

SF 253

W6

SF 253
.W6
Copy 1

WEIGHTS AND MEASURES

Regulations Relating to Cream Test Scales and Bab-
cock Milk and Cream Test Bottles

Prescribed by

J. Q. EMERY,

Ex Officio State Superintendent of Weights and Measures

of

WISCONSIN

"Dairy and food commission."

ISSUED MARCH 3, 1914

SF 253
W6

D. OF D.
NOV 18 1914

STATE OF WISCONSIN

OFFICE OF

DAIRY AND FOOD COMMISSION AND WEIGHTS AND
MEASURES.

Madison, January 17, 1914.

To Wisconsin Sealers of Weights and Measures:

Subsection 6 of section 1659 of the Wisconsin statutes contains the following provision:

"The superintendent of weights and measurers shall issue from time to time, regulations for the guidance of all sealers, and the said regulations shall govern the procedure to be followed by the aforesaid officers in the discharge of their duties. In said regulations he shall prescribe the amount of tolerance to be allowed."

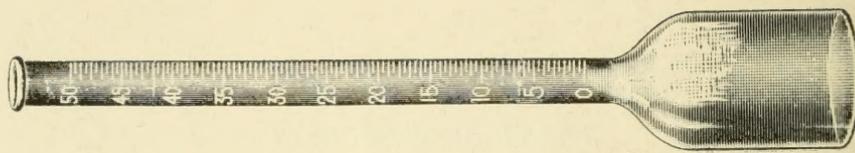
In obedience to the requirements of this statute, the following regulations are prescribed for the guidance of sealers of weights and measures in the performance of their official duties so far as the same relate to the subject of Babcock milk test bottles, standard Babcock pipettes, Babcock cream test bottles, and cream test and butter fat test scales.

BABCOCK MILK TEST BOTTLES.

Babcock milk test bottles complying with the following specifications shall be sealed:

The standard Babcock test bottles for milk shall have a capacity of two cubic centimeters for each 10 per cent marked on the necks thereof.

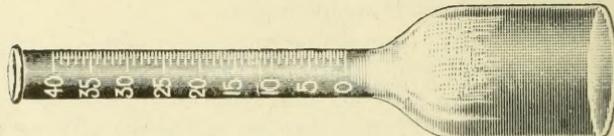
The necks of the standard Babcock milk test bottles shall be graduated from zero to 10 per cent and the graduated scale shall be 75 millimeters in length, with an allowable tolerance of 5 millimeters either above or below. The graduated scale shall be divided into per cent and fifth per cent divisions. The fifth per cent graduation marks shall be not less than 3 milli-



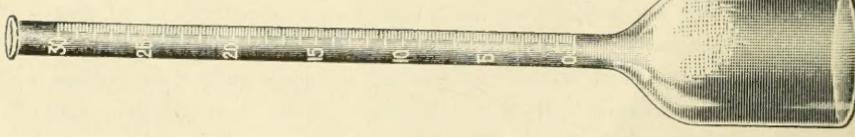
Type E.



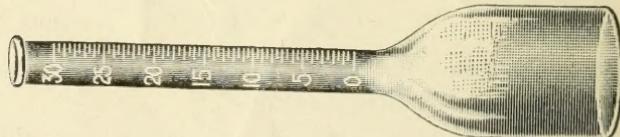
Type D.



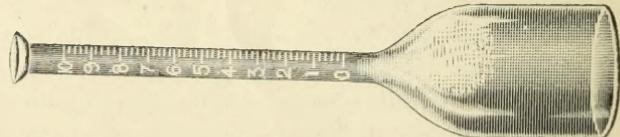
Type C.



Type B.



Type A.



Milk Test Bottle.

meters in length and the per cent graduation marks shall be not less than 1½ millimeters longer than the fifth per cent graduations. Each per cent graduation shall be numbered and the tolerance for the entire graduated scale or for any part thereof shall not exceed one-tenth of one per cent.

The necks shall be cylindrical for at least 5 millimeters below the lowest and above the highest graduation mark. The top of the necks shall be flared to an interior diameter of not less than 10 millimeters.

The capacity of the bulb up to the junction of the neck shall be not less than 40 cubic centimeters.

The total height of the bottle shall be between 150 and 165 millimeters.

Each bottle shall bear either a ground surface for identification number or a permanent identification number.

Subsection 1 of section 1494aa of the Wisconsin statutes provides as follows:

“In the use of the Babcock test, the standard milk measures or pipettes shall have a capacity of seventeen and six tenths cubic centimeters, and the standard test tubes or bottles for milk shall have a capacity of two cubic centimeters for each ten per cent marked on the necks thereof; cream shall be tested by weight and the standard unit for testing shall be eighteen grams, and it is hereby made a misdemeanor to use any other standards of milk or cream measure where milk or cream is purchased by or furnished to creameries or cheese factories and where the value of said milk or cream is determined by the per cent of butter fat contained in the same, or wherever the value of milk or cream is determined by the per cent of butter fat contained in the same by the Babcock test.”

Referring to the foregoing provisions of law and other laws prescribing the duties of the state superintendent of weights and measures, Attorney General Owen has rendered the following official opinion:

“The fact that the statute says that the standard test tubes or bottles shall have a capacity of two cubic centimeters for each 10 per cent marked on the necks thereof implies that the necks should have marked thereon the 10 per cent mark. I believe that a so-called milk test bottle having only 8 per cent mark on the neck is, therefore, not in compliance with the provision of this law and you are, therefore, instructed that you would not be warranted in approving the same.”

STANDARD BABCOCK PIPETTES.

The standard pipettes shall have a capacity of 17.6 cubic centimeters.

The total length of pipette shall be not more than 330 millimeters (13 $\frac{1}{4}$ inches).

