

Notes on the Normalities of Standard Solutions.

By

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In volumetric analysis, much attention is usually not paid to the change of the normality of standard solutions by variation of room temperature, but as the exactness of a volume measurement with a pipette is about 0.5% of its content, and with a measuring flask, the error may be less than that amount,¹⁾ it is possible to increase the exactness of a volumetric analysis by applying a proper correction to the change of normality by variation of room temperature, if the latter causes any more change in the former than the extent of the said exactness of measurement. For this correction, P. Casamajor²⁾ put the change of standard solutions to be equal to that of pure water. As this, however, is not applicable to all standard solutions, A. Schultze³⁾ measured the thermal expansion of various standard solutions by the dilatometer method at every fifth degree from 5° to 30°. He put the volume at 0° as 1.0000000 and estimated graphically the volume at each temperature from 0° to 30°. He took the temperature of 17.5° as the standard temperature, and taking the thermal expansion of glass also into consideration, calculated the volume of water to be added to the normal solution prepared at room temperature to make it exactly normal at the standard temperature.

¹ Ostwald-Luther, Hand- und Hilfsbuch z. Ausf. physiko-chemi. Messungen, 3. Aufl., 166, 176.

² Chem. News, 35, 1160 (1877).

³ Zs. anal. Chem., 21, 167 (1882).

Then Schlösser¹ using Schultze's data, taking 15° and also 20° as the standard temperatures, worked out a table to show how much greater or less a given volume is at different temperatures than it would be at the standard temperatures.

K. Inamura² measured the densities of some standard solutions, by using a Sprengel-Ostwald pyknometer, at every fifth degree from 5° to 35° and taking 20° as the standard temperature, calculated the normalities at other temperatures which would be exactly normal at the standard temperature.

Now, the writer has calculated new tables, practically convenient, using the data given by Schultze and by Inamura, and taking as the standard temperature 15°, 20°, and 25° successively.

Let d be the density of a solution at the standard temperature t and d' be that at another temperature t' , then a normal solution at t would be d'/d normal at t' . The ratio d'/d for different solutions, referring to the three standard temperatures, is given in Column I of Tables I to 16.

For the correction of the thermal expansion of glass the capacity of a glass vessel was taken to be calibrated for that volume named on it at 15°, and the cubical expansion coefficient of glass to be 0.000029. A normal solution at t is d'/d normal at t' and the capacity of a litre-flask at that temperature is 1 litre \times (1 + 0.000029 ($t-15$)). Thus the amount of the solute required for the preparation of its normal solution at t , which would be exactly normal at t , is not 1 gram-equivalent, but (1 + 0.000029 ($t-15$)) d'/d . This value is given in Column II of Tables I to 16 for each of the three standard temperatures.

In these tables, the normality of all standard solutions at the respective standard temperatures was denoted by 1.00000; so in the case of decinormal solutions, the values given in the tables are to be divided by 10, and in the case of centinormal solutions by 100. For comparison a similar table was constructed for pure water. The tables marked* are based on Inamura's data and all the others on Schulze's.

¹ Chem. Zg., 29, 509 (1905).

² Report, No. 59 (1917) of the Kure Naval Explosive Research Laboratory, communicated by T. Nakatani.

TABLE I.
Oxalic Acid : Normal.

Standard temp. Temp.	15°		25°		25°	
	I	II	I	II	I	II
5°	1.00160	1.00131	1.00279	1.00250	1.00422	1.00393
6	149	123	267	241	411	385
7	137	114	255	232	399	375
8	124	103	242	222	386	365
9	110	92	228	211	372	354
10	95	80	213	198	356	342
11	78	66	196	185	340	328
12	60	51	178	170	322	313
13	41	35	159	153	302	297
14	21	18	139	136	282	279
15	1.00000	1.00000	118	118	262	262
16	0.99978	0.99981	96	99	239	242
17	955	960	73	79	216	222
18	931	940	50	58	193	201
19	907	919	25	37	169	180
20	882	896	1.00000	1.00014	143	158
21	854	872	0.99973	0.99990	116	133
22	828	848	946	966	89	109
23	799	822	917	940	60	83
24	769	795	887	913	30	56
25	739	768	857	886	1.00000	0.99990
26	708	740	826	858	0.99969	1.00001
27	677	712	795	830	938	0.99973
28	646	683	764	801	906	944
29	613	654	731	771	874	914
30	580	623	698	741	840	884

TABLE 2.*
Oxalic Acid : $\frac{1}{10}$ Normal.

