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Revision of Section 2.4M in *Standard Methods for the Examination of Dairy Products*, 15th Edition[1]

R. T. MARSHALL, R. A. CASE[2], R. E. GINN[3], J. W. MESSER[4], J. T. PEELER[4], G. H. RICHARDSON[5], and H. M. WEHR[6]

Department of Food Science and Nutrition, University of Missouri, Columbia, Missouri 65211

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2.4 M. Pipets

Pipets may be made of glass or plastic and operated manually or mechanically. They should be nontoxic, conform to specifications, be marked to contrast sharply with milk, and be undamaged. If for manual use, they should have straight walls. If glass tips, they should be ground or fire polished or otherwise designed to ensure volume delivery.

The major types of laboratory pipets are classified based on the following method of draining:

1. To deliver (TD) pipets: Designed to release the calibrated amount when the pipet tip is held against the receiving vessel wall until draining stops. Bacteriological, Mohr, serological, and volumetric pipets are this type.

2. To contain (TC) pipets: Calibrated to hold or contain the amount specified. *Must* be completely emptied to provide the stated volume.

3. Blow-out pipets (marked with double band on the stem): Intended for rapid use in serology and are emptied by forceful blowout. Deliver the calibrated amount only when completely emptied. *Pipets of this type are not used in the microbiological examination of milk.*

4. Dual purpose pipets: Combines three calibrations. The pipet's upper graduation mark is the *to-deliver* and *blowout* line and the lower graduation mark is the *to contain* line. It also carries the double band for blow-out. Pipets of this type are not used in the microbiological examination of milk.

5. Bacteriological pipets: For microbiological examination of milk use only transfer pipets calibrated for bacteriological use and conforming to APHA specifications (Fig. 2.1).

6. Mechanical pipets: Numerous semi-automated repeating pipets exist that can be used in analyses. Volumes can be adjusted on some. Sterile disposable tips exist which can make them adaptable to microbiological techniques.

Pipet tolerance values: Several tolerance specifications exist to describe pipet accuracy. When accuracy of measurements is critical in chemical determinations, only Class A pipets with the following tolerance limits should be used (reference NBS specifications for Mohr measuring pipets, Class A Volume Tolerances Circular 602, and Federal Specification NNN-P-350).

Capacity/Grad (mL)	*Tolerance (mL)*
1/10 in 1/100	±0.0025
2/10 in 1/100	±0.004
1 in 1/10	±0.01
2 in 1/10	±0.01
5 in 1/10	±0.02
10 in 1/10	±0.03
17.6 in 1/10	±0.05
25 in 1/10	±0.05

Bacteriological transfer pipets should conform to the following accuracy specifications:

Pipet Size	*Accuracy**
1.0 and 1.1 mL	±0.025 mL
2.2 mL	±0.040 mL
11 mL	±0.20 mL

*All pipets calibrated to deliver with stated accuracy at 20°C.

When accuracy cannot be readily determined by measuring volume, use the following procedure to determine ac-

[1]*Prepared July 22, 1987.*
[2]*Kraft, Inc., Kraft Court, Glenview, IL 60025.*
[3]*Dairy Quality Control Institute, 2353 N. Rice St., St. Paul, MN 55113.*
[4]*Food and Drug Administration, 1090 Tusculum Ave., Cincinnati, OH 45226.*
[5]*Department of Nutrition and Food Sciences, Utah State University, Logan, UT 84322.*
[6]*Oregon Department of Agriculture, 635 Capital St. NE, Salem, OR 97310.*

curacy by weight. This procedure is recommended for mechanical pipets.

Test Frequency

Perform a single sample measurement following a change of any removable parts.

Perform a four-sample test monthly – or more frequently, depending on use.

Perform a ten-sample test quarterly.

Test Method

The test is based upon the determination of weight of water picked up and delivered by the instrument.

Equipment and test water should be placed in the test environment of 19-24°C (66-75°F) for at least two hours before testing.

Test Procedure

1. Place a 50 cc or smaller beaker or vessel containing 20-25 g of water onto an analytical balance and record its weight.
2. Using another container of water, double-rinse the mechanical pipet tip by aspirating the quantity of sample to be transferred.
3. If sample is to be transferred without diluting it within the pipet tip, aspirate water from beaker on analytical balance equal to the quantity of sample to be pipeted and record weight of the beaker. Expel the quantity back into the same beaker and note the weight.
4. If 1.0 mL of 1:10 dilution is to be made within a pipet tip, aspirate 0.9 mL then 0.1 mL into the tip noting the weight of each volume separately. Expel the 1.0 mL volume back into the same beaker and note the weight.
5. Repeat steps 1-3 or 1, 2, and 4 as appropriate for the number of samples to be examined and divide by the number of measurements to obtain the average value.
6. Calculate weights of sample removed from and returned to the vessel on the balance. Both weights should fall within tolerance limits listed below:

   Tolerances

   a. 0.1 mL should weigh 0.0975-0.1025 g
   b. 0.9 mL should weigh 0.890-0.910 g
   c. 1.0 mL should weigh 0.990-1.101 g

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