The outside diameter of suction tube shall be 6 to 8 millimeters. The length of the suction tube shall be 130 millimeters. The outside diameter of the delivery tube shall be 4.5 to 5.5 millimeters. The length of the delivery tube shall be 100 to 120 millimeters. The distance of the graduation mark above the bulb shall be 30 to 60 millimeters. The nozzle shall be straight. When filled with water at 20° C. delivery shall be in 5 to 8 seconds. The tolerance shall not exceed .05 cubic centimeter.

A pipette having a capacity of 18 cubic centimeters or having any other capacity than that above specified, namely 17.6 cubic centimeters which is the only pipette that complies with the terms of the law, must not be sealed.

Note. Section 1494aa of the Wisconsin statutes contains the following provision:

“Cream shall be tested by weight and the standard unit for testing shall be eighteen grams, and it is hereby made a misdemeanor to use any other standards of * * * * cream measure where * * * * cream is purchased by or furnished to creameries or cheese factories and where the value of said * * * * cream is determined by the per cent of butter fat contained in the same, or wherever the value of * * * * cream is determined by the percent of butter fat contained in the same by the Babcock test.”

BABCOCK CREAM TEST BOTTLES.

Babcock cream test bottles of the following types and complying with the following specifications are to be sealed:

Type A. Thirty per cent, 18 gram, 6 inch, $\frac{1}{2}$ per cent graduations. Each 5 per cent on the neck of the bottle shall represent a volume of 1 cubic centimeter.

The neck of the bottle shall be graduated from zero to 30 per cent and the graduated scale shall be 75 millimeters in length, with an allowable tolerance of 8 millimeters above or below. The graduated scale shall be divided into 5

per cent, 1 per cent and $\frac{1}{2}$ per cent divisions. The $\frac{1}{2}$ per cent graduation marks shall be not less than 3 millimeters in length. The 1 per cent graduation marks shall be not less than $1\frac{1}{2}$ millimeters longer than the $\frac{1}{2}$ per cent graduations. The 5 per cent graduation marks shall be not less than $1\frac{1}{2}$ millimeters longer than the 1 per cent graduation marks. Each 5 per cent graduation shall be numbered. The allowable tolerance for calibration shall not exceed $\frac{1}{2}$ per cent for the entire graduated scale or for any part thereof.

The capacity of the bulb up to the junction of the neck shall be not less than 40 cubic centimeters.

Each bottle shall bear either a ground glass surface for identification number or a permanent identification number.

The neck shall be cylindrical for at least 5 millimeters below the lowest and above the highest graduation mark. The top of the neck shall be flared to an interior diameter of not less than 10 millimeters.

The standard unit for testing shall be 18 grams.

The total height of the bottle shall be between 150 and 165 millimeters ($5\frac{7}{8}$ and $6\frac{1}{2}$ inches).

Type B. Thirty per cent, 18 gram, 9 inch, .2 per cent graduations.

The neck of the bottle shall be graduated from zero to 30 per cent and the graduated scale shall be 125 millimeters in length, with an allowable tolerance of 10 millimeters either above or below. The graduated scale shall be divided into 5 per cent, 1 per cent and .2 per cent divisions. The .2 per cent graduation marks shall be not less than 3 millimeters in length. The 1 per cent and 5 per cent graduation marks shall be not less than 1.5 millimeters longer than the .2 per cent graduations. The allowable tolerance for calibration shall not exceed .2 per cent for the entire graduated scale or for any part thereof.

The total height of the bottle shall be between 210 and 225 millimeters ($8\frac{1}{4}$ and $8\frac{7}{8}$ inches).

All other specifications are to be the same as for *Type A*.

Type C. Forty per cent, 18 gram, 6 inch, $\frac{1}{2}$ per cent graduations.

The neck of the bottle shall be graduated from zero to 40 per cent and the graduated scale shall be 75 millimeters in length, with an allowable tolerance of 8 millimeters either above or below.

All other specifications are to be the same as for *Type A*.

Type D. Fifty per cent, 18 gram, 7 inch, $\frac{1}{2}$ per cent graduations.

The neck of the bottle shall be graduated from zero to 50 per cent and the graduated scale shall be 105 millimeters in length, with an allowable tolerance of 10 millimeters either above or below.

The total height of the bottle shall be between 180 and 195 millimeters ($7\frac{1}{8}$ and $7\frac{3}{4}$ inches).

All other specifications are to be the same as for *Type A*.

Type E. Fifty per cent, 18 gram, 9 inch, $\frac{1}{2}$ per cent graduations.

The neck of the bottle shall be graduated from zero to 50 per cent and the graduated scale shall be 125 millimeters in length, with an allowable tolerance of 10 millimeters either above or below.

The total height of the bottle shall be between 210 and 225 millimeters ($8\frac{1}{4}$ and $8\frac{7}{8}$ inches).

All other specifications are to be the same as for *Type A*.

Referring to the provisions of section 1494aa of the Wisconsin statutes hereinbefore quoted, Attorney General Owen has rendered the following official opinion relative to 9 gram cream test bottles:

"Under this statute it is provided that 'cream shall be tested by weight and the standard unit for testing shall be 18-grams and it is hereby made a misdemeanor to use any other standards of milk or cream measure,' etc. As 18 grams are expressly mentioned as the standard unit used in testing, and as no mention is made of a 9-gram standard unit, I am of the opinion that only the 18-gram cream test bottles can be used and the 9-gram cream test bottles should be condemned."

CREAM TEST AND BUTTER FAT TEST SCALES.

The scale shall be provided with a graduated plate of at least ten divisions over which the pointer plays.

The pointer shall reach to the graduated divisions and shall terminate in a fine point to enable the readings to be made clearly and distinctly.

The clear interval between the divisions on the graduated face shall not be less than .05 inch.

