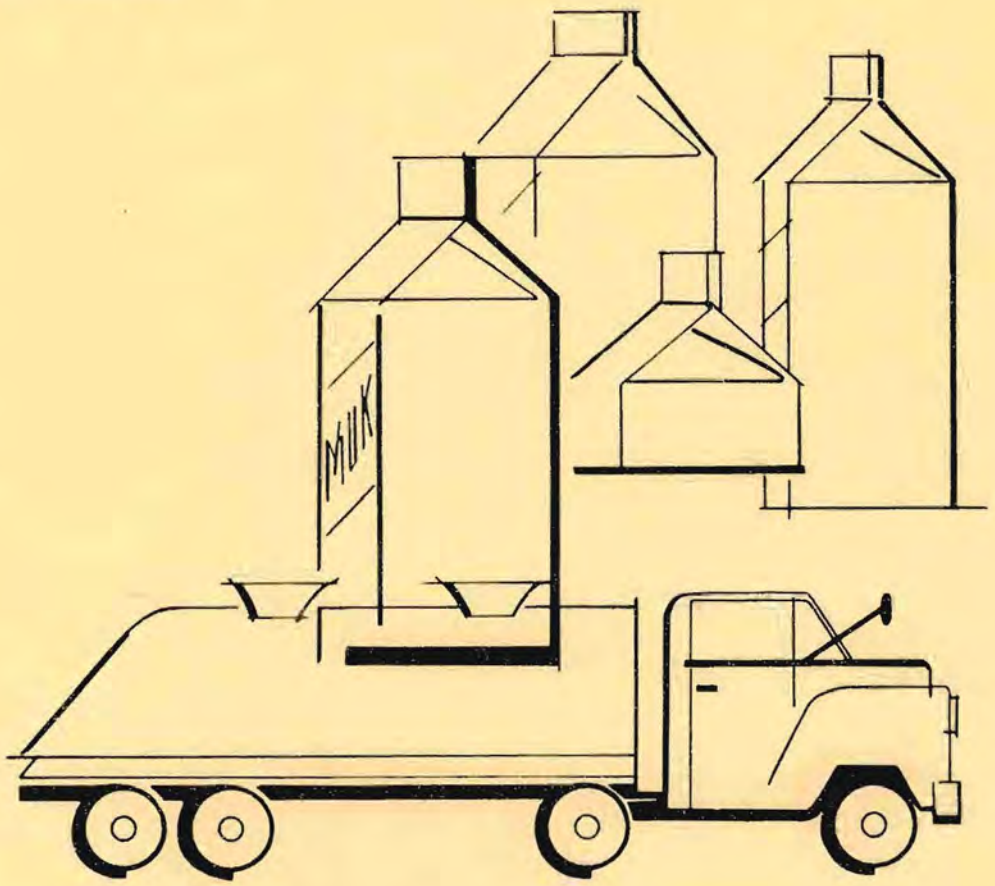
Full Committee Report of Study
Conducted in 13 Federal Milk Order Markets on

VOLUME-WEIGHT CONVERSION FACTORS FOR MILK



SUPPLEMENT TO MARKETING RESEARCH REPORT 701

U.S. DEPARTMENT OF AGRICULTURE ◻ CONSUMER AND MARKETING SERVICE
DAIRY DIVISION ◻ WASHINGTON, D.C.

PREFACE AND ACKNOWLEDGMENTS

This report presents the results of a study dealing with composition-volume-weight relationships for milk and fluid milk products. While the project was initiated primarily to determine appropriate volume-weight conversion factors to be used in administering Federal milk orders, the findings are of widespread interest and application throughout the dairy industry.

The project was undertaken in recognition of the need for developing more reliable and, if feasible, uniform factors for converting volumes of fluid milk products to pound equivalents. The need for up-to-date conversion factors was accelerated by the growth in the number and scope of Federal milk marketing areas, the increased movement of fluid milk products between markets, and the introduction of new products and the modification of others. Thirteen Federal order markets, located in representative parts of the country, participated in the experimental work, either using their own laboratory facilities or contracting for such facilities with a university or other outside laboratory.

A Committee comprised of technical personnel in these markets was set up to carry out the research, and two Subcommittees were organized to report on the project: one to describe the methods and procedures employed in the research work; the other to compile and report the findings. Members of the Subcommittees are listed separately on page ii. Special recognition is due Dr. B. L. Herrington of Cornell University, Committee Chairman, who developed the laboratory procedures, supervised and guided the laboratory work, and offered many helpful suggestions in other phases of the project. Chapman E. Dunham and Richard Fleming who were Chairmen of the Findings and Procedures Subcommittees, respectively, did the major work involved in preparing their Subcommittee Reports. Dr. H. C. Olson of Oklahoma State University and Dr. W. C. Vanderzant of Texas A. and M. University contributed important technical assistance. Dr. R. W. Baughman of Iowa State University participated in the study as a member of the Findings Subcommittee. Anna A. Schlenker of the Dairy Division, Consumer and Marketing Service, assisted by Dorothy S. Cohen, summarized and analyzed the voluminous raw and processed data and did extensive research on previous work in the field of composition-volume-weight relationships for milk. Others of the Dairy Division who contributed to the project were Robert W. March, Joseph J. Westwater, Glenn W. Freemyer, Ellen Henderson, Floyd Fenton, Joel L. Blum, Fred Stein, and Robert E. Freeman (now with Economic Research Service). Paul D. Watson, now retired from Agricultural Research Service, was most helpful in the preparatory phases of the study. Elsie D. Anderson, Economic Research Service, developed the statistical procedures and served as a statistical consultant throughout the project.

PARTICIPATING MARKETS

Federal Milk Marketing Area	Market Administrator
Central Arizona	Wilson M. Haverfield
Chicago	A. W. Colebank
Des Moines	James V. O'Meara
Kansas City	U. Grant Grayson
Louisville-Lexington-Evansville	Joseph E. Bobo
Minneapolis-St. Paul	Sanford A. Balgaard
New York-New Jersey	Dr. C. J. Blanford
North Texas	Byford W. Bain
Northeastern Ohio	W. W. Hurwitz
Oklahoma Metropolitan	Richard E. Arnold
Puget Sound	Nicholas L. Keyock
Southeastern Florida	John D. Nord
Southern Michigan	George Irvine
Washington, D.C.	Edward L. St. Clair

TECHNICAL COMMITTEE MEMBERS

	Federal Milk Marketing Area
Dr. B. L. Herrington, Chairman (Cornell University)	New York-New Jersey
Procedures Subcommittee	
Richard Fleming, Chairman	North Texas
Truman Jutson	Central Arizona
Walter Thompson	Kansas City
Cleveland B. Lewis	Louisville-Lexington-Evansville
William Fisher	Southern Michigan
Lyman Schooley, Jr.	Washington, D.C.
Findings Subcommittee	
C. E. Dunham, Chairman	North Texas
William E. Ferguson	Chicago
Dr. R. W. Baughman (Iowa State University)	Des Moines
Lamartine F. Hood (Quality Control Laboratory)	Minneapolis-St. Paul
Dr. Elmer George, Jr. (Quality Control Laboratory)	Minneapolis-St. Paul
A. S. Margolin	Northeastern Ohio
Myron McKinley	Oklahoma Metropolitan
Edward A. Bugbee	Puget Sound

SUMMARY

The administration of Federal milk orders requires the conversion of volumes of milk and cream to pounds. Conversion factors presently in use are based on early studies which sometimes overlooked such factors as the nonfat solids content of the product and the precise temperature at which the weights were determined. Previously no single set of factors has been considered acceptable in all areas.

This report covers the results of testing more than eight thousand samples of raw and processed whole milk, skim milk, and cream, including products fortified by the addition of nonfat milk solids. Samples were collected at producers' farms, handlers' plants, and some at retail stores. The markets from which the samples were drawn represent a cross section of the country. The testing was conducted for a full year, and weights were determined at four temperatures. Samples were tested for fat and nonfat milk solids content and precisely weighed to ascertain the specific gravity and hence the weight per gallon. Differences due to composition, temperature, geographic location, season, and other possible influences on volume-weight relationships were carefully investigated.

The procedures used for determining the milk solids content of the milk and cream were those in general use in the dairy industry. In testing for milkfat, the procedure outlined in the Laboratory Manual published by the Milk Industry Foundation was followed, except that some modifications were made for testing homogenized milk and half-and-half. Total solids content was determined by gravimetric methods.

The procedure for determining specific gravity was developed by Dr. B. L. Herrington of Cornell University. It involved the use of Babcock bottles in which the weight of a precise volume of the milk product was compared with the weight of the same volume of distilled water at regulated temperatures of 40°, 50°, 68°, and 102° Fahrenheit. The specific gravity so determined when multiplied by the appropriate weight of a gallon of water gives the weight of a gallon of the milk product.

Laboratory reports of percentages of fat and nonfat solids content, specific gravities, and other pertinent data were verified for arithmetical accuracy and tabulated by data processing equipment. These tabulations provide a permanent record, and were the basis for computing average composition and weight for each product in each market, as well as regression equations which show the average relationship between fat, solids-not-fat, and weight per gallon.

The regression equations for each market were used to compute the weights of products with exactly the same composition. The results showed that products of like composition had such closely similar weights in all the participating markets as to indicate the feasibility of preparing tables of weights of all fluid milk products according to their fat and nonfat solids content. In order to prepare such tables, it was necessary to develop an overall or "universal" equation for a desired temperature which, when applied to the composition of any product from fortified skim milk to heavy cream, would give a weight per gallon which would fit closely the average of actual weights found for such composition by actual weighing.

A basic formula was used to develop such a universal equation for each of the four temperatures:

$$\frac{100}{100 + (\%\ \text{BF} \times \text{BF factor}) - (\%\ \text{SNF} \times \text{SNF factor})} \times \text{wt. of water} = \text{wt. of milk product}$$

Weights of a fluid milk product of any specified composition may be computed by inserting the fat and nonfat percentages and the following factors for the desired temperature:

	Butterfat factor	Solids-not-fat factor	Wt. /gallon of water in pounds
40°F.	.03928	.39221	8.3364
50°F.	.04811	.38556	8.3341
68°F.	.07181	.38146	8.3217
102°F.	.09493	.37312	8.2752

The conclusions of the study were:

(1) Composition of fluid milk products is the most important factor affecting weight;

(2) The effect of temperature on the weight of fluid milk products is sufficiently important to require its inclusion in weight determinations;

(3) Differences in weight associated with geographic location, breed of cow (except as breed affects composition), and season of the year are relatively unimportant; and

(4) Weights computed from the universal equation or taken from the standard weight conversion tables, when related to product composition determined by acceptable laboratory methods, are more accurate than any single equation or table of weights heretofore developed.

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Full Committee Report of Study Conducted in 13 Federal Milk Order Markets on Volume-Weight Conversion Factors for Milk

Report of Market Administrators' Committee

Section I

INTRODUCTION

Federal milk marketing orders are part of the broad program of marketing agreements and orders authorized by the Agricultural Marketing Agreement Act of 1937. Orders are legal instruments designed to promote and maintain orderly marketing conditions with respect to the sale of milk by dairy farmers to regulated milk handlers. They establish classes of utilization and prescribe methods of allocating receipts of milk and milk products to the established classes. These orders specify minimum prices on a hundredweight basis to be paid by handlers to producers for milk in each class of utilization.

Milk orders are administered by market administrators who are agents of the Secretary of Agriculture. It is their responsibility to ascertain that handlers are in fact paying not less than the established minimum prices for milk received from producers in accordance with its classification. Producer prices are a blend of the minimum class prices resulting from the pooling of milk utilized and paid for at each class price. Milk utilized as whole milk carries a higher price than milk processed into cheese or butter. Thus, it is incumbent upon the market administrators in administering the terms and provisions of the current orders to determine the pounds of skim milk and butterfat received and disposed of by regulated handlers.

Producers are paid for their milk on a hundredweight basis and handlers maintain their records of receipts and disposition in pounds. Butterfat and solids-not-fat tests are reported in percentage by weight. On the other hand, the weight of bulk tank producer milk is computed from volumetric measurements in the bulk tanks. Also, fluid milk products are distributed on wholesale and retail routes in half-pints, pints, quarts, half-gallons, gallons, and more recently in even larger size containers. It is thus necessary for purposes of product accounting in milk plants to convert these volumes to pounds.

In recent years, the standardization of whole milk has become more prevalent. Fluid milk products standardized by the addition or removal of fat and cream and fortified products produced either by concentration or by the addition of condensed or dried milk began to have an impact on the market. Along with these changes came the practice of accounting for added nonfat solids in terms of skim milk equivalent. The consumption of plain and fortified skim milk increased substantially. The use of flavored whole milk became more prevalent; yogurt sales increased. Sales of mixtures of milk and cream, sour cream, and eggnog increased. Flavored skim milk showed gains in some markets. Little information was available about the weight of these products, particularly since composition varied widely among handlers.

During the past decade, with supplies of approved milk increasing and with a concentration of milk bottling and processing operations into fewer but larger plants, regulated handlers used greater volumes of producer milk in the manufacture of such

products as condensed milk, cottage cheese, ice cream and frozen desserts, cheese, powder and butter. This intensified the need for more accurate and detailed information on the volume-weight relationship of milk and its products.

During the early period of the Federal milk order program, factors used by market administrators to convert sales and receipts volumes to pounds were mostly those which either had been developed and published by Federal agencies or had been in use by the industry prior to regulation. They were based on butterfat variations with no adjustment for solids-not-fat content.

The conversion factors used in these early years were generally considered adequate by the fluid milk industry. There was little movement of milk between markets, whole milk and cream represented most of the fluid product sales, and sales of modified products were insignificant. Milk from producers was weighed as received at plants and receiving stations. With the introduction of bulk farm tanks, weights of producer milk were determined by converting volume measurements to pounds by use of a weight conversion factor. With the many important changes that have occurred in the industry during the past two decades, questions have arisen concerning the adequacy and accuracy of these early conversion factors.

The growth in the number and scope of Federal marketing areas; the increased movement of fluid milk products between markets; and the introduction of new products and the modification of others focused attention on the need for more reliable, and if feasible, uniform weight conversion factors, not only in the administration of Federal milk orders, but also for use throughout the dairy industry.

In recognition of the need for more reliable conversion factors, volume-weight conversion tables were developed and adopted by several Federal order markets in 1956. They showed actual weights and skim equivalent weights for gallons, quarts, and half-pints of milk products of varying percentages of fat and solids-not-fat. The basic formula used in computing these tables was developed from a review of various literature and limited experimental work conducted by several market administrators. No reliable information was available on weight variations due to temperature, season of the year, geographic location, and breed of cow, each of which may have important bearing upon whether or not it might be possible to develop one set of conversion factors for use in all markets. Other markets adopted these same factors, but many market administrators considered it advisable to conduct additional research.

By 1960, the need for more uniform conversion factors was evident. The use of existing weight conversion factors created inequities among regulated handlers. There were 80 Federal order markets handling 43.3 percent of all milk sold to plants and dealers in the United States. In October 1959, the total movements of milk for fluid disposition between Federal order markets exceeded 100 million pounds. At a meeting in August 1960 of market administrators, members of their staffs, and dairy experts from several universities, plans were made for undertaking a joint research project to obtain more detailed information about the weights of milk and fluid milk products.

Thirteen Federal order markets, located in representative areas of the country, participated in the project, either using their own laboratory facilities or those of a university or other outside laboratory: Central Arizona, Chicago, Des Moines, Kansas City, Louisville-Lexington, Minneapolis-St. Paul, New York-New Jersey, North Texas, Northeastern Ohio, Oklahoma Metropolitan, Puget Sound, Southern Michigan, and Washington, D. C. In addition to the samples from these marketing areas, producer milk samples were sent from the Southeastern Florida market to Washington, D. C., for testing. Most of the laboratory work was completed during 1962.

The project was primarily a study of composition-volume-weight relationships of finished products. Some very useful data on volume-weight relationships of raw milk received from producers were also developed and should be of value, since more and more producers are changing to bulk tanks as a method of handling milk on the farm.

Additional information developed incidental to the main line of research is available for further analysis.

This report deals primarily with the subject "development and application of standard weight conversion factors for fluid dairy products" and presents conclusions on the major objectives for which the study was undertaken. The findings of the committee, however, suggest the following other areas of investigation:

1. Establishing the weight per gallon of milk received directly from dairy farmers when the solids-not-fat content is not available. --The study shows there are significant differences in weights of producer milk due to composition. It does not provide a procedure for computing the weight per gallon from butterfat tests alone; further work is needed to determine whether sufficiently accurate weights per gallon of producer milk can be derived from butterfat tests when the nonfat solids content is not known.

2. Determining the weight per gallon of such products as ice cream mix, chocolate milk, chocolate drink, plain and sweetened condensed milk, etc. --It is possible that the universal equation described in the report can be applied to those products not tested which do not contain added sugar. More laboratory tests are needed to confirm this tentative finding. For sweetened products, the equation may need a factor to be multiplied by the percent of sucrose. The value of this factor might be derived from the specific gravities of sucrose solutions. The reliability of such an equation must be established in the laboratory. Its application would be relatively simple because the composition of these products is usually known.

3. Establishing the temperature at which milk containers should contain the specified volume. --At higher temperatures, a given weight will appear to over-fill a container, and at lower temperatures the same weight will appear to under-fill the container. This is a legal question, but data developed incidental to this study should be of value to those responsible for weights and measures.

Section II

REPORT OF THE PROCEDURES SUBCOMMITTEE

Methods and Procedures Involved in Arriving at Standard Weight Factors for Dairy Products

After extensive preliminary studies, Dr. B. L. Herrington prepared a handbook of instructions for the weighing and testing program. The purpose of the handbook was to aid in obtaining uniformity in procedures in each of the participating laboratories. Further assurance of uniformity in testing was achieved by visits of the co-ordinator to each of the laboratories. In addition, cans of evaporated milk, taken from one standardized batch, were sent to each of the participating laboratories. They were periodically tested for total solids along with samples collected throughout the duration of the testing project. This procedure was used to determine uniformity and consistency of total solids results in individual laboratories and also was used to compare uniformity among the different laboratories. Control samples of kerosene were also sent to each participating laboratory for determinations of specific gravity.

The basic program for collection of data included the measurements of fat, total solids and specific gravity on a wide range of dairy products with primary emphasis on raw producer milk, processed milk, skim milk and cream. The collection of samples varied somewhat among the different laboratories. Individual producer samples were collected at the farm or plant by some, while others collected samples of producer milk

from holding tanks at the milk plants. Finished product samples were taken from milk plants by the majority of the laboratories, while a few samples were collected at retail stores.

DETERMINATION OF PERCENT FAT

A. Raw Producer and Creamline Milk

The Babcock test as outlined in the Laboratory Manual by the Milk Industry Foundation was used by all participating laboratories.

B. Homogenized Milk

A modified Babcock procedure was followed. This was recommended by personnel of the Chicago Market Administrator's office as a procedure capable of yielding accurate results over a wide range of testing conditions. It was pointed out that there are other modified Babcock tests capable of yielding comparable results, but it was agreed upon by all the laboratories to use this modified test. Following are the modifications that were made:

1. Approximately 11 ml of sulphuric acid at room temperature (68° - 70° F., specific gravity 1.82 - 1.83) was added to each sample which was then mixed by shaking in a rotary motion for about 5 seconds before being placed in a mechanical shaker.

2. Each sample was allowed to shake for 3 to 5 minutes, and then a second portion of acid, approximately 10 ml of the same sulphuric acid, was added.

3. The samples were again placed in a mechanical shaker and allowed to shake for at least 5 minutes.

4. They were then placed in a heated centrifuge for 5 minutes at the proper speed.

5. Soft water at 140° - 150° F. was then added to each sample, bringing the level of the bottle contents halfway up on the shoulder of the test bottle.

6. Again, they were allowed to centrifuge for 5 minutes and then hot water was added to bring the contents of each test bottle to approximately the 0% calibration mark.

7. Then a third 5 minute centrifuging was allowed after which hot water was added, bringing the contents of each test bottle to approximately the 7.0% calibration mark.

8. The samples were then centrifuged for 4 minutes after which they were removed from the centrifuge and placed in a water bath at 135° - 140° F. and allowed to temper for 5 minutes before being read.

C. Homogenized Half-and-half

The fat content of homogenized half-and-half was determined by a procedure similar to the one described for homogenized milk with the following exceptions:

1. Nine grams of the thoroughly mixed sample was weighed into a 20%, 9 gram ice cream test bottle.

2. After the sample was weighed, 7 ml of soft water, at approximately 80° F., was added.

3. Ten ml of acid was used for the first addition and 9 ml of acid for the second addition.

The remaining procedure was the same as that outlined for homogenized milk.

D. Skim Milk

The American Association test, as outlined in the Laboratory Manual by the Milk Industry Foundation was used for determining percent fat in skim milk low enough in fat content to be tested in a 0.50% skim milk test bottle.

A few of the laboratories used the Mojonnier procedure for all of their butterfat testing, while others used it only for testing certain products. All samples tested, regardless of the type procedure, were run in duplicate.

DETERMINATION OF PERCENT TOTAL SOLIDS

Several types of equipment, all of which give satisfactory results, were used in the participating laboratories. Five of the laboratories used Mojonnier equipment and procedures; six used forced air-drying ovens at 100° C., allowing from 3 to 4 hours drying; and two laboratories used Dietert equipment and procedures. Analytical balances were used by all laboratories, with the majority using a one-pan, direct reading type balance.

Cans of evaporated milk, taken from one standardized batch, were collected and sent to each laboratory. These were used as control samples. Each laboratory periodically ran total solids tests on the control samples along with samples collected throughout the duration of the testing project. These results were used as a means of comparing uniformity and consistency in total solids testing, not only in the individual laboratories, but among different laboratories as well.

All samples tested were run in duplicate, with some of the laboratories testing the control samples in triplicate and quadruplicate.

DETERMINATION OF SPECIFIC GRAVITY BY THE BABCOCK BOTTLE METHOD

Specific gravity determinations were made on all products by a technique involving the use of 8% Babcock test bottles. This procedure was used because precision lactometers were not available with a range sufficiently great to test cream, milk, skim milk, and modified skim milk. Furthermore, lactometers could not be used to test cream at low temperatures because of its high viscosity. With this method, the changes in volume of weighed samples of milk products at various temperatures were measured in the calibrated part of the neck of the Babcock bottles.

The accuracy of the graduation of Babcock milk test bottles was pointed out in an article by Dr. B. L. Herrington and R. A. Scanlan, published in the May 1960 issue of the Journal of Dairy Science. Their data indicated that Babcock bottles are graduated quite accurately.

Following is a detailed procedure of the Babcock bottle method for determining specific gravity:

A. Equipment and Material

1. Constant-temperature water baths, thermostatically controlled and capable of operating at 102° and 68° Fahrenheit (± 0.3° F.), were used. Water baths capable of being operated at 40° and 50° F. were also used. Determinations of specific gravity were made at each of these four temperatures by as many laboratories as possible. Some of the laboratories made determinations at

only two or three of these temperatures. A separate bath for each temperature was used by a few of the laboratories. The water baths were equipped with wire racks to hold Babcock test bottles so that the tops of the bottles were nearly even with the top of the water bath.

2. Thermometers graduated in degrees Fahrenheit, with divisions spaced wide enough to enable reading variations of 1/4° F. were used. For the 102° F. bath, Saybolt thermometers, graduated from 94° to 108° F. in fifth degrees, were used. All thermometers were checked with a thermometer certified for accuracy by the Bureau of Standards, and if necessary, appropriate corrections were made.

3. Babcock milk test bottles that had been checked for accuracy were used.

4. Rubber caps made by cutting the reinforcing ring from molded medicine dropper bulbs were used to cover the top of the necks of the test bottles. The purpose was to guard against water entering the bottles and also to limit evaporation of the contents of the bottles. A good sized pinhole was made in the top of each bulb to allow for escape of air.

5. The use of deodorized kerosene, with enough oil soluble red dye to give a light red color, made it possible to make more accurate readings.

6. Automatic syringe pipettes or micro-burettes capable of delivering exactly 0.75 ml were used for adding the colored kerosene.

7. Analytical balances were used by all laboratories with the majority using Mettler one-pan balances or some other similar one-pan balance.

8. Magnifocusers were used to aid in determining the point at which to read the meniscus. Readings were made to the nearest half division by reading at the top of the kerosene meniscus.

9. Fifty ml pipettes or 50 ml syringes were used in filling the test bottles.

B. Preparation of the Babcock Test Bottles

1. Bottles were permanently marked for easy identification and then accurately weighed to the nearest milligram.

2. Each bottle was then filled with distilled water at room temperature to approximately the 4% mark and allowed to stand at room temperature until the neck of the bottle was dry. Drying time was shortened greatly by wiping the neck of the bottles with a cotton tipped applicator.

3. The weight of the bottle plus water was determined to the nearest milligram.

4. Rubber caps were then placed over the necks of the bottles and they were immersed in a water bath at 68° F. with only the top of the bottle necks and caps extending above the water level. (Some of the laboratories used the 102° F. temperature.) Five to ten minutes were allowed for the bottles to reach constant temperature. The bottles were then lifted part way out of the water and the top of the meniscus was read to the nearest half division. By reading to the nearest half division, the maximum error in reading was only 1/4 division with the average error being only 1/8 division. All readings were made in duplicate.

5. The weight of water that each bottle contained at the 4.0% mark was determined as follows:

   a. The weight of the empty bottle was subtracted from the weight of the bottle plus water to obtain the actual weight of water.

   b. This weight was then corrected, if the reading was not at the 4.0% mark, by multiplying the number of small divisions between the observed reading and the 4.0% mark by 0.020 grams. The correction was added if the observed reading was less than 4.0% and subtracted if above 4.0%.

   c. The weight of water contained at the 4.0% mark at the other temperatures was arrived at by multiplying the weight of water at 102° F. by the following factors:

      For 40° F., 1.00642 For 50° F., 1.00631 For 68° F., 1.00508

      For the laboratories that calibrated their bottles at the 68° F. temperature, the following factors were used:

      For 40° F., 1.00133 For 50° F., 1.00122 For 102° F., .99494

      These factors contain a correction for the expansion of both the water and the glass used by the Kimble Glass Company for test bottles.

   d. Several determinations were made for each bottle and an average was taken establishing the weight of water at the different temperatures. Tables were then prepared to show for each bottle number the weight of the empty bottle and the weight of the water contained at the 4.0% mark for each of the different temperatures.

   e. Throughout the testing program checks were made to see that bottle weights did not differ more than 5 milligrams from the established weights.

C. Procedure for the Determination of Specific Gravity of Milk and Skim Milk

1. All determinations were made in duplicate.

2. Each sample was warmed to approximately 105° F. and then poured back and forth between two containers to mix it thoroughly. It was then transferred to a test bottle to approximately the 2.5% mark.

3. The test bottles were then centrifuged in an unheated Babcock centrifuge for approximately 15 seconds to expel air bubbles. Prolonged centrifuging was found to be undesirable and was avoided.

4. The inside of the necks of the bottles were cleaned to the 3.0% mark with cotton tipped applicators that had been dipped in a detergent solution and pressed nearly dry.

5. The weight of each bottle was then determined to the nearest milligram.

6. To each bottle 0.75 ml of colored kerosene at a temperature of 70° to 75° F. was then added.

7. Rubber caps were then placed over the bottle necks and the bottles were immersed in the 102° F. water bath almost to the rubber caps.

8. After the bath was warmed back up to 102° F., and ample time was allowed for the contents of the bottles to reach constant temperature, readings were

made by lifting the bottles part way out of the bath, only high enough to observe the meniscus against a lighted background without parallax error. The top of the kerosene meniscus was read to the nearest half division.

9. The bottles were then transferred to the 40° F. water bath. Skim milk samples were read after 30 minutes' tempering. For all creamline milk the samples were held at least 8 hours before they were read. Homogenized milk samples were held at least 15 hours before the reading

10. The bottles were then transferred to the next higher temperature. Readings were made 30 minutes after the bath had recovered its proper temperature.

11. The same procedure was followed for the reading at the next higher temperature.

12. The following steps were taken in calculating the specific gravity at each temperature.

    a. The weight of the empty bottle was subtracted from the weight of the sample plus bottle.

    b. The standard weight of water contained at the 4.0% mark was then recorded.

    c. The water weight correction table for milk and skim milk (appendix 3) was then used to correct for the volume of kerosene used, and also to adjust the weight of the water contained at the 4.0% mark to that of a volume equal to the volume of milk in the Babcock bottle being tested.

    d. The specific gravity was then obtained by dividing the weight of the sample by the weight of water equal to the volume of the sample. This was done for each of the given temperatures.

D. Procedure for the Determination of Specific Gravity of Cream

Because heavy cream shows a very large volume change between 102° and 40° F., and because it is very difficult to remove air bubbles, special precautions were necessary.

1. Samples were warmed to 105° F. and poured back and forth to mix and to release dissolved air.

2. The bottles were filled to approximately the 0.0% mark.

3. They were then placed in the 102° F. water bath for 5 to 10 minutes, after which a glass tube with the end drawn out to a very small tip was used to adjust the cream meniscus to 0.0% or a little below.

4. Rubber caps were placed on each bottle and the bottles were then placed in a tempering bath for 10 minutes at 135° to 140° F.

5. The bottles were then centrifuged in an unheated Babcock centrifuge for 1/2 minute to expel air bubbles.

6. The samples were then cooled to 85° F. or less and the necks of the bottles were cleaned to the 0.0% mark with a cotton tipped applicator that had been dipped in a detergent solution and pressed nearly dry.

