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ORNL-2150
C-84 – Reactors-Special
Features of Aircraft Reactors

A PHYSICAL PROPERTY SUMMARY FOR ANP FLUORIDE MIXTURES

S. I. Cohen
W. D. Powers
N. D. Greene

OAK RIDGE NATIONAL LABORATORY
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ORNL-2150
C-84 Aircraft Reactors

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Reactor Experimental Engineering Division

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by

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FOREWORD

For the past five years the Heat Transfer and Physical Properties Section of ORNL has investigated some of the physical properties of fluoride mixtures of specific interest to the ANP Project. Particular attention has been given to the "thermal properties", namely, the density, heat capacity, viscosity, and thermal conductivity, because of the important role that they play in the heat and momentum transfer processes in ANP reactors. A limited study of the electrical conductivity and surface tension of molten fluorides was also conducted.

During the first few years of this research task, a large part of the group effort was directed toward the investigation and evaluation of techniques and devices by which these properties could be measured accurately in the temperature range of about 1000°F to 1800°F. The necessity of operating equipment at such high temperature levels as well as in controlled inert atmospheres often made it impossible to use prosaic property equipment. Consequently many new devices had to be developed.

The earlier summaries of the physical properties measurements for fluorides were presented in the form of ORNL memoranda; some of these data were designated as "preliminary" because measuring techniques were still in the process of being refined and because the chemical purities of fluoride samples were at times inadequate. The experimental data summarized in this report in most cases were obtained by two independent measurement techniques; also, it is believed that most of the samples used were relatively pure. Although much progress has been made in the art and science of making these difficult measurements, further refinements should be and are being made, particularly in the case of thermal conductivity measurements for liquids.

General interpretations and correlations of these physical property data in terms of the known theoretical and semi-theoretical relations have been and are being made for the fluoride measurements. Such studies have already been reported in some of the topical reports on individual properties (see for example, ORNL 1702 and 1956). Additional topical reports on thermal properties are in the process of preparation.

In general, the molten fluorides are good heat transfer media because their thermal conductivities, thermal capacities per unit volume, and densities are high and their viscosities and vapour pressures are reasonable; the following tabulation gives the approximate ranges over which each of the thermal properties varies:

thermal conductivity: 0.5 to 2.6 Btu/hr-ft^2-($^\circ$F/ft)

thermal capacity per unit volume: 0.7 to 1.3 cal/cm^3-$^\circ$C

density: 2 to 4.5 gm/cc

viscosity: 2 to 12 centipoise

These thermal properties influence the heat and momentum transfer in reactor cores and heat exchangers in more or less complicated ways depending upon the system geometry and the fluid flow regime. Hence, it is not possible to rate a heat transfer fluid on the basis of its properties alone. However, detailed studies of the effectiveness of molten fluorides as reactor coolants and fuels (for a range of system geometries and flow conditions) have been conducted and presented in the ANP literature (see for example references 48 and 49).

Within the last year or two, several external organizations have initiated thermal property research on fluoride mixtures. The National Bureau of Standards and the Naval Research Laboratory have made heat capacity measurements and the

Mound Laboratory has made density and viscosity determinations. The Battelle Memorial Institute and the Mound Laboratory have started thermal conductivity research on these liquids.

The Heat Transfer and Physical Properties Section wishes to acknowledge the cooperation received from two of the Laboratory's Divisions. The former Materials Chemistry Division prepared the many samples which were needed in the study; valuable information on melting temperatures, vapor pressures, and phase diagrams of molten fluoride mixtures were also supplied. The Metallurgy Division performed complicated welding tasks in connection with some of the physical property devices.

H. F. Poppendiek

H. F. Poppendiek

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SUMMARY

This report presents a summary of certain physical properties that have been determined experimentally on the fluoride mixtures that have been formulated within the ANP program at ORNL (Refs. 1, 2). These properties include the density, enthalpy, heat capacity, heat of fusion, thermal conductivity, viscosity, Prandtl number, electrical conductivity and surface tension. In addition to the experimental data, values have been predicted for the heat capacity and density of the other mixtures from the correlations of these properties. Estimates of the viscosity have also been made for a number of the mixtures on which no experimental data were available.

INTRODUCTION

This report presents a compilation of certain physical properties that have been determined experimentally or predicted from correlations of experimental data for mixtures of fluorides that have been formulated within the ANP program (Ref. 1, 2). Each individual page of the tabulation is devoted to a summary of all of the known properties for a mixture together with the composition in mole and weight percent, the average molecular weight, and the liquidus temperature.

This introductory section will present brief discussions of each of the properties, providing short descriptions of the experimental systems used and statements regarding the accuracy of the data. Also included in this section is a tabulation of the mixture numbers arranged according to chemical system.

A. Density.

Density measurements have been made on sixteen molten fluoride mixtures. In addition, about nine mixtures containing BeF_2 have been studied at Mound Laboratory[1]. Measurements were made by the buoyancy principle using a plummet suspended in the molten salt from an analytical balance. An error analysis indicated that the values reported are within $\pm 5\%$ of the true values. The results are reported in gms/cc as a function of ^{o}C and in lbs/ft^3 as a function of ^{o}F.

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[1] A large number of fluoride mixtures other than those reported here have been studied at Mound Laboratory. However, the contents of this report will be limited to mixtures which have been assigned composition numbers within the ANP project at this Laboratory.

Work at Mound is being carried out by B. C. Blanke, aided at present by E. N. Bousquet and E. L. Murphy and in the past by L. V. Jones, K. W. Foster and R. E. Vallee. The density (and viscosity) program there at present involves a thorough investigation of systems containing the alkali fluorides with BeF_2 and UF_4.

Predicted values are given for all the mixtures for which densities have not been experimentally studied. The values given for non-BeF_2 mixtures are based on an empirical correlation using the experimental data available (Ref. 16). The densities of mixtures containing BeF_2 have been predicted from a similarly developed but slightly different correlation using the experimental data taken on BeF_2-bearing mixtures at Mound Laboratory. These relationships correlate the experimental values to within $\pm 5\%$ and it is felt that the predicted values are of comparable accuracy.

Solid densities at room temperature have been measured for fifteen mixtures. The measurements were made by the buoyancy principle; samples of salt were weighed in air and then in toluene. An error analysis indicated errors of no more than $\pm 5\%$. Solid densities were calculated for the remainder of the mixtures by a simple formula involving the method of mixtures (Ref. 16). These calculated values agreed within $\pm 10\%$ with the experimental values available in most cases; however, a larger deviation was observed in one case which may be attributed to structural complexities.

Values of the volumetric coefficient of liquid expansion, β_L, were calculated from the experimental or predicted density data using the equation:

$$\beta_L = - \frac{1}{\rho} \left(\frac{d\rho}{dT} \right)_P$$

where $\left(\frac{d\rho}{dT} \right)_P$ is the slope of the density-temperature function. Values have been calculated at 700°C except when specified otherwise.

B. Heat Capacity.

The enthalpies, heats of fusion and heat capacities of twenty-one salt mixtures have been determined experimentally by dropping samples at various temperatures into

calorimeters and then measuring the amount of heat liberated. The heat capacity is the slope of the enthalpy-temperature relation thus obtained. Two types of calorimeters have been used. One was an ice calorimeter in which the heat given up by the sample melted ice in an ice-water mixture. The amount of ice melted was proportional to the amount of heat transferred and was determined by the volume change in the ice-water mixture. The other calorimeter was a copper block device. The amount of heat liberated by the sample was measured by the temperature rise of a large mass of copper. From the experimental values obtained for the particular fluorides studied, correlations have been found which enable one to predict the heat capacities of other mixtures (Ref. 4). Hence, estimates have been made of the heat capacities of all the mixtures not studied experimentally. The accuracies of the heat capacities determined experimentally are believed to be within $\pm 10\%$ of the true values; the predicted values are believed to be in error by no more than $\pm 20\%$.

The heats of fusion for the fluoride mixtures were obtained directly from the enthalpy-temperature relations.

C. Thermal Conductivity.

Thermal conductivities of seven mixtures in the liquid state have been measured by variable gap devices (Ref. 11). The conductivity is determined by measuring the temperature gradient across a liquid layer as well as the heat flow through it. The layer thickness is varied so that it is possible to eliminate the effect of interface resistances that may exist in the cell. The thermal conductivities of several liquids were determined in a constant gap device. Great difficulty was encountered when using this device because it was difficult to fill the cell completely with the sample liquid. Two methods have been used to measure solid

thermal conductivities; one is a steady state technique in which heat is passed through a slab of the solid salt, and the other is a transient method in which the time-temperature behavior of a solid sphere of the salt is studied.

Error analyses of liquid thermal conductivity measurements indicated that the errors were less than ±25%. It is believed that the solid thermal conductivities are known more accurately than the liquid values. Consequently, liquid conductivities in particular are considered to be of a preliminary nature at this time. Improved conductivity devices are being designed to increase the accuracy. The temperature dependence of the conductivities of fluoride mixtures is currently being studied; the results indicate that the variation is not a large one. Thus, only mean conductivities are reported here.

D. Viscosity.

Viscosity measurements have been made on thirty-eight molten fluoride mixtures. Thirty-two of these were studied at ORNL and nine at Mound Laboratory[2], three being investigated at both laboratories.[3] Measurements at ORNL were made with two devices; one of these is a capillary efflux viscometer and the other is a modified Brookfield rotational device. Measurements were made at Mound with a rotational viscometer developed there.

