

Conductivity of Sulfuric Acid Solutions

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The conductivity of sulfuric acid was measured over the range of 0.5% to 99.0% concentration, and over a temperature range of 0° F. to 240° F. Results are presented in tabular form for accurate reference, and as a family of constant temperature curves to illustrate the conductance-concentration-temperature relationship. The range of concentration and temperature covered is adequate for most industrial applications.

SULFURIC ACID is one of the most widely used reagents in chemical processing today, hence, a quick and accurate determination of its concentration is essential for process control. One method very commonly used for determining concentration is the electrical measurement of conductivity. A search of the literature revealed that only small, isolated sections of the conductivity-concentration-temperature characteristic have been reported, each small section apparently being measured to solve a particular problem. The measurement of conductivity of H₂SO₄ covering a wide range of concentration (5% to 99%) is for a temperature of 18° C. (1).

In view of the sparseness of the conductivity information, and because of the pressing need for this information over a wide range of concentrations and temperatures for the solution of automatic control problems, the measurement of the entire conductivity characteristic was undertaken to cover the range of expected practical applications.

EXPERIMENTAL PROCEDURE

The conductivity cell used was made by Leeds and Northrup, of the design proposed by Jones and Prendergast (8) as a standard for conductivity measurements. A single cell was used to cover the entire range of H₂SO₄ concentrations, having a cell constant of approximately 163. The cell was chemically cleaned, then calibrated with a 1*N* or 0.1*N* solution of pure KCl, according to the technique proposed by Jones and Prendergast (8).

The formula used for the conductivity of KCl *vs.* temperature is:

$$K_t = 0.065430 + 0.0017319T + 0.000004618T^2 \quad (1)$$

where *T* is the solution temperature in °C. (8). Observations were made to check the accuracy of preparation of solutions and agreement with the above formula. Results were found to be reproducible to 0.05%, and to coincide with the temperature dependence of the above formula to the same degree.

For all standardizing and conductivity measurements, the cells were immersed in a water and glycerine bath, designed to cover a range of 0° to 240° F. The bath temperature was determined by a nickel resistance bulb placed in contact with the cell. The resistance change was amplified electronically, and used to modulate a thyatron to control the current through heaters immersed in the solution. With the fluid circulating rapidly around the cell, the temperature of the cell body was maintained constant to 0.05° F. of the desired temperature level. A precision mercury thermometer, also in contact with the cell, readable to 0.05° F. was used for the temperature

measurement. All measurements were made at 1000 c.p.s. to minimize polarization effects. Resistance could be measured to five significant figures.

The acid assay of chemically pure H₂SO₄ was checked. Specific gravity at a known temperature was obtained, and compared with the published values in the International Critical Tables (4). In preparing solutions, double-distilled water of negligible conductivity (less than 2 micromhos) was mixed with this CP grade acid of known assay. The concentration was calculated as percent acid by weight. For values above 10%, the calculated concentration was checked by at least two gravimetric measurements, and the results agreed to 0.2% before the solution was used. Below 10%, the calculated concentration was used because the accuracy of the gravimetric check was questionable in this range.

Acid concentrations from 94% to 99% were prepared by mixing 94% assay acid with 15% fuming H₂SO₄ (115% concentration), and the final mixture checked by gravimetric means. For this range, concentrations were reproducible to an accuracy of 0.25%.

An air chamber in the stems of the cell allowed for expansion and contraction of the solution with temperature, maintaining approximately one atmosphere of pressure within the cell. Measurements of conductivity were made over a range of 0° F. to 240° F., or from just above the freezing point to just below the boiling point, whichever came first. Accurate data on the freezing and boiling points of H₂SO₄ is available in the literature (2, 5). The cell was maintained at each temperature level for at least one-half hour, or until no further change in resistance with time could be measured.

The range of conductivities investigated was from 0.5% to 99.0% concentration.

RESULTS

The experimental data of the conductivity (mho) of H₂SO₄ *vs.* concentration (% by weight) and temperature (° F.) are listed in Table I in intervals of 0.5% concentration from 0.5% to 4.5%, and in intervals of 1% concentration from 5% to 99%, and at 10° F. differences in temperature from 0° to 240° F.

For the region of 0% to 0.5% concentration, some information exists in the literature (3, 6, 7, 9, 10), but for most practical purposes, a linear extrapolation can be made from the listed conductivity at 0.5% to the desired lower value of concentration.

In the temperature range below 0° F., and in concentrations from 15% to 45%, the conductivity has been measured and published (11), hence, temperatures below 0° F. were not included in this work.

Table I. Conductivity of Sulfuric Acid
(Conductivity values are given in mhos)

