Molten Salts: Volume 4, Part 4

Mixed Halide Melts

Electrical Conductance, Density, Viscosity, and Surface Tension Data

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Data on the electrical conductance, density, viscosity, and surface tension of mixed halide melts have been systematically collected and evaluated. Results are given for eighty-five binary mixtures over a range of compositions and temperatures.

Key words: Bromides; chlorides; data compilation; density; electrical conductance; fluorides; halides; iodides; molten salt mixtures; standard reference data; surface tension; viscosity.

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1. Introduction

The published data for the four physical properties: electrical conductance, density, viscosity, and surface tension for molten mixed halide systems have been reviewed and critically assessed, and the results, together with value judgements, are reported herewith. The collection and evaluation of molten salts data was undertaken as part of the NSRDS program in 1965. The physical properties were limited to the four most widely encountered in materials science and technology, viz., electrical conductance, viscosity, density, and surface tension; and the scope of the systems to inorganic compounds as "single-salt melts", i.e., one-component systems, and to binary mixtures of inorganic compounds. For a systematic approach, an anion classification was used to order the salts, and within each anion family an alphabetical order was followed for listing the salts by cationic constituent. The molten salts data series thus falls naturally into nine parts, as summarized in table I. The present publication is the seventh in this series [1-6][1], and completes the recommendations for binary mixtures of molten halides. The literature embraced is current to June, 1977.

TABLE I. NSRDS molten salts data series

(For single salts and their binary mixtures relative to the data for electrical conductance, viscosity, density and surface tension)

Molten salts	NSRDS recommendations	Ref.
Vol. 1 (1968)	Single salts (κ,η,ρ)[a]	[1]
Vol. 2 (1969)	Single salts (γ)[a]	[2]
Vol. 3 (1972)	Binary mixtures: nitrates, nitrites	[3]
Vol. 4, Pt. 1 (1974)	Binary mixtures of fluorides	[4]
Vol. 4, Pt. 2 (1976)	Binary mixtures of chlorides	[5]
Vol. 4, Pt. 3 (1977)	Binary mixtures: bromides, iodides	[6]
Vol. 4, Pt. 4	Binary mixtures: mixed halides[b]	
Vol. 5, Pt. 1	Binary mixtures: anion families[c] other than nitrates, nitrites, halides	
Vol. 5, Pt. 2	Additional binary mixtures[c]	

[a]Single Salt Updates: Some of the NSRDS recommendations advanced in 1968 and 1969 for single salt melts have been revised in the sequels. See the single-salts updates in Volumes 3-5, respectively, for information.

[b]Present work. Submitted for publication, July, 1977.

[c]Work in progress.

[1]Numbers in brackets refer to literature references in section 8.

The organization of the narrative and tabular data supporting the recommendations follows the style of the preceding parts of the series. Observations concerning melt preparation and purification are given; the temperature-liquidus phase diagram is included where possible. This material is followed by a tabular summary of the investigations critically examined (with temperature and concentration ranges, and comments on cell materials and method of calibration). Table(s) of recommended numerical values complete the presentation. The preceding analysis was developed for each of the four properties. Summary tables have been compiled to provide a total overview of the investigations, and are at the end of the manuscript.

2. Symbols and Units

The symbols and units[2] for the four physical properties in this compilation are:

κ = specific conductance ($ohm^{-1}\,cm^{-1}$)
ρ = density ($g\,cm^{-3}$)
η = viscosity (cp)
γ = surface tension ($dyn\,cm^{-1}$).[3]

In addition:

E = activation energy ($cal\,mol^{-1}$)
Λ = equivalent conductance ($ohm^{-1}\,cm^2\,cquiv^{-1}$)
C = concentration (mol %)
R = gas constant = 1.98717 $cal\,mol^{-1}\,K^{-1}$
T = temperature in kelvins, defined on the thermodynamic scale by assigning 273.16 K to the triple point of water (freezing point, 273.15 K = 0 °C)

3. Experimental Methods

Practical aspects of molten salts containment (materials) and designs of experimental assemblies for measurements of electrical conductivity, viscosity, density, and surface tension have been reviewed in the preceding parts of this series. A summary is given in table II. In table III, an analysis of the use of the various techniques in the studies of mixed halides is given.

[2]For conversion to the SI system.

1 $ohm^{-1}\,cm^{-1}$	=	1 x $10^2\,\Omega^{-1}\,m^{-1}$
1 $g\,cm^{-3}$	=	1 x 10^{-3} Kg cm^{-3}
1 cp	=	1 x 10^{-3} N s m^{-2}
1 $dyn\,cm^{-1}$	=	1 x 10^{-3} N m^{-1}
1 $cal\,mol^{-1}$	=	4.184 J mol^{-1}.

[3]When γ is treated as a free energy per unit area, it is given the unit, $erg\,cm^{-2}$; this is dimensionally identical to $dyn\,cm^{-1}$.

The general principles for purification procedures and the preparation of mixtures are those reviewed for the fluorides, chlorides, bromides and iodides [4-6]. Additional details are given for specific mixtures in section 5, this work.

TABLE II. Experimental techniques

Techniques	Aspects reviewed and reference
γ	Various possible methods and % application: This series, Vol. 2, Part 2 [2].
$\kappa,\rho,\kappa,\gamma$	Descriptions of experimental assemblies: This series, Vol. 3 [3].
κ,ρ,η,γ	Practical aspects of studies with molten fluorides: This series, Vol. 4, Part 1 [4].
η,ρ,η,γ	Conductance: possible errors in measurements. Viscosity: comparison of oscillational and capillary techniques: This series, Vol. 4, Part 2 [5].
κ	Calibration techniques in molten salts conductivity measurements: This series, Vol. 4, Part 3 [6].

TABLE III. Percent application of techniques – mixed halide melts

Specific conductance	
Method	Percent application
Classical ac	95%
Other	5%
Density	
Archimedean	66%
Pycnometric, dilatometric	17%
Bubble pressure	11%
Flotation	6%
Viscosity	
Capillary	75%
Oscillational	25%
Surface tension	
Maximum bubble pressure	64%
Pin detachment	27%
Wilhelmy slide plate	9%

4. Treatment of Data

4.1. Statistical Analysis

The statistical analysis was performed on the computer facilities (IBM 360, PDP 15 and G.E. Mark II Time Sharing Unit) at Rensselaer Polytechnic Institute.

The density, specific conductance, viscosity and surface tension values were recalculated by a one-dimensional analysis, using the method of least squares to establish equations indicating the variations of the physical quantities with temperature at the experimental composition. For density and surface tension results, where five or more experimental compositions and temperatures or temperature-dependent equations were reported, the values were recalculated by a two-dimensional analysis, using a stepwise multiple regression routine. In this way a physical property-temperature-composition matrix was developed. Tabulated values given in brackets indicate that the data base was minimal for statistical analysis, i.e., insufficient number of data points.

(a). One-Dimensional Analysis

The criterion for choosing the equation of best fit in the one-dimensional analysis is the standard error of estimate computed from the residuals and defined by

$$s = \sqrt{\frac{\sum^{n} (\gamma_e - \gamma_c)^2}{n - q}} ,$$

where γ_e = the experimental value at each temperature, γ_c = the value calculated from the least squares equation at the same temperature as γ_e, n = the number of experimental data points, and q = the number of coefficients in the least squares equation (2 for linear, 3 for quadratic).

(b). Two-Dimensional Analysis

Computer Programs Used

Programs from the IBM Scientific Subroutine Package[4] were used with the IBM 360/65 computer facility at Rensselaer. The routines consist of STPRG, CORRE, LOC, and MSTR, the latter two being storage routines which have no effect on the accuracy of the results. In addition the subroutine STOUT is used to print the results of each regression step and the subroutine MATRIX is used for printing a matrix of the final equation.

Statistical Procedure

The abbreviated Doolittle method[5] was used to select the variables entering the regression and for calculation of coefficients. The independent variable included in each step of the analysis was selected by computing the reduction of sums of squares of each variable. The variable causing the largest reduction was added to the equation and deleted from the table of sums of squares. The coefficients, intercept and statistical parameters for the new equation were computed and printed. This procedure was repeated until the maximum proportion of sums of squares to the total reduced was less than a limit set by the programmer. The independent vari-

[4] System 360 Scientific Subroutine Package Programmers Manual; IBM H20-0205-3, 1969.

[5] C. A. Bennet and N. L. Franklin, Statistical Analysis in Chemistry and the Chemical Industry (John Wiley and Sons, 1954).

ables used in the initial selection were chosen from a generalized procedure, which generated 30 combinations of the input variables using powers, reciprocals, logarithmic and exponential quantities. It was found that the procedure consistently selected the combination $(T + C)^3$ so that the working program used nine independent variables. After the final equation was produced, it was transferred to the MATRIX routine, which calculates values at rounded compositions and temperatures within specified boundary conditions. In the presentation of the matrix, due cognizance is taken of the experimental range of the investigation and of the phase relationships for the system so that values are always "interpolated" rather than "extrapolated". The final step in the procedure involves the residual analysis, where the deviations of the original values from those computed from the "best" equations are given.

Statistical Parameters

For each step in the regression analysis a summary of significant statistical parameters is given. First the sums of squares reduced (S_i), the proportion of S_i/D, where D is defined below, given by P, the cumulative S_i given by S_{cum} and the cumulative proportion given by (P_{cum}) are listed. These quantities give an indication of the effect of each variable in the final equation. The programmers limit on P was always in the range $0.0001 \leqslant P \leqslant 0.001$.

Standard Error of Estimate

The standard error in the estimated y values adjusted for degrees of freedom is given by:

$$\text{s.e.} = \sqrt{\frac{D - S_{cum}}{n - q - 1}}$$

where

$$D = \sum_{j=1}^{n} (y_j - \bar{y})^2$$

y_j = experimental values

$\bar{y}$ = average of all experimental values

q = the number of independent variables in the equations

As a general guide, about 68% of the results lie within the standard error of estimate, 95% within twice this value and approximately 99 percent within three times the value.[6] The standard error of estimate has been reported as a percent in this study. Where this information was reported in the literature as standard deviation, the preceding approach was not possible and we refer to the published error estimates of the original authors.

F Value for Analysis of Variance

This value is used to determine if a particular model is acceptable[7]. Tables of F values indicate that values greater than 2.0 are acceptable for the routine used here. In all cases values of F were greater than 500 and in most cases, greater than 1000. The F value is defined as:

$$F = \frac{S_{cum/q}}{(D - S_{cum})/(n - q - 1)},$$

where S_{cum}, q, D, and n were defined earlier.

4.2. Value Judgements

The recommendations advanced in this work are based on three criteria: (a) type and quantity of experimental data, (b) experimental method used, and (c) an error analysis of the reported results. The principles followed in selecting the most reliable data were as follows:

(a) Studies reporting either numerical data, results derived from statistically generated equations or data in the form of temperature-dependent equations were preferred over graphical results, except in those cases where the graphical results were based on a more complete investigation (i.e., wider composition or temperature range).

(b) The experimental aspects were examined, and the preparation, purification, stability and analyses of the single salts and binary melts were critically assessed. The reliability of the measuring technique (determined from standard "calibration" checks) was an important further consideration.

(c) The statistical parameters and percent departures as discussed in sections 4.1 and 4.3, respectively, were considered. For systems where investigations had similar quantity and quality of data, the results with superior statistical parameters were selected.

For some systems more than one reference was used to generate the recommendations. This was done to extend the recommended values to the widest possible range of composition and temperature.

4.3. Physical Property Tables

Four types of tables are used to present information relative to the physical properties.

(a) Number of investigations. In such tables, the published studies are analyzed with respect to:

- the investigations critically re-examined
- composition and temperature ranges

[6] I. D. Sterling and S. V. Pollack, Introduction to Statistical Data Processing (Prentice-Hall, 1968)

[7] H. Smith and N. R. Draper, Applied Regression Analysis (John Wiley and Sons, 1968)

- a summary of experimental details such as cell material and calibration method
- the minimum and maximum percent departures of the data with respect to NSRDS recommendations [1,2,4, 5,6, this volume].

The notation (g) indicates the data were presented graphically. Otherwise it is to be assumed that the data were reported in numerical or equation form. Footnotes to these tables call attention to information of unusual importance (technique, experimental uncertainty, etc.). A recommended reference is always indicated by a bold-face reference number. In situations where the composition-temperature-physical property data base is based on more than one investigation, all references used to develop the value judgements are listed in bold-face.

(b) Numerical values. Each table of values either contains the equation from which the values were calculated with the statistical parameters associated with it, or it has a footnote stating how the values were obtained. Where the experimental data were published in graphical form only, the numerical values were derived by interpolation.

(c) Percent departure. The percent departure has been used to compare the results of different investigations with either previous or current recommendations and has been considered when evaluating a study for possible recommendation.

The percent departure is given by

$$\text{Percent departure} = \frac{(\text{"compared value"} - \text{"recommended value"}) \cdot 100}{(\text{"recommended value"})}$$

The recommended values are those in NSRDS-NBS 15 [1], NSRDS-NBS 28 [2], references [4, 5 or 6] or given in the present work. Only the maximum and minimum departures of the data from the NSRDS reference data base are reported. Percent departures are not given for data interpolated from graphical presentations.

(d) Summary tables. In section 6, a series of summarizing tables are developed to give information on the total number of investigations, the studies selected for the best-value recommendations, and related aspects of the work.

4.4. Phase Diagrams

Phase, diagrams, where available, are included with the systems. It should be understood that these are not advanced as critically evaluated recommendations. The liquidus curves are used as boundary conditions in generating the matrix of recommended values in the two-dimensional analysis so that extrapolation into the solid state cannot occur. The literature reference for a phase diagram is given with the diagram.

5. Mixed Halide Systems

5.1. Fluoride-Chloride Systems

BaF_2-$BaCl_2$

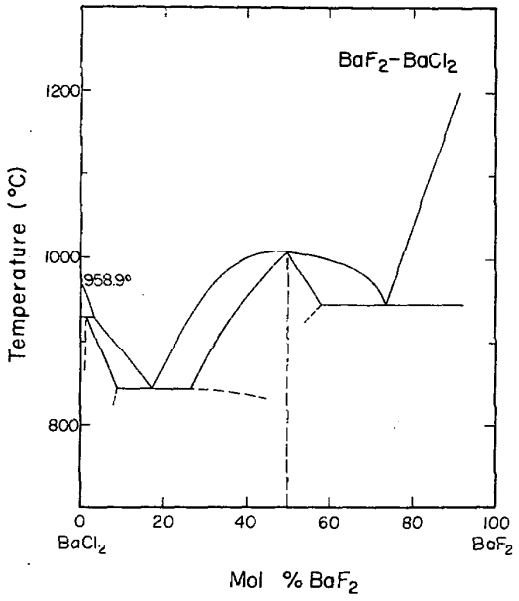

FIGURE 1. Temperature-composition phase diagram for BaF_2-$BaCl_2$. W. Plato, Z. Phys. Chem., 58, 360 (1907).

Melt Preparation and Purification

Kuvakin and Klyakin [68] purified barium fluoride by roasting the commercial product with a mixture of ammonium fluoride and barium chloride. Similarly, barium chloride was treated with ammonium chloride to volatilize any impurities. The salts were fused before use.

Bukhalova and Yagub'yan [40] used recrystallized C. P. chemicals. Fluoride salts were prepared by dissolving the carbonates in hydrofluoric acid.

TABLE 1. Electrical conductance studies: BaF_2-$BaCl_2$

Investigations critically re-examined			
Ref.	$BaCl_2$ mol %	Temp. range (T)	Comments
68	50-100	1273-1373	Cell material: Pt vessel; Pt electrodes; frequency: 1000 Hz; calibration: molten NaCl, KCl and NaF.

Deviations from previous NSRDS recommendations [1, p. 7]			
Ref.	$BaCl_2$ mol %	Min. departure	Max. departure
68	100	−13.19% (1355 K)	−18.17% (1275 K)

TABLE 2. BaF_2-$BaCl_2$: Specific conductance ($ohm^{-1}\,cm^{-1}$)

	Mol percent $BaCl_2$				
T	50.0	62.5	75.0	87.5	100
1275	1.457	1.106	1.035	1.268	1.784
1280	1.476	1.123	1.051	1.287	1.806
1285	1.495	1.139	1.067	1.305	1.829
1290	1.515	1.155	1.082	1.324	1.851
1300	1.553	1.188	1.113	1.361	1.892
1305	1.572	1.204	1.129	1.380	1.917
1310	1.591	1.220	1.145	1.398	1.940
1315	1.611	1.237	1.160	1.417	1.962
1320	1.630	1.253	1.176	1.436	1.984
1325	1.649	1.269	1.192	1.454	2.007
1330	1.669	1.285	1.207	1.473	2.029
1335	1.688	1.302	1.223	1.491	2.057
1340	1.707	1.318	1.254	1.529	2.095
1350	1.745	1.351	1.270	1.547	2.118
1355	1.765	1.367	1.285	1.566	2.140
1360	1.784	1.383	1.301	1.585	2.162
1365	1.803	1.399	1.317	1.603	2.185
1370	1.823	1.416	1.332	1.622	2.207

Temperature-dependent equations
$\kappa = a + bT$

Mol % $BaCl_2$	$-a$	$b \cdot 10^3$	Standard deviation
50	3.452	3.850	0.017
62.5	3.045	3.256	0.006
75	2.949	3.125	0.008
87.5	3.484	3.727	0.009
100	3.891	4.451	0.008

These values are based on the work of Kuvakin and Klyakin (classical ac technique) [68]. The data were reported in equation form. The standard deviations reported by the authors are given.

TABLE 3. Density studies: BaF_2–$BaCl_2$

Investigations critically re-examined			
Ref.	$BaCl_2$ mol %	Temp. range (T)	Comments
40	0-100 (g)	1573	Platinum sphere; calibration: volume of sphere determined using substances of known density.

TABLE 4. BaF_2–$BaCl_2$: Density (g cm^{-3})

Mol % BaF_2	1573 K
0	2.94
10	2.98
20	3.03
30	3.12
40	3.22
50	3.34
60	3.46
70	3.61
80	3.74
90	3.86
100	3.94

These values have been interpolated to three significant figures from the graphical presentation of Bukhalova and Yagub'yan (Archimedean method) [40].

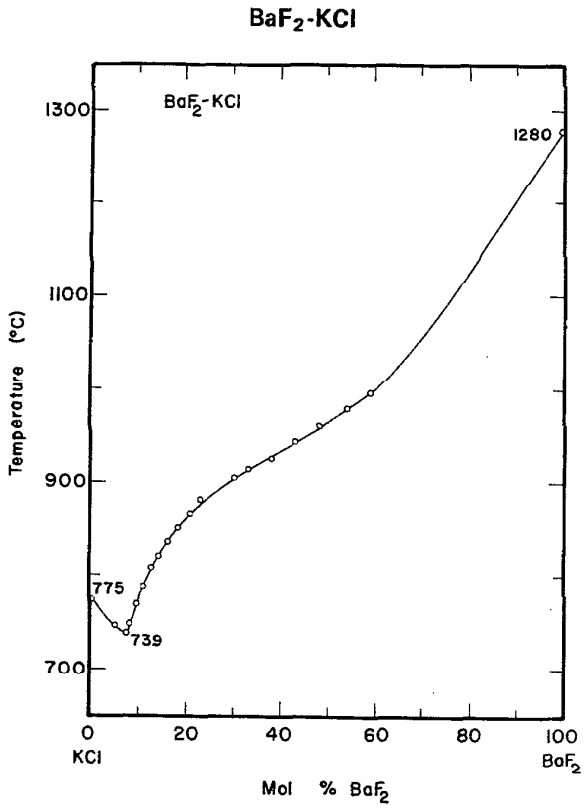

FIGURE 2. Temperature-composition phase diagram for BaF_2-KCl.

E. I. Banashek and A. G. Bergman, Dokl. Akad. Nauk SSSR, 57, 905 (1947).

Melt Preparation and Purification

Bukhalova and Yagub'yan [31] used C. P. potassium chloride, recrystallized twice before use. Barium fluoride was prepared by dissolving the chemically-pure carbonate in hydrofluoric acid.

TABLE 5. Density studies: BaF_2-KCl

Investigations critically re-examined			
Ref.	KCl mol %	Temp. range (T)	Comments
31	0-100 (g)	1573	Platinum sphere; calibration: volume of sphere determined using substances of known density.

TABLE 6. BaF_2-KCl: Density (g cm^{-3})

Mol % BaF_2	1573 K
0	1.20
10	1.50
20	1.80
30	2.06
40	2.34
50	2.62
60	2.92
70	3.14
80	3.40
90	3.68
100	3.96

These values have been interpolated to three significant figures from the graphical presentation of Bukhalova and Yagub'yan (Archimedean method) [31].

CsF-CsCl

Melt Preparation and Purification

References [85] and [65] (Smirnov et al.) give no information on melt preparation and purification. For a description of Smirnov's method of purifying LiCl, refer [5], p. 1005. See also KF-KCl. In a recent publication [94], Smirnov describes the preparation of alkali halide melts as follows: The salts were recrystallized and dried for 24 h during which time the temperature was raised gradually up to melting. Because it hydrolyzes relatively readily, LiCl was dehydrated under vacuum during 6 days, the temperature being increased very slowly to avoid caking of the salt. When it was molten, dry HCl was bubbled through the melt for approximately 6 h. All salt mixtures with LiCl were prepared in a similar way. Contact with quartz was avoided to prevent contamination of the melts by oxide.

TABLE 7. Electrical conductance studies: CsF-CsCl

Investigations critically re-examined			
Ref.	CsCl mol %	Temp. range (T)	Comments
85	0-100	923-1183	Pt electrodes; freq. range: 50.000 Hz.

Deviations from previous NSRDS recommendations [1, pp. 3,6]

Ref.	CsCl mol %	Min. departure	Max. departure
85	100	0.06% (960 K)	−5.49% (1070 K)
85	0	−1.58% (1010 K)	−4.69% (1125 K)

TABLE 8. CsF-CsCl: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent CsCl								
	100	88	75	63	50	37	25	12	0
930	1.160								
940	1.184								
950	1.208								
960	1.232	1.285	1.374		1.564				
970	1.255	1.307	1.396		1.589		1.885		
980	1.279	1.329	1.417	1.504	1.613	1.763	1.915	2.134	
990	1.301	1.351	1.439	1.526	1.637	1.790	1.945	2.163	2.456
1000	1.324	1.373	1.461	1.548	1.661	1.816	1.975	2.191	2.488
1010	1.346	1.395	1.483	1.570	1.684	1.841	2.004	2.219	2.520
1020	1.368	1.416	1.505	1.592	1.707	1.867	2.033	2.247	2.551
1030	1.390	1.438	1.527	1.613	1.730	1.891	2.062	2.274	2.583
1040	1.412	1.459	1.548	1.635	1.753	1.915	2.090	2.301	2.614
1050	1.433	1.480	1.570	1.657	1.775	1.939	2.118	2.328	2.645
1060	1.454	1.501	1.592	1.678	1.797	1.963	2.145	2.355	2.677
1070	1.475	1.522	1.614	1.699	1.819	1.985	2.172	2.381	2.708
1080		1.543	1.636	1.721	1.840	2.008	2.199	2.407	2.739
1090		1.564	1.658	1.742	1.861	2.030	2.225	2.433	2.770
1100		1.585	1.680	1.763	1.882	2.051	2.251	2.459	2.801
1110		1.605	1.703	1.785	1.902	2.072	2.276	2.484	2.832
1120		1.626	1.725	1.806	1.922	2.093	2.301	2.509	2.863
1130		1.646	1.747	1.827	1.942	2.113	2.326	2.534	2.893
1140		1.666	1.769	1.848	1.961	2.132	2.350	2.559	2.924
1150		1.687	1.791	1.869	1.980	2.152	2.374	2.583	2.955
1160		1.707	1.813		1.999	2.170	2.398	2.607	2.985
1170		1.726	1.836		2.018	2.189	2.421	2.631	3.016
1180			1.858			2.207			3.046
1190			1.880						
1200			1.903						
1210			1.925						
1220			1.948						
1230			1.970						
1240			1.993						

Temperature-dependent equations

$$\kappa = a + bT + cT^2$$

Mol % CsCl	$-a$	$b \cdot 10^3$	$-c \cdot 10^6$	Standard deviation
0	1.055	3.918	0.375	0.006
12	1.853	5.286	1.242	0.008
25	2.897	6.794	1.922	0.002
37	3.037	7.127	2.274	0.005
50	2.228	5.419	1.530	0.001
63	0.951	2.811	0.312	0.003
75	0.567	1.877	−0.151	0.004
88	1.330	3.236	0.533	0.004
100	2.271	4.943	1.348	0.002

These values are based on the work of Smirnov, Shumov, Stepanov, Khokhlov and Noskevich (classical ac technique) [85].

TABLE 9. Density studies: CsF-CsCl

Investigations critically re-examined			
Ref.	CsCl mol %	Temp. range (T)	Comments
85	0-100	923-1073	Cell material: Pt sphere; calibration: molten KNO_3.

Deviations from previous NSRDS recommendations [1, pp. 3,5]

Ref.	CsCl mol %	Min. departure	Max. departure
85	100	0.40% (940 K)	0.53% (1070 K)
85	0	-0.28% (1070 K)	-0.39% (1010 K)

TABLE 10. CsF-CsCl: Density (g cm^{-3})

	Mol percent CsCl								
T	100	88	75	63	50	37	25	12	0
930	2.789	2.857	2.934	3.035	3.141	3.259	3.404	3.543	3.688
940	2.779	2.846	2.924	3.023	3.129	3.247	3.391	3.529	3.676
950	2.768	2.835	2.913	3.011	3.117	3.235	3.378	3.515	3.663
960	2.758	2.825	2.902	2.999	3.105	3.223	3.364	3.502	3.651
970	2.747	2.813	2.891	2.988	3.093	3.211	3.351	3.489	3.639
980	2.737	2.803	2.881	2.976	3.081	3.199	3.338	3.475	3.627
1000	2.716	2.792	2.870	2.964	3.070	3.187	3.324	3.462	3.615
1010	2.705	2.770	2.848	2.941	3.046	3.163	3.298	3.435	3.591
1020	2.695	2.759	2.837	2.929	3.034	3.151	3.285	3.422	3.579
1030	2.684	2.748	2.827	2.917	3.022	3.139	3.271	3.408	3.567
1040	2.673	2.737	2.816	2.905	3.011	3.126	3.258	3.395	3.555
1050	2.663	2.726	2.805	2.893	3.000	3.114	3.245	3.381	3.542
1060	2.652	2.715	2.794	2.882	2.987	3.102	3.231	3.368	3.530
1070	2.642	2.704	2.784	2.870	2.975	3.090	3.218	3.354	3.518

Temperature-dependent equations

$$\rho = a - bT$$

Mol % CsCl	a	$b \cdot 10^3$	Standard deviation
0	4.8135	1.2105	0.0004
12	4.7942	1.3456	0.0006
25	4.6394	1.3283	0.0013
37	4.3801	1.2054	0.0008
50	4.2382	1.1803	0.0009
63	4.1302	1.1778	0.0009
75	3.9361	1.0770	0.0007
88	3.8766	1.0959	0.0008
100	3.7693	1.0536	0.0004

These values are based on the work of Smirnov, Shumov, Stepanov, Khokhlov, and Noskevich (Archimedean method) [85]. The following equation, with concentration, C, in mole percent CsCl and temperature in K, has been derived from the preceding data: $\rho = e + bT + cC^2 + dTC + eTC^2 + fCT^2$, where $a = 4.90268$, $b \cdot 10^3 = -1.30079$, $c \cdot 10^5 = 2.54535$, $d \cdot 10^5 = -2.71649$, $e \cdot 10^8 = 1.50924$, $f \cdot 10^8 = 1.42221$, with a maximum departure of 0.33% at 923 K and 75 mol % CsCl, and a standard error of estimate of 0.002. This equation may be used to calculate the density of CsF-CsCl melts at any given composition in the temperature range 923-1073 K.

TABLE 11. Viscosity studies: CsF-CsCl

Investigations critically re-examined		
Ref.	CsCl mol %	Temp. range
65	0-100	See footnote a.
Deviation from previous NSRDS recommendations [Vol. 4, Pt. 2]		
Ref.	CsCl mol %	Departure
65	100	−2.82 % (1070 K)

[a]The temperature range was not given. The isotherm at 1070 K (molar viscosity vs. composition) was reported and the values in the following table were calculated from this set of data.

TABLE 12. CsF-CsCl: Viscosity (cp)

Mol % CsCl	1070 K
0	1.30_4
12	1.17_3
25	1.10_8
37	1.06_8
50	1.07_9
63	1.07_3
75	1.06_4
88	1.06_1
100	1.03_4

These values are based on the work of Smirnov, Khokhlov and Antonov (oscillating sphere method) [65] and the density data of Smirnov, Shumov, and Khokhlov [83]. The data were reported in equation form and no estimate of error was given.

TABLE 13. CsF-CsCl: Molar viscosity (crg s mol^{-1})[a]

Temperature-dependent equations $\log \eta_M = A + B/T$		
Mol % CsCl	$-A$	B
0	1.6660	1516
12	1.2178	1015
25	1.2219	1019
37	1.2308	1036
50	1.1422	970
63	1.1259	974
75	1.1731	1039
88	1.1666	1050
100	1.1743	1065

Equations as reported by Smirnov, Khokhlov and Antonov [65] (see footnote, table 11); of limited value since temperature limits of applicability and standard deviation were not reported.

[a]Molar viscosity is defined by $\eta(M\rho^{-1})$, where $M = X_1M_1 + X_2M_2$ and ρ, X_1, X_2 are the density and mol fraction composition of the molten mixture, with the units of η in poise.

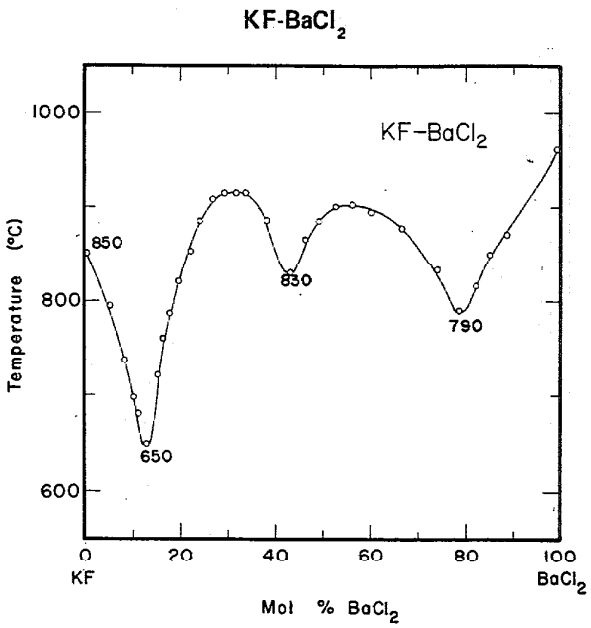

FIGURE 3. Temperature-composition phase diagram for KF-$BaCl_2$. E. I. Banashek and A. G. Bergman, Dokl. Akad. Nauk SSSR, 57, 905 (1947).

Melt Preparation and Purification

Bukhalova and Yaguh'yan [31] purified chemically pure barium chloride by recrystallizing twice from aqueous solution. Potassium fluoride was prepared by reacting chemically pure potassium carbonate with hydrofluoric acid.

TABLE 14. Density studies: KF-$BaCl_2$

Investigations critically re-examined			
Ref.	$BaCl_2$ mol %	Temp. range (T)	Comments
31	0-100 (g)	1573	Platinum sphere; calibration: volume of sphere determined using substances of known density.

TABLE 15. KF-$BaCl_2$: Density (g cm^{-3})

Mol % $BaCl_2$	1573
0	1.60
10	1.74
20	1.90
30	2.06
40	2.21
50	2.35
60	2.50
70	2.61
80	2.72
90	2.84
100	2.93

These values have been interpolated to three significant figures from the graphical presentation of Bukhalova and Yaguh'yan (Archimedean method) [31].

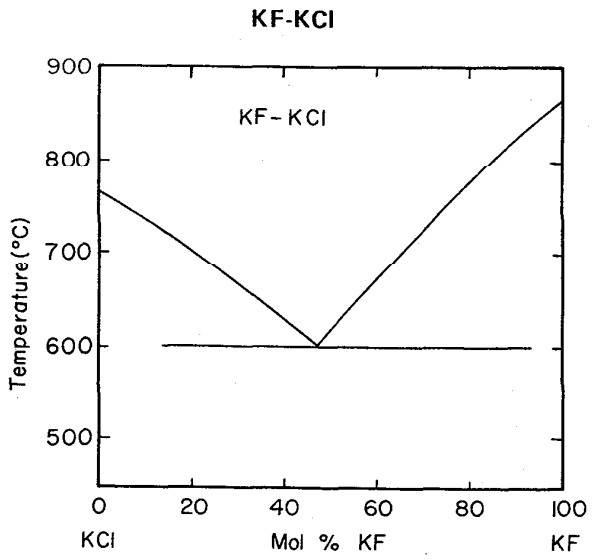

FIGURE 4. Temperature-composition phase diagram for KF-KCl.
W. Plato, Z. Phys. Chem., 58, 364 (1907).

Melt Preparation and Purification

Holm and Berge [60, 88] used reagent-grade KF and KCl dried at 400 – 500 °C under moderate vacuum (0.1 – 0.01 torr) and then melted in a platinum crucible in an atmosphere of purified nitrogen.

Narushkin, Patrov, and Chebotarev [87] used chemically pure KF and KCl dried to constant weight at 100 – 150 °C. The salts were then cooled in a desiccator and weighed in sintered corundum containers in an argon atmosphere.

Smirnov et al. [84] used high purity potassium halides. Anhydrous KF was obtained by dehydrating $KF \cdot 2H_2O$.

TABLE 16. Electrical conductance studies: KF-KCl

Investigations critically re-examined			
Ref.	KCl mol %	Temp. range (*T*)	Comments
84	0-100	993-1293	Pt electrodes; freq. range 50,000 Hz.

Deviations from previous NSRDS recommendations [1, pp. 3,5]

Ref.	KCl mol %	Min. departure	Max. departure
84	100	–0.11% (1065 K)	–0.11% (1195 K)
84	0	–7.44% (1155 K)	–7.64% (1220 K)

TABLE 17. KF-KCl: Specific conductance ($ohm^{-1}\ cm^{-1}$)

T	Mol percent KCl							
	100	88	75	63	50	37	12	0
1000			2.065	2.155				
1010			2.099	2.187				
1020			2.133	2.218				
1030		2.067	2.166	2.249	2.340	2.470		
1040		2.094	2.199	2.280	2.373	2.502		
1050		2.121	2.231	2.309	2.405	2.534		
1060	2.200	2.147	2.262	2.339	2.436	2.565		
1070	2.227	2.173	2.293	2.367	2.467	2.596		
1080	2.252	2.198	2.323	2.395	2.497	2.626		
1090	2.277	2.223	2.352	2.395	2.497	2.626		
1100	2.302	2.247	2.380	2.450	2.555	2.685		
1110	2.326	2.270	2.408	2.476	2.583	2.713	3.013	
1120	2.349	2.293	2.436	2.502	2.611	2.741	3.041	
1130	2.372	2.316	2.462	2.527	2.638	2.768	3.068	
1140	2.394	2.338	2.489	2.552	2.664	2.795	3.095	
1150	2.415	2.359	2.514	2.576	2.690	2.821	3.122	
1160	2.436	2.381	2.539	2.600	2.715	2.847	3.149	3.373
1170	2.457	2.401	2.563	2.623	2.739	2.872	3.176	3.400
1180	2.476	2.421	2.586	2.645	2.763	2.897	3.203	3.426
1190	2.495	2.440	2.609	2.667	2.786	2.921	3.229	3.453
1200	2.514	2.459	2.631	2.689	2.808	2.945	3.255	3.481
1210	2.532	2.478	2.653	2.709	2.830	2.968	3.282	3.509
1220	2.549	2.496	2.673	2.730	2.851	2.990	3.308	3.537
1230	2.566	2.513	2.694	2.749	2.872	3.012	3.334	3.565
1240	2.582	2.530	2.713	2.767	2.892	3.033	3.360	3.594
1250	2.597	2.546	2.732			3.054	3.386	3.623
1260	2.612	2.562				3.075	3.411	3.653
1270	2.626	2.577				3.094	3.437	3.682
1280							3.462	
1290							3.488	

TABLE 17. KF-KCl: Specific conductance (ohm^{-1} cm^{-1})—Continued

Temperature-dependent equations
$\kappa = a + bT + cT^2$

Mol % KCl	$-a$	$b.10^3$	$-c.10^6$	Standard deviation
0	−2.660	−1.392	−1.730	0.012
12	0.794	4.115	0.617	0.007
37	3.775	8.871	2.726	0.004
50	4.455	9.894	3.201	0.006
63	3.864	8.811	2.792	0.005
75	4.648	9.948	3.235	0.003
88	3.525	8.107	2.600	0.006
100	3.989	9.019	3.000	

These values are based on the work of Smirnov, Shumov, Khokhlov, Stepanov, Noskevich and Antonenko (classical ac technique) [84].

TABLE 10. Density studies. KF-KCl

Investigations critically re-examined

Ref.	KCl mol %	Temp. range (T)	Comments
84	0-100	993-1253	Pt ball; calibration: molten KNO_3.
60,88	50	1077.4,1136.4, 1190.0	Pt-10% Rh sinker; calibration: water.

Deviations from previous NSRDS recommendations [1, pp. 3,5 and this volume]

Ref.	KCl mol %	Min. departure	Max. departure
84	100	0.35% (1140 K)	0.38% (1020 K)
60,88	50	−0.78% (1077.4 K)	−0.92% (1136.4 K)
84	0	0.36% (1150 K)	1.91% (1250 K)

TABLE 19. KF-KCl: Density (g cm^{-3})

T	Mol percent KCl							
	100	88	75	63	50	37	12	0
1000						1.803		
1010			1.617			1.797		
1020		1.576	1.611			1.790		
1030		1.570	1.605			1.784		
1040		1.564	1.599			1.778		
1050		1.558	1.593			1.772		
1060	1.516	1.552	1.587	1.626	1.675	1.766		
1070	1.510	1.546	1.581	1.619	1.669	1.760		
1080	1.505	1.540	1.575	1.613	1.662	1.754		
1090	1.499	1.534	1.569	1.607	1.656	1.748	1.856	
1100	1.493	1.529	1.563	1.601	1.650	1.742	1.850	
1120	1.481	1.517	1.551	1.589	1.638	1.729	1.836	
1130	1.476	1.511	1.545	1.583	1.631	1.723	1.830	
1140	1.470	1.505	1.539	1.577	1.625	1.717	1.823	
1150	1.464	1.499	1.533	1.571	1.619	1.711	1.817	1.904
1160	1.458	1.493	1.527	1.565	1.613		1.810	1.898
1170	1.453	1.487	1.521	1.559	1.607		1.803	1.891
1180	1.447		1.515	1.552	1.601		1.797	1.884
1190	1.441		1.509	1.546	1.595		1.790	1.877
1200			1.503	1.540	1.588		1.783	1.871
1210				1.534	1.582		1.777	1.864
1220				1.528	1.576		1.770	1.857
1230				1.522	1.570		1.763	1.850
1240				1.516	1.564			1.844
1250				1.510	1.557			1.837

Temperature-dependent equations

$\rho = a - bT$

Mol % KCl	a	$b \cdot 10^3$	Standard deviation
0	2.6806	0.6750	0.0002
12	2.5800	0.6639	0.0005
37	2.4136	0.6109	0.0006
50	2.3296	0.6177	0.0003
63	2.2722	0.6100	0.0004
75	2.2187	0.5962	0.0004
88	2.1830	0.5950	0.0003
100	2.1300	0.5790	0.0010

These values are based on the work of Smirnov, Shumov, Stepanov, Khokhlov and Noskevich (Archimedean method) [84].

TABLE 20. Surface tension studies: KF-KCl

Investigations critically re-examined			
Ref.	KCl mol %	Temp. range (T)	Comments
60	50	1073	Pt-10% Rh sinker; calibration: water.
87	10-90	1173	Calibration: molten NaCl, KCl, NaF, KF.

TABLE 21. KF-KCl: Surface tension (dyn cm^{-1})

Mol % KCl	1173 K
10	92.3
20	96.3
30	96.3
40	99.6
50	103.8
60	106.0
70	106.9
80	110.1
90	114.7

The values in this table are those obtained experimentally by Narushkin, Patrov and Chebotarev (modified maximum bubble pressure method) [87].

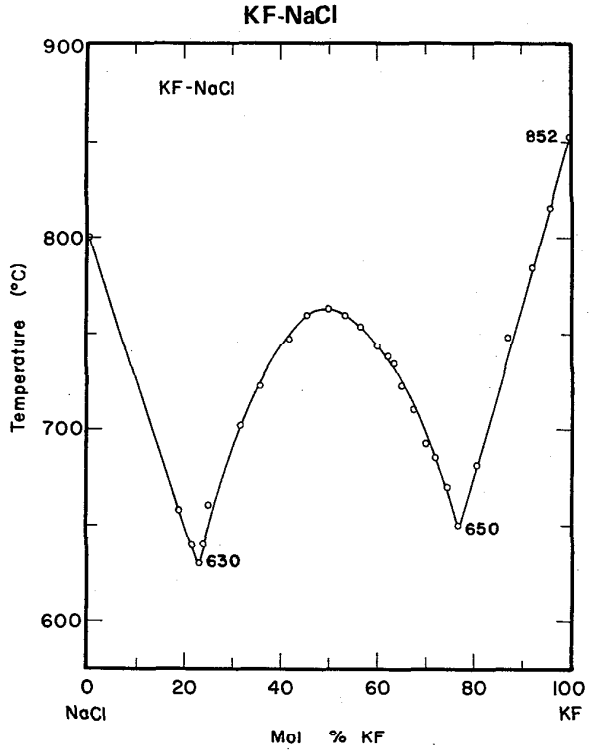

FIGURE 5. Temperature-composition phase diagram for KF-NaCl.
V. D. Polykov and S. I. Berul, Izv. Sekt. Fiz.-Khim., Nal. Inst. Ob. Neorg. Khim., Akad. Nauk SSSR, 22, 170 (1953).

Melt Preparation and Purification

Ryschkewitsch [9] used chemically pure KF and NaCl, and carried out the measurements under dry nitrogen.

TABLE 22. Electrical conductance studies: KF-NaCl

Investigations critically re-examined			
Ref.	NaCl mol %	Temp. range (T)	Comments
9	0,33,66, 100[a]	983-1273	Cell material: quartz cell or Pt crucible; Pt electrodes; freq. range: ≅6000 Hz; calibration: H_2SO_4 solutions, saturated NaCl solution, molten KNO_3.

[a]Ryschkewitsch reported the specific conductance of single salt melts graphically. The temperature measurements were accurate to within 1 °C.

TABLE 23. KF-NaCl: Specific conductance (ohm^{-1} cm^{-1})

	Mol percent NaCl		
T	66.6	50	33.3
990	2.32		2.57
1000	2.41	2.70	2.69
1010	2.51	2.78	2.81
1020	2.59	2.86	2.93
1030	2.68	2.94	3.04
1040	2.77	3.02	3.14
1050	2.86	3.10	3.24
1060	2.94	3.18	3.34
1070	3.03	3.26	3.43
1080	3.11	3.33	3.52
1090	3.19	3.40	3.60
1100	3.27	3.48	3.60
1110	3.35	3.55	3.76
1120	3.43	3.62	3.83
1130	3.51	3.69	3.89
1140	3.59	3.76	3.95
1150	3.66	3.83	4.01
1160	3.74	3.89	4.06
1170	3.81	3.96	4.11
1180	3.88	4.02	4.15
1190	3.95	4.09	4.19
1200	4.02	4.15	4.23
1210	4.09	4.21	
1220	4.16	4.27	
1230	4.23	4.33	
1240	4.29		
1250	4.36		
1260	4.42		
1270	4.49		

Temperature-dependent equations
$\kappa = a + bT + cT^2$

NaCl mol %	a	$b \cdot 10^2$	$c \cdot 10^6$	Standard error of estimate
33.3	−31.6045	5.6488	−22.1904	4.33%
50	−11.3609	1.9723	− 5.6670	2.11%
66.6	−12.1839	2.0052	− 5.4536	2.32%

These values are based on the work of Ryschewitsch (classical ac technique) [9].

TABLE 24. Density studies: KF-NaCl

Investigations critically re-examined		
Ref.	KF mol %	Temp. range (T)
43	0-70 (g)	1073

TABLE 25. KF-NaCl: Molar volume (cm^3) and density ($g\ cm^{-3}$)

Mol % KF	Molar volume (T = 1073 K)	Density (T = 1073 K)
0	37.7	1.55
10	37.5	1.56
20	37.0	1.58
30	36.4	1.60
40	35.7	1.63
50	34.9	1.67
60	34.3	1.70
70	33.5	1.74

These values are based on the work of Markov and Prisyazhnyii [43] (Archimedean method). The values were obtained by interpolation of the graphically-presented results (mole volume), and subsequent conversion of this data to densities in the conventional manner.

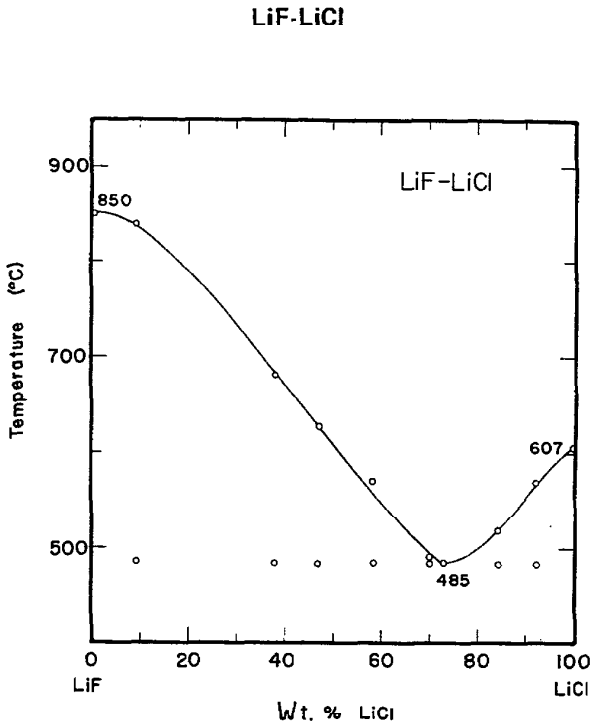

FIGURE 6. Temperature-composition phase diagram for LiF-LiCl.

A.A. Rochvar, Tsvetn. Metall. 1, 508 (1930); Z. Anorg. Allg. Chem. 210, 183 (1933).

Melt Preparation and Purification

Danielyan and Belyaev [52] used salts prepared from chemically pure reagents dried at 150 °C for several hours.

Holm and Berge [60, 88] used reagent grade lithium fluoride and lithium chloride dried at 400-500 °C under moderate vacuum (0.1-0.01 torr) and then melted in a platinum crucible under an atmosphere of purified nitrogen.

References [79] and [82] (Smirnov et al.) contain no information on melt preparation. However, see CsF-CsCl.

TABLE 26. Electrical conductance studies: LiF-LiCl

Investigations critically re-examined			
Ref.	LiCl mol %	Temp. range (T)	Comments
52	60, 69.5, 80, 100 (g)	≅788-1033	Cell material: quartz capillary; Pt disc-shaped electrodes; freq. range: 2000-20,000 Hz; calibration: 0.1 M KCl.
82	0-100	933-1273	Pt electrodes; freq. range: 50,000 Hz.

Deviations from previous NSRDS recommendations [1, pp. 3,4]			
Ref.	LiCl mol %	Min. departure	Max. departure
82	100	0.00% (970 K)	−0.15% (1055 K)
82	0	0.03% (1260 K)	−2.56% (1150 K)

TABLE 27. LiF-LiCl: Specific conductance (ohm^{-1} cm^{-1})

	Mol percent LiCl								
T	100	88	75	63	50	37	25	12	0
940	6.023	5.463	4.856	4.610	4.741	4.915	5.391	5.912	6.700
960	6.118	5.566	4.973	4.743	4.880	5.081	5.556	6.081	6.895
980	6.211	5.656	5.095	4.867	5.025	5.244	5.717	6.245	7.077
1000	6.299	5.749	5.205	4.994	5.161	5.402	5.875	6.403	7.254
1020	6.379	5.833	5.317	5.110	5.295	5.552	6.026	6.561	7.421
1040	6.464	5.915	5.419	5.229	5.427	5.709	6.175	6.706	7.590
1060	6.541	5.996	5.527	5.345	5.556	5.856	6.321	6.860	7.755
1080	6.613	6.072	5.626	5.452	5.679	6.000	6.461	7.005	7.917
1100	6.684	6.143	5.720	5.562	5.801	6.143	6.603	7.139	8.071
1120	6.749	6.213	5.816	5.665	5.917	6.282	6.738	7.283	8.218
1140	6.811	6.282	5.903	5.763	6.035	6.421	6.867	7.410	8.368
1160	6.875	6.342	5.992	5.864	6.147	6.547	6.999	7.539	8.510
1180	6.931	6.401	6.072	5.959	6.253	6.677	7.118	7.664	8.645
1200	6.981	6.455	6.155	6.048	6.357	6.805	7.241	7.788	8.784
1220	7.031	6.512	7.232	6.136	6.460	6.926	7.357	7.900	8.914
1240	7.076	6.561	6.304	6.222	6.557	7.045	7.471	8.021	9.042
1260	7.120	6.608	6.374	6.037	6.651	7.163	7.583	8.134	9.164

Temperature-dependent equation

$$\kappa = a + bT + cT^2 + dT^3$$

Mol % LiCl	$-a$	$b \cdot 10^2$	$-c \cdot 10^6$	$d \cdot 10^{10}$	Stand. error of est.
100	2.38328	1.30626	4.38178		0.022%
88	3.79487	1.53803	6.54756	7.08847	0.029%
75	4.53422	1.39024	4.16275		0.031%
63	5.09117	1.40770	3.99430		0.031%
50	4.45470	1.14329	0.812034	10.05267	0.024%
37	6.50401	1.59769	4.07234		0.029%
25	6.35426	1.67159	4.48874		0.023%
12	6.13153	1.72097	4.67529		0.041%
0	6.62282	1.90497	5.17567		0.025%

These values are based on the work of Smirnov, Khokhlov, Stepanov, and Shumov (classical ac technique) [82]. These authors reported equivalent conductivities in the form of semilogarithmic equations. The original data were converted to specific conductivities using the density equations reported in the same paper.

TABLE 28. Density studies: LiF-LiCl

Investigations critically re-examined

Ref.	LiCl mol %	Temp. range (T)	Comments
60	50	982.2,1014.2, 1085.2	Pt-10% Rh sinker; calibration: water.
82	0-100	933-1273	Pt sphere; calibration: molten KNO_3.

Deviations from NSRDS recommendations [1, pp. 3, 4 and this volume]

Ref.	LiCl mol %	Min. departure	Max. departure
82	100	−0.03% (930 K)	−0.14% (1050 K)
60	50	0.33% (1085.2 K)	0.76% (982.2 K)
82	0	0.01% (1210 K)	0.28% (1270 K)

TABLE 29. LiF-LiCl: Density (g cm^{-3})

T	Mol percent LiCl								
	100	88	75	63	50	37	25	12	0
940	1.477	1.493	1.517	1.548	1.588	1.640	1.699	1.768	1.877
960	1.468	1.485	1.508	1.540	1.579	1.631	1.691	1.760	1.869
980	1.459	1.476	1.500	1.531	1.571	1.623	1.682	1.751	1.860
1000	1.450	1.467	1.491	1.522	1.562	1.614	1.673	1.743	1.852
1020	1.441	1.458	1.482	1.513	1.553	1.605	1.664	1.735	1.844
1040	1.432	1.449	1.473	1.504	1.544	1.597	1.655	1.726	1.835
1060	1.423	1.441	1.465	1.496	1.536	1.588	1.646	1.718	1.827
1080	1.414	1.432	1.456	1.487	1.527	1.579	1.637	1.710	1.819
1100	1.405	1.423	1.447	1.478	1.518	1.570	1.629	1.701	1.811
1120	1.396	1.414	1.439	1.469	1.509	1.562	1.620	1.693	1.802
1140	1.387	1.406	1.430	1.460	1.501	1.553	1.611	1.685	1.794
1160	1.379	1.397	1.421	1.452	1.492	1.544	1.602	1.676	1.786
1180	1.370	1.397	1.421	1.452	1.492	1.544	1.602	1.676	1.786
1200	1.361	1.379	1.421	1.452	1.492	1.544	1.602	1.676	1.786
1220	1.352	1.371	1.395	1.425	1.466	1.518	1.575	1.651	1.761
1240	1.343	1.362	1.386	1.416	1.457	1.509	1.567	1.643	1.753
1260	1.334	1.353	1.377	1.408	1.448	1.501	1.558	1.634	1.744

Temperature dependent equations

$\rho = a - bT$

Mol % LiCl	a	$b \cdot 10^3$	Standard deviation
0	2.266	0.414	0.002
12	2.160	0.417	0.003
25	2.116	0.443	0.003
37	2.050	0.436	0.003
50	2.000	0.438	0.002
63	1.962	0.440	0.004
75	1.928	0.437	0.004
88	1.905	0.438	0.004
100	1.896	0.446	0.005

These values are based on the work of Smirnov, Khokhlov, Stepanov and Shumov (modified maximum bubble pressure method) [82]. The following equation, with concentration, C, in mole percent LiCl and temperature in K, has been derived from the preceding data: $\rho = a + bC + cT + dC^2 + eC^3 + fTC^2 + gCT^2$, where $a = 2.25621$, $b \cdot 10^3 = -8.20475$, $c \cdot 10^4 = -4.09235$, $d \cdot 10^5 = 6.37250$, $e \cdot 10^7 = -2.52846$, $f \cdot 10^9 = 8.73570$, $g \cdot 10^{10} = -5.11184$, with a maximum departure of 0.54% at 933 K and 12.0 mol % LiCl, and a standard error of estimate of 0.004. This equation may be used to calculate the density of LiF-LiCl melts at any given composition in the temperature range 933-1273 K.

TABLE 30. Surface tension studies: LiF-LiCl

Investigations critically re-examined

Ref.	LiCl mol %	Temp. range (T)	Comments
88	50	1073	Pt-10% Rh sinker; calibration: water.
79	0-88	929-1240	Cell material: Mo crucible; calibration: molten NaCl.

Deviations from NSRDS recommendations [2, p. 55 and this volume]

Ref.	LiCl mol %	Min. departure	Max. departure
88	50	−18.45% (1073 K)	
79	0	1.70% (1170 K)	1.76% (1240 K)

TABLE 31. LiF-LiCl: Surface tension (dyn cm^{-1})

T	Mol percent LiCl							
	88	75	63	50	37	25	12	0
930	144.9							
940	144.1							
950	143.2							
960	142.4	152.2						
970	141.5	151.3	162.1					
980	140.7	150.5	161.2					
990	139.8	149.7	160.3					
1000	139.0	148.8	159.4					
1010	138.1	147.9	158.5					
1020	137.3	147.1	157.6	171.3				
1030	136.5	147.1	157.6	171.3				
1040	135.6	145.4	155.8	169.4				
1050	134.8	144.5	154.9	168.5				
1060	133.9	143.7	154.0	167.6	184.0			
1070	133.1	142.8	153.1	165.8	183.0	200.8		
1080	132.3	142.0	152.1	164.9	182.1	199.8		
1090	131.4	141.1	151.2	164.0	181.2	198.9		
1100	130.6	140.3	150.3	163.1	180.3	197.9	219.4	241.7
1110	129.7	1394.	149.4	162.1	179.3	197.0	218.5	240.7
1120		138.6	148.5	161.2	178.4	196.0	217.5	239.8
1130		137.7	147.6	160.3	177.5	195.0	216.6	238.8
1140		136.9	146.7	159.4	176.6	194.1	215.6	237.8
1150			145.8	158.5	175.7	193.1	214.7	236.8
1160				157.6	174.7	192.2	213.7	235.8
1170					173.8	191.2	212.8	234.8
1180					172.9	190.3	211.8	233.9
1190					172.0	189.3	210.9	232.9
1200						188.3	209.9	231.9
1210							209.0	230.9
1220							208.0	229.9
1230								228.9
1240								227.9

Temperature-dependent equations
$\gamma = a + bT$

Mol % LiCl	a	$-b$
0	350.2	0.0986
12	323.8	0.0949
25	303.3	0.0958
37	281.7	0.0922
50	264.4	0.0913
63	250.0	0.0906
75	234.1	0.0853
88	223.2	0.0842

These values are based on the work of Smirnov and Stepanov (maximum bubble pressure method) [79]. The following equation, with concentration, C, in mole percent LiCl and temperature in K, has been derived from the preceding data: $\gamma = a + bTC + eC^2 + dCT^2 + eTC^2 + fT^3$, where a = 271.25732, $b \cdot 10^3$ = –2.89297, $c \cdot 10^4$ = –4.13850, $d \cdot 10^6$ = 1.04392, $e \cdot 10^6$ = 7.27278, $f \cdot 10^8$ = –2.89297, with a maximum departure of 0.37% at 1109 K and 88 mol % LiCl, and a standard error of estimate of 0.317. This equation may be used to calculate the surface tension of LiF-LiCl melts at any given composition in the temperature range 929-1240 K.

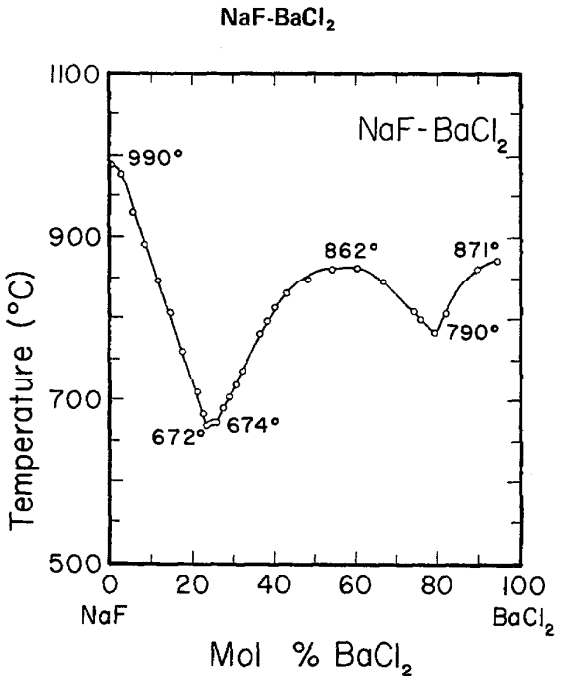

FIGURE 7. Temperature-composition phase diagram for $NaF-BaCl_2$.

E. I. Banashek and A. G. Bergman, Dokl. Akad. Nauk SSSR, 56, 485 (1947).

Melt Preparation and Purification

Taniuchi [47] used best quality commercial reagents dried at 110 °C and kept in a desiccator.

TABLE 32. Electrical conductance studies: $NaF-BaCl_2$

Investigations critically re-examined			
Ref.	$BaCl_2$ mol %	Temp. range (T)	Comments
47	0-100 (g)[a]	1123, 1173, 1273	Cell material: Pt crucible; Pt electrodes; freq. range: 2500, 5000 and 10,000 Hz; calibration: 0.01N KCl solution.

Deviations from previous NSRDS recommendations [1, pp. 3,7]		
Ref.	$BaCl_2$ mol %	Min. departure
47	100	4.44% (1273 K)
47	0	0.46% (1273 K)

[a]Numerical values for pure components at 1273 K.

TABLE 33. $NaF-BaCl_2$: Specific conductance ($ohm^{-1}cm^{-1}$)

$BaCl_2$ mol %	1123 K	1173 K	1273 K
0			5.13
10	3.67	3.87	4.17
20	2.92	3.16	3.43
30		2.74	2.98
40		2.48	2.70
50			2.54
60			2.44
70			2.34
80			2.30
90			2.24
100			2.18

These values have been interpolated to three significant figures from the graphical presentation of Taniuchi (classical ac technique) [47].

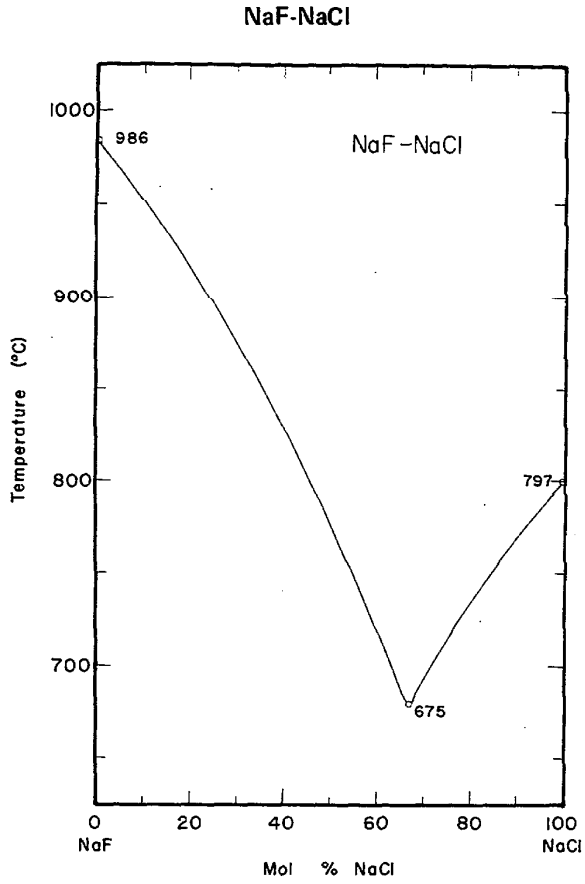

FIGURE 8. Temperature-composition phase diagram for NaF-NaCl.

Argonne National Laboratory, ANL-7316, Galvanic Cells with Fused Electrolytes (1967).

Melt Preparation and Purification

Ohta [63] dried Merck p.a. NaF and NaCl under a vacuum of 10^{-2} torr at a temperature of 400 °C. The salts were then allowed to crystallize as the temperature was slowly lowered. Imperfect crystals were discarded.

Narishkin, Patrov and Chebotarev [87] used chemically pure NaF and NaCl dried to constant weight at 100-150 °C. The salts were then cooled in a desiccator and weighed in sintered corundum containers in an argon atmosphere.

TABLE 34. Density studies: NaF-NaCl

Investigations critically re-examined		
Ref.	NaCl mol %	Temp. range
41	0, 25, 50, 75, 100, 30, 50, 75	1173
66		1273

Comparisons with previous NSRDS recommendations [1, pp. 3 and 4]

Ref.	NaCl mol %	Departure
41	100	−1.08% (1173 K)
66	0	−0.51% (1173 K)

TABLE 35. NaF-NaCl: Density (g cm^{-3})

T	Mol percent NaCl					
	100	75	50	30	25	0
1173	1.486	1.567	1.663		1.814	1.932
1273		1.5006	1.6452	1.7160		

The values at 1173 K in this table are those of Shieko, Perks and Pozdnyokov (Archimedean method) [41]; those at 1273 K are from Bukhalova, Shegurova and Yagub'yan (Archimedean method) [66]. The data of [41] were reported in equation form; the experimental values of [66] are given. Neither paper gives an error estimate.

