Chapter 1. General Information

1.1 Scope

Routine verification of the net contents of packages is an important part of any weights and measures program to facilitate value comparison and fair competition. Consumers have the right to expect packages to bear accurate net content information. Those manufacturers whose products are sold in such packages have the right to expect that their competitors will be required to adhere to the same standards.

The procedures in this handbook are recommended for use to verify the net quantity of contents of packages kept, offered, or exposed for sale, or sold by weight, measure (including volume, and dimensions), or count at any location (e.g., at the point-of-pack, in storage warehouses, retail stores, and wholesale outlets).

When and where to use these procedures?

An effective program will typically include testing at each of the following levels.

Point-of-pack

Testing packages at the "point-of-pack" has an immediate impact on the packaging process. Usually, a large number of packages of a single product are available for testing at one place. This allows the inspector to verify that the packer is following current good packaging practices. Inspection at the point-of-pack also provides the opportunity to educate the packer about the legal requirements that products must meet and may permit resolution of any net content issues or other problems that arise during the testing. Point-of-pack testing is not always possible because packing locations can be in other States or countries. Work with other State, county, and city jurisdictions to encourage point-of-pack inspection on products manufactured in their geographic jurisdictions. Point-of-pack inspections cannot entirely replace testing at wholesale or retail outlets, because point-of-pack inspections do not include imported products or the possible effects of product distribution and moisture loss. Point-of-pack inspections only examine the manufacturing process. Therefore, an effective testing program will also include testing at wholesale and retail outlets.

Wholesale

Testing packages at a distribution warehouse is an alternative to testing at the point-of-pack with respect to being able to test large quantities of and a variety of products. Wholesale testing is a very good way to monitor products imported from other countries and to follow up on products suspected of being underfilled based on consumer complaints or findings made during other inspections, including those done at retail outlets.

Retail

Testing packages at retail outlets evaluates the soundness of the manufacturing, distributing, and retailing processes of the widest variety of goods at a single location. It is an easily accessible, practical means for State, county and city jurisdictions to monitor packaging procedures and to detect present or potential problems. Generally, retail package testing is not conducive to checking large quantities of individual products of any single production lot. Therefore, follow-up inspections of a particular brand or lot code number at a number of retail and wholesale outlets, and ultimately at the point-of-pack are extremely important aspects in any package-checking scheme. After the evaluation of an inspection lot is completed, the jurisdiction should consider what, if any, further investigation or follow-up is warranted. At the point-of-sale, a large number of processes may affect the quality or quantity of the product. Therefore, there may be many reasons for any inspection lot being out of compliance. A shortage in weight or measure may result from mishandling the product in the store, or the retailer's failure to rotate stock. Shortages may also be caused through mishandling by a distributor, or failure of some part of the packaging process. Shortages may also be

caused by moisture loss (desiccation) if the product is packaged in permeable media. Therefore, being able to determine the cause of an error in order to correct defects is more difficult when retail testing is used.
(Amended 2002)

What products can be tested?

Any commodity sold by weight, measure, or count may be tested. The product to be tested may be chosen in several ways. The decision may be based on different factors, such as (1) marketplace surveys (e.g., jurisdiction-wide surveys of all soft drinks or breads), (2) surveys based on sales volume, or (3) audit testing (see Section 1.3) to cover as large a product variety as possible at food, farm, drug, hardware stores, or specialty outlets, discount and department stores. Follow-up of possible problems detected in audit testing or in review of past performance tends to concentrate inspection resources on particular commodity types, brand names, retail or wholesale locations, or even particular neighborhoods. The expected benefits for the public must be balanced against the cost of testing. Expensive products should be tested because of their cost per unit. However, inexpensive items should also be tested because the overall cost to individual purchasers may be considerable over an extended period. Store packaged items, which are usually perishable and not subject to other official monitoring, should be routinely tested because they are offered for sale where they are packed. Products on sale and special products produced for local consumption should not be overlooked because these items sell quickly in large amounts.

Regardless of where the test occurs, remember that it is the inspector's presence in the marketplace through routine unannounced testing that ensures equity and fair competition in the manufacturing and distribution process. Finally, always follow up on testing to ensure that the problems are corrected; otherwise, the initial testing may be ineffective.

1.2 Package Requirements

The net quantity of content statement must be "accurate," but reasonable variations are permitted. Variations in package contents may be a result of deviations in filling. The limits for acceptable variation are based on current good manufacturing practices in the weighing, measuring, and packaging process. The first requirement is that accuracy is applied to the average net contents of the packages in the lot. The second requirement is applied to negative errors in individual packages. These requirements apply simultaneously to the inspection of all lots of packages except as specified in "Exceptions to the Average and Individual Package Requirements" in this section.

Inspection Lot

An "inspection lot" (called a "lot" in this handbook) is defined as a collection of identically labeled (except for quantity or identity in the case of random packages) packages available for inspection at one time. The collection of packages will pass or fail as a whole based on the results of tests on a sample drawn from this collection. This handbook describes procedures to determine if the packages in an "inspection lot" contain the declared net quantity of contents and if the individual packages variations are within acceptable limits.

Average Requirement

In general, the average net quantity of contents of packages in a lot must at least equal the net quantity of contents declared on the label. Plus or minus variations from the declared net weight, measure, or count are permitted when they are caused by unavoidable variations in weighing, measuring, or counting the contents of individual packages that occur in current good manufacturing practice. Such variations must not be permitted to the extent that the average of the quantities in the packages of a particular commodity or a lot of the commodity that is kept, offered, exposed for sale, or sold, is below the stated quantity. (See Section 3.7, "Pressed and Blown Glass Tumblers and Stemware" and Section 4.3, "Packages Labeled by Count of 50 Items or Less" for exceptions to this requirement.)

Individual Package Requirement

The variation of individual package contents from the labeled quantity must not be "unreasonably large." In this handbook, packages that are underfilled by more than the Maximum Allowable Variation specified for the package are considered unreasonable errors. Unreasonable shortages are not generally permitted, even when overages in other

packages in the same lot, shipment or delivery compensate for such shortage. This handbook does not specify limits of overfilling, which is usually controlled by the packer.

Maximum Allowable Variation

The limit of "reasonable variation" for an individual package is called a "Maximum Allowable Variation" (MAV). An MAV is a deviation from the labeled weight, measure, or count of an individual package beyond which the deficiency is considered unreasonable. Each sampling plan limits the number of negative package errors permitted to be greater than the MAV.

Deviations Caused by Moisture Loss or Gain

Deviations from the net quantity of contents caused by the loss or gain of moisture from the package are permitted when they are caused by ordinary and customary exposure to conditions that normally occur in good distribution practice and that unavoidably result in change of weight or measure. According to regulations adopted by the U.S. Environmental Protection Agency, no moisture loss is recognized on pesticides. (See Code of Federal Regulations 40 CFR 156.10.)

Why do we allow for moisture loss or gain?

Some packaged products may lose or gain moisture and, therefore, lose or gain weight or volume after packaging. The amount of lost moisture depends upon the nature of the product, the packaging material, the length of time it is in distribution, environmental conditions, and other factors. Moisture loss may occur even when manufacturers follow good distribution practices. Loss of weight "due to exposure" may include solvent evaporation, not just loss of water. For loss or gain of moisture, apply the moisture allowances to both the maximum allowable variations permitted for individual packages and the average net quantity of contents before determining the conformance of a lot.

This handbook provides "moisture allowances" for some meat and poultry products, flour, and dry pet food. (See "Moisture Allowances" in Chapter 2.) These allowances are based on the premise that when the average net weight of a sample is found to be less than the labeled weight, but not by an amount that exceeds the allowable limit, either the lot is declared to be within the moisture allowance, or more information must be collected before deciding lot compliance or noncompliance.

Test procedures for flour, some meat, and poultry are based on the concept of a "moisture allowance" also known as a "gray area" or "no decision" area. (See Section 2.3, Basic Test Procedure, Calculations, "How is the Maximum Allowable Variation corrected for the Moisture Allowance/How is the Average Error for Moisture Allowance corrected?") When the average net weight of a sample is found to be less than the labeled weight, but not more than the boundary of the "gray area," the lot is said to be in the "gray" or "no decision area." The gray area is not a tolerance. More information must be collected before lot compliance or noncompliance can be decided. Appropriate enforcement should be taken on packages found short weight and outside of the "moisture allowance" or "gray area." (Amended 2002)

Exceptions to the Average and Individual Package Requirements

There is an exemption from the average requirement for packages labeled by count of 50 or fewer items. The reason for this exemption is that the package count does not follow a "normal" distribution even if the package is designed to hold the maximum count indicated by the label declaration (e.g., egg cartons and packages of chewing gum). Another exception permits an "allowable difference" in the capacity of glass tumblers and stemware because mold capacity doesn't follow a normal distribution.

1.3 Sampling Plans

This handbook contains two sampling plans to use to inspect packages: **Category A** and **Category B**. Use the **Category B** Sampling Plans to test meat and poultry products at point-of-pack locations that are subject to U. S. Department of Agriculture Food Safety and Inspection Service (FSIS) requirements. When testing all other packages, use the **Category A** Sampling Plan.

Why is sampling used to test packages?

Inspections by weights and measures officials must provide the public with the greatest benefit at the lowest possible cost. Sampling reduces the time to inspect a lot of packages, so a greater number of items can be inspected. Net content inspection, using sampling plans for marketplace surveillance, protects consumers who cannot verify the net quantity of contents. This ensures fair trade practices and maintains a competitive marketplace. It also encourages manufacturers, distributors, and retailers to follow good manufacturing and distribution practices.

Why is the test acceptance criteria statistically corrected, and what are the confidence levels of the sampling plans?

Testing a "sample" of packages from a lot instead of every package is efficient, but the test results have a "sampling variability" that must be corrected before determining if the lot passes or fails. The Category A sampling plans give acceptable lots a 97 % or better probability of passing. An "acceptable" lot is defined as one in which the "average" net quantity of contents of the packages equals or exceeds the labeled quantity. The Category B sampling plans give acceptable lots at least a 50 % probability of passing. The sampling plans used in this handbook are statistically valid. That means the test acceptance criteria are statistically adjusted, so they are both valid and legally defensible. This handbook does not discuss the statistical basis, risk factors, or provide the operating characteristic curves for the sampling plans. For information on these subjects, see explanations on "acceptance sampling" in statistical reference books.

Why random samples?

A randomly selected sample is necessary to ensure statistical validity and reliable data. This is accomplished by using random numbers to determine which packages are chosen for inspection. Improper collection of sample packages can lead to bias and unreliable results.

May audit tests and other shortcuts be used to identify potentially violative lots?

Shortcuts may be used to speed the process of detecting possible net content violations. These audit procedures may include the following: using smaller sample sizes, spot checks using tare lists provided by manufacturers, selecting samples without collecting a random sample. These and other shortcuts allow spot checking of more products than is possible with the more structured techniques, but do not take the place of Category A or B testing.

Can audit tests and other shortcuts be used to take enforcement action?

No. Do not take enforcement action using audit test results.

If, after an audit test, there is suspicion that a lot of packages is not in compliance, use the appropriate Category A or Category B sampling plan to determine if the lot complies with the package requirements.

1.4 Other Regulatory Agencies Responsible for Package Regulations and Applicable Requirements

In the United States, several Federal agencies issue regulations regarding package labeling and net contents. The U.S. Department of Agriculture regulates meat and poultry. The Food and Drug Administration regulates food, drugs, cosmetic products, and medical devices under the Food, Drug, and Cosmetic Act (FDCA) and the Fair Packaging and Labeling Act (FPLA). The Federal Trade Commission regulates most non-food consumer packaged products as part of the agency's responsibility under the FPLA. The Environmental Protection Agency regulates pesticides. The Bureau of Alcohol, Tobacco, and Firearms in the U.S. Department of the Treasury promulgates regulations for packaged tobacco and alcoholic beverages as part of its responsibility under the Federal Alcohol Administration Act.

Packaged goods produced for distribution and sale also come under the jurisdiction of State and local weights and measures agencies that adopt their own legal requirements for packaged goods. Federal statutes set requirements that pre-empt State and local regulations that are or may be less stringent or not identical to Federal regulation depending on the Federal law that authorizes the Federal regulation. The application of Handbook 133 procedures occurs in the context of the concurrent jurisdiction among Federal, State, and local authorities. Therefore, all agencies using this handbook should keep abreast of the revisions to Federal agency regulations that may contain sampling or testing information not in the

regulations at the time of publication of this handbook. See Table 1-1. in Appendix A for information on the responsible agencies for package regulations and the requirements of this handbook that must be used when testing products concurrently subject to pre-emptive federal regulations.

1.5 Assistance in Testing Operations

If the storage, display, or location of any lot of packages requires special equipment or an abnormal amount of labor for inspection, the owner or the operator of the business must supply the equipment and/or labor as required by the weights and measures official.

1.6 Health and Safety

This handbook cannot address all of the health and safety issues associated with its use. The inspector is responsible for determining the appropriate safety and health practices and procedures before starting an inspection (e.g., contact the establishment's health and safety official). Comply with all handling, health, and safety warnings on package labels and those contained in any associated material safety data sheets. The inspector must also comply with Federal, State, or local health and safety laws or other appropriate requirements in effect at the time and location of the inspection. Contact your supervisor to obtain information regarding your agencies safety and health policies and to obtain appropriate safety equipment.

1.7 Good Measurement Practices

The procedures in this handbook are designed to be technically sound and represent good measurement practices. To assist in documenting tests, we have included “model” inspection report forms designed to record the information.

Traceability Requirements for Measurement Standards and Test Equipment

Each test procedure presented in this handbook includes a list of the equipment needed to perform the inspection. The scales and other measurement standards used (e.g., balances, mass standards, volumetric, and linear measures) to conduct any test must be traceable to the National Institute of Standards and Technology (NIST). Standards must be used in the manner in which they were designed and calibrated for use.

Certification Requirements for Standards and Test Equipment

All measurement standards and test equipment identified in this handbook or associated with the test procedures must be calibrated or standardized before initial use. This must be done according to the instructions found in NIST Handbook 145, “Handbook for the Quality Assurance of Metrological Measurements,” or other recognized procedures (e.g., those adopted for use by a State weights and measures laboratory). After initial certification, the standards must be routinely recertified according to your agency’s measurement assurance policies.

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Chapter 2. Basic Test Procedure – Gravimetric Testing

2.1 Gravimetric Test Procedure for Checking the Net Contents of Packaged Goods

The gravimetric test method uses weight measurement to determine the net quantity of contents of packaged goods. This handbook includes general test methods to determine the net quantity of contents of packages labeled in terms of weight and special test methods for packages labeled in terms of fluid measure or count. Gravimetric testing is the preferred method of testing most products because it reduces destructive testing while maximizing inspection resources.

2.2 Measurement Standards and Test Equipment

What type of scale is required to perform the gravimetric test method?

Use a scale (for this handbook the term scale includes balances) that has at least 100 scale divisions. It must have a load-receiving element of sufficient size and capacity to hold the packages during weighing. It also requires a scale division no larger than 1/6 of the Maximum Allowable Variation (MAV) for the package size being weighed. The MAV/6 requirement is crucial to ensure that the scale has adequate resolution to determine the net contents of the packages. Subsequent references to product test criteria agreeing within one scale division are based on scale divisions that are equal to or only slightly smaller than the MAV/6.

> **Example:** The MAV for packages labeled 113 g (0.25 lb) is 7.2 g (0.016 lb) (See Table 2.5.) MAV/6 is 1.2 g (0.002 lb). In this example, a 1 g (0.002 lb) scale division would be the largest unit of measure appropriate for weighing these packages.

How often should I verify the accuracy of a scale?

Verify the accuracy of a scale before each initial daily use, each use at a new location, or when there is any indication of abnormal equipment performance (e.g., erratic indications). Recheck the scale accuracy if it is found that the lot does not pass, so there can be confidence that the test equipment is not at fault.

Which accuracy requirements apply?

Scales used to check packages must meet the acceptance tolerances specified for their accuracy class in the current edition of NIST Handbook 44, "Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices" (NIST HB 44). The tolerances for Class II and Class III digital scales are presented in Section 2.20, Scales, NIST HB 44.

Note: If the package checking scale is not marked with a "class" designation, use NIST HB 44 Table 1-1. to determine the applicable tolerance.

What considerations affect measurement accuracy?

Always use good weighing and measuring practices. For example, be sure to use weighing and measuring equipment according to the manufacturer's instructions and make sure the environment is suitable. Place scales and other measuring equipment (e.g., flasks and volumetric measures) on a rigid support and maintain them in a level condition if being level is a requirement to ensure accuracy.

In testing, which tolerances apply to the scale?

Do not use a scale if it has an error that exceeds the specified tolerance in any of the performance tests described in the following section.

1. Determine the total number of divisions (i.e., the minimum increment or graduation indicated by the scale) of the scale by dividing the scale's capacity by the minimum division.

   Example: A scale with a capacity of 5 000 g and a minimum division of 0.1 g has 50 000 divisions.

2. From Table 1-1. determine the class of the scale using the minimum scale division and the total number of scale divisions.

   Example: On a scale with a minimum division of 0.1 g and 50 000 total scale divisions the appropriate class of scale is "II."

Note: If a scale is used where the number of scale divisions is between 5 001 and 10 000 and the division size is 0.1 g or greater and is not marked with an accuracy Class II marking, Class III scale tolerances apply.

Table 1-1. Class of Scale

Value of Scale Division[1]	Minimum and Total Number of Divisions	Class of Scale
1 mg to 0.05 g	At least 100, but not more than 100 000	II
0.1 g or more	More than 5 000, but not more than 100 000	II
0.1 g to 2 g 0.000 2 lb to 0.005 lb 0.005 oz to 0.125 oz	More than 100, but not more than 10 000	III
5 g or more 0.01 lb or more 0.25 oz or more	More than 500, but not more than 10 000	III

[1]On some scales, manufacturers designated and marked the scale with a verification division (e) for testing purposes (e = 1 g and d = 0.1 g). For scales marked Class II, the verification division is larger than the minimum displayed division. The minimum displayed division must be differentiated from the verification scale division by an auxiliary reading means such as a vernier, rider, or at least significant digit that is differentiated by size, shape, or color. Where the verification division is less than or equal to the minimum division, use the verification division instead of the minimum division. Where scales are made for use with mass standards (e.g., an equal arm balance without graduations on the indicator) the smallest mass standard used for the measurement is the minimum division.

3. Determine the tolerance from Table 1-2. in divisions appropriate for the test load and class of scale.

Example: Determine the number of divisions for any test load by dividing the value of the mass standard being applied by the minimum division indicated by the scale. For example, if the scale has a minimum division of 0.1 g and a 1 500 g mass standard is applied, the test load is equal to 15 000 divisions (1 500/0.1). On a Class II scale with a test load between 10 000 and 20 000 divisions, Table 1-2. indicates the tolerance is plus or minus one division.

Table 1-2. Acceptance Tolerances for Class of Scale based on Test Load in Divisions

Test Load in Divisions		Tolerance
Class II Scale	Class III Scale	
0 to 5 000	0 to 500	Plus or Minus 0.5 Division
5 001 to 20 000	501 to 2 000	Plus or Minus 1 Division
20 001 or more	2 001 to 4 000	Plus or Minus 1.5 Divisions
Not Applicable	4 001 or more	Plus or Minus 2.5 Divisions

Which performance tests should be conducted to ensure the accuracy of a scale?

Use the following procedures to verify the scale. The following procedures, based on those required in NIST Handbook 44, have been modified to reduce the amount of time required for testing scales in field situations.

