DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
George K. Burgess, Director

CIRCULAR OF THE BUREAU OF STANDARDS, No. 295

TEMPERATURE CORRECTIONS TO READINGS OF BAUMÉ HYDROMETERS, BUREAU OF STANDARDS BAUMÉ SCALE FOR SUGAR SOLUTIONS (STANDARD AT 20° C.)

January 16, 1926

PRICE 5 CENTS
Sold only by the Superintendent of Documents, Government Printing Office
Washington, D. C.

WASHINGTON
GOVERNMENT PRINTING OFFICE
1926

TEMPERATURE CORRECTIONS TO READINGS OF BAUMÉ HYDROMETERS, BUREAU OF STANDARDS BAUMÉ SCALE FOR SUGAR SOLUTIONS (STANDARD AT 20° C.)[1]

The Baumé scale is widely used in the sugar industry, particularly in connection with the sale of molasses and sirups, in preference to a true density determination. It seems to be the general practice to specify in the sales contract the Baumé of the molasses or sirup. In some instances the particular Baumé scale and the temperature are not specified in the contract. It is obvious that these should be stated. There have been a large number of different Baumé scales proposed and used since the original scale was devised by Antoine Baumé,[2] a French chemist, in 1768. Prof. C. F. Chandler, in a paper read before the National Academy of Sciences at Philadelphia [3] in 1881, gave an admirable review of the origin and history of the Baumé scales in use up to that time. This subject of Baumé scales has also been discussed in B. S. Circular No. 59.

In the determination of the Baumé of a very thick molasses by spindle it is obviously necessary to make the determination at a higher temperature than 20° C. Various temperatures between 38 and 60° C. are used. In some cases the spindle reading is corrected to the standard temperature, while in other cases no correction is applied. This condition has led to inaccuracies and misunderstandings.

In a number of instances in which the Bureau of Standards has acted as referee in disputes between the buyer and the seller of molasses the two contracting parties have accepted the Bureau of Standards Baumé scale for sugar solutions, proposed by Bates and Bearce.[4] This scale, which is standard at 20° C., is based on the specific gravity values of Plato [5] and on the modulus 145.

The table of Bates and Bearce lies between the "old" or "Holland" table and the "new" or "Gerlach" table, being in close agreement with the former up to about 13° and from that point on from 0.1 to 0.2° higher. A comparison of the differences in the three scales in the neighborhood of 42 Baumé is given in Table 1.

---

[1] Prepared by C. F. Snyder.

[2] Antoine Baumé, "Elements de Pharmacie," 8th ed.; 1797.

[3] Memoirs of National Academy of Sciences III, 3, part 1, pp. 63-71; 1884.

[4] B. S. Tech. Paper No. 115.

[5] F. Plato, Wiss. Abh. der Kaiserlichen Normal-Eichungs-Kommission 2, p. 153; 1900.

68516°—26†

TABLE 1.—*Corresponding degrees Baumé*

Bureau of Standards scale modulus 145	"Old" or "Holland" scale modulus 144	"New" or "Gerlach" scale modulus 146.78
40.00	39.9	40.6
41.00	40.8	41.6
42.00	41.8	42.6
43.00	42.8	43.6
44.00	43.8	44.6

It is recognized that a density determination by means of a spindle on a viscous liquid of the character of molasses is not capable of yielding results of high precision. However, the method has become so firmly fixed in trade practice that it does not seem feasible to discard it in favor of one of the more precise picnometer methods.

It has frequently been necessary for purposes of comparison in trade transactions to make determinations of the Baumé of molasses by spindle at various temperatures and correct the readings to the standard temperature of 20° C. Since no table of temperature corrections for Baumé hydrometers has heretofore been available it has been necessary to make the corrections as follows: The Baumé reading was converted to the equivalent in Brix; this Brix value was then corrected for temperature and finally converted back to the equivalent in Baumé. To eliminate this laborious method of correcting for temperature, Table 2 has been calculated. It is based on the values of the thermal expansion of sugar solutions of Plato,[6] assuming the instrument to be of Jena 16^{III} glass. The table is submitted as supplementary to the Baumé table of Bates and Bearce (Table 31, B. S. Circular No. 44) and the table of temperature corrections for Brix hydrometers (Table 11, B. S. Circular No. 44).

The calculations were checked by Miss E. E. Hill of the volumetric laboratory of this bureau.

[6] F. Plato, ibid, 2, p. 140; 1900.

TABLE 2.—*Temperature corrections to readings of Baumé hydrometers, Bureau of Standards Baumé scale for sugar solutions (standard at 20° C.)*

[This table is based on the values of the thermal expansion of sugar solutions by Plato, assuming the instrument to be of Jena 16^{III} glass. The table should be used with caution and only for approximate results when the temperature differs much from the standard or from the temperature of the surrounding air.]

Temperature (° C.)	Observed degrees Baumé								
	0	5	10	15	20	25	30	35	40
	Subtract from observed degrees Baumé								
0	0.17	0.34	0.47	0.57	0.65	0.72	0.77	0.79	0.81
5	.21	.30	.39	.45	.51	.55	.59	.60	.61
10	.18	.23	.28	.32	.36	.38	.40	.41	.42
11	.18	.22	.26	.29	.32	.34	.36	.37	.38
12	.17	.20	.23	.26	.29	.31	.32	.33	.34
13	.15	.18	.20	.23	.25	.27	.28	.29	.29
14	.14	.16	.18	.20	.22	.23	.24	.25	.25
15	.11	.13	.15	.17	.18	.20	.20	.21	.21
16	.10	.11	.13	.14	.15	.15	.16	.17	.17
17	.07	.08	.10	.11	.11	.11	.13	.13	.13
18	.05	.06	.07	.07	.08	.08	.08	.08	.09
19	.03	.03	.03	.03	.04	.04	.04	.04	.05
	Add to observed degrees Baumé								
21	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05
22	.06	.06	.07	.07	.08	.08	.08	.09	.09
23	.09	.09	.10	.11	.12	13	.13	.13	.13
24	.12	.13	.14	.15	.16	.17	.17	.17	.17
25	.15	.17	.18	.19	.20	.21	.21	.21	.21
26	.19	.20	.22	.22	.24	.26	.26	.26	.26
27	.23	.23	.25	.27	.29	.30	.30	.30	.30
28	.26	.27	.29	.31	.33	.34	.35	.35	.34
29	.31	.31	.34	.35	.37	.38	.39	.39	.38
30	.35	.35	.38	.39	.42	.43	.44	.43	.43
35	.56	.57	.60	.63	.65	.66	.66	.66	.65
40	.81	.82	.85	.87	.89	.90	.90	.89	.88
45	1.09	1.09	1.12	1.14	1.15	1.15	1.14	1.13	1.11
50	1.40	1.39	1.42	1.42	1.43	1.41	1.40	1.37	1.33
55	1.74	1.72	1.73	1.73	1.71	1.69	1.66	1.62	1.57
60	2.10	2.08	2.06	2.05	2.00	1.97	1.92	1.87	1.82
65	2.5	2.5	2.4	2.4	2.3	2.2	2.2	2.1	2.1
70	2.9	2.8	2.8	2.8	2.6	2.6	2.5	2.4	2.3
75	3.5	3.3	3.2	3.2	3.1	3.0	2.9	2.7	2.6
80	4.0	3.9	3.8	3.7	3.5	3.4	3.3	3.1	2.8