TABLE 36. Viscosity studies: NaF-NaCl

Investigations critically re-examined			
Ref.	NaCl mol %	Temp. range (T)	Comments
63	0-100	1273	Pt-10% Ir sphere; tungsten torsion wire; calibration: water, molten KNO_3, NaCl, KCl.

TABLE 37. NaF-NaCl: Viscosity (cp)

Mol % NaCl	1273 K
0	1.420
22	1.185
40	0.990
60	0.863
81	0.76

These values are those of Ohta (oscillating sphere method [63]. Ohta estimated the error in these measurements as ± 2.5%.

TABLE 38. Surface tension studies: NaF–NaCl

Investigations critically re-examined			
Ref.	NaCl mol %	Temp. range (T)	Calibration
87	10-90	1273	Sodium and potassium chlorides and fluorides.

TABLE 39. NaF-NaCl: Surface tension (dyn cm^{-1})

Mol % NaCl	1273 K
10	162.2
20	134.4
30	125.5
40	121.3
50	115.8
60	116.2
70	111.3
80	110.4
90	108.6

The values in this table are those reported by Narishkin, Patrov and Chebotarev (maximum bubble pressure method) [87].

RbF-RbCl

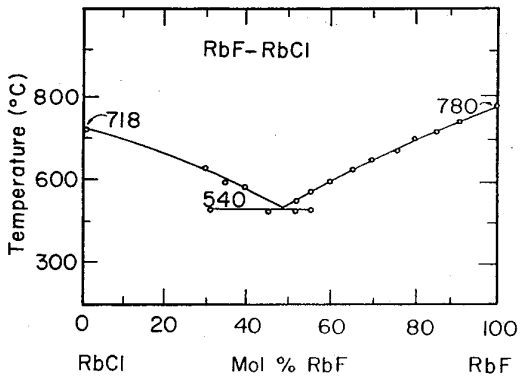

FIGURE 9. Temperature-composition phase diagram for RbF-RbCl.

E. I. Banashek, Izv. Sekt. Fiz. Khim, Anal., Akad. Nauk SSSR, 20, 139 (1950).

Melt Preparation and Purification

Holm and Berge [88] used reagent grade RbF and RbCl. The salts were dried at 400-500 °C under moderate vacuum (0.1-0.01 torr) and then melted in a platinum crucible in an atmosphere of purified N_2.

TABLE 40. Surface tension studies: RbF-RbCl

Investigations critically re-examined			
Ref.	RbCl Mol %	Temp. range (T)	Comments
88	51	1073	Pt-10% Rh sinker; calibration: water.

TABLE 41. RbF-RbCl: Surface tension (dyn cm^{-1})

Mol % RbCl	1073 K
51	95.1

The value in this table is that reported by Berge and Holm (pin detachment method) [88].

5.2. Fluoride-Bromide Systems

CsF-CsBr

Melt Preparation and Purification

References [85] and [65], Smirnov et. al, give no information as to melt purification. However, see CsF-CsCl.

TABLE 42. Electrical conductance studies: CsF-CsBr

Investigations critically re-examined			
Ref.	CsBr mol %	Temp. range (T)	Comments
85	0-100	923-1193	Pt electrodes; frequency: 50,000 Hz.

Deviations from previous NSRDS recommendations [1, pp. 3, 15]

Ref.	CsBr mol %	Min. departure	Max. departure
85	100	−0.10% (945 K)	−9.85% (1070 K)
85	0	−1.58% (1010 K)	−4.69% (1125 K)

TABLE 43. CsF-CsBr: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent CsBr								
	100	88	75	63	50	37	25	12	0
930	0.867								
940	0.884								
950	0.901	0.903							
960	0.917	0.923							
970	0.933	0.944		1.137	1.263	1.424		2.006	
980	0.949	0.963		1.154	1.282	1.445	1.701	2.033	
990	0.965	0.982	1.075	1.171	1.301	1.465	1.725	2.060	2.456
1000	0.980	1.001	1.091	1.187	1.319	1.485	1.750	2.087	2.488
1010	0.995	1.019	1.107	1.203	1.337	1.524	1.798	2.139	2.551
1020	1.010	1.037	1.122	1.219	1.354	1.505	1.774	2.139	2.551
1030	1.025	1.053	1.137	1.235	1.371	1.543	1.821	2.164	2.583
1040	1.039	1.070	1.153	1.251	1.388	1.562	1.844	2.189	2.614
1050	1.053	1.086	1.168	1.267	1.404	1.581	1.866	2.214	2.645
1060	1.067	1.101	1.183	1.283	1.420	1.599	1.888	2.238	2.677
1070	1.081	1.116	1.197	1.298	1.435	1.617	1.910	2.262	2.708
1080	1.094	1.313	1.212	1.313	1.450	1.635	1.931	2.285	2.739
1090		1.144	1.226	1.328	1.464	1.652	1.952	2.308	2.770
1100		1.157	1.241	1.343	1.478	1.669	1.972	2.330	2.801
1110		1.170	1.255	1.356	1.492	1.686	1.992	2.352	2.832
1120		1.182	1.268	1.373	1.505	1.703	2.012	2.374	2.863
1130		1.194	1.282	1.387	1.517	1.719	2.031	2.395	2.893
1140		1.205	1.296	1.401	1.530	1.735	2.050	2.415	2.924
1150		1.216	1.309	1.415	1.541	1.751	2.068	2.436	2.955
1160		1.226	1.323	1.429	1.553	1.766	2.086	2.455	2.985
1170		1.235	1.336	1.443	1.564	1.781	2.104	2.475	3.016
1180				1.457					3.046
1190				1.471					

TABLE 43. CsF-CsBr: Specific conductance ($ohm^{-1}\ cm^{-1}$)—Continued

Temperature-dependent equations
$\kappa = a + bT + cT^2$

Mol % CsBr	$-a$	$b \cdot 10^3$	$-c \cdot 10^6$	Standard deviation
0	1.055	3.918	0.375	0.008
12	2.702	6.932	2.143	0.004
25	2.679	6.435	2.006	0.004
37	1.993	4.962	1.484	0.005
50	2.690	6.205	2.196	0.004
63	1.225	3.185	0.773	0.004
75	1.283	3.173	0.799	0.002
88	3.494	7.158	2.663	0.003
100	1.791	4.015	1.244	0.002

These values are based on the work of Smirnov, Shumov, Stepanov, Khokhlov and Noskevich (classical ac technique) [85].

TABLE 44. Density studies: CsF-CsBr

Investigations critically re-examined

Ref.	CsBr mol %	Temp. range (T)	Comments
85	0-100	923-1073	Pt sphere; calibration: molten KNO_3.

Deviations from previous NSRDS recommendations [1, pp. 3, 15]

Ref.	CsBr mol %	Min. departure	Max. departure
85	100	0.03% (1070 K)	0.16% (930 K)
85	0	−0.28% (1070 K)	−0.39% (1010 K)

TABLE 45. CsF-CsBr: Density ($g\ cm^{-3}$)

T	Mol percent CsBr								
	100	88	75	63	50	37	25	12	0
930	3.112	3.154	3.196	3.242	3.306	3.379	3.469	3.587	3.688
940	3.100	3.141	3.184	3.229	3.293	3.367	3.456	3.573	3.676
950	3.087	3.129	3.171	3.217	3.280	3.354	3.443	3.560	3.663
960	3.075	3.116	3.159	3.204	3.267	3.341	3.430	3.547	3.651
970	3.062	3.104	3.147	3.192	3.255	3.328	3.418	3.534	3.639
980	3.050	3.091	3.134	3.179	3.242	3.316	3.405	3.521	3.627
990	3.037	3.079	3.121	3.167	3.229	3.303	3.392	3.508	3.615
1000	3.025	3.066	3.109	3.154	3.216	3.290	3.379	3.495	3.603
1010	3.012	3.053	3.097	3.142	3.204	3.277	3.366	3.482	3.591
1020	3.000	3.041	3.084	3.129	3.191	3.265	3.353	3.468	3.579
1030	2.987	3.029	3.072	3.117	3.178	3.252	3.340	3.455	3.567
1040	2.975	3.016	3.059	3.104	3.165	3.239	3.327	3.442	3.555
1050	2.962	3.003	3.047	3.092	3.153	3.227	3.315	3.429	3.542
1060	2.950	2.991	3.034	3.079	3.140	3.214	3.302	3.416	3.530
1070	2.937	2.978	3.022	3.067	3.127	3.201	3.289	3.403	3.518

TABLE 45. CsF-CsBr: Density (g cm^{-3})—Continued

Temperature-dependent equations.
$\rho = a - bT$

Mol % CsBr	a	$b \cdot 10^3$	Standard deviation
0	4.8135	1.2105	0.0004
12	4.8084	1.3137	0.0007
25	4.6676	1.2885	0.0005
37	4.5614	1.2711	0.0006
50	4.4914	1.2749	0.0006
63	4.4032	1.2488	0.0008
75	4.3567	1.2476	0.0005
88	4.3178	1.2517	0.0006
100	4.2716	1.2468	0.0005

These values are based on the work of Smirnov, Shumov, Stepanov, Khokhlov and Noskevich (Archimedean method) [85]. The following equation, with concentration, C, in mole percent CsBr and temperature in K, has been derived from the preceding data: $\rho = a + bT + cC^2 + dTC + eC^3 + fTC^2 + gCT^2$, where $a = 4.86120$, $b \cdot 10^3 = -1.25435$, $c \cdot 10^5 = 5.15260$, $d \cdot 10^5 = -2.01680$, $e \cdot 10^7 = -1.94613$, $f \cdot 10^8 = 1.72902$, $g \cdot 10^9 = 9.41693$, with a maximum departure of 0.28% at 923 K and 12 mol % CsBr, and a standard error of estimate of 0.003. This equation may be used to calculate the density of CsF-CsBr melts at any composition in the temperature range 923-1073 K.

TABLE 46. Viscosity studies: CsF-CsBr

Investigations critically re-examined

Ref.	CsBr mol %	Temp. range (T)
65[a]	0-100	See footnote a.

[a]The temperature range was not given. A 1070 K isotherm (molar viscosity versus composition) was reported and the values in the following table were calculated from these data.

TABLE 47. CsF-CsBr: Viscosity (cp)

Mol % CsBr	1070 K
0	1.30_4
25	1.22_4
37	1.17_8
63	1.11_7
75	1.12_2
88	1.14_2
100	1.20_3

These values are based on the work of Smirnov, Khokhlov and Antonov (oscillating sphere method) [65] and the density data of Smirnov, Shumov and Khokhlov [83]. The data were reported in equation form and no estimate of error was given.

TABLE 48. CsF-CsBr: Molar viscosity (erg s mol^{-1})[a]

Temperature-dependent equations
$\log \eta_M = A + B/T$

Mol % CsBr	$-A$	B
0	1.6660	1516
25	1.3296	1202
37	1.2840	1168
63	0.9267	821
75	0.9464	869
88	1.2039	985
100	1.0230	1031

Equations as reported by Smirnov, Khokhlov and Antonov [65] (see footnote, table 46); of limited value since temperature limits of applicability and standard deviation were not reported.

[a]Molar viscosity is defined by $\eta(M\rho^{-1})$ where $M = X_1M_1 + X_2M_2$, and ρ, X_1, X_2, are the density and mol fraction composition of the molten mixture, with the units of η in poise.

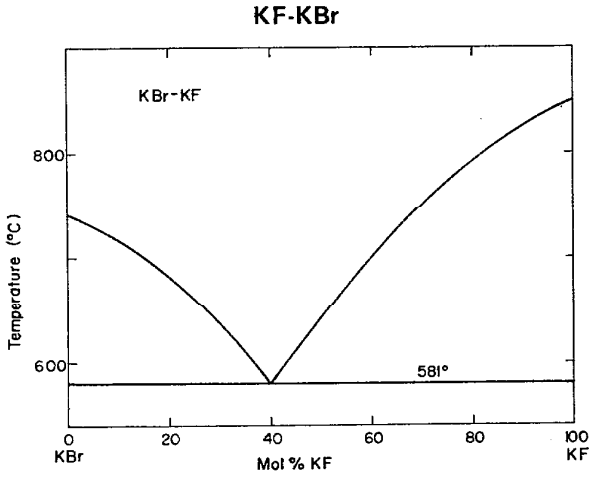

FIGURE 10. Temperature-composition phase diagram for KBr-KF. N. S. Kurnakow and J. B. Wrzesnewsky, Z. Anorg. Chem. 74, 90 (1912).

Melt Preparation and Purification

Smirnov et al. [84] used high purity potassium halides. Anhydrous KF was obtained by dehydrating $KF \cdot 2H_2O$.

TABLE 49. Electrical conductance studies: KF-KBr

Investigations critically re-examined			
Ref.	KBr mol %	Temp. range (T)	Comments
84	0-100	1003-1293	Pt electrodes; freq. range: 50,000 Hz.

Deviations from previous NSRDS recommendations [1, pp. 3,14]			
Ref.	KBr mol %	Min. departure	Max. departure
84	100	−2.69% (1220 K)	−4.92% (1100 K)
84	0	−7.44% (1155% K)	−7.64% (1220 K)

TABLE 50. KF-KBr: Specific conductance ($ohm^{-1}\ cm^{-1}$)

T	Mol percent KBr								
	100	88	75	63	50	37	25	12	0
1010				1.824					
1020		1.708		1.845					
1030	1.602	1.731	1.795	1.865					
1040	1.625	1.753	1.817	1.886					
1050	1.647	1.775	1.838	1.906					
1060	1.669	1.796	1.859	1.927		2.167			
1070	1.691	1.817	1.879	1.947		2.188			
1080	1.712	1.837	1.900	1.968		2.210			
1090	1.733	1.856	1.919	1.988		2.231	2.397		
1100	1.753	1.875	1.939	2.009	2.090	2.252	2.423		
1110	1.774	1.893	1.958	2.029	2.115	2.273	2.449	2.763	
1120	1.794	1.911	1.977	2.050	2.140	2.294	2.475	2.791	
1130	1.814	1.928	1.996	2.071	2.165	2.315	2.500	2.820	
1140	1.833	1.945	2.014	2.091	2.189	2.336	2.525	2.848	
1150	1.852	1.961	2.032	2.112	2.212	2.357	2.550	2.876	
1160	1.871	1.976	2.050	2.133	2.235	2.378	2.575	2.904	3.37
1170	1.890	1.991	2.067	2.153	2.258	2.398	2.599	2.932	3.39
1180	1.908	2.006	2.084	2.174	2.280	2.419	2.622	2.960	3.42
1190	1.926	2.019	2.101	2.195	2.301	2.439	2.646	2.987	3.45
1200	1.944	2.033	2.117	2.216	2.322	2.460	2.669	3.015	3.48
1210	1.961	2.045	2.133	2.237	2.343	2.480	2.692	3.042	3.50
1220	1.978	2.058	2.149	2.258	2.363	2.501	2.714	3.069	3.53
1230		2.069	2.164		2.383	2.521	2.737	3.096	3.56
1240		2.080	2.179		2.402	2.541	2.758	3.123	3.59
1250		2.091	2.194		2.420	2.561	2.780	3.150	3.62
1260			2.208		2.439	2.581	2.801	3.176	3.65
1270						2.601	2.822	3.203	3.68
1280								3.229	
1290								3.255	

Temperature-dependent equation

$$\kappa = a + bT + cT^2$$

Mol % KBr	$-a$	$b \cdot 10^3$	$-c \cdot 10^6$	Standard deviation
0	−2.660	−1.392	−1.730	0.012
12	1.359	4.557	0.760	0.007
25	2.417	6.180	1.618	0.008
37	0.513	2.913	0.363	0.006
50	3.699	7.953	2.446	0.005
63	0.112	1.796	−0.120	0.005
75	2.144	5.484	1.611	0.004
88	3.559	8.021	2.801	0.005
100	2.343	5.395	1.519	0.003

These values are based on the work of Smirnov, Shumov, Khokhlov, Stepanov, Noskevich and Antonenko (classical ac technique) [84].

TABLE 51. Density studies: KF-KBr

Investigations critically re-examined			
Ref.	KBr mol %	Temp. range (T)	Comments
84	0-100	873-1253	Pt ball; calibration: molten KNO_3.

Deviations from previous NSRDS recommendations [1, pp. 3,14]			
Ref.	KBr mol %	Min. departure	Max. departure
84	100	0.35% (1140 K)	0.38% (1020 K)
84	0	0.36% (1150 K)	1.91% (1250 K)

TABLE 52. KF-KBr: Density (g cm^{-3})

T	Mol percent KBr								
	100	88	75	63	50	37	25	12	0
980						2.066			
990					2.075	2.058			
1000					2.068	2.051			
1010	2.133				2.060	2.043			
1020	2.124				2.052	2.036			
1030	2.116				2.044	2.028			
1040	2.108				2.037	2.021	2.008		
1050	2.099				2.029	2.013	2.001		
1060	2.091				2.021	2.006	1.993		
1070	2.083				2.014	1.999	1.979		
1080	2.074		2.040	2.021	2.006	1.991	1.979		
1090	2.066	2.054	2.032	2.013	1.998	1.984	1.971	1.957	
1100	2.058	2.046	2.024	2.005	1.991	1.976	1.964	1.950	
1110	2.049	2.038	2.016	1.997	1.983	1.969	1.957	1.943	
1120	2.041	2.030	2.008	1.989	1.975	1.961	1.950	1.936	
1130	2.033	2.022	2.001	1.982	1.967	1.954	1.942	1.929	
1140	2.024	2.013	1.993	1.974	1.960		1.935	1.922	
1150		2.005	1.985	1.966	1.952		1.928	1.915	1.904
1160		1.997	1.977	1.958				1.908	1.898
1170		1.989	1.969	1.950				1.901	1.891
1180		1.981	1.961	1.942				1.894	1.884
1190		1.973	1.954	1.935				1.887	1.877
1200		1.964	1.946	1.927				1.880	1.871
1210		1.956	1.938	1.919					1.864
1220		1.948	1.930	1.911					1.857
1230			1.922	1.903					1.850
1240				1.895					1.844
1250									1.837

TABLE 52. KF-KBr: Density (g cm^{-3})–Continued

Temperature-dependent equations $\rho = a - bT$			
Mol % KBr	a	$b \cdot 10^3$	Standard deviation
0	2.6806	0.6750	0.0002
12	2.7232	0.7030	0.0003
25	2.7657	0.7286	0.0003
37	2.7956	0.7448	0.0004
50	2.8378	0.7702	0.0006
63	2.8691	0.7853	0.0005
75	2.8841	0.7819	0.0005
88	2.9464	0.8184	0.0004
100	2.9740	0.8329	0.0009

These values are based on the work of Smirnov, Shumov, Khokhlov, Stepanov, Noskevich and Antonenko (Archimedean method) [84]. The following equation, with concentration, C, in mole percent KBr and temperature in K, has been derived from the preceding data: $\rho = a + bC + cT^2 + dTC^2 + eT^3 + fCT^2$, where $a = 2.47777$, $b \cdot 10^3 = 1.47828$, $c \cdot 10^7 = -6.83004$, $d \cdot 10^9 = 3.70657$, $e \cdot 10^{10} = 2.17657$, $f \cdot 10^{10} = -5.69776$, with a maximum departure of 0.22% at 1083 K and 88 mol % KBr, and a standard error of estimate of 0.002. This equation may be used to calculate the density of KF-KBr melts at any given composition in the temperature range 873-1253 K.

LiF-LiBr

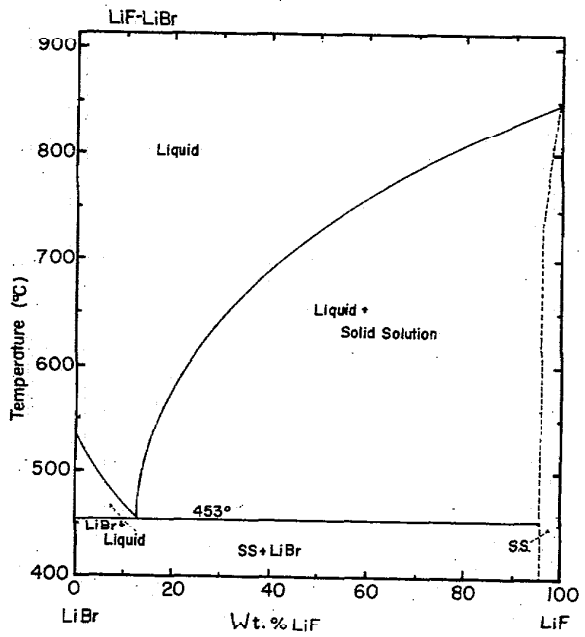

FIGURE 11. Temperature-composition phase diagram for LiF-LiBr.

A. A. Botschwar, Z. Anorg. Allg. Chem. 210, 163 (1933).

Melt Preparation and Purification

References [79] and [82], Smirnov et al., contain no information on melt purification. However, see CsF-CsCl.

TABLE 53. Electrical conductance studies: LiF-LiBr

Ref.	LiBr mol %	Temp. range (T)	Comments
82	0-100	873-1283	Pt electrodes; freq. range: 50,000 Hz.

Deviations from previous NSRDS recommendations [1, pp. 3,14]

Ref.	LiBr mol %	Min. departure	Max. departure
82	100	0.02% (915 K)	−2.08% (1020 K)
82	0	0.03% (1260 K)	−2.56% (1150 K)

TABLE 54. LiF-LiBr: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent LiBr								
	100	88	75	63	50	37	25	12	0
880	5.058	4.274	3.415	3.158	3.076	3.075	4.009	4.600	6.131
900	5.139	4.357	3.511	3.257	3.197	3.223	4.147	4.784	6.328
920	5.218	4.437	3.605	3.353	3.315	3.370	4.281	4.967	6.521
940	5.295	4.514	3.696	3.447	3.432	3.516	4.412	5.148	6.709
960	5.369	4.589	3.785	3.539	3.547	3.661	4.542	5.327	6.894
980	5.441	4.660	3.871	3.629	3.660	3.805	4.668	5.503	7.074
1000	5.511	4.728	3.955	3.716	3.771	3.948	4.791	5.677	7.250
1020	5.578	4.794	4.036	3.801	3.881	4.089	4.911	5.849	7.422
1040	5.642	4.857	4.116	3.884	3.989	4.228	5.029	6.018	7.590
1060	5.704	4.918	4.192	3.965	4.094	4.366	5.143	6.183	7.754
1080	5.763	4.975	4.267	4.043	4.198	4.503	5.255	6.346	7.914
1100	5.818	5.030	4.339	4.120	4.300	4.637	5.364	6.506	8.069
1120	5.871	5.082	4.408	4.194	4.400	4.770	5.470	6.662	8.221
1140	5.920	5.133	4.475	4.266	4.450	4.901	5.574	6.815	8.368
1160	5.966	5.180	4.540	4.335	4.593	5.029	5.674	6.964	8.511
1180	6.008	5.226	4.062	4.402	4.686	5.156	5.772	7.110	8.650
1200	6.046	5.268	4.662	4.468	4.777	5.280	5.866	7.252	8.785
1220	6.081	5.309	4.720	4.351	4.866	5.402	5.958	7.389	8.916
1240	6.122	3.347	4.775	4.591	4.952	5.522	6.047	7.523	9.043
1260	6.138	5.383	4.828	4.650	5.036	5.639	6.133	7.652	9.166
1280	6.161	5.417	4.879	4.706	5.118	5.753	6.217	7.777	9.284

Temperature-dependent equations

$$\kappa = a + bT + cT^2 + dT^3$$

Mol % LiBr	a	$b \cdot 10^3$	$c \cdot 10^6$	$d \cdot 10^9$	Standard Error of estimate
100	1.35534	2.38932	4.26653	–2.52079	0.018%
88	–3.08073	13.2314	–6.39220	0.976343	0.021%
75	–3.24985	10.3448	–3.21006	0.077853	0.028%
63	–3.37401	9.86628	–2.77621		0.038%
50	–3.16662	7.44947	0.388531	–0.941942	0.026%
37	–2.98903	4.88492	3.95182	–1.91644	0.033%
25	–4.85468	13.2030	–3.55740		0.023%
12	–3.18689	6.09129	5.77301	–3.00310	0.11%
0	–6.61583	19.0245	–515839		0.023%

These values are based on the work of Smirnov, Khokhlov, Stepanov, and Shumov (classical ac technique) [82] and were calculated from the reported values of equivalent conductivity and density.

TABLE 55. Density studies: LiF-LiBr

Investigations critically re-examined			
Ref.	LiBr mol %	Temp. range (T)	Comments
82	0-100	873-1283	Pt sphere; calibration: molten KNO_3.

Deviations from previous NSRDS recommendations [1, pp. 3,14]			
Ref.	LiBr mol %	Min. departure	Max. departure
82	100	–0.30% (1020 K)	–0.47% (830 K)
82	0	0.01% (1210 K)	0.31% (1280 K)

TABLE 56. LiF-LiBr: Density (g cm^{-3})

T	Mol percent LiBr								
	100	88	75	63	50	37	25	12	0
880	2.481	2.442	2.384	2.333	2.280	2.210	2.138	2.035	1.902
900	2.469	2.429	2.373	2.321	2.269	2.200	2.128	2.026	1.893
920	2.456	2.417	2.361	2.310	2.258	2.190	2.118	2.017	1.885
940	2.444	2.405	2.350	2.299	2.247	2.180	2.107	2.007	1.877
960	2.431	2.393	2.338	2.288	2.236	2.169	2.097	1.998	1.869
980	2.419	2.380	2.327	2.277	2.225	2.159	2.087	1.989	1.860
1000	2.406	2.368	2.315	2.266	2.214	2.149	2.077	1.980	1.852
1020	2.393	2.356	2.303	2.255	2.203	2.139	2.067	1.971	1.844
1040	2.381	2.343	2.292	2.244	2.192	2.129	2.057	1.962	1.835
1060	2.368	2.331	2.280	2.233	2.181	2.118	2.046	1.952	1.827
1080	2.356	2.319	2.269	2.222	2.070	2.108	2.036	1.943	1.819
1100	2.343	2.307	2.257	2.211	2.159	2.098	2.026	1.935	1.811
1120	2.331	2.294	2.246	2.199	2.148	2.088	2.016	1.925	1.802
1140	2.318	2.282	2.234	2.188	2.137	2.077	2.006	1.916	1.794
1060	2.305	2.270	2.223	2.177	2.126	2.067	1.995	1.907	1.786
1080	2.293	2.257	2.211	2.166	2.115	2.057	1.985	1.897	1.777
1200	2.280	2.245	2.199	2.155	2.104	2.047	1.975	1.888	1.769
1220	2.268	2.233	2.188	2.144	2.093	2.037	1.965	1.879	1.761
1240	2.255	2.220	2.176	2.133	2.082	2.026	1.955	1.870	1.753
1260	2.243	2.208	2.165	2.122	2.071	2.016	1.945	1.861	1.744
1280	2.230	2.196	2.153	2.111	2.060	2.006	1.934	1.851	1.736

Temperature-dependent equations

$\rho = a - bT$

Mol % LiBr	a	$b \cdot 10^3$	Standard deviation
0	2.266	0.414	0.002
12	2.439	0.459	0.004
25	2.586	0.509	0.004
37	2.660	0.511	0.005
50	2.763	0.549	0.004
63	2.821	0.555	0.004
75	2.893	0.578	0.004
88	2.983	0.615	0.005
100	3.034	0.628	0.004

These values are based on the work of Smirnov, Khokhlov, Stepanov and Shunov (modified maximum bubble pressure method) [82]. The following equation, with concentration, C, in mole percent LiBr and temperature in K, has been derived from the preceding data: $\rho = a + bC + cT + dC^2 + eC^3 + fTC^2 + gCT^2$, where $a = 2.29126$, $b \cdot 10^2 = 1.17976$, $c \cdot 10^4 = -4.34204$, $d \cdot 10^5 = -9.40849$, $e \cdot 10^7 = 3.97207$, $f \cdot 10^9 = 1.72173$, $g \cdot 10^{10} = -9.99427$, with a maximum departure of 0.40% at 873 K and 0.0 mol % LiBr, and a standard error of estimate of 0.004. This equation may be used to calculate the density of LiF-LiBr melts at any concentration in the temperature range 873-1283 K.

TABLE 57. Surface tension studies: LiF-LiBr

Investigations critically re-examined

Ref.	LiBr mol %	Temp. range (T)	Comments
79	0-100	884-1290	Cell material: molybdenum crucible; calibration: molten NaCl.

Deviations from previous NSRDS recommendations [2, p. 55]

Ref.	LiBr mol %	Min. departure	Max. departure
79	0	1.70% (1170 K)	1.76% (1240 K)

TABLE 58. LiF-LiBr: Surface tension (dyn cm^{-1})

T	Mol percent LiBr								
	100	88	75	63	50	37	25	12	0
890	123.7		142.0						
900	123.0	130.9	141.2						
910	122.3	130.1	140.5						
920	121.6	129.4	139.7						
930	120.9	128.7	138.9	150.5					
940	120.2	127.9	138.2	149.7					
950	119.5	127.2	137.4	148.9					
960	118.9	126.5	136.6	148.1	162.5				
970	118.2	125.8	135.9	147.3	161.7				
980	117.5	125.1	135.1	146.5	160.9				
990	116.8	124.3	134.4	145.7	160.1				
1000	116.1	123.6	133.6	144.9	159.3				
1010	115.4	122.9	132.8	144.1	158.5				
1020	114.7	122.1	132.1	143.3	157.7	175.5			
1030	114.0	121.4	131.3	142.5	156.9	174.6			
1040	113.3	120.7	130.5	141.7	156.1	173.8			
1050	112.6	120.0	129.8	140.9	155.3	172.9			
1060	111.9	119.3	129.0	140.1	154.4	172.0			
1070	111.3	118.5	128.3	139.3	153.6	171.2			
1080	110.6	117.8	127.5	138.5	152.8	170.3	189.2		
1090	109.9	117.1	126.7	137.7	152.0	169.5	188.3		
1100	109.2	116.3	126.0	136.9	151.2	168.6	187.4		241.7
1110	108.5	115.6	125.2	136.1	150.4	167.7	186.5	211.2	240.7
1120	107.8	114.9	124.5	135.3	149.6	166.9	185.6	210.2	239.8
1130	107.1	114.2		134.5	148.8	166.0	184.7	209.2	238.8
1140				133.7	148.0	165.2	183.8	208.3	237.8
1150					147.1	164.3	182.9	207.3	236.8
1160					146.3	163.4	182.0	206.4	235.8
1170					145.5	162.6	181.1	205.4	234.8
1180					144.7	161.7	180.3	204.5	233.9
1190					143.9	160.9	179.3	203.5	232.9
1200					143.1	160.0	178.5	202.6	231.9
1210					142.3	159.1	177.6	201.6	230.9
1220						158.3	176.7	200.7	229.9
1230						157.4	175.8	199.7	228.9
1240						156.6	174.9	198.7	227.9
1250						155.7	174.0	197.8	226.9
1260							173.1	196.8	226.0
1270							172.2	195.9	225.0
1280								194.9	224.0
1290									223.0

Temperature-dependent equations

$\gamma = a - bT$

Mol % LiBr	a	b
0	350.2	0.0986
12	316.8	0.0952
25	286.1	0.0897
37	263.2	0.0860
50	240.3	0.0810
63	224.6	0.0797
75	209.8	0.0762
88	196.1	0.0725
100	185.2	0.0691

These values are based on the work of Smirnov and Stepanov (maximum bubble pressure method) [79]. The data were reported in equation form. No error estimate was given.

5.3. Fluoride-Iodide Systems

CsF-CsI

Melt Preparation and Purification

Neither [65] nor [85], Smirnov et al., give information on melt preparation. However, see CsF-CsCl.

TABLE 59. Electrical conductance studies: CsF-CsI

Investigations critically re-examined			
Ref.	CsI mol %	Temp. range (T)	Comments
85	0-100	923-1183	Pt electrodes; freq. range: 50,000 Hz.

Deviations from previous NSRDS recommendations [1, pp. 3,20]

Ref.	CsI mol %	Min. departure	Max. departure
85	100	−0.54% (935 K)	−12.84% (1070 K)
85	0	−1.58% (1910 K)	−4.92% (1125 K)

TABLE 60. CsF-CsI: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent CsI								
	100	88	75	63	50	37	25	12	0
930	0.707								
940	0.721								
950	0.734	0.755	0.807						
960	0.747	0.769	0.821	0.895		1.147	1.351		
970	0.759	0.783	0.835	0.910		1.165	1.370		
980	0.772	0.796	0.848	0.926	1.031	1.183	1.390		
990	0.785	0.810	0.861	0.941	1.047	1.201	1.409	1.716	2.456
1000	0.797	0.823	0.874	0.956	1.062	1.219	1.428	1.738	2.488
1010	0.809	0.836	0.887	0.971	1.077	1.236	1.447	1.760	2.520
1020	0.821	0.849	0.900	0.985	1.092	1.253	1.466	1.782	2.551
1030	0.833	0.862	0.912	1.000	1.107	1.270	1.485	1.804	2.583
1040	0.845	0.975	0.925	1.014	1.212	1.286	1.503	1.825	2.614
1050	0.857	0.888	0.937	1.028	1.135	1.302	1.522	1.847	2.645
1060	0.869	0.907	0.949	1.042	1.149	1.318	1.541	1.868	2.677
1070	0.880	0.913	0.962	1.055	1.163	1.333	1.559	1.889	2.708
1080		0.926	0.974	1.069	1.177	1.349	1.577	1.910	2.739
1090		0.938	0.985	1.082	1.190	1.363	1.593	1.930	2.770
1100		0.951	0.997	1.095	1.203	1.378	1.613	1.951	2.801
1110		0.963	1.009	1.107	1.216	1.392	1.631	1.971	2.832
1120		0.975	1.021	1.120	1.229	1.406	1.649	1.991	2.863
1130				1.132	1.242	1.420	1.667	2.011	2.893
1140				1.144	1.254	1.433	1.685	2.031	2.924
1150				1.156	1.266	1.446	1.702	2.051	2.955
1160				1.168	1.278	1.459	1.720	2.071	2.985
1170				1.179	1.290	1.471	1.737	2.090	3.016
1180								2.109	3.046

Temperature-dependent equations

$$\kappa = a + bT + cT^2$$

Mol % CsI	$-a$	$b \cdot 10^3$	$-c \cdot 10^6$	Standard deviation
0	1.055	3.918	0.375	0.008
12	1.331	3.923	0.854	0.005
25	0.990	2.930	0.512	0.004
37	2.026	4.749	1.504	0.003
50	1.512	3.629	1.055	0.002
63	1.586	3.592	1.050	0.001
75	1.057	2.565	0.634	0.003
88	0.987	2.296	0.486	0.004
100	1.081	2.523	0.645	0.001

These values are based on the work of Smirnov, Shumov, Stepanov, Khokhlov and Noskevich (classical ac technique) [85].

TABLE 61. Density studies: CsF-CsI

Investigations critically re-examined			
Ref.	CsI mol %	Temp. range (T)	Comments
85	0-100	923-1073	Pt sphere; calibration: molten KNO_3.

Deviations from previous NSRDS recommendations [1, pp. 3, 20]			
Ref.	CsI mol %	Min. departure	Max. departure
85	100	0.50% (1070 K)	0.94% (930 K)
85	0	−0.28% (1070 K)	−0.39% (1010 K)

TABLE 62. CsF-CsI: Density (g cm^{-3})

T	Mol percent CsI								
	100	88	75	63	50	37	25	12	0
930	3.170	3.185	3.219	3.250	3.295	3.363	3.461	3.577	3.688
940	3.157	3.172	3.206	3.237	3.282	3.350	3.448	3.563	3.676
950	3.144	3.160	3.193	3.224	3.269	3.337	3.435	3.550	3.663
960	3.131	3.147	3.180	3.211	3.257	3.324	3.422	3.537	3.651
970	3.118	3.135	3.167	3.198	3.244	3.311	3.409	3.524	3.639
980	3.105	3.122	3.154	3.185	3.231	3.298	3.396	3.511	3.627
990	3.093	3.110	3.141	3.172	3.218	3.285	3.383	3.498	3.615
1000	*3.080*	*3.097*	*3.128*	*3.159*	*3.205*	*3.273*	*3.370*	*3.485*	*3.603*
1010	3.067	3.085	3.115	3.146	3.192	3.260	3.357	3.472	3.591
1020	3.054	3.072	3.102	3.133	3.179	3.247	3.344	3.459	3.579
1030	3.041	3.060	3.089	3.120	3.166	3.234	3.331	3.445	3.567
1040	3.028	3.047	3.076	3.107	3.153	3.221	3.318	3.432	3.555
1050	3.015	3.035	3.063	3.094	3.140	3.208	3.305	3.419	3.542
1060	3.002	3.022	3.049	3.081	3.127	3.195	3.292	3.406	3.530
1070	2.989	3.010	3.036	3.068	3.114	3.182	3.279	3.393	3.518

Temperature-dependent equations

$\rho = a - bT$

Mol % CsI	a	$b \cdot 10^3$	Standard deviation
0	4.8135	1.2105	0.0004
12	4.7959	1.3110	0.0008
25	4.6753	1.3052	0.0006
37	4.5627	1.2901	0.0006
50	4.4988	1.2940	0.0006
63	4.4598	1.3010	0.0006
75	4.4337	1.3058	0.0005
88	4.3478	1.2506	0.0006
100	4.3677	1.2880	0.0007

These values are based on the work of Smirnov, Shumov, Stepanov, Khokhlov and Noskevich (Archimedean method) [85]. The following equation, with concentration, C, in mole percent CsI and temperature in K, has been derived from the preceding data: $\rho = a + bT + cC^2 + dTC + eC^3 + fTC^2 + gCT^2$, where $a = 4.85201$, $b \cdot 10^3 = -1.24454$, $c \cdot 10^5 = 6.13518$, $d \cdot 10^5 = -2.09668$, $e \cdot 10^7 = -2.25767$, $f \cdot 10^8 = 2.64349$, $g \cdot 10^9 = 9.16775$, with a maximum departure of 0.30% at 923 K and 37 mol % CsI, and a standard error of estimate of 0.004. This equation may be used to calculate the density of CsF-CsI melts at any composition in the temperature range 923-1073 K.

TABLE 63. Viscosity studies: CsF-CsI

Investigations critically re-examined		
Ref.	CsI mol %	Temp. range
65	0-100	See footnote a.

[a]The temperature range was not given. The isotherm at 1070 K (molar viscosity vs. composition) was reported and the values in the following table were calculated from these data.

TABLE 64. CsF-CsI: Viscosity (cp)

Mol % CsI	1070 K
0	1.30_4
12	1.26_4
37	1.09_1
50	1.03_8
63	0.975
75	0.998
88	1.03_0
100	1.01_1

These values were calculated from the data of Smirnov, Khokhlov and Antonov (oscillating sphere method) [65], and the density data of Smirnov, Shumov and Khokhlov [83]. The data were reported in equation form and no estimate of error was given.

TABLE 65. CsF-CsI: Molar viscosity (erg s mol^{-1})[a]

Temperature-dependent equations $\log \eta_M = A + B/T$		
Mol % CsI	$-A$	B
0	1.6660	1516
12	1.5893	1474
37	1.1203	1004
50	1.0130	909
63	1.1284	1041
75	1.0525	1002
88	0.9461	934
100	0.9142	918

Equations as reported by Smirnov et al. [65]. Of limited usefulness since the temperature ranges to which they pertain and standard deviation were not reported.

[a]Molar viscosity is defined by $\eta(M\rho^{-1})$ where $M = X_1M_1 + X_2M_2$, and ρ, X_1, X_2, are the density and mol fraction composition of the molten mixture, with the units of η in poise.

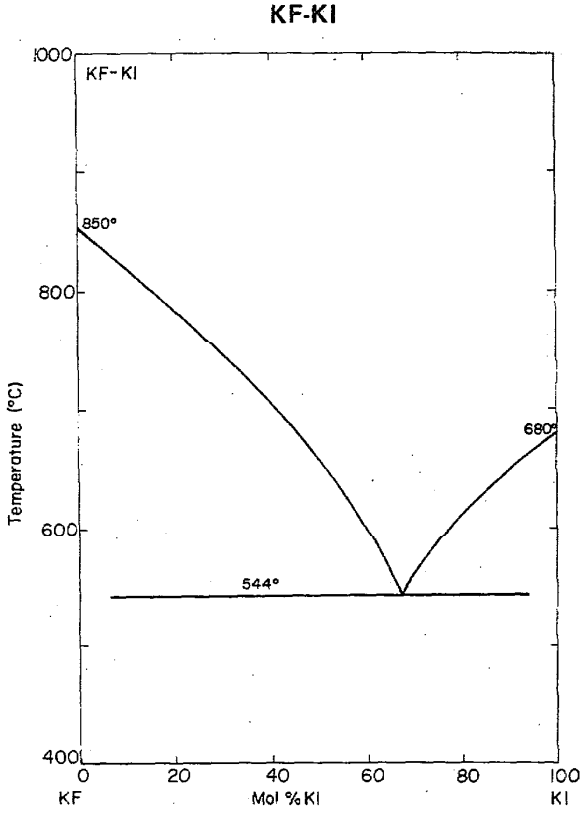

FIGURE 12. Temperature composition phase diagram for KF-KI.

A. G. Bergman and F. P. Platonov. Izv. Sekt. Fiz. Khim. Anal. Inst. Obshch. Neorg. Khim., Akad Nauk SSSR 11, 256 (1938).

Melt Preparation and Purification

Smirnov et al. [84] used high purity potassium iodide. Anhydrous KF was prepared from the dihydrate.

TABLE 66. Electrical conductance studies: KF-KI

Investigations critically re-examined			
Ref.	KI mol %	Temp. range (T)	Comments
84	0-100	963-1313	Pt electrodes; freq. range: 50,000 Hz.

Deviations from previous NSRDS recommendations [1, pp. 3,19]

Ref.	KI mol%	Min. departure	Max. departure
84	100	0.02% (1045 K)	4.17% (965 K)
84	0	−7.44% (1155 K)	−7.64% (1220 K)

TABLE 67. KF-KI: Specific conductance ($ohm^{-1} cm^{-1}$)

T	Mol percent KI								
	100	88	75	63	50	37	25	12	0
970	1.338								
980	1.357	1.247	1.293						
990	1.376	1.271	1.316						
1000	1.394	1.295	1.338	1.374					
1010	1.412	1.318	1.360	1.398					
1020	1.429	1.341	1.382	1.423					
1030	1.447	1.364	1.404	1.447	1.574				
1040	1.463	1.386	1.426	1.471	1.598	1.708			
1050	1.480	1.407	1.447	1.494	1.621	1.733			
1060	1.496	1.429	1.469	1.517	1.644	1.757			
1070	1.511	1.449	1.490	1.541	1.667	1.780			
1080	1.527	1.470	1.512	1.563	1.689	1.804			
1090	1.541	1.480	1.533	1.586	1.711	1.827			
1100	1.556	1.509	1.554	1.609	1.732	1.850			
1110	1.570	1.528	1.575	1.631	1.753	1.873	2.143		
1120	1.584	1.546	1.596	1.653	1.773	1.896	2.165	2.580	
1130	1.597	1.565	1.617	1.675	1.793	1.918	2.186	2.611	
1140	1.610	1.582	1.638	1.696	1.813	1.940	2.208	2.642	
1150	1.622	1.599	1.658	1.718	1.832	1.962	2.230	2.673	
1160	1.635	1.616	1.679	1.739	1.851	1.984	2.251	2.703	3.373
1170	1.646	1.632	1.699	1.760	1.869	2.005	2.273	2.733	3.399
1180	1.658	1.648	1.719	1.781	1.888	2.026	2.294	2.763	3.426
1190		1.663	1.739	1.801	1.905	2.047	2.316	2.793	3.453
1200		1.678	1.759		1.923	2.068	2.337	2.823	3.481
1210			1.779		1.939	2.089	2.358	2.853	3.509
1220			1.799		1.956	2.109	2.380	2.883	3.537
1230					1.972	2.129	2.401	2.912	3.565
1240					1.987	2.149	2.422	2.942	3.594
1250					2.003	2.168	2.443	2.971	3.623
1260					2.017	2.188	2.464	3.000	3.656
1270					2.032	2.207	2.485	3.029	3.682
1280					2.046	2.226	2.506	3.057	
1290						2.244	2.527	3.086	
1300							2.548	3.115	
1310							2.569		

Temperature-dependent equations
$\kappa = a + bT + cT^2$

Mol % KI	$-a$	$b \cdot 10^3$	$-c \cdot 10^6$	Standard deviation
0	−2.660	−1.392	−1.730	0.012
12	1.762	4.660	0.699	0.007
25	0.588	2.740	0.252	0.006
37	2.087	4.863	1.167	0.004
50	3.021	6.534	2.012	0.006
63	2.198	4.685	1.113	0.004
75	1.420	3.300	0.542	0.004
88	3.306	6.838	2.237	0.004
100	2.355	5.605	1.936	0.002

These values are based on the work of Smirnov, Shumov, Khokhlov, Stepanov, Noskevich and Antonenko (classical ac technique) [84].

TABLE 68. Density studies: KF-KI

Ref.	KI mol %	Temp. range (T)	Comments
84	0-100	1003-1253	Pt ball; calibration: molten KNO_3.

Deviations from previous NSRDS recommendation [1, pp. 3,19]

Ref.	KI mol %	Min. departure	Max. departure
84	100	0.38% (1090 K)	0.45% (1005 K)
84	0	0.36% (1150 K)	1.91% (1250 K)

TABLE 69. KF-KI: Density (g cm^{-3})

T	Mol percent KI								
	100	88	75	63	50	37	25	12	0
1010	2.405	2.368							
1020	2.395	2.359			2.236				
1030	2.385	2.350			2.223				
1040	2.375	2.340			2.219	2.172			
1050	2.365	2.331	2.290		2.211	2.164			
1060	2.356	2.322	2.281		2.203	2.156	2.106		
1070	2.346	2.312	2.272		2.194	2.148	2.098		
1080	2.336	2.303	2.263	2.229	2.186	2.140	2.091		
1090	2.326	2.294	2.254	2.220	2.177	2.132	2.083		
1100		2.285	2.245	2.211	2.169	2.124	2.075	2.013	
1110		2.275	2.236	2.203	2.161	2.116	2.067	2.006	
1120		2.266	2.227	2.194	2.152	2.108	2.060	1.999	
1130		2.257	2.218	2.185	2.144	2.100	2.052	1.991	
1140			2.209	2.176	2.136	2.092	2.044	1.984	
1150			2.201	2.168	2.127	2.084	2.036	1.977	1.904
1160			2.192	2.159		2.076	2.029	1.970	1.898
1170			2.183	2.150		2.068	2.021	1.963	1.891
1180				2.141		2.060	2.013	1.955	1.884
1190						2.052	2.005	1.948	1.877
1200								1.941	1.877
1210								1.933	1.864
1220								1.926	1.857
1230									1.850
1240									1.844
1250									1.867

Temperature-dependent equations

$\rho = a - bT$

Mol % KI	a	$b \cdot 10^3$	Standard deviation
0	2.6806	0.6750	0.0002
12	2.8122	0.7262	0.0005
25	2.9281	0.7754	0.0003
37	3.0044	0.8001	0.0004
50	3.0887	0.8359	0.0003
63	3.1716	0.8729	0.0004
75	3.2247	0.8905	0.0004
88	3.3108	0.9330	0.0003
100	3.3927	0.9782	0.0005

These values are based on the work of Smirnov, Shumov, Stepanov, Khokhlov, Noskevich and Antonenko (Archimedean method) [84]. The following equation, with concentration, C, in mole percent KI and temperature in K, has been derived from the preceding data: $\rho = a + bC + cT^2 + dC^3 + eTC^2 + fT^3$, where $a = 2.45700$, $b \cdot 10^3 = 5.94014$, $c \cdot 10^7 = -6.01598$, $d \cdot 10^7 = 1.27720$, $e \cdot 10^8 = -3.21815$, $f \cdot 10^{10} = 1.62975$, with a maximum departure of 0.28% at 1143 K and 0.0 mol % KI, and a standard error of estimate of 0.002. This equation may be used to calculate the density of KF-KI melts at any composition in the temperature range 1003-1253 K.

LiF-LiI

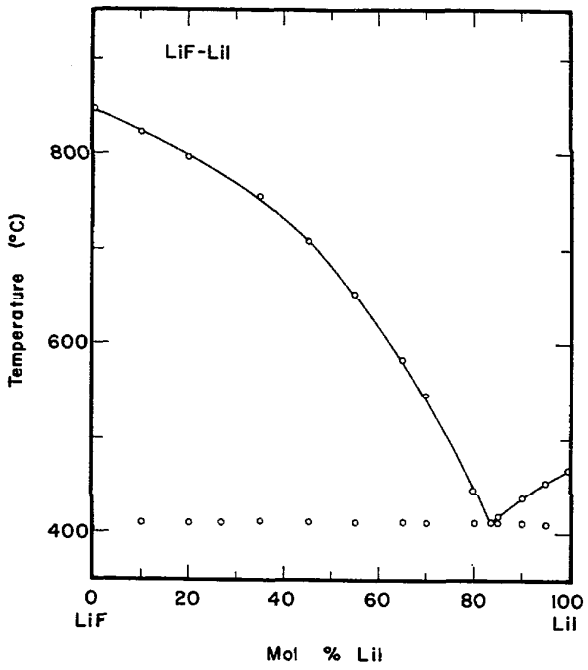

FIGURE 13. Temperature-composition phase diagrams for LiF-LiI.

Argonne National Laboratory, ANL-7316, Galvanic Cells With Fused Electrolytes (1967).

Melt Preparation and Purification

Johnson [303] used reagent-grade LiI purified by bubbling anhydrous HI through the molten salt to remove the last traces of water. Single-crystal LiF was used without further purification.

Smirnov et al. [79,82] gave no details on melt preparation and purification. However, see CsF-CsCl.

TABLE 70. Electrical conductance studies: LiF-LiI

Investigations critically re-examined			
Ref.	LiI mol %	Temp. range (T)	Comments
89[a]	83.5,100	726-821	Quartz capillary cell; Pt electrodes; freq. range: 5000-45,000 Hz; calibration: molten salts.
82	0-100	758-1273	Pt electrode; freq. range: 50,000 Hz.

Deviations from previous NSRDS recommendations [1, pp. 3, 19]			
Ref.	LiI mol %	Min. departure	Max. departure
82	100	0.29% (875 K)	0.40% (760 K)
82	0	0.03% (1260 K)	−2.56% (1150 K)

[a]Reference [89] is the NSRDS data base for the specific conductance of molten lithium iodide.

TABLE 71. LiF-LiI: Specific conductance ($ohm^{-1} cm^{-1}$)

T	Mol percent LiI						
	100	75	63	50	37	25	0
760	4.005	2.467	2.033	1.863	1.667	1.651	4.871
780	4.103	2.559	2.107	1.959	1.775	1.763	5.090
800	4.198	2.647	2.178	2.054	1.884	1.876	5.305
820	4.292	2.733	2.247	2.148	1.993	1.990	5.519
840	4.379	2.817	2.315	2.240	2.103	2.103	5.724
860	4.463	2.900	2.380	2.332	2.212	2.217	5.930
880	4.543	2.979	2.444	2.422	2.322	2.331	6.132
900	4.618	3.057	2.505	2.511	2.430	2.447	6.326
920	4.692	3.132	2.565	2.598	2.539	2.560	6.520
940	4.760	3.205	2.623	2.683	2.646	2.673	6.710
960	4.827	3.275	2.679	2.768	2.753	2.787	6.896
980	4.889	3.343	2.733	2.850	2.859	2.898	7.073
1000	4.950	3.409	2.785	2.931	2.963	3.009	7.254
1020	5.007	3.473	2.836	3.010	3.066	3.118	7.421
1040	5.059	3.533	2.884	3.087	3.169	3.227	7.590
1060	5.109	3.593	2.932	3.163	3.269	3.335	7.755
1080	5.157	3.649	2.975	3.237	3.369	3.441	7.917
1100	5.201	3.705	3.019	3.307	3.466	3.545	8.071
1120	5.244	3.757	3.061	3.379	3.562	3.648	8.218
1140	5.285	3.808	3.100	3.447	3.657	3.751	8.368
1160	5.322	3.855	3.138	3.511	3.749	3.851	8.510
1180	5.354	3.902	3.173	3.577	3.841	3.949	8.645
1200	5.387	3.945	3.210	3.639	3.930	4.045	8.784
1220	5.418	3.988	3.244	3.700	4.019	4.141	8.914
1240	5.445	4.030	3.274	4.103	4.103	4.235	9.042
1260	5.472	4.070	3.307	4.189	4.189	4.324	9.164

TABLE 71. LiF-LiI: Specific conductance (ohm^{-1} cm^{-1})—Continued

Temperature-dependent equations
$\kappa = a + bT + cT^2 + dT^3 + eT^4$

Mol % LiI	$-a$	$b \cdot 10^3$	$c \cdot 10^6$	$-d \cdot 10^9$	$e \cdot 10^{12}$	Standard error of estimate
100	3.62727	16.0374	−9.24434	−1.78348		0.018%
75	2.97832	9.90818	−3.89050	−0.369061		0.027%
63	0.929985	2.02887	6.15144	6.08011	1.62537	0.025%
50	2.43833	6.03857	0.0362856	0.706150		0.027%
37	−0.667306	−7.30341	18.6039	11.31381	2.30892	0.018%
25	0.0814219	−4.23728	13.4613	7.37307	1.23944	0.020%
0	6.30288	18.1177	−4.28362	0.281087		0.028%

These values are based on the work of Smirnov, Khokhlov, Stepanov, and Shumov (classical ac technique) [82]. These authors reported equivalent conductance. The data were converted to specific conductance using the density equations reported in the same paper.

TABLE 72. Density studies: LiF-LiI

Investigations critically re-examined

Ref.	LiI mol %	Temp. range (T)	Comments
82	0-100	785-1273	Pt sphere; calibration: molten KNO_3.

Deviations from previous NSRDS recommendations [1, pp. 3, 19]

Ref.	LiI mol %	Min. departure	Max. departure
82	100	0.48% (760 K)	0.49% (880 K)
82	0	0.01% (1210 K)	0.27% (1270 K)

TABLE 73. LiF-LiI: Density (g cm^{-3})

T	Mol percent LiI				
	100	75	50	25	0
760	3.108	2.925	2.745	2.486	1.951
780	3.089	2.910	2.731	2.474	1.943
800	3.071	2.894	2.717	2.463	1.935
820	3.053	2.878	2.703	2.451	1.927
840	3.034	2.862	2.689	2.439	1.918
860	3.016	2.846	2.675	2.427	1.910
880	2.997	2.830	2.661	2.415	1.902
900	2.979	2.814	2.647	2.404	1.893
920	2.961	2.799	2.633	2.392	1.885
940	2.942	2.783	2.619	2.380	1.877
960	2.924	2.767	2.605	2.369	1.869
980	2.905	2.751	2.591	2.357	1.860
1000	2.887	2.735	2.577	2.345	1.852
1020	2.869	2.719	2.563	2.333	1.844
1040	2.850	2.703	2.549	2.321	1.835
1060	2.832	2.687	2.535	2.310	1.827
1080	2.813	2.671	2.521	2.298	1.819
1100	2.795	2.656	2.507	2.286	1.811
1120	2.777	2.640	2.493	2.274	1.802
1140	2.758	2.624	2.479	2.263	1.794
1160	2.740	2.608	2.465	2.251	1.786
1180	2.721	2.592	2.451	2.239	1.777
1200	2.703	2.567	2.437	2.227	1.769
1220	2.685	2.560	2.423	2.216	1.761
1240	2.666	2.544	2.409	2.204	1.753
1260	2.648	2.529	2.395	2.192	1.744

Temperature-dependent equations
$\rho = a - bT$

Mol % LiI	a	$b \cdot 10^3$	Standard deviation
0	2.266	0.414	0.002
25	2.933	0.588	0.004
50	3.275	0.698	0.005
75	3.529	0.794	0.005
100	3.807	0.920	0.005

These values are based on the work of Smirnov, Khokhlov, Stepanov and Shumov (modified maximum bubble pressure method) [82]. The following equation, with concentration, C, in mole percent LiI and temperature in K, has been derived from the preceding data: $\rho = a + bC + cT + dC^2 + eC^3 + fTC + gT^2$, where, a = 2.26901, $b \cdot 10^2$ = 3.35030, $c \cdot 10^4$ = -4.15396, $d \cdot 10^4$ = -3.08415, $e \cdot 10^6$ = -1.35819, $f \cdot 10^5$ = -6.7312, $g \cdot 10^5$ = 1.82021, with a maximum departure of 0.49% at 1258 K and 75 mol % LiI, and a standard error of estimate of 0.006. This equation may be used to calculate the density of LiF-LiI melts at any concentration in the temperature range 758-1273 K.

TABLE 74. Surface tension studies: LiF-LiI

Investigations critically re-examined			
Ref.	LiI mol %	Temp. range (T)	Comments
79	0-100	870-1240	Molybdenum crucible; calibration: molten NaCl.

Deviations from previous NSRDS recommendations [2, p. 55]

Ref.	LiI mol %	Min. departure	Max. departure
79	0	1.70% (1170 K)	1.76% (1240 K)

TABLE 75. LiF-LiI: Surface tension (dyn cm^{-1})

T	Mol percent LiI				
	100	75	50	25	0
870	91.5				
880	91.0				
890	90.4	109.2			
900	89.9	108.6			
910	89.3	107.9			
920	88.7	107.3			
930	88.1	106.7			
940	87.6	106.1			
950	87.0	105.5			
960	86.5	104.9	132.8		
970	85.9	104.3	132.0		
980	85.3	103.6	131.3		
990	84.8	103.0	130.5		
1000	84.2	102.4	129.8		
1010	83.6	101.8	129.1		
1020	83.1	101.2	128.3		
1030	82.5	100.5	127.5		
1040	81.9	99.9	126.8		
1050	81.4	99.3	126.1		
1060	80.8	98.7	125.3		
1070	80.2	98.1	124.5		
1080	79.7	97.5	123.8	168.0	
1090	79.1	96.8	123.1	167.1	
1100	78.5	96.2	122.3	166.3	241.7
1110			121.6	165.4	240.7
1120			120.8	164.5	239.8
1130			120.1	163.6	238.6
1140			119.3	162.7	237.8
1150			118.6	161.8	236.8
1160			117.8	160.9	235.8
1170			117.1	160.1	234.8
1180				159.2	233.9
1190				158.3	232.9
1200				157.4	231.9
1210				156.5	230.9
1220				155.7	229.9
1230					228.9
1240					227.9

Temperature-dependent equations

$$\gamma = a - bT$$

Mol % LiI	a	b
0	350.2	0.0986
25	263.5	0.0884
50	204.7	0.0749
75	164.1	0.0617
100	140.7	0.0565

These values are based on the work of Smirnov and Stepanov (maximum bubble pressure method [79]. The data were reported in equation form and no error estimate was given.

5.4. Chloride-Bromide Systems

AgCl-AgBr

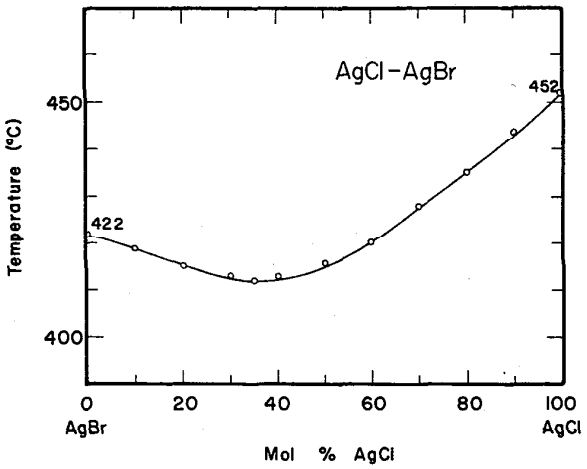

FIGURE 14. Temperature-composition phase diagram for AgCl-AgBr.

K. Monkemeyer, Neues Jahrb. Mineral., Geol., Palantol., Beil.Band, 22, 1, (1906).

Melt Preparation and Purification

Boardman et al. [12] used salts either of analytical grade purity or obtained from reagents of that purity and recrystallized. They prepared silver bromide from the nitrate and hydrobromic acid. Mixtures were prepared by melting weighed quantities of fused silver chloride and silver bromide together.

Harrap and Heymann [15] precipitated the silver halides from aqueous solutions of A. R. $AgNO_3$ with the corresponding hydrogen halide. The salts were dried by evaporating the solution to dryness in the dark in the presence of excess acid.

Brooks and Paul [67, 70] used 99.8% B. D. H. AgCl dried by heating under vacuum for three days at 150 °C, followed by treatment with a stream of freshly prepared dry HCl gas while gradually raising the temperature to the melting point. Similarly, 99.9% Research Inorganic Chemical Corporation AgBr was dried by heating under vacuum for three days at 200 °C, followed by treatment with dry, freshly prepared HBr for two hours while raising the temperature to the melting point. Dry nitrogen was bubbled through the melt for two hours to remove all traces of HBr.

TABLE 76. Electrical conductance studies: AgCl-AgBr

Investigations critically re-examined			
Ref.	AgBr mol %	Temp. range (T)	Comments
8	0,30,50, 70,100	773	Cell material: silica and quartz U-tubes; Pt electrodes; calibration: 1N KCl solution.
15[a]	0-100	713-873	Pt electrodes; freq. range: ≅3000 Hz; calibration: 1N KCl solution.

Deviations from previous NSRDS recommendations [1, pp. 10, 16]			
Ref.	AgBr mol %	Min. departure	Max. departure
8	100	−3.3% (773 K)	
8	0	−8.5% (773 K)	
15	0	−2.4% (978 K)	−2.6% (873 K)

[a]The mixtures in reference [15] were not heated above 600 °C inasmuch as above that temperature the melts were observed to decompose with liberation of bromine. The data reported were taken from smoothed curves drawn through the experimental points. The deviation of these points from the conductivity curves was never greater than 0.05%.

TABLE 77. AgCl-AgBr: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent AgBr					
	100	80	60	40	20	0
720	2.89	2.99	3.15	3.32	3.50	
730	2.92	3.02	3.18	3.36	3.54	3.73
740	2.95	3.06	3.22	3.39	3.58	3.77
750	2.97	3.09	3.25	3.42	3.62	3.81
760	2.99	3.13	3.28	3.46	3.66	3.85
770	3.02	3.16	3.30	3.49	3.70	3.89
780	3.04	3.18	3.33	3.52	3.73	3.92
790	3.06	3.21	3.36	3.55	3.76	3.96
800	3.08	3.24	3.38	3.58	3.80	3.99
810	3.10	3.26	3.41	3.61	3.83	4.02
820	3.12	3.28	3.43	3.63	3.86	4.06
830	3.14	3.30	3.46	3.66	3.88	4.09
840	3.16	3.32	3.47	3.69	3.91	4.12
850	3.17	3.34	3.50	3.71	3.93	3.15
860	3.19	3.35	3.52	3.73	3.96	4.18
870	3.21	3.37	3.54	3.76	3.98	4.21
880						4.24
890						4.26
900						4.29
910						4.31
920						4.34
930						4.36
940						4.38
950						4.41
960						4.43
970						4.45

Temperature-dependent equations

$$\kappa = a + bT + cT^2$$

Mol % AgBr	$-a$	$b \cdot 10^2$	$-c \cdot 10^6$	Standard error of estimate
0	1.4332	1.0160	4.2248	0.15%
20	3.1339	1.4217	6.9438	0.15%
40	1.3888	0.9546	4.1725	0.18%
60	1.5896	0.9896	4.5987	0.17%
80	4.2603	1.6284	8.6401	0.32%
100	1.2864	0.8886	4.2800	0.10%

The values in this table are based on the work of Harrap and Heymann (classical ac technique) [15].