Increasing-Load Test

Use certified mass standards to conduct an "increasing-load test" with all test loads centered on the load-receiving element. Start the test with the device on zero and progress with increasing test loads to a "maximum test load" of at least 10 percent more than the gross weight of the packages to be tested. Use at least three different test loads of approximately equal value to test the device up to the "maximum test load." Verify the accuracy of the device at each test load. Include the package tare weight as one of the test points.

Decreasing-Load Test

For all types of scales, other than one with a beam indicator or equal-arm balance, conduct a "decreasing-load test" with all test loads centered on the load-receiving element. Use the same test loads used in the "increasing-load test" of this section, and start at the "maximum test load." Remove the test loads in the reverse order of the increasing-load test until all test loads are removed. Verify the accuracy of the scale at each test load.

Shift Test

Use a test load equal to one-half of the "maximum test load" used for the "increasing-load test." For bench scales (see Diagram 1) place the test load in the center of four separate quadrants, equidistant between the center and edge of the load-receiving element and determine the accuracy in each quadrant for equal-arm balances. For example, where the load-receiving element is a rectangular or circular shape, place the test load in the center of the area represented by the shaded boxes in the following diagrams.

Diagram 1. Bench Scales

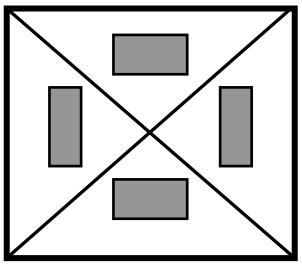
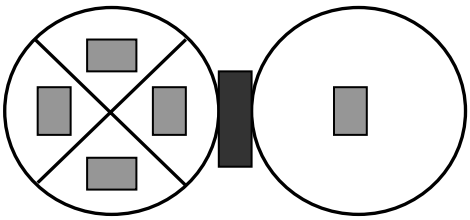


Diagram 2. Equal-Arm Balance



Return to Zero

Conduct the return to zero test whenever all the test weights from the scale are removed, check to ensure that it returns to a zero indication.

Which standards apply to other test equipment?

Specifications, tolerances, and other technical requirements for the other measurement standards and test equipment cited in this handbook are specified in the following NIST publications. These publications may be obtained from the Office of Weights and Measures or the U.S. Government Printing Office.

- Mass Standards - Use NIST Handbook 105-1, "Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures-Field Standard Weights (NIST Class F)" (1990)

- Volumetric Flasks and Cylinders - Use NIST Handbook 105-2, "Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures-Field Standard Measuring Flasks" (1996)

- Stopwatches - Use NIST Handbook 105-5, "Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures-Field Standard Stopwatches" (1997)

- Thermometers - Use NIST Handbook 105-6, "Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures-Specifications and Tolerances for Thermometers" (1997)

2.3 Basic Test Procedure

The following steps apply when gravimetrically testing any type of packaged product except Borax and glazed or frozen foods. If the tested products contain Borax, refer to Section 2.4, Borax. If glazed or frozen food is tested, refer to Section 2.6, Drained Weight for Glazed or Frozen Foods.

The Basic Test Procedure:

1. **Identify and define the inspection lot.**
2. **Select the sampling plan.**
3. **Select the random sample.**
4. **Measure the net contents of the packages in the sample.**
5. **Evaluate compliance with the Maximum Allowable Variation (MAV) requirement.**
6. **Evaluate compliance with the average requirement.**

Define the Inspection Lot

The official defines which packages are to be tested and the size of the inspection lot. The lot may be smaller or larger than the production lot defined by the packer. Only take action on the packages contained in the lot that has been defined.

Note: Normally, there will never be access to the entire "production lot" from a manufacturer. The "inspection lot" is selected from packages that are available for inspection/test at any location in the distribution chain.

> **Example:** An inspection lot should consist of all of the cans of a single brand of peach halves, labeled with a net quantity of 453 g (1 lb). When packages are tested in retail stores, it is not necessary to sort by lot code. If lot codes are mixed during retail testing, be sure to record the lot codes for all of the packages included in the sample so that the inspector and other interested parties can follow up on the information. For special reasons, such as a large number of packages or the prior history of problems with the product or store, the inspector may choose to define a lot as only one type of packaged product (e.g., ground beef). Another reason to narrowly define the lot is if the results of an audit test indicate the possibility of a shortage in one particular lot code within a particular product.

What is the difference between standard and random weight packages?

Standard packages are those with identical net content declarations such as containers of soda in 2 L bottles and 2.26 kg (5 lb) packages of flour. "Random packages" are those with differing or no fixed patterns of weight, such as packages of meat, poultry, fish, or cheese.

Sampling Plans

Where are sampling plans located for Category A inspections?

Use Table 2-1., Sampling Plans for Category A, in Appendix A to conduct Category A inspections.

Where are sampling plans located for Category B inspections?

Use Table 2-2., Sampling Plans for Category B, in Appendix A to conduct Category B inspections.

Basic Inspection Procedure and Record Keeping

How are the specific steps of the Basic Test Procedure documented?

Use an official inspection report to record the inspection information. Attach additional worksheets, test notes, and other information as needed. This handbook provides random and standard packaged products model inspection report forms in Appendix E. The references to box numbers in these instructions refer to the random and standard package reports in Appendix E. Modify the model reports and the box numbers to meet your agency's needs. Other formats that contain more or less information may be acceptable.

Note: Inspection reports should be legible and complete. Good record keeping practices typically include record retention for a specified period of time (e.g., 1 to 3 years).

- Record the product identity, packaging description, lot code, location of test, and other pertinent data.

- Record the labeled net quantity of contents in box 1. Record both metric and inch-pound declarations if they are provided on the package label.

  Example: If the labeled weight is 453 g (1 lb), record this in box 1.

- When the declaration of net quantity on the package includes both the International System of Units (SI) (metric) and inch-pound units, the larger of the two declarations must be verified. The rounding rules in the Uniform Packaging and Labeling Regulation in NIST Handbook 130 permit packers to round declarations up or down based on their knowledge of their package filling targets and the accuracy of packaging equipment.

  Determine the larger of the values by converting the SI declaration to inch-pound units, or vice versa, using conversion factors that are accurate to at least six places. Compare the values, and use the larger value in computing the nominal gross weight (see later steps). Indicate on the report which of the declarations are being verified when packages labeled with two units of measure are encountered.

  Example: If the net weight declared on a package is 1 lb, the metric equivalent (accurate to six significant digits) is 453.592 g. Do not round down or truncate values in the calculations until the nominal gross weight is determined and recorded. If the package is also labeled 454 g, then the metric declaration is larger than the inch-pound declaration and should be used to verify the net contents of the package. The Basic Test Procedure does not prohibit the use of units of weight instead of dimensionless units when recording package errors, nor does it prohibit the use of net content computer programs to determine product compliance. Record the unit of measure in box 2. The unit of measure is the minimum division of the unit of measurement used to conduct the test. If a scale is used that reads to thousandths of a pound, the unit of measure is 0.001 lb even if the scale division is 0.002 lb or 0.005 lb.

  Example: If the scale has a scale division of 0.5 g, the unit of measure is 0.1 g. If a weighed package that has an error of "- 0.5 g," record the error as "- 5" using "dimensionless units." If the scale indicates in increments of 0.002 lb, the unit of measure is 0.001 lb. If a weighed package has an error of "+ 0.016," record the error as "+ 16" using "dimensionless units." When using dimensionless units, multiply package errors by the unit of measure to obtain the package error in weight.

- Enter the appropriate MAV value in box 3 for the type of package (weight, volume, etc.), the labeled net contents, and the unit of measure.

Where are Maximum Allowable Variations found?

Find the MAV values for packages labeled by weight, volume, count, and measure in the tables listed below in Appendix A.

- packages labeled by weight **See Table 2-5.**
- packages labeled by volume liquid or dry **See Table 2-6.**
- packages labeled by count **See Table 2-7.**
- packages labeled by length, (width), or area **See Table 2-8.**

  packages bearing a USDA seal of inspection – Meat and Poultry

- textiles, polyethylene sheeting and film, mulch and soil labeled by volume, packaged firewood, and packages labeled by count with less than 50 items **See Table 2-10.**

How is the value of an MAV found?

Refer to the appropriate table of MAVs and locate the declared quantity that is on the package label in the column marked "Labeled Quantity." Read across the table to find the value in the column titled "Maximum Allowable Variation." Record this number in box 3. Determine the MAV in dimensionless units and record in box 4 on the Standard Package Report Form (a dimensionless unit is obtained by dividing the MAV recorded in box 3 by the unit of measure recorded in box 2). Refer to Appendix C, "The Glossary," for the definition of dimensionless units.

How many MAVs are permitted in a sample?

To find out how many minus package errors are permitted to exceed the MAV, see Column 4 in either Table 2-1. (Category A) or Table 2-2. (Category B). Record this number in box 8.

Random Sample Selection

How are the sample packages selected?

Randomly select a sample from the inspection lot. Random number tables (see Appendix B) or a calculator that is able to generate random numbers may be used to identify the sample. If the packages for the sample are not randomly selected, the test results may not be statistically valid.

Note: If the inspector and the party that is ultimately responsible for the packing and declaration of net weight for the product agree to an alternative method of sample selection, document how the sample packages were selected as part of the inspection record.

How is the size of the "Lot" determined?

Count the number of packages comprising the inspection lot or estimate the size to within 5 % and record the inspection lot size in box 5.

How is the sample size determined?

Refer to Table 2-1. or Table 2-2. to determine the sample size. In Column 1, find the size of the inspection lot (the number recorded in box 5 of the report form). Read across from Column 1 to find the appropriate sample size in Column 2 and record this number in box 6 of the report form.

Tare Procedures

What types of tare may be used to determine the net weight of package goods?

This handbook defines three types of tare for the inspection of packaged goods. The tare weight may vary considerably from package to package as compared with the variability of the package net contents, even for packages in the same production lot. Although this is not common for most packaging, the basic test procedure in this handbook considers the variation for all tare materials.

Used Dry Tare

Used Dry Tare is defined as follows: Used tare material that has been air dried, or dried in some manner to simulate the unused tare weight. It includes all packaging materials that can be separated from the packaged product, either readily (e.g., by shaking) or by washing, scraping, ambient air drying, or other techniques involving more than "normal" household recovery procedures, but not including laboratory procedures like oven drying. Labels, wire closures, staples, prizes, decorations, and such are considered tare. Used Dry Tare is available regardless of where the packages are tested. The net content procedures described in this handbook reference Used Dry Tare.

Unused Dry Tare

If testing packages in retail store locations where they are packaged, and sold in small quantities to the ultimate consumers, the basic test procedure may be modified by using samples of the packaging material available in the store. Unused dry tare is defined as:

All unused packaging materials (including glue, labels, ties, etc.) that contain or enclose a product. It includes prizes, gifts, coupons, or decorations that are not part of the product.

Wet Tare

If the jurisdiction uses wet tare to determine net weight, follow the procedures described below that reference Used Dry Tare, except make no effort to dry the tare material. If Wet Tare is used to verify the net weight of packages of fresh poultry, hot dogs, and franks that are subject to the USDA regulations, the inspector must allow for moisture loss. Wet Tare is defined as: Used tare material where no effort is made to dry the tare material. Free-flowing liquids are considered part of the tare weight.

How is a tare weight determined?

Except in the instance of applying unused dry tare, select the packages for the initial tare sample from the sample packages. Mark the first two (three or five) packages in the order the random numbers were selected; these packages provide the initial tare sample. Determine the gross weight of each package and record it in block a, "Gross Wt," under the headings "Pkg. 1," "Pkg. 2," "Pkg. 3," etc. on the report form. Except for aerosol or other pressurized packages, open the sample packages, empty, clean, and dry them as appropriate for the packaging material.

Does the inspection of aerosol containers require special procedures?

Yes, aerosol containers are handled differently for two reasons. First, regulations under the Uniform Packaging and Labeling Regulation in NIST HB 130 require that packages designed "to deliver" the product under pressure, "must state the net quantity of the contents that will be expelled when the instructions for use as shown on the container are followed." This means that any product retained in aerosol containers after full dispersion is included in the tare weight. Second, aerosol containers must not be opened because they are pressurized; for safety reasons they should not be punctured or opened. When emptying aerosol containers to determine a tare weight, exhaust them in a well-ventilated area (e.g., under an exhaust hood or outdoors) at least 15 m (50 ft) from any source of open flame or spark.

To ensure that the container properly dispenses the product, read and follow any dispensing instructions on the package. If shaking during use is specified in the instructions, periodically shake (at least two or three times during

expulsion of the product). If directions are not given, shake the container five times with a brisk wrist twisting motion. If the container has a ball agitator, continue the shaking procedure for one minute after the ball has shaken loose.

How is the tare of vacuum-packed coffee determined?

The gross weight of a can of vacuum-packed coffee will be more after the seal is broken and air enters the can. In the procedure to determine the tare weight of the packaging material, correct the gross weight determined for unopened cans as follows. Use the initial tare sample packages, weigh, and record the gross weight of the product-filled cans before and after breaking the vacuum seal. Compute the average gross weight difference (open weight minus sealed weight) and record this in box 13a of the report form. The nominal gross weight equals the average tare weight minus the average difference in gross weights plus the labeled weight (box 14): box 13 - box 13a + box 1.

How is it determined how many packages to select for the initial tare sample?

For the initial tare sample size, see Column 5 under initial tare sample size in Table 2-1., or Column 3 under initial tare sample size in Table 2-2. Record the initial tare sample size in box 7 on the report form.

Note: The initial tare sample size is considered the total tare sample size when the sample size is less than 12.

How are the tare sample and tare weight of the packaging material determined?

1. Except for unused dry tare at the point-of-pack, first determine the tare weight for each package in the initial tare sample and record the value in row b, "Tare Wt." under the appropriate package number column.

2. For sample sizes of 12 or more, subtract the individual tare weights from the gross weights (block a, minus block b, on the report form) to obtain the net weight for each package and record these values in block c, "Net Wt," on the report form.

   Determine and record the "range of package errors" (called R_c) for the initial tare sample in box 9 on the report form. (The range is the difference between the package errors.)
   (Amended 2002)

3. Determine and record the "range of tare weights" (called R_t) in box 10.

4. Compute the ratio R_c/R_t by dividing the value in box 9 by the value in box 10. Record the resulting value in box 11. (R_c and R_t must both be in the same unit of measure or both in dimensionless units.)

5. Determine and record in box 12 the total number of packages to be opened for the tare determination from either Table 2-3., for a Category A test or Table 2-4., for a Category B test.

   - In the first column (titled Ratio of R_c/R_t), locate the range in which the computed R_c/R_t falls. Then, read across to the column headed with the appropriate sample size.

   - If the total number of packages to open equals the number already opened go to Step 6.

   - If the total number of packages to open is greater than the number of packages already opened, compute the number of additional packages to open for the tare determination and go to Step 6. Enter the total number of tare samples in box 12.

6. Determine the average tare weight using the tare weight values for all the packages opened and record the average tare weight in box 13.

When and where is unused dry tare used, and how is it used to determine an average tare weight?

You may determine the average tare weight using samples of unused dry tare when testing meat, poultry, or any other products that are not subject to regulation of the Food and Drug Administration (FDA). You may use unused dry tare samples when conducting inspections at locations where the point-of-pack and sale are identical (e.g., store-packed products in a supermarket meat case). To determine unused dry tare at the point-of-sale, randomly select two (2) samples of unused dry tare, and weigh each separately. If there is no measurable variation in weight between the samples, proceed with the test using the weight of one of the samples. If the weight of the two (2) initial samples vary, randomly select three (3) additional tare samples and determine the average weight of all five (5) samples. Use this value as the average tare weight.
(Amended 2002)

Determine Nominal Gross Weight and Package Errors for Tare Sample

What is a nominal gross weight?

A nominal gross weight is used to simplify the calculation of package errors. To compute the nominal gross weight, add the average tare weight (recorded in box 13) to the labeled weight (recorded in box 1). To obtain the package error, subtract a package's gross weight from the nominal gross weight. The nominal gross weight is represented by the formula:

Nominal gross weight = average tare + labeled weight

How are individual package errors determined for the tare sample packages?

Determine the errors of the packages opened for tare by subtracting the nominal gross weight recorded in box 14 from the individual package gross weights recorded for each package ("Pkg 1," "Pkg 2," etc.) in block a, "Gross Wt." The nominal gross weight must be used, rather than the actual net weight, for each package to determine the package error. This ensures that the same average tare weight is used to determine
the error for every package in the sample, not just the unopened packages.

- For standard packages, record the package error in the appropriate plus or minus column on the report form for each package opened for tare.

- For random packages, determine the package error for the tare sample using a nominal gross weight for each package so that all of the package errors are determined with the same tare weight value. Record the package error on the Random Package Report Form in the appropriate plus or minus column under Package Errors.

  Note: Converting the package error to dimensionless units allows the inspector to record the package errors as whole numbers disregarding decimal points and zeroes in front and unit of measure after the number.

  Example: If weighing in 0.001 lb increments, the unit of measure is also 0.001 lb. If the package error for the first package opened for tare is + 0.008 lb, instead of recording 0.008 lb in the plus column, record the error as "8" in the plus column. If the second package error is + 0.060 lb, record the package error as "60" in the plus column, and so on. (This section does not prohibit the use of units of weight or computer programs instead of dimensionless units.)

How are individual package errors determined for the other packages in the sample?

Compare the gross weight of each of the unopened sample packages with the nominal gross weight (box 14). Record the package errors in the "Package Errors" section of the report form using either units of weight (lb or g) or dimensionless units.

How is the total package error computed?

Add all the package errors for the packages in the sample. Be sure to subtract the minus package errors from the plus package errors and to record the total net error in box 15.

Evaluating Results

How is it determined if a sample passes or fails*?*

The following steps lead the inspector through the process to determine if a sample passes or fails. If the product is subject to moisture allowance, follow the procedures under "Moisture Allowances" in this chapter to correct the MAV.

How is it determined if packages exceed the Maximum Allowable Variation?

Compare each minus package error with the MAV recorded in box 3 or box 4 (if using dimensionless units). Circle the package errors that exceed the MAV. These are "unreasonable errors." Record the number of unreasonable minus errors found in the sample in box 16.

How is it determined if the negative package errors in the sample exceed the number of MAVs allowed for the sample?

Compare the number in box 16 with the number of unreasonable errors allowed (recorded in box 8.) If the number found exceeds the allowed number, the lot fails. Record in box 17 whether the number of unreasonable errors found is less or more than allowed.

Note: If the total error recorded in box 15 is a plus value and box 17 is "No", then the number of unreasonable errors is equal to or less than the number allowed (recorded in box 8) and the lot passes.

How is the average error of the sample determined and does the inspected lot pass or fail the average requirement?

Determine the average error by dividing the total error recorded in box 15 by the sample size recorded in box 6. Record the average error in box 18 if using dimensionless units or in box 19 if using units of weight. Compute the average error in terms of weight (if working in dimensionless units up to this time) by multiplying the average error in dimensionless units by the unit of measure and record the value in box 19.

1. If the average error is positive, the inspection lot passes the average requirement.

2. If the average error is negative, the inspection lot fails under a Category B test. Record in box 20.

3. If the average error is a negative value when testing under the Sampling Plans for Category A, compute the Sample Error Limit (SEL) as follows:

    - Compute the Sample Standard Deviation and record it in box 21.

    - Obtain the Sample Correction Factor from Column 3 of Table 2-1. For Category A test. Record this value in box 22.

    - Compute the Sample Error Limit using the formula:

    Sample Error Limit (box 23) = Sample Standard Deviation (box 21) x
    Sample Correction Factor (box 22)

4. Compliance Evaluation of the Average Error:

    - If the value of the Average Error (box 18) is smaller than the SEL (box 23), the inspection lot passes.