Temp., ° F.	Percent Concentration									
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5
30	...	...	...	0.0627	0.0780	0.0930	0.1079	0.1224	0.1364	0.1496
40	0.0177	0.0355	0.0527	0.0695	0.0865	0.1031	0.1194	0.1355	0.1510	0.1662
50	0.0192	0.0385	0.0574	0.0760	0.0943	0.1126	0.1304	0.1480	0.1651	0.1818
60	0.0212	0.0418	0.0622	0.0823	0.1022	0.1218	0.1410	0.1600	0.1785	0.1966
70	0.0224	0.0446	0.0664	0.0880	0.1093	0.1305	0.1512	0.1715	0.1912	0.2102
80	0.0237	0.0472	0.0704	0.0932	0.1158	0.1383	0.1602	0.1817	0.2029	0.2232
90	0.0250	0.0498	0.0742	0.0983	0.1222	0.1458	0.1690	0.1917	0.2138	0.2351
100	0.0261	0.0520	0.0775	0.1027	0.1277	0.1525	0.1770	0.2010	0.2242	0.2465
110	0.0273	0.0543	0.0808	0.1070	0.1331	0.1590	0.1845	0.2095	0.2337	0.2574
120	0.0284	0.0561	0.0838	0.1111	0.1381	0.1650	0.1915	0.2173	0.2425	0.2672
130	0.0288	0.0580	0.0864	0.1147	0.1428	0.1706	0.1981	0.2247	0.2507	0.2673
140	0.0295	0.0596	0.0891	0.1182	0.1470	0.1758	0.2040	0.2317	0.2587	0.2853
150	0.0300	0.0610	0.0912	0.1213	0.1513	0.1810	0.2100	0.2383	0.2661	0.2934
160	0.0308	0.0622	0.0932	0.1243	0.1550	0.1855	0.2155	0.2444	0.2727	0.3007
170	0.0315	0.0633	0.0952	0.1270	0.1586	0.1900	0.2210	0.2512	0.2802	0.3085
180	0.0322	0.0645	0.0972	0.1295	0.1620	0.1940	0.2253	0.2560	0.2860	0.3150
190	0.0327	0.0658	0.0993	0.1322	0.1650	0.1977	0.2297	0.2612	0.2917	0.3217
200	0.0332	0.0672	0.1011	0.1346	0.1681	0.2013	0.2338	0.2662	0.2975	0.3283
210	0.0340	0.0682	0.1027	0.1372	0.1713	0.2050	0.2380	0.2708	0.3028	0.3335
220	...	...	...	...	...	...	...	...	...	...
	6	7	8	9	10	11	12	13	14	15
10	...	...	...	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	...	0.3270	0.3430
30	0.1800	0.2075	0.2330	0.2580	0.2825	0.3050	0.3275	0.3490	0.3695	0.3885
40	0.1995	0.2315	0.2605	0.2890	0.3160	0.3420	0.3660	0.3890	0.4115	0.4325
50	0.2175	0.2525	0.2845	0.3165	0.3470	0.3755	0.4030	0.4295	0.4535	0.4780
60	0.2360	0.2730	0.3085	0.3430	0.3770	0.4090	0.4395	0.4675	0.4945	0.5200
70	0.2515	0.2935	0.3330	0.3695	0.4055	0.4415	0.4740	0.5055	0.5335	0.5625
80	0.2675	0.3115	0.3540	0.3945	0.4335	0.4725	0.5075	0.5415	0.5735	0.6045
90	0.2820	0.3290	0.3740	0.4165	0.4575	0.4980	0.5360	0.5720	0.6070	0.6395
100	0.2955	0.3455	0.3925	0.4370	0.4820	0.5255	0.5670	0.6050	0.6410	0.6770
110	0.3110	0.3625	0.4130	0.4615	0.5075	0.5525	0.5945	0.6355	0.6735	0.7110
120	0.3225	0.3770	0.4295	0.4800	0.5275	0.5745	0.6205	0.6630	0.7025	0.7425
130	0.3340	0.3920	0.4450	0.4990	0.5505	0.6000	0.6455	0.6895	0.7315	0.7730
140	0.3445	0.4040	0.4600	0.5150	0.5685	0.6195	0.6670	0.7130	0.7570	0.8015
150	0.3540	0.4145	0.4735	0.5290	0.5840	0.6390	0.6895	0.7375	0.7840	0.8310
160	0.3640	0.4260	0.4860	0.5435	0.6000	0.6565	0.7070	0.7580	0.8060	0.8545
170	0.3735	0.4375	0.4950	0.5590	0.6170	0.6720	0.7250	0.7770	0.8275	0.8795
180	0.3815	0.4480	0.5115	0.5705	0.6305	0.6885	0.7435	0.7965	0.8470	0.8990
190	0.3900	0.4575	0.5210	0.5825	0.6455	0.7050	0.7605	0.8155	0.8665	0.9215
200	0.3975	0.4660	0.5315	0.5935	0.6570	0.7170	0.7755	0.8310	0.8855	0.9410
210	0.4060	0.4755	0.5420	0.6045	0.6675	0.7295	0.7885	0.8470	0.9025	0.9575
220	...	...	...	...	...	...	...	...	...	...
	16	17	18	19	20	21	22	23	24	25
0	...	...	...	...	...	...	...	0.3060	0.3105	0.3130
10	...	...	...	0.3370	0.3465	0.3545	0.3615	0.3675	0.3720	0.3750
20	0.3480	0.3720	0.3845	0.3960	0.4065	0.4155	0.4235	0.4300	0.4355	0.4395
30	0.4065	0.4225	0.4375	0.4515	0.4640	0.4750	0.4850	0.4930	0.5005	0.5065
40	0.4530	0.4715	0.4885	0.5045	0.5195	0.5325	0.5440	0.5530	0.5615	0.5680
50	0.5000	0.5210	0.5395	0.5570	0.5725	0.5860	0.5980	0.6075	0.6160	0.6235
60	0.5445	0.5675	0.5890	0.6080	0.6265	0.6425	0.6565	0.6690	0.6790	0.6880
70	0.5895	0.6145	0.6385	0.6605	0.6805	0.6985	0.7140	0.7275	0.7385	0.7480
80	0.6335	0.6610	0.6865	0.7095	0.7315	0.7510	0.7680	0.7830	0.7965	0.8080
90	0.6725	0.7030	0.7310	0.7570	0.7810	0.8030	0.8225	0.8395	0.8540	0.8665
100	0.7120	0.7450	0.7755	0.8045	0.8305	0.8550	0.8765	0.8950	0.9120	0.9255
110	0.7480	0.7835	0.8160	0.8460	0.8755	0.9020	0.9250	0.9455	0.9635	0.9790
120	0.7815	0.8190	0.8545	0.8880	0.9190	0.9475	0.9725	0.9950	1.0150	1.0330
130	0.8135	0.8535	0.8910	0.9265	0.9600	0.9910	1.0185	1.0435	1.0660	1.0855
140	0.8440	0.8860	0.9250	0.9630	0.9980	1.0305	1.0600	1.0870	1.1110	1.1330
150	0.8755	0.9180	0.9590	0.9985	1.0355	1.0705	1.1020	1.1305	1.1555	1.1790
160	0.9020	0.9470	0.9910	1.0315	1.0710	1.1065	1.1395	1.1690	1.1970	1.2215
170	0.9290	0.9755	1.0200	1.0625	1.1030	1.1420	1.1765	1.2080	1.2375	1.2640
180	0.9500	0.9990	1.0450	1.0900	1.1330	1.1740	1.2110	1.2455	1.2765	1.3045
190	0.9745	1.0245	1.0725	1.1180	1.1630	1.2045	1.2420	1.2770	1.3100	1.3405
200	0.9935	1.0460	1.0960	1.1440	1.1905	1.2330	1.2725	1.3100	1.3440	1.3750
210	1.0110	1.0645	1.1175	1.1675	1.2155	1.2605	1.3020	1.3400	1.3760	1.4110
220	...	...	...	...	...	1.2850	1.3270	1.3670	1.4040	1.4395
230	...	...	...	...	...	...	...	...	...	...
240	...	...	...	...	...	...	...	...	...	...