The values are presented in c.g.s. units and in engineering units. Kinematic viscosities are given as well as absolute viscosities. In addition, the viscosity of each salt is presented in terms of the usual exponential formula for viscosity:

$$\mu = A\, e^{B/T^{\circ}K}$$

---

[2] A number of measurements have been made at Mound which are not reported here (see footnote 1, page 4).

[3] The results obtained independently at the two laboratories were in satisfactory agreement; the average values are reported here.

Agreement between the values determined by the two different instruments indicated that the results reported are within ±10% of the true values.

Predicted viscosities are given for a number of salts on which no measurements were made. These estimates were based on measurements on fluorides of similar compositions. These predicted values are probably within ±20% of the actual values.

A blank sheet of graph paper specially prepared for plotting viscosity data is furnished at the end of this report to facilitate interpolation and extrapolation of the values reported.

E. Electrical Conductivity.

The data on electrical conductivity included in this report were primarily obtained by means of a current-potential type cell (Ref. 13). This device measured directly the amount of current flow for a given voltage drop across a molten salt sample. Measurements were made on five molten fluoride mixtures. Since redeterminations of the conductivities of molten $LiNO_3$, KNO_3, and NaOH were made within ±10% of the values reported in the literature, it was felt that the fluoride measurements were in error by no more than this amount.

F. Surface Tension.

Surface tension measurements were made on one fluoride mixture, Composition 30, using a system consisting of a platinum ring supported from a calibrated wire spring which could be raised and lowered with a vernier (Ref. 21). A thermocouple probe was used to measure the surface temperature of the molten fluoride as accurately as possible.

G. Accuracy Summary.

The following is a summary of the accuracy limits for the properties presented in this report:

TABLE 1

	Error Limits for Experimental Measurements	Error Limits for Predicted or Estimated Values
Density (Solid)	± 5%	----
Density (Liquid)	± 5%	± 5%
Heat Capacity	±10%	±20%
Thermal Conductivity	±25%	----
Viscosity	±10%	±20%
Electrical Conductivity	±10%	----
Surface Tension	----	----

H. Tabulation of Mixtures According to Chemical System.

The following table lists the mixture numbers arranged according to chemical system.

TABLE II

Binary Coolants		Corresponding Ternary Fuels	
System	Mixtures	System	Mixtures
$NaF-ZrF_4$	28, 29, 31, 32, 34, 45, C test, 71, 83	$NaF-ZrF_4-UF_4$	27, 30, 33, 38, 39, 40, 41, 42, 44, 46, 70, 99, 108
		$NaF-ZrF_4-UF_3$	49
$NaF-BeF_2$	35, 77, 113	$NaF-BeF_2-UF_4$	1, 3, 16, 17, 36, 76, 92
$LiF-BeF_2$	74, 112	$LiF-BeF_2-UF_4$	75
LiF-NaF	100	$LiF-NaF-UF_4$	18, 101
LiF-KF	102	$LiF-KF-UF_4$	103
LiF-RbF	104	$LiF-RbF-UF_4$	105
$KF-BeF_2$	114, 116		
$RbF-BeF_2$	115		
		$NaF-KF-UF_4$	2, 2a, 4, 7
		$NaF-PbF_2-UF_4$	5
		$NaF-RbF-UF_4$	13
		$RbF-ZrF_4-UF_4$	87, 95
		$LiF-ZrF_4-UF_4$	93
		$KF-ZrF_4-UF_4$	22, 94

Ternary Coolants		Corresponding Quaternary Fuels	
System	Mixtures	System	Mixtures
NaF-KF-LiF	12	$NaF-KF-LiF-UF_4$	14, 106, 107
		$NaF-KF-LiF-ThF_4$	23
$NaF-KF-BeF_2$	6, 90	$NaF-KF-BeF_2-UF_4$	15
$NaF-KF-ZrF_4$	20, 24	$NaF-KF-ZrF_4-UF_4$	19,21,25,25a,26,110
$NaF-LiF-ZrF_4$	73, 80, 81	$NaF-LiF-ZrF_4-UF_4$	72, 82, 86, 91
$NaF-LiF-BeF_2$	47,78,84,88,89,96,97	$NaF-LiF-BeF_2-UF_4$	79, 85, 98
		$NaF-RbF-BeF_2-UF_4$	109
		$LiF-BeF_2-ThF_4-UF_4$	111

Binary Fuels	
System	Mixtures
$NaF-UF_4$	37, 43
$NaF-ThF_4$	48

TABULATED FLUORIDE PROPERTY DATA

Note: Mixture numbers 50 through 69 have been omitted. These numbers have been reserved by the ANP Chemistry Section for hydroxides (Ref. 1)

SECRET

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
1	BeF_2	12	7.50	75.2	514°C (957°F)
	NaF	76	42.41		
	UF_4	12	50.09		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.77

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 3.62 - 0.00075T$ (Ref. 3)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 226.8 - 0.0260T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.42

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (250° - 465°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -5 + 0.219T$ (Ref. 4)

Heat Capacity (cal/gm °C) $c_p^* = 0.22$

Heat Capacity at 300°C (572°F) $c_p^* = 0.22$

LIQUID (520° - 990°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -35 + 0.325T$

Heat Capacity (cal/gm °C) $c_p^* = 0.32$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.32$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 24$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
700	7.2* (Ref. 3)	2.33	1300	17.1*	0.0886
800	4.5*	1.50	1500	10.2*	0.0543

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

SECRET

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
2	NaF	46.5	16.14	121.0	530°C (986°F)
	KF	26.0	12.49		
	UF_4	27.5	71.37		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.7* (Ref. 5)

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 4.70 - 0.00115T$ (Ref. 6)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 294.7 - 0.0399T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.96

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (240°-480°C)

Enthalpy (cal/gm)	$H_T - H_{0°C}^* = -1 + 0.149T$ (Ref. 4)
Heat Capacity (cal/gm °C)	$c_p^* = 0.15$
Heat Capacity at 300°C (572°F)	$c_p^* = 0.15$

LIQUID (540°-1000°C)

Enthalpy (cal/gm)	$H_T - H_{0°C}^* = -13 + 0.230T$
Heat Capacity (cal/gm °C)	$c_p^* = 0.23$
Heat Capacity at 700°C (1292°F)	$c_p^* = 0.23$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 31$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F) 0.5 (Liquid) (Ref. 7)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	17.3* (Ref. 8)	4.33	1100	43.6*	0.1768
700	9.8*	2.52	1300	23.5*	0.0983
800	6.3*	1.67	1500	14.3*	0.0616
900	4.35*	1.19			

Exponential Form (centipoises) $\mu = 0.0767e^{4731/T°K}$

PRANDTL NUMBER 20 at 1100°F, 11 at 1300°F, 6.6 at 1500°F

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
2a	NaF	48.2	17.67	114.3	558°C (1036°F)
	KF	26.8	13.65		
	UF_4	25.0	68.68		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.53

LIQUID (ρ = gm/cc, T = °C) ρ^* = 4.54 - 0.0011T (Ref. 15)

LIQUID (ρ = lbs/ft^3, T = °F) ρ^* = 284.6 - 0.0381T

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.92

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T-H_{0°C}^*$ =

Heat Capacity (cal/gm °C) c_p^* =

Heat Capacity at 300°C (572°F) c_p = 0.16

LIQUID

Enthalpy (cal/gm) $H_T-H_{0°C}^*$ =

Heat Capacity (cal/gm °C) c_p^* =

Heat Capacity at 700°C (1292°F) c_p = 0.23

HEAT OF FUSION (cal/gm) $H_L-H_S^*$ =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	17.3		1100	43.6	
700	9.8		1300	23.5	
800	6.3		1500	14.3	
900	4.35				

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
3	BeF_2	60	32.87	85.8	465°C (869°F)
	NaF	25	12.23		
	UF_4	15	54.90		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.8* (Ref. 5)

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.43 - 0.00070T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 209.5 - 0.0243T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.37

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p =$

LIQUID OR GLASS (280°-1050°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -43 + 0.315T$ (Ref. 4)

Heat Capacity (cal/gm °C) $c_p^* = 0.32$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.32$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 0$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
4	NaF	35	8.77	167.6	708°C (1306°F)
	KF	20	6.93		
	UF_4	45	84.30		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 5.40

LIQUID (ρ = gm/cc, T = °C) $\rho = 5.60 - 0.00116T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 350.9 - 0.0402T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.44

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.14$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p =$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
5	NaF	60	18.67	135	465°C (869°F)
	PbF_2	23	41.78		
	UF_4	17	39.55		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 5.9* (Ref. 5)

LIQUID (ρ = gm/cc, T = °C) $\rho = 6.01 - 0.00122T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 376.5 - 0.0423T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.35

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.14$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.19$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
6	NaF	30	27.35	46.1	435°C (815°F)
	BeF_2	65	66.33		
	KF	5	6.32		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.3* (Ref. 5)

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.12 - 0.00033T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 132.7 - 0.0114T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 1.74

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.39

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.54

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
7	NaF	50	16.55	126.8	575°C (1067°F)
	KF	20	9.16		
	UF_4	30	74.28		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 5.1* (Ref. 5)

LIQUID (ρ = gm/cc, T = °C) $\rho = 4.78 - 0.00104T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 299.5 - 0.0361T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.57

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.15$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.22$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
700	10.0		1300	23.7	
800	6.65		1500	15.3	
900	4.75				

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
8	NaF	100	100	42	995°C (1823°F)

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.79* (Ref. 9)

LIQUID (ρ = gm/cc, T = °C)

LIQUID (ρ = lbs/ft^3, T = °F)