- If the value of the Average Error (disregarding the sign) (box 18) is larger than the SEL (box 23) the inspection lot fails. However, if the product is subject to moisture loss, the lot does not necessarily fail. Follow the procedures under "Moisture Allowances" in this chapter.

Moisture Allowances

How is reasonable moisture loss allowed?

If the product tested is subject to moisture loss, provide for the moisture allowance by following the steps listed below.

Determine the value of the moisture allowance if the product is listed below.

What is the moisture allowance for flour and dry pet food?

The moisture allowance for flour and dry pet food is 3 % of the labeled net weight.

Note: Dry pet food means all extruded dog and cat foods and baked treat products packaged in kraft paper bags and/or cardboard boxes with a moisture content of 13 % or less at the time of pack.

What moisture allowance is used with Used Dry Tare when testing packages that bear a USDA Seal of Inspection?

There is no moisture allowance when inspecting meat and poultry from a USDA inspected plant when Used Dry Tare and a Category A sampling plan are used.

What moisture allowance is used with wet tare when testing packages bearing a USDA seal of inspection?

- Use the following guideline when testing meat and poultry from any USDA inspected plant using Wet Tare and a Category A sampling plan.

- For packages of fresh poultry that bear a USDA seal of inspection, the moisture allowance is 3 5 of the labeled net weight. For net weight determinations, only, fresh poultry is defined as poultry above – 3 ºC (26 ºF). This is a product that yields or gives when push with the thumb.

- For packages of franks or hotdogs that bear an USDA seal of inspection, the moisture allowance is 2.5 % of the labeled net weight.

- For packages of bacon, fresh sausage, and luncheon meats that bear a USDA seal of inspection, there is no moisture allowance if there is no free-flowing liquid or absorbent materials in contact with the product and the package is cleaned of clinging material. Luncheon meats are any cooked sausage product, loaves, jellied products, cured products, and any sliced sandwich style meat. This does not include whole hams, briskets, roasts, turkeys, or chickens requiring further preparation to be made into ready-to-eat sliced product. When there is no free-flowing liquid inside the package and there are no absorbent materials in contact with the product, Wet Tare and Dried Used Tare are equivalent.

When there is free flowing liquid or absorbent packaging materials in contact with the product, all free liquid is part of the wet tare.

Calculations

How is moisture allowance computed and applied to the average error?

To compute moisture allowance, multiply the labeled quantity by the decimal percent value of the allowance.

Example: Labeled net quantity of flour is 907 g (2 lb)

Moisture Allowance is 3 % (0.03)

Moisture Allowance = 907 g (2 lb) x 0.03 = 27 g (0.06 lb) record this value in box 13a.

How is the Maximum Allowable Variation corrected for the moisture allowance?

- Adjust the MAV by adding the moisture allowance to the MAV.

  Example: 907 g (2 lb) package of flour: moisture allowance added to the MAV = 31.7 g (0.07 lb) (MAV for 907 g [2 lb] package) + 27 g (0.06 lb) moisture allowance = a corrected MAV of 58.7 g (0.13 lb)

- Correct MAV in dimensionless units by converting the moisture allowance to dimensionless units = 0.06 lb ÷ 0.001 lb = 60. Go to box 4 and add the moisture allowance in dimensionless units to the MAV in dimensionless units.

  Example: MAV = 70 (MAV for 2 lb where the unit of measure = 0.001 lb) + 60 (moisture allowance in dimensionless units) = 130. Minus package errors must exceed the MAV + gray area before they are declared "unreasonable errors."

- If the number of unreasonable errors exceeds the allowed number (recorded in box 8) the inspection lot fails.

How is the average error for the moisture allowance corrected?

If the minus average error (box 18) is larger (disregarding the sign) than the SEL (box 23) and moisture loss applies, compare the difference between box 18 and box 23 with the moisture allowance recorded in box 13a. (Make sure that all the values are in units of weight or in dimensionless units before making this comparison.) If box 13a is larger than the difference between box 18 and 23, then the lot is considered to be in the gray area.

Example: Box 13a for 2 lb flour is 60 (dimensionless units); box 18 is 2 (dimensionless units); box 23 is 0.550 (dimensionless units). The difference between box 18 and box 23 is 1.450 (dimensionless units). Since box 13a is 60 (dimensionless units), 13a is larger than the difference between box 18 and box 23, the lot is considered to be in the gray area and further investigation is necessary before ruling out moisture loss as the reason for shortweight.

When the average error of a lot of fresh poultry, franks, or hot dogs from a USDA-inspected plant is minus, but does not exceed the established "moisture allowance" or "gray area," contact the appropriate USDA official and/or plant management personnel to determine what information is available on the lot in question. Questions to the USDA official and/or plant management representative may include:

(a) Is a quality control program in place?
(b) What information is available concerning the lot in question?
(c) If net weight checks were completed, what were the results of those checks?
(d) What adjustments, if any, were made to the target weight?

Note: If USDA or plant management has data on the lot, such data may help to substantiate that the "lot" met net content requirements at the point of manufacture.

This handbook provides "moisture allowances" for some meat and poultry products, flour, and dry pet food. These allowances are based on the premise that when the average net weight of a sample is found to be less than the labeled weight, but not by an amount that exceeds the allowable limit, either the lot is declared to be within the moisture allowance or further investigation can be conducted.

Deviations from net quantity of contents caused by the loss or gain of moisture from the package are permitted when caused by ordinary and customary exposure to conditions that occur under good distribution practices. If evidence is obtained and documented to prove that the lot was shipped from the packaging plant in a shortweght condition or was distributed under inappropriate or damaging distribution practices, appropriate enforcement action should be taken.
(Amended 2002)

2.4 Borax

How is it determined if the net weight labeled on packages of borax is accurate?

Use the following procedures to determine if packages of borax are labeled correctly. This procedure applies to packages of powdered or granular products consisting predominantly (more than 50 %) of borax. Such commodities are labeled by weight, but borax can lose more than 23 % of its weight due to moisture loss. However, it does not lose volume upon moisture loss, and this property makes possible a method of volume testing based on a density determination in the event that the net weight of the product does not meet the average or individual package requirements. This method may be used for audit testing to identify possible short-filling by weight at point-of-pack. Since the density of these commodities can vary at point-of-pack, further investigation is required to determine whether, such short filling has occurred.

Test Equipment

- Metal density cup with a capacity of 550.6 mL or (1 dry pt).
- Metal density funnel with slide-gate and stand.
- Scale or balance having a scale division not larger than 1 g or (0.002 lb).
- Rigid straightedge or ruler
- Pan suitable for holding overflow of density cup

Test Procedure

Follow Chapter 2, Section 2.3, Basic Test Procedures. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following test procedure to determine product compliance.

1. If the lot does not comply by weight with the sampling plan requirements (either the average or individual package requirements), select the lightest package and record the net weight of this package.
2. Determine the weight of the density cup.
3. Place the density cup in the pan and put the funnel on top of the density cup. Close the funnel slide-gate.
4. Pour sufficient commodity into the funnel so that the density cup can be filled to overflowing.
5. Quickly remove the slide-gate from the funnel, allowing the commodity to flow into the density cup.
6. Carefully, without agitating the density cup, remove the funnel and level off the commodity with the ruler or straight edge. Hold the ruler or straight edge at a right angle to the rim of the cup, and carefully draw it back across the top of the density cup to leave an even surface.
7. Weigh the filled density cup. Subtract the weight of the density cup from the gross weight of the commodity plus the density cup to obtain the net weight of commodity in the cup.

How is the volume determined?

1. Multiply the net weight (in pounds) as found for the package under test by 550.6.

2. Divide the answer just obtained by the weight of the commodity in the density cup, step (7). The result is the net volume of commodity in the package in milliliters.

3. Compare the net volume of the commodity in the package with the volume declared on the package. The volume declaration is not located on the principal display panel. The following example is how the declaration of volume should appear.

Volume 2530 cm^3 per NIST Handbook 133

Note. (1 mL = 1 cm^3)

What action can be taken based on the results of the density test*?*

If the net volume of commodity in the lightest package equals or exceeds the declared volume on the package, treat the lot as being in compliance based on volume and take no further action. If the net volume of borax in the lightest package is less than the declared volume on the package, further compliance testing will be necessary. Take further steps to determine if the lot was in compliance with net weight requirements at point-of-pack or was short-filled by weight. To determine this, perform a laboratory moisture loss analysis to ascertain the weight of the original borax product when it was fully hydrated; obtain additional data at the location of the packager; and/or investigate the problem with the packager of the commodity.

2.5 The Determination of Drained Weight

Since the weight per unit volume of a drained product is of the same order of magnitude as that of the packaging liquid that is drained off, an "average nominal gross weight" cannot be used in checking packages of this type. The entire sample must be opened. The procedure is based upon a test method accepted by the U.S. Food and Drug Administration.

A tare sample is not needed because all the packages in the sample will be opened and measured.

The weight of the container plus drained-away liquid is determined. This weight is then subtracted from the gross weight to determine the package error.

Equipment

- Scales and weights recommended in Section 2.2 are suitable for the determination of drained weight.
- Sieves
  - For drained weight of 1.36 kg or (3 lb) or less, one 20 cm or (8 in) No. 8 mesh U.S. Standard Series Sieve, receiving pan, and cover
  - For drained weight greater than 1.36 kg or (3 lb), one 30 cm or (12 in) sieve, with same specifications as above
- Stopwatch

Test Procedure

Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A or a Category B sampling plan in the inspection (depending on the location of test); select a random sample; then use the following test procedure to determine lot compliance.

1. Fill out boxes 1 through 8 on the standard pack report form on page E-4. Select the random sample. Determine and record on a worksheet the weight of the receiving pan.

2. Determine and record on a worksheet the gross weight of each individual package comprising the sample.

3. Pour the contents of the first package into the dry sieve with the receiving pan beneath it, incline sieve to an angle between 17° to 20° from horizontal to facilitate drainage, and allow the liquid from the product to drain into receiving pan for 2 minutes [Do not shake or shift material on the sieve.] Remove sieve and product.

4. Weigh the receiving pan, liquid, wet container, and any other tare material. [Do not include sieve and product.] Record this weight as tare and receiving pan.

5. Subtract the weight of the receiving pan, determined in step 1, from the weight obtained in step 4 to obtain the package tare weight (which includes the weight of the liquid).

6. Subtract the tare weight, found in step 5, from the corresponding package gross weight determined in step 2 to obtain the drained weight of that package. Determine the package error (drained weight - labeled drained weight).

7. Repeat steps 3 through 6 for the remaining packages in the sample, cleaning and drying the sieve and receiving pan between measurements of individual packages.

8. Transfer the individual package errors to the standard pack report form, page E-4.

9. To determine lot conformance, return to Chapter 2, Section 2.3., Evaluating Results".

2.6 Drained Weight for Glazed or Frozen Foods

How is the drained weight of frozen shrimp and crabmeat determined?

When determining the net weight of frozen shrimp and crabmeat, use the test equipment and procedure provided below. Immerse the product directly in water in a mesh basket or open container to thaw (e.g., it is not placed in a plastic bag). Direct immersion does not result in the product absorbing moisture because the freezing process causes the tissue to lose its ability to hold water. Maintain the water temperature between 23 ^{o}C to 29 °C (75 ^{o}F to 85 °F). This is accomplished by maintaining a constant flow of warm water into the container holding the product (e.g., place a bucket in a sink to catch the overflow, and feed warm water into the bottom of the bucket through a hose). After thawing, drain the product on a sieve for 2 minutes and then weigh it.

Equipment

- Partial immersion thermometer or equivalent with 1 °C (2 °F) graduations and a -35 ^{o}C to +50 °C (-30 ^{o}F to +120 °F) accurate to ±1 °C (±2 °F)

- Water source and hose with a 4 L to 15 L (1 gal to 4 gal) per minute flow rate

- Sink or other receptacle [i.e., 15 L (4 gal) bucket]

- A wire mesh basket or other container that is large enough to hold the contents of 1 package [e.g., 2.27 kg or (5 lb) box of shrimp] and has openings small enough to retain all pieces of the product (e.g., an expanded metal test tube basket lined with standard 16 mesh screen)

- Number 8 mesh, 20 cm (8 in) or 30 cm (12 in) sieve

- Stopwatch

Test Procedure

Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A or a Category B sampling plan in the inspection (depending on the location of test); select a random sample; then use the following test procedure to determine lot compliance.

1. Place the unwrapped frozen shrimp or crabmeat in the wire mesh basket and immerse in a 15 L (4 gal) or larger container of fresh water at a temperature between 23 °C to 29 °C (75 °F to 85 °F). Submerge the basket so that the top of the basket extends above the water level.

2. Maintain a continuous flow of water into the bottom of the container to keep the temperature within the specified range.

3. As soon as the product thaws, determined by loss of rigidity, transfer all material to a sieve (20 cm [8 in] for packages less than 453 g [1 lb] or 30 cm [12 in] for packages weighing more than 453 g [1 lb]) and distribute it evenly over the sieve.

4. Without shifting the product, incline the sieve 30° from the horizontal position to facilitate drainage, and drain for 2 minutes.

5. At the end of the drain time, immediately transfer the product to a tared pan for weighing to determine the net weight.

How is the net weight of glazed raw seafood and fish determined?

For glazed raw seafood and fish, determine the net weight after removing the glaze using the following procedure. Use this method for any frozen glazed food product.

Equipment

Use the equipment listed in Section 2.6.

Test Procedures

Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; and use the following test procedure to determine lot compliance.

1. Fill out a report form and select the random sample. A tare sample is not needed.

2. Weigh sieve and receiving pan. Record this weight on a worksheet as “sieve weight.”

3. Remove each package from low temperature storage; open it immediately and place the contents under a gentle spray of cold water. Carefully agitate the product to avoid breaking the product. Continue the spray until all ice glaze that is seen or felt is removed. In general, the product should remain rigid; however, the ice glaze on certain products, usually smaller sized commodities, sometimes cannot be removed without defrosting the product. Nonetheless, remove the glaze, because it is a substantial part of the package weight.
   (Amended 2002)

4. Transfer the product to the weighed sieve. Without shifting the product, incline the sieve to an angle of 17° to 20° to facilitate drainage and drain (into waste receptacle or sink) for exactly 2 minutes.

5. Place the product and sieve on the receiving pan and weigh. Record this weight on a worksheet as the "sieve + product weight."

6. The net weight of product is equal to the weight of the pan plus the sieve plus the product (recorded in step 5) minus the "sieve weight" (recorded in step 2). Record the product net weight on the worksheet. The package error is equal to the net weight of the product as measured minus the labeled weight. Record the package error on the worksheet and transfer it to the report form.

7. Repeat steps 3 through 6 for each package in the sample, cleaning and drying the sieve and the receiving pan between package measurements.

Evaluation of Results

Follow the procedures in Chapter 2, Section 2.3., Evaluating Results

Chapter 3. Test Procedures – For Packages Labeled by Volume

3.1 Scope

What types of packaged goods can be tested using these procedures?

Use this procedure to determine the net contents of packaged goods labeled in fluid volume such as milk, water, beer, oil, paint, distilled spirits, soft drinks, juices, liquid cleaning supplies, or liquid chemicals. This chapter also includes procedures for testing the capacities of containers such as paper cups, bowls, glass tumblers, and stemware.

What types of packages are not covered by these procedures?

These procedures do not cover berry baskets and rigid-dry measures that are covered by specific code requirements in NIST Handbook 44.

When can the gravimetric test procedure be used to verify the net quantity of contents of packages labeled by volume?

The gravimetric procedure may be used to verify the net quantity of contents of packages labeled in volume when the density (density means the weight of a specific volume of liquid determined at a reference temperature) of the product being tested does not vary excessively from one package to another.

What procedure is followed if the gravimetric test procedure cannot be used?

Test each package as described in Section 3.3, Volumetric Test Procedure for Liquids.

What considerations besides density affect measurement accuracy?

In addition to possible package-to-package variations in product density, the temperature of the liquid will affect the volume of product. The product will expand or contract based on a rise or fall in product temperature.

> **Example:** The volume of a liquid cleaning product might be 5 L (1.32 gal) at 20 °C (68 °F) and 5.12 L (1.35 gal) at 25 °C (77 °F), which represents a 2.2 % change in volume.
>
> **Note:** This extreme example is for illustrative purposes, a 2.2 % volume change will not occur in normal testing.

What reference temperature should be used to determine the volume of a liquid?

Use the reference temperature specified in Table 3-1., Reference Temperatures for Liquids to determine volume. When checking liquid products labeled by volume using the gravimetric procedure, maintain the packages used to determine product densities at reference temperatures. If testing the packages in a sample volumetrically, each package in the sample must be maintained at or corrected to the reference temperature when its volume is determined.

Note. When checking liquid products using a volumetric or gravimetric procedure, the temperature of the samples must be maintained at the reference temperature ±2 ºC (±5 ºF).

Table 3-1. Reference Temperatures for Liquids		
	If the Liquid Commodity is	**Then, the reference temperature is**
1	Frozen food labeled by volume (e.g., fruit juice)	-18 °C (0 °F)
2	Beer	3.9 °C (39.1 °F)
3	Food that must be kept refrigerated (e.g., milk and other dairy products. Usually labeled "Keep Refrigerated")	4.4 °C (40 °F)
4	Distilled spirits or petroleum	15 °C (60 °F)
5	Unrefrigerated products (e.g., includes liquids sold unchilled, such as soft-drinks and wine)	20 °C (68 °F)

3.2 Gravimetric Test Procedure for Liquids

Equipment

- A scale that meets the requirements in Chapter 2, Section 2.2, Measurement Standards and Test Equipment.

Note: To verify that the scale has adequate resolution for use, it is first necessary to determine the density of the liquid; next verify that the scale division is no larger than MAV/6 for the package size under test. The smallest graduation on the scale must not exceed the weight value for MAV/6.

Example: Assume the inspector is using a scale with 1 g (0.002 lb) increments to test packages labeled 1 L (33.8 fl oz) that have an MAV of 29 mL (1 fl oz). Also, assume the inspector finds that the weight of 1 L of the liquid is 943 g (2.078 lb). This will result in an MAV/6 value in weight of 4.715 g (0.010 lb):

29 mL/6 = 4.8 mL	(1 fl oz/6 = 0.166 6 fl oz)
943 g/1 000 mL= 0.943 g/mL	(2.07 8 lb/33.6 fl oz = 0.061 8 lb/fl oz)
4.8 mL x 0.943 g/mL = 4.5264 g	(0.166 6 fl oz x 0.061 8 lb/fl oz = 0.010 lb)

In this example, the 1 g (0.002 lb) scale division is smaller than the MAV/6 value of 4.5264 g (0.10 lb) so the scale is suitable for making a density determination.

- A partial immersion thermometer (or equivalent) with a range of –35 °C to +50 °C (30 °F to 120 °F), at least 1 °C (1 °F) graduations, and with a tolerance of ±1 °C (±2 °F)

- Volumetric measures

  Example: When checking packages labeled in SI units, flask sizes of 100 mL, 200 mL, 500 mL, 1 L, 2 L, 4 L, and 5 L and a 50 mL cylindrical graduate with 1 mL divisions may be used. When checking packages labeled in inch-pound units the use of measuring flasks and graduates with capacities of gill, half-pint, pint, quart, half-gallon, gallon, and a 2 fl oz cylindrical graduate, graduated to ½ fluid dram is recommended.

- Defoaming agents may be necessary for testing liquids such as beer and soft drinks that effervesce or are carbonated. Two such products are Hexanol or Octanol (Capryl Alcohol).

Note: The mention of trade or brand names does not imply that these products are endorsed or recommended by the U.S. Department of Commerce over similar products commercially available from other manufacturers.

- Bubble level at least 15.24 cm (6 in) in length

- Stopwatch

Test Procedure

1. Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection. Select a random sample; then use the following procedure to determine lot compliance.