Beam scales and trip balances provided with knife edges and bearings shall be provided with leveling screws and an attached level.

The scale shall be so constructed and adjusted that when the pans are released or disturbed the pointer will return to rest at the zero mark.

The addition of 32.4 milligrams or one half grain to the scale when loaded to capacity shall cause a movement of the pointer at least equal to one division on the graduated face.

The tolerance either in excess or deficiency when the scale is fully loaded shall be one grain.

Weights. A tolerance of 20 milligrams is allowable in 18 gram weights and 10 milligrams in 9 gram weights. The manufacturers' tolerance shall be one half this amount.

Note. To avoid liability of penalty for violation of the weights and measures law by the use of any unsealed weight, scale, measure or measuring appliance of any description, including new appliances, or any such appliance that has not been sealed within one year, owners of the same should give notice in writing to the state superintendent of weights and measures, Madison, Wis., or to the city sealer if in a city having a city sealer of weights and measures, of the fact that they have such weight or measure or weighing or measuring device, giving a description of the same and its location. See subsection 3, section 4432 Wisconsin statutes.

J. L. Emery.

Dairy and Food Commissioner,
Ex officio State Superintendent of Weights and Measures.

OFFICE OF

DAIRY AND FOOD COMMISSION AND WEIGHTS AND MEASURES.

Madison, Wis., March 4, 1914.

To Cheese Factory and Creamery Managers, Cheese Makers and Butter Makers;:

Paragraph 3 of section 1659 of the Wisconsin statutes relating to weights and measures places a general supervision of all weights and measures and weighing or measuring devices of the state in the hands of the state superintendent of weights and measures. It further provides that he or his inspectors by his direction shall, upon the written request of any citizen, firm or corporation, or educational institution of the state, test or calibrate weights, measures, weighing or measuring devices, and instruments or apparatus used as standards in this state.

Under the provisions of this act, owners of creameries and cheese factories may send to the office of weights and measures at Madison, Wis. any Babcock milk, cream, or butter test bottles, any milk pipettes, and any scales or weights used in the weighing of cream samples, and the same will be tested. No fees are charged for testing. Many managers are now ordering their new supplies sent direct to the office of weights and measures for testing and sealing, thus insuring accuracy before being put to use, with little or no inconvenience. In sending in old glassware, it is best to send only part of the supply on hand at one time, as sometimes several weeks may elapse before the glassware can be returned.

In sending apparatus for testing and sealing the following rules should be complied with:

1. Address all packages to J. Q. Emery, Office of Weights and Measures, State Capitol, Madison, Wis.
2. The name and address of consignor should be placed on the outside of the package.
3. Transportation charges on packages should be prepaid.

4. If consignor desires package to be returned by parcel post, postage should be enclosed in letter to pay for return of same.
5. Bottles to be tested must be thoroughly cleaned before sending, so that all sediment or deposit on the inside of the bottles is removed. No tests will be made of glassware that is not thoroughly cleaned when submitted.
6. Extreme care should be exercised in packing such glassware or scales for shipment, as this department will not be responsible for breakage.

J. Q. EMERY,

Dairy and Food Commissioner,

Ex officio State Superintendent of *Weights and Measures.*

CREAM TEST SCALES AND BABCOCK TEST BOTTLES.

By F. P. DOWNING, Chief Inspector of Weights and Measures.

CREAM TEST SCALES.

Many articles have been published upon the testing of milk and cream by what is commonly known as the Babcock method. In obtaining the percent of milk fat by this means the operator starts with a known volume or weight of the sample, places it in a graduated milk or cream bottle, treats it with sulphuric acid and then after centrifuging or whirling the bottle a definite period, reads the percent of fat directly from the bottle. In making the above test, skill and experience are required to secure accurate results. But no matter how careful the operator may be, it will be impossible for him to get correct results if he is not provided with accurate glassware and sensitive and accurate scales.

In the past, the creameries of the state have been obliged to depend largely upon the advice of salesmen when ordering supplies and apparatus with which to work. This has resulted in the purchase of certain types of scales entirely unfit for the purpose for which they were purchased, and the use of such scales has been the cause of great errors and heavy losses.

There was a time when an 18 cc. cream pipette was considered sufficiently accurate to use in making cream determinations. But when it became known that such a pipette would deliver 17.9 grams of a 10% cream and only 15.8 grams of a 50% cream, the cream pipette was replaced by various types of cream test scales. The wide range in the specific gravity of cream showed the unreliability of the use of a pipette. Every intelligent creameryman is now aware of this. But it is not so generally known that errors approximately as great as those obtained through the use of the cream pipette may be obtained by the use of inaccurate and insensitive cream test scales.

The better class of books on the testing of cream give minute explanations to the operator concerning various ways in which

mistakes or errors in the reading of the fat content of the cream are produced, the proper temperature at which to take readings, the proper method of reading the meniscus, the strength of the acid to be used, and the number of revolutions made by the centrifuge. These and other essential details are described, but little or nothing has ever been published with regard to the errors that arise through the use of inaccurate cream test scales.

Investigation shows that many of the mistakes now made in the creameries in this state in the determining of the fat content of cream are due, not simply to the causes enumerated in the paragraph above, but to the use of scales of improper construction. Frequently creamerymen find themselves unable to obtain duplicate tests in the determination of the percent of cream. Frequently farmers send their cream to the state dairy and food commission, to the university, or to the county training schools for analysis and the results obtained differ from the readings given at the factory. In a number of instances, this difference has been found to be due to the use of cream scales that are not sufficiently sensitive.