Table I. Conductivity of Sulfuric Acid (Continued)

(Conductivity values are given in mhos)

Temp., ° F.	Percent Concentration									
	26	27	28	29	30	31	32	33	34	35
0	0.3150	0.3160	0.3155	0.3140	0.3120	0.3095	0.3065	0.3035	0.3000	0.2960
10	0.3770	0.3780	0.3780	0.3775	0.3755	0.3730	0.3705	0.3665	0.3625	0.3570
20	0.4425	0.4440	0.4450	0.4440	0.4420	0.4385	0.4345	0.4300	0.4245	0.4185
30	0.5110	0.5140	0.5155	0.5155	0.5140	0.5110	0.5070	0.5020	0.4960	0.4895
40	0.5730	0.5770	0.5780	0.5795	0.5780	0.5760	0.5730	0.5680	0.5635	0.5570
50	0.6295	0.6340	0.6365	0.6385	0.6400	0.6385	0.6365	0.6335	0.6280	0.6230
60	0.6950	0.7005	0.7045	0.7065	0.7075	0.7060	0.7040	0.7000	0.6955	0.6890
70	0.7560	0.7625	0.7670	0.7700	0.7720	0.7720	0.7710	0.7680	0.7640	0.7585
80	0.8175	0.8250	0.8315	0.8360	0.8385	0.8395	0.8385	0.8365	0.8325	0.8270
90	0.8775	0.8860	0.8930	0.8985	0.9025	0.9040	0.9045	0.9030	0.9000	0.8950
100	0.9375	0.9475	0.9560	0.9620	0.9665	0.9690	0.9700	0.9685	0.9660	0.9615
110	0.9930	1.0045	1.0145	1.0220	1.0280	1.0320	1.0340	1.0330	1.0310	1.0270
120	1.0485	1.0620	1.0730	1.0820	1.0890	1.0945	1.0965	1.0975	1.0965	1.0930
130	1.1030	1.1180	1.1310	1.1415	1.1495	1.1550	1.1590	1.1605	1.1600	1.1575
140	1.1525	1.1695	1.1845	1.1960	1.2055	1.2130	1.2180	1.2205	1.2200	1.2180
150	1.2000	1.2185	1.2350	1.2480	1.2590	1.2675	1.2735	1.2770	1.2780	1.2765
160	1.2440	1.2640	1.2815	1.2965	1.3090	1.3195	1.3270	1.3320	1.3350	1.3350
170	1.2880	1.3100	1.3295	1.3460	1.3505	1.3720	1.3805	1.3870	1.3910	1.3920
180	1.3300	1.3535	1.3735	1.3915	1.4075	1.4210	1.4310	1.4385	1.4445	1.4465
190	1.3685	1.3940	1.4170	1.4370	1.4550	1.4680	1.4800	1.4880	1.4945	1.4970
200	1.4045	1.4325	1.4575	1.4800	1.4995	1.5150	1.5280	1.5375	1.5445	1.5490
210	1.4410	1.4690	1.4945	1.5165	1.5370	1.5545	1.5690	1.5815	1.5900	1.5965
220	1.4725	1.5030	1.5315	1.5575	1.5795	1.5980	1.6140	1.6265	1.6365	1.6430
230	...	...	...	...	...	1.6355	1.6540	1.6690	1.6800	1.6880
240	...	...	...	...	...	...	...	...	...	...
	36	37	38	39	40	41	42	43	44	45
0	0.2915	0.2870	0.2825	0.2775	0.2725	0.2675	0.2620	0.2565	0.2500	0.2445
10	0.3515	0.3455	0.3395	0.3335	0.3265	0.3200	0.3135	0.3060	0.2985	0.2915
20	0.4120	0.4055	0.3980	0.3915	0.3840	0.3760	0.3685	0.3605	0.3525	0.3440
30	0.4820	0.4740	0.4655	0.4570	0.4280	0.4395	0.4300	0.4205	0.4110	0.4010
40	0.5495	0.5410	0.5320	0.5225	0.5125	0.5025	0.4915	0.4805	0.4695	0.4580
50	0.6155	0.6070	0.5975	0.5875	0.5770	0.5665	0.5555	0.5440	0.5325	0.5205
60	0.6815	0.6730	0.6635	0.6540	0.6425	0.6315	0.6195	0.6070	0.5945	0.5815
70	0.7515	0.7425	0.7330	0.7220	0.7110	0.6980	0.6855	0.6725	0.6590	0.6450
80	0.8200	0.8110	0.8010	0.7905	0.7785	0.7655	0.7520	0.7380	0.7240	0.7080
90	0.8875	0.8805	0.8710	0.8600	0.8470	0.8335	0.8195	0.8045	0.7895	0.7735
100	0.9550	0.9470	0.9370	0.9260	0.9135	0.8995	0.8850	0.8700	0.8545	0.8375
110	1.0210	1.0125	1.0030	0.9925	0.9795	0.9660	0.9510	0.9355	0.9190	0.9030
