

The Volumetric Properties of Aqueous Sodium Chloride Solutions from 0° to 500°C at Pressures up to 2000 Bars Based on a Regression of Available Data in the Literature

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By ROBERT W. POTTER II *and* DAVID L. BROWN

PRELIMINARY STEAM TABLES FOR NaCl SOLUTIONS

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**THE VOLUMETRIC PROPERTIES OF
AQUEOUS SODIUM CHLORIDE SOLUTIONS
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AVAILABLE DATA IN THE
LITERATURE**

By ROBERT W. POTTER II and DAVID L. BROWN

ABSTRACT

The volumetric properties of aqueous sodium chloride solutions from 0° to 500°C at pressures up to 2000 bars for concentrations ranging from infinite dilution to as high as 8.0 molal have been obtained by a computer regression of the available experimental data from the literature. The regression was done using (1) the simplest forms of equations capable of describing the experimental data, (2) unsmoothed data where possible, and (3) a least-squares regression technique in which the individual data points were weighted with respect to their relative uncertainty. By following this procedure, a set of internally consistent data was generated. The results are presented in 27 tables of density data at various concentrations, temperatures, and pressures. Two tables of empirical constants capable of generating the tables of density values as well as interpolating the tabulated values are also given.

INTRODUCTION

Pressure-volume-temperature-composition (P-V-T-X) data for brines are required to establish optimum operating temperatures, pressures, and flow rates for the production of geothermal brine fields, to minimize scaling and corrosion, and to design intelligently turbines for production of electricity. One of the prerequisites for successful chemical modeling of geothermal brine systems, as well as reservoir modeling, is thermodynamic data derived from the volumetric properties of brines, for example, partial and apparent molal volumes. In view of the critical importance of P-V-T-X data to the utilization and understanding of geothermal brine systems, a compilation of the available data from the literature and a critical evaluation of these data are required. The compilation of the available data from the literature has been completed (Potter and others, 1975), and this chapter presents a critical evaluation of the volumetric data for aqueous sodium chloride solutions.

The volumetric properties of aqueous sodium chloride solutions have been the focus of experimental investigation since 1854. The experimental data prior to 1928, from a total of 103 published references, have been collected, critically evaluated, and published as smoothed values in the International Critical Tables (National Research Council, 1928). The data published since 1928 have been collected and summarized by Potter, Shaw, and Haas (1975). The 119 references covered by them produced a total of 2,453 volumetric measurements as well as 802 smoothed densities. These data and the data presented in the International Critical Tables served as the data base used in this critical evaluation of the volumetric properties of aqueous sodium chloride solutions.

Prior to the present evaluation, the only fairly extensive tabulations of smoothed volumetric data for aqueous, vapor-saturated sodium chloride solutions were: International Critical Tables (National Research Council, 1928) for 0.5–26 weight percent solutions from 0°–100°C; Fabuss and Korosi (1968) for 0.1–3.5 molal (also given in weight percent and molarity) solutions from 20°–150°C (tables also in °F); and Haas (1970) for 0–8.0 molal solutions from 75°–325°C. There are no critical compilations of smoothed data available for solutions at pressures greater than the saturation vapor pressure (Potter, 1976). The limited range of critically evaluated numbers is further evidence of a need for a critical evaluation of all the data over the whole P-V-T-X space if it is available, despite the fact that experimental data summarized by Potter, Shaw, and Haas (1975) are for solutions from 10⁻⁶–15.8 molal over the temperature range 0°–770°C at pressures up to 12000 bars.

DATA REGRESSION METHODS

The intent of this critical evaluation of aqueous sodium chloride solutions is to produce a set of internally consistent densities that describes the available volumetric data without introducing any theoretical bias. Hence only the raw experimental values were used in the regression of the volumetric properties, except for the pre-1928 data. Since many of these data are unavailable, the smoothed data from the International Critical Tables (National Research Council, 1928) were used in their place. These data were converted to a common system of units and were then fit to the simplest form of an equation that would adequately describe the experimental data. A minimum amount of data points were rejected using statistical criterion, and the data were then refit to an equation of the same form. The equations that were finally derived in this fashion were used to generate the smoothed density values.

The experimental data for the volumetric properties of aqueous

sodium chloride solutions are reported in the literature in every unit imaginable, from densities in $\text{ft}^3/\text{lb-mol}$ to pressure in amagats. Hence all the volumetric property data had to be converted to a common system of units before they could be evaluated. The system of units used was bars, $^{\circ}\text{C}$, g/cm^3 , and molality for the pressure, temperature, density, and composition, respectively. All these units at the present time are acceptable SI units (Page and Vigoureux, 1972).

A less tractable problem was that of converting the data to a common reference base for the volumetric properties of pure water. Most workers used water either directly or indirectly as a standard for their volumetric measurements, and hence their reported values depend on the set of volumetric data for pure water that the investigator chose to employ. Wherever possible, the volumetric data for aqueous sodium chloride solutions used in the regression were corrected to the reference base for pure water of Kell and Whalley (1965) below 150°C and Keenan, Keyes, Hill, and Moore (1969) at higher temperatures.

Each datum of the data base was evaluated as to its relative uncertainty. In general, the uncertainty was taken to be the precision as stated by the original investigator. However, in those cases where no precision or estimate of uncertainty was stated, an estimated value for the uncertainty was supplied. The precision was estimated as one in the last decimal place of the reported data or on the basis of the precision that could be expected from the method employed under normal conditions. The estimate that yielded the largest uncertainty was the estimate used to weight the data for the regression.

After several trial fittings of the density as a function of composition at constant temperature and pressure, the following equations were found to be the simplest equations that could most precisely describe the experimental data:

$$d = \frac{1000d_0 + M_2md_0}{1000 + A_0md_0 + B_0m^{3/2}d_0 + C_0m^2d_0} \quad (T, P \text{ constant}) \quad (1)$$

and

$$d = A_1 + B_1m^{1/2} + C_1m \quad (T, P \text{ constant}) \quad (2)$$

where d is the density of the aqueous sodium chloride solution, d_0 is the density of pure water at the temperature and pressure of consideration; m is the molality; M_2 is the molecular weight of sodium chloride; and A_0, A_1, B_0, B_1, C_0 , and C_1 are empirical constants. Equation (1) was required to be able to fit the highly precise data, that is, $\pm 10^{-6}$ – $\pm 10^{-4}$ g/cm^3 , which were available below 100°C . At higher temperatures where most of the data had a precision of ± 0.001 –

$\pm 0.005 \text{ g/cm}^3$, equation (2) proved adequate to describe the experimental data. The density as a function of temperature at constant composition and pressure was found to be adequately described by an equation of the following form:

$$d = A + BT + CT^2 \quad (\text{Composition, } P \text{ constant}) \quad (3)$$

where A , B , and C are empirical constants.

The smoothed densities were obtained from a computer regression of the P-V-T-X data base previously described. The regression of these data was accomplished by using a least-squares method in which the individual data points were weighted with respect to their relative uncertainty (Meyer, 1975). The experimental data were first regressed at constant temperature and pressure as a function of composition, then the resulting smoothed densities were regressed as a function of temperature at constant composition and pressure. After the initial fit as a function of composition, the experimental data were evaluated via Chauvenet's criterion and the inappropriate data were rejected. The remaining data were then refit to either equation (1) or (2) depending on the temperature, and the subsequent smoothed values were used in the final regression. This was the only stage in the regression at which data were rejected.

RESULTS

Table 1 summarizes the densities for the vapor-saturated aqueous sodium chloride solutions from 0°–500°C for various concentrations expressed as molality. The densities for vapor-saturated aqueous sodium chloride solutions with concentration expressed in weight percent (table 2) were derived by interpolating the expressions for density as a function of the molality. The densities for various molalities, 0.5–6.0 molal in 0.5 molal steps, at pressures greater than the saturation vapor pressure up to 2000 bars from 25°–500°C are summarized in tables 3–14; the densities for various sodium chloride solutions with concentration expressed in weight percent, 1–25 weight percent in 2 weight percent increments, for the same pressure and temperature range are summarized in tables 15–27. The regression constants for the equations used to generate tables 1–27 are tabulated in tables 28 and 29.

The uncertainties for the densities given in tables 1–27 are the mean deviation of the experimental values from the final regressed equations. The extrapolated densities have been assigned an uncertainty of 10 times the mean standard deviation for the final regressed equations (tables 28 and 29). These assignments were made because of the simple form of the equations used; for although the equations

fit the data well, they cannot be readily extrapolated with any certainty. Data is available for higher temperatures, pressures, and concentrations than those summarized in tables 1-27; however, in general, these data are not consistent with the lower temperature, pressure, and concentration data or not extensive enough to allow for a reliable regression that would yield internally consistent P-V-T-X data.

As has been previously stated, there are three critical compilations of density data for limited temperature ranges previous to this study: International Critical Tables (National Research Council, 1928), Fabuss and Korosi (1968), and Haas (1970). The observed mean standard deviations between these data sets and the data in this study are $\pm 0.0003 \text{ g/cm}^3$, $\pm 0.0007 \text{ g/cm}^3$, and $\pm 0.0036 \text{ g/cm}^3$, respectively. The percentages of the smoothed points from the previous compilations that lie within the error bands determined for this study are 69.2 percent, 85.7 percent, and 82.0 percent for the International Critical Tables, Fabuss and Korosi, and Haas, respectively.

The tabulations given here will differ from those given in Chapters A and B of this Bulletin (Haas, 1976a, b) because these results were not available when the earlier chapters were prepared. Haas used an earlier formulation for the density of NaCl solutions to calculate the density and specific volume of the vapor-saturated solutions and to estimate the partial molal volumes of the H_2O and NaCl components. As indicated in the foregoing analysis, these differences are minor in nature when the precision and accuracy of the available data are considered.

The density data obtained from smoothing all the available experimental data are in substantial agreement with previous studies of a similar nature. The smoothed values presented in tables 1-27 represent a reliable set of internally consistent data that describes the available experimental data for the volumetric properties of aqueous sodium chloride solutions. Their wider scope, both in temperature-pressure-composition space and in completeness of data considered, makes these tabulations superior to the previously available compilations. The data as presented in tables 1-27 appear to be of significant precision for engineering purposes; however the precision is such that only preliminary thermochemical data can be extracted from the data set (Potter, 1976).

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TABLES 1-29

TABLE 1.—*Densities of vapor-saturated NaCl solutions, g/cm³*

[The uncertainties in the densities are: 5-place figures $\pm 10^{-5}$, 50° data $\pm 10^{-6}$, 75° data $\pm 5 \times 10^{-6}$, 3-place figures ± 0.005 , 2-place figures ± 0.05 .]