Standard temp. Temp.	15°		20°		25°	
	I	II	I	II	I	II
5°	1.00078	1.00049	1.00161	1.00132	1.00270	1.00241
6	74	48	158	131	267	240
7	68	46	152	130	263	238
8	62	43	147	127	256	234
9	55	40	140	123	249	230
10	49	35	132	120	242	227
11	40	30	124	114	234	222
12	30	24	115	109	224	216
13	21	18	105	102	214	209
14	10	10	95	94	203	201
15	1.00000	1.00000	83	83	192	192
16	0.99985	0.99990	67	73	180	181
17	970	978	51	60	164	170
18	954	964	35	47	146	155
19	936	949	18	33	128	140
20	918	931	1.00000	1.00015	109	124
21	897	913	0.99980	0.99998	87	107
22	876	897	959	982	66	90
23	854	880	937	962	44	70
24	831	860	914	943	22	50
25	806	837	891	920	1.00000	0.99990
26	782	814	866	900	0.99974	1.00006
27	756	792	840	880	948	0.99983
28	730	770	813	854	921	960
29	702	744	785	830	894	936
30	674	713	757	801	866	910

TABLE 3.
Hydrochloric Acid : Normal.

Temp.	Standard temp.	15°		20°		25°	
		I	II	I	II	I	II
5°		1.00153	1.00124	1.00264	1.00235	1.00395	1.00366
6		142	116	253	227	385	359
7		131	108	242	219	374	350
8		118	098	229	209	361	340
9		103	087	215	197	346	329
10		089	075	200	185	331	317
11		073	062	184	172	315	304
12		056	048	167	158	298	290
13		038	034	149	143	280	275
14		020	017	130	127	261	259
15		1.00000	1.00000	111	111	242	242
16		0.99980	0.99983	090	093	221	224
17		958	964	069	074	200	206
18		936	944	046	055	177	186
19		913	924	023	035	154	166
20		890	904	1.00000	015	131	146
21		865	882	0.99975	0.99993	106	124
22		841	861	951	971	082	102
23		814	838	925	948	056	079
24		787	813	898	924	029	055
25		759	788	869	898	1.00000	029
26		730	761	840	872	0.99971	1.00003
27		700	735	811	845	942	0.99976
28		670	708	780	818	911	949
29		639	679	749	789	880	920
30		608	651	718	761	849	892

TABLE 4.
Nitric Acid : Normal.

Temp.	Standard temp.	15°		20°		25°	
		I	II	I	II	I	II
5°		1.00227	1.00198	1.00371	1.00342	1.00534	1.00504
6		209	183	353	327	516	489
7		189	166	333	310	496	473
8		168	148	312	292	475	455
9		147	130	291	274	454	436
10		125	110	269	254	431	416
11		102	090	246	234	408	396
12		077	069	221	212	384	375
13		052	046	196	190	358	352
14		026	023	170	167	332	329
15		1.00000	1.00000	144	144	306	306
16		0.99973	0.99975	116	119	279	281
17		945	950	088	094	251	256
18		916	925	059	068	222	230
19		886	898	030	041	192	204
20		857	871	1.00000	1.00014	162	177
21		826	844	0.99970	0.99987	132	149
22		795	815	938	958	100	120
23		762	785	905	928	067	090
24		729	755	872	898	034	060
25		695	724	838	867	1.00000	1.00029
26		660	692	803	835	0.99965	0.99996
27		624	659	767	802	929	964
28		588	626	731	768	893	930
29		551	592	694	735	856	897
30		516	559	658	702	820	863

TABLE 5.
Sulphuric Acid : Normal.