TABLE 78. Density studies: AgCl-AgBr

Investigations critically re-examined			
Ref.	AgBr mol %	Temp. range (T)	Comments
12[a]	0,22.7, 40.3,65.8 100,	693-903	Silica glass dilatometer; calibration: molten $AgNO_3$.
67, 70	50,100	760-1037	Pt bob, Pt suspension wire; calibration: water.

Deviations from previous NSRDS recommendations [1, pp. 10, 16]			
Ref.	AgBr mol %	Min. departure	Max. departure
12	0	−0.82% (760 K)	−1.0% (900 K)
67,70	100	0.00% (930 K)	0.06% (720 K)

[a]Boardman et al. [12] applied corrections for the shape of the meniscus, buoyancy and the expansion of the silica dilatometer.

TABLE 79. AgCl-AgBr: Density (g cm^{-3})

T	Mol percent AgBr				
	100	65.8	40.3	22.7	0
700		5.375	5.200		
710		5.365	5.189		
720	5.561	5.354	5.178	5.040	
730	5.551	5.343	5.166	5.030	
740	5.540	5.333	5.155	5.019	
750	5.530	5.322	5.144	5.008	
760	5.520	5.311	5.133	4.997	4.804
770	5.509	5.300	5.122	4.986	4.795
780	5.499	5.290	5.110	4.976	4.786
790	5.488	5.279	5.099	4.965	4.776
800	5.478	5.268	5.088	4.954	4.767
810	5.468	5.258	5.077	4.943	4.757
820	5.457	5.247	5.066	4.932	4.748
830	5.447	5.236	5.054	4.922	4.739
840	5.436	5.226	5.042	4.911	9.729
850	5.426	5.215	5.032	4.900	4.720
860	5.416		5.021		4.710
870	5.405				4.701
880					4.692
890					4.682
900					4.673

Temperature-dependent equations
$\rho = a - bT$

Mol % AgBr	a	$b \cdot 10^3$
0	5.519	0.94
22.7	5.818	1.08
40.3	5.984	1.12
65.8	6.124	1.07
100	6.310	1.04

The values in this table are based on the work of Boardman, Dorman and Heymann (dilatometric method) [12]. These authors estimated the maximum error to be ±0.15%. The following equation, with concentration, C, in mole percent AgCl and temperature in K, has been derived from the preceding data: $\rho = a + bT + cC^2 + dTC + eTC^2$, where $a = 6.32998$, $b \cdot 10^3 = -1.06497$, $c \cdot 10^5 = -1.44515$, $d \cdot 10^5 = -1.44609$, $e \cdot 10^9 = 9.21738$, with a maximum percent departure of 0.14% at 863.2 K and 59.7 mol % AgCl, and a standard error of estimate of 0.002. This equation may be used to calculate the density of AgCl-AgBr melts at any concentration in the temperature range 693-903 K.

TABLE 80. Viscosity studies: AgCl-AgBr

Investigations critically re-examined			
Ref.	AgBr mol %	Temp. range (T)	Comments
15[a]	0-100	713-873	Cell material: B.T.H.-C14 glass; calibration: molten KNO_3.
37	0-100	773	As for [15], and see also [11].

[a]Reference [15] is the NSRDS reference data base for the viscosity of pure molten AgCl and of pure molten AgBr. The data reported by the authors were obtained from smoothed curves through the experimental points. The deviation of these points from the curves was never greater than 1.5%.

TABLE 81. AgCl-AgBr: Viscosity (cp)

T	Mol percent AgBr					
	100.0	80.0	60.0	40.0	26.8	0.0
720	3.30	3.05	2.91	2.70	2.53	
730	3.20	2.96	2.82	2.62	2.47	2.29
740	3.11	2.87	2.74	2.55	2.41	2.24
750	3.03	2.78	2.66	2.47	2.35	2.19
760	2.94	2.70	2.58	2.40	2.29	2.14
770	2.86	2.63	2.51	2.33	2.23	2.09
780	2.79	2.55	2.44	2.27	2.18	2.05
790	2.72	2.48	2.37	2.20	2.12	2.00
800	2.65	2.42	2.31	2.14	2.07	1.96
810	2.58	2.36	2.25	2.08	2.02	1.91
820	2.52	2.30	2.19	2.02	1.97	1.87
830	2.47	2.25	2.14	1.96	1.92	1.83
840	2.42	2.21	2.10	1.90	1.88	1.79
850	2.37	2.17	2.05	1.85	1.84	1.75
860	2.33	2.13	2.02	1.80	1.79	1.71
870	2.29	2.10	1.99	1.75	1.76	1.67
880						1.64
890						1.61
900						1.58
910						1.55
920						1.52
930						1.49
940						1.47
950						1.45
960						1.43
970						1.41

Temperature-dependent equations

$$\eta = a + bT + cT^2 + dT^3$$

Mol % AgBr	a	$b \cdot 10^3$	$c \cdot 10^5$	$d \cdot 10^8$	Standard error of estimate
0	3.1508	8.7420	-2.1890	1.1367	0.46%
26.8	5.9550	2.6085	-1.8307	1.1219	0.55%
40	7.0068	2.1679	-2.0421	1.2629	0.13%
60	9.3546	1.4645	-2.9122	2.0346	0.27%
80	9.6253	3.3292	-3.4298	2.3594	0.30%
100	15.4159	-18.7388	-0.4743	1.0270	0.31%

These values are based on the work of Harrap and Heymann (capillary method) [15].

TABLE 82. Surface tension studies: AgCl-AgBr

Investigations critically re-examined			
Ref.	AgBr mol %	Temp. range (T)	Comments
76[a]	0-100 (g)	773,883	Cell material: capillary of B.T.H.-C46 glass; melt contained in a tube of B.T.H.-C14 glass; calibration: water;

[a]Boardman, Palmer and Heymann [76] calibrated their apparatus before and after each experiment and found the calibration reproducible to within 0.3%. The maximum error was estimated to be ±1.0%.

TABLE 83. AgCl-AgBr: Surface tension (dyn cm^{-1})

Mol percent AgBr	773 K	883 K
0	176.0	171.0
10	172.9	168.3
20	169.6	165.5
30	166.6	162.9
40	163.8	160.4
50	161.0	158.1
60	158.7	156.0
70	156.5	154.0
80	154.6	152.4
90	153.2	151.2
100	152.1	150.2

These values have been interpolated to four significant figures from the graphical presentation of Boardman, Palmer and Heymann (maximum bubble pressure method) [76].

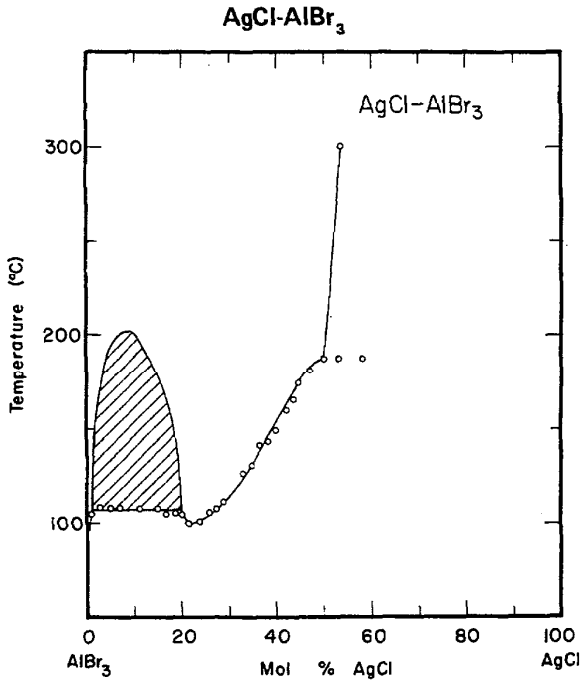

FIGURE 15. Temperature-composition phase diagram for $AgCl-AlBr_3$.
V. A. Plotnikov and U. I. Shartsman, Zap. Inst. Khim., Akad. Nauk SSSR, 4, 222 (1937); Zh. Fiz.-Khim. 12, 120 (1938).

Melt Preparation and Purification

Reference [35] contains no information on melt preparation.

TABLE 84. Electrical conductance studies: $AgCl-AlBr_3$

Investigations critically re-examined		
Ref.	$AlBr_3$ mol %	Temp. range
35	73.80	373-443

TABLE 85. $AgCl-AlBr_3$: Specific conductance ($ohm^{-1}cm^{-1}$)

T	Mol % $AlBr_3$ 73.8
373.2	0.0107
378.2	0.0116
383.2	0.0121
388.2	0.0136
393.2	0.0148
398.2	0.0161
403.2	0.0168
408.2	0.0178
413.2	0.0190
418.2	0.0214
423.2	0.0242
438.2	0.0296
443.2	0.0322

These values are based on the work of Mezhennii (classical ac technique) [35].

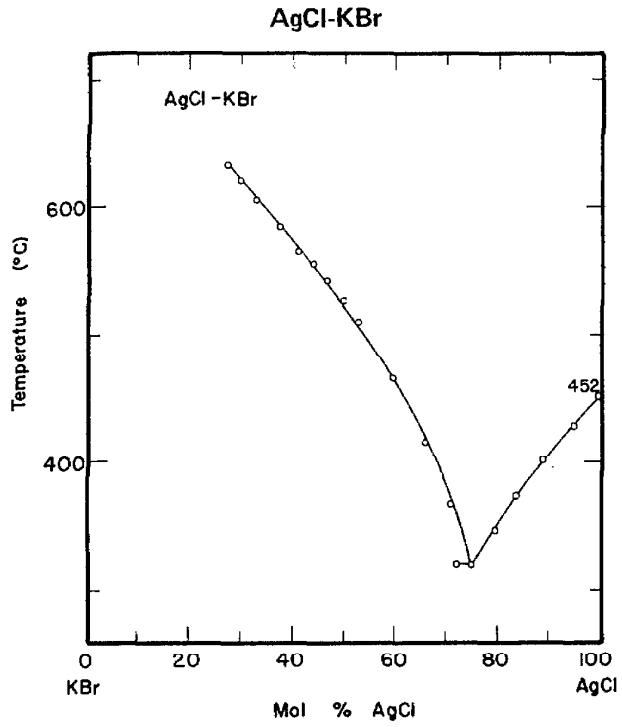

FIGURE 16. Temperature-composition phase diagram for AgCl-KBr.

A. P. Pakkin, Tr. Sredneatziat. Gos. Univ., Ser. 6: (Khimiya), 4, 3 (1930).

Melt Preparation and Purification

Bizouard [22, 44] used Merck p.a. grade reagents. The AgCl was prepared by precipitation from aqueous $AgNO_3$ solution with hydrochloric acid.

Sternberg and Terzi [71] used chemically pure reagents. The KBr was recrystallized from aqueous solution and dried by melting in a stream of pure dry gaseous HBr. The AgCl was prepared by precipitation from aqueous $AgNO_3$ solution with freshly-prepared HCl obtained by treatment of the aqueous acid with concentrated H_2SO_4.

For Markov's method of melt preparation refer to the system $CdCl_2$-$ZnBr_2$.

TABLE 86. Electrical conductance studies: AgCl-KBr

Investigations critically re-examined			
Ref.	KBr mol %	Temp. range (T)	Comments
21,34	0-100 (g)	1073	Cell material: quartz U-shaped capillary cell; Pt electrodes; calibration H_2SO_4 solutions.
22,44[a]	0-100	823-1073	Cell material: Pyrex up to 500 °C and silica up to 1000 °C; Pt electrodes; freq. range: 5000 Hz; calibration: 1N KCl, saturated NaCl and H_2SO_4 solutions.

Deviations from previous NSRDS recommendations [1, pp. 10,14]			
Ref.	KBr mol %	Min. departure	Max. departure
22,44	100	−0.73% (1023 K)	2.6% (1073 K)
22,44	0	−0.19% (1073 K)	−1.06% (873 K)

[a]Bizouard reported a precision of better than 0.5% in the measurements.

TABLE 87. AgCl-KBr: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent KBr					
	100	80	60	40	20	0
780				1.760	2.619	3.984
790				1.788	2.647	4.017
800				1.815	2.675	4.050
810				1.842	2.703	4.083
820				1.868	2.729	4.114
830			1.473	1.894	2.756	4.146
840			1.499	1.920	2.781	4.176
850			1.525	1.945	2.806	4.206
860			1.550	1.970	2.830	4.235
870			1.575	1.994	2.854	4.264
880		1.416	1.599	2.018	2.878	4.292
890		1.443	1.623	2.041	2.900	4.320
900		1.469	1.647	2.064	2.922	4.347
910		1.495	1.670	2.086	2.944	4.373
920		1.520	1.692	2.108	2.965	4.399
930		1.544	1.714	2.129	2.985	4.424
940		1.567	1.736	2.150	3.005	4.448
950		1.590	1.758	2.171	3.024	4.472
960		1.612	1.778	2.191	3.042	4.495
970		1.633	1.799	2.211	3.060	4.518
980		1.654	1.819	2.230	3.077	4.540
990		1.674	1.839	2.248	3.094	4.561
1000		1.694	1.858	2.267	3.110	4.582
1010		1.712	1.876	2.284	3.126	4.602
1020		1.731	1.895	2.302	3.141	4.622
1030	[1.649]	1.748	1.913	2.318	3.155	4.641
1040	[1.669]	1.765	1.930	2.335	3.169	4.659
1050	[1.689]	1.781	1.947	2.351	3.182	4.677
1060	[1.709]	1.796	1.964	2.366	3.195	4.694
1070	[1.729]	1.811	1.980	2.381	3.207	4.710

Temperature-dependent equations

$\kappa = a + bT + cT^2$

Mol % KBr	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate
0	−0.5183	8.1521	−3.0519	0.12%
20	−1.4194	7.4724	−2.9428	0.39%
40	−1.8273	6.3885	−2.2947	0.29%
60	−2.1875	6.1945	−2.1492	0.49%
80	−3.5836	8.6469	−3.3696	0.19%
100	[−0.4114]	[2.0000]	0	0.00%

These values are based on the work of Bizouard and Doucet (potentiometric ac method) [44]. Bizouard used the potentiometric ac method to eliminate the polarization correction. See also reference [22]. Values given in square brackets were generated from fewer than four data points.

TABLE 88. Density studies: AgCl-KBr

Ref.	KBr mol %	Temp. range (T)	Comments
34,46	0-100 (g)	1073	Quartz sphere filled with molybdenum or tungsten; calibration: water.

TABLE 89. AgCl-KBr: Density (g cm^{-3})

Mol % KBr	1073 K
0	4.52
10	4.10
20	3.76
30	3.47
40	3.21
50	2.98
60	2.77
70	2.57
80	2.38
90	2.21
100	2.05

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (Archimedean method) [46].

TABLE 90. Surface tension studies: AgCl-KBr

Investigations critically re-examined

Ref.	KBr mol %	Temp. range (T)	Comments
71	0-100	675-1148	Pt pin; calibration: organic liquids.

Deviations from previous NSRDS recommendations [2, pp. 59, 63]

Ref.	KBr mol %	Min. departure	Max. departure
71	100	2.77% (1145 K)	2.95% (1025 K)
71	0	2.41% (970 K)	2.75% (735 K)

TABLE 91. AgCl-KBr: Surface tension (dyn cm^{-1})

T	Mol percent KBr										
	100	90	80	70	60	50	35.1	30	20	10	0
680								141.1			
690								140.4	148.3		
700								139.7	147.7		
710							134.9	139.1	147.0		
720							134.2	138.4	146.3	157.0	
730							133.6	137.7	145.6	156.5	
740							132.9	137.1	145.0	155.9	182.9
750							132.3	136.4	144.3	155.3	182.3
760							131.6	135.8	143.6	154.7	181.7
770							131.0	135.1	142.9	154.1	181.1
780							130.3	134.4	142.3	153.6	180.6
790							129.7	133.8	141.6	153.0	
800							129.1	133.1	140.9	152.4	179.5
810						117.8	128.4	132.5	140.3	151.9	178.9
820						172.2	127.7	131.8	139.6	151.3	178.3
830						116.6	127.1	131.1	138.9	150.7	177.8
840						116.0	126.5	130.5	138.2	150.1	177.2
850						115.5	125.8	129.8	137.6	149.6	176.7
860						114.9	125.2	129.1	136.9	149.0	176.1
870							124.5	128.5	136.2	148.4	175.5
880							123.9				175.0
890							123.2				174.4
900							122.6				173.8
910					108.9						173.3
920					108.1						172.7
930					107.3						172.1
940				102.7	106.5						171.6
950				102.0	105.7						171.0
960				101.3	104.9						170.5
970				100.6	104.1						169.9
980				99.9	103.3						
990				99.1	102.5						
1000			95.5	98.5	101.8						
1010			94.8	97.7	101.0						
1020			94.1	97.0	100.2						
1030	90.3		93.4	96.3	99.4						
1040	89.6	91.2	92.7	95.6							
1050	88.8	90.4	92.7	94.9							
1060	88.1	89.7	91.4	94.2							
1070	87.3	89.0	90.7	93.5							
1080	86.6	88.2	90.0	92.8							
1090	85.8	87.5	89.3								
1100	85.1	86.8	88.7								
1110	84.3	86.0	88.0								
1120	83.6	85.3	87.3								
1130	82.8		86.6								
1140	82.1		85.9								

TABLE 91. AgCl-KBr: Surface tension (dny cm^{-1})—Continued

Temperature-dependent equations $\gamma = a - bT$					
Mol % KBr	a	b	Mol % KBr	a	b
0	224.6	0.0564	60	180.67	0.0789
10	198.28	0.0573	70	168.95	0.0705
20	194.69	0.0672	80	163.67	0.0682
30	186.08	0.0662	90	167.51	0.0734
35.1	180.73	0.0646	100	167.90	0.0753
50	165.85	0.0593			

These values are based on the work of Sternberg and Terzi (pin detachment method) [71]. The reproducibility in the measurements was reported as ±1%.

AgCl-LiBr

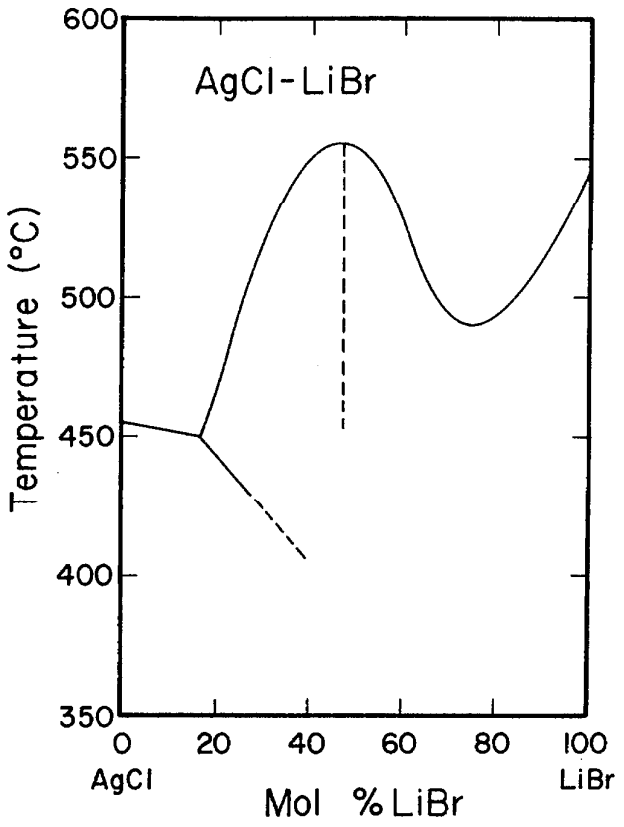

FIGURE 17. Temperature-composition phase diagram for AgCl-LiBr.

M. Bizouard, Ann. Phys., 6, 851 (1961).

Melt Preparation and Purification

Bizouard [22] used Merck p. a. grade reagents. The AgCl was prepared by precipitation from aqueous silver nitrate with hydrochloric acid.

TABLE 92. Electrical conductance studies: AgCl-LiBr

Investigations critically re-examined			
Ref.	LiBr mol %	Temp. range (T)	Comments
22[a]	0-100	823-1073	Cell material: Pyrex glass up to 500 °C and silica up to 1000 °C; Pt electrodes; freq: 1000 Hz; calibration: 1N KCl, saturated NaCl and H_2SO_4 solutions.

Deviations from previous NSRDS recommendations [1, pp. 10, 14]			
Ref.	LiBr mol %	Min. departure	Max. departure
22	100	−0.02% (1023 K)	−0.08% (1073 K)
22	0	0.19% (1073 K)	−1.06% (873 K)

[a]Bizouard [22] reported a precision of better than 0.5% in the measurements.

TABLE 93. AgCl-LiBr: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent LiBr					
	100	80	60	40	20	0
830		4.175	3.534	3.413	3.632	4.151
840		4.223	3.588	3.456	3.670	4.181
850		4.271	3.641	3.598	3.706	4.210
860		4.319	3.694	3.540	3.742	4.239
870		4.367	3.746	3.582	3.776	4.268
880	5.003	4.414	3.798	3.622	3.810	4.296
890	5.507	4.461	3.849	3.662	3.843	4.323
900	5.111	4.508	3.899	3.701	3.874	4.349
910	5.165	4.554	3.949	3.740	3.905	4.375
920	5.217	4.600	3.998	3.778	3.935	4.401
930	5.270	4.646	4.047	3.815	3.964	4.425
940	5.321	4.692	4.095	3.851	3.991	4.450
950	5.372	4.737	4.143	3.887	4.018	4.473
960	5.423	4.783	4.190	3.922	4.004	4.496
970	5.473	4.827	4.236	3.957	4.069	4.519
980	5.523	4.872	4.282	3.991	4.093	4.540
990	5.571	4.917	4.327	4.024	4.116	4.562
1000	5.620	4.961	4.371	4.056	4.138	4.582
1010	5.668	5.005	4.415	4.088	4.159	4.602
1020	5.715	5.048	4.459	4.119	4.179	4.622
1030	5.762	5.092	4.501	4.150	4.199	4.640
1040	5.808	5.135	4.544	4.179	4.217	4.659
1050	5.853	5.178	4.585	4.209	4.234	4.676
1060	5.898	5.220	4.626	4.237	4.250	4.693
1070	5.943	5.263	4.667	4.265	4.266	4.710

Temperature-dependent equations

$$\kappa = a + bT + cT^2$$

Mol % LiBr	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate
0	−0.4247	7.9819	−2.9751	0.02%
20	−2.8334	11.7863	−4.8146	0.19%
40	−2.5285	9.9558	−3.3710	0.38%
60	−2.9967	10.3103	−2.9423	0.33%
80	−0.7191	6.9556	−1.2758	0.12%
100	−1.9802	10.3927	−2.7926	0.07%

These values are based on the work of Bizouard (potentiometric ac method) [22].

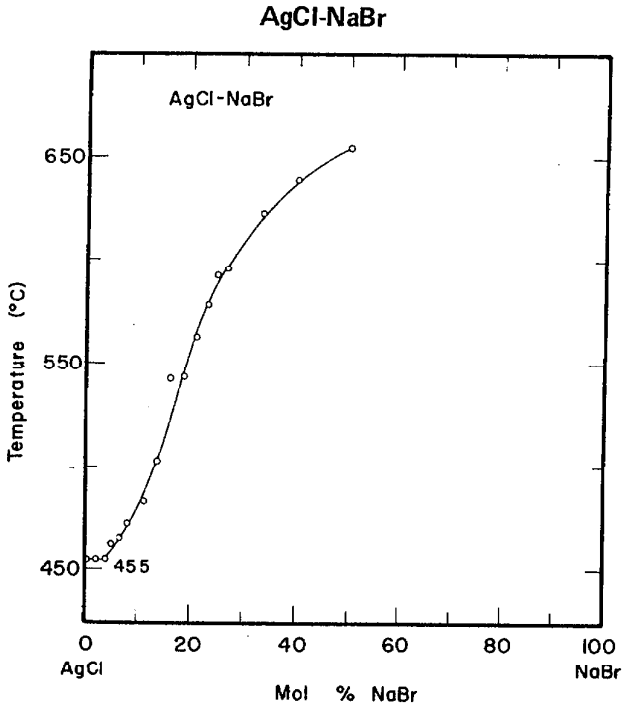

FIGURE 18. Temperature-composition phase diagram for AgCl-NaBr.

N. S. Dombrovskaya, Zh. Obshch. Khim. 3, 737 (1933).

Melt Preparation and Purification

For Sternberg and Terzi's [71, 80] method of melt preparation, refer to the system AgCl-KBr. Sodium bromide was treated in the same manner as potassium bromide. For Bizouard's [22] method of melt treatment, see also the system AgCl-KBr. Markov's method of melt preparation is given under the system $CdCl_2$-$ZnBr_2$.

TABLE 94. Electrical conductance studies: AgCl-NaBr

Investigations critically re-examined			
Ref.	NaBr mol %	Temp. range (T)	Comments
22[a]	0-100	823-1073	Cell material: Pyrex glass up to 500 °C and silica glass to 1000 °C; Pt electrodes; 1000 Hz; calibration: 1N KCl, saturated NaCl and H_2SO_4 solutions.
34	0-100 (g)	1073	Quartz U-shaped capillary cell; Pt electrodes; calibration: H_2SO_4 solutions.

Deviations from previous NSRDS recommendations [], pp. 10,14]

Ref.	NaBr mol %	Min. departure	Max. departure
22	100	0.03% (1073 K)	
22	0	0.19% (1073 K)	−1.06% (873 K)

[a]Bizouard [22] reported a precision of better than 0.5% in the measurements.

TABLE 95. AgCl-NaBr: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent NaBr					
	100	80	60	40	20	0
830					3.464	4.151
840					3.491	4.181
850					3.517	4.210
860					3.543	4.239
870					3.568	4.268
880					3.593	4.296
890					3.617	4.323
900					3.641	4.349
910					3.664	4.375
920					3.687	4.401
930				3.101	3.709	4.425
940				3.126	3.731	4.450
950				3.151	3.752	4.473
960				3.175	3.773	4.496
970				3.199	3.793	4.519
980			[2.872]	3.223	3.812	4.540
990			[2.900]	3.245	3.831	4.562
1000			[2.928]	3.268	3.850	4.582
1010			[2.955]	3.290	3.868	4.602
1020			[2.982]	3.311	3.886	4.622
1030	[2.924]	[2.919]	[3.009]	3.332	3.903	4.640
1040	[2.955]	[2.947]	[3.036]	3.353	3.919	4.659
1050	[2.987]	[2.976]	[3.061]	3.373	3.935	4.676
1060	[3.018]	[3.004]	[3.087]	3.393	3.951	4.693
1070	[3.049]	[3.032]	[3.112]	3.412	3.966	4.710

TABLE 95. AgCl-NaBr: Specific conductance (ohm^{-1} cm^{-1})—Continued

Temperature-dependent equations
$\kappa = a + bT + cT^2$

Mol % NaBr	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate
0	−0.4247	7.9819	−2.9751	0.02%
20	−0.5488	6.9661	−2.5674	0.03%
40	−1.2902	6.8965	−2.3384	0.14%
60	[−1.8451]	[6.7728]	[−2.0000]	0.00%
80	[0.0146]	[2.8200]	0	0.00%
100	[−0.2894]	[3.1200]	0	0.00%

These values are based on the work of Bizouard (potentiometric ac technique) [22]. Values given in square brackets were generated from fewer than four data points.

TABLE 96. Density studies: AgCl-NaBr

Investigations critically re-examined

Ref.	NaBr mol %	Temp. range (T)	Comments
34,46	0-100 (g)	1073	Quartz sphere filled with molybdenum or tungsten: calibration: water.

TABLE 97. AgCl-NaBr: Density (g cm^{-3})

Mol % NaBr	1073 K
0	4.58
10	4.22
20	3.93
30	3.68
40	3.45
50	3.22
60	3.00
70	2.82
80	2.62
90	2.45
100	2.28

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (Archimedean method) [46].

TABLE 98. Surface tension studies: AgCl-NaBr

Ref.	NaBr mol %	Temp. range (T)	Comments
80	0-100	740-1193	Pt pin; quartz vessel; calibration: water, benzene, carbon tetrachloride, toluene, acetone; calibration at 20 °C.

Deviations from previous NSRDS recommendations [2, pp. 62, 59]

Ref.	NaBr mol %	Min. departure	Max. departure
80	100	−0.10% (1053 K)	1.63% (1173 K)
80	0	2.35% (973 K)	2.81% (743 K)

TABLE 99. AgCl-NaBr: Surface tension (dyn cm^{-1})

T	Mol percent NaBr							
	100	90	70	50	30	20	10	0
740								182.86
760								181.73
780							167.27	180.60
800							166.09	179.47
820							164.91	178.34
840							163.73	177.21
860							162.55	176.09
880						151.61	161.36	174.96
900						150.40	160.18	173.83
920					141.22	149.19	159.00	172.70
940					139.75	147.98	157.82	171.57
960					138.28	146.78	156.64	170.45
980					136.81	145.57		
1000					135.35	144.36		
1020				122.44	133.88	143.15		
1040		105.10	110.85	120.86	132.41	141.95		
1060	101.19	103.57	109.48	119.27	130.94	140.74		
1080	99.82	102.04	108.12	117.69				
1100	98.46	100.50	106.75	116.10				
1120	97.09	98.97	105.38	114.52				
1140	95.73	97.44	104.02	112.93				
1160	94.37	95.90	102.65	111.35				
1180	93.00							

Temperature-dependent equations

$\gamma = a - bT$

Mol % NaBr	a	$b \cdot 10^2$	Standard deviation
0	224.601	5.6412	0.109
10	213.316	5.9036	0.293
20	204.730	6.0369	0.349
30	208.835	7.3490	0.162
50	203.302	7.9272	0.275
70	181.924	6.8341	0.246
90	184.798	7.6632	0.267
100	173.472	6.8195	0.256

These values are based on the work of Sternberg and Terzi (pin detachment method) [80]. The following equation, with concentration, C, in mole percent AgCl and temperature in K, has been derived from the preceding data: $\gamma = a + bT + cC + dC^2 + eC^3 + fTC + gCT^2$, where a = 179.15637, $b \cdot 10^2$ = –7.35312, $c \cdot 10^2$ = 3.93273, $d \cdot 10^4$ = –1.02893, $e \cdot 10^5$ = 3.89684, $f \cdot 10^4$ =2.47478, $g \cdot 10^6$ = –4.42703, with a maximum departure of –1.14% at 1019.2 K and 50 mol % AgCl, and a standard error of estimate of 0.38%. This equation may be used to calculate the surface tension of AgCl-NaBr melts at any given concentration in the temperature range 740-1193 K. Sternberg and Terzi reported a reproducibility of 1%.

$AlCl_3$-NaBr

Melt Preparation and Purification

Moss [33] used "Certified Pure" reagent-grade sodium bromide and Fisher "Certified Pure" grade aluminum chloride. The aluminum chloride was purified before use by distillation from an $AlCl_3$-NaCl mixture.

TABLE 100. Electrical conductance studies: $AlCl_3$-NaBr

Investigations critically re-examined		
Ref.	NaBr mol %	Temp. range
33	25-47.5	448,473,498

TABLE 101. $AlCl_3$-NaBr: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent NaBr					
	47.5	45.0	40.0	35.0	30.0	25.0
448.2	0.346	0.307	0.241	0.193	0.155	
473.2	0.405	0.361	0.286	0.229	0.184	0.138
498.2	0.462	0.412	0.328	0.265	0.212	0.159

These values are those obtained experimentally by Moss (classical ac technique) [33].

TABLE 102. Density studies: $AlCl_3$-NaBr

Investigations critically re-examined			
Ref.	NaBr mol %	Temp. range (T)	Comments
33	25-47.5	448,473,498	Glass dilatometer; calibration: purified mercury .

TABLE 103. $AlCl_3$-NaBr: Density (g cm^{-3})

T	Mol percent NaBr					
	47.5	45.0	40.0	35.0	30.0	25.0
450	1.995	1.967	1.902	1.847	1.798	
455	1.990	1.962	1.897	1.842	1.793	
460	1.986	1.958	1.893	1.837	1.788	
465	1.981	1.954	1.888	1.832	1.782	
470	1.976	1.949	1.884	1.827	1.777	
475	1.972	1.945	1.879	1.823	1.772	[1.718]
480	1.967	1.941	1.874	1.818	1.767	[1.712]
485	1.963	1.937	1.870	1.813	1.762	[1.707]
490	1.958	1.932	1.865	1.808	1.757	[1.701]
495	1.953	1.928	1.861	1.803	1.752	[1.696]

Temperature-dependent equations

$\rho = a + bT$

Mol % NaBr	a	$b \cdot 10^3$	Standard error of estimate
25.0	[2.2500]	[-1.1200]	0.00%
30.0	2.2567	-1.0200	0.05%
35.00	2.2786	-0.9600	0.03%
40.0	2.3160	-0.9200	0.03%
45.0	2.3536	-0.8600	0.01%
47.5	2.4087	-0.9200	0.03%

These values are based on the work of Moss (dilatometric method) [33]. Values given in square brackets were generated from fewer than four data points.

$BiCl_3$ - $BiBr_3$

Melt Preparation and Purification

Ichikawa and Shimoji used "guaranteed" reagent-grade $BiCl_3$ and $BiBr_3$ dried at 100 °C for several days to remove water and excess hydrogen halide.

TABLE 104. Electrical conductance studies: $BiCl_3$-$BiBr_3$

Investigations critically re-examined		
Ref.	$BiBr_3$ mol %	Temp. range (T)
58	0-100 (g)	523-723

TABLE 105. $BiCl_3$-$BiBr_3$: Specific conductance (ohm^{-1} cm^{-1})

Mol % $BiBr_3$	523 K	573 K	623 K	673 K	723 K
0	0.351	0.406	0.462	0.490	0.478
10	0.342	0.398	0.442	0.475	0.459
20	0.334	0.391	0.428	0.461	0.446
30	0.324	0.382	0.414	0.446	0.437
40	0.316	0.370	0.405	0.433	0.427
50	0.304	0.360	0.396	0.420	0.417
60	0.294	0.350	0.386	0.405	0.408
70	0.282	0.339	0.376	0.392	0.398
80	0.269	0.328	0.366	0.378	0.388
90	0.256	0.316	0.352	0.368	0.377
100	0.242	0.306	0.338	0.360	0.367

These values have been interpolated to three significant figures from the graphical presentation of Ichikawa and Shimoji (classicl ac technique) [58].

$CaCl_2$-KBr

Melt Preparation and Purification

Markov's method of melt preparation is given under the system $CdCl_2$-$ZnBr_2$.

TABLE 106. Electrical conductance studies: $CaCl_2$-KBr

Investigations critically re-examined			
Ref.	KBr mol %	Temp. range (T)	Comments
64	0-100 (g)	1023	Quartz U-shaped capillary cell; Pt electrodes.

TABLE 107. $CaCl_2$-KBr: Equivalent conductance ($ohm^{-1}cm^2$ $equiv^{-1}$)

Mol percent KBr	1023 K
0	50.8
10	44.1
20	42.1
30	42.8
40	46.1
50	51.2
60	57.3
70	64.6
80	73.7
90	83.8
100	94.7

These values have been interpolated to three significant figures from the graphical presentation of Markov, Prisyazhnyii and Zaval'skaya (classical ac technique) [64]. Density data, as required for conversion of the above to specific conductivity, were not reported.

$CdCl_2$-$CaBr_2$

Melt Preparation and Purification

Markov's method of melt preparation is given under the system $CdCl_2$-$ZnBr_2$.

TABLE 108. Electrical conductance studies: $CdCl_2$-$CaBr_2$

Investigations critically re-examined			
Ref.	$CaBr_2$ mol %	Temp. range (T)	Comments
64	0-100 (g)	1023	Quartz U-shaped capillary cell; Pt electrodes.

TABLE 109. $CdCl_2$-$CaBr_2$: Equivalent conductance ($ohm^{-1}cm^2$ $equiv^{-1}$)

Mol percent $CaBr_2$	1023 K
0	65.8
10	63.6
20	61.2
30	58.5
40	55.0
50	52.8
60	51.8
70	50.9
80	49.7
90	48.0
100	45.0

These values have been interpolated to three significant figures from the graphical presentation of Markov, Prisyazhnyii and Zaval'skaya (classical ac technique) [64]. Density data, as required for conversion of the above to specific conductivity, were not reported.

$CdCl_2$-$CdBr_2$

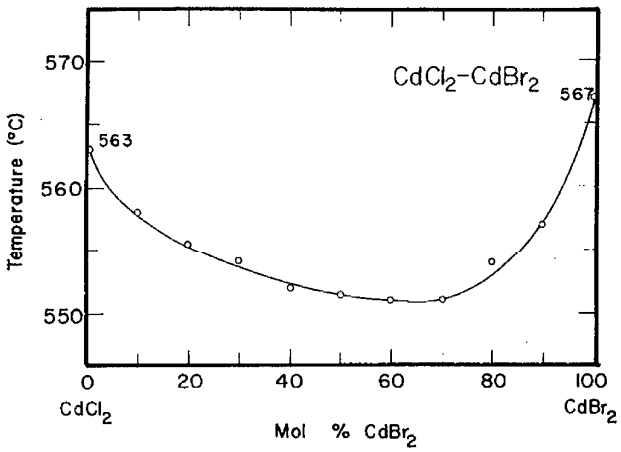

FIGURE 19. Temperature-composition phase diagrams for $CdCl_2$-$CdBr_2$.
R. Nacken, Cbl. Mineral., Geol., Palaontol, 301 (1907).

Melt Preparation and Purification

Heymann and his co-workers [10, 11, 12, 76] treated a high quality commercial preparation (May and Baker "Pure") of cadmium bromide by filtering the aqueous solution to remove organic matter, evaporating the solution to dryness and subsequently fusing the residue while passing a gaseous mixture of HBr and Br_2 through it. The cadmium chloride was made from pure electrolytic cadmium (Electrolytic Zinc Co., Tasmania). It was also dried by passing a stream of HCl through the melt. The method later used by Bloom for preparing and purifying cadmium chloride probably yields a better product (refer: $CdCl_2$-CsCl in [5], page 975.).

TABLE 110. Electrical conductance studies: $CdCl_2$-$CdBr_2$

Investigations critically re-examined			
Ref.	$CdBr_2$ mol %	Temp. range (T)	Comments
10[a]	0-100[b]	843-993	Cell material: Supremax glass; Pt electrodes; freq. range: ≅3000 Hz; calibration: molten $PbCl_2$ and 1N KCl solution.

Deviations from previous NSRDS recommendations [1, p. 11]			
Ref.	$CdBr_2$ mol %	Min. departure	Max. departure
10	0	0.0% (918 K)	0.27% (936 K)

[a]Bloom and Heyman [10] used a dipping type conductance cell in which one electrode was enclosed in a capillary tube with the other outside. Conductivity through the glass wall of the capillary was found to be negligible compared to that of the melt. Resistance measurements were made to within 0.1 to 0.2% using a Wein bridge. The cell constant did not change appreciably (0.3%) during prolonged use.

[b]Mixtures reported graphically.

TABLE 111. $CdCl_2$-$CdBr_2$: Specific conductance ($ohm^{-1}cm^{-1}$)

Mol percent $CdBr_2$	873 K	913 K
0	1.95	2.08
10	1.82	1.96
20	1.71	1.85
30	1.61	1.75
40	1.52	1.66
50	1.43	1.58
60	1.35	1.50
70	1.27	1.44
80	1.20	1.38
90	1.13	1.32
100	1.07	1.26

These values have been interpolated to three significant figures from the graphical presentation of Bloom and Heymann (classical ac technique) [10].

TABLE 112. Density studies: $CdCl_2$-$CdBr_2$

Investigations critically re-examined			
Ref.	$CdBr_2$ mol %	Temp. range (T)	Comments
12[a]	0-100	853-998	Silica glass dilatometer; calibration: molten $AgNO_3$.

[a]Reference [12] is the NSRDS reference data base for the density of pure molten $CdCl_2$ and of pure molten $CdBr_2$. The reported error estimate is ±0.10%.

TABLE 113. $CdCl_2$-$CdBr_2$: Density (g cm^{-3})

T	Mol percent $CdBr_2$				
	100	65.3	45.6	29.7	0
860	4.054			3.610	3.377
870	4.043		3.712	3.601	3.369
880	4.033	3.826	3.703	3.592	3.360
890	4.022	3.816	3.694	3.583	3.352
900	4.011	3.807	3.685	3.574	3.344
910	4.000	3.798	3.676	3.565	3.335
920	3.989	3.789	3.666	3.556	3.327
930	3.979	3.779	3.657	3.547	3.318
940	3.968	3.770	3.648	3.538	3.310
950	3.957	3.761	3.639	3.529	3.302
960	3.946	3.751	3.630		3.293
970	3.935	3.742	3.621		3.285
980	3.925		3.612		3.276
990	3.914				

Temperature-dependent equations

$\rho = a - bT$

Mol % $CdBr_2$	a	$b \cdot 10^3$
0	4.100	0.84
29.7	4.384	0.90
45.6	4.504	0.91
65.3	4.644	0.93
100	4.983	1.08

These values are based on the work of Boardman, Palmer and Heymann (dilatometric method) [12]. The following equation, with concentration, C, in mole percent CdCl, and temperature in K, has been derived from the preceding data: $\rho = a + bT + cC + dC^2 + eCT^2$, where $a = 4.96809$, $b \cdot 10^3 = -1.06458$, $c \cdot 10^3 = -6.21200$, $d10^5 = -1.46299$, $e \cdot 10^9 = 1.25113$, with a maximum departure of 0.16% at 879.2 K and 34.7 mol % $CdCl_2$ and a standard error of estimate of 0.06%. This equation may be used to calculate the density of $CdCl_2$-$CdBr_2$ melts at any given composition in the temperature range 853-998 K.

TABLE 114. Viscosity studies: $CdCl_2$-$CdBr_2$

Ref.	$CdBr_2$ mol %	Temp. range (T)	Comments
11,37[a]	0-100 (g)	853-1023	Cell material: Moncrieff, Supremax and B.T.H. (C14 and C46) glass; calibration: molten molten KNO_3.

[a]Reference [11] is the NSRDS reference data base for the viscosity of pure molten $CdCl_2$ and of pure molten $CdBr_2$. The viscometers were calibrated at frequent intervals, and no change of greater than 0.3% was found. The authors estimated a maximum error in the results of 1.0 –1.5%.

TABLE 115. $CdCl_2$-$CdBr_2$: Viscosity (cp)

Mol percent $CdBr_2$	873 K	933 K
0	2.31	1.98
10	2.33	2.00
20	2.36	2.02
30	2.39	2.04
40	2.41	2.06
50	2.44	2.08
60	2.46	2.10
70	2.49	2.12
80	2.52	2.14
90	2.54	2.16
100	2.56	2.18

These values have been interpolated to three significant figures from the graphical presentation of Bloom, Harrap and Heymann (capillary technique) [11].

TABLE 116. Surface tension studies: $CdCl_2$-$CdBr_2$

Investigations critically re-examined			
Ref.	$CdBr_2$ mol %	Temp. range (T)	Comments
76[a]	0-100 (g)	873,973	Capillary of B.T.H.-C46 glass, melt contained in tube of B.T.H.-C14 glass; calibration: water.

[a]Boardman, Palmer and Heymann [76] estimated a maximum error of ±1.0%. Calibrations performed before and after experiments were found to be reproducible to within 0.3%.

TABLE 117. $CdCl_2$-$CdBr_2$: Surface tension (dyn cm^{-1})

Mol % $CdBr_2$	873 K	973 K
0	83.8	81.2
10	81.3	78.5
20	79.0	76.4
30	77.0	74.4
40	75.0	72.4
50	73.2	70.8
60	71.6	69.0
70	70.2	67.6
80	69.0	66.4
90	68.0	65.5
100	67.5	64.0

These values have been interpolated to three significant figures from the graphical presentation of Boardman, Palmer and Heymann (maximum bubble pressure method) [76].

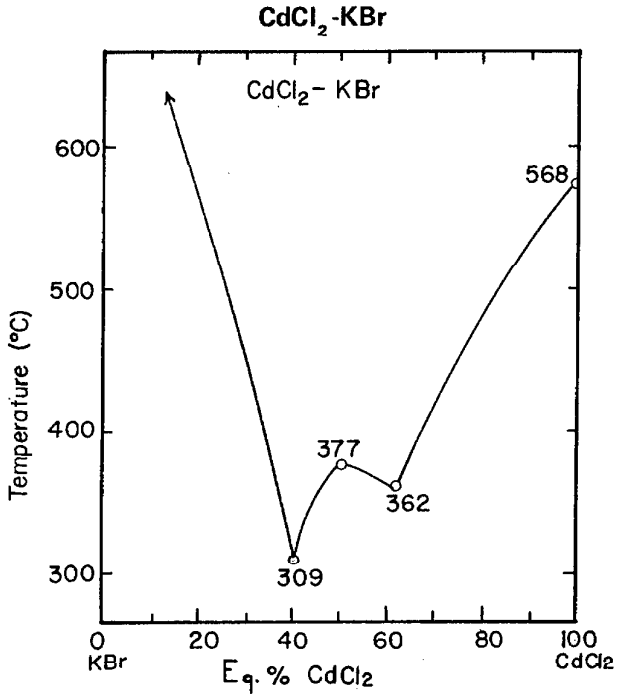

FIGURE 20. Temperature-composition phase diagram for $CdCl_2$-KBr.

I. I. Il'yasov and A. G. Bergman, Zh. Neorg. Khim., 7, 1970 (1962); Russ. J. Inorg. Chem. 7, 1017 (1962).

Melt Preparation and Purification

Ellis and his co-workers [39, 45, 49, 50, 77] dried Baker and Adamson reagent grade salts at 200 °C. Mixtures were prepared by grinding the weighed salts together in a ball mill and drying by heating under vacuum at 400 °C. Melts containing less than 60 mol percent KBr were filtered through a Pyrex frit. KBr-rich mixtures were fused in a Vycor apparatus, allowed to solidify and reground. Analysis of the mixtures after determination of the properties was made by EDTA titration (for cadmium) and potentiometric titration with $AgNO_3$ (for halide).

TABLE 118. Density studies: $CdCl_2$-KBr

Investigations critically re-examined		
Ref.	KBr mol %	Temp. range (T)
26	0-100	670-1271
39	20-100	1037-1271
49	0-90	670-1267

Deviations from previous NSRDS recommendations [1, pp. 11,14]

Ref.	KBr mol %	Min. departure	Max. departure
26	100	−1.2% (1100 K)	−1.1% (1200 K)
39	100	−1.1% (1099 K)	−1.0% (1179 K)
26	0	0.0% (1060 K)	−0.9% (900 K)
49	0	−0.03% (966 K)	−0.15% (895 K)

Ellis used both the flotation method [39] and a modified maximum bubble pressure method [26] for density determinations. See also KCl-$CdBr_2$.

TABLE 119. $CdCl_2$-KBr: Density (g cm^{-3})

T	Mol percent KBr										
	100.0	90.3	80.3	70.1	60.4	48.5	44.6	36.2	18.8	10.4	0.0
680						2.902					
700						2.883					
720						2.864					
740					2.740	2.844					
760					2.722	2.825	2.946				
780					2.703	2.805	2.925				
800					2.685	2.786	2.905	3.058	3.201		
820					2.667	2.767	2.885	3.039	3.182		
840					2.648	2.747	2.864	3.019	3.163	3.286	
860					2.630	2.728	2.844	3.000	3.145	3.268	3.370
880					2.611	2.708	2.823	2.980	3.126	3.251	3.354
900					2.593	2.689	2.803	2.961	3.107	3.233	3.338
920					2.575	2.670	2.783	2.942	3.088	3.215	3.322
940				2.432	2.556	2.650	2.762	2.922	3.069	3.198	3.306
960				2.417	2.538	2.631	2.742	2.903	3.051	3.180	3.290
980				2.401	2.519	2.611		2.883		3.163	3.274
1000			2.281	2.385				2.864			
1020			2.267	2.369				2.845			
1040		2.198	2.253	2.353				2.825			
1060		2.181	2.238	2.338							
1080	2.044	2.164	2.224	2.322							
1100	2.028	2.147	2.210	2.306							
1120	2.012	2.130	2.196	2.290							
1140	1.996	2.113	2.182	2.274							
1160	1.980	2.096	2.167	2.259							
1180	1.964	2.079	2.153	2.243							
1200	1.948	2.062	2.139	2.227							
1220	1.932	2.045	2.125	2.211							
1240	1.916	2.028									
1260	1.900	2.011									

Temperature-dependent equations
$\rho = a - bT$

Mol % KBr	a	$b \cdot 10^4$
0.0	4.058	8.0
10.4	4.025	8.8
18.8	3.953	9.4
36.2	3.834	9.7
44.6	3.721	10.2
48.5	3.562	9.7
60.4	3.421	9.2
70.1	3.175	7.9
80.3	2.991	7.1
90.3	3.082	8.5
100.0	2.908	8.0

These values are based on the work of Ellis and Oglesby (modified maximum bubble pressure method) [26,49].

TABLE 120. Viscosity studies: $CdCl_2$-KBr

Investigations critically re-examined			
Ref.	KBr mol %	Temp. range (T)	Comments
45	49.2,56.1	698-916	Pt viscometer tube and capillary; melt contained in a Vycor tube.
50	40.1,46.5, 62.1,67.3	644-930	As for [45].
59	20-50 (g)	683-793	

TABLE 121. $CdCl_2$-KBr: Viscosity (cp)

T	Mol percent KBr					
	67.3	62.1	56.1	49.2	46.5	40.1
650		4.26				5.01
660		4.00				4.63
670		3.75			4.04	4.29
680		3.52			3.77	3.98
690	3.45	3.31			3.52	3.70
700	3.28	3.19	3.20		3.30	3.44
710	3.18	2.94	2.98	3.35	3.10	3.22
720	2.97	2.78	2.79	3.17	2.93	3.02
730	2.83	2.64	2.62	3.00	2.78	2.84
740	2.71	2.51	2.47	2.84	2.64	2.69
750	2.59	2.39	2.34	2.70	2.52	2.55
760	2.48	2.29	2.23	2.56	2.42	2.43
770	2.39	2.19	2.13	2.44	2.33	2.33
780	2.30	2.11	2.04	2.32	2.25	2.24
790	2.22	2.03	1.96	2.22	2.18	2.16
800	2.14	1.96	1.90	2.12	2.12	2.09
810	2.07	1.90	1.84	2.04	2.07	2.02
820	2.01	1.84	1.79	1.96	2.02	1.96
830	1.95	1.79	1.74	1.89	1.98	1.91
840	1.89	1.74	1.70	1.82	1.94	1.96
850	1.83	1.70	1.65	1.77	1.89	1.81
860	1.78	1.65	1.61	1.72	1.85	1.75
870	1.73	1.61	1.57	1.67	1.80	1.69
880	1.68	1.57	1.52		1.75	1.62
890	1.63	1.52	1.46		1.68	1.55
900	1.58	1.48	1.40		1.62	1.47
910	1.53	1.43	1.32		1.54	
920	1.48					
930	1.42					

Temperature-dependent equations

$$\eta = a + bT + cT^2 + dT^3$$

$$\eta = A \cdot \exp(E/RT)$$

Mol % KBr	Temp. range (T)	a	$b \cdot 10^1$	$c \cdot 10^4$	$d \cdot 10^7$	$A \cdot 10^2$	E (cal mol^{-1})	Standard error of estimate
40.1	650-904	197.4329	−6.8962	8.1666	−3.2483			1.49%
46.5	667-911	173.2970	−6.0396	7.1451	−2.8378			1.59%
49.2	704.3-877.6	72.6588	2.1136	2.0918	−0.6898			1.15%
56.1	697.9-916.0					7.333	5225	2.66%
62.1	644-918	114.1160	−3.8045	4.3357	−1.6656			0.72%
67.3	683-930	90.0361	−2.9182	3.2659	−1.2394			1.77%

These values are based on the work of Ellis (capillary method) [45,50]. The error in the viscosity measurements was estimated to be less than 1%. See also [26], [51] and [77].

TABLE 122. Surface tension studies: $CdCl_2$-KBr

Investigations critically re-examined			
Ref.	KBr mol %	Temp. range (T)	Comments
77,86[a]	0-100	752-1245	Capillary of Pt-11% Rh; melt contained in Pt crucible; calibration: capillary diameter measured with a microscope.
39	0-80	853-1234	As for [77].
49	7.8-100	739-1245	As for [77].

Deviations from previous NSRDS recommendations [2, pp. 61, 63]			
Ref.	KBr mol %	Min. departure	Max. departure
77	100	1.9% (1083 K)	3.1% (1223 K)
77	0	0.0% (1223 K)	1.2% (853 K)

[a]Ellis et al. [77] reported a precision of ±0.5 dyn cm^{-1}.

TABLE 123. $CdCl_2$-KBr: Surface tension (dyn cm^{-1})

T	Mol percent KBr									
	100	90.3	80.3	70.1	60.4	49.9	40.4	30.0	7.8	0
760					89.6	91.3	89.7	89.9		
780					88.7	90.3	88.6	88.9		
800					87.9	89.2	87.5	88.0		
820					87.1	88.2	86.4	87.0		
840					86.2	87.2	85.3	86.0		
860				89.5	85.4	86.1	84.1	85.1	84.1	84.9
880				88.3	84.5	85.1	83.0	84.1	83.6	84.4
900			91.6	87.1	83.7	84.1	81.9	83.1	83.0	83.8
920			90.4	85.9	82.9		80.8	82.2	82.4	83.2
940			89.3	84.7	82.0		79.7	81.2	81.8	82.7
960			88.1	83.6			78.5	80.2	81.3	82.1
980		89.9	87.0	82.4				79.3	80.7	81.6
1000		88.7	85.8	81.2				78.3	80.1	81.0
1020		87.5	84.6	80.0				77.3	79.5	80.4
1040		86.4	83.5	78.8				76.4	78.9	79.9
1060		85.2	82.3	77.7				75.4		79.3
1080	85.7	84.1	81.2	76.5				74.4		78.8
1100	84.3	82.9	80.0							78.2
1120	83.0	81.7	78.9							77.6
1140	81.6	80.6	77.7							77.1
1160	80.3	79.4	76.5							76.5
1180	79.0	78.2	75.4							76.0
1200	77.6									
1220	76.3									
1240	75.0									

TABLE 123. $CdCl_2$-KBr: Surface tension (dyn cm^{-1})—Continued

Temperature-dependent equations
$\gamma = a - bT$

Mol % KBr	a	$b \cdot 10^2$	Standard deviation
0	109.0	2.80	0.6
7.8	108.9	2.88	0.7
30.0	126.7	4.84	0.3
40.4	132.3	5.60	1.6
49.9	130.5	5.16	0.9
60.4	121.5	4.20	1.2
70.1	140.2	5.90	0.7
80.3	143.7	5.79	0.8
90.3	146.8	5.81	0.8
100	157.8	6.68	0.8

These values are based on the work of Ellis, Smith, Wilcox and Crook (maximum bubble pressure method) [77].

$CdCl_2$ - NaBr

Melt Preparation and Purification

Reference [59] contains no information on melt preparation.

TABLE 124. Viscosity studies: $CdCl_2$-NaBr

Investigations critically re-examined			
Ref.	NaBr mol %	Temp. range (T)	Calibration
59	20-40 (g)	753-793	Molten KNO_3.

TABLE 125. $CdCl_2$-NaBr: Viscosity (cp)

Mol percent NaBr	735 K	793 K
20		2.61
30	2.90	2.45
40	2.80	2.42

These values have been interpolated to three significant figures from the graphical presentation of Il'yasov and Barsegov (capillary technique) [59].

$CdCl_2$ - $PbBr_2$

Melt Preparation and Purification

An outline of the method used by Markov [30] and his co-workers [69] for melt preparation is given under the system $CdCl_2$-$ZnBr_2$.

TABLE 126. Electrical conductance studies: $CdCl_2$-$PbBr_2$

Investigations critically re-examined		
Ref.	$PbBr_2$ mol %	Temp. range (T)
69	0-100	873

Deviations from previous NSRDS recommendations [1, pp. 11, 18]

Ref.	$PbBr_2$ mol %	Departure
69	0	0.71% (873 K)
69	100	−1.99% (873 K)

TABLE 127. $CdCl_2$-$PbBr_2$: Equivalent conductance (ohm^{-1} cm^2 $equiv^{-1}$)

Mol % $PbBr_2$	873 K
0	53.51
20	53.96
30	54.15
40	54.03
50	53.60
60	52.75
70	51.52
80	50.10
100	46.76

These values are those obtained experimentally by Voronin, Prisyazhnyii and Baranov (classical ac technique). Densities to convert to specific conductances were not reported [69].

TABLE 128. Viscosity studies: $CdCl_2$-$PbBr_2$

Investigations critically re-examined			
Ref.	$PbBr_2$ mol %	Temp. range (T)	Calibration
59	50-90 (g)	733-793	Molten KNO_3.

TABLE 129. $CdCl_2$-$PbBr_2$: Viscosity (cp)

Mol percent $PbBr_2$	733 K	793 K
40		3.40
50		3.40
60	5.06	3.42
70	5.12	3.50
80	5.22	3.62
90	5.38	3.77
100	5.56	3.94

These values have been interpolated to three significant figures from the graphical presentation of Il'yasov and Barsegov (capillary technique) [59].

$CdCl_2$-$ZnBr_2$

Melt Preparation and Purification

Markov and his co-workers [30, 69] used analytical grade salts purified by recrystallization and dried by fusion under a stream of the appropriate hydrogen halide gas. Argon was bubbled through the melt to remove any remaining hydrogen chloride or bromide. Zinc salts were distilled from the quartz retort into ampoules. Mixtures were prepared by weighing in a dry box and all operation were carried out under dry argon.

TABLE 130. Electrical conductance studies: $CdCl_2$-$ZnBr_2$

Investigations critically re-examined		
Ref.	$ZnBr_2$ mol %	Temp. range (T)
69	0-100	873

Deviations from previous NSRDS recommendations [1, pp. 11, 17]

Ref.	$ZnBr_2$ mol %	Departure
69	0	0.71% (873 K)
69	100	–9.95% (873 K)

TABLE 131. $CdCl_2$-$ZnBr_2$: Equivalent conductance ($ohm^{-1} cm^2$ $equiv^{-1}$)

mol % $ZnBr_2$	873 K
0	53.51
20	38.10
30	31.51
40	25.69
50	20.72
60	16.83
70	13.71
80	11.03
100	7.510

These values are those obtained experimentally by Voronin, Prisyazhnii and Baranov (classical ac technique) [69].

TABLE 132. Density studies: $CdCl_2$-$ZnBr_2$

Investigations critically re-examined			
Ref.	$ZnBr_2$ mol %	Temp. range (T)	Comments
30[a]	0-100	683-968	Quartz ball containing tungsten for weight; calibration: water, carbon tetrachloride.

Deviations from previous NSRDS recommendations [1, pp. 11,17]

Ref.	$ZnBr_2$ mol %	Min. departure	Max. departure
30	100	0.12% (700 K)	0.42% (860 K)
30	0	1.32% (920 K)	1.37% (880 K)

[a]No correction for thermal expansion of quartz was made as this error was estimated to be much less than the overall accuracy of the measurements (i.e., $<<0.2\%$).

TABLE 133. $CdCl_2$-$ZnBr_2$: Density (g cm^{-3})

T	Mol percent $ZnBr_2$										
	100	90	80	70	60	50	40	30	20	10	0
690	3.456										
700	3.447										
710	3.438										
720	3.429										
730	3.420										
740	3.410										
750	3.401										
760	3.392										
770	3.383										
780	3.374										
790	3.365					3.355					
800	3.356				3.342	3.348					
810	3.347				3.335	3.341					
820	3.338	3.337	3.333	3.330	3.328	3.334	3.342	3.353	3.367	3.386	
830	3.329	3.328	3.324	3.322	3.320	3.327	3.334	3.346	3.359	3.378	
840	3.320	3.319	3.316	3.315	3.313	3.320	3.327	3.339	3.352	3.371	
850	3.311	3.311	3.308	3.307	3.306	3.313	3.320	3.332	3.345	3.363	
860	3.302	3.302	3.299	3.299	3.299	3.305	3.313	3.325	3.337	3.356	
870		3.293	3.291	3.291	3.291	3.298	3.306	3.318	3.330	3.348	
880		3.284	3.283	3.284	3.284	3.291	3.299	3.310	3.323	3.340	3.358
890		3.275	3.274	3.276	3.277	3.284	3.292	3.303	3.315	3.333	3.350
900		3.266	3.266	3.268	3.269	3.277	3.284	3.296	3.300	3.325	3.341
910		3.257	3.258	3.260	3.252		3.277	3.289	3.301	3.318	3.333
920			3.249				3.270	3.282			3.325
930											3.316
940											3.308
950											3.299
960											3.291

Temperature-dependent equations

$\rho = a - bT$

Mol % $ZnBr_2$	a	$b \cdot 10^4$
0	4.098	8.40
10	4.004	7.54
20	3.969	7.34
30	3.942	7.18
40	3.927	7.14
50	3.920	7.15
60	3.926	7.30
70	3.967	7.77
80	4.016	8.33
90	4.067	8.90
100	4.080	9.05

These values are based on the work of Markov, Prisyazhnyii and Prikhodko (Archimedean method) [30]. The following equation, with concentration, C, in mole percent $CdCl_2$ and temperature in K, has been derived from the preceding data: $\rho = a + bT + cC + dC^2 + eC^3 + fTC^2$, where a = 4.02220, $b \cdot 10^4 = -8.29499$, $c \cdot 10^4 = -9.16624$, $d \cdot 10^5 = 1.03492$, $e \cdot 10^8 = -3.17686$, $f \cdot 10^9 = 9.49386$, with a maximum departure of 0.22% at 863.2 K and 0.0 mol % $CdCl_2$, and a standard error of estimate of 0.09%. This equation may be used to calculate the density of $CdCl_2$-$ZnBr_2$ melts at any given composition in the temperature range 683-968 K.

CsCl-AgBr

Melt Preparation and Purification

Brooks and Paul [67, 70] treated 99.9% pure AgBr (Research Inorganic Chemical Corporation and 99.9% CsCl (Cerac/Pure) by heating under a vacuum for three days at 200 °C, followed by treatment with a stream of the appropriate freshly-prepared dry hydrogen halide gas for two hours while slowly raising the temperature to the melting point. Dry nitrogen was bubbled through the melt for two hours to remove any remaining HCl or HBr.

TABLE 134. Density studies: CsCl-AgBr

Investigations critically re-examined

Ref.	AgBr mol %	Temp. range (T)	Comments
67,70	50	717-1090	Pt bob, Pt suspension wire; calibration: water.

