.80
33.00	.99725	-.00043	268.90
34.00	.99539	-.00025	269.10
35.00	.99675	.00056	269.10
36.00	.99651	.00033	269.20
37.00	.99741	.00079	269.20
38.00	.99809	.00068	269.20
39.00	.99877	-.00041	269.20
40.00	.99728	.00040	269.30
41.00	.99957	.00034	269.20
42.00	.99796	-.00075	269.30
43.00	.99807	-.00058	269.30
44.00	.99681	.00023	269.40
45.00	.99853	.00011	269.30
46.00	.99703	.00011	269.40
47.00	.99875	-.00069	269.30
48.00	.99565	-.00052	269.50
49.00	.99771	.00103	269.40

NORMALIZED DATA FROM RUN 64 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
50.00	.99771	.00086	269.40
51.00	.99943	.00000	269.30
52.00	.99771	-.00086	269.40
53.00	.99771	.00017	269.40
54.00	.99805	.00028	269.40
55.00	.99828	.00000	269.40
56.00	.99805	.00086	269.40
57.00	1.00000	.00011	269.30

NORMALIZED DATA FROM RUN 66

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.0	.00000	.00001	325.8
10.0	.00017	.00003	325.8
20.0	.00056	.00001	325.7
30.0	.00029	.00004	325.7
40.0	.00133	.00010	325.7
50.0	.00237	-.00001	325.7
60.0	.00111	-.00011	325.7
70.0	.00018	-.00003	325.7
80.0	.00057	.00010	325.7
90.0	.00227	.00009	325.7
100.0	.00233	.00005	325.7
110.0	.00337	.00002	325.7
120.0	.00277	.00009	325.8
130.0	.00512	.00025	325.8
140.0	.00781	.00028	325.8
150.0	.01082	.00020	325.8
160.0	.01186	.00017	325.8
170.0	.01422	.00027	325.8
180.0	.01723	.00025	325.8
190.0	.01926	.00020	325.8
200.0	.02129	.00022	325.8
210.0	.02365	.00028	325.8
220.0	.02699	.00038	325.8
230.0	.03131	.00032	325.8
240.0	.03334	.00024	325.8
250.0	.03603	.00035	325.8
260.0	.04035	.00056	325.8
270.0	.04731	.00056	325.8
280.0	.05164	.00040	326.0
290.0	.05531	.00045	326.0
300.0	.06062	.00050	326.0
310.0	.06528	.00048	326.1
320.0	.07026	.00050	326.1
330.0	.07524	.00051	326.1
340.0	.08056	.00053	326.1
350.0	.08587	.00048	326.1
360.0	.09020	.00051	326.0
370.0	.09617	.00058	326.0
380.0	.10181	.00068	326.0
390.0	.10975	.00074	326.0
400.0	.11670	.00066	326.0
410.0	.12300	.00066	326.0
420.0	.12996	.00066	326.0
430.0	.13626	.00060	326.0
440.0	.14190	.00058	326.0
450.0	.14787	.00065	326.0
460.0	.15482	.00071	325.9
470.0	.16211	.00079	325.9
480.0	.17070	.00078	325.9
490.0	.17766	.00073	325.9

NORMALIZED DATA FROM RUN 66 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
500.0	.18527	.00076	325.9
510.0	.19288	.00076	325.9
520.0	.20050	.00074	325.9
530.0	.20778	.00074	325.9
540.0	.21539	.00079	325.9
550.0	.22366	.00076	325.9
560.0	.23062	.00078	326.0
570.0	.23922	.00083	326.0
580.0	.24716	.00081	326.0
590.0	.25543	.00083	326.0
600.0	.26370	.00083	326.0
610.0	.27196	.00081	326.0
620.0	.27991	.00093	326.0
630.0	.29047	.00107	326.0
640.0	.30137	.00099	326.0
650.0	.31030	.00094	326.0
660.0	.32021	.00089	325.8
670.0	.32815	.00088	325.8
680.0	.33773	.00104	325.8
690.0	.34896	.00097	325.8
700.0	.35723	.00094	325.8
710.0	.36780	.00101	325.8
720.0	.37738	.00089	325.8
730.0	.38565	.00088	325.8
740.0	.39491	.00097	325.8
750.0	.40515	.00106	325.8
760.0	.41604	.00116	325.9
770.0	.42826	.00107	325.9
780.0	.43751	.00094	325.9
790.0	.44709	.00106	325.9
800.0	.45865	.00099	325.9
810.0	.46692	.00106	325.8
820.0	.47979	.00112	325.8
830.0	.48937	.00099	325.8
840.0	.49961	.00104	325.8
850.0	.51018	.00104	325.8
860.0	.52042	.00102	325.8
870.0	.53066	.00097	325.8
880.0	.53992	.00096	325.8
890.0	.54983	.00104	325.8
900.0	.56073	.00104	325.8
910.0	.57064	.00106	325.8
920.0	.58186	.00120	325.8
930.0	.59473	.00116	325.8
940.0	.60497	.00106	325.8
950.0	.61587	.00127	325.8
960.0	.63038	.00135	325.8
970.0	.64292	.00120	325.8
980.0	.65448	.00119	325.8
990.0	.66669	.00124	325.8

NORMALIZED DATA FROM RUN 66 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
1000.0	.67923	.00120	325.8
1010.0	.69078	.00111	325.7
1020.0	.70135	.00102	325.7
1030.0	.71126	.00097	325.7
1040.0	.72085	.00097	325.7
1050.0	.73076	.00111	325.7
1060.0	.74297	.00117	325.7
1070.0	.75419	.00099	325.7
1080.0	.76279	.00088	325.7
1090.0	.77172	.00102	325.7
1100.0	.78327	.00101	325.7
1110.0	.79187	.00088	325.6
1120.0	.80080	.00096	325.6
1130.0	.81104	.00101	325.6
1140.0	.82095	.00093	325.6
1150.0	.82955	.00093	325.6
1160.0	.83946	.00096	325.6
1170.0	.84872	.00086	325.6
1180.0	.85666	.00076	325.6
1190.0	.86394	.00084	325.6
1200.0	.87352	.00089	325.6
1210.0	.88179	.00074	325.5
1220.0	.88842	.00073	325.5
1230.0	.89636	.00076	325.5
1240.0	.90364	.00076	325.5
1250.0	.91159	.00079	325.5
1260.0	.91953	.00065	325.5
1270.0	.92451	.00061	325.5
1280.0	.93179	.00070	325.5
1290.0	.93842	.00051	325.5
1300.0	.94209	.00048	325.5
1310.0	.94806	.00050	325.8
1320.0	.95206	.00048	325.8
1330.0	.95770	.00040	325.8
1340.0	.96006	.00037	325.8
1350.0	.96504	.00043	325.8
1360.0	.96871	.00033	325.7
1370.0	.97173	.00028	325.7
1380.0	.97441	.00037	325.7
1390.0	.97907	.00040	325.7
1400.0	.98241	.00028	325.7
1410.0	.98476	.00019	325.5
1420.0	.98613	.00019	325.5
1430.0	.98849	.00025	325.5
1440.0	.99118	.00025	325.5
1450.0	.99353	.00010	325.5
1460.0	.99326	-.00001	325.5
1470.0	.99332	.00010	325.5
1480.0	.99534	.00033	325.5
1490.0	1.00000	.00023	325.5

NORMALIZED DATA FROM RUN 68

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00014	326.10
5.00	.00142	.00020	326.00
10.00	.00203	.00012	326.00
15.00	.00264	.00015	326.00
20.00	.00356	.00018	326.00
25.00	.00447	.00018	326.00
30.00	.00539	.00012	326.00
35.00	.00569	.00021	326.00
40.00	.00752	.00024	326.00
45.00	.00813	.00018	326.00
50.00	.00935	.00034	326.00
55.00	.01149	.00030	326.00
60.00	.01240	.00034	326.00
65.00	.01484	.00058	326.00
70.00	.01819	.00058	326.00
75.00	.02063	.00046	326.00
80.00	.02277	.00070	326.00
85.00	.02765	.00098	326.00
90.00	.03253	.00095	326.00
95.00	.03710	.00116	326.00
100.00	.04411	.00146	326.00
105.00	.05174	.00165	326.00
110.00	.06058	.00174	326.00
115.00	.06912	.00180	326.00
120.00	.07857	.00226	326.00
125.00	.09168	.00229	326.00
130.00	.10144	.00226	326.00
135.00	.11425	.00265	326.00
140.00	.12797	.00271	326.00
145.00	.14139	.00281	326.00
150.00	.15602	.00290	326.00
155.00	.17035	.00311	326.00
160.00	.18713	.00239	326.00
165.00	.19426	.00215	326.10
170.00	.20859	.00290	326.10
175.00	.22323	.00233	326.10
180.00	.23188	.00236	326.20
185.00	.24682	.00296	326.20
190.00	.26146	.00287	326.20
195.00	.27548	.00248	326.20
200.00	.28625	.00269	326.30
205.00	.30242	.00332	326.30
210.00	.31949	.00326	326.30
215.00	.33504	.00338	326.30
220.00	.35334	.00357	326.30
225.00	.37072	.00335	326.30
230.00	.38688	.00348	326.30
235.00	.40548	.00297	326.30
240.00	.41655	.00291	326.40
245.00	.43454	.00363	326.40

NORMALIZED DATA FROM RUN 68 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
250.00	.45283	.00384	326.40
255.00	.47296	.00390	326.40
260.00	.49187	.00375	326.40
265.00	.51047	.00384	326.40
270.00	.53029	.00415	326.40
275.00	.55194	.00415	326.40
280.00	.57176	.00366	326.40
285.00	.58853	.00354	326.40
290.00	.60713	.00403	326.40
295.00	.62878	.00396	326.40
300.00	.64677	.00378	326.40
305.00	.66659	.00433	326.40
310.00	.69007	.00393	326.40
315.00	.70593	.00424	326.40
320.00	.73246	.00506	326.40
325.00	.75655	.00476	326.40
330.00	.78003	.00467	326.40
335.00	.80320	.00457	326.40
340.00	.82576	.00436	326.40
345.00	.84680	.00439	326.40
350.00	.86967	.00467	326.40
355.00	.89346	.00473	326.40
360.00	.91694	.00436	326.40
365.00	.93706	.00372	326.40
370.00	.95414	.00323	326.40
375.00	.96939	.00238	326.40
380.00	.97793	.00203	326.40
385.00	.98973	.00178	326.30
390.00	.99573	.00084	326.20
395.00	.99817	.00015	326.20
400.00	.99726	.00018	326.20
405.00	1.00000	.00024	326.20

NORMALIZED DATA FROM RUN 69

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. °F
.00	.00000	.00007	325.80
5.00	.00066	.00015	325.80
10.00	.00154	.00026	325.80
15.00	.00330	.00026	325.80
20.00	.00418	.00018	325.80
25.00	.00505	.00015	325.80
30.00	.00564	.00015	325.80
35.00	.00652	.00006	325.80
40.00	.00622	-.00003	325.80
45.00	.00622	.00003	325.80
50.00	.00652	.00023	325.80
55.00	.00857	.00020	325.80
60.00	.00857	.00000	325.80
65.00	.00857	.00003	325.80
70.00	.00886	.00015	325.80
75.00	.01003	.00015	325.80
80.00	.01032	.00018	325.80
85.00	.01179	.00038	325.80
90.00	.01413	.00056	325.80
95.00	.01735	.00067	325.80
100.00	.02086	.00064	325.80
105.00	.02379	.00073	325.80
110.00	.02818	.00082	325.80
115.00	.03198	.00082	325.80
120.00	.03637	.00114	325.80
125.00	.04340	.00132	325.80
130.00	.04954	.00149	325.80
135.00	.05833	.00170	325.80
140.00	.06652	.00179	325.80
145.00	.07618	.00190	325.80
150.00	.08555	.00208	325.80
155.00	.09696	.00258	325.80
160.00	.11131	.00269	325.80
165.00	.12389	.00275	325.80
170.00	.13882	.00296	325.80
175.00	.15346	.00296	325.80
180.00	.16838	.00316	325.80
185.00	.18507	.00337	325.80
190.00	.20204	.00325	325.80
195.00	.21756	.00354	325.80
200.00	.23746	.00383	325.80
205.00	.25590	.00309	325.80
210.00	.26841	.00321	325.90
215.00	.28802	.00398	325.90
220.00	.30821	.00359	325.90
225.00	.32394	.00377	326.00
230.00	.34589	.00445	326.00
235.00	.36843	.00397	326.00
240.00	.38561	.00394	326.10
245.00	.40785	.00436	326.10

NORMALIZED DATA FROM RUN 69 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
250.00	.42922	.00424	326.10
255.00	.45030	.00427	326.10
260.00	.47196	.00454	326.10
265.00	.49567	.00457	326.10
270.00	.51762	.00462	326.10
275.00	.54191	.00489	326.10
280.00	.56650	.00483	326.10
285.00	.59021	.00580	326.10
290.00	.62446	.00594	326.10
295.00	.64963	.00501	326.10
300.00	.67451	.00486	326.10
305.00	.69822	.00489	326.10
310.00	.72339	.00509	326.10
315.00	.74915	.00509	326.10
320.00	.77432	.00518	326.10
325.00	.80096	.00515	326.10
330.00	.82584	.00492	326.10
335.00	.85013	.00495	326.10
340.00	.87531	.00495	326.10
345.00	.89960	.00506	326.10
350.00	.92595	.00498	326.10
355.00	.94936	.00442	326.10
360.00	.97014	.00340	326.10
365.00	.98332	.00228	326.10
370.00	.99298	.00114	326.10
375.00	.99473	.00047	326.10
380.00	.99766	.00029	326.10
385.00	.99766	.00003	326.10
390.00	.99795	.00006	326.10
395.00	.99824	.00006	326.10
400.00	.99854	.00003	326.10
405.00	.99854	.00015	326.10
410.00	1.00000	.00015	326.10

NORMALIZED DATA FROM RUN 70

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00022	338.20
5.00	.00224	.00046	338.20
10.00	.00457	.00047	338.20
15.00	.00690	.00061	338.20
20.00	.01069	.00087	338.20
25.00	.01564	.00108	338.20
30.00	.02146	.00137	338.20
35.00	.02933	.00175	338.20
40.00	.03894	.00227	338.20
45.00	.05204	.00259	338.20
50.00	.06485	.00240	338.20
55.00	.07608	.00281	338.30
60.00	.09297	.00390	338.30
65.00	.11511	.00437	338.30
70.00	.13666	.00401	338.30
75.00	.15516	.00409	338.50
80.00	.17758	.00498	338.50
85.00	.20496	.00556	338.50
90.00	.23320	.00559	338.50
95.00	.26087	.00580	338.50
100.00	.29116	.00591	338.50
105.00	.31999	.00591	338.50
110.00	.35028	.00609	338.50
115.00	.38086	.00620	338.50
120.00	.41231	.00641	338.50
125.00	.44493	.00652	338.50
130.00	.47754	.00652	338.50
135.00	.51016	.00670	338.50
140.00	.54452	.00676	338.50
145.00	.57772	.00606	338.50
150.00	.60510	.00591	338.50
155.00	.63684	.00681	338.50
160.00	.67325	.00711	338.50
165.00	.70790	.00702	338.50
170.00	.74343	.00716	338.50
175.00	.77954	.00711	338.50
180.00	.81449	.00681	338.50
185.00	.84769	.00670	338.50
190.00	.88147	.00649	338.50
195.00	.91263	.00600	338.50
200.00	.94146	.00533	338.50
205.00	.96593	.00419	338.50
210.00	.98340	.00291	338.50
215.00	.99505	.00157	338.50
220.00	.99913	.00044	338.50
225.00	.99942	.00009	338.50
230.00	1.00000	.00003	338.50

NORMALIZED DATA FROM RUN 71

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00022	338.60
5.00	.00222	.00037	338.60
10.00	.00369	.00029	338.60
15.00	.00515	.00044	338.60
20.00	.00808	.00050	338.60
25.00	.01013	.00056	338.60
30.00	.01365	.00094	338.60
35.00	.01951	.00126	338.60
40.00	.02625	.00141	338.60
45.00	.03358	.00161	338.60
50.00	.04237	.00149	338.60
55.00	.04846	.00130	338.70
60.00	.05542	.00228	338.80
65.00	.07125	.00343	338.80
70.00	.08971	.00399	338.80
75.00	.11111	.00443	338.80
80.00	.13397	.00475	338.80
85.00	.15858	.00495	338.80
90.00	.18350	.00513	338.80
95.00	.20987	.00528	338.80
100.00	.23625	.00587	338.80
105.00	.26856	.00602	338.70
110.00	.29640	.00560	338.70
115.00	.32454	.00563	338.70
120.00	.35267	.00580	338.70
125.00	.38256	.00607	338.70
130.00	.41334	.00559	338.70
135.00	.43847	.00556	338.80
140.00	.46895	.00621	338.80
145.00	.50060	.00633	338.80
150.00	.53225	.00636	338.80
155.00	.56420	.00648	338.80
160.00	.59702	.00633	338.80
165.00	.62750	.00627	338.80
170.00	.65974	.00648	338.80
175.00	.69227	.00385	338.80
180.00	.69829	.00686	339.30
185.00	.76085	.00939	338.80
190.00	.79221	.00651	338.80
195.00	.82591	.00654	338.80
200.00	.85757	.00662	338.80
205.00	.89215	.00677	338.80
210.00	.92527	.00621	338.80
215.00	.95428	.00528	338.80
220.00	.97802	.00366	338.80
225.00	.99091	-.00086	338.80
230.00	.96938	.00073	339.30
235.00	.99824	.00306	338.80
240.00	1.00000	.00015	338.80

NORMALIZED DATA FROM RUN 72

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.0	.00000	.00001	339.1
10.0	.00023	.00006	339.1
20.0	.00119	.00021	339.1
30.0	.00447	.00020	339.1
40.0	.00515	.00013	339.0
50.0	.00698	.00015	339.0
60.0	.00823	.00017	339.0
70.0	.01036	.00015	339.0
80.0	.01132	.00017	339.0
90.0	.01373	.00023	339.0
100.0	.01585	.00024	339.0
110.0	.01855	.00026	339.0
120.0	.02096	.00023	339.0
130.0	.02308	.00023	339.0
140.0	.02549	.00024	338.9
150.0	.02790	.00027	338.9
160.0	.03089	.00034	338.9
170.0	.03474	.00036	338.9
180.0	.03802	.00041	338.9
190.0	.04302	.00053	338.9
200.0	.04860	.00044	338.9
210.0	.05188	.00050	338.9
220.0	.05862	.00050	338.9
230.0	.06189	.00044	338.9
240.0	.06748	.00062	338.9
250.0	.07421	.00054	338.9
260.0	.07835	.00037	338.9
270.0	.08163	.00052	338.9
280.0	.08866	.00062	338.9
290.0	.09395	.00054	339.0
300.0	.09953	.00066	339.0
310.0	.10714	.00072	339.0
320.0	.11387	.00066	339.0
330.0	.12032	.00067	339.0
340.0	.12735	.00085	339.0
350.0	.13726	.00093	339.0
360.0	.14602	.00082	339.0
370.0	.15362	.00088	339.0
380.0	.16353	.00103	339.0
390.0	.17431	.00108	339.1
400.0	.18509	.00112	339.1
410.0	.19673	.00119	339.1
420.0	.20895	.00122	338.9
430.0	.22117	.00119	338.9
440.0	.23281	.00124	338.9
450.0	.24589	.00135	338.9
460.0	.25984	.00132	338.9
470.0	.27235	.00128	338.9
480.0	.28544	.00141	338.9
490.0	.30054	.00150	338.9

NORMALIZED DATA FROM RUN 72 (CONT'D)

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
500.0	.31536	.00142	338.9
510.0	.32902	.00158	338.9
520.0	.34701	.00183	339.1
530.0	.36558	.00177	339.1
540.0	.38241	.00177	339.1
550.0	.40098	.00173	339.1
560.0	.41695	.00176	339.1
570.0	.43609	.00187	339.1
580.0	.45437	.00184	339.1
590.0	.47294	.00193	339.1
600.0	.49295	.00199	339.1
610.0	.51267	.00196	339.1
620.0	.53210	.00190	339.1
630.0	.55067	.00212	339.1
640.0	.57443	.00229	339.1
650.0	.59646	.00215	339.1
660.0	.61733	.00204	339.1
670.0	.63734	.00209	339.1
680.0	.65908	.00210	339.1
690.0	.67938	.00204	339.1
700.0	.69997	.00204	339.1
710.0	.72026	.00194	339.1
720.0	.73883	.00191	339.1
730.0	.75855	.00187	339.1
740.0	.77625	.00178	339.1
750.0	.79424	.00160	339.1
760.0	.80819	.00157	339.1
770.0	.82561	.00164	339.1
780.0	.84100	.00155	339.1
790.0	.85668	.00150	339.1
800.0	.87092	.00141	339.1
810.0	.88487	.00138	339.1
820.0	.89853	.00118	339.1
830.0	.90844	.00101	339.1
840.0	.91864	.00101	339.1
850.0	.92855	.00102	339.1
860.0	.93904	.00106	339.1
870.0	.94982	.00092	339.1
880.0	.95742	.00062	339.1
890.0	.96214	.00054	339.1
900.0	.96830	.00059	339.1
910.0	.97388	.00059	339.1
920.0	.98004	.00047	339.1
930.0	.98332	.00036	339.1
940.0	.98717	.00027	339.1
950.0	.98872	.00018	339.1
960.0	.99084	.00026	339.1
970.0	.99382	.00024	339.1
980.0	.99566	.00017	339.1
990.0	.99720	.00018	339.1
1000.0	.99932	.00014	339.1
1010.0	1.00000	.00003	339.1

NORMALIZED DATA FROM RUN 73

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00040	347.70
5.00	.00404	.00081	347.70
10.00	.00814	.00005	347.70
15.00	.00451	-.00009	347.80
20.00	.00724	.00044	347.80
25.00	.00888	-.00012	347.80
30.00	.00606	-.00006	347.90
35.00	.00825	.00055	347.90
40.00	.01153	.00066	347.90
45.00	.01481	.00093	347.90
50.00	.02083	.00211	347.90
55.00	.03594	.00263	347.80
60.00	.04715	.00254	347.80
65.00	.06137	.00303	347.80
70.00	.07750	.00394	347.80
75.00	.10073	.00492	347.80
80.00	.12670	.00552	347.80
85.00	.15595	.00610	347.80
90.00	.18766	.00670	347.80
95.00	.22292	.00719	347.80
100.00	.25955	.00688	347.80
105.00	.29172	.00685	347.90
110.00	.32808	.00733	347.90
115.00	.36499	.00749	347.90
120.00	.40298	.00771	347.90
125.00	.44207	.00793	347.90
130.00	.48226	.00859	347.90
135.00	.52799	.00867	347.80
140.00	.56900	.00806	347.80
145.00	.60863	.00834	347.80
150.00	.65237	.00872	347.80
155.00	.69584	.00888	347.80
160.00	.74121	.00894	347.80
165.00	.78522	.00902	347.80
170.00	.83142	.00852	347.80
175.00	.87043	.00830	347.90
180.00	.91444	.00831	347.90
185.00	.95353	.00664	347.90
190.00	.98086	.00391	347.90
195.00	.99262	.00167	347.90
200.00	.99754	.00068	347.90
205.00	.99945	.00025	347.90
210.00	1.00000	-.00003	347.90

NORMALIZED DATA FROM RUN 75

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.00	.00000	.00021	347.60
5.00	.00213	.00035	347.60
10.00	.00351	.00033	347.60
15.00	.00544	.00010	347.60
20.00	.00450	.00018	347.70
25.00	.00727	-.00033	347.70
30.00	.00118	-.00039	347.70
35.00	.00339	.00066	347.70
40.00	.00782	.00105	347.70
45.00	.01390	.00166	347.70
50.00	.02441	.00241	347.70
55.00	.03796	.00299	347.70
60.00	.05427	.00365	347.70
65.00	.07445	.00418	347.70
70.00	.09602	.00434	347.70
75.00	.11786	.00418	347.70
80.00	.13777	.00346	347.70
85.00	.15243	.00357	347.70
90.00	.17344	.00451	347.70
95.00	.19749	.00433	347.70
100.00	.21678	.00455	347.80
105.00	.24304	.00539	347.80
110.00	.27069	.00550	347.80
115.00	.29807	.00559	347.80
120.00	.32662	.00554	347.70
125.00	.35344	.00509	347.70
130.00	.37749	.00514	347.70
135.00	.40487	.00561	347.70
140.00	.43362	.00498	347.70
145.00	.45464	.00398	347.70
150.00	.47344	.00418	347.70
155.00	.49639	.00451	347.70
160.00	.51851	.00445	347.70
165.00	.54090	.00411	347.70
170.00	.55963	.00447	347.80
175.00	.58562	.00539	347.80
180.00	.61355	.00570	347.80
185.00	.64258	.00619	347.80
190.00	.67548	.00739	347.80
195.00	.71648	.00819	347.70
200.00	.75740	.00827	347.70
205.00	.79915	.00885	347.70
210.00	.84588	.00932	347.70
215.00	.89233	.00885	347.70
220.00	.93436	.00735	347.70
225.00	.96588	.00495	347.70
230.00	.98385	.00252	347.70
235.00	.99104	.00122	347.70
240.00	.99602	.00064	347.70
245.00	.99740	.00019	347.70
250.00	.99795	-.00006	347.70
255.00	.99684	-.00003	347.70
260.00	.99767	.00032	347.70
265.00	1.00000	.00004	347.60

NORMALIZED DATA FROM RUN 76

TIME MIN	ALPHA	RATE MIN^{-1}	TEMP. OF
.0	.00000	.00002	347.0
10.0	.00031	.00010	347.0
20.0	.00205	.00016	347.0
30.0	.00351	.00012	347.0
40.0	.00437	.00009	347.0
50.0	.00523	.00013	347.0
60.0	.00697	.00009	347.0
70.0	.00695	.00013	347.0
80.0	.00958	.00034	347.0
90.0	.01370	.00034	347.0
100.0	.01633	.00032	347.0
110.0	.02015	.00040	347.0
120.0	.02427	.00037	347.0
130.0	.02750	.00044	347.0
140.0	.03309	.00054	347.0
150.0	.03839	.00049	347.0
160.0	.04280	.00046	347.0
170.0	.04751	.00043	347.1
180.0	.05133	.00050	347.1
190.0	.05752	.00071	347.1
200.0	.06548	.00074	347.1
210.0	.07226	.00081	347.1
220.0	.08170	.00093	347.1
230.0	.09085	.00086	347.1
240.0	.09881	.00078	347.1
250.0	.10648	.00094	347.1
260.0	.11770	.00112	347.0
270.0	.12892	.00118	346.9
280.0	.14132	.00130	346.9
290.0	.15491	.00130	346.9
300.0	.16731	.00131	346.9
310.0	.18119	.00146	346.9
320.0	.19655	.00167	346.9
330.0	.21458	.00168	346.9
340.0	.23024	.00164	346.9
350.0	.24738	.00174	346.9
360.0	.26511	.00186	346.9
370.0	.28461	.00213	346.9
380.0	.30767	.00220	346.9
390.0	.32865	.00216	346.9
400.0	.35082	.00231	346.8
410.0	.37477	.00241	346.8
420.0	.39901	.00245	346.8
430.0	.42384	.00254	346.8
440.0	.44986	.00278	346.8
450.0	.47943	.00290	346.8
460.0	.50781	.00282	346.8
470.0	.53590	.00278	346.8
480.0	.56340	.00282	346.8
490.0	.59238	.00284	346.8
500.0	.62017	.00275	346.8
510.0	.64737	.00269	346.8
520.0	.67398	.00257	346.8
530.0	.69881	.00256	346.8
540.0	.72513	.00257	346.8
550.0	.75026	.00239	346.7
560.0	.77302	.00202	346.7
570.0	.79075	.00207	346.7
580.0	.81440	.00214	346.7
590.0	.83361	.00197	346.8
600.0	.85370	.00174	346.8
610.0	.86847	.00164	346.8
620.0	.88650	.00171	346.8
630.0	.90275	.00149	346.8
640.0	.91634	.00124	346.8
650.0	.92756	.00115	346.8
660.0	.93937	.00100	346.8
670.0	.94763	.00090	346.8
680.0	.95736	.00081	346.8
690.0	.96385	.00072	346.8
700.0	.97181	.00074	346.8
710.0	.97859	.00054	346.8
720.0	.98271	.00046	346.8
730.0	.98771	.00046	346.8
740.0	.99182	.00046	346.8
750.0	.99683	.00031	346.8
760.0	.99798	.00007	346.8
770.0	.99825	.00010	346.8
780.0	1.00000	.00009	346.8

APPENDIX U

OBSERVED EXPERIMENTAL DATA

OBSERVED EXPERIMENTAL DATA FROM RUN 6

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	79.4	-.---	50.0	259.8	17.210	100.0	259.8	22.470
1.0	125.0	-.---	51.0	259.8	17.320	101.0	259.8	22.570
2.0	158.0	-.---	52.0	259.8	17.420	102.0	259.8	22.670
3.0	183.0	-.---	53.0	259.8	17.540	103.0	259.8	22.760
4.0	199.7	8.230	54.0	259.8	17.640	104.0	259.8	22.855
5.0	213.0	9.580	55.0	259.8	17.750	105.0	259.8	22.950
6.0	222.6	10.690	56.0	259.8	17.860	106.0	259.8	23.040
7.0	231.2	11.550	57.0	259.8	17.970	107.0	259.8	23.140
8.0	237.0	12.235	58.0	259.8	18.075	108.0	259.8	23.225
9.0	242.0	12.770	59.0	259.8	18.180	109.0	259.8	23.320
10.0	245.7	13.198	60.0	259.8	18.285	110.0	259.8	23.410
11.0	249.0	13.525	61.0	259.8	18.400	111.0	259.8	23.500
12.0	251.0	13.780	62.0	259.8	18.500	112.0	259.8	23.590
13.0	253.0	13.991	63.0	259.8	18.605	113.0	259.8	23.680
14.0	254.2	14.145	64.0	259.8	18.710	114.0	259.8	23.760
15.0	255.6	14.270	65.0	259.8	18.820	115.0	259.8	23.855
16.0	256.6	14.370	66.0	259.8	18.925	116.0	259.8	23.930
17.0	257.1	14.440	67.0	259.8	19.025	117.0	259.8	24.010
18.0	257.7	14.495	68.0	259.8	19.140	118.0	259.8	24.110
19.0	258.1	14.545	69.0	259.8	19.250	119.0	259.8	24.190
20.0	258.3	14.585	70.0	259.8	19.350	120.0	259.8	24.270
21.0	258.9	14.620	71.0	259.8	19.460	121.0	259.8	24.350
22.0	259.0	14.660	72.0	259.8	19.560	122.0	259.8	24.425
23.0	259.2	14.700	73.0	259.8	19.665	123.0	259.8	24.505
24.0	259.2	14.755	74.0	259.8	19.775	124.0	259.8	24.590
25.0	259.5	14.805	75.0	259.8	19.885	125.0	259.8	24.665
26.0	259.6	14.875	76.0	259.8	19.990	126.0	259.8	24.745
27.0	259.7	14.950	77.0	259.8	20.098	127.0	259.8	24.810
28.0	259.8	15.020	78.0	259.8	20.200	128.0	259.8	24.895
29.0	259.8	15.100	79.0	259.8	20.310	129.0	259.8	24.970
30.0	259.8	15.185	80.0	259.8	20.420	130.0	259.8	25.040
31.0	259.8	15.270	81.0	259.8	20.525	131.0	259.8	25.120
32.0	259.8	15.355	82.0	259.8	20.630	132.0	259.8	25.190
33.0	259.8	15.450	83.0	259.8	20.735	133.0	259.8	25.240
34.0	259.8	15.548	84.0	259.8	20.840	134.0	259.8	25.338
35.0	259.8	15.645	85.0	259.8	20.945	135.0	259.8	25.400
36.0	259.8	15.745	86.0	259.8	21.055	136.0	259.8	25.470
37.0	259.8	15.850	87.0	259.8	21.160	137.0	259.8	25.530
38.0	259.8	15.950	88.0	259.8	21.265	138.0	259.8	25.600
39.0	259.8	16.055	89.0	259.8	21.375	139.0	259.8	25.655
40.0	259.8	16.160	90.0	259.8	21.475	140.0	259.8	25.710
41.0	259.8	16.260	91.0	259.8	21.570	141.0	259.8	25.788
42.0	259.8	16.365	92.0	259.8	21.675	142.0	259.8	25.840
43.0	259.8	16.470	93.0	259.8	21.780	143.0	259.8	25.900
44.0	259.8	16.575	94.0	259.8	21.880	144.0	259.8	25.955
45.0	259.8	16.685	95.0	259.8	21.975	145.0	259.8	26.010
46.0	259.8	16.792	96.0	259.8	22.070	146.0	259.8	26.085
47.0	259.8	16.895	97.0	259.8	22.170	147.0	259.8	26.110
48.0	259.8	17.000	98.0	259.8	22.270	148.0	259.8	26.170
49.0	259.8	17.100	99.0	259.8	22.385	149.0	259.8	26.220

OBSERVED EXPERIMENTAL DATA FROM RUN 6 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
150.0	259.8	26.280	173.0	260.0	27.105	196.0	260.0	27.560
151.0	259.8	26.325	174.0	259.9	27.135	197.0	260.0	27.580
152.0	259.8	26.375	175.0	260.0	27.170	198.0	260.0	27.590
153.0	259.8	26.420	176.0	259.9	27.190	199.0	260.0	27.600
154.0	259.8	26.465	177.0	260.0	27.210	200.0	260.0	27.610
155.0	259.8	26.500	178.0	260.0	27.240	201.0	260.1	27.620
156.0	259.8	26.555	179.0	260.0	27.255	202.0	260.0	27.635
157.0	259.8	26.588	180.0	260.0	27.280	203.0	260.1	27.640
158.0	259.8	26.630	181.0	260.0	27.300	204.0	260.0	27.650
159.0	259.8	26.670	182.0	260.0	27.320	205.0	260.2	27.655
160.0	259.9	26.705	183.0	260.0	27.330	206.0	260.1	27.670
161.0	259.9	26.740	184.0	260.0	27.360	207.0	260.2	27.680
162.0	259.9	26.785	185.0	260.0	27.380	208.0	260.1	27.685
163.0	259.9	26.810	186.0	260.0	27.400	209.0	260.2	27.690
164.0	259.9	26.855	187.0	260.0	27.410	210.0	260.1	27.695
165.0	260.0	26.880	188.0	260.0	27.440	211.0	260.2	27.700
166.0	259.9	26.900	189.0	260.0	27.455	212.0	260.1	27.702
167.0	260.0	26.935	190.0	260.0	27.470	213.0	260.2	27.708
168.0	259.9	26.965	191.0	260.0	27.480	214.0	260.1	27.710
169.0	260.0	27.000	192.0	260.0	27.500	215.0	260.2	27.715
170.0	259.9	27.030	193.0	260.0	27.510	216.0	260.1	27.720
171.0	260.0	27.060	194.0	260.0	27.530	217.0	260.2	27.725
172.0	259.9	27.085	195.0	260.0	27.555	218.0	260.2	27.730

OBSERVED EXPERIMENTAL DATA FROM RUN 7

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	80.0	--.---	34.0	257.5	24.510	68.0	258.0	30.435
1.0	130.1	--.---	35.0	257.1	24.745	69.0	258.0	30.485
2.0	163.2	10.810	36.0	257.0	24.980	70.0	258.0	30.530
3.0	185.1	13.450	37.0	256.9	25.230	71.0	258.0	30.560
4.0	201.7	15.460	38.0	256.8	25.478	72.0	258.2	30.590
5.0	213.8	17.060	39.0	256.8	25.735	73.0	258.2	30.620
6.0	223.5	18.310	40.0	256.6	25.990	74.0	258.3	30.655
7.0	231.0	19.310	41.0	256.4	26.260	75.0	258.3	30.680
8.0	237.0	20.135	42.0	256.2	26.500	76.0	258.3	30.700
9.0	241.2	20.790	43.0	256.1	26.755	77.0	258.3	30.725
10.0	245.3	21.310	44.0	256.1	27.000	78.0	258.4	30.745
11.0	248.0	21.710	45.0	256.1	27.240	79.0	258.4	30.758
12.0	250.2	22.020	46.0	256.1	27.470	80.0	258.5	30.770
13.0	252.0	22.260	47.0	256.1	27.700	81.0	258.5	30.780
14.0	253.4	22.450	48.0	256.1	27.915	82.0	258.7	30.795
15.0	254.3	22.590	49.0	256.1	28.125	83.0	258.6	30.810
16.0	255.2	22.708	50.0	256.1	28.330	84.0	258.7	30.820
17.0	256.0	22.790	51.0	256.1	28.520	85.0	258.6	30.830
18.0	256.9	22.860	52.0	256.1	28.700	86.0	258.7	30.840
19.0	257.0	22.920	53.0	256.2	28.880	87.0	258.6	30.845
20.0	257.3	22.960	54.0	256.5	29.040	88.0	258.5	30.850
21.0	257.8	22.990	55.0	256.6	29.200	89.0	258.6	30.870
22.0	258.0	23.030	56.0	256.7	29.350	90.0	258.7	30.875
23.0	258.1	23.080	57.0	256.9	29.480	91.0	258.7	30.875
24.0	258.2	23.130	58.0	257.0	29.605	92.0	258.7	30.880
25.0	258.2	23.190	59.0	257.0	29.720	93.0	258.7	30.880
26.0	258.2	23.260	60.0	257.0	29.835	94.0	258.7	30.890
27.0	258.2	23.360	61.0	257.0	29.940	95.0	258.8	30.890
28.0	258.2	23.460	62.0	257.2	30.025	96.0	258.8	30.892
29.0	258.1	23.600	63.0	257.3	30.110	97.0	258.9	30.894
30.0	258.0	23.750	64.0	257.5	30.185	98.0	258.9	30.896
31.0	258.0	23.910	65.0	257.6	30.255	99.0	258.9	30.898
32.0	257.9	24.100	66.0	257.6	30.325	100.0	258.9	30.900
33.0	257.7	24.300	67.0	257.7	30.380			

OBSERVED EXPERIMENTAL DATA FROM RUN 8

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	80.0	--.---	29.0	257.2	29.180	58.0	257.0	35.430
1.0	146.0	16.300	30.0	257.3	29.430	59.0	257.0	35.530
2.0	173.0	18.600	31.0	257.0	29.685	60.0	257.0	35.640
3.0	192.0	20.450	32.0	257.0	29.950	61.0	257.0	35.730
4.0	206.7	21.960	33.0	256.9	30.220	62.0	257.2	35.810
5.0	217.9	23.120	34.0	256.9	30.490	63.0	257.2	35.880
6.0	226.9	24.060	35.0	256.5	30.750	64.0	257.4	35.950
7.0	233.3	24.800	36.0	256.7	31.020	65.0	257.4	36.010
8.0	239.0	25.360	37.0	256.6	31.300	66.0	257.6	36.080
9.0	243.0	25.830	38.0	256.6	31.560	67.0	257.5	36.110
10.0	246.3	26.185	39.0	256.4	31.810	68.0	257.9	36.160
11.0	248.7	26.460	40.0	256.5	32.080	69.0	257.8	36.205
12.0	250.9	26.670	41.0	256.4	32.320	70.0	258.0	36.240
13.0	252.2	26.825	42.0	256.5	32.565	71.0	258.0	36.270
14.0	253.9	26.970	43.0	256.4	32.800	72.0	258.0	36.300
15.0	254.8	27.080	44.0	256.4	33.040	73.0	258.1	36.320
16.0	255.4	27.170	45.0	256.3	33.260	74.0	258.2	36.350
17.0	256.2	27.250	46.0	256.4	33.480	75.0	258.1	36.360
18.0	256.8	27.340	47.0	256.2	33.685	76.0	258.4	36.380
19.0	257.0	27.440	48.0	256.3	33.880	77.0	258.2	36.390
20.0	257.3	27.540	49.0	256.3	34.080	78.0	258.4	36.400
21.0	257.4	27.650	50.0	256.4	34.260	79.0	258.2	36.410
22.0	257.6	27.780	51.0	256.3	34.440	80.0	258.6	36.420
23.0	257.7	27.930	52.0	256.3	34.600	81.0	258.3	36.430
24.0	257.8	28.100	53.0	256.3	34.760	82.0	258.7	36.435
25.0	257.8	28.285	54.0	256.6	34.910	83.0	258.5	36.440
26.0	257.8	28.490	55.0	256.5	35.060	84.0	258.7	36.440
27.0	257.8	28.700	56.0	256.8	35.190			
28.0	257.8	28.930	57.0	256.8	35.310			

OBSERVED EXPERIMENTAL DATA FROM RUN 9

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	79.2	-.---	28.0	259.5	17.040	56.0	257.1	22.910
1.0	133.1	-.---	29.0	259.5	17.120	57.0	257.1	23.100
2.0	163.0	5.970	30.0	259.4	17.220	58.0	257.1	23.270
3.0	185.4	8.180	31.0	259.5	17.330	59.0	257.2	23.435
4.0	202.0	9.890	32.0	259.3	17.460	60.0	257.2	23.600
5.0	215.0	11.309	33.0	259.2	17.600	61.0	257.3	23.750
6.0	224.2	12.360	34.0	259.0	17.780	62.0	257.5	23.890
7.0	232.0	13.270	35.0	259.0	17.950	63.0	257.7	24.000
8.0	238.0	14.000	36.0	258.9	18.140	64.0	257.8	24.120
9.0	242.4	14.600	37.0	258.7	18.350	65.0	258.0	24.220
10.0	246.0	15.070	38.0	258.2	18.580	66.0	258.0	24.320
11.0	249.0	15.445	39.0	258.2	18.810	67.0	258.0	24.400
12.0	251.0	15.740	40.0	258.0	19.045	68.0	258.1	24.480
13.0	253.0	15.990	41.0	258.0	19.290	69.0	258.3	24.550
14.0	254.2	16.185	42.0	257.8	19.550	70.0	258.3	24.600
15.0	255.3	16.320	43.0	257.8	19.800	71.0	258.6	24.660
16.0	256.3	16.435	44.0	257.4	20.070	72.0	258.7	24.710
17.0	257.0	16.530	45.0	257.4	20.320	73.0	258.9	24.745
18.0	257.5	16.610	46.0	257.1	20.590	74.0	259.0	24.780
19.0	258.0	16.660	47.0	257.1	20.850	75.0	259.0	24.800
20.0	258.2	16.710	48.0	257.1	21.100	76.0	259.1	24.830
21.0	258.7	16.740	49.0	257.1	21.350	77.0	259.2	24.850
22.0	258.9	16.780	50.0	257.1	21.600	78.0	259.1	24.860
23.0	259.0	16.810	51.0	257.1	21.820	79.0	259.3	24.880
24.0	259.1	16.840	52.0	257.1	22.070	80.0	259.3	24.880
25.0	259.3	16.880	53.0	257.1	22.290	81.0	259.4	24.890
26.0	259.5	16.910	54.0	257.1	22.500			
27.0	259.5	16.980	55.0	257.1	22.710			

OBSERVED EXPERIMENTAL DATA FROM RUN 10

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	81.3	--.---	28.0	258.0	32.450	56.0	256.0	38.480
1.0	139.3	--.---	29.0	258.0	32.555	57.0	256.0	38.560
2.0	171.0	--.---	30.0	258.0	32.675	58.0	256.2	38.810
3.0	192.4	--.---	31.0	258.0	32.810	59.0	256.0	38.980
4.0	207.3	23.140	32.0	258.0	32.960	60.0	256.2	39.110
5.0	218.5	25.100	33.0	257.9	33.180	61.0	256.2	39.255
6.0	227.4	26.610	34.0	257.8	33.320	62.0	256.8	39.360
7.0	233.1	27.810	35.0	257.6	33.525	63.0	256.7	39.460
8.0	238.6	28.750	36.0	257.5	33.745	64.0	256.9	39.565
9.0	242.4	29.480	37.0	257.2	33.970	65.0	256.9	39.655
10.0	246.0	30.045	38.0	257.1	34.210	66.0	257.1	39.780
11.0	248.3	30.510	39.0	256.9	34.450	67.0	257.0	39.800
12.0	250.5	30.845	40.0	256.9	34.700	68.0	257.6	39.860
13.0	252.0	31.125	41.0	256.8	34.955	69.0	257.5	39.910
14.0	253.2	31.350	42.0	256.8	35.210	70.0	257.9	39.960
15.0	254.1	31.665	43.0	256.4	35.475	71.0	257.9	40.000
16.0	255.0	31.760	44.0	256.4	35.740	72.0	258.0	40.020
17.0	256.2	31.850	45.0	256.1	35.990	73.0	258.0	40.050
18.0	257.0	31.910	46.0	256.2	36.250	74.0	258.2	40.080
19.0	257.0	31.960	47.0	256.1	36.500	75.0	258.1	40.100
20.0	257.0	32.010	48.0	256.2	36.750	76.0	258.4	40.110
21.0	257.0	32.050	49.0	256.0	37.000	77.0	258.2	40.120
22.0	257.3	32.080	50.0	256.0	37.300	78.0	258.6	40.130
23.0	257.3	32.110	51.0	256.0	37.460	79.0	258.4	40.140
24.0	257.7	32.180	52.0	256.0	37.690	80.0	258.8	40.140
25.0	257.7	32.220	53.0	256.0	37.900	81.0	258.9	40.150
26.0	258.0	32.280	54.0	256.0	38.105	82.0	259.0	40.160
27.0	258.0	32.350	55.0	256.0	38.300			

