The Babcock Test is the most satisfactory and practical method for determining the percentage of butterfat in milk. Commercial dairy plants use it to control the fat content of their products and to provide a fair basis of payment for milk delivered.

Equipment for Making Babcock Test for Fat in Milk

1. Rubber-stoppered sample bottle; 2. milk testing bottle; 3. 17.6-ml. pipet; 4. glass-stoppered bottle of commercial sulfuric acid having a specific gravity between 1.82 and 1.83; 5. 17.5-ml. acid dipper; 6. 17.5-ml. acid cylinder; 7. test-bottle block and cover (wood block 1 1/2 x 5 1/2 x 9 inches with 12 holes 1 1/2 inches in diameter and 1 1/4 inches deep; cover 5/8 x 5 1/2 x 9 inches with 12 holes 3/8 inch in diameter); 8. floating dairy thermometer; 9. dividers; 10. water bath and tray (pan 6 3/4 x 10 x 6 1/2 inches deep, of galvanized sheet metal; tray of same material with 24 holes 1 1/2 inches in diameter). A testing machine (not shown here) to whirl the filled bottles is also an essential part of the equipment. (Fig. 1)
to the plants. Dairy herd improvement associations use it extensively to ascertain the fat production of individual cows in the herds. Farmers who do not have the opportunity to join an improvement association may use it, without much expense or inconvenience, to determine the fat production of individual cows.

Test Uses Sulfuric Acid and Centrifugal Force

In this test sulfuric acid and centrifugal force are used to separate the fat from the other components of the milk. The sulfuric acid does at least three things:

1. It acts on the solids other than the fat in such a way as to allow the fat to separate more easily from them.

2. Acting with the water and the solids of the milk, the acid produces so much heat that the fat globules melt and tend to flow together.

3. Because the fat is much lighter than the rest of the milk, and the acid is much heavier than milk, the difference between the specific gravity of the fat and that of the surrounding liquid is greatly increased.

After the action of the acid is complete, the fat is separated from the heavy mixture by centrifugal force.

Taking Sample for Testing

The sample of milk that is taken for testing should have the same composition as the entire amount of milk to be tested. The milk must therefore be thoroughly mixed just before it is sampled. To do this, pour it from one container to another several times or stir it vigorously and thoroughly. Then take the sample with a small dipper or a sampling tube.

At milk plants where the number of patrons is large, sampling and testing the daily deliveries of each patron is not practical. Instead a composite sample of several days’ deliveries of each patron is obtained.

To get a representative composite sample, take a sample of each patron’s delivery each day. The daily sample may be taken after the milk has been poured into the weighing can. Add this sample immediately to the patron’s sample jar. A small dipper will measure these portions exactly enough for practical purposes.

Keep all composite samples in tightly stoppered containers and in a cool place. A refrigerator is best. To prevent them from
souring, use a preservative (1 tablet of corrosive sublimate or 1 ml. of formalin will keep a pint sample sweet for a week or more). Each day mix the contents of each container by gently shaking the container.

When composite samples are kept in a refrigerator, they are usually in good condition for testing at the end of a week. All that is necessary is to pour them from one container to another several times. If, however, spots or rings of cream should stick to the sides of the sample jars, set the jars in water at 100°-110° F. for a few minutes. Then loosen the adhering cream with a rubber scraper before mixing the sample.

Samples may be taken periodically instead of daily. When this is done, the patron's milk is sampled and tested at irregular intervals 4 or 5 times during a payment period. The average of these tests is taken as the test of the milk delivered during the period. This method gives fairly good results.

To Test Whole Milk (Not Homogenized)

1. Mix the sample (which should be at 50°-70° F.) by pouring it back and forth from one sample bottle to another several times.

2. Immediately after mixing, draw the milk above the mark on the large stem of the 17.6-ml. pipet. Place the ball of your forefinger on the opening at the top and let the milk flow back into the sample until the bottom of the curved surface of the milk is exactly at the mark. Then let the milk flow into the testing bottle. This may be done by holding the bottle in a slanting position or, if the delivery tube is long enough, by inserting it completely thru the bottle neck. Blow out the last drop.

3. Measure 17.5 ml. of sulfuric acid with an acid dipper or cylinder. (This is the usual amount, but more or less may be needed, depending on the strength of the acid — the object is to get a clear fat column.) Pour the acid into the test bottle, rotating the bottle at the same time. Hold the bottle at an angle of about 45 degrees from vertical while rotating it. Holding it in this position will cause the acid to flow down the bottle neck and wash down into the body of the bottle any milk that adheres to the sides. Be careful to have all the acid flow down the side of the bottle — don't let any of it flow directly thru the milk.