2. Bring the sample packages and their contents to the reference temperature as specified in Table 3-1., Reference Temperatures for Liquids. To determine if the liquid is at its reference temperature, immerse the thermometer in the liquid before starting the test. Verify the temperature again immediately after the flask and liquid is weighed. If the product requires mixing for uniformity, mix it before opening in accordance with any instructions specified on the package label. Shaking liquids, such as flavored milk, often entraps air that will affect volume measurements, so use caution when testing these products. Often, less air is entrapped if the package is gently rolled to mix the contents.

3. For milk, select a volumetric measure equal to or one size smaller than the label declaration. For all other products, select a volumetric measure that is one size smaller than the label declaration. For example, if testing a 1 L bottle of juice or a soft drink, select a 500 mL volumetric measure.
(Amended 2004)

   Note: When determining the density of milk, if the product from the first container does not fill the volumetric measure to the nominal capacity graduation, product may be added from another container as long as product integrity is maintained (i.e., brand, identity, lot code, and temperature).

4. Prepare a clean volumetric measure to use according to the following procedures:

   - Because flasks are ordinarily calibrated on a "to deliver" basis, they must be "wet down" before using. Immediately before use, fill the volumetric flask(s) or graduate with water. The water should be at the reference temperature of the product being tested. Fill the flask(s) with water to a point slightly below the top graduation on the neck. The flask should be emptied in 30 seconds (± 5 seconds). Tilt the flask gradually so the flask walls are splashed as little as possible as is emptied. When the main flow stops, the flask should be nearly inverted. Hold the flask in this position for 10 seconds more and touch off the drop of water that adheres to the tip. If necessary, dry the outside of the flask. The flask or graduate is then ready to fill with liquid from a package. This is called the "wet down" condition.

     Note: When using a volumetric measure that is calibrated "to contain," the measure must be dry before each measurement.

   - If the liquid effervesces or foams when opened or poured (such as carbonated beverages), add two drops of a defoaming agent to the bottom of the volumetric measure before filling with the liquid. If working with a carbonated beverage, make all density determinations immediately upon placing the product into the standard. This reduces the chance of volume changes occurring from the loss of carbonization.

   - Before making additional measurements of a liquid, use water to wash or rinse and prepare the volumetric measure. Between each two measurements of liquid from the sample packages, prepare the volumetric measure as described above, dry the outside of the flask, and drain the volumetric measure as described in earlier paragraphs of this section, as appropriate.

5. If the flask capacity is equal to the labeled volume, pour the liquid into the volumetric measure tilting the package to a nearly vertical position. If the flask capacity is smaller than the package's labeled volume, fill the flask to its nominal capacity graduation. If conducting a volumetric test, drain the container into the volumetric measure for 1 minute after the stream of liquid breaks into drops.

6. Position the volumetric measure on a level surface at eye level. For clear liquids, place a material of some dark color outside the flask immediately below the level of the meniscus. Read the volume from the lowest point of the meniscus. For opaque liquids, read volume from the center top rim of the liquid surface.

7. Use the gravimetric procedure to determine the volume if the limit specified for the difference in density is not exceeded.

   - Select a volumetric measure equal to or one size smaller than the labeled volume (depending on the product) and prepare it as described in paragraph 4 of this section. Then determine and record its empty weight.

   - Determine acceptability of the liquid density variation, using two packages selected for tare according to Chapter 2 as follows:

     - Determine the gross weight of the first package.

     - Pour the liquid from the first package into a volumetric measure exactly to the nominal capacity marked on the neck of the measure.

     - Weigh the filled volumetric measure and subtract its empty weight to obtain the weight of the liquid. Determine density by dividing the weight of the liquid by the capacity of the volumetric measure.

     - Determine the weight of the liquid from a second package using the same procedure.

     - If the difference between the densities of the two packages exceeds one division, use the volumetric procedure in Section 3.3., Volumetric Test Procedure for Liquids.

How is "nominal gross weight" determined?

Determine the "nominal gross weight" as follows:

1. Determine the Average Used Dry Tare Weight of the sample according to provisions of Section 2.3.

2. Calculate the Average Product Density by adding the densities of the liquid from the two packages and dividing the sum by two.

3. Calculate the "nominal gross weight" using the following formula if the flask capacity is equal to the labeled volume:

   Nominal Gross Weight = (Average Product Density [in weight units]) +
   (Average Used Dry Tare Weight)

Note: If the flask size is smaller than the labeled volume, the following formula is used:

Nominal Gross Weight = (Average Product Density x [Labeled Volume/ Flask Capacity]) + (Average Used Dry Tare Weight)

How are the errors in the sample determined?

1. Weigh the remaining packages in the sample.

   Subtract the nominal gross weight from the gross weight of each package to obtain package errors in terms of weight. All sample packages are compared to the nominal gross weight.

2. To convert the average error or package error from weight to volume, use the following formula:

   Package Error in Volume = Package Error in Weight/Average Product Density
   Per Volume Unit of Measure

Evaluation of Results

Follow the procedures in "Evaluating Results" in Chapter 2, Section 2.3, to determine lot conformance.

3.3 Volumetric Test Procedure for Liquids

How is the volume of liquid contained in a package determined volumetrically?

Follow steps 1 through 6 in Section 3.2., Gravimetric Test Procedure for Liquids for each package in the sample.

How are the errors in the sample determined?

Read the package errors directly from the graduations on the measure. The reference temperature must be maintained within ± 2 °C (± 5 °F) for the entire sample.

Evaluation of Results

Follow the procedures in Chapter 2, Section 2.3, Evaluating Results to determine lot conformance.

3.4 Other Volumetric Test Procedures

What other methods can be used to determine the net contents of packages labeled by volume?

Depending on how level the surface of the commodity is, use one of two headspace test procedures. Use the first headspace test procedure to determine volume where the liquid has a smooth surface (e.g., oils, syrups, and other viscous liquids). Use the second procedure to determine volume where the commodity does not have a smooth surface (e.g., mayonnaise and salad dressing).

Test Procedure

Before conducting any of the following volumetric test procedures, follow Section 2.3, Basic Test Procedure in Chapter 2. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following procedure to determine lot compliance.

Test Equipment

- Micrometer depth gage (ends of rods fully rounded) 0 mm to 225 mm (0 in to 9 in) or longer
- Level (at least 15 cm (6 in) in length)
- Laboratory pipets and/or buret
  - Class A 500 mL buret that conforms to ASTM E 287-94, "Standard Specification for Laboratory Glass Graduated Burets"

- Class A Pipets, calibrated "to deliver" that conform to ASTM E 969-95, "Standard Specification for Glass Volumetric (Transfer) Pipets"

- Volumetric measures
- Water
- Rubber bulb syringe
- Plastic disks that are 3 mm (1/8 in) thick with diameters equal to the seat diameter or larger than the brim diameter of each container tested. The diameter tolerance for the disks is 50 µm (± 0.05 mm [± 0.002 in]). The outer edge should be smooth and beveled at a 30° angle with the horizontal to 800 µm (0.8 mm [1/32 in]) thick at the edge. Each disk must have a 20 mm (3/4 in) diameter hole through its center and a series of 1.5 mm (1/16 in) diameter holes 25 mm (1 in) from the outer edge.
- Stopwatch

How is the volume of oils, syrups, and other viscous liquids that have smooth surfaces determined?

1. Make all measurements on a level surface
2. Bring the temperature of both the liquid and the water to be used to measure the volume of the liquid to the reference temperature specified in Table 3-1., Reference Temperatures for Liquids.
3. Measure the headspace of the package at the point of contact with the liquid using a depth gauge with a fully rounded, rather than a pointed, rod end. If necessary, support the package to prevent the bottom of the container from distorting.
4. Empty, clean, and dry the package.
5. Refill the container with water measured from a volumetric standard to the original liquid headspace level measured in paragraph (3) of this section until the water touches the depth gauge.
6. Determine the amount of water used in paragraph (5) of this section to obtain the volume of the liquid and calculate the "package error" based on that volume.

Evaluation of Results

Follow the procedures in "Evaluating Results" in Chapter 2, Section 2.3, to determine lot conformance.

3.5 Mayonnaise and Salad Dressing

Volumetric Headspace Test Procedure

Use the volumetric headspace procedure described in this section to determine volume when the commodity does not have a smooth surface (e.g., mayonnaise, salad dressing, and other water immiscible products without a level liquid surface). The procedure guides the inspector to determine the amount of headspace above the product in the package and the volume of the container. Determine the product volume by subtracting the headspace volume from the container volume. Open every package in the sample.

1. Make all measurements on a level surface.

2. Bring the temperature of both the commodity and the water used to measure the volume to the appropriate temperature designated in Table 3-1., Reference Temperatures for Liquids.

3. Open the first package and place a disk larger than the package container opening over the opening.

4. Measurement Procedure

   - Deliver water from a flask (or flasks), graduate, or buret, through the central hole in the disk onto the top of the product until the container is filled. If it appears that the contents of the flask may overfill the container, do not empty the flask. Add water until all of the air in the container has been displaced and the water begins to rise in the center hole of the disk. Stop the filling procedure when the water fills the center disk hole and domes up slightly due to the surface tension. Do not add additional water after the level of the water dome has dropped.

   - If the water dome breaks on the surface of the disk, the container has been overfilled and the test is void; dry the container and start over.

5. To obtain the headspace capacity, record the volume of water used to fill the container and subtract 1 mL (0.03 fl oz), which is the amount of water held in the hole in the disk specified.

6. Empty, clean, and dry the package container.

7. Repeat steps 4 and 5 of this section. Refill the package container with water measured from a volumetric measure to the maximum capacity of the package, subtract 1 mL (0.03 fl oz), and record the amount of water used as the container volume; and

8. From the container volume determined in paragraph 7 of this section, subtract the headspace capacity in paragraph (5) of this section to obtain the measured volume of the product and calculate the "package error" for that volume where "package error" equals labeled volume minus the measured volume of the product.

Evaluation of Results

Follow the procedures in Chapter 2, Section 2.3., Evaluating Results to determine lot conformance.

3.6 Goods Labeled by Capacity - Volumetric Test Procedure

What type of measurement equipment is needed to perform the headspace test procedures?

Use the test equipment in Section 3.4. (except for the micrometer depth gage) to perform these test procedures.

How is it determined if goods labeled by capacity meet the average and individual requirements?

Before conducting any of the following volumetric test procedures, refer to Chapter 2, Section 2.3., Basic Test Procedure. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following test procedure to determine lot compliance.

1. Make all measurements on a level surface.

2. When testing goods labeled by capacity, use water at a reference temperature of 20 °C ± 2 °C (68°F ± 5 °F).

3. Select a sample container and place a disk larger than the container opening over the opening.

4. Measurement Procedure

   - Add water to the container using flask (or flasks), graduate, or buret corresponding to labeled capacity of the container. If it appears that the contents of the flask may overfill the container, do not empty the flask. Add water until all of the air in the container has been displaced and the water begins to rise in the center hole of the disk. Stop filling the container when the water fills the center disk hole and domes up slightly due to the surface tension.

   - If the water dome breaks on the surface of the disk, the container has been overfilled and the test is void; dry the container and start over.

   - Record the amount of water used to fill the container and subtract 1 mL (0.03 fl oz) (this is the amount of water held in the hole in the disk specified) to obtain the total container volume.

5. Test the other containers in the sample according to the procedures in paragraph (4) of this section.

6. To determine package errors, subtract the total container volume obtained in paragraphs (4) and (5) from the labeled capacity of the container.

Evaluation of Results

Follow the procedures in Chapter 2, Section 2.3., Evaluating Results to determine lot compliance.

3.7 Pressed and Blown Glass Tumblers and Stemware

What requirements apply to pressed and blown glass tumblers and stemware?

This handbook provides a tolerance to the labeled capacity of glass tumblers and stemware. The average requirement does not apply to the capacity of these products. See Table 3-2., Allowable Differences for Pressed and Blown Glass Tumblers and Stemware.

How is it determined if tumblers and stemware meet the individual package requirement?

Follow the Basic Test Procedure in Section 2.3. Define the inspection lot and determine which sampling plan to use in the inspection, select a random sample, and then use the following volumetric test procedure to determine container capacity and volume errors.

What type of measuring equipment is needed to perform the test procedures?

Use the equipment specified in Section 3.4., (except for the micrometer depth gage) to perform these test procedures.

What are the steps of the test procedure?

Follow steps 1 through 6 in 3.6, Goods Labeled by Capacity - Volumetric Test Procedure.

How is it determined if the samples conform to the allowable difference?

Compare the individual container error with the allowable difference that applies in Table 3-2., Allowable Differences for Pressed and Blown Glass Tumblers and Stemware. If a package contains more than one container, all of the containers in the package must meet the allowable difference requirements in order for the package to pass.

Table 3-2. Allowable Differences for Pressed and Blown Glass Tumblers and Stemware	
Unit of measure	
If the capacity in metric units is:	**Then the allowable difference is:**
200 mL or less	± 10 mL
More than 200 mL	± 5 % of the labeled capacity
If the capacity in inch-pound units is:	**Then the allowable difference is:**
5 fluid ounces or less	± ¼ fluid ounce
More than 5 fluid ounces	± 5 % of the labeled capacity

Evaluation of Results

Count the packages in the sample with volume errors greater than the allowable difference and compare the resulting number with the number given in Column 3 of Table 2-11., in Appendix A.

- If the number of containers in the sample with errors exceeding the allowable difference exceeds the number allowed in Column 3, the lot fails.

- If the number of packages with errors exceeding the allowable difference is less than or equal to the number in Column 3, the lot passes.

Note: The average capacity error is not calculated because the lot passes or fails based on the individual volume errors. Act on the individual units containing errors exceeding the allowable difference individually even though the lot passes the requirement.

3.8 Volumetric Test Procedure for Paint, Varnish, and Lacquers – Non-aerosol

How is the volume of paint, varnish, and lacquers contained in a package determined?

Use one of three different test methods depending upon the required degree of accuracy and the location of the inspection. The procedures include both retail and in-plant audits and a "possible violation" method, which is designed, for laboratory or in plant use because of cleanup and product collection requirements. The procedures are suitable to use with products labeled by volume and packaged in cylindrical containers with separate lids that can be resealed.

Equipment

- A scale that meets the requirements in Chapter 2, Section 2.2., Measurement Standards and Test Equipment
- Volumetric measures
- Micrometer depth gage (ends of rods fully rounded), 0 mm to 225 mm (0 in to 9 in)
- Diameter (Pi) tape measure, 5 cm to 30 cm (2 in to 12 in)
- Spanning bar, 2.5 cm by 2.5 cm by 30 cm or (1 in by 1 in by 12 in)
- Rule, 30 cm (12 in)
- Paint solvent or other solvent suitable for the product being tested
- Cloth, 30 cm (12 in) square
- Wood, 5 cm (2 in) thick, by 15 cm (6 in) wide, by 30 cm (12 in) long
- Rubber mallet

- Metal disk, 6.4 mm (1/4 in) thick and slightly smaller than the diameter of package container bottom.
- Rubber spatula
- Level at least 15 cm (6 in) in length
- Micrometer (optional)
- Stopwatch

What test procedure is used to conduct a retail audit test?

Conduct a retail audit using the following test procedure that is suitable for checking cylindrical containers up to 4 L (1 gal) in capacity. Use step 2 in the retail audit test procedure with any size container, but step 3 must be used for containers with capacities of 4 L (1 gal). The method determines the volume of a single can in the sample selected as most likely to contain the smallest volume of product. Do not empty any containers because only their critical dimensions are being measured.

How accurate is the dimensional test procedure?

The configuration of the bottom of the can, paint clinging to the lid, and slight variations in the wall and label thicknesses of the paint container may produce an uncertainty estimated to be at least 0.6 % in this auditing procedure. Therefore, this method is recommended solely to eliminate from more rigorous testing those packages that appear to be full measure. Use the violation procedures when the volume determined in step 10 is less than the labeled volume or in any case where short measure is suspected.

What worksheets make data recording easier?

Use the following format to develop worksheets to perform audits and determine the volume when checking paint. Follow the procedure and it will indicate the column in which the various measurements made can be recorded.

Example: Audit Worksheet for Checking Paint – Add additional rows as needed									
1. Can Height	Can Diameter				6. Avg Liquid Diameter	7. Avg Liquid Level	8. Avg Container Depth	9. Avg Liquid Depth	10. Volume*
	2. Top	3. Middle	4. Bottom	5. Average					
*10. Volume = 0.7854 x 6 x 6 x 9									

Note: When the following instructions require recording a measurement, refer to the numbered columns in the "Audit Worksheet for Checking Paint" shown above.

How is a retail audit test performed?

1. Select a random sample. A tare sample is not needed.

2. For containers less than 4 L or (1 gal): measure the outside diameter of each container near its middle to the closest 0.02 mm (0.001 in). Use a diameter tape measure to record the measurements in Column 3. Place the containers on a level surface and using the micrometer depth gage, record their heights in Column 1 on the worksheet. If the range of outside diameters exceeds 0.125 mm (0.005 in) or the range in heights exceeds 1.58 mm (0.062 5 in), do

not use this procedure. If the ranges are within the specified limits, weigh all cans in the sample, select the container with the lightest gross weight, and remove its lid. Continue with step 4 below.

3. For 4 L (1 gal) containers: gross weigh each package in the sample. Select the package with the lightest gross weight and remove its lid.

4. Use a direct reading diameter tape measure to measure the outside diameter of the selected container near its top, middle (already measured if step 2 was followed), and bottom to the closest 0.02 mm (0.001 in). Record these measurements in Columns 2, 3, and 4. Add the three diameter values and divide by three to obtain the average diameter and record this value in Column 5.

5. If a micrometer is available, measure the wall and the paper label thickness of the container; otherwise, assume the wall and label thicknesses given in Table 3-3. Thickness of Paint Can Walls and Labels below:

Table 3-3. Thickness of Paint Can Walls and Labels

Can Size	**Wall Thickness**
4 L (1 gal)	250 μm (0.25 mm) [0.010 in]
2 L (1/2 gal)	250 μm (0.25 mm) [0.010 in]
1 L (1 qt)	230 μm (0.23 mm) [0.009 in]
500 mL (1 pt)	230 μm (0.23 mm) [0.009 in}
250 mL	200 μm (0.20 mm) [0.008 in]
Label Thickness* for all can sizes: 100 μm (0.10 mm) [0.004 in] (*Paper only – ignore labels lithographed directly onto the container)	

Subtract twice the thickness of the wall of the can and paper label from the average can diameter (step 4) to obtain the average liquid diameter. Record the liquid diameter in Column 6.

6. On a level surface, place the container on the circular metal disk that is slightly smaller in diameter than the lower rim of the can so the bottom of the container nests on the disk to eliminate any "sag" in the bottom of the container.

7. Place the spanning bar and depth gage across the top of the paint can and mark the location of the spanning bar on the rim of the paint container. Measure the distance to the liquid level, to the nearest 20 μm (0.02 mm) (0.001 in), at three points in a straight line. Take measurements at points approximately 1 cm (3/8 in) from the inner rim for cans 12.5 cm (5 in) in diameter or less (and at 1.5 cm [1/2 in] from the rim for cans exceeding 12.5 cm [5 in]) in diameter and at the center of the can. Add the three readings and divide by three to obtain the average distance to the liquid level in the container. Record the average distance to the liquid level in Column 7.

8. Measure the distance to the bottom of the container at three points in a straight line in the same manner as outlined in step 7. Add the three readings and divide by three to obtain the average height of the container and record it in Column 8.

9. Subtract the average distance to the liquid level (Column 7) from the average height of the container (Column 8) to obtain the average height of the liquid column and record it in Column 9.

