

NATIONAL BUREAU OF STANDARDS REPORT

INSIDE THE COVER

GPO PRICE \$ _____

CFSTI PRICE(S) \$ _____

Hard copy (HC) 1.00

Microfiche (MF) 1.50

ff 653 July 65

Harold J. ...

FACILITY FORM 602

<p>N66 37275 (ACCESSION NUMBER)</p> <p># (PAGES)</p> <p>CL-78145 (NBSA CR OR TMX OR AD NUMBER)</p>	<p>(THRU)</p> <p>1 (CODE)</p> <p>06 (CATEGORY)</p>
---	--

NATIONAL BUREAU OF STANDARDS

NATIONAL BUREAU OF STANDARDS REPORT

NBS PROJECT

NBS REPORT

2110432

August 15, 1966

9394

ELECTROCHEMICAL DATA

Part III

by

Harold J. DeWane and Walter J. Hamer

Quarterly Report for period

April 1, 1966 to June 30, 1966

NASA Contract Number: R-09-022-029

IMPORTANT NOTICE

NATIONAL BUREAU OF STANDARDS REPORTS are usually preliminary or progress accounting documents intended for use within the Government. Before material in the reports is formally published it is subjected to additional evaluation and review. For this reason, the publication, reprinting, reproduction, or open-literature listing of this Report, either in whole or in part, is not authorized unless permission is obtained in writing from the Office of the Director, National Bureau of Standards, Washington 25, D.C. Such permission is not needed, however, by the Government agency for which the Report has been specifically prepared if that agency wishes to reproduce additional copies for its own use.



U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

Electrochemical Data

I. Introduction

This report gives the equivalent conductance of hydrochloric acid at 25°C at rounded concentrations between 1.0×10^{-4} and 11.6 N in absolute mhos. in table 1. The theoretical constants used were those given in Part I of this series of Reports. They were incorporated into the following empirical equation to evaluate the data over the whole range:

$$\Lambda = \Lambda_0 - Sc^{1/2} + Ec \log c + Ac + Bc^{3/2} + Cc^2 + Dc^{5/2}$$

This was rearranged for fitting to the following form,

$$\Lambda - (\Lambda_0 - Sc^{1/2} + Ec \log c) = Ac + Bc^{3/2} + Cc^2 + Dc^{5/2}$$

for the lower range of concentrations and altered to,

$$\Lambda - (\Lambda_0 - Sc^{1/2}) = Ac + Bc^{3/2} + Cc^2 + Dc^{5/2}$$

for the higher concentrations. It was necessary to divide the data into four concentration ranges to obtain reasonable least square fits. After the empirical coefficients were obtained from the fit, the theoretical terms were returned to the righthand side of the equation, and the equivalent conductance computed at the various round concentrations. As the concentration decreases the equation reduces to the Fuoss-Onsager-Accascina equation.¹

¹R. M. Fuoss and F. Accascina, *Electrolytic Conductance*, Interscience Publishers, Inc., pp. 191-205, 1959.

TABLE 1 - Equivalent electrolytic conductance of hydrochloric acid at 25°C

c	Λ	c	Λ	c	Λ	c	Λ
0.0001	424.5	0.08	393.8	2.4	263.2	6.8	121.1
.0002	423.8	.09	392.4	2.5	258.9	7.0	116.9
.0003	423.3	.1	391.1	2.6	254.5	7.2	112.8
.0004	422.9	.2	381.1	2.7	250.2	7.4	108.9
.0005	422.5	.3	373.5	2.8	246.0	7.6	105.2
.0006	422.2	.4	366.9	2.9	241.8	7.8	101.6
.0007	421.9	.5	360.7	3.0	237.6	8.0	98.2
.0008	421.7	.6	354.8	3.2	229.8	8.2	94.9
.0009	421.4	.7	349.0	3.4	222.1	8.4	91.8
.001	421.2	.8	343.3	3.6	214.5	8.6	88.8
.002	419.3	.9	337.7	3.8	207.2	8.8	85.9
.003	417.9	1.0	332.2	4.0	200.0	9.0	83.1
.004	416.7	1.1	326.7	4.2	193.1	9.2	80.4
.005	415.7	1.2	321.4	4.4	186.4	9.4	77.9
.006	414.8	1.3	316.1	4.6	179.8	9.6	75.4
.007	414.0	1.4	310.9	4.8	173.5	9.8	73.0
.008	413.2	1.5	305.8	5.0	167.4	10.0	70.7
.009	412.5	1.6	300.8	5.2	161.4	10.2	68.5
.01	411.9	1.7	295.8	5.4	155.7	10.4	66.3
.02	407.1	1.8	290.9	5.6	150.2	10.6	64.2
.03	403.7	1.9	286.1	5.8	144.9	10.8	62.2
.04	401.0	2.0	281.4	6.0	139.7	11.0	60.2
.05	398.9	2.1	276.8	6.2	134.8	11.2	58.5
.06	397.0	2.2	272.2	6.4	130.0	11.4	56.4
.07	395.3	2.3	267.7	6.6	125.5	11.6	54.1