4. Use a rotary motion to mix the acid and milk in the bottle. Let the sample stand 2 or 3 minutes and mix again. When a large number of samples are to be tested, a mechanical shaker saves time.
5. Place bottles in a tester. Use an even number of bottles and make sure they are so placed that the machine is balanced.

6. Whirl the tester for 5 minutes at the speed indicated for the tester you are using. Add soft water at 140° F. or warmer to the base of the neck of each bottle, and whirl the tester for 2 minutes more. Add warm water again to fill the bottles almost to the top mark on the neck, and whirl for 1 minute. **Do not start counting time until the tester has reached the proper speed.**

7. Remove bottles from tester and place them in a water bath. Have the water in the bath at 140° F. and see that it is deep enough to cover the top mark on the bottles. Leave the bottles in the hot water for at least 5 minutes to make sure that the fat will be at the correct temperature for reading. When reading the tests be sure the temperature of the water in the bath is between 135° and 140° F.

8. Take one bottle at a time from the water bath and **read the percentage of fat immediately** (see Fig. 2 for directions).

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**TO READ THE PERCENTAGE OF FAT**

Place the dividers so that one point is even with the bottom of the fat column and the other is even with the extreme top of the column (**left**).

Then without changing the distance between the points of the dividers, place one point on the zero mark (**right**). The upper point of the dividers then gives the reading — in this case 4.7 percent. **(Fig. 2)**
9. Empty the bottles by inverting and shaking them to loosen the white deposit that has collected in the bottom. Rinse with hot water and wash with a hot solution of washing powder, using a bottle brush. Rinse again with hot water to remove the washing-powder solution.

**Testing Homogenized Milk**

1. Temper the acid and the milk to 70° F.
2. Use sulfuric acid of 1.83-1.835 specific gravity.
3. Use the full amount (17.5 ml.) of acid.
4. Add the acid in three portions: 8, 5, and 4.5 ml.
5. After each addition of acid, mix the acid and milk by rotating the bottle for at least 15 seconds.
6. Shake the tests for at least 2 minutes (preferably in a mechanical shaker) before centrifuging them.
7. Centrifuge and add hot distilled or soft water exactly as in the regular Babcock test.
8. Complete the test by following Steps 7 and 8 for whole milk exactly as directed on page 4.
9. Empty and wash bottles as directed in 9 above.

**Using the Test on the Farm**

In order to determine the butterfat production of a cow, it is necessary to know the weight of the milk produced and to test the milk at regular intervals. The following procedure is very satisfactory:

Weigh the milk after each milking.

Take samples from each milking during a 24-hour period on approximately the same date each month.

Test these samples for fat.

To calculate the weight of the fat produced each month multiply the pounds of milk produced, by the fat test. This way of calculating the fat yield has been shown by many trials to be very close to the actual amount of fat produced.

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[ 5 ]
Observations and Precautions

1. **Distilled water** or clean rain water is best to use in filling the test bottles. Hard water may cause foam to form at the top of the fat. If hard water must be used, add a few drops of sulfuric acid to it before filling the bottles.

2. Keep sulfuric acid in tightly closed vessels. If exposed to the air this acid absorbs moisture and becomes so diluted that it does not give good tests. (Glass-stoppered bottles are satisfactory.)

3. The fat should be a clear straw-yellow-to-amber. Division between the fat and the acid solution should be sharp and distinct.

4. The most common defects are:
   - A dark fat column, or brown or black solid matter in, above, or at the base of the fat; this may be caused by —
     a. Too strong acid (above 1.83 specific gravity)
     b. Too much acid
     c. Too high temperature of milk, acid, or both
     d. Failure to mix milk and acid promptly after acid was added
     e. Adding the acid in such a way that it goes thru the milk instead of flowing down the inside surface of the bottle and taking its position in a layer below the milk
     f. Milk was not mixed thoroly enough with the acid
   - A pale, cloudy fat column, or light-colored solid matter in, above, or at the base of the fat; this may be caused by —
     a. Too weak an acid (below 1.82 specific gravity)
     b. Too small an amount of acid
     c. Too low temperature of milk or acid or both

5. **Sulfuric acid is extremely corrosive.** If any is spilled on the skin or on clothing, wash off immediately with large quantities of cold water. If the skin or flesh is burned, dress with a burn ointment (after washing the area thoroly) and consult a physician. Bad burns may result if acid is allowed to remain on the skin.

6. Never try to reduce strength of acid by mixing it with water. Instead, use less acid.