10. Determine the volume of paint in the container by using the following formula:

$$\text{Volume} = 0.7854\ D^2H$$

Where D = average liquid diameter (Column 6) and H = average liquid height (Column 9)

11. Record this value in Column 10. If the calculated volume is less than labeled volume, go to the Violation Procedure.

How is an in-plant audit conducted?

Use the following procedures to conduct an in-plant audit inspection. This method applies to a container that probably contains the smallest volume of product. Duplicate the level of fill with water in a can of the same dimensions as the one under test. Use this method to check any size of package if the liquid level is within the measuring range of the depth gage. If any paint is clinging to the sidewall or lid, carefully scrape the paint into the container using a rubber spatula.

1. Follow steps 1 through 6 of the retail audit test.

2. Place the spanning bar and depth gage across the top of the paint can. Measure the liquid level at the center of the surface and record the level in Column 7.

3. Select an empty can with the same bottom configuration as the container under test and with a diameter and height equal to that of the container under test within plus or minus the following tolerances:

    a. For 500 mL or (1 pt) cans - within 25 μm (0.025 mm) (0.001 in)
    b. For 1 L or (1 qt) cans - within 50 μm (0.05 mm) (0.002 in)
    c. For 2 L or (1/2 gal) cans - within 75μm (0.075 mm) (0.003 in)
    d. For 4 L or (1 gal) cans - within 100 μm (0.1 mm) (0.004 in)

    Set the empty can on a level work surface with a circular metal disk that is slightly smaller in diameter than the bottom can rim underneath the can to eliminate sag. Set up the spanning bar and depth gage as in step 2 above. Fill the container with water from a volumetric measure of the same volume as the labeled volume. Measure the distance to the liquid level at the center of the container and record this level in Column 7 below the reading recorded in step 2. If this distance is equal to or greater than the distance determined in step 2, assume that the package is satisfactory. If the distance is less than the distance determined in step 2, the product may be short measure. Use the possible violation procedure given in the next section when the audit test indicates that short measure is possible.

Violation Procedure

How is it determined if the containers meet the package requirements?

Use the following method if the liquid level is within the measuring range of the micrometer. The first step is to follow the Basic Test Procedure in Section 2.3. Define the inspection lot to determine which Category A sampling plan to use; select a random sample; and then use the following procedure. The steps noted with an (*) are required if there is paint adhering to the lid and it cannot removed by scraping into the can.

1. Do not shake or invert the containers selected as the sample. Determine the gross weight of these packages and record in Column 2 of the "Example Worksheet for Possible Violation in Checking Paint" below.

Example Worksheet for Possible Violation in Checking Paint – Add additional rows as needed								
1. Labeled Volume	2. Gross Weight	3. Lid Paint Weight (Wet - Dry)	4. Liquid Level	5. Tare	6. Water Volume	7. Net Wt. = 2 - 5	8. Weight of Labeled Volume = 7 x 1÷ 6	9. Package Volume = 6 + [(3 ÷7) x 6)]

Record the labeled volume of the first tare sample package in Column 1 of the worksheet. Use a circular metal disk to eliminate can "sag" and remove the lid. If paint clings to the lid of the container, scrape it off with a spatula.

2.* If paint that adheres to the lid cannot be completely removed by scraping the paint into the can, determine the weight of the lid plus any adhering paint. Clean the paint lid with solvent and weigh again. Subtract the clean lid weight from the lid weight with paint to determine the weight of the paint adhering to the lid. Record this weight in Column 3.

3. Place the spanning bar and depth gage across the top of the paint can. Mark the location of the spanning bar on the rim of the paint container. Measure the distance to the liquid level at the center of the container to the nearest 20 μm (0.02 mm) (0.001 in). Record the distance in Column 4.

4. Empty and clean the sample container and lid with solvent; dry and weigh the container and lid. Record the tare weight in Column 5.

5. Set up the container in the same manner as in step 1.

6. Place the spanning bar at the same location on the rim of the paint container as marked in step 3. With the depth gage set as described in step 3, deliver water into the container in known amounts until the water reaches the same level occupied by the paint as indicated by the depth gage. Record this volume of water (in mL or fl oz) in Column 6 of the worksheet. This is the volume occupied by the paint in the container. Follow steps, 7a, 8a, and 9a if scraping does not remove the paint from the lid. In order to determine if gravimetric testing can be used to test the other packages in the sample, follow only steps 7, 8, and 9 when no paint adheres to the lid.

7. Subtract the weight of the container (Column 5) from the gross weight (Column 2) to arrive at the net weight of paint in the selected container. Record the net weight in Column 7 of the worksheet.

   7a* Subtract the weight of the container (Column 5) and the weight of product on the lid (Column 3) from the gross weight (Column 2) to arrive at the net weight of paint in the container. Record in Column 7 (excluding the weight of the paint on the lid).

8. Calculate the weight of the labeled volume of paint (for the first package opened for tare = on the lid).

   net weight (Column 7) x labeled volume (Column 1) ÷ volume of paint in can (Column 6)

   Record this value in Column 8.

   8a* Calculate the package volume =

   volume in can (Column 6) + [lid paint weight (Column 3) x
   volume in can (Column 6) / net weight (Column 7)]

   Record it in Column 9 of the worksheet.

9. Calculate the package error. Use the following formula if paint does not adhere to the lid:

   Package error = (Column 6 value) - (labeled volume)

   9a* Use the following formula if paint does adhere to the lid and will not come off by scraping.

   Package error = (Column 9 value) - (labeled volume)

10. Repeat steps 1 through 9 for the second package chosen for tare.

When can a gravametric procedure be used?

A gravimetric procedure is used if the weights of the labeled volume for the first two packages do not differ from each other by more than one division on the scale (if they meet this criterion, check the rest of the sample gravimetrically and record in Column 8).

How is "nominal gross weight" determined?

Determine the "nominal gross weight" for use with Chapter 2, Section 2.3. as follows:

The nominal gross weight equals the sum of the average weight of the labeled volume (average of values recorded in Column 8) plus the average tare (average of values recorded in Column 3) for the packages selected for tare. Note that the weight of a given volume of paint often varies considerably from container to container; therefore, volumetric measurements may prove necessary for the entire sample.

Evaluation of Results

Follow the procedures in "Evaluating Results" in Chapter 2, Section 2.3. to determine lot conformance.

3.9 Testing Viscous Materials - Such As Caulking Compounds and Pastes

How are viscous materials such as caulking compounds and paste tested?

Use the following procedure for any package of viscous material labeled by volume. It is suitable for very viscous materials such as cartridge packed caulking compounds, glues, pastes, and other similar products. It is best to conduct this procedure in a laboratory using a hood to ventilate solvent fumes. If used in the field, use in a well ventilated area. Except for the special measurement procedures to determine the weight of the labeled volume, this procedure follows the basic test procedure. For each weight of a known volume determination, pack a portion of the packaged product into a pre-weighed cup of known volume (called a "density cup" or "pycnometer") and weigh. From the weight of the known volume, determine the weight of the labeled volume. Compare the nominal gross weight with the gross weight to determine the package error.

What type of measurement equipment is needed to test packages of caulk, pastes, and glues?

- A scale that meets the requirements in Chapter 2, Section 2.2. Measurement Standards and Test Equipment.

- Pycnometer, a vessel of known volume used for weighing semifluids. The pycnometer can be bought or made. If it is made, refer to it as a "density cup." To make a 150 mL or 5 fl oz density cup, cut off the lip of a 150 mL beaker with an abrasive saw and grind the lip flat on a lap wheel. The slicker plate is available commercially. Calibrate the density cup gravimetrically with respect to the contained volume using the procedure in ASTM E 542–94, "Standard Practice for Calibration of Laboratory Volumetric Apparatus."

- Appropriate solvents (water, Stoddard solvent, kerosene, alcohol, etc.)

- Caulking gun (for cartridge packed products)

How is a pycnometer prepared for use?

Before using, weigh and calibrate the pycnometer (or the density cup and slicker plate) with respect to volume (mL or fl oz). If applicable, comply with any special instructions furnished by the manufacturer to calibrate a pycnometer that has not been calibrated. It is not necessary to reweigh or recalibrate for each test; however, mark the pieces of each unit to prevent interchange of cups and slicker plates.

How is it determined if the containers meet the package requirements?

1. First, follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then, use the following procedure to determine lot compliance.

2. Weigh a calibrated pycnometer and slicker plate and record as "pycnometer weight" and record this weight and the volume of the pycnometer.

3. Determine the gross weight of the first package and record the weight value. Open the package and transfer the product to the pycnometer by filling it to excess. Use a caulking gun to transfer product from the caulking cartridges. If using a pycnometer, cover it with a lid and screw the cap down tightly. Excess material will be forced out through the hole in the lid, so the lid must be clean. If using a density cup, place the slicker plate over 3/4 of the cup mouth, press down and slowly move the plate across the remainder of the opening. With the slicker plate in place, clean all the exterior surfaces with solvent and dry.

4. Completely remove the product from the package container; clean the package container with solvent; dry and weigh it to determine the tare weight.

5. Weigh the filled pycnometer or filled density cup with slicker plate and record this weight. Subtract the weight of the empty pycnometer from the filled weight to determine the net weight of the product contained in the pycnometer and record this weight.

6. Clean the pycnometer and repeat steps 3, 4, and 5 for the second package in the tare sample.

   Determine acceptability of the density variation on the two packages selected for tare. If the difference between the densities of both packages exceeds one division of the scale, do not use the gravimetric procedure to determine the net quantity of contents. Instead, use the procedure in steps 9 and 10.

   Note: If the gravimetric procedure can be used perform steps 8 and 10.

7. Calculate the weight of product corresponding to the labeled volume of product according to the following formula:

   Weight of Product in Pycnometer ÷ Pycnometer Volume = Product Density

8. Test each package individually by determining the product density in each package using the pycnometer and record the gross, tare, and net weight of each package. Subtract the weight of the labeled volume (determined for each package) from the net weight of product to arrive at each individual package error in units of weight.

9. Convert the package errors to units of volume using the following formula:

   Package Error (volume) = (Package Error [weight] x Pycnometer Volume) ÷ (Weight of Product in Pycnometer)

10. Record the package errors on the report form using an appropriate unit of measure.

Evaluation of Results

Follow the procedures in "Evaluation Results" in Chapter 2, Section 2.3 to determine lot conformance.

3.10 Peat Moss

How are packages of peat and peat moss labeled by compressed volume tested?

Measure the dimensions of the compressed material to determine if it contains the labeled quantity.

How are packages of peat and peat moss labeled by uncompressed volume tested?

Use the following method to test peat moss sold using an uncompressed volume as the declaration of content. The procedure is based on ASTM D 2978-90, "Standard Method of Test for Volume of Processed Peat Materials."

Equipment

- 12.7 mm (or ½ in) sieve.
- Use one of the following measures as appropriate for the package size. (See Table 3-4., "Specifications for Test Measures for Mulch and Soils" for additional information on test measure construction.)
    - 28.3 L (1 ft^3) measure with inside dimensions of 30.4 cm (12 in) by 30.4 cm (12 in) by 30.4 cm (12 in). Mark the inside of the measure with horizontal lines every 1.2 cm (1/2 in) so that package errors can be directly determined.
    - 100 L (3.5 ft^3) measure with inside dimensions of 50 cm (19.68 in) by 50 cm (19.68 in) by 40 cm (15.74 in). The inside of the measure should be marked with horizontal lines every 1.2 cm (1/2 in) so that package errors can be directly determined.
- Straight edge, 50.8 cm (20 in) in length.
- Sheet for catching overflow of material.
- Level (at least 15.24 cm (6 in) in length).

How is it determined if the packages meet the requirements in this handbook?

1. Follow Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then, use the following procedure to determine lot compliance.

2. Open each package in turn, remove the contents, and pass them through the sieve directly into the measuring container (overfilling it). Use this method for particulate solids (such as soils or other garden materials) labeled in cubic dimensions or dry volume. Some materials may not pass through the sieve for peat moss; in these instances, separate the materials by hand (to compensate for packing and settling of the product after packaging) before filling the measure.

   Note: Separated material (product not passing through the sieve) must be included in the product volume.

   Shake the measuring container with a rotary motion at one rotation per second for 5 seconds. Do not lift the measuring container when rotating it. If the package contents are greater than the measuring container capacity, level the measuring container with a straight edge using a zigzag motion across the top of the container. Empty the container. Repeat the filling operations as many times as necessary, noting the partial fill of the container for the last quantity delivered using the interior horizontal markings as a guide. Record the total volume.

3. To compute each package error, subtract the labeled quantity from the total volume and record it.

Evaluation of Results

Follow the procedures in "Evaluating Results" in Chapter 2, Section 2.3 to determine lot conformance.

3.11 Mulch and Soils Labeled by Volume

What products are defined as mulch and soil?

- Mulch is defined as "any product or material except peat or peat moss that is advertised, offered for sale, or sold for primary use as a horticultural, above-ground dressing, for decoration, moisture control, weed control, erosion control, temperature control, or other similar purposes."

- Soil is defined as "any product or material, except peat or peat moss that is advertised or offered for sale, or sold for primary use as a horticultural growing media, soil amendment, and/or soil replacement."

What type of measurement equipment is needed to test packages of mulch and soil?

- A test measure appropriate for the package size that meets the specifications for test measures in Table 3-4.

Table 3-4. Specifications for Test Measures for Mulch and Soils

Nominal Volume of Test Measure	Interior Wall Dimensions*			Marked Intervals on Interior Walls ***	Volume Equivalent of Marked Intervals
	Length	Width	Height**		
30.2 L (1.07 ft^3) for testing packages that contain less than 28.3 L (1 ft^3 or 25.7 dry qt)	20.32 cm (8 in)	20.32cm (8 in)	73.66 cm (29 in)	1.27 cm (1/2 in)	524.3 mL (32 in^3)
28.3 L (1 ft^3)	30.48 cm (12 in)	30.48 cm (12 in)	30.48 cm (12 in)	1.27 cm (1/2 in)	1 179.8 mL (72 in^3)
56.6 L (2 ft^3)	40.64 cm (16 in)	22.86 cm (9 in)	121.92 cm (48 in)	1.27 cm (1/2 in)	1 179.8 mL (72 in^3)
84.9 L (3 ft^3)	40.64 cm (16 in)	22.86 cm (9 in)	121.92 cm (48 in)	1.27 cm (1/2 in)	1 179.8 mL (72 in^3)

Measures are typically constructed of 1.27 cm (1/2 in) marine plywood. A transparent sidewall is useful for determining the level of fill, but must be reinforced if it is not thick enough to resist distortion. If the measure has a clear front, place the level gage at the back (inside) of the measure so that the markings are read over the top of the mulch.

Notes

* Other interior dimensions are acceptable if the test measure approximates the configuration of the package under test and does not exceed a base configuration of the package cross-section.

**The height of the test measure may be reduced, but this will limit the volume of the package that can be tested.

*** When lines are marked in boxes, they should extend to all four sides of the measure if possible to improve readability. It is recommended that a line indicating the MAV level also be marked to reduce the possibility of reading errors when the level of the mulch is at or near the MAV.

- Drop cloth/polyethylene sheeting for catching overflow of material.

- Level (at least 15 cm (6 in) in length).

How is it determined if the packages meet the package requirements?

Use the following procedure:

1. Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection, select a random sample, then, use the following procedure to determine lot conformance.

2. Open each package in turn. Empty the contents of the package into a test measure and level the contents by hand. Do not rock, shake, drop, rotate, or tamp the test measure. Read the horizontal marks to determine package net volume.

Note: Some types of mulch are susceptible to clumping and compacting. Take steps to ensure that the material is loose and free flowing when placed into the test measure. Gently roll the bag before opening to reduce the clumping and compaction of material.

3. Exercise care in leveling the surface of the mulch/soil and determine the volume reading from a position that minimizes errors caused by parallax.

How are package errors determined?

Determine package errors by subtracting the labeled volume from the package net volume in the measure. Record each package error.

Package Error = Package Net Volume Labeled Volume

Evaluation of Results

Follow the procedures in Chapter 2, Section 2.3., Evaluating Results to determine lot conformance.

Note: In accordance with Table 2-10., in Appendix A, apply an MAV of 5 % of the declared quantity to mulch and soil sold by volume. When testing mulch and soil with a net quantity in terms of volume, one package out of every 12 in the sample may exceed the 5 % MAV (e.g., one in a sample of 12 packages; two in a sample of 24 packages; four in a sample of 48 packages.) However, the sample must meet the average requirement of the Category A Sampling Plan.

3.12 Ice Cream Novelties

Note: The following procedure can be used to test packaged products that are solid or semisolid and that will not dissolve in, mix with, absorb, or be absorbed by the fluid into which the product will be immersed. For example, ice cream labeled by volume can be tested using ice water or kerosene as the immersion fluid.

How are ice cream novelties inspected to see if the labeled volume meets the package requirements?

Use the following volume displacement procedure that uses a displacement vessel specifically designed for ice cream novelties such as ice cream bars, ice cream sandwiches, or cones. The procedure determines the volume of the novelty by measuring the amount of water displaced when the novelty is submerged in the vessel. Two displacements per sample are required to subtract the volume of sticks or cups.

The procedure first determines if the densities of the novelties are the same from package to package (in the same lot) so that a gravimetric test can be used to verify the labeled volume. If a gravimetric procedure is used, compute an average weight for the declared volume from the first two packages and weigh the remainder of the sample. If the gravimetric procedure cannot be used, use the volume displacement procedure for all of the packages in the sample.

Equipment

- A scale that meets the requirements in Chapter 2, Section 2.2. Measurement Standards and Test Equipment.
- Volumetric measures

- Displacement vessel with dimensions that are appropriate for the size of novelties being tested. Figure 3-1., shows an example of a displacement vessel. It includes an interior baffle that reduces wave action when the novelty is inserted and the downward angle of the overflow spout reduces dripping. Other designs may be used.

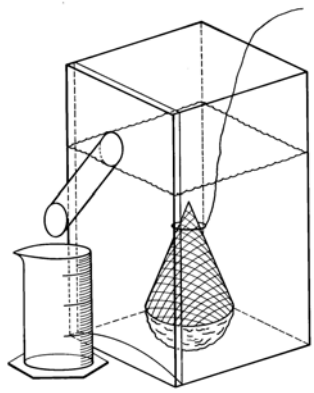


Figure 3-1. Example of a Displacement Vessel

Note: This displacement vessel can be constructed or similar devices may be obtained from any Laboratory Equipment or Science Education suppliers. The U.S. Department of Commerce does not endorse or recommend any particular device over similar commercially available products from other manufacturers.

- Thin wire, clamp, or tongs
- Freezer or ice chest and dry ice
- Single-edged razor or sharp knife (for sandwiches only)
- Ice water/kerosene maintained at 1 °C (33 °F) or below
- Indelible marker (for ice pops only)
- Level, at least 15.24 cm (6 in) in length
- A partial immersion thermometer (or equivalent) with a range of -1 °C to +50 °C (30 °F to 120 °F), at least 1 °C (1 °F) graduations, and with a tolerance of ±1 °C (±2 °F)
- A table-top, laboratory-type jack of sufficient size to hold the displacement vessel
- Stopwatch

Test Procedure

Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following procedure to determine lot compliance.

1. Maintain the samples at the reference temperature for frozen products that is specified in Table 3-1. Reference Temperatures for Liquids in this chapter [i.e., -18 °C (0 °F)]. Place the samples in the freezer or ice chest until they are ready to be tested, and then remove packages from the freezer one at a time.

2. According to the type of novelty, prepare the sample products as follows:

   - Ice-pop. Mark on the stick(s) with the indelible marker the point to which the pop will be submerged in the ice water. (After the ice-pop contents have been submerged, remove the novelty to determine the volume of the stick.)