7. The weight of each bottle plus sample was then determined and recorded to the nearest milligram.

8. To each bottle 1.50 ml of colored kerosene, measured at about 75° F., was then added.

9. Rubber caps were again placed over the necks of the bottles and the bottles were immersed almost to the cap in the 102° F. water bath. (When testing heavy cream, a difference of 0.2° F. equals 1/4 division in the volume reading, thus emphasizing the importance of accurately controlling the temperature at exactly 102° F.)

10. After allowing sufficient time for the bath to warm back to 102° F. and after there had been no detectable change in the position of the meniscus during a 5 minute period, the bottles were lifted part way out of the bath, only high enough to observe the meniscus against a lighted background without parallax error. The top of the kerosene meniscus was then read to the nearest half division.

11. The bottles were then transferred to the water bath at the lowest temperature to be used, and held at constant temperature for at least 15 hours before they were read. (Crystallization of the fat approaches completion very slowly. See appendix 8.)

12. In case the meniscus fell below the 0.0% mark another 0.75 ml portion of kerosene measured at 40° - 50° F. was added, and then a reading was made.

13. The bottles were then transferred to a water bath at the next higher temperature and held at least 90 minutes before being read. (Cream warms more slowly than milk. Part of the fat will melt quickly, with the remainder dissolving at a slower rate in the melted portion. This requires time, but it is much faster than the crystallization which takes place when cooling. Extreme care was taken to prevent overheating.)

14. The calculation of specific gravity at each temperature was as follows:

    a. The weight of the empty bottle was subtracted from the weight of the sample plus bottle.

    b. The standard weight of water at the 4.0% mark was recorded.

    c. The water weight correction tables for cream (appendixes 4-7) were then used to correct for the volume of kerosene used, and to adjust the weight of water contained at the 4.0% mark to that of a volume equal to the volume of the cream in the Babcock bottle. Special water weight correction tables were established for cream because two additions of kerosene (1.50 ml) and in some cases, three additions (2.25 ml) were used.

    d. The specific gravity was then obtained by dividing the weight of the sample by the weight of water equal to the volume of the sample. This was done for each of the given temperatures.

DETERMINATION OF SPECIFIC GRAVITY BY THE WATSON LACTOMETER

The specific gravity of milk and of some skim milk samples was also determined at 102° F. by the use of Watson lactometers. All of the lactometers used were recalibrated under the direction and suggestions of Mr. Paul Watson, United States Department of Agriculture, retired. Appropriate corrections were made for lactometers that were found to have errors existing in their lactometer scale. The procedure for using the Watson lactometer was as follows:

1. Constant temperature water baths at 102° F. were used. The baths were deep enough that the water came within at least one inch of the tops of the cylinders.

2. The samples were warmed to 102° - 103° F. and then poured back and forth between their containers and the cylinders several times to release air dissolved in the milk sample.

3. Cylinders were then filled to such a point that they would overflow, or nearly overflow, when the lactometers were inserted.

4. The lactometers and the thermometers were placed in the cylinders so they neither touched nor rested against the walls of the cylinders. The lactometers were raised and lowered to stir the milk and to prevent separation of the cream until the milk, the cylinder and the lactometer came to a uniform temperature at 102° F. When the temperature became constant, the reading was recorded to the nearest fifth of a degree, and the thermometer was removed from the cylinder. Before the lactometers were read, they were lifted partially out of the cylinder and the upper part of the lactometer stem was quickly wiped with tissue, avoiding lifting the lactometer out of the milk further than necessary. Lactometers were then centered in the cylinder and read where the upper edge of the curved meniscus touched the stem of the lactometers. All readings were made to the nearest tenth degree Quevenne.

5. Corrections for error in the lactometer scale, if any, were then applied.

6. Temperature corrections were also applied. The difference between the actual temperature and 102° F. was multiplied by 0.23° Q. This correction was added if the reading was made above 102° F. and subtracted if the reading was made below 102° F. All corrections were rounded off to the nearest tenth degree Quevenne.

7. The results were then expressed as specific gravity (102°/102° F.) by writing 10 before the reading and moving the decimal point three places to the left.

CALCULATION OF WEIGHT PER GALLON

Calculation of the weight per gallon was made by multiplying the weight per gallon of water at a given temperature by the specific gravity of the product tested at that same temperature. From "International Critical Tables," Volume I, page 24, the following values for the volume of one gram of water weighed in air at 76 cm. or 29.9 inches pressure, 50% relative humidity, with brass weight density 8.3, were found:

1.00106 ml at 40° F.
1.00133 ml at 50° F.
1.00283 ml at 68° F.
1.00846 ml at 102° F.

There are 3,785.33 milliliters in a gallon and 453.592 grams in a pound. From this information the weight per gallon of water at the different temperatures was calculated as follows:

$$\frac{3,785.33 \text{ ml}}{453.592 \times 1.00106} = 8.3364 \text{ lbs. at } 40^\circ \text{ F.}$$

$$\frac{3,785.33 \text{ ml}}{453.592 \times 1.00133} = 8.3341 \text{ lbs. at } 50^\circ \text{ F.}$$

$$\frac{3,785.33 \text{ ml}}{453.592 \times 1.00283} = 8.3217 \text{ lbs. at } 68^\circ \text{ F.}$$

$$\frac{3,785.33 \text{ ml}}{453.592 \times 1.00846} = 8.2752 \text{ lbs. at } 102^\circ \text{ F.}$$

The weight in pounds per gallon for each product tested was then computed as follows:

8.3364 x sp. gr. 40°/ 40° F. = lbs. per gallon at 40° F.
8.3341 x sp. gr. 50°/ 50° F. = lbs. per gallon at 50° F.
8.3217 x sp. gr. 68°/ 68° F. = lbs. per gallon at 68° F.
8.2752 x sp. gr. 102°/102° F. = lbs. per gallon at 102° F.

ACTUAL WEIGHTS OF RETAIL CONTAINERS

A few of the laboratories made a study of actual weights of milk products in retail containers. Various types of scales were used in establishing the weight of the milk plus the container and of the thoroughly dried container after being emptied. The weight per unit volume was reported in grams or ounces.

TEMPERATURE

The weight per unit volume was determined at 40°, 50°, 68°, and 102° F. for the following reasons:

1. There was no established answer from a legal aspect as to what temperature should be used. This was clearly pointed out by Dr. B. L. Herrington in his article titled, "When is a Quart of Milk a Quart?", published in the November 1961 volume of the Journal of Dairy Science. That was one reason for the decision to work at several different temperatures.

2. At 40° F. because milk and many milk products are usually handled at that temperature.

3. The temperature of 50° F. was used by only a limited number of the laboratories. This temperature was used mainly for making comparisons with published tables that were based on that temperature.

4. A temperature of 68° F. was used for several reasons. It is the temperature frequently used for the calibration of laboratory glassware and glass milk bottles. It is in reasonable conformity with the present practice of most milk plants to check fill at room temperature. Then, too, the "Federal Food, Drug and Cosmetic Act," title 21, part 1.8(f), states that the labeling of liquid food sold by volume shall be in terms of the United States gallon of 231 cubic inches and quart, pint and fluid ounce subdivisions thereof, and volume shall be expressed at 68° F. (20° centigrade).

5. A temperature of 102° F. was selected because the Watson lactometer was designed to be read at that temperature. This enabled a comparison of specific gravity determined by the Babcock bottle method with the specific gravity determined by the Watson lactometer. At the 102° F. temperature, the fat in all dairy products is in a liquid state, thus insuring uniformity in the condition of fat in all samples at the time of testing. It was not possible to know the complete history of all the samples, thus involving Recknagel's phenomenon on the solidification and contraction of fat. For milk products it takes several hours of storage at low temperatures to reach maximum specific gravity due to the slow solidification of fat.

6. The temperatures of 40°, 50°, 68°, and 102° F. provided sufficient data to permit the study of the expansion of dairy products over a wide range of temperature changes.

Section III

REPORT OF THE FINDINGS SUBCOMMITTEE

The history and background of this cooperative study are described in Section I of this report. In Section II, the methods and procedures employed in the research work are set forth in detail. This Section is a factual report of the findings based on the research and analysis, with conclusions for use as guidelines.

The weight of a gallon of a fluid milk product depends primarily upon the proportionate amounts of butterfat and solids-not-fat. It also depends upon other factors such as the temperature of the milk; and to a lesser degree differences in the nature of the constituents attributable to geographic areas of production, seasonality of production and breed of cows; and to some extent the prior history of the sample being tested. Each of these factors can vary independently. Over the years, approximately 75 equations relating specific gravity to composition have been proposed, but none has been entirely satisfactory. Differences in these equations indicate the need for more comprehensive evidence of composition-volume-weight relationships.

DIFFERENCES IN WEIGHT DUE TO COMPOSITION

In this study, a number of samples of different kinds of fluid milk products in each of the participating markets were collected throughout the testing period. Butterfat and total solids determinations were made on all of these samples as outlined in Section II of this report. Specific gravity determinations at various temperatures were made by the Babcock bottle method.

Specific gravity determinations were also made at 102° F. by use of the Watson lactometer for homogenized milk, raw producer milk, and some unfortified skim milk products. Appendix 9 presents a comparison of the specific gravities determined by these two methods. The specific gravities determined by the Watson lactometer were slightly lower than those determined by the Babcock bottle method, averaging .00021 less. This should be expected when consideration is given to the special precaution taken in the Babcock bottle method to expel the minute air bubbles from the samples. (Section II of this report.)

Regression equations were obtained for each of the major products tested in this study for each of the participating markets, with an overall regression equation being computed for all participating markets for each of the major products tested (see appendixes 10 through 13). The regression equations computed for the same products varied somewhat among markets, but weights computed from these, as shown in appendixes 14 through 17, were surprisingly close in agreement. An examination of data for a given product within each market revealed variances among individual samples about as great as the variances among the markets. This fact is of even greater significance when the variations in product composition within and among markets are considered. Appendixes 14 through 17 also show for each market and product the number of samples tested, average and range of butterfat and solids-not-fat content, standard deviations of butterfat and solids-not-fat and the average weights per gallon.

It is appropriate to point out that these tables, as well as some others included in this report, contain only data from markets that analyzed a sufficient number of samples of each product to enable the calculation of regression equations. Even though a particular market may not have analyzed enough samples of a particular product to permit a regression equation to be calculated, such available test and weighing results were beneficial in appraising results obtained by other markets and were included in the major product regression equations developed for all markets. Since all markets worked at the 102° F. temperature, appendix 18 shows for each participating market the results for each product tested.

To observe differences in weight due to product composition, the effects of variations in the average butterfat and solids-not-fat contents of the samples tested in each market were eliminated by computing weights for products of identical compositions by use of regression equations derived for each product in each market. The identical compositions used for each product in this analysis approximated the average composition of each product tested in all participating markets. Appendix 19 shows the weights per gallon computed by individual market product regression equations for products with identical butterfat and solids-not-fat content at each of the recorded temperatures. For example, following are average weights per gallon for five products of average composition at specified temperatures:

	Pounds Per Gallon			
	40° F.	50° F.	68° F.	102° F.
Fortified skim milk	8.677	8.671	8.652	8.597
Homogenized milk	8.613	8.604	8.581	8.518
Half-and-half	8.559	8.544	8.502	8.420
Light cream	8.511	8.488	8.433	8.333
Heavy cream	8.406	8.376	8.290	8.154

THE EFFECT OF TEMPERATURE ON WEIGHTS OF FLUID MILK PRODUCTS

Volumes of fluid milk products, and hence weights per gallon, vary with changes in their temperature. Appendix 19 shows that as temperature increases, weight per gallon decreases. The amount of weight change per unit volume of a fluid milk product for each degree change in temperature is dependent primarily upon the amount of butterfat and solids-not-fat in the product. The weight changes for high fat products are greater than for low fat products. This is because the milkfat expands and contracts more than solids-not-fat with changing temperatures. For example, the weight of a gallon of heavy cream is one-quarter pound greater at 40° than at 102° F.:

Weight Per Gallon of Cream Containing 36.60% BF and 5.55% SNF	
40° F.	8.406 pounds
50° F.	8.376 pounds
68° F.	8.290 pounds
102° F.	8.154 pounds

The weight of a gallon of fortified skim milk, on the other hand, varied only from 8.677 pounds at 40° F. to 8.597 pounds at 102° F.:

Weight Per Gallon of Fortified Skim Milk Containing 0.15% BF and 10.15% SNF	
40° F	8.677 pounds
50° F.	8.671 pounds
68° F.	8.652 pounds
102° F.	8.597 pounds

Because of the significant effect of temperature on weight per unit volume of fluid milk products, it is important to establish all volume-weight conversion factors at specified temperatures. The effect of temperature on weight is shown graphically in appendix 20, which is based on the weights per gallon (computed by use of all market product regression equations), shown in appendix 19 for mixed breed producer milk, homogenized milk, and plain skim milk.

OTHER FACTORS AFFECTING WEIGHT OF FLUID MILK PRODUCTS

Geographic Location - The areas from which samples were drawn represent a geographic distribution that made it possible to observe differences due to location. Appendix 19, which contains the weight per gallon computed by individual market product regression equations as well as those computed from the all market product regression equations, shows that although the regression equations varied somewhat among markets for each product, when applied to products of like composition, the computed weights per gallon for each market were in close agreement. For example, in homogenized milk, the greatest variation in weight per gallon at 40° F. between the participating markets was .006 pound per gallon. The difference between the highest and the lowest weight at 50°, 68°, and 102° F. were .006, .008 and .011 pound per gallon, respectively. In the three lower temperatures, the weight in any one market did not differ by more than plus or minus .004 pound per gallon from the average. At 102° F., the widest variation from the average was .008 pound.

This is of great significance when consideration is given to the fact that the regression equations developed for each product in each market were based on samples of varying composition, and the number of samples tested varied among markets. Likewise, differences among markets attributable to different personnel, laboratory equipment, and laboratory conditions should be considered in appraising the closeness of these computed weights. From analysis of these data there appears to be little or no difference in weight per gallon of fluid milk products among the participating markets associated with geographic location.

Seasonality - Samples of different fluid milk products in many of the participating markets were collected monthly throughout the testing period so that differences in weight due to seasonality could be analyzed. It would be expected that the greatest variation in weight due to season of the year would occur in raw milk in its natural state; consequently, the weights of such milk were examined at 40° F. to determine if differences were associated with season of the year. In appendix 21, which contains data for mixed breed milk in three markets, the greatest difference for any month from the testing period average was .008 pound per gallon and the variation between the month of highest actual weight and the month of lowest actual weight in any one of the three markets was .014 pound per gallon. By using equations (explained later in this section) with the data in this appendix, the effects of the variations in product composition can be found to explain practically all the monthly weight differences.

Breed of Cow - Appendixes 22 through 26 contain limited data for specific breeds of cows. As was expected, there were sizeable variations in both the butterfat and solids-not-fat content of the milk from different breeds. In appendix 27, which shows a summary by markets of the individual breed data as well as data for mixed breeds, it is readily seen that Holstein milk contained the lowest average amount of solids-not-fat and butterfat. Guernsey milk had the highest average butterfat test, but Jersey milk contained the highest level of solids-not-fat. Even with these wide differences in milk composition, the average actual weights only varied by .033 pound per gallon among the five breeds (using the Central Arizona data - the only market that tested milk from all five breeds).

These weight differences as illustrated in appendixes 22 through 27 are due primarily to composition. Using equations discussed later to compute the weight of milk with the data contained in these tables, few, if any, of these differences were found to be attributable to differences in breed of cow.

DEVELOPMENT OF EQUATIONS FOR COMPUTING WEIGHTS OF FLUID MILK PRODUCTS

As illustrated in the foregoing part of this report, the two major factors affecting the weight of a fluid milk product are composition and temperature. Furthermore, it was found that weights per gallon of fluid milk products having identical composition at a given temperature do not differ substantially because of geographic location, season of the

year, or breed of cow. Therefore, it appears feasible to develop a mean of ascertaining a set of weight factors for use in all markets if product composition and temperatures are known.

REGRESSION EQUATIONS

As indicated previously, regression equations were obtained for each of the major products tested, where a sufficient number of samples was analyzed for each of the participating markets, with a regression equation being computed for all participating markets for each of the major products tested. These individual market and all market regression equations for the four temperatures (40°, 50°, 68°, and 102° F.) are shown in appendixes 10 through 13.

After determining that weights per gallon of fluid milk products with identical composition when computed from individual market regression equations did not differ substantially among markets, regression equations were calculated for like products for all participating markets. This resulted in eight principal regression equations, one each for (a) raw producer milk, (b) homogenized milk, (c) skim milk, (d) fortified skim milk, (e) half-and-half, (f) fortified half-and-half, (g) light cream and (h) heavy cream.

UNIVERSAL EQUATIONS

Realizing that the use of this number of different equations was impractical in computing weights of fluid milk products, the feasibility of using single equations at 40°, 50°, 68° and 102° F. for all products was investigated. A review was made of previous published research relating to mathematical determination of the weight of fluid milk products by use of equations. It was concluded that the use of equations that related weight to composition of the mixture was sound.

The formula, which involves the specific gravity approach, is as follows:

$$\text{Specific gravity of mixture} = \frac{100}{\frac{A}{\text{Sp. gr. of BF}} + \frac{B}{\text{Sp. gr. of SNF}} + \frac{C}{\text{Sp. gr. of water}}}$$

or

$$\text{Specific volume factor}^{1} = \frac{A}{\text{Sp. gr. of BF}} + \frac{B}{\text{Sp. gr. of SNF}} + \frac{C}{\text{Sp. gr. of water}}$$

$$\text{Specific gravity} = \frac{100}{\text{Sp. vol. factor}}$$

where: A = % by weight of butterfat in the mixture
B = % by weight of solids-not-fat in the mixture
C = % by weight of water in the mixture

For example, if a specific gravity of .9541 for butter fat and 1.6275 for solids-not-fat, are assumed, then starting with a volume of 100 percent of water and substituting 3.5 percent butterfat and 8.5 percent solids-not-fat for equal weights of water, the volume of the resulting product would be 96.8911 percent of the starting volume of water. Dividing 96.8911 (the specific volume factor) into 100 would give the specific gravity, 1.0321.

$$\frac{100}{\frac{3.5\%}{.9541} + \frac{8.5\%}{1.6275} + \frac{88\%}{1}} = \frac{100}{96.8911} = 1.0321$$

[1] The term specific volume factor is used here to refer to the specific volume x 100.

The specific gravities of butterfat and solids-not-fat may be converted to expansion factors for use in this equation by dividing the specific gravity into 1 and subtracting 1 from the result. Examples:

$$\frac{(\ 1\ )}{(.9541)} - 1 = 1.04811 - 1 \text{ or } .04811 = \text{the expansion factor for butterfat}$$

$$\frac{(\ 1\ )}{(1.6275)} - 1 = .61444 - 1 \text{ or } .38556 = \text{the expansion factor for solids-not-fat}$$

The factor for butterfat indicates that for each increase of one percent in the butterfat content, an increase of .04811 in the specific volume factor can be expected. The factor for solids-not-fat indicates that for each increase of one percent in the solids-not-fat content, a decrease of .38556 in the specific volume factor can be expected.

The formula for specific gravity may then be expressed as follows:

$$\text{Specific gravity of mixture} = \frac{100}{A + \%\ BF\ (BF\ factor) - \%\ SNF\ (SNF\ factor)}$$

Where A represents 100 percent water; the percentage of fat times the fat factor represents the increase in the volume of the product due to the substitution of fat for water; and the percentage of solids-not-fat times the solids-not-fat factor represents the contraction of the volume due to the substitution of solids-not-fat for water. Applying the same values as in the previous example to determine specific gravity:

$$\frac{100}{100 + 3.5\%\ (.04811) - 8.5\%\ (.38556)} = \frac{100}{96.8911} = 1.0321$$

The specific gravity determined by either of the above equations, when multiplied by the weight of a gallon of water, results in the weight of a gallon of the fluid milk product. In applying either of these equations, care should be exercised to make certain that all factors and the weight of water used are for the same temperature.

Using this type equation, review of previous research conducted by Sharp[2], Hilker and Caldwell[3], McDowell[4], and Jenness et al.[5] on the specific gravity of butterfat, and analysis of data collected in this study with respect to the specific gravity of solids-not-fat, a universal equation was developed. This universal equation along with the specific gravities of butterfat and solids-not-fat and the computed butterfat and solids-not-fat factors for use in this formula at the various temperatures are shown in appendix 28. It may be pointed out that this equation may be used to compute percent solids-not-fat when the percent butterfat and specific gravity of a fluid milk product are known. (See appendixes 40 and 41).

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[2] Sharp, Paul F., "Density of Fat at Different Temperatures" - Journal of Dairy Science, Vol. 11, Page 259, 1928.

[3] Hilker, L. D. and Caldwell, W. R., "A Method for Calculating the Weight Per Gallon of Fluid Dairy Products" - Journal of Dairy Science, Vol. 44, Page 183, 1961.

[4] McDowell, K. R., "The Properties of New Zealand Butterfat" - Journal of Dairy Research, Vol. 21, Page 383, 1954.

[5] Jenness, Robert; Herreid, Ernest O.; and coworkers, "The Density of Milk Fat" - Journal of Dairy Science, Vol. 25, Page 949, 1942.

The weight and test data collected for skim milk in this study served as the basis for calculating the apparent specific gravities of solids-not-fat in fluid skim milk products. Using the formula:

$$\frac{\text{\% SNF}}{\frac{100}{\text{(Sp. gr. of mixture)}} - \left(\frac{\text{\% BF}}{\text{(Sp. gr. of BF}} + \frac{\text{\% } H_2O}{\text{Sp. gr. of } H_2O)}\right)} = \text{Sp. gr. of SNF}$$

Specific gravities of solids-not-fat were calculated from a number of skim milk samples in several widely scattered markets at each of the four temperatures. (See appendixes 29 through 32) The following is a summary of the apparent specific gravities determined for solids-not-fat at the different recorded temperatures.

Apparent Specific Gravities of SNF at Selected Temperatures

Temperature	Apparent sp. gr. of SNF
40°/ 40° F.	1.6453
50°/ 50° F.	1.6275
68°/ 68° F.	1.6167
102°/102° F.	1.5952

It is appropriate to point out that even though a constant specific gravity for milk solids-not-fat was used for each temperature in this universal formula, recognition is given to the fact that changes in the composition of milk solids-not-fat will result in small changes in the specific gravity of the milk solids-not-fat. Previous studies have shown that as the level of milk solids-not-fat increases in natural milk, the specific gravities increase at a decreasing rate. These studies have shown that the lactose (sugar) and the ash content in the milk solids-not-fat change very little as total milk solids-not-fat increase, but the principal change is in the amount of protein. Protein is the lightest component of milk solids-not-fat. Thus, when total milk solids-not-fat increase, most of the increase is due to increased amounts of protein with the resulting change (decreasing rate) in the specific gravity of the total milk solids-not-fat.

After consideration of all pertinent data, the committee concluded that the small effect resulting from this change in specific gravity of milk solids-not-fat would have no appreciable effect on the end result: computed weight per gallon of fluid milk products.

In the universal formula shown in appendix 28, the specific gravities used for butterfat were computed from the density values determined by Sharp. A review of the work of others (previously referenced) in this area revealed that Sharp's values were near the average for all work reviewed. Sharp's data were based on extensive work over a wide range of temperatures. It is generally agreed that the specific gravity of milk fat is relatively constant for a specific temperature regardless of geographic location or breeds. The variations in the specific gravity of butterfat which occur would result in very few, if any, differences in resultant weight computations.

To show the reliability of the all market regression equations and universal equation for computing the weight per gallon of fluid milk products, five samples (where available) were selected at random from each participating market for each group of products: (1) raw producer milk, (2) homogenized milk, (3) skim milk, (4) fortified skim milk, (5) half-and-half, (6) fortified half-and-half, (7) light cream, and (8) heavy cream. The weights per gallon of the fluid milk products were computed using the regression equation for each specific group of products from all participating markets at each of the recorded temperatures. The universal equation with the specific gravities for milk solids-not-fat and butterfat, previously described, was applied to these same random selected samples and weights per gallon were computed. Appendixes 33 through 36 show a comparison of the weights of the selected samples as determined by (1) the bottle method, (2) the all market product regression equations, and (3) the universal equation for each of the four temperatures.

It is appropriate to point out that the weights determined by the all market regression equation for each product would be expected to be in near agreement with the weights determined by the bottle method of determining specific volume, since the latter were actually used in arriving at the individual product regression equations. Thus, any testing and weighing errors that may have occurred in the determinations are automatically reflected in the regression equations.

To further illustrate the workability of the universal equation, comparisons were made of weight computations on specific breed milks. Limited data were available from this study on individual breed milk; however, the Chicago and Central Arizona markets did collect some monthly breed data. The Puget Sound, North Texas, and Washington, D. C., markets collected data on mixed breed milk. Appendix 27 shows a summary of the average butterfat and solids-not-fat tests of these samples and average weights per gallon as determined by the Babcock bottle method compared with the average weights computed by use of the universal equation for individual breed and mixed breed milk in each of the selected markets (at 40° F.). From the monthly weights by market and breed shown in appendixes 22 through 26, it can readily be seen that weights determined by the universal equation check closely (in the third decimal place) with the actual weights determined by the bottle method.

From the weight comparisons and differences shown in appendixes 33 through 36, it was concluded that weights computed by using the universal equation differed from actual weights (determined by bottle method) slightly more than those computed by using the eight all market product regression equations. These differences were minute enough to permit the use of a single universal equation in the computation of unit weights of fluid milk products.

WEIGHT CONVERSION FACTORS

Appendixes 37-39 show weights of fluid milk products that contain varying amounts of butterfat and solids-not-fat (for 40°, 50°, and 68° F.). Weights were computed for 40° F. because this temperature approaches the temperature at which producer milk is measured on the farm and received at plants, as well as the temperature at which most plants bottle and store fluid milk products. The weights at 50° F. were computed for comparison with weights on many published tables. The weights were computed at 68° F. primarily because this is the more common temperature used by most regulatory agencies in checking the fill of packaged and bottled fluid milk products.

CONCLUSIONS

After consideration of the manner in which this study was conducted and after careful review of the findings as reported herein, the committee presents the following conclusions:

(1) Composition of fluid milk products is the most important factor affecting weight.

(2) The effect of temperature on the weight of fluid milk products is sufficiently important to require its inclusion in weight determinations.

(3) Differences in weight associated with geographic location, breed of cow (except as breed affects composition), and season of the year are relatively unimportant.

(4) Weights computed from the universal equation or taken from the standard weight conversion tables (appendixes 37-39), when related to product composition determined by acceptable laboratory methods, are more accurate than any single equation or table of weights heretofore developed.

APPENDIX

APPENDIX

APPENDIX 1.--CALCULATION OF STANDARD WEIGHTS OF WATER

A. Based on table in Volume I of International Critical Tables, page 80, the following values for the volume of 1 gram of water weighed in air with brass weights, were used:

at 40°F. or	4.4°C.	1.00106* ml
50°F. or	10.0°C.	1.00133 ml
68°F. or	20.0°C.	1.00283 ml
102°F. or	38.9°C.	1.00846* ml

*The values for fractional degrees centigrade were obtained by interpolation.

B. The weight of water occupying 1 ml of space at different temperatures was calculated by taking the reciprocals of the volumes per gram. Values below are for those who calibrated their bottles at 102°F.

Temperatures	Actual values	Relative values
40°F.	.998941	1.00739
50°F.	.998672	1.00712
68°F.	.997178	1.00561
102°F.	.991611	1.00000

Values below are for those who calibrated their bottles at 68°F.

Temperatures	Actual values	Relative values
40°F.	.998941	1.00177
50°F.	.998672	1.00150
68°F.	.997178	1.00000
102°F.	.991611	.99442

C. We can measure the weight of water required to fill a test bottle at 102°F. by direct weighing. We can calculate the weight of water required to fill it at other temperatures by making two corrections:

1. The changing weight of 1 ml of water is shown in part B.

2. The change in the number of ml as the bottle expands or contracts is shown in part D.

D. The Kimble Glass Company reported that the coefficient of cubical expansion of their glass was 0.0000279 per degree centigrade. If the original measurements were made at 102°F. the correction factor for volume will be:

at 40°F.	1-(34.5°C. x 0.0000279)	or	.999037
at 50°F.	1-(28.9°C. x 0.0000279)	or	.999194
at 68°F.	1-(18.9°C. x 0.0000279)	or	.999473

If the original measurements were made at 68°F. the correction factor for volume will be:

at 40°F.	1-(15.6°C. x 0.0000279)	or	.999565
at 50°F.	1-(10.0°C. x 0.0000279)	or	.999721
at 102°F.	1+(18.9°C. x 0.0000279)	or	1.000527

E. We can combine the correction factors for changing weight of 1 ml of water, last column of part B, and the correction for changing volume of the glass bottle, part D, by

multiplying them together.* The combined correction factors for computing standard weight of water at other temperatures from the values at 102 °F. are:

40 °F.	1.00642
50 °F.	1.00631
68 °F.	1.00508

The combined correction factors for computing standard weight of water at other temperatures from the values at 68 °F. are:

40 °F.	1.00133
50 °F.	1.00122
102 °F.	.99494

*The expansion factor is multiplied by the relative weight rather than the relative volume of the water because a volumetric expansion of the Babcock bottle would result in a lower reading.

APPENDIX 2.--CALCULATION OF WATER WEIGHT CORRECTIONS

A. The syringe should deliver 0.750 ml at 70°-75° F. It is impractical and unnecessary to get closer temperature control than "room temperature."

B. .750 ml kerosene at 73° F. becomes:

.738 ml at 40° F.
.741 ml at 50° F.
.748 ml at 68° F.
.761 ml at 102° F.