Comparisons with previous NSRDS recommendations [1, p. 16]

Ref.	AgBr mol %	Min. departure	Max. departure
67,70	100	0.00% (930 K)	0.06% (720 K)

TABLE 135. CsCl-AgBr: Density (gcm^{-3})

T	Mol percent AgBr 50	100
720		5.565
740		5.544
760		5.523
780		5.502
800		5.481
820		5.460
840	3.725	5.439
860	3.690	5.418
880	3.666	5.397
900	3.643	5.376
920	3.619	5.355
940	3.596	5.334
960	3.572	5.313
980	3.548	
1000	3.525	
1020	3.501	
1040	3.477	
1060	3.454	
1080	3.430	

Temperature-dependent equations
$\rho = a - bT$

Mol % AgBr	a	b x 10^3	Std. dev.
50	4.7056	1.1809	0.0009
100	6.321	1.050	

These values are based on the work of Paul (Archimedean method) [67,70].

CsCl - CsBr

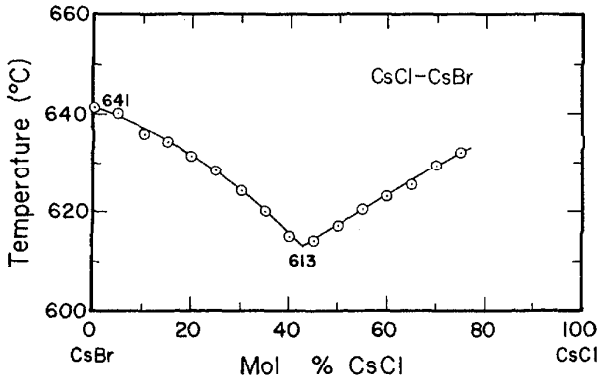

FIGURE 21. Temperature-composition phase diagram for CsCl-CsBr.

I. I. Il'yasov and A.G. Bergman, Zh. Neorg. Khim., 9, [6], 68 (1964).

Melt Preparation and Purification

Zuca and Olteanu [38] used B.D.H. and Merck p.a. halides (purity >99%) dried according to the method of Gruen and McBeth (J. Inorg. Chem. 9, 290, 1959). The salts were heated near the melting point first in vacuum and then under an argon atmosphere. The temperature was then increased beyond the melting point and pure dry HCl (with chlorides) or HBr (with bromides) was bubbled through the melt. The salts were tested for neutrality with phenolphthalein before and after each experiment.

TABLE 136. Electrical conductance studies: CsCl-CsBr

Investigations critically re-examined

Ref.	CsBr mol %	Temp. range (T)	Comments
38[a]	0-100	943-1153	Silica U-shaped capillary cell; Pt electrodes; freq. range: 1000-7000 Hz; calibration: 0.1M and 1.0M KCl solutions.
83,85	0-100	923-1073	Pt electrodes; freq.: 50,000 Hz.

Deviations from NSRDS recommendations [1, pp. 6, 15 and this volume]

Ref.	CsBr mol %	Min. departure	Max. departure
38	100	0.22% (950 K)	−10.1% (1090 K)
83,855	100	−0.10% (945 K)	−9.85% (1070 K)
83,85	75	−0.04% (1030 K)	−0.48% (950 K)
83,85	50	−0.57% (1030 K)	−0.84% (960 K)
83,85	25	−0.41% (1040 K)	−0.53% (970 K)
38	0	0.08% (970 K)	−6.3% (1080 K)
83,85	0	0.06% (960 K)	−5.49% (1070 K)

[a]Zuca and Olteanu [38] reported equivalent conductance in the form of Arrhenius equations. The values for the specific conductance in the following table were obtained by converting the Arrhenius equations to polynomial form and using the density equations reported by these authors in the same publication.

TABLE 137. CsCl-CsBr: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent CsBr				
	100	75	50	25	0
950	0.906	0.967			1.220
960	0.922	0.984	1.057		1.242
970	0.938	1.001	1.075	1.161	1.264
980	0.954	1.018	1.093	1.181	1.286
990	0.970	1.034	1.111	1.200	1.308
1000	0.985	1.050	1.128	1.220	1.329
1010	1.000	1.066	1.145	1.239	1.350
1020	1.016	1.082	1.162	1.257	1.371
1030	1.031	1.098	1.179	1.276	1.392
1040	1.046	1.113	1.196	1.294	1.412
1050	1.060	1.128	1.213	1.312	1.432
1060	1.075	1.144	1.229	1.330	1.452
1070	1.089	1.158	1.245	1.348	1.472
1080	1.103			1.366	1.491
1090	1.117			1.383	
1100				1.400	
1110				1.417	
1120				1.433	

Temperature-dependent equations
$\kappa = a + bT + cT^2$

CsBr mol %	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate	Temp. range (T)
0	−2.0036	4.5422	−1.2096	0.02%	943.2-1148.2
25	−1.7790	4.0832	−1.0848	0.03%	963.2-1153.2
50	−1.4923	3.5044	−0.8841	0.03%	973.2-1143.2
75	−1.4244	3.3397	−0.8653	0.04%	963.2-1128.2
100	−1.4726	3.3704	−0.9125	0.03%	963.2-1133.2

These values are based on the work of Zuca and Olteanu (classical ac technique) [38].

TABLE 138. Density studies: CsCl-CsBr

Investigations critically re-examined

Ref.	CsBr mol %	Temp. range (T)	Comments
38	0-100	933-1123	Pt bob; calibration: water
74,85	0-100	923-1073	Pt sphere; calibration: molten KNO_3.

Deviations from NSRDS recommendation
[1, pp. 6, 15 and this volume]

Ref.	CsBr mol %	Min. departure	Max. departure
38	100	0.17% (950 K)	0.32% (1090 K)
74,85	100	0.03% (1070 K)	0.16% (930 K)
74,85	75	0.00% (940 K)	−0.03% (1070 K)
74,85	50	−0.11% (1070 K)	−0.20% (940 K)
74,85	25	0.00% (1070 K)	0.17% (960 K)
38	0	0.30% (1080 K)	0.36% (950 K)
74,85	0	0.40% (940 K)	0.53% (1070 K)

TABLE 139. CsCl-CsBr: Density (g cm^{-3})

T	Mol percent CsBr				
	100	75	50	25	0
940	3.100	3.023	2.949		2.779
950	3.088	3.012	2.937		2.768
960	3.076	3.000	2.926	2.844	2.757
970	3.064	2.988	2.914	2.833	2.746
980	3.052	2.976	2.902	2.821	2.735
990	3.040	2.965	2.891	2.810	2.725
1000	3.028	2.953	2.879	2.798	2.714
1010	3.016	2.941	2.867	2.787	2.703
1020	3.004	2.929	2.856	2.775	2.692
1030	2.993	2.918	2.844	2.764	2.681
1041	2.981	2.906	2.832	2.752	2.670
1050	2.969	2.894	2.821	2.741	2.660
1060	2.957	2.882	2.809	2.729	2.649
1070	2.945	2.871	2.797	2.718	2.638
1080	2.933			2.706	2.627
1090	2.921			2.695	
1100				2.683	
1110				2.672	
1120				2.660	

Temperature-dependent equations

$\rho = a - bT$

Mol % CsBr	a	$b \cdot 10^3$
0	3.7987	1.0849
25	3.9488	1.1506
50	4.0482	1.1692
75	4.1283	1.1755
100	4.2236	1.1952

The values in this table are based on the work of Zuca and Olteanu (Archimedean method) **[38]**. The data were reported in equation form with no error estimate. The following equation, with concentration, C, in mole percent CsCl and temperature in K, has been derived from the preceding data: $\rho = a + bT + cC + dCT^2$, where $a = 4.23938$, $b \cdot 10^3 = -1.20827$, $c \cdot 10^3 = -3.66196$, $d \cdot 10^{10} = 5.23888$, with a maximum departure of −0.19% at 933.2 K and 50 mol % CsCl, and a standard error of estimate of 0.11%. This equation may be used to calculate the density of CsCl-CsBr melts at any given composition in the temperature range 933-1123 K.

TABLE 140. Viscosity studies: CsCl-CsBr

Investigations critically re-examined		
Ref.	CsBr mol %	Temp. range
65[a]	0-100	See footnote a.
Deviations from previous NSRDS recommendations [5, p. 885]		
Ref.	CsBr mol %	Min. departure
65	0	−2.82% (1070 K)

[a]The temperature range was not given. The isotherm at 1070 K (molar viscosity vs. composition) was reported and the values in the following table were calculated from this set of data.

TABLE 141. CsCl-CsBr: Viscosity (cp)

Mol percent CsBr	1070 K
0	1.03_4
25	1.08_0
75	1.10_8
75	1.16_3
100	1.20_3

The values in this table are based on the work of Smirnov, Khokhlvo and Antonov (oscillating sphere method) **[65]** and the density data of Stepanov and Smirnov [74]. The data were reported in equation form and no estimate of error was given.

TABLE 142. CsCl-CsBr: Molar viscosity (erg s mol $^{-1}$)[a]

Temperature-dependent equations
$\log \eta_M = A + B/T$

Mol percent CsBr	$-A$	B
0	1.1743	1065
25	1.1769	1102
50	1.1783	1131
75	1.0788	1061
100	1.0230	1031

Equations as reported by Smirnov, Khoklov and Antonov [65] (see footnote, table 140): of limited value since temperature limits of applicability and standard deviation were not reported.

[a]Molar viscosity is defined by $\eta(M\rho^{-1})$ where $M = X_1M_1 + X_2M_2$, and ρ, X_1, X_2, are the density and mol fraction composition of the molten mixture, with the units of η in poise.

TABLE 143. Surface tension studies: CsCl-CsBr

Investigations critically re-examined

Ref.	CsBr mol %	Temp. range (T)
81[a]	0,50,100	933-1123
74	12-100	923-1073

Deviations from NSRDS recommendations
[2, pp. 58, 63 and this volume]

Ref.	CsBr mol %	Min. departure	Max. departure
74	100	0.46% (935 K)	1.44% (1070 K)
81	50	0.37% (925 K)	0.39% (1070 K)
81	0	0.46% (973 K)	0.0% (1013 K)

[a]The surface tension data reported by Bertozzi [81] for pure CsBr were critically evaluated and given as the recommended values in "Molten Salts: Surface Tension Data" (NSRDS-NBS-28) [2].

TABLE 144. CsCl-CsBr: Surface tension (dyn cm^{-1})

T	Mol percent CsBr							
	100	88	75	63	50	37	25	12
930	82.8	83.6	84.4	85.3	86.3	87.3	88.3	89.4
940	82.2	82.9	83.7	84.6	85.6	86.6	87.5	88.7
950	81.5	82.3	83.1	83.9	84.9	85.9	86.8	87.9
960	80.9	81.7	82.4	83.2	84.2	85.2	86.1	87.1
970	80.3	81.0	81.8	82.5	83.5	84.4	85.3	86.4
980	79.7	80.4	81.1	81.9	82.8	83.7	84.6	85.6
990	79.0	79.7	80.5	81.2	82.1	83.0	83.8	84.9
1000	78.4	79.1	79.8	80.5	81.4	82.3	83.1	84.1
1010	77.8	78.5	79.1	79.8	80.7	81.6	82.4	83.3
1020	77.1	77.8	78.5	79.1	80.0	80.9	81.6	82.6
1030	76.5	77.2	77.8	78.5	79.3	80.1	80.9	81.8
1040	75.9	76.5	77.2	77.8	78.6	79.4	80.1	81.1
1050	75.3	75.9	76.5	77.1	77.9	78.7	79.4	80.3
1060	74.6	75.3	75.8	76.4	77.2	78.0	78.7	79.5
1070	74.0	74.6	75.2	75.7	76.5	77.3	77.9	78.8

Temperature-dependent equations
$\rho = a - bT$

Mol % CsBr	a	b
12	160.2	0.0761
25	157.0	0.0739
37	153.8	0.0715
50	151.1	0.0697
63	148.5	0.0680
75	145.7	0.0659
88	143.1	0.0640
100	141.4	0.0630

These values are based on the work of Stepanov and Smirnov (maximum bubble pressure method) [74]; a precision of ±0.1 dyn cm^{-1} was reported. The following equation, with concentration, C, in mole percent CsBr and temperature in K, has been derived from the preceding data: $\gamma = a + bC + cT + dC^2 + eCT^2$, where a = 162.51497, $b \cdot 10^1$ = −1.55653, $c \cdot 10^2$ = −7.74760, $d \cdot 10^4$ = 1.38419, $e \cdot 10^8$ = 7.53894, with a maximum departure of 0.11% at 1073 K and 100 mol % CsBr, and a standard error of estimate of 0.037. This equation may be used to calculate the surface tension of CsCl-CsBr melts at any given composition in the temperature range 993-1123 K.

CsCl-KBr

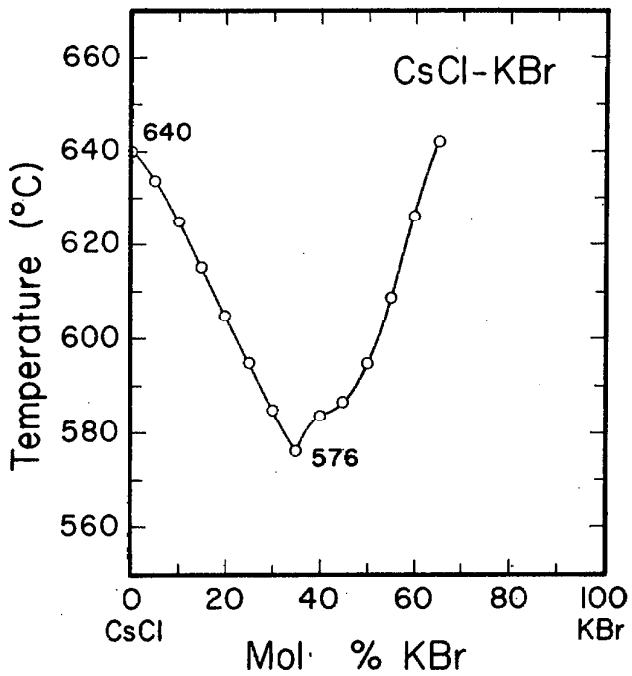

FIGURE 22. Temperature-composition phase diagram for CsCl-KBr.

I.I. Il'yasov and A.G. Bergman, Zh. Neorg. Khim 9 [6], 768 (1964).

Melt Preparation and Purification

The method used by Markov and Prisrazhnyii [28, 34, 46] for melt preparation is given under the system $CdCl_2$-$ZnBr_2$.

TABLE 145. Electrical conductance studies: CsCl-KBr

Investigations critically re-examined			
Ref.	KBr mol %	Temp. range (T)	Comments
28,34	0-100 (g)	1048,1073	Quartz U-shaped capillary cell; Pt electrodes; calibration H_2SO_4 solutions.

TABLE 146. CsCl-KBr: Specific conductance ($ohm^{-1}cm^{-1}$)

Mol percent KBr	1048 K	1073 K
0	1.40	1.44
10	1.41	1.45
20	1.41	1.45
30	1.42	1.47
40	1.44	1.49
50	1.46	1.51
60	1.50	1.55
70	1.54	1.59
80	1.58	1.63
90	1.64	1.69
100	1.70	1.76

The values in this table have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (classical ac technique) [28].

TABLE 147. Density studies: CsCl-KBr

Investigations critically re-examined			
Ref.	KBr mol %	Temp. range (T)	Comments
34,46	0-100 (g)	1073	Quartz sphere weighted with molybdenum or tungsten; calibration: water.

TABLE 148. CsCl-KBr: Density ($g\ cm^{-3}$)

Mol percent KBr	1073 K
0	2.63
10	2.58
20	2.52
30	2.46
40	2.40
50	2.35
60	2.30
70	2.24
80	2.18
90	2.13
100	2.08

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (Archimedean method) [46].

CsCl-NaBr

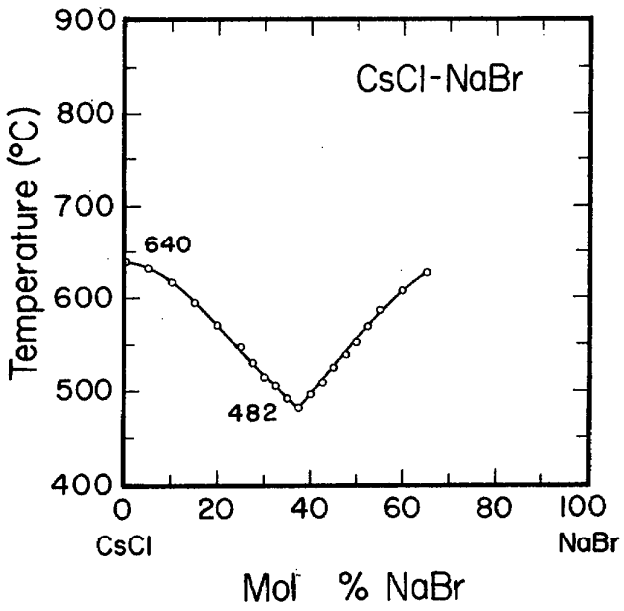

FIGURE 23. Temperature-composition phase diagram for CsCl-NaBr.

I.I. Il'yasov, Ukr. Khim. Zh., 31 [9], 930 (1965).

Melt Preparation and Purification

The method used by Markov and his co-workers for melt preparation is given under the system $CdCl_2$-$ZnBr_2$.

TABLE 149. Electrical conductance studies: CsCl-NaBr

Investigations critically re-examined			
Ref.	NaBr mol %	Temp. range (T)	Comments
23,34	0-100 (g)	1073,1123	Quartz U-shaped capillary cell; Pt electrodes; calibration: H_2SO_4 solutions.

TABLE 150. CsCl-NaBr: Specific conductance ($ohm^{-1}cm^{-1}$)

Mol percent NaBr	1073 K	1123 K
0	1.41	1.54
10	1.42	1.55
20	1.43	1.56
30	1.46	1.57
40	1.51	1.59
50	1.55	1.62
60	1.63	1.73
70	1.85	1.92
80	2.06	2.15
90	2.45	2.60
100	3.00	3.12

The values in this table have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (classical ac technique) [23].

TABLE 151. Density studies: CsCl-NaBr

Investigations critically re-examined			
Ref.	NaBr mol %	Temp. range (T)	Comments
34,46	0-100 (g)	1073	Quartz sphere weighted with tungsten or molybdenum; calibration: water.

TABLE 152. CsCl-NaBr: Density ($g\ cm^{-3}$)

Mol percent NaBr	1073 K
0	2.63
10	2.61
20	2.58
30	2.56
40	2.52
50	2.48
60	2.45
70	2.42
80	2.36
90	2.33
100	2.28

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (Archimedean method) [46].

KCl-AgBr

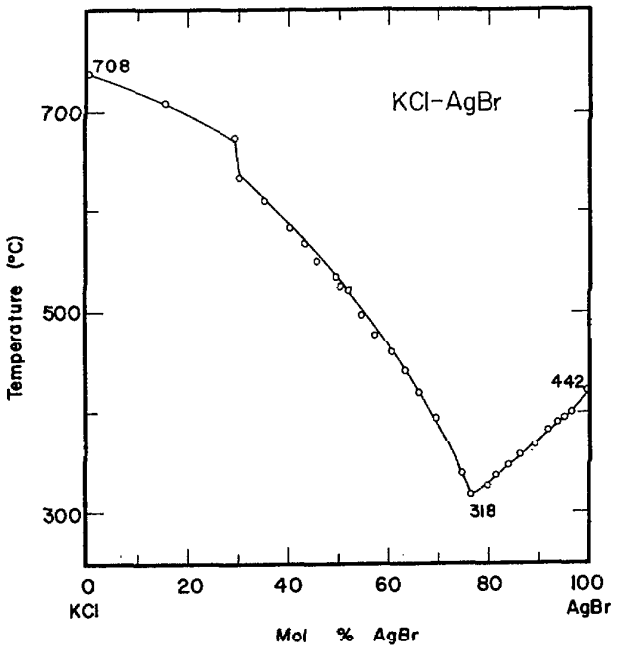

FIGURE 24. Temperature-composition phase diagram for KCl-AgBr. N.K. Voskryesyenskaya, H.H. Evserva, C.N. Byerouly and N.P. Vereshchyenchena, Akad. Nauk SSSR, Inst. Obsh. Neorg. Khim., (1961).

Melt Preparation and Purification

Bizouard [22, 44] used Merck p.a. KCl and AgBr. Markov and Prisyazhnyii [46] prepared the silver bromide from recrystallized silver nitrate. The method of melt preparation is given under the system $CdCl_2$-$ZnBr_2$. Brooks and Paul [67, 76] used 99.8% B. D. H. KCl. The method of melt preparation is given under the system AgCl-AgBr. That of Sternberg and Terzi [71] is also given under the system AgCl-KBr.

TABLE 153. Electrical conductance studies: KCl-AgBr

Investigations critically re-examined			
Ref.	AgBr mol %	Temp. range (T)	Comments
21,34	0-100 (g)	1073	Equivalent conductance given.
22,44[a]	0-100	823-1073, 773-1073	Cell material: Pyrex up to 500 °C and silica up to 1000 °C; Pt electrodes; freq. 1000 Hz; calibration: 1N KCl, saturated NaCl and H_2SO_4 solutions.

Deviations from previous NSRDS recommendations [1, p. 5]			
Ref.	AgBr mol %	Min. departure	Max. departure
22,44	0	0.0% (1073 K)	0.05% (1023 K)

[a] *Bizouard [22,44] reported a precision of better than 0.5% in the electrical conductance measurements.*

TABLE 154. KCl-AgBr: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent AgBr					
	100	80	60	40	20	0
780	3.036	2.230	1.695			
790	3.056	2.253	1.724			
800	3.076	2.276	1.752			
810	3.096	2.298	1.780			
820	3.116	2.320	1.807			
830	3.135	2.342	1.834	1.580		
840	3.154	2.363	1.861	1.605		
850	3.172	2.384	1.887	1.630		
860	3.191	2.404	1.912	1.654		
870	3.209	2.424	1.937	1.679		
880	3.226	2.443	1.962	1.703		
890	3.244	2.463	1.986	1.727		
900	3.261	2.481	2.010	1.752		
910	3.277	2.500	2.033	1.776		
920	3.294	2.518	2.056	1.800		
930	3.310	2.535	2.078	1.824	1.763	
940	3.326	2.552	2.100	1.847	1.788	
950	3.341	2.569	2.122	1.871	1.813	
960	3.356	2.585	2.143	1.895	1.838	
970	3.371	2.601	2.163	1.918	1.864	
980	3.386	2.616	2.183	1.942	1.889	
990	3.400	2.632	2.203	1.965	1.914	
1000	3.414	2.646	2.222	1.988	1.940	
1010	3.427	2.660	2.241	2.011	1.965	
1020	3.441	2.674	2.259	2.034	1.991	
1030	3.454	2.688	2.277	2.057	2.017	[2.119]
1040	3.466	2.701	2.294	2.080	2.042	[2.147]
1050	3.479	2.713	2.311	2.103	2.068	[2.174]
1060	3.491	2.726	2.328	2.125	2.094	[2.201]
1070	3.503	2.737	2.344	2.148	2.120	[2.228]

Temperature-dependent equations

$\kappa = a + bT + cT^2$

Mol % AgBr	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate
0	[−0.6821]	[2.7200]	0	0.00%
20	−0.3603	2.0518	0.2484	0.05%
40	−0.8209	3.3020	−0.4929	0.39%
60	−1.9430	6.4333	−2.2682	0.35%
80	−0.8398	5.5272	−2.0412	0.12%
100	0.4760	4.4997	−1.5619	0.10%

These values are based on the work of Bizouard and Doucet (potentiometric ac method) [44]. Values given in square brackets were generated from fewer than four data points.

TABLE 155. Density studies: KCl-AgBr

Investigations critically re-examined			
Ref.	AgBr mol %	Temp. range (T)	Comments
34,46	0-100 (g)	1073	Quartz sphere weighted with Mo or W; calibration: water.
67,76	50,100	717-1074	Pt bob and suspension wire; calibration: water.

Deviations from previous NSRDS recommendations [1, p. 16]			
Ref.	AgBr mol %	Min. departure	Max. departure
67,76	100	0.00% (930 K)	0.06% (720 K)

Markov and Priyazhnyii's [34,46] investigation was made at a single temperature over a wide concentration range. That of Brooks and Paul [67,76] was made at a single composition over a wide range of temperature. The results of the analysis of both studies are given in the following tables.

TABLE 156. KCl-AgBr: Density (g cm^{-3})

Mol percent AgBr	1073 K
0	1.50
10	1.75
20	2.03
30	2.33
40	2.64
50	2.98
60	3.30
70	3.70
80	4.14
90	4.62
100	5.19

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (Archimedean method) [46].

TABLE 157. KCl-AgBr: Density (g cm^{-3})

T	50 mol % AgBr
700	3.3141
725	3.2908
750	3.2675
775	3.2442
800	3.2209
825	3.1976
850	3.1744
875	3.1510
900	3.1278
925	3.1045
950	3.0812
975	3.0579
1000	3.0346
1025	3.0113
1050	2.9880
1073	2.9666

These values are based on the work of Brooks and Paul (Archimedean Method) [67,70]. The temperature-dependent equation is $\rho = 3.9663 - 9.317.10^{-4}T$, standard deviation = 0.0009. For the results of a study made over a wider concentration range, see the previous table.

TABLE 158. Surface tension studies: KCl-AgBr

Investigations critically re-examined			
Ref.	AgBr mol %	Temp. range (T)	Comments
71	0-100	681-1183	Pt pin; calibration: organic liquids.

Deviations from previous NSRDS recommendations [5, page 888 and 6]			
Ref.	AgBr mol %	Min. departure	Max. departure
71	100	1.56% (990 K)	4.38% (735 K)
71	0	−2.10% (1180 K)	−2.61% (1065 K)

TABLE 159. KCl-AgBr: Surface tension (dyn cm^{-1})

T	Mol percent AgBr									
	100	90	70	60	50	40	30	20	10	0
690		144.8	132.5							
700		144.3	131.9							
710		143.8	131.3							
720		143.3	130.7							
730	159.8	142.8	130.1							
740	159.4	142.3	129.5							
750	159.0	141.8	128.9							
760	156.6	141.3	128.3							
770	158.2	140.8	127.7	124.2						
780	157.8	140.3	127.1	123.5						
790	157.4	139.8	126.5	122.9						
800	157.0	139.3	125.9	122.2						
810	156.5	138.7	125.3	121.5						
820	156.2	138.3	124.7	120.8						
830	155.8	137.7	124.1	120.1	117.7					
840	155.4	137.2	123.5	119.5	117.0					
850	155.0	136.7	122.9	118.8	116.4					
860	154.6	136.2	122.3	118.1	115.7					
870	154.2	135.7	121.7	117.4	115.0					
880	153.8	135.2	121.2	116.7	114.4	112.5				
890	153.4	134.7	120.6	116.1	113.7	111.8				
900	153.0	134.2	120.0	115.4	113.1	111.1				
910	152.6	133.7		114.7	112.4	110.4				
920	152.2	133.2		114.0	111.7	109.7				
930	151.8			113.3	111.1	109.0				
940	151.4			112.7	110.4	108.3				
950	151.0			112.0	109.8	107.7				
960	150.6			111.3	109.1	107.0				
970	150.2				108.4	106.3				
980	149.8				107.8	105.6				
990	149.4				107.1	104.9	102.0			
1000	149.0				106.5	104.2	101.2			
1010					105.8	103.5	100.5	100.3		
1020					105.1	102.9	99.7	99.5		
1030					104.5	102.2	99.0	99.8		
1040						101.5	98.3	98.0		
1050						100.8	97.5	97.3		
1060						100.1	96.8	96.5		
1070							96.0	95.8		96.4
1080							95.3	95.0	93.5	95.7
1090							94.5	94.3	92.7	95.0
1100								93.5	91.8	94.3
1110								92.8	91.0	93.6
1120								92.0	90.1	92.9
1130									89.3	92.2
1140									88.5	91.5
1150										90.7
1160										90.0
1170										89.3
1180										88.6

Temperature-dependent equations

$\gamma = a - bT$

Mol % AgBr	a	b	Mol % AgBr	a	b
0	172.39	0.0710	50	172.46	0.0660
10	183.89	0.0837	60	176.50	0.0679
20	176.04	0.0750	70	173.61	0.0596
30	175.43	0.0742	90	179.66	0.0505
40	172.93	0.0687	100	188.90	0.0399

These values are based on the work of Sternberg and Terzi (pin detachment method) [71]. These authors reported a reproducibility of ±1%.

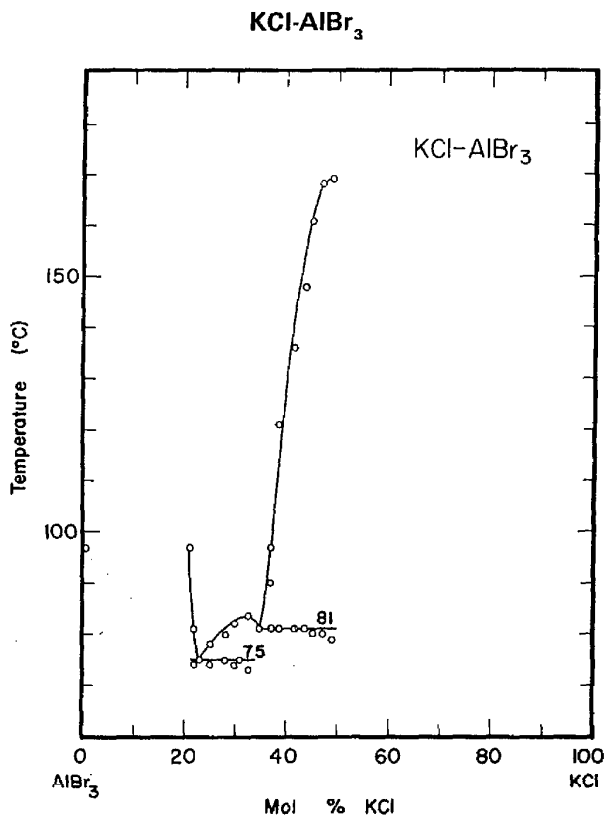

FIGURE 25. Temperature-composition phase diagram for KCl-$AlBr_3$.

U.A. Plotnikov and V.I. Shvarzman, Zap. Inst. Chem., Akad. Nauk, U.S.S.R., 4, 137 (1937); Zhur. Fiz. Khim., 12, 120 (1938).

Melt Preparation and Purification

Gorenbein [13] recrystallized KCl several times and stored the purified salt in a desiccator. The $AlBr_3$ was prepared by direct synthesis from bromine gas and aluminum filings. The initial product of aluminum bromide was refluxed over solid aluminum metal and distilled into glass ampoules.

TABLE 160. Electrical conductance studies: KCl-$AlBr_3$

Investigations critically re-examined		
Ref.	$AlBr_3$ mol %	Temp. range (T)
13	66.7,100	353-443
35	66.7	353-443

Deviations from previous NSRDS recommendations [this volume]			
Ref.	$AlBr_3$ mol %	Min. departure	Max. departure
35	66.7	3.5% (393 K)	−20.5% (443 K)

TABLE 161. KCl-$AlBr_3$: Specific conductance ($ohm^{-1}cm^{-1}$)

T	Mol percent $AlBr_3$	
	100	66.7
370		0.02748
380	0.002255	0.03405
390	0.002012	0.04092
400	0.001815	0.04810
410		0.05560
420		0.06341
430		0.07152
440		0.07995

Temperature-dependent equations
$\kappa = a + bT + cT^2$

Mol % $AlBr_3$	$a \cdot 10^2$	$b \cdot 10^4$	$c \cdot 10^7$	Standard error of estimate
66.7	0.3209	−5.0956	15.5449	0.82%
100	4.5550	−2.0130	2.2991	0.17%

These values are based on the work of Gorenbein (classical ac technique) [13].

TABLE 162. Density studies: KCl-$AlBr_3$

Investigations critically re-examined		
Ref.	$AlBr_3$ mol %	Temp. range (T)
13	66.7, 100	353-443

TABLE 163. KCl-$AlBr_3$: Density ($g\ cm^{-3}$)

T	Mol percent $AlBr_3$	
	66.7	100
360	2.721	
370	2.707	
380	2.692	2.631
390	2.678	2.608
400	2.664	2.585
410	2.649	2.562
420	2.635	2.538
430	2.621	2.515
440	2.606	

Temperature-dependent equations
$\rho = a - bT$

Mol % $AlBr_3$	a	$b \cdot 10^5$	Standard error of estimate
66.7	3.2364	1.4321	0.09%
100	3.5104	2.3143	0.03%

These values are based on the work of Gorenbein (pycnometric method) [13].

TABLE 164. Viscosity studies: KCl-$AlBr_3$

Investigations critically re-examined		
Ref.	$AlBr_3$ mol %	Temp. range (T)
13	66.7, 100	353-443

Deviations from previous NSRDS recommendations [1, p. 18]

Ref.	$AlBr_3$ mol %	Min. departure	Max. departure
13	100	1.4% (423 K)	3.8% (433 K)

TABLE 165. KCl-$AlBr_3$: Viscosity (cp)

T	Mol percent $AlBr_3$	
	100	66.7
353.2		41.603
363.2		29.599
373.2		22.068
383.2		16.927
393.2		13.678
403.2		11.166
413.2	1.610	9.286
423.2	1.453	7.936
433.2	1.368	6.854
443.2		5.994

These values are those obtained experimentally by Gorenbein (capillary technique) [13].

KCl-$CaBr_2$

Melt Preparation and Purification

The method used by Markov and his co-workers for melt preparation is described under the system $CdCl_2$-$ZnBr_2$.

TABLE 166. Electrical conductance studies: KCl-$CaBr_2$

Investigations critically re-examined			
Ref.	$CaBr_2$ mol %	Temp. range (T)	Comments
64	0-100 (g)	1023	Quartz U-shaped capillary cell; Pt electrodes.

TABLE 167. KCl-$CaBr_2$: Equivalent conductance (ohm^{-1} cm^2 $equiv^{-1}$)

Mol percent $CaBr_2$	1023 K
0	100.0
10	90.0
20	79.0
30	67.5
40	58.2
50	50.8
60	45.4
70	42.5
80	41.0
90	42.3
100	45.7

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (classical ac technique) [64]. No density data were reported.

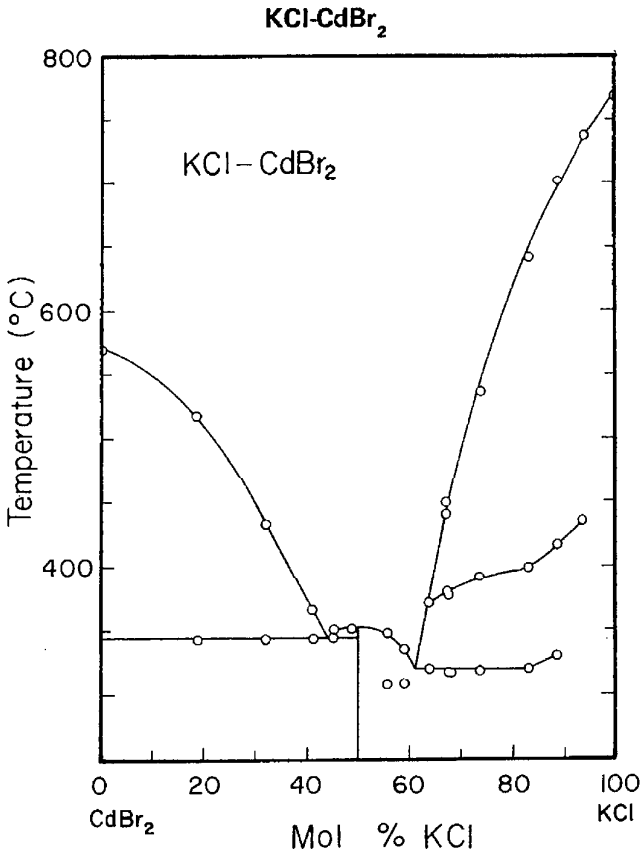

FIGURE 26. Temperature-composition phase diagram for KCl-$CdBr_2$.

Prog. Rep. U.S.A.E.C. Contract No. AT-(40-1)-2073 on Surface Tension of Fused Salts.

Melt Preparation and Purification

The method used by Markov for melt preparation is given under the system $CdCl_2$-$ZnBr_2$. That of Ellis is given under the system $CdCl_2$-KBr.

TABLE 168. Electrical conductance studies: KCl-$CdBr_2$

Investigations critically re-examined

Ref.	$CdBr_2$ mol %	Temp. range (T)	Comments
64	0-100 (g)	1023	Quartz U-shaped cell; Pt electrodes.

TABLE 169. KCl-$CdBr_2$: Equivalent conductance (ohm^{-1} cm^2 $equiv^{-1}$)

Mol percent $CdBr_2$	1023 K
0	103.2
10	92.5
20	82.6
30	72.4
40	64.7
50	58.4
60	55.4
70	54.7
80	55.3
90	54.0
100	49.0

These values have been interpolated to three significant figures from the graphical presentation of Markov, Prisyazhnyii and Zavel'skaya (classical ac technique) [64].

TABLE 170. Density studies: KCl-$CdBr_2$

Investigations critically re-examined

Ref.	$CdBr_2$ mol %	Temp. range (T)	Comments
26	0-100	708-1330	Capillary of 89% Pt 11% Rh. Pt bob and chain as for 26.
39[a]	0-60	999-1330	
50	45.3-100	708-1088	

Deviations from previous NSRDS recommendations [1, pp. 5,17]

Ref.	$CdBr_2$ mol %	Min. departure	Max. departure
26	100	0.05% (960 K)	−1.14% (880 K)
50	100	0.02% (893 K)	1.8% (1031 K)
26	0	−1.04% (1200 K)	−1.33% (1090 K)
39	0	−0.90% (1113 K)	−1.2% (1091 K)

[a]Ellis used both the buoyancy method [39] and the modified maximum bubble pressure method [26,50] for density determinations. The values in the next table are based on the author's final summary report [26].

TABLE 171. KCl-$CdBr_2$: Density (g cm^{-3})

T	Mol percent $CdBr_2$					
	100	80.5	61.8	60	45.3	0
720			3.421			
740			3.390			
760			3.358			
780			3.327			
800			3.295	3.263		
820				3.245	2.855	
840				3.227	2.841	
860				3.208	2.828	
880		3.639		3.190	2.814	
900	3.977	3.611		3.172	2.801	
920	3.966	3.583			2.788	
940	3.955	3.555			2.774	
960	3.945	3.526				
980	3.934	3.498				
1000	3.923	3.470				
1020	3.912	3.442				
1040	3.901	3.414				
1060	3.891	3.385				
1080		3.357				
1100						1.476
1120						1.465
1140						1.454
1160						1.444
1180						1.433
1200						1.422
1220						1.411
1240						1.400
1260						1.390
1280						1.379
1300						1.368
1320						1.357

TABLE 171. KCl-$CdBr_2$: Density (g cm^{-3})—Continued

Temperature-dependent equations
$\rho = a - bT$

Mol % $CdBr_2$	a	$b \cdot 10^4$	Standard deviation
0	2.070	5.4	0.004
20	2.731	6.73	0.003
40	3.294	7.91	0.003
45.3	3.404	6.7	0.012
60	3.991	9.1	0.030
61.8	4.559	15.8	0.033
80.5	4.880	14.1	0.046
100	4.463	5.4	0.031

These values are based on the work of Ellis and Oglesby (modified maximum bubble pressure method) [26].

TABLE 172. Viscosity studies: KCl-$CdBr_2$

Investigations critically re-examined

Ref.	$CdBr_2$ mol %	Temp. range (T)	Calibration
59	50-80 (g)	683-791	Molten KNO_3.

TABLE 173. KCl-$CdBr_2$: Viscosity (cp)

Mol % $CdBr_2$	683 K	733 K	791 K
50	3.52	2.80	2.40
60	3.42	2.74	2.30
70		2.78	2.30
80		2.90	2.38

These values have been interpolated to three significant figures from the graphical presentation of Il'yasov and Barsegov (capillary technique) [59].

TABLE 174. Surface tension studies: KCl-$CdBr_2$

Investigations critically re-examined

Ref.	$CdBr_2$ mol %	Temp. range (T)
86[a]	20-100	658-1283
26	20-100	658-1283
39	20-100	911-1284
50	45.3-100	658-1088

[a] *The data for pure $CdBr_2$ in references [26,50,86] were critically* evaluated and given as the recommended values in "Molten Salts: Volume 2" (NSRDS-NBS-28) [2].

TABLE 175. KCl-$CdBr_2$: Surface tension (dyn cm^{-1})

T	Mol percent $CdBr_2$								
	100.0	80.5	61.8	60.0	49.5	45.3	34.0	30.1	20.0
660			86.3	87.4					
680			85.4	86.3					
700			84.5	85.3					
720			83.7	84.2					
740			82.8	83.1					
760			81.9	82.0					
780			81.1	80.9	86.4				
800			80.2	79.9	85.3	85.1			
820				78.8	84.1	84.1			
840				77.7	83.0	83.0			
860				76.6	81.8	81.9			
880		70.1		75.5	80.7	80.8			
900		69.5		74.5	79.5	79.7			
920	64.5	68.8		73.4	78.4	78.6		85.9	
940	63.9	68.2			77.2	77.5	82.3	84.8	
960	63.2	67.5			76.0		81.1	83.7	
980	62.6	66.9			74.9		79.9	82.5	87.5
1000	62.0	66.2			73.7		78.7	81.4	86.4
1020	61.4	65.6					77.5	80.2	85.3
1040	60.7	64.9					76.2	79.1	84.2
1060	60.11	64.3					75.0	78.0	83.0
1080		63.6					73.8	76.8	81.9
1100							72.6	75.7	80.8
1120							71.4	74.5	79.7
1140							70.1	73.4	78.6
1160							68.9	72.3	77.4
1180							67.7		76.3
1200							66.5		75.2
1220							65.3		74.1
1240							64.0		73.0
1260							62.8		71.8
1280									70.7

Temperature-dependent equations

$\gamma = a - bT$

Mol % $CdBr_2$	a	$b \cdot 10^2$	Standard deviation
20.0	142.4	5.60	0.6
30.1	138.4	5.70	1.5
34.0	139.7	6.10	1.0
45.3	128.8	5.46	0.4
49.5	131.3	5.76	2.1
60.0	123.1	5.40	1.0
61.8	114.8	4.33	0.7
80.5	98.5	3.23	0.8
100.0	93.4	3.14	1.1

These values are based on the work of Ellis and Freeman (maximum bubble pressure method) [50,86].

KCl-CsBr

Melt Preparation and Purification

The method used by Brooks and Paul for melt preparation is described under the system AgCl-AgBr. That of Markov is described under the system $CdCl_2$-$ZnBr_2$.

TABLE 176. Electrical conductance studies: KCl-CsBr

Investigations critically re-examined			
Ref.	CsBr mol %	Temp. range (T)	Comments
28,34	0-100 (g)	1048,1073	Quartz U-shaped capillary cell; Pt electrodes; calibration: H_2SO_4 solutions.

TABLE 177. KCl-CsBr: Specific conductance ($ohm^{-1}cm^{-1}$)

Mol percent CsBr	1048 K	1073 K
0	2.15	2.20
10	1.96	2.01
20	1.83	1.88
30	1.70	1.75
40	1.57	1.63
50	1.46	1.52
60	1.37	1.42
70	1.28	1.33
80	1.20	1.24
90	1.13	1.17
100	1.06	1.09

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (classical ac technique) [28].

TABLE 178. Density studies: KCl-CsBr

Investigations critically re-examined			
Ref.	CsBr mol %	Temp. range (T)	Comments
34,46	0-100 (g)	1073	Quartz sphere weighted with molybdenum or tungsten; calibration: water.
67,70	50	933-1100	Pt bob and suspension wire; calibration: water.

Analyses both of the study of Markov and Prisyazhnyii [34,46] and that of Brooks and Paul [67,70] are given in the following tables. The results of Markov and Prisyazhnyii are low compared to those of Brooks and Paul and to the values advanced in "Molten Salts, Volume 1, Electrical Conductance, Density and Viscosity" (NSRDS-NBS 15) [1, pp. 48,66].

TABLE 179. KCl-CsBr: Density ($g\ cm^{-3}$)

Mol % CsBr	1073 K
0	1.45
10	1.57
20	1.68
30	1.80
40	1.92
50	2.04
60	2.16
70	2.27
80	2.39
90	2.51
100	2.63

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (Archimedean method) [46]. For the results of a study made over a wider temperature range, see the following table.

TABLE 180. KCl-CsBr: Density ($g\ cm^{-3}$)

T	50 mol % CsBr
940	2.4754
960	2.4565
980	2.4377
1000	2.4189
1020	2.4000
1040	2.3813
1060	2.3625
1073	2.3502
1080	2.3436
1100	2.3248

Temperature-dependent equation
$\rho = 3.3597 - 0.9408 \cdot 10^{-3}T$
Standard deviation = 0.0009

These values are based on the work of Brooks and Paul (Archimedean method) [67]. For the results of a study over a wider concentration range, see the previous table.

KCl-KBr

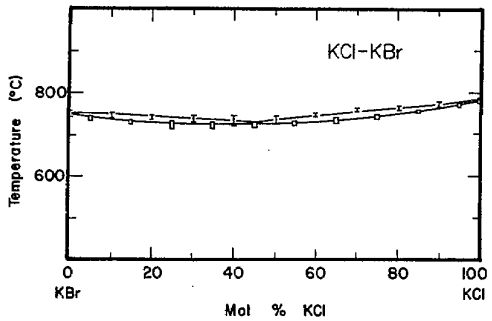

FIGURE 27. Temperature-composition phase diagram for KCl-KBr.

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Melt Preparation and Purification

Murgulescu and Zuca [18] used pure analytical grade reagents. Zuca's [27] method of drying salts is described under the system CsCl-CsBr. The method used by Brooks and Paul [67, 70] for melt preparation is described under the system AgCl-AgBr, as is that of Heymann [76].

Holm [60] used reagent-grade KCl and KBr dried at 400-500 °C under moderate vacuum (0.1 - 0.01 torr) and then fused in a platinum crucible under an atmosphere of purified nitrogen. Bertozzi [81] used reagent-grade salts without further purification.

TABLE 181. Electrical conductance studies: KCl-KBr

Investigations critically re-examined

Ref.	KBr mol %	Temp. range (T)	Comments
27	0-100	1013-1223	Silica U-shaped capillary cell; Pt electrodes; freq. range: 1000-7000 Hz; calibration: 0.1M and 1.0M KCl solutions.
55	0-100	1086,1126, 1166	Freq.: 800 Hz.

Deviations from NSRDS recommendations [1, pp. 5, 14 and this volume]

Ref.	KBr mol %	Min. departure	Max. departure
27	100	0.11% (1040 K)	–1.2% (1120 K)
55	100	–1.6% (1086 K)	–2.1% (1126 K)
55	80	–3.1% (1086 K)	–3.4% (1086 K)
55	60	–0.57% (1166 K)	0.52% (1086 K)
55	40	0.0% (1086 K)	–5.2% (1166 K)
55	20	0.0% (1166 K)	0.46% (1086 K)
27	0	0.0% (1200 K)	–0.54% (1140 K)
55	0	0.0% (1086 K)	0.42% (1126 K)

TABLE 182. KCl-KBr: Specific conductance ($ohm^{-1}\ cm^{-1}$)

T	Mol percent KBr						
	100	80	60	50	40	20	0
1020			1.779				
1030	1.678	1.794	1.805				
1040	1.698	1.815	1.830	1.877	1.917		
1050	1.719	1.837	1.855	1.899	1.941	2.069	
1060	1.740	1.858	1.879	1.921	1.964	2.091	2.205
1070	1.760	1.879	1.903	1.943	1.988	2.113	2.227
1080	1.781	1.900	1.927	1.964	2.011	2.135	2.249
1090	*1.901*	*1.921*	*1.949*	*1.986*	*2.034*	*2.157*	*2.272*
1100	1.822	1.943	1.972	2.008	2.056	2.179	2.294
1110	1.843	1.964	1.994	2.029	2.079	2.201	2.316
1120	1.863	1.985	2.015	2.051	2.101	2.223	2.338
1130	1.884	2.006	2.036	2.073	2.123	2.245	2.361
1140	1.905	2.027	2.056	2.094	2.144	2.267	2.383
1150	1.925	2.048	2.076	2.116	2.116	2.290	2.405
1160	1.946	2.070	2.096	2.138	2.187	2.312	2.427
1170	1.966	2.091	2.115	2.159	2.208	2.334	2.450
1180	1.987	2.112	2.133	2.181	2.229	2.356	2.472
1190	2.008	2.133	2.151	2.203		2.378	2.494
1200			2.168				2.517
1210							2.539

Temperature-dependent equations

$$\kappa = a + bT + cT^2$$

KBr mol %	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate	Temp. range (T)
0	–0.1565	2.2275	0	0.16%	1059.2-1213.2
20	–0.2498	2.2081	0	0.14%	1048.2-1198.2
40	–1.7842	4.7341	–1.1298	0.06%	1030.2-1183.2
50	–0.3772	2.1679	0	0.17%	1023.2-1193.2
60	–3.4458	7.6383	–2.4665	0.12%	1018.2-1203.2
80	–0.3878	2.1184	0	0.18%	1013.2-1193.2
100	–0.4470	2.0629	0	0.18%	1017.2-1223.2

These values are based on the work of Zuca and Ionescu-Vasu (classical ac technique) [27].

TABLE 183. Density studies: KCl-KBr

Investigations critically re-examined			
Ref.	KBr mol %	Temp. range (T)	Comments
18	0-100	1009-1222	Pt bob; calibration: water.
27	0-100	1013-1223	As for 18.
67,70	50	1017-1125	Pt bob and suspension wire; calibration: water.
60	50	1014-1110	Pt-10% Rh sinker; calibration: water.

Deviations from NSRDS recommendations [1, pp. 5, 15 and this volume]			
Ref.	KBr mol %	Min. departure	Max. departure
18	100	0.18% (1020 K)	0.13% (1190 K)
27	100	0.00% (1020 K)	0.02% (1140 K)
67,70	50	0.00% (1125 K)	−0.16% (1040 K)
60	50	−0.17% (1110 K)	−0.22% (1056 K)
18	0	0.01% (1100 K)	0.18% (1200 K)
27	0	0.01% (1100 K)	0.18% (1200 K)

[a]Zuca [27] reported a precision of 0.1% in these measurements.

TABLE 184. KCl-KBr: Density (g cm^{-3})

T	Mol percent KBr						
	100	80	60	50	40	20	0
1020			1.913				
1030	2.109	2.013	1.905				
1040	2.100	2.005	1.898	1.839	1.782		
1050	2.092	1.997	1.890	1.832	1.775	1.654	
1060	2.084	1.989	1.883	1.825	1.768	1.648	1.517
1070	2.076	1.981	1.875	1.818	1.761	1.642	1.512
1080	2.067	1.973	1.867	1.811	1.754	1.635	1.506
1090	2.059	1.965	1.860	1.803	1.747	1.629	1.500
1100	2.051	1.957	1.852	1.796	1.740	1.622	1.495
1110	2.043	1.949	1.844	1.789	1.733	1.616	1.489
1120	2.035	1.941	1.837	1.782	1.726	1.610	1.484
1130	2.026	1.933	1.829	1.775	1.719	1.603	1.478
1140	2.018	1.925	1.822	1.768	1.712	1.597	1.472
1150	2.010	1.917	1.814	1.760	1.705	1.591	1.467
1160	2.002	1.909	1.806	1.753	1.698	1.584	1.461
1170	1.993	1.901	1.799	1.746	1.691	1.578	1.456
1180	1.985	1.893	1.791	1.739	1.684	1.571	1.450
1190	1.977	1.885	1.784	1.732	1.678	1.565	1.445
1200		1.877	1.776	1.724	1.671	1.559	1.439
1210		1.869	1.768	1.717	1.664		1.433
1220					1.657		

TABLE 184. KCl-KBr: Density (g cm^{-3})—Continued

Temperature-dependent equations $\rho = a - bT$		
Mol % KBr	a	$b \cdot 10^3$
0	2.1089	0.5583
20	2.3228	0.6367
40	2.5030	0.6937
50	2.5856	0.7176
60	2.6897	0.7615
80	2.8374	0.8004
100	2.9552	0.8220

These values are based on the work of Zuca and Ionescu-Vasu (Archimedean method) [27]. The data were reported in equation form. No estimate of error was given.

TABLE 185. Viscosity studies: KCl-KBr

Investigations critically re-examined			
Ref.	KBr mol %	Temp. range (T)	Comments
18[a]	0-100	1023-1203	Pt sphere; molybdenum suspension wire.
55	0-100	1098,1138, 1178	Pt disc.

Deviations from NSRDS recommendations [1, pp. 5, 14 and this volume]			
Ref.	KBr mol %	Min. departure	Max. departure
18	100	0.0% (1023 K)	1.3% (1183 K)
55	100	16.0% (1073 K)	18.9% (1133 K)
55	80	16.1% (1103 K)	
55	60	14.1% (1103 K)	
55	40	22.6% (1103 K)	
55	20	22.9% (1098 K)	35.6% (1138 K)

[a]The data for pure KCl from reference [18] were critically evaluated and given as the recommended values in "Molten Salts: Volume 1" (NSRDS-NBS-15) [1].

TABLE 186. KCl-KBr: Viscosity (cp)

T	Mol percent KBr						
	100	80	60	50	40	20	0
1030	1.137	1.098	1.097	1.115	1.135	1.169	
1040	1.105	1.070	1.070	1.083	1.104	1.136	
1050	1.075	1.043	1.044	1.052	1.074	1.104	
1060	1.047	1.017	1.019	1.023	1.046	1.075	
1070	1.020	0.992	0.995	0.994	1.019	1.046	1.097
1080	0.995	0.968	0.972	0.967	0.993	1.019	1.068
1090	0.971	0.946	0.951	0.942	0.968	0.993	1.039
1100	0.949	0.925	0.929	0.918	0.945	0.968	1.012
1110	0.928	0.905	0.909	0.895	0.922	0.944	0.986
1120	0.909	0.886	0.890	0.873	0.900	0.921	0.962
1130	0.892	0.869	0.871	0.853	0.979	0.899	0.938
1140	0.876	0.853	0.853	0.835	0.859	0.878	0.915
1150	0.862	0.838	0.836	0.818	0.840	0.858	0.893
1160	0.850	0.825	0.819	0.802	0.822	0.838	0.872
1170	0.840	0.813	0.803	0.789	0.804	0.820	0.852
1180	0.831	0.803	0.788	0.776	0.787	0.802	0.833
1190	0.824	0.794	0.773	0.765	0.770	0.785	0.814
1200	0.819	0.786	0.758	0.756	0.754	0.768	0.797

Temperature-dependent equations

$$\eta = a + bT + cT^2 + dT^3$$

$$\eta = A \exp(E/RT)$$

Mol % KBr	a	$b \cdot 10^3$	$c \cdot 10^6$	$d \cdot 10^9$	$A \cdot 10^2$	E (cal mol^{-1})	Standard error of estimate
0					5.706	6286	1.82%
20					6.042	6063	0.62%
40					6.339	5905	0.82%
50	7.0096	−4.1933	−5.3405	3.7435			0.56%
60					8.085	5337	0.63%
80	6.2734	−3.5762	−4.8943	3.3865			0.88%
100	7.3507	−4.3689	−5.9815	4.2386			1.04%

These values are based on the work of Murgulescu and Zuca (oscillating sphere technique) [18].

TABLE 187. Surface tension studies: KCl-KBr

Ref.	KBr mol %	Temp. range (T)	Comments
Investigations critically re-examined			
76[a]	0-100 (g)	1023,1073	Capillary of B.T.H. C46 glass; melt contained in a tube of B.T.H. C14 glass; calibration: water.
81[a]	0,50,100	1010-1173	
88	50	1073	Pt-10% Rh sinker.
Deviations from NSRDS recommendations [2, pp. 58,63 and this volume]			
81	100	2.8% (1023 K)	3.0% (1123 K)
88	50	−2.99% (1073 K)	
81	0	0.81% (1073 K)	1.2% (1173 K)

[a]Both the studies of Boardman, Palmer and Heymann [76] and Bertozzi [81] are recommended to afford reference to a wider composition and temperature range than is possible with either study alone. However, it should be noted that the results obtained by the Wilhelmy slide plate method appear to be systematically higher than those obtained by the maximum bubble pressure method.

TABLE 188. KCl-KBr: Surface tension (dyn cm^{-1})

T	Mol percent KBr		
	100	50	0
1020	91.0	97.2	
1030	90.3	96.4	
1040	89.5	95.7	
1050	88.8	94.9	
1060	88.1	94.1	
1070	87.3	93.4	
1080	86.6	92.6	99.1
1090	85.9	91.8	98.4
1100	85.1	91.0	97.6
1120	83.7	89.5	96.1
1130		88.7	95.4
1140		88.0	94.7
1150		87.2	93.9
1160		86.4	93.2
1170		85.7	92.4

Temperature-dependent equations
$\gamma = a - bT$

Mol % KBr	a	$b \cdot 10^2$
0	179.0	7.4
50	175.7	7.7
100	165.4	7.3

These values are based on the work of Bertozzi (Wilhelmy slide plate method) [81]. For the results of a study over a wider composition range, see the next table.

TABLE 189. KCl-KBr: Surface tension (dyn cm^{-1})

Mol % KCl	1023 K	1073 K
0	90.0	85.5
10	90.3	86.2
20	90.7	87.0
30	91.5	87.9
40	92.4	89.0
50	93.5	90.2
60	95.0	91.5
70	96.6	93.1
80	98.2	94.7
90	100.0	96.8
100	102.0	99.4

These values have been interpolated to three significant figures from the graphical presentation of Boardman, Palmer and Heymann (maximum bubble pressure method) [76]. For the results of a study over a wider temperature range, refer to the previous table.

KCl-NaBr

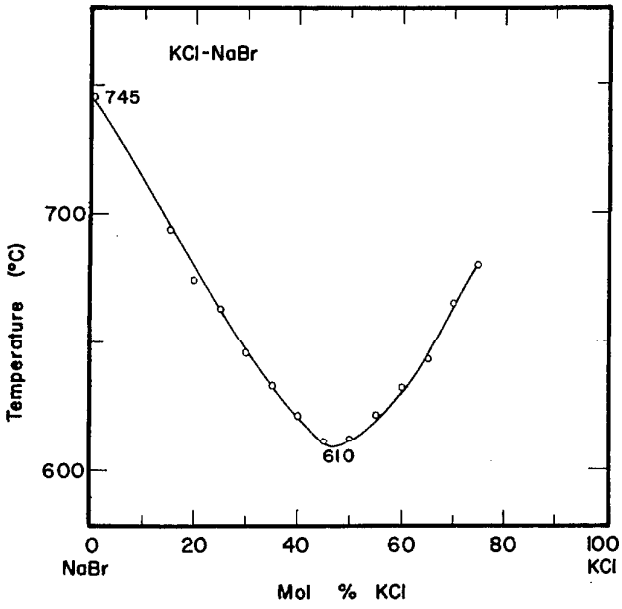

FIGURE 28. Temperature-composition phase diagram for KCl-NaBr.

U.P. Radichev, Zh. Obshch. Khim., 5, 455 (1935).

Melt Preparation and Purification

The method used by Markov and Prisyazhnyii [19, 46] is described under the system $CdCl_2$-$ZnBr_2$. That of Sternberg and Terzi [32] is given under the system AgCl-KBr.

Bloom [14] used analytical grade reagents or salts prepared to a purity of not less than 99.8%, dried by fusion and stored in a desiccator. Standard methods of analysis were used.

TABLE 190. Electrical conductance studies: KCl-NaBr

Investigations critically re-examined			
Ref.	NaBr mol %	Temp. range (T)	Comments
14[a]	0,50	895-1073	Capillary cells of silica glass or B.T.H. #37 glass; Pt electrodes; freq. range: 100-10,000 Hz; calibration: 1N KCl solutions.
19,34	0-100 (g)	1073,1123	Quartz U-shaped capillary cell; Pt electrodes; calibration: H_2SO_4 solutions.

Deviations from previous NSRDS recommendations [1, p. 5]			
Ref.	NaBr mol %	Min. departure	Max. departure
14	0	−0.45% (1070 K)	−0.64% (1060 K)

[a]Bloom et al. [14] found no change in resistance over the frequency range studied and estimated their overall accuracy as ±0.5%. However, due to a possible printing error in reference [14] for the conductance of the 50 mol percent KCl-NaBr mixture, the data are not given here.

TABLE 191. KCl-NaBr: Specific conductance ($ohm^{-1}cm^{-1}$)

Mol percent NaBr	1073 K	1123 K
0	2.20	2.32
10	2.21	2.34
20	2.23	2.37
30	2.26	2.38
40	2.30	2.40
50	2.35	2.47
60	2.42	2.55
70	2.52	2.63
80	2.64	2.78
90	2.80	2.91
100	3.00	3.12

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (classical ac technique) [19].

TABLE 192. Density studies: KCl-NaBr

Investigations critically re-examined			
Ref.	NaBr mol %	Temp. range (T)	Comments
14[a,b]	0,50	895-1073	Sinker and suspension wire of Pt-10% Rh alloy.
46[b]	0-100 (g)	1073	Quartz sphere weighted with molybdenum or tungsten; calibration: water.

Deviations from previous NSRDS recommendations [1, p. 5]			
Ref.	NaBr mol %	Min. departure	Max. departure
14	0	0.53% (1070 K)	0.79% (1060 K)

[a]Bloom et al. [14] took precautions to prevent air bubbles from clinging to the sinker, and made corrections for thermal expansion.

[b]Both the study of Bloom, Molloy, Knaggs and Welch [14] and that of Markov and Prisyazhnyii [46] are recommended, inasmuch as the first covers a wide temperature range with only two compositions, and the second covers a wide composition range at a single temperature. There is good agreement between the results of the two studies (≅0.5% at 50 mol percent and ≅1070 K).

TABLE 193. KCl-NaBr: Density ($g\ cm^{-3}$)

T	Mol % NaBr	
	50	0
900	1.993	
910	1.986	
920	1.978	
930	1.971	
940	1.964	
950	1.956	
960	1.949	
970	1.942	
980	1.935	
990	1.927	
1000	1.920	
1010	1.913	
1020	1.905	
1030	1.898	
1040	1.891	
1050	1.884	
1060	1.876	1.526
1070	1.869	1.520

Temperature-dependent equations
$\rho = a - bT$

Mol % NaBr	a	$b \cdot 10^4$
0	2.146	5.85
50	2.648	7.28

These values are based on the work of Bloom, Knaggs, Molloy and Welch (Archimedean method) [14]. See the next table for the study of Markov and Prisyazhnyii.

TABLE 194. KCl-NaBr: Density (g cm^{-3})

Mol % NaBr	1073 K
0	1.50
10	1.57
20	1.64
30	1.72
40	1.79
50	1.86
60	1.95
70	2.02
80	2.16
90	2.18
100	2.27

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (Archimedean method) [46]. See the previous table for the study of Bloom, Knaggs, Molloy and Welch.

TABLE 195. Surface tension studies: KCl-NaBr

Investigations critically re-examined

Ref.	NaBr mol %	Temp. range (T)	Comments
78	0-100 (g)	1093	Pt capillary.[a]
32	0-100	912-1261	Pt bob; calibration: molten KNO_3.

Deviations from previous NSRDS recommendations [2, pp. 58, 62]

Ref.	NaBr mol %	Min. departure	Max. departure
32	100	0.03% (1065 K)	1.47% (1170 K)
32	0	−1.81% (1240 K)	−2.63% (1065 K)

[a]Argon gas pressure (maximum bubble pressure method) measured with a dibutylphthalate manometer. The results were estimated to be accurate to ±1 dyn/cm.