Concentration Range: 0.0001 - 0.01 N

$$\Lambda = \Lambda_0 - Sc^{1/2} + Ec \log c + Ac - Bc^{3/2}$$

$$\Lambda = 426.06 - 158.63 c^{1/2} + 206.31 c \log c + 816.29 c - 2357.1 c^{3/2}$$

Standard Deviation 0.05

Murr B. L., Jr. and Shiner V. J., Jr., JACS, 84, 4672 (1962)

Owen B. B. and Sweeton F. H., JACS, 63, 2811 (1941)

Saxton B. and Langer T. W., JACS, 55, 3638 (1933)*

Shedlovsky T., JACS, 54, 1411 (1932)*

Stokes R. H., J. Phys. Chem., 65, 1242 (1961)

Concentration Range: 0.01 - 0.1 N

$$\Lambda = \Lambda_0 - Sc^{1/2} + Ac + Bc^{3/2} - Cc^2$$

$$\Lambda = 426.06 - 158.63 c^{1/2} + 173.11 c + 43.515 c^{3/2} - 345.46 c^2$$

Standard Deviation 0.14

Hlasko M., J. chim. phys., 26, 125 (1929)*

Owen B. B. and Sweeton F. H., JACS, 63, 2811 (1941)

Ruby C. E. and Kwai J., JACS, 48, 1119 (1926)*

Saxton B. and Langer T. W., JACS, 55, 3638 (1933)*

Shedlovsky T., JACS, 54, 1411 (1932)*

Stokes R. H., J. Phys. Chem., 65, 1242 (1921)

Concentration Range: 0.1 - 3.0 N

$$\Lambda = \Lambda_0 - Sc^{1/2} + Ac - Bc^{3/2} + Cc^2 - Dc^{5/2}$$

$$\Lambda = 426.06 - 158.63 c^{1/2} + 221.501 c - 252.771 c^{3/2} + 115.606 c^2 - 19.5824 c^{5/2}$$

Standard Deviation 0.10

Klochko M. A. and Kurbanov M. Sh., Akad. nauk SSSR, Izvest. sek. Fiz-Khim.,
analiza, 24, 237 (1954)

*Data adjusted to Jones and Bradshaw standard.

Owen B. B. and Sweeton F. H., JACS, 63, 2811 (1941)

Stokes R. H., J. Phys. Chem., 65, 1242 (1961)

Concentration Range: 3.0 - 11.6 N

$$\Lambda = \Lambda_0 - Sc^{1/2} + Ac - Bc^{3/2} + Cc^2 - Dc^{5/2}$$

$$\Lambda = 426.06 - 158.63 c^{1/2} + 143.554 c - 116.628 c^{3/2} + 35.2535 c^2 - 3.56231 c^{5/2}$$

Standard Deviation 0.15

Hlasko M., J. chim. phys., 26, 125 (1929)*

Howell O. R. J. Chem. Soc., 162 (1929)*

Klochko M. A. and Kurbanov M. Sh., Akad. nauk SSSR, Izvest. sek., Fiz-Khim., analiza, 24, 237 (1954)

Owen B. B. and Sweeton F. H., JACS, 63, 2811 (1941)

II. Λ_0 and J of Hydrochloric Acid at 25°C

Data obtained at low concentrations were used to determine values of Λ_0 and J, following the procedure given by Fuoss and Accasina on page 200 of "Electrolytic Conductance" and least square fits on the IBM 7090 computer. The results are given in the following table.

TABLE 2 - Values of Λ_0 and J of hydrochloric acid at 25°C

Author	Λ_0	Dev.	J	Dev.	Std. Dev.	Measurements
Shedlovsky	426.00	0.07	659.20	47.62	0.16	11
Saxton & Langer	426.35	.08	581.31	15.91	.17	10

*Data adjusted to Jones and Bradshaw standard.

TABLE 2 (continued)

Author	Λ_0	Dev.	J	Dev.	Std. Dev.	Measurements
Owen & Sweeton	426.55	.07	528.69	12.01	.07	5
Murr & Shiner	426.06	.02	636.10	36.62	.04	20
Stokes	426.40	.04	543.98	7.11	.08	9

III. Results at other Temperatures

Data on the equivalent conductance of hydrochloric acid at temperatures from -20 to 65°C are being studied and the results will be given in a subsequent report.