Temp.	Standard temp.	15°		20°		25°	
		I	II	I	II	I	II
5°		1.0221	1.00192	1.00365	1.00336	1.00526	1.00496
6		204	178	348	322	508	482
7		185	162	328	305	489	465
8		165	144	309	288	469	448
9		144	126	287	270	448	430
10		122	108	266	251	426	411
11		099	088	243	232	403	392
12		076	067	220	211	380	371
13		051	045	195	189	355	349
14		026	023	169	166	329	327
15		1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
16		0.99972	0.99975	0.99970	0.99987	0.99966	0.99997
17		945	951	089	095	249	255
18		916	925	060	068	220	228
19		887	899	031	042	191	202
20		857	871	1.00000	1.00015	160	174
21		827	844	0.99970	0.99987	130	147
22		796	816	939	960	099	119
23		764	788	907	931	067	091
24		731	757	874	900	034	060
25		697	726	840	869	1.00000	1.00029
26		663	694	805	837	0.99966	0.99997
27		627	662	770	805	929	964
28		590	628	733	771	893	930
29		554	594	697	737	856	897
30		516	559	659	702	818	862

TABLE 6.
Sodium Carbonate : Normal.

Temp.	Standard temp.	15°		20°		25°	
		I	II	I	II	I	II
5°		1.00230	1.00201	1.00374	1.00345	1.00534	1.00505
6		211	185	355	329	515	489
7		191	168	334	311	494	471
8		169	149	313	292	472	452
9		147	130	291	273	450	433
10		125	110	268	253	428	413
11		101	089	244	233	404	392
12		077	068	220	211	380	371
13		053	047	196	190	355	349
14		026	024	170	167	329	326
15		1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
16		0.99973	0.99976	0.99969	0.99987	0.99966	0.99997
17		945	951	088	094	247	253
18		916	925	059	068	219	227
19		887	899	030	041	189	201
20		857	872	1.00000	1.00014	159	174
21		826	844	0.99969	0.99987	129	146
22		795	816	938	958	097	118
23		764	787	907	930	066	089
24		733	758	875	901	034	060
25		698	727	841	870	1.00000	1.00029
26		664	696	807	840	0.99966	0.99997
27		630	665	773	807	982	966
28		595	632	737	775	896	934
29		558	599	701	741	860	900
30		521	564	664	707	822	866

TABLE 7.*
Sodium Carbonate : $\frac{1}{10}$ Normal.

Temp.	15°		20°		25°	
	I	II	I	II	I	II
5°	1.00095	1.00065	1.00177	1.00148	1.00287	1.00258
6	90	63	172	146	281	256
7	84	60	166	142	275	252
8	76	56	159	138	269	248
9	67	50	151	132	260	243
10	58	44	141	126	251	236
11	49	38	132	119	241	229
12	38	30	120	111	230	220
13	26	20	109	103	219	211
14	13	10	096	094	205	202
15	1.00000	1.00000	082	082	192	192
16	0.99986	0.99990	069	070	177	181
17	971	978	053	059	161	170
18	955	964	037	046	145	155
19	938	949	019	031	128	140
20	918	932	1.00000	1.00015	110	124
21	897	916	0.99980	0.99999	090	108
22	876	899	959	982	070	091
23	854	880	936	962	049	072
24	831	860	914	941	025	051
25	808	837	890	919	1.00000	029
26	782	812	865	898	0.99975	1.00006
27	756	791	840	875	950	0.99983
28	730	769	813	851	924	960
29	703	745	785	826	896	935
30	675	718	757	800	866	910

TABLE 8.
Sodium Hydroxide : Normal.