TABLE 196. KCl-NaBr: Surface tension (dyn cm^{-1})

T	Mol percent NaBr						
	100	85	70	50	30	15	0
920				104.7			
930				104.1			
940				103.5			
950				102.8			
960				102.1			
970			101.9	101.5	101.7		
980			101.3	100.8	101.0		
990			100.7	100.1	100.3		
1000			100.1	99.5	99.7	100.3	
1010		100.7	99.5	99.8	99.0	99.6	
1020		100.1	98.9	98.1	98.4	98.9	
1030		99.6	98.3	97.5	97.7	98.3	
1040		99.1	97.8	96.8	97.1	97.6	
1050	101.8	98.6	97.2	96.1	96.4	96.9	
1060	101.1	98.0	96.6	95.5	95.8	96.3	
1070	100.4	97.5	96.0	94.8	95.1	95.6	96.4
1080	99.7	97.0	95.4	94.1	94.5	94.9	95.7
1090	99.1	96.5	94.8	93.5	93.8	94.3	95.0
1100	98.4	95.9	94.3	92.8	93.2	93.6	94.3
1110	97.7	95.4	93.7	92.1	92.5	92.9	93.6
1120	97.0	94.9	93.1	91.5	91.9	92.2	92.9
1130	96.3	94.3	92.5	90.8	91.2	91.6	92.2
1140	95.7	93.8	91.9	90.1	90.5	90.9	91.5
1150	95.0	93.3	91.3	89.5	89.9	90.2	90.7
1160	94.3	92.8	90.7	88.8	89.3	89.6	90.0
1170	93.6	92.2	90.1		88.6	88.9	89.3
1180	92.9	91.7	89.6		87.9	88.2	88.6
1190	92.2	91.2				87.6	87.9
1200	91.5	90.7				86.9	87.2
1210	90.9						86.5
1220	90.2						85.8
1230							85.1
1240							84.3
1250							83.7
1260							82.9

TABLE 196. KCl-NaBr: Surface tension (dyn cm^{-1})—Continued

Temperature-dependent equations $\gamma = a - bT$		
Mol % NaBr	a	b
0	172.4	0.0710
15	167.4	0.0671
30	165.0	0.0653
50	165.4	0.0660
70	158.6	0.0585
85	153.9	0.0527
100	173.4	0.0682

These values are based on the work of Sternberg and Terzi (pin detachment method) [32]. The data were reported in equation form with an estimated error of ±1%.

KCl-$PbBr_2$

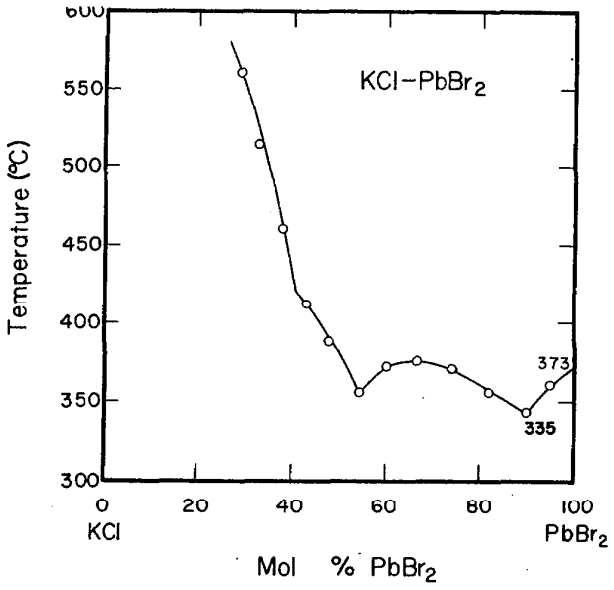

FIGURE 29. Temperature-composition phase diagram for KCl-$PbBr_2$.

A.K. Bostanzhiyan, I.I. Il'yasov and A.G. Bergman, Russ. J. Inorg. Chem., 4 942 (1959); D. G. Barsegov and I. I. Il'yasov. Ukr. Khim. Zh., 36, 798 (1970).

Melt Preparation and Purification

Reference [48] contains no information on melt preparation.

TABLE 197. Viscosity studies: KCl-$PbBr_2$

Investigations critically re-examined		
Ref.	$PbBr_2$ mol %	Temp. range (T)
48	50-100 (g)	668-791

TABLE 198. KCl-$PbBr_2$: Viscosity (cp)

Mol % $PbBr_2$	668 K	703 K	753 K	791 K
50			3.4	3.0
60		4.2	3.4	3.0
70	5.0	4.2	3.4	3.0
80	5.3	4.2	3.4	3.0
90	5.7	4.5	3.7	3.2
100	5.6	5.3	4.2	3.6

These values have been interpolated to two significant figures from the graphical presentation of Barsegov and Il'yasov (capillary method) [48].

KCl-RbBr

Melt Preparation and Purification

The method used by Markov and his associates for melt preparation is given under the system $CdCl_2$-$ZnBr_2$. That used by Sternberg and Terzi is given under the system AgCl-KBr.

TABLE 199. Electrical conductance studies: KCl-RbBr

Investigations critically re-examined			
Ref.	RbBr mol %	Temp. range (T)	Comments
20,34	0-100 (g)	1043, 1073, 1123	Quartz U-shaped capillary cell; Pt electrodes; calibration: H_2SO_4 solutions.

TABLE 200. KCl-RbBr: Specific conductance ($ohm^{-1}cm^{-1}$)

Mol % RbBr	1043 K	1073 K	1123 K
0	2.14	2.22	2.32
10	2.01	2.08	2.20
20	1.88	1.96	2.10
30	1.80	1.88	1.98
40	1.72	1.78	1.89
50	1.64	1.71	1.80
60	1.57	1.64	1.73
70	1.50	1.56	1.64
80	1.43	1.50	1.57
90	1.36	1.41	1.50
100	1.30	1.36	1.42

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (classical ac technique) [20].

TABLE 201. Density studies: KCl-RbBr

Investigations critically re-examined

Ref.	RbBr mol %	Temp. range (T)	Comments
34,46	0-100 (g)	1073	Quartz sphere weighted with molybdenum or tungsten; calibration: water.

TABLE 202. KCl-RbBr: Density ($g\ cm^{-3}$)

Mol % KCl	1073 K
0	2.60
10	2.52
20	2.43
30	2.33
40	2.23
50	2.12
60	2.01
70	1.90
80	1.78
90	1.65
100	1.50

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnii (Archimedean method) [46].

TABLE 203. Surface tension studies: KCl-RbBr

Investigations critically re-examined

Ref.	RbBr mol %	Temp. range (T)	Comments
32	0-100	967-1261	Pt bob; calibration: molten KNO_3; reproducibility reported: ±1%.

Deviations from previous NSRDS recommendations [2, pp. 58, 63]

Ref.	RbBr mol %	Min. departure	Max. departure
32	100	0.05% (1065 K)	−1.38% (995 K)
32	0	−1.81% (1240 K)	−2.63% (1065 K)

TABLE 204. KCl-RbBr: Surface tension (dyn cm^{-1})

T	Mol percent RbBr							
	100	85	70	50	30	20	10	0
970	86.2							
980	85.7							
990	85.1							
1000	84.6							
1010	84.1							
1020	83.5							
1030	83.0							
1040	82.4							
1050	81.9		84.7	87.5				
1060	81.3	82.2	84.0	86.7			93.9	
1070	80.8	81.6	83.4	86.0		91.0	93.1	96.4
1080	80.2	81.0	82.7	85.3	88.3	90.3	92.4	95.7
1090	79.7	80.3	82.1	84.6	87.6	89.7	91.7	95.0
1100	79.1	79.7	81.5	83.8	86.9	89.0	91.0	94.3
1110	78.6	79.1	80.8	83.1	86.3	88.3	90.3	93.6
1120	78.1	78.4	80.2	82.4	85.6	87.7	89.6	92.9
1130	77.5	77.8	79.5	81.7	84.9	87.0	88.9	92.2
1140	77.0	77.2	78.9	80.9	84.2	86.4	88.2	91.5
1150	76.4	76.5	78.2	80.2	83.5	85.7	87.5	90.7
1160	75.9	75.9	77.6	79.5	82.9	85.1	86.8	90.0
1170	75.3	75.3	76.9	78.8	82.2	84.4	86.1	89.3
1180		74.7	76.3	78.0	81.5	83.7	85.4	88.6
1190		74.0	75.7	77.3	80.8	83.1	84.7	87.9
1200		73.4	75.0	76.6	80.1	82.4	84.0	87.2
1212		72.8	74.4	75.9	79.4	81.8	83.3	86.5
1220		72.1	73.7	75.1	78.7	81.1	82.5	85.8
1230			73.1			80.4	81.8	85.1
1240			72.4				81.1	84.3
1250							80.4	83.7
1260								82.9

Temperature-dependent equations

$\gamma = a - bT$

Mol % RbBr	a	b
0	172.4	0.0710
10	168.8	0.0707
20	161.5	0.0659
30	162.2	0.0684
50	163.6	0.0725
70	152.3	0.0644
85	149.0	0.0630
100	139.1	0.0545

These values are based on the work of Sternberg and Terzi (pin detachment method) [32].

LiCl-AgBr

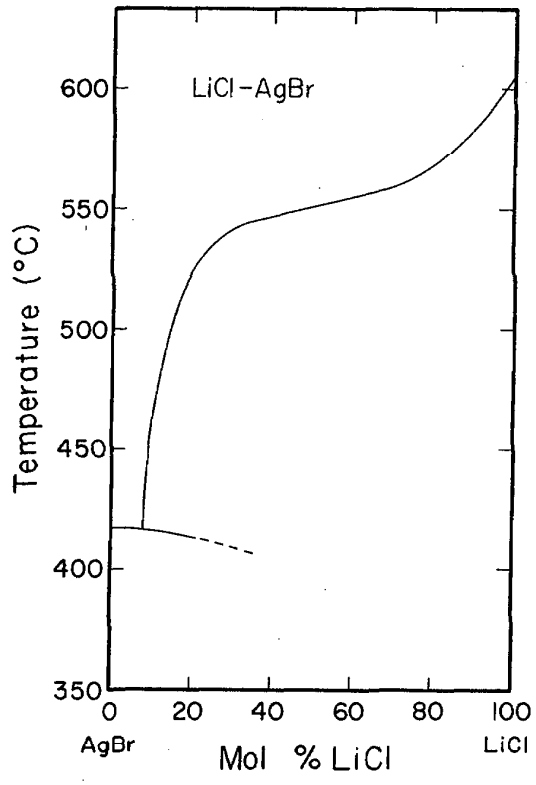

FIGURE 30. Temperature-composition phase diagram for LiCl-AgBr.
M. Bizouard, Ann. Phys., 6, 851 (1961).

Melt Preparation and Purification

The method used by Brooks and Paul [67, 70] for melt preparation is described under the systems AgCl-AgBr and CsCl-AgBr. The lithium chloride used by these authors was B. D. H. 99.8% LiCl.

Bizouard [22] used Merck p. a. grade AgBr and LiCl.

TABLE 205. Electrical conductance studies: LiCl-AgBr

Investigations critically re-examined

Ref.	AgBr mol %	Temp. range (T)	Comments
22	0-100	823-1073	Cell material: Pyrex up to 500 °C and silica up to 1000 °C; Pt electrodes; freq.: 1000 Hz, calibration: 1N KCl, saturated NaCl and H_2SO_4 solutions; reported precision: 0.5%.

Deviations from previous NSRDS recommendations [1, p. 4]

Ref.	AgBr mol %	Min. departure	Max. departure
22	0	−0.6% (973 K)	−0.18% (923 K)

TABLE 206. LiCl-AgBr: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent AgBr					
	100	80	60	40	20	0
830	3.132	3.194				
840	3.151	3.215				
850	3.170	3.236				
860	3.188	3.256				
870	3.206	3.277				
880	3.224	3.298	3.448	3.877	4.705	
890	3.242	3.318	3.482	3.919	4.760	
900	3.259	3.339	3.515	3.960	4.813	
910	3.276	3.360	3.548	4.002	4.866	
920	3.292	3.380	3.581	4.043	4.917	
930	3.308	3.401	3.613	4.085	4.967	5.943
940	3.324	3.422	3.644	4.126	5.016	6.000
950	3.340	3.442	3.675	4.168	5.064	6.056
960	3.355	3.463	3.706	4.209	5.111	6.110
970	3.370	3.484	3.736	4.251	5.156	6.162
980	3.385	3.504	3.765	4.292	5.201	6.212
990	3.399	3.525	3.794	4.334	5.244	6.261
1000	3.413	3.546	3.822	4.375	5.286	6.309
1010	3.427	3.566	3.850	4.417	5.327	6.354
1020	3.441	3.587	3.878	4.459	5.367	6.398
1030	3.454	3.608	3.905	4.500	5.405	6.440
1040	3.467	3.628	3.932	4.542	5.443	6.481
1050	3.479	3.649	3.958	4.583	5.479	6.520
1060	3.491	3.670	3.983	4.625	5.514	6.557
1070	3.503	3.690	4.008	4.666	5.548	6.592

TABLE 206. LiCl-AgBr: Specific conductance (ohm^{-1} cm^{-1})—Continued

Temperature-dependent equations
$\kappa = a + bT + cT^2$

Mol % AgBr	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate
0	−6.7384	21.4553	−8.4083	0.17%
20	−4.6065	15.6354	−5.7430	0.12%
40	0.2228	4.1527	0	0.37%
60	−1.4531	7.7265	−2.4509	0.17%
80	1.4796	2.0660	0	0.20%
100	0.4724	4.4912	−1.5502	0.08%

These values are based on the work of Bizouard (potentiometric ac technique) [22].

TABLE 207. Density studies: LiCl-AgBr

Investigations critically re-examined

Ref.	AgBr mol %	Temp. range (T)	Comments
67,70	50,100	717-998	Pt bob, Pt suspension wire; calibration: water.

Comparisons with previous NSRDS recommendations [1, p. 16]

Ref.	AgBr mol %	Min. departure	Max. departure
67,70	100	0.00% (930 K)	0.06% (720 K)

TABLE 208. LiCl-AgBr: Density (g cm^{-3})

T	Mol percent AgBr 50	100
720		5.565
740		5.544
760		5.523
780		5.502
800		5.481
820		5.460
840		5.439
860		5.418
880	3.587	5.397
900	3.570	5.376
920	3.553	5.355
940	3.535	5.334
960	3.518	5.313
980	3.501	

TABLE 208 cont'd. LiCl-AgBr: Density
Temperature-dependent equations
$\rho = a - bT$

Mol % AgBr	a	$b \cdot 10^3$	Standard deviation
50	4.3431	0.8592	0.0004
100	6.321	1.050	

These values are based on the work of Brooks and Paul (archimedean method) [67,70]

$LiCl$-$AlBr_3$

Melt Preparation and Purification

Reference [35] gives no information on melt preparation.

TABLE 209. Electrical conductance studies: LiCl-$AlBr_3$

Investigations critically re-examined

Ref.	$AlBr_3$ mol %	Temp. range (T)
35	80.13	353-453

TABLE 210. LiCl-$AlBr_3$: Specific conductance ($ohm^{-1}cm^{-1}$)

T	Mol % $AlBr_3$ 80.13
360	0.0110
370	0.0134
380	0.0150
390	0.0165
400	0.0180
410	0.0195
420	0.0210
430	0.0224
440	0.0238
450	0.0252

Temperature-dependent equations
$\kappa = a + bT + cT^2$

Mol % $AlBr_3$	a	$b \cdot 10^4$	$c \cdot 10^7$	Standard error of estimate
80.13	−0.0648	2.6441	−1.4297	1.65%

These values are based on the work of Mezhnii (classical ac technique) [35].

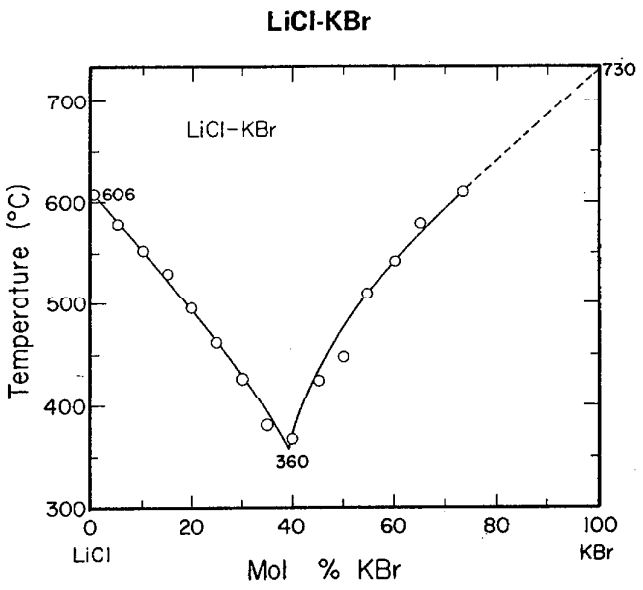

FIGURE 31. Temperature-composition phase diagram for LiCl-KBr.

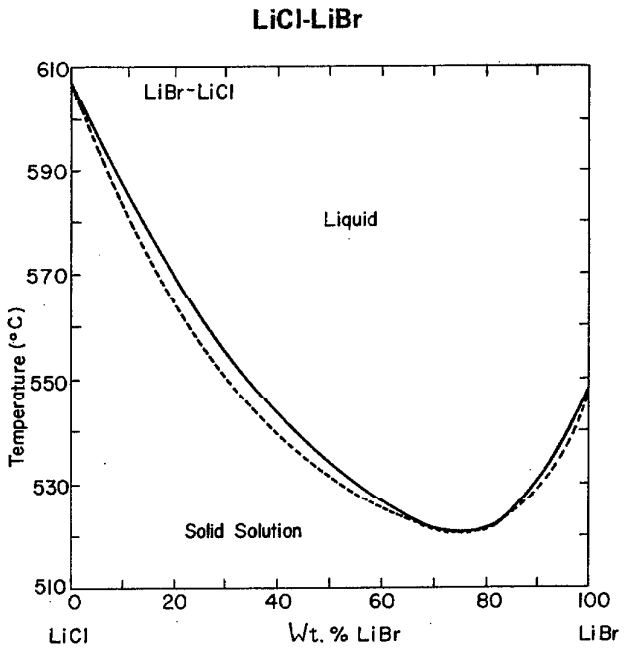

FIGURE 32. Temperature-composition phase diagram for LiBr-LiCl.

Melt Preparation and Purification

Reference [29] gives no information on melt preparation.

TABLE 211. Density studies: LiCl-KBr

Investigations critically re-examined			
Ref	KBr mol %	Temp. range (T)	Comments
29	0-100 (g)	1073	Pt sphere and suspension wire; calibration: water.

TABLE 212. LiCl-KBr: Density (g cm^{-3})

Mol % KBr	1073 K
0	1.40
10	1.55
20	1.64
30	1.72
40	1.78
50	1.83
60	1.87
70	1.92
80	1.94
90	1.97
100	2.00

These values have been interpolated to three significant figures from the graphical presentation of Kunugi, Yamate and Takeuchi (Archimedean method) [29].

A. A. Botschwar, Z. Anorg. Allg. Chem. 210, 163 (1933).

Melt Preparation and Purification

Holm and Berge [60, 88] used reagent grade salts dried at 400-500 °C under moderate vacuum (0.1 - 0.01 torr) and then melted in a platinum crucible in an atmosphere of purified nitrogen.

TABLE 213. Electrical conductance studies: LiCl-LiBr

Investigations critically re-examined			
Ref.	LiBr mol %	Temp. range (T)	Comments
82	0-100	973-1083	Pt electrodes; frequency: 50,000 Hz.

Deviations from previous NSRDS recommendations [1, pp. 4, 14]			
Ref.	LiBr mol %	Min. departure	Max. departure
82	100	−1.24% (975 K)	−2.08% (1020 K)
82	0	−0.02% (980 K)	−0.15% (1055 K)

TABLE 214. LiCl-LiBr: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent LiBr								
	100	88	75	63	50	37	25	12	0
980	5.422	5.485	5.505	5.546	5.628	5.696	5.875	6.034	6.594
990	5.457	5.523	5.540	5.578	5.666	5.737	5.920	6.079	6.642
1000	5.490	5.559	5.574	5.613	5.703	5.778	5.957	6.122	6.690
1010	5.523	5.596	5.608	5.647	5.737	5.818	5.995	6.163	6.737
1020	5.557	5.629	5.642	5.678	5.774	5.856	6.032	6.202	6.785
1030	5.587	5.665	5.675	5.708	5.805	5.895	6.072	6.246	6.832
1040	5.619	5.698	5.706	5.736	5.838	5.929	6.105	6.285	6.871
1050	5.652	5.731	5.738	5.766	5.871	5.965	6.141	6.323	6.917
1060	5.679	5.763	5.771	5.793	5.904	5.998	6.177	6.359	6.955
1070	5.708	5.795	5.798	5.823	5.934	6.033	6.209	6.401	6.997
1080	5.737	5.823	5.827	5.849	5.960	6.069	6.241	6.435	7.034

Temperature-dependent equations

$\kappa = a + bT + cT^2 + dT^3$

Mol % LiBr	a	$b \cdot 10^3$	$c \cdot 10^6$	$-d \cdot 10^9$	Standard error of estimate
100	1.35534	2.38932	4.26653	2.52079	0.018%
88	0.819480	3.01402	4.55294	2.82716	0.014%
75	1.03664	3.37228	3.42431	2.25867	0.017%
63	−1.60341	11.1673	−3.95100		0.022%
50	0.264123	4.73363	3.24007	2.53562	0.023%
37	−2.48317	12.5587	−4.29775		0.023%
25	0.784597	3.29175	5.00996	3.12949	0.026%
12	−2.18288	12.3581	−4.05415		0.024%
0	0.272673	3.60216	7.24893	4.43272	0.024%

These values are based on the work of Smirnov, Khokhlov, Stepanov, and Shumov (classical ac technique) [82]. The data were reported in equation form as equivalent conductance. The equations given above were generated by converting to specific conductance using the density equations given in [82].

TABLE 215. Density studies: LiCl-LiBr

Investigations critically re-examined

Ref.	LiBr mol %	Temp. range (T)	Comments
60	50	966.8-1065.1	Pt-10% Rh sinker; calibration: water.
82	0-100	973-1083	Pt sphere; calibration: molten KNO_3.

Deviations from NSRDS recommendations

[1, pp. 4, 14 and this volume]

Ref.	LiBr mol %	Min. departure	Max. departure
82	100	−0.30% (1020 K)	−0.34% (980 K)
60	50	0.83% (1065.1 K)	0.87% (1061.3 K)
82	0	−0.08% (980 K)	−0.14% (1050 K)

TABLE 216. LiCl-LiBr: Density (g cm^{-3})

T	Mol percent LiBr								
	100	88	75	63	50	37	25	12	0
980	2.419	2.323	2.211	2.103	1.979	1.852	1.730	1.593	1.439
990	2.412	2.316	2.205	2.097	1.974	1.847	1.726	1.588	1.435
1000	2.406	2.310	2.199	2.092	1.969	1.842	1.721	1.583	1.430
1010	2.400	2.304	2.193	2.087	1.964	1.837	1.716	1.578	1.425
1020	2.393	2.297	2.187	2.081	1.959	1.832	1.711	1.573	1.421
1030	2.387	2.291	2.181	2.076	1.953	1.827	1.707	1.569	1.416
1040	2.381	2.285	2.175	2.070	1.948	1.821	1.702	1.564	1.411
1050	2.375	2.278	2.170	2.065	1.943	1.816	1.697	1.559	1.407
1060	2.368	2.272	2.164	2.059	1.938	1.811	1.693	1.554	1.402
1070	2.362	2.266	2.158	2.054	1.933	1.806	1.688	1.550	1.397
1080	2.356	2.259	2.152	2.048	1.927	1.801	1.683	1.545	1.393

Temperature-dependent equations

$\rho = a - bT$

Mol % LiBr	a	$b \cdot 10^3$	Standard deviation
0	1.896	0.446	0.005
12	2.060	0.477	0.004
25	2.192	0.471	0.004
37	2.354	0.512	0.005
50	2.487	0.518	0.005
63	2.636	0.544	0.005
75	2.785	0.586	0.006
88	2.942	0.632	0.005
100	3.034	0.628	0.004

These values are based on the work of Smirnov, Khokhlov, Stepanov and Shumov (modified maximum bubble pressure method) [82]. The following equation, with concentration, C, in mole percent LiBr and temperature in K, has been derived from the preceding data: $\rho = a + bC + cT + dTC^2$, where a = 1.92776, $b \cdot 10^2$ = 1.11913, $c \cdot 10^4$ = −4.76765, $d \cdot 10^8$ = −1.63587, with a maximum departure of 0.125% at 973 K and 0.0 mol % LiBr, and a standard error of estimate of 0.002. This equation may be used to calculate the density of LiCl-LiBr melts at any concentration in the temperature range 973-1083 K.

TABLE 217. Surface tension studies: LiCl-LiBr

Investigations critically re-examined

Ref.	LiBr mol %	Temp. range (T)	Comments
88	50	1073	Pt-10% Rh sinker; calibration: water.
79	12-100	896-1081	Molybdenum crucible; calibration: molten NaCl.

Deviations from NSRDS recommendations [this volume]

Ref.	LiBr mol %	Deviation
88	50	−10.05% (1073 K)

TABLE 218. LiCl-LiBr: Surface tension (dyn cm^{-1})

T	Mol percent LiBr							
	100	88	75	63	50	37	25	12
900	123.0		125.5			133.0		137.7
910	122.3	124.1	125.8	127.8	130.0	132.2	134.4	136.8
920	121.6	123.3	125.1	127.1	129.2	131.4	133.6	136.0
930	120.9	122.6	124.3	126.3	128.4	130.6	132.8	135.2
940	120.2	121.9	123.6	125.6	127.7	129.9	132.0	134.4
950	119.5	121.2	122.9	124.8	126.9	129.1	131.2	133.6
960	118.9	120.5	122.1	124.1	126.1	128.3	130.4	132.8
970	118.2	119.7	121.4	123.3	125.3	127.5	129.6	131.9
980	117.5	119.0	120.7	122.6	124.5	126.7	128.8	131.1
990	116.8	118.3	119.9	121.8	123.8	126.0	128.0	130.3
1000	116.1	117.6	119.2	121.1	123.0	125.2	127.2	129.5
1010	115.4	116.9	118.5	120.3	122.2	124.4	126.4	128.7
1020	114.7	116.2	117.7	119.6	121.4	123.6	125.6	127.9
1030	114.0	115.4	117.0	118.9	120.7	122.9	124.8	127.1
1040	113.3	114.7	116.3	118.1	119.9	122.1	124.0	126.2
1050	112.6	114.0	115.5	117.4	119.1	121.3	123.2	125.4
1060	111.9	113.3	114.8	116.6	118.3	120.5	122.4	124.6
1070	111.3	112.6	114.1	115.9	117.5	119.7	121.6	123.8
1080	110.6		113.3	115.1				

Temperature-dependent equations

$\gamma = a - bT$

Mol % LiBr	a	b
12	211.1	0.0816
25	206.8	0.0796
37	203.0	0.0778
50	200.8	0.0778
63	195.5	0.0744
75	192.7	0.0735
88	189.5	0.0719
100	185.2	0.0691

These values are based on the work of Smirnov and Stepanov (maximum bubble pressure method) [79]. The data were reported in equation form. No error estimate was given. The following equation, with concentration, C, in mole percent LiBr and temperature in K, has been derived from the preceding data: $\gamma = a + bC + cT + dC^3 + eCT^2$, where a = 214.84718, $b \cdot 10^1$ = -2.44423, $c \cdot 10^2$ = -8.32539, $d \cdot 10^5$ = 2.14548, $e \cdot 10^8$ = 6.79638, with a maximum departure of 0.13% at 1073 K and 50 Mol % LiBr, and a standard error of estimate of 0.061. This equation may be used to calculate the surface tension of LiCl-LiBr melts at any concentration in the temperature range 896-1081 K.

NaCl-AgBr

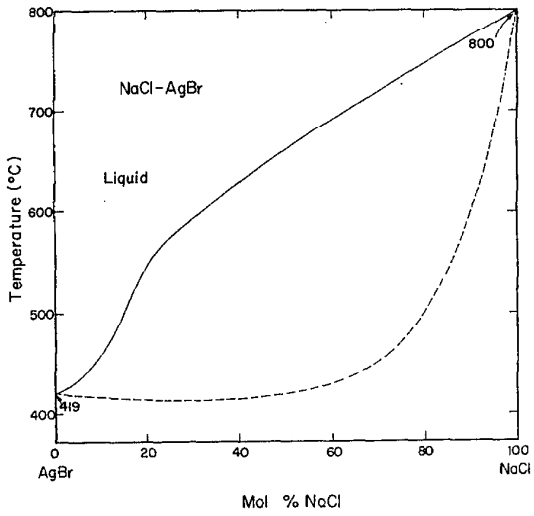

FIGURE 33. Temperature-compostion phase diagram for NaCl-AgBr.
N.S. Dombrovskaya, Zh. Obshch. Khim., 3, 738 (1933).

Melt Preparation and Purification

Bizouard [22] *used Merck p. a. grade AgBr and NaCl.*

The method of Markov and Prisyazhnyii [46] for melt preparation is given under the system $CdCl_2$-$ZnBr_2$. AgBr was prepared from the recrystallized nitrate.

The methods used by Brooks and Paul [67, 70] and Sternberg and Terzi [80] are described under the systems AgCl-AgBr and AgCl-KBr, respectively.

TABLE 219. Electrical conductance studies: NaCl-AgBr

Investigations critically re-examined

Ref.	AgBr mol %	Temp. range (T)	Comments
22[a]	0-100	823-1123	Cell material: Pyrex up to 500 °C and silica up to 1000 ° C. Pt electrodes; frequency: 1000 Hz, calibration: 1N KCl, saturated NaCl and H_2SO_4 solutions; reported precision: 0.5%.
34	0-100 (g)	1073	Quartz U-shaped capillary cell; Pt electrodes; calibration: H_2SO_4 solutions.

Deviations from previous NSRDS recommendations [1, p. 5]

Ref.	AgBr mol %	Deviation
22	0	0.20% (1123 K)

[a]Bizouard's [22] data for pure AgBr were critically evaluated and given as the recommended values in "Molten Salts, Volume 1" (NSRDS-NBS-15) [1].

TABLE 220. NaCl-AgBr: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent AgBr					
	100	80	60	40	20	0
880	3.224	2.991				
890	3.242	3.011				
900	3.260	3.031				
910	3.277	3.050				
920	3.294	3.068				
930	3.310	3.087	2.920			
940	3.326	3.105	2.944			
950	3.342	3.122	2.967			
960	3.357	3.140	2.990			
970	3.372	3.157	3.013			
980	3.387	3.173	3.035	3.047		
990	3.401	3.190	3.057	3.071		
1000	3.415	3.205	3.078	3.094		
1010	3.428	3.221	3.099	3.117		
1020	3.441	3.236	3.120	3.139		
1030	3.453	3.251	3.140	3.160	[3.261]	
1040	3.466	3.265	3.160	3.181	[3.290]	
1050	3.477	3.279	3.179	3.201	[3.318]	
1060	3.489	3.293	3.198	3.221	[3.346]	
1070	3.500	3.307	3.217	3.240	[3.372]	
1080	3.510	3.320	3.235	3.258	[3.397]	[3.609]
1090	3.521	3.332	3.252	3.276	[3.421]	[3.639]
1100	3.531	3.345	3.270	3.293	[3.445]	[3.669]
1110	3.540	3.357	3.287	3.309	[3.467]	[3.699]
1120	3.549	3.368	3.303	3.325	[3.488]	[3.729]

Temperature-dependent equations

$$\kappa = a + bT + cT^2$$

Mol % AgBr	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate
0	[0.3469]	[3.0200]	0	0.00%
20	[-5.1154]	[13.2820]	[-5.0000]	0.00%
40	-2.3817	8.6470	-3.1713	0.00%
60	-1.1185	6.2737	-2.0767	0.06%
80	-0.1452	5.1304	-1.7798	0.05%
100	0.1379	5.2000	-1.9234	0.11%

TABLE 221. Density studies: NaCl-AgBr

Investigations critically re-examined

Ref.	AgBr mol %	Temp. range (T)	Comments
34,46	0-100 (g)	1073	Quartz sphere weighted with Mo or W; calibration: water.
67,70	50,100	974-1086	Pt bob, Pt suspension wire; calibration: water.

Deviations from previous NSRDS recommendations [1, p. 16]

Ref.	AgBr mol %	Min. departure	Max. departure
67,70	100	0.00% (930 K)	0.06% (720 K)

Markov and Prisyazhnyii's [34,46] investigation was made at a single temperature over a wide concentration range. That of Brooks and Paul was made at a single composition over a wide temperature range. The results of the analysis of both studies are given in the following tables.

TABLE 222. NaCl-AgBr: Density (g cm^{-3})

Mol % AgBr	1073 K
0	1.59
10	1.88
20	2.22
30	2.56
40	2.90
50	3.26
60	3.63
70	3.80
80	4.40
90	4.81
100	5.24

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (Archimedean method) [46].

TABLE 223. NaCl-AgBr: Density (g cm^{-3})

T	50 mol % AgBr
980	3.3347
990	3.3257
1000	3.3168
1010	3.3079
1020	3.2989
1030	3.2900
1040	3.2811
1050	3.2721
1060	3.2632
1070	3.2543
1080	3.2453

These values are based on the work of Brooks and Paul (Archimedean method) [67,70]. The temperature-dependent equation is $\rho = 4.2101 - 8.933 \cdot 10^{-4} T$ with a standard deviation of 0.0006. For the results of a study made over a wider concentration range, see the previous table.

TABLE 224. Surface tension studies: NaCl-AgBr

Investigations critically re-examined

Ref.	AgBr mol %	Temp. range (T)	Comments
80[a]	0-100	740-1215	Pt pin; quartz vessel; calibration: water, benzene, carbon tetrachloride, toluene and acetone, 20 °C.

Deviations from previous NSRDS recommendations [2, pp. 57,59]

Ref.	AgBr mol %	Min. departure	Max departure
80	100	2.83% (893 K)	4.19% (743 K)
80	0	0.53% (1093 K)	−1.54% (1213 K)

[a]Sternberg and Terzi [80] reported the experimental results were reproducible within 1%.

TABLE 225. NaCl-AgBr: Surface tension (dyn cm^{-1})

T	Mol percent AgBr								
	100	90	80	70	50	30	20	10	0
760	158.54								
780	157.74								
800	156.94								
820	156.14								
840	155.34								
860	154.54								
880	153.75								
900	152.95		139.31						
920	152.15		137.80						
940	151.35	142.73	136.29	133.60					
960	150.55	141.26	134.78	132.09					
980	149.75	139.79	133.27	130.59	124.26				
1000	148.95	138.31	131.77	129.09	122.93				
1020		136.84	130.26	127.59	121.59	117.77			
1040				126.08	120.25	116.35			
1060				124.58	118.92	114.93	115.86	114.92	
1080				123.08	117.58	113.51	114.04	113.19	
1100					116.24	112.08	112.23	111.46	112.47
1120						110.66	110.41	109.74	110.67
1140						109.24	108.59	108.01	108.87
1160							106.77	106.28	107.07
1180								104.55	105.27
1200									103.47

Temperature-dependent equations

$\gamma = a - bT$

Mol % AgBr	a	$b \cdot 10^2$	Standard deviation
0	211.509	9.0033	0.405
10	206.472	8.6371	0.170
20	212.169	9.0857	0.187
30	190.282	7.1089	0.150
50	189.783	6.6856	0.104
70	204.214	7.5125	0.279
80	207.201	7.5435	0.271
90	211.933	7.3619	0.314
100	188.918	3.9969	0.426

These values are based on the work of Sternberg and Terzi (pin detachment method) [80].

$NaCl\text{-}AlBr_3$

Melt Preparation and Purification

Reference [35] contains no information on melt preparation.

TABLE 226. Electrical conductance studies: $NaCl\text{-}AlBr_3$

Investigations critically re-examined		
Ref.	$AlBr_3$ mol %	Temp. range (T)
35	68.21, 76.50, 80.07	373-443

TABLE 227. $NaCl\text{-}AlBr_3$: Specific conductance (ohm^{-1} cm^{-1} x 10^2)

T	Mol percent $AlBr_3$		
	80.07	76.50	68.21
373.2	1.56	2.22	1.89
378.2	1.90	2.39	2.14
383.2	2.20	2.62	2.52
388.2	2.27		2.62
393.2	2.34	2.79	3.20
398.2	2.43		3.95
403.2	2.57		
413.2		3.97	
423.2	3.13	4.28	
438.2	3.45		
443.2	3.65		

The values in this table are those reported by Mezhenii (classical ac technique) [35].

$NaCl-CdBr_2$

Melt Preparation and Purification

Reference [59] contains no information on melt preparation.

TABLE 228. Viscosity studies: $NaCl-CdBr_2$

Investigations critically examined			
Ref.	$CdBr_2$ mol %	Temp. range (T)	Calibration
59	60-80 (g)	763-793	Molten KNO_3

TABLE 229. $NaCl-CdBr_2$: Viscosity (cp)

Mol % $CdBr_2$	793 K
60	2.50
70	2.55
80	2.62

These values have been interpolated to three significant figures from the graphical presentation of Il'yasov and Barsegov (capillary method) [59].

NaCl-CsBr

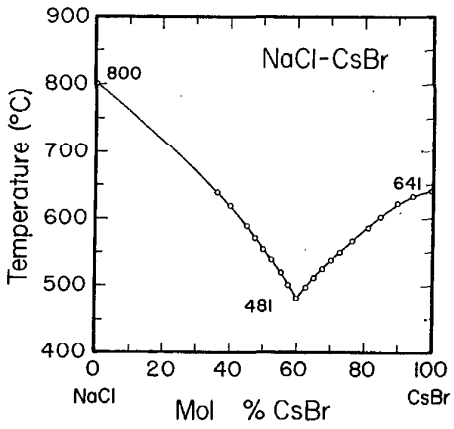

FIGURE 34. Temperature-composition phase diagram for NaCl-CsBr. I.I. Il'yasov, Ukr. Khim. Zh., 31 [9], 930 (1965).

Melt Preparation and Purification

The method used by Markov and Prisyazhnyii [23, 34] for melt preparation is described under the system $CdCl_2-ZnBr_2$.

TABLE 230. Electrical conductance studies: NaCl-CsBr

Investigations critically re-examined			
Ref.	CsBr mol %	Temp. range (T)	Comments
23,34	0-100 (g)	1073,1123	Cell material: quartz U-shaped capillary cell; Pt electrodes; calibration: H_2SO_4 solutions.

TABLE 231. NaCl-CsBr: Specific conductance ($ohm^{-1}cm^{-1}$)

Mol % CsBr	1073 K	1123 K
0	3.55	3.70
10	2.90	3.08
20	2.42	2.60
30	2.06	2.18
40	1.70	1.80
50	1.55	1.63
60	1.43	1.48
70	1.31	1.41
80	1.22	1.31
90	1.13	1.20
100	1.08	1.14

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (classical ac method) [34].

TABLE 232. Density studies: NaCl-CsBr

Investigations critically re-examined			
Ref.	CsBr mol %	Temp. range (T)	Comments
34,46	0-100 (g)	1073	Quartz sphere weighted with tungsten or molybdenum; calibration: water.

TABLE 233. NaCl-CsBr: Density ($g\ cm^{-3}$)

Mol % CsBr	1073 K
0	1.56
10	1.80
20	2.00
30	2.17
40	2.32
50	2.46
60	2.60
70	2.70
80	2.80
90	2.88
100	2.96

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (Archimedean method) [46].

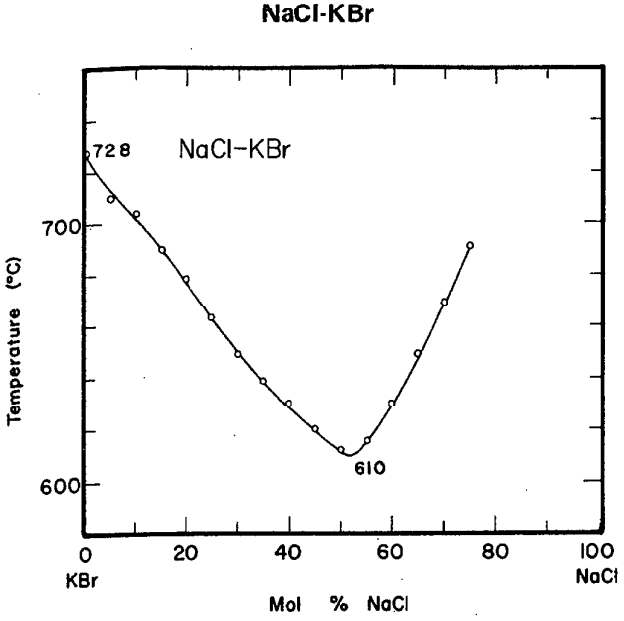

FIGURE 35. Temperature-composition phase diagram for NaCl-KBr.

V.P. Radichev, Zh. Obshch. Khim., 5, 455 (1933).

Melt Preparation and Purification

Refer to the following systems for the methods of melt preparation used by Markov and Prisyazhnyii ($CdCl_2$-$ZnBr_2$); Bloom, Molloy, Knaggs and Welch (KCl-NaBr); Sternberg and Terzi (AgCl-KBr).

TABLE 234. Electrical conductance studies: NaCl-KBr

Investigations critically re-examined

Ref.	KBr mol %	Temp. range (T)	Comments
14[a]	50,100	894-1123	Capillary cells of silica glass or B.T.H. #37 glass; Pt electrodes; freq. range: 100-10,000 Hz; calibration: 1N KCl solutions.
19,34	0-100 (g)	1073,1123	Quartz U-shaped capillary cell; Pt electrodes; calibration: H_2SO_4 solutions.

Deviations from previous NSRDS recommendations [1, p. 14]

Ref.	KBr mol %	Min. departure	Max. departure
14	100	−0.67% (1020 K)	−2.9% (1140 K)

[a]Bloom et al. [14] found no change in resistance over the frequency range studied and estimated their overall accuracy to be ±0.5%. Due to a possible printing error in the published value for 50 mol % KBr, however, their data are not reported here.

TABLE 235. NaCl-KBr: Specific conductance ($ohm^{-1}\,cm^{-1}$)

Mol % KBr	1073 K	1123 K
0	3.55	3.70
10	3.22	3.37
20	2.97	3.08
30	2.72	2.84
40	2.51	2.62
50	2.36	2.47
60	2.20	2.31
70	2.08	2.18
80	1.96	2.06
90	1.86	1.97
100	1.76	1.85

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (classical ac technique) [19].

TABLE 236. Density studies: NaCl-KBr

Investigations critically re-examined

Ref.	KBr mol %	Temp. range (T)	Comments
14[a,b]	0,50,100	894-1123	Pt-10% Rh sinker and suspension wire.
46[b]	0-100 (g)	1073	Quartz sphere weighted with Mo or W; calibration: water.

Deviations from previous NSRDS recommendation [1, pp. 4, 14]

Ref.	KBr mol %	Min. departure	Max. departure
14	100	0.71% (1020 K)	1.1% (1200 K)
14	0	0.0% (1080 K)	−0.1% (1120 K)

[a]Refer to the system KCl-NaBr for a brief discussion of the experimental techniques of Bloom et al. [14].

[b]As in the system KCl-NaBr, both of the above studies are recommended. The agreement between them is good (about 0.5% at 50 mol % KBr and ≅1070 K).

TABLE 237. NaCl-KBr: Density (g cm^{-3})

T	Mol percent KBr		
	100	50	0
900		1.994	
910		1.987	
920		1.980	
930		1.973	
940		1.965	
950		1.958	
960		1.951	
970		1.944	
980		1.936	
990		1.929	
1000		1.922	
1010		1.915	
1020	2.132	1.908	
1030	2.124	1.900	
1040	2.116	1.893	
1050	2.108	1.886	
1060	2.100	1.879	1.526
1070	2.092	1.871	1.520

Temperature-dependent equations
$\rho = a - bT$

Mol % KBr	a	$b \cdot 10^4$
0	2.146	5.85
50	2.645	7.23
100	2.942	7.94

These values are based on the work of Bloom, Knaggs, Molloy and Welch (Archimedean method) [14]. For the results of a study over a wider concentration range, see the next table.

TABLE 238. NaCl-KBr: Density (g cm^{-3})

Mol percent KBr	1073 K
0	1.56
10	1.63
20	1.70
30	1.76
40	1.81
50	1.86
60	1.92
70	1.96
80	2.00
90	2.03
100	2.06

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (Archimedean method) [46]. For the results of a study over a wider temperature range, see the previous table.

TABLE 239. Surface tension studies: NaCl-KBr

Investigations critically re-examined

Ref.	KBr mol %	Temp. range (T)	Comments
78	0-100 (g)	1093	Pt capillary (maximum bubble pressure method); argon gas; dibutylphthalate manometer; estimated accuracy: ±1 dyn/cm.
32	0-100	929-1227	Pt bob; calibration: molten KNO_3; reported reproducibility in measurements: ±1%.

Deviations from previous NSRDS recommendations [2, pp. 57, 63]

Ref.	KBr mol %	Min. departure	Max. departure
32	100	2.74% (1175 K)	2.97% (1025 K)
32	0	0.03% (1125 K)	−1.72% (1225 K)

TABLE 240. NaCl-KBr: Surface tension (dyn cm^{-1})

T	Mol percent KBr						
	100	70	50	40	30	20	0
930				108.1			
940			103.7	107.3			
950		99.0	103.0	106.7			
960		98.3	102.3	106.0			
970		97.6	101.6	105.3			
980		96.9	100.9	104.6			
990		96.3	100.2	103.9			
1000		95.6	99.5	103.2	107.1		
1010		94.9	98.8	102.5	106.5	110.3	
1020		94.2	98.1	101.8	105.8	109.7	
1030	90.3	93.6	97.4	101.1	105.1	109.0	
1040	89.6	92.9	96.7	100.4	104.5	108.4	
1050	88.8	92.2	96.0	99.7	103.9	107.7	
1060	88.1	91.5	95.3	99.0	103.2	107.1	
1070	87.3	90.8	94.6	98.3	102.5	106.4	
1080	86.6	90.2	93.9	97.7	101.9	105.7	
1090	85.8	89.5	93.2	97.0	101.3	105.1	113.4
1100	85.1	88.8	92.5	96.3	100.6	104.4	112.5
1100	84.3	88.1	91.8	95.6	99.9	103.8	111.6
1120	83.6	87.5	91.1	94.9	99.3	103.1	110.7
1130	82.8	86.8	90.4	94.2	98.7	102.4	109.8
1140	82.1	86.1	89.7	93.5	98.0	101.8	108.9
1150	81.3	85.4		92.8	97.3	101.1	108.0
1160	80.5	84.7			96.7	100.5	107.1
1170	79.8	84.1			94.0	99.8	106.2
1180					95.4	99.1	105.3
1190					94.7	98.5	104.4
1200					94.1	97.8	103.5
1210					93.4	97.2	102.6
1220					92.8		101.7

Temperature-dependent equations

$$\gamma = a - bT$$

Mol % KBr	a	b
0	211.5	0.0900
20	176.8	0.0658
30	172.1	0.0650
40	172.5	0.0693
50	169.2	0.0697
70	163.5	0.0679
100	167.9	0.0753

These values are based on the work of Sternberg and Terzi (pin detachment method) [32]. The results are estimated to be accurate to within 1% [80].

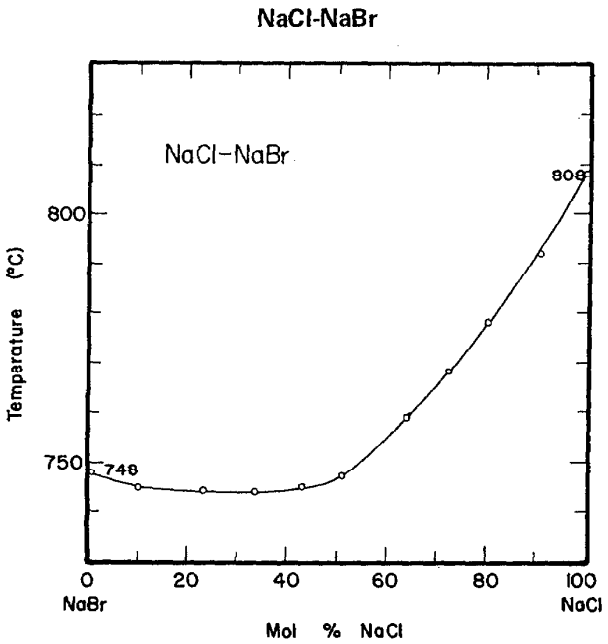

FIGURE 36. Temperature-composition phase diagram for NaCl-NaBr. M. Amadori, Atti della Reale Accad. dei Lincei, (5), 21, I, 467 (1912).

Melt Preparation and Purification

For Zuca's [27] method of melt purification, refer to the system CsCl-CsBr. Holm and Berge [60, 88] used Baker Analyzed NaCl and NaBr dried at 400-500 °C under moderate vacuum and then fused in an atmosphere of purified nitrogen. Bertozzi [81] used chemically pure dried salts (surface tension measurements).

TABLE 241. Electrical conductance studies: NaCl-NaBr

Investigations critically re-examined

Ref.	NaBr mol %	Temp. range (T)	Comments
27	0-100	1038-1228	Silica U-shaped capillary cell, Pt electrodes; freq. range: 1000-7000 Hz; calibration: 0.1M and 1.0M KCl solutions; reported precision. 0.1%.
55	0-100	1106-1166	Freq. range: 800 Hz.

Deviations from NSRDS recommendations [1, pp. 4,14 and this volume]

Ref.	NaBr mol %	Min. departure	Max. departure
27	100	−1.0% (1050 K)	−7.1% (1220 K)
55	100	−4.7% (1106 K)	−7.5% (1166 K)
55	80	−0.3% (1126 K)	−1.3% (1106 K)
55	60	0.0% (1166 K)	−0.9% (1106 K)
55	40	0.0% (1126 K)	0.9% (1166 K)
55	20	0.3% (1166 K)	−0.9% (1106 K)
27	0	−0.03% (1090 K)	−1.8% (1200 K)
55	0	−1.1% (1106 K)	−1.6% (1166 K)

TABLE 242. NaCl-NaBr: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent NaBr						
	100	80	60	50	40	20	0
1050	2.946		3.095	3.098			
1060	2.963		3.115	3.119	3.238		
1070	2.981		3.135	3.139	3.259		
1080	2.998	3.063	3.156	3.160	3.280	3.434	
1090	3.015	3.082	3.176	3.180	3.302	3.459	3.626
1100	3.033	3.101	3.196	3.200	3.323	3.481	3.652
1110	3.050	3.120	3.216	3.221	3.344	3.503	3.677
1120	3.067	3.138	3.236	3.241	3.366	3.526	3.701
1130	3.085	3.157	3.256	3.262	3.387	3.548	3.725
1140	3.102	3.175	3.276	3.282	3.408	3.569	3.748
1150	3.119	3.193	3.296	3.303	3.429	3.591	3.771
1160	3.137	3.211	3.317	3.323	3.451	3.612	3.794
1170	3.154	3.228	3.337	3.344	3.472	3.634	3.816
1180	3.172	3.246	3.357	3.364	3.493	3.655	3.838
1190	3.189	3.263	3.377	3.385	3.514	3.676	3.860
1200	3.206	3.280	3.397	3.405	3.536	3.696	3.880
1210	3.224			3.426	3.557		
1220	3.241						

TABLE 242. NaCl-NaBr: Specific conductance (ohm^{-1} cm^{-1})—Continued

Temperature-dependent equations $\kappa = a + bT + cT^2$					
NaBr mol %	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate	Temp. range (T)
0	−1.0299	6.0544	−1.6353	0.03%	1080.2-1223.2
20	−0.0709	4.2153	−0.8965	0.08%	1073.2-1223.2
40	0.9843	2.1261	0	0.16%	1056.2-1228.2
50	0.9483	2.0474	0	0.17%	1043.2-1223.2
60	0.9832	2.0115	0	0.13%	1038.2-1223.2
80	−0.0329	3.8178	−0.8807	0.05%	1080.2-1223.2
100	1.1218	1.7371	0	0.18%	1043.2-1223.2

These values are based on the work of Zuca and Ionescu-Vasu (classical ac technique) [27].

TABLE 243. Density studies: NaCl-NaBr

Investigations critically re-examined			
Ref.	NaBr mol %	Temp. range (T)	Comments
27[a]	0-100	1028-1223	Pt bob; calibration: water.
29	0-100 (g)	1073	Pt sphere and suspension wire; calibration: water.
60	50	1058-1125	Pt-10% Rh sinker; calibration: water.

Deviations from NSRDS recommendations [1, pp. 4, 14 and this volume]			
Ref.	NaBr mol %	Min. departure	Max. departure
27	100	2.1% (1050 K)	2.2% (1220 K)
60	50	0.00% (1058 K)	−0.36% (1125 K)
27	0	3.0% (1120 K)	3.5% (1200 K)

TABLE 244. NaCl-NaBr: Density (g cm^{-3})

T	Mol percent NaBr						
	100	80	60	50	40	20	0
1030				1.985			
1040				1.978			
1050	2.317	2.185	2.044	1.971	1.897		
1060	2.309	2.177	2.037	1.965	1.891		
1070	2.300	2.170	2.030	1.958	1.884	1.725	
1080	2.292	2.162	2.023	1.952	1.877	1.719	
1090	2.284	2.154	2.016	1.945	1.871	1.713	1.546
1100	2.276	2.146	2.009	1.938	1.864	1.707	1.540
1110	2.267	2.139	2.002	1.932	1.858	1.701	1.535
1120	2.259	2.131	1.994	1.925	1.851	1.694	1.529
1130	2.251	2.123	1.987	1.919	1.844	1.688	1.524
1140	2.243	2.115	1.980	1.912	1.838	1.682	1.518
1150	2.235	2.107	1.973	1.905	1.831	1.676	1.513
1160	2.226	2.100	1.966	1.899	1.824	1.670	1.508
1170	2.218	2.092	1.959	1.892	1.818	1.663	1.502
1180	2.210	2.084	1.952	1.885	1.811	1.657	1.497
1190	2.202	2.076	1.945	1.879	1.805	1.651	1.491
1200	2.194	2.069	1.938	1.872	1.798	1.645	1.486
1210	2.185			1.866	1.791		
1220	2.177						

Temperature-dependent equations

$\rho = a - bT$

Mol % NaBr	a	$b.10^3$
0	2.1390	0.5444
20	2.3875	0.6189
40	2.5924	0.6620
50	2.6657	0.6612
60	2.7896	0.7100
80	3.0010	0.7770
100	3.1799	0.8220

These values are based on the work of Zuca and Ionescu-Vasu (Archimedean method) [27]. The data were reported in equation form with an estimated precision of 0.1%.

TABLE 245. Viscosity studies: NaCl-NaBr

Investigations critically re-examined

Ref.	NaBr mol %	Temp. range (T)
55	0-100	1083-1143

Deviations from previous NSRDS recommendations [1, pp. 4, 14]

Ref.	NaBr mol %	Min. departure	Max. departure
55	100	11.7% (1083 K)	17.0% (1143 K)
55	0	2.8% (1113 K)	−6.3% (1083 K)

TABLE 246. NaCl-NaBr: Viscosity (cp)

T	Mol percent NaBr					
	100	80	60	40	20	0
1083.2	1.338	1.218	1.190	1.553	1.388	1.327
1113.2	1.286	1.126	1.148	1.419	1.250	1.290
1143.2	1.238	1.088	1.065	1.373	1.153	1.160

These values are those obtained experimentally by Matsumura, Mizuno and Nishihara (oscillating disc technique) [55].

TABLE 247. Surface tension studies: NaCl-NaBr

Investigations critically re-examined

Ref.	NaBr mol %	Temp. range (T)	Comments
81	0,50,100	1033-1183	Pt-10% Rh sinker; calibration: water.

Deviations from NSRDS recommendations [2, pp. 57, 62 and this volume]

Ref.	NaBr mol %	Min. departure	Max. departure
81	100	0.1% (1073 K)	0.8% (1133 K)
88	50	−2.23% (1073 K)	
81	0	3.4% (1083 K)	3.6% (1183 K)

TABLE 248. NaCl-NaBr: Surface tension (dyn cm^{-1})

T	Mol percent NaBr		
	100	50	0
1030		110.8	
1040	102.5	110.1	
1050	101.8	109.4	
1060	101.1	108.7	
1070	100.4	107.9	
1080	99.7	107.2	
1090	99.0	106.5	116.7
1100	98.3	105.8	115.9
1110	97.6	105.1	115.2
1120	96.9	104.3	114.4
1130	96.2	103.6	113.7
1140		102.9	113.0
1150		102.2	112.2
1160		101.5	111.5
1170		100.7	110.7
1180			110.0

Temperature-dependent equations
$\gamma = a - bT$

Mol % NaBr	a	$b \cdot 10^2$
0	197.3	7.4
50	185.0	7.2
100	175.3	7.0

These values are based on the work of Bertozzi (Wilhelmy slide plate method) [81]. The data were reported in equation form and no error estimate was given.

$PbCl_2$-$CdBr_2$

Melt Preparation and Purification

The method used by Prisyazhnyii and his co workers for melt preparation is described under the system $CdCl_2$-$ZnBr_2$.

TABLE 249. Electrical conductance studies: $PbCl_2$-$CdBr_2$

Investigations critically re-examined

Ref.	$CdBr_2$ mol %	Temp. range (T)
69	0-100	873

Deviations from previous NSRDS recommendations [1, pp. 13, 17]

Ref.	$CdBr_2$ mol %	Departure
69	0	2.77% (873 K)
69	100	0.66% (873 K)

TABLE 250. $PbCl_2$-$CdBr_2$: Equivalent conductance (ohm^{-1} cm^2 $equiv^{-1}$)

Mol % $CdBr_2$	873 K
0	57.09
20	56.20
30	55.50
40	54.80
50	53.60
60	52.00
70	49.70
80	46.80
100	38.15

These values are those obtained experimentally by Voronin, Prisyazhnyii and Baranov (classical ac technique) [69]. No density data has been published by these authors for the mixtures. However if, for the pure salts, the densities are taken to be given by the equations recommended in [1], the specific conductances may be calculated from the above data as $PbCl_2$, κ = 1.972; $CdBr_2$, κ = 1.132. These correspond, respectively, to 2.28% and 0.67% deviation from the NSRDS recommended data bases at 873 K.

TABLE 251. Viscosity studies: $PbCl_2$-$CdBr_2$

Investigations critically re-examined			
Ref.	$CdBr_2$ mol %	Temp. range (T)	Comments
59	20-50 (g)	733-793	Calibration: molten KNO_3.

TABLE 252. $PbCl_2$-$CdBr_2$: Viscosity (cp)

Mol % $CdBr_2$	733 K	793 K
0		3.80
10		3.70
20		3.60
30	4.73	3.48
40	4.49	3.34
50	4.30	3.21
60	4.24	3.23
70	4.27	
80	4.36	
90	4.50	
100	4.70	

These values have been interpolated to three significant figures from the graphical presentation of Il'yasov and Barsegov (capillary technique) [59].

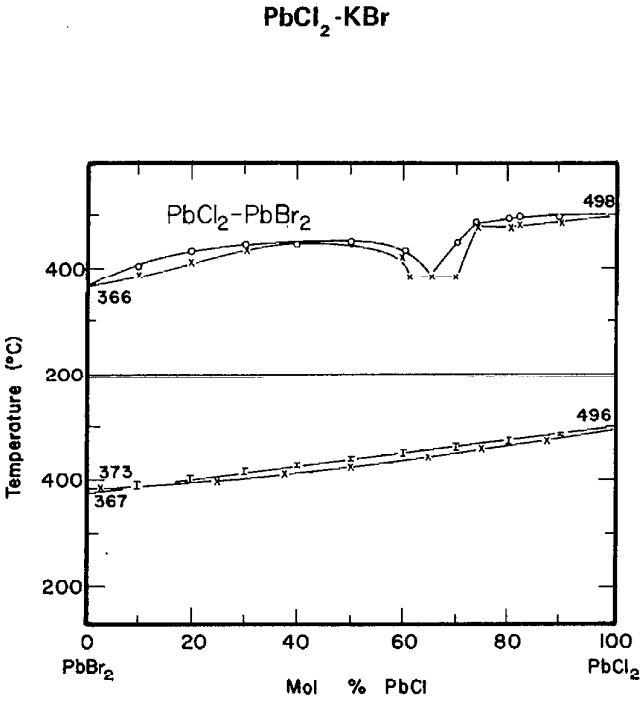

FIGURE 37. Temperature-composition phase diagram for $PbCl_2$-KBr.

A.K. Bostandzhiyan, I.I. Il'yasov and A.G. Bergman, Russ. J. Inorg. Chem., 4, 9 (1959).

Melt Preparation and Purification

Reference [48] contains no information on melt preparation.

TABLE 253. Viscosity studies: $PbCl_2$-KBr

Investigations critically re-examined			
Ref.	KBr mol %	Temp. range (T)	Comments
48	0-60 (g)	703,743,791	Calibration: molten KNO_3.

TABLE 254. $PbCl_2$-KBr: Viscosity (cp)

Mol % KBr	703 K	743 K	791 K
0			2.7
10			2.5
20	3.7	2.8	2.3
30	3.4	2.6	2.1
40		2.6	2.1

These values have been interpolated to two significant figures from the graphical presentation of Barsegov and Il'yasov (capillary technique) [48].

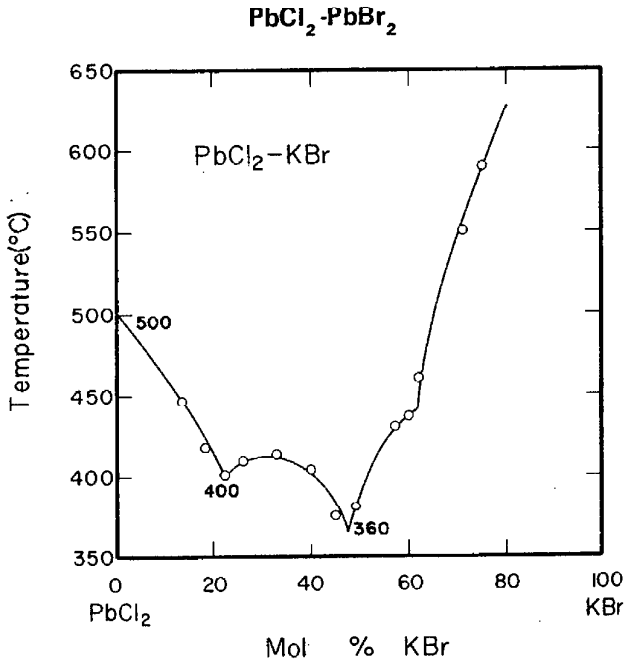

FIGURE 38. Temperature-composition phase diagrams for $PbCl_2$-$PbBr_2$.

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2. I.I. Pavorskii, Ann. Secteur Anal. Phys. chim. Inst. chim. gen. (U.S.S.R.), 13, 231 (1940).
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6. W.D. Robertson (Yale Univ.), U.S.A.E.C. Rpt. At (30-1)-2723 (2 vols.) (1966) NTIS, Springfield, Va.