OBSERVED EXPERIMENTAL DATA FROM RUN 11

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	81.0	--.---	29.0	259.5	25.290	58.0	257.0	31.300
1.0	135.0	--.---	30.0	259.5	25.380	59.0	257.0	31.460
2.0	160.9	12.450	31.0	259.5	25.490	60.0	257.2	31.640
3.0	183.0	15.000	32.0	259.3	25.610	61.0	257.3	31.785
4.0	199.9	17.085	33.0	259.2	25.745	62.0	257.6	31.920
5.0	213.2	18.775	34.0	259.0	25.910	63.0	257.8	32.040
6.0	222.5	20.125	35.0	259.0	26.085	64.0	257.9	32.160
7.0	231.0	21.210	36.0	258.8	26.280	65.0	258.0	32.265
8.0	236.3	22.065	37.0	258.7	26.475	66.0	258.1	32.355
9.0	241.2	22.760	38.0	258.2	26.685	67.0	258.3	32.430
10.0	245.0	23.270	39.0	258.2	26.910	68.0	258.6	32.510
11.0	248.1	23.680	40.0	258.0	27.140	69.0	258.8	32.570
12.0	250.4	24.000	41.0	258.0	27.375	70.0	258.9	32.620
13.0	252.3	24.250	42.0	257.8	27.620	71.0	259.0	32.680
14.0	254.0	24.440	43.0	257.8	27.860	72.0	259.0	32.710
15.0	255.0	24.590	44.0	257.3	28.110	73.0	259.2	32.740
16.0	256.0	24.700	45.0	257.4	28.370	74.0	259.1	32.775
17.0	256.9	24.780	46.0	257.3	28.610	75.0	259.3	32.790
18.0	257.2	24.850	47.0	257.2	28.860	76.0	259.2	32.810
19.0	257.9	24.910	48.0	257.1	29.110	77.0	259.4	32.820
20.0	258.1	24.950	49.0	257.1	29.355	78.0	259.5	32.845
21.0	258.7	24.975	50.0	257.0	29.600	79.0	259.6	32.850
22.0	258.9	25.000	51.0	257.0	29.825	80.0	259.6	32.860
23.0	259.0	25.030	52.0	257.0	30.070	81.0	259.7	32.865
24.0	259.1	25.060	53.0	257.0	30.290	82.0	259.7	32.870
25.0	259.2	25.080	54.0	257.0	30.510	83.0	259.8	32.880
26.0	259.2	25.115	55.0	257.0	30.720	84.0	259.8	32.885
27.0	259.5	25.160	56.0	257.0	30.910	85.0	259.8	32.890
28.0	259.5	25.225	57.0	257.0	31.110			

OBSERVED EXPERIMENTAL DATA FROM RUN 12

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	83.0	-.---	29.0	260.0	25.200	58.0	257.4	31.440
1.0	131.9	9.030	30.0	260.0	25.250	59.0	257.5	31.655
2.0	162.8	11.830	31.0	260.0	25.305	60.0	257.6	31.840
3.0	184.9	14.500	32.0	260.0	25.375	61.0	257.8	32.002
4.0	201.0	16.670	33.0	260.0	25.460	62.0	257.9	32.160
5.0	213.0	18.409	34.0	260.0	25.570	63.0	258.0	32.300
6.0	222.9	19.800	35.0	259.9	25.690	64.0	258.1	32.420
7.0	230.8	20.912	36.0	259.9	25.835	65.0	258.2	32.525
8.0	236.0	21.789	37.0	259.8	25.995	66.0	258.5	32.615
9.0	240.8	22.478	38.0	259.8	26.182	67.0	258.7	32.700
10.0	245.0	23.020	39.0	259.4	26.382	68.0	258.9	32.765
11.0	247.6	23.461	40.0	259.2	26.610	69.0	259.0	32.815
12.0	250.0	23.826	41.0	259.0	26.850	70.0	259.1	32.870
13.0	252.3	24.104	42.0	258.9	27.100	71.0	259.2	32.906
14.0	254.0	24.325	43.0	258.7	27.360	72.0	259.5	32.940
15.0	255.2	24.500	44.0	258.5	27.630	73.0	259.6	32.956
16.0	256.3	24.633	45.0	258.4	27.910	74.0	259.7	32.980
17.0	257.1	24.740	46.0	258.0	28.200	75.0	259.8	32.990
18.0	257.8	24.822	47.0	257.9	28.490	76.0	259.8	33.000
19.0	258.2	24.885	48.0	257.9	28.786	77.0	259.9	33.010
20.0	258.7	24.935	49.0	257.7	29.080	78.0	260.0	33.020
21.0	259.0	24.978	50.0	257.7	29.370	79.0	260.0	33.025
22.0	259.3	25.015	51.0	257.6	29.660	80.0	260.0	33.030
23.0	259.4	25.040	52.0	257.4	29.944	81.0	260.0	33.030
24.0	259.8	25.060	53.0	257.3	30.221	82.0	260.0	33.035
25.0	259.8	25.090	54.0	257.4	30.475	83.0	260.0	33.035
26.0	259.8	25.110	55.0	257.3	30.740	84.0	260.0	33.040
27.0	259.9	25.140	56.0	257.3	30.990			
28.0	260.0	25.170	57.0	257.3	31.215			

OBSERVED EXPERIMENTAL DATA FROM RUN 13

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	85.0	-.---	26.0	259.9	26.340	52.0	258.0	30.610
1.0	127.0	8.133	27.0	259.9	26.370	53.0	258.0	30.830
2.0	158.3	11.367	28.0	260.0	26.400	54.0	258.0	31.020
3.0	181.0	14.600	29.0	260.0	26.450	55.0	258.2	31.200
4.0	198.3	16.980	30.0	260.0	26.510	56.0	258.4	31.360
5.0	211.5	18.870	31.0	260.0	26.580	57.0	258.6	31.500
6.0	222.0	20.205	32.0	260.0	26.660	58.0	258.8	31.628
7.0	230.0	21.640	33.0	260.0	26.741	59.0	259.0	31.742
8.0	236.2	22.610	34.0	260.0	26.840	60.0	259.2	31.840
9.0	241.2	23.410	35.0	260.0	26.960	61.0	259.4	31.920
10.0	245.1	24.050	36.0	259.8	27.099	62.0	259.6	31.988
11.0	248.0	24.545	37.0	259.5	27.240	63.0	259.8	32.042
12.0	251.0	24.940	38.0	259.2	27.400	64.0	259.9	32.088
13.0	253.0	25.237	39.0	259.0	27.570	65.0	259.9	32.125
14.0	254.2	25.430	40.0	259.0	27.772	66.0	260.0	32.150
15.0	255.3	25.631	41.0	258.8	27.972	67.0	260.0	32.172
16.0	256.5	25.790	42.0	258.5	28.200	68.0	260.0	32.190
17.0	257.1	25.910	43.0	258.2	28.432	69.0	260.1	32.200
18.0	257.9	26.000	44.0	258.1	28.678	70.0	260.1	32.210
19.0	258.2	26.080	45.0	258.0	28.925	71.0	260.1	32.220
20.0	258.9	26.138	46.0	258.0	29.180	72.0	260.2	32.228
21.0	259.0	26.189	47.0	258.0	29.430	73.0	260.2	32.230
22.0	259.5	26.225	48.0	258.0	29.690	74.0	260.3	32.235
23.0	259.5	26.251	49.0	258.0	29.930	75.0	260.3	32.240
24.0	259.8	26.286	50.0	258.0	30.170	76.0	260.4	32.242
25.0	259.9	26.305	51.0	258.0	30.400	77.0	260.5	32.245

OBSERVED EXPERIMENTAL DATA FROM RUN 14

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	87.0	-.---	26.0	260.1	22.885	52.0	258.6	28.365
1.0	137.0	6.510	27.0	260.2	22.970	53.0	258.7	28.550
2.0	166.3	9.800	28.0	260.2	23.060	54.0	258.8	28.725
3.0	187.9	12.450	29.0	260.2	23.190	55.0	259.0	28.880
4.0	203.7	14.570	30.0	260.2	23.340	56.0	259.0	29.025
5.0	216.0	16.260	31.0	260.1	23.505	57.0	259.1	29.150
6.0	225.7	17.650	32.0	260.0	23.700	58.0	259.1	29.270
7.0	233.4	18.730	33.0	260.0	23.900	59.0	259.8	29.370
8.0	239.0	19.595	34.0	259.8	24.110	60.0	259.8	29.445
9.0	244.0	20.270	35.0	259.5	24.300	61.0	259.9	29.525
10.0	247.0	20.800	36.0	259.3	24.565	62.0	260.0	29.590
11.0	250.0	21.250	37.0	259.1	24.800	63.0	260.0	29.630
12.0	252.1	21.595	38.0	259.0	25.040	64.0	260.1	29.690
13.0	254.0	21.860	39.0	259.0	25.280	65.0	260.2	29.710
14.0	255.3	22.070	40.0	258.8	25.525	66.0	260.3	29.750
15.0	256.7	22.225	41.0	258.8	25.775	67.0	260.4	29.770
16.0	257.3	22.350	42.0	258.4	26.020	68.0	260.5	29.790
17.0	258.0	22.450	43.0	258.4	26.280	69.0	260.7	29.800
18.0	258.6	22.525	44.0	258.4	26.530	70.0	260.7	29.805
19.0	259.0	22.590	45.0	258.4	26.780	71.0	260.8	29.815
20.0	259.4	22.620	46.0	258.3	27.025	72.0	260.9	29.825
21.0	259.8	22.680	47.0	258.3	27.270	73.0	261.0	29.830
22.0	259.9	22.720	48.0	258.2	27.505	74.0	261.0	29.835
23.0	260.0	22.750	49.0	258.2	27.745	75.0	261.0	29.840
24.0	260.0	22.790	50.0	258.2	27.958			
25.0	260.1	22.825	51.0	258.4	28.171			

OBSERVED EXPERIMENTAL DATA FROM RUN 15

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	85.0	-.---	32.0	258.9	17.880	64.0	257.1	24.800
1.0	128.6	3.750	33.0	258.9	18.000	65.0	257.2	24.930
2.0	158.4	5.500	34.0	258.9	18.130	66.0	257.4	25.050
3.0	186.0	7.250	35.0	258.9	18.290	67.0	257.8	25.165
4.0	198.0	9.350	36.0	258.8	18.450	68.0	257.9	25.260
5.0	211.1	11.050	37.0	258.8	18.640	69.0	258.0	25.340
6.0	221.6	12.400	38.0	258.8	18.840	70.0	258.0	25.405
7.0	229.8	13.500	39.0	258.8	19.050	71.0	258.0	25.470
8.0	235.9	14.390	40.0	258.2	19.260	72.0	258.2	25.510
9.0	240.5	15.085	41.0	258.1	19.485	73.0	258.6	25.560
10.0	244.5	15.620	42.0	258.0	19.710	74.0	258.7	25.595
11.0	247.1	16.050	43.0	257.9	19.950	75.0	258.8	25.620
12.0	249.9	16.385	44.0	257.8	20.180	76.0	258.9	25.645
13.0	251.6	16.640	45.0	257.7	20.420	77.0	259.0	25.660
14.0	253.0	16.840	46.0	257.2	20.670	78.0	258.9	25.680
15.0	254.2	17.000	47.0	257.2	20.920	79.0	259.0	25.690
16.0	255.1	17.130	48.0	257.1	21.178	80.0	259.0	25.700
17.0	256.0	17.230	49.0	257.0	21.430	81.0	259.0	25.700
18.0	256.7	17.305	50.0	257.0	21.690	82.0	259.0	25.705
19.0	257.1	17.370	51.0	257.0	21.950	83.0	259.1	25.708
20.0	257.2	17.420	52.0	257.0	22.215	84.0	259.0	25.710
21.0	257.8	17.450	53.0	257.0	22.475	85.0	259.2	25.720
22.0	258.0	17.490	54.0	256.9	22.730	86.0	259.1	25.730
23.0	258.1	17.510	55.0	257.0	22.990	87.0	259.2	25.735
24.0	258.2	17.530	56.0	256.9	23.225	88.0	259.2	25.740
25.0	258.3	17.550	57.0	257.0	23.460	89.0	259.3	25.750
26.0	258.4	17.570	58.0	256.9	23.690	90.0	259.2	25.750
27.0	258.5	17.590	59.0	257.0	23.910	91.0	259.2	25.760
28.0	258.6	17.620	60.0	256.9	24.110	92.0	259.2	25.760
29.0	258.8	17.660	61.0	257.0	24.300	93.0	259.5	25.765
30.0	258.8	17.720	62.0	257.0	24.520	94.0	259.3	25.768
31.0	258.9	17.790	63.0	257.0	24.650	95.0	259.5	25.770

OBSERVED EXPERIMENTAL DATA FROM RUN 16

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	88.0	-.---	34.0	260.0	13.940	68.0	258.8	20.310
1.0	132.0	-.---	35.0	260.0	14.100	69.0	258.8	20.440
2.0	162.0	-.---	36.0	260.0	14.280	70.0	258.9	20.560
3.0	183.9	3.150	37.0	259.9	14.470	71.0	259.0	20.670
4.0	200.5	5.200	38.0	259.9	14.645	72.0	259.1	20.770
5.0	213.2	6.870	39.0	259.7	14.830	73.0	259.1	20.850
6.0	223.8	8.230	40.0	259.7	15.020	74.0	259.3	20.925
7.0	231.6	9.310	41.0	259.4	15.200	75.0	259.4	20.990
8.0	238.0	10.180	42.0	259.6	15.390	76.0	259.6	21.040
9.0	242.3	10.870	43.0	259.3	15.570	77.0	259.7	21.090
10.0	246.1	11.400	44.0	259.3	15.750	78.0	259.9	21.130
11.0	249.0	11.835	45.0	259.1	15.925	79.0	260.0	21.160
12.0	251.3	12.180	46.0	259.1	16.100	80.0	260.0	21.190
13.0	253.0	12.440	47.0	259.0	16.280	81.0	260.0	21.210
14.0	254.8	12.655	48.0	259.0	16.450	82.0	260.1	21.230
15.0	255.8	12.815	49.0	258.9	16.630	83.0	260.1	21.250
16.0	257.0	12.950	50.0	258.9	16.805	84.0	260.1	21.260
17.0	257.2	13.050	51.0	258.7	17.000	85.0	260.1	21.265
18.0	258.0	13.140	52.0	258.8	17.190	86.0	260.1	21.280
19.0	258.2	13.195	53.0	258.4	17.380	87.0	260.1	21.290
20.0	258.9	13.250	54.0	258.6	17.580	88.0	260.2	21.299
21.0	259.0	13.285	55.0	258.4	17.790	89.0	260.2	21.300
22.0	259.2	13.310	56.0	258.5	18.000	90.0	260.2	21.300
23.0	259.2	13.340	57.0	258.1	18.205	91.0	260.2	21.302
24.0	259.7	13.360	58.0	258.2	18.420	92.0	260.3	21.305
25.0	259.8	13.380	59.0	258.1	18.640	93.0	260.2	21.305
26.0	259.9	13.400	60.0	258.2	18.851	94.0	260.3	21.310
27.0	259.9	13.410	61.0	258.1	19.066	95.0	260.3	21.310
28.0	260.0	13.440	62.0	258.2	19.270	96.0	260.5	21.315
29.0	260.0	13.470	63.0	258.1	19.470	97.0	260.4	21.315
30.0	260.0	13.520	64.0	258.2	19.650	98.0	260.5	21.320
31.0	260.0	13.590	65.0	258.2	19.830	99.0	260.4	21.320
32.0	260.0	13.688	66.0	258.3	20.000			
33.0	260.0	13.800	67.0	258.4	20.1'5			

OBSERVED EXPERIMENTAL DATA FROM RUN 19

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	94.8	-.---	50.0	250.5	17.885	100.0	250.0	20.845
1.0	129.7	2.847	51.0	250.7	17.889	101.0	250.0	20.946
2.0	156.7	5.779	52.0	250.6	17.900	102.0	249.9	21.044
3.0	177.5	8.189	53.0	250.6	17.907	103.0	250.0	21.143
4.0	193.2	10.156	54.0	250.6	17.912	104.0	249.9	21.239
5.0	205.6	11.745	55.0	250.6	17.925	105.0	250.0	21.336
6.0	215.1	13.026	56.0	250.5	17.933	106.0	249.9	21.442
7.0	222.6	14.053	57.0	250.6	17.955	107.0	249.9	21.539
8.0	228.3	14.856	58.0	250.5	17.969	108.0	249.8	21.639
9.0	233.2	15.510	59.0	250.6	17.981	109.0	249.9	21.744
10.0	236.5	16.011	60.0	250.5	18.002	110.0	249.8	21.843
11.0	239.7	16.410	61.0	250.6	18.029	111.0	249.8	21.950
12.0	241.6	16.716	62.0	250.5	18.054	112.0	249.8	22.049
13.0	243.6	16.962	63.0	250.6	18.080	113.0	249.8	22.151
14.0	244.8	17.153	64.0	250.4	18.112	114.0	249.8	22.254
15.0	246.0	17.300	65.0	250.6	18.142	115.0	249.8	22.352
16.0	246.9	17.419	66.0	250.4	18.180	116.0	249.8	22.456
17.0	247.5	17.510	67.0	250.6	18.218	117.0	249.9	22.559
18.0	248.0	17.581	68.0	250.4	18.263	118.0	249.8	22.656
19.0	248.7	17.638	69.0	250.6	18.315	119.0	249.9	22.760
20.0	248.8	17.679	70.0	250.4	18.364	120.0	249.8	22.862
21.0	249.3	17.717	71.0	250.6	18.416	121.0	249.9	22.963
22.0	249.4	17.742	72.0	250.3	18.475	122.0	249.8	23.061
23.0	249.7	17.765	73.0	250.5	18.535	123.0	249.9	23.162
24.0	249.8	17.785	74.0	250.3	18.601	124.0	249.8	23.260
25.0	249.9	17.796	75.0	250.5	18.669	125.0	249.8	23.356
26.0	250.0	17.810	76.0	250.3	18.739	126.0	249.8	23.461
27.0	250.0	17.816	77.0	250.6	18.809	127.0	249.8	23.553
28.0	250.1	17.823	78.0	250.3	18.886	128.0	249.7	23.651
29.0	250.1	17.825	79.0	250.5	18.958	129.0	249.8	23.749
30.0	250.2	17.833	80.0	250.2	19.041	130.0	249.7	23.845
31.0	250.3	17.839	81.0	250.4	19.116	131.0	249.8	23.938
32.0	250.3	17.841	82.0	250.1	19.197	132.0	249.6	24.032
33.0	250.4	17.841	83.0	250.3	19.286	133.0	249.8	24.124
34.0	250.3	17.844	84.0	250.2	19.367	134.0	249.7	24.213
35.0	250.5	17.847	85.0	250.2	19.457	135.0	249.8	24.305
36.0	250.3	17.853	86.0	250.2	19.545	136.0	249.8	24.394
37.0	250.4	17.851	87.0	250.2	19.635	137.0	249.8	24.481
38.0	250.3	17.856	88.0	250.2	19.721	138.0	249.7	24.556
39.0	250.4	17.858	89.0	250.2	19.818	139.0	249.8	24.646
40.0	250.3	17.859	90.0	250.0	19.909	140.0	249.7	24.726
41.0	250.4	17.856	91.0	250.1	20.000	141.0	249.8	24.811
42.0	250.3	17.860	92.0	250.0	20.090	142.0	249.8	24.884
43.0	250.5	17.862	93.0	250.1	20.184	143.0	249.8	24.963
44.0	250.4	17.866	94.0	250.0	20.276	144.0	249.7	25.037
45.0	250.4	17.864	95.0	250.0	20.371	145.0	249.8	25.108
46.0	250.4	17.870	96.0	250.0	20.468	146.0	249.7	25.185
47.0	250.6	17.872	97.0	250.1	20.564	147.0	249.8	25.245
48.0	250.5	17.874	98.0	250.0	20.662	148.0	249.6	25.313
49.0	250.7	17.879	99.0	250.0	20.754	149.0	249.8	25.379

OBSERVED EXPERIMENTAL DATA FROM RUN 19 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
150.0	249.6	25.437	176.0	250.0	26.385	202.0	250.0	26.550
151.0	249.8	25.498	177.0	250.0	26.396	203.0	250.1	26.551
152.0	249.7	25.558	178.0	250.0	26.408	204.0	250.2	26.551
153.0	249.8	25.614	179.0	250.0	26.419	205.0	250.2	26.554
154.0	249.8	25.663	180.0	250.0	26.429	206.0	250.2	26.554
155.0	249.8	25.719	181.0	250.1	26.442	207.0	250.3	26.558
156.0	249.9	25.768	182.0	250.1	26.448	208.0	250.3	26.557
157.0	249.9	25.819	183.0	250.1	26.461	209.0	250.3	26.559
158.0	249.8	25.868	184.0	250.0	26.467	210.0	250.3	26.561
159.0	249.9	25.908	185.0	250.0	26.477	211.0	250.3	26.561
160.0	249.9	25.950	186.0	250.0	26.484	212.0	250.2	26.562
161.0	249.9	25.991	187.0	250.0	26.495	213.0	250.3	26.563
162.0	249.9	26.021	188.0	250.0	26.499	214.0	250.3	26.563
163.0	249.9	26.060	189.0	250.0	26.506	215.0	250.3	26.563
164.0	249.9	26.096	190.0	250.0	26.507	216.0	250.3	26.564
165.0	249.9	26.120	191.0	250.0	26.510	217.0	250.3	26.568
166.0	249.9	26.159	192.0	250.0	26.517	218.0	250.2	26.571
167.0	250.0	26.188	193.0	250.0	26.520	219.0	250.3	26.569
168.0	250.0	26.216	194.0	250.0	26.526	220.0	250.2	26.571
169.0	250.0	26.242	195.0	250.0	26.532	221.0	250.3	26.569
170.0	250.0	26.264	196.0	250.0	26.530	222.0	250.2	26.571
171.0	250.0	26.286	197.0	250.0	26.538	223.0	250.3	26.571
172.0	250.0	26.313	198.0	250.0	26.538	224.0	250.2	26.572
173.0	250.0	26.328	199.0	250.0	26.538	225.0	250.3	26.572
174.0	250.0	26.347	200.0	250.0	26.542	226.0	250.3	26.572
175.0	250.1	26.359	201.0	250.0	26.548			

OBSERVED EXPERIMENTAL DATA FROM RUN 20

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	94.3	-.---	50.0	249.8	22.194	100.0	249.3	25.384
1.0	127.1	6.749	51.0	249.8	22.217	101.0	249.5	25.494
2.0	154.6	9.687	52.0	249.8	22.234	102.0	249.3	25.606
3.0	176.0	12.192	53.0	249.8	22.252	103.0	249.6	25.715
4.0	191.8	14.165	54.0	249.8	22.272	104.0	249.3	25.827
5.0	204.4	15.849	55.0	249.8	22.291	105.0	249.6	25.941
6.0	213.8	17.165	56.0	249.8	22.315	106.0	249.3	26.054
7.0	221.6	18.204	57.0	249.8	22.341	107.0	249.3	26.172
8.0	227.2	19.032	58.0	249.8	22.364	108.0	249.2	26.285
9.0	232.1	19.688	59.0	249.8	22.390	109.0	249.3	26.396
10.0	235.6	20.195	60.0	249.8	22.418	110.0	249.1	26.515
11.0	238.5	20.598	61.0	249.9	22.448	111.0	249.2	26.622
12.0	240.7	20.906	62.0	249.8	22.482	112.0	249.1	26.735
13.0	242.5	21.153	63.0	249.8	22.514	113.0	249.3	26.851
14.0	244.2	21.346	64.0	249.8	22.548	114.0	249.1	26.962
15.0	245.3	21.500	65.0	249.8	22.589	115.0	249.2	27.070
16.0	246.3	21.614	66.0	249.8	22.627	116.0	249.0	27.181
17.0	247.0	21.713	67.0	249.9	22.669	117.0	249.2	27.290
18.0	247.4	21.785	68.0	249.9	22.715	118.0	249.0	27.393
19.0	247.8	21.844	69.0	249.9	22.765	119.0	249.2	27.502
20.0	248.3	21.891	70.0	249.9	22.810	120.0	249.0	27.609
21.0	248.5	21.927	71.0	249.9	22.865	121.0	249.2	27.711
22.0	248.8	21.952	72.0	249.8	22.918	122.0	249.0	27.818
23.0	249.0	21.976	73.0	249.9	22.975	123.0	249.2	27.917
24.0	249.1	21.996	74.0	249.8	23.035	124.0	249.1	28.016
25.0	249.2	22.008	75.0	249.9	23.099	125.0	249.3	28.116
26.0	249.3	22.018	76.0	249.9	23.163	126.0	249.1	28.215
27.0	249.5	22.027	77.0	249.9	23.230	127.0	249.3	28.314
28.0	249.5	22.031	78.0	249.8	23.302	128.0	249.1	28.409
29.0	249.5	22.037	79.0	249.9	23.373	129.0	249.3	28.499
30.0	249.7	22.046	80.0	249.8	23.451	130.0	249.1	28.590
31.0	249.8	22.050	81.0	249.8	23.525	131.0	249.3	28.680
32.0	249.8	22.056	82.0	249.8	23.609	132.0	249.0	28.768
33.0	249.8	22.055	83.0	249.8	23.688	133.0	249.3	28.851
34.0	249.8	22.059	84.0	249.8	23.775	134.0	249.1	28.932
35.0	249.8	22.067	85.0	249.8	23.861	135.0	249.3	29.015
36.0	249.8	22.071	86.0	249.8	23.949	136.0	249.0	29.093
37.0	249.8	22.076	87.0	249.8	24.040	137.0	249.2	29.170
38.0	249.8	22.078	88.0	249.8	24.133	138.0	249.1	29.244
39.0	249.8	22.082	89.0	249.8	24.230	139.0	249.3	29.312
40.0	249.9	22.089	90.0	249.7	24.326	140.0	249.1	29.383
41.0	249.8	22.094	91.0	249.8	24.425	141.0	249.3	29.451
42.0	249.8	22.102	92.0	249.7	24.521	142.0	249.1	29.517
43.0	249.8	22.111	93.0	249.8	24.629	143.0	249.3	29.575
44.0	249.8	22.119	94.0	249.6	24.733	144.0	249.1	29.638
45.0	249.8	22.132	95.0	249.8	24.837	145.0	249.4	29.698
46.0	249.8	22.142	96.0	249.3	24.943	146.0	249.2	29.754
47.0	249.8	22.152	97.0	249.5	25.051	147.0	249.4	29.806
48.0	249.8	22.169	98.0	249.3	25.159	148.0	249.2	29.854
49.0	249.8	22.186	99.0	249.5	25.268	149.0	249.4	29.906

OBSERVED EXPERIMENTAL DATA FROM RUN 20 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
150.0	249.2	29.951	173.0	249.9	30.518	196.0	249.8	30.639
151.0	249.4	29.990	174.0	249.8	30.534	197.0	249.9	30.638
152.0	249.2	30.040	175.0	249.9	30.543	198.0	249.8	30.641
153.0	249.4	30.086	176.0	249.8	30.549	199.0	249.9	30.640
154.0	249.2	30.125	177.0	249.9	30.561	200.0	249.8	30.645
155.0	249.5	30.159	178.0	249.9	30.567	201.0	249.9	30.648
156.0	249.3	30.192	179.0	249.9	30.572	202.0	249.8	30.649
157.0	249.5	30.220	180.0	249.9	30.576	203.0	249.9	30.650
158.0	249.4	30.253	181.0	250.0	30.582	204.0	249.8	30.649
159.0	249.6	30.281	182.0	249.8	30.588	205.0	249.9	30.650
160.0	249.4	30.309	183.0	249.9	30.595	206.0	249.8	30.647
161.0	249.6	30.332	184.0	249.8	30.599	207.0	249.9	30.648
162.0	249.4	30.362	185.0	249.9	30.601	208.0	249.9	30.647
163.0	249.6	30.381	186.0	249.8	30.607	209.0	249.9	30.648
164.0	249.4	30.403	187.0	249.9	30.612	210.0	249.9	30.649
165.0	249.7	30.417	188.0	249.8	30.617	211.0	249.9	30.653
166.0	249.5	30.434	189.0	249.9	30.618	212.0	249.8	30.652
167.0	249.8	30.452	190.0	249.8	30.619	213.0	249.8	30.654
168.0	249.6	30.467	191.0	249.9	30.622	214.0	249.8	30.654
169.0	249.8	30.481	192.0	249.8	30.623	215.0	249.8	30.655
170.0	249.7	30.495	193.0	249.9	30.632	216.0	249.8	30.655
171.0	249.9	30.506	194.0	249.8	30.635	217.0	249.9	30.655
172.0	249.8	30.513	195.0	249.9	30.637			

OBSERVED EXPERIMENTAL DATA FROM RUN 21

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	91.1	-.---	50.0	250.1	22.515	100.0	249.9	26.470
1.0	125.0	6.985	51.0	250.1	22.531	101.0	249.9	26.566
2.0	152.9	10.004	52.0	250.1	22.554	102.0	249.9	26.658
3.0	174.0	12.460	53.0	250.1	22.577	103.0	249.9	26.758
4.0	190.1	14.483	54.0	250.1	22.603	104.0	250.0	26.852
5.0	202.8	16.128	55.0	250.1	22.634	105.0	249.9	26.952
6.0	213.1	17.463	56.0	250.1	22.670	106.0	250.0	27.051
7.0	221.1	18.521	57.0	250.1	22.713	107.0	249.9	27.146
8.0	226.9	19.362	58.0	250.1	22.760	108.0	249.9	27.244
9.0	231.7	20.023	59.0	250.1	22.809	109.0	249.9	27.347
10.0	235.8	20.546	60.0	250.1	22.862	110.0	249.9	27.441
11.0	238.5	20.952	61.0	250.1	22.923	111.0	249.8	27.548
12.0	240.8	21.270	62.0	250.1	22.986	112.0	249.8	27.646
13.0	242.7	21.526	63.0	250.1	23.053	113.0	249.8	27.746
14.0	244.1	21.720	64.0	250.1	23.127	114.0	249.8	27.843
15.0	245.4	21.871	65.0	250.0	23.206	115.0	249.8	27.947
16.0	246.4	21.995	66.0	250.0	23.287	116.0	249.8	28.044
17.0	247.2	22.088	67.0	250.0	23.367	117.0	249.8	28.145
18.0	247.7	22.160	68.0	250.0	23.452	118.0	249.8	28.239
19.0	248.3	22.213	69.0	250.0	23.542	119.0	249.8	28.334
20.0	248.7	22.262	70.0	250.0	23.636	120.0	249.8	28.435
21.0	248.9	22.300	71.0	250.0	23.729	121.0	249.8	28.526
22.0	249.2	22.331	72.0	250.0	23.823	122.0	249.8	28.618
23.0	249.4	22.352	73.0	250.0	23.919	123.0	249.8	28.715
24.0	249.6	22.373	74.0	250.0	24.017	124.0	249.8	28.806
25.0	249.8	22.388	75.0	250.0	24.114	125.0	249.9	28.894
26.0	249.8	22.399	76.0	250.0	24.211	126.0	249.8	28.984
27.0	249.9	22.408	77.0	250.0	24.309	127.0	249.9	29.068
28.0	249.9	22.413	78.0	250.0	24.412	128.0	249.9	29.151
29.0	249.9	22.418	79.0	250.0	24.506	129.0	249.9	29.231
30.0	250.0	22.418	80.0	250.0	24.605	130.0	249.8	29.313
31.0	250.0	22.428	81.0	249.9	24.699	131.0	249.9	29.395
32.0	250.0	22.430	82.0	249.9	24.798	132.0	249.9	29.472
33.0	250.1	22.435	83.0	249.9	24.892	133.0	249.9	29.546
34.0	250.1	22.435	84.0	249.9	24.988	134.0	249.8	29.616
35.0	250.1	22.436	85.0	249.9	25.076	135.0	249.9	29.688
36.0	250.1	22.435	86.0	249.9	25.173	136.0	249.8	29.755
37.0	250.1	22.440	87.0	249.9	25.264	137.0	249.9	29.817
38.0	250.1	22.439	88.0	249.9	25.357	138.0	249.8	29.887
39.0	250.1	22.440	89.0	249.9	25.453	139.0	249.9	29.941
40.0	250.1	22.444	90.0	249.9	25.537	140.0	249.9	30.006
41.0	250.1	22.444	91.0	249.9	25.629	141.0	249.9	30.064
42.0	250.1	22.448	92.0	250.0	25.724	142.0	249.9	30.115
43.0	250.1	22.450	93.0	249.9	25.818	143.0	250.0	30.166
44.0	250.1	22.456	94.0	250.0	25.909	144.0	249.9	30.213
45.0	250.1	22.464	95.0	249.9	26.003	145.0	250.0	30.263
46.0	250.1	22.469	96.0	250.0	26.097	146.0	249.9	30.307
47.0	250.1	22.476	97.0	249.9	26.188	147.0	250.0	30.342
48.0	250.1	22.486	98.0	249.9	26.285	148.0	249.9	30.387
49.0	250.1	22.500	99.0	249.9	26.375	149.0	250.0	30.420

OBSERVED EXPERIMENTAL DATA FROM RUN 21 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
150.0	250.0	30.459	166.0	250.0	30.796	182.0	250.1	30.899
151.0	250.0	30.493	167.0	250.1	30.808	183.0	250.2	30.900
152.0	250.0	30.522	168.0	250.0	30.813	184.0	250.2	30.901
153.0	250.0	30.541	169.0	250.0	30.823	185.0	250.3	30.903
154.0	250.0	30.578	170.0	250.0	30.828	186.0	250.2	30.904
155.0	250.0	30.608	171.0	250.0	30.835	187.0	250.3	30.905
156.0	250.0	30.627	172.0	250.0	30.843	188.0	250.2	30.909
157.0	250.0	30.648	173.0	250.0	30.844	189.0	250.3	30.910
158.0	250.0	30.676	174.0	250.0	30.846	190.0	250.2	30.914
159.0	250.0	30.690	175.0	250.0	30.862	191.0	250.3	30.914
160.0	250.0	30.709	176.0	250.0	30.868	192.0	250.2	30.917
161.0	250.1	30.729	177.0	250.1	30.871	193.0	250.3	30.918
162.0	250.0	30.739	178.0	250.1	30.879	194.0	250.2	30.918
163.0	250.0	30.755	179.0	250.1	30.883	195.0	250.3	30.918
164.0	250.0	30.772	180.0	250.1	30.886			
165.0	250.1	30.784	181.0	250.2	30.893			

OBSERVED EXPERIMENTAL DATA FROM RUN 22

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	90.1	--.---	50.0	250.0	30.863	100.0	249.3	34.385
1.0	123.7	14.648	51.0	250.0	30.901	101.0	249.3	34.491
2.0	152.3	17.856	52.0	249.9	30.922	102.0	249.2	34.604
3.0	174.6	20.503	53.0	250.0	30.940	103.0	249.2	34.708
4.0	190.9	22.626	54.0	250.0	30.968	104.0	249.2	34.817
5.0	203.8	24.329	55.0	250.0	30.996	105.0	249.2	34.928
6.0	213.8	25.692	56.0	250.0	31.019	106.0	249.2	35.035
7.0	221.7	26.759	57.0	250.0	31.047	107.0	249.2	35.143
8.0	227.3	27.692	58.0	250.0	31.079	108.0	249.1	35.254
9.0	232.2	28.245	59.0	250.0	31.114	109.0	249.2	35.360
10.0	236.0	28.756	60.0	250.0	31.148	110.0	249.1	35.470
11.0	238.7	29.144	61.0	250.0	31.182	111.0	249.2	35.573
12.0	240.9	29.463	62.0	250.0	31.219	112.0	249.1	35.677
13.0	242.7	29.715	63.0	250.0	31.263	113.0	249.2	35.782
14.0	244.2	29.894	64.0	250.0	31.308	114.0	249.0	35.886
15.0	245.5	30.037	65.0	250.0	31.351	115.0	249.2	35.992
16.0	246.4	30.140	66.0	250.0	31.405	116.0	249.1	36.095
17.0	247.1	30.244	67.0	250.0	31.455	117.0	249.2	36.192
18.0	247.7	30.314	68.0	250.0	31.511	118.0	249.1	36.293
19.0	248.0	30.367	69.0	250.0	31.568	119.0	249.2	36.386
20.0	248.4	30.410	70.0	250.0	31.619	120.0	249.1	36.491
21.0	248.7	30.444	71.0	250.0	31.685	121.0	249.2	36.580
22.0	249.0	30.474	72.0	249.9	31.750	122.0	249.1	36.674
23.0	249.2	30.496	73.0	249.9	31.823	123.0	249.2	36.764
24.0	249.3	30.523	74.0	249.9	31.888	124.0	249.0	36.847
25.0	249.4	30.522	75.0	249.9	31.962	125.0	249.1	36.938
26.0	249.7	30.538	76.0	249.9	32.033	126.0	249.1	37.021
27.0	249.7	30.545	77.0	249.9	32.110	127.0	249.2	37.109
28.0	249.8	30.559	78.0	249.9	32.194	128.0	249.0	37.198
29.0	249.9	30.560	79.0	249.9	32.278	129.0	249.2	37.274
30.0	249.9	30.569	80.0	249.9	32.366	130.0	249.0	37.347
31.0	250.0	30.572	81.0	249.9	32.439	131.0	249.0	37.422
32.0	250.0	30.583	82.0	249.9	32.543	132.0	249.0	37.501
33.0	250.0	30.589	83.0	249.9	32.629	133.0	249.1	37.569
34.0	250.0	30.598	84.0	249.9	32.722	134.0	249.0	37.639
35.0	249.9	30.606	85.0	249.9	32.820	135.0	249.2	37.705
36.0	249.9	30.615	86.0	249.8	32.918	136.0	249.1	37.765
37.0	249.9	30.627	87.0	249.8	33.016	137.0	249.1	37.832
38.0	249.9	30.636	88.0	249.8	33.111	138.0	249.1	37.889
39.0	249.9	30.642	89.0	249.7	33.215	139.0	249.2	37.950
40.0	250.0	30.654	90.0	249.7	33.317	140.0	249.1	38.006
41.0	250.0	30.669	91.0	249.7	33.420	141.0	249.1	38.056
42.0	250.0	30.684	92.0	249.5	33.522	142.0	249.1	38.110
43.0	250.0	30.705	93.0	249.5	33.627	143.0	249.1	38.156
44.0	250.0	30.723	94.0	249.4	33.739	144.0	249.0	38.205
45.0	250.0	30.736	95.0	249.3	33.842	145.0	249.0	38.247
46.0	250.0	30.760	96.0	249.4	33.953	146.0	249.0	38.272
47.0	250.0	30.782	97.0	249.5	34.058	147.0	249.0	38.326
48.0	250.0	30.827	98.0	249.4	34.169	148.0	249.1	38.358
49.0	250.0	30.845	99.0	249.4	34.274	149.0	249.2	38.398

OBSERVED EXPERIMENTAL DATA FROM RUN 22 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
150.0	249.2	38.438	171.0	249.8	38.807	192.0	249.8	38.877
151.0	249.3	38.437	172.0	249.7	38.811	193.0	249.9	38.878
152.0	249.2	38.472	173.0	249.8	38.814	194.0	249.8	38.878
153.0	249.3	38.506	174.0	249.8	38.819	195.0	249.9	38.886
154.0	249.2	38.528	175.0	249.8	38.827	196.0	249.8	38.885
155.0	249.3	38.555	176.0	249.8	38.834	197.0	249.9	38.887
156.0	249.2	38.586	177.0	249.8	38.838	198.0	249.8	38.889
157.0	249.3	38.605	178.0	249.8	38.841	199.0	250.0	38.893
158.0	249.2	38.623	179.0	249.8	38.844	200.0	249.9	38.893
159.0	249.3	38.643	180.0	249.7	38.849	201.0	250.0	38.893
160.0	249.3	38.663	181.0	249.8	38.855	202.0	249.9	38.895
161.0	249.6	38.684	182.0	249.8	38.858	203.0	250.0	38.896
162.0	249.5	38.703	183.0	249.8	38.867	204.0	249.9	38.897
163.0	249.7	38.717	184.0	249.8	38.868	205.0	250.0	38.898
164.0	249.7	38.729	185.0	249.8	38.873	206.0	249.9	38.897
165.0	249.7	38.743	186.0	249.8	38.869	207.0	250.0	38.898
166.0	249.7	38.753	187.0	249.9	38.869	208.0	249.9	38.896
167.0	249.8	38.764	188.0	249.8	38.874	209.0	250.0	38.897
168.0	249.7	38.773	189.0	249.9	38.872	210.0	249.9	38.897
169.0	249.8	38.781	190.0	249.8	38.880			
170.0	249.7	38.798	191.0	249.8	38.878			

OBSERVED EXPERIMENTAL DATA FROM RUN 23

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	89.2	--.---	50.0	249.8	27.346	100.0	249.4	30.298
1.0	122.7	--.---	51.0	249.8	27.363	101.0	249.4	30.404
2.0	150.8	14.510	52.0	249.8	27.383	102.0	249.4	30.515
3.0	172.4	17.039	53.0	249.8	27.404	103.0	249.5	30.626
4.0	190.0	19.113	54.0	249.8	27.423	104.0	249.4	30.734
5.0	202.1	20.906	55.0	249.7	27.447	105.0	249.4	30.846
6.0	212.2	22.167	56.0	249.8	27.473	106.0	249.4	30.957
7.0	220.0	23.253	57.0	249.8	27.498	107.0	249.5	31.073
8.0	226.1	24.103	58.0	249.8	27.521	108.0	249.4	31.185
9.0	231.2	24.776	59.0	249.8	27.551	109.0	249.5	31.297
10.0	234.9	25.305	60.0	249.8	27.579	110.0	249.5	31.406
11.0	237.8	25.718	61.0	249.7	27.611	111.0	249.5	31.516
12.0	240.2	26.040	62.0	249.8	27.640	112.0	249.4	31.631
13.0	242.0	26.293	63.0	249.7	27.671	113.0	249.4	31.741
14.0	243.5	26.491	64.0	249.8	27.710	114.0	249.4	31.851
15.0	244.8	26.652	65.0	249.8	27.740	115.0	249.3	31.957
16.0	245.6	26.773	66.0	249.8	27.777	116.0	249.2	32.061
17.0	246.6	26.876	67.0	249.8	27.814	117.0	249.3	32.171
18.0	247.1	26.953	68.0	249.8	27.854	118.0	249.3	32.276
19.0	247.5	27.009	69.0	249.8	27.888	119.0	249.2	32.374
20.0	247.8	27.056	70.0	249.8	27.929	120.0	249.2	32.485
21.0	248.3	27.093	71.0	249.8	27.979	121.0	249.2	32.586
22.0	248.5	27.121	72.0	249.8	28.029	122.0	249.2	32.685
23.0	248.6	27.146	73.0	249.8	28.078	123.0	249.2	32.782
24.0	248.8	27.168	74.0	249.8	28.123	124.0	249.2	32.883
25.0	249.2	27.184	75.0	249.8	28.182	125.0	249.2	32.981
26.0	249.2	27.194	76.0	249.8	28.239	126.0	249.2	33.078
27.0	249.3	27.203	77.0	249.7	28.304	127.0	249.2	33.171
28.0	249.3	27.207	78.0	249.7	28.360	128.0	249.2	33.265
29.0	249.4	27.216	79.0	249.8	28.423	129.0	249.2	33.354
30.0	249.3	27.218	80.0	249.7	28.491	130.0	249.2	33.437
31.0	249.3	27.224	81.0	249.8	28.560	131.0	249.1	33.531
32.0	249.5	27.230	82.0	249.8	28.629	132.0	249.2	33.616
33.0	249.5	27.232	83.0	249.8	28.708	133.0	249.3	33.698
34.0	249.5	27.234	84.0	249.7	28.779	134.0	249.2	33.777
35.0	249.5	27.235	85.0	249.6	28.863	135.0	249.3	33.860
36.0	249.5	27.237	86.0	249.7	28.946	136.0	249.2	33.940
37.0	249.5	27.240	87.0	249.5	29.020	137.0	249.2	34.013
38.0	249.5	27.243	88.0	249.6	29.114	138.0	249.2	34.088
39.0	249.5	27.248	89.0	249.6	29.203	139.0	249.3	34.159
40.0	249.5	27.256	90.0	249.5	29.293	140.0	249.2	34.226
41.0	249.6	27.260	91.0	249.4	29.391	141.0	249.3	34.298
42.0	249.7	27.262	92.0	249.4	29.479	142.0	249.2	34.360
43.0	249.7	27.275	93.0	249.4	29.577	143.0	249.3	34.422
44.0	249.8	27.278	94.0	249.4	29.676	144.0	249.2	34.487
45.0	249.8	27.292	95.0	249.4	29.774	145.0	249.2	34.547
46.0	249.8	27.299	96.0	249.4	29.873	146.0	249.2	34.600
47.0	249.8	27.309	97.0	249.4	29.981	147.0	249.3	34.659
48.0	249.7	27.319	98.0	249.4	30.085	148.0	249.2	34.711
49.0	249.7	27.333	99.0	249.4	30.190	149.0	249.3	34.766