120	1.0875	1.0800	1.0710	1.0600	1.0475	1.0340	1.0190	1.0030	0.9360	0.9690
130	1.1520	1.1445	1.1355	1.1250	1.1130	1.0990	1.0835	1.0675	1.0510	1.0335
140	1.2135	1.2070	1.1975	1.1875	1.1755	1.1615	1.1460	1.1290	1.1120	1.0945
150	1.2735	1.2670	1.2595	1.2490	1.2380	1.2250	1.2090	1.1930	1.1755	1.1570
160	1.3325	1.3275	1.3210	1.3120	1.3015	1.2875	1.2735	1.2570	1.2400	1.2220
170	1.3905	1.3875	1.3820	1.3745	1.3640	1.3520	1.3375	1.3220	1.3045	1.2850
180	1.4470	1.4450	1.4400	1.4335	1.4245	1.4130	1.3995	1.3845	1.3670	1.3480
190	1.4975	1.4960	1.4920	1.4860	1.4775	1.4665	1.4535	1.4385	1.4225	1.4045
200	1.5510	1.5500	1.5465	1.5410	1.5330	1.5230	1.5110	1.4970	1.4805	1.4630
210	1.5990	1.6000	1.5980	1.5945	1.5880	1.5790	1.5680	1.5550	1.5400	1.5225
220	1.6465	1.6480	1.6475	1.6445	1.6385	1.6300	1.6200	1.6070	1.5930	1.5770
230	1.6940	1.6965	1.6970	1.6945	1.6900	1.6825	1.6720	1.6600	1.6455	1.6280
240	...	...	...	1.7350	1.7310	1.7245	1.7160	1.6845	1.6915	1.6750
	46	47	48	49	50	51	52	53	54	55
0	0.2380	0.2320	0.2260	0.2190	0.2125	0.2055	0.1980	0.1915	0.1840	0.1770
10	0.2840	0.2760	0.2680	0.2595	0.2515	0.2430	0.2340	0.2260	0.2175	0.2095
20	0.3355	0.3265	0.3175	0.3085	0.2995	0.2905	0.2815	0.2720	0.2625	0.2525
30	0.3910	0.3805	0.3705	0.3600	0.3500	0.3390	0.3280	0.3175	0.3060	0.2950
40	0.4465	0.4350	0.4240	0.4120	0.4000	0.3880	0.3760	0.3640	0.3520	0.3390
50	0.5080	0.4955	0.4830	0.4695	0.4560	0.4430	0.4285	0.4150	0.4010	0.3870
60	0.5680	0.5540	0.5400	0.5260	0.5120	0.4970	0.4815	0.4660	0.4510	0.4350
70	0.6305	0.6160	0.6010	0.5855	0.5700	0.5535	0.5370	0.5200	0.5025	0.4850
80	0.6930	0.6770	0.6610	0.6440	0.6270	0.6095	0.5915	0.5745	0.5565	0.5370
90	0.7570	0.7400	0.7230	0.7050	0.6870	0.6690	0.6500	0.6310	0.6115	0.5915
100	0.8205	0.8030	0.7850	0.7665	0.7475	0.7275	0.7075	0.6875	0.6670	0.6455
110	0.8855	0.8670	0.8480	0.8280	0.8080	0.7870	0.7660	0.7450	0.7230	0.7000
120	0.9500	0.9310	0.9110	0.8910	0.8690	0.8470	0.8240	0.8010	0.7780	0.7540
130	1.0150	0.9955	0.9745	0.9530	0.9305	0.9070	0.8830	0.8585	0.8335	0.8080
140	1.0755	1.0565	1.0350	1.0145	0.9920	0.9690	0.9445	0.9195	0.8940	0.8670
150	1.1375	1.1180	1.0975	1.0755	1.0530	1.0290	1.0040	0.9775	0.9510	0.9230
160	1.2015	1.1815	1.1600	1.1380	1.1145	1.0900	1.0635	1.0375	1.0095	0.9810
170	1.2650	1.2445	1.2225	1.2000	1.1755	1.1500	1.1235	1.0955	1.0660	1.0360
180	1.3280	1.3070	1.2850	1.2615	1.2370	1.2100	1.1830	1.1550	1.1255	1.0950
190	1.3850	1.3655	1.3445	1.3215	1.2970	1.2690	1.2410	1.2115	1.1810	1.1485
200	1.4445	1.4240	1.4020	1.3790	1.3545	1.3285	1.3005	1.2715	1.2405	1.2085
210	1.5035	1.4835	1.4625	1.4390	1.4145	1.3880	1.3600	1.3310	1.3000	1.2680
220	1.5585	1.5390	1.5180	1.4950	1.4710	1.4445	1.4175	1.3880	1.3570	1.3245
230	1.6095	1.5890	1.5670	1.5430	1.5175	1.4905	1.4635	1.4340	1.4040	1.3725
240	1.6575	1.6370	1.6150	1.5915	1.5660	1.5405	1.5130	1.4850	1.4550	1.4250