Melt Preparation and Purification

Heymann et al. [12, 15] used analytical reagent grade salts. The mixtures were analyzed for lead content by precipitation as the sulfate.

Protsenko and Shatskaya [36] prepared lead halides by reacting the nitrate with the appropriate hydrogen halide. The salts were dried under vacuum (five torr) at 160 °C. The melting points were determined as a criterion of purity.

TABLE 255. Electrical conductance studies: $PbCl_2$-$PbBr_2$

Investigations critically re-examined			
Ref.	$PbBr_2$ mol %	Temp. range (T)	Comments
8	0-100	773	Cell material: silica and quartz U-tubes; Pt electrodes; calibration: 1N KCl solutions.
15[a]	0-100	698-823	Cell material: B.T.H.-C14 glass cell; Pt electrodes; freq. range: ≅3000 Hz, calibration: 1N KCl solution.
36	0-100 (g)	648-773	Modified Biltz glass cell; calibration: molten KNO_3 .
42			Data from [8].

Deviations from previous NSRDS recommendations [1, pp. 13, 18]			
Ref.	$PbBr_2$ mol %	Min. departure	Max. departure
8	100	2.7% (773 K)	
15	100	–1.6% (723 K)	2.9% (773 K)
8	0	1.3% (773 K)	
15	0	–0.24% (923 K)	–0.42% (873 K)

[a]The values in reference [15] were taken from smoothed curves drawn through the experimental points. Deviations were never greater than 0.5%.

TABLE 256. $PbCl_2$-$PbBr_2$: Electrical conductance (ohm^{-1} cm^{-1})

T	Mol percent $PbBr_2$					
	100.0	79.7	60.2	38.5	19.0	0.0
700	0.779	0.824	0.868			
710	0.813	0.863	0.911			
720	0.847	0.902	0.954			
730	0.881	0.941	0.996	1.053		
740	0.914	0.978	1.038	1.099		
750	0.948	1.015	1.079	1.145	1.222	
760	0.982	1.051	1.119	1.189	1.271	
770	1.015	1.086	1.159	1.233	1.319	
780	1.049	1.120	1.198	1.276	1.365	[1.468]
790	1.083	1.154	1.237	1.318	1.411	[1.522]
800	1.116	1.186	1.275	1.359	1.456	[1.576]
810	1.150	1.218	1.312	1.399	1.500	[1.627]
820	1.184	1.249	1.349	1.439	1.542	[1.678]

Temperature-dependent equations

$$\kappa = a + bT + cT^2$$

Mol % $PbBr_2$	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate
0.0	[-6.7261]	[15.4969]	[-6.4000]	0.0%
19.0	-5.4615	12.8768	-5.2876	0.16%
38.5	-4.6120	10.8545	-4.2386	0.15%
60.2	-3.6434	8.5262	-2.9735	0.07%
79.7	-3.9230	9.5403	-3.9420	0.19%
100.0	-1.5789	3.3691	0	1.21%

These values are based on the work of Harrap and Heymann (classical ac technique) [15]. Values in brackets were generated from fewer than five data points.

TABLE 257. Density studies: $PbCl_2$-$PbBr_2$

Investigations critically re-examined			
Ref.	$PbBr_2$ mol %	Temp. range (T)	Comments
12[a]	0-100	683-983	Cell material: B.T.H.-C14 glass tube with pear-shaped B.T.H.-C14 glass stopper; calibration: molten $AgNO_3$.

[a]Boardman, Dorman and Heymann [12] applied corrections for the shape of the meniscus, buoyancy of air and expansion of the silica glass dilatometer. The authors reported a maximum error in their results of ±0.1%. The data for the pure salts, $PbCl_2$ and $PbBr_2$, were critically evaluated and given as the recommended values in "Molten Salts, Volume 1" NSRDS-NBS-15) [1].

TABLE 258. $PbCl_2$-$PbBr_2$: Density (g cm^{-3})

T	Mol percent $PbBr_2$				
	100	84.6	50.3	19.7	0
690		5.577			
700		5.560			
710		5.543			
720		5.526			
730		5.509			
740		5.492	5.302		
750		5.475	5.286		
760		5.458	5.271		
770		5.441	5.255	5.085	
780	5.502	5.423	5.240	5.070	
790	5.485	5.406	5.224	5.055	4.927
800	5.469	5.389	5.209	5.039	4.912
810	5.452	5.372	5.193	5.024	4.897
820	5.436	5.355	5.178	5.009	4.882
830	5.419	5.338	5.162	4.994	4.867
840	5.403	5.321	5.147	4.979	4.852
850	5.386	5.304	5.131	4.963	4.837
860	5.370	5.287	5.116	4.948	4.822
870	5.353	5.270	5.100	4.933	4.807
880			5.085	4.918	4.792
890			5.069	4.903	4.777
900			5.054		4.762
910			5.038		4.747
920					4.732
930					4.717
940					4.702
950					4.687
960					4.672

Temperature-dependent equations

$\rho = a - bT$

Mol % $PbBr_2$	a	$b \cdot 10^3$
0	6.112	1.50
19.7	6.255	1.52
50.3	6.449	1.55
84.6	6.767	1.71
100	6.789	1.65

These values are based on the work of Boardman, Dorman and Heymann (dilatometric method) [12]. The following equation, with concentration, C, in mole percent $PbCl_2$ and temperature in K, has been derived from the preceding data: $\rho = a + bT + cC + dCT^2$, where $a = 6.80858$, $b \cdot 10^3 = -1.66565$, $c \cdot 10^3 = -5.79669$, $d \cdot 10^{10} = 4.61250$, with a maximum departure of 0.31% at 789.2 K and 100 mol % $PbCl_2$, and a standard error of estimate of 0.15%. This equation may be used to calculate the density of $PbCl_2$-$PbBr_2$ melts at any composition in the temperature range 683-983 K.

TABLE 259. Viscosity studies: $PbCl_2$-$PbBr_2$

Investigations critically re-examined			
Ref.	$PbBr_2$ mol %	Temp. range (T)	Comments
15[a]	0-100	698-823	B.T.H.-C14 glass viscometer; calibration: molten KNO_3.
17	23.1, 56.4, 75.3	783	As for [15] and see also [11].

Deviations from previous NSRDS recommendations [1, p. 18]			
Ref.	$PbBr_2$ mol %	Min. departure	Max. departure
15	100	–0.52% (698 K)	–3.6% (748 K)

[a]The viscosity data for pure $PbCl_2$ in reference [15] were critically evaluated and given as the recommended values in "Molten Salts, Volume 1" (NSRDS-NBS-15) [1].

TABLE 260. $PbCl_2$-$PbBr_2$: Viscosity (cp)

T	Mol percent $PbBr_2$				
	100.0	75.3	56.4	23.1	0.0
700	5.57	6.15	6.66		
710	5.25	5.76	6.18		
720	4.95	5.40	5.74		
730	4.68	5.07	5.34		
740	4.43	4.76	4.97		
750	4.20	4.47	4.64	[5.14]	
760	3.99	4.22	4.33	[4.83]	
770	3.79	3.98	4.07	[4.54]	
780	3.61	3.76	3.83	[4.27]	4.40
790	3.44	3.57	3.63	[4.03]	4.18
800	3.29	3.40	3.46	[3.81]	3.97
810	3.14	3.25	3.31	[3.61]	3.78
820	3.00	3.12	3.20	[3.43]	3.60

Temperature-dependent equations

$$\eta = a + bT + cT^2 + dT^3$$

$$\eta = A \cdot \exp(E/RT)$$

Mol % $PbBr_2$	a	$b \cdot 10^1$	$c \cdot 10^4$	$d \cdot 10^7$	$A \cdot 10^2$	E (cal mol^{-1})	Standard error of estimate
0.0					7.066	6403	0.17%
23.1	[195.5828]	[–5.9507]	[6.1488]	[–2.1335]			0.00%
56.4	166.2536	–4.5631	3.9726	–1.0156			1.54%
75.3					5.754	6493	0.94%
100.0					8.165	5873	0.82%

These values are based on the work of Harrap and Heymann (capillary method) [15]. Values given in square brackets were generated from fewer than five data points.

$PbCl_2$-$ZnBr_2$

Melt Preparation and Purification

Prisyazhnyii's method of melt preparation is described under the system $CdCl_2$-$ZnBr_2$.

TABLE 261. Electrical conductance studies: $PbCl_2$-$ZnBr_2$

Investigations critically re-examined		
Ref.	$ZnBr_2$ mol %	Temp. range (T)
61	0-100	873

Deviations from previous NSRDS recommendations [1, pp. 13, 17]

Ref.	$ZnBr_2$ mol %	Departure
61	0	2.73% (873 K)
61	100	−4.69% (873 K)

TABLE 262. $PbCl_2$-$ZnBr_2$: Equivalent conductance ($ohm^{-1}cm^2$ $equiv^{-1}$)

Mol % $ZnBr_2$	873 K
0	57.09
20	48.90
30	44.37
40	39.52
50	34.07
60	28.70
70	22.91
80	17.35
100	7.51

These values are those obtained experimentally by Prisyazhnyii and Voronin (classical ac technique) **[61]**. No density data has been published by these authors for the mixtures. However, if for the pure salts, the densities are taken to be given by the equations recommended in [1], the specific conductances may be calculated from the above data as $PbCl_2$, κ = 1.972; $ZnBr_2$, κ = 0.218 $ohm^{-1}cm^{-1}$. These correspond, respectively, to 2.28% and 0.0% deviation from the NSRDS recommended data bases at 873 K.

RbCl-AgBr

Melt Preparation and Purification

The method of Brooks and Paul for melt preparation is described under the system CsCl-AgBr. The rubidium bromide was Cerac/Pure, 99.9%.

TABLE 263. Density studies: RbCl-AgBr

Investigations critically re-examined			
Ref.	AgBr mol %	Temp. range (T)	Comments
67,70	50,100	717-1074	*Pt bob, Pt suspension wire;* calibration: water.

Comparisons with previous NSRDS recommendations [1, p. 16]

Ref.	AgBr mol %	Min. departure	Max. departure
67,70	100	0.00% (930 K)	0.06% (720 K)

TABLE 264. RbCl-AgBr: Density (g cm^{-3})

	Mol percent AgBr	
T	50	100
720		5.565
740		5.544
760		5.523
780		5.502
800		5.481
820	3.529	5.460
840	3.507	
860	3.485	
880	3.462	
900	3.440	
920	3.418	
940	3.396	
960	3.374	
980	3.352	
1000	3.330	
1020	3.308	
1040	3.286	
1060	3.264	

Temperature dependent equations
$\rho = a - bT$

Mol % AgBr	a	$b \cdot 10^3$	Standard deviation
50	4.4345	1.1046	0.0003
100	6.321	1.050	

These values are based on the work of Brooks and Paul (Archimedean method) **[67, 70]**.

RbCl-KBr

Melt Preparation and Purification

The method used by Markov and Prisyazhnyii for melt preparation and purification is given under the system $CdCl_2$-$ZnBr_2$. That of Sternberg and Terzi is given under the system AgCl-KBr.

TABLE 265. Electrical conductance studies: RbCl-KBr

Investigations critically re-examined			
Ref.	KBr mol %	Temp. range (T)	Comments
20,34	0-100 (g)	1043, 1073, 1123	Quartz U-shaped capillary cell; Pt electrodes; calibration: H_2SO_4 solutions.

TABLE 266. RbCl-KBr: Specific conductance ($ohm^{-1} cm^{-1}$)

Mol % KBr	1043 K	1073 K	1123 K
0	1.64	1.70	1.80
10	1.63	1.70	1.80
20	1.63	1.70	1.80
30	1.62	1.70	1.80
40	1.62	1.70	1.79
50	1.63	1.70	1.80
60	1.64	1.71	1.80
70	1.65	1.72	1.81
80	1.67	1.74	1.83
90	1.69	1.75	1.85
100	1.70	1.78	1.87

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (classical ac technique) [20].

TABLE 267. Density studies: RbCl-KBr

Investigations critically re-examined			
Ref.	KBr mol %	Temp. range (T)	Comments
34,46	0-100 (g)	1073	Quartz sphere weighted with molybdenum or tungsten; calibration: water.

TABLE 268. RbCl-KBr: Density ($g\ cm^{-3}$)

Mol percent KBr	1073 K
0	2.19
10	2.18
20	2.17
30	2.16
40	2.15
50	2.14
60	2.13
70	2.12
80	2.10
90	2.08
100	2.07

These values have been interpolated to three significant figures from the graphical presentation of Markov and Prisyazhnyii (Archimedean method) [46].

TABLE 269. Surface tension studies: RbCl-KBr

Investigations critically re-examined			
Ref.	KBr mol %	Temp. range (T)	Comments
32	0-100	1018-1289	Pt bob; calibration: molten KNO_3, reported reproducibility: ±1%.

Deviations from previous NSRDS recommendations [2, pp. 58, 63]

Ref.	KBr mol %	Min. departure	Max. departure
32	100	2.74% (1175 K)	2.97% (1025 K)
32	0	0.02% (1120 K)	−1.03% (1035 K)

TABLE 270. RbCl-KBr: Surface tension (dyn cm^{-1})

T	Mol percent KBr									
	100	85	70	60	50	40	30	23	15	0
1020					89.5					
1030	90.3	89.1		88.9	88.9			90.2	90.0	94.1
1040	89.6	88.3		88.3	88.1		88.1	89.4	89.3	93.4
1050	88.8	87.6	86.9	87.6	87.5		87.3	88.6	88.5	92.7
1060	88.1	86.9	86.3	86.9	86.8	86.9	86.6	87.9	87.8	91.9
1070	87.3	86.2	85.6	86.2	86.1	86.2	85.8	87.1	87.1	91.1
1080	86.6	85.5	84.9	85.5	85.4	85.5	85.1	86.3	86.4	90.4
1090	85.8	84.8	84.2	84.9	84.7	84.8	84.3	85.6	85.7	89.7
1100	85.1	84.1	83.5	84.2	84.0	84.0	83.6	84.8	85.0	88.9
1110	84.3	83.4	82.8	83.5	83.3	83.3	82.8	84.0	84.3	88.2
1120	83.6	82.7	82.1	82.8	82.6	82.6	82.1	83.2	83.6	87.4
1130	82.8	82.0	81.5	82.1	81.9	81.9	81.3	82.5	82.9	86.7
1140	82.1	81.3	80.8	81.4	81.3	81.2	80.6	81.7	82.2	85.9
1150	81.3	80.5	80.1	80.7	80.6	80.5	79.8	80.9	81.5	85.2
1160	80.5	79.8	79.4	80.1	79.9	79.7	79.1	80.2	80.7	84.4
1170	79.8	79.1	78.7	79.4	79.2	79.0	78.3	79.4	80.0	83.7
1180		78.4	78.0	78.7	78.5	78.3	77.6	78.6	79.3	82.9
1190		77.7	77.3	78.0	77.8	77.6	76.8	77.9	78.6	82.2
1200			76.7	77.3	77.1	76.9	76.1	77.1	77.9	
1210			75.9	76.6	76.4	76.2	75.3		77.2	
1220			75.3	76.0	75.7	75.5	74.5		76.5	
1230			74.6	75.3	75.1		73.8			
1240				74.6	74.4					
1250				73.9						
1260				73.2						
1270				72.5						
1280				71.9						

Temperature-dependent equations

$\gamma = a - bT$

Mol % KBr	a	b
0	171.3	0.0749
15	163.0	0.0709
23	169.6	0.0771
30	166.3	0.0752
40	162.7	0.0715
50	159.8	0.0689
60	159.3	0.0683
70	159.2	0.0688
85	162.2	0.0710
100	167.9	0.0753

These values are based on the work of Sternberg and Terzi (pin detachment method) [32]. The accuracy is estimated to be within 1% [80].

RbCl-RbBr

Melt Preparation and Purification

Zuca and Olteanu [38] used Merck p. a. reagents. Their procedure for drying the salts is given under the system CsCl-CsBr.

TABLE 271. Electrical conductance studies: RbCl-RbBr

Investigations critically re-examined			
Ref.	RbBr mol %	Temp. range (T)	Comments
38	0-100	963-1193	Silica U-shaped capillary cell; Pt electrodes; freq. range: 1000-7000 Hz; calibration: 0.1M and 1.0M KCl solutions.

Deviations from previous NSRDS recommendations [1, pp. 6, 15]			
Ref.	RbBr mol %	Min. departure	Max. departure
38	100	−0.80% (1000 K)	−4.0% (1120 K)
38	0	0.11% (1060 K)	−3.0% (1190 K)

TABLE 272. RbCl-RbBr: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent RbBr				
	100	75	50	25	0
980	1.160	1.229	1.300	1.390	
990	1.178	1.248	1.320	1.413	
1000	1.195	1.266	1.340	1.436	
1010	1.212	1.284	1.360	1.458	
1020	1.229	1.302	1.380	1.480	1.602
1030	1.246	1.319	1.399	1.502	1.624
1040	1.262	1.337	1.418	1.523	1.646
1050	1.278	1.354	1.437	1.544	1.668
1060	1.294	1.371	1.456	1.565	1.690
1070	1.310	1.387	1.474	1.585	1.711
1080	1.326	1.404	1.493	1.605	1.733
1090	1.341	1.420	1.511	1.625	1.753
1100	1.356	1.436	1.529	1.644	1.774
1110	1.371	1.452	1.546	1.663	1.794
1120	1.386	1.467	1.563	1.682	1.814
1130	1.401	1.482		1.700	1.834
1140	1.415	1.497			1.853
1150					1.872
1160					1.891
1170					1.909
1180					1.927
1190					1.945

Temperature-dependent equations

$$\kappa = a + bT + cT^2$$

RbBr mol %	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate	Temp. range (T)
0	−2.2588	5.2957	−1.4815	0.02%	1013.2-1193.2
25	−2.5349	5.6852	−1.7146	0.07%	973.2-1183.2
50	−1.8305	4.3415	−1.1708	0.03%	873.2-1178.2
75	−1.7212	4.1565	−1.1696	0.03%	973.2-1173.2
100	−1.6004	3.8682	−1.0729	0.02%	963.2-1153.2

These values are based on the work of Zuca and Olteanu (classical ac technique) [38].

TABLE 273. Density studies: RbCl-RbBr

Investigations critically re-examined			
Ref.	RbBr mol %	Temp. range (T)	Comments
38	0-100	958-1233	Pt bob; calibration: water.

Deviations from previous NSRDS recommendations [1, pp. 6, 15]

Ref.	RbBr mol %	Min. departure	Max. departure
38	100	0.1% (1100, 1140 K)	0.04% (1060 K)
38	0	0.0% (1100 K)	0.14% (1140 K)

TABLE 274. RbCl-RbBr: Density (g cm^{-3})

T	Mol percent RbBr				
	100	75	50	25	0
960		2.610			
970		2.600			
980	2.688	2.589	2.471	2.373	
990	2.678	2.579	2.461	2.364	
1000	2.667	2.569	2.452	2.355	
1010	2.656	2.559	2.442	2.346	
1020	2.645	2.549	2.433	2.336	2.218
1030	2.635	2.539	2.423	2.327	2.209
1040	2.624	2.529	2.414	2.318	2.201
1050	2.613	2.518	2.404	2.309	2.192
1060	2.603	2.508	2.395	2.300	2.184
1070	2.592	2.498	2.385	2.291	2.175
1080	2.581	2.488	2.376	2.282	2.167
1090	2.571	2.478	2.366	2.272	2.158
1100	2.560	2.468	2.357	2.263	2.150
1110	2.549	2.458	2.348	2.254	2.141
1120	2.538	2.448	2.338	2.245	2.133
1130	2.528	2.437		2.236	2.124
1140	2.517	2.427			2.116
1150					2.107
1160					2.099
1170					2.090
1180					2.082
1190					2.073
1200					2.065
1210					2.056
1220					2.048
1230					2.039

Temperature-dependent equations

$\rho = a - bT$

Mol % RbBr	a	$b \cdot 10^4$
0	3.0863	8.5140
25	3.2688	9.1410
50	3.3996	9.4780
75	3.5833	10.1410
100	3.7373	10.7040

These values are based on the work of Zuca and Olteanu (Archimedean method) [38]. The following equation, with concentration in mole percent RbCl and temperature in K, has been derived from the preceding data: $\rho = a + bT + cTC + dTC^2 + eCT^2$, where a = 3.71650, $b \cdot 10^3$ = –1.04980, $c \cdot 10^6$ = –9.03576, $d \cdot 10^9$ = –2.71993, $e \cdot 10^9$ = 5.04623, with a maximum departure of 0.42% at 973.2 K and 50 mol % RbCl, and a standard error of estimate of 0.17%. This equation may be used to calculate the density of RbCl-RbBr melts at a composition in the temperature range 958-1233 K.

TABLE 275. Surface tension studies: RbCl-RbBr

Investigations critically re-examined		
Ref.	RbBr mol %	Temp. range (T)
81	0, 50, 100	993-1173

Deviations from previous NSRDS recommendations [2, p. 58]

Ref.	RbBr mol %	Min. departure	Max. departure
81	0	−0.58% (1133 K)	−1.9% (1033 K)

Reference [81] is the NSRDS reference data base for the surface tension of pure molten RbBr.

TABLE 276. RbCl-RbBr: Surface tension (dyn cm^{-1})

T	Mol % RbBr		
	100	50	0
1000	85.7	90.4	
1010	85.0	89.7	94.8
1020	84.2	88.9	94.0
1030	83.5	88.2	93.3
1040	82.8	87.5	92.6
1050	82.1	86.7	91.8
1060	81.4	86.0	91.1
1070	80.6	85.2	90.3
1080	79.9	84.5	89.6
1090	79.2	84.5	89.6
1110	78.5	83.0	88.1
1120		81.5	86.6
1130		80.8	85.9
1140		80.1	
1150		79.3	
1160		70.6	
1170		77.8	

Temperature-dependent equations
$\gamma = a - bT$

Mol % RbBr	a	$b \cdot 10^2$
0	169.5	7.4
50	164.4	7.4
100	157.7	7.2

These values are based on the work of Bertozzi (Wilhelmy slide plate method) [81]. The reproducibility was estimated as ±0.5%.

TlCl-TlBr

Melt Preparation and Purification

The thallous chloride and thallous bromide used by Buckle and Tsaoussoglou [72] were prepared from metal of 99.9% purity (Johnson-Matthey). The mixtures were prepared by mixing weighed amounts of the dried powered salts in a silica test tube and melting under anhydrous nitrogen or argon.

Lisitskii, Tret'yakova and Fomichev [90] purified these compounds by zone refining. The main impurities were found to be Pb, In, Sn $\leq 1 \cdot 10^{-4}$ weight percent.

TABLE 277. Density studies: TlCl-TlBr

Investigations critically re-examined			
Ref.	TlBr mol %	Temp. range (T)	Comments
72[a]	0-100	786-923	Indium pycnometer; calibration: triply distilled mercury.
90[b]	0-100 (g)	698-1213	Pycnometer filled by distillation.

Deviations from previous NSRDS recommendations [1, pp. 12, 18]

Ref.	TlBr mol %	Min. departure	Max. departure
72	100	0.00% (786 K)	−0.03% (849 K)
90	100	−0.28% (1125 K)	−0.93% (745 K)
72	0	0.04% (849 K)	0.13% (786 K)
90	0	−0.34% (720 K)	−0.52% (1160 K)

[a]Buckle and Tsaoussoglou [72] estimated the maximum deviation to be about 1.5%.

[b]Lisitskii, Tretyakova and Fomichev reported data for the 26.5 mol percent TlBr mixture as $\rho = 6.563 - 2.2 \times 10^{-3} t - 3.6 \times 10^{-7} t^2 - 2.0 \times 10^{-10} t^3$, where t is the temperature in degrees Celsius, with an rms deviation of 0.0080. Data for pure TlCl and TlBr were also reported in polynomial form. See also TlBr-TlI [90].

TABLE 278. TlCl-TlBr: Density (g cm^{-3})

TlBr Mol %	786 K	TlBr Mol %	849 K	TlBr Mol %	923 K
0.0	5.485	0.0	5.800	0.0	5.228
21.0	5.560	20.7	5.445	34.0	5.320
25.7	5.570	25.0	5.451	39.0	5.349
34.0	5.614	33.7	5.484	47.1	5.377
39.1	5.638	34.5	5.487	52.0	5.395
43.8	5.674	35.5	5.492	58.8	5.420
47.7	5.688	45.4	5.537	70.7	5.483
56.6	5.727	46.6	5.536	79.6	5.553
64.2	5.758	55.6	5.577	81.3	5.548
69.5	5.781	57.4	5.591	100.0	5.658
77.5	5.819	60.0	5.602		
79.0	5.823	61.6	5.616		
82.4	5.841	69.3	5.647		
100.0	5.923	73.2	5.665		
		83.2	5.718		
		100.0	5.800		

The values in this table are based on the molar volume data of Buckle and Tsaoussoglou (pycnometric method) [72].

TABLE 279. Viscosity studies: TlCl-TlBr

Investigations critically re-examined			
Ref.	TlBr mol %	Temp. range (T)	Comments
90[a]	0-100 (g)	733-1173	Quartz viscometer, filled by distillation.

Deviations from previous NSRDS recommendations [5, p. 896, 6]			
Ref.	TlBr mol %	Min. departure	Max. departure
90	100	−2.18% (760 K)	−10.7% (990 K)
90	0	1.49% (863 K)	10.4% (1053 K)

[a]Data for pure salts reported in equation form.

TABLE 280. TlCl-TlBr: Viscosity (cp)

Wt % TlBr	Mol % TlBr	733 K	773 K	873 K	973 K	1073 K	1173 K
0	0	*1.858*	*1.646*	*1.253*	*1.074*	*0.947*	
10	8.7	1.88	1.67	1.27	1.09	0.96	0.86
20	17.7	1.91	1.70	1.29	1.11	0.98	0.87
50	26.9	1.93	1.72	1.31	1.12	0.99	0.88
40	36.4	1.96	1.75	1.33	1.14	1.00	0.89
50	46.2	1.99	1.77	1.37	1.15	1.01	0.90
60	56.3	2.02	1.79	1.39	1.17	1.03	0.91
70	66.7	2.05	1.82	1.41	1.19	1.04	0.92
80	77.4	2.07	1.84	1.43	1.21	1.05	0.93
90	88.5	2.10	1.87	1.43	1.23	1.06	0.94
100	100	*2.137*	*1.894*	*1.470*	*1.226*	*1.071*	*0.957*

Temperature-dependent equations

$\eta = A \cdot \exp(E/RT)$

Mol % TlBr	A	E cal/mol	Temp. range (T)
0	0.180	3400	713-863
0	0.280	2600	863-1153
100	0.207	3400	733-873
100	0.288	2800	873-1193

These values are based on the work of Lisitskii, Tret'yakova, and Fomichev (capillary method) [90]. The values in italics were obtained by evaluating the temperature-dependent equations. The remainder were obtained by interpolating the graphical presentation.

$ZnCl_2$ - $CdBr_2$

Melt Preparation and Purification

The method used by Prisyazhnyii et al. for melt preparation is described under the system $CdCl_2$-$ZnBr_2$.

TABLE 281. Electrical conductance studies: $ZnCl_2$-$CdBr_2$

Investigations critically re-examined		
Ref.	$CdBr_2$ mol %	Temp. range (T)
69[a]	0-100	873

Deviations from previous NSRDS recommendations [1, pp. 10, 17]

Ref.	$CdBr_2$ mol %	Departure
69	0	−0.98% (873 K)
69	100	−0.66% (873 K)

[a]See footnote on the following table. Reference [69] reported equivalent conductance. The departures given in this table were calculated by comparing the reported values to the recommended equivalent conductance values of reference [1].

TABLE 282. $ZnCl_2$-$CdBr_2$: Specific conductance ($ohm^{-1}cm^{-1}$)

Mol % $CdBr_2$	873 K
0	[0.2375]
20	0.3967
30	0.4853
40	0.5840
50	0.6692
60	0.7842
70	0.8807
80	0.9684
100	1.1297

These values are based on the work of Voronin, Prisyazhnyii and Baronov (classical ac technique) [69]. These authors reported equivalent conductance. Conversion to specific conductance was made using the density data of Markov and Prisyazhnyii [30], except for the value in square brackets, which was converted using the density data recommended in [1].

TABLE 283. Density studies: $ZnCl_2$-$CdBr_2$

Investigations critically re-examined			
Ref.	$CdBr_2$ mol %	Temp. range (T)	Comments
30[a]	0-100	623-953	Quartz ball weighted with tungsten; calibration: water and carbon tetrachloride.

Deviations from previous NSRDS recommendations [1, pp. 11, 17]			
Ref.	$CdBr_2$ mol %	Min. departure	Max. departure
30	100	0.00% (900 K)	0.15% (940 K)
30	0	0.0% (680 K)	−0.24% (760 K)

[a]Markov and Prisyazhnyii [30] did not correct for the thermal expansion of the quartz float inasmuch as the errors involved were much less that the overall accuracy of the results (±0.2%).

TABLE 284. $ZnCl_2$-$CdBr_2$: Density (g cm^{-3})

T	Mol percent $CdBr_2$										
	100	90	80	70	60	50	40	30	20	10	0
630											2.503
640											2.498
650											2.493
660											2.488
670											2.483
680											2.478
690											2.473
700											2.468
710											2.463
720											2.458
730											2.453
740											2.448
750										2.651	2.443
760										2.646	2.438
770								3.016	2.836	2.641	
780							3.194	3.010	2.830	2.635	
790							3.187	3.003	2.824	2.630	
800							3.181	2.997	2.818	2.625	
810							3.174	2.990	2.812	2.619	
820					3.487	3.332	3.167	2.984	2.806	2.614	
830				3.637	3.480	3.325	3.161	2.977	2.800	2.609	
840		3.915	3.775	3.629	3.473	3.318	3.154	2.971	2.795	2.604	
850		3.906	3.766	3.622	3.465	3.311	3.147	2.964	2.789	2.598	
860		3.897	3.758	3.614	3.458	3.304	3.140	2.958	2.783	2.593	
870	4.038	3.888	3.749	3.606	3.451	3.297	3.134	2.951	2.777	2.588	
880	4.029	3.879	3.741	3.598	3.443	3.289	3.127	2.945	2.771	2.582	
890	4.020	3.870	3.733	3.590	3.436	3.282	3.120	2.939	2.765	2.577	
900	4.010	3.861	3.724	3.582	3.428	3.275	3.114	2.932	2.759		
910	4.001	3.852				3.268	3.107	2.926			
920	3.992	3.843					3.100				
930	3.983	3.835									
940	3.974										
950	3.965										

TABLE 284. $ZnCl_2$-$CdBr_2$: Density (g cm^{-3})—Continued

Temperature-dependent equations $\rho = a - bT$		
Mol % $CdBr_2$	a	$b \cdot 10^4$
0	2.822	5.06
10	3.049	5.30
20	3.290	5.90
30	3.514	6.46
40	3.710	6.70
50	3.921	7.18
60	4.093	7.38
70	4.290	7.86
80	4.482	8.42
90	4.668	8.96
100	4.834	9.15

These values are based on the work of Markov and Prisyazhnyii (Archimedean method) [30]. The results were estimated to be accurate to ±0.2%. The following equation, with concentration, C, in mole percent $ZnCl_2$ and temperature in K, has been derived from the preceding data: $\rho = a + bC + cT^3 + dC^3 + eTC^2 + fCT^2$, where a = 4.27958, $b \cdot 10^2$ = −1.52851, $c \cdot 10^{10}$ = −3.73712, $d \cdot 10^7$ = −1.58968, $e \cdot 10^8$ = −1.22211, $f \cdot 10^9$ = 1.88010 with a maximum departure of −0.33% at 623.2 K and 100 mol % $ZnCl_2$ and a standard error of estimate of 0.10%. This equation may be used to calculate the density of $ZnCl_2$-$CdBr_2$ melts at any composition in the temperature range 623-953 K.

$ZnCl_2$ - $PbBr_2$

Melt Preparation and Purification

The method used by Prisyazhnyii and his associates for melt preparation is described under the system $CdCl_2$-$ZnBr_2$.

TABLE 285. Electrical conductance studies: $ZnCl_2$-$PbBr_2$

Investigations critically re-examined		
Ref.	$PbBr_2$ mol %	Temp. range (T)
61	0-100	873

Deviations from previous NSRDS recommendations [1, pp. 10, 18]		
Ref.	$PbBr_2$ mol %	Departure
61	0	−1.05% (873 K)
61	100	−2.03% (873 K)

TABLE 286. $ZnCl_2$-$PbBr_2$: Equivalent conductance (ohm^{-1} cm^2 equiv^{-1})

Mol % $PbBr_2$	873 K
0	6.765
20	18.98
30	24.60
40	29.87
50	34.05
60	38.03
70	40.84
80	43.15
100	46.76

These values are those obtained experimentally by Prisyazhnyii and Voronin (classical ac technique) [61]. No density data was given by these authors. However, if for $ZnCl_2$, the density is taken to be that given by the equation recommended in [1], the specific conductance may be calculated from the above data as 0.237 ohm^{-1}cm^{-1}, a value which departs from that recommended in [1] by 1.74%. There is no recommended density data for $PbBr_2$ in this temperature range.

5.5. Chloride-Iodide Systems

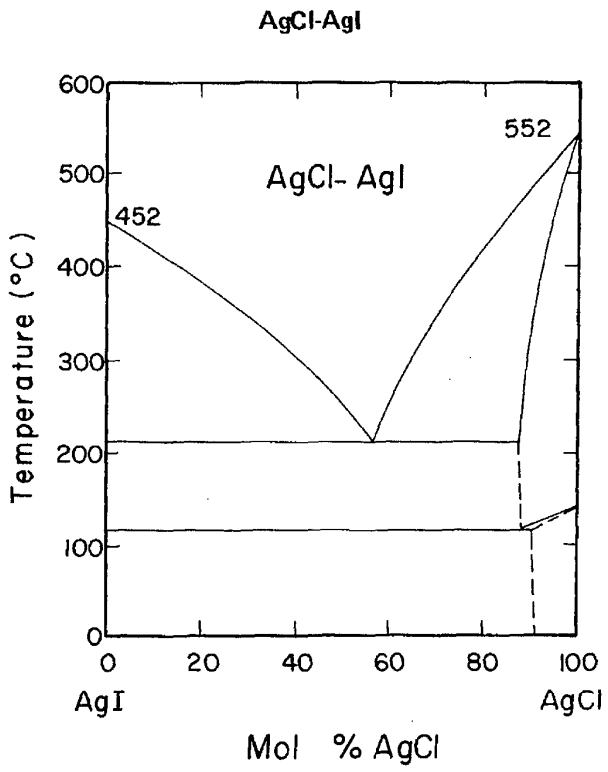

FIGURE 39. Temperature-composition phase diagram for AgCl-AgI.

K. Monkemeyer, Neues Jahrb. Mineral., Geol., 22, 33 (1906).

Melt Preparation and Purification

Tubandt and Lorenz [53] prepared AgI and AgCl by reacting $AgNO_3$ with KI and HCl, respectively. The salts were dried at 300 °C, the AgCl under an atmosphere of chlorine.

TABLE 287. Electrical conductance studies: AgCl-AgI

Investigations critically re-examined			
Ref.	AgI mol %	Temp. range (T)	Comments
53	10, 58, 75, 90	573-873	Porcelain cell; Pt electrodes; calibration: 1N KCl solution at 25 °C.

TABLE 288. AgCl-AgI: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent AgI			
	90	75	58	10
580			2.27	
590			2.31	
600			2.34	
610			2.37	
620			2.41	
630			2.44	
640			2.47	
650			2.50	
660			2.52	
670			2.55	
680			2.57	
690			2.60	
700			2.62	
710			2.64	
720			2.66	
730		2.35	2.68	3.40
740		2.36	2.70	3.44
750		2.38	2.72	3.47
760		2.39	2.74	3.50
770		2.41	2.75	3.53
780		2.42	2.77	3.57
790		2.43	2.78	3.60
800		2.44	2.79	3.63
810		2.46	2.80	3.66
820		2.47	2.81	3.69
830	[2.43]	2.48	2.82	3.71
840	[2.44]	2.49	2.83	3.74
850	[2.45]	2.50	2.84	3.77
860	[2.46]	2.51	2.84	3.80
870	[2.48]	2.52	2.85	3.82

Temperature-dependent equations
$\kappa = a + bT + cT^2$

AgI mol %	a	bx10^3	cx10^6	Standard of error estimate
10	−0.693	7.791	−2.988	0.13%
58	−1.634	9.912	−5.475	0.25%
75	0.213	4.383	−1.994	0.0009%
90	[1.432]	[1.200]	0	0.0000%

These values are based on the work of Tubandt and Lorenz (classical ac technique) [53]. Values in brackets were generated from fewer than five data points.

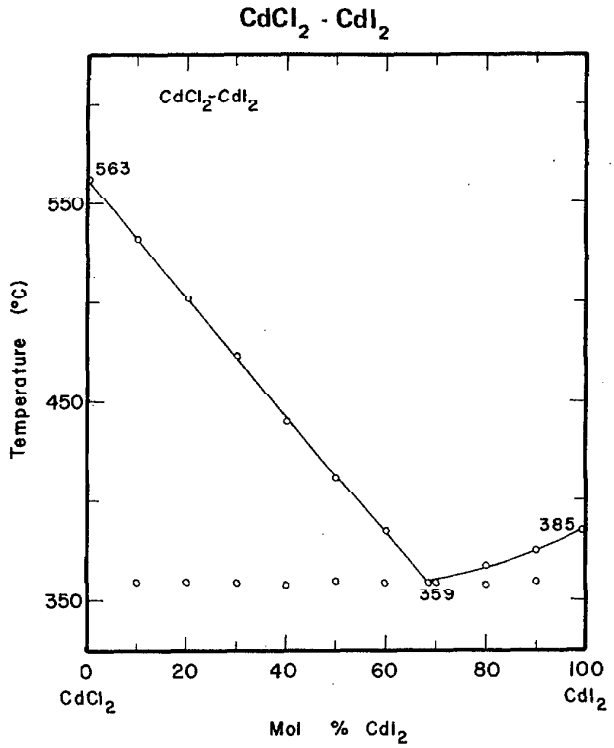

FIGURE 40. Temperature-composition phase diagram for $CdCl_2$-CdI_2.

R. Nacken, Neues Jahrb. Mineral, Geol., Palaeontol., **26**, 301 (1907).

Melt Preparation and Purification

Bloom et al. [14] prepared cadmium salts by direct reaction of the highly purified elements. Electroanalytic and volumetric analyses showed the product to be better than 99.98% pure. See also $CdCl_2$-$CdBr_2$.

TABLE 289. Electrical conductance studies: $CdCl_2$-CdI_2

Investigations critically re-examined			
Ref.	CdI_2 mol %	Temp. range (T)	Comments
14	0, 25, 50, 75, 100	640-973	Silica or B.T.H. #37 glass capillary cell; Pt electrodes; freq. range: 100-10,000 Hz; calibration: 1N KCl solutions.

Deviations from previous NSRDS recommendations [1, pp. 11, 22]			
Ref.	CdI_2 mol %	Min. departure	Max. departure
14	100	0.35% (840 K)	3.6% (680 K)
14	0	−0.10% (920 K)	0.79% (1000 K)

TABLE 290. $CdCl_2$-CdI_2: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent CdI_2				
	100	75.0	50.0	25.0	0
650		0.309			
665		0.335			
680	0.232	0.363			
695	0.257	0.392	0.584		
710	0.283	0.422	0.619		
725	0.310	0.452	0.655		
740	0.339	0.484	0.691		
755	0.370	0.516	0.727		
770	0.401	0.549	0.764		
785	0.434	0.583	0.802	1.089	
800	0.469	0.617	0.839	1.129	
815	0.504	0.652	0.877	1.169	
830	0.541	0.688	0.915	1.208	
845	0.580	0.724	0.954	1.248	
860	0.619	0.761	0.992	1.287	1.910
875	0.660	0.798	1.031	1.326	1.952
890	0.702	0.836	1.070	1.365	1.994
905	0.745	0.874	1.109	1.403	2.036
920	0.789	0.912	1.148	1.442	2.077
935	0.834	0.951	1.187	1.480	2.118
950	0.880	0.991	1.227	1.518	2.157
965	0.927	1.030	1.266	1.556	2.197

TABLE 290. $CdCl_2$-CdI_2: Specific conductance (ohm^{-1} cm^{-1})—Continued

Temperature-dependent equations
$\kappa = A \cdot \exp(-E/RT)$

CdI_2 mol %	A	E (cal mol^{-1})
0	6.92	2200
25.0	7.36	2980
50.0	9.28	3820
75.0	12.4	4770
100	25.3	6340

These values are based on the work of Bloom, Knaggs, Molloy and Welch (classical ac technique) [14]. The temperature range given by the authors is "from approximately ten degrees above the liquidus to 700 °C (973 K)". The overall accuracy was estimated as ±0.5%.

TABLE 291. Density studies: $CdCl_2$-CdI_2

Investigations critically re-examined

Ref.	CdI_2 mol %	Temp. range (T)	Comments
14[a]	0-100	640-973	See KCl-NaBr.
56	0-100 (g)	913	Pt sphere (float).

[a]Reference [14] is the NSRDS reference data base for the density of pure molten $CdCl_2$ and of pure molten CdI_2.

TABLE 292. $CdCl_2$-CdI_2: Density (g cm^{-3})

T	Mol percent CdI_2				
	100	75.0	50.0	25.0	0.0
650		4.239			
660		4.228			
670	4.385	4.218			
680	4.373	4.207			
690	4.362	4.197			
700	4.351	4.186	3.991		
710	4.340	4.175	3.982		
720	4.329	4.165	3.973		
730	4.318	4.154	3.965		
740	4.306	4.144	3.956		
750	4.295	4.133	3.947		
760	4.284	4.122	3.938		
770	4.273	4.112	3.929		
780	4.262	4.101	3.921	3.746	
790	4.251	4.091	3.912	3.738	
800	4.239	4.080	3.903	3.729	
810	4.228	4.069	3.894	3.720	
820	4.217	4.059	3.885	3.712	
830	4.206	4.048	3.877	3.703	
840	4.195	4.038	3.868	3.694	
850	4.184	4.027	3.859	3.685	
860	4.172	4.016	3.850	3.677	3.370
870	4.161	4.006	3.841	3.668	3.362
880	4.150	3.995	3.833	3.659	3.354
890	4.139	3.985	3.824	3.651	3.346
900	4.128	3.974	3.815	3.642	3.338
910	4.117	3.963	3.806	3.633	3.330
920	4.105	3.953	3.797	3.625	3.322
930	4.094	3.942	3.789	3.616	3.314
940	4.083	3.932	3.780	3.607	3.306
950	4.072	3.921	3.771	3.598	3.298
960	4.061	3.910	3.762	3.590	3.290
970	4.050	3.900	3.753	3.581	3.282

TABLE 292. $CdCl_2$-CdI_2: Density (g cm^{-3})—Continued

Temperature-dependent equations
$\rho = a - bT$

CdI_2 Mol %	a	$b \cdot 10^4$
0.0	4.058	8.0
25.0	4.425	8.70
50.0	4.607	8.80
75.0	4.928	10.60
100.0	5.133	11.17

These values are based on the work of Bloom, Knaggs, Molloy and Welch (Archimedean method) [14]. The temperature range is from approximately ten degrees above the liquidus to 973 K. The accuracy is estimated to be ±0.1%.

The following equation, with concentration, C, in mole percent $CdCl_2$ and temperature in K, has been derived from the preceding data: $\rho = a + bT + cC + dC^2 + eC^3 + fTC + gCT^2$, where $a = 5.15125$, $b \cdot 10^3 = -1.13701$, $c \cdot 10^2 = -1.33473$, $d \cdot 10^5 = 5.40955$, $e \cdot 10^7 = -5.97772$, $f \cdot 10^6 = 9.67135$, $g \cdot 10^9 = -3.26930$, with a maximum departure of -0.40% at 772.0 K and 75 mol % $CdCl_2$ and a standard error of estimate of 0.24%. This equation may be used to calculate the density of $CdCl_2$-CdI_2 melt in the temperature range given above.

TABLE 293. Viscosity studies: $CdCl_2$-CdI_2

Investigations critically re-examined		
Ref.	CdI_2 mol %	Temp. range
48	0-100 (g)	683-793

TABLE 294. $CdCl_2$-CdI_2: Viscosity (cp)

Mol % $CdCl_2$	683 K	723 K	763 K	793 K
0	9.3	6.7	5.2	4.2
10	8.3	6.1	5.1	4.2
20	8.1	6.1	5.2	4.2
30	7.9	5.9	5.1	4.2
40	8.0	6.1	5.1	4.2
50	7.9	6.0	5.2	4.2

These values have been interpolated to two significant figures from the graphical presentation of Barsegov and Ilyasov (capillary technique) [48].

CsCl - CsI

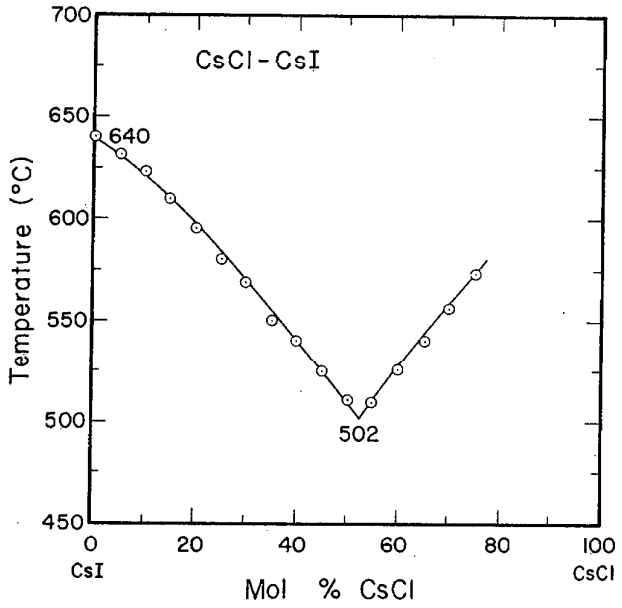

FIGURE 41. Temperature-composition phase diagram for CsCl-CsI.
I.I. Il'yasov and A.G. Bergman, Zhur. Neorg. Khim., 9, [6] 768 (1964).

Melt Preparation and Purification

Zuca's method of melt preparation and purification is described under the system CsCl-CsBr. B.D.H. reagent-grade cesium halides were used [38].

TABLE 295. Electrical conductance studies: CsCl-CsI

Investigations critically re-examined

Ref.	CsI mol %	Temp. range (T)	Comments
38	0-100	933-1148	Silica U-shaped capillary cell; Pt electrodes; freq. range: 1000 to 7000 Hz; calibration: 0.1M and 1.0M KCl solutions.
83,85, 91	0-100	923-1073	Pt electrodes; freq.: 50,000 Hz.

Deviations from NSRDS recommendations
[1, pp. 6, 20 and this volume]

Ref.	CsI mol %	Min. departure	Max. departure
38	100	2.3% (940 K)	−8.8% (1060 K)
91	100	−0.54% (935 K)	−11.38% (1070 K)
91	75	1.66% (940 K)	2.01% (1015 K)
91	50	0.00% (1020 K)	−0.14% (970 K)
91	25	−0.22% (1045 K)	−0.39% (970 K)
38	0	0.08% (970 K)	−6.3% (1080 K)
91	0	0.06% (960 K)	−5.49% (1070 K)

TABLE 296. CsCl-CsI: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent CsI				
	100	75	50	25	0
940	0.746	0.793			
950	0.759	0.808			1.220
960	0.771	0.822			1.242
970	0.784	0.836	0.937	1.069	1.264
980	0.796	0.850	0.953	1.087	1.286
990	0.808	0.964	0.968	1.105	1.308
1000	0.820	0.878	0.983	1.123	1.329
1010	0.832	0.891	0.998	1.141	1.350
1020	0.843	0.904	1.013	1.158	1.371
1030	0.855	0.918	1.028	1.176	1.392
1040	0.866	0.931	1.043	1.193	1.412
1050	0.877	0.943	1.057	1.210	1.432
1060	0.888	0.956	1.071	1.226	1.452
1070	0.899	0.969	1.085	1.243	1.472
1080		0.981	1.099	1.259	1.491
1090		0.993	1.112	1.275	
1100		1.005	1.125	1.291	
1110		1.017			

Temperature-dependent equations
$\kappa = a + bT + cT^2$

CsI mol %	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate	Temp. range (T)
0	−2.0036	4.5422	−1.2096	0.03%	943.2-1148.2
25	−1.6435	3.7543	−0.9877	0.02%	933.2-1103.2
50	−1.4771	3.4061	−0.9455	0.03%	948.2-1108.2
75	−1.2937	2.9874	−0.8160	0.03%	933.2-1113.2
100	−1.1976	2.8516	−0.8339	0.03%	943.2-1148.2

These values are based on the work of Zuca and Olteanu (classical ac technique) [38].

TABLE 297. Density studies: CsCl-CsI

Investigations critically re-examined

Ref.	CsI mol %	Temp. range (T)	Comments
38	0-100	933-1133	Pt bob; calibration: water.
74,85, 91	0-100	923-1073	Pt sphere; calibration: molten KNO_3.

Deviations from NSRDS recommendations [1, pp. 6, 20, and this volume]

Ref.	CsI mol %	Min. departure	Max. departure
38	100	0.47% (1080 K)	0.77% (940 K)
85	100	0.49% (1070 K)	0.94% (930 K)
85	75	−0.11% (1070 K)	−0.11% (940 K)
85	50	−0.30% (970 K)	−0.32% (1070 K)
85	25	−0.04% (1070 K)	−0.90% (970 K)
38	0	0.30% (1080 K)	0.36% (950 K)
85	0	0.40% (940 K)	0.53% (1070 K)

TABLE 298. CsCl-CsI: Density (g cm^{-3})

T	Mol percent CsI				
	100	75	50	25	0
940		3.073			2.779
950	3.141	3.061			2.768
960	3.128	3.049			2.757
970	3.115	3.036	2.960	2.855	2.746
980	3.103	3.024	2.948	2.844	2.735
990	3.090	3.012	2.936	2.832	2.725
1000	3.078	3.000	2.924	2.820	2.714
1010	3.065	2.987	2.913	2.809	2.703
1020	3.053	2.975	2.901	2.797	2.692
1030	3.040	2.963	2.889	2.785	2.681
1040	3.027	2.950	2.877	2.774	2.670
1050	3.015	2.938	2.865	2.762	2.660
1060	3.002	2.926	2.854	2.750	2.649
1070	2.990	2.914	2.842	2.739	2.638
1080	2.977	2.901	2.830	2.727	2.627
1090		2.889	2.818	2.715	
1100		2.877	2.806	2.704	
1110		2.864	2.794	2.692	
1120		2.852	2.783	2.680	
1130				2.668	

Temperature-dependent equations

$\rho = a - bT$

Mol % CsI	a	$b \cdot 10^3$
0	3.7987	1.0849
25	3.9872	1.1670
50	4.1068	1.1823
75	4.2279	1.2283
100	4.3345	1.2568

These values are based on the work of Zuca and Olteanu (Archimedean method) [38]. The data were reported in equation form with no error estimate. The following equation, with concentration, C, in mole percent CsCl and temperature in K, has been derived from the preceding data: $\rho = a + bT + cC + dC^2 + eCT^2$, where $a = 4.34318$, $b \cdot 10^3 = -1.26695$, $c \cdot 10^3 = -3.42565$, $d \cdot 10^6 = -9.63920$, $e \cdot 10^{10} = 7.60146$, with a maximum departure of −0.22% at 1123.3 K and 50 mol % CsCl and a standard error of estimate of 0.13%. This equation may be used to calculate the density of CsCl-CsI melts at any composition in the temperature range 933-1133 K.

TABLE 299. Viscosity studies: CsCl-CsI

Investigations critically re-examined		
Ref.	CsI mol %	Temp. range (T)
65	0-100	See footnote a.

Deviations from previous NSRDS recommendations [1, p. 20; 5, p. 885]

Ref.	CsI mol %	Departure
65	0	−2.82% (1070 K)
65	100	−11.3% (1070 K)

[a]The temperature range was not given. The isotherm at 1070 K (molar viscosity versus composition) was reported and the values in the following table were calculated from these data.

TABLE 300. CsCl-CsI: Viscosity (cp)

Mol % CsI	1073 K
0	1.03_4
25	1.03_2
50	1.02_0
75	1.01_3
100	1.01_1

These values are based on the work of Smirnov, Khokhlov and Antonov (oscillating sphere method) [65] and the density data of Stepanov and Shumov [74]. The data were reported in equation form with no error estimate.

TABLE 301. CsCl-CsI: Molar Viscosity (erg s mol^{-1})[a]

Temperature-dependent equations $\log \eta_M = A + B/T$		
Mol % CsI	$-A$	B
0	1.1743	1065
25	1.0934	1018
50	1.0351	987
75	0.9726	950
100	0.9142	918

Equations as reported by Smirnov, Khokhlov and Antonov [65] (see footnote, table 299); of limited value since temperature limits of applicability and standard deviation were not reported.

[a]Molar viscosity is defined by $\eta(M\rho^{-1})$ where $M = X_1M_1 + X_2M_2$, and ρ, X_1, X_2, are the density and mol fraction composition of the molten mixture, with the units of η in poise.

TABLE 302. Surface tension studies: CsCl-CsI

Investigations critically re-examined		
Ref.	CsI mol %	Temp. range (T)
74	12-100	923-1073

Deviations from previous NSRDS recommendations [2, p. 64]

Ref.	CsI mol %	Min. departure	Max. departure
74	100	0.93% (950 K)	2.10% (1073 K)

TABLE 303. CsCl-CsI: Surface tension (dyn cm^{-1})

T	Mol percent CsI							
	100	88	75	63	50	37	25	12
930	73.2	74.7	76.8	78.7	80.8	83.3	85.6	88.3
940	72.6	74.1	76.2	78.1	80.2	82.6	84.9	87.5
950	72.0	73.5	75.6	77.5	79.5	81.9	84.2	86.8
960	71.5	73.0	75.0	76.8	78.8	81.2	83.5	86.0
970	70.9	72.4	74.3	76.2	78.2	80.5	82.8	85.3
980	70.3	71.9	73.7	75.6	77.5	79.8	82.0	84.5
990	69.8	71.3	73.1	74.9	76.9	79.1	81.3	83.7
1000	69.2	70.7	72.5	74.3	76.2	78.4	80.6	83.0
1010	68.6	70.1	71.9	73.7	75.5	77.7	79.9	82.2
1020	68.7	69.5	71.3	73.0	74.9	77.0	79.2	81.5
1030	67.5	69.0	70.6	72.4	74.2	76.3	78.4	80.7
1040	66.9	68.4	70.0	71.7	73.6	75.6	77.7	80.0
1050	66.4	67.8	69.4	71.1	72.9	74.9	77.0	79.2
1060	65.8	67.2	68.8	70.5	72.2	74.2	76.3	78.5
1070	65.2	66.7	68.2	69.8	71.6	73.5	75.6	77.7

Temperature-dependent equations
$\rho = a - bT$

Mol % CsI	a	$b \cdot 10^2$
12	158.2	7.52
25	152.6	7.20
37	147.8	6.94
50	142.2	6.60
63	138.0	6.37
75	134.4	6.19
88	128.3	5.76
100	125.9	5.67

These values are based on the work of Stepanov and Smirnov (maximum bubble pressure method) [74]. The precision was estimated to be ±0.1 dny cm^{-1}. The following equation, with concentration, C, in mole percent CsI and temperature in K, has been derived from the above data: $\gamma = a + bT + cTC + dTC^2 + eCT^2$, where a = 161.70416, $b \cdot 10^2$ = −7.63280, $c \cdot 10^4$ = −5.75318, $d \cdot 10^7$ = 4.11532, $e \cdot 10^7$ = 3.71699, with a maximum departure of 0.34% at 1073 K and 100 mol % CsI, and a standard error of estimate of 0.052. This equation may be used to calculate the surface tension of CsCl-CsI melts at any composition in the temperature range 923-1073 K.

CsCl-KI

Melt Preparation and Purification

Prisyazhnyii and Bryzgailo [57] used chemically pure grade salts recrystallized from doubly-distilled water and fused under an inert gas atmosphere.

TABLE 304. Density studies: CsCl-KI

Investigations critically re-examined			
Ref.	KI mol %	Temp. range (T)	Comments
57	0-100 (g)	1073	Quartz sphere filled with molybdenum or tungsten; calibration: water.

TABLE 305. CsCl-KI: Density (g cm^{-3})

Mol % CsCl	1073 K
0	2.32
10	2.34
20	2.36
30	2.38
40	2.40
50	2.42
60	2.46
70	2.48
80	2.52
90	2.56
100	2.62

These values have been interpolated to three significant figures from the graphical presentation of Prisyazhnyii and Bryzgailo (Archimedean method) [57].

TABLE 306. Electrical conductance studies: $HgCl_2$-HgI_2

Investigations critically re-examined

Ref.	$HgCl_2$ mol %	Temp. range (T)	Comments
25	0-100	473-573	Glass vessel; Pt electrodes; frequency: 1000 Hz; calibration: molten KNO_3.

Deviations from previous NSRDS recommendations [1, pp. 11, 22]

Ref.	$HgCl_2$ mol %	Min. departure	Max. departure
25	100	7.4% (550 K)	9.7% (570 K)
25	0	7.5% (573 K)	

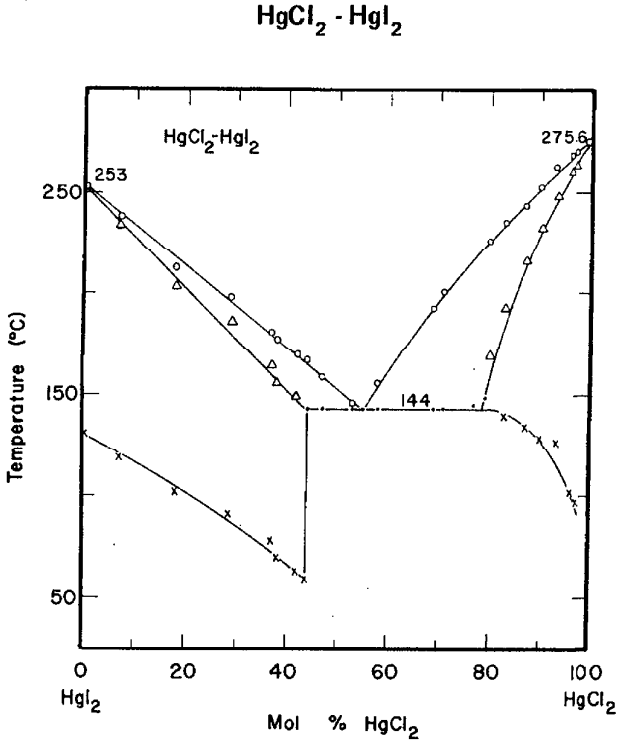

FIGURE 42. Temperature-composition phase diagram for $HgCl_2$-HgI_2.

L. Loskna, Gazz. Chim. Ital. 56. 301 (1926).

Melt Preparation and Preparation

The mercuric iodide used by Bergman and Chavin [25] was prepared by reacting $HgCl_2$ with potassium iodide. Both the mercuric iodide and the mercuric chloride were purified by sublimation. The salts were stored over concentrated sulfuric acid.

TABLE 307. $HgCl_2$-HgI_2: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent HgI_2										
	100	90	80	70	60	50	40	30	20	10	0[a]
480				0.0229	0.0160	0.0091	0.0050				
490				0.0227	0.0160	0.0093	0.0051				
500			0.0294	0.0224	0.0160	0.0094	0.0053	0.0023			
510			0.0288	0.0222	0.0160	0.0095	0.0054	0.0025			
520			0.0283	0.0220	0.0160	0.0097	0.0056	0.0026			
530		[0.0317]	0.0277	0.0217	0.0160	0.0098	0.0057	0.0028	[0.0012]		
540		[0.0311]	0.0271	0.0215	0.0160	0.0100	0.0058	0.0029	[0.0014]		
550	[0.0303]	[0.0306]	0.0265	0.0213	0.0160	0.0101	0.0060	0.0030	[0.0015]	[0.0008]	
560	[0.0293]	[0.0300]	0.0260	0.0210	0.0160	0.0102	0.0061	0.0032	[0.0018]	[0.0011]	
570	[0.0283]	[0.0294]	0.0254	0.0208	0.0160	0.0104	0.0062	0.0033	[0.0020]	[0.0013]	
573.2											0.0013

Temperature-dependent equations
$\kappa = a + bT + cT^2$

Mol % HgI_2	$a \cdot 10^2$	$b \cdot 10^4$	$c \cdot 10^7$	Standard error of estimate
10	[−1.2357]	[0.2400]	0	0.00%
20	[−3.2309]	[1.0571]	[−0.800]	0.00%
30	−1.5567	0.5558	−0.3956	0.55%
40	−0.1516	0.1360	0	0.56%
50	0.2395	0.1400	0	0.28%
60	1.6000	−0.000003	0	0.00%
70	3.4457	−0.2400	0	0.00%
80	5.8206	−0.5760	0	0.94%
90	[1.3316]	[1.1942]	[−1.600]	0.00%
100	[8.5320]	[−1.0000]	0	0.00%

[a]The experimental value is given for pure $HgCl_2$.

These values are based on the work of Bergman and Chavin (classical ac technique) [25]. Values in square brackets were generated from fewer than five data points.

KCl - CsI

Melt Preparation and Purification

See CsCl-KI.

TABLE 308. Density studies: KCl-CsI

Investigations critically re-examined			
Ref.	CsI mol %	Temp. range (T)	Comments
57	0-100 (g)	1073	Float: quartz sphere weighted with tungsten or molybdenum; calibration: water.

TABLE 309. KCl-CsI: Density (g cm^{-3})

Mol percent CsI	1073 K
0	1.50
10	1.74
20	1.94
30	2.12
40	2.28
50	2.42
60	2.55
70	2.66
80	2.76
90	2.86
100	2.96

These values have been interpolated to three significant figures from the graphical presentation of Prisyazhnyii and Bryzgailo (Archimedean method) [57].

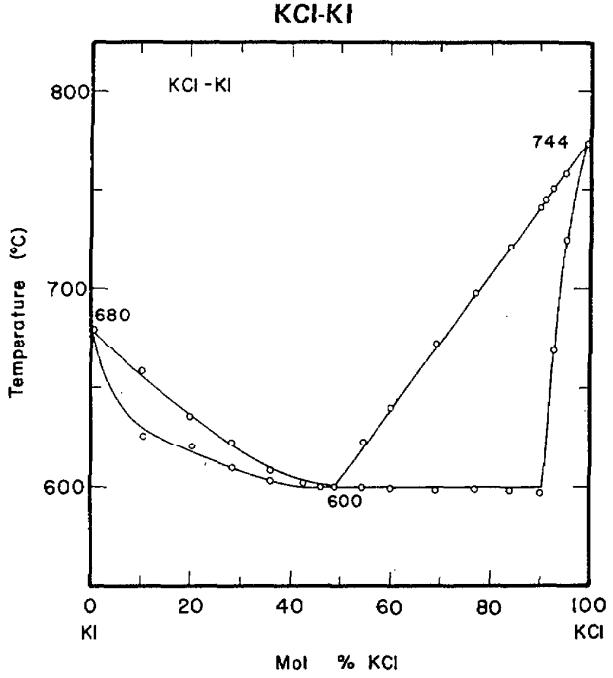

FIGURE 43. Temperature-composition phase diagram for KCl-KI.