Temp.	15°		20°		25°	
	I	II	I	II	I	II
5°	1.00245	1.00216	1.00393	1.00364	1.00559	1.00530
6	224	198	372	346	538	512
7	202	179	350	327	516	492
8	180	159	327	307	493	473
9	155	138	303	286	469	452
10	131	116	279	264	445	430
11	107	095	255	243	421	409
12	081	073	229	221	395	386
13	055	050	203	197	369	363
14	028	025	176	173	341	339
15	1.00000	1.00000	148	148	313	313
16	0.99972	0.99975	120	123	285	288
17	944	949	091	097	257	263
18	914	923	062	070	227	236
19	884	895	032	043	197	209
20	852	867	1.00000	1.00015	165	180
21	821	839	0.99969	0.99986	134	152
22	789	809	937	957	102	122
23	756	779	903	926	068	091
24	722	748	869	895	034	060
25	688	716	835	864	1.00000	1.00029
26	653	685	801	832	0.99966	0.99997
27	617	652	765	799	930	964
28	582	619	729	766	894	931
29	546	586	693	733	858	898
30	508	551	655	698	819	863

TABLE 9.
Sodium Chloride : $\frac{1}{10}$ Normal.

Temp.	15°		20°		25°	
	I	II	I	II	I	II
5°	1.00108	1.00078	1.00201	1.00172	1.00321	1.00291
6	102	75	196	170	315	289
7	095	72	189	165	308	285
8	087	72	180	160	300	279
9	077	66	171	153	290	273
10	067	60	160	146	280	265
11	056	52	149	137	269	257
12	043	44	137	128	256	248
13	030	35	123	118	243	237
14	016	24	109	106	229	226
15	1.00000	1.00013	093	093	213	213
16	0.99984	0.99987	077	080	196	199
17	966	971	059	065	178	184
18	946	955	040	049	159	168
19	927	938	021	032	140	151
20	907	921	1.00000	1.00015	119	134
21	888	906	0.99982	0.99999	101	118
22	861	882	955	975	074	094
23	838	861	931	954	050	074
24	813	839	906	932	025	051
25	788	817	881	910	1.00000	029
26	761	792	857	888	0.99973	1.00005
27	732	767	826	860	945	0.99979
28	703	741	796	834	915	953
29	672	713	766	806	884	925
30	642	685	735	778	854	897

TABLE 10.
Sodium Chloride : $\frac{1}{100}$ Normal.

Temp.	15°		20°		25°	
	I	II	I	II	I	II
5°	1.00089	1.00060	1.00178	1.00149	1.00295	1.00265
6	85	59	174	148	290	264
7	80	57	169	146	285	262
8	75	55	164	143	280	260
9	69	51	158	140	274	256
10	61	46	150	135	266	251
11	51	40	140	128	256	245
12	40	31	129	120	245	236
13	28	22	117	111	233	227
14	15	12	103	100	220	217
15	1.00000	1.00000	1.00089	089	205	205
16	0.99985	0.99988	74	077	190	193
17	969	974	57	063	173	179
18	950	958	39	047	155	164
19	931	942	20	031	136	147
20	911	926	1.00000	1.00015	116	131
21	890	907	0.99978	0.99996	094	112
22	868	888	956	976	072	093
23	845	868	933	957	050	073
24	821	847	909	936	026	052
25	796	824	884	913	1.00000	029
26	769	800	857	889	0.99973	1.00005
27	740	774	828	863	944	0.99979
28	710	748	798	836	914	952
29	680	720	768	809	884	925
30	649	693	738	781	853	897

TABLE I I.
Silver Nitrate : $\frac{1}{10}$ Normal.