Temp °C	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
0	1.02190	1.04244	1.06206	1.08086	1.09891	1.11625	1.13292	1.14895	1.16437	1.17920	1.19347	1.20719	--	--	--	--
25	1.01710	1.03621	1.05458	1.07227	1.08932	1.10576	1.12162	1.13691	1.15167	1.16591	1.17964	1.19288	--	--	--	--
50	1.0074	1.0259	1.0437	1.0609	1.0775	1.0936	1.1092	1.1242	1.1389	1.1530	1.1667	1.1801	--	--	--	--
75	0.9941	1.0126	1.0304	1.0477	1.0645	1.0807	1.0963	1.1115	1.1263	1.1405	1.1543	1.1677	--	--	--	--
100	0.978	0.997	1.014	1.031	1.046	1.062	1.078	1.093	1.107	1.122	1.136	1.151	1.165	--	--	--
125	0.961	0.980	0.998	1.013	1.028	1.044	1.060	1.075	1.089	1.104	1.118	1.133	1.147	--	--	--
150	0.941	0.960	0.979	0.993	1.008	1.024	1.040	1.055	1.070	1.084	1.099	1.114	1.128	1.143	--	--
175	0.916	0.937	0.957	0.971	0.985	1.003	1.018	1.034	1.049	1.064	1.079	1.094	1.108	1.123	1.14	--
200	0.888	0.910	0.932	0.947	0.961	0.979	0.996	1.011	1.027	1.042	1.057	1.072	1.088	1.103	1.12	1.14
225	0.856	0.880	0.903	0.920	0.934	0.955	0.971	0.987	1.004	1.019	1.035	1.050	1.066	1.081	1.10	1.12
250	0.820	0.846	0.872	0.890	0.905	0.928	0.945	0.962	0.980	0.996	1.012	1.027	1.043	1.058	1.08	1.10
275	0.780	0.810	0.838	0.859	0.874	0.899	0.918	0.936	0.954	0.971	0.987	1.003	1.019	1.034	1.05	1.08
300	0.736	0.769	0.801	0.824	0.842	0.869	0.889	0.908	0.927	0.945	0.962	0.978	0.994	1.009	1.03	1.05
325	0.689	0.726	0.760	0.788	0.807	0.837	0.859	0.880	0.899	0.917	0.935	0.952	0.968	0.984	1.00	1.02
350	0.637	0.679	0.717	0.749	0.770	0.804	0.827	0.849	0.870	0.889	0.907	0.925	0.941	0.957	0.97	0.99
375	0.56	0.629	0.671	0.708	0.730	0.768	0.794	0.818	0.839	0.860	0.878	0.896	0.913	0.929	0.94	0.95
400	--	0.56	0.621	0.665	0.689	0.731	0.760	0.785	0.808	0.829	0.849	0.867	0.884	0.900	0.90	0.91
425	--	--	0.569	0.619	0.646	0.693	0.724	0.751	0.775	0.797	0.818	0.837	0.854	0.869	0.87	0.87
450*	--	--	--	0.57	0.60	0.65	0.67	0.72	0.74	0.76	0.79	0.81	0.82	0.84	0.83	0.82
475*	--	--	--	--	--	0.61	0.65	0.68	0.71	0.73	0.75	0.77	0.79	0.81	0.79	0.77
500*	--	--	--	--	--	--	0.61	0.64	0.67	0.70	0.72	0.74	0.76	0.77	0.75	0.72

* Extrapolated values

TABLE 2.—*Densities of vapor-saturated NaCl solutions, g/cm³*

[The uncertainties in the densities are: 5-place figures $\pm 10^{-5}$, 50° data $\pm 10^{-4}$, 75° data $\pm 5 \times 10^{-4}$, 3-place figures ± 0.005 , 2-place figures ± 0.05 .]

Temp °C	1	3	5	7	9	11	13	15	17	19	21	23	25	30*
0	1.00755	1.02283	1.03814	1.05354	1.06908	1.08476	1.10060	1.11660	1.13276	1.14906	1.16551	1.18210	1.19880	--
25	1.00411	1.01823	1.03247	1.04688	1.06146	1.07624	1.09122	1.10639	1.12176	1.13732	1.15307	1.16900	1.18509	--
50	0.9948	1.0085	1.0222	1.0362	1.0503	1.0647	1.0793	1.0942	1.1093	1.1247	1.1403	1.1561	1.1722	--
75	0.9816	0.9952	1.0090	1.0229	1.0372	1.0516	1.0663	1.0813	1.0965	1.1119	1.1277	1.1436	1.1598	--
100	0.963	0.979	0.993	1.007	1.021	1.035	1.049	1.063	1.078	1.093	1.109	1.125	1.142	--
125	0.947	0.962	0.976	0.990	1.003	1.017	1.031	1.045	1.060	1.075	1.091	1.107	1.124	--
150	0.926	0.942	0.956	0.970	0.984	0.997	1.011	1.025	1.040	1.055	1.071	1.088	1.105	--
175	0.901	0.917	0.932	0.947	0.961	0.975	0.989	1.003	1.018	1.034	1.050	1.067	1.085	1.14
200	0.871	0.889	0.905	0.921	0.936	0.950	0.965	0.980	0.995	1.011	1.028	1.046	1.064	1.12
225	0.836	0.857	0.875	0.892	0.908	0.923	0.939	0.955	0.971	0.988	1.005	1.023	1.041	1.10
250	0.797	0.822	0.842	0.860	0.878	0.894	0.912	0.928	0.945	0.963	0.981	0.999	1.018	1.07
275	0.753	0.782	0.805	0.825	0.845	0.863	0.882	0.900	0.918	0.937	0.955	0.974	0.994	1.05
300	0.705	0.739	0.765	0.787	0.809	0.830	0.850	0.870	0.890	0.909	0.928	0.948	0.968	1.02
325	0.652	0.692	0.721	0.745	0.771	0.794	0.817	0.838	0.859	0.880	0.901	0.921	0.942	1.00
350	0.594	0.641	0.675	0.701	0.730	0.756	0.781	0.805	0.828	0.850	0.872	0.893	0.914	0.97
375	0.532	0.586	0.624	0.654	0.686	0.716	0.744	0.770	0.795	0.819	0.841	0.864	0.886	0.93
400	--	--	0.571	0.603	0.640	0.674	0.704	0.733	0.760	0.786	0.810	0.833	0.856	0.90
425	--	--	--	0.550	0.591	0.630	0.663	0.694	0.724	0.752	0.778	0.802	0.825	0.87
450*	--	--	--	--	0.54	0.58	0.62	0.65	0.69	0.72	0.74	0.77	0.79	0.83
475*	--	--	--	--	--	--	--	0.61	0.65	0.68	0.71	0.74	0.76	0.79
500*	--	--	--	--	--	--	--	--	0.61	0.64	0.67	0.70	0.73	0.75

* Extrapolated values

TABLE 3.—*Densities of 0.5 molal NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)										
	100	200	300	400	500	600	700	800	900	1000	1250
25	1.018	1.022	1.027	1.031	1.035	1.039	1.043	1.048	1.051	1.055	1.064
50	1.012	1.015	1.020	1.026	1.030	1.034	1.039	1.042	1.046	1.050	1.058
75	1.002	1.005	1.009	1.017	1.021	1.026	1.032	1.034	1.038	1.042	1.051
100	0.989	0.991	0.996	1.005	1.010	1.015	1.021	1.024	1.028	1.032	1.041
125	0.971	0.975	0.980	0.990	0.995	1.000	1.008	1.011	1.015	1.020	1.029
150	0.950	0.955	0.960	0.971	0.977	0.983	0.992	0.995	1.000	1.005	1.015
175	0.925	0.931	0.938	0.950	0.956	0.963	0.972	0.976	0.982	0.988	0.999
200	0.897	0.905	0.913	0.925	0.933	0.940	0.950	0.955	0.961	0.968	0.981
225	0.865	0.875	0.884	0.897	0.906	0.914	0.924	0.931	0.938	0.946	0.961
250	0.829	0.842	0.853	0.866	0.876	0.885	0.896	0.904	0.913	0.921	0.939
275	0.789	0.806	0.818	0.831	0.843	0.854	0.864	0.875	0.885	0.894	0.915
300	0.746	0.767	0.780	0.793	0.806	0.819	0.830	0.843	0.854	0.865	0.888
325	--	0.724	0.740	0.752	0.767	0.781	0.792	0.808	0.821	0.833	0.860
350	--	0.68*	0.70*	0.71*	0.725	0.741	0.752	0.771	0.785	0.798	0.829
375	--	0.63*	0.65*	0.66*	0.68*	0.70*	0.71*	0.731	0.747	0.762	0.797
400	--	--	--	--	0.63*	0.65*	0.66*	0.69*	0.71*	0.722	0.762
425	--	--	--	--	--	--	--	0.64*	0.66*	0.68*	0.725
450	--	--	--	--	--	--	--	--	--	0.64*	0.69*
475	--	--	--	--	--	--	--	--	--	--	0.64*
500	--	--	--	--	--	--	--	--	--	--	--

*Extrapolated values

TABLE 4.—*Densities of 1 molal NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)									
	100	200	300	400	500	600	700	800	900	1000
25	1.038	1.042	1.046	1.052	1.055	1.059	1.064	1.067	1.071	1.075
50	1.031	1.035	1.038	1.045	1.050	1.054	1.057	1.060	1.065	1.068
75	1.020	1.024	1.028	1.036	1.042	1.046	1.048	1.051	1.057	1.060
100	1.006	1.010	1.015	1.024	1.030	1.035	1.037	1.039	1.046	1.049
125	0.989	0.993	0.999	1.009	1.016	1.021	1.023	1.026	1.033	1.036
150	0.968	0.974	0.980	0.991	0.999	1.005	1.006	1.010	1.018	1.022
175	0.945	0.951	0.958	0.970	0.979	0.985	0.987	0.993	1.000	1.005
200	0.918	0.926	0.934	0.946	0.956	0.963	0.966	0.973	0.980	0.986
225	0.888	0.898	0.907	0.919	0.930	0.938	0.942	0.951	0.958	0.964
250	0.856	0.866	0.877	0.889	0.900	0.910	0.916	0.927	0.934	0.941
275	0.819	0.832	0.845	0.856	0.868	0.880	0.882	0.901	0.908	0.916
300	0.780	0.795	0.809	0.821	0.833	0.846	0.856	0.873	0.879	0.888
325	--	0.755	0.771	0.782	0.795	0.810	0.822	0.843	0.848	0.859
350	--	0.71*	0.730	0.741	0.754	0.771	0.785	0.810	0.815	0.827
375	--	0.67*	0.69*	0.70*	0.710	0.729	0.747	0.776	0.779	0.793
400	--	--	0.64*	0.65*	0.663	0.685	0.705	0.740	0.741	0.758
425	--	--	--	--	0.613	0.638	0.662	0.701	0.701	0.720
450	--	--	--	--	0.56*	0.59*	0.615	0.660	0.659	0.680
475	--	--	--	--	0.50*	0.53*	0.57*	0.62*	0.614	0.637
500	--	--	--	--	0.44*	0.48*	0.52*	0.57*	0.57*	0.593
										0.64*
										0.684
										0.72*
										0.754