M. Amadori and G. Pampanini, Atti della Reale Accad. dei Lincei, (5), 20, II, 572 (1911).

Melt Preparation and Preparation

Van Artsdalen and Yaffe [16] used analytical-grade reagents dried by fusion under an atmosphere of hydrogen or argon gas. The melts were cooled, pulverized, and stored under a dry atmosphere. Mixtures were dried by gradually raising the temperature from room temperature to slightly above the melting point (Pt-Rh crucible). Each mixture was tested for hydrolysis after each experiment. Composition was determined by analysis for total chloride by precipitation with silver nitrate.

TABLE 311. Electrical conductance studies: KCl-KI

Investigations critically re-examined			
Ref.	KI mol %	Temp. range (T)	Comments
16	0-100	881-1198	Quartz dip-type capillary cell; Pt electrodes; freq. range: 2000-20,000 Hz; calibration: 1 demal KCl.
62	eutectic (g)	1174-1372	

Reference [16] is the NSRDS data base for KCl and KI.

Resistance measurements in the frequency range 2000-20,000 Hz were found to vary less than 0.5%. Recalibration of the cell after each experiment showed changes of less than 0.3% (average 0.1%) in the cell constant. The conductance data were reported in temperature-dependent equations of the form $\kappa = a + bT + cT^2$ with standard deviations in the range 1×10^{-3} ohm^{-1} cm^{-1} (at 93.96 mol % KI) to 3.0×10^{-3} ohm^{-1} (at 100 mol percent KI and at 100 mol percent KCl) [16].

TABLE 312. KCl-KI: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent KI							
	100	93.96	84.70	74.33	54.85	38.88	19.78	0
890					1.2708			
900					1.2979			
910				1.2624	1.3246			
920				1.2881	1.3508	1.2951		
930				1.3132	1.3766	1.3431		
940				1.3377	1.4020	1.3893		
950			1.3268	1.3618	1.4270	1.4337		
960	1.2622		1.3474	1.3852	1.4515	1.4762		
970	1.2904	1.3067	1.3678	0.4082	0.4757	1.5168		
980	1.3176	1.3314	1.3879	1.4306	1.4994	1.5556		
990	1.3439	1.3552	1.4077	1.4524	1.5226	1.4925	1.7183	
1000	1.3692	1.3784	1.4273	1.4737	1.5455	1.6275	1.7508	
1010	1.3935	1.4008	1.4466	1.4945	1.5679	1.6607	1.7821	
1020	1.4168	1.4225	1.4656	1.5148	1.5899	1.6920	1.8124	
1030	1.4391	1.4435	1.4843	1.5344	1.6115	1.7214	1.8415	
1040	1.4604	1.4638	1.5028	1.5536	1.6327	1.7490	1.8695	
1050	1.4808	1.4833	1.5210	1.5722	1.6534	1.7747	1.8964	
1060	1.5001	1.5021	1.5390	1.5903	1.6737	1.7985	1.9222	2.1967
1070	1.5185	1.5201	1.5566	1.6078	1.6936	1.8205	1.9469	2.2248
1080	1.5359	1.5374	1.5741	1.6248	1.7130	1.8406	1.9704	2.2521
1090	1.5523	1.5540	1.5912	1.6413	1.7320	1.8589	1.9928	2.2785
1100	1.5678	1.5699	1.6081	1.6572	1.7507	1.8753	2.0142	2.3041
1110	1.5822	1.5850	1.6247	1.6725	1.7688	1.8898	2.0344	2.3288
1120	1.5957	1.5994	1.6410	1.6874	1.7866	1.9025	2.0534	2.3528
1130	1.6081	1.6131	1.6571	1.7017	1.8039	1.9133	2.0714	2.3759
1140	1.6196	1.6261	1.6729	1.7154	1.8208	1.9222	2.0883	2.3981
1150	1.6302	1.6383	1.6884	1.7286	1.8373	1.9293	2.1040	2.4195
1160	1.6397	1.6498	1.7037	1.7413	1.8534	1.9345	2.1186	2.4401
1170	1.6482	1.6606	1.7187	1.7534	1.8690	1.9379	2.1321	2.4598
1180	1.6558							2.4787
1190								2.4968

Temperature-dependent equations

$$\kappa = a + bT + cT^2$$

Mol % KI	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate
0	- 5.5231	11.7136	-4.1800	0.9%
19.78	- 7.0191	14.3482	-5.5783	0.16%
38.88	-11.1003	22.0457	-9.3179	4.42%
54.85	- 2.8414	6.5099	-2.1231	0.14%
75.33	- 3.3338	7.5105	-2.7030	0.17%
84.70	- 1.8547	4.6219	-1.3400	0.19%
93.96	- 4.5474	9.5720	-3.6462	0.04%
100	- 6.0292	12.3188	-4.9204	0.49%

These values are based on the work of Van Artsdalen and Yaffe (classical ac method) [16].

TABLE 313. Density studies: KCl-KI

Investigations critically re-examined			
Ref.	KI mol %	Temp. range (T)	Comments
16	0-100	892-1212	Calibrated Pt bob suspended by a Pt-Rh wire; data corrected for thermal expansion of the Pt.

Reference [16] is the NSRDS data base for the density of molten KCl and KI (NSRDS-NBS 15) [1].

Both the experimental density values and linear temperature-dependent equations were reported. Standard deviations were in the range 2 x 10^{-4} g cm^{-3} at 38.88 mol percent KI to 8 x 10^{-4} g cm^{-3} at 54.85 mol percent KI.

TABLE 314. KCl-KI: Density (g cm^{-3})

T	Mol percent KI							
	100.00	93.96	84.04	74.33	54.85	38.88	19.78	0.00
900					2.166			
910					2.158			
920				2.297	2.150			
930				2.288	2.141			
940				2.279	2.133			
950				2.271	2.125			
960	2.442	2.391		2.262	2.117	1.980		
970	2.432	2.382		2.253	2.108	1.973		
980	2.423	2.372	2.353	2.244	2.100	1.965		
990	2.413	2.363	2.345	2.235	2.092	1.957	1.779	
1000	2.404	2.354	2.336	2.226	2.084	1.950	1.772	
1010	2.394	2.345	2.327	2.217	2.075	1.942	1.765	
1020	2.385	2.336	2.319	2.208	2.067	1.935	1.759	
1030	2.375	2.327	2.310	2.199	2.059	1.927	1.752	
1040	2.366	2.318	2.301	2.191	2.051	1.920	1.745	
1050	2.356	2.308	2.293	2.182	2.042	1.912	1.738	
1060	2.347	2.299	2.284	2.173	2.034	1.905	1.731	1.518
1070	2.337	2.290	2.275	2.164	2.026	1.897	1.724	1.512
1080	2.327	2.281	2.267	2.155	2.018	1.890	1.717	1.506
1090	2.318	2.272	2.258	2.146	2.009	1.882	1.710	1.501
1100	2.308	2.263	2.249	2.137	2.001	1.874	1.703	1.495
1110	2.299	2.254	2.241	2.128	1.993	1.867	1.696	1.489
1120	2.289	2.245	2.232	2.119	1.985	1.859	1.690	1.483
1130	2.280	2.235	2.223	2.110	1.976	1.852	1.683	1.477
1140	2.270	2.226	2.215	2.102	1.968	1.844	1.676	1.471
1150	2.261	2.217	2.206	2.093	1.960	1.837	1.669	1.466
1160	2.251	2.208	2.198	2.084	1.952	1.829	1.662	1.460
1170	2.242	2.199	2.189	2.075	1.943	1.822	1.655	1.454
1180				2.066		1.814		1.448
1190								1.442
1200								1.436
1210								1.430

Temperature-dependent equations

$\rho = a - bT$

Mol % KI	a	$b \cdot 10^4$	Standard of error estimate
0.00	2.1376	5.8445	0.03%
19.78	2.4625	6.9017	0.03%
38.88	2.7042	7.5432	0.01%
54.85	2.9088	8.2524	0.04%
74.33	3.1155	8.8940	0.01%
84.04	3.2007	8.6476	0.03%
93.96	3.2676	9.1348	0.10%
100.00	3.3568	9.5313	0.02%

These values are based on the work of Van Artsdalen and Yaffe (Archimedean method) [16].

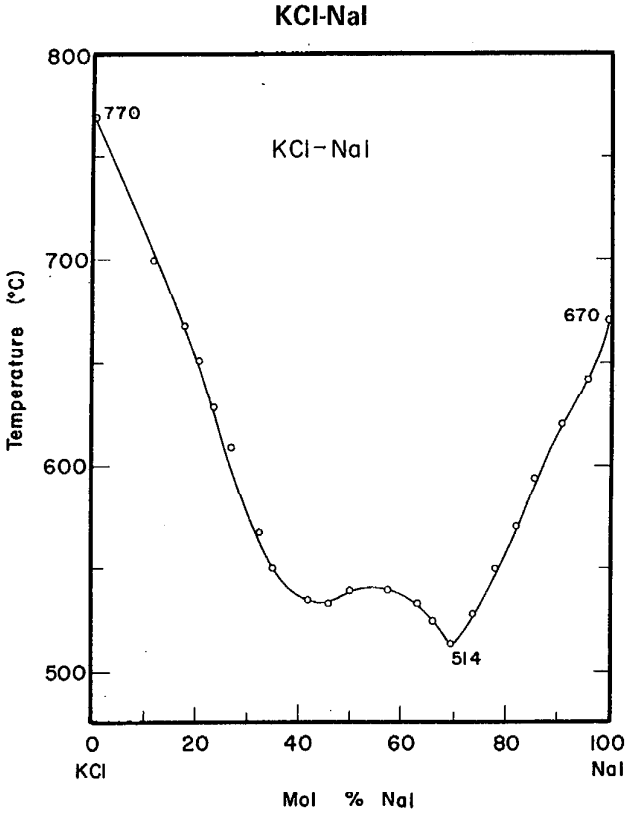

FIGURE 44. Temperature-composition phase diagram for KCl-NaI.

N. M. Vaksberg, Zh. Russ. Fiz. Khim, Ova., Chast Khim., **62**, 1259 (1930).

Melt Preparation and Purification

Bloom et al. [14, 75] used salts of analytical reagent quality or prepared to a purity of not less than 99.8%. Standard methods of analysis were used. Each salt was dried or fused before use and allowed to cool in a desiccator. Mixtures were prepared by weighing the dried salts directly into the silica containers.

TABLE 315. Electrical conductance studies: KCl-NaI

Investigations critically re-examined

Ref.	NaI mol %	Temp. range (*T*)	Comments
14[a]	0-100	803-1073	Cell material: capillary cells of silica or B.T.H. #37 glass; Pt electrodes; freq. range: 100-10,000 Hz; calibration: 1N KCl solution.

Deviations from previous NSRDS recommendations [1, pp. 5, 19]

Ref.	NaI mol %	Min. departure	Max. departure
14	100	4.0% (940 K)	0.78% (1180 K)
14	0	−0.45% (1070 K)	−0.64% (1060 K)

[a]Bloom et al. [14] used a dipping type conductivity cell with one electrode enclosed in a capillary tube and the other outside. Conductivity through the wall of the capillary was found to be negligible.

TABLE 316. KCl-NaI: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent NaI						
	100	85.0	66.7	50.0	33.3	15.0	0
810			1.468				
820			1.503				
830			1.538	1.407			
840			1.573	1.439			
850			1.608	1.471	1.438		
860			1.643	1.504	1.472		
870			1.678	1.536	1.506		
880		1.906	1.713	1.568	1.540		
890		1.940	1.747	1.600	1.573		
900		1.973	1.782	1.632	1.607		
910		2.006	1.816	1.664	1.641		
920		2.039	1.851	1.696	1.675		
930		2.072	1.885	1.727	1.708		
940		2.105	1.919	1.759	1.742		
950	2.378	2.137	1.953	1.791	1.776		
960	2.406	2.170	1.987	1.822	1.810		
970	2.434	2.202	2.021	1.853	1.843	1.869	
980	2.462	2.234	2.055	1.884	1.876	1.900	
990	2.489	2.266	2.088	1.915	1.910	1.931	
1000	2.516	2.297	2.122	1.946	1.943	1.962	
1010	2.543	2.328	2.155	1.977	1.976	1.993	
1020	2.570	2.360	2.188	2.008	2.009	2.024	
1030	2.596	2.391	2.221	2.038	2.042	2.055	
1040	2.622	2.421	2.254	2.069	2.075	2.085	
1050	2.648	2.452	2.286	2.099	2.107	2.116	
1060	2.674	2.482	2.319	2.129	2.140	2.146	2.189
1070	2.699	2.512	2.351	2.159	2.172	2.176	2.219

TABLE 316. KCl-NaI: Specific conductance (ohm^{-1} cm^{-1})—Continued

Temperature-dependent equations $\kappa = A \exp(-E/RT)$		
NaI mol %	A	E (cal mol^{-1})
0	9.14	3010
15.0	9.53	3140
33.3	10.7	3390
50.0	9.50	3150
66.7	10.2	3120
85.0	9.03	2720
100	7.35	2130

These values are based on the work of Bloom, Knaggs, Molloy and Welch (classical ac technique) [14]. The overall accuracy of the measurements was estimated to be about 0.5%. The temperature range of applicability is approximately ten degrees above the liquidus to 800 °C (1070 K).

TABLE 317. Density studies: KCl-NaI

Investigations critically re-examined			
Ref.	NaI mol %	Temp. range (T)	Comments
14	0-100	803-1073	Silica cell; Pt-10% Rh sinker and suspension wire.
34,43	0-100 (g)	1073	

Deviations from previous NSRDS recommendations [1, pp. 5, 19]			
Ref.	NaI mol %	Min. departure	Max. departure
14	100	0.04% (1200 K)	0.36% (940 K)
14	0	0.53% (1060-1080 K)	

Markov and Prisyazhnyii [34,43] reported molar volume versus composition.

Bloom et al. [14] took precautions to prevent air bubbles from clinging to the sinker and corrected for the thermal expansion of the silica.

TABLE 318. KCl-NaI: Density (g cm^{-3})

T	Mol percent NaI								
	100.0	95.0	85.0	66.7	50.0	33.7	15.0	5.0	0.0
810				2.488					
820				2.479					
830				2.470	2.271				
840				2.461	2.262				
850				2.452	2.254	2.063			
860				2.443	2.246	2.056			
870				2.434	2.238	2.049			
880			2.618	2.425	2.230	2.041			
890			2.610	2.416	2.222	2.034			
900			2.601	2.407	2.213	2.027			
910			2.593	2.398	2.205	2.019			
920			2.585	2.389	2.197	2.012			
930		2.697	2.577	2.380	2.189	2.005			
940		2.688	2.568	2.371	2.181	1.998			
950	2.735	2.678	2.560	2.362	2.173	1.990			
960	2.725	2.669	2.552	2.353	2.165	1.983			
970	2.715	2.659	2.544	2.344	2.156	1.976	1.760		
980	2.705	2.650	2.535	2.335	2.148	1.969	1.753		
990	2.695	2.640	2.527	2.326	2.140	1.961	1.747		
1000	2.685	2.631	2.519	2.317	2.132	2.954	1.741		
1010	2.675	2.622	2.511	2.308	2.124	1.947	1.735		
1020	2.665	2.612	2.503	2.299	2.116	1.939	1.728		
1030	2.655	2.603	2.494	2.290	2.108	1.932	1.722	1.600	
1040	2.645	2.593	2.486	2.281	2.099	1.925	1.716	1.594	
1050	2.635	2.584	2.478	2.272	2.091	1.918	1.710	1.587	
1060	2.625	2.574	2.470	2.263	2.083	1.910	1.703	1.581	1.526
1070	2.615	2.565	2.461	2.254	2.075	1.903	1.697	1.575	1.520

Temperature-dependent equations

$\rho = a - bT$

NaI mol %	a	$b \cdot 10^4$
0.0	2.146	5.85
5.0	2.228	6.10
15.0	2.366	6.25
33.7	2.681	7.27
50.0	2.947	8.15
66.7	3.217	9.00
85.0	3.343	8.24
95.0	3.574	9.43
100.0	3.685	10.00

These values are based on the work of Bloom, Knaggs, Molloy and Welch (Archimedean method) [14]. The overall accuracy was estimated to be within ±0.1%. The temperature limits of applicability are from approximately ten degrees above the liquidus to 800 °C (1073 K).

The following equation, with C in mole percent KCl and temperature in K, has been derived from the preceding data: $\rho = a + bT + cC + dT^3 + eTC$, where a = 3.61971, $b \cdot 10^4 = -9.36537$, $c \cdot 19^2 = -1.34736$, $d \cdot 10^8 = -2.68418$, $e \cdot 10^6 = 2.58584$, with a maximum departure of −0.41% at 1073.0 K and 66.7 mol % KCl, and a standard error of estimate of 0.20%. This equation may be used to calculate the density of KCl-NaI melts at any composition in the temperature range given above.

TABLE 319. Surface tension studies: KCl-NaI

Investigations critically re-examined			
Ref.	NaI mol %	Temp. range (T)	Comments
75	0-100	820-1260	Cell material: Pt-10% Rh capillary; calibration: diameter of capillary checked with microscope, method checked using benzene.

Deviations from previous NSRDS recommendations [2, pp. 58, 64]			
Ref.	NaI mol %	Min. departure	Max. departure
75	100	5.57% (760 K)	−6.54% (860 K)
75	0	−1.52% (970 K)	−1.99% (780 K)

TABLE 320. KCl-NaI: Surface tension (dyn cm^{-1})

T	Mol percent NaI							
	100.0	92.0	85.0	66.7	50.0	33.3	15.0	0.0
820				90.0				
840				88.7	89.4			
860				87.4	88.3	91.0		
880			85.3	86.2	87.1	89.8		
990			84.0	84.9	86.0	88.5		
920		83.2	82.6	83.7	84.8	87.3		
940		81.8	81.2	82.4	83.7	86.0		
960	85.6	80.4	79.8	81.1	82.6	84.7	89.9	
980	83.8	79.0	78.4	79.9	81.4	83.5	88.6	
1000	82.0	77.6	77.1	78.6	80.3	82.2	87.2	
1020	80.2	76.2	75.7		79.1	81.0	85.9	
1040	78.4	74.8	74.3			79.7	84.6	
1060	76.6	73.4	72.9			78.4	83.3	97.8
1080	74.8	72.0	71.5				82.0	96.3
1100	73.0	70.6					80.6	94.8
1120	71.2						79.3	93.4
1140	69.4						78.0	91.9
1160	67.6						76.7	90.5
1180								89.0
1200								87.5
1220								86.1
1240								84.6
1260								83.2

Temperature-dependent equations

$\gamma = a - bT$

NaI mol %	a	$b \cdot 10^2$
0.0	175.1	7.3
15.0	153.2	6.6
33.3	145.2	6.3
50.0	137.3	5.7
66.7	141.6	6.3
85.0	146.1	6.9
92.0	147.6	7.0
100.0	172.0	9.0

These values are based on the work of Bloom, Davis and James (maximum bubble pressure method) [75]. The estimated accuracy is ±0.25 dyn cm^{-1}

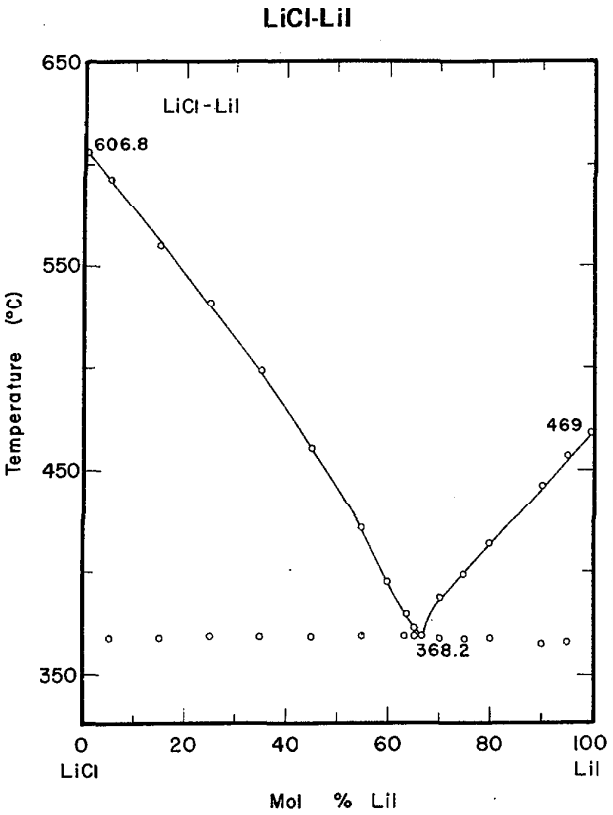

FIGURE 45. Temperature-composition phase diagram for LiCl-LiI. Argonne National Laboratory, ANL-7316, Galvanic Cells with Fused Salt Electrolytes (1967).

Melt Preparation and Purification

Johnson [89] used purified reagent-grade salts. Anhydrous hydrogen halide was used to remove the last traces of water from the melt. The melting point of the pure salts were 606.8 °C (LiCl) and 469.2 °C (LiI). Reference [82] contains no information on melt preparation.

TABLE 321. Electrical conductance studies: LiCl-LiI

Investigations critically re-examined			
Ref.	LiI mol %	Temp. range (T)	Comments
82	0-100	708-1113	Pt electrodes; freq: 50,000 Hz.
89[a]	65.4, 100	677-822	Quartz capillary cell; Pt electrodes; *freq. range: 5000-45,000* Hz.

Deviations from previous NSRDS recommendations [1, pp. 4, 19]			
Ref.	LiI mol %	Min. departure	Max. departure
82	100	0.29% (875 K)	0.40% (760 K)
82	0	0.00% (970 K)	−0.15% (1055 K)

[a]Reference [89] is the NSRDS data base for the specific conductance of molten lithium iodide (NSRDS-NBS 15) [1].

TABLE 322. LiCl-LiI: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent LiI								
	100	88	75	63	50	38.8	25	12	0
710	3.737	3.556	3.445	3.381	3.394	3.550	3.787	4.066	4.566
730	3.846	3.669	3.563	3.510	3.522	3.681	3.927	4.211	4.721
750	3.954	3.779	3.676	3.627	3.646	3.810	4.066	4.351	4.867
770	4.054	3.881	3.788	3.742	3.768	3.935	4.199	4.486	5.011
790	4.151	3.983	3.894	3.856	3.885	4.055	4.330	4.619	5.149
810	4.245	4.078	3.997	3.965	3.997	4.174	4.457	4.746	5.278
830	4.335	4.171	4.097	4.071	4.107	4.285	4.578	4.868	5.406
850	4.420	4.261	4.193	4.175	4.213	4.395	4.694	4.988	5.528
870	4.504	4.345	4.282	4.273	4.315	4.501	4.806	5.100	5.644
890	4.580	4.428	4.370	4.369	4.413	4.605	4.916	5.209	5.759
910	4.657	4.506	4.456	4.462	4.509	4.702	5.021	5.314	5.865
930	4.727	4.582	4.536	4.550	4.598	4.798	5.122	5.414	5.969
950	4.794	4.651	4.612	4.635	4.686	4.889	5.218	5.512	6.069
970	4.861	4.719	4.687	4.716	4.769	4.977	5.312	5.605	6.163
990	4.920	4.784	4.759	4.796	4.849	5.063	5.402	5.693	6.255
1010	4.977	4.847	4.826	4.872	4.929	5.145	5.488	5.777	6.342
1030	5.032	4.905	4.892	4.944	5.001	5.223	5.572	5.859	6.429
1050	5.085	4.961	4.951	5.013	5.071	5.297	5.648	5.935	6.507
1070	5.135	5.013	5.012	5.081	5.140	5.369	5.723	6.008	6.580
1090	5.180	5.063	5.066	5.145	5.203	5.439	5.797	6.079	6.651
1110	5.224	5.109	5.120	5.205	5.266	5.504	5.867	6.145	6.717

TABLE 322. LiCl-LiI: Specifiic conductance (ohm^{-1} cm^{-1})—Continued

Temperature-dependent equations $\kappa = a + bT + cT^2 + dT^3$					
Mol % LiI	$-a$	$b \cdot 10^2$	$-c \cdot 10^6$	$d \cdot 10^9$	Standard error of estimate
100	3.51092	1.56298	8.77783	1.60882	0.021%
88	3.65514	1.53284	8.32632	1.46868	0.018%
75	3.81377	1.50531	7.67359	1.22731	0.023%
63	3.86681	1.46228	6.93385	1.01195	0.027%
50	4.10924	1.50729	7.01107	0.936919	0.020%
38.8	3.86521	1.45371	6.24782	0.680230	0.017%
25	4.43008	1.64056	7.48671	0.957169	0.025%
12	4.42037	1.70250	7.81731	0.949083	0.018%
0	4.79817	1.946696	9.98996	1.61865	0.028%

These values are based on the work of Smirnov, Khokhlov, Stepanov, and Shumov (classical ac technique) [82]. The data were reported as equivalent conductance in equation form. The equations given above were generated by converting equivalent to specific specific conductivity using the density equations given in [82].

TABLE 323. Density studies: LiCl-LiI

Investigations critically re-examined			
Ref.	LiI mol %	Temp. range (T)	Comments
82	0-100	708-1113	Pt sphere; calibration: molten potassium nitrate.

Deviations from previous NSRDS recommendations [1, pp. 4, 19]			
Ref.	LiI mol %	Min. departure	Max. departure
82	100	0.48% (760 K)	0.49% (880 K)
82	0	−0.01% (910 K)	−0.14% (1050 K)

TABLE 324. LiCl-LiI: Density (g cm^{-3})

T	Mol percent LiI				
	100	75	50	25	0
710	3.154	2.858	2.522	2.116	1.579
730	3.135	2.841	2.507	2.104	1.570
750	3.117	2.824	2.493	2.093	1.561
770	3.099	2.807	2.478	2.081	1.553
790	3.080	2.790	2.463	2.069	1.544
810	3.062	2.773	2.449	2.057	1.535
830	3.043	2.756	2.434	2.045	1.526
850	3.025	2.739	2.419	2.033	1.517
870	3.007	2.722	2.404	2.021	1.508
890	2.988	2.705	2.389	2.009	1.499
910	2.970	2.688	2.375	1.997	1.490
930	2.951	2.671	2.360	1.985	1.481
950	2.933	2.654	2.345	1.973	1.472
970	2.915	2.637	2.330	1.961	1.463
990	2.896	2.620	2.315	1.949	1.454
1010	2.878	2.603	2.301	1.937	1.445
1030	2.859	2.587	2.286	1.925	1.437
1050	2.841	2.569	2.271	1.913	1.428
1070	2.823	2.553	2.256	1.901	1.419
1090	2.804	2.535	2.241	1.889	1.410
1110	2.786	2.519	2.227	1.877	1.401

Temperature-dependent equations

$$\rho = a - bT$$

Mol % LiI	a	$b \cdot 10^3$	Standard deviation
0	1.896	0.446	0.005
25	2.541	0.598	0.005
50	3.047	0.739	0.005
75	3.461	0.849	0.005
100	3.807	0.920	0.005

These values are based on the work of Smirnov, Khokhlov, Stepanov and Shumov (modified maximum bubble pressure method) [82].

TABLE 325. Surface tension studies: LiCl-LiI

Investigations critically re-examined			
Ref.	LiI mol %	Temp. range (T)	Comments
79[a]	25-100	832-1115	Molybdenum crucible; calibration: molten NaCl.

[a]Reference [79] is the NSRDS data base for the surface tension of molten lithium iodide (NSRDS-NBS 15) [6].

TABLE 326. LiCl-LiI: Surface tension (dyn cm^{-1})

T	Mol percent LiI			
	100	75	50	25
840		101.7		
850		101.0		
860	92.1	100.4		
870	91.5	99.8		
880	91.0	99.2		124.7
890	90.4	98.6		123.9
900	89.9	98.0		123.2
910	89.3	97.3	108.1	122.4
920	88.7	96.7	107.5	121.7
930	88.1	96.1	106.8	121.0
940	87.6	95.5	106.1	120.2
950	87.0	94.9	105.5	119.5
960	86.5	94.3	104.8	118.7
970	85.9	93.7	104.1	118.0
980	85.3	93.0	103.4	117.3
990	84.8	92.4	102.7	116.5
1000	84.2	92.8	102.1	115.8
1010	83.6	91.2	101.4	115.1
1020	83.1	90.6	100.7	114.3
1030	82.5	89.9	100.1	113.6
1040	81.9	89.3	99.4	112.8
1050	81.4	88.7	98.7	112.1
1060	80.8	88.1	98.1	111.4
1070	80.2	87.5	97.4	110.6
1080	79.7	86.9	96.7	109.9
1090	79.1	86.2	96.0	109.1
1100	78.5		95.4	
1110	78.0		94.7	

Temperature-dependent equations
$\gamma = a - bT$

Mol % LiI	a	b
25	189.6	0.0738
50	169.4	0.0673
75	153.5	0.0617
100	140.7	0.0565

These values are based on the work of Smirnov and Stepanov (maximum bubble pressure method) [79]. The data on the mixtures was reported in equation form with no estimate of error.

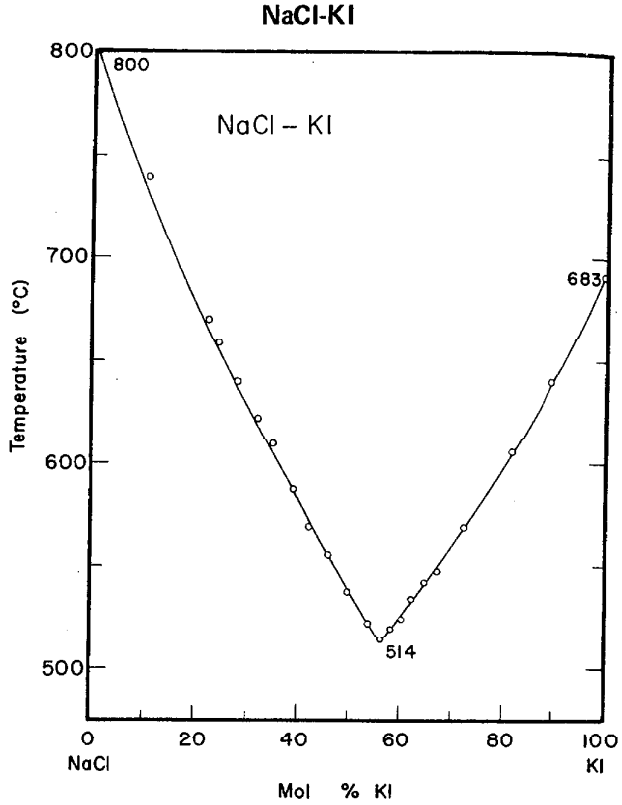

FIGURE 46. Temperature-composition phase diagram for NaCl-KI.

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Melt Preparation and Purification

See KCl-NaI.

TABLE 327. Electrical conductance studies: NaCl-KI

Investigations critically re-examined

Ref.	KI mol %	Temp. range (T)	Comments
14	15-100	811-1073	Capillary cell of silica or B.T.H. #37 glass; Pt electrodes; freq. range: 100-10,000 Hz; calibration: 1N KCl solution.

Deviations from previous NSRDS recommendations [1, p. 19]

Ref.	KI mol %	Min. departure	Max. departure
14	100	1.10% (100 K)	0.19% (1080 K)

See also KCl-NaI.

TABLE 328. NaCl-KI: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent KI					
	100	85.0	70.0	50.0	30.0	15.0
830				1.425		
840				1.457		
850			1.282	1.490		
860			1.311	1.523		
870			1.341	1.555		
880			1.370	1.588		
890			1.399	1.620		
900			1.428	1.653		
910		1.327	1.457	1.685		
920		1.353	1.486	1.717	2.051	
930		1.378	1.515	1.749	2.089	
940		1.404	1.544	1.781	2.126	
950		1.430	1.573	1.813	2.163	
960		1.455	1.602	1.845	2.200	
970	1.324	1.481	1.630	1.877	2.237	
980	1.344	1.506	1.659	1.908	2.274	
990	1.364	1.531	1.687	1.940	2.310	
1000	1.384	1.557	1.716	1.971	2.346	2.759
1010	1.404	1.582	1.744	2.002	2.383	2.803
1020	1.424	1.607	1.772	2.033	2.419	2.845
1030	1.443	1.632	1.800	2.064	2.454	2.888
1040	1.463	1.656	1.828	1.095	2.490	2.931
1050	1.482	1.681	1.856	2.126	2.525	2.973
1060	1.501	1.706	1.884	2.156	2.561	3.015
1070	1.521	1.730	1.911	2.186	2.596	3.057

Temperature-dependent equations

$\kappa = A \cdot \exp(-E/RT)$

Mol % KI	A	E (cal mol^{-1})
15.0	13.2	3110
30.0	11.0	3070
50.0	9.62	3150
70.0	8.94	3280
85.0	7.83	3210
100	5.81	2850

These values are based on the work of Bloom, Knaggs, Molloy and Welch (classical ac technique) [14]. The overall error was estimated to be about ±0.5%. The temperature range to which these equations apply was given as from approximately ten degrees above the liquidus to 800 °C (1073 K).

TABLE 329. Density studies: NaCl-KI

Investigations critically re-examined

Ref.	KI mol %	Temp. range (T)
14	15-100	811-1073
34,43	0-100 (g)	1073

Deviations from previous NSRDS recommendations [1, p. 19]

Ref.	KI mol %	Min. departure	Max. departure
14	100	0.25% (1000 K)	0.26% (1080 K)

Markov and Prisyazhnyii [34,43] reported isotherms of molar volume versus composition. See KCl-NaCl for a brief discussion of Bloom's [14] experimental techniques.

TABLE 330. NaCl-KI: Density (g cm^{-3})

T	Mol percent KI					
	100.0	85.0	70.0	50.0	30.0	15.0
830				2.271		
840				2.263		
850			2.398	2.255		
860			2.389	2.247		
870			2.381	2.238		
880			2.372	2.230		
890			2.363	2.222		
900			2.355	2.214		
910		2.420	2.346	2.206		
920		2.410	2.338	2.198	2.027	
930		2.401	2.329	2.189	2.020	
940		2.391	2.320	2.181	2.013	
950		2.381	2.312	2.173	2.006	
960		2.372	2.303	2.165	1.999	
970	2.439	2.362	2.295	2.157	1.992	
980	2.429	2.352	2.286	2.148	1.985	
990	2.420	2.343	2.278	2.140	1.978	
1000	2.410	2.333	2.269	2.132	1.971	1.794
1010	2.400	2.323	2.260	2.124	1.964	1.788
1020	2.391	2.314	2.252	2.116	1.957	1.781
1030	2.381	2.304	2.243	2.107	1.950	1.775
1040	2.372	2.294	2.235	2.099	1.943	1.769
1050	2.362	2.285	2.226	2.091	1.936	1.762
1060	2.352	2.275	2.218	2.083	1.929	1.756
1070	2.343	2.265	2.209	2.075	1.922	1.750

Temperature-dependent equations

$\rho = a - bT$

Mol % KI	a	$b \cdot 10^4$
0.0[a]	2.165	5.66
15.0	2.426	6.32
30.0	2.677	7.06
50.0	2.951	8.19
70.0	3.127	8.58
85.0	3.298	9.65
100.0	3.370	9.60

These values are based on the work of Bloom, Knaggs, Molloy and Welch (Archimedean method) [14]. The error in the measurements was estimated as approximately ±0.1%. The temperature range is from approximately ten degrees above the liquidus to 800 °C (1073 K). The following equation, with concentration, C, in mole percent NaCl and temperature in K, has been derived from the above data: $\rho = a + bT + cC + dC^3 + eTC + fTC^2$, where a =3.39993, $b \cdot 10^4$ = −9.90846, $c \cdot 10^3$ = −8.15935, $d \cdot 10^7$ = −4.42548, $e \cdot 10^6$ = 3.3976, $f \cdot 10^9$ = 8.79927, with a maximum departure of −0.38% at 1066.0 K and 30 mol % NaCl, and a standard error of estimate of 0.24%. This equation may be used to calculate the density of NaCl-KI melts at any composition in the temperature range given above.

Temperature range of density equation for pure NaCl was not in [14].

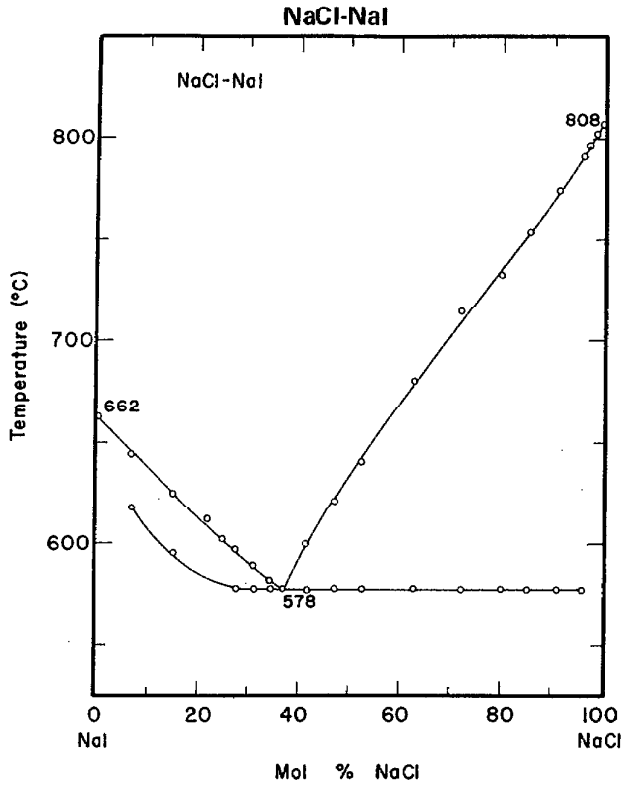

FIGURE 47. Temperature-composition phase diagram for NaCl-NaI.

M. Amadori, Atti della Reale Accad. dei Lincei, (5), 21, I, 467 (1912).

Melt Preparation and Purification

Zuca's [27] method of drying salts is described under the system CsCl-CsBr.

TABLE 331. Electrical conductance studies: NaCl-NaI

Investigations critically re-examined			
Ref.	NaI mol %	Temp. range (T)	Comments
27	0-100	928-1223	Silica U-shaped capillary cell; Pt electrodes; freq. range: 1000-7000 Hz, calibration: 0.1 and 1.0 molar KCl solutions.

Deviations from previous NSRDS recommendations [1, pp. 4, 19]			
Ref.	NaI mol %	Min. departure	Max. departure
27	100	0.31% (1040 K)	4.3% (960 K)
27	0	−0.33% (1090 K)	−1.8% (1200 K)

TABLE 332. NaCl-NaI: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent NaI					
	100	80	60	40	20	0
960	2.425					
970	2.446					
980	2.466		2.538			
990	2.486		2.562			
1000	2.506	2.525	2.585	2.736		
1010	2.525	2.545	2.608	2.759		
1020	2.545	2.565	2.631	2.783		
1030	2.563	2.585	2.653	2.807		
1040	2.582	2.605	2.675	2.830	3.107	
1050	2.600	2.624	2.697	2.853	3.132	
1060	2.619	2.643	2.718	2.875	3.156	
1070	2.636	2.662	2.739	2.898	3.180	
1080	2.654	2.681	2.759	2.920	3.203	
1090	2.671	2.700	2.779	2.941	3.227	3.628
1100	2.688	2.718	2.799	2.963	3.250	3.652
1110	2.705	2.737	2.818	2.984	3.274	3.677
1120	2.721	2.755	2.836	3.005	3.297	3.701
1130		2.773			3.320	3.725
1140						3.748
1150						3.771
1160						3.794
1170						3.816
1180						3.838
1190						3.860
1200						3.882

TABLE 332. NaCl-NaI: Specific conductance (ohm^{-1} cm^{-1})—Continued

Temperature-dependent equations $\kappa = a + bT + cT^2$					
NaI mol %	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate	Temp. range (T)
0	−1.0299	6.0554	−1.6353	0.03%	1080.2-1223.2
20	−0.3133	4.1474	−0.8252	0.05%	1034.2-1153.2
40	−1.0201	5.1027	−1.3470	0.03%	997.2-1133.2
60	−1.7985	6.4285	−2.0448	0.03%	928.2-1123.2
80	−0.3913	3.8130	−0.8964	0.09%	976.2-1133.2
100	−0.8315	4.7141	−1.3768	0.07%	943.2-1153.2

These values are based on the work of Zuca and Ionescu-Vasu (classical ac technique) [27].

TABLE 333. Density studies: NaCl-NaI

Investigations critically re-examined			
Ref.	NaI mol %	Temp. range (T)	Comments
27	0-100	953-1203	Pt bob; calibration: water.

Deviations from previous NSRDS recommendations [1, pp. 4, 19]			
Ref.	NaI mol %	Min. departure	Max. departure
27	100	−0.04% (1120 K)	−0.11% (960 K)
27	0	3.0% (1120 K)	3.5% (1200 K)

TABLE 334. NaCl-NaI: Density (g cm^{-3})

T	Mol percent NaI					
	100	80	60	40	20	0
960	2.713					
970	2.703					
980	2.694		2.356			
990	2.685		2.349			
1000	2.675	2.520	2.341	2.135		
1010	2.666	2.512	2.333	2.128		
1020	2.656	2.503	2.325	2.121		
1030	2.647	2.494	2.317	2.114	1.871	
1040	2.638	2.485	2.309	2.107	1.865	
1050	2.628	2.477	2.302	2.100	1.859	
1060	2.619	2.468	2.294	2.093	1.852	
1070	2.609	2.459	2.286	2.086	1.846	
1080	2.600	2.451	2.278	2.079	1.840	
1090	2.591	2.442	2.270	2.072	1.834	1.546
1100	2.581	2.433	2.262	2.065	1.827	1.540
1110	2.572	2.425	2.255	2.058	1.821	1.535
1120	2.563	2.416	2.247	2.051	1.815	1.529
1130		2.407			1.808	1.524
1140						1.518
1150						1.513
1160						1.508
1170						1.502
1180						1.497
1190						1.491
1200						1.486

TABLE 334. NaCl-NaI: Density (g cm^{-3})—Continued

Temperature-dependent equation
$\rho = a - bT$

Mol % NaI	a	$b \cdot 10^3$
0	2.1390	0.5444
20	2.5162	0.6263
40	2.8372	0.7020
60	3.1240	0.7832
80	3.3898	0.8696
100	3.6144	0.9392

These values are based on the work of Zuca and Ionescu-Vasu (Archimedean method) [27]. The precision of the measurements is estimated to be about 0.1%.

The following equation, with concentration, C, in mole percent NaCl and temperature in K, has been derived from the preceding data: $\rho = a + bT + cC^2 + dTC + eTC^2 + fCT^2$, where $a = 3.66166$, $b \cdot 10^4 = -9.86391$, $c \cdot 10^5 = 5.30277$, $d \cdot 10^5 = -2.19827$, $e \cdot 10^8 = -8.71001$, $f \cdot 10^8 = 1.50135$, with a maximum departure of 0.70% at 1082.2 K and 100 mol % NaCl, and a standard error of estimate of 0.15%. This equation may be used to calculate the density of NaCl-NaI melts at any composition in the temperature range 935-1203 K.

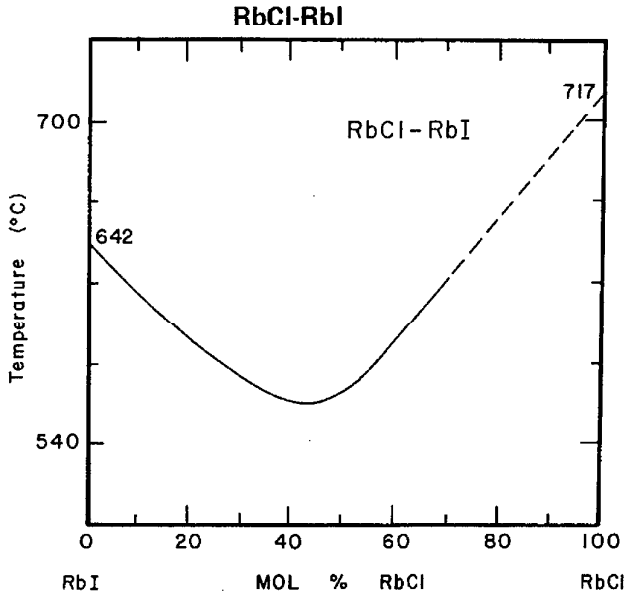

FIGURE 48. Temperature-composition phase diagram for RbI-RbCl.

I. I. Il'yasov and Yu. G. Litvinov, Ukr. Khim. Zh. 40. 476 (1974).

Melt Preparation and Purification

See CsCl-CsBr.

TABLE 335. Electrical conductance studies: RbCl-RbI

Investigations critically re-examined			
Ref.	RbI mol %	Temp. range (T)	Comments
38	0-100	933-1193	Silica U-shaped capillary cell; Pt electrodes; freq. range: 1000-7000 Hz; calibration: 0.1M and 1.0M KCl solutions.

Deviations from previous NSRDS recommendations [1, pp. 6, 20]			
Ref.	RbI mol %	Max. departure	Min. departure
38	100	0.10% (980 K)	−1.8% (1100 K)
38	0	0.11% (1060 K)	−3.0% (1190 K)

TABLE 336. RbCl-RbI: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent RbI				
	100	75	50	25	0
950	0.927				
960	0.943			1.236	
970	0.958			1.257	
980	0.973	1.047	1.142	1.278	
990	0.987	1.062	1.160	1.298	
1000	1.002	1.077	1.177	1.319	
1010	1.016	1.092	1.195	1.339	
1020	1.031	1.107	1.212	1.358	1.602
1030	1.044	1.122	1.229	1.378	1.624
1040	1.058	1.136	1.245	1.397	1.646
1050	1.072	1.150	1.262	1.416	1.668
1060	1.085	1.164	1.278	1.435	1.690
1070	1.098	1.178	1.294	1.454	1.712
1080	1.111	1.191	1.310	1.472	1.733
1090	1.124	1.205	1.325	1.490	1.753
1100	1.137	1.218	1.341	1.508	1.774
1110		1.231	1.356	1.526	1.794
1120		1.244	1.371	1.543	1.814
1130		1.256	1.386	1.560	1.834
1140			1.400	1.577	1.853
1150					1.872
1160					1.891
1170					1.909
1180					1.927
1190					1.945

Temperature-dependent equations

$$\kappa = a + bT + cT^2$$

RbI mol %	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate	Temp. range (T)
0	−2.2588	5.2957	−1.4815	0.02%	1013.2-1193.2
25	−1.9108	4.4425	−1.2130	0.02%	953.2-1143.2
50	−1.6220	3.8578	−1.0585	0.02%	973.2-1143.2
75	−1.4319	3.4938	−0.9946	0.02%	973.2-1143.2
100	−1.4378	3.4345	−0.9947	0.03%	933.2-1103.2

These values are based on the work of Zuca and Olteanu (classical ac technique [38].

TABLE 337. Density studies: RbCl-RbI

Investigations critically re-examined			
Ref.	RbI mol %	Temp. range (T)	Comments
38	0-100	943-1233	Pt bob; calibration: water.

Deviations from previous NSRDS recommendations [1, pp. 6, 20]			
Ref.	RbI mol %	Min. departure	Max. departure
38	100	0.0% (980 K)	−0.11% (1100 K)
38	0	0.0% (1100 K)	0.14% (1140 K)

TABLE 338. RbCl-RbI: Density (g cm^{-3})

T	Mol percent RbI				
	100	75	50	25	0
950	2.863		2.613	2.455	
960	2.852	2.741	2.603	2.445	
970	2.840	2.729	2.592	2.435	
980	2.829	2.718	2.582	2.426	
990	2.817	2.707	2.572	2.416	
1000	2.805	2.696	2.562	2.406	
1010	2.794	2.684	2.552	2.396	
1020	2.782	2.673	2.542	2.387	2.218
1030	2.771	2.662	2.531	2.377	2.209
1040	2.759	2.650	2.521	2.367	2.201
1050	2.747	2.639	2.511	2.357	2.192
1060	2.736	2.628	2.501	2.348	2.184
1070	2.724	2.617	2.491	2.338	2.175
1080	2.712	2.605	2.480	2.328	2.167
1090	2.701	2.594	2.470	2.319	2.158
1100	2.689	2.583	2.460	2.309	2.150
1100	2.678	2.571	2.450	2.299	2.141
1120	2.666	2.560	2.440	2.289	2.133
1130		2.549	2.430	2.280	2.124
1140			2.419	2.270	2.116
1150					2.107
1160					2.099
1170					2.090
1180					2.082
1190					2.073
1200					2.065
1210					2.056
1220					2.048
1230					2.039

Temperature-dependent equations

$\rho = a - bT$

Mol % RbI	a	$b \cdot 10^4$
0	3.0863	−8.5140
25	3.3805	−9.7430
50	3.5802	−10.1830
75	3.8244	−11.2880
100	3.9667	−11.6130

These values are based on the work of Zuca and Olteanu (Archimedean method). [38]. The following equation, with concentration, C, in mole percent RbCl and temperature in K, has been derived from the preceding data: $\rho = a + bT + cC^2 + dTC + eCT^2$, where a = 3.96632, $b \cdot 10^3$ = −1.16021, $c \cdot 10^5$ = −1.56861, $d \cdot 10^5$ = −1.01252, $e \cdot 10^9$ = 6.00177, with a maximum departure of 0.32% at 1233.2 K and 100 mol % RbCl and a standard error of estimate of 0.06%. This equation may be used to calculate the density of RbCl-RbI melts at any composition in the temperature range 943-1233 K.

5.6. Bromide-Iodide Systems

AgBr-AgI

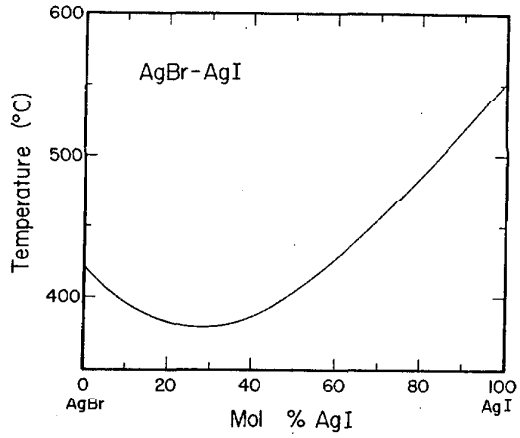

FIGURE 49. Temperature-composition phase diagram for AgBr-AgI.

Melt Preparation and Purification

The method used by Tubandt and Lorenz [53] for melt preparation and purification is given under the system AgCl-AgI. For Markov's [54] method, see KCl-AgBr. The methods used by Heymann et al. [12, 15, 76] are described under the system AgCl-AgBr.

TABLE 339. Electrical conductance studies: AgBr-AgI

Investigations critically re-examined			
Ref.	AgI mol %	Temp. range (T)	Comments
53	10-95	673-873	Cell material: porcelain; Pt electrodes; calibration: 1 N KCl solution at 25 °C.
54	30 (g)	645-870	

K. Monkemeyer, Neues Jahrb. Mineral., Geol., 22, 30 (1906).

TABLE 340. AgBr-AgI: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent AgI								
	95	90	80	70	60	40	30	20	10
680						2.40	2.44	2.43	
690						2.42	2.46	2.46	
700						2.44	2.48	2.48	
710						2.46	2.50	2.50	
720						2.48	2.52	2.52	
730					[2.36]	2.50	2.53	2.53	2.69
740					[2.38]	2.52	2.55	2.55	2.71
750					[2.40]	2.53	2.57	2.57	2.72
760					[2.42]	2.55	2.58	2.59	2.74
770					[2.44]	2.57	2.60	2.60	2.76
780			[2.37]	[2.40]	[2.45]	2.58	2.61	2.62	2.78
790			[2.38]	[2.40]	[2.46]	2.60	2.62	2.63	2.79
800			[2.39]	[2.41]	[2.48]	2.61	2.64	2.65	2.81
810			[2.40]	[2.42]	[2.49]	2.63	2.65	2.66	2.82
820			[2.41]	[2.43]	[2.50]	2.64	2.66	2.68	2.84
830	[2.41]	[2.39]	[2.42]	[2.44]		2.65	2.68	2.69	2.85
840	[2.42]	[2.40]	[2.42]	[2.44]		2.66	2.69	2.70	2.86
850	[2.43]	[2.41]	[2.43]	[2.45]		2.67	2.70	2.71	2.88
860	[2.44]	[2.41]	[2.44]	[2.46]		2.69	2.71	2.73	2.89
870	[2.46]	[2.42]	[2.45]	[2.47]		2.70	2.72	2.74	2.90

Temperature-dependent equations

$$\kappa = a + bT + cT^2$$

Mol % AgI	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate
10	−0.944	7.881	−3.985	0.11%
20	−0.335	6.014	−2.855	0.05%
30	−0.0643	5.434	−2.570	0.08%
40	−0.528	6.439	−3.142	0.15%
60	[−2.307]	[10.778]	[−6.000]	0.00%
70	[1.771]	[0.800]	[−0.00000596]	0.00%
80	[0.314]	[4.193]	[−2.000]	0.00%
90	[1.896]	[0.600]	0	0.00%
95	[1.412]	[1.200]	0	0.00%

These values are based on the work of Tubandt and Lorenz (classical ac technique) [53]. Values given in square brackets were generated from fewer than five data points.

TABLE 341. Surface tension studies: AgBr-AgI

Investigations critically re-examined			
Ref.	AgI mol %	Temp. range (T)	Comments
76	0-100	773,873	Glass (B.T.H.-C46) capillary; melt contained in a tube of B.T.H.-C14 glass; calibration: water.

Heymann et al. [76] estimated the maximum error in their surface tension measurements to be on the order of ±1%.

TABLE 342. AgBr-AgI: Surface tension (dyn cm^{-1})

Mol percent AgBr	773 K	873 K
0	116.3	114.0
10	118.4	115.6
20	120.8	118.0
30	123.6	120.4
40	126.7	123.4
50	130.2	126.6
60	133.9	130.0
70	137.9	134.1
80	142.2	138.7
90	146.6	143.8
100	151.4	149.0

These values have been interpolated to four significant figures from the graphical presentation of Boardman, Palmer and Heymann (maximum bubble pressure method) [76].

$BiBr_3$-BiI_3

Melt Preparation and Purification

Ichikawa and Shimoji used "guaranteed" reagent-grade $BiBr_3$ and BiI_3 dried at 100 °C for several days to remove water and excess hydrogen halide.

TABLE 343. Electrical conductance studies: $BiBr_3$-BiI_3

Investigations critically re-examined		
Ref.	BiI_3 mol %	Temp. range (T)
58	0-100 (g)	673-773

CsBr-CsI

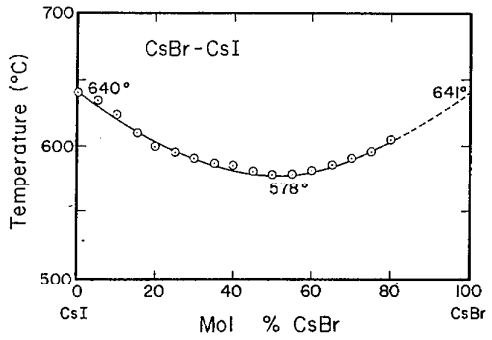

FIGURE 50. Temperature-composition phase diagram for CsBr-CsI. I.I. Il'yasov and A.G. Bergman, Zhur. Neorg. Khim., 9 [6], 768 (1964).

Melt Preparation and Purification

Zuca's [38] method of drying melts is given under the system CsCl-CsBr.

TABLE 344. $BiBr_3$-BiI_3: Specific conductance ($ohm^{-1}cm^{-1}$)

Mol % BiI_3	673 K	723 K	773 K
0	0.346	0.360	0.346
10	0.346	0.356	0.338
20	0.336	0.348	0.336
30	0.326	0.339	0.329
40	0.315	0.327	0.328
50	0.302	0.324	0.322
60	0.292	0.318	0.320
70	0.284	0.312	0.318
80	0.279	0.308	0.318
90	0.276	0.300	0.316
100		0.295	0.315

These values have been interpolated to three significant figures from the graphical presentation of Ichikawa and Shimoji (classical ac technique) [58].

TABLE 345. Electrical conductance studies: CsBr-CsI

Investigations critically re-examined			
Ref.	CsI mol %	Temp. range (T)	Comments
38	0-100	943-1148	Silica U-shaped capillary cell; Pt electrodes; freq. range: 1000-7000 Hz; calibration: 0.1M and 1.0M KCl solutions.
83,85	0-100	923-1073	Pt electrodes; freq.: 50,000 Hz.

Deviations from previous NSRDS recommendations [1, pp. 15, 20]

Ref.	CsI mol %	Min. departure	Max. departure
38	100	2.3% (940 K)	−8.8% (1060 K)
83,85	100	−0.54% (935 K)	−11.38% (1070 K)
38	0	0.22% (950 K)	−10.1% (1090 K)
83,85	0	−0.10% (945 K)	−9.85% (1070 K)

TABLE 346. CsBr-CsI: Specific conductance (ohm^{-1} cm^{-1})

T	Mol Percent CsI				
	100	75	50	25	0
950	0.746			0.863	0.906
960	0.759	0.793	0.830	0.878	0.922
970	0.771	0.806	0.844	0.893	0.938
980	0.784	0.819	0.857	0.907	0.954
990	0.796	0.832	0.871	0.921	0.970
1000	0.808	0.845	0.884	0.935	0.985
1010	0.820	0.857	0.897	0.949	1.001
1020	0.832	0.869	0.910	0.962	1.016
1030	0.843	0.882	0.923	0.976	1.031
1040	0.855	0.894	0.936	0.989	1.046
1050	0.866	0.906	0.948	1.002	1.060
1060	0.877	0.917	0.961	1.015	1.075
1070	0.888	0.929	0.973	1.027	1.089
1080	0.899	0.940	0.985	1.040	1.103
1090		0.952	0.997	1.052	1.117
1100		0.963	1.008	1.064	
1110			1.020	1.076	
1120					
1130					

Temperature-dependent equations
$\kappa = a + bT + cT^2$

CsI mol %	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate	Temp. range (T)
0	−1.4726	3.3704	−0.9125	0.03%	943.2-1133.2
25	−1.3951	3.2760	−0.9459	0.03%	948.2-1118.2
50	−1.2221	2.8902	−0.7840	0.03%	948.2-1118.2
75	−1.1616	2.7539	−0.7477	0.03%	948.2-1103.2
100	−1.2210	2.8578	−0.8288	0.03%	943.2-1148.2

These values are based on the work of Zuca and Olteanu (classical ac technique) **[38]**.

TABLE 347. Density studies: CsBr-CsI

Investigations critically re-examined

Ref.	CsI mol %	Temp. range (T)	Comments
38	0-100	943-1138	Pt bob; calibration: water.
74,85	0-100	923-1073	Pt sphere; calibration: molten potassium nitrate.

Deviations from NSRDS recommendations
[1, pp. 15, 20 and this volume]

Ref.	CsI mol %	Min. departure	Max. departure
38	100	0.47% (1080 K)	0.77% (940 K)
74,85	100	0.49% (1070 K)	0.94% (930 K)
74,85	75	−0.06% (960 K)	−0.07% (1070 K)
74,85	50	−0.10% (960 K)	−0.13% (1070 K)
74,85	25	−0.34% (1070 K)	−0.35% (950 K)
38	0	0.17% (950 K)	0.32% (1090 K)
74,85	0	0.03% (1070 K)	0.16% (930 K)

TABLE 348. CsBr-CsI: Density (g cm^{-3})

T	Mol percent CsI				
	100	75	50	25	0
940					3.100
950	3.141			3.109	3.088
960	3.128	3.113	3.101	3.097	3.076
970	3.115	3.100	3.088	3.085	3.064
980	3.103	3.088	3.076	3.072	3.052
990	3.090	3.075	3.064	3.060	3.040
1000	3.078	3.063	3.051	3.048	3.028
1010	3.065	3.050	3.039	3.035	3.016
1020	3.053	3.038	3.027	3.023	3.004
1030	3.040	3.025	3.014	3.011	2.993
1040	3.027	3.013	3.002	2.998	2.981
1050	3.015	3.000	2.990	2.986	2.969
1060	3.002	2.988	2.978	2.974	2.957
1070	2.990	2.975	2.965	2.961	2.945
1080	2.977	2.963	2.953	2.949	2.933
1090		2.950	2.941	2.937	
1100		2.938	2.928	2.924	
1110		2.925	2.916	2.912	
1120		2.913	2.904	2.900	
1130		2.900	2.891	2.887	

Temperature-dependent equations
$\rho = a - bT$

Mol % CsI	a	$b \cdot 10^3$
0	4.2236	1.1952
25	4.2811	1.2334
50	4.2817	1.2303
75	4.3130	1.2501
100	4.3345	1.2568

These values are based on the work of Zuca and Olteanu (Archimedean method) [38]. The following equation, with concentration, C, in mole percent CsBr and temperature in K, has been derived from the preceding data: $\rho = a + bC + cT^2 + dT^3 + eCT^2$, where a = 3.91098, $b \cdot 10^4 = -9.13810$, $c \cdot 10^6 = -1.22167$, $d \cdot 10^{10} = 3.87251$, $e \cdot 10^{10} = 4.56724$, with a maximum departure of −0.22% at 943.3 K and 75 mol % CsBr, and a standard error of estimate of 0.10%. This equation may be used to calculate the density of CsBr-CsI melts at any concentration in the temperature range 943-1138 K.

TABLE 349. Viscosity studies: CsBr-CsI

Investigations critically re-examined		
Ref.	CsI mol %	Temp. range (T)
65	0-100	See footnote a
Deviations from previous NSRDS recommendations [1, p. 20]		
Ref.	CsI mol %	Departure
65	100	−11.3% (1070 K)

[a]The temperature range was not given. The isotherm at 1070 K (molar viscosity vs. composition) was reported. The values in the following table were calculated from these data.

TABLE 350. CsBr-CsI: Viscosity (cp)

Mol % CsI	1070 K
0	1.20_3
12	1.17_2
25	1.15_6
37	1.12_7
50	1.08_7
63	1.07_7
75	1.05_3
88	1.04_2
100	1.01_1

These values are based on the work of Smirnov, Khokhlov and Antonov (oscillating sphere method) [65] and the density data of reference [74].

TABLE 351. CsBr-CsI: Molar viscosity (erg s mol $^{-1}$)[a]

Temperature-dependent equations
$\log \eta_M = A + B/T$

Mol % CsI	$-A$	B
0	1.0230	1031
12	1.0633	1073
25	1.0330	1046
37	1.0266	1038
50	1.0235	1033
63	0.9939	1004
75	0.9606	968
88	0.8736	880
100	0.9142	918

Equations as reported by Smirnov, Khokhlov and Antonov [65] (see footnote, table 349); of limited value since temperature limits of applicability and standard deviation were not reported.

[a]Molar viscosity is defined by $\eta(M\rho^{-1})$ where $M = X_1M_1 + X_2M_2$, and ρ, X_1, X_2, are the density and mol fraction composition of the molten mixture, with the units of η in poise.