For the purpose of determining what types of cream scales were the most accurate and the best adapted to weighing a nine or eighteen gram sample of cream, state inspectors of weights and measures were sent to various creameries of the state to inspect the scales in use and to check up the weights obtained upon such scales by the creamerymen. The butter-maker at the creamery was asked to weigh a given number of samples of cream on his scale, following the methods pursued by him in his daily work at the factory. In practically every instance, greater than usual care was taken in making the weighings. The bottles containing the samples of cream were then securely corked and brought to the office of the state department of weights and measures at Madison, where they were reweighed on a delicate Becker office balance sensitive to .1 milligram. The results obtained were indeed surprising and are given in Table I.

TABLE I.
Results Obtained in the Weighing of Cream on Various Types of Ureum Test Scales in Use in Wisconsin.

No. of test	Date	Type of scale	Cream weighed at	Weighed by	Sensitivity in grains	Charge in grains	Number samples weighed	Highest weight obtained, grams	Lowest weight obtained, grams	Variation of weight	Average of variation of weight		
1	Jan. 28 1913	12 bottle Torsion No. 3005	Madison..... Cross Plains..... H.M. Zanders..... Brodhead Cr'y..... J.E. Boettcher..... Roach & Seiber.....	Mansfield Cr'y.....	9 6 8 8 8 2	18 18 9 5 5 18	8 4 4 5 5 18	18,246 18,154 17,731 9,635 8,768 18,720	17,6152 17,731 17,731 8,768 8,768 17,937	.6314 .4229 .8675 .9,614 .9,18 17,8462	3.50 2.35 4.35 3.65	17.98 17.48 18.264 18.11	
2	Jan. 30	"	"	"	"	"	"						
3	Feb. 21	"	"	"	"	"	"						
4	Apr. 5	"	"	"	"	"	"						
5	Feb. 18	12 bottle Troemner No. 612	Waterloo.....	Tilden Cr'y..... Ft. Atkinson..... John Roberts..... Wm. Moves..... H. L. Bornheil.....	Chipp. Falls.....	7	18	5	18,263 18,743 17,5294 17,9490 17,6474 18,1304	.6739 .8440 .7,74 2,68 18,016	3.74 4.7 17.97 18.31 18.012		
6	Apr. 5	"	"	"	"	"	"						
7	May 31	"	"	"	"	"	"						
8	June 14	"	"	"	"	"	"						
9	June 14	"	"	"	"	"	"						
10	Jan. 25	4 bottle Fairbanks No. 349	Richland Ctr. No. 612	Buchanan.....	Richland Ctr. Geo. Buchanan.....	18	8	18,715	17,9270 17,9270	.2073 1.15		
11	Jan. 30	Troemner No. 60.	"	Cross Plains.....	Cr. Pl. Dairy Co. Macomarie Co. Cr. Macomarie Cr. Co. Wm. Winder.....	1 1 1 1 18	18 4 4 4 18	18,151 17,994 18,0115 18,0015	17,4232 17,4232 1,2923 1,2923	.1411 .78 .1034 .57			
12	Mc. 13	"	"	Madison.....	.....							
13	May	12 bottle Troemner No. 615	Madison.....	Madison.....	Wm. Winder.....	18	5	18,0165	17,9994	.0171	.09	18.005
14	Feb. 11	4 bottle Torsion No. 1530	Richland Ctr. No. 1530	F. Thompson.....	F. Thompson.....	18	5	18,0225	17,8549	.1676	.93	17.9499
15	Apr. 5	"	"	"	"	"							
16	Mc. 13	"	"	"	"	"							
17	Mc. 18	2 bottle Torsion No. 1515	Madison.....	J. E. Boettcher..... Wm. Winder.....	Madison.....	1/2 2/5 2/7	13 4 4	18,0720 17,9980 17,9930	18,0180 17,9925 17,9913	.054 .0052 .0017	.30 .030 .01	18.044 17.9845 17.9824	
18	Mch. 14	1 bottle Torsion No. 1500	Madison.....	Wm. Winder.....	Madison.....	1/3	18	4	18,0325	17,9770	.0555	.31	18.0001