*Extrapolated values

TABLE 5.—Densities of 1.5 molal NaCl solutions, g/cm³[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)													
	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
25	1.058	1.062	1.065	1.071	1.074	1.078	1.082	1.085	1.089	1.093	1.101	1.109	1.117	1.124
50	1.049	1.053	1.057	1.064	1.068	1.072	1.076	1.079	1.083	1.086	1.094	1.103	1.110	1.118
75	1.038	1.042	1.046	1.054	1.059	1.063	1.067	1.071	1.074	1.078	1.086	1.095	1.102	1.110
100	1.024	1.028	1.032	1.042	1.047	1.052	1.056	1.060	1.064	1.067	1.076	1.085	1.093	1.101
125	1.007	1.011	1.017	1.027	1.033	1.038	1.043	1.047	1.051	1.055	1.064	1.074	1.082	1.091
150	0.987	0.992	0.998	1.010	1.016	1.022	1.027	1.032	1.036	1.040	1.050	1.062	1.070	1.080
175	0.964	0.971	0.977	0.989	0.996	1.003	1.009	1.014	1.019	1.024	1.035	1.047	1.057	1.067
200	0.938	0.946	0.954	0.967	0.974	0.982	0.988	0.995	1.000	1.006	1.018	1.032	1.042	1.053
225	0.910	0.919	0.928	0.941	0.950	0.958	0.966	0.973	0.979	0.986	1.000	1.015	1.026	1.038
250	0.878	0.890	0.899	0.913	0.922	0.932	0.941	0.949	0.956	0.963	0.979	0.996	1.009	1.022
275	0.844	0.857	0.868	0.882	0.893	0.903	0.913	0.922	0.931	0.939	0.957	0.976	0.990	1.004
300	0.807	0.822	0.835	0.848	0.860	0.872	0.883	0.894	0.903	0.913	0.934	0.954	0.970	0.986
325	0.77	0.785	0.799	0.812	0.826	0.838	0.851	0.863	0.874	0.885	0.909	0.931	0.949	0.966
350	--	0.745	0.760	0.773	0.788	0.802	0.817	0.830	0.842	0.845	0.882	0.906	0.926	0.944
375	--	0.70*	0.72*	0.731	0.748	0.764	0.780	0.794	0.809	0.822	0.853	0.880	0.902	0.922
400	--	0.66*	0.68*	0.69*	0.71*	0.72*	0.741	0.757	0.773	0.788	0.823	0.852	0.877	0.898
425	--	--	--	0.64*	0.66*	0.68*	0.70*	0.72*	0.735	0.752	0.791	0.822	0.850	0.874
450	--	--	--	--	--	--	0.66*	0.68*	0.70*	0.73*	0.758	0.791	0.822	0.847
475	--	--	--	--	--	--	--	--	0.65*	0.67*	0.72*	0.759	0.793	0.820
500	--	--	--	--	--	--	--	--	--	--	0.68*	0.725	0.762	0.792

*Extrapolated values

TABLE 6.—*Densities of 2 molal NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)											
	100	200	300	400	500	600	700	800	900	1000	1250	1500
25	1.075	1.079	1.081	1.088	1.091	1.095	1.098	1.102	1.106	1.109	1.118	1.125
50	1.065	1.071	1.072	1.081	1.086	1.089	1.092	1.096	1.099	1.103	1.111	1.119
75	1.053	1.059	1.061	1.071	1.078	1.081	1.085	1.088	1.091	1.094	1.102	1.111
100	1.038	1.045	1.048	1.059	1.067	1.071	1.075	1.077	1.080	1.084	1.092	1.101
125	1.020	1.028	1.032	1.044	1.054	1.058	1.063	1.065	1.068	1.071	1.081	1.091
150	1.000	1.007	1.014	1.027	1.038	1.042	1.048	1.050	1.053	1.057	1.068	1.078
175	0.976	0.984	0.994	1.007	1.019	1.024	1.032	1.034	1.037	1.042	1.053	1.065
200	0.950	0.958	0.972	0.985	0.998	1.004	1.013	1.015	1.019	1.024	1.036	1.050
225	0.921	0.929	0.947	0.961	0.974	0.981	0.992	0.994	0.999	1.004	1.019	1.033
250	0.889	0.897	0.920	0.934	0.947	0.955	0.968	0.970	0.976	0.983	0.999	1.015
275	0.854	0.862	0.891	0.905	0.917	0.927	0.943	0.945	0.952	0.960	0.978	0.996
300	0.82*	0.83*	0.859	0.873	0.885	0.897	0.915	0.917	0.926	0.935	0.955	0.975
325	--	--	0.825	0.839	0.850	0.863	0.885	0.888	0.898	0.908	0.931	0.953
350	--	--	0.790	0.802	0.812	0.828	0.853	0.856	0.868	0.879	0.905	0.929
375	--	--	0.71*	0.763	0.772	0.790	0.818	0.822	0.836	0.849	0.878	0.904
400	--	--	--	0.72*	0.728	0.749	0.782	0.786	0.802	0.816	0.849	0.877
425	--	--	--	0.68*	0.683	0.706	0.743	0.747	0.766	0.782	0.819	0.849
450	--	--	--	--	0.634	0.660	0.701	0.707	0.728	0.746	0.787	0.820
475	--	--	--	--	0.58*	0.61*	0.658	0.664	0.678	0.71*	0.753	0.789
500	--	--	--	--	0.53*	0.56*	0.61*	0.62*	0.646	0.67*	0.72*	0.757

*Extrapolated values

TABLE 7.—*Densities of 2.5 molal NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)									
	100	200	300	400	500	600	700	800	900	1000
25	1.092	1.096	1.099	1.104	1.108	1.111	1.114	1.118	1.122	1.125
50	1.084	1.087	1.090	1.097	1.101	1.104	1.109	1.112	1.115	1.118
75	1.072	1.075	1.078	1.087	1.091	1.095	1.101	1.103	1.107	1.110
100	1.057	1.061	1.064	1.075	1.079	1.084	1.091	1.093	1.096	1.100
125	1.040	1.044	1.048	1.060	1.066	1.071	1.078	1.080	1.084	1.088
150	1.019	1.024	1.031	1.043	1.049	1.055	1.064	1.066	1.070	1.074
175	0.995	1.001	1.011	1.024	1.031	1.037	1.048	1.049	1.054	1.058
200	0.968	0.976	0.989	1.003	1.010	1.017	1.029	1.031	1.036	1.041
225	0.938	0.948	0.965	0.979	0.988	0.995	1.008	1.010	1.016	1.022
250	0.906	0.918	0.939	0.953	0.963	0.971	0.985	0.988	0.994	1.001
275	0.87	0.884	0.911	0.925	0.935	0.945	0.960	0.963	0.971	0.979
300	0.84	0.848	0.881	0.894	0.906	0.916	0.933	0.937	0.946	0.954
325	--	0.81	0.849	0.862	0.874	0.886	0.903	0.908	0.918	0.928
350	--	0.77	0.814	0.826	0.840	0.853	0.872	0.878	0.889	0.900
375	--	--	0.78	0.789	0.804	0.818	0.838	0.846	0.858	0.871
400	--	--	0.74*	0.75*	0.765	0.781	0.802	0.811	0.826	0.840
425	--	--	--	0.71*	0.73*	0.74*	0.764	0.775	0.791	0.807
450	--	--	--	--	0.68*	0.70*	0.72*	0.74*	0.75*	0.772
475	--	--	--	--	--	--	0.68*	0.70*	0.72*	0.74*
500	--	--	--	--	--	--	--	--	--	0.70*

*Extrapolated values

TABLE 8.—*Densities of 3 molal NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)													
	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
25	1.108	1.112	1.115	1.120	1.123	1.126	1.130	1.133	1.136	1.140	1.148	1.156	1.163	1.170
50	1.098	1.102	1.105	1.112	1.118	1.121	1.124	1.128	1.131	1.134	1.142	1.149	1.157	1.164
75	1.086	1.091	1.093	1.102	1.110	1.113	1.116	1.122	1.124	1.127	1.133	1.141	1.149	1.157
100	1.071	1.076	1.079	1.090	1.099	1.103	1.106	1.113	1.115	1.117	1.123	1.132	1.140	1.148
125	1.054	1.059	1.064	1.076	1.087	1.090	1.094	1.102	1.104	1.106	1.112	1.122	1.130	1.139
150	1.034	1.040	1.046	1.059	1.071	1.075	1.079	1.088	1.090	1.093	1.099	1.110	1.119	1.128
175	1.012	1.018	1.027	1.040	1.054	1.058	1.063	1.072	1.075	1.078	1.085	1.097	1.106	1.116
200	0.987	0.994	1.006	1.019	1.033	1.039	1.044	1.054	1.057	1.061	1.069	1.082	1.092	1.104
225	0.960	0.967	0.982	0.996	1.011	1.017	1.023	1.034	1.038	1.042	1.052	1.066	1.078	1.090
250	0.930	0.938	0.957	0.971	0.985	0.993	1.000	1.011	1.016	1.021	1.033	1.049	1.062	1.075
275	0.898	0.906	0.931	0.944	0.958	0.967	0.975	0.986	0.992	0.998	1.013	1.031	1.045	1.059
300	0.864	0.872	0.902	0.914	0.927	0.938	0.948	0.959	0.969	0.974	0.991	1.011	1.026	1.041
325	--	0.837	0.871	0.882	0.895	0.907	0.919	0.930	0.940	0.948	0.968	0.990	1.007	1.023
350	--	--	0.839	0.848	0.860	0.874	0.887	0.898	0.909	0.921	0.943	0.967	0.986	1.004
375	--	--	0.804	0.812	0.822	0.838	0.853	0.864	0.875	0.892	0.917	0.943	0.964	0.983
400	--	--	0.768	0.773	0.782	0.800	0.817	0.828	0.839	0.861	0.889	0.918	0.941	0.961
425	--	--	0.73*	0.74*	0.74*	0.760	0.779	0.789	0.800	0.829	0.860	0.892	0.917	0.939
450	--	--	0.69*	0.70*	0.70*	0.718	0.739	0.749	0.759	0.795	0.825	0.864	0.892	0.915
475	--	--	--	--	--	0.673	0.697	0.705	0.716	0.76*	0.797	0.825	0.865	0.890
500	--	--	--	--	--	0.63*	0.65*	0.66*	0.670	0.72*	0.764	0.804	0.838	0.864