(Continued on page 424)

Table I. Conductivity of Sulfuric Acid (Continued)

(Conductivity values are given in mhos)

Temp., ° F.	Percent Concentration									
	56	57	58	59	60	61	62	63	64	65
0	0.1690	0.1620	0.1540	0.1460	0.1385	0.1310	0.1240	0.1165	0.1095	0.1020
10	0.2010	0.1925	0.1840	0.1755	0.1670	0.1580	0.1495	0.1405	0.1320	0.1240
20	0.2425	0.2325	0.2225	0.2120	0.2020	0.1920	0.1810	0.1710	0.1610	0.1515
30	0.2840	0.2720	0.2600	0.2485	0.2365	0.2250	0.2125	0.2010	0.1895	0.1780
40	0.3265	0.3140	0.3010	0.2880	0.2750	0.2620	0.2490	0.2355	0.2230	0.2105
50	0.3720	0.3580	0.3435	0.3285	0.3140	0.2990	0.2840	0.2690	0.2540	0.2400
60	0.4185	0.4030	0.3865	0.3700	0.3535	0.3375	0.3210	0.3050	0.2895	0.2745
70	0.4670	0.4485	0.4310	0.4125	0.3950	0.3770	0.3595	0.3420	0.3250	0.3085
80	0.5180	0.4995	0.4800	0.4605	0.4415	0.4220	0.4020	0.3830	0.3645	0.3470
90	0.5715	0.5505	0.5295	0.5085	0.4870	0.4660	0.4455	0.4250	0.4045	0.3850
100	0.6235	0.6020	0.5790	0.5570	0.5345	0.5125	0.4900	0.4675	0.4465	0.4255
110	0.6770	0.6540	0.6305	0.6070	0.5830	0.5590	0.5355	0.5125	0.4890	0.4670
120	0.7295	0.7050	0.6805	0.6560	0.6310	0.6065	0.5815	0.5570	0.5330	0.5090
130	0.7825	0.7565	0.7300	0.7030	0.6770	0.6510	0.6250	0.5995	0.5750	0.5505
140	0.8395	0.8125	0.7850	0.7575	0.7300	0.7025	0.6760	0.6490	0.6230	0.5970
150	0.8950	0.8660	0.8380	0.8095	0.7810	0.7525	0.7235	0.6955	0.6690	0.6430
160	0.9515	0.9210	0.8920	0.8620	0.8315	0.8020	0.7730	0.7440	0.7165	0.6890
170	1.0050	0.9745	0.9445	0.9140	0.8835	0.8535	0.8230	0.7940	0.7660	0.7380
180	1.0635	1.0320	1.0020	0.9700	0.9390	0.9075	0.8775	0.8470	0.8185	0.7900
190	1.1155	1.0830	1.0515	1.0200	0.9880	0.9565	0.9250	0.8945	0.8655	0.8365
200	1.1750	1.1425	1.1095	1.0765	1.0435	1.0110	0.9785	0.9470	0.9165	0.8865
210	1.2350	1.2015	1.1680	1.1345	1.1000	1.0660	1.0325	0.9990	0.9675	0.9370
220	1.2915	1.2570	1.2235	1.1890	1.1550	1.1200	1.0865	1.0535	1.0215	0.9895
230	1.3400	1.3075	1.2750	1.2420	1.2085	1.1750	1.1410	1.1070	1.1730	1.0400
240	1.3930	1.3600	1.3265	1.2930	1.2600	1.2260	1.1920	1.1580	1.1240	1.0910
	66	67	68	69	70	71	72	73	74	75
0	0.0955	0.0890	0.0825	0.0765	0.0710	0.0650	0.0595	0.0540	0.0480	0.0435
10	0.1155	0.1075	0.1000	0.0925	0.0850	0.0785	0.0720	0.0660	0.0595	0.0530
20	0.1420	0.1325	0.1225	0.1135	0.1045	0.0965	0.0885	0.0810	0.0735	0.0670
30	0.1670	0.1565	0.1450	0.1350	0.1250	0.1150	0.1060	0.0975	0.0890	0.0810
40	0.1975	0.1850	0.1730	0.1615	0.1500	0.1385	0.1280	0.1180	0.1075	0.0990
50	0.2260	0.2125	0.1990	0.1865	0.1740	0.1620	0.1510	0.1395	0.1285	0.1185
60	0.2585	0.2440	0.2295	0.2150	0.2015	0.1880	0.1755	0.1640	0.1520	0.1410
70	0.2925	0.2760	0.2610	0.2460	0.2315	0.2170	0.2035	0.1900	0.1775	0.1650
80	0.3290	0.3115	0.2940	0.2780	0.2620	0.2470	0.2320	0.2175	0.2040	0.1910
90	0.3660	0.3470	0.3290	0.3120	0.2950	0.2790	0.2630	0.2480	0.2330	0.2190
100	0.4055	0.3850	0.3665	0.3480	0.3300	0.3125	0.2960	0.2800	0.2645	0.2485