C. When read to the nearest half division on the test bottle, these volumes of kerosene represent:

3.70% at 40° F.
3.70% at 50° F.
3.75% at 68° F.
3.80% at 102° F.

D. The recorded reading of test bottles containing one portion of kerosene will be high by these percentages. For example, if the true reading of the sample is 4.00% at 102° F., the kerosene reading (including the sample plus the kerosene) will be 7.80% because .750 ml of kerosene at 102° F. amounts to 3.80% in the graduated portion of the test bottles. Therefore, if the kerosene reading is 7.8% the water weight correction is zero because the standard weight of water was established at the 4.0% mark and the only time a correction is needed is when the true volume of the sample varies from 4.0%.

E. If the kerosene reading is one graduation below 7.80 at 102° F. (or below 7.70 at 40° F.), the standard weight of water would be one graduation greater than the true volume of the sample. Consequently, the standard weight of water must be reduced by 0.02 ml times the weight of 1 ml of water at this temperature. The change in weight per half graduation would be:

0.01 ml times 0.9989 at 40° F.
0.01 ml times 0.9987 at 50° F.
0.01 ml times 0.9972 at 68° F.
0.01 ml times 0.9916 at 102° F.

F. The table of water weight corrections was calculated by starting where the water weight correction was zero and increasing the correction by the amount in part E for each half graduation. The corrections were then rounded off to two decimal places.

The same method was used to calculate corrections when two or three portions of kerosene were used.

APPENDIX 3.--WATER WEIGHT CORRECTIONS FOR MILK AND SKIM MILK

This table assumes that 0.75 ml of kerosene, measured at 70°-75°F. has been added to each bottle. It allows for the expansion of both kerosene and water.

Oil reading	Water weight correction			Oil reading	Water weight correction		
	40°-50°F.	68°F.	102°F.		40°-50°F.	68°F.	102°F.
Percent		Grams		Percent		Grams	
1.00	1.34			2.95	.95	.96	.97
1.05	1.33			3.00	.94	.95	.96
1.10	1.32			3.05	.93	.94	.95
1.15	1.31			3.10	.92	.93	.94
1.20	1.30			3.15	.91	.92	.93
1.25	1.29			3.20	.90	.91	.92
1.30	1.28			3.25	.89	.90	.91
1.35	1.27			3.30	.88	.89	.90
1.40	1.26			3.35	.87	.88	.89
1.45	1.25			3.40	.86	.87	.88
1.50	1.24			3.45	.85	.86	.87
1.55	1.23			3.50	.84	.85	.86
1.60	1.22			3.55	.83	.84	.85
1.65	1.21			3.60	.82	.83	.84
1.70	1.20			3.65	.81	.82	.83
1.75	1.19			3.70	.80	.81	.82
1.80	1.18			3.75	.79	.80	.81
1.85	1.17			3.80	.78	.79	.80
1.90	1.16			3.85	.77	.78	.79
1.95	1.15			3.90	.76	.77	.78
2.00	1.14	1.15	1.16	3.95	.75	.76	.77
2.05	1.13	1.14	1.15	4.00	.74	.75	.76
2.10	1.12	1.13	1.14	4.05	.73	.74	.75
2.15	1.11	1.12	1.13	4.10	.72	.73	.74
2.20	1.10	1.11	1.12	4.15	.71	.72	.73
2.25	1.09	1.10	1.11	4.20	.70	.71	.72
2.30	1.08	1.09	1.10	4.25	.69	.70	.71
2.35	1.07	1.08	1.09	4.30	.68	.69	.70
2.40	1.06	1.07	1.08	4.35	.67	.68	.69
2.45	1.05	1.06	1.07	4.40	.66	.67	.68
2.50	1.04	1.05	1.06	4.45	.65	.66	.67
2.55	1.03	1.04	1.05	4.50	.64	.65	.66
2.60	1.02	1.03	1.04	4.55	.63	.64	.65
2.65	1.01	1.02	1.03	4.60	.62	.63	.64
2.70	1.00	1.01	1.02	4.65	.61	.62	.63
2.75	.99	1.00	1.01	4.70	.60	.61	.62
2.80	.98	.99	1.00	4.75	.59	.60	.61
2.85	.97	.98	.99	4.80	.58	.59	.60
2.90	.96	.97	.98	4.85	.57	.58	.59

APPENDIX 3.--WATER WEIGHT CORRECTIONS FOR MILK AND SKIM MILK--Continued

Oil reading	Water weight correction			Oil reading	Water weight correction		
	40°-50°F.	68°F.	102°F.		40°-50°F.	68°F.	102°F.
Percent		Grams		Percent		Grams	
4.90	.56	.57	.58	6.60	.22	.23	.24
4.95	.55	.56	.57	6.65	.21	.22	.23
5.00	.54	.55	.56	6.70	.20	.21	.22
5.05	.53	.54	.55	6.75	.19	.20	.21
5.10	.52	.53	.54	6.80	.18	.19	.20
5.15	.51	.52	.53	6.85	.17	.18	.19
5.20	.50	.51	.52	6.90	.16	.17	.18
5.25	.49	.50	.51	6.95	.15	.16	.17
5.30	.48	.49	.50	7.00	.14	.15	.16
5.35	.47	.48	.49	7.05	.13	.14	.15
5.40	.46	.47	.48	7.10	.12	.13	.14
5.45	.45	.46	.47	7.15	.11	.12	.13
5.50	.44	.45	.46	7.20	.10	.11	.12
5.55	.43	.44	.45	7.25	.09	.10	.11
5.60	.42	.43	.44	7.30	.08	.09	.10
5.65	.41	.42	.43	7.35	.07	.08	.09
5.70	.40	.41	.42	7.40	.06	.07	.08
5.75	.39	.40	.41	7.45	.05	.06	.07
5.80	.38	.39	.40	7.50	.04	.05	.06
5.85	.37	.38	.39	7.55	.03	.04	.05
5.90	.36	.37	.38	7.60	.02	.03	.04
5.95	.35	.36	.37	7.65	.01	.02	.03
6.00	.34	.35	.36	7.70	.00	.01	.02
6.05	.33	.34	.35	7.75	+.01	.00	.01
6.10	.32	.33	.34	7.80	+.02	+.01	.00
6.15	.31	.32	.33	7.85	+.03	+.02	+.01
6.20	.30	.31	.32	7.90	+.04	+.03	+.02
6.25	.29	.30	.31	7.95	+.05	+.04	+.03
6.30	.28	.29	.30	8.00	+.06	+.05	+.04
6.35	.27	.28	.29	8.05	+.07	+.06	+.05
6.40	.26	.27	.28	8.10	+.08	+.07	+.06
6.45	.25	.26	.27	8.15	+.09	+.08	+.07
6.50	.24	.25	.26	8.20	+.10	+.09	+.08
6.55	.23	.24	.25	8.25	+.11	+.10	+.09

Values marked + should be added instead of subtracted.

APPENDIX 4.--WATER WEIGHT CORRECTIONS FOR CREAM AT 102°F.

This table for cream assumes that exactly 1.50 ml of kerosene, measured at 70°-75°F., has been added to each bottle.

102°F.					
Percent	Grams	Percent	Grams	Percent	Grams
4.10	1.50	5.65	1.19	7.20	.88
4.15	1.49	5.70	1.18	7.25	.87
4.20	1.48	5.75	1.17	7.30	.86
4.25	1.47	5.80	1.16	7.35	.85
4.30	1.46	5.85	1.15	7.40	.84
4.35	1.45	5.90	1.14	7.45	.83
4.40	1.44	5.95	1.13	7.50	.82
4.45	1.43	6.00	1.12	7.55	.81
4.50	1.42	6.05	1.11	7.60	.80
4.55	1.41	6.10	1.10	7.65	.79
4.60	1.40	6.15	1.09	7.70	.78
4.65	1.39	6.20	1.08	7.75	.77
4.70	1.38	6.25	1.07	7.80	.76
4.75	1.37	6.30	1.06	7.85	.75
4.80	1.36	6.35	1.05	7.90	.74
4.85	1.35	6.40	1.04	7.95	.73
4.90	1.34	6.45	1.03	8.00	.72
4.95	1.33	6.50	1.02	8.05	.71
5.00	1.32	6.55	1.01	8.10	.70
5.05	1.31	6.60	1.00	8.15	.69
5.10	1.30	6.65	.99	8.20	.68
5.15	1.29	6.70	.98	8.25	.67
5.20	1.28	6.75	.97	8.30	.66
5.25	1.27	6.80	.96	8.35	.65
5.30	1.26	6.85	.95	8.40	.64
5.35	1.25	6.90	.94	8.45	.63
5.40	1.24	6.95	.93	8.50	.62
5.45	1.23	7.00	.92	8.55	.61
5.50	1.22	7.05	.91	8.60	.60
5.55	1.21	7.10	.90	8.65	.59
5.60	1.20	7.15	.89	8.70	.58

APPENDIX 5.--WATER WEIGHT CORRECTIONS FOR CREAM AT 68°F.

This table for cream assumes that exactly 1.50 ml of kerosene, measured at 70°-75°F., has been added to each bottle. If additional kerosene is needed to read heavy cream at lower temperatures, the extra amount should be exactly 0.75 ml measured at 40°-50°F.

68° F.

1.50 ml kerosene added				2.25 ml kerosene added			
Percent	Grams	Percent	Grams	Percent	Grams	Percent	Grams
3.00	1.70	4.75	1.35	4.50	2.15	6.30	1.79
3.05	1.69	4.80	1.34	4.55	2.14	6.35	1.78
3.10	1.68	4.85	1.33	4.60	2.13	6.40	1.78
3.15	1.67	4.90	1.32	4.65	2.12	6.45	1.77
3.20	1.66	4.95	1.31	4.70	2.11	6.50	1.76
3.25	1.65	5.00	1.30	4.75	2.10	6.55	1.75
3.30	1.64	5.05	1.29	4.80	2.09	6.60	1.74
3.35	1.63	5.10	1.28	4.85	2.08	6.65	1.73
3.40	1.62	5.15	1.27	4.90	2.07	6.70	1.72
3.45	1.61	5.20	1.26	4.95	2.06	6.75	1.71
3.50	1.60	5.25	1.25	5.00	2.05	6.80	1.70
3.55	1.59	5.30	1.24	5.05	2.04	6.85	1.69
3.60	1.58	5.35	1.23	5.10	2.03	6.90	1.68
3.65	1.57	5.40	1.22	5.15	2.02	6.95	1.67
3.70	1.56	5.45	1.21	5.20	2.01	7.00	1.66
3.75	1.55	5.50	1.20	5.25	2.00	7.05	1.65
3.80	1.54	5.55	1.19	5.30	1.99	7.10	1.64
3.85	1.53	5.60	1.18	5.35	1.98	7.15	1.63
3.90	1.52	5.65	1.17	5.40	1.97	7.20	1.62
3.95	1.51	5.70	1.16	5.45	1.96	7.25	1.61
4.00	1.50	5.75	1.15	5.50	1.95	7.30	1.60
4.05	1.49	5.80	1.14	5.55	1.94	7.35	1.59
4.10	1.48	5.85	1.13	5.60	1.93	7.40	1.58
4.15	1.47	5.90	1.12	5.65	1.92	7.45	1.57
4.20	1.46	5.95	1.11	5.70	1.91	7.50	1.56
4.25	1.45	6.00	1.10	5.75	1.90	7.55	1.55
4.30	1.44	6.05	1.09	5.80	1.89	7.60	1.54
4.35	1.43	6.10	1.08	5.85	1.88	7.65	1.53
4.40	1.42	6.15	1.07	5.90	1.87	7.70	1.52
4.45	1.41	6.20	1.06	5.95	1.86	7.75	1.51
4.50	1.40	6.25	1.05	6.00	1.85	7.80	1.50
4.55	1.39	6.30	1.04	6.05	1.84	7.85	1.49
4.60	1.38	6.35	1.03	6.10	1.83	7.90	1.48
4.65	1.37	6.40	1.02	6.15	1.82	7.95	1.47
4.70	1.36	6.45	1.01	6.20	1.81	8.00	1.46
		6.50	1.00	6.25	1.80		

APPENDIX 6.--WATER WEIGHT CORRECTIONS FOR CREAM AT 40°-50°F.

1.50 ml kerosene added

40°-50°F.

Percent	Grams	Percent	Grams	Percent	Grams
.00	2.28	2.00	1.88	4.00	1.48
.05	2.27	2.05	1.87	4.05	1.47
.10	2.26	2.10	1.86	4.10	1.46
.15	2.25	2.15	1.85	4.15	1.45
.20	2.24	2.20	1.84	4.20	1.44
.25	2.23	2.25	1.83	4.25	1.43
.30	2.22	2.30	1.82	4.30	1.42
.35	2.21	2.35	1.81	4.35	1.41
.40	2.20	2.40	1.80	4.40	1.40
.45	2.19	2.45	1.79	4.45	1.39
.50	2.18	2.50	1.78	4.50	1.38
.55	2.17	2.55	1.77	4.55	1.37
.60	2.16	2.60	1.76	4.60	1.36
.65	2.15	2.65	1.75	4.65	1.35
.70	2.14	2.70	1.74	4.70	1.34
.75	2.13	2.75	1.73	4.75	1.33
.80	2.12	2.80	1.72	4.80	1.32
.85	2.11	2.85	1.71	4.85	1.31
.90	2.10	2.90	1.70	4.90	1.30
.95	2.09	2.95	1.69	4.95	1.29
1.00	2.08	3.00	1.68	5.00	1.28
1.05	2.07	3.05	1.67	5.05	1.27
1.10	2.06	3.10	1.66	5.10	1.26
1.15	2.05	3.15	1.65	5.15	1.25
1.20	2.04	3.20	1.64	5.20	1.24
1.25	2.03	3.25	1.63	5.25	1.23
1.30	2.02	3.30	1.62	5.30	1.22
1.35	2.01	3.35	1.61	5.35	1.21
1.40	2.00	3.40	1.60	5.40	1.20
1.45	1.99	3.45	1.59	5.45	1.19
1.50	1.98	3.50	1.58	5.50	1.18
1.55	1.97	3.55	1.57	5.55	1.17
1.60	1.96	3.60	1.56	5.60	1.16
1.65	1.95	3.65	1.55	5.65	1.15
1.70	1.94	3.70	1.54	5.70	1.14
1.75	1.93	3.75	1.53	5.75	1.13
1.80	1.92	3.80	1.52	5.80	1.12
1.85	1.91	3.85	1.51	5.85	1.11
1.90	1.90	3.90	1.50	5.90	1.10
1.95	1.89	3.95	1.49	5.95	1.09
				6.00	1.08

APPENDIX 7.--WATER WEIGHT CORRECTIONS FOR CREAM AT 40°-50°F.

2.25 ml kerosene added

40°-50°F.

Percent	Grams	Percent	Grams
1.00	2.83	3.00	2.43
1.05	2.82	3.05	2.42
1.10	2.81	3.10	2.41
1.15	2.80	3.15	2.40
1.20	2.79	3.20	2.39
1.25	2.78	3.25	2.38
1.30	2.77	3.30	2.37
1.35	2.76	3.35	2.36
1.40	2.75	3.40	2.35
1.45	2.74	3.45	2.34
1.50	2.73	3.50	2.33
1.55	2.72	3.55	2.32
1.60	2.71	3.60	2.31
1.65	2.70	3.65	2.30
1.70	2.69	3.70	2.29
1.75	2.68	3.75	2.28
1.80	2.67	3.80	2.27
1.85	2.66	3.85	2.26
1.90	2.65	3.90	2.25
1.95	2.64	3.95	2.24
2.00	2.63	4.00	2.23
2.05	2.62	4.05	2.22
2.10	2.61	4.10	2.21
2.15	2.60	4.15	2.20
2.20	2.59	4.20	2.19
2.25	2.58	4.25	2.18
2.30	2.57	4.30	2.17
2.35	2.56	4.35	2.16
2.40	2.55	4.40	2.15
2.45	2.54	4.45	2.14
2.50	2.53	4.50	2.13
2.55	2.52	4.55	2.12
2.60	2.51	4.60	2.11
2.65	2.50	4.65	2.10
2.70	2.49	4.70	2.09
2.75	2.48	4.75	2.08
2.80	2.47	4.80	2.07
2.85	2.46	4.85	2.06
2.90	2.45	4.90	2.05
2.95	2.44	4.95	2.04
		5.00	2.03

APPENDIX 8.--RATE OF TEMPERATURE EQUILIBRATION

The time required to come to equilibrium at 40° F. is long because crystallization of fat is slow, especially in homogenized products. The effect of slow crystallization of fat is most easily observed in high fat products where the total contraction is larger. The following experiment was designed to measure the rate of contraction.

Twelve bottles were used. The first four contained cream (18% fat). The remaining eight contained the same cream after passing through a Manton Gaulin homogenizer at 2500 pounds pressure.

All bottles were read with kerosene estimating to tenths of divisions. All bottles were carefully equilibrated at 102° F. The meniscus reading at 102° F. was considered the initial reading during the cooling process.

The bottles were placed in a water bath at 40° F. and read after various intervals of time in the 40° F. bath. Bottles 3, 4, 7, 8, 11, and 12 were precooled in ice water for 20 minutes before placing them in the 40°F. bath. The other bottles were transferred directly from the bath at 102°F. to the bath at 40°F.

Contraction was considered complete after 21 hours at 40° F. The percent of the total contraction which had occurred after various periods of time is shown in the following table.

Percent of Total Contraction (Average Total Contraction 50.2 Spaces)

Minutes in 40° F. bath	Bottle Numbers											
	1	2	3	4	5	6	7	8	9	10	11	12
	Percent											
15	83.4	81.4	87.9	87.6	79.6	79.4	84.3	83.9	81.9	82.7	85.4	84.1
30	87.3	85.0	92.4	91.2	83.1	83.3	85.3	85.0	83.3	84.7	86.4	86.9
45	90.2	88.3	94.3	94.6	84.3	84.3	87.6	87.9	84.6	85.7	88.4	88.9
60	92.2	91.0	95.3	95.4	84.9	85.2	87.6	87.9	85.5	86.7	88.4	88.9
90	95.2	94.0	96.5	96.2	86.8	87.6	89.6	89.4	86.9	87.8	89.9	90.5
120	95.8	95.7	97.8	97.4	89.8	90.2	92.2	91.9	88.4	90.4	91.8	92.1
150	98.1	96.8	98.6	98.0	91.2	91.8	93.2	92.9	90.8	91.8	93.0	93.0
210	98.1	97.8	98.8	98.4	92.9	93.4	94.5	93.9	92.3	93.5	94.6	95.0
270	98.7	97.8	99.0	98.6	94.0	95.4	95.5	95.0	93.7	94.5	95.4	95.0
1260	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

NOTES: The homogenized samples (5-12) contracted more slowly than the non homogenized samples. This is most evident at 90 minutes but it is still evident at 270 minutes (4 1/2 hours). Prechilling in ice water did not appreciably shorten the time required for equilibration at 40° F. Contraction is not complete after 4 1/2 hours. (Average error in homogenized cream at 4 1/2 hours would be 2.7 divisions.) On the basis of this and similar experiments, it is recommended that bottles be held at least 15 hours at 40° F. before reading.

APPENDIX 9.--SPECIFIC GRAVITIES DETERMINED BY THE BABCOCK BOTTLE METHOD AT 102° F. COMPARED WITH THE WATSON LACTOMETER AT 102° F.

Product	Market	Number of samples	Sp. gr. bottle method	Sp. gr. Watson lact.	Watson minus bottle method
Mixed breed producer milk	North Texas	74	1.02949	1.02930	-.00019
	Oklahoma Metropolitan	5	1.03068	1.03028	-.00040
	Puget Sound	408	1.03017	1.02991	-.00026
	Southeastern Florida	16	1.02987	1.02931	-.00056
	Washington, D.C.	63	1.03000	1.02967	-.00033
Breed milk Holstein	Central Arizona	49	1.02803	1.02816	+.00013
	Chicago	63	1.02915	1.02929	+.00014
	Southeastern Florida	13	1.02983	1.02941	-.00042
Jersey	Central Arizona	49	1.03095	1.03093	-.00002
	Southeastern Florida	15	1.03053	1.03001	-.00052
Guernsey	Central Arizona	51	1.02914	1.02941	+.00027
	Southeastern Florida	8	1.02983	1.02938	-.00045
Ayrshire	Central Arizona	51	1.02971	1.02986	+.00015
	Chicago	50	1.02948	1.02949	+.00001
Brown Swiss	Central Arizona	51	1.03027	1.03030	+.00003
Homogenized milk, packaged	Central Arizona	106	1.02878	1.02903	+.00025
	Chicago	55	1.02924	1.02949	+.00025
	Kansas City	45	1.02943	1.02904	-.00039
	Minneapolis-St. Paul	126	1.02935	1.02907	-.00028
	North Texas	100	1.02912	1.02882	-.00030
	Oklahoma Metropolitan	13	1.02992	1.02953	-.00039
	Puget Sound	100	1.03031	1.03002	-.00029
	Washington, D.C.	286	1.02960	1.02924	-.00036
Skim milk (raw)	Chicago	66	1.03443	1.03437	-.00006
	Kansas City	1	1.03381	1.03360	-.00021
	North Texas	1	1.03426	1.03420	-.00006
	Puget Sound	16	1.03484	1.03462	-.00022
	Washington, D.C.	62	1.03419	1.03389	-.00030

APPENDIX 9.--SPECIFIC GRAVITIES DETERMINED BY THE BABCOCK BOTTLE METHOD AT 102° F. COMPARED WITH THE WATSON LACTOMETER AT 102° F.--Continued

Product	Market	Number of samples	Sp. gr. bottle method	Sp. gr. Watson lact.	Watson minus bottle method
Skim milk, packaged	Central Arizona	103	1.03369	1.03369	.00000
	Kansas City	11	1.03366	1.03327	-.00039
	Minneapolis-St. Paul	24	1.03414	1.03368	-.00046
	North Texas	8	1.03460	1.03429	-.00031
	Puget Sound	31	1.03498	1.03475	-.00023
	Washington, D.C.	71	1.03421	1.03395	-.00026
Fortified skim milk, packaged	Central Arizona	14	1.03668	1.03650	-.00018
	Minneapolis-St. Paul	26	1.03542	1.03504	-.00038
	Puget Sound	6	1.03714	1.03687	-.00027
Part skim, packaged	Kansas City	16	1.03229	1.03202	-.00027
	North Texas	11	1.03201	1.03160	-.00041
	Oklahoma Metropolitan	5	1.03201	1.03186	-.00015
	Puget Sound	13	1.03335	1.03313	-.00022
	Washington, D.C.	71	1.03298	1.03266	-.00032
Fortified part skim, packaged	Central Arizona	61	1.03484	1.03478	-.00006
	Chicago	56	1.03554	1.03556	+.00002
	Puget Sound	32	1.03587	1.03569	-.00018
	Oklahoma Metropolitan	1	1.03510	1.03500	-.00010
	Kansas City	19	1.03606	1.03548	-.00058
	Minneapolis-St. Paul	80	1.03508	1.03472	-.00036
Average			1.03217	1.03196	-.00021

APPENDIX 10.--MARKET REGRESSION EQUATIONS FOR DIFFERENT PRODUCTS TESTED[1] - 40° F.

Product and market	Number of samples	A	B	Std. dev. of B + or -	C	Std. dev of C + or -	Std. error of est.[2] + or -	Coefficient of multiple determination
Mixed breed producer milk								
New York[3]	18	98.941959	+.060101	.020679	-.276663	.043712	.053417	.728586
North Texas	74	99.060849	-.016316	.014841	-.261055	.023364	.028881	.930241
Oklahoma Metropolitan	48	98.964646	+.024648	.010537	-.270249	.023400	.055839	.872694
Puget Sound	407	98.773096	-.015733	.005027	-.228876	.008283	.038254	.831779
Washington, D.C.	62	98.514512	-.105030	.022940	-.161752	.032327	.038440	.732145
All markets[4]	[5] 562	98.801944	-.017527	.004595	-.231511	.007345	.037883	.838974
Homogenized milk, packaged								
Central Arizona	105	98.740952	+.005993	.026793	-.230379	.036519	.046464	.302424
Chicago	55	96.914470	-.028334	.119416	+.000448	.051236	.038583	.001083
Minneapolis-St. Paul	126	98.094259	+.047762	.007802	-.170769	.023747	.034530	.475720
New York - all regions[6]	891	98.875169	-.021579	.006920	-.232053	.007749	.044193	.609548
Region 6	144	98.381843	-.035590	.019592	-.167481	.020410	.048115	.489974
Region 2	184	99.318453	+.002189	.012876	-.294362	.014586	.051165	.740077
Region 3 & 4	297	98.933634	-.014965	.010602	-.241800	.013856	.035609	.657607
Region 1 & 5	266	98.382244	-.050020	.019146	-.161639	.016214	.040929	.297628
North Texas	100	99.038060	+.020426	.012129	-.267959	.021672	.038677	.611856
Oklahoma Metropolitan	82	99.523205	+.007979	.012797	-.323751	.015883	.024615	.862649
Puget Sound	100	98.937735	+.045709	.006734	-.273827	.016126	.030393	.790312
Washington, D.C.	264	98.964609	-.013562	.010397	-.252074	.015886	.054417	.561090
All markets[4]	1,737	99.134288	-.002757	.004309	-.271933	.005599	.051368	.604523
Skim milk, packaged								
Central Arizona	106	99.005922	-.054351	.030179	-.277240	.019834	.038264	.667573
Minneapolis-St. Paul	24	99.341147	+.020342	.037525	-.314973	.090262	.106503	.367032
New York - all regions[6]	405	99.721225	-.066483	.034352	-.356059	.005743	.048919	.905918
Region 6	90	99.549532	+.037715	.073138	-.337355	.013592	.039927	.879056
Region 2	126	99.686100	-.085747	.051964	-.350974	.007618	.039574	.946696
Region 3 & 4	164	99.656788	-.084368	.061289	-.348588	.014170	.058473	.790094
Region 1 & 5	25	99.936817	-.116528	.173934	-.383545	.010497	.022485	.992980
Puget Sound	34	99.689292	-.036621	.056291	-.356363	.022651	.025532	.892666
Washington, D.C.	72	99.492542	+.102377	.055295	-.335707	.026935	.040678	.715538
All markets[4]	650	99.636628	-.003920	.012356	-.348242	.005458	.050816	.862859
Fortified skim milk, packaged								
Central Arizona	29	99.460937	-.056821	.288305	-.332106	.040181	.084661	.731488
Minneapolis-St. Paul	46	99.740390	-.047674	.071030	-.356601	.006605	.031708	.988170
New York - all regions[6]	248	99.827523	+.035554	.037054	-.371927	.005115	.038458	.955938
Region 6	29	99.812185	-.194092	.100200	-.367386	.021576	.032457	.939278
Region 2	45	99.782021	+.021595	.096290	-.368008	.015241	.038509	.940341
Region 3 & 4	25	99.668597	+.125296	.123427	-.354855	.014688	.046776	.970655
Region 1 & 5	149	99.801547	+.062314	.049693	-.369822	.009120	.037508	.919627
Puget Sound	25	99.958260	+.000287	.105270	-.384275	.008201	.028249	.990974
All markets[4]	351	99.834863	+.064414	.033110	-.372357	.004380	.046424	.954434
Half-and-half, packaged								
Central Arizona	96	96.486188	+.056791	.016175	+.030252	.026014	.073838	.122890
Minneapolis-St. Paul	95	96.239268	+.074141	.011603	+.026180	.021854	.070740	.354360
New York[3]	28	99.654249	+.040915	.013978	-.348488	.039808	.071707	.892180
Oklahoma Metropolitan	38	98.633920	+.024819	.020081	-.198643	.031668	.064876	.530175
Puget Sound	45	96.989856	+.040936	.020217	-.015427	.048132	.069104	.108975
Washington, D.C.	81	97.640045	+.077356	.013833	-.157102	.040671	.102326	.491194
All markets[4]	398	97.104886	+.056161	.005789	-.055549	.010772	.092151	.335864
Fortified half-and-half, packaged								
Chicago	56	97.311652	-.005862	.042436	-.019043	.043110	.092426	.003790
New York[3]	24	99.979017	+.031635	.016058	-.379730	.027273	.068706	.902431
Oklahoma Metropolitan	18	98.535981	+.050677	.026349	-.236139	.038055	.063194	.773947
All markets[4]	115	100.113516	-.009341	.019238	-.339908	.022760	.171178	.675893
Light cream, packaged								
Central Arizona	90	96.785108	+.053395	.009987	+.011898	.025113	.081443	.257658
Minneapolis-St. Paul	47	95.982904	+.088756	.012305	+.028176	.035248	.098740	.580330
New York - all regions[6]	98	97.543508	+.061416	.004884	-.106896	.025622	.112093	.727356
Region 6	27	96.806933	+.063305	.003639	-.005855	.030539	.046493	.945215
Region 2	20	97.489884	+.045611	.016284	-.057728	.048273	.152871	.365815
Region 3 & 4	28	98.574931	+.051827	.011362	-.227954	.069270	.097348	.819908
Region 1 & 5	23	98.783280	+.057294	.015654	-.274533	.098579	.125254	.697862
Oklahoma Metropolitan	22	95.875361	+.073703	.032993	+.071407	.058299	.101388	.215263
Puget Sound	40	97.388275	+.062862	.014461	-.099798	.063854	.144918	.440751
Washington, D.C.	89	95.783032	+.092331	.011805	+.049827	.028909	.138319	.432748
All markets[4]	400	96.902881	+.065543	.003888	-.035325	.013199	.124665	.473550

APPENDIX 10.--MARKET REGRESSION EQUATIONS FOR DIFFERENT PRODUCTS TESTED[1] - 40° F.--Continued

Product and market	Number of samples	A	B	Std. dev. of B + or -	C	Std. dev. of C + or -	Std. error of est.[2] + or -	Coefficient of multiple determination
Heavy cream, packaged								
Central Arizona	92	97.378036	+.044262	.016623	+.012099	.029365	.113462	.074181
Chicago	51	95.146954	+.106168	.028011	+.059096	.070360	.099185	.280736
Minneapolis-St. Paul	93	96.938785	+.058946	.005611	+.000102	.024787	.118292	.576844
New York - all regions[6]	596	97.930492	+.053256	.002791	-.111642	.018390	.147774	.532215
Region 6	101	97.082673	+.060770	.004701	-.017652	.032752	.134287	.703997
Region 2	128	98.129456	+.057925	.006576	-.185195	.050707	.170818	.584987
Region 3 & 4	206	98.474928	+.044518	.005092	-.144669	.027610	.142573	.475699
Region 1 & 5	161	97.642207	+.057733	.007550	-.087942	.042523	.130173	.384949
Oklahoma Metropolitan	31	97.398237	+.048892	.006705	-.030337	.048201	.089560	.708976
Puget Sound	51	98.102564	+.037056	.006378	-.075996	.041479	.104851	.589149
Washington, D.C.	67	99.559506	-.000611	.019970	-.075539	.038083	.173334	.064745
All markets[4]	1,005	96.433690	+.071494	.004007	+.022685	.014395	.201000	.496801

[1] Basic formula: A + B (Percent BF) + C (Percent SNF) = Specific volume factor.
[2] Standard error of estimating the specific volume factor.
[3] Data by region not available.
[4] Individual market regression equations were not made for markets having small numbers of samples, but all markets participating were included in all market regression equations.
[5] New York and Oklahoma Metropolitan samples not included, as these samples were from individual cows.
[6] New York was divided into six geographic regions in respect to where the samples were collected. (Region 6 - Mohawk Valley; Region 2 - Southern New York State; Regions 3 & 4 - New Jersey; Regions 1 & 5 - New York City and Long Island.)