*Extrapolated values

TABLE 9.—*Densities of 3.5 molal NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
	Pressure (bars)													
25	1.126	1.028	1.130	1.134	1.139	1.142	1.045	1.149	1.152	1.155	1.165	1.171	1.178	1.185
50	1.113	1.117	1.120	1.127	1.133	1.136	1.139	1.143	1.146	1.149	1.157	1.164	1.172	1.178
75	1.100	1.106	1.108	1.117	1.125	1.128	1.131	1.137	1.139	1.142	1.148	1.156	1.163	1.171
100	1.083	1.091	1.094	1.105	1.114	1.118	1.121	1.128	1.130	1.132	1.138	1.147	1.154	1.162
125	1.066	1.074	1.079	1.091	1.102	1.105	1.108	1.117	1.119	1.121	1.127	1.137	1.144	1.153
150	1.047	1.055	1.061	1.074	1.086	1.090	1.094	1.103	1.105	1.108	1.114	1.125	1.133	1.142
175	1.026	1.034	1.043	1.055	1.068	1.073	1.078	1.087	1.090	1.093	1.100	1.112	1.121	1.131
200	1.002	1.011	1.022	1.035	1.049	1.054	1.059	1.069	1.072	1.076	1.084	1.097	1.107	1.119
225	0.977	0.984	0.998	1.012	1.027	1.033	1.039	1.050	1.054	1.058	1.068	1.081	1.093	1.105
250	0.950	0.956	0.974	0.988	1.002	1.010	1.017	1.028	1.032	1.037	1.049	1.065	1.078	1.090
275	0.921	0.926	0.949	0.962	0.975	0.984	0.992	1.003	1.009	1.015	1.030	1.047	1.061	1.075
300	0.886	0.893	0.921	0.933	0.946	0.956	0.966	0.977	0.986	0.991	1.008	1.028	1.042	1.057
325	0.85*	0.860	0.892	0.903	0.915	0.927	0.938	0.949	0.958	0.966	0.986	1.007	1.024	1.040
350	--	0.82*	0.861	0.870	0.882	0.895	0.907	0.918	0.928	0.940	0.961	0.985	1.004	1.021
375	--	0.78*	0.821	0.834	0.844	0.860	0.874	0.885	0.896	0.912	0.936	0.962	1.982	1.001
400	--	--	0.79*	0.796	0.805	0.823	0.840	0.851	0.862	0.882	0.909	0.937	0.960	0.979
425	--	--	--	0.76*	0.77*	0.791	0.811	0.821	0.832	0.852	0.881	0.912	0.937	0.958
450	--	--	--	--	--	0.739	0.759	0.770	0.780	0.815	0.845	0.885	0.912	0.935
475	--	--	--	--	--	0.708	0.734	0.746	0.757	0.787	0.817	0.857	0.887	0.911
500	--	--	--	--	--	0.67*	0.69*	0.72*	0.74*	0.75*	0.789	0.829	0.863	0.888

*Extrapolated values

TABLE 10—Densities of 4 molal NaCl solutions, g/cm³[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)										
	100	200	300	400	500	600	700	800	900	1000	1250
25	1.140	1.142	1.145	1.150	1.153	1.157	1.159	1.163	1.166	1.169	1.177
50	1.128	1.131	1.135	1.141	1.145	1.149	1.153	1.156	1.160	1.163	1.170
75	1.115	1.119	1.123	1.131	1.136	1.140	1.145	1.148	1.151	1.154	1.162
100	1.099	1.105	1.109	1.119	1.124	1.129	1.135	1.137	1.141	1.144	1.153
125	1.083	1.089	1.094	1.105	1.110	1.116	1.123	1.125	1.129	1.133	1.142
150	1.064	1.071	1.077	1.089	1.095	1.101	1.109	1.111	1.115	1.120	1.130
175	1.044	1.052	1.058	1.071	1.078	1.084	1.093	1.095	1.100	1.105	1.116
200	1.022	1.031	1.037	1.051	1.058	1.066	1.075	1.077	1.083	1.089	1.101
225	0.999	1.008	1.015	1.029	1.037	1.045	1.055	1.058	1.065	1.071	1.084
250	0.974	0.984	0.992	1.005	1.014	1.023	1.033	1.037	1.044	1.051	1.066
275	0.947	0.958	0.966	0.980	0.989	0.998	1.009	1.014	1.022	1.030	1.047
300	0.919	0.930	0.939	0.952	0.962	0.972	0.983	0.989	0.999	1.007	1.026
325	0.889	0.901	0.910	0.923	0.933	0.944	0.955	0.962	0.973	0.982	1.004
350	--	0.870	0.880	0.892	0.902	0.914	0.925	0.934	0.946	0.956	0.981
375	--	0.837	0.848	0.858	0.870	0.882	0.893	0.903	0.917	0.929	0.956
400	--	0.803	0.814	0.823	0.835	0.848	0.859	0.871	0.887	0.899	0.929
425	--	0.77*	0.78*	0.786	0.798	0.812	0.823	0.838	0.855	0.869	0.902
450	--	0.73*	0.74*	0.75*	0.76*	0.77*	0.785	0.802	0.821	0.836	0.872
475	--	--	--	0.71*	0.72*	0.73*	0.745	0.765	0.785	0.802	0.842
500	--	--	--	--	--	--	0.703	0.725	0.748	0.766	0.810

* Extrapolated values

TABLE 11.—*Densities of 4.5 molal NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)													
	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
25	1.155	1.158	1.161	1.165	1.168	1.171	1.174	1.177	1.181	1.184	1.191	1.198	1.205	1.212
50	1.142	1.146	1.149	1.155	1.159	1.163	1.167	1.170	1.173	1.177	1.184	1.192	1.199	1.206
75	1.128	1.133	1.136	1.145	1.149	1.153	1.157	1.161	1.165	1.168	1.176	1.184	1.191	1.199
100	1.113	1.118	1.122	1.132	1.137	1.142	1.146	1.151	1.154	1.158	1.166	1.175	1.183	1.191
125	1.096	1.102	1.107	1.118	1.123	1.129	1.133	1.138	1.142	1.146	1.155	1.165	1.173	1.182
150	1.078	1.084	1.090	1.102	1.108	1.114	1.119	1.125	1.129	1.133	1.143	1.154	1.162	1.172
175	1.058	1.065	1.071	1.084	1.091	1.097	1.103	1.109	1.114	1.118	1.129	1.141	1.150	1.161
200	1.037	1.045	1.051	1.064	1.072	1.079	1.085	1.092	1.097	1.102	1.114	1.127	1.137	1.148
225	1.014	1.023	1.030	1.043	1.051	1.059	1.066	1.073	1.079	1.084	1.098	1.112	1.123	1.135
250	0.990	1.000	1.007	1.020	1.029	1.037	1.045	1.052	1.059	1.065	1.080	1.095	1.108	1.121
275	0.965	0.975	0.983	0.996	1.005	1.013	1.022	1.030	1.037	1.045	1.062	1.078	1.092	1.106
300	0.938	0.949	0.957	0.970	0.979	0.988	0.997	1.007	1.014	1.022	1.041	1.059	1.074	1.090
325	0.904	0.922	0.930	0.942	0.951	0.961	0.971	0.981	0.989	0.999	1.020	1.038	1.056	1.072
350	--	0.893	0.902	0.912	0.922	0.933	0.943	0.954	0.963	0.973	0.997	1.017	1.036	1.054
375	--	0.863	0.872	0.880	0.891	0.902	0.914	0.925	0.936	0.946	0.972	0.994	1.015	1.034
400	--	0.831	0.841	0.847	0.858	0.870	0.883	0.895	0.906	0.918	0.947	0.970	0.993	1.014
425	--	0.80*	0.81*	0.81*	0.82*	0.836	0.850	0.863	0.875	0.888	0.920	0.945	0.970	0.993
450	--	0.76*	0.77*	0.78*	0.79*	0.80*	0.82*	0.83*	0.843	0.857	0.892	0.919	0.946	0.970
475	--	--	--	--	--	0.76*	0.78*	0.79*	0.81*	0.82*	0.862	0.891	0.921	0.947
500	--	--	--	--	--	--	--	--	0.77*	0.79*	0.831	0.862	0.895	0.922

*Extrapolated values

TABLE 12.—*Densities of 5 molal NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)													
	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
25	1.168	1.172	1.175	1.179	1.182	1.185	1.188	1.191	1.194	1.198	1.205	1.212	1.219	1.225
50	1.153	1.160	1.163	1.170	1.173	1.177	1.180	1.184	1.187	1.190	1.198	1.205	1.212	1.219
75	1.137	1.147	1.151	1.158	1.163	1.167	1.171	1.175	1.178	1.181	1.189	1.197	1.204	1.212
100	1.119	1.132	1.136	1.146	1.151	1.156	1.160	1.164	1.167	1.171	1.180	1.188	1.195	1.203
125	1.101	1.116	1.121	1.132	1.137	1.142	1.147	1.152	1.155	1.159	1.169	1.178	1.185	1.194
150	1.083	1.099	1.104	1.116	1.122	1.128	1.133	1.138	1.142	1.146	1.157	1.166	1.175	1.184
175	1.063	1.080	1.086	1.098	1.105	1.111	1.117	1.123	1.127	1.132	1.143	1.154	1.163	1.173
200	1.042	1.060	1.066	1.079	1.086	1.093	1.099	1.106	1.110	1.116	1.128	1.140	1.150	1.161
225	1.021	1.038	1.045	1.058	1.066	1.073	1.080	1.087	1.092	1.098	1.112	1.125	1.136	1.148
250	0.998	1.016	1.023	1.036	1.044	1.052	1.059	1.067	1.073	1.079	1.095	1.109	1.121	1.134
275	0.975	0.991	0.999	1.011	1.020	1.029	1.037	1.045	1.052	1.059	1.076	1.091	1.105	1.119
300	0.950	0.966	0.974	0.986	0.995	1.004	1.013	1.022	1.029	1.037	1.056	1.073	1.088	1.103
325	0.922	0.939	0.947	0.958	0.968	0.978	0.987	0.997	1.005	1.014	1.035	1.053	1.070	1.086
350	--	0.910	0.919	0.929	0.939	0.950	0.960	0.970	0.979	0.989	1.012	1.032	1.051	1.068
375	--	0.881	0.890	0.899	0.909	0.920	0.931	0.942	0.952	0.963	0.989	1.010	1.031	1.049
400	--	0.850	0.860	0.867	0.877	0.889	0.901	0.912	0.924	0.936	0.964	0.987	1.010	1.030
425	--	0.82*	0.83*	0.83*	0.844	0.856	0.869	0.880	0.894	0.907	0.937	0.963	0.988	1.009
450	--	0.78*	0.80*	0.80*	0.81*	0.82*	0.84*	0.847	0.862	0.876	0.909	0.937	0.965	0.987
475	--	--	--	--	0.77*	0.79*	0.80*	0.812	0.829	0.845	0.880	0.910	0.940	0.965
500	--	--	--	--	--	--	--	0.78*	0.80*	0.811	0.850	0.883	0.915	0.941