TABLE 352. Surface tension studies: CsBr-CsI

Investigations critically re-examined

Ref.	CsI mol %	Temp. range (T)
74	0-100	923-1073

Deviations from previous NSRDS recommendations [2, pp. 63, 64]

Ref.	CsI mol %	Min. departure	Max. departure
74	0	0.46% (935 K)	1.44% (1070 K)
74	100	0.93% (950 K)	2.10% (1070 K)

TABLE 353. CsBr-CsI: Surface tension (dyn cm^{-1})

T	Mol percent CsI								
	100	88	75	63	50	37	25	12	0
930	73.2	74.0	75.1	76.2	77.3	78.7	80.0	81.4	82.8
940	72.6	73.4	74.5	75.6	76.7	78.1	79.3	80.8	82.2
950	72.0	72.9	74.0	75.0	76.1	77.5	78.7	80.2	81.5
960	71.5	72.3	73.4	74.4	75.5	76.9	78.1	79.6	80.9
970	70.9	71.7	72.8	73.8	74.9	76.3	77.5	79.0	80.3
980	70.3	71.1	72.2	73.3	74.4	75.7	76.9	78.3	79.7
990	69.8	70.6	71.7	72.7	73.8	75.1	76.3	77.7	79.0
1000	69.2	70.0	71.1	72.1	73.2	74.5	75.7	77.1	78.4
1010	68.6	69.4	70.5	71.5	72.6	73.9	75.1	76.5	77.8
1020	68.1	68.9	69.9	70.9	72.0	73.3	74.5	75.9	77.1
1030	67.5	68.3	69.4	70.3	71.5	72.7	73.8	75.2	76.5
1040	66.9	67.7	68.8	69.8	70.9	72.1	73.3	74.6	75.9
1050	66.4	67.1	68.2	69.2	70.3	71.5	72.7	74.0	75.3
1060	65.8	66.5	67.7	68.6	69.7	70.9	72.0	73.4	74.6
1070	65.2	66.0	67.1	68.0	69.1	70.3	71.4	72.7	74.0

Temperature-dependent equations
$\gamma = a - bT$

Mol % CsI	a	b
0	141.4	0.0630
12	139.2	0.0621
25	136.6	0.0609
37	134.3	0.0598
50	131.3	0.0581
63	130.2	0.0581
75	128.4	0.0573
88	127.4	0.0574
100	125.9	0.0567

These values are based on the work of Stepanov and Smirnov (maximum bubble pressure method) [74]. The precision in the measurements was reported as ±0.1 dyn cm^{-1}.

$HgBr_2$ - HgI_2

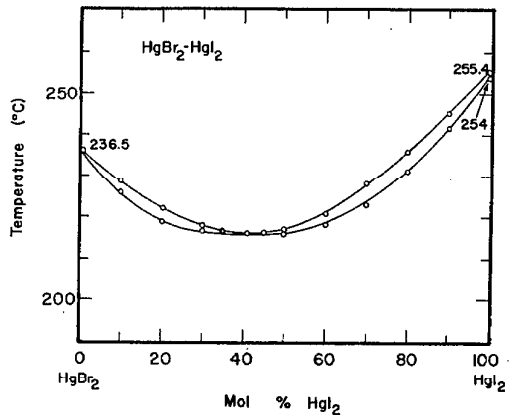

FIGURE 51. Temperature-composition phase diagram for $HgBr_2$-HgI_2.
W. Reinders, Z. Phys. Chem., 32, 494 (1900).

Melt Preparation and Purification

Mentus and Susic [73] used Merck (99.0%) HgI_2 and (99.5%) $HgBr_2$. The HgI_2 was distilled under a partial O_2 pressure and then sublimed under vacuum. The $HgBr_2$ was distilled three times in a stream of N_2 and HBr and then sublimed under vacuum.

TABLE 354. Electrical conductance studies: $HgBr_2$-HgI_2

Investigations critically re-examined			
Ref.	HgI_2 mol %	Temp. range (T)	Comments
73	0-100	~493-813 (g)	Cell material: Pyrex; Pt electrodes; calibration: molten HgI_2.

TABLE 355. $HgBr_2$-HgI_2: Specific conductance (ohm^{-1} cm^{-1} x 10^3)

HgI_2 Mol %	Temperature (K)						
	500	550	600	650	700	750	800
0		0.20	0.27	0.35	0.40	0.40	0.35
1		0.24	0.32	0.40	0.42	0.41	0.38
5		0.37	0.48	0.69	0.76	0.74	0.66
8		0.49	0.63	0.76	0.78	0.76	0.65
12	0.50	0.74	0.95	1.1	1.1	0.98	0.85
17	0.83	1.2	1.5	1.6	1.5	1.5	1.2
23	1.4	1.9	2.2	2.2	2.1	1.9	1.5
31	2.1	2.6	3.1	3.1	2.8	2.5	2.0
49	6.3	7.6	7.8	6.9	5.6	4.5	3.5
66		15.	13.	11.	8.9	6.8	4.1
77		19.	16.	13.	11.	9.5	6.5
89		24.	20.	16.	13.	9.5	7.1
100		26.	22.	17.	14.	10.	

These values were interpolated to two significant figures from the graphical presentation of Mentus and Susic (classical ac technique) [73].

TABLE 356. Density studies: $HgBr_2$-HgI_2

Investigations critically re-examined			
Ref.	HgI_2 mol %	Temp. range (T)	Comments
7	0,41,100	493-531	Glass bob filled with mercury.

TABLE 357. $HgBr_2$-HgI_2: Density (g cm^{-3})

	Mol percent HgI_2		
T	100	41	0
493.2		5.36	
513.2			5.26
520.2		5.29	5.24
531.2	5.34	5.27	5.22

These values are those obtained experimentally by Beck (Archimedean method) [7].

TABLE 358. Viscosity studies: $HgBr_2$-HgI_2

Investigations critically re-examined			
Ref.	HgI_2 mol %	Temp. range (T)	Comments
7	0,41,100	493-531	Cell material: glass viscometer; calibration: water, aniline (25 °C).

Deviations from previous NSRDS recommendations [1, pp. 17, 22]

Ref.	HgI_2 mol %	Min. departure	Max. departure
7	100	35.2% (531.2 K)	
7	0	3.7% (531.2 K)	−40.6% (520.2 K)

The apparatus used by Beck [7] was designed so that both density and viscosity measurements could be obtained.

TABLE 359. $HgBr_2$-HgI_2: Viscosity (cp)

	Mol percent HgI_2		
T	100	41	0
493.2		5.133	
513.2			3.698
520.2		3.266	3.321
531.2	3.963	2.888	2.208

These values are those obtained experimentally by Beck (capillary method) [7].

KBr-KI

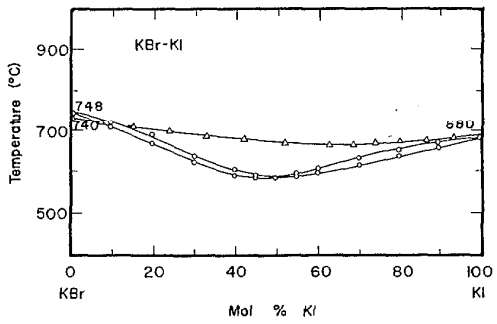

FIGURE 52. Temperature-composition phase diagram for KBr-KI.

I.B. Vrzhesnevskii, J. Russ. Phys. Chem. Soc., **41**, 1302 (1909); Z. anorg. Chem., **74**, 95 (1912).

M. Amadori and G. Pampanini, Atti. accad. Lincei, **20** [11], 572 (1911).

Melt Preparation and Purification

Zuca's [27] method of drying melts is given under the system CsCl-CsBr.

TABLE 360. Electrical conductance studies: KBr-KI

Investigations critically re-examined

Ref.	KI mol %	Temp. range (T)	Comments
27	0-100	949-1223	Silica U-shaped capillary cell; Pt electrodes; freq. range: 1000-7000 Hz, calibration: 0.1M and 1.0M KCl solutions.
62	eutectic (g)	*1225-1384*	

Deviations from previous NSRDS recommendations [1, pp. 14, 19]

Ref.	KI mol %	Min. departure	Max. departure
27	100	–0.2 % (1040 K)	1.7% (1000 K)
27	0	0.11% (1040 K)	–1.2% (1120 K)

TABLE 361. KBr-KI: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent KI					
	100	80	60	40	20	0
960			1.367	1.405		
970		1.348	1.387	1.427		
980		1.368	1.408	1.449		
990		1.388	1.428	1.470		
1000	1.392	1.408	1.448	1.491		
1010	1.408	1.428	1.468	1.512	1.572	
1020	1.425	1.447	1.487	1.533	1.594	
1030	1.442	1.466	1.506	1.553	1.615	1.678
1040	1.458	1.484	1.526	1.573	1.636	1.698
1050	1.475	1.503	1.544	1.593	1.656	1.719
1060	1.491	1.521	1.563	1.612	1.677	1.740
1070	1.508	1.538	1.582	1.631	1.697	1.760
1080	1.525	1.555	1.600	1.650	1.717	1.781
1090	1.541	1.572	1.618	1.668	1.736	1.801
1100	1.558	1.589	1.636	1.686	1.756	1.822
1110	1.575	1.606	1.653	1.704	1.775	1.843
1120	1.591	1.622	1.671	1.722	1.794	1.863
1130	1.608	1.637	1.688	1.739	1.812	1.884
1140	1.624	1.653		1.756	1.830	1.905
1150	1.641	1.668				1.925
1160	1.658	1.683				1.946
1170	1.674	1.697				1.966
1180						1.987
1190						2.008

TABLE 361. KBr-KI: Specific conductance (ohm^{-1} cm^{-1})—Continued

Temperature-dependent equations
$\kappa = a + bT + cT^2$

KI mol %	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate	Temp. range (T)
0	−0.4470	2.0628	0	0.18%	1017.2-1223.2
20	−2.0029	4.9139	−1.3609	0.03%	973.2-1143.2
40	−2.0584	5.0035	−1.4537	0.04%	957.2-1143.2
60	−1.5950	4.1011	−1.0582	0.05%	943.2-1133.2
80	−2.1017	5.0566	−1.5466	0.06%	954.2-1193.2
100	−0.2701	1.6618	0	0.20%	993.2-1173.2

These values are based on the work of Zuca and Ionescu-Vasu (classical ac technique) [27].

TABLE 362. Density studies: KBr-KI

Investigations critically re-examined

Ref.	KI mol %	Temp. range (T)	Comments
27	0-100	958-1223	Platinum bob; calibration: water.

Deviations from previous NSRDS recommendations [1, pp. 14, 19]

Ref.	KI mol %	Min. departure	Max. departure
27	100	0.04% (1000 K)	0.27% (1170 K)
27	0	0.00% (1020 K)	0.02% (1140 K)

TABLE 363. KBr-KI: Density ($g\ cm^{-3}$)

T	Mol percent KI					
	100	80	60	40	20	0
960			2.338	2.284		
970		2.383	2.329	2.275		
980		2.374	2.320	2.266		
990	2.414	2.365	2.311	2.257		
1000	2.405	2.356	2.302	2.248		
1010	2.395	2.347	2.293	2.239	2.182	
1020	2.386	2.337	2.283	2.230	2.174	
1030	2.377	2.328	2.274	2.221	2.165	2.109
1040	2.367	2.319	2.265	2.212	2.157	2.100
1050	2.358	2.310	2.256	2.203	2.148	2.092
1060	2.349	2.301	2.247	2.194	2.139	2.084
1070	2.340	2.292	2.238	2.185	2.131	2.076
1080	2.330	2.282	2.229	2.176	2.122	2.067
1090	2.321	2.273	2.220	2.167	2.114	2.059
1100	2.312	2.264	2.211	2.158	2.105	2.051
1110	2.302	2.255	2.202	2.149	2.096	2.043
1120	2.293	2.246	2.193	2.140	2.088	2.035
1130	2.284	2.237	2.184	2.131	2.079	2.026
1140	2.275	2.228	2.175	2.122	2.071	2.018
1150	2.265	2.218	2.166	2.113	2.062	2.010
1160	2.256	2.209	2.157	2.105	2.053	2.002
1170	2.247	2.200	2.147	2.096	2.045	1.993
1180			2.138	2.087	2.036	1.985
1190						1.977
1200						1.969
1210						1.961
1220						1.952

TABLE 363. KBr-KI: Density (g cm^{-3})—Continued

Temperature-dependent equations $\rho = a - bT$		
Mol % KI	a	$b \cdot 10^3$
0	2.9552	0.8220
20	3.0501	0.8592
40	3.1426	0.8949
60	3.2085	0.9069
80	3.2709	0.9152
100	3.3336	0.9290

These values are based on the work of Zuca and Ionescu-Vasu (Archimedean method) [27]. The precision in the measurements was estimated as 0.1%. The following equation, with concentration, C, in mole percent KBr and temperature in K, has been derived from the preceding data: $\rho = a + bT + cC^2 + dTC + eCT^2$, where $a = 3.34229$, $b \cdot 10^4 = -9.36244$, $c \cdot 10^6 = -1.47865$, $d \cdot 10^6 = -5.50902$, $e \cdot 10^9 = 2.95892$, with a maximum departure of 0.13% at 1178.2 K and 60.0 mol % KBr, and a standard error of estimate of 0.01%. This equation may be used to calculate the density of KBr-KI melts at any composition in the temperature range 958-1223 K.

LiBr-LiI

Melt Preparation and Purification

References [79] and [82] contain no information on melt preparation and purification. However, see CsF-CsCl.

TABLE 364. Electrical conductance studies: LiBr-LiI

Ref.	LiI mol %	Temp. range (T)	Comments
82	0-100	758-1113	Pt electrodes; freq. range; 50,000 Hz.

Deviations from previous NSRDS recommendations [1, pp. 14, 19]

Ref.	LiI mol %	Min. departure	Max. departure
82	100	0.29% (875 K)	0.40% (760 K)
82	0	0.02% (915 K)	2.15% (830 K)

TABLE 365. LiBr-LiI: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent LiI								
	100	88	75	63	50	37	25	12	0
760	4.005	4.286	4.059	4.194	4.056	4.242	4.169	4.276	4.425
780	4.103	4.384	4.160	4.301	4.163	4.358	4.280	4.392	4.534
800	4.198	4.478	4.254	4.405	4.267	4.454	4.385	4.500	4.641
820	4.292	4.571	4.345	4.506	4.364	4.553	4.488	4.607	4.742
840	4.379	4.657	4.432	4.600	4.462	4.649	4.586	4.707	4.838
860	4.463	4.740	4.515	4.693	4.552	4.743	4.679	4.806	4.936
880	4.543	4.819	4.594	4.783	4.641	4.831	4.768	4.897	5.024
900	4.618	4.894	4.672	4.865	4.723	4.915	4.855	4.988	5.111
920	4.692	4.966	4.745	4.947	4.806	4.997	4.939	5.074	5.194
940	4.760	5.034	4.813	5.024	4.883	5.073	5.016	5.157	5.273
960	4.827	5.099	4.879	5.099	4.957	5.148	5.091	5.235	5.348
980	4.889	5.158	4.943	5.166	5.028	5.219	5.164	5.310	5.422
1000	4.950	5.219	5.001	5.236	5.095	5.287	5.231	5.384	5.490
1020	5.007	5.273	5.058	5.299	5.158	5.351	5.298	4.451	5.557
1040	5.059	5.327	5.112	5.359	5.221	5.411	5.359	5.517	5.619
1060	5.109	5.377	5.163	5.417	5.277	5.470	5.421	5.582	5.679
1080	5.157	5.421	5.210	5.470	5.332	5.525	5.474	5.641	5.737
1100	5.201	5.467	5.255	5.521	5.385	5.577	5.529	5.698	5.791

TABLE 365. LiBr-LiI: Specific conductance (ohm $^{-1}$ cm $^{-1}$)—Continued

Temperature-dependent equations
$\kappa = a + bT + cT^2 + dT^3$

Mol % LiI	$-a$	$b \cdot 10^2$	$-c \cdot 10^5$	$d \cdot 10^9$	Standard error of estimate
100	4.08582	1.75137	1.08152	2.33612	0.022%
88	4.09478	1.85403	1.19801	2.75254	0.021%
75	4.27672	1.84010	1.18656	2.74209	0.025%
63	3.55317	1.56781	0.825362	1.36391	0.019%
50	3.66209	1.57076	0.842946	1.47862	0.018%
37	3.72232	1.64967	0.926179	1.77342	0.039%
25	4.42783	1.83388	1.10448	2.36562	0.020%
12	4.44181	1.84793	1.10134	2.35860	0.017%
0	4.14735	1.82938	1.10546	2.39809	0.020%

These values are based on the work of Smirnov, Khokhlov, Stepanov, and Shumov. (classical ac technique) [82]. The data were reported in equation form as equivalent conductance. The equations given above were generated by converting to specific conductance using the density equations of [82].

TABLE 366. Density studies: LiBr-LiI

Investigations critically re-examined

Ref.	LiI mol %	Temp. range (T)	Comments
82	0-100	758-1113	Platinum sphere; calibration: KNO_3.

Deviations from previous NSRDS recommendations [1, pp. 14, 19]

Ref.	LiI mol %	Min. departure	Max. departure
82	100	0.48% (760 K)	0.49% (880 K)
82	0	−0.30% (1020 K)	−0.47% (830 K)

TABLE 367. LiBr-LiI: Density (g cm^{-3})

T	Mol percent LiI				
	100	75	50	25	0
760	3.108	2.977	2.849	2.730	2.557
780	3.089	2.960	2.834	2.714	2.544
800	3.071	2.943	2.818	2.699	2.532
820	3.053	2.925	2.802	2.684	2.519
840	3.034	2.908	2.787	2.668	2.506
860	3.016	2.891	2.771	2.653	2.494
880	2.997	2.874	2.755	2.637	2.481
900	2.979	2.857	2.739	2.622	2.469
920	2.961	2.840	2.724	2.607	2.456
940	2.942	2.823	2.708	2.591	2.444
960	2.924	2.806	2.692	2.576	2.431
980	2.905	2.789	2.677	2.560	2.419
1000	2.887	2.772	2.661	2.545	2.406
1020	2.869	2.755	2.645	2.530	2.393
1040	2.850	2.738	2.630	2.514	2.381
1060	2.832	2.721	2.614	2.499	2.368
1080	2.813	2.704	2.598	2.483	2.356
1100	2.795	2.687	2.583	2.468	2.343

Temperature-dependent equations

$\rho = a - bT$

Mol % LiI	a	$b \cdot 10^3$	Standard deviation
0	3.034	0.628	0.004
25	3.315	0.770	0.005
50	3.446	0.785	0.005
75	3.625	0.853	0.006
100	3.807	0.920	0.005

These values are based on the work of Smirnov, Khokhlov, Stepanov and Shumov (Archimedean method) [82]. The following equation, with concentration, C, in mole percent LiI and temperature in K, has been derived from the preceding data: $\rho = a + bC + cT + dC^2 + eTC + fC^3 + gTC^2$, where $a = 3.04785$, $b \cdot 10^2 = 1.20585$, $c \cdot 10^4 = -6.42550$, $d \cdot 10^5 = -4.67221$, $e \cdot 10^6 = -3.87489$, $f \cdot 10^7 = 1.91326$, $g \cdot 10^8 = 1.20274$, with a maximum departure of 0.29% at 758 K and 25 mol % LiI, and a standard error of estimate of 0.003. This equation may be used to calculate the density of LiBr-LiI melts at any concentration in the temperature range 758-1113 K.

TABLE 368. *Surface tension studies: LiBr-LiI*

Investigations critically re-examined

Ref.	LiI mol %	Temp. range (T)	Comments
79	0-100	861-1120	Molybdenum crucible; calibration: molten NaCl.

TABLE 369. LiBr-LiI: Surface tension (dyn cm^{-1})

T	Mol percent LiI				
	100	75	50	25	0
870	91.5		105.5		
880	91.0		104.8	113.2	124.4
890	90.4	96.7	104.2	112.6	123.7
900	89.9	96.1	103.6	111.9	123.0
910	89.3	95.5	103.0	111.2	122.3
920	88.7	94.9	102.4	110.6	121.6
930	88.1	94.4	101.7	109.9	120.9
940	87.6	93.8	101.1	109.3	120.2
950	87.0	93.2	100.5	108.6	119.5
960	86.5	92.6	99.9	107.9	118.9
970	85.9	92.0	99.3	107.3	118.2
980	85.3	91.5	98.6	106.6	117.5
990	84.8	90.9	98.0	106.0	116.8
1000	84.2	90.3	97.4	105.3	116.1
1010	83.6	89.7	96.8	104.6	115.4
1020	83.1	89.1	92.2	104.0	114.7
1030	82.5	88.6	95.5	103.3	114.0
1040	81.9	88.0	94.9	102.7	113.3
1050	81.4	87.4	94.3	102.0	112.6
1060	80.8	86.8	93.7	101.3	111.9
1070	80.2	86.2	93.1	100.7	111.3
1080	79.7	85.7	92.4	100.0	110.6
1090	79.1	85.1	91.8	99.3	109.9
1100	78.5	84.5	91.2	98.7	109.2
1110	78.0			98.0	108.5
1120					107.8

Temperature-dependent equations

$\gamma = a - bT$

Mol % LiI	a	b
0	185.2	0.0691
25	171.4	0.0661
50	159.5	0.0620
75	148.3	0.0580
100	140.7	0.0565

These values are based on the work of Smirnov and Stepanov (maximum bubble pressure method) [79]. The following equation, with concentration, C, in mole percent LiI and temperature in K, has been derived from the preceding data: $\gamma = a + bTC + cC^2 + dT^2 + eC^3 + fCI^2 + gT^3$, where a = 152.81339, $b \cdot 10^3$ = -1.11105, $c \cdot 10^3$ = 2.62520, $d \cdot 10^5$ = -4.06922, $e \cdot 10^6$ = -9.74567, $f \cdot 10^7$ = 6.23915, $g \cdot 10^9$ = 4.08568, with a maximum departure of 0.43% at 1110 K and 100 mol % LiI, and a standard error of estimate of 0.194 dyn cm^{-1}. This equation can be used to calculate the surface tension of melts in the LiBr-LiI system at any composition in the temperature range 861-1120 K.

NaBr-NaI

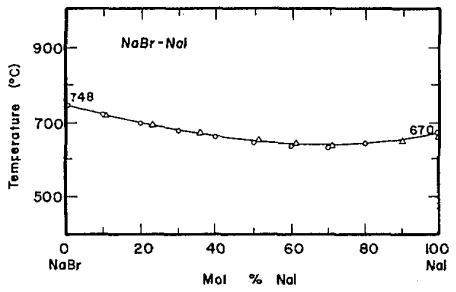

FIGURE 53. Temperature-composition phase diagram for NaBr-NaI.

E. Schobert, Dissertation, Leipzig, 1912.

M. Amadori, Atti. accad. Lincei, 21, I, 467 (1912).

Melt Preparation and Purification

Zuca's [27] method for drying salt melts is described under the system CsCl-CsBr.

TABLE 370. Electrical conductance studies: NaBr-NaI

Investigations critically re-examined

Ref.	NaI mol %	Temp. range (T)	Comments
27	0-100	943-1223	Silica U-shaped capillary; Pt electrodes; freq. range: 1000-7000 Hz; calibration: 0.1M and 1.0M KCl solutions.

Deviations from previous NSRDS recommendations [1, pp. 14, 19]

Ref.	NaI mol %	Min. departure	Max. departure
27	100	0.31% (1040 K)	4.3% (960 K)
27	0	−1.0 % (1050 K)	−7.1% (1220 K)

TABLE 371. NaBr-NaI: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent NaI					
	100	80	60	40	20	0
960	2.425					
970	2.446		2.497			
980	2.466		2.518			
990	2.486		2.539			
1000	2.506	2.524	2.559	2.619		
1010	2.525	2.543	2.579	2.640	2.733	
1020	2.545	2.563	2.600	2.660	2.755	
1030	2.563	2.582	2.619	2.680	2.776	
1040	2.582	2.600	2.639	2.700	2.797	
1050	2.600	2.619	2.658	2.719	2.817	2.946
1060	2.619	2.637	2.678	2.738	2.837	2.963
1070	2.636	2.655	2.697	2.757	2.856	2.981
1080	2.654	2.672	2.713	2.776	2.875	2.998
1090	2.671	2.690	2.734	2.795	2.894	3.015
1100	2.688	2.706	2.752	2.813	2.912	3.033
1110	2.705	2.723	2.770	2.831	2.930	3.050
1120	2.721	2.739	2.788	2.848	2.947	3.067
1130						3.085
1140						3.102
1150						3.119
1160						3.137
1170						3.154
1180						3.172
1190						3.189
1200						3.206
1210						3.224
1220						3.241

Temperature-dependent equations

$\kappa = a + bT + cT^2$

NaI mol %	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate	Temp. range (T)
0	1.1218	1.7371	0	0.18%	1043.2-1223.2
20	−1.7118	6.6207	−2.1976	0.03%	1007.2-1127.2
40	−0.7070	4.5909	−1.2646	0.06%	991.2-1133.2
60	−0.6172	4.3102	−1.1338	0.08%	963.2-1127.2
80	−0.9488	4.9699	−1.4972	0.04%	981.2-1124.2
100	−0.8315	4.7141	−1.3768	0.07%	943.2-1153.2

These values are based on the work of Zuca and Ionescu-Vasu (classical ac technique) [27].

TABLE 372. Density studies: NaBr-NaI

Investigations critically re-examined			
Ref.	NaI mol %	Temp. range (T)	Comments
27[a]	0-100	943-1223	Pt bob: calibration: water.

Deviations from previous NSRDS recommendations [1, pp. 14, 19]

Ref.	NaI mol %	Min. departure	Max. departure
27	100	−0.04% (1120 K)	−0.11% (960 K)
27	0	2.1 % (1050 K)	2.2 % (1220 K)

[a]Zuca [27] reported a precision in density measurements of 0.1%.

TABLE 373. NaBr-NaI: Density (g cm^{-3})

T	Mol percent NaI					
	100	80	60	40	20	0
950			2.609			
960	2.713		2.560	2.537		
970	2.703		2.591	2.528		
980	2.694		2.582	2.520		
990	2.685		2.573	2.511		
1000	2.675	2.625	2.564	2.502	2.435	
1010	2.666	2.616	2.556	2.493	2.426	
1020	2.656	2.607	2.547	2.485	2.418	
1030	2.647	2.598	2.538	2.476	2.409	
1040	2.638	2.588	2.529	2.467	2.400	
1050	2.628	2.579	2.520	2.458	2.392	2.317
1060	2.619	2.570	2.511	2.449	2.383	2.309
1070	2.609	2.561	2.503	2.441	2.374	2.300
1080	2.600	2.552	2.494	2.432	2.366	2.292
1090	2.591	2.542	2.485	2.423	2.357	2.284
1100	2.581	2.533	2.476	2.414	2.348	2.276
1110	2.572	2.524	2.467	2.405	2.339	2.267
1120	2.563	2.515	2.458	2.397	2.331	2.259
1130			2.450			2.251
1140						2.243
1150						2.235
1160						2.226
1170						2.218
1180						2.210
1190						2.202
1200						2.194
1210						2.185
1220						2.177

TABLE 373. NaBr-NaI: Density (g cm^{-3})—Continued

Temperature-dependent equations
$\rho = a + bT$

Mol % NaI	a	$b \cdot 10^3$
0	3.1799	−0.8220
20	3.3058	−0.8706
40	3.3808	−0.8787
60	3.4473	−0.8829
80	3.5445	−0.9193
100	3.6144	−0.9392

These values are based on the work of Zuca and Ionescu-Vasu (Archimedean method) [27]. A precision of 0.1% was reported. The following equation, with concentration, C, in mole percent NaBr and temperature in K, has been derived from the preceding data: $\rho = a + bT + cTC + dCT^2$, where $a = 3.56238$, $b \cdot 10^4 = -8.81874$, $c \cdot 10^6 = -5.10017$, $d \cdot 10^9 = 2.08591$, with a maximum departure of 0.64% at 1043 K and 100 mol % NaBr, and a standard error of estimate of 0.25%. This equation may be used to calculate the density of NaBr-NaI melts at any concentration in the temperature range 943-1223 K.

RbBr-RbI

Melt Preparation and Purification

Zuca's [38] method of drying fused salts is described under the system CsBr-CsI.

TABLE 374. Electrical conductance studies: RbBr-RbI

Investigations critically re-examined

Ref.	RbI mol %	Temp. range (T)	Comments
38	0-100	933-1188	Silica U-shaped capillary cell; Pt electrodes; freq. range: 1000-7000 Hz; calibration: 0.1M and 1.0M KCl solutions.

Deviations from previous NSRDS recommendations [1, pp. 17, 20]

Ref.	RbI mol %	Min. departure	Max. departure
38	100	0.10% (980 K)	−1.8% (1100 K)
38	0	−0.80% (1000 K)	−4.0% (1120 K)

TABLE 375. RbBr-RbI: Specific conductance (ohm^{-1} cm^{-1})

T	Mol percent RbI				
	100	75	50	25	0
950	0.927		0.986		
960	0.943		1.002		
970	0.958		1.018		
980	0.973	1.001	1.034	1.084	1.160
990	0.987	1.016	1.049	1.100	1.178
1000	1.002	1.031	1.065	1.116	1.195
1010	1.016	1.045	1.080	1.132	1.212
1020	1.031	1.060	1.095	1.148	1.229
1030	1.044	1.074	1.109	1.163	1.246
1040	1.058	1.088	1.124	1.178	1.262
1050	1.072	1.102	1.138	1.193	1.278
1060	1.085	1.115	1.152	1.208	1.294
1070	1.098	1.128	1.166	1.222	1.310
1080	1.111	1.142	1.179	1.237	1.326
1090	1.124	1.155	1.193	1.251	1.341
1100	1.137	1.168	1.206	1.265	1.356
1110		1.180	1.219	1.279	1.371
1120		1.193	1.232		1.386
1130					1.401
1140					1.415

Temperature-dependent equations
$\kappa = a + bT + cT^2$

RbI mol %	a	$b \cdot 10^3$	$c \cdot 10^6$	Standard error of estimate	Temp. range (T)
0	−1.6004	3.8682	−1.0729	0.02%	963.2-1153.2
25	−1.4377	3.5218	−0.9679	0.02%	973.2-1173.2
50	−1.5223	3.6524	−1.0655	0.03%	933.2-1188.2
75	−1.3832	3.3654	−0.9514	0.03%	953.2-1153.2
100	−1.4378	3.4345	−0.9947	0.03%	933.3-1103.2

These values are based on the work of Zuca and Olteanu (classical ac technique) [38].

TABLE 376. Density studies: RbBr-RbI

Investigations critically re-examined

Ref.	RbI mol %	Temp. range (T)	Comments
38	0-100	943-1143	Pt. bob; calibration: water.

Deviations from previous NSRDS recommendations [1, pp. 17, 20]

Ref.	RbI mol %	Min. departure	Max. departure
38	100	0.0% (980 K)	−0.11% (1100 K)
38	0	0.0% (1100, 1140 K)	−0.04% (1060 K)

TABLE 377. RbBr-RbI: Density (g cm^{-3})

T	Mol percent RbI				
	100	75	50	25	0
950	2.863		2.787		
960	2.852		2.777	2.737	
970	2.840		2.766	2.726	
980	2.829	2.783	2.756	2.715	2.688
990	2.817	2.773	2.745	2.705	2.678
1000	2.805	2.763	2.735	2.694	2.667
1010	2.794	2.752	2.724	2.683	2.656
1020	2.782	2.742	2.714	2.672	2.645
1030	2.771	2.732	2.703	2.661	2.635
1040	2.759	2.722	2.693	2.650	2.624
1050	2.747	2.712	2.682	2.639	2.613
1060	2.736	2.701	2.671	2.628	2.603
1070	2.724	2.691	2.661	2.617	2.592
1080	2.712	2.681	2.650	2.606	2.581
1090	2.701	2.671	2.640	2.595	2.571
1100	2.689	2.660	2.629	2.585	2.560
1110	2.678	2.650	2.619	2.574	2.549
1120	2.666	2.640	2.608		2.538
1130					2.528
1140					2.517

Temperature-dependent equations

$\rho = a + bT$

Mol % RbI	a	$b \cdot 10^3$
0	3.7373	–1.0704
25	3.7845	–1.0909
50	3.7863	–1.0517
75	3.7860	–1.0233
100	3.9667	–1.1613

These values are based on the work of Zuca and Olteanu (Archimedean method) [38]. The following equation, with concentration, C, in mole percent RbBr and temperature in K, has been derived from the preceding data: $\rho = a + bT + cC + dCT^2$, where a = 3.92671, $b \cdot 10^3$ = –1.12343, $c \cdot 10^3$ = –1.81127, $d \cdot 10^{10}$ = 4.02830, with a maximum departure of 0.30% at 1113.2 K and 75 mol % RbBr and a standard error of estimate of 0.14%. This equation may be used to calculate the density of RbBr-RbI melts at any concentration in the temperature range 943-1143 K.

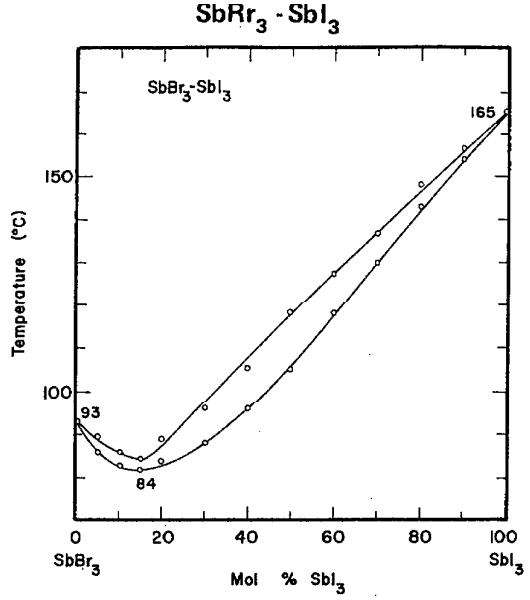

FIGURE 54. Temperature-composition phase diagram for $SbBr_3$-SbI_3.
G.B. Bernardis, Atti. della Reale Accad dei Lincei, (5), 21, II, 438 (1912).

Melt Preparation and Purification

Saito et al. [24] purified antimony halides by vacuum distillation. The samples taken for conductance measurements were distilled directly into the cell.

TABLE 378. Electrical conductance studies: $SbBr_3$-SbI_3

Investigations critically re-examined			
Ref.	SbI_3 mol %	Temp. range (T)	Comments
24	0-100	380-540	Cell material: Pyrex; four tungsten electrodes; calibration: KCl solutions.

TABLE 379. $SbBr_3$-SbI_3: Specific conductance ($ohm^{-1}\ cm^{-1} \times 10^5$)

T	Mol percent SbI_3											
	100.0	95.0	90.0	80.0	70.0	60.0	50.0	40.0	30.0	20.0	10.0	5.0	0.0
380												6.369	3.470
390									11.52	10.39	9.049	7.043	3.861
400								13.89	12.64	11.49	9.968	7.712	4.251
410							14.69	15.09	13.73	12.56	10.87	8.373	4.637
420						15.43	15.89	16.27	14.80	13.58	11.76	9.020	5.026
430					18.00	16.68	17.08	17.42	15.82	14.55	12.62	9.651	5.386
440				19.79	19.43	17.92	18.26	18.55	16.81	15.45	13.45	10.27	5.745
450			21.81	21.47	20.85	19.16	19.43	19.63	17.74	16.29	14.25	10.86	6.092
460		23.37	23.58	23.16	22.27	20.38	20.58	20.69	18.63	17.05	15.02	11.43	6.456
470		25.54	25.37	24.85	23.66	21.59	21.22	21.71	19.47	17.75	15.75	11.98	6.746
480		27.74	27.09	26.54	24.82	22.78	22.83	22.68	20.26	18.37	16.44	12.51	6.996
490	36.02	29.96	28.84	28.21	26.41	23.96	23.92	23.62	21.00	18.96	17.09	13.01	7.341
500	38.60	32.19	30.57	29.87	27.75	25.11	24.99	24.52	21.69	19.39	17.70	13.49	7.615
510	41.19	34.43	32.29	31.52	29.08	26.86	26.04	25.38	22.33	19.80	18.27	13.94	7.874
520	43.77	36.68	33.99	33.15	30.38	27.36	27.07	26.20	22.92	20.14	18.80	14.37	8.116
530	46.35												8.344
540	48.91												

Temperature-dependent equations
$\kappa = a + bT + cT^2 + dT^3$

Mol % SbI_3	a	$b \cdot 10^1$	$c \cdot 10^3$	$d \cdot 10^6$	Standard error of estimate
0.0	− 9.8709	0.1121	0.1114	−0.1277	0.29%
5.0	−15.2664	0.1239	0.2024	−0.2243	0.04%
10.0	61.4770	− 5.3341	1.4886	−1.1936	1.65%
20.0	−51.1733	1.4077	0.1957	−0.3898	0.09%
30.0	−45.7090	1.3867	0.1211	−0.2576	0.04%
40.0	−48.4081	1.6160	0.0524	−0.1678	0.03%
50.0	−41.2977	1.5558	− 0.0462		0.66%
60.0	−35.6624	1.2176			0.78%
70.0	−51.5890	1.8194	− 0.0467		0.28%
80.0	−62.7269	2.0463	− 0.0389		0.10%
90.0	−69.2115	2.2677	− 0.0544		0.04%
95.0	−60.1548	1.4580	0.0778		0.02%
00.0	−90.3668	2.5794			0.01%

These values are based on the work of Saito, Ichikawa, and Shimoji (classical ac technique) [24].

TABLE 380. Density studies: $SbBr_3$-SbI_3

Investigations critically re-examined		
Ref.	SbI_3 mol %	Temp. range (T)
24	0-100	366-595

TABLE 381. $SbBr_3$-SbI_3: Density (g cm^{-3})

T	Mol percent SbI_3					
	100.0	80.0	60.0	40.0	20.0	0.0
370			3.978	3.829		
380			3.954	3.804	3.658	3.494
390			3.930	3.778	3.637	3.469
400			3.907	3.752	3.615	3.444
410			3.883	3.727	3.594	3.419
420			3.859	3.701	3.572	3.394
430		3.983	3.835	3.675	3.551	3.368
440		3.958	3.812	3.650	3.529	3.343
450		3.933	3.788	3.624	3.507	3.318
460	4.124	3.908	3.764	3.598	3.486	3.293
470	4.099	3.883	3.740	3.573	3.464	3.268
480	4.075	3.858	3.716	3.547	3.443	3.243
490	4.050	3.833	3.693	3.521	3.421	3.218
500	4.025	3.808	3.669	3.496	3.400	3.193
510	4.000	3.783	3.645	3.470	3.378	2.168
520	3.975	3.759	3.621	3.444	3.357	3.142
530	3.950	3.734	3.598	3.419	3.335	
540	3.926	3.709	3.574	3.393	3.314	
550	3.901	3.684	3.550	3.367	3.292	
560	3.876					
570	3.851					
580	3.826					
590	3.801					

Temperature-dependent equations
$\rho = a + bT$

Mol % SbI_3	a	$b \cdot 10^3$	Standard deviation
0.0	4.448	−2.510	0.080
20.0	4.476	−2.152	0.074
40.0	4.780	−2.568	0.091
60.0	4.857	−2.377	0.102
80.0	5.053	−2.490	0.079
100.0	5.266	−2.483	0.073

These values are based on the work of Saito, Ichikawa and Shimoji (pycnometric method) [24].

TlBr-TlI

Melt Preparation and Purification

Lisitiskii, Tret'yakova and Fomichev [90] purified thallium halides by direct crystallization. Impurities were found to be present to about one part in ten thousand by weight, or less. The main impurities were lead, indium and tin. Transfer of the purified salts was made by distillation to avoid random contamination.

TABLE 382. Density studies: TlBr-TlI

Investigations critically re-examined

Ref.	TlI mol %	Temp. range (T)	Comments
90	0-100 (g)[a]	688-1263	Pycnometer filled by distillation to avoid random contamination.

Deviations from previous NSRDS recommendations [1, p. 18, 6]

Ref.	TlI mol %	Min. departure	Max. departure
90	100	−0.35% (873 K)	0.78% (733 K)
90	0	−0.28% (1125 K)	−0.93% (745 K)

[a]Lisitskii, Tretyakova and Fomichev [90] reported data for the 54.2 mol % TlI mixture in polynomial form (see next table) with an rms deviation of 0.0008. Values for the pure salts were also reported in polynomial form with a rms error of 0.0003 for the bromide and 0.0006 for the iodide.

TABLE 383. TlBr-TlI: Density (g cm^{-3})

Wt % TlI	Mol % TlI	733 K	773 K	873 K	973 K	1073 K	1173 K
0	0.00	*5.968*	*5.893*	*5.711*	*5.530*	*5.350*	*5.168*
10	8.71	5.98	5.90	5.72	5.54	5.36	5.18
20	17.67	5.99	5.92	5.74	5.56	5.38	5.20
30	26.89	6.00	5.93	5.75	5.57	5.39	5.22
40	36.39	6.01	5.94	5.76	5.58	5.41	5.23
50	45.77	6.02	5.95	5.77	5.60	5.42	5.25
60	55.19	6.03	5.96	5.78	5.61	5.44	5.26
70	66.69	6.04	5.97	5.80	5.62	5.45	5.28
80	77.44	6.05	5.98	5.81	5.64	5.46	5.29
90	88.53	6.06	5.99	5.82	5.65	5.48	5.31
100	100.00	*6.074*	*6.006*	*5.834*	*5.663*	*5.493*	*5.325*

T	Mol % TlI 54.2	T	Mol % TlI 54.2
700	6.102	1000	5.536
750	6.006	1050	5.445
800	5.911	1100	5.354
850	5.816	1150	5.265
900	5.722	1200	5.176
950	5.629	1250	5.089

Temperature-dependent equation

$$\rho = 7.4915 - 2.012\times10^{-3}T - 3.167\times10^{-9}T^2 + 6\times10^{-11}T^3$$

(54.2 mol % TlI)

These values are based on the work of Lisitskii, Tret'nikova and Fomichev (pycnometric method) [90]. The values in italics in the first part of the table were calculated from the polynomial equations given by the authors for the pure salts. The remainder were interpolated from their graphical presentation.

TABLE 384. Viscosity studies: TlBr-TlI

Investigations critically re-examined

Ref.	TlI mol %	Temp. range (T)	Comments
90	0-100 (g)	723-1173	Quartz viscometer filled by distillation.

Deviations from previous NSRDS recommendations [6]

Ref.	TlI mol %	Min. departure	Max. departure
90	100	−3.60% (860 K)	−7.37% (960 K)
90	0	−2.18% (760 K)	−10.7% (990 K)

Data for pure salts reported in equation form.

TABLE 385. TlBr-TlI: Viscosity (cp)

Wt % TlI	Mol % TlI	733 K	773 K	873 K	973 K	1073 K	1173 K
0	0.00	*2.137*	*1.894*	*1.470*	*1.226*	*1.071*	*0.957*
10	8.71	2.16	1.92	1.48	1.23	1.08	0.96
20	17.67	2.19	1.94	1.50	1.24	1.08	0.97
30	26.89	2.21	1.96	1.51	1.25	1.09	0.97
40	36.39	2.24	1.98	1.53	1.25	1.10	0.98
50	45.77	2.26	2.00	1.54	1.26	1.10	0.98
60	55.19	2.29	2.02	1.55	1.27	1.11	0.99
70	66.69	2.31	2.04	1.57	1.28	1.12	1.00
80	77.44	2.34	2.06	1.58	1.28	1.12	1.00
90	88.53	2.37	2.08	1.60	1.29	1.13	1.01
100	100.00	*2.392*	*2.105*	*1.609*	*1.298*	*1.134*	*1.014*

Temperature-dependent equations

$\eta = A \cdot \exp(E/RT)$

Mol % TlI	A	E cal/mol	Temp. range
0	0.207	3400	733-873
0	0.288	2800	873-1193
100	0.202	3600	723-963
100	0.305	2800	963-1173

These values are based on the work of Lisitskii, Tret'yakova, and Fomichev (capillary method) [90]. The values in italics were obtained by evaluating the temperature-dependent equations. The remainder were obtained by interpolating the graphical presentation.

6. General Summary Tables

The following tables present, first, for each of the four properties—electrical conductance, density, viscosity and surface tension—the binary systems for which a recommendation has been advanced in this study, together with the reference numbers of the re-examined studies, the recommended reference in boldface type, and the technique employed in the recommended study and its authors; and, second, an overview of the recommendations advanced in this study of mixed halide melts.

TABLE 386. Electrical conductance
A: Classical ac technique
B: Potentiometric ac technique

System	Investigations critically re-examined	Total	Technique of recommended reference	Authors of recommended reference
BaF_2-$BaCl_2$	68	1	A	Kuvakin and Klyakin
CsF-CsCl	85	1	A	Smirnov, Shumov, Stepanov, Khokhlov, Noskevich
KF-KCl	85	1	A	Smirnov et al., see above.
KF-NaCl	9	1	A	Ryschewitsch
LiF-LiCl	52, 82	2	A	Smirnov, Khokhlov, Stepanov, Shumov
NaF-$BaCl_2$	47	1	A	Taniuchi
CsF-CsBr	85	1	A	Smirnov et al., see above.
KF-KBr	84	1	A	Smirnov, Shumov, Khokhlov, Stepanov, Noskevich, Antonenko
LiF-LiBr	82	1	A	Smirnov, Khokhlov, Stepanov, Shumov
CsF-CsI	85	1	A	Smirnov et al., see above.
KF-KI	84	1	A	Smirnov et al., see above.
LiF-LiI	82, 89	2	A	Smirnov et al., see above.
AgCl-AgBr	8, 15	2	A	Harrap and Heymann
AgCl-$AlBr_3$	35	1	A	Mezhennii
AgCl-KBr	21, 22, 34, 44	2	B	Bizouard and Doucet
AgCl-LiBr	22	1	B	Bizouard
AgCl-NaBr	22, 34	2	B	Bizouard
$AlCl_3$-NaBr	33	1	A	Moss
$BiCl_3$-$BiBr_3$	58	1	A	Ichikawa and Shimoji
$CaCl_2$-KBr	64	1	A	Markov, Prisyazhnyii, Zavalskaya
$CdCl_2$-$CaBr_2$	64	1	A	Markov et al. see above.
$CdCl_2$-$CdBr_2$	10	1	A	Bloom and Heymann
$CdCl_2$-$PbBr_2$	69	1	A	Voronin, Prisyazhnyii, Baranov
$CdCl_2$-$ZnBr_2$	69	1	A	As above.
CsCl-CsBr	38	1	A	Zuca and Olteanu
CsCl-KBr	28	1	A	Markov and Prisyazhnyii
CsCl-NaBr	23	1	A	Markov and Prisyazhnyii
KCl-RbBr	21, 22, 34, 44	2	B	Bizouard and Doucet
KCl-$AlBr_3$	13, 35	2	A	Gorenbein
KCl-$CaBr_2$	64	1	A	Markov, Prisyazhnyii, Zavalskaya
KCl-$CdBr_2$	64	1	A	As above.
KCl-CsBr	28	1	A	Markov and Prisyazhnyii
KCl-KBr	27, 55	2	A	Zuca and Ionescu-Vasu
KCl-NaBr	19	1	A	Markov and Prisyazhnyii
KCl-RbBr	20	1	A	Markov and Prisyazhnyii
LiCl-AgBr	22	1	B	Bizouard
LiCl-$AlBr_3$	35	1	A	Mezhennii
LiCl-LiBr	82	1	A	Smirnov et al, see above.
NaCl-AgBr	22	1	B	Bizouard
NaCl-$AlBr_3$	35	1	A	Mezhennii
NaCl-CsBr	34	1	A	Markov and Prisyazhnyii
NaCl-KBr	14, 19, 34	2	A	Markov and Prisyazhnyii
NaCl-NaBr	27, 55	2	A	Zuca and Ionescu-Vasu
$PbCl_2$-$CdBr_2$	69	1	A	Voronin, Prisyazhnyii, Baranov
$PbCl_2$-$PbBr_2$	8, 15, 36, 42	3	A	Harrap and Heymann

TABLE 386. Electrical conductance (continued)
A: Classical ac technique
B: Potentiometric ac technique

System	Investigations critically re-examined	Total	Technique of recommended reference	Authors of recommended reference
$PbCl_2$-$ZnBr_2$	61	1	A	Prisyazhnyii and Voronin
RbCl-KBr	20	1	A	Markov and Prisyazhnyiii
RbCl-RbBr	38	1	A	Zuca and Olteanu
$ZnCl_2$-$CdBr_2$	69	1	A	Voronin, Prisyazhnyii, Baranov
$ZnCl_2$-$PbBr_2$	61	1	A	Prisyazhnyii and Voronin
AgCl-AgI	53	1	A	Tubandt and Lorenz
$CdCl_2$-CdI_2	14	1	A	Bloom, Knaggs, Molloy, Welch
CsCl-CsI	38	1	A	Zuca and Olteanu
$HgCl_2$-HgI_2	25	1	A	Bergman and Chavin
KCl-KI	16, 62	2	A	Van Artsdalen and Yaffe
KCl-NaI	14	1	A	Bloom, Knaggs, Molloy, Welch
LiCl-LiI	82, 89	2	A	Smirnov, Khokhlov, Stepanov, Shumov
NaCl-KI	14	1	A	Bloom et al., see above.
RbCl-RbI	38	1	A	Zuca and Olteanu
AgBr-AgI	53, 54	2	A	Tubandt and Lorenz
CsBr-CsI	38, 83, 85	2	A	Zuca and Olteanu
$HgBr_2$-HgI_2	73	1	A	Mentus and Susic
KBr-KI	27, 62	2	A	Zuca and Ionescu-Vasu
LiBr-LiI	82	1	A	Smirnov, Khokhlov, Stepanov, Shumov
NaBr-NaI	27	1	A	Zuca and Olteanu
RbBr-RbI	38	1	A	Zuca and Olteanu
$SbBr_3$-SbI_3	24	1	A	Saito, Ichikawa, Shimoji

TABLE 387. Density
A: Archimedean method; hydrostatic weighing
B: Modified flotation methods
C: Modified maximum bubble pressure method
D: Pycnometric, dilatometric

System	Investigations critically re-examined	Total	Technique of recommended reference	Authors of recommended reference
BaF_2-$BaCl_2$	40	1	A	Bukhalova and Yugub'yan
BaF_2-KCl	31	1	A	Bukhalova and Yagub'yan
CsF-CsCl	85	1	A	Smirnov, Shumov, Stepanov, Khokhlov, Noskevich
KF-$BaCl_2$	31	1	A	Bukhalova and Yagub'yan
KF-KCl	84, 60, 88	2	A	Smirnov, Shumov, Khokhlov, Stepanov, Noskevich, Antonenko
KF-NaCl	43	1	A	Markov and Prisyazhnyii
LiF-LiCl	60, 82	1	C	Smirnov, Khokhlov, Stepanov, Shumov
NaF-NaCl	41, 66	2	A	Shieko, Perks, Pozdnyokov, Bukhalova, Shegurova, Yagub'yan
CsF-CsBr	85	1	A	Smirnov et al., see above.
KF-KBr	84	1	A	Smirnov et al., see above.
LiF-LiBr	82	1	C	Smirnov, Khokhlov, Stepanov, Shumov
CsF-CsI	85	1	A	Smirnov et al., see above.
KF-KI	84	1	A	Smirnov et al., see above.
LiF-LiI	82	1	C	Smirnov et al., see above.
AgCl-AgBr	12, 67, 70	2	D	Boardman, Dorman, Heymann
AgCl-KBr	46	1	A	Markov and Prisyazhnyii
AgCl-NaBr	46	1	A	As above.
$AlCl_3$-NaBr	33	1	D	Moss
$CdCl_2$-$CdBr_2$	12	1	D	Boardman, Dorman, Heymann
$CdCl_2$-KBr	26, 39, 49	3	C	Ellis and Ogleby
$CdCl_2$-$ZnBr_2$	30	1	A	Markov, Prisyazhnyii, Prikhodko
$CdCl_2$- AgBr	67, 70	1	A	Brooks and Paul
CsCl-CsBr	38, 74, 85	2	A	Zuca and Olteanu
CsCl-KBr	46	1	A	Markov and Prisyazhnyii
CsCl-NaBr	46	1	A	Markov and Prisyazhnyii
KCl-AgBr	34, 67, 70	2	A	Markov and Prisyazhnyii Brooks and Paul
KCl-$AlBr_3$	13	1	D	Gorenbein
KCl-$CdBr_2$	26, 39, 50	3	C	Ellis
KCl-CsBr	34, 46, 67, 70	2	A	Markov and Prisyazhnyii Brooks and Paul
KCl-KBr	27	1	A	Zuca and Ionescu-Vasu
KCl-NaBr	14, 46	2	A	Bloom, Knaggs, Molloy and Welch Markov and Prisyazhnyii
KCl-RbBr	46	1	A	Markov and Prisyazhnyii
LiCl-AgBr	67, 70	1	A	Brooks and Paul
LiCl-KBr	29	1	A	Kunugi, Yamate and Takeuchi
LiCl-LiBr	60, 82	2	C	Smirnov, Stepanov, Khokhlov, Shumov
NaCl-AgBr	34, 46, 67, 70	2	A	Markov and Prisyazhnyii Brooks and Paul
NaCl-CsBr	46	1	A	Markov and Prisyazhnyii
NaCl-KBr	46, 66	2	A	Bloom, Knaggs, Molloy, Welch Markov and Prisyazhnyii

TABLE 387. Density—Continued
A: Archimedean method; hydrostatic weighing
B: Modified flotation methods
C: Modified maximum bubble pressure method
D: Pyenometric, dilatometric

System	Investigations critically re-examined	Total	Technique of recommended reference	Authors of recommended reference
NaCl-NaBr	27, 29, 60	3	A	Zuca and Ionescu-Vasu
$PbCl_2$-$PbBr_2$	12	1	D	Boardman, Dorman, Heymann
RbCl-AgBr	67, 70	1	A	Brooks and Paul
RbCl-KBr	46	1	A	Markov and Prisyazhnyii
RbCl-RbBr	38	1	A	Zuca and Olteanu
TlCl-TlBr	72, 90	2	D	Buckle and Tsaoussoglou
$ZnCl_2$-$CdBr_2$	30	1	A	Markov and Prisyazhnyii
$CdCl_2$-CdI_2	14, 56	2	A	Bloom, Knaggs, Molloy, Welch
CsCl-CsI	38, 74, 85, 91	2	A	Zuca and Olteanu
CsCl-KI	57	1	A	Prisyazhnyii and Bryzgailo
KCl-CsI	57	1	A	As above.
KCl-KI	16	1	A	Van Artsdalen and Yaffe
KCl-NaI	14, 34, 43	2	A	Bloom, Knaggs, Molloy, Welch
LiCl-LiI	82	1	C	Smirnov, Khokhlov, Stepanov, Shumov
NaCl-KI	14, 34, 43	2	A	Bloom, Knaggs, Molloy, Welch
NaCl-NaI	27	1	A	Zuca and Olteanu
RbCl-RbI	38	1	A	Zuca and Olteanu
CsBr-CsI	38, 74, 85	2	A	Zuca and Olteanu
$HgBr_2$-HgI_2	7	1	A	Beck
KBr-KI	27	1	A	Zuca and Ionescu-Vasu
LiBr-LiI	82	1	C	Smirnov, Khokhlov, Stepanov, Shumov
NaBr-NaI	27	1	A	Zuca and Ionescu-Vasu
RbBr-RbI	38	1	A	Zuca and Olteanu
TlBr-TlI	90	1	D	Lisitskii, Tret'yakova, Fomichev

TABLE 38B. Viscosity
A: Capillary method
B: Oscillating body method
C: Falling body method

System	Investigations critically re-examined	Total	Technique of recommended reference	Authors of recommended reference
CsF-CsCl	65	1	B	Smirnov, Khokhlov, Antonov
NaF-NaCl	63	1	B	Ohta
CsF-CsBr	65	1	B	Smirnov, Khokhlov, Antonov
CsF-CsI	65	1	B	As above.
AgCl-AgBr	15	1	A	Harrap and Heymann
$CdCl_2$-$CdBr_2$	11	1	A	Bloom, Harrap and Heymann
$CdCl_2$-KBr	45, 50, 59	3	A	Ellis
$CdCl_2$-NaBr	59	1	A	Il'yasov and Barsegov
$CdCl_2$ $PbBr_2$	59	1	A	As above.
CsCl-CsBr	65	1	B	Smirnov, Khokhlov, Antonov
KCl-$AlBr_3$	13	1	A	Gorenbein
KCl-CsBr	59	1	A	Il'yasov and Barsegov
KCl-KBr	18, 55	2	B	Murgulescu and Zuca
KCl-$PbBr_2$	48	1	A	Barsegov and Il'yasov
NaCl-$CdBr_2$	59	1	A	Il'yasov and Barsegov
NaCl-NaBr	55	1	B	Matsumura, Mizuno, Nishihara
$PbCl_2$-$CdBr_2$	59	1	A	Il'yasov and Barsegov
$PbCl_2$-KBr	48	1	A	Barsegov and Il'yasov
$PbCl_2$-$PbBr_2$	15	1	A	Harrap and Heymann
TlCl-TlBr	90	1	A	Lisitskii, Tre'tyakova, Fomichev
$CdCl_2$-CdI_2	48	1	A	Barsegov and Il'yasov
CsCl-CsI	65	1	B	Smirnov, Khokhlov, Antonov
CsBr-CsI	65	1	B	As above.
$HgBr_2$-HgI_2	7	1	A	Beck
TlBr-TlI	90	1	A	Lisitskii, Tret'yakova, Fomichev

TABLE 389. Surface tension
A: Wilhemly slide plate method
B: Pin detachment
C: Maximum bubble pressure method

System	Investigations critically re-examined	Total	Technique of recommended reference	Authors of recommended reference
KF-KCl	60, 87	2	C	Narishkin, Patrov, Chebotarev
LiF-LiCl	79, 88	2	C	Smirnov and Stepanov
NaF-NaCl	87	1	C	Narishkin, Patrov, Chebotarev
RbF-RbCl	88	1	B	Berge and Holm
LiF-LiBr	79	1	C	Smirnov and Stepanov
LiF-LiI	79	1	C	As above.
AgCl-AgBr	76	1	C	Boardman, Palmer, Heymann
AgCl-KBr	71	1	B	Sternberg and Terzi
AgCl-NaBr	71	1	B	As above.
$CdCl_2$-$CdBr_2$	76	1	C	Boardman, Palmer, Heymann
$CdCl_2$-KBr	39, 49, 77, 86	3	C	Ellis, Smith, Wilcox, Crook
CsCl-CsBr	74, 81	2	C	Stepanov and Smirnov
KCl-AgBr	71	1	B	Sternberg and Terzi
KCl-$CdBr_2$	26, 39, 50, 86	4	C	Ellis and Freeman
KCl-KBr	76, 81, 88	3	C, A	Boardman, Palmer, Heymann Bertozzi
KCl-NaBr	32, 78	2	B	Sternberg and Terzi
KCl-RbCl	32	1	B	Sternberg and Terzi
LiCl-LiBr	79, 88	2	C	Smirnov and Stepanov
NaCl-AgBr	80	1	B	Sternberg and Terzi
NaCl-KBr	32, 78	1	B	Sternberg and Terzi
NaCl-NaBr	81, 88	2	A	Bertozzi
RbCl-KBr	32	1	B	Sternberg and Terzi
RbCl-RbBr	81	1	A	Bertozzi
CsCl-CsI	74	1	C	Stepanov and Smirnov
KCl-NaI	75	1	C	Bloom, Davis, James
LiCl-LiI	79	1	C	Smirnov and Stepanov
CsBr-CsI	74	1	C	Stepanov and Smirnov
LiBr-LiI	79	1	C	Smirnov and Stepanov

TABLE 390. Recommendations

System	Recommended reference			
	κ	ρ	η	γ
BaF_2-$BaCl_2$	68	40		
BaF_2-KCl		31		
CsF-CsCl	85	85	65	
KF-$BaCl_2$		31		
KF-KCl	84	84		87
KF-NaCl	9	43		
LiF-LiCl	82	82		79
NaF-$BaCl_2$	47			
NaF-NaCl		41, 66	63	87
RbF-RbCl				88
CsF-CsBr	85	85	65	
KF-KBr	84	84		
LiF-LiBr	82	82		79
CsF-CsI	85	85	65	
KF-KI	84	84		
LiF-LiI	82	82		79
AgCl-AgBr	15	12	15	76
AgCl-$AlBr_3$	35			
AgCl-KBr	44	46		71
AgCl-LiBr	22			
AgCl-NaBr	22	46		80
$AlCl_3$-NaBr	33	33		
$BiCl_3$-$BiBr_3$	58			
$CaCl_2$-KBr	64			
$CdCl_2$-$CaBr_2$	64			
$CdCl_2$-$CdBr_2$	10	12	11	76
$CdCl_2$-KBr		26, 49	45,50	77
$CdCl_2$-NaBr			59	
$CdCl_2$-$PbBr_2$	69		59	
$CdCl_2$-$ZnBr_2$	69	30		
CsCl-AgBr		67, 70		
CsCl-CsBr	38	38	65	74
CsCl-KBr	28	46		
CsCl-NaBr	23	46		
KCl-AgBr	44	34, 67		71
KCl-$AlBr_3$	13	13	13	
KCl-$CaBr_2$	64			
KCl-$CdBr_2$	64	26	59	50, 86
KCl-CsBr	28	67, 70		
KCl-KBr	27	27	18	76, 81
KCl-NaBr	19	14, 46		32
KCl-PbBr			48	

TABLE 390. Recommendations

System	Recommended reference			
	κ	ρ	η	γ
KCl-RbBr	20	46		32
LiCl-AgBr	22	67, 70		
LiCl-$AlBr_3$	35	29		
LiCl-LiBr	82	82		79
NaCl-AgBr	22	46		80
NaCl-$AlBr_3$	35			
NaCl-$CdBr_2$			59	
NaCl-CsBr	34	46		
NaCl-KBr	19	46, 66		32
NaCl-NaBr	27	27	55	81
$PbCl_2$-$PbBr_2$	69		59	
$PbCl_2$-KBr			48	
$PbCl_2$-$PbBr_2$	15	12	15	
$PbCl_2$-$ZnBr_2$	61			
RbCl-AgBr		67, 70		
RbCl-KBr	20	46		32
RbCl-RbBr	38	38		81
TlCl-TlBr		72	90	
$ZnCl_2$-$CdBr_2$	69	30		
$ZnCl_2$-$PbBr_2$	61			
AgCl-AgI	53			
$CdCl_2$-CdI_2	14	14	48	
CsCl-CsI	38	38	65	74
CsCl-KI		57		
$HgCl_2$-$HgBr_2$	25			
KCl-CsI		57		
KCl-KI	16	16		
KCl-NaI	14	14		75
LiCl-LiI	82	82		79
NaCl-KI	14	14		
NaCl-NaI	27	27		
RbCl-RbI	38	38		
AgBr-AgI	53			
$BiBr_3$-BiI_3				76
CsBr-CsI	38	38	65	74
$HgBr_2$-HgI_2	73	7	7	
KBr-KI	27	27		
LiBr-LiI	82	82		79
NaBr-NaI	27	27		
RbBr-RbI	38	38		
$SbBr_3$-SbI_3	24	24		
TlBr-TlI		90	90	

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