APPENDIX 11.--MARKET REGRESSION EQUATIONS FOR DIFFERENT PRODUCTS TESTED[1] - 50° F.

Product and market	Number of samples	A	B	Std. dev. of B + or -	C	Std. dev. of C + or -	Std. error of est.[2] + or -	Coefficient of multiple determination
Mixed breed producer milk								
New York[3]	18	99.918191	+.066945	.020467	-.268341	.043263	.052869	.723713
Puget Sound	408	98.798819	-.011123	.004990	-.225668	.008229	.038008	.822746
All markets[4]	[5]408	98.798819	-.011123	.004990	-.225668	.008229	.038008	.822746
Homogenized milk, packaged								
New York - all regions[6]	875	98.879545	-.017897	.006968	-.225698	.007783	.043996	.590133
Region 6	131	98.364219	-.033919	.021090	-.157676	.021186	.048213	.434013
Region 2	184	99.318413	+.009631	.012640	-.288931	.014319	.050228	.734897
Region 3 & 4	296	98.901255	-.014359	.010675	-.229869	.013917	.035761	.633152
Region 1 & 5	264	98.386049	-.047655	.019352	-.154644	.016482	.041151	.273220
Puget Sound	99	98.967627	+.051774	.007040	-.271771	.016856	.031755	.782812
All markets[4]	988	99.176825	+.012672	.006137	-.274237	.007080	.048970	.634343
Skim milk, packaged								
New York - all regions[6]	396	99.748570	-.058886	.034599	-.353801	.005794	.049045	.905275
Region 6	81	99.574480	+.075341	.067056	-.334692	.012632	.035328	.902766
Region 2	126	99.708437	-.080666	.054139	-.348180	.007937	.041231	.941562
Region 3 & 4	164	99.657929	-.069822	.061251	-.343579	.014161	.058437	.785365
Region 1 & 5	25	99.977155	-.124689	.195748	-.382671	.011813	.025305	.991103
Puget Sound	33	99.675440	-.018891	.054953	-.349301	.022114	.024588	.898188
All markets[4]	429	99.770308	-.077420	.031312	-.356251	.005557	.048032	.906254
Fortified skim milk, packaged								
New York - all regions[6]	245	99.825528	+.055075	.038333	-.366721	.005221	.039116	.953584
Region 6	27	99.836050	-.168461	.105151	-.364772	.020115	.029064	.952991
Region 2	44	99.758162	+.021947	.100799	-.360587	.015817	.039847	.934287
Region 3 & 4	25	99.654544	+.155758	.126211	-.348596	.015020	.047831	.968583
Region 1 & 5	149	99.815271	+.078984	.051020	-.366103	.009364	.038510	.913905
Puget Sound	24	99.963939	+.025272	.106202	-.380088	.008262	.028448	.991096
All markets[4]	269	99.856749	+.050267	.035620	-.369788	.004505	.038277	.962211
Half-and-half, packaged								
New York[3]	28	99.721409	+.048213	.013129	-.350163	.037390	.067352	.910616
Puget Sound	41	97.128454	+.042303	.018913	-.019326	.044270	.063209	.145752
All markets[4]	69	98.850858	+.050453	.011759	-.246922	.035354	.083793	.682243
Fortified half-and-half, packaged								
New York[3]	24	99.945121	+.040344	.015258	-.371886	.025914	.065281	.907469
All markets[4]	35	99.236842	-.039891	.022493	-.211291	.047903	.171680	.489844
Light cream, packaged								
New York - all regions[6]	98	97.754589	+.064609	.004898	-.115886	.025692	.112399	.747971
Region 6	27	97.033389	+.067170	.003529	-.020828	.029618	.045090	.954992
Region 2	20	97.639761	+.053069	.016993	-.068366	.050375	.159529	.419100
Region 3 & 4	28	98.558498	+.059347	.012629	-.217216	.076992	.108200	.807694
Region 1 & 5	23	98.941936	+.058471	.014336	-.268842	.090276	.114706	.735017
Puget Sound	36	98.097040	+.055121	.013025	-.148411	.053971	.116483	.505117
All markets[4]	134	98.094396	+.059091	.004665	-.151283	.022992	.118609	.684171
Heavy cream, packaged								
New York - all regions[6]	590	97.930240	+.060479	.003046	-.104532	.019870	.158928	.538456
Region 6	101	97.004991	+.068087	.004787	+.000133	.033352	.136746	.733907
Region 2	124	98.195205	+.064145	.007339	-.183375	.055544	.183509	.568850
Region 3 & 4	205	98.464120	+.053545	.005330	-.146912	.028767	.148174	.522838
Region 1 & 5	160	97.509007	+.066783	.008673	-.069118	.048692	.148963	.367926
Puget Sound	47	98.132081	+.044795	.006255	-.080070	.041510	.102460	.688496
All markets[4]	649	97.238053	+.070156	.003135	-.050478	.020316	.181986	.554151

[1] Basic formula: A + B (Percent BF) + C (Percent SNF) = Specific volume factor.
[2] Standard error of estimating the specific volume factor.
[3] Data by region not available.
[4] Individual market regression equations were not made for markets having small numbers of samples, but all markets participating were included in the all market regression equations.
[5] New York samples not included, as these were from individual cows.
[6] New York was divided into six geographic regions in respect to where the samples were collected. (Region 6 - Mohawk Valley; Region 2 - Southern New York State; Regions 3 & 4 - New Jersey; Regions 1 & 5 - New York City and Long Island.)

APPENDIX 12.--MARKET REGRESSION EQUATIONS FOR DIFFERENT PRODUCTS TESTED[1] - 68° F.

Product and market	Number of samples	A	B	Std. dev. of B + or -	C	Std dev. of C + or -	Std. error of est.[2] + or -	Coefficient of multiple determination
Mixed breed producer milk								
New York[3]	18	98.900707	+.089161	.019468	-.258909	.041152	.050289	.749290
North Texas	74	98.923813	+.003838	.015086	-.228613	.023749	.029357	.887856
Oklahoma								
Metropolitan	44	98.703247	+.032744	.008347	-.221174	.018212	.042110	.872181
Puget Sound	393	98.745740	+.014673	.005360	-.214641	.008815	.039751	.742457
Washington, D.C.	63	98.439837	-.062126	.022390	-.146733	.031551	.037529	.619722
All markets[4]	[5]549	98.796063	+.013420	.004812	-.219736	.007659	.038843	.761532
Homogenized milk, packaged								
Central Arizona	109	99.214918	+.000805	.022523	-.262525	.030955	.040222	.422336
Chicago	55	97.061066	-.012089	.124332	-.001372	.053345	.040171	.000195
Kansas City	78	99.664888	-.012453	.029790	-.310667	.024220	.029296	.703187
Louisville-Lexington	22	97.579111	-.001071	.098593	-.073961	.098490	.098491	.028872
Minneapolis-St. Paul	126	98.025887	+.078924	.007076	-.151276	.021536	.031314	.635358
New York - all regions[6]	894	98.852800	+.008020	.006692	-.218245	.007507	.042805	.556532
Region 6	145	98.353993	-.015315	.018402	-.148702	.019451	.046179	.414990
Region 2	185	99.262004	+.033664	.012776	-.277484	.014460	.050769	.697089
Region 3 & 4	299	98.976500	+.018215	.009566	-.237061	.012450	.032019	.644920
Region 1 & 5	265	98.406361	-.025061	.018960	-.151716	.016210	.040514	.259710
North Texas	100	98.965534	+.053642	.012559	-.249353	.022440	.040047	.576587
Oklahoma								
Metropolitan	82	99.519397	+.034755	.011801	-.310723	.014647	.022700	.862694
Puget Sound	100	98.894754	+.077421	.007591	-.259430	.018177	.034258	.780847
Washington, D.C.	286	98.886936	+.027712	.009518	-.235076	.014976	.052702	.479424
All markets[4]	1866	99.036303	+.031012	.004141	-.251116	.005392	.050763	.545403
Skim milk, packaged								
Central Arizona	105	98.958859	-.030940	.030182	-.261418	.019843	.038255	.649402
Kansas City	24	99.963016	+.099841	.056426	-.376719	.024499	.017078	.920914
Minneapolis-St. Paul	24	99.182259	+.038803	.023877	-.284335	.057432	.067766	.546346
New York - all regions[6]	405	99.727391	-.038247	.035129	-.345896	.005872	.050025	.897008
Region 6	90	99.550471	+.056981	.073387	-.326684	.013638	.040063	.871724
Region 2	126	99.707370	-.058588	.053492	-.342309	.007842	.040738	.941186
Region 3 & 4	164	99.680332	-.048896	.063092	-.340577	.014587	.060193	.772041
Region 1 & 5	25	99.937566	-.115445	.173318	-.372388	.010459	.022405	.992612
Puget Sound	34	99.665431	+.000174	.057217	-.343411	.023023	.025952	.883904
Washington, D.C.	72	99.440624	+.159014	.053450	-.319900	.026036	.039320	.722772
All markets[4]	673	99.625087	+.028602	.011982	-.336255	.005270	.049412	.858985
Fortified skim milk, packaged								
Central Arizona	29	99.489499	-.123202	.278739	-.322213	.038848	.081852	.735173
Minneapolis-St. Paul	46	99.753696	-.000470	.073031	-.347951	.006791	.032602	.986745
New York - all regions[6]	247	99.831944	+.069049	.039206	-.361899	.005413	.040690	.948603
Region 6	29	99.752181	-.188802	.098805	-.351209	.021275	.032005	.935762
Region 2	45	99.799959	+.059612	.104786	-.359316	.016586	.041906	.927746
Region 3 & 4	25	99.671905	+.156573	.132454	-.344557	.015763	.050197	.964750
Region 1 & 5	148	99.780258	+.096175	.052522	-.357249	.009645	.039644	.905401
Puget Sound	25	99.988981	+.050637	.101657	-.377305	.007920	.027280	.991322
All markets[4]	357	99.848705	+.088212	.033285	-.363238	.004433	.047070	.950397
Half-and-half, packaged								
Central Arizona	104	96.285188	+.086200	.012099	+.065462	.019035	.056306	.335362
Kansas City	30	97.810729	+.119793	.028068	-.168630	.101637	.138691	.499909
Minneapolis-St. Paul	95	96.206234	+.105258	.010612	+.045744	.019986	.064693	.559533
New York[3]	28	99.585074	+.075513	.015054	-.333488	.042872	.077226	.905006
Oklahoma								
Metropolitan	38	98.736111	+.052007	.016169	-.193251	.025499	.052237	.640305
Puget Sound	45	97.319040	+.063769	.015210	-.034946	.036212	.051990	.358431
Washington, D.C.	86	97.501227	+.106805	.012723	-.119676	.037369	.095731	.591605
All markets[4]	441	96.481092	+.106851	.005644	+.006962	.010279	.094988	.489707
Fortified half-and-half, packaged								
Chicago	56	97.197157	+.044443	.034053	-.023417	.034594	.074168	.043949
Kansas City	26	98.388045	+.074992	.029275	-.191642	.082803	.116761	.544712
New York[3]	24	100.045509	+.069655	.012816	-.383365	.021768	.054836	.937515
Oklahoma								
Metropolitan	18	98.457685	+.072648	.024764	-.202892	.035766	.059393	.777286
All markets[4]	141	100.420337	+.014116	.017301	-.352678	.022629	.176992	.638096

APPENDIX 12.--MARKET REGRESSION EQUATIONS FOR DIFFERENT PRODUCTS TESTED[1] - 68° F.--Continued

Product and market	Number of samples	A	B	Std. dev. of B + or -	C	Std. dev. of C + or -	Std. error of est.[2] + or -	Coefficient of multiple determination
Light cream, packaged								
Central Arizona	98	96.656848	+.085848	.007417	+.028612	.018243	.062915	.592761
Minneapolis-St. Paul	47	96.056505	+.126409	.009820	+.021989	.028130	.078800	.821196
New York - all regions[6]	98	97.543352	+.091891	.004867	-.090786	.025531	.111695	.838705
Region 6	27	96.804637	+.094391	.004057	+.008559	.034048	.051835	.967928
Region 2	20	97.377133	+.077595	.017727	-.030869	.052551	.166418	.540245
Region 3 & 4	28	98.574828	+.081548	.010696	-.210405	.065209	.091640	.898806
Region 1 & 5	23	98.952132	+.085428	.013132	-.274873	.082694	.105072	.846329
Oklahoma Metropolitan	22	96.928285	+.073037	.011548	+.028349	.020407	.035489	.753129
Puget Sound	40	97.709475	+.089321	.012041	-.117014	.053166	.120660	.683107
Washington, D.C.	96	95.855070	+.125272	.010812	+.056015	.026243	.127740	.612198
All markets[4]	416	96.807227	+.096605	.004083	-.008064	.013810	.132663	.607029
Heavy cream, packaged								
Central Arizona	98	97.490153	+.068103	.011108	+.033749	.018513	.074940	.284020
Chicago	51	97.190805	+.073288	.032513	+.072559	.081667	.115124	.104833
Kansas City	26	97.919352	+.078345	.010327	-.063064	.059811	.139262	.722094
Minneapolis-St. Paul	93	96.701583	+.100496	.005367	+.013876	.023710	.113153	.809515
New York - all regions[6]	597	97.804089	+.086696	.002628	-.088330	.017170	.138052	.737695
Region 6	101	96.749148	+.096982	.004685	+.026793	.032637	.133815	.848984
Region 2	127	98.170253	+.088621	.006586	-.171457	.049512	.166791	.728327
Region 3 & 4	207	98.201879	+.079237	.004666	-.105640	.025299	.130675	.696486
Region 1 & 5	162	98.233264	+.083338	.006629	-.141158	.037212	.114233	.634283
Oklahoma Metropolitan	31	96.854125	+.091958	.005861	+.006755	.042135	.078290	.912203
Puget Sound	51	97.880069	+.072470	.006079	-.046593	.039532	.099930	.823934
Washington, D.C.	71	98.627534	+.052036	.015594	-.020811	.030735	.141240	.179529
All markets[4]	1042	95.501157	+.111830	.003650	+.146154	.013920	.199374	.683742

[1] Basic formula: A + B (Percent BF) + C (Percent SNF) = Specific volume factor.
[2] Standard error of estimating the specific volume factor.
[3] Data by region not available.
[4] Individual market regression equations were not made for markets having small numbers of samples, but all markets participating were included in the all market regression equations.
[5] New York and Oklahoma Metropolitan samples not included, as these samples were from individual cows.
[6] New York was divided into six geographic regions in respect to where the samples were collected.
(Region 6 - Mohawk Valley; Region 2 - Southern New York State; Regions 3 & 4 - New Jersey; Regions 1 & 5 New York City and Long Island.)

APPENDIX 13.--MARKET REGRESSION EQUATIONS FOR DIFFERENT PRODUCTS TESTED[1] - 102° F.

Product and market	Number of samples	A	B	Std. dev. of B + or -	C	Std. dev. of C + or -	Std error of est.[2] + or -	Coefficient of multiple determination
Mixed breed producer milk								
New York[3]	18	98.983418	+.119356	.021454	-.262085	.045351	.055420	.754938
North Texas	74	99.037925	+.048164	.015723	-.241435	.024752	.030597	.816707
Oklahoma								
Metropolitan	48	98.614633	+.076862	.008574	-.210941	.019039	.045434	.732147
Puget Sound	408	98.804332	+.060770	.004905	-.222760	.008090	.037366	.689829
Washington, D.C.	63	98.315703	-.038697	.018277	-.123218	.025756	.030636	.588049
All markets[4]	[5]564	98.873909	+.058403	.004469	-.229255	.007148	.036876	.707349
Homogenized milk, packaged								
Central Arizona	108	99.408994	+.035756	.029298	-.276777	.040067	.051718	.357203
Chicago	55	97.525872	+.062955	.173220	-.067847	.074321	.055967	.018195
Kansas City	78	99.691001	+.017346	.030448	-.308409	.024755	.029943	.682944
Louisville-Lexington	78	98.670803	+.038041	.047502	-.203770	.040322	.084189	.289653
Minneapolis-St. Paul	126	97.941108	+.103569	.007004	-.133444	.021318	.030998	.714610
New York - All regions[6]	898	98.760932	+.039338	.006908	-.201684	.007776	.044232	.459510
Region 6	144	98.197628	+.013364	.020246	-.123307	.021421	.050779	.238462
Region 2	183	99.167294	+.065011	.012641	-.260688	.014371	.049974	.656555
Region 3 & 4	304	98.950850	+.054148	.010057	-.230487	.013134	.033932	.547192
Region 1 & 5	267	98.236275	+.016920	.019213	-.130029	.016275	.041089	.194810
North Texas	100	98.836758	+.085166	.012243	-.228081	.021876	.039041	.593250
Oklahoma								
Metropolitan	82	99.367492	+.063720	.011415	-.286651	.014168	.021958	.842010
Puget Sound	100	98.951585	+.111430	.006495	-.261599	.015553	.029312	.870479
Southern Michigan	335	99.311009	-.002060	.016657	-.249733	.017136	.050539	.434208
Washington, D.C.	286	98.732253	+.060404	.008420	-.212455	.013248	.046622	.476623
All markets[4]	2272	99.073110	+.059137	.004334	-.248363	.005441	.055725	.478750
Skim milk, packaged								
Central Arizona	105	98.997132	-.017615	.031014	-.256746	.020379	.039303	.633172
Kansas City	24	101.872577	+.076326	.293803	-.585868	.127564	.088924	.505067
Minneapolis-St. Paul	24	99.190492	+.064325	.025406	-.278015	.061112	.072108	.535032
New York - All regions[6]	404	99.762833	-.003421	.035921	-.342323	.005973	.050956	.892330
Region 6	90	99.525243	+.113499	.068895	-.315774	.012803	.037611	.879481
Region 2	126	99.723640	-.012314	.051651	-.336996	.007572	.039336	.943692
Region 3 & 4	163	99.696462	-.016350	.066440	-.334854	.015286	.063268	.749954
Region 1 & 5	25	99.971242	-.130149	.190137	-.368538	.011474	.024579	.990972
Puget Sound	34	99.745714	+.007022	.065761	-.344720	.026461	.029827	.853597
Southern Michigan	52	99.744960	+.073139	.024024	-.342544	.018109	.040880	.881801
Washington, D.C.	72	99.354869	+.160851	.051092	-.301927	.024887	.037586	.720315
All markets[4]	729	99.690452	+.054283	.011568	-.335684	.005380	.052243	.844194
Fortified skim milk, packaged								
Central Arizona	29	99.501617	+.027536	.280843	-.318514	.039141	.082470	.722879
Minneapolis-St. Paul	46	99.734658	-.027138	.080070	-.337917	.007445	.035744	.983271
New York - All regions[6]	248	99.842837	+.099274	.039845	-.355530	.005499	.041406	.945122
Region 6	30	100.004140	-.001240	.084983	-.368842	.018677	.028097	.947825
Region 2	44	99.755988	+.088795	.108691	-.347757	.017278	.042022	.922833
Region 3 & 4	25	99.677978	+.163189	.137459	-.337557	.016358	.052094	.960730
Region 1 & 5	149	99.845249	+.118185	.054810	-.356139	.010059	.041371	.896527
Puget Sound	25	99.923375	+.173972	.100900	-.366131	.007861	.027076	.991076
All markets[4]	361	99.844994	+.131264	.034886	-.355614	.004563	.049439	.944969
Half-and-half, packaged								
Central Arizona	104	96.785902	+.088277	.011514	+.051557	.018115	.053585	.376600
Kansas City	29	97.221658	+.160505	.039406	-.108501	.141523	.192657	.437757
Minneapolis-St Paul	95	96.022580	+.137982	.010872	+.066870	.020476	.066281	.670171
New York[3]	28	99.564293	+.105557	.015118	-.325141	.043054	.077554	.924114
Oklahoma								
Metropolitan	38	98.747266	+.060209	.017026	-.155501	.026849	.055005	.540911
Puget Sound	45	97.943222	+.086402	.010714	-.101628	.025508	.036623	.728686
Washington, D.C.	86	97.405713	+.128323	.012293	-.091827	.036107	.092498	.659715
All markets[4]	455	96.780275	+.122792	.005867	-.005524	.010654	.099945	.546052
Fortified half-and-half, pkgd.								
Chicago	56	97.544415	+.093143	.029847	-.084382	.030322	.065008	.275144
Kansas City	25	98.880336	-.041488	.049153	-.168972	.067227	.094792	.224026
New York[3]	24	99.905718	+.105932	.012231	-.371200	.020774	.052333	.943240
Oklahoma								
Metropolitan	18	98.082231	+.118185	.025927	-.172696	.037445	.062181	.788819
All markets[4]	143	100.332178	+.037934	.016062	-.331041	.019361	.149027	.676321

APPENDIX 13.--MARKET REGRESSION EQUATIONS FOR DIFFERENT PRODUCTS TESTED[1] - 102° F.--Continued

Product and market	Number of samples	A	B	Std. dev. of B + or -	C	Std. dev. of C + or -	Std. error of est.[2] + or -	Coefficient of multiple determination
Light cream, packaged								
Central Arizona	98	96.256324	+.123918	.005667	+.079248	.013956	.048008	.834623
Minneapolis-St. Paul	48	96.333458	+.143688	.008608	+.020496	.024379	.069160	.883839
New York - All regions[6]	98	97.146397	+.124072	.004759	-.037832	.024965	.109220	.897988
Region 6	27	96.667761	+.120863	.003540	+.041937	.029705	.045223	.984391
Region 2	20	96.784854	+.116730	.016391	+.029682	.048590	.153875	.748999
Region 3 & 4	28	98.399229	+.111266	.010946	-.179683	.066735	.093786	.927547
Region 1 & 5	23	98.939189	+.116043	.012932	-.275407	.081434	.103470	.899483
Oklahoma Metropolitan	22	96.185315	+.117841	.010563	+.091076	.018665	.032460	.881331
Puget Sound	40	97.877797	+.117757	.010906	-.134095	.048158	.109294	.814741
Washington, D.C.	95	95.902069	+.147466	.009784	+.070269	.023766	.115594	.728265
All markets[4]	434	96.957605	+.123062	.003389	-.013929	.011230	.112093	.779987
Heavy cream, packaged								
Central Arizona	99	97.470300	+.097280	.009322	+.070552	.015806	.064337	.541208
Chicago	51	96.197351	+.139093	.012446	+.036820	.031262	.044070	.795469
Kansas City	26	97.201288	+.116277	.008385	+.008184	.048566	.113080	.893356
Minneapolis-St Paul	94	96.957188	+.119452	.003074	+.027363	.013912	.066420	.947153
New York - All regions[6]	606	97.517100	+.119577	.001972	-.063943	.013009	.104684	.896631
Region 6	101	96.433246	+.128498	.003431	+.071673	.023867	.097822	.946606
Region 2	132	97.478926	+.122789	.003491	-.085014	.026933	.090997	.936830
Region 3 & 4	209	98.046076	+.112702	.004115	-.108379	.022330	.115359	.845877
Region 1 & 5	164	98.306827	+.111133	.005001	-.149868	.028162	.086512	.832998
Oklahoma Metropolitan	31	96.122759	+.132824	.003436	+.078970	.024701	.045895	.983555
Puget Sound	50	97.229828	+.112019	.004573	+.001738	.030133	.073922	.948608
Washington, D.C.	71	98.321512	+.081271	.010108	+.041597	.019922	.091551	.489254
All markets[4]	1066	96.090265	+.134898	.002714	+.083581	.010811	.156561	.849047

[1] Basic formula: A + B (Percent BF) + C (Percent SNF) = Specific volume factor.
[2] Standard error of estimating the specific volume factor.
[3] Data by region not available.
[4] Individual market regression equations were not made for markets having small numbers of samples, but all markets participating were included in the all market regression equations.
[5] New York and Oklahoma Metropolitan samples not included, as these samples were from individual cows.
[6] New York was divided into six geographic regions in respect to where the samples were collected. (Region 6 - Mohawk Valley; Region 2 - Southern New York State; Regions 3 & 4 - New Jersey; Regions 1 & 5 - New York City and Long Island.)

APPENDIX 14.--AVERAGE TESTS, STANDARD DEVIATIONS, RANGES OF BUTTERFAT AND SOLIDS-NOT-FAT, AND WEIGHTS PER GALLON AT 40° F.