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$)

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (25° - 992°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = 0.2593T + 5.36 \times 10^{-5} T^2$ (Ref. 46)

Heat Capacity (cal/gm °C) $c_p^* = 0.2593 + 10.72 \times 10^{-5} T$

Heat Capacity at 300°C (572°F) $c_p^* = 0.291$

LIQUID (992° - 1027°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = 117.24 + 0.3810T$

Heat Capacity (cal/gm °C) $c_p^* = 0.381$

Heat Capacity at 700°C (1292°F) $c_p =$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 185.2$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
9	BeF_2	100	100	47	543°C (1009°F)

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 1.98* (Ref. 9, 10)

LIQUID (ρ = gm/cc, T = °C)

LIQUID (ρ = lbs/ft^3, T = °F)

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION (1/°C x 10^4)

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T-H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p =

LIQUID

Enthalpy (cal/gm) $H_T-H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p =

HEAT OF FUSION (cal/gm) H_L-H_S* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Composition	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
10	LiF	100	100	25.9	848°C (1558°F)

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.64*(Ref. 9)

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (0°-848°C)

Enthalpy (cal/gm)

$$H_T - H_{0°C}^* = 0.54240T + 2.0624 \times 10^{-5} T^2 - 2.4217 \times 10^{-8} T^3 + 0.40261 \times 10^{-10} T^4 - 108.00 \log_{10}(T + 273.16/273.16)$$ (Ref. 47)

Heat Capacity (cal/gm °C)

c_p^* = 0.371 at 0°C
= 0.450 at 200°C
= 0.488 at 400°C
= 0.522 at 600°C
= 0.568 at 800°C

LIQUID (848°-900°C)

Enthalpy (cal/gm)

$$H_T - H_{0°C}^* = 157.14 + 0.59777T$$

Heat Capacity (cal/gm °C)

c_p^* = 0.598

HEAT OF FUSION (cal/gm)

$H_L - H_S^*$ = 249.4

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
11	KF	100	100	58.1	856°C (1573°F)

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.51* (Ref. 9)

LIQUID (ρ = gm/cc, T = °C)

LIQUID (ρ = lbs/ft^3, T = °F)

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION (1/°C x 10^4)

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (25°-857°C)

Enthalpy (cal/gm)	$H_T - H_{0°C}^* = 0.2044T + 2.69 \times 10^{-5}T^2$ (Ref. 46)
Heat Capacity (cal/gm °C)	$c_p^* = 0.2044 + 5.38 \times 10^{-5}T$
Heat Capacity at 300°C (572°F)	$c_p^* = 0.221$

LIQUID (857°-927°C)

Enthalpy (cal/gm)	$H_T - H_{0°C}^* = 75.02 + 0.2754T$
Heat Capacity (cal/gm °C)	$c_p^* = 0.2754$
Heat Capacity at 700°C (1292°F)	c_p =

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 116.1$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
12	NaF	11.5	11.70	41.2	454°C (849°F)
	KF	42.0	59.09		
	LiF	46.5	29.21		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.6* (Ref. 5)

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 2.53 - 0.00073T$ (Ref. 16)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 158.7 - 0.0253T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.61

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (60°-454°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -2.6 + 0.271T + 9.8 \times 10^{-5}T^2$ (Ref. 4)

Heat Capacity (cal/gm °C) $c_p^* = 0.27 + 19.6 \times 10^{-5}T$

Heat Capacity at 300°C (572°F) $c_p^* = 0.33$

LIQUID (475°-875°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = 30.3 + 0.453T$

Heat Capacity (cal/gm °C) $c_p^* = 0.45$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.45$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 95$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F) 2.6 (Liquid) (Ref. 11)
2.7 (Solid sphere)(Ref. 45)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
500	9.2* (Ref. 12)	4.26	1100	12.1*	0.0923
600	4.75*	2.27	1300	6.9*	0.0547
700	2.9*	1.44	1500	4.4*	0.0363
800	1.95*	1.00			

Exponential Form (centipoises) $\mu = 0.0400e^{4170/T°K}$

PRANDTL NUMBER 2.1 at 1100°F, 1.2 at 1300°F, 0.76 at 1500°F

ELECTRICAL CONDUCTIVITY (ohm-cm)$^{-1}$ 1.34 at 1100°F, 1.58 at 1300°F, 1.80 at 1500°F (Ref. 13)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
13	NaF	53	17.40	128	490°C (914°F)
	RbF	20	16.33		
	UF_4	27	66.27		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 5.02

LIQUID (ρ = gm/cc, T = °C) $\rho = 5.05 - 0.00108T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 316.4 - 0.0374T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.53

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.15

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.21

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
14	NaF	10.9	10.21	44.9	452°C (846°F)
	KF	43.5	56.34		
	LiF	44.5	25.73		
	UF_4	1.1	7.71		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.7* (Ref. 5)

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 2.65 - 0.00090T$ (Ref. 17)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 166.4 - 0.0312T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 4.46

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (90°-450°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -9 + 0.310T$ (Ref. 4)

Heat Capacity (cal/gm °C) $c_p^* = 0.31$

Heat Capacity at 300°C (572°F) $c_p^* = 0.31$

LIQUID (500°-1000°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = 21 + 0.437T$

Heat Capacity (cal/gm °C) $c_p^* = 0.44$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.44$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 87$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F) 2.3 (Liquid) (Ref. 14)
2.0 (Solid sphere) (Ref. 45)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
500	8.8* (Ref. 12)	4.00	1100	11.6*	0.0876
600	4.6*	2.18	1300	6.6*	0.0525
700	2.75*	1.36	1500	4.2*	0.0351
800	1.85*	0.96			

Exponential Form (centipoises) $\mu = 0.0348e^{4265/T°K}$

PRANDTL NUMBER 2.2 at 1100°F; 1.3 at 1300°F, 0.80 at 1500°F

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
15	NaF	29.5	24.60	50.3	433°C (811°F)
	BeF_2	64.0	59.75		
	KF	4.9	5.66		
	UF_4	1.6	9.99		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.5* (Ref. 5)

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.26 - 0.00036T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 141.5 - 0.0125T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 1.80

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.36$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.51$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
16	NaF	34.0	21.00	68.0	550°C (1022°F)
	BeF_2	57.5	39.74		
	UF_4	8.5	39.26		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.99

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.90 - 0.00054T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 181.6 - 0.0187T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.14

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.28

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.39

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
17	NaF	47	39.48	50.0	395°C (743°F)
	BeF_2	51	47.96		
	UF_4	2	12.56		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.6* (Ref. 5)

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.39 - 0.00040T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 149.6 - 0.0139T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 1.89

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.35

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.49

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	16.5		1100	42.4	
700	8.0		1300	18.9	
800	4.4		1500	9.8	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
18	NaF	45	19.57	96.5	506°C (943°F)
	LiF	33	8.87		
	UF_4	22	71.56		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 5.0* (Ref. 5)

LIQUID (ρ = gm/cc, T = °C) $\rho = 4.54 - 0.00101T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 284.5 - 0.035T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.64

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.19$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.26$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
19	NaF	5	1.94	108.2	405°C (761°F)
	KF	51	27.38		
	ZrF_4	42	64.88		
	UF_4	2	5.80		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.67

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 3.78 - 0.00109T$ (Ref. 18)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 237.2 - 0.0378T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.48 (600°C)

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.18$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.25$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
500	11.0		1100	16.0	
600	6.4		1300	10.3	
700	4.3		1500	7.6	
800	3.25				

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
20	NaF	5	2.01	104.2	425°C (797°F)
	KF	52	28.99		
	ZrF_4	43	69.00		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.57

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.38 - 0.00084T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 211.9 - 0.0291T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.02

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.19$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.26$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
500	10.5* (Ref. 19)	3.57	1100	15.2*	0.0850
600	6.1*	2.13	1300	9.8*	0.0566
700	4.1*	1.47	1500	7.1*	0.0424
800	3.1*	1.15			

Exponential Form (centipoises) $\mu = 0.161e^{3171/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
21	NaF	4.8	1.80	112.1	540°C (1004°F)
	KF	50.1	25.96		
	ZrF_4	41.3	61.59		
	UF_4	3.8	10.65		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.76

LIQUID (ρ = gm/cc, T = °C) ρ^* = 4.27 - 0.00163T (Ref. 18)

LIQUID (ρ = lbs/ft^3, T = °F) ρ^* = 268.3 - 0.0565T

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 5.51 (800°C)

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm)	$H_T-H_{0°C}$* =
Heat Capacity (cal/gm °C)	c_p* =
Heat Capacity at 300°C (572°F)	c_p =

LIQUID (510°-890°C)**

Enthalpy (cal/gm)	$H_T-H_{0°C}$* = -14.5 + 0.277T (Ref. 4)
Heat Capacity (cal/gm °C)	c_p* = 0.28
Heat Capacity at 700°C (1292°F)	c_p* = 0.28

HEAT OF FUSION (cal/gm) H_L-H_S* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	6.7		1100	16.9	
700	4.5		1300	10.8	
800	3.4		1500	8.0	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

**No discontinuity was noted in the temperature-enthalpy relationship in this temperature range.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
22	KF	46	21.75	122.9	605°C (1121°F)
	ZrF_4	50	68.03		
	UF_4	4	10.22		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.90

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.69 - 0.00089T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 231.3 - 0.0309T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.91

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.17$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.24$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
21	NaF	4.8	1.80	112.1	540°C (1004°F)
	KF	50.1	25.96		
	ZrF_4	41.3	61.59		
	UF_4	3.8	10.65		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.76