OBSERVED EXPERIMENTAL DATA FROM RUN 23 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
150.0	249.3	34.813	166.0	249.7	35.369	182.0	249.9	35.585
151.0	249.3	34.861	167.0	249.8	35.389	183.0	249.9	35.590
152.0	249.3	34.909	168.0	249.8	35.409	184.0	249.8	35.598
153.0	249.4	34.951	169.0	249.8	35.428	185.0	249.9	35.604
154.0	249.3	34.989	170.0	249.8	35.447	186.0	249.9	35.609
155.0	249.3	35.026	171.0	249.8	35.460	187.0	249.9	35.613
156.0	249.3	35.067	172.0	249.8	35.478	188.0	249.9	35.617
157.0	249.3	35.108	173.0	249.8	35.496	189.0	249.9	35.620
158.0	249.3	35.141	174.0	249.8	35.507	190.0	249.9	35.622
159.0	249.3	35.174	175.0	249.9	35.515	191.0	250.0	35.626
160.0	249.3	35.209	176.0	249.9	35.527	192.0	249.9	35.625
161.0	249.4	35.238	177.0	249.9	35.539	193.0	249.9	35.625
162.0	249.4	35.268	178.0	249.8	35.550	194.0	249.9	35.625
163.0	249.5	35.294	179.0	249.9	35.564	195.0	250.0	35.626
164.0	249.6	35.316	180.0	249.9	35.572	196.0	249.9	35.627
165.0	249.7	35.342	181.0	249.9	35.579			

OBSERVED EXPERIMENTAL DATA FROM RUN 24

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	93.3	-.---	50.0	249.7	24.453	100.0	249.2	27.303
1.0	130.9	9.118	51.0	249.5	24.480	101.0	249.0	27.396
2.0	159.7	12.168	52.0	249.8	24.509	102.0	249.2	27.502
3.0	180.5	14.614	53.0	249.4	24.533	103.0	249.0	27.600
4.0	195.5	16.581	54.0	249.5	24.555	104.0	249.1	27.700
5.0	206.6	18.148	55.0	249.4	24.585	105.0	249.0	27.804
6.0	215.3	19.408	56.0	249.6	24.612	106.0	249.1	27.909
7.0	222.5	20.414	57.0	249.4	24.643	107.0	249.0	28.013
8.0	228.5	21.219	58.0	249.6	24.667	108.0	249.1	28.115
9.0	232.7	21.853	59.0	249.4	24.694	109.0	249.0	28.218
10.0	236.3	22.348	60.0	249.6	24.721	110.0	249.1	28.325
11.0	238.8	22.730	61.0	249.4	24.753	111.0	249.0	28.425
12.0	241.0	23.035	62.0	249.6	24.783	112.0	249.1	28.528
13.0	242.4	23.272	63.0	249.5	24.813	113.0	249.0	28.630
14.0	243.8	23.454	64.0	249.6	24.845	114.0	249.2	28.734
15.0	244.8	23.597	65.0	249.4	24.878	115.0	249.0	28.836
16.0	245.9	23.709	66.0	249.5	24.913	116.0	249.1	28.943
17.0	246.2	23.798	67.0	249.4	24.954	117.0	249.0	29.044
18.0	247.2	23.869	68.0	249.7	24.987	118.0	249.1	29.148
19.0	247.3	23.920	69.0	249.4	25.031	119.0	249.0	29.242
20.0	247.8	23.954	70.0	249.6	25.074	120.0	249.0	29.343
21.0	248.0	24.000	71.0	249.4	25.119	121.0	249.0	29.440
22.0	248.5	24.023	72.0	249.6	25.166	122.0	249.0	29.535
23.0	248.8	24.045	73.0	249.4	25.212	123.0	249.0	29.633
24.0	248.8	24.062	74.0	249.5	25.263	124.0	249.0	29.719
25.0	248.8	24.077	75.0	249.4	25.314	125.0	249.0	29.817
26.0	249.0	24.088	76.0	249.6	25.374	126.0	249.0	29.913
27.0	248.9	24.099	77.0	249.6	25.432	127.0	249.0	30.002
28.0	249.1	24.109	78.0	249.7	25.488	128.0	249.0	30.094
29.0	249.1	24.114	79.0	249.6	25.550	129.0	248.9	30.178
30.0	249.3	24.117	80.0	249.6	25.610	130.0	249.0	30.267
31.0	249.1	24.123	81.0	249.5	25.677	131.0	249.0	30.352
32.0	249.3	24.129	82.0	249.6	25.740	132.0	249.0	30.433
33.0	249.3	24.133	83.0	249.4	25.814	133.0	249.0	30.513
34.0	249.6	24.142	84.0	249.6	25.889	134.0	249.0	30.594
35.0	249.3	24.148	85.0	249.4	25.959	135.0	249.0	30.672
36.0	249.6	24.157	86.0	249.4	26.039	136.0	249.0	30.743
37.0	249.3	24.167	87.0	249.2	26.119	137.0	249.0	30.818
38.0	249.6	24.183	88.0	249.3	26.201	138.0	249.0	30.892
39.0	249.5	24.193	89.0	249.2	26.281	139.0	248.9	30.959
40.0	249.8	24.208	90.0	249.3	26.360	140.0	248.9	31.027
41.0	249.5	24.223	91.0	249.2	26.451	141.0	248.9	31.099
42.0	249.8	24.247	92.0	249.3	26.532	142.0	248.9	31.168
43.0	249.7	24.270	93.0	249.2	26.627	143.0	248.9	31.226
44.0	249.7	24.295	94.0	249.3	26.718	144.0	248.9	31.290
45.0	249.6	24.316	95.0	249.2	26.814	145.0	248.9	31.352
46.0	249.7	24.341	96.0	249.3	26.909	146.0	249.0	31.406
47.0	249.5	24.366	97.0	249.2	27.003	147.0	249.0	31.463
48.0	249.7	24.395	98.0	249.2	27.102	148.0	249.0	31.518
49.0	249.5	24.421	99.0	249.1	27.193	149.0	249.0	31.573

OBSERVED EXPERIMENTAL DATA FROM RUN 24 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
150.0	249.0	31.625	179.0	249.2	32.471	208.0	249.5	32.657
151.0	249.0	31.676	180.0	249.2	32.485	209.0	249.5	32.660
152.0	249.0	31.721	181.0	249.2	32.497	210.0	249.5	32.663
153.0	249.0	31.767	182.0	249.2	32.509	211.0	249.4	32.663
154.0	249.0	31.811	183.0	249.2	32.517	212.0	249.5	32.662
155.0	249.0	31.853	184.0	249.2	32.530	213.0	249.4	32.666
156.0	249.0	31.898	185.0	249.2	32.537	214.0	249.5	32.663
157.0	249.0	31.934	186.0	249.2	32.545	215.0	249.4	32.665
158.0	249.0	31.970	187.0	249.2	32.556	216.0	249.5	32.665
159.0	249.0	32.009	188.0	249.2	32.560	217.0	249.4	32.666
160.0	249.0	32.043	189.0	249.3	32.569	218.0	249.5	32.665
161.0	249.0	32.076	190.0	249.3	32.574	219.0	249.5	32.667
162.0	249.0	32.109	191.0	249.3	32.582	220.0	249.5	32.668
163.0	249.0	32.138	192.0	249.3	32.588	221.0	249.5	32.666
164.0	249.0	32.165	193.0	249.3	32.596	222.0	249.5	32.667
165.0	249.0	32.192	194.0	249.3	32.601	223.0	249.5	32.670
166.0	249.0	32.215	195.0	249.3	32.605	224.0	249.5	32.670
167.0	249.1	32.244	196.0	249.3	32.610	225.0	249.5	32.673
168.0	249.1	32.264	197.0	249.3	32.614	226.0	249.5	32.672
169.0	249.2	32.287	198.0	249.3	32.620	227.0	249.4	32.671
170.0	249.2	32.315	199.0	249.3	32.626	228.0	249.5	32.674
171.0	249.2	32.333	200.0	249.3	32.630	229.0	249.4	32.674
172.0	249.3	32.354	201.0	249.3	32.634	230.0	249.4	32.675
173.0	249.2	32.374	202.0	249.3	32.639	231.0	249.3	32.674
174.0	249.3	32.394	203.0	249.3	32.639	232.0	249.4	32.675
175.0	249.2	32.410	204.0	249.4	32.644	233.0	249.3	32.674
176.0	249.3	32.423	205.0	249.4	32.647	234.0	249.4	32.674
177.0	249.2	32.440	206.0	249.5	32.653	235.0	249.3	32.674
178.0	249.3	32.452	207.0	249.4	32.652			

OBSERVED EXPERIMENTAL DATA FROM RUN 25

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	91.2	-.---	50.0	249.8	19.852	100.0	248.8	24.479
1.0	125.8	3.784	51.0	249.8	19.922	101.0	249.0	24.563
2.0	154.2	6.775	52.0	249.7	19.994	102.0	248.8	24.650
3.0	175.9	9.438	53.0	249.8	20.064	103.0	249.0	24.734
4.0	192.1	11.243	54.0	249.7	20.141	104.0	248.8	24.817
5.0	204.8	12.856	55.0	249.7	20.216	105.0	249.0	24.894
6.0	214.2	14.148	56.0	249.7	20.297	106.0	248.8	24.980
7.0	222.0	15.180	57.0	249.7	20.376	107.0	249.0	25.057
8.0	227.9	16.007	58.0	249.4	20.461	108.0	248.8	25.135
9.0	232.7	16.640	59.0	249.5	20.538	109.0	248.9	25.213
10.0	236.1	17.144	60.0	249.3	20.624	110.0	248.8	25.286
11.0	238.9	17.542	61.0	249.5	20.714	111.0	249.0	25.358
12.0	241.0	17.854	62.0	249.2	20.798	112.0	248.8	25.431
13.0	242.8	18.092	63.0	249.5	20.891	113.0	249.0	25.504
14.0	244.2	18.279	64.0	249.2	20.981	114.0	248.8	25.569
15.0	245.8	18.428	65.0	249.5	21.074	115.0	249.1	25.636
16.0	246.4	18.545	66.0	249.3	21.172	116.0	249.0	25.702
17.0	247.3	18.637	67.0	249.4	21.268	117.0	249.1	25.768
18.0	247.6	18.714	68.0	249.2	21.355	118.0	249.0	25.830
19.0	248.3	18.767	69.0	249.3	21.456	119.0	249.1	25.895
20.0	248.5	18.817	70.0	249.2	21.554	120.0	249.0	25.954
21.0	248.7	18.852	71.0	249.3	21.653	121.0	249.2	26.018
22.0	248.9	18.881	72.0	249.1	21.753	122.0	249.1	26.073
23.0	249.2	18.913	73.0	249.2	21.856	123.0	249.2	26.131
24.0	249.2	18.932	74.0	249.1	21.956	124.0	249.2	26.188
25.0	249.4	18.952	75.0	249.3	22.049	125.0	249.4	26.242
26.0	249.4	18.965	76.0	249.0	22.154	126.0	249.3	26.294
27.0	249.7	18.981	77.0	249.3	22.255	127.0	249.4	26.341
28.0	249.7	19.005	78.0	249.0	22.354	128.0	249.2	26.396
29.0	249.8	19.020	79.0	249.2	22.458	129.0	249.5	26.449
30.0	249.8	19.036	80.0	248.8	22.558	130.0	249.2	26.493
31.0	249.8	19.056	81.0	249.0	22.662	131.0	249.5	26.536
32.0	249.9	19.077	82.0	248.9	22.764	132.0	249.4	26.584
33.0	249.9	19.103	83.0	249.0	22.868	133.0	249.7	26.619
34.0	249.9	19.127	84.0	248.9	22.964	134.0	249.4	26.661
35.0	250.0	19.155	85.0	249.0	23.064	135.0	249.7	26.701
36.0	250.0	19.179	86.0	248.9	23.164	136.0	249.4	26.743
37.0	250.0	19.217	87.0	249.0	23.265	137.0	249.6	26.780
38.0	250.0	19.251	88.0	248.8	23.359	138.0	249.4	26.816
39.0	250.0	19.289	89.0	249.0	23.457	139.0	249.8	26.852
40.0	250.0	19.330	90.0	248.8	23.556	140.0	249.5	26.889
41.0	250.0	19.372	91.0	249.0	23.652	141.0	249.8	26.917
42.0	250.0	19.418	92.0	248.8	23.750	142.0	249.5	26.948
43.0	250.0	19.465	93.0	249.0	23.843	143.0	249.8	26.982
44.0	250.0	19.516	94.0	248.8	23.937	144.0	249.7	27.011
45.0	250.0	19.567	95.0	249.0	24.029	145.0	249.8	27.040
46.0	249.9	19.618	96.0	248.8	24.121	146.0	249.6	27.068
47.0	249.9	19.685	97.0	249.0	24.208	147.0	249.8	27.090
48.0	249.8	19.729	98.0	248.8	24.297	148.0	249.6	27.114
49.0	249.8	19.792	99.0	249.0	24.385	149.0	249.8	27.144

OBSERVED EXPERIMENTAL DATA FROM RUN 25 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
150.0	249.6	27.169	183.0	250.0	27.566	216.0	250.0	27.634
151.0	249.8	27.195	184.0	250.0	27.570	217.0	250.0	27.637
152.0	249.7	27.216	185.0	250.0	27.574	218.0	249.9	27.639
153.0	249.8	27.233	186.0	249.9	27.582	219.0	250.0	27.642
154.0	249.8	27.252	187.0	250.0	27.583	220.0	249.9	27.640
155.0	249.8	27.273	188.0	250.0	27.587	221.0	250.0	27.640
156.0	249.8	27.289	189.0	250.1	27.590	222.0	249.9	27.643
157.0	249.9	27.312	190.0	250.0	27.597	223.0	250.0	27.643
158.0	249.8	27.327	191.0	250.0	27.599	224.0	249.9	27.644
159.0	249.9	27.340	192.0	250.0	27.602	225.0	250.0	27.644
160.0	249.8	27.356	193.0	250.0	27.606	226.0	249.9	27.645
161.0	249.9	27.371	194.0	250.0	27.606	227.0	250.0	27.644
162.0	249.8	27.386	195.0	250.0	27.610	228.0	249.9	27.643
163.0	249.9	27.396	196.0	250.0	27.612	229.0	249.9	27.644
164.0	249.8	27.413	197.0	250.0	27.614	230.0	249.9	27.644
165.0	249.9	27.421	198.0	250.0	27.616	231.0	250.0	27.643
166.0	249.8	27.436	199.0	250.0	27.616	232.0	249.9	27.644
167.0	249.9	27.445	200.0	250.0	27.618	233.0	250.0	27.646
168.0	249.8	27.458	201.0	250.0	27.619	234.0	249.9	27.649
169.0	249.9	27.470	202.0	250.0	27.619	235.0	250.0	27.649
170.0	249.9	27.478	203.0	250.0	27.620	236.0	249.9	27.649
171.0	250.0	27.491	204.0	250.0	27.621	237.0	250.0	27.650
172.0	249.9	27.498	205.0	250.0	27.627	238.0	249.9	27.650
173.0	250.0	27.506	206.0	250.0	27.628	239.0	250.0	27.650
174.0	249.9	27.515	207.0	250.0	27.630	240.0	249.9	27.651
175.0	250.0	27.519	208.0	250.0	27.631	241.0	249.9	27.652
176.0	250.0	27.524	209.0	250.0	27.632	242.0	249.9	27.653
177.0	250.0	27.534	210.0	249.9	27.631	243.0	249.9	27.651
178.0	250.0	27.537	211.0	250.0	27.632	244.0	249.9	27.651
179.0	250.0	27.542	212.0	250.0	27.633	245.0	249.9	27.651
180.0	250.0	27.549	213.0	250.0	27.633	246.0	249.9	27.653
181.0	250.0	27.555	214.0	250.0	27.633	247.0	249.9	27.652
182.0	250.0	27.559	215.0	250.0	27.634	248.0	249.9	27.651

OBSERVED EXPERIMENTAL DATA FROM RUN 26

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	91.3	-.---	50.0	249.8	19.514	100.0	249.4	20.864
1.0	129.3	4.581	51.0	249.9	19.515	101.0	249.6	20.944
2.0	157.5	7.563	52.0	249.8	19.518	102.0	249.4	21.001
3.0	178.8	9.993	53.0	249.9	19.522	103.0	249.6	21.062
4.0	195.6	11.960	54.0	249.8	19.524	104.0	249.3	21.120
5.0	206.8	13.561	55.0	249.9	19.530	105.0	249.5	21.198
6.0	215.7	14.833	56.0	249.7	19.536	106.0	249.3	21.273
7.0	223.0	15.844	57.0	249.9	19.541	107.0	249.5	21.343
8.0	228.5	16.644	58.0	249.8	19.544	108.0	249.2	21.415
9.0	233.3	17.265	59.0	249.9	19.550	109.0	249.4	21.489
10.0	236.6	17.750	60.0	249.8	19.556	110.0	249.2	21.561
11.0	239.4	18.128	61.0	249.9	19.562	111.0	249.4	21.636
12.0	241.2	18.431	62.0	249.8	19.573	112.0	249.1	21.713
13.0	243.1	18.663	63.0	249.8	19.580	113.0	249.3	21.788
14.0	244.2	18.839	64.0	249.7	19.591	114.0	249.2	21.867
15.0	245.6	18.982	65.0	249.9	19.599	115.0	249.3	21.943
16.0	246.2	19.093	66.0	249.7	19.608	116.0	249.2	22.019
17.0	247.0	19.177	67.0	249.8	19.624	117.0	249.3	22.099
18.0	247.3	19.240	68.0	249.7	19.638	118.0	249.2	22.179
19.0	247.8	19.296	69.0	249.9	19.652	119.0	249.3	22.258
20.0	248.0	19.335	70.0	249.6	19.665	120.0	249.1	22.339
21.0	248.4	19.369	71.0	249.7	19.684	121.0	249.3	22.417
22.0	248.5	19.397	72.0	249.5	19.702	122.0	249.2	22.499
23.0	248.8	19.418	73.0	249.7	19.721	123.0	249.3	22.581
24.0	248.8	19.431	74.0	249.5	19.742	124.0	249.2	22.662
25.0	248.9	19.445	75.0	249.7	19.763	125.0	249.3	22.742
26.0	249.1	19.456	76.0	249.6	19.788	126.0	249.2	22.827
27.0	249.2	19.465	77.0	249.8	19.814	127.0	249.3	22.919
28.0	249.2	19.469	78.0	249.5	19.839	128.0	249.1	22.991
29.0	249.3	19.475	79.0	249.8	19.865	129.0	249.2	23.074
30.0	249.2	19.478	80.0	249.5	19.897	130.0	249.2	23.159
31.0	249.6	19.480	81.0	249.7	19.931	131.0	249.3	23.237
32.0	249.4	19.486	82.0	249.6	19.965	132.0	249.2	23.319
33.0	249.5	19.487	83.0	249.8	20.004	133.0	249.3	23.404
34.0	249.4	19.493	84.0	249.5	20.028	134.0	249.2	23.487
35.0	249.6	19.495	85.0	249.7	20.074	135.0	249.3	23.570
36.0	249.5	19.495	86.0	249.5	20.120	136.0	249.2	23.654
37.0	249.6	19.495	87.0	249.7	20.161	137.0	249.3	23.736
38.0	249.6	19.498	88.0	249.4	20.206	138.0	249.1	23.820
39.0	249.7	19.499	89.0	249.6	20.250	139.0	249.3	23.905
40.0	249.7	19.498	90.0	249.4	20.301	140.0	249.0	23.988
41.0	249.8	19.498	91.0	249.6	20.351	141.0	249.0	24.073
42.0	249.8	19.500	92.0	249.4	20.402	142.0	248.9	24.154
43.0	249.8	19.500	93.0	249.6	20.455	143.0	249.0	24.234
44.0	249.8	19.503	94.0	249.4	20.509	144.0	248.9	24.317
45.0	249.9	19.504	95.0	249.7	20.564	145.0	249.0	24.402
46.0	249.9	19.505	96.0	249.4	20.620	146.0	248.9	24.482
47.0	249.9	19.507	97.0	249.6	20.680	147.0	249.0	24.559
48.0	249.8	19.511	98.0	249.4	20.740	148.0	248.9	24.642
49.0	249.9	19.513	99.0	249.6	20.804	149.0	249.0	24.728

OBSERVED EXPERIMENTAL DATA FROM RUN 26 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
150.0	248.9	24.800	200.0	249.4	27.434	250.0	249.5	27.889
151.0	249.0	24.879	201.0	249.5	27.455	251.0	249.5	27.893
152.0	249.0	24.959	202.0	249.5	27.479	252.0	249.5	27.896
153.0	249.1	25.037	203.0	249.6	27.498	253.0	249.5	27.899
154.0	249.0	25.113	204.0	249.7	27.515	254.0	249.5	27.903
155.0	249.1	25.191	205.0	249.7	27.533	255.0	249.5	27.905
156.0	249.0	25.269	206.0	249.7	27.557	256.0	249.5	27.907
157.0	249.1	25.344	207.0	249.7	27.572	257.0	249.5	27.909
158.0	249.0	25.418	208.0	249.6	27.587	258.0	249.6	27.911
159.0	249.1	25.495	209.0	249.6	27.603	259.0	249.7	27.913
160.0	249.0	25.567	210.0	249.6	27.616	260.0	249.8	27.916
161.0	249.1	25.635	211.0	249.5	27.630	261.0	249.9	27.920
162.0	249.0	25.705	212.0	249.5	27.643	262.0	249.8	27.926
163.0	249.1	25.772	213.0	249.5	27.655	263.0	249.8	27.928
164.0	249.0	25.842	214.0	249.5	27.663	264.0	249.8	27.930
165.0	249.1	25.906	215.0	249.5	27.673	265.0	249.8	27.935
166.0	249.0	25.971	216.0	249.4	27.689	266.0	249.8	27.937
167.0	249.1	26.035	217.0	249.4	27.700	267.0	249.9	27.940
168.0	249.0	26.098	218.0	249.4	27.707	268.0	249.8	27.941
169.0	249.2	26.157	219.0	249.5	27.718	269.0	249.8	27.945
170.0	249.1	26.218	220.0	249.5	27.729	270.0	249.8	27.945
171.0	249.2	26.279	221.0	249.5	27.736	271.0	249.8	27.946
172.0	249.1	26.336	222.0	249.5	27.745	272.0	249.8	27.944
173.0	249.2	26.395	223.0	249.5	27.750	273.0	249.8	27.945
174.0	249.1	26.450	224.0	249.5	27.755	274.0	249.8	27.946
175.0	249.2	26.503	225.0	249.5	27.767	275.0	249.9	27.949
176.0	249.0	26.557	226.0	249.5	27.766	276.0	249.8	27.953
177.0	249.1	26.606	227.0	249.6	27.769	277.0	249.8	27.957
178.0	249.1	26.657	228.0	249.6	27.786	278.0	249.8	27.955
179.0	249.1	26.706	229.0	249.5	27.793	279.0	249.9	27.959
180.0	249.0	26.756	230.0	249.6	27.802	280.0	249.8	27.960
181.0	249.1	26.802	231.0	249.5	27.807	281.0	249.9	27.962
182.0	249.0	26.845	232.0	249.5	27.812	282.0	249.8	27.964
183.0	249.2	26.893	233.0	249.5	27.817	283.0	249.8	27.968
184.0	249.1	26.930	234.0	249.5	27.820	284.0	249.8	27.969
185.0	249.2	26.974	235.0	249.6	27.828	285.0	249.8	27.970
186.0	249.1	27.012	236.0	249.5	27.831	286.0	249.8	27.971
187.0	249.2	27.051	237.0	249.5	27.840	287.0	249.8	27.973
188.0	249.3	27.093	238.0	249.5	27.842	288.0	249.8	27.973
189.0	249.4	27.122	239.0	249.5	27.846	289.0	249.8	27.976
190.0	249.3	27.159	240.0	249.6	27.851	290.0	249.8	27.976
191.0	249.5	27.190	241.0	249.5	27.855	291.0	249.8	27.979
192.0	249.4	27.219	242.0	249.7	27.859	292.0	249.9	27.982
193.0	249.5	27.253	243.0	249.6	27.865	293.0	249.9	27.983
194.0	249.4	27.282	244.0	249.5	27.870	294.0	249.9	27.983
195.0	249.5	27.308	245.0	249.6	27.874	295.0	249.9	27.983
196.0	249.4	27.339	246.0	249.6	27.875	296.0	249.9	27.984
197.0	249.5	27.366	247.0	249.6	27.879	297.0	249.9	27.984
198.0	249.5	27.388	248.0	249.5	27.880	298.0	249.9	27.985
199.0	249.6	27.411	249.0	249.5	27.885	299.0	249.9	27.986

OBSERVED EXPERIMENTAL DATA FROM RUN 26 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
300.0	249.9	27.986	303.0	249.9	27.987	306.0	249.9	27.987
301.0	249.9	27.990	304.0	249.9	27.987	307.0	249.9	27.989
302.0	249.9	27.985	305.0	249.9	27.988			

OBSERVED EXPERIMENTAL DATA FROM RUN 27

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	87.4	--.---	50.0	250.2	29.257	100.0	249.8	31.211
1.0	128.8	13.567	51.0	250.1	29.265	101.0	249.8	31.298
2.0	157.7	16.715	52.0	250.2	29.270	102.0	249.8	31.388
3.0	178.6	19.273	53.0	250.1	29.278	103.0	249.7	31.473
4.0	193.9	21.317	54.0	250.2	29.286	104.0	249.8	31.559
5.0	205.9	22.978	55.0	250.1	29.295	105.0	249.6	31.648
6.0	214.9	24.298	56.0	250.2	29.307	106.0	249.8	31.741
7.0	222.0	25.374	57.0	250.1	29.314	107.0	249.6	31.827
8.0	228.2	26.219	58.0	250.2	29.322	108.0	249.8	31.911
9.0	232.8	26.878	59.0	250.1	29.338	109.0	249.6	32.014
10.0	236.6	27.390	60.0	250.2	29.350	110.0	249.8	32.108
11.0	239.2	27.796	61.0	250.1	29.363	111.0	249.7	32.206
12.0	241.6	28.110	62.0	250.2	29.379	112.0	249.8	32.299
13.0	243.2	28.359	63.0	250.1	29.396	113.0	249.4	32.392
14.0	244.8	28.447	64.0	250.2	29.411	114.0	249.6	32.486
15.0	245.8	28.691	65.0	250.1	29.428	115.0	249.3	32.583
16.0	246.9	28.809	66.0	250.2	29.447	116.0	249.5	32.679
17.0	247.3	28.899	67.0	250.1	29.466	117.0	249.3	32.774
18.0	247.9	28.971	68.0	250.2	29.489	118.0	249.5	32.870
19.0	248.4	29.026	69.0	250.1	29.509	119.0	249.3	32.966
20.0	248.7	29.075	70.0	250.2	29.536	120.0	249.4	33.064
21.0	249.0	29.104	71.0	250.2	29.565	121.0	249.3	33.159
22.0	249.3	29.133	72.0	250.2	29.595	122.0	249.4	33.256
23.0	249.4	29.156	73.0	250.2	29.622	123.0	249.3	33.350
24.0	249.8	29.176	74.0	250.2	29.657	124.0	249.5	33.444
25.0	249.8	29.193	75.0	250.2	29.690	125.0	249.2	33.541
26.0	249.9	29.204	76.0	250.2	29.726	126.0	249.4	33.632
27.0	249.9	29.214	77.0	250.1	29.767	127.0	249.3	33.727
28.0	249.9	29.217	78.0	250.2	29.805	128.0	249.5	33.815
29.0	250.0	29.225	79.0	250.0	29.847	129.0	249.3	33.909
30.0	250.0	29.231	80.0	250.0	29.889	130.0	249.5	33.998
31.0	249.9	29.230	81.0	250.0	29.936	131.0	249.3	34.089
32.0	250.1	29.238	82.0	250.0	29.986	132.0	249.5	34.176
33.0	249.9	29.240	83.0	249.9	30.042	133.0	249.3	34.261
34.0	250.0	29.243	84.0	250.0	30.094	134.0	249.5	34.349
35.0	250.0	29.242	85.0	249.9	30.145	135.0	249.3	34.432
36.0	250.1	29.243	86.0	250.0	30.203	136.0	249.4	34.518
37.0	250.0	29.244	87.0	249.9	30.266	137.0	249.3	34.606
38.0	250.1	29.247	88.0	250.1	30.325	138.0	249.4	34.690
39.0	250.1	29.247	89.0	249.9	30.388	139.0	249.3	34.770
40.0	250.2	29.249	90.0	250.0	30.455	140.0	249.4	34.847
41.0	250.1	29.251	91.0	249.9	30.517	141.0	249.3	34.931
42.0	250.2	29.252	92.0	250.0	30.589	142.0	249.4	35.011
43.0	250.1	29.242	93.0	249.9	30.663	143.0	249.3	35.088
44.0	250.2	29.230	94.0	249.9	30.736	144.0	249.5	35.163
45.0	250.1	29.222	95.0	249.8	30.811	145.0	249.3	35.236
46.0	250.2	29.229	96.0	249.9	30.892	146.0	249.6	35.308
47.0	250.2	29.235	97.0	249.8	30.967	147.0	249.3	35.381
48.0	250.2	29.244	98.0	249.9	31.051	148.0	249.6	35.449
49.0	250.2	29.251	99.0	249.8	31.129	149.0	249.3	35.519

OBSERVED EXPERIMENTAL DATA FROM RUN 27 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
150.0	249.5	35.588	187.0	249.7	37.158	224.0	250.0	37.515
151.0	249.3	35.654	188.0	249.8	37.180	225.0	250.0	37.515
152.0	249.5	35.721	189.0	249.8	37.200	226.0	250.0	37.518
153.0	249.3	35.785	190.0	249.8	37.216	227.0	249.9	37.520
154.0	249.4	35.848	191.0	249.8	37.233	228.0	250.0	37.525
155.0	249.3	35.910	192.0	249.9	37.253	229.0	249.9	37.525
156.0	249.3	35.970	193.0	249.9	37.270	230.0	250.0	37.531
157.0	249.3	36.027	194.0	249.9	37.287	231.0	249.9	37.532
158.0	249.4	36.087	195.0	249.9	37.302	232.0	250.0	37.531
159.0	249.3	36.139	196.0	249.9	37.317	233.0	250.0	37.535
160.0	249.4	36.194	197.0	249.8	37.329	234.0	250.0	37.536
161.0	249.3	36.246	198.0	249.9	37.345	235.0	250.0	37.537
162.0	249.5	36.295	199.0	249.9	37.357	236.0	250.0	37.539
163.0	249.4	36.343	200.0	249.8	37.367	237.0	250.0	37.539
164.0	249.5	36.392	201.0	249.8	37.379	238.0	250.0	37.540
165.0	249.4	36.448	202.0	249.9	37.391	239.0	249.9	37.541
166.0	249.6	36.498	203.0	249.9	37.402	240.0	250.0	37.542
167.0	249.4	36.536	204.0	249.9	37.411	241.0	249.9	37.544
168.0	249.6	36.576	205.0	249.9	37.418	242.0	250.0	37.544
169.0	249.5	36.615	206.0	249.9	37.429	243.0	250.0	37.546
170.0	249.6	36.653	207.0	249.8	37.435	244.0	250.0	37.546
171.0	249.4	36.692	208.0	249.9	37.442	245.0	250.0	37.548
172.0	249.5	36.730	209.0	249.8	37.448	246.0	250.0	37.547
173.0	249.5	36.766	210.0	249.9	37.456	247.0	250.0	37.548
174.0	249.7	36.800	211.0	249.8	37.460	248.0	250.0	37.550
175.0	249.6	36.834	212.0	249.8	37.469	249.0	250.0	37.550
176.0	249.7	36.865	213.0	249.8	37.473	250.0	250.0	37.550
177.0	249.7	36.901	214.0	249.9	37.478	251.0	250.0	37.551
178.0	249.7	36.930	215.0	249.8	37.484	252.0	250.0	37.552
179.0	249.7	36.959	216.0	249.8	37.491	253.0	250.0	37.551
180.0	249.7	36.988	217.0	249.8	37.498	254.0	250.0	37.552
181.0	249.7	37.014	218.0	249.9	37.498	255.0	250.0	37.553
182.0	249.8	37.041	219.0	249.9	37.503	256.0	250.1	37.552
183.0	249.7	37.070	220.0	250.0	37.507	257.0	250.0	37.551
184.0	249.8	37.094	221.0	250.0	37.508	258.0	250.1	37.551
185.0	249.8	37.114	222.0	250.0	37.510	259.0	250.0	37.552
186.0	249.8	37.137	223.0	250.0	37.515	260.0	250.0	37.552

OBSERVED EXPERIMENTAL DATA FROM RUN 28

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	87.3	--.---	50.0	249.1	26.780	100.0	249.2	27.708
1.0	125.7	11.215	51.0	249.2	26.783	101.0	249.4	27.754
2.0	154.0	14.239	52.0	249.1	26.784	102.0	249.2	27.808
3.0	175.2	16.754	53.0	249.2	26.787	103.0	249.3	27.854
4.0	191.2	18.809	54.0	249.1	26.790	104.0	249.1	27.909
5.0	203.9	20.464	55.0	249.2	26.794	105.0	249.2	27.958
6.0	213.4	21.796	56.0	249.1	26.800	106.0	249.0	28.016
7.0	221.2	22.855	57.0	249.2	26.806	107.0	249.2	28.068
8.0	227.1	23.692	58.0	249.1	26.813	108.0	249.0	28.124
9.0	231.6	24.342	59.0	249.3	26.816	109.0	249.2	28.180
10.0	235.0	24.863	60.0	249.1	26.822	110.0	249.0	28.239
11.0	238.1	25.270	61.0	249.3	26.827	111.0	249.2	28.303
12.0	240.2	25.588	62.0	249.1	26.834	112.0	249.0	28.367
13.0	242.0	25.831	63.0	249.2	26.842	113.0	249.2	28.430
14.0	243.2	26.020	64.0	249.1	26.850	114.0	249.0	28.492
15.0	244.5	26.176	65.0	249.2	26.858	115.0	249.2	28.558
16.0	245.3	26.293	66.0	249.1	26.868	116.0	248.9	28.619
17.0	246.2	26.389	67.0	249.2	26.879	117.0	249.0	28.692
18.0	246.7	26.460	68.0	249.1	26.886	118.0	249.8	28.763
19.0	247.2	26.519	69.0	249.2	26.897	119.0	249.9	28.832
20.0	247.3	26.571	70.0	249.0	26.908	120.0	249.8	28.904
21.0	247.7	26.605	71.0	249.3	26.918	121.0	249.0	28.976
22.0	247.8	26.637	72.0	249.1	26.932	122.0	248.8	29.051
23.0	248.2	26.658	73.0	249.3	26.945	123.0	248.9	29.123
24.0	248.3	26.676	74.0	249.1	26.959	124.0	248.7	29.197
25.0	248.6	26.689	75.0	249.3	26.976	125.0	248.9	29.274
26.0	248.4	26.699	76.0	249.2	26.989	126.0	248.7	29.351
27.0	248.6	26.709	77.0	249.5	27.009	127.0	248.8	29.430
28.0	248.5	26.717	78.0	249.3	27.024	128.0	248.6	29.508
29.0	248.7	26.725	79.0	249.5	27.045	129.0	248.7	29.587
30.0	248.7	26.727	80.0	249.3	27.069	130.0	248.6	29.666
31.0	248.8	26.735	81.0	249.5	27.087	131.0	248.8	29.746
32.0	248.8	26.736	82.0	249.3	27.106	132.0	248.6	29.826
33.0	248.9	26.739	83.0	249.5	27.127	133.0	248.8	29.908
34.0	248.9	26.740	84.0	249.3	27.152	134.0	248.6	29.987
35.0	249.0	26.745	85.0	249.4	27.178	135.0	248.7	30.073
36.0	249.0	26.749	86.0	249.3	27.205	136.0	248.6	30.151
37.0	249.1	26.748	87.0	249.4	27.234	137.0	248.7	30.236
38.0	249.0	26.753	88.0	249.3	27.261	138.0	248.5	30.314
39.0	249.2	26.753	89.0	249.4	27.293	139.0	248.7	30.395
40.0	249.1	26.753	90.0	249.2	27.322	140.0	248.5	30.477
41.0	249.2	26.757	91.0	249.4	27.358	141.0	248.7	30.558
42.0	249.1	26.758	92.0	249.2	27.390	142.0	248.5	30.639
43.0	249.2	26.758	93.0	249.5	27.425	143.0	248.7	30.720
44.0	249.1	26.759	94.0	249.3	27.459	144.0	248.5	30.806
45.0	249.3	26.766	95.0	249.5	27.500	145.0	248.7	30.878
46.0	249.2	26.769	96.0	249.3	27.539	146.0	248.5	30.960
47.0	249.2	26.771	97.0	249.5	27.578	147.0	248.7	31.045
48.0	249.1	26.773	98.0	249.2	27.619	148.0	248.6	31.120
49.0	249.2	26.776	99.0	249.5	27.663	149.0	248.7	31.202

OBSERVED EXPERIMENTAL DATA FROM RUN 28 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
150.0	248.5	31.284	197.0	248.7	34.082	244.0	249.1	34.989
151.0	248.7	31.361	198.0	248.8	34.116	245.0	249.1	34.998
152.0	248.5	31.439	199.0	248.8	34.153	246.0	249.1	35.006
153.0	248.8	31.515	200.0	248.8	34.187	247.0	249.1	35.010
154.0	248.5	31.593	201.0	248.8	34.223	248.0	249.2	35.017
155.0	248.7	31.670	202.0	248.8	34.254	249.0	249.2	35.022
156.0	248.4	31.746	203.0	249.0	34.285	250.0	249.2	35.026
157.0	248.7	31.818	204.0	248.9	34.320	251.0	249.3	35.032
158.0	248.4	31.895	205.0	248.9	34.349	252.0	249.3	35.037
159.0	248.6	31.963	206.0	248.9	34.376	253.0	249.3	35.040
160.0	248.4	32.038	207.0	249.0	34.405	254.0	249.3	35.046
161.0	248.5	32.112	208.0	248.9	34.428	255.0	249.4	35.051
162.0	248.4	32.183	209.0	249.0	34.453	256.0	249.3	35.056
163.0	248.5	32.252	210.0	248.9	34.480	257.0	249.4	35.061
164.0	248.4	32.323	211.0	249.0	34.509	258.0	249.3	35.066
165.0	248.5	32.391	212.0	248.9	34.533	259.0	249.4	35.066
166.0	248.4	32.458	213.0	249.0	34.555	260.0	249.3	35.069
167.0	248.5	32.527	214.0	248.9	34.576	261.0	249.3	35.070
168.0	248.5	32.594	215.0	249.0	34.601	262.0	249.3	35.074
169.0	248.5	32.661	216.0	248.9	34.623	263.0	249.4	35.078
170.0	248.4	32.726	217.0	249.0	34.644	264.0	249.3	35.083
171.0	248.5	32.784	218.0	249.0	34.658	265.0	249.3	35.084
172.0	248.4	32.851	219.0	249.1	34.678	266.0	249.3	35.088
173.0	248.5	32.912	220.0	249.1	34.695	267.0	249.3	35.089
174.0	248.4	32.962	221.0	249.2	34.713	268.0	249.3	35.088
175.0	248.4	33.033	222.0	249.1	34.730	269.0	249.3	35.090
176.0	248.4	33.090	223.0	249.1	34.742	270.0	249.3	35.093
177.0	248.4	33.146	224.0	249.1	34.761	271.0	249.3	35.094
178.0	248.4	33.207	225.0	249.1	34.778	272.0	249.3	35.093
179.0	248.5	33.259	226.0	249.1	34.792	273.0	249.4	35.094
180.0	248.4	33.308	227.0	249.2	34.808	274.0	249.3	35.095
181.0	248.5	33.363	228.0	249.1	34.819	275.0	249.4	35.096
182.0	248.5	33.415	229.0	249.1	34.833	276.0	249.3	35.099
183.0	248.5	33.466	230.0	249.1	34.845	277.0	249.3	35.100
184.0	248.5	33.516	231.0	249.1	34.859	278.0	249.3	35.100
185.0	248.5	33.568	232.0	249.1	34.872	279.0	249.3	35.101
186.0	248.5	33.615	233.0	249.0	34.884	280.0	249.3	35.101
187.0	248.6	33.658	234.0	249.1	34.898	281.0	249.3	35.102
188.0	248.5	33.708	235.0	249.1	34.909	282.0	249.2	35.104
189.0	248.5	33.752	236.0	249.1	34.921	283.0	249.2	35.106
190.0	248.5	33.800	237.0	249.0	34.933	284.0	249.2	35.105
191.0	248.5	33.837	238.0	249.1	34.942	285.0	249.3	35.104
192.0	248.5	33.879	239.0	249.1	34.951	286.0	249.3	35.105
193.0	248.6	33.923	240.0	249.1	34.959	287.0	249.7	35.106
194.0	248.6	33.965	241.0	249.1	34.968	288.0	249.8	35.105
195.0	248.6	34.006	242.0	249.1	34.973			
196.0	248.6	34.044	243.0	249.1	34.981			