   - Cone. Make a small hole in the cone below the ice cream portion to allow air to escape.

   - Sandwich. Determine whether the declared volume is (a) the total volume of the novelty (that is, including the cookie portion) or (b) the volume of the ice-cream-like portion only. If the declared volume is the volume of only the ice-cream-like portion, shave off the cookie with a razor or knife, leaving some remnants of cookie to ensure that no ice cream is accidentally shaved off. Work quickly, and return the novelty to the freezer before the sandwich softens.

   - Cup. Remove the cap from the cup. (After the cup and novelty contents have been submerged, remove the novelty from the cup to determine the volume of the cup.)

How is it determined if the ice cream novelty packages meet the requirements in this handbook?

1. Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following procedure to determine lot compliance.

2. Fill the displacement vessel with ice water until it overflows the spout. Allow it to sit until dripping stops. Raise the displacement vessel as necessary and place the graduate beneath the spout.

3. Remove a package from the freezer, determine its gross weight and record it.

4. Submerge the novelty as suggested until it is below the surface level of the water.

   - Ice-pop. Use a clamp, tongs, or your fingers to hold the stick(s) and submerge the pop to the level marked in Step 2 of the Test Procedures.

   - Cone. Shape the wire into a loop, and use it to push the cone, headfirst (ice cream portion first) into the ice water. Do not completely submerge the cone immediately: let water fill the cone through the hole made in Step 2 of the Test Procedures before completely submerging the novelty.

   - Sandwich or cup. Skewer the novelty with the thin wire or form a loop on the end of the wire to push the sandwich or ice-cream-portion or cup completely below the liquid level.

5. Record the total water volume in the graduate. For a cone or sandwich, record the water volume as the net volume and go to step (7). For ice-pops or cups, record the water volume in the graduate as the gross volume and go to step (6).

6. Refill the displacement vessel with water to overflowing and reposition the empty graduate under the spout.

   - Ice-pop. Melt the ice pop off the stick or sticks. Submerge the stick or sticks to the line marked in step (4). Record the volume of tare material (i.e., stick) by measuring the water displaced into the graduate. The net volume for the ice-pop is the gross volume recorded in step (5) minus the volume of the tare materials in this step. Record this volume as the "volume of novelty." To determine the error in the package, subtract the labeled quantity from the volume of novelty.

   - Cup. Remove the novelty from the cup. Rinse the cup, and then submerge it in the displacement vessel. Small pinholes in the base of the cup can be made to make submersion easier. Record the volume of water displaced into the graduate by the cup as the volume of tare material. The net volume for the novelty is the gross volume determined in step (5) minus the volume of the tare materials determined in

this step. Record this as the net volume of the novelty. To determine the error in the package, subtract the labeled quantity from the volume of novelty.

7. Clean and air-dry the tare materials (sticks, wrappers, cup, lid, etc.). Weigh and record the weight of these materials for the package.

8. Subtract the tare weight from the gross weight to obtain the net weight and record this value.

9. Compute the weight of the labeled volume for the package using the following formula and then record the weight:

Product Density = (weight in item 3) ÷ (the total water volume in item 5)
Weight of labeled volume = (labeled volume) x (Product Density)

10. Repeat steps (3) through (9) for a second package.

11. If the weight of the labeled volume in steps (9) and (10) differ from each other by more than one division on the scale, the gravimetric test procedure cannot be used to test the sample for compliance. If this is the case, steps (2) through (6) for each of the remaining packages in the sample must be used to determine their net volumes and package errors. Then go to evaluation of results.

How is "nominal gross weight" determined?

1. Determine the Average Used Dry Tare Weight of the sample according to provisions in Chapter 2, Section 2.3.

2. Using the weights determined in step (11) calculate the Average Product Weight by adding the densities of the liquid from the two packages and dividing the sum by two.

3. Calculate the "nominal gross weight" using the formula:

Nominal Gross Weight = Average Product Weight + Average Used Dry Tare Weight

How are the errors in the sample determined?

1. Weigh the remaining packages in the sample.

2. Subtract the nominal gross weight from the gross weight of each package to obtain package errors in terms of weight.

Note: Compare the sample packages to the nominal gross weight.

3. Follow the Basic Test Procedure in Section 2.3.

To convert the average error or package error from weight to volume, use the following formula:

Package Error in Volume = (Package Error in Weight) ÷ (Product Density)

Evaluation of Results

Follow the procedures in Chapter 2, Section 2.3., Evaluating Results to determine lot conformance.

3.13 Fresh Oysters Labeled by Volume

What requirements apply to packages of fresh oysters labeled by volume?

Packaged fresh oysters removed from the shell must be labeled by volume. The maximum amount of permitted free liquid is limited to 15 % by weight. Testing the quantity of contents of fresh oysters requires the inspector to determine total volume, total weight of solids and liquid, and the weight of the free liquid.

Equipment

- A scale that meets the requirements in Chapter 2, Section 2.2 Measurement Standards and Test Equipment
- Volumetric measures
- Micrometer depth gage (ends of rods fully rounded), 0 mm to 228 mm (0 in to 9 in)
- Strainer for determining the amount of drained liquid from shucked oysters. Use as a strainer a flat bottom metal pan or tray constructed to the following specifications:
    - Sides: 5.08 cm (2 in)
    - Area: 1,935 cm^2 (300 in^2) or more for each 3.78 L (1 gal) of oysters
    - Perforations:
      Diameter: 6.35 mm (1/4 in)
      Location: 3.17 cm (1 1/4 in) apart in a square pattern, or perforations of equivalent area and distribution.
- Spanning bar, 2.54 cm by 2.54 cm by 30.48 cm (1 in by 1in by 12 in)
- Rubber spatula
- Level, at least 15.24 cm (6 in) in length
- Stopwatch

How is it determined if the containers meet the package requirements?

Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then, use the following test procedure to determine lot compliance.

1. Determine and record the gross weight of a sample package.
2. Set the container on a level surface and open it. Use a depth gage to determine the level of fill. Lock the depth gauge. Mark the location of the gauge on the package.
3. Weigh a dry 20.32 cm or 30.48 cm (8 in or 12 in) receiving pan and record the weight. Set strainer over the receiving pan.
4. Pour the contents from the container onto the strainer without shaking it. Tip the strainer slightly and let it drain for 2 minutes. Remove strainer with oysters. It is normal for oysters to include mucous (which is part of the

product) that will not pass through the strainer, so do not force it.

5. Weigh the receiving pan and liquid and record the weight. Subtract the weight of the dry receiving pan from the weight of pan and liquid to obtain the weight of free liquid and record the value.

6. Clean, dry, and weigh the container and record the tare weight. Subtract the tare weight from the gross weight to obtain the total weight of the oysters and liquid and record this value.

7. Determine and record the percent of free liquid by weight as follows:

   Percent of free liquid by weight = [(weight of free liquid) ÷ (weight of oysters + liquid)] x 100.

8. Set up the depth gauge on the dry package container as in step 2. Pour water from the flasks and graduate as needed to re-establish the level of fill obtained in step 2. Add the volumes delivered as the actual net volume for the container and record the value.

Note: Some containers will hold the declared volume only when filled to the brim; they may have been designed for other products, rather than for oysters. If the net volume is short-measure (per step 8), determine if the container will reach the declared volume only if filled to the brim. Under such circumstance, the package net volumes will all be short measure because the container cannot be filled to the brim with a solid and liquid mixture. A small headspace is required in order to get the lid into the container without losing any liquid.

Evaluation of Results

Follow the procedures in "Evaluating Results" in Chapter 2, Section 2.3, to determine lot conformance.

3.14 Determining the Net Contents of Compressed Gas in Cylinders

What type of compressed gases may be tested with these procedures?

These procedures are for industrial compressed gas. Compressed gas may be labeled by weight (for example, Liquefied Petroleum [LP] gas, or carbon dioxide) or by volume. Acetylene, liquid; oxygen, nitrogen, nitrous oxide, and argon are all filled by weight. Acetylene is sold by liters or by cubic feet. Helium, gaseous oxygen, nitrogen, air, and argon are filled according to pressure and temperature tables.

What type of test procedures must be used?

Checking the net contents of compressed gas cylinders depends on the method of labeling; those labeled by weight are generally checked by weight. Cylinders filled by using pressure and temperature charts must be tested using a pressure gauge that is connected to the cylinder. Determine the volume using the pressure and temperature of the cylinder.

Should any specific safety procedures be followed?

Yes, be aware of the hazards of the high pressure found in cylinders of compressed gas. An inspector should handle compressed gas only if the inspector has been trained and is knowledgeable regarding the product, cylinder, fittings, and proper procedures (see *Compressed Gas Association [CGA] pamphlet P-1, "Safe Handling of Compressed Gases in Containers*," for additional information). Additional precautions that are necessary for personal safety are described in the CGA Handbook of Compressed Gases. All personnel testing compressed gases should have this manual for reference and be familiar with its contents. It is essential that the inspector be certain of the contents before connecting to the cylinder. Discharging a gas or cryogenic liquid through a system for which the material is not intended could result in a fire and/or explosion or property damage due to the incompatibility of the system and the product. Before connecting a cylinder to anything, be certain of the following:

- Always wear safety glasses.

- The cylinder is clearly marked or labeled with the correct name of the contents and that no conflicting marks or labels are present. Do not rely on the color of the cylinder to identify the contents of a cylinder. Be extremely careful with all gases because some react violently when mixed or when coming in contact with other substances. For example, oxygen reacts violently when it comes in contact with hydrocarbons.

- The cylinder is provided with the correct Compressed Gas Association (CGA) connection(s) for the product. A proper connection will go together smoothly; so excessive force should not be used. Do not use an adapter to connect oxygen to non-oxygen cleaned equipment. When a cylinder valve is opened to measure the internal pressure, position the body away from the pressure gauge blowout plug or in front of the gauge if the gauge has a solid cast front case. If the bourdon tube should rupture, do not be in a position to suffer serious injuries from gas pressure or fragments of metal.

- Thoroughly know the procedure and place emphasis on safety precautions before attempting any tests. Do not use charts referred to in the procedure until the necessary training has been completed. When moving a cylinder, always place the protective cap on the cylinder. Do not leave spaces between cylinders when moving them. This can lead to a “domino" effect if one cylinder is pushed over.

- Open all valves slowly. A failure of the gauge or other ancillary equipment can result in injuries to nearby persons. Remember that high gas pressure can propel objects with great force. Gas ejected under pressure can also cause serious bodily injuries if someone is too close during release of pressure.

- One of the gauges will be reserved for testing oxygen only and will be prominently labeled “For Oxygen Use Only.” This gauge must be cleaned for oxygen service and maintained in that “clean” condition. The other gauge(s) may be used for testing a variety of gases if they are compatible with one another.

- Observe special precautions with flammable gas in cylinders in addition to the several precautions necessary for the safe handling of any compressed gas in cylinders. Do not “crack” cylinder valves of flammable gas before connecting them to a regulator or test gauge. This is extremely important for hydrogen or acetylene.

What type of measurement equipment is needed to test cylinders of compressed gas?

- Use a scale that meets the requirements in Chapter 2, Section 2.2 Measurement Standards and Test Equipment. Use a wooden or non-sparking metal ramp to roll the cylinders on the scale to reduce shock loading.

- Two calibrated precision bourdon tube gauges or any other approved laboratory-type pressure-measuring device that can be accurately read within plus or minus 40 kPa (5 psi). A gauge having scale increments of 200 kPa (25 psi) or smaller shall be considered as satisfactory for reading within plus or minus 40 kPa (5 psi). The range of both gauges shall be a minimum of 0 kPa to 23 MPa (0 psi to 5 000 psi) when testing cylinders using standard industrial cylinder valve connections. These standardized connections are listed in “CGA Standard V-1, Standard for Compressed Gas Cylinder Valve Outlet and Inlet for use with Gas Pressures up to 21 MPa (3 000 psi).” For testing cylinders with cylinder valve connections rated for over 21 MPa (3 000 psi), the test gauge and its inlet connection must be rated at 14 MPa (2 000 psi) over the maximum pressure that the connection is rated for in CGA V-1. Note: there are standard high-pressure industrial connections on the market that are being used up to their maximum pressure of 52 MPa (7 500 psi).

Note: Any gauge or connectors used with oxygen cylinders must be cleaned for oxygen service, transported in a manner which will keep them clean, and never used for any other gas including air or oxygen mixtures. Oxygen will react with hydrocarbons and many foreign materials that may cause a fire or explosion.

- An approved and calibrated electronic temperature measuring device or three calibrated mercury-in-glass thermometers having either a digital readout or scale division of no more than 1 ^{o}F (0.5 °C). The electronic device equipped with a surface temperature sensor is preferred over a mercury-in-glass thermometer because of its shorter response time.

- Two box-end wrenches of 29 mm (1 1/8 in) for oxygen, nitrogen, carbon dioxide, argon, helium, and hydrogen and 22 mm (7/8 in) for some sizes of propane. All industrial CGA connections are limited to these two hex sizes. Avoid using an adjustable wrench because of the tendency to round the edges of the fittings, which can lead to connections not being tightened properly.

- Use a separate gauge and fitting for each gas to be tested. If adapters must be used, do not use on oxygen systems.

Test Procedure for Cylinders Labeled by Weight

How is it determined if the containers meet the package requirements using the gravimetric test procedure?

1. Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following test procedure to determine lot compliance.

2. The cylinder should be marked or stenciled with a tare weight. The marked value may or may not be used by the filling plant when determining the net weight of those cylinders sold or filled by weight. If there is a tare weight marked on the net contents tag or directly on the cylinder, then an actual tare weight was determined at the time of fill. If there is no tare weight marked on a tag or on the cylinder, then the stamped or stenciled tare weight is presumed to have been used to determine the net contents.

Note: Check the accuracy of the stamped tare weights on empty cylinders whenever possible. The actual tare weight must be within (a) 1/2 % of the stamped tare weight for 9.07 kg (20 lb) tare weights or less or (b) 1/4 % of the stamped tare weight for greater than 9.07 kg (20 lb) tare weights. (See NIST Handbook 130, Section 2.16, "Method of Sale Regulation.")

3. Place cylinder on scale and remove protective cap. The cap is not included in the tare weight.

   Weigh the cylinder and determine net weight, using either the stamped or stenciled tare weight, or the tare weight marked on the tag. Compare actual net weight with labeled net weight, or use the actual net weight to look up the correct volume declaration (For Acetylene Gas), and compare that with the labeled volume.

Note: The acetone in acetylene cylinders is included in the tare weight of the cylinder. Therefore, as acetylene is withdrawn from the cylinder, some acetone will also be withdrawn, changing the tare weight.

Most producers will replace acetone in the cylinder before the cylinder is refilled, filling the cylinder with acetone to the stamped tare weight. Other producers, although not following recommended procedures, do not replace the acetone until it drops to a predetermined weight. In the latter situation, the refilling plant must note the actual tare weight of the cylinder and show it on the tag containing the net content statement or on the cylinder itself. Refer to tables for acetylene if necessary (if the acetylene is labeled by volume).

Test Procedure for Cylinders Labeled by Volume

How is it determined if the containers meet the package requirements using the volumetric test procedure?

1. Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following test procedure to determine lot compliance.

2. Determine the temperature of the cylinders in the sample. Place the thermometer approximately halfway up a cylinder in contact with the outside surface. Take the temperature of three cylinders selected at random and use the average temperature of the three values.

3. Using the appropriate pressure gauge, measure the pressure of each cylinder in the sample.

4. Determine the cylinder nominal capacity from cylinder data tables or from the manufacturer. (These tables must be obtained in advance of testing.)

5. Using NIST Technical Note 1079 "Tables of Industrial Gas Container Contents and Density for Oxygen, Argon, Nitrogen, Helium, and Hydrogen" determine the value (SCF/CF) from the content tables at the temperature and pressure of the cylinder under test.

6. Multiply the cylinder nominal capacity by the value (SCF/CF) obtained from the content tables. This is the actual net quantity of gas.

7. Subtract the labeled net quantity from the actual net quantity to determine the error.

Evaluation of Results

Follow the procedures in "Evaluating Results" in Chapter 2, Section 2.3 to determine lot conformance.

3.15 Volumetric Test Procedure for Packaged Firewood with a Labeled Volume of 113 L (4 Ft^3) or Less

How are packages of firewood tested?

Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample, then use the test procedure provided in Section 3.17 to determine lot compliance.

Equipment

- Linear Measure. Take all measurements in increments of 0.5 cm (3/16 in) or less and round up.

- Binding Straps. Binding Straps are used to hold wood bundles together if the bundles need to be removed from the package/wrapping material.

How is it determined if the containers meet the package requirements?

Unless otherwise indicated, take all measurements without rearranging the wood or removing it from the package. If the layers of wood are crosshatched or not ranked in discrete sections in the package, remove the wood from the package re-stack and measure accordingly.

3.16 Boxed Firewood

How is the volume of firewood contained in a box determined?

Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following test procedure to determine lot conformance.

1. Open the box to determine the average height of wood within the box; measure the internal height of the box. Take three measurements (record as "d_1, d_2...etc.") along each end of the stack. Measure from the bottom of a straight edge placed across the top of the box to the highest point on the two outermost top pieces of wood and the center-most top piece of wood. Round measurements down to the nearest 0.5 cm (1/8 in). If pieces are obviously missing from the top layer of wood, take additional height measurements at the highest point of the uppermost pieces of wood located at the midpoints between the three measurements on each end of the stack. Calculate the average height of the stack by averaging these measurements and subtracting from the internal height of the box according to the following formula.

   Average Height of Stack = (Internal Height of Box) – (sum of measurements) ÷ (number of measurements)

2. Determine the average width of the stack of wood in the box by taking measurements at three places along the top of the stack. Measure the inside distance from one side of the box to the other on both ends and in the middle of the box. Calculate the average width.

   $$\text{Average Width} = (W_1 + W_2 + W_3) \div (3)$$

3. To determine the average length of the pieces of wood, remove the wood from the box and select the five pieces with the greatest girth. Measure the length of each of the five pieces from center-to-center. Calculate the average length of the five pieces.

   $$\text{Average Length} = (L_1 + L_2 + L_3 + L_4 + L_5) \div (5)$$

4. Calculate the volume of the wood within the box. Use dimensions for height, width, and length.

   Volume in liters = (height in cm x width in cm x length in cm) ÷ (1 000)

   Volume in cubic feet = (height in inches x width in inches x length in inches) ÷ (1 728)

5. For boxes of wood that are packed with the wood ranked in two discrete sections perpendicular to each other, calculate the volume of wood in the box as follows: (1) determine the average height, width, and length as in 1, 2 and 3 above for each discrete section, compute total volume, and (2) total the calculated volumes of the two sections. Take the width measurement for Volume 2 (V_2) from the inside edge of the box adjacent to V_2 to the plane separating V_1 and V_2. Compute total volume by adding Volume 1 (V_1) and V_2 according to the following formula.

   $$\text{Total Volume} = V_1 + V_2$$

6. Follow the procedures in Chapter 2, Section 2.3., Evaluating Results to determine lot conformance.

3.17 Crosshatched Firewood

How must the volume of stacked or crosshatched firewood be measured?

Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; and use the following test procedure to determine lot compliance.

1. Stack the firewood in a ranked and well-stowed geometrical shape that facilitates volume calculations (i.e., rectangular). The number of measurements for each dimension given below is the minimum that should be taken.

2. Determine the average measurements of the stack:

   - Height: Start at one end of the stack; measure the height of the stack on both sides at four equal intervals. Calculate and record the average height.

   - Length: Start at the base of the stack; Measure the length of the stack in four equal intervals. Calculate and record the average length.