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 4.27 - 0.00163T$ (Ref. 18)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 268.3 - 0.0565T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 5.51 (800°C)

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p =$

LIQUID (510°-890°C)**

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -14.5 + 0.277T$ (Ref. 4)

Heat Capacity (cal/gm °C) $c_p^* = 0.28$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.28$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	6.7		1100	16.9	
700	4.5		1300	10.8	
800	3.4		1500	8.0	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

**No discontinuity was noted in the temperature-enthalpy relationship in this temperature range.

[redacted] [redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
22	KF	46	21.75	122.9	605°C (1121°F)
	ZrF_4	50	68.03		
	UF_4	4	10.22		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.90

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.69 - 0.00089T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 231.3 - 0.0309T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.91

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.17$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.24$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted] [redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
23	KF	41.8	56.61	42.9	450°C (842°F)
	NaF	11.4	11.16		
	LiF	46.2	27.92		
	ThF_4	0.6	4.31		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.53

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.52 - 0.00070T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 158.1 - 0.0243T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.45

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.32$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.45$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
500	9.2		1100	12.1	
600	4.75		1300	6.9	
700	2.9		1500	4.4	
800	1.95				

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
24	KF	18	10.20	102.5	450°C (842°F)
	NaF	36	14.75		
	ZrF_4	46	75.04		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.80

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.59 - 0.00087T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 225.1 - 0.0302T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.92

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.19$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.27$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	7.15		1100	17.9	
700	4.4		1300	10.5	
800	3.05		1500	6.9	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
25	KF	17.4	9.20	109.9	545°C (1013°F)
	NaF	34.7	13.25		
	ZrF_4	44.4	67.55		
	UF_4	3.5	10.00		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.97

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 3.78 - 0.00091T$ (Ref. 18)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 237.0 - 0.0315T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.90

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.18$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.25$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	8.1		1100	20.3	
700	5.2		1300	12.1	
800	3.6		1500	8.0	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
25a	KF	17.6	13.65	107.7	545°C (1013°F)
	NaF	35.1	9.47		
	ZrF_4	44.8	69.55		
	UF_4	2.5	7.34		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.92

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 3.65 - 0.00080T$ (Ref. 18)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 228.7 - 0.0277T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.59

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.19$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.26$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	8.1		1100	20.3	
700	5.1		1300	12.1	
800	3.5		1500	8.0	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
26	KF	14.0	7.28	111.6	540°C (1004°F)
	NaF	36.6	13.76		
	ZrF_4	45.6	68.27		
	UF_4	3.8	10.69		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.02

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.82 - 0.00091T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 239.5 - 0.0315T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.87

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.18$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.25$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	8.2		1100	20.6	
700	5.3		1300	12.6	
800	3.7		1500	8.5	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
27	NaF	46	16.73	115.5	510°C (950°F)
	ZrF_4	50	72.39		
	UF_4	4	10.88		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.17

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.97 - 0.00093T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 248.9 - 0.0322T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.79

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.18$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.25$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F) 0.6 (solid sphere and slab)(Ref. 45)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	8.9		1100	22.3	
700	5.7		1300	13.6	
800	3.9		1500	9.0	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
28	NaF	48	18.82	107.1	515°C (959°F)
	ZrF_4	52	81.18		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.99

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.79 - 0.00090T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 237.6 - 0.0312T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.86

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.19$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.27$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	8.5		1100	21.5	
700	5.3		1300	12.5	
800	3.5		1500	8.0	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
29	NaF	42.2	15.49	114.3	570°C (1058°F)
	ZrF_4	57.8	84.51		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.06

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.86 - 0.00092T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 242.0 - 0.0319T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.87

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.19$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.26$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
30	NaF	50	19.01	110.5	520°C (968°F)
	ZrF_4	46	69.62		
	UF_4	4	11.37		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.09* (Ref. 10)

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.93 - 0.00093T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 246.4 - 0.0322T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.84

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (340°-500°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -12.6 + 0.215T$ (Ref. 4)

Heat Capacity (cal/gm °C) $c_p^* = 0.22$

Heat Capacity at 300°C (572°F) $c_p^* = 0.22$

LIQUID (540°-894°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = 2.1 + 0.3178T - 4.28 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.3178 - 8.56 \times 10^{-5}T$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.258$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 57$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F) 0.5 (Solid slab) (Ref. 45)

1.3 (Liquid) (Ref. 14)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	8.5* (Ref. 20)	2.52	1100	21.3*	0.1009
700	5.4*	1.65	1300	12.8*	0.0625
800	3.7*	1.16	1500	8.5*	0.0430
850	3.2*	1.02			

Exponential Form (centipoises) $\mu = 0.0981e^{3895/T°K}$

PRANDTL NUMBER 4.4 at 1100°F, 2.5 at 1300°F, 1.6 at 1500°F

ELECTRICAL CONDUCTIVITY $(ohm\text{-}cm)^{-1}$ 0.87 at 1100°F, 1.16 at 1300°F, 1.45 at 1500°F (Ref. 13)

SURFACE TENSION (dynes/cm) 157 at 530°C, 132 at 630°C, 115 at 730°C (Ref. 21)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
31	NaF	50	20.08	104.6	510°C (950°F)
	ZrF_4	50	79.92		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.11* (Ref. 22)

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 3.79 - 0.00093T$ (Ref. 23)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 237.6 - 0.0322T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.96

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (54°-488°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = 0.1 + 0.1798T + 2.69 \times 10^{-5}T^2$ (Ref.4)

Heat Capacity (cal/gm °C) $c_p^* = 0.1798 + 5.38 \times 10^{-5}T$

Heat Capacity at 300°C (572°F) $c_p^* = 0.196$

LIQUID (546°-899°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -5.3 + 0.3508T - 5.39 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.3508 - 10.79 \times 10^{-5}T$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.275$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 61$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	8.4* (Ref. 24)	2.60	1100	20.9*	0.1033
700	5.2*	1.66	1300	12.3*	0.0627
800	3.45*	1.13	1500	7.9*	0.0416

Exponential Form (centipoises) $\mu = 0.0709e^{4168/T°K}$

ELECTRICAL CONDUCTIVITY $(ohm\text{-}cm)^{-1}$ 0.64 at 1100°F, 1.05 at 1300°F, 1.47 at 1500°F (Ref. 13)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
32	NaF	52	21.39	102.1	515°C (959°F)
	ZrF_4	48	78.61		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.10*(Ref. 22)

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.72 - 0.00089T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 233.2 - 0.0309T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.87

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.20$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.27$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	7.9		1100	20.1	
700	4.8		1300	11.4	
800	3.35		1500	7.7	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
33	NaF	50	14.86	141.4	610°C (1130°F)
	ZrF_4	25	29.58		
	UF_4	25	55.56		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.93

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 5.09 - 0.00159T$ (Ref. 23)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 319.5 - 0.0551T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.99

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (280°-610°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -17.7 + 0.166T$ (Ref. 4)

Heat Capacity (cal/gm °C) $c_p^* = 0.17$

Heat Capacity at 300°C (572°F) $c_p^* = 0.17$

LIQUID (610°-930°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -39.0 + 0.270T$

Heat Capacity (cal/gm °C) $c_p^* = 0.27$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.27$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 42$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
700	8.5* (Ref. 25)	2.05	1300	20.1*	0.0781
800	5.0*	1.24	1500	11.3*	0.0451
900	3.5*	0.89			

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
34	NaF	57	24.98	95.8	500°C (932°F)
	ZrF_4	43	75.02		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.86

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.65 - 0.00088T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 228.8 - 0.0305T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.90

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.20

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.28

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	7.5		1100	18.9	
700	4.6		1300	10.9	
800	3.2		1500	7.4	

Exponential Form (centipoises)

ELECTRICAL CONDUCTIVITY (ohm-cm)$^{-1}$ 0.95 at 1100°F, 1.41 at 1300°F, 1.85 at 1500°F (Ref. 13)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
35	NaF	57	54.22	44.1	360°C (680°F)
	BeF_2	43	45.78		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.35

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.27 - 0.00037T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 142.1 - 0.0128T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 1.84

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.37$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.52$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F) 2.4 (Liquid) (Ref. 26)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
550	18.0 (Ref. 27)	8.70	1100	32.7*	0.2555
600	12.8*	6.27	1300	16.5*	0.1315
700	7.0*	3.43	1500	9.6*	0.0783
800	4.25*	2.16			

Exponential Form (centipoises) $\mu = 0.0346e^{5164/T°K}$

PRANDTL NUMBER 7.1 at 1100°F, 3.6 at 1300°F, 2.1 at 1500°F

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
36	NaF	55	40.10	57.6	450°C (842°F)
	BeF_2	40	32.64		
	UF_4	5	27.26		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.86

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.76 - 0.00050T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 172.8 - 0.0173T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.08

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.30$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.42$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	11.2		1100	28.3	
700	5.6		1300	13.1	
800	3.2		1500	7.1	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
37	NaF	50	11.80	178.05	715°C (1319°F)
	UF_4	50	88.20		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 5.75

LIQUID (ρ = gm/cc, T = °C) $\rho = 6.16 - 0.00123T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 385.9 - 0.0426T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.32

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.13$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p =$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
38	NaF	50	19.53	107.5	510°C (950°F)
	ZrF_4	48	74.63		
	UF_4	2	5.84		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.04

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.83 - 0.00091T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 240.1 - 0.0315T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.84