Product and market	Number of samples	Percent fat content			Percent SNF content			Weight per gallon[1]	Difference from average
		Average	Std. dev. + or -	Range	Average	Std. dev. + or -	Range		
		Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pounds	Pounds
Mixed breed producer milk									
New York[2]	18	3.671	.681	2.60- 5.23	9.108	.322	8.40- 9.71	8.626	+.002
North Texas	74	3.959	.575	3.15- 5.20	8.670	.365	7.94- 9.43	8.618	-.006
Oklahoma Metropolitan	48	4.594	1.402	2.98- 7.62	9.315	.631	7.91-10.91	8.633	+.009
Puget Sound	407	4.102	.562	3.10- 6.10	8.899	.341	7.94-10.09	8.623	-.001
Washington, D.C.	62	3.873	.307	3.10- 4.35	8.755	.218	8.16- 9.10	8.622	-.002
Total/Average	609	4.040			8.949			8.624	
Homogenized milk, packaged (Includes a few samples of premium grade milk)									
Central Arizona	105	3.612	.177	3.28- 3.88	8.447	.130	8.13- 8.90	8.611	-.002
Chicago	55	3.420	.044	3.30- 3.50	8.578	.102	8.41- 8.79	8.610	-.003
Minneapolis-St. Paul	126	3.585	.404	3.10- 4.80	8.717	.133	8.27- 9.21	8.614	+.001
New York									
Region 6[3]	144	3.556	.254	3.08- 4.72	8.510	.244	7.87- 9.94	8.609	-.004
Region 2[3]	184	3.655	.332	2.70- 5.14	8.587	.293	8.05- 9.62	8.612	-.001
Region 3 & 4[3]	297	3.582	.252	3.07- 4.98	8.503	.193	8.15- 9.45	8.610	-.003
Region 1 & 5[3]	266	3.482	.132	2.98- 4.26	8.418	.156	7.61- 9.57	8.608	-.005
North Texas	100	3.664	.323	3.15- 4.80	8.674	.181	8.28- 9.39	8.613	.000
Oklahoma Metropolitan	82	3.512	.237	2.98- 4.12	8.753	.191	8.26- 9.13	8.619	+.006
Puget Sound	100	3.639	.457	3.10- 6.70	8.789	.191	8.41- 9.38	8.622	+.009
Washington, D.C.	264	3.733	.358	2.50- 5.35	8.625	.234	7.91- 9.52	8.617	+.004
Total/Average	1723	3.585			8.600			8.613	
Skim milk, packaged									
Central Arizona	106	.149	.132	.01- .60	8.780	.201	8.11- 9.87	8.633	-.005
Minneapolis-St. Paul	24	.511	.599	.05- 2.10	9.082	.249	8.72- 9.85	8.640	+.002
New York									
Region 6[3]	90	.077	.058	.02- .26	8.761	.314	7.42- 9.75	8.630	-.008
Region 2[3]	126	.086	.070	.00- .28	9.052	.475	7.82-10.41	8.639	+.001
Region 3 & 4[3]	164	.123	.075	.00- .30	8.785	.323	7.94- 9.82	8.632	-.006
Region 1 & 5[3]	25	.060	.040	.02- .16	9.208	.658	8.43-10.61	8.648	+.010
Puget Sound	34	.159	.081	.04- .36	9.096	.202	8.81- 9.79	8.644	+.006
Washington, D.C.	72	.128	.089	.02- .46	8.885	.182	8.39- 9.33	8.637	-.001
Total/Average	641	.162			8.956			8.638	
Fortified skim milk, packaged									
Central Arizona	29	.223	.056	.08- .29	9.749	.404	8.79-10.80	8.665	-.012
Minneapolis-St. Paul	46	.147	.073	.02- .29	9.992	.790	8.98-11.14	8.668	-.009
New York									
Region 6[3]	29	.107	.068	.02- .27	10.565	.317	9.97-11.12	8.692	+.015
Region 2[3]	45	.092	.064	.02- .27	10.344	.405	9.55-11.31	8.686	+.009
Region 3 & 4[3]	25	.116	.085	.02- .28	9.496	.713	8.49-10.83	8.656	-.021
Region 1 & 5[3]	149	.095	.063	.00- .29	10.185	.342	9.37-11.35	8.680	+.003
Puget Sound	25	.135	.057	.07- .29	10.554	.737	9.42-12.26	8.692	+.015
Total/Average	348	.131			10.126			8.677	
Half-and-half, packaged									
Central Arizona	96	12.223	.554	10.95-13.40	7.132	.344	6.21- 8.23	8.559	-.002
Minneapolis-St. Paul	95	13.043	.774	11.25-16.50	7.361	.411	6.15- 8.26	8.559	-.002
New York[2]	28	11.264	1.303	7.97-12.20	8.000	.458	7.56- 8.90	8.566	+.005
Oklahoma Metropolitan	38	12.524	.536	11.60-13.65	7.878	.340	7.27- 8.65	8.561	.000
Puget Sound	45	12.170	.544	11.30-13.50	7.944	.228	7.44- 8.39	8.562	+.001
Washington, D.C.	81	12.470	.901	10.30-16.20	7.689	.307	6.77- 8.22	8.559	-.002
Total/Average	383	12.282			7.667			8.561	

APPENDIX 14.--AVERAGE TESTS, STANDARD DEVIATIONS, RANGES OF BUTTERFAT AND SOLIDS-NOT-FAT, AND WEIGHTS PER GALLON AT 40° F.--Continued

Product and market	Number of samples	Percent fat content: Average	Percent fat content: Std. dev. + or -	Percent fat content: Range	Percent SNF content: Average	Percent SNF content: Std. dev. + or -	Percent SNF content: Range	Weight per gallon[1]	Difference from average
		Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pounds	Pounds
Fortified half-and-half, packaged									
Chicago	56	11.663	.296	11.05-13.20	8.871	.292	8.16- 9.74	8.587	-.011
New York[2]	24	10.745	.908	9.68-12.90	9.635	.535	8.95-11.54	8.625	+.027
Oklahoma									
Metropolitan	18	11.164	.601	10.45-12.90	8.255	.416	7.58- 9.42	8.581	-.017
Total/Average	98	11.191			8.920			8.598	
Light cream, packaged									
Central Arizona	90	20.125	.910	18.50-23.50	6.965	.362	6.11- 7.78	8.511	+.002
Minneapolis-St. Paul	47	20.511	1.343	18.50-25.50	7.344	.469	5.99- 8.14	8.506	-.003
New York									
Region 6[3]	27	21.134	2.914	17.02-27.02	7.052	.347	6.48- 8.03	8.497	-.012
Region 2[3]	20	19.244	2.159	15.48-25.21	7.329	.728	6.73-10.12	8.511	+.002
Region 3 & 4[3]	28	19.422	2.405	16.38-25.33	7.195	.395	6.40- 8.14	8.511	+.002
Region 1 & 5[3]	23	19.422	2.039	17.20-25.88	6.855	.324	6.09- 7.51	8.506	-.003
Oklahoma									
Metropolitan	22	20.126	.938	18.00-21.50	7.586	.531	6.73- 9.23	8.515	+.006
Puget Sound	40	20.394	1.703	15.00-23.50	7.406	.386	6.04- 8.08	8.512	+.003
Washington, D.C.	89	19.466	1.406	15.50-25.00	7.173	.574	5.67- 8.54	8.512	+.003
Total/Average	386	19.983			7.212			8.509	
Heavy cream, packaged									
Central Arizona	92	35.891	.735	33.25-37.50	5.221	.416	4.28- 6.69	8.418	+.011
Chicago	51	32.358	.654	29.00-34.50	5.855	.260	5.22- 6.50	8.426	+.019
Minneapolis-St. Paul	93	35.921	2.318	31.00-40.88	5.717	.525	4.55- 7.36	8.416	+.009
New York									
Region 6[3]	101	39.195	3.302	28.98-51.22	5.479	.474	4.29- 7.95	8.390	-.017
Region 2[3]	128	39.151	2.732	33.79-47.62	5.504	.354	4.54- 7.51	8.389	-.018
Region 3 & 4[3]	206	38.769	2.198	30.72-47.88	5.499	.405	4.50- 7.24	8.386	-.021
Region 1 & 5[3]	161	37.512	1.540	33.15-42.68	5.571	.273	4.85- 6.77	8.394	-.013
Oklahoma									
Metropolitan	31	36.847	2.662	33.25-45.00	5.728	.370	5.04- 6.55	8.418	+.011
Puget Sound	51	34.137	2.766	30.25-45.25	6.042	.425	4.71- 7.01	8.428	+.021
Washington, D.C.	67	37.765	1.140	34.25-40.25	4.877	.598	3.22- 6.37	8.406	-.001
Total/Average	981	36.755			5.549			8.407	

[1] Weights per gallon as computed by use of each market's product regression equation which is the same as an average of the weights determined by the bottle method.

[2] Data by region not available.

[3] New York was divided into six geographic regions in respect to where the samples were collected. (Region 6 - Mohawk Valley; Region 2 - Southern New York State; Regions 3 & 4 - New Jersey; Regions 1 & 5 - New York City and Long Island.)

APPENDIX 15.--AVERAGE TESTS, STANDARD DEVIATIONS, RANGES OF BUTTERFAT AND SOLIDS-NOT-FAT, AND WEIGHTS PER GALLON AT 50° F.

Product and market	Number of samples	Percent fat content			Percent SNF content			Weight per gallon[1]	Difference from average
		Average	Std. dev. + or -	Range	Average	Std. dev. + or -	Range		
		Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pounds	Pounds
Mixed breed producer milk									
New York[2]	18	3.671	.681	2.60- 5.23	9.108	.322	8.40- 9.71	8.617	+.001
Puget Sound	408	4.101	.562	3.10- 6.10	8.898	.341	7.94-10.09	8.614	-.002
Total/Average	426	3.886			9.003			8.616	
Homogenized milk, packaged (Includes a few samples of premium grade milk)									
New York -									
Region 6[3]	131	3.545	.236	3.08- 4.72	8.492	.235	7.87- 9.94	8.600	-.003
Region 2[3]	184	3.655	.332	2.70- 5.14	8.587	.293	8.05- 9.62	8.603	.000
Region 3 & 4[3]	296	3.580	.252	3.07- 4.98	8.503	.193	8.15- 9.45	8.601	-.002
Region 1 & 5[3]	264	3.480	.131	2.98- 4.26	8.416	.154	7.61- 9.57	8.599	-.004
Puget Sound	99	3.641	.459	3.10- 6.70	8.790	.192	8.41- 9.38	8.612	+.009
Total/Average	974	3.580			8.558			8.603	
Skim milk, packaged									
New York -									
Region 6[3]	81	.075	.059	.02- .26	8.759	.316	7.42- 9.75	8.623	-.009
Region 2[3]	126	.086	.070	.00- .28	9.052	.475	7.82-10.41	8.632	.000
Region 3 & 4[3]	164	.123	.075	.00- .30	8.785	.323	7.94- 9.82	8.625	-.007
Region 1 & 5[3]	25	.060	.040	.02- .16	9.208	.658	8.43-10.61	8.642	+.010
Puget Sound	33	.160	.082	.04- .36	9.101	.204	8.81- 9.79	8.637	+.005
Total/Average	429	.101			8.981			8.632	
Fortified skim milk, packaged									
New York -									
Region 6[3]	27	.101	.063	.02- .27	10.564	.329	9.97-11.12	8.684	+.010
Region 2[3]	44	.090	.064	.02- .27	10.352	.406	9.55-11.31	8.679	+.005
Region 3 & 4[3]	25	.116	.085	.02- .28	9.496	.713	8.49-10.83	8.649	-.025
Region 1 & 5[3]	149	.095	.063	.00- .29	10.185	.342	9.37-11.35	8.672	-.002
Puget Sound	24	.136	.059	.07- .29	10.555	.753	9.42-12.26	8.686	+.012
Total/Average	269	.108			10.230			8.674	
Half-and-half, packaged									
New York[2]	28	11.264	1.303	7.97-12.20	8.000	.458	7.56- 8.90	8.551	+.001
Puget Sound	41	12.174	.558	11.30-13.50	7.946	.238	7.44- 8.39	8.548	-.002
Total/Average	69	11.719			7.973			8.550	
Fortified half-and-half, packaged									
New York[2]	24	10.745	.908	9.68-12.90	9.635	.535	8.95-11.54	8.610	.000
Light cream, packaged									
New York -									
Region 6[3]	27	21.134	2.914	17.02-27.02	7.052	.347	6.48- 8.03	8.477	-.010
Region 2[3]	20	19.244	2.159	15.48-25.21	7.329	.728	6.73-10.12	8.490	+.003
Region 3 & 4[3]	28	19.422	2.405	16.38-25.33	7.195	.395	6.40- 8.14	8.492	+.005
Region 1 & 5[3]	23	19.422	2.039	17.20-25.88	6.855	.324	6.09- 7.51	8.484	-.003
Puget Sound	36	20.556	1.564	15.00-23.50	7.382	.378	6.04- 8.08	8.492	+.005
Total/Average	134	19.956			7.163			8.487	
Heavy cream, packaged									
New York -									
Region 6[3]	101	39.195	3.302	28.98-51.22	5.479	.474	4.29- 7.95	8.362	-.007
Region 2[3]	124	39.113	2.633	33.79-47.62	5.501	.348	4.54- 7.51	8.360	-.009
Region 3 & 4[3]	205	38.784	2.193	30.72-47.88	5.500	.406	4.50- 7.24	8.357	-.012
Region 1 & 5[3]	160	37.522	1.540	33.15-42.68	5.571	.274	4.85- 6.77	8.365	-.004
Puget Sound	47	34.245	2.853	30.25-45.25	6.013	.430	4.71- 7.01	8.402	+.033
Total/Average	637	37.772			5.613			8.369	

[1] Weights per gallon as computed by use of each market's product regression equation which is the same as an average of the weights determined by the bottle method.

[2] Data by region not available.

[3] New York was divided into six geographic regions in respect to where the samples were collected. (Region 6 - Mohawk Valley; Region 2 - Southern New York State; Regions 3 & 4 - New Jersey; Regions 1 & 5 - New York City and Long Island.)

APPENDIX 16.--AVERAGE TESTS, STANDARD DEVIATIONS, RANGES OF BUTTERFAT AND SOLIDS-NOT-FAT, AND WEIGHTS PER GALLON AT 68° F.

Product and market	Number of samples	Percent fat content			Percent SNF content			Weight per gallon[1]	Difference from average
		Average	Std. dev. + or -	Range	Average	Std. dev. + or -	Range		
		Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pounds	Pounds
Mixed breed producer milk									
New York[2]	18	3.671	.681	2.60- 5.23	9.108	.322	8.40- 9.71	8.590	+.001
North Texas	74	3.959	.575	3.15- 5.20	8.670	.365	7.94- 9.43	8.583	-.006
Oklahoma Metropolitan	44	4.686	1.413	3.00- 7.62	9.330	.648	7.91-10.91	8.597	+.008
Puget Sound	393	4.093	.561	3.10- 6.10	8.901	.341	7.94-10.09	8.588	-.001
Washington, D.C.	63	3.874	.305	3.10- 4.35	8.755	.216	8.16- 9.10	8.586	-.003
Total/Average	592	4.057			8.953			8.589	
Homogenized milk, packaged (Includes a few samples of premium grade milk)									
Kansas City	78	3.408	.115	3.05- 3.80	8.411	.142	7.85- 8.67	8.578	-.002
Louisville-Lexington	22	3.777	.218	3.45- 4.35	8.588	.218	7.99- 8.92	8.585	+.005
Central Arizona	109	3.611	.178	3.28- 3.88	8.443	.130	8.13- 8.90	8.579	-.001
Chicago	55	3.420	.044	3.30- 3.50	8.578	.102	8.41- 8.79	8.578	-.002
Minneapolis-St. Paul	126	3.585	.404	3.10- 4.80	8.717	.133	8.27- 9.21	8.580	.000
New York-									
Region 6[3]	145	3.560	.257	3.08- 4.72	8.510	.243	7.87- 9.94	8.576	-.004
Region 2[3]	185	3.654	.331	2.70- 5.14	8.586	.292	8.05- 9.62	8.579	-.001
Region 3 & 4[3]	299	3.578	.251	3.07- 4.98	8.501	.193	8.15- 9.45	8.576	-.004
Region 1 & 5[3]	265	3.481	.132	2.98- 4.26	8.416	.154	7.61- 9.57	8.576	-.004
North Texas	100	3.664	.323	3.15- 4.80	8.674	.181	8.28- 9.39	8.579	-.001
Oklahoma Metropolitan	82	3.512	.237	2.98- 4.12	8.753	.191	8.26- 9.13	8.586	+.006
Puget Sound	100	3.639	.457	3.10- 6.70	8.789	.191	8.41- 9.38	8.588	+.008
Washington, D.C.	286	3.739	.359	2.50- 5.35	8.626	.228	7.91- 9.52	8.582	+.002
Total/Average	1,852	3.587			8.584			8.580	
Skim milk, packaged									
Kansas City	24	.132	.063	.02- .26	8.707	.146	8.46- 9.18	8.606	-.007
Central Arizona	105	.149	.133	.01- .60	8.780	.202	8.11- 9.87	8.610	-.003
Minneapolis-St. Paul	24	.511	.599	.05- 2.10	9.082	.249	8.72- 9.85	8.613	.000
New York-									
Region 6[3]	90	.077	.058	.02- .26	8.761	.314	7.42- 9.75	8.606	-.007
Region 2[3]	126	.086	.070	.00- .28	9.052	.475	7.82-10.41	8.615	+.002
Region 3 & 4[3]	164	.123	.075	.00- .30	8.785	.323	7.94- 9.82	8.607	-.006
Region 1 & 5[3]	25	.060	.040	.02- .16	9.208	.658	8.43-10.61	8.624	+.011
Puget Sound	34	.159	.081	.04- .36	9.096	.202	8.81- 9.79	8.620	+.007
Washington, D.C.	72	.128	.089	.02- .46	8.885	.182	8.39- 9.33	8.613	.000
Total/Average	664	.158			8.928			8.613	
Fortified skim milk, packaged									
Central Arizona	29	.223	.056	.08- .29	9.749	.404	8.79-10.80	8.640	-.012
Minneapolis-St. Paul	46	.147	.073	.02- .29	9.992	.790	8.98-11.14	8.644	-.008
New York-									
Region 6[3]	29	.107	.068	.02- .27	10.565	.317	9.97-11.12	8.666	+.014
Region 2[3]	45	.092	.064	.02- .27	10.344	.405	9.55-11.31	8.660	+.008
Region 3 & 4[3]	25	.116	.085	.02- .28	9.496	.713	8.49-10.83	8.631	-.021
Region 1 & 5[3]	148	.095	.063	.00- .29	10.186	.343	9.37-11.35	8.655	+.003
Puget Sound	25	.135	.057	.07- .29	10.554	.737	9.42-12.26	8.667	+.015
Total/Average	347	.131			10.127			8.652	
Half-and-Half, packaged									
Kansas City	30	12.142	.955	11.00-14.50	8.127	.264	7.66- 8.70	8.501	-.003
Central Arizona	104	12.222	.543	10.95-13.40	7.138	.345	6.21- 8.23	8.508	+.004
Minneapolis-St. Paul	95	13.043	.774	11.25-16.50	7.361	.411	6.15- 8.26	8.499	-.005
New York[2]	28	11.264	1.303	7.97-12.20	8.000	.458	7.56- 8.90	8.511	+.007
Oklahoma Metropolitan	38	12.524	.536	11.60-13.65	7.878	.340	7.27- 8.65	8.503	-.001
Puget Sound	45	12.170	.544	11.30-13.50	7.944	.228	7.44- 8.39	8.507	+.003
Washington, D.C.	86	12.468	.887	10.30-16.20	7.689	.302	6.77- 8.22	8.499	-.005
Total/Average	426	12.262			7.734			8.504	

APPENDIX 16.--AVERAGE TESTS, STANDARD DEVIATIONS, RANGES OF BUTTERFAT AND SOLIDS-NOT-FAT, AND WEIGHTS PER GALLON AT 68° F.--Continued

Product and market	Number of samples	Percent fat content			Percent SNF content			Weight per gallon[1]	Difference from average
		Average	Std. dev. + or -	Range	Average	Std. dev. + or -	Range		
		Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pounds	Pounds
Fortified half-and-half, packaged									
Kansas City	26	11.673	.969	10.50-16.00	8.935	.343	8.06- 9.65	8.531	-.010
Chicago	56	11.663	.296	11.05-13.20	8.871	.292	8.16- 9.74	8.535	-.006
New York[2]	24	10.745	.908	9.68-12.90	9.635	.535	8.95-11.54	8.571	+.030
Oklahoma									
Metropolitan	18	11.164	.601	10.45-12.90	8.255	.416	7.58- 9.42	8.527	-.014
Total/Average	124	11.311			8.924			8.541	
Light cream, packaged									
Central Arizona	98	20.120	.905	18.50-23.50	6.956	.368	6.11- 7.78	8.442	+.010
Minneapolis-St. Paul	47	20.511	1.343	18.50-25.50	7.344	.469	5.99- 8.14	8.422	-.010
New York-									
Region 6[3]	27	21.134	2.914	17.02-27.02	7.052	.347	6.48- 8.03	8.417	-.015
Region 2[3]	20	19.244	2.159	15.48-25.21	7.329	.728	6.73-10.12	8.436	+.004
Region 3 & 4[3]	28	19.422	2.405	16.38-25.33	7.195	.395	6.40- 8.14	8.436	+.004
Region 1 & 5[3]	23	19.422	2.039	17.20-25.88	6.855	.324	6.09- 7.51	8.429	-.003
Oklahoma									
Metropolitan	22	20.126	.938	18.00-21.50	7.586	.531	6.73- 9.23	8.439	+.007
Puget Sound	40	20.394	1.703	15.00-23.50	7.406	.386	6.04- 8.08	8.434	+.002
Washington, D.C.	96	19.501	1.362	15.50-25.00	7.170	.561	5.67- 8.54	8.432	+.000
Total/Average	401	19.986			7.210			8.432	
Heavy cream, packaged									
Kansas City	26	35.067	2.701	32.00-40.50	5.491	.466	4.55- 6.16	8.295	+.011
Central Arizona	98	35.883	.707	33.25-37.50	5.228	.424	4.28- 6.69	8.313	+.029
Chicago	51	32.358	.654	29.00-34.50	5.855	.260	5.22- 6.50	8.323	+.039
Minneapolis-St. Paul	93	35.921	2.318	31.00-40.88	5.717	.525	4.55- 7.36	8.289	+.005
New York-									
Region 6[3]	101	39.195	3.302	28.98-51.22	5.479	.474	4.29- 7.95	8.264	-.020
Region 2[3]	127	39.087	2.646	33.79-47.62	5.509	.352	4.54- 7.51	8.265	-.019
Region 3 & 4[3]	207	38.771	2.193	30.72-47.88	5.499	.405	4.50- 7.24	8.264	-.020
Region 1 & 5[3]	162	37.514	1.532	33.15-42.68	5.569	.273	4.85- 6.77	8.274	-.010
Oklahoma									
Metropolitan	31	36.847	2.662	33.25-45.00	5.728	.370	5.04- 6.55	8.298	+.014
Puget Sound	51	34.137	2.766	30.25-45.25	6.042	.425	4.71- 7.01	8.262	-.022
Washington, D.C.	71	37.806	1.152	34.25-40.25	4.881	.585	3.22- 6.37	8.281	-.003
Total/Average	1,018	36.599			5.545			8.284	

[1] Weights per gallon as computed by use of each market's product regression equation, which is the same as an average of the weights determined by the bottle method.

[2] Data by region not available.

[3] New York was divided into six geographic regions in respect to where the samples were collected. (Region 6 - Mohawk Valley; Region 2 - Southern New York State; Regions 3 & 4 - New Jersey; Regions 1 & 5 - New York City and Long Island.)

APPENDIX 17.--AVERAGE TESTS, STANDARD DEVIATIONS, RANGES OF BUTTERFAT AND SOLIDS-NOT-FAT, AND WEIGHTS PER GALLON AT 102° F.

Product and market	Number of samples	Percent fat content			Percent SNF content			Weight per gallon[1]	Difference from average
		Average	Std. dev. + or -	Range	Average	Std. dev. + or -	Range		
		Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pounds	Pounds
Mixed breed producer milk									
New York[2]	18	3.671	.681	2.60- 5.23	9.108	.322	8.40- 9.71	8.528	+.003
North Texas	74	3.959	.575	3.15- 5.20	8.670	.365	7.94- 9.43	8.519	-.006
Oklahoma Metropolitan	48	4.594	1.402	2.98- 7.62	9.315	.631	7.91-10.91	8.531	+.006
Puget Sound	408	4.101	.562	3.10- 6.10	8.898	.341	7.94-10.09	8.525	.000
Washington, D.C.	63	3.874	.305	3.10- 4.35	8.755	.216	8.16- 9.10	8.523	-.002
Total/Average	611	4.040			8.949			8.525	
Homogenized milk, packaged (Includes a few samples of premium grade milk)									
Southern Michigan	335	3.567	.181	3.00- 4.58	8.474	.176	7.81- 9.16	8.514	-.004
Kansas City	78	3.408	.115	3.05- 3.80	8.411	.142	7.85- 8.67	8.518	.000
Louisville-Lexington	78	3.702	.210	3.10- 4.35	8.588	.247	7.81- 9.28	8.526	+.008
Central Arizona	108	3.614	.178	3.28- 3.88	8.444	.130	8.13- 8.90	8.513	-.005
Chicago	55	3.420	.044	3.30- 3.50	8.578	.102	8.41- 8.79	8.517	-.001
Minneapolis-St. Paul	126	3.585	.404	3.10- 4.80	8.717	.133	8.27- 9.21	8.518	.000
New York[3]									
Region 6	144	3.560	.258	3.08- 4.72	8.511	.244	7.87- 9.94	8.514	-.004
Region 2	183	3.656	.332	2.70- 5.14	8.585	.292	8.05- 9.62	8.517	-.001
Region 3 & 4	304	3.580	.251	3.07- 4.98	8.502	.192	8.15- 9.45	8.515	-.003
Region 1 & 5	267	3.481	.132	2.98- 4.26	8.418	.155	7.61- 9.57	8.513	-.005
North Texas	100	3.664	.323	3.15- 4.80	8.674	.181	8.28- 9.39	8.516	-.002
Oklahoma Metropolitan	82	3.512	.237	2.98- 4.12	8.753	.191	8.26- 9.13	8.524	+.006
Puget Sound	100	3.639	.457	3.10- 6.70	8.789	.191	8.41- 9.38	8.526	+.008
Washington, D.C.	286	3.739	.359	2.50- 5.35	8.626	.228	7.91- 9.52	8.520	+.002
Total/Average	2246	3.581			8.576			8.518	
Skim milk, packaged									
Southern Michigan	52	.229	.238	.04- .24	8.731	.316	8.35-10.09	8.551	-.006
Kansas City	24	.132	.063	.02- .26	8.707	.146	8.46- 9.18	8.551	-.006
Central Arizona	105	.150	.133	.01- .60	8.779	.202	8.11- 9.87	8.554	-.003
Minneapolis-St. Paul	24	.511	.599	.05- 2.10	9.082	.249	8.72- 9.85	8.557	.000
New York[3]									
Region 6	90	.077	.058	.02- .26	8.761	.314	7.42- 9.75	8.551	-.006
Region 2	126	.086	.070	.00- .28	9.052	.475	7.82-10.41	8.560	+.003
Region 3 & 4	163	.122	.075	.00- .30	8.783	.325	7.94- 9.82	8.553	-.004
Region 1 & 5	25	.060	.040	.02- .16	9.208	.658	8.43-10.61	8.569	+.012
Puget Sound	34	.159	.081	.04- .36	9.096	.202	8.81- 9.79	8.566	+.009
Washington, D.C.	72	.128	.089	.02- .46	8.885	.182	8.39- 9.33	8.558	+.001
Total/Average	715	.165			8.908			8.557	
Fortified skim milk, packaged									
Central Arizona	29	.223	.056	.08- .29	9.749	.404	8.79-10.80	8.584	-.012
Minneapolis-St. Paul	46	.147	.073	.02- .29	9.992	.790	8.98-11.14	8.588	-.008
New York[3] -									
Region 6	30	.109	.069	.02- .27	10.570	.313	9.97-11.12	8.610	+.014
Region 2	44	.093	.064	.02- .27	10.356	.402	9.55-11.31	8.605	+.009
Region 3 & 4	25	.116	.085	.02- .28	9.496	.713	8.49-10.83	8.576	-.020
Region 1 & 5	149	.095	.063	.00- .29	10.185	.342	9.37-11.35	8.599	+.003
Puget Sound	25	.135	.057	.07- .29	10.554	.737	9.42-12.26	8.613	+.017
Total/Average	348	.131			10.129			8.596	
Half-and-half, packaged									
Kansas City	29	12.112	.958	11.00-14.50	8.133	.267	7.66- 8.70	8.420	-.003
Central Arizona	104	12.222	.543	10.95-13.40	7.138	.345	6.21- 8.23	8.424	+.001
Minneapolis-St. Paul	95	13.043	.774	11.25-16.50	7.361	.411	6.15- 8.26	8.417	-.006
New York[2]	28	11.264	1.303	7.97-12.20	8.000	.458	7.56- 8.90	8.431	+.008
Oklahoma Metropolitan	38	12.524	.536	11.60-13.65	7.878	.340	7.27- 8.65	8.420	-.003
Puget Sound	45	12.170	.544	11.30-13.50	7.944	.228	7.44- 8.39	8.428	+.005
Washington, D.C.	86	12.468	.887	10.30-16.20	7.689	.302	6.77- 8.22	8.418	-.005
Total/Average	425	12.258			7.735			8.423	

APPENDIX 17.--AVERAGE TESTS, STANDARD DEVIATIONS, RANGES OF BUTTERFAT AND SOLIDS-NOT-FAT, AND WEIGHTS PER GALLON AT 102° F.--Continued

Product and market	Number of samples	Percent fat content			Percent SNF content			Weight per gallon[1]	Difference from average
		Average	Std. dev. + or -	Range	Average	Std. dev. + or -	Range		
		Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pounds	Pounds
Fortified half-and-half, packaged									
Kansas City	25	11.500	.408	10.50-12.50	8.970	.298	8.52- 9.65	8.454	-.007
Chicago	56	11.663	.296	11.05-13.20	8.871	.292	8.16- 9.74	8.454	-.007
New York[2]	24	10.745	.908	9.68-12.90	9.635	.535	8.95-11.54	8.490	+.029
Oklahoma									
Metropolitan	18	11.164	.601	10.45-12.90	8.255	.416	7.58- 9.42	8.446	-.015
Total/Average	123	11.268			8.933			8.461	
Light cream, packaged									
Central Arizona	98	20.120	.905	18.50-23.50	6.954	.367	6.11- 7.78	8.333	+.001
Minneapolis-St. Paul	48	20.506	1.329	18.50-25.50	7.355	.469	5.99- 8.14	8.322	-.010
New York[3] -									
Region 6	27	21.134	2.914	17.02-27.02	7.052	.347	6.48- 8.03	8.316	-.016
Region 2	20	19.244	2.159	15.48-25.21	7.329	.728	6.73-10.12	8.338	+.006
Region 3 & 4	28	19.422	2.405	16.38-25.33	7.195	.395	6.40- 8.14	8.336	+.004
Region 1 & 5	23	19.422	2.039	17.20-25.88	6.855	.324	6.09- 7.51	8.333	+.001
Oklahoma									
Metropolitan	22	20.126	.938	18.00-21.50	7.586	.531	6.73- 9.23	8.338	+.006
Puget Sound	40	20.394	1.703	15.00-23.50	7.406	.386	6.04- 8.08	8.335	+.003
Washington, D.C.	95	19.504	1.369	15.50-25.00	7.167	.564	5.67- 8.54	8.335	+.003
Total/Average	401	19.986			7.211			8.332	
Heavy cream, packaged									
Kansas City	26	35.067	2.701	32.00-40.50	5.491	.466	4.55- 6.16	8.167	+.012
Central Arizona	99	35.896	.717	33.25-37.50	5.231	.423	4.28- 6.69	8.167	+.012
Chicago	51	32.358	.654	29.00-34.50	5.855	.260	5.22- 6.50	8.200	+.045
Minneapolis-St. Paul	94	35.975	2.364	31.00-41.00	5.714	.522	4.55- 7.36	8.160	+.005
New York[3] -									
Region 6	101	39.212	3.298	28.98-51.22	5.478	.474	4.29- 7.95	8.124	-.031
Region 2	132	39.149	2.695	33.79-47.62	5.506	.349	4.54- 7.51	8.128	-.027
Region 3 & 4	209	38.780	2.185	30.72-47.88	5.499	.403	4.50- 7.24	8.127	-.028
Region 1 & 5	164	37.506	1.528	33.15-42.68	5.569	.271	4.85- 6.77	8.142	-.013
Oklahoma									
Metropolitan	31	36.847	2.662	33.25-45.00	5.728	.370	5.04- 6.55	8.155	.000
Puget Sound	50	34.125	2.780	30.25-45.25	6.057	.422	4.71- 7.01	8.188	+.033
Washington, D.C.	71	37.806	1.152	34.25-40.25	4.881	.585	3.22- 6.37	8.145	-.010
Total/Average	1028	36.611			5.546			8.155	

[1] Weights per gallon as computed by use of each market's product regression equation which is the same as an average of the weights determined by the bottle method.