OBSERVED EXPERIMENTAL DATA FROM RUN 29

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	83.7	--.---	50.0	249.4	30.599	100.0	249.2	31.951
1.0	122.6	--.---	51.0	249.5	30.606	101.0	249.3	32.010
2.0	151.0	17.729	52.0	249.4	30.613	102.0	249.2	32.078
3.0	173.4	20.335	53.0	249.5	30.617	103.0	249.3	32.140
4.0	188.8	22.461	54.0	249.4	30.620	104.0	249.2	32.206
5.0	201.4	24.165	55.0	249.5	30.632	105.0	249.3	32.274
6.0	211.6	25.545	56.0	249.3	30.636	106.0	249.1	32.340
7.0	219.8	26.643	57.0	249.4	30.644	107.0	249.2	32.407
8.0	226.1	27.504	58.0	249.3	30.655	108.0	249.0	32.476
9.0	231.3	28.175	59.0	249.5	30.664	109.0	249.0	32.545
10.0	234.9	28.702	60.0	249.4	30.672	110.0	248.9	32.618
11.0	238.0	29.113	61.0	249.5	30.681	111.0	249.0	32.691
12.0	240.0	29.433	62.0	249.4	30.694	112.0	248.8	32.766
13.0	242.0	29.681	63.0	249.6	30.704	113.0	249.0	32.837
14.0	243.3	29.876	64.0	249.4	30.715	114.0	248.9	32.915
15.0	244.8	30.019	65.0	249.6	30.729	115.0	249.0	32.991
16.0	245.5	30.133	66.0	249.5	30.744	116.0	248.9	33.066
17.0	246.4	30.214	67.0	249.6	30.760	117.0	249.0	33.141
18.0	246.8	30.282	68.0	249.5	30.777	118.0	248.9	33.216
19.0	247.3	30.333	69.0	249.6	30.791	119.0	249.0	33.295
20.0	247.7	30.370	70.0	249.5	30.810	120.0	248.9	33.375
21.0	248.1	30.405	71.0	249.5	30.826	121.0	249.0	33.452
22.0	248.2	30.434	72.0	249.4	30.843	122.0	248.9	33.531
23.0	248.5	30.458	73.0	249.6	30.868	123.0	249.0	33.611
24.0	248.6	30.474	74.0	249.4	30.888	124.0	248.9	33.697
25.0	248.7	30.486	75.0	249.6	30.911	125.0	249.0	33.775
26.0	248.8	30.498	76.0	249.5	30.934	126.0	248.9	33.854
27.0	249.0	30.506	77.0	249.6	30.961	127.0	249.0	33.935
28.0	248.9	30.515	78.0	249.5	30.984	128.0	248.7	34.010
29.0	249.1	30.522	79.0	249.6	31.010	129.0	248.8	34.096
30.0	249.1	30.525	80.0	249.5	31.043	130.0	248.6	34.178
31.0	249.2	30.528	81.0	249.7	31.072	131.0	248.8	34.259
32.0	249.1	30.533	82.0	249.4	31.104	132.0	248.7	34.338
33.0	249.2	30.538	83.0	249.7	31.137	133.0	248.8	34.416
34.0	249.1	30.539	84.0	249.5	31.171	134.0	248.7	34.495
35.0	249.3	30.543	85.0	249.6	31.210	135.0	248.8	34.579
36.0	249.2	30.545	86.0	249.4	31.247	136.0	248.7	34.658
37.0	249.3	30.545	87.0	249.7	31.291	137.0	248.8	34.739
38.0	249.2	30.549	88.0	249.4	31.330	138.0	248.7	34.813
39.0	249.3	30.551	89.0	249.7	31.376	139.0	248.8	34.894
40.0	249.2	30.555	90.0	249.3	31.418	140.0	248.7	34.975
41.0	249.3	30.558	91.0	249.6	31.468	141.0	248.8	35.047
42.0	249.2	30.561	92.0	249.3	31.515	142.0	248.7	35.127
43.0	249.3	30.563	93.0	249.6	31.563	143.0	248.8	35.203
44.0	249.2	30.570	94.0	249.2	31.615	144.0	248.7	35.281
45.0	249.4	30.573	95.0	249.5	31.667	145.0	248.7	35.358
46.0	249.4	30.581	96.0	249.2	31.724	146.0	248.6	35.427
47.0	249.5	30.586	97.0	249.3	31.781	147.0	248.7	35.503
48.0	249.5	30.589	98.0	249.2	31.838	148.0	248.7	35.569
49.0	249.6	30.593	99.0	249.3	31.897	149.0	248.8	35.645

OBSERVED EXPERIMENTAL DATA FROM RUN 29 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
150.0	248.7	35.715	194.0	248.8	37.839	238.0	249.1	38.416
151.0	248.8	35.787	195.0	248.8	37.867	239.0	249.0	38.421
152.0	248.7	35.854	196.0	248.8	37.892	240.0	249.0	38.425
153.0	248.8	35.923	197.0	248.8	37.915	241.0	249.0	38.427
154.0	248.7	35.992	198.0	248.7	37.939	242.0	249.1	38.431
155.0	248.8	36.056	199.0	248.8	37.962	243.0	249.0	38.431
156.0	248.7	36.112	200.0	248.7	37.986	244.0	249.1	38.435
157.0	248.9	36.190	201.0	248.8	38.008	245.0	249.1	38.436
158.0	248.8	36.253	202.0	248.8	38.027	246.0	249.1	38.439
159.0	248.9	36.311	203.0	248.8	38.048	247.0	249.1	38.441
160.0	248.8	36.367	204.0	248.8	38.067	248.0	249.1	38.442
161.0	248.9	36.469	205.0	248.8	38.080	249.0	249.1	38.447
162.0	248.8	36.506	206.0	248.8	38.097	250.0	249.1	38.447
163.0	248.8	36.558	207.0	248.8	38.118	251.0	249.0	38.450
164.0	248.8	36.615	208.0	248.8	38.133	252.0	249.0	38.450
165.0	248.8	36.670	209.0	248.9	38.150	253.0	249.0	38.452
166.0	248.8	36.727	210.0	248.9	38.165	254.0	249.0	38.450
167.0	248.9	36.780	211.0	249.0	38.182	255.0	249.0	38.453
168.0	248.8	36.835	212.0	249.0	38.192	256.0	249.0	38.455
169.0	248.9	36.889	213.0	249.0	38.208	257.0	249.0	38.455
170.0	248.8	36.938	214.0	248.9	38.219	258.0	249.0	38.456
171.0	248.9	36.987	215.0	249.0	38.233	259.0	249.0	38.458
172.0	248.8	37.036	216.0	248.9	38.246	260.0	249.0	38.460
173.0	248.9	37.084	217.0	249.0	38.258	261.0	249.0	38.463
174.0	248.8	37.133	218.0	249.0	38.271	262.0	249.0	38.464
175.0	248.9	37.177	219.0	249.0	38.286	263.0	249.0	38.464
176.0	248.8	37.221	220.0	249.0	38.297	264.0	249.0	38.465
177.0	249.0	37.272	221.0	249.0	38.306	265.0	249.0	38.466
178.0	248.8	37.306	222.0	249.0	38.315	266.0	249.0	38.468
179.0	248.9	37.345	223.0	249.0	38.324	267.0	249.0	38.470
180.0	248.8	37.387	224.0	249.0	38.333	268.0	249.0	38.471
181.0	248.9	37.424	225.0	249.0	38.339	269.0	249.0	38.471
182.0	248.8	37.464	226.0	249.0	38.351	270.0	248.9	38.474
183.0	248.8	37.502	227.0	249.0	38.356	271.0	248.9	38.474
184.0	248.8	37.535	228.0	249.0	38.363	272.0	248.8	38.475
185.0	248.8	37.568	229.0	249.0	38.368	273.0	248.9	38.477
186.0	248.8	37.603	230.0	249.0	38.376	274.0	248.8	38.477
187.0	248.8	37.637	231.0	249.0	38.385	275.0	248.9	38.477
188.0	248.8	37.666	232.0	249.0	38.390	276.0	248.9	38.478
189.0	248.9	37.696	233.0	249.0	38.396	277.0	248.9	38.478
190.0	248.8	37.728	234.0	249.0	38.400	278.0	248.9	38.479
191.0	248.8	37.756	235.0	249.0	38.406	279.0	248.9	38.478
192.0	248.8	37.784	236.0	249.0	38.411	280.0	248.9	38.479
193.0	248.8	37.813	237.0	249.0	38.414			

OBSERVED EXPERIMENTAL DATA FROM RUN 30

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	86.0	-.---	50.0	249.3	23.961	100.0	249.3	24.632
1.0	127.6	8.398	51.0	249.3	23.964	101.0	249.2	24.671
2.0	155.5	11.436	52.0	249.3	23.965	102.0	249.3	24.716
3.0	177.9	13.972	53.0	249.3	23.970	103.0	249.3	24.757
4.0	192.8	16.035	54.0	249.4	23.970	104.0	249.3	24.808
5.0	205.6	17.696	55.0	249.4	23.974	105.0	249.3	24.853
6.0	215.0	19.028	56.0	249.5	23.975	106.0	249.3	24.905
7.0	221.8	20.080	57.0	249.5	23.974	107.0	249.3	24.955
8.0	227.5	20.919	58.0	249.5	23.978	108.0	249.3	25.008
9.0	232.0	21.673	59.0	249.5	23.983	109.0	249.3	25.065
10.0	235.5	22.087	60.0	249.5	23.984	110.0	249.2	25.123
11.0	238.2	22.483	61.0	249.5	23.985	111.0	249.3	25.179
12.0	240.8	22.799	62.0	249.5	23.992	112.0	249.3	25.243
13.0	242.1	23.044	63.0	249.5	23.994	113.0	249.2	25.305
14.0	243.6	23.234	64.0	249.5	23.996	114.0	249.2	25.371
15.0	244.7	23.379	65.0	249.5	24.000	115.0	249.2	25.436
16.0	245.9	23.497	66.0	249.5	24.007	116.0	249.1	25.503
17.0	246.3	23.587	67.0	249.5	24.012	117.0	249.1	25.573
18.0	247.2	23.590	68.0	249.6	24.016	118.0	249.0	25.645
19.0	247.2	23.661	69.0	249.6	24.021	119.0	249.1	25.718
20.0	248.0	23.717	70.0	249.5	24.028	120.0	249.0	25.790
21.0	248.2	23.765	71.0	249.6	24.031	121.0	249.0	25.867
22.0	248.3	23.799	72.0	249.6	24.038	122.0	249.0	25.947
23.0	248.4	23.828	73.0	249.5	24.046	123.0	249.0	26.027
24.0	248.7	23.851	74.0	249.6	24.055	124.0	249.1	26.107
25.0	248.9	23.871	75.0	249.5	24.064	125.0	249.0	26.190
26.0	249.0	23.884	76.0	249.5	24.076	126.0	249.0	26.269
27.0	248.9	23.895	77.0	249.5	24.086	127.0	249.0	26.358
28.0	249.0	23.909	78.0	249.5	24.099	128.0	249.0	26.444
29.0	249.0	23.913	79.0	249.4	24.113	129.0	248.9	26.527
30.0	249.1	23.921	80.0	249.5	24.124	130.0	248.9	26.618
31.0	249.1	23.926	81.0	249.5	24.137	131.0	248.9	26.707
32.0	249.1	23.930	82.0	249.5	24.155	132.0	248.9	26.801
33.0	249.1	23.933	83.0	249.5	24.170	133.0	248.9	26.887
34.0	249.1	23.935	84.0	249.5	24.187	134.0	248.9	26.977
35.0	249.1	23.939	85.0	249.4	24.206	135.0	248.8	27.070
36.0	249.2	23.944	86.0	249.4	24.224	136.0	248.8	27.165
37.0	249.2	23.944	87.0	249.4	24.243	137.0	248.8	27.260
38.0	249.3	23.944	88.0	249.4	24.265	138.0	248.8	27.353
39.0	249.3	23.946	89.0	249.4	24.286	139.0	248.7	27.449
40.0	249.4	23.948	90.0	249.4	24.313	140.0	248.8	27.547
41.0	249.3	23.950	91.0	249.4	24.340	141.0	248.8	27.640
42.0	249.3	23.950	92.0	249.4	24.363	142.0	248.8	27.736
43.0	249.3	23.950	93.0	249.4	24.389	143.0	248.8	27.832
44.0	249.4	23.955	94.0	249.3	24.421	144.0	248.9	27.925
45.0	249.3	23.955	95.0	249.3	24.447	145.0	248.8	28.025
46.0	249.3	23.955	96.0	249.4	24.482	146.0	248.8	28.119
47.0	249.3	23.957	97.0	249.3	24.515	147.0	248.8	28.219
48.0	249.3	23.958	98.0	249.3	24.555	148.0	248.8	28.317
49.0	249.3	23.958	99.0	249.3	24.589	149.0	248.8	28.410

OBSERVED EXPERIMENTAL DATA FROM RUN 30 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
150.0	248.9	28.508	186.0	248.8	31.224	222.0	249.2	32.187
151.0	248.8	28.590	187.0	248.7	31.270	223.0	249.2	32.198
152.0	248.8	28.688	188.0	248.8	31.318	224.0	249.3	32.205
153.0	248.8	28.780	189.0	248.7	31.366	225.0	249.2	32.213
154.0	248.9	28.873	190.0	248.8	31.412	226.0	249.3	32.221
155.0	248.7	28.963	191.0	248.8	31.454	227.0	249.2	32.228
156.0	248.8	29.057	192.0	248.8	31.491	228.0	249.3	32.234
157.0	248.8	29.150	193.0	248.7	31.537	229.0	249.2	32.237
158.0	248.8	29.236	194.0	248.8	31.571	230.0	249.4	32.243
159.0	248.8	29.325	195.0	248.8	31.613	231.0	249.3	32.249
160.0	248.8	29.413	196.0	248.8	31.648	232.0	249.4	32.253
161.0	248.7	29.503	197.0	248.8	31.679	233.0	249.3	32.255
162.0	248.8	29.582	198.0	248.9	31.714	234.0	249.5	32.260
163.0	248.8	29.670	199.0	248.9	31.746	235.0	249.3	32.265
164.0	248.8	29.751	200.0	249.0	31.772	236.0	249.4	32.269
165.0	248.8	29.833	201.0	248.9	31.808	237.0	249.3	32.273
166.0	248.8	29.913	202.0	248.9	31.832	238.0	249.5	32.276
167.0	248.8	29.990	203.0	248.9	31.861	239.0	249.3	32.278
168.0	248.9	30.075	204.0	248.9	31.884	240.0	249.5	32.281
169.0	248.8	30.154	205.0	248.9	31.913	241.0	249.3	32.284
170.0	248.9	30.232	206.0	249.0	31.931	242.0	249.5	32.285
171.0	248.8	30.306	207.0	248.9	31.955	243.0	249.3	32.288
172.0	248.8	30.373	208.0	248.9	31.972	244.0	249.4	32.289
173.0	248.8	30.445	209.0	248.9	32.014	245.0	249.3	32.290
174.0	248.8	30.515	210.0	249.0	32.034	246.0	249.3	32.292
175.0	248.8	30.579	211.0	248.9	32.049	247.0	249.3	32.293
176.0	248.7	30.647	212.0	249.0	32.066	248.0	249.4	32.295
177.0	248.7	30.718	213.0	248.9	32.083	249.0	249.3	32.298
178.0	248.7	30.776	214.0	249.0	32.097	250.0	249.5	32.301
179.0	248.7	30.838	215.0	248.9	32.115	251.0	249.3	32.305
180.0	248.8	30.902	216.0	249.0	32.128	252.0	249.4	32.306
181.0	248.8	30.956	217.0	249.0	32.136	253.0	249.3	32.305
182.0	248.8	31.014	218.0	249.0	32.147	254.0	249.4	32.304
183.0	248.8	31.065	219.0	249.0	32.161	255.0	249.3	32.304
184.0	248.8	31.122	220.0	249.0	32.169			
185.0	248.8	31.170	221.0	249.1	32.176			

OBSERVED EXPERIMENTAL DATA FROM RUN 31

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	87.0	.000	50.0	249.8	21.611	100.0	249.9	22.954
.0	87.0	-.---	50.0	249.8	21.611	100.0	249.9	22.954
1.0	124.9	6.115	51.0	249.8	21.613	101.0	249.9	23.028
2.0	154.5	9.129	52.0	249.8	21.616	102.0	249.9	23.099
3.0	175.1	11.648	53.0	249.9	21.617	103.0	249.9	23.179
4.0	191.9	13.707	54.0	249.8	21.622	104.0	249.8	23.256
5.0	204.4	15.364	55.0	249.9	21.623	105.0	249.8	23.336
6.0	214.8	16.697	56.0	249.8	21.630	106.0	249.8	23.418
7.0	222.3	17.748	57.0	249.9	21.635	107.0	249.8	23.502
8.0	228.1	18.569	58.0	249.8	21.637	108.0	249.8	23.588
9.0	232.8	19.218	59.0	249.9	21.643	109.0	249.8	23.676
10.0	236.2	19.778	60.0	249.9	21.648	110.0	249.8	23.766
11.0	239.0	20.131	61.0	249.9	21.654	111.0	249.8	23.853
12.0	241.0	20.448	62.0	249.9	21.665	112.0	249.8	23.948
13.0	243.2	20.696	63.0	249.9	21.673	113.0	249.6	24.042
14.0	244.3	20.894	64.0	249.9	21.682	114.0	249.5	24.138
15.0	245.6	21.040	65.0	249.9	21.692	115.0	249.5	24.236
16.0	246.3	21.158	66.0	249.9	21.704	116.0	249.5	24.336
17.0	247.1	21.256	67.0	249.9	21.719	117.0	249.6	24.440
18.0	247.5	21.327	68.0	249.9	21.730	118.0	249.5	24.535
19.0	248.0	21.385	69.0	249.9	21.748	119.0	249.5	24.640
20.0	248.2	21.426	70.0	249.9	21.754	120.0	249.5	24.742
21.0	248.6	21.459	71.0	249.9	21.776	121.0	249.5	24.845
22.0	248.8	21.490	72.0	249.9	21.791	122.0	249.4	24.948
23.0	249.0	21.513	73.0	249.9	21.808	123.0	249.4	25.056
24.0	249.1	21.533	74.0	250.0	21.827	124.0	249.3	25.164
25.0	249.4	21.544	75.0	250.0	21.849	125.0	249.2	25.270
26.0	249.3	21.558	76.0	250.0	21.871	126.0	249.2	25.378
27.0	249.4	21.566	77.0	250.0	21.894	127.0	249.2	25.487
28.0	249.6	21.574	78.0	250.0	21.919	128.0	249.2	25.594
29.0	249.8	21.579	79.0	250.0	21.942	129.0	249.2	25.701
30.0	249.8	21.583	80.0	250.1	21.973	130.0	249.2	25.810
31.0	249.8	21.585	81.0	250.1	21.999	131.0	249.2	25.917
32.0	249.8	21.588	82.0	250.0	22.028	132.0	249.2	26.020
33.0	249.8	21.588	83.0	250.1	22.063	133.0	249.2	26.126
34.0	249.8	21.592	84.0	250.0	22.099	134.0	249.2	26.236
35.0	249.8	21.592	85.0	250.0	22.139	135.0	249.2	26.342
36.0	249.8	21.592	86.0	250.0	22.164	136.0	249.2	26.449
37.0	249.8	21.595	87.0	250.0	22.219	137.0	249.2	26.549
38.0	249.8	21.595	88.0	249.9	22.260	138.0	249.2	26.653
39.0	249.8	21.596	89.0	249.9	22.305	139.0	249.2	26.759
40.0	249.8	21.596	90.0	249.9	22.353	140.0	249.1	26.860
41.0	249.8	21.595	91.0	249.9	22.405	141.0	249.2	26.964
42.0	249.8	21.596	92.0	249.9	22.455	142.0	249.2	27.064
43.0	249.8	21.598	93.0	249.9	22.511	143.0	249.2	27.159
44.0	249.8	21.598	94.0	249.9	22.567	144.0	249.2	27.264
45.0	249.8	21.600	95.0	249.9	22.626	145.0	249.2	27.360
46.0	249.8	21.600	96.0	249.9	22.685	146.0	249.1	27.460
47.0	249.8	21.603	97.0	249.9	22.749	147.0	249.2	27.559
48.0	249.8	21.606	98.0	249.9	22.815	148.0	249.2	27.650
49.0	249.8	21.607	99.0	249.9	22.882	149.0	249.1	27.740

OBSERVED EXPERIMENTAL DATA FROM RUN 31 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
150.0	249.1	27.833	179.0	249.4	29.622	208.0	250.0	30.074
151.0	249.1	27.920	180.0	249.5	29.655	209.0	250.0	30.077
152.0	249.1	28.006	181.0	249.6	29.687	210.0	250.0	30.080
153.0	249.0	28.093	182.0	249.6	29.718	211.0	250.0	30.088
154.0	249.0	28.178	183.0	249.7	29.746	212.0	250.0	30.089
155.0	249.1	28.259	184.0	249.7	29.772	213.0	250.0	30.093
156.0	249.1	28.340	185.0	249.8	29.798	214.0	249.9	30.095
157.0	249.0	28.413	186.0	249.8	29.818	215.0	250.0	30.096
158.0	249.1	28.489	187.0	249.8	29.840	216.0	249.9	30.098
159.0	249.0	28.565	188.0	249.8	29.864	217.0	249.9	30.099
160.0	249.1	28.638	189.0	249.8	29.880	218.0	250.0	30.102
161.0	249.0	28.709	190.0	249.8	29.899	219.0	250.0	30.107
162.0	249.0	28.777	191.0	249.8	29.911	220.0	249.9	30.109
163.0	249.0	28.842	192.0	249.8	29.924	221.0	249.9	30.110
164.0	249.0	28.908	193.0	249.8	29.938	222.0	250.0	30.114
165.0	249.1	28.964	194.0	249.8	29.953	223.0	250.0	30.116
166.0	249.1	29.026	195.0	249.8	29.964	224.0	250.0	30.117
167.0	249.0	29.082	196.0	249.8	29.977	225.0	250.1	30.120
168.0	249.2	29.142	197.0	249.9	29.992	226.0	250.0	30.120
169.0	249.2	29.194	198.0	249.9	30.007	227.0	250.0	30.120
170.0	249.3	29.245	199.0	249.9	30.013	228.0	250.0	30.120
171.0	249.3	29.296	200.0	249.9	30.021	229.0	250.0	30.120
172.0	249.3	29.344	201.0	249.9	30.030	230.0	250.0	30.120
173.0	249.4	29.389	202.0	249.9	30.038	231.0	250.0	30.124
174.0	249.3	29.437	203.0	249.9	30.044	232.0	250.0	30.124
175.0	249.3	29.472	204.0	249.9	30.051	233.0	250.0	30.124
176.0	249.3	29.513	205.0	250.0	30.057	234.0	250.0	30.124
177.0	249.3	29.551	206.0	250.0	30.063	235.0	250.0	30.124
178.0	249.3	29.588	207.0	250.0	30.068			

OBSERVED EXPERIMENTAL DATA FROM RUN 32

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	89.9	-.---	50.0	249.8	22.700	100.0	249.9	22.909
1.0	128.8	7.494	51.0	249.6	22.700	101.0	249.9	22.924
2.0	158.3	10.520	52.0	249.7	22.700	102.0	249.9	22.941
3.0	178.6	12.994	53.0	249.6	22.700	103.0	249.9	22.959
4.0	194.8	15.026	54.0	249.7	22.700	104.0	249.9	22.983
5.0	206.5	16.652	55.0	249.6	22.700	105.0	249.9	23.006
6.0	215.8	17.960	56.0	249.8	22.699	106.0	249.9	23.027
7.0	223.0	18.988	57.0	249.6	22.698	107.0	249.9	23.051
8.0	228.9	19.813	58.0	249.8	22.697	108.0	249.9	23.078
9.0	233.1	20.453	59.0	249.6	22.696	109.0	249.8	23.104
10.0	236.6	20.948	60.0	249.8	22.692	110.0	249.8	23.131
11.0	239.3	21.334	61.0	249.6	22.692	111.0	249.8	23.158
12.0	241.3	21.633	62.0	249.8	22.691	112.0	249.9	23.190
13.0	242.9	21.858	63.0	249.6	22.692	113.0	249.9	23.220
14.0	244.3	22.033	64.0	249.8	22.690	114.0	249.9	23.254
15.0	245.3	22.178	65.0	249.7	22.691	115.0	249.9	23.289
16.0	246.3	22.289	66.0	249.8	22.696	116.0	249.9	23.328
17.0	246.8	22.374	67.0	249.7	22.697	117.0	249.9	23.362
18.0	247.3	22.445	68.0	249.7	22.700	118.0	249.9	23.404
19.0	247.6	22.498	69.0	249.7	22.702	119.0	249.8	23.443
20.0	248.1	22.540	70.0	249.8	22.704	120.0	249.8	23.484
21.0	248.2	22.573	71.0	249.8	22.709	121.0	249.8	23.523
22.0	248.5	22.598	72.0	249.8	22.711	122.0	249.9	23.569
23.0	248.7	22.620	73.0	249.8	22.711	123.0	249.8	23.613
24.0	248.9	22.633	74.0	249.9	22.713	124.0	249.9	23.657
25.0	248.8	22.647	75.0	249.8	22.711	125.0	249.8	23.707
26.0	249.2	22.660	76.0	249.9	22.716	126.0	249.9	23.755
27.0	249.2	22.667	77.0	249.9	22.717	127.0	249.8	23.806
28.0	249.5	22.673	78.0	249.9	22.719	128.0	249.9	23.853
29.0	249.2	22.677	79.0	249.9	22.721	129.0	249.8	23.909
30.0	249.4	22.682	80.0	250.0	22.725	130.0	249.9	23.950
31.0	249.3	22.688	81.0	249.9	22.729	131.0	249.8	24.006
32.0	249.6	22.689	82.0	249.9	22.732	132.0	249.8	24.056
33.0	249.4	22.693	83.0	249.9	22.738	133.0	249.8	24.113
34.0	249.6	22.697	84.0	250.0	22.743	134.0	249.8	24.168
35.0	249.4	22.697	85.0	249.9	22.750	135.0	249.8	24.223
36.0	249.6	22.698	86.0	250.0	22.754	136.0	249.8	24.281
37.0	249.4	22.698	87.0	249.9	22.759	137.0	249.8	24.340
38.0	249.6	22.697	88.0	250.0	22.768	138.0	249.8	24.400
39.0	249.4	22.697	89.0	249.9	22.776	139.0	249.8	24.457
40.0	249.7	22.697	90.0	250.0	22.787	140.0	249.8	24.511
41.0	249.4	22.698	91.0	249.9	22.792	141.0	249.8	24.577
42.0	249.7	22.698	92.0	250.0	22.800	142.0	249.8	24.637
43.0	249.5	22.698	93.0	249.9	22.813	143.0	249.8	24.699
44.0	249.7	22.698	94.0	250.0	22.823	144.0	249.8	24.760
45.0	249.6	22.699	95.0	249.9	22.835	145.0	249.8	24.826
46.0	249.7	22.699	96.0	250.0	22.847	146.0	249.8	24.890
47.0	249.5	22.699	97.0	249.9	22.863	147.0	249.8	24.954
48.0	249.8	22.700	98.0	250.0	22.874	148.0	249.8	25.022
49.0	249.6	22.700	99.0	249.9	22.892	149.0	249.8	25.088

OBSERVED EXPERIMENTAL DATA FROM RUN 32 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
150.0	249.8	25.157	200.0	249.3	28.744	250.0	249.8	30.628
151.0	249.7	25.225	201.0	249.3	28.797	251.0	249.7	30.643
152.0	249.8	25.295	202.0	249.3	28.862	252.0	249.7	30.657
153.0	249.7	25.364	203.0	249.3	28.922	253.0	249.7	30.675
154.0	249.7	25.435	204.0	249.3	28.978	254.0	249.7	30.689
155.0	249.7	25.509	205.0	249.3	29.030	255.0	249.7	30.705
156.0	249.7	25.576	206.0	249.4	29.085	256.0	249.7	30.720
157.0	249.6	25.649	207.0	249.3	29.133	257.0	249.7	30.732
158.0	249.6	25.720	208.0	249.4	29.193	258.0	249.7	30.749
159.0	249.6	25.793	209.0	249.4	29.248	259.0	249.5	30.760
160.0	249.6	25.868	210.0	249.5	29.296	260.0	249.7	30.774
161.0	249.6	25.940	211.0	249.4	29.348	261.0	249.6	30.786
162.0	249.6	26.014	212.0	249.5	29.398	262.0	249.7	30.796
163.0	249.5	26.090	213.0	249.4	29.449	263.0	249.6	30.807
164.0	249.5	26.164	214.0	249.5	29.497	264.0	249.5	30.817
165.0	249.5	26.238	215.0	249.3	29.541	265.0	249.6	30.826
166.0	249.5	26.313	216.0	249.5	29.587	266.0	249.6	30.834
167.0	249.6	26.387	217.0	249.4	29.632	267.0	249.5	30.847
168.0	249.6	26.467	218.0	249.5	29.673	268.0	249.6	30.853
169.0	249.7	26.545	219.0	249.4	29.717	269.0	249.6	30.862
170.0	249.6	26.617	220.0	249.5	29.759	270.0	249.7	30.872
171.0	249.7	26.693	221.0	249.5	29.807	271.0	249.5	30.881
172.0	249.7	26.770	222.0	249.6	29.847	272.0	249.7	30.887
173.0	249.6	26.843	223.0	249.6	29.885	273.0	249.6	30.896
174.0	249.7	26.916	224.0	249.7	29.924	274.0	249.6	30.904
175.0	249.7	26.994	225.0	249.7	29.963	275.0	249.6	30.910
176.0	249.7	27.073	226.0	249.8	30.000	276.0	249.7	30.916
177.0	249.7	27.150	227.0	249.8	30.035	277.0	249.6	30.919
178.0	249.6	27.226	228.0	249.8	30.069	278.0	249.6	30.924
179.0	249.6	27.299	229.0	249.8	30.104	279.0	249.6	30.929
180.0	249.6	27.372	230.0	249.8	30.137	280.0	249.6	30.938
181.0	249.5	27.445	231.0	249.8	30.169	281.0	249.6	30.938
182.0	249.5	27.521	232.0	249.8	30.201	282.0	249.6	30.943
183.0	249.4	27.595	233.0	249.7	30.230	283.0	249.6	30.948
184.0	249.4	27.670	234.0	249.7	30.260	284.0	249.7	30.950
185.0	249.4	27.738	235.0	249.8	30.291	285.0	249.6	30.954
186.0	249.4	27.811	236.0	249.8	30.319	286.0	249.7	30.958
187.0	249.3	27.884	237.0	249.8	30.343	287.0	249.6	30.961
188.0	249.3	27.952	238.0	249.8	30.369	288.0	249.7	30.968
189.0	249.4	28.020	239.0	249.8	30.395	289.0	249.6	30.970
190.0	249.4	28.090	240.0	249.8	30.419	290.0	249.8	30.973
191.0	249.4	28.160	241.0	249.8	30.442	291.0	249.6	30.975
192.0	249.4	28.228	242.0	249.8	30.468	292.0	249.7	30.977
193.0	249.3	28.296	243.0	249.8	30.490	293.0	249.6	30.981
194.0	249.3	28.360	244.0	249.8	30.509	294.0	249.7	30.984
195.0	249.3	28.427	245.0	249.8	30.532	295.0	249.6	30.988
196.0	249.4	28.490	246.0	249.8	30.556	296.0	249.8	30.990
197.0	249.3	28.553	247.0	249.8	30.568	297.0	249.7	30.991
198.0	249.3	28.615	248.0	249.8	30.590	298.0	249.7	30.993
199.0	249.3	28.680	249.0	249.8	30.608	299.0	249.7	30.998

OBSERVED EXPERIMENTAL DATA FROM RUN 32 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
300.0	249.8	30.999	306.0	249.7	31.006	312.0	249.6	31.009
301.0	249.7	31.000	307.0	249.6	31.008	313.0	249.6	31.009
302.0	249.8	31.000	308.0	249.8	31.008	314.0	249.7	31.010
303.0	249.6	31.000	309.0	249.6	31.008	315.0	249.6	31.011
304.0	249.8	31.002	310.0	249.7	31.008	316.0	249.6	31.013
305.0	249.6	31.004	311.0	249.6	31.008	317.0	249.4	31.014

OBSERVED EXPERIMENTAL DATA FROM RUN 33

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	86.2	-.---	100.0	249.6	20.682	200.0	249.3	21.010
2.0	155.1	8.193	102.0	249.6	20.683	202.0	249.3	21.039
4.0	192.9	12.831	104.0	249.7	20.680	204.0	249.3	21.071
6.0	214.6	15.870	106.0	249.7	20.679	206.0	249.3	21.103
8.0	228.2	17.768	108.0	249.7	20.679	208.0	249.3	21.139
10.0	236.2	18.919	110.0	249.7	20.680	210.0	249.3	21.174
12.0	240.2	19.610	112.0	249.6	20.680	212.0	249.3	21.213
14.0	244.2	20.016	114.0	249.6	20.681	214.0	249.3	21.252
16.0	246.1	20.268	116.0	249.6	20.679	216.0	249.3	21.288
20.0	247.9	20.518	120.0	249.6	20.670	220.0	249.3	21.372
18.0	247.2	20.420	118.0	249.7	20.675	218.0	249.3	21.331
22.0	248.4	20.583	122.0	249.6	20.670	222.0	249.3	21.417
24.0	248.8	20.621	124.0	249.7	20.668	224.0	249.3	21.463
26.0	248.8	20.647	126.0	249.7	20.668	226.0	249.3	21.505
28.0	249.0	20.663	128.0	249.7	20.670	228.0	249.3	21.545
30.0	249.2	20.670	130.0	249.6	20.669	230.0	249.3	21.586
32.0	249.3	20.678	132.0	249.7	20.668	232.0	249.3	21.629
34.0	249.3	20.680	134.0	249.6	20.665	234.0	249.3	21.666
36.0	249.3	20.686	136.0	249.6	20.665	236.0	249.3	21.720
38.0	249.3	20.686	138.0	249.6	20.667	238.0	249.3	21.762
40.0	249.5	20.687	140.0	249.6	20.670	240.0	249.3	21.803
42.0	249.6	20.686	142.0	249.6	20.667	242.0	249.3	21.843
44.0	249.6	20.688	144.0	249.6	20.672	244.0	249.3	21.883
46.0	249.6	20.689	146.0	249.6	20.669	246.0	249.3	21.926
48.0	249.7	20.689	148.0	249.6	20.670	248.0	249.3	21.965
50.0	249.7	20.688	150.0	249.5	20.673	250.0	249.3	22.003
52.0	249.8	20.689	152.0	249.5	20.671	252.0	249.3	22.048
54.0	249.8	20.689	154.0	249.5	20.673	254.0	249.3	22.082
56.0	249.8	20.688	156.0	249.5	20.672	256.0	249.3	22.125
58.0	249.8	20.688	158.0	249.4	20.672	258.0	249.3	22.165
60.0	249.8	20.686	160.0	249.4	20.673	260.0	249.3	22.197
62.0	249.8	20.687	162.0	249.4	20.677	262.0	249.3	22.236
64.0	249.8	20.683	164.0	249.4	20.679	264.0	249.3	22.270
66.0	249.8	20.684	166.0	249.4	20.688	266.0	249.4	22.306
68.0	249.8	20.684	168.0	249.3	20.696	268.0	249.4	22.341
70.0	249.8	20.684	170.0	249.3	20.709	270.0	249.4	22.377
72.0	249.8	20.686	172.0	249.3	20.718	272.0	249.4	22.412
74.0	249.8	20.687	174.0	249.3	20.733	274.0	249.4	22.451
76.0	249.8	20.684	176.0	249.3	20.747	276.0	249.4	22.483
78.0	249.8	20.683	178.0	249.3	20.757	278.0	249.4	22.514
80.0	249.8	20.684	180.0	249.3	20.778	280.0	249.4	22.549
82.0	249.8	20.683	182.0	249.3	20.792	282.0	249.4	22.585
84.0	249.7	20.681	184.0	249.3	20.813	284.0	249.4	22.624
86.0	249.8	20.682	186.0	249.3	20.829	286.0	249.4	22.658
88.0	249.7	20.683	188.0	249.3	20.854	288.0	249.4	22.690
90.0	249.7	20.682	190.0	249.3	20.875	290.0	249.4	22.729
92.0	249.7	20.680	192.0	249.3	20.899	292.0	249.4	22.767
94.0	249.6	20.682	194.0	249.3	20.925	294.0	249.4	22.801
96.0	249.6	20.681	196.0	249.3	20.949	296.0	249.4	22.839
98.0	249.5	20.683	198.0	249.3	20.978	298.0	249.4	22.873

OBSERVED EXPERIMENTAL DATA FROM RUN 33 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
300.0	249.4	22.909	400.0	249.4	24.921	500.0	249.2	27.934
302.0	249.4	22.948	402.0	249.4	24.972	502.0	249.2	27.986
304.0	249.4	22.987	404.0	249.4	25.014	504.0	249.2	28.043
306.0	249.4	23.018	406.0	249.4	25.061	506.0	249.2	28.097
308.0	249.4	23.058	408.0	249.4	25.111	508.0	249.2	28.146
310.0	249.4	23.095	410.0	249.4	25.151	510.0	249.2	28.193
312.0	249.4	23.134	412.0	249.4	25.199	512.0	249.2	28.239
314.0	249.4	23.163	414.0	249.4	25.253	514.0	249.2	28.281
316.0	249.4	23.207	416.0	249.4	25.304	516.0	249.2	28.321
318.0	249.4	23.242	418.0	249.4	25.349	518.0	249.2	28.358
320.0	249.4	23.278	420.0	249.4	25.398	520.0	249.2	28.388
322.0	249.4	23.316	422.0	249.4	25.451	522.0	249.2	28.427
324.0	249.4	23.353	424.0	249.4	25.503	524.0	249.2	28.458
326.0	249.4	23.385	426.0	249.4	25.555	526.0	249.2	28.489
328.0	249.4	23.433	428.0	249.4	25.607	528.0	249.2	28.517
330.0	249.4	23.464	430.0	249.4	25.658	530.0	249.2	28.544
332.0	249.4	23.506	432.0	249.4	25.713	532.0	249.2	28.571
334.0	249.4	23.540	434.0	249.4	25.770	534.0	249.2	28.595
336.0	249.4	23.579	436.0	249.4	25.821	536.0	249.2	28.616
338.0	249.4	23.617	438.0	249.4	25.881	538.0	249.2	28.637
340.0	249.4	23.654	440.0	249.4	25.932	540.0	249.2	28.658
342.0	249.4	23.698	442.0	249.4	25.988	542.0	249.2	28.685
344.0	249.4	23.740	444.0	249.4	26.048	544.0	249.2	28.701
346.0	249.4	23.778	446.0	249.4	26.103	546.0	249.2	28.723
348.0	249.4	23.821	448.0	249.4	26.163	548.0	249.2	28.742
350.0	249.4	23.857	450.0	249.3	26.221	550.0	249.2	28.763
352.0	249.4	23.898	452.0	249.2	26.283	552.0	249.2	28.779
354.0	249.4	23.937	454.0	249.1	26.339	554.0	249.2	28.796
356.0	249.4	23.974	456.0	249.1	26.397	556.0	249.2	28.809
358.0	249.4	24.015	458.0	249.1	26.464	558.0	249.2	28.824
360.0	249.4	24.059	460.0	249.1	26.524	560.0	249.2	28.833
362.0	249.4	24.099	462.0	249.1	26.590	562.0	249.2	28.842
364.0	249.4	24.143	464.0	249.1	26.656	564.0	249.2	28.853
366.0	249.4	24.186	466.0	249.1	26.722	566.0	249.2	28.863
368.0	249.4	24.224	468.0	249.1	26.792	568.0	249.2	28.869
370.0	249.4	24.264	470.0	249.1	26.863	570.0	249.2	28.880
372.0	249.4	24.306	472.0	249.1	26.933	572.0	249.2	28.884
374.0	249.4	24.347	474.0	249.1	27.004	574.0	249.2	28.891
376.0	249.4	24.389	476.0	249.1	27.083	576.0	249.2	28.898
378.0	249.4	24.429	478.0	249.1	27.163	578.0	249.2	28.901
380.0	249.4	24.472	480.0	249.1	27.239	580.0	249.2	28.908
382.0	249.4	24.513	482.0	249.1	27.315	582.0	249.2	28.909
384.0	249.4	24.555	484.0	249.1	27.394	584.0	249.2	28.910
386.0	249.4	24.604	486.0	249.1	27.469	586.0	249.2	28.914
388.0	249.4	24.648	488.0	249.1	27.542	588.0	249.2	28.917
390.0	249.4	24.692	490.0	249.1	27.609	590.0	249.2	28.919
392.0	249.4	24.738	492.0	249.1	27.681	592.0	249.2	28.920
394.0	249.4	24.783	494.0	249.1	27.746	594.0	249.2	28.921
396.0	249.4	24.832	496.0	249.1	27.809	596.0	249.2	28.921
398.0	249.4	24.878	498.0	249.1	27.872	598.0	249.2	28.922

OBSERVED EXPERIMENTAL DATA FROM RUN 33 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
600.0	249.2	28.921	610.0	249.2	28.926	620.0	249.2	28.927
602.0	249.2	28.922	612.0	249.2	28.928	622.0	249.2	28.927
604.0	249.2	28.922	614.0	249.2	28.930	624.0	249.2	28.924
606.0	249.2	28.923	616.0	249.2	28.930			
608.0	249.2	28.925	618.0	249.2	28.929			

OBSERVED EXPERIMENTAL DATA FROM RUN 34

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	85.0	-.---	50.0	249.5	17.150	100.0	249.3	19.379
1.0	122.0	-.---	51.0	249.5	17.153	101.0	249.3	19.480
2.0	151.3	4.488	52.0	249.5	17.157	102.0	249.3	19.580
3.0	173.3	6.938	53.0	249.5	17.164	103.0	249.2	19.687
4.0	190.2	8.981	54.0	249.5	17.169	104.0	249.2	19.789
5.0	203.9	10.656	55.0	249.5	17.178	105.0	249.0	19.894
6.0	213.0	12.012	56.0	249.5	17.188	106.0	249.0	20.003
7.0	220.9	13.096	57.0	249.5	17.194	107.0	249.0	20.112
8.0	226.8	13.959	58.0	249.5	17.206	108.0	249.0	20.223
9.0	231.7	14.638	59.0	249.5	17.219	109.0	249.0	20.329
10.0	235.2	15.178	60.0	249.5	17.232	110.0	249.0	20.439
11.0	238.0	15.593	61.0	249.5	17.249	111.0	249.0	20.550
12.0	240.5	15.923	62.0	249.5	17.260	112.0	249.0	20.659
13.0	242.1	16.179	63.0	249.5	17.279	113.0	248.9	20.774
14.0	243.8	16.379	64.0	249.5	17.299	114.0	248.9	20.881
15.0	244.8	16.534	65.0	249.5	17.316	115.0	248.9	20.995
16.0	245.8	16.657	66.0	249.5	17.335	116.0	248.9	21.108
17.0	246.4	16.755	67.0	249.5	17.355	117.0	248.9	21.217
18.0	247.0	16.827	68.0	249.5	17.387	118.0	248.9	21.335
19.0	247.3	16.888	69.0	249.5	17.412	119.0	248.9	21.446
20.0	247.9	16.934	70.0	249.5	17.439	120.0	248.9	21.559
21.0	248.0	16.973	71.0	249.5	17.470	121.0	248.9	21.669
22.0	248.3	17.000	72.0	249.5	17.500	122.0	248.9	21.779
23.0	248.5	17.015	73.0	249.5	17.534	123.0	248.9	21.889
24.0	248.9	17.039	74.0	249.5	17.574	124.0	248.9	22.004
25.0	248.9	17.053	75.0	249.5	17.613	125.0	248.9	22.114
26.0	249.0	17.063	76.0	249.5	17.652	126.0	248.9	22.216
27.0	249.0	17.072	77.0	249.5	17.696	127.0	248.9	22.324
28.0	249.1	17.078	78.0	249.5	17.745	128.0	248.9	22.431
29.0	249.1	17.079	79.0	249.5	17.793	129.0	248.9	22.531
30.0	249.2	17.092	80.0	249.5	17.842	130.0	248.9	22.638
31.0	249.2	17.092	81.0	249.5	17.899	131.0	248.9	22.743
32.0	249.4	17.096	82.0	249.5	17.953	132.0	248.9	22.846
33.0	249.4	17.097	83.0	249.5	18.013	133.0	248.9	22.940
34.0	249.4	17.104	84.0	249.5	18.069	134.0	248.9	23.039
35.0	249.4	17.104	85.0	249.5	18.131	135.0	248.9	23.134
36.0	249.5	17.104	86.0	249.5	18.203	136.0	248.9	23.235
37.0	249.5	17.108	87.0	249.5	18.274	137.0	248.9	23.327
38.0	249.5	17.113	88.0	249.5	18.347	138.0	248.9	23.415
39.0	249.5	17.117	89.0	249.5	18.418	139.0	248.9	23.509
40.0	249.5	17.115	90.0	249.5	18.496	140.0	248.9	23.598
41.0	249.5	17.119	91.0	249.5	18.573	141.0	248.9	23.687
42.0	249.5	17.120	92.0	249.5	18.655	142.0	248.9	23.769
43.0	249.5	17.124	93.0	249.5	18.736	143.0	248.9	23.853
44.0	249.5	17.128	94.0	249.5	18.823	144.0	248.9	23.936
45.0	249.5	17.129	95.0	249.3	18.907	145.0	248.9	24.019
46.0	249.5	17.135	96.0	249.3	19.001	146.0	248.9	24.093
47.0	249.5	17.138	97.0	249.3	19.095	147.0	248.9	24.168
48.0	249.5	17.142	98.0	249.3	19.189	148.0	248.9	24.243
49.0	249.5	17.145	99.0	249.3	19.283	149.0	248.9	24.315