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.19$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.26$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	8.5		1100	21.3	
700	5.4		1300	12.8	
800	3.7		1500	8.5	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
39	NaF	65	23.69	115.2	610°C (1130°F)
	ZrF_4	15	21.80		
	UF_4	20	54.51		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.64

LIQUID (ρ = gm/cc, T = °C) $\rho = 4.55 - 0.00102T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 285.2 - 0.0354T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.66

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (90° - 610°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -2.9 + 0.172T$ (Ref. 4)

Heat Capacity (cal/gm °C) $c_p^* = 0.17$

Heat Capacity at 300°C (572°F) $c_p^* = 0.17$

LIQUID (653° - 924°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = 22.3 + 0.199T$

Heat Capacity (cal/gm °C) $c_p^* = 0.20$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.20$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 42$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
40	NaF	53	20.83	106.8	520°C (968°F)
	ZrF_4	43	67.42		
	UF_4	4	11.75		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.09

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.90 - 0.00092T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 244.5 - 0.0319T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.83

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (70° - 520°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = 0.0 + 0.182T$ (Ref. 4)

Heat Capacity (cal/gm °C) $c_p^* = 0.18$

Heat Capacity at 300°C (572°F) $c_p^* = 0.18$

LIQUID (571° - 884°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = 19.4 + 0.2656T$

Heat Capacity (cal/gm °C) $c_p^* = 0.266$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.266$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 63$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	8.3		1100	20.8	
700	5.3		1300	12.6	
800	3.65		1500	8.4	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
41	NaF	63	24.97	106.0	595°C (1103°F)
	ZrF_4	25	39.45		
	UF_4	12	35.57		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.32

LIQUID (ρ = gm/cc, T = °C) $\rho = 4.15 - 0.00096T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 260.1 - 0.0333T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.77

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.17

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.24

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
42	NaF	64.5	20.87	129.8	650°C (1202°F)
	ZrF_4	6.0	7.73		
	UF_4	29.5	71.40		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 5.03

LIQUID (ρ = gm/cc, T = °C) $\rho = 5.05 - 0.00107T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 316.4 - 0.0371T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.49

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.14$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.19$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
700	10.25		1300	24.2	
800	7.0		1500	16.1	
900	5.15				

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
43	NaF	66.7	21.12	132.6	665°C (1229°F)
	UF_4	33.3	78.88		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 5.17

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 5.51 - 0.0013T$ (Ref. 16)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 345.4 - 0.0451T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.83

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.15$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.21$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
700	10.25* (Ref.28)	2.23	1300	24.2*	0.0843
800	7.0*	1.57	1500	16.1*	0.0580
900	5.15*	1.19			

Exponential Form (centipoises) $\mu = 0.181e^{3927/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
44	NaF	53.5	20.47	109.8	540°C (1004°F)
	ZrF_4	40.0	60.93		
	UF_4	6.5	18.60		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.19

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 4.04 - 0.0011T$ (Ref. 16)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 253.4 - 0.0381T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.36

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (260° - 490°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -4.1 + 0.189T$ (Ref. 4)

Heat Capacity (cal/gm °C) $c_p^* = 0.19$

Heat Capacity at 300°C (572°F) $c_p^* = 0.19$

LIQUID (590° - 920°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = 34.5 + 0.235T$

Heat Capacity (cal/gm °C) $c_p^* = 0.24$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.24$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 63$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F) 1.2 (Liquid)(Ref. 29)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	8.5* (Ref.22)	2.51	1100	21.1*	0.0968
700	5.7*	1.74	1300	13.7*	0.0648
800	4.2*	1.33	1500	9.7*	0.0474
850	3.7*	1.14			

Exponential Form (centipoises) $\mu = 0.194e^{3302/T°K}$

PRANDTL NUMBER 4.2 at 1100°F, 2.7 at 1300°F, 1.9 at 1500°F

ELECTRICAL CONDUCTIVITY $(ohm\text{-}cm)^{-1}$ 0.66 at 1100°F, 0.97 at 1300°F, 1.27 at 1500°F (Ref. 13)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
45	NaF	53	22.07	100.9	520°C (968°F)
	ZrF_4	47	77.93		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.11* (Ref. 22)

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.71 - 0.00089T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 232.6 - 0.0309T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.89

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.20

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.27

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	7.5* (Ref. 22)	2.36	1100	18.9*	0.0952
700	4.6*	1.49	1300	10.9*	0.0567
800	3.2*	1.07	1500	7.4*	0.0398

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
C TEST	NaF	66.7	33.47	83.7	680°C (1256°F)
	ZrF_4	33.3	66.53		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.70

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.49 - 0.00086T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 218.8 - 0.0298T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.53

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.21$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.29$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
46	NaF	62.5	20.90	125.7	635°C (1175°F)
	ZrF_4	12.5	16.61		
	UF_4	25.0	62.49		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.86

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 4.75 - 0.0012T$ (Ref. 16)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 266.6 - 0.0416T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.07

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.15$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.20$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
47	NaF	35	16.75	41.1	335°C (635°F)
	LiF	20	59.13		
	BeF_2	45	24.12		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.26

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.19 - 0.00035T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 137.1 - 0.0121T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 1.79

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.40$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.56$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
48	NaF	50	12.00	175.1	733°C (1351°F)
	ThF_4	50	88.00		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 5.73

LIQUID (ρ = gm/cc, T = °C) $\rho = 6.13 - 0.00123T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 384.0 - 0.0426T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.32

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.14

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p =

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
49	NaF	40	13.85	121.0	510°C (950°F)
	ZrF_4	57	78.85		
	UF_3	3	7.30		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.24

LIQUID (ρ = gm/cc, T = °C) $\rho = 4.06 - 0.00094T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 254.5 - 0.0326T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.76

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.18

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.25

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
70	NaF	56	22.52	104.4	530°C (986°F)
	ZrF_4	39	62.45		
	UF_4	5	15.03		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.10

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.90 - 0.00092T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 244.5 - 0.0319T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.83

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (137° - 503°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = 1.3 + 0.1596T + 5.15 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.1596 + 10.29 \times 10^{-5}T$ (Ref. 4)

Heat Capacity at 300°C (572°F) $c_p^* = 0.190$

LIQUID (567° - 892°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = 6.2 + 0.3033T - 3.24 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.3033 - 6.47 \times 10^{-5}T$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.258$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 57$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	8.1* (Ref.30)	2.42	1100	20.3*	0.0969
700	5.2*	1.60	1300	12.3*	0.0606
800	3.6*	1.14	1500	8.2*	0.0418

Exponential Form (centipoises) $\mu = 0.104e^{3798/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
71	NaF	54.1	22.84	99.5	520°C (968°F)
	ZrF_4	45.9	77.16		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.91

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.70 - 0.00089T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 232.0 - 0.0309T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.87

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.20

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.28

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	7.5		1100	18.9	
700	4.6		1300	10.9	
800	3.2		1500	7.4	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
72	NaF	20.9	9.33	94.1	490°C (914°F)
	LiF	38.4	10.58		
	ZrF_4	35.7	63.41		
	UF_4	5.0	16.68		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.04

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.83 - 0.00091T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 240.1 - 0.0315T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.84

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.20$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.28$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
500	20.0* (Ref.31)	5.88	1100	24.8*	0.1198
600	9.9*	3.0	1300	14.3*	0.0714
700	6.0*	1.88	1500	9.8*	0.0505
800	4.25*	1.36			

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
73	NaF	22.0	11.21	82.4	510°C (950°F)
	LiF	40.5	12.75		
	ZrF_4	37.5	76.04		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.74

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.52 - 0.00086T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 220.7 - 0.0298T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.95

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.22

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.31

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
500	19.0		1100	23.7	
600	9.4		1300	13.7	
700	5.7		1500	9.3	
800	4.05				

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
74	LiF	69	55.13	32.4	505°C (941°F)
	BeF_2	31	44.87		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.14

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 2.16 - 0.00040T$ (Ref. 3)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 135.3 - 0.0139T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.13

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.48$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.67$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	7.5**	3.90	1100	18.9**	0.1577
700	4.9**	2.60	1300	11.6**	0.0994
800	3.45**	1.89	1500	8.0**	0.0700

Exponential Form (centipoises) $\mu = 0.118e^{3624/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

**Average values, Refs. 3 and 27.

[redacted]

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
75	LiF	67.0	43.92	39.5	464°C (867°F)
	BeF_2	30.5	36.24		
	UF_4	2.5	19.84		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.48

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.38 - 0.00040T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 149.0 - 0.0139T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 1.90

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.41

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.57

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	8.4		1100	21.1	
700	5.5		1300	13.1	
800	3.85		1500	9.0	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
76	NaF	55.5	45.80	50.9	400°C (752°F)
	BeF_2	42.0	38.78		
	UF_4	2.5	15.42		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.61

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.50 - 0.00043T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 156.5 - 0.0149T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 1.95

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.33$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.46$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	10.5		1100	26.6	
700	6.0		1300	14.2	
800	3.75		1500	8.6	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
77	NaF	70	67.59	43.5	590°C (1094°F)
	BeF_2	30	32.41		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.46

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 2.41 - 0.00050T$ (Ref. 3)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 151.0 - 0.0173T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.43

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.36$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.50$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	5.0* (Ref. 3)	2.37	1100	12.5*	0.0944
700	3.9*	1.77	1300	8.6*	0.0669
800	2.8*	1.39	1500	6.5*	0.0519

Exponential Form (centipoises) $\mu = 0.223e^{2716/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
78	NaF	56	57.60	40.8	478°C (892°F)
	LiF	16	10.17		
	BeF_2	28	32.23		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.42