Temp.	15°		20°		25°	
	I	II	I	II	I	II
5°	1.00105	1.00076	1.00202	1.00173	1.00321	1.00292
6	099	73	196	170	315	289
7	093	69	189	166	309	286
8	085	65	182	161	301	281
9	077	60	174	156	294	276
10	068	53	164	150	284	269
11	056	44	153	141	272	260
12	044	35	141	132	260	251
13	031	25	128	122	247	241
14	016	13	113	110	232	229
15	1.00000	1.00000	097	097	216	216
16	0.99983	0.69986	080	083	199	202
17	965	971	062	068	181	187
18	946	954	042	051	162	170
19	925	937	022	033	141	153
20	904	918	1.00000	1.00015	119	134
21	882	900	0.99979	0.99996	098	116
22	859	880	956	976	075	096
23	835	859	932	955	051	076
24	811	837	907	933	027	053
25	784	813	881	910	1.00000	029
26	757	789	854	885	0.99973	1.00005
27	730	764	826	861	945	0.99980
28	700	737	796	833	915	953
29	670	710	766	807	885	926
30	640	683	737	780	856	899

TABLE I 2.
Silver Nitrate : $\frac{1}{100}$ Normal.

Temp.	15°		20°		25°	
	I	II	I	II	I	II
5°	1.00089	1.00059	1.00177	1.00148	1.00294	1.00265
6	86	60	175	148	291	265
7	82	58	170	147	287	263
8	76	55	164	144	281	260
9	69	52	158	140	274	257
10	60	46	149	134	266	251
11	50	39	139	127	255	244
12	39	31	128	119	244	236
13	28	22	116	111	233	227
14	15	12	104	101	220	217
15	1.00000	1.00000	089	089	205	205
16	0.99984	0.99987	073	076	189	192
17	968	973	056	062	172	178
18	950	958	038	047	155	163
19	931	942	020	031	136	147
20	911	926	1.00000	1.00015	116	131
21	891	908	0.99979	0.99997	095	113
22	868	888	956	977	073	093
23	846	869	934	957	050	074
24	821	847	909	935	025	051
25	795	824	884	913	1.00000	029
26	770	801	858	890	0.99974	1.00006
27	742	777	831	865	947	0.99981
28	715	752	803	841	919	957
29	686	726	774	815	890	931
30	655	698	743	787	859	903

TABLE 13.
Potassium Permanganate : $\frac{1}{10}$ Normal.

Temp.	Standard temp.		15°		20°		25°	
	I	II	I	II	I	II	I	II
5°	1.00096	1.00069	1.00193	1.00164	1.00312	1.00283		
6	93	67	187	161	307	281		
7	89	66	183	160	302	279		
8	82	62	176	156	295	275		
9	74	57	168	151	288	270		
10	65	51	159	145	279	264		
11	54	43	149	137	268	256		
12	42	34	137	128	256	247		
13	29	23	123	117	243	237		
14	15	12	109	106	228	225		
15	1.00000	1.00000	0.94	0.94	213	213		
16	0.99984	0.99986	0.78	0.80	197	200		
17	966	972	0.60	0.66	179	185		
18	947	955	0.41	0.49	160	169		
19	927	938	0.21	0.32	140	151		
20	906	921	1.00000	1.00015	119	134		
21	885	902	0.99979	0.99996	0.98	115		
22	862	882	956	976	0.75	0.95		
23	838	861	932	955	0.51	0.74		
24	813	839	907	933	0.26	0.52		
25	787	816	881	910	1.00000	0.29		
26	760	792	854	886	0.99973	1.00005		
27	732	766	826	861	945	0.99980		
28	703	741	797	835	916	953		
29	674	714	767	808	886	927		
30	643	686	737	780	856	899		

TABLE 14.
Potassium Permanganate : $\frac{1}{100}$ Normal.