OBSERVED EXPERIMENTAL DATA FROM RUN 34 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT · CM	TIME MIN	TEMP. OF	HEIGHT CM
150.0	248.9	24.385	184.0	249.0	25.635	218.0	249.5	25.791
151.0	248.9	24.451	185.0	249.0	25.648	219.0	249.5	25.792
152.0	248.9	24.517	186.0	249.0	25.657	220.0	249.5	25.794
153.0	248.9	24.578	187.0	249.0	25.672	221.0	249.5	25.791
154.0	248.9	24.641	188.0	249.2	25.677	222.0	249.5	25.795
155.0	248.9	24.695	189.0	249.2	25.688	223.0	249.5	25.792
156.0	248.9	24.753	190.0	249.2	25.693	224.0	249.5	25.795
157.0	248.9	24.812	191.0	249.2	25.703	225.0	249.5	25.798
158.0	248.9	24.860	192.0	249.2	25.710	226.0	249.5	25.794
159.0	248.9	24.912	193.0	249.2	25.718	227.0	249.5	25.796
160.0	248.9	24.963	194.0	249.2	25.720	228.0	249.5	25.796
161.0	248.9	25.009	195.0	249.2	25.728	229.0	249.5	25.795
162.0	248.9	25.052	196.0	249.2	25.734	230.0	249.5	25.791
163.0	248.9	25.095	197.0	249.2	25.741	231.0	249.5	25.795
164.0	248.9	25.136	198.0	249.2	25.743	232.0	249.5	25.796
165.0	248.9	25.179	199.0	249.2	25.750	233.0	249.5	25.798
166.0	248.9	25.216	200.0	249.2	25.750	234.0	249.5	25.794
167.0	248.9	25.250	201.0	249.2	25.754	235.0	249.5	25.799
168.0	248.9	25.286	202.0	249.2	25.762	236.0	249.5	25.796
169.0	248.9	25.320	203.0	249.2	25.764	237.0	249.5	25.800
170.0	248.9	25.351	204.0	249.3	25.766	238.0	249.5	25.799
171.0	248.9	25.383	205.0	249.3	25.769	239.0	249.5	25.798
172.0	249.0	25.404	206.0	249.3	25.772	240.0	249.5	25.798
173.0	249.0	25.432	207.0	249.3	25.773	241.0	249.5	25.797
174.0	249.0	25.459	208.0	249.3	25.777	242.0	249.5	25.799
175.0	249.0	25.480	209.0	249.4	25.776	243.0	249.5	25.799
176.0	249.0	25.503	210.0	249.4	25.778	244.0	249.5	25.797
177.0	249.0	25.524	211.0	249.4	25.782	245.0	249.5	25.800
178.0	249.0	25.543	212.0	249.4	25.783	246.0	249.5	25.800
179.0	249.0	25.558	213.0	249.4	25.786	247.0	249.5	25.800
180.0	249.0	25.574	214.0	249.4	25.786	248.0	249.5	25.797
181.0	249.0	25.589	215.0	249.4	25.786	249.0	249.5	25.798
182.0	249.0	25.608	216.0	249.4	25.787	250.0	249.5	25.800
183.0	249.0	25.619	217.0	249.5	25.789			

OBSERVED EXPERIMENTAL DATA FROM RUN 35

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	77.0	--.---	50.0	248.8	22.508	100.0	248.5	23.878
1.0	118.1	--.---	51.0	248.8	22.514	101.0	248.5	23.942
2.0	149.0	11.900	52.0	248.9	22.514	102.0	248.5	24.006
3.0	171.0	14.031	53.0	248.9	22.516	103.0	248.5	24.071
4.0	188.0	15.777	54.0	248.9	22.525	104.0	248.5	24.139
5.0	201.0	17.192	55.0	248.9	22.529	105.0	248.5	24.206
6.0	210.5	18.324	56.0	248.9	22.538	106.0	248.5	24.274
7.0	218.9	19.225	57.0	248.9	22.544	107.0	248.5	24.348
8.0	225.5	19.926	58.0	248.9	22.552	108.0	248.5	24.418
9.0	230.0	20.482	59.0	248.9	22.558	109.0	248.5	24.492
10.0	234.0	20.921	60.0	248.9	22.573	110.0	248.5	24.565
11.0	236.5	21.255	61.0	248.9	22.575	111.0	248.5	24.640
12.0	239.2	21.520	62.0	248.9	22.587	112.0	248.5	24.718
13.0	240.8	21.725	63.0	248.9	22.600	113.0	248.5	24.793
14.0	242.5	21.888	64.0	248.9	22.611	114.0	248.5	24.875
15.0	243.4	22.009	65.0	248.9	22.623	115.0	248.5	24.950
16.0	244.6	22.108	66.0	248.9	22.638	116.0	248.5	25.032
17.0	245.1	22.180	67.0	248.9	22.647	117.0	248.5	25.116
18.0	246.0	22.246	68.0	248.8	22.668	118.0	248.5	25.196
19.0	246.2	22.289	69.0	248.8	22.681	119.0	248.5	25.280
20.0	246.8	22.327	70.0	248.8	22.696	120.0	248.5	25.362
21.0	247.0	22.355	71.0	248.8	22.715	121.0	248.4	25.445
22.0	247.2	22.376	72.0	248.8	22.733	122.0	248.4	25.536
23.0	247.5	22.393	73.0	248.8	22.754	123.0	248.4	25.613
24.0	247.7	22.410	74.0	248.8	22.775	124.0	248.4	25.700
25.0	247.8	22.416	75.0	248.8	22.800	125.0	248.3	25.780
26.0	248.0	22.429	76.0	248.8	22.823	126.0	248.3	25.872
27.0	247.8	22.442	77.0	248.8	22.849	127.0	248.3	25.956
28.0	248.0	22.446	78.0	248.8	22.876	128.0	248.3	26.045
29.0	248.0	22.455	79.0	248.8	22.907	129.0	248.3	26.129
30.0	248.1	22.462	80.0	248.8	22.936	130.0	248.3	26.217
31.0	248.0	22.463	81.0	248.8	22.969	131.0	248.3	26.301
32.0	248.1	22.471	82.0	248.8	23.003	132.0	248.3	26.391
33.0	248.2	22.469	83.0	248.8	23.039	133.0	248.2	26.480
34.0	248.3	22.475	84.0	248.8	23.075	134.0	248.2	26.562
35.0	248.3	22.479	85.0	248.8	23.113	135.0	248.2	26.652
36.0	248.5	22.483	86.0	248.8	23.154	136.0	248.2	26.738
37.0	248.5	22.483	87.0	248.8	23.197	137.0	248.1	26.822
38.0	248.5	22.487	88.0	248.8	23.240	138.0	248.1	26.911
39.0	248.5	22.485	89.0	248.7	23.284	139.0	248.1	26.991
40.0	248.5	22.485	90.0	248.7	23.328	140.0	248.0	27.079
41.0	248.5	22.490	91.0	248.7	23.374	141.0	248.0	27.170
42.0	248.6	22.490	92.0	248.7	23.425	142.0	248.0	27.253
43.0	248.6	22.490	93.0	248.7	23.478	143.0	248.0	27.339
44.0	248.7	22.492	94.0	248.7	23.529	144.0	248.0	27.424
45.0	248.7	22.492	95.0	248.6	23.584	145.0	248.0	27.511
46.0	248.7	22.499	96.0	248.6	23.640	146.0	248.0	27.593
47.0	248.7	22.502	97.0	248.6	23.700	147.0	248.0	27.681
48.0	248.8	22.504	98.0	248.6	23.759	148.0	248.0	27.763
49.0	248.8	22.506	99.0	248.6	23.815	149.0	248.0	27.849

OBSERVED EXPERIMENTAL DATA FROM RUN 35 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
150.0	248.0	27.926	184.0	248.0	30.122	218.0	248.5	30.884
151.0	248.0	28.013	185.0	248.0	30.164	219.0	248.5	30.893
152.0	248.0	28.093	186.0	248.0	30.202	220.0	248.5	30.894
153.0	248.0	28.173	187.0	248.0	30.240	221.0	248.5	30.901
154.0	248.0	28.250	188.0	248.0	30.275	222.0	248.5	30.909
155.0	248.0	28.329	189.0	248.0	30.314	223.0	248.5	30.916
156.0	248.0	28.402	190.0	248.0	30.348	224.0	248.6	30.922
157.0	248.0	28.483	191.0	248.0	30.382	225.0	248.6	30.930
158.0	248.0	28.560	192.0	248.0	30.416	226.0	248.6	30.932
159.0	248.0	28.636	193.0	248.0	30.445	227.0	248.6	30.935
160.0	248.0	28.712	194.0	248.0	30.466	228.0	248.7	30.935
161.0	248.0	28.783	195.0	248.1	30.501	229.0	248.7	30.943
162.0	248.0	28.856	196.0	248.1	30.529	230.0	248.7	30.946
163.0	248.0	28.927	197.0	248.1	30.553	231.0	248.7	30.950
164.0	248.0	28.997	198.0	248.1	30.580	232.0	248.7	30.952
165.0	248.0	29.067	199.0	248.1	30.603	233.0	248.7	30.955
166.0	248.0	29.135	200.0	248.2	30.628	234.0	248.7	30.959
167.0	248.0	29.204	201.0	248.2	30.647	235.0	248.7	30.962
168.0	248.0	29.269	202.0	248.2	30.672	236.0	248.7	30.962
169.0	248.0	29.327	203.0	248.2	30.689	237.0	248.7	30.968
170.0	248.0	29.393	204.0	248.2	30.709	238.0	248.7	30.968
171.0	248.0	29.454	205.0	248.2	30.727	239.0	248.7	30.969
172.0	248.0	29.508	206.0	248.3	30.739	240.0	248.7	30.969
173.0	248.0	29.567	207.0	248.3	30.760	241.0	248.8	30.968
174.0	248.0	29.629	208.0	248.3	30.774	242.0	248.8	30.969
175.0	248.0	29.682	209.0	248.3	30.783	243.0	248.8	30.969
176.0	248.0	29.737	210.0	248.3	30.798	244.0	248.8	30.968
177.0	248.0	29.790	211.0	248.3	30.812	245.0	248.8	30.969
178.0	248.0	29.842	212.0	248.4	30.825	246.0	248.8	30.970
179.0	248.0	29.889	213.0	248.4	30.836	247.0	248.8	30.969
180.0	248.0	29.941	214.0	248.4	30.845	248.0	248.8	30.970
181.0	248.0	29.988	215.0	248.4	30.857	249.0	248.8	30.969
182.0	248.0	30.036	216.0	248.4	30.868	250.0	248.9	30.969
183.0	248.0	30.075	217.0	248.4	30.878			

OBSERVED EXPERIMENTAL DATA FROM RUN 36

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	79.9	--.---	32.0	245.3	30.612	64.0	248.9	35.054
1.0	118.3	--.---	33.0	245.3	31.003	65.0	248.9	35.058
2.0	148.0	14.078	34.0	245.2	31.380	66.0	248.9	35.060
3.0	170.8	16.665	35.0	245.2	31.745	67.0	248.9	35.062
4.0	187.8	18.787	36.0	245.2	32.089	68.0	248.9	35.064
5.0	201.1	20.500	37.0	245.2	32.412	69.0	249.0	35.063
6.0	211.1	21.879	38.0	245.2	32.710	70.0	249.0	35.069
7.0	219.5	22.967	39.0	245.3	32.988	71.0	249.0	35.067
8.0	225.2	23.818	40.0	245.3	33.247	72.0	249.0	35.068
9.0	230.4	24.495	41.0	245.7	33.487	73.0	249.0	35.071
10.0	234.3	25.024	42.0	245.9	33.700	74.0	249.0	35.069
11.0	237.3	25.436	43.0	246.0	33.891	75.0	249.0	35.073
12.0	239.6	25.755	44.0	246.2	34.063	76.0	249.0	35.075
13.0	241.6	26.007	45.0	246.7	34.212	77.0	249.0	35.074
14.0	242.9	26.202	46.0	246.8	34.349	78.0	249.0	35.073
15.0	244.1	26.357	47.0	247.0	34.460	79.0	249.0	35.074
16.0	245.0	26.486	48.0	247.2	34.558	80.0	249.0	35.074
17.0	246.0	26.587	49.0	247.5	34.648	81.0	249.0	35.075
18.0	246.3	26.683	50.0	247.6	34.720	82.0	249.0	35.073
19.0	246.9	26.780	51.0	247.9	34.780	83.0	249.0	35.075
20.0	247.0	26.882	52.0	247.9	34.829	84.0	249.0	35.076
21.0	247.3	27.009	53.0	248.0	34.875	85.0	249.0	35.075
22.0	247.3	27.172	54.0	248.1	34.910	86.0	249.0	35.075
23.0	247.3	27.374	55.0	248.2	34.942	87.0	249.0	35.073
24.0	247.3	27.617	56.0	248.3	34.970	88.0	249.0	35.075
25.0	247.2	27.909	57.0	248.5	34.990	89.0	249.0	35.073
26.0	246.8	28.233	58.0	248.6	35.003	90.0	249.0	35.073
27.0	246.6	28.600	59.0	248.7	35.018	91.0	249.0	35.073
28.0	246.0	28.988	60.0	248.8	35.030	92.0	249.0	35.074
29.0	246.0	29.389	61.0	248.9	35.039	93.0	249.0	35.072
30.0	245.7	29.799	62.0	248.9	35.045	94.0	249.0	35.070
31.0	245.6	30.211	63.0	248.9	35.050	95.0	249.0	35.070

OBSERVED EXPERIMENTAL DATA FROM RUN 37

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	80.0	-.---	17.5	238.5	23.701	35.0	248.0	25.986
.5	106.9	-.---	18.0	239.0	23.977	35.5	248.0	25.989
1.0	125.2	-.---	18.5	239.5	24.227	36.0	248.1	25.990
1.5	142.1	7.155	19.0	240.0	24.457	36.5	248.1	25.990
2.0	155.5	8.586	19.5	240.5	24.665	37.0	248.1	25.994
2.5	167.1	9.819	20.0	241.0	24.850	37.5	248.1	25.994
3.0	177.0	10.889	20.5	241.6	25.010	38.0	248.1	25.995
3.5	185.3	11.827	21.0	242.1	25.157	38.5	248.1	25.994
4.0	193.0	12.656	21.5	242.7	25.283	39.0	248.1	25.997
4.5	199.0	13.391	22.0	243.2	25.386	39.5	248.1	26.000
5.0	205.1	14.044	22.5	243.7	25.478	40.0	248.1	26.000
5.5	209.9	14.636	23.0	244.0	25.558	40.5	248.1	26.000
6.0	214.1	15.042	23.5	244.6	25.622	41.0	248.1	26.003
6.5	218.1	15.691	24.0	245.0	25.677	41.5	248.1	26.002
7.0	221.4	15.987	24.5	245.5	25.722	42.0	248.1	26.002
7.5	224.7	16.335	25.0	245.8	25.761	42.5	248.1	26.003
8.0	227.2	16.651	25.5	246.0	25.793	43.0	248.1	26.004
8.5	229.3	16.959	26.0	246.2	25.818	43.5	248.1	26.004
9.0	231.2	17.265	26.5	246.6	25.840	44.0	248.1	26.006
9.5	232.6	17.594	27.0	246.8	25.863	44.5	248.1	26.006
10.0	233.3	17.954	27.5	247.0	25.880	45.0	248.1	26.007
10.5	234.1	18.341	28.0	247.1	25.890	45.5	248.1	26.006
11.0	234.5	18.746	28.5	247.2	25.904	46.0	248.1	26.005
11.5	234.9	19.157	29.0	247.3	25.915	46.5	248.1	26.004
12.0	235.1	19.573	29.5	247.4	25.928	47.0	248.1	26.006
12.5	235.2	19.993	30.0	247.6	25.937	47.5	248.1	26.005
13.0	235.7	20.415	30.5	247.7	25.945	48.0	248.1	26.006
13.5	236.0	20.833	31.0	247.8	25.952	48.5	248.1	26.005
14.0	236.2	21.240	31.5	247.8	25.961	49.0	248.1	26.004
14.5	236.5	21.642	32.0	247.9	25.965	49.5	248.1	26.006
15.0	236.8	22.026	32.5	247.9	25.967	50.0	248.1	26.005
15.5	237.1	22.397	33.0	248.0	25.973	50.5	248.1	26.005
16.0	237.6	22.753	33.5	248.0	25.974	51.0	248.1	26.005
16.5	237.8	23.090	34.0	248.0	25.980			
17.0	238.2	23.407	34.5	248.0	25.984			

OBSERVED EXPERIMENTAL DATA FROM RUN 38

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	77.3	-.---	47.0	239.0	22.588	94.0	239.7	28.293
1.0	115.6	-.---	48.0	239.0	22.780	95.0	239.7	28.318
2.0	143.7	8.784	49.0	239.0	22.964	96.0	239.7	28.346
3.0	165.0	11.092	50.0	238.9	23.156	97.0	239.7	28.374
4.0	181.4	12.972	51.0	238.9	23.347	98.0	239.8	28.399
5.0	194.1	14.500	52.0	238.9	23.537	99.0	239.8	28.414
6.0	203.8	15.739	53.0	238.9	23.727	100.0	239.8	28.434
7.0	211.3	16.725	54.0	238.9	23.917	101.0	239.8	28.449
8.0	217.4	17.505	55.0	238.9	24.104	102.0	239.8	28.462
9.0	222.1	18.123	56.0	238.8	24.296	103.0	239.8	28.480
10.0	225.8	18.610	57.0	238.8	24.476	104.0	239.9	28.485
11.0	228.6	18.997	58.0	238.7	24.653	105.0	239.9	28.500
12.0	231.1	19.293	59.0	238.7	24.832	106.0	239.9	28.511
13.0	233.0	19.525	60.0	238.7	25.000	107.0	239.9	28.519
14.0	234.5	19.715	61.0	238.7	25.177	108.0	239.9	28.526
15.0	235.6	19.860	62.0	238.7	25.341	109.0	239.9	28.535
16.0	236.5	19.973	63.0	238.7	25.505	110.0	239.9	28.541
17.0	237.1	20.059	64.0	238.7	25.667	111.0	239.9	28.553
18.0	237.8	20.129	65.0	238.7	25.817	112.0	239.9	28.553
19.0	238.3	20.191	66.0	238.7	25.966	113.0	239.9	28.559
20.0	238.5	20.231	67.0	238.7	26.108	114.0	239.9	28.565
21.0	238.9	20.270	68.0	238.7	26.250	115.0	239.9	28.563
22.0	239.0	20.300	69.0	238.7	26.387	116.0	239.9	28.570
23.0	239.3	20.322	70.0	238.8	26.517	117.0	239.9	28.570
24.0	239.4	20.348	71.0	238.8	26.638	118.0	239.9	28.575
25.0	239.5	20.373	72.0	238.8	26.762	119.0	239.9	28.577
26.0	239.7	20.400	73.0	238.8	26.877	120.0	239.9	28.578
27.0	239.8	20.423	74.0	238.8	26.991	121.0	239.9	28.581
28.0	239.8	20.451	75.0	238.9	27.098	122.0	239.9	28.580
29.0	239.8	20.490	76.0	238.9	27.199	123.0	239.9	28.583
30.0	239.9	20.526	77.0	238.9	27.289	124.0	239.8	28.585
31.0	239.9	20.577	78.0	238.9	27.378	125.0	239.8	28.584
32.0	239.9	20.632	79.0	239.0	27.469	126.0	239.8	28.588
33.0	239.9	20.694	80.0	239.0	27.548	127.0	239.8	28.588
34.0	239.9	20.769	81.0	239.0	27.628	128.0	239.8	28.588
35.0	239.9	20.849	82.0	239.0	27.700	129.0	239.8	28.589
36.0	239.9	20.946	83.0	239.1	27.770	130.0	239.8	28.583
37.0	239.9	21.051	84.0	239.2	27.835	131.0	239.8	28.588
38.0	239.9	21.165	85.0	239.2	27.900	132.0	239.8	28.586
39.0	239.8	21.292	86.0	239.2	27.952	133.0	239.8	28.585
40.0	239.7	21.429	87.0	239.2	28.006	134.0	239.8	28.583
41.0	239.6	21.563	88.0	239.3	28.055	135.0	239.8	28.584
42.0	239.5	21.726	89.0	239.4	28.104	136.0	239.8	28.585
43.0	239.4	21.890	90.0	239.5	28.142	137.0	239.8	28.589
44.0	239.2	22.055	91.0	239.5	28.188	138.0	239.8	28.580
45.0	239.1	22.227	92.0	239.5	28.224	139.0	239.8	28.585
46.0	239.1	22.407	93.0	239.6	28.258	140.0	239.9	28.585

OBSERVED EXPERIMENTAL DATA FROM RUN 39

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	75.0	--.---	43.0	237.5	27.641	86.0	240.3	30.355
1.0	114.2	--.---	44.0	237.5	27.868	87.0	240.3	30.354
2.0	143.2	10.948	45.0	237.5	28.088	88.0	240.3	30.358
3.0	165.0	13.323	46.0	237.6	28.291	89.0	240.3	30.360
4.0	181.7	15.239	47.0	237.6	28.483	90.0	240.4	30.360
5.0	194.4	16.768	48.0	237.7	28.667	91.0	240.4	30.363
6.0	204.2	17.982	49.0	237.8	28.834	92.0	240.5	30.363
7.0	211.8	18.950	50.0	238.0	28.992	93.0	240.5	30.359
8.0	217.8	19.713	51.0	238.0	29.140	94.0	240.5	30.362
9.0	222.3	20.316	52.0	238.1	29.275	95.0	240.5	30.363
10.0	226.1	20.788	53.0	238.2	29.398	96.0	240.5	30.363
11.0	229.0	21.157	54.0	238.4	29.509	97.0	240.5	30.359
12.0	231.4	21.446	55.0	238.5	29.610	98.0	240.5	30.362
13.0	233.1	21.674	56.0	238.5	29.701	99.0	240.5	30.362
14.0	234.6	21.847	57.0	238.7	29.785	100.0	240.5	30.370
15.0	235.7	21.990	58.0	238.9	29.863	101.0	240.5	30.372
16.0	236.6	22.100	59.0	239.0	29.927	102.0	240.5	30.375
17.0	237.3	22.195	60.0	239.1	29.984	103.0	240.5	30.379
18.0	237.8	22.274	61.0	239.2	30.036	104.0	240.5	30.387
19.0	238.2	22.348	62.0	239.3	30.077	105.0	240.5	30.386
20.0	238.4	22.422	63.0	239.3	30.122	106.0	240.5	30.385
21.0	238.7	22.503	64.0	239.5	30.154	107.0	240.5	30.385
22.0	238.9	22.590	65.0	239.6	30.184	108.0	240.5	30.389
23.0	239.0	22.698	66.0	239.7	30.209	109.0	240.5	30.395
24.0	239.0	22.827	67.0	239.7	30.234	110.0	240.5	30.397
25.0	239.0	22.972	68.0	239.8	30.249	111.0	240.5	30.395
26.0	239.0	23.148	69.0	239.9	30.267	112.0	240.5	30.398
27.0	239.0	23.346	70.0	240.0	30.282	113.0	240.5	30.397
28.0	239.0	23.558	71.0	240.0	30.294	114.0	240.5	30.397
29.0	238.7	23.788	72.0	240.0	30.305	115.0	240.5	30.396
30.0	238.7	24.046	73.0	240.0	30.313	116.0	240.5	30.399
31.0	238.5	24.322	74.0	240.0	30.319	117.0	240.6	30.400
32.0	238.2	24.600	75.0	240.0	30.327	118.0	240.7	30.400
33.0	238.0	24.888	76.0	240.1	30.332	119.0	240.7	30.401
34.0	238.0	25.179	77.0	240.1	30.337	120.0	240.8	30.402
35.0	237.9	25.473	78.0	240.1	30.334	121.0	240.8	30.403
36.0	237.8	25.773	79.0	240.1	30.340	122.0	240.8	30.401
37.0	237.7	26.054	80.0	240.1	30.343	123.0	240.8	30.401
38.0	237.6	26.341	81.0	240.1	30.345	124.0	240.8	30.404
39.0	237.5	26.617	82.0	240.1	30.345	125.0	240.8	30.402
40.0	237.5	26.888	83.0	240.2	30.348	126.0	240.8	30.403
41.0	237.5	27.151	84.0	240.2	30.349	127.0	240.8	30.403
42.0	237.5	27.400	85.0	240.2	30.355	128.0	240.8	30.403

OBSERVED EXPERIMENTAL DATA FROM RUN 40

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	75.5	--.---	21.5	235.7	28.158	43.0	239.5	33.099
.5	96.3	--.---	22.0	235.7	28.376	43.5	239.8	33.111
1.0	118.5	--.---	22.5	235.7	28.593	44.0	239.8	33.125
1.5	137.7	14.718	23.0	235.7	28.809	44.5	239.8	33.134
2.0	150.0	15.887	23.5	235.7	29.026	45.0	239.8	33.148
2.5	160.0	16.945	24.0	235.7	29.237	45.5	239.9	33.152
3.0	169.4	17.915	24.5	235.7	29.442	46.0	240.0	33.159
3.5	177.9	18.768	25.0	235.7	29.646	46.5	240.0	33.169
4.0	185.0	19.550	25.5	235.7	29.846	47.0	240.0	33.174
4.5	191.1	20.242	26.0	235.7	30.040	47.5	240.1	33.178
5.0	196.7	20.865	26.5	235.7	30.226	48.0	240.1	33.183
5.5	201.7	21.417	27.0	235.7	30.413	48.5	240.1	33.188
6.0	206.1	21.919	27.5	235.7	30.585	49.0	240.1	33.188
6.5	209.9	22.360	28.0	235.7	30.761	49.5	240.1	33.194
7.0	213.3	22.754	28.5	235.7	30.925	50.0	240.2	33.194
7.5	216.2	23.100	29.0	235.7	31.087	50.5	240.2	33.196
8.0	219.0	23.411	29.5	235.8	31.238	51.0	240.2	33.200
8.5	221.3	23.687	30.0	236.0	31.383	51.5	240.3	33.200
9.0	223.2	23.929	30.5	236.0	31.519	52.0	240.5	33.203
9.5	225.0	24.142	31.0	236.2	31.650	52.5	240.5	33.206
10.0	227.0	24.337	31.5	236.4	31.765	53.0	240.5	33.205
10.5	228.5	24.509	32.0	236.7	31.894	53.5	240.5	33.208
11.0	229.6	24.661	32.5	236.7	32.005	54.0	240.5	33.211
11.5	230.7	24.800	33.0	236.7	32.110	54.5	240.5	33.209
12.0	231.8	24.923	33.5	236.9	32.208	55.0	240.5	33.210
12.5	232.4	25.039	34.0	237.1	32.299	55.5	240.5	33.212
13.0	233.3	25.161	34.5	237.2	32.386	56.0	240.5	33.216
13.5	234.1	25.275	35.0	237.5	32.464	56.5	240.5	33.213
14.0	234.7	25.397	35.5	237.7	32.537	57.0	240.5	33.214
14.5	235.0	25.520	36.0	238.0	32.603	57.5	240.5	33.216
15.0	235.2	25.659	36.5	238.1	32.666	58.0	240.6	33.215
15.5	235.3	25.800	37.0	238.1	32.721	58.5	240.6	33.213
16.0	235.7	25.960	37.5	238.3	32.772	59.0	240.6	33.215
16.5	235.7	26.126	38.0	238.6	32.822	59.5	240.6	33.218
17.0	235.7	26.308	38.5	238.7	32.863	60.0	240.6	33.215
17.5	235.8	26.490	39.0	238.7	32.904	60.5	240.6	33.217
18.0	235.9	26.681	39.5	238.9	32.938	61.0	240.7	33.218
18.5	235.8	26.878	40.0	239.1	32.970	61.5	240.7	33.216
19.0	235.7	27.077	40.5	239.1	32.998	62.0	240.7	33.219
19.5	235.7	27.293	41.0	239.2	33.023	62.5	240.7	33.218
20.0	235.7	27.506	41.5	239.3	33.042	63.0	240.7	33.219
20.5	235.7	27.720	42.0	239.5	33.067			
21.0	235.7	27.941	42.5	239.5	33.084			

OBSERVED EXPERIMENTAL DATA FROM RUN 41

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	83.1	-.---	21.5	229.8	22.838	43.0	234.4	26.621
.5	101.3	-.---	22.0	230.0	23.026	43.5	234.3	26.633
1.0	118.3	7.528	22.5	230.0	23.205	44.0	234.4	26.648
1.5	132.8	8.987	23.0	230.1	23.387	44.5	234.5	26.659
2.0	145.2	10.274	23.5	230.1	23.556	45.0	234.7	26.666
2.5	156.0	11.388	24.0	230.2	23.728	45.5	234.7	26.680
3.0	165.4	12.354	24.5	230.3	23.893	46.0	234.9	26.680
3.5	173.4	13.200	25.0	230.6	24.055	46.5	234.9	26.689
4.0	180.9	13.955	25.5	230.7	24.203	47.0	235.0	26.694
4.5	187.0	14.616	26.0	230.8	24.354	47.5	235.0	26.700
5.0	192.5	15.207	26.5	231.0	24.497	48.0	235.1	26.706
5.5	197.3	15.734	27.0	231.0	24.638	48.5	235.2	26.709
6.0	201.7	16.200	27.5	231.1	24.770	49.0	235.2	26.715
6.5	205.2	16.607	28.0	231.2	24.893	49.5	235.1	26.718
7.0	208.8	16.969	28.5	231.4	25.016	50.0	235.2	26.720
7.5	211.6	17.297	29.0	231.5	25.134	50.5	235.2	26.724
8.0	214.0	17.579	29.5	231.6	25.249	51.0	235.2	26.722
8.5	216.6	17.832	30.0	231.9	25.354	51.5	235.2	26.728
9.0	218.8	18.056	30.5	231.9	25.449	52.0	235.2	26.729
9.5	220.2	18.259	31.0	232.0	25.548	52.5	235.2	26.731
10.0	222.1	18.435	31.5	232.1	25.636	53.0	235.2	26.733
10.5	223.3	18.601	32.0	232.2	25.721	53.5	235.2	26.733
11.0	224.8	18.762	32.5	232.3	25.800	54.0	235.2	26.733
11.5	225.4	18.910	33.0	232.4	25.875	54.5	235.2	26.734
12.0	226.7	19.064	33.5	232.6	25.943	55.0	235.2	26.736
12.5	227.1	19.227	34.0	232.8	26.001	55.5	235.2	26.738
13.0	227.7	19.400	34.5	232.9	26.067	56.0	235.2	26.736
13.5	227.9	19.583	35.0	233.0	26.120	56.5	235.2	26.738
14.0	228.3	19.773	35.5	233.1	26.179	57.0	235.2	26.737
14.5	228.4	19.978	36.0	233.2	26.224	57.5	235.1	26.739
15.0	228.6	20.185	36.5	233.3	26.275	58.0	235.2	26.740
15.5	228.6	20.390	37.0	233.5	26.315	58.5	235.2	26.738
16.0	228.9	20.600	37.5	233.6	26.360	59.0	233.2	26.739
16.5	229.0	20.811	38.0	233.7	26.396	59.5	235.1	26.739
17.0	229.0	21.022	38.5	233.8	26.427	60.0	235.3	26.739
17.5	229.1	21.233	39.0	233.9	26.456	60.5	235.2	26.738
18.0	229.2	21.441	39.5	234.0	26.486	61.0	235.2	26.739
18.5	229.3	21.651	40.0	234.1	26.509	61.5	235.2	26.739
19.0	229.4	21.856	40.5	234.1	26.535	62.0	235.2	26.739
19.5	229.5	22.058	41.0	234.2	26.553	62.5	235.2	26.739
20.0	229.8	22.261	41.5	234.2	26.570	63.0	235.2	26.739
20.5	229.8	22.455	42.0	234.4	26.590			
21.0	229.9	22.649	42.5	234.3	26.608			

OBSERVED EXPERIMENTAL DATA FROM RUN 42

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	78.0	--.---	500.0	239.4	20.970	1000.0	239.7	25.517
10.0	226.2	15.991	510.0	239.4	21.139	1010.0	239.7	25.533
20.0	237.6	17.814	520.0	239.3	21.305	1020.0	239.7	25.550
30.0	239.0	18.016	530.0	239.3	21.484	1030.0	239.6	25.565
40.0	239.6	18.056	540.0	239.3	21.654	1040.0	239.6	25.579
50.0	239.7	18.072	550.0	239.3	21.823	1050.0	239.6	25.593
60.0	239.8	18.076	560.0	239.3	21.996	1060.0	239.7	25.613
70.0	239.7	18.069	570.0	239.3	22.167	1070.0	239.7	25.629
80.0	239.6	18.070	580.0	239.3	22.332	1080.0	239.7	25.640
90.0	239.6	18.078	590.0	239.3	22.497	1090.0	239.7	25.658
100.0	239.6	18.073	600.0	239.3	22.659	1100.0	239.6	25.669
110.0	239.7	18.075	610.0	239.3	22.824	1110.0	239.6	25.685
120.0	239.8	18.077	620.0	239.3	22.981	1120.0	239.6	25.696
130.0	239.8	18.079	630.0	239.4	23.134	1130.0	239.6	25.700
140.0	239.7	18.085	640.0	239.4	23.284	1140.0	239.7	25.716
150.0	239.7	18.090	650.0	239.4	23.422	1150.0	239.7	25.730
160.0	239.8	18.106	660.0	239.5	23.559	1160.0	239.7	25.739
170.0	239.8	18.110	670.0	239.5	23.695	1170.0	239.7	25.752
180.0	239.9	18.113	680.0	239.5	23.815	1180.0	239.7	25.768
190.0	239.9	18.123	690.0	239.6	23.940	1190.0	239.7	25.773
200.0	239.9	18.132	700.0	239.6	24.053	1200.0	239.8	25.790
210.0	239.8	18.143	710.0	239.6	24.169	1210.0	239.8	25.800
220.0	239.8	18.164	720.0	239.6	24.275	1220.0	239.8	25.821
230.0	239.8	18.182	730.0	239.6	24.370	1230.0	239.8	25.833
240.0	239.8	18.204	740.0	239.5	24.439	1240.0	239.8	25.840
250.0	239.8	18.229	750.0	239.4	24.537	1250.0	239.8	25.853
260.0	239.8	18.262	760.0	239.4	24.622	1260.0	239.7	25.869
270.0	239.8	18.295	770.0	239.4	24.700	1270.0	239.7	25.883
280.0	239.8	18.332	780.0	239.4	24.766	1280.0	239.7	25.894
290.0	239.8	18.386	790.0	239.4	24.828	1290.0	239.7	25.913
300.0	239.8	18.445	800.0	239.4	24.887	1300.0	239.7	25.928
310.0	239.8	18.510	810.0	239.5	24.943	1310.0	239.8	25.940
320.0	240.0	18.590	820.0	239.5	24.994	1320.0	239.9	25.958
330.0	240.0	18.673	830.0	239.5	25.045	1330.0	239.9	25.970
340.0	240.0	18.766	840.0	239.8	25.085	1340.0	240.0	25.982
350.0	240.0	18.866	850.0	239.8	25.126	1350.0	240.0	25.993
360.0	240.0	18.972	860.0	239.8	25.159	1360.0	240.0	26.006
370.0	240.0	19.085	870.0	239.7	25.198	1370.0	240.0	26.017
380.0	239.8	19.192	880.0	239.6	25.232	1380.0	240.0	26.035
390.0	239.8	19.311	890.0	239.6	25.262	1390.0	240.0	26.048
400.0	239.8	19.444	900.0	239.5	25.288	1400.0	240.0	26.063
410.0	239.8	19.577	910.0	239.5	25.317	1410.0	240.0	26.075
420.0	239.8	19.710	920.0	239.5	25.342	1420.0	240.0	26.087
430.0	239.8	19.856	930.0	239.5	25.372	1430.0	240.0	26.102
440.0	239.8	20.011	940.0	239.4	25.396	1440.0	240.0	26.120
450.0	239.8	20.170	950.0	239.4	25.420	1450.0	240.0	26.135
460.0	239.8	20.320	960.0	239.4	25.441	1460.0	240.0	26.151
470.0	239.7	20.479	970.0	239.5	25.459	1470.0	240.0	26.162
480.0	239.7	20.644	980.0	239.6	25.482	1480.0	240.0	26.171
490.0	239.5	20.802	990.0	239.6	25.497	1490.0	240.0	26.180

OBSERVED EXPERIMENTAL DATA FROM RUN 42 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
1500.0	240.0	26.193	1580.0	240.0	26.264	1660.0	240.0	26.293
1510.0	240.0	26.205	1590.0	240.0	26.269	1670.0	240.0	26.295
1520.0	240.0	26.214	1600.0	239.9	26.275	1680.0	239.9	26.295
1530.0	240.0	26.225	1610.0	239.9	26.276	1690.0	239.9	26.300
1540.0	240.0	26.234	1620.0	239.9	26.278	1700.0	239.9	26.296
1550.0	240.0	26.238	1630.0	240.0	26.283	1710.0	239.9	26.296
1560.0	240.0	26.242	1640.0	240.0	26.288	1720.0	240.0	26.294
1570.0	240.0	26.250	1650.0	240.0	26.290			

OBSERVED EXPERIMENTAL DATA FROM RUN 43

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	79.2	--.---	50.0	239.7	26.270	100.0	239.3	28.459
1.0	110.8	--.---	51.0	239.7	26.282	101.0	239.3	28.531
2.0	143.9	13.973	52.0	239.7	26.288	102.0	239.3	28.610
3.0	164.8	16.427	53.0	239.7	26.300	103.0	239.3	28.690
4.0	181.3	18.434	54.0	239.7	26.312	104.0	239.3	28.771
5.0	193.8	20.063	55.0	239.7	26.325	105.0	239.3	28.848
6.0	203.4	21.370	56.0	239.7	26.339	106.0	239.3	28.927
7.0	211.1	22.407	57.0	239.7	26.350	107.0	239.3	29.010
8.0	217.2	23.229	58.0	239.7	26.367	108.0	239.3	29.093
9.0	222.0	23.870	59.0	239.7	26.384	109.0	239.3	29.169
10.0	225.4	24.372	60.0	239.7	26.407	110.0	239.3	29.246
11.0	228.3	24.768	61.0	239.6	26.424	111.0	239.3	29.331
12.0	230.8	25.076	62.0	239.6	26.443	112.0	239.3	29.410
13.0	232.6	25.318	63.0	239.5	26.463	113.0	239.2	29.488
14.0	234.1	25.503	64.0	239.5	26.490	114.0	239.2	29.564
15.0	235.1	25.650	65.0	239.5	26.518	115.0	239.2	29.648
16.0	236.0	25.768	66.0	239.5	26.545	116.0	239.2	29.732
17.0	236.7	25.857	67.0	239.5	26.575	117.0	239.2	29.810
18.0	237.4	25.926	68.0	239.5	26.604	118.0	239.2	29.890
19.0	237.7	25.980	69.0	239.5	26.639	119.0	239.2	29.968
20.0	238.2	26.020	70.0	239.5	26.670	120.0	239.2	30.048
21.0	238.5	26.056	71.0	239.5	26.706	121.0	239.2	30.128
22.0	238.6	26.085	72.0	239.5	26.744	122.0	239.2	30.203
23.0	238.8	26.108	73.0	239.5	26.785	123.0	239.2	30.279
24.0	239.0	26.122	74.0	239.5	26.828	124.0	239.2	30.357
25.0	239.1	26.139	75.0	239.5	26.864	125.0	239.2	30.432
26.0	239.2	26.150	76.0	239.5	26.910	126.0	239.3	30.506
27.0	239.3	26.162	77.0	239.5	26.957	127.0	239.3	30.578
28.0	239.4	26.170	78.0	239.5	27.002	128.0	239.3	30.645
29.0	239.4	26.179	79.0	239.5	27.058	129.0	239.3	30.718
30.0	239.5	26.186	80.0	239.5	27.110	130.0	239.3	30.787
31.0	239.5	26.189	81.0	239.5	27.165	131.0	239.3	30.861
32.0	239.7	26.195	82.0	239.5	27.222	132.0	239.3	30.934
33.0	239.7	26.196	83.0	239.5	27.278	133.0	239.4	31.003
34.0	239.7	26.203	84.0	239.5	27.340	134.0	239.4	31.073
35.0	239.7	26.205	85.0	239.5	27.400	135.0	239.4	31.135
36.0	239.7	26.209	86.0	239.5	27.465	136.0	239.4	31.204
37.0	239.7	26.209	87.0	239.5	27.525	137.0	239.4	31.269
38.0	239.7	26.215	88.0	239.5	27.593	138.0	239.4	31.339
39.0	239.7	26.220	89.0	239.5	27.658	139.0	239.4	31.409
40.0	239.7	26.220	90.0	239.5	27.730	140.0	239.4	31.469
41.0	239.7	26.220	91.0	239.5	27.800	141.0	239.4	31.530
42.0	239.7	26.226	92.0	239.5	27.867	142.0	239.4	31.598
43.0	239.7	26.228	93.0	239.5	27.936	143.0	239.4	31.655
44.0	239.7	26.233	94.0	239.5	28.005	144.0	239.4	31.717
45.0	239.7	26.239	95.0	239.4	28.080	145.0	239.4	31.776
46.0	239.7	26.244	96.0	239.4	28.150	146.0	239.4	31.837
47.0	239.7	26.247	97.0	239.4	28.228	147.0	239.4	31.900
48.0	239.7	26.257	98.0	239.4	28.303	148.0	239.4	31.954
49.0	239.7	26.262	99.0	239.3	28.381	149.0	239.4	32.008

OBSERVED EXPERIMENTAL DATA FROM RUN 43 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
150.0	239.4	32.063	200.0	239.3	33.808	250.0	239.0	34.224
151.0	239.4	32.108	201.0	239.3	33.826	251.0	239.0	34.232
152.0	239.4	32.164	202.0	239.3	33.843	252.0	239.0	34.233
153.0	239.4	32.224	203.0	239.3	33.858	253.0	239.0	34.235
154.0	239.4	32.276	204.0	239.3	33.874	254.0	239.0	34.235
155.0	239.4	32.331	205.0	239.3	33.891	255.0	239.0	34.235
156.0	239.4	32.385	206.0	239.3	33.902	256.0	239.0	34.238
157.0	239.3	32.432	207.0	239.3	33.915	257.0	239.0	34.239
158.0	239.3	32.484	208.0	239.3	33.932	258.0	239.0	34.241
159.0	239.3	32.530	209.0	239.2	33.945	259.0	239.0	34.244
160.0	239.3	32.580	210.0	239.2	33.957	260.0	239.0	34.245
161.0	239.3	32.622	211.0	239.2	33.971	261.0	239.0	34.247
162.0	239.3	32.667	212.0	239.2	33.981	262.0	239.0	34.250
163.0	239.3	32.710	213.0	239.2	33.997	263.0	239.0	34.253
164.0	239.3	32.756	214.0	239.2	34.006	264.0	239.0	34.255
165.0	239.3	32.802	215.0	239.2	34.017	265.0	239.0	34.260
166.0	239.3	32.843	216.0	239.2	34.026	266.0	239.0	34.259
167.0	239.3	32.885	217.0	239.2	34.036	267.0	239.0	34.261
168.0	239.3	32.924	218.0	239.2	34.048	268.0	239.0	34.263
169.0	239.3	32.964	219.0	239.2	34.053	269.0	239.0	34.266
170.0	239.3	32.997	220.0	239.2	34.062	270.0	239.0	34.263
171.0	239.3	33.038	221.0	239.2	34.074	271.0	239.0	34.265
172.0	239.3	33.073	222.0	239.2	34.080	272.0	239.0	34.266
173.0	239.3	33.114	223.0	239.2	34.088	273.0	239.0	34.270
174.0	239.3	33.153	224.0	239.2	34.096	274.0	239.0	34.270
175.0	239.3	33.190	225.0	239.2	34.104	275.0	239.0	34.273
176.0	239.3	33.224	226.0	239.2	34.111	276.0	239.0	34.277
177.0	239.3	33.263	227.0	239.2	34.119	277.0	239.0	34.279
178.0	239.3	33.293	228.0	239.2	34.126	278.0	239.0	34.279
179.0	239.3	33.319	229.0	239.2	34.133	279.0	239.0	34.281
180.0	239.3	33.348	230.0	239.2	34.139	280.0	239.0	34.278
181.0	239.3	33.380	231.0	239.2	34.144	281.0	239.0	34.279
182.0	239.3	33.410	232.0	239.2	34.151	282.0	239.0	34.279
183.0	239.3	33.439	233.0	239.2	34.153	283.0	239.0	34.282
184.0	239.3	33.467	234.0	239.2	34.162	284.0	239.1	34.282
185.0	239.3	33.495	235.0	239.2	34.164	285.0	239.1	34.285
186.0	239.3	33.517	236.0	239.2	34.170	286.0	239.1	34.285
187.0	239.3	33.544	237.0	239.2	34.174	287.0	239.1	34.285
188.0	239.3	33.569	238.0	239.2	34.179	288.0	239.2	34.285
189.0	239.3	33.591	239.0	239.2	34.182	289.0	239.2	34.287
190.0	239.3	33.614	240.0	239.2	34.190	290.0	239.2	34.285
191.0	239.3	33.635	241.0	239.2	34.193	291.0	239.2	34.287
192.0	239.3	33.657	242.0	239.2	34.200	292.0	239.2	34.286
193.0	239.3	33.678	243.0	239.0	34.208	293.0	239.2	34.289
194.0	239.3	33.694	244.0	239.0	34.208	294.0	239.3	34.291
195.0	239.3	33.716	245.0	239.0	34.213	295.0	239.3	34.289
196.0	239.3	33.735	246.0	239.0	34.213	296.0	239.3	34.289
197.0	239.3	33.754	247.0	239.0	34.217	297.0	239.3	34.293
198.0	239.3	33.770	248.0	239.0	34.217	298.0	239.3	34.288
199.0	239.3	33.793	249.0	239.0	34.224	299.0	239.3	34.290
						300.0	239.7	34.291