* Extrapolated values

TABLE 13.—*Densities of 5.5 molal NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)														
	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000	
25	1.183	1.186	1.189	1.193	1.196	1.199	1.202	1.205	1.209	1.211	1.218	1.225	1.232	1.238	
50	1.171	1.174	1.177	1.183	1.187	1.191	1.194	1.197	1.201	1.204	1.211	1.218	1.225	1.232	
75	1.157	1.161	1.164	1.172	1.176	1.180	1.184	1.188	1.192	1.195	1.202	1.210	1.217	1.224	
100	1.142	1.146	1.150	1.159	1.164	1.169	1.173	1.177	1.181	1.184	1.193	1.200	1.208	1.215	
125	1.125	1.130	1.135	1.145	1.150	1.156	1.160	1.165	1.169	1.173	1.182	1.190	1.198	1.206	
150	1.107	1.113	1.118	1.129	1.135	1.141	1.146	1.151	1.156	1.160	1.169	1.178	1.187	1.196	
175	1.088	1.094	1.100	1.112	1.118	1.124	1.130	1.135	1.141	1.145	1.156	1.166	1.175	1.185	
200	1.068	1.074	1.080	1.093	1.100	1.107	1.112	1.119	1.124	1.129	1.141	1.152	1.162	1.172	
225	1.046	1.053	1.059	1.072	1.080	1.087	1.094	1.100	1.106	1.112	1.125	1.137	1.148	1.160	
250	1.024	1.030	1.037	1.050	1.058	1.066	1.073	1.080	1.087	1.093	1.108	1.121	1.133	1.146	
275	0.999	1.007	1.014	1.027	1.035	1.043	1.051	1.059	1.066	1.073	1.090	1.104	1.118	1.131	
300	0.974	0.982	0.989	1.001	1.010	1.019	1.028	1.036	1.044	1.052	1.070	1.086	1.101	1.116	
325	0.947	0.955	0.963	0.975	0.984	0.993	1.002	1.012	1.021	1.029	1.049	1.067	1.083	1.099	
350	0.919	0.928	0.936	0.946	0.956	0.966	0.976	0.986	0.995	1.005	1.027	1.046	1.065	1.082	
375	0.89*	0.899	0.908	0.916	0.926	0.937	0.948	0.959	0.969	0.979	1.004	1.025	1.045	1.064	
400	0.85*	0.868	0.878	0.885	0.895	0.907	0.918	0.930	0.941	0.952	0.979	1.002	1.025	1.044	
425	--	0.84*	0.846	0.852	0.863	0.875	0.887	0.899	0.912	0.924	0.954	0.979	1.003	1.024	
450	--	0.80*	0.81*	0.82*	0.83*	0.84*	0.854	0.868	0.881	0.894	0.927	0.954	0.981	1.004	
475	--	--	0.78*	0.78*	0.79*	0.81*	0.82*	0.83*	0.85*	0.863	0.898	0.928	0.958	0.982	
500	--	--	--	--	--	--	0.78*	0.80*	0.82*	0.83*	0.869	0.902	0.934	0.959	

*Extrapolated values

TABLE 14.—*Densities of 6 molal NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)													
	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
25	1.198	1.201	1.203	1.207	1.210	1.213	1.216	1.219	1.222	1.225	1.232	1.239	1.245	1.251
50	1.184	1.188	1.191	1.196	1.200	1.203	1.207	1.211	1.214	1.217	1.224	1.231	1.238	1.244
75	1.170	1.174	1.178	1.184	1.189	1.192	1.196	1.201	1.204	1.207	1.215	1.222	1.229	1.236
100	1.154	1.159	1.163	1.171	1.176	1.180	1.184	1.190	1.193	1.197	1.205	1.213	1.220	1.228
125	1.138	1.142	1.147	1.156	1.161	1.166	1.171	1.177	1.181	1.185	1.193	1.202	1.210	1.218
150	1.120	1.125	1.130	1.140	1.146	1.151	1.157	1.163	1.167	1.171	1.181	1.191	1.199	1.208
175	1.101	1.107	1.112	1.123	1.129	1.135	1.141	1.148	1.152	1.157	1.167	1.178	1.187	1.197
200	1.081	1.087	1.093	1.104	1.111	1.117	1.123	1.131	1.136	1.141	1.153	1.164	1.174	1.185
225	1.060	1.067	1.073	1.084	1.091	1.098	1.105	1.113	1.118	1.124	1.137	1.149	1.161	1.172
250	1.038	1.045	1.052	1.063	1.071	1.078	1.085	1.094	1.099	1.106	1.120	1.134	1.146	1.158
275	1.015	1.022	1.029	1.040	1.048	1.056	1.064	1.073	1.079	1.086	1.102	1.117	1.130	1.143
300	0.991	0.998	1.006	1.016	1.025	1.033	1.041	1.050	1.057	1.065	1.083	1.099	1.114	1.128
325	0.965	0.973	0.981	0.991	1.000	1.009	1.018	1.027	1.035	1.043	1.063	1.080	1.097	1.112
350	0.939	0.947	0.955	0.964	0.974	0.983	0.992	1.002	1.010	1.020	1.041	1.061	1.078	1.095
375	0.91*	0.919	0.928	0.938	0.946	0.956	0.966	0.975	0.985	0.995	1.019	1.040	1.059	1.077
400	0.88*	0.891	0.900	0.907	0.917	0.928	0.938	0.947	0.958	0.969	0.995	1.018	1.039	1.058
425	--	0.86*	0.87*	0.88*	0.89*	0.898	0.909	0.918	0.930	0.942	0.971	0.995	1.018	1.039
450	--	0.83*	0.84*	0.85*	0.86*	0.87*	0.88*	0.888	0.900	0.913	0.945	0.971	0.996	1.018
475	--	--	--	--	--	0.84*	0.85*	0.856	0.869	0.883	0.918	0.946	0.974	0.997
500	--	--	--	--	--	--	--	0.822	0.837	0.852	0.890	0.920	0.950	0.975

*Extrapolated values

TABLE 15.—*Densities of 1 weight percent NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)													
	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
25	1.003	1.010	1.015	1.019	1.023	1.027	1.032	1.036	1.040	1.044	1.052	1.061	1.069	1.077
50	1.000	1.003	1.008	1.014	1.017	1.021	1.027	1.029	1.034	1.038	1.046	1.055	1.063	1.071
75	0.991	0.993	0.997	1.004	1.007	1.013	1.018	1.020	1.025	1.029	1.039	1.047	1.058	1.065
100	0.978	0.979	0.984	0.992	0.996	1.001	1.008	1.010	1.015	1.019	1.029	1.038	1.049	1.058
125	0.960	0.963	0.968	0.977	0.980	0.986	0.993	0.996	1.001	1.007	1.017	1.027	1.039	1.047
150	0.939	0.943	0.947	0.957	0.962	0.968	0.978	0.980	0.985	0.991	1.003	1.014	1.026	1.037
175	0.914	0.919	0.924	0.936	0.940	0.947	0.957	0.961	0.967	0.974	0.986	0.998	1.012	1.023
200	0.886	0.893	0.899	0.910	0.916	0.923	0.934	0.939	0.945	0.953	0.968	0.980	0.997	1.008
225	0.853	0.862	0.869	0.881	0.888	0.897	0.908	0.914	0.921	0.930	0.947	0.961	0.979	0.991
250	0.817	0.829	0.837	0.849	0.858	0.867	0.879	0.886	0.896	0.905	0.924	0.940	0.958	0.972
275	0.776	0.793	0.800	0.813	0.824	0.835	0.845	0.856	0.867	0.877	0.900	0.916	0.936	0.953
300	--	0.754	0.761	0.773	0.786	0.799	0.810	0.823	0.834	0.847	0.872	0.891	0.914	0.931
325	--	0.71*	0.719	0.731	0.746	0.760	0.770	0.788	0.801	0.814	0.843	0.864	0.887	0.907
350	--	--	0.68*	0.69*	0.703	0.719	0.729	0.750	0.764	0.777	0.811	0.835	0.860	0.882
375	--	--	--	--	0.66*	0.67*	0.68*	0.709	0.726	0.740	0.778	0.804	0.831	0.855
400	--	--	--	--	--	--	--	0.66*	0.68*	0.698	0.741	0.771	0.800	0.827
425	--	--	--	--	--	--	--	--	--	0.65*	0.699	0.735	0.766	0.796
450	--	--	--	--	--	--	--	--	--	--	0.65*	0.699	0.732	0.764
475	--	--	--	--	--	--	--	--	--	--	--	0.659	0.694	0.730
500	--	--	--	--	--	--	--	--	--	--	--	--	0.67*	0.695

*Extrapolated values

TABLE 16.—*Densities of 3 weight percent NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)													
	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
25	1.018	1.024	1.028	1.033	1.037	1.041	1.045	1.050	1.053	1.057	1.065	1.074	1.082	1.090
50	1.014	1.017	1.021	1.028	1.031	1.035	1.040	1.043	1.047	1.051	1.059	1.068	1.076	1.084
75	1.003	1.006	1.010	1.018	1.022	1.027	1.033	1.035	1.039	1.043	1.052	1.060	1.070	1.078
100	0.990	0.992	0.997	1.006	1.011	1.016	1.022	1.025	1.029	1.033	1.042	1.051	1.061	1.070
125	0.973	0.976	0.981	0.991	0.996	1.001	1.009	1.012	1.016	1.021	1.030	1.040	1.051	1.060
150	0.952	0.956	0.961	0.972	0.978	0.984	0.993	0.996	1.001	1.006	1.016	1.027	1.039	1.049
175	0.927	0.932	0.939	0.951	0.957	0.964	0.973	0.977	0.983	0.989	1.000	1.012	1.025	1.036
200	0.899	0.906	0.914	0.926	0.934	0.941	0.951	0.956	0.962	0.969	0.982	0.995	1.010	1.021
225	0.867	0.876	0.885	0.898	0.907	0.915	0.925	0.932	0.939	0.947	0.962	0.976	0.993	1.005
250	0.832	0.843	0.854	0.867	0.877	0.886	0.897	0.905	0.914	0.922	0.940	0.956	0.973	0.987
275	0.793	0.807	0.819	0.832	0.844	0.855	0.865	0.876	0.886	0.895	0.916	0.933	0.952	0.968
300	0.747	0.768	0.781	0.794	0.807	0.820	0.831	0.844	0.855	0.866	0.889	0.909	0.930	0.947
325	--	0.725	0.741	0.753	0.768	0.782	0.793	0.809	0.822	0.834	0.861	0.883	0.905	0.924
350	--	--	0.70*	0.71*	0.726	0.742	0.753	0.772	0.786	0.799	0.830	0.855	0.879	0.900
375	--	--	--	--	0.68*	0.70*	0.71*	0.732	0.748	0.763	0.798	0.825	0.851	0.874
400	--	--	--	--	--	--	--	0.69*	0.70*	0.724	0.763	0.793	0.821	0.847
425	--	--	--	--	--	--	--	--	--	0.68*	0.723	0.759	0.789	0.817
450	--	--	--	--	--	--	--	--	--	--	0.68*	0.725	0.757	0.787
475	--	--	--	--	--	--	--	--	--	--	--	0.687	0.721	0.755
500	--	--	--	--	--	--	--	--	--	--	--	0.66*	0.69*	0.722