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 2.22 - 0.00041T$ (Ref. 3)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 139.0 - 0.0142T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.11

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.38$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.53$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	6.0**	3.03	1100	15.0**	0.1213
700	4.0**	2.07	1300	9.5**	0.0788
800	2.85**	1.50	1500	6.6**	0.0559

Exponential Form (centipoises) $\mu = 0.111e^{3486/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

**Average values, Refs. 3 and 32.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
79	NaF	55.0	48.36	47.8	470°C (878°F)
	LiF	15.0	8.14		
	BeF_2	27.5	27.07		
	UF_4	2.5	16.43		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.70

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.60 - 0.00045T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 162.8 - 0.0156T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 1.98

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.33$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.47$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	6.6		1100	16.7	
700	4.4		1300	10.5	
800	3.15		1500	7.3	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
80	NaF	51	43.12	49.7	605°C (1121°F)
	LiF	38	19.85		
	ZrF_4	11	37.02		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.08

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.95 - 0.00077T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 185.0 - 0.0267T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.21

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.27$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.38$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
81	NaF	22	14.91	62.0	570°C (1058°F)
	LiF	55	23.03		
	ZrF_4	23	62.06		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.41

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.22 - 0.00081T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 201.9 - 0.0281T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.06

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (106°-368°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -1.5 + 0.2392T + 7.20 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.2392 + 14.39 \times 10^{-5}T$ (Ref. 33)

Heat Capacity at 300°C (572°F) $c_p^* = 0.282$

LIQUID (603°-897°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -13.0 + 0.4526T - 5.95 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.4526 - 11.89 \times 10^{-5}T$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.369$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	12.0* (Ref. 34)	4.4	1100	30.3*	0.1771
700	7.0*	2.64	1300	16.5*	0.0997
800	4.45*	1.73	1500	10.2*	0.0638
900	3.05*	1.22			

Exponential Form (centipoises) $\mu = 0.0585e^{4647/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
82	NaF	20	11.93	70.3	545°C (1013°F)
	LiF	55	20.30		
	ZrF_4	21	49.92		
	UF_4	4	17.85		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.70

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.49 - 0.00085T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 218.8 - 0.0295T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.93

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (98° - 363°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -3.7 + 0.2304T + 4.07 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.2304 + 8.14 \times 10^{-5}T$ (Ref. 4)

Heat Capacity at 300°C (572°F) $c_p^* = 0.255$

LIQUID (582°-900°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -20.1 + 0.4314T - 7.42 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.4314 - 14.85 \times 10^{-5}T$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.327$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	12.0* (Ref. 34)	4.03	1100	30.3*	0.1626
700	7.0*	2.42	1300	16.5*	0.0915
800	4.45*	1.61	1500	10.2*	0.0586

Exponential Form (centipoises) $\mu = 0.0585e^{4647/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
83	NaF	81	51.71	65.8	750°C (1382°F)
	ZrF_4	19	48.29		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.40

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.22 - 0.00081T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 201.9 - 0.0281T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.06

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.23$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p =$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
84	NaF	27	29.62	38.3	338°C (640°F)
	LiF	35	23.72		
	BeF_2	38	46.66		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.25

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 2.22 - 0.00041T$ (Ref. 35)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 139.0 - 0.0142T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.09

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.42$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.59$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	7.8* (Ref. 35)	3.91	1100	19.8*	0.1586
700	4.45*	2.27	1300	10.5*	0.0858
800	2.8*	1.48	1500	6.3*	0.0530

Exponential Form (centipoises) $\mu = 0.0338e^{4738/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
85	NaF	26.5	24.62	45.2	360°C (680°F)
	LiF	34.0	19,52		
	BeF_2	37.0	38.50		
	UF_4	2.5	17.36		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.54

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 2.33 - 0.00018T$ (Ref. 35)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 145.7 - 0.00624T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$)

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.37$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.51$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	9.0* (Ref. 35)	4.04	1100	22.7*	0.1631
700	4.95*	2.24	1300	11.7*	0.0848
800	3.05*	1.41	1500	6.9*	0.0506

Exponential Form (centipoises) $\mu = 0.0261e^{5094/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
86	LiF	35	10.87	83.6	445°C (833°F)
	NaF	32	16.08		
	ZrF_4	29	58.02		
	UF_4	4	15.03		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.87

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.66 - 0.00088T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 229.4 - 0.0305T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.89

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.21

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.29

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
500	20.5* (Ref. 36)	6.37	1100	26.6*	0.1357
600	10.5*	3.35	1300	15.4*	0.0811
700	6.45*	2.12	1500	10.5*	0.0572
800	4.55*	1.54			

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
87	RbF	48	35.08	143.0	425°C (797°F)
	ZrF_4	48	56.13		
	UF_4	4	8.79		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.19

LIQUID (ρ = gm/cc, T = °C) $\rho = 4.00 - 0.00093T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 250.7 - 0.0322T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.78

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (142°-398°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -3.2 + 0.1490T + 3.2 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.1490 + 6.5 \times 10^{-5}T$ (Ref. 37)

Heat Capacity at 300°C (572°F) $c_p^* = 0.169$

LIQUID (458°-880°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -9.8 + 0.2844T - 5.4 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.2844 - 10.8 \times 10^{-5}T$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.209$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 35$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F) 1.0 (Liquid, constant gap) (Ref. 45)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	7.1* (Ref. 38)	2.11	1100	17.8*	0.0844
700	4.65*	1.41	1300	11.0*	0.0537
800	3.3*	1.03	1500	7.6*	0.0382

Exponential Form (centipoises) $\mu = 0.116e^{3590/T°K}$

PRANDTL NUMBER 3.9 at 1100°F, 2.3 at 1300°F, 1.5 at 1500°F

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
88	NaF	64	62.88	42.8	555°C (1031°F)
	LiF	5	3.04		
	BeF_2	31	34.08		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.44

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 2.39 - 0.00050T$ (Ref. 3)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 149.7 - 0.0173T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.45

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.37$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.51$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	7.1**	3.39	1100	17.8**	0.1364
700	4.75**	2.32	1300	11.3**	0.0887
800	3.4*	1.71	1500	7.9**	0.0636

Exponential Form (centipoises) $\mu = 0.138e^{3435/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

**Average values, Refs. 3 and 39.

[redacted]

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
89	NaF	63.5	63.12	42.2	535°C (995°F)
	LiF	7.5	4.62		
	BeF_2	29.0	32.26		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.44

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 2.38 - 0.00051T$ (Ref. 3)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 149.1 - 0.0177T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.52

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.37$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.51$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	7.0* (Ref. 3)	3.37	1100	17.4*	0.1340
700	4.6*	2.28	1300	10.9*	0.0864
800	3.3*	1.67	1500	7.6*	0.0620

Exponential Form (centipoises) $\mu = 0.121e^{3543/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
90	NaF	49	45.00	46.2	555°C (1031°F)
	KF	15	17.95		
	BeF_2	36	37.05		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.38

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.30 - 0.00038T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 144.0 - 0.0132T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 1.86

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.35$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.48$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	8.0* (Ref. 40)	3.86	1100	20.1*	0.1555
700	5.0*	2.46	1300	11.9*	0.0937
800	3.4*	1.70	1500	7.9*	0.0634

Exponential Form (centipoises) $\mu = 0.0811e^{4008/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
91	NaF	53	38.86	57.3	590°C (1094°F)
	LiF	35	15.85		
	ZrF_4	8	23.36		
	UF_4	4	21.93		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.40

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.22 - 0.00081T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 201.9 - 0.0281T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.06

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.24

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.33

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	10.5		1100	26.6	
700	6.45		1300	15.4	
800	4.55		1500	10.5	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
92	NaF	49.5	40.61	51.2	415°C (779°F)
	BeF_2	48.0	44.06		
	UF_4	2.5	15.33		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.56

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.46 - 0.00042T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 154.0 - 0.0146T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 1.94

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.34$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.47$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	13.7		1100	34.6	
700	7.3		1300	17.3	
800	4.4		1500	9.9	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
93	LiF	50	12.66	102.4	550°C (1022°F)
	ZrF_4	46	75.08		
	UF_4	4	12.26		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.12

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.92 - 0.00092T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 245.7 - 0.0319T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.81

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.20$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.28$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
94	KF	50	24.51	118.5	
	ZrF_4	46	64.89		
	UF_4	4	10.60		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.83

LIQUID (ρ = gm/cc, T = ^{o}C) $\rho = 3.61 - 0.00087T$

LIQUID (ρ = lbs/ft^3, T = ^{o}F) $\rho = 226.3 - 0.0302T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/^{o}C \times 10^4$) 2.90

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0^{o}C}^{*} =$

Heat Capacity (cal/gm ^{o}C) $c_p^{*} =$

Heat Capacity at 300°C (572°F) $c_p = 0.17$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0^{o}C}^{*} =$

Heat Capacity (cal/gm ^{o}C) $c_p^{*} =$

Heat Capacity at 700°C (1292°F) $c_p = 0.24$

HEAT OF FUSION (cal/gm) $H_L - H_S^{*} =$

THERMAL CONDUCTIVITY

K (BTU/hr ft ^{o}F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

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[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
95	RbF	50	36.87	141.7	500°C (932°F)
	ZrF_4	46	54.27		
	UF_4	4	8.86		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.18

LIQUID (ρ = gm/cc, T = °C) $\rho = 4.00 - 0.00093T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 250.7 - 0.0322T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.78