[2] Data by region not available.

[3] New York was divided into six geographic regions in respect to where the samples were collected. (Region 6 - Mohawk Valley; Region 2 - Southern New York State; Region 3 & 4 - New Jersey; Regions 1 & 5 - New York City and Long Island.)

APPENDIX 18.--AVERAGE BUTTERFAT AND SOLIDS-NOT-FAT TESTS AND WEIGHTS PER GALLON - SUMMARY OF DATA FROM ALL PARTICIPATING MARKETS - 102° F.

Product and market	Number of samples	Percent fat content		Percent SNF content		Weight per gallon[1]
		Average	Range	Average	Range	
		Pct.	Pct.	Pct.	Pct.	Pounds
Mixed breed producer milk						
New York[2]	18	3.671	2.60- 5.23	9.108	8.40- 9.71	8.528
North Texas	74	3.959	3.15- 5.20	8.670	7.94- 9.43	8.519
Northeastern Ohio	8	4.625	4.00- 5.80	8.990	8.36- 9.58	8.515
Oklahoma Metropolitan	48	4.594	2.98- 7.62	9.315	7.91-10.91	8.531
Puget Sound	408	4.101	3.10- 6.10	8.898	7.94-10.09	8.525
Southeastern Florida	16	3.694	3.15- 4.42	8.644	8.45- 8.96	8.523
Washington, D.C.	63	3.874	3.10- 4.35	8.755	8.16- 9.10	8.523
Breed milk						
Holstein						
Central Arizona	50	3.468	2.95- 4.00	8.177	7.30- 8.77	8.507
Chicago	63	3.723	3.50- 4.40	8.591	7.98- 9.08	8.517
Southeastern Florida	13	3.825	3.40- 4.00	8.678	8.51- 8.79	8.522
Jersey						
Central Arizona	50	4.537	3.60- 5.20	9.263	8.44- 9.64	8.531
Southeastern Florida	15	4.457	3.80- 4.75	9.053	8.45- 9.29	8.527
Guernsey						
Central Arizona	52	4.738	4.25- 5.32	8.901	8.57- 9.25	8.517
Southeastern Florida	8	4.415	4.00- 4.85	8.902	8.77- 9.09	8.522
Ayrshire						
Central Arizona	52	3.944	3.28- 4.48	8.772	8.39- 9.18	8.521
Chicago	50	4.337	4.00- 4.70	8.859	8.66- 9.13	8.519
Brown Swiss						
Central Arizona	52	3.946	3.50- 4.48	8.898	8.43- 9.46	8.526
Unprocessed milk at plant						
Chicago	52	3.510	3.30- 3.78	8.564	8.15- 8.96	8.517
Des Moines	16	3.778	3.40- 5.00	8.686	8.31- 9.28	8.520
Kansas City	1	3.750	---	8.540	---	8.516
Minneapolis-St. Paul	2	3.715	3.75- 3.68	8.725	8.63- 8.82	8.516
North Texas	1	3.900	---	8.380	---	8.516
Northeastern Ohio	5	3.600	3.30- 3.90	8.500	8.39- 8.54	8.511
Oklahoma Metropolitan	3	3.947	3.80- 4.12	9.007	8.90- 9.06	8.528
Puget Sound	103	3.914	3.20- 5.55	8.743	7.54- 9.94	8.523
Washington, D.C.	65	3.554	2.29- 4.20	8.513	7.71- 8.84	8.519
Homogenized milk, packaged (Includes a few samples of premium grade milk)						
Central Arizona	108	3.614	3.28- 3.88	8.444	8.13- 8.90	8.513
Chicago	55	3.420	3.30- 3.50	8.578	8.41- 8.79	8.517
Des Moines	15	3.548	3.30- 3.70	8.832	8.31- 9.32	8.528
Kansas City	78	3.408	3.05- 3.80	8.411	7.85- 8.67	8.518

APPENDIX 18.--AVERAGE BUTTERFAT AND SOLIDS-NOT-FAT TESTS AND WEIGHTS PER GALLON - SUMMARY OF DATA FROM ALL PARTICIPATING MARKETS - 102° F.--Continued

Product and market	Number of samples	Percent fat content		Percent SNF content		Weight per gallon[1]
		Average	Range	Average	Range	
		Pct.	Pct.	Pct.	Pct.	Pounds
Homogenized milk, packaged--Cont.						
Louisville-Lexington	78	3.702	3.10- 4.35	8.588	7.81- 9.28	8.526
Minneapolis-St. Paul	126	3.585	3.10- 4.80	8.717	8.27- 9.21	8.518
New York[3] -						
Region 6	144	3.560	3.08- 4.72	8.511	7.87- 9.94	8.514
Region 2	183	3.656	2.70- 5.14	8.585	8.05- 9.62	8.517
Region 3 & 4	304	3.580	3.07- 4.98	8.502	8.15- 9.45	8.515
Region 1 & 5	267	3.481	2.98- 4.26	8.418	7.61- 9.57	8.513
North Texas	100	3.664	3.15- 4.80	8.674	8.28- 9.39	8.516
Northeastern Ohio	11	3.650	3.40- 4.40	8.495	8.13- 8.72	8.508
Oklahoma Metropolitan	82	3.512	2.98- 4.12	8.753	8.26- 9.13	8.524
Puget Sound	100	3.639	3.10- 6.70	8.789	8.41- 9.38	8.526
Southern Michigan	335	3.567	3.00- 4.58	8.474	7.81- 9.16	8.514
Washington, D.C.	286	3.739	2.50- 5.35	8.626	7.91- 9.52	8.520
Creamline whole milk, packaged						
Central Arizona	52	3.343	3.12- 3.60	8.588	8.19- 9.00	8.515
Des Moines	12	4.267	3.90- 4.65	8.282	8.11- 8.51	8.507
Minneapolis-St. Paul	5	3.612	3.30- 4.50	8.970	8.47- 9.58	8.522
New York[2]	35	3.795	3.07- 5.24	8.723	8.23-10.15	8.516
Northeastern Ohio	7	3.514	3.30- 3.60	8.560	8.36- 8.78	8.512
Oklahoma Metropolitan	2	3.390	3.20- 3.58	8.820	8.79- 8.85	8.524
Puget Sound	81	3.808	3.25- 6.88	8.771	8.46- 9.28	8.523
Southern Michigan	50	3.774	3.20- 5.10	8.395	7.87- 8.89	8.511
Washington, D.C.	120	4.026	3.35- 4.80	8.542	7.80- 9.30	8.513
Plain skim milk, packaged						
Central Arizona	105	.150	.01- .60	8.779	8.11- 9.87	8.554
Kansas City	24	.132	.02- .26	8.707	8.46- 9.18	8.551
Minneapolis-St. Paul	24	.511	.05- 2.10	9.082	8.72- 9.85	8.557
New York[3] -						
Region 6	90	.077	.02- .26	8.761	7.42- 9.75	8.551
Region 2	126	.086	.00- .28	9.052	7.82-10.41	8.560
Region 3 & 4	163	.122	.00- .30	8.783	7.94- 9.82	8.553
Region 1 & 5	25	.060	.02- .16	9.208	8.43-10.61	8.569
North Texas	9	.108	.08- .11	8.938	8.81- 9.20	8.561
Northeastern Ohio	5	.098	.08- .12	8.884	8.72- 9.08	8.550
Puget Sound	34	.159	.04- .36	9.096	8.81- 9.79	8.566
Southern Michigan	52	.229	.04- .24	8.731	8.35-10.09	8.551
Washington, D.C.	72	.128	.02- .46	8.885	8.39- 9.33	8.558
Fortified skim milk, packaged						
Central Arizona	29	.223	.08- .29	9.749	8.79-10.80	8.584
Kansas City	7	.137	.07- .28	10.280	10.07-10.72	8.603
Minneapolis-St. Paul	46	.147	.02- .29	9.992	8.98-11.14	8.588

APPENDIX 18.--AVERAGE BUTERFAT AND SOLIDS-NOT-FAT TESTS AND WEIGHTS PER GALLON - SUMMARY OF DATA FROM ALL PARTICIPATING MARKETS 102° F.--Continued

Product and market	Number of samples	Percent fat content Average Pct.	Percent fat content Range Pct.	Percent SNF content Average Pct.	Percent SNF content Range Pct.	Weight per gallon[1] Pounds
Fortified skim milk, packaged--Cont.						
New York[3]						
Region 6	30	.109	.02- .27	10.570	9.97-11.12	8.610
Region 2	44	.093	.02- .27	10.356	9.55-11.31	8.605
Region 3 & 4	25	.116	.02- .28	9.496	8.49-10.83	8.576
Region 1 & 5	149	.095	.00- .29	10.185	9.37-11.35	8.599
North Texas	3	.183	.17- .20	10.147	9.90-10.47	8.602
Puget Sound	25	.135	.07- .29	10.554	9.42-12.26	8.613
Southern Michigan	3	.157	.11- .14	9.867	8.36-11.20	8.580
Unprocessed skim milk						
Chicago	66	.078	.04- .15	9.057	8.77- 9.74	8.560
Kansas City	1	.090	---	8.750	---	8.555
New York[2]	16	.446	.08- 1.94	9.310	8.44-10.03	8.566
North Texas	1	.090	---	8.810	---	8.599
Northeastern Ohio	3	.100	.08- .14	8.780	8.65- 8.89	8.544
Puget Sound	18	.454	.04- 2.30	9.228	8.78-10.57	8.566
Washington, D.C.	62	.135	.01- .36	8.835	8.17- 9.15	8.558
Skim milk, packaged[4]						
Kansas City	35	1.421	.30- 2.55	8.690	8.33- 9.63	8.542
New York[3]						
Regior 6, 2 & 1	33	1.070	.08- 2.80	8.639	8.19- 9.41	8.539
Region 3 & 4	68	.690	.31- 2.52	8.667	7.86- 9.66	8.546
North Texas	11	1.496	1.25- 1.86	8.677	8.37- 8.91	8.540
Oklahoma						
Metropolitan	25	1.441	.62- 1.85	8.757	8.48- 9.12	8.543
Puget Sound	13	1.554	.30- 2.48	9.027	8.60- 9.90	8.551
Washington, D.C.	72	1.225	.30- 2.80	8.800	8.24- 9.52	8.548
Fortified skim milk, packaged[4]						
Central Arizona	125	1.747	.30- 2.88	9.915	8.91-11.45	8.579
Chicago	56	2.106	1.80- 2.30	9.753	8.72-10.23	8.569
Des Moines	24	1.398	.70- 2.10	9.370	8.60- 9.88	8.560
Kansas City	69	1.685	.30- 2.40	10.050	9.10-11.00	8.586
Louisville-Lexington	26	1.492	.30- 2.68	9.858	8.85-11.01	8.580
Minneapolis-St. Paul	123	1.653	.32- 2.32	9.977	8.71-10.95	8.576
New York[2]	72	.629	.30- 2.18	10.133	9.03-11.12	8.594
North Texas	31	1.555	.42- 2.38	10.048	8.48-11.02	8.584
Northeastern Ohio	10	2.122	1.90- 2.30	10.559	10.30-10.81	8.591
Oklahoma						
Metropolitan	20	.696	.35- 1.20	9.311	8.74- 9.76	8.568
Puget Sound	50	2.009	.52- 2.90	10.000	8.69-10.95	8.580
Southern Michigan	1	.820	---	10.100	---	8.594
Unprocessed light cream						
New York[2]	15	22.012	18.72-26.74	7.619	7.07- 8.52	8.319
Washington, D.C.	25	21.192	17.00-24.75	6.726	6.24- 7.14	8.323

APPENDIX 18.--AVERAGE BUTTERFAT AND SOLIDS-NOT-FAT TESTS AND WEIGHTS PER GALLON - SUMMARY OF DATA FROM ALL PARTICIPATING MARKETS 102° F.--Continued

Product and market	Number of samples	Percent fat content		Percent SNF content		Weight per gallon[1]
		Average	Range	Average	Range	
		Pct.	Pct.	Pct.	Pct.	Pounds
Unprocessed heavy cream						
New York[2]	1	27.620	---	7.210	---	8.260
North Texas	2	32.235	31.79-32.68	6.320	6.21- 6.43	8.207
Northeastern Ohio	5	37.950	33.00-41.50	5.424	4.71- 6.03	8.132
Puget Sound	1	31.250	---	6.330	---	8.210
Washington, D.C.	34	38.092	33.50-49.00	4.703	2.34- 5.94	8.148
Half-and-half, packaged						
Central Arizona	104	12.222	10.95-13.40	7.138	3.00- 8.23	8.424
Kansas City	29	12.112	11.00-14.50	8.133	7.66- 8.70	8.420
Minneapolis-St. Paul	95	13.043	11.25-16.50	7.361	6.15- 8.26	8.417
New York[2]	28	11.264	7.97-12.20	8.000	7.56- 8.90	8.431
North Texas	15	12.160	11.20-13.60	7.975	7.48- 8.51	8.430
Northeastern Ohio	12	12.189	11.65-13.22	7.648	6.84- 8.75	8.415
Oklahoma Metropolitan	38	12.524	11.60-13.65	7.878	7.27- 8.65	8.420
Puget Sound	45	12.170	11.30-13.50	7.944	7.44- 8.39	8.428
Southern Michigan	3	10.750	10.50-11.00	8.270	8.02- 8.57	8.446
Washington, D.C.	86	12.468	10.30-16.20	7.689	6.77- 8.22	8.418
Fortified half-and-half, packaged						
Chicago	56	11.663	11.05-13.20	8.871	8.16- 9.74	8.454
Des Moines	12	13.125	12.50-13.50	10.098	7.83-11.29	8.506
Kansas City	25	11.500	10.50-12.50	8.970	8.52- 9.65	8.454
New York[2]	24	10.745	9.68-12.90	9.635	8.95-11.54	8.490
North Texas	5	12.100	11.80-12.30	8.662	8.17- 9.06	8.441
Oklahoma Metropolitan	18	11.164	10.45-12.90	8.255	7.58- 9.42	8.446
Southern Michigan	3	10.667	10.50-11.00	8.977	8.76- 9.14	8.465
Light cream, packaged						
Central Arizona	98	20.120	18.50-23.50	6.954	6.11- 7.78	8.333
Kansas City	1	25.500	---	6.270	---	8.275
Minneapolis-St. Paul	48	20.506	18.50-25.50	7.355	5.99- 8.14	8.322
New York[3] -						
Region 6	27	21.134	17.02-27.02	7.052	6.48- 8.03	8.316
Region 2	20	19.244	15.48-25.21	7.329	6.73-10.12	8.338
Region 3 & 4	28	19.422	16.38-25.33	7.195	6.40- 8.14	8.336
Region 1 & 5	23	19.422	17.20-25.88	6.855	6.09- 7.51	8.333
North Texas	13	19.356	17.86-20.98	7.250	6.52- 8.11	8.341
Northeastern Ohio	11	18.295	17.00-19.75	7.668	6.98- 8.26	8.347
Oklahoma Metropolitan	22	20.126	18.00-21.50	7.586	6.73- 9.23	8.338
Puget Sound	40	20.394	15.00-23.50	7.406	6.04- 8.08	8.335
Southern Michigan	7	18.893	17.25-21.50	7.080	5.71- 8.62	8.342
Washington, D.C.	95	19.504	15.50-25.00	7.167	5.67- 8.54	8.335

APPENDIX 18.--AVERAGE BUTTERFAT AND SOLIDS-NOT-FAT TESTS AND WEIGHTS PER GALLON - SUMMARY OF DATA FROM ALL PARTICIPATING MARKETS 102° F.--Continued

Product and market	Number of samples	Percent fat content		Percent SNF content		Weight per gallon[1]
		Average	Range	Average	Range	
		Pct.	Pct.	Pct.	Pct.	Pounds
Heavy cream, packaged						
Central Arizona	99	35.896	33.25-37.50	5.231	4.28- 6.69	8.167
Chicago	51	32.358	29.00-34.50	5.855	5.22- 6.50	8.200
Des Moines	12	39.125	37.50-40.00	4.681	4.08- 5.28	8.153
Kansas City	26	35.067	32.00-40.50	5.491	4.55- 6.16	8.167
Minneapolis-St. Paul	94	35.975	31.00-40.88	5.714	4.55- 7.36	8.160
New York[3] -						
Region 6	101	39.212	28.98-51.22	5.478	4.29- 7.95	8.124
Region 2	132	39.149	33.79-47.62	5.506	4.54- 7.51	8.128
Region 3 & 4	209	38.780	30.72-47.88	5.499	4.50- 7.24	8.127
Region 1 & 5	164	37.506	33.15-42.68	5.569	4.85- 6.77	8.142
North Texas	12	38.097	34.36-42.34	5.665	5.24- 6.10	8.140
Northeastern Ohio	6	33.833	32.00-35.00	5.555	4.98- 6.10	8.166
Oklahoma						
Metropolitan	31	36.847	33.25-45.00	5.728	5.04- 6.55	8.155
Puget Sound	50	34.125	30.25-45.25	6.057	4.71- 7.01	8.188
Southern Michigan	7	34.643	31.50-38.50	5.517	4.85- 6.69	8.173
Washington, D.C.	71	37.806	34.25-40.25	4.881	3.22- 6.37	8.145

[1] Weights per gallon as computed by use of each market's product regression equation, which is the same as an average of the weights determined by the bottle method.

[2] Data by region not available.

[3] New York was divided into six geographic regions in respect to where the samples were collected. (Region 6 - Mohawk Valley; Region 2 - Southern New York State; Regions 3 & 4 - New Jersey; Regions 1 & 5 - New York City and Long Island.)

[4] Skim and fortified skim of somewhat higher butterfat content than the previously shown plain skim and fortified skim.

APPENDIX 19.--COMPARISON OF WEIGHTS COMPUTED FOR A PRODUCT OF AN AVERAGE BUTTERFAT AND SOLIDS-NOT-FAT CONTENT BY USE OF INDIVIDUAL MARKET REGRESSION EQUATIONS AND ALL MARKET PRODUCT REGRESSION EQUATIONS AT 40°, 50°, 68°, 102° F.

Product and market	Product composition		Weight Per Gallon at			
	B.F.	S.N.F.	40°F.	50°F.	68°F.	102°F.
	Percent	Percent	Pounds			
Mixed breed producer milk						
New York	4.00	8.95	8.621	8.611	8.585	8.521
North Texas	4.00	8.95	8.625	-	8.589	8.525
Oklahoma Metropolitan	4.00	8.95	8.627	-	8.592	8.527
Puget Sound	4.00	8.95	8.624	8.616	8.590	8.527
Washington, D.C.	4.00	8.95	8.626	-	8.590	8.526
Average			8.625	8.614	8.589	8.525
All market product regression equation			8.625	8.616	8.590	8.526
Homogenized milk, packaged						
Central Arizona	3.60	8.60	8.614	-	8.583	8.518
Chicago	3.60	8.60	8.611	-	8.579	8.516
Kansas City	3.60	8.60	-	-	8.584	8.523
Louisville-Lexington	3.60	8.60	-	-	8.585	8.526
Minneapolis-St. Paul	3.60	8.60	8.612	-	8.578	8.517
New York[1] -						
Region 6	3.60	8.60	8.611	8.602	8.577	8.515
Region 2	3.60	8.60	8.612	8.604	8.580	8.517
Region 3 & 4	3.60	8.60	8.612	8.603	8.579	8.517
Region 1 & 5	3.60	8.60	8.611	8.602	8.578	8.515
North Texas	3.60	8.60	8.612	-	8.578	8.515
Oklahoma Metropolitan	3.60	8.60	8.615	-	8.581	8.519
Puget Sound	3.60	8.60	8.617	8.608	8.584	8.522
Southern Michigan	3.60	8.60	-	-	-	8.518
Washington, D.C.	3.60	8.60	8.617	-	8.582	8.518
Average			8.613	8.604	8.581	8.518
All market product regression equation			8.613	8.604	8.580	8.518
Skim milk, packaged						
Central Arizona	.15	8.90	8.636	-	8.612	8.556
Kansas City	.15	8.90	-	-	8.612	8.560
Minneapolis-St. Paul	.15	8.90	8.635	-	8.610	6.556
New York[1] -						
Region 6	.15	8.90	8.634	8.627	8.610	8.555
Region 2	.15	8.90	8.634	8.627	8.610	8.556
Region 3 & 4	.15	8.90	8.635	8.628	8.610	8.557
Region 1 & 5	.15	8.90	8.638	8.632	8.614	8.560
Puget Sound	.15	8.90	8.637	8.631	8.614	8.560
Southern Michigan	.15	8.90	-	-	-	8.556
Washington, D.C.	.15	8.90	8.637	-	8.613	8.558
Average			8.636	8.629	8.612	8.557
All market product regression equation			8.635	8.628	8.611	8.557
Fortified skim milk, packaged						
Central Arizona	.15	10.15	8.677	-	8.650	8.595
Minneapolis-St. Paul	.15	10.15	8.673	-	8.649	8.593
New York[1] -						
Region 6	.15	10.15	8.679	8.672	8.654	8.597
Region 2	.15	10.15	8.679	8.672	8.654	8.599
Region 3 & 4	.15	10.15	8.676	8.669	8.650	8.595
Region 1 & 5	.15	10.15	8.678	8.672	8.653	8.598
Puget Sound	.15	10.15	8.678	8.672	8.654	8.599
Average			8.677	8.671	8.652	8.597
All market product regression equation			8.678	8.672	8.652	8.597

APPENDIX 19.--COMPARISON OF WEIGHTS COMPUTED FOR A PRODUCT OF AN AVERAGE BUTTERFAT AND SOLIDS-NOT-FAT CONTENT BY USE OF INDIVIDUAL MARKET REGRESSION EQUATIONS AND ALL MARKET PRODUCT REGRESSION EQUATIONS AT 40°, 50°, 68°, 102° F.--Continued

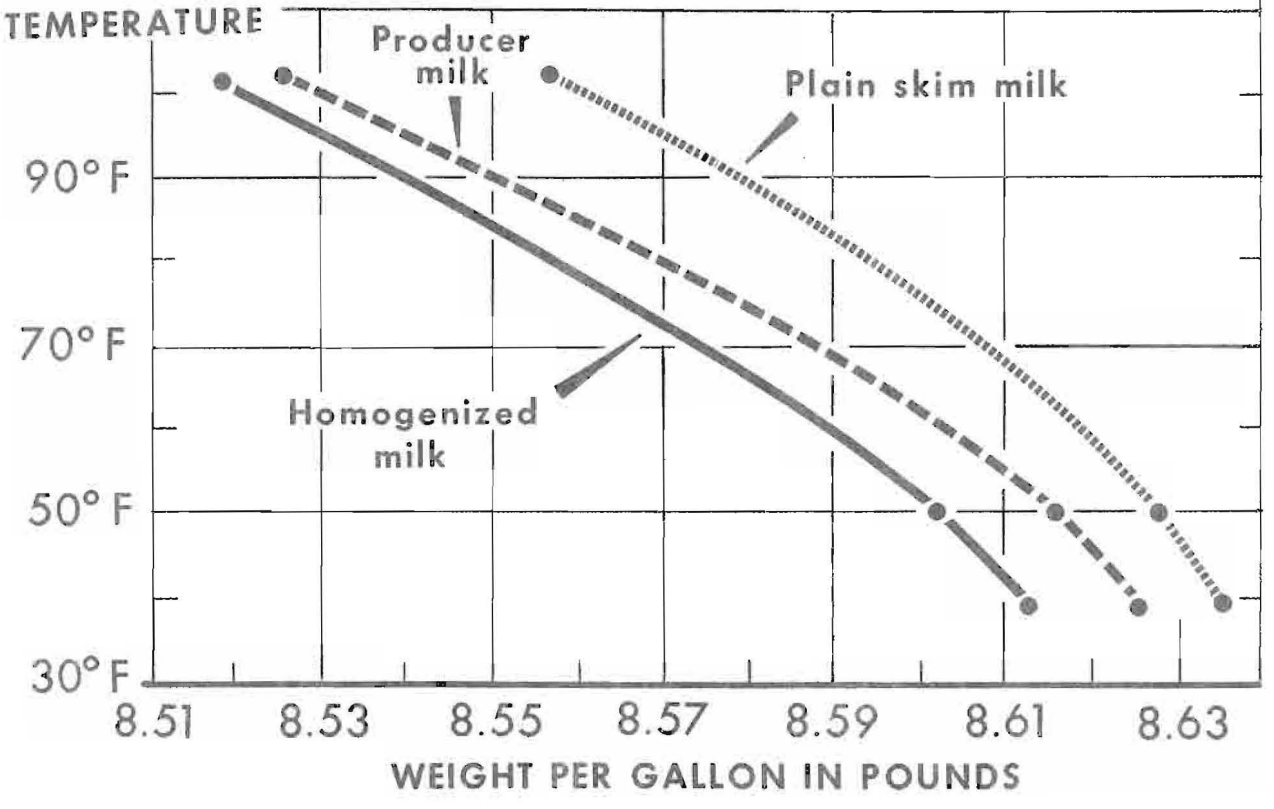
Product and market	Product composition		Weight Per Gallon at			
	B.F.	S.N.F.	40°F.	50°F.	68°F.	102°F.
	Percent	Percent	Pounds			
Half-and-half, packaged						
Central Arizona	12.25	7.75	8.557	-	8.505	8.421
Kansas City	12.25	7.75	-	-	8.494	8.414
Minneapolis-St. Paul	12.25	7.75	8.563	-	8.505	8.424
New York - All regions[1]	12.25	7.75	8.554	8.539	8.498	8.415
Oklahoma Metropolitan	12.25	7.75	8.559	-	8.502	8.420
Puget Sound	12.25	7.75	8.561	8.548	8.506	8.426
Washington, D.C.	12.25	7.75	8.561	-	8.501	8.421
Average			8.559	8.544	8.502	8.420
All market product regression equation			8.562	8.542	8.506	8.423
Fortified half-and-half, packaged						
Chicago	11.30	8.90	8.587	-	8.536	8.457
Kansas City	11.30	8.90	-	-	8.532	8.452
New York - All regions[1]	11.30	8.90	8.598	8.584	8.542	8.461
Oklahoma Metropolitan	11.30	8.90	8.594	-	8.537	8.455
Average			8.593	8.584	8.537	8.456
All market product regression equation			8.596	8.600	8.541	8.461
Light cream, packaged						
Central Arizona	20.00	7.20	8.511	-	8.442	8.333
Minneapolis-St. Paul	20.00	7.20	8.510	-	8.427	8.329
New York[1] -						
Region 6	20.00	7.20	8.504	8.485	8.427	8.326
Region 2	20.00	7.20	8.507	8.486	8.431	8.331
Region 3 & 4	20.00	7.20	8.509	8.488	8.432	8.331
Region 1 & 5	20.00	7.20	8.511	8.489	8.433	8.336
Oklahoma Metropolitan	20.00	7.20	8.518	-	8.441	8.342
Puget Sound	20.00	7.20	8.513	8.492	8.435	8.336
Washington, D.C.	20.00	7.20	8.507	-	8.426	8.329
Average			8.511	8.488	8.433	8.333
All market product regression equation			8.510	8.487	8.433	8.331
Heavy cream, packaged						
Central Arizona	36.60	5.55	8.415	-	8.308	8.159
Chicago	36.60	5.55	8.390	-	8.298	8.153
Kansas City	36.60	5.55	-	-	8.286	8.153
Minneapolis-St. Paul	36.60	5.55	8.412	-	8.284	8.154
New York[1] -						
Region 6	36.60	5.55	8.403	8.376	8.284	8.150
Region 2	36.60	5.55	8.401	8.374	8.283	8.153
Region 3 & 4	36.60	5.55	8.395	8.367	8.279	8.147
Region 1 & 5	36.60	5.55	8.398	8.370	8.280	8.149
Oklahoma Metropolitan	36.60	5.55	8.419	-	8.300	8.159
Puget Sound	36.60	5.55	8.417	8.391	8.299	8.166
Washington, D.C.	36.60	5.55	8.411	-	8.288	8.151
Average			8.406	8.376	8.290	8.154
All market product regression equation			8.406	8.373	8.288	8.154

[1] Region 6 - Mohawk Valley; Region 2 - Southern New York State; Region 3 & 4 - New Jersey; Region 1 & 5 - New York City and Long Island.

APPENDIX 20.- WEIGHTS PER GALLON AT TEMPERATURES OF 40° TO 102° F

	FAT	SNF
Mixed breed producer milk	4.00%	8.95%
Homogenized milk	3.60	8.60
Skim milk	.15	8.90

(Source of data – Appendix 19)



U. S. DEPARTMENT OF AGRICULTURE NEG. C&MS 57-65 (6) CONSUMER AND MARKETING SERVICE

APPENDIX 21.--MIXED BREED PRODUCER MILK

Averages of Butterfat, Solids-Not-Fat, and Actual Weights Per Gallon as Determined by the Babcock Bottle Method Compared with Computed Weights Per Gallon at 40° F.