*Extrapolated values

TABLE 17.—*Densities of 5 weight percent NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars.)													
	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
25	1.033	1.038	1.042	1.046	1.051	1.055	1.059	1.063	1.067	1.070	1.079	1.087	1.095	1.103
50	1.027	1.031	1.034	1.041	1.046	1.049	1.054	1.057	1.061	1.064	1.073	1.081	1.089	1.097
75	1.016	1.020	1.023	1.032	1.037	1.042	1.047	1.050	1.053	1.057	1.065	1.073	1.083	1.091
100	1.003	1.006	1.010	1.020	1.026	1.031	1.036	1.040	1.044	1.047	1.055	1.064	1.074	1.082
125	0.985	0.989	0.995	1.005	1.012	1.017	1.024	1.028	1.031	1.035	1.043	1.053	1.064	1.073
150	0.964	0.970	0.975	0.986	0.994	1.000	1.008	1.012	1.017	1.021	1.030	1.041	1.052	1.062
175	0.940	0.946	0.953	0.966	0.974	0.980	0.988	0.994	0.999	1.004	1.014	1.026	1.038	1.049
200	0.913	0.920	0.929	0.941	0.952	0.958	0.967	0.973	0.978	0.985	0.996	1.010	1.023	1.035
225	0.882	0.890	0.901	0.914	0.926	0.933	0.942	0.951	0.957	0.963	0.977	0.991	1.007	1.019
250	0.848	0.857	0.871	0.885	0.896	0.905	0.915	0.924	0.932	0.939	0.955	0.971	0.987	1.002
275	0.809	0.821	0.838	0.851	0.864	0.875	0.884	0.896	0.905	0.913	0.932	0.950	0.967	0.983
300	0.765	0.783	0.802	0.815	0.828	0.841	0.852	0.865	0.876	0.885	0.906	0.926	0.946	0.963
325	--	0.741	0.764	0.776	0.790	0.804	0.816	0.831	0.843	0.854	0.879	0.902	0.922	0.941
350	--	0.70*	0.72*	0.734	0.749	0.765	0.777	0.794	0.808	0.821	0.849	0.875	0.897	0.918
375	--	0.66*	0.68*	0.69*	0.700	0.709	0.725	0.755	0.770	0.786	0.819	0.846	0.871	0.893
400	--	--	--	--	0.678	0.694	0.709	0.720	0.731	0.748	0.785	0.815	0.842	0.867
425	--	--	--	--	0.64*	0.65*	0.666	0.676	0.687	0.716	0.747	0.783	0.812	0.839
450	--	--	--	--	--	--	0.625	0.635	0.645	0.681	0.711	0.750	0.781	0.810
475	--	--	--	--	--	--	--	--	--	0.64*	0.676	0.714	0.747	0.779
500	--	--	--	--	--	--	--	--	--	--	0.63*	0.677	0.718	0.748

*Extrapolated values

TABLE 18.—Densities of 7 weight percent NaCl solutions, g/cm³[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)													
	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
25	1.049	1.052	1.055	1.060	1.065	1.069	1.073	1.077	1.080	1.084	1.093	1.101	1.109	1.116
50	1.041	1.045	1.048	1.055	1.060	1.064	1.068	1.071	1.075	1.078	1.086	1.094	1.102	1.110
75	1.030	1.034	1.037	1.046	1.052	1.056	1.061	1.064	1.067	1.071	1.078	1.085	1.096	1.104
100	1.015	1.020	1.024	1.034	1.041	1.046	1.050	1.055	1.058	1.061	1.068	1.077	1.087	1.095
125	0.998	1.003	1.008	1.019	1.028	1.032	1.038	1.043	1.046	1.050	1.057	1.067	1.077	1.086
150	0.977	0.983	0.988	1.001	1.011	1.016	1.022	1.028	1.032	1.036	1.043	1.054	1.065	1.075
175	0.954	0.960	0.968	0.980	0.991	0.997	1.004	1.011	1.015	1.019	1.028	1.040	1.051	1.062
200	0.927	0.934	0.944	0.957	0.969	0.975	0.983	0.990	0.995	1.001	1.011	1.024	1.037	1.048
225	0.897	0.904	0.917	0.931	0.944	0.951	0.959	0.968	0.974	0.980	0.992	1.006	1.021	1.033
250	0.864	0.872	0.888	0.902	0.915	0.924	0.933	0.942	0.949	0.956	0.971	0.987	1.003	1.016
275	0.827	0.837	0.857	0.870	0.884	0.894	0.903	0.915	0.923	0.930	0.948	0.966	0.983	0.998
300	0.784	0.799	0.823	0.835	0.849	0.861	0.872	0.884	0.895	0.903	0.923	0.944	0.962	0.978
325	--	0.758	0.786	0.798	0.812	0.826	0.837	0.851	0.863	0.873	0.897	0.920	0.940	0.957
350	--	0.72*	0.74*	0.757	0.772	0.788	0.800	0.816	0.829	0.842	0.869	0.894	0.916	0.935
375	--	0.68*	0.70*	0.71*	0.732	0.748	0.764	0.778	0.792	0.808	0.839	0.866	0.890	0.911
400	--	--	--	--	0.69*	0.70*	0.725	0.741	0.757	0.772	0.807	0.837	0.863	0.886
425	--	--	--	--	--	--	0.69*	0.71*	0.715	0.732	0.771	0.806	0.834	0.860
450	--	--	--	--	--	--	--	--	0.67*	0.69*	0.741	0.774	0.804	0.832
475	--	--	--	--	--	--	--	--	--	--	0.71*	0.740	0.772	0.802
500	--	--	--	--	--	--	--	--	--	--	--	0.707	0.744	0.774

*Extrapolated values

TABLE 19.—*Densities of 9 weight percent NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)											
	100	200	300	400	500	600	700	800	900	1000	1250	1500
25	1.064	1.067	1.070	1.074	1.079	1.083	1.087	1.091	1.094	1.098	1.107	1.114
50	1.055	1.059	1.062	1.069	1.075	1.078	1.082	1.085	1.089	1.092	1.100	1.108
75	1.043	1.048	1.051	1.060	1.067	1.070	1.074	1.079	1.082	1.085	1.092	1.100
100	1.029	1.034	1.037	1.048	1.056	1.060	1.064	1.070	1.073	1.075	1.082	1.091
125	1.011	1.017	1.022	1.034	1.043	1.047	1.052	1.059	1.061	1.064	1.071	1.081
150	0.991	0.997	1.003	1.016	1.026	1.031	1.037	1.044	1.047	1.050	1.057	1.068
175	0.967	0.974	0.983	0.995	1.008	1.013	1.019	1.027	1.031	1.034	1.042	1.055
200	0.941	0.949	0.960	0.973	0.985	0.992	0.998	1.007	1.011	1.016	1.025	1.039
225	0.912	0.919	0.933	0.947	0.961	0.968	0.975	0.985	0.991	0.996	1.007	1.021
250	0.880	0.888	0.906	0.920	0.933	0.942	0.950	0.960	0.967	0.972	0.986	1.003
275	0.845	0.853	0.876	0.889	0.903	0.913	0.922	0.933	0.941	0.948	0.965	0.983
300	0.803	0.816	0.843	0.855	0.869	0.881	0.892	0.904	0.915	0.921	0.940	0.961
325	--	0.777	0.808	0.819	0.834	0.847	0.859	0.872	0.883	0.893	0.915	0.938
350	--	0.73*	0.773	0.785	0.795	0.810	0.823	0.837	0.850	0.862	0.888	0.912
375	--	0.69*	0.73*	0.737	0.754	0.770	0.786	0.800	0.813	0.830	0.859	0.886
400	--	--	--	0.69*	0.71*	0.73*	0.748	0.764	0.780	0.795	0.828	0.858
425	--	--	--	--	--	--	0.70*	0.72*	0.738	0.755	0.794	0.829
450	--	--	--	--	--	--	--	--	0.69*	0.71*	0.765	0.798
475	--	--	--	--	--	--	--	--	--	--	0.734	0.765
500	--	--	--	--	--	--	--	--	--	--	0.70*	0.733

*Extrapolated values

TABLE 20.—Densities of 11 weight percent NaCl solutions, g/cm³[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)													
	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
25	1.080	1.082	1.085	1.089	1.094	1.098	1.101	1.105	1.108	1.112	1.121	1.128	1.136	1.143
50	1.069	1.073	1.076	1.084	1.089	1.092	1.096	1.100	1.103	1.106	1.114	1.122	1.130	1.137
75	1.057	1.063	1.065	1.074	1.081	1.085	1.088	1.094	1.096	1.099	1.106	1.114	1.122	1.130
100	1.042	1.048	1.051	1.062	1.071	1.075	1.078	1.085	1.087	1.089	1.096	1.105	1.113	1.121
125	1.025	1.031	1.036	1.048	1.058	1.062	1.066	1.073	1.076	1.078	1.084	1.095	1.103	1.112
150	1.004	1.012	1.017	1.030	1.042	1.046	1.051	1.059	1.061	1.065	1.071	1.082	1.092	1.101
175	0.982	0.989	0.997	1.011	1.024	1.028	1.034	1.042	1.046	1.049	1.057	1.069	1.079	1.089
200	0.956	0.964	0.975	0.988	1.002	1.008	1.014	1.024	1.027	1.031	1.040	1.053	1.064	1.076
225	0.928	0.935	0.950	0.964	0.978	0.985	0.991	1.002	1.007	1.012	1.022	1.036	1.050	1.062
250	0.897	0.904	0.923	0.937	0.951	0.959	0.967	0.978	0.984	0.989	1.002	1.019	1.033	1.046
275	0.863	0.870	0.895	0.908	0.922	0.932	0.940	0.951	0.958	0.965	0.981	0.999	1.015	1.029
300	0.823	0.834	0.863	0.875	0.889	0.901	0.911	0.923	0.933	0.939	0.957	0.978	0.994	1.010
325	--	0.796	0.829	0.841	0.855	0.867	0.879	0.892	0.903	0.911	0.933	0.956	0.974	0.990
350	--	0.76*	0.795	0.807	0.817	0.832	0.845	0.858	0.870	0.882	0.906	0.931	0.951	0.970
375	--	--	0.75*	0.763	0.772	0.790	0.818	0.822	0.834	0.851	0.879	0.905	0.928	0.948
400	--	--	--	0.72*	0.730	0.751	0.784	0.788	0.804	0.818	0.849	0.879	0.903	0.924
425	--	--	--	--	0.69*	0.702	0.741	0.745	0.764	0.780	0.817	0.851	0.877	0.900
450	--	--	--	--	--	0.67*	0.703	0.709	0.730	0.748	0.789	0.821	0.850	0.875
475	--	--	--	--	--	--	0.66*	0.67*	0.69*	0.71*	0.761	0.789	0.820	0.847
500	--	--	--	--	--	--	--	--	--	--	0.73*	0.760	0.794	0.822

*Extrapolated values

TABLE 21.—Densities of 13 weight percent NaCl solutions, g/cm^3 [The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)										
	100	200	300	400	500	600	700	800	900	1000	1250
25	1.095	1.097	1.100	1.103	1.109	1.112	1.116	1.119	1.123	1.126	1.135
50	1.083	1.088	1.090	1.098	1.104	1.107	1.110	1.114	1.117	1.120	1.128
75	1.071	1.077	1.079	1.088	1.096	1.099	1.102	1.108	1.110	1.113	1.119
100	1.055	1.062	1.065	1.076	1.085	1.089	1.092	1.099	1.101	1.103	1.109
125	1.038	1.045	1.050	1.062	1.073	1.076	1.080	1.088	1.090	1.092	1.098
150	1.018	1.026	1.032	1.045	1.057	1.061	1.065	1.074	1.076	1.079	1.085
175	0.996	1.003	1.013	1.026	1.040	1.044	1.049	1.058	1.061	1.064	1.071
200	0.971	0.979	0.991	1.004	1.018	1.024	1.030	1.039	1.042	1.047	1.055
225	0.944	0.951	0.966	0.980	0.995	1.002	1.008	1.019	1.023	1.027	1.037
250	0.914	0.921	0.940	0.954	0.968	0.976	0.984	0.995	1.000	1.006	1.018
275	0.882	0.888	0.913	0.926	0.940	0.950	0.958	0.969	0.975	0.982	0.997
300	0.843	0.853	0.883	0.895	0.908	0.920	0.930	0.941	0.952	0.957	0.974
325	--	0.816	0.850	0.862	0.875	0.888	0.900	0.911	0.922	0.930	0.951
350	--	0.77*	0.818	0.827	0.839	0.853	0.866	0.878	0.890	0.902	0.925
375	--	--	0.782	0.791	0.801	0.817	0.832	0.843	0.855	0.872	0.898
400	--	--	0.770	0.777	0.786	0.794	0.811	0.822	0.833	0.840	0.869
425	--	--	0.71*	0.72*	0.73*	0.738	0.757	0.767	0.778	0.808	0.839
450	--	--	--	--	--	0.704	0.724	0.735	0.745	0.774	0.803
475	--	--	--	--	--	0.67*	0.69*	0.701	0.713	0.746	0.773
500	--	--	--	--	--	--	--	0.67*	0.68*	0.70*	0.743