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.14$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.20$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	7.05* (Ref. 38)	2.06	1100	17.9*	0.0837
700	4.35*	1.31	1300	10.4*	0.0501
800	2.95*	0.91	1500	6.8*	0.0338

Exponential Form (centipoises) $\mu = 0.0657e^{4081/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
96	NaF	53	56.66	39.3	535°C (995°F)
	LiF	24	15.83		
	BeF_2	23	27.51		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.43

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.34 - 0.00039T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 146.5 - 0.0135T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 1.88

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.38$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.54$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	5.9* (Ref. 40)	2.80	1100	14.8*	0.1121
700	4.1*	1.98	1300	9.7*	0.0749
800	3.0*	1.47	1500	6.9*	0.0543

Exponential Form (centipoises) $\mu = 0.157e^{3168/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
97	NaF	49	55.70	37.0	597°C (1107°F)
	LiF	36	25.22		
	BeF_2	15	19.08		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.47

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.37 - 0.00039T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 148.4 - 0.0135T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 1.87

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.39$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.55$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	5.65* (Ref. 41)	2.65	1100	14.0*	0.1053
700	3.95*	1.89	1300	9.4*	0.0720
800	2.95*	1.44	1500	6.9*	0.0540

Exponential Form (centipoises) $\mu = 0.173e^{3043/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
98	NaF	56	49.23	47.8	505°C (941°F)
	LiF	21	11.39		
	BeF_2	20	19.67		
	UF_4	3	19.72		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.82

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.72 - 0.00048T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 170.3 - 0.0166T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.03

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.32$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.45$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	7.3* (Ref. 41)	3.0	1100	18.4*	0.1215
700	4.6*	1.94	1300	10.9*	0.0737
800	3.1*	1.34	1500	7.1*	0.0492

Exponential Form (centipoises) $\mu = 0.0737e^{4012/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
99	NaF	63.5	23.22	114.9	607°C (1125°F)
	ZrF_4	18.0	26.20		
	UF_4	18.5	50.58		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.59

LIQUID (ρ = gm/cc, T = °C) $\rho = 4.46 - 0.0010T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 279.5 - 0.0347T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.66

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.16$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.22$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
100	LiF	60	48.08	32.3	652°C (1206°F)
	NaF	40	51.92		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.53

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 2.42 - 0.00055T$ (Ref. 16)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 151.7 - 0.0191T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.71

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (112°-572°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -0.1 + 0.3191T + 9.94 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.3191 + 19.87 \times 10^{-5}T$ (Ref. 42)

Heat Capacity at 300°C (572°F) $c_p^* = 0.379$

LIQUID (688°-898°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -78.5 + 0.9249T - 24.62 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.9249 - 49.23 \times 10^{-5}T$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.580$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 170$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
700	3.2* (Ref. 25)	1.58	1300	7.6*	0.0597
800	2.35*	1.19	1500	5.4*	0.0439

Exponential Form (centipoises) $\mu = 0.116e^{3225/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
101	LiF	57.6	34.24	43.6	645°C (1193°F)
	NaF	38.4	36.97		
	UF_4	4.0	28.79		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.08

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.95 - 0.00077T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 185.0 - 0.0267T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.21

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (97°-594°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = 0 + 0.227T + 17 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.227 + 33 \times 10^{-5}T$ (Ref. 4)

Heat Capacity at 300°C (572°F) $c_p^* = 0.326$

LIQUID (655°-916°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -68.9 + 0.531T$

Heat Capacity (cal/gm °C) $c_p^* = 0.53$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.53$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 56$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
700	3.5		1300	8.4	
800	2.6		1500	6.0	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
102	LiF	50	30.85	42.1	492°C (918°F)
	KF	50	69.15		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.43

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.46 - 0.00068T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 154.3 - 0.0236T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.40

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (107°-466°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -2.3 + 0.2817T + 3.82 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.2817 + 7.64 \times 10^{-5}T$ (Ref. 4)

Heat Capacity at 300°C (572°F) $c_p^* = 0.305$

LIQUID (532°-893°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -23.8 + 0.5839T - 10.28 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.5839 - 20.56 \times 10^{-5}T$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.440$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 93$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	4.75		1100	12.1	
700	2.9		1300	6.9	
800	1.95		1500	4.4	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
103	LiF	48	23.55	52.9	560°C (1040°F)
	KF	48	52.70		
	UF_4	4	23.75		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.85

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.75 - 0.00073T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 172.5 - 0.0253T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.24

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (127°-465°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = 0.1 + 0.234T + 4.9 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.234 + 9.7 \times 10^{-5}T$ (Ref. 4)

Heat Capacity at 300°C (572°F) $c_p^* = 0.263$

LIQUID (563°-882°C)

Enthalpy (cal/gm) $H_T - H_{0°C}^* = -82.4 + 0.657T - 19.7 \times 10^{-5}T^2$

Heat Capacity (cal/gm °C) $c_p^* = 0.657 - 39.3 \times 10^{-5}T$

Heat Capacity at 700°C (1292°F) $c_p^* = 0.382$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$ 68 at 500°C**

THERMAL CONDUCTIVITY

K (BTU/hr ft °F) 1.4 (solid sphere and slab)(Ref. 45)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	5.25		1100	13.2	
700	3.2		1300	7.6	
800	2.15		1500	5.0	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

**The major break in the enthalpy-temperature curve was at 500°C.

[redacted]

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
104	LiF	43	15.77	70.7	475°C (887°F)
	RbF	57	84.23		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.27

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 3.30 - 0.00096T$ (Ref. 22)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 207.1 - 0.0333T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.65

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID (134°-420°C)

Enthalpy (cal/gm)	$H_T - H_{0°C}^* = -1.1 + 0.1849T + 2.45 \times 10^{-5}T^2$
Heat Capacity (cal/gm °C)	$c_p^* = 0.1849 + 4.9 \times 10^{-5}T$ (Ref. 37)
Heat Capacity at 300°C (572°F)	$c_p^* = 0.200$

LIQUID (497°-878°C)

Enthalpy (cal/gm)	$H_T - H_{0°C}^* = -22.9 + 0.3969T - 8.1 \times 10^{-5}T^2$
Heat Capacity (cal/gm °C)	$c_p^* = 0.3969 - 16.1 \times 10^{-5}T$
Heat Capacity at 700°C (1292°F)	$c_p^* = 0.284$

HEAT OF FUSION (cal/gm) $H_L - H_S^* = 55$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F) 1.2 (Liquid) (Ref. 43)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
500	9.0* (Ref. 38)	3.19	1100	11.4*	[redacted]
550	6.2*	2.24	1200	8.2*	0.0491
600	4.5*	1.65			
650	3.4*	1.27			

Exponential Form (centipoises) $\mu = 0.0212e^{4678/T°K}$

PRANDTL NUMBER 2.9 at 1100°F

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
105	LiF	41.3	13.32	80.5	660°C (1220°F)
	RbF	54.7	71.06		
	UF_4	4.0	15.62		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.56

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.36 - 0.00084T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 210.7 - 0.0291T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.57

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.18

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.25

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
106	LiF	44.7	22.23	52.2	560°C (1040°F)
	KF	40.3	8.85		
	NaF	11.0	44.86		
	UF_4	4.0	24.06		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.90

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.80 - 0.00074T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 175.6 - 0.0257T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.26

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.27$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.38$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	5.35		1100	13.6	
700	3.2		1300	7.6	
800	2.15		1500	4.8	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
107	NaF	11.2	9.77	48.1	490°C (914°F)
	KF	41.0	49.52		
	LiF	45.3	24.39		
	UF_4	2.5	16.32		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.74

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.67 - 0.00072T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 167.5 - 0.0250T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.32

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.29

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.41

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	5.1* (Ref.12)	2.27	1100	12.8*	0.0909
700	3.0*	1.38	1300	7.1*	0.0523

Exponential Form (centipoises) $\mu = 0.0292e^{4507/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
108	NaF	56.0	22.06	106.6	550°C (1022°F)
	ZrF_4	37.5	58.80		
	UF_4	6.5	19.15		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 4.16

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.97 - 0.00093T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 248.9 - 0.0322T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.80

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.18$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.25$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	8.5		1100	21.3	
700	5.4		1300	12.8	
800	3.7		1500	8.5	

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
109	NaF	32	16.96	79.3	535°C (995°F)
	RbF	31	40.88		
	BeF_2	31	18.38		
	UF_4	6	23.78		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.29

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.20 - 0.00064T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 200.5 - 0.0222T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.33

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) $c_p = 0.21$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) $c_p = 0.30$

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
110	NaF	61.7	37.2	69.6	775°C (1427°F)
	KF	20.5	17.1		
	ZrF_4	16.4	39.4		
	UF_4	1.4	6.3		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.27* (Ref. 22)

LIQUID (ρ = gm/cc, T = °C) $\rho = 3.15 - 0.00080T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 197.5 - 0.0277T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 3.19

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.21

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p =

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr

Exponential Form (centipoises)

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
111	LiF	71	27.86	66.02	
	BeF_2	16	11.39		
	ThF_4	12	56.00		
	UF_4	1	4.76		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 3.71

LIQUID (ρ = gm/cc, T = ^{o}C) $\rho = 3.82 - 0.00082T$

LIQUID (ρ = lbs/ft^3, T = ^{o}F) $\rho = 239.4 - 0.0284T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/^{o}C \times 10^{4}$) 2.52

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0^{o}C}^{*} =$

Heat Capacity (cal/gm ^{o}C) $c_p^{*} =$

Heat Capacity at 300°C (572°F) $c_p = 0.26$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0^{o}C}^{*} =$