40° F

Market and Month	Number of samples	Average BF	Average SNF	Actual wt. per gallon	Diff. from average	Computed wt. per gal.[1]	Computed wt. minus actual
		Percent	Percent	Pounds	Pounds	Pounds	Pounds
Puget Sound							
Dec. 1961	8	4.256	8.585	8.617	-.006	8.612	-.005
Jan. 1962	15	4.130	8.753	8.622	-.001	8.618	-.004
Feb.	23	3.844	8.682	8.619	-.004	8.617	-.002
Mar.	47	4.045	8.802	8.622	-.001	8.621	-.001
Apr.	40	4.088	8.786	8.621	-.002	8.620	-.001
May	30	4.020	9.064	8.627	+.004	8.630	+.003
Jun.	62	3.899	8.888	8.624	+.001	8.624	.000
Jul.	23	4.324	9.104	8.629	+.006	8.630	+.001
Aug.	13	3.862	8.750	8.618	-.005	8.619	+.001
Sep.	30	3.992	8.989	8.622	-.001	8.627	+.005
Oct.	51	4.447	9.156	8.627	+.004	8.632	+.005
Nov.	28	4.200	8.886	8.624	+.001	8.622	-.002
Dec.	37	4.200	8.797	8.622	-.001	8.620	-.002
Total/Average	407	4.102	8.899	8.623		8.622	
Washington, D. C.							
Jun. 1961	2	3.850	8.810	8.621	-.001	8.622	+.001
Jul.	3	3.800	8.773	8.617	-.005	8.620	+.003
Aug.	9	3.822	8.619	8.617	-.005	8.615	-.002
Sep.	3	3.983	8.643	8.618	-.004	8.615	-.003
Oct.	6	3.833	8.727	8.620	-.002	8.618	-.002
Nov.	5	3.970	8.884	8.624	+.002	8.623	-.001
Dec.	5	4.100	8.962	8.627	+.005	8.626	-.001
Jan. 1962	6	4.075	8.918	8.630	+.008	8.624	-.006
Feb.	3	4.150	8.997	8.630	+.008	8.627	-.003
Mar.	2	4.025	8.945	8.624	+.002	8.626	+.002
Apr.	5	3.880	8.768	8.622	.000	8.620	-.002
May	4	3.788	8.700	8.622	.000	8.617	-.005
Jun.	4	3.488	8.390	8.616	-.006	8.608	-.008
Jul.	2	3.500	8.630	8.617	-.005	8.617	.000
Aug.	3	3.633	8.650	8.622	.000	8.617	-.005
Total/Average	62	3.873	8.755	8.622		8.620	

APPENDIX 21.--MIXED BREED PRODUCER MILK--Continued

Averages of Butterfat, Solids-Not-Fat, and Actual Weights Per Gallon as Determined by the Babcock Bottle Method Compared with Computed Weights Per Gallon at 40° F.

Market and Month	Number of samples	Average BF	Average SNF	Actual wt. per gallon	Diff. from average	Computed wt. per gal.[1]	Computed wt. minus actual
		Percent	Percent	Pounds	Pounds	Pounds	Pounds
		40° F.					
North Texas							
Jan. 1962	7	4.071	8.699	8.621	+.004	8.617	-.004
Feb.	1	3.700	8.480	8.615	-.002	8.611	-.004
Mar.	6	4.017	8.787	8.621	+.004	8.620	-.001
Apr.	24	4.035	8.772	8.622	+.005	8.619	-.003
May	-	-	-	-	-	-	-
Jun.	12	3.896	8.546	8.616	-.001	8.612	-.004
Jul.	6	3.858	8.602	8.614	-.003	8.614	.000
Aug.	7	3.833	8.559	8.614	-.003	8.612	-.002
Sep.	-	-	-	-	-	-	-
Oct.	7	4.014	8.680	8.616	-.001	8.617	+.001
Nov.	4	3.738	8.532	8.615	-.002	8.612	-.003
Dec.	-	-	-	-	-	-	-
Total/Average	74	3.959	8.670	8.617		8.615	

[1] Computed by use of universal equation:

$$\frac{100}{100 + (\% \text{ BF} \times .03928) - (\% \text{ SNF} \times .39221)} = \text{Specific gravity at } 40^\circ \text{ F.}$$

Sp. gr. x 8.3364 (wt./gal. water at 40° F.) = Computed weight per gallon at 40° F.

APPENDIX 22.--JERSEY PRODUCER MILK

Averages of Butterfat, Solids-Not-Fat and Actual Weights Per Gallon as Determined by the Babcock Bottle Method Compared with Computed Weights Per Gallon at 40° F.

40° F.

Market and Month	Number of samples	Average BF	Average SNF	Actual wt. per gallon	Diff. from average	Computed wt. per gal.[1]	Computed wt. minus actual
		Percent	Percent	Pounds	Pounds	Pounds	Pounds
Central Arizona							
Oct. 1961	2	4.910	9.255	8.635	-.001	8.633	-.002
Nov.	5	4.946	9.540	8.642	+.006	8.643	+.001
Dec.	4	4.980	9.558	8.642	+.006	8.643	+.001
Jan. 1962	4	4.905	9.438	8.638	+.002	8.640	+.002
Feb.	3	4.907	9.427	8.639	+.003	8.639	.000
Mar.	4	4.750	9.352	8.637	+.001	8.637	.000
Apr.	4	4.602	9.008	8.627	-.009	8.633	+.006
May	5	4.190	9.110	8.635	-.001	8.631	-.004
Jun.	4	4.082	9.142	8.637	+.001	8.632	-.005
Jul.	1	4.120	9.210	8.621	-.015	8.634	+.013
Aug.	3	3.860	9.030	8.634	-.002	8.629	-.005
Sep.	4	3.875	9.140	8.633	-.003	8.632	-.001
Oct.	4	4.792	9.372	8.642	+.006	8.637	-.005
Total/Average	47	4.550	9.285	8.636		8.636	

[1] Computed by use of universal equation:

$$\frac{100}{100 + (\% \text{ BF} \times .03928) - (\% \text{ SNF} \times .39221)} = \text{Specific gravity at } 40^\circ \text{ F.}$$

Sp. gr. x 8.3364 (wt./gal. water at 40° F.) = Computed weight per gallon at 40° F.

APENDIX 23.--GUERNSEY PRODUCER MILK

Averages of Butterfat, Solids-Not-Fat and Actual Weights Per Gallon as Determined by the Babcock Bottle Method Compared with Computed Weights Per Gallon at 40° F.

40° F.

Market and Month	Number of samples	Average BF	Average SNF	Actual wt. per gallon	Diff. from average	Computed wt. per gal.[1]	Computed wt. minus actual
		Percent	Percent	Pounds	Pounds	Pounds	Pounds
Central Arizona							
Oct. 1961	2	4.700	9.020	8.632	+.008	8.626	-.006
Nov.	5	4.994	9.080	8.626	+.002	8.627	+.001
Dec.	4	4.858	8.852	8.627	+.003	8.619	-.008
Jan. 1962	4	5.005	9.052	8.630	+.006	8.626	-.004
Feb.	3	5.067	8.920	8.621	-.003	8.621	.000
Mar.	4	4.788	8.788	8.619	-.005	8.617	-.002
Apr.	4	4.685	8.960	8.627	+.003	8.623	-.004
May	5	4.670	8.986	8.628	+.004	8.625	-.003
Jun.	4	4.570	9.022	8.624	.000	8.627	+.003
Jul.	3	4.640	8.880	8.622	-.002	8.621	-.001
Aug.	4	4.410	8.728	8.619	-.005	8.617	-.002
Sep.	4	4.542	8.752	8.612	-.012	8.617	+.005
Oct.	4	4.740	8.728	8.619	-.005	8.616	-.003
Total/Average	50	4.745	8.906	8.624		8.622	

[1] Computed by use of universal equation:

$$\frac{100}{100 + (\% \text{ BF} \times .03928) - (\% \text{ SNF} \times .39221)} = \text{Specific gravity at } 40^\circ \text{ F.}$$

Sp. gr. x 8.3364 (wt./gal. water at 40° F.) = Computed weight per gallon at 40° F.

APPENDIX 24.--BROWN SWISS PRODUCER MILK

Averages of Butterfat, Solids-Not-Fat and Actual Weights Per Gallon as Determined by the Babcock Bottle Method Compared with Computed Weights Per Gallon at 40° F.

40° F.

Market and Month	Number of samples	Average BF Percent	Average SNF Percent	Actual wt. per gallon Pounds	Diff. from average Pounds	Computed wt. per gal.[1] Pounds	Computed wt. minus actual Pounds
Central Arizona							
Oct. 1961	3	4.253	9.193	8.633	+.007	8.633	.000
Nov.	3	4.403	9.113	8.630	+.004	8.630	.000
Dec.	4	4.112	9.245	8.632	+.006	8.636	+.004
Jan. 1962	4	4.265	8.948	8.630	+.004	8.625	-.005
Feb.	4	4.155	8.972	8.625	-.001	8.626	+.001
Mar.	4	3.968	8.928	8.624	-.002	8.625	+.001
Apr.	4	3.818	8.932	8.628	+.002	8.626	-.002
May	4	3.838	8.920	8.627	+.001	8.625	-.002
Jun.	4	3.852	8.678	8.628	+.002	8.617	-.011
Jul.	3	3.607	8.557	8.617	-.009	8.613	-.004
Aug.	4	3.575	8.622	8.618	-.008	8.616	-.002
Sep.	4	3.642	8.825	8.625	-.001	8.622	-.003
Oct.	4	3.955	8.855	8.626	.000	8.622	-.004
Total/Average	49	3.949	8.904	8.626		8.624	

[1] Computed by use of universal equation:

$$\frac{100}{100 + (\%\ BF \times .03928) - (\%\ SNF \times .39221)} = \text{Specific gravity at } 40^\circ \text{ F.}$$

Sp. gr. x 8.3364 (wt./gal. water at 40° F.) = Computed weight per gallon at 40° F.

APPENDIX 25.--AYRSHIRE PRODUCER MILK

Averages of Butterfat, Solids-Not-Fat, and Actual Weights Per Gallon as Determined by the Babcock Bottle Method Compared with Computed Weights Per Gallon at 40° F.

40° F.

Market and Month	Number of samples	Average BF	Average SNF	Actual wt. per gallon	Diff. from average	Computed wt. per gal.[1]	Computed wt. minus actual
		Percent	Percent	Pounds	Pounds	Pounds	Pounds
Central Arizona							
Oct. 1961	2	4.050	8.900	8.625	+.003	8.624	-.001
Nov.	5	4.392	9.068	8.630	+.008	8.628	-.002
Dec.	4	4.252	8.855	8.625	+.003	8.622	-.003
Jan. 1962	3	4.240	8.930	8.625	+.003	8.624	-.001
Feb.	4	4.055	8.762	8.617	-.005	8.619	+.002
Mar.	3	4.133	8.650	8.617	-.005	8.615	-.002
Apr.	4	3.705	8.625	8.620	-.002	8.616	-.004
May	5	3.748	8.648	8.622	.000	8.616	-.006
Jun.	4	3.738	8.848	8.626	+.004	8.623	-.003
Jul.	3	3.793	8.737	8.620	-.002	8.619	-.001
Aug.	4	3.730	8.660	8.620	-.002	8.617	-.003
Sep.	4	3.645	8.578	8.616	-.006	8.614	-.002
Oct.	4	3.838	8.722	8.619	-.003	8.618	-.001
Total/Average	49	3.942	8.766	8.622		8.620	
Chicago							
Nov. 1961	3	4.300	8.813	8.613	-.004	8.620	+.007
Dec.	4	4.230	8.770	8.613	-.004	8.618	+.005
Jan. 1962	4	4.412	8.855	8.619	+.002	8.621	+.002
Feb.	4	4.442	8.795	8.617	.000	8.619	+.002
Mar.	5	4.474	8.768	8.615	-.002	8.617	+.002
Apr.	3	4.467	8.750	8.617	.000	8.617	.000
May[2]							
Jun.	4	4.235	8.930	8.612	-.005	8.624	+.012
Jul.	4	4.115	8.908	8.617	.000	8.624	+.007
Aug.	4	4.150	8.970	8.616	-.001	8.626	+.010
Sep.	4	4.182	8.962	8.617	.000	8.626	+.009
Oct.	3	4.317	8.850	8.617	.000	8.621	+.004
Nov.	4	4.498	8.905	8.621	+.004	8.622	+.001
Dec.	4	4.545	8.878	8.621	+.004	8.622	+.001
Total/Average	50	4.337	8.859	8.617		8.621	

[1] Computed by use of universal equation:

$$\frac{100}{100 + (\%\ \text{BF} \times .03928) - (\%\ \text{SNF} \times .39221)} = \text{Specific gravity at } 40^\circ \text{ F.}$$

Sp. gr. x 8.3364 (wt./gal. water at 40° F.) = Computed weight per gallon at 40° F.

[2] Data not available for May.

APPENDIX 26.--HOLSTEIN PRODUCER MILK

Averages of Butterfat, Solids-Not-Fat, and Actual Weights per Gallon as Determined by the Babcock Bottle Method Compared with Computed Weights Per Gallon at 40° F.

Market and Month	Number of Samples	Average BF	Average SNF	Actual wt. per gallon	Diff. from average	Computed wt. per gallon[1]	Computed wt. minus actual
		Percent	Percent	Pounds	Pounds	Pounds	Pounds
Central Arizona							
October 1961	3	3.453	8.287	8.608	+.004	8.604	-.004
November	4	3.695	8.415	8.610	+.006	8.608	-.002
December	3	3.800	8.400	8.609	+.005	8.607	-.002
January 1962	5	3.820	8.316	8.604	.000	8.604	.000
February	4	3.690	8.072	8.594	-.010	8.596	+.002
March	4	3.670	8.302	8.611	+.007	8.604	-.007
April	4	3.292	8.088	8.601	-.003	8.598	-.003
May	4	3.330	8.170	8.606	+.002	8.601	-.005
June	3	3.427	8.207	8.610	+.006	8.601	-.009
July	2	3.115	7.985	8.600	-.004	8.595	-.005
August	4	3.110	8.045	8.600	-.004	8.597	-.003
September	4	3.130	7.888	8.596	-.008	8.591	-.005
October	4	3.420	8.130	8.603	-.001	8.599	-.004
Total/Average	48	3.473	8.181	8.604		8.600	
Chicago							
November 1961	4	3.625	8.130	8.594	-.015	8.598	+.004
December	4	3.562	8.042	8.591	-.018	8.596	+.005
January 1962	5	3.690	8.446	8.608	-.001	8.609	+.001
February	3	3.677	8.607	8.615	+.006	8.615	.000
March	5	3.594	8.686	8.616	+.007	8.618	+.002
April	6	3.887	8.718	8.615	+.006	8.618	+.003
May	8	4.034	8.814	8.615	+.006	8.621	+.006
June	4	3.625	8.672	8.607	-.002	8.617	+.010
July	4	3.645	8.795	8.611	+.002	8.622	+.011
August	4	3.750	8.798	8.610	+.001	8.622	+.012
September	5	3.624	8.594	8.607	-.002	8.615	+.008
October	3	3.657	8.523	8.611	+.002	8.612	+.001
November	4	3.625	8.582	8.612	+.003	8.614	+.002
December	4	3.780	8.578	8.614	+.005	8.613	-.001
Total/Average	63	3.723	8.591	8.609		8.614	

[1] Computed by use of universal equation:

$$\frac{100}{100 + (\%\ \text{BF} \times .03928) - (\%\ \text{SNF} \times .39221)} = \text{Specific gravity at } 40^{\circ}\text{F.}$$

Sp. gr. x 8.3364 (wt./gal. water at 40°F.) = Computed weight per gallon at 40°F.

APPENDIX 27.--AVERAGE BUTTERFAT, SOLIDS-NOT-FAT, AND ACTUAL WEIGHTS PER GALLON AS DETERMINED BY THE BABCOCK BOTTLE METHOD COMPARED WITH THE AVERAGE COMPUTED WEIGHTS PER GALLON BY MARKETS AND BREEDS AT 40° F.

Market	Breed	Number of samples	Average BF	Average SNF	Actual wt. per gallon	Comp. wt. per gal.[1]	Comp. wt. minus actual
			40° F.				
			Percent	Percent	Pounds	Pounds	Pounds
Central Arizona	Jersey	47	4.550	9.285	8.636	8.636	.000
Central Arizona	Guernsey	50	4.745	8.906	8.624	8.622	-.002
Central Arizona	Brown Swiss	49	3.949	8.904	8.626	8.624	-.002
Central Arizona	Ayrshire	49	3.942	8.766	8.622	8.620	-.002
Chicago	Ayrshire	50	4.337	8.859	8.617	8.621	+.004
Central Arizona	Holstein	48	3.473	8.181	8.604	8.600	-.004
Chicago	Holstein	63	3.723	8.591	8.609	8.614	+.005
Puget Sound	Mixed Breed	407	4.102	8.899	8.623	8.622	-.001
Washington, D.C.	Mixed Breed	62	3.873	8.755	8.622	8.620	-.002
North Texas	Mixed Breed	74	3.959	8.670	8.617	8.615	-.002

[1] Computed by use of the universal equation:

$$\frac{100}{100 + (\%\ BF \times .03928) - (\%\ SNF \times .39221)} = \text{Specific gravity at } 40^\circ \text{ F.}$$

Sp. gr. of mixture x 8.3364 wt./gal. water = Computed weight per gallon (40° F.)

APPENDIX 28.--VALUES FOR SPECIFIC GRAVITIES OF BUTTERFAT AND SOLIDS-NOT-FAT AS THEY APPEAR IN SOLUTION, FACTORS FOR BUTTERFAT AND SOLIDS-NOT-FAT, AND WEIGHTS PER GALLON OF WATER AT DIFFERENT TEMPERATURES

Temperature	Sp. gr. butterfat[1]	Butterfat factor[2]	Apparent sp. gr. SNF	SNF factor[3]	Pounds per gallon H_2O
$102^{\circ}/102^{\circ}$ F.	.9133	.09493	1.5952	.37312	8.2752
$68^{\circ}/68^{\circ}$ F.	.9330	.07181	1.6167	.38146	8.3217
$50^{\circ}/50^{\circ}$ F.	.9541	.04811	1.6275	.38556	8.3341
$40^{\circ}/40^{\circ}$ F.	.9622	.03928	1.6453	.39221	8.3364

Universal formula for computing weight per gallon for fluid milk products:

$$\frac{100}{100 + (\% \text{ BF} \times \text{BF factor}) - (\% \text{ SNF} \times \text{SNF factor})} = \text{Sp. gr. of mixture}$$

Sp. gr. of mixture x weight per gallon of water = Weight per gallon of fluid milk products

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[1] Calculated from butterfat density values determined by Sharp.

[2] Calculated by subtracting the specific gravity of butterfat from 1.00 (sp. gr. of water) and dividing the resulting amount by the specific gravity of butterfat.

[3] Calculated by subtracting 1.00 (sp. gr. of water) from the specific gravity of solids-not-fat and then dividing the resulting amount by the specific gravity of solids-not-fat.

APPENDIX 29.--COMPUTED SPECIFIC GRAVITY OF SOLIDS-NOT-FAT AT 40° F.

40° F.

Product and Market	Number of samples	Average butterfat	Average SNF	Average sp. gr. of product	Average sp. gr. of SNF[1]
		Percent	Percent	Sp. gr.	Sp. gr.
Skim milk, packaged					
North Texas	9	.108	8.938	1.03632	1.64649
New York[2]	25	.060	9.208	1.03737	1.64323
Puget Sound	34	.159	9.096	1.03689	1.64441
Central Arizona	105	.150	8.779	1.03558	1.64582
Raw skim milk					
Washington, D.C.	62	.135	8.835	1.03608	1.65225
New York[2]	16	.446	9.310	1.03731	1.63525
Fortified skim, packaged					
Central Arizona	29	.223	9.749	1.03939	1.63882
Total/Average[3]	280	.1830	9.1307	1.036991	1.6453

[1] The following equation was used in computing the apparent specific gravity of SNF for each of the individual samples for each market:

$$\frac{\frac{100}{\text{Sp. gr. product}} - \left[\frac{\text{\% BF}}{.9622 \text{ sp. gr. Fat}} + \frac{\text{\% } H_2O}{1 \text{ sp. gr. } H_2O}\right]}{\text{\% SNF}} = \text{Sp. gr. SNF at } 40^\circ \text{ F.}$$

[2] Data from samples collected from Regions 1 and 5 only.

[3] Averages for % butterfat, % SNF, and specific gravity of product are all simple averages, whereas the average for specific gravity of SNF is a weighted average.

APPENDIX 30.--COMPUTED SPECIFIC GRAVITY OF SOLIDS-NOT-FAT AT 50° F.

50° F.

Product and Market	Number of samples	Average butterfat	Average SNF	Average sp. gr. of product	Average sp. gr. of SNF[1]
Skim milk, packaged		Percent	Percent	Sp. gr.	Sp. gr.
New York[2]	25	.060	9.208	1.03686	1.62939
Puget Sound	33	.160	9.101	1.03634	1.62914
Raw skim milk					
New York[2]	16	.446	9.310	1.03673	1.62103
Total/Average[3]	74	.222	9.2063	1.036643	1.6275

[1] The following equation was used in computing the apparent specific gravity of SNF for each of the individual samples for each market:

$$\frac{\frac{100}{\text{Sp. gr. product}} - \left[\frac{\text{\% BF}}{.9541 \text{ sp. gr. Fat}} + \frac{\text{\% } H_2O}{1 \text{ sp. gr. } H_2O}\right]}{\text{\% SNF}} = \text{Sp. gr. SNF at } 50^\circ \text{ F.}$$

[2] Data from samples collected from Regions 1 and 5 only.

[3] Averages for % butterfat, % SNF, and specific gravity of product, are all simple averages, whereas the average for specific gravity of SNF is a weighted average.

APPENDIX 31.--COMPUTED SPECIFIC GRAVITY OF SOLIDS-NOT-FAT AT 68° F.

68° F.

Product and Market	Number of samples	Average butterfat	Average SNF	Average sp. gr. of product	Average sp. gr. of SNF[1]
		Percent	Percent	Sp. gr.	Sp. gr.
Skim milk, packaged					
Kansas City	24	.132	8.707	1.03417	1.61432
North Texas	9	.108	8.938	1.03527	1.61841
New York[2]	25	.060	9.208	1.03626	1.61395
Puget Sound	34	.159	9.096	1.03582	1.61673
Central Arizona	104	.150	8.779	1.03456	1.61780
Raw skim milk					
Washington, D.C.	62	.135	8.835	1.03498	1.62270
New York[2]	16	.446	9.310	1.03603	1.60587
Fortified skim milk, packaged					
Kansas City	7	.137	10.280	1.04050	1.61206
Central Arizona	29	.223	9.749	1.03820	1.61092
Total/Average[3]	310	.1722	9.2113	1.036199	1.6167

[1] The following equation was used in computing the apparent specific gravity of SNF for each of the individual samples for each market:

$$\frac{\% \text{ SNF}}{\frac{100}{\text{Sp. gr. product}} - \left[\frac{\% \text{ BF}}{.9330 \text{ sp. gr. Fat}} + \frac{\% H_2O}{1 \text{ sp. gr. } H_2O}\right]} = \text{Sp. gr. SNF at } 68^\circ \text{ F.}$$

[2] Data from samples collected from Regions 1 and 5 only.

[3] Averages for % butterfat, % SNF, and specific gravity of product are all simple averages, whereas the average for specific gravity of SNF is a weighted average.

APPENDIX 32.--COMPUTED SPECIFIC GRAVITY OF SOLIDS-NOT-FAT AT 102° F.

102° F.

Product and Market	Number of samples	Average butterfat	Average SNF	Average sp. gr. of product	Average sp. gr. of SNF[1]
		Percent	Percent	Sp. gr.	Sp. gr.
Skim milk, packaged					
Kansas City	24	.132	8.707	1.03326	1.59031
Southern Michigan	52	.229	8.731	1.03337	1.59335
North Texas	9	.108	8.938	1.03460	1.60097
New York[2]	25	.060	9.208	1.03553	1.59521
Puget Sound	34	.159	9.096	1.03508	1.59806
Central Arizona	105	.150	8.779	1.03369	1.59497
Raw skim milk					
Washington, D.C.	62	.135	8.835	1.03419	1.60178
New York[2]	16	.446	9.310	1.03512	1.58531
Fortified skim milk, packaged					
Kansas City	7	.137	10.280	1.03962	1.59248
Central Arizona	29	.223	9.749	1.03732	1.59074
Total/Average	363	.1779	9.1633	1.035178	1.5952

[1] The following equation was used in computing the apparent specific gravity of SNF for each of the individual samples for each market:

$$\frac{\%\ \text{SNF}}{\frac{100}{\text{Sp. gr. product}} - \left[\frac{\%\ \text{BF}}{.9133\ \text{sp. gr. Fat}} + \frac{\%\ H_2O}{1\ \text{sp. gr. } H_2O}\right]} = \text{Sp. gr. at } 102^\circ \text{ F.}$$

[2] Data from samples collected from Regions 1 and 5 only.

[3] Averages for % butterfat, % SNF, and specific gravity of product are all simple averages, whereas the average for specific gravity of SNF is a weighted average.

APPENDIX 33.--COMPARISON OF WEIGHTS PER GALLON DETERMINED BY UNIVERSAL EQUATION, BOTTLE METHOD, AND ALL MARKET PRODUCT REGRESSION EQUATION

40° F.

Product	Number of markets	Number of samples	Average BF	Average SNF	Computed weight[1]	Actual weight[2]	Comp. wt. minus actual	Wt. comp. by regr. equation[3]	Regr. wt. minus actual
			Percent	Percent		Pounds per gallon			
Raw producer milk	5	23	3.859	8.787	8.620	8.621	-.001	8.621	.000
Homogenized milk	9	45	3.572	8.643	8.617	8.615	+.002	8.614	-.001
Skim milk	6	30	.120	8.953	8.639	8.638	+.001	8.637	-.001
Fortified skim milk	5	23	.149	10.159	8.682	8.679	+.003	8.678	-.001
Half-and-half	7	33	12.178	7.760	8.556	8.563	-.007	8.563	.000
Fortified half-and-half	5	25	11.759	9.034	8.601	8.610	-.009	8.600	-.010
Light cream	7	34	19.782	7.252	8.512	8.511	+.001	8.511	.000
Heavy cream	9	44	36.461	5.577	8.400	8.415	-.015	8.406	-.009

[1] Computed by use of universal equation: $\frac{100}{100 + (\% \text{ BF} \times .03928) - (\% \text{ SNF} \times .39221)}$ = Sp. gr. at 40° F.

Sp. gr. x 8.3364 (wt./gal. water at 40° F.) = Computed weight per gallon at 40° F.

[2] Weights per gallon determined by the Babcock bottle method.

[3] Computed by using the all market product regression equation.

APPENDIX 34.--COMPARISON OF WEIGHTS PER GALLON DETERMINED BY UNIVERSAL EQUATION, BOTTLE METHOD AND ALL MARKET PRODUCT REGRESSION EQUATION

50° F.

Product	Number of markets	Number of samples	Average BF	Average SNF	Computed weight[1]	Actual weight[2]	Comp. wt. minus actual	Wt. comp. by regr. equation[3]	Regr. wt. minus actual
			Percent	Percent		Pounds per gallon			
Raw producer milk	1	5	4.000	8.958	8.615	8.618	-.003	8.615	-.003
Homogenized milk	3	15	3.563	8.743	8.610	8.612	-.002	8.608	-.004
Skim milk	2	10	.108	8.998	8.633	8.632	+.001	8.631	-.001
Fortified skim milk	2	9	.111	10.546	8.687	8.685	+.002	8.685	.000
Half-and-half	2	9	11.337	8.108	8.555	8.557	-.002	8.555	-.002
Fortified half-and-half	2	10	11.947	9.764	8.609	8.630	-.021	8.619	-.011
Light cream	2	10	19.997	7.104	8.485	8.489	-.004	8.487	-.002
Heavy cream	3	15	36.909	5.518	8.364	8.384	-.020	8.372	-.012

[1] Computed by use of universal equation: $\frac{100}{100 + (\% \text{ BF} \times .04811) - (\% \text{ SNF} \times .38556)}$ = Sp. gr. at 50° F.

Sp. gr. x 8.3341 (wt./gal. water at 50° F.) = Computed weight per gallon at 50° F.

[2] Weights per gallon determined by the Babcock bottle method.

[3] Computed by using the all market product regression equation.

APPENDIX 35.--COMPARISON OF WEIGHTS PER GALLON DETERMINED BY UNIVERSAL EQUATION, BOTTLE METHOD, AND ALL MARKET PRODUCT REGRESSION EQUATION

68° F.

Product	Number of markets	Number of samples	Average BF	Average SNF	Computed weight[1]	Actual weight[2]	Comp. wt. minus actual	Wt. comp. by regr. equation[3]	Regr. Wt. minus actual
			Percent	Percent		Pounds per gallon			
Raw producer milk	5	22	3.855	8.782	8.586	8.586	.000	8.586	.000
Homogenized milk	10	50	3.552	8.616	8.582	8.582	.000	8.581	-.001
Skim milk	7	35	.117	8.913	8.614	8.613	+.001	8.612	-.001
Fortified skim milk	6	28	.141	10.189	8.657	8.654	+.003	8.654	.000
Half-and-half	8	40	12.110	7.813	8.501	8.507	-.006	8.506	-.001
Fortified half-and-half	6	30	11.682	9.012	8.544	8.551	-.007	8.543	-.008
Light cream	8	35	19.946	7.224	8.433	8.432	+.001	8.434	+.002
Heavy cream	10	50	36.440	5.585	8.281	8.297	-.016	8.289	-.008

[1] Computed by use of universal equation: $\frac{100}{100 + (\% \text{ BF} \times .07181) - (\% \text{ SNF} \times .38146)} = \text{Sp. gr. at } 68^{\circ} \text{ F.}$

Sp. gr. x 8.3217 (wt./gal. water at 68° F.) = Computed weight per gallon at 68° F.