Temp.	Standard temp.		15°		20°		25°	
	I	II	I	II	I	II	I	II
5°	1.00087	1.00058	1.00181	1.00151	1.00294	1.00264		
6	84	58	178	151	291	264		
7	80	57	173	150	286	263		
8	75	55	168	148	283	263		
9	68	51	161	144	274	257		
10	60	46	154	139	266	252		
11	51	39	143	132	256	245		
12	40	31	133	124	246	237		
13	28	23	121	116	234	229		
14	15	12	108	105	220	218		
15	1.00000	1.00000	0.93	0.93	206	206		
16	0.99983	0.99986	0.76	0.79	189	192		
17	966	971	0.58	0.64	171	177		
18	947	956	0.40	0.49	153	162		
19	928	939	0.20	0.32	133	145		
20	907	922	1.00000	1.00015	113	127		
21	886	904	0.99979	0.99996	0.92	109		
22	864	885	957	977	0.70	0.90		
23	842	865	935	958	0.48	0.71		
24	819	845	912	937	0.24	0.50		
25	795	823	887	916	1.00000	0.29		
26	769	801	862	894	9.99975	1.00006		
27	742	777	835	870	947	0.99982		
28	713	751	806	843	918	956		
29	684	724	777	817	889	930		
30	653	696	745	789	858	901		

TABLE 15.
Ammonium Thiocyanate : $\frac{1}{10}$ Normal.

Temp.	Standard temp.		15°		20°		25°	
	I	II	I	II	I	II	I	II
5°	1·00104	1·00075	1·00199	1·00170	1·00322	1·00292		
6	100	74	194	168	317	291		
7	093	70	188	165	311	287		
8	086	66	181	161	304	283		
9	078	61	173	155	295	278		
10	068	53	163	148	285	271		
11	057	45	151	140	274	262		
12	044	36	139	130	261	253		
13	031	25	125	119	248	242		
14	016	13	111	108	233	230		
15	1·00000	1·00000	094	094	217	217		
16	0·99983	0·99986	078	081	200	203		
17	966	972	060	066	183	189		
18	946	955	040	049	163	172		
19	926	937	021	032	143	154		
20	906	920	1·00000	1·00015	122	137		
21	883	900	0·99977	0·99995	100	117		
22	860	880	954	974	076	097		
23	835	858	930	953	052	075		
24	810	836	904	930	027	053		
25	783	812	878	907	1·00000	029		
26	756	788	851	882	0·99973	1·00005		
27	728	763	822	857	945	0·99979		
28	699	737	793	831	916	953		
29	669	710	764	804	886	926		
30	639	683	734	777	856	899		

TABLE 16.
Water.

Temp.	Standard temp.		15°		20°		25°	
	I	II	I	II	I	II	I	II
5°	1·00083	1·00054	1·00174	1·00144	1·00288	1·00259		
6	81	55	171	145	286	260		
7	77	54	168	144	282	259		
8	73	52	163	143	277	257		
9	66	49	157	139	271	254		
10	59	44	149	134	263	249		
11	49	38	140	128	254	243		
12	39	30	129	120	244	235		
13	27	21	117	112	232	226		
14	14	11	104	101	219	216		
15	1·00000	1·00000	090	090	205	205		
16	0·99984	0·99987	074	077	189	192		
17	968	974	058	064	173	178		
18	949	958	040	048	154	163		
19	930	941	020	032	134	146		
20	910	924	1·00000	1·00015	114	129		
21	889	906	0·99974	0·99996	093	111		
22	867	887	957	977	071	092		
23	844	867	934	957	048	071		
24	820	846	911	937	025	051		
25	796	825	886	915	1·00000	029		
26	770	802	860	892	0·99974	1·00006		
27	744	779	834	869	948	0·99983		
28	717	754	807	844	921	958		
29	689	729	779	819	893	934		
30	661	704	751	794	864	908		

If we compare the normalities at the extreme temperatures for each of the standard temperatures, as reproduced in Table 17, it may be easily seen that the solutions, as to the change of the normality with temperature, may be divided into three groups.

TABLE 17.