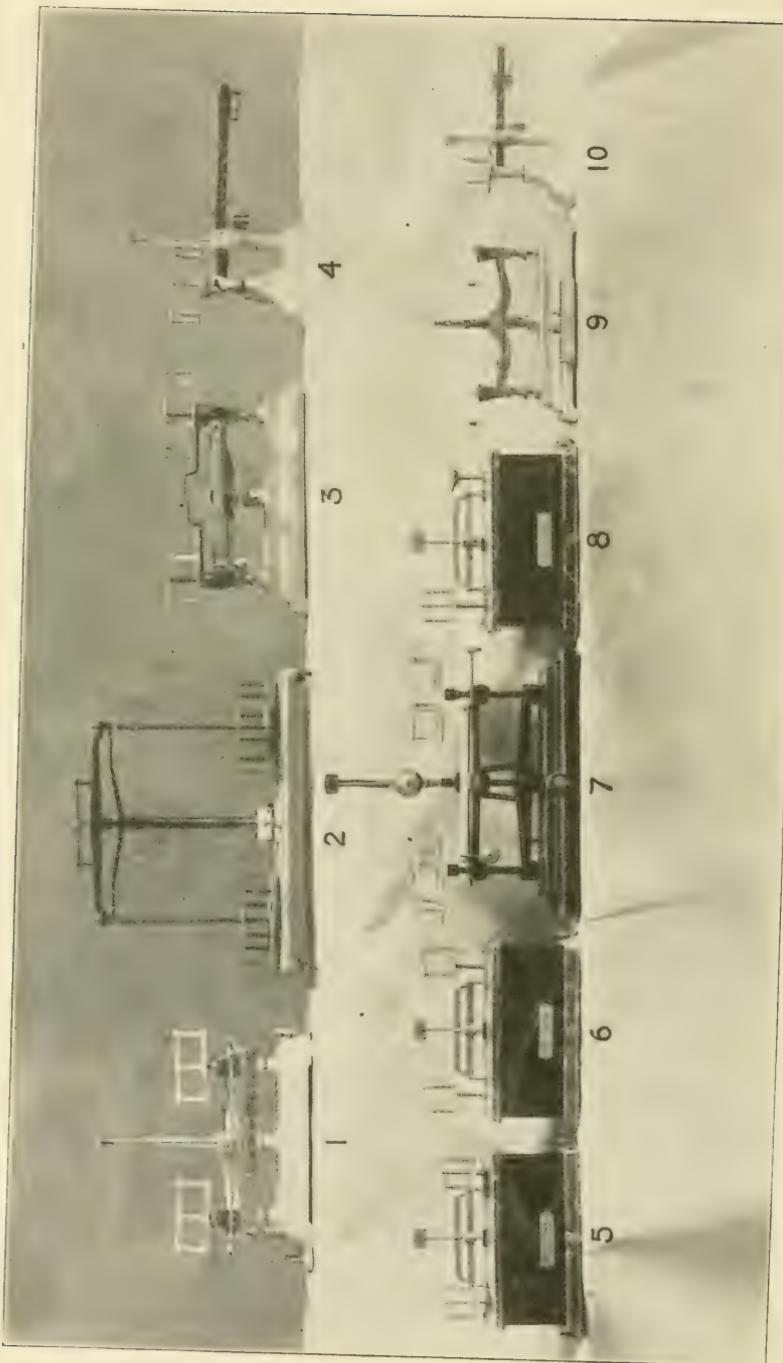
A careful study of this table reveals the fact that the more sensitive the scale the smaller the error resulting in weighing the cream. For instance, in test No. 1 the error of variation in duplicate tests amounted to 3.5%. In test No. 18 the variation was only .31%. The first scale had a sensitiveness of nine grains, whereas the latter was sensitive to one-third grain. In test No. 3 made at Brodhead 9 gram samples were weighed and the variation was 9.64%. It is clear from this that the smaller the charge the greater will be the percentage of error accruing through the use of a sluggish scale. If a nine gram sample had been taken in test No. 1 instead of an 18 gram, the variation in duplicate tests would undoubtedly have been about 7%.

Tests Nos. 8 and 9 made at Helenville by Messrs. Moyes and H. L. Bornheimer show the personal factor in the use of a scale. In this instance Mr. Moyes, the buttermaker, weighed six samples of cream upon the scale, following which Mr. Bornheimer weighed the remaining six samples. On checking up the weights obtained by these two men, it was found that the variation in weighings in the case of Mr. Moyes amounted to 2.68%, while in the case of Mr. Bornheimer the variation was but 1.15%. The types of scales used in making the tests given in Table I were the twelve bottle torsion balance No. 3005, the twelve bottle Troemner balance No. 612, the four bottle Fairbanks Troemner balance No. 6612 with hanging pans, the four bottle torsion balance No. 1530, the two bottle torsion balance No. 1515 and the one bottle torsion balance No. 1500. (See Illustration).

The figures show that accurate results are unobtainable through the use of the twelve bottle torsion balance 3005, the twelve bottle Troemner balance No. 612, and the four bottle Fairbanks balance No. 949 when the same are sluggish and insensitive in their action.

Scale manufacturers concede that it is almost an impossibility to make a twelve bottle scale with overhead pans which will remain sensitive to $\frac{1}{2}$ grain and not show a greater error at full load than one grain.

The figures in Table I likewise show that the specifications for cream scales must differ radically from the specifications applied to the ordinary commercial weighing appliances used in grocery stores and meat markets. It is not necessary for a grocer's balance to be sensitive to one or two grains. He weighs his groceries in large quantities. An error of one grain in the



Types of Cream Test Scales. The one, two and four bottle torsion balance (Nos. 5, 6, 8) and the 12 bottle balance with hanging pans (No. 2) are the only types that comply with the Wisconsin specifications.

weighing of a pound of tea would be an error of only 1/7000 of the load while an error of one grain in the weighing of a nine gram sample of cream would be an error of 1/139 of the sample, the proportionate error being fifty times as great in the weight of the cream as it is in the weight of the tea.

To show the losses resulting through the use of inaccurate scales, a few cases are cited, taking the figures from Table I.

In the case of H. M. Zanders of Cross Plains, the average weight of the tests was 17.48 grams, the error being minus .52 grams or 2.89%. The error on 10,000 lbs. of butter fat would amount to 289 lbs. At 25 cts. a pound for butter fat the loss to the patrons would be \$72.25.

In the case of test No. 7, John Roberts of Fort Atkinson, the average weight of the tests was 18.31 grams, the excess weight being .31 grams or 1.72%. The error on 10,000 pounds would be 172 pounds. At 25 cts. a pound the loss to the creamery would be \$43.

In test No. 3 at the Brodhead Creamery the highest reading of the nine gram sample obtained showed an error of .6359 grams or 7.06%. The loss to the creamery on 100 pounds of butter fat at 25 cts. a pound in this case would amount to \$1.76. The lowest individual reading obtained at the Brodhead Creamery was .2319 grams short of 9 grams or 2.57%. The gain to the creamery on 100 pounds of butter fat at 25 cts. a pound in this case would amount to 2.57 pounds valued at 64 cts. By using scales sensitive to $\frac{1}{2}$ grain or less, the errors are very slight, almost negligible.

The results obtained in Table I applied to scales in actual use, some of which were a number of years old.

To be absolutely sure that the unfitness of the types of scales mentioned in Table I is due largely to the inherent construction of the scale and not to the operator of the scale, nor to imperfections brought about through use, manufacturers of cream test scales were requested by the state department of weights and measures to submit different types of new scales which they manufactured. The manufacturers were perfectly willing and glad to coöperate with the department in this matter and in each case a loan of the different types of scales manufactured was made to the department.