OBSERVED EXPERIMENTAL DATA FROM RUN 44

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	77.0	--.---	100.0	239.9	24.642	200.0	239.9	27.596
2.0	149.3	--.---	102.0	239.9	24.662	202.0	239.9	27.679
4.0	185.2	17.617	104.0	239.9	24.684	204.0	239.9	27.760
6.0	206.2	20.426	106.0	239.8	24.704	206.0	239.9	27.846
8.0	219.0	22.176	108.0	239.9	24.727	208.0	239.9	27.926
10.0	226.6	23.233	110.0	239.8	24.756	210.0	239.9	28.009
12.0	231.5	23.845	112.0	239.9	24.783	212.0	239.9	28.091
14.0	234.5	24.207	114.0	239.9	24.815	214.0	239.9	28.179
16.0	236.4	24.414	116.0	239.9	24.850	216.0	239.9	28.256
18.0	237.5	24.526	118.0	239.9	24.884	218.0	239.8	28.341
20.0	238.2	24.585	120.0	239.9	24.920	220.0	239.8	28.426
22.0	238.6	24.605	122.0	239.9	24.959	222.0	239.8	28.505
24.0	239.0	24.620	124.0	239.9	25.002	224.0	239.8	28.592
26.0	239.2	24.616	126.0	239.9	25.045	226.0	239.8	28.673
28.0	239.4	24.605	128.0	239.9	25.089	228.0	239.8	28.754
30.0	239.5	24.594	130.0	239.9	25.136	230.0	239.8	28.834
32.0	239.5	24.584	132.0	239.9	25.185	232.0	239.8	28.917
34.0	239.5	24.570	134.0	239.9	25.233	234.0	239.8	28.996
36.0	239.7	24.557	136.0	239.9	25.281	236.0	239.8	29.076
38.0	239.7	24.548	138.0	239.9	25.337	238.0	239.8	29.157
40.0	239.7	24.538	140.0	239.9	25.393	240.0	239.8	29.236
42.0	239.7	24.524	142.0	239.9	25.452	242.0	239.7	29.315
44.0	239.7	24.518	144.0	239.9	25.511	244.0	239.7	29.383
46.0	239.7	24.508	146.0	239.9	25.569	246.0	239.7	29.462
48.0	239.9	24.502	148.0	239.9	25.632	248.0	239.7	29.539
50.0	239.9	24.494	150.0	239.9	25.694	250.0	239.7	29.614
52.0	240.0	24.490	152.0	239.9	25.755	252.0	239.6	29.691
54.0	240.0	24.484	154.0	239.9	25.823	254.0	239.6	29.768
56.0	240.0	24.480	156.0	239.9	25.890	256.0	239.5	29.841
58.0	239.9	24.477	158.0	239.9	25.959	258.0	239.5	29.912
60.0	239.9	24.474	160.0	239.9	26.026	260.0	239.5	29.989
62.0	239.9	24.472	162.0	239.9	26.100	262.0	239.5	30.059
64.0	239.9	24.474	164.0	239.9	26.173	264.0	239.6	30.132
66.0	239.9	24.472	166.0	239.9	26.246	266.0	239.6	30.203
68.0	239.9	24.472	168.0	239.9	26.323	268.0	239.6	30.274
70.0	239.9	24.475	170.0	239.9	26.395	270.0	239.6	30.341
72.0	239.9	24.482	172.0	239.9	26.470	272.0	239.6	30.403
74.0	239.9	24.488	174.0	239.9	26.546	274.0	239.6	30.470
76.0	239.8	24.492	176.0	239.9	26.625	276.0	239.5	30.533
78.0	239.8	24.500	178.0	239.9	26.703	278.0	239.5	30.600
80.0	239.9	24.506	180.0	239.9	26.778	280.0	239.5	30.659
82.0	239.9	24.515	182.0	239.9	26.858	282.0	239.5	30.719
84.0	239.9	24.524	184.0	239.9	26.938	284.0	239.5	30.780
86.0	239.9	24.535	186.0	239.9	27.019	286.0	239.5	30.839
88.0	239.9	24.548	188.0	239.9	27.103	288.0	239.5	30.895
90.0	239.9	24.560	190.0	239.9	27.184	290.0	239.5	30.950
92.0	239.8	24.573	192.0	239.9	27.269	292.0	239.5	31.003
94.0	239.9	24.584	194.0	239.9	27.347	294.0	239.5	31.063
96.0	239.9	24.603	196.0	239.9	27.432	296.0	239.5	31.114
98.0	239.9	24.625	198.0	239.9	27.515	298.0	239.4	31.167

OBSERVED EXPERIMENTAL DATA FROM RUN 44 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
300.0	239.3	31.219	368.0	239.3	32.366	436.0	239.5	32.642
302.0	239.3	31.270	370.0	239.3	32.385	438.0	239.5	32.646
304.0	239.3	31.318	372.0	239.3	32.400	440.0	239.5	32.646
306.0	239.3	31.369	374.0	239.3	32.413	442.0	239.5	32.654
308.0	239.3	31.412	376.0	239.3	32.427	444.0	239.5	32.655
310.0	239.3	31.463	378.0	239.3	32.441	446.0	239.5	32.657
312.0	239.3	31.508	380.0	239.3	32.455	448.0	239.5	32.659
314.0	239.3	31.552	382.0	239.3	32.469	450.0	239.5	32.663
316.0	239.3	31.595	384.0	239.3	32.482	452.0	239.5	32.669
318.0	239.3	31.634	386.0	239.3	32.496	454.0	239.5	32.670
320.0	239.3	31.680	388.0	239.3	32.505	456.0	239.5	32.673
322.0	239.3	31.723	390.0	239.3	32.514	458.0	239.5	32.673
324.0	239.3	31.760	392.0	239.3	32.525	460.0	239.5	32.675
326.0	239.3	31.798	394.0	239.3	32.537	462.0	239.6	32.672
328.0	239.3	31.835	396.0	239.3	32.546	464.0	239.6	32.672
330.0	239.3	31.874	398.0	239.3	32.556	466.0	239.6	32.674
332.0	239.3	31.907	400.0	239.3	32.559	468.0	239.6	32.675
334.0	239.3	31.939	402.0	239.3	32.569	470.0	239.7	32.676
336.0	239.3	31.969	404.0	239.3	32.575	472.0	239.7	32.677
338.0	239.3	32.006	406.0	239.3	32.580	474.0	239.7	32.677
340.0	239.3	32.035	408.0	239.3	32.587	476.0	239.7	32.679
342.0	239.3	32.066	410.0	239.3	32.597	478.0	239.7	32.677
344.0	239.3	32.091	412.0	239.3	32.602	480.0	239.7	32.678
346.0	239.3	32.121	414.0	239.3	32.608	482.0	239.8	32.679
348.0	239.3	32.147	416.0	239.3	32.615	484.0	239.8	32.679
350.0	239.3	32.173	418.0	239.3	32.619	486.0	239.8	32.679
352.0	239.3	32.197	420.0	239.3	32.621	488.0	239.8	32.680
354.0	239.3	32.220	422.0	239.3	32.623	490.0	239.8	32.681
356.0	239.3	32.245	424.0	239.4	32.626	492.0	239.8	32.683
358.0	239.3	32.267	426.0	239.4	32.628	494.0	239.8	32.681
360.0	239.3	32.290	428.0	239.4	32.632	496.0	239.8	32.679
362.0	239.3	32.310	430.0	239.5	32.634	498.0	239.8	32.683
364.0	239.3	32.330	432.0	239.5	32.633	500.0	239.9	32.683
366.0	239.3	32.353	434.0	239.5	32.636			

OBSERVED EXPERIMENTAL DATA FROM RUN 45

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	83.0	--.---	50.0	239.1	28.304	100.0	237.8	34.111
1.0	121.3	13.774	51.0	239.0	28.347	101.0	237.9	34.211
2.0	148.2	16.674	52.0	239.0	28.386	102.0	237.8	34.306
3.0	169.0	19.048	53.0	239.1	28.427	103.0	237.8	34.396
4.0	184.1	20.954	54.0	239.1	28.484	104.0	237.8	34.485
5.0	196.1	22.475	55.0	239.1	28.534	105.0	237.9	34.573
6.0	205.1	23.678	56.0	239.0	28.593	106.0	237.9	34.655
7.0	212.1	24.625	57.0	239.0	28.660	107.0	238.0	34.734
8.0	217.4	25.379	58.0	239.0	28.735	108.0	237.9	34.813
9.0	222.2	25.963	59.0	239.0	28.815	109.0	237.9	34.886
10.0	225.9	26.422	60.0	239.0	28.905	110.0	237.9	34.958
11.0	228.5	26.782	61.0	239.0	28.994	111.0	238.0	35.025
12.0	230.4	27.066	62.0	238.9	29.095	112.0	237.9	35.084
13.0	232.5	27.288	63.0	239.0	29.202	113.0	238.0	35.149
14.0	233.6	27.459	64.0	238.6	29.308	114.0	238.0	35.209
15.0	234.6	27.594	65.0	238.6	29.425	115.0	238.0	35.261
16.0	235.4	27.700	66.0	238.3	29.548	116.0	238.0	35.316
17.0	236.1	27.781	67.0	238.5	29.677	117.0	238.0	35.366
18.0	236.8	27.850	68.0	238.2	29.807	118.0	238.0	35.414
19.0	237.0	27.897	69.0	238.3	29.940	119.0	238.0	35.459
20.0	237.5	27.935	70.0	238.1	30.082	120.0	238.0	35.505
21.0	238.0	27.970	71.0	238.0	30.222	121.0	238.0	35.540
22.0	238.0	27.999	72.0	238.0	30.369	122.0	238.0	35.579
23.0	238.2	28.015	73.0	238.0	30.516	123.0	238.1	35.615
24.0	238.3	28.031	74.0	238.0	30.664	124.0	238.1	35.648
25.0	238.6	28.046	75.0	238.0	30.811	125.0	238.1	35.684
26.0	238.8	28.059	76.0	237.9	30.964	126.0	238.1	35.711
27.0	238.9	28.065	77.0	238.0	31.111	127.0	238.1	35.737
28.0	238.8	28.076	78.0	237.9	31.261	128.0	238.1	35.765
29.0	238.9	28.079	79.0	238.0	31.414	129.0	238.2	35.791
30.0	238.8	28.088	80.0	237.9	31.568	130.0	238.2	35.815
31.0	238.9	28.093	81.0	238.0	31.710	131.0	238.3	35.839
32.0	238.9	28.096	82.0	237.8	31.860	132.0	238.3	35.857
33.0	239.0	28.100	83.0	237.9	32.008	133.0	238.4	35.867
34.0	238.9	28.104	84.0	237.6	32.148	134.0	238.4	35.895
35.0	239.0	28.108	85.0	237.9	32.290	135.0	238.5	35.910
36.0	238.9	28.114	86.0	237.7	32.430	136.0	238.5	35.925
37.0	238.9	28.116	87.0	237.8	32.571	137.0	238.4	35.939
38.0	238.9	28.121	88.0	237.7	32.707	138.0	238.4	35.955
39.0	239.1	28.130	89.0	237.8	32.837	139.0	238.4	35.967
40.0	239.0	28.138	90.0	237.6	32.971	140.0	238.4	35.978
41.0	239.2	28.143	91.0	237.9	33.097	141.0	238.3	35.988
42.0	239.1	28.155	92.0	237.6	33.224	142.0	238.4	36.002
43.0	239.2	28.164	93.0	237.9	33.345	143.0	238.4	36.010
44.0	239.1	28.178	94.0	237.9	33.462	144.0	238.4	36.016
45.0	239.2	28.195	95.0	237.6	33.581	145.0	238.5	36.025
46.0	239.2	28.213	96.0	237.6	33.689	146.0	238.4	36.032
47.0	239.2	28.234	97.0	237.8	33.800	147.0	238.4	36.038
48.0	239.1	28.258	98.0	237.8	33.908	148.0	238.4	36.044
49.0	239.1	28.283	99.0	237.8	34.008	149.0	238.5	36.048

OBSERVED EXPERIMENTAL DATA FROM RUN 45 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
150.0	238.4	36.050	160.0	238.5	36.075	170.0	238.8	36.082
151.0	238.4	36.054	161.0	238.6	36.075	171.0	238.7	36.081
152.0	238.5	36.058	162.0	238.6	36.075	172.0	238.8	36.081
153.0	238.5	36.060	163.0	238.7	36.079	173.0	238.8	36.082
154.0	238.5	36.062	164.0	238.6	36.080	174.0	238.8	36.083
155.0	238.5	36.066	165.0	238.8	36.078	175.0	238.8	36.082
156.0	238.5	36.069	166.0	238.8	36.080	176.0	238.6	36.082
157.0	238.6	36.071	167.0	238.8	36.082	177.0	238.6	36.082
158.0	238.5	36.072	168.0	238.6	36.082	178.0	238.7	36.084
159.0	238.5	36.075	169.0	238.8	36.082			

OBSERVED EXPERIMENTAL DATA FROM RUN 47

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	89.5	-.---	23.0	239.8	20.956	46.0	239.6	27.787
1.0	121.9	-.---	24.0	239.6	21.256	47.0	240.0	27.873
2.0	152.8	9.883	25.0	239.5	21.594	48.0	240.0	27.948
3.0	172.1	11.974	26.0	239.1	21.959	49.0	240.1	28.009
4.0	187.6	13.674	27.0	238.9	22.344	50.0	240.5	28.060
5.0	199.3	15.045	28.0	238.5	22.747	51.0	240.5	28.097
6.0	208.1	16.132	29.0	238.1	23.153	52.0	240.8	28.129
7.0	215.3	17.000	30.0	238.0	23.562	53.0	241.0	28.154
8.0	221.0	17.672	31.0	238.0	23.968	54.0	241.0	28.174
9.0	225.1	18.209	32.0	238.0	24.365	55.0	241.1	28.192
10.0	228.5	18.625	33.0	238.0	24.748	56.0	241.0	28.211
11.0	231.2	18.952	34.0	237.8	25.112	57.0	241.2	28.219
12.0	233.2	19.204	35.0	237.8	25.463	58.0	241.2	28.228
13.0	234.9	19.403	36.0	237.8	25.786	59.0	241.2	28.228
14.0	236.1	19.562	37.0	237.8	26.093	60.0	241.2	28.230
15.0	237.3	19.688	38.0	237.9	26.369	61.0	241.3	28.238
16.0	238.0	19.800	39.0	237.9	26.622	62.0	241.3	28.232
17.0	238.8	19.901	40.0	238.0	26.854	63.0	241.4	28.236
18.0	239.0	20.014	41.0	238.1	27.067	64.0	241.4	28.234
19.0	239.4	20.138	42.0	238.3	27.253	65.0	241.4	28.238
20.0	239.6	20.286	43.0	238.8	27.413	66.0	241.4	28.240
21.0	239.6	20.473	44.0	239.0	27.559			
22.0	239.7	20.693	45.0	239.3	27.681			

OBSERVED EXPERIMENTAL DATA FROM RUN 48

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	89.0	-.---	25.0	237.4	25.378	50.0	241.9	29.366
.5	104.8	-.---	25.5	237.3	25.611	50.5	241.9	29.366
1.0	121.9	-.---	26.0	237.3	25.843	51.0	241.9	29.369
1.5	136.6	9.741	26.5	237.1	26.066	51.5	242.0	29.373
2.0	149.0	11.071	27.0	237.1	26.284	52.0	242.0	29.373
2.5	161.6	12.240	27.5	237.1	26.494	52.5	242.0	29.376
3.0	170.0	13.223	28.0	237.1	26.697	53.0	242.0	29.378
3.5	178.5	14.205	28.5	237.1	26.890	53.5	242.0	29.377
4.0	186.0	15.030	29.0	237.1	27.072	54.0	242.0	29.378
4.5	187.1	15.767	29.5	237.2	27.258	54.5	242.0	29.378
5.0	198.0	16.419	30.0	237.3	27.423	55.0	242.0	29.381
5.5	203.1	17.002	30.5	237.3	27.585	55.5	242.0	29.383
6.0	207.4	17.519	31.0	237.5	27.737	56.0	242.0	29.383
6.5	212.0	17.975	31.5	237.7	27.880	56.5	242.0	29.386
7.0	214.8	18.379	32.0	238.0	28.014	57.0	242.0	29.382
7.5	217.7	18.739	32.5	238.0	28.143	57.5	242.0	29.387
8.0	220.4	19.056	33.0	238.1	28.267	58.0	242.0	29.388
8.5	222.8	19.343	33.5	238.3	28.370	58.5	242.0	29.388
9.0	225.1	19.589	34.0	238.7	28.475	59.0	242.0	29.390
9.5	227.0	19.808	34.5	238.8	28.570	59.5	242.0	29.390
10.0	228.9	20.000	35.0	238.9	28.658	60.0	242.0	29.390
10.5	230.0	20.178	35.5	239.1	28.736	60.5	242.0	29.389
11.0	231.4	20.329	36.0	239.5	28.811	61.0	242.0	29.390
11.5	232.9	20.465	36.5	239.5	28.875	61.5	242.0	29.390
12.0	233.8	20.585	37.0	239.7	28.935	62.0	242.0	29.391
12.5	234.5	20.698	37.5	239.9	28.989	62.5	242.0	29.391
13.0	235.2	20.793	38.0	240.0	29.036	63.0	242.0	29.394
13.5	236.0	20.887	38.5	240.2	29.080	63.5	242.0	29.395
14.0	236.9	20.974	39.0	240.3	29.115	64.0	242.0	29.395
14.5	237.1	21.068	39.5	240.5	29.147	64.5	242.0	29.395
15.0	237.8	21.160	40.0	240.8	29.181	65.0	242.0	29.396
15.5	238.1	21.264	40.5	240.9	29.206	65.5	242.0	29.398
16.0	238.5	21.379	41.0	240.9	29.233	66.0	242.0	29.398
16.5	238.5	21.512	41.5	241.0	29.249	66.5	242.0	29.400
17.0	238.5	21.664	42.0	241.1	29.267	67.0	242.0	29.400
17.5	238.5	21.827	42.5	241.1	29.280	67.5	242.0	29.400
18.0	238.6	22.014	43.0	241.2	29.287	68.0	242.1	29.400
18.5	238.6	22.212	43.5	241.4	29.307	68.5	242.1	29.400
19.0	238.6	22.425	44.0	241.5	29.314	69.0	242.1	29.400
19.5	238.6	22.653	44.5	241.5	29.323	69.5	242.1	29.400
20.0	238.6	22.887	45.0	241.5	29.329	70.0	242.1	29.400
20.5	238.5	23.125	45.5	241.5	29.336	70.5	242.1	29.400
21.0	238.4	23.374	46.0	241.5	29.338	71.0	242.1	29.401
21.5	238.2	23.627	46.5	241.5	29.348	71.5	242.1	29.402
22.0	238.0	23.876	47.0	241.6	29.350	72.0	242.1	29.403
22.5	237.8	24.132	47.5	241.7	29.353	72.5	242.1	29.402
23.0	237.7	24.389	48.0	241.9	29.359	73.0	242.1	29.404
23.5	237.7	24.638	48.5	241.9	29.362	73.5	242.1	29.402
24.0	237.7	24.885	49.0	241.9	29.361	74.0	242.1	29.402
24.5	237.4	25.124	49.5	241.9	29.365	74.5	242.1	29.402
						75.0	242.1	29.403

OBSERVED EXPERIMENTAL DATA FROM RUN 49

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	89.1	--.---	29.0	241.0	28.576	58.0	239.9	35.377
1.0	127.8	--.---	30.0	240.7	28.744	59.0	240.1	35.460
2.0	153.5	17.403	31.0	240.5	28.944	60.0	240.2	35.531
3.0	173.6	19.656	32.0	240.0	29.168	61.0	240.4	35.593
4.0	188.2	21.456	33.0	239.9	29.421	62.0	240.4	35.647
5.0	200.0	22.983	34.0	239.5	29.694	63.0	240.8	35.685
6.0	208.6	24.012	35.0	239.4	29.989	64.0	240.8	35.732
7.0	215.9	24.900	36.0	239.0	30.300	65.0	241.0	35.762
8.0	221.1	25.602	37.0	238.9	30.606	66.0	241.0	35.788
9.0	225.5	26.149	38.0	238.5	30.927	67.0	241.0	35.813
10.0	228.7	26.565	39.0	238.5	31.245	68.0	241.0	35.830
11.0	231.6	26.897	40.0	238.4	31.569	69.0	241.1	35.846
12.0	233.5	27.153	41.0	238.4	31.883	70.0	241.2	35.855
13.0	235.3	27.350	42.0	238.1	32.191	71.0	241.4	35.865
14.0	236.5	27.501	43.0	238.1	32.495	72.0	241.5	35.875
15.0	237.8	27.619	44.0	238.0	32.785	73.0	241.6	35.880
16.0	238.3	27.716	45.0	238.0	33.069	74.0	241.6	35.888
17.0	239.1	27.784	46.0	238.0	33.329	75.0	241.6	35.888
18.0	239.4	27.842	47.0	238.2	33.584	76.0	241.6	35.890
19.0	240.0	27.885	48.0	238.2	33.819	77.0	241.6	35.891
20.0	240.1	27.925	49.0	238.5	34.042	78.0	241.6	35.894
21.0	240.6	27.965	50.0	238.6	34.249	79.0	241.6	35.895
22.0	240.6	28.003	51.0	238.9	34.436	80.0	241.6	35.897
23.0	240.9	28.043	52.0	238.9	34.614	81.0	241.7	35.898
24.0	240.9	28.095	53.0	239.1	34.776	82.0	241.7	35.899
25.0	241.0	28.151	54.0	239.1	34.922	83.0	241.8	35.898
26.0	241.0	28.226	55.0	239.5	35.060	84.0	241.8	35.898
27.0	241.0	28.318	56.0	239.6	35.176	85.0	241.8	35.896
28.0	241.0	28.434	57.0	239.9	35.284	86.0	241.8	35.896

OBSERVED EXPERIMENTAL DATA FROM RUN 50

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	86.8	--.---	42.0	240.9	25.081	84.0	240.5	31.906
1.0	126.4	10.217	43.0	240.9	25.215	85.0	240.5	31.956
2.0	153.1	13.105	44.0	240.7	25.383	86.0	240.5	32.001
3.0	173.0	15.413	45.0	240.7	25.559	87.0	240.8	32.045
4.0	187.8	17.262	46.0	240.5	25.736	88.0	240.8	32.096
5.0	198.9	18.740	47.0	240.1	25.930	89.0	240.9	32.118
6.0	207.6	19.923	48.0	240.0	26.139	90.0	240.9	32.151
7.0	214.8	20.857	49.0	240.0	26.350	91.0	240.9	32.179
8.0	220.4	21.595	50.0	240.0	26.569	92.0	241.0	32.205
9.0	224.9	22.170	51.0	240.0	26.796	93.0	241.0	32.229
10.0	228.0	22.620	52.0	239.9	27.027	94.0	241.0	32.248
11.0	230.7	22.972	53.0	239.9	27.252	95.0	241.0	32.269
12.0	232.8	23.246	54.0	239.8	27.488	96.0	241.0	32.284
13.0	234.7	23.461	55.0	239.8	27.713	97.0	241.0	32.296
14.0	235.9	23.628	56.0	239.7	27.938	98.0	241.0	32.310
15.0	237.0	23.758	57.0	239.7	28.168	99.0	241.0	32.324
16.0	237.8	23.860	58.0	239.7	28.394	100.0	241.0	32.335
17.0	238.5	23.943	59.0	239.6	28.608	101.0	241.0	32.340
18.0	238.9	24.003	60.0	239.5	28.819	102.0	241.0	32.352
19.0	239.3	24.053	61.0	239.5	29.025	103.0	241.0	32.363
20.0	239.6	24.088	62.0	239.5	29.229	104.0	241.0	32.366
21.0	240.0	24.120	63.0	239.5	29.427	105.0	241.2	32.375
22.0	240.1	24.144	64.0	239.5	29.614	106.0	241.2	32.380
23.0	240.2	24.165	65.0	239.5	29.800	107.0	241.3	32.385
24.0	240.3	24.185	66.0	239.5	29.973	108.0	241.3	32.390
25.0	240.5	24.198	67.0	239.5	30.141	109.0	241.4	32.392
26.0	240.5	24.212	68.0	239.5	30.300	110.0	241.4	32.400
27.0	240.6	24.230	69.0	239.5	30.454	111.0	241.5	32.400
28.0	240.7	24.244	70.0	239.5	30.584	112.0	241.5	32.405
29.0	240.7	24.259	71.0	239.6	30.733	113.0	241.5	32.405
30.0	240.8	24.279	72.0	239.6	30.860	114.0	241.5	32.408
31.0	240.9	24.300	73.0	239.7	30.979	115.0	241.5	32.407
32.0	240.9	24.326	74.0	239.8	31.100	116.0	241.5	32.411
33.0	240.9	24.355	75.0	239.9	31.210	117.0	241.5	32.411
34.0	240.9	24.396	76.0	239.9	31.312	118.0	241.5	32.414
35.0	240.9	24.442	77.0	239.9	31.404	119.0	241.5	32.415
36.0	240.9	24.496	78.0	240.0	31.494	120.0	241.5	32.414
37.0	240.9	24.564	79.0	240.1	31.573	121.0	241.5	32.418
38.0	240.9	24.628	80.0	240.1	31.650	122.0	241.5	32.419
39.0	240.9	24.730	81.0	240.2	31.723	123.0	241.5	32.418
40.0	240.9	24.824	82.0	240.2	31.787	124.0	241.5	32.417
41.0	240.9	24.950	83.0	240.4	31.847	125.0	241.5	32.420

OBSERVED EXPERIMENTAL DATA FROM RUN 51

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	82.2	--.---	50.0	235.0	21.229	100.0	234.3	23.184
1.0	122.3	--.---	51.0	235.0	21.240	101.0	234.3	23.272
2.0	148.0	10.515	52.0	235.0	21.241	102.0	234.3	23.361
3.0	168.1	12.719	53.0	235.0	21.242	103.0	234.2	23.449
4.0	181.8	14.486	54.0	235.0	21.252	104.0	234.1	23.538
5.0	193.2	15.918	55.0	235.0	21.259	105.0	234.0	23.628
6.0	202.0	17.063	56.0	235.0	21.263	106.0	234.0	23.717
7.0	209.1	17.965	57.0	235.0	21.266	107.0	234.0	23.807
8.0	214.5	18.678	58.0	235.0	21.277	108.0	234.0	23.903
9.0	218.6	19.235	59.0	235.0	21.286	109.0	234.0	23.992
10.0	222.0	19.669	60.0	235.0	21.296	110.0	234.0	24.090
11.0	224.9	20.009	61.0	235.0	21.306	111.0	234.0	24.180
12.0	226.7	20.269	62.0	235.0	21.317	112.0	234.0	24.276
13.0	228.4	20.479	63.0	235.0	21.326	113.0	234.0	24.369
14.0	229.7	20.638	64.0	235.0	21.342	114.0	234.0	24.467
15.0	230.8	20.763	65.0	235.0	21.360	115.0	234.0	24.560
16.0	231.6	20.862	66.0	235.0	21.373	116.0	234.0	24.654
17.0	232.1	20.935	67.0	235.0	21.394	117.0	234.0	24.745
18.0	232.8	20.999	68.0	235.0	21.414	118.0	234.0	24.843
19.0	233.1	21.046	69.0	235.0	21.439	119.0	234.0	24.933
20.0	233.5	21.079	70.0	235.0	21.458	120.0	234.0	25.025
21.0	233.9	21.110	71.0	235.0	21.484	121.0	234.0	25.118
22.0	234.0	21.131	72.0	235.0	21.511	122.0	234.0	25.209
23.0	234.1	21.150	73.0	235.0	21.539	123.0	233.9	25.302
24.0	234.3	21.164	74.0	235.0	21.569	124.0	233.9	25.392
25.0	234.5	21.176	75.0	235.0	21.604	125.0	233.9	25.484
26.0	234.6	21.185	76.0	235.0	21.641	126.0	233.9	25.569
27.0	234.7	21.193	77.0	235.0	21.680	127.0	233.9	25.656
28.0	234.8	21.198	78.0	235.0	21.718	128.0	233.9	25.742
29.0	234.9	21.203	79.0	235.0	21.765	129.0	233.9	25.831
30.0	234.9	21.206	80.0	235.0	21.808	130.0	233.9	25.915
31.0	234.9	21.208	81.0	234.9	21.857	131.0	233.9	26.000
32.0	234.9	21.208	82.0	234.8	21.909	132.0	233.9	26.086
33.0	234.9	21.211	83.0	234.7	21.960	133.0	233.9	26.169
34.0	234.9	21.214	84.0	234.7	22.019	134.0	233.9	26.254
35.0	234.9	21.215	85.0	234.6	22.076	135.0	233.9	26.334
36.0	235.0	21.215	86.0	234.6	22.139	136.0	233.9	26.414
37.0	235.0	21.216	87.0	234.6	22.200	137.0	233.9	26.496
38.0	235.0	21.219	88.0	234.6	22.266	138.0	233.9	26.572
39.0	235.0	21.217	89.0	234.5	22.336	139.0	233.9	26.650
40.0	235.0	21.219	90.0	234.5	22.407	140.0	233.9	26.729
41.0	235.0	21.219	91.0	234.5	22.470	141.0	233.9	26.801
42.0	235.0	21.219	92.0	234.5	22.548	142.0	233.9	26.874
43.0	235.0	21.220	93.0	234.5	22.620	143.0	233.9	26.950
44.0	235.0	21.219	94.0	234.5	22.697	144.0	233.9	27.020
45.0	235.0	21.222	95.0	234.5	22.777	145.0	233.9	27.088
46.0	235.0	21.225	96.0	234.5	22.856	146.0	233.9	27.157
47.0	235.0	21.230	97.0	234.4	22.934	147.0	233.9	27.223
48.0	235.0	21.229	98.0	234.4	23.019	148.0	233.9	27.290
49.0	235.0	21.229	99.0	234.3	23.103	149.0	233.9	27.353

OBSERVED EXPERIMENTAL DATA FROM RUN 51 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
150.0	233.9	27.434	192.0	234.0	29.040	234.0	234.4	29.363
151.0	233.9	27.486	193.0	234.0	29.056	235.0	234.4	29.364
152.0	233.9	27.544	194.0	234.0	29.074	236.0	234.4	29.367
153.0	233.9	27.605	195.0	234.0	29.091	237.0	234.4	29.365
154.0	233.9	27.662	196.0	234.0	29.104	238.0	234.4	29.267
155.0	233.9	27.720	197.0	234.0	29.121	239.0	234.4	29.269
156.0	233.9	27.775	198.0	234.0	29.135	240.0	234.4	29.369
157.0	233.9	27.832	199.0	234.1	29.152	241.0	234.4	29.373
158.0	233.9	27.885	200.0	234.1	29.162	242.0	234.4	29.373
159.0	233.9	27.938	201.0	234.1	29.175	243.0	234.4	29.378
160.0	233.9	27.991	202.0	234.1	29.188	244.0	234.4	29.379
161.0	233.9	28.040	203.0	234.2	29.199	245.0	234.5	29.379
162.0	233.9	28.090	204.0	234.2	29.211	246.0	234.5	29.378
163.0	233.9	28.138	205.0	234.2	29.217	247.0	234.5	29.380
164.0	233.9	28.184	206.0	234.2	29.228	248.0	234.5	29.383
165.0	233.9	28.229	207.0	234.3	29.239	249.0	234.5	29.382
166.0	233.9	28.273	208.0	234.3	29.247	250.0	234.5	29.380
167.0	233.9	28.315	209.0	234.3	29.257	251.0	234.5	29.384
168.0	233.9	28.357	210.0	234.3	29.266	252.0	234.5	29.386
169.0	233.9	28.399	211.0	234.3	29.273	253.0	234.5	29.387
170.0	233.9	28.436	212.0	234.3	29.279	254.0	234.5	29.384
171.0	233.9	28.477	213.0	234.3	29.285	255.0	234.5	29.386
172.0	233.9	28.504	214.0	234.3	29.294	256.0	234.5	29.382
173.0	233.9	28.548	215.0	234.4	29.302	257.0	234.5	29.384
174.0	233.9	28.583	216.0	234.4	29.309	258.0	234.5	29.382
175.0	233.9	28.614	217.0	234.4	29.313	259.0	234.5	29.382
176.0	233.9	28.644	218.0	234.4	29.317	260.0	234.5	29.387
177.0	233.9	28.677	219.0	234.4	29.318	261.0	234.5	29.386
178.0	233.9	28.712	220.0	234.4	29.322	262.0	234.5	29.386
179.0	233.9	28.740	221.0	234.4	29.328	263.0	234.5	29.383
180.0	233.9	28.769	222.0	234.4	29.330	264.0	234.5	29.386
181.0	233.9	28.796	223.0	234.4	29.332	265.0	234.5	29.384
182.0	233.9	28.820	224.0	234.4	29.337	266.0	234.5	29.384
183.0	234.0	28.846	225.0	234.4	29.340	267.0	234.5	29.382
184.0	234.0	28.870	226.0	234.4	29.343	268.0	234.5	29.383
185.0	234.0	28.895	227.0	234.4	29.346	269.0	234.5	29.383
186.0	234.0	28.917	228.0	234.4	29.349	270.0	234.5	29.385
187.0	234.0	28.940	229.0	234.4	29.348	271.0	234.5	29.386
188.0	234.0	28.960	230.0	234.4	29.357	272.0	234.5	29.385
189.0	234.0	28.981	231.0	234.4	29.258	273.0	234.5	29.384
190.0	234.0	29.003	232.0	234.4	29.358	274.0	234.5	29.386
191.0	234.0	29.020	233.0	234.4	29.360	275.0	235.0	29.385

OBSERVED EXPERIMENTAL DATA FROM RUN 52

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	80.0	-.---	50.0	234.9	19.426	100.0	234.0	24.165
1.0	117.0	5.005	51.0	234.9	19.501	101.0	234.0	24.240
2.0	143.6	7.712	52.0	234.9	19.580	102.0	234.0	24.313
3.0	163.9	9.914	53.0	234.9	19.660	103.0	234.0	24.387
4.0	179.5	11.706	54.0	234.7	19.745	104.0	234.0	24.456
5.0	191.3	13.150	55.0	234.7	19.830	105.0	234.0	24.526
6.0	200.4	14.305	56.0	234.5	19.920	106.0	234.0	24.595
7.0	207.6	15.228	57.0	234.5	20.010	107.0	234.0	24.663
8.0	213.2	15.958	58.0	234.5	20.104	108.0	234.0	24.728
9.0	217.8	16.527	59.0	234.5	20.197	109.0	234.0	24.796
10.0	221.3	16.978	60.0	234.5	20.293	110.0	234.0	24.859
11.0	224.1	17.325	61.0	234.5	20.390	111.0	234.0	24.918
12.0	226.1	17.600	62.0	234.5	20.482	112.0	234.0	24.979
13.0	228.0	17.818	63.0	234.5	20.589	113.0	234.0	25.036
14.0	229.4	17.985	64.0	234.5	20.693	114.0	234.0	25.092
15.0	230.7	18.118	65.0	234.4	20.794	115.0	234.0	25.155
16.0	231.4	18.220	66.0	234.3	20.896	116.0	234.0	25.200
17.0	232.0	18.300	67.0	234.2	21.001	117.0	234.0	25.251
18.0	232.7	18.364	68.0	234.2	21.108	118.0	234.0	25.301
19.0	233.1	18.415	69.0	234.2	21.211	119.0	234.0	25.358
20.0	233.5	18.454	70.0	234.2	21.317	120.0	234.0	25.402
21.0	233.9	18.483	71.0	234.2	21.421	121.0	234.0	25.450
22.0	234.0	18.510	72.0	234.1	21.526	122.0	234.0	25.495
23.0	234.1	18.530	73.0	234.1	21.630	123.0	234.0	25.542
24.0	234.2	18.550	74.0	234.1	21.739	124.0	234.0	25.587
25.0	234.4	18.563	75.0	234.0	21.840	125.0	234.0	25.627
26.0	234.5	18.578	76.0	234.0	21.943	126.0	234.0	25.663
27.0	234.7	18.590	77.0	234.0	22.049	127.0	234.0	25.703
28.0	234.8	18.601	78.0	234.0	22.149	128.0	234.0	25.741
29.0	234.9	18.613	79.0	234.0	22.253	129.0	234.0	25.777
30.0	234.9	18.630	80.0	234.0	22.354	130.0	234.0	25.819
31.0	234.9	18.642	81.0	234.0	22.458	131.0	234.0	25.857
32.0	234.9	18.660	82.0	234.0	22.557	132.0	234.0	25.891
33.0	234.9	18.680	83.0	234.0	22.657	133.0	234.0	25.923
34.0	234.9	18.701	84.0	234.0	22.757	134.0	234.0	25.952
35.0	234.9	18.724	85.0	234.0	22.849	135.0	234.0	25.982
36.0	234.9	18.747	86.0	234.0	22.949	136.0	234.0	26.015
37.0	234.9	18.775	87.0	234.0	23.044	137.0	234.1	26.042
38.0	234.9	18.807	88.0	234.0	23.137	138.0	234.1	26.071
39.0	234.9	18.840	89.0	234.0	23.231	139.0	234.1	26.096
40.0	234.9	18.865	90.0	234.0	23.321	140.0	234.1	26.122
41.0	234.9	18.915	91.0	234.0	23.415	141.0	234.3	26.148
42.0	234.9	18.957	92.0	234.0	23.503	142.0	234.3	26.176
43.0	234.9	19.004	93.0	234.0	23.589	143.0	234.3	26.202
44.0	234.9	19.050	94.0	234.0	23.675	144.0	234.3	26.226
45.0	234.9	19.106	95.0	234.0	23.760	145.0	234.3	26.248
46.0	234.9	19.164	96.0	234.0	23.847	146.0	234.4	26.269
47.0	234.9	19.223	97.0	234.0	23.929	147.0	234.4	26.289
48.0	234.9	19.287	98.0	234.0	24.006	148.0	234.4	26.310
49.0	234.9	19.357	99.0	234.0	24.084	149.0	234.4	26.329

OBSERVED EXPERIMENTAL DATA FROM RUN 52 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
150.0	234.4	26.348	176.0	234.7	26.647	202.0	234.8	26.745
151.0	234.4	26.366	177.0	234.7	26.650	203.0	234.8	26.749
152.0	234.4	26.384	178.0	234.7	26.657	204.0	234.8	26.750
153.0	234.4	26.398	179.0	234.7	26.663	205.0	234.8	26.750
154.0	234.4	26.415	180.0	234.7	26.669	206.0	234.8	26.752
155.0	234.4	26.430	181.0	234.7	26.673	207.0	234.8	26.752
156.0	234.4	26.445	182.0	234.7	26.676	208.0	234.8	26.760
157.0	234.4	26.458	183.0	234.7	26.681	209.0	234.8	26.755
158.0	234.4	26.472	184.0	234.7	26.684	210.0	234.8	26.759
159.0	234.4	26.486	185.0	234.7	26.690	211.0	234.8	26.759
160.0	234.5	26.500	186.0	234.8	26.696	212.0	234.8	26.757
161.0	234.5	26.514	187.0	234.8	26.705	213.0	234.8	26.762
162.0	234.5	26.523	188.0	234.8	26.707	214.0	234.8	26.762
163.0	234.5	26.535	189.0	234.8	26.706	215.0	234.8	26.763
164.0	234.5	26.548	190.0	234.8	26.711	216.0	234.8	26.764
165.0	234.5	26.558	191.0	234.8	26.715	217.0	234.8	26.766
166.0	234.5	26.568	192.0	234.8	26.716	218.0	234.8	26.768
167.0	234.5	26.580	193.0	234.8	26.719	219.0	234.8	26.769
168.0	234.5	26.588	194.0	234.8	26.723	220.0	234.8	26.768
169.0	234.5	26.594	195.0	234.8	26.724	221.0	234.8	26.769
170.0	234.5	26.602	196.0	234.8	26.728	222.0	234.8	26.769
171.0	234.5	26.611	197.0	234.8	26.734	223.0	234.8	26.768
172.0	234.5	26.619	198.0	234.8	26.732	224.0	234.8	26.766
173.0	234.7	26.625	199.0	234.8	26.738	225.0	234.9	26.765
174.0	234.7	26.635	200.0	234.8	26.746			
175.0	234.7	26.643	201.0	234.8	26.741			

OBSERVED EXPERIMENTAL DATA FROM RUN 53

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	76.4	--.---	50.0	230.1	24.673	100.0	230.1	26.712
1.0	116.0	11.339	51.0	230.1	24.690	101.0	230.1	26.765
2.0	142.9	14.027	52.0	230.1	24.709	102.0	230.1	26.822
3.0	162.2	16.184	53.0	230.1	24.729	103.0	230.1	26.880
4.0	177.1	17.921	54.0	230.1	24.745	104.0	230.1	26.934
5.0	188.4	19.283	55.0	230.1	24.764	105.0	230.1	26.993
6.0	196.9	20.363	56.0	230.1	24.788	106.0	230.1	27.050
7.0	203.8	21.210	57.0	230.1	24.808	107.0	230.1	27.106
8.0	208.6	21.874	58.0	230.1	24.823	108.0	230.1	27.166
9.0	212.8	22.384	59.0	230.1	24.859	109.0	230.1	27.221
10.0	215.8	22.777	60.0	230.1	24.887	110.0	230.1	27.275
11.0	218.9	22.928	61.0	230.1	24.911	111.0	230.1	27.338
12.0	221.1	23.273	62.0	230.1	24.940	112.0	230.1	27.392
13.0	222.9	23.537	63.0	230.1	24.973	113.0	230.1	27.449
14.0	224.1	23.750	64.0	230.1	25.000	114.0	230.1	27.505
15.0	225.2	23.918	65.0	230.1	25.033	115.00	230.1	27.561
16.0	226.1	24.053	66.0	230.1	25.067	116.0	230.1	27.616
17.0	227.0	24.153	67.0	230.1	25.103	117.0	230.1	27.676
18.0	227.6	24.233	68.0	230.1	25.139	118.0	230.1	27.730
19.0	228.0	24.291	69.0	230.1	25.175	119.0	230.1	27.790
20.0	228.2	24.343	70.0	230.1	25.214	120.0	230.1	27.842
21.0	228.8	24.382	71.0	230.1	25.258	121.0	230.1	27.899
22.0	229.0	24.403	72.0	230.1	25.298	122.0	230.1	27.954
23.0	229.2	24.435	73.0	230.1	25.334	123.0	230.1	28.012
24.0	229.3	24.458	74.0	230.1	25.378	124.0	230.1	28.063
25.0	229.5	24.467	75.0	230.1	25.419	125.0	230.1	28.117
26.0	229.8	24.485	76.0	230.1	25.466	126.0	230.1	28.173
27.0	229.9	24.492	77.0	230.1	25.513	127.0	230.1	28.224
28.0	229.9	24.500	78.0	230.1	25.560	128.0	230.1	28.278
29.0	230.0	24.505	79.0	230.1	25.600	129.0	230.1	28.330
30.0	230.0	24.511	80.0	230.1	25.653	130.0	230.1	28.382
31.0	230.0	24.518	81.0	230.1	25.702	131.0	230.1	28.434
32.0	230.0	24.524	82.0	230.1	25.749	132.0	230.1	28.483
33.0	230.0	24.528	83.0	230.1	25.799	133.0	230.1	28.539
34.0	230.0	24.532	84.0	230.1	25.847	134.0	230.1	28.593
35.0	230.0	24.534	85.0	230.1	25.899	135.0	230.1	28.646
36.0	230.0	24.542	86.0	230.1	25.951	136.0	230.1	28.693
37.0	230.0	24.546	87.0	230.1	26.007	137.0	230.1	28.746
38.0	230.0	24.555	88.0	230.1	26.057	138.0	230.1	28.798
39.0	230.0	24.560	89.0	230.1	26.105	139.0	230.1	28.851
40.0	230.0	24.569	90.0	230.1	26.159	140.0	230.1	28.900
41.0	230.0	24.573	91.0	230.1	26.217	141.0	230.1	28.950
42.0	230.0	24.581	92.0	230.1	26.270	142.0	230.1	28.993
43.0	230.0	24.593	93.0	230.1	26.318	143.0	230.0	29.044
44.0	230.0	24.600	94.0	230.1	26.376	144.0	230.0	29.094
45.0	230.1	24.611	95.0	230.1	26.429	145.0	230.0	29.140
46.0	230.1	24.622	96.0	230.1	26.487	146.0	230.0	29.188
47.0	230.1	24.634	97.0	230.1	26.544	147.0	230.0	29.230
48.0	230.1	24.648	98.0	230.1	26.603	148.0	230.0	29.280
49.0	230.1	24.660	99.0	230.1	26.657	149.0	230.0	29.326