*Extrapolated values

TABLE 22.—*Densities of 15 weight percent NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)													
	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
25	1.111	1.112	1.115	1.119	1.124	1.127	1.130	1.134	1.137	1.141	1.150	1.156	1.164	1.171
50	1.098	1.103	1.105	1.113	1.119	1.122	1.125	1.129	1.132	1.135	1.143	1.150	1.158	1.165
75	1.085	1.092	1.094	1.103	1.111	1.114	1.117	1.123	1.125	1.128	1.134	1.142	1.150	1.158
100	1.069	1.077	1.080	1.091	1.100	1.104	1.107	1.114	1.116	1.118	1.124	1.133	1.141	1.149
125	1.052	1.060	1.065	1.077	1.088	1.091	1.095	1.103	1.105	1.107	1.113	1.123	1.131	1.140
150	1.033	1.041	1.047	1.060	1.072	1.076	1.080	1.089	1.091	1.094	1.100	1.111	1.120	1.129
175	1.011	1.019	1.028	1.041	1.055	1.059	1.064	1.073	1.076	1.079	1.086	1.098	1.107	1.117
200	0.987	0.995	1.007	1.020	1.034	1.040	1.045	1.055	1.059	1.062	1.070	1.083	1.093	1.105
225	0.961	0.967	0.982	0.996	1.012	1.018	1.024	1.035	1.039	1.043	1.053	1.067	1.079	1.091
250	0.932	0.938	0.957	0.971	0.985	0.993	1.001	1.012	1.017	1.022	1.034	1.050	1.063	1.076
275	0.901	0.907	0.931	0.944	0.958	0.967	0.975	0.986	0.992	0.998	1.014	1.032	1.046	1.060
300	0.865	0.873	0.902	0.914	0.927	0.938	0.948	0.959	0.969	0.974	0.991	1.012	1.027	1.042
325	--	0.838	0.871	0.882	0.895	0.907	0.919	0.930	0.940	0.948	0.968	0.990	1.008	1.024
350	--	0.79*	0.839	0.848	0.860	0.874	0.887	0.898	0.909	0.921	0.943	0.967	0.986	1.005
375	--	--	0.804	0.812	0.822	0.838	0.853	0.864	0.875	0.892	0.917	0.943	0.964	0.983
400	--	--	0.768	0.773	0.782	0.800	0.817	0.828	0.839	0.861	0.889	0.918	0.941	0.961
425	--	--	0.73*	0.74*	0.75*	0.760	0.779	0.789	0.800	0.829	0.860	0.892	0.917	0.939
450	--	--	--	--	--	0.718	0.739	0.749	0.759	0.794	0.824	0.865	0.892	0.915
475	--	--	--	--	--	0.67*	0.69*	0.705	0.716	0.762	0.795	0.835	0.865	0.890
500	--	--	--	--	--	--	--	0.66*	0.68*	0.72*	0.768	0.808	0.842	0.867

* Extrapolated values

TABLE 23.—*Densities of 17 weight percent NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)										
	100	200	300	400	500	600	700	800	900	1000	1250
25	1.126	1.128	1.131	1.134	1.139	1.142	1.145	1.149	1.152	1.155	1.165
50	1.113	1.118	1.120	1.128	1.133	1.136	1.139	1.143	1.146	1.149	1.157
75	1.100	1.105	1.108	1.117	1.125	1.128	1.131	1.137	1.139	1.142	1.148
100	1.084	1.091	1.094	1.105	1.114	1.118	1.121	1.128	1.130	1.132	1.138
125	1.067	1.074	1.079	1.091	1.102	1.105	1.109	1.117	1.119	1.121	1.127
150	1.047	1.055	1.061	1.074	1.086	1.090	1.094	1.103	1.105	1.108	1.114
175	1.026	1.034	1.043	1.056	1.069	1.073	1.078	1.087	1.090	1.093	1.100
200	1.002	1.011	1.022	1.035	1.049	1.055	1.059	1.069	1.073	1.076	1.085
225	0.977	0.985	0.999	1.013	1.027	1.033	1.039	1.050	1.054	1.058	1.068
250	0.950	0.956	0.975	0.988	1.002	1.010	1.017	1.028	1.032	1.037	1.049
275	0.921	0.926	0.949	0.962	0.976	0.984	0.992	1.003	1.009	1.015	1.030
300	0.886	0.894	0.922	0.933	0.946	0.956	0.966	0.977	0.986	0.991	1.008
325	0.85*	0.860	0.892	0.903	0.915	0.927	0.938	0.949	0.958	0.966	0.986
350	--	0.82*	0.861	0.870	0.882	0.895	0.908	0.918	0.928	0.940	0.961
375	--	0.78*	0.821	0.834	0.844	0.860	0.874	0.885	0.896	0.912	0.936
400	--	--	0.79*	0.796	0.805	0.823	0.840	0.851	0.862	0.882	0.909
425	--	--	--	0.76*	0.77*	0.791	0.811	0.821	0.832	0.852	0.882
450	--	--	--	--	--	0.739	0.759	0.770	0.780	0.815	0.845
475	--	--	--	--	--	0.708	0.734	0.746	0.757	0.787	0.817
500	--	--	--	--	--	0.67*	0.69*	0.72*	0.74*	0.75*	0.789

*Extrapolated values

TABLE 24.—*Densities of 19 weight percent NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)													
	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
25	1.141	1.144	1.146	1.150	1.154	1.158	1.161	1.164	1.167	1.170	1.180	1.185	1.193	1.199
50	1.128	1.133	1.135	1.142	1.148	1.151	1.154	1.158	1.161	1.164	1.172	1.179	1.186	1.193
75	1.114	1.121	1.123	1.132	1.139	1.142	1.145	1.151	1.153	1.156	1.163	1.170	1.178	1.186
100	1.098	1.106	1.109	1.120	1.128	1.132	1.135	1.142	1.144	1.146	1.153	1.161	1.169	1.177
125	1.081	1.089	1.094	1.105	1.115	1.119	1.123	1.131	1.133	1.135	1.141	1.151	1.159	1.168
150	1.062	1.071	1.076	1.089	1.100	1.104	1.108	1.117	1.119	1.122	1.129	1.139	1.148	1.157
175	1.041	1.050	1.058	1.071	1.083	1.088	1.092	1.101	1.104	1.108	1.115	1.127	1.135	1.145
200	1.019	1.027	1.038	1.051	1.063	1.069	1.074	1.084	1.087	1.091	1.100	1.112	1.122	1.133
225	0.995	1.002	1.015	1.029	1.042	1.048	1.054	1.065	1.069	1.073	1.083	1.097	1.108	1.120
250	0.969	0.975	0.992	1.005	1.018	1.026	1.033	1.043	1.048	1.053	1.065	1.081	1.093	1.105
275	0.941	0.946	0.967	0.980	0.992	1.001	1.009	1.020	1.025	1.031	1.046	1.063	1.077	1.090
300	0.908	0.915	0.941	0.952	0.964	0.974	0.984	0.994	1.003	1.009	1.025	1.044	1.059	1.073
325	0.87*	0.884	0.912	0.923	0.935	0.946	0.957	0.967	0.976	0.984	1.004	1.024	1.041	1.056
350	--	0.870	0.880	0.892	0.903	0.915	0.927	0.937	0.947	0.959	0.979	1.003	1.021	1.038
375	--	0.837	0.848	0.858	0.870	0.882	0.893	0.906	0.916	0.931	0.955	0.980	1.000	1.018
400	--	0.803	0.814	0.823	0.835	0.848	0.859	0.871	0.887	0.899	0.929	0.956	0.978	0.997
425	--	0.77*	0.78*	0.786	0.796	0.812	0.823	0.838	0.855	0.869	0.902	0.932	0.956	0.977
450	--	--	--	0.75*	0.76*	0.77*	0.785	0.803	0.821	0.836	0.872	0.904	0.932	0.954
475	--	--	--	--	--	--	0.745	0.765	0.786	0.802	0.842	0.876	0.908	0.931
500	--	--	--	--	--	--	0.70*	0.725	0.748	0.766	0.810	0.842	0.880	0.909

*Extrapolated values

TABLE 25.—*Densities of 21 weight percent NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)													
	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
25	1.157	1.160	1.162	1.166	1.170	1.173	1.176	1.179	1.182	1.185	1.195	1.200	1.207	1.214
50	1.143	1.148	1.151	1.158	1.163	1.166	1.169	1.173	1.176	1.179	1.187	1.193	1.201	1.207
75	1.129	1.136	1.139	1.147	1.154	1.157	1.160	1.166	1.168	1.171	1.177	1.185	1.192	1.200
100	1.113	1.121	1.124	1.134	1.142	1.146	1.149	1.156	1.158	1.161	1.167	1.176	1.183	1.191
125	1.096	1.104	1.109	1.120	1.129	1.133	1.137	1.144	1.147	1.149	1.156	1.166	1.173	1.182
150	1.077	1.086	1.092	1.104	1.114	1.118	1.122	1.130	1.133	1.136	1.144	1.154	1.162	1.171
175	1.057	1.066	1.073	1.086	1.097	1.102	1.107	1.115	1.118	1.122	1.130	1.141	1.150	1.160
200	1.035	1.044	1.054	1.066	1.078	1.083	1.088	1.098	1.102	1.106	1.115	1.127	1.136	1.148
225	1.012	1.020	1.032	1.045	1.057	1.063	1.069	1.079	1.083	1.088	1.099	1.112	1.123	1.135
250	0.988	0.994	1.009	1.022	1.034	1.041	1.048	1.058	1.063	1.069	1.081	1.096	1.108	1.121
275	0.962	0.967	0.985	0.997	1.009	1.018	1.025	1.036	1.041	1.047	1.062	1.079	1.092	1.105
300	0.931	0.938	0.960	0.971	0.982	0.991	1.001	1.019	1.025	1.042	1.060	1.070	1.079	1.089
325	0.901	0.908	0.932	0.943	0.954	0.964	0.975	0.985	0.993	1.002	1.021	1.041	1.057	1.072
350	--	0.893	0.902	0.912	0.923	0.935	0.947	0.956	0.966	0.977	0.997	1.020	1.037	1.055
375	--	0.864	0.873	0.880	0.892	0.904	0.914	0.926	0.936	0.950	0.974	0.997	1.017	1.036
400	--	0.832	0.843	0.849	0.858	0.872	0.885	0.899	0.910	0.922	0.948	0.974	0.996	1.015
425	--	0.80*	0.81*	0.82*	0.83*	0.837	0.852	0.863	0.872	0.890	0.922	0.951	0.974	0.995
450	--	--	--	--	--	0.80*	0.82*	0.83*	0.849	0.863	0.898	0.925	0.951	0.973
475	--	--	--	--	--	--	--	--	0.819	0.835	0.868	0.899	0.927	0.951
500	--	--	--	--	--	--	--	--	0.78*	0.80*	0.837	0.868	0.903	0.928

*Extrapolated values

TABLE 26.—*Densities of 23 weight percent NaCl solutions, g/cm³*[The uncertainties in the densities are: 3-place figures ± 0.005 and ± 0.05 for 2-place figures.]