TABLE II.
Results Obtained in the Weighing of Cream on Different Types of New Cream Scales Loaned the State Department of Weights and Measures.

Type of Cream Test Scale ...	12 bottle Torsion No. 3005.	4 bottle Torsion No. 1530.	2 bottle Torsion No. 1515.	12 bottle Troemner No. 612.	Troemner No. 90.	12 bottle Fairbanks No. 350.	4 bottle Fairbanks No. 349.	12 bottle hanging pans Troemner No. 6612.	1 bottle Fairbanks No. 948.	12 bottle hanging pans No. 948.
Sensibility Reciprocal, grains...	1	0.5	2	.5	1.5	6.6	4	2	0.1	0
Error at full load, grains...	.....	0.5	0.	2.5	2.0	4	4	0	0.1	0
Time required to weigh 12 samples ...	20 min.	23 min.	28 min.	25 min.	23 min.	18 min.	17 min.	27 min.	28 min.	28 min.
Weight of sample of cream in grams obtained by reweighing on office balance,.....	17.8790 18.1140 17.6755 18.1125 18.0755 17.8985 17.9110 17.9750 18.0454 18.1514 17.9135 18.2171 17.9870 0.5396 2.191%	18.0120 18.0040 18.0475 18.0350 18.0040 17.9300 17.9920 17.9960 18.0220 17.9930 18.0314 18.0625 18.0506 18.0292 0.0755 0.31%	18.0085 18.0100 18.0075 17.9890 18.0080 18.0280 17.9160 17.9860 18.0220 17.9930 18.0314 18.0624 18.0595 18.0128 18.0129 0.1364 0.1364 0.1364 0.1364 0.1364	17.9280 17.9720 17.9825 18.0350 18.0060 18.0165 17.9160 17.9560 18.0220 17.9930 18.0314 18.0624 18.0595 18.0128 18.0129 0.1364 0.1364 0.1364 0.1364 0.1364	18.0570 18.0400 18.1515 18.0550 17.9630 18.1165 17.9160 17.9560 18.0220 17.9930 18.0314 18.0624 17.9895 18.0220 18.0107 0.1364 0.1364 0.1364 0.1364 0.1364	18.2604 18.2684 18.2010 18.4521 17.9570 18.0360 18.1760 18.0775 17.9720 18.0350 18.0380 18.0430 17.9855 18.0320 18.0499 0.1885 0.1885 0.1885 0.1885 0.1885	..... ..... ..... 18.321 17.570 18.0100 18.1700 18.1675 17.9850 18.0650 18.0880 18.3570 18.0470 17.9660 18.0320 18.0120 18.0028 0.0600 0.0600 0.0600 0.0600 0.0600	..... ..... ..... 18.0370 18.0100 18.0390 18.0390 17.9775 17.9850 18.0650 18.0834 18.0324 17.9660 18.0320 18.0120 18.0024 18.0355 18.0621 18.074	18.0510 18.0105 18.1590 18.1740 18.0390 18.0390 18.0390 18.0390 18.0390 18.0390 18.0390 18.0390 18.0390 18.0390 18.0390 0.1685 0.1685 0.1685 0.1685 0.1685	
Average of weighings, grams...	17.9870	18.0292	18.0129	18.0107	18.0499	18.1200	18.1127	18.0028	18.074	18.074
Variation in grams	0.5396	0.0755	0.1364	0.1364	0.1364	0.1885	0.1885	0.0600	0.0820	0.0820
Percent of variations	2.191%	0.31%	0.76%	1.05%	1.04%	5.09%	5.09%	3.33%	0.45%	0.45%
Error due to plus and minus reading of pointer by one division in grams	0.1296	0.0348	0.0348	0.0348	0.0348	0.1944	0.1944	0.5184	0.2592	0.0129

Table II gives the results of the weighings made upon these new scales. Twelve 18 gram samples of cream were very carefully weighed upon each type of scale, extreme care being taken in placing the cream in the Babcock bottles not to add an excess. If a few drops of cream in excess were accidentally poured into the bottle, the same were removed so as to bring the scale back as near as possible to a perfect balance. The samples were then reweighed upon the Becker office balance and the variations in weight recorded. The results obtained again show that the more sensitive the scale, the more accurate the weighings recorded and the less the variation of duplicate samples. By studying the variation of the duplicate weights in grams, it will be observed that the greatest variations were obtained upon the twelve bottle Fairbanks cream test scale No. 950, the four bottle Fairbanks cream test scale No. 949 and the twelve bottle torsion balance No. 3005. In these experiments the twelve bottle Troemner balance with hanging pans, No. 6612, is the only type of twelve bottle cream test scale that gave reasonably accurate results.

The errors resulting through the use of the twelve bottle Troemner No. 612 and the Troemner scale No. 60 are almost identical. It will be noted that the twelve bottle Troemner No. 612 submitted to the state department of weights and measures is an exceptionally sensitive scale for one of this type.

It seems necessary at this point to explain the meaning of the term sensitiveness. More technically speaking, this term should be called the "sensibility reciprocal". It is defined as the weight in grains required to move the pointer over one scale division. Where the scale was not provided with an indicator as was the case in the twelve bottle Troemner No. 612 the sensibility reciprocal was considered as the weight which when placed on the pan would move the pointer a distance equal to the thickness of the pointer, or about three millimeters.

Comparing the results obtained on the twelve bottle Troemner No. 612 in Table II with the results obtained in Table I, it will be observed that the sensitiveness of this scale decreases rapidly with use. This is no doubt due to the fact that there are a large number of friction points. Exposure to moisture rusts the connecting rods beneath the base of the scale, producing sluggishness in its action.