OBSERVED EXPERIMENTAL DATA FROM RUN 53 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
150.0	230.0	29.371	200.0	229.9	31.147	250.0	229.9	31.993
151.0	230.0	29.418	201.0	229.9	31.175	251.0	229.9	32.007
152.0	230.0	29.465	202.0	229.9	31.200	252.0	229.9	32.016
153.0	230.0	29.509	203.0	229.9	31.225	253.0	229.9	32.026
154.0	230.0	29.553	204.0	229.9	31.250	254.0	229.9	32.037
155.0	230.0	29.591	205.0	229.9	31.275	255.0	229.9	32.045
156.0	230.0	29.639	206.0	229.9	31.300	256.0	229.9	32.055
157.0	230.0	29.677	207.0	229.9	31.322	257.0	229.9	32.062
158.0	230.0	29.722	208.0	229.9	31.340	258.0	229.9	32.072
159.0	230.0	29.766	209.0	229.9	31.366	259.0	229.9	32.081
160.0	230.0	29.808	210.0	229.9	31.388	260.0	229.9	32.089
161.0	229.9	29.850	211.0	229.9	31.410	261.0	229.9	32.095
162.0	229.9	29.893	212.0	229.9	31.430	262.0	229.9	32.103
163.0	229.9	29.934	213.0	229.9	31.450	263.0	230.0	32.113
164.0	229.9	29.973	214.0	229.9	31.469	264.0	230.0	32.121
165.0	229.9	30.014	215.0	229.9	31.490	265.0	230.0	32.129
166.0	229.9	30.056	216.0	229.9	31.510	266.0	230.0	32.135
167.0	229.9	30.093	217.0	229.9	31.529	267.0	230.0	32.142
168.0	229.9	30.130	218.0	229.9	31.548	268.0	230.0	32.150
169.0	229.9	30.172	219.0	229.9	31.565	269.0	230.0	32.158
170.0	229.9	30.210	220.0	229.9	31.583	270.0	230.0	32.164
171.0	229.9	30.245	221.0	229.9	31.601	271.0	230.0	32.172
172.0	229.9	30.281	222.0	229.9	31.618	272.0	230.0	32.178
173.0	229.9	30.318	223.0	229.9	31.636	273.0	230.0	32.186
174.0	229.9	30.358	224.0	229.9	31.655	274.0	230.0	32.189
175.0	229.9	30.395	225.0	229.9	31.671	275.0	230.0	32.196
176.0	229.9	30.431	226.0	229.9	31.687	276.0	230.0	32.201
177.0	229.9	30.466	227.0	229.9	31.703	277.0	230.0	32.204
178.0	229.9	30.502	228.0	229.9	31.720	278.0	230.0	32.210
179.0	229.9	30.536	229.0	229.9	31.735	279.0	230.0	32.213
180.0	229.9	30.570	230.0	229.9	31.748	280.0	230.0	32.218
181.0	229.9	30.601	231.0	229.9	31.765	281.0	230.0	32.225
182.0	229.9	30.630	232.0	229.9	31.775	282.0	230.0	32.232
183.0	229.9	30.664	233.0	229.9	31.797	283.0	230.0	32.236
184.0	229.9	30.697	234.0	229.9	31.806	284.0	230.0	32.239
185.0	229.9	30.725	235.0	229.9	31.823	285.0	230.0	32.243
186.0	229.9	30.759	236.0	229.9	31.835	286.0	230.0	32.247
187.0	229.9	30.792	237.0	229.9	31.850	287.0	230.0	32.253
188.0	229.9	30.820	238.0	229.9	31.863	288.0	230.0	32.255
189.0	229.9	30.850	239.0	229.9	31.874	289.0	230.0	32.261
190.0	229.9	30.882	240.0	229.9	31.890	290.0	230.0	32.265
191.0	229.9	30.910	241.0	229.9	31.900	291.0	230.0	32.267
192.0	229.9	30.934	242.0	229.9	31.905	292.0	230.0	32.270
193.0	229.9	30.959	243.0	229.9	31.918	293.0	230.0	32.274
194.0	229.9	30.988	244.0	229.9	31.929	294.0	230.0	32.276
195.0	229.9	31.017	245.0	229.9	31.939	295.0	230.0	32.279
196.0	229.9	31.042	246.0	229.9	31.950	296.0	230.0	32.281
197.0	229.9	31.070	247.0	229.9	31.965	297.0	230.0	32.284
198.0	229.9	31.095	248.0	229.9	31.970	298.0	230.0	32.285
199.0	229.9	31.123	249.0	229.9	31.986	299.0	230.0	32.288

OBSERVED EXPERIMENTAL DATA FROM RUN 53 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
300.0	230.0	32.288	319.0	230.0	32.337	338.0	230.0	32.360
301.0	230.0	32.293	320.0	230.0	32.339	339.0	230.0	32.361
302.0	230.0	32.293	321.0	230.0	32.341	340.0	230.0	32.362
303.0	230.0	32.298	322.0	230.0	32.343	341.0	230.0	32.364
304.0	230.0	32.301	323.0	230.0	32.343	342.0	230.0	32.365
305.0	230.0	32.303	324.0	230.0	32.347	343.0	230.0	32.365
306.0	230.0	32.307	325.0	230.0	32.347	344.0	230.0	32.366
307.0	230.0	32.309	326.0	230.0	32.348	345.0	230.0	32.370
308.0	230.0	32.313	327.0	230.0	32.351	346.0	230.0	32.368
309.0	230.0	32.315	328.0	230.0	32.354	347.0	230.0	32.370
310.0	230.0	32.316	329.0	230.0	32.358	348.0	230.0	32.371
311.0	230.0	32.319	330.0	230.0	32.355	349.0	230.0	32.372
312.0	230.0	32.323	331.0	230.0	32.355	350.0	230.1	32.373
313.0	230.0	32.327	332.0	230.0	32.355	351.0	230.1	32.373
314.0	230.0	32.328	333.0	230.0	32.357	352.0	230.1	32.373
315.0	230.0	32.330	334.0	230.0	32.359	353.0	230.1	32.373
316.0	230.0	32.333	335.0	230.0	32.358	354.0	230.1	32.373
317.0	230.0	32.334	336.0	230.0	32.359			
318.0	230.0	32.335	337.0	230.0	32.360			

OBSERVED EXPERIMENTAL DATA FROM RUN 54

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	82.0	-.---	50.0	229.8	20.360	100.0	230.0	20.415
1.0	118.1	7.484	51.0	229.8	20.360	101.0	230.0	20.415
2.0	143.1	10.037	52.0	229.8	20.360	102.0	230.0	20.419
3.0	163.1	12.139	53.0	229.8	20.360	103.0	230.0	20.424
4.0	177.0	13.834	54.0	229.8	20.366	104.0	230.0	20.427
5.0	187.9	15.200	55.0	229.8	20.365	105.0	230.0	20.432
6.0	196.8	16.295	56.0	229.8	20.361	106.0	230.0	20.439
7.0	203.5	17.160	57.0	229.8	20.363	107.0	230.0	20.444
8.0	208.8	17.846	58.0	229.9	20.367	108.0	230.0	20.450
9.0	213.1	18.385	59.0	229.8	20.366	109.0	230.0	20.455
10.0	216.7	18.815	60.0	229.9	20.363	110.0	230.0	20.460
11.0	219.1	19.143	61.0	229.8	20.364	111.0	230.0	20.465
12.0	221.4	19.406	62.0	229.9	20.363	112.0	230.0	20.473
13.0	223.0	19.611	63.0	229.8	20.366	113.0	230.0	20.479
14.0	224.4	19.771	64.0	229.9	20.367	114.0	230.0	20.487
15.0	225.2	19.897	65.0	229.9	20.368	115.0	230.0	20.494
16.0	226.3	19.993	66.0	229.9	20.365	116.0	230.0	20.500
17.0	227.0	20.077	67.0	229.9	20.367	117.0	230.0	20.509
18.0	227.6	20.136	68.0	229.9	20.368	118.0	230.0	20.517
19.0	227.8	20.186	69.0	229.8	20.366	119.0	230.0	20.523
20.0	228.1	20.203	70.0	229.9	20.368	120.0	230.0	20.533
21.0	228.2	20.253	71.0	229.9	20.365	121.0	230.0	20.543
22.0	228.8	20.274	72.0	229.9	20.366	122.0	230.0	20.552
23.0	228.9	20.294	73.0	229.9	20.366	123.0	230.0	20.564
24.0	229.1	20.307	74.0	229.9	20.369	124.0	230.0	20.573
25.0	229.1	20.320	75.0	229.9	20.370	125.0	230.0	20.585
26.0	229.3	20.330	76.0	229.9	20.374	126.0	230.0	20.590
27.0	229.2	20.335	77.0	229.9	20.377	127.0	230.0	20.600
28.0	229.3	20.335	78.0	229.9	20.378	128.0	230.0	20.614
29.0	229.4	20.344	79.0	229.8	20.382	129.0	230.0	20.629
30.0	229.6	20.348	80.0	229.9	20.383	130.0	230.0	20.641
31.0	229.6	20.353	81.0	229.8	20.380	131.0	230.0	20.655
32.0	229.6	20.359	82.0	229.9	20.385	132.0	230.0	20.669
33.0	229.6	20.361	83.0	229.9	20.383	133.0	230.0	20.683
34.0	229.7	20.365	84.0	229.9	20.387	134.0	230.0	20.700
35.0	229.6	20.366	85.0	229.8	20.386	135.0	230.0	20.715
36.0	229.7	20.360	86.0	229.9	20.385	136.0	230.0	20.732
37.0	229.7	20.360	87.0	229.9	20.386	137.0	230.0	20.751
38.0	229.8	20.360	88.0	229.9	20.386	138.0	230.0	20.768
39.0	229.8	20.363	89.0	229.9	20.392	139.0	230.0	20.786
40.0	229.9	20.362	90.0	229.9	20.395	140.0	230.0	20.803
41.0	229.9	20.362	91.0	229.9	20.395	141.0	230.0	20.824
42.0	229.9	20.366	92.0	230.0	20.395	142.0	230.0	20.843
43.0	229.9	20.365	93.0	230.0	20.400	143.0	230.0	20.863
44.0	229.8	20.360	94.0	230.0	20.401	144.0	230.0	20.886
45.0	229.8	20.365	95.0	230.0	20.403	145.0	230.0	20.905
46.0	229.8	20.360	96.0	230.0	20.407	146.0	230.0	20.928
47.0	229.8	20.362	97.0	230.0	20.404	147.0	230.0	20.949
48.0	229.8	20.360	98.0	230.0	20.409	148.0	230.0	20.978
49.0	229.8	20.360	99.0	230.0	20.410	149.0	230.0	20.998

OBSERVED EXPERIMENTAL DATA FROM RUN 54 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
150.0	230.0	21.021	200.0	230.0	22.631	250.0	230.0	24.460
151.0	230.0	21.052	201.0	230.0	22.666	251.0	229.9	24.497
152.0	230.0	21.074	202.0	230.0	22.704	252.0	230.0	24.533
153.0	230.0	21.091	203.0	230.0	22.739	253.0	229.9	24.572
154.0	230.0	21.113	204.0	230.0	22.779	254.0	230.0	24.602
155.0	230.0	21.144	205.0	230.0	22.810	255.0	229.9	24.643
156.0	230.0	21.170	206.0	230.0	22.846	256.0	230.0	24.680
157.0	230.0	21.199	207.0	230.0	22.881	257.0	229.9	24.720
158.0	230.0	21.230	208.0	230.0	22.919	258.0	230.0	24.756
159.0	230.0	21.256	209.0	230.0	22.956	259.0	229.9	24.792
160.0	230.0	21.285	210.0	230.0	22.993	260.0	230.0	24.827
161.0	230.0	21.312	211.0	230.0	23.029	261.0	229.9	24.868
162.0	230.0	21.341	212.0	230.0	23.067	262.0	230.0	24.903
163.0	230.0	21.372	213.0	230.0	23.101	263.0	229.9	24.935
164.0	230.0	21.400	214.0	230.0	23.139	264.0	230.0	24.971
165.0	230.0	21.432	215.0	229.9	23.176	265.0	229.9	25.016
166.0	230.0	21.460	216.0	230.0	23.211	266.0	230.0	25.044
167.0	230.0	21.490	217.0	229.9	23.250	267.0	229.9	25.081
168.0	230.0	21.524	218.0	230.0	23.284	268.0	230.0	25.118
169.0	230.0	21.556	219.0	229.9	23.318	269.0	229.9	25.156
170.0	230.0	21.593	220.0	230.0	23.358	270.0	230.0	25.191
171.0	230.0	21.620	221.0	229.9	23.395	271.0	229.9	25.224
172.0	230.0	21.659	222.0	230.0	23.430	272.0	230.0	25.263
173.0	230.0	21.691	223.0	229.9	23.464	273.0	229.9	25.297
174.0	230.0	21.721	224.0	230.0	23.500	274.0	230.0	25.335
175.0	230.0	21.759	225.0	229.9	23.533	275.0	229.9	25.369
176.0	230.0	21.790	226.0	230.0	23.572	276.0	230.0	25.405
177.0	230.0	21.823	227.0	229.9	23.606	277.0	229.9	25.436
178.0	230.0	21.857	228.0	230.0	23.644	278.0	230.0	25.470
179.0	230.0	21.890	229.0	229.9	23.683	279.0	229.9	25.506
180.0	230.0	21.923	230.0	230.0	23.718	280.0	230.0	25.538
181.0	230.0	21.956	231.0	229.9	23.759	281.0	229.9	25.574
182.0	230.0	21.987	232.0	230.0	23.797	282.0	230.0	25.607
183.0	229.9	22.022	233.0	229.9	23.830	283.0	229.9	25.640
184.0	230.0	22.060	234.0	230.0	23.865	284.0	230.0	25.673
185.0	229.9	22.095	235.0	229.9	23.903	285.0	229.9	25.710
186.0	230.0	22.127	236.0	230.0	23.938	286.0	230.0	25.743
187.0	230.0	22.161	237.0	229.9	23.976	287.0	229.9	25.775
188.0	230.0	22.200	238.0	230.0	24.016	288.0	230.0	25.810
189.0	229.9	22.230	239.0	229.9	24.054	289.0	229.9	25.845
190.0	230.0	22.271	240.0	230.0	24.090	290.0	230.0	25.872
191.0	230.0	22.303	241.0	229.9	24.124	291.0	229.9	25.904
192.0	230.0	22.340	242.0	230.0	24.163	292.0	230.0	25.931
193.0	230.0	22.374	243.0	229.9	24.199	293.0	229.9	25.967
194.0	230.0	22.410	244.0	230.0	24.237	294.0	230.0	26.003
195.0	229.9	22.451	245.0	229.9	24.273	295.0	229.9	26.031
196.0	230.0	22.488	246.0	230.0	24.310	296.0	230.0	26.062
197.0	230.0	22.518	247.0	229.9	24.345	297.0	229.9	26.093
198.0	230.0	22.557	248.0	230.0	24.384	298.0	230.0	26.124
199.0	230.0	22.582	249.0	229.9	24.419	299.0	229.9	26.152

OBSERVED EXPERIMENTAL DATA FROM RUN 54 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
300.0	230.0	26.186	350.0	230.0	27.424	400.0	230.1	28.091
301.0	229.9	26.217	351.0	230.0	27.444	401.0	230.1	28.100
302.0	230.0	26.246	352.0	230.0	27.467	402.0	230.1	28.107
303.0	229.9	26.276	353.0	230.0	27.485	403.0	230.1	28.116
304.0	230.0	26.305	354.0	230.0	27.500	404.0	230.1	28.123
305.0	229.9	26.333	355.0	230.0	27.520	405.0	230.1	28.131
306.0	230.0	26.363	356.0	230.0	27.542	406.0	230.1	28.139
307.0	229.9	26.393	357.0	230.0	27.559	407.0	230.1	28.149
308.0	230.0	26.422	358.0	230.0	27.574	408.0	230.1	28.157
309.0	229.9	26.450	359.0	229.9	27.586	409.0	230.1	28.159
310.0	230.0	26.483	360.0	230.0	27.602	410.0	230.1	28.164
311.0	229.9	26.507	361.0	229.9	27.615	411.0	230.1	28.172
312.0	230.0	26.537	362.0	230.0	27.633	412.0	230.1	28.178
313.0	229.9	26.563	363.0	230.0	27.650	413.0	230.1	28.183
314.0	230.0	26.593	364.0	230.0	27.663	414.0	230.1	28.191
315.0	229.9	26.618	365.0	229.9	27.678	415.0	230.1	28.198
316.0	230.0	26.649	366.0	230.0	27.695	416.0	230.1	28.205
317.0	229.9	26.679	367.0	229.9	27.711	417.0	230.1	28.211
318.0	230.0	26.701	368.0	230.0	27.728	418.0	230.1	28.218
319.0	229.9	26.729	369.0	229.9	27.743	419.0	230.1	28.225
320.0	230.0	26.756	370.0	230.0	27.755	420.0	230.1	28.229
321.0	229.9	26.781	371.0	230.0	27.770	421.0	230.1	28.238
322.0	230.0	26.804	372.0	230.0	27.783	422.0	230.1	28.243
323.0	229.9	26.833	373.0	230.0	27.796	423.0	230.1	28.247
324.0	230.0	26.859	374.0	230.0	27.811	424.0	230.1	28.253
325.0	229.9	26.883	375.0	230.0	27.826	425.0	230.1	28.261
326.0	230.0	26.909	376.0	230.0	27.838	426.0	230.1	28.264
327.0	229.9	26.934	377.0	230.0	27.852	427.0	230.1	28.270
328.0	230.0	26.959	378.0	230.0	27.865	428.0	230.1	28.278
329.0	229.9	26.987	379.0	230.0	27.874	429.0	230.1	28.283
330.0	230.0	27.007	380.0	230.0	27.886	430.0	230.1	28.287
331.0	229.9	27.030	381.0	230.0	27.900	431.0	230.1	28.290
332.0	230.0	27.055	382.0	230.0	27.912	432.0	230.1	28.295
333.0	229.9	27.077	383.0	230.0	27.922	433.0	230.1	28.301
334.0	230.0	27.096	384.0	230.0	27.932	434.0	230.1	28.305
335.0	229.9	27.119	385.0	230.0	27.949	435.0	230.1	28.307
336.0	230.0	27.143	386.0	230.1	27.959	436.0	230.1	28.310
337.0	230.0	27.164	387.0	230.1	27.969	437.0	230.1	28.316
338.0	230.0	27.185	388.0	230.1	27.984	438.0	230.1	28.318
339.0	230.0	27.204	389.0	230.1	27.992	439.0	230.1	28.325
340.0	230.0	27.224	390.0	230.1	28.005	440.0	230.1	28.326
341.0	230.0	27.247	391.0	230.1	28.016	441.0	230.1	28.330
342.0	230.0	27.267	392.0	230.1	28.022	442.0	230.1	28.335
343.0	229.9	27.288	393.0	230.1	28.032	443.0	230.1	28.338
344.0	230.0	27.308	394.0	230.1	28.042	444.0	230.1	28.340
345.0	230.0	27.328	395.0	230.1	28.050	445.0	230.1	28.344
346.0	230.0	27.348	396.0	230.1	28.059	446.0	230.1	28.347
347.0	229.9	27.368	397.0	230.1	28.068	447.0	230.1	28.348
348.0	230.0	27.388	398.0	230.1	28.077	448.0	230.1	28.349
349.0	229.9	27.408	399.0	230.1	28.085	449.0	230.1	28.353

OBSERVED EXPERIMENTAL DATA FROM RUN 54 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
450.0	230.1	28.359	476.0	230.1	28.420	502.0	230.1	28.451
451.0	230.1	28.363	477.0	230.1	28.422	503.0	230.1	28.452
452.0	230.1	28.366	478.0	230.1	28.422	504.0	230.1	28.454
453.0	230.1	28.369	479.0	230.1	28.424	505.0	230.1	28.455
454.0	230.1	28.373	480.0	230.1	28.427	506.0	230.1	28.456
455.0	230.1	28.375	481.0	230.1	28.427	507.0	230.1	28.456
456.0	230.1	28.378	482.0	230.1	28.429	508.0	230.1	28.458
457.0	230.1	28.379	483.0	230.1	28.430	509.0	230.1	28.459
458.0	230.1	28.382	484.0	230.1	28.432	510.0	230.1	28.459
459.0	230.1	28.385	485.0	230.1	28.436	511.0	230.1	28.460
460.0	230.1	28.387	486.0	230.1	28.436	512.0	230.1	28.464
461.0	230.1	28.390	487.0	230.1	28.437	513.0	230.1	28.466
462.0	230.1	28.393	488.0	230.1	28.438	514.0	230.1	28.467
463.0	230.1	28.395	489.0	230.1	28.438	515.0	230.1	28.467
464.0	230.1	28.397	490.0	230.1	28.440	516.0	230.1	28.468
465.0	230.1	28.398	491.0	230.1	28.442	517.0	230.1	28.468
466.0	230.1	28.400	492.0	230.1	28.442	518.0	230.1	28.469
467.0	230.1	28.400	493.0	230.1	28.445	519.0	230.1	28.469
468.0	230.1	28.403	494.0	230.1	28.445	520.0	230.1	28.470
469.0	230.1	28.408	495.0	230.1	28.446	521.0	230.1	28.471
470.0	230.1	28.409	496.0	230.1	28.447	522.0	230.1	28.470
471.0	230.1	28.410	497.0	230.1	28.448	523.0	230.1	28.469
472.0	230.1	28.413	498.0	230.1	28.450	524.0	230.1	28.473
473.0	230.1	28.414	499.0	230.1	28.448	525.0	230.1	28.470
474.0	230.1	28.415	500.0	230.1	28.449			
475.0	230.1	28.416	501.0	230.1	28.451			

OBSERVED EXPERIMENTAL DATA FROM RUN 55

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	84.1	-.---	25.0	243.6	20.916	50.0	243.1	27.360
.5	104.2	-.---	25.5	243.6	21.034	50.5	243.2	27.424
1.0	122.6	-.---	26.0	243.5	21.161	51.0	243.3	27.488
1.5	138.1	6.950	26.5	243.5	21.293	51.5	243.3	27.547
2.0	151.3	8.366	27.0	243.3	21.432	52.0	243.4	27.597
2.5	162.9	9.643	27.5	243.2	21.573	52.5	243.4	27.649
3.0	173.0	10.784	28.0	243.1	21.719	53.0	243.7	27.698
3.5	181.3	11.813	28.5	243.0	21.870	53.5	243.5	27.747
4.0	188.9	12.721	29.0	242.8	22.023	54.0	243.6	27.793
4.5	195.4	13.547	29.5	242.8	22.180	54.5	243.7	27.830
5.0	201.2	14.276	30.0	242.8	22.339	55.0	243.9	27.868
5.5	206.2	14.935	30.5	242.7	22.500	55.5	243.8	27.907
6.0	210.8	15.516	31.0	242.5	22.659	56.0	244.0	27.940
6.5	214.7	16.033	31.5	242.4	22.821	56.5	244.1	27.970
7.0	218.1	16.490	32.0	242.3	22.979	57.0	244.2	28.000
7.5	221.1	16.897	32.5	242.3	23.143	57.5	244.2	28.028
8.0	223.9	17.262	33.0	242.2	23.307	58.0	244.2	28.055
8.5	226.3	17.578	33.5	242.2	23.469	58.5	244.3	28.083
9.0	228.4	17.860	34.0	242.2	23.629	59.0	244.4	28.108
9.5	230.2	18.109	34.5	242.2	23.788	59.5	244.4	28.128
10.0	231.8	18.326	35.0	242.1	23.943	60.0	244.4	28.146
10.5	233.3	18.521	35.5	242.2	24.104	60.5	244.5	28.164
11.0	234.4	18.693	36.0	242.1	24.257	61.0	244.7	28.181
11.5	236.0	18.846	36.5	242.2	24.408	61.5	244.6	28.195
12.0	236.9	18.979	37.0	242.1	24.556	62.0	244.8	28.214
12.5	237.8	19.098	37.5	242.0	24.706	62.5	244.8	28.229
13.0	238.5	19.205	38.0	242.1	24.848	63.0	244.9	28.240
13.5	239.1	19.299	38.5	242.1	24.993	63.5	244.8	28.250
14.0	239.9	19.378	39.0	242.1	25.134	64.0	244.8	28.261
14.5	240.4	19.457	39.5	242.1	25.270	64.5	244.8	28.271
15.0	241.0	19.526	40.0	242.0	25.403	65.0	244.8	28.282
15.5	241.2	19.587	40.5	242.1	25.535	65.5	244.8	28.288
16.0	241.6	19.641	41.0	242.1	25.660	66.0	244.9	28.296
16.5	242.2	19.693	41.5	242.1	25.782	66.5	245.0	28.303
17.0	242.5	19.744	42.0	242.1	25.905	67.0	245.1	28.309
17.5	242.8	19.794	42.5	242.2	26.020	67.5	245.0	28.314
18.0	243.0	19.845	43.0	242.2	26.136	68.0	245.1	28.322
18.5	243.4	19.894	43.5	242.2	26.247	68.5	245.2	28.327
19.0	243.3	19.947	44.0	242.2	26.350	69.0	245.2	28.335
19.5	243.4	20.001	44.5	242.3	26.457	69.5	245.1	28.337
20.0	243.7	20.056	45.0	242.4	26.551	70.0	245.2	28.340
20.5	243.7	20.116	45.5	242.3	26.652	70.5	245.2	28.345
21.0	243.6	20.182	46.0	242.4	26.744	71.0	245.2	28.347
21.5	243.6	20.252	46.5	242.4	26.833	71.5	245.1	28.350
22.0	243.7	20.328	47.0	242.6	26.918	72.0	245.1	28.353
22.5	243.7	20.412	47.5	242.7	27.002	72.5	245.2	28.357
23.0	243.6	20.495	48.0	242.7	27.080	73.0	245.1	28.359
23.5	243.6	20.589	48.5	242.8	27.154	73.5	245.2	28.359
24.0	243.6	20.694	49.0	243.0	27.226	74.0	245.1	28.361
24.5	243.6	20.802	49.5	243.0	27.298	74.5	245.2	28.363

OBSERVED EXPERIMENTAL DATA FROM RUN 55 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
75.0	245.1	28.364	80.0	245.1	28.374	85.0	245.4	28.380
75.5	245.2	28.367	80.5	245.2	28.378	85.5	245.3	28.380
76.0	245.1	28.369	81.0	245.1	28.376	86.0	245.2	28.379
76.5	245.2	28.368	81.5	245.2	28.377	86.5	245.3	28.379
77.0	245.1	28.370	82.0	245.1	28.378	87.0	245.4	28.379
77.5	245.2	28.370	82.5	245.2	28.378	87.5	245.2	28.379
78.0	245.1	28.371	83.0	245.3	28.378	88.0	245.2	28.379
78.5	245.2	28.374	83.5	245.2	28.380	88.5	245.3	28.378
79.0	245.1	28.374	84.0	245.1	28.379			
79.5	245.1	28.375	84.5	245.3	28.380			

OBSERVED EXPERIMENTAL DATA FROM RUN 56

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	81.8	--.---	41.0	229.8	32.803	82.0	229.7	32.798
1.0	119.2	19.858	42.0	229.8	32.800	83.0	229.7	32.798
2.0	144.0	22.489	43.0	229.8	32.800	84.0	229.7	32.797
3.0	163.3	24.639	44.0	229.6	32.800	85.0	229.7	32.796
4.0	177.8	26.366	45.0	229.8	32.803	86.0	229.7	32.794
5.0	189.0	27.744	46.0	229.5	32.802	87.0	229.8	32.797
6.0	197.6	28.829	47.0	229.8	32.802	88.0	229.8	32.795
7.0	204.4	29.689	48.0	229.8	32.803	89.0	229.8	32.794
8.0	209.8	30.372	49.0	229.5	32.802	90.0	229.8	32.793
9.0	213.8	30.898	50.0	229.8	32.802	91.0	229.8	32.792
10.0	217.1	31.312	51.0	229.7	32.802	92.0	229.8	32.793
11.0	219.9	31.634	52.0	229.8	32.801	93.0	229.8	32.792
12.0	221.8	31.886	53.0	229.8	32.800	94.0	229.7	32.790
13.0	223.4	32.080	54.0	229.7	32.799	95.0	229.8	32.792
14.0	224.7	32.230	55.0	229.8	32.798	96.0	229.8	32.792
15.0	225.7	32.354	56.0	229.7	32.799	97.0	229.7	32.791
16.0	226.4	32.449	57.0	229.7	32.799	98.0	229.7	32.791
17.0	227.2	32.525	58.0	229.7	32.799	99.0	229.7	32.790
18.0	227.6	32.585	59.0	229.7	32.801	100.0	229.7	32.791
19.0	228.2	32.632	60.0	229.7	32.800	101.0	229.7	32.790
20.0	228.3	32.669	61.0	229.7	32.800	102.0	229.7	32.789
21.0	228.7	32.704	62.0	229.7	32.800	103.0	229.7	32.790
22.0	228.8	32.723	63.0	229.8	32.800	104.0	229.7	32.792
23.0	229.1	32.743	64.0	229.7	32.800	105.0	229.7	32.790
24.0	229.0	32.753	65.0	229.7	32.800	106.0	229.7	32.789
25.0	229.3	32.766	66.0	229.7	32.799	107.0	229.8	32.787
26.0	229.2	32.771	67.0	229.7	32.800	108.0	229.8	32.788
27.0	229.4	32.777	68.0	229.7	32.800	109.0	229.7	32.788
28.0	229.3	32.788	69.0	229.7	32.799	110.0	229.7	32.788
29.0	229.6	32.791	70.0	229.7	32.799	111.0	229.7	32.788
30.0	229.4	32.796	71.0	229.6	32.799	112.0	229.8	32.789
31.0	229.7	32.798	72.0	229.7	32.798	113.0	229.7	32.788
32.0	229.5	32.801	73.0	229.7	32.798	114.0	229.8	32.787
33.0	229.7	32.801	74.0	229.7	32.797	115.0	229.7	32.787
34.0	229.6	32.804	75.0	229.7	32.796	116.0	229.7	32.788
35.0	229.8	32.805	76.0	229.7	32.796	117.0	229.7	32.787
36.0	229.4	32.805	77.0	229.7	32.795	118.0	229.8	32.787
37.0	229.7	32.804	78.0	229.8	32.795	119.0	229.7	32.788
38.0	229.7	32.804	79.0	229.7	32.795	120.0	229.7	32.788
39.0	229.7	32.804	80.0	229.7	32.794			
40.0	229.8	32.805	81.0	229.7	32.797			

OBSERVED EXPERIMENTAL DATA FROM RUN 57

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	79.9	-.---	41.0	230.0	16.424	82.0	230.1	16.423
1.0	116.8	3.430	42.0	230.2	16.424	83.0	229.9	16.423
2.0	142.8	5.991	43.0	229.9	16.420	84.0	230.1	16.424
3.0	162.0	8.081	44.0	230.1	16.420	85.0	229.9	16.424
4.0	176.8	9.789	45.0	229.9	16.420	86.0	230.1	16.421
5.0	188.8	11.192	46.0	230.2	16.427	87.0	229.9	16.424
6.0	197.3	12.304	47.0	229.9	16.424	88.0	230.1	16.420
7.0	204.3	13.194	48.0	230.1	16.424	89.0	229.9	16.420
8.0	209.8	13.893	49.0	229.9	16.424	90.0	230.1	16.420
9.0	214.1	14.445	50.0	230.0	16.424	91.0	230.0	16.420
10.0	217.7	14.888	51.0	230.0	16.420	92.0	230.0	16.420
11.0	220.0	15.218	52.0	229.9	16.422	93.0	229.9	16.418
12.0	222.5	15.485	53.0	230.0	16.421	94.0	230.1	16.418
13.0	223.8	15.693	54.0	229.9	16.426	95.0	230.0	16.419
14.0	225.3	15.858	55.0	230.0	16.424	96.0	230.0	16.414
15.0	226.2	15.984	56.0	230.2	16.425	97.0	229.9	16.417
16.0	227.2	16.080	57.0	230.0	16.425	98.0	230.0	16.414
17.0	227.6	16.157	58.0	230.2	16.427	99.0	230.0	16.415
18.0	228.3	16.213	59.0	230.0	16.427	100.0	230.0	16.415
19.0	228.4	16.260	60.0	230.1	16.430	101.0	230.0	16.414
20.0	229.0	16.294	61.0	230.0	16.430	102.0	230.0	16.414
21.0	229.0	16.322	62.0	230.2	16.429	103.0	229.9	16.415
22.0	229.3	16.342	63.0	230.0	16.431	104.0	230.0	16.412
23.0	229.3	16.364	64.0	230.0	16.433	105.0	229.9	16.412
24.0	229.7	16.375	65.0	230.0	16.432	106.0	229.9	16.410
25.0	229.7	16.386	66.0	230.0	16.433	107.0	229.9	16.410
26.0	229.8	16.396	67.0	230.0	16.431	108.0	230.0	16.411
27.0	229.8	16.405	68.0	229.9	16.431	109.0	230.0	16.412
28.0	229.9	16.410	69.0	230.0	16.430	110.0	230.0	16.410
29.0	229.8	16.415	70.0	230.2	16.430	111.0	230.0	16.412
30.0	230.0	16.420	71.0	229.9	16.429	112.0	230.1	16.410
31.0	229.9	16.420	72.0	229.9	16.431	113.0	230.0	16.413
32.0	230.0	16.424	73.0	230.0	16.429	114.0	230.0	16.414
33.0	229.9	16.427	74.0	229.9	16.428	115.0	230.0	16.411
34.0	230.2	16.429	75.0	230.0	16.426	116.0	230.0	16.413
35.0	229.9	16.430	76.0	229.9	16.429	117.0	229.9	16.411
36.0	230.2	16.428	77.0	229.9	16.429	118.0	229.9	16.411
37.0	229.9	16.431	78.0	230.1	16.430	119.0	229.9	16.411
38.0	230.0	16.431	79.0	229.9	16.429	120.0	230.0	16.409
39.0	230.0	16.428	80.0	230.1	16.426			
40.0	230.2	16.426	81.0	229.9	16.423			

OBSERVED EXPERIMENTAL DATA FROM RUN 58

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
.0	81.8	-.---	50.0	255.1	23.011	100.0	255.5	29.952
1.0	122.3	5.243	51.0	254.8	23.149	101.0	255.5	29.978
2.0	152.5	8.390	52.0	254.8	23.288	102.0	255.7	30.014
3.0	175.6	11.048	53.0	254.7	23.440	103.0	255.5	30.037
4.0	193.3	13.226	54.0	254.8	23.596	104.0	255.7	30.056
5.0	206.9	14.996	55.0	254.6	23.760	105.0	255.5	30.075
6.0	217.8	16.421	56.0	254.7	23.931	106.0	255.8	30.096
7.0	226.0	17.558	57.0	254.3	24.103	107.0	255.8	30.113
8.0	232.4	18.456	58.0	254.5	24.283	108.0	255.8	30.134
9.0	237.2	19.160	59.0	254.3	24.468	109.0	255.7	30.146
10.0	241.2	19.720	60.0	254.3	24.652	110.0	255.8	30.156
11.0	244.8	20.155	61.0	254.1	24.849	111.0	255.8	30.165
12.0	247.0	20.486	62.0	254.3	25.045	112.0	255.8	30.176
13.0	248.9	20.750	63.0	254.0	25.244	113.0	255.7	30.187
14.0	250.6	20.954	64.0	254.0	25.444	114.0	256.0	30.197
15.0	251.8	21.118	65.0	254.0	25.647	115.0	255.9	30.201
16.0	252.8	21.242	66.0	254.1	25.850	116.0	256.0	30.207
17.0	253.3	21.338	67.0	253.8	26.042	117.0	255.9	30.217
18.0	254.0	21.415	68.0	253.9	26.243	118.0	256.0	30.219
19.0	254.3	21.470	69.0	253.8	26.440	119.0	255.9	30.225
20.0	254.8	21.514	70.0	253.9	26.640	120.0	256.0	30.229
21.0	254.9	21.555	71.0	253.8	26.830	121.0	255.9	30.233
22.0	255.2	21.586	72.0	253.8	27.015	122.0	256.0	30.238
23.0	255.3	21.610	73.0	253.7	27.207	123.0	255.9	30.240
24.0	255.6	21.630	74.0	253.9	27.380	124.0	256.0	30.244
25.0	255.7	21.649	75.0	253.8	27.555	125.0	255.9	30.251
26.0	255.8	21.667	76.0	254.0	27.720	126.0	256.0	30.255
27.0	255.8	21.683	77.0	253.9	27.891	127.0	255.9	30.255
28.0	256.0	21.695	78.0	254.0	28.048	128.0	256.0	30.254
29.0	255.9	21.714	79.0	254.0	28.201	129.0	255.9	30.254
30.0	256.1	21.731	80.0	254.2	28.352	130.0	256.0	30.259
31.0	256.0	21.751	81.0	254.2	28.496	131.0	256.0	30.262
32.0	256.0	21.768	82.0	254.3	28.625	132.0	256.0	30.264
33.0	256.0	21.790	83.0	254.2	28.750	133.0	256.0	30.263
34.0	256.0	21.815	84.0	254.5	28.874	134.0	256.0	30.264
35.0	255.9	21.845	85.0	254.3	28.985	135.0	256.0	30.268
36.0	256.0	21.881	86.0	254.7	29.093	136.0	256.0	30.268
37.0	255.9	21.921	87.0	254.4	29.186	137.0	256.0	30.271
38.0	256.0	21.960	88.0	254.7	29.280	138.0	256.0	30.274
39.0	255.8	22.012	89.0	254.5	29.363	139.0	256.0	30.273
40.0	255.8	22.067	90.0	254.8	29.439	140.0	256.0	30.275
41.0	255.8	22.127	91.0	254.8	29.516	141.0	256.0	30.277
42.0	255.8	22.193	92.0	254.8	29.585	142.0	256.0	30.278
43.0	255.6	22.270	93.0	254.9	29.646	143.0	256.0	30.277
44.0	255.7	22.353	94.0	255.1	29.707	144.0	256.0	30.279
45.0	255.3	22.442	95.0	254.9	29.753	145.0	256.0	30.281
46.0	255.4	22.538	96.0	255.1	29.806	146.0	256.0	30.280
47.0	255.2	22.642	97.0	255.1	29.849	147.0	256.0	30.281
48.0	255.3	22.758	98.0	255.2	29.887	148.0	256.0	30.283
49.0	255.1	22.878	99.0	255.2	29.922	149.0	256.0	30.284

OBSERVED EXPERIMENTAL DATA FROM RUN 58 (CONT'D)

TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM	TIME MIN	TEMP. OF	HEIGHT CM
150.0	256.0	30.285	157.0	256.0	30.292	164.0	256.0	30.295
151.0	256.0	30.286	158.0	256.0	30.294	165.0	256.0	30.294
152.0	256.0	30.287	159.0	256.0	30.294	166.0	256.0	30.292
153.0	256.0	30.290	160.0	256.0	30.293	167.0	256.0	30.294
154.0	256.0	30.290	161.0	256.0	30.296	168.0	256.0	30.293
155.0	256.0	30.288	162.0	256.0	30.294	169.0	256.0	30.293
156.0	256.0	30.291	163.0	256.0	30.297	170.0	256.0	30.293

OBSERVED EXPERIMENTAL DATA FROM RUN 59

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	88.1	-.---	50.0	249.0	15.821	100.0	248.2	19.088
1.0	129.4	-.---	51.0	249.0	15.833	101.0	248.1	19.198
2.0	159.7	3.260	52.0	248.9	15.849	102.0	248.0	19.307
3.0	181.2	5.797	53.0	249.0	15.868	103.0	248.2	19.421
4.0	196.7	8.870	54.0	249.0	15.885	104.0	248.0	19.534
5.0	208.5	9.531	55.0	249.0	15.906	105.0	248.1	19.651
6.0	217.1	10.863	56.0	248.9	15.929	106.0	248.0	19.765
7.0	224.6	11.916	57.0	248.9	15.953	107.0	248.0	19.876
8.0	229.4	12.742	58.0	248.9	15.977	108.0	248.0	19.988
9.0	233.8	13.389	59.0	249.0	16.004	109.0	248.2	20.108
10.0	236.8	13.899	60.0	248.9	16.033	110.0	248.2	20.217
11.0	239.5	14.290	61.0	249.0	16.062	111.0	248.0	20.328
12.0	241.3	14.603	62.0	249.0	16.095	112.0	248.1	20.443
13.0	243.1	14.849	63.0	249.0	16.131	113.0	248.0	20.553
14.0	244.5	15.036	64.0	248.8	16.175	114.0	248.0	20.663
15.0	245.6	15.181	65.0	248.9	16.213	115.0	248.0	20.773
16.0	246.2	15.296	66.0	248.8	16.254	116.0	247.8	20.885
17.0	246.8	15.385	67.0	248.8	16.297	117.0	248.0	20.993
18.0	247.2	15.453	68.0	248.8	16.346	118.0	247.9	21.099
19.0	247.8	15.504	69.0	248.8	16.399	119.0	248.0	21.199
20.0	248.1	15.550	70.0	248.7	16.454	120.0	247.9	21.307
21.0	248.3	15.580	71.0	248.7	16.508	121.0	248.0	21.415
22.0	248.6	15.609	72.0	248.7	16.562	122.0	247.9	21.512
23.0	248.7	15.628	73.0	248.8	16.622	123.0	248.0	21.615
24.0	248.8	15.644	74.0	248.8	16.683	124.0	248.0	21.713
25.0	249.0	15.656	75.0	248.8	16.748	125.0	248.0	21.809
26.0	249.0	15.668	76.0	248.8	16.819	126.0	248.0	21.908
27.0	249.1	15.678	77.0	248.8	16.887	127.0	248.0	22.002
28.0	249.2	15.684	78.0	248.6	16.962	128.0	248.0	22.092
29.0	249.2	15.687	79.0	248.6	17.033	129.0	248.0	22.182
30.0	249.2	15.689	80.0	248.5	17.111	130.0	248.0	22.270
31.0	249.2	15.695	81.0	248.5	17.191	131.0	248.0	22.355
32.0	249.2	15.700	82.0	248.6	17.278	132.0	248.0	22.439
33.0	249.2	15.705	83.0	248.7	17.360	133.0	248.0	22.519
34.0	249.2	15.706	84.0	248.5	17.439	134.0	248.1	22.597
35.0	249.2	15.709	85.0	248.5	17.539	135.0	248.1	22.676
36.0	249.0	15.716	86.0	248.5	17.632	136.0	248.1	22.749
37.0	249.2	15.717	87.0	248.5	17.729	137.0	248.1	22.813
38.0	249.1	15.720	88.0	248.4	17.820	138.0	248.1	22.891
39.0	249.4	15.723	89.0	248.3	17.919	139.0	248.1	22.959
40.0	249.2	15.728	90.0	248.2	18.018	140.0	248.1	23.028
41.0	249.2	15.733	91.0	248.2	18.119	141.0	248.2	23.088
42.0	249.2	15.739	92.0	248.3	18.225	142.0	248.2	23.151
43.0	249.3	15.746	93.0	248.4	18.329	143.0	248.2	23.214
44.0	249.0	15.756	94.0	248.3	18.436	144.0	248.2	23.268
45.0	249.3	15.765	95.0	248.3	18.536	145.0	248.2	23.325
46.0	249.2	15.772	96.0	248.2	18.646	146.0	248.2	23.378
47.0	249.2	15.782	97.0	248.2	18.754	147.0	248.2	23.431
48.0	249.0	15.794	98.0	248.0	18.866	148.0	248.2	23.478
49.0	249.1	15.802	99.0	248.0	18.976	149.0	248.2	23.520