[2] Weights per gallon determined by the Babcock bottle method.

[3] Computed by using the all market product regression equation.

APPENDIX 36.--COMPARISON OF WEIGHTS PER GALLON DETERMINED BY UNIVERSAL EQUATION, BOTTLE METHOD, AND ALL MARKET PRODUCT REGRESSION EQUATION

Product	Number of markets	Number of samples	Average BF	Average SNF	Computed weight[1]	Actual weight[2]	Comp. wt. minus actual	Wt. comp. by regr. equation[3]	Regr. wt. minus actual
			102° F.						
			Pct.	Pct.		Pounds per gallon			
Raw producer milk	5	23	3.859	8.787	8.523	8.523	.000	8.523	.000
Homogenized milk	13	65	3.576	8.586	8.519	8.518	+.001	8.518	.000
Skim milk	9	45	.115	8.876	8.558	8.556	+.002	8.556	.000
Fortified skim milk	7	30	.143	10.217	8.602	8.599	+.003	8.599	.000
Half-and-half	10	48	12.056	7.794	8.424	8.425	-.001	8.425	.000
Fortified half-and-half	7	33	11.590	9.008	8.467	8.467	.000	8.462	-.005
Light cream	10	46	19.622	7.247	8.346	8.334	+.012	8.336	+.002
Heavy cream	12	60	36.042	5.584	8.166	8.161	+.005	8.159	-.002

[1] Computed by using universal equation: $\frac{100}{100 + (\% \text{ BF} \times .09493) - (\% \text{ SNF} \times .37312)}$ = Sp. gr. at 102° F.
Sp. gr. x 8.2752 (wt./gal. water at 102° F.) = Computed weight per gallon at 102° F.

[2] Weights per gallon determined by the Babcock bottle method.

[3] Computed by using the all market product regression equation.

APPENDIX 37.--WEIGHTS AT 40° F. OF FLUID MILK PRODUCTS CONTAINING SPECIFIED PERCENTAGES OF BUTTERFAT AND MILK SOLIDS-NOT-FAT

Percent butterfat in mixture

Percent SNF in mixture	0.5	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0	38.0	40.0	42.0	44.0
	Pounds per gallon at 40° F.																						
13.0	8.78	8.78	8.77	8.76	8.75	8.75	8.74	8.73	8.73	8.72	8.71												
12.8	8.77	8.77	8.76	8.76	8.75	8.74	8.73	8.73	8.72	8.71	8.70												
12.6	8.77	8.76	8.76	8.75	8.74	8.73	8.73	8.72	8.71	8.70	8.70												
12.4	8.76	8.76	8.75	8.74	8.73	8.73	8.72	8.71	8.70	8.70	8.69												
12.2	8.75	8.75	8.74	8.73	8.73	8.72	8.71	8.70	8.70	8.69	8.68												
12.0	8.75	8.74	8.73	8.73	8.72	8.71	8.70	8.70	8.69	8.68	8.68	8.67	8.66	8.66	8.65	8.64							
11.8	8.74	8.73	8.73	8.72	8.71	8.70	8.70	8.69	8.68	8.68	8.67	8.66	8.66	8.65	8.64	8.63							
11.6	8.73	8.73	8.72	8.71	8.70	8.70	8.69	8.68	8.68	8.67	8.66	8.66	8.65	8.64	8.63	8.63							
11.4	8.72	8.72	8.71	8.70	8.70	8.69	8.68	8.68	8.67	8.66	8.66	8.65	8.64	8.63	8.63	8.62							
11.2	8.72	8.71	8.70	8.70	8.69	8.68	8.68	8.67	8.66	8.66	8.65	8.64	8.63	8.63	8.62	8.61							
11.0	8.71	8.70	8.70	8.69	8.68	8.68	8.67	8.66	8.66	8.65	8.64	8.63	8.63	8.62	8.61	8.61							
10.8	8.70	8.70	8.69	8.68	8.68	8.67	8.66	8.66	8.65	8.64	8.63	8.63	8.62	8.61	8.61	8.60							
10.6	8.70	8.69	8.68	8.68	8.67	8.66	8.66	8.65	8.64	8.63	8.63	8.62	8.61	8.61	8.60	8.59							
10.4	8.69	8.68	8.68	8.67	8.66	8.66	8.65	8.64	8.63	8.63	8.62	8.61	8.61	8.60	8.59	8.59							
10.2	8.68	8.68	8.67	8.66	8.66	8.65	8.64	8.63	8.63	8.62	8.61	8.61	8.60	8.59	8.59	8.58							
10.0	8.67	8.67	8.66	8.66	8.65	8.64	8.63	8.63	8.62	8.61	8.61	8.60	8.59	8.59	8.58	8.57							
9.8	8.67	8.66	8.66	8.65	8.64	8.63	8.63	8.62	8.61	8.61	8.60	8.59	8.59	8.58	8.57	8.56							
9.6	8.66	8.66	8.65	8.64	8.63	8.63	8.62	8.61	8.61	8.60	8.59	8.59	8.58	8.57	8.56	8.56							
9.4	8.65	8.65	8.64	8.63	8.63	8.62	8.61	8.61	8.60	8.59	8.59	8.58	8.57	8.56	8.56	8.55	8.54						
9.2	8.65	8.64	8.63	8.63	8.62	8.61	8.61	8.60	8.59	8.59	8.58	8.57	8.56	8.56	8.55	8.54	8.54						
9.0	8.64	8.63	8.63	8.62	8.61	8.61	8.60	8.59	8.59	8.58	8.57	8.56	8.56	8.55	8.54	8.54	8.53	8.52					
8.8	8.63	8.63	8.62	8.61	8.61	8.60	8.59	8.59	8.58	8.57	8.56	8.56	8.55	8.54	8.54	8.53	8.52	8.52					
8.6	8.63	8.62	8.61	8.61	8.60	8.59	8.59	8.58	8.57	8.56	8.56	8.55	8.54	8.54	8.53	8.52	8.52	8.51	8.50				
8.4	8.62	8.61	8.61	8.60	8.59	8.59	8.58	8.57	8.56	8.56	8.55	8.54	8.54	8.53	8.52	8.52	8.51	8.50	8.50				
8.2	8.61	8.61	8.60	8.59	8.59	8.58	8.57	8.56	8.56	8.55	8.54	8.54	8.53	8.52	8.52	8.51	8.50	8.50	8.49				
8.0	8.60	8.60	8.59	8.59	8.58	8.57	8.56	8.56	8.55	8.54	8.54	8.53	8.52	8.52	8.51	8.50	8.50	8.49	8.48	8.48			
7.8		8.59	8.59	8.58	8.57	8.56	8.56	8.55	8.54	8.54	8.53	8.52	8.52	8.51	8.50	8.50	8.49	8.48	8.48	8.47			
7.6		8.59	8.58	8.57	8.56	8.56	8.55	8.54	8.54	8.53	8.52	8.52	8.51	8.50	8.50	8.49	8.48	8.48	8.47	8.46			
7.4			8.57	8.56	8.56	8.55	8.54	8.54	8.53	8.52	8.52	8.51	8.50	8.50	8.49	8.48	8.48	8.47	8.46	8.46	8.45		
7.2			8.56	8.56	8.55	8.54	8.54	8.53	8.52	8.52	8.51	8.50	8.50	8.49	8.48	8.48	8.47	8.46	8.46	8.45	8.44		
7.0			8.56	8.55	8.54	8.54	8.53	8.52	8.52	8.51	8.50	8.50	8.49	8.48	8.48	8.47	8.46	8.46	8.45	8.44	8.44		
6.8				8.54	8.54	8.53	8.52	8.52	8.51	8.50	8.50	8.49	8.48	8.48	8.47	8.46	8.46	8.45	8.44	8.44	8.43	8.42	8.42
6.6				8.54	8.53	8.52	8.52	8.51	8.50	8.50	8.49	8.48	8.48	8.47	8.46	8.46	8.45	8.44	8.44	8.43	8.42	8.42	8.41
6.4				8.53	8.52	8.52	8.51	8.50	8.50	8.49	8.48	8.48	8.47	8.46	8.46	8.45	8.44	8.44	8.43	8.42	8.42	8.41	8.40
6.2					8.52	8.51	8.50	8.50	8.49	8.48	8.48	8.47	8.46	8.46	8.45	8.44	8.44	8.43	8.42	8.42	8.41	8.40	8.40
6.0					8.51	8.50	8.50	8.49	8.48	8.48	8.47	8.46	8.46	8.45	8.44	8.44	8.43	8.42	8.42	8.41	8.40	8.40	8.39
5.8												8.46	8.45	8.44	8.44	8.43	8.42	8.42	8.41	8.40	8.40	8.39	8.38
5.6												8.45	8.44	8.44	8.43	8.42	8.42	8.41	8.40	8.40	8.39	8.38	8.38
5.4												8.44	8.44	8.43	8.42	8.42	8.41	8.40	8.40	8.39	8.38	8.38	8.37
5.2												8.44	8.43	8.42	8.42	8.41	8.40	8.40	8.39	8.38	8.38	8.37	8.36
5.0												8.43	8.42	8.42	8.41	8.40	8.40	8.39	8.38	8.38	8.37	8.36	8.36
4.8												8.42	8.42	8.41	8.40	8.40	8.39	8.38	8.38	8.37	8.36	8.36	8.35
4.6												8.42	8.41	8.40	8.40	8.39	8.38	8.38	8.37	8.36	8.36	8.35	8.34
4.4												8.41	8.40	8.40	8.39	8.38	8.38	8.37	8.36	8.36	8.35	8.34	8.34
4.2												8.40	8.40	8.39	8.38	8.38	8.37	8.36	8.36	8.35	8.34	8.34	8.33

Weights per gallon computed by use of universal equation:

$$\frac{100}{100 + (\% \text{ BF} \times .03928) + (\% \text{ SNF} \times .39221)} = \text{Specific gravity}$$

Sp. gr. x 8.3364 = Wt. per gallon at 40°F.

APPENDIX 38.--WEIGHTS AT 50° F. OF FLUID MILK PRODUCTS CONTAINING SPECIFIED PERCENTAGES OF BUTTERFAT AND MILK SOLIDS-NOT-FAT

Percent SNF in mixture	Percent butterfat in mixture																						
	0.5	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0	38.0	40.0	42.0	44.0
	Pounds per gallon at 50° F.																						
13.0	8.77	8.76	8.76	8.75	8.74	8.73	8.72	8.71	8.70	8.69	8.69												
12.8	8.76	8.76	8.75	8.74	8.73	8.72	8.71	8.71	8.70	8.69	8.68												
12.6	8.76	8.75	8.74	8.73	8.72	8.72	8.71	8.70	8.69	8.68	8.67												
12.4	8.75	8.74	8.73	8.73	8.72	8.71	8.70	8.69	8.68	8.67	8.66												
12.2	8.74	8.74	8.73	8.72	8.71	8.70	8.69	8.68	8.68	8.67	8.66												
12.0	8.74	8.73	8.72	8.71	8.70	8.69	8.69	8.68	8.67	8.66	8.65	8.64	8.63	8.63	8.62	8.61							
11.8	8.73	8.72	8.71	8.71	8.70	8.69	8.68	8.67	8.66	8.65	8.64	8.64	8.63	8.62	8.61	8.60							
11.6	8.72	8.72	8.71	8.70	8.69	8.68	8.67	8.66	8.65	8.65	8.64	8.63	8.62	8.61	8.60	8.59							
11.4	8.72	8.71	8.70	8.69	8.68	8.67	8.66	8.66	8.65	8.64	8.63	8.62	8.61	8.60	8.60	8.59							
11.2	8.71	8.70	8.69	8.68	8.68	8.67	8.66	8.65	8.64	8.63	8.62	8.61	8.61	8.60	8.59	8.58							
11.0	8.70	8.69	8.69	8.68	8.67	8.66	8.65	8.64	8.63	8.63	8.62	8.61	8.60	8.59	8.58	8.57							
10.8	8.69	8.69	8.68	8.67	8.66	8.65	8.64	8.64	8.63	8.62	8.61	8.60	8.59	8.58	8.58	8.57							
10.6	8.69	8.68	8.67	8.66	8.65	8.65	8.64	8.63	8.62	8.61	8.60	8.59	8.59	8.58	8.57	8.56							
10.4	8.68	8.67	8.66	8.66	8.65	8.64	8.63	8.62	8.61	8.60	8.60	8.59	8.58	8.57	8.56	8.55							
10.2	8.67	8.67	8.66	8.65	8.64	8.63	8.62	8.61	8.61	8.60	8.59	8.58	8.57	8.56	8.56	8.55							
10.0	8.67	8.66	8.65	8.64	8.63	8.63	8.62	8.61	8.60	8.59	8.58	8.57	8.57	8.56	8.55	8.54							
9.8	8.66	8.65	8.64	8.64	8.63	8.62	8.61	8.60	8.59	8.58	8.58	8.57	8.56	8.55	8.54	8.53							
9.6	8.65	8.65	8.64	8.63	8.62	8.61	8.60	8.59	8.59	8.58	8.57	8.56	8.55	8.54	8.54	8.53							
9.4	8.65	8.64	8.63	8.62	8.61	8.60	8.60	8.59	8.58	8.57	8.56	8.55	8.55	8.54	8.53	8.52	8.51						
9.2	8.64	8.63	8.62	8.61	8.61	8.60	8.59	8.58	8.57	8.56	8.56	8.55	8.54	8.53	8.52	8.51	8.50						
9.0	8.63	8.63	8.62	8.61	8.60	8.59	8.58	8.57	8.57	8.56	8.55	8.54	8.53	8.52	8.51	8.51	8.50	8.49					
8.8	8.62	8.62	8.61	8.60	8.59	8.58	8.58	8.57	8.56	8.55	8.54	8.53	8.52	8.52	8.51	8.50	8.49	8.48					
8.6	8.62	8.61	8.60	8.59	8.59	8.58	8.57	8.56	8.55	8.54	8.53	8.53	8.52	8.51	8.50	8.49	8.48	8.48	8.47				
8.4	8.61	8.60	8.60	8.59	8.58	8.57	8.56	8.55	8.55	8.54	8.53	8.52	8.51	8.50	8.49	8.49	8.48	8.47	8.46				
8.2	8.60	8.60	8.59	8.58	8.57	8.56	8.56	8.55	8.54	8.53	8.52	8.51	8.50	8.50	8.49	8.48	8.47	8.46	8.45				
8.0	8.60	8.59	8.58	8.57	8.57	8.56	8.55	8.54	8.53	8.52	8.51	8.51	8.50	8.49	8.48	8.47	8.46	8.46	8.45	8.44			
7.8		8.58	8.58	8.57	8.56	8.55	8.54	8.53	8.52	8.52	8.51	8.50	8.49	8.48	8.47	8.47	8.46	8.45	8.44	8.43			
7.6		8.58	8.57	8.56	8.55	8.54	8.53	8.53	8.52	8.51	8.50	8.49	8.48	8.48	8.47	8.46	8.45	8.44	8.44	8.43			
7.4			8.56	8.55	8.55	8.54	8.53	8.52	8.51	8.50	8.49	8.49	8.48	8.47	8.46	8.45	8.45	8.44	8.43	8.42	8.41		
7.2			8.56	8.55	8.54	8.53	8.52	8.51	8.50	8.50	8.49	8.48	8.47	8.46	8.45	8.45	8.44	8.43	8.42	8.41	8.41		
7.0			8.55	8.54	8.53	8.52	8.51	8.51	8.50	8.49	8.48	8.47	8.46	8.46	8.45	8.44	8.43	8.42	8.42	8.41	8.40		
6.8				8.53	8.52	8.52	8.51	8.50	8.49	8.48	8.47	8.47	8.46	8.45	8.44	8.43	8.43	8.42	8.41	8.40	8.39	8.38	8.38
6.6				8.53	8.52	8.51	8.50	8.49	8.48	8.48	8.47	8.46	8.45	8.44	8.44	8.43	8.42	8.41	8.40	8.39	8.39	8.38	8.37
6.4				8.52	8.51	8.50	8.49	8.49	8.48	8.47	8.46	8.45	8.44	8.44	8.43	8.42	8.41	8.40	8.40	8.39	8.38	8.37	8.36
6.2					8.50	8.50	8.49	8.48	8.47	8.46	8.45	8.45	8.44	8.43	8.42	8.41	8.41	8.40	8.39	8.38	8.37	8.37	8.36
6.0					8.50	8.49	8.48	8.47	8.46	8.46	8.45	8.44	8.43	8.42	8.42	8.41	8.40	8.39	8.38	8.37	8.37	8.36	8.35
5.8												8.43	8.43	8.42	8.41	8.40	8.39	8.38	8.38	8.37	8.36	8.35	8.34
5.6												8.43	8.42	8.41	8.40	8.39	8.39	8.38	8.37	8.36	8.35	8.35	8.34
5.4												8.42	8.41	8.40	8.40	8.39	8.38	8.37	8.36	8.36	8.35	8.34	8.33
5.2												8.41	8.41	8.40	8.39	8.38	8.37	8.36	8.36	8.35	8.34	8.33	8.32
5.0												8.41	8.40	8.39	8.38	8.37	8.37	8.36	8.35	8.34	8.33	8.33	8.32
4.8												8.40	8.39	8.38	8.38	8.37	8.36	8.35	8.34	8.34	8.33	8.32	8.31
4.6												8.39	8.39	8.38	8.37	8.36	8.35	8.35	8.34	8.33	8.32	8.31	8.31
4.4												8.39	8.38	8.37	8.36	8.36	8.35	8.34	8.33	8.32	8.32	8.31	8.30
4.2												8.38	8.37	8.36	8.36	8.35	8.34	8.33	8.32	8.32	8.31	8.30	8.29

Weights computed by use of universal equation:

$$\frac{100}{100 + (\% \text{ BF} \times .04811) - (\% \text{ SNF} \times .38556)} = \text{Sp. gr.}$$

Sp. gr. x 8.3341 = Wt. per gallon at 50° F.

APPENDIX 39.--WEIGHTS AT 68° F. OF FLUID MILK PRODUCTS CONTAINING SPECIFIED PERCENTAGES OF BUTTERFAT AND MILK SOLIDS-NOT-FAT

Percent SNF in mixture	Percent butterfat in mixture																					
	0.5	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0	38.0	40.0	42.0	44.0
	Pounds per gallon at 68° F.																						
13.0	8.75	8.74	8.73	8.72	8.70	8.69	8.68	8.66	8.65	8.64	8.63												
12.8	8.75	8.74	8.72	8.71	8.70	8.68	8.67	8.66	8.64	8.63	8.62												
12.6	8.74	8.73	8.72	8.70	8.69	8.68	8.66	8.65	8.64	8.62	8.61												
12.4	8.73	8.72	8.71	8.70	8.68	8.67	8.66	8.64	8.63	8.62	8.61												
12.2	8.72	8.71	8.70	8.69	8.68	8.66	8.65	8.64	8.62	8.61	8.60												
12.0	8.72	8.71	8.69	8.68	8.67	8.66	8.64	8.63	8.62	8.60	8.59	8.58	8.57	8.55	8.54	8.53							
11.8	8.71	8.70	8.69	8.67	8.66	8.65	8.64	8.62	8.61	8.60	8.58	8.57	8.56	8.55	8.53	8.52							
11.6	8.70	8.69	8.68	8.67	8.65	8.64	8.63	8.62	8.60	8.59	8.58	8.57	8.55	8.54	8.53	8.51							
11.4	8.70	8.69	8.67	8.66	8.65	8.64	8.62	8.61	8.60	8.58	8.57	8.56	8.55	8.53	8.52	8.51							
11.2	8.69	8.68	8.67	8.65	8.64	8.63	8.62	8.60	8.59	8.58	8.56	8.55	8.54	8.53	8.51	8.50							
11.0	8.68	8.67	8.66	8.65	8.63	8.62	8.61	8.60	8.58	8.57	8.56	8.55	8.53	8.52	8.51	8.49							
10.8	8.68	8.67	8.65	8.64	8.63	8.61	8.60	8.59	8.58	8.56	8.55	8.54	8.53	8.51	8.50	8.49							
10.6	8.67	8.66	8.65	8.63	8.62	8.61	8.60	8.58	8.57	8.56	8.54	8.53	8.52	8.51	8.49	8.48							
10.4	8.66	8.65	8.64	8.63	8.61	8.60	8.59	8.58	8.56	8.55	8.54	8.53	8.51	8.50	8.49	8.48							
10.2	8.66	8.65	8.63	8.62	8.61	8.59	8.58	8.57	8.56	8.54	8.53	8.52	8.51	8.49	8.48	8.47							
10.0	8.65	8.64	8.63	8.61	8.60	8.59	8.57	8.56	8.55	8.54	8.52	8.51	8.50	8.49	8.47	8.46							
9.8	8.64	8.63	8.62	8.61	8.59	8.58	8.57	8.56	8.54	8.53	8.52	8.51	8.49	8.48	8.47	8.46							
9.6	8.63	8.63	8.61	8.60	8.59	8.57	8.56	8.55	8.54	8.52	8.51	8.50	8.49	8.47	8.46	8.45							
9.4	8.63	8.62	8.61	8.59	8.58	8.57	8.55	8.54	8.53	8.52	8.50	8.49	8.48	8.47	8.45	8.44	8.43						
9.2	8.62	8.61	8.60	8.59	8.57	8.56	8.55	8.54	8.52	8.51	8.50	8.49	8.47	8.46	8.45	8.44	8.42						
9.0	8.61	8.60	8.59	8.58	8.57	8.55	8.54	8.53	8.52	8.50	8.49	8.48	8.47	8.45	8.44	8.43	8.42	8.40					
8.8	8.61	8.60	8.59	8.57	8.56	8.55	8.53	8.52	8.51	8.50	8.48	8.47	8.46	8.45	8.43	8.42	8.41	8.40					
8.6	8.60	8.59	8.58	8.57	8.55	8.54	8.53	8.52	8.50	8.49	8.48	8.47	8.45	8.44	8.43	8.42	8.40	8.39	8.38				
8.4	8.59	8.58	8.57	8.56	8.55	8.53	8.52	8.51	8.50	8.48	8.47	8.46	8.45	8.43	8.42	8.41	8.40	8.39	8.37				
8.2	8.59	8.58	8.56	8.55	8.54	8.53	8.51	8.50	8.49	8.48	8.46	8.45	8.44	8.43	8.42	8.40	8.39	8.38	8.37				
8.0	8.58	8.57	8.56	8.55	8.53	8.52	8.51	8.50	8.48	8.47	8.46	8.45	8.43	8.42	8.41	8.40	8.38	8.37	8.36	8.35			
7.8		8.56	8.55	8.54	8.53	8.51	8.50	8.49	8.48	8.46	8.45	8.44	8.43	8.41	8.40	8.39	8.38	8.37	8.35	8.34			
7.6		8.56	8.54	8.53	8.52	8.51	8.49	8.48	8.47	8.46	8.44	8.43	8.42	8.41	8.40	8.38	8.37	8.36	8.35	8.34			
7.4			8.54	8.53	8.51	8.50	8.49	8.48	8.46	8.45	8.44	8.43	8.41	8.40	8.39	8.38	8.37	8.35	8.34	8.33	8.32		
7.2			8.53	8.52	8.51	8.49	8.48	8.47	8.46	8.44	8.43	8.42	8.41	8.40	8.38	8.37	8.36	8.35	8.34	8.32	8.31		
7.0			8.52	8.51	8.50	8.49	8.47	8.46	8.45	8.44	8.43	8.41	8.40	8.39	8.38	8.36	8.35	8.34	8.33	8.32	8.31		
6.8				8.51	8.49	8.48	8.47	8.46	8.44	8.43	8.42	8.41	8.39	8.38	8.37	8.36	8.35	8.33	8.32	8.31	8.30	8.29	8.28
6.6				8.50	8.49	8.47	8.46	8.45	8.44	8.42	8.41	8.40	8.39	8.38	8.36	8.35	8.34	8.33	8.32	8.30	8.29	8.28	8.27
6.4				8.49	8.48	8.47	8.45	8.44	8.43	8.42	8.41	8.39	8.38	8.37	8.36	8.35	8.33	8.32	8.31	8.30	8.29	8.27	8.26
6.2					8.47	8.46	8.45	8.44	8.42	8.41	8.40	8.39	8.38	8.36	8.35	8.34	8.33	8.32	8.30	8.29	8.28	8.27	8.26
6.0					8.47	8.45	8.44	8.43	8.42	8.41	8.39	8.38	8.37	8.36	8.35	8.33	8.32	8.31	8.30	8.29	8.27	8.26	8.25
5.8												8.37	8.36	8.35	8.34	8.33	8.31	8.30	8.29	8.28	8.27	8.26	8.24
5.6												8.37	8.36	8.34	8.33	8.32	8.31	8.30	8.28	8.27	8.26	8.25	8.24
5.4												8.36	8.35	8.34	8.33	8.31	8.30	8.29	8.28	8.27	8.25	8.24	8.23
5.2												8.36	8.34	8.33	8.32	8.31	8.30	8.28	8.27	8.26	8.25	8.24	8.23
5.0												8.35	8.34	8.33	8.31	8.30	8.29	8.28	8.27	8.25	8.24	8.23	8.22
4.8												8.34	8.33	8.32	8.31	8.30	8.28	8.27	8.26	8.25	8.24	8.22	8.21
4.6												8.34	8.32	8.31	8.30	8.29	8.28	8.27	8.25	8.24	8.23	8.22	8.21
4.4												8.33	8.32	8.31	8.29	8.28	8.27	8.26	8.25	8.24	8.22	8.21	8.20
4.2												8.32	8.31	8.30	8.29	8.28	8.26	8.25	8.24	8.23	8.22	8.21	8.19

Weights per gallon computed by use of universal equation:

$$\frac{100}{100 + (\% \text{ BF} \times .07181) - (\% \text{ SNF} \times .38146)} = \text{Specific gravity}$$

Sp. gr. x 8.3217 = Wt. per gallon at 68° F.

APPENDIX 40.--FORMULA FOR COMPUTING PERCENT SNF FOR A GIVEN FLUID MILK PRODUCT WHEN PERCENT BUTTERFAT AND SPECIFIC GRAVITY OF THE PRODUCT ARE KNOWN

Considerable interest was shown in certain areas to have an equation developed for estimating solids-not-fat content of milk when butterfat content and specific gravity of the product were known. Using previously developed butterfat and solids-not-fat factors (appendix 28), the following equation was developed:

$$\frac{100 - \frac{100}{\text{Sp. gr. product}} + (\% \text{ BF} \times \text{BF factor}^1)}{\text{SNF factor}^2} = \% \text{ SNF}$$

Using this equation along with the butterfat and solids-not-fat factors listed below for 102° F., Appendix 41 was prepared which shows a comparison of computed solids-not-fat percentages with actual solids-not-fat percentages on several random selected samples of producer milk in five markets. This equation would appear useful in estimating solids-not-fat content of producer milk to the first decimal point. For more accurate results, oven drying methods of total solids determinations are recommended.

[1] BF factors for different temperatures:

102°F.	.09493
68°F.	.07181
50°F.	.04811
40°F.	.03928

[2] Solids-not-fat factors for different temperatures:

102°F.	.37312
68°F.	.38146
50°F.	.38556
40°F.	.39221

APPENDIX 41.--COMPUTED PERCENT SOLIDS-NOT-FAT COMPARED WITH ACTUAL PERCENT SOLIDS-NOT-FAT FOR PRODUCER MILK ON RANDOM SELECTED SAMPLES FROM FIVE DIFFERENT MARKETS - 102° F.

Market	Sp. gr. by bottle method at 102° F	Percent butterfat	Actual[1] percent SNF	Computed[2] percent SNF	Computed minus actual
Chicago	1.0293	3.30	8.53	8.47	-.06
	1.0286	3.40	8.57	8.32	-.25
	1.0301	3.40	8.79	8.70	-.09
	1.0291	3.60	8.41	8.49	+.08
	1.0297	3.40	8.54	8.60	+.06
North Texas	1.0293	3.60	8.41	8.54	+.13
	1.0301	5.00	9.23	9.10	-.13
	1.0299	4.30	8.80	8.87	+.07
	1.0292	3.80	8.48	8.57	+.09
	1.0287	3.18	8.20	8.29	+.09
Oklahoma Metropolitan	1.0305	3.72	8.98	8.88	-.10
	1.0303	4.05	8.97	8.91	-.06
	1.0304	4.25	9.13	8.99	-.14
Puget Sound	1.0287	4.00	8.42	8.49	+.07
	1.0315	3.35	8.98	9.04	+.06
	1.0319	4.60	9.45	9.46	+.01
	1.0303	4.10	9.06	8.92	-.14
	1.0302	3.95	8.88	8.86	-.02
Washington, D. C.	1.0293	3.35	8.48	8.48	.00
	1.0301	4.00	8.85	8.85	.00
	1.0307	4.20	9.06	9.05	-.01
	1.0301	4.30	9.03	8.93	-.10
	1.0302	3.90	8.84	8.85	+.01
Average			8.7865	8.7678	-.0187

[1] Percent total solids determinations were all made by oven drying methods as previously outlined.

[2] Computed by equation:

$$\frac{100 - \frac{100}{\text{Sp. gr. product}} + (\% \text{ BF} \times .09493)}{.37312} = \text{SNF}$$