Attention is called to the figures in the last row of Table II in which the error due to a plus or minus reading of the pointer

one scale division is recorded. These figures are obtained by multiplying the sensitiveness of the scale in milligrams by two. In the ordinary operation of cream test scales the operator undoubtedly frequently overloads or underloads his scale an amount which would cause the pointer to deviate one division to the right or left. In doing this the error for the different types of scales depends strictly upon the sensitiveness of the scale. By comparing the figures in this row with the figures shown in the row indicating the actual variation in grams of the duplicate weighings an idea is given of what proportion of the variation is due to the use of a sluggish scale and what proportion is due to the personal element.

There seems to be a prevailing opinion among creamerymen of the state that the use of a twelve bottle cream test scale results in the saving of much time. To determine just what this saving would amount to a record was kept of the number of minutes required to make twelve weighings and the figures are recorded in the third line of Table II. The results show that the more sluggish and insensitive the scale the less time is required in making twelve weighings. It will be observed that twenty minutes were required to make twelve weighings on the twelve bottle Torsion balance No. 3005 and but twenty-three minutes in weighing twelve bottles upon the four bottle torsion balance No. 1530. This time included the balancing of the four bottle balance three times. While the ability to make rapid weighings on a cream test scale is important, nevertheless accuracy should never be sacrificed for speed. While it required three minutes more to make twelve weighings on the four bottle torsion balance than it did upon the twelve bottle torsion balance, the percent of variation in the twelve bottle balance was about ten times greater than that obtained in the use of the four bottle balance.

A cream test scale should fulfill the following requirements:— It should be sensitive to one drop of cream, which is approximately thirty-two milligrams or one half grain. The maximum error permissible at full load or less should not be in excess of 64.8 milligrams or one grain. If of the beam or lever type, it should be provided with leveling screws and a level so that the errors due to weighing on a scale out of level can be avoided. If provided with a tare weight this weight should not be so heavy that it is difficult to bring the scale into balance through

a very slight movement of the tare weight. A tare weight which moves upon a threaded rod is much easier to manipulate than one that slides along a smooth rod. The weight of samples of cream should not vary on different parts of the pan, which is found to be the case with some of the twelve bottle cream test scales. The scale should be provided with a pointer which plays over a graduated indicator. It is extremely difficult to use a scale with two blunt pointers, such as are found in the twelve bottle Troemner cream test scale, and obtain accurate results. The scale should respond quickly so that time will not be lost in the operation of weighing.

In order that accurate testing be done in creameries, the operator must be provided with proper utensils. It is of the highest importance that the scale be accurate and sensitive. It must be remembered, however, that even if a new scale does weigh accurately it will soon become sluggish and inaccurate if it is not properly cared for. Comparatively few creameries give proper care and attention to the cream test scales in use. They are left exposed in a damp, room and become rusted. Dirt and dust accumulate on the bearings. The weighings are frequently made upon surfaces that are not level. A scale, to weigh accurately, must be kept clean and free from the moisture and dirt of the factory. The life of the scale could be greatly prolonged if the operator went to the slight additional expense of purchasing a glass frame or cover in which to keep his scale when not in use. A level shelf should be provided for the scale. This shelf should be free from all jars and vibrations due to the movement of the machinery in the creamery. One of the state inspectors reports that in visiting a creamery he found that the operator had placed his cream test scale upon the top of the centrifuge while the same was in motion and was making his weighings under these totally unfit conditions. It it any wonder that inaccurate results are obtained under such adverse conditions?

BABCOCK TEST BOTTLES.

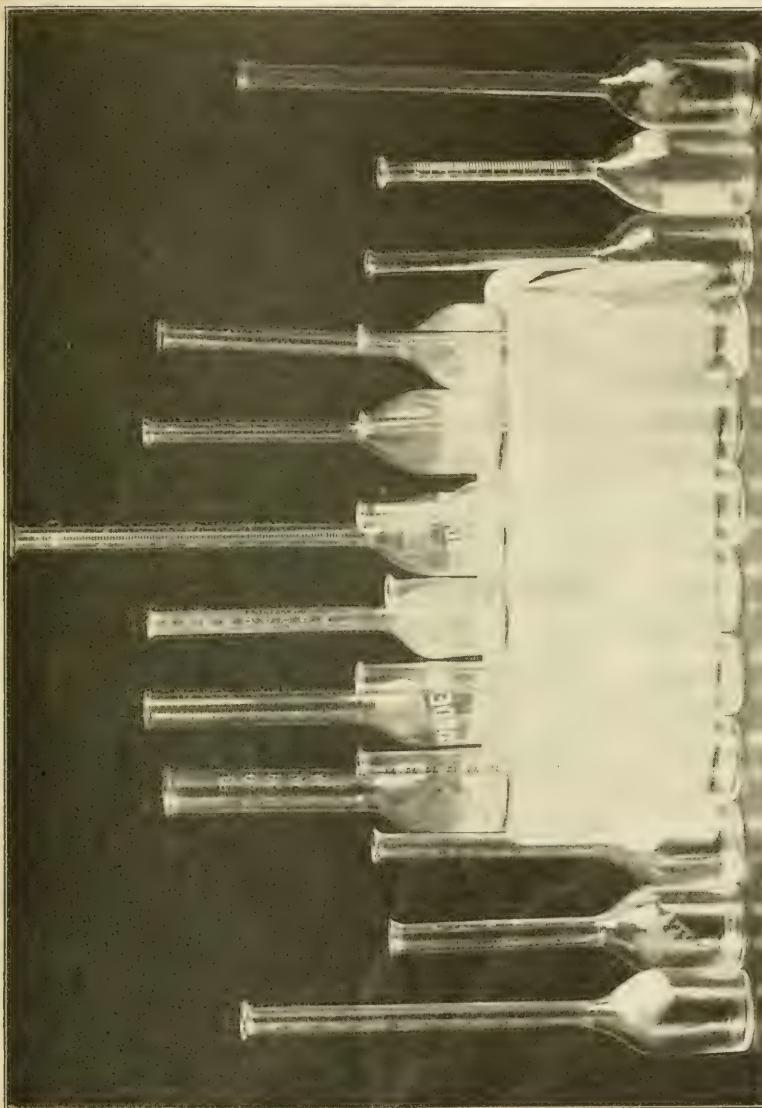
The Babcock method of testing milk and cream is volumetric, the unit of graduation being the true cubic centimeter or the volume occupied by one gram of distilled water at 40° C. In the 18 gram bottle each cubic centimeter represents 5% on the graduated neck of the bottle.