   - Width: Select the five pieces with the greatest girth. Measure the length of the pieces, calculate and record the average piece length. (3)

     Calculate Volume:

     Volume in liters = (Avg. Height [cm] x Avg. Width [cm] x Avg. Length in [cm]) ÷ 1 000

     Volume in cubic feet = (Avg. Height [in] x Avg. Width [in] x Avg. Length [in]) ÷ 1 728

3. Follow the procedures in Chapter 2, Section 2.3., Evaluating Results to determine lot conformance.

3.18 Bundles and Bags of Firewood

How is the volume of bundles and bags of firewood measured?

Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following test procedure to determine lot compliance.

1. Average area of ends: secure a strap around each end of the bundle or bag of wood to prevent movement during testing and to provide a definite perimeter. Use two or more straps to secure the wood.

2. Set one end of the bundle or bag on tracing paper large enough to cover the end completely. Draw a line around the perimeter of the bundle or bag on the tracing paper.

3. Transfer the tracing paper to a template graduated in square centimeters or square inches. Count the number of square centimeters or square inches that are enclosed within the perimeter line. Estimate portions of square centimeters or square inches not completely within the perimeter line to the nearest one-quarter square inch.

4. Repeat this process on the opposite end of the bundle or bag.

5. Calculate the Average Area.

$$\text{Average Area} = (\text{Area 1} + \text{Area 2}) \div 2$$

6. Average length of the pieces of wood: select the five pieces with the greatest girth and measure the length of the pieces. Calculate the average length of the pieces of wood:

$$\text{Average Length} = (L_1 + L_2 + L_3 + L_4 + L_5) \div 5$$

7. Calculate Volume:

$$\text{Volume in liters} = (\text{Average Area } [cm^2] \times \text{Average Length } [cm]) \div 1\,000$$

$$\text{Volume in cubic feet} = (\text{Average Area } [in^2] \times \text{Average Length } [in]) \div 1\,728$$

Evaluation of Results

Follow the procedures in Chapter 2, Section 2.3., Evaluating Results to determine lot conformance.

Note: Specified in Table 2-10., Appendix A, maximum allowable variations for individual packages are not applied to packages of firewood.

Chapter 4. Test Procedures – Packages Labeled by Count, Linear Measure, Area, Thickness, and Combinations of Quantities

4.1 Scope

What types of packaged goods can be tested using these procedures?

Use these procedures to determine the net contents of products sold by count, area, thickness, and linear measure. If a package includes more than one declaration of quantity, each declaration must meet the package requirements.

Can the gravimetric test procedure be used to verify the net quantity of contents of packages labeled by count and linear measure?

Use the gravimetric procedure to test products sold by measure or count if the density of the product does not vary excessively from one package to another.

What procedures may be used if the gravimetric test procedure cannot be used?

Open each package in the sample and measure or count the items.

4.2 Packages Labeled by Count

How are packages tested labeled by count?

If the labeled count, is 50 items or less, use Section 4.3. If the labeled count is, more than 50 items see Section 4.4.

Can a gravimetric test procedure be used to verify the labeled count of a package?

Yes, if the scale being used is sensitive enough to determine the weight of individual items. Use the following procedures to determine if the sample packages can be tested gravimetrically.

1. For packages labeled with a count of 84 or higher, calculate the weight equivalent for the MAV/6 for the labeled count of the package. MAV/6 must be at least equal to one-half scale division on a mechanical scale or one division on a digital scale.

2. For packages with a labeled count of 83 or fewer, when each unit weighs at least 2 scale divisions, consider the scale acceptable.

   Example: According to Table 2-7., in Appendix A, the MAV is 7 for a package labeled with a count of 250 items. The scale should be capable of measuring differences corresponding to MAV/6 or, in this example, the weight of one item.

   - If the scale meets the appropriate requirement, gravimetric testing can be used to determine package count or,

   - If the scale does not meet the criteria, count the content in each package in the sample.

4.3 Packages Labeled with 50 Items or Less

Test Procedure

1. Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following test procedure to determine lot compliance.

2. Open the packages and count the number of items in each. Record the number of packages that contain less than the labeled count.

Evaluation of Results

1. For the sample size indicated in Column 1 of Table 2-11., Accuracy Requirements for Packages Labeled by Low Count of (50 or less), refer to Column 2 to determine the number of packages that are allowed to contain less than the labeled count.

2. If the number of packages in the sample that contain less than the labeled count exceeds the number permitted in Column 2, the sample and the lot fail to meet the package requirement.

Note: For statistical reasons, the average requirement does not apply to packages labeled by count of 50 or fewer items, and the MAV does not apply to the lot. It only applies to the packages in the sample.

3. Maximum Allowable Variations: The MAVs listed in Table 2-7., MAVs for Packages Labeled by Count define the limits of reasonable variation for an individual package even though the MAV is not directly used in the sampling plan. Individual packages that are undercount by more than the MAV are considered defective. Even if the sample passes, these should be repacked, relabeled, or otherwise handled.

   Example: If testing a lot of 160 packages of pencils labeled "50 pencils," choose a random sample of 12 packages from the lot. If the scale cannot discriminate between differences in count, open every package and count the pencils. For example, assume the 12 package counts are: 50, 52, 50, 50, 51, 53, 52, 50, 50, 50, 47, and 50.

   Because only one package contains fewer than 50 pencils, the sample passes the test (Refer to Table 2-11.). However, the package containing 47 pencils should not be introduced into commerce even though the lot complies with the package requirements because it is undercount by more than the MAV (1 item) permitted in Table 2-7.

4.4 Packages Labeled by Count of More than 50 Items

Test Procedures

There are two procedures to determine count without opening all packages in the sample. Both use the weight of a counted number of items in the package. If the weight of discrete items or numbers of items in a package varies, the packaged items must be counted rather than weighed.

Equipment

Use a scale that meets the requirements in Chapter 2, Section 2.2, Measurement Standards and Test Equipment.

Audit Procedure

Use this procedure to audit lots of packages labeled by count of more than 50 items, but the precision of this procedure is only ± 1 %. Determine the lot compliance based on actual count or the violation procedure.

1. Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following test procedure to determine lot compliance.

2. Select an initial tare sample according to Chapter 2, Section 2.3.

3. Gross weigh the first package in the tare sample and record this weight.

4. Select the number of items from the first tare package that weighs the greater:

   - 10 % of the labeled count; or

   - a quantity equal to at least 50 minimum divisions on the scale.

   Example: Using a scale with 1 g divisions, the selected count must weigh at least 50 grams. If a scale with 0.001 lb divisions is used, the selected count must weigh at least 0.05 lb. Record the count and weight.

5. Calculate the weight of the labeled count using the following formula:

   Weight of the Labeled Count = (labeled count x weight of items in step [4]) ÷ (count of items in step [4])

   Record the result as "labeled count weight."

6. Gross weigh the remaining packages of the tare sample and keep contents of opened packages separated in case all of the items must be counted.

7. Determine the Average Used Dry Tare Weight of the sample according to Chapter 2, Section 2.3.

8. The weight of the labeled count plus the average tare weight represents the "nominal gross weight."

9. Subtract the nominal gross weight from the gross weight of the individual packages and record the errors.

(Package error [weight]) = (actual package gross weight) (nominal gross weight)

10. Convert the package errors in units of weight to count:

    Package error (count) = (Package error [weight] x labeled count) ÷ (labeled count weight)

Round any fractional counts up to whole items in favor of the packager. Record the package error in units of count. Compute the average error.

- If the average error is minus, go to the "procedure to use if the inspector suspects the lot violates the package requirements" below

- If the average error is zero or positive, the sample is presumed to conform to the package requirements.

Procedures to use if the inspector suspects the lot violates the package requirements

If possible, use the gravimetric procedure to determine compliance. To minimize the number of packages to be opened, combine the measurement of the weight of the number of units in the package with the determination of tare.

Therefore, it will not be necessary to open more packages than the tare sample. If the audit procedure in this section has been used, the possible violation procedure below can be followed with the same sample if package contents have been kept separate and can still be counted. Use the following steps to determine if the sample passes or fails.

1. Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following test procedure to determine lot compliance. Use a scale that meets the criteria specified in 4.2.

2. Select an initial tare sample according to Chapter 2, Section 2.3.

3. Gross weigh the packages selected for the tare sample and record these weights. Open these packages and determine the tare and net weights of the contents, and count the exact number of items in the packages. Record this information.

4. Calculate and record the weights of the labeled counts for the first two packages using the formula:

   Weight of labeled count = (labeled count) x (contents weight ÷ contents count)

To avoid round off errors, carry at least two extra decimal places in the calculation until the weight of the labeled count is obtained. To use the gravimetric procedure, the difference in weights of the labeled counts of the two packages must not exceed one scale division.

- If the difference in weights exceeds this criterion, determine the actual count per package for every package in the sample recording plus and minus errors. Then, follow the procedures in "Evaluating Results" in Chapter 2, Section 2.3, to determine lot conformance.

- If the difference is within the criterion, average the weights of the labeled count and go on to step (5).

5. Determine the Average Used Dry Tare Weight of the sample according to provisions in Chapter 2, Section 2.3.

6. Determine and record the nominal gross weight by adding the average weight of the labeled count of items in the package step (4) to the average tare weight step (5).

7. Weigh the remaining packages in the sample, subtract the nominal gross weight from the gross weight of the individual packages, and record the errors.

   Package Error (weight) = (Actual Package Gross Weight) (Nominal Gross Weight)

8. Look up the MAV for the package size from Table 2-7. and convert it to weight using the formula:

   MAV (weight) = (MAV (count) x Avg. Wt. of Labeled Count step [4]) ÷ (Labeled Count)

Convert the MAV to dimensionless units by dividing the MAV (weight) by the unit of measure and record.

Evaluation of Results

Follow the procedures in Chapter 2, Section 2.3., Evaluation Results to determine lot conformance.

Convert back to count when completing the report form using the following formula:

Avg. Pkg. Error (count) = (Avg. Pkg. Error [dimensionless units]) x (Unit of Measure) x (Labeled Count) ÷ (Avg. Weight of Labeled Count.)

4.5 Paper Plates and Sanitary Paper Products

How are the labeled dimensions of paper plates and sanitary paper products verified?

Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following procedure to determine lot compliance.

The following procedures are used to verify the size of paper plates and other products. The following procedure may be used to verify the size declarations of other disposable dinnerware.

Note: Do not distort the item's shape during measurement.

The count of sanitary paper products cannot be adequately determined by weighing. Variability in sheet weight and core weight requires that official tests be conducted by actual count. However, weighing can be a useful audit method. These products often declare total area as well as unit count and sheet size. If the actual sheet size measurements and the actual count comply with the average requirements, the total area declaration is assumed correct.

Equipment

- Steel tapes and rules. Determine measurements of length to the nearest division of the appropriate tape or rule.
  - Metric Units:

    For labeled dimensions 40 cm or less, Linear Measure: 30 cm in length, 1 mm divisions; or a 1 m rule with 0.1 mm divisions, overall length tolerance of 0.4 mm.

    For labeled dimensions greater than 40 cm, 30 m tape with 1 mm divisions.

  - Inch pound Units:

    For labeled dimensions 25 in or less, use a 36 in rule with 1/64 in or 1/100 in divisions and an overall length tolerance of 1/64 in.

    For dimensions greater than 25 in, use a 100 ft tape with 1/16 in divisions and an overall length tolerance of 0.1 in.

- Measuring Base

Note: A measuring base may be made of any flat, sturdy material approximately 38 cm (15 in) square. Two vertical side pieces approximately 3 cm (1 in) high and the same length as the sides of the measuring base are attached along two adjoining edges of the measuring base to form a 90° corner. Trim all white borders from two or more sheets of graph paper (10 divisions per centimeter or 20 divisions per inch). Place one sheet on the measuring base and position it so that one corner of graph paper is snug in the corner of the measuring base and vertical sides. Tape the sheet to the measuring base. Overlap other sheets on the first sheet so that the lines of top and bottom sheet coincide, expanding the graph area to a size bigger than plates to be measured; tape these sheets to the measuring base. Number each line from the top and left side of base plates: 1, 2, 3, etc.

How are paper products inspected?

1. Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following test procedure to determine lot compliance.

2. Select an initial tare sample according to Chapter 2, Section 2.3.

3. Open each package and select one item from each.

Note: Some packages of plates contain a combination of different-sized plates. In this instance, take a plate of each declared size from the package to represent all the plates of that size in the package. For example, if three sizes are declared, select three different plates from each package.

How are paper products measured?

Note: Occasionally, packages of plates declared to be one size contain plates that can be seen by inspection to be of different sizes in the same package. In this instance, select the smallest plate and use the methods below to determine the package error. If the smallest plate is not short measure by more than the MAV, measure each size of plate in the package and calculate the average dimensions.

> **Example:** If 5 plates measure 21.41 cm (8.43 in) and 15 measure 21.74 cm (8.56 in), the average dimension for this package of 20 plates is 21.66 cm (8.53 in).

4. For paper plates: place each item on the measuring base plate (or use the linear measure) with the eating surface down so two sides of the plate touch the sides of the measuring base. For other products, use either the measuring base or a linear measure to determine actual labeled dimensions (e.g., packages of napkins, rolls of paper towels). If testing folded products, be sure that the folds are pressed flat so that the measurement is accurate.

5. If the measurements reveal that the dimensions of the individual items vary, select at least 10 items from each package. Measure and average these dimensions. Use the average dimensions to determine package error in step 5 below.

6. The package error equals the actual dimensions minus the labeled dimensions.

Evaluation of Results

Follow the procedures in Chapter 2, Section 2.3., Evaluating Results to determine lot conformance.

4.6 Special Test Requirements for Packages Labeled by Linear or Square Measure (Area)

Are there special measurement requirements for packages labeled by dimensions?

Yes, products labeled by length (such as yarn) or area often requires the application of tension to the ends of the product in order to straighten the product before measuring. When testing yarn and thread apply tension and use the specialized equipment specified in ASTM D 1907-97, “Standard Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method,” in conjunction with the sampling plans and package requirements described in this handbook.

Evaluation of Results

Follow the procedures in Chapter 2, Section 2.3., Evaluating Results to determine lot conformance.

4.7 Polyethylene Sheeting

Which procedures are used to verify the declarations on polyethylene sheeting and bags?

Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following test procedure to determine lot compliance.

Note: Most polyethylene products are sold by length, width, thickness, area, and net weight.

Equipment

- A scale that meets the requirements in Chapter 2, Section 2.2., Measurement Standards and Test Equipment.
- Steel measuring tapes and rules as specified in 4.5.
- Deadweight dial micrometer (or equal) equipped with a flat anvil, 6.35 mm or (1/4 in) diameter or larger, and a 4.75 mm (3/16 in) diameter flat surface on the head of the spindle. The anvil and spindle head surfaces should be ground and lapped, parallel to within 0.002 mm (0.0001 in), and should move on an axis perpendicular to their surfaces. The dial spindle should be vertical, and the dial should be at least 50.8 mm (2 in) in diameter. The dial indicator should be continuously graduated to read directly to 0.002 mm (0.00-01 in) and should be capable of making more than one revolution. It must be equipped with a separate indicator to indicate the number of complete revolutions. The dial indicator mechanism should be fully jeweled. The frame should be of sufficient rigidity that a load of 1.36 kg (3 lb) applied to the dial housing, exclusive of the weight or spindle presser foot, will not cause a change in indication on the dial of more than 0.02 mm (0.001 in). The indicator reading must be repeatable to 0.001 2 mm (0.000 05 in) at zero. The mass of the probe head (total of anvil, weight 102 g or [3.6 oz], spindle, etc.) must be 113.4 g (4 oz). The micrometer should be operated in an atmosphere free from drafts and fluctuating temperature and should be stabilized at ambient room temperature before use.
- Gage blocks covering the range of thicknesses to be tested should be used to check the accuracy of the micrometer
- T-square

Test Procedure

1. Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following test procedure to determine lot compliance.

2. Be sure the product is not mislabeled. Check the label declaration to confirm that all of the declared dimensions are consistent with the required standards. The declaration on sheeting, film, and bags shall be equal to or greater than the weight calculated by using the formulas below. Calculate the final value to four digits and declare to three digits dropping the final digit (e.g., if the calculated value is 2.078 lb, then the declared net weight is truncated to 2.07 lb).

Example Label:

Polyethylene Sheeting
1.82 m (6 ft) x 30.48 m (100 ft)
101.6 µm (4 mil)
5.03 kg (11.1 lb)

3. Use the following formulas to compute a target net weight. The labeled weight should equal or exceed the target net weight or the package is not in compliance.

   - For metric dimensions:

     Target Mass in Kilograms = (T x A x D) ÷ 1,000

     Where: T = nominal thickness in centimeters

     A = nominal length in centimeters x nominal width (the nominal width for bags is twice the labeled width) in centimeters

     D = density in grams per cubic centimeter*

   - For inch-pound dimensions:

     Target Weight in Pounds = T x A x D x 0.036 13

     Where: T = nominal thickness in inches;

     A = nominal area; that is the nominal length in inches x nominal width (the nominal width for bags is twice the labeled width) in inches;

     D = density in grams per cubic centimeter; 0.036 13 is a factor for converting $^{g}/_{cm^3}$ to $^{lb}/_{in^3}$.

*Determined by ASTM Standard D 1505-98, "Standard Method of Test for Density of Plastics by the Density Gradient Technique." For the purpose of this handbook, the minimum density shall be 0.92 g/cm^3 when the actual density is not known.

Evaluation

1. Perform the calculations as shown in the following samples. If the product complies with the label declaration, go to step (2).

   Sample Calculations

   - For metric units:

     (0.010 16 cm x [(1.82 m x 100 $^{cm}/_{m}$) x (30.48 m x 100 $^{cm}/_{m}$)] x 0.92 $^{g}/_{cm^3}$) ÷ 1,000 $^{g}/_{kg}$
     = a target net mass of 5.18 kg

at one end and along the length on one side of the In this example, the labeled net mass of 5.03 kg does not meet the target net mass, so the product is not in compliance.

- For inch-pound units:

$$(0.004 \text{ in}) \times [(6 \text{ ft} \times 12\ ^{\text{in}}/_{\text{ft}}) \times (100 \text{ ft} \times 12\ ^{\text{in}}/_{\text{ft}})] \times 0.92\ ^{\text{g}}/_{\text{cm}^3} \times 0.03613 = \text{a target net weight of } 11.48 \text{ lb}$$

In this example, the labeled net weight of 11.1 lb does not meet the target net weight, so the product is not in compliance.

2. Select packages for tare samples. Determine and record the gross weights of the initial tare sample.

3. Extend the product in the sample packages to their full dimensions and remove by hand all creases and folds.

4. Measure the length and width of the product to the closest 3 mm (1/8 in). Make all measurements at intervals uniformly distributed along the length and width of the sample and record the results. Compute the average length and width, and record.

    - With rolls of product, measure the length of the roll at three points along the width of each roll and measure the width at a minimum of 10 points along the length of each roll.

    - For folded products, such as drop cloths or tarpaulins, make three length measurements along the width of the sample and three width measurements along the length of the sample.

5. Determine and record the average tare weight according to Chapter 2, Section 2.3, Tare Procedures.

Evaluation of Results – Length, Width, and Net Weight

Follow the procedures in Chapter 2, Section 2.3., Evaluating Results to determine the lot conformance requirements for length, width, and weight.

- If the sample fails to meet the package requirements for any of these declarations, no further measurements are necessary. The lot fails to conform.

- If the sample meets the package requirements for the declarations of length, widths, and weight, go to step 6 to verify the thickness declaration.

Measure the thickness of the plastic sheet with a micrometer using the following guide. Place the micrometer on a solid level surface. If the dial does not read zero with nothing between the anvil and the spindle head, set it at zero. Raise and lower the spindle head or probe several times; it should indicate zero each time. If it does not, find and correct the cause before proceeding.