110	0.4445	0.4230	0.4030	0.3830	0.3640	0.3455	0.3280	0.3110	0.2945	0.2785
120	0.4860	0.4630	0.4420	0.4210	0.4010	0.3820	0.3635	0.3455	0.3285	0.3120
130	0.5275	0.5040	0.4820	0.4610	0.4400	0.4200	0.4020	0.3830	0.3650	0.3475
140	0.5715	0.5475	0.5250	0.5025	0.4810	0.4600	0.4400	0.4210	0.4020	0.3840
150	0.6175	0.5930	0.5685	0.5445	0.5220	0.5000	0.4790	0.4590	0.4390	0.4210
160	0.6625	0.6375	0.6125	0.5890	0.5660	0.5430	0.5210	0.4995	0.4790	0.4590
170	0.7110	0.6850	0.6590	0.6340	0.6090	0.5855	0.5630	0.5415	0.5200	0.5005
180	0.7615	0.7350	0.7075	0.6820	0.6570	0.6330	0.6090	0.5860	0.5635	0.5430
190	0.8080	0.7815	0.7545	0.7290	0.7035	0.6790	0.6550	0.6320	0.6090	0.5880
200	0.8580	0.8305	0.8030	0.7765	0.7510	0.7255	0.7015	0.6775	0.6540	0.6320
210	0.9075	0.8795	0.8510	0.8230	0.7960	0.7700	0.7450	0.7210	0.6975	0.6750
220	0.9585	0.9280	0.8990	0.8710	0.8425	0.8160	0.7905	0.7660	0.7420	0.7195
230	1.0070	0.9760	0.9460	0.9165	0.8880	0.8605	0.8345	0.8100	0.7870	0.7650
240	1.0575	1.0245	0.9930	0.9625	0.9345	0.9070	0.8810	0.8570	0.8330	0.8110
	76	77	78	79	80	81	82	83	84	85
0	0.0385	0.0340	...	...	...	...	...	...	...	...
10	0.0475	0.0425	0.0375	...	...	...	...	...	...	...
20	0.0600	0.0540	0.0480	...	...	...	...	...	...	...
30	0.0740	0.0670	0.0610	0.0560	0.0520	...	...	...	...	...
40	0.0900	0.0825	0.0755	0.0700	0.0655	0.0625	0.0605	0.0600	0.0605	0.0610
50	0.1090	0.1005	0.0930	0.0865	0.0810	0.0775	0.0745	0.0740	0.0745	0.0755
60	0.1310	0.1215	0.1130	0.1055	0.1000	0.0955	0.0930	0.0915	0.0915	0.0915
70	0.1535	0.1430	0.1335	0.1260	0.1200	0.1145	0.1120	0.1100	0.1095	0.1100
80	0.1785	0.1675	0.1575	0.1490	0.1420	0.1375	0.1340	0.1320	0.1315	0.1315
90	0.2060	0.1940	0.1830	0.1730	0.1655	0.1600	0.1560	0.1540	0.1530	0.1530
100	0.2345	0.2215	0.2100	0.2000	0.1915	0.1850	0.1805	0.1780	0.1765	0.1760
110	0.2640	0.2500	0.2380	0.2280	0.2190	0.2130	0.2095	0.2060	0.2040	0.2040
120	0.2965	0.2820	0.2695	0.2585	0.2495	0.2430	0.2385	0.2360	0.2340	0.2330
130	0.3310	0.3165	0.3035	0.2920	0.2825	0.2755	0.2705	0.2665	0.2635	0.2620
140	0.3665	0.3510	0.3370	0.3250	0.3150	0.3080	0.3025	0.2980	0.2945	0.2920
150	0.4035	0.3870	0.3730	0.3610	0.3495	0.3420	0.3360	0.3320	0.3280	0.3255
160	0.4415	0.4245	0.4100	0.3970	0.3860	0.3775	0.3705	0.3660	0.3620	0.3595
170	0.4815	0.4640	0.4490	0.4350	0.4235	0.4140	0.4065	0.4010	0.3965	0.3935
180	0.5230	0.5045	0.4880	0.4740	0.4620	0.4530	0.4460	0.4400	0.4350	0.4315
190	0.5675	0.5490	0.5315	0.5160	0.5035	0.4920	0.4840	0.4765	0.4710	0.4660
200	0.6110	0.5910	0.5730	0.5575	0.5445	0.5340	0.5255	0.5180	0.5120	0.5065
210	0.6545	0.6350	0.6175	0.6020	0.5880	0.5770	0.5675	0.5585	0.5520	0.5450
220	0.6980	0.6790	0.6615	0.6450	0.6315	0.6190	0.6090	0.5995	0.5915	0.5840
230	0.7440	0.7245	0.7070	0.6905	0.6770	0.6640	0.6525	0.6420	0.6325	0.6235
240	0.7900	0.7690	0.7510	0.7340	0.7190	0.7055	0.6930	0.6815	0.6720	0.6630

Table I. Conductivity of Sulfuric Acid (Continued)
(Conductivity values are given in mhos)