That there is great need in Wisconsin for establishing specifications relating both to the form and accuracy of Babcock glassware is revealed by investigations carried on by the state department of weights and measures. Thousands of Babcock bottles have during the past year been tested by this department and large numbers have been found inaccurately graduated, in a few cases the inaccuracies amounting to as much as 4% or 5% on a 50% cream test bottle. A bewildering variety of types of Babcock bottles is now listed in the catalogues of glass ware manufacturers. A few of this multitudinous variety of types of bottles are so constructed that they can be readily used in obtaining accurate results in the reading of the fat content of milk or cream. The remaining types are worse than worthless as they are misleading to the dairymen. The use of the wide neck bottle is especially objectionable. The use of bottles in which the graduations are placed very close together is likewise objectionable, it being impossible to obtain accurate results when either of the above objectionable types of bottles is used.

In the reading of cream the fat content should be read to at least within .5%. This being the case, cream test bottles graduated in 1% divisions should not be sealed. Dividers should be used in making the reading.

Specifications prescribing the minimum and maximum length of the graduated neck of both milk and cream bottles are necessary for two reasons. First, it is to the manufacturer's advantage to use tubing having a wide variation in diameter. If no limit is placed on the diameter of the tubing used, the manufacturer to avoid waste uses up all available tubing, thus producing a varying percentage of bottles with extremely wide necks and graduations crowded closely together. While such bottles may be accurately calibrated they are difficult to read. Second, the graduations on the 6 inch cream test bottles, which originally did not exceed 30% or 40%, have been increased to 50% or 55%. The graduations are thus crowded together so closely that accurate reading is practically impossible. It is not in the interest of accuracy to have the distance between graduations appreciably less than one millimeter.

In determining types of bottles which will be approved for sealing by sealers of weights and measures, the work was done on the theory that specifications should be of such a nature as



A few of the numerous types of Babcock Test Bottles now used in Wisconsin creameries. Note the difference in the diameter of the neck of the bottle and the closeness of the graduation in some of the six inch bottles.

to lead to the securing of accurate results. The work was not done on the theory that specifications for Babcock bottles should be such as to grant the manufacturer a wide latitude in the selection of his tubing. Neither are the specifications prepared on the theory that cream bottles should be so closely graduated as to permit the reading of cream with a high fat content when centrifuges of a narrow diameter are used. Accuracy must not be sacrificed for mere convenience; neither should the matter of a few dollars extra expense to the creamerymen be the essential consideration. The purchase of defective glassware at any price is a short sighted policy. Such glass ware must utterly fail to accomplish the legitimate purpose of its use.

Specifications are prescribed for five types of cream test bottles. When cream does not run above 30%, the 18 gram, 6 inch, 30% cream test bottle with $\frac{1}{2}\%$ graduations can be used. It is not necessary in such cases to use the 40% or 50% bottle. If readings within .2% are desired, as is the case in research work or in cases for court, the 30%, 18 gram, 9 inch cream test bottle graduated in .2% divisions can be used.

In most of the Wisconsin creameries the 40%, 18 gram, 6 inch cream test bottle will be found to be graduated sufficiently high to test all samples of cream brought to the factory. In creameries where the percent of fat in the cream runs above 40%, either the 50%, 18 gram, 7 inch cream test bottle or the 50%, 18 gram, 9 inch cream test bottle can be used. Owing to the claim by dairymen that a large amount of breakage results through the use of the 9 inch bottle, a new type of bottle is approved, namely, the 50%, 18 gram, 7 inch cream test bottle adapted to use in centrifuges of wide diameter.

Where creameries do not desire to go to the expense of installing a centrifuge that will hold 7 or 9 inch bottles, a 40%, 18 gram, 6 inch bottle can be used. If cream runs over 40%, a 9 gram charge can be weighed into the bottle and 9 grams of water added before the acid is placed in the bottle. The reading obtained will have to be multiplied by two. When sensitive cream scales are used, the doubling of any error due to inaccurate weighings will be exceedingly slight. The dilution of concentrated cream with water causes it to approximate more closely the composition of milk, and it is to be borne in mind that the Babcock test was originally designed for the determination of the butter fat of milk and not of cream.

Owing to the opinion of the attorney general that the law does not permit 8% milk test bottles graduated to .1% divisions being sealed, this type is not included in the specifications. Furthermore, it is highly desirable from the standpoint of accuracy to have all milk bottles with necks of approximately the same diameter. In reading the fat content of milk, the reading is taken to the top of the meniscus. Shortening the diameter of the neck changes the shape of this meniscus and produces an error in the reading which though small is appreciable. As many of the 8% bottles in use have narrower necks than the 10% bottle; a constant error is thus introduced, if this type of bottle is used.

The use of Babcock glassware complying with these specifications will do away with many of the disputes between factory-man and patron now due to the use of inaccurate glassware.

LIBRARY OF CONGRESS



0 000 895 829 4