- Take measurements at five uniformly distributed locations across the width at each end and five locations along each side of each roll in the sample. If this is not possible, take measurements at five uniformly distributed locations across the width product for each package in the sample.

When measuring the thickness, place the sample between the micrometer surfaces and lower the spindle head or probe near, but outside, the area where the measurement will be made. Raise the spindle head or probe a distance of 0.008 mm to 0.01 mm (0.000 3 in to 0.000 4 in) and move the sheet to the measurement position. Drop the spindle head onto the test area of the sheet.

Read the dial thickness two seconds or more after the drop, or when the dial hand or digital readout becomes stationary. This procedure minimizes small errors that may occur when the spindle head or probe is lowered slowly onto the test area.

For succeeding measurements, raise the spindle head 0.008 mm to 0.01 mm (0.000 3 in to 0.000 4 in) above the rest position on the test surface, move to the next measurement location, and drop the spindle head onto the test area. Do not raise the spindle head more than 0.01 mm (0.000 4 in) above its rest position on the test area. Take measurements at least 6 mm (1/4 in) or more from the edge of the sheet.

- Repeat Step 6 above on the remaining packages in the sample and record all thickness measurements. Compute and record the average thickness for the individual package and apply the following MAV requirements.

Evaluation of Results – Individual Thickness

- No measured thickness of polyethylene labeled 25 µm (1 mil) or greater should be less than 80 % of the labeled thickness.

- No measured thickness of polyethylene labeled less than 25 µm (1 mil) should be less than 65 % of the labeled thickness.

Count the number of values that are smaller than specified MAVs (0.8 x labeled thickness if 25 µm [1 mil] or greater or 0.65 x labeled thickness, if less than 25 µm [1 mil]). If the number of values that fail to meet the thickness requirement exceeds the number of MAVs permitted for the sample size, the lot fails to conform to requirements. No further testing of the lot is necessary. If the number of MAVs for thickness measurements is less than or equal to the number permitted for the sample size, go on to Evaluation of Results - Average Thickness.

Evaluation of Results – Average Thickness

The average thickness for any single package should be at least 96 % of the labeled thickness. This is an MAV of 4 %. Circle and count the number of package average thickness values that are smaller than 0.96 x labeled thickness. If the number of package average thicknesses circled exceeds the number of MAVs permitted for the sample size, the lot fails to conform to requirements. No further testing of the lot is necessary. If the number of MAVs for package average thickness is less than or equal to the number of MAVs permitted for the sample size, proceed to "Evaluating Results" in Section 2.3 of Chapter 2 to determine if the lot meets the package requirements for average thickness.

4.8 Packages Labeled by Linear or Square (Area) Measure

Equipment

- Use a scale that meets the requirements in Chapter 2, Section 2.2., Measurement Standards and Test Equipment. Calculate the length or area of packaged product corresponding to MAV/6. If there is no suitable weighing device, all of the packages in the sample must be opened and measured.

- Steel tapes and rules as specified in 4.5

- T-square

Test Procedure

1. Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following test procedure to determine lot compliance.

2. Select an initial tare sample according to Chapter 2, Section 2.3.

3. Gross weigh the first package in the tare sample and record this weight.

4. Determine and record the measurements (to the nearest division of the appropriate tape or rule) of the packaged goods (length, width, area; depending upon which dimensions are declared on the label) and weigh the goods from the first package opened for tare determination.

- Calculate and record the weight of the labeled measurements using the following formula:

  Weight of the labeled measurement = (labeled measurement) x (contents weight) ÷ (contents measurement)

- Look up and record the MAV in units of length or area measure (given in Table 2-8.)

Note: See Table 2-10., Exceptions to the MAVs for textiles, and polyethylene sheeting and film.

5. Determine and record the tare weight of the first package opened.

6. Determine and record the measurements (length, width, area; depending upon which dimensions are declared on the label) of the product in the second package chosen for tare determination (to the nearest division of the appropriate tape or rule). Determine and record the tare weight of this package.

7. Calculate and record the weight of the labeled measurement for the second package using the following formula:

   Weight of the labeled measurement = (labeled measurement) x (contents weight ÷ contents measurement)

The weights of the labeled measurement for two packages must not differ by more than one division on the scale. If they do, open all packages in the sample, measure individually, and compare them against the labeled measure to determine the package errors. If the criterion is met, go to step 8.

8. Calculate the average weight of the labeled measurement and record.

9. Determine and record the average tare weight according to Chapter 2, Section 2.3., Tare Procedures.

10. Compute and record the nominal gross weight by adding the average weight of the labeled measurements to the average tare weight.

11. Compute package errors according to the following formula:

    Package error (weight) = (actual package gross weight) (nominal gross weight)

12. Convert the MAV to units of weight using the following formula:

    MAV (weight) = (avg. wt. of label measurements x MAV [length]) ÷ (labeled measurements)

Convert the MAV to dimensionless units by dividing the MAV (weight) by the unit of measure and record.

Evaluation of Results

Follow the procedure in Chapter 2, Section 2.3., Evaluating Results to determine lot conformance.

Convert back to dimensions when completing the report form using following the formula:

Avg. Pkg. Error (dimension) = (Avg. Pkg. Error [dimensionless units]) x (Unit of Measure) x (Labeled unit of measure) ÷ (Avg. Weight of Labeled dimension.)

4.9 Baler Twine - Test Procedure for Length

Equipment

- A scale that meets the requirements in Chapter 2, Section 2.2., Measurement Standards and Test Equipment, except a scale with 0.1 g (0.000 2 lb) increments must be used for weighing twine samples. The recommended minimum load for weighing samples is 20 divisions.

- Steel tapes and rules specified in Section 4.5.

- A hand-held straight-face spring scale of at least 4.53 kg (10 lb) capacity or a cordage-testing device that applies the specified tension to the twine being measured. When measuring twine samples or total roll length, apply 4.53 kg (10 lb) of tension to the twine.

Test Procedure

Follow the Basic Test Procedure in Section 2.3. Define the inspection lot. Use a Category A sampling plan in the inspection; select a random sample; then use the following test procedure to determine lot compliance.

1. Select packages for tare samples. Determine gross weights of the initial tare sample and record. Open the tare samples. Use the procedures for tare determination in Tare Procedures of Chapter 2, Section 2.3 to compute the average tare weight and record this value.

2. Procedure for obtaining twine samples: randomly select four balls of twine from the packages that were opened for tare.

   From each of the four balls of twine:

   - Measure and discard the first 10.05 m (33 ft) of twine from each roll. Accurate measurement requires applying tension to the ends of the twine before measuring in order to straighten the product.

   - Take two 30.48 m (100 ft) lengths of twine from inside each roll.

   - Weigh and record the weight of each piece separately and record the values. Compare the weight values to determine the variability of the samples. If the individual weights of the eight twine samples vary by more than one division on the scale, use one of the following steps: If the lot is short, determine the actual length of the lightest-weight roll found in the lightest-weight package of the lot to confirm that the weight shortages reflect the shortages in the length of the rolls; or, determine the average weight-per-unit of measure by taking ten 30.48 m (100 ft) lengths from inside the lightest weight package. Use this value to recalculate its length and determine lot compliance.

3. Weigh all of the sample lengths together and record the total value. Determine the total length of the samples (243.8 m or 800 ft, unless more than eight sample-lengths were taken) and record the value. Compute the average weight-per-unit-of-length by dividing the total weight by the total length of the pieces.

4. Determine the MAV for a package of twine (refer to Table 2-8., Maximum Allowable Variations for Packages Labeled by Length, Width, or Area).

   - Record the total declared package length.

   - Multiply the MAV from Table 2-8. times the total package length to obtain the MAV for length and record this value.

   - Multiply the weight per unit of length (from step 3) times the MAV for the total declared package length to obtain the MAV by weight and record this value.

- Convert the MAV to dimensionless units and record.

4. Calculate the nominal gross weight and record.

   Follow the Basic Test procedure in Section 2.3 to determine individual package errors. Determine errors using the following formula:

   - Package error (weight) = (package gross weight) (nominal gross weight).

   - To convert the Package error in weight back to length, divide the weight by the average weight-per-unit-of-length.

Evaluation of Results

Follow the procedures in Chapter 2, Section 2.3., Evaluating Results to determine lot compliance.

4.10 Procedure for Checking the Area Measurement of Chamois

Chamois is natural leather made from skins of sheep and lambs that have been oil-tanned. Chamois are irregularly shaped, which makes area measurement difficult. Because of these characteristics, an accurate area determination can only be made using an internationally recognized method of conditioning (rehydrating) and measurement. Chamois is produced in a wet manufacturing process, so it has high moisture content at time of measurement. Chamois is hydroscopic; therefore, its dimensions and total area change as it loses or absorbs moisture. It is also subject to wrinkling. Because of the variation of the thickness and density, and therefore the weight per unit area of chamois, an estimated gross weight procedure cannot be used to verify the labeled area declaration.

Standard Test Conditions: As with all hydroscopic products, reasonable variations in measure must be allowed if caused by ordinary and customary exposure to atmospheric conditions that normally occur in good distribution practice. Both Federal and international standards specify procedures to restore the moisture content of chamois so that tests to verify dimensions and area can be conducted.

Federal Test Method Standard 311, "Leather, Methods of Sampling and Testing," (January 15, 1969) defines the standard atmospheric condition for chamois as 50 ± 4 % relative humidity and 23 ± 2 °C (73.4 ± 3.6 °F). The chamois is considered to be at equilibrium moisture when the difference in two successive weighings, made at 1 hr intervals, is no greater than 0.25 % (e.g., the maximum change in weight on a 100 g sample in two successive weighings is less than 0.25 g (250 mg).

Test Procedures

The area of chamois is verified using a two-stage test procedure. The first stage is a field audit using the template test procedure. This test is used for field audits because it is simpler to perform and does not require the chamois to be conditioned. The field audit is used to identify chamois that are potentially under measure. It is not as accurate as the gravimetric procedure because some error results from reading the area from the template. The gravimetric procedure should be used for compliance testing because it includes conditioning (rehydrating) the chamois.

Template Test Method (for field audits)

Select a random sample of chamois and use the Template Procedure (below) to determine the area of each sample. Chamois is labeled in uniform sizes in terms of square decimeters and square feet, and are sized in increments of ¼ ft^2 (e.g., 1 ft^2, 1¼ ft^2, and 1½ ft^2). Separate the chamois into different sizes and define the inspection lot by specific sizes.

Equipment

Use a transparent, flexible template that is graduated in square centimeters or square inches and that has been verified for accuracy. The template must be large enough to completely cover the chamois under test.

Template Procedures

1. Template Procedure

   Place the template over the chamois specimen on a smooth surface. Determine the area by counting the number of squares that cover the surface of the chamois. Estimate parts of the template that do not completely cover the chamois by adding the number of partially covered blocks. (See Figure 1.)
   Compute the total area and go to Evaluation to determine if further action is necessary.

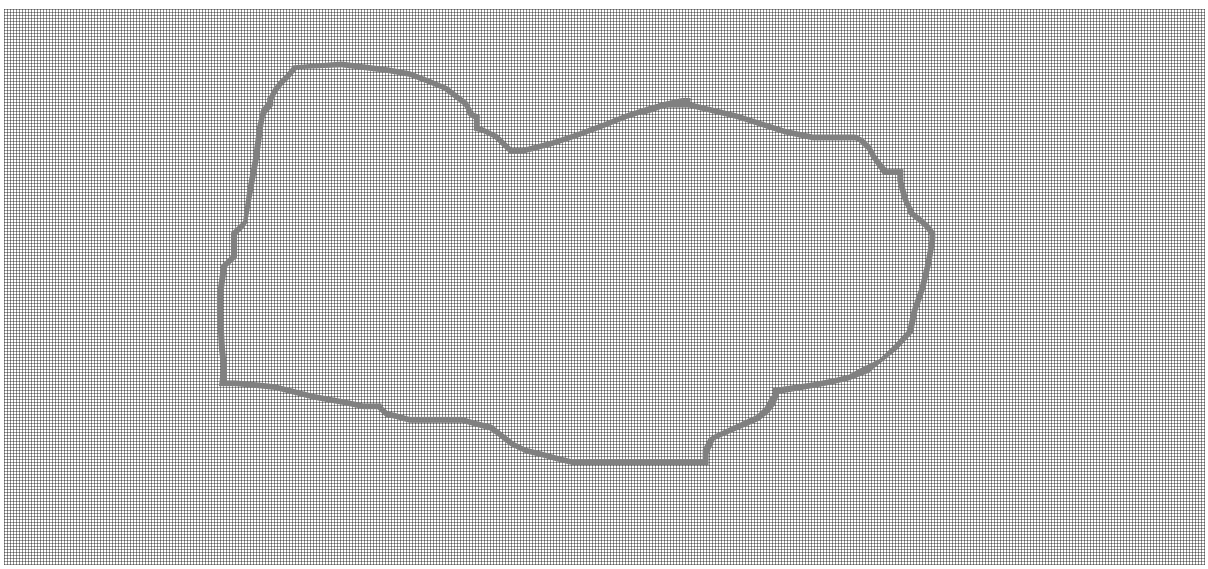


Figure 1.

First Stage - Decision Criteria

If the average minus error exceeds 3 % of the labeled area, the chamois may not be labeled accurately. To confirm the finding, the sample must be taken to a laboratory for conditioning and testing using the gravimetric test procedure.

2. Gravimetric Procedure for Area Measurement

   This test cannot be performed in the field because the samples must be conditioned with water before testing. This method is intended for use in checking full or cut skins, or pattern shapes. Open and condition all of the packages in the sample before determining their area on the recommended paper. Conditioning and verifying chamois can be accomplished without destroying the product. When successful tests are completed, the chamois may be repackaged for sale, so do not destroy the packaging material.

Equipment

- Scale with a capacity of 1 kg that is accurate to at least ± 0.01 g and a load receiving element of adequate size to properly hold the chamois
- Atomizer or trigger type sprayer and sealable, airtight polyethylene bags
- Medium weight drawing paper (e.g., drawing paper, medium weight (100 lb), regular surface or comparable)
- Household iron with low temperature settings 30 °C to 40 °C (86 °F to 104 °F)
- Rule or tape that is graduated in centimeters or inches
- Instrument for cutting paper (razor blade, scissors, or cutting board)

Sample Conditioning

1. Remove each sample from its packages weigh and record each weight. Using an atomizer-type sprayer, spray water in the amount of 25 % of the weight of each skin uniformly over its area. Place wetted chamois in an airtight polyethylene bag; seal the bag, and leave it in this condition at room temperature for 24 hours.

2. Open the bag, remove the chamois, and reweigh the chamois to confirm that it retained maximum moisture. This is done by confirming that the difference in the two consecutive weighings conducted an hour apart does not exceed 0.25 %).

3. Place the chamois flat on a continuous piece of drawing paper. To remove wrinkles and make the chamois lie flat, use a normal domestic iron that is heated to a maximum of 30 °C to 40 °C (86 °F to 104 °F). Place the iron on the bottom of the skin, and iron the skin up the center to the top. Then, iron the skin from the center out to each side. Iron until the skin is fully extended and perfectly flat.

Measurement

1. Immediately after ironing, carefully draw around the outline of the skin on the paper. Remove the skin; carefully cut along the outline of the skin; weigh the cutout pattern, and record to the nearest 0.1 g as Sample Weight 1 (W1).

2. Lay out the pattern and cut an accurately measured rectangle of a size not less than one-half the area of the pattern. Weigh the cutout rectangle and record the weight to the nearest 0.1 g as Sample Weight 2 (W2). Calculate the area of the rectangle cut from the patterns by multiplying length by width and record as Area (A) in centimeters or square inches.

   - For metric units - calculate the area of the original skin being checked as follows:

$$W1/W2 \times A = \text{Skin Area in cm}^2/100 = \text{Area in dm}^2$$

   - For inch-pound units - calculate the area of the original skin being checked as follows:

$$W1/W2 \times A = \text{Skin Area in in}^2/144 = \text{Area ft}^2$$

Evaluation of Results

Compute the average error for the sample and follow the procedures in Chapter 2, Section 2.3., Evaluating Results to determine lot conformance.

The MAV for area declarations on chamois is 3 % of the labeled area as specified in Table 2-8.

NIST Handbook 133 Fourth Edition (2005) Index

aerosol containers 13
Assistance in Testing Operations 5
Average Requirement 2
Baler Twine 64
Basic Inspection Procedure and Record Keeping 11
Basic Test Procedure 7
Borax 10, 19
Boxed Firewood 50
Bundles and Bags of Firewood 51
Calculations 17, 60
Caulking Compounds 37
Chamois 65, 66
coffee 14
Count 2, 12, 32, 51, 53, 54, 55, 56, 57, 62
Crosshatched Firewood 51
Decreasing-Load Test 9
Defoaming agent 25
Determining the Net Contents of Compressed Gas in Cylinders 46
Drained Weight 21
Drained Weight for Glazed or Frozen Foods 21
Evaluating Results16, 21, 23, 28, 29, 30, 31, 37, 39, 41, 45, 46, 49, 50, 51, 52, 56, 58, 59, 61, 62, 63, 65, ... 68
firewood 12, 49, 50, 51, 52
flour 3
Fresh Oysters 45
Frozen Foods 21
Glossary 12
Good Measurement Practices 5
Goods Labeled by Capacity 30
Gravimetric Test Procedure for Checking the Net Contents of Packaged Goods 7
Gravimetric Test Procedure for Liquids 25
Health and Safety 5
Ice Cream Novelties 41
Increasing-Load Test 9
Individual Package Requirement 2
initial tare sample 14
Inspection Lot 2
Linear Measure, Area, Thickness, and Combinations of Quantities 53
Maximum Allowable Variation ... 2, 3, 7, 10, 12, 16, 18
Mayonnaise and Salad Dressing 29
Measurement Standards and Test Equipment 5
milk 24
Moisture Allowances 17
Moisture Loss or Gain 3
Mulch and Soils Labeled by Volume 40
nominal gross weight11, 14, 15, 20, 27, 28, 37, 44, 55, ... 56, 63, 65
Nominal Gross Weight 15
Other Volumetric Test Procedures 28
package errors for the tare sample packages 15
Package Requirements 2
Packages Labeled by Count 53
Packages Labeled by Count of More than 50 Items .. 54
Packages Labeled by Linear or Square (Area) Measure **62**
Packages Labeled by Volume 24
Packages Labeled with 50 Items or Less 54
Paint 32, 33, 34, 35
Paper Plates and Sanitary Paper Products 57
Peat Moss 38
Point of pack 1
Point-of-pack 1
point-of-sale 1
Polyethylene Sheeting 59
Pressed and Blown Glass Tumblers and Stemware ... 31
Random number tables 12
Random Sample Selection 12
reasonable variation 3
reference temperature 24
Regulatory Agencies Responsible for Package Regulations and Applicable Requirements 4
Retail 1
Return to Zero 9
Sampling Plans 3, 10, 11, 16
Scope 1, 24, 53
Shift Test 9
Special Test Requirements for Packages Labeled by Linear or Square Measure (Area) 58
Tare Procedures 13
Test Procedure for Cylinders Labeled by Volume 49
Test Procedure For Cylinders Labeled By Weight 48
Testing Viscous Materials - Such As Caulking Compounds 37
The Determination of Drained Weight 20
Unit of measure 32
Unused Dry Tare 13
Used Dry Tare 13
vacuum-packed 14
Volumetric Headspace Test Procedure 29
Volumetric Test Procedure for Liquids 28
Volumetric Test Procedure for Packaged Firewood with a Labeled Volume 49
Volumetric Test Procedure for Paint, Varnish, and Lacquers – Non-aerosol 32
Wet Tare 13
Wholesale 1