Temp., ° F.	Percent Concentration									
	86	87	88	89	90	91	92	93	94	95
0	...	...	...	...	...	...	0.0290	0.0300	0.0300	0.0290
10	...	...	...	...	...	...	0.0380	0.0385	0.0380	0.0365
20	...	...	...	...	...	...	0.0485	0.0485	0.0480	0.0455
30	...	...	...	...	0.0460	0.0480	0.0485	0.0595	0.0600	0.0560
40	0.0625	0.0640	0.0520	0.0535	0.0565	0.0585	0.0595	0.0725	0.0725	0.0670
50	0.0765	0.0785	0.0805	0.0820	0.0840	0.0855	0.0860	0.0860	0.0835	0.0800
60	0.0925	0.0945	0.0960	0.0980	0.1005	0.1025	0.1035	0.1025	0.0990	0.0940
70	0.1110	0.1130	0.1150	0.1170	0.1175	0.1200	0.1210	0.1195	0.1160	0.1100
80	0.1320	0.1330	0.1350	0.1370	0.1375	0.1400	0.1400	0.1375	0.1330	0.1255
90	0.1540	0.1550	0.1565	0.1580	0.1590	0.1600	0.1600	0.1570	0.1515	0.1425
100	0.1770	0.1785	0.1800	0.1815	0.1820	0.1820	0.1810	0.1775	0.1710	0.1610
110	0.2040	0.2040	0.2045	0.2055	0.2065	0.2060	0.2040	0.1990	0.1920	0.1805
120	0.2325	0.2330	0.2325	0.2330	0.2325	0.2310	0.2275	0.2215	0.2130	0.2000
130	0.2605	0.2600	0.2600	0.2600	0.2600	0.2575	0.2535	0.2465	0.2355	0.2210
140	0.2910	0.2900	0.2880	0.2880	0.2860	0.2835	0.2790	0.2715	0.2595	0.2430
150	0.3235	0.3220	0.3205	0.3185	0.3170	0.3125	0.3060	0.2965	0.2830	0.2645
160	0.3565	0.3540	0.3520	0.3490	0.3465	0.3415	0.3350	0.3240	0.3090	0.2890
170	0.3905	0.3875	0.3840	0.3810	0.3760	0.3720	0.3645	0.3525	0.3360	0.3140
180	0.4275	0.4235	0.4190	0.4145	0.4085	0.4025	0.3950	0.3825	0.3640	0.3395
190	0.4630	0.4590	0.4550	0.4500	0.4430	0.4360	0.4260	0.4120	0.3925	0.3665
200	0.5015	0.4960	0.4905	0.4845	0.4770	0.4680	0.4570	0.4415	0.4210	0.3925
210	0.5385	0.5330	0.5275	0.5200	0.5130	0.5015	0.4880	0.4715	0.4490	0.4185
220	0.5775	0.5705	0.5640	0.5560	0.5460	0.5335	0.5185	0.5005	0.4765	0.4450
230	0.6165	0.6090	0.6020	0.5930	0.5825	0.5670	0.5500	0.5290	0.5045	0.4720
240	0.6550	0.6465	0.6375	0.6285	0.6175	0.6000	0.5820	0.5590	0.5330	0.4990

	96	97	98	99
0	0.0265	...	...	...
10	0.0335	...	...	...
20	0.0420	0.0360	...	...
30	0.0505	0.0435	...	...
40	0.0620	0.0540	0.0405	...
50	0.0735	0.0640	0.0485	0.0225
60	0.0860	0.0740	0.0555	0.0260
70	0.1000	0.0860	0.0650	0.0305
80	0.1140	0.0980	0.0735	0.0345
90	0.1300	0.1110	0.0835	0.0395
100	0.1465	0.1250	0.0940	0.0450
110	0.1640	0.1400	0.1050	0.0515
120	0.1820	0.1555	0.1170	0.0575
130	0.2000	0.1715	0.1290	0.0645
140	0.2200	0.1880	0.1415	0.0710
150	0.2405	0.2060	0.1560	0.0785
160	0.2625	0.2235	0.1685	0.0870
170	0.2845	0.2430	0.1830	0.0935
180	0.3075	0.2630	0.1975	0.1015
190	0.3315	0.2825	0.2110	0.1090
200	0.3545	0.3020	0.2250	0.1180
210	0.3785	0.3230	0.2415	0.1255
220	0.4030	0.3445	0.2575	0.1340
230	0.4275	0.3655	0.2740	0.1425
240	0.4530	0.3885	0.2900	0.1525

At temperatures above 240° F., the pressure within the glass conductivity cell increased rapidly above atmospheric, and introduced a pressure dependent factor which was difficult to measure with the present equipment. All measurements reported here are for approximately one atmosphere standard pressure conditions.

The conductivity curve by Lange (1) is shown in Figure 1, on which are superimposed some points extrapolated from Table I for the temperature of 18° C. The agreement is generally quite good.

In Figure 2 is plotted a family of constant temperature curves of conductivity vs. concentration for the 0.5% to 5.0% region. The boiling and freezing point curves were initially obtained from the literature (2, 5), and these points were approached as closely as feasible consistent with risk of possible damage to the cell.

Figure 3 is a similar plot of constant temperature curves from 5% to 90% concentration, and shows clearly the double-humped characteristic of most of the constant temperature curves.