OBSERVED EXPERIMENTAL DATA FROM RUN 59 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
150.0	248.2	23.566	172.0	248.7	24.103	194.0	248.8	24.213
151.0	248.3	23.607	173.0	248.7	24.115	195.0	248.8	24.216
152.0	248.3	23.650	174.0	248.8	24.123	196.0	248.8	24.215
153.0	248.5	23.688	175.0	248.8	24.132	197.0	248.8	24.218
154.0	248.5	23.722	176.0	248.8	24.140	198.0	248.8	24.218
155.0	248.5	23.756	177.0	248.8	24.146	199.0	248.8	24.219
156.0	248.5	23.788	178.0	248.8	24.157	200.0	248.8	24.222
157.0	248.5	23.815	179.0	248.8	24.161	201.0	248.8	24.222
158.0	248.5	23.843	180.0	248.8	24.167	202.0	248.8	24.224
159.0	248.5	23.870	181.0	248.8	24.172	203.0	248.8	24.226
160.0	248.5	23.894	182.0	248.8	24.177	204.0	248.8	24.227
161.0	248.5	23.921	183.0	248.8	24.187	205.0	248.8	24.227
162.0	248.5	23.942	184.0	248.8	24.187	206.0	248.8	24.228
163.0	248.5	23.963	185.0	248.8	24.189	207.0	248.8	24.229
164.0	248.5	23.984	186.0	248.8	24.193	208.0	248.8	24.233
165.0	248.5	24.003	187.0	248.8	24.193	209.0	248.8	24.233
166.0	248.5	24.012	188.0	248.8	24.196	210.0	248.8	24.233
167.0	248.6	24.039	189.0	248.8	24.201	211.0	248.8	24.233
168.0	248.6	24.058	190.0	248.8	24.207	212.0	248.8	24.234
169.0	248.6	24.068	191.0	248.8	24.208	213.0	248.8	24.232
170.0	248.6	24.081	192.0	248.8	24.209	214.0	248.8	24.233
171.0	248.7	24.092	193.0	248.8	24.210	215.0	248.8	24.233

OBSERVED EXPERIMENTAL DATA FROM RUN 60

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	77.3	-.---	50.0	247.1	27.633	100.0	248.6	28.201
1.0	124.1	4.709	51.0	247.3	27.730	101.0	248.8	28.201
2.0	154.3	7.723	52.0	247.6	27.814	102.0	248.8	28.203
3.0	177.7	10.198	53.0	247.9	27.880	103.0	248.8	28.204
4.0	194.1	12.217	54.0	248.0	27.935	104.0	248.8	28.204
5.0	206.7	13.840	55.0	248.3	27.983	105.0	248.9	28.205
6.0	215.9	15.141	56.0	248.3	28.021	106.0	248.8	28.205
7.0	223.0	16.166	57.0	248.3	28.056	107.0	248.8	28.206
8.0	228.8	16.970	58.0	248.4	28.078	108.0	248.8	28.207
9.0	233.0	17.616	59.0	248.6	28.095	109.0	248.9	28.208
10.0	236.3	18.094	60.0	248.4	28.115	110.0	248.8	28.209
11.0	239.0	18.478	61.0	248.6	28.129	111.0	248.9	28.209
12.0	241.0	18.776	62.0	248.7	28.139	112.0	248.8	28.208
13.0	242.8	19.004	63.0	248.8	28.147	113.0	248.9	28.209
14.0	244.1	19.179	64.0	248.8	28.154	114.0	248.8	28.211
15.0	245.2	19.314	65.0	248.8	28.163	115.0	248.9	28.213
16.0	245.8	19.417	66.0	248.8	28.164	116.0	248.8	28.213
17.0	246.5	19.498	67.0	248.7	28.167	117.0	248.8	28.215
18.0	246.9	19.568	68.0	248.7	28.167	118.0	248.8	28.213
19.0	247.5	19.622	69.0	248.7	28.168	119.0	248.9	28.215
20.0	247.7	19.675	70.0	248.8	28.173	120.0	248.7	28.214
21.0	247.8	19.735	71.0	248.8	28.178	121.0	248.9	28.216
22.0	248.1	19.807	72.0	248.8	28.179	122.0	248.9	28.216
23.0	248.1	19.895	73.0	248.8	28.179	123.0	248.9	28.219
24.0	247.9	20.021	74.0	248.8	28.182	124.0	248.9	28.221
25.0	248.0	20.185	75.0	248.8	28.180	125.0	248.9	28.219
26.0	247.8	20.391	76.0	248.8	28.180	126.0	248.9	28.221
27.0	247.6	20.645	77.0	249.0	28.184	127.0	248.9	28.219
28.0	247.2	20.930	78.0	248.8	28.186	128.0	248.9	28.220
29.0	246.8	21.276	79.0	249.0	28.187	129.0	248.9	28.222
30.0	246.4	21.648	80.0	248.8	28.189	130.0	248.9	28.219
31.0	246.2	22.042	81.0	248.8	28.190	131.0	248.9	28.220
32.0	245.9	22.460	82.0	248.8	28.193	132.0	248.9	28.217
33.0	245.7	22.881	83.0	248.8	28.193	133.0	248.9	28.216
34.0	245.2	23.308	84.0	248.8	28.193	134.0	248.9	28.217
35.0	245.3	23.726	85.0	248.8	28.193	135.0	248.9	28.220
36.0	245.2	24.131	86.0	248.8	28.195	136.0	248.9	28.223
37.0	245.3	24.524	87.0	248.8	28.199	137.0	248.9	28.225
38.0	245.2	24.894	88.0	248.8	28.198	138.0	248.9	28.227
39.0	245.3	25.253	89.0	248.8	28.199	139.0	248.9	28.227
40.0	245.3	25.580	90.0	248.7	28.199	140.0	248.9	28.227
41.0	245.7	25.886	91.0	248.9	28.199	141.0	248.9	28.226
42.0	245.7	26.172	92.0	248.8	28.199	142.0	248.9	28.228
43.0	245.8	26.435	93.0	248.8	28.200	143.0	248.9	28.228
44.0	246.0	26.669	94.0	248.7	28.200	144.0	248.9	28.228
45.0	246.2	26.882	95.0	248.8	28.200	145.0	248.9	28.227
46.0	246.3	27.071	96.0	248.8	28.200	146.0	248.9	28.228
47.0	246.6	27.245	97.0	248.8	28.200	147.0	248.9	28.227
48.0	246.7	27.393	98.0	248.7	28.200	148.0	248.9	28.226
49.0	246.7	27.519	99.0	248.9	28.200	149.0	248.9	28.225

OBSERVED EXPERIMENTAL DATA FROM RUN 61

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	77.0	-.---	35.0	243.9	21.019	70.0	243.1	28.015
1.0	134.1	-.---	36.0	243.8	21.168	71.0	243.2	28.094
2.0	162.1	9.940	37.0	243.7	21.334	72.0	243.3	28.166
3.0	181.9	12.143	38.0	243.3	21.515	73.0	243.3	28.236
4.0	196.0	13.890	39.0	243.1	21.716	74.0	243.5	28.302
5.0	206.4	15.274	40.0	243.0	21.932	75.0	243.6	28.353
6.0	214.8	16.374	41.0	242.7	22.160	76.0	243.7	28.400
7.0	221.1	17.242	42.0	242.6	22.397	77.0	243.7	28.441
8.0	226.2	17.921	43.0	242.3	22.650	78.0	243.8	28.475
9.0	230.0	18.459	44.0	242.2	22.913	79.0	243.9	28.509
10.0	233.0	18.878	45.0	242.1	23.171	80.0	243.9	28.537
11.0	235.3	19.201	46.0	242.0	23.434	81.0	243.9	28.560
12.0	237.3	19.456	47.0	241.9	23.699	82.0	244.0	28.581
13.0	238.8	19.656	48.0	241.8	23.966	83.0	244.0	28.598
14.0	240.1	19.815	49.0	241.8	24.230	84.0	244.1	28.616
15.0	240.9	19.935	50.0	241.8	24.494	85.0	244.1	28.625
16.0	241.8	20.033	51.0	241.8	24.743	86.0	244.1	28.642
17.0	242.2	20.108	52.0	241.8	24.997	87.0	244.1	28.651
18.0	242.8	20.170	53.0	241.9	25.243	88.0	244.3	28.665
19.0	243.0	20.217	54.0	241.8	25.476	89.0	244.3	28.674
20.0	243.5	20.256	55.0	241.8	25.709	90.0	244.5	28.683
21.0	243.6	20.285	56.0	241.8	25.927	91.0	244.4	28.693
22.0	244.0	20.315	57.0	241.9	26.136	92.0	244.5	28.700
23.0	244.0	20.335	58.0	242.0	26.335	93.0	244.3	28.703
24.0	244.1	20.356	59.0	242.0	26.537	94.0	244.5	28.708
25.0	244.3	20.376	60.0	242.0	26.717	95.0	244.2	28.713
26.0	244.3	20.396	61.0	242.2	26.888	96.0	244.3	28.714
27.0	244.2	20.427	62.0	242.3	27.056	97.0	244.3	28.716
28.0	244.3	20.461	63.0	242.3	27.203	98.0	244.3	28.717
29.0	244.3	20.500	64.0	242.5	27.346	99.0	244.4	28.716
30.0	244.3	20.550	65.0	242.5	27.481	100.0	244.6	28.715
31.0	244.3	20.611	66.0	242.6	27.605	101.0	244.4	28.718
32.0	244.3	20.689	67.0	242.8	27.725	102.0	244.3	28.716
33.0	244.3	20.780	68.0	242.9	27.830	103.0	244.2	28.718
34.0	244.0	20.893	69.0	243.0	27.929	104.0	244.4	28.720

OBSERVED EXPERIMENTAL DATA FROM RUN 62

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	73.3	--.---	165.0	244.0	32.863	330.0	244.1	38.568
5.0	199.2	24.457	170.0	244.0	33.079	335.0	244.0	38.608
10.0	230.9	28.847	175.0	243.9	33.299	340.0	244.1	38.635
15.0	239.9	30.137	180.0	243.9	33.522	345.0	244.0	38.661
25.0	243.9	30.632	190.0	243.8	33.988	355.0	244.0	38.713
30.0	244.3	30.673	195.0	243.8	34.219	360.0	244.1	38.728
35.0	244.2	30.688	200.0	243.8	34.458	365.0	244.0	38.744
40.0	244.3	30.692	205.0	243.8	34.691	370.0	244.1	38.757
45.0	244.2	30.696	210.0	243.8	34.930	375.0	244.1	38.770
20.0	242.9	30.518	185.0	243.9	33.753	350.0	244.1	38.691
50.0	244.3	30.696	215.0	243.8	35.173	380.0	244.2	38.784
55.0	244.2	30.702	220.0	243.8	35.408	385.0	244.1	38.788
60.0	244.3	30.712	225.0	243.8	35.641	390.0	244.2	38.798
65.0	244.2	30.721	230.0	243.8	35.865	395.0	244.1	38.805
70.0	244.3	30.734	235.0	243.8	36.093	400.0	244.2	38.806
75.0	244.2	30.750	240.0	243.8	36.321	405.0	244.1	38.815
80.0	244.3	30.772	245.0	243.8	36.523	410.0	244.1	38.819
85.0	244.2	30.796	250.0	243.8	36.728	415.0	244.1	38.825
90.0	244.3	30.840	255.0	243.8	36.929	420.0	244.1	38.828
95.0	244.2	30.882	260.0	243.8	37.120	425.0	244.1	38.833
100.0	244.3	30.940	265.0	243.9	37.283	430.0	244.2	38.839
105.0	244.2	31.011	270.0	243.9	37.451	435.0	244.1	38.839
110.0	244.2	31.093	275.0	243.9	37.602	440.0	244.2	38.843
115.0	244.2	31.192	280.0	243.9	37.747	445.0	244.1	38.843
120.0	244.2	31.306	285.0	243.9	37.882	450.0	244.1	38.850
125.0	244.2	31.429	290.0	243.9	37.996	455.0	244.1	38.852
130.0	244.1	31.567	295.0	243.9	38.100	460.0	244.1	38.854
135.0	244.1	31.719	300.0	243.9	38.200	465.0	244.1	38.854
140.0	244.1	31.882	305.0	243.9	38.281	470.0	244.1	38.857
145.0	244.0	32.059	310.0	244.0	38.361	475.0	244.2	38.858
150.0	244.0	32.251	315.0	244.0	38.418	480.0	244.1	38.857
155.0	244.0	32.449	320.0	244.0	38.467			
160.0	244.0	32.651	325.0	244.0	38.526			

OBSERVED EXPERIMENTAL DATA FROM RUN 63

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	75.2	-.---	32.0	261.0	22.553	64.0	261.2	30.324
1.0	121.9	4.234	33.0	260.9	22.760	65.0	261.3	30.367
2.0	153.3	7.588	34.0	260.6	22.990	66.0	261.4	30.404
3.0	178.0	10.424	35.0	260.4	23.253	67.0	261.7	30.436
4.0	196.1	12.756	36.0	260.0	23.542	68.0	261.8	30.461
5.0	210.8	14.644	37.0	259.8	23.846	69.0	261.7	30.482
6.0	221.8	16.171	38.0	259.4	24.176	70.0	261.7	30.493
7.0	230.8	17.388	39.0	259.3	24.522	71.0	261.9	30.511
8.0	237.3	18.350	40.0	259.0	24.878	72.0	261.9	30.520
9.0	242.8	19.104	41.0	258.9	25.238	73.0	262.0	30.528
10.0	246.8	19.694	42.0	258.6	25.611	74.0	261.8	30.533
11.0	250.1	20.159	43.0	258.7	25.974	75.0	262.2	30.543
12.0	252.7	20.519	44.0	258.5	26.331	76.0	261.8	30.545
13.0	254.8	20.810	45.0	258.6	26.679	77.0	262.0	30.546
14.0	256.3	21.029	46.0	258.3	27.022	78.0	262.0	30.550
15.0	257.6	21.197	47.0	258.5	27.354	79.0	262.2	30.556
16.0	258.5	21.336	48.0	258.5	27.670	80.0	262.0	30.555
17.0	259.5	21.438	49.0	258.7	27.967	81.0	262.2	30.559
18.0	259.9	21.521	50.0	258.6	28.251	82.0	262.0	30.563
19.0	260.6	21.587	51.0	258.9	28.515	83.0	262.2	30.561
20.0	260.8	21.635	52.0	259.0	28.758	84.0	262.0	30.561
21.0	261.1	21.679	53.0	259.3	28.983	85.0	262.2	30.562
22.0	261.3	21.718	54.0	259.3	29.191	86.0	262.0	30.565
23.0	261.5	21.755	55.0	259.8	29.381	87.0	262.1	30.565
24.0	261.6	21.790	56.0	259.8	29.544	88.0	262.0	30.567
25.0	261.8	21.832	57.0	260.0	29.693	89.0	262.3	30.565
26.0	261.6	21.881	58.0	260.1	29.827	90.0	262.0	30.561
27.0	261.7	21.943	59.0	260.5	29.941	91.0	262.2	30.565
28.0	261.5	22.022	60.0	260.6	30.048	92.0	262.1	30.564
29.0	261.6	22.117	61.0	260.8	30.136	93.0	262.2	30.564
30.0	261.4	22.235	62.0	260.9	30.208	94.0	262.1	30.563
31.0	261.4	22.380	63.0	261.2	30.274			

OBSERVED EXPERIMENTAL DATA FROM RUN 64

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	81.9	-.---	27.0	264.3	25.449	54.0	268.2	32.088
1.0	126.6	4.945	28.0	263.9	25.987	55.0	268.2	32.095
2.0	158.9	8.499	29.0	263.3	26.549	56.0	268.2	32.101
3.0	183.9	11.486	30.0	262.9	27.117	57.0	268.2	32.107
4.0	202.7	13.931	31.0	262.8	27.665	58.0	268.3	32.109
5.0	217.2	15.913	32.0	262.7	28.198	59.0	268.2	32.114
6.0	228.7	17.405	33.0	262.6	28.706	60.0	268.3	32.115
7.0	237.3	18.760	34.0	263.0	29.172	61.0	268.3	32.116
8.0	244.2	19.746	35.0	263.0	29.606	62.0	268.4	32.120
9.0	249.3	20.523	36.0	263.4	29.992	63.0	268.3	32.120
10.0	253.7	21.132	37.0	263.6	30.341	64.0	268.4	32.122
11.0	256.9	21.602	38.0	264.2	30.648	65.0	268.3	32.122
12.0	259.4	21.973	39.0	264.5	30.912	66.0	268.5	32.125
13.0	261.1	22.256	40.0	265.0	31.140	67.0	268.4	32.128
14.0	262.7	22.479	41.0	265.2	31.329	68.0	268.4	32.128
15.0	263.9	22.658	42.0	265.8	31.488	69.0	268.3	32.128
16.0	265.0	22.796	43.0	266.0	31.617	70.0	268.4	32.128
17.0	265.7	22.909	44.0	266.5	31.725	71.0	268.4	32.128
18.0	266.3	23.010	45.0	266.9	31.806	72.0	268.4	32.131
19.0	266.7	23.107	46.0	267.3	31.875	73.0	268.4	32.132
20.0	266.9	23.215	47.0	267.3	31.928	74.0	268.4	32.131
21.0	266.9	23.351	48.0	267.7	31.969	75.0	268.3	32.132
22.0	266.9	23.536	49.0	267.6	31.999	76.0	268.4	32.132
23.0	266.5	23.776	50.0	267.8	32.026	77.0	268.3	32.132
24.0	266.2	24.091	51.0	267.9	32.049	78.0	268.5	32.132
25.0	265.6	24.480	52.0	268.1	32.063	79.0	268.3	32.131
26.0	265.0	24.939	53.0	268.1	32.075			

OBSERVED EXPERIMENTAL DATA FROM RUN 66

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	82.3	--.---	500.0	324.5	33.686	1000.0	324.4	34.750
10.0	---.-	--.---	510.0	324.6	33.698	1010.0	324.3	34.771
20.0	315.0	32.163	520.0	324.6	33.710	1020.0	324.3	34.807
30.0	323.1	33.548	530.0	324.6	33.722	1030.0	324.3	34.833
40.0	324.0	33.644	540.0	324.6	33.736	1040.0	324.3	34.861
50.0	324.1	33.650	550.0	324.6	33.749	1050.0	324.3	34.889
60.0	324.0	33.645	560.0	324.5	33.760	1060.0	324.3	34.917
70.0	324.4	33.641	570.0	324.5	33.775	1070.0	324.3	34.945
80.0	324.3	33.637	580.0	324.5	33.789	1080.0	324.3	34.970
90.0	324.4	33.632	590.0	324.5	33.811	1090.0	324.3	34.996
100.0	324.3	33.627	600.0	324.5	33.830	1100.0	324.3	35.026
110.0	324.3	33.624	610.0	324.5	33.846	1110.0	324.3	35.053
120.0	324.3	33.618	620.0	324.5	33.865	1120.0	324.3	35.084
130.0	324.3	33.614	630.0	324.5	33.881	1130.0	324.3	35.119
140.0	324.3	33.606	640.0	324.5	33.896	1140.0	324.3	35.147
150.0	324.3	33.603	650.0	324.5	33.911	1150.0	324.3	35.177
160.0	324.3	33.600	660.0	324.4	33.930	1160.0	324.3	35.217
170.0	324.3	33.598	670.0	324.4	33.949	1170.0	324.3	35.252
180.0	324.3	33.597	680.0	324.4	33.973	1180.0	324.3	35.284
190.0	324.3	33.596	690.0	324.4	33.992	1190.0	324.3	35.317
200.0	324.3	33.594	700.0	324.4	34.012	1200.0	324.3	35.352
210.0	324.3	33.592	710.0	324.4	34.033	1210.0	324.2	35.384
220.0	324.2	33.590	720.0	324.4	34.053	1220.0	324.2	35.412
230.0	324.2	33.585	730.0	324.4	34.073	1230.0	324.2	35.439
240.0	324.2	33.585	740.0	324.4	34.094	1240.0	324.2	35.465
250.0	324.2	33.585	750.0	324.4	34.116	1250.0	324.2	35.491
260.0	324.2	33.578	760.0	324.5	34.135	1260.0	324.2	35.523
270.0	324.2	33.572	770.0	324.5	34.158	1270.0	324.2	35.553
280.0	324.2	33.570	780.0	324.5	34.180	1280.0	324.2	35.575
290.0	324.2	33.572	790.0	324.5	34.202	1290.0	324.2	35.598
300.0	324.2	33.569	800.0	324.5	34.224	1300.0	324.2	35.628
310.0	324.2	33.569	810.0	324.5	34.245	1310.0	324.1	35.650
320.0	324.3	33.564	820.0	324.5	34.266	1320.0	324.1	35.673
330.0	324.3	33.568	830.0	324.5	34.295	1330.0	324.1	35.700
340.0	324.3	33.573	840.0	324.5	34.325	1340.0	324.1	35.725
350.0	324.3	33.579	850.0	324.5	34.349	1350.0	324.1	35.747
360.0	324.3	33.579	860.0	324.3	34.375	1360.0	324.1	35.773
370.0	324.3	33.583	870.0	324.3	34.396	1370.0	324.1	35.797
380.0	324.3	33.590	880.0	324.3	34.422	1380.0	324.1	35.817
390.0	324.3	33.593	890.0	324.3	34.453	1390.0	324.1	35.835
400.0	324.3	33.596	900.0	324.3	34.475	1400.0	324.1	35.860
410.0	324.3	33.600	910.0	324.3	34.503	1410.0	324.0	35.881
420.0	324.3	33.607	920.0	324.3	34.529	1420.0	324.0	35.897
430.0	324.3	33.617	930.0	324.3	34.551	1430.0	324.0	35.917
440.0	324.3	33.620	940.0	324.3	34.576	1440.0	324.0	35.935
450.0	324.3	33.626	950.0	324.3	34.604	1450.0	324.0	35.955
460.0	324.3	33.636	960.0	324.4	34.633	1460.0	324.0	35.975
470.0	324.3	33.654	970.0	324.4	34.667	1470.0	324.0	35.987
480.0	324.5	33.665	980.0	324.4	34.692	1480.0	324.0	36.005
490.0	324.5	33.673	990.0	324.4	34.718	1490.0	324.0	36.021

OBSERVED EXPERIMENTAL DATA FROM RUN 66 (CONT'D)

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
1500.0	324.0	36.029	1580.0	324.2	36.098	1660.0	324.0	36.129
1510.0	324.3	36.043	1590.0	324.2	36.109	1670.0	324.0	36.126
1520.0	324.3	36.052	1600.0	324.2	36.116	1680.0	324.0	36.129
1530.0	324.3	36.065	1610.0	324.0	36.119	1690.0	324.0	36.139
1540.0	324.3	36.069	1620.0	324.0	36.120	1700.0	324.0	36.127
1550.0	324.3	36.080	1630.0	324.0	36.124	1710.0	324.0	36.127
1560.0	324.2	36.088	1640.0	324.0	36.129			
1570.0	324.2	36.094	1650.0	324.0	36.133			

OBSERVED EXPERIMENTAL DATA FROM RUN 68

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	80.9	--.---	175.0	324.5	33.313	350.0	324.9	34.923
5.0	---.-	--.---	180.0	324.5	33.329	355.0	324.9	34.983
10.0	297.0	29.094	185.0	324.5	33.343	360.0	324.9	35.048
15.0	317.8	32.047	190.0	324.5	33.365	365.0	324.9	35.118
20.0	322.6	32.830	195.0	324.5	33.389	370.0	324.9	35.183
25.0	323.8	33.059	200.0	324.5	33.416	375.0	324.9	35.237
30.0	324.2	33.129	205.0	324.5	33.443	380.0	324.9	35.298
35.0	324.2	33.167	210.0	324.5	33.473	385.0	324.9	35.368
40.0	324.3	33.185	215.0	324.5	33.514	390.0	324.9	35.426
45.0	324.3	33.194	220.0	324.5	33.547	395.0	324.9	35.490
50.0	324.3	33.206	225.0	324.5	33.591	400.0	324.9	35.563
55.0	324.3	33.212	230.0	324.5	33.637	405.0	324.9	35.613
60.0	324.4	33.216	235.0	324.5	33.682	410.0	324.9	35.696
65.0	324.4	33.220	240.0	324.5	33.732	415.0	324.9	35.771
70.0	324.5	33.225	245.0	324.5	33.780	420.0	324.9	35.845
75.0	324.5	33.226	250.0	324.5	33.837	425.0	324.9	35.917
80.0	324.5	33.226	255.0	324.6	33.882	430.0	324.9	35.988
85.0	324.5	33.226	260.0	324.6	33.931	435.0	324.9	36.054
90.0	324.6	33.231	265.0	324.6	33.980	440.0	324.9	36.125
95.0	324.5	33.231	270.0	324.7	34.031	445.0	324.9	36.199
100.0	324.5	33.233	275.0	324.7	34.081	450.0	324.9	36.273
105.0	324.5	33.235	280.0	324.7	34.131	455.0	324.9	36.336
110.0	324.5	33.238	285.0	324.7	34.178	460.0	324.9	36.389
115.0	324.5	33.241	290.0	324.8	34.234	465.0	324.9	36.437
120.0	324.5	33.244	295.0	324.8	34.286	470.0	324.9	36.464
125.0	324.5	33.245	300.0	324.8	34.342	475.0	324.8	36.481
130.0	324.5	33.250	305.0	324.8	34.392	480.0	324.7	36.480
135.0	324.5	33.252	310.0	324.8	34.452	485.0	324.7	36.488
140.0	324.5	33.256	315.0	324.8	34.508	490.0	324.7	36.485
145.0	324.5	33.263	320.0	324.8	34.561	495.0	324.7	36.493
150.0	324.5	33.266	325.0	324.8	34.622	500.0	324.7	36.492
155.0	324.5	33.273	330.0	324.9	34.678	505.0	324.7	36.492
160.0	324.5	33.284	335.0	324.9	34.737	510.0	324.7	36.493
165.0	324.5	33.291	340.0	324.9	34.796	515.0	324.7	36.488
170.0	324.5	33.298	345.0	324.9	34.862	520.0	324.7	36.487

OBSERVED EXPERIMENTAL DATA FROM RUN 69

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	80.1	--.---	165.0	324.3	37.781	330.0	324.6	39.639
5.0	---.-	--.---	170.0	324.3	37.804	335.0	324.6	39.750
10.0	288.2	32.446	175.0	324.3	37.825	340.0	324.6	39.831
15.0	315.5	36.243	180.0	324.3	37.854	345.0	324.6	39.913
20.0	321.7	37.233	185.0	324.3	37.881	350.0	324.6	39.996
25.0	323.3	37.514	190.0	324.3	37.914	355.0	324.6	40.083
30.0	324.0	37.605	195.0	324.3	37.945	360.0	324.6	40.173
35.0	324.1	37.635	200.0	324.3	37.983	365.0	324.6	40.260
40.0	324.3	37.649	205.0	324.3	38.031	370.0	324.6	40.353
45.0	324.3	37.657	210.0	324.3	38.073	375.0	324.6	40.439
50.0	324.3	37.662	215.0	324.3	38.123	380.0	324.6	40.523
55.0	324.3	37.665	220.0	324.3	38.172	385.0	324.6	40.611
60.0	324.3	37.670	225.0	324.3	38.223	390.0	324.6	40.696
65.0	324.3	37.673	230.0	324.3	38.279	395.0	324.6	40.788
70.0	324.3	37.676	235.0	324.3	38.336	400.0	324.6	40.870
75.0	324.3	37.678	240.0	324.3	38.388	405.0	324.6	40.942
80.0	324.3	37.681	245.0	324.3	38.455	410.0	324.6	40.988
85.0	324.3	37.680	250.0	324.3	38.517	415.0	324.6	41.022
90.0	324.3	37.680	255.0	324.4	38.575	420.0	324.6	41.028
95.0	324.3	37.681	260.0	324.4	38.640	425.0	324.6	41.038
100.0	324.3	37.688	265.0	324.4	38.706	430.0	324.6	41.038
105.0	324.3	37.688	270.0	324.5	38.771	435.0	324.6	41.039
110.0	324.3	37.688	275.0	324.5	38.841	440.0	324.6	41.040
115.0	324.3	37.689	280.0	324.5	38.913	445.0	324.6	41.041
120.0	324.3	37.693	285.0	324.6	38.982	450.0	324.6	41.041
125.0	324.3	37.694	290.0	324.6	39.053	455.0	324.6	41.047
130.0	324.3	37.699	295.0	324.6	39.121	460.0	324.6	41.046
135.0	324.3	37.707	300.0	324.6	39.188	465.0	324.6	41.045
140.0	324.3	37.717	305.0	324.6	39.257	470.0	324.6	41.044
145.0	324.3	37.729	310.0	324.6	39.333	475.0	324.6	41.044
150.0	324.3	37.739	315.0	324.6	39.404	480.0	324.6	41.044
155.0	324.3	37.753	320.0	324.6	39.483			
160.0	324.3	37.766	325.0	324.6	39.562			

OBSERVED EXPERIMENTAL DATA FROM RUN 70

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	80.7	--.---	110.0	336.6	39.715	220.0	336.9	41.566
5.0	---.-	--.---	115.0	336.6	39.740	225.0	336.9	41.678
10.0	319.2	34.946	120.0	336.6	39.771	230.0	336.9	41.770
15.0	329.8	38.344	125.0	336.6	39.814	235.0	336.9	41.876
20.0	334.2	39.228	130.0	336.6	39.856	240.0	336.9	41.991
25.0	335.7	39.473	135.0	336.7	39.908	245.0	336.9	42.101
30.0	336.0	39.551	140.0	336.7	39.967	250.0	336.9	42.214
35.0	336.1	39.587	145.0	336.7	40.045	255.0	336.9	42.328
40.0	336.2	39.601	150.0	336.7	40.120	260.0	336.9	42.439
45.0	336.3	39.610	155.0	336.9	40.215	265.0	336.9	42.546
50.0	336.3	39.620	160.0	336.9	40.294	270.0	336.9	42.655
55.0	336.3	39.630	165.0	336.9	40.389	275.0	336.9	42.755
60.0	336.6	39.639	170.0	336.9	40.488	280.0	336.9	42.848
65.0	336.6	39.638	175.0	336.9	40.585	285.0	336.9	42.927
70.0	336.6	39.637	180.0	336.9	40.691	290.0	336.9	42.983
75.0	336.6	39.636	185.0	336.9	40.792	295.0	336.9	43.021
80.0	336.6	39.645	190.0	336.9	40.898	300.0	336.9	43.034
85.0	336.6	39.652	195.0	336.9	41.006	305.0	336.9	43.035
90.0	336.6	39.660	200.0	336.9	41.116	310.0	336.9	43.037
95.0	336.6	39.667	205.0	336.9	41.230	315.0	336.9	43.036
100.0	336.6	39.680	210.0	336.9	41.340	320.0	336.9	43.033
105.0	336.6	39.696	215.0	336.9	41.450			

OBSERVED EXPERIMENTAL DATA FROM RUN 71

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	82.1	--.---	115.0	337.0	34.185	230.0	337.2	35.939
5.0	---.-	--.---	120.0	337.0	34.208	235.0	337.2	36.043
10.0	308.8	29.440	125.0	337.0	34.233	240.0	337.2	36.150
15.0	329.9	32.813	130.0	337.0	34.262	245.0	337.2	36.249
20.0	335.0	33.673	135.0	337.1	34.302	250.0	337.2	36.354
25.0	336.0	33.946	140.0	337.2	34.345	255.0	337.2	36.460
30.0	336.6	34.043	145.0	337.2	34.398	260.0	337.7	36.571
35.0	336.7	34.074	150.0	337.2	34.461	265.0	337.2	36.683
40.0	336.8	34.087	155.0	337.2	34.533	270.0	337.2	36.794
45.0	336.9	34.099	160.0	337.2	34.611	275.0	337.2	36.915
50.0	336.9	34.109	165.0	337.2	34.694	280.0	337.2	37.029
55.0	337.0	34.108	170.0	337.2	34.778	285.0	337.2	37.153
60.0	337.0	34.108	175.0	337.2	34.868	290.0	337.2	37.272
65.0	337.0	34.108	180.0	337.2	34.957	295.0	337.2	37.376
70.0	337.0	34.110	185.0	337.1	35.047	300.0	337.2	37.456
75.0	337.0	34.113	190.0	337.1	35.141	305.0	337.2	37.499
80.0	337.0	34.115	195.0	337.1	35.236	310.0	337.7	37.522
85.0	337.0	34.124	200.0	337.1	35.331	315.0	337.2	37.524
90.0	337.0	34.130	205.0	337.1	35.432	320.0	337.2	37.530
95.0	337.0	34.135	210.0	337.1	35.534	325.0	337.2	37.529
100.0	337.0	34.145	215.0	337.2	35.634	330.0	337.2	37.528
105.0	337.0	34.152	220.0	337.2	35.733	335.0	337.2	37.526
110.0	337.0	34.165	225.0	337.2	35.836			

OBSERVED EXPERIMENTAL DATA FROM RUN 72

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	84.9	--.---	500.0	337.5	40.432	1000.0	337.5	41.330
10.0	---.-	--.---	510.0	337.4	40.427	1010.0	337.5	41.380
20.0	331.3	39.341	520.0	337.4	40.426	1020.0	337.5	41.436
30.0	336.9	40.639	530.0	337.4	40.423	1030.0	337.5	41.483
40.0	337.4	40.734	540.0	337.4	40.423	1040.0	337.5	41.541
50.0	337.5	40.742	550.0	337.4	40.419	1050.0	337.5	41.596
60.0	337.5	40.744	560.0	337.4	40.420	1060.0	337.5	41.652
70.0	337.5	40.736	570.0	337.4	40.420	1070.0	337.5	41.713
80.0	337.5	40.730	580.0	337.4	40.422	1080.0	337.5	41.773
90.0	337.5	40.720	590.0	337.4	40.423	1090.0	337.5	41.832
100.0	337.5	40.716	600.0	337.4	40.423	1100.0	337.5	41.886
110.0	337.6	40.710	610.0	337.3	40.424	1110.0	337.5	41.955
120.0	337.6	40.700	620.0	337.3	40.425	1120.0	337.5	42.019
130.0	337.7	40.695	630.0	337.3	40.428	1130.0	337.5	42.079
140.0	337.7	40.682	640.0	337.3	40.434	1140.0	337.5	42.136
150.0	337.7	40.675	650.0	337.3	40.438	1150.0	337.5	42.199
160.0	337.7	40.669	660.0	337.3	40.448	1160.0	337.5	42.257
170.0	337.7	40.662	670.0	337.3	40.460	1170.0	337.5	42.316
180.0	337.7	40.651	680.0	337.3	40.465	1180.0	337.5	42.374
190.0	337.7	40.645	690.0	337.3	40.481	1190.0	337.5	42.427
200.0	337.7	40.640	700.0	337.3	40.485	1200.0	337.5	42.484
210.0	337.7	40.630	710.0	337.3	40.497	1210.0	337.5	42.534
220.0	337.7	40.625	720.0	337.3	40.513	1220.0	337.5	42.586
230.0	337.7	40.615	730.0	337.3	40.520	1230.0	337.5	42.625
240.0	337.7	40.610	740.0	337.3	40.524	1240.0	337.5	42.674
250.0	337.7	40.607	750.0	337.3	40.542	1250.0	337.5	42.717
260.0	337.6	40.595	760.0	337.4	40.553	1260.0	337.5	42.762
270.0	337.6	40.588	770.0	337.4	40.565	1270.0	337.5	42.801
280.0	337.6	40.581	780.0	337.4	40.585	1280.0	337.5	42.839
290.0	337.6	40.580	790.0	337.4	40.601	1290.0	337.5	42.877
300.0	337.6	40.573	800.0	337.4	40.616	1300.0	337.5	42.902
310.0	337.5	40.569	810.0	337.4	40.634	1310.0	337.5	42.929
320.0	337.5	40.560	820.0	337.4	40.661	1320.0	337.5	42.954
330.0	337.5	40.557	830.0	337.4	40.685	1330.0	337.5	42.981
340.0	337.5	40.552	840.0	337.4	40.704	1340.0	337.5	43.009
350.0	337.5	40.548	850.0	337.4	40.732	1350.0	337.5	43.027
360.0	337.6	40.540	860.0	337.5	40.762	1360.0	337.5	43.036
370.0	337.6	40.531	870.0	337.5	40.793	1370.0	337.5	43.049
380.0	337.6	40.494	880.0	337.5	40.827	1380.0	337.5	43.060
390.0	337.6	40.484	890.0	337.3	40.863	1390.0	337.5	43.074
400.0	337.6	40.480	900.0	337.3	40.898	1400.0	337.5	43.078
410.0	337.6	40.470	910.0	337.3	40.932	1410.0	337.5	43.085
420.0	337.6	40.464	920.0	337.3	40.971	1420.0	337.5	43.082
430.0	337.6	40.462	930.0	337.3	41.013	1430.0	337.5	43.082
440.0	337.6	40.457	940.0	337.3	41.050	1440.0	337.5	43.086
450.0	337.6	40.450	950.0	337.3	41.088	1450.0	337.5	43.085
460.0	337.5	40.436	960.0	337.3	41.134	1460.0	337.5	43.083
470.0	337.5	40.435	970.0	337.3	41.179	1470.0	337.5	43.082
480.0	337.5	40.432	980.0	337.3	41.220	1480.0	337.5	43.077
490.0	337.5	40.428	990.0	337.5	41.274			

OBSERVED EXPERIMENTAL DATA FROM RUN 73

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	81.1	--.---	90.0	346.1	26.277	180.0	346.1	28.378
5.0	---.-	--.---	95.0	346.1	26.316	185.0	346.1	28.536
10.0	325.2	22.429	100.0	346.1	26.366	190.0	346.1	28.691
15.0	341.1	25.183	105.0	346.1	26.423	195.0	346.1	28.854
20.0	344.1	25.671	110.0	346.1	26.505	200.0	346.1	29.011
25.0	345.1	25.948	115.0	346.1	26.597	205.0	346.1	29.174
30.0	345.8	26.050	120.0	346.1	26.702	210.0	346.2	29.329
35.0	346.0	26.117	125.0	346.1	26.815	215.0	346.2	29.482
40.0	346.0	26.145	130.0	346.1	26.941	220.0	346.2	29.619
45.0	346.0	26.160	135.0	346.1	27.072	225.0	346.2	29.714
50.0	346.1	26.166	140.0	346.2	27.213	230.0	346.2	29.756
55.0	346.1	26.176	145.0	346.2	27.352	235.0	346.2	29.773
60.0	346.1	26.182	150.0	346.2	27.493	240.0	346.2	29.780
65.0	346.2	26.191	155.0	346.2	27.639	245.0	346.2	29.782
70.0	346.2	26.199	160.0	346.2	27.788	250.0	346.2	29.779
75.0	346.2	26.211	165.0	346.2	27.936	255.0	346.2	29.780
80.0	346.2	26.222	170.0	346.1	28.083	260.0	346.2	29.778
85.0	346.2	26.243	175.0	346.1	28.233	265.0	346.2	29.776

OBSERVED EXPERIMENTAL DATA FROM RUN 75

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	81.8	--.---	110.0	346.0	40.132	220.0	346.1	42.013
5.0	---.-	--.---	115.0	346.0	40.212	225.0	346.1	42.110
10.0	329.7	35.626	120.0	346.0	40.286	230.0	346.1	42.220
15.0	339.6	38.686	125.0	346.0	40.339	235.0	346.0	42.345
20.0	344.0	39.471	130.0	346.0	40.417	240.0	346.0	42.482
25.0	345.4	39.689	135.0	346.0	40.505	245.0	346.0	42.624
30.0	345.9	39.743	140.0	346.1	40.590	250.0	346.0	42.782
35.0	345.9	39.763	145.0	346.1	40.687	255.0	346.0	42.940
40.0	345.9	39.773	150.0	346.1	40.789	260.0	346.0	43.085
45.0	345.9	39.781	155.0	346.1	40.890	265.0	346.0	43.201
50.0	345.9	39.786	160.0	346.0	40.982	270.0	346.0	43.268
55.0	345.9	39.792	165.0	346.0	41.081	275.0	346.0	43.294
60.0	346.0	39.802	170.0	346.0	41.170	280.0	346.0	43.313
65.0	346.0	39.811	175.0	346.0	41.269	285.0	346.0	43.318
70.0	346.0	39.790	180.0	346.0	41.371	290.0	346.0	43.320
75.0	346.0	39.798	185.0	346.0	41.446	295.0	346.0	43.316
80.0	346.0	39.813	190.0	346.0	41.513	300.0	346.0	43.319
85.0	346.0	39.834	195.0	346.0	41.594	305.0	345.9	43.314
90.0	346.0	39.870	200.0	346.0	41.673	310.0	345.9	43.307
95.0	346.0	39.919	205.0	346.0	41.753	315.0	345.9	43.304
100.0	346.0	39.979	210.0	346.1	41.832			
105.0	346.0	40.053	215.0	346.1	41.920			

OBSERVED EXPERIMENTAL DATA FROM RUN 76

TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM	TIME MIN	TEMP. °F	HEIGHT CM
.0	79.6	--.---	380.0	345.3	40.783	760.0	345.1	41.892
10.0	322.5	37.515	390.0	345.3	40.781	770.0	345.1	41.965
20.0	343.8	40.786	400.0	345.3	40.773	780.0	345.1	42.050
30.0	345.1	41.016	410.0	345.3	40.774	790.0	345.1	42.132
40.0	345.2	41.035	420.0	345.3	40.780	800.0	345.1	42.212
50.0	345.3	41.033	430.0	345.3	40.781	810.0	345.1	42.290
60.0	345.3	41.029	440.0	345.3	40.786	820.0	345.1	42.373
70.0	345.3	41.026	450.0	345.3	40.792	830.0	345.1	42.453
80.0	345.3	41.019	460.0	345.3	40.795	840.0	345.1	42.532
90.0	345.3	41.017	470.0	345.3	40.806	850.0	345.1	42.609
100.0	345.3	41.005	480.0	345.3	40.817	860.0	345.1	42.680
110.0	345.3	40.997	490.0	345.3	40.824	870.0	345.1	42.756
120.0	345.3	40.988	500.0	345.4	40.832	880.0	345.0	42.828
130.0	345.3	40.980	510.0	345.4	40.837	890.0	345.0	42.893
140.0	345.3	40.971	520.0	345.4	40.850	900.0	345.0	42.942
150.0	345.3	40.942	530.0	345.4	40.870	910.0	345.0	43.009
160.0	345.3	40.932	540.0	345.4	40.885	920.0	345.1	43.063
170.0	345.3	40.928	550.0	345.4	40.910	930.0	345.1	43.124
180.0	345.3	40.917	560.0	345.4	40.933	940.0	345.1	43.167
190.0	345.3	40.911	570.0	345.4	40.953	950.0	345.1	43.222
200.0	345.3	40.901	580.0	345.4	40.971	960.0	345.1	43.270
210.0	345.3	40.888	590.0	345.3	41.002	970.0	345.1	43.309
220.0	345.3	40.874	600.0	345.2	41.032	980.0	345.1	43.339
230.0	345.3	40.865	610.0	345.2	41.067	990.0	345.1	43.372
240.0	345.3	40.864	620.0	345.2	41.106	1000.0	345.1	43.393
250.0	345.3	40.857	630.0	345.2	41.141	1010.0	345.1	43.418
260.0	345.3	40.844	640.0	345.2	41.180	1020.0	345.1	43.432
270.0	345.3	40.841	650.0	345.2	41.225	1030.0	345.1	43.452
280.0	345.3	40.833	660.0	345.2	41.277	1040.0	345.1	43.467
290.0	345.3	40.828	670.0	345.2	41.321	1050.0	345.1	43.473
300.0	345.3	40.820	680.0	345.2	41.370	1060.0	345.1	43.483
310.0	345.3	40.816	690.0	345.2	41.421	1070.0	345.1	43.489
320.0	345.3	40.808	700.0	345.2	41.478	1080.0	345.1	43.498
330.0	345.3	40.800	710.0	345.2	41.547	1090.0	345.1	43.494
340.0	345.3	40.798	720.0	345.2	41.609	1100.0	345.1	43.487
350.0	345.3	40.796	730.0	345.1	41.675	1110.0	345.1	43.485
360.0	345.3	40.793	740.0	345.1	41.747			
370.0	345.3	40.788	750.0	345.1	41.820			

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