Temp °C	Pressure (bars)													
	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
25	1.172	1.176	1.179	1.182	1.186	1.189	1.192	1.195	1.198	1.201	1.211	1.215	1.222	1.228
50	1.159	1.164	1.167	1.173	1.178	1.181	1.184	1.188	1.191	1.194	1.202	1.208	1.216	1.222
75	1.145	1.151	1.154	1.162	1.168	1.171	1.174	1.180	1.182	1.185	1.192	1.200	1.207	1.214
100	1.128	1.136	1.140	1.149	1.156	1.160	1.163	1.170	1.172	1.175	1.182	1.191	1.198	1.206
125	1.111	1.119	1.124	1.134	1.142	1.146	1.151	1.158	1.161	1.164	1.171	1.180	1.188	1.196
150	1.093	1.102	1.107	1.118	1.127	1.131	1.136	1.144	1.147	1.150	1.159	1.169	1.177	1.186
175	1.073	1.082	1.089	1.101	1.110	1.115	1.121	1.129	1.132	1.136	1.145	1.156	1.165	1.175
200	1.052	1.061	1.069	1.081	1.091	1.097	1.102	1.112	1.116	1.120	1.130	1.142	1.151	1.163
225	1.030	1.039	1.048	1.061	1.071	1.078	1.084	1.093	1.098	1.103	1.114	1.127	1.138	1.150
250	1.007	1.015	1.027	1.039	1.049	1.056	1.063	1.073	1.078	1.084	1.097	1.111	1.123	1.136
275	0.983	0.989	1.003	1.015	1.025	1.033	1.041	1.051	1.057	1.063	1.078	1.094	1.107	1.120
300	0.955	0.961	0.978	0.989	0.999	1.009	1.017	1.027	1.035	1.041	1.059	1.076	1.090	1.105
325	0.927	0.933	0.952	0.962	0.973	0.982	0.993	1.002	1.011	1.018	1.038	1.057	1.073	1.088
350	0.90*	0.915	0.924	0.934	0.944	0.955	0.965	0.975	0.984	0.994	1.015	1.037	1.054	1.071
375	--	0.886	0.895	0.904	0.914	0.925	0.936	0.946	0.956	0.968	0.992	1.015	1.034	1.052
400	--	0.855	0.865	0.872	0.882	0.894	0.906	0.917	0.928	0.941	0.967	0.992	1.014	1.033
425	--	0.825	0.836	0.843	0.849	0.861	0.874	0.885	0.898	0.912	0.942	0.969	0.992	1.013
450	--	0.78*	0.79*	0.80*	0.813	0.823	0.843	0.855	0.868	0.882	0.915	0.944	0.970	0.991
475	--	--	--	--	0.77*	0.79*	0.80*	0.820	0.837	0.853	0.888	0.918	0.947	0.970
500	--	--	--	--	--	--	--	0.78*	0.80*	0.817	0.856	0.889	0.922	0.947

*Extrapolated values

TABLE 28.—Interpolation coefficients for NaCl solutions

$$[d = \frac{1000d_0 + M_2md_0}{1000 + A_0md_0 + B_0m^3/2d_0 + C_0m^2d_0}$$

where d_0 = density of water at temperature in g/cm³
and M_2 = molecular weight of NaCl.]

Temp (°C)	A ₀	B ₀	C ₀	d ₀
0	12.43	3.07	-.02	.999839
25	16.62	1.773	.098	.997047
50	18.00	1.66	.002	.988038
75	18.18	1.19	.12	.974844

TABLE 29.—NaCl interpolation formula coefficients

Molality		Pressure (bars)														
		Sat.	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000
0.5	A	1.0059	1.021	1.026	1.031	1.034	1.038	1.042	1.044	1.050	1.053	1.057	1.067	1.076	1.083	1.091
	-10 ⁴ XB	-0.318	0.239	0.868	1.077	0.305	0.376	0.365	0.110	0.460	0.508	0.553	0.924	1.081	0.834	0.914
	-10 ⁶ XC	3.099	2.974	2.592	2.427	2.569	2.446	2.355	2.421	2.147	2.044	1.954	1.675	1.502	1.437	1.304
1.0	A	1.0312	1.043	1.047	1.051	1.055	1.057	1.062	1.068	1.072	1.075	1.079	1.088	1.096	1.104	1.111
	-10 ⁴ XB	0.743	1.200	1.399	1.417	0.843	0.294	0.476	1.093	1.605	1.137	1.314	1.280	1.401	1.248	1.267
	-10 ⁶ XC	2.661	2.520	2.336	2.213	2.326	2.392	2.238	1.991	1.678	1.803	1.681	1.522	1.370	1.280	1.174
1.5	A	1.049	1.063	1.068	1.071	1.075	1.078	1.082	1.086	1.089	1.093	1.097	1.106	1.114	1.122	1.130
	-10 ⁴ XB	1.028	1.613	1.869	1.878	1.121	1.112	1.060	1.098	1.164	1.305	1.413	1.752	1.682	1.856	1.869
	-10 ⁶ XC	2.413	2.314	2.102	2.001	2.430	2.052	1.981	1.882	1.788	1.676	1.578	1.334	1.221	1.067	0.979
2.0	A	1.077	1.081	1.085	1.088	1.093	1.093	1.097	1.101	1.106	1.110	1.114	1.123	1.131	1.138	1.146
	-10 ⁴ XB	2.769	1.994	1.602	2.222	1.418	0.422	0.655	0.819	1.151	1.425	1.800	1.770	1.829	1.918	1.918
	-10 ⁶ XC	1.888	2.276	2.368	1.803	1.967	2.174	2.014	1.790	1.715	1.572	1.471	1.261	1.140	1.022	0.921
2.5	A	1.099	1.098	1.102	1.107	1.109	1.113	1.116	1.118	1.123	1.127	1.130	1.139	1.146	1.154	1.161
	-10 ⁴ XB	3.602	1.666	1.939	2.631	1.622	1.535	1.479	1.008	1.441	1.561	1.653	1.939	1.860	2.088	1.997
	-10 ⁶ XC	1.601	2.411	2.173	1.635	1.847	1.788	1.726	1.720	1.586	1.491	1.403	1.183	1.086	0.932	0.873
3.0	A	1.117	1.116	1.119	1.123	1.125	1.126	1.129	1.133	1.135	1.137	1.145	1.154	1.161	1.169	1.175
	-10 ⁴ XB	4.136	2.548	2.239	2.894	1.798	0.673	0.841	1.028	1.401	0.0006	1.603	1.827	1.812	1.932	1.820
	-10 ⁶ XC	1.378	1.955	1.994	1.496	1.752	1.982	1.846	1.718	1.819	1.867	1.372	1.195	1.064	0.938	0.882
3.5	A	1.137	1.135	1.135	1.138	1.140	1.142	1.147	1.151	1.153	1.155	1.162	1.170	1.177	1.184	1.190
	-10 ⁴ XB	4.746	3.439	2.608	2.855	1.914	0.926	1.226	1.449	0.965	0.878	1.660	1.972	1.970	2.104	1.947
	-10 ⁶ XC	1.174	1.593	1.820	1.464	1.608	1.872	1.706	1.568	1.636	1.604	1.328	1.141	1.001	0.8712	0.825
4.0	A	1.155	1.150	1.152	1.154	1.156	1.159	1.162	1.164	1.168	1.171	1.175	1.182	1.189	1.197	1.202
	-10 ⁴ XB	5.106	3.741	3.354	3.161	2.233	1.989	1.777	1.269	1.686	1.701	1.724	1.820	1.714	1.918	1.249
	-10 ⁶ XC	1.033	1.318	1.343	1.338	1.525	1.529	1.520	1.587	1.434	1.588	1.127	1.047	0.892	0.892	0.992
4.5	A	1.168	1.166	1.168	1.170	1.172	1.175	1.177	1.180	1.183	1.186	1.189	1.191	1.204	1.210	1.217
	-10 ⁴ XB	5.084	4.103	3.881	3.688	2.644	2.367	2.160	2.077	1.922	1.941	1.923	1.991	1.837	1.868	1.759
	-10 ⁶ XC	0.980	1.165	1.137	1.138	1.369	1.387	1.381	1.342	1.320	1.265	1.213	1.064	0.998	0.889	0.828
5.0	A	1.184	1.183	1.183	1.185	1.187	1.189	1.192	1.195	1.197	1.201	1.203	1.211	1.218	1.224	1.231
	-10 ⁴ XB	5.334	5.588	3.967	3.772	2.793	2.533	2.325	2.227	1.981	2.119	2.077	2.056	2.021	2.094	1.965
	-10 ⁶ XC	0.887	0.717	1.091	1.090	1.303	1.317	1.311	1.281	1.289	1.200	1.154	1.031	0.936	0.818	0.767
5.5	A	1.198	1.194	1.197	1.199	1.201	1.204	1.206	1.209	1.212	1.215	1.217	1.224	1.231	1.238	1.244
	-10 ⁴ XB	5.292	4.266	3.870	2.932	2.679	2.471	2.377	2.250	2.226	2.164	2.204	2.220	2.200	2.174	2.144
	-10 ⁶ XC	0.858	1.028	1.038	1.043	1.242	1.256	1.253	1.224	1.198	1.156	1.112	0.981	0.875	0.760	0.705
6.0	A	1.213	1.210	1.212	1.215	1.217	1.219	1.221	1.224	1.226	1.229	1.231	1.239	1.245	1.252	1.258
	-10 ⁴ XB	5.428	4.642	4.467	4.294	3.543	3.269	3.079	2.909	2.510	2.537	2.464	2.503	2.407	2.416	2.319
	-10 ⁶ XC	0.805	0.885	0.892	0.891	1.047	1.069	1.065	1.059	1.112	1.059	1.024	0.895	0.819	0.723	0.665
6.5	A	1.225	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	-10 ⁴ XB	5.242	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	-10 ⁶ XC	0.825	--	--	--	--	--	--	--	--	--	--	--	--	--	--
7.0	A	1.238	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	-10 ⁴ XB	5.094	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	-10 ⁶ XC	0.843	--	--	--	--	--	--	--	--	--	--	--	--	--	--

$$[d = A + Bp + Cp^2, \dots]$$

Preliminary Steam Tables for NaCl Solutions

G E O L O G I C A L S U R V E Y B U L L E T I N 1 4 2 1

*This volume was published
as separate chapters A-C*

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