Heat Capacity (cal/gm ^{o}C) $c_p^{*} =$

Heat Capacity at 700°C (1292°F) $c_p = 0.37$

HEAT OF FUSION (cal/gm) $H_L - H_S^{*} =$

THERMAL CONDUCTIVITY

K (BTU/hr ft ^{o}F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	13.0* (Ref.22)	3.90	1100	33.9*	0.1628
700	7.1*	2.18	1300	16.9*	0.0835
800	4.8*	1.51	1500	11.0*	0.0559

Exponential Form (centipoises) $\mu = 0.0620e^{4666/T^{o}K}$

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
112	LiF	50	35.53	36.5	350°C (662°F)
	BeF_2	50	64.47		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.08

LIQUID (ρ = gm/cc, T = °C) $\rho^* = 2.22 - 0.00040T$ (Ref. 3)

LIQUID (ρ = lbs/ft^3, T = °F) $\rho^* = 139.0 - 0.0139T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.06

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.46$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.65$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	22.2* (Ref.3)	11.2	1100	56.9*	0.4874
700	10.7*	5.52	1300	25.2*	0.2200
800	5.95*	3.12	1500	13.3*	0.1184

Exponential Form (centipoises) $\mu = 0.0189e^{6174/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
113	NaF	50	47.19	44.5	380°C (716°F)
	BeF_2	50	52.81		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.45* (Ref. 10)

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.25 - 0.00040T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 140.9 - 0.0139T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.02

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.38

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.53

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	15.3*(Ref.44)	7.61	1100	38.7*	0.3084
700	8.4*	4.26	1300	20.1*	0.1634
800	5.25*	2.72	1500	11.9*	0.0988

Exponential Form (centipoises) $\mu = 0.0493e^{5009/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
114	KF	50	55.28	52.6	445°C (833°F)
	BeF_2	50	44.72		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.23

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.18 - 0.00035T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 136.5 - 0.0121T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 1.81

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.32$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p = 0.45$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	15.3* (Ref.44)	7.77	1100	39.2*	0.3187
700	6.7*	3.45	1300	15.7*	0.1300
800	3.45	1.82	1500	7.6*	0.0641

Exponential Form (centipoises) $\mu = 0.00517e^{6976/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

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Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
115	RbF	50	68.98	75.8	400°C(752°F)
	BeF_2	50	31.02		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.85

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.75 - 0.00050T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 172.2 - 0.0173T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 2.08

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 300°C (572°F) c_p = 0.22

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}$* =

Heat Capacity (cal/gm °C) c_p* =

Heat Capacity at 700°C (1292°F) c_p = 0.31

HEAT OF FUSION (cal/gm) $H_L - H_S$* =

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
600	11.5* (Ref.22)	4.69	1100	30.3*	0.1977
700	5.2*	2.17	1300	12.3*	0.0821
800	2.75*	1.17	1500	6.1*	0.0417

Exponential Form (centipoises) $\mu = 0.00534e^{6701/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

Mixture	Component	Mol %	Wt. %	Avg. M.W.	Liquidus Temp.
116	KF	79	82.30	55.8	730°C (1346°F)
	BeF_2	21	17.70		

DENSITY

SOLID AT ROOM TEMPERATURE (gm/cc) 2.38

LIQUID (ρ = gm/cc, T = °C) $\rho = 2.32 - 0.00040T$

LIQUID (ρ = lbs/ft^3, T = °F) $\rho = 145.3 - 0.0139T$

MEAN VOLUMETRIC COEFFICIENT OF LIQUID EXPANSION ($1/°C \times 10^4$) 1.97

ENTHALPY, HEAT CAPACITY AND HEAT OF FUSION

SOLID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 300°C (572°F) $c_p = 0.27$

LIQUID

Enthalpy (cal/gm) $H_T - H_{0°C}^* =$

Heat Capacity (cal/gm °C) $c_p^* =$

Heat Capacity at 700°C (1292°F) $c_p =$

HEAT OF FUSION (cal/gm) $H_L - H_S^* =$

THERMAL CONDUCTIVITY

K (BTU/hr ft °F)

VISCOSITY

°C	(Centipoises)	(Centistokes)	°F	(lb./ft-hr)	ft^2/hr
800	2.2* (Ref.40)	1.10	1500	5.0*	0.0401

Exponential Form (centipoises) $\mu = 0.0770e^{3600/T°K}$

*Denotes experimental values. Other values given are calculated or estimated.

[redacted]

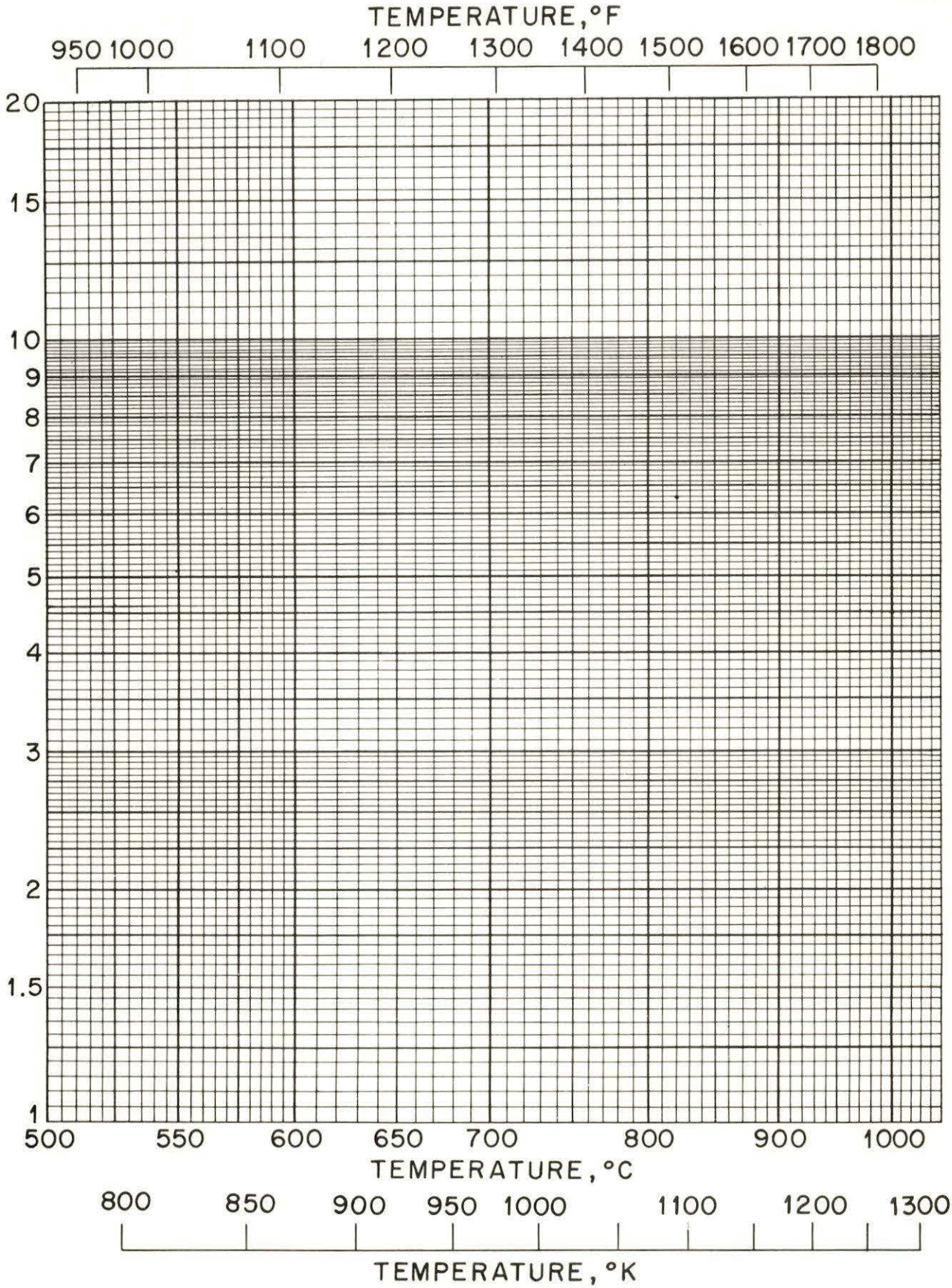

Figure I. Viscosity Worksheet (This sheet of specially prepared graph paper has been included to facilitate interpolation and extrapolation of viscosity data).

CONCLUDING REMARKS

The summary of physical properties presented in this report has been compiled for the various technical groups within the ANP Project who need it. Properties have been measured or predicted for a large portion of the fluoride systems that have been of interest to the Project thus far. It is anticipated that more measurements will be made for new fluoride systems as they become attractive.

In the meantime, however, in most cases the thermal properties of such new fluoride systems can be estimated satisfactorily for preliminary design purposes with the aid of the correlation relations that have been developed. For example, molten densities have been related uniquely to room temperature densities or molecular weight which can be calculated (see topical report, ORNL 1702). The heat capacities were found to be inversely proportional to the average molecular weight and directly proportional to the average number of atoms in the mixture (see topical report, ORNL 1956).

Topical reports on the viscosity and thermal conductivity research on fluorides are being prepared. Viscosities have been found to vary with molecular weight and also with molar volume along the lines indicated by the Batchinski relation. The thermal conductivities have been found to vary inversely with average molecular weight. In addition, liquid thermal conductivities have been proportioned into atomic and ionic contributions each of which has been separately correlated.

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