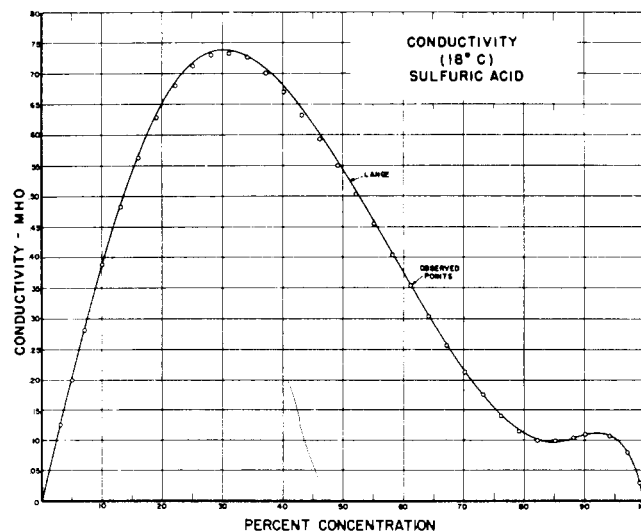


Figure 1. Conductivity of sulfuric acid vs. percent concentration at 18° C.

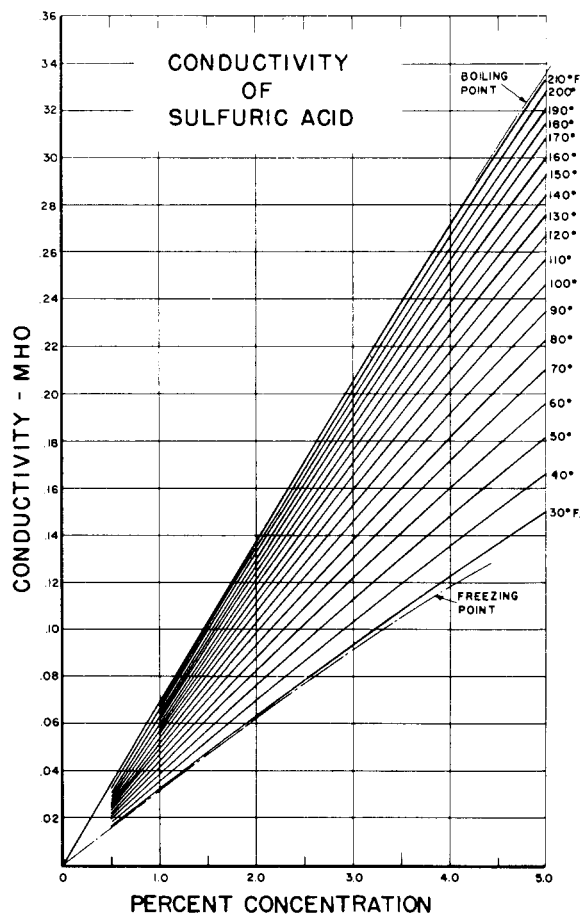


Figure 2. Constant temperature curves of conductivity vs. percent concentration (0.5% to 5.0%)

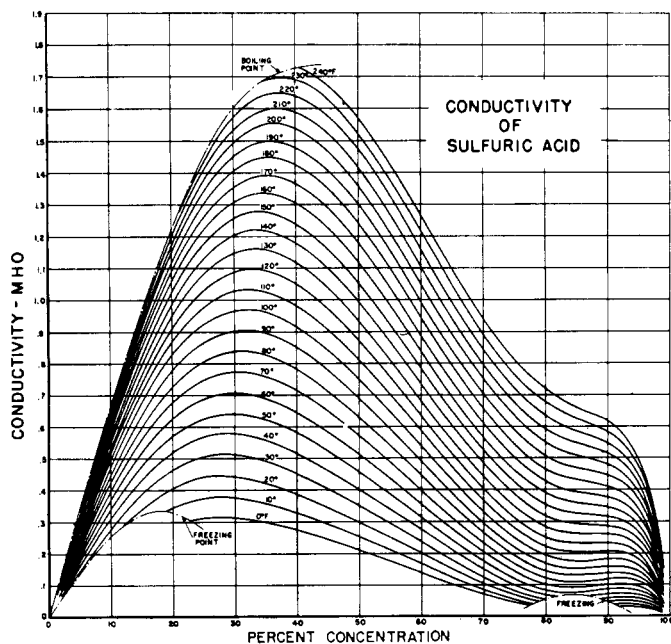


Figure 3. Constant temperature curves of conductivity vs. percent concentration (5.0% to 90%)

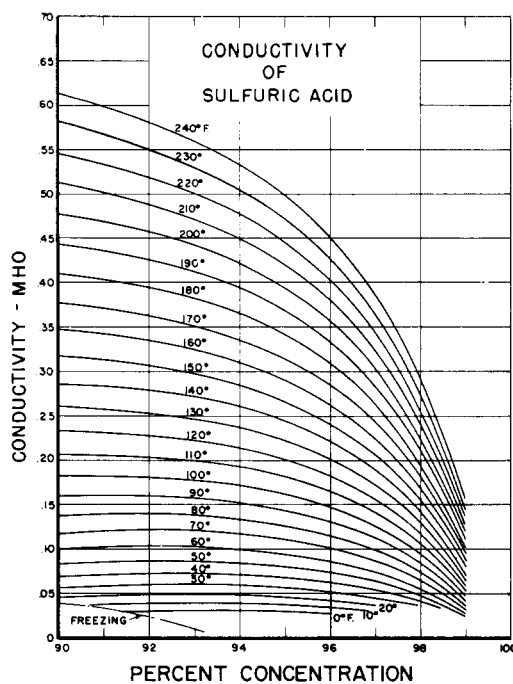


Figure 4. Constant temperature curves of conductivity vs. percent concentration (90.0% to 99.0%)

Figure 4 covers the remaining region from 90% to 99%. The graphs provide an over-all picture of the conductivity-concentration-temperature relationship, while Table I provides specific values for accurate concentration measurements.

Tabulated values are considered accurate to 0.1% for concentrations above 10%, and to 0.5% for concentrations below 10%.

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