Standard temp. Solution.	15°		20°		25°	
	5°	30°	5°	30°	5°	30°
Sodium hydroxide . . (n)	1.00245	0.99508	1.00393	0.99655	1.00550	0.99819
Sodium carbonate . . (n)	230	521	374	664	534	820
Nitric acid (n)	227	516	371	658	534	822
Sulphuric acid (n)	221	516	356	659	526	818
Oxalic acid (n)	1.00160	0.99580	1.00279	0.99698	1.00422	0.99840
Hydrochloric acid . . (n)	153	608	264	718	395	849
Sodium chloride (1/10-n)	1.00108	1.00642	1.00201	0.99735	1.00321	0.99854
Silver nitrate (n)	105	640	202	737	321	856
Amm. thiocyanate . . (n)	104	639	199	734	322	856
Potas. permanganate. (n)	096	643	193	737	312	856
Sodium carbonate . . (n)	095	675	177	757	237	866
Oxalic acid (n)	078	674	161	757	270	866
Sodium chloride (1/100-n)	089	649	178	738	295	853
Silver nitrate (n)	089	655	177	743	294	858
Potas. permanganate. (n)	087	653	181	745	294	858
Water (n)	083	661	174	751	288	864

As seen from Table 17, the normal solutions are to be divided into two groups according to the degree of change of the normality with temperature. In each group, the change of the normality with temperature for different solutions do not differ from one another more than 0.5%, but if we take the two groups together, the change of the normality may differ from one another more than 1%.

Table 18 represents the mean values of those of the two groups of the normal solutions. The greatest deviation of the values in this table from the corresponding values of each solution is 0.7%. Thus, this table may be used for all normal solutions, if an error less than 0.7% is disregarded.

As to the decinormal and centinormal solutions, the change of volume with temperature may be taken as equal among themselves and also to the pure water, without any greater error than 0.5%.

TABLE 18.
Normal Solutions.

Standard temp. Temp.	15°		20°		25°	
	I	II	I	II	I	II
5°	1.0019	1.0016	1.0032	1.0029	1.0048	1.0044
6	18	15	32	28	46	43
7	16	15	29	28	44	42
8	15	13	28	25	42	41
9	13	11	26	24	41	39
10	11	09	24	22	39	38
11	09	08	22	21	38	36
12	07	06	20	19	35	34
13	05	04	18	17	32	32
14	02	02	16	15	30	30
15	1.0000	1.0000	13	13	28	28
16	0.9997	0.9998	11	11	25	26
17	95	96	08	09	23	24
18	93	94	05	07	20	21
19	90	91	03	04	18	19
20	87	89	1.0000	1.0002	15	16
21	84	86	0.9997	0.9999	12	14
22	81	83	94	96	09	11
23	78	80	91	94	06	09
24	75	78	88	91	03	06
25	72	75	85	88	1.0000	03
26	69	72	82	85	0.9997	1.0000
27	66	69	79	82	94	0.9997
28	63	66	75	79	90	94
29	59	63	72	76	87	91
30	56	60	68	73	83	88

TABLE 19.
Decinormal and Centinormal Solutions.

Standard temp. Temp.	15°		20°		25°	
	I	II	I	II	I	II
5°	1.0010	1.0007	1.0019	1.0016	1.0030	1.0027
6	10	7	18	16	30	27
7	09	7	18	16	29	27
8	08	6	17	15	29	27
9	07	6	16	15	28	27
10	06	5	15	14	27	26
11	05	4	14	13	26	25
12	04	3	13	12	25	24
13	03	2	12	11	24	23
14	01	1	10	10	23	22
15	1.0000	1.0000	09	09	21	21
16	0.9998	0.9999	07	07	19	19
17	97	98	06	06	18	18
18	95	96	04	05	16	18
19	93	95	02	03	14	16
20	91	93	1.0000	01	12	15
21	89	91	0.9998	0.9999	10	13
22	87	89	96	98	08	11
23	85	87	93	96	06	09
24	82	85	91	94	03	08
25	80	82	88	91	1.0000	05
26	77	80	85	89	0.9997	1.0003
27	74	78	83	87	95	0.9998
28	72	75	80	84	93	95
29	69	73	77	82	90	93
30	65	71	74	79	86	90

Table 19 gives the mean values of all the decinormal and centinormal solutions. The values in this table differ from the corresponding values of each of the solutions by 0.3% in extreme cases. Thus, this table is sufficient for all solutions